



**KA-Waimanawa Partnership Ltd & Stepping Towards Far Limited**

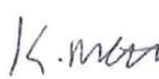

**GEOTECHNICAL ASSESSMENT REPORT**

Proposed Warkworth South Unitary Plan Change  
(Waimanawa Valley, West of State Highway One)

**Project Reference: 18707  
December 16, 2022**

## DOCUMENT CONTROL

Version	Date	Comments
C	6/28/2022	Updated Liquefaction assessment, Consolidation Analysis, and lateral spread assessment.
D	21/09/2022	Updated with Maven Earthworks Model
E	14/12/2022	Updated with revised Master Plan

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## EXECUTIVE SUMMARY

This report represents the results of the geotechnical investigations carried out by LDE Limited for KA-Wamianawa LP and in accordance with instructions received for a proposed plan change.

Based on the investigation and appraisal of the site reported herein, the following key conclusions and recommendations have been drawn with respect to the proposed potential development at the site:

1. Building platforms proposed on slopes steeper than 1V:4H will require site-specific stability analysis for each proposed building platform at resource consent stage, to show a level of fundamental stability. Generally, these are areas with slopes classified as medium to high risk of instability are better suited to a zoning of residential large lot living, having a minimum lot size of 4000m<sup>2</sup>. Additionally, onsite stormwater and wastewater disposal generally need to be accounted for unless a public system is installed.
2. The Liquefaction assessment showed that the Pakiri Formation Soils (Zone 2) have a very low potential for liquefaction, however the Pleistocene and Holocene Alluvium (Zone 1) are considered to have low to minor potential for liquefaction, but the liquefaction manifestation is low, due to the suppressive nature of the overlying non-liquefiable crust
3. Under a ULS event settlements within the low-lying alluvial deposits (Zone 1) are calculated to be between 4mm to 70mm, and are generally outside the limits afforded in NZS3604
4. Highly organic clays and peat, up to 2m thick, are present within the study site. Most of these areas will be zoned for recreational use, except for the central business region which is proposed to be in an area containing peat deposits. Precedent for development within these areas has been set in the wider Auckland region, however all foundations and earthworks in this area will require specific engineering design and further geotechnical investigation, which are matter for future Resource and/ or Building Consent(s).
5. Consolidation due to loading (from buildings and/ or earthworks) is possible in localised regions of the Pleistocene Alluvium (Tauranga Group) and Holocene alluvial deposits and will require site-specific assessment that account for the proposed loads. It is likely that specific foundation consideration and/or preload designs will be required for such areas, commensurate at resource consent stage.
6. Groundwater was measured to be near the surface, <1.5m, within the low-lying regions and should be taken into consideration during the design of the cut to fill earthworks.

This executive summary must not be taken out of context with the balance of this report. Additional recommendations and considerations are made in the body of the report which provides the context for the above key findings relating to the plan change under consideration.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact the engineer's listed above.

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## 1 INTRODUCTION

Land Development & Engineering Ltd (LDE) have been engaged by KA-Waimanawa LP to undertake a Preliminary Geotechnical Assessment for the proposed plan change of the area west of State Highway 1 of the Warkworth South Plan Change, named Waimanawa Valley.

The properties covered by this report are all those located west of State Highway one, excluding Morrison Heritage Orchard, the summary of land parcels considered in this assessment are presented in Table 1. The extent of the proposed plan change is shown on the appended drawings by Reset Urban Design Ltd, and Figure 1, and has been split into three zones A, B, C based on assessment levels and consideration.

LDE has also undertaken a separate geotechnical suitability assessment for the property owner at 1768 State Highway 1, Warkworth, (shown as Waimanawa Hills (b) in Figure 1), for consideration as part of the wider Proposed Plan Change, and a full copy of this report is appended (with permission).

This report represents the results of the geotechnical assessment for the proposed plan change area west of State Highway one. The purpose of the report is to confirm if the area within the plan change is suitable for future development and provide support of an application to Auckland Council for a proposed plan change in Warkworth South.

## 2 SITE DESCRIPTION AND CURRENT LAND USE

The subject area is situated within the current extents of the Future Urban Zone of Warkworth, and part of the wider Warkworth future urban extent. The proposed plan area is bounded by Valerie Close to the south, State Highway One to the east and the existing residential area at Mason Heights in the north. The Mahurangi River flows on north-south trend and forms the western boundary extent of the plan change. The legal titles and corresponding lot sizes covered in this report are shown in Table 1.

**Table 1:** Property lots and approximate sizes

Property Description	Property Area (Ha)	Address
Lot 1 DP 539629	5.0112	11 State Highway 1, Warkworth
Lot 2 DP 539629	5.0128	1723 State Highway 1, Warkworth
Lot 3 DP 539629	16.3450	40 Valerie Close, Warkworth
Lot 4 DP 539629	2.0237	36 Valerie Close Warkworth
Lot 3 DP 155544	8.0000	46 Valerie Close Warkworth
Lot 6 DP 155544	5.6000	123 Valerie Close Warkworth
Lot 2 DP 451512	2.0277	30 Valerie Close Warkworth
Lot 6 DP 353748	0.8367	8 Valerie Close Warkworth
Lot 5 DP 353748	0.1407	8 Valerie Close Warkworth
Lot 4 DP 353748	0.0998	8 Valerie Close Warkworth
Lot 5 DP 155544	7.0000	83 Valerie Close Warkworth
Lot 1 DP 344489	6.54000	127 Valerie Close Warkworth
Lot 2 DP 344489	1.0006	125 Valerie Close Warkworth
Lot 3 DP 344489	0.2030	N/A
Lot 6 DP 150976	4.3556	6D Mason Heights, Warkworth
Lot 7 DP 150976	5.0384	49 Mason Heights, Warkworth
Lot 5 DP 150976	2.8553	43 Mason Heights, Warkworth

The current land uses comprise of a mixture of lifestyle, residential and rural productive land including horticulture & agriculture land uses and a former vineyard, with the remaining lots predominately in pasture and lifestyle blocks with hobby orchards, residential dwellings, and associated utility sheds.

### 3 PROPOSED PLAN CHANGE

The entire plan change area, as shown in Figure 1, is proposed to comprise a mix of Urban Zones, including Business Neighbourhood Centre, Residential Large Lot, Single House Lots, Mixed Housing Urban and Suburban Zones. The exception to this is the Morrison Heritage Orchard, located centrally along the northern boundary of the plan change, which will be zoned rural and large lot residential (Figure 1). The area considered in this geotechnical assessment is all that area west of State Highway One, excluding the Morrison Heritage Orchard shown as mixed rural zone in Figure 1.

A review of the Maven Associates Limited, Proposed Cut/fill Plan, their Project Number 211007, Drawing C221, dated August 2022, indicates that cuts of approximately 4m and fills of 4m are proposed within the Waimanawa Valley (area west of State Highway One), with the average cuts/fills being between 0m to 2m. Copies of the preliminary earthwork's plans are appended.

5.3 Zoning Concept Plan

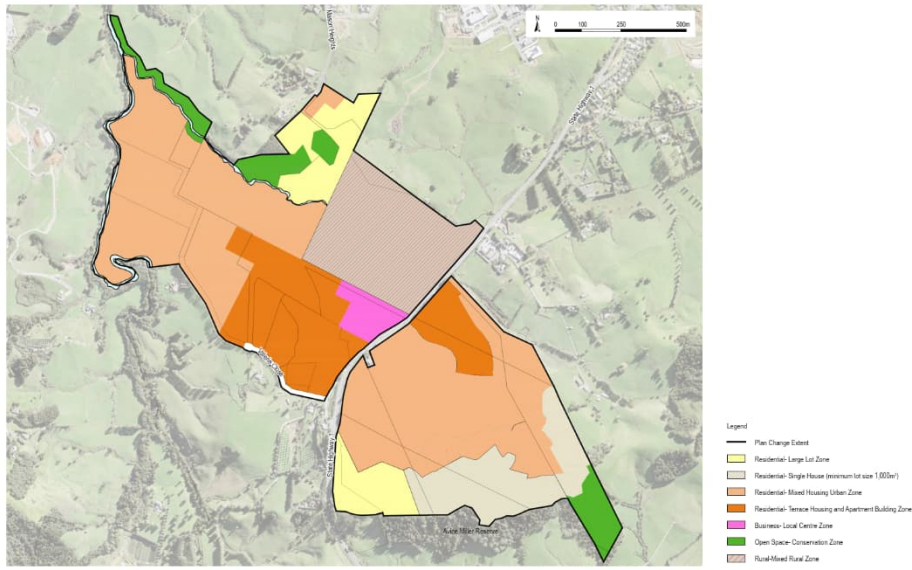


Figure 19 - Warkworth South Zoning Concept Plan

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Waimanawa Plan Change (Warkworth) | consultation | Reset Urban Design 21

Figure 1. Draft plan view of the overarching proposed development and plan change extent. Source: Reset Urban Design

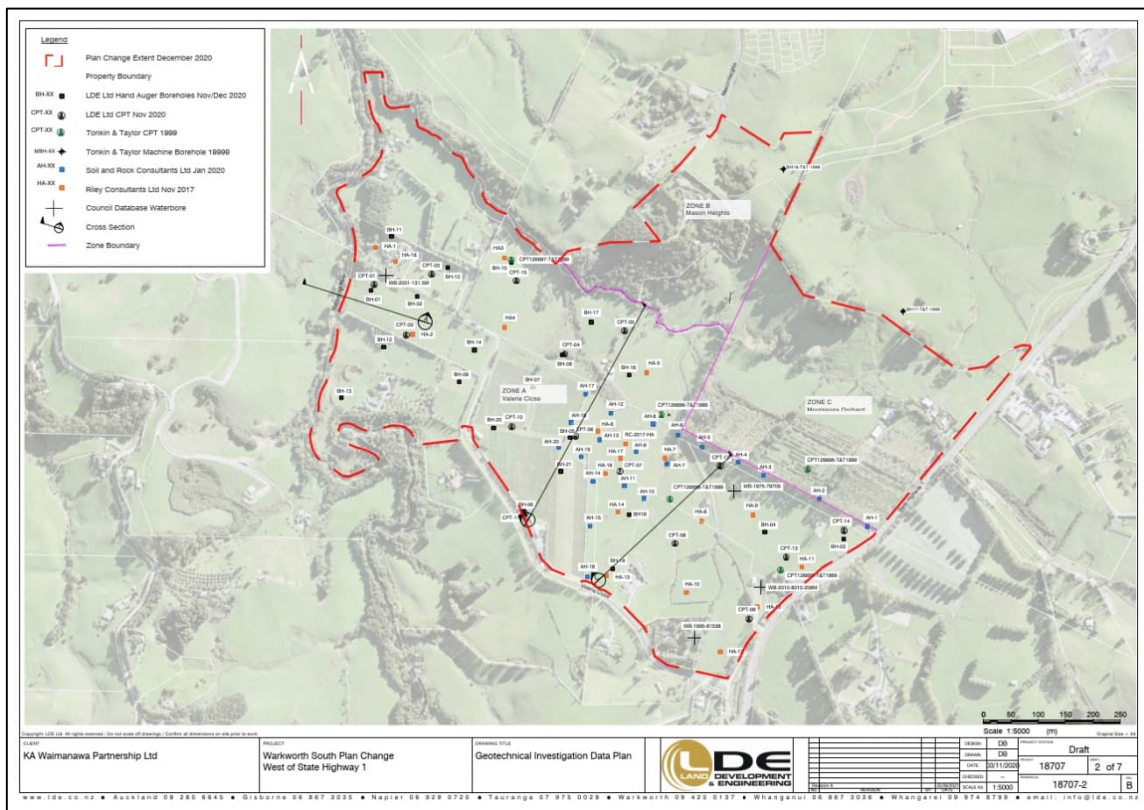


Figure 2. Geotechnical investigation plan denoting Zones A, B and C.

Prior to resource consent application the properties located in Zones B and C as described and shown in Figure 2, are to be subject to further geotechnical assessment and investigation, (if not already done so), and are only



considered to be assessed by a desktop level study in this report. The focus of this assessment is primarily on zone A.

## 4 DESKTOP STUDY

### 4.1 Previous reports

The following historical Geotechnical assessments have been reviewed by LDE as part of this assessment and have been obtained from either the property owners or the New Zealand Geotechnical Database and online retrieval.

- Riley Consultants Ltd – Geotechnical and Civil Engineering Assessment Proposed Accommodation Development, 46 Valerie Close, Warkworth, Reference 160422-K, 24<sup>th</sup> August 2018.
- Riley Consultants Ltd - Geotechnical Assessment, Proposed Accommodation Development, Valerie Close, Reference 160422-C, 11 December 2017.
- Soil & Rock Consultants Ltd – GIR – 19583 – 1711 SH1 Warkworth, May 2020

Additionally, LDE has reviewed the Auckland Council (AC) document “Geotechnical and Coastal Hazards Assessment, Warkworth Structure Change” and the Tonkin & Taylor (T&T) report titled ‘Geotechnical Desk Study North and North-West Auckland Rural Urban Boundary Project (DRAFT)’, ref 29129.001 dated August 2013. The T&T report provides a general baseline geotechnical desktop assessment of the wider Auckland Unitary Plan Change of which the study site is included, and the AC report is a more specific review for the wider Warkworth Structure change.

The reports comment on geotechnical hazards including slope instability and liquefaction potential of the underlying geological units, with the T&T report going as far as assigning areas of low, medium, and high Instability Potential, which is dependent on slope geometry and underlying geology. The study site's low lying slopes (Zone A) would fall within the Low category while the steeper slopes towards the North are likely medium to high-risk areas (Zone B), with an existing surface expression of slips and soil creep.

The same classification terminology is also applied for the sites Liquefaction Potential, of which Warkworth South is deemed to be low in the T & T report.

### 4.2 Auckland Council GIS

The Auckland council GIS database Flood susceptibility overlay shows that areas adjacent to the watercourse through the property are prone to flooding. A flood assessment is outside the scope of this report.

Additionally the GIS shows that the site is mapped as having areas subject to a very low liquefaction vulnerability and where liquefaction damage is unlikely, further consideration towards the liquefaction potential is presented in section 8.2

## 4.3 Aerial Imagery

A review of the available aerial images dating from 1966 to present, sourced from retrolens.co.nz and the Auckland Council GIS, indicates that the study site has primarily been used for horticultural and agricultural purposes (1966-present).

By the early 1990's the larger farm had been subdivided and new residential dwelling's constructed adjacent to Valerie close and within the western extent of the plan change. Additionally, a vineyard was established on the southern slopes around the same time. Besides the earthworks associated with the construction of the dwellings no major fills and earthworks is observed to have been undertaken in the study site.

## 5 GEOLOGY

### 5.1 General

The geological boundaries according to the published NZGS 1:250,000 Maps<sup>1</sup>, and a revised interpretive geological map based on subsurface information are presented in Appendix B. Additionally, the following descriptions are for each unit encountered within the study site.

### 5.2 Alluvium (Holocene, Q1a)

Holocene alluvium (0.0-0.014 ya) is a common deposit located adjacent to stream margins and water courses, it can comprise of highly compressible, organic rich, soft to firm silts and clays. Generally, these units are deemed unsuitable for construction purposes and are removed from sites prior to development or are earmarked for parks, open spaces, and riparian margins.

### 5.3 Pleistocene Alluvium ((Undifferentiated Tauranga Group Alluvium (Pleistocene, 1Qa))

Generally, the low-lying, low relief regions of the property adjacent to State Highway 1 and the Mahurangi River are underlain by Pleistocene aged (mid to late Pleistocene epoch (0.014 – 0.128 Mya) alluvial soils of the Tauranga Group.

Tauranga Group (alluvium) tends to comprise of predominantly pumiceous sand, silt, mud and clay with interbedded gravels and peat (organics). They have generally been deposited by fluvial processes and are often associated with river and stream margins. These materials are highly variable in strength and can range from being soft to hard in consistency. Generally, these materials are not highly compressible unless weaker materials and organics are present, which can be compressible if subject to concentrated heavy loading.

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<sup>1</sup> GNS.cri.nz



#### 5.4 Pakiri Formation of the Waitemata Group (Miocene, Mwp)

Miocene aged (5.33 - 23.8 Mya) volcanoclastic sedimentary rocks comprising of alternating, thick-bedded, volcanic rich coarse grained, graded sandstone and siltstone with volcanoclastic grit beds. The residual soils generally comprise of silty clays and silts with varying degrees of sand and gravels. The near surface soils tend to be bright orange, red, pink, and purple in colour. These deposits typically comprise weak to very weak sandstones and siltstone with the underlying rock generally very weak to weak i.e., 1-2MPa.

## 6 GEOMORPHOLOGY

An overview of the Geomorphology of the study site is presented on the Geomorphological Map, drawing 18707-1 appended and has been split into three zones for reference. These zones have been determined based on lot boundaries, the level of investigation afforded to each area and the proposed land use zones. The geomorphological assessment was conducted by an Engineering Geologist and comprised a combination of a site walkover over of the proposed Plan Change area, where access was allowed, and an aerial photography analysis.

### 6.1 Zone A

Overall, the area forms a section of a water catchment that feeds the Mahurangi River which in turn flows out to the Mahurangi Harbour. The catchment commences at McKinney Road on the southern side of Warkworth township, to the northeast of the site and ends at the Mahurangi River on the western boundary of the subject site. Most of the site comprises an alluvial plain which gently slopes in a north-west direction towards the river. Hills to the north and south contribute to the overall catchment.

The site consists of a grassed plains area with gently undulating hills to the south and a steep undulating escarpment to the North. The Mahurangi River flows along the western boundary of the site and a tributary to the Mahurangi River flows adjacent to the northern boundary, and at the base of the East-west trending escarpment. The western slopes leading down to the Mahurangi River are indicative of an incised riverbed, with associated terracing.

A small pond is in the south-western portion of the site and the slopes surrounding the eastern half of the pond exhibit a geomorphology likening to that of a headscarp which could indicate past soil movement. Anthropological processes often reduce the visibility soil creep; in this case, the plan change area consists of existing dwellings with lawns and orchards which could have been smoothed out.

The Mahurangi river is located along the Western boundary, stream banks have incised to form a river terrace which ranges in height from 10m to 14m, with slope angles exceeding 26 degrees (i.e., 1v:4h) down towards the stream bed.

Other than minor soil creep, in the slopes near the western site boundary and the ecologist identified wetlands no other significant geomorphological features are considered present within Zone A.

## 6.2 Zone B

The Geomorphological assessment of Zone B is based on an aerial photography review only. A full site walkover, and geotechnical assessment by an Engineering Geologist or Geotechnical Engineer will need to conduct at the time of Resource Consent, to identify any geomorphological features which may be obscured by vegetation or is not apparent in the available aerial photographs.

A steep escarpment, and a gully head dominates Zone B and falls towards a tributary of the Mahurangi River in the southwest at a slope of between 1V:2.5H and 1V:4H. From the crest of the escarpment, north, the land gently falls towards Mason Heights. The over steepened face of the escarpment contains near surface movement in the form of soil creep and gully erosion associated with the ephemeral streams which flow south off the escarpment, this is expressed in the form of hummocky ground. Additionally, terrecettes are evident in the aerial photographs.

At the base of the escarpment adjacent to the westward flowing tributary of the Mahurangi River, a wetland has developed within what is anticipated to be a colluvial deposit.

The north face of the escarpment within the confines of the plan change contains an arcuate gully head with a possible slip scarp obscured within well-established vegetation at the crest. The flow mechanism is likely associated with groundwater as a stream exits the extent of the slip below what appears to be hummocky ground.

It should be noted that a large portion of the south face of the escarpment is obscured by vegetation and an accurate Geomorphological assessment is not possible with the existing aerial photographs.

## 6.3 Zone C

The escarpment in Zone C is a continuation of the one described in Zone B and has similar geomorphological features. However, minor scale slip features have been identified in this area of the escarpment and have likely been triggered from water runoff during periods of high rainfall and associated high groundwater table, coupled with steep slopes. Toe erosion and incision from the watercourse at its base may have contributed to the release of material within the slip.

The low-lying regions, where the proposed heritage orchard is to be located, are a continuation of the alluvial plains described in Zone A.

## 7 PRELIMINARY SITE INVESTIGATION

In addition to reviewing the available geotechnical data from previous reports available for the accompanying lots and the NZGD database. LDE has undertaken a limited geotechnical investigation that satisfies the Auckland Council Code of Practice for Land Development and Subdivision guidelines (Auckland Council, 2013), MBIE Guidelines, Module 2: Geotechnical testing for Earthquake Engineering (NZGS & MBIE, 2021) and NZGS New Zealand Ground Investigation Specification 2017 (NZGS, 2017). Additionally, the investigation meets or exceeds the density required to undertake a Level B (Calibrated Desktop Assessment) liquefaction assessment as defined in *“Planning and Engineering Guidance for Potentially Liquefaction-Prone Land”*, (MBIE, 2017), for area A.

The investigation comprised of the following:

1. A site walkover assessment by an Engineering Geologist, inspection of existing slopes and any evidence of historical slope failures. Inspect any exposures of the underlying geology.
2. Drilling of 22 hand augured boreholes to depths of between 3m and 5m, across the properties. Undertake handheld shear vane measurements at 200mm intervals in cohesive soils to appropriately assess the ground strength profile.
3. The sounding of 15 Cone Penetration Tests (CPTs) to establish a deeper soil profile and ascertain potential bedrock, zones of liquefaction and areas which may need deep machine borehole testing at the resource consent phase.

The ground investigation was conducted between 24<sup>th</sup> November 2020 and 7<sup>th</sup> December 2020.

### 7.1 Summary of Ground Conditions.

The site contains two main geotechnical zones based on the soil properties encountered during the field investigations.

- Zone 1: includes all areas underlain by Tauranga Group alluvial deposits (mid to late Pleistocene epoch (0.014 – 0.128 Mya deposits and isolated Holocene alluvial deposits (<0.011 Mya) within the stream margins and wetland areas. Typical soil profiles of this unit encountered near surface inorganic and organic peats of variable thicknesses of up to 2.5m, which in turn overlies thick inorganic clays and silty clays, with thin sands and silt layers. This zone is typically located across the low-lying regions of the site, and it is inferred that Waitemata group bedrock underlies this unit at variable depths of between 10m and 15m.
- Zone 2: has been defined as the hillslopes to the south which are mapped as Pakiri Formation residual soils. Generally, this unit comprise of stiff to hard, inorganics silts and clays with varying degrees of sand contents. With depth, over consolidated Waitemata group bedrock was inferred to be encountered at depths of between 15m to 20m.

## 7.2 Topsoil

Topsoil was encountered between 100mm and 400mm and averaging approximately 300mm.

## 7.3 Filling

No Fills were encountered during the LDE field investigation, however through anthropological processes, it is inferred that isolated regions of filling will be encountered along the farm tracks, roads and adjacent to the existing dwellings located within the plan change extent.

## 7.4 Ground Water

Groundwater depth is variable across the study area. Within low-lying land, it is often encountered near-surface <1.5m, whilst beneath elevated areas it can be greater than 5m+. During winter it is anticipated for groundwater to be located nearer to the surface within the low-lying lands and may rise to within 0.5m below ground level, and potentially subject to flooding as shown on the Auckland Council GIS. Further assessment of groundwater will be required at subdivision stage.

In addition to the regional groundwater, an area within Lot 3 DP155544 has been identified as a possible spring dewatering the surrounding slopes.

The Auckland Council database indicates that the site falls under the Waitemata Group Watershed. A review of the available NZGD water bores, indicates that the aquifer for drinking or irrigation water is located 3m to 13m below ground surface level. Groundwater levels during the investigations were measured between 0.8m and 2.0m within the Pleistocene and Holocene alluvial deposits (low lying regions, zone 1) and 2.2m and 5.3m in the Pakiri Formation (Southern hillslopes).

## 7.5 Percolation Testing

Falling head percolation testing has been completed in accordance with the methods outlined in GD07:2022 “*Stormwater soakage and groundwater recharge in the Auckland Region*”. A factual letter has been prepared presenting the results of this testing which is included in Appendix G, and are summarised in the table below.

**Table 2:** Summary of Percolation Rates.

Test ID	GD07 Test Method	Geological Unit	Percolation Rate (mm/hr/m2)*	Test Notes
P-01	Talman-Hallam Permeameter (constant head method)	Pakiri Formation	0.06	Clay
P-02			0.24	Clay
P-02a			3.15	Clayey silt encountered at 0.5m, and possible rootlet.
P-03		Alluvium	0.025	Ground Water seepage into hole at 0.5mbgl, likely still recharging from the previous night's rain
P-03a			5.80	Retested hole at 5pm due to inferred recharge. No rainfall had occurred during the day.
P-04			0.62	
P-05	Falling Head	Pakiri Formation	0.00	clay

\* No factor of safety has been applied to the percolation results. A factor of safety may be applied as recommended in GD07:2022. This should be decided by the designer based upon the application and intended purpose/ use of the percolation rates.

## 8 GEOTECHNICAL HAZARDS

### 8.1 General

This section presents the Geotechnical Hazards identified across the study site, as defined in the Auckland Code of Practice for land subdivision.

Additionally, Table 10 of the Tonkin and Taylor Geotechnical Desk Study (Tonkin & Taylor Ltd, 2013), “*Summary of predominant Geotechnical Hazards and Considerations for Future Urban Development in Warkworth*” Outlines the following Geotechnical Hazards to be considered for Warkworth South.

- Slope Instability Potential
- Liquefaction Potential
- Soil Compressibility and building Settlement Potential

LDE has undertaken a preliminary Earthquake hazard assessment for the site to supplement the lack of information available on the properties proposed within the plan change area, this was also recommended in an earlier Soil and Rock Consultants Limited report. In addition to this, soft compressible Pleistocene and Holocene alluvial deposits containing peat, and sand were identified during the site investigation, within Zone 1. At the future subdivision stage, it is understood that a more in-depth, site-specific analysis will be conducted.

### 8.2 Seismic Hazard Assessment

#### 8.2.1 Seismic Site Class

Based on the investigation data and on-site conditions we consider that different areas of the site are either Class C or D (Shallow soil and Deep or soft soil) as defined by NZS 1170.5 (2004) “Structural Design Actions: Part 5: Earthquake actions – New Zealand”.

The low-lying regions (Zone 1) which contain low strength clays, silts, and peat (alluvium) are deemed to be Class D (Deep or soft soil) while the mid-slopes to upper slopes containing Pakiri Formation (Zone 2) tend to exhibit Class C (Shallow soil) characteristics. Further specific seismic testing (e.g. sCPT) during the more comprehensive investigations required for Resource Consent, may help classify this further, particularly for the structural design of any infrastructure or buildings.

#### 8.2.2 Fault Line Surface Rupture (Proximity to Faults)

The GNS NZ Geology Webmap and Active Faults Database<sup>2</sup> do not show any faults passing beneath the site. The Waikoupua Fault trace in the Hunua Ranges, 70km south of the study site, is the nearest active source.

<sup>2</sup> [data.gns.cri.nz/af/](http://data.gns.cri.nz/af/)

There also does not appear to be any surface expressions which would indicate the presence of an active fault line beneath or within proximity to the site. We therefore consider the surface fault line rupture risk to be low.

Due to the inland location and elevation above sea level, we consider the risk of tsunami due to a fault line rupture to be low.

### 8.2.3 Seismic Parameters

The assessed seismic design parameters for the site are taken from Table A1: *Peak Ground Acceleration ( $a_{max}$ ) and Earthquake Magnitude (M) values recommended for Geotechnical Assessment, for Site Classes A, B, C, D and E, for level ground conditions*, of the MBIE Guidelines Module 1 for Auckland and Northland. The PGA was assessed based on the following assumptions: -

- We have assumed a Building Importance Level of 2 (IL2) in terms of NZS1170.0:2002, as is consistent with a dwelling or 'ordinary' structure, with a design life of not less than 50 years.
- The Serviceability Limit State (SLS1) design earthquake has an annual exceedance probability of 1/25.
- The Ultimate Limit State (ULS) design earthquake has an annual exceedance probability of 1/500.
- Additionally, the following return period scenario has been adopted in accordance with MBIE Guidelines and good practice. The Index Limit State (ILS) design earthquake has an annual exceedance probability of 1/100.

A summary of the parameters is presented in Table 3, below.

**Table 3:** Summary of MBIE Module 1 Guidelines values assumed in analysis.

Scenario	Location ID Number	Magnitude (M)	Horizontal Peak Ground Acceleration (PGA)
SLS1 (1/25yr)	7 (Warkworth)	5.9	0.05
ILS (1/100yr)		5.9	0.09
ULS (1/500yr)		6.5	0.19

### 8.2.4 Liquefaction

#### 8.2.4.1 Geological Age

MBIE Module 3 advises aging of soils generally improves their resistance against liquefaction, and that liquefaction is almost exclusively occurring in geologically young Holocene sediments, constructed fills and soils that have liquefied previously, and that in rare instances liquefaction of saturated sandy soils has been recorded in late Pleistocene soils (>11,000 years).

The soils within the stream margin and wetlands are likely of Holocene age and are therefore considered susceptible from a geological age perspective to the liquefaction calculated in our computer analyses.

The Undifferentiated Tauranga Group alluvial soils (mid to late Pleistocene epoch (0.014 – 0.128 Mya)) and Pakiri Formation (Miocene age (5.3-23.8 Mya)) are likely to comprise of over consolidated cohesive materials, with only thin beds of silty sands and sandy silts and in the case of the Undifferentiated Tauranga Group alluvium, minor peat lenses and organic layers.

Therefore, considering the above, the two units are not considered to be susceptible to liquefaction due to their age.

#### 8.2.4.2 Methodology

Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground and structure settlement, and lateral spreading of the ground.

A quantitative liquefaction assessment has been performed for the site using proprietary liquefaction analysis software CLiq V.3, which provides an assessment of liquefaction potential using the available CPT data. This assessment was undertaken in accordance with the NZGS Guidelines (NZGS & MBIE, 2021) , including a simplified liquefaction assessment procedure limited to 15.0m depth BGL, for those CPT's where its applicable, i.e., greater than 15m in depth, and an indexed depth of 10mbgl for comparison to the MBIE Canterbury Guidance.

The design groundwater depths were established from either direct measurement, by dipping the CPT following completion, or from an interpolation of the groundwater levels from nearby hand auger boreholes. Additionally, we have assumed an uplift of 0.5m in the groundwater level under earthquake conditions. A summary of the assumed ground water levels for the analysis purposes are presented in Table 4 below.

**Table 4:** Summary of ground water levels in the CPT's.

CPT Number	Water Level (mBgl)	CPT Number	Water Level (mBgl)	CPT Number	Water Level (mBgl)
CPT1	5.83	CPT6	1	CPT11	2.22
CPT2	1.96	CPT7	2	CPT12	0.8
CPT3	2.5	CPT8	2.2	CPT13	1.6
CPT4	0.8	CPT9	2.2	CPT14	1.58
CPT5	1.7	CPT10	2.2	CPT15	



We have assessed the liquefaction potential of soils at site using the Idriss and Boulanger (2014) method, as recommended by the NZGS Guidelines (NZGS & MBIE, 2021). The soils behaviour index ( $I_c$ ) has been estimated based on the Robertson and Wride methods (1997). Soils have been assumed to be non-liquefiable when the  $I_c$  value is greater than 2.6. Liquefaction-induced free-field vertical volumetric strains were estimated for the SLS, ILS and ULS design seismic events using the Zhang method (Zhang, Robertson, & W.I, 2002).

### 8.2.4.3 Liquefaction assessment results

The Liquefaction Potential Index (LPI) and Liquefaction Severity Number (LSN) are indices used to assess the general performance level of liquefied deposits in accordance with the NZGS Guidelines (NZGS & MBIE, 2021).

The results are differentiated based on the underlying geology encountered. The Pakiri formation soils (Zone 2), CPT9-11) returned results that are within the limits afforded by NZS3604 and with a very low probability of liquefaction potential based on the LPI and LSN values.

Liquefaction induced settlement is expected within the Pleistocene (Tauranga Group) and Holocene alluvium (Zone 1). Specifically, no settlement is generally predicted under SLS conditions for Zone 1 soil types, the exception to this is within the Holocene alluvium, (CPT 14) of which less than 1mm of settlement is predicted. However based on the LSN and LPI values, the likelihood of manifestation is nil. Under ULS and ILS earthquake conditions settlements are generally outside the limits afforded by NZS3604, with low to minor potential for liquefaction. The ULS and ILS results are presented in Table 5 below, with 10m indexed values in brackets (as per MBIE Canterbury Guidelines), the full output of the liquefaction analysis is presented in Appendix D.

**Table 5:**Liquefaction analysis summary for Zone 2 Materials.

Test ID	ULS Earthquake (PGA=0.19g)			ILS Earthquake (PGA=0.09g)		
	LPI	LSN	Liquefaction Induced Settlement (mm)*	LPI	LSN	Liquefaction Induced Settlement (mm)*
CPT01	<1	1	9[4]	0	0	0
CPT02	3.5	7	36[18]	0	0	2
CPT03	1.4	3	19[19]	0	0	0
CPT04	2	3	26[4]	<1	0	4

CPT05	<1	3	28[9]	0	0	<1
CPT06	2	1	10[0]	0	0	0
CPT07	<1	4	38[8]	0	0	0
CPT08	<1	2	14[12]	0	0	<1
CPT12	12	12	50[34]	<1	1	9
CPT13	<1	1	7[3]	0	0	<1
CPT14	1.7	3	22[19]	0	0	<1
CPT15	3.5	7	70[21]	0	0	0

\*The MBIE guidelines (MBIE, 2012) reference 'index' values relate to settlement within 10m of the ground surface. For Comparison with MBIE Technical Categories, the 10m depth Limited values are presented in [brackets] for each CPT data set.

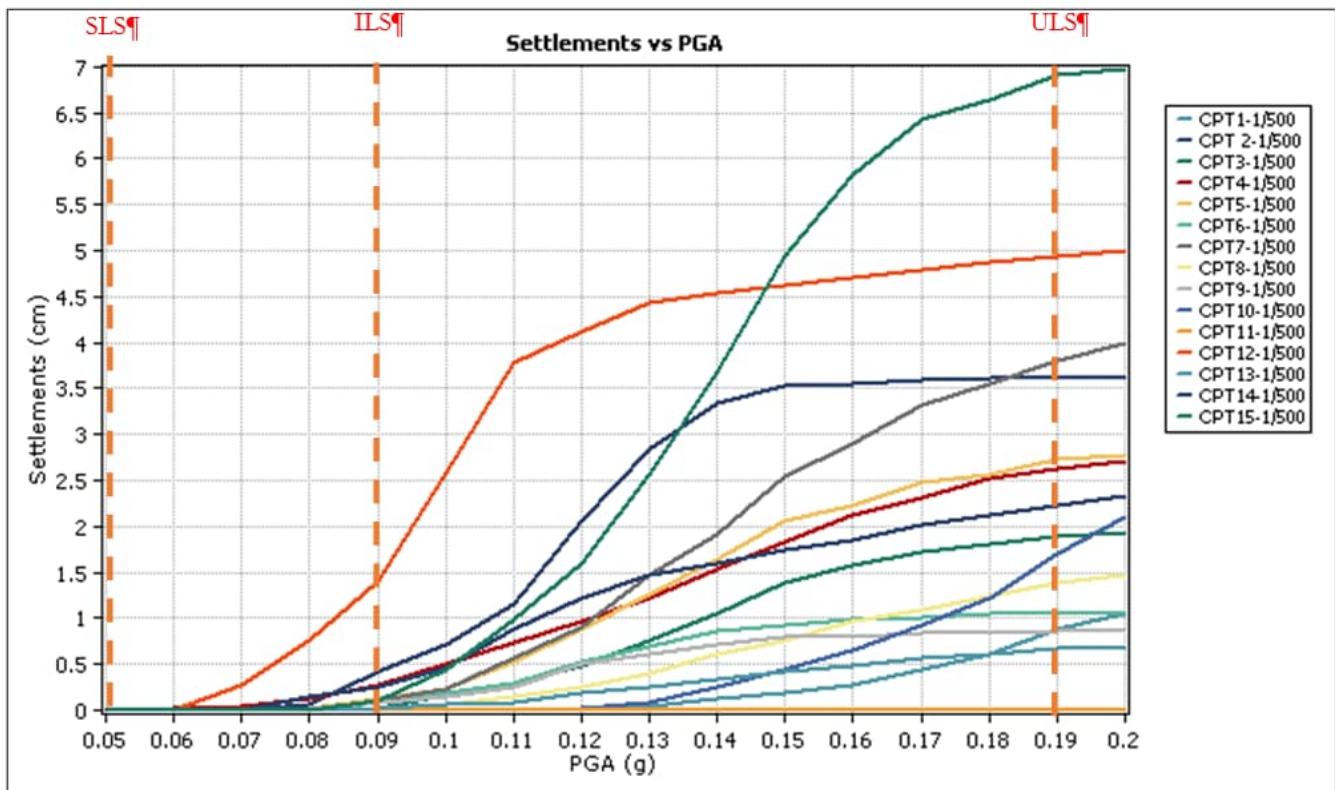


Figure 3: Total Settlements vs Peak Ground Acceleration (PGA).

The above graph (Figure 3) presents a summary of the total settlements expected following a 0.05PGA (SLS) to 0.19PGA (ULS), the results show that under a ULS event the maximum amount of settlement expected is up to 70mm (CPT15), very minor settlements (<10mm) can be expected under an ILS event and no settlement under SLS conditions. When compared to the criteria presented within the MBIE Module 3 Table 5.1, the effect of

liquefaction under both ULS and SLS earthquake conditions the site can generally be classified as mild (L1) performance level, which is in general agreement with the Low classification of the Tonkin & Taylor Desktops Study. The graph above (figure 3) shows a large increase in expected settlement around a PGA of 0.11g within the CPT's located within Zone 1 soil types.

The exception to this is CPT 12, within the low-lying region adjacent to the boundary with the historical Morrisons orchard, where high ground water (0.8m) was encountered. The assessment presented results consistent with moderate (L2) performance level and shows that the results of the liquefaction analysis is highly sensitive to ground water levels.

Assuming a 2.6 Ic cut off the liquefaction analysis generally returned values greater than this within the first 15m. The SBT plots were reviewed and generally the plots trend towards the right hand side of the 2.6Ic cut off, with only isolated, less than 0.2m, layers encountered between 4-6m in zone 2 type soils. Based on this, the likelihood of the soils behaving as liquefiable is very low and in accordance with the Tonkin and Taylor, 2013 classification. Generally for a soil to behave as liquefiable it needs to contain a large component of granular type material (i.e., sands and gravels) and the plan change area is generally underlain by highly compressible peats and cohesive inorganic clays and silt.

### 8.2.5 Liquefaction Triggering and Surface Manifestation Criteria

Liquefaction is triggered when the factor of safety (the ratio between the Cyclic Resistance Ratio and Cycle Stress Ratio) is less than 1. NZGS Module 3 refers to specific studies (specifically Ishihara, 1985) that suggests that if a non-liquefiable crust, that meets the ratio criteria (H1/H2) it would suppress the surface manifestation of liquefaction. Ishihara set out a framework for assessing the thickness of a non-liquefiable crust (H1) and the thickness of any underlying liquefied layer (H2) in determining sites which are susceptible to liquefaction-induced ground settlements.

As shown in Figure 4 our analysis considered the H1 and H2 layers, and these demonstrate that the non-liquefiable crust thickness (H1) was between 3.3m (CPT4) and 10m under ULS(CPT7) seismic conditions, and the total thickness of the underlying liquefiable layer (H2) was less than 0.45m under the SLS case and up to 4.3m under the ULS case. The resulting ULS settlements were up to 50mm. When compared to the Ishihara criteria we can assume that the liquefaction manifestation is low across the study site, due to the suppressive nature of the overlying non-liquefiable crust.

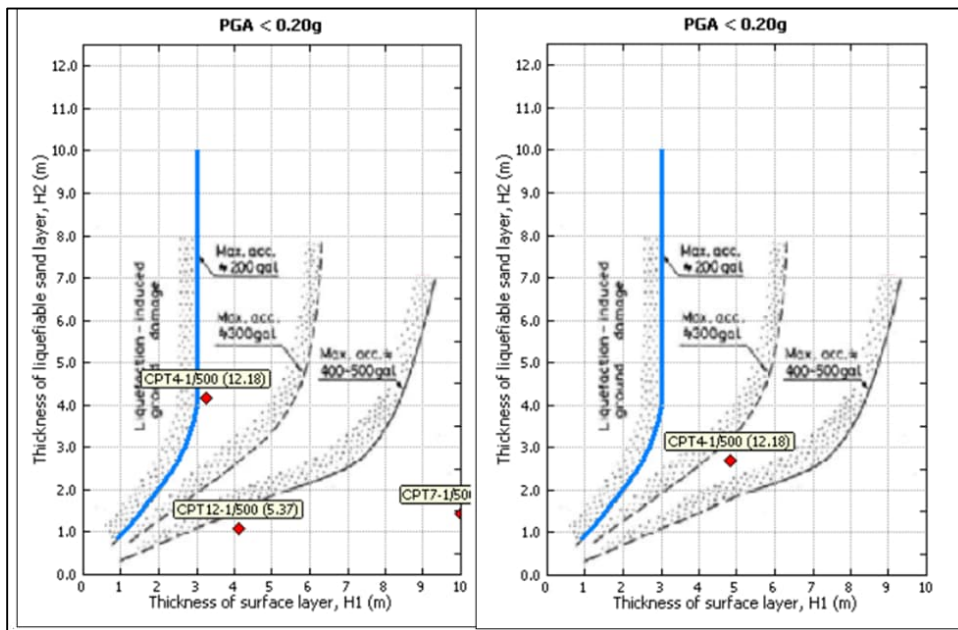


Figure 4: Ishihara plots of H1 vs H2 (0.5m thickness left, 2.0m thickness)

## 8.2.6 Lateral Spread

The T&T Desktop study did not consider that the Warkworth South urban development area to be subject to Lateral spread potential. The site walkover assessment identified a free face of up to 14m in height (discussed in section 8.4), adjacent to the Mahurangi River along the western plan change boundary, that is zoned mixed housing suburban zone. It is considered that this area could be subject to lateral spread, but given the cohesive nature of the underlying soils, the results returned in the liquefaction analysis and the tapering of the phreatic surface down towards the stream, it is considered that the probability of lateral spread is low.

We still recommended that further consideration for this region be addressed as part of the resource consent stage once final development plans are known. Elsewhere, we anticipated the probability of lateral spread of manifesting at the surface to be low due the lack of significant free faces i.e., drainage culverts and ditches generally being less than 1m in height and are likely to be modified through earthworks.

## 8.3 Compressible Ground and Consolidation Assessment

The T&T Desktop identified that localised areas of highly compressible soils are likely to be present in Warkworth South, some of which will necessitate ground improvements or deep foundations, during earthworks and site development.

The site testing confirmed the presence of isolated pockets of soft, potentially compressible soils within the low-lying alluvial deposits. Soft organic clays and peat were most evident in CPT's 4, 5, 12, 14, and 15 at depths of between 0.5m and 6.2mbgl and similar ground conditions were encountered in the hand augers drilled adjacent to the CPT's. Generally the soils encountered in the Hand augers comprised of organic clays, peat, sand, and sandy

silts, to depths of up to 5.0mbgl. As such a first pass consolidation (settlement) analysis was conducted on the CPT data using the programme CPeT-IT Version 3.5.2.3.

The settlements derived by 'consolidation' (primary settlement) is largely influenced by settlement derived by the magnitude of the static load applied to the soil, meaning the greater the load, the more settlement through consolidation occurs. The time for the completion of the consolidation settlement to occur is dependent on the speed at which water can freely flow from the soil. It can be assumed that consolidation is generally complete when the overall predicted settlement has reached 90% completion. The settlement derived by 'creep' is settlement which occurs under the weight of the soil and is independent of static loading, therefore will continue to settle through the process of material decay and is hard to predict its performance beyond a 50-design life. The total overall predicted settlement includes both the primary and secondary components.

For the settlement assessments the following assumptions were made:

- A nominal 10 x 20m rectangular building footprint is assumed.
- A rigid footing (i.e. stiffened pod-raft) is used, for residential dwellings and flexible footing for fills.
- Fill levels were derived from the proposed earthworks model appended
- The footing depth / embedment depth is equal to the depth of topsoil to be stripped
- Building loads were calculated using an anticipated total uniformly distributed load (UDL, G + Q) of 10kPa, typical for a lightweight residential structure of up to two stories.

For each CPT, the following cases were assessed:

- Case 1 – proposed earthworks load only of 18.5kPa per 1m of fill (In accordance with ACCoP).
- Case 2 – proposed earthworks and an assumed residential building load (Case 1 + 10kPa).

A summary of the assumptions against each CPT are indicated in Table 6 below and a full summary of the calculated settlements are given in Table 7. Full CPeT-IT records are presented in Appendix E.

**Table 6:** Load case scenario

Test ID	Earthworks (m)	Case 1 (kPa)	Case 2 (kPa)
<b>Zone 1 - Pakiri Formation (Waitemata Group, Zone 2)</b>			
CPT09	0	0	10
CPT10	4.5	83.25	93.25
CPT11	-2.0	0	10
<b>Pleistocene Alluvium (Tauranga Group) / Holocene Alluvium, Zone 1</b>			
CPT01	-1.0	0	10
CPT02	-1.0	0	10
CPT03	-1.0	0	10
CPT04	1.5	27.5	37.5

CPT05	0	0	10
CPT06	1.5	27.5	37.5
CPT07	1.5	27.5	37.5
CPT08	1.5	27.5	37.5
CPT12	1.5	27.5	37.5
CPT13	1.5	27.5	37.5
CPT14	1.5	27.5	37.5
CPT15	1.5	27.5	37.5

### 8.3.1 Consolidation Results

The results above indicate that the soft Holocene aged alluvial material located adjacent to the wetland areas and stream margin (CPT04) is sensitive to consolidation with expected settlements of up 445mm under 1.5m of fill loading; expected settlements in the Pleistocene age Alluvium (Tauranga Group) range from 1mm, (for a standard static residential loading of 10kPa) to 128mm, (1.5m of earthworks and a standard residential dwelling). This would indicate that for a rigid footing structure i.e., raft type construction, settlement is either greatly reduced or were in the tolerances afforded by NZS3604.

Based on these preliminary analyses, the settlements for Pakiri formation soils are assessed to be generally suitable for standard NZS3604-type foundations. It is anticipated that the settlements expressed in CPT 10 can be managed by standard earthworks, i.e., removal of mullock and near surface organics, installation of underfill drains, prior to compaction.

A preload design for areas identified as having highly compressible clays and peat should be completed commensurate with a future Resource Consent Application (s), and this will need to consider the final earthworks proposal, building typology and uniformly distributed loads (UDL's) and preferred preload material. It is recommended that a trial preload is undertaken during the Resource Consent / detailed design phases.

**Table 7:** Summary of total accumulated settlements due to consolidation.

Test ID	Case 1 (mm)	Case 2 (mm)
<b>Pakiri Formation (Waitemata Group), Zone 2</b>		
CPT09	-	3
CPT10	32	36
CPT11	-	2
<b>Pleistocene Alluvium (Tauranga Group) / Holocene Alluvium, Zone 1</b>		
CPT01	-	1
CPT02	-	3
CPT03	-	3
CPT04	445	428

CPT05	-	10
CPT06	41	44
CPT07	68	66
CPT08	59	61
CPT12	32	31
CPT13	102	90
CPT14	108	128
CPT15	129	70

The assessment for settlement beneath large footprint commercial, industrial, and/ or multi-storey buildings exceeding a 10kPa dead load has not been completed as part of this assessment, however, it is foreseeable that such construction would likely require piled foundations to support building due to wind or seismic loading requirements from structural actions. Such assessments should be addressed in further investigations.

## 8.4 Slope Stability

### 8.4.1 General

A preliminary assessment of slope instability potential was undertaken in the 2013 T & T report as mentioned in section 4. The report established three slope instability hazard vulnerability classes based on the expected geology and the ground surface topography, the summary of the parameters for the geological units present in the study site are shown in Table 8.

**Table 8:** Slope Instability Potential & Slope Profile Limits taken from Tonkin and Taylor 2013.

Geological Unit	Slope Instability Potential – Slope Profile Limits		
	Low	Medium	High
Holocene Alluvium	0-10	10-23	>23
Puketoka Formation/ Undifferentiated Tauranga Group.	0-10	10-23	>23
Waitemata Group (Pakiri Formation)	0-15	15-26	>26

Further discussion on the stability for each zone of the plan change is as follows.

### 8.4.2 Zone A

The overall stability of Zone A and the immediate surrounding slopes has a geomorphology that is indicative of fundamental stability. In its existing state, the site ranges from generally flat, within the low-lying regions containing Pleistocene alluvium (Tauranga Group), transitioning to slopes of approximately 7° degrees (1V:8H),



comprising of Pakiri Formation Residual Soils. These slopes are generally considered having a low potential for instability.

The gently sloping land across the site is smooth and lacking in visible evidence of slope instability or deformation. Nevertheless, soil creep is still likely to occur in the sloping areas because of gravity and the plasticity of the underlying soils over the design life of any buildings. Both anthropological and horticultural processes often erase traces of soil creep or minor instability. A vineyard is planted over the highest area of elevation, 60m above sea level (asl), which may have shown signs of soil creep in the past. The smooth sloped lawns of the existing dwellings may also have diminished any visible signs of shallow seated instability.

The slopes along the western and northern boundaries of the proposed plan change area slope toward the west and north respectively and terminate at the Mahurangi River, isolated slopes of significance of up to 26° degrees (1V:2H) were observed during the site walkover assessment. On average, the slopes in this area range from approximately 18° degrees (1V:3H) to 26° degrees (1V:2H) extending 75m horizontally from the riverbank to the crest of the slope, which can be up to 14m in vertical height. This region is generally classified as medium potential for instability based on the underlying geology, with isolated regions of high slope instability potential.

Evidence of soil creep has been identified in the grassed slopes above the river in areas of approximately 18 degrees (1V:3H), this has formed the terraces visible in the slope (commonly referred to as sheep tracks, as these features are often exacerbated by livestock). We expect that this is due to the shrinkage and swelling of the moderately to highly plastic near surface soils and the effect of gravity over the long term. While this is evidence of shallow seated instability there are no features present which indicate that deep-seated instability has occurred. The steepest areas of the riverbank are currently planted in mature trees, helping to increase the overall stability of the slopes.

Areas of notable soil creep will be present within the development boundaries. Soil creep can be mitigated against using retaining, slope regrading, the deepening of foundations within the vicinity of the soil creep and revegetation of the slope.

The Warkworth South Plan Change initial concept drawings indicate that the immediate area surrounding the steep slopes within the plan change extend are generally conserved as riparian margin. This area covers a distance of at least 20m from the banks of the Mahurangi River and stream margins to the edge of the development horizontally. If the proposed area is as planned this will cover the steepest slopes of the site and allow a setback distance for the development. Further slope stability analysis will be required to define the setback distance from these slopes. If the proposed development encroaches on these distances' stability increasing measures can be implemented to reduce the risk of loading the slope which may lead to slope failure. Examples of such measures may include, but are not limited to, a shear key, palisade wall, tree planting, MSE walls and slope regrading.



### 8.4.3 Zone B & C

The escarpment within zones B & C has historically been prone to instability issues, as evident by the surface expressions in the available aerial photographs. An analysis of the available contours indicates that the slopes within the escarpment range from 18° to approximately 34°. While parts of the escarpment are planned to be part of the riparian planting, the escarpment is one of the few areas in the wider Warkworth plan change extent which would fall into the medium to high Instability Potential classification, in terms of T & T's 2013 classification framework, summarised in table 8 and is rightly zoned for large-lot residential living. These areas will require site-specific analysis once the locations of building platforms have been determined.

Overall, slope instability is not considered to be a significant geotechnical risk for the future urban development is area and can be controlled by standard industry engineering methods (such as subsoil drainage, retaining walls, earth shear keys, etc). Further slope stability analysis is required at resource consent phase which needs to include specific geotechnical investigation and consideration for the development proposal in these areas.

### 8.5 Erosion

Pakiri Formation soils are known to be slightly dispersive in nature which can lead to the development of tunnel gully erosion. Tunnel gully erosion occurs when dispersive soils such as silts, clays and fine sands interact with water which cause dissolution of the soil and the fines washing away. This can lead to underground cavities or shallow sink holes developing.

Although no tunnel gully features were observed within the site during the site walkover and investigation, the presence can often be hidden by vegetation and grass, and only become visible after collapse.

Although the erodible (or dispersive) soils require additional engineering controls and measures to be undertaken to ensure that any building development is not adversely affected by tunnel gullies, the occurrence of erosion features, tunnels, and gullies are not considered to be detrimental to the development and generally will require simple remediations by removal of the affected material and replacement with engineered fill and drainage measures.

Furthermore, extensive earth working of the land within the plan change extent is likely required, this will expose any shallow erosion, or tunnel gully's which will allow for observation by a Geotechnical Engineer or Engineering Geologist. These features are commonly remediated by engineering methods at the time of excavation.

## 9 GEOTECHNICAL ENGINEERING CONSIDERATIONS

### 9.1 Foundation for Buildings

#### 9.1.1 Pakiri Formation Soils (Waitemata Group)

Based on the field investigation and our experience with similar soils in the region it is anticipated that where inorganic natural ground is present, bearing capacities is expected to be in accordance with the limitations imposed by NZS3604 where 300kPa Geotechnical Ultimate Bearing Capacity, can be adopted, provided that weak lenses, organics, saturated ground, and topsoil are remediated or removed during bulk earthworks.

#### 9.1.2 Pleistocene Alluvium (Tauranga Group).

It is anticipated that Specific Engineering Design of foundations within these areas will need to be undertaken given the variable thicknesses and inter-laying of peat materials and bearing capacities afforded across the site.

However, precedence has been set in the plan change extent with residential dwellings currently situated within these geological units, additionally ground remediation can be undertaken during the placement of the proposed fills across the site. If fills are placed to an engineering standard this would improve the ground performance in these areas. Additionally if they designed to account for consolidation (discussed further in section 9.3), they can often afford higher bearing capacities

Practical mitigation measures include reserving areas with large pockets of peat for recreational use, piling structures down to firm ground, or as mentioned removing the overburden load through cut earthworks (discussed in section 9.3, in depth).

### 9.2 Expansive Soils

'A phenomenon common to the plastic soils found throughout this region is their expansive nature and tendency to shrink and swell, particularly with seasonal fluctuations of near surface water contents.

Soil reactivity has been determined based upon visual characteristics observed during the drilling of the hand augers and based on our experience of similar soils within the region. Further laboratory testing to determine the site soil class as outline in B1/AS1:2019 (e.g. shrink-swell testing), should be undertaken commensurate with an earthwork's proposal at the Resource Consent stage to determine expansivity of the onsite soils. The site soil reactivity will need to be accounted for in the foundation design of all future infrastructure and building developments.

Expansive soils are outside the provisions of NZS 3604 (according to its definition of "good ground") and therefore foundations on such soils require specific design to establish appropriate embedment depths and/ or concrete reinforcement configurations. Based on the soils encountered across the site our knowledge of the soils

encountered within this area of Auckland, the preliminary expansive site class for this site is as follows when assessed in accordance with MBIE (Acceptable Solution and Verification Methods Amendment 19) and AS2870:2011 guidelines are as follows: As mentioned prior, the site soil classes need to be confirmed by laboratory testing at the resource consent stage.

MBIE Acceptable Solutions and Verification Methods Amendment 19

- Class M (moderate) to Class H (high)
- Characteristic ground movement of up to 44mm and 78mm, respectively

AS2870:2011

- Class M (moderate)\* to Class H2 (high)\*
- Characteristic ground movement of 40mm and 75mm, respectively\*

\*Note: This AS2870:2011 assessment is based on the scaling factor of the site being adjusted to a 1/500yr event to meet the recommendations of MBIE. 2

It is foreseeable that foundation design in the Pakiri Formation soils may be carried out in accordance with NZ3604 with provision for expansive soils as outlined in MBIE B1/AS1 if the buildings meet the simple structure definition outlined in section 3.2.2 of that document or alternatively the buildings may be designed in accordance with AS2870:2011 provided they are designed to the recommendations above on expansive site class and characteristic ground movement. If strip and pad type foundations with a suspended floor system are proposed (instead of a concrete slab on grade), then a minimum foundation depth below cleared ground level of 600mm to 900mm is recommended.

Within the areas that peat is underlying, consolidation settlement of the underlying peat soils and the need to control groundwater will govern here, not expansivity.

This will be addressed in greater detail as part of a Resource Consent report and will need to consider proposed earthworks.

## 9.3 Earthworks and Civil Works

### 9.3.1 Holocene Alluvium & Pleistocene Alluvium (Tauranga Group)

The risk of ground settlement in this area requires that careful mitigation measures be implemented to ensure that any settlements that do occur are within acceptable limits. Surficial soils within these units are relatively sensitive to disturbance, especially those located around the stream margins and existing wetland, and any earthworks and construction operations should be undertaken with care and consideration for consolidation and disturbance.

Based on the results of our settlement analyses, isolated areas could be subject to significant consolidation settlements which will be more than Building Code limits for differential settlements. It is our view that development in these areas should be subject to ground improvements comprising of the undercutting and replacement of weaker soils immediately beneath the foundations or the preloading of the building platforms following post-construction earthworks. Additionally, in some areas, a hold-period could be implemented where construction is able to commence without additional ground improvement following, say 1-year, to allow fills to settle under their own self-weight. Such assessments should be made at Resource Consent stage when further detail is available regarding the proposed development schemes and may be dependent on the outcome of preload trial as recommended in section 9.1 above.

Control of post-construction settlement is usually reduced through appropriate engineering design, such as preloading if required (refer preload trial recommendation above), identification and removal of buried tree stumps/ logs from beneath building platforms and service line corridors, and settlement monitoring of fills.

Pleistocene Alluvial soils, particularly pumiceous soils (which are common in Tauranga Group), can be sensitive to disturbance during earthworks and trafficking with pumping and weaving occurring under heavy machinery trafficking (i.e. the subgrade may lose strength and become difficult for primary earthworks machinery to traverse). If sensitive and/ or pumiceous soils are uncovered near to proposed levels on site, appropriate earthworks methodologies and programming should be implemented to avoid disturbing these materials. This can include keeping machinery trafficking to designated haul roads and maintaining levels at 200mm-300mm above final level until topsoil or basecourse can be placed. Where these soils are disturbed, undercutting and reinstatement of the disturbed soil mass with engineered filling will likely be necessary.

### 9.3.2 Pakiri Formation Soils (Waitemata Group)

Based on our previous experience with Pakiri Formation Soils we expect that they should generally be suitable as borrow materials. Confirmation of their suitability for use should be undertaken prior to Resource Consent and bulk earthworks. That testing should comprise (but not limited to) a series of Atterberg tests, moisture contents, particle size distribution and one-dimensional consolidation test. Earthworks compaction should be undertaken in accordance with NZS4431:2022.

In some cases Pakiri Formation Soils may present as silty and be difficult to work with due to the lack of clay content necessary to bind the material. Methods to deal with such

## 9.4 Pipes and Buried Services

The laying of deep pipelines in ground with a high groundwater table can be extremely difficult and is best undertaken by a Constructor with a proven track record in this regard (i.e. laying pipes in peat).

If flat grades are proposed then the risk of settlement dipping the lines increases, and redundancy should be incorporated into the design, such as oversizing pipeline internal diameters, careful consideration in selection of

trench backfill materials, seepage cut off collars at regular intervals to prevent the pipe bedding media acting as a groundwater drawdown drain, etc.

Increased bedding thickness and undercut to provide a uniform support to the pipelines will also be necessary. It is important to note that despite design and construction best efforts, differential settlement on flat service lines always poses a risk and cannot be completely mitigated in this terrain. It will be important to ensure settlement in bulk fill areas has attenuated to acceptable level prior to the laying of minimal grade service lines and roading kerbs, etc. This is an important construction sequencing issue.

Deep trench fills (e.g. greater than 3m) if hard filled may induce settlements that dip lines, so lightweight fills (e.g. PolyRock) or Puni sand with 3% cement (i.e. to immobilise it) may be warranted in isolated areas.

It is also important that service pipes are designed to withstand long-term corrosion. We anticipate that specialist advice will need to be sought for assessments in accordance with AS4058:2007 Appendix E, Table E1 (or current standard) as to concrete pipe resistance to the corrosive nature of the soils. Chemical testing and analyses of the organic soils/groundwater may be required for this (e.g. pH, total alkalinity (mg/L), Baumann-Gully acidity (mL/kg), chloride and sulphate (mg/kg)) prior to Resource Consent.

## 10 CONCLUSION

Specific consideration will be required for the points summarised within this document when developing the proposed plan change and as the project progresses to subdivision and design. Consolidation and settlement analysis should be conducted in more detail and be site specific for the different stages of the proposed plan change, with remediation methods considered to overcome potential consolidation settlement. In particular, the low-lying alluvial plains to the northwest of the proposed plan change extent.

Based on our review of the data available and our site-specific investigations and preliminary assessment, it is considered that the proposed land within the plan change boundary west of state highway one is geotechnically suitable for residential subdivision, including light infrastructure and community centres (i.e., schools and parks). While earthworks, site contouring, retaining wall and specific analysis and development will be required, these are considered part in parcel for developments of this nature.

## 11 LIMITATIONS

This report has been prepared exclusively for the KA-Waimanawa Ltd with respect to the brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party. Furthermore, this report should be read in its entirety to understand the context of the opinions and considerations given.

To support a Resource Consent application, it is recommended that additional geotechnical investigations and analyses will be required that are commensurate with a future development scheme / earthworks proposal / staging's. We anticipate much of the data presented herein could be introduced into subsequent Resource Consent reports.

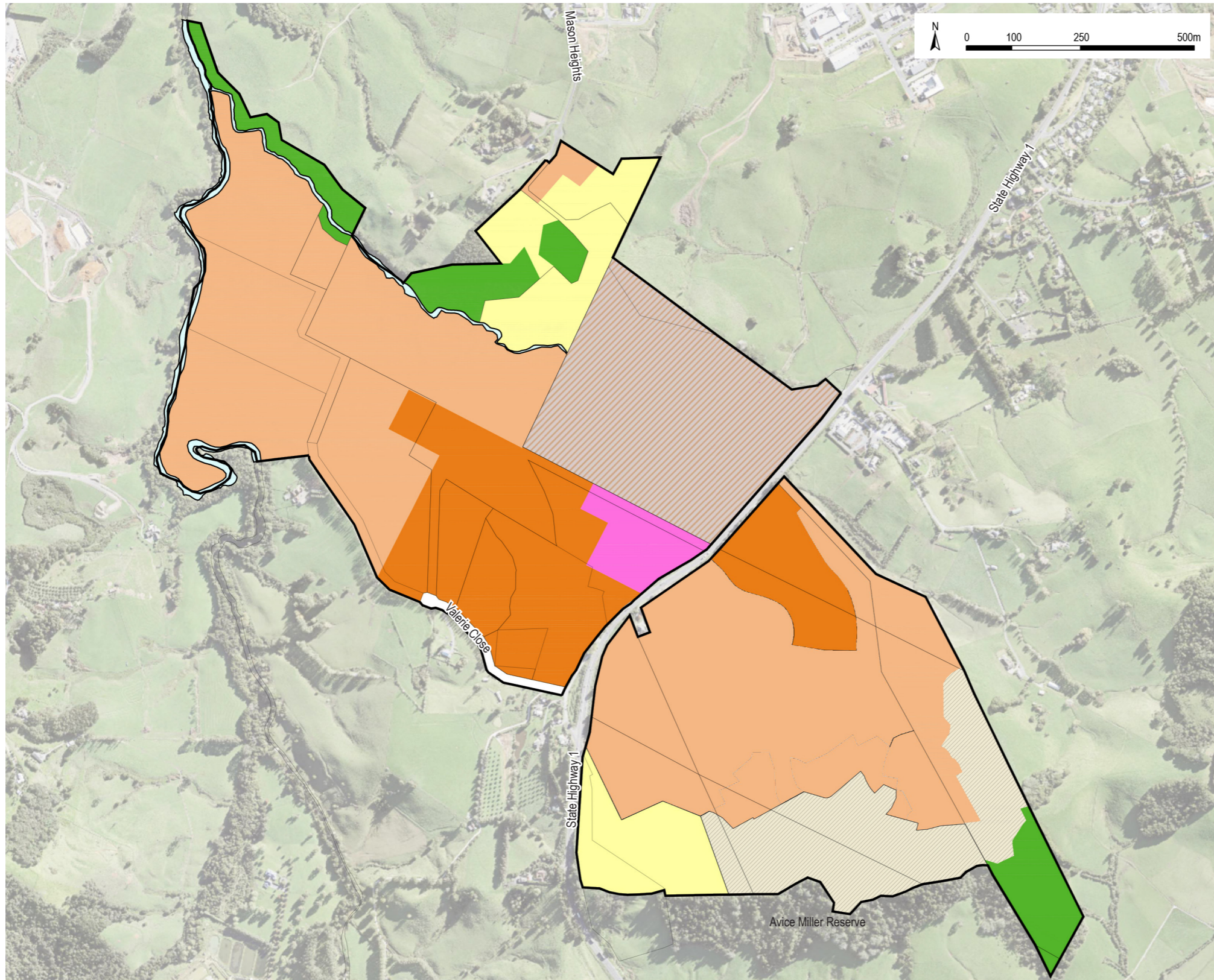
## 12 REFERENCES

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**APPENDIX A**  
**PROVIDED PLANS AND DRAWINGS**



### 5.3 Zoning Concept Plan

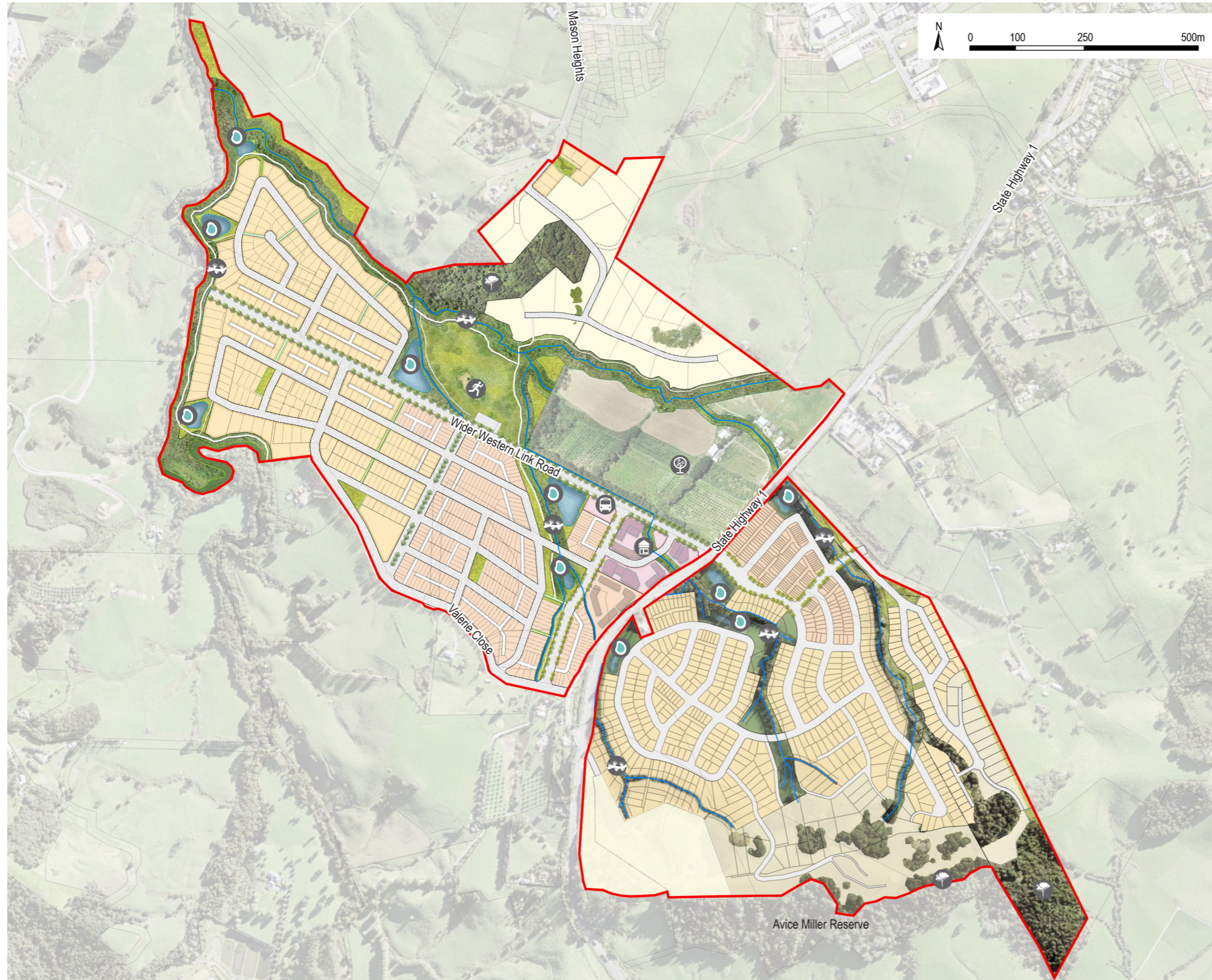


- Legend
- Plan Change Extent
  - Residential- Large Lot Zone
  - Residential- Single House (minimum lot size 1,000m<sup>2</sup>)
  - Residential- Mixed Housing Urban Zone
  - Residential- Terrace Housing and Apartment Building Zone
  - Business- Local Centre Zone
  - Open Space- Conservation Zone
  - Rural-Mixed Rural Zone








Figure 19 - Warkworth South Zoning Concept Plan



## 5.4 Indicative Masterplan



### Key Features

-  Local Centre
-  Public Transport Interchange (Indicative)
-  Morrison Heritage Orchard
-  Recreational Park
-  Stream Corridor
-  Bush Reserve
-  Stormwater Pond (indicative)

### Residential

-  Terrace Housing & Apartment Buildings
-  Mixed Housing Urban
-  Single House
-  Large Lot
-  Plan Change Boundary

Figure 20 - Warkworth South Indicative Masterplan





REFER C221

MASON HEIGHT

REFER C222

MORRISON HERITAGE ORCHID

STATE HIGHWAY ONE

WAIMANAWA VALLEY

WAIMANAWA HILLS

VALERIE CLOSE

EARTH WORKS (SURFACE EX-GL COMPARISON WITH SURFACE PROP- GL )

CUT VOLUME 355000m<sup>3</sup>  
FILL VOLUME 444000 m<sup>3</sup>  
NET FILL 89000 m<sup>3</sup>

TOPSOIL STRIPPED (200mm) = 163000m<sup>3</sup>  
EARTHWORKS AREA = 81.3 Ha

NOTE: NO ALLOWANCE FOR SERVICE TRENCHES,  
VOLUMES ARE UNFACTORED AND IN SITU

- Notes
- All works to be in accordance with Auckland council standards.
  - Co-ordinates in terms of NZ Geodetic Datum Mt Eden 2000
  - Levels in terms of the Auckland Vertical Datum 1946.
  - Origin of Levels = CA 97 (ABLQ)  
Published RL=43.36, sourced from The LINZ Digital Geodetic Database.
  - Boundaries are subject to final survey.

Legend

	EX BDY
	PROP BDY
	PLAN CHANGE BDY
	EX PERM. STREAM
	EX INT. STREAM
	EX WETLAND

Cut/Fill Table

Number #	Minimum Elevation	Maximum Elevation	Color
1	-7.019	-6.000	
2	-6.000	-4.000	
3	-4.000	-2.000	
4	-2.000	0.000	
5	0.000	2.000	
6	2.000	4.000	
7	4.000	6.000	
8	6.000	8.684	

A	PPC		KH	08/2022
Rev	Description	By	Date	
		By	Date	
Survey	PARALAX & MAVEN	03/21		
Design	KH	07/22		
Drawn	KH	08/22		
Checked	GB	08/22		

Project  
**WARKWORTH SOUTH  
PLAN CHANGE FORE  
KA WAIMANAWA LP &  
STEPPING TOWARDS  
FAR LTD**

Title  
**PROPOSED  
CUT/FILL OVERVIEW  
PLAN**

Project no.	211001
Scale	1:7500 @ A3
Cad file	211001-COMBINED PC EW.DWG
Drawing no.	C220
Rev	<b>A</b>





**EARTH WORKS (SURFACE EX-GL COMPARISON WITH SURFACE PROP- GL )**

CUT VOLUME 355000m<sup>3</sup>  
 FILL VOLUME 444000 m<sup>3</sup>  
 NET FILL 89000 m<sup>3</sup>

TOPSOIL STRIPPED (200mm) = 163000m<sup>3</sup>  
 EARTHWORKS AREA = 81.3 Ha

NOTE: NO ALLOWANCE FOR SERVICE TRENCHES,  
 VOLUMES ARE UNFACTORED AND IN SITU

- Notes
1. All works to be in accordance with Auckland council standards.
  2. Co-ordinates in terms of NZ Geodetic Datum Mt Eden 2000
  3. Levels in terms of the Auckland Vertical Datum 1946.
  4. Origin of Levels = CA 97 (ABLQ)  
Published RL=43.36, sourced from The LINZ Digital Geodetic Database.
  5. Boundaries are subject to final survey.

Legend

	EX BDY
	PROP BDY
	PLAN CHANGE BDY
	EX PERM. STREAM
	EX INT. STREAM
	EX WETLAND

Cut/Fill Table

Number #	Minimum Elevation	Maximum Elevation	Color
1	-7.019	-6.000	
2	-6.000	-4.000	
3	-4.000	-2.000	
4	-2.000	0.000	
5	0.000	2.000	
6	2.000	4.000	
7	4.000	6.000	
8	6.000	8.684	

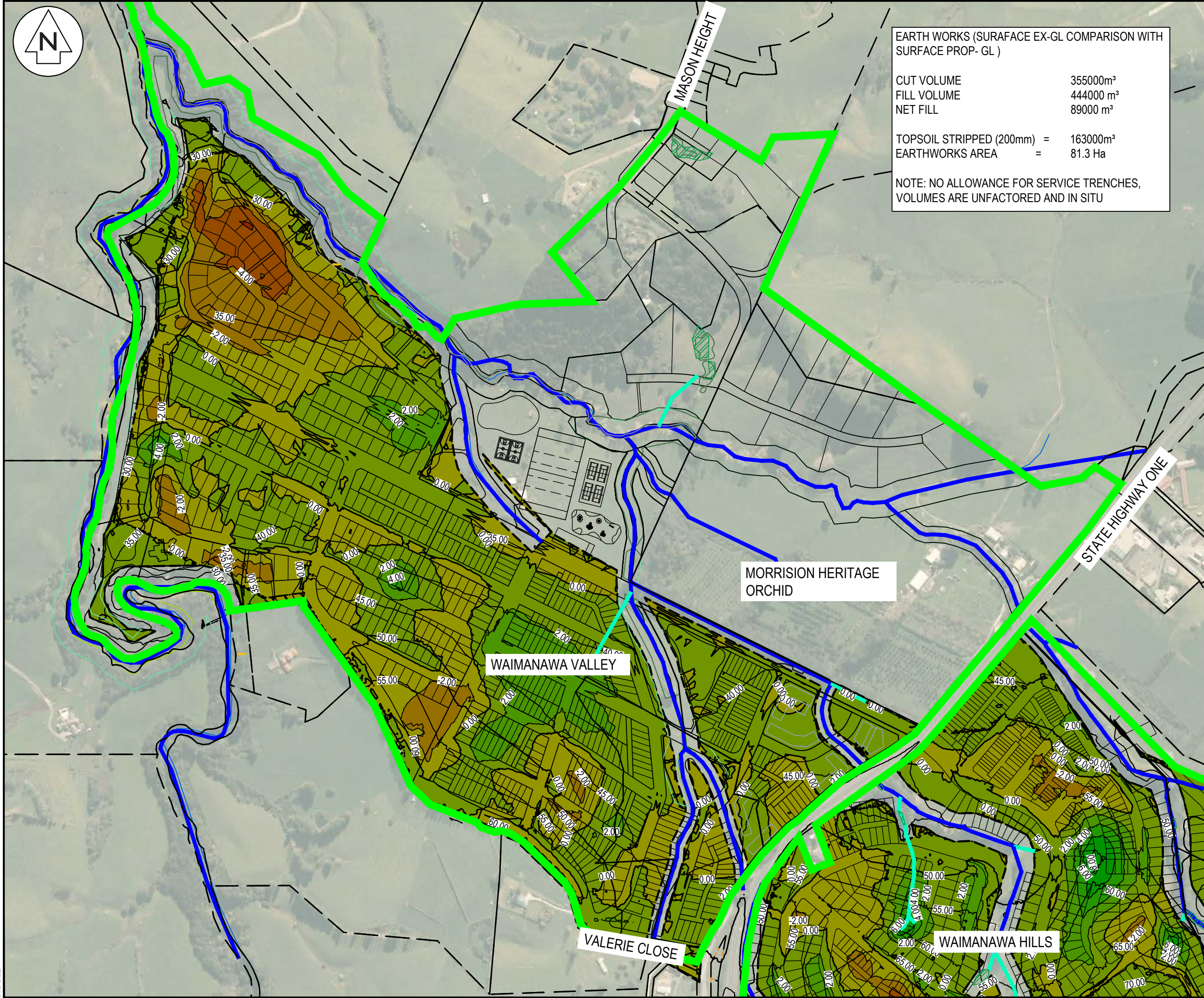
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Rev	Description		By	Date
			By	Date
Survey	PARALAX & MAVEN		03/21	
Design	KH		07/22	
Drawn	KH		08/22	
Checked	GB		08/22	

Maven Associates  
 09 571 0050  
 info@maven.co.nz  
 www.maven.co.nz  
 5 Owens Road, Epsom  
 Auckland 1023

Project  
**WARKWORTH SOUTH  
 PLAN CHANGE FORE  
 KA WAIMANAWA LP &  
 STEPPING TOWARDS  
 FAR LTD**

Title  
**PROPOSED  
 CUT/FILL  
 PLAN**

Project no.	211001
Scale	1:5000 @ A3
Cad file	211001-COMBINED PC EW.DWG
Drawing no.	C221
Rev	<b>A</b>



DATE: 8/8/22





**EARTH WORKS (SURFACE EX-GL COMPARISON WITH SURFACE PROP- GL )**

CUT VOLUME 355000m<sup>3</sup>  
 FILL VOLUME 444000 m<sup>3</sup>  
 NET FILL 89000 m<sup>3</sup>

TOPSOIL STRIPPED (200mm) = 163000m<sup>3</sup>  
 EARTHWORKS AREA = 81.3 Ha

NOTE: NO ALLOWANCE FOR SERVICE TRENCHES,  
 VOLUMES ARE UNFACTORED AND IN SITU

- Notes
- All works to be in accordance with Auckland council standards.
  - Co-ordinates in terms of NZ Geodetic Datum Mt Eden 2000
  - Levels in terms of the Auckland Vertical Datum 1946.
  - Origin of Levels = CA 97 (ABLQ)  
 Published RL=43.36, sourced from The LINZ Digital Geodetic Database.
  - Boundaries are subject to final survey.

Legend

- EX BDY
- PROP BDY
- PLAN CHANGE BDY
- EX PERM. STREAM
- EX INT. STREAM
- EX WETLAND

Cut/Fill Table			
Number #	Minimum Elevation	Maximum Elevation	Color
1	-7.019	-6.000	Dark Red
2	-6.000	-4.000	Red
3	-4.000	-2.000	Light Red
4	-2.000	0.000	Yellow
5	0.000	2.000	Light Green
6	2.000	4.000	Green
7	4.000	6.000	Dark Green
8	6.000	8.684	Very Dark Green

A	PPC		KH	08/2022
Rev	Description	By	Date	
Survey	PARALAX & MAVEN		03/21	
Design	KH		07/22	
Drawn	KH		08/22	
Checked	GB		08/22	

**M** Maven Associates  
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 info@maven.co.nz  
 www.maven.co.nz  
 5 Owens Road, Epsom  
 Auckland 1023

Project  
**WARKWORTH SOUTH  
 PLAN CHANGE FORE  
 KA WAIMANAWA LP &  
 STEPPING TOWARDS  
 FAR LTD**

Title  
**PROPOSED  
 CUT/FILL  
 PLAN**

Project no.	211001
Scale	1:5000 @ A3
Cad file	211001- COMBINED PC EW.DWG
Drawing no.	C222
Rev	<b>A</b>

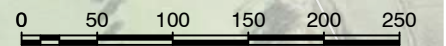


## APPENDIX B LDE DRAWINGS



**Legend**

- ┌┐ Plan Change Extent August 2020
- Zone Boundary



Scale 1:5000 (m) Original Size = A3

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CLIENT  
**KA Waimanawa Partnership Ltd**

PROJECT  
**Warkworth South Plan Change  
 West of State Highway 1**

DRAWING TITLE  
**Zone Boundaries**



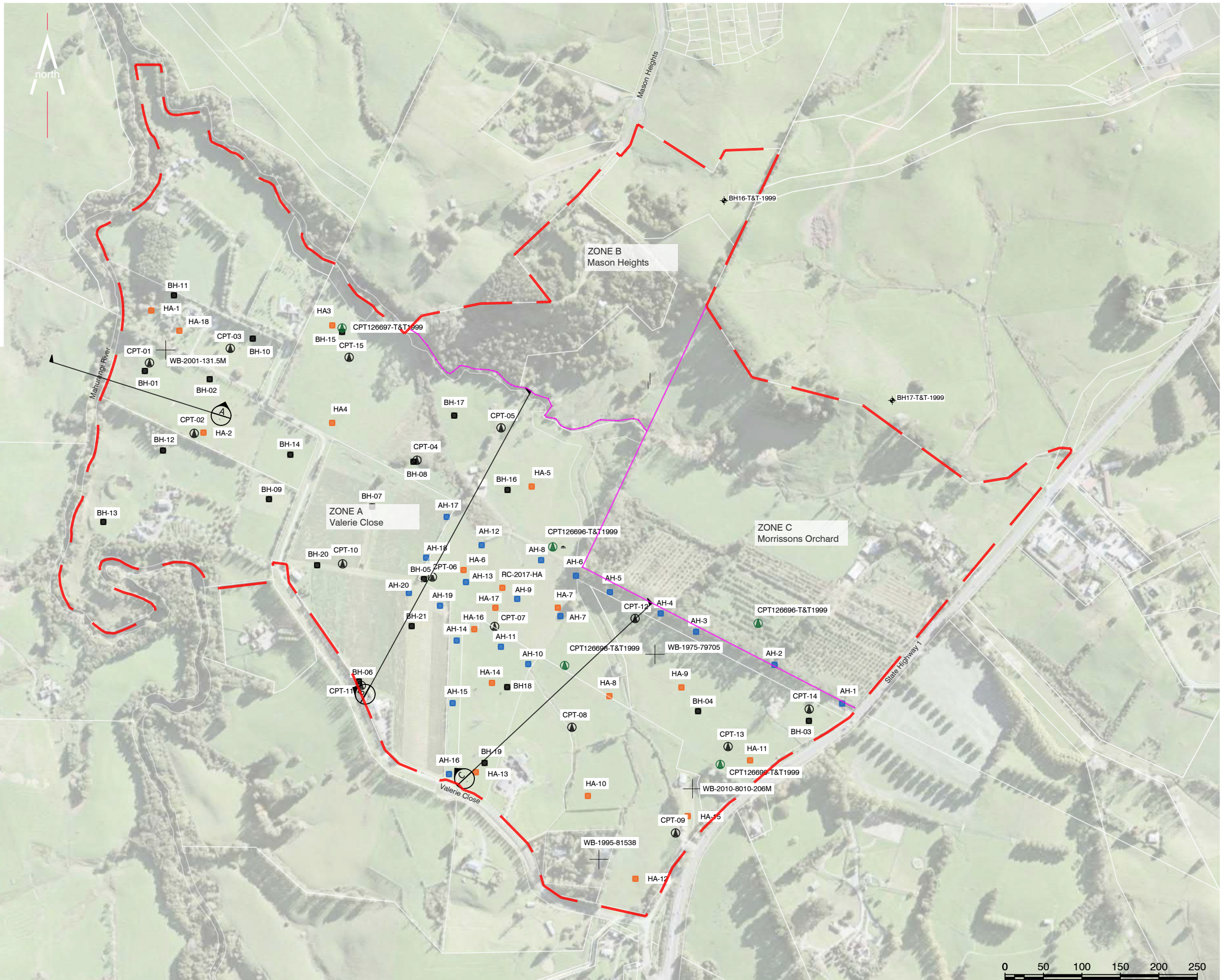
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DATE:	03/11/2020
CHECKED:	--
REVISION	BY DATE
Revision A	25/08/2021

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PROJECT:	18707	SHEET: 1 of 7
DRAWING No:	18707-	REV: A
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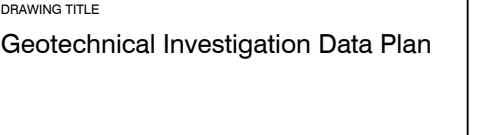
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- Property Boundary
- BH-XX  LDE Ltd Hand Auger Boreholes Nov/Dec 2020
- CPT-XX  LDE Ltd CPT Nov 2020
- CPT-XX  Tonkin & Taylor CPT 1999
- MBH-XX  Tonkin & Taylor Machine Borehole 19999
- AH-XX  Soil and Rock Consultants Ltd Jan 2020
- HA-XX  Riley Consultants Ltd Nov 2017
- + Council Database Waterbore
- ↔ Cross Section
- Zone Boundary



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CLIENT <b>KA Waimanawa Partnership Ltd</b>	PROJECT <b>Warkworth South Plan Change West of State Highway 1</b>
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DRAWING TITLE <b>Geotechnical Investigation Data Plan</b>
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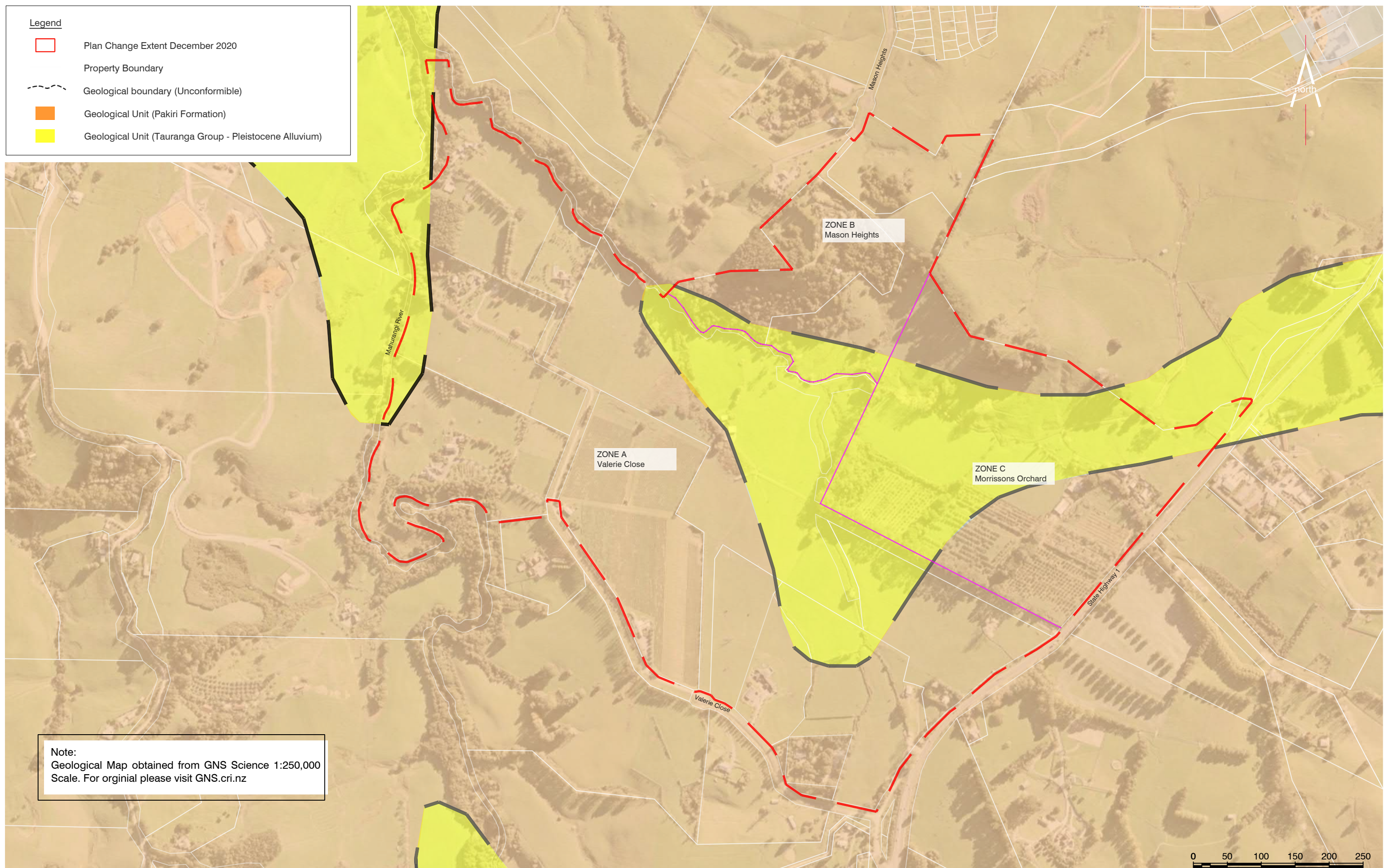
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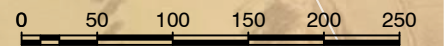


**Legend**

- Plan Change Extent December 2020
- Property Boundary
- Geological boundary (Unconformable)
- Geological Unit (Pakiri Formation)
- Geological Unit (Tauranga Group - Pleistocene Alluvium)



**Note:**  
 Geological Map obtained from GNS Science 1:250,000  
 Scale. For orginial please visit GNS.cri.nz



Scale 1:5000 (m) Original Size = A3

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CLIENT  
 KA Waimanawa Partnership Ltd

PROJECT  
 Warkworth South Plan Change  
 West of State highway 1

DRAWING TITLE  
 GNS Science Geological Map  
 1:250,000



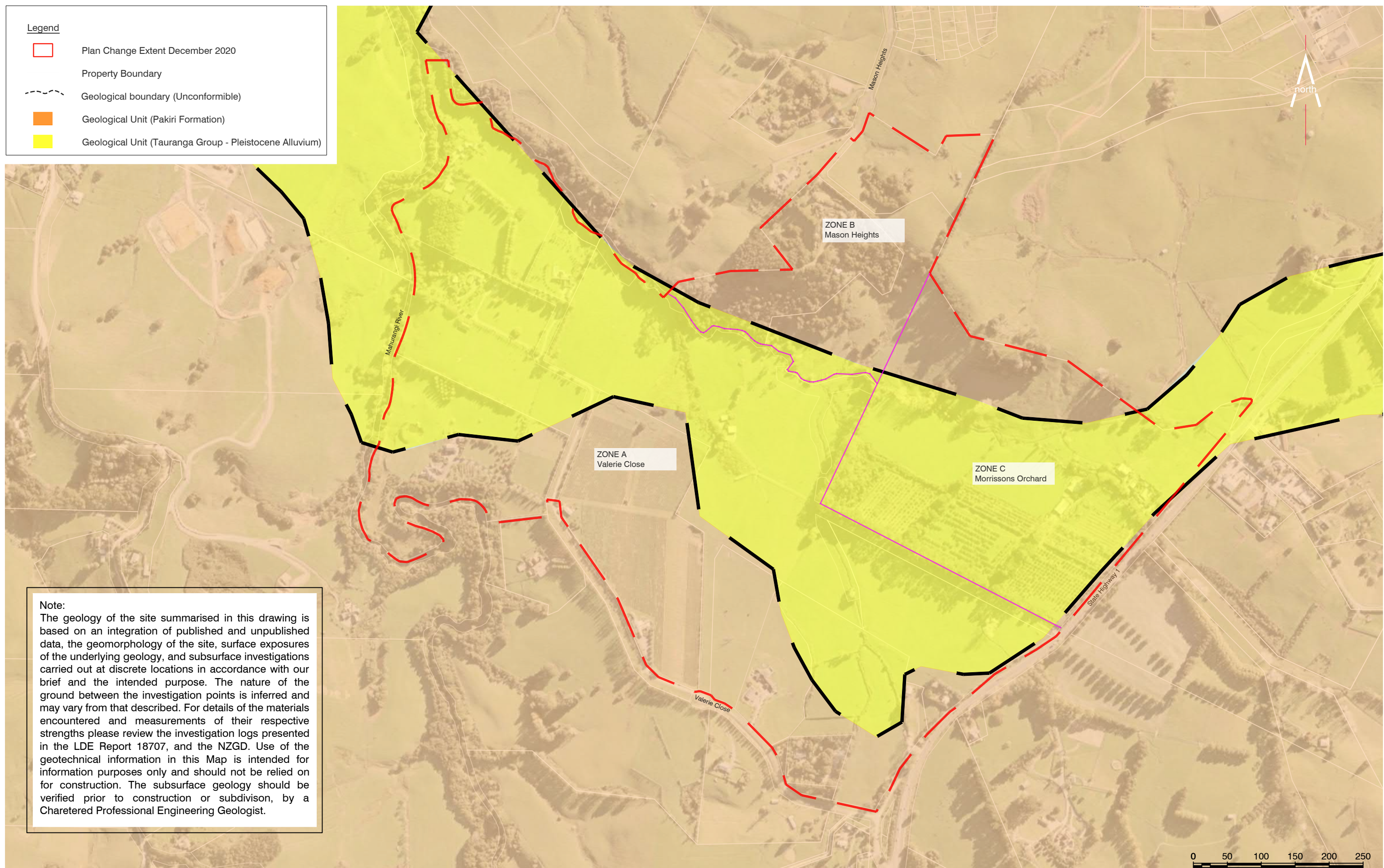
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BY	DATE
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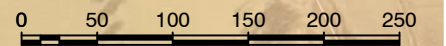


**Legend**

- Plan Change Extent December 2020
- Property Boundary
- Geological boundary (Unconformable)
- Geological Unit (Pakiri Formation)
- Geological Unit (Tauranga Group - Pleistocene Alluvium)



**Note:**  
 The geology of the site summarised in this drawing is based on an integration of published and unpublished data, the geomorphology of the site, surface exposures of the underlying geology, and subsurface investigations carried out at discrete locations in accordance with our brief and the intended purpose. The nature of the ground between the investigation points is inferred and may vary from that described. For details of the materials encountered and measurements of their respective strengths please review the investigation logs presented in the LDE Report 18707, and the NZGD. Use of the geotechnical information in this Map is intended for information purposes only and should not be relied on for construction. The subsurface geology should be verified prior to construction or subdivision, by a Chartered Professional Engineering Geologist.



Scale 1:5000 (m) Original Size = A3

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CLIENT  
 KA Waimanawa Partnership Ltd

PROJECT  
 Warkworth South Plan Change  
 West of State Highway 1

DRAWING TITLE  
 GNS Science Geological Map  
 1:250,000  
 Revised



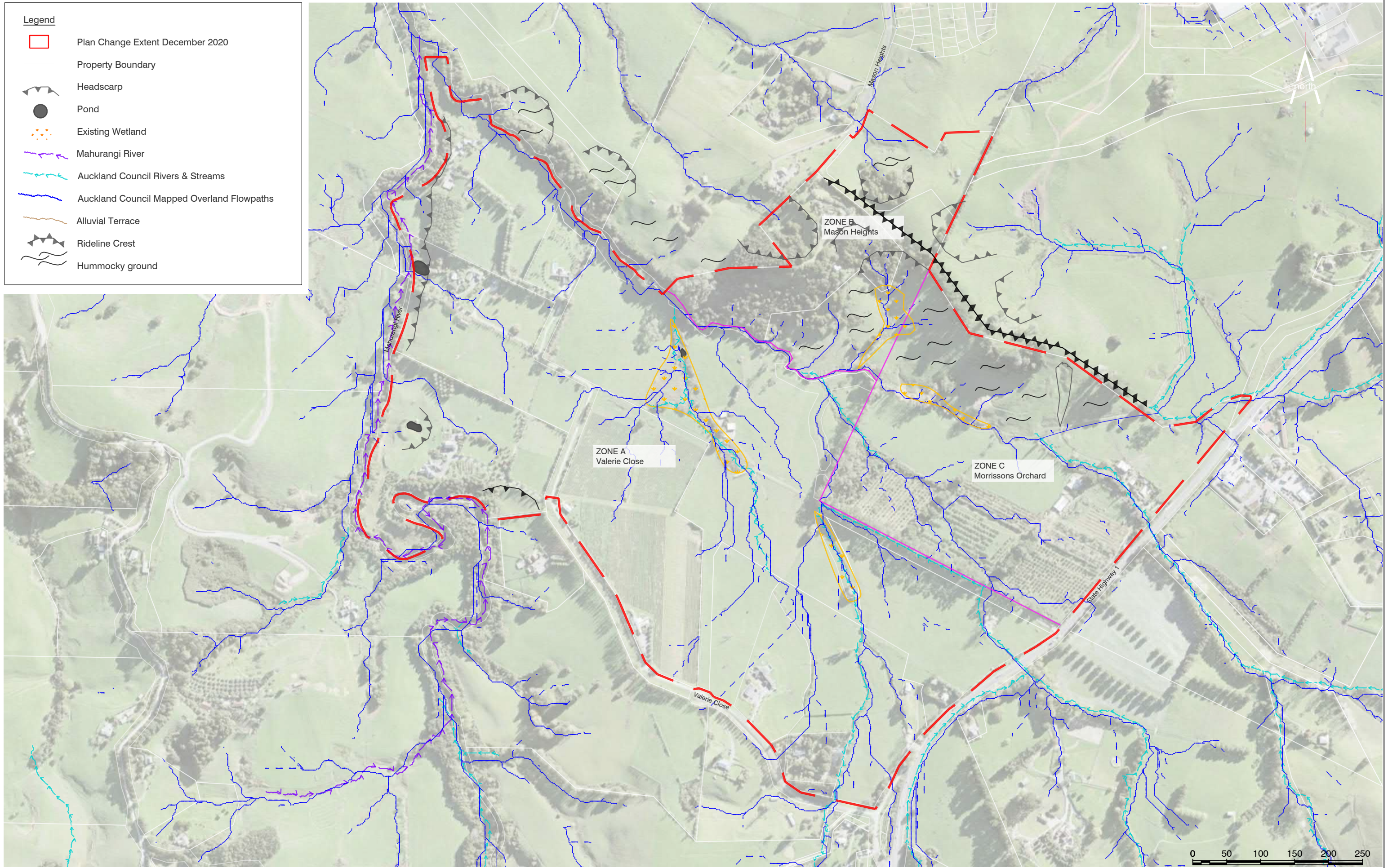
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No.							

DRAWING No: 18707-4  
 REV: B



**Legend**

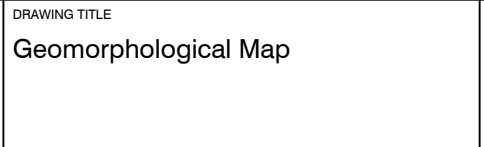
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- Property Boundary
- Headscarp
- Pond
- Existing Wetland
- Mahurangi River
- Auckland Council Rivers & Streams
- Auckland Council Mapped Overland Flowpaths
- Alluvial Terrace
- Rideline Crest
- Hummocky ground



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<b>CLIENT</b> KA Waimanawa Partnership Ltd	<b>PROJECT</b> Warkworth South Plan Change West of State highway 1
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





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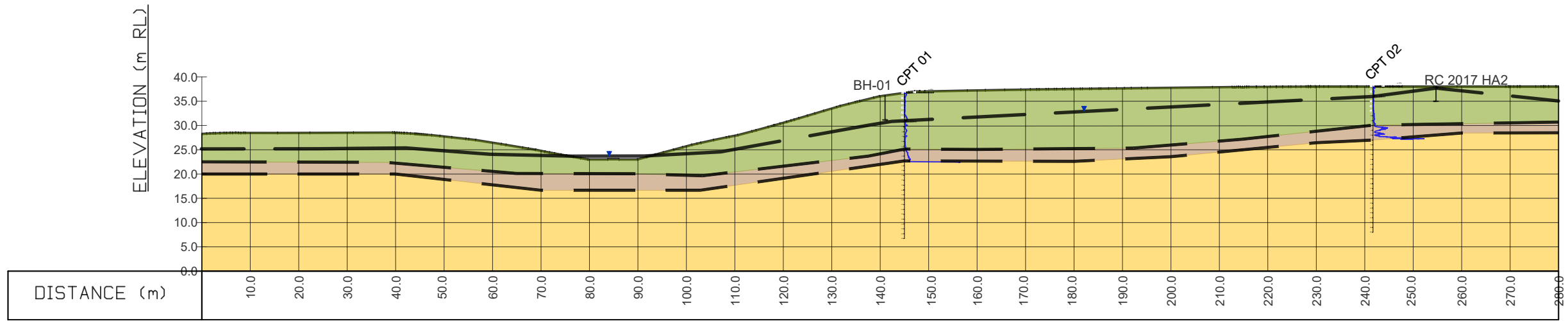


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REVISION	BY	DATE	REV:
			A

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Legend	
	Existing Profile
	Residual Soil: Stiff to Very Stiff - (Pakiri Formation)
	Highly Weathered Sandstone (Pakiri Formation)
	Completely Weather Sandstone (Pakiri Formation)
	Pleistocene Alluvium (Undiff. Tauranga Group)
	Groundwater Level (Inferred)



SECTION A

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Original Size = A3

CLIENT  
KA Waimanawa Partnership Ltd







PROJECT  
Warkworth South Plan Change  
West of State Highway 1

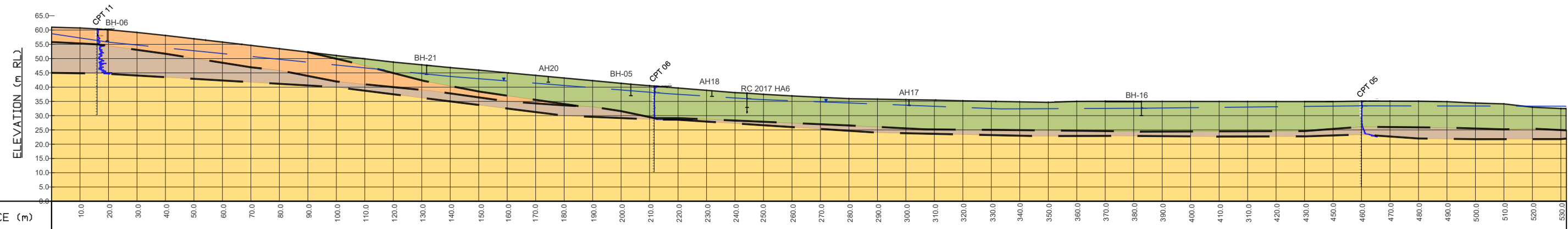
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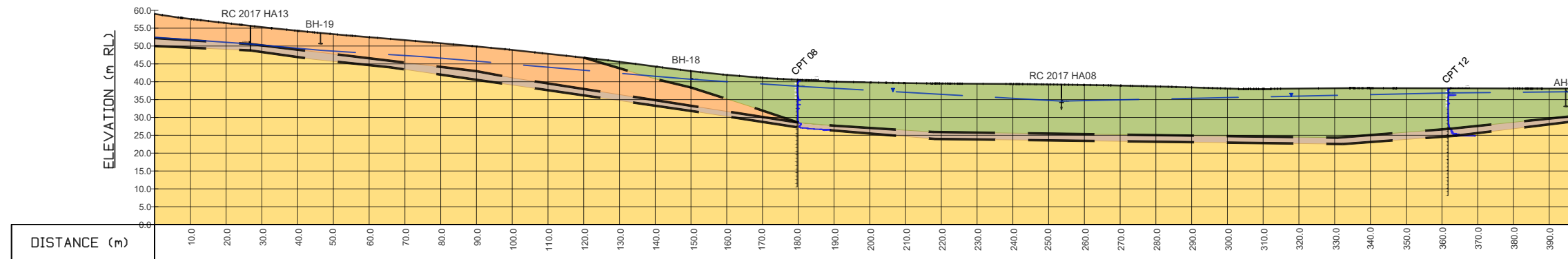
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PROJECT STATUS: <b>Draft</b>	
PROJECT: 18707	SHEET: 6 of 7
DRAWING No: 18707-6	REV: A

Legend	
	Existing Profile
	Residual Soil: Stiff to Very Stiff - (Pakiri Formation)
	Highly Weathered Sandstone (Pakiri Formation)
	Completely Weather Sandstone (Pakiri Formation)
	Pleistocene Alluvium (Undiff. Tauranga Group)
	Groundwater Level (Inferred)



SECTION B



SECTION C

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Original Size = A3

CLIENT  
KA Waimanawa Partnership Ltd

PROJECT  
Warkworth South Plan Change  
West of State Highway 1

DRAWING TITLE  
Cross Sections B & C



DESIGN:	DB
DRAWN:	DB
DATE:	03/11/2020
CHECKED:	--
SCALE A3:	NTS

PROJECT STATUS: <b>Draft</b>	
PROJECT: 18707	SHEET: 7 of 7
DRAWING No: 18707-7	REV: A



## APPENDIX C LDE INVESTIGATION DATA



# Hand Auger Borehole Log

Test ID: **BH-01**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite measurements

**Coordinates:** 5968637mN, 1746819mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 23/11/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0 - 0.1	TS	Organic SILT; dark brown. Low plasticity.	Topsoil		2	50	119/51	
0.1 - 0.5	TS	Silty CLAY; light brownish orange. High plasticity; moist; Moderate - high plasticity. Very stiff-hard.	Pleistocene river and hillslope deposits - Tauranga Group		4	100	238+/-	-0.5
0.5 - 0.8	TS	0.8m: with some silt; brownish orange. High plasticity; moist.			6	150	238+/-	
0.8 - 1.1	TS	1.1m: with trace gravel. Gravel, fine, angular, highly weathered, Limonite.			8	200	214/119	
1.1 - 1.4	TS	1.4m: with minor silt; brownish orange with light grey streaks.					214/122	-1.0
1.4 - 1.7	TS						177/109	
1.7 - 2.0	TS						204/115	-1.5
2.0 - 2.4	TS						170/102	
2.4 - 2.7	TS	2.4m: with some silt. High plasticity.					173/98	-2.0
2.7 - 3.0	TS						166/98	
3.0 - 3.5	TS						238+/-	-2.5
3.5 - 3.8	TS	3.5m: magnesium oxide staining (MnO2), black streaks					195/115	
3.8 - 4.0	TS	4.0m: with minor silt; light grey with orange streaks. Moist to wet.					238+/-	-3.0
4.0 - 4.3	TS						153/61	
4.3 - 4.6	TS						161/78	-3.5
4.6 - 4.9	TS	4.6m: with minor silt and sand; light grey with black streaks. Sand, fine to medium.					195/85	
4.9 - 5.0	TS	End of hole at target depth of 5.00m				238+/-	-4.0	
						161/68	-4.5	
						153/76		
						136/68	-5.0	
						109/51		
						95/41	-4.5	
						119/58		
						139/51	-5.0	

**Remarks:**  
 Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-02**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite measurements

**Coordinates:** 5968622mN, 1746922mE

**System:** NZTM

**Elevation:** Ground

**Located By:**

**Test Date:** 23/11/2020

**Logged By:** DB

**Checked By:**

**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
		Organic SILT; dark brown. Low plasticity; dry.	Topsoil				51/7	
0.5		Clayey SILT; light brown. Stiff to very stiff; low plasticity; moist.	Pleistocene river and hillslope deposits - Tauranga Group				136/54	-0.5
		Silty CLAY; light brownish orange. Stiff to very stiff; high plasticity; moist. 0.8m: with trace rootlets (fresh); wet						149/58
1.0		CLAY, with some silt; orange with light grey streaks. Stiff to very stiff; high plasticity; wet.					238+/-	-1.0
1.5							88/24	-1.5
		With minor sand; orange with light grey streaks. Saturated; sand, fine to medium; Ground water seepage encountered at 1.6m.					119/44	-1.5
		Light grey with black and orange streaks. .					122/58	-1.5
2.0							119/14	-1.5
							68/17	-2.0
							92/24	-2.0
							110/37	-2.5
2.5							68/20	-2.5
							102/34	-2.5
							68/34	-3.0
3.0							65/24	-3.0
		End of hole at target depth of 3.20m					51/7	-3.5
3.5								-3.5
4.0								-4.0
4.5								-4.5
5.0								-5.0

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-03**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968107mN, 1747827mE

**System:** NZTM

**Elevation:** Ground

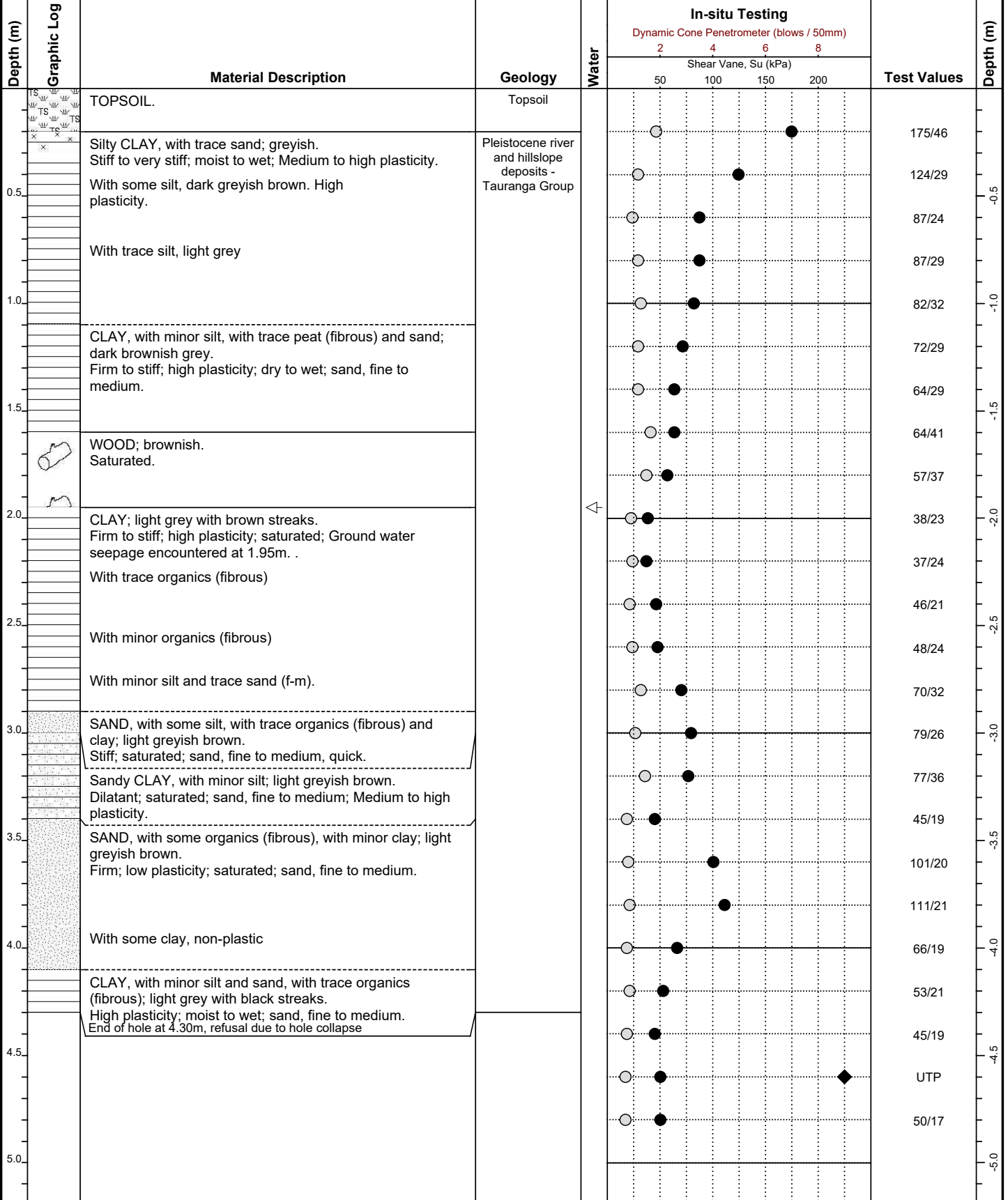
**Located By:**

**Test Date:** 26/11/2020

**Logged By:** CS, DB

**Checked By:**

**Vane ID:** 2908



**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-04**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968122mN, 1747659mE

**System:** NZTM

**Elevation:** Ground

**Located By:**

**Test Date:** 30/11/2020

**Logged By:** CS

**Checked By:**

**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
		TOPSOIL.	Topsoil							
0.5		Silty CLAY; brownish grey. Stiff to very stiff; high plasticity; moist. With trace sand (f-m), light grey with brown streaks With some organics (fibrous), with trace sand (f-m). Blueish grey With trace silt, light grey, high plasticity, wet	Pleistocene river and hillslope deposits - Tauranga Group							
1.0										
1.5										
2.0		Rootlets. Light grey.								
2.5		Silty. High plasticity; wet to saturated. With some silt.								
3.0		Sandy. Saturated; sand, fine to medium.								
3.5		End of hole at 3.60m, refusal due to hole collapse								
4.0										
4.5										
5.0										

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Generated with CORE-GS by Geroc - HA/TP Log v4 (new) - 27/06/2022 2:29:36 pm



# Hand Auger Borehole Log

Test ID: **BH-05**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968322mN, 1747243mE

**System:** NZTM

**Elevation:** Ground

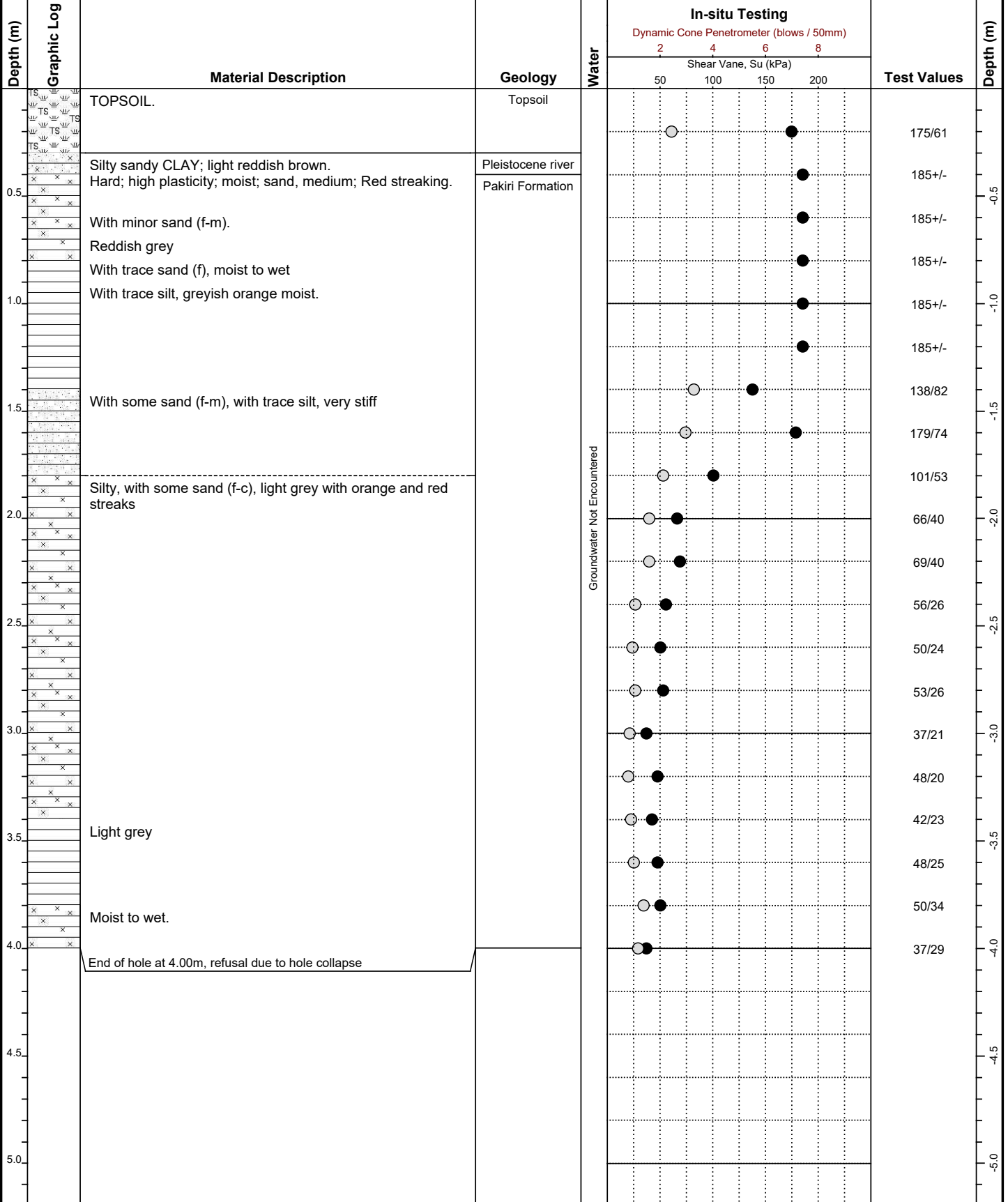
**Located By:**

**Test Date:** 02/12/2020

**Logged By:** CS

**Checked By:**

**Vane ID:** 2908



**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow





# Hand Auger Borehole Log

Test ID: **BH-06**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968166mN, 1747143mE

**System:** NZTM

**Elevation:** Ground

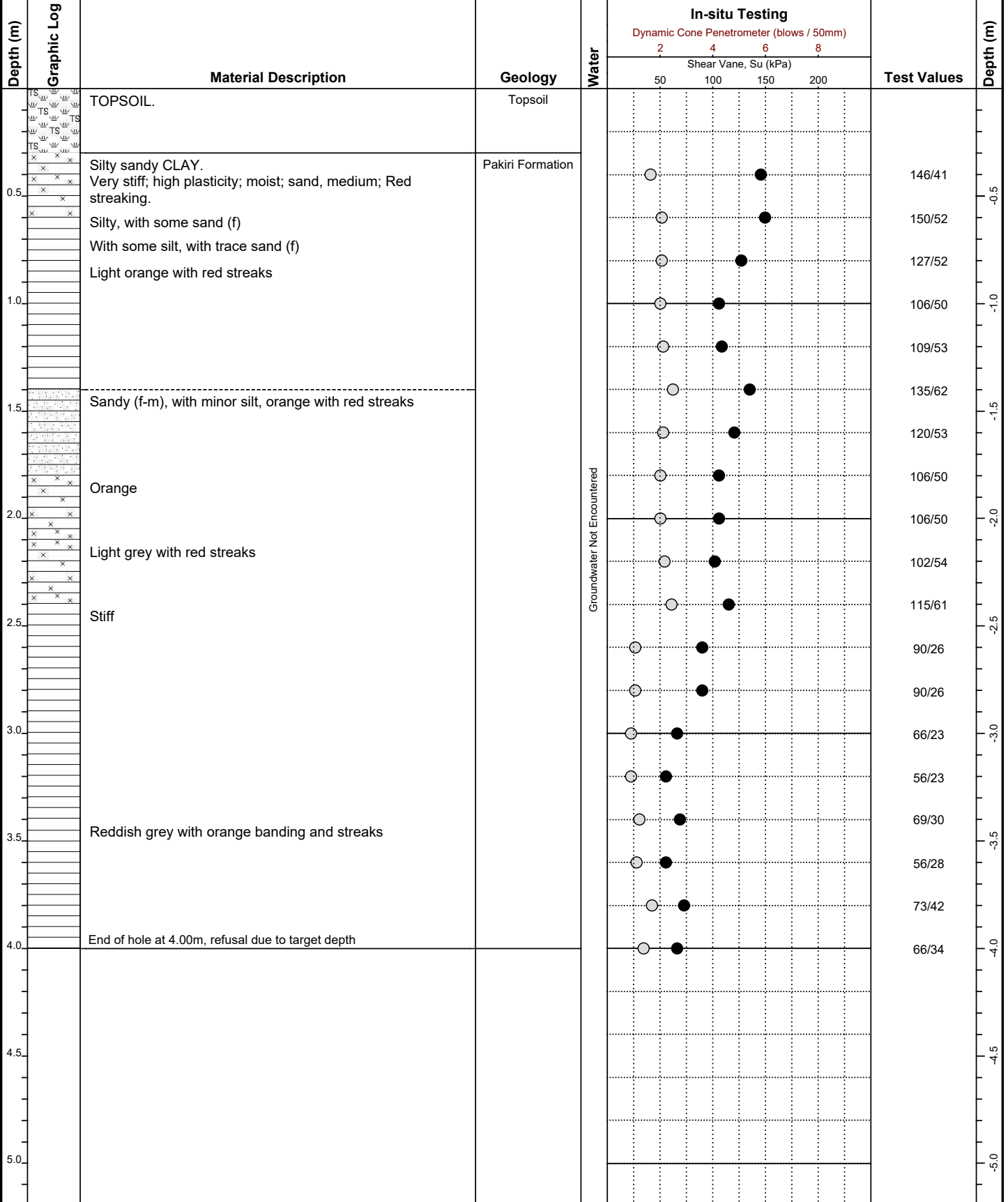
**Located By:**

**Test Date:** 03/12/2020

**Logged By:** CS

**Checked By:**

**Vane ID:** 2908



**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-07**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968432mN, 1747164mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 03/12/2020  
**Logged By:** CS  
**Checked By:**  
**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
		TOPSOIL.	Topsoil							
0.5		Silty sandy CLAY; dark brown. Firm; high plasticity; moist to wet; sand, medium.	Pleistocene river and hillslope deposits - Tauranga Group						41/24	-0.5
		Silty, brownish grey With some organics (fibrous), dark grey with orange streaks								24/5
		Saturated, groundwater seepage encountered at 0.7m. With some silt, with minor organics (fibrous). dark grey grey with black streaks		↕					34/11	
1.0		Core loss							25/5	-1.0
									33/16	
									34/16	-1.5
									34/13	
									36/12	
2.0									24/12	-2.0
									29/13	
									21/5	-2.5
2.5									16/5	
		WOOD							28/15	-3.0
		Core loss								
3.0		End of hole at 3.00m, refusal due to target depth							29/15	
3.5										-3.5
4.0										-4.0
4.5										-4.5
5.0										-5.0

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ↙ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-08**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968498mN, 1747227mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 03/12/2020  
**Logged By:** CS  
**Checked By:**  
**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0 - 0.5	TOPSOIL.	TOPSOIL.	Topsoil					
0.5 - 1.0	Silty CLAY, with some organics (fibrous); dark grey with orange streaks. Stiff; high plasticity; moist. Becoming silty and sandy (f-m). With minor organics (fibrous), with trace silt, light grey with black streaks	Holocene Alluvial Deposits						
1.0 - 1.5	WOOD Organic (fibrous) silty CLAY; grey with dark streaks. Low plasticity; saturated.							
1.5 - 2.0	Core loss							
2.0 - 2.5	CLAY; dark grey. Firm; high plasticity; saturated.							
2.5 - 3.0	End of hole at 3.00m, refusal due to target depth							

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-09**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968444mN, 1747007mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 07/12/2020  
**Logged By:** CS  
**Checked By:**  
**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TOPSOIL.		Topsoil							
0.5 - 1.0	Clayey SILT, with some sand; brownish grey. Firm to very stiff; low plasticity; dry; sand, fine.		Pakiri Formation		●				159/28	-0.5
1.0 - 1.5	Silty sandy CLAY; yellowish grey. Firm to very stiff; high plasticity; moist; sand, fine to medium. With trace rootlets, light yellow with some grey streaks				○				160/53	-1.0
1.5 - 2.0	Light yellow with grey streaks				○				148/69	-1.5
2.0 - 2.5	With trace silt, yellowish grey, high plasticity				○				109/57	-2.0
2.5 - 3.0	Stiff, grey with orange streaks				○				106/53	-2.5
3.0 - 3.5					○				109/56	-3.0
3.5 - 4.0					○				109/65	-3.5
4.0 - 4.5					○				115/77	-4.0
4.5 - 5.0					○				115/77	-4.5
5.0 - 5.5					○				115/64	-5.0
5.5 - 6.0					○				93/45	-5.5
6.0 - 6.5					○				86/77	-6.0
6.5 - 7.0					○				90/48	-6.5
7.0 - 7.5					○				64/34	-7.0
7.5 - 8.0					○				56/37	-7.5
8.0 - 8.5					○				40/24	-8.0
8.5 - 9.0					○				40/28	-8.5
9.0 - 9.5					○				77/46	-9.0
9.5 - 10.0					○				132/62	-9.5
10.0 - 10.5										-10.0
10.5 - 11.0										-10.5
11.0 - 11.5										-11.0
11.5 - 12.0										-11.5
12.0 - 12.5										-12.0
12.5 - 13.0										-12.5
13.0 - 13.5										-13.0
13.5 - 14.0										-13.5
14.0 - 14.5										-14.0
14.5 - 15.0										-14.5
15.0 - 15.5										-15.0
15.5 - 16.0										-15.5
16.0 - 16.5										-16.0
16.5 - 17.0										-16.5
17.0 - 17.5										-17.0
17.5 - 18.0										-17.5
18.0 - 18.5										-18.0
18.5 - 19.0										-18.5
19.0 - 19.5										-19.0
19.5 - 20.0										-19.5
20.0 - 20.5										-20.0
20.5 - 21.0										-20.5
21.0 - 21.5										-21.0
21.5 - 22.0										-21.5
22.0 - 22.5										-22.0
22.5 - 23.0										-22.5
23.0 - 23.5										-23.0
23.5 - 24.0										-23.5
24.0 - 24.5										-24.0
24.5 - 25.0										-24.5
25.0 - 25.5										-25.0
25.5 - 26.0										-25.5
26.0 - 26.5										-26.0
26.5 - 27.0										-26.5
27.0 - 27.5										-27.0
27.5 - 28.0										-27.5
28.0 - 28.5										-28.0
28.5 - 29.0										-28.5
29.0 - 29.5										-29.0
29.5 - 30.0										-29.5
30.0 - 30.5										-30.0
30.5 - 31.0										-30.5
31.0 - 31.5										-31.0
31.5 - 32.0										-31.5
32.0 - 32.5										-32.0
32.5 - 33.0										-32.5
33.0 - 33.5										-33.0
33.5 - 34.0										-33.5
34.0 - 34.5										-34.0
34.5 - 35.0										-34.5
35.0 - 35.5										-35.0
35.5 - 36.0										-35.5
36.0 - 36.5										-36.0
36.5 - 37.0										-36.5
37.0 - 37.5										-37.0
37.5 - 38.0										-37.5
38.0 - 38.5										-38.0
38.5 - 39.0										-38.5
39.0 - 39.5										-39.0
39.5 - 40.0										-39.5
40.0 - 40.5										-40.0
40.5 - 41.0										-40.5
41.0 - 41.5										-41.0
41.5 - 42.0										-41.5
42.0 - 42.5										-42.0
42.5 - 43.0										-42.5
43.0 - 43.5										-43.0
43.5 - 44.0										-43.5
44.0 - 44.5										-44.0
44.5 - 45.0										-44.5
45.0 - 45.5										-45.0
45.5 - 46.0										-45.5
46.0 - 46.5										-46.0
46.5 - 47.0										-46.5
47.0 - 47.5										-47.0
47.5 - 48.0										-47.5
48.0 - 48.5										-48.0
48.5 - 49.0										-48.5
49.0 - 49.5										-49.0
49.5 - 50.0										-49.5
50.0 - 50.5										-50.0

**Remarks:**  
 Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

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# Hand Auger Borehole Log

Test ID: **BH-10**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968687mN, 1746982mE

**System:** NZTM

**Elevation:** Ground

**Located By:**

**Test Date:** 07/12/2020

**Logged By:** CS

**Checked By:**

**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
50	100	150	200							
0.0 - 0.5	TOPSOIL.		Topsoil							
0.5 - 1.0	Silty sandy CLAY; brownish orange, stiff to very stiff; high plasticity; dry; sand, fine to coarse. Moist Orange, grey with white flecks.		Pleistocene river and hillslope deposits - Tauranga Group						85/42	-0.5
1.0 - 1.5	High plasticity. Greyish orange, firm.								106/49	-1.0
1.5 - 2.0	With trace organics (fibrous), stiff. With some silt and sand (f-c), reddish grey.								83/46	-1.5
2.0 - 2.5	Greyish orange, very stiff, high plasticity.								89/44	-2.0
2.5 - 3.0	With minor organics (fibrous), wet. Stiff, saturated, Ground water seepage encountered at 2.5m.								69/42	-2.5
3.0 - 3.5	End of hole at 3.00m, refusal due to target depth								58/33	-3.0
3.5 - 4.0									93/53	-3.5
4.0 - 4.5									106/64	-4.0
4.5 - 5.0									143/86	-4.5
									168/106	-5.0

**Remarks:**  
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-11**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968752mN, 1746863mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 07/12/2020  
**Logged By:** CS  
**Checked By:**  
**Vane ID:** 2908

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
					2 4 6 8	50 100 150 200		
0.0 - 0.5	TOPSOIL.		Topsoil					
0.5 - 3.4	Silty sandy CLAY; stiff to very stiff; sand, (f-c). Silty, high plasticity, moist.		Pleistocene river and hillslope deposits - Tauranga Group	Groundwater Not Encountered			168/74 139/79 135/50 110/62 144/75 159/77 148/69 159/79 164/40 136/69 156/69 120/73 155/56 148/77 138/79 140/95	
	Sandy (f-m).							
	With some organics (fibrous).							
	High plasticity.							
3.4 - 3.5	End of hole at 3.40m, refusal due to hole collapse							

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow

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# Hand Auger Borehole Log

Test ID: **BH-12**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

Client: LDE Land Development & Engineering  
 Project: Geotechnical Investigation  
 Location: Warkworth South Plan Change  
 Test Site: Onsite Measurements

Coordinates: 5968516mN, 1746846mE  
 System: NZTM  
 Elevation: Ground  
 Located By:

Test Date: 07/12/2020  
 Logged By: DB  
 Checked By:  
 Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
					2 4 6 8	50 100 150 200		
0.0 - 0.5	TS	TOPSOIL.	Topsoil					
0.5 - 1.0	X	Silty CLAY; light brown, stiff to very stiff; dry to moist; high plasticity.  Light greyish brown with orange streaks.  With some silt, with trace sand (f).	Pleistocene river and hillslope deposits - Tauranga Group				190/27	-0.5
1.0 - 1.5	X	With some sand (f).					163/58	-1.0
1.5 - 2.0	X	With some sand (f).					139/65	-1.5
2.0 - 2.5	X	Silty, sandy, orange.					132/65	-2.0
2.5 - 3.0	X	SAND, with minor clay; low plasticity.					105/58	-2.5
3.0 - 3.5	X	Dark grey, saturated.					115/51	-3.0
3.5 - 4.0	X	Dark grey, saturated.					139/54	-3.5
4.0 - 4.5	X	WOOD & SILT; black; dry; organic smell.					115/48	-4.0
4.5 - 5.0	X	SILT & SAND, with trace clay; dark grey; saturated.					109/51	-4.5
5.0 - 5.5	X	End of hole at 4.40m, refusal due to hole collapse					105/48	-5.0

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-13**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

Client: LDE Land Development & Engineering

Project: Geotechnical Investigation

Location: Warkworth South Plan Change

Test Site: Onsite Measurements

Coordinates: 5968408mN, 1746755mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 07/12/2020

Logged By: DB

Checked By:

Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TS	TOPSOIL.	Topsoil							
0.5 - 1.0	X	Silty CLAY, with trace sand (f); light brownish orange; stiff to very stiff; high plasticity. With minor sand.	Pleistocene river and hillslope deposits - Tauranga Group		○		●		146/48	-0.5
1.0 - 1.5	X	CLAY & SILT; light orange; low plasticity; moist to wet.			○		●		170/61	-0.75
1.5 - 2.0	X				○		●		195/82	-1.0
2.0 - 2.5	X	Silty SAND, with minor clay; light greyish orange; moist.			○		●		115/48	-1.25
2.5 - 3.0	X	Wet.			○		●		119/48	-1.5
3.0 - 3.5	X	Pumiceous, with trace clay, light grey, non-plastic, wet, sand.			○		●		149/65	-1.75
3.5 - 4.0	X				○		●		183/92	-2.0
4.0 - 4.5	X	Saturated, groundwater seepage encountered at 4m. Silty with trace peat (fibrous) and clay, dark grey, high plasticity, wet to saturated.		◁	○		●		224/58	-2.25
4.5 - 5.0	X	End of hole at 5.00m, refusal due to target depth			○		●		238+/-	-2.5
					○		●		149/42	-2.75
					○		●		132/34	-3.0
					○		●		144/48	-3.25
					○		●		102/27	-3.5
					○		●		115/31	-3.75
					○		●		119/31	-4.0
					○		●		105/31	-4.25
					○		●		115/31	-4.5
					○		●		156/27	-4.75
					○		●		129/17	-5.0
					○		●		102/27	-5.25
					○		●		102/34	-5.5
					○		●		127/25	-5.75
					○		●		129/25	-6.0
					○		●		68/20	-6.25

**Remarks:**

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

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# Hand Auger Borehole Log

Test ID: **BH-14**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968510mN, 1747040mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 07/12/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)			
0.0 - 0.5	TS TS TS TS TS	TOPSOIL.	Topsoil		2	4	6	8	
0.5 - 2.0		CLAY, with minor silt; high plasticity; soft to stiff; moist to wet; grey with orangish & brown streaking.	Pleistocene river and hillslope deposits - Tauranga Group		50	100	150	200	190/51 146/54 119/51 92/44 82/51 78/34 59/27 65/31 61/31
2.0 - 2.6		Light grey with orange streaks.							76/48 76/34
2.6 - 3.0		Blueish grey, groundwater seepage at 2.6m.		▽					68/24 48/17
3.0 - 3.5									31/7 42/25 34/14 27/10
3.5 - 4.0									34/10 37/10 37/10
4.0 - 4.5									41/20 34/20
4.5 - 5.0		End of hole at 5.00m, refusal due to target depth							34/14

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

**Test ID: BH-15**  
**Project ID: 18707**  
**Sheet: 1 of 1**

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968696mN, 1747118mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 07/12/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
				2	4	6	8			
	[Symbol]	TOPSOIL.	Topsoil							
0.5	[Symbol]	Silty CLAY; light brown; low plasticity; dry to moist.  With minor silt, light greyish orange, firm to stiff, high plasticity, moist.	Pleistocene river and hillslope deposits - Tauranga Group						163/51	-0.5
	[Symbol]								115/44	
	[Symbol]								92/41	
1.0	[Symbol]								75/34	-1.0
	[Symbol]								75/31	
1.5	[Symbol]								98/48	-1.5
	[Symbol]								75/24	
2.0	[Symbol]	With trace silt, light grey, wet.		Groundwater Not Encountered					85/37	-2.0
	[Symbol]								58/24	
	[Symbol]								34/14	
2.5	[Symbol]	PEAT; brownish black. Firm, saturated.							34/7	-2.5
	[Symbol]								20/7	
3.0	[Symbol]	Core loss							105/31	-3.0
	[Symbol]								37/31	
3.5	[Symbol]									-3.5
	[Symbol]	CLAY; light grey. Firm to stiff, saturated, high plasticity.							75/24	
4.0	[Symbol]	End of hole at 4.00m, refusal due to hole collapse							102/17	-4.0
4.5										-4.5
5.0										-5.0

<b>Remarks:</b>  Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005). No correlation is implied between shear vane and DCP values.	● Vane peak ○ Vane residual ◆ Vane UTP	▼ Standing water level ◁ Groundwater inflow ▷ Groundwater outflow
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# Hand Auger Borehole Log

Test ID: **BH-16**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968456mN, 1747369mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 30/11/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0 - 0.5	TS	TOPSOIL.	Topsoil					
0.5 - 1.0	X	CLAY, with some silt, with minor sand (f); stiff to very stiff; high plasticity; moist; grey with brown streaking. With minor silt.	Pleistocene river and hillslope deposits - Tauranga Group				132/37	-0.5
1.0 - 1.5	X	With trace peat (fibrous), wet, light grey with orange streaking. With black organics.					85/24	-1.0
1.5 - 2.0	X	Bluish grey.					71/24	-1.5
2.0 - 2.5	X	Brownish grey, soft to firm, saturated, groundwater seepage encountered at 2.4m.					61/27	-2.0
2.5 - 3.0	X	Organic, dark brownish grey.					75/41	-2.5
3.0 - 3.5	X	WOOD; brown.					75/41	-3.0
3.5 - 4.0	X	Organic CLAY; light grey.					76/34	-3.5
4.0 - 4.5	X	Pumiceous SILT & SAND; stiff.					65/24	-4.0
4.5 - 5.0	X	CLAY.					51/17	-4.5
5.0		End of hole at 5.00m, refusal due to target depth					75/34	-5.0

**Remarks:**

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

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# Hand Auger Borehole Log

Test ID: **BH-17**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

<b>Client:</b> LDE Land Development & Engineering	<b>Coordinates:</b> 5968570mN, 1747289mE	<b>Test Date:</b> 30/11/2020
<b>Project:</b> Geotechnical Investigation	<b>System:</b> NZTM	<b>Logged By:</b> DB
<b>Location:</b> Warkworth South Plan Change	<b>Elevation:</b> Ground	<b>Checked By:</b>
<b>Test Site:</b> Onsite Measurements	<b>Located By:</b>	<b>Vane ID:</b> 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0 - 0.5	[TS symbols]	TOPSOIL.	Topsoil					
0.5 - 4.0	[TS symbols]	CLAY, with minor silt; firm to stiff; high plasticity; moist; light grey with orange streaking.  With trace peat (fibrous) and dark decomposed organics, black streaking.  Wet; dark grey with black streaking.	Pleistocene river and hillslope deposits - Tauranga Group					
4.0 - 4.8	[SAND symbols]	SAND, (f-c); groundwater seepage at 4.0m. With trace clay and silt, dark grey, saturated.		◁				
4.8 - 5.0	[N/R symbols]	Core loss. End of hole at 4.80m, refusal due to core loss						

**Remarks:**

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

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# Hand Auger Borehole Log

Test ID: **BH-18**

Project ID: 18707

Sheet: 1 of 1

Method: Hand augered test pit and shear vane

Client: LDE Land Development & Engineering

Project: Geotechnical Investigation

Location: Warkworth South Plan Change

Test Site: Onsite Measurements

Coordinates: 5968158mN, 1747369mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 02/12/2020

Logged By: DB

Checked By:

Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0		TOPSOIL.	Topsoil							
0.5		Silty CLAY; with trace sand (f); brownish grey; stiff to very stiff; low plasticity; moist. With minor silt, brownish orange, high plasticity.	Pleistocene river and hillslope deposits - Tauranga Group						153/51	-0.5
									95/27	
									88/27	
1.0		With trace black organics (fibrous), light grey, moist to wet.							61/27	-1.0
									68/34	
1.5									68/37	-1.5
		With trace silt, with trace sand (m-c), orange streaking.							65/34	
									68/34	
2.0									54/20	-2.0
		Firm, saturated, groundwater seepage encountered at 2.2m.			◁				42/24	
2.5								37/17	-2.5	
								37/14		
		With some sand (f), slightly quick.						27/14		
3.0								34/14	-3.0	
								58/24		
3.5		With minor silt and sand.						51/20	-3.5	
								34/17		
		Light reddish brown & grey, firm.						34/17		
4.0								31/14	-4.0	
								41/25		
4.5		With some silt and sand (f), light grey.						37/17	-4.5	
		End of hole at 4.60m, refusal due to target depth						48/17		
								48/31		
5.0								37/24	-5.0	

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-19**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968044mN, 1747334mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 02/12/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
		TOPSOIL.	Topsoil		2	4	6	8		
0.5		Silty CLAY; with trace sand (f); light brown with orange streaking; very stiff, high plasticity, moist.	Pakiri Formation		50	100	150	200	136/41	-0.5
									119/37	
									126/44	
1.0		With minor silt, light orangish brown.							129/44	-1.0
									136/58	
1.5					Groundwater Not Encountered				160/75	-1.5
									166/82	
									166/76	
2.0		With some silt, orange with red streaking.							166/68	-2.0
									160/78	
2.5		Silty CLAY.						149/58	-2.5	
								109/41		
								98/34		
3.0		End of hole at 3.00m, refusal due to target depth						115/58	-3.0	
3.5									-3.5	
4.0									-4.0	
4.5									-4.5	
5.0									-5.0	

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow



# Hand Auger Borehole Log

**Test ID:** BH-20

**Project ID:** 18707

**Sheet:** 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Test Site:** Onsite Measurements

**Coordinates:** 5968343mN, 1747080mE

**System:** NZTM

**Elevation:** Ground

**Located By:**

**Test Date:** 02/12/2020

**Logged By:** DB

**Checked By:**

**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0		TOPSOIL.	Topsoil					
0.5		Silty CLAY; with trace sand (f); light brown; stiff to very stiff; low plasticity; moist.  With minor silt, light orangish brown, high plasticity.	Pakiri Formation					
1.0		Silty, red, pink, white & orange.  With some silt, high plasticity, moist to wet.						
2.0		CLAY & SILT.		Groundwater Not Encountered				
2.5								
3.0		Silty CLAY; with trace subround to angular gravel; white specks.						
3.2		End of hole at 3.20m, refusal due to target depth						
3.5								
4.0								
4.5								
5.0								

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow



# Hand Auger Borehole Log

Test ID: **BH-21**  
 Project ID: 18707  
 Sheet: 1 of 1

Method: Hand augered test pit and shear vane

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change  
**Test Site:** Onsite Measurements

**Coordinates:** 5968251mN, 1747224mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:**

**Test Date:** 02/12/2020  
**Logged By:** DB  
**Checked By:**  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.0 - 0.1	TS	TOPSOIL.	Topsoil	Water							
0.1 - 0.2	X	SAND (f-c), very stiff; wet.	Pleistocene river and hillslope deposits - Tauranga Group	Groundwater Not Encountered					238+/-	-0.5	
0.2 - 0.3	X	Silty CLAY, with trace sand (f), high plasticity, moist.								187/78	
0.3 - 0.4	X									160/65	
0.4 - 0.5	X	with some silt.								153/65	-1.0
0.5 - 0.6	X									UTP	
0.6 - 0.7	X	WOOD; dark brown.								139/65	-1.5
0.7 - 0.8	X	Light grey streaking.								153/71	
0.8 - 0.9	X									170/65	-2.0
0.9 - 1.0	X	With minor silt, brown & light grey, high plasticity.								132/51	
1.0 - 1.1	X									149/61	-2.5
1.1 - 1.2	X	With some silt, with trace sand (f).						166/58			
1.2 - 1.3	X							119/42	-3.0		
1.3 - 1.4	X	With some fine gravel, brown with light grey streaking, rounded to subround.						122/37			
1.4 - 1.5	X							126/51	-3.5		
1.5 - 1.6	X	WOOD.	Pakiri Formation					126/51	-4.0		
1.6 - 1.7	X	Silty, light grey with red & orange mottling, high plasticity, wet.						136/42			
1.7 - 1.8	X	End of hole at 3.20m, refusal due to target depth								-4.5	

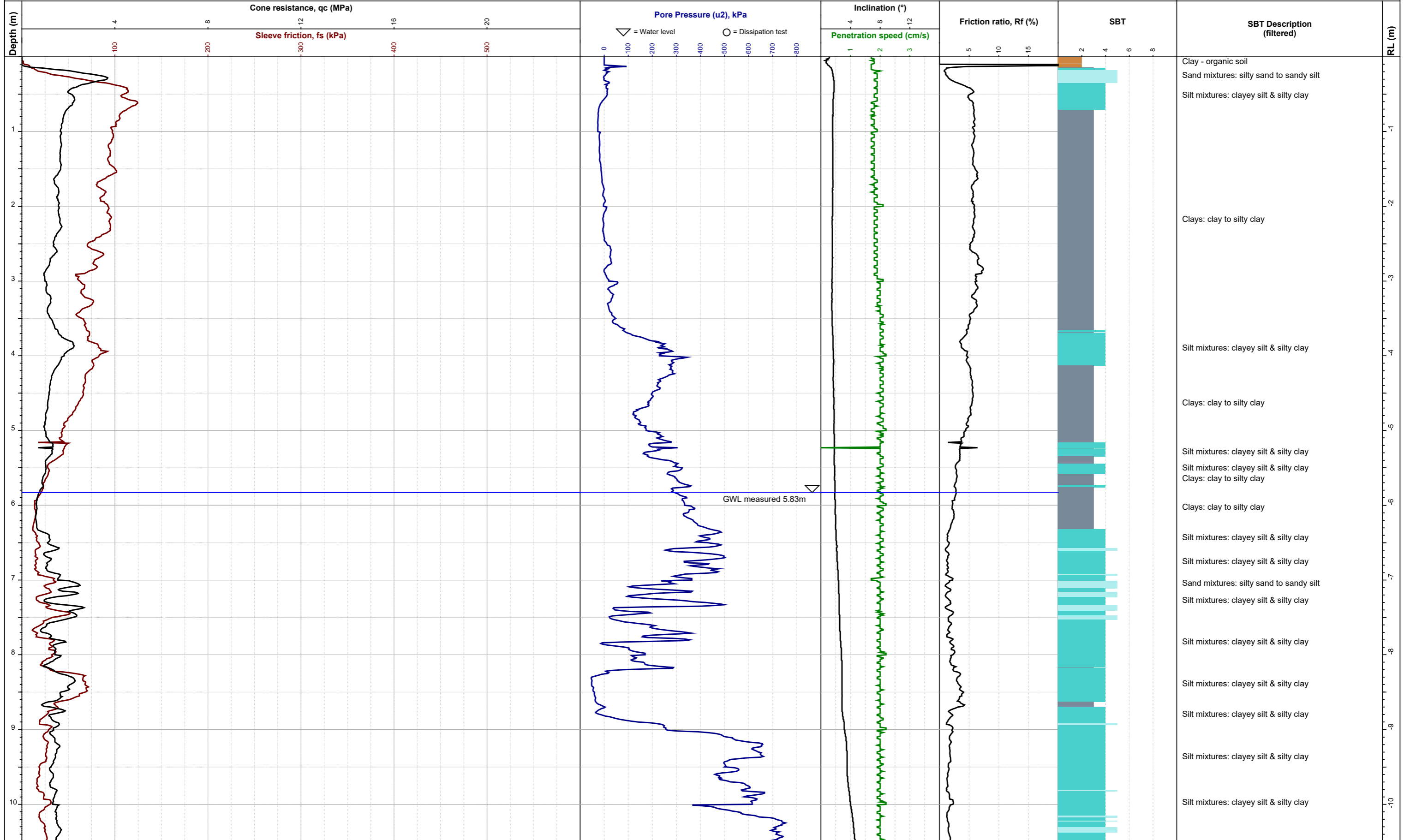
**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-01**



**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 5.83m

**Termination Reason:**  
high pore pressure

**Northing:** 5968649mN  
**Easting:** 1746825mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

**Test ID:**

**CPT-01**

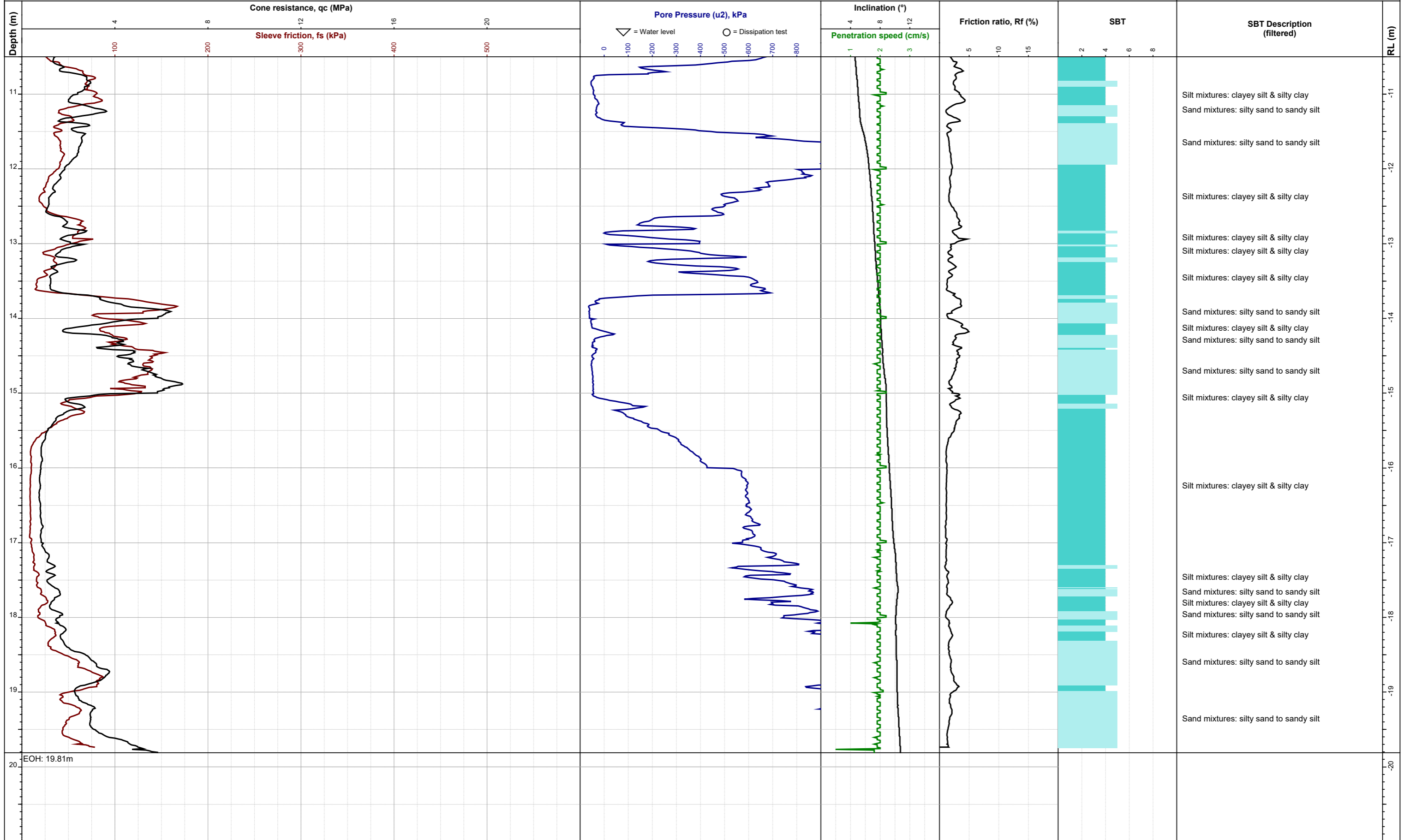
**Project ID:** 18707  
**Depth:** 19.81m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020





# Cone Penetration Test (CPTu) Log

Test ID: **CPT-01**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:29:57 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 5.83m  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968649mN  
**Easting:** 1746825mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

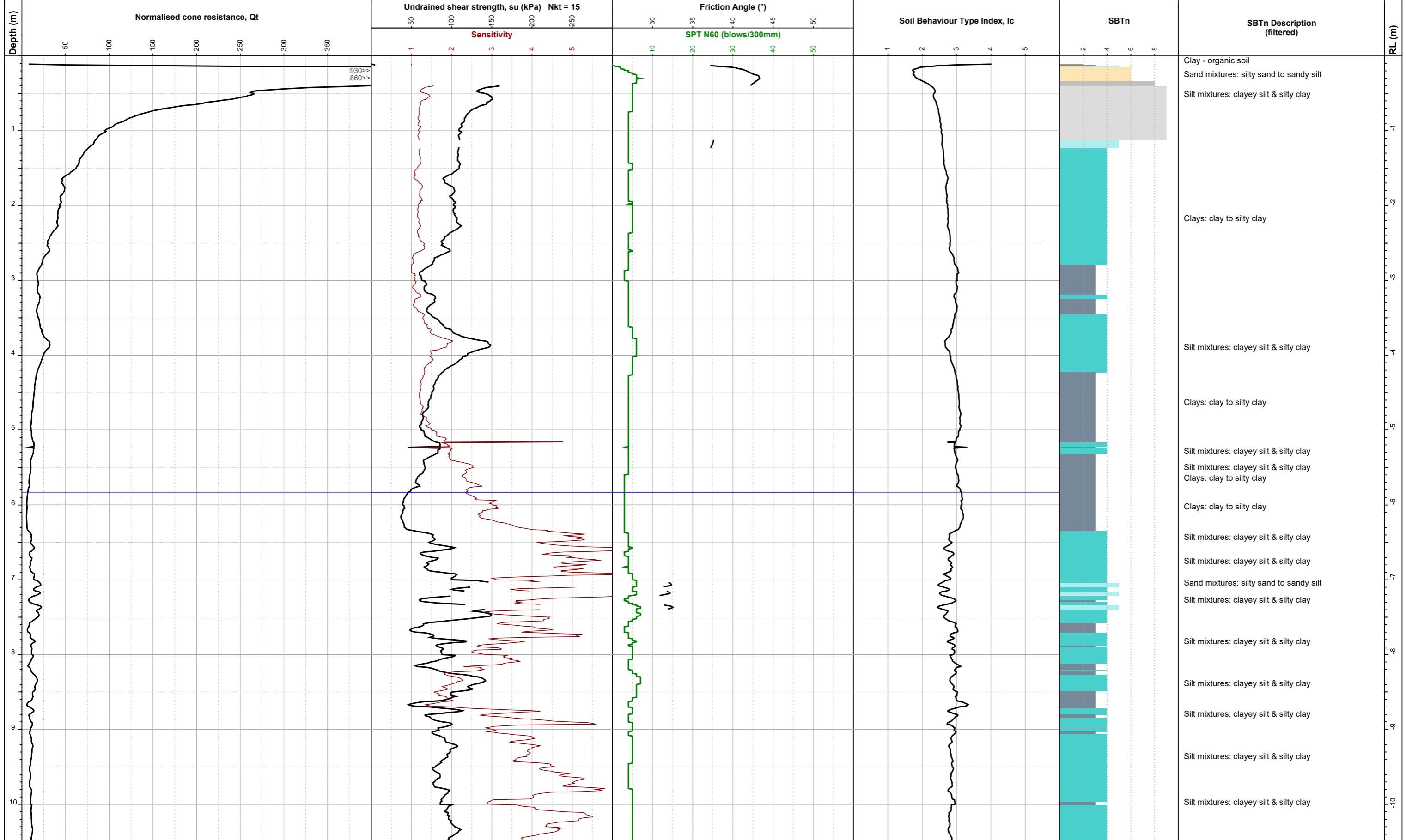
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-01**  
**Project ID:** 18707  
**Depth:** 19.81m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-01**



**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 5.83m

**Termination Reason:**  
high pore pressure

**Northing:** 5968649mN  
**Easting:** 1746825mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

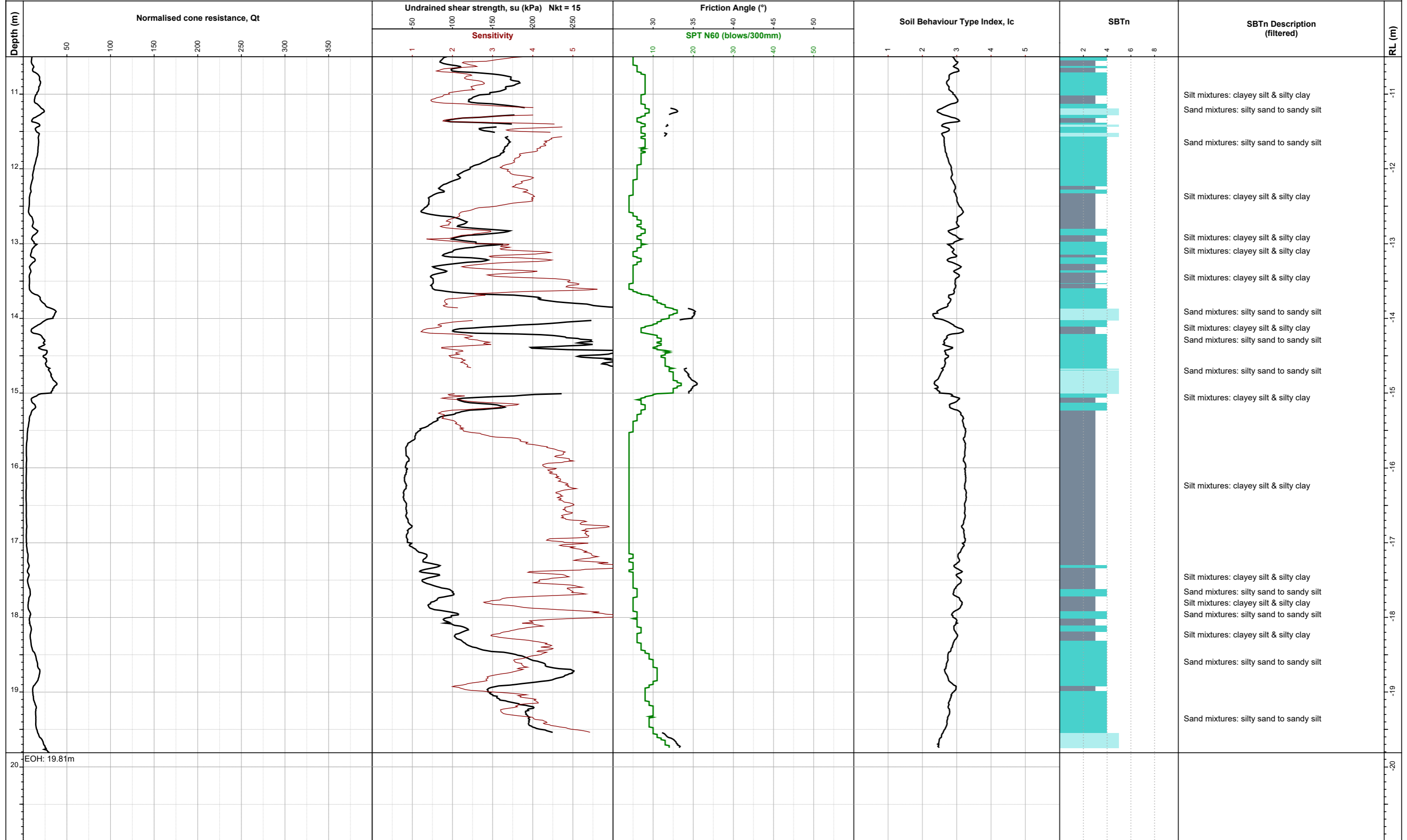
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-01**  
**Project ID:** 18707  
**Depth:** 19.81m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-01**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 5.83m  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968649mN  
**Easting:** 1746825mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

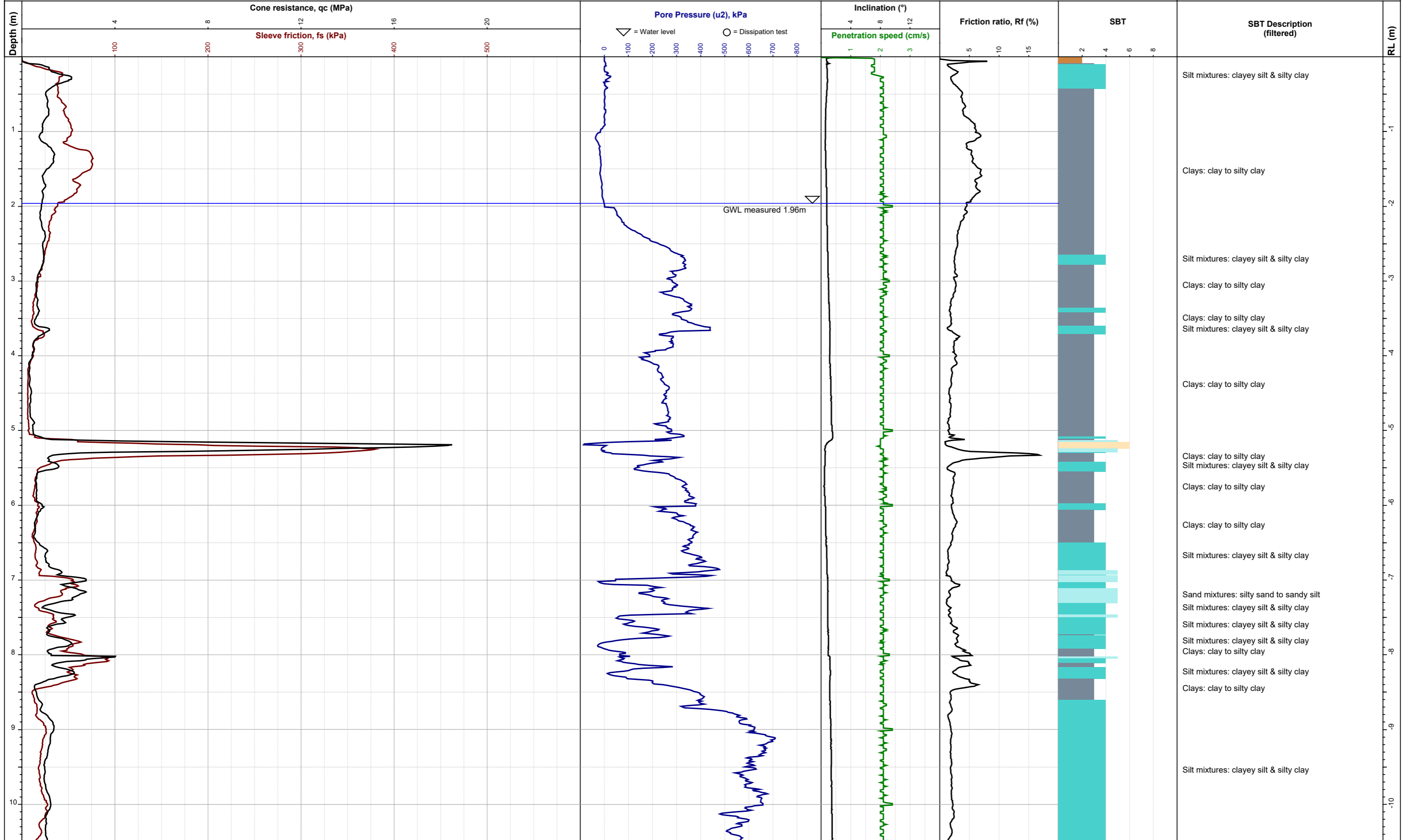
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-01**  
**Project ID:** 18707  
**Depth:** 19.81m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-02**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:29:59 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 1.96m

**Termination Reason:**  
 target depth

**Northing:** 5968564mN  
**Easting:** 1746918mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

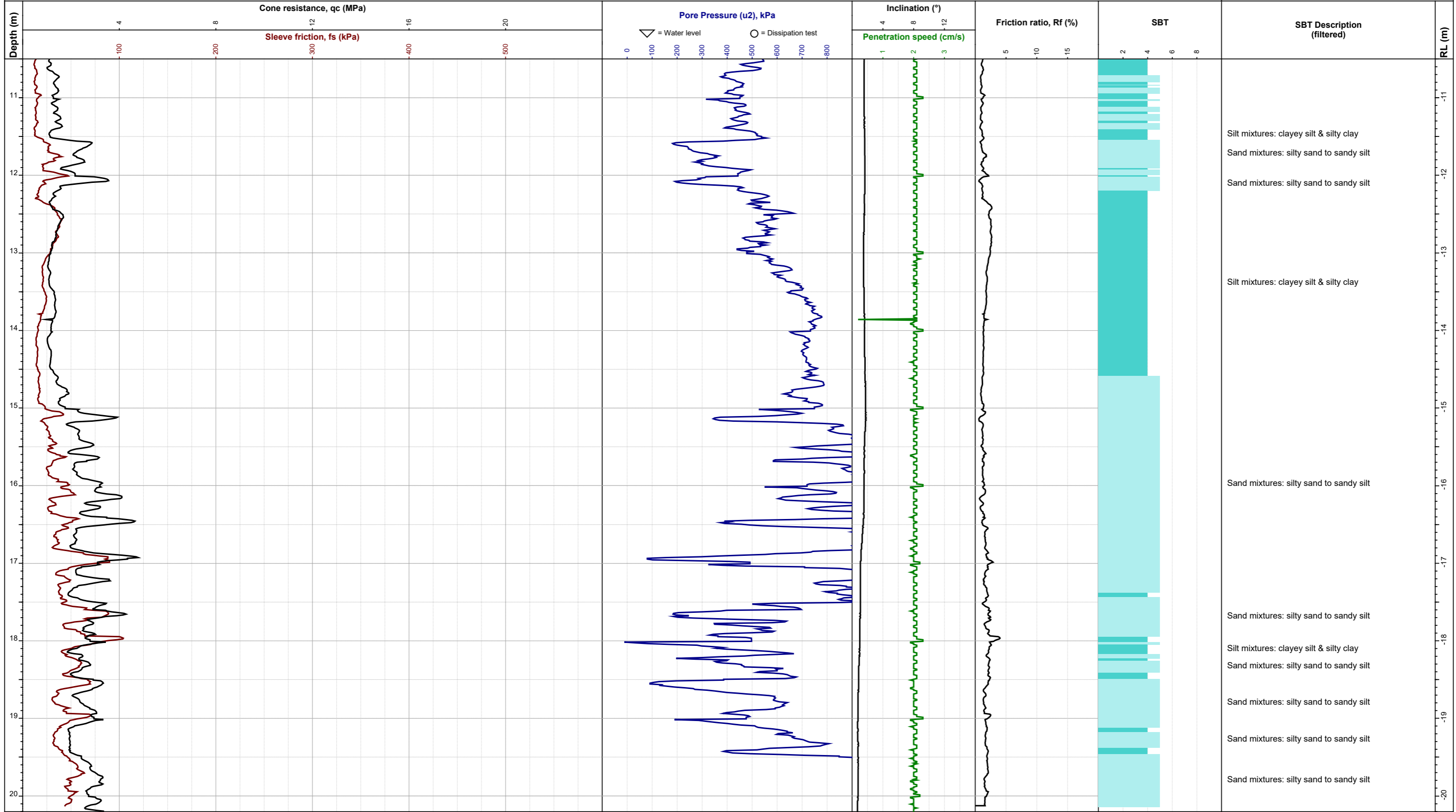
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-02**

**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-02**



EOH: 20.2m

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 1.96m  
**Termination Reason:** target depth

**Northing:** 5968564mN  
**Easting:** 1746918mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

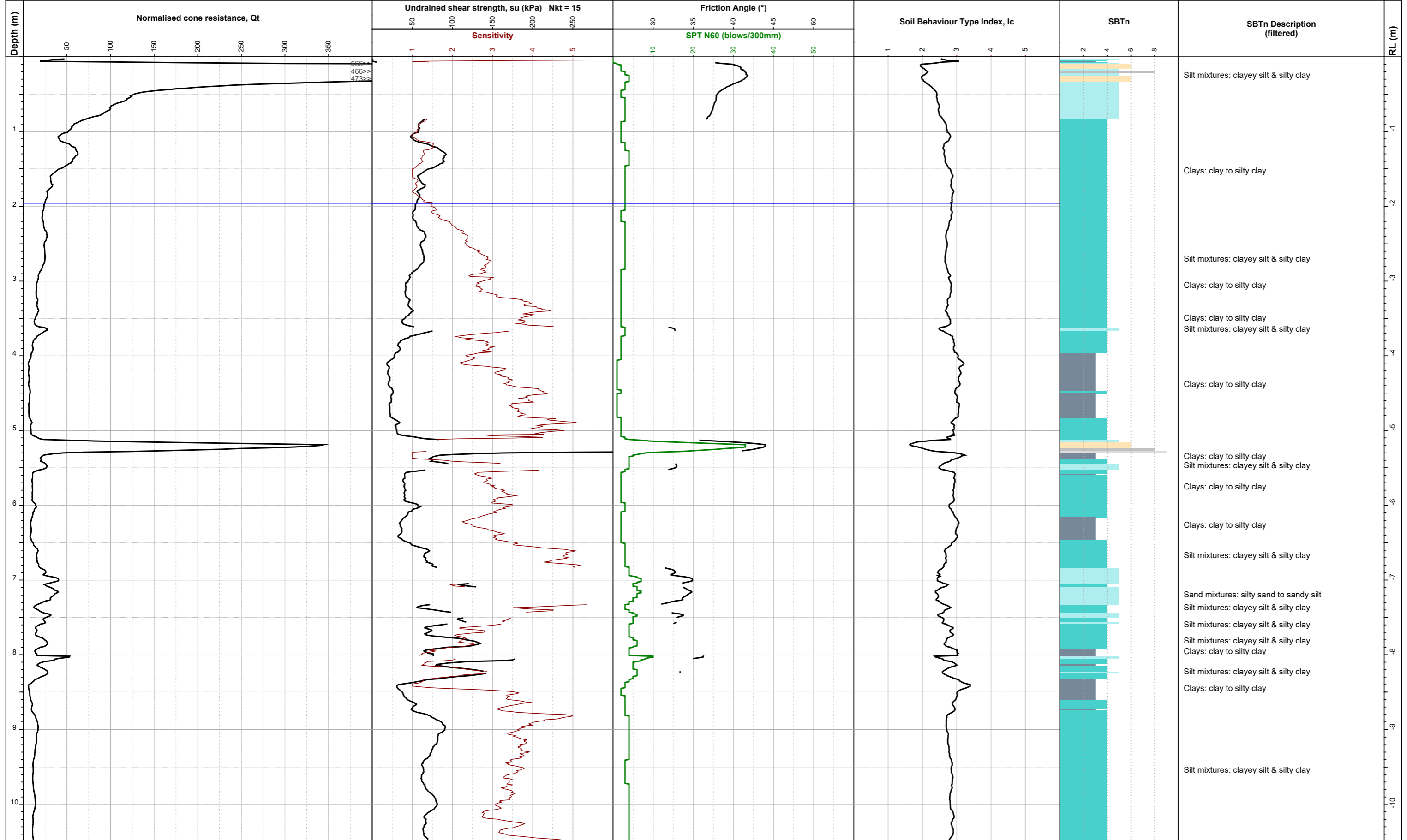
**Test ID:** **CPT-02**  
**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020





# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-02**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:00 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 1.96m

**Termination Reason:**  
target depth

**Northing:** 5968564mN  
**Easting:** 1746918mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

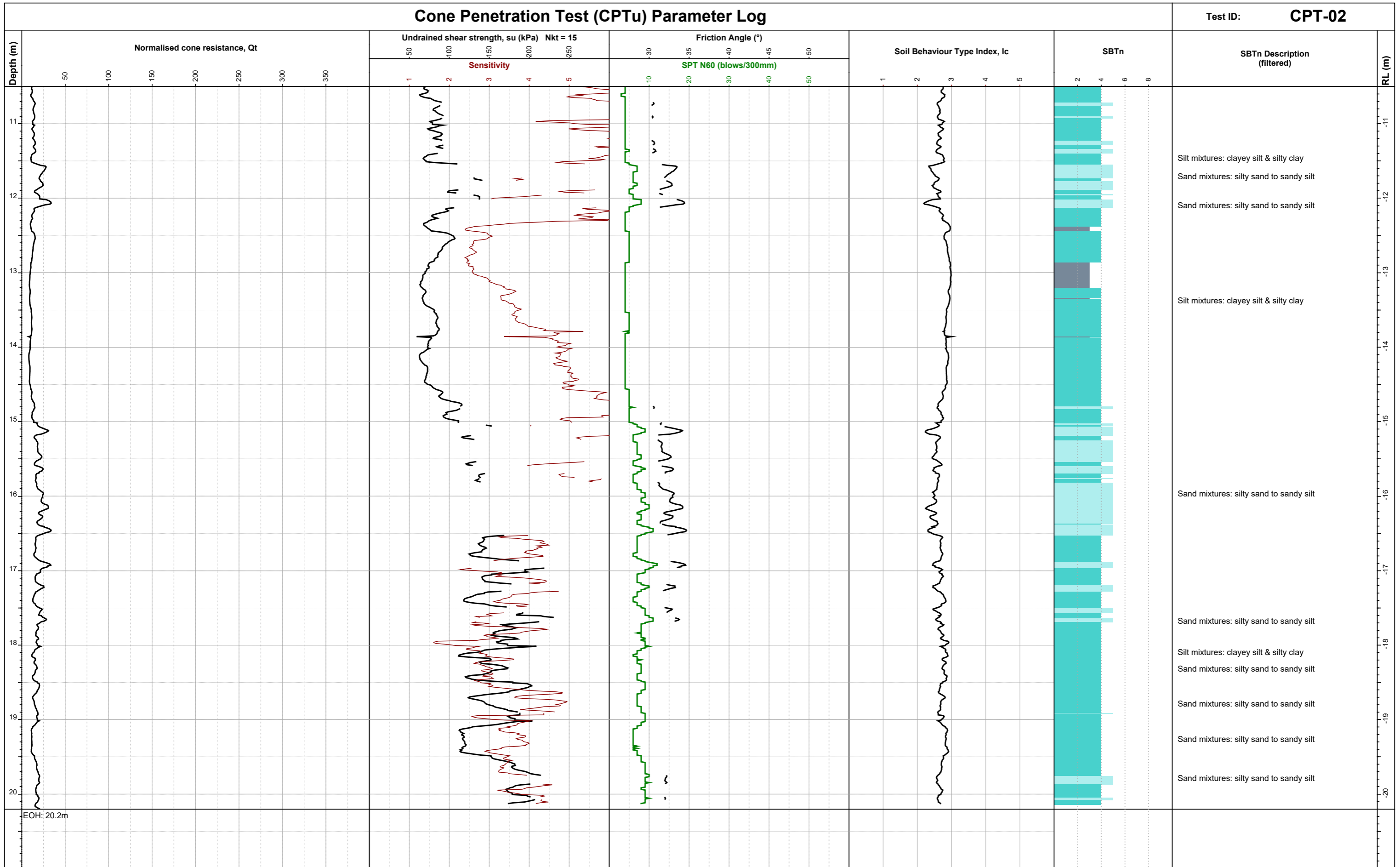
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-02**

**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020

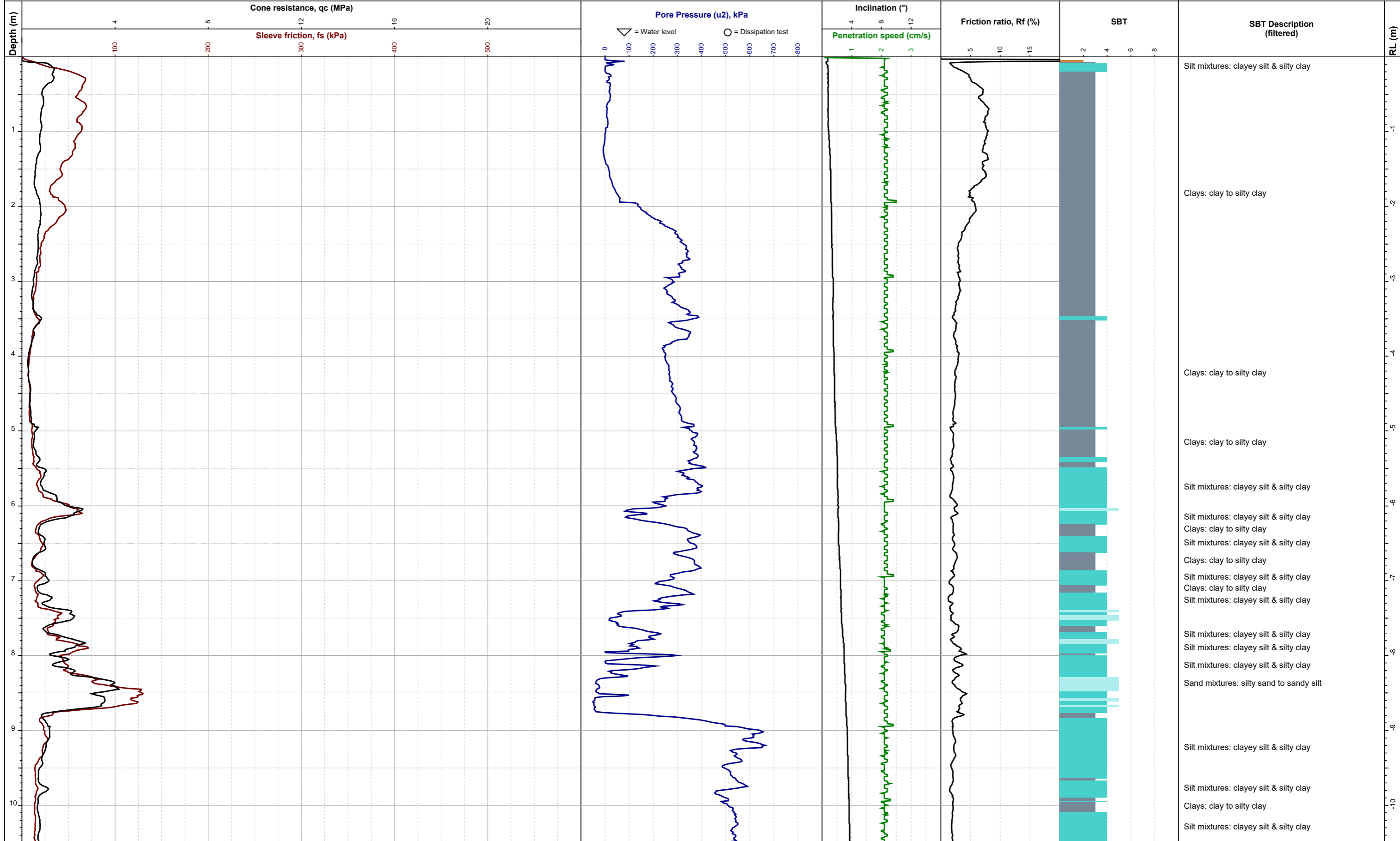
Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:00 pm



	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Ground water located at 1.96m  <b>Termination Reason:</b> target depth	<b>Northing:</b> 5968564mN <b>Easting:</b> 1746918mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKj650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr><td>0</td><td>Undefined</td><td>5</td><td>Sand mixtures: silty sand to sandy silt</td></tr> <tr><td>1</td><td>Sensitive fine-grained</td><td>6</td><td>Sands: clean sands to silty sands</td></tr> <tr><td>2</td><td>Clay - organic soil</td><td>7</td><td>Dense sand to gravelly sand</td></tr> <tr><td>3</td><td>Clays: clay to silty clay</td><td>8</td><td>Stiff sand to clayey sand</td></tr> <tr><td>4</td><td>Silt mixtures: clayey silt &amp; silty clay</td><td>9</td><td>Stiff fine-grained</td></tr> </table>	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	<b>Test ID:</b> <div style="text-align: center; font-weight: bold; font-size: 1.2em;">CPT-02</div> <b>Project ID:</b> 18707 <b>Depth:</b> 20.2m <b>Sheet:</b> 2 of 2 <b>Date:</b> 23/11/2020
	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																							

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-03**



Generated with CORE-GS by Geoc - CPT Combined A3 v0 (new) - 27/06/2022 2:30:02 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 0.64m prevented measurement of ground water  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968673mN  
**Easting:** 1746949mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

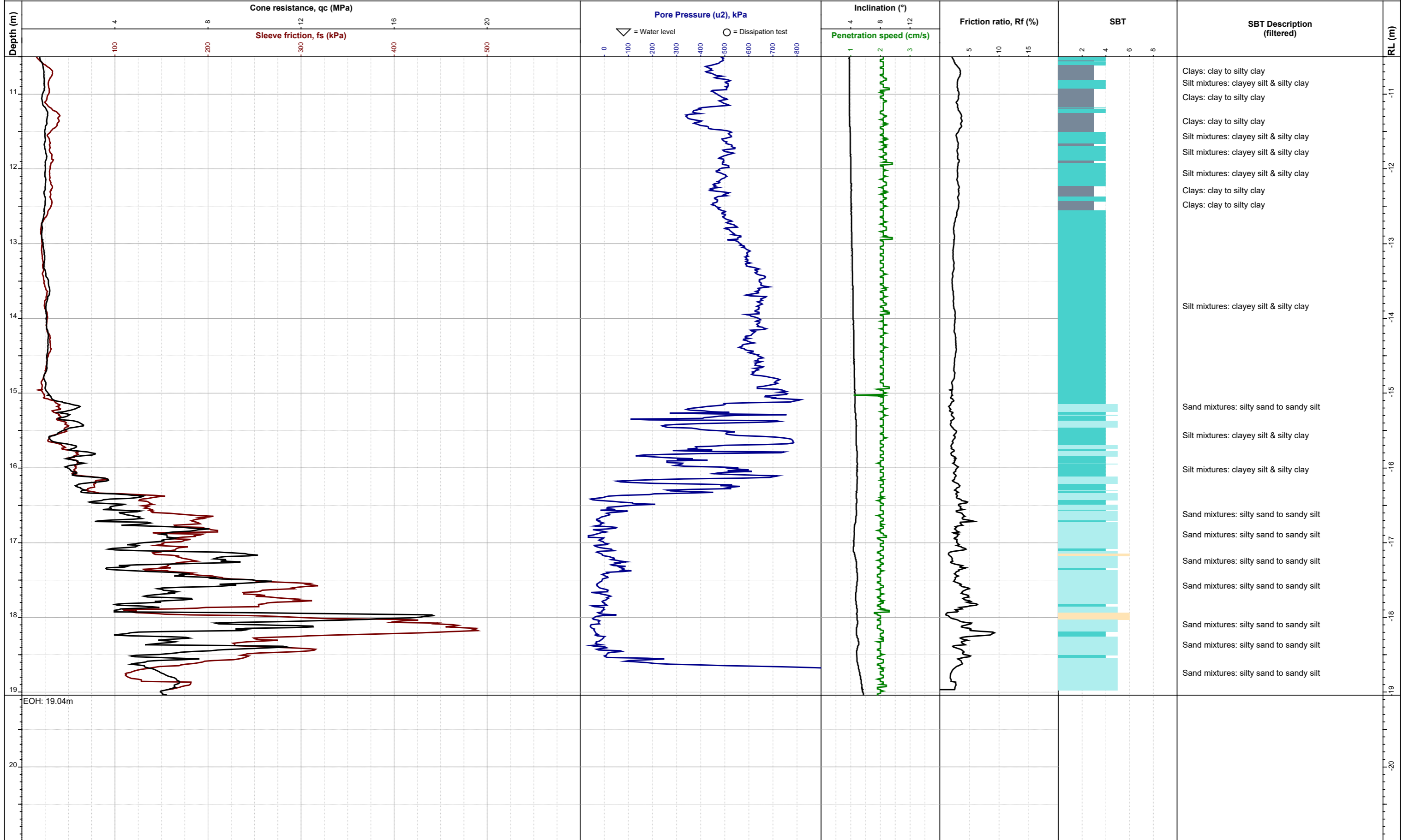
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-03**  
**Project ID:** 18707  
**Depth:** 19.04m  
**Sheet:** 1 of 2  
**Date:** 22/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-03**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:02 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 0.64m prevented measurement of ground water  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968673mN  
**Easting:** 1746949mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

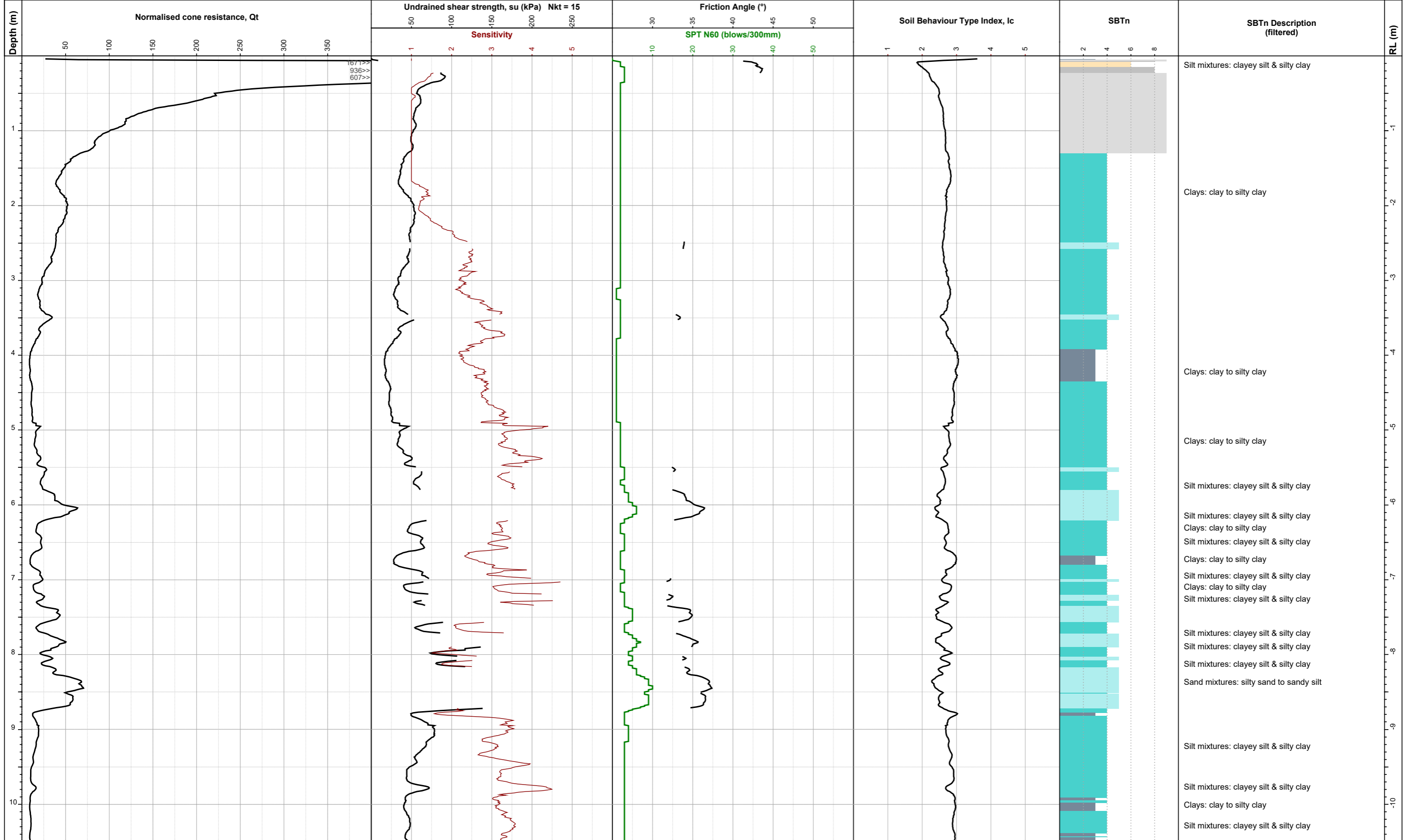
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-03**  
**Project ID:** 18707  
**Depth:** 19.04m  
**Sheet:** 2 of 2  
**Date:** 22/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-03**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 0.64m prevented measurement of ground water  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968673mN  
**Easting:** 1746949mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

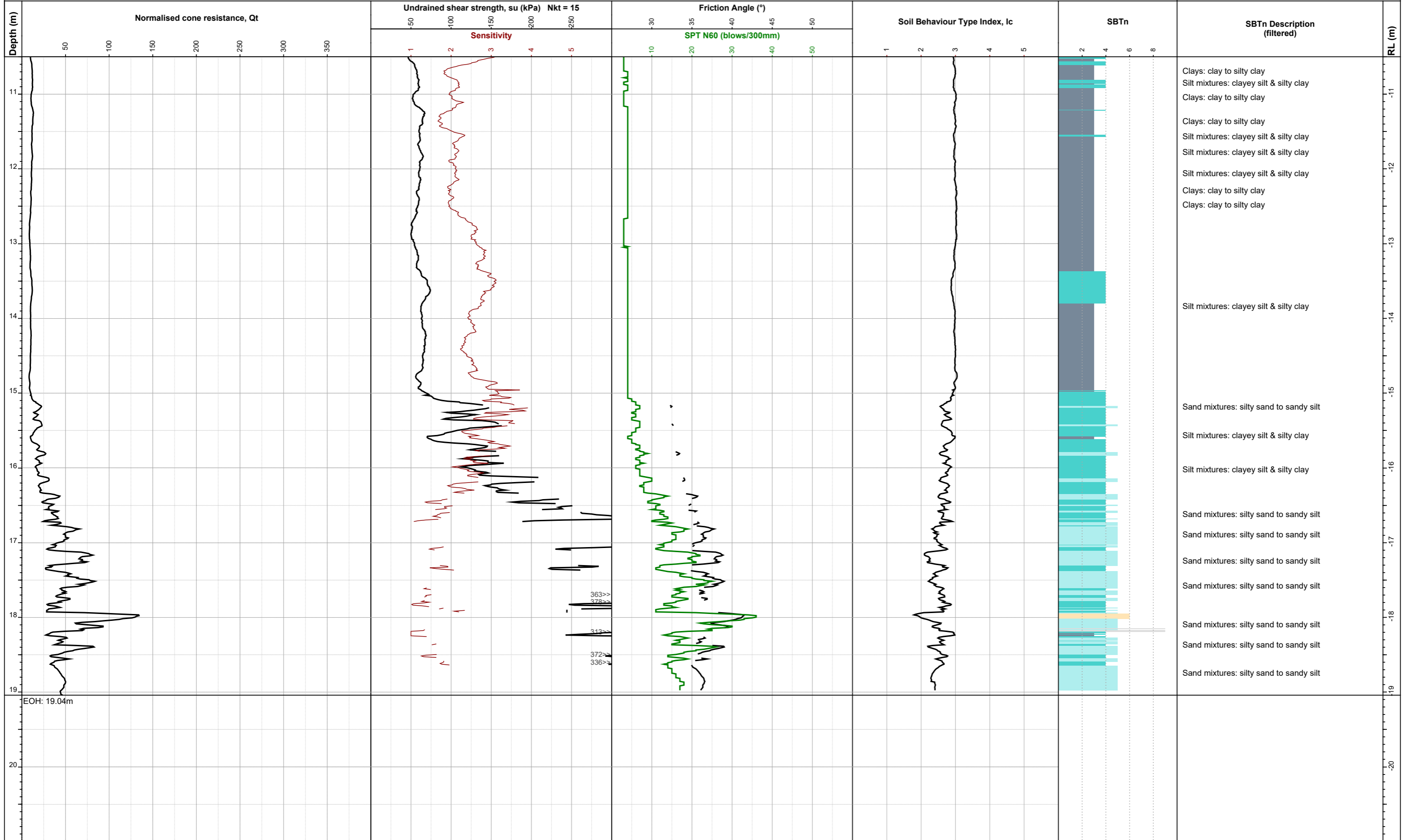
Soil Behaviour Type - Robertson 1986	
0	Undefined
1	Sensitive fine-grained
2	Clay - organic soil
3	Clays: clay to silty clay
4	Silt mixtures: clayey silt & silty clay
5	Sand mixtures: silty sand to sandy silt
6	Sands: clean sands to silty sands
7	Dense sand to gravelly sand
8	Stiff sand to clayey sand
9	Stiff fine-grained

**Test ID:** **CPT-03**  
**Project ID:** 18707  
**Depth:** 19.04m  
**Sheet:** 1 of 2  
**Date:** 22/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-03**

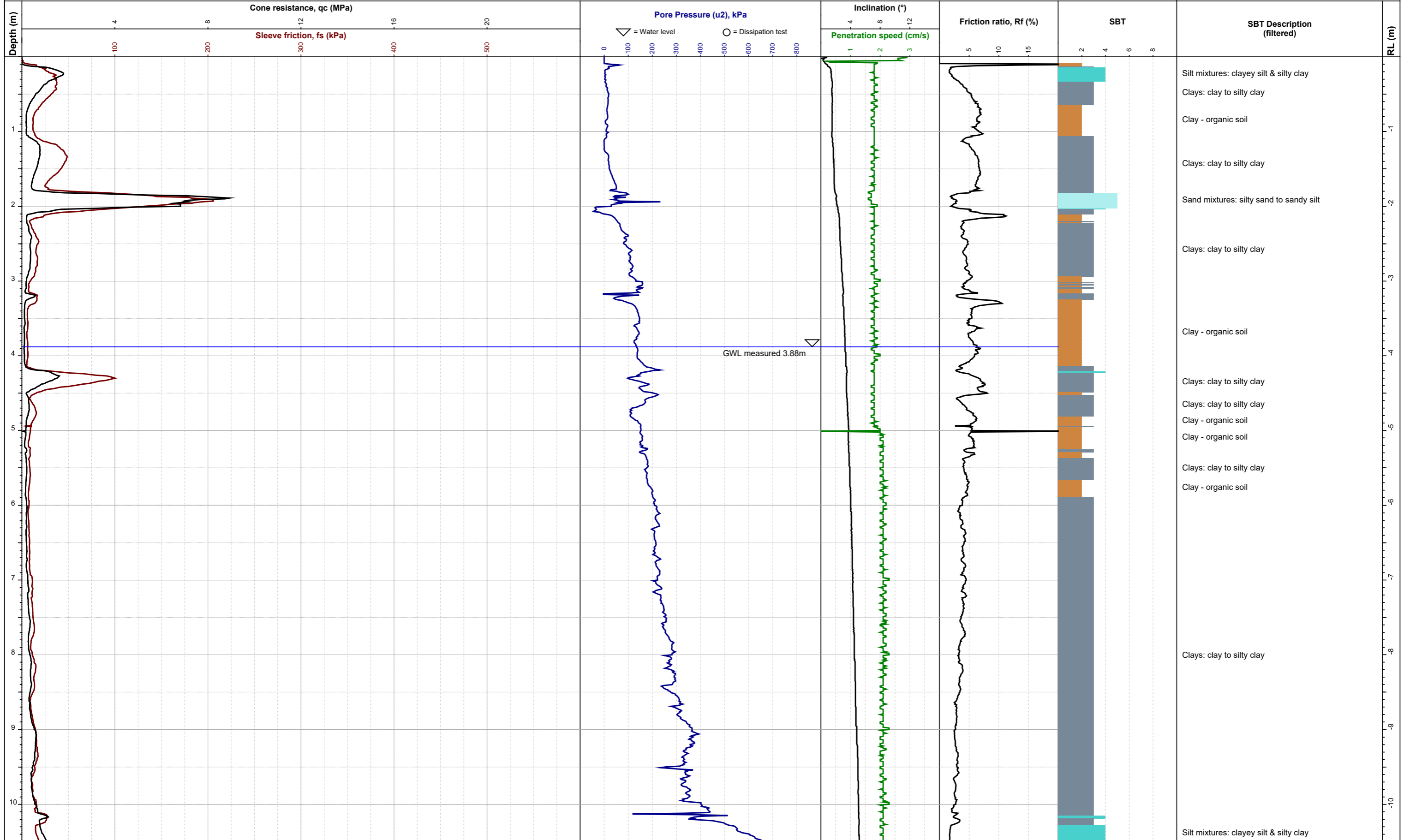


Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:02 pm

	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Collapse of hole at 0.64m prevented measurement of ground water  <b>Termination Reason:</b> high pore pressure	<b>Northing:</b> 5968673mN <b>Easting:</b> 1746949mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKJ650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr><td>0</td><td>Undefined</td><td>5</td><td>Sand mixtures: silty sand to sandy silt</td></tr> <tr><td>1</td><td>Sensitive fine-grained</td><td>6</td><td>Sands: clean sands to silty sands</td></tr> <tr><td>2</td><td>Clay - organic soil</td><td>7</td><td>Dense sand to gravelly sand</td></tr> <tr><td>3</td><td>Clays: clay to silty clay</td><td>8</td><td>Stiff sand to clayey sand</td></tr> <tr><td>4</td><td>Silt mixtures: clayey silt &amp; silty clay</td><td>9</td><td>Stiff fine-grained</td></tr> </table>	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	<b>Test ID:</b> <div style="text-align: center; font-weight: bold; font-size: 1.2em;">CPT-03</div> <b>Project ID:</b> 18707 <b>Depth:</b> 19.04m <b>Sheet:</b> 2 of 2 <b>Date:</b> 22/11/2020
	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																							

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-04**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 3.88m

**Termination Reason:**  
 limit of reaction force

**Northing:** 5968503mN  
**Easting:** 1747231mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

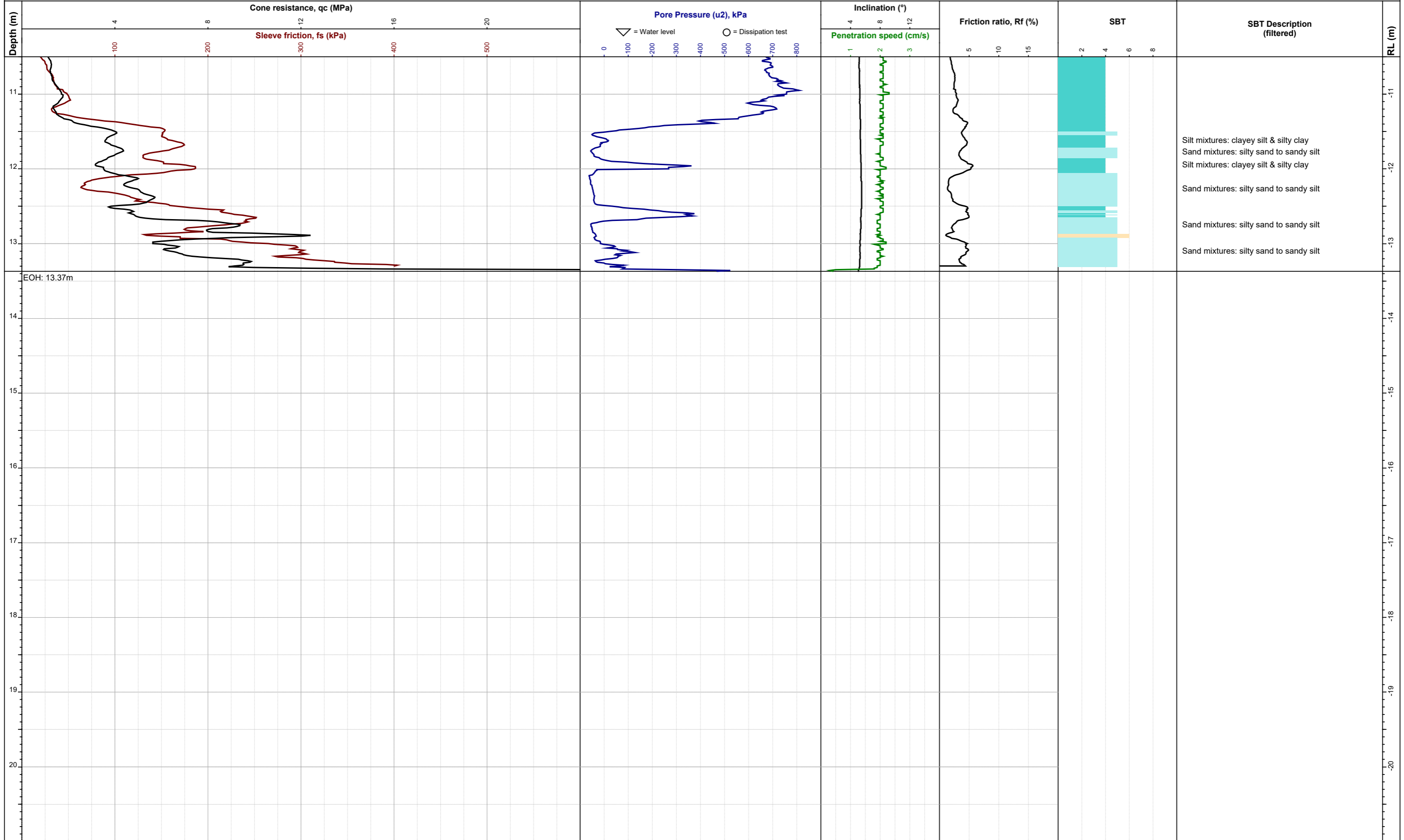
**Test ID:** **CPT-04**

**Project ID:** 18707  
**Depth:** 13.37m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-04**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 3.88m

**Termination Reason:**  
 limit of reaction force

**Northing:** 5968503mN  
**Easting:** 1747231mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

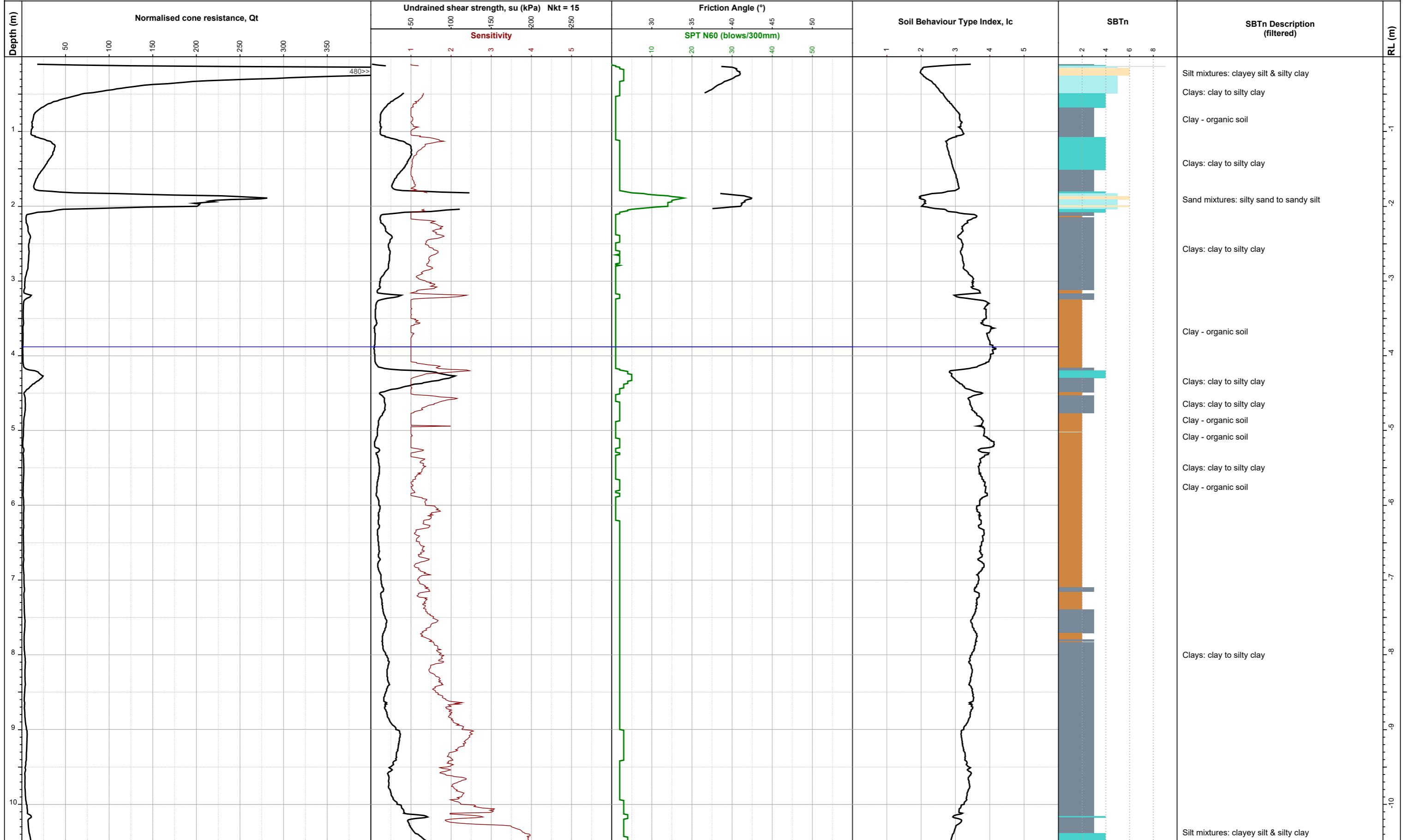
**Test ID:** **CPT-04**

**Project ID:** 18707  
**Depth:** 13.37m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-04**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 3.88m  
**Termination Reason:** limit of reaction force

**Northing:** 5968503mN  
**Easting:** 1747231mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

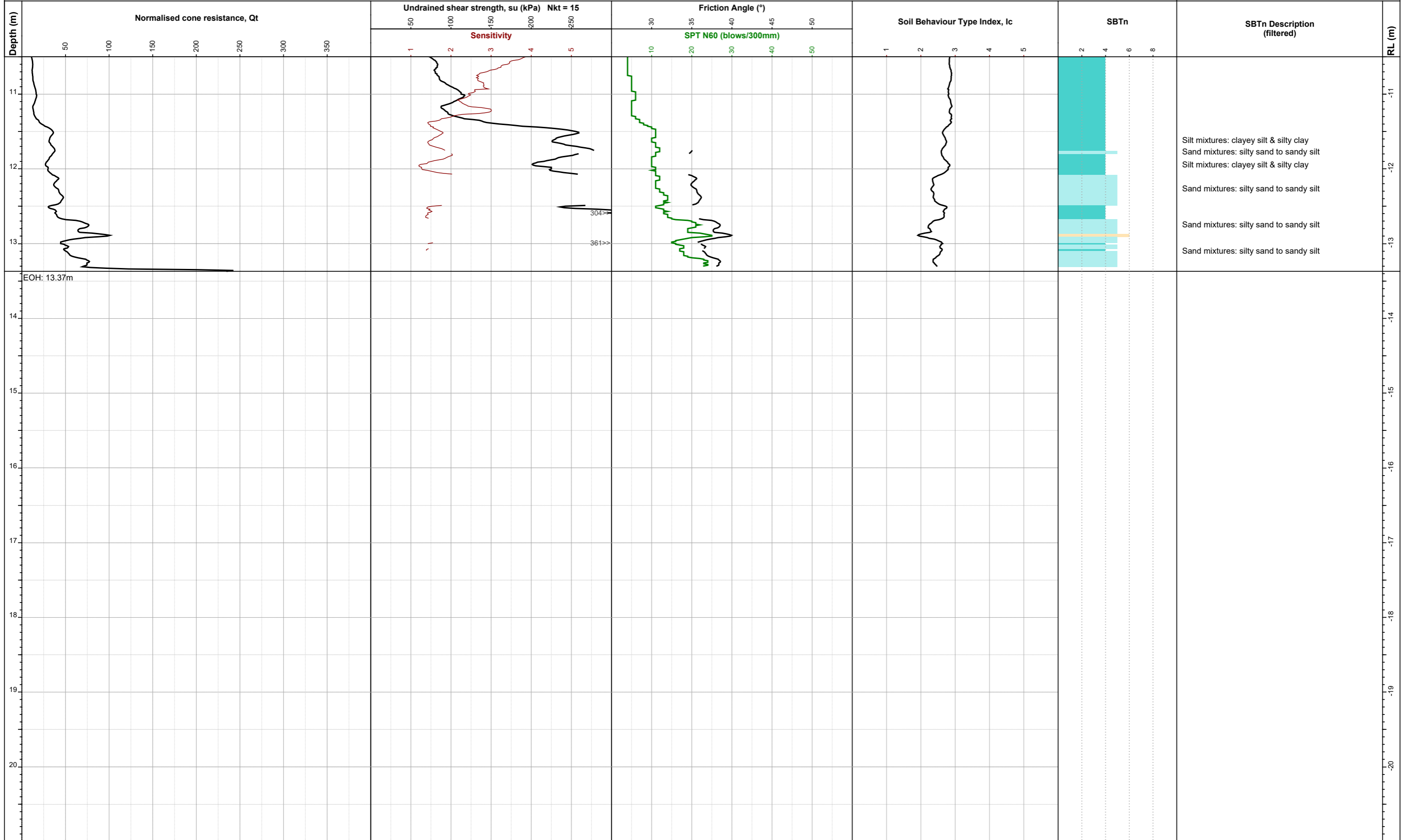
**Soil Behaviour Type - Robertson 1986**

**Test ID:** **CPT-04**  
**Project ID:** 18707  
**Depth:** 13.37m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-04**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 3.88m

**Termination Reason:**  
 limit of reaction force

**Northing:** 5968503mN  
**Easting:** 1747231mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

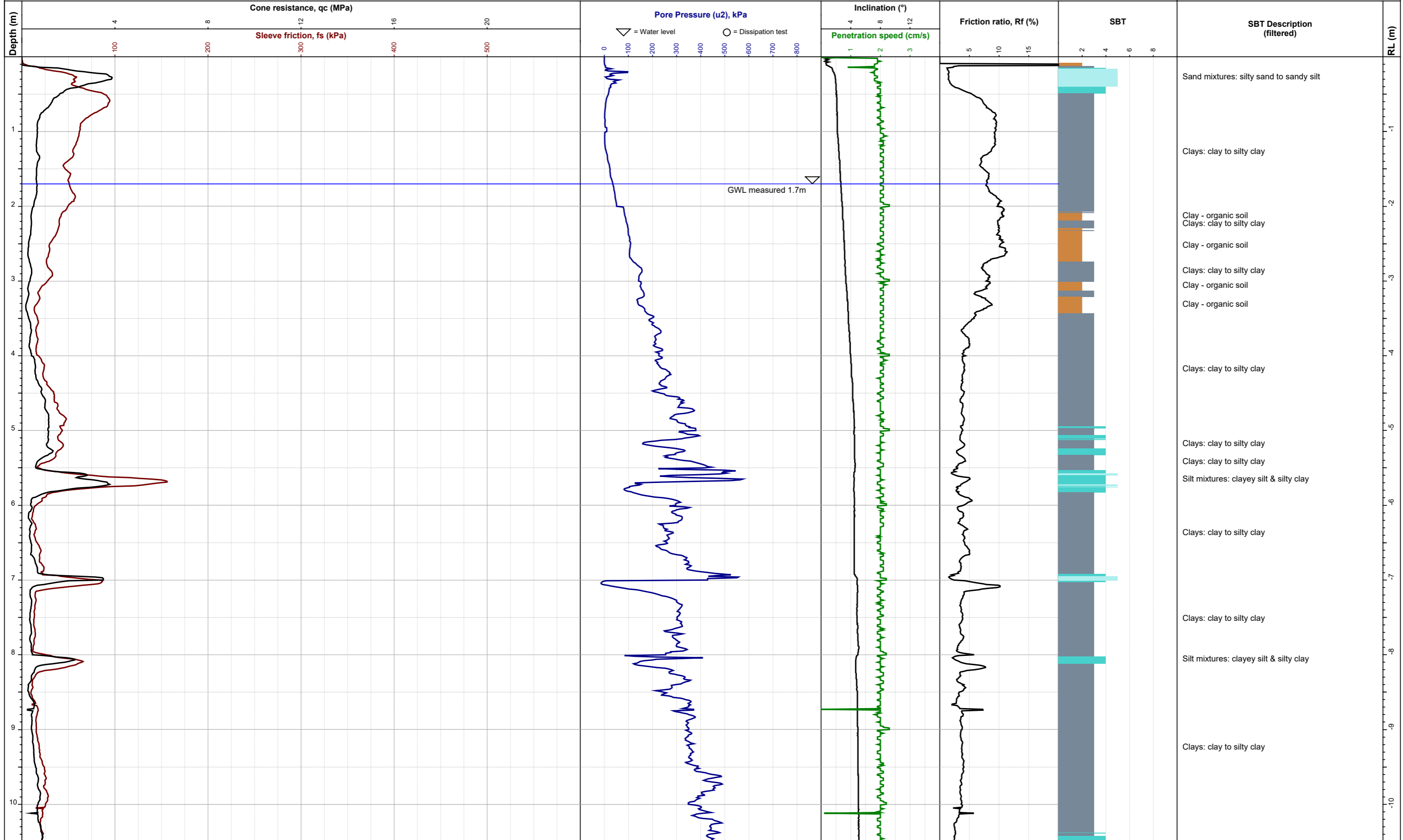
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-04**

**Project ID:** 18707  
**Depth:** 13.37m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-05**



Generated with CORE-GS by Geoc - CPT Combined A3 v0 (new) - 27/06/2022 2:30:07 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 1.70m

**Termination Reason:**  
 limit of reaction force

**Northing:** 5968552mN  
**Easting:** 1747360mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

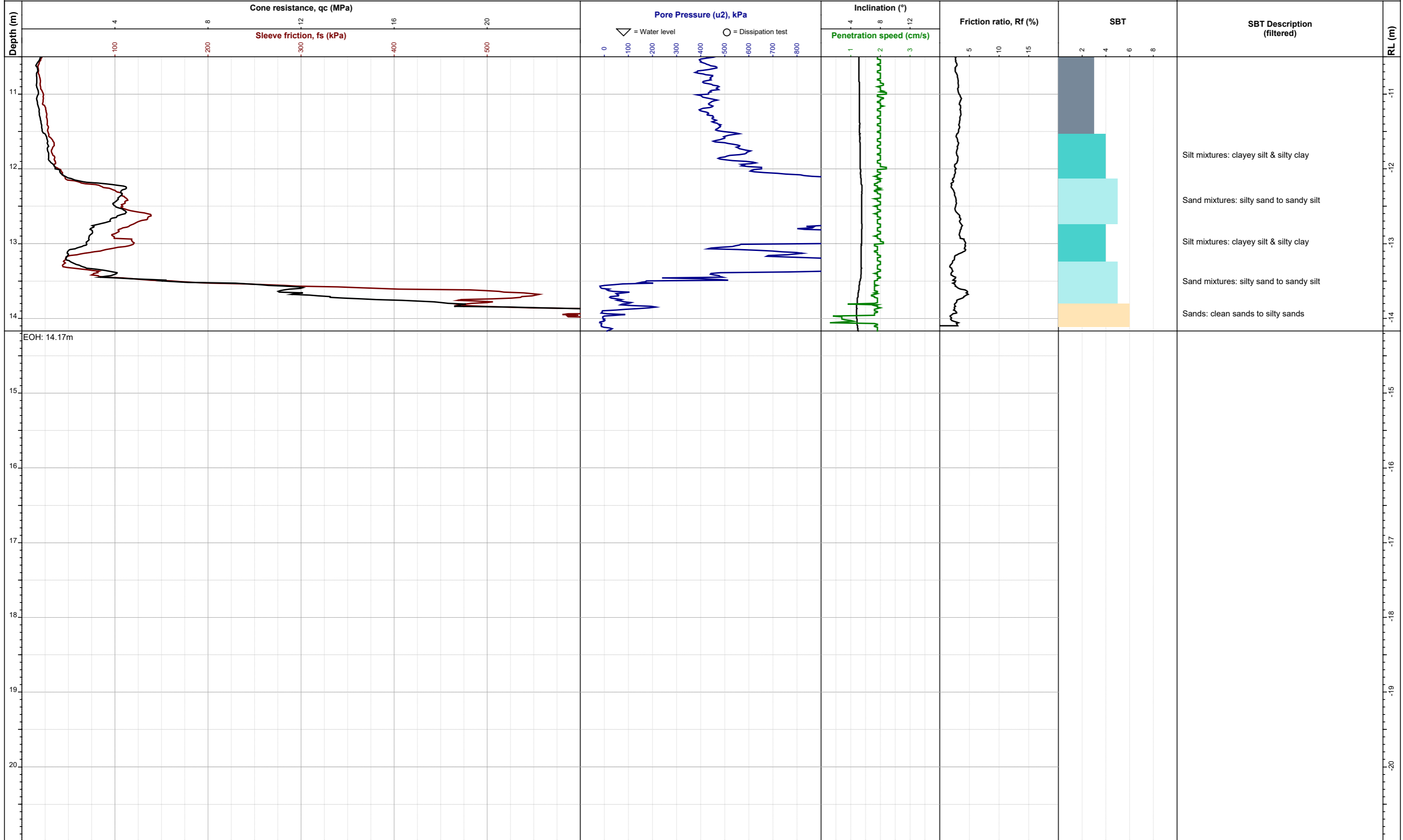
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-05**

**Project ID:** 18707  
**Depth:** 14.17m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-05**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 1.70m  
**Termination Reason:** limit of reaction force

**Northing:** 5968552mN  
**Easting:** 1747360mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

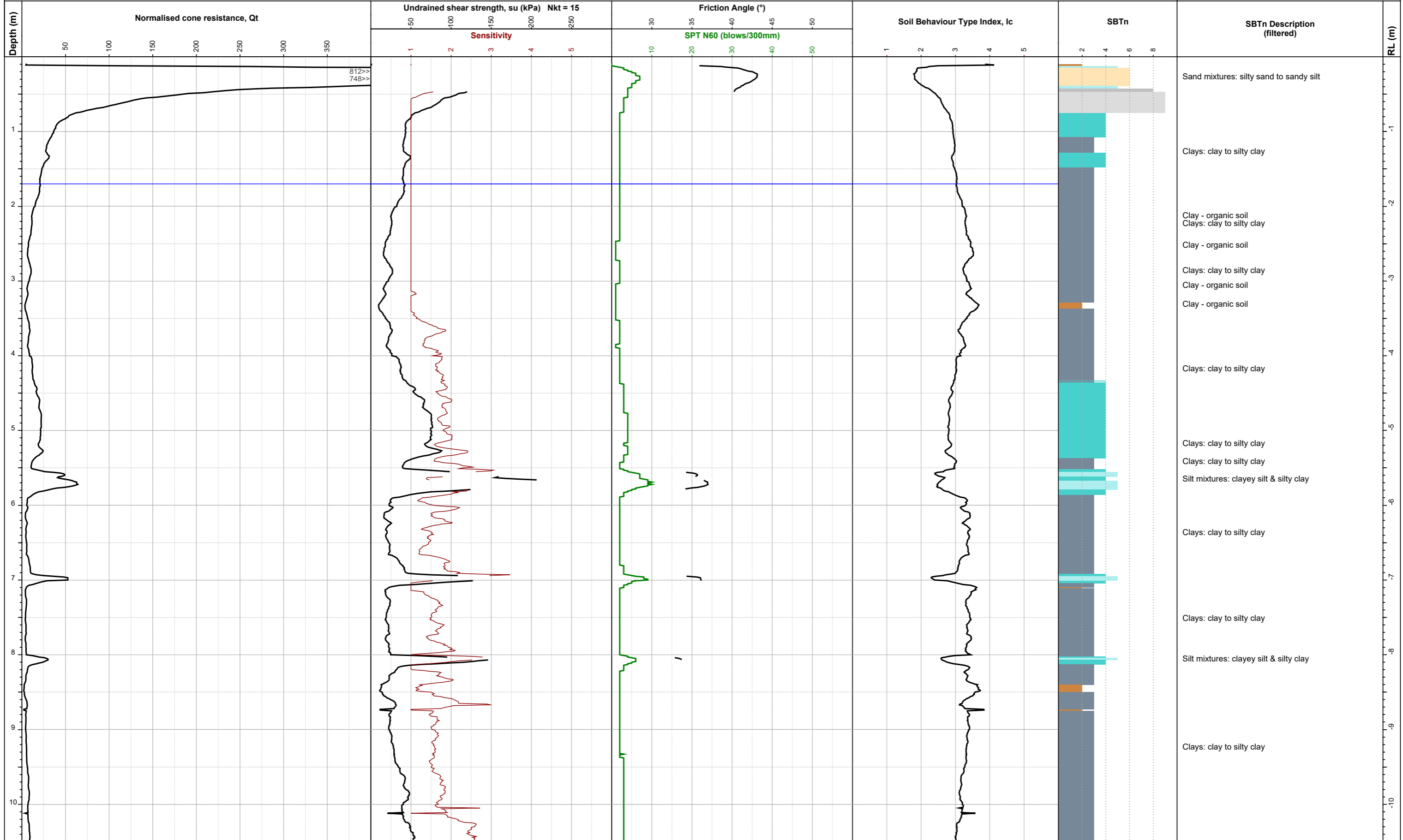
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-05**  
**Project ID:** 18707  
**Depth:** 14.17m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-05**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 1.70m  
**Termination Reason:** limit of reaction force

**Northing:** 5968552mN  
**Easting:** 1747360mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

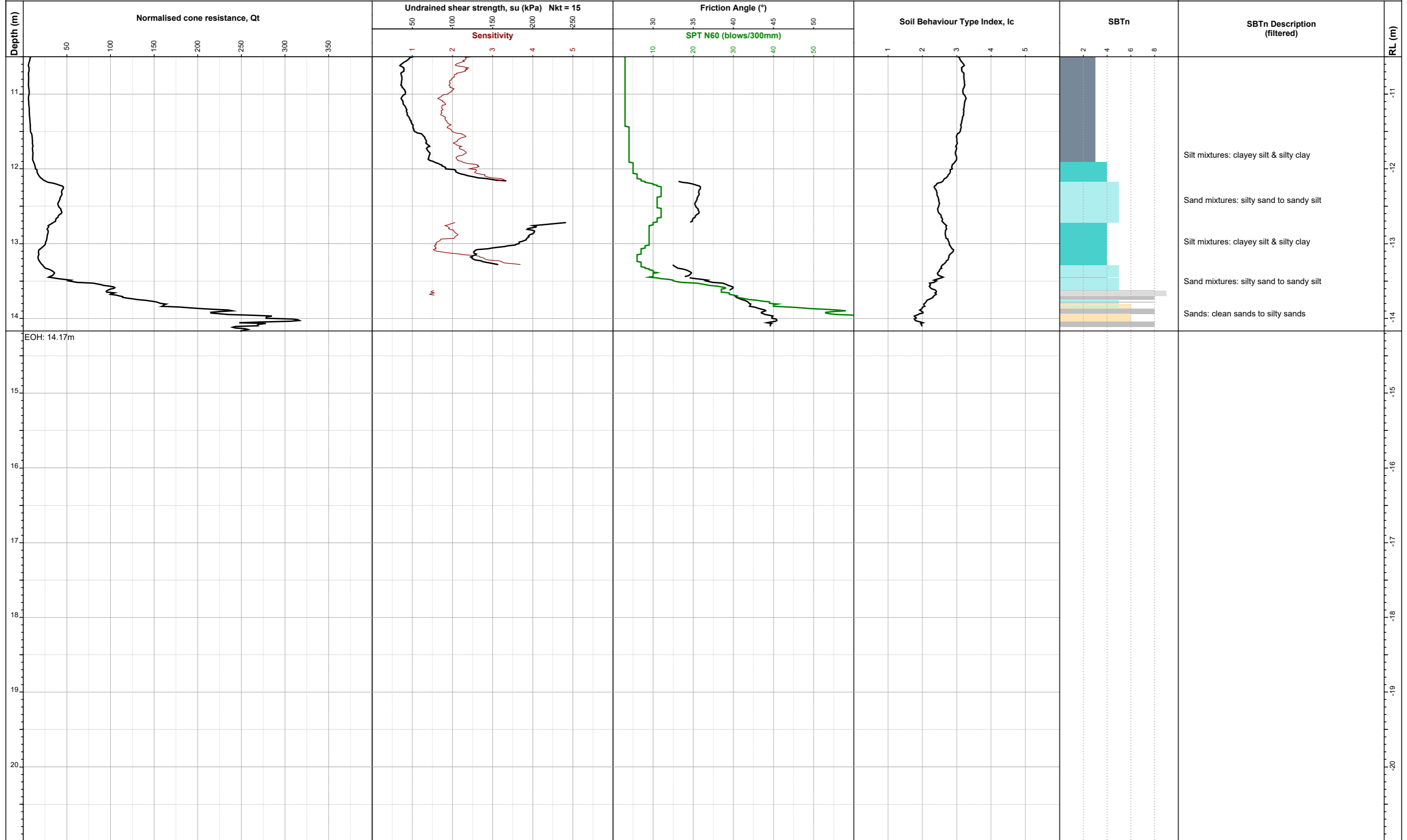
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-05**  
**Project ID:** 18707  
**Depth:** 14.17m  
**Sheet:** 1 of 2  
**Date:** 23/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-05**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:07 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 1.70m

**Termination Reason:**  
limit of reaction force

**Northing:** 5968552mN  
**Easting:** 1747360mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

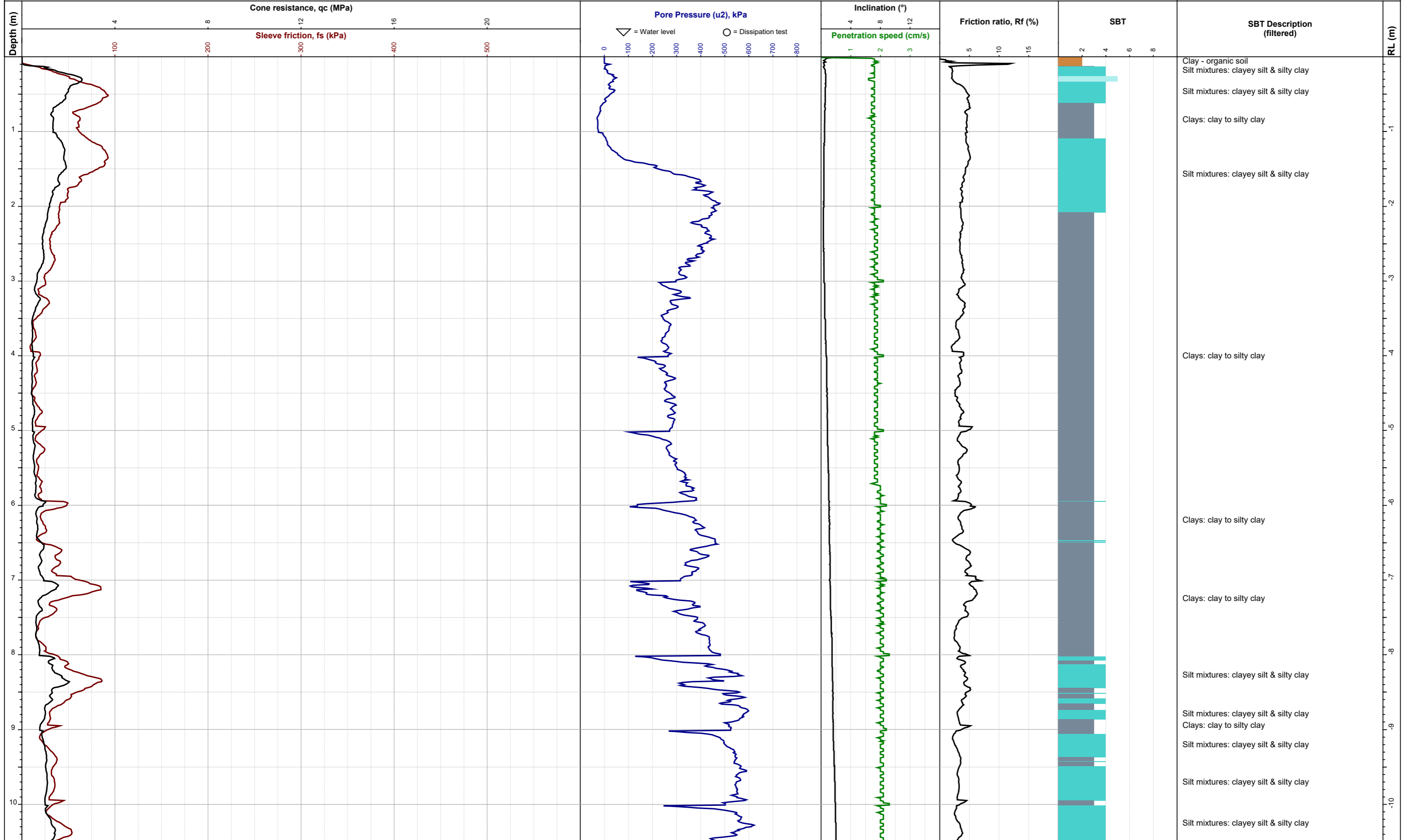
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-05**

**Project ID:** 18707  
**Depth:** 14.17m  
**Sheet:** 2 of 2  
**Date:** 23/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-06**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:09 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 2.20m

**Termination Reason:**  
 limit of reaction force

**Northing:** 5968325mN  
**Easting:** 1747255mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

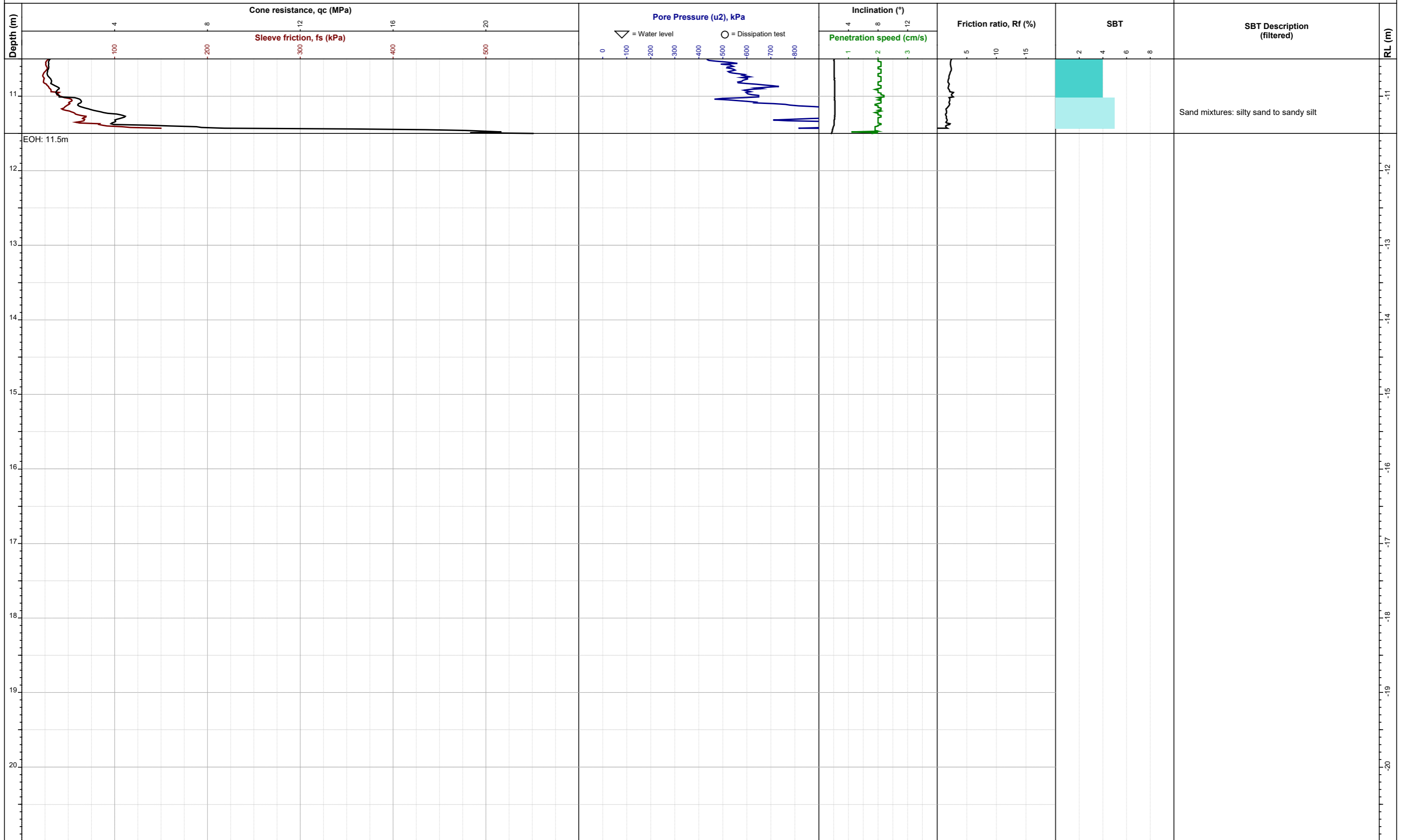
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-06**

**Project ID:** 18707  
**Depth:** 11.5m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-06**



**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 2.20m

**Termination Reason:**  
limit of reaction force

**Northing:** 5968325mN  
**Easting:** 1747255mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

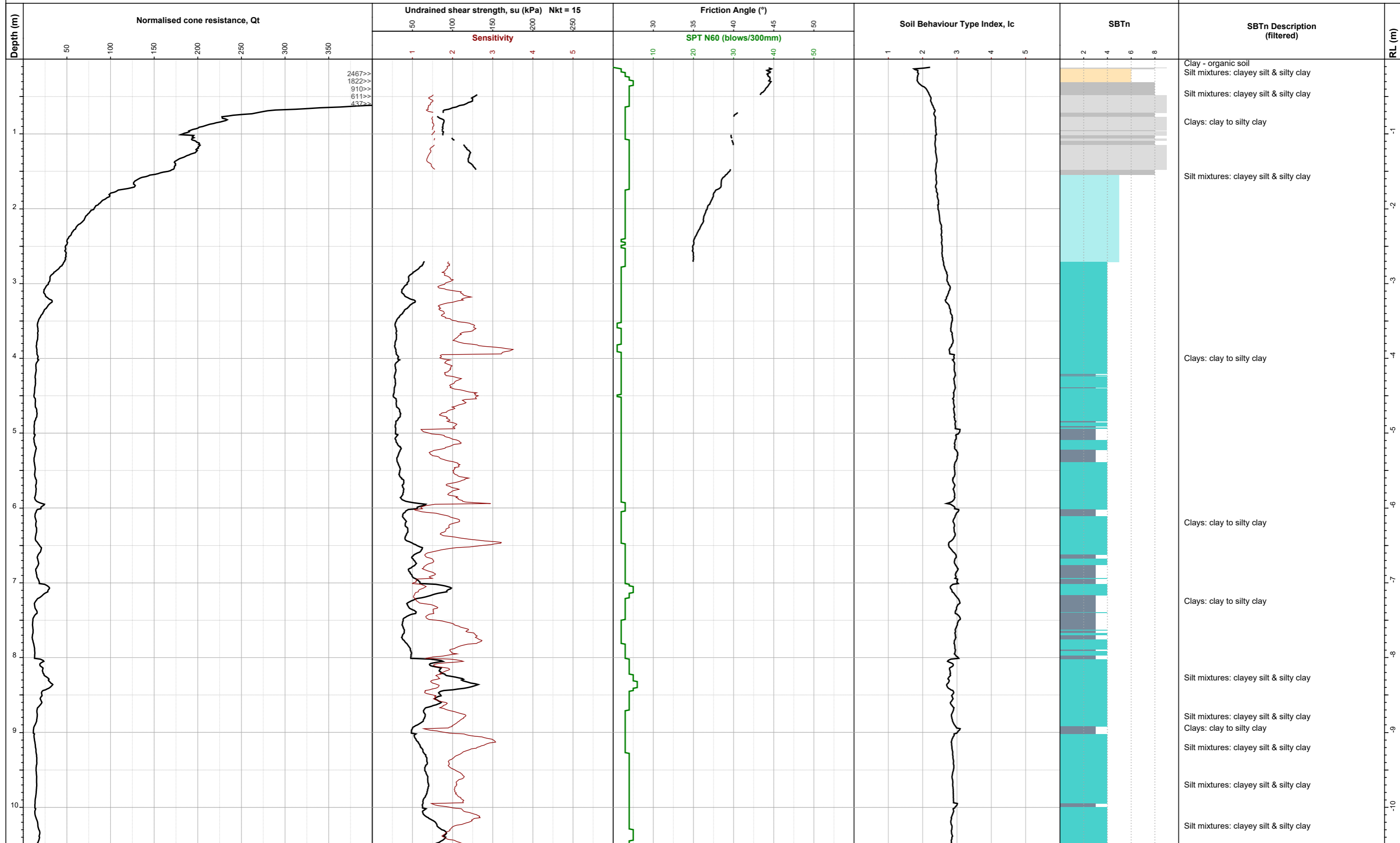
**Test ID:** **CPT-06**  
**Project ID:** 18707  
**Depth:** 11.5m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020





# Cone Penetration Test (CPTu) Parameter Log

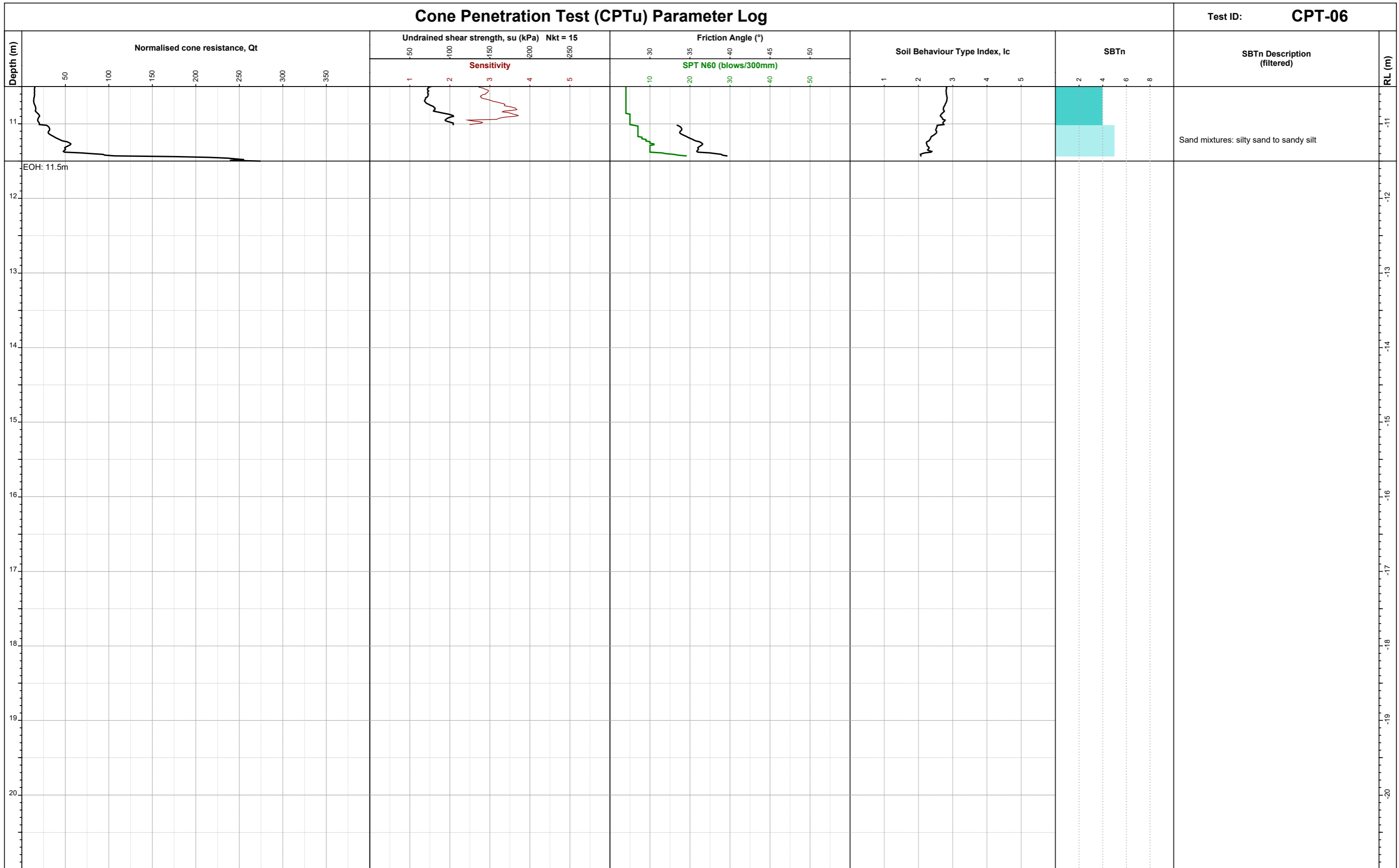
Test ID: **CPT-06**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:09 pm

	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Ground water located at 2.20m  <b>Termination Reason:</b> limit of reaction force	<b>Northing:</b> 5968325mN <b>Easting:</b> 1747255mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKj650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr><td>0</td><td>Undefined</td><td>5</td><td>Sand mixtures: silty sand to sandy silt</td></tr> <tr><td>1</td><td>Sensitive fine-grained</td><td>6</td><td>Sands: clean sands to silty sands</td></tr> <tr><td>2</td><td>Clay - organic soil</td><td>7</td><td>Dense sand to gravelly sand</td></tr> <tr><td>3</td><td>Clays: clay to silty clay</td><td>8</td><td>Stiff sand to clayey sand</td></tr> <tr><td>4</td><td>Silt mixtures: clayey silt &amp; silty clay</td><td>9</td><td>Stiff fine-grained</td></tr> </table>	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	<b>Test ID:</b> <div style="text-align: center; font-weight: bold; font-size: 1.2em;">CPT-06</div> <b>Project ID:</b> 18707 <b>Depth:</b> 11.5m <b>Sheet:</b> 1 of 2 <b>Date:</b> 24/11/2020
	0	Undefined	5	Sand mixtures: silty sand to sandy silt																						
1	Sensitive fine-grained	6	Sands: clean sands to silty sands																							
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3	Clays: clay to silty clay	8	Stiff sand to clayey sand																							
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained																							

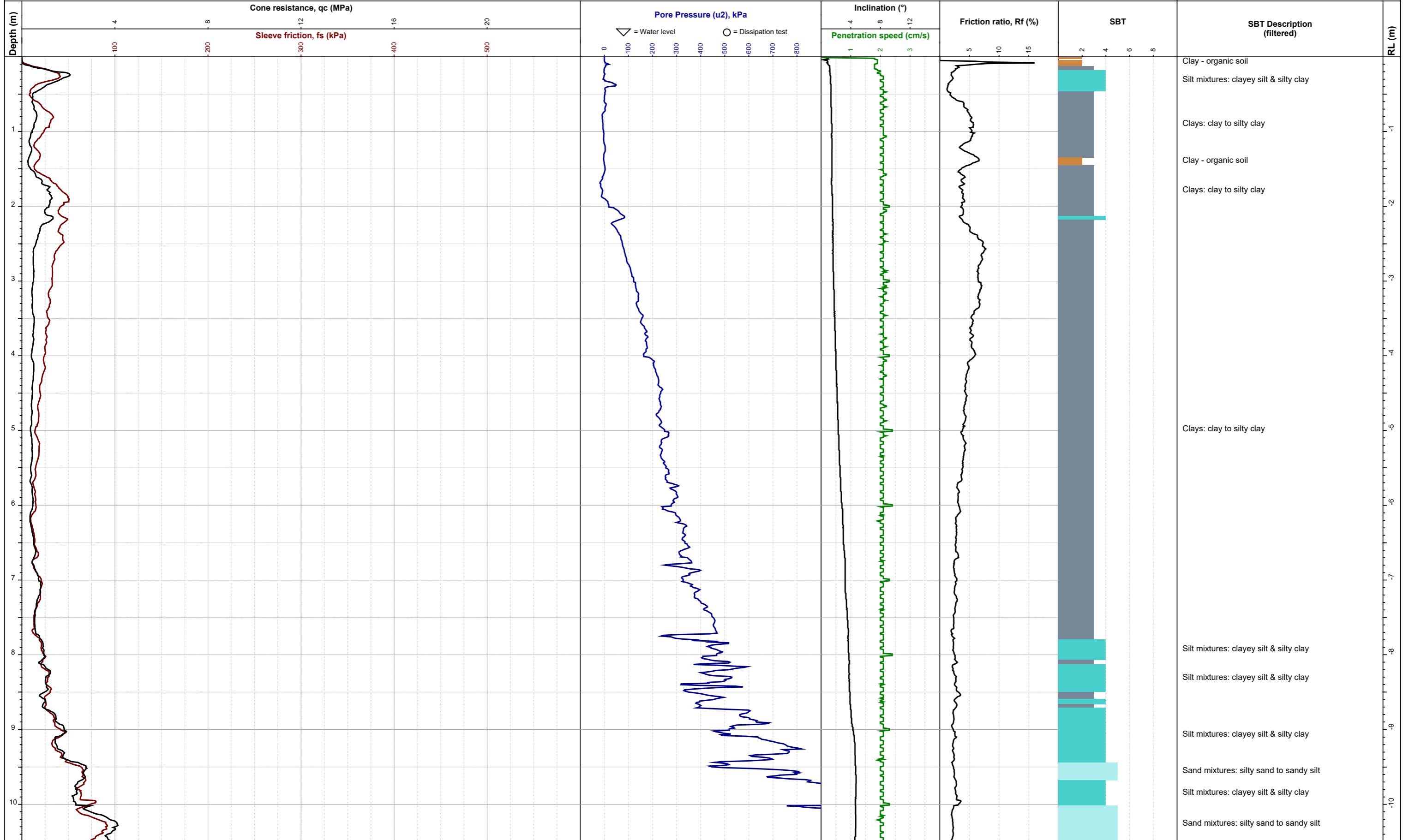
Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:09 pm



	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Ground water located at 2.20m  <b>Termination Reason:</b> limit of reaction force	<b>Northing:</b> 5968325mN <b>Easting:</b> 1747255mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKj650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr> <td style="background-color: black; color: white; padding: 2px;">0</td> <td>Undefined</td> <td style="background-color: #e0e0e0; padding: 2px;">5</td> <td>Sand mixtures: silty sand to sandy silt</td> </tr> <tr> <td style="background-color: #ff0000; color: white; padding: 2px;">1</td> <td>Sensitive fine-grained</td> <td style="background-color: #e0e0e0; padding: 2px;">6</td> <td>Sands: clean sands to silty sands</td> </tr> <tr> <td style="background-color: #0000ff; color: white; padding: 2px;">2</td> <td>Clay - organic soil</td> <td style="background-color: #e0e0e0; padding: 2px;">7</td> <td>Dense sand to gravelly sand</td> </tr> <tr> <td style="background-color: #0000ff; color: white; padding: 2px;">3</td> <td>Clays: clay to silty clay</td> <td style="background-color: #e0e0e0; padding: 2px;">8</td> <td>Stiff sand to clayey sand</td> </tr> <tr> <td style="background-color: #0000ff; color: white; padding: 2px;">4</td> <td>Silt mixtures: clayey silt &amp; silty clay</td> <td style="background-color: #e0e0e0; padding: 2px;">9</td> <td>Stiff fine-grained</td> </tr> </table>	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	<b>Test ID:</b> <h2 style="text-align: center;">CPT-06</h2> <b>Project ID:</b> 18707 <b>Depth:</b> 11.5m <b>Sheet:</b> 2 of 2 <b>Date:</b> 24/11/2020
	0	Undefined	5	Sand mixtures: silty sand to sandy silt																						
1	Sensitive fine-grained	6	Sands: clean sands to silty sands																							
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# Cone Penetration Test (CPTu) Log

Test ID: **CPT-07**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.08m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968251mN  
**Easting:** 1747350mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

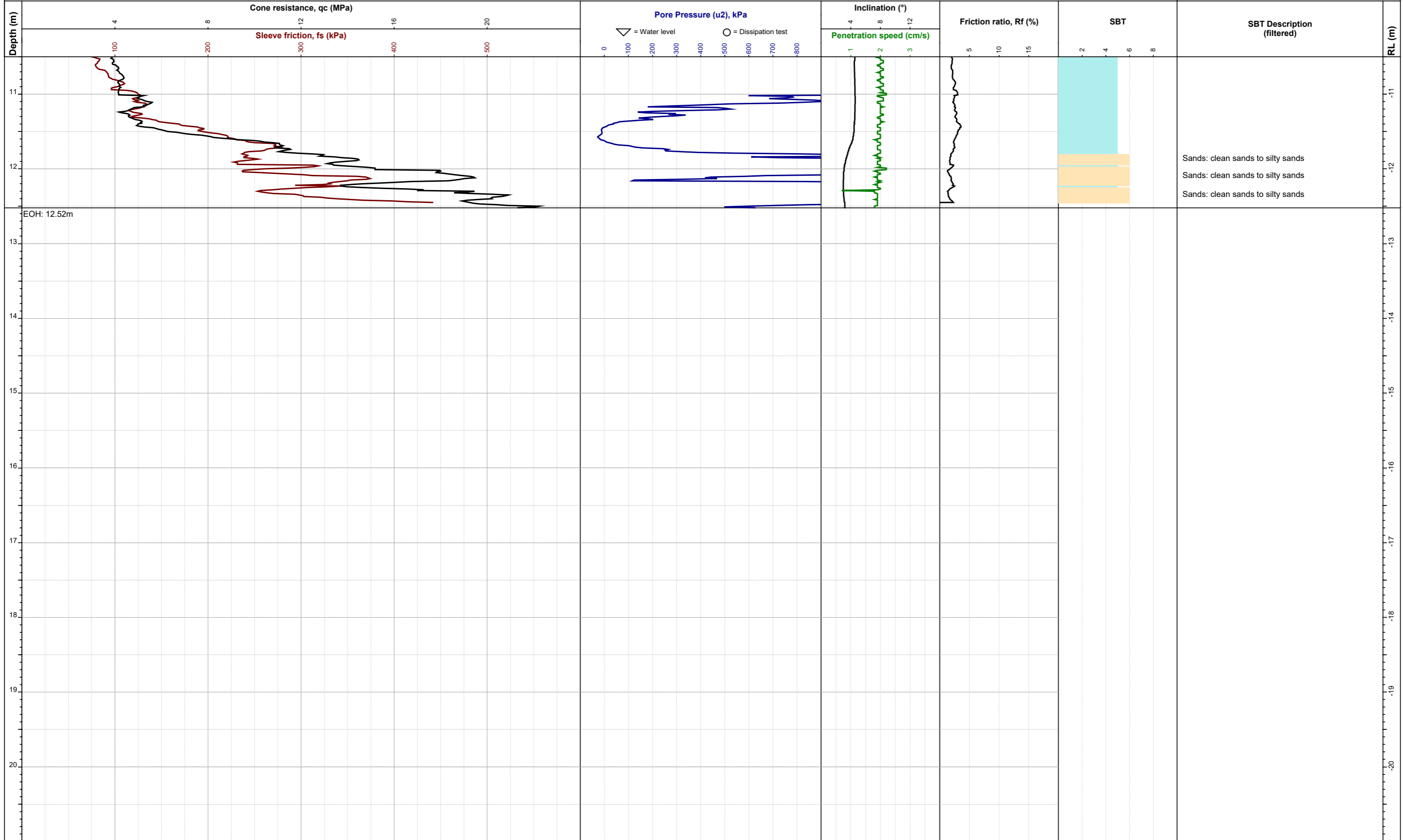
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-07**  
**Project ID:** 18707  
**Depth:** 12.52m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-07**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.08m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968251mN  
**Easting:** 1747350mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

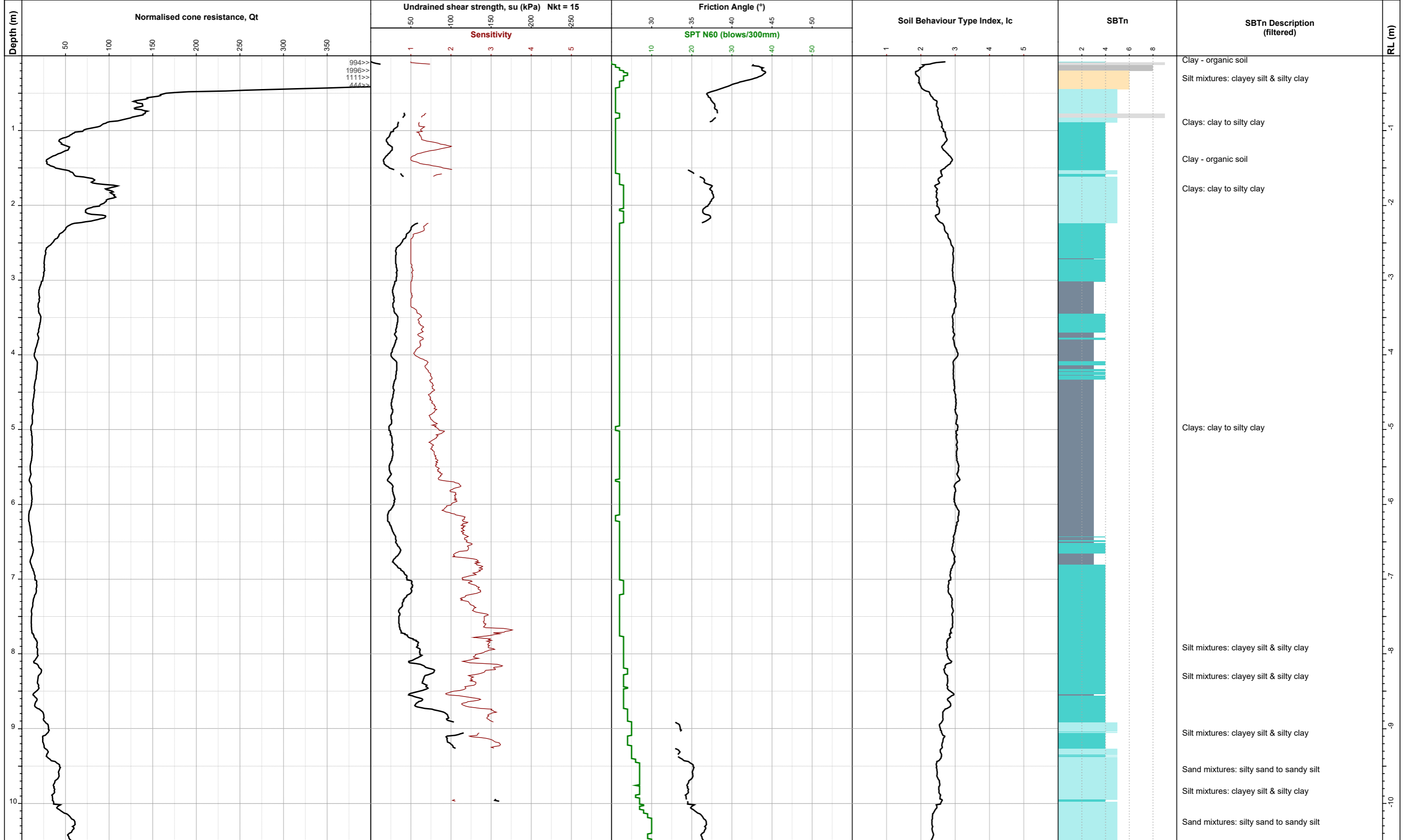
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
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4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-07**  
**Project ID:** 18707  
**Depth:** 12.52m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-07**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.08m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968251mN  
**Easting:** 1747350mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

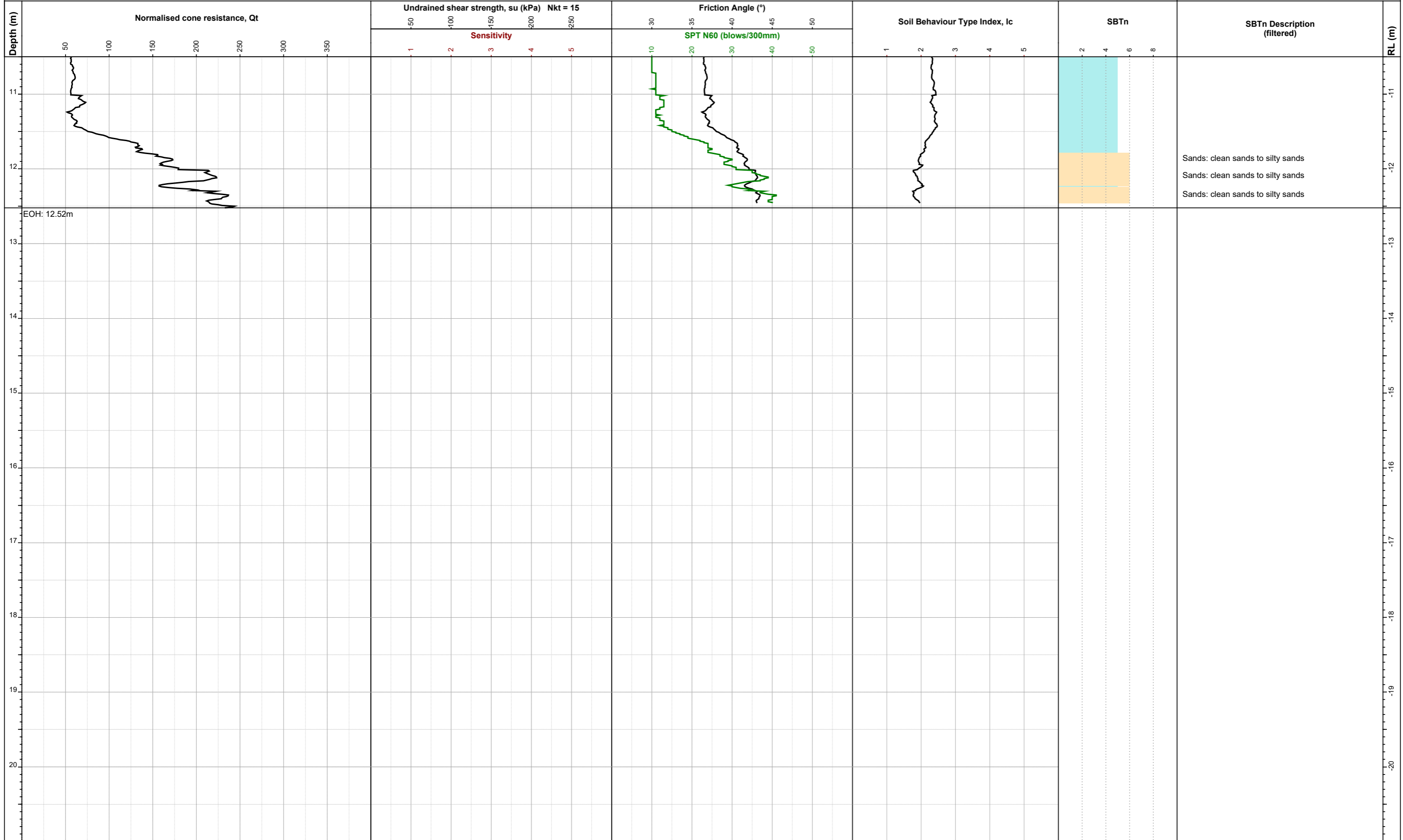
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-07**  
**Project ID:** 18707  
**Depth:** 12.52m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-07**



EOH: 12.52m



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Collapse of hole at 1.08m prevented measurement of ground water

**Termination Reason:**  
limit of reaction force

**Northing:** 5968251mN  
**Easting:** 1747350mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

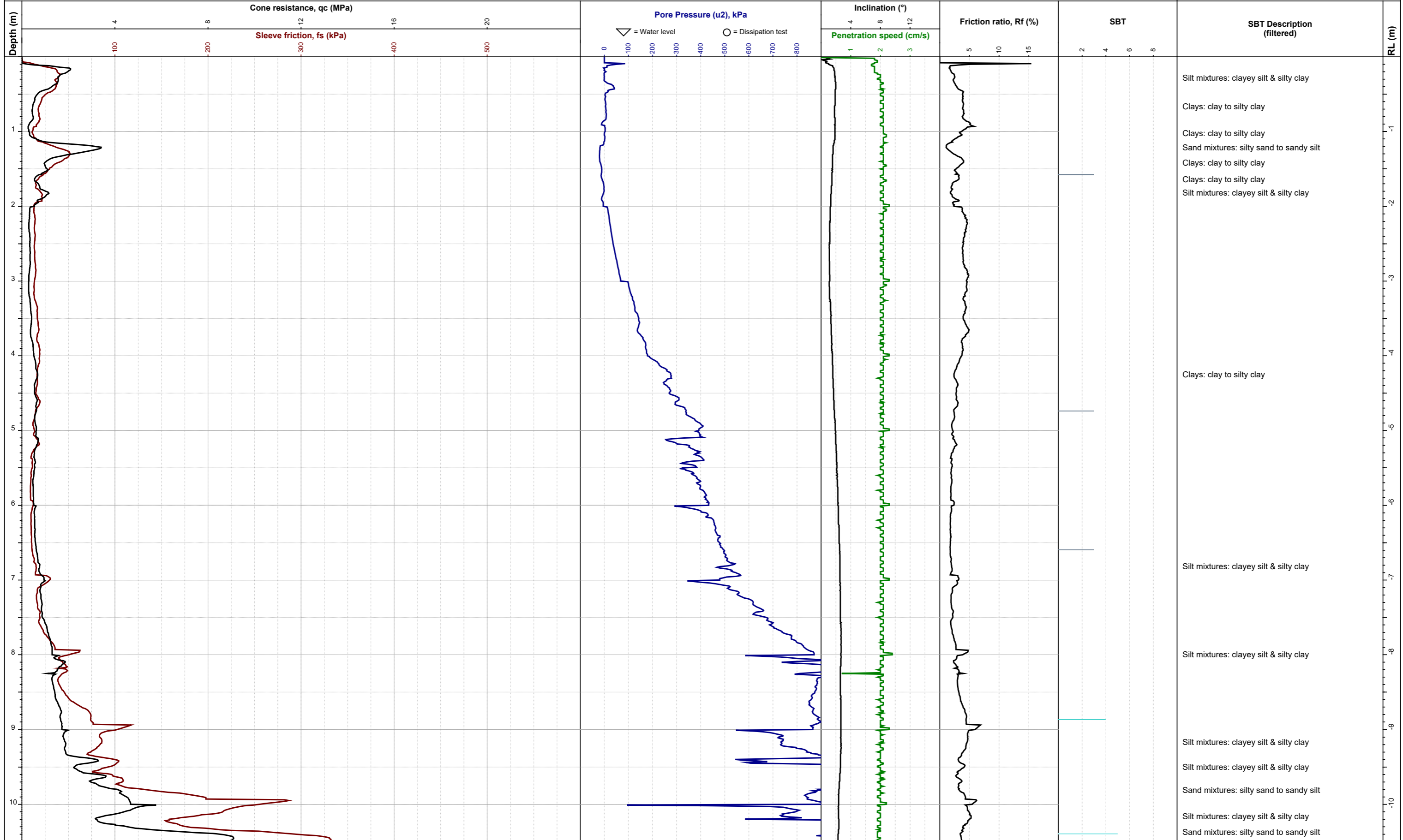
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-07**

**Project ID:** 18707  
**Depth:** 12.52m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-08**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:17 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Collapse of hole at 1.72m prevented measurement of ground water

**Termination Reason:**  
limit of reaction force

**Northing:** 5968098mN  
**Easting:** 1747467mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

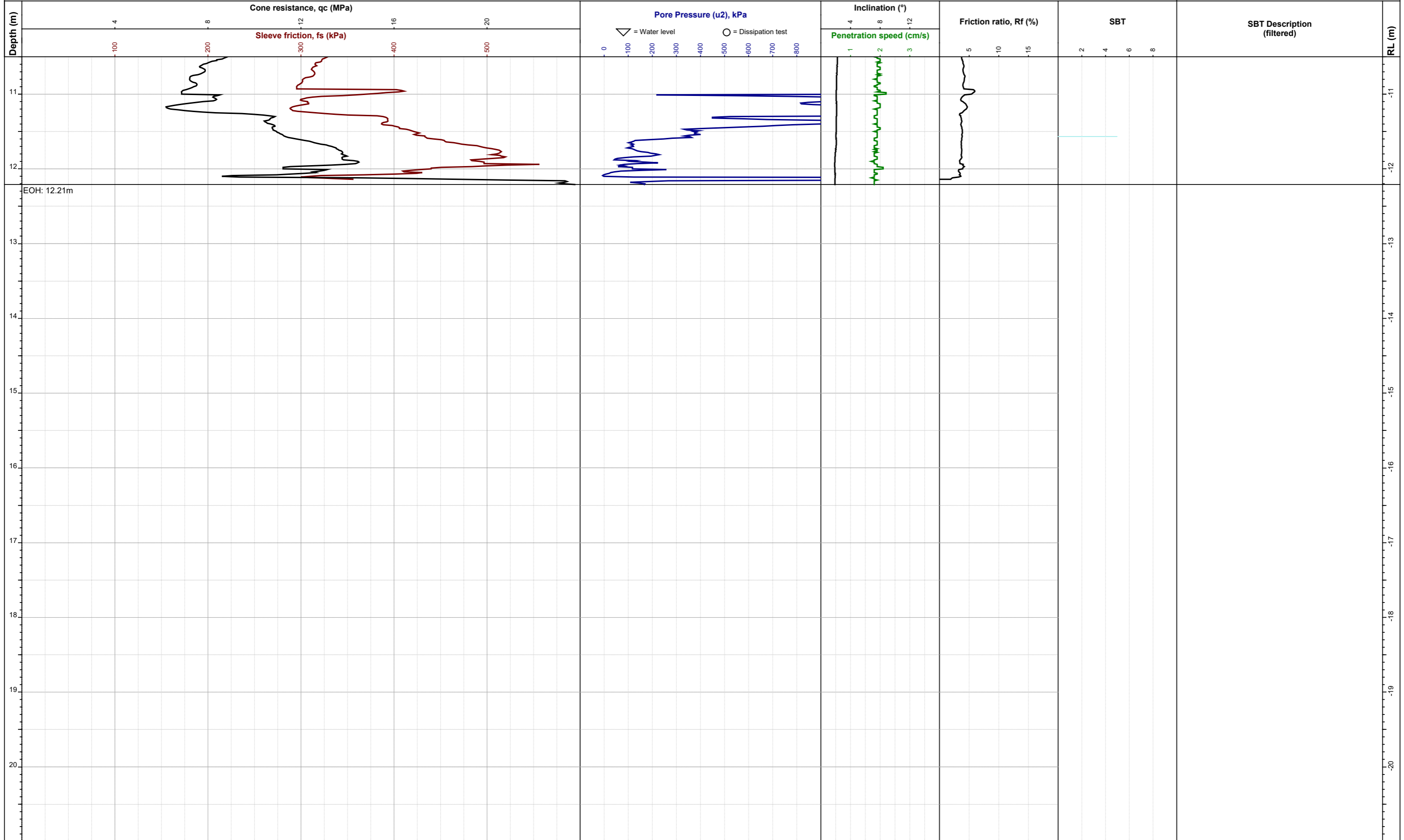
**Test ID:** **CPT-08**

**Project ID:** 18707  
**Depth:** 12.21m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-08**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.72m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968098mN  
**Easting:** 1747467mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

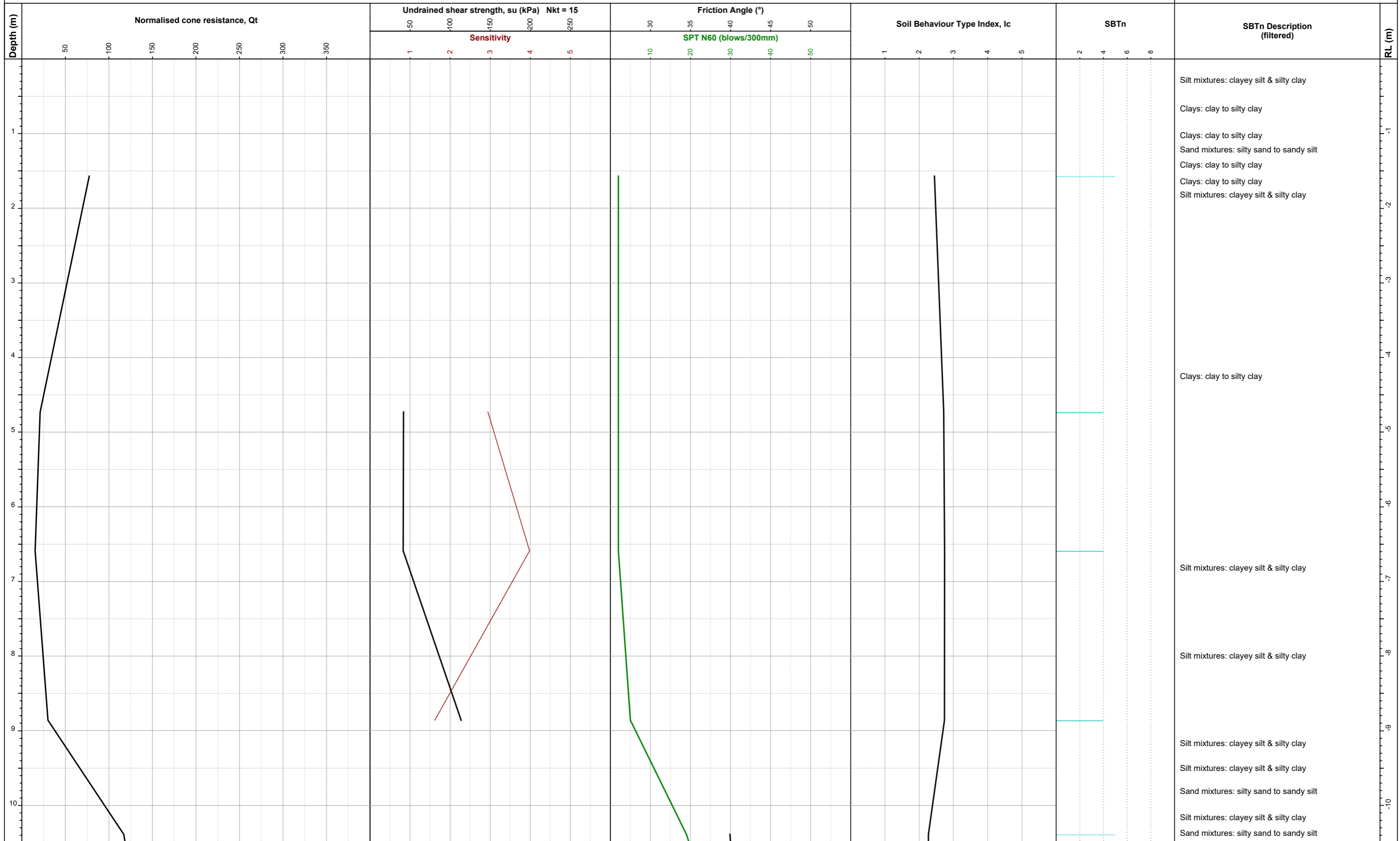
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:**  
**CPT-08**  
**Project ID:** 18707  
**Depth:** 12.21m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-08**



Silt mixtures: clayey silt & silty clay  
 Clays: clay to silty clay  
 Clays: clay to silty clay  
 Sand mixtures: silty sand to sandy silt  
 Clays: clay to silty clay  
 Clays: clay to silty clay  
 Silt mixtures: clayey silt & silty clay  
  
 Clays: clay to silty clay  
  
 Silt mixtures: clayey silt & silty clay  
  
 Silt mixtures: clayey silt & silty clay  
 Silt mixtures: clayey silt & silty clay  
 Sand mixtures: silty sand to sandy silt  
 Silt mixtures: clayey silt & silty clay  
 Sand mixtures: silty sand to sandy silt

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.72m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968098mN  
**Easting:** 1747467mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKJ650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

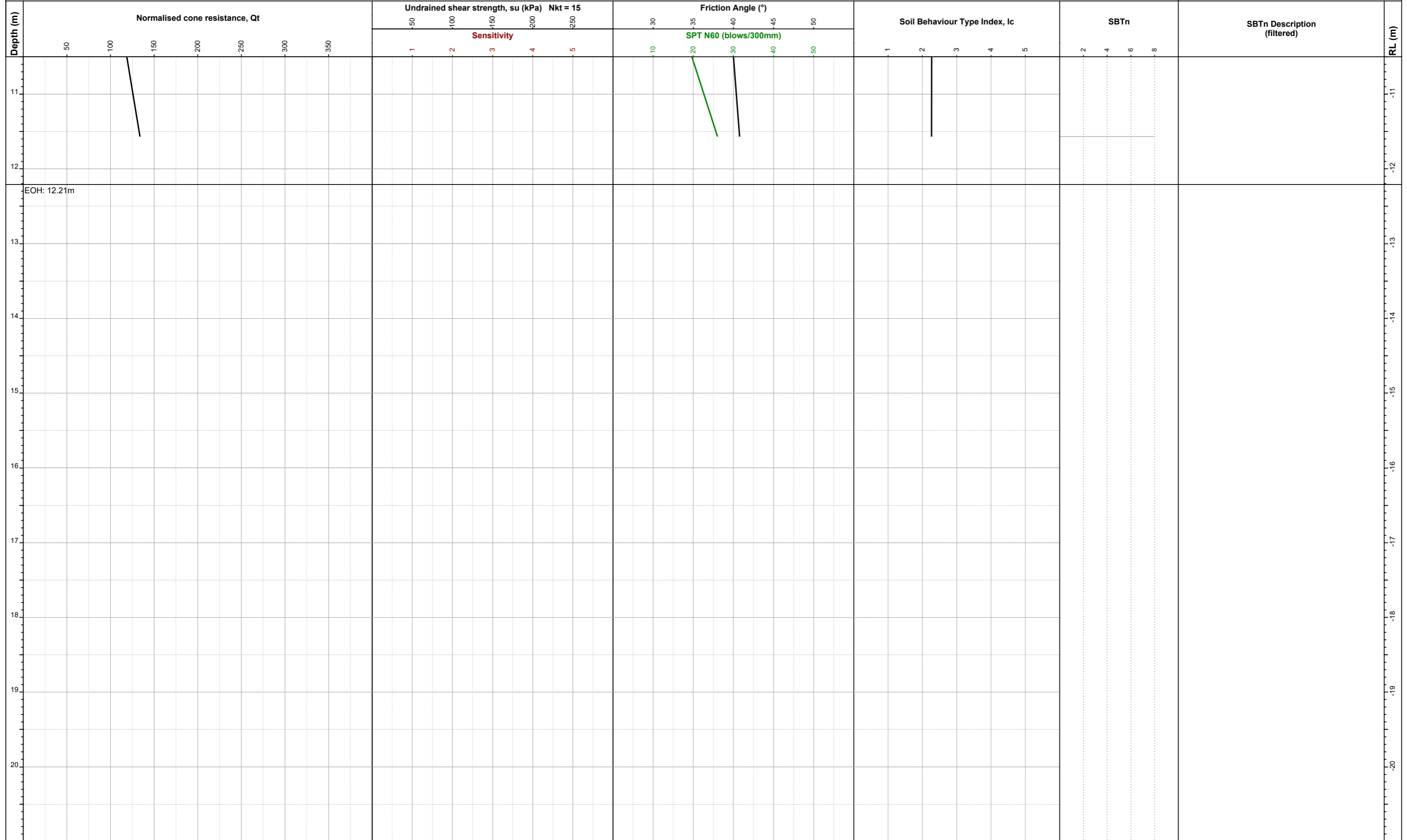
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-08**  
**Project ID:** 18707  
**Depth:** 12.21m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-08**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.72m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968098mN  
**Easting:** 1747467mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKJ650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

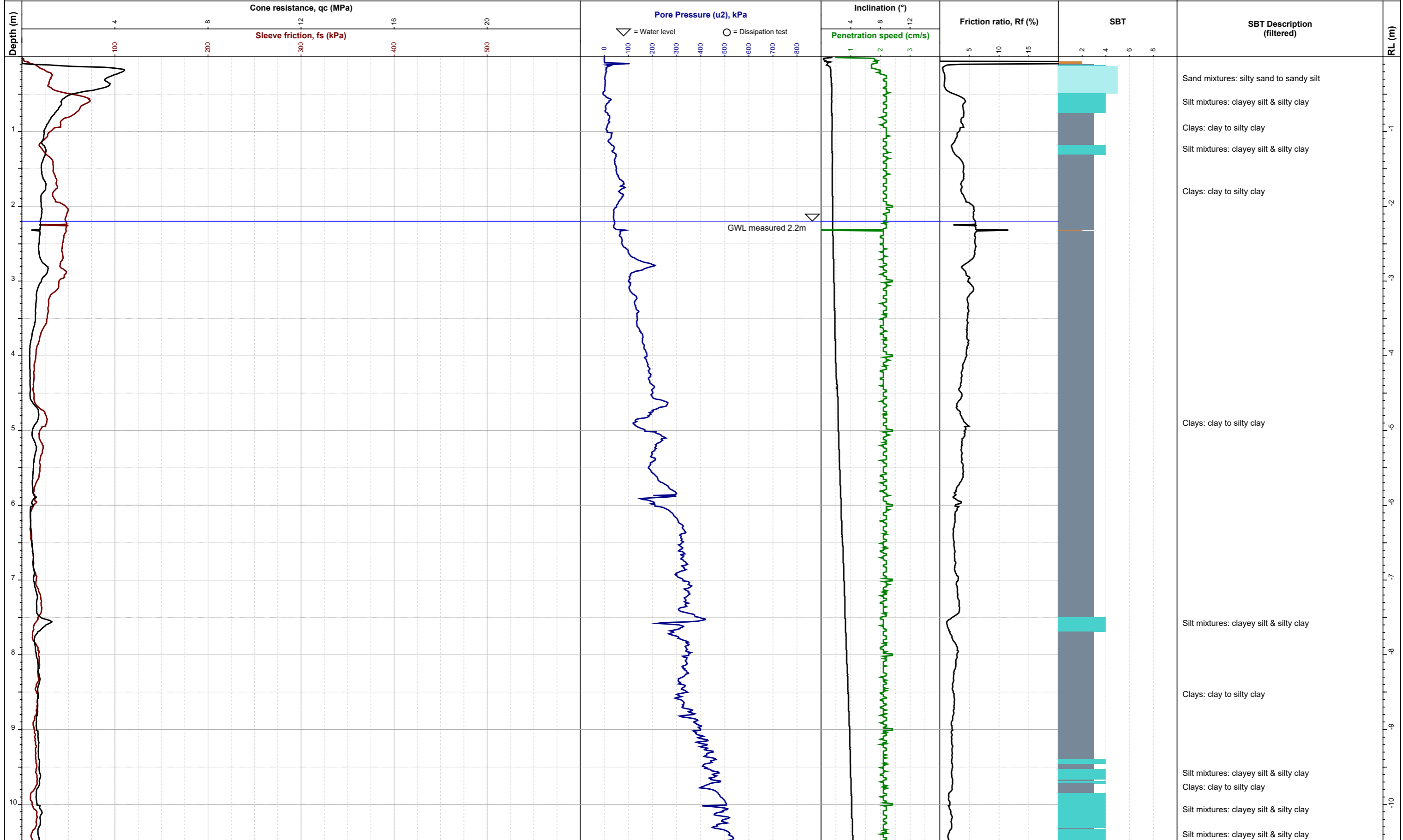
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-08**  
**Project ID:** 18707  
**Depth:** 12.21m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-09**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Collapse of hole at 1.23m prevented measurement of ground water  
**Termination Reason:** high cone resistance

**Northing:** 5967936mN  
**Easting:** 1747624mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

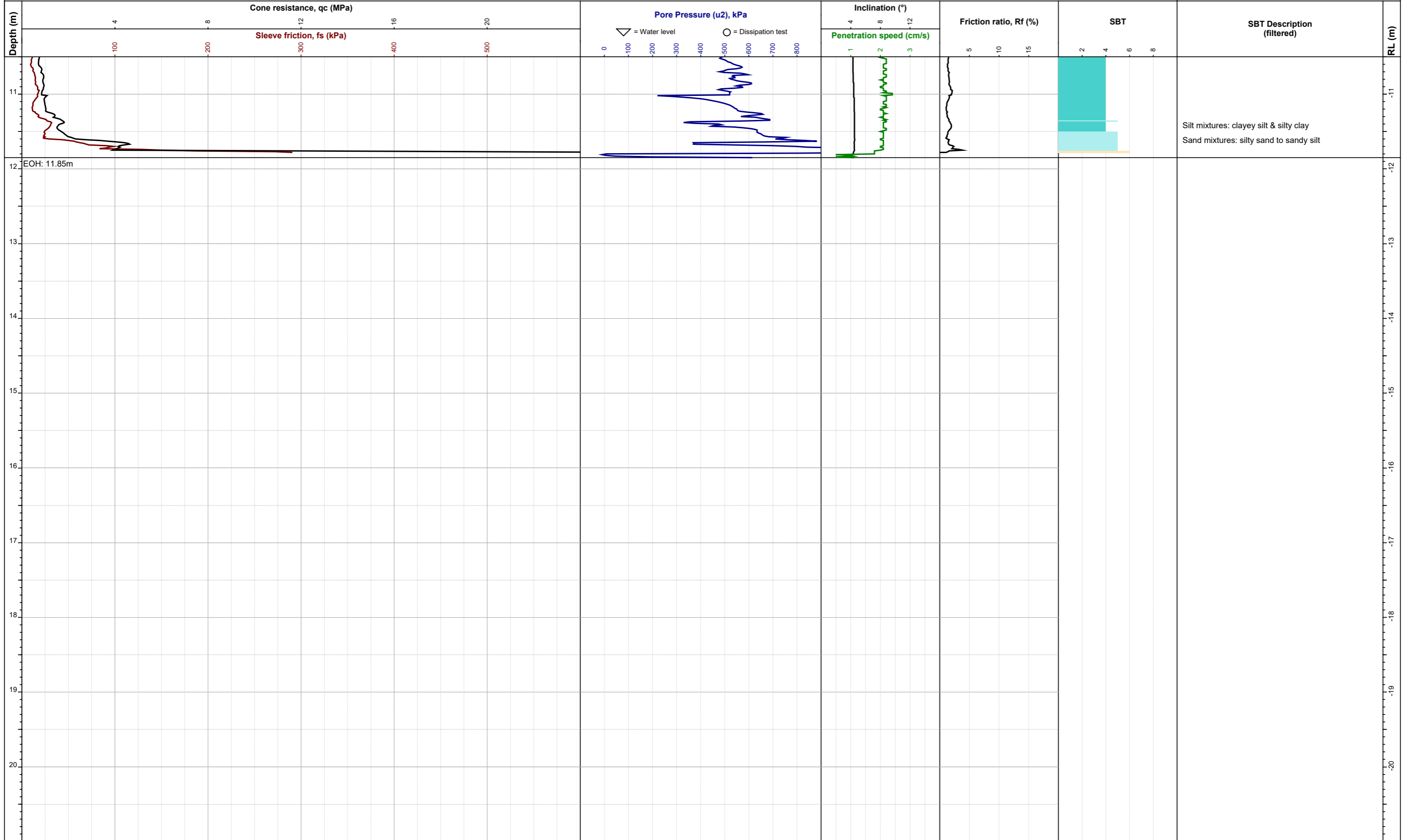
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-09**  
**Project ID:** 18707  
**Depth:** 11.85m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-09**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.23m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5967936mN  
**Easting:** 1747624mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

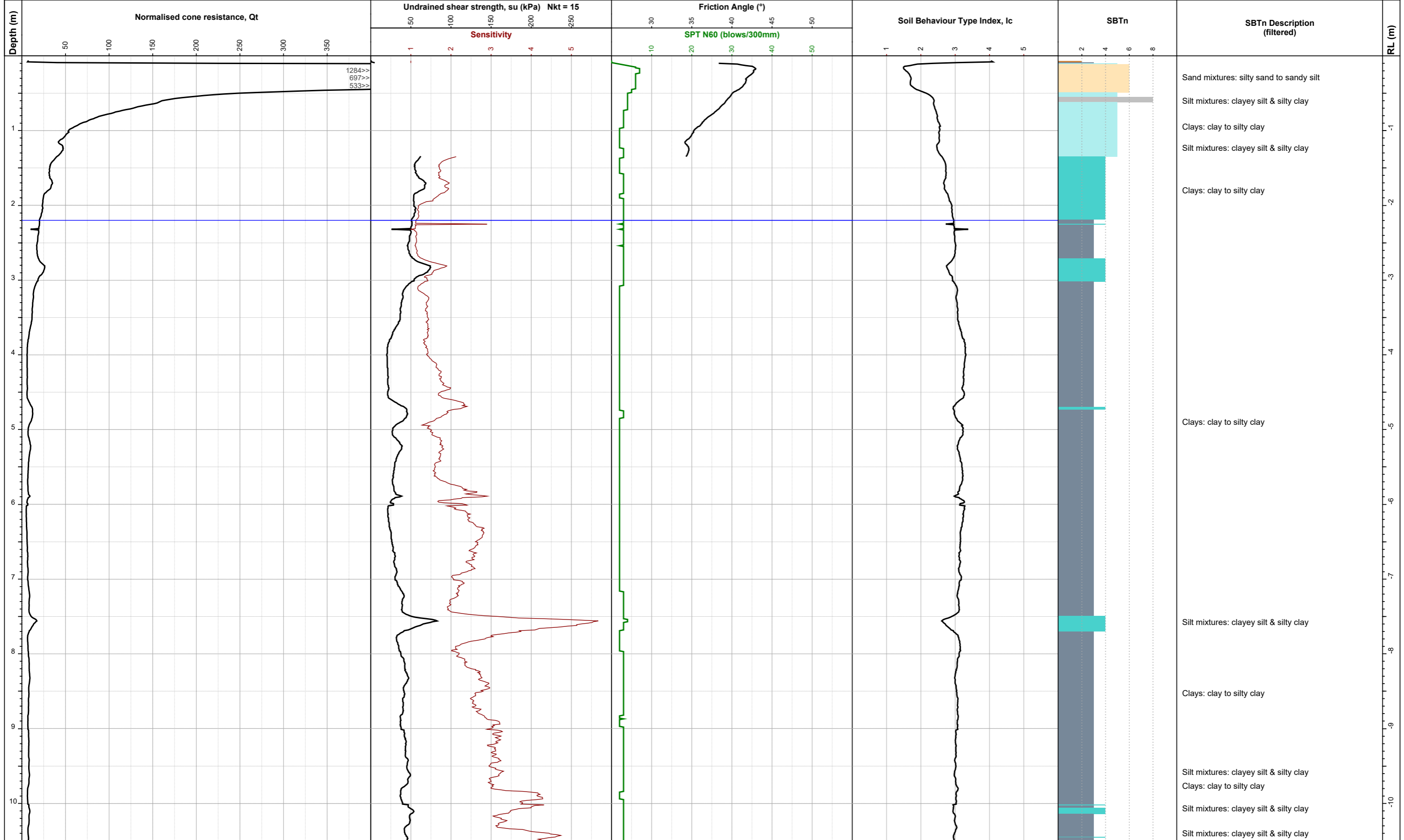
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-09**  
**Project ID:** 18707  
**Depth:** 11.85m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-09**



1284>>  
697>>  
533>>

Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:19 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Collapse of hole at 1.23m prevented measurement of ground water  
**Termination Reason:**  
high cone resistance

**Northing:** 5967936mN  
**Easting:** 1747624mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

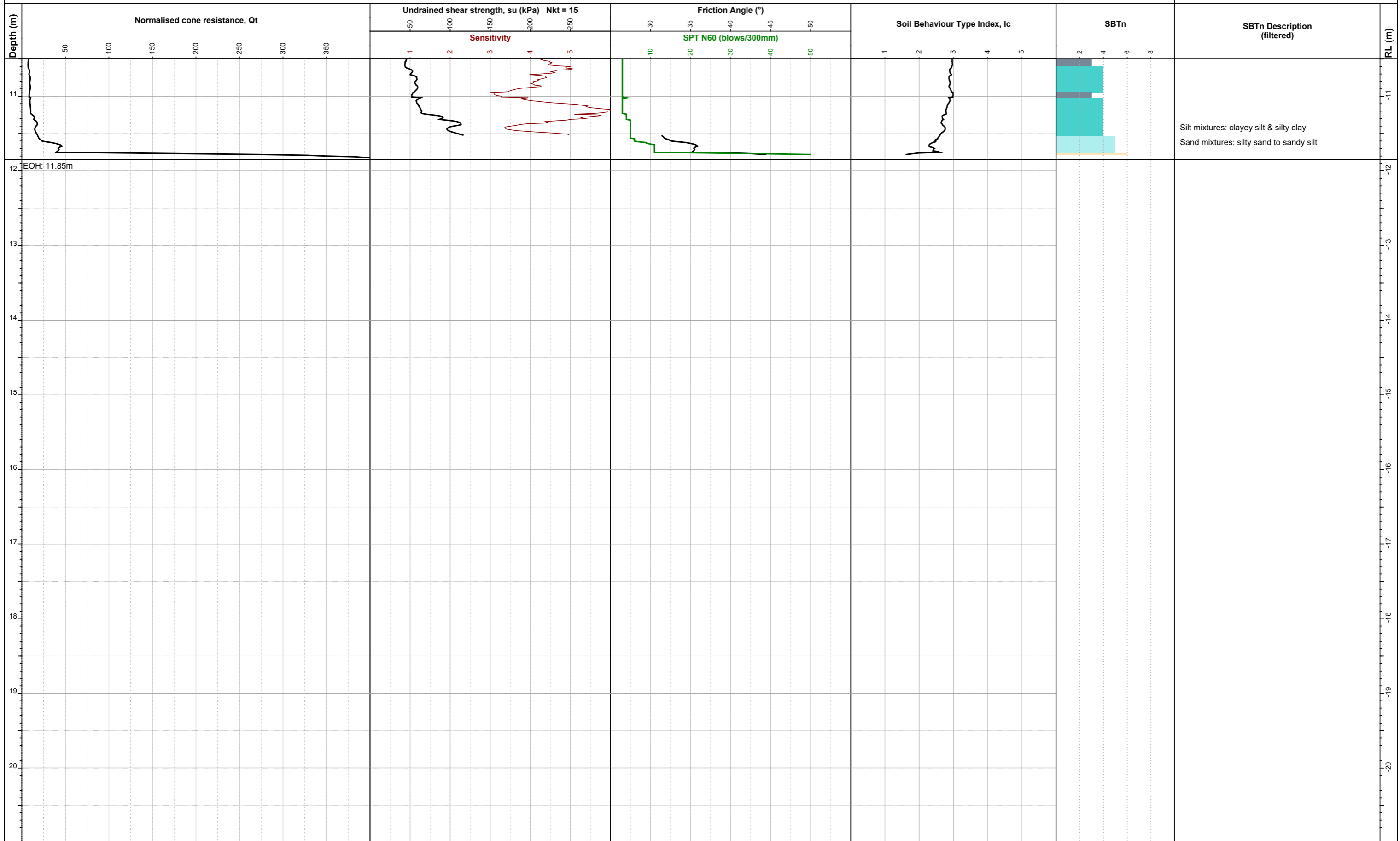
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-09**  
**Project ID:** 18707  
**Depth:** 11.85m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-09**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Collapse of hole at 1.23m prevented measurement of ground water

**Termination Reason:**  
high cone resistance

**Northing:** 5967936mN  
**Easting:** 1747624mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

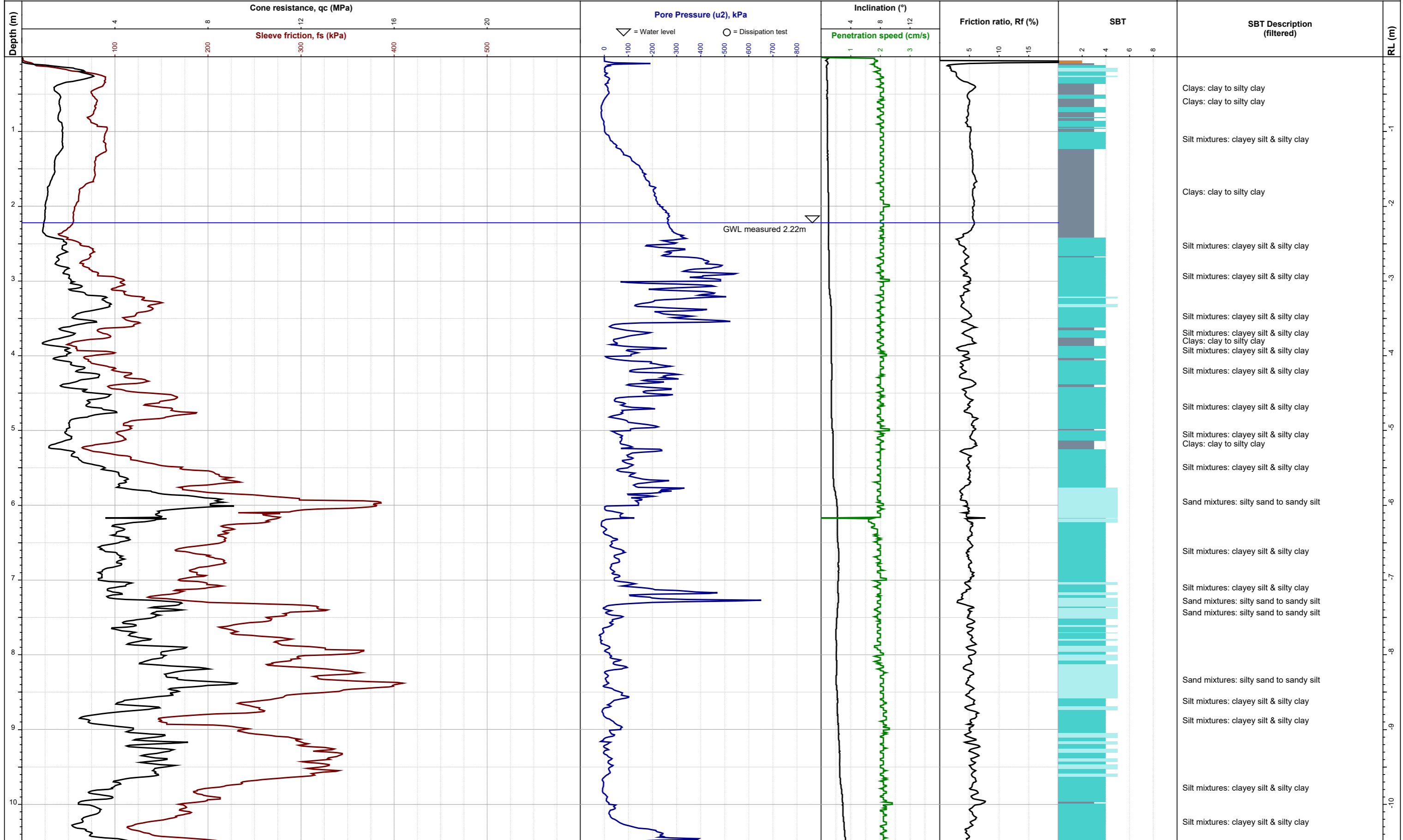
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-09**

**Project ID:** 18707  
**Depth:** 11.85m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-10**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 2.22m  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968345mN  
**Easting:** 1747119mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

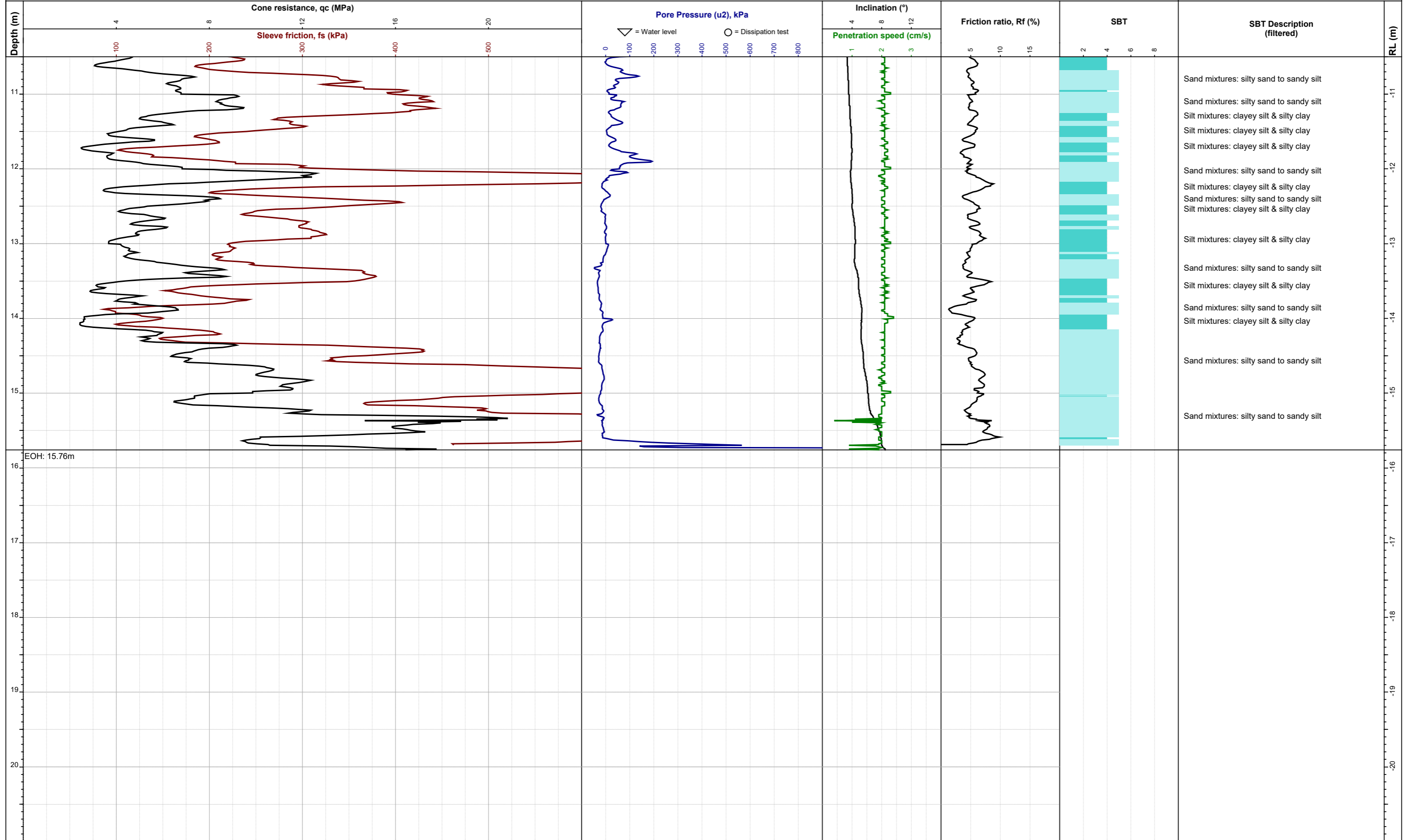
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-10**  
**Project ID:** 18707  
**Depth:** 15.76m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-10**



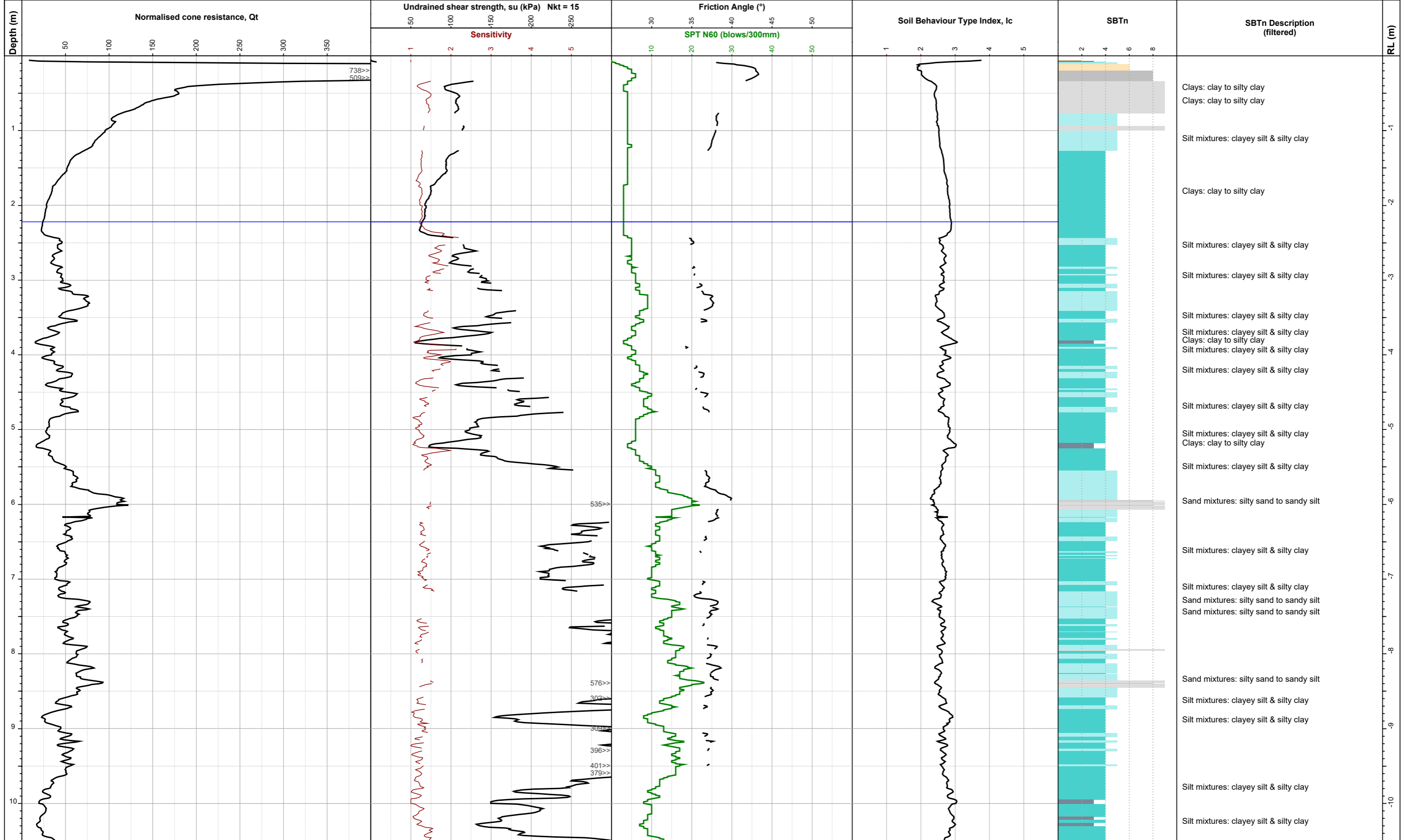
Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:21 pm

	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Ground water located at 2.22m  <b>Termination Reason:</b> high pore pressure	<b>Northing:</b> 5968345mN <b>Easting:</b> 1747119mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKj650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr> <td style="border: 1px solid black; padding: 2px;">0</td><td>Undefined</td> <td style="border: 1px solid black; padding: 2px;">5</td><td>Sand mixtures: silty sand to sandy silt</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">1</td><td>Sensitive fine-grained</td> <td style="border: 1px solid black; padding: 2px;">6</td><td>Sands: clean sands to silty sands</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">2</td><td>Clay - organic soil</td> <td style="border: 1px solid black; padding: 2px;">7</td><td>Dense sand to gravelly sand</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td><td>Clays: clay to silty clay</td> <td style="border: 1px solid black; padding: 2px;">8</td><td>Stiff sand to clayey sand</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">4</td><td>Silt mixtures: clayey silt &amp; silty clay</td> <td style="border: 1px solid black; padding: 2px;">9</td><td>Stiff fine-grained</td> </tr> </table>	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	<b>Test ID:</b> <div style="text-align: center; font-weight: bold; font-size: 1.2em;">CPT-10</div> <b>Project ID:</b> 18707 <b>Depth:</b> 15.76m <b>Sheet:</b> 2 of 2 <b>Date:</b> 24/11/2020
	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																							



# Cone Penetration Test (CPTu) Parameter Log

**Test ID: CPT-10**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 2.22m  
**Termination Reason:**  
 high pore pressure

**Northing:** 5968345mN  
**Easting:** 1747119mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

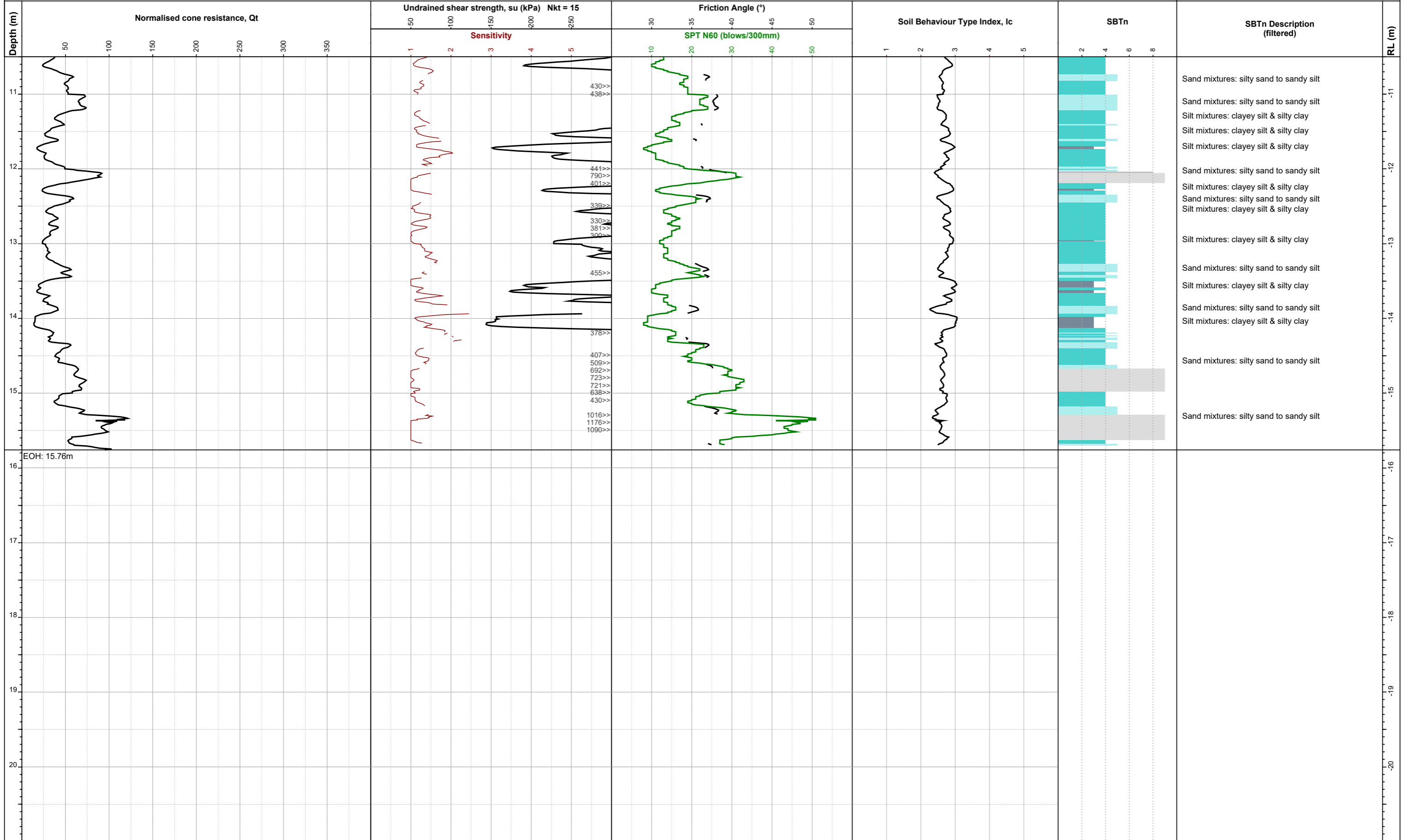
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** CPT-10  
**Project ID:** 18707  
**Depth:** 15.76m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-10**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 2.22m  
**Termination Reason:** high pore pressure

**Northing:** 5968345mN  
**Easting:** 1747119mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

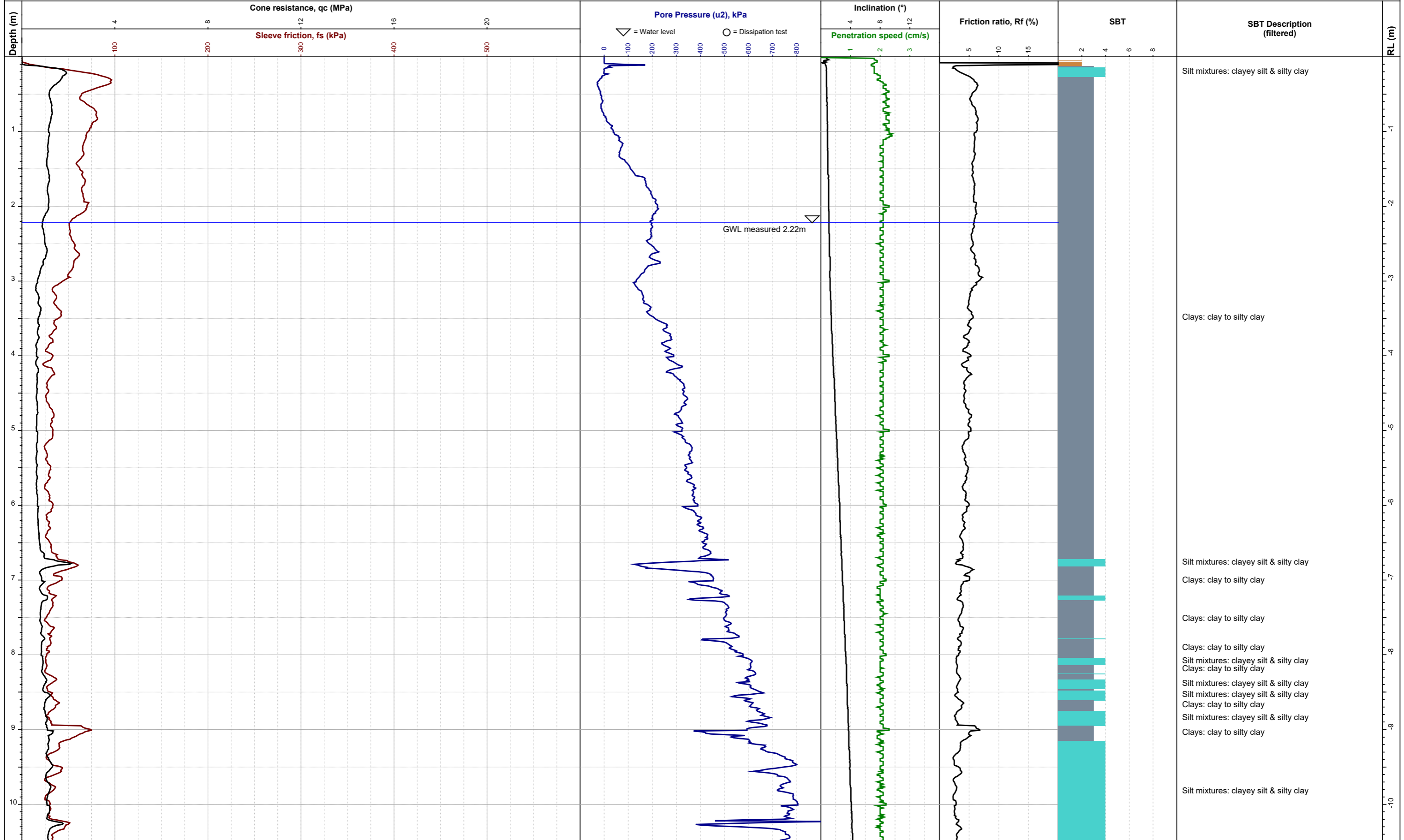
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-10**  
**Project ID:** 18707  
**Depth:** 15.76m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-11**



**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 2.22m

**Termination Reason:**  
target depth

**Northing:** 5968161mN  
**Easting:** 1747147mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

**Test ID:**

**CPT-11**

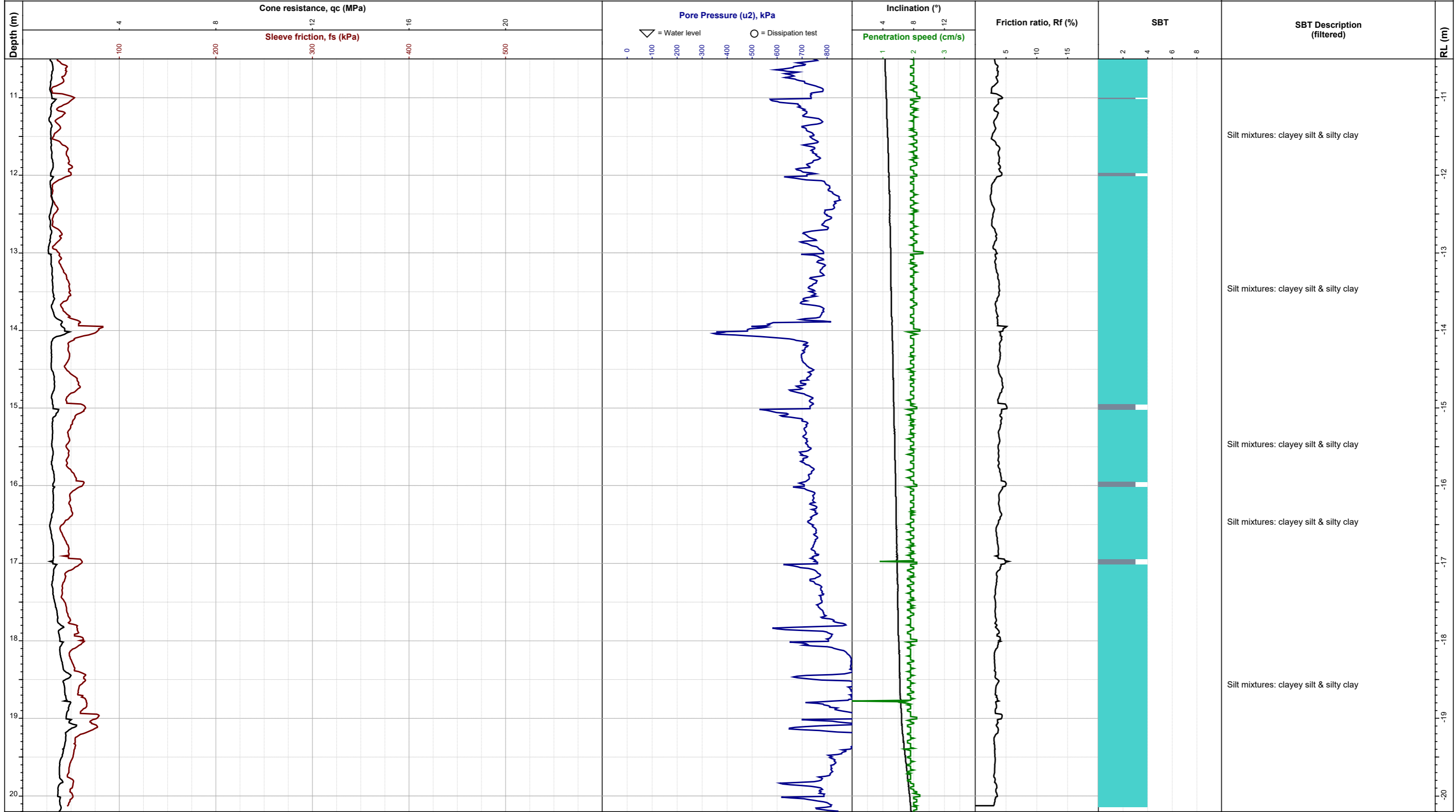
**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020





# Cone Penetration Test (CPTu) Log

Test ID: **CPT-11**



EOH: 20.2m

Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:24 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 2.22m

**Termination Reason:**  
 target depth

**Northing:** 5968161mN  
**Easting:** 1747147mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

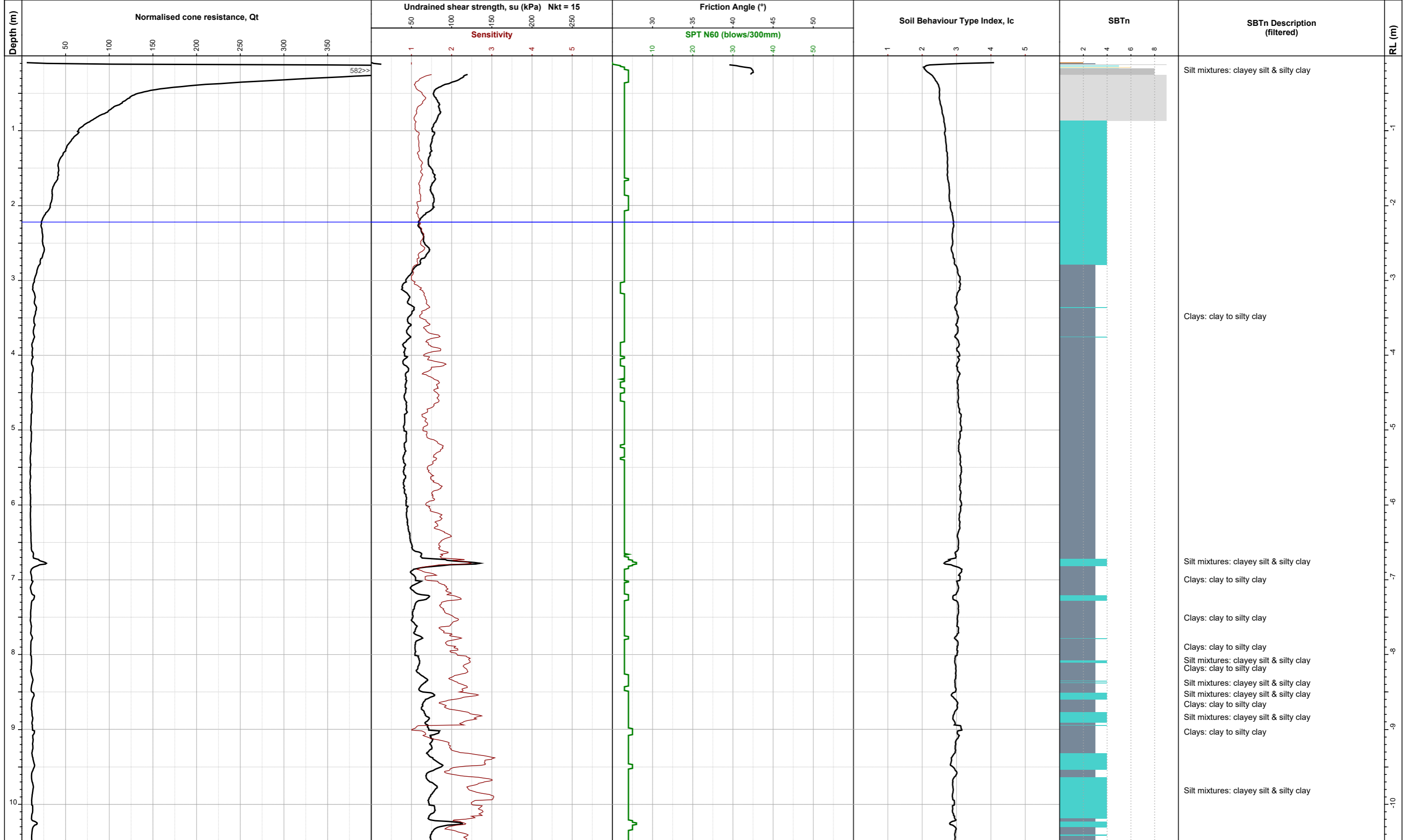
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-11**

**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-11**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:24 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 2.22m

**Termination Reason:**  
target depth

**Northing:** 5968161mN  
**Easting:** 1747147mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

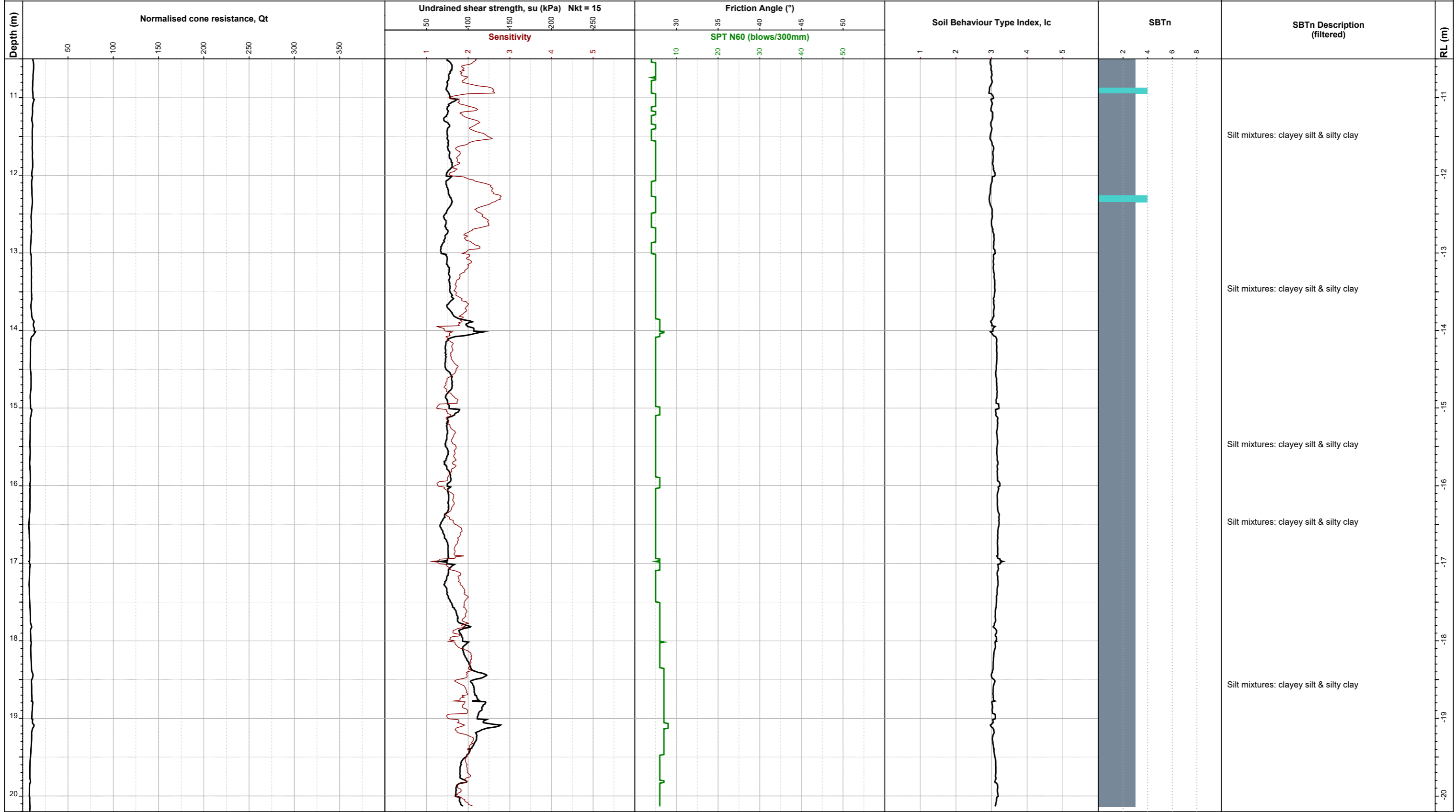
Soil Behaviour Type - Robertson 1986	
0	Undefined
1	Sensitive fine-grained
2	Clay - organic soil
3	Clays: clay to silty clay
4	Silt mixtures: clayey silt & silty clay
5	Sand mixtures: silty sand to sandy silt
6	Sands: clean sands to silty sands
7	Dense sand to gravelly sand
8	Stiff sand to clayey sand
9	Stiff fine-grained

**Test ID:** **CPT-11**

**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 1 of 2  
**Date:** 24/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-11**



EOH: 20.2m



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 2.22m  
**Termination Reason:** target depth

**Northing:** 5968161mN  
**Easting:** 1747147mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

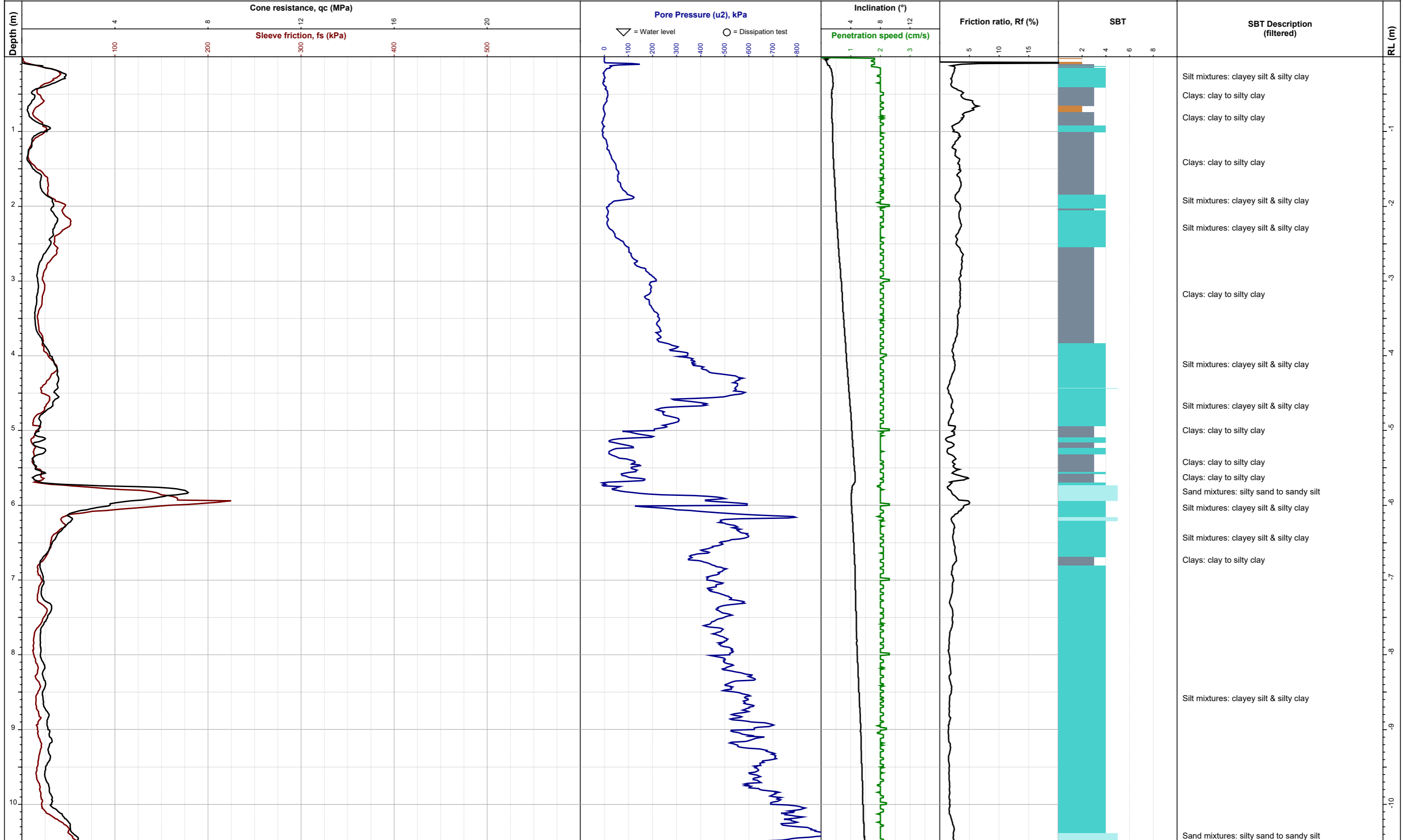
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-11**  
**Project ID:** 18707  
**Depth:** 20.2m  
**Sheet:** 2 of 2  
**Date:** 24/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-12**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:26 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.38m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968262mN  
**Easting:** 1747563mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

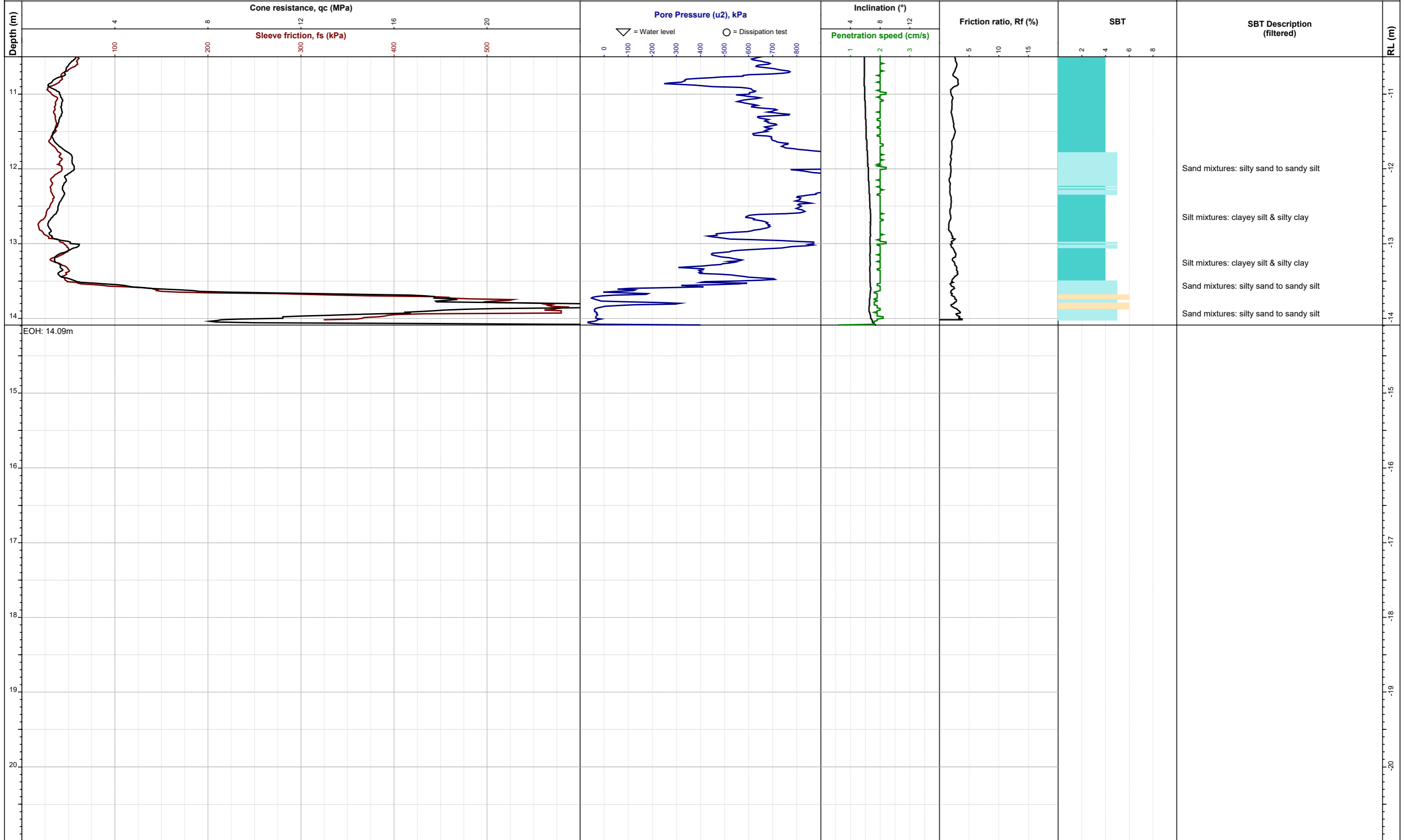
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-12**  
**Project ID:** 18707  
**Depth:** 14.09m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-12**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.38m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968262mN  
**Easting:** 1747563mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

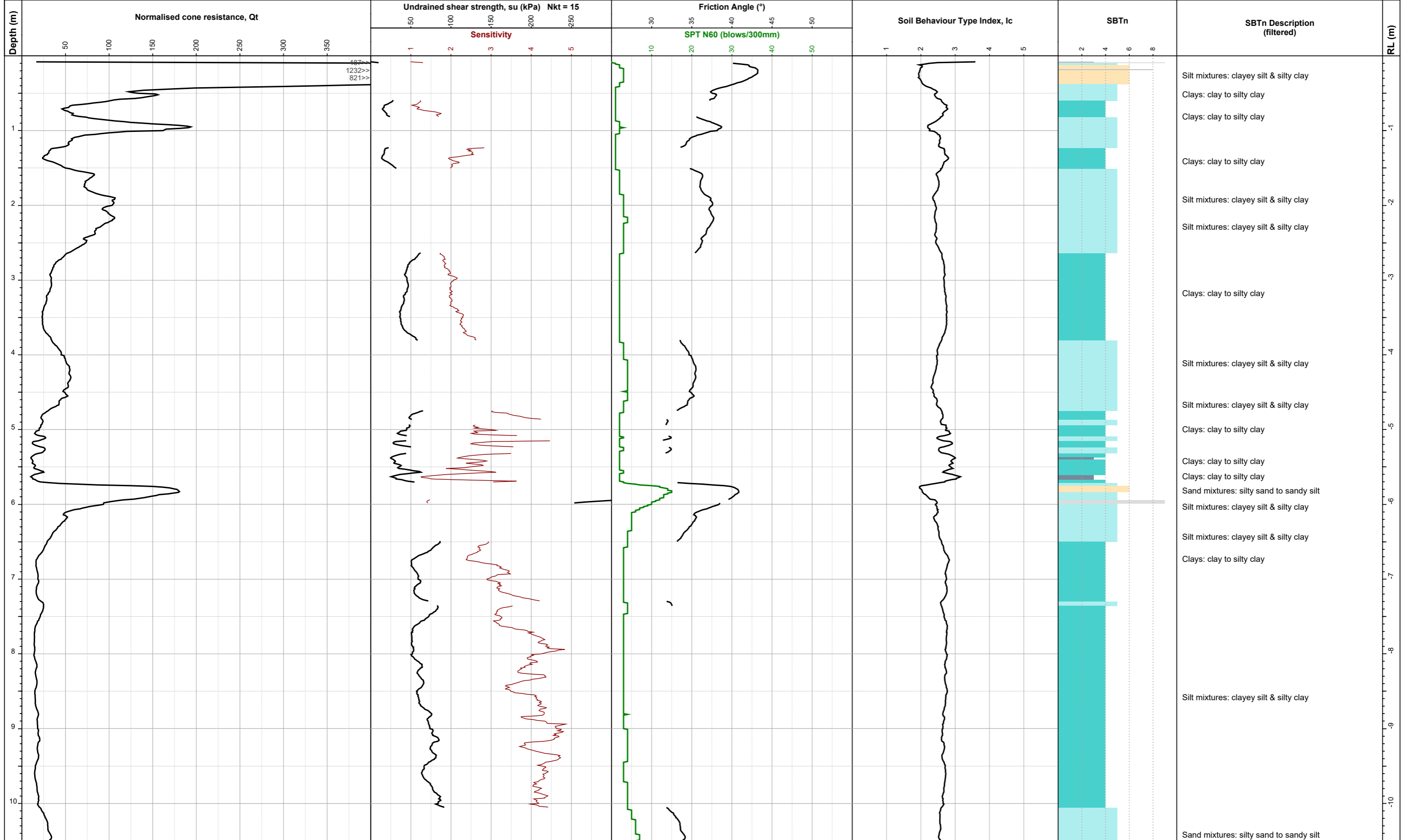
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-12**  
**Project ID:** 18707  
**Depth:** 14.09m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-12**



Generated with CORE-GS by Geoc - CPT Combined A3 v0 (new) - 27/06/2022 2:30:27 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.38m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968262mN  
**Eastings:** 1747563mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

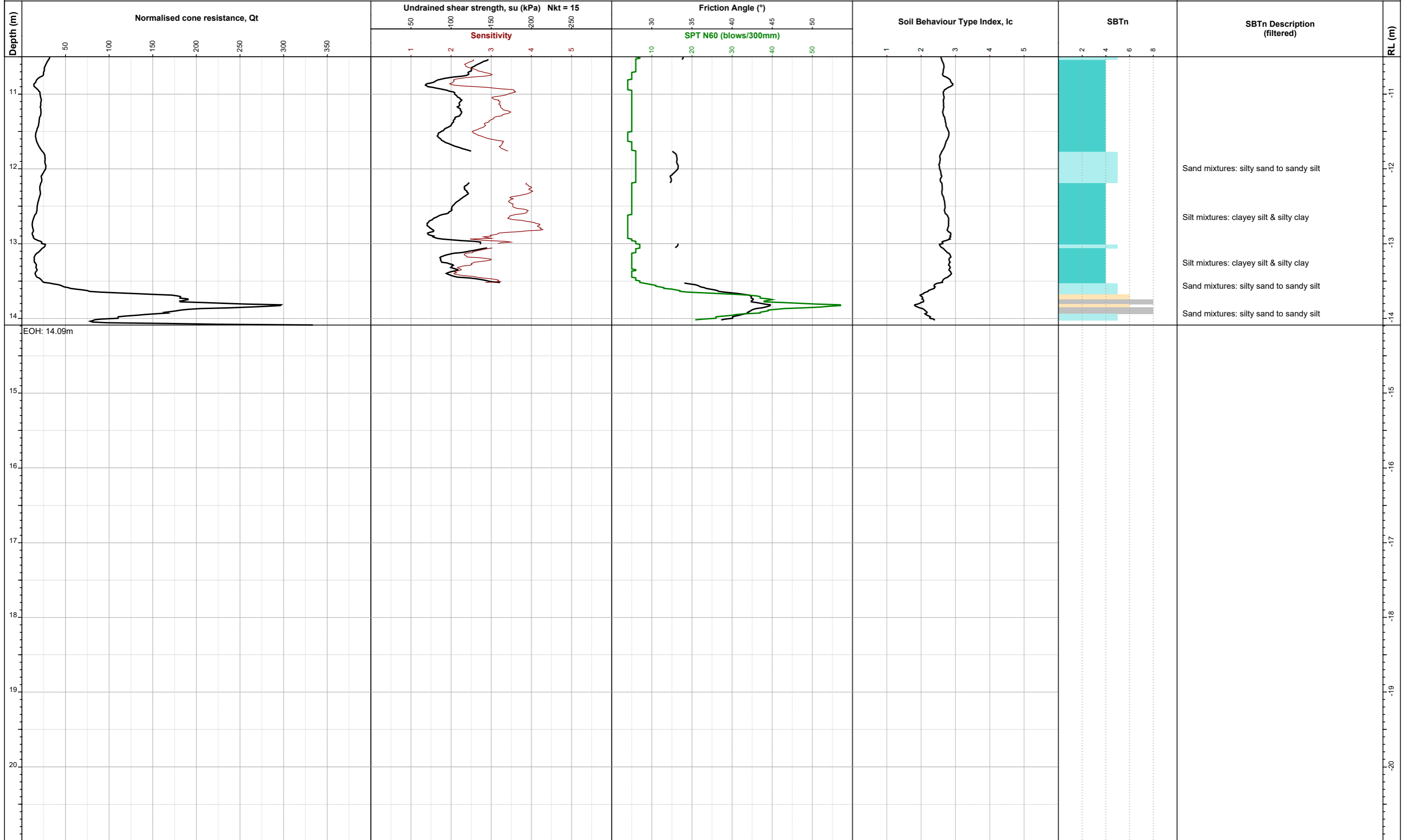
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-12**  
**Project ID:** 18707  
**Depth:** 14.09m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-12**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.38m prevented measurement of ground water  
**Termination Reason:**  
 limit of reaction force

**Northing:** 5968262mN  
**Easting:** 1747563mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

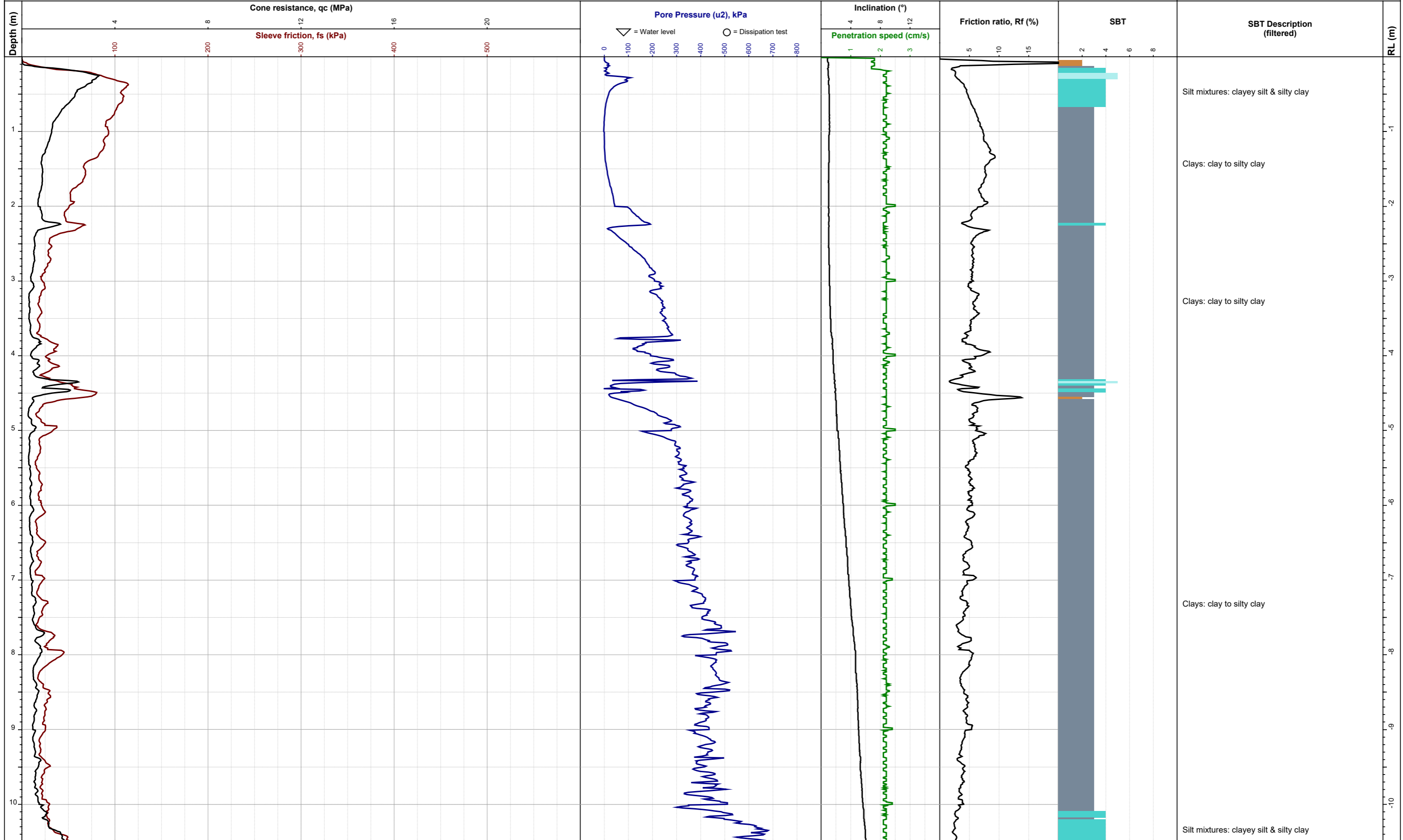
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-12**  
**Project ID:** 18707  
**Depth:** 14.09m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-13**



Generated with CORE-GS by Geoc - CPT Combined A3 v0 (new) - 27/06/2022 2:30:29 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 2.68m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5968069mN  
**Easting:** 1747705mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

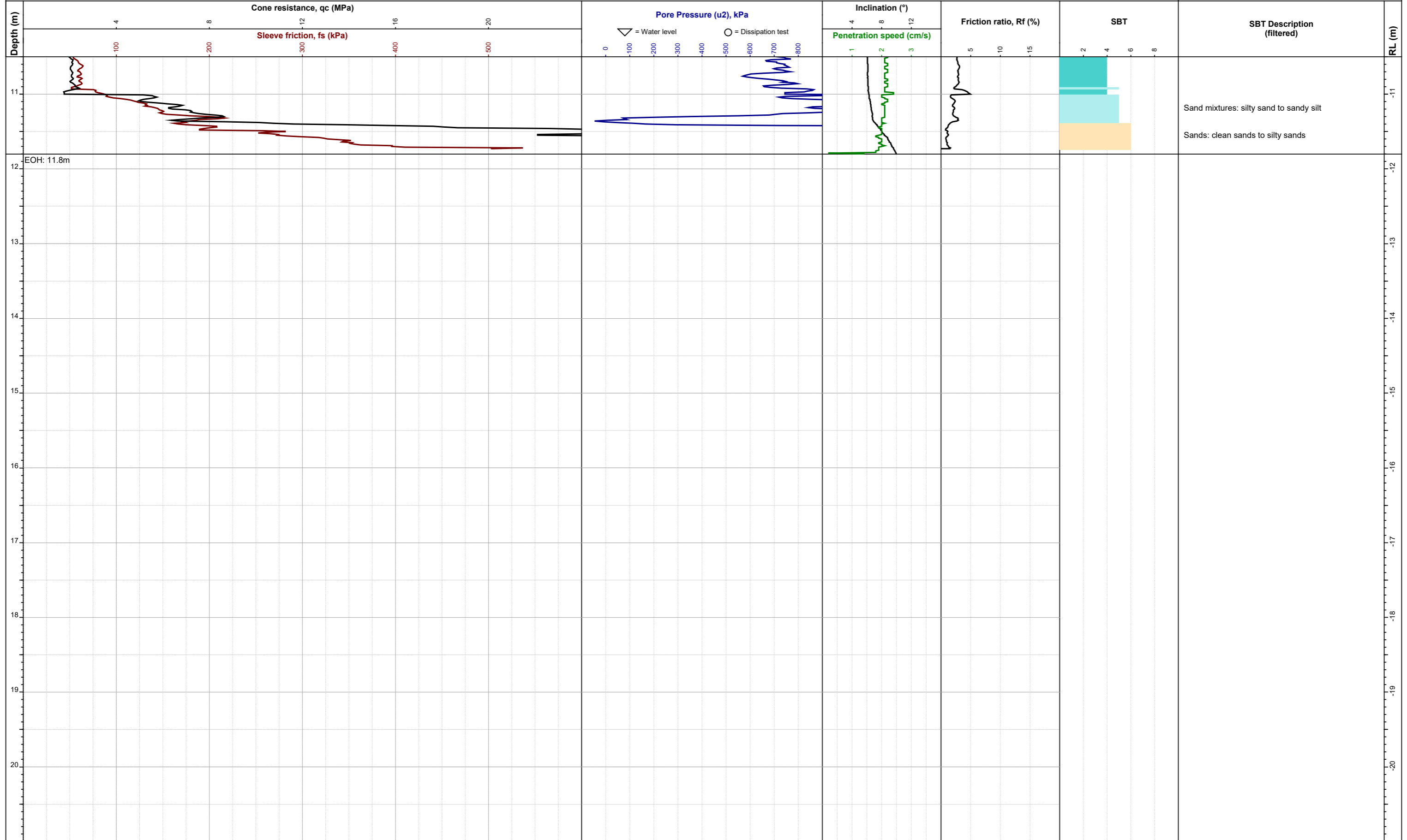
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-13**  
**Project ID:** 18707  
**Depth:** 11.8m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-13**



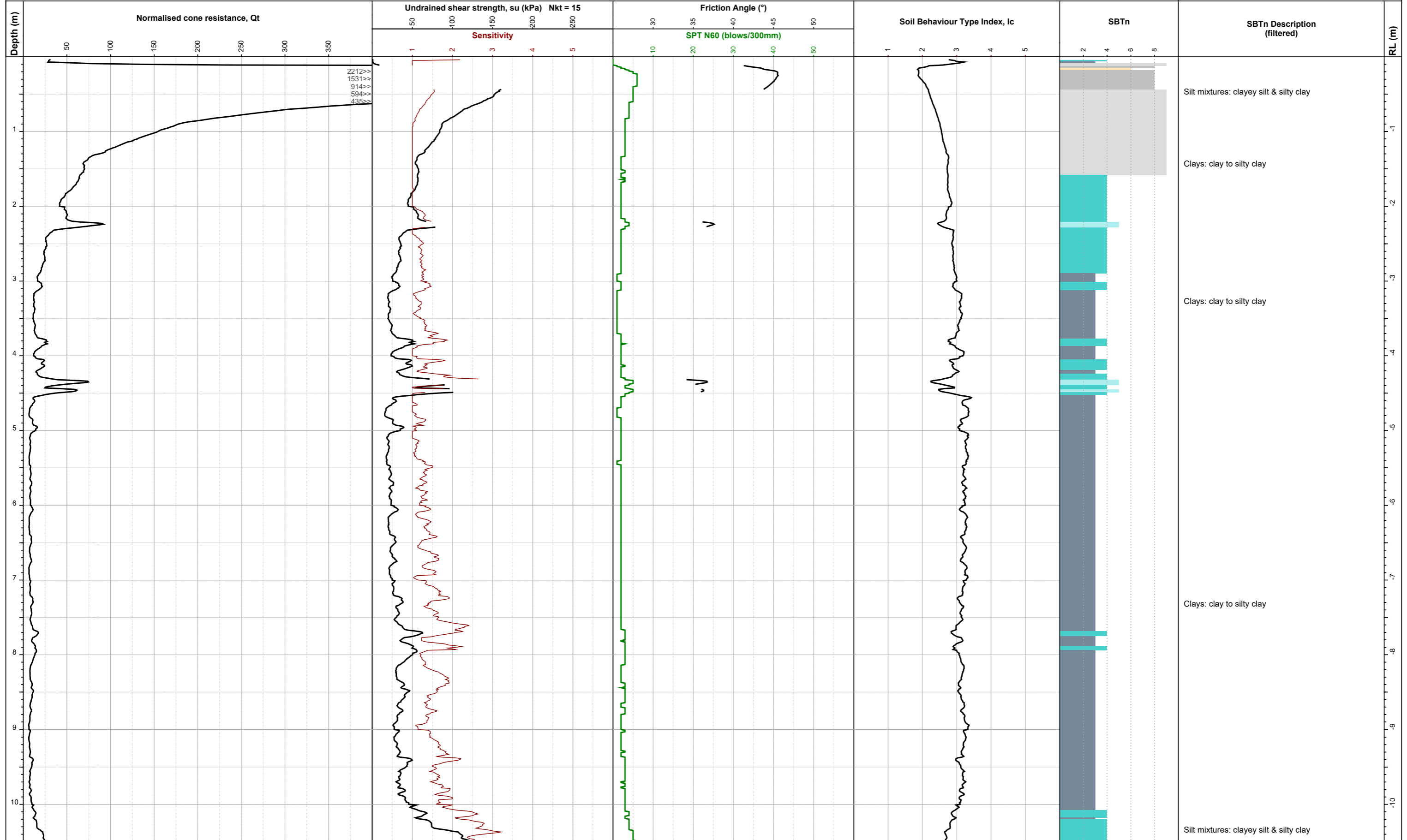
Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:29 pm

	<b>Client:</b> LDE Land Development & Engineering <b>Project:</b> Geotechnical Investigation <b>Location:</b> Warkworth South Plan Change	<b>Remarks:</b> Collapse of hole at 2.68m prevented measurement of ground water  <b>Termination Reason:</b> high cone resistance	<b>Northing:</b> 5968069mN <b>Easting:</b> 1747705mE <b>System:</b> NZTM <b>Elevation:</b> Ground <b>Located By:</b> Pagani GPS <b>Location:</b> GPS	<b>Operator:</b> JC <b>Rig:</b> TG63-150 Pagani <b>Cone ID:</b> MKj650 <b>Type:</b> PC <b>Cone Area:</b> 10 cm <sup>2</sup> <b>Sleeve Area:</b> 150 cm <sup>2</sup> <b>Area Ratio:</b> 0.7864	<b>Soil Behaviour Type - Robertson 1986</b> <table style="font-size: small;"> <tr> <td style="border: 1px solid black; padding: 2px;">0</td><td>Undefined</td> <td style="border: 1px solid black; padding: 2px;">5</td><td>Sand mixtures: silty sand to sandy silt</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">1</td><td>Sensitive fine-grained</td> <td style="border: 1px solid black; padding: 2px;">6</td><td>Sands: clean sands to silty sands</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">2</td><td>Clay - organic soil</td> <td style="border: 1px solid black; padding: 2px;">7</td><td>Dense sand to gravelly sand</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">3</td><td>Clays: clay to silty clay</td> <td style="border: 1px solid black; padding: 2px;">8</td><td>Stiff sand to clayey sand</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">4</td><td>Silt mixtures: clayey silt &amp; silty clay</td> <td style="border: 1px solid black; padding: 2px;">9</td><td>Stiff fine-grained</td> </tr> </table>	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	<b>Test ID:</b> <h2 style="text-align: center;">CPT-13</h2> <b>Project ID:</b> 18707 <b>Depth:</b> 11.8m <b>Sheet:</b> 2 of 2 <b>Date:</b> 26/11/2020
	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																							



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-13**



2212>>  
1531>>  
914>>  
594>>  
435>>

v

v



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Collapse of hole at 2.68m prevented measurement of ground water  
**Termination Reason:** high cone resistance

**Northing:** 5968069mN  
**Easting:** 1747705mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

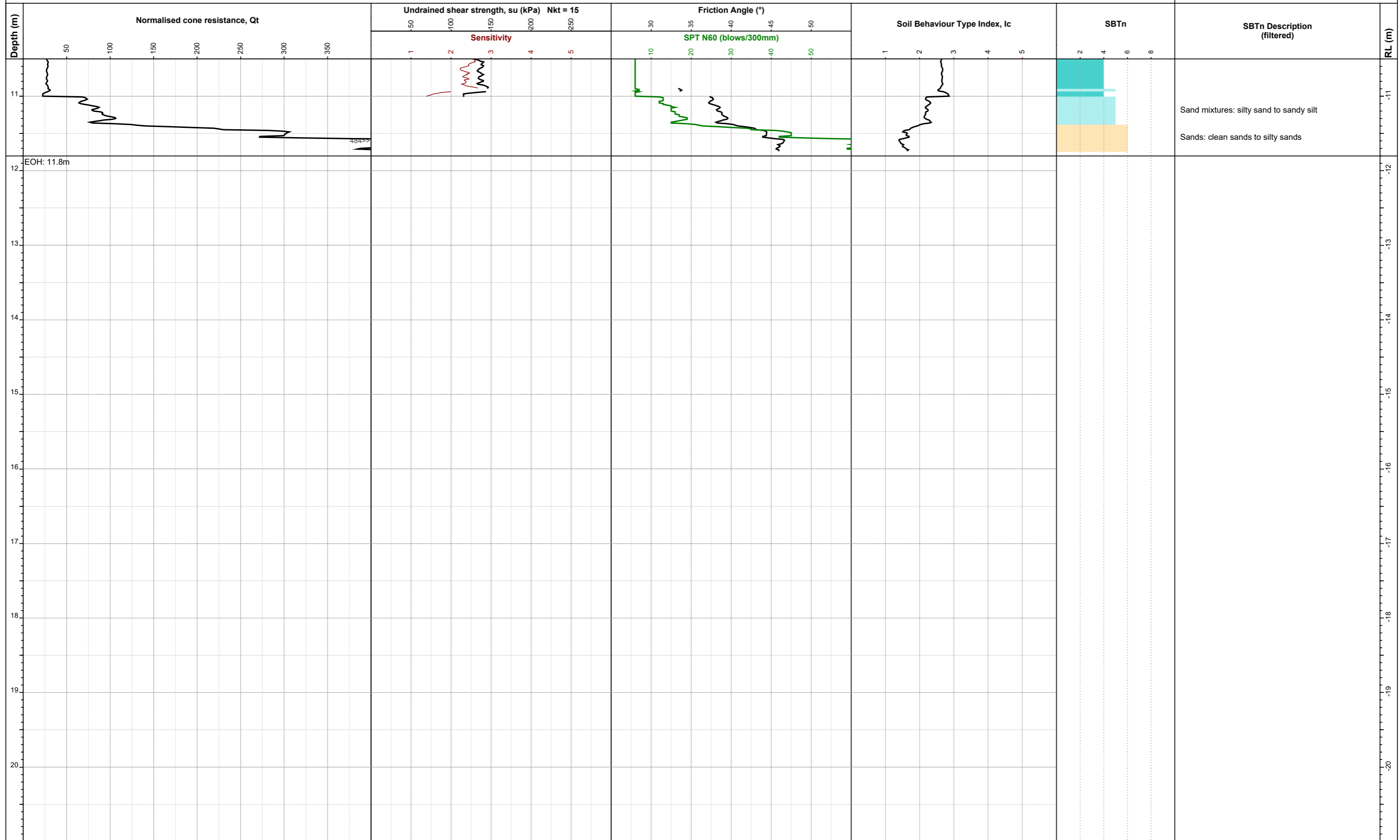
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-13**  
**Project ID:** 18707  
**Depth:** 11.8m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-13**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:30 pm

**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Collapse of hole at 2.68m prevented measurement of ground water

**Termination Reason:**  
high cone resistance

**Northing:** 5968069mN  
**Easting:** 1747705mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

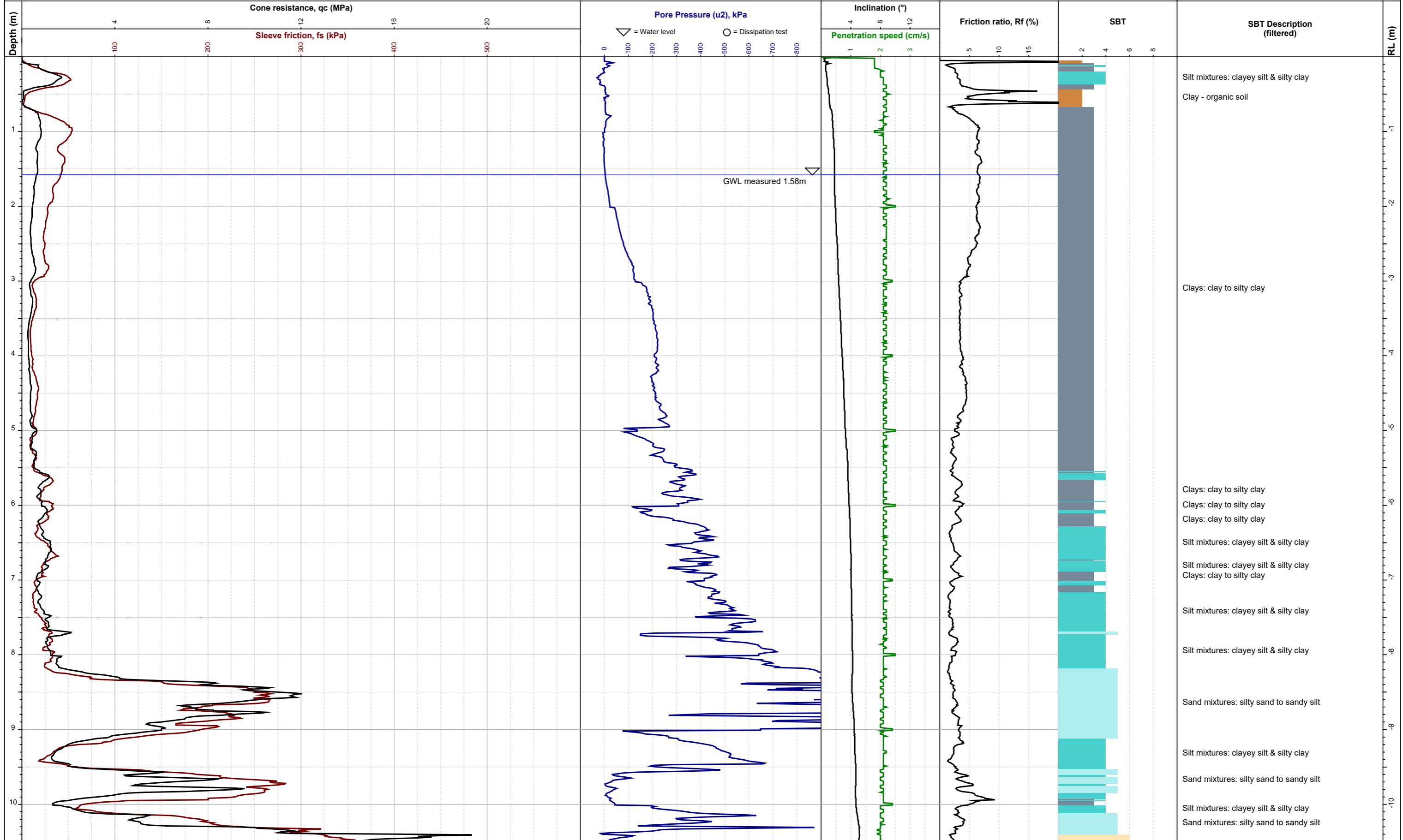
0 Undefined	5 Sand mixtures: silty sand to sandy silt
1 Sensitive fine-grained	6 Sands: clean sands to silty sands
2 Clay - organic soil	7 Dense sand to gravelly sand
3 Clays: clay to silty clay	8 Stiff sand to clayey sand
4 Silt mixtures: clayey silt & silty clay	9 Stiff fine-grained

**Test ID:** **CPT-13**

**Project ID:** 18707  
**Depth:** 11.8m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Log

Test ID: **CPT-14**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 1.58m  
**Termination Reason:** high cone resistance

**Northing:** 5968125mN  
**Easting:** 1747827mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

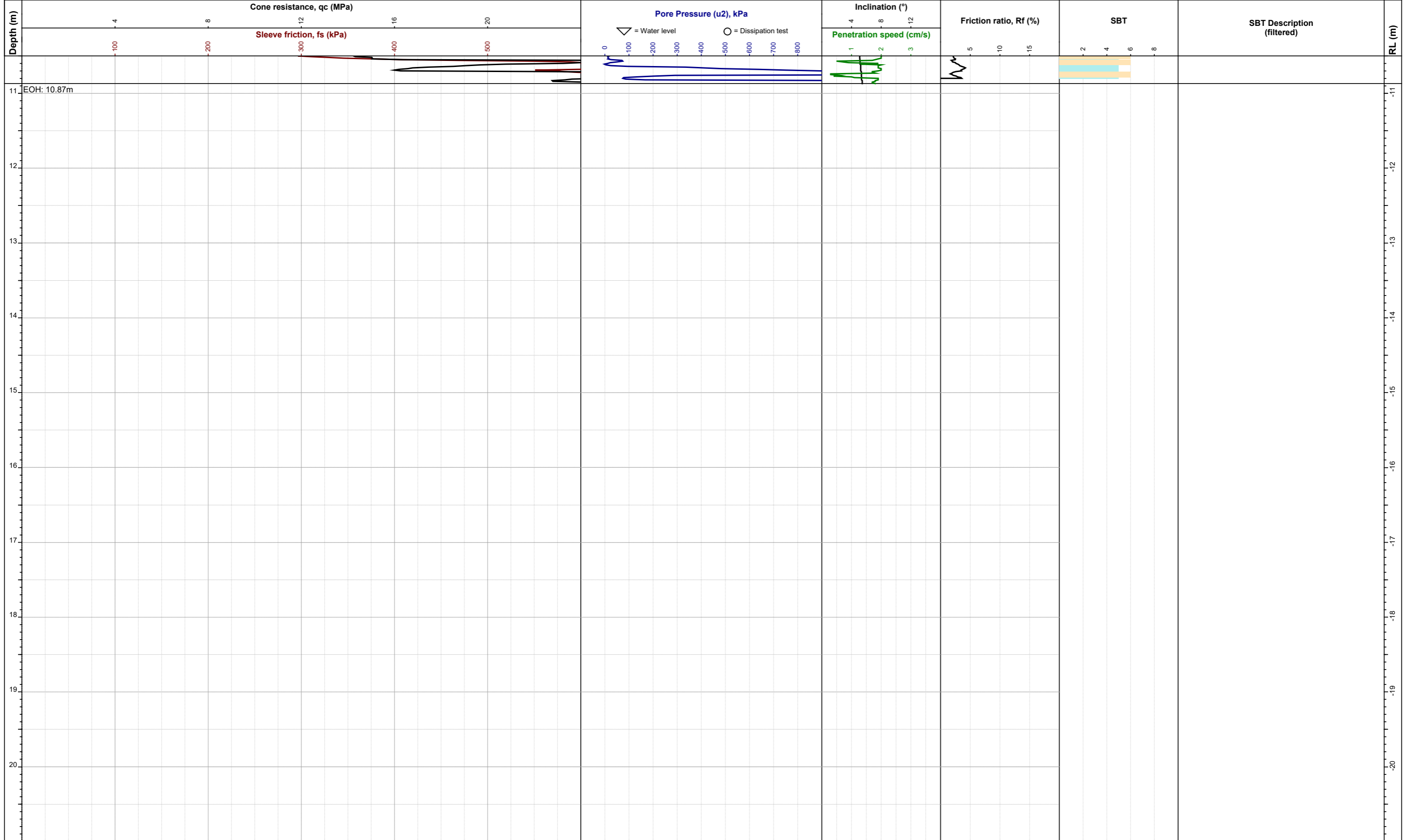
**Test ID:** **CPT-14**  
**Project ID:** 18707  
**Depth:** 10.87m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020





# Cone Penetration Test (CPTu) Log

Test ID: **CPT-14**



**Client:** LDE Land Development & Engineering

**Project:** Geotechnical Investigation

**Location:** Warkworth South Plan Change

**Remarks:**  
Ground water located at 1.58m

**Termination Reason:**  
high cone resistance

**Northing:** 5968125mN  
**Easting:** 1747827mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

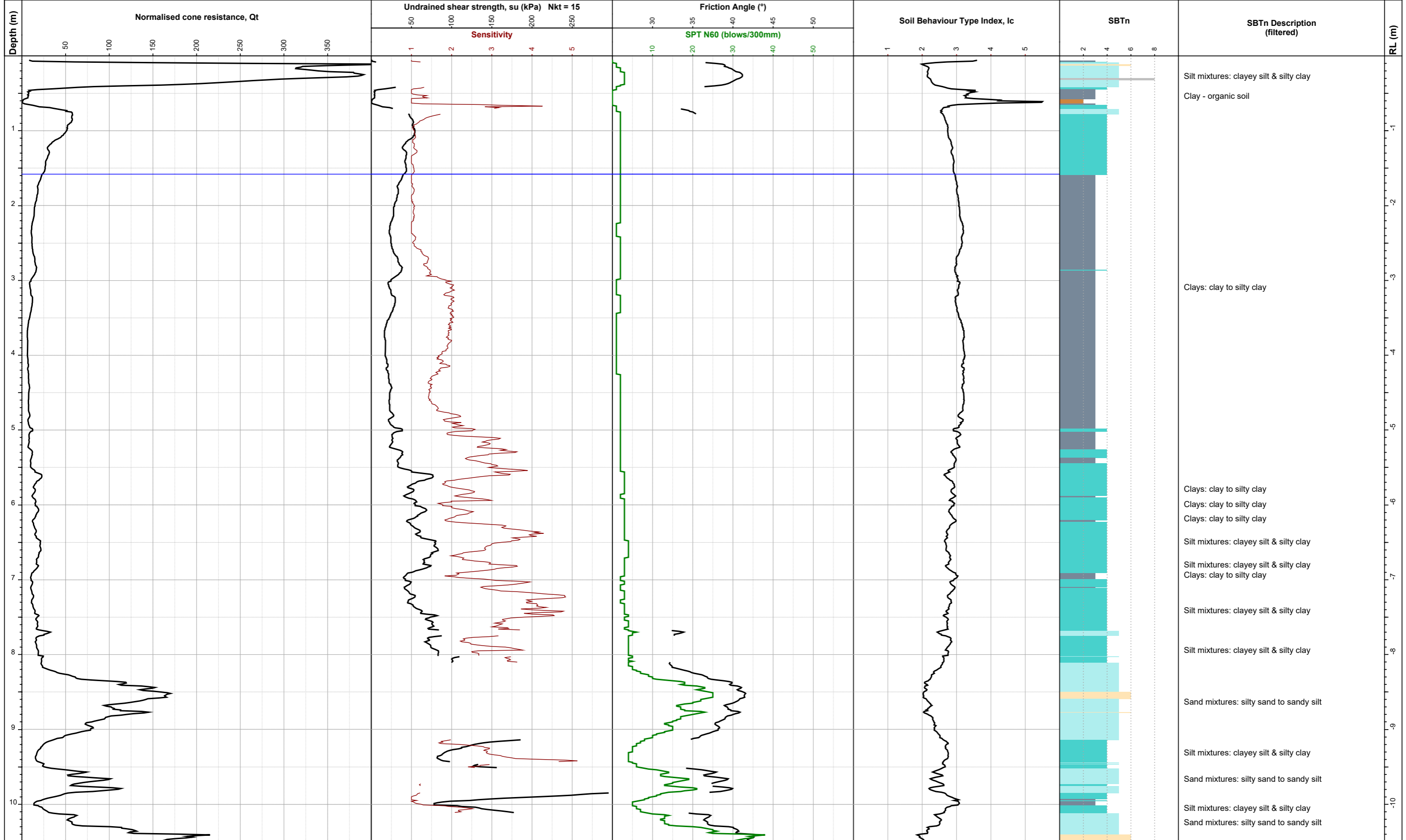
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-14**  
**Project ID:** 18707  
**Depth:** 10.87m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-14**



Silt mixtures: clayey silt & silty clay  
 Clay - organic soil

Clays: clay to silty clay

Clays: clay to silty clay  
 Clays: clay to silty clay  
 Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay  
 Silt mixtures: clayey silt & silty clay  
 Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay  
 Sand mixtures: silty sand to sandy silt

**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Ground water located at 1.58m

**Termination Reason:**  
 high cone resistance

**Northing:** 5968125mN  
**Easting:** 1747827mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

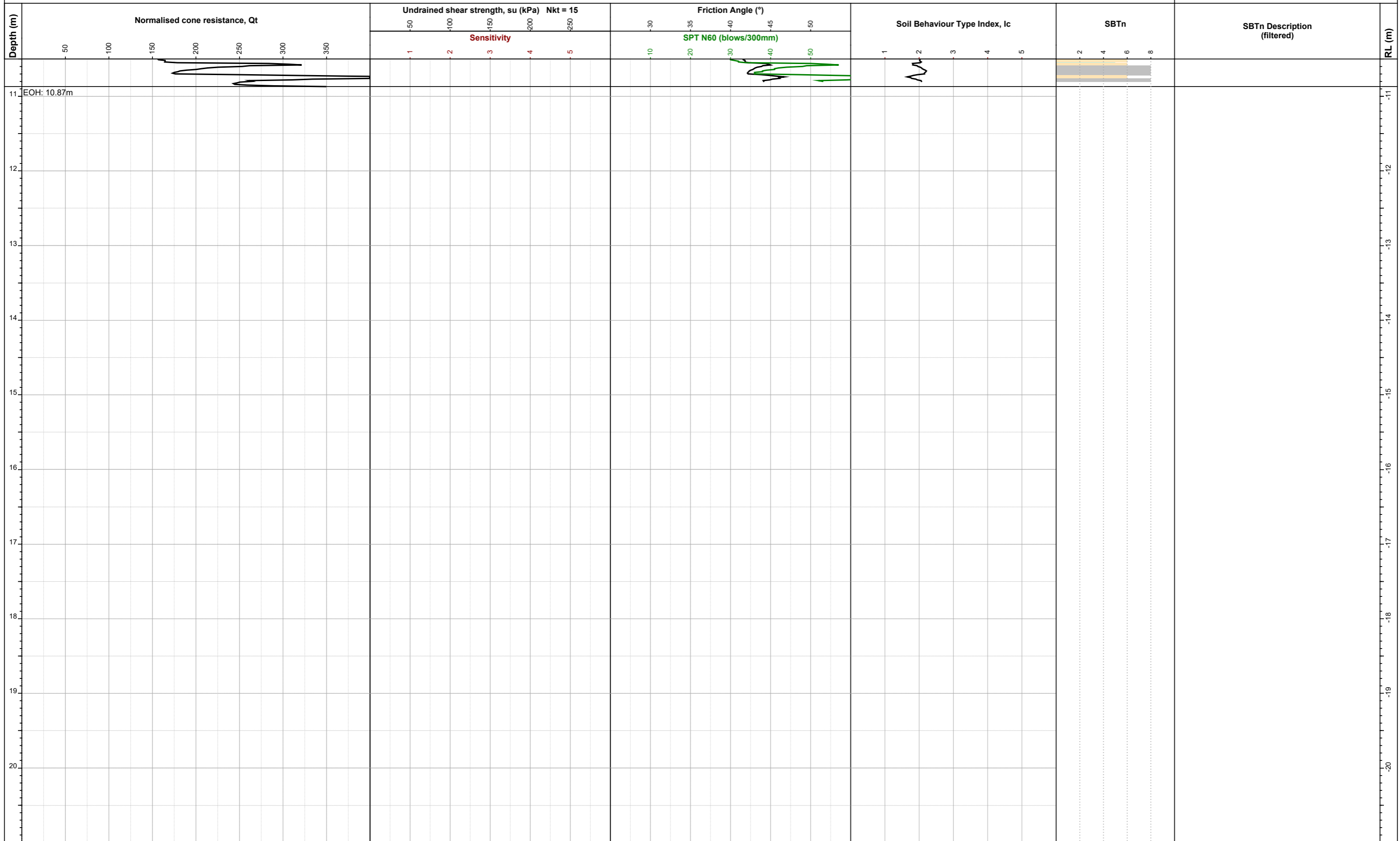
**Test ID:** **CPT-14**

**Project ID:** 18707  
**Depth:** 10.87m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-14**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:** Ground water located at 1.58m  
**Termination Reason:** high cone resistance

**Northing:** 5968125mN  
**Easting:** 1747827mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

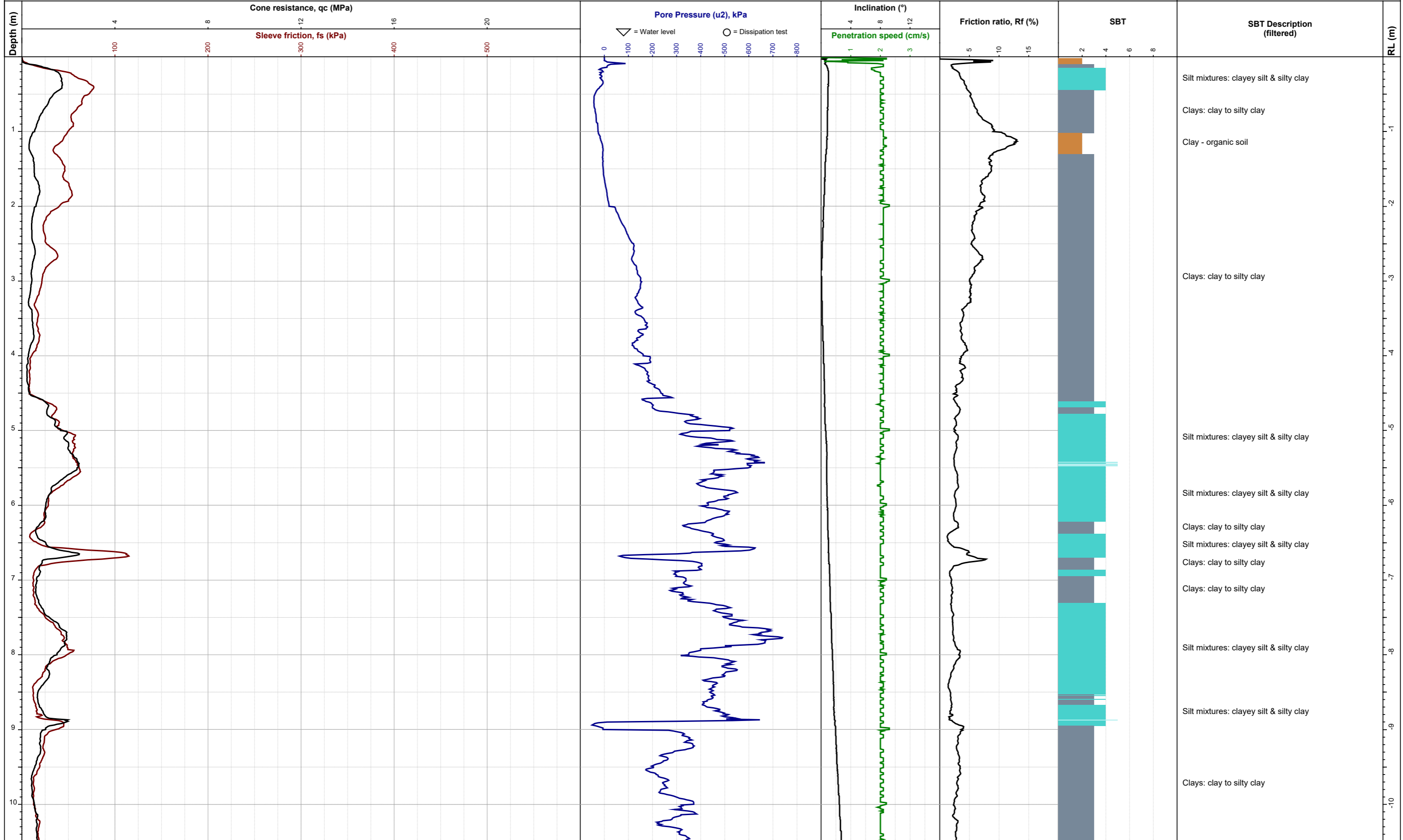
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-14**  
**Project ID:** 18707  
**Depth:** 10.87m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-15**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.73m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5968657mN  
**Easting:** 1747129mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

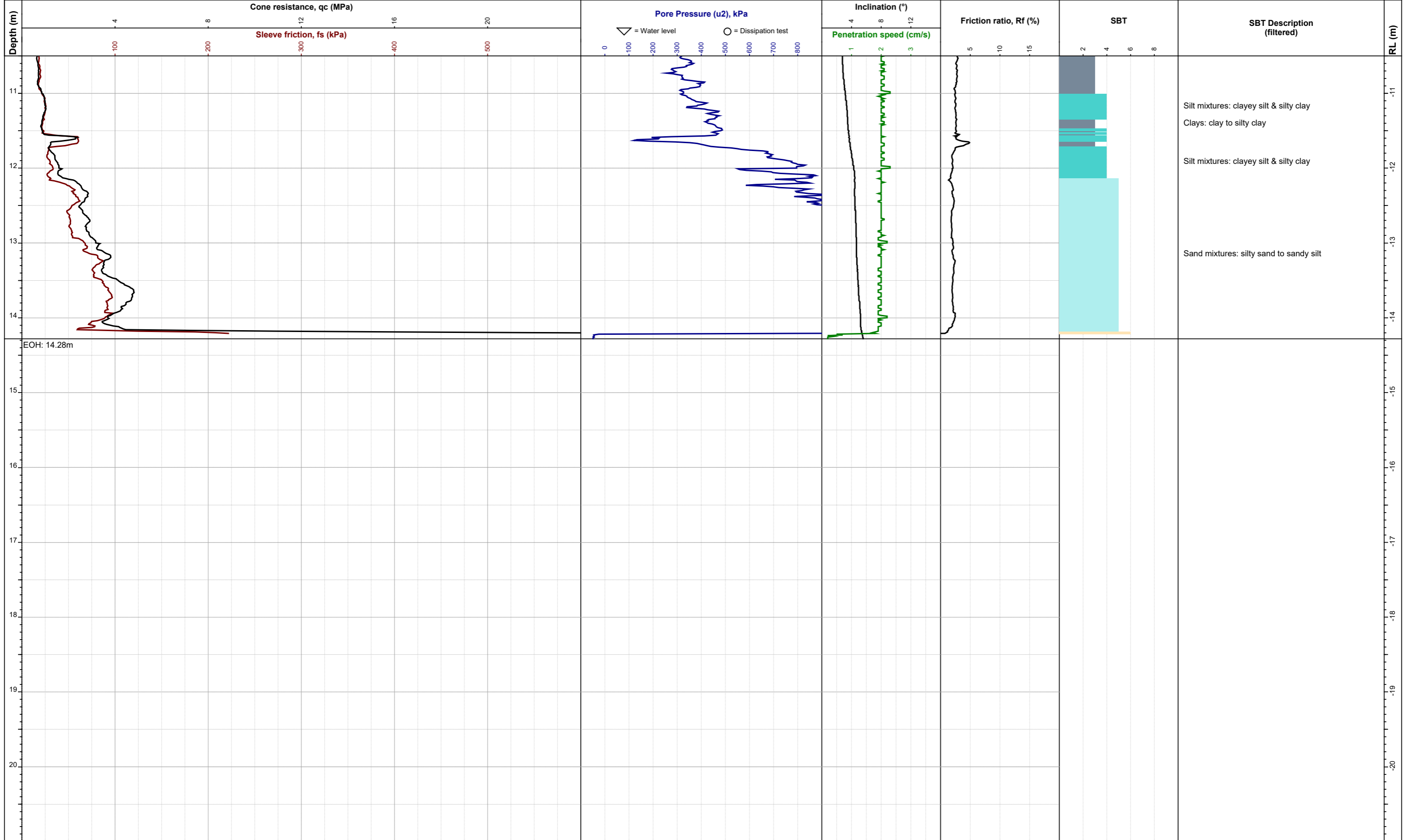
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-15**  
**Project ID:** 18707  
**Depth:** 14.28m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Log

Test ID: **CPT-15**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.73m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5968657mN  
**Easting:** 1747129mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

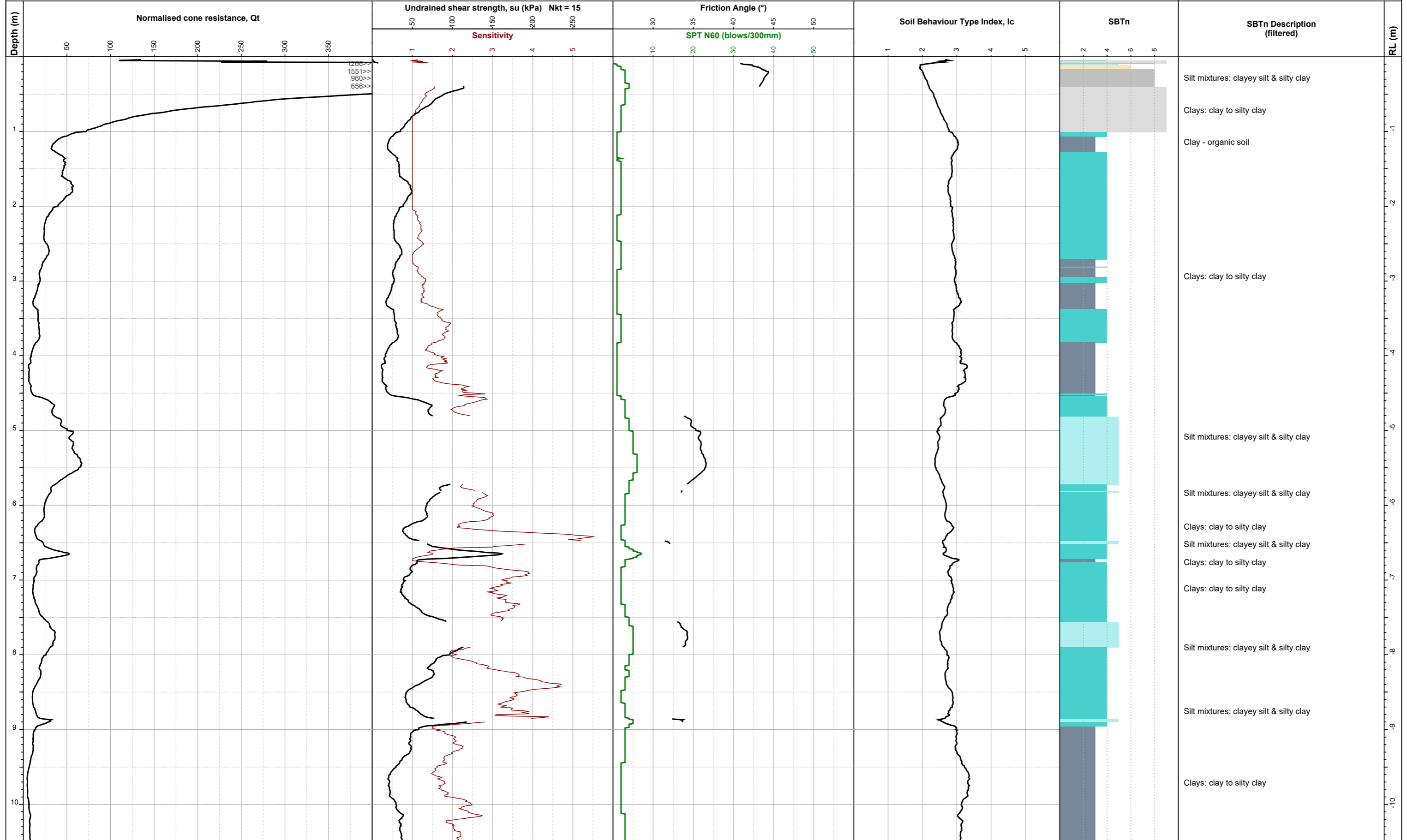
**Soil Behaviour Type - Robertson 1986**

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

**Test ID:** **CPT-15**  
**Project ID:** 18707  
**Depth:** 14.28m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020

# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-15**



Generated with CORE-GS by Geococ - CPT Combined A3 v0 (new) - 27/06/2022 2:30:34 pm



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.73m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5968657mN  
**Easting:** 1747129mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

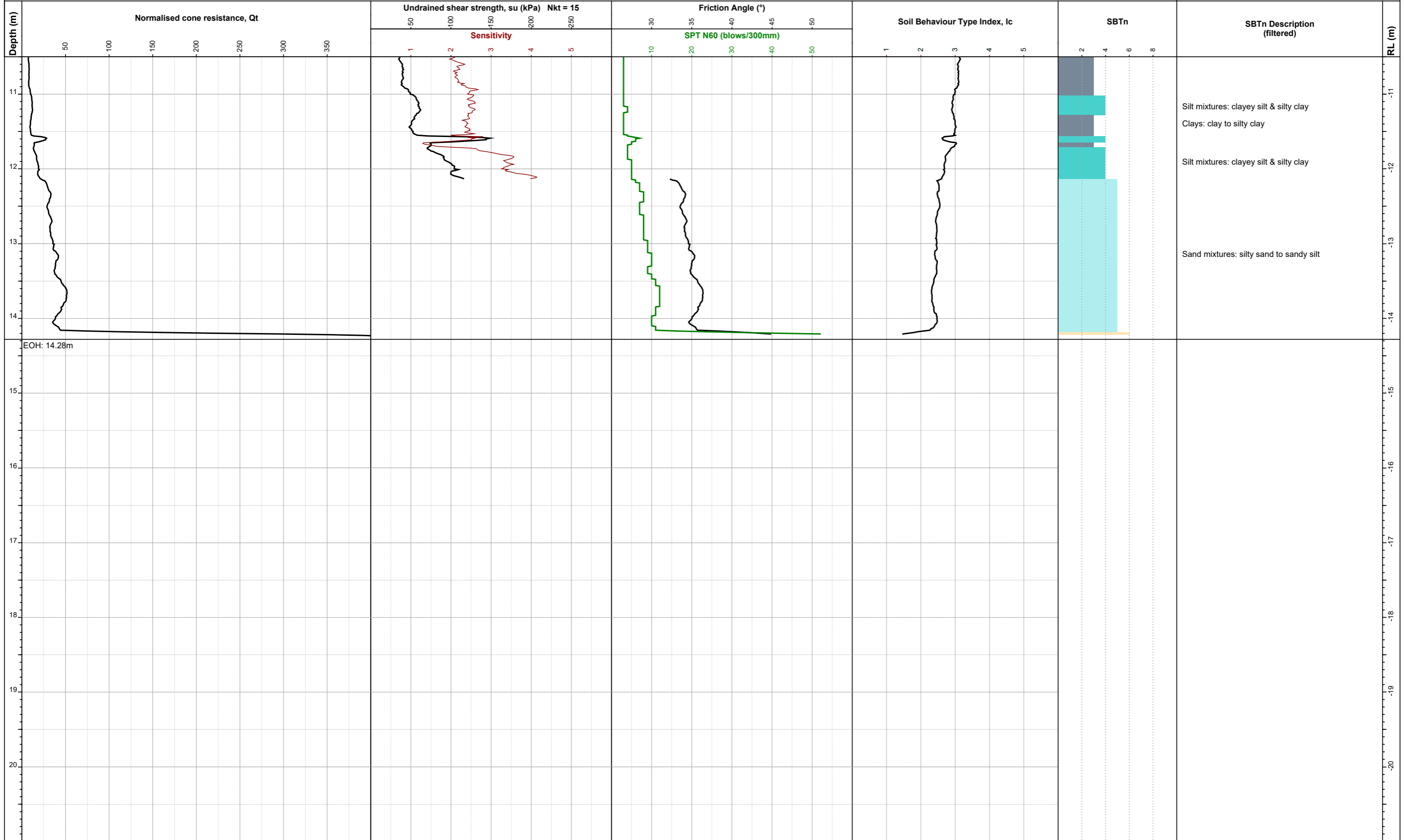
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

**Test ID:** **CPT-15**  
**Project ID:** 18707  
**Depth:** 14.28m  
**Sheet:** 1 of 2  
**Date:** 26/11/2020



# Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-15**



**Client:** LDE Land Development & Engineering  
**Project:** Geotechnical Investigation  
**Location:** Warkworth South Plan Change

**Remarks:**  
 Collapse of hole at 1.73m prevented measurement of ground water  
**Termination Reason:**  
 high cone resistance

**Northing:** 5968657mN  
**Easting:** 1747129mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Pagani GPS  
**Location:** GPS

**Operator:** JC  
**Rig:** TG63-150 Pagani  
**Cone ID:** MKj650  
**Type:** PC  
**Cone Area:** 10 cm<sup>2</sup>  
**Sleeve Area:** 150 cm<sup>2</sup>  
**Area Ratio:** 0.7864

**Soil Behaviour Type - Robertson 1986**

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

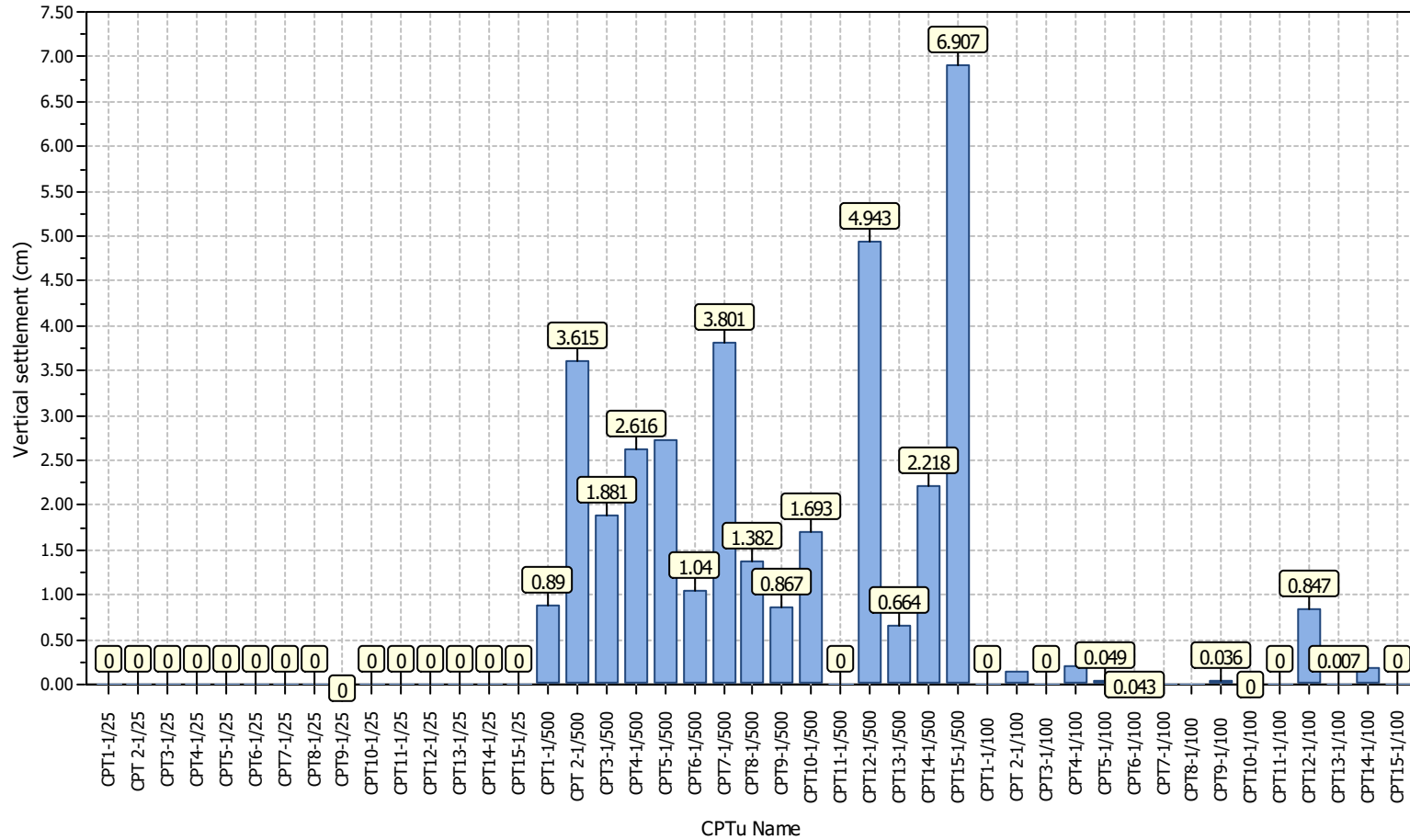
**Test ID:** **CPT-15**  
**Project ID:** 18707  
**Depth:** 14.28m  
**Sheet:** 2 of 2  
**Date:** 26/11/2020

## APPENDIX D LIQUEFACTION ANALYSIS

**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

**Overall vertical settlements report**

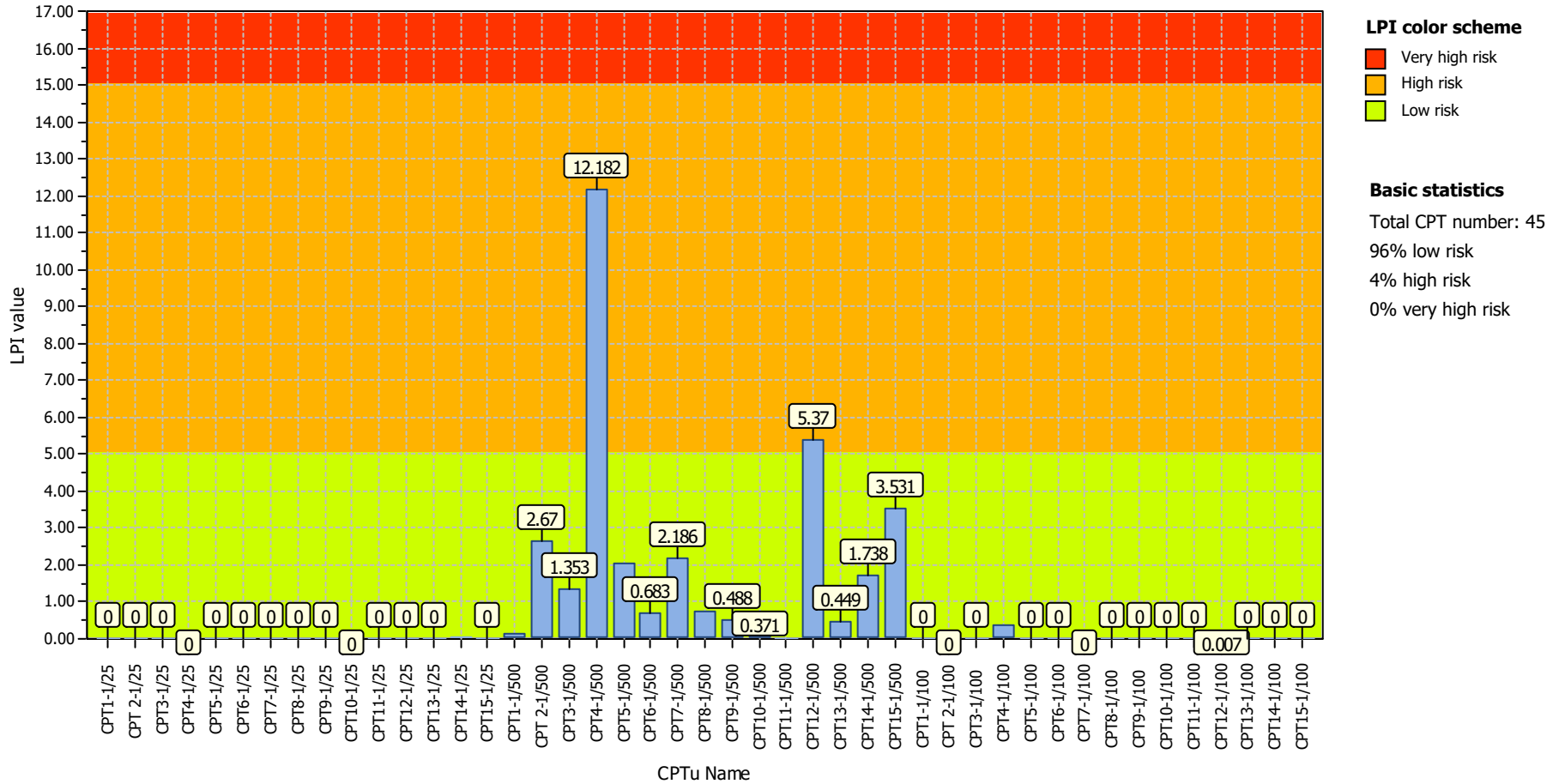




**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

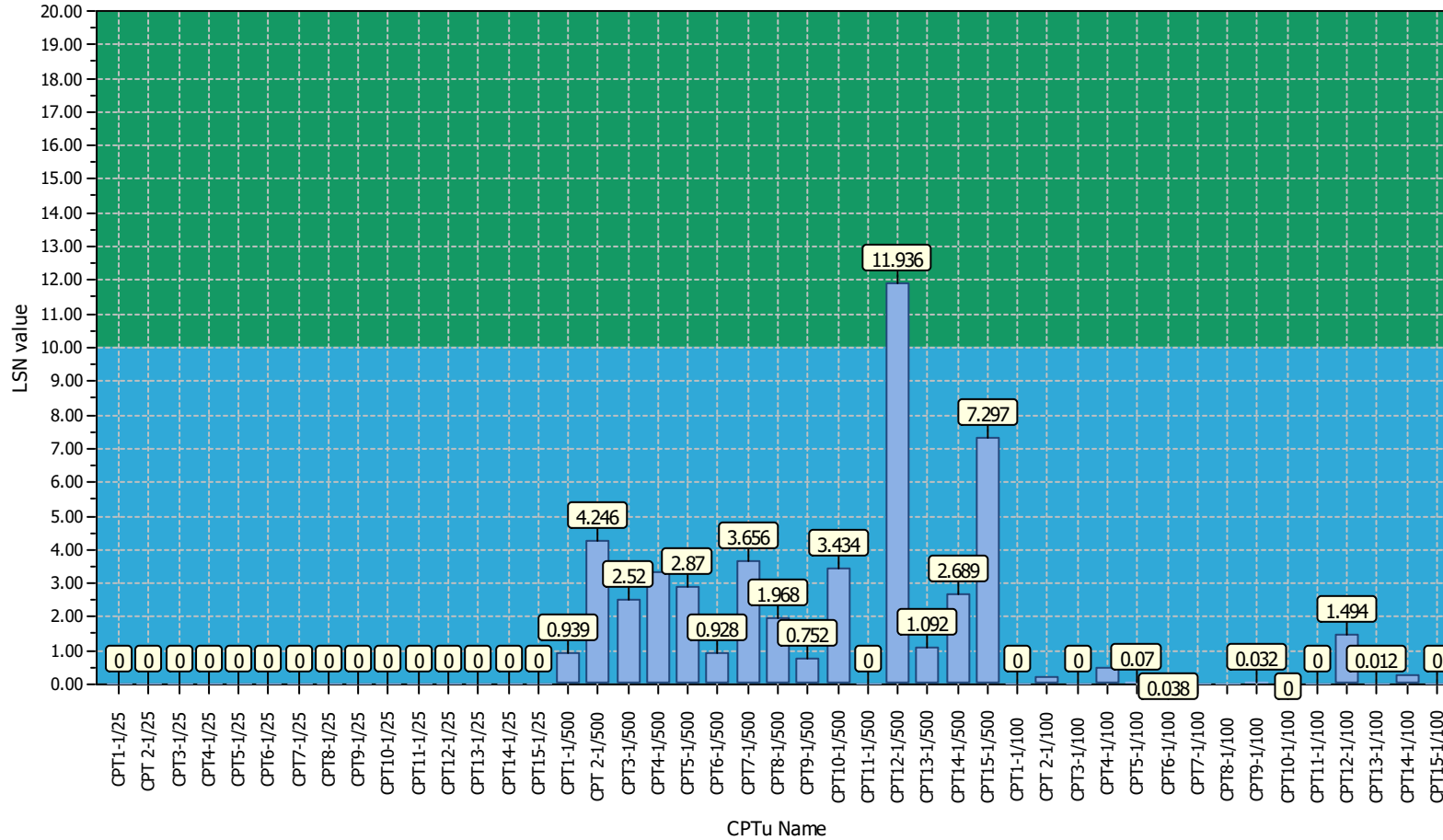
**Overall Liquefaction Potential Index report**



**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

### 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

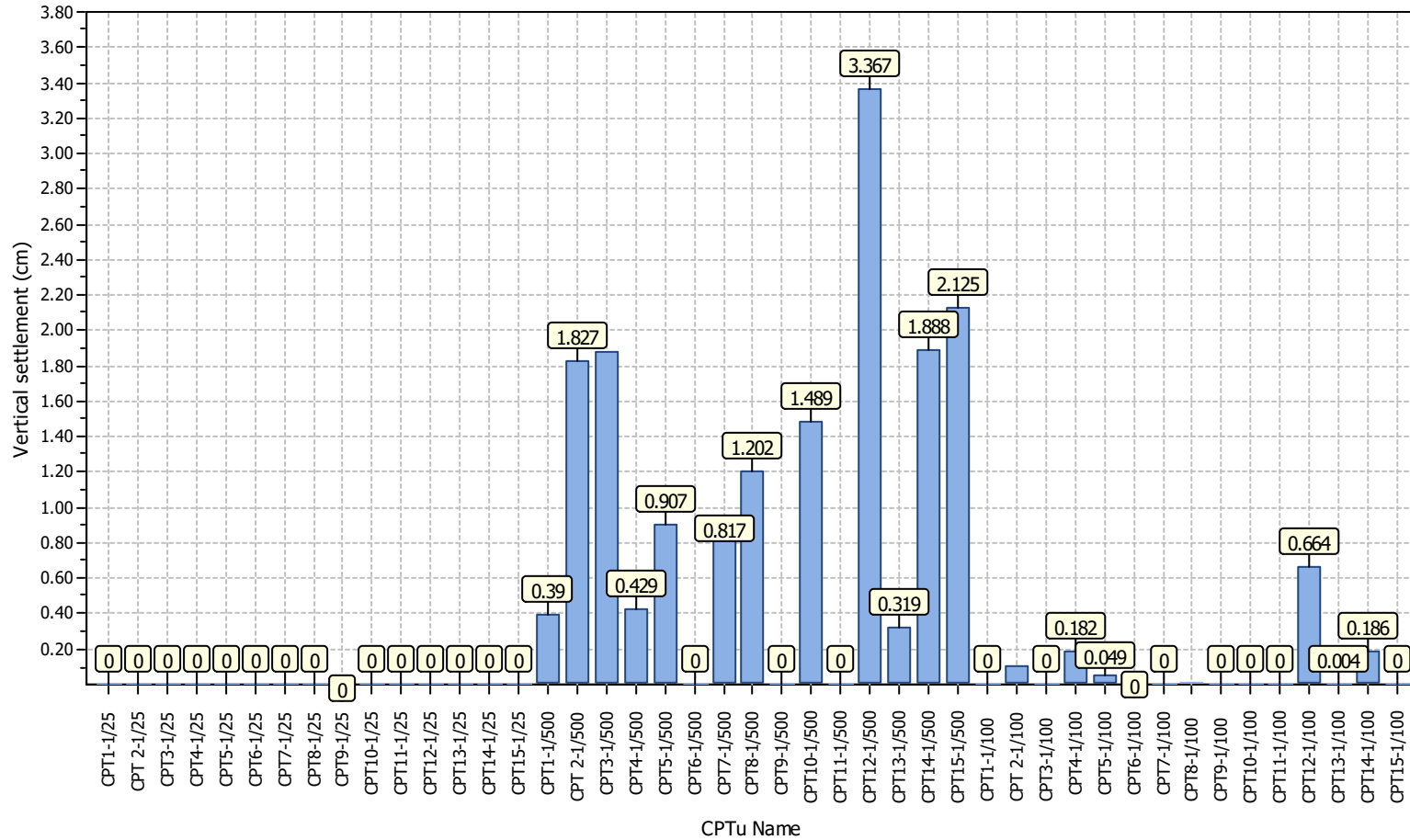
**Basic statistics**

- Total CPT number: 45
- 98% little liquefaction
- 2% minor liquefaction
- 0% moderate liquefaction
- 0% moderate to major liquefaction
- 0% major liquefaction
- 0% severe liquefaction

Project title : Warkworth South Plan Change -Indexed 10m

Location : 48 Valerie Close, Warkworth

### Overall vertical settlements report





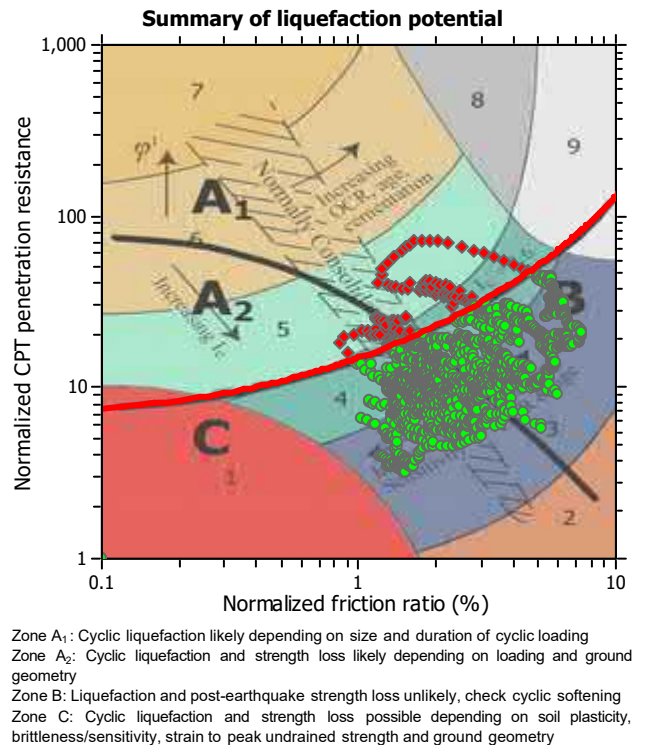
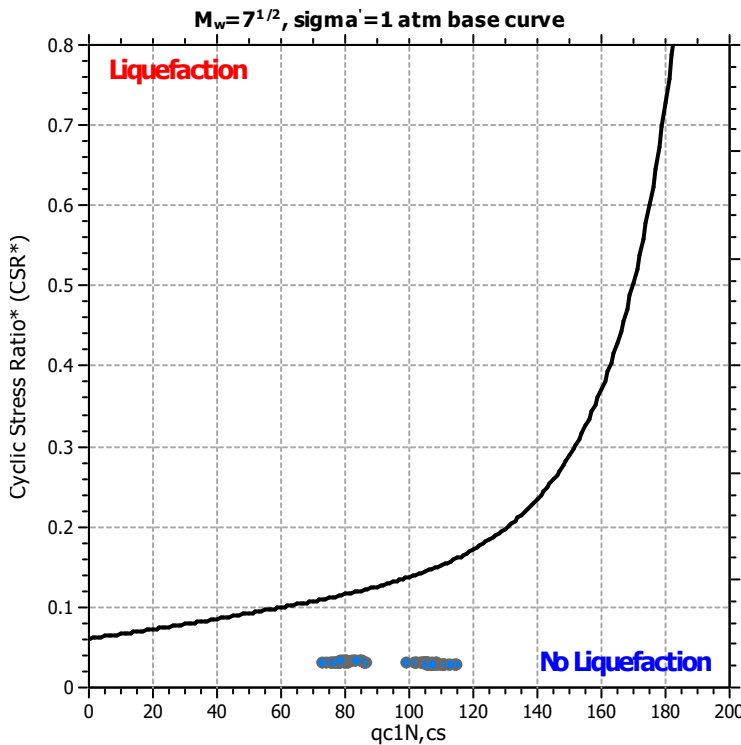
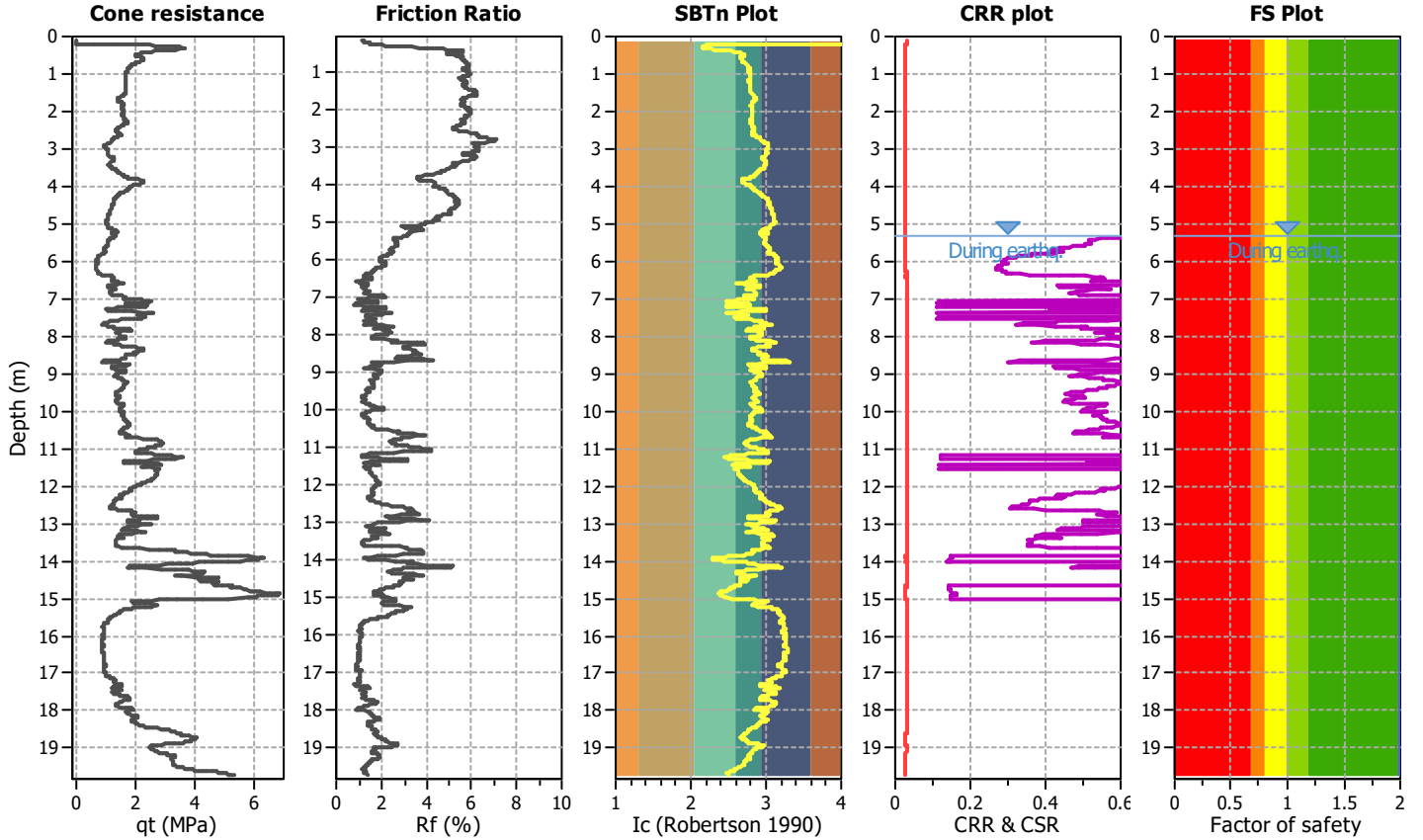
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT1-1/25**

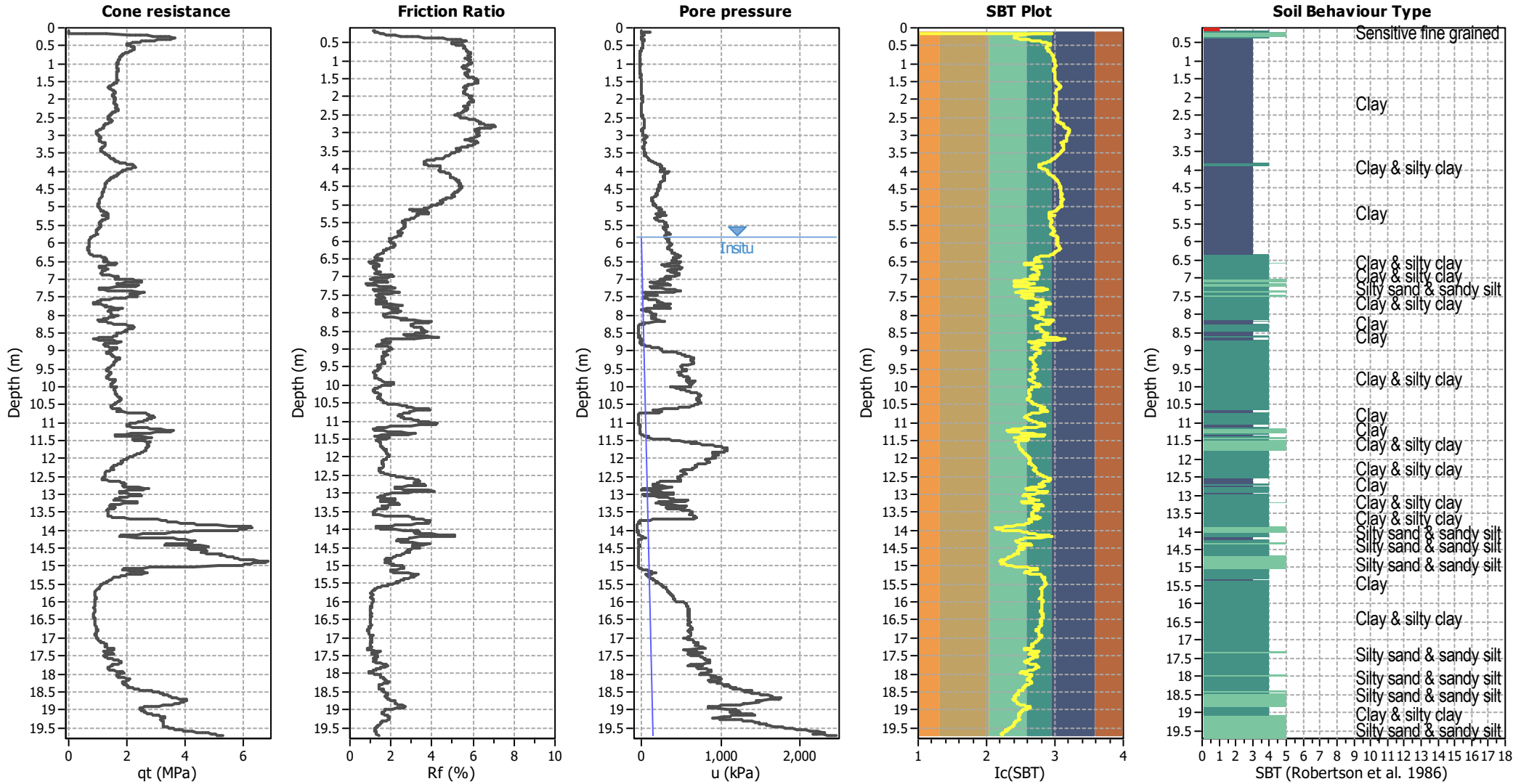
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.83 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.33 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:	15.00 m
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



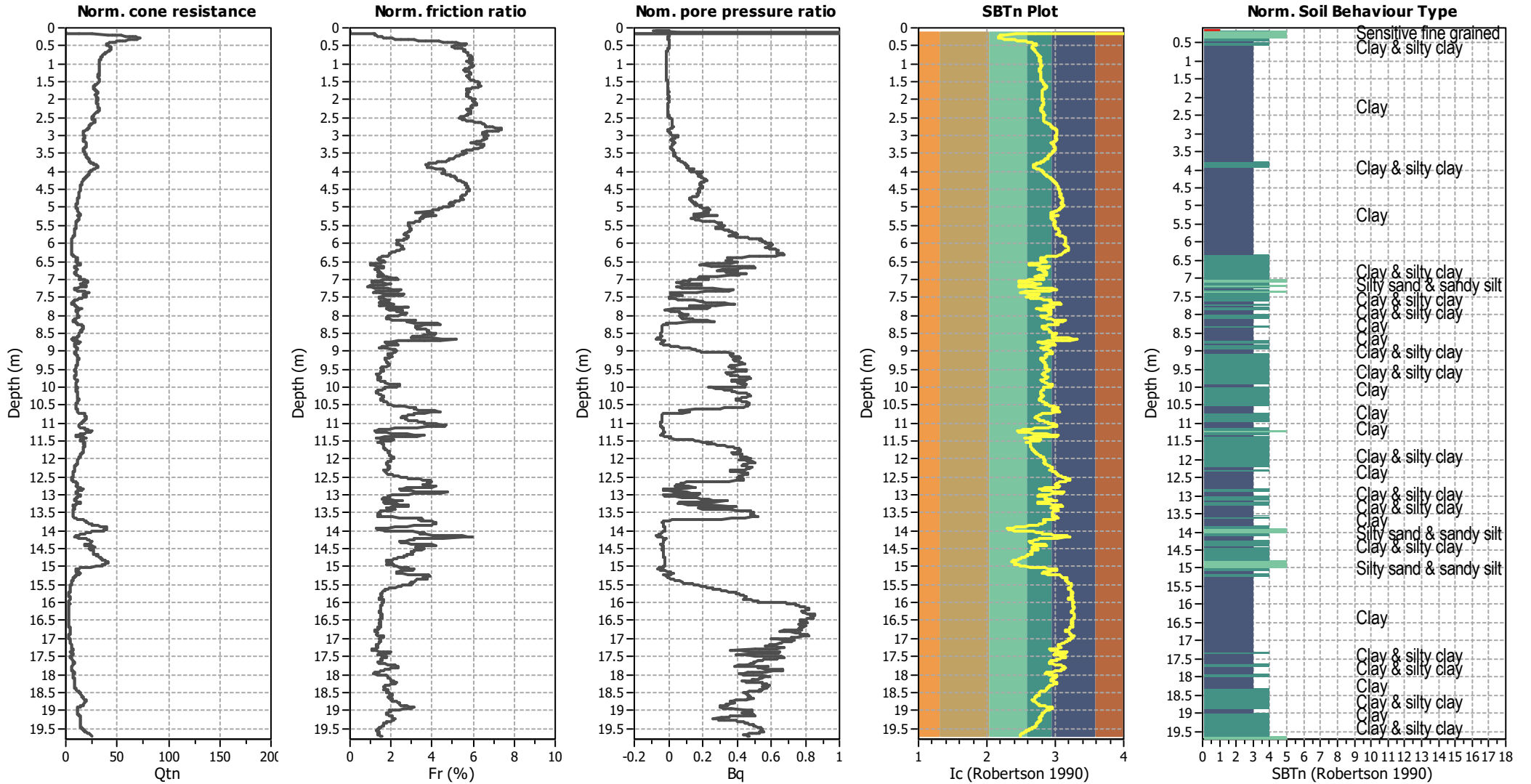
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



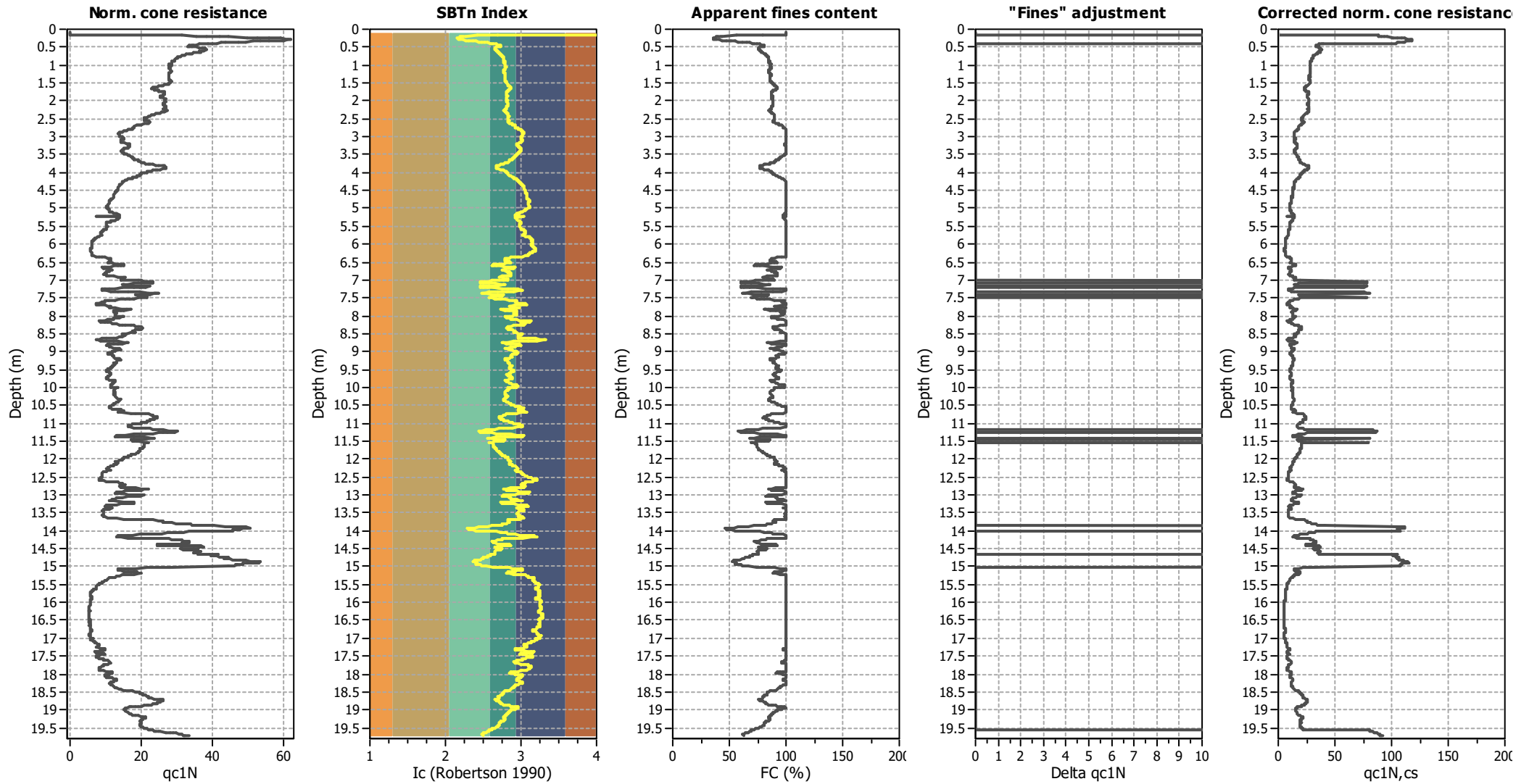
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

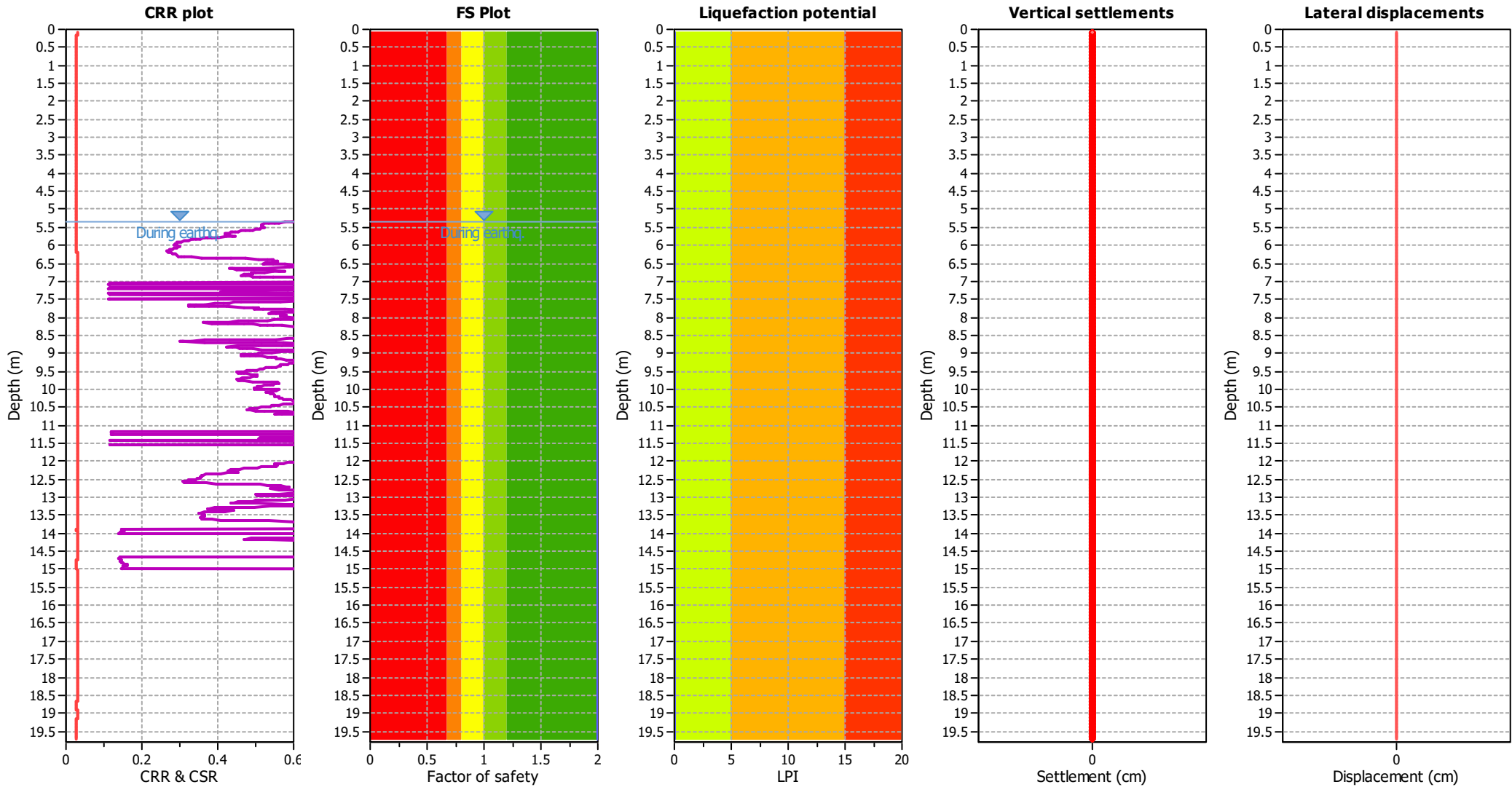


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

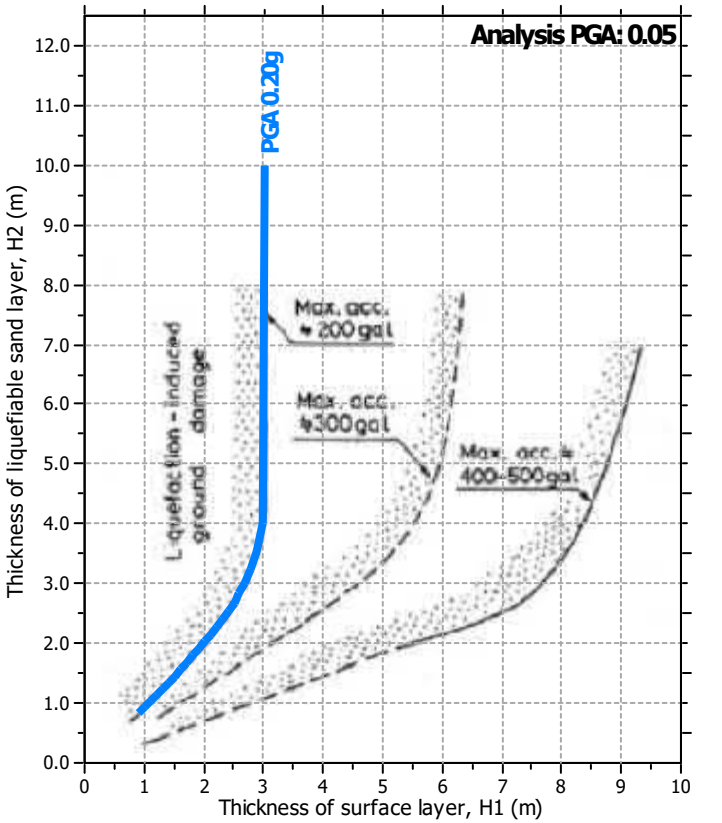
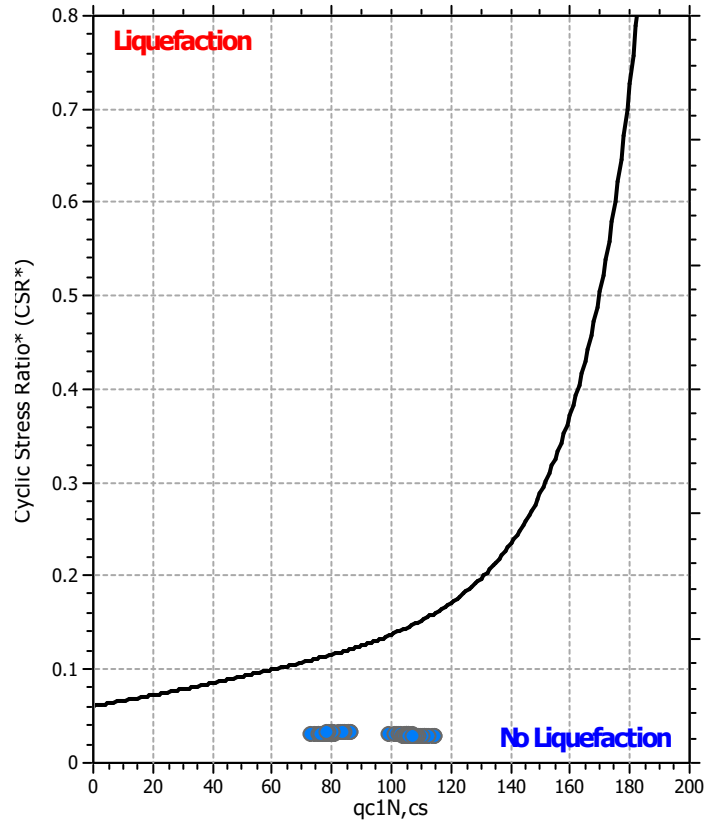
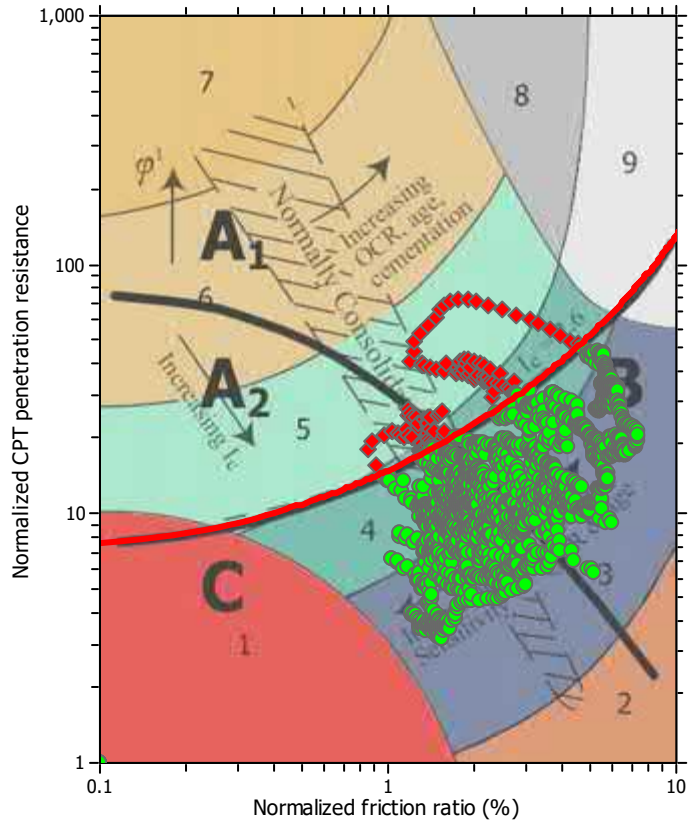
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

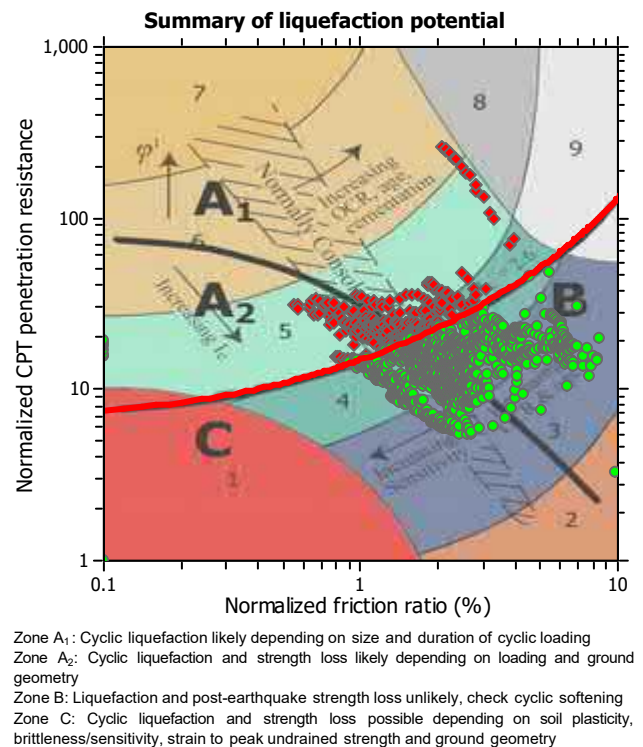
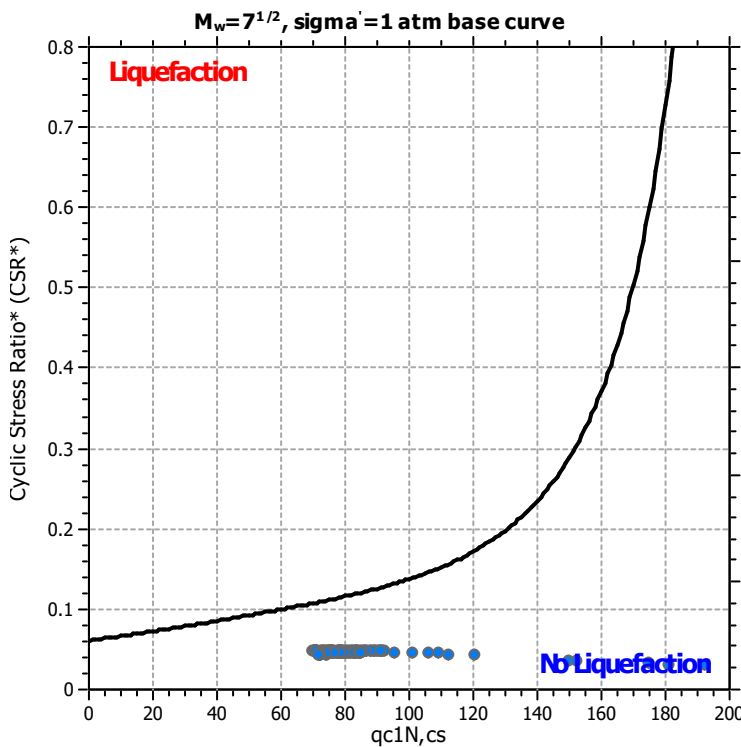
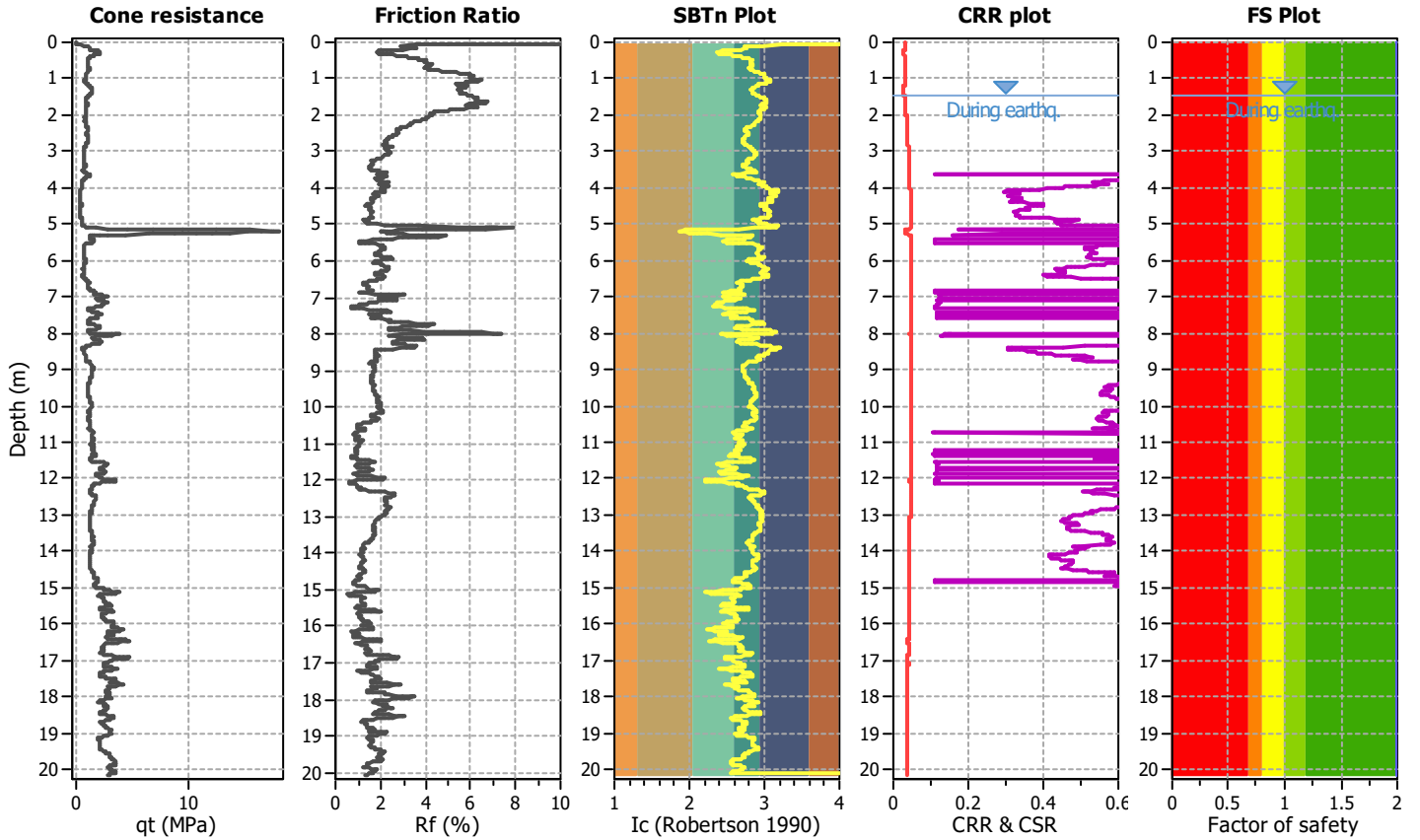
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT 2-1/25**

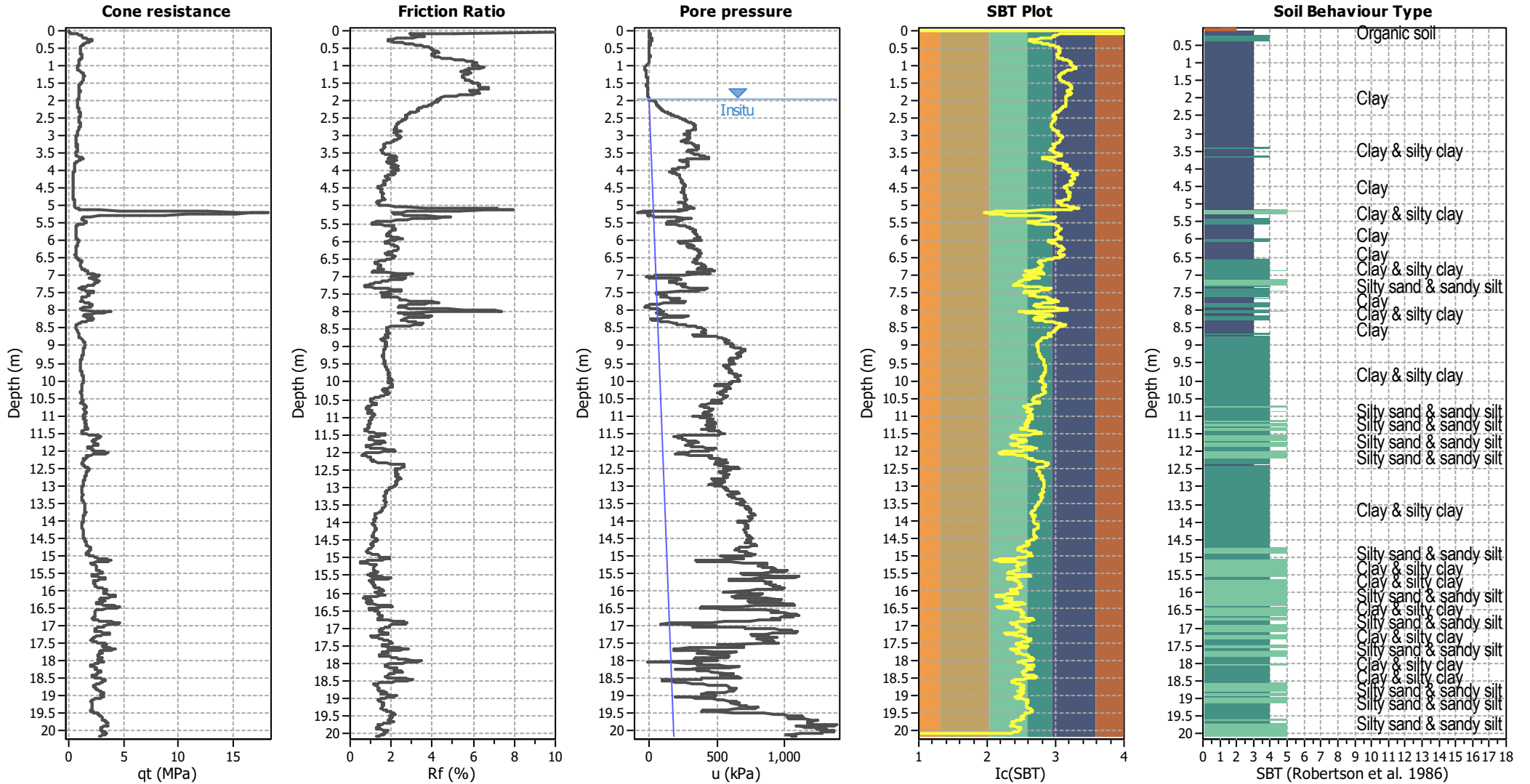
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.96 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.46 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

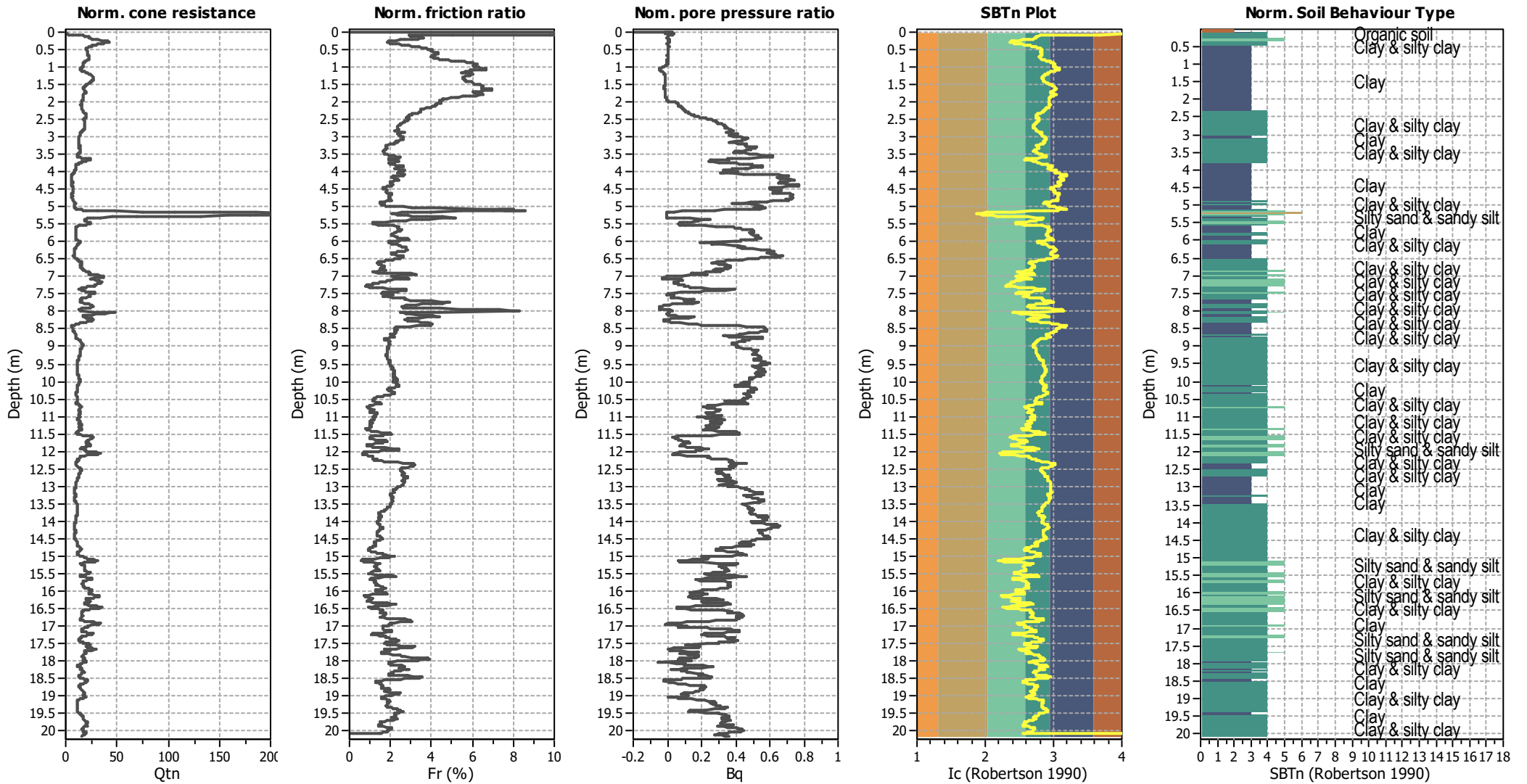
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



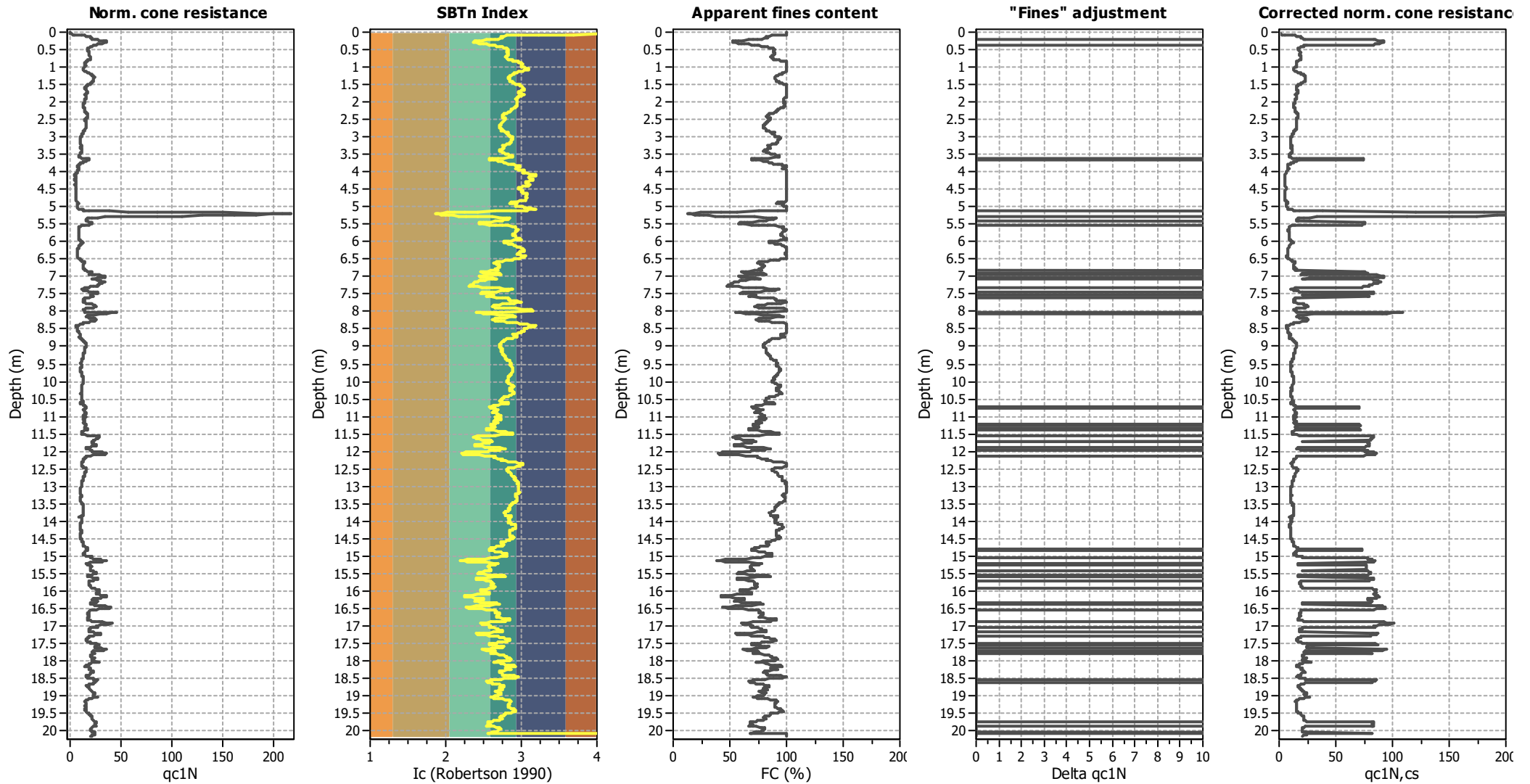
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

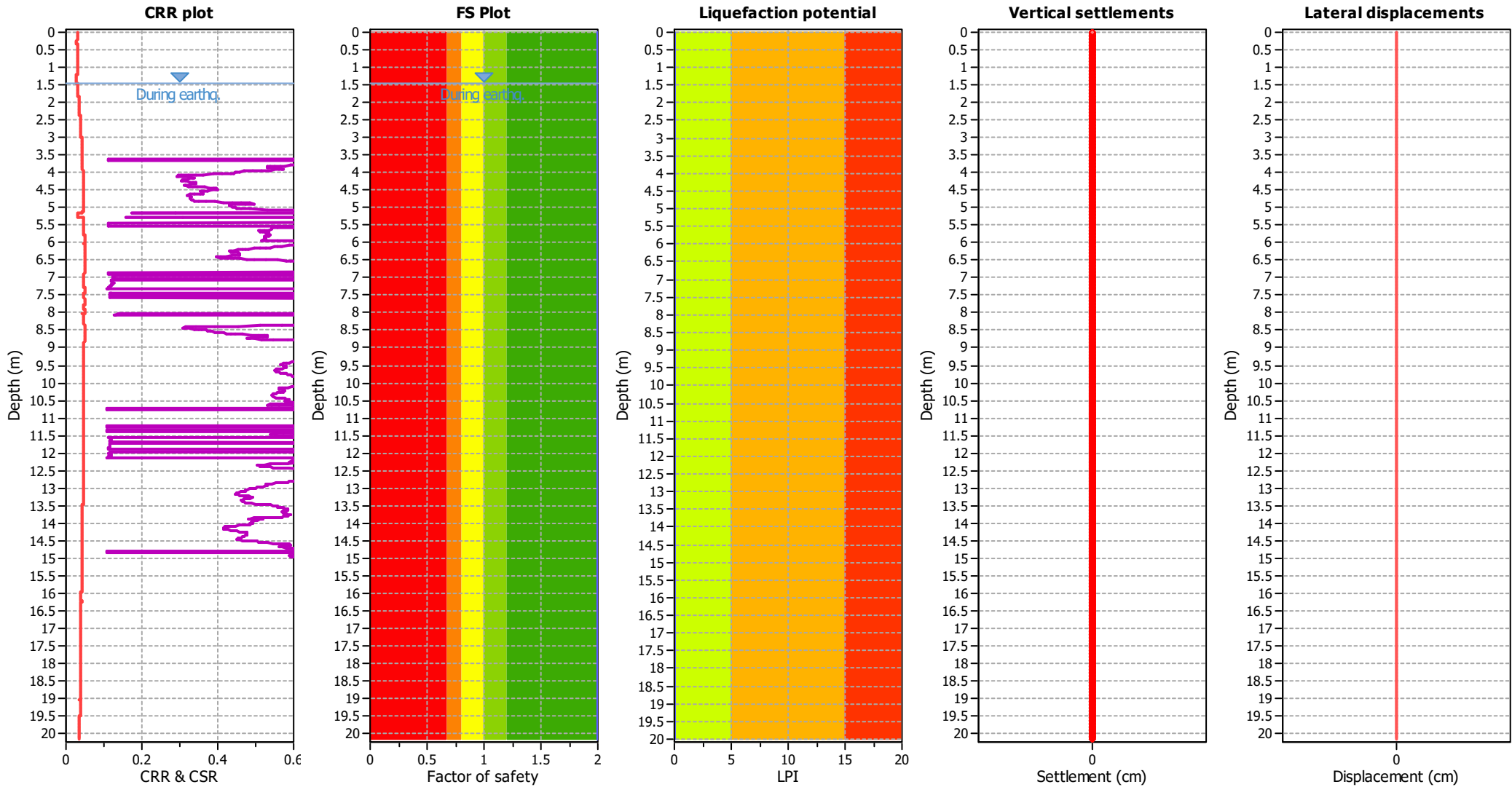
### Liquefaction analysis overall plots (intermediate results)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

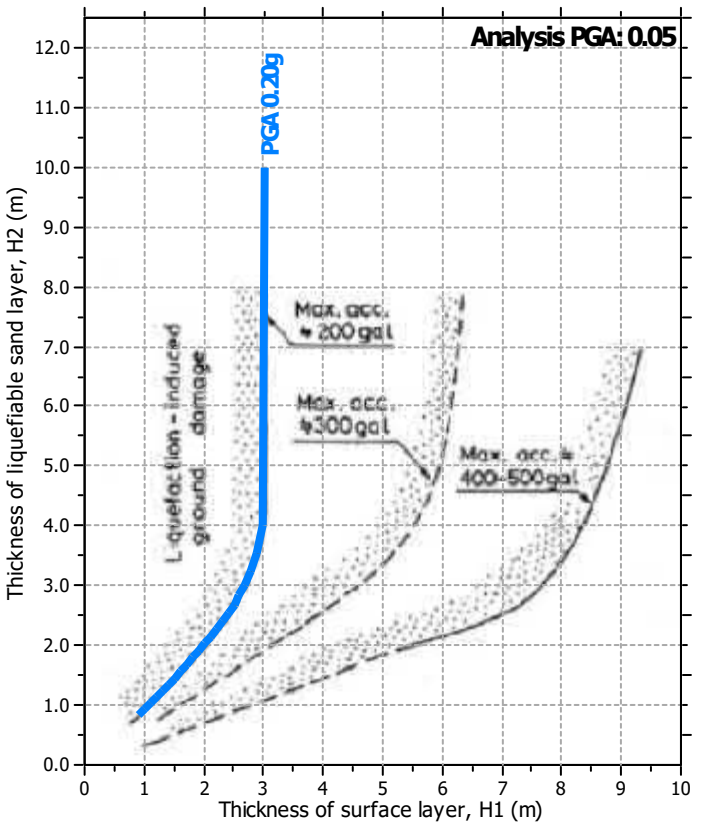
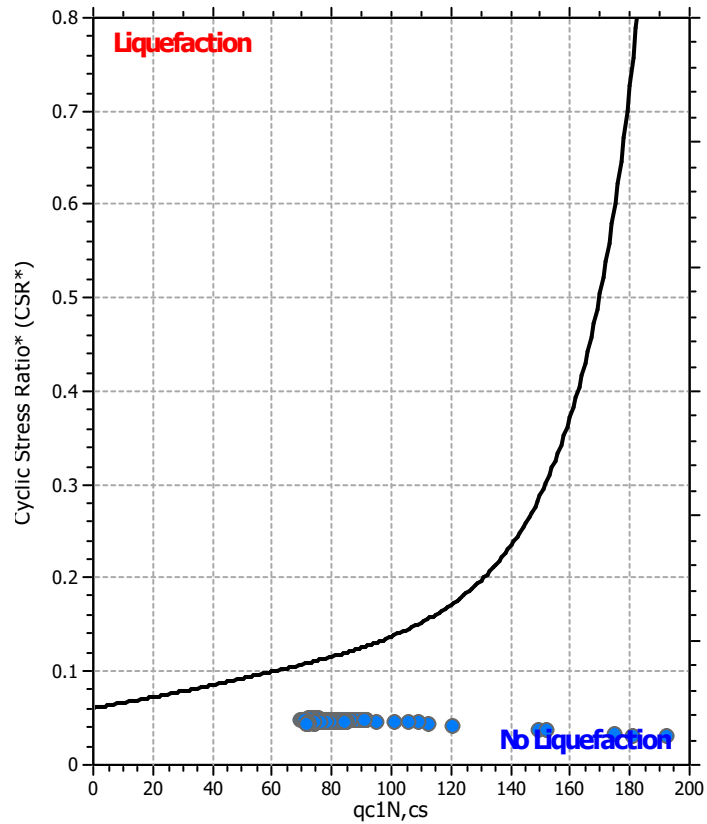
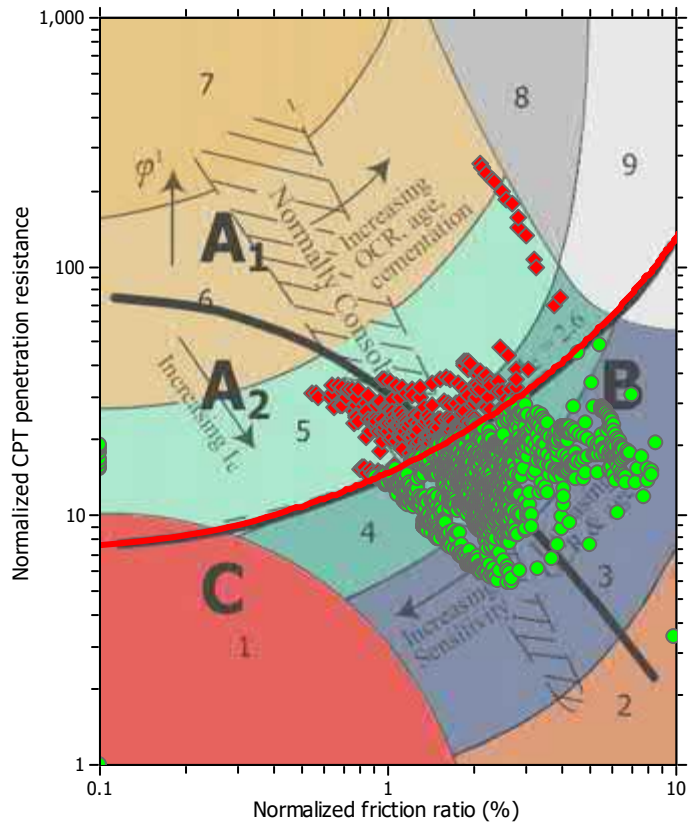
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m



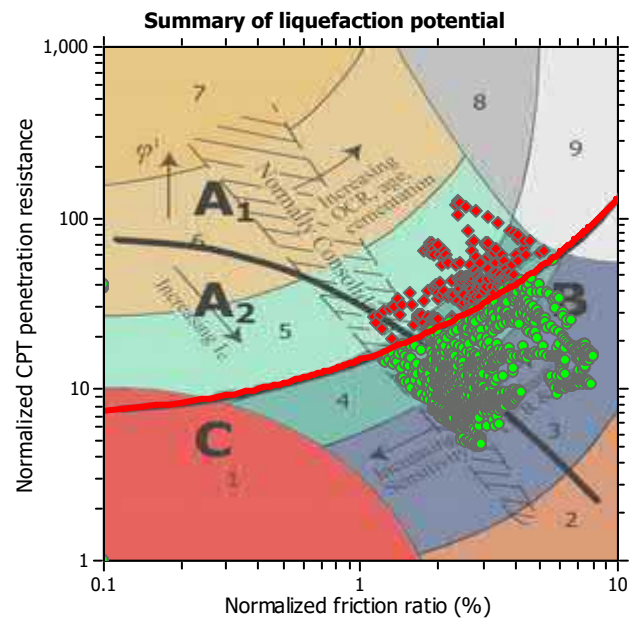
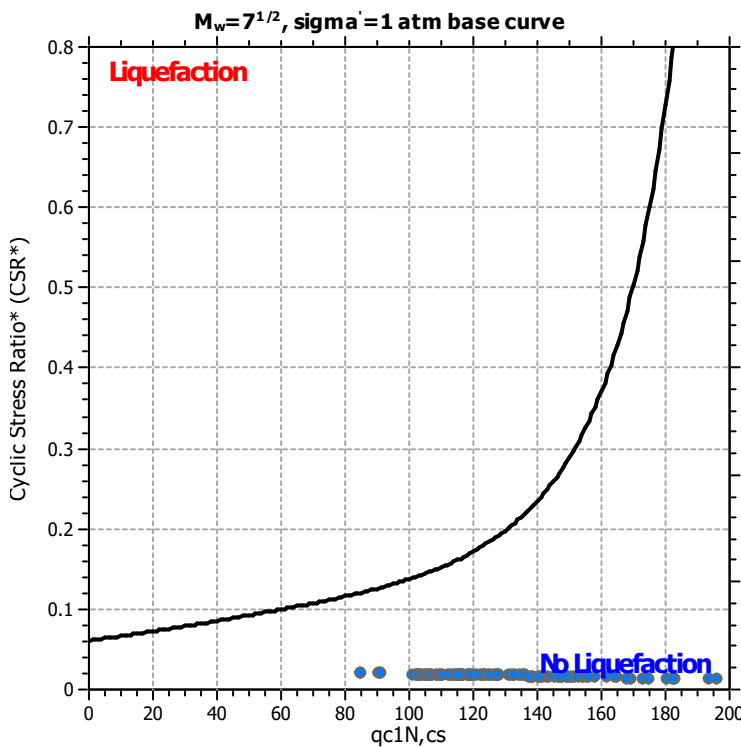
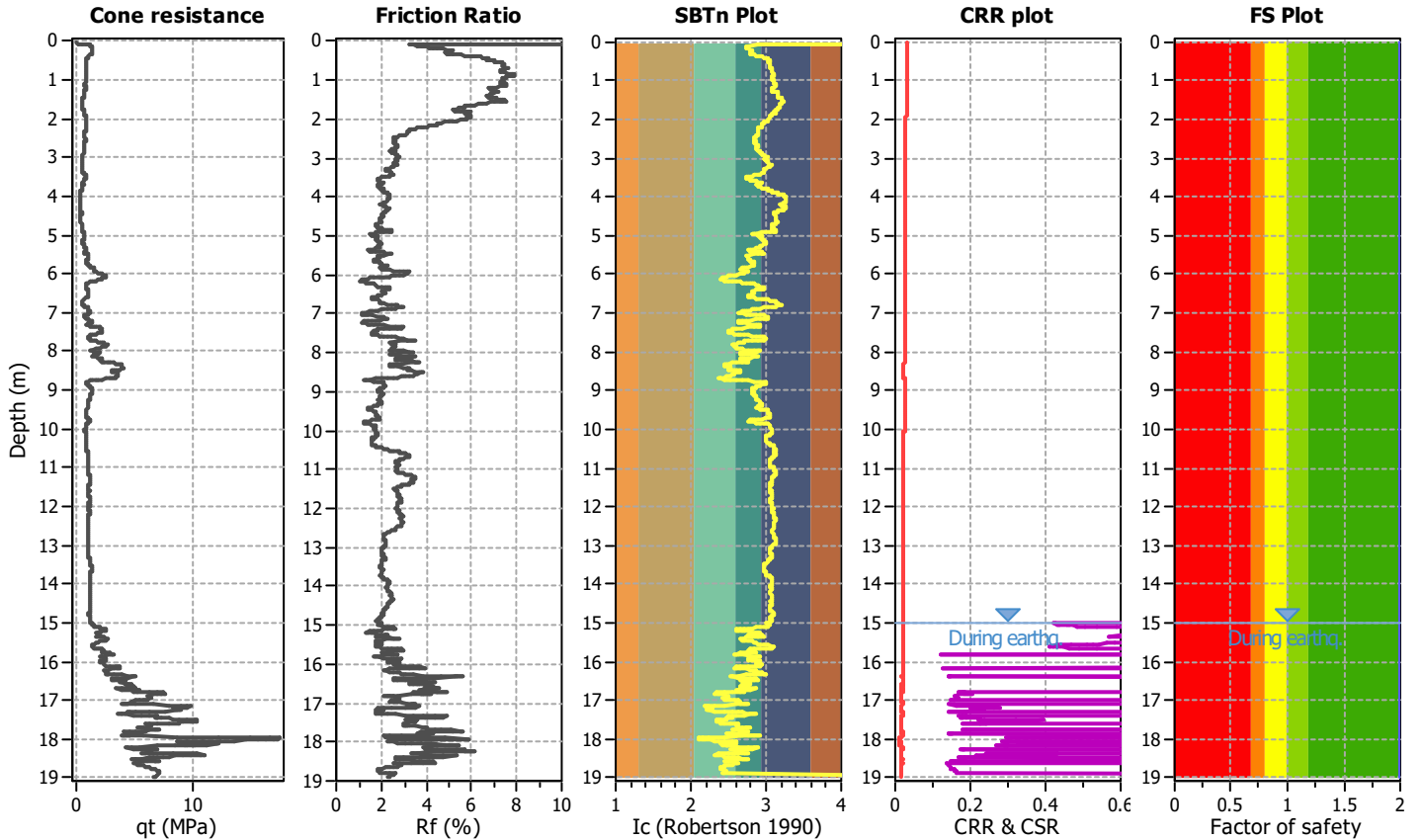
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT3-1/25**

**Location : 48 Valerie Close, Warkworth**

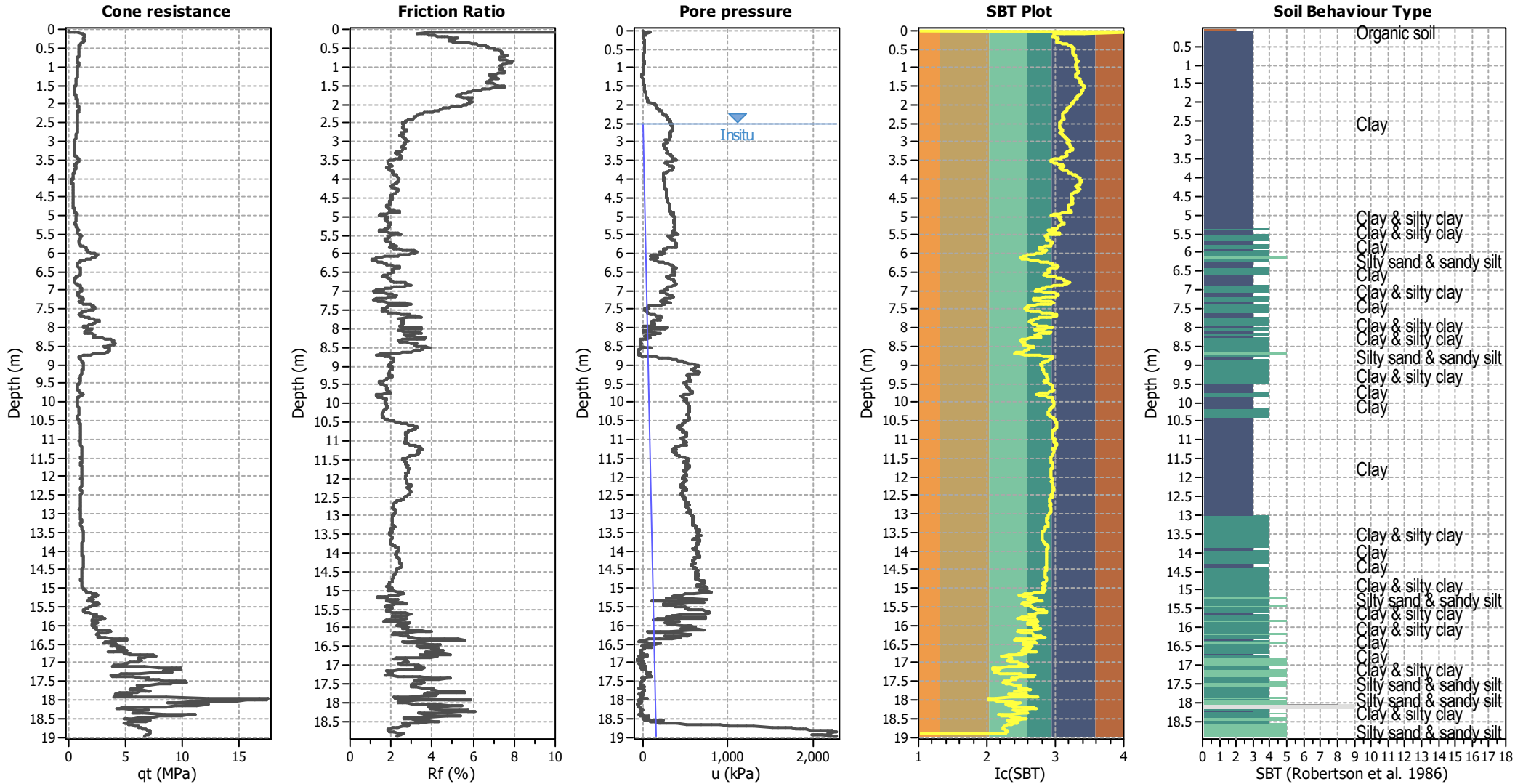
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	15.00 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 $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading  
 Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
 Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
 Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



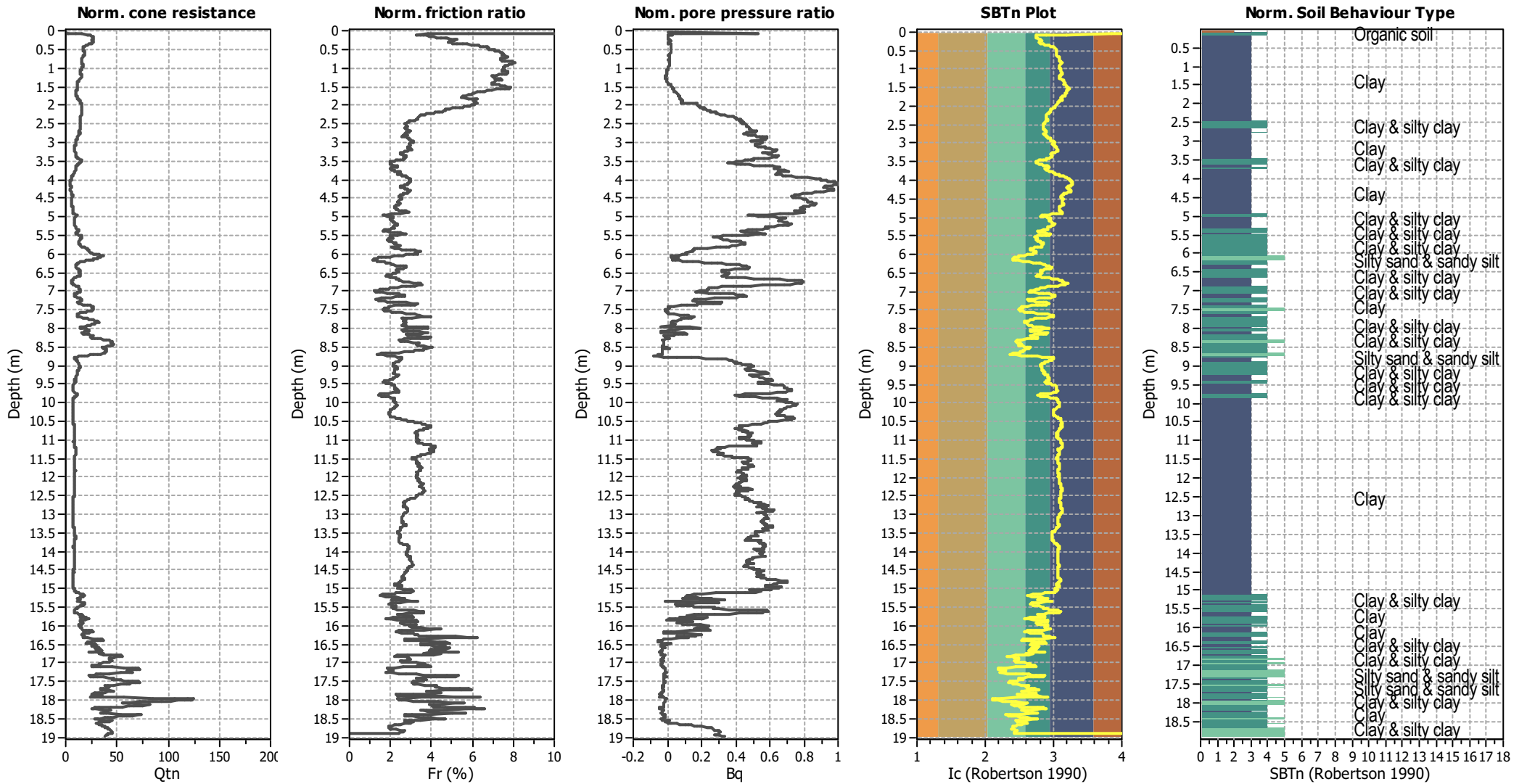
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	15.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>g</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



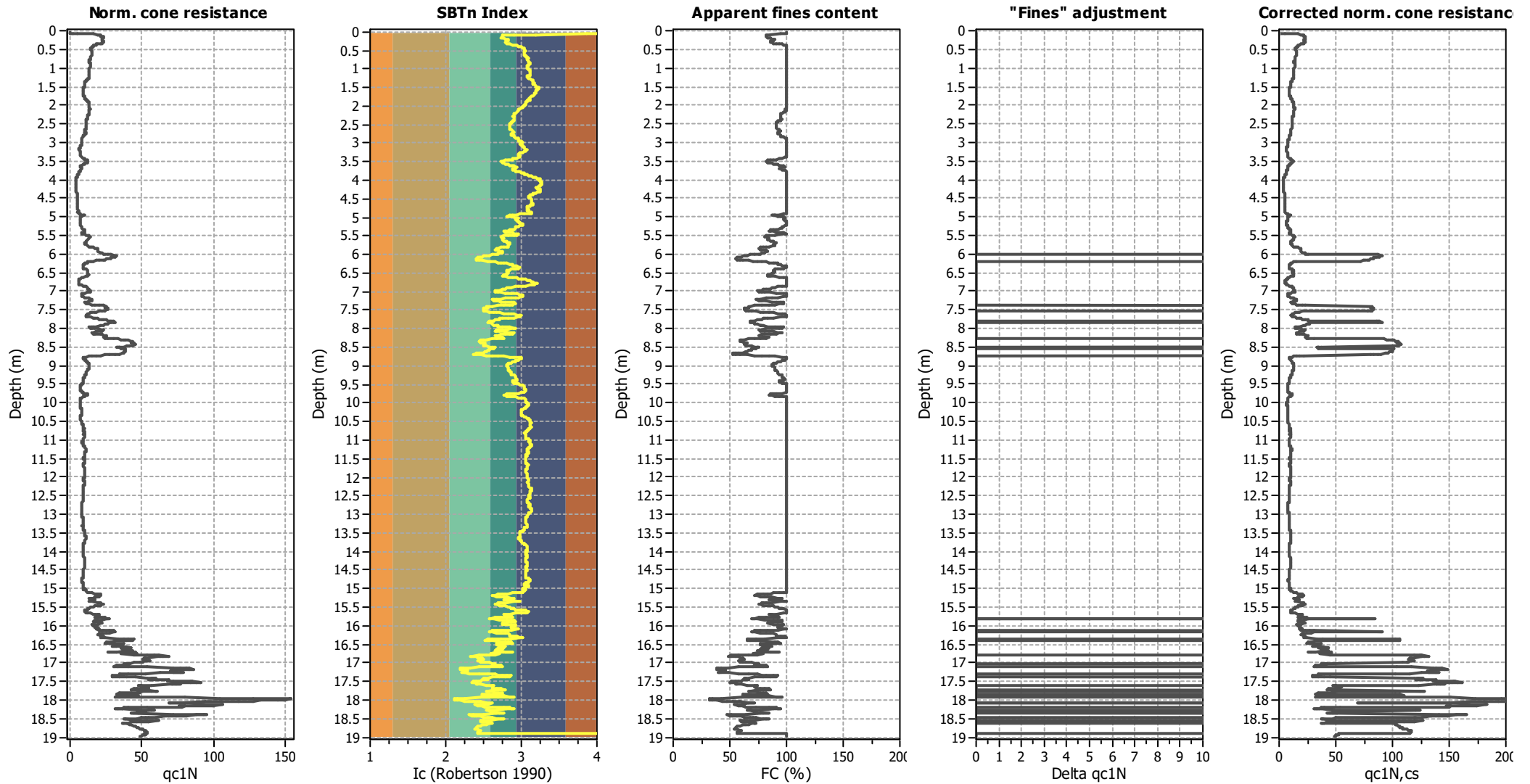
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	15.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

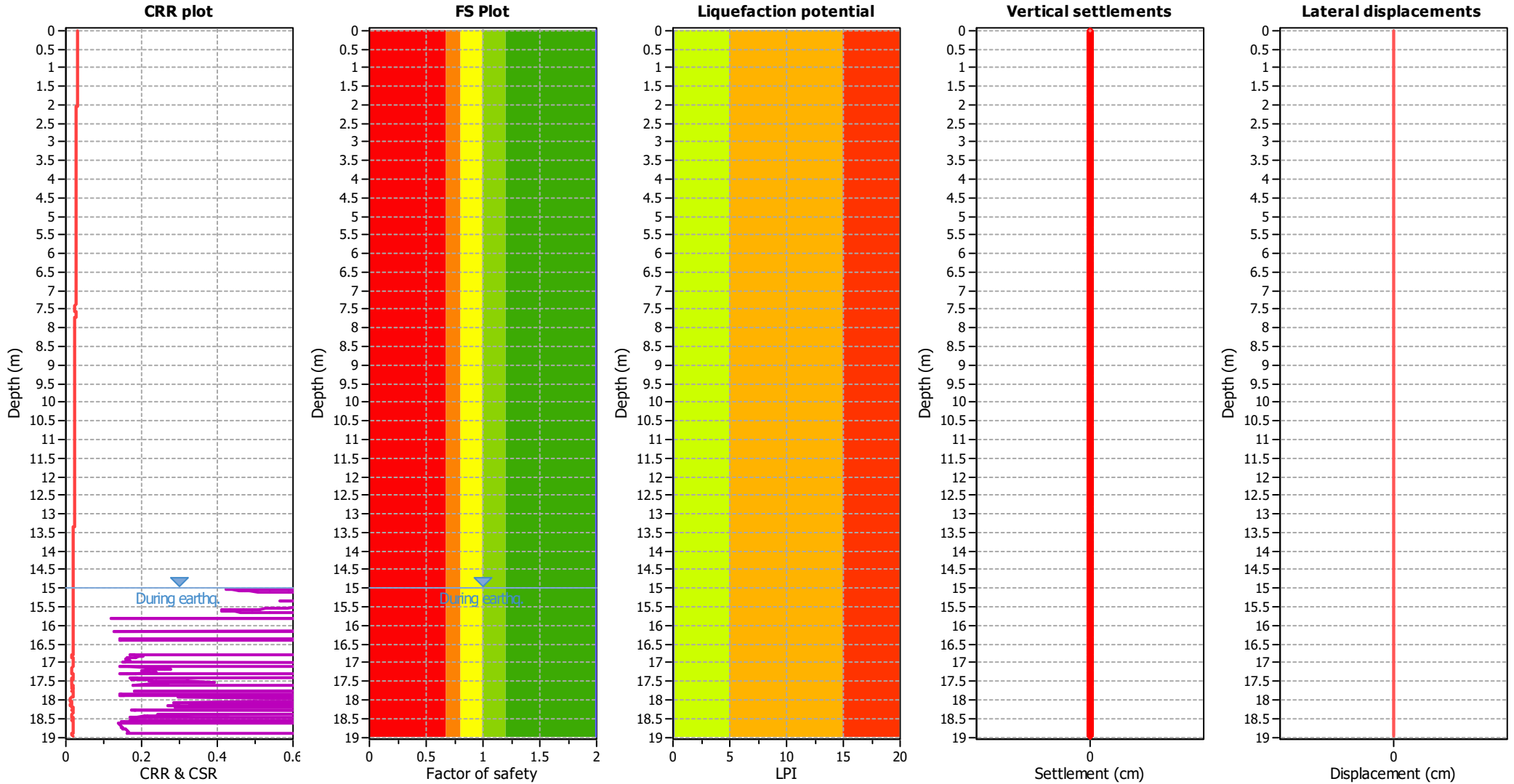


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	15.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	15.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

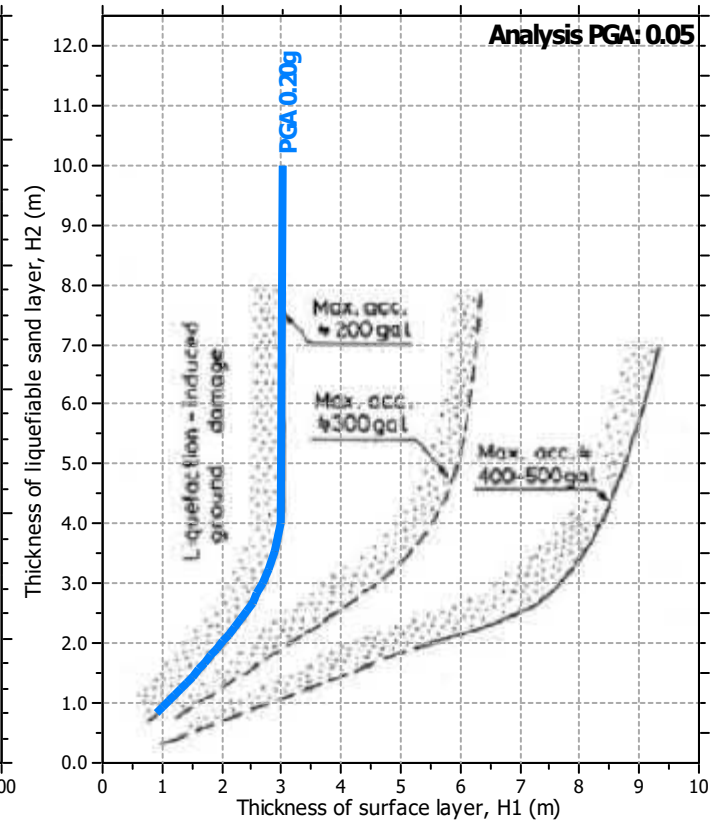
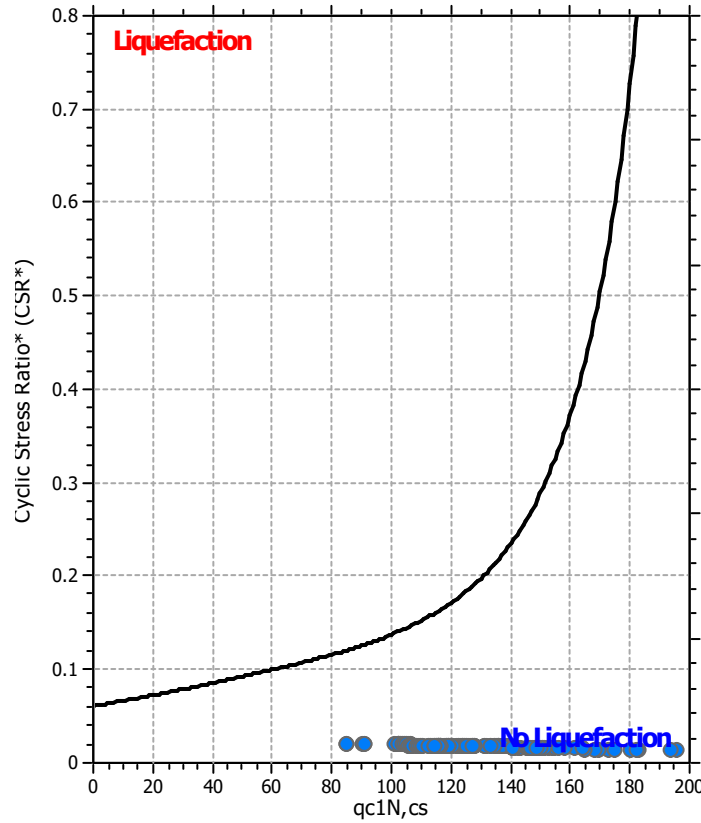
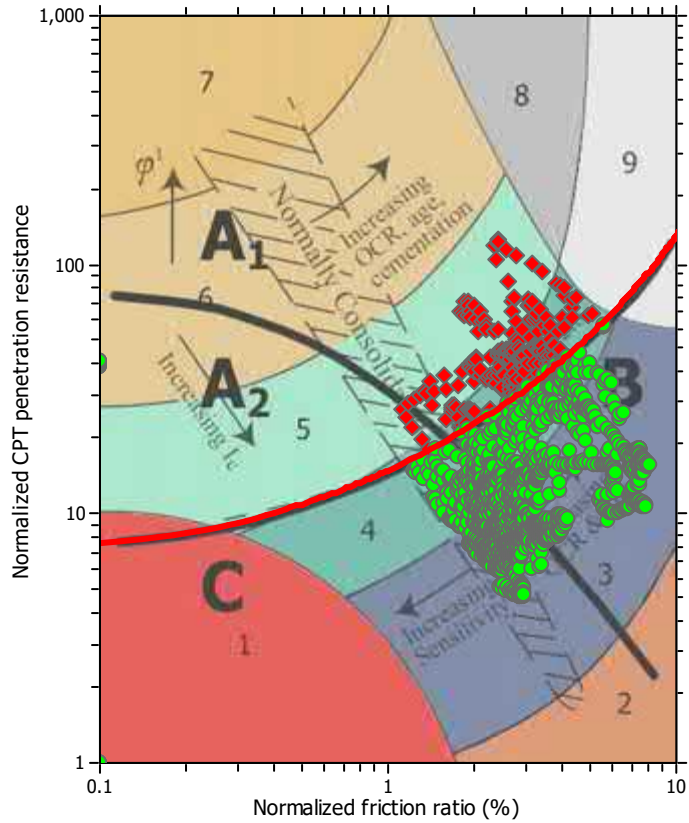
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	15.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

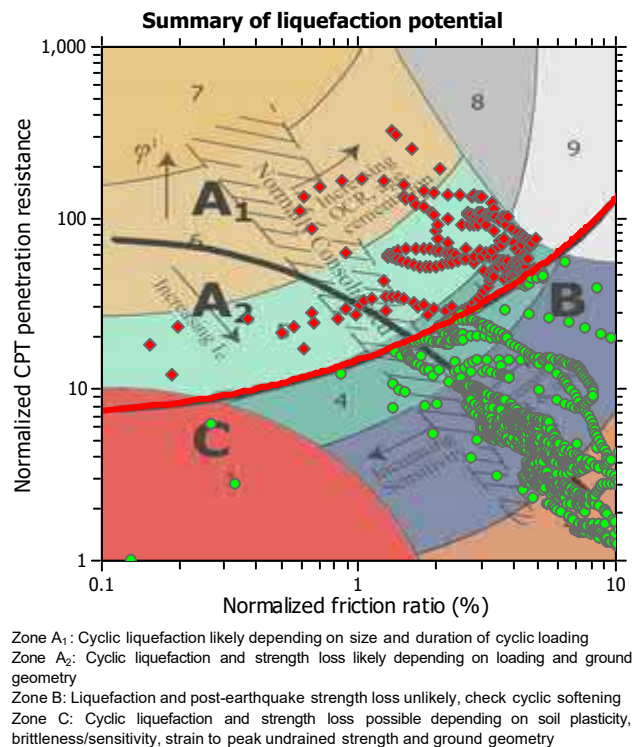
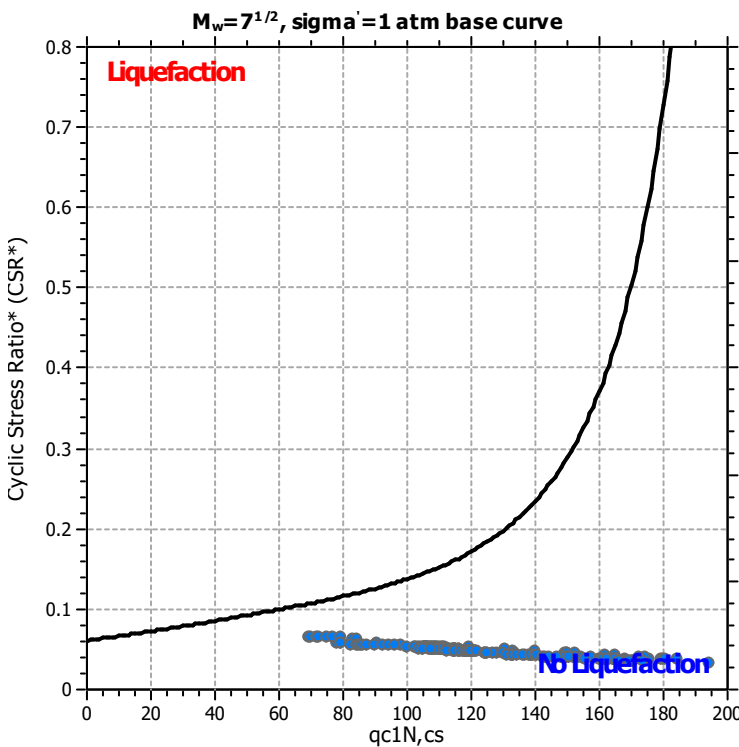
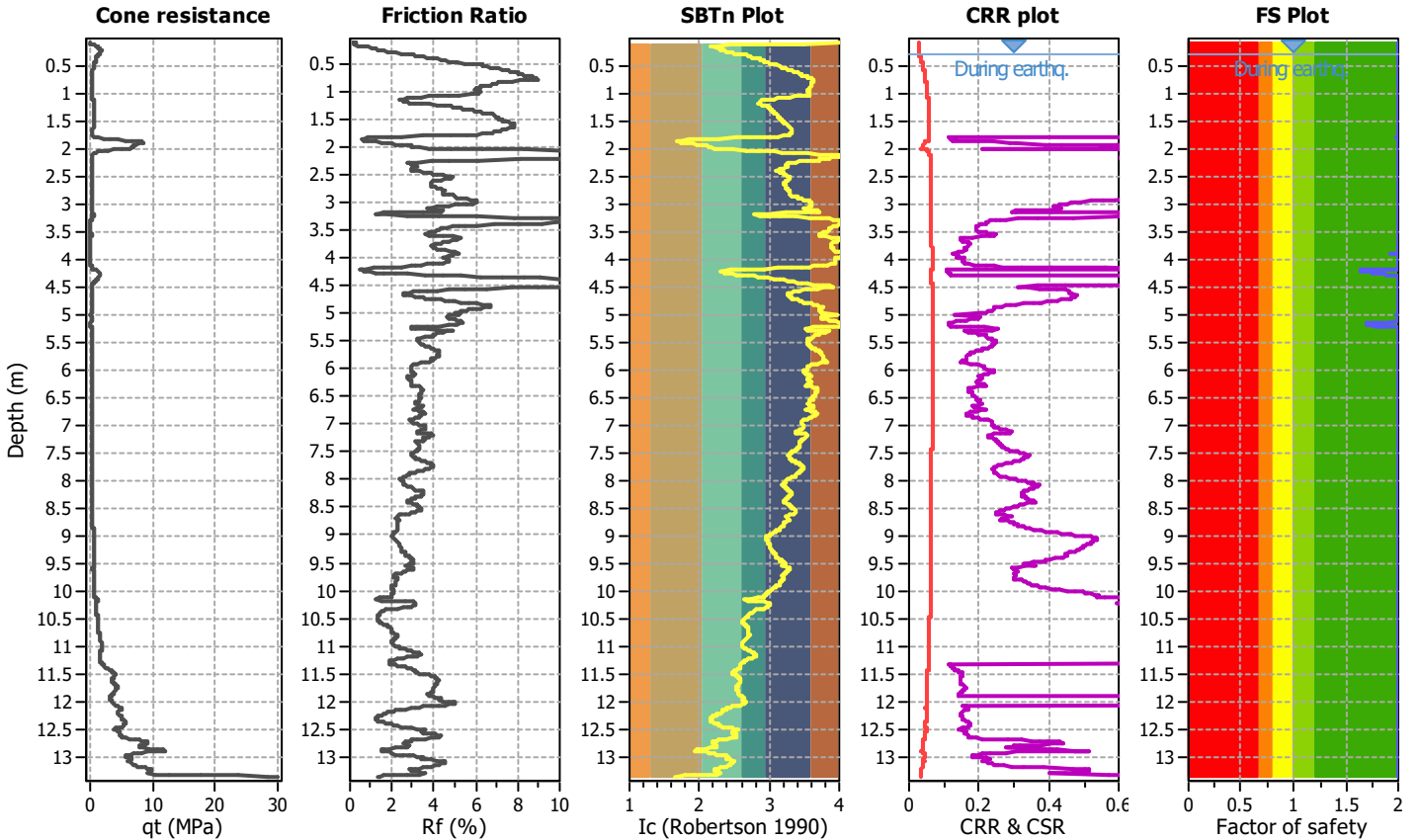
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT4-1/25**

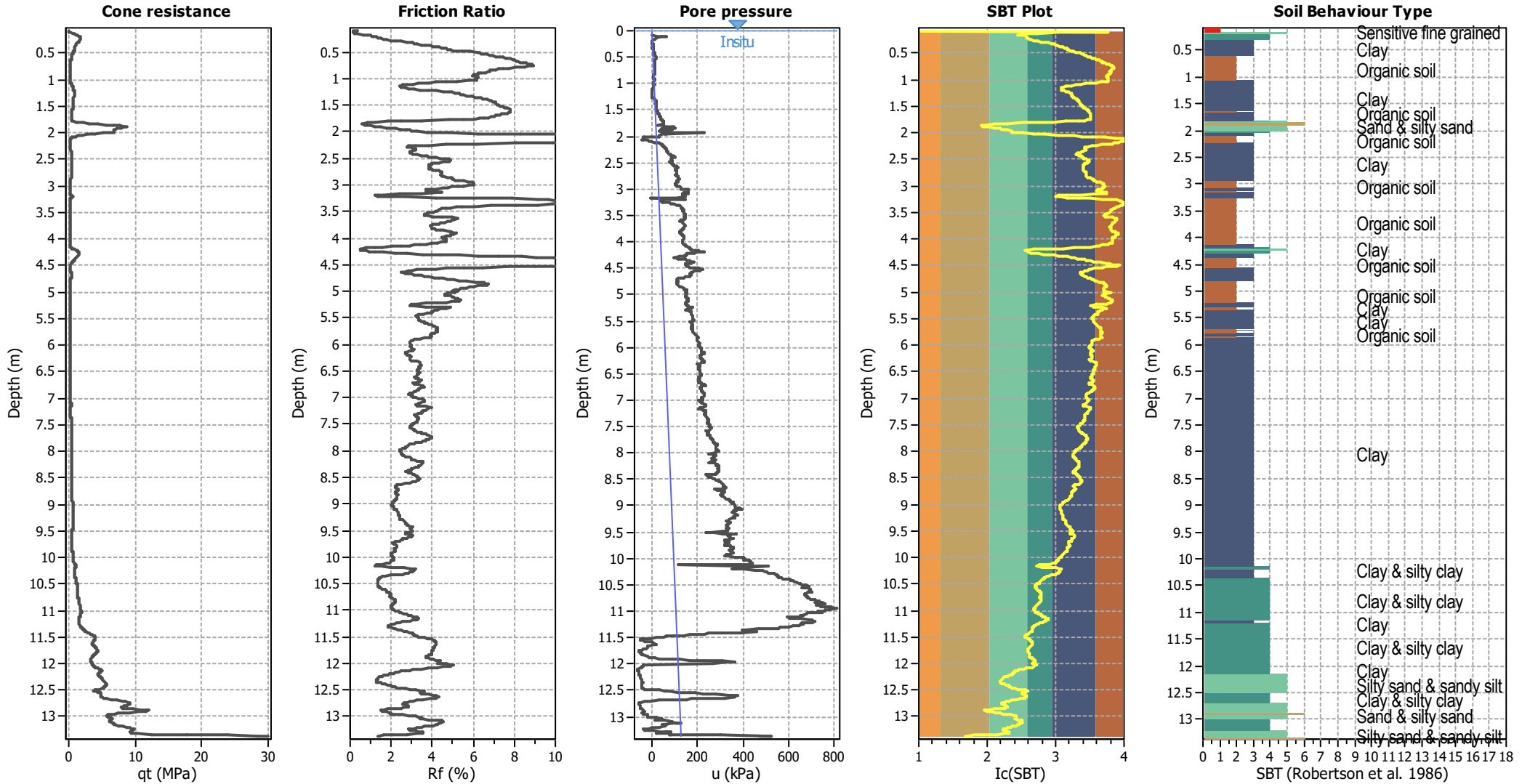
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

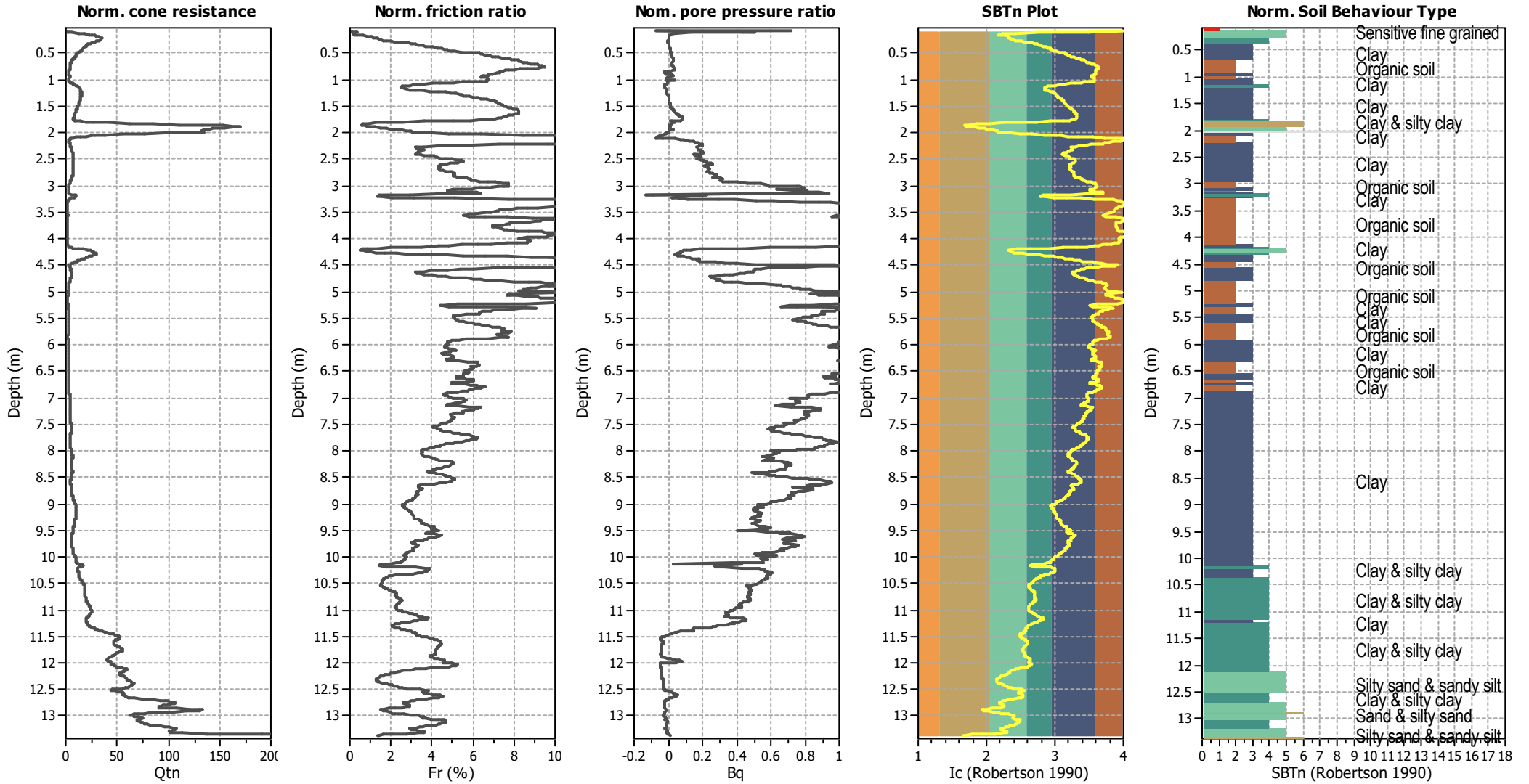
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>s</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



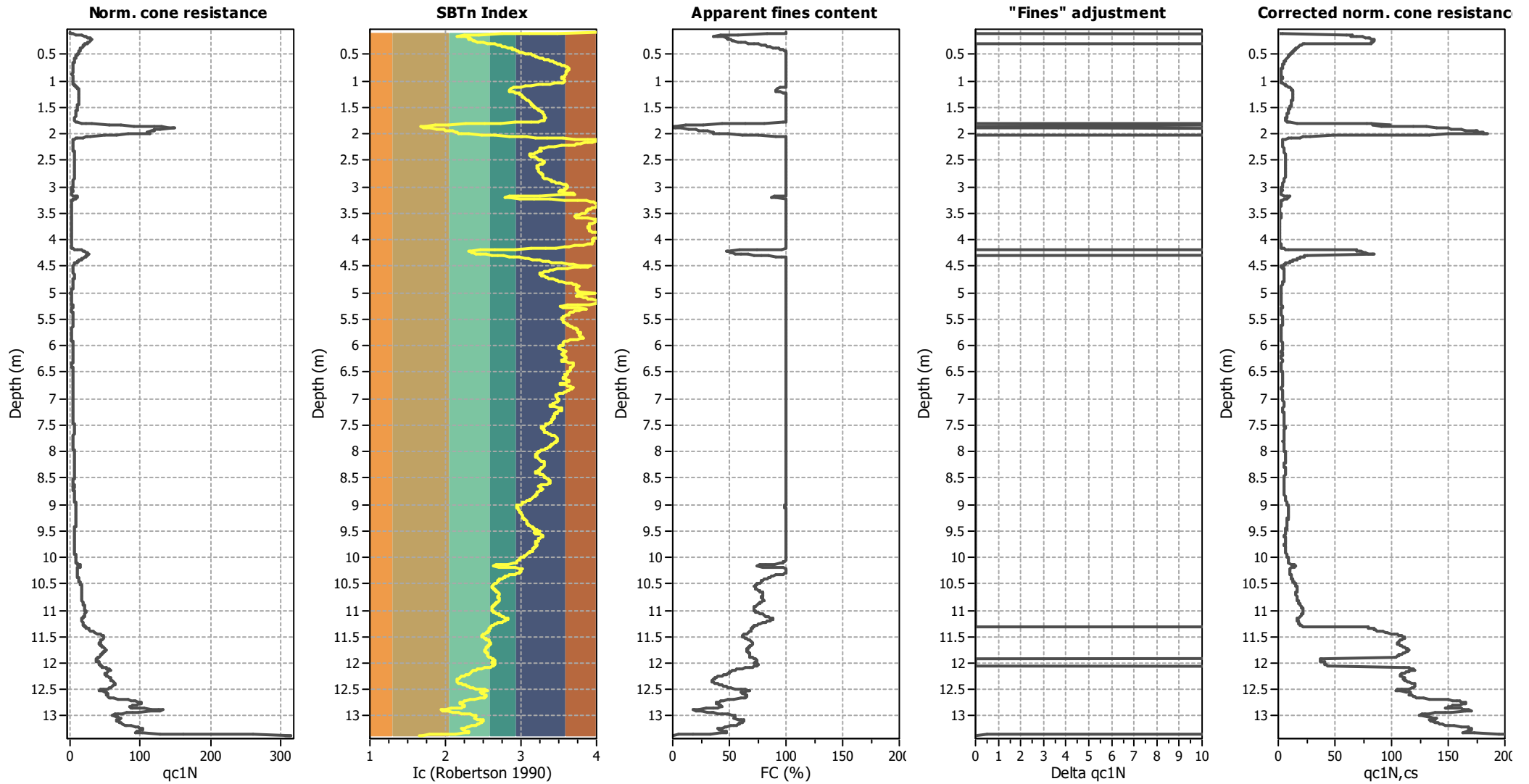
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

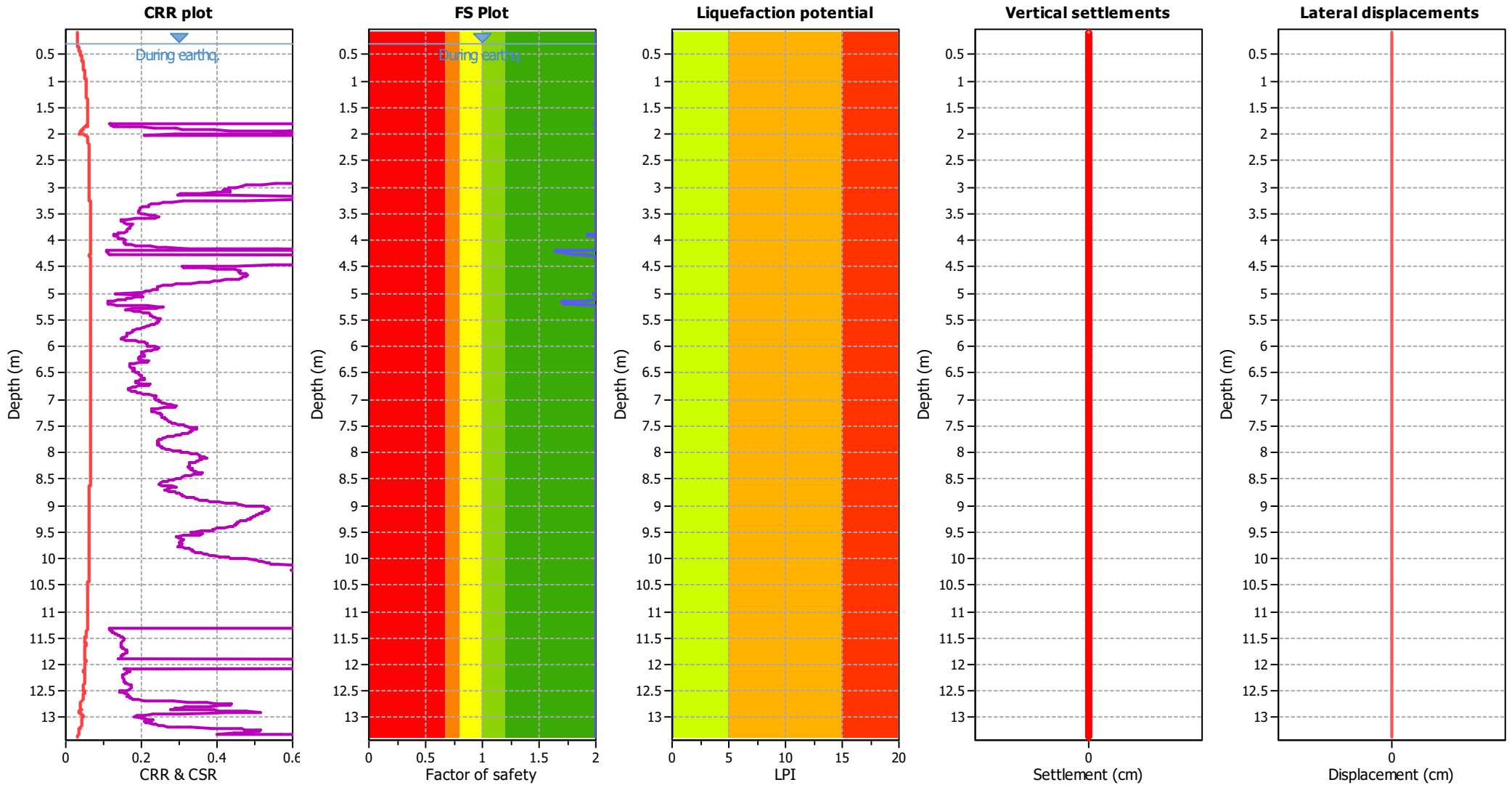
### Liquefaction analysis overall plots (intermediate results)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

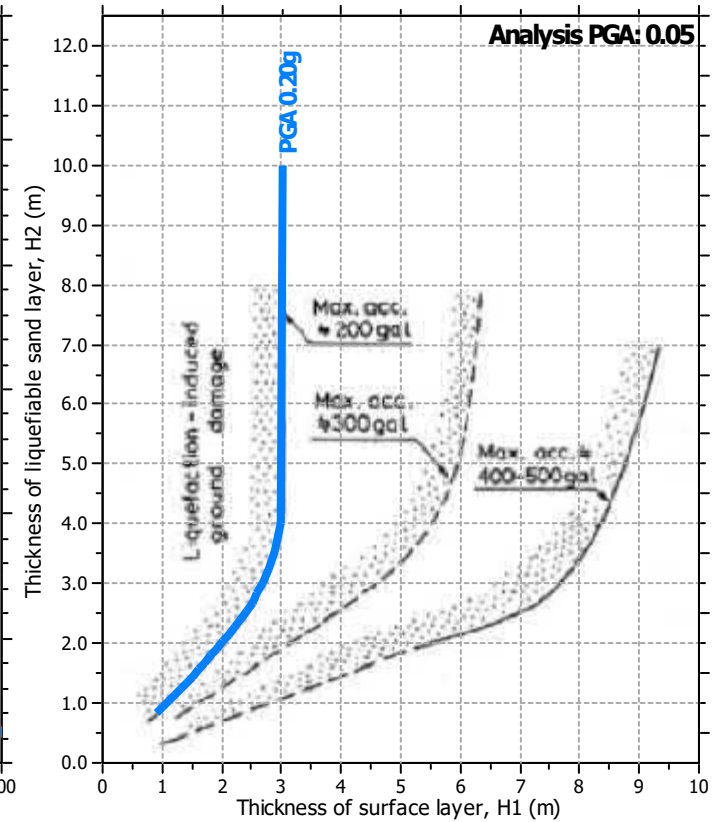
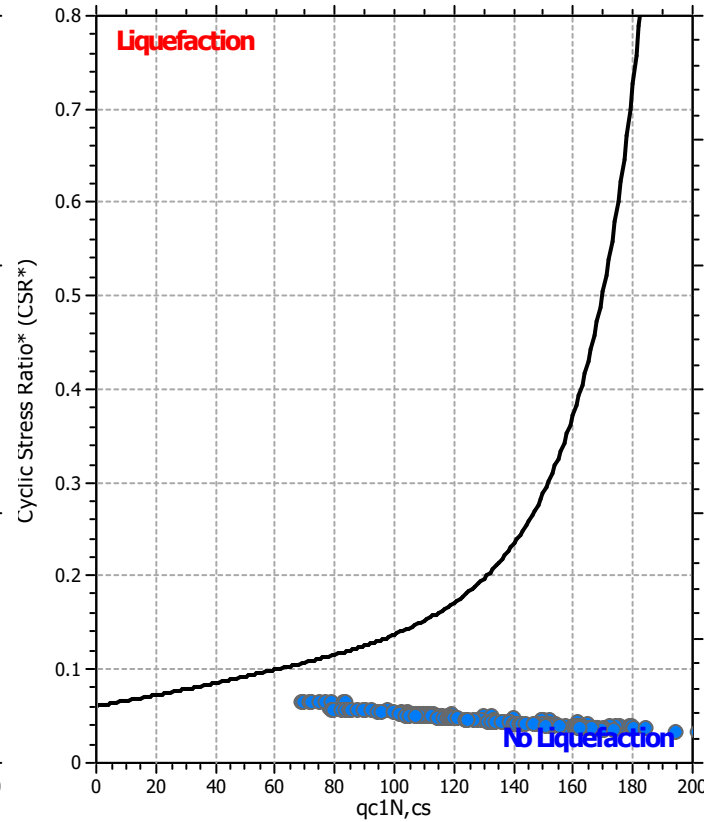
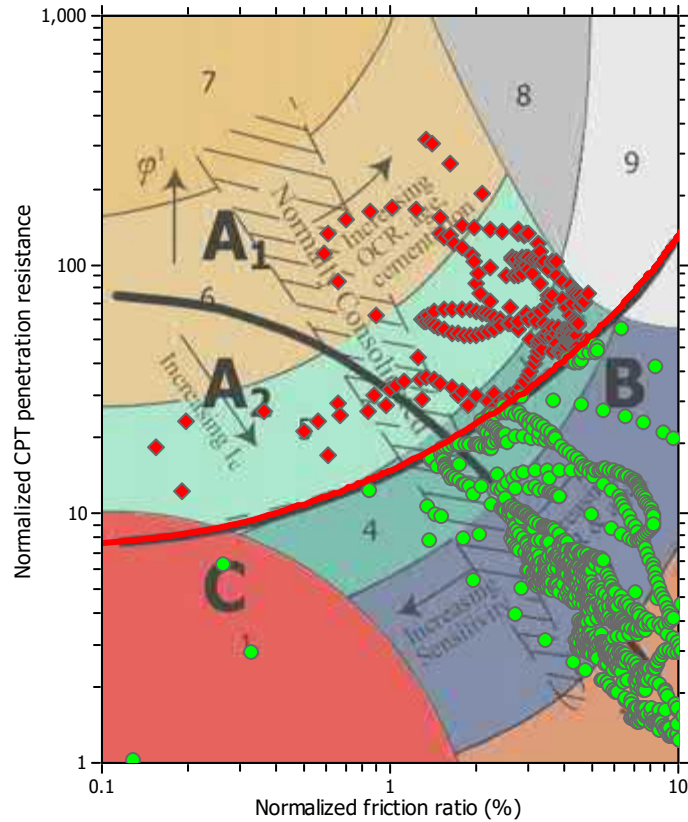
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A



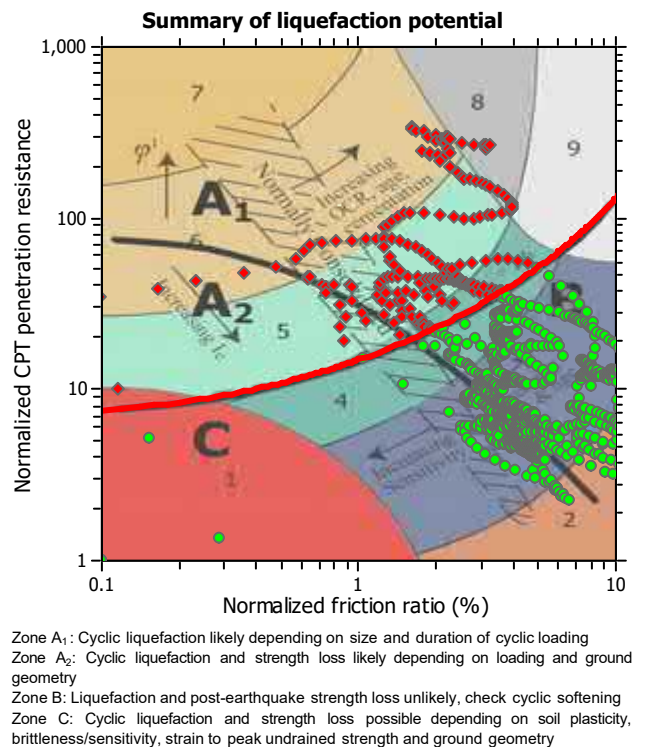
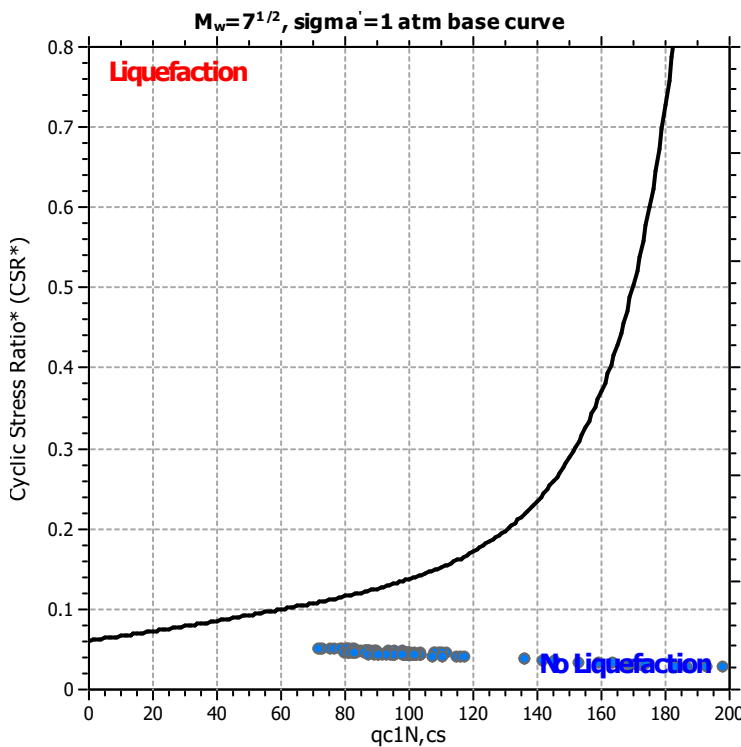
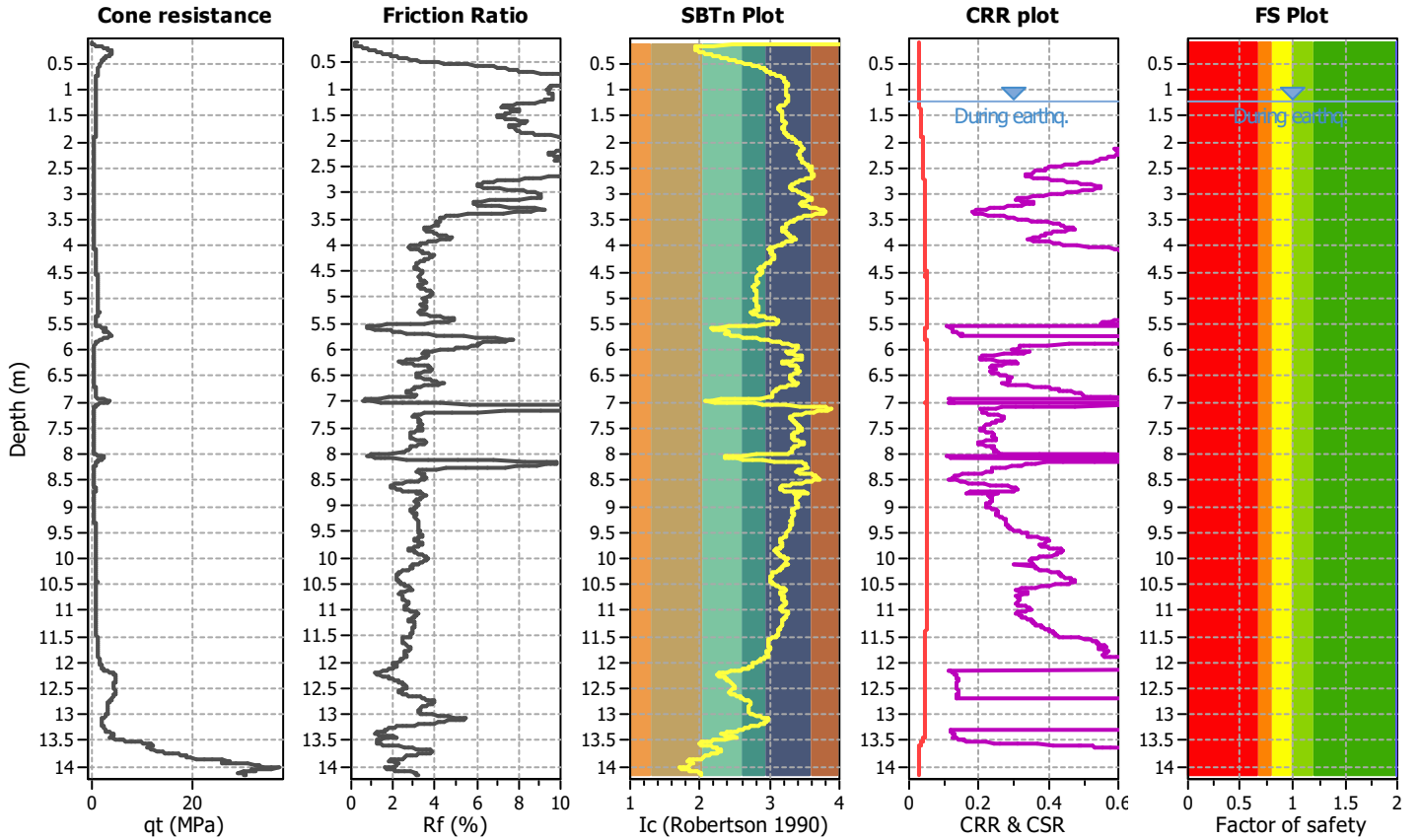
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT5-1/25**

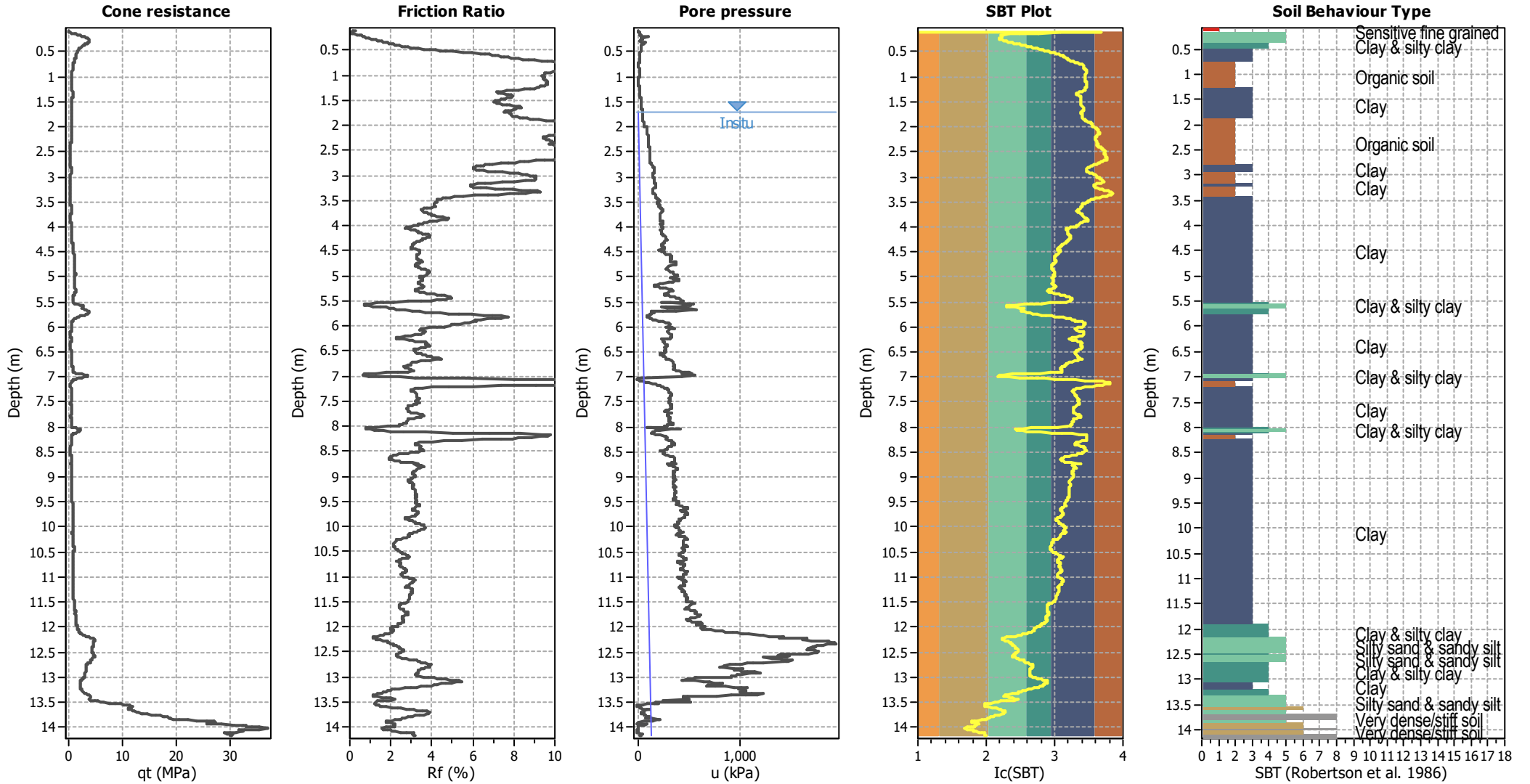
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.20 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



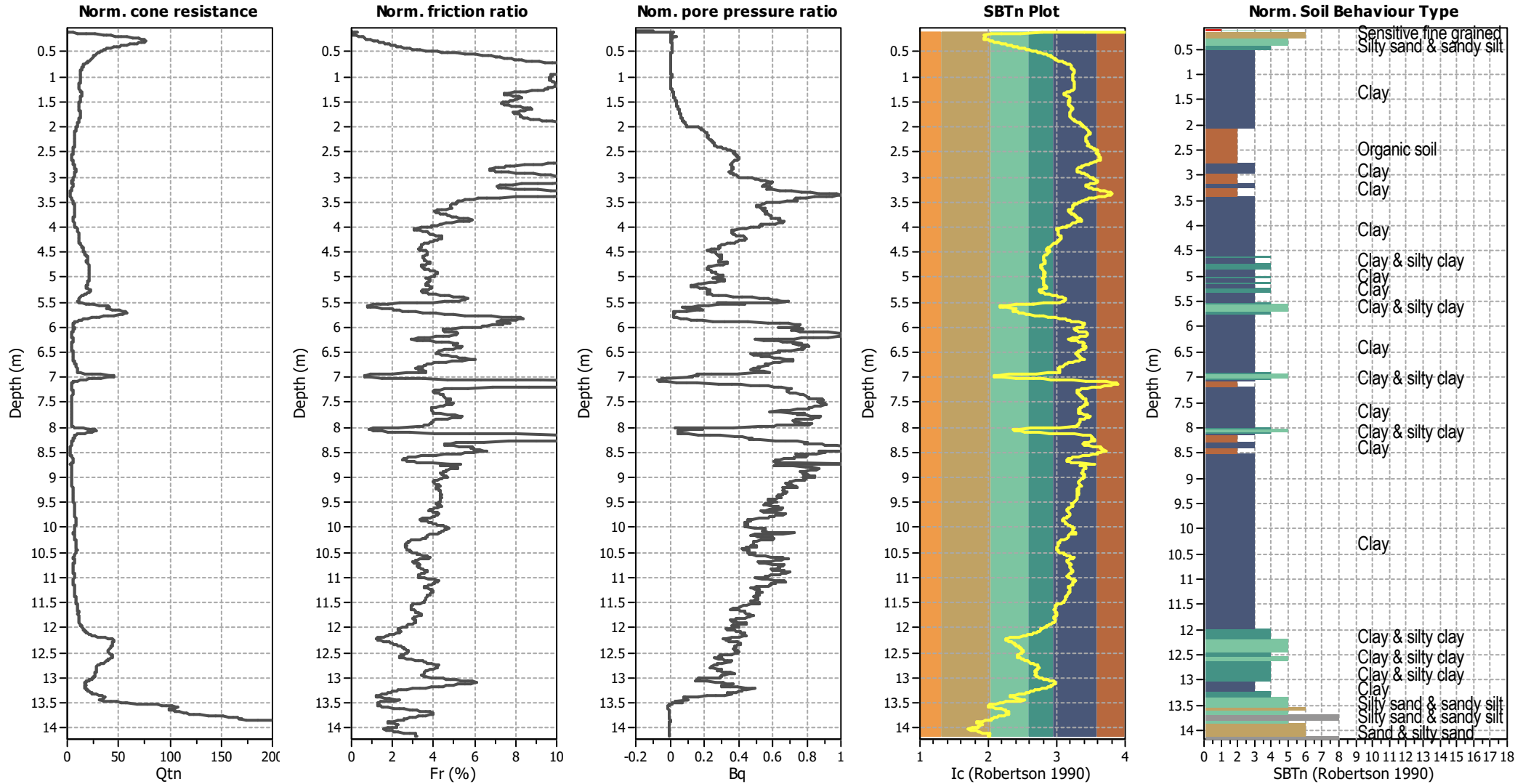
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



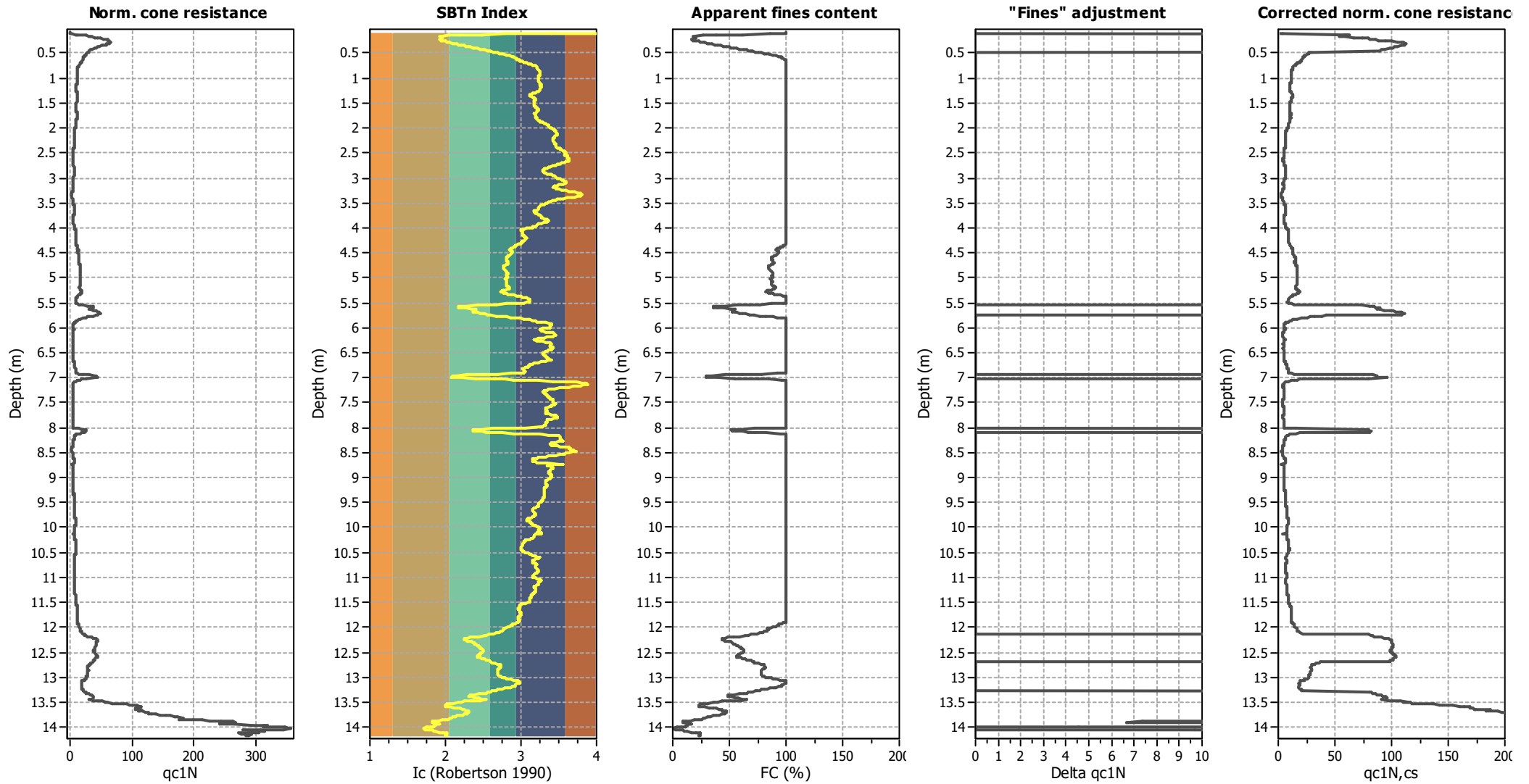
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

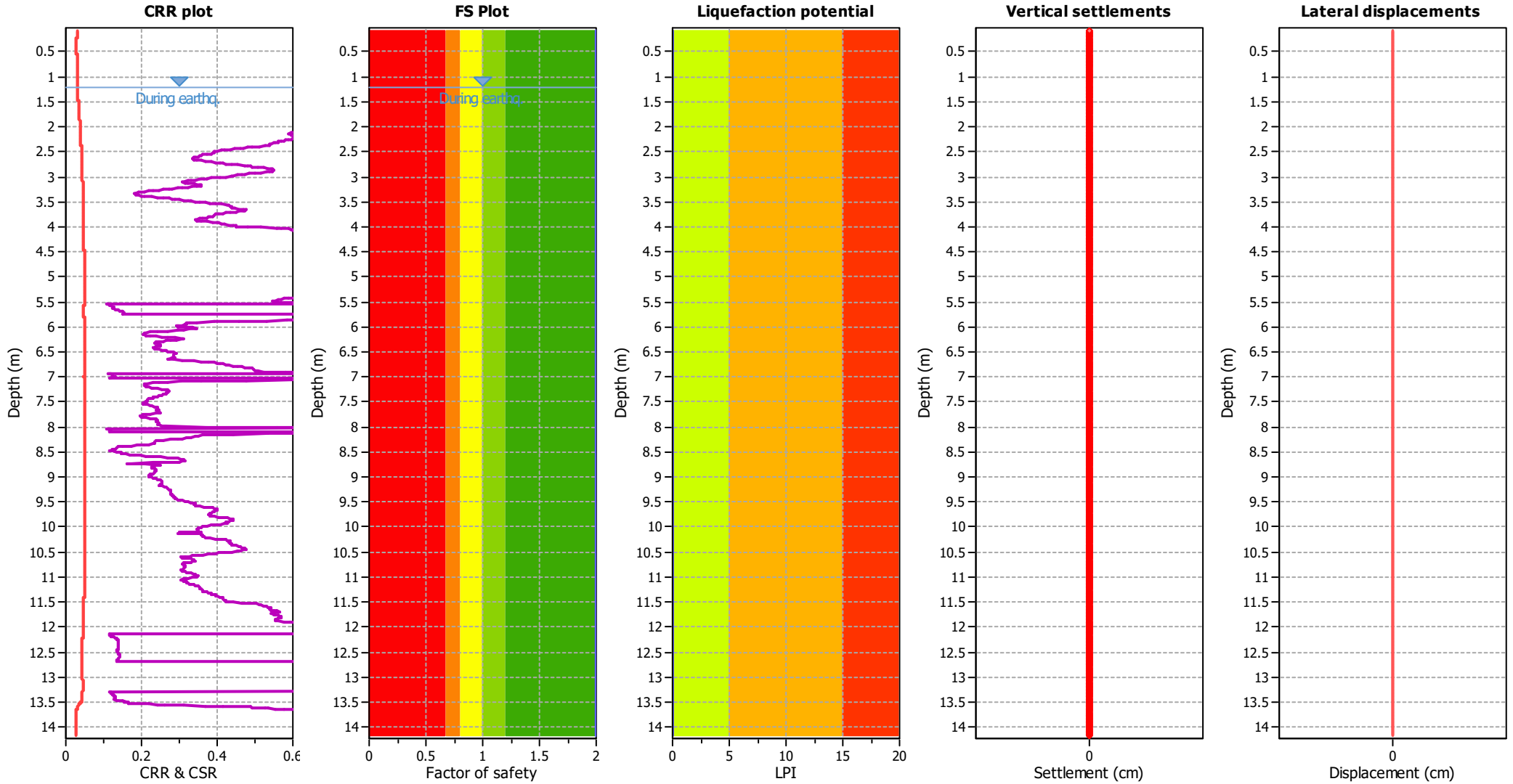


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

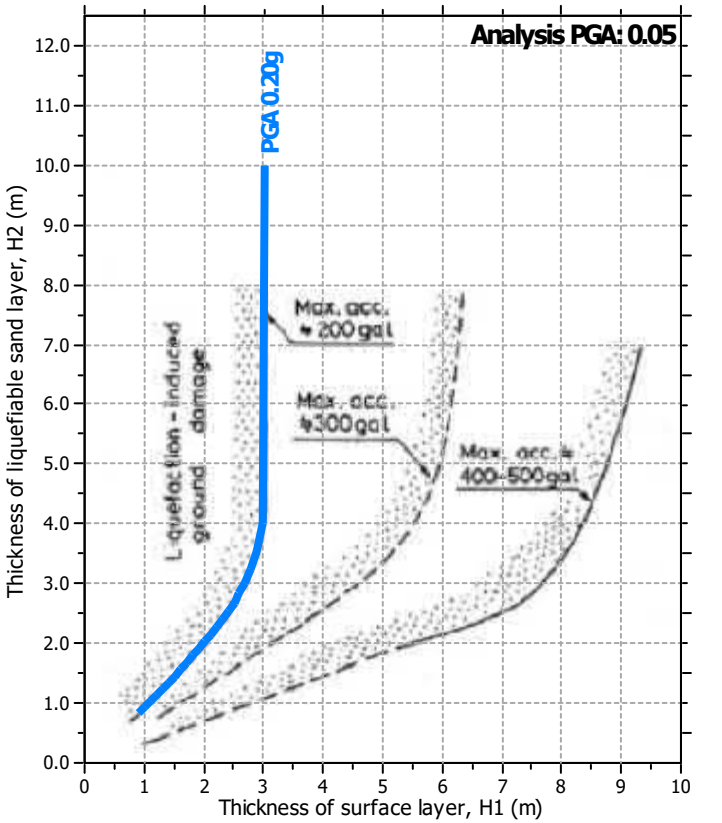
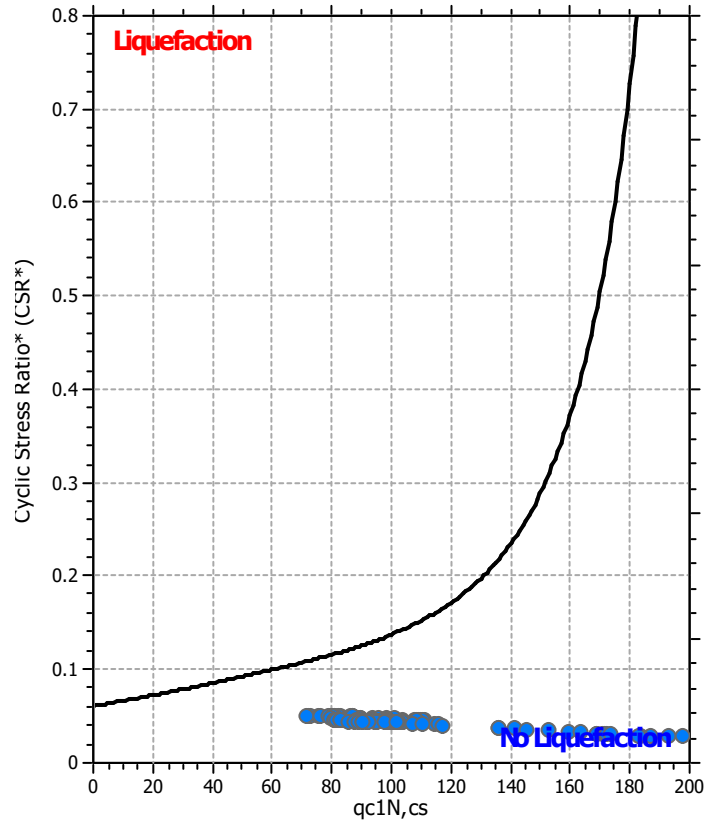
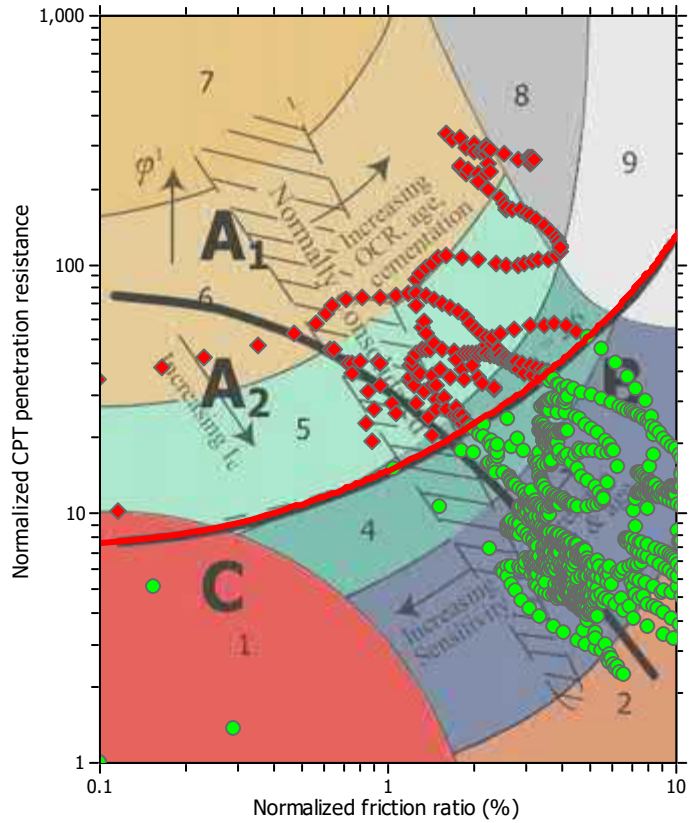
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

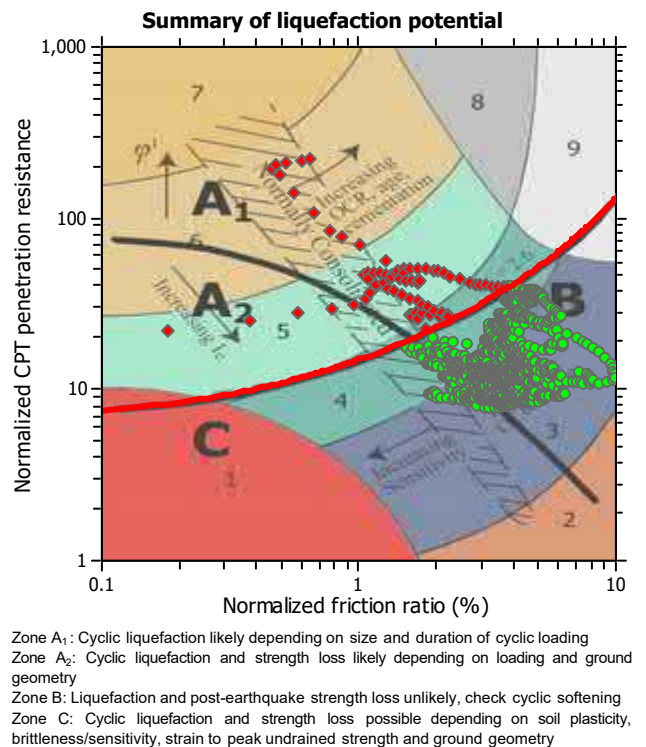
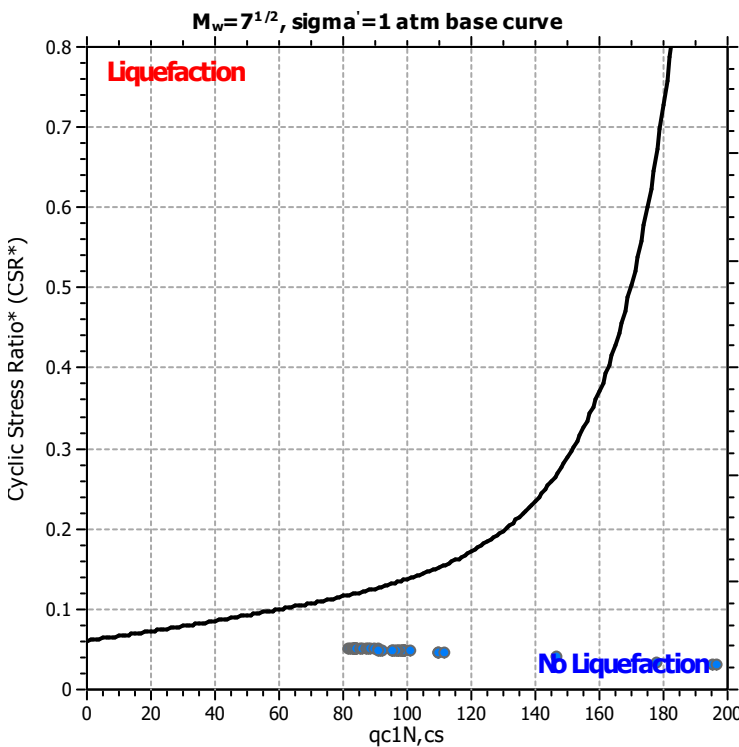
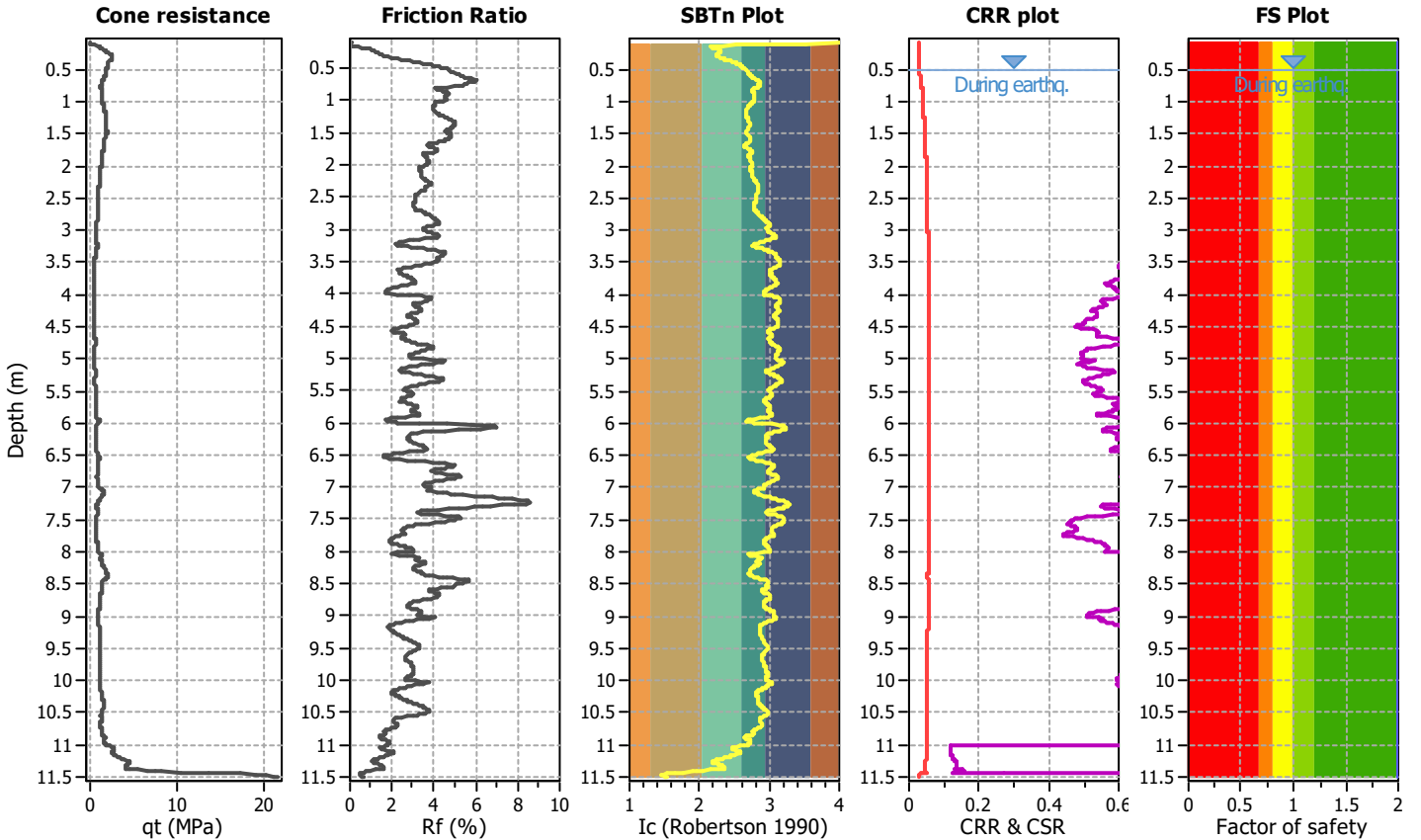
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT6-1/25**

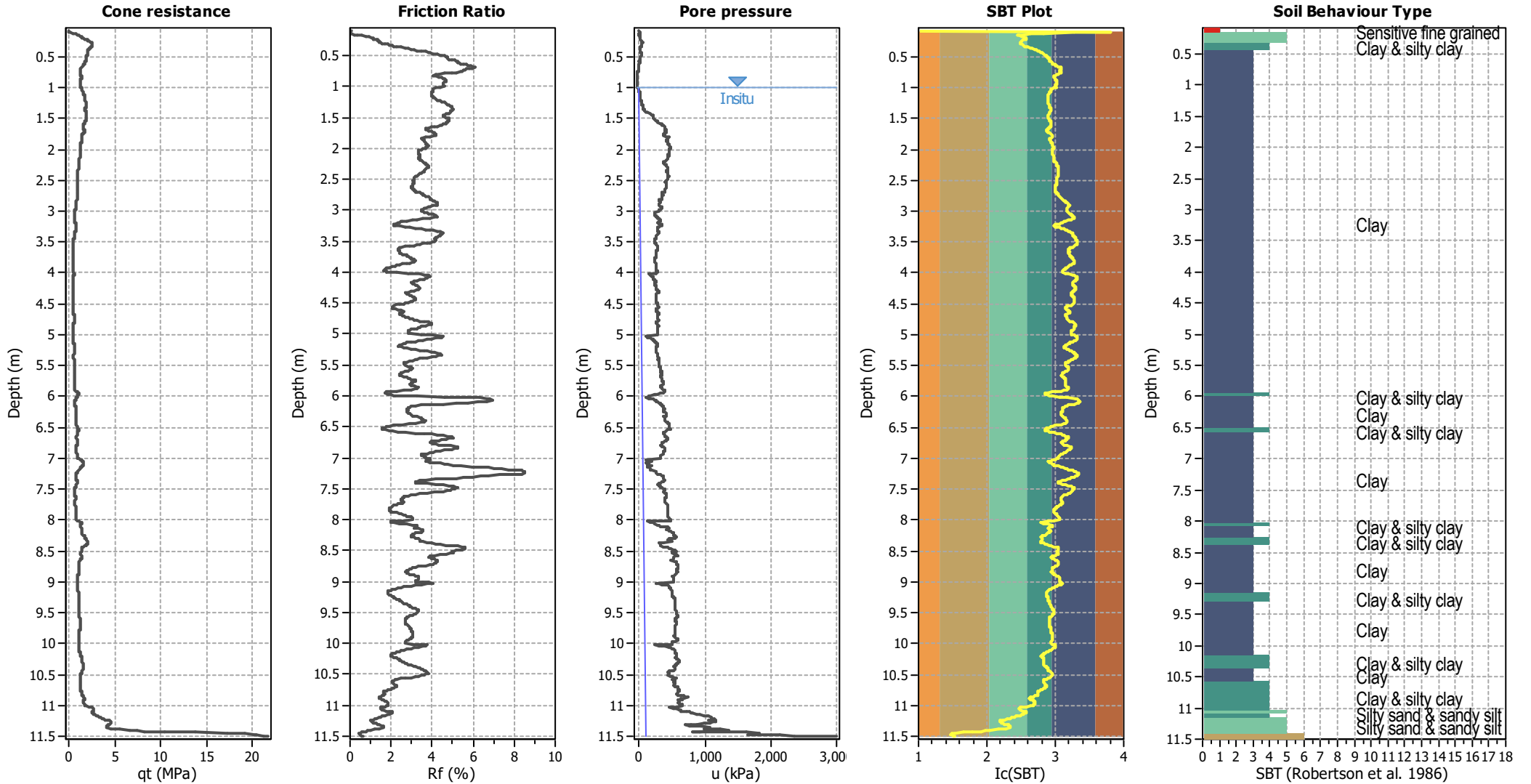
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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 $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

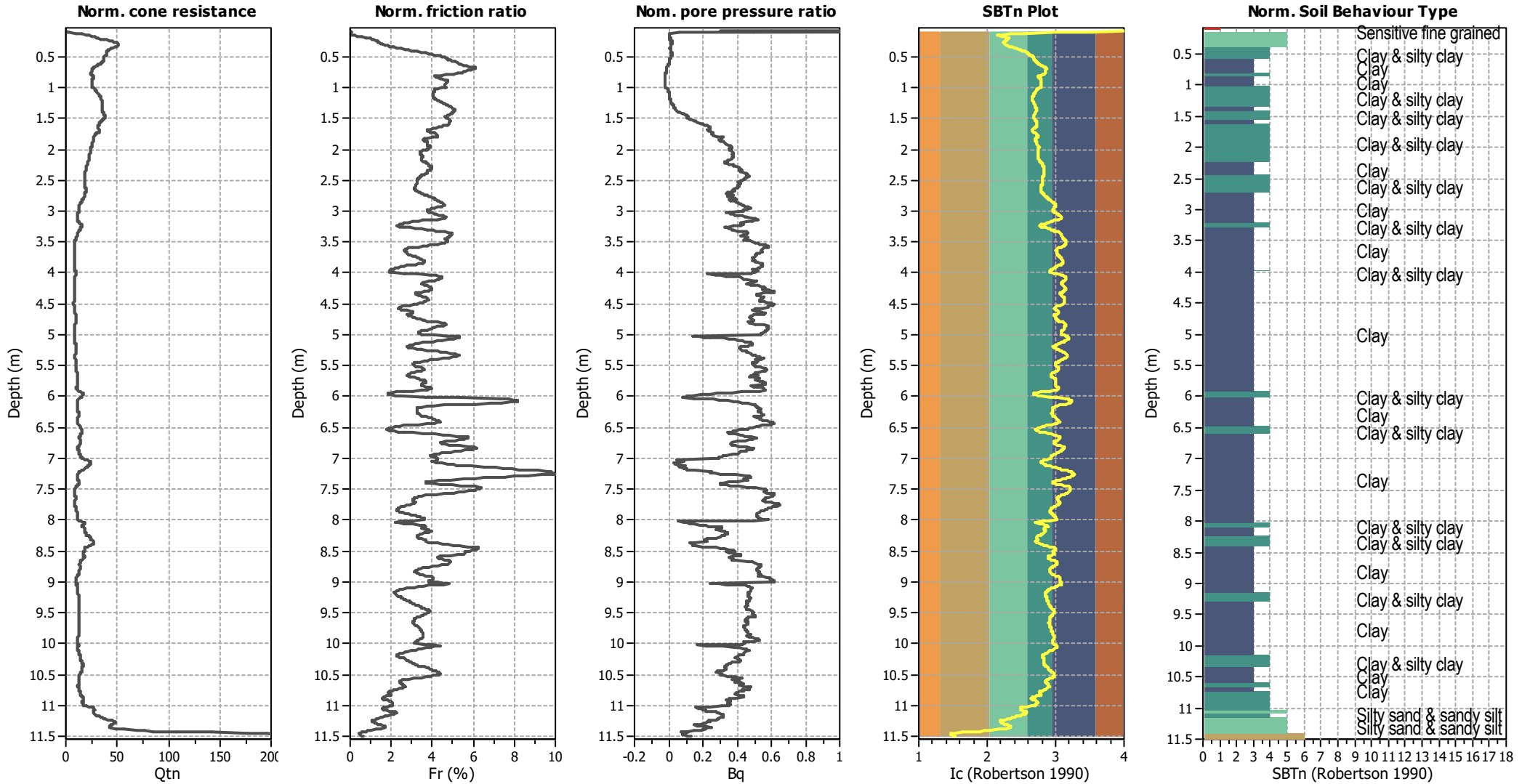
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



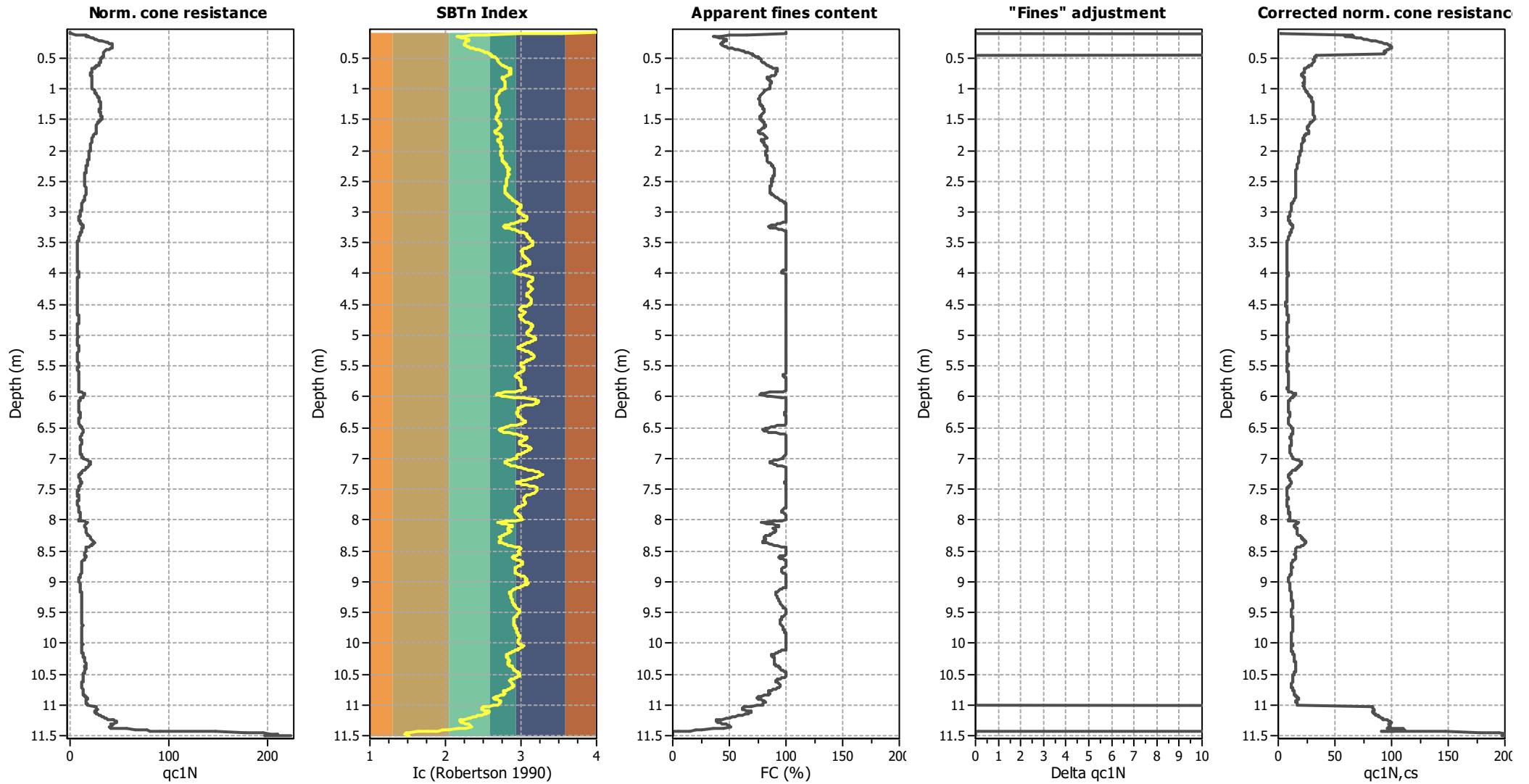
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

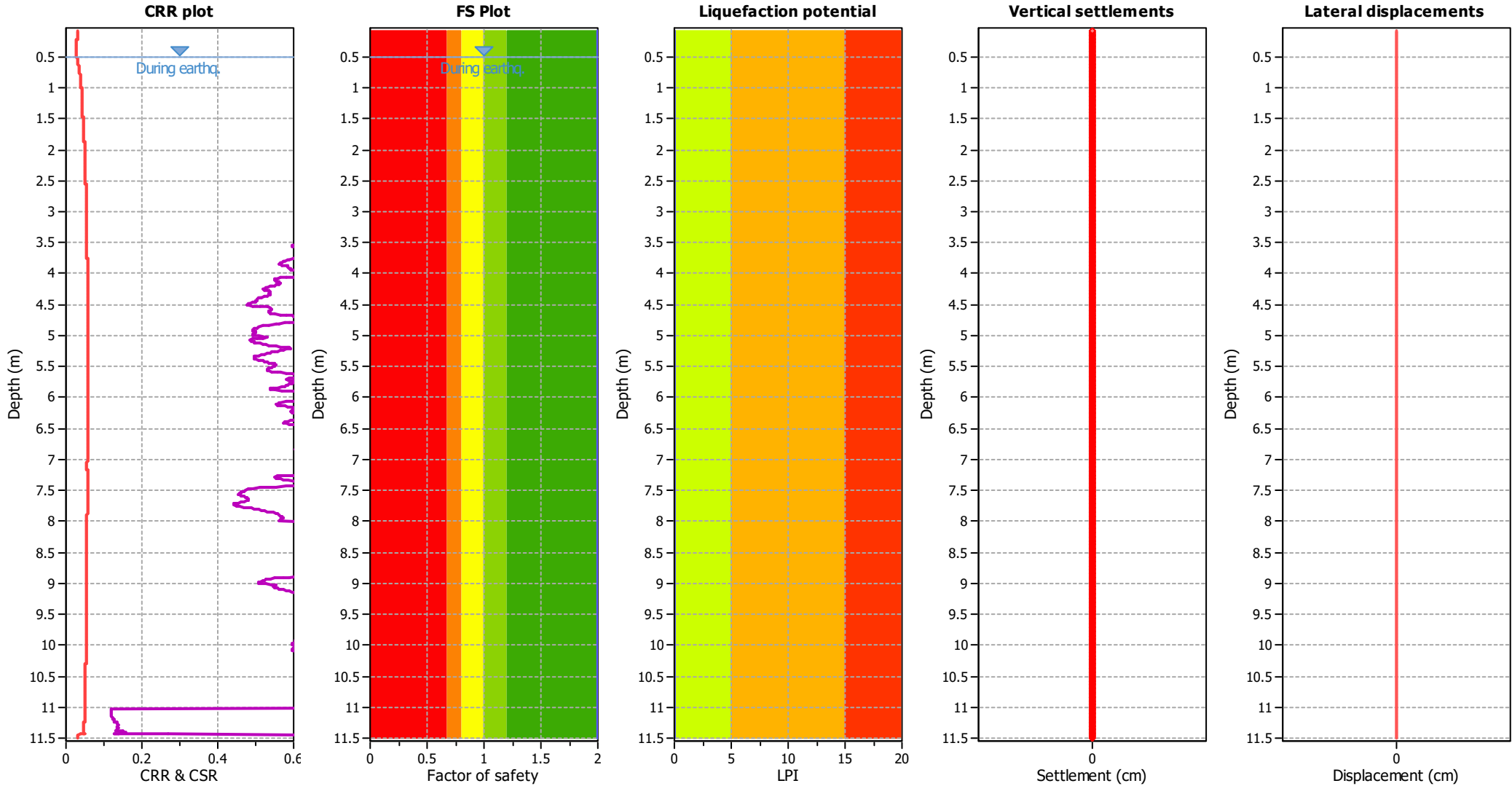
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

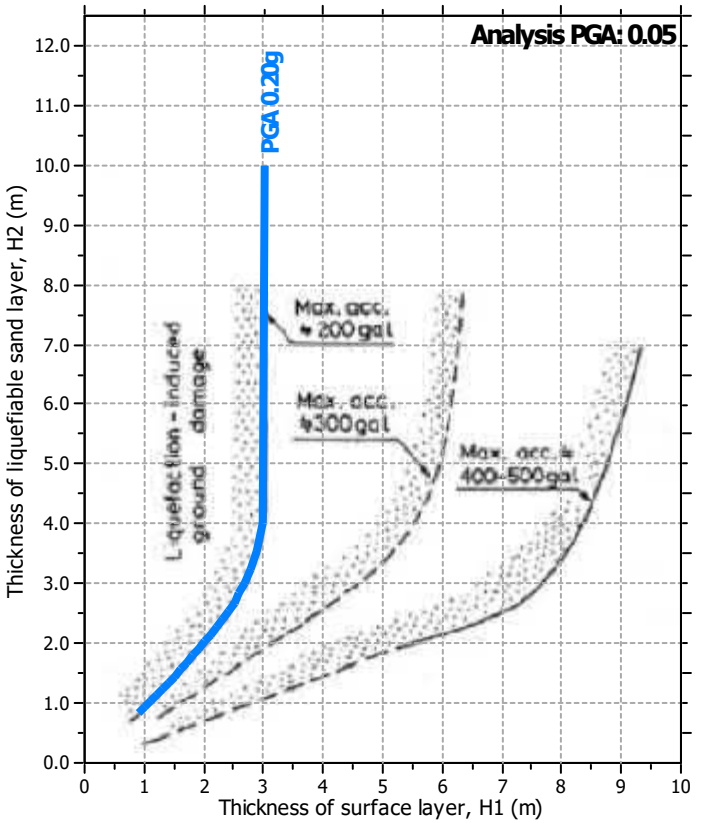
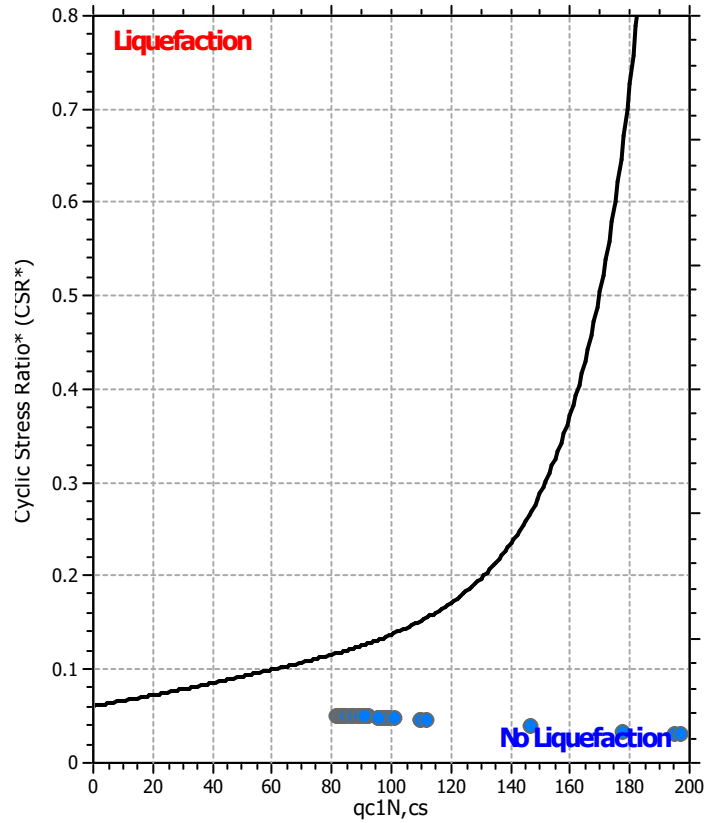
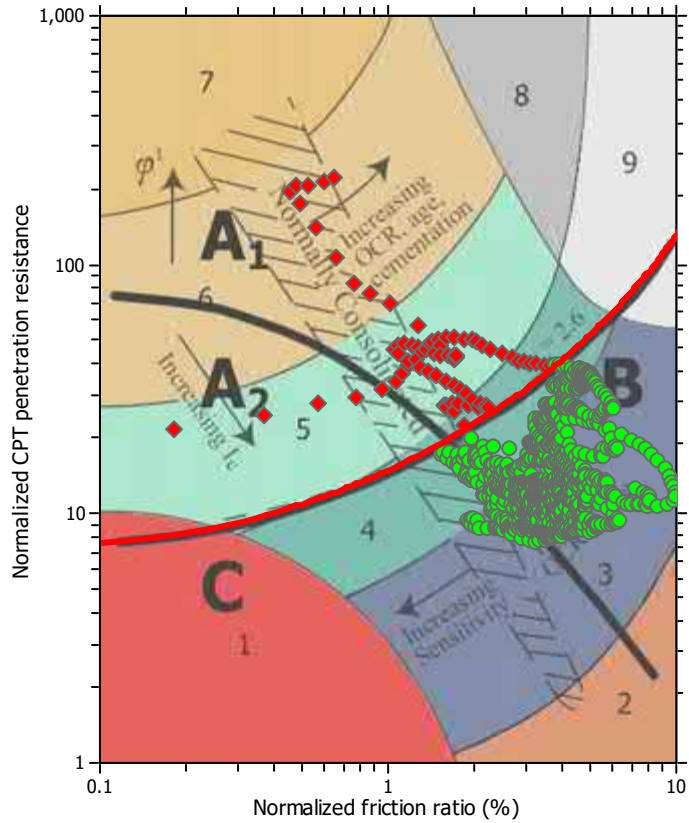
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A



**LIQUEFACTION ANALYSIS REPORT**

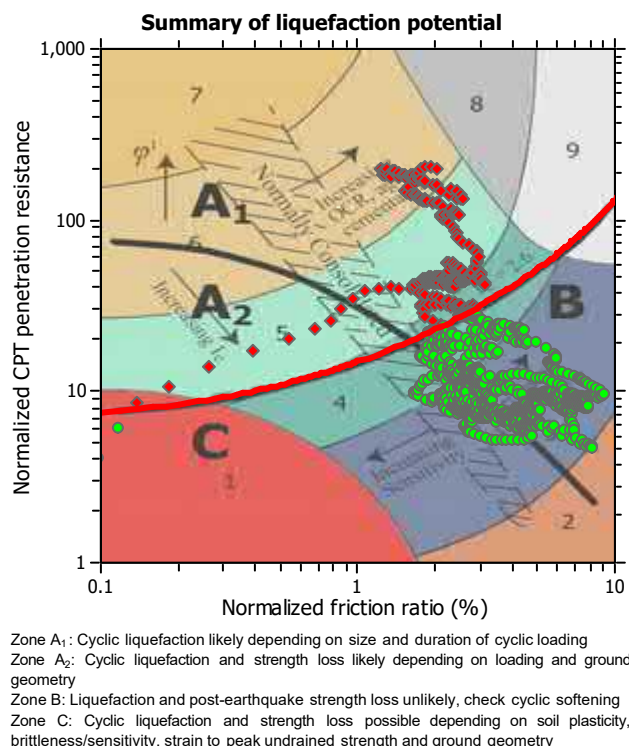
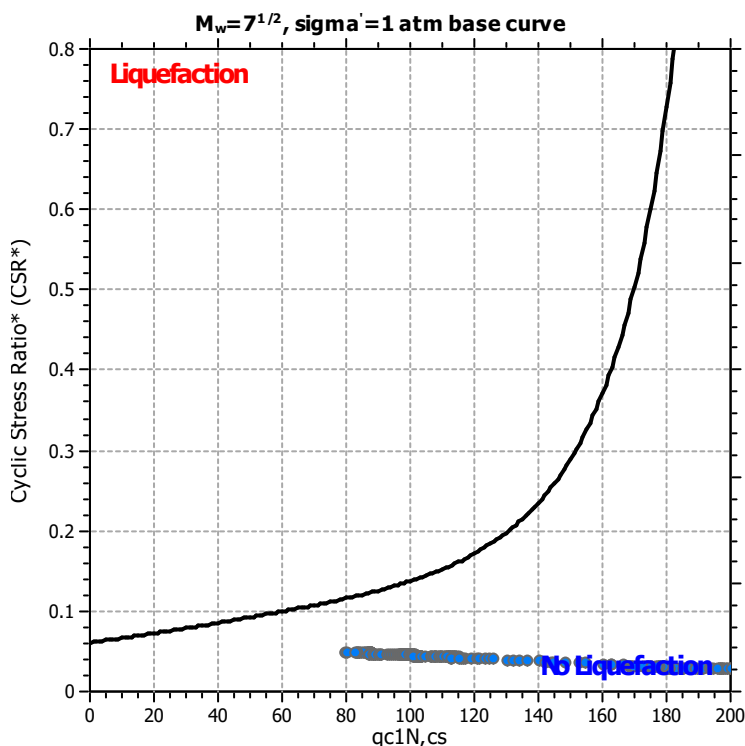
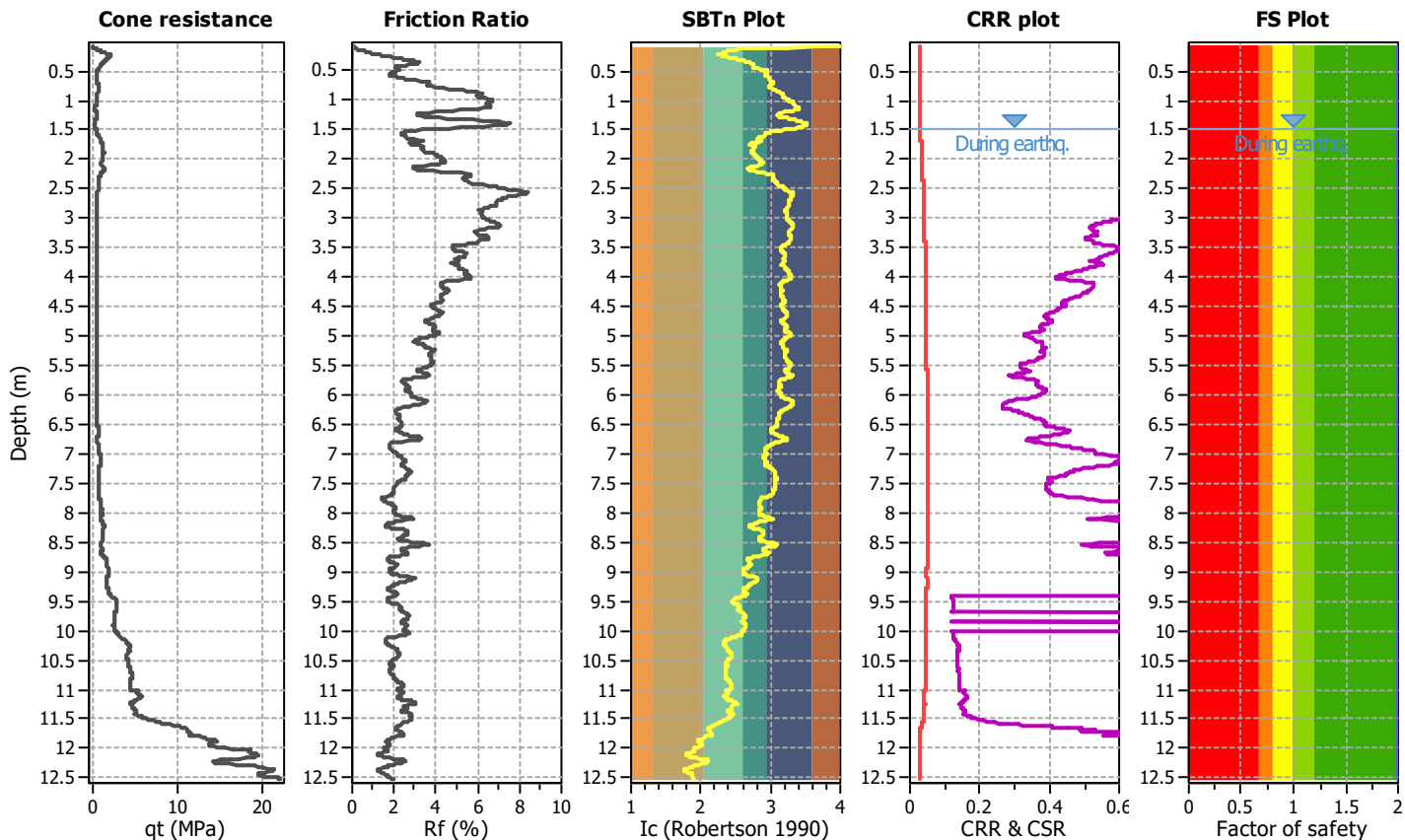
**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

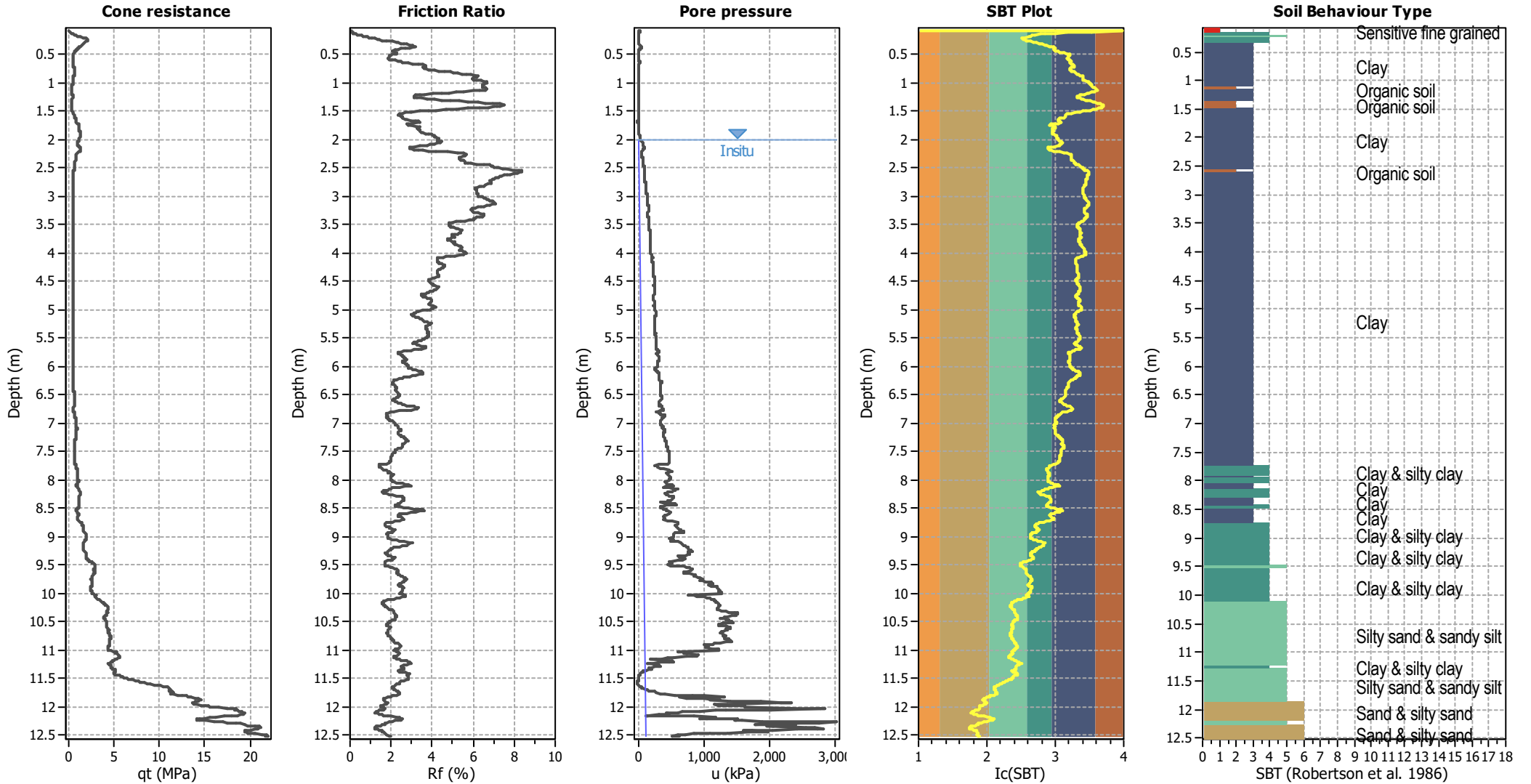
**CPT file : CPT7-1/25**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



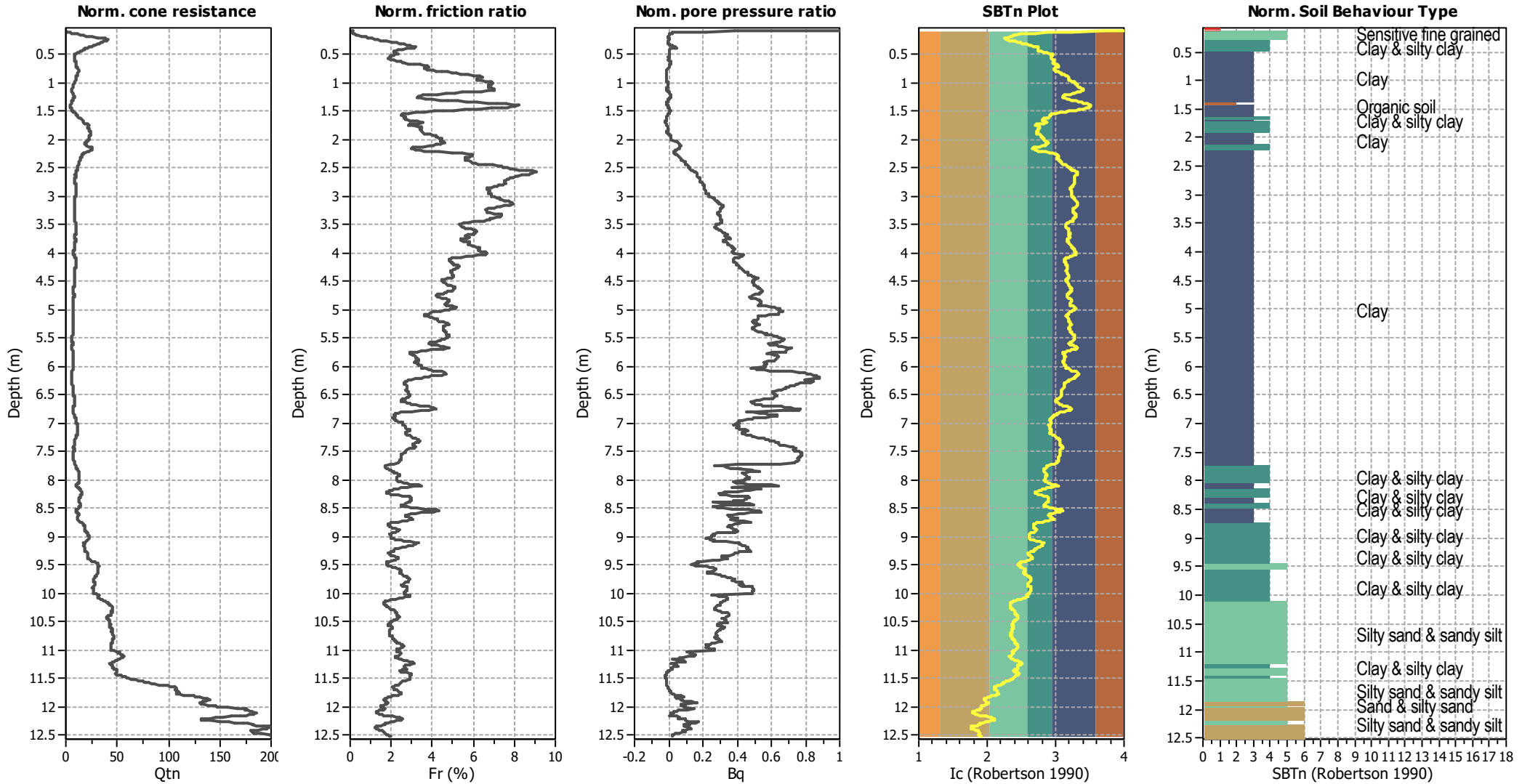
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

<span style="color:red">■</span> 1. Sensitive fine grained	<span style="color:green">■</span> 4. Clayey silt to silty	<span style="color:orange">■</span> 7. Gravely sand to sand
<span style="color:brown">■</span> 2. Organic material	<span style="color:lightgreen">■</span> 5. Silty sand to sandy silt	<span style="color:grey">■</span> 8. Very stiff sand to
<span style="color:blue">■</span> 3. Clay to silty clay	<span style="color:yellow">■</span> 6. Clean sand to silty sand	<span style="color:lightgrey">■</span> 9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



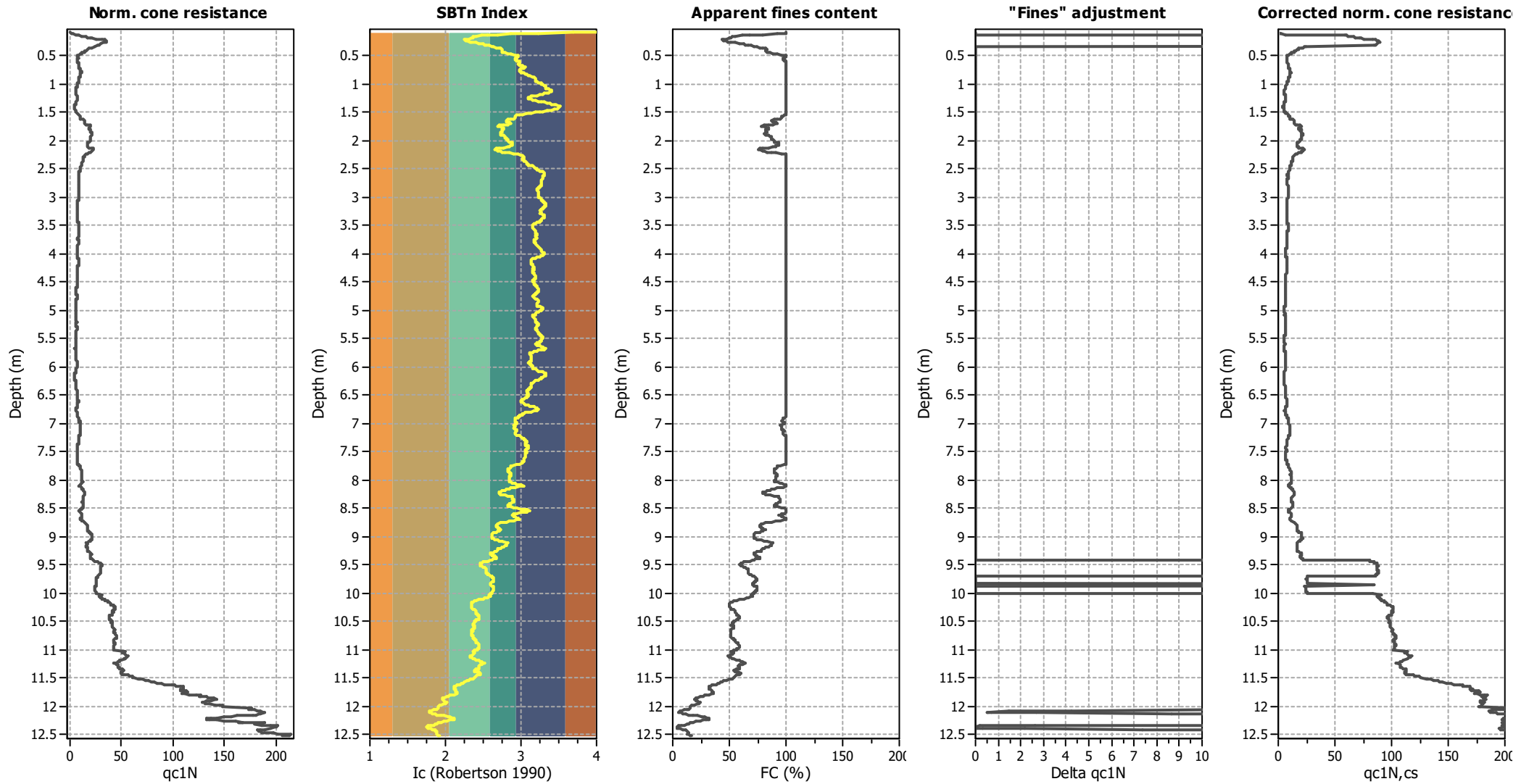
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

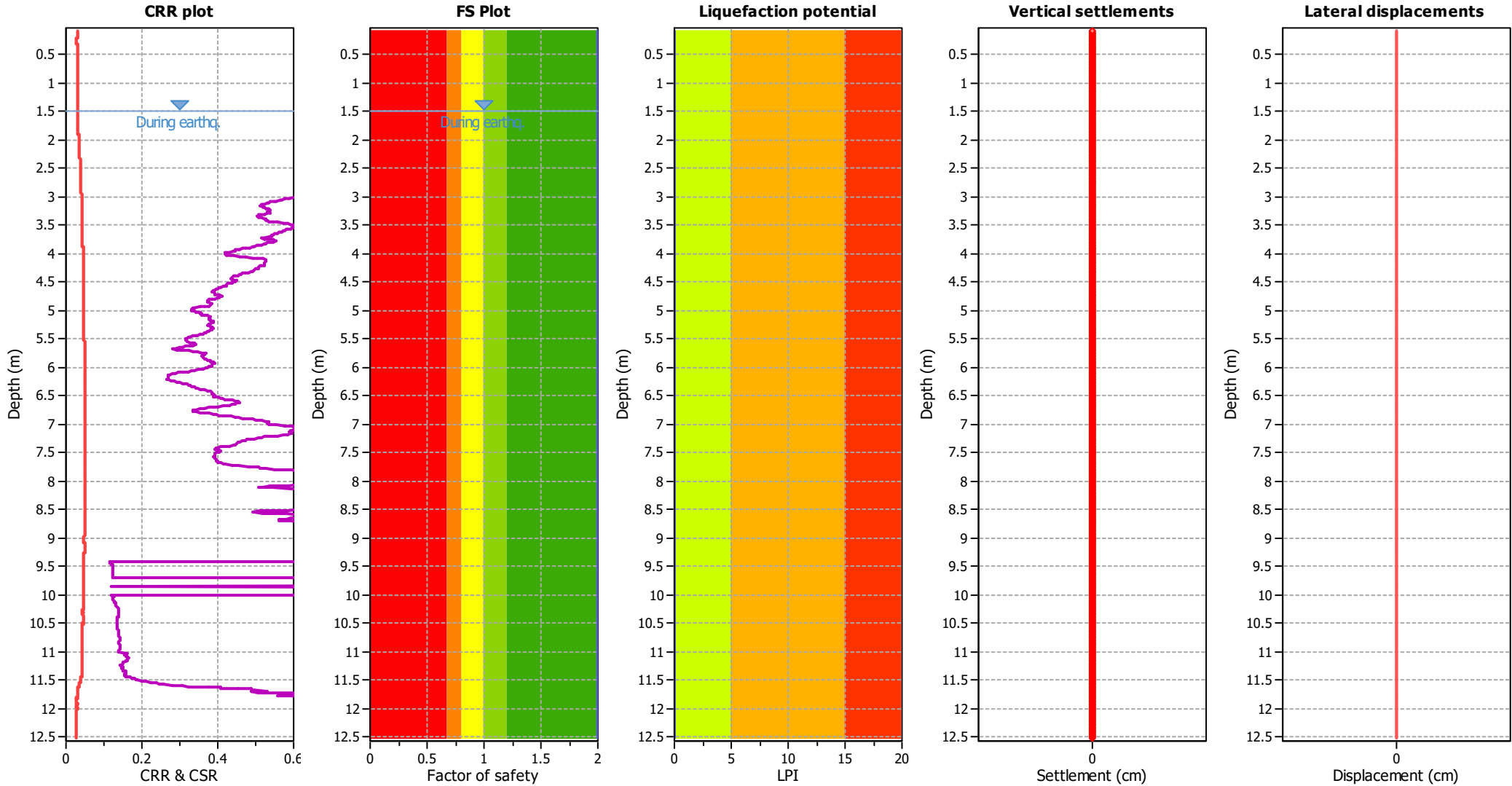


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWL (earthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

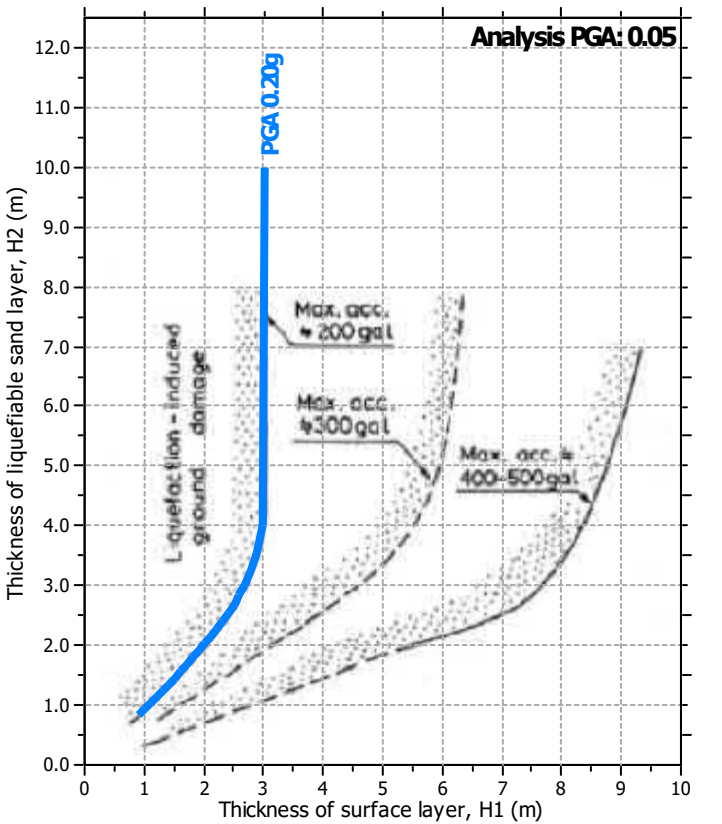
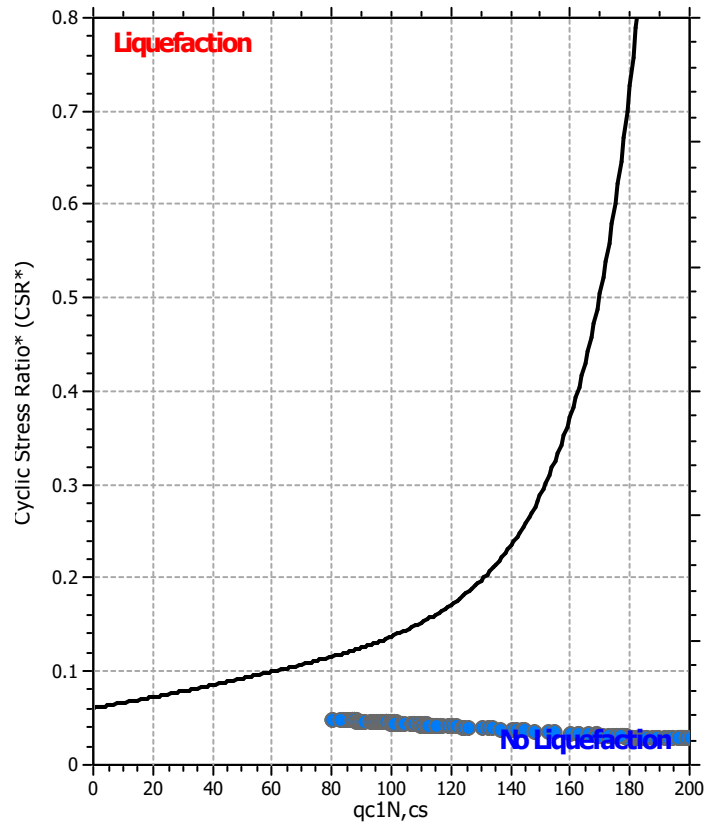
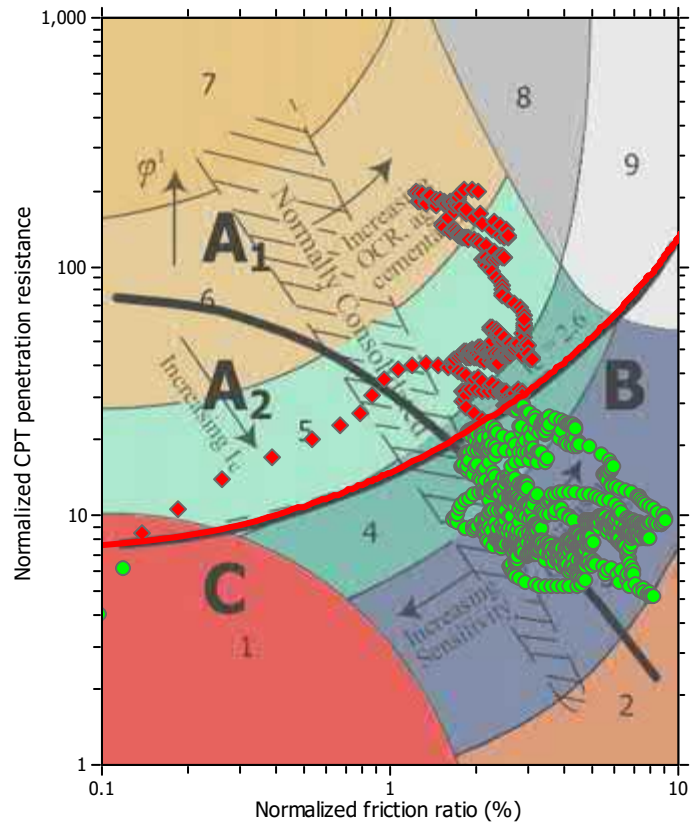
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_\sigma$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

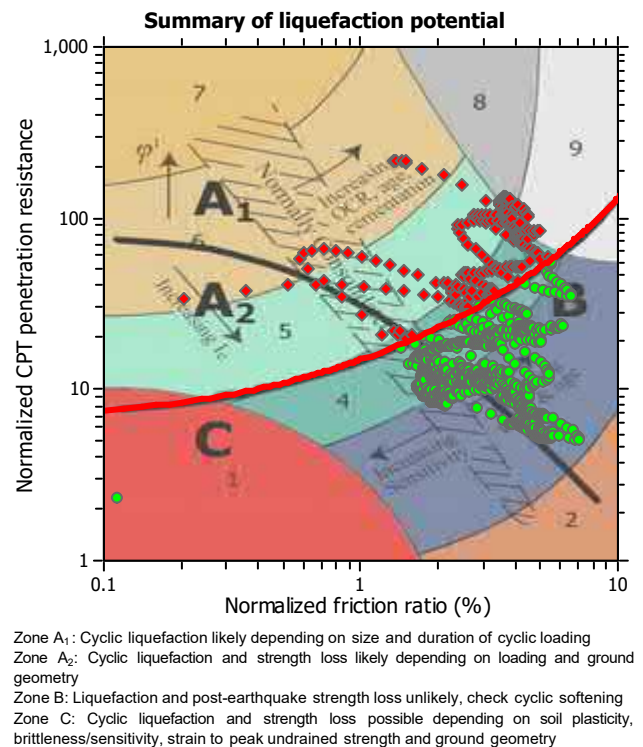
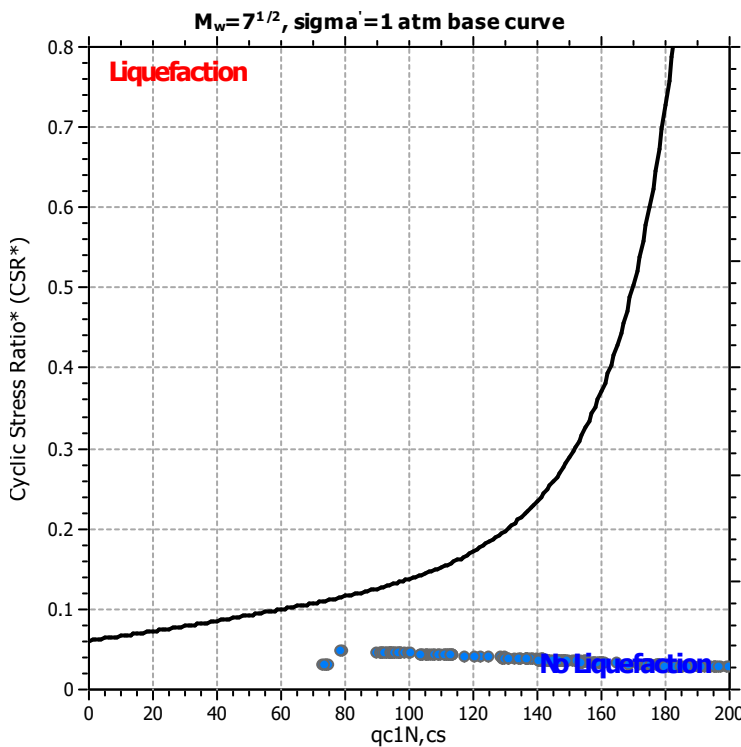
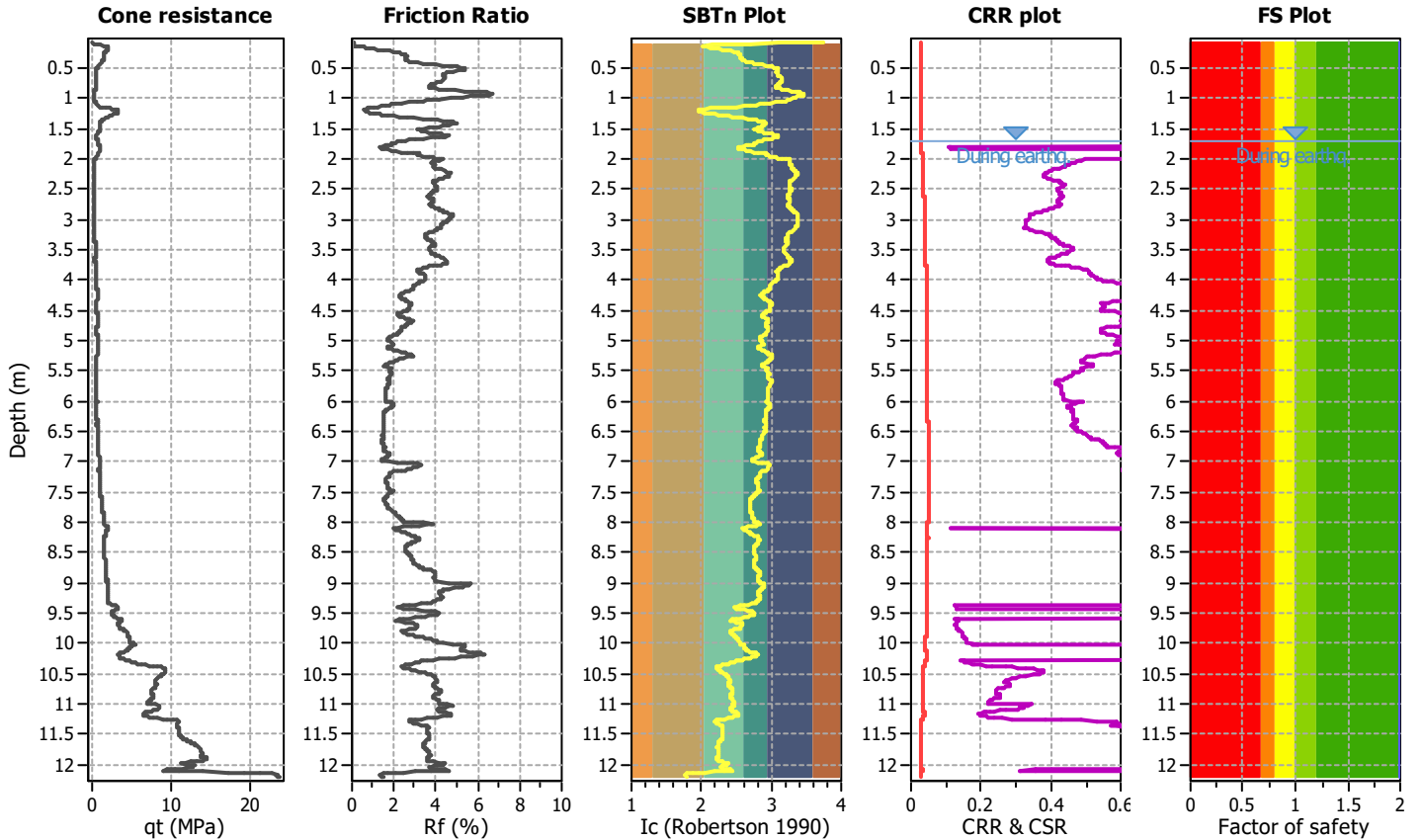
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT8-1/25**

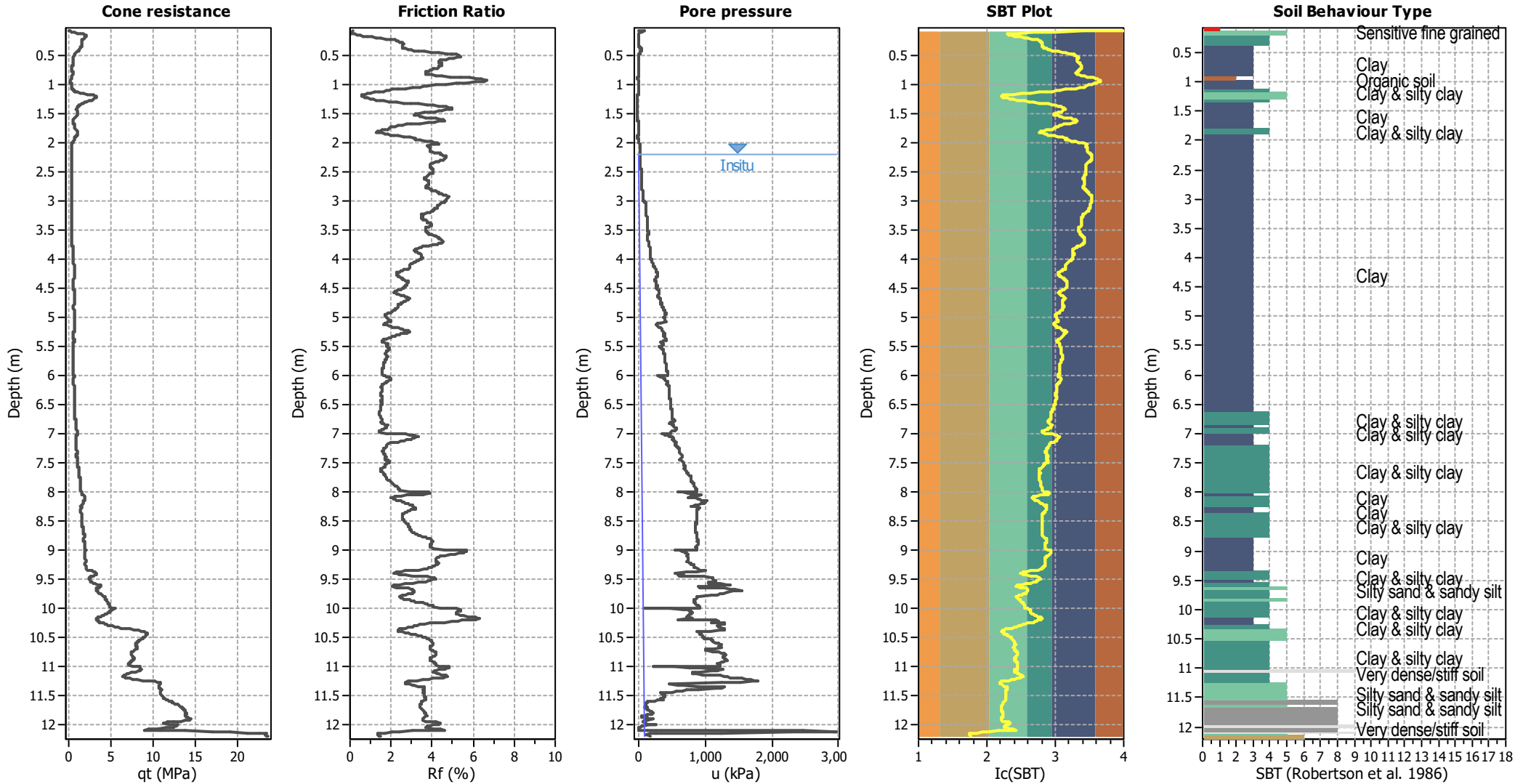
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

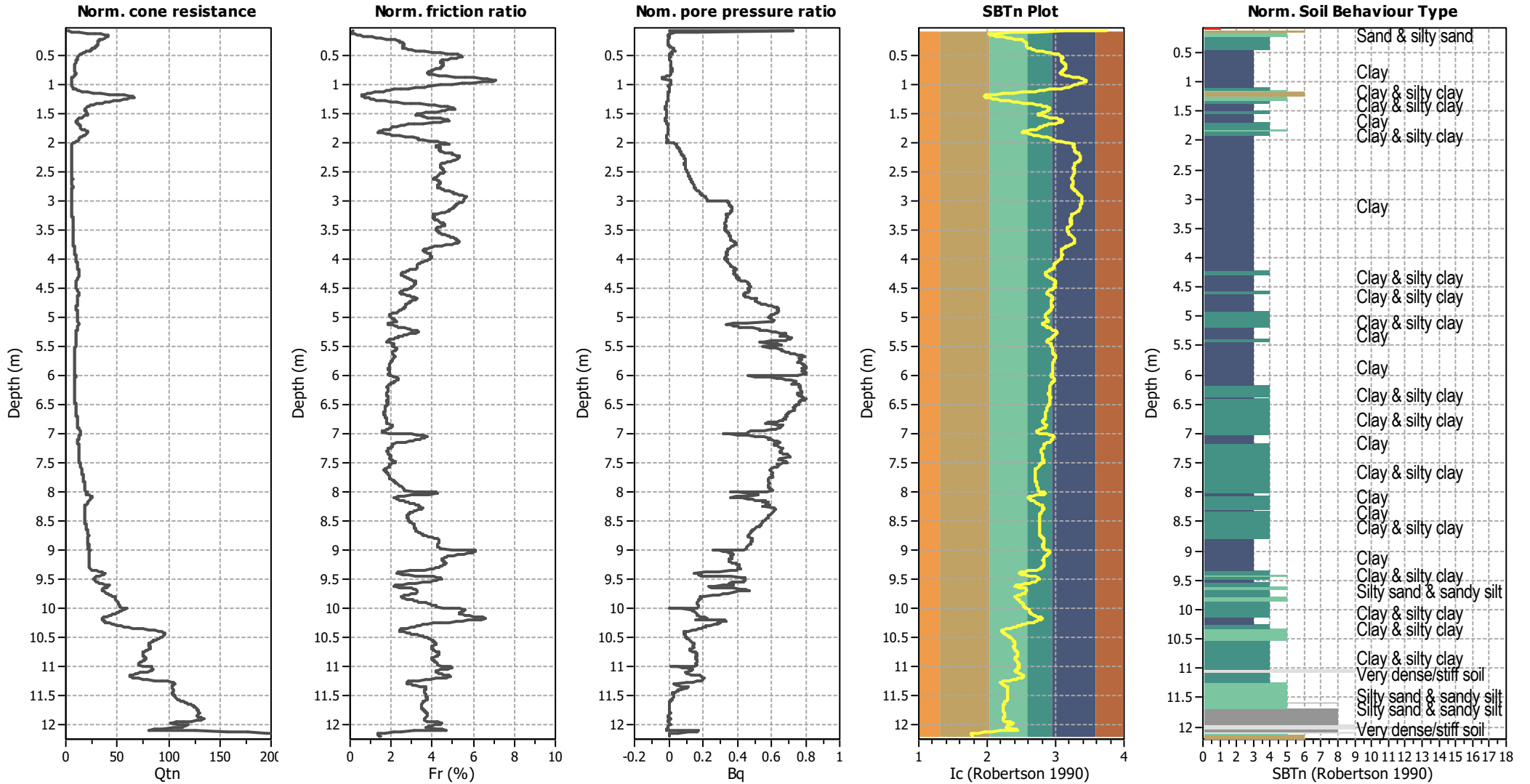
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



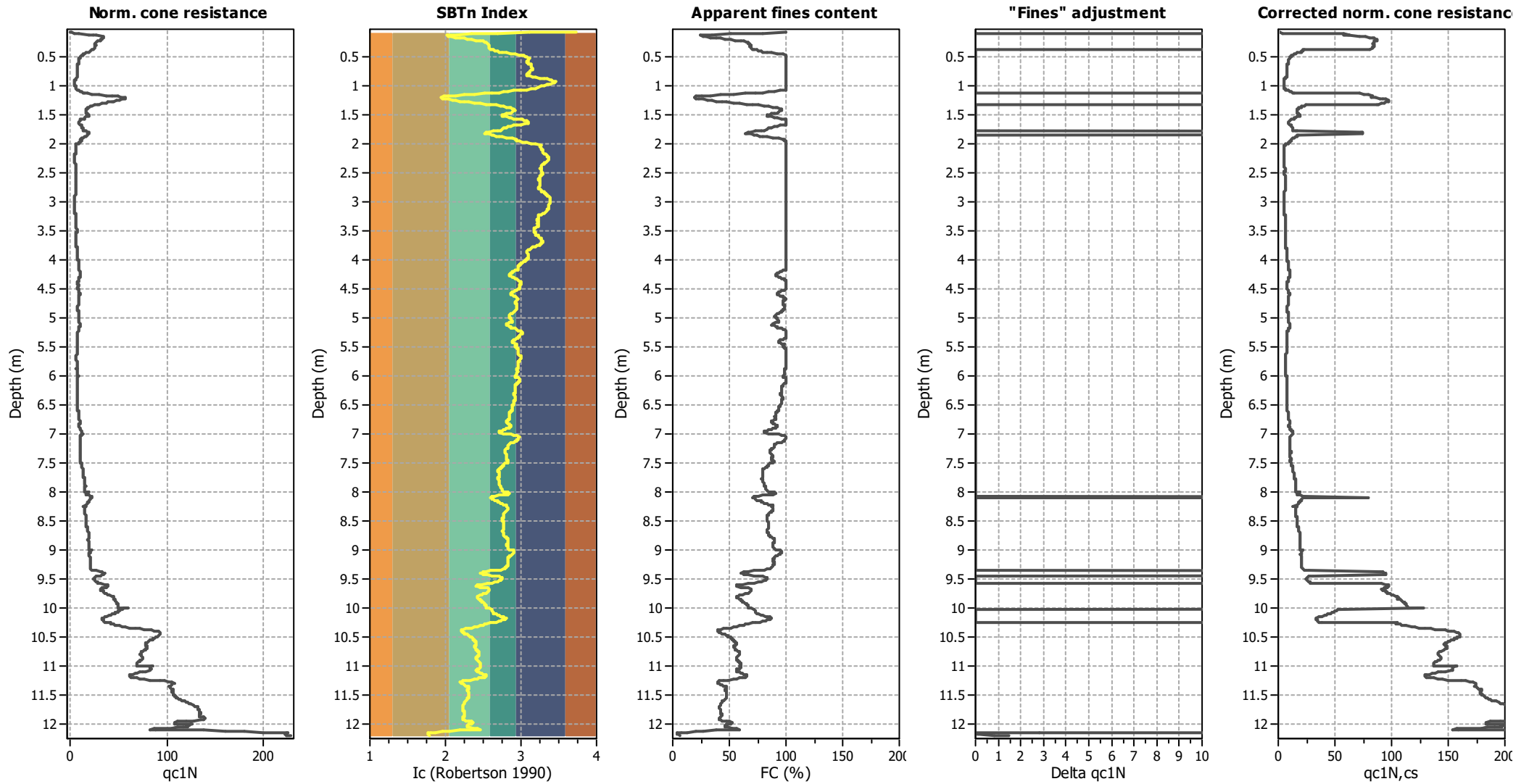
**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

**SBTn legend**

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

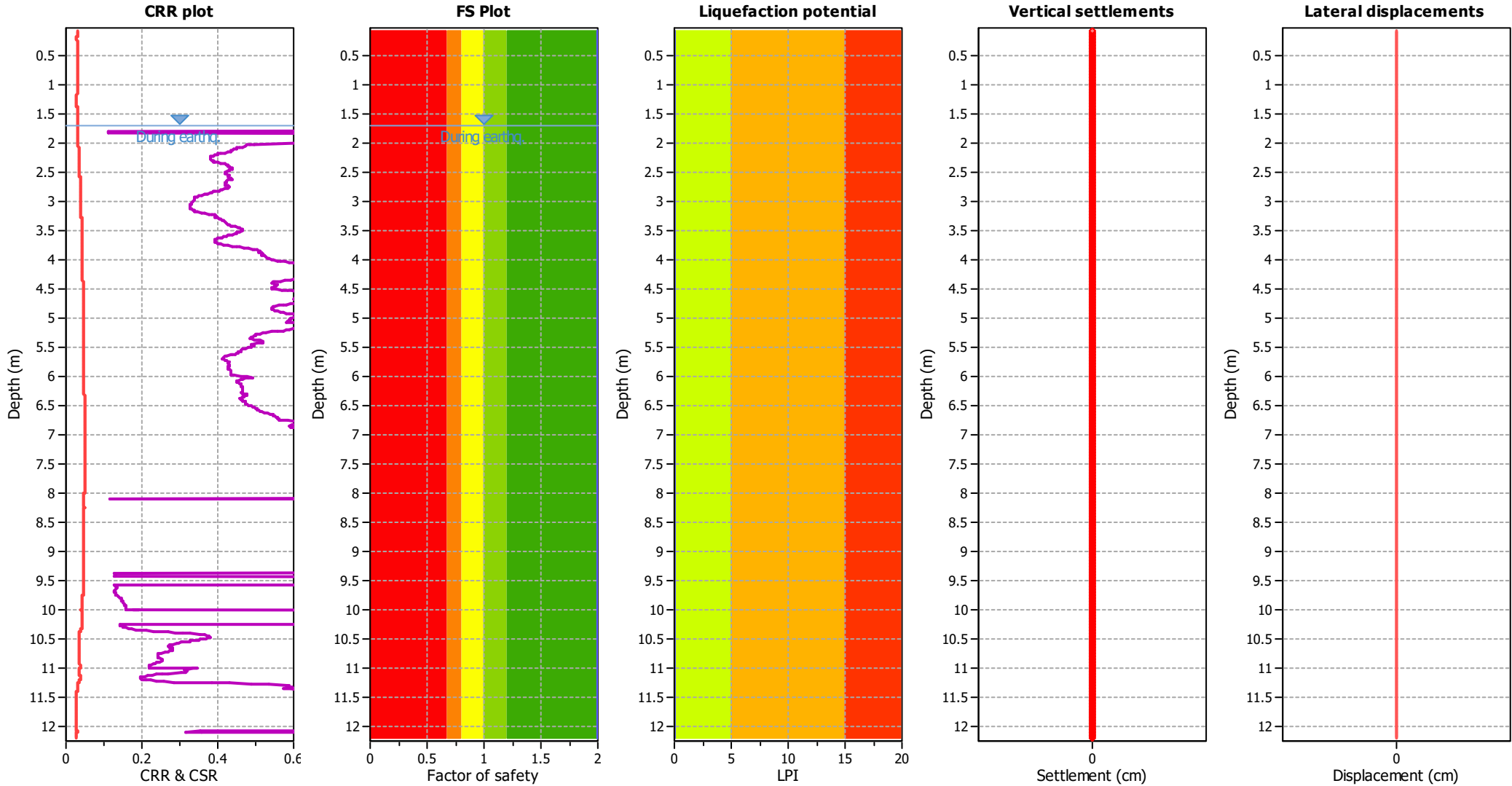
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

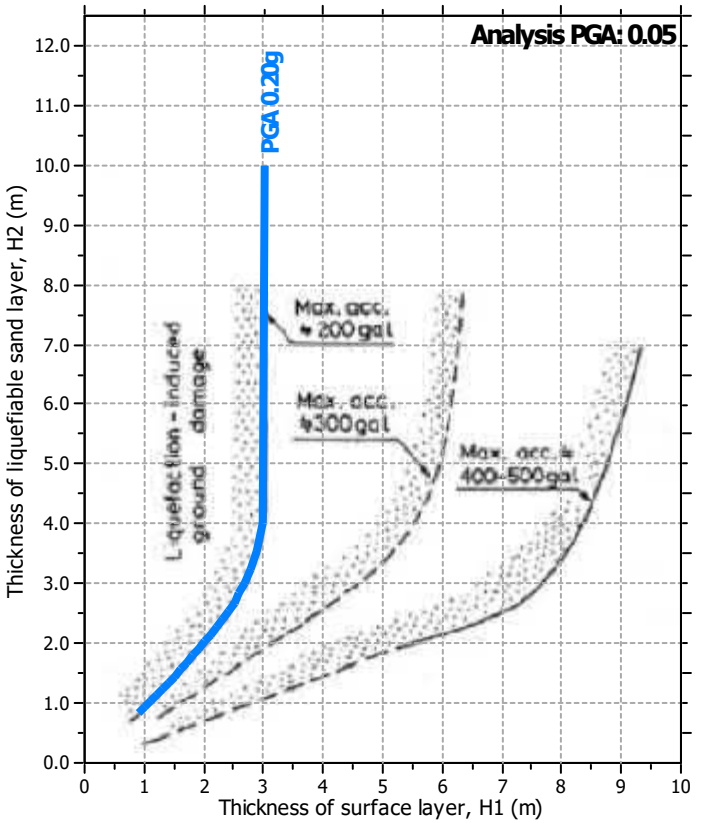
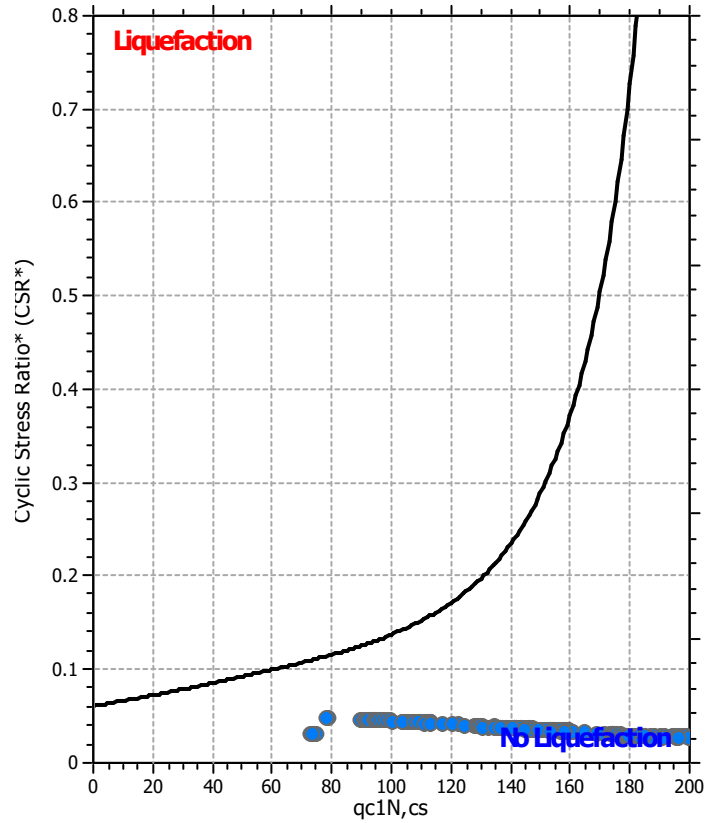
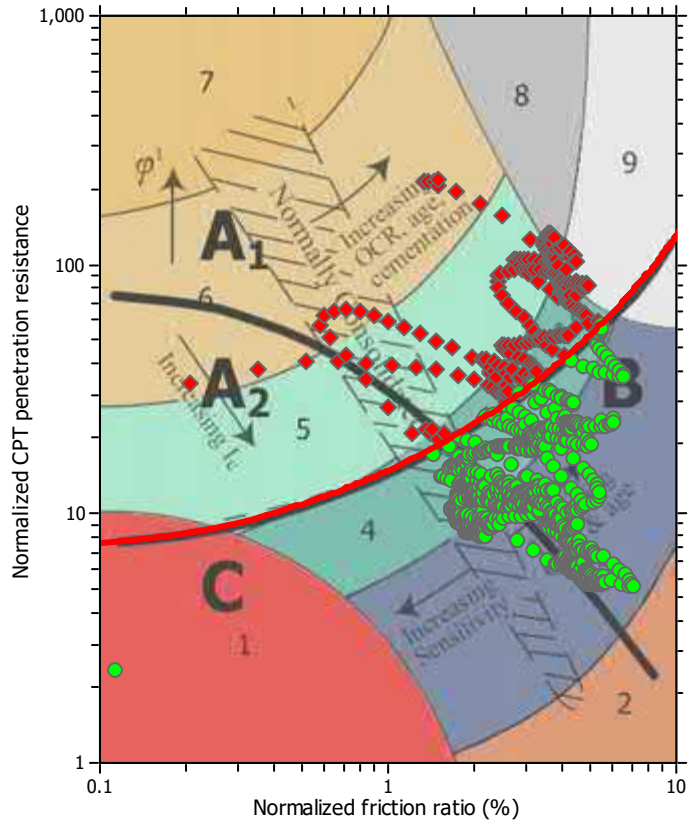
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



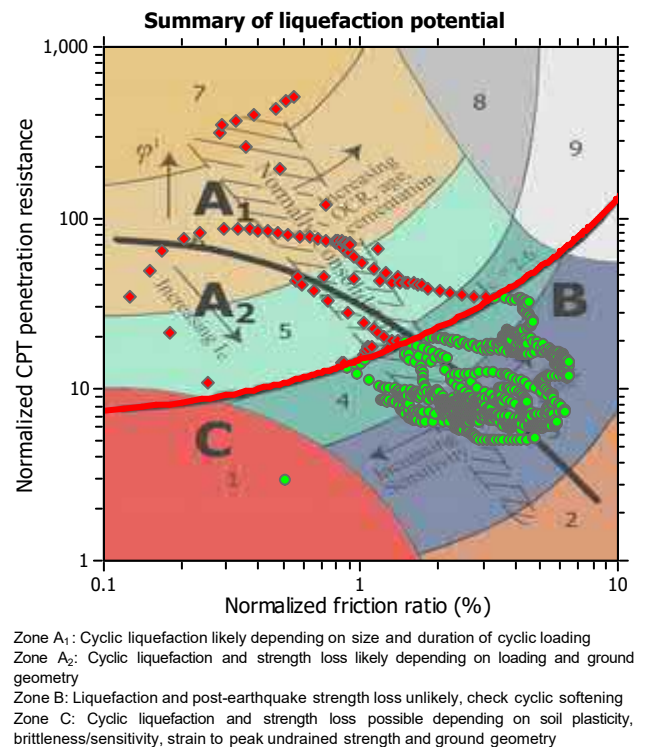
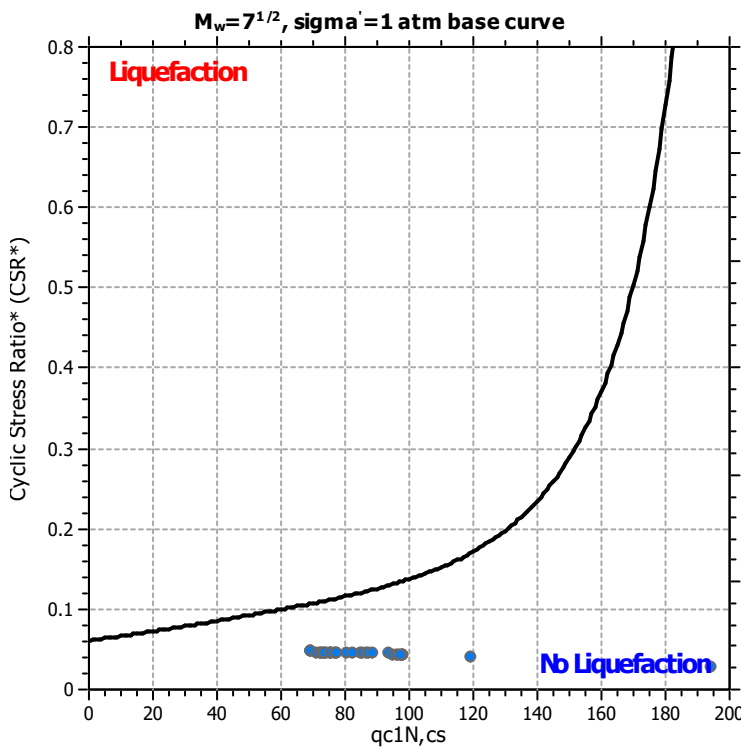
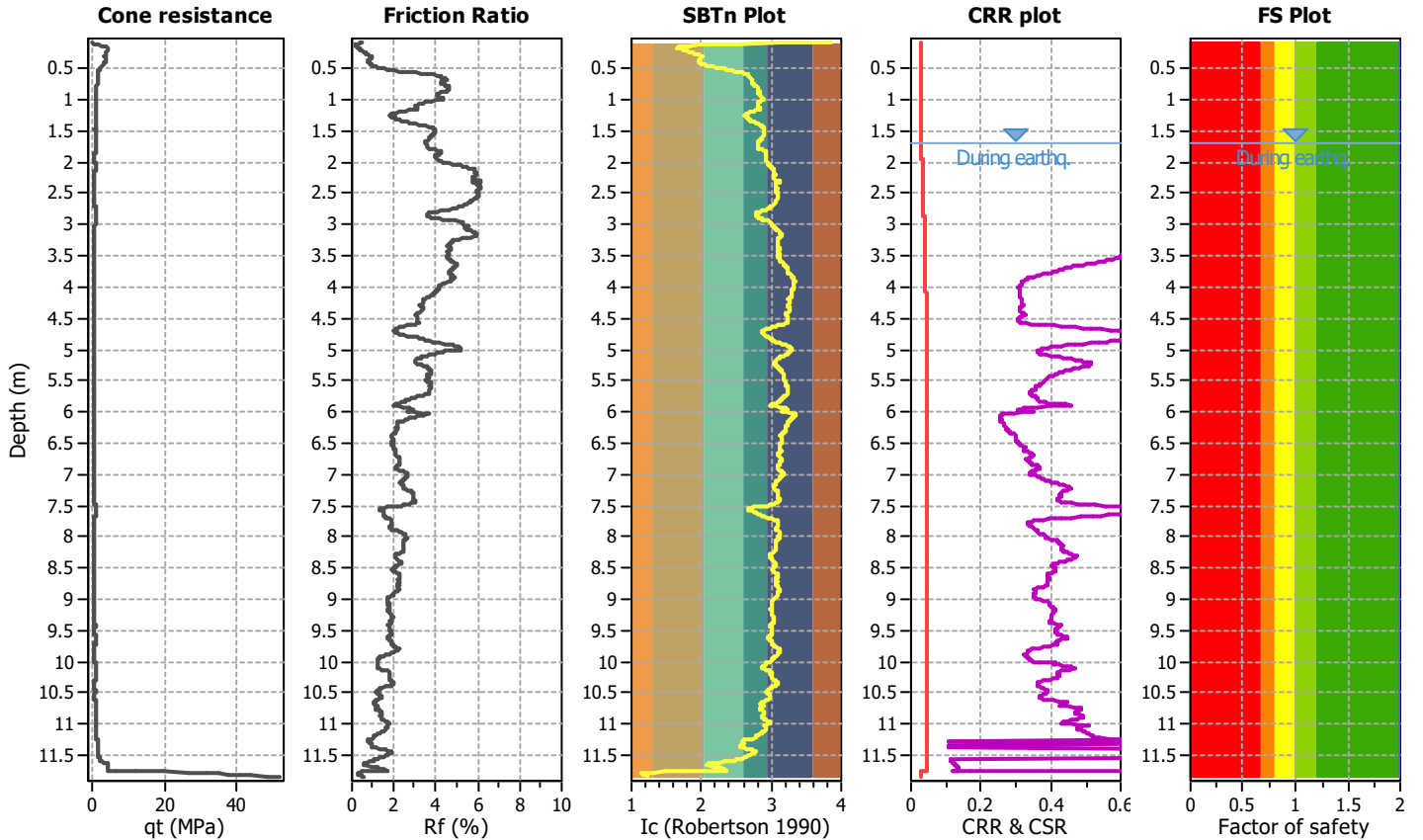
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT9-1/25**

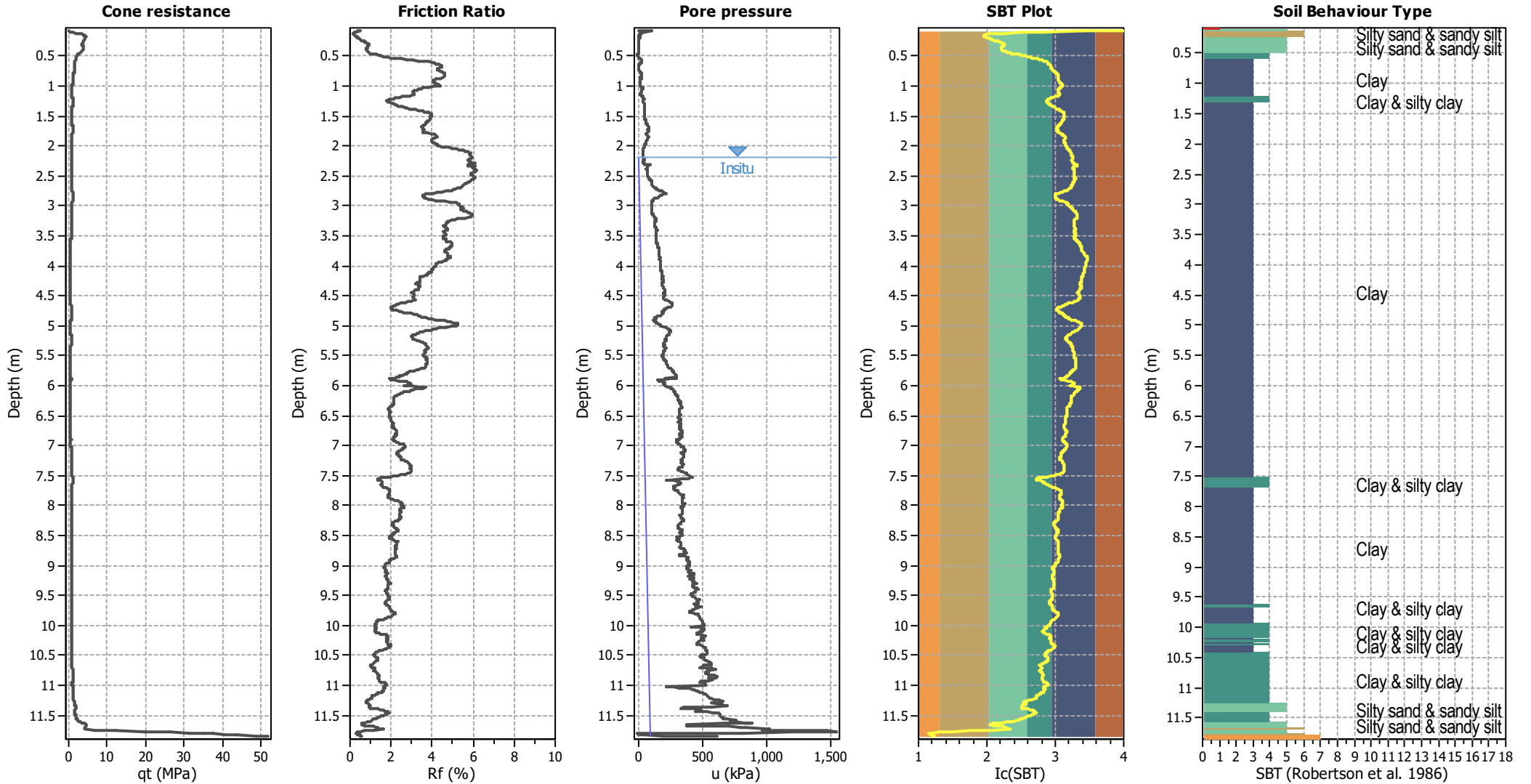
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 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 $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



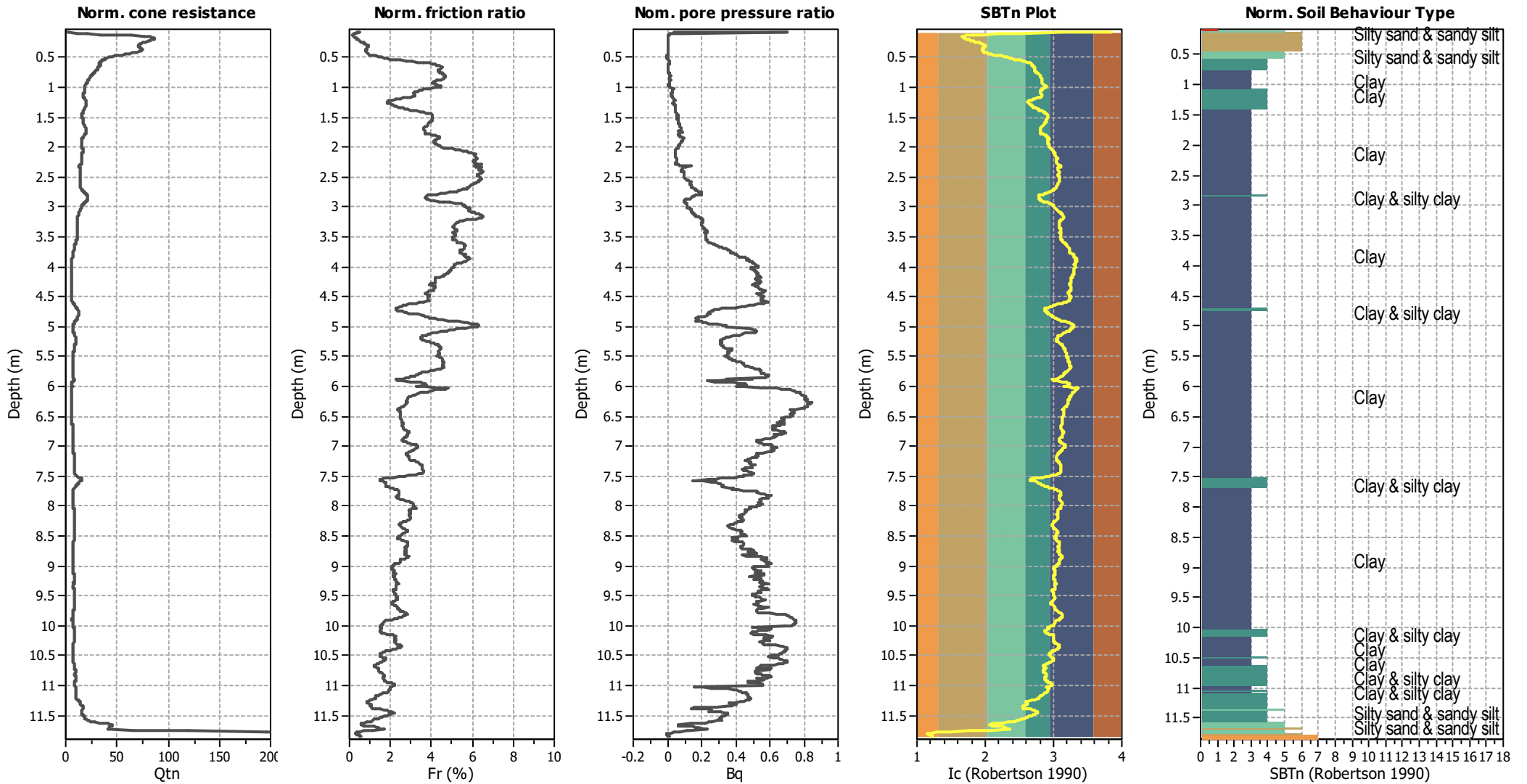
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clay
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



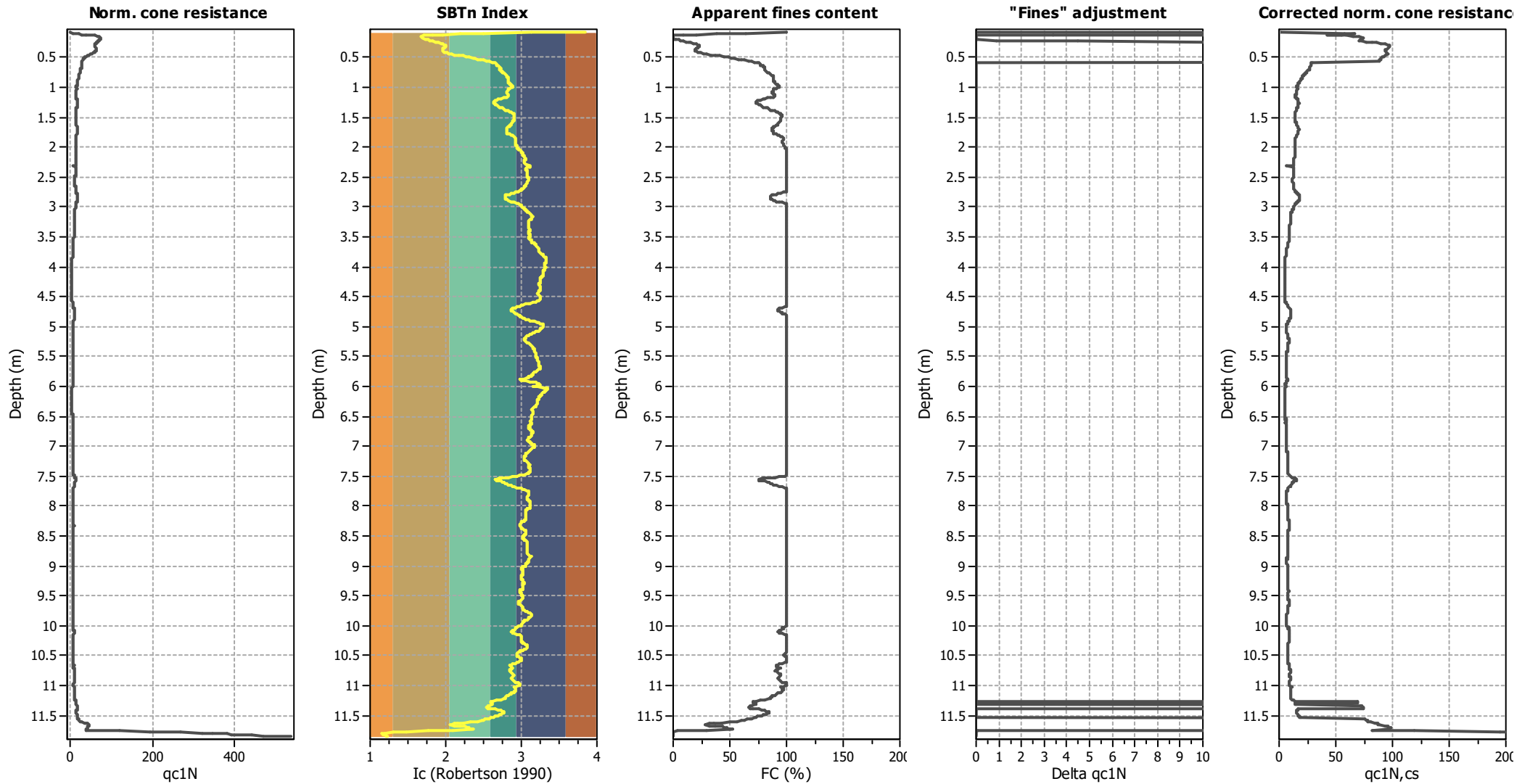
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

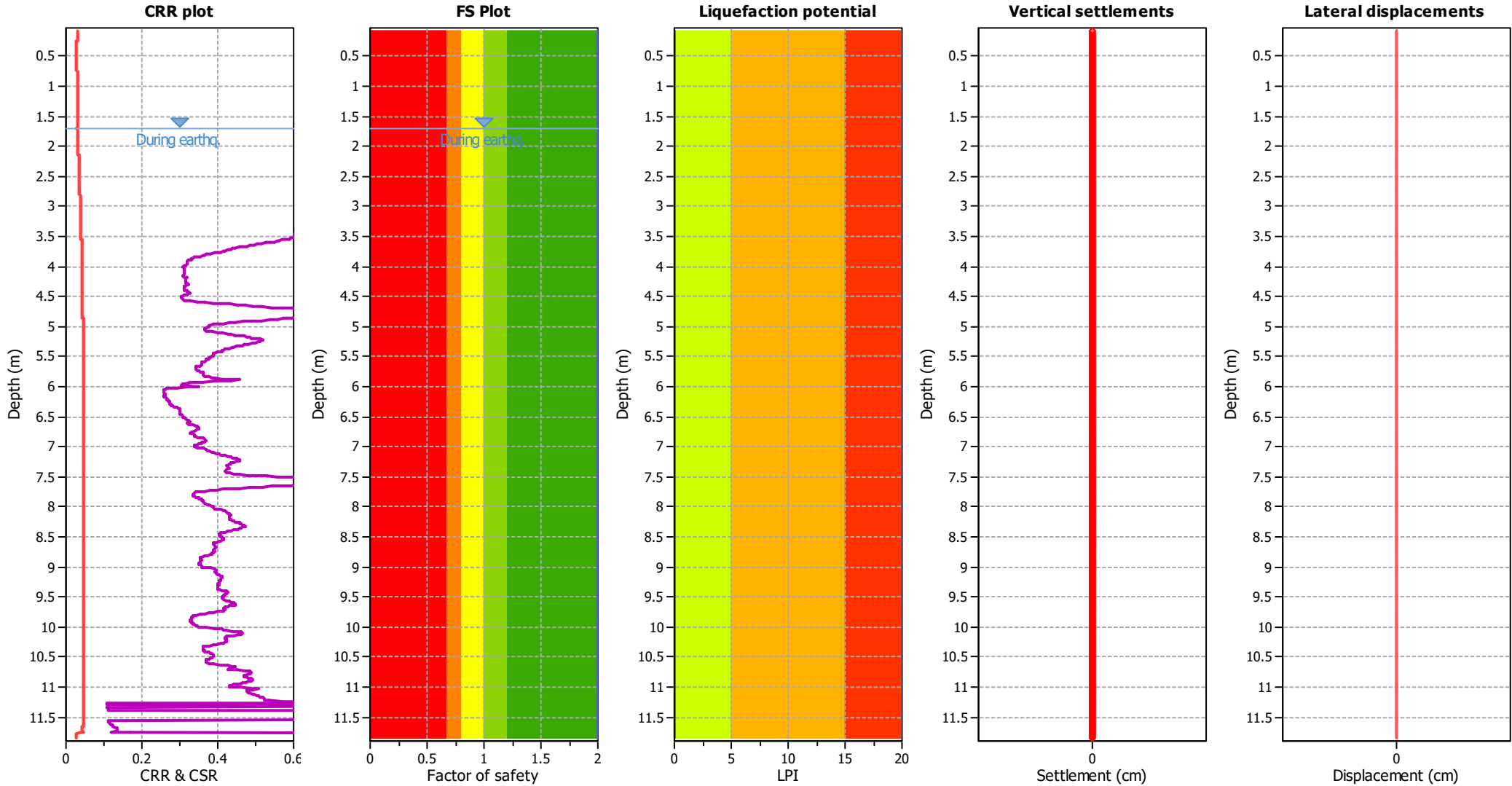


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

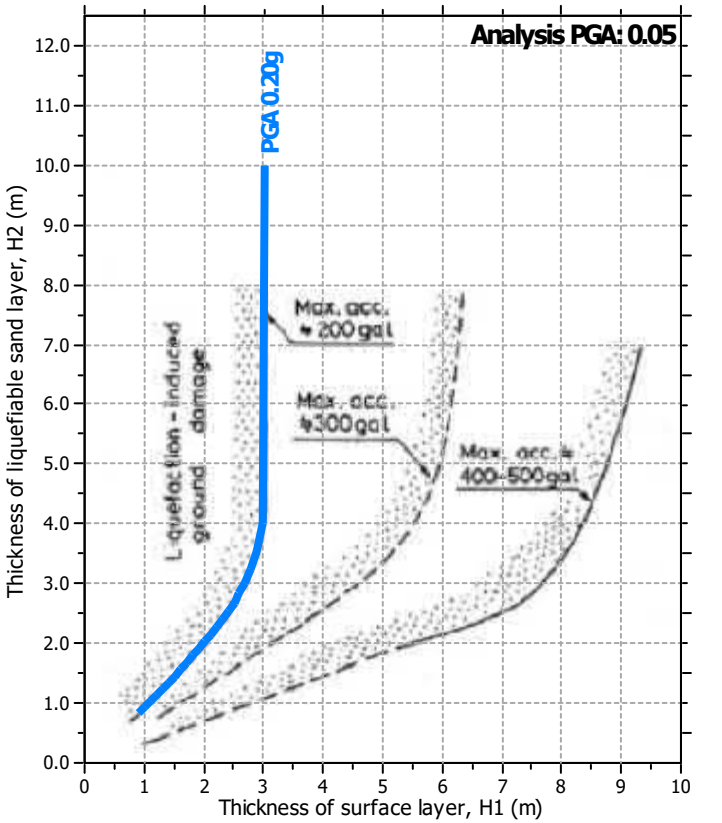
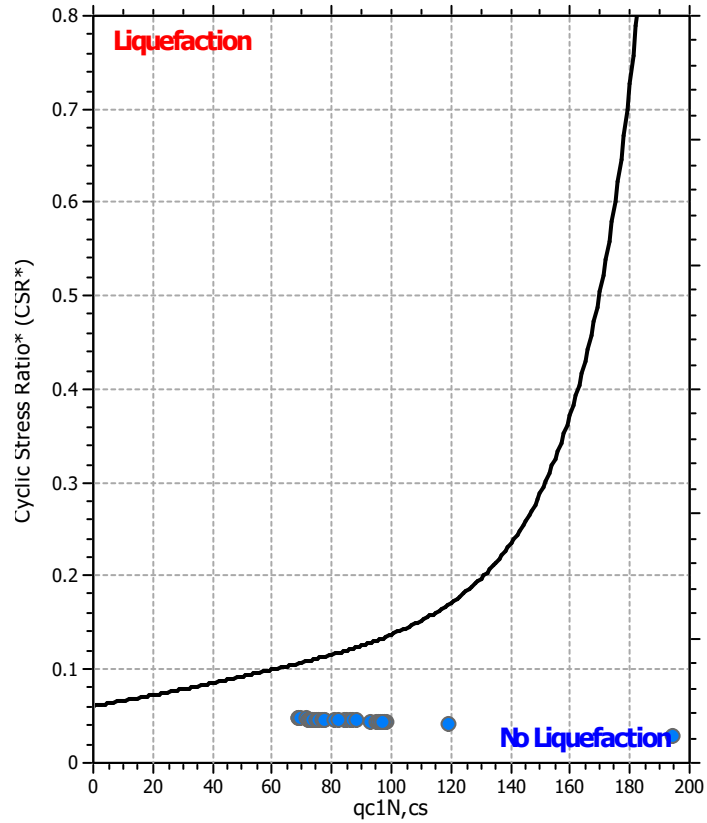
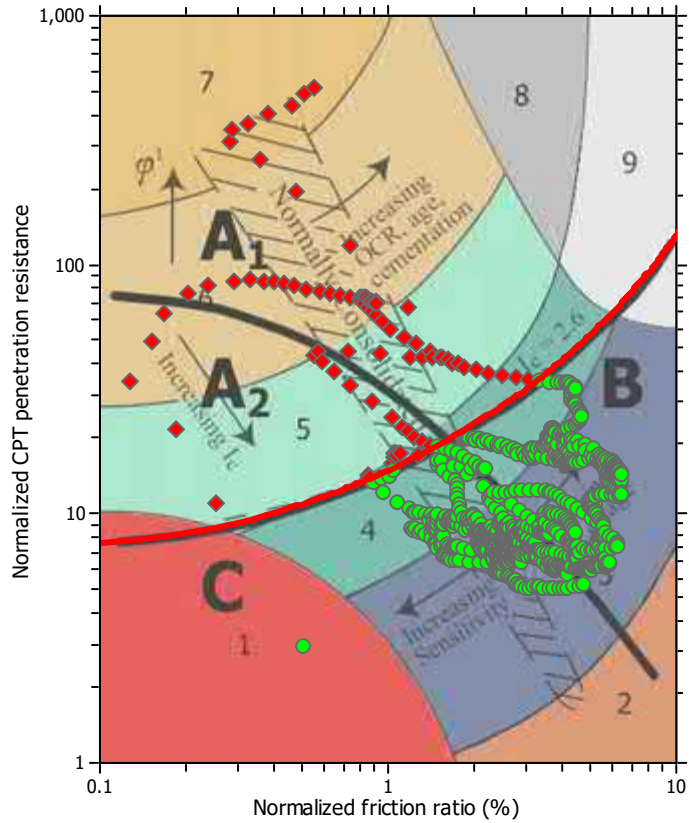
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

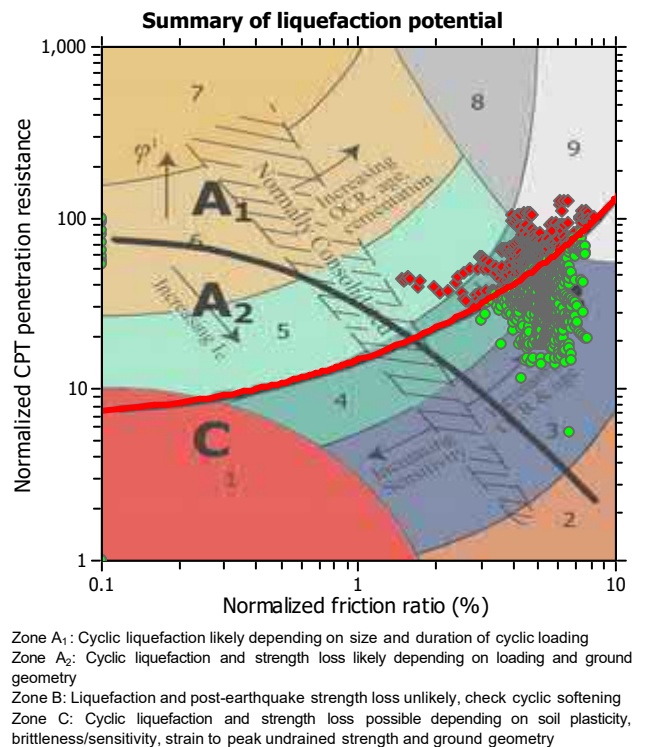
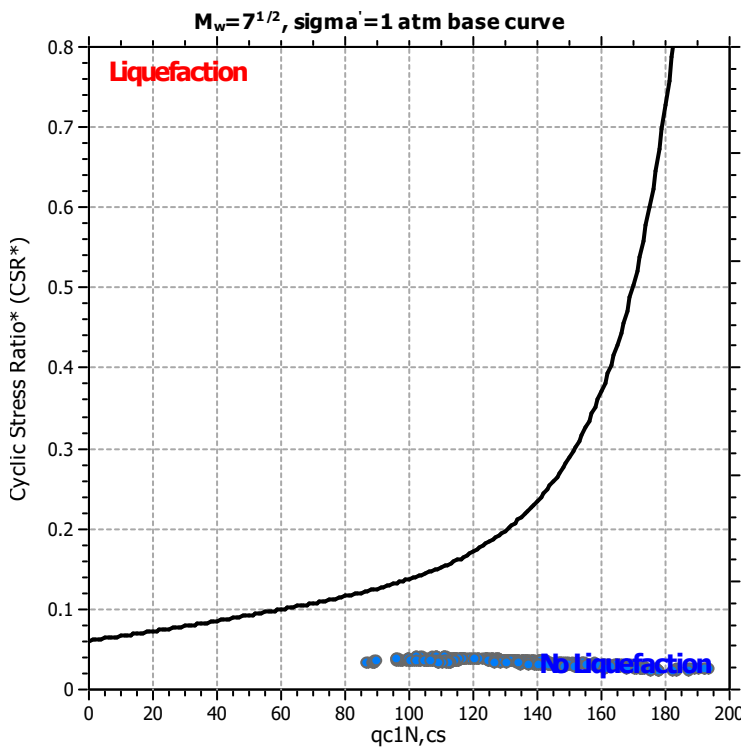
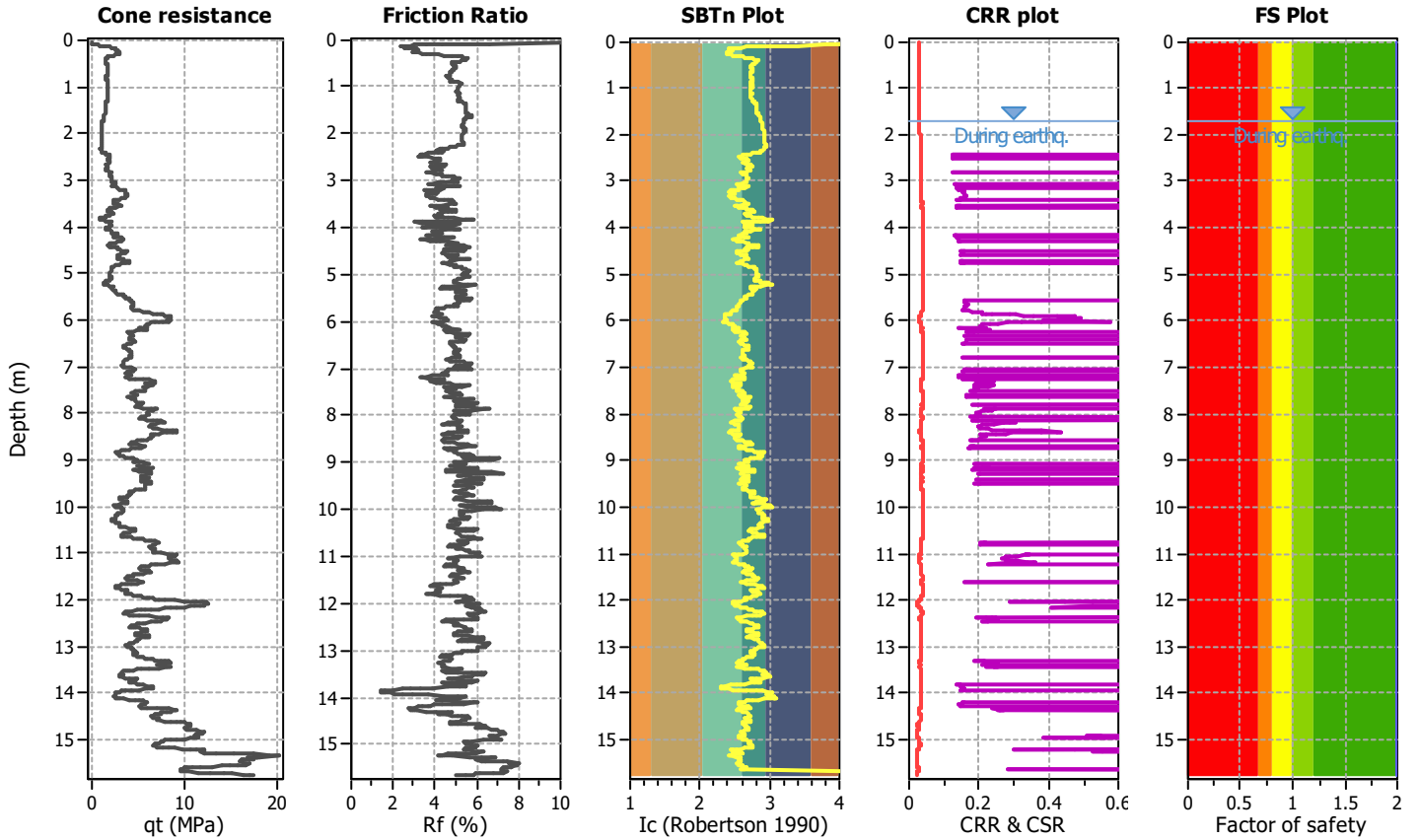
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT10-1/25**

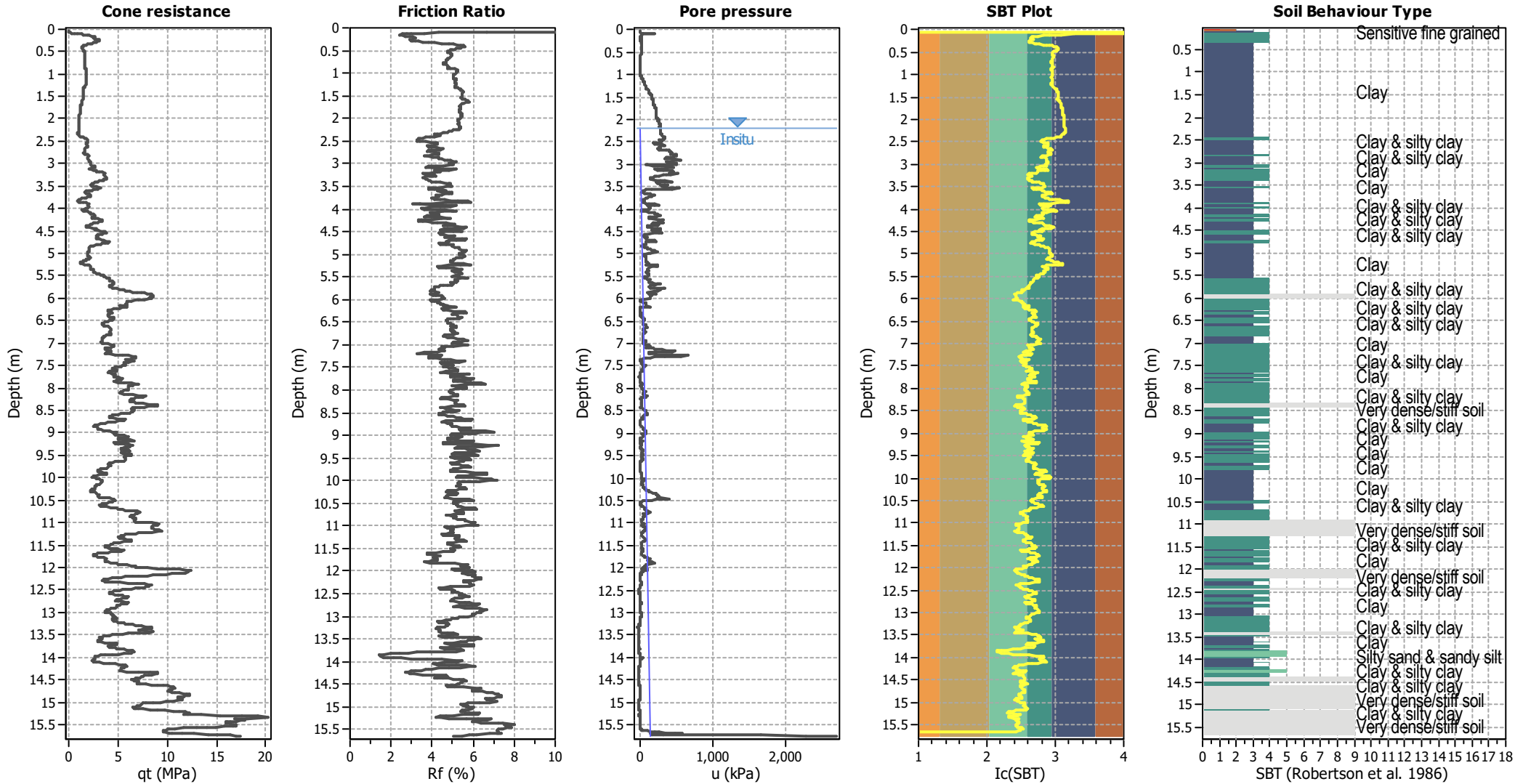
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 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 $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

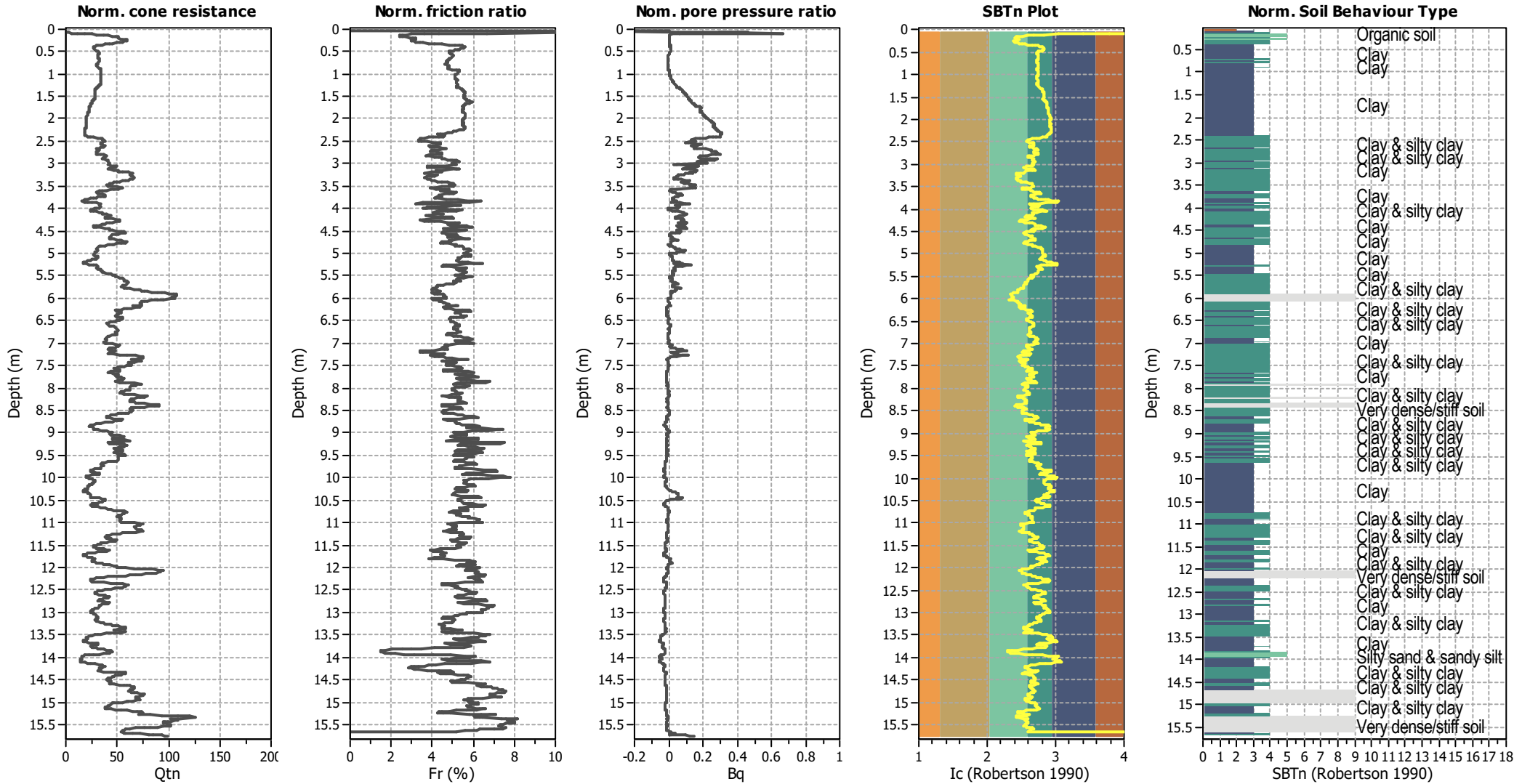
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



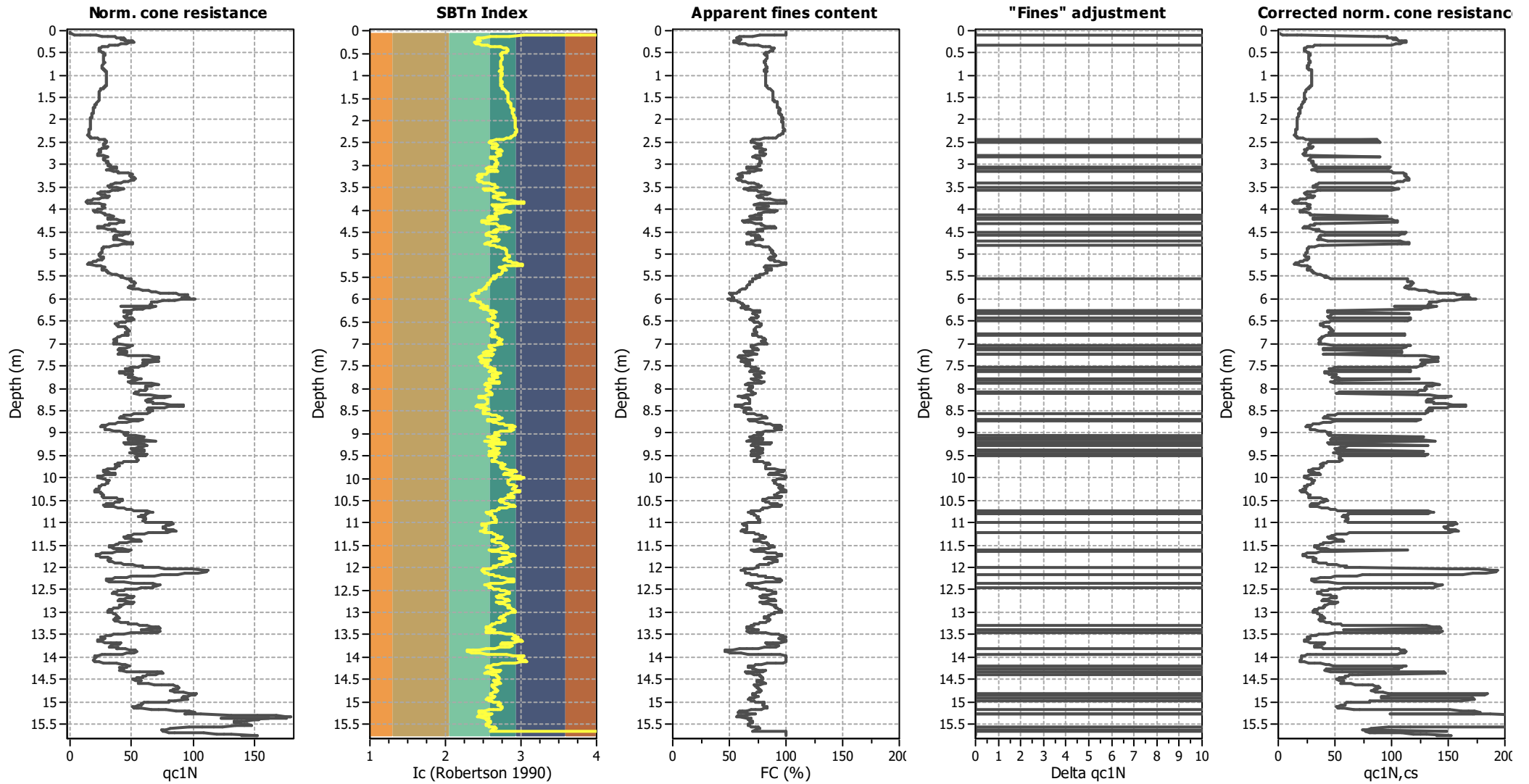
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

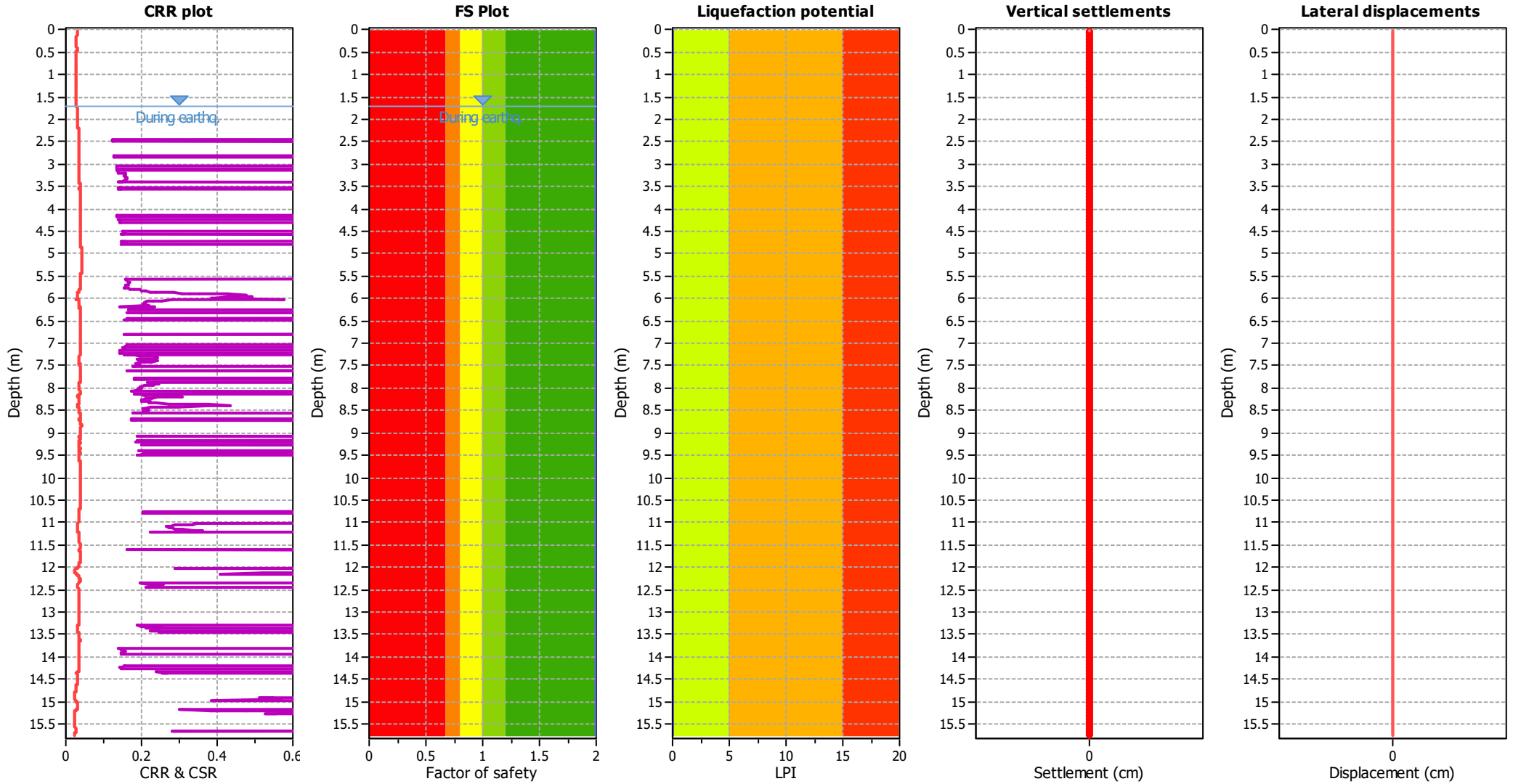
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

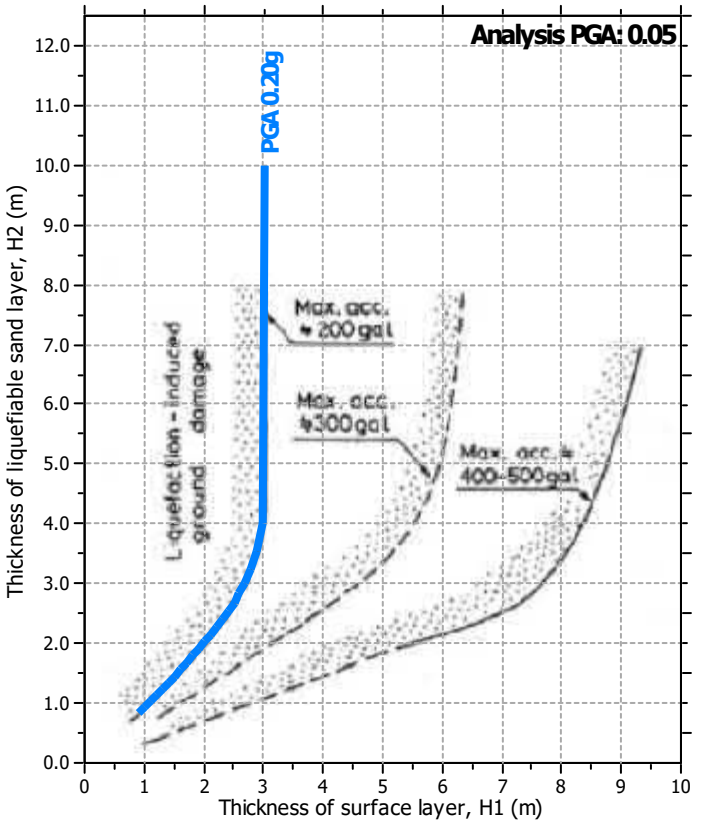
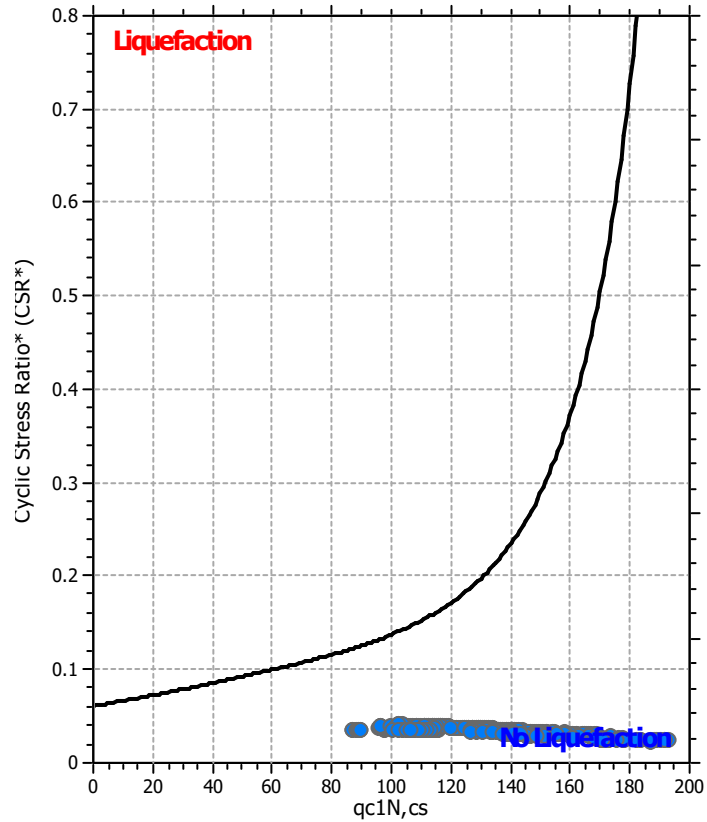
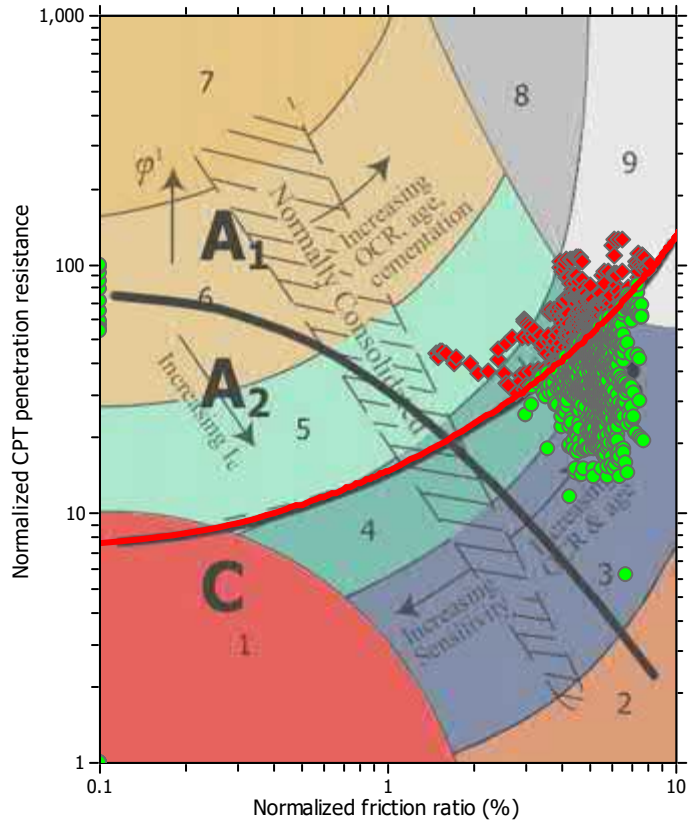
#### F.S. color scheme

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



**LIQUEFACTION ANALYSIS REPORT**

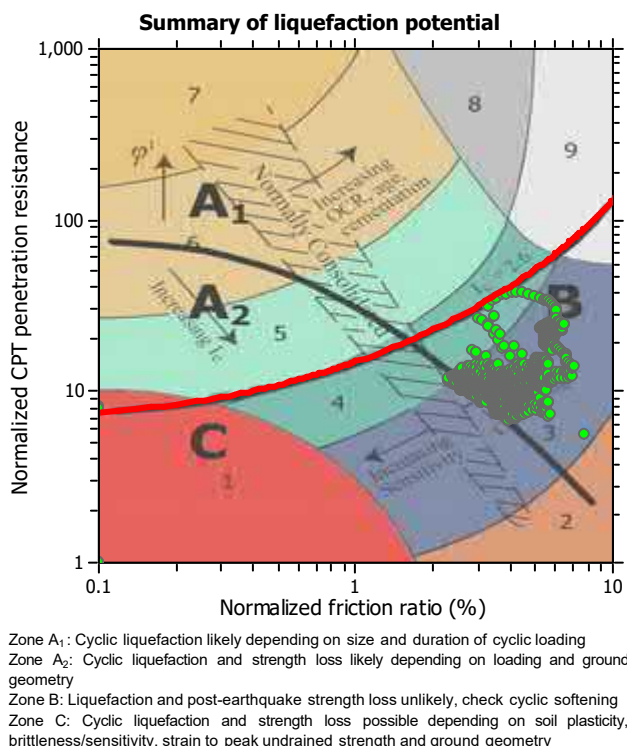
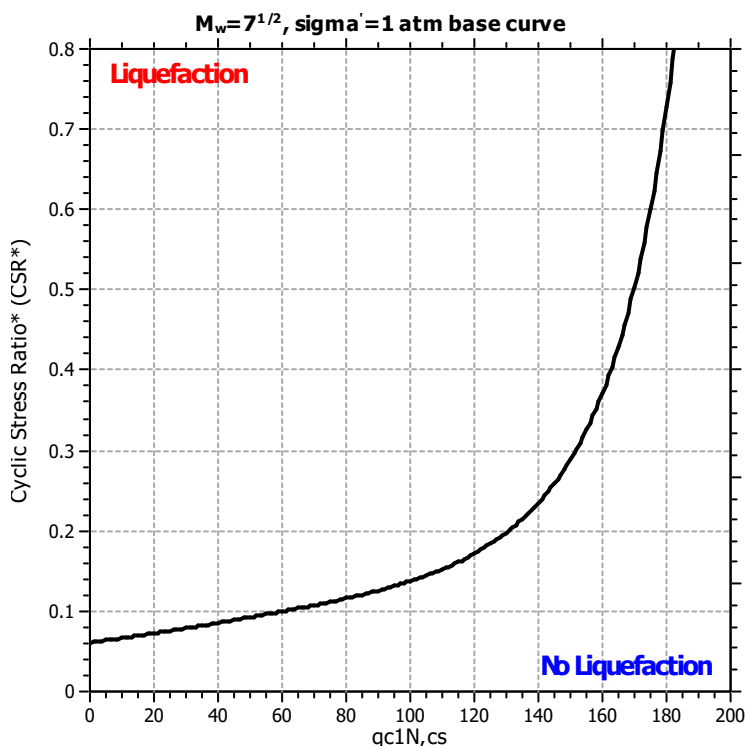
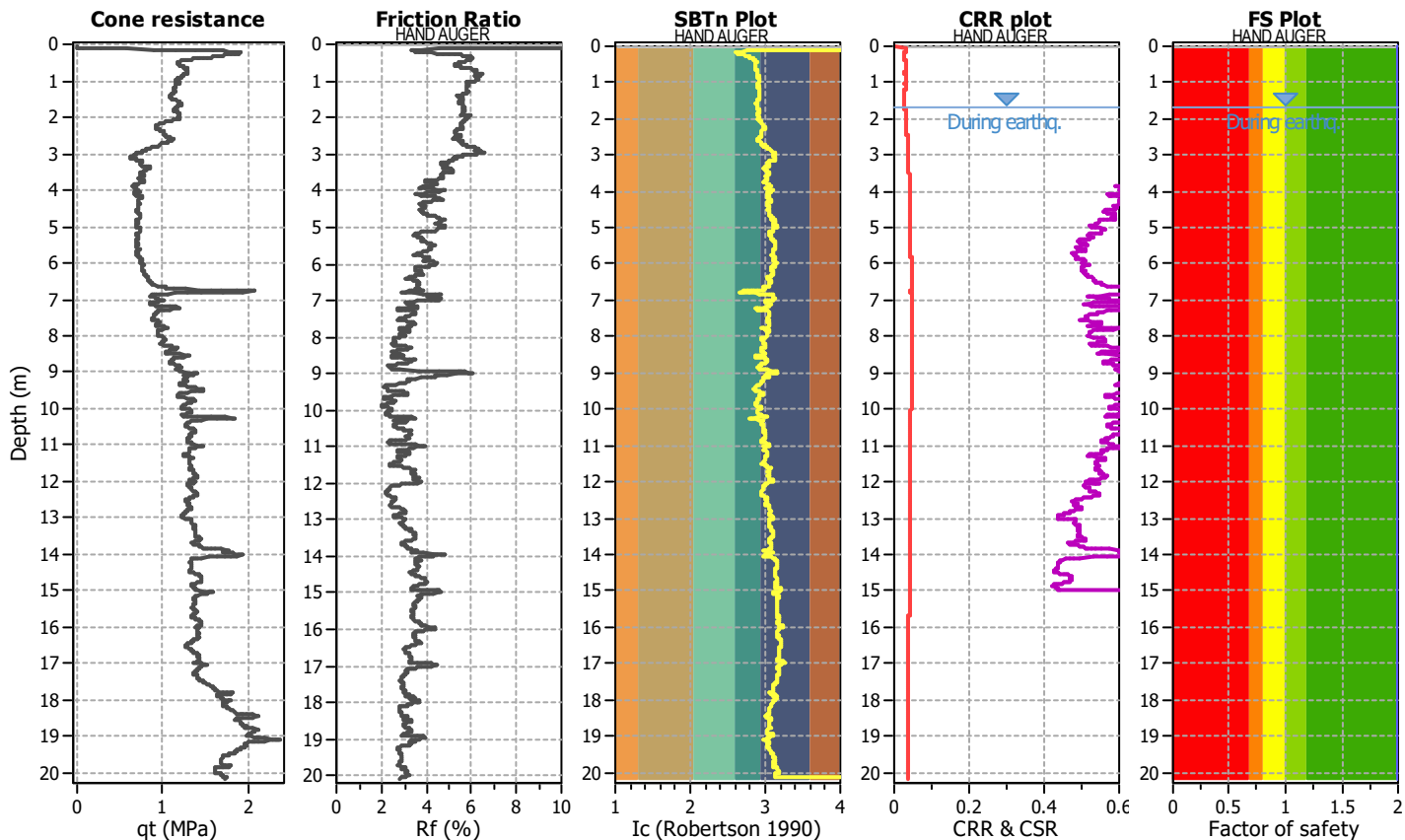
**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

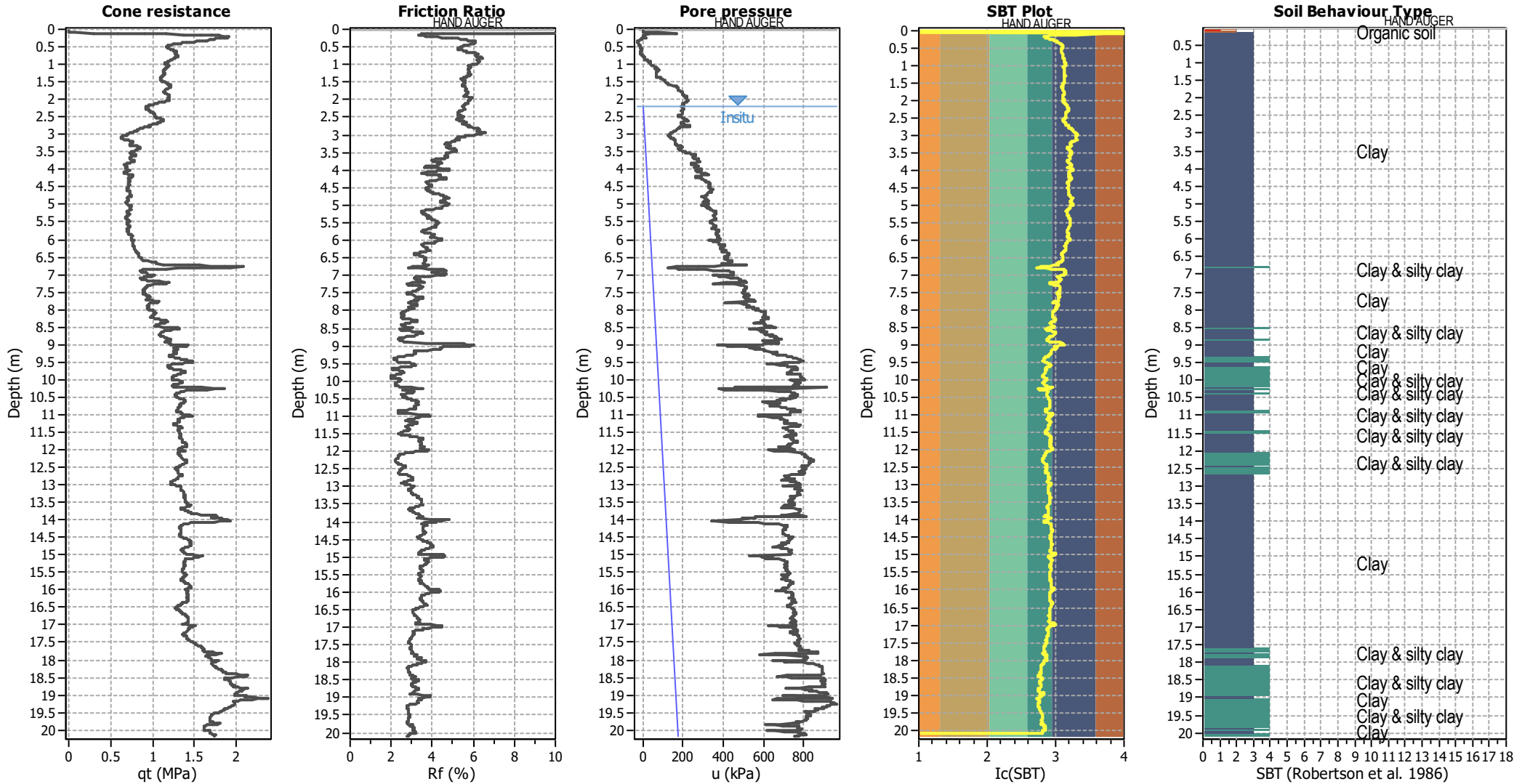
**CPT file : CPT11-1/25**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



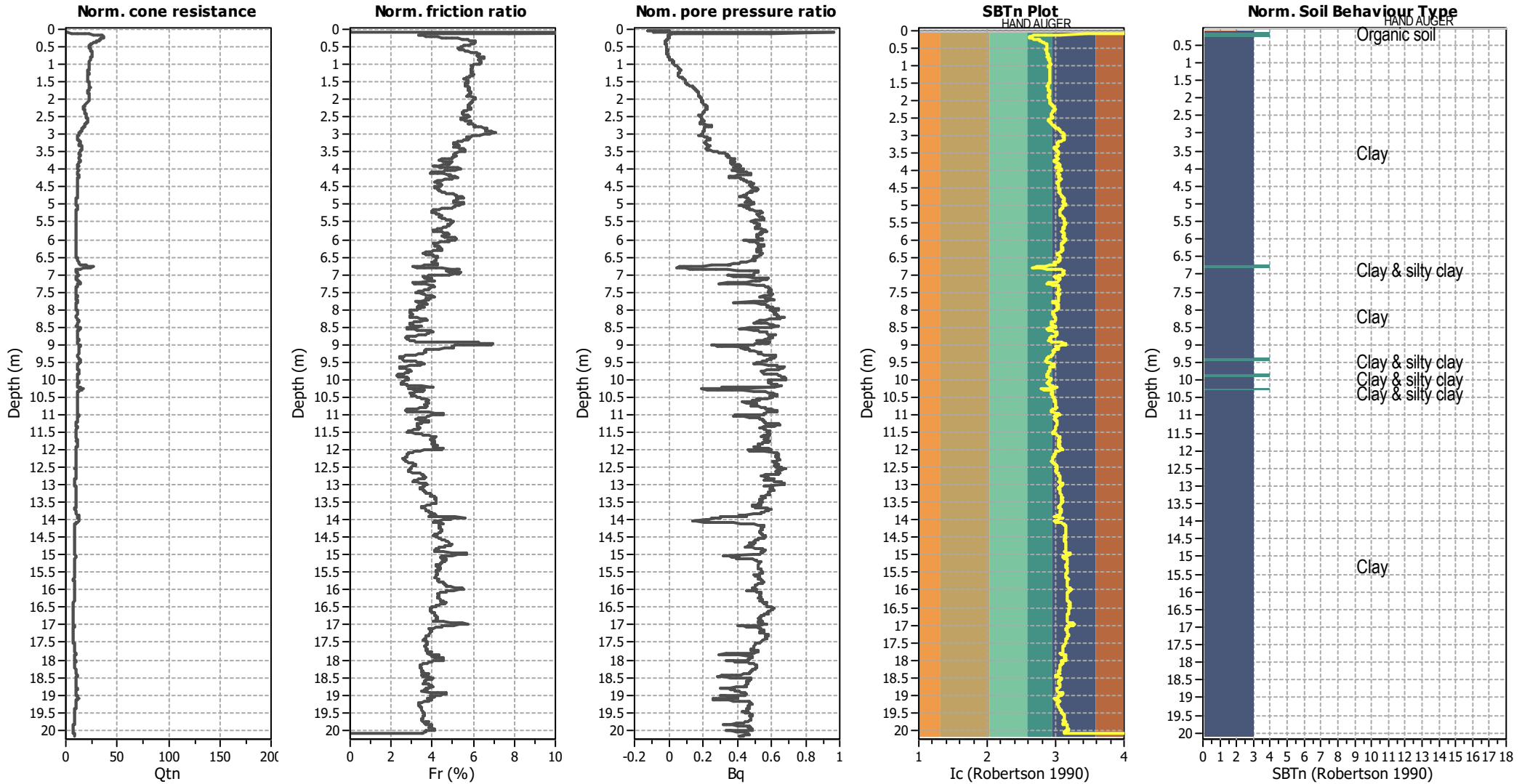
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



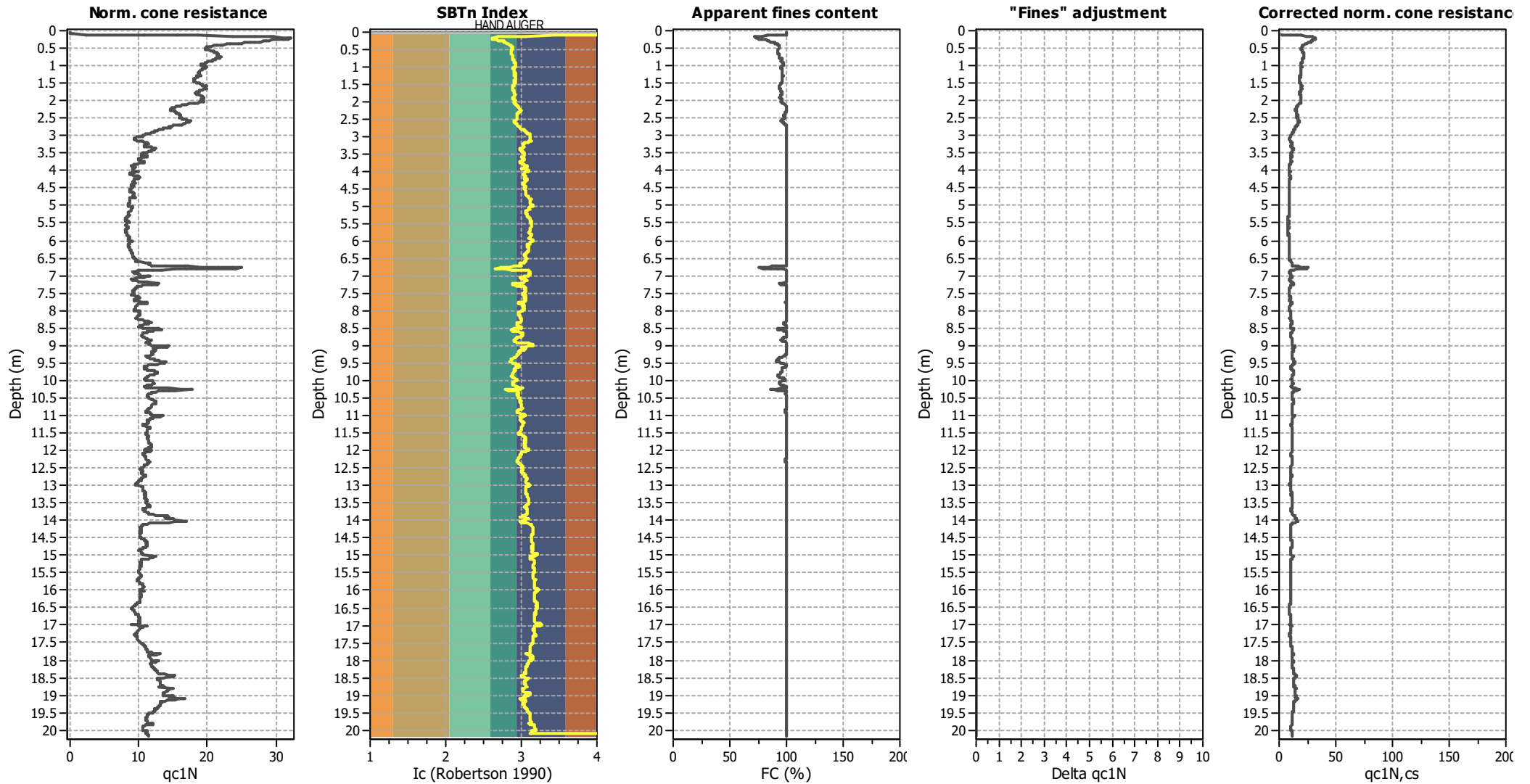
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

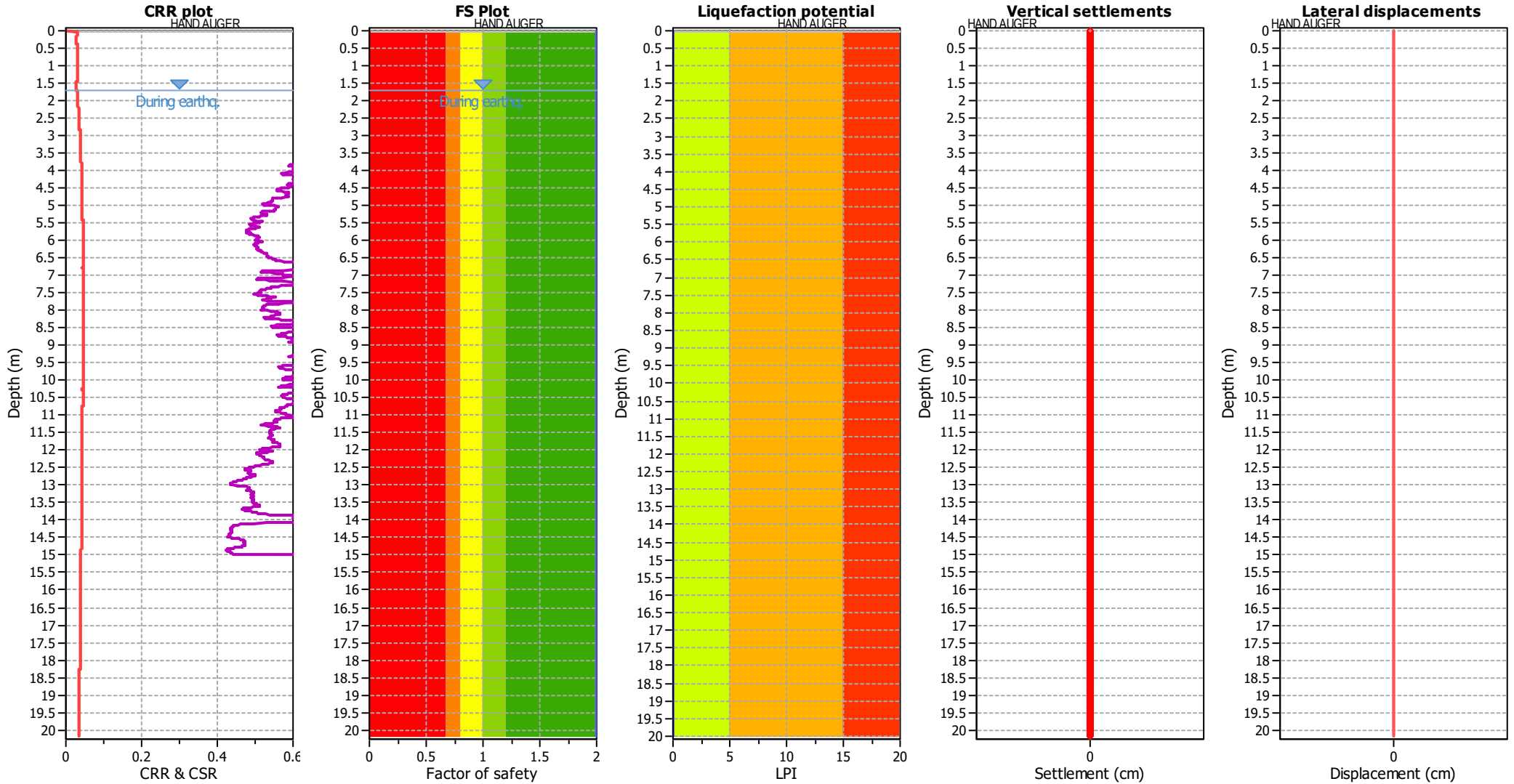


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

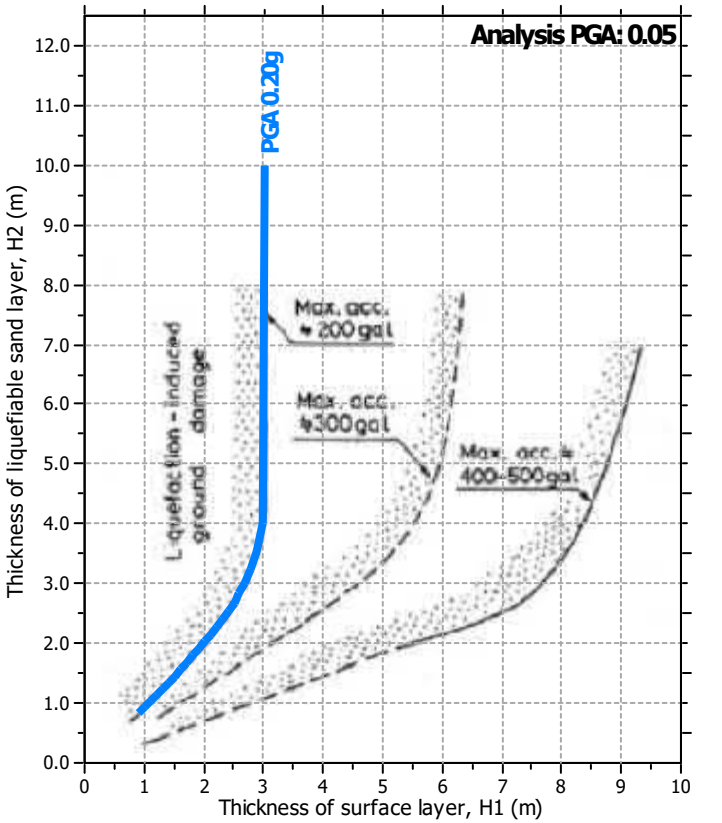
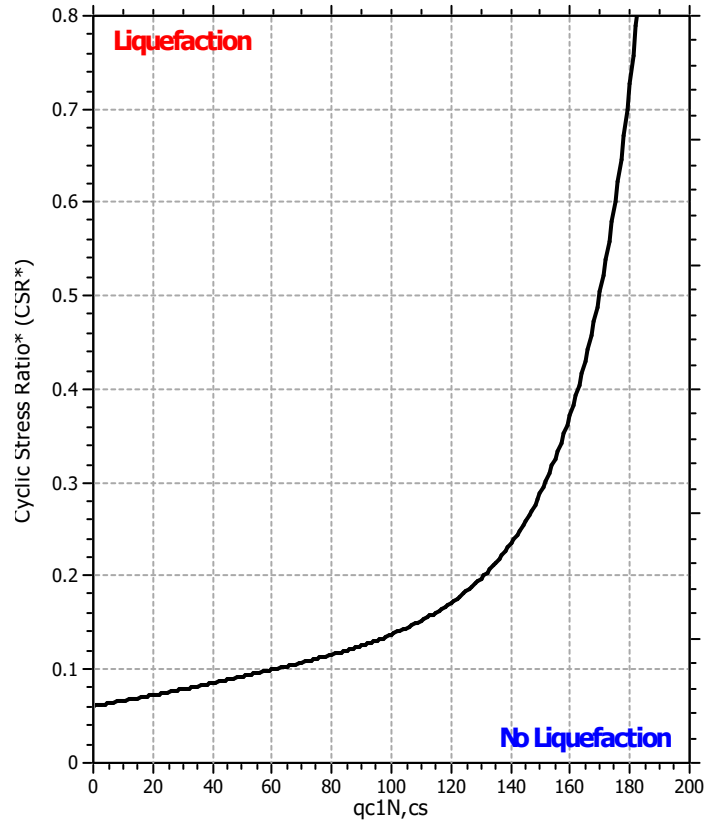
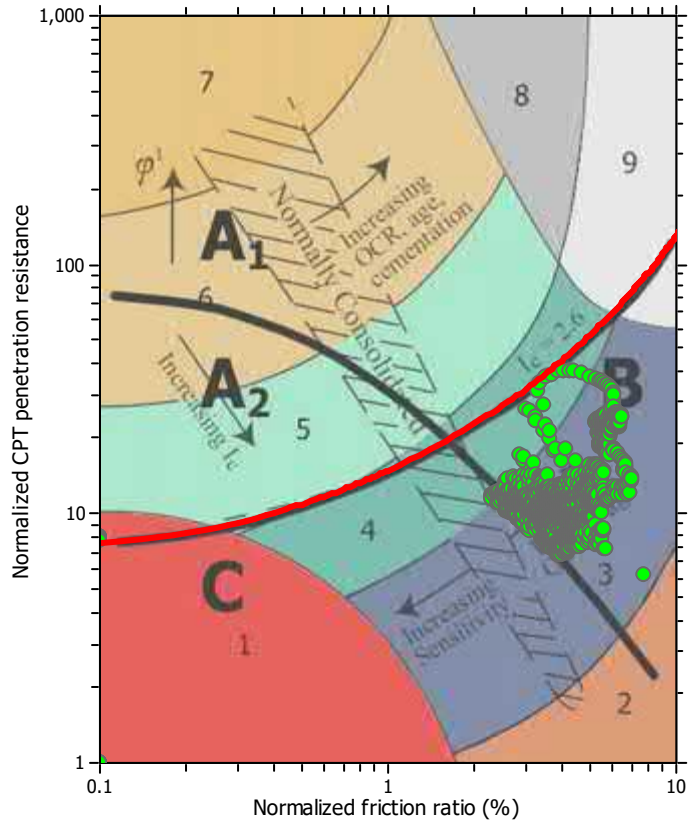
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

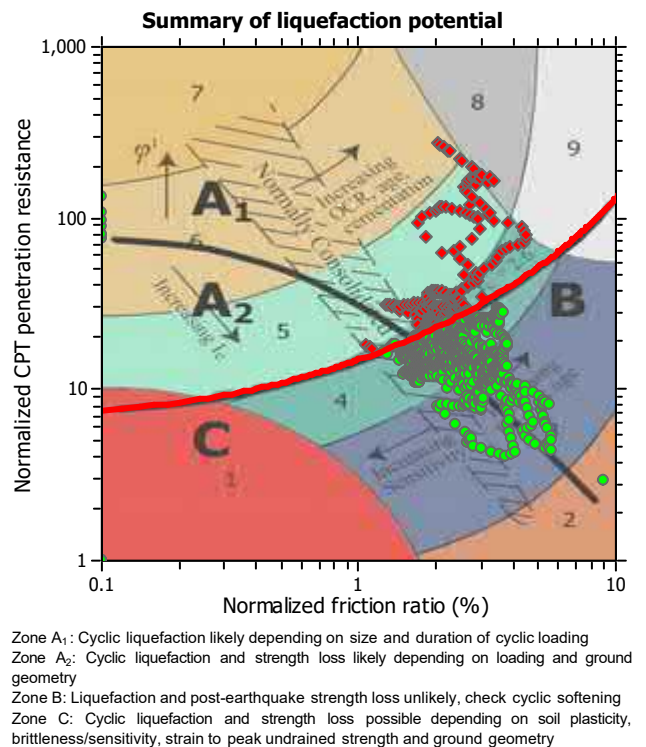
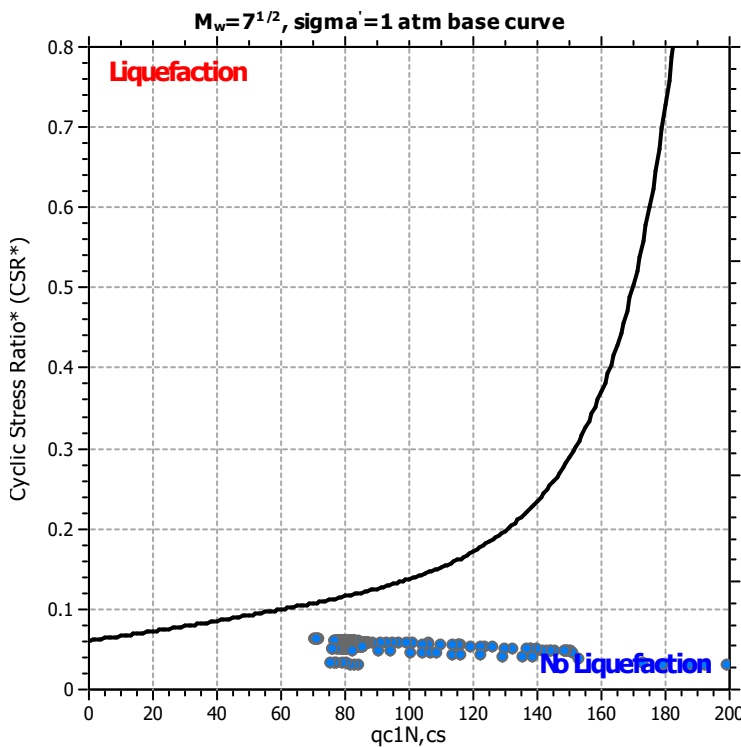
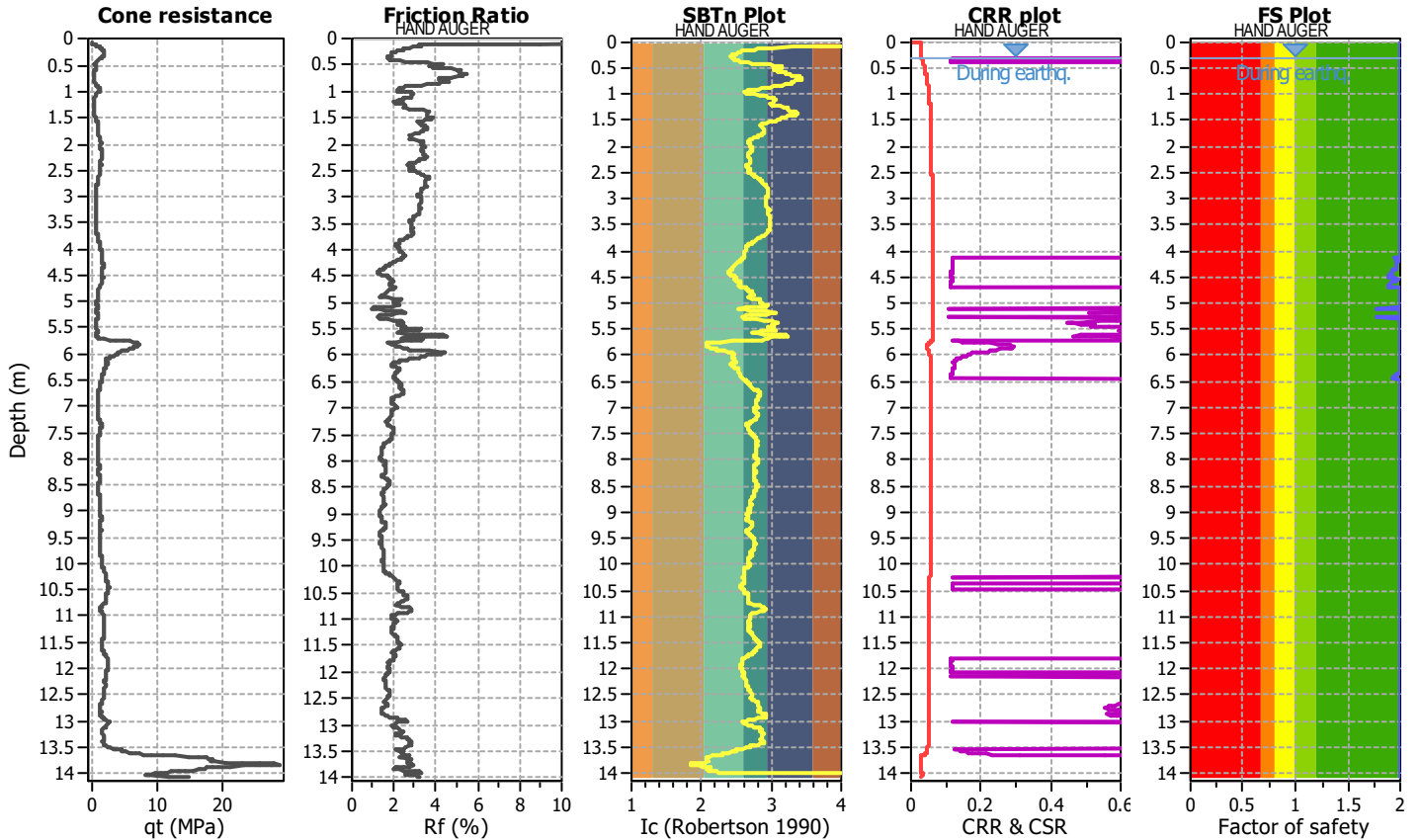
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT12-1/25**

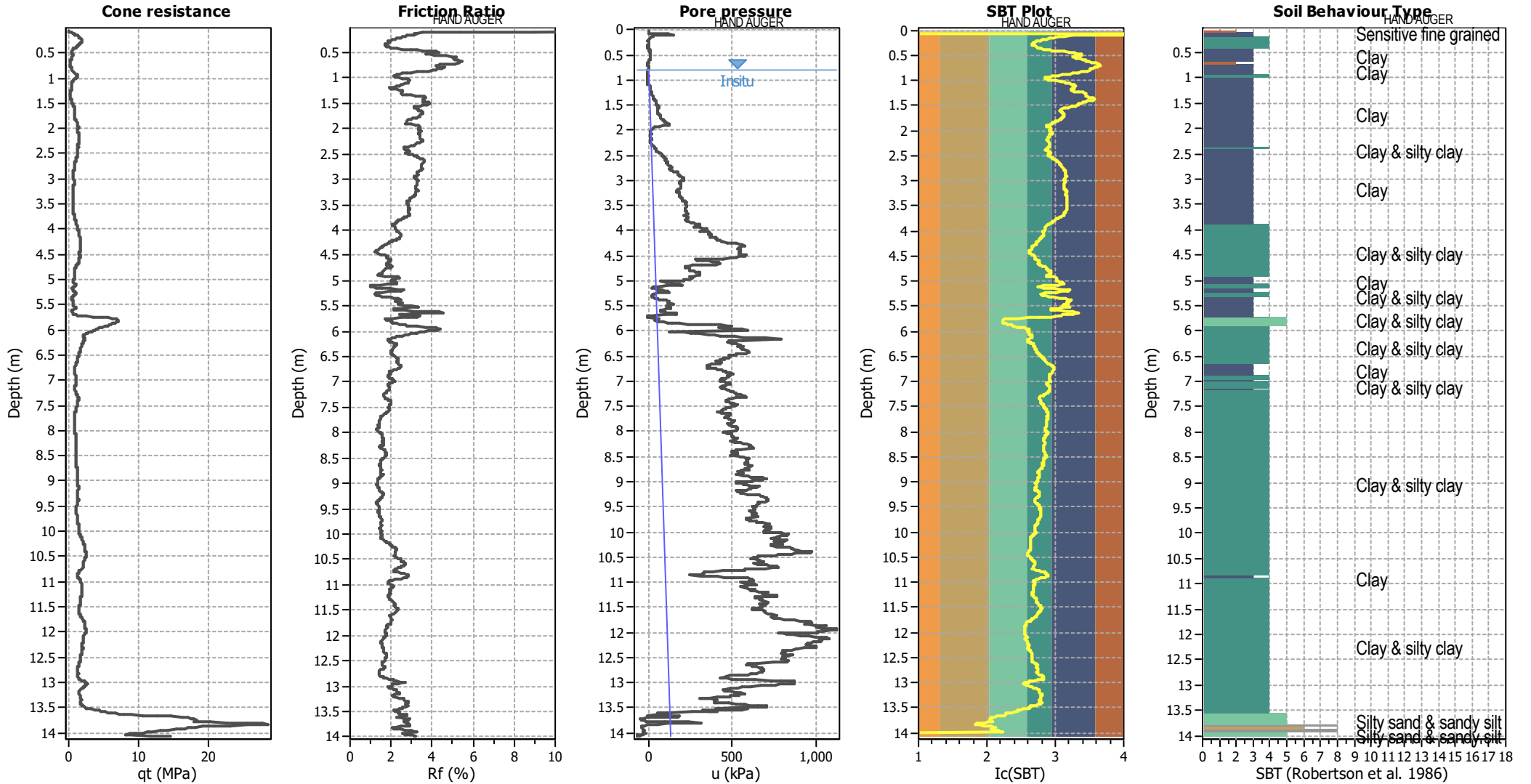
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

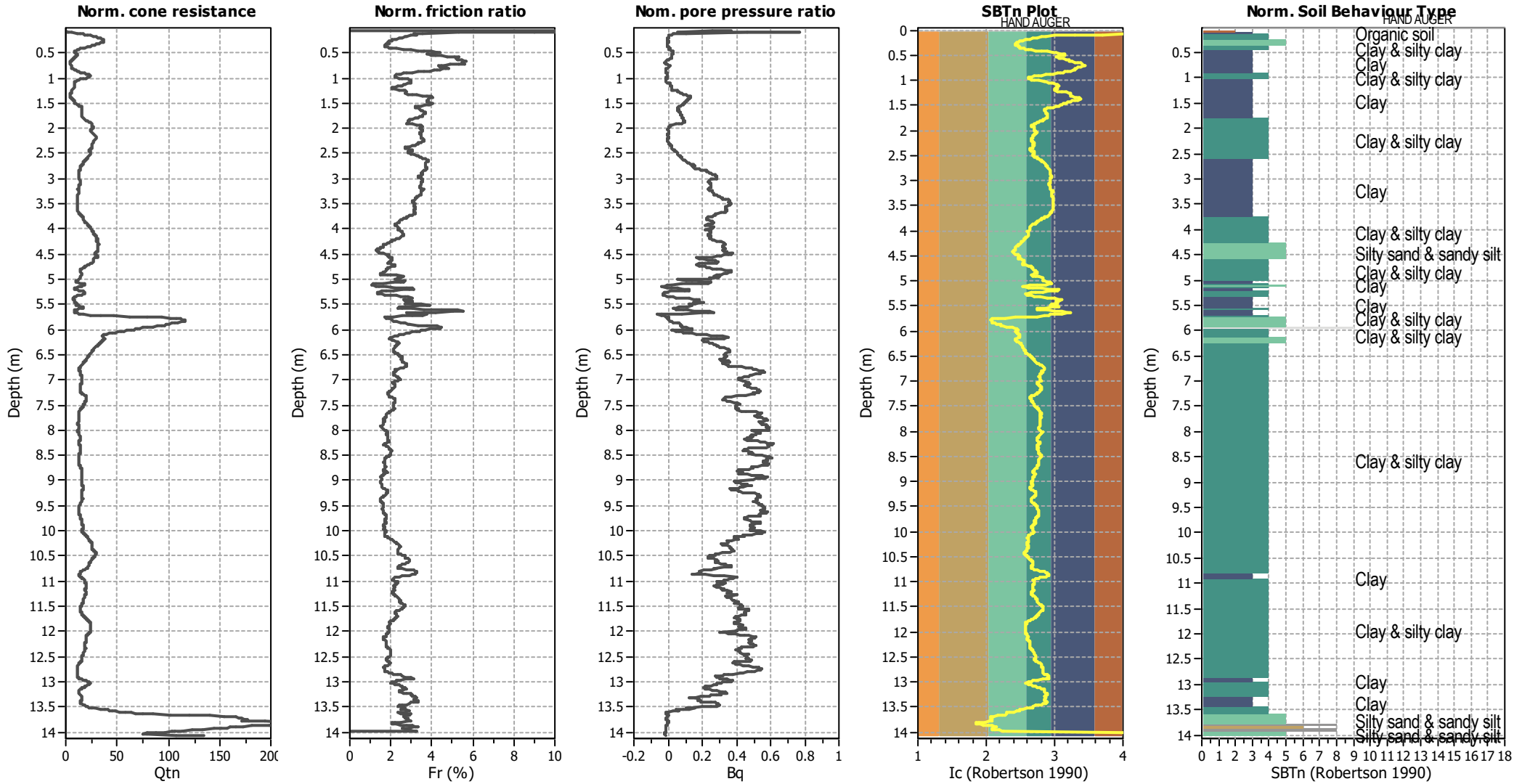
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



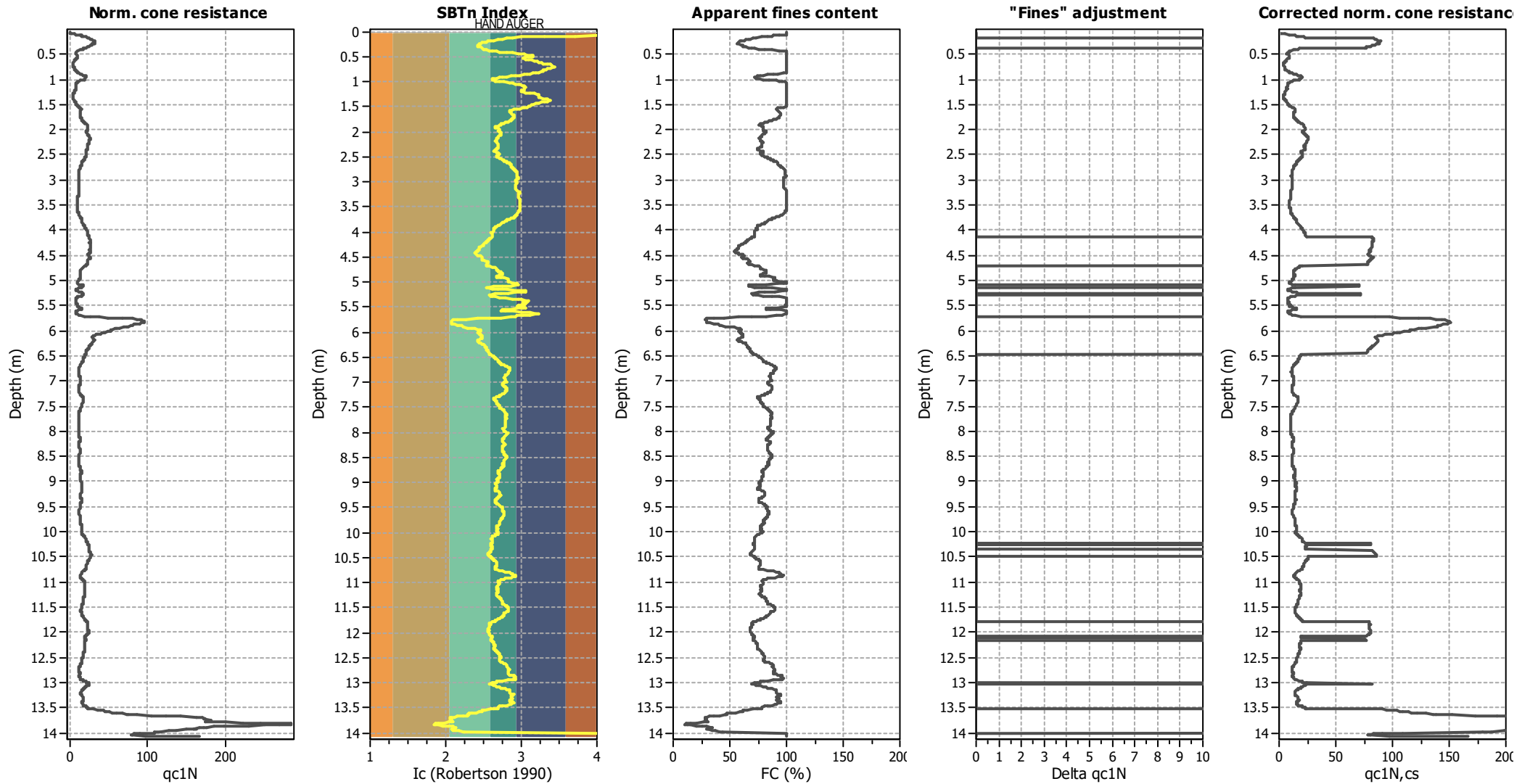
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

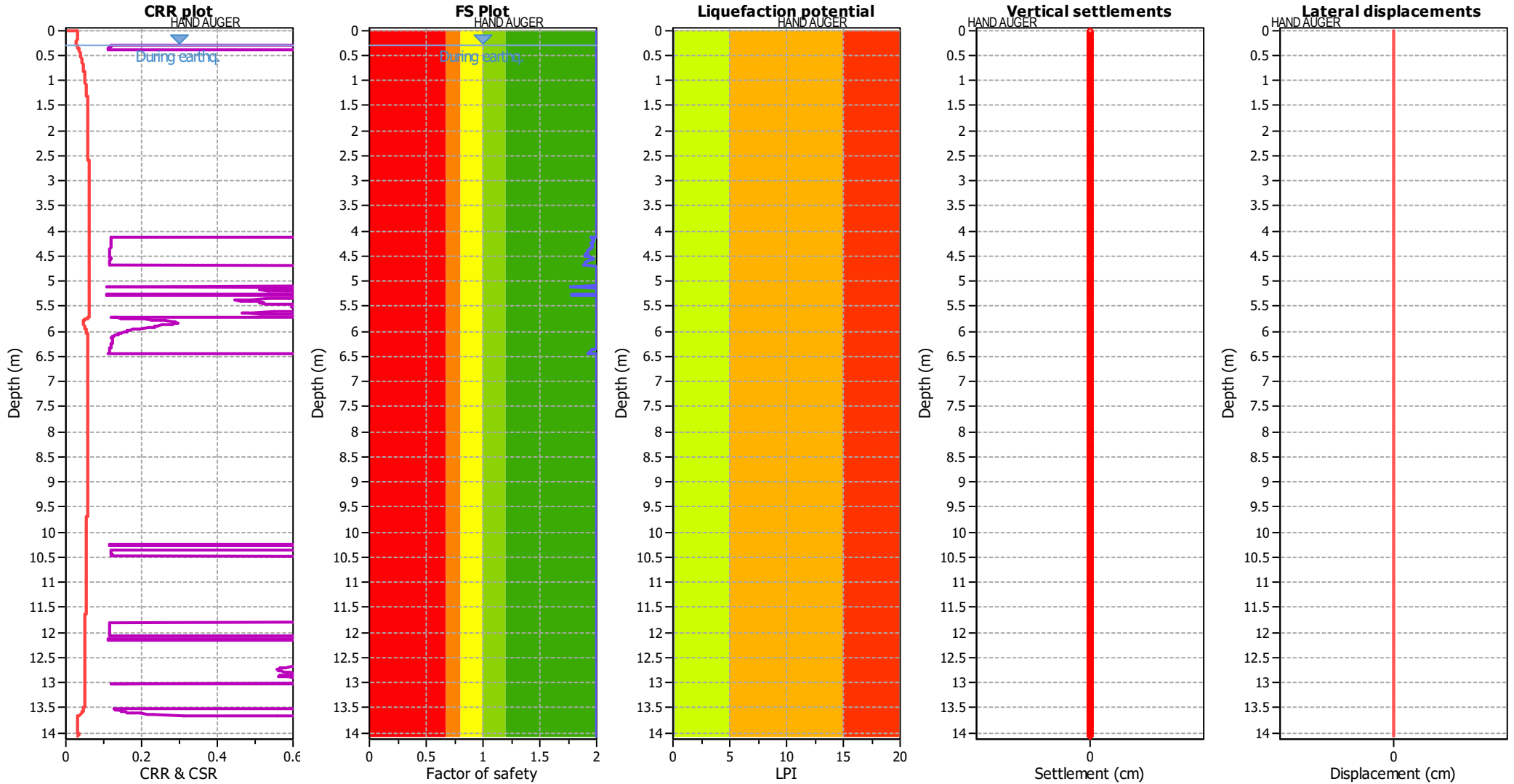
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

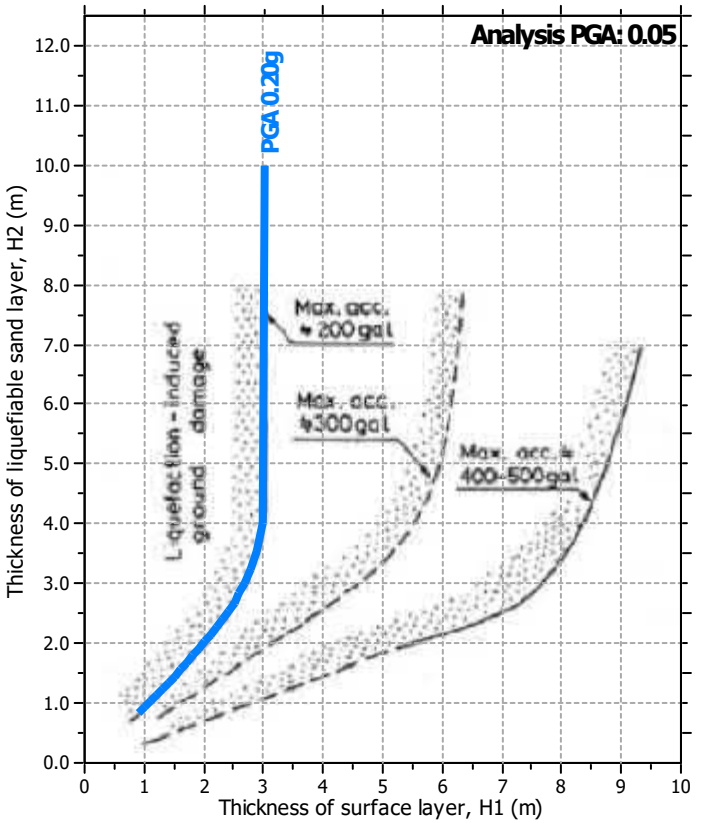
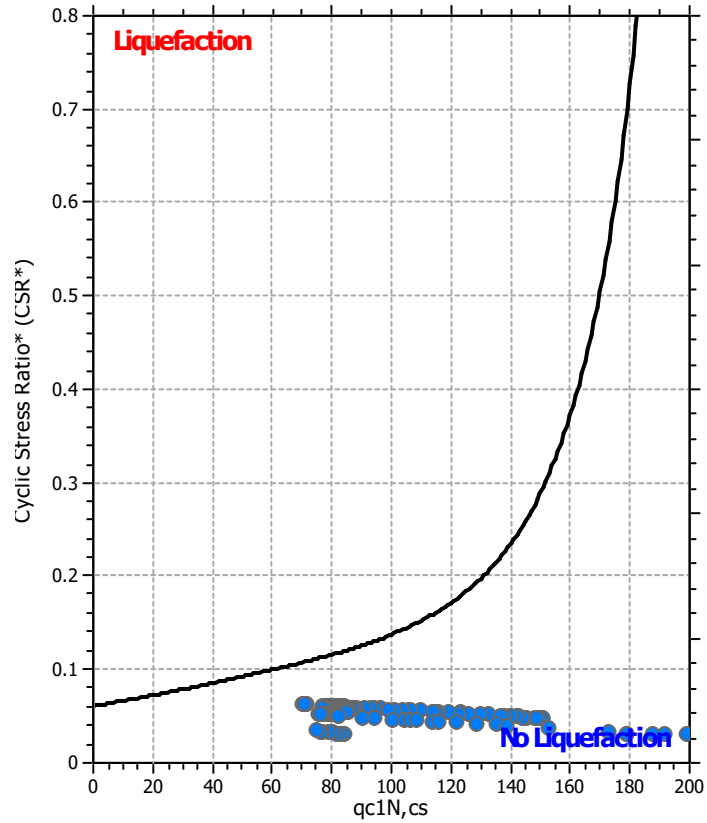
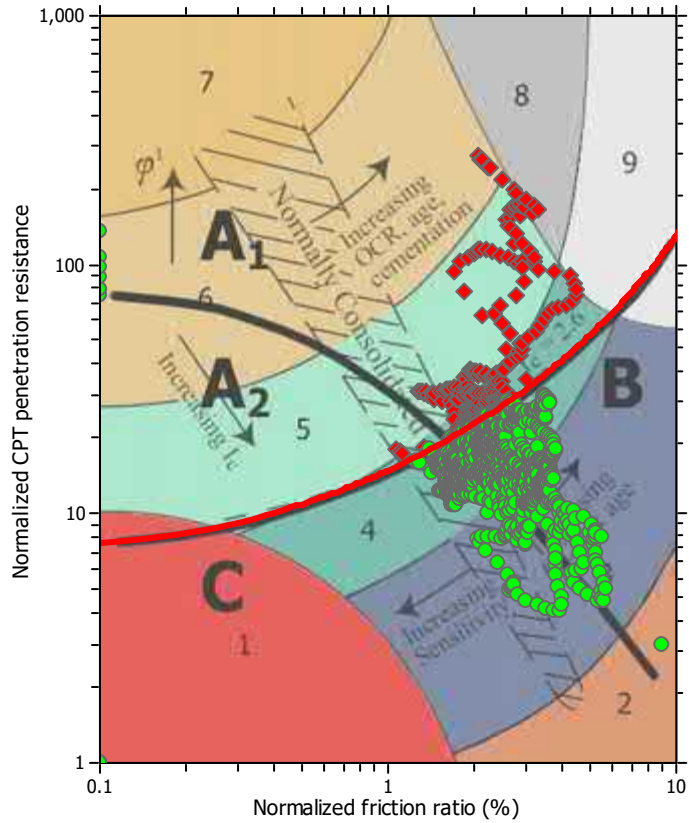
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A



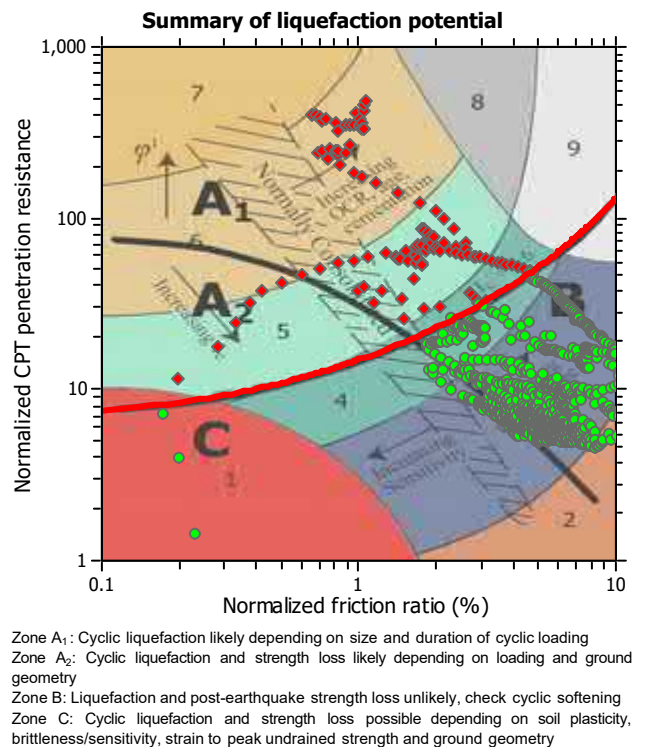
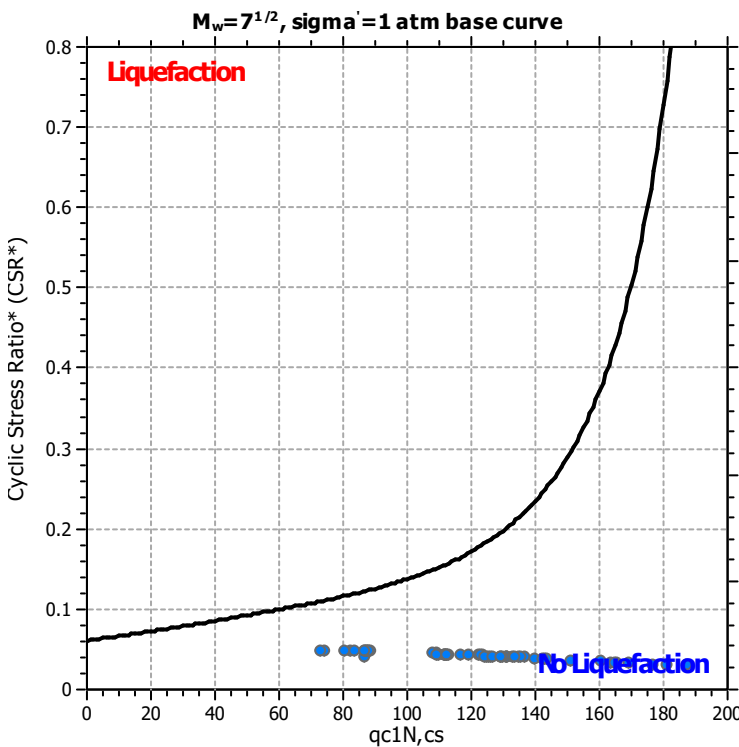
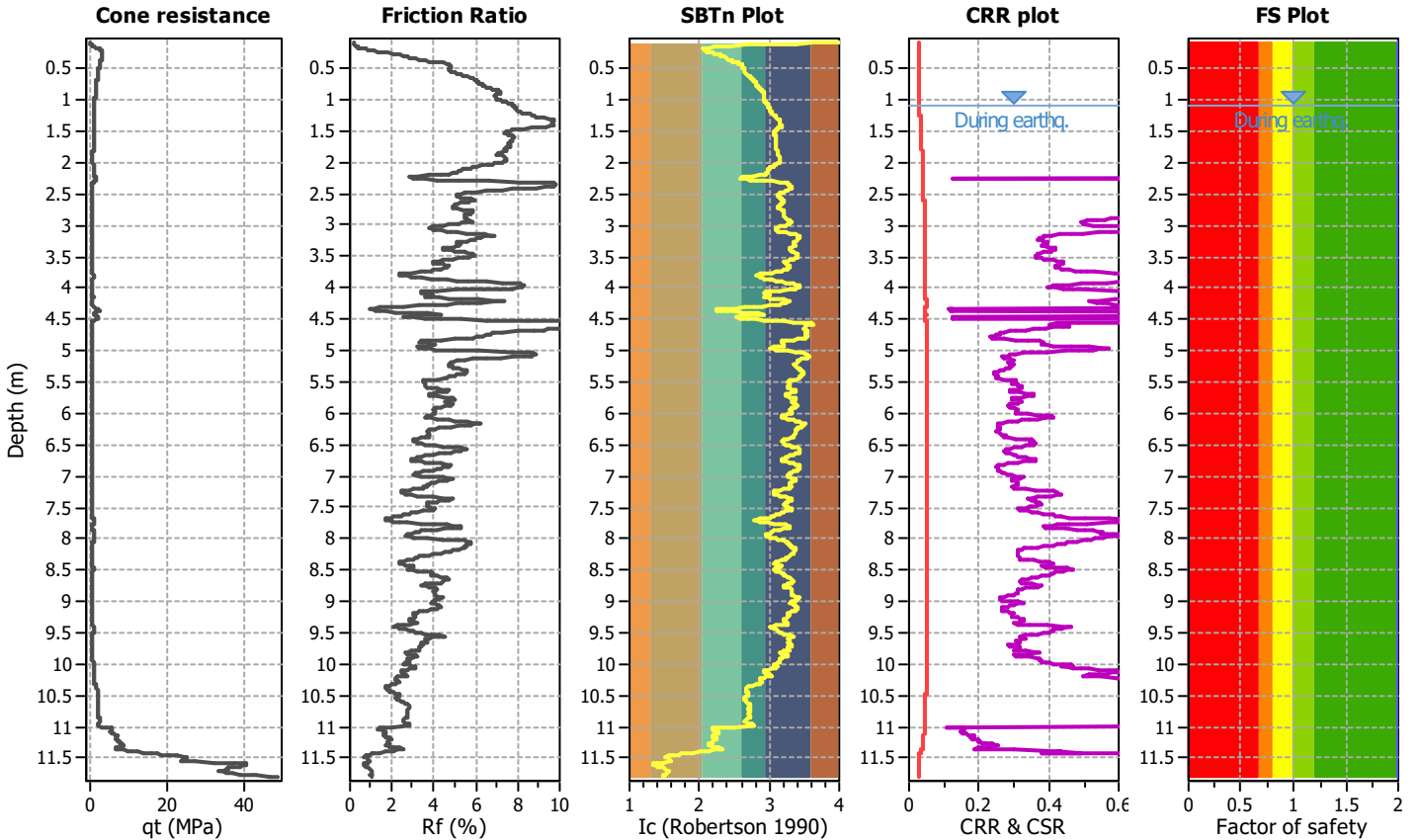
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT13-1/25**

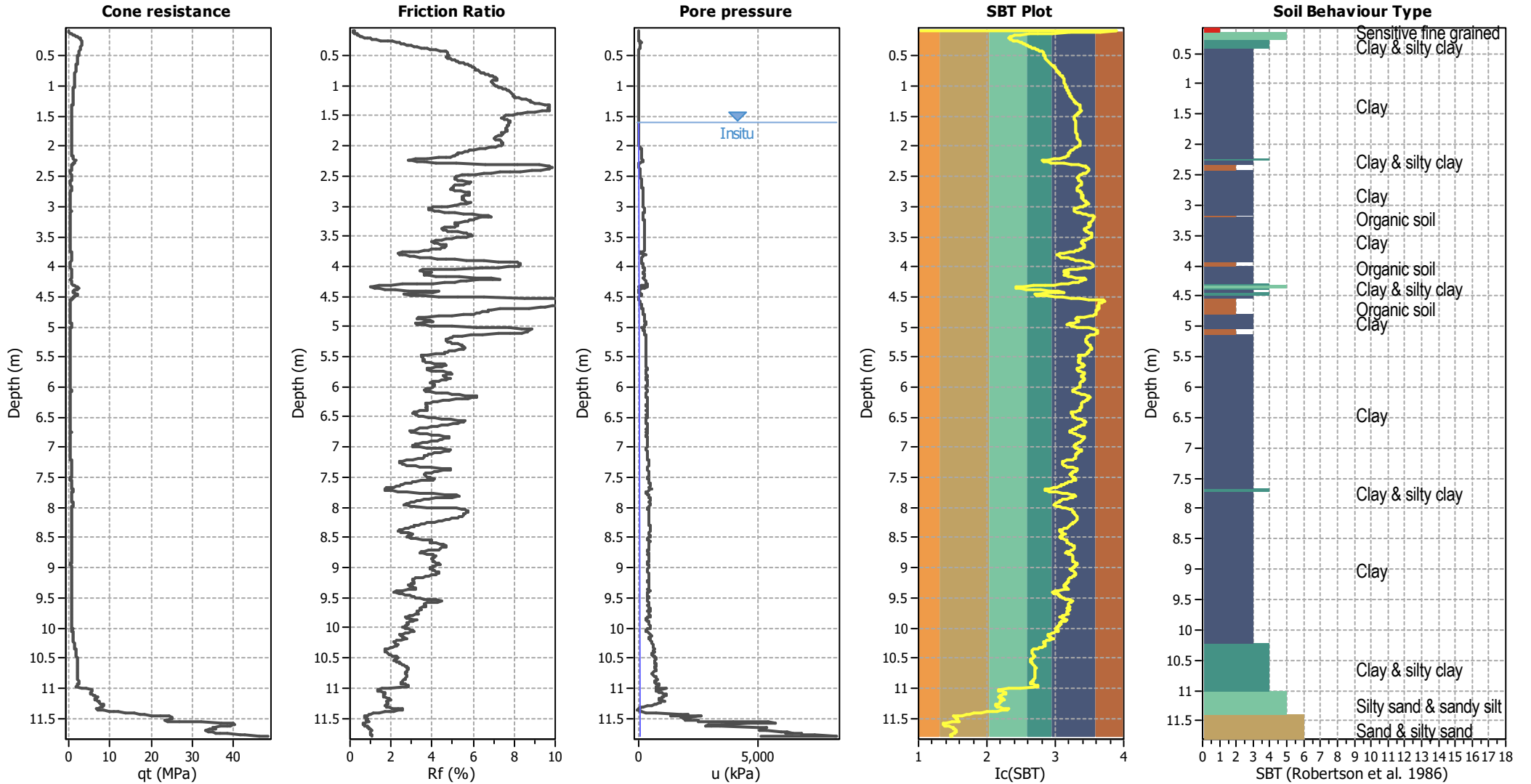
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.10 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



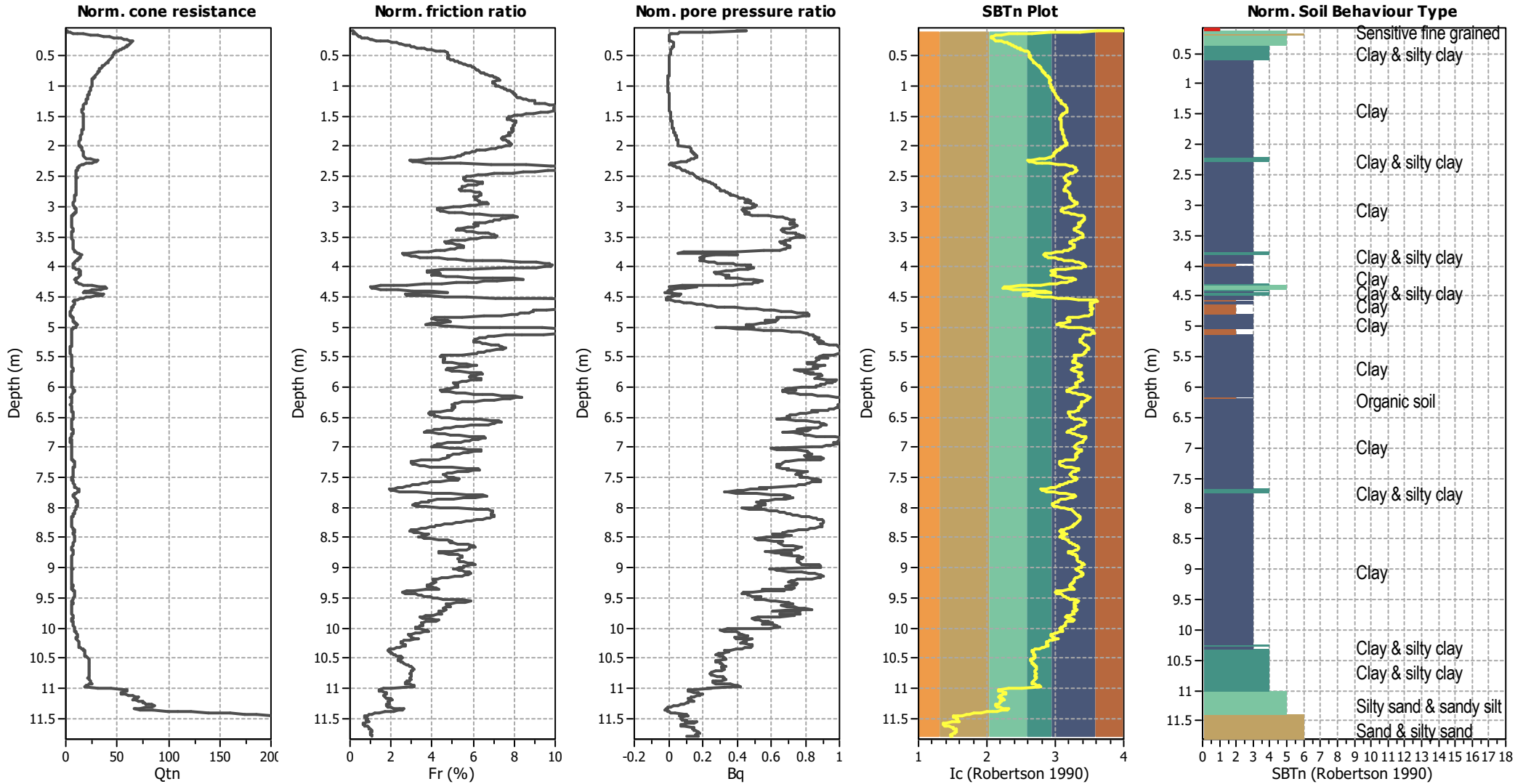
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



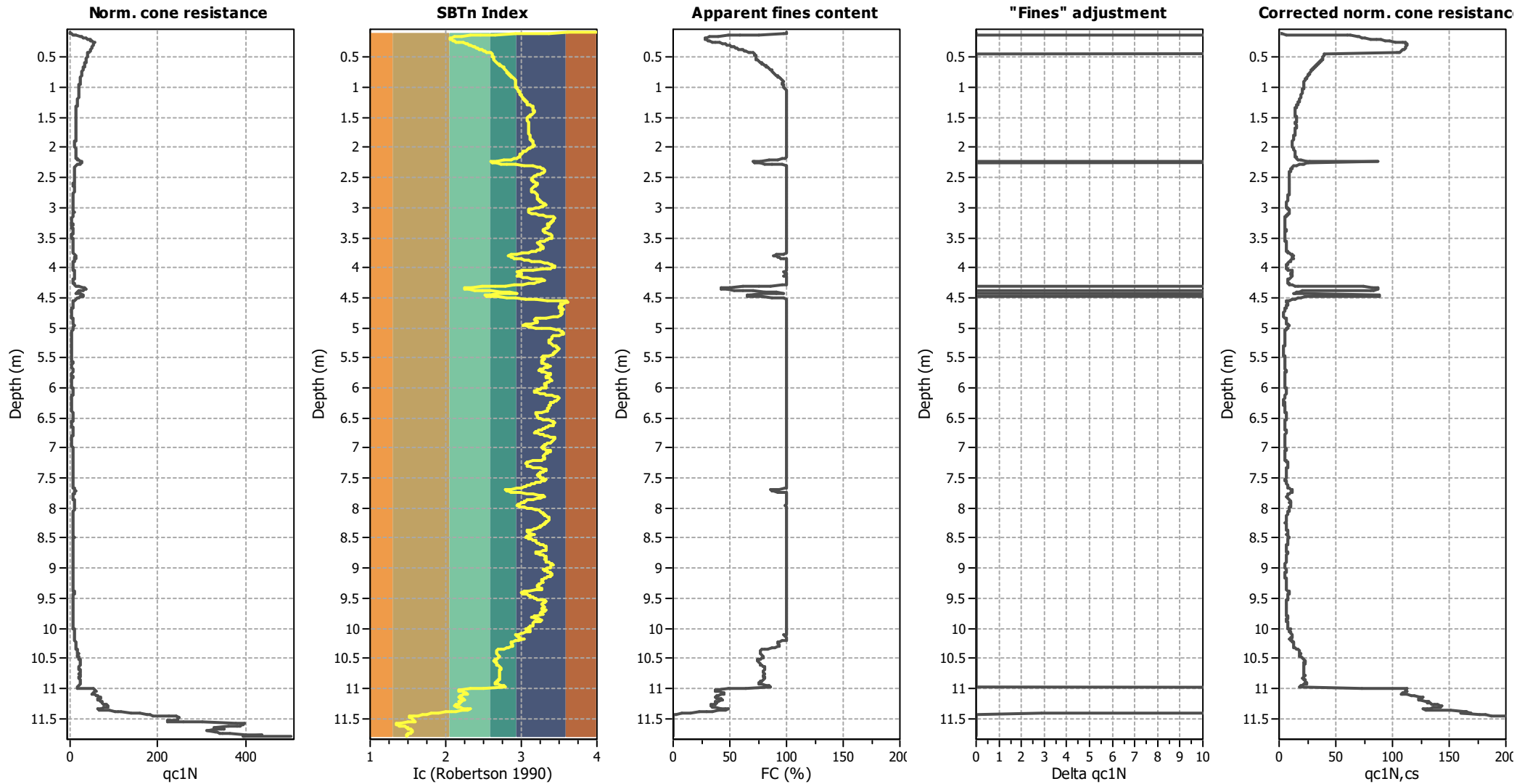
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

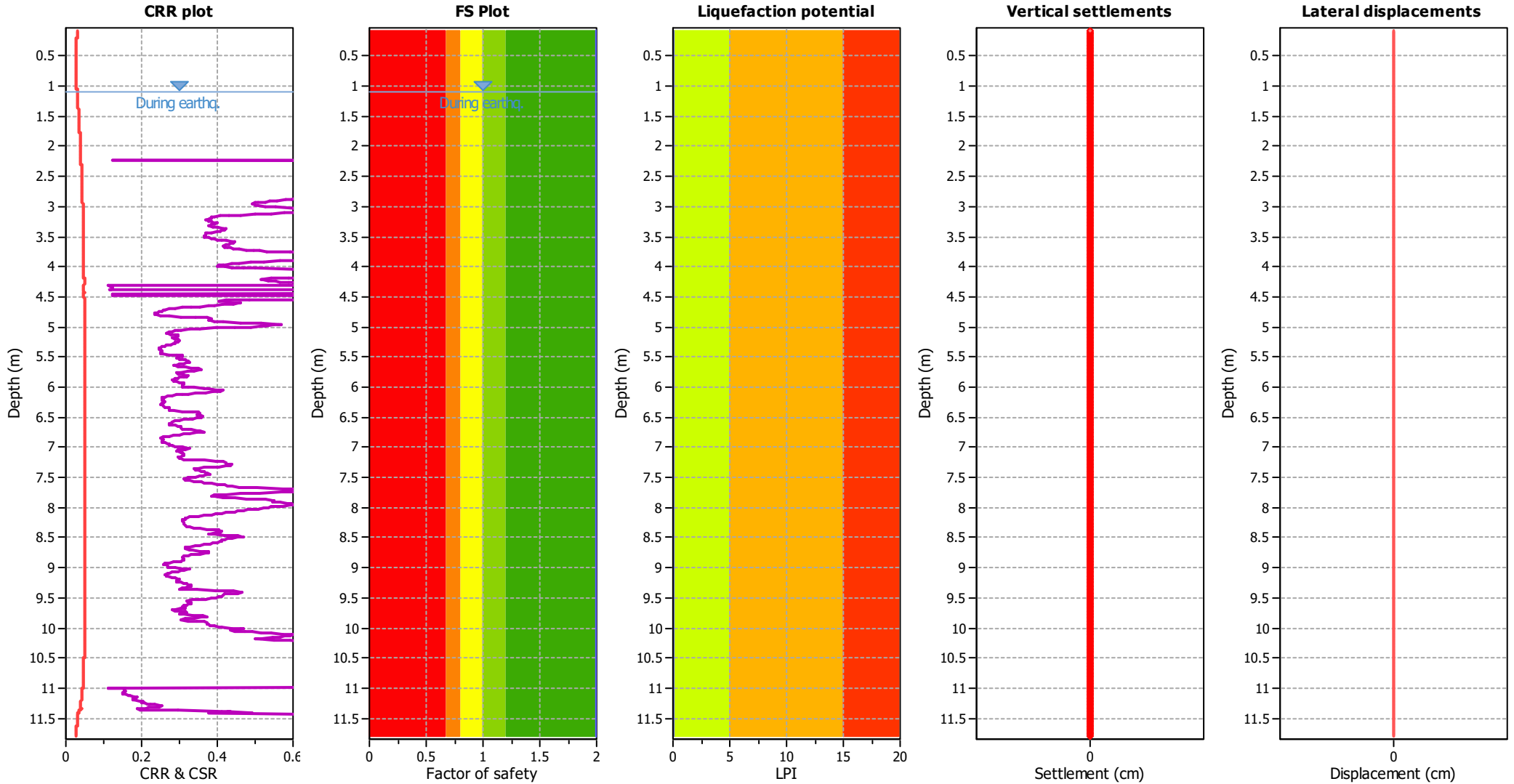


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

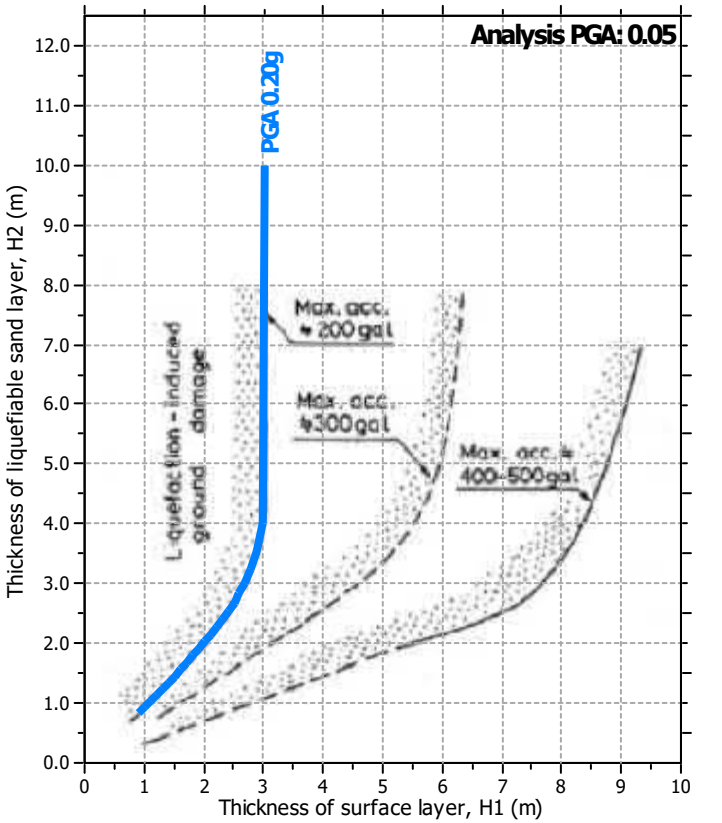
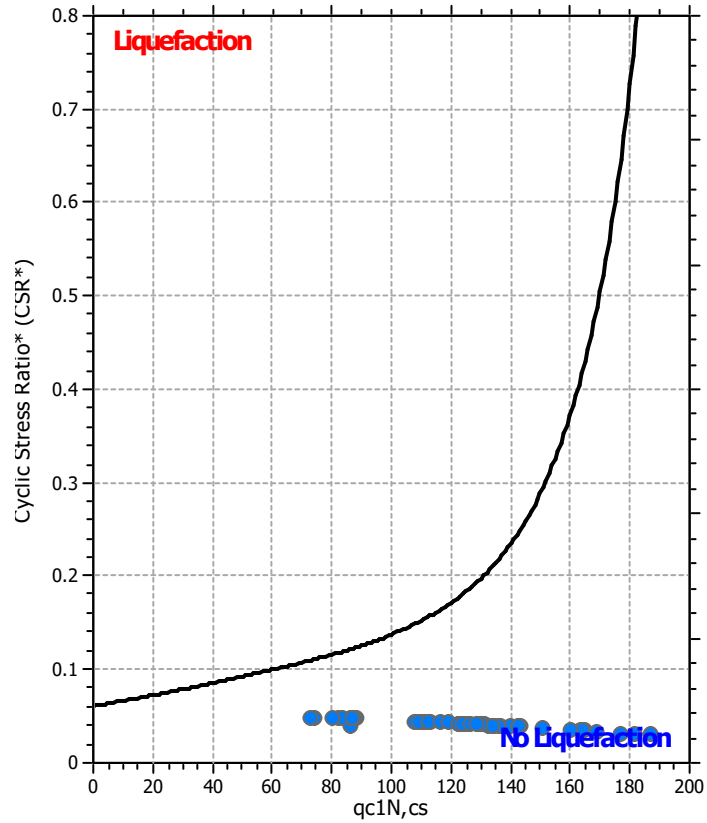
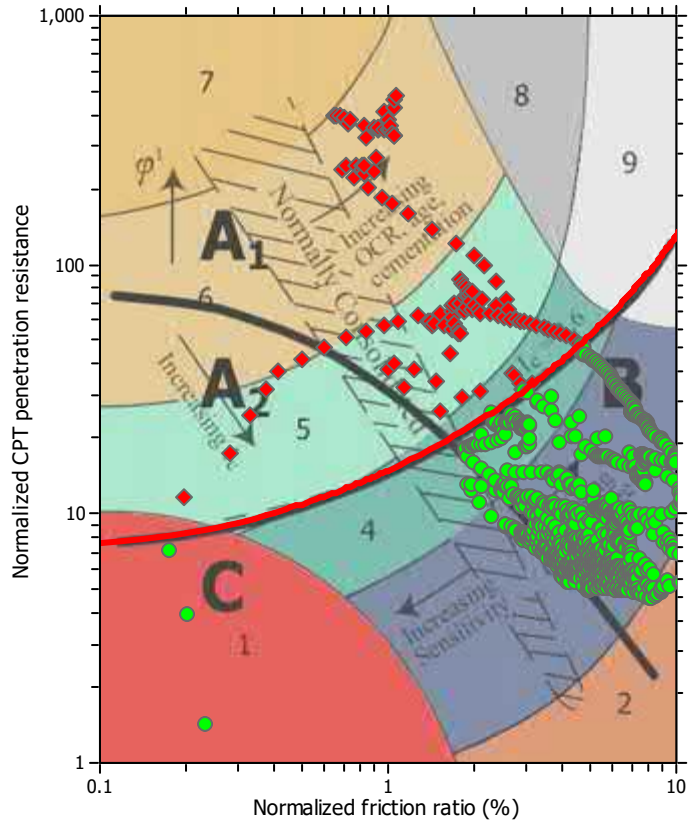
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

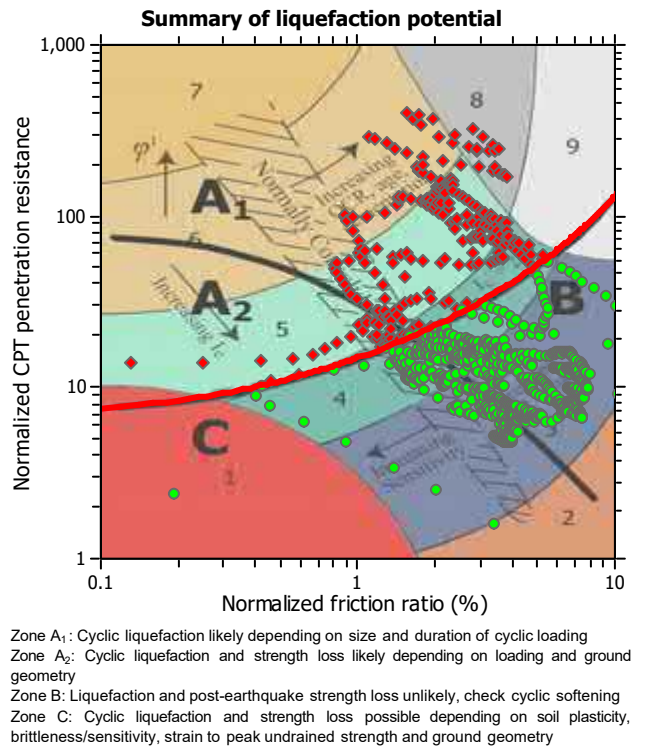
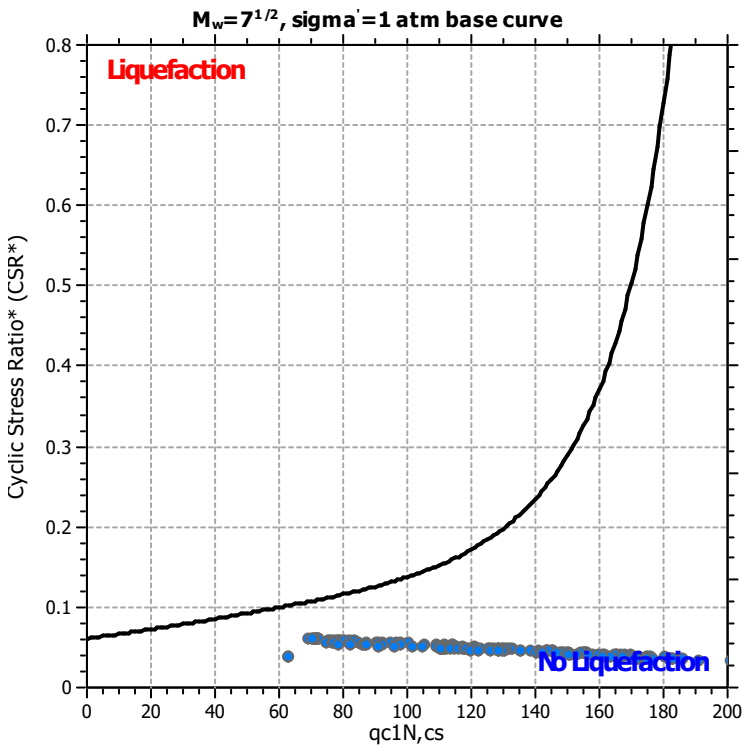
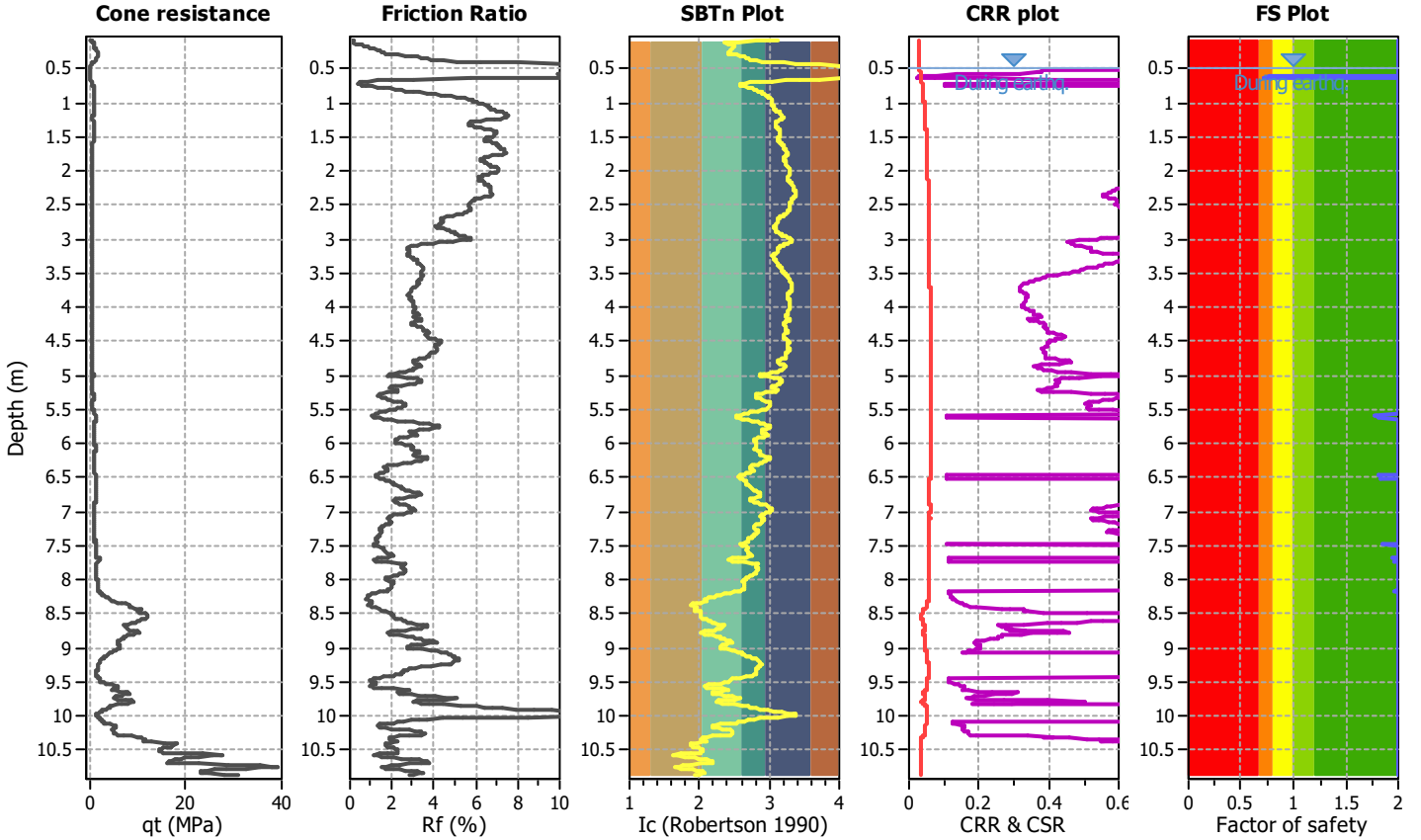
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT14-1/25**

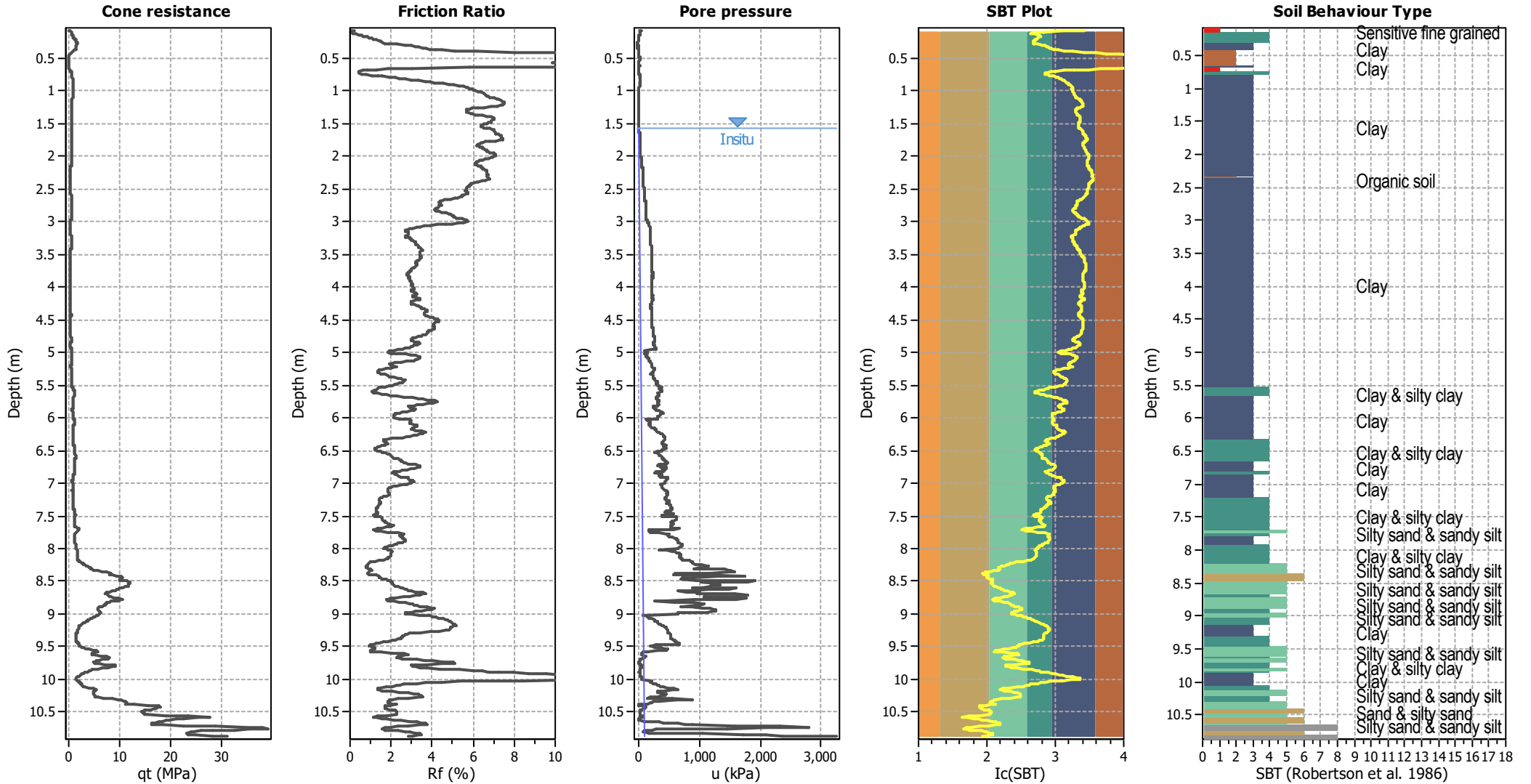
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.58 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



**Input parameters and analysis data**

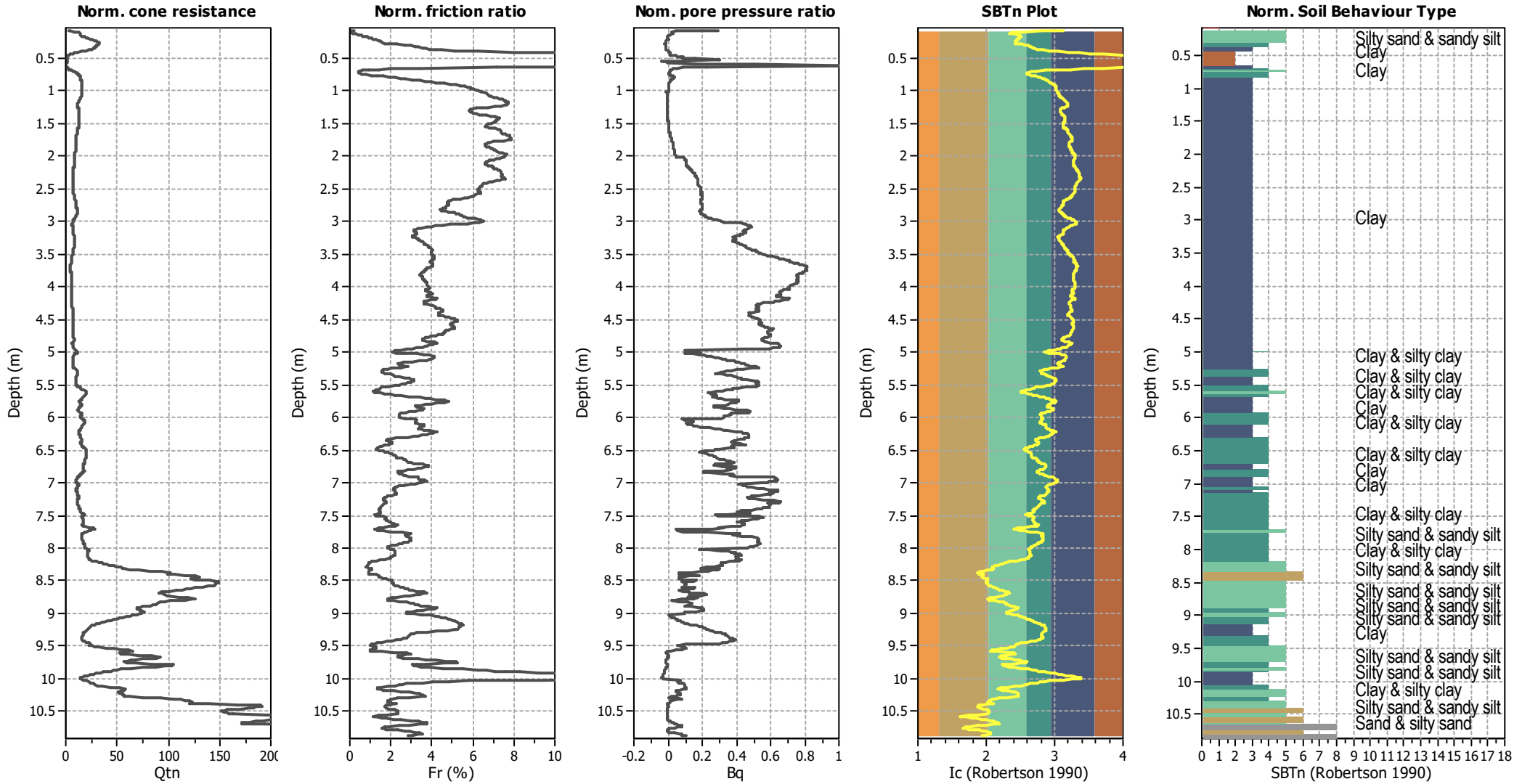
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

**SBT legend**

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



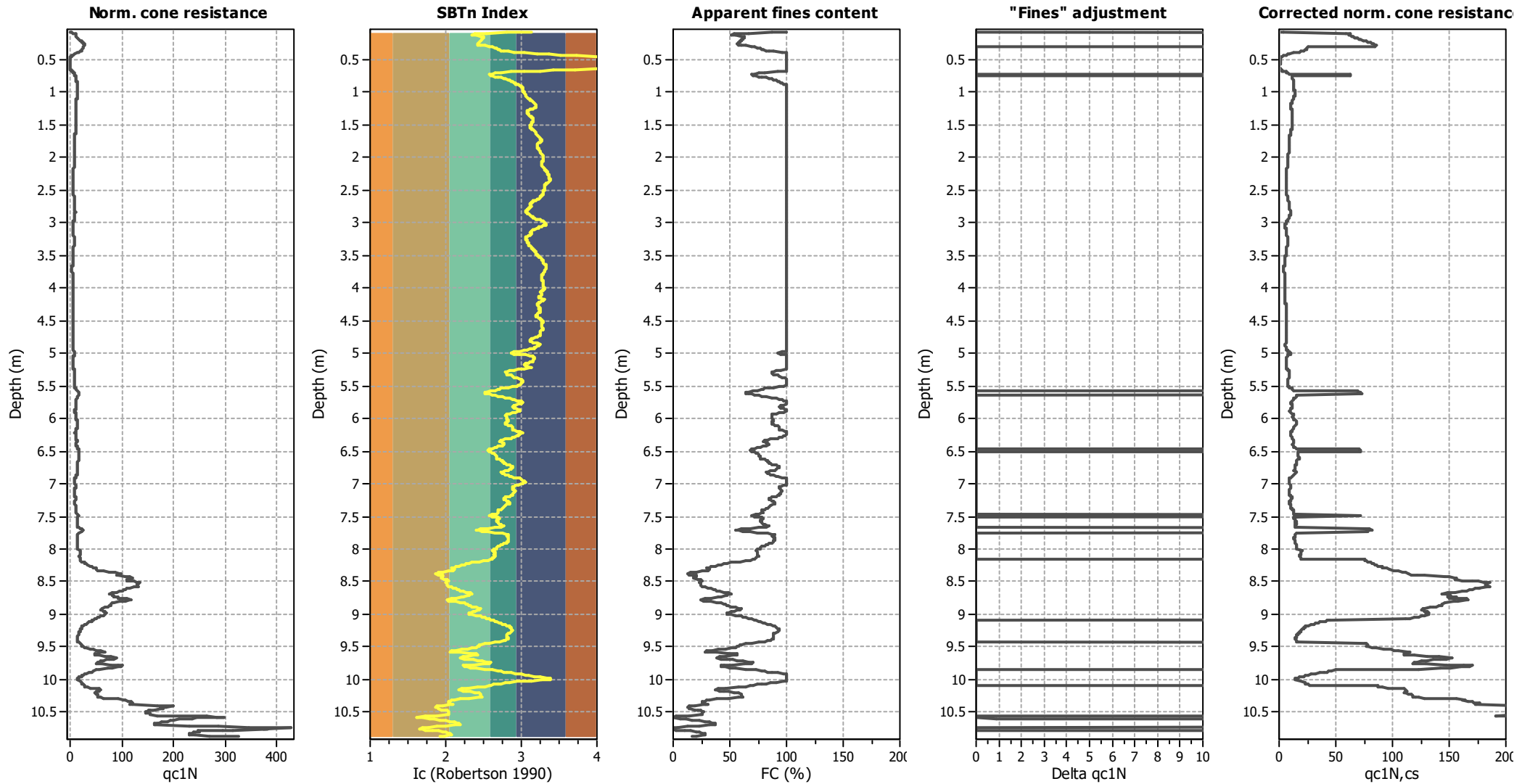
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_v$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

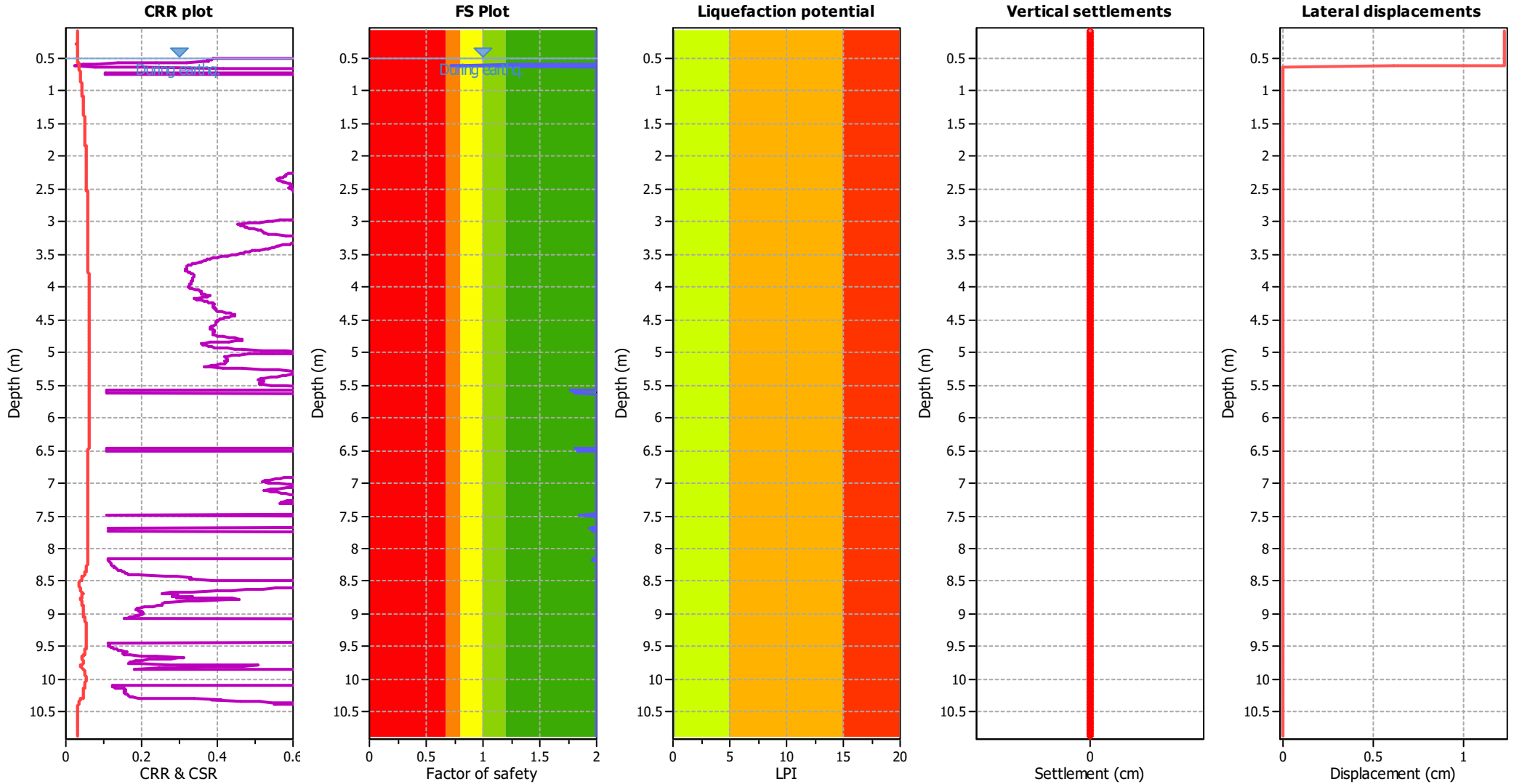
### Liquefaction analysis overall plots (intermediate results)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

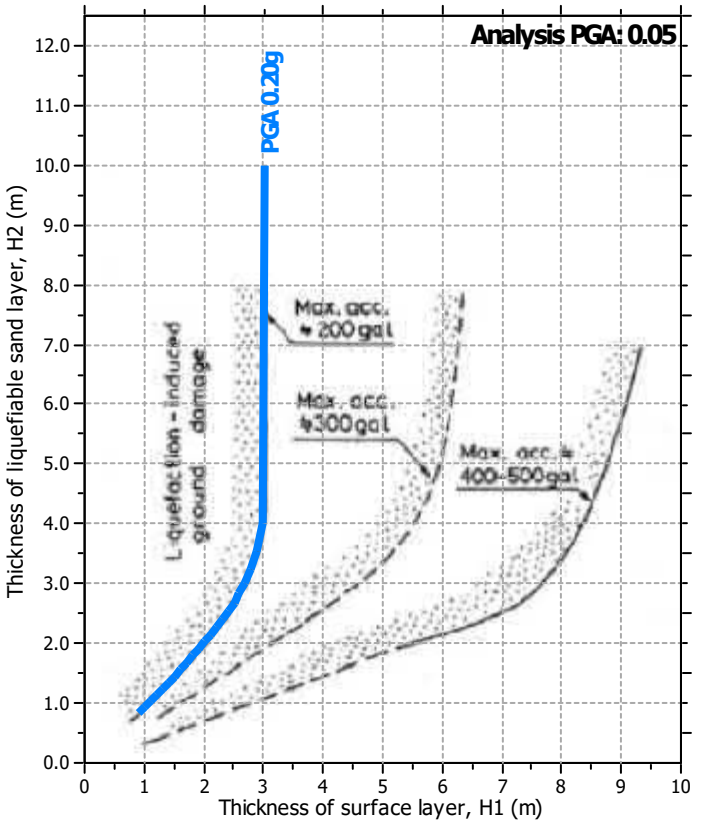
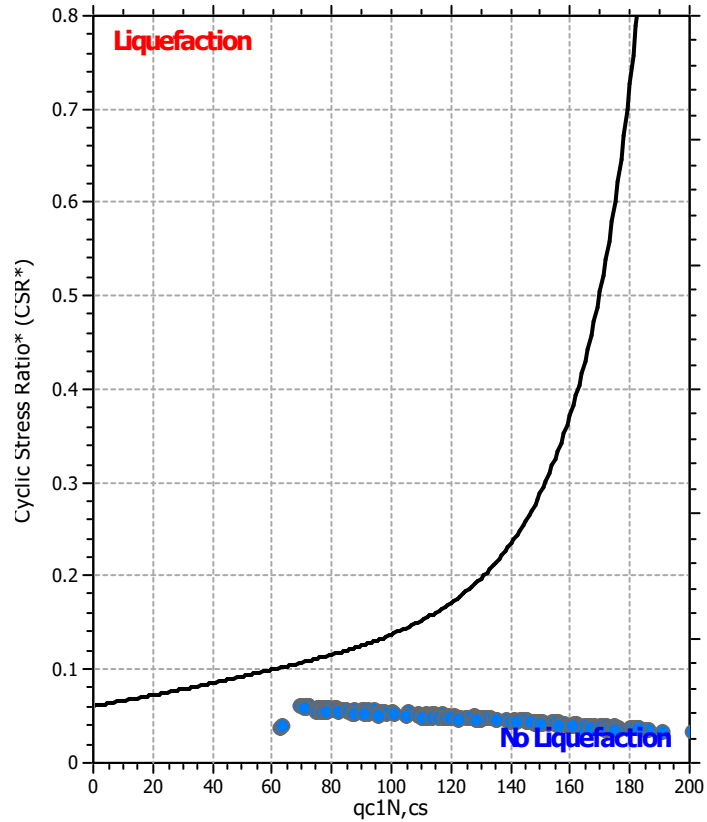
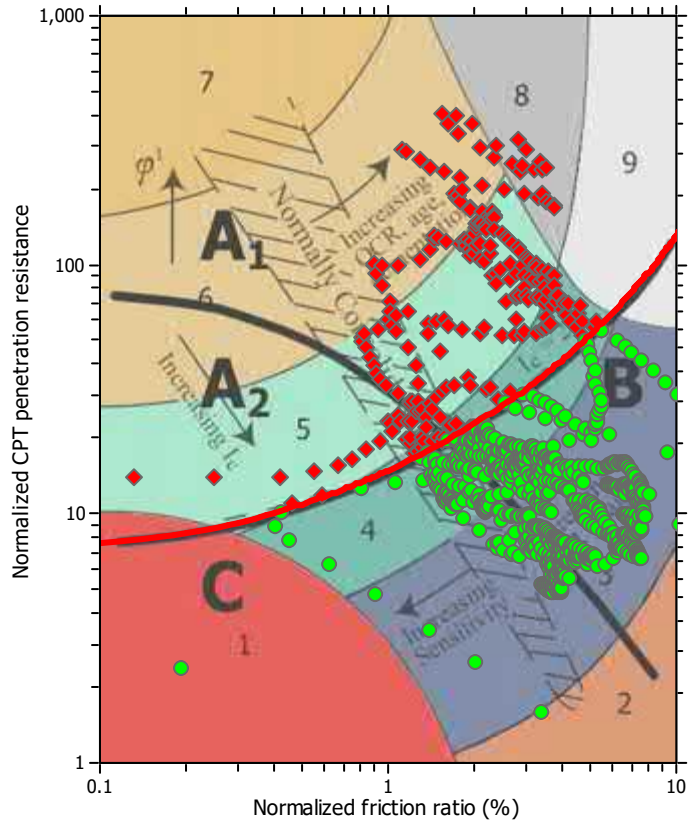
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A



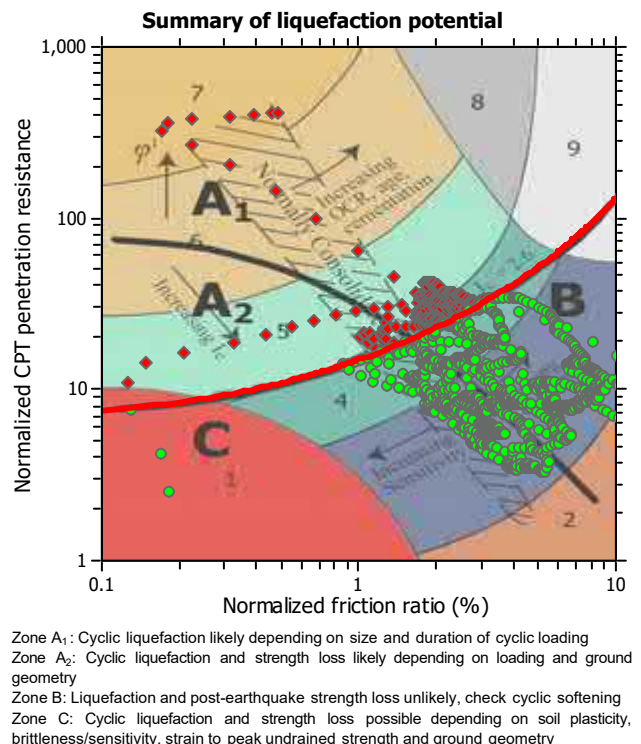
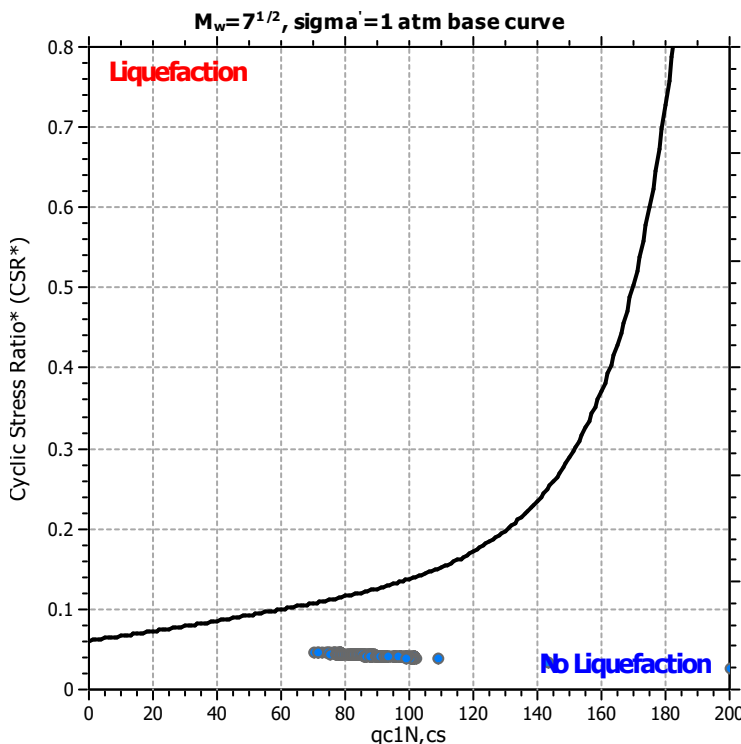
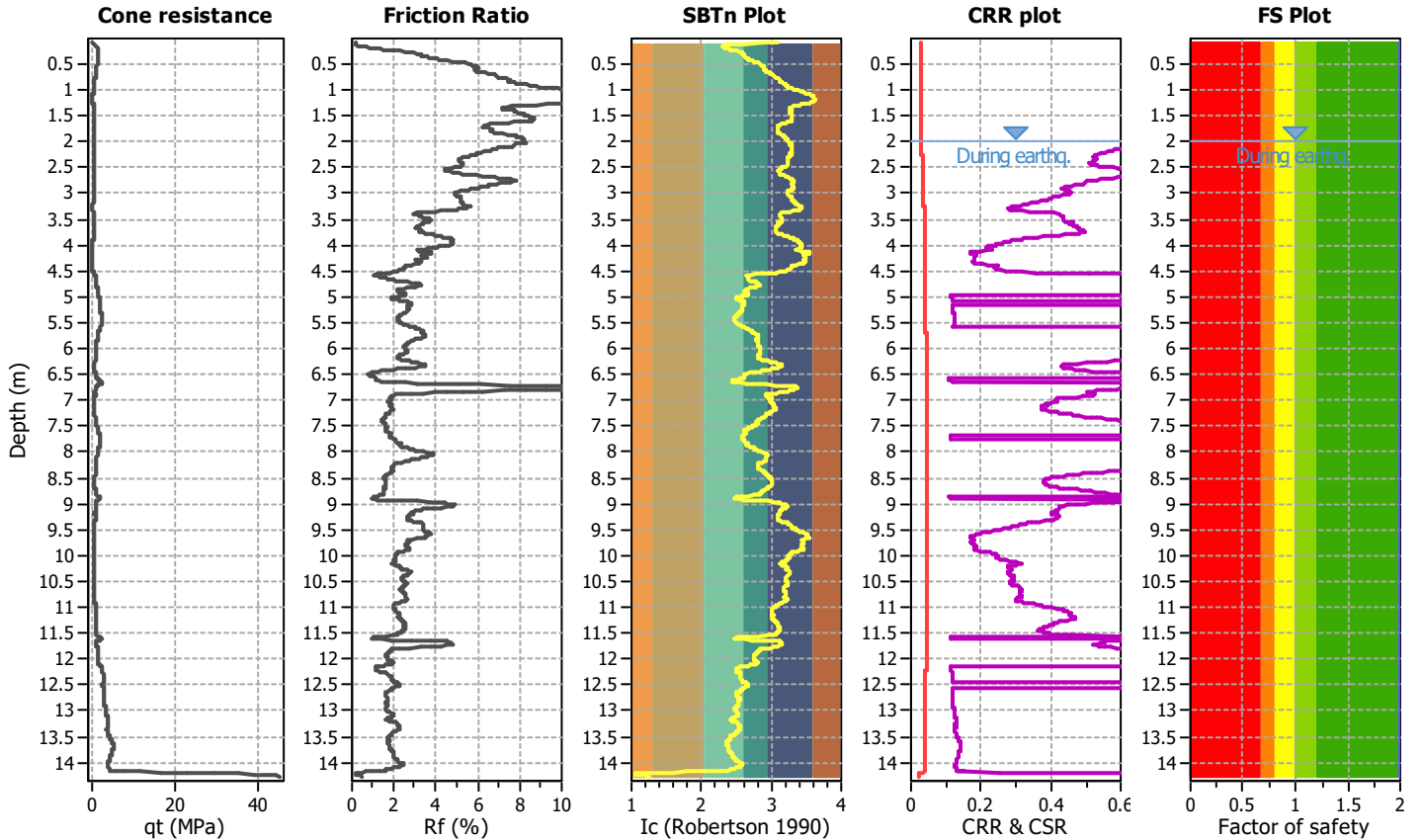
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT15-1/25**

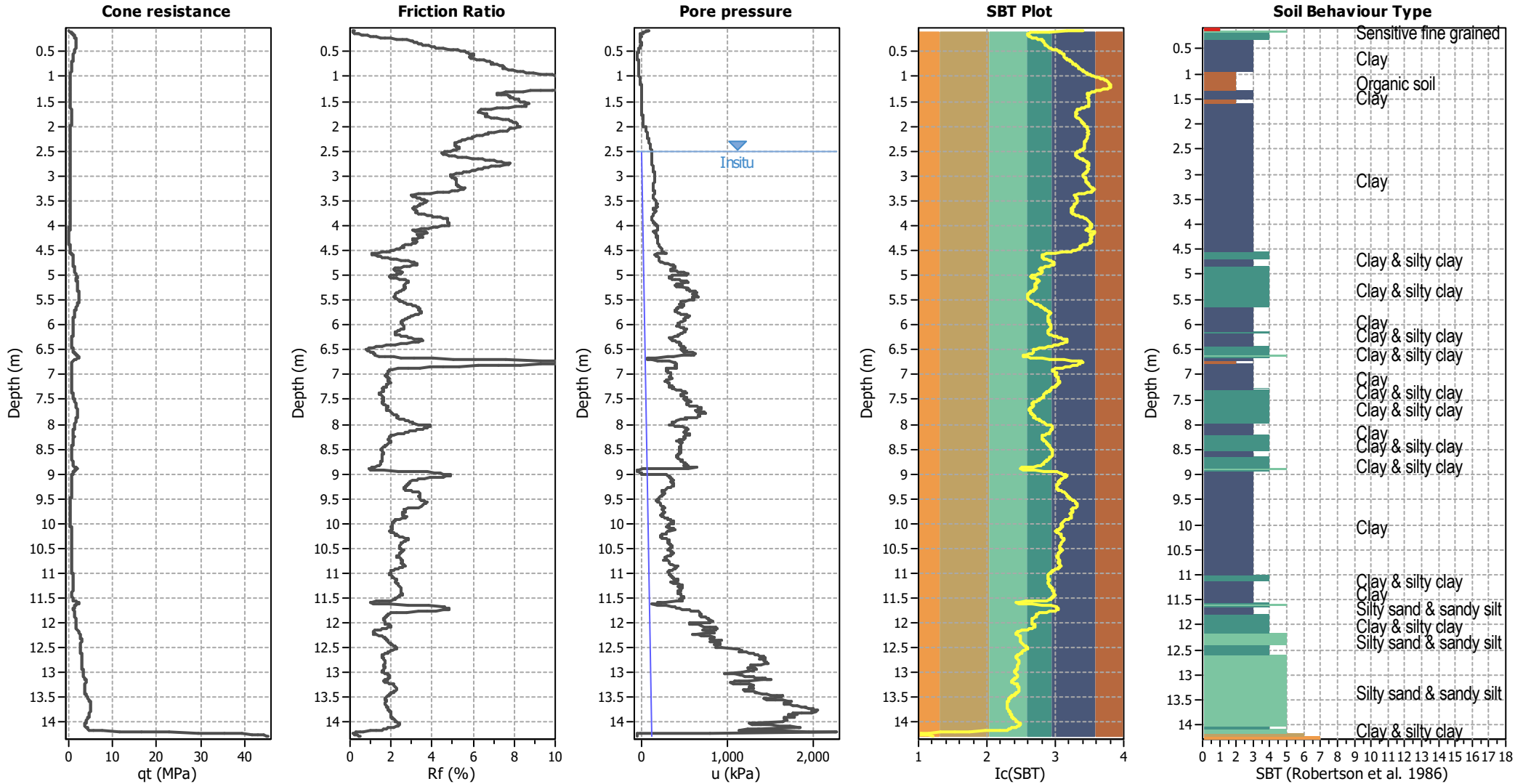
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.05	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



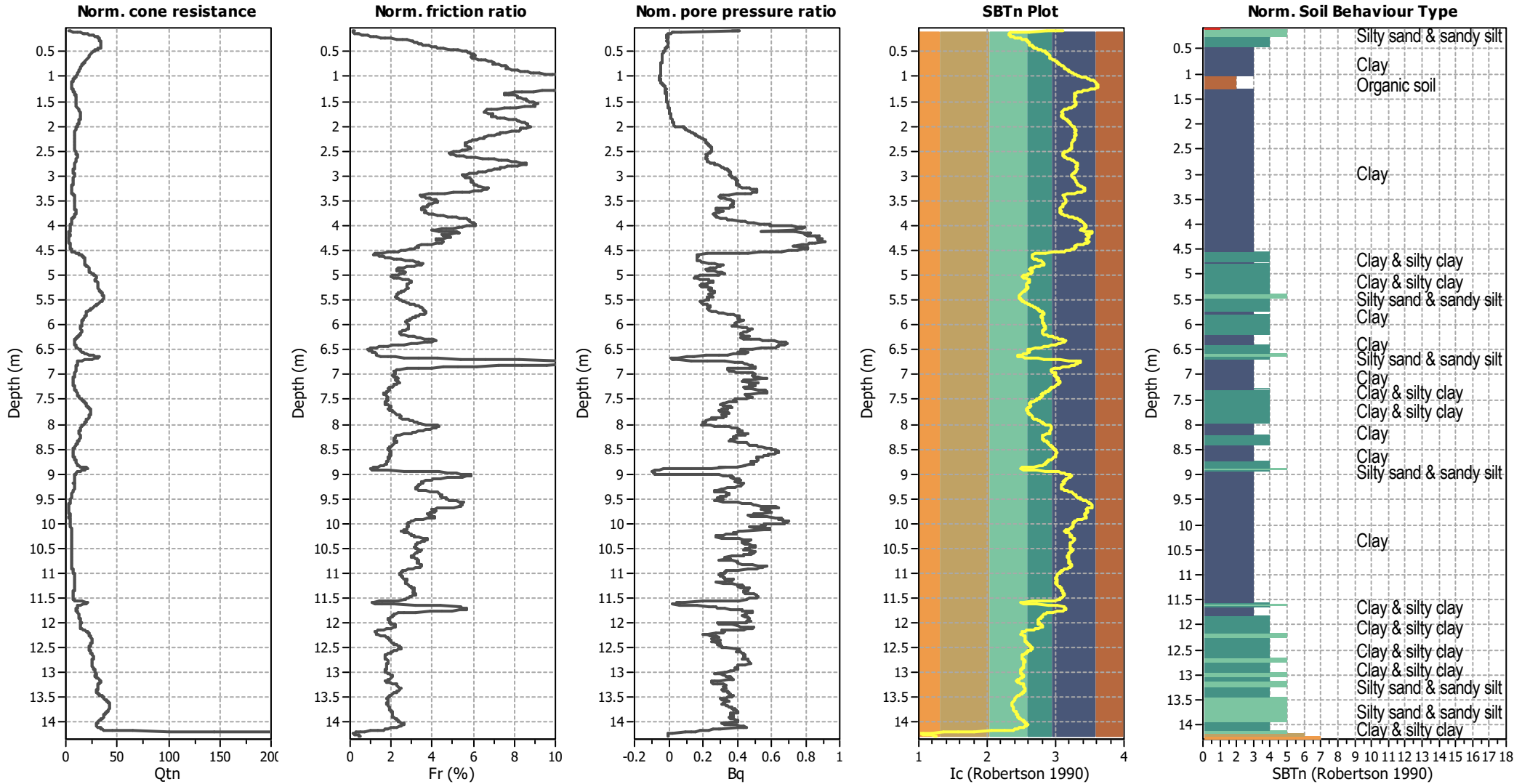
**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

**SBT legend**

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



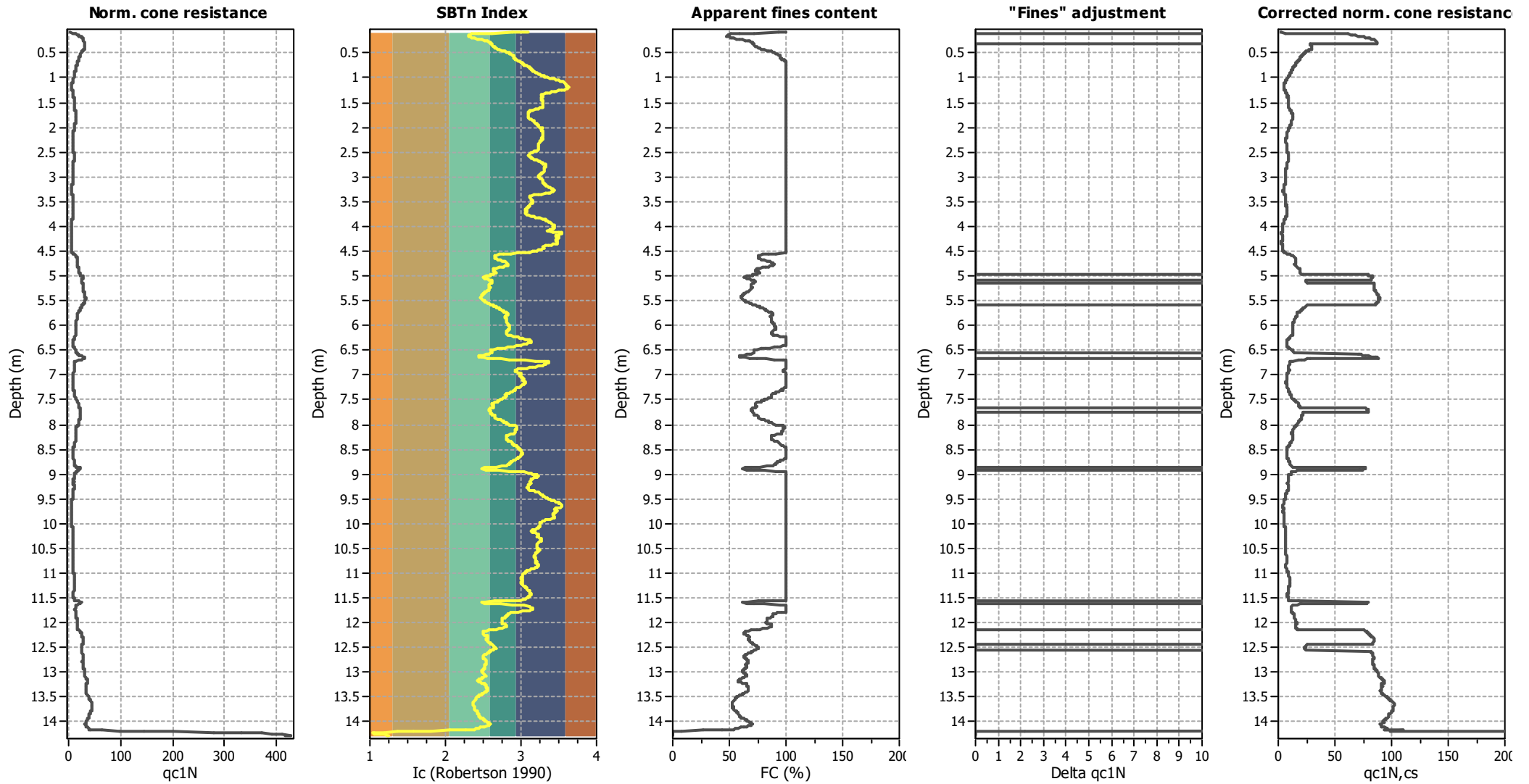
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

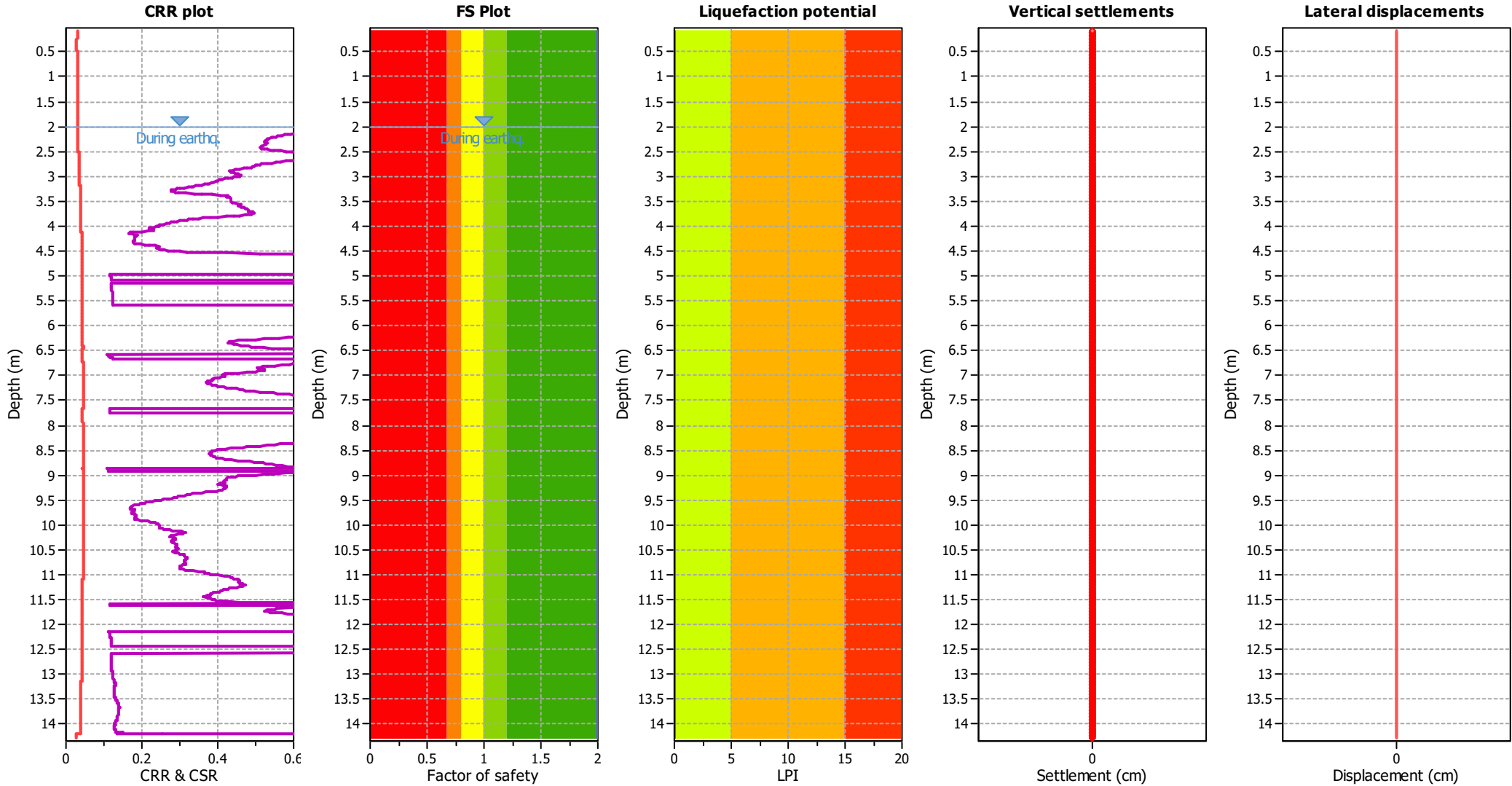


**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

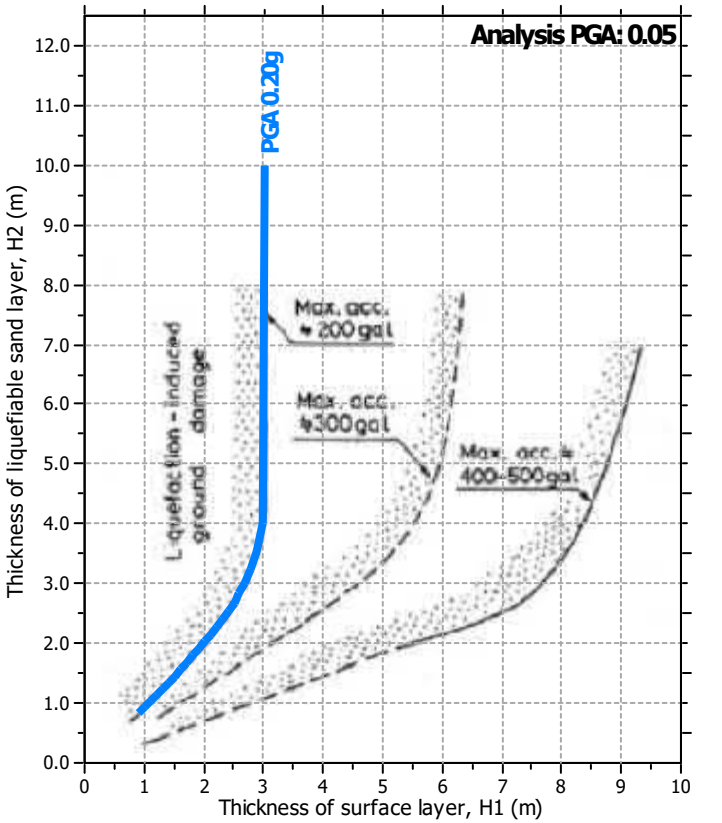
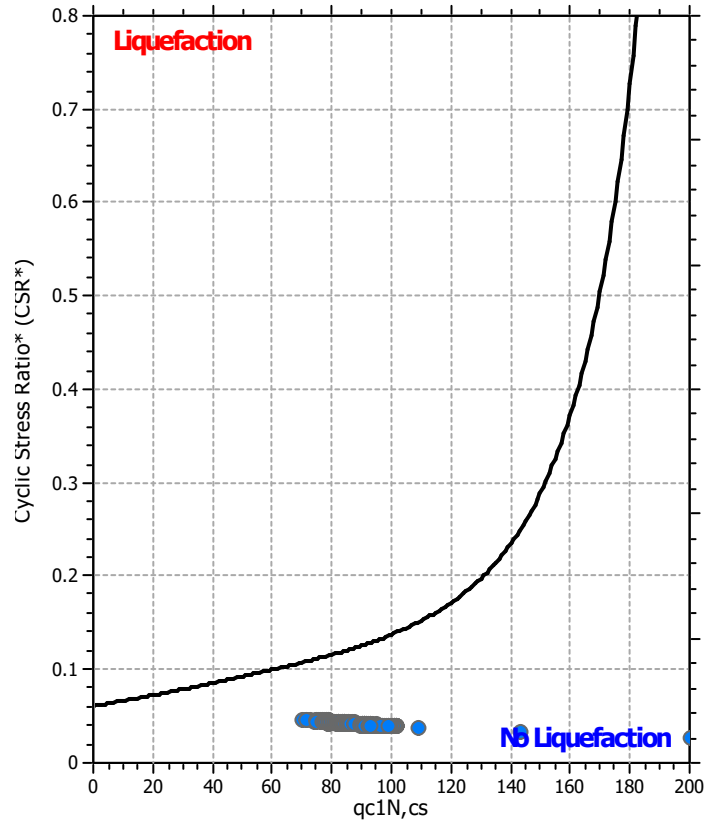
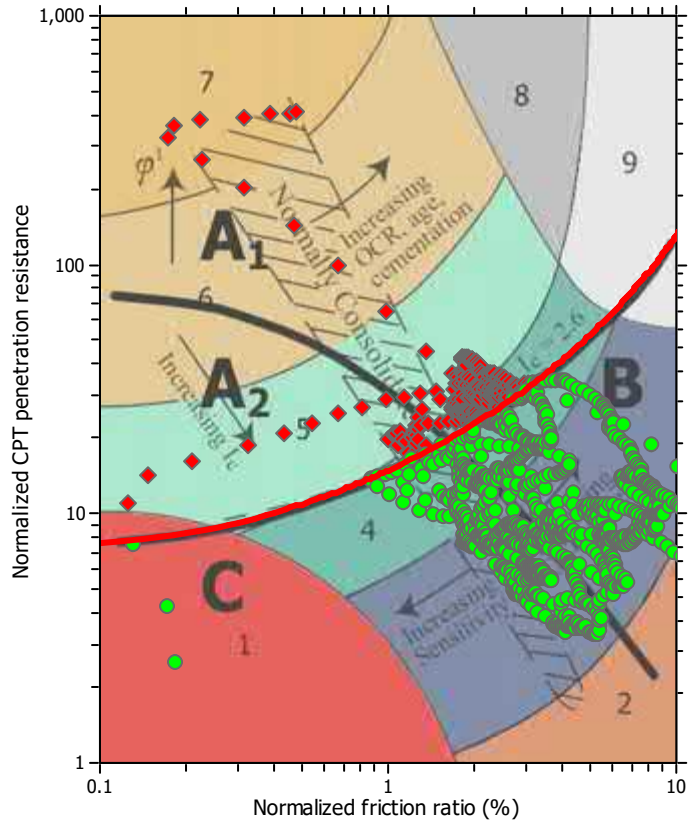
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

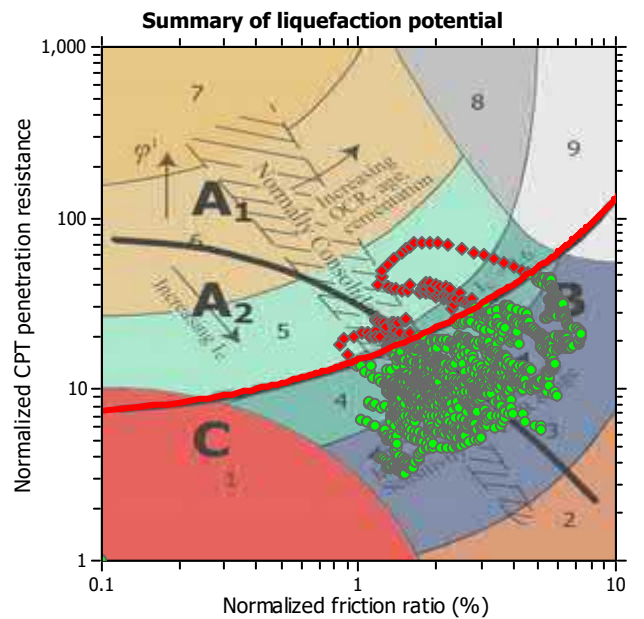
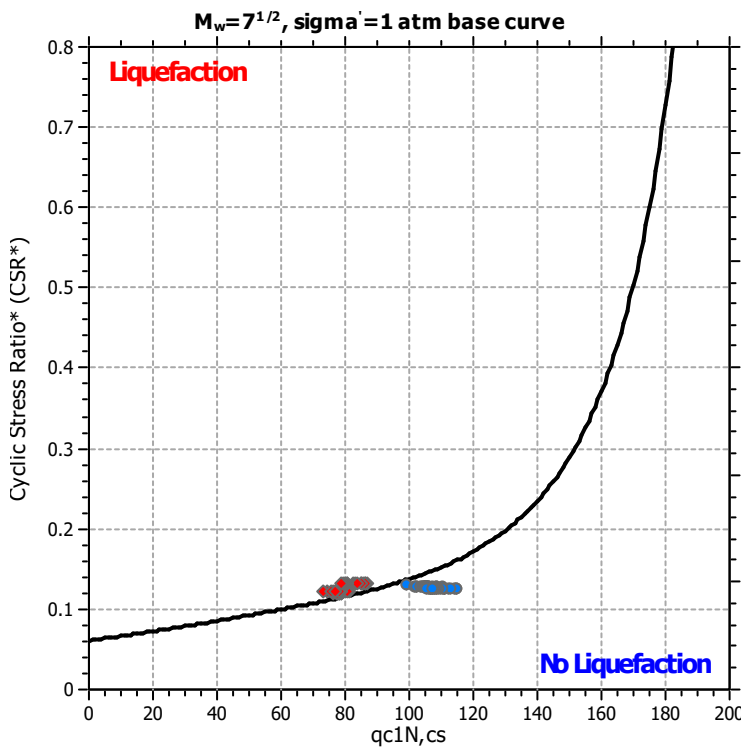
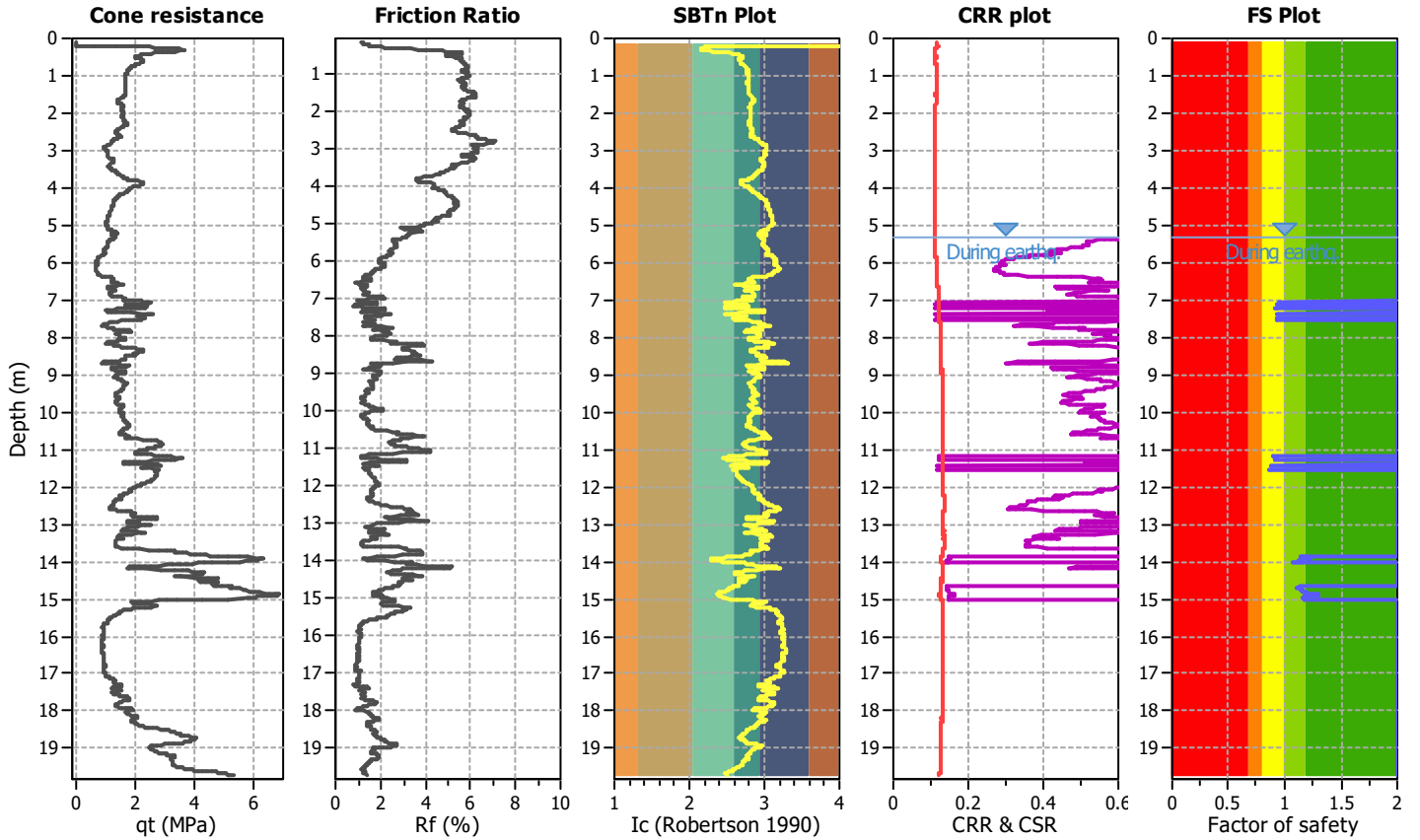
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT1-1/500**

**Location : 48 Valerie Close, Warkworth**

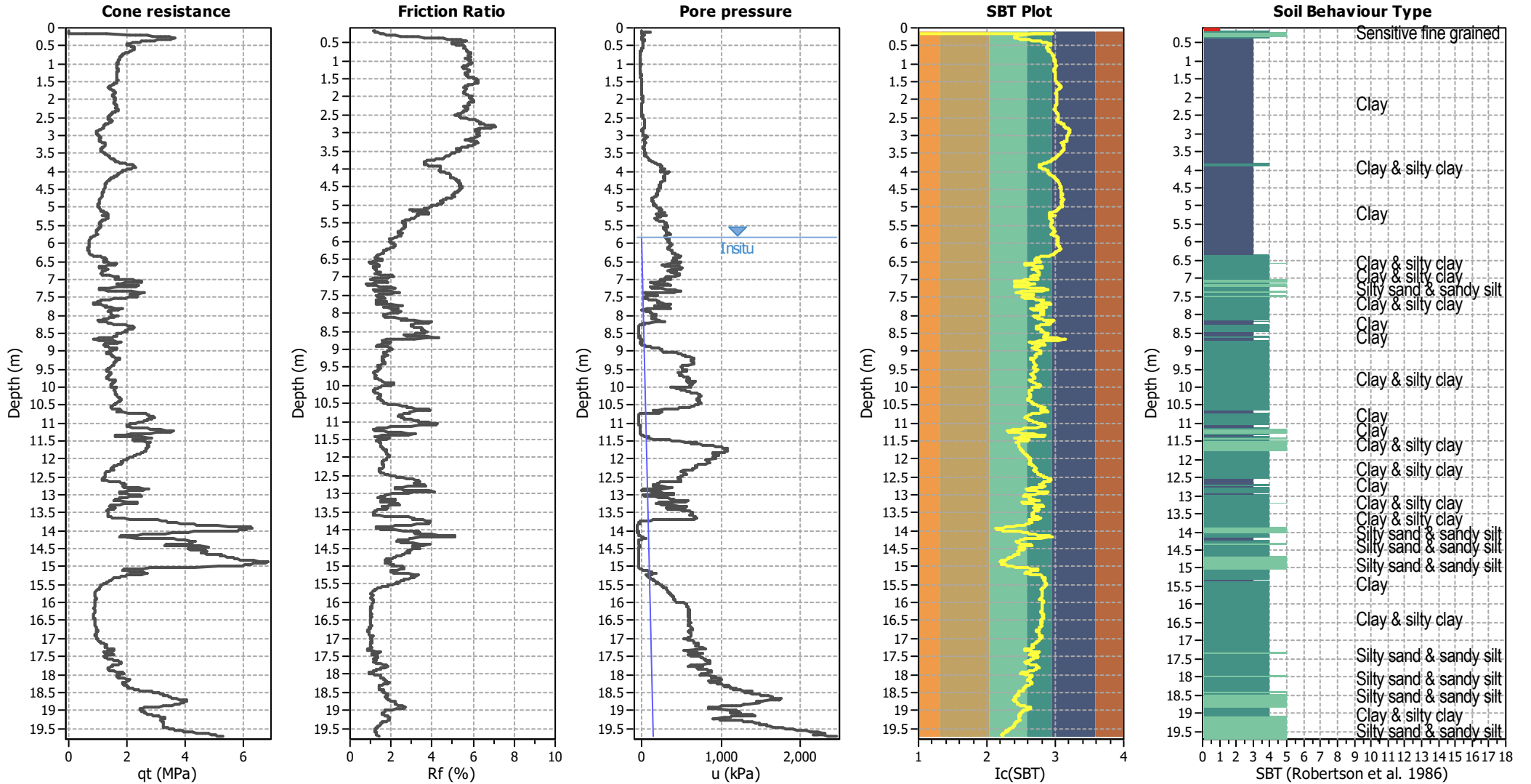
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.83 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.33 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading  
 Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
 Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
 Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



#### Input parameters and analysis data

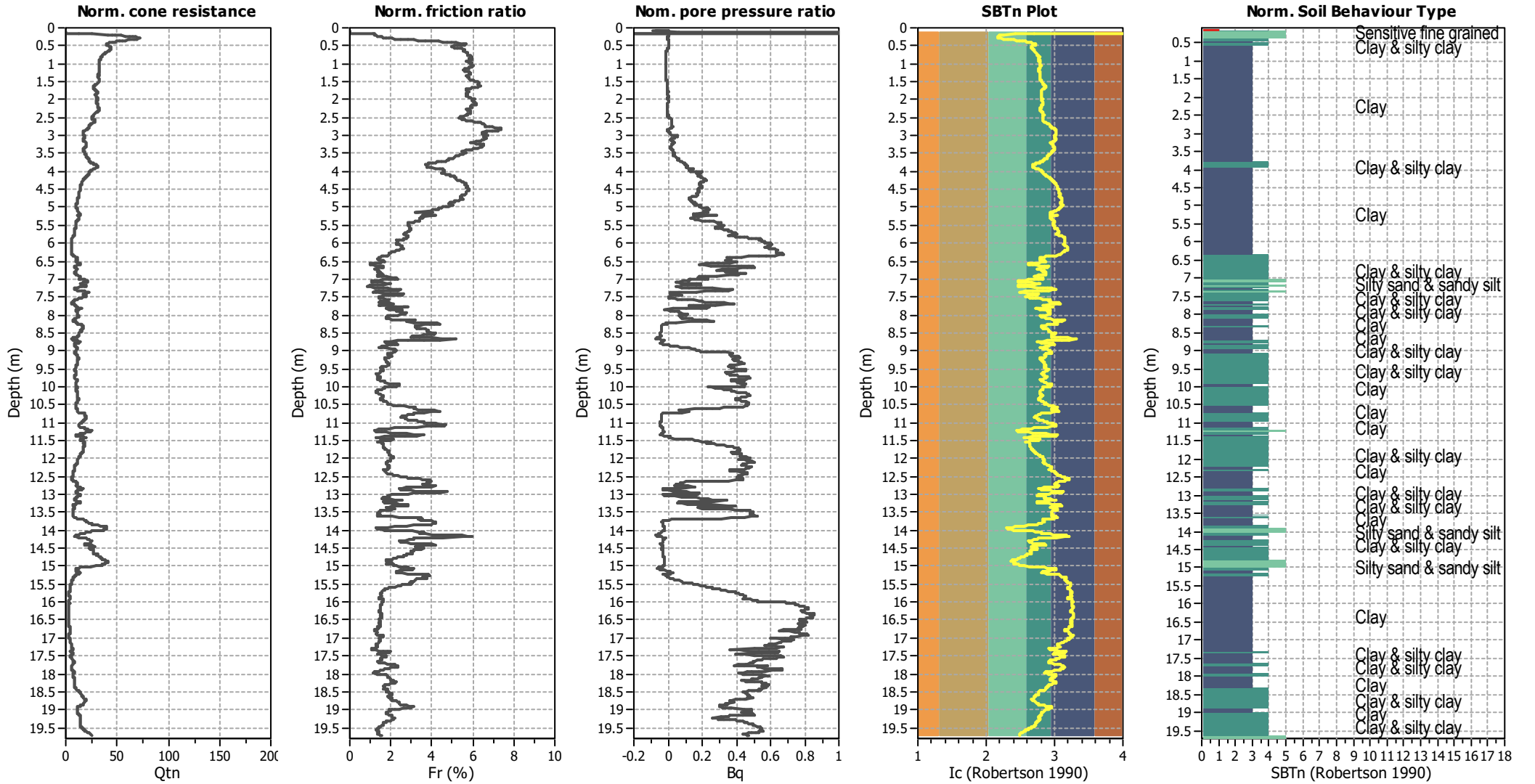
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



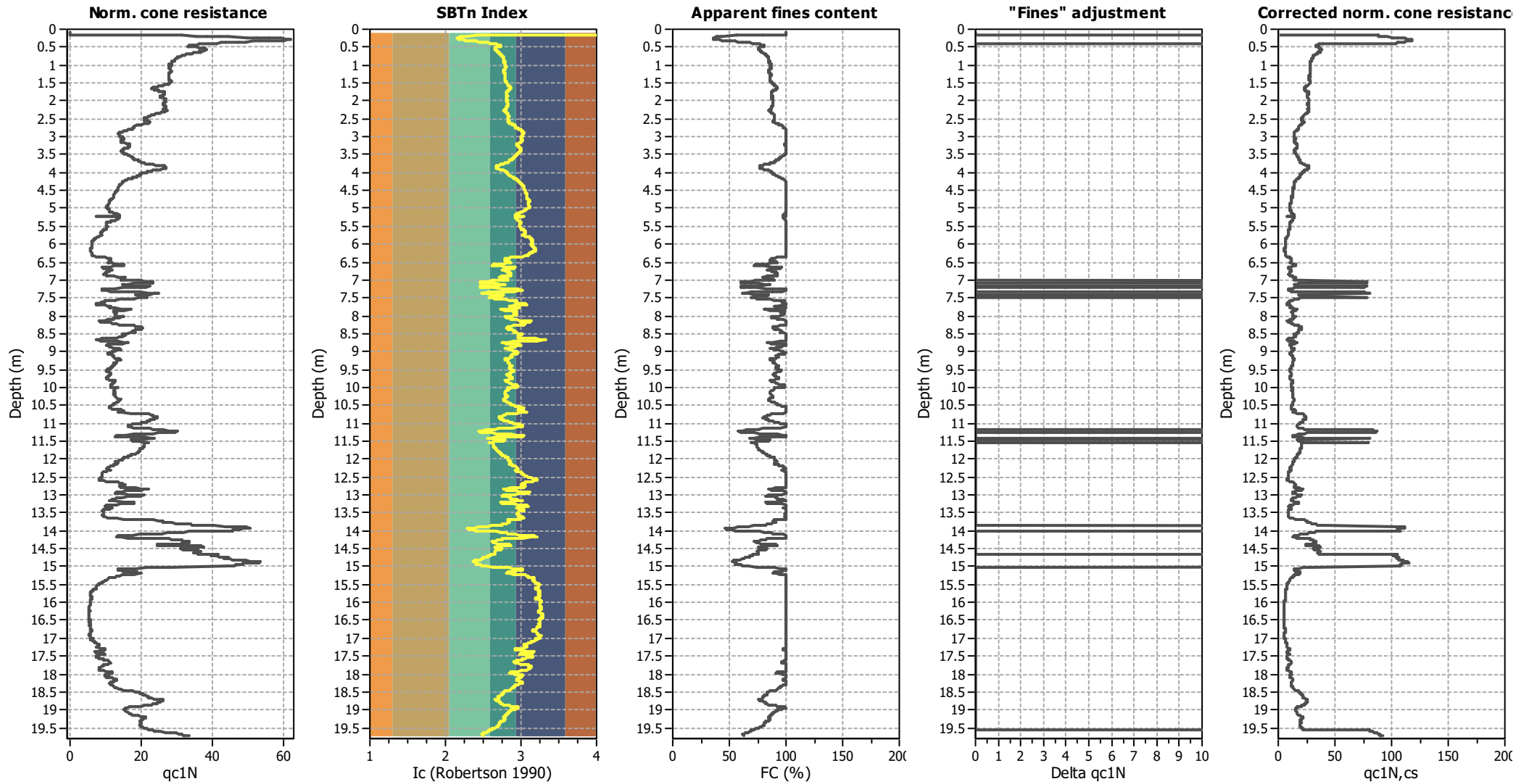
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

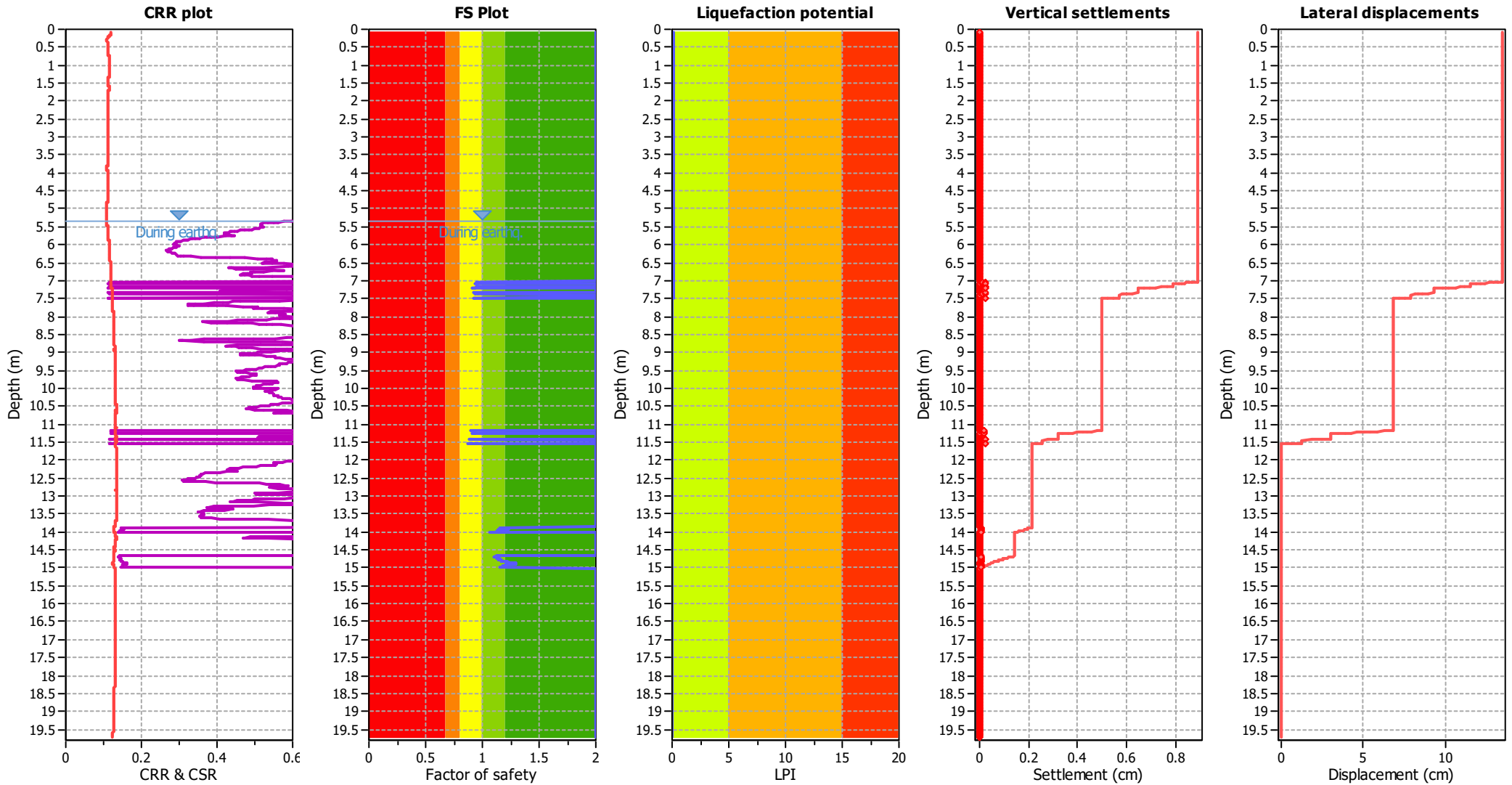
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

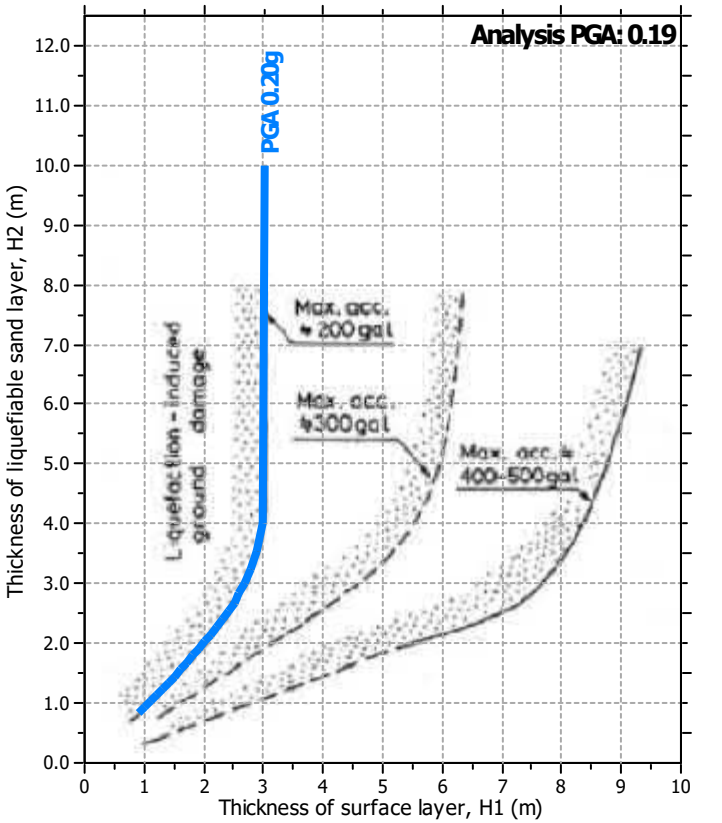
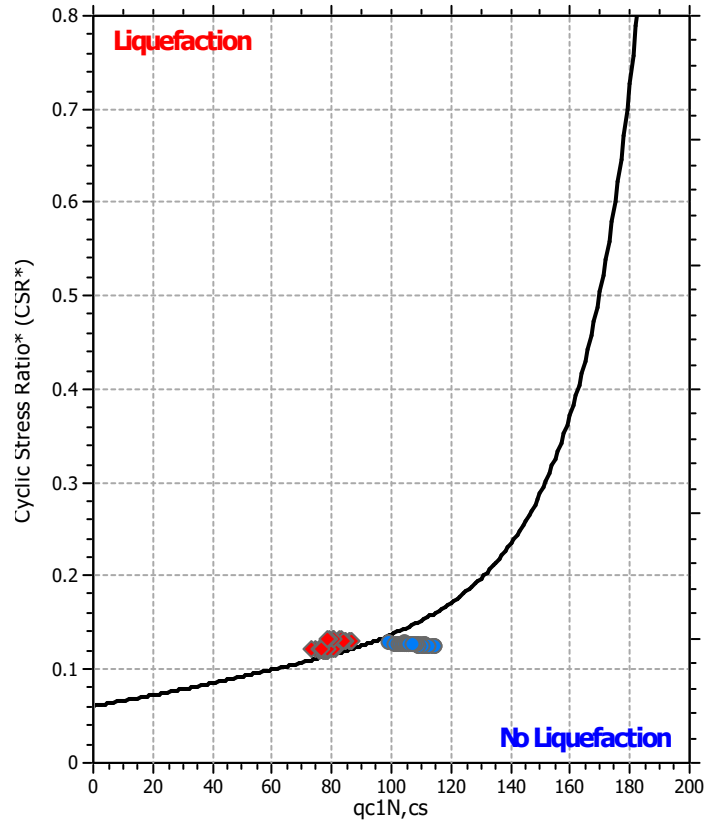
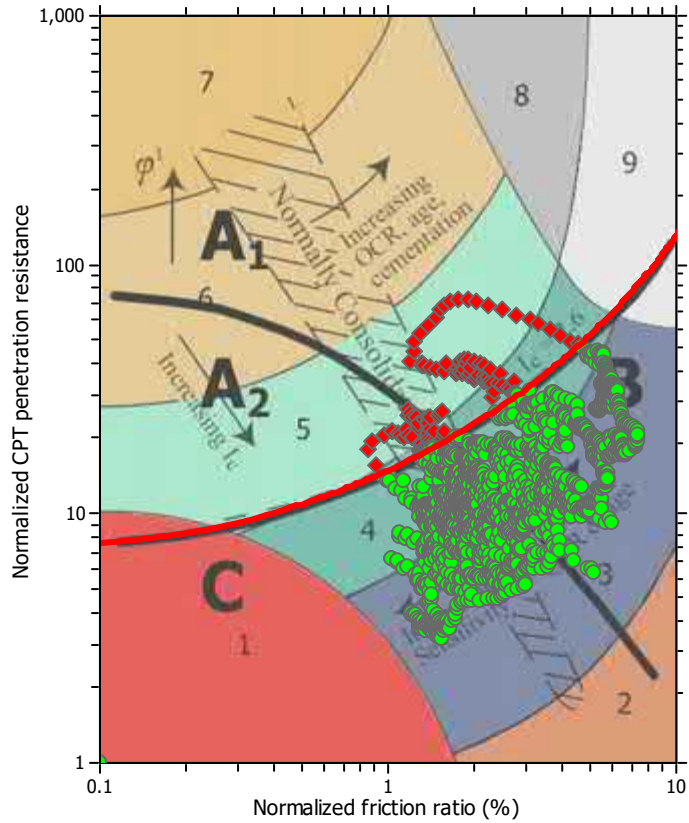
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m



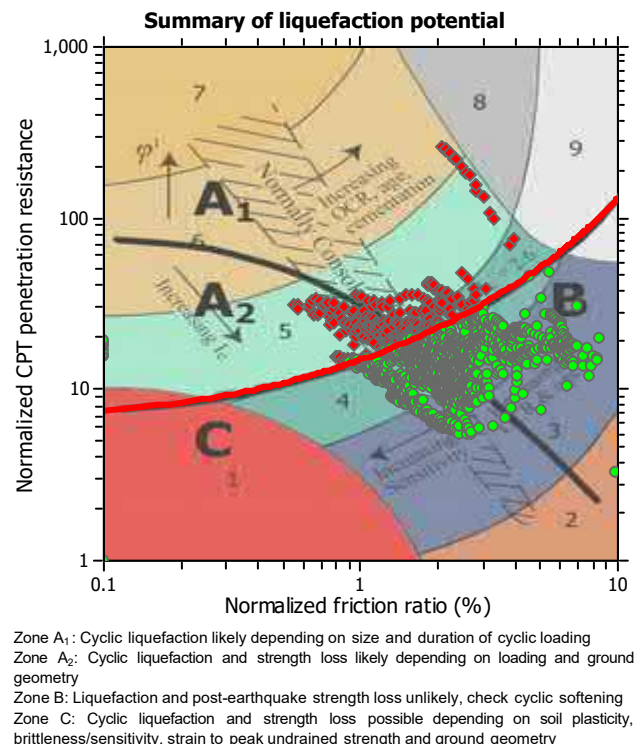
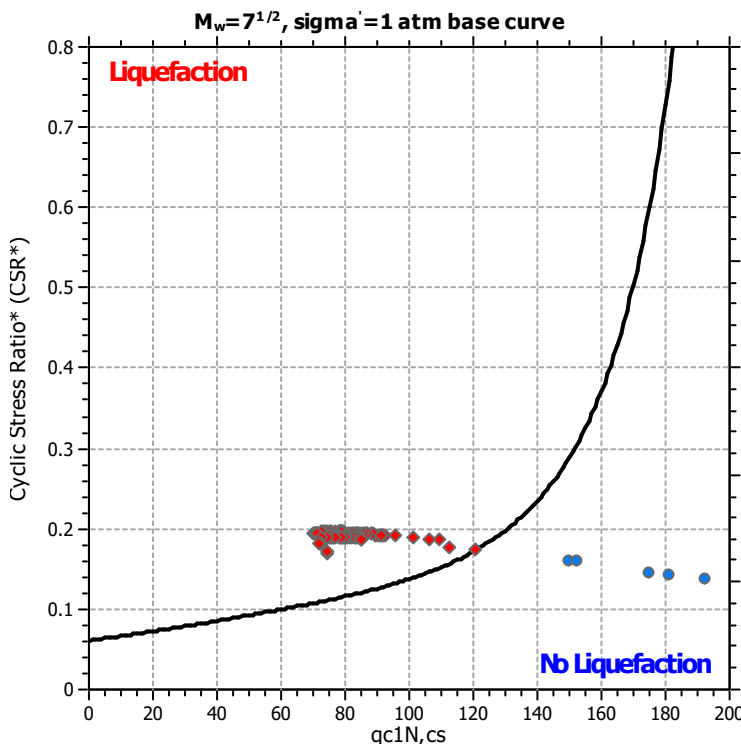
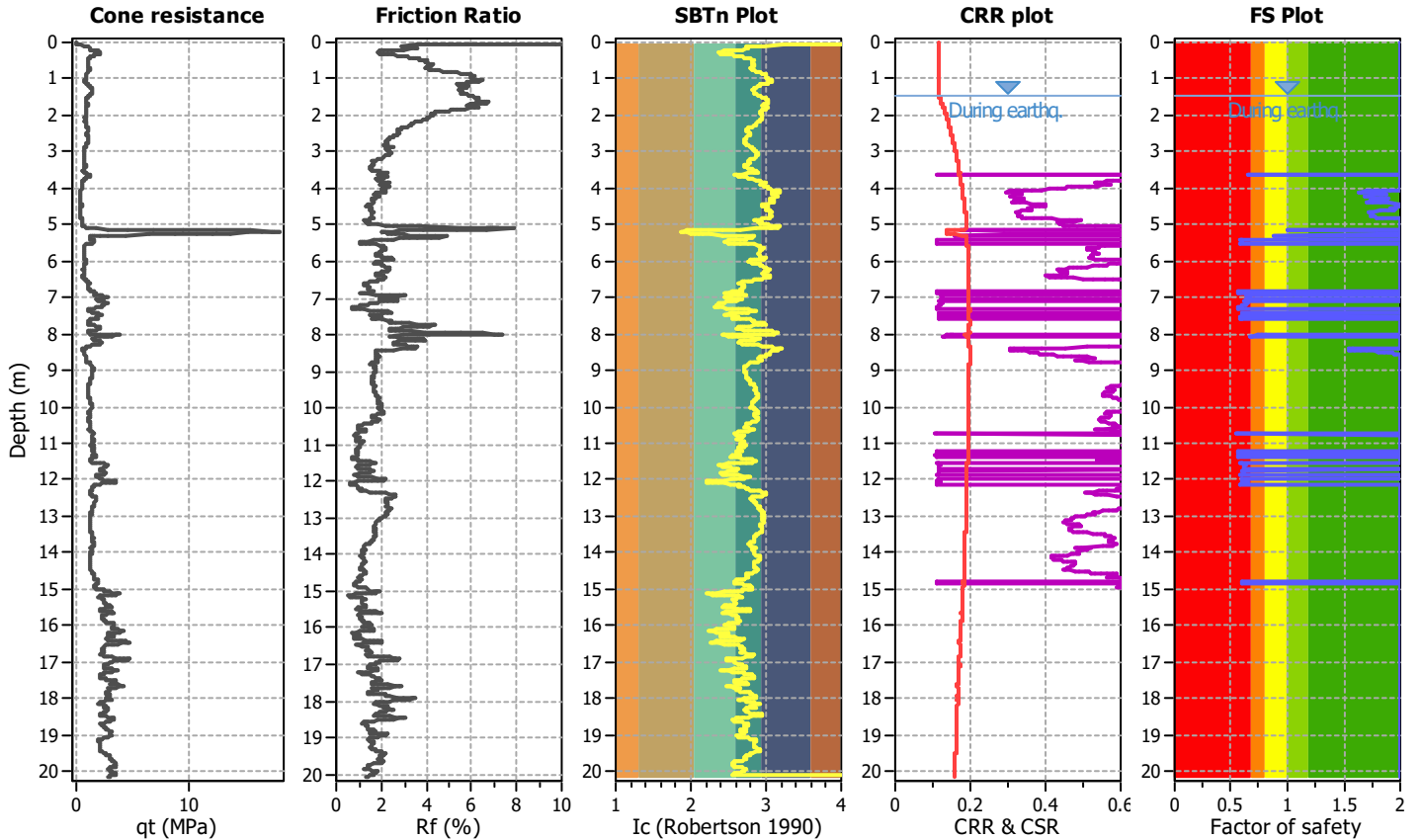
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT 2-1/500**

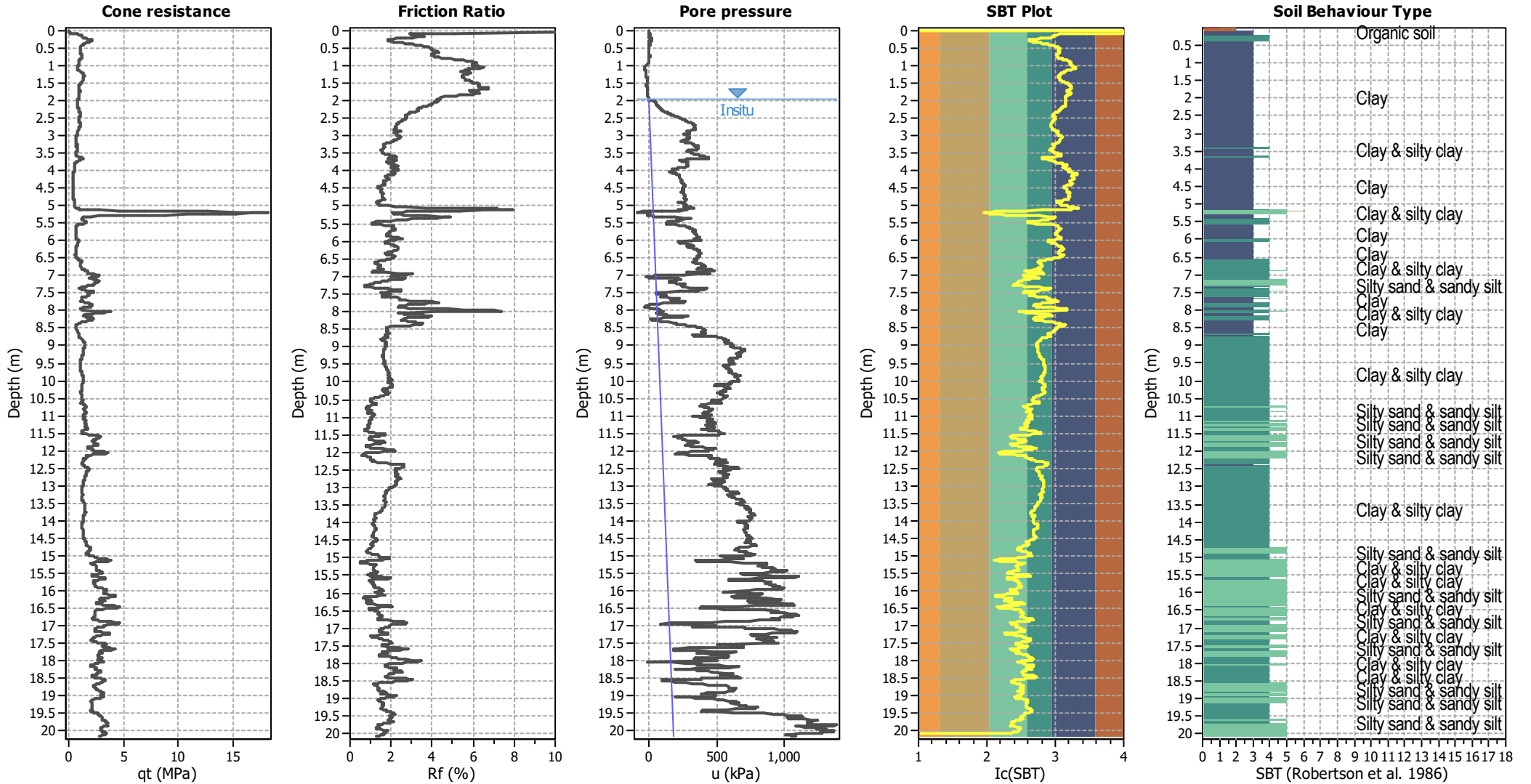
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.96 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.46 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:	15.00 m
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



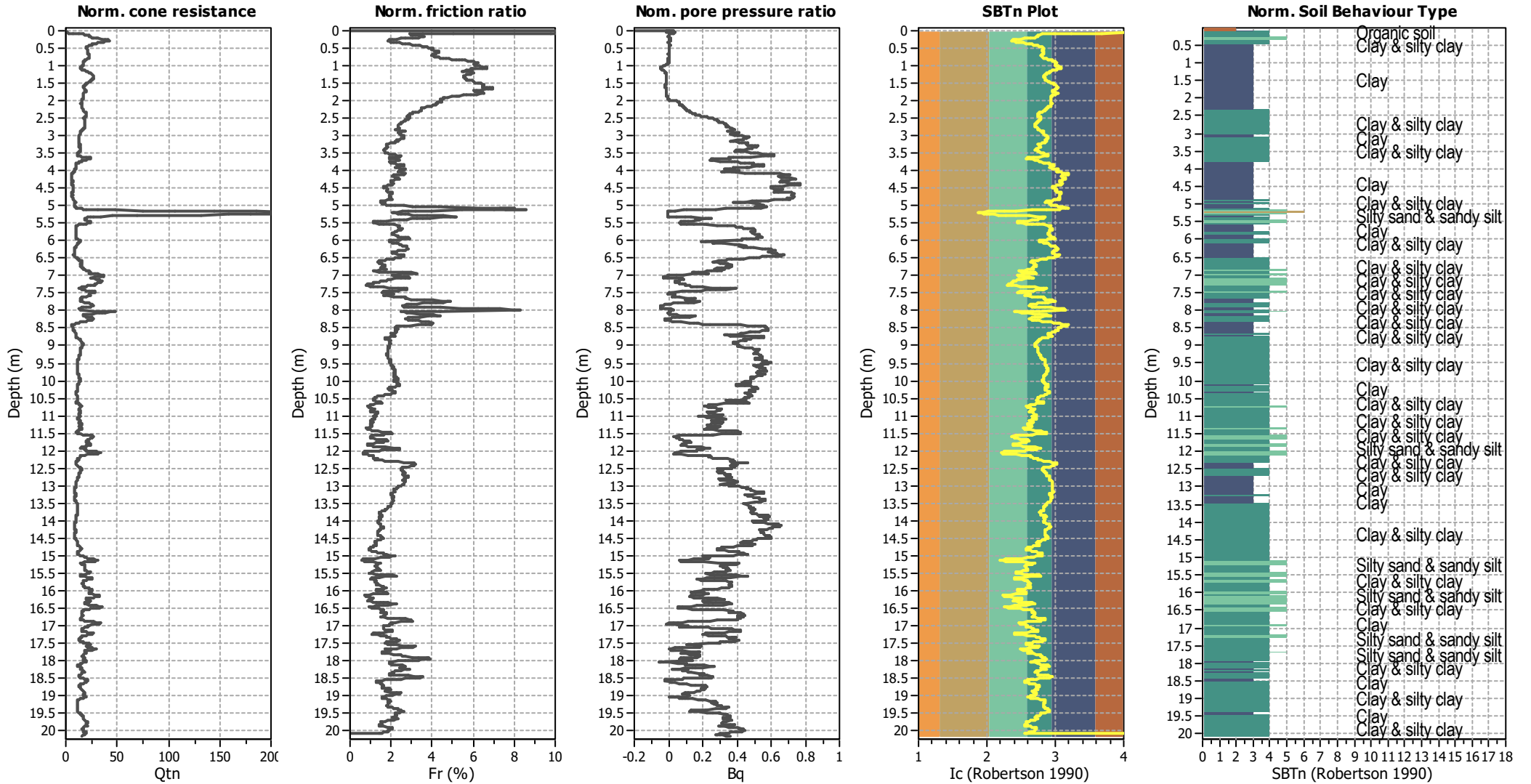
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



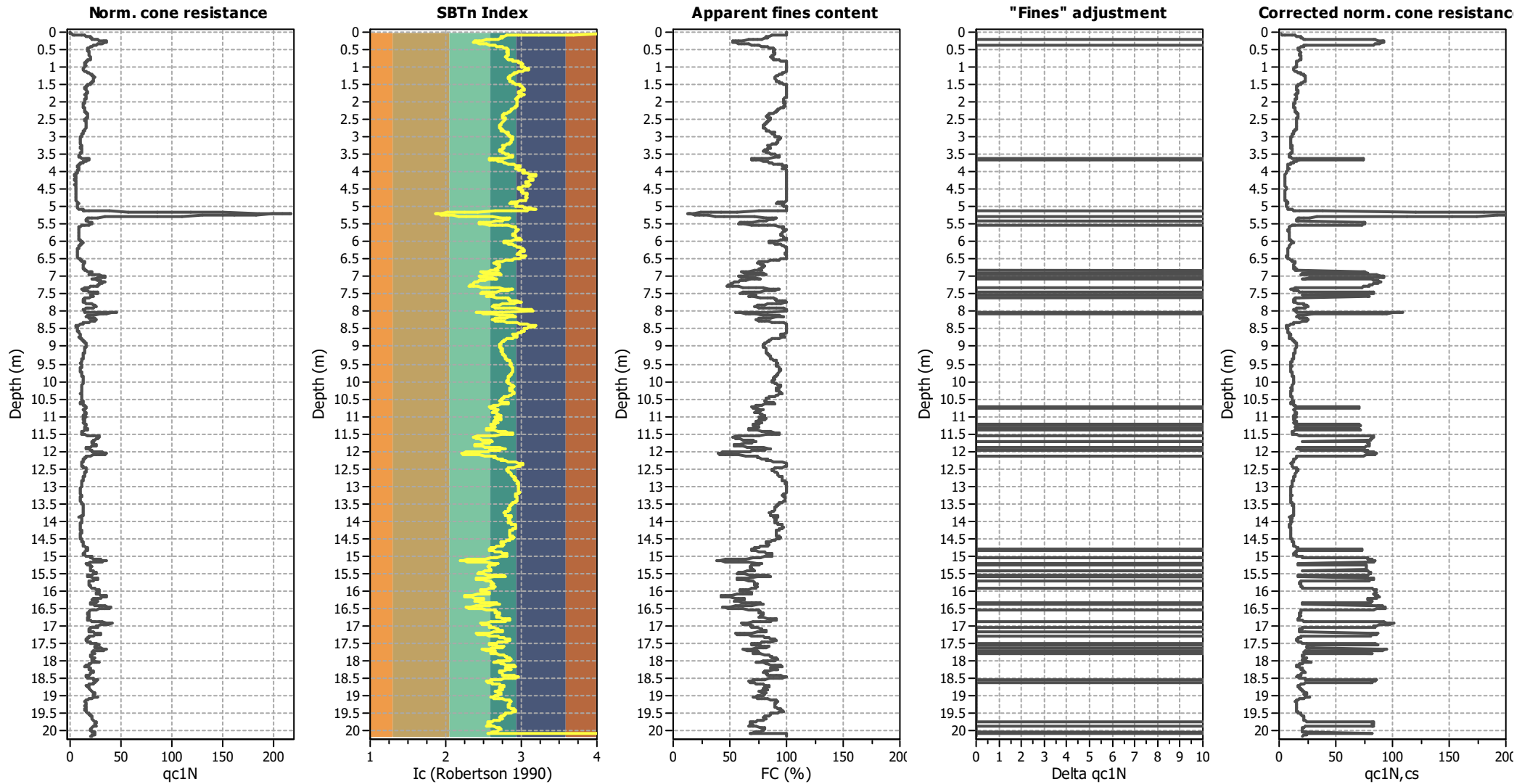
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

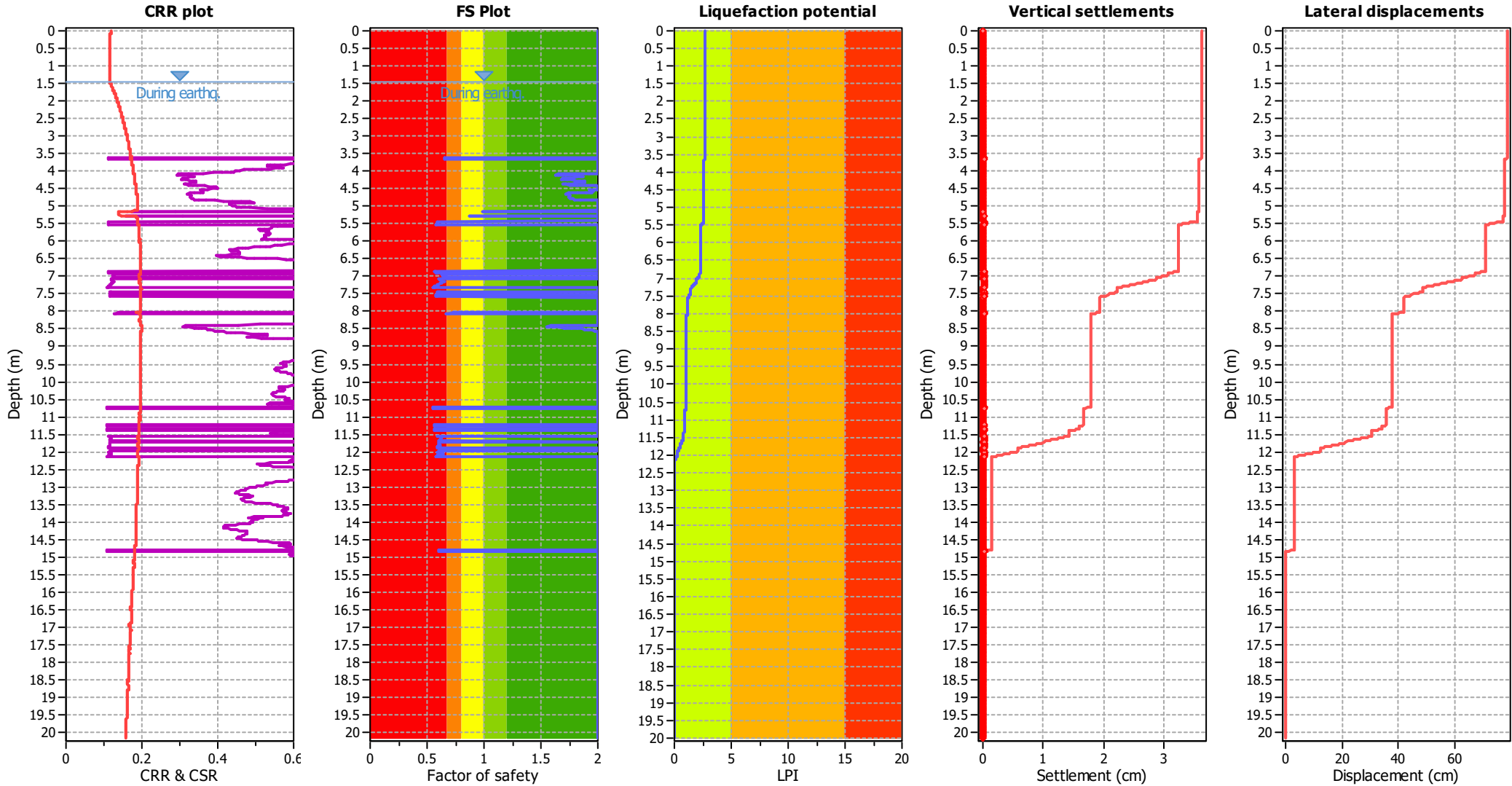


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

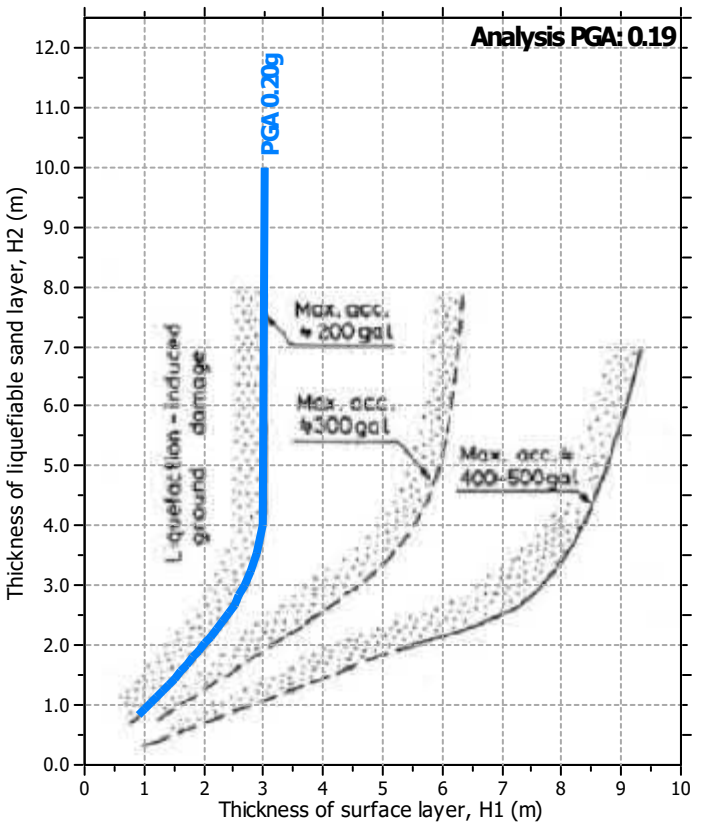
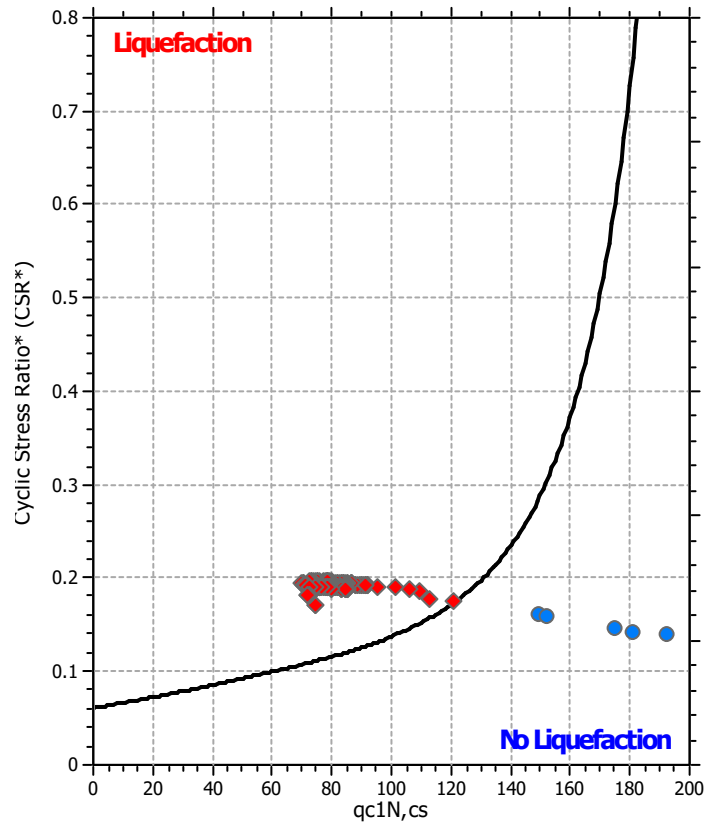
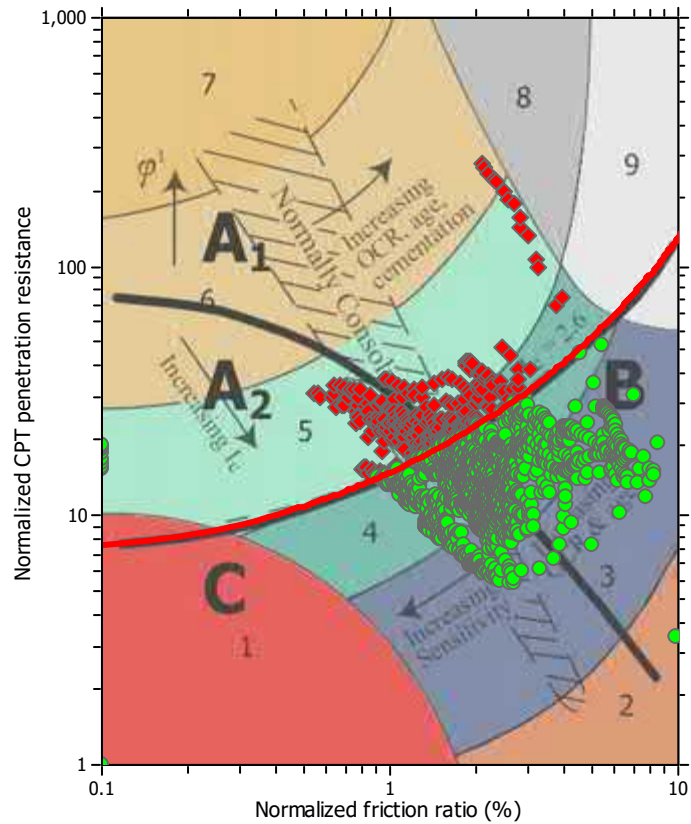
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

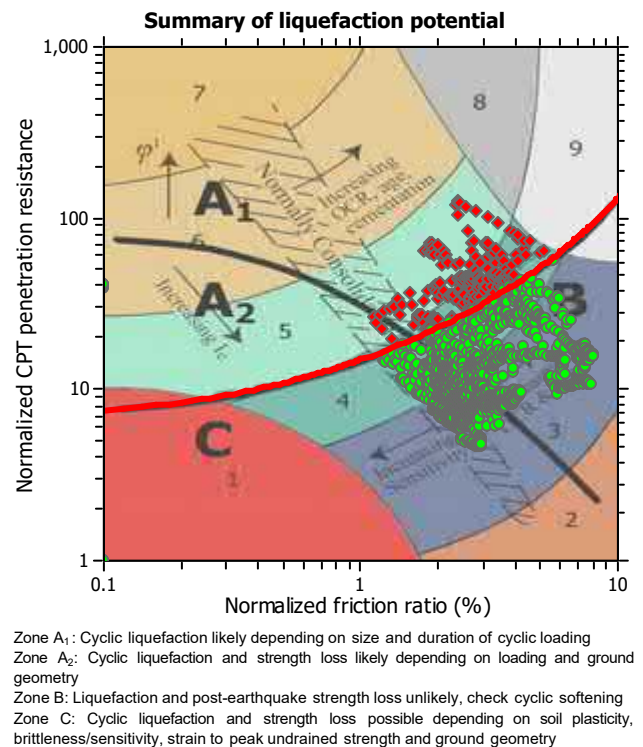
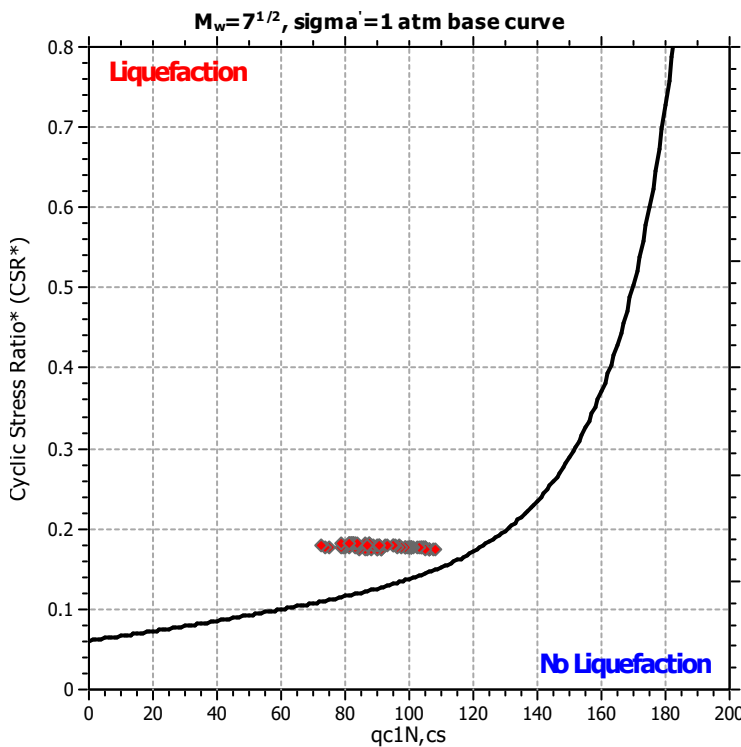
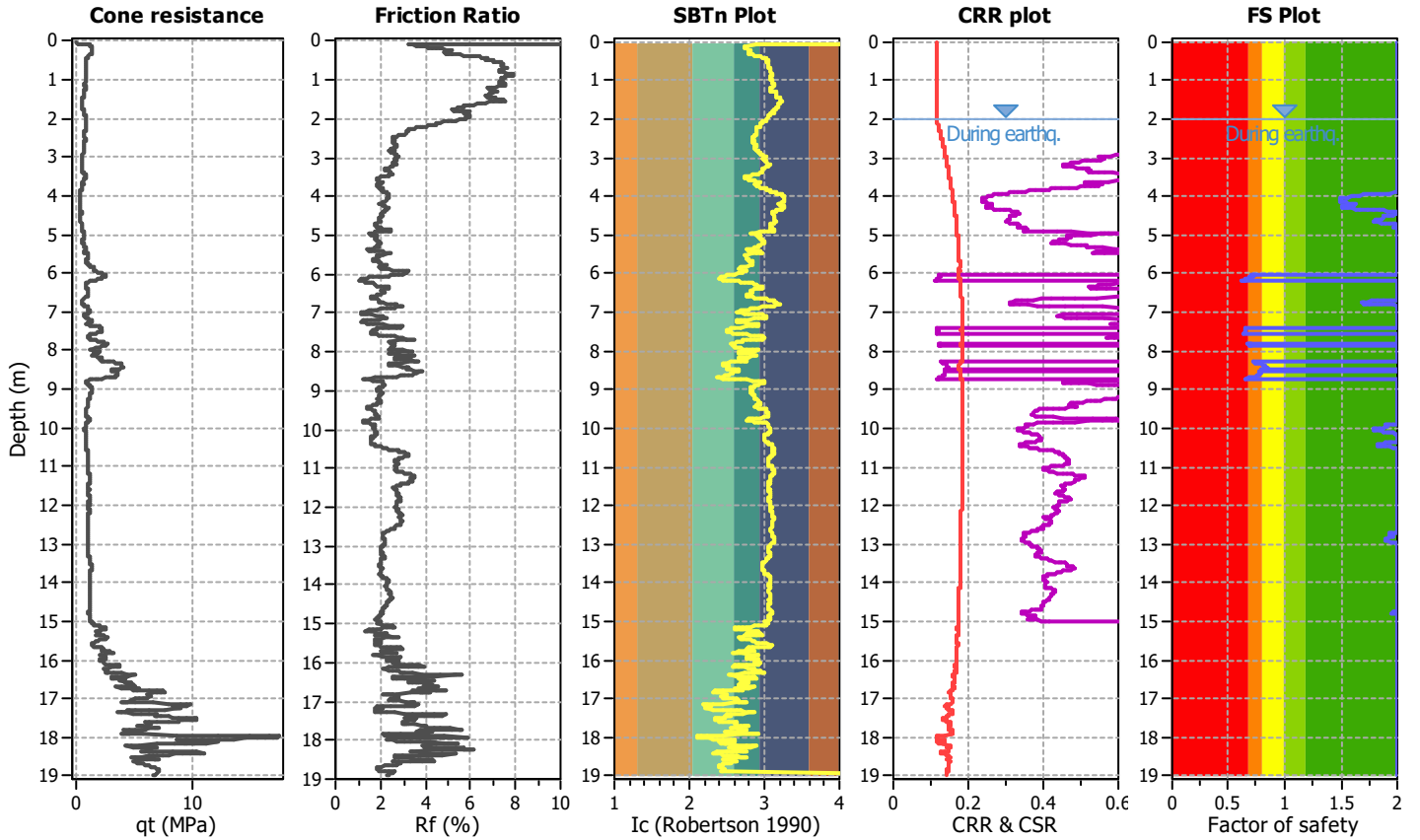
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT3-1/500**

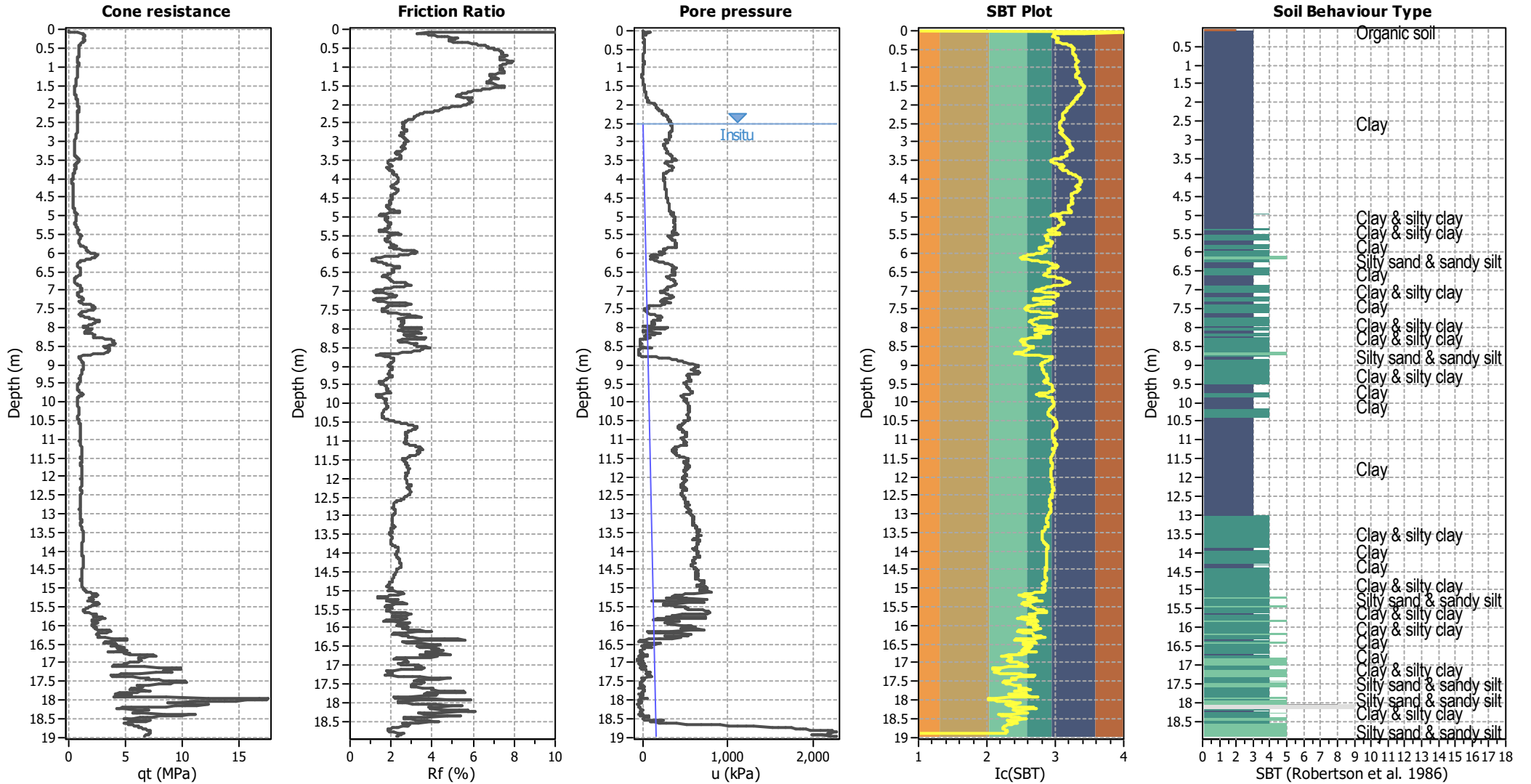
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 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:	15.00 m
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

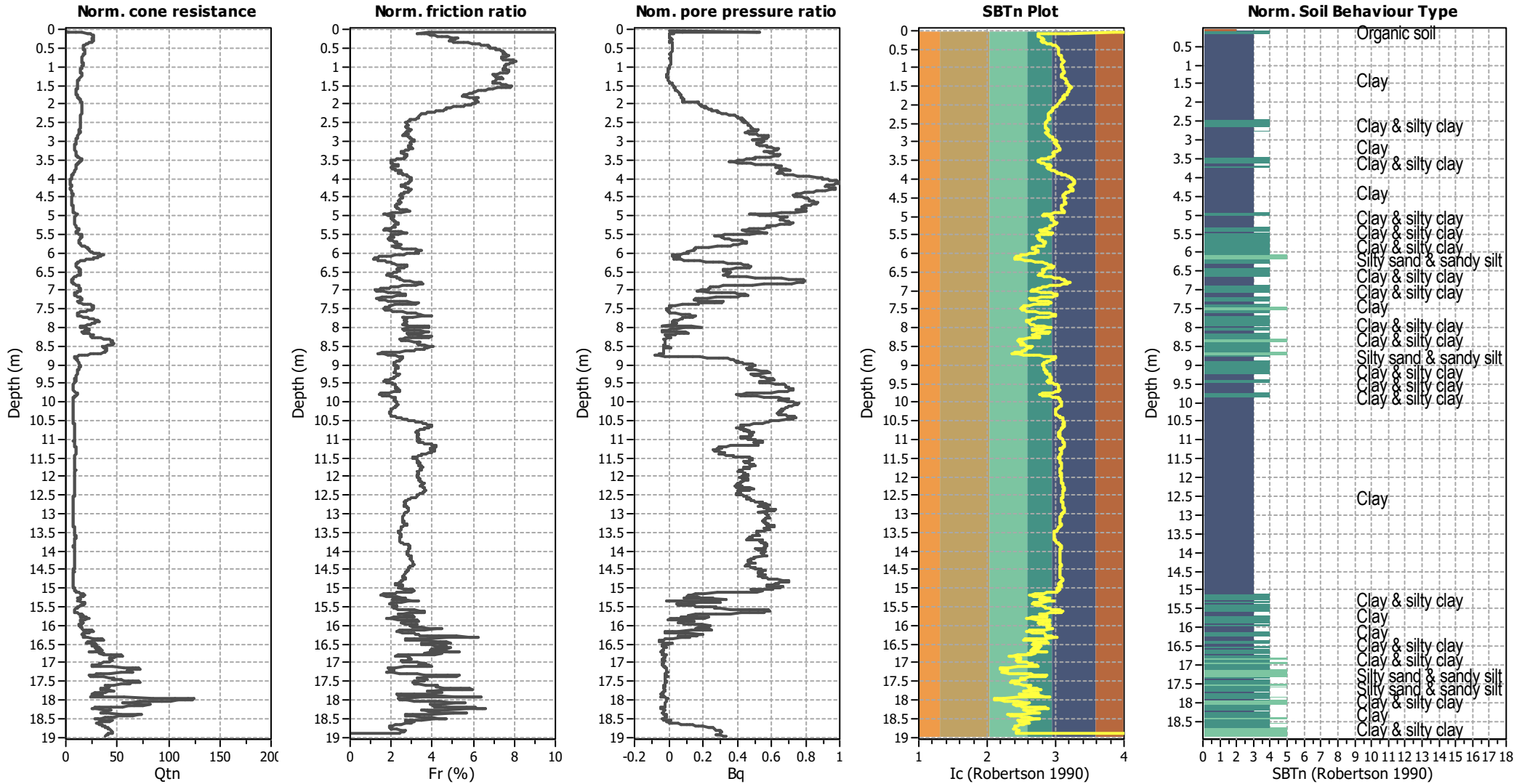
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>g</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



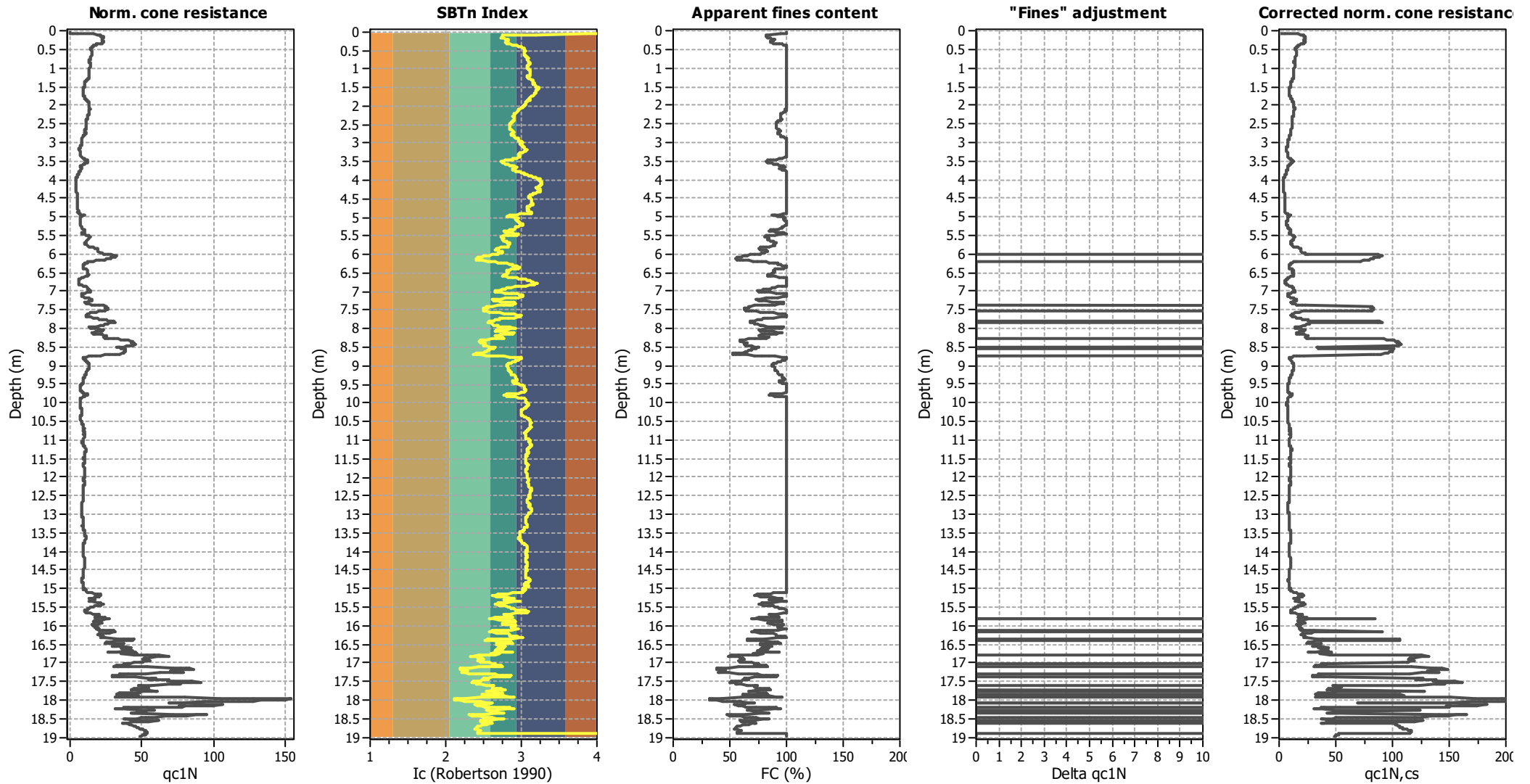
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

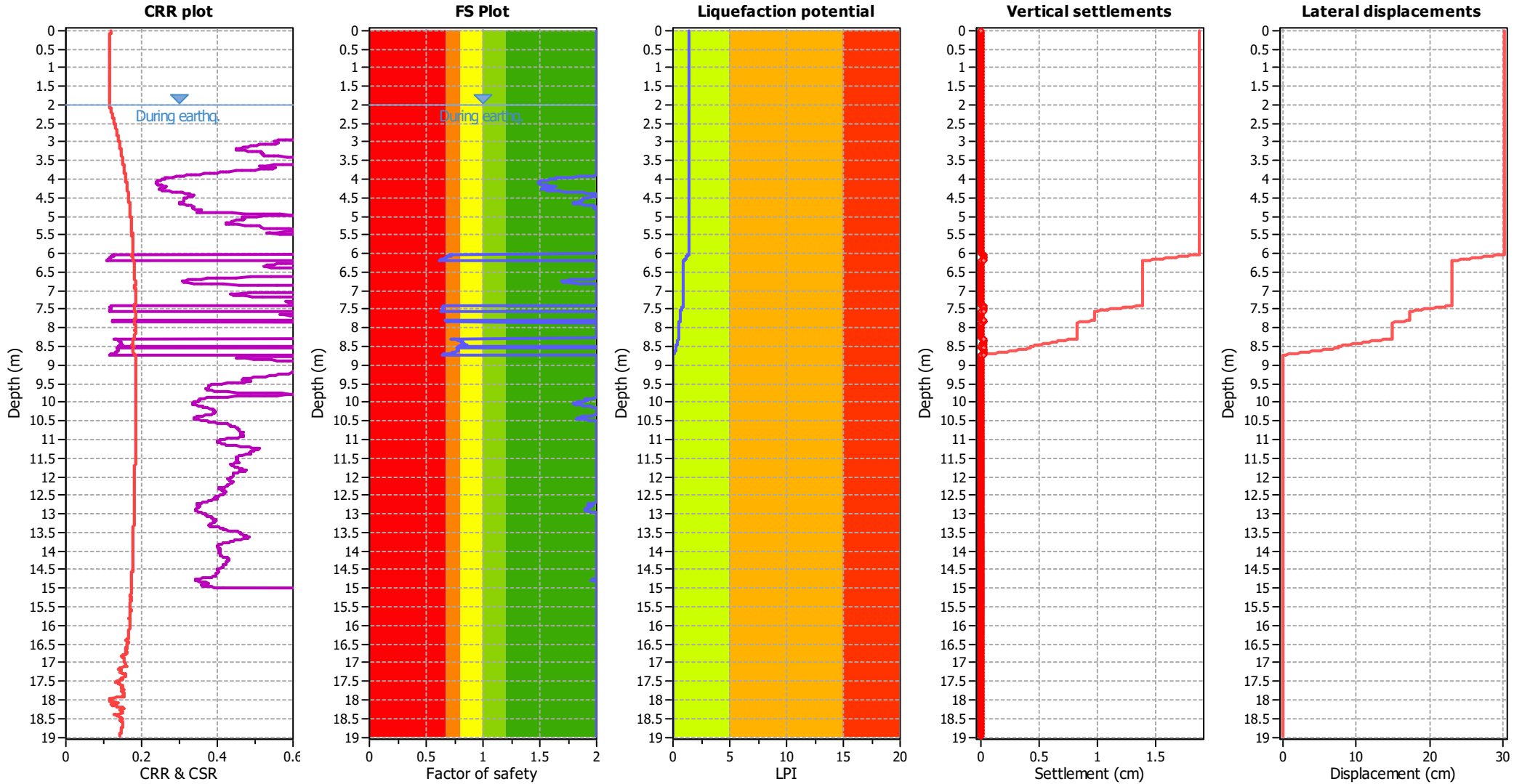
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

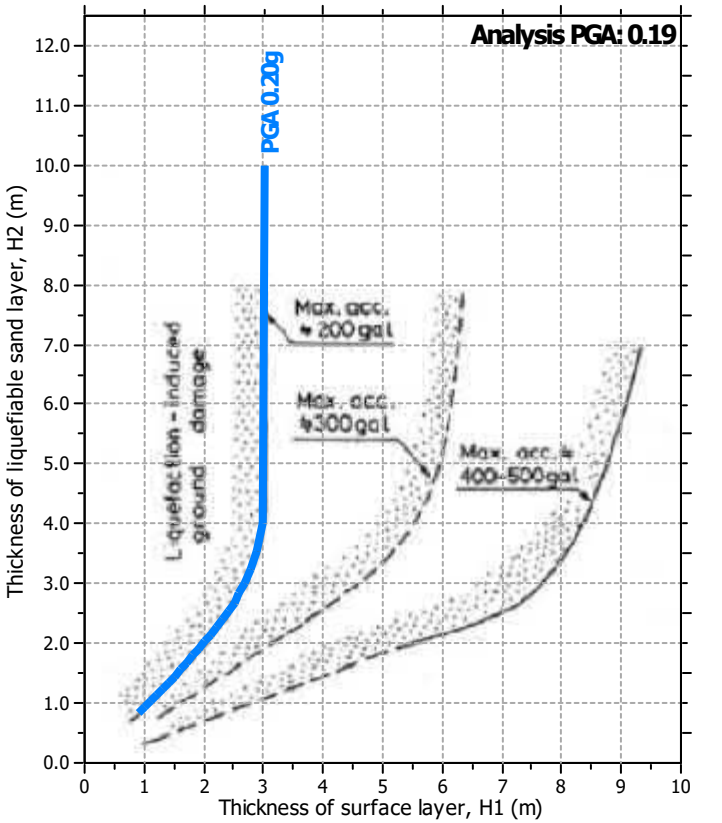
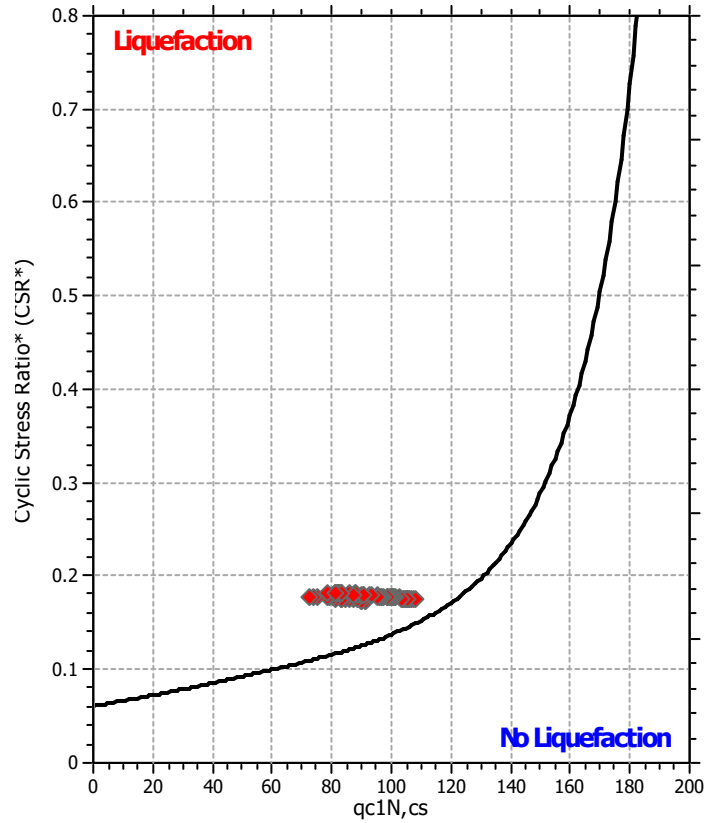
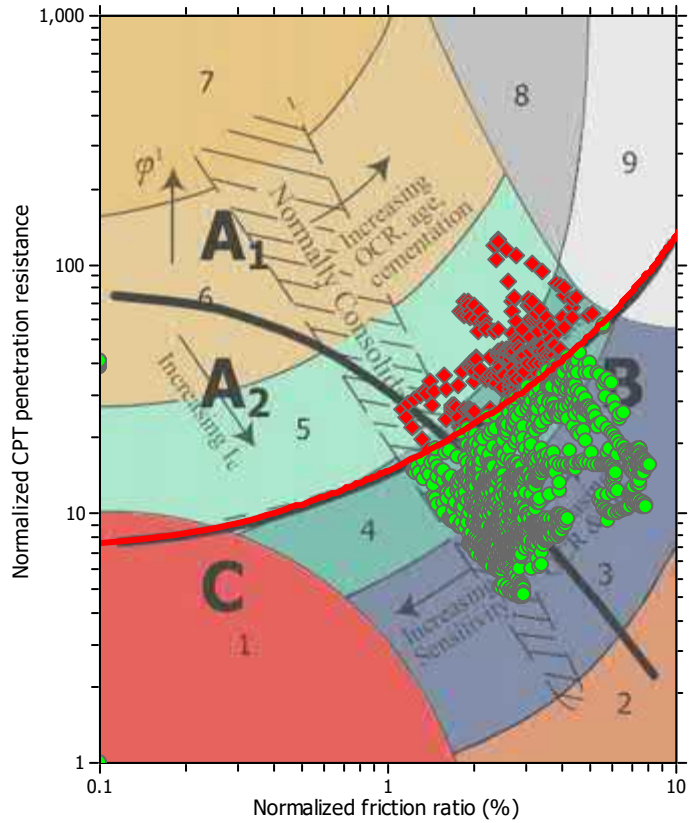
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m



**LIQUEFACTION ANALYSIS REPORT**

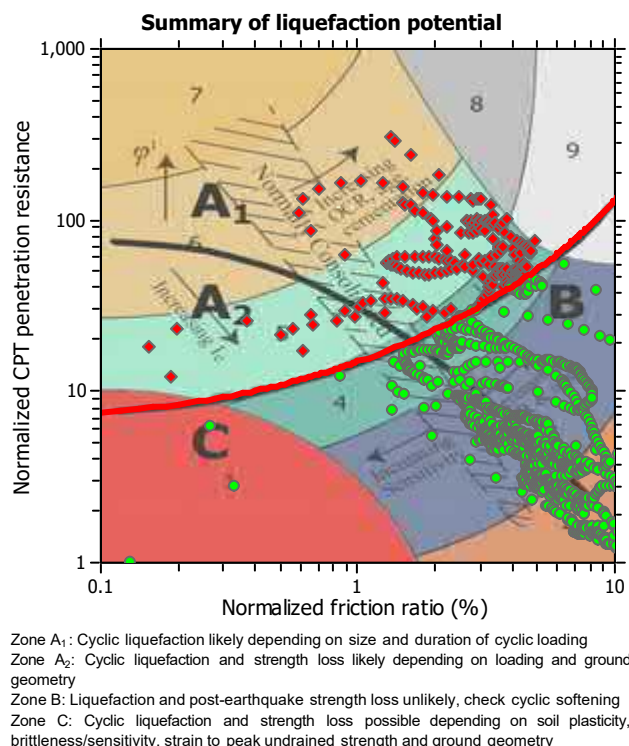
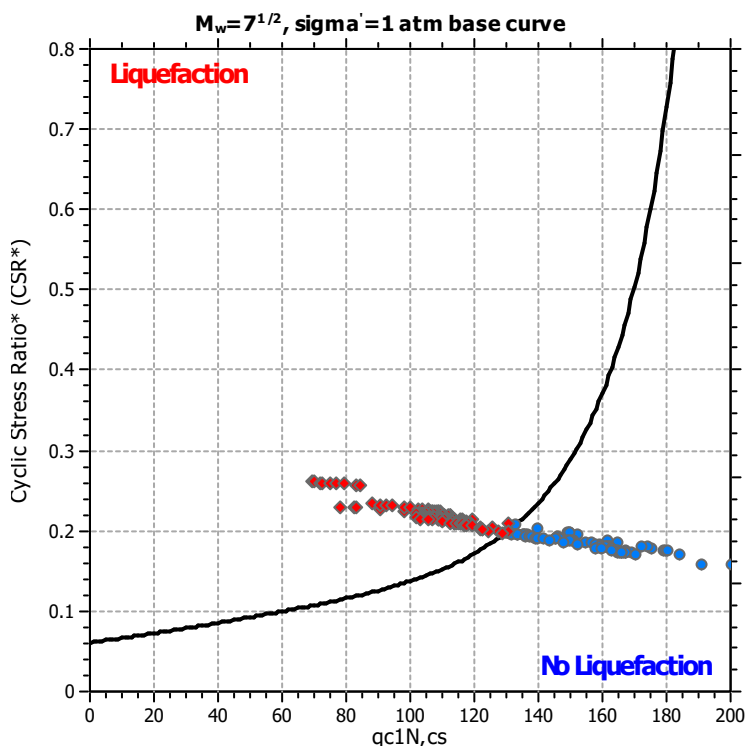
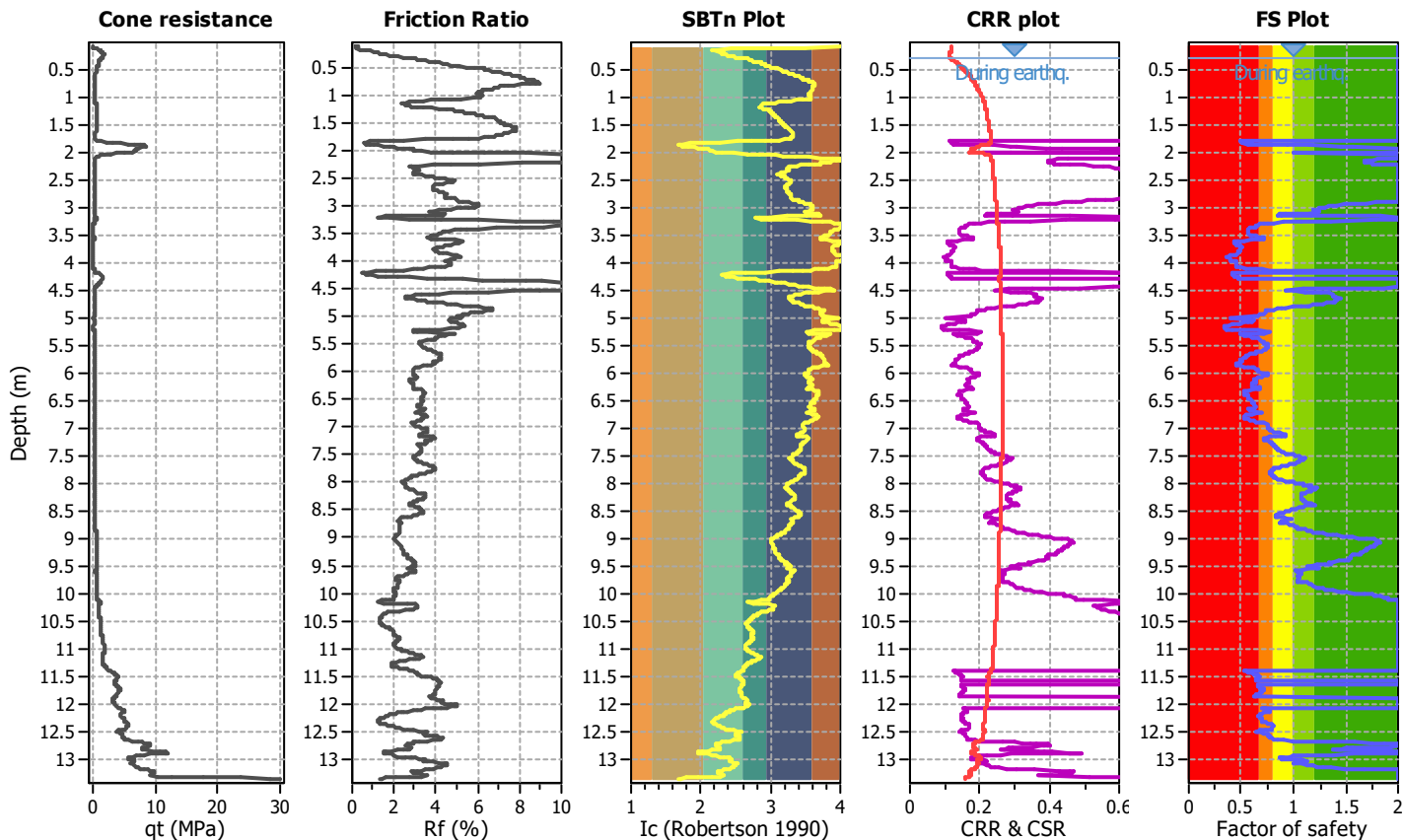
**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

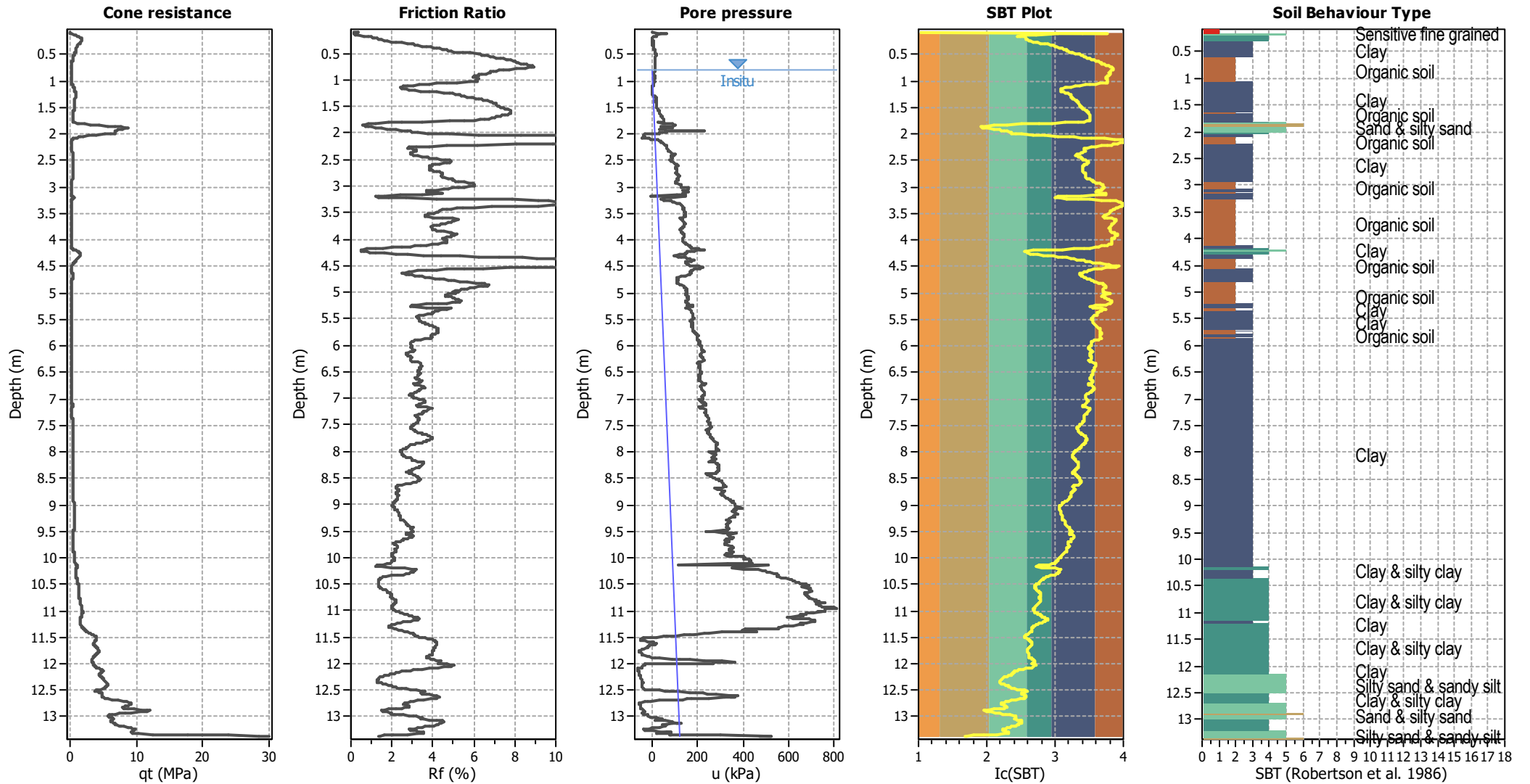
**CPT file : CPT4-1/500**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



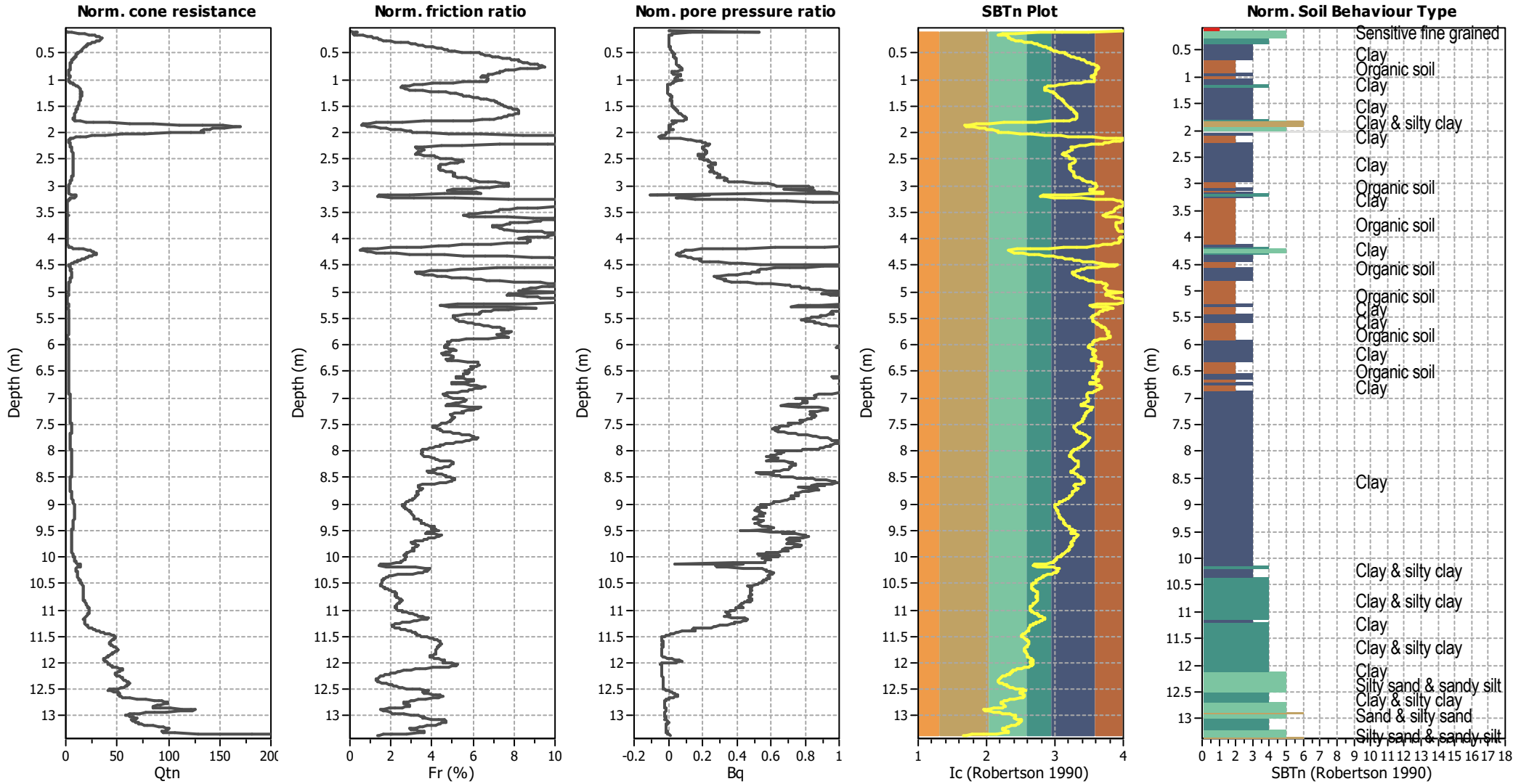
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



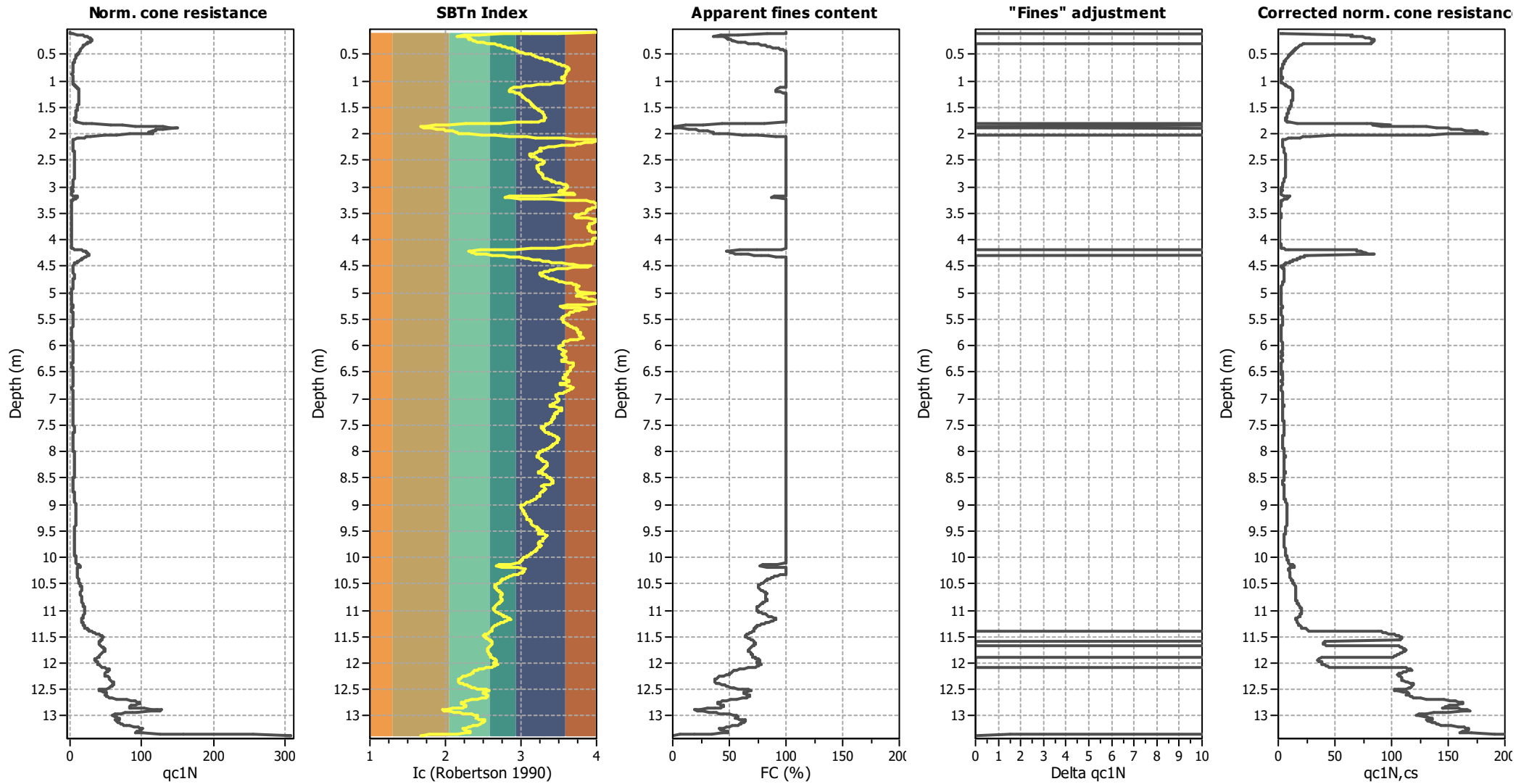
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

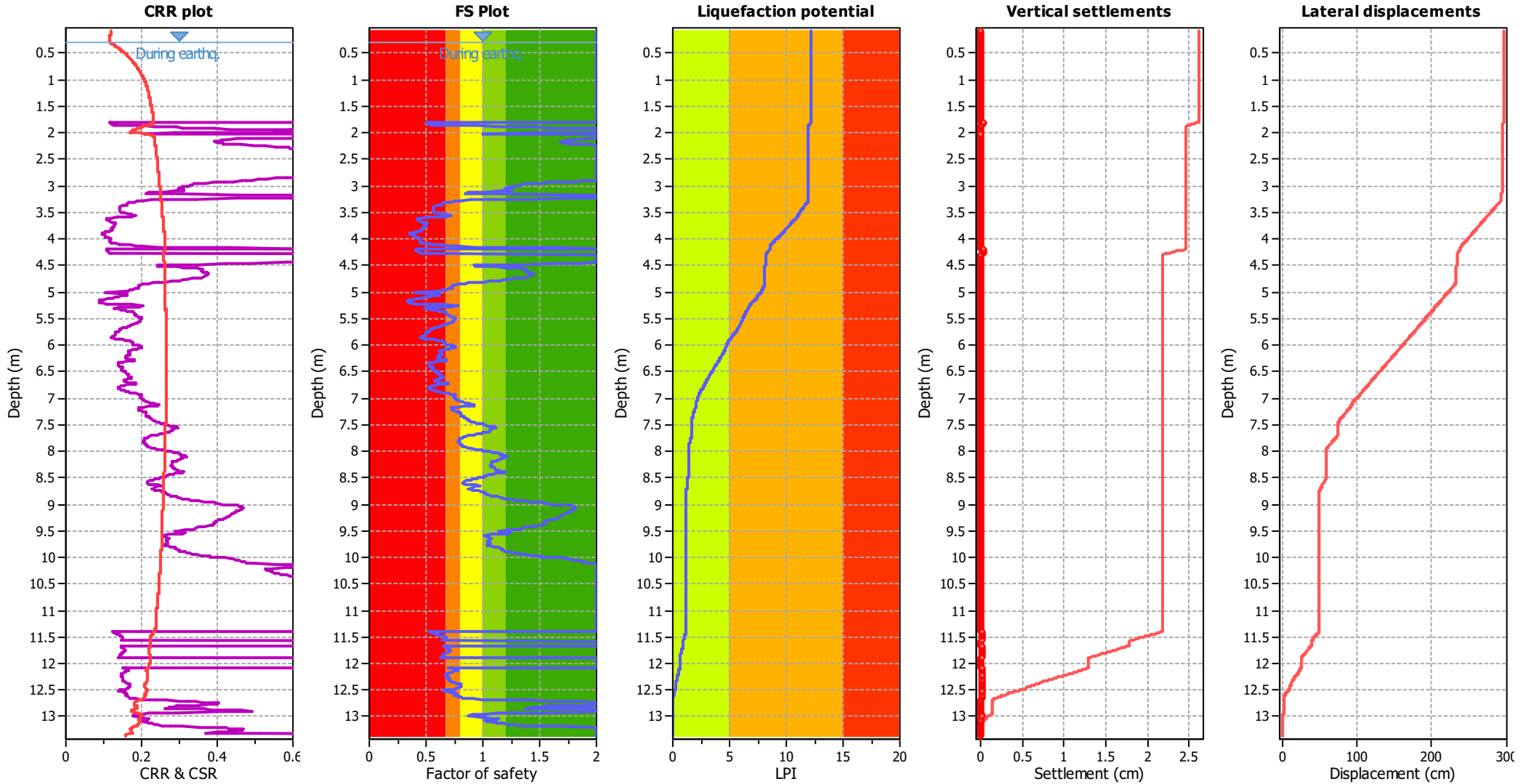


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

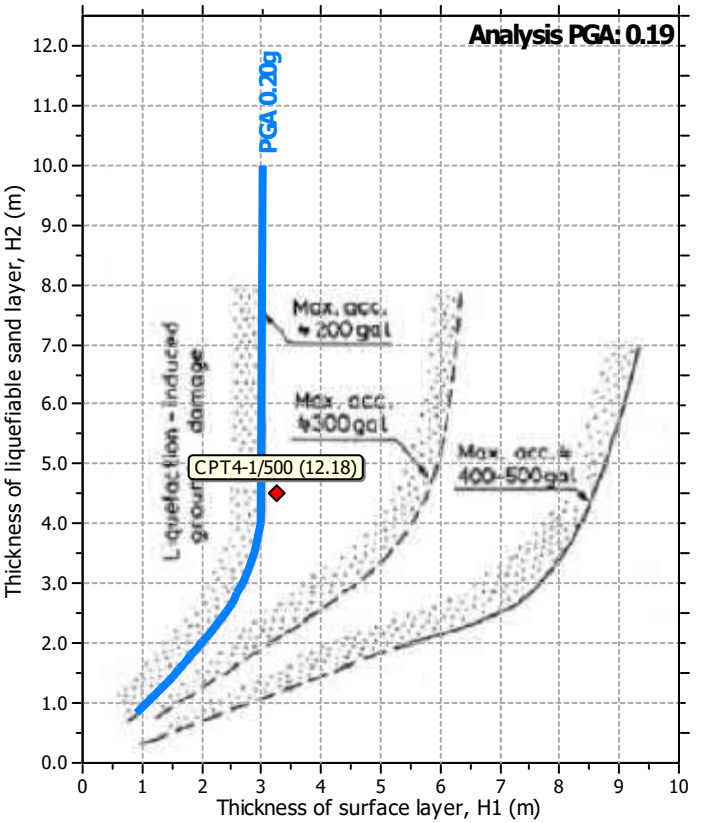
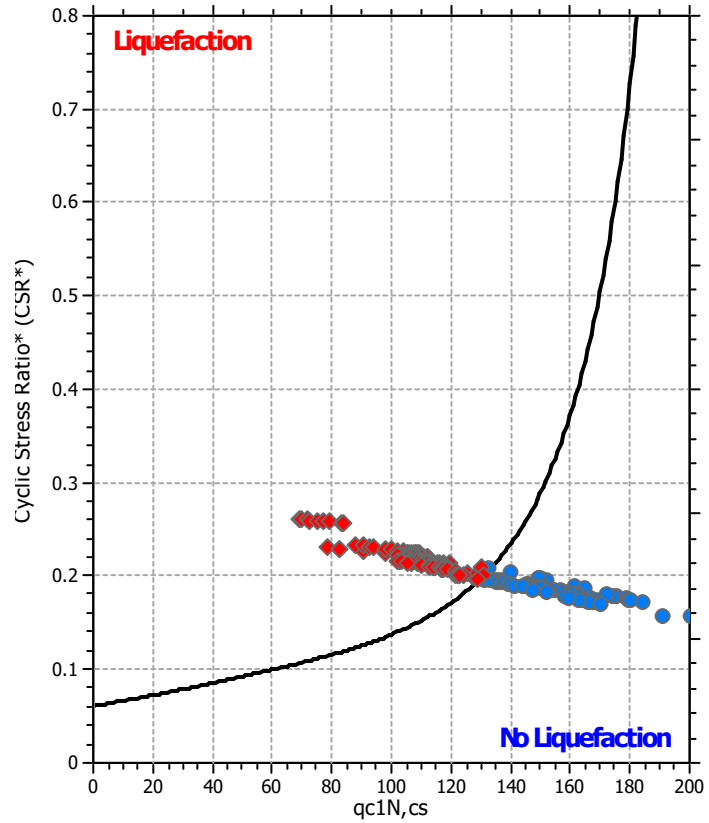
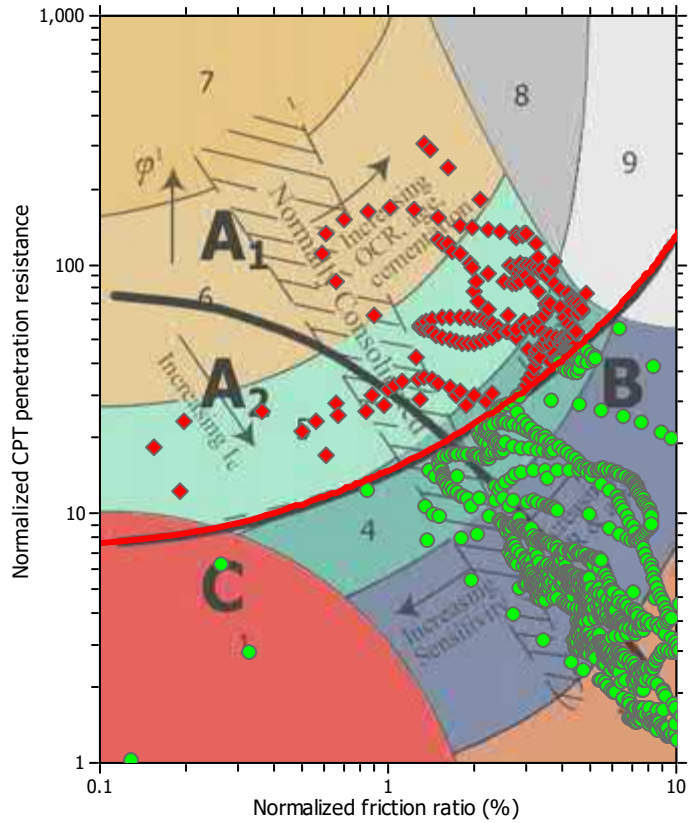
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

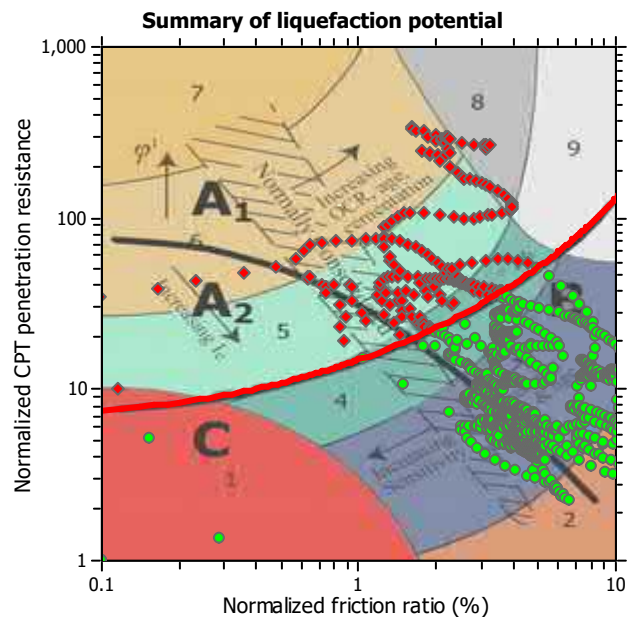
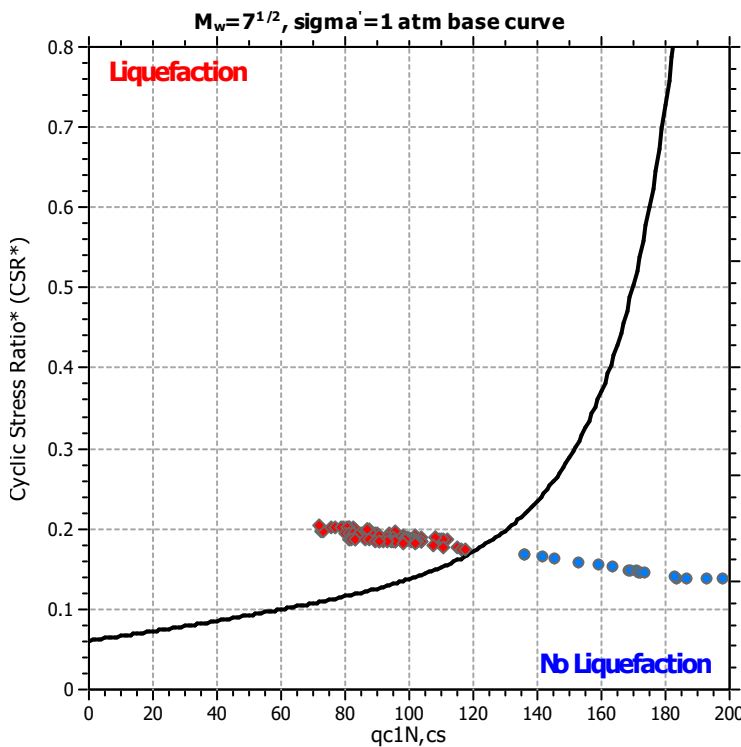
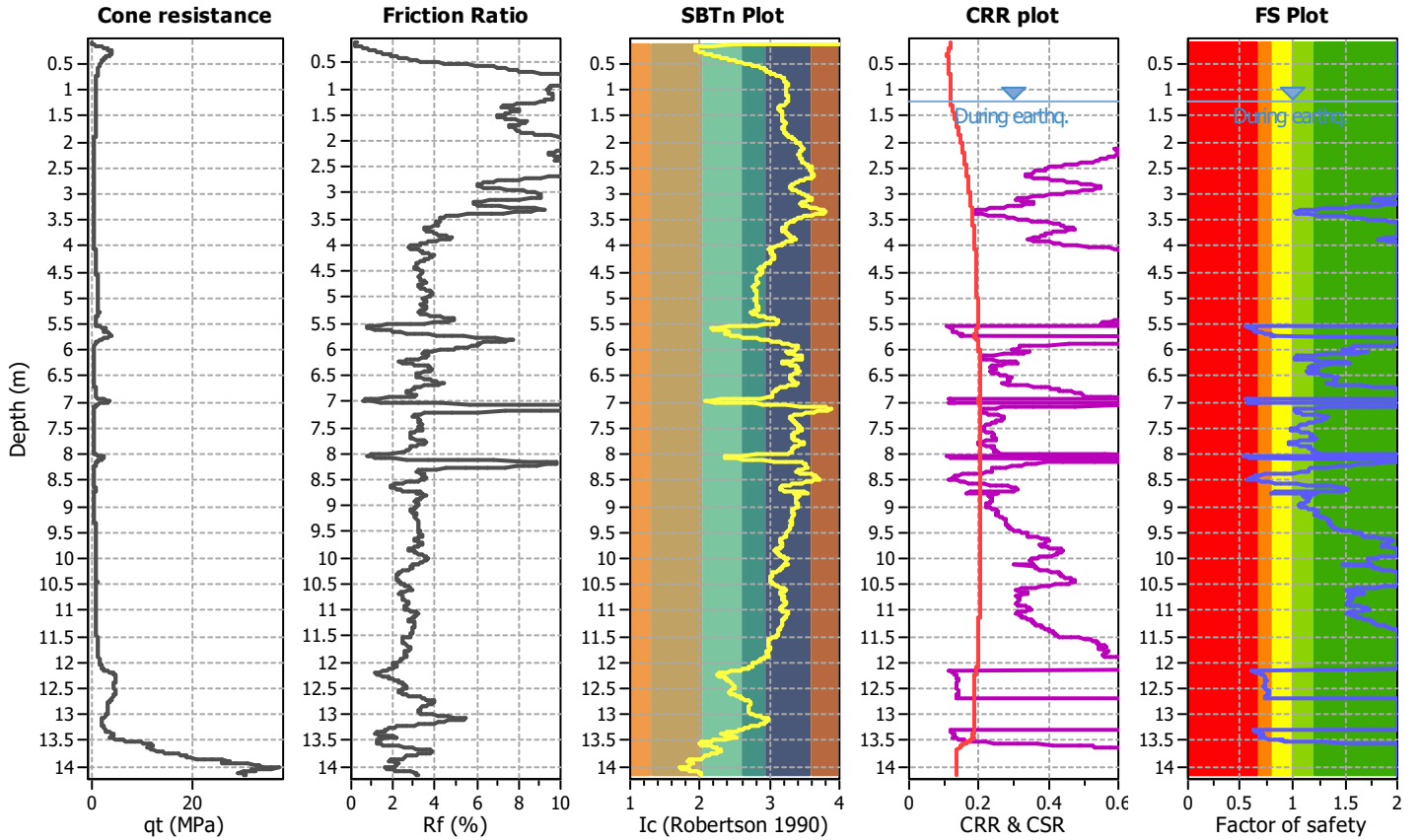
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT5-1/500**

**Location : 48 Valerie Close, Warkworth**

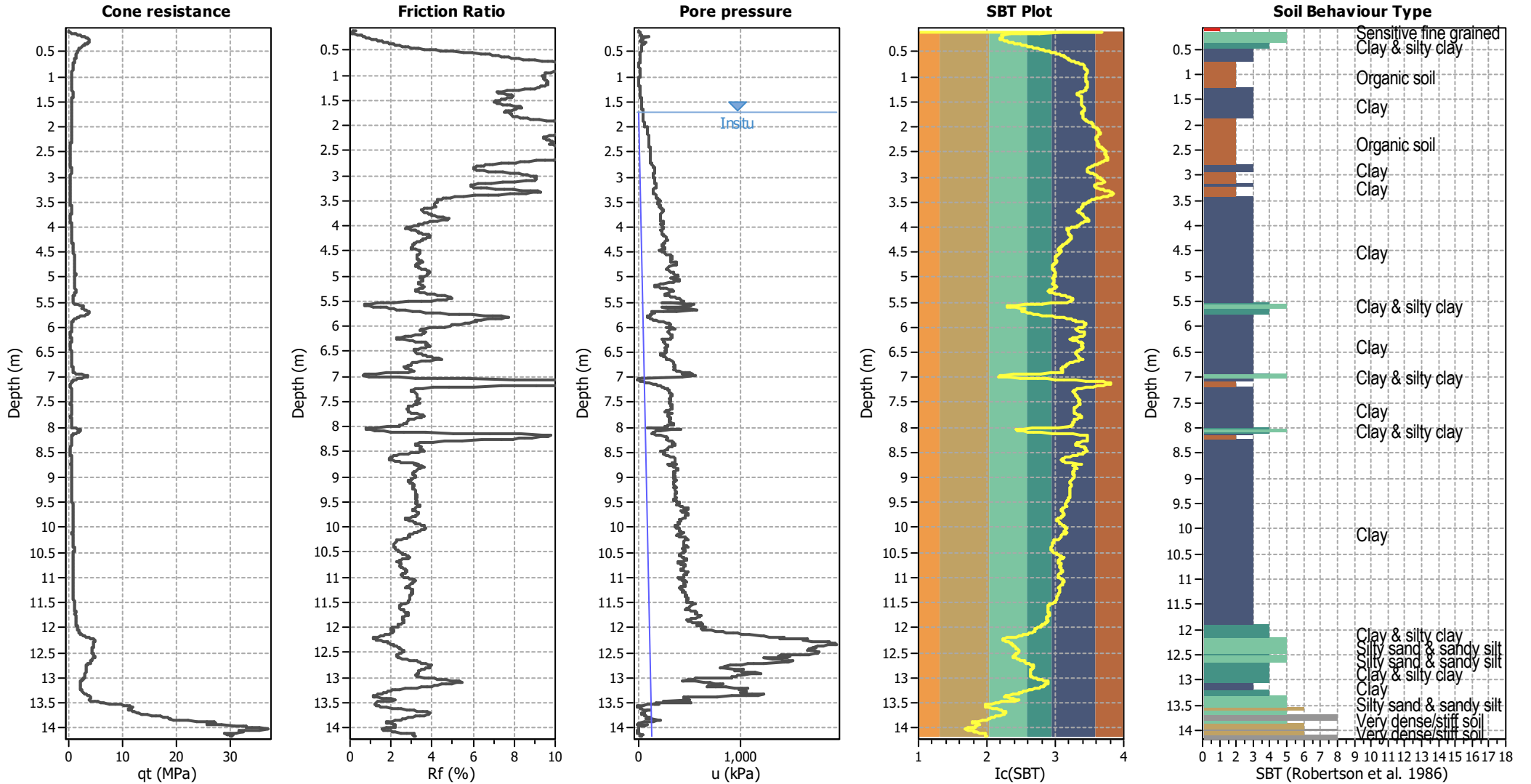
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.20 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



**Zone A<sub>1</sub>:** Cyclic liquefaction likely depending on size and duration of cyclic loading  
**Zone A<sub>2</sub>:** Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
**Zone B:** Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
**Zone C:** Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



#### Input parameters and analysis data

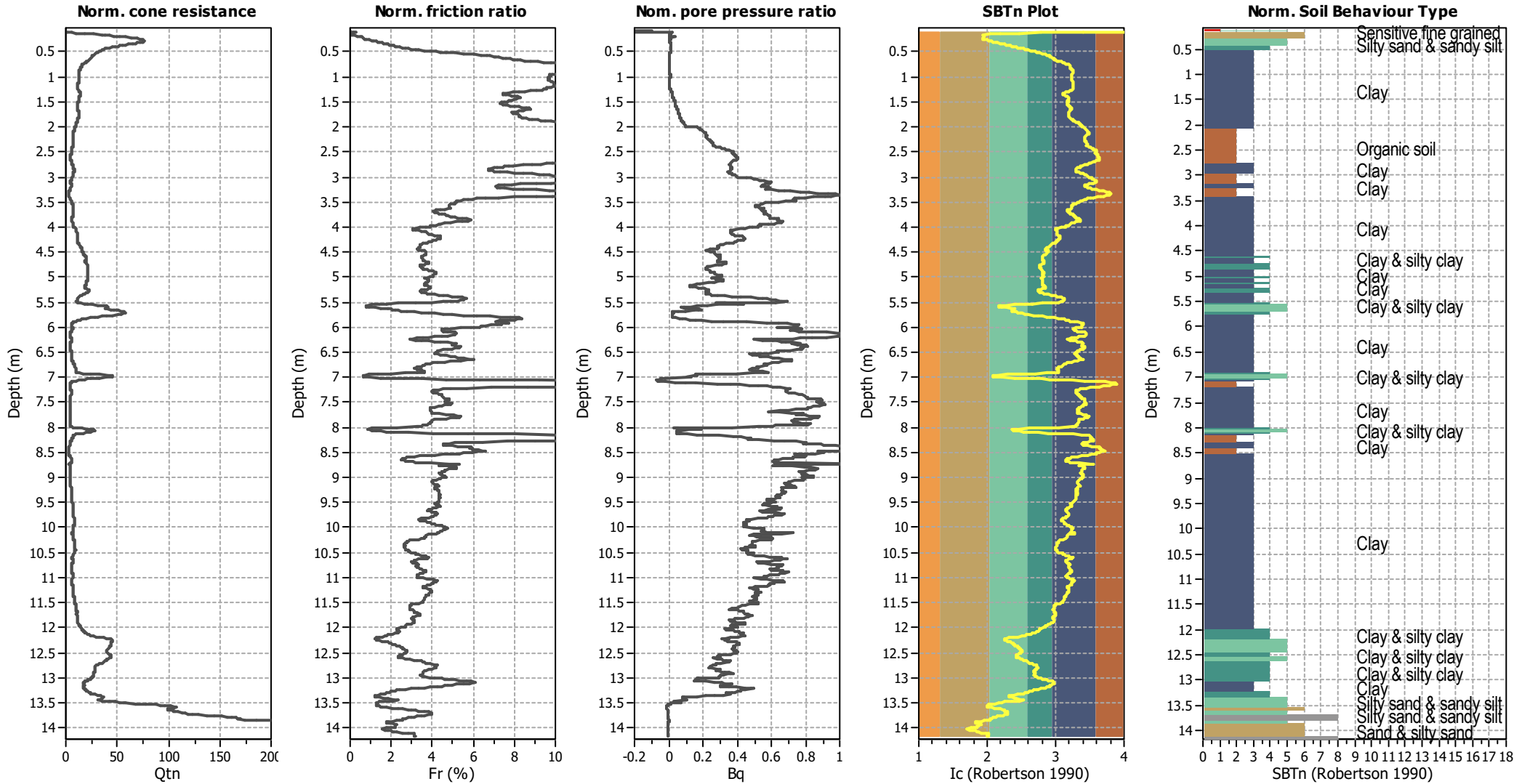
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



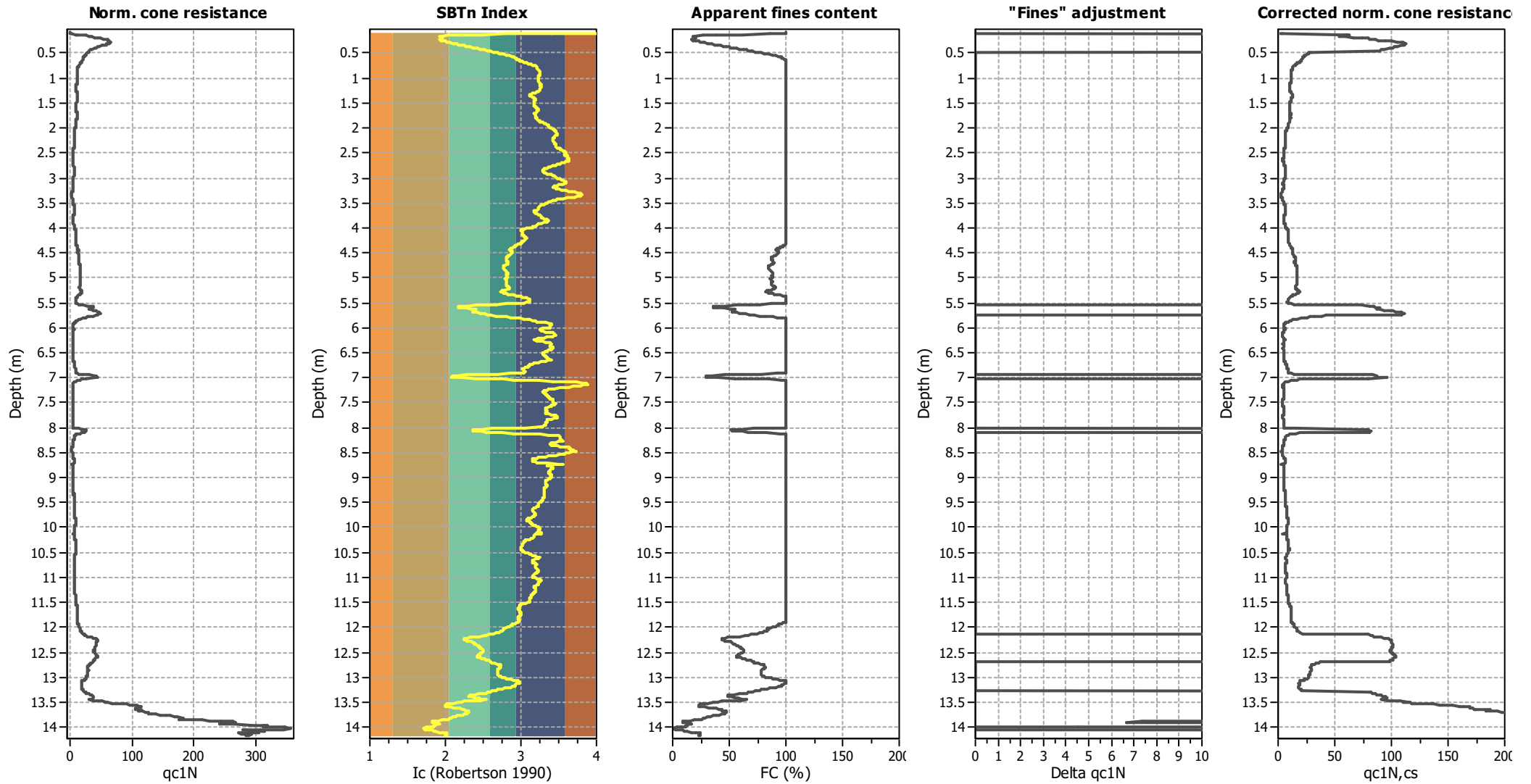
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

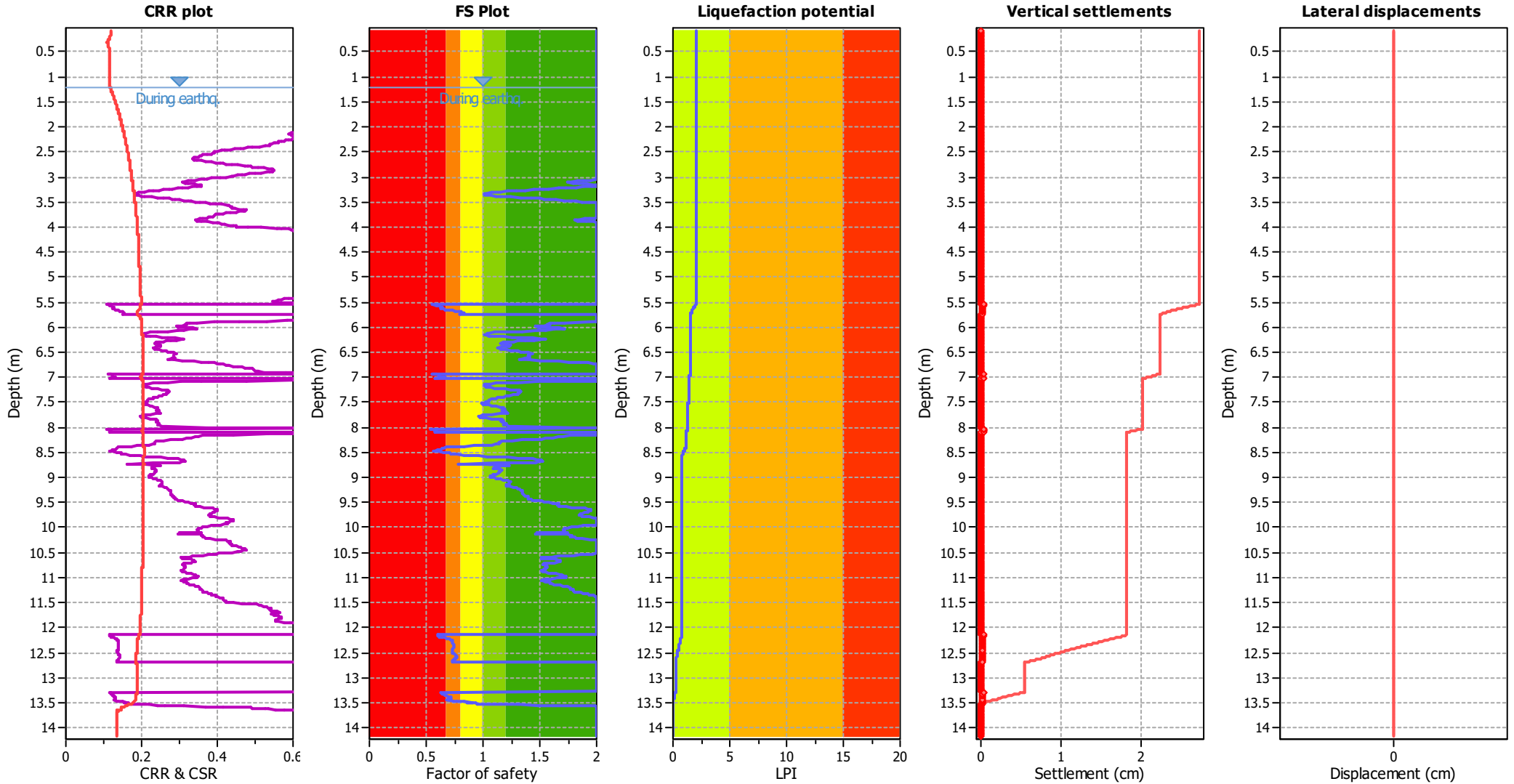
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

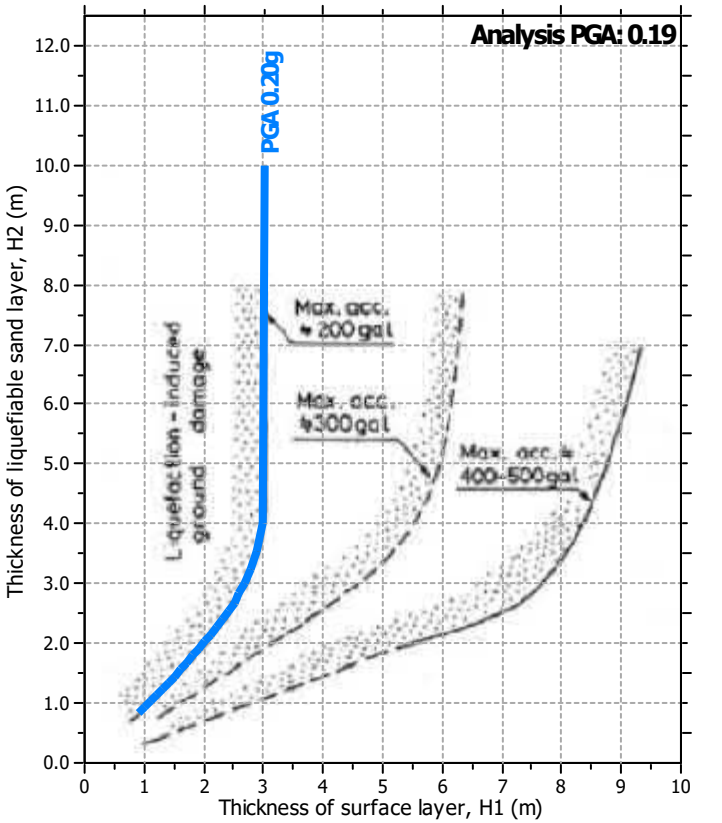
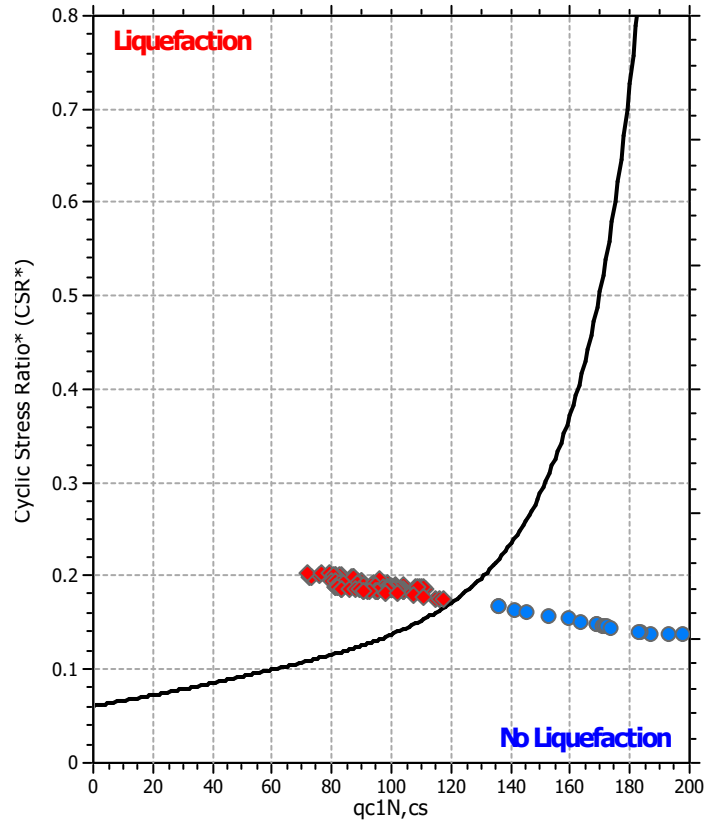
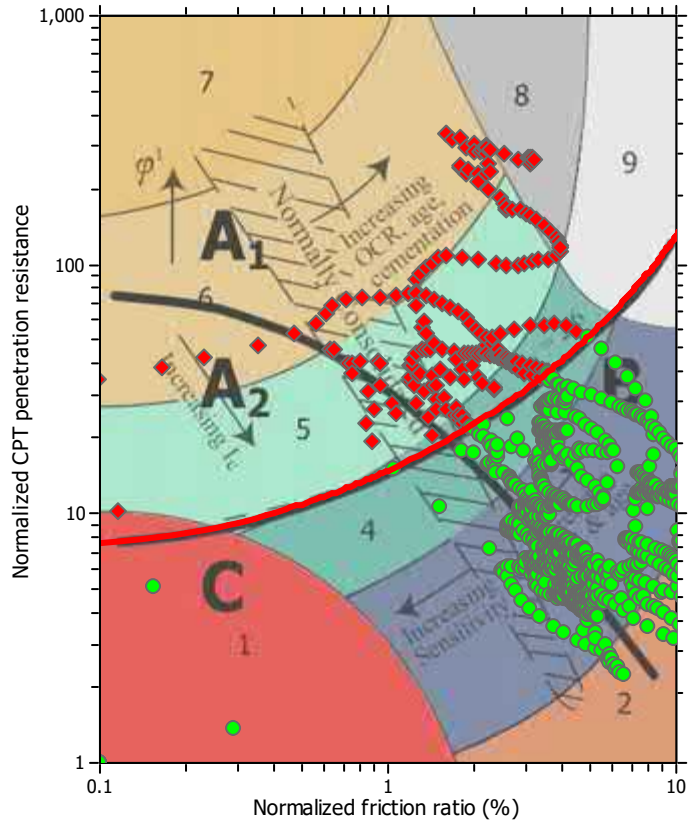
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A



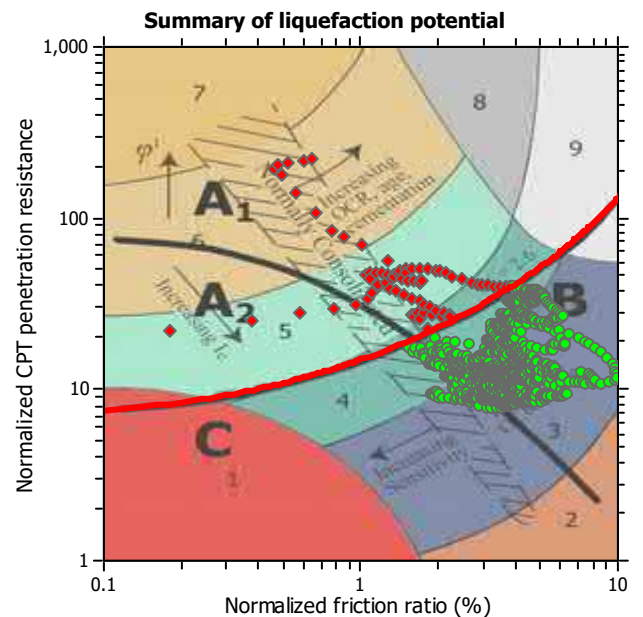
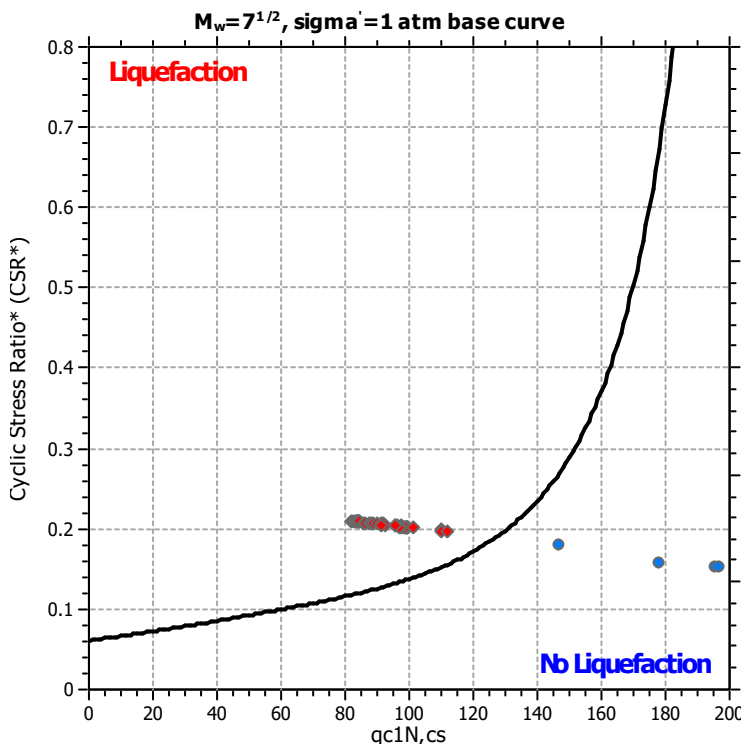
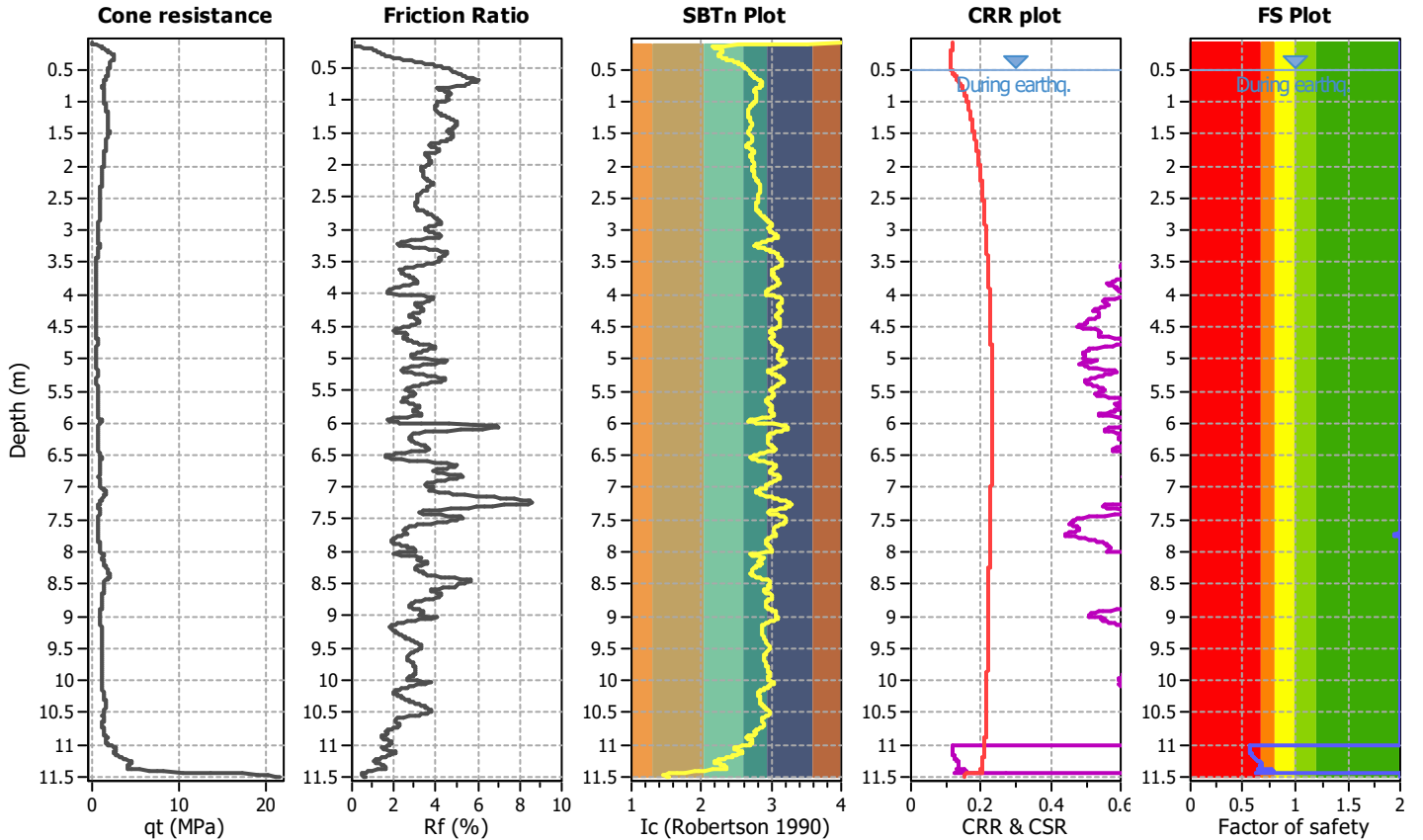
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT6-1/500**

**Location : 48 Valerie Close, Warkworth**

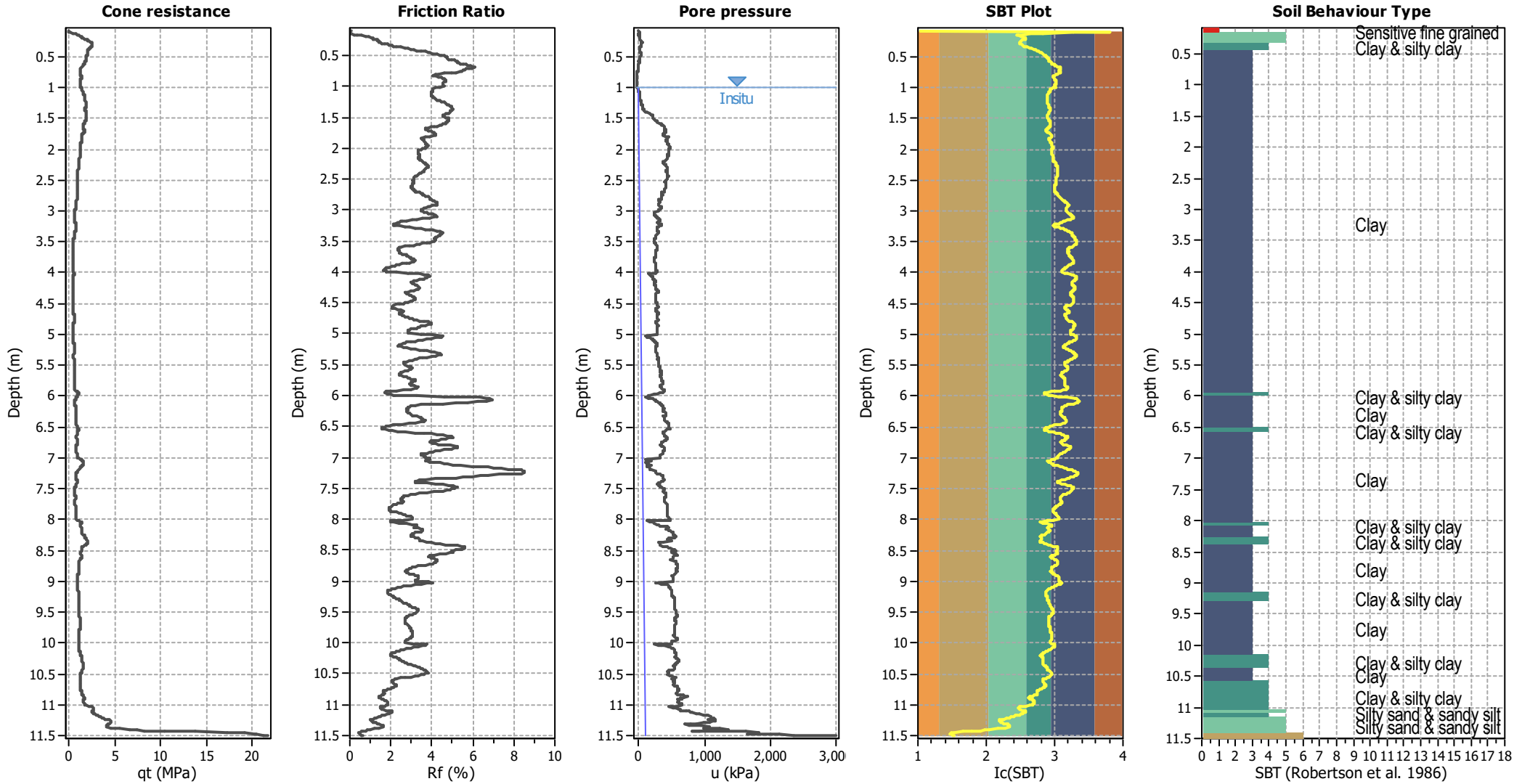
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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 $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading  
 Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
 Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
 Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



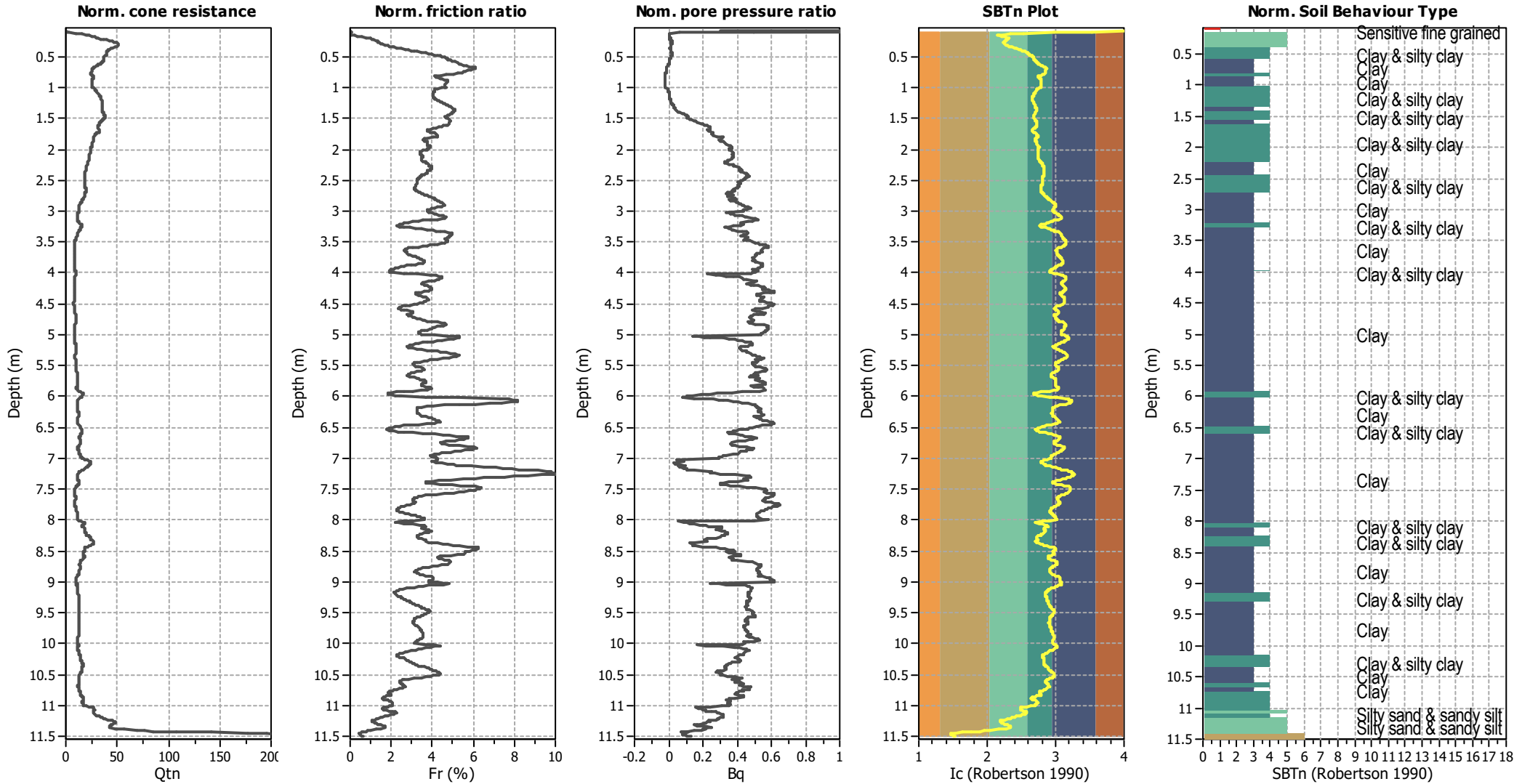
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



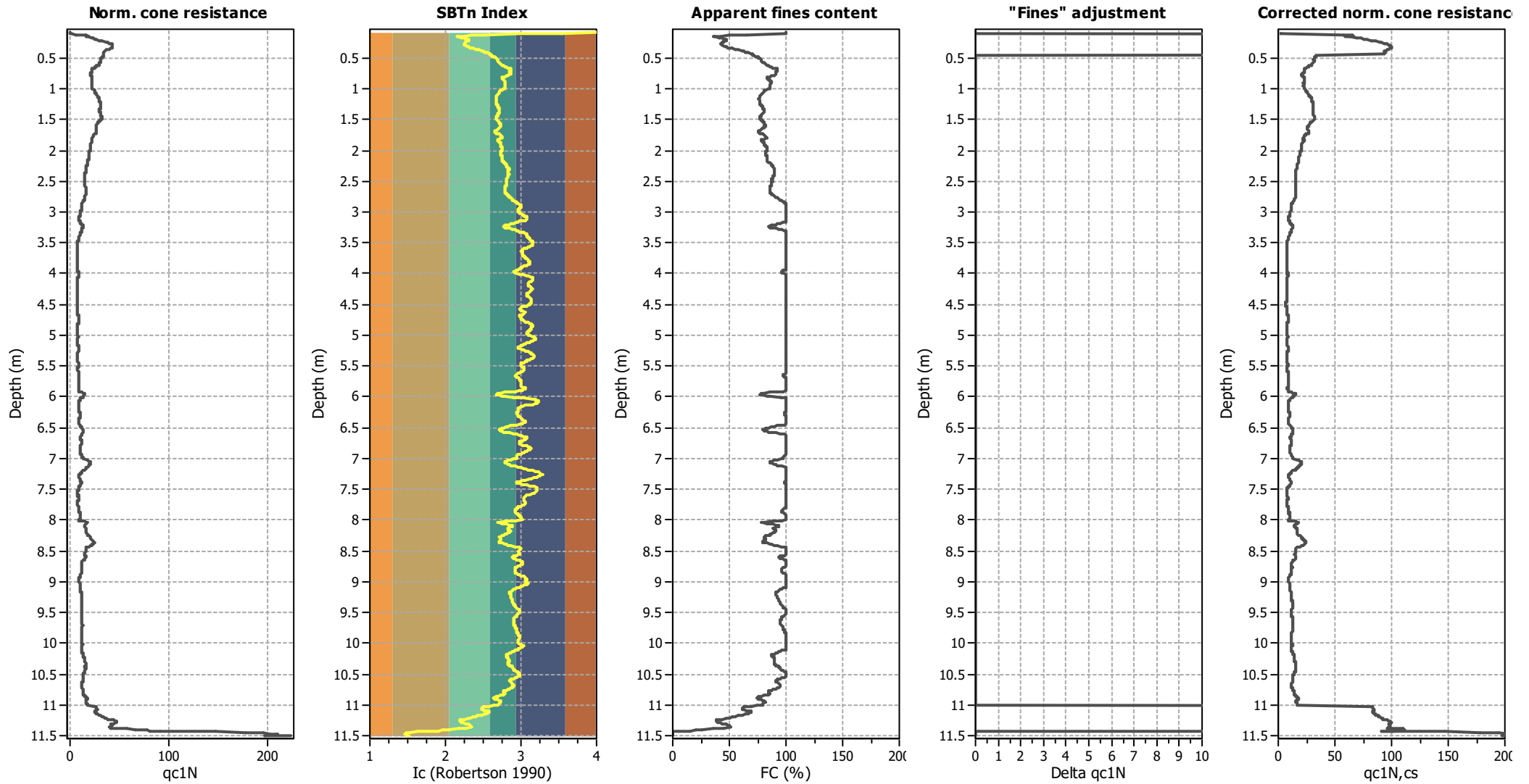
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

<span style="color: red;">■</span> 1. Sensitive fine grained	<span style="color: teal;">■</span> 4. Clayey silt to silty	<span style="color: orange;">■</span> 7. Gravely sand to sand
<span style="color: brown;">■</span> 2. Organic material	<span style="color: lightgreen;">■</span> 5. Silty sand to sandy silt	<span style="color: grey;">■</span> 8. Very stiff sand to
<span style="color: blue;">■</span> 3. Clay to silty clay	<span style="color: tan;">■</span> 6. Clean sand to silty sand	<span style="color: lightgrey;">■</span> 9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

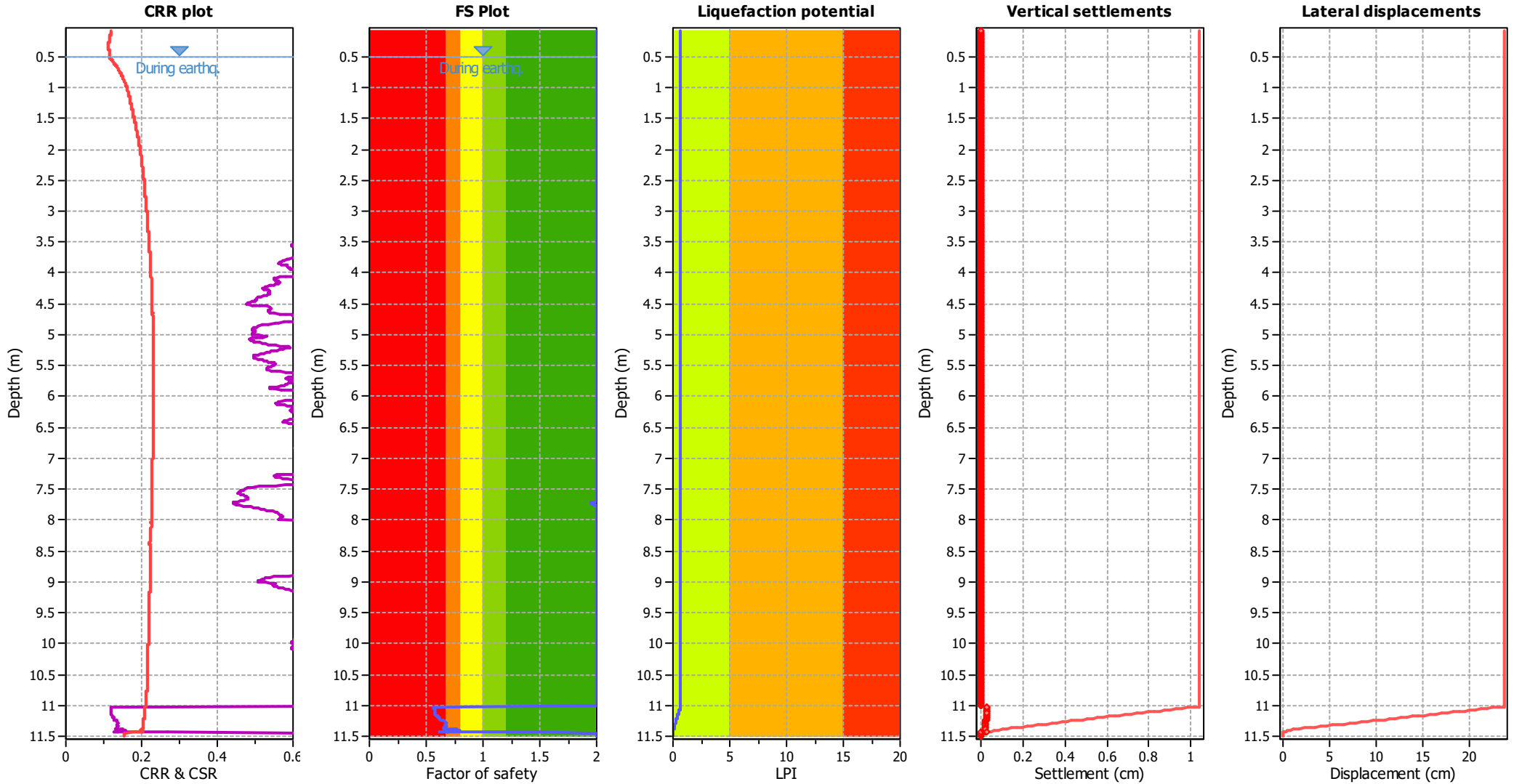


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

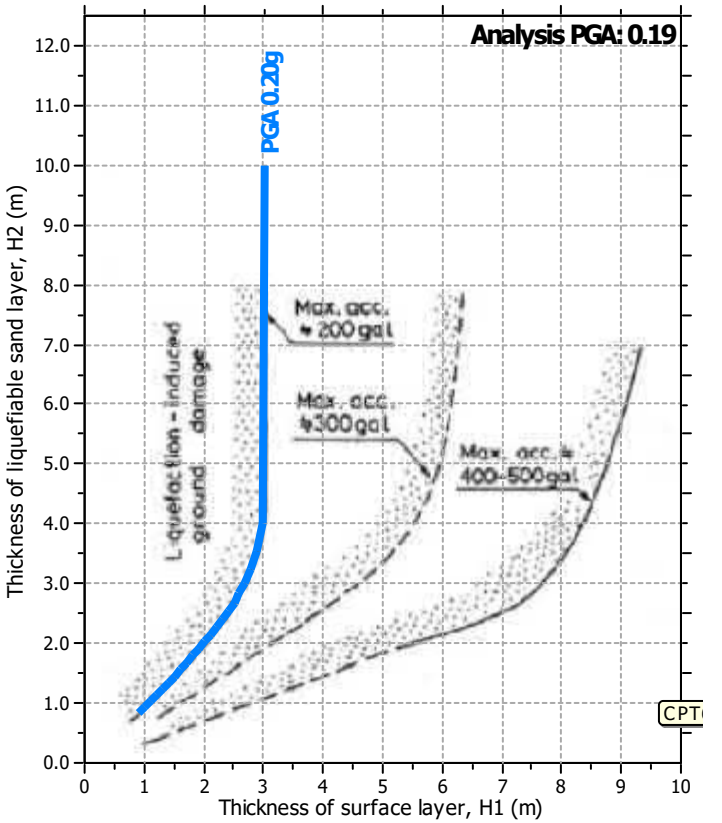
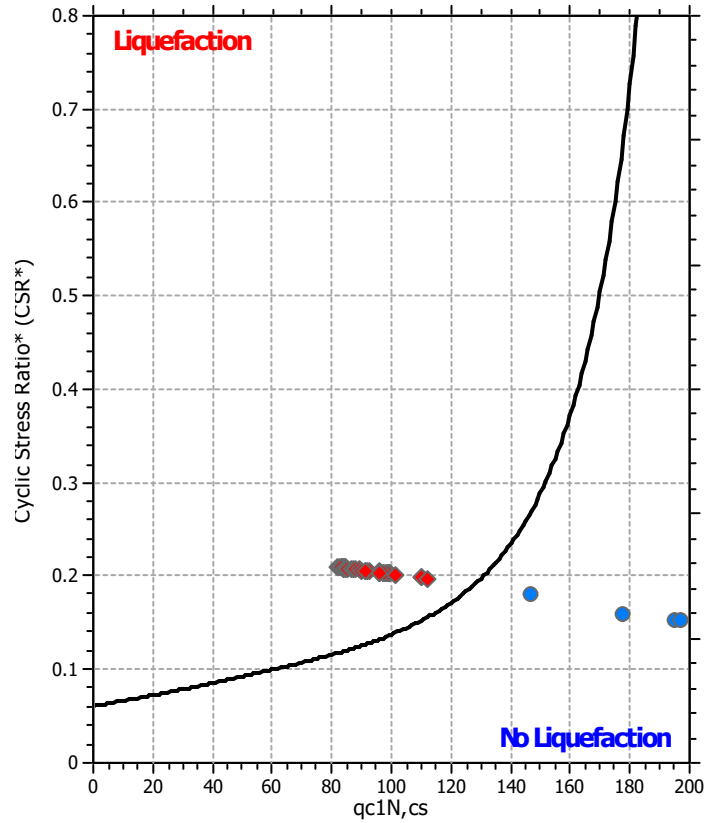
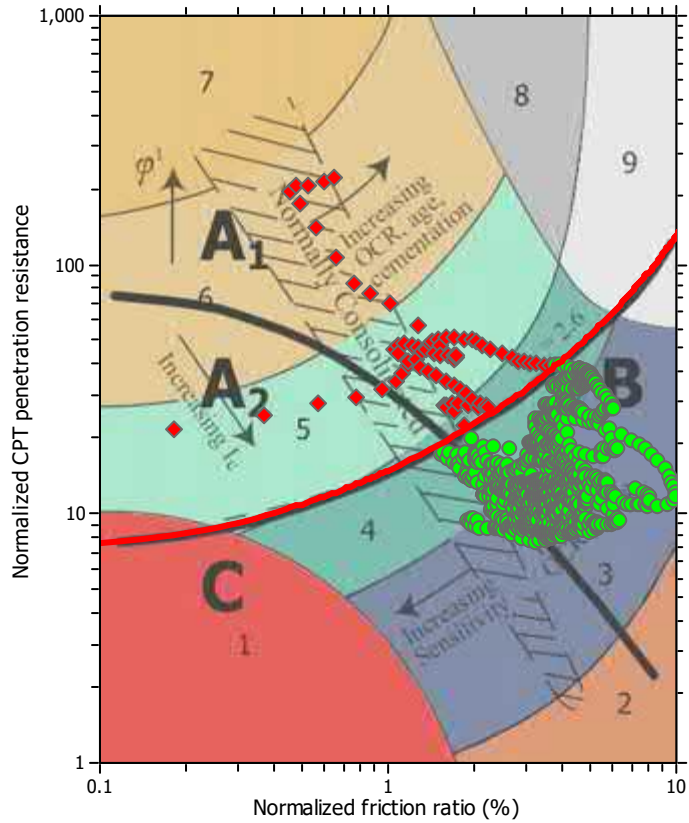
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

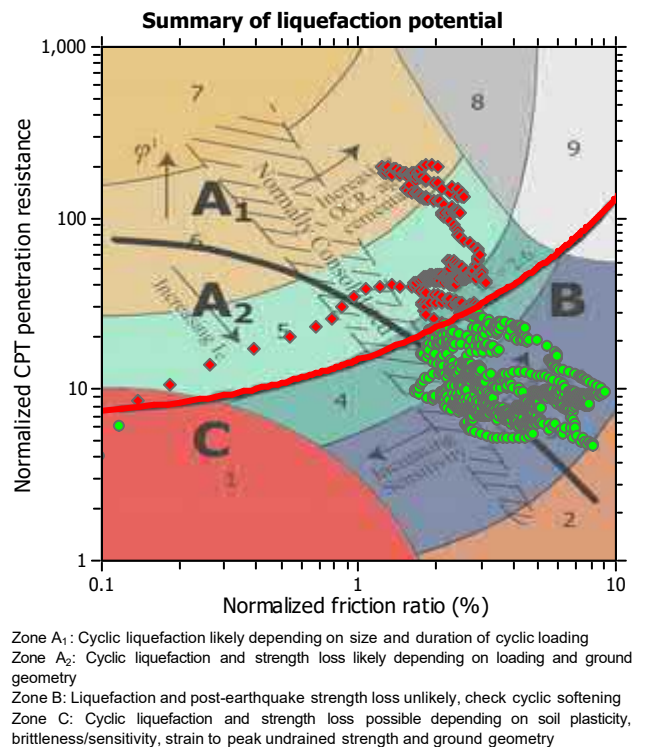
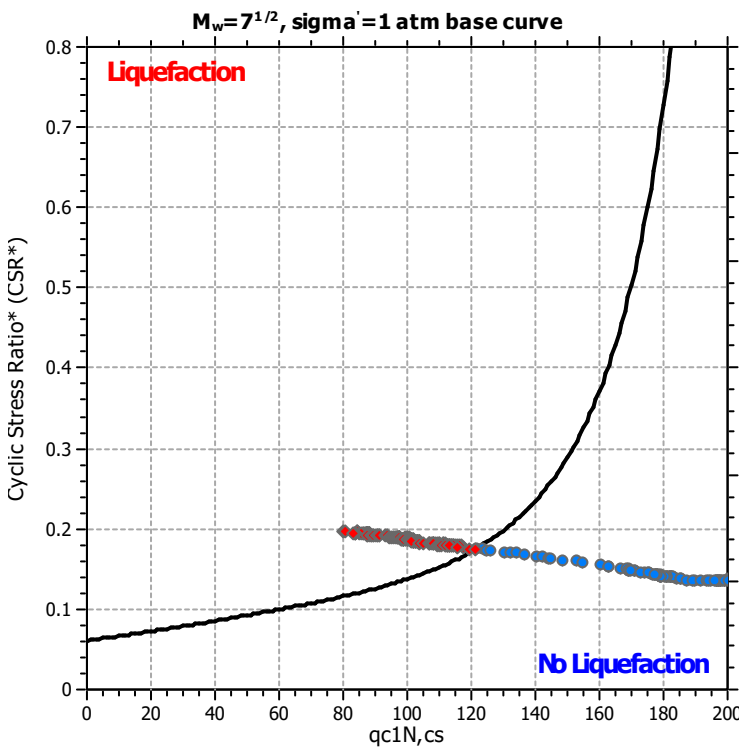
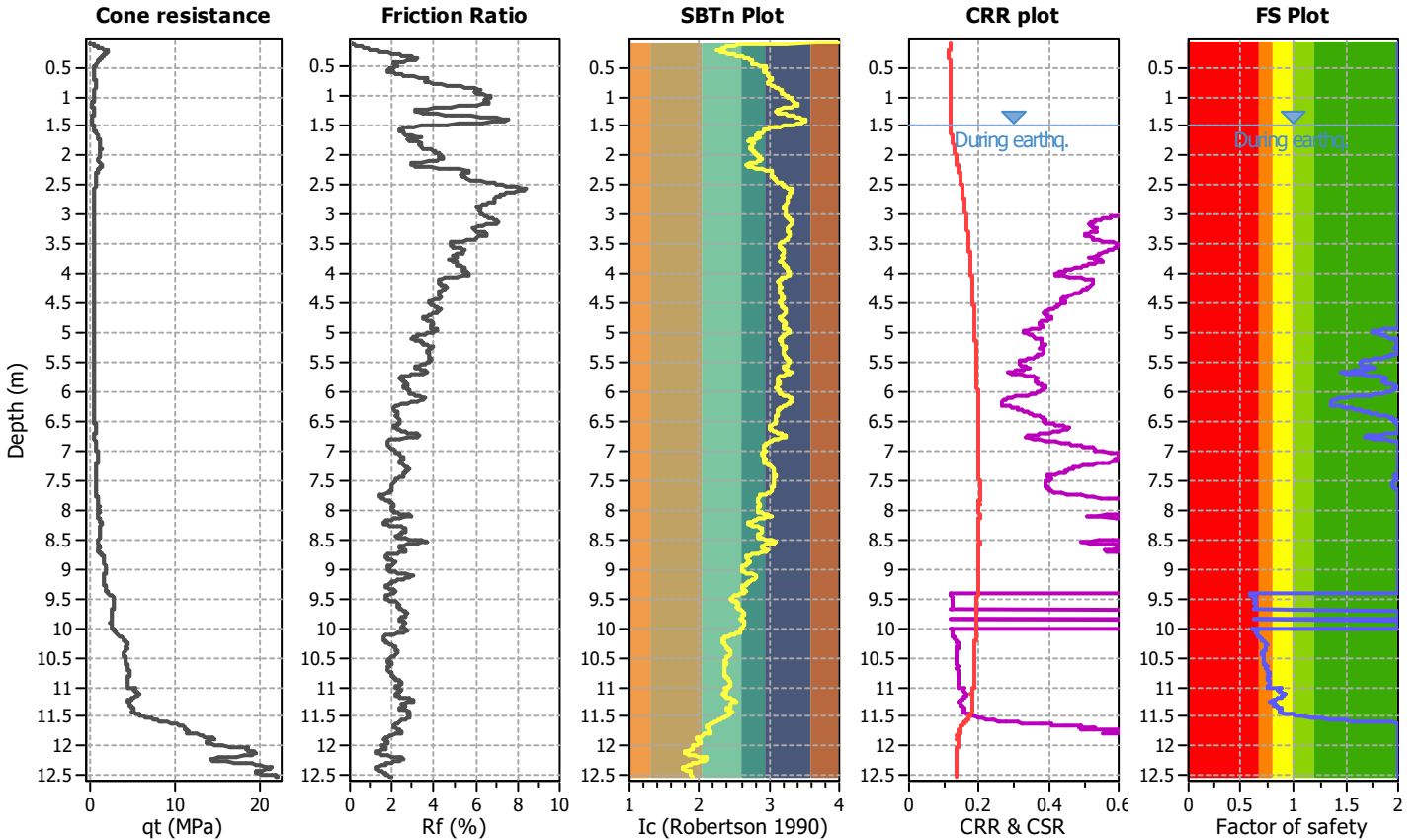
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT7-1/500**

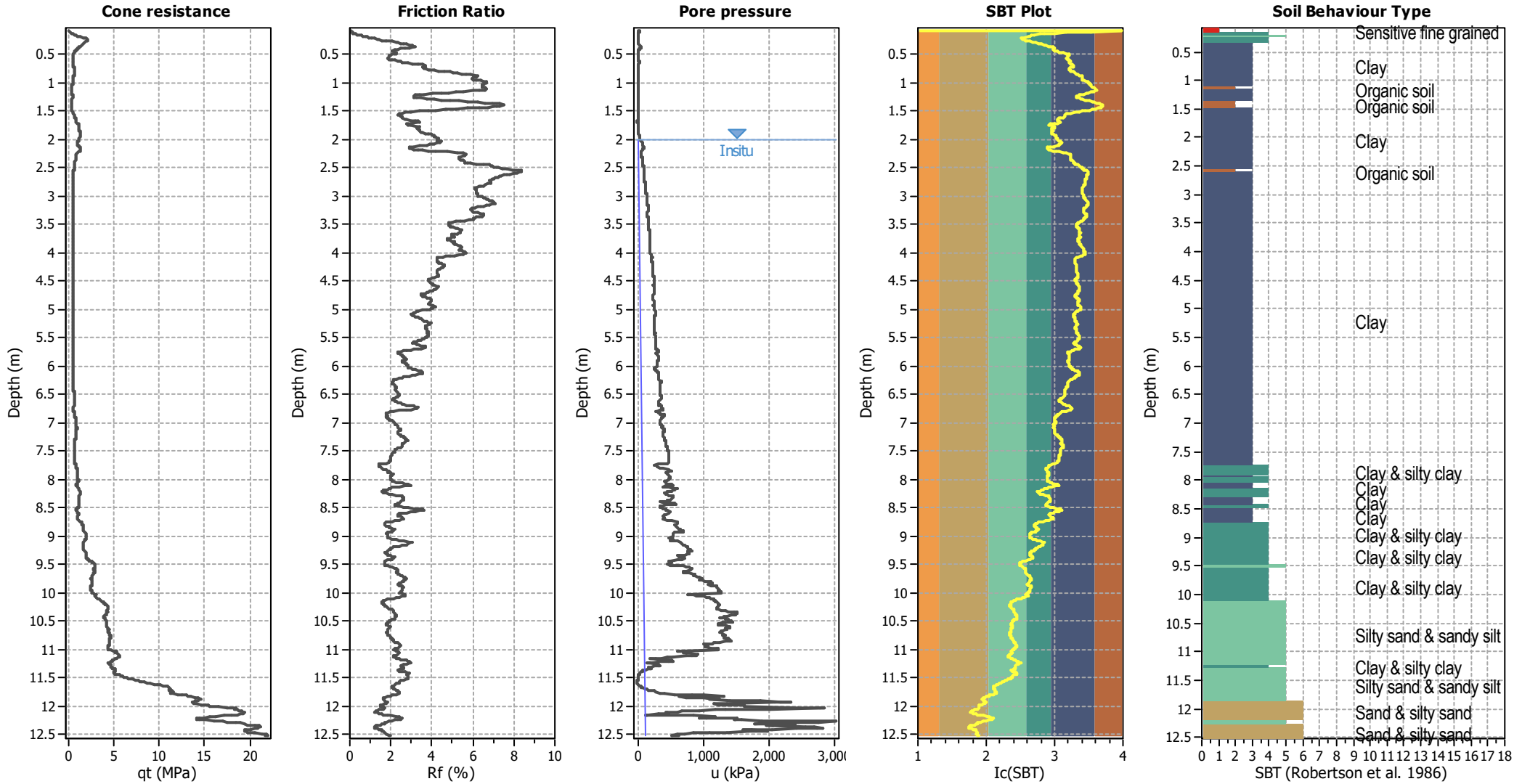
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

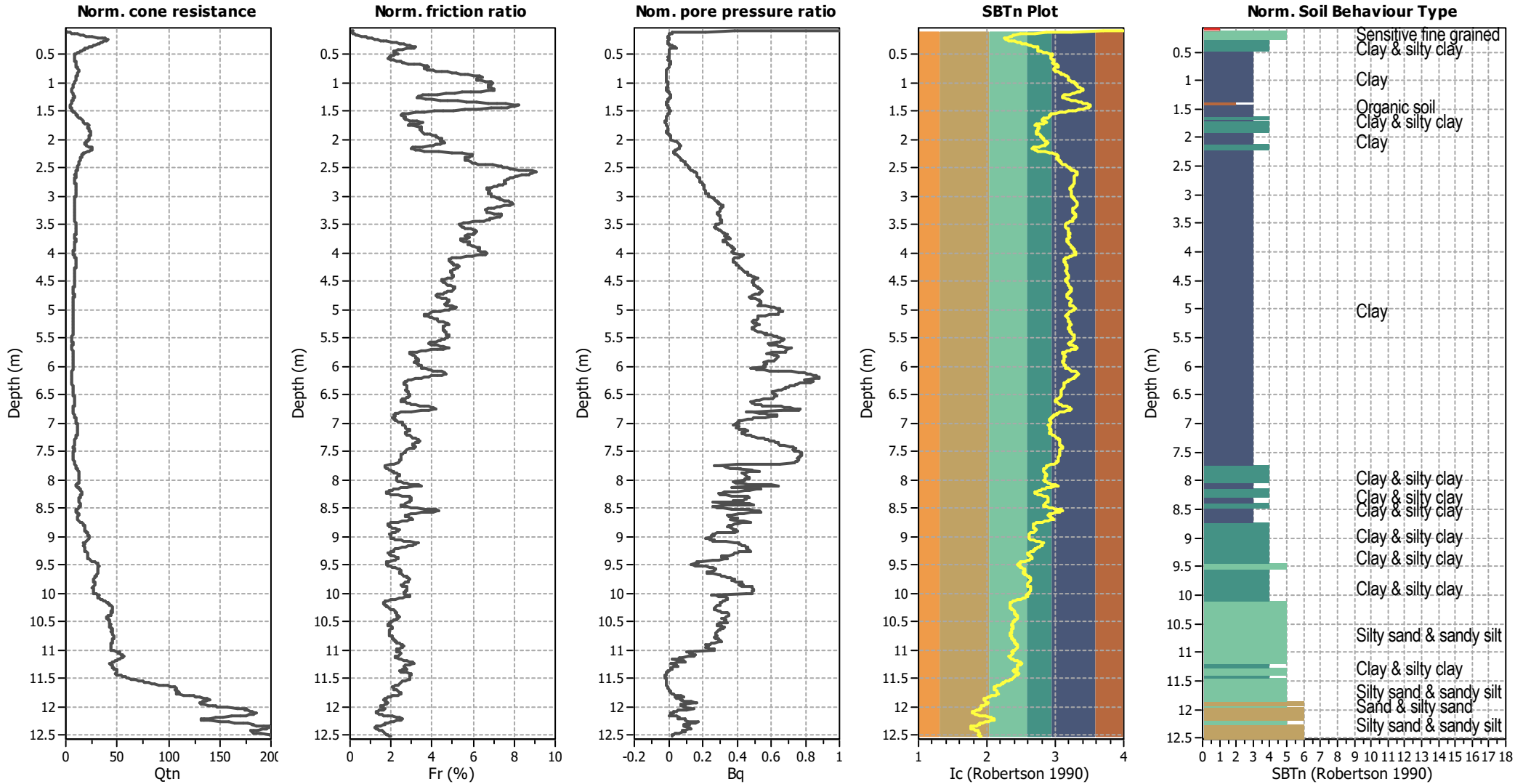
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



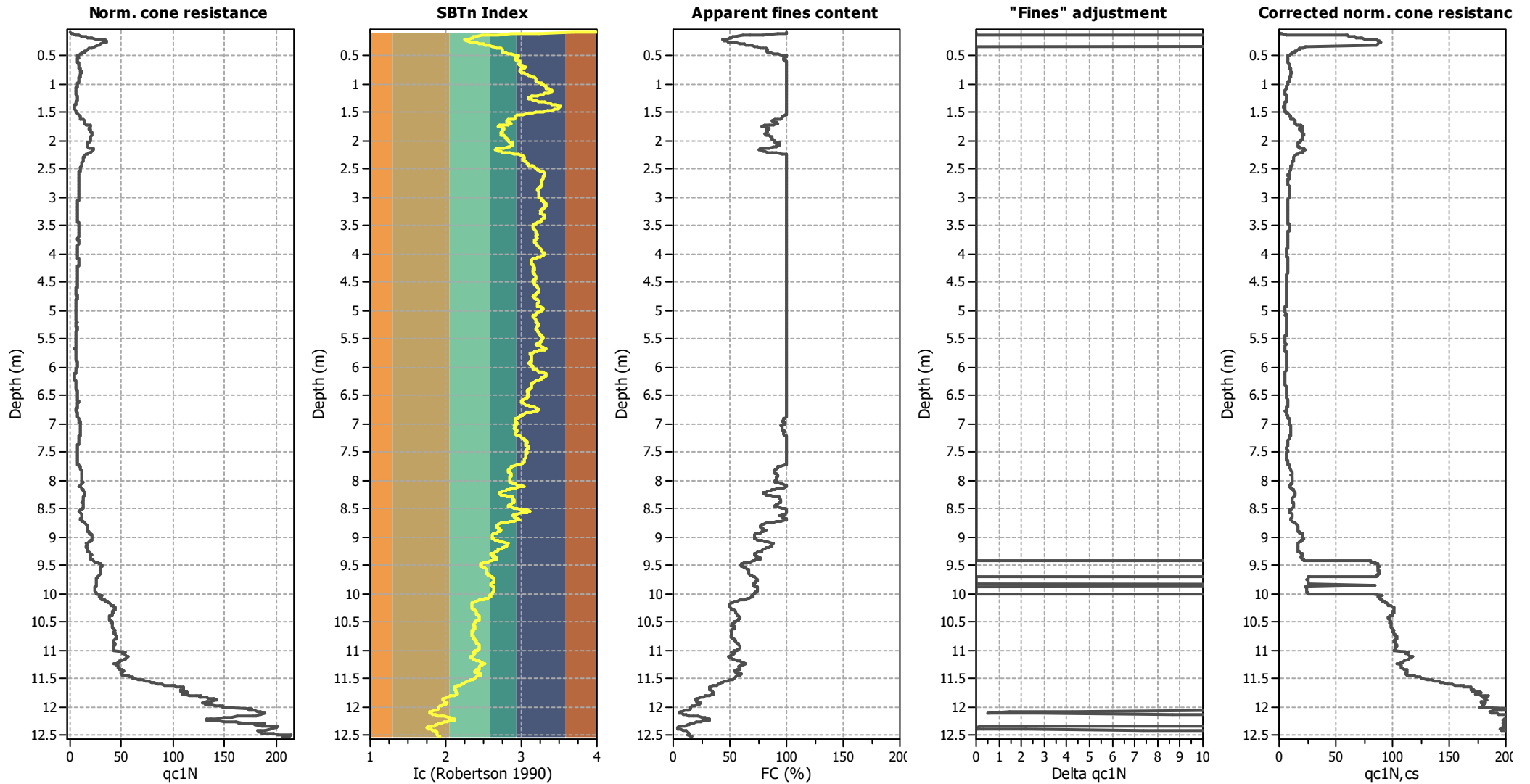
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_v$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

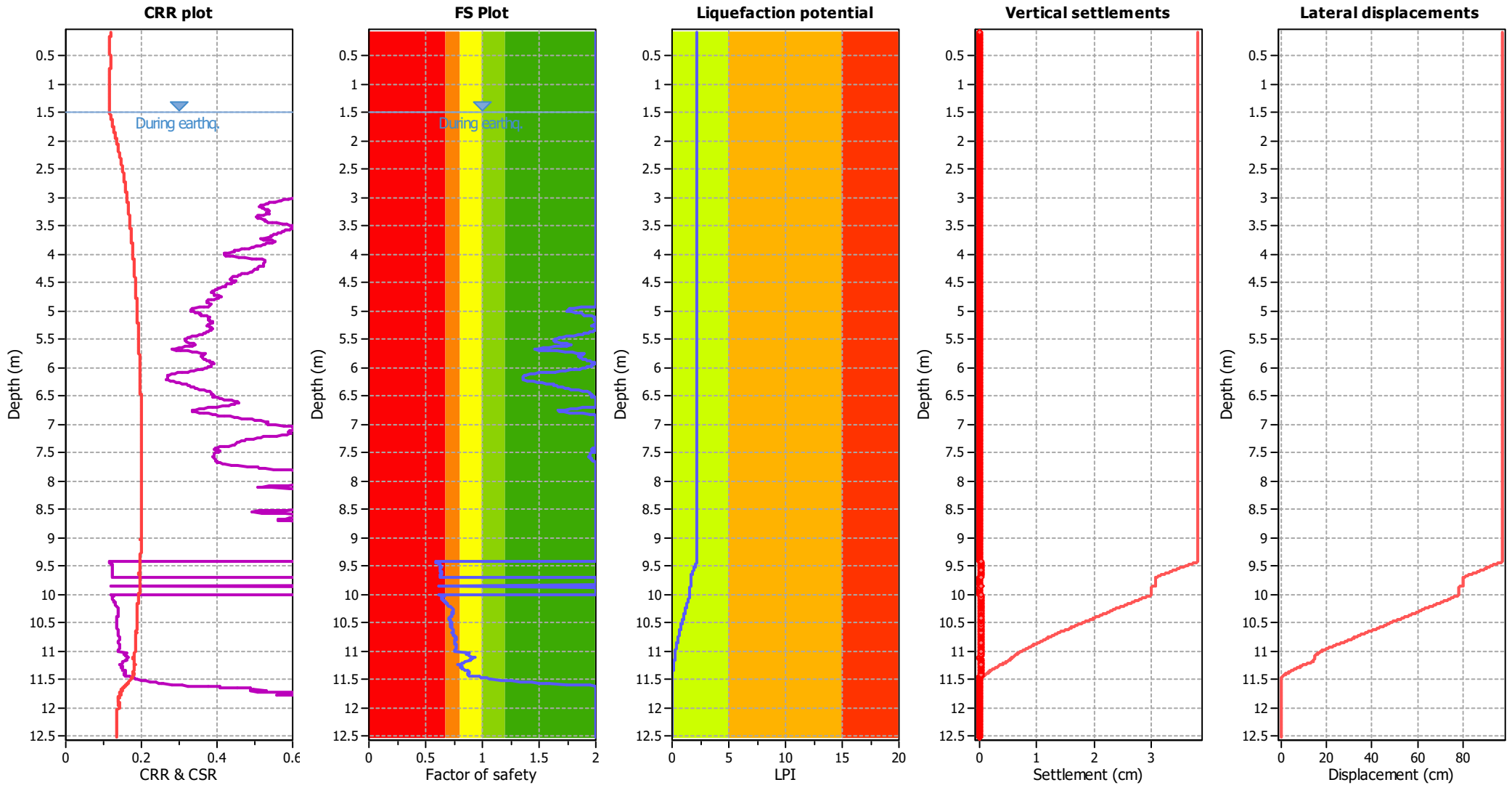
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

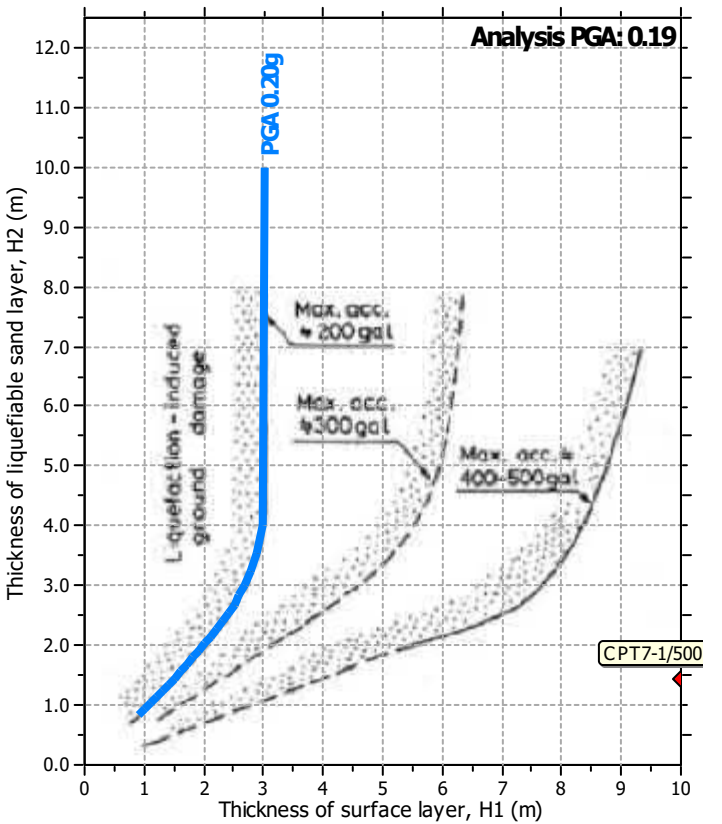
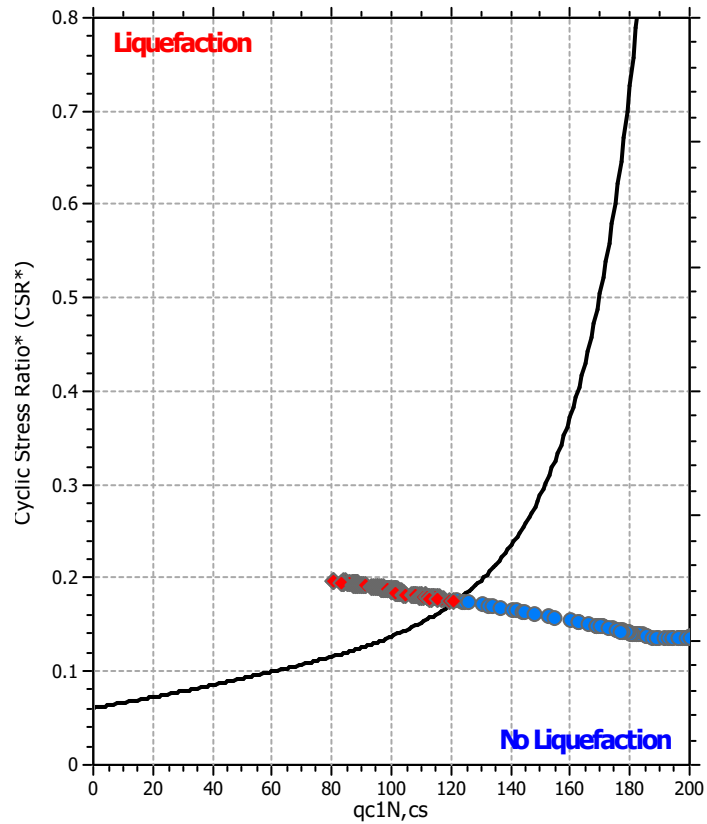
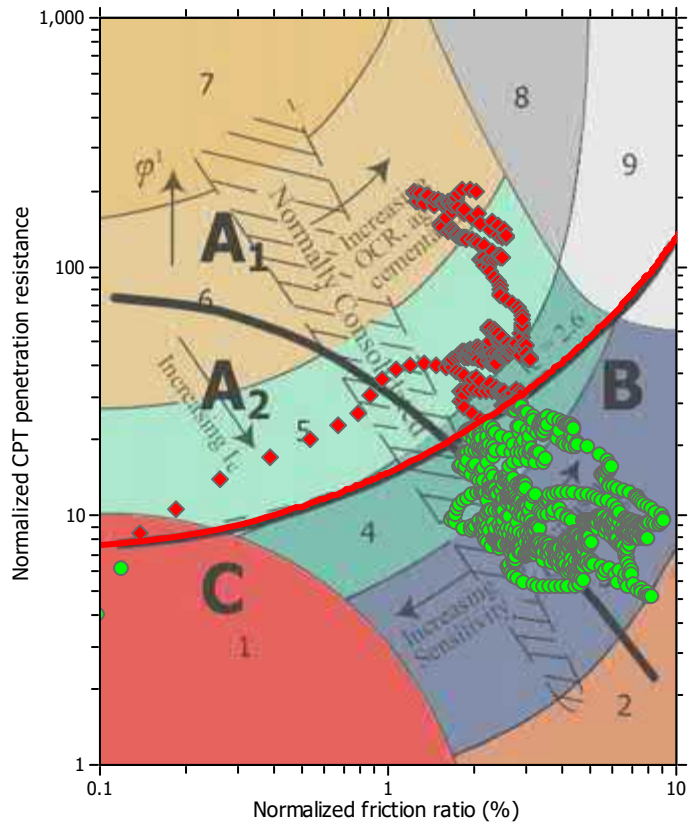
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A



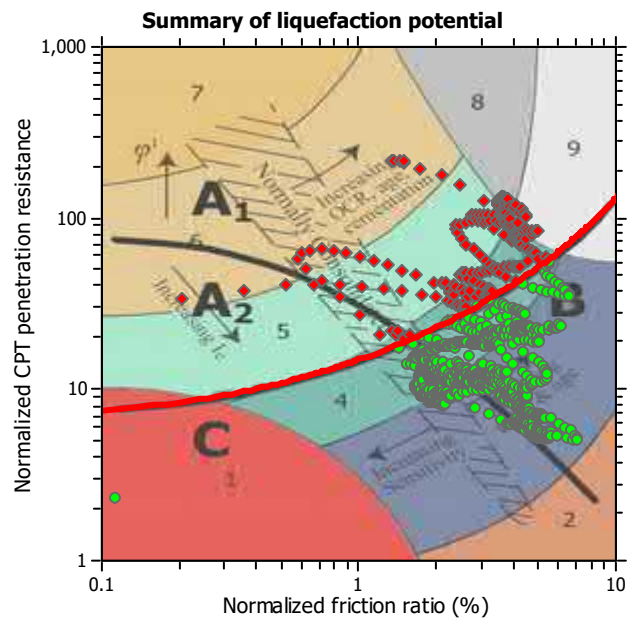
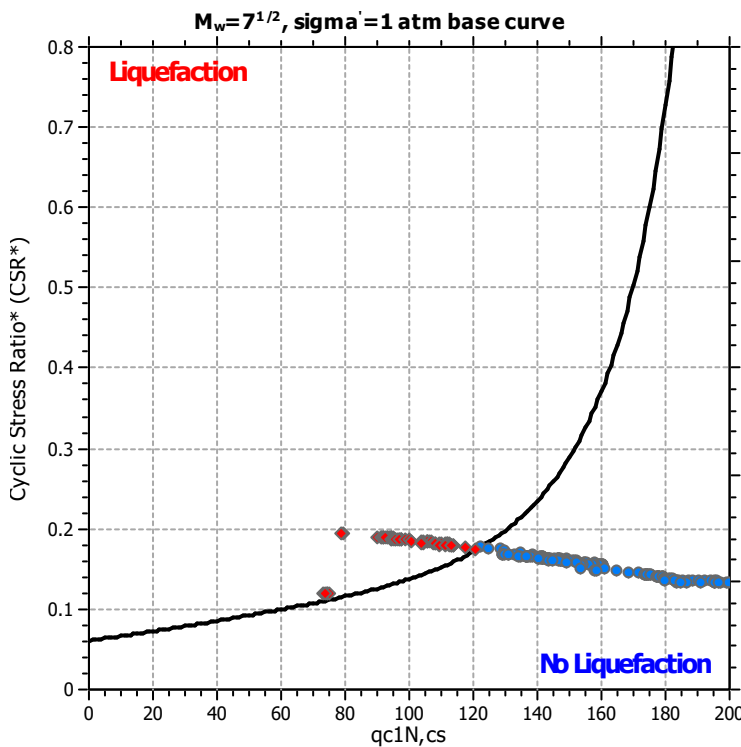
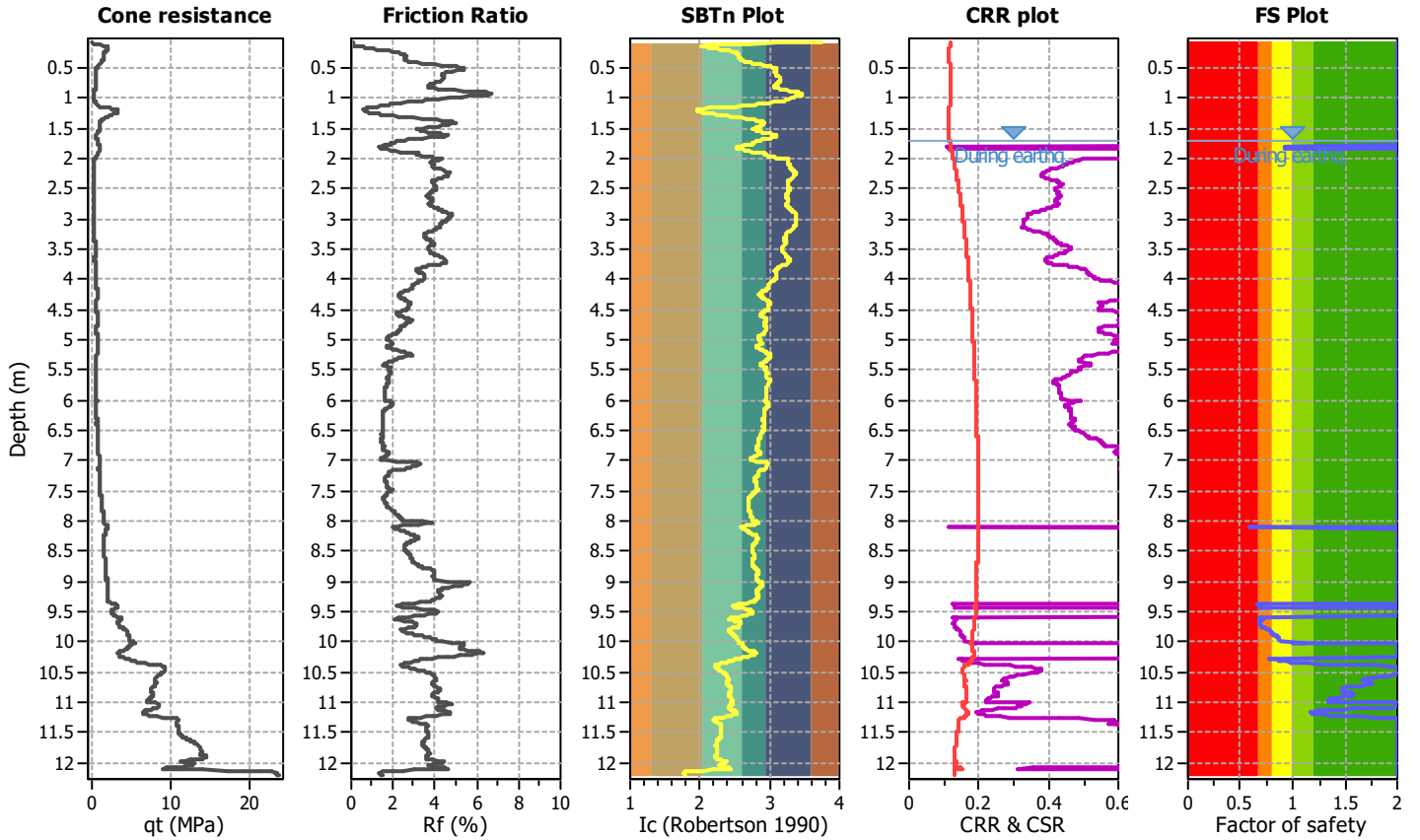
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT8-1/500**

**Location : 48 Valerie Close, Warkworth**

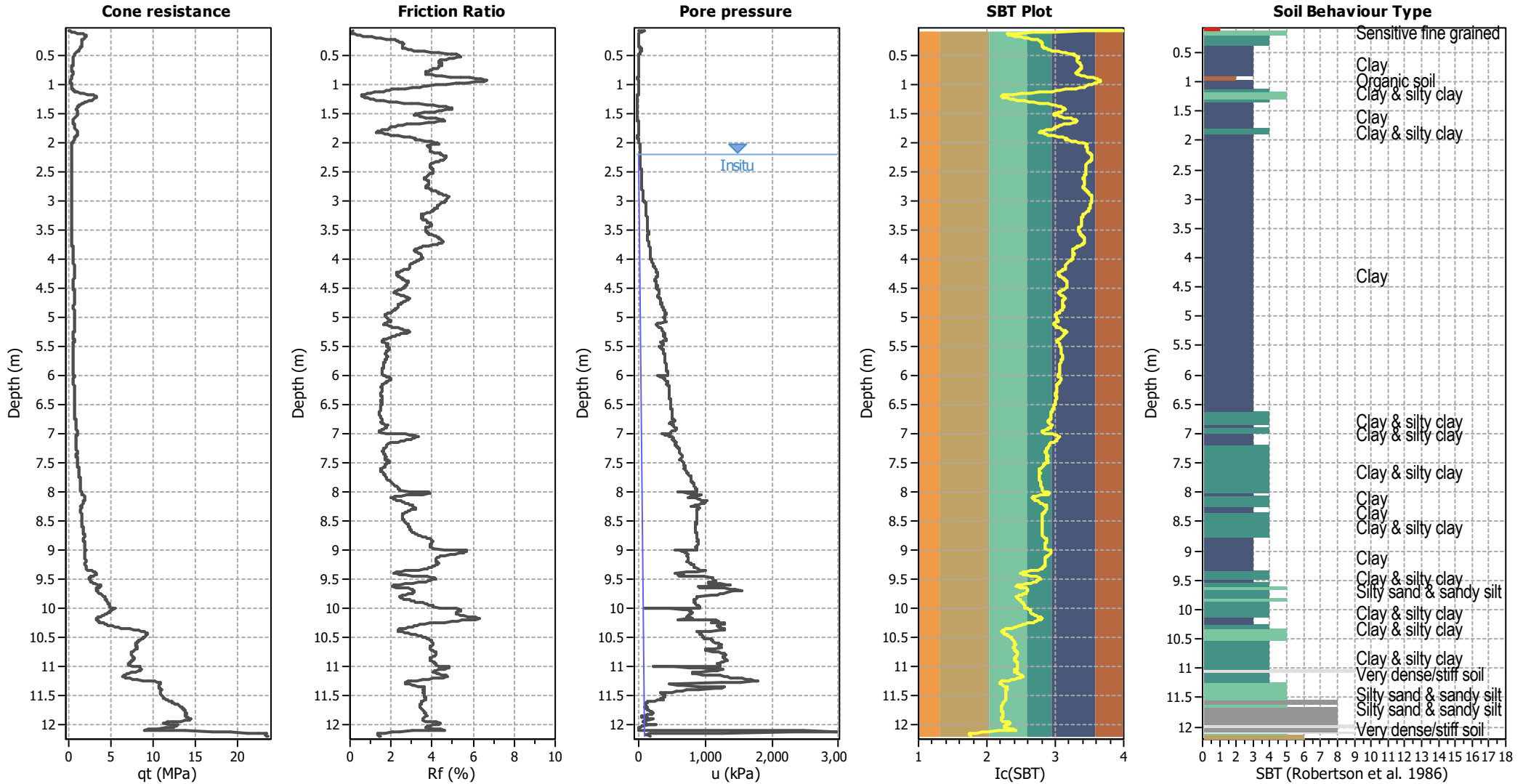
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



**Zone A<sub>1</sub>:** Cyclic liquefaction likely depending on size and duration of cyclic loading  
**Zone A<sub>2</sub>:** Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
**Zone B:** Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
**Zone C:** Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



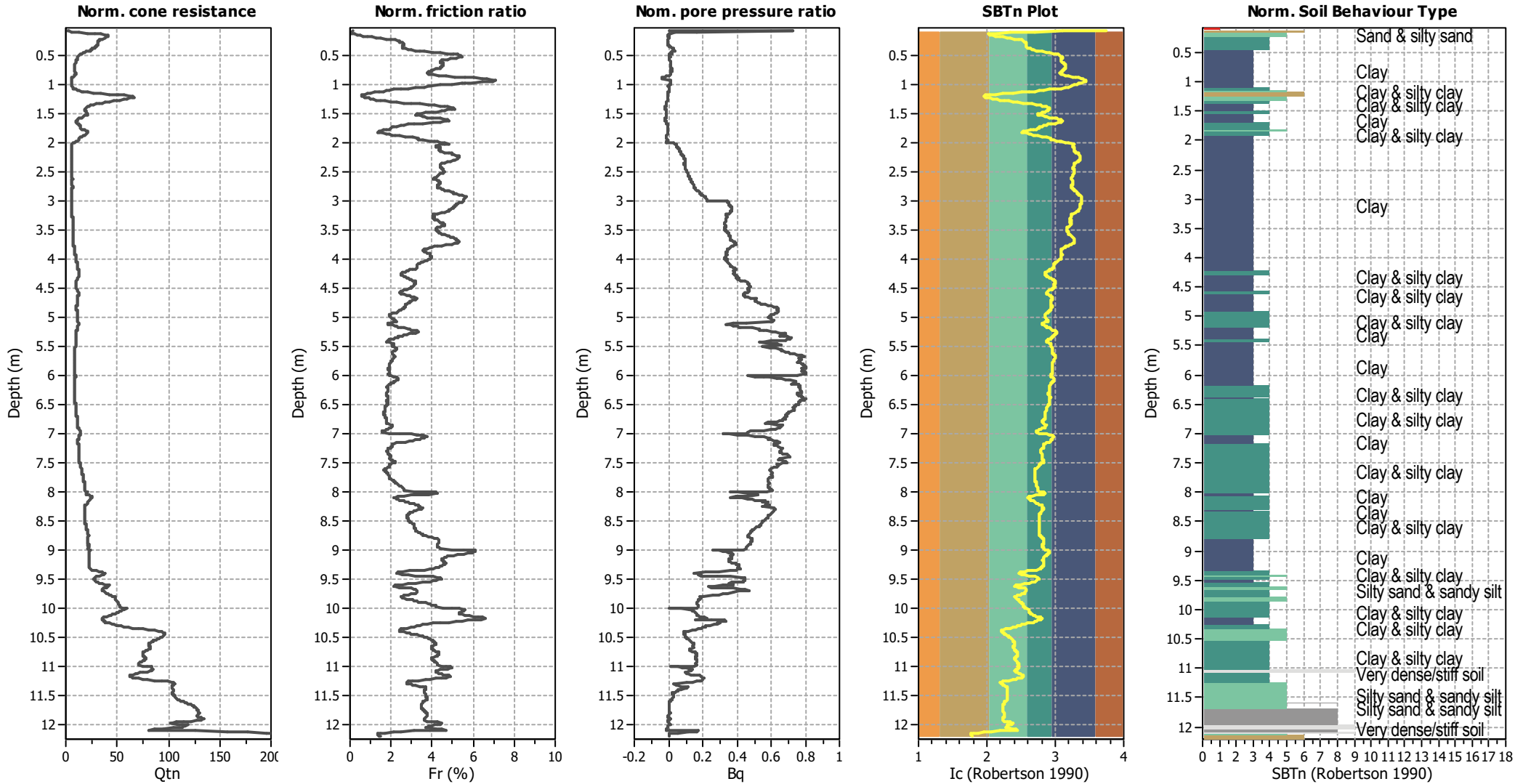
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



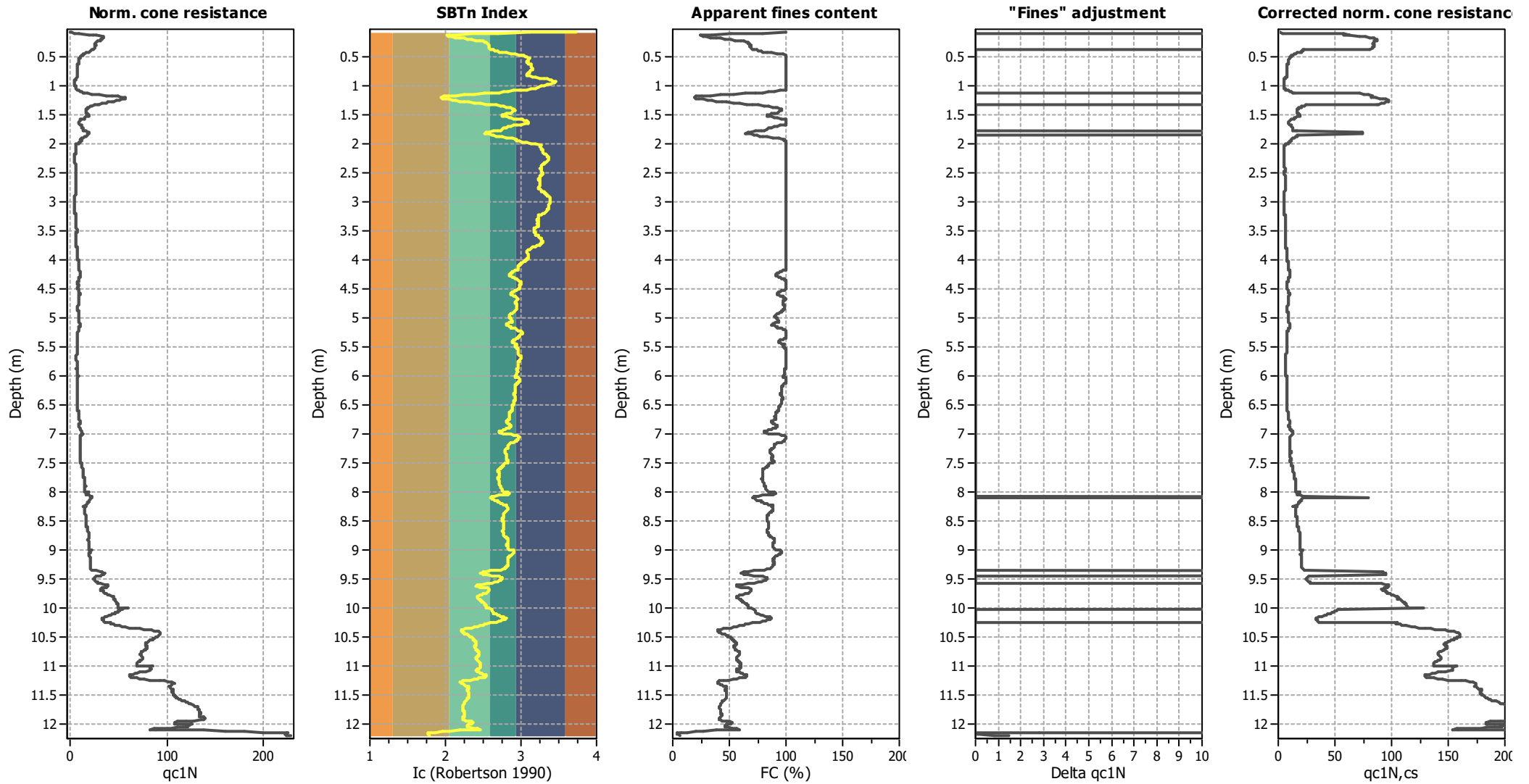
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

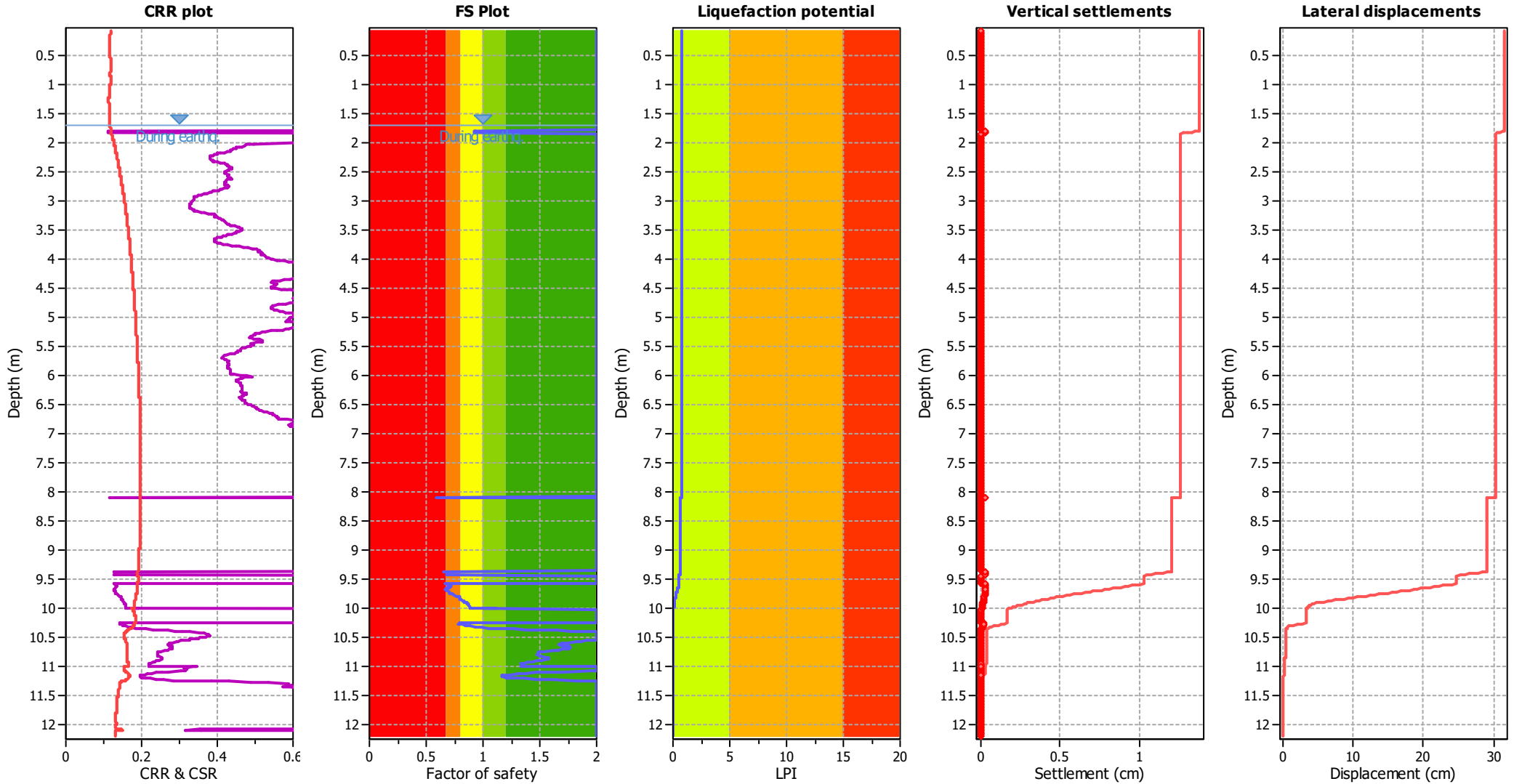


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

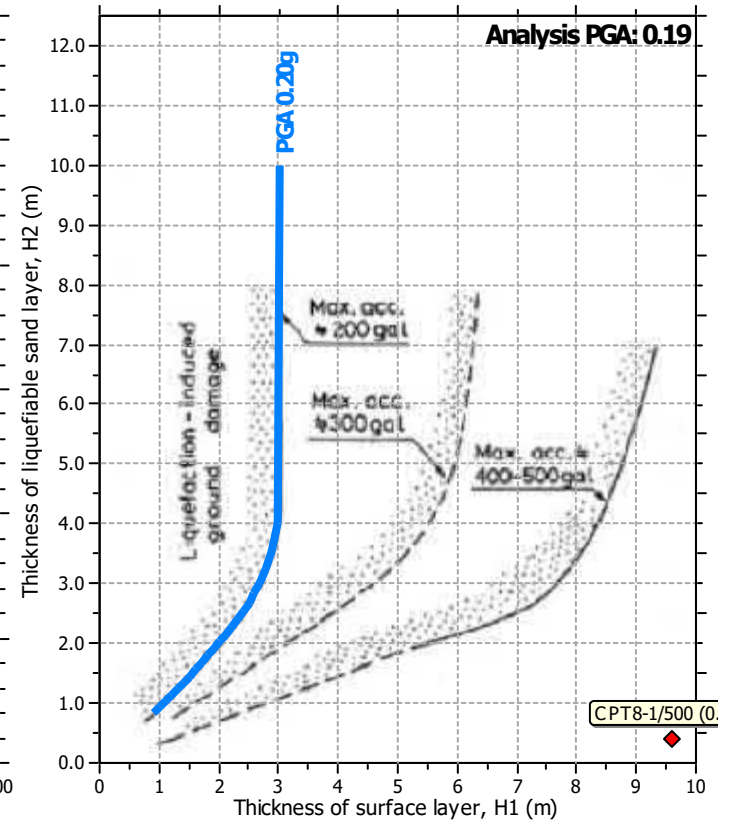
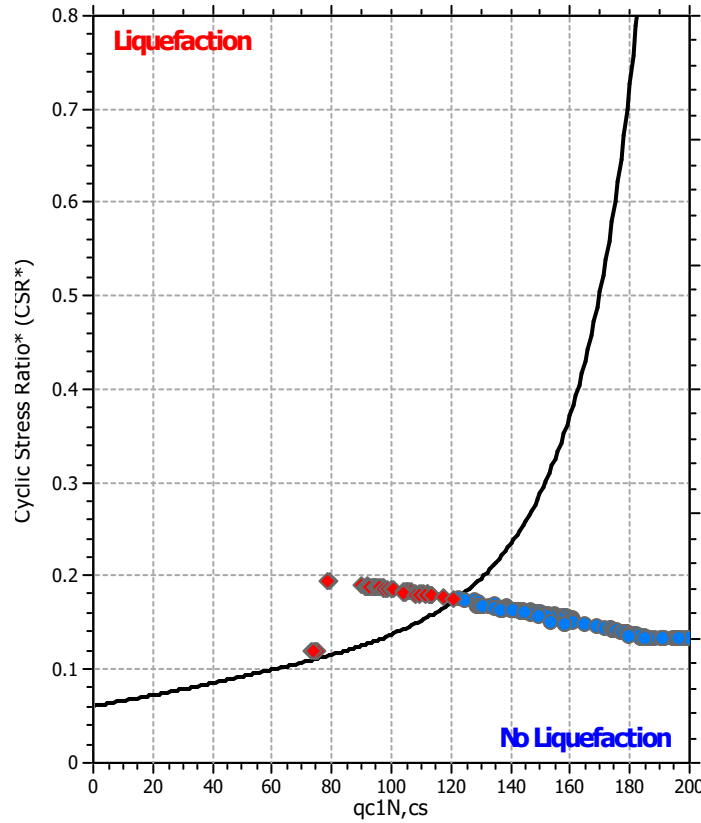
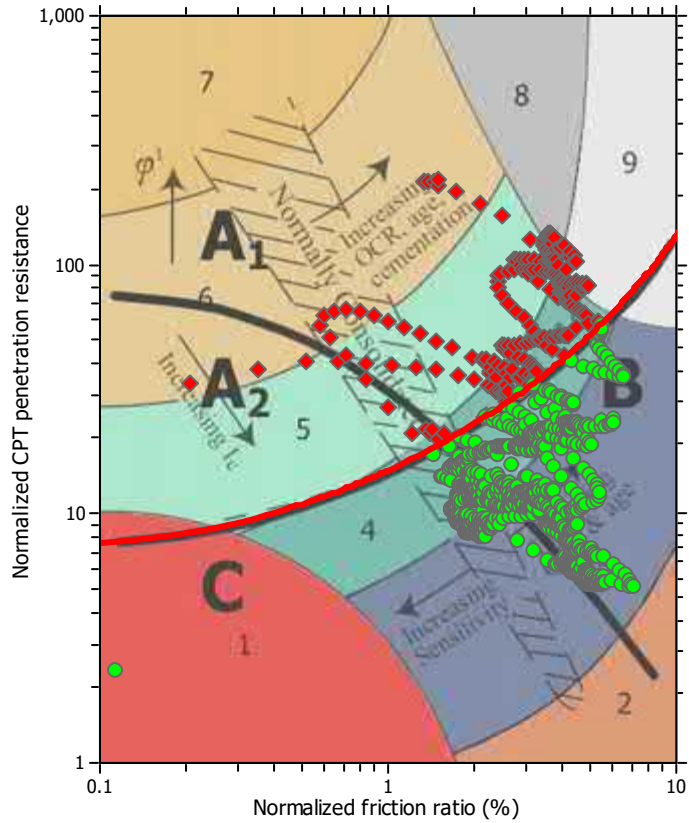
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

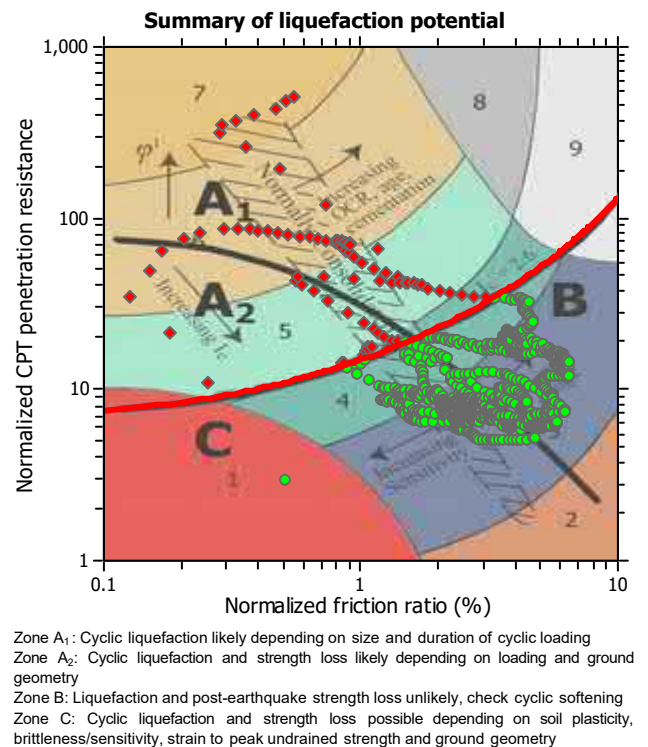
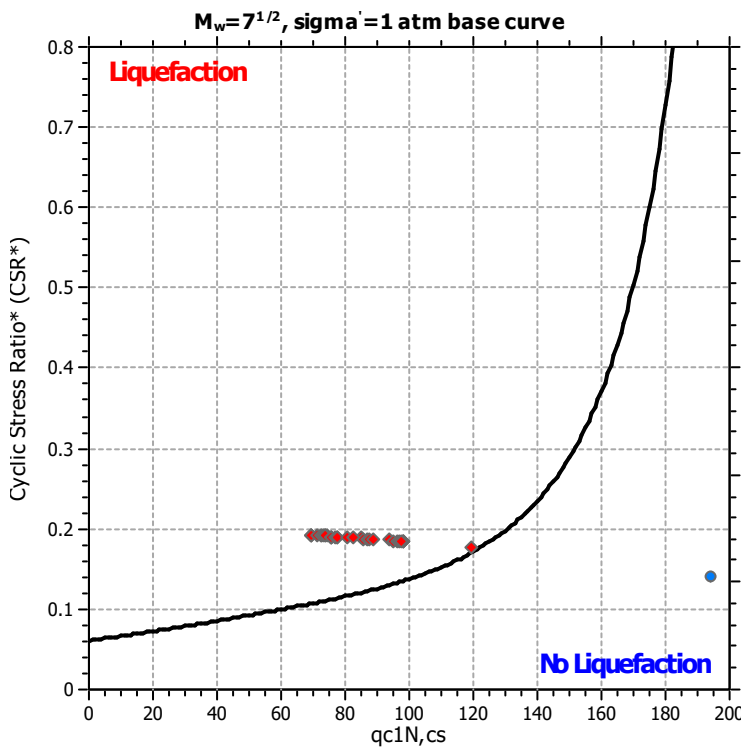
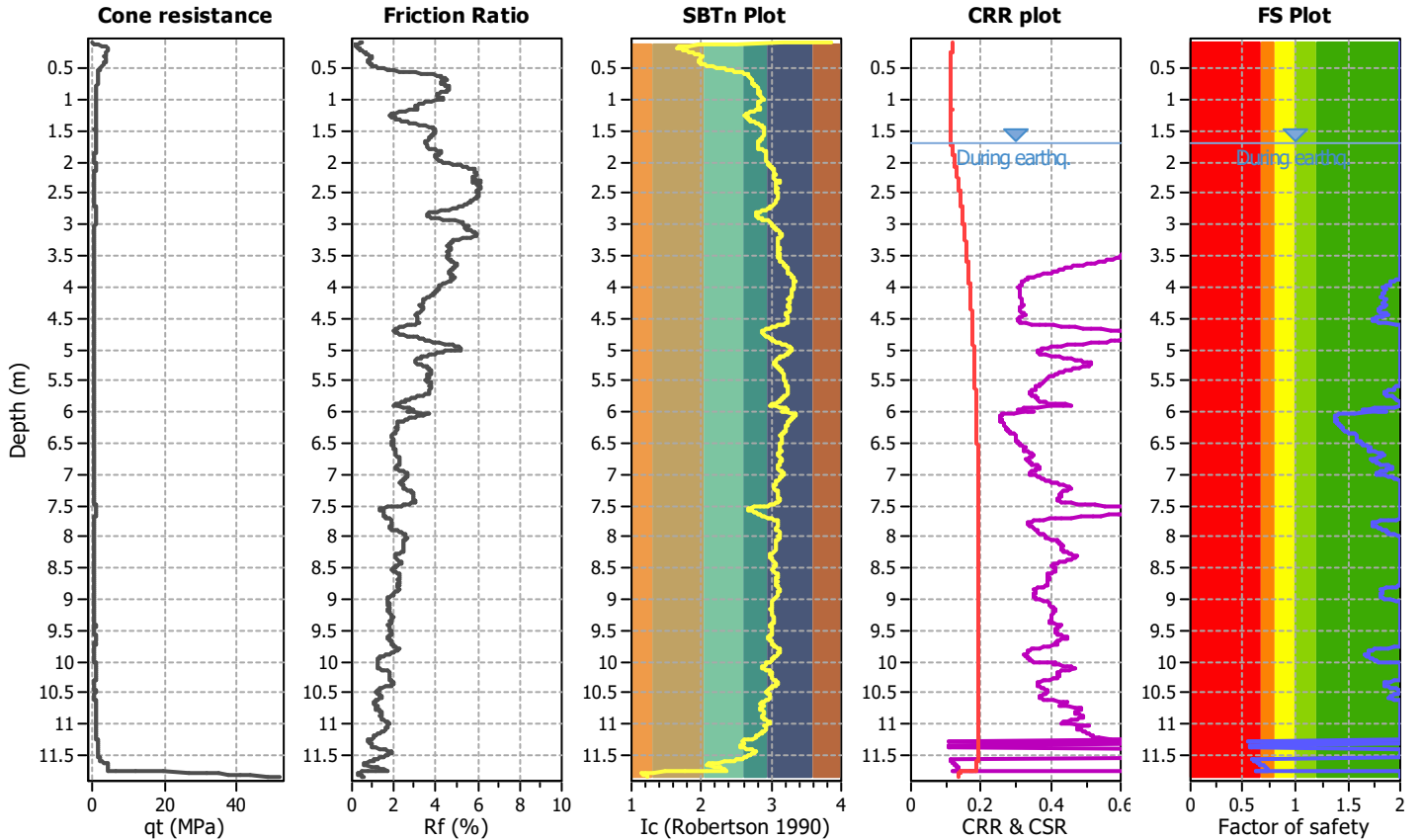
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT9-1/500**

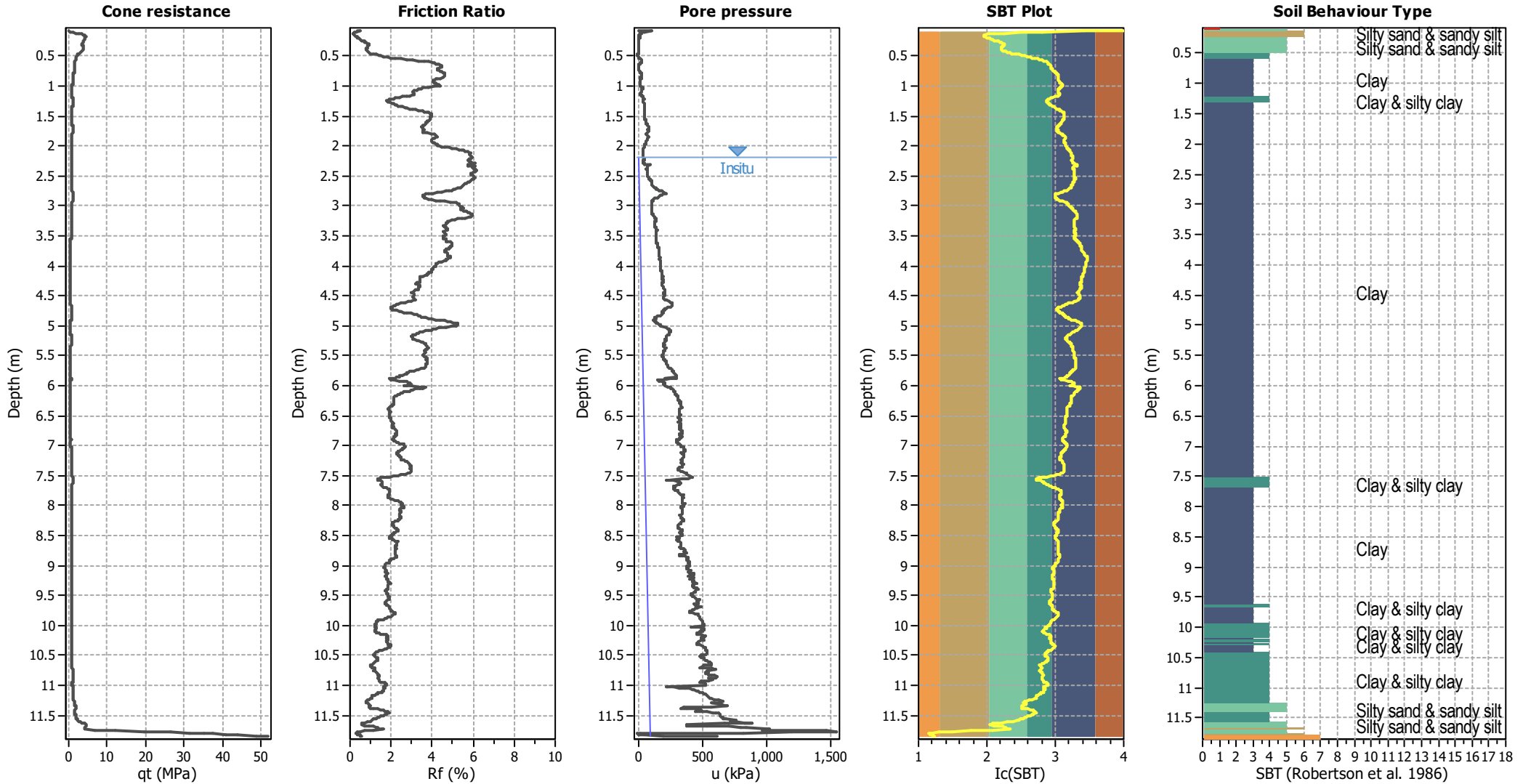
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

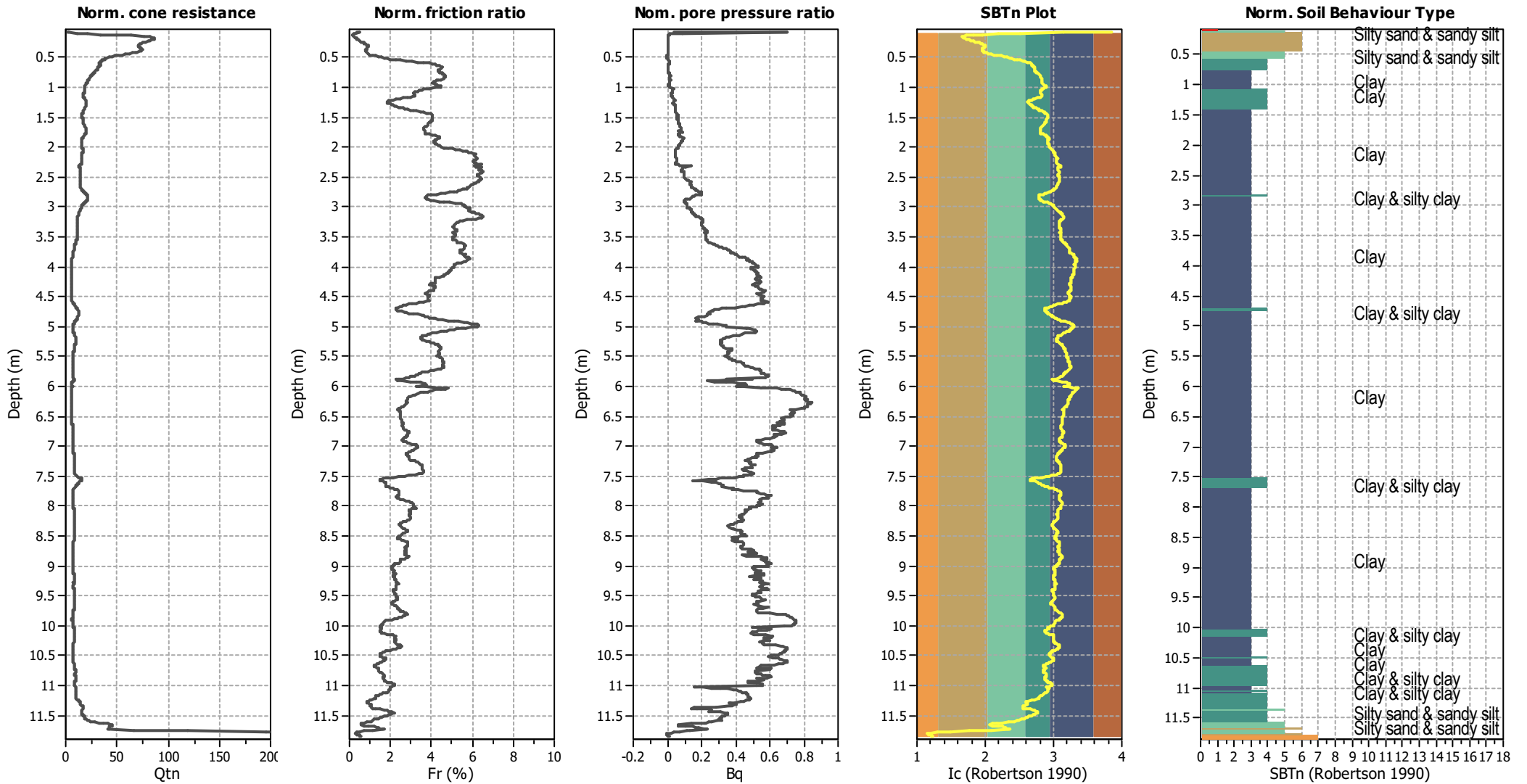
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



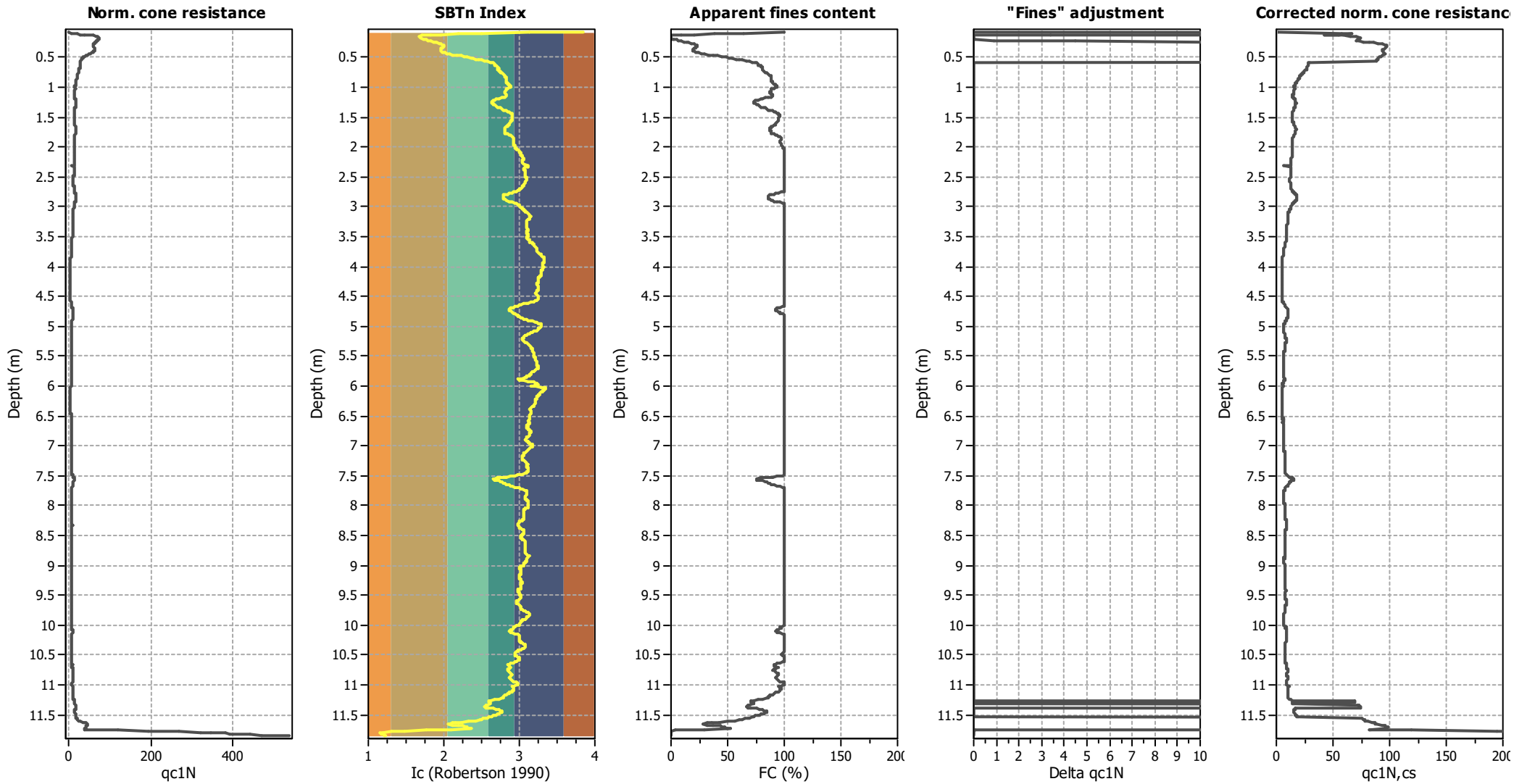
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

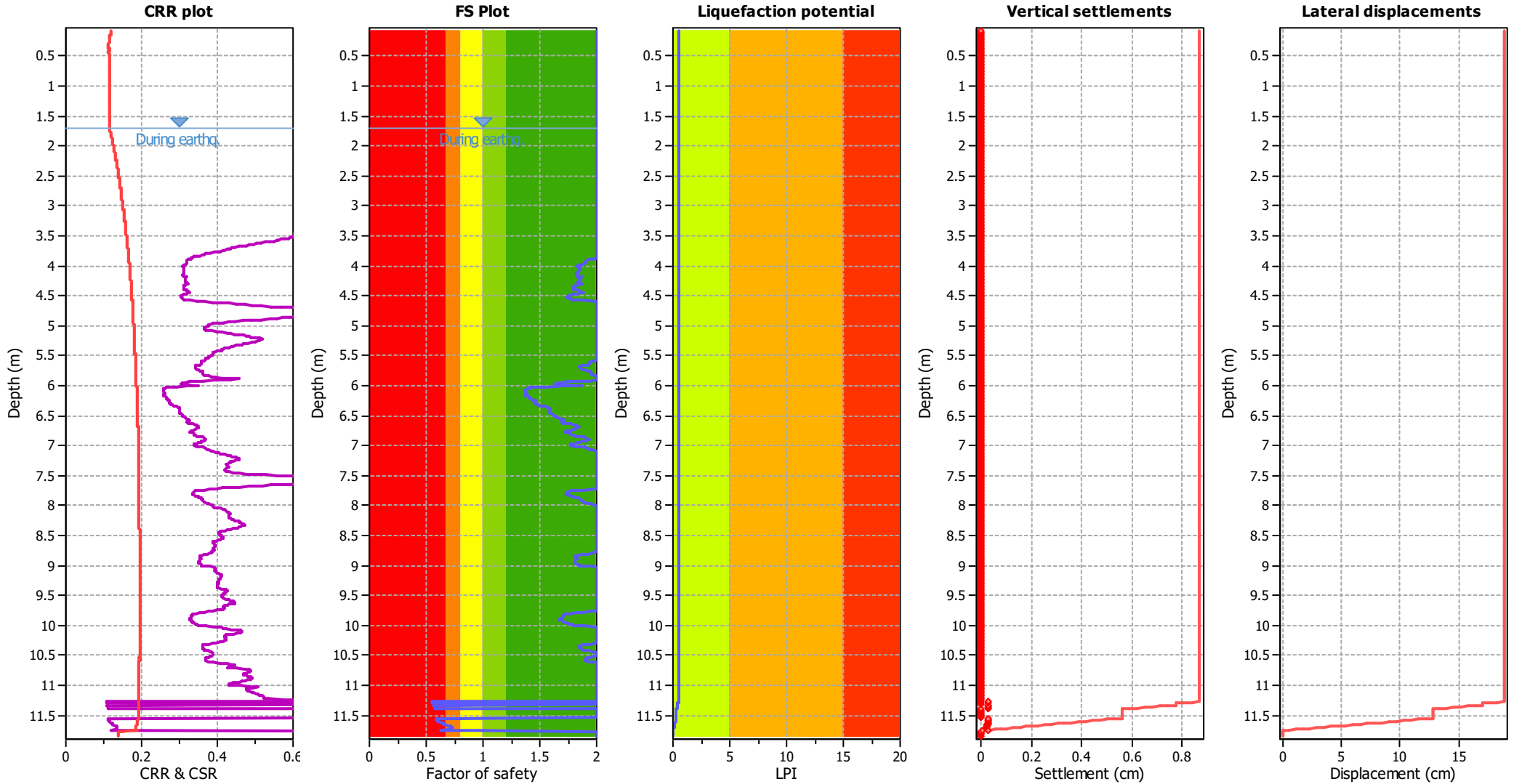
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

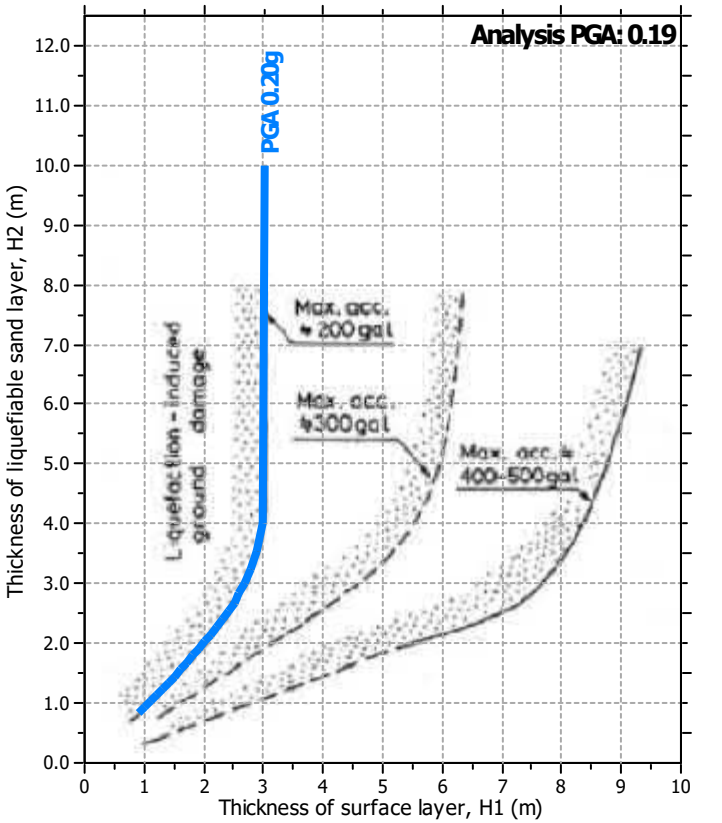
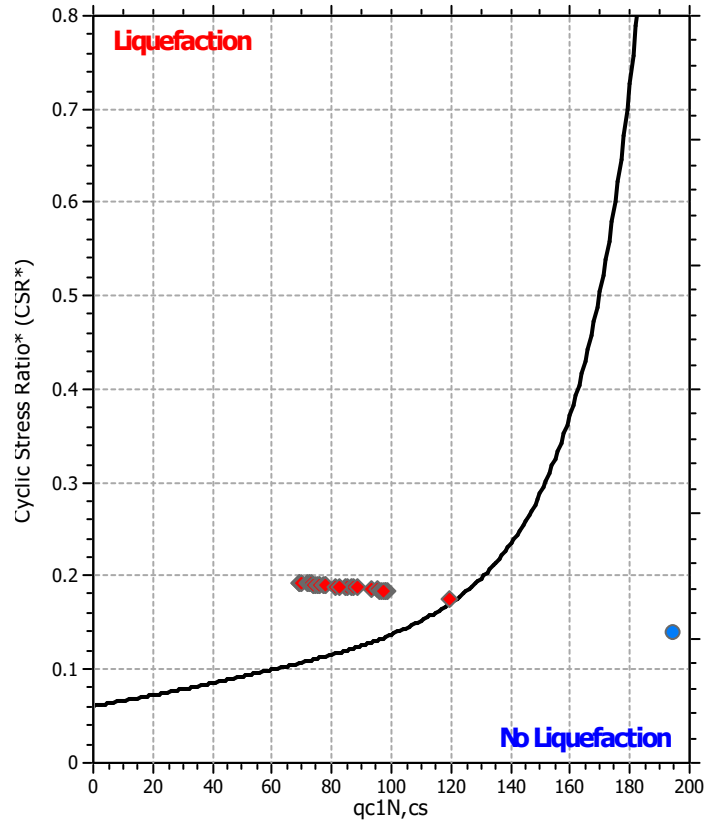
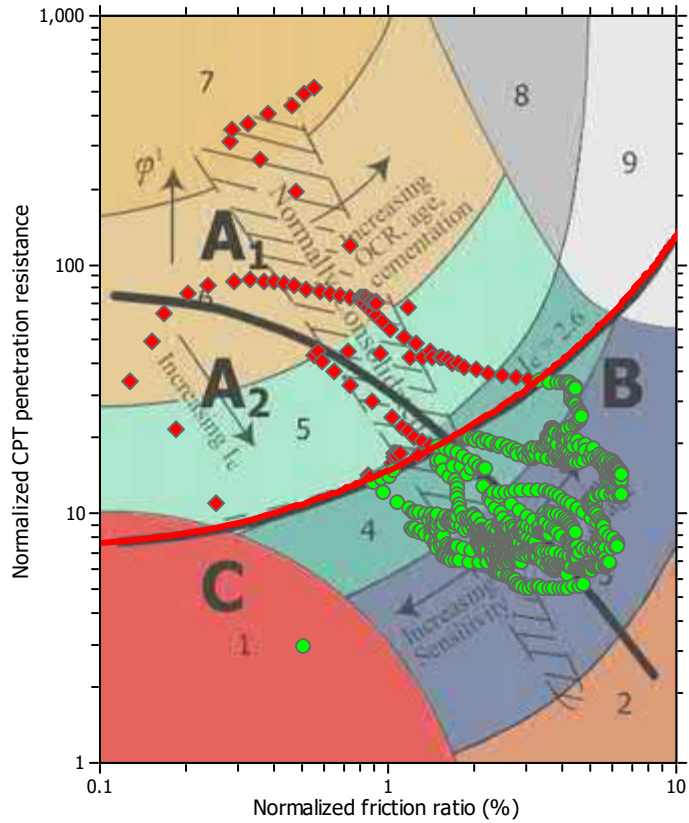
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



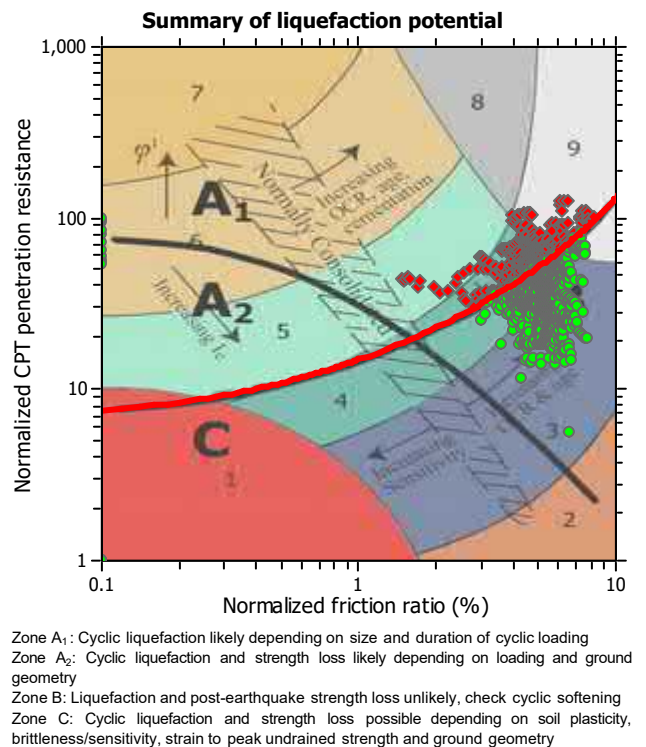
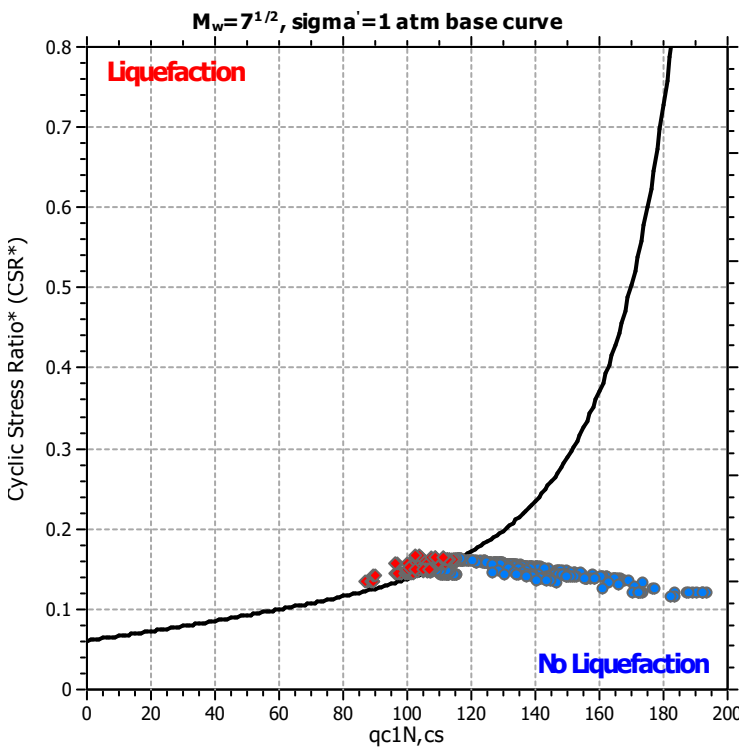
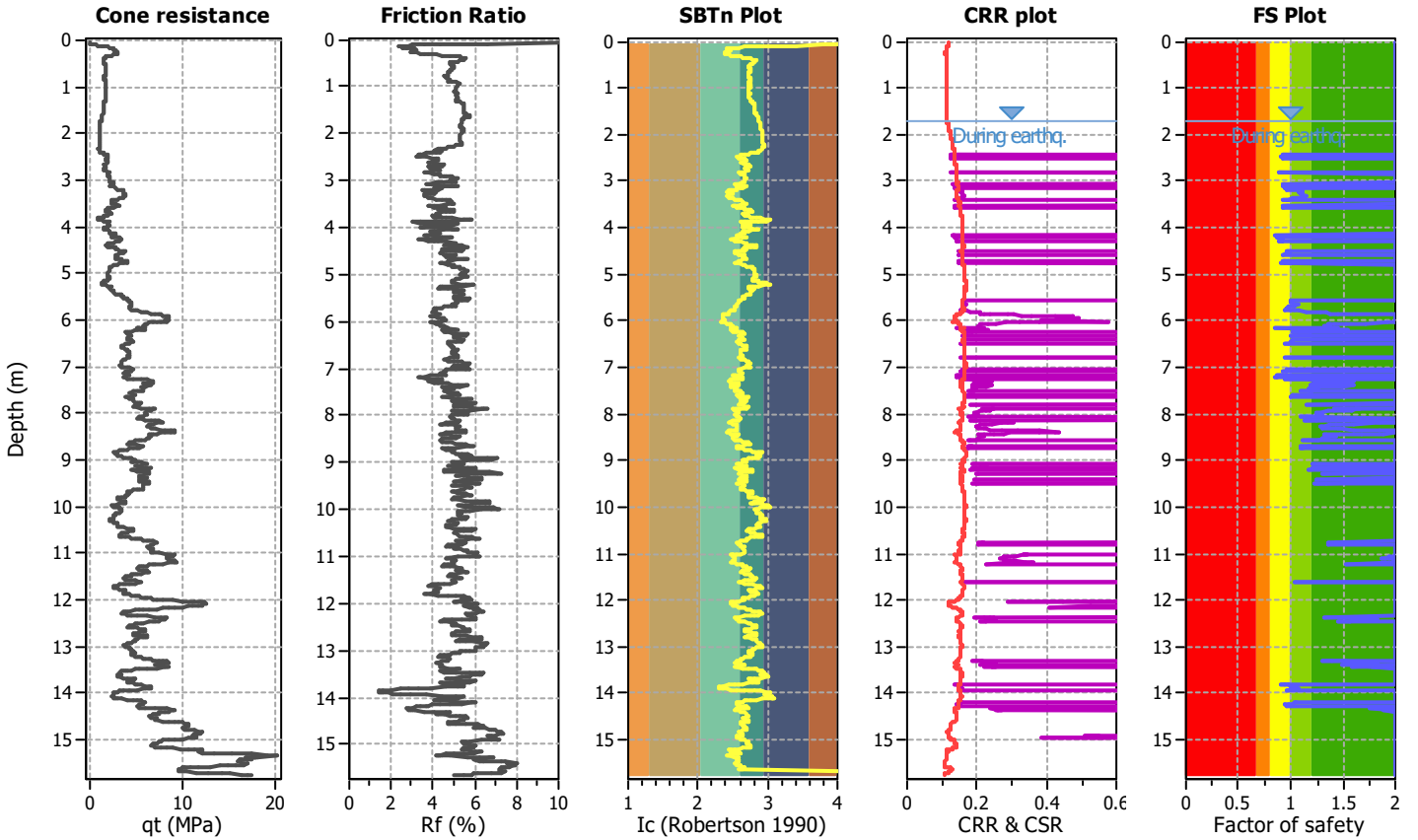
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT10-1/500**

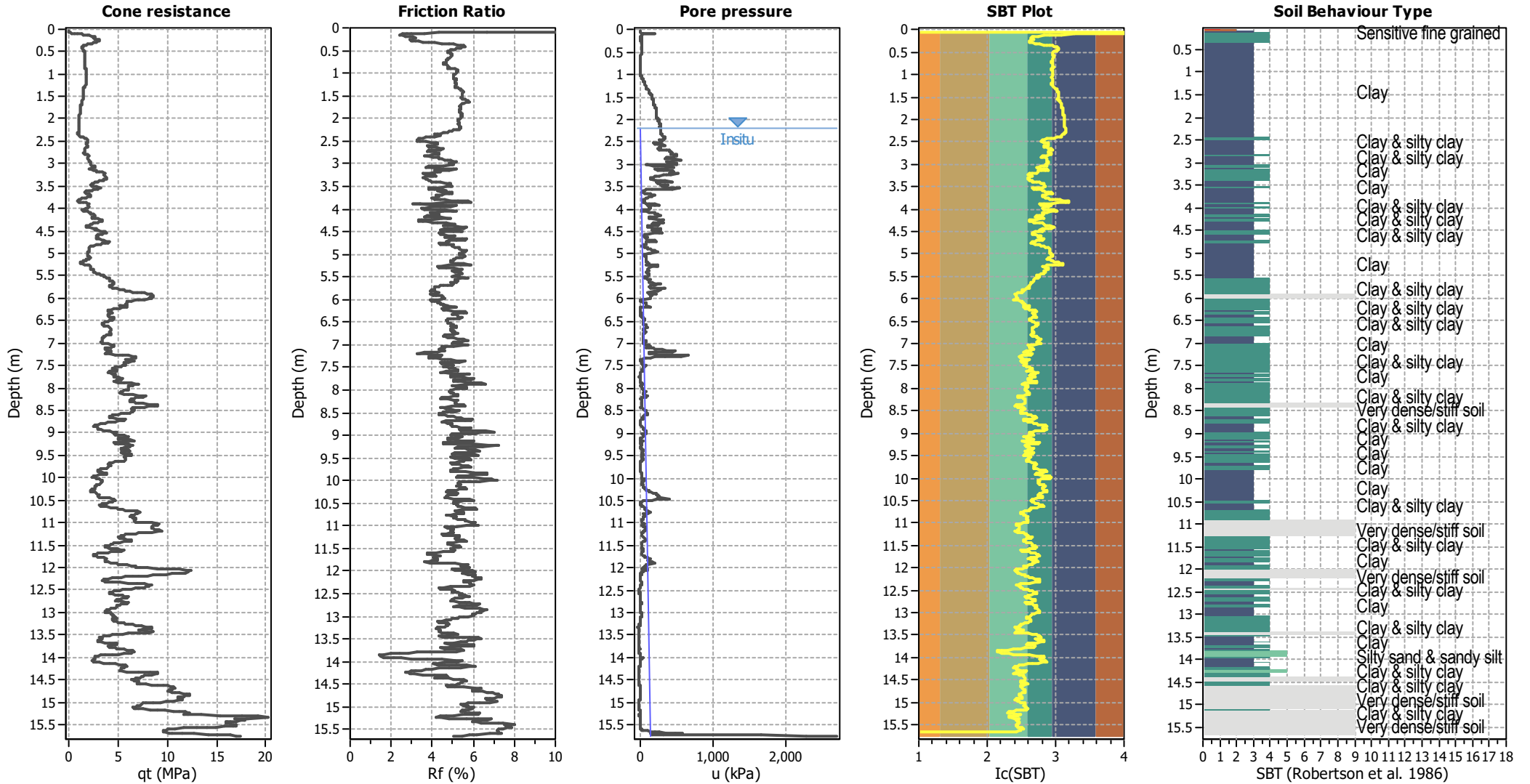
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 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:	15.00 m
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



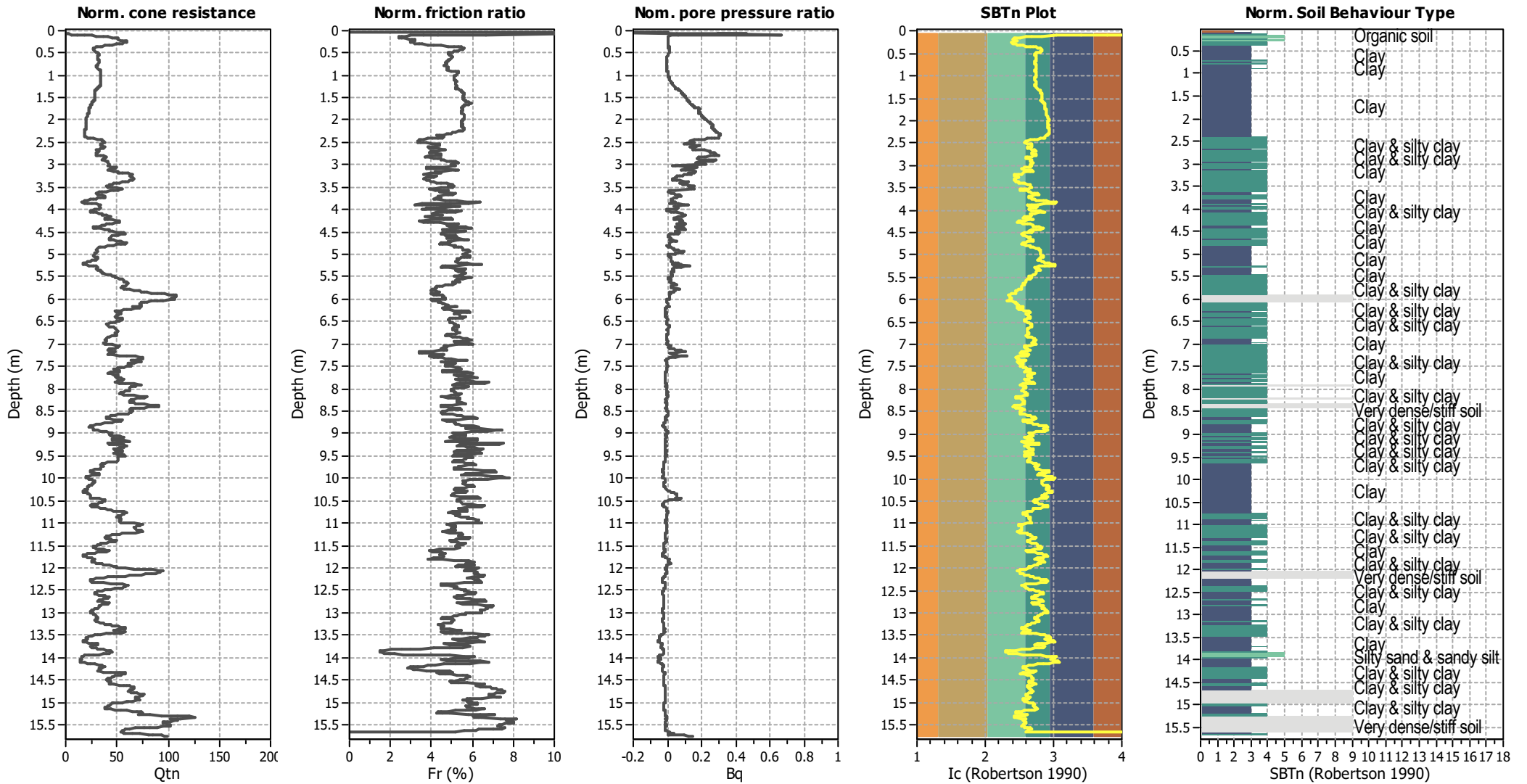
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



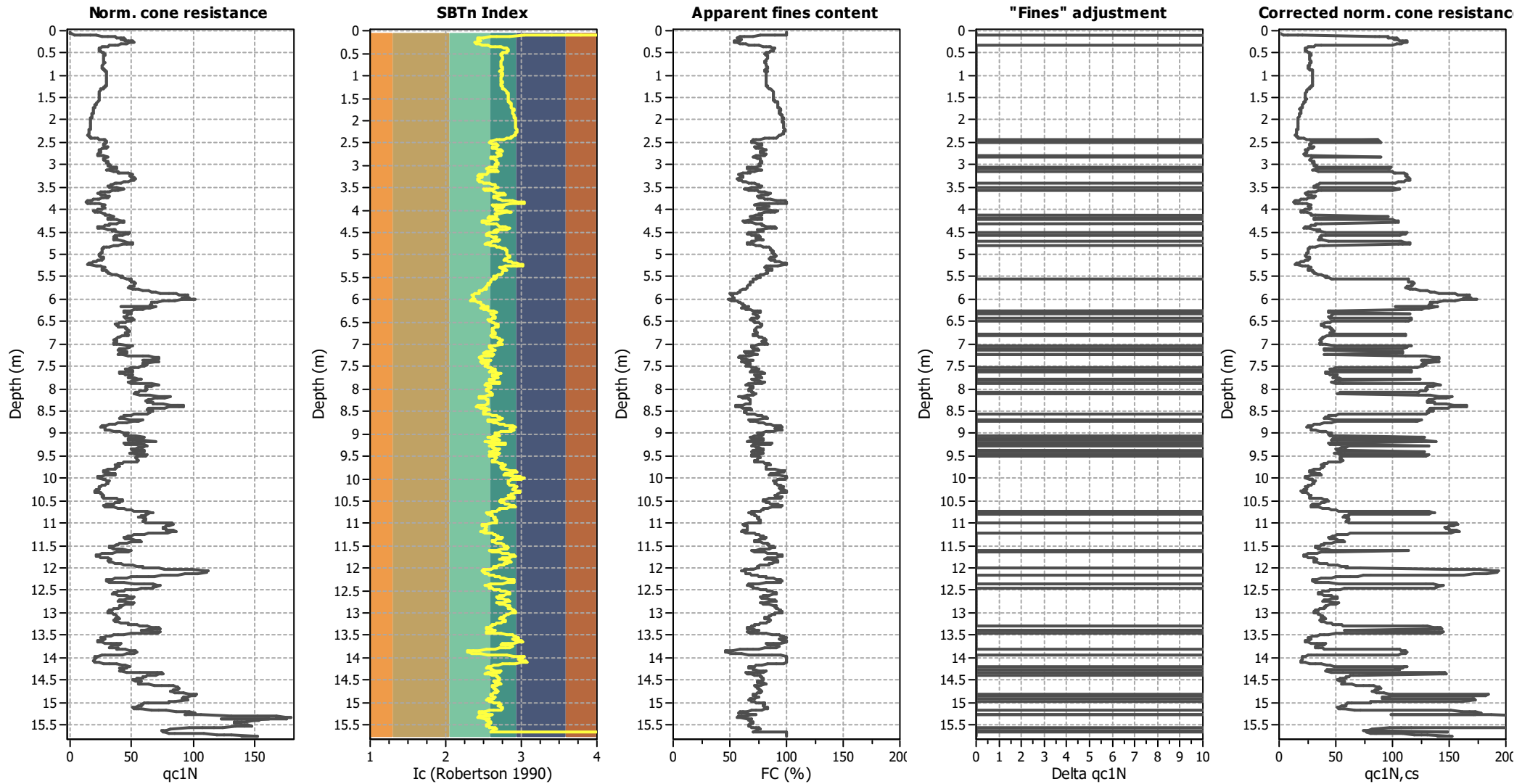
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

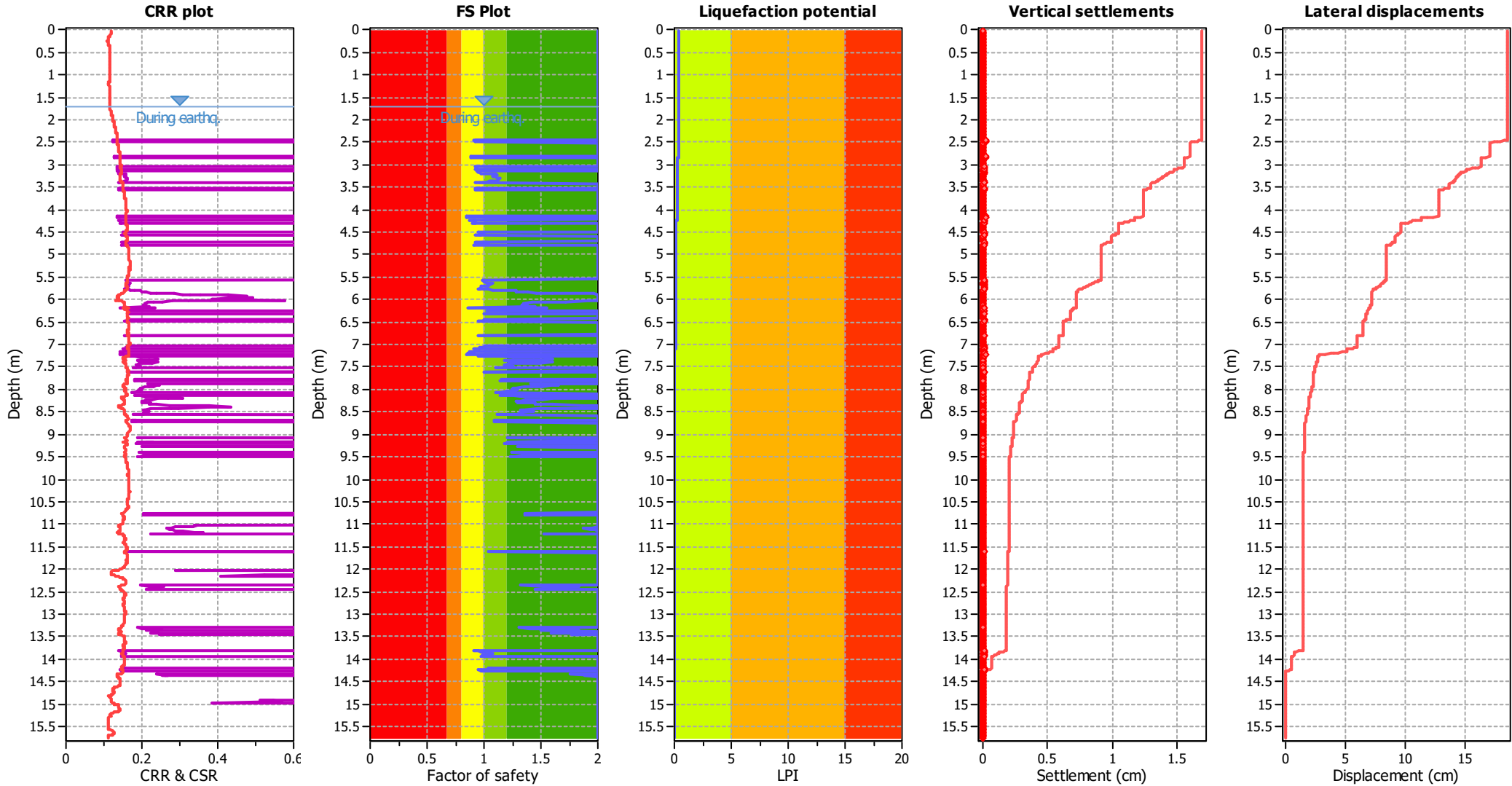


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fil weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

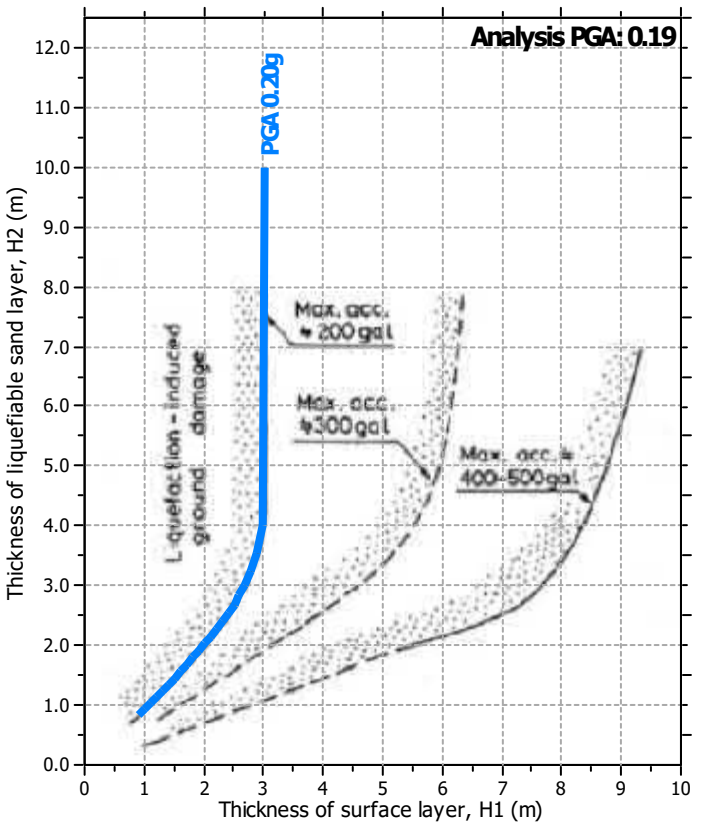
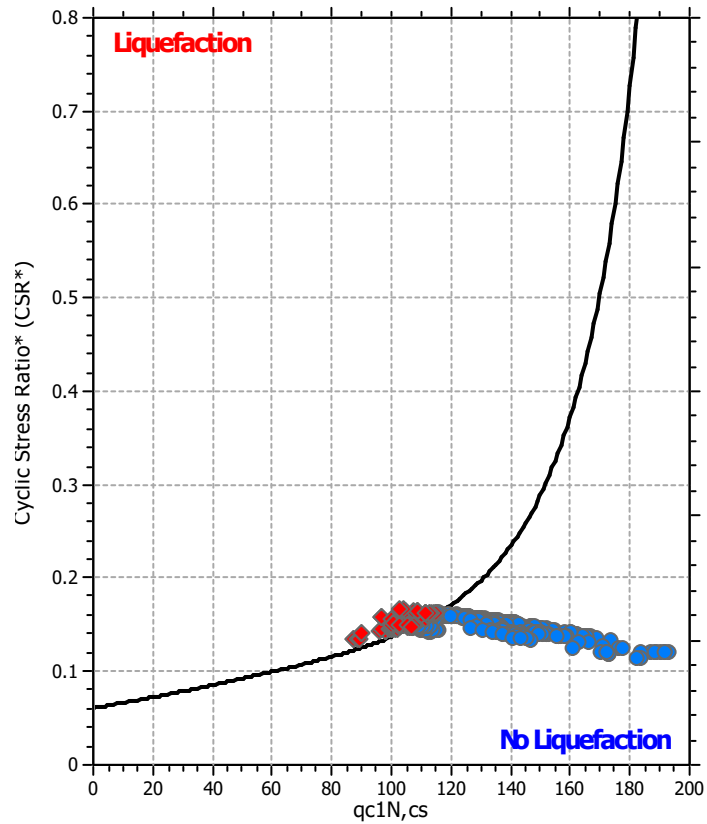
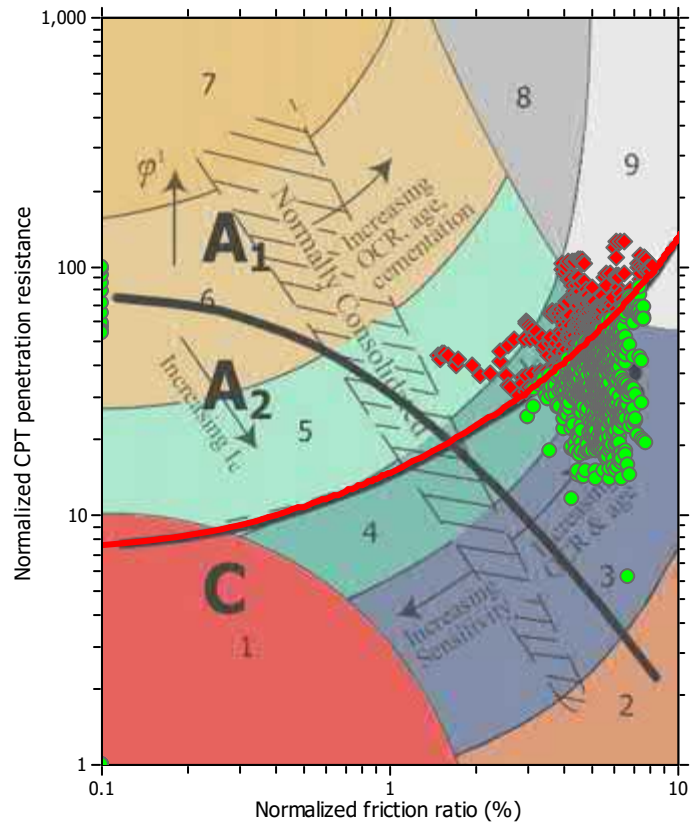
#### F.S. color scheme

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

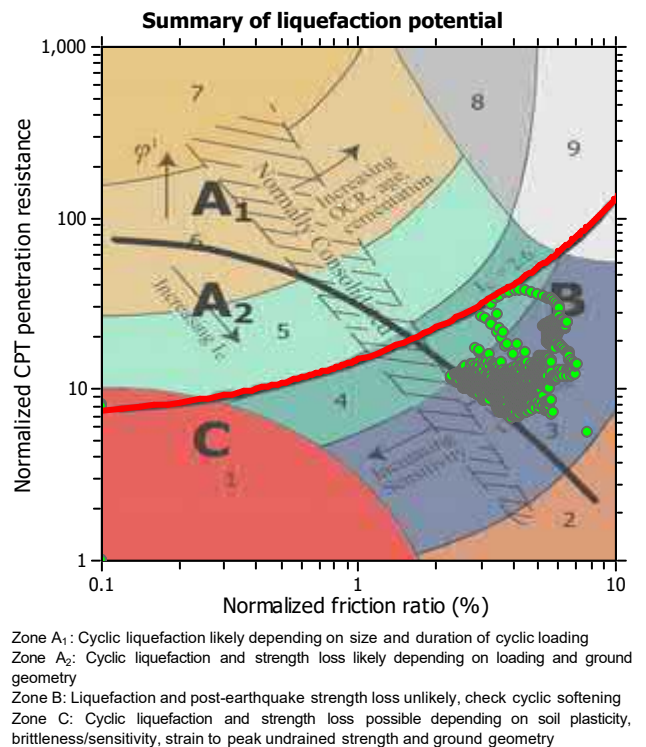
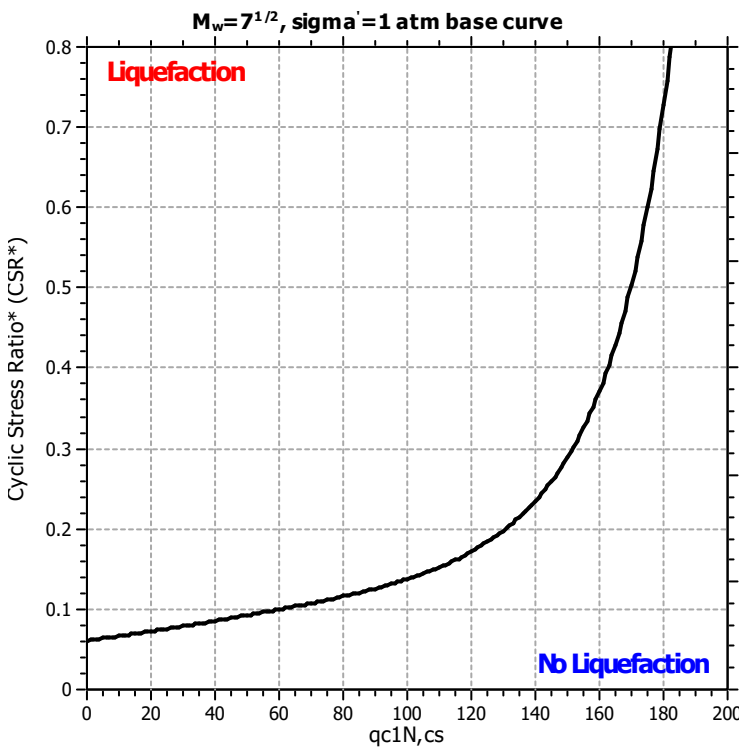
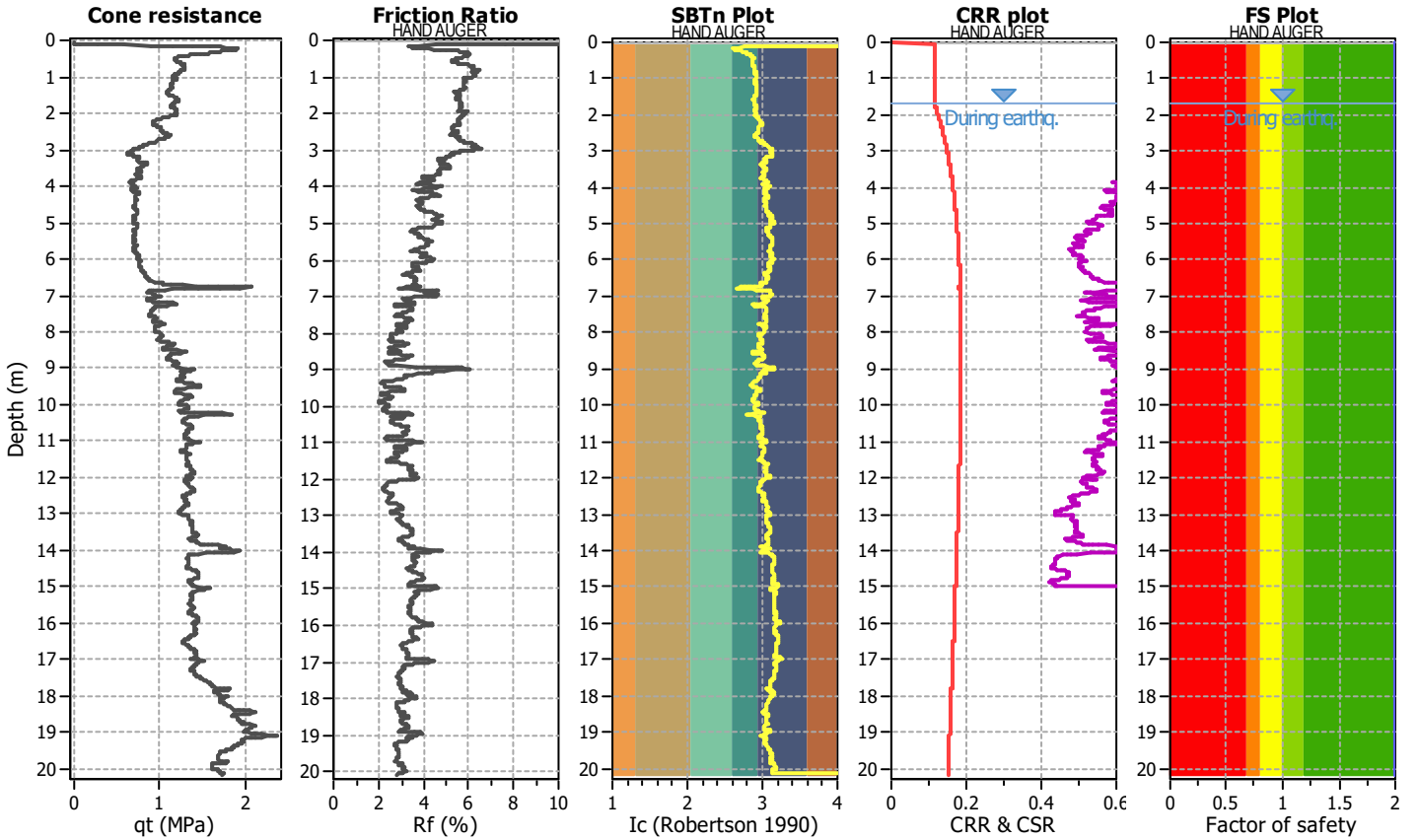
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT11-1/500**

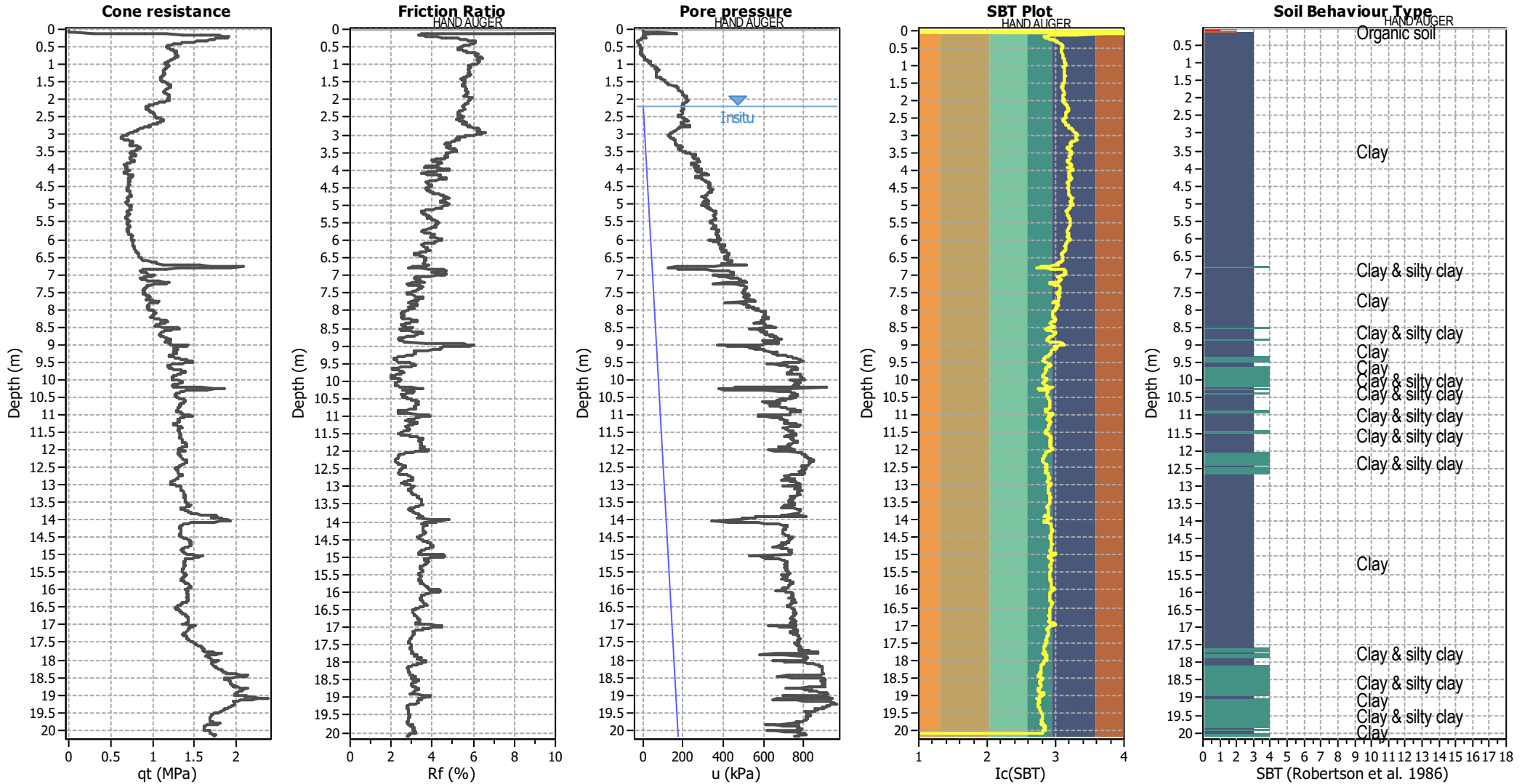
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

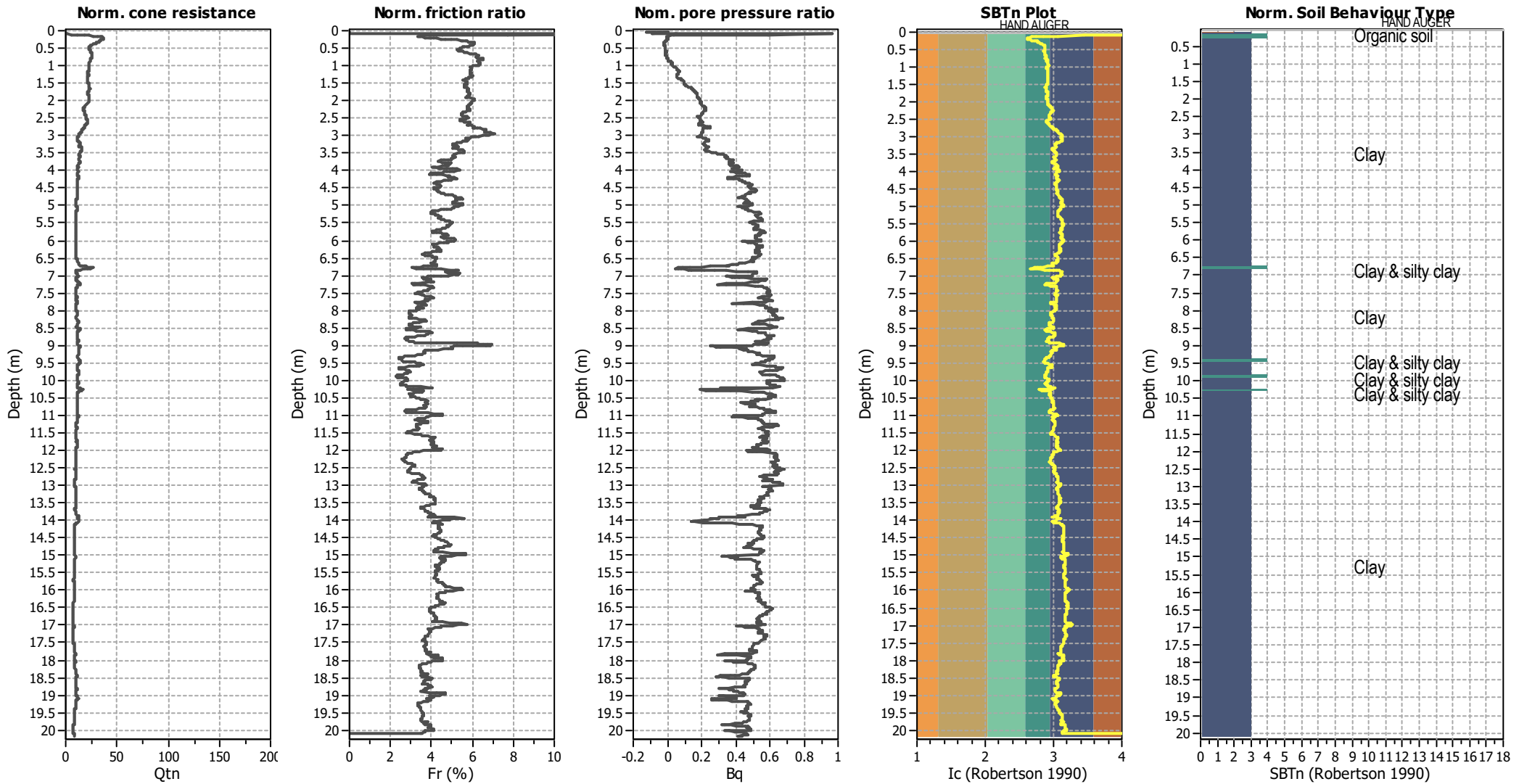
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



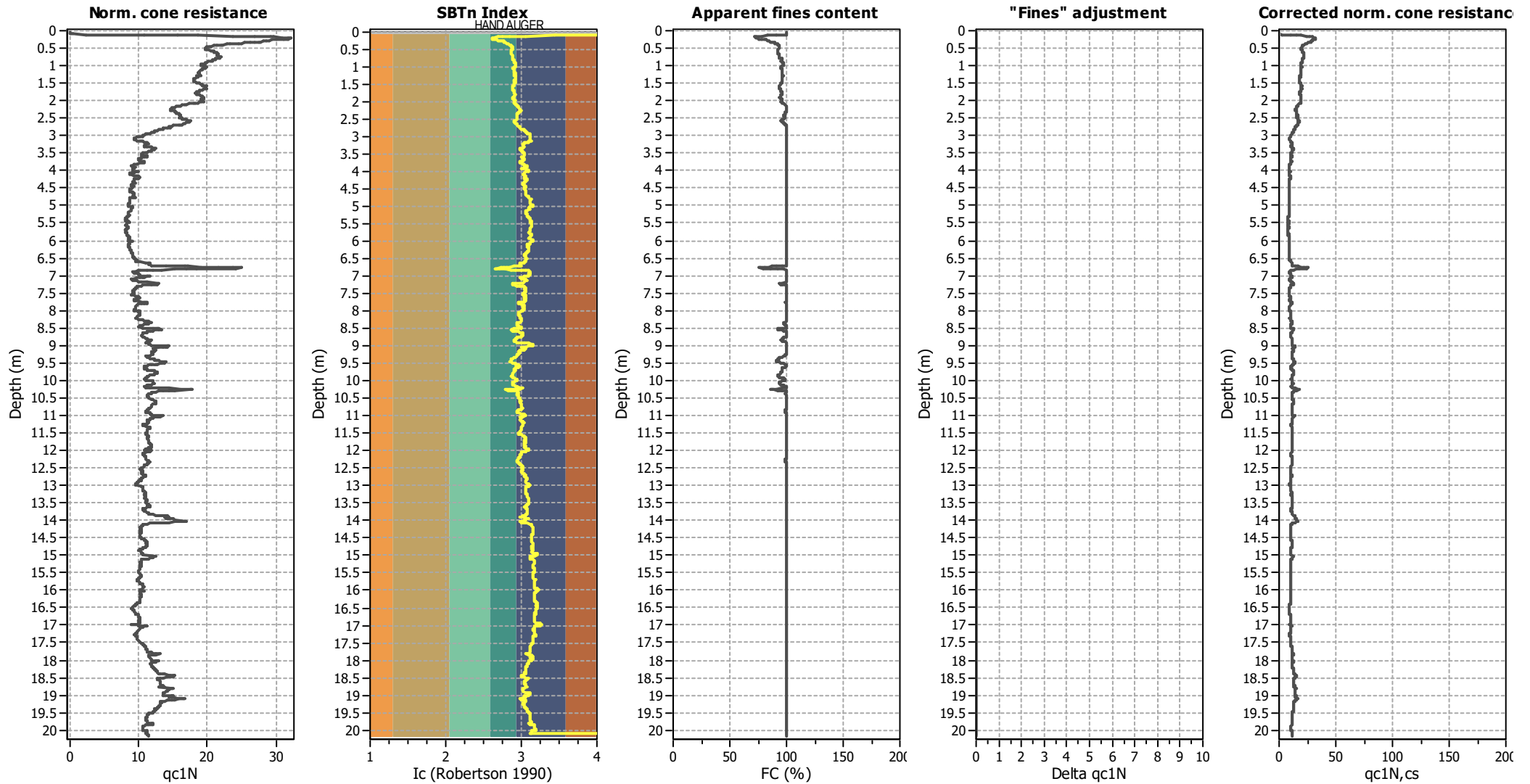
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

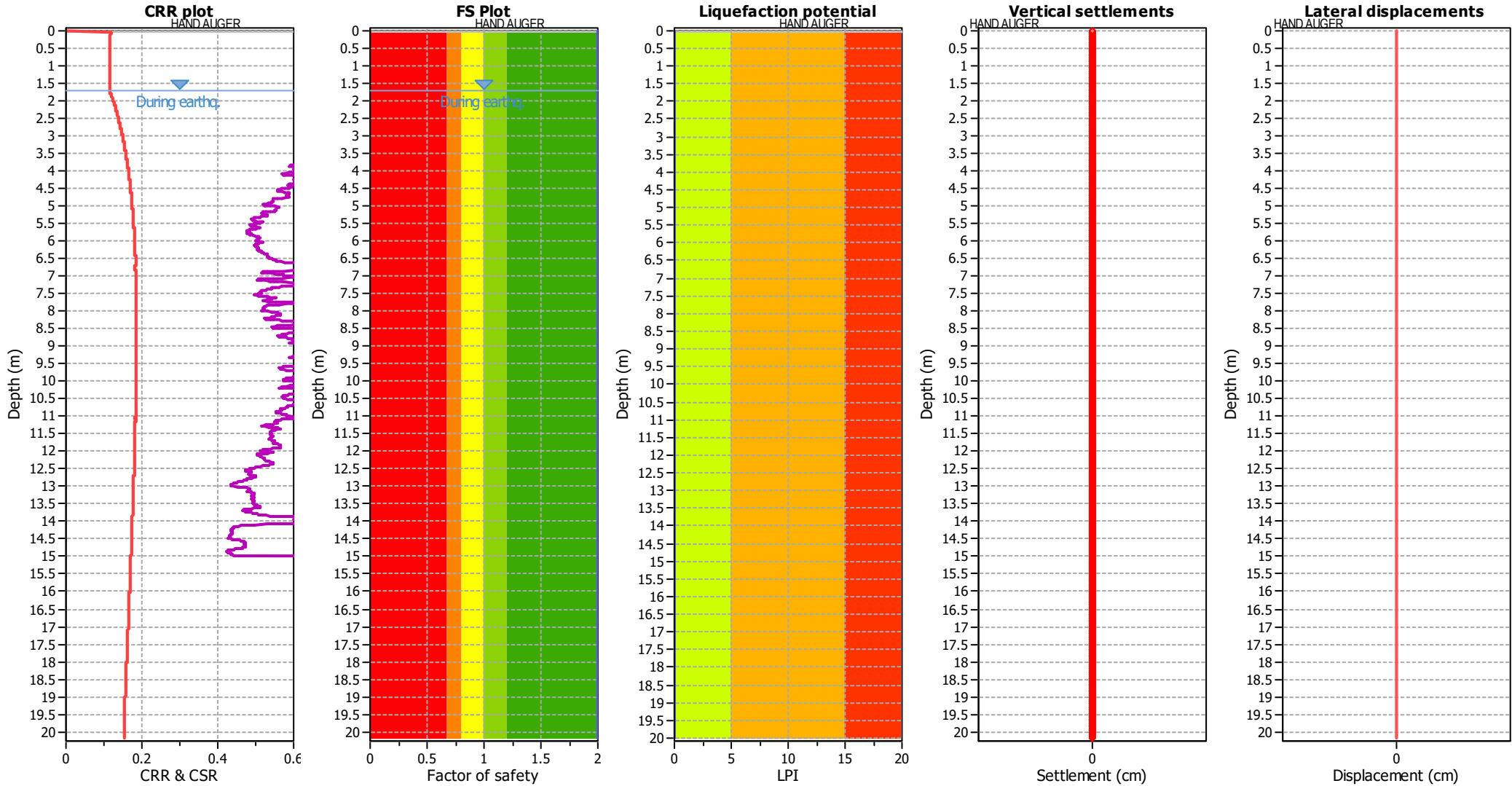
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

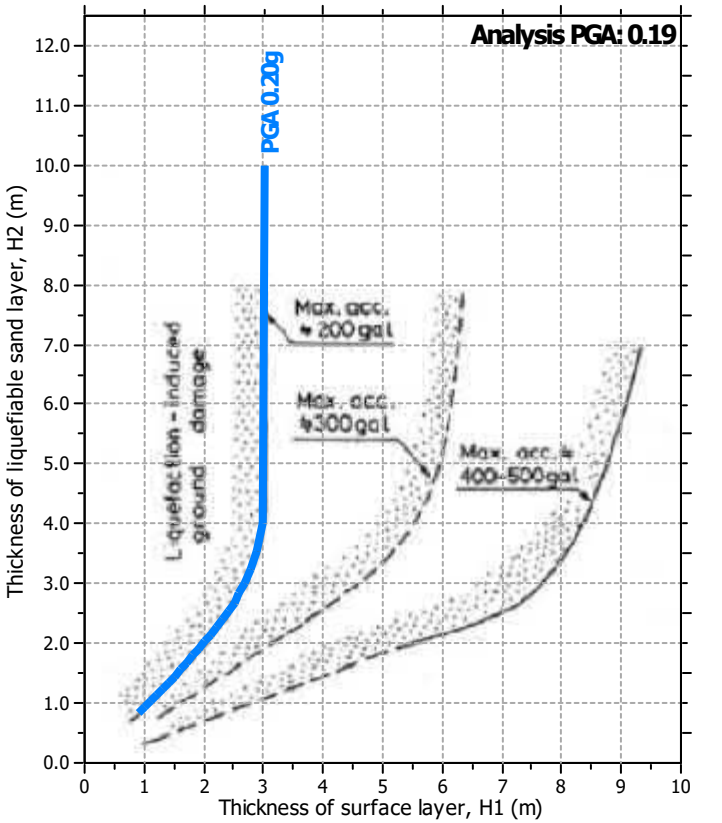
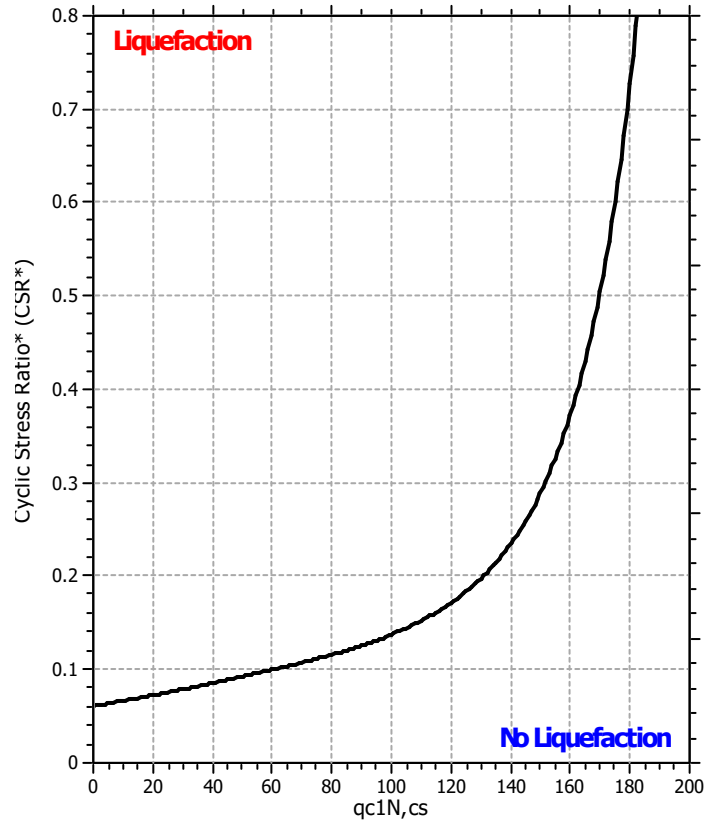
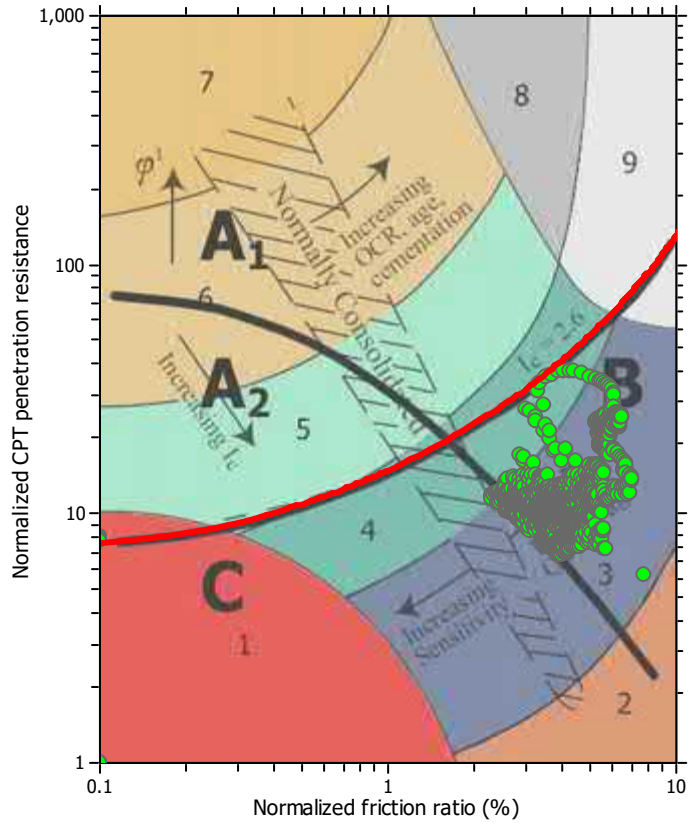
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m



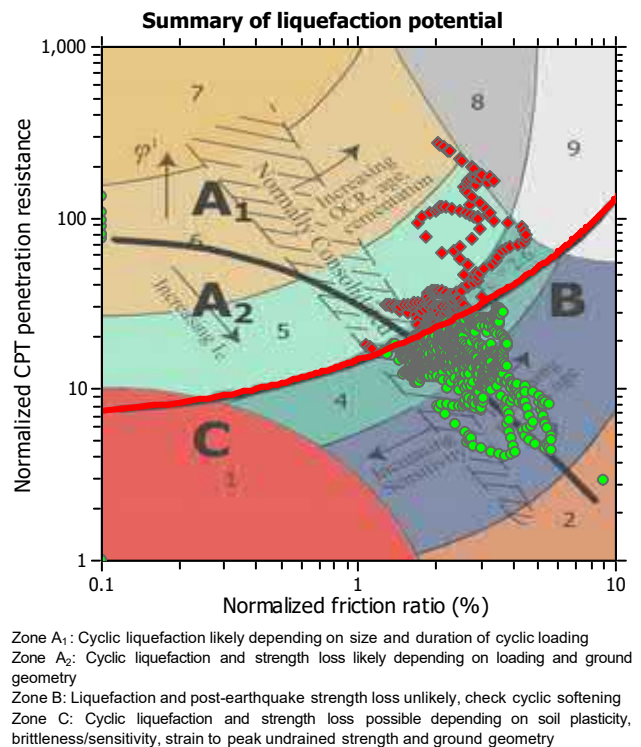
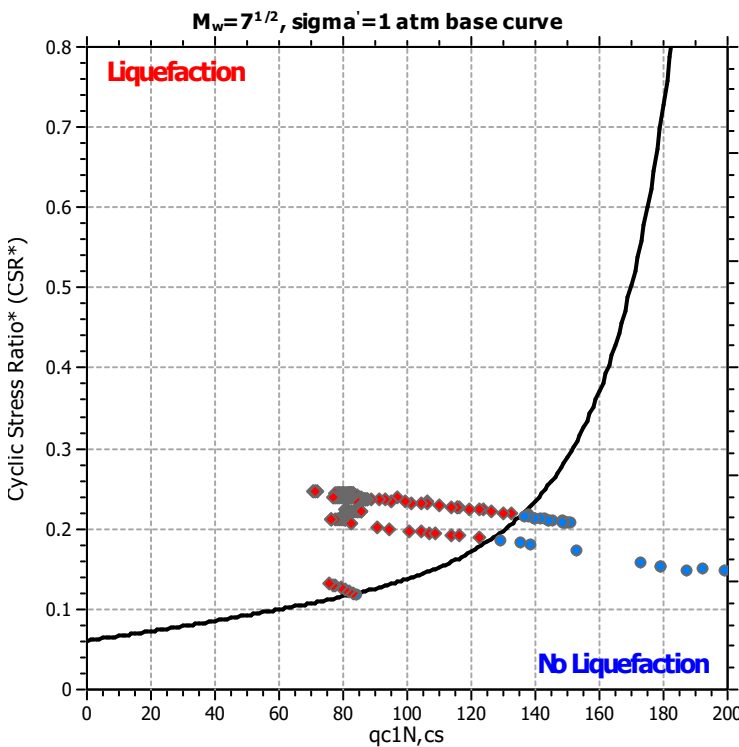
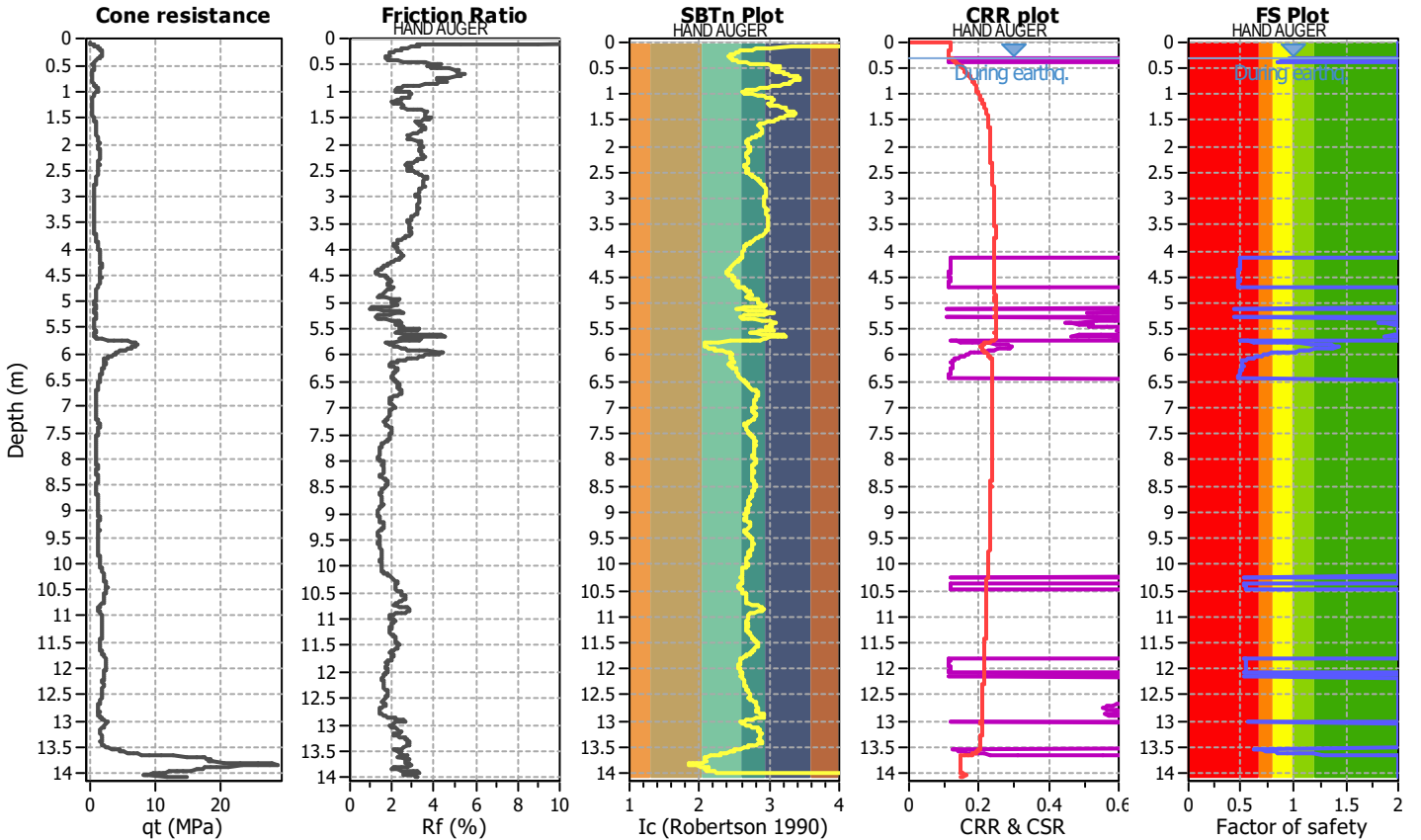
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT12-1/500**

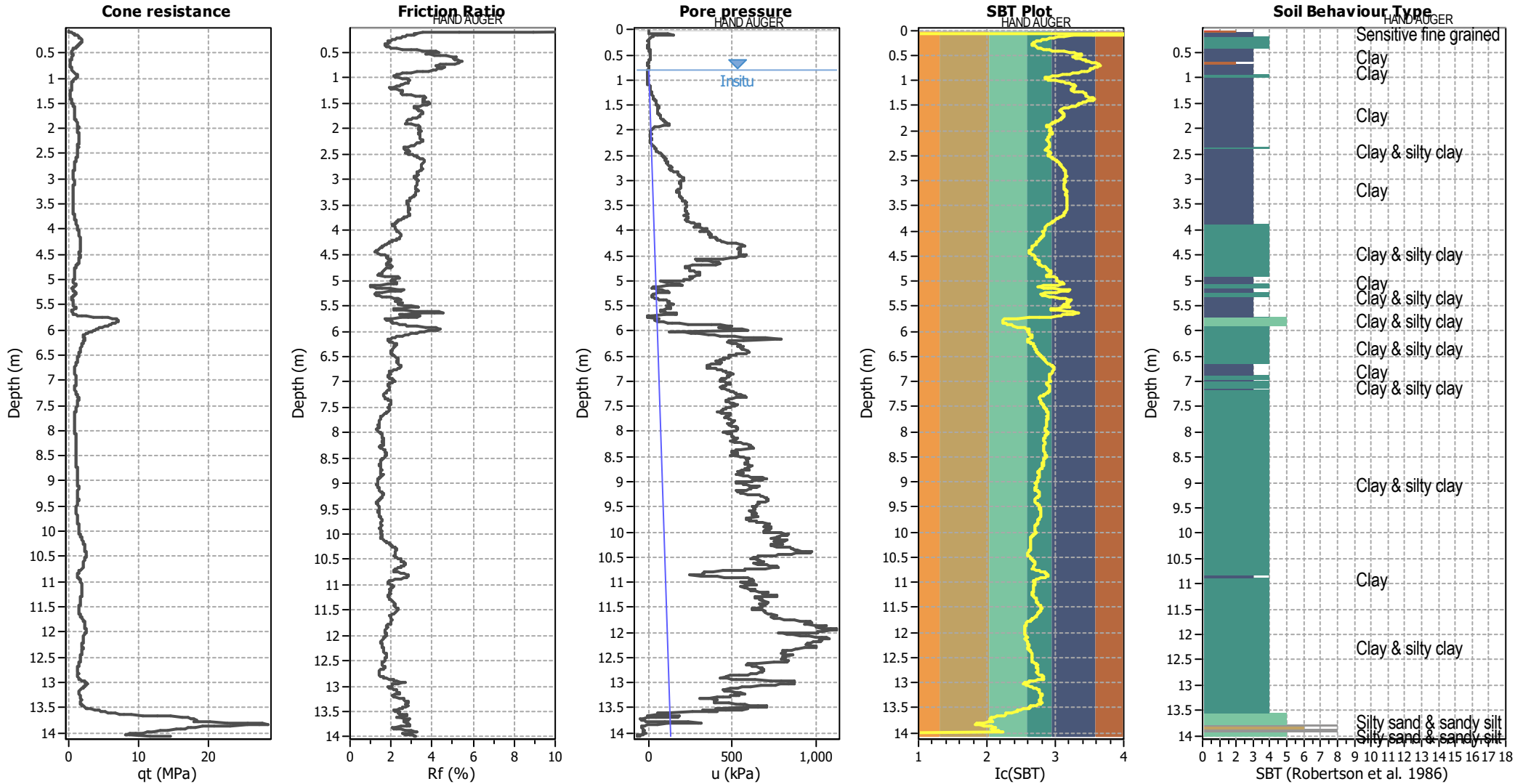
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



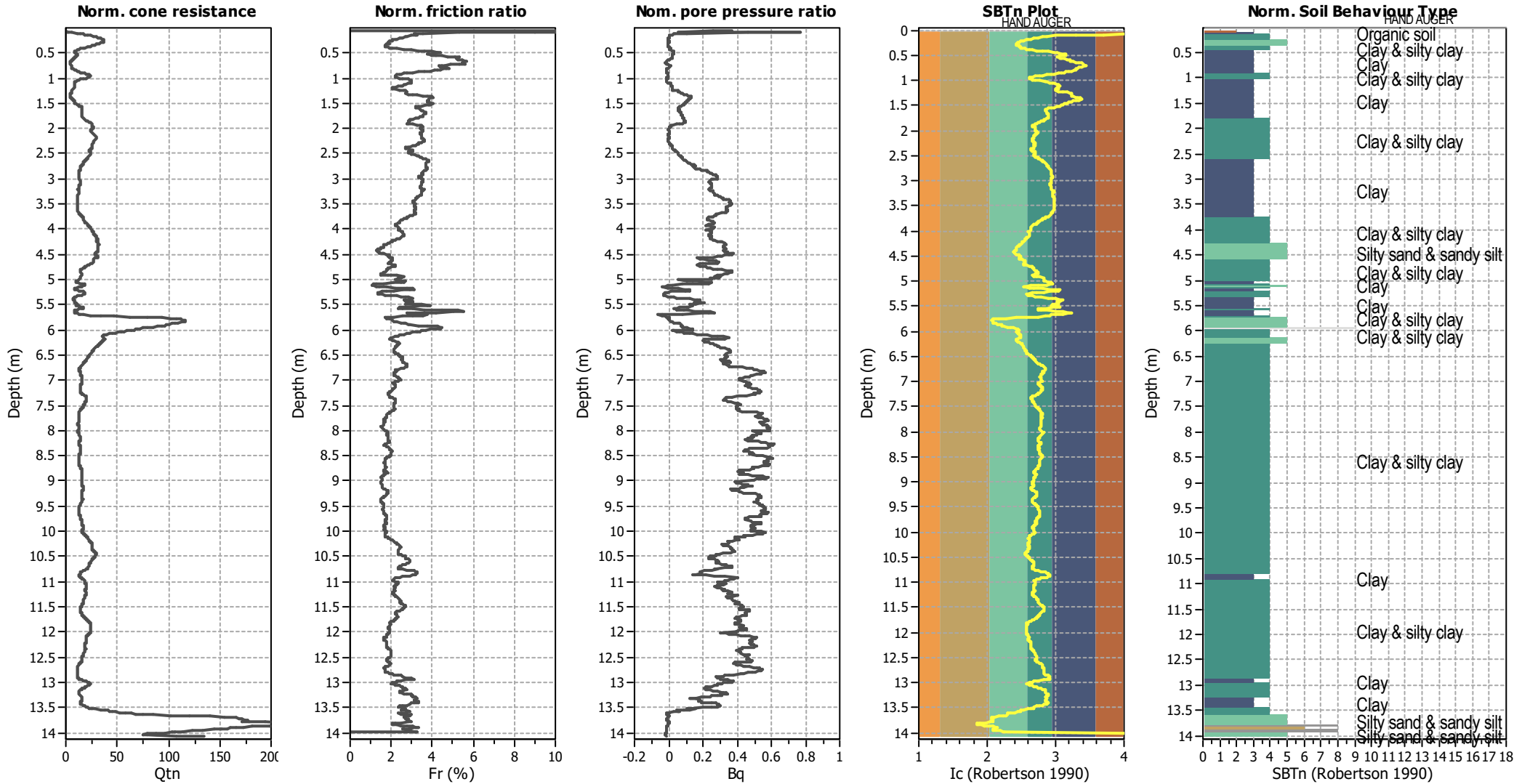
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



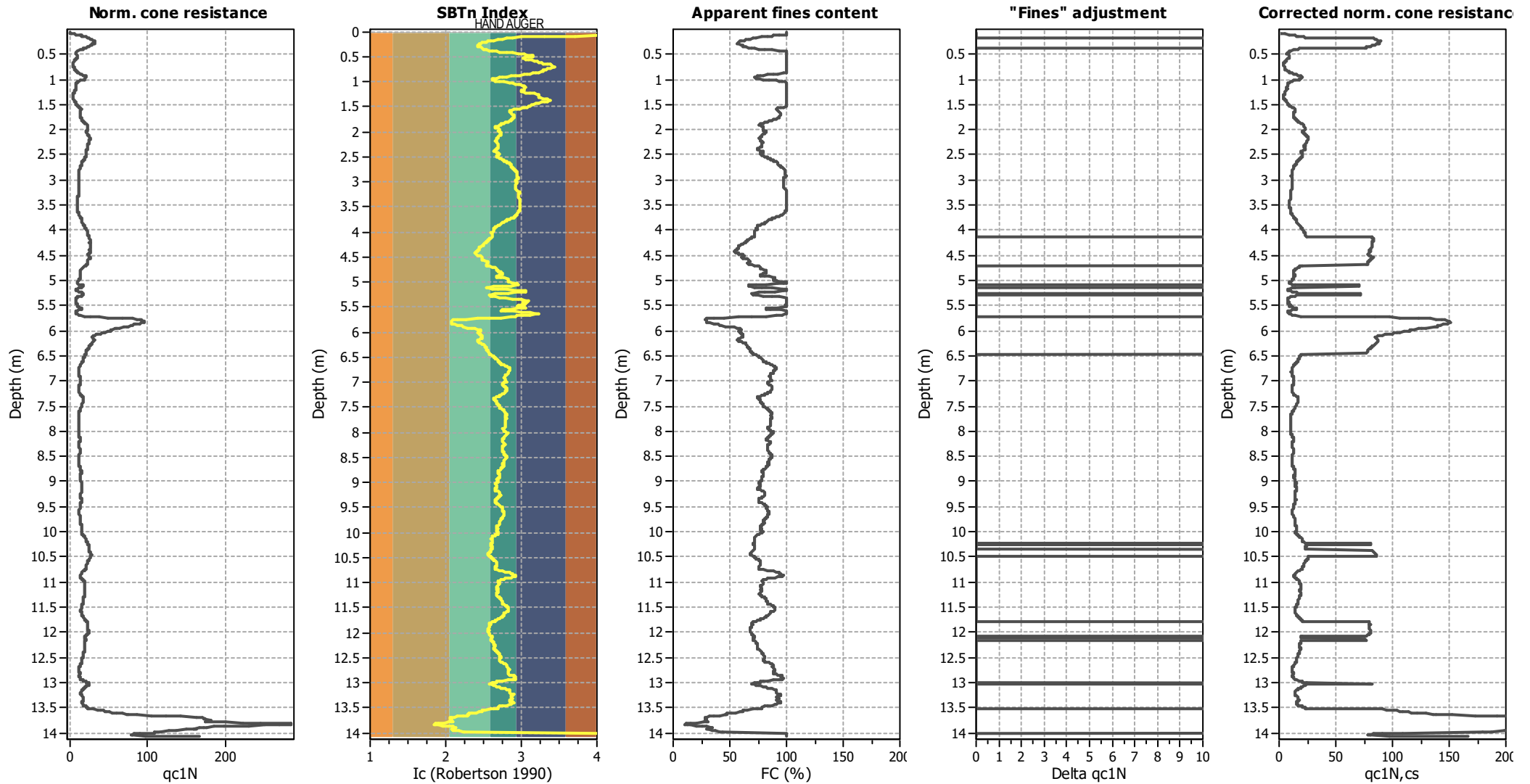
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

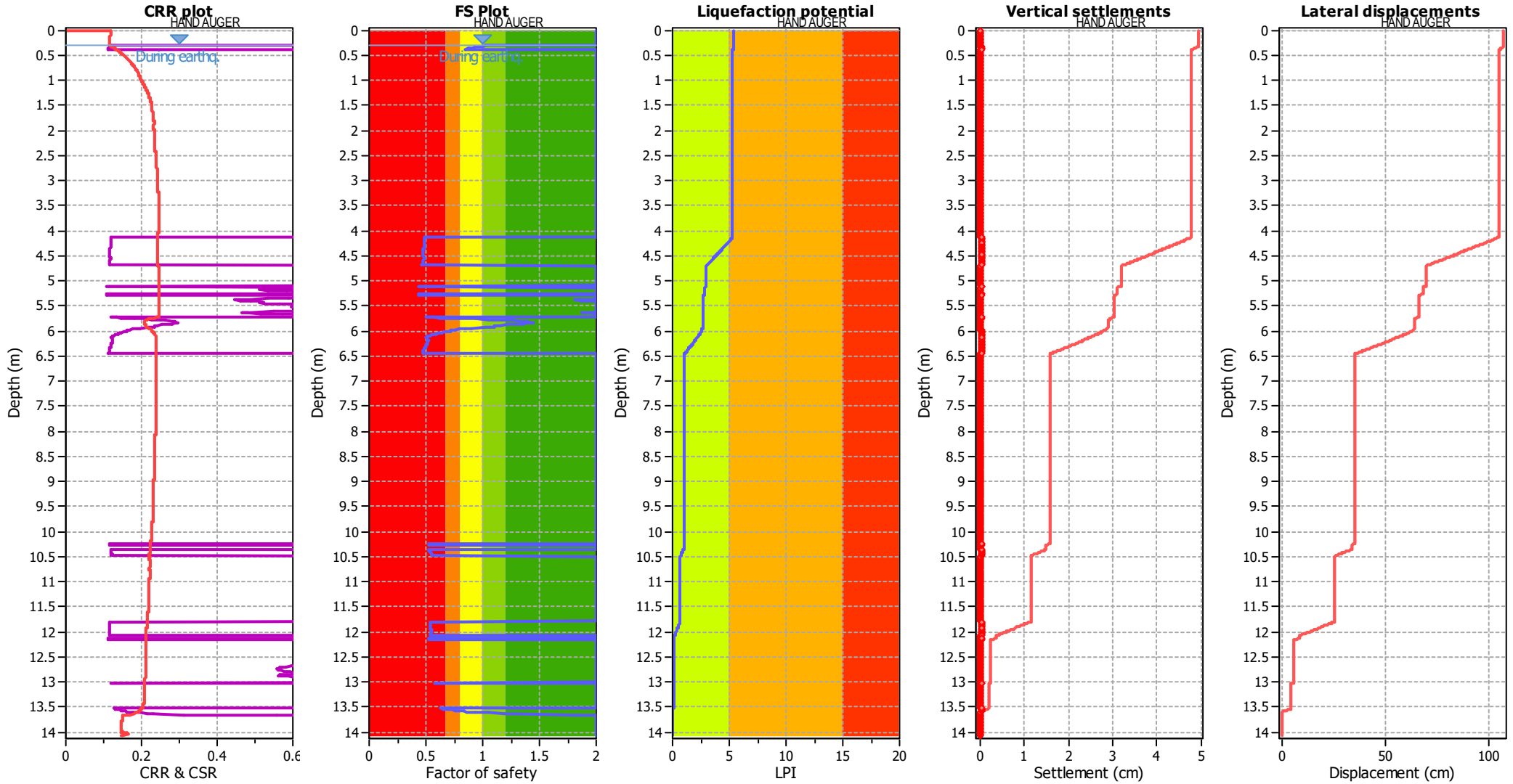


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWL (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_o$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

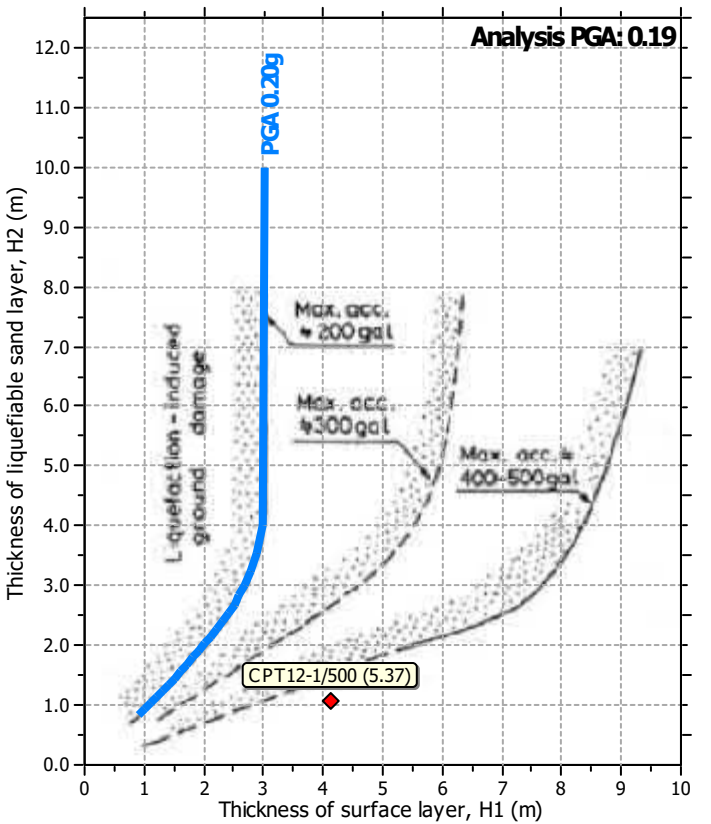
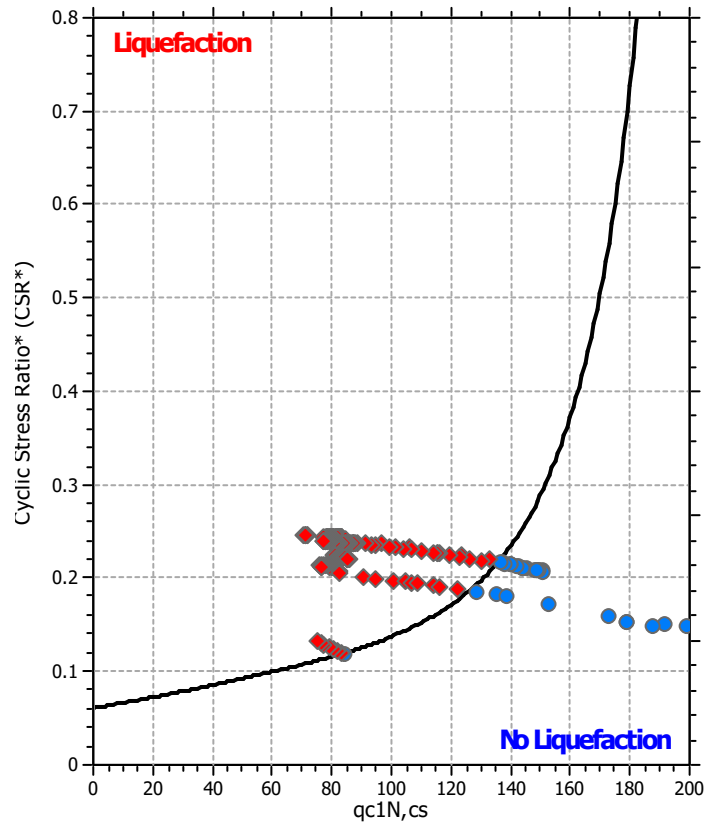
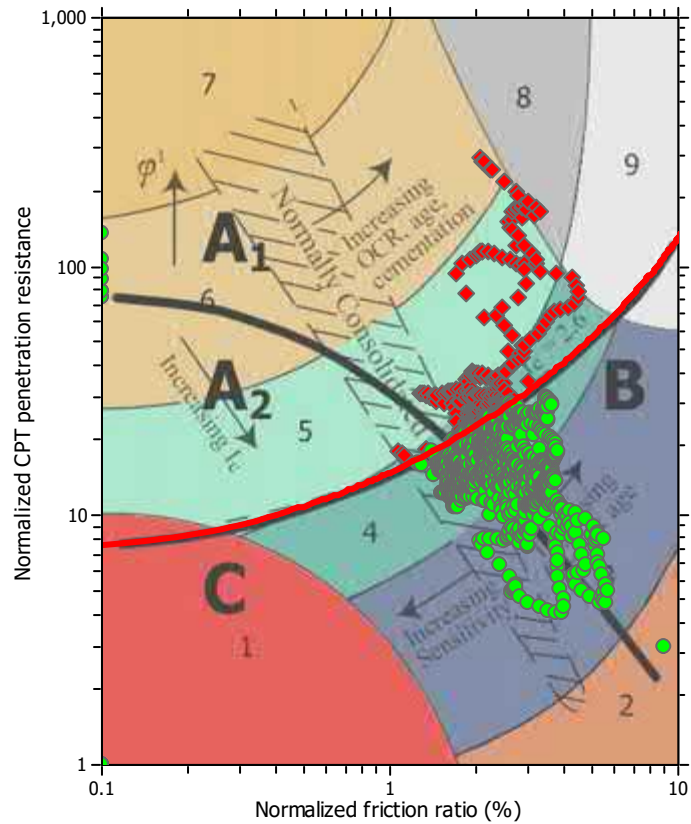
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

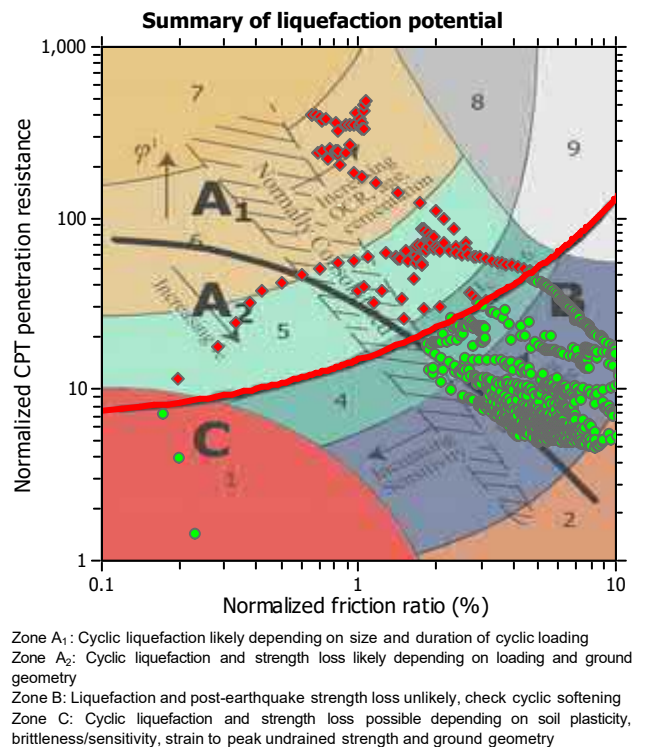
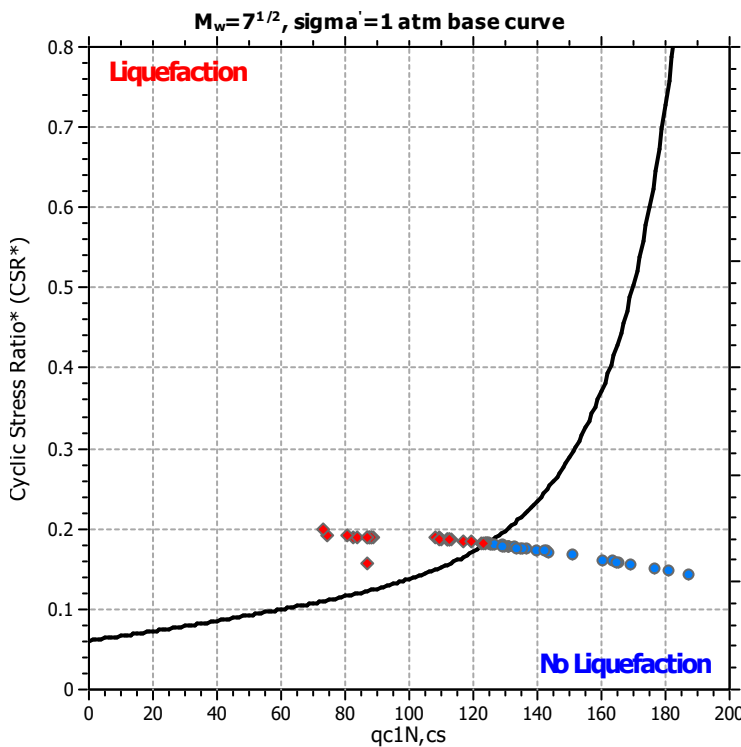
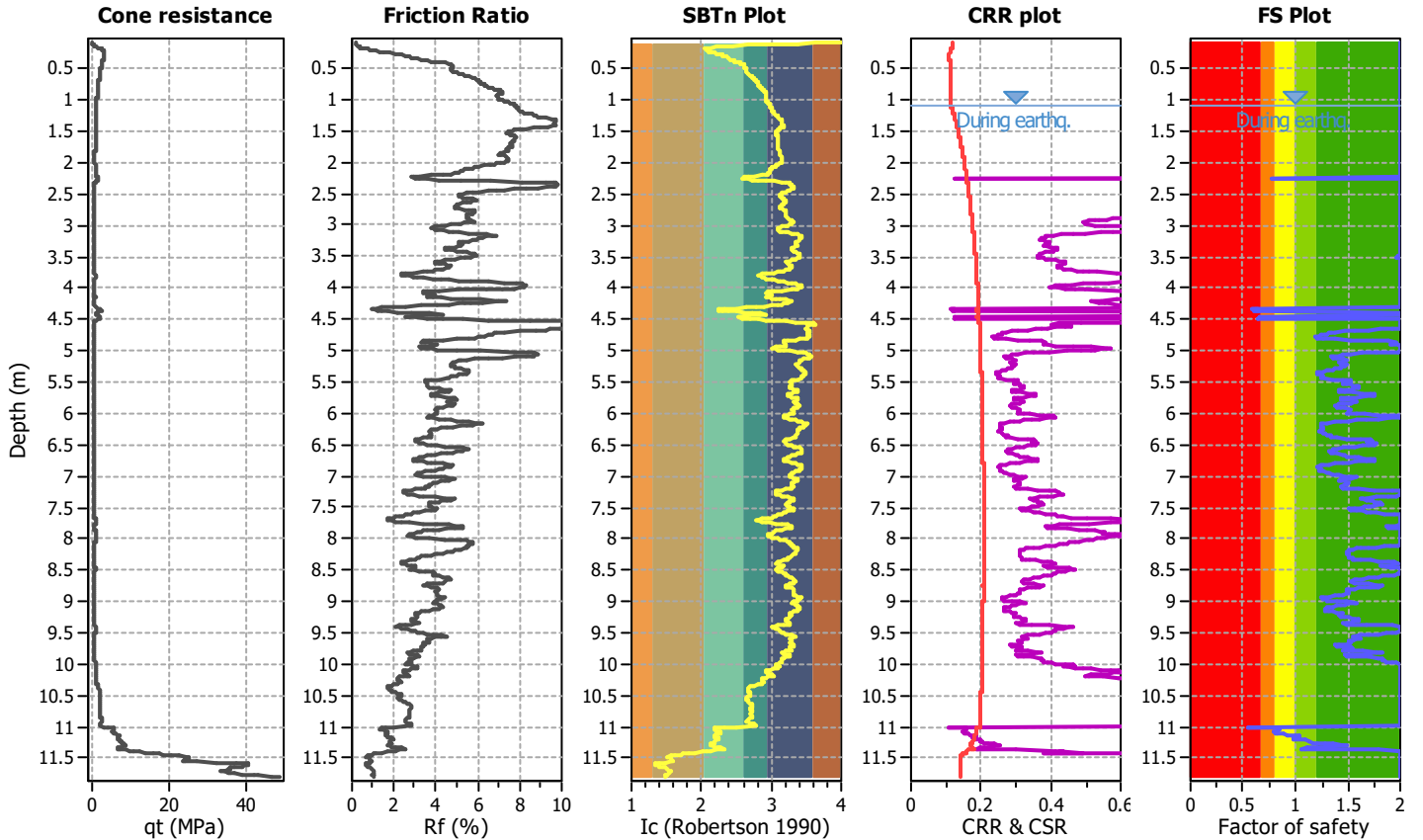
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT13-1/500**

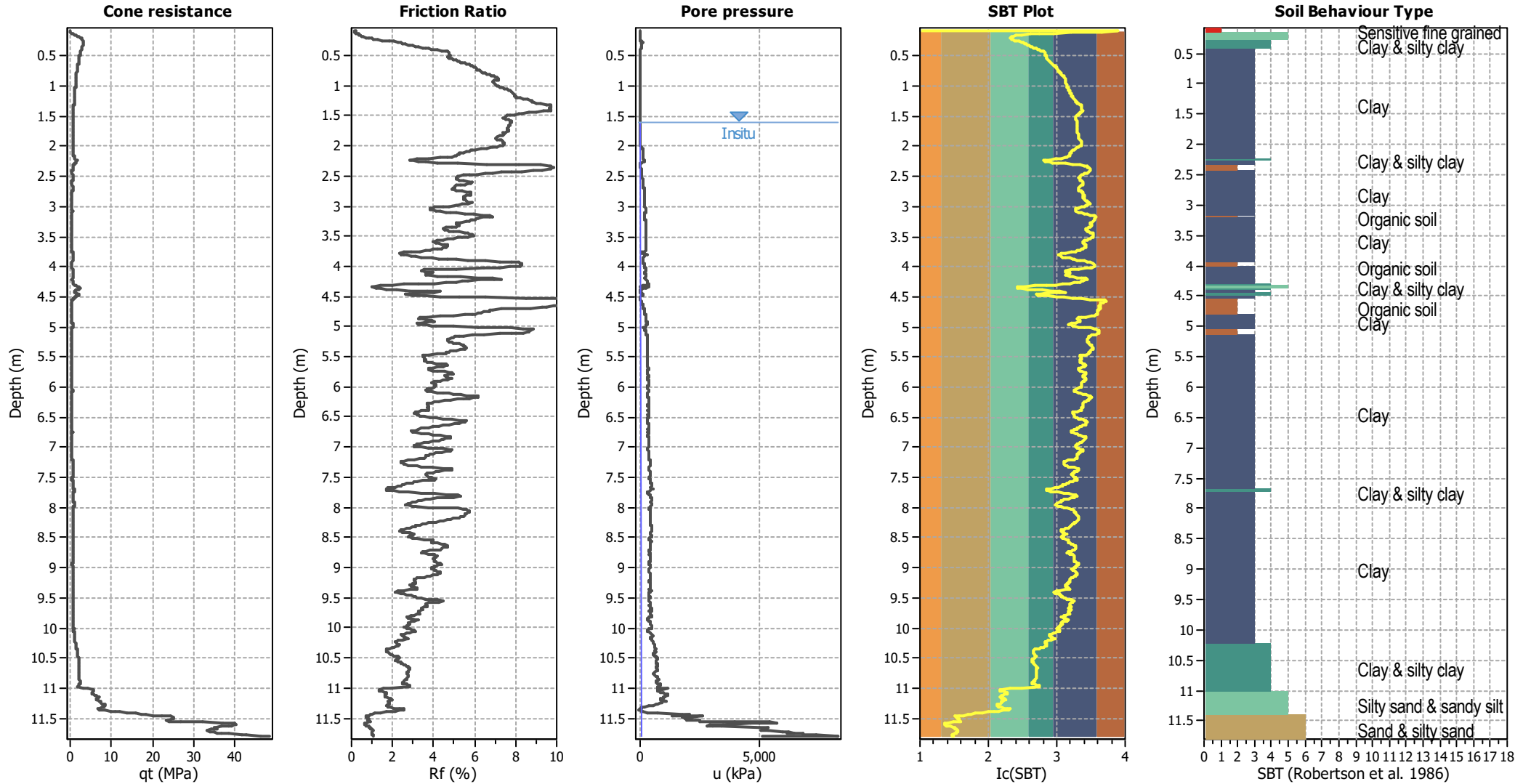
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.10 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

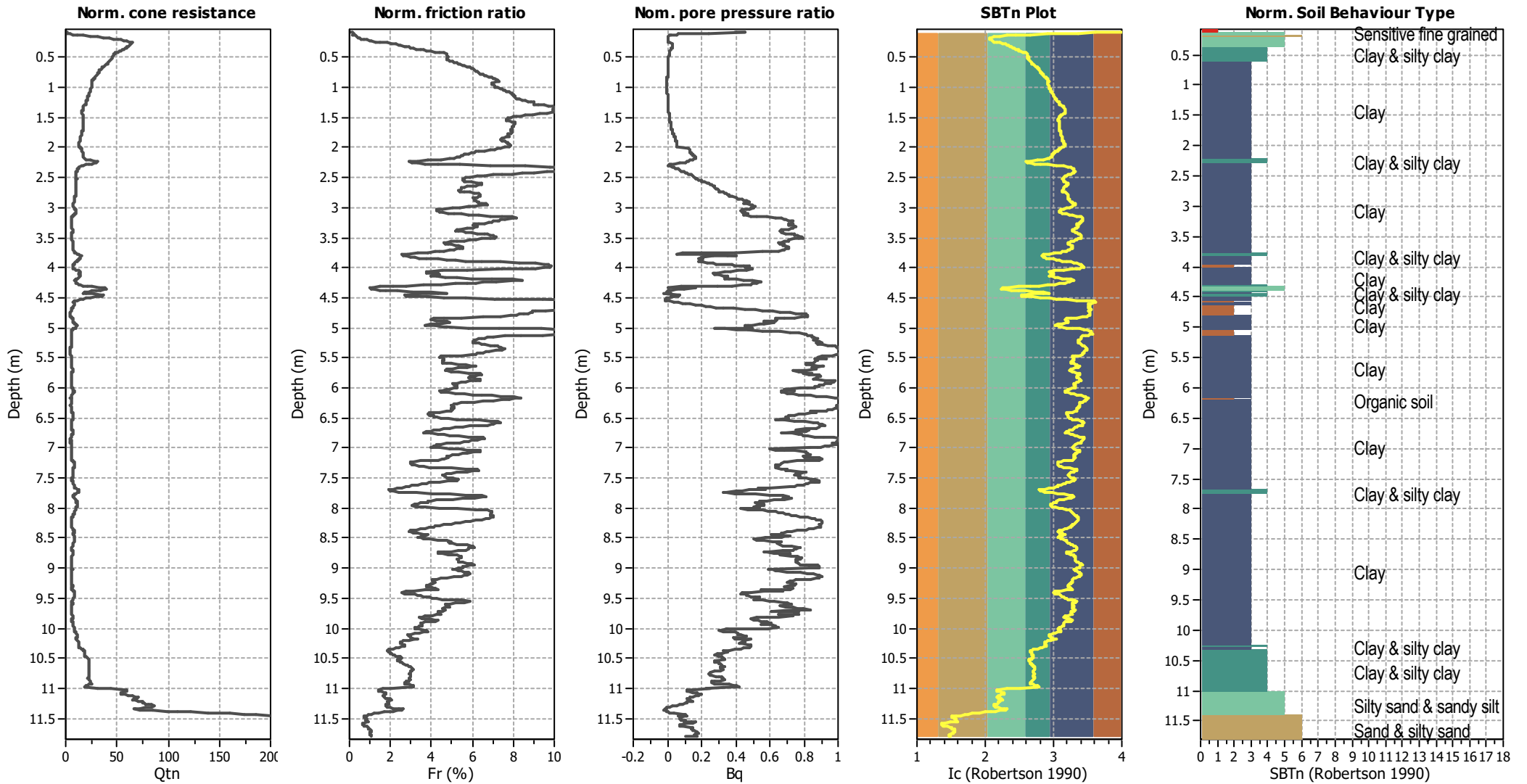
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



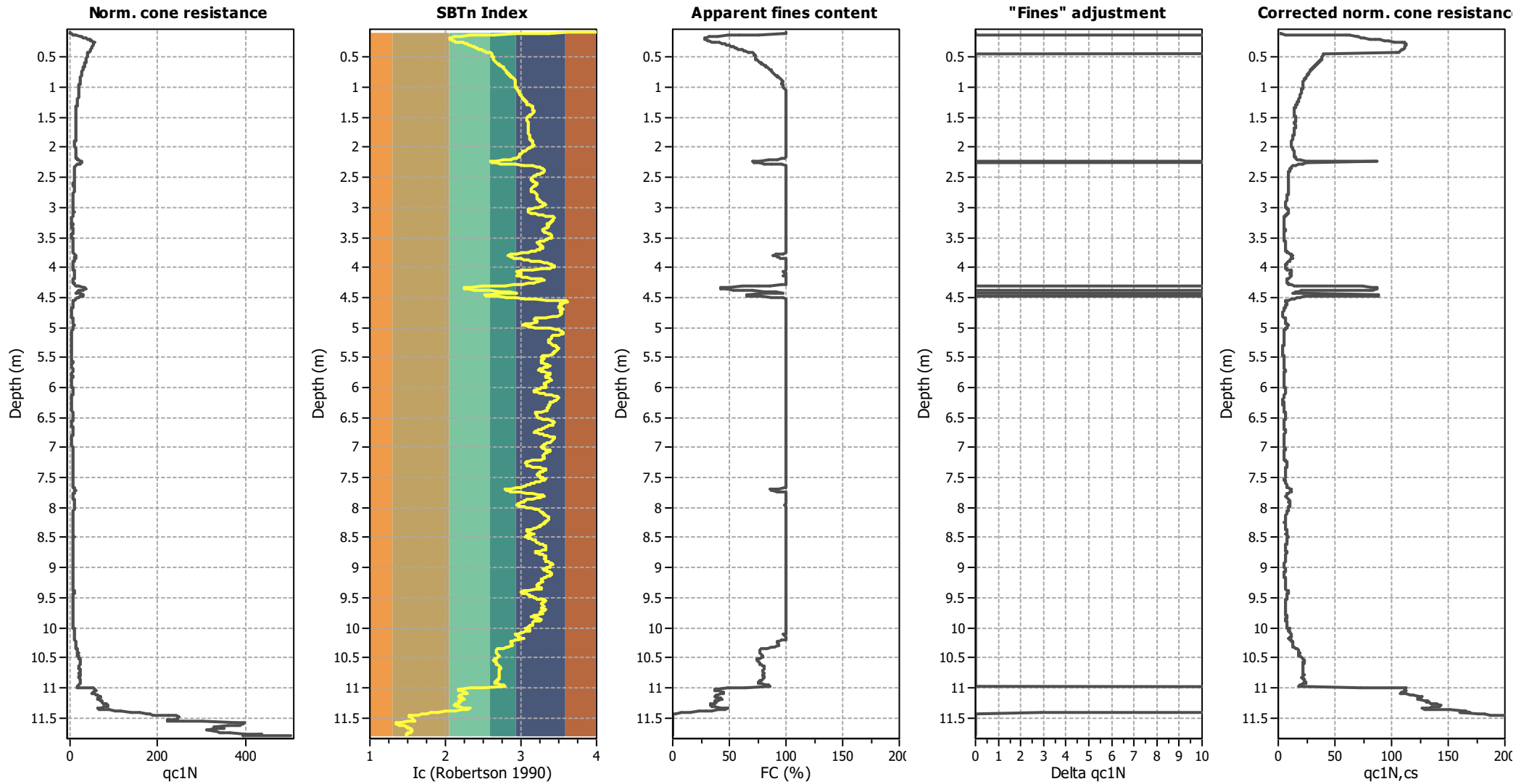
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

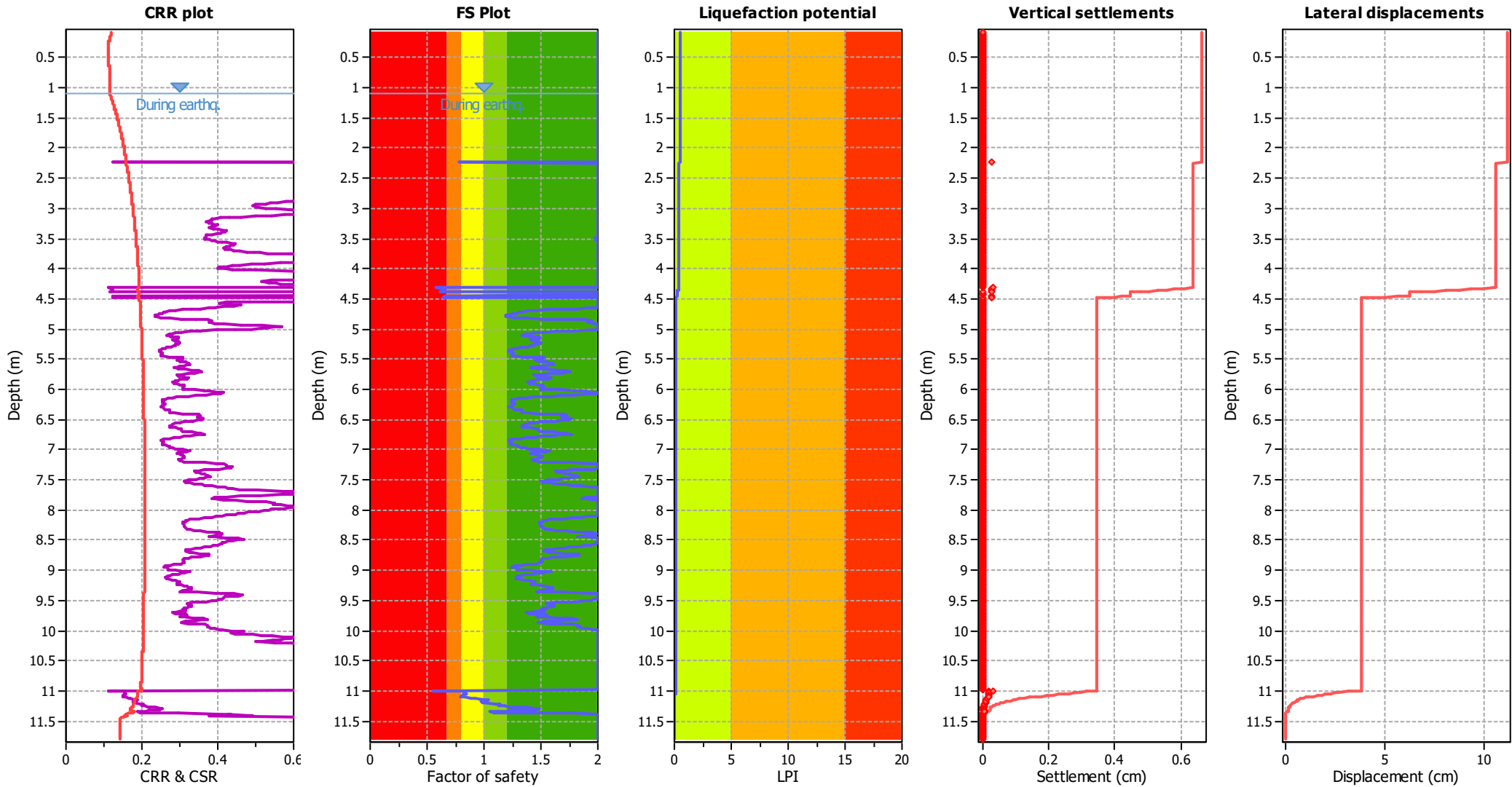
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

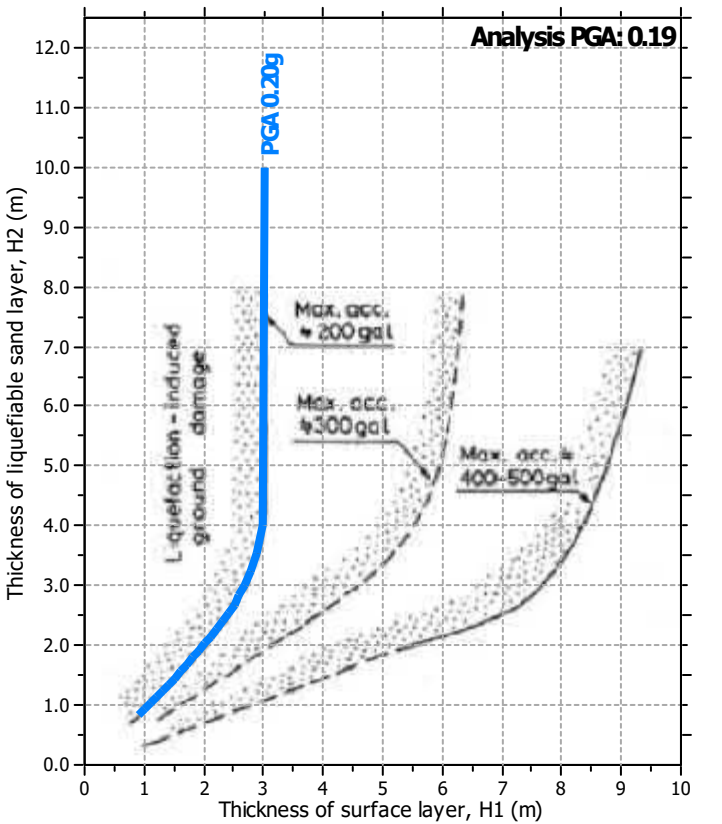
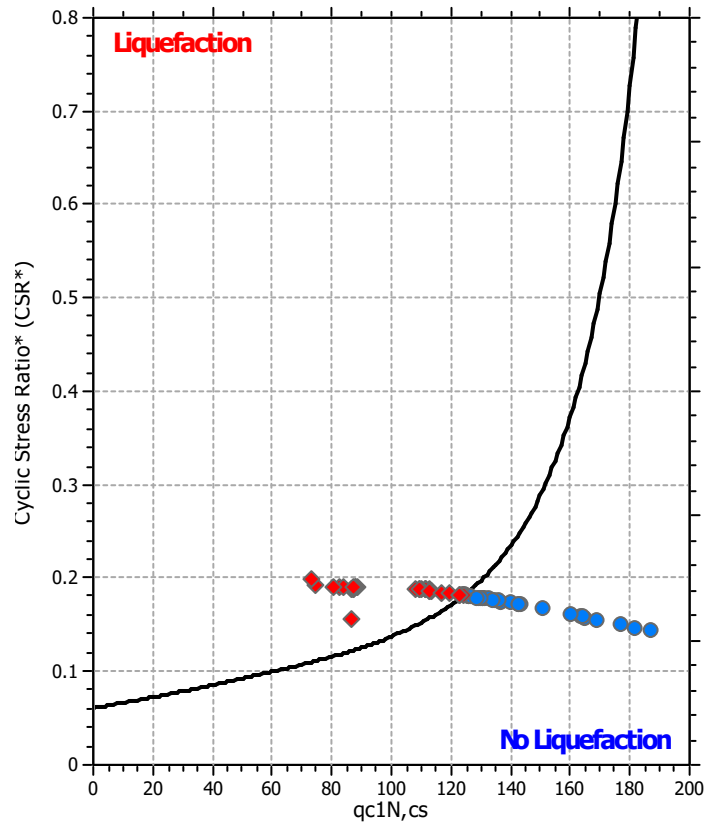
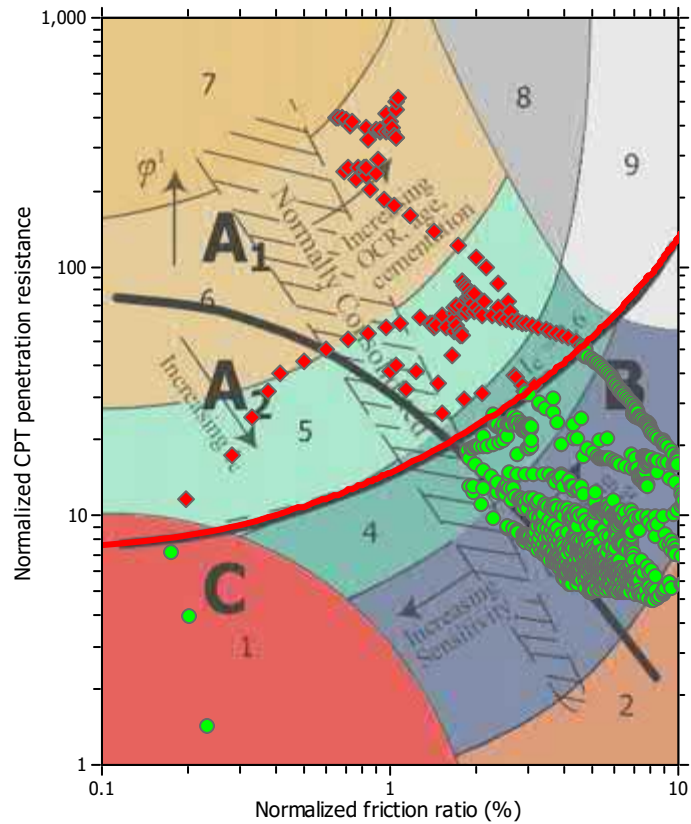
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A



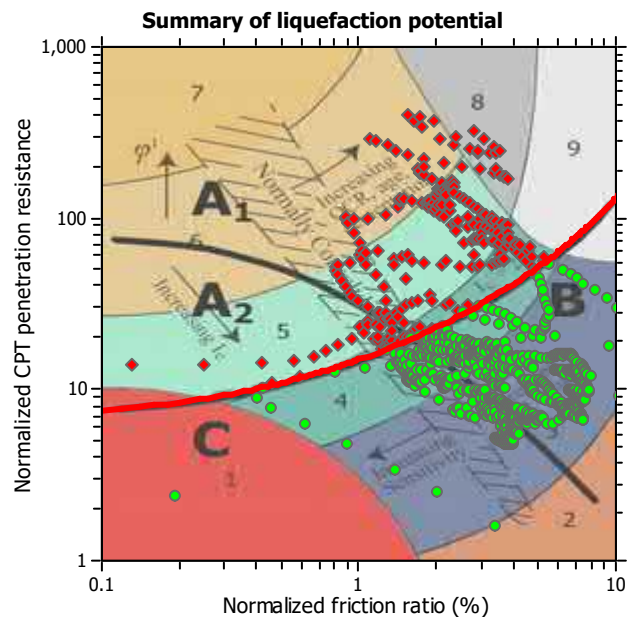
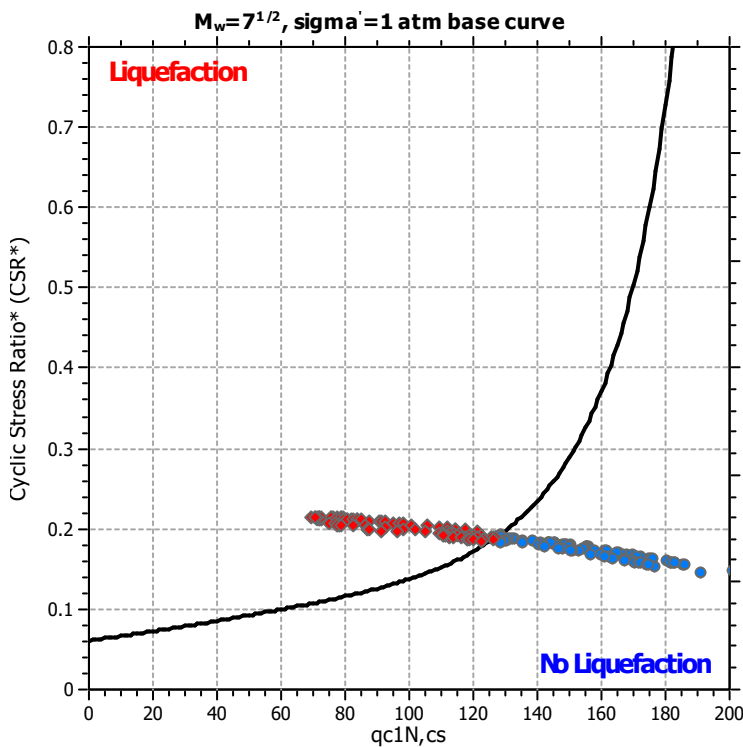
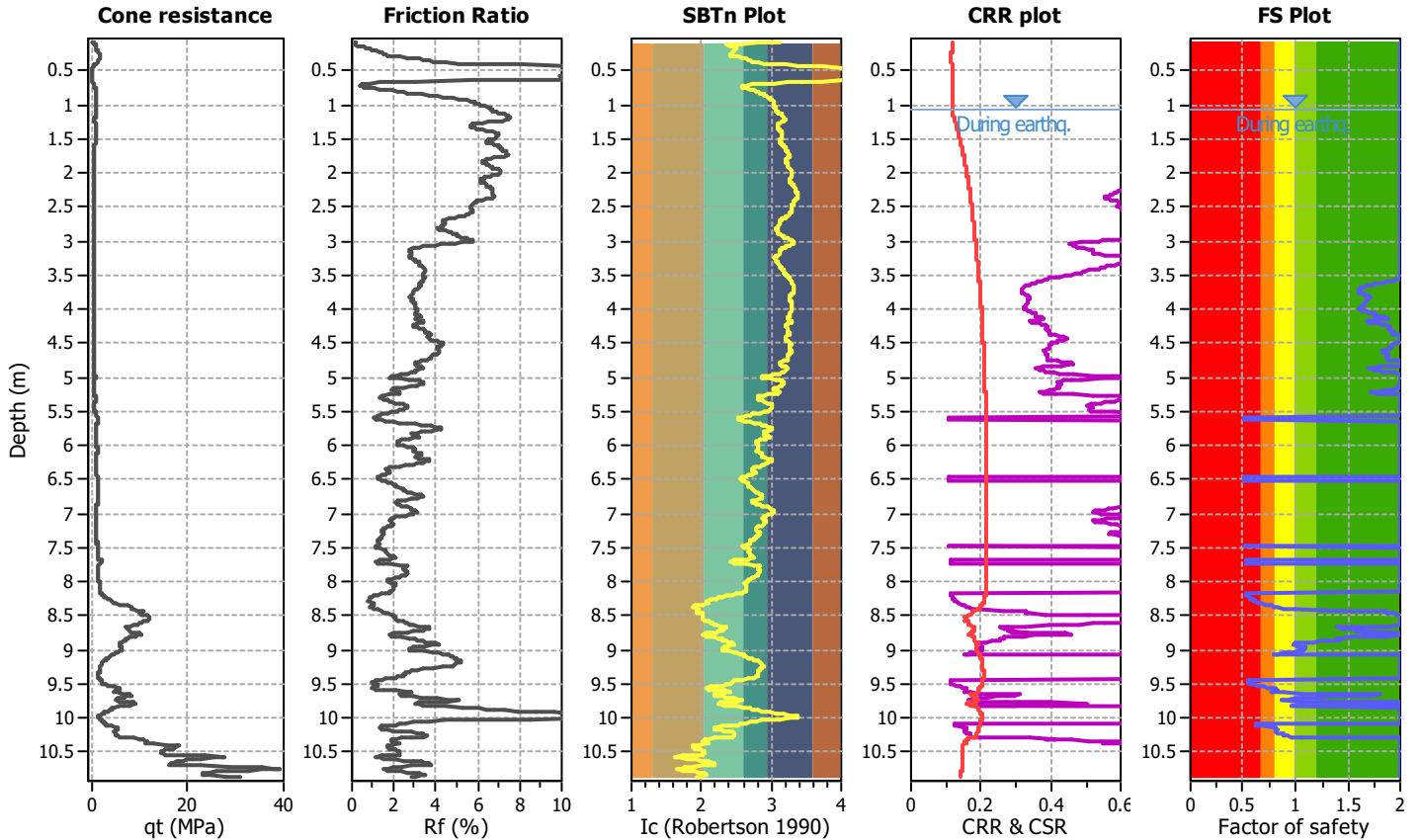
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT14-1/500**

**Location : 48 Valerie Close, Warkworth**

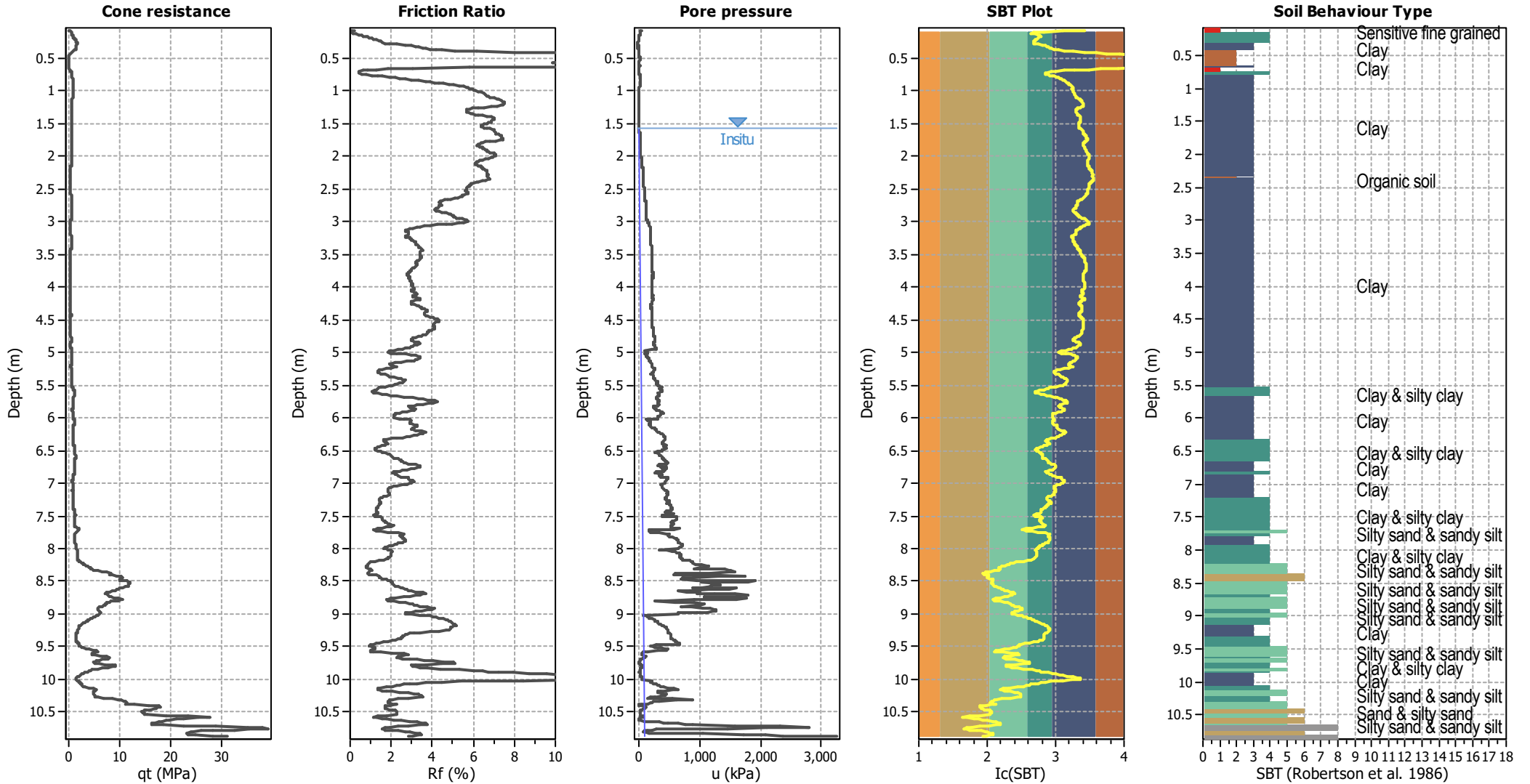
**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.58 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.08 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading  
 Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground geometry  
 Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening  
 Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

### CPT basic interpretation plots



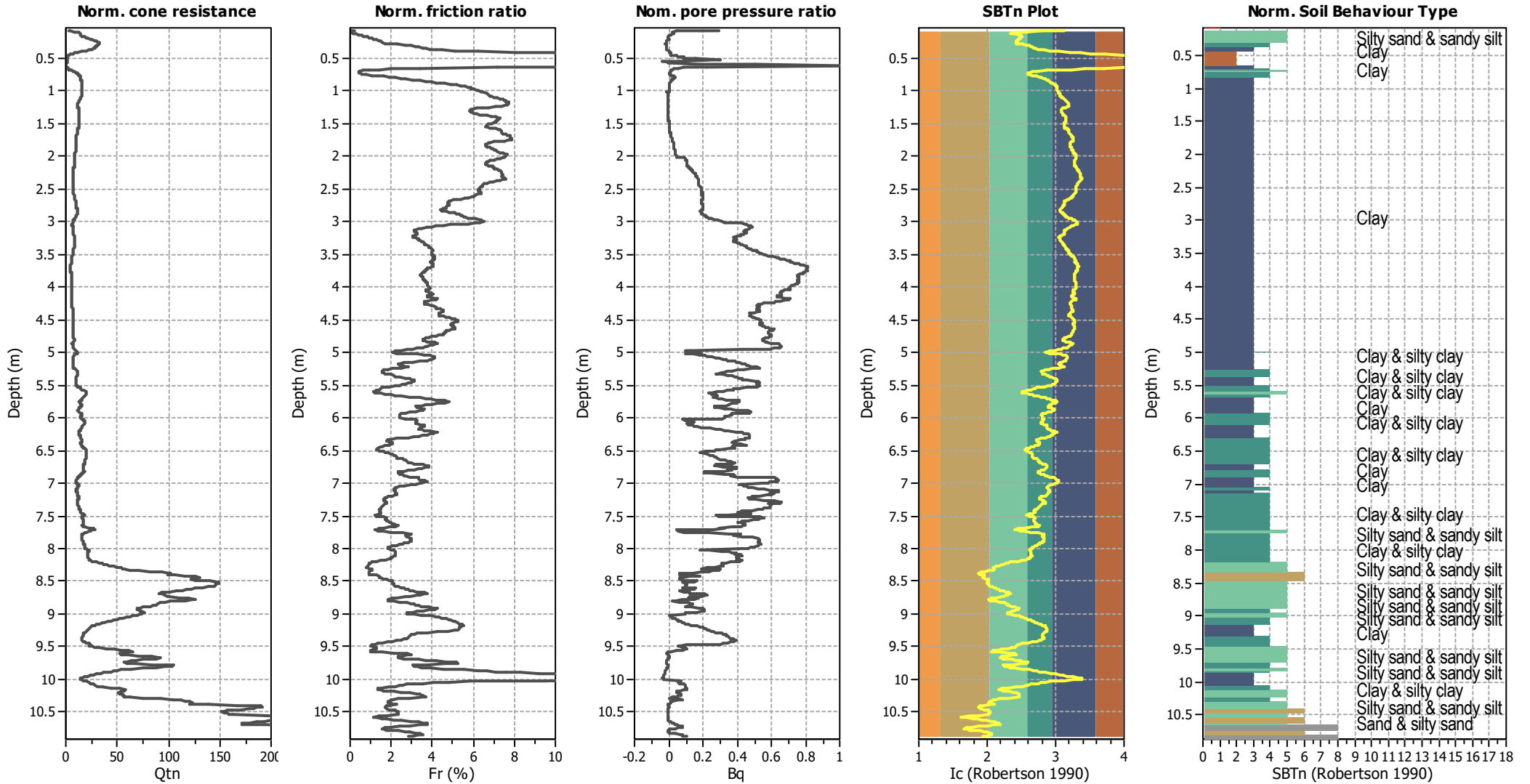
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



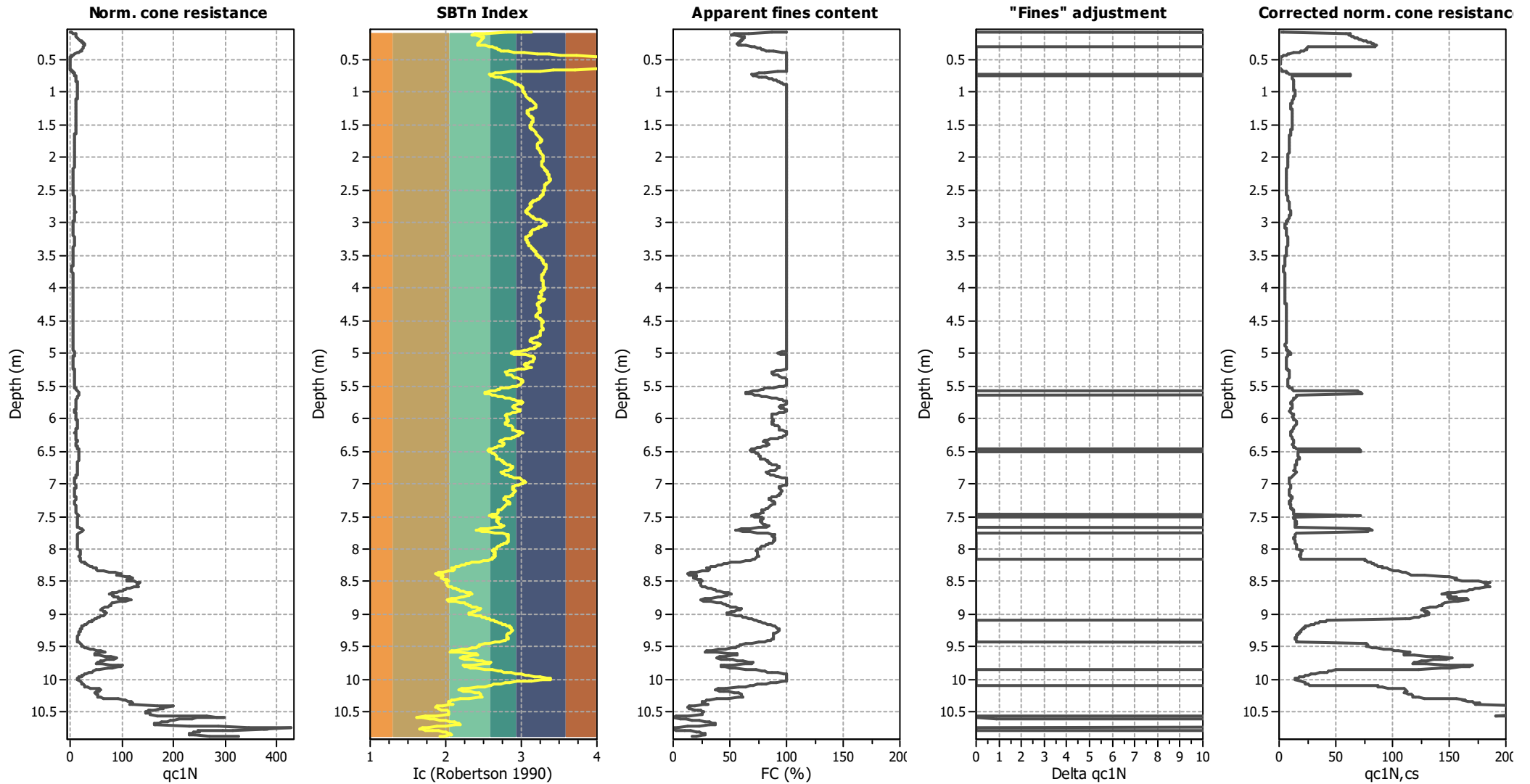
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

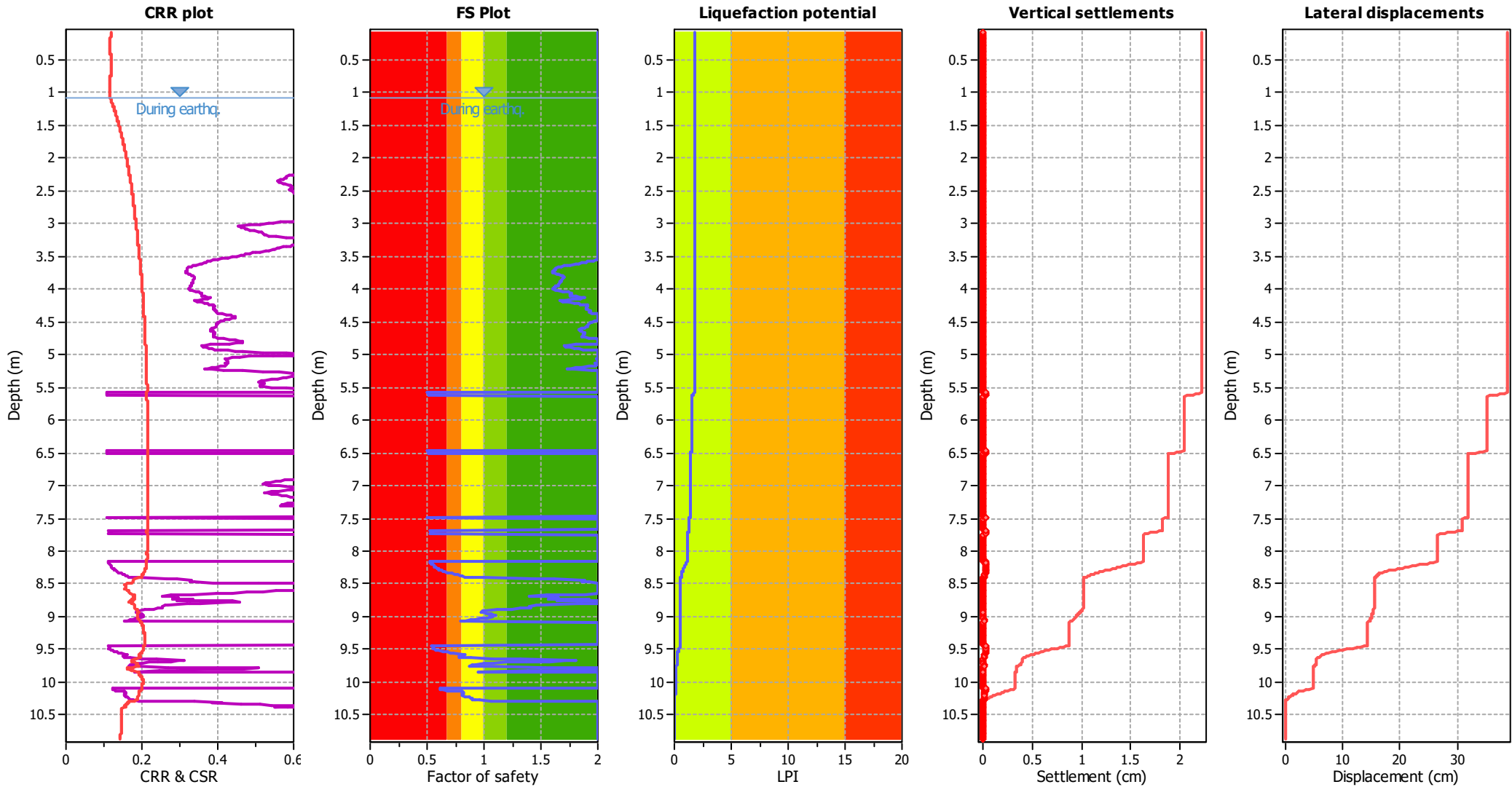


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

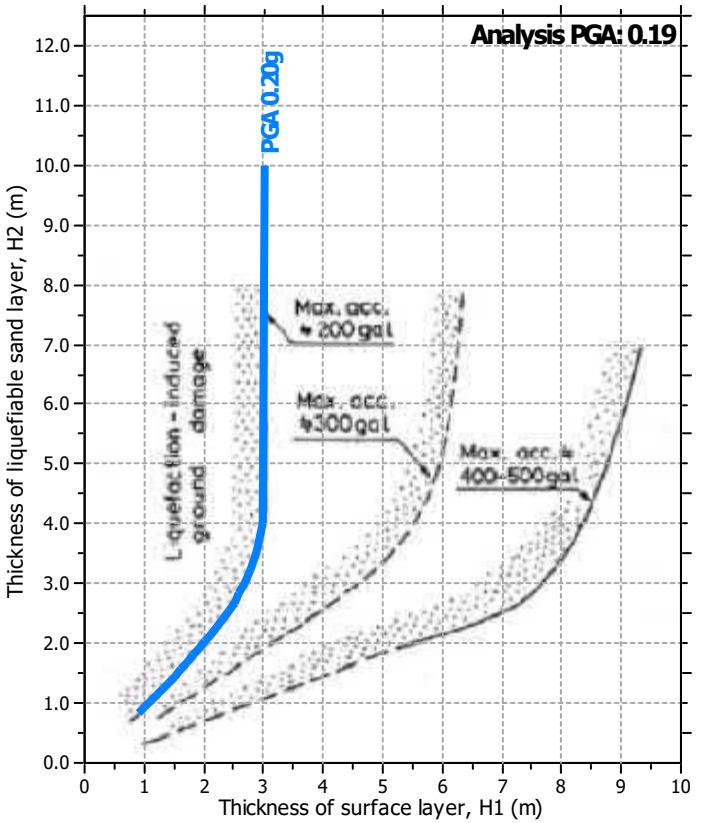
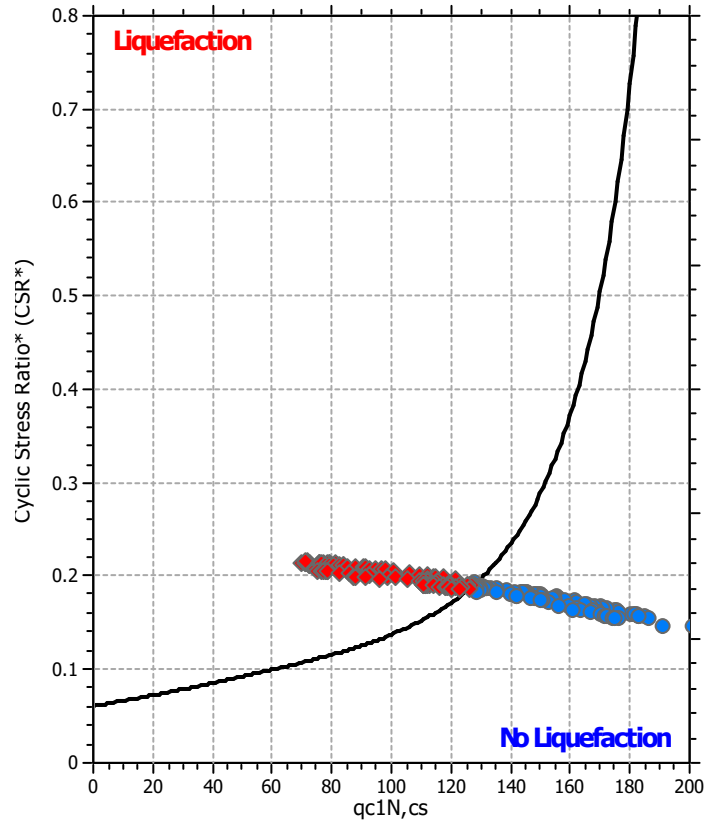
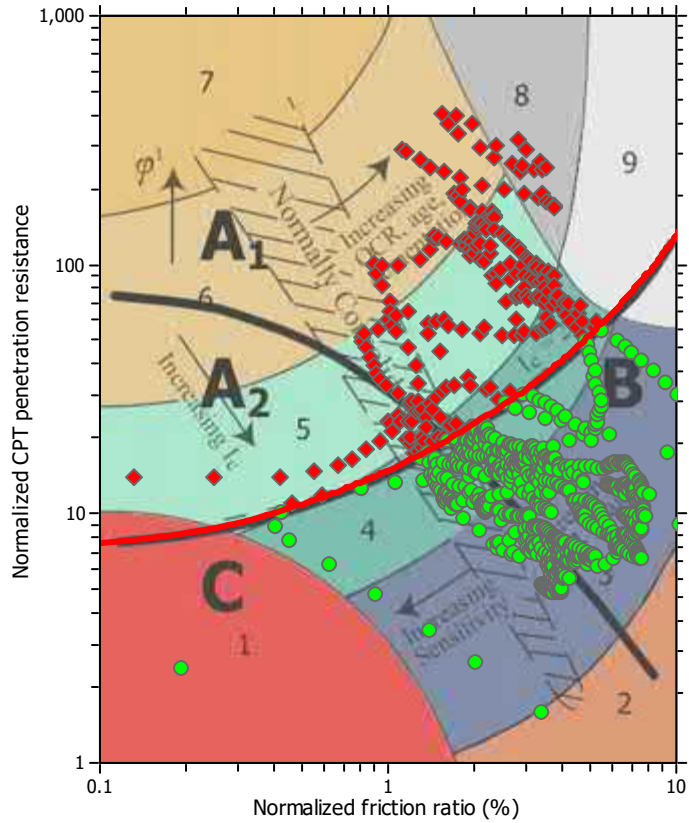
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

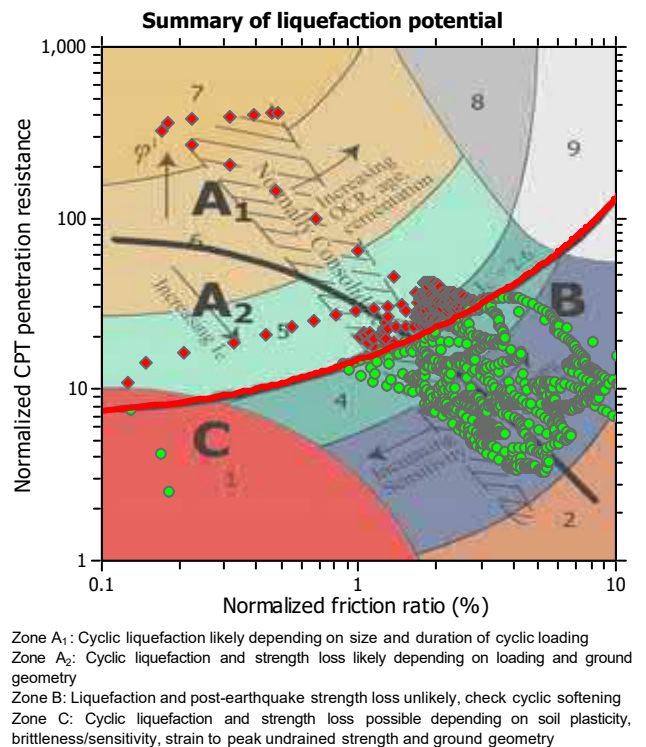
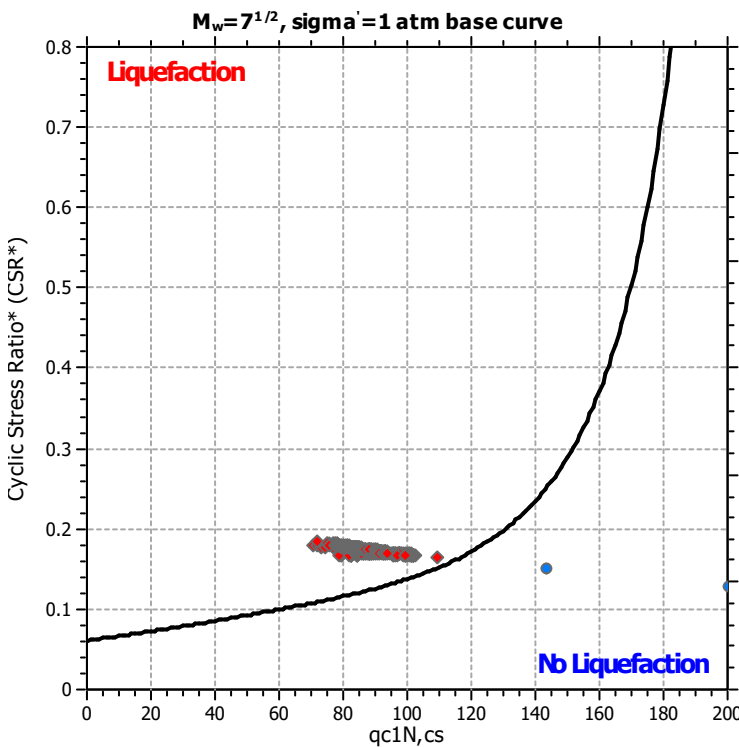
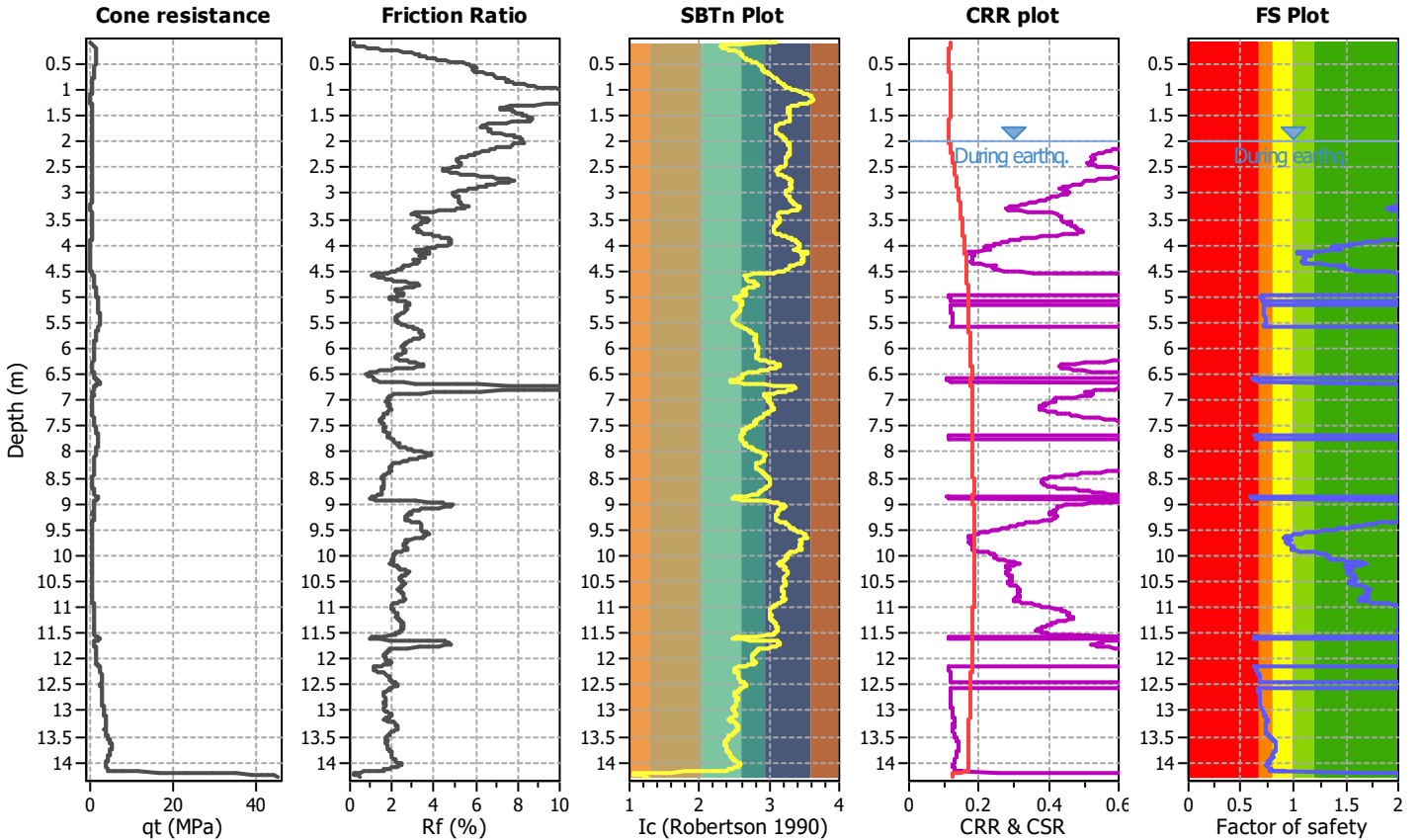
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT15-1/500**

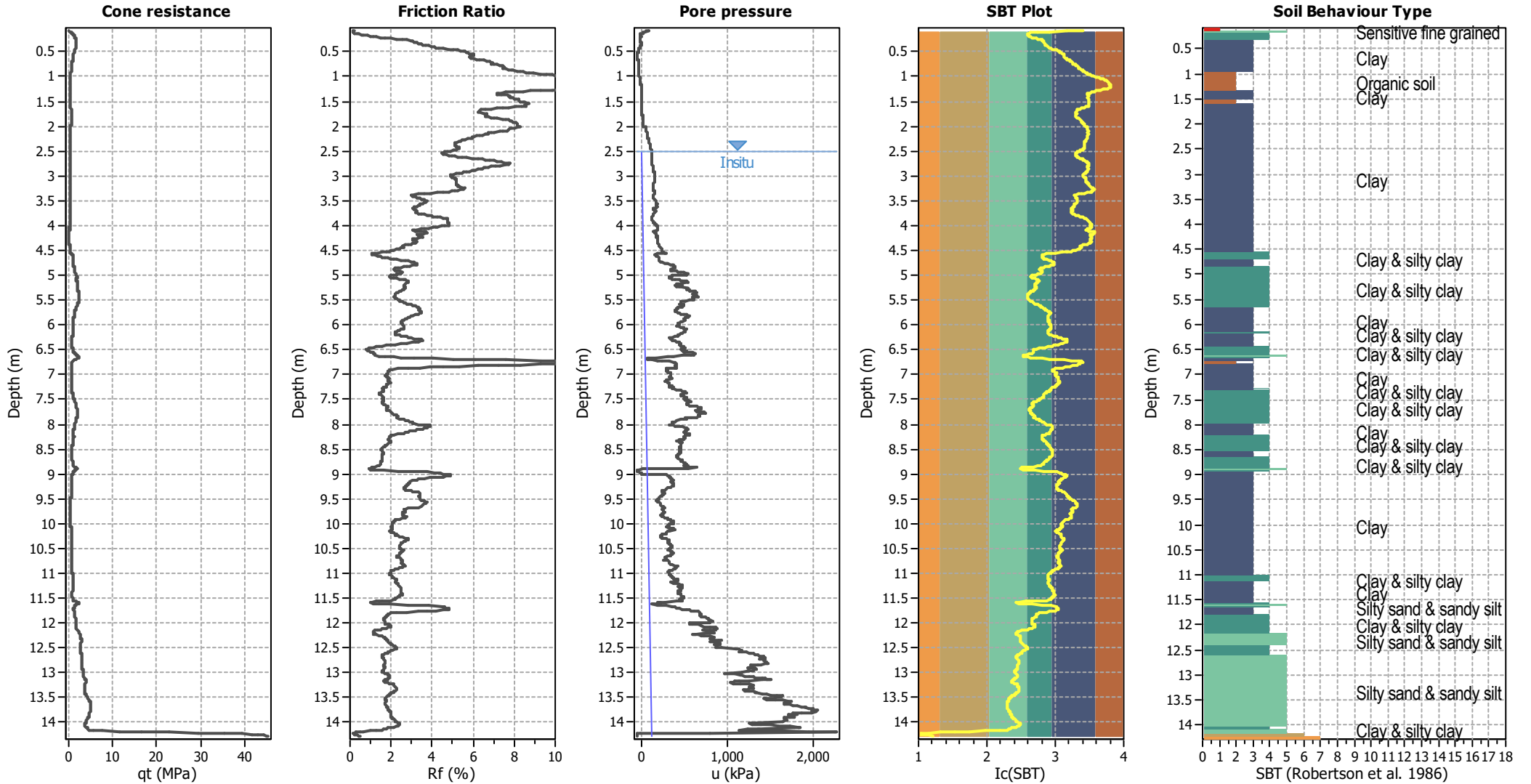
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 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 $M_w$ :	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

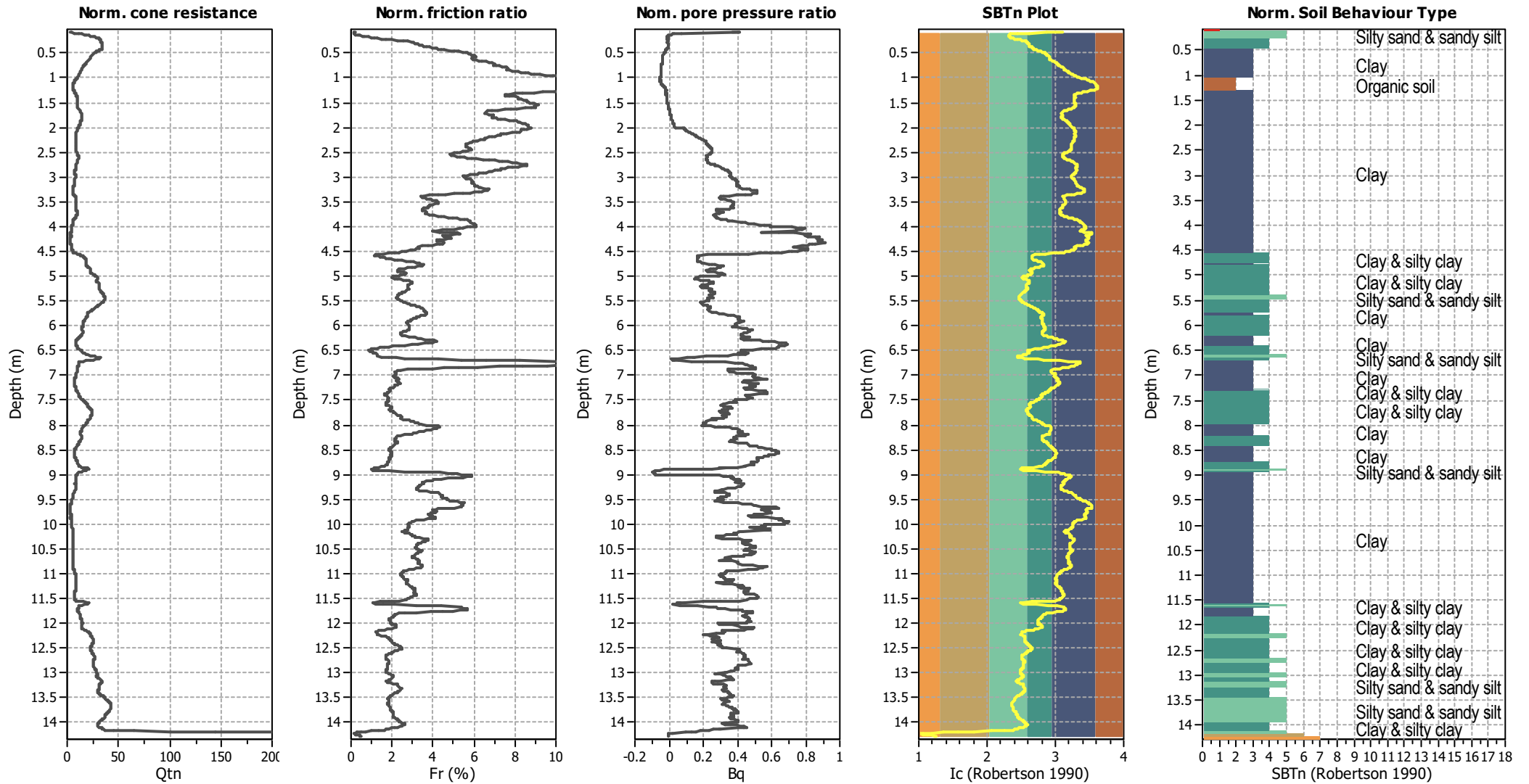
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



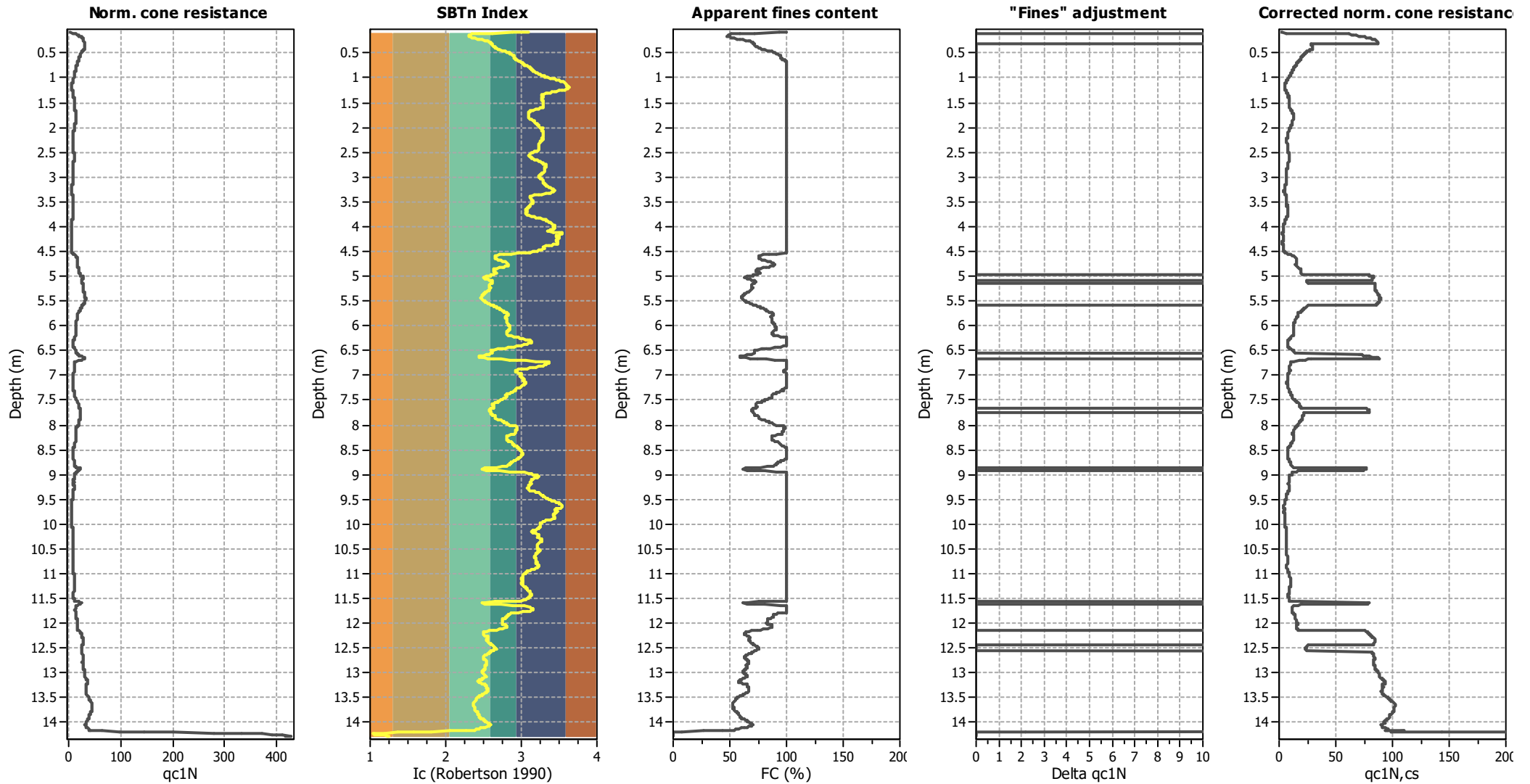
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

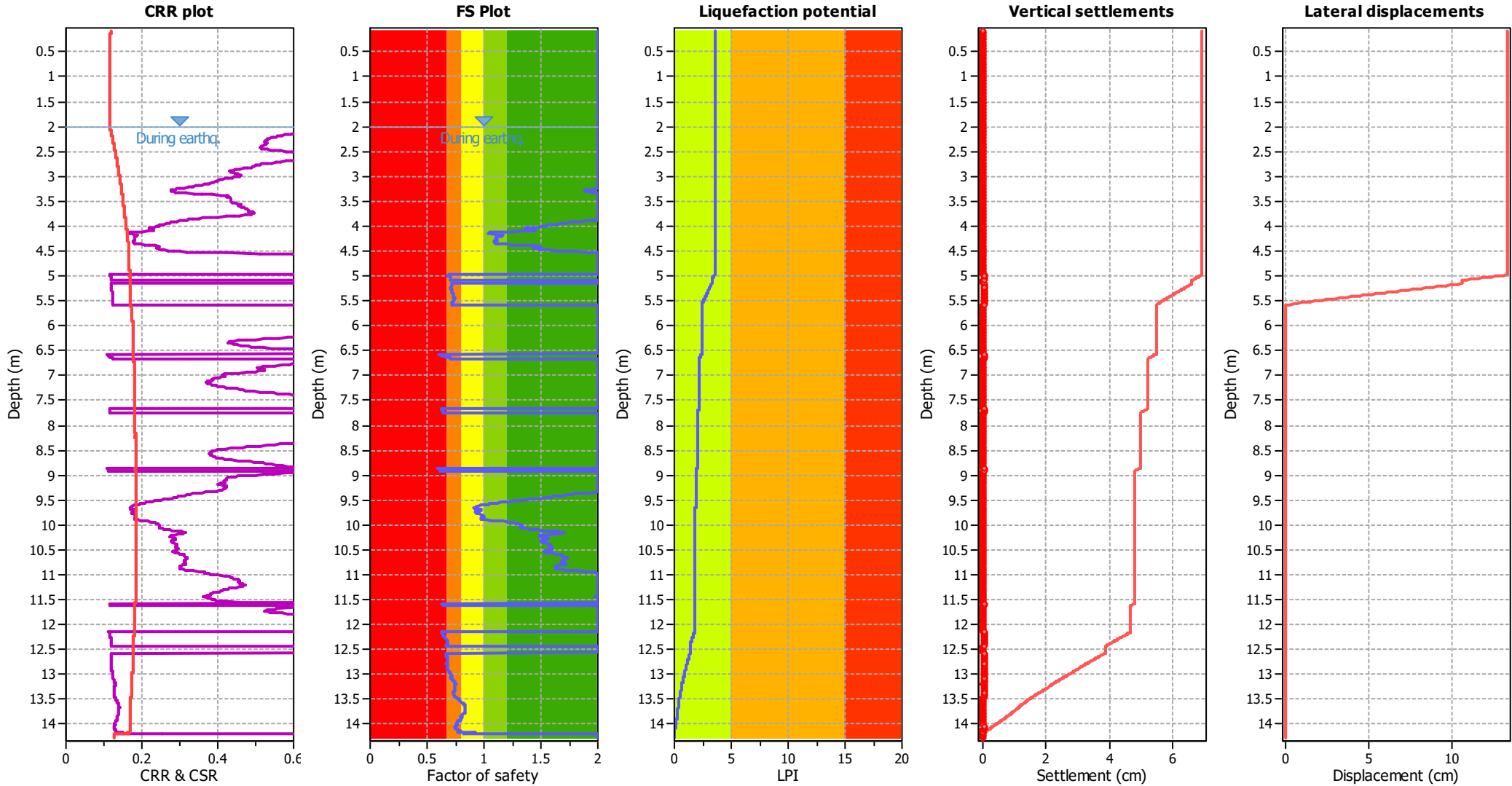
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

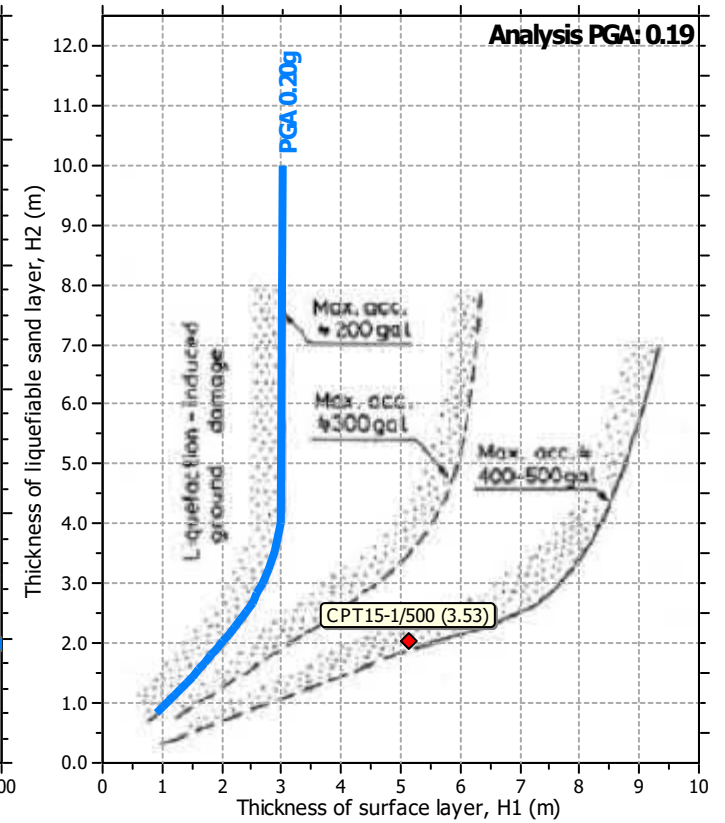
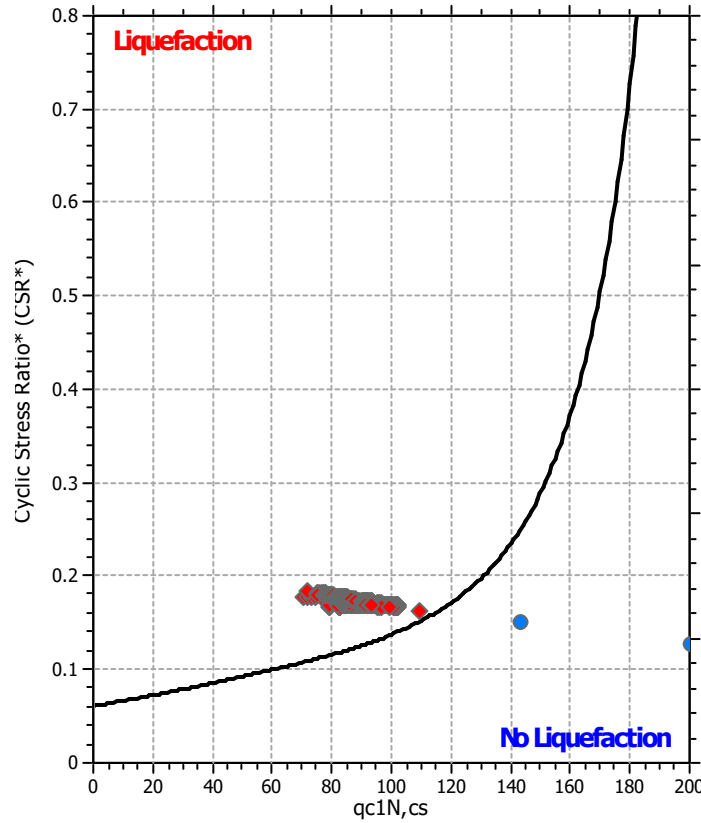
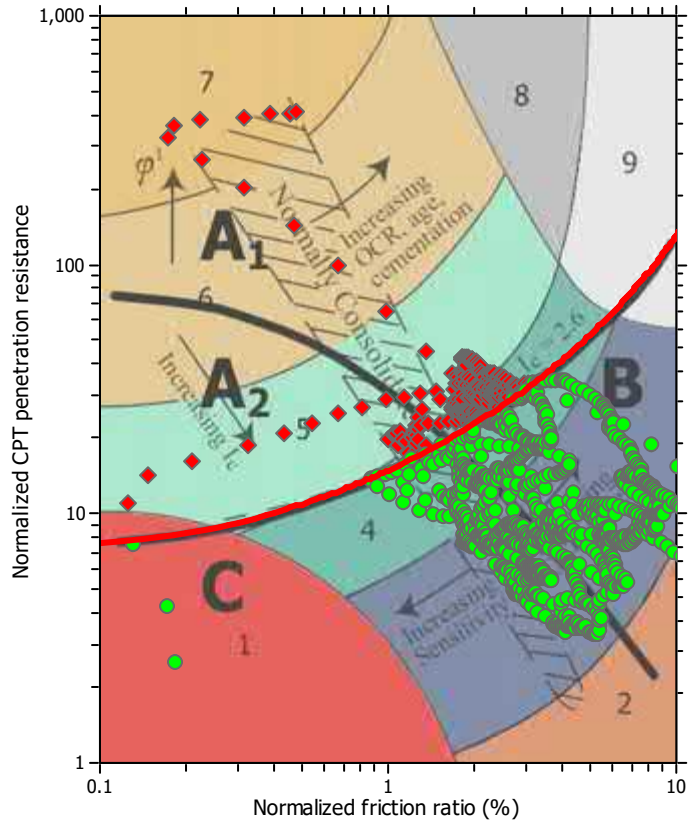
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A



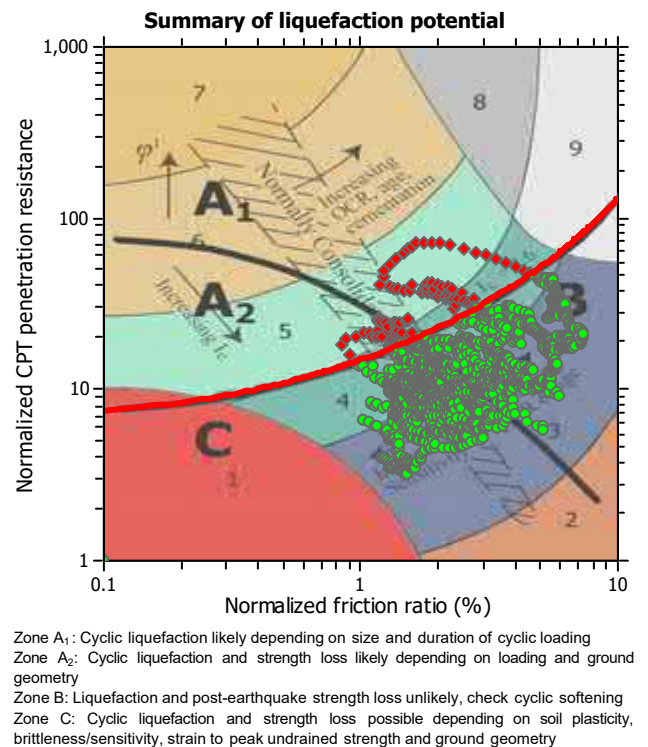
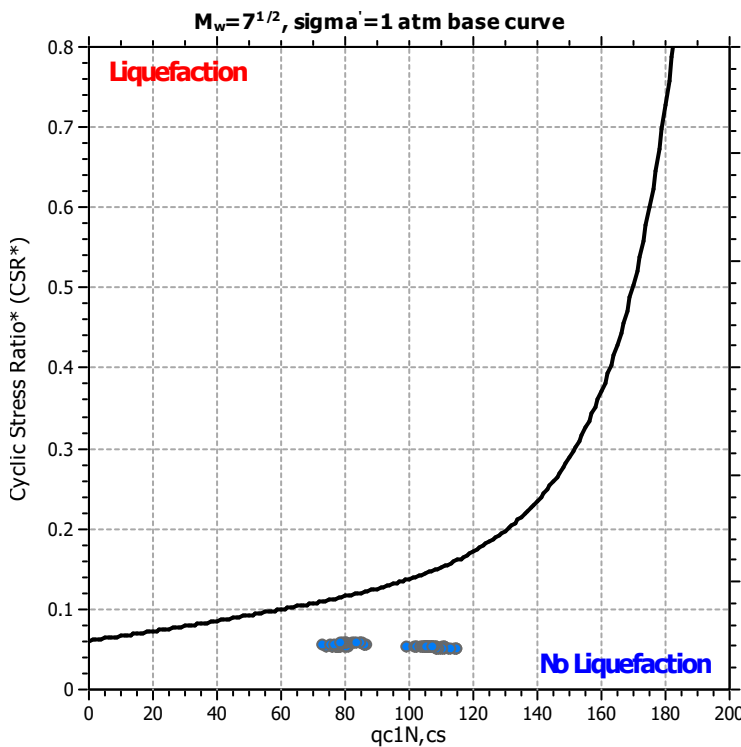
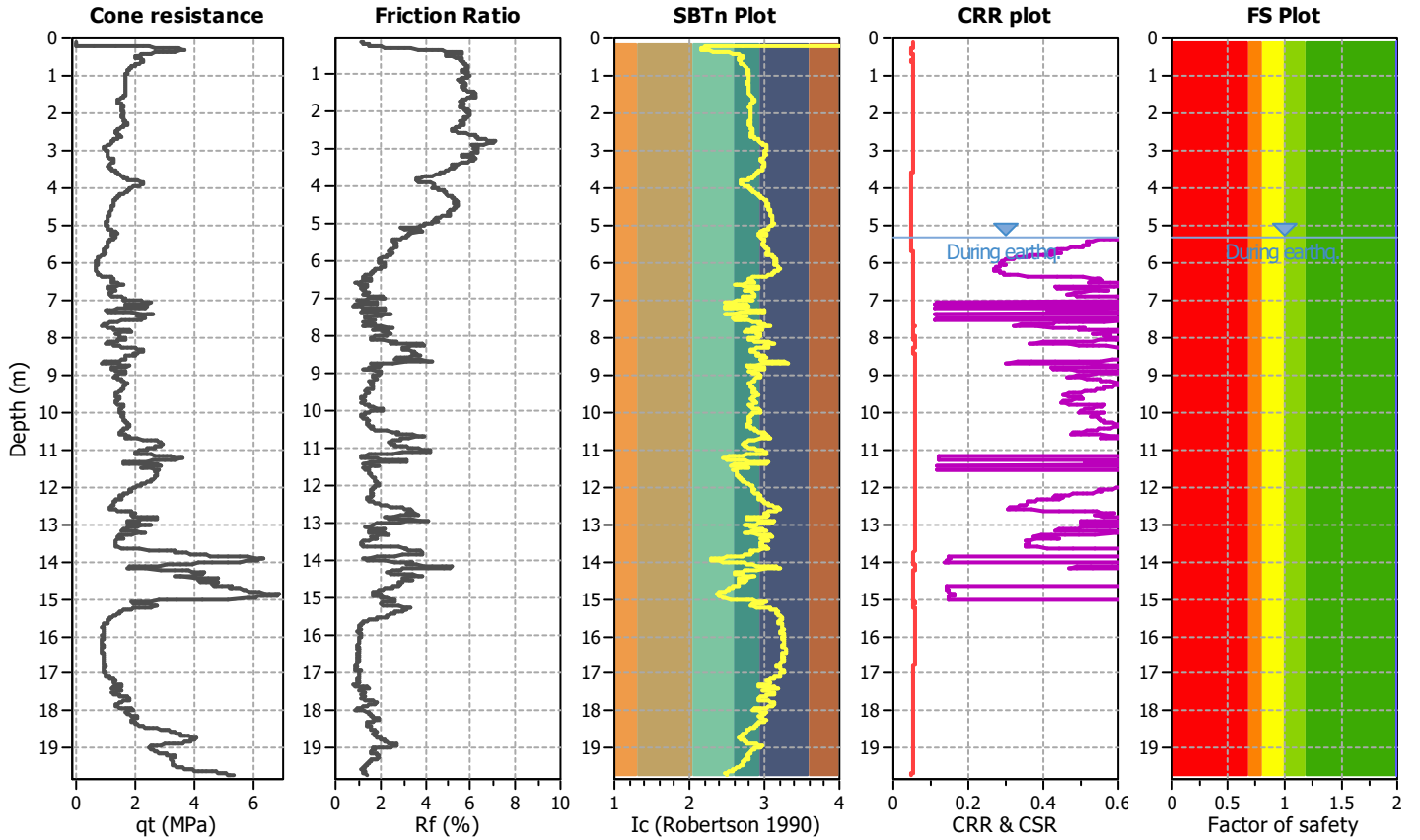
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT1-1/100**

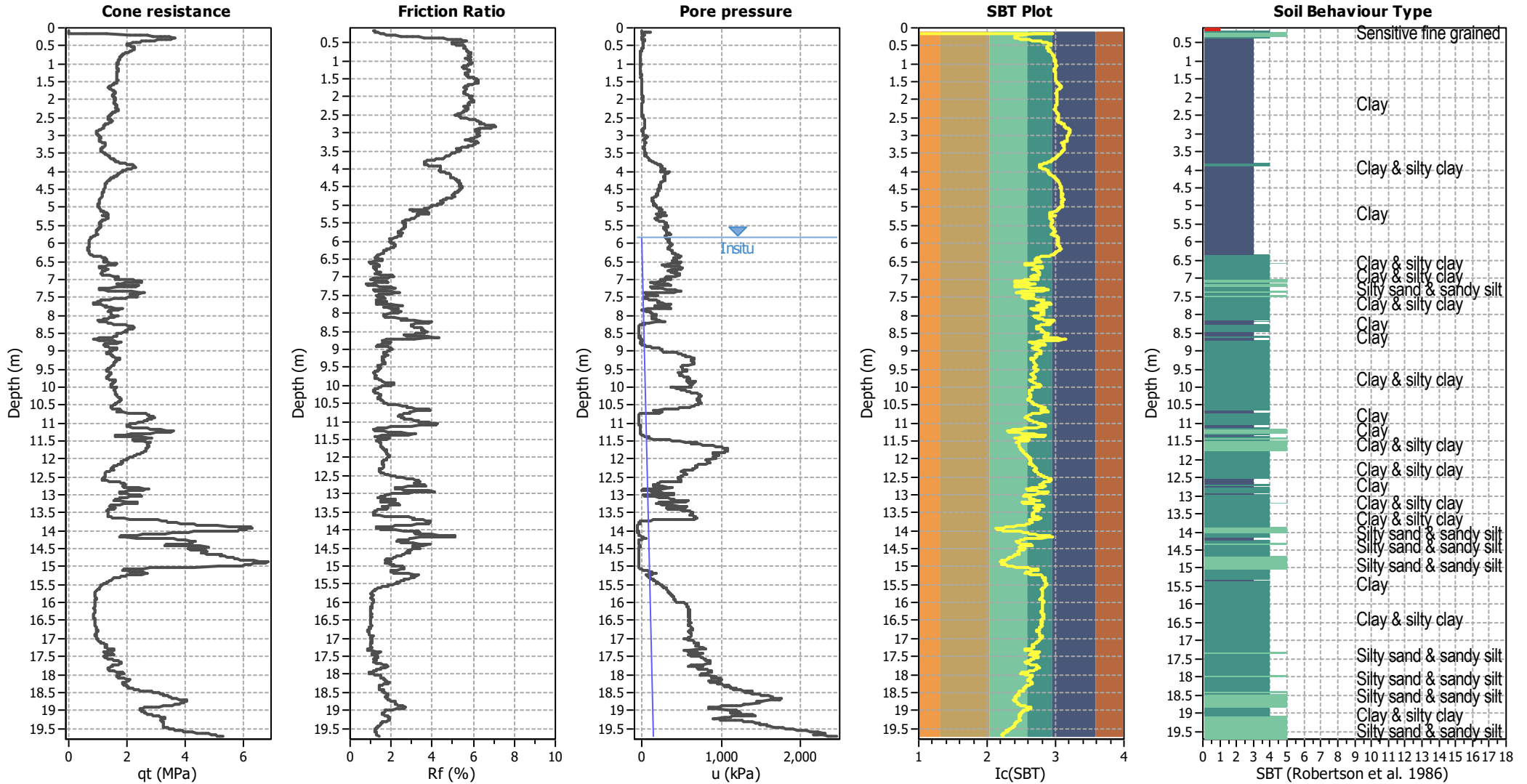
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.83 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.33 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



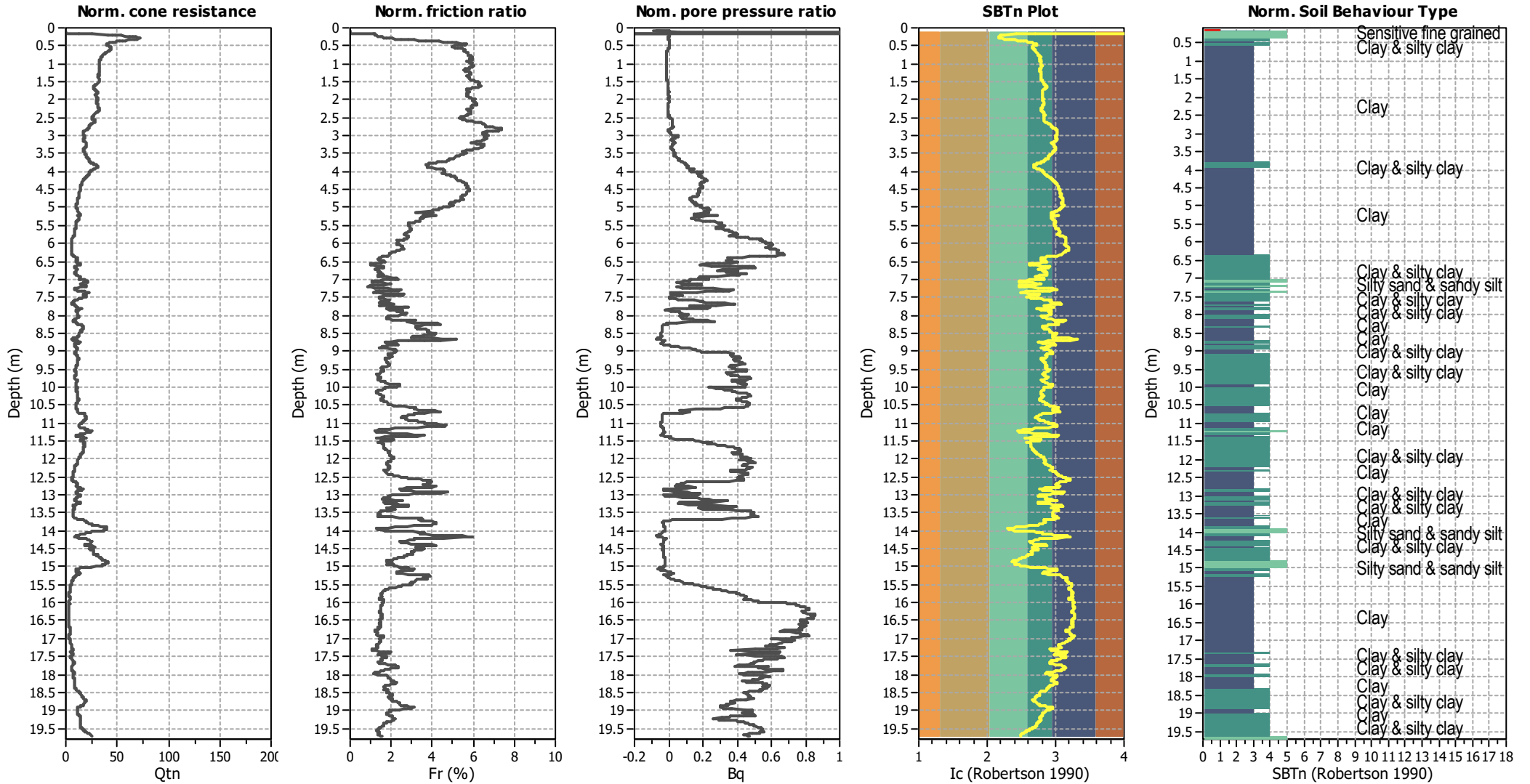
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



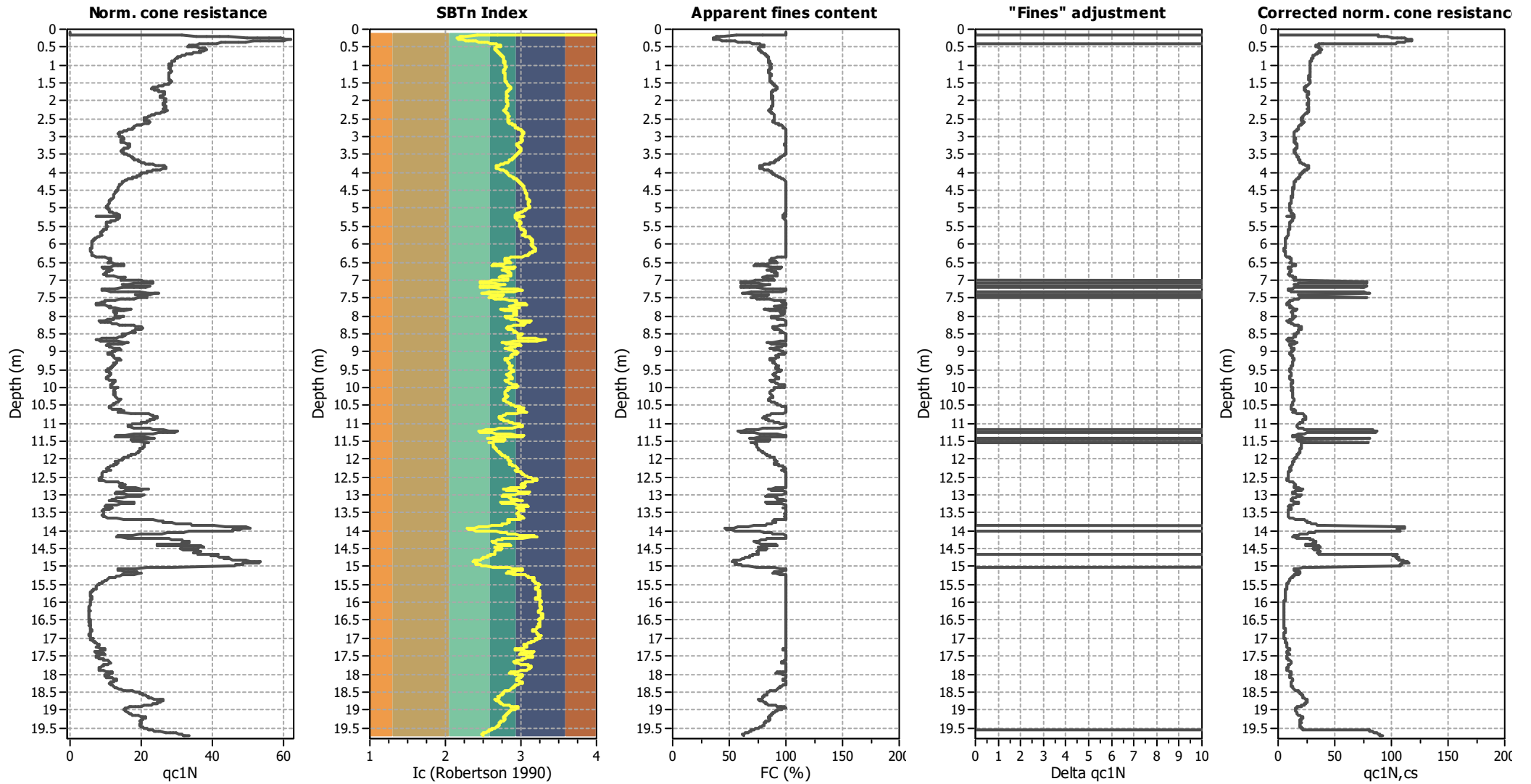
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

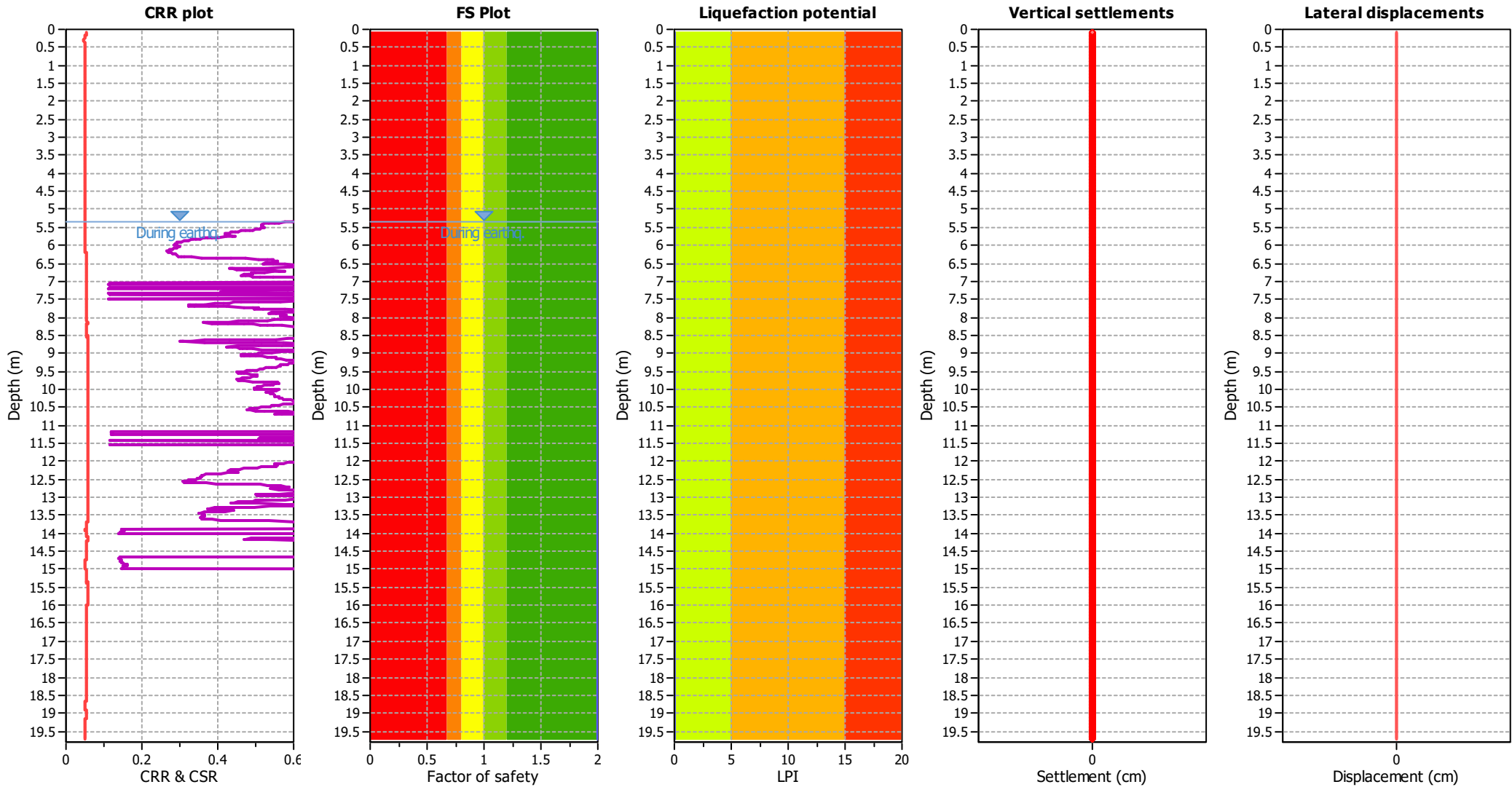


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

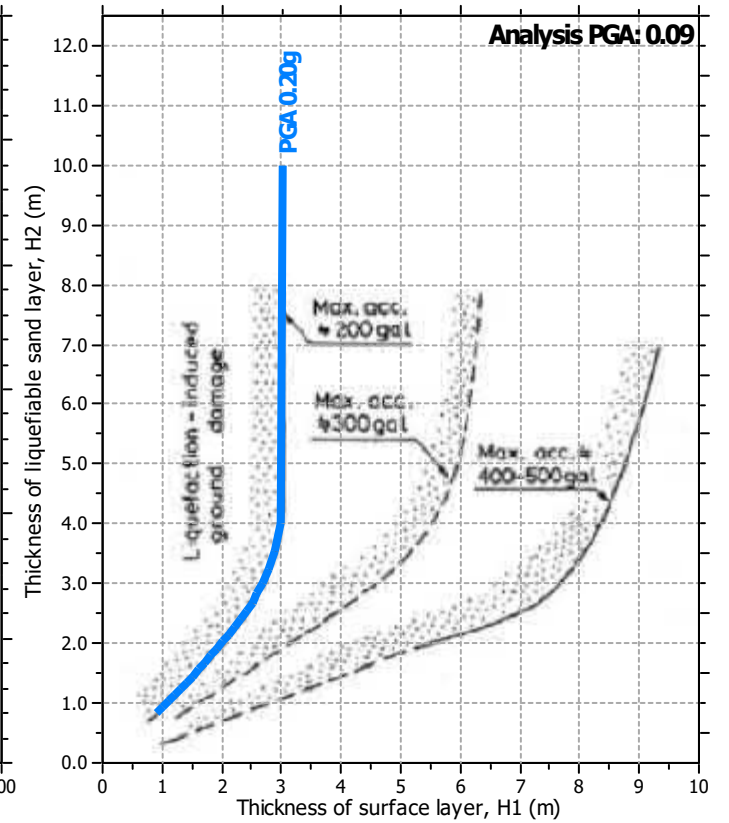
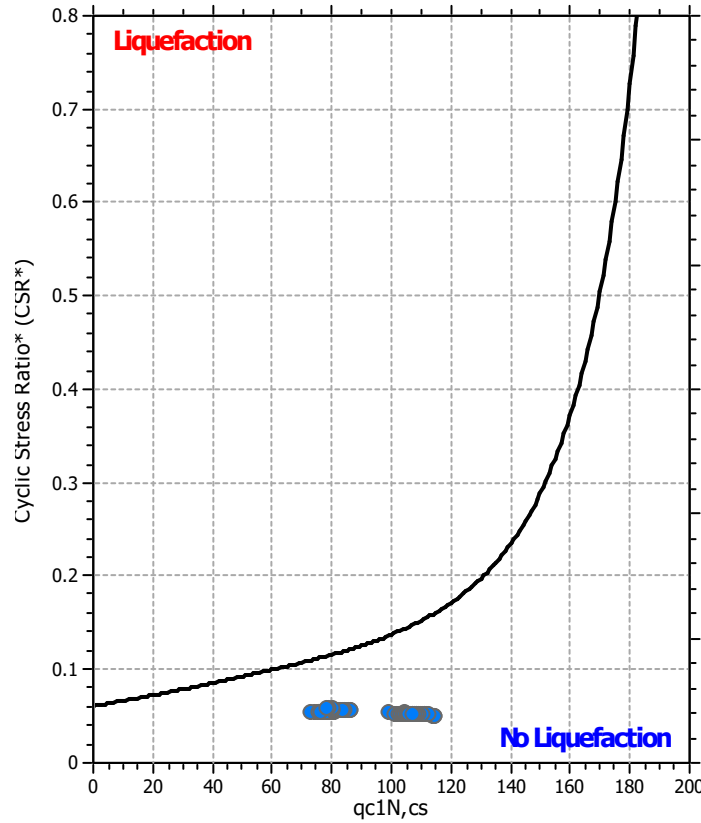
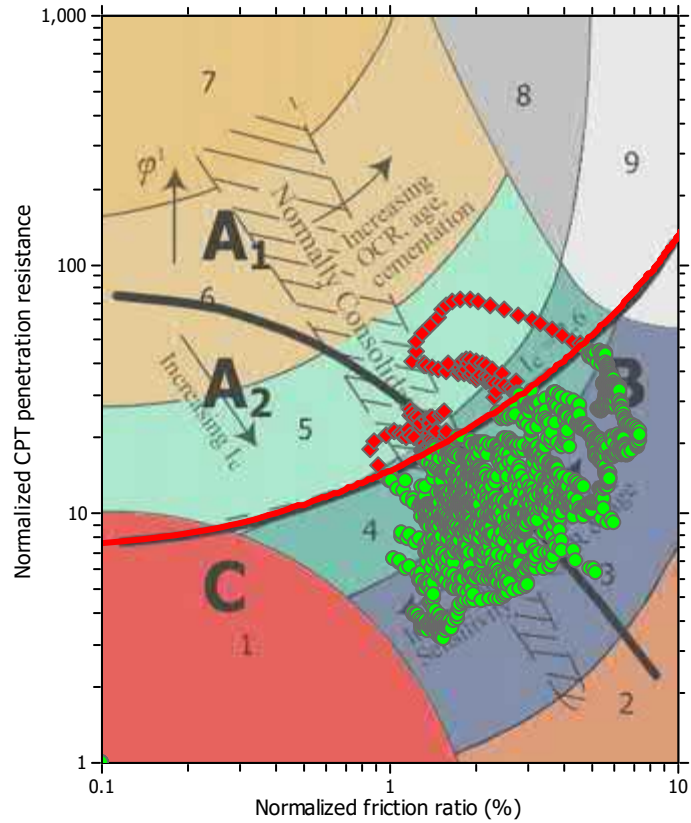
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.33 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.83 m	Fill height:	N/A	Limit depth:	15.00 m

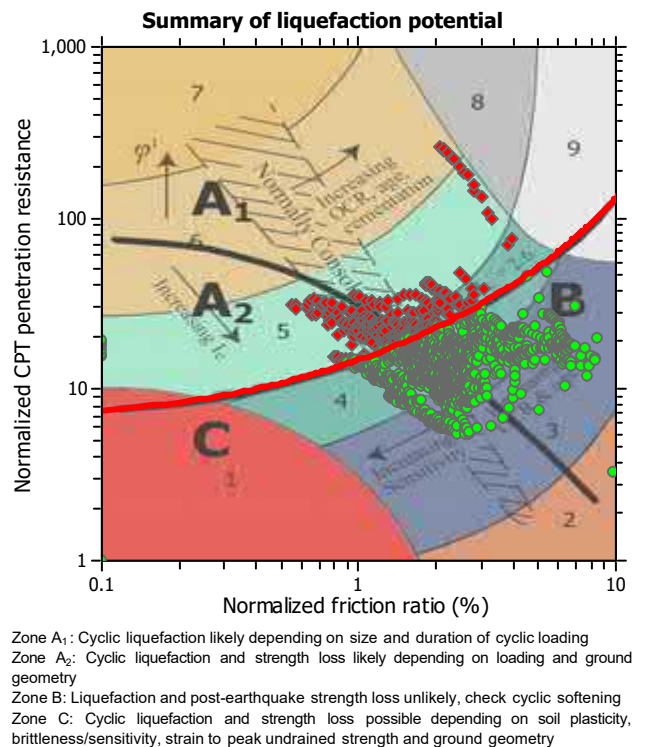
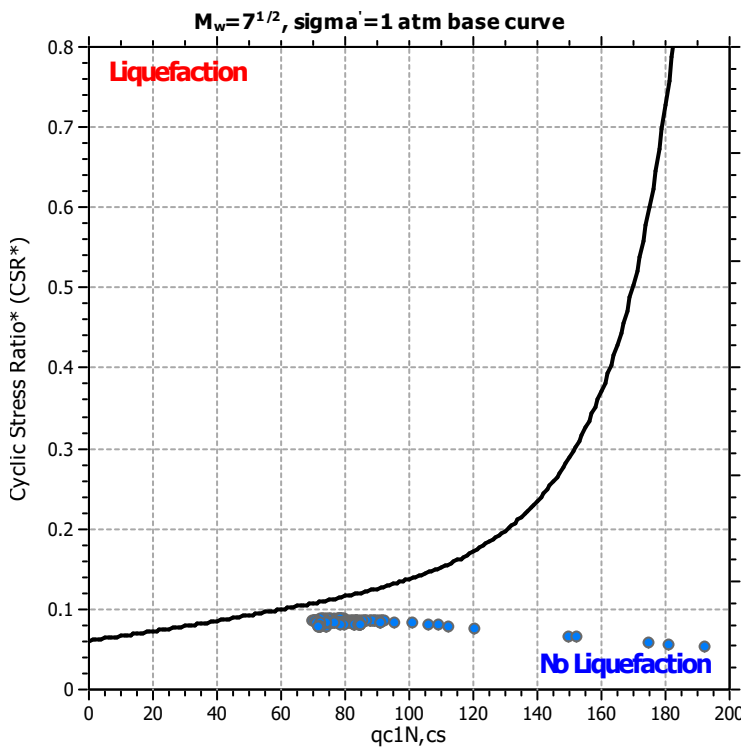
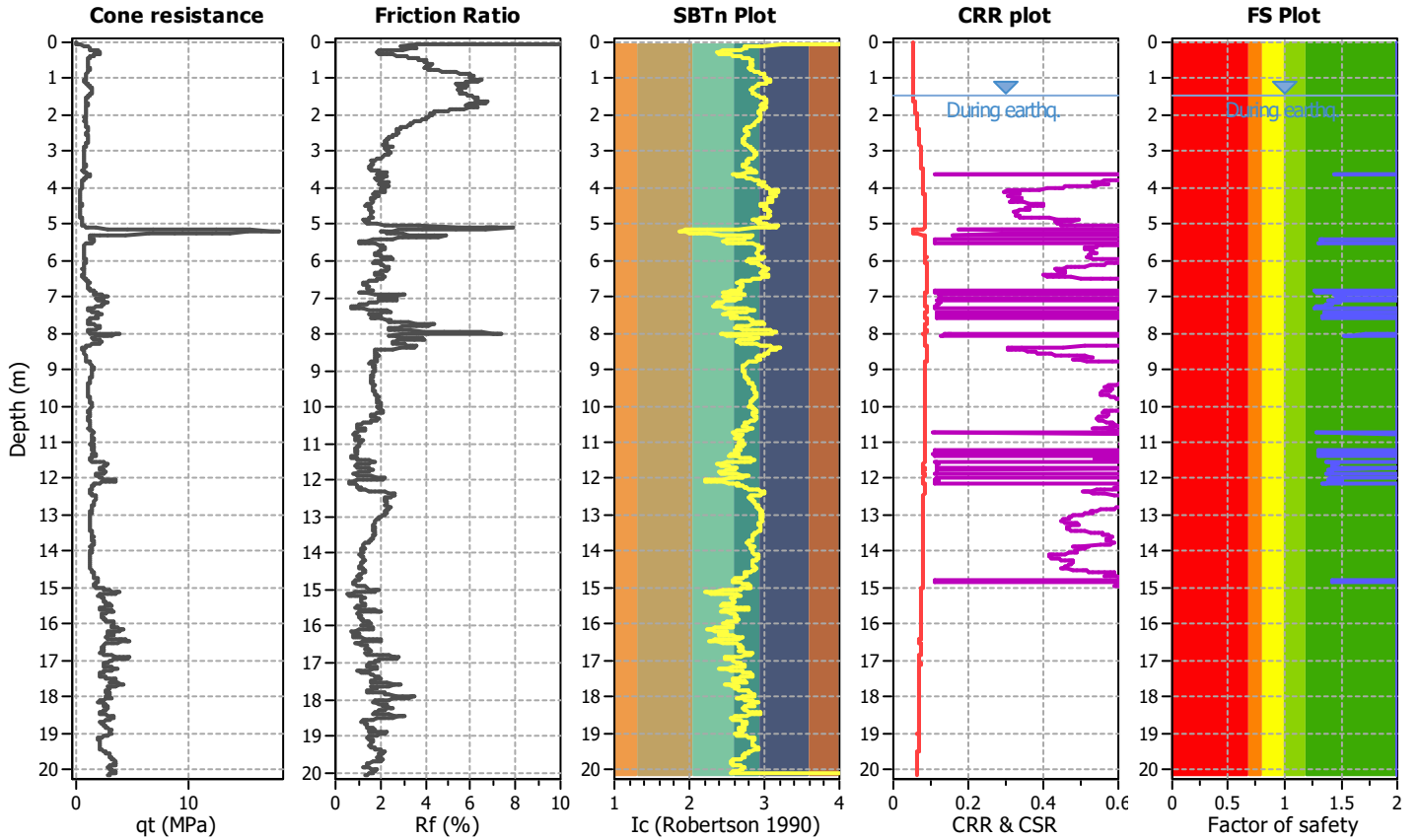
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT 2-1/100**

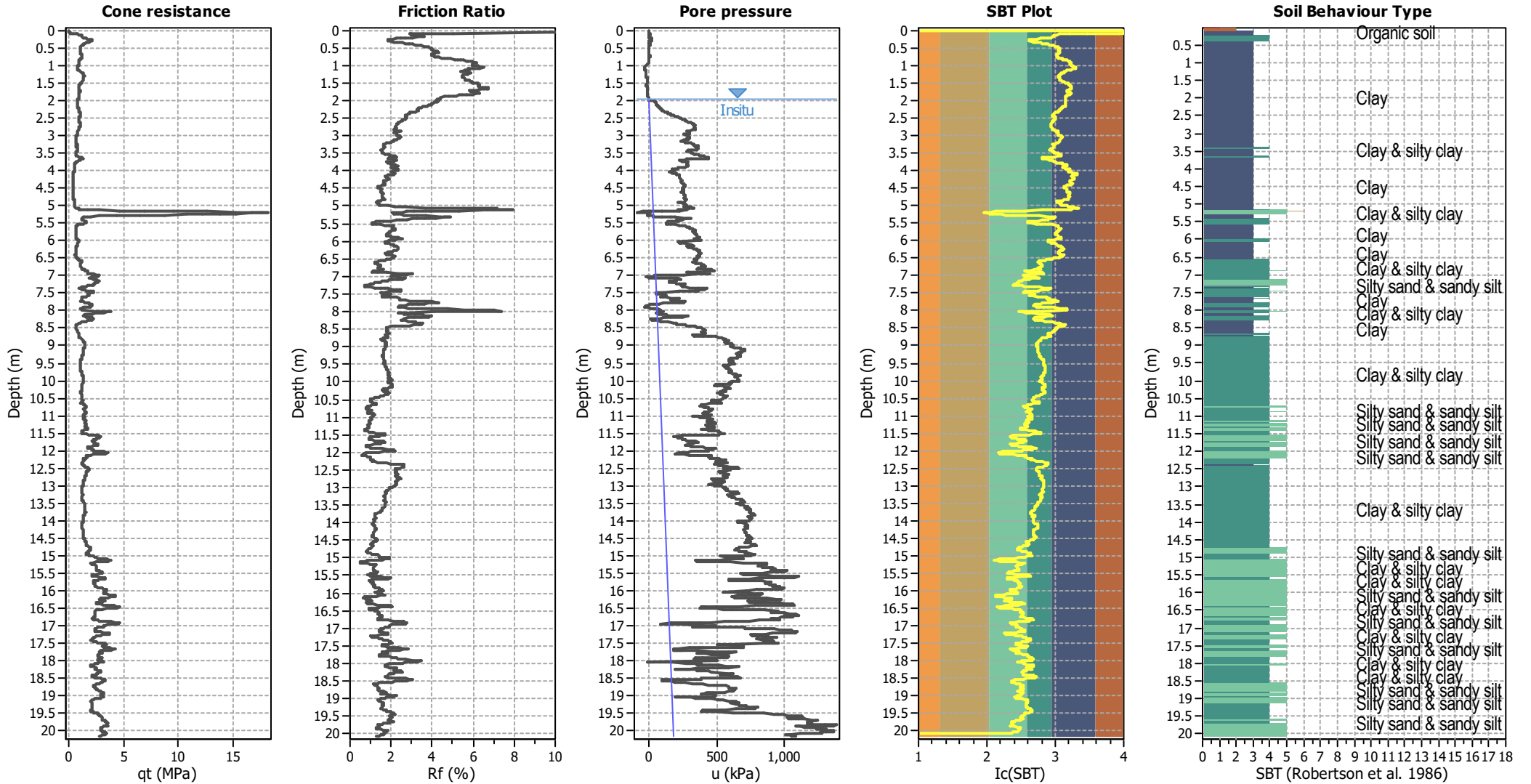
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.96 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.46 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:	15.00 m
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

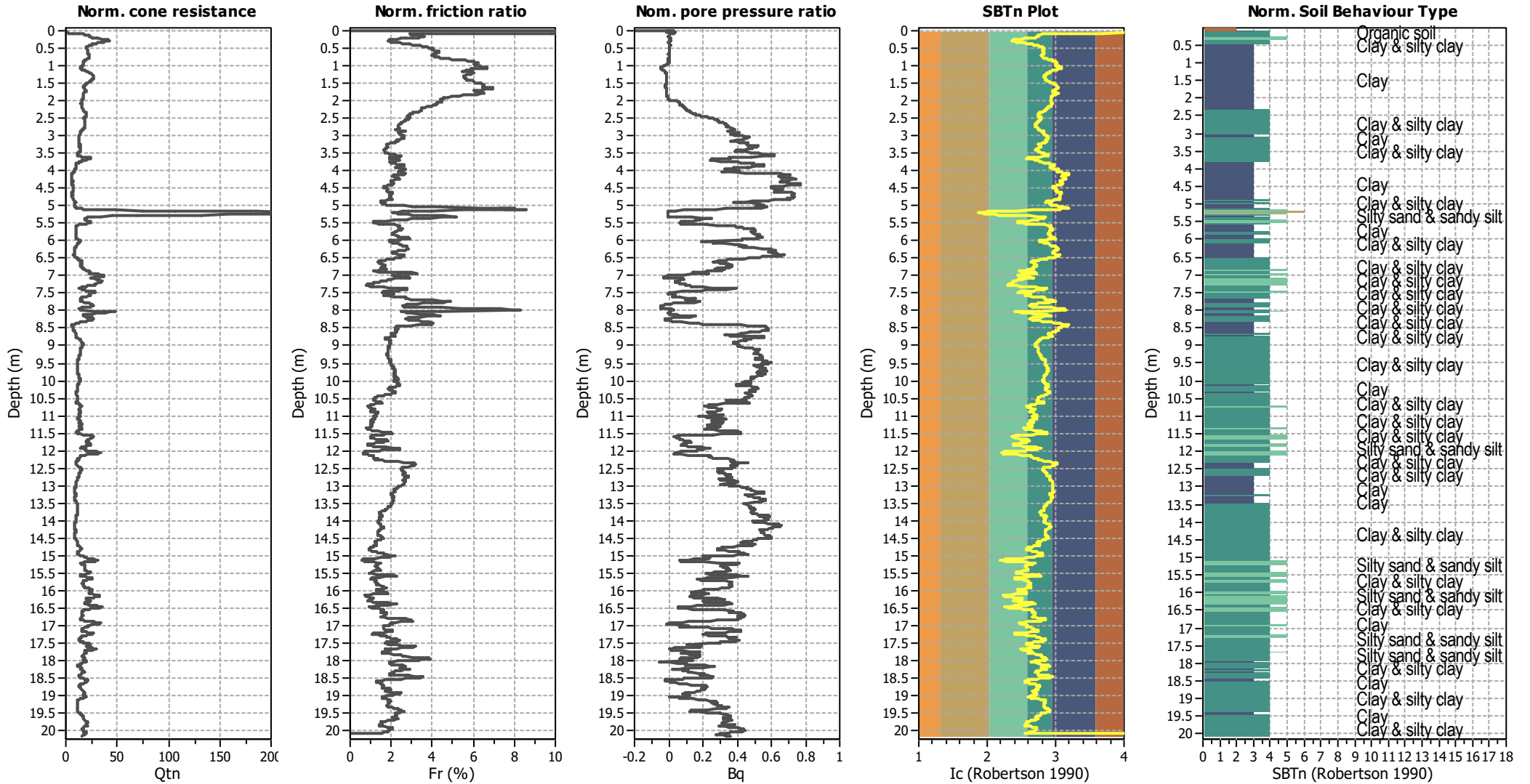
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



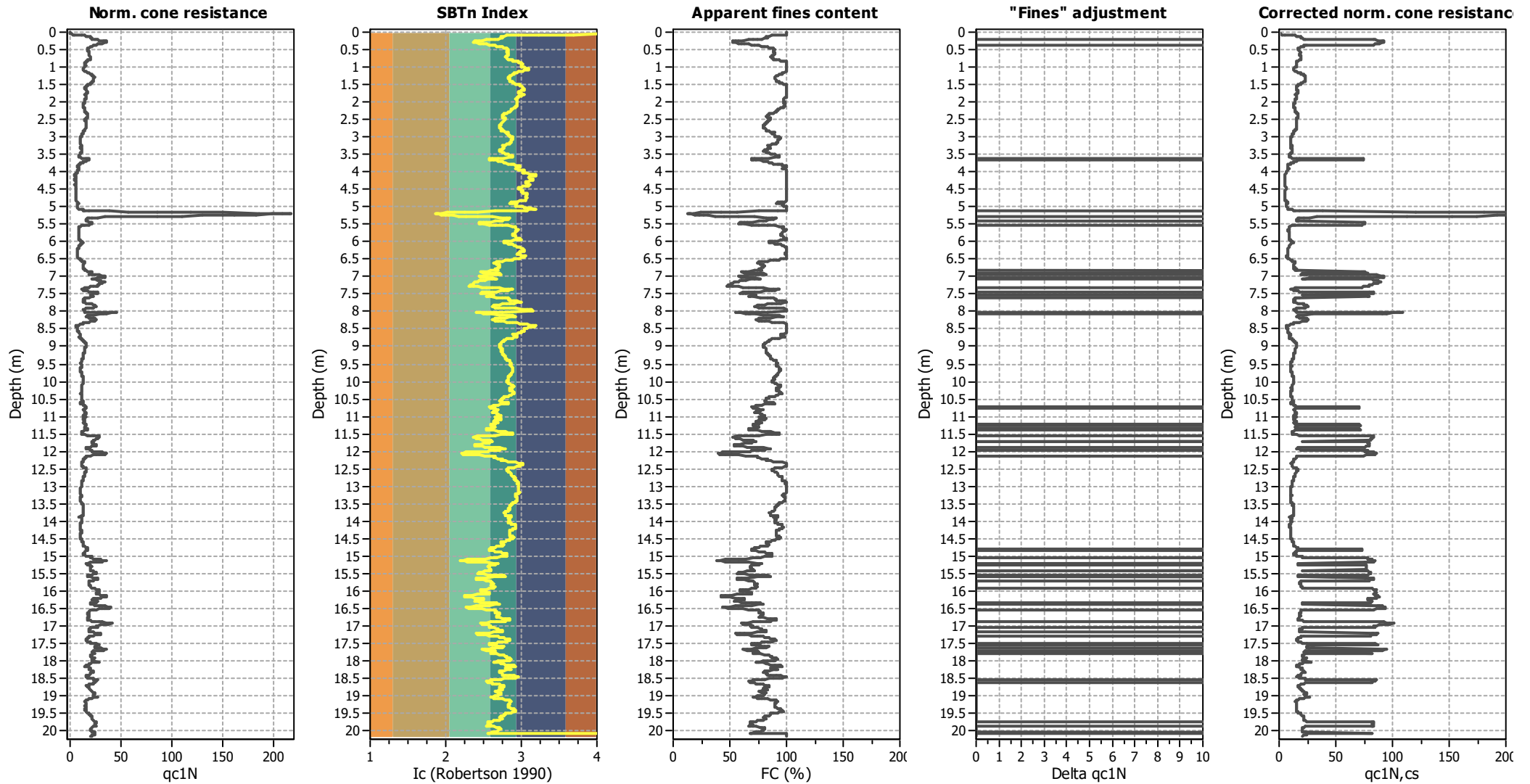
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

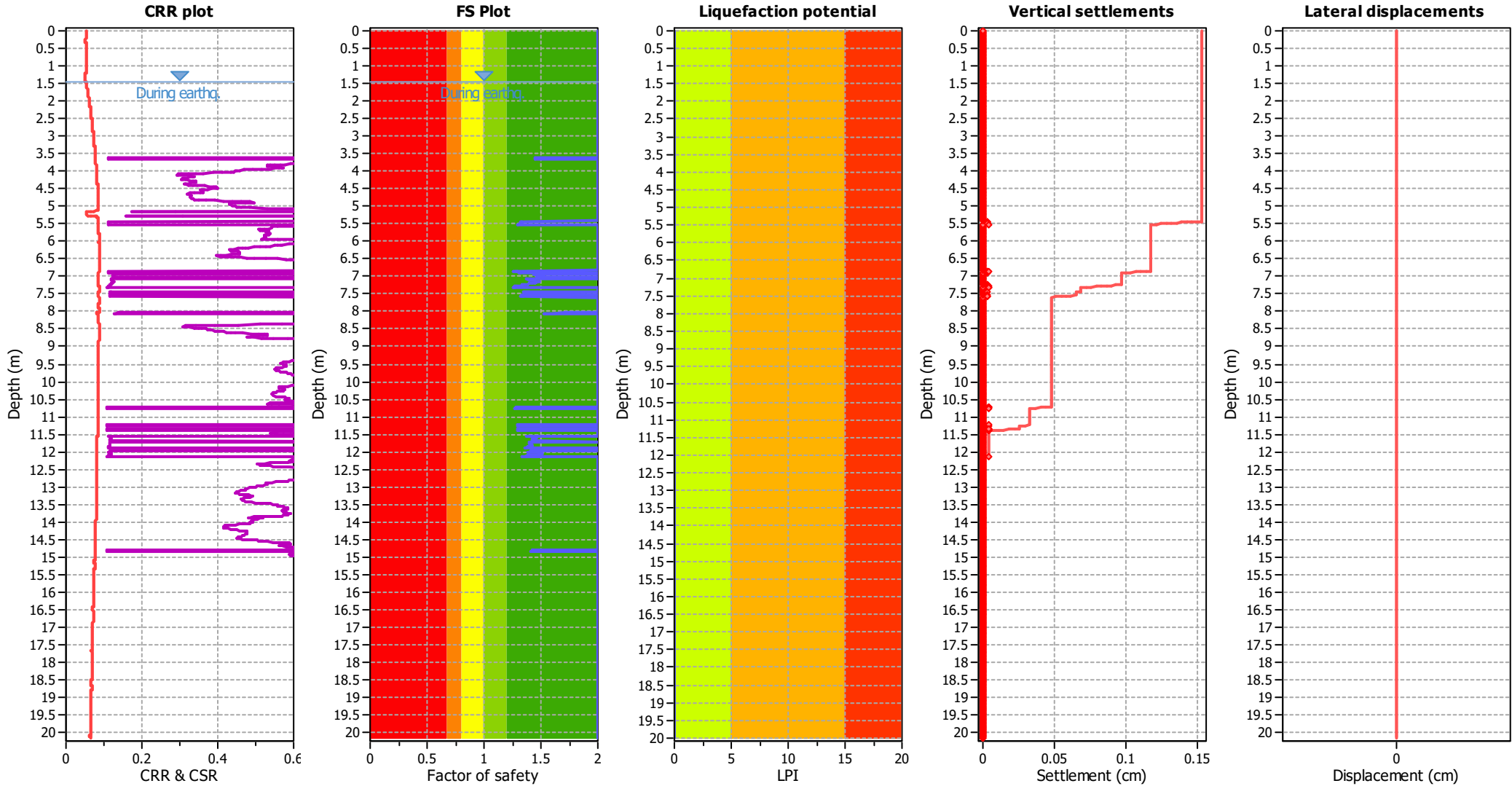
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m

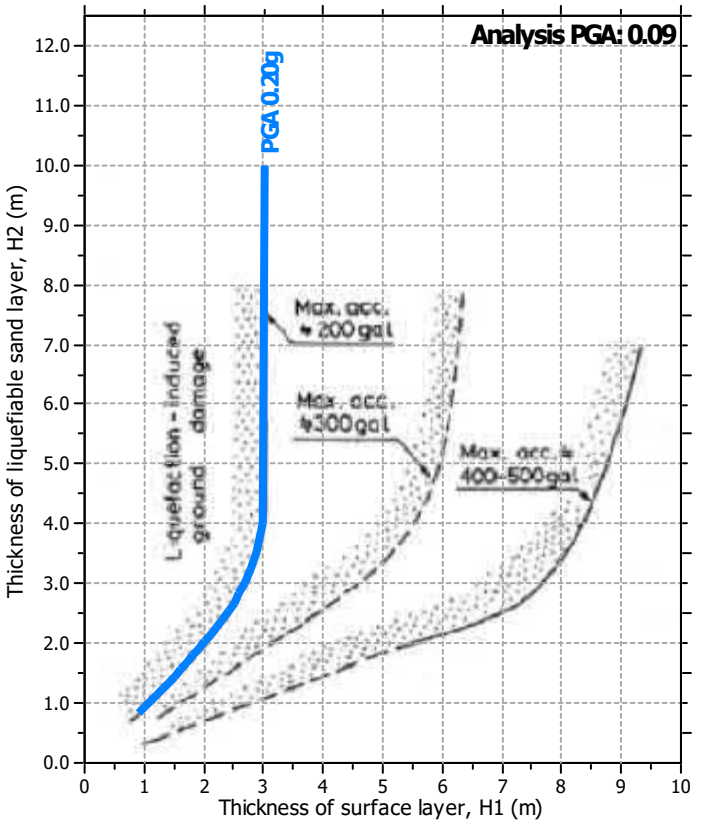
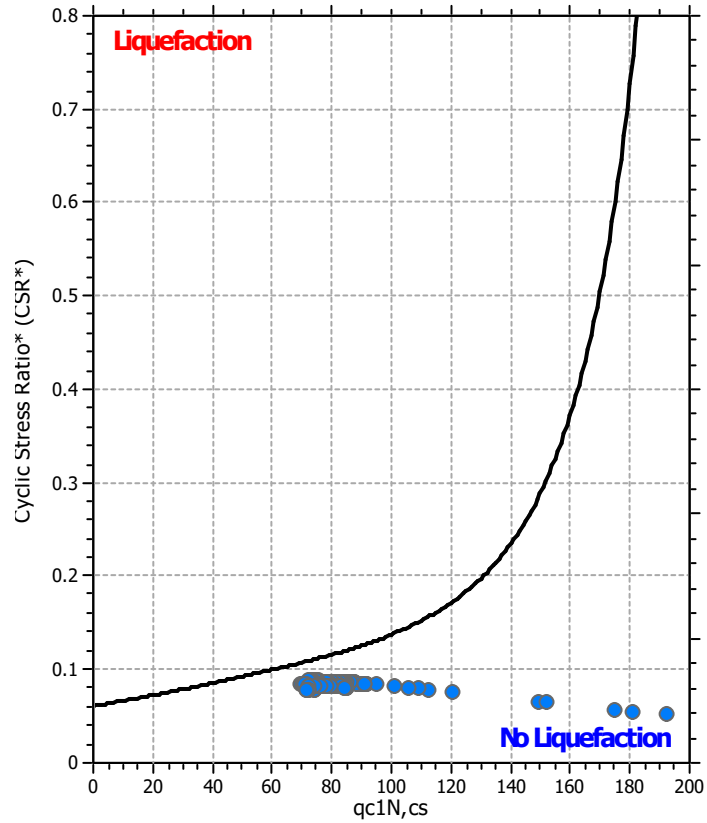
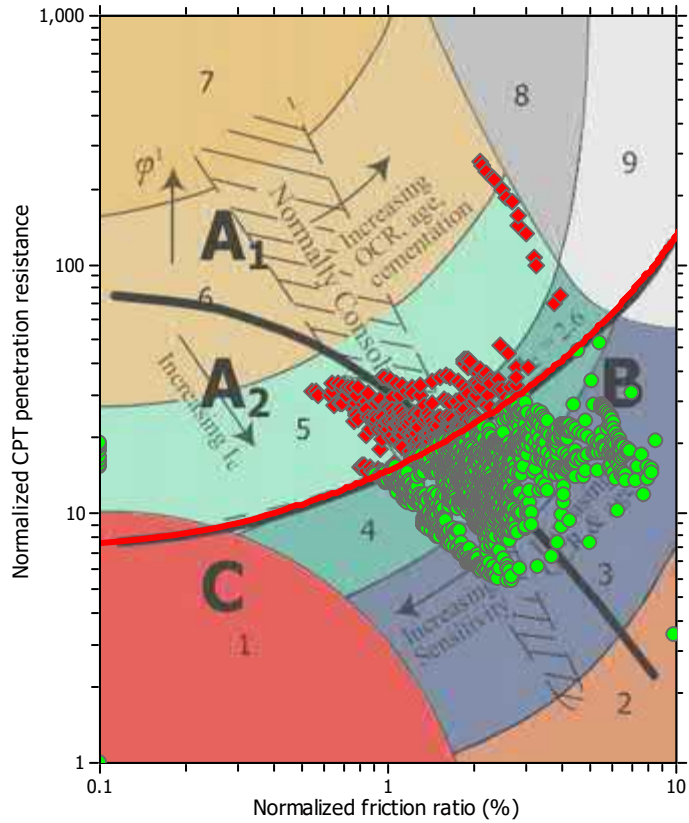
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.46 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.96 m	Fill height:	N/A	Limit depth:	15.00 m



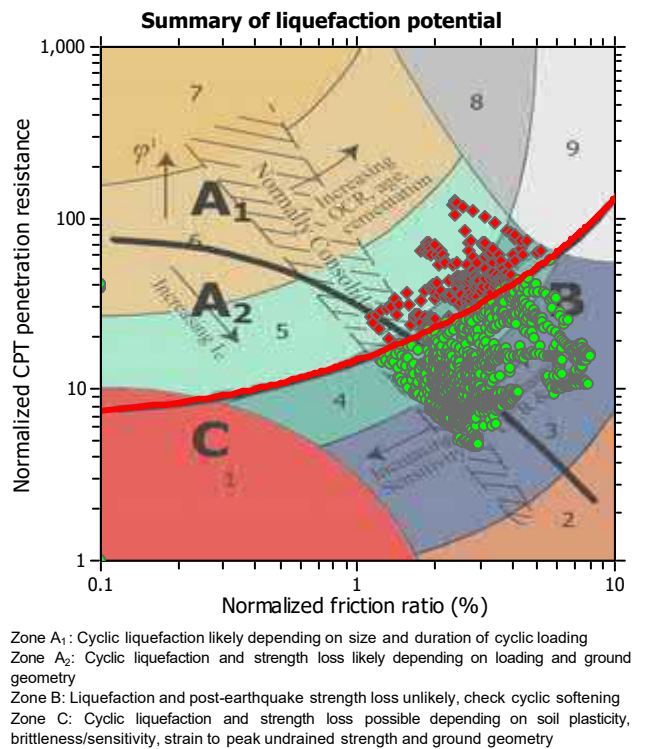
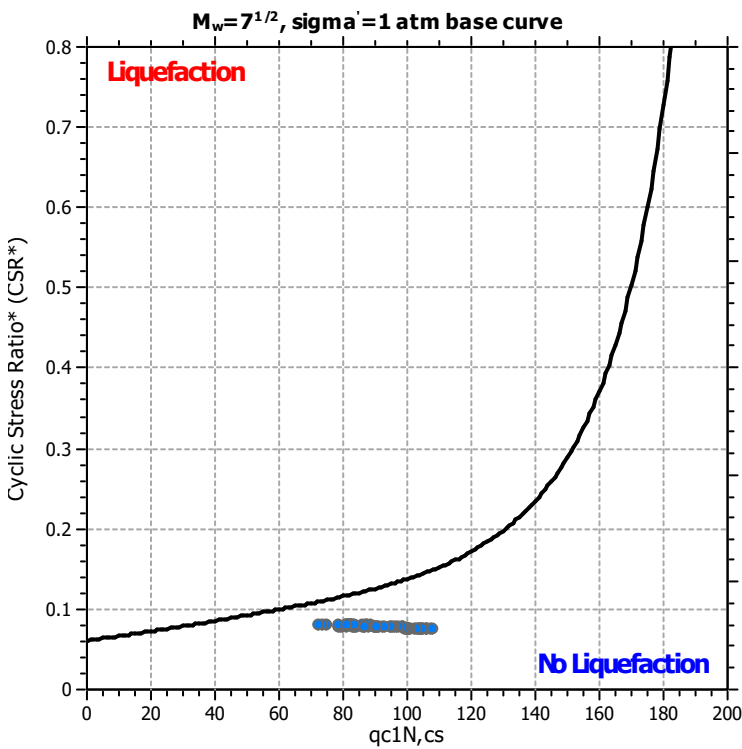
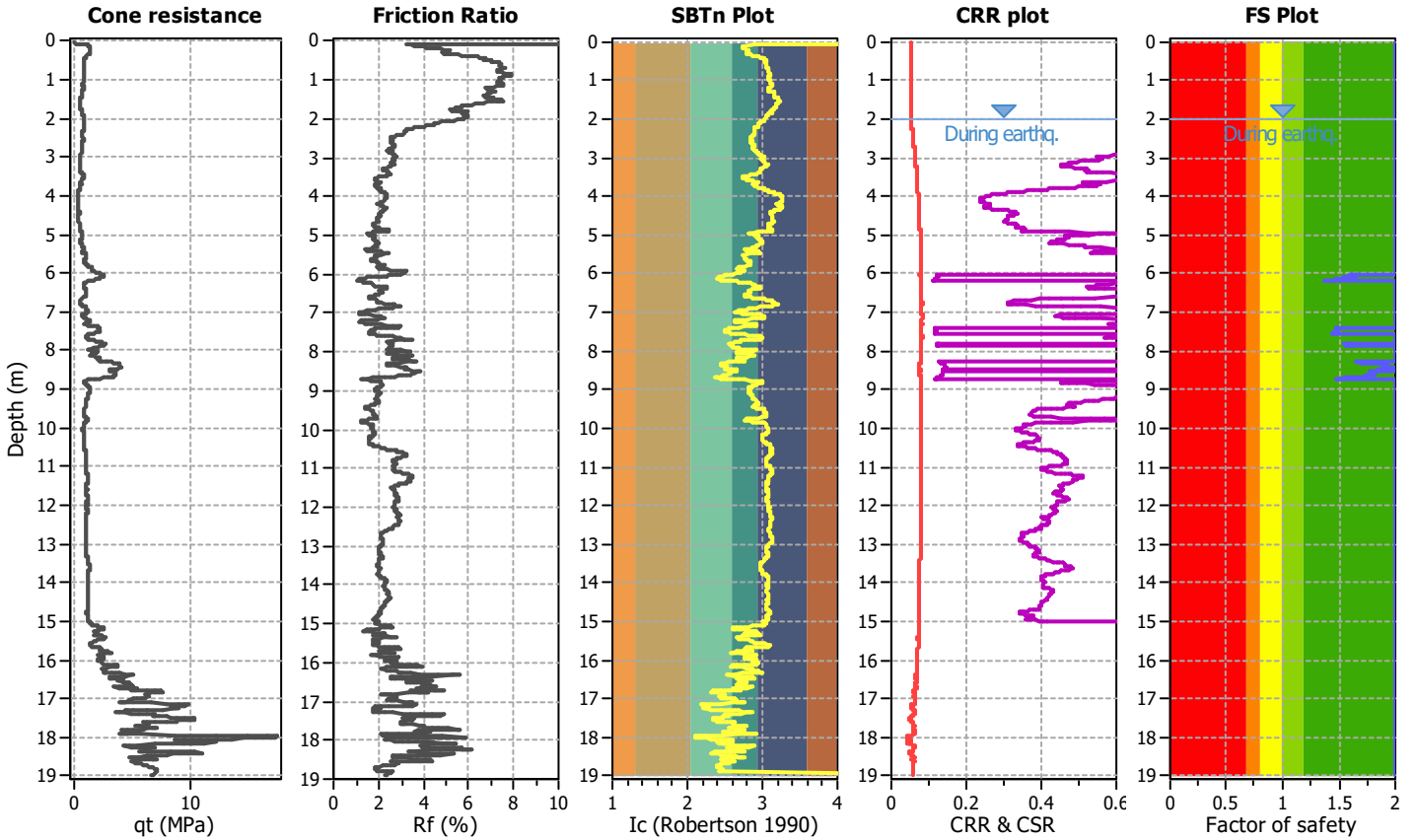
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT3-1/100**

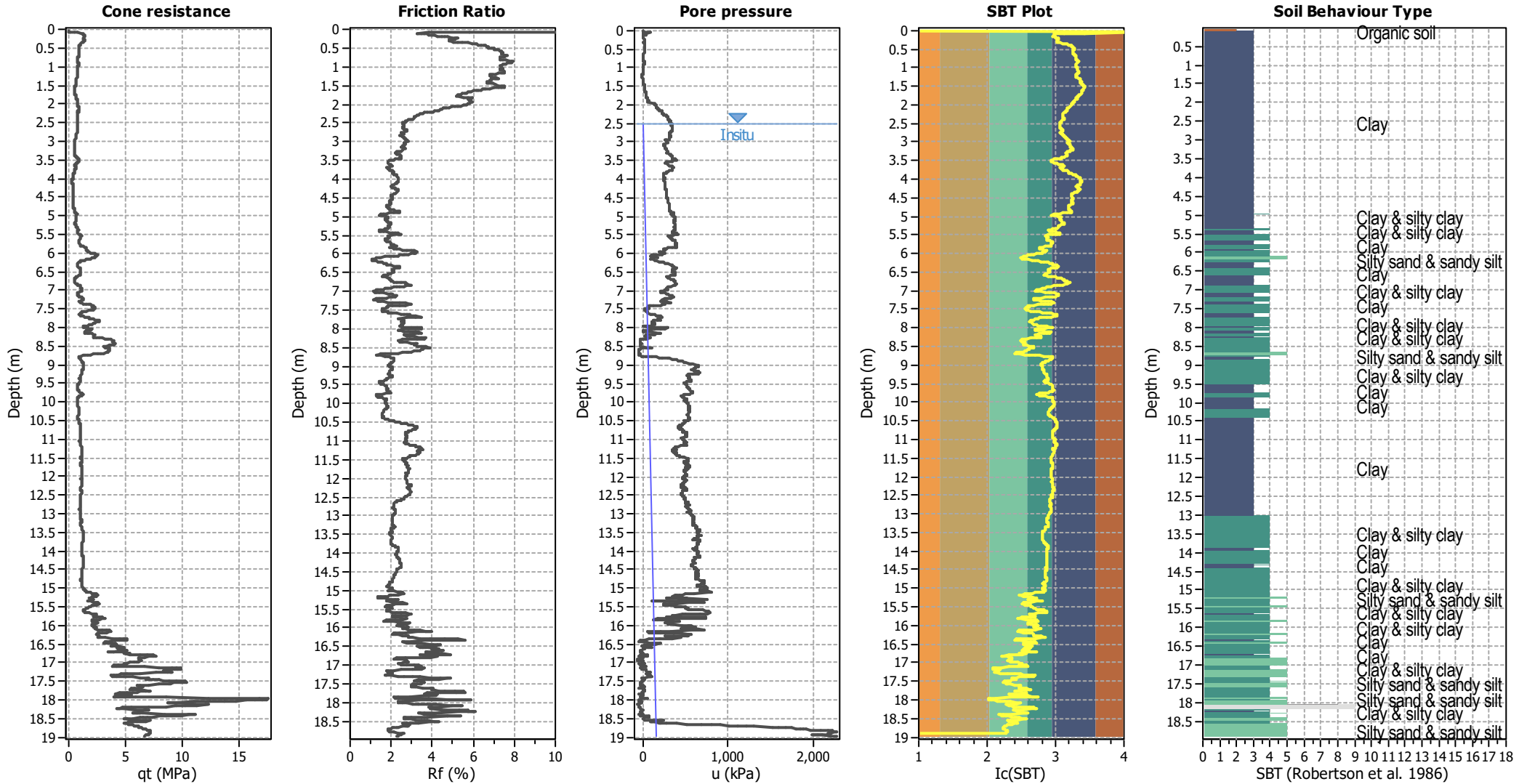
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 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:	15.00 m
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



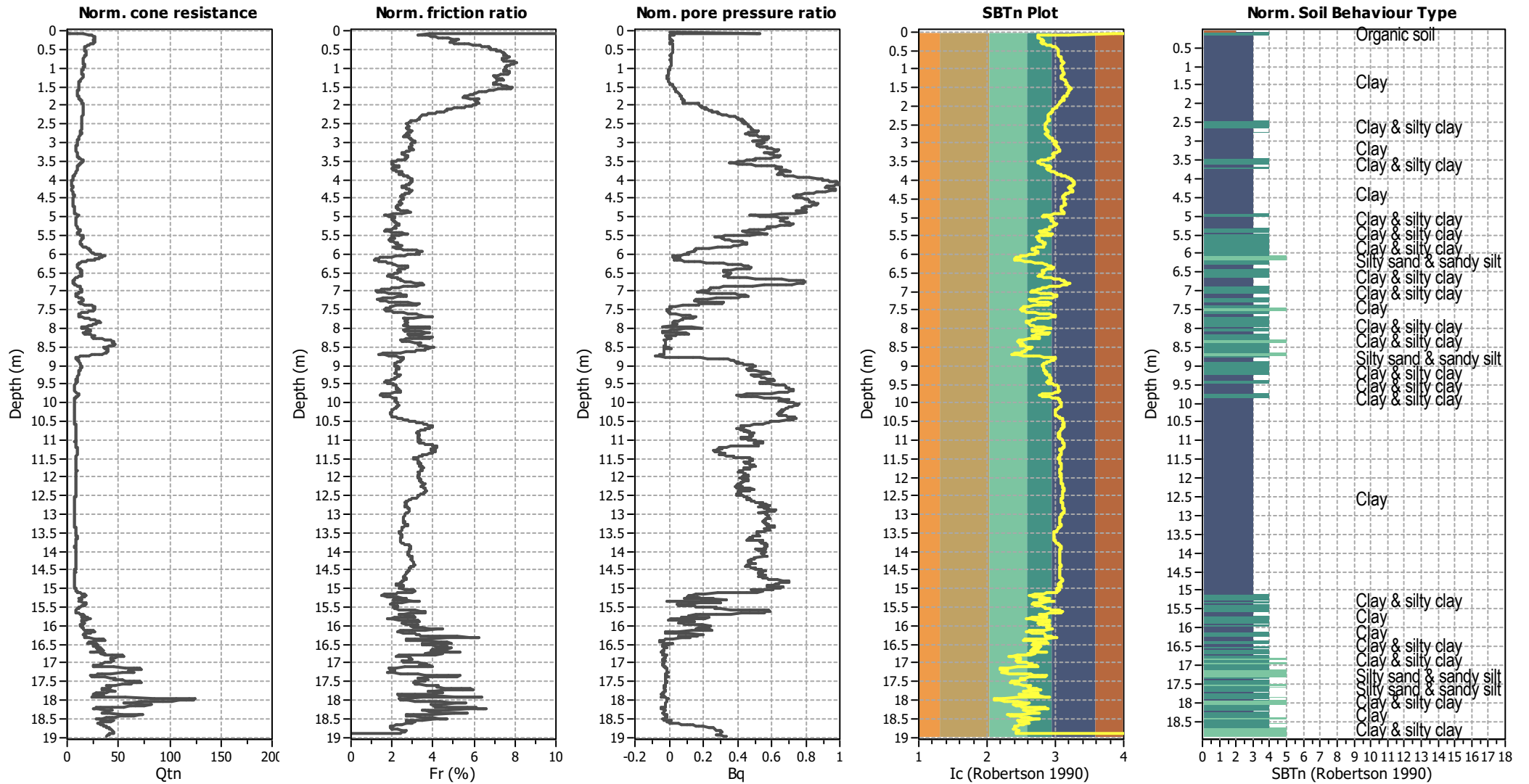
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>g</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



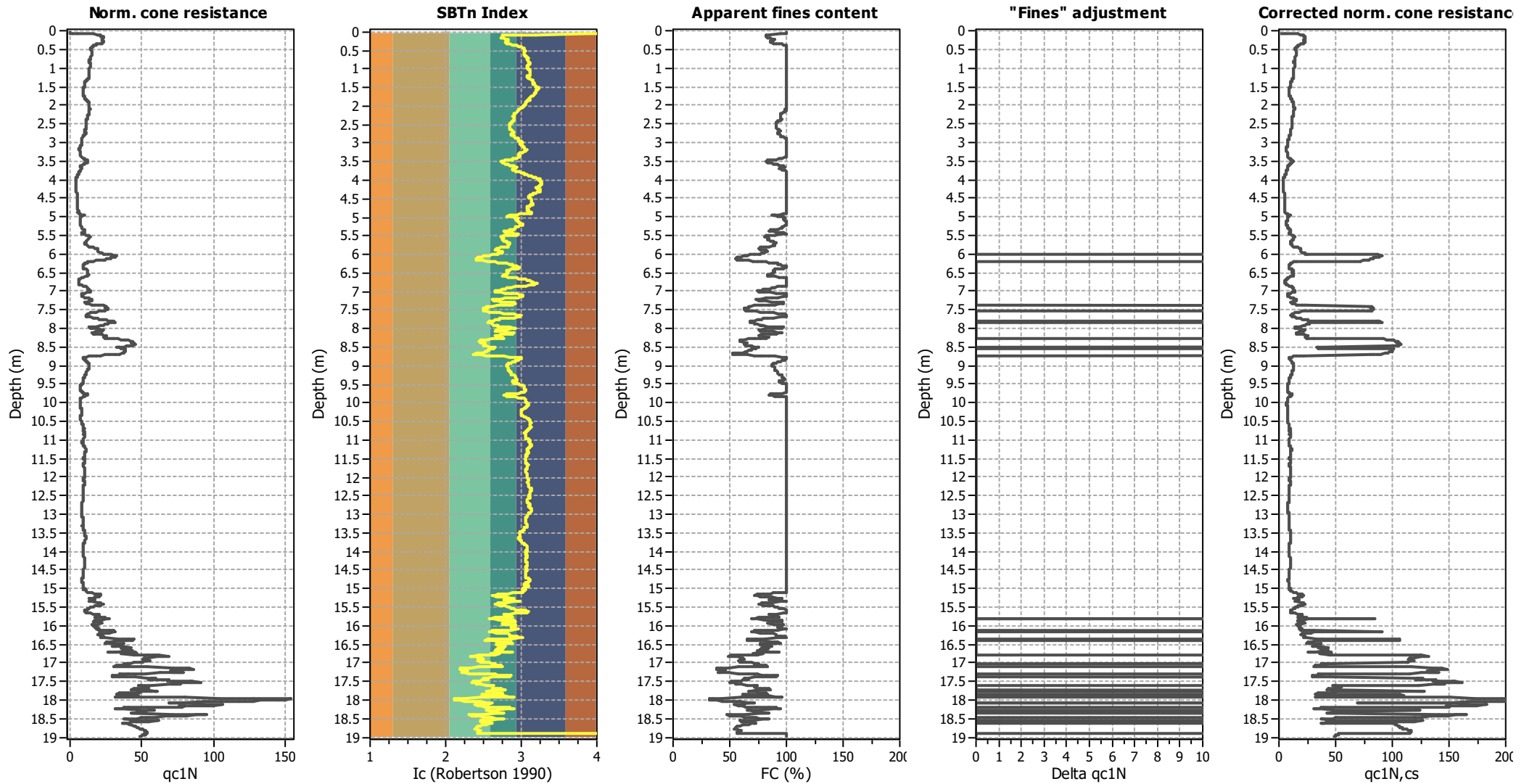
**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

**SBTn legend**

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

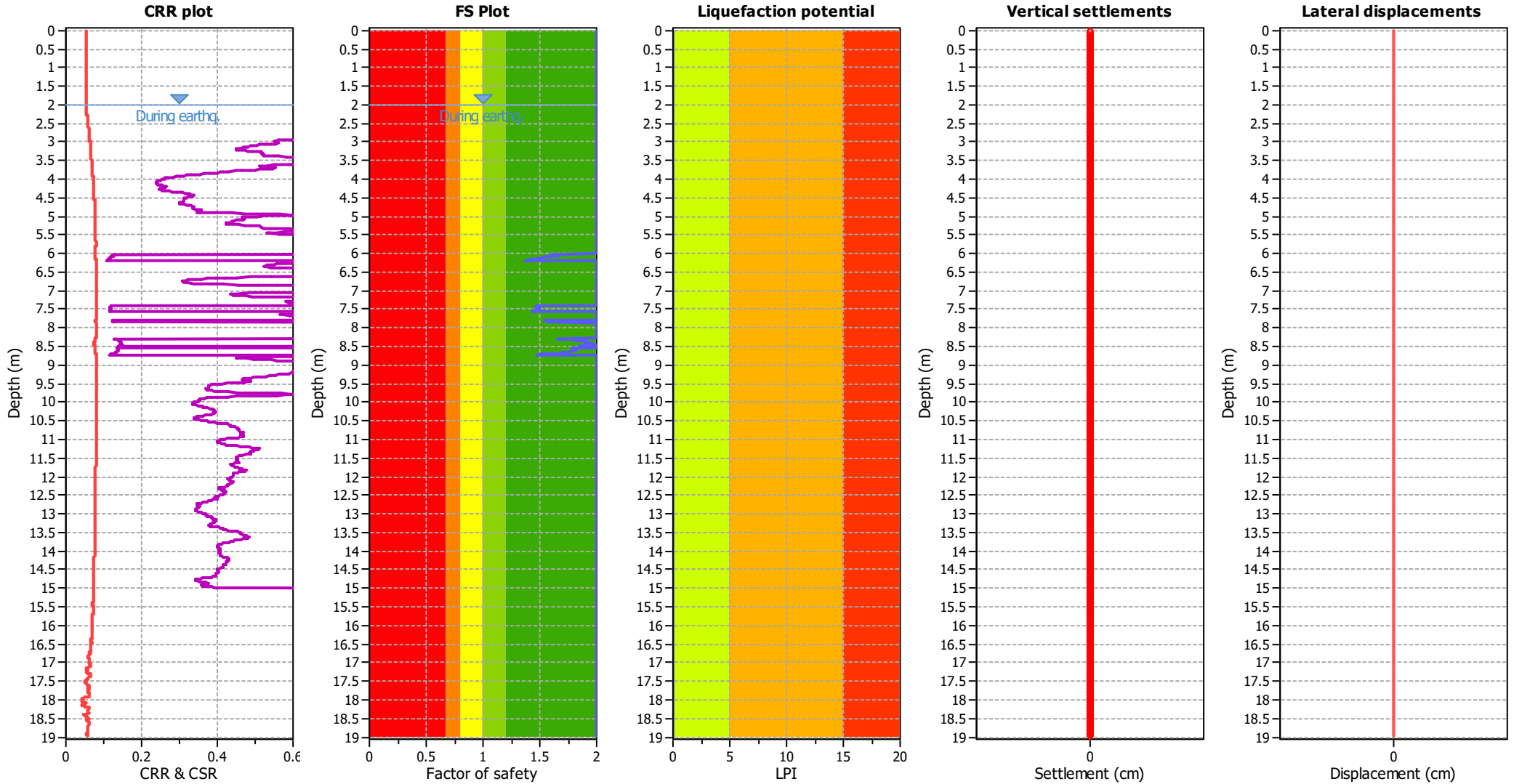


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

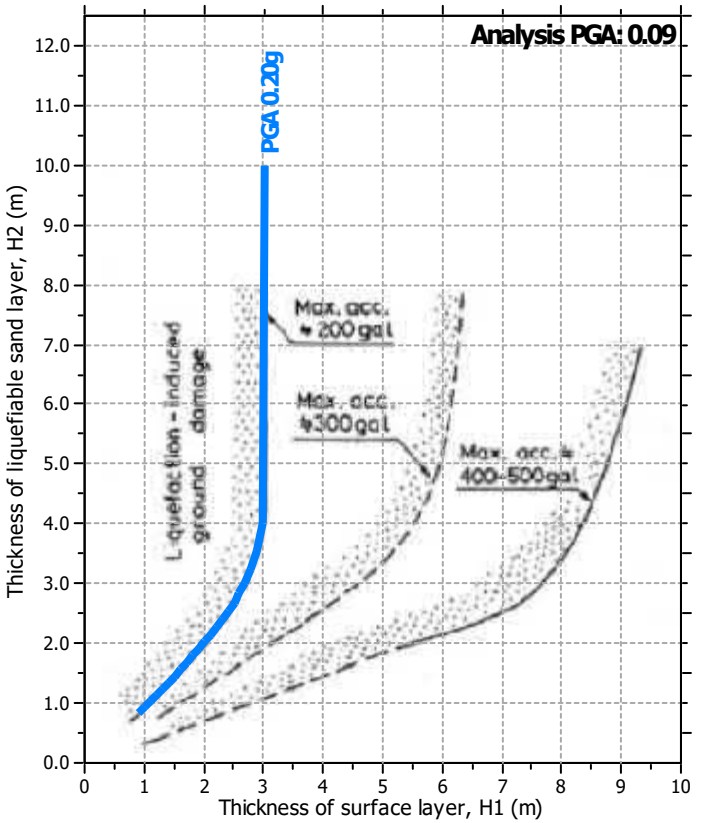
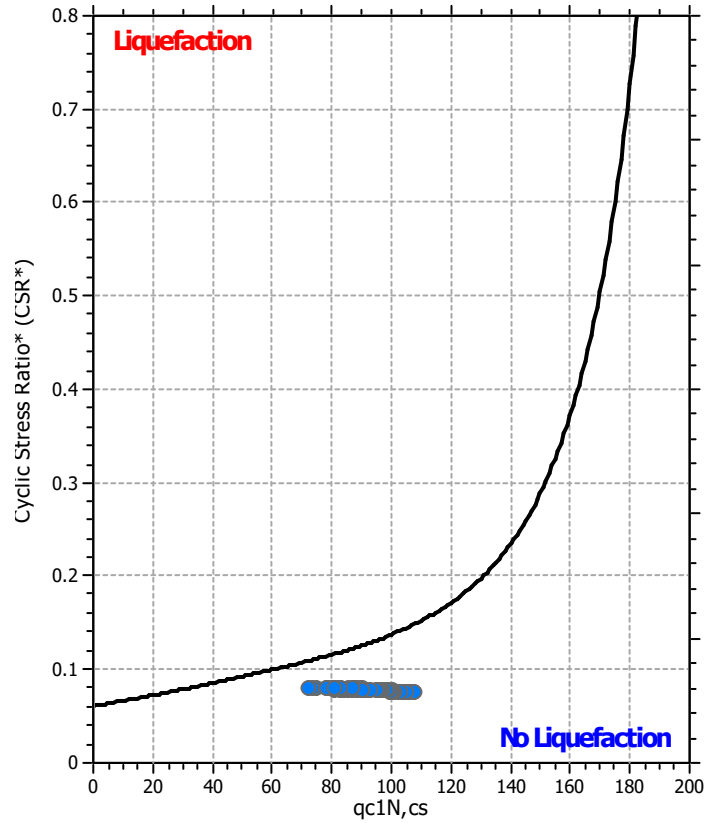
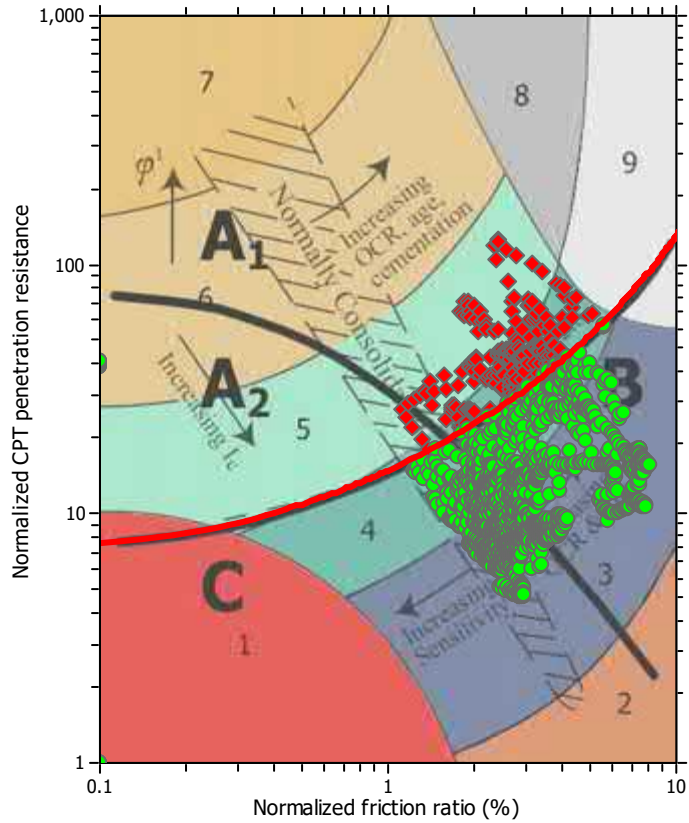
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	15.00 m

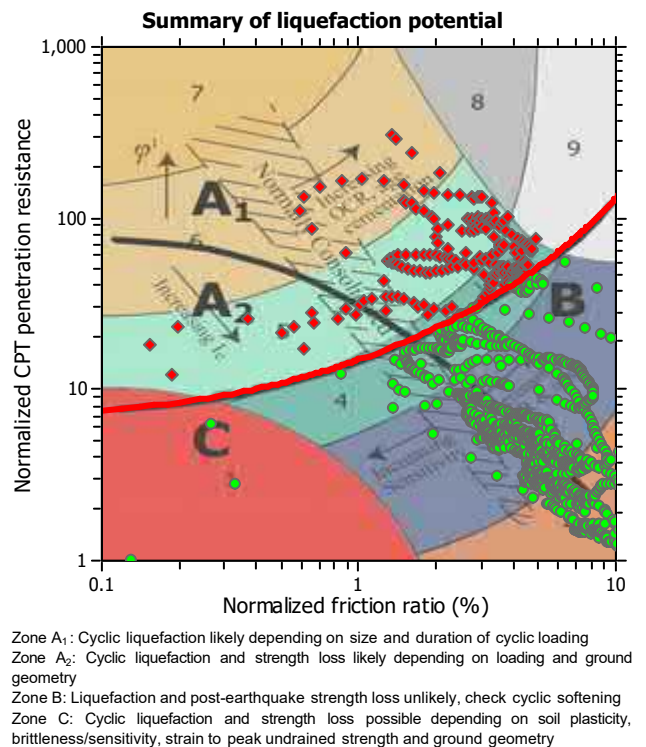
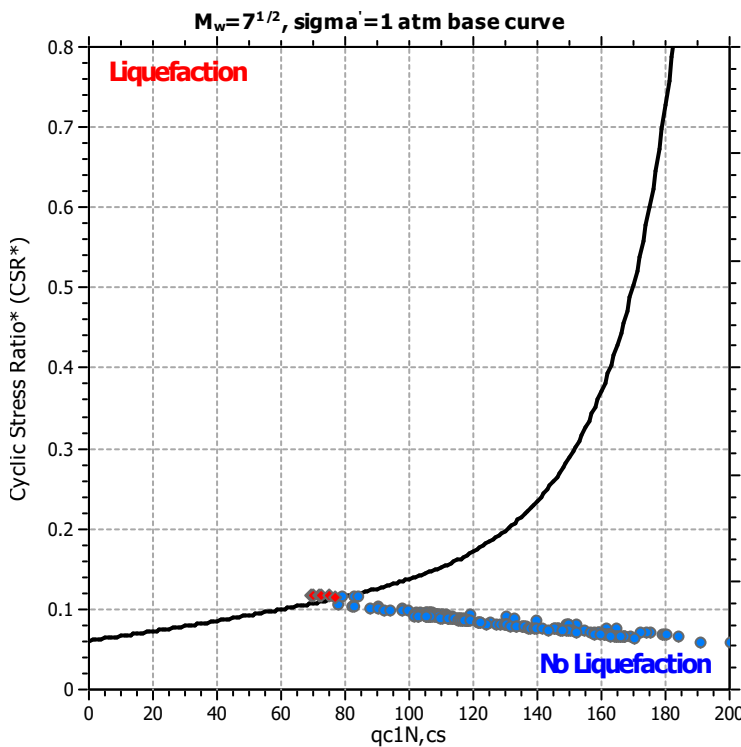
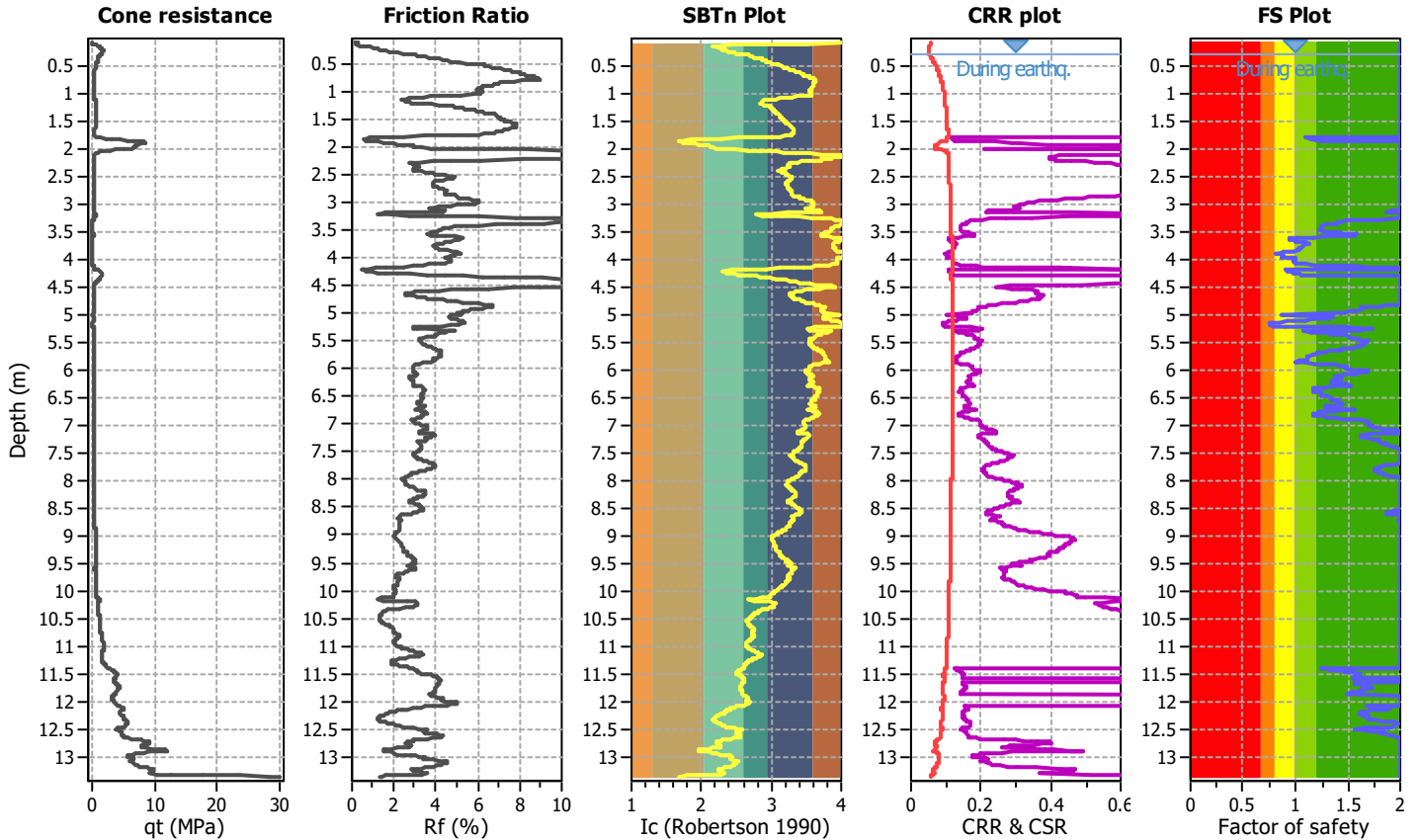
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT4-1/100**

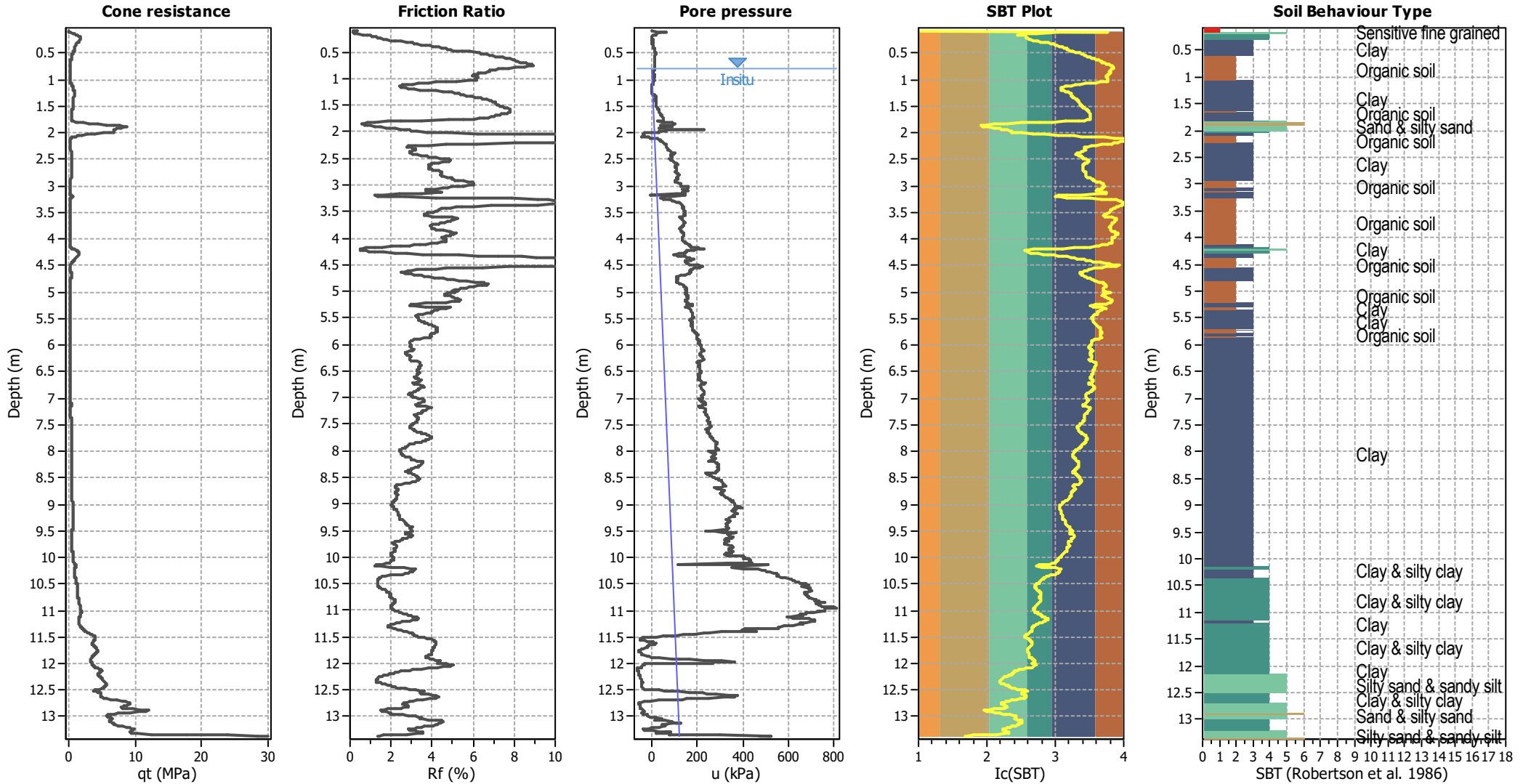
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

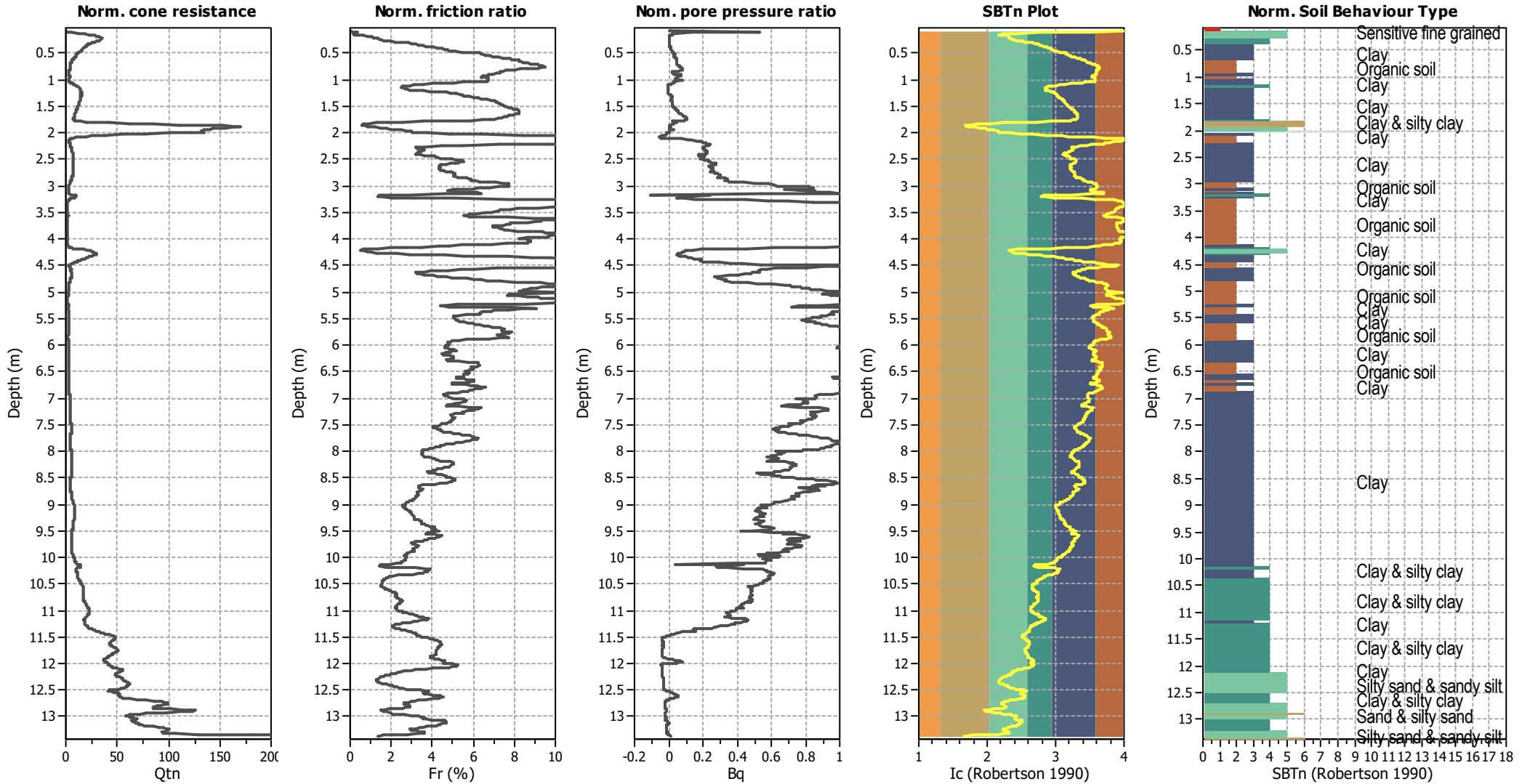
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



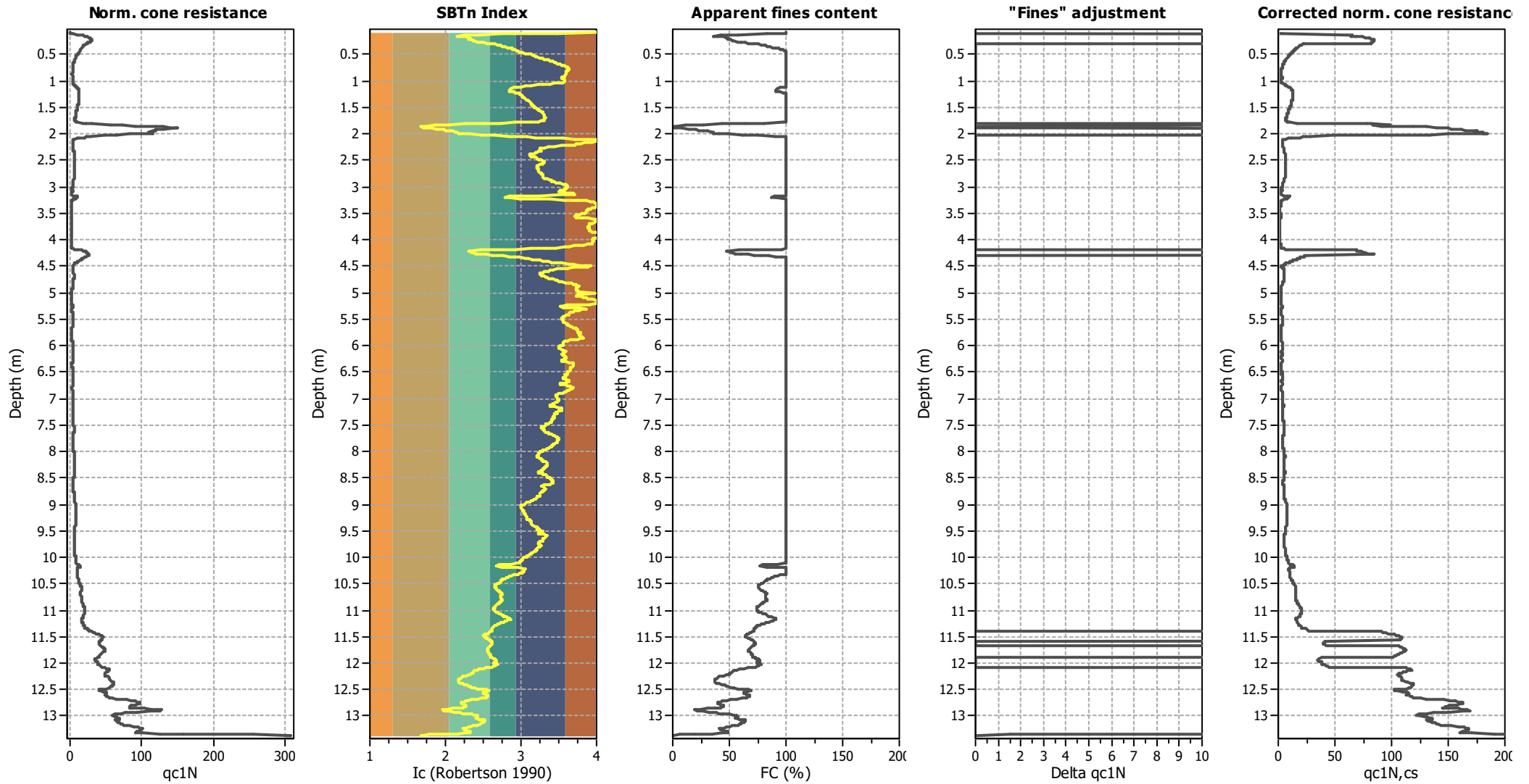
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

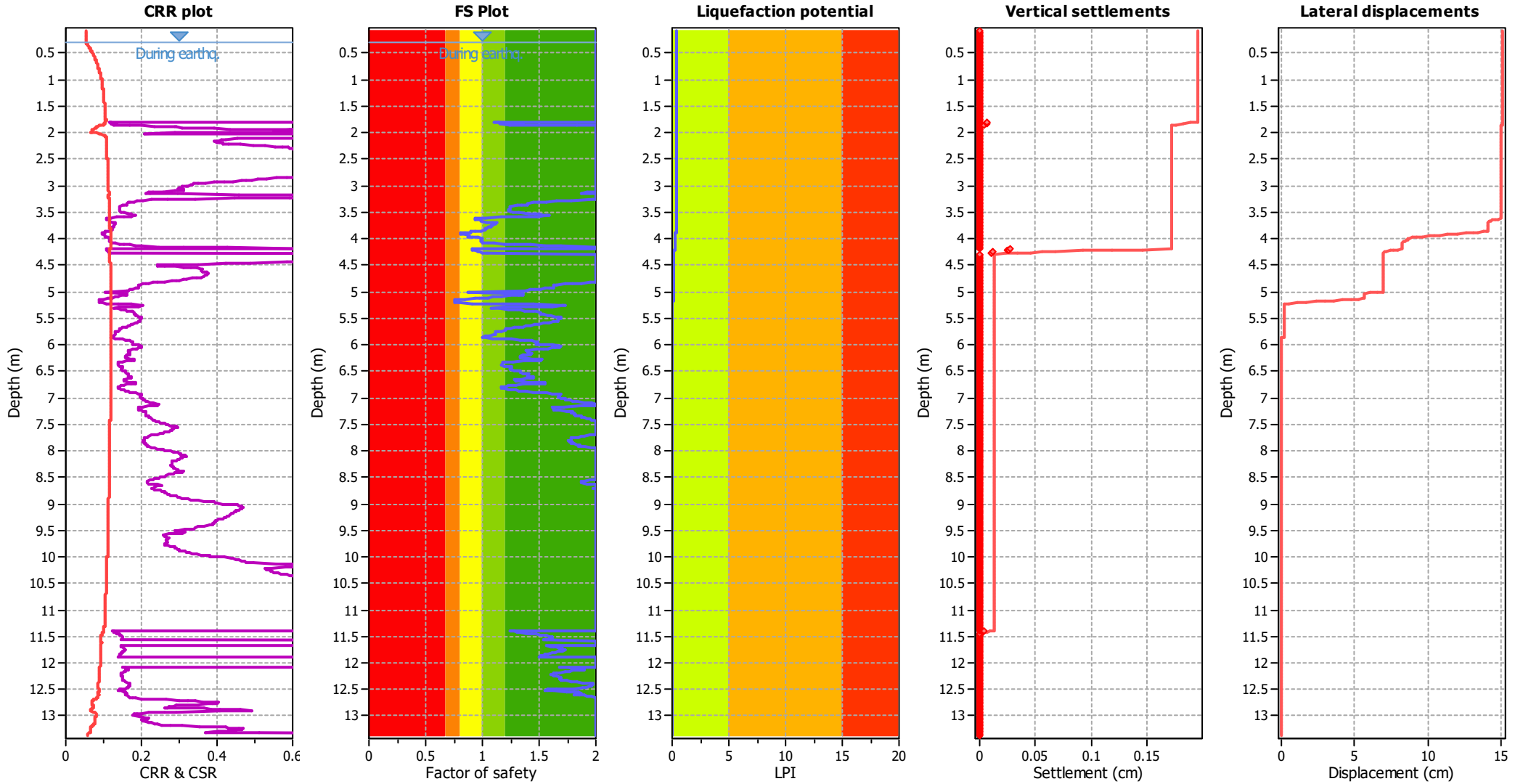
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

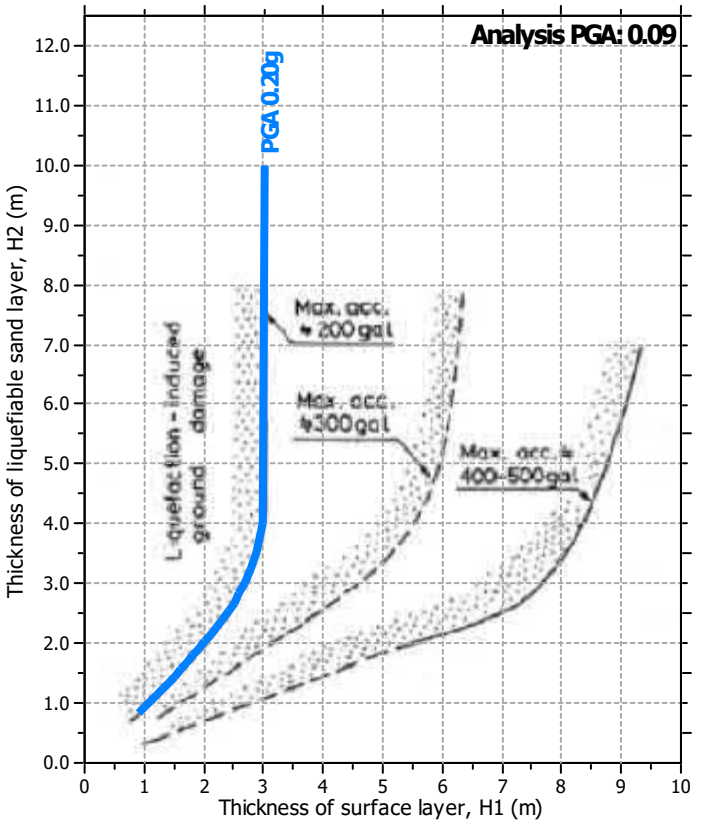
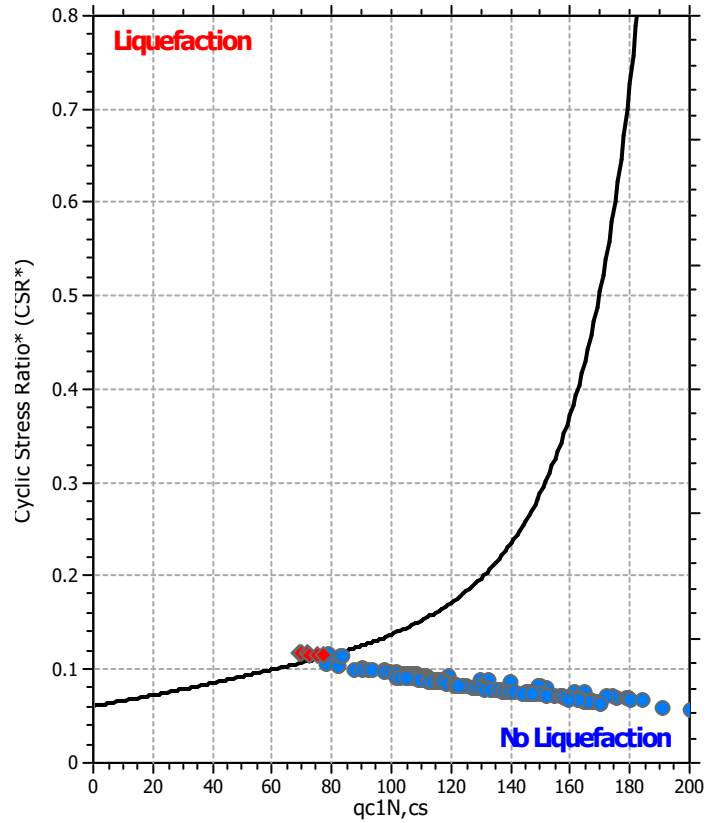
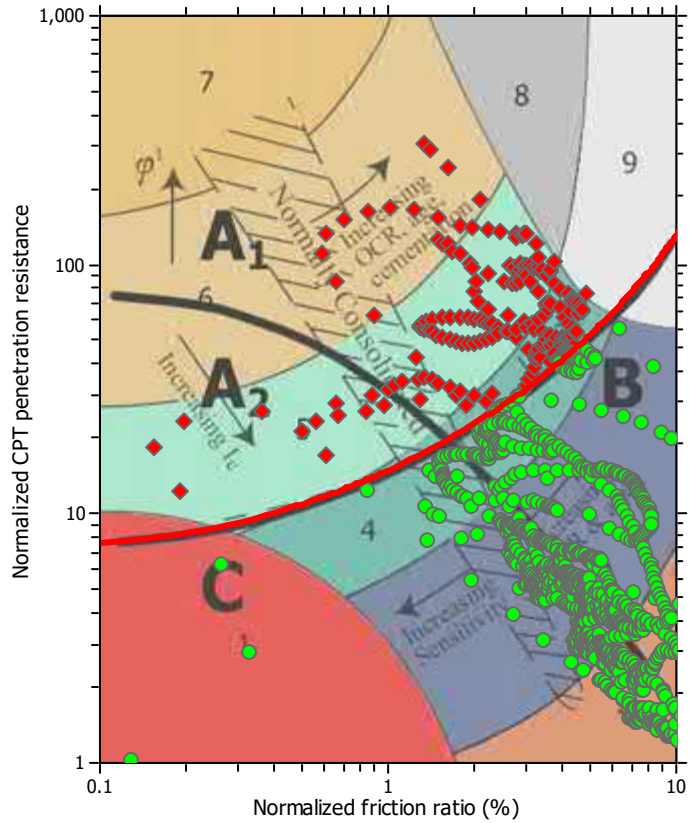
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A



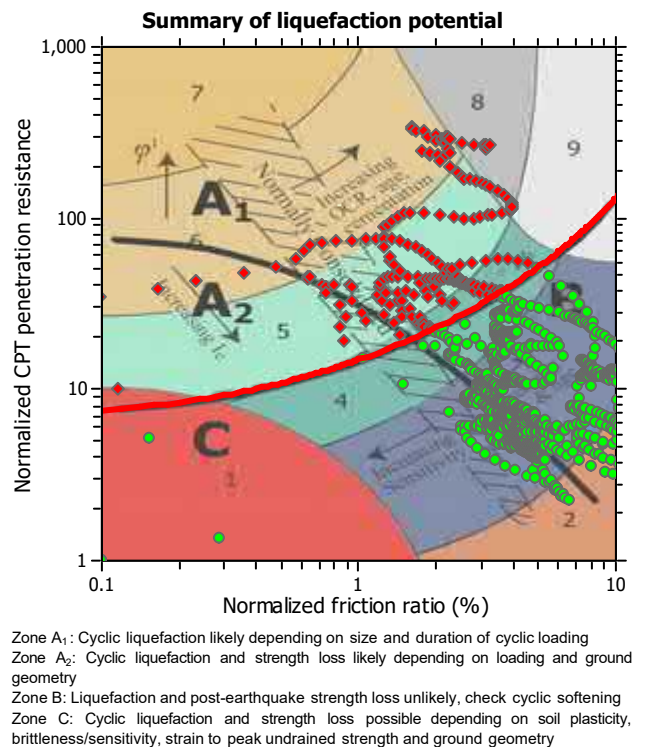
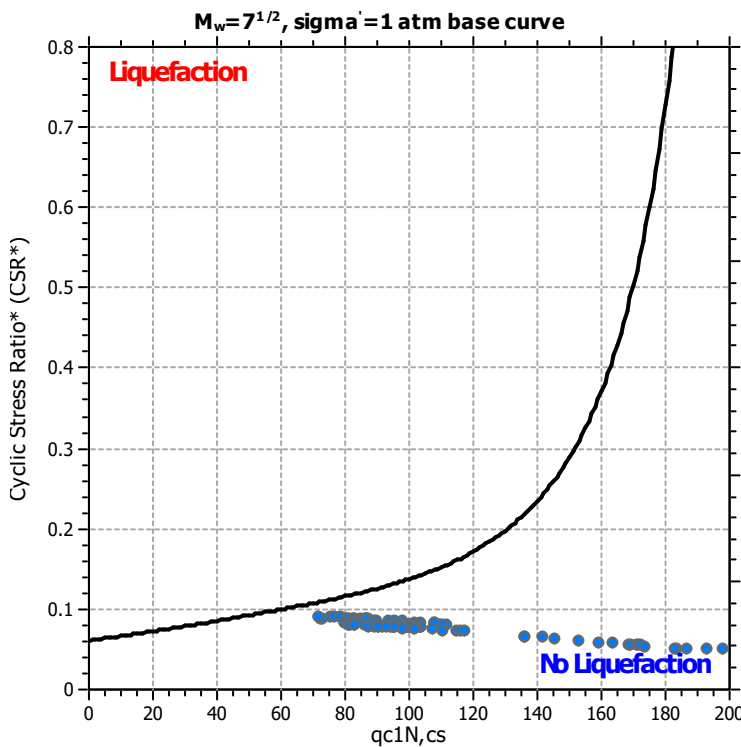
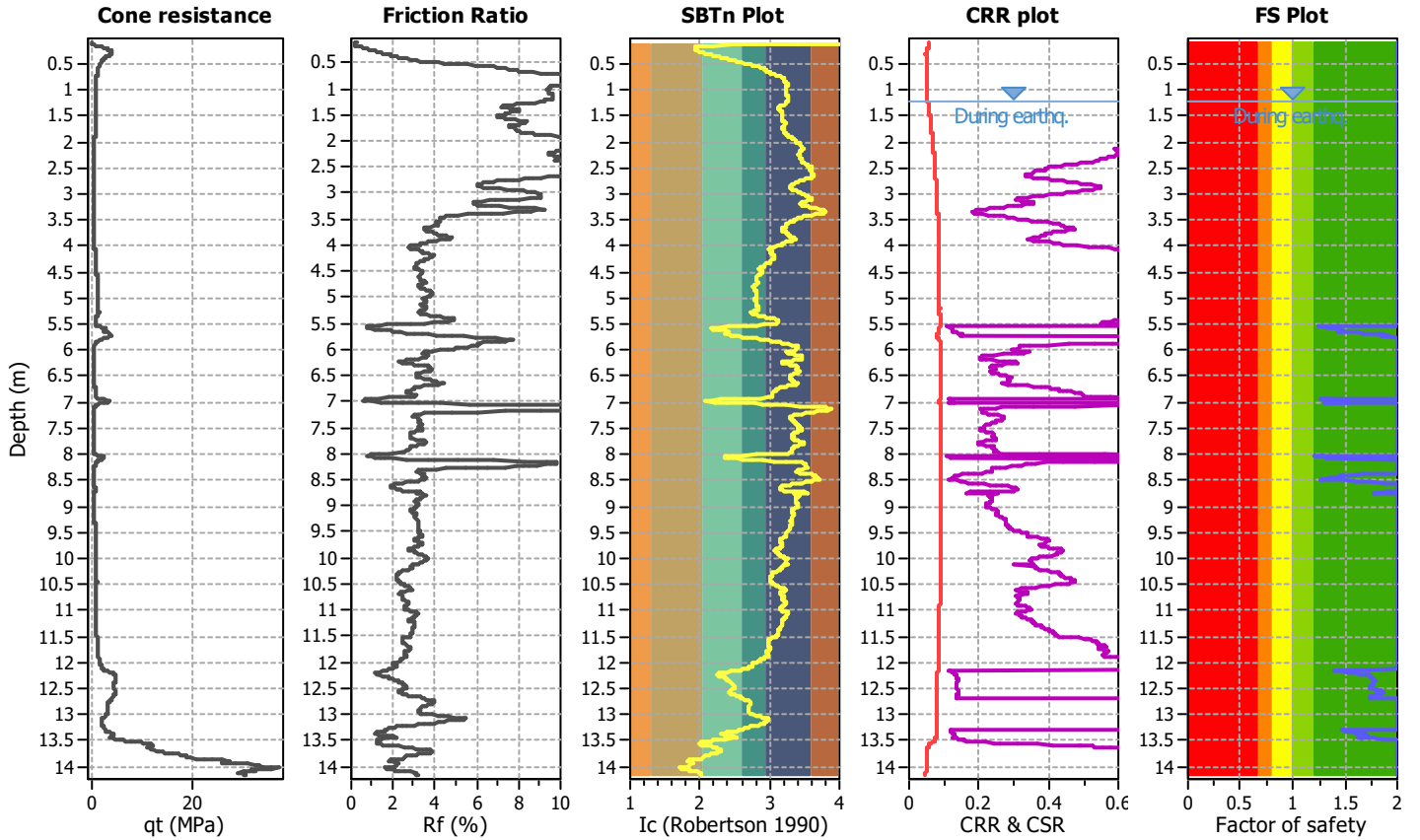
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT5-1/100**

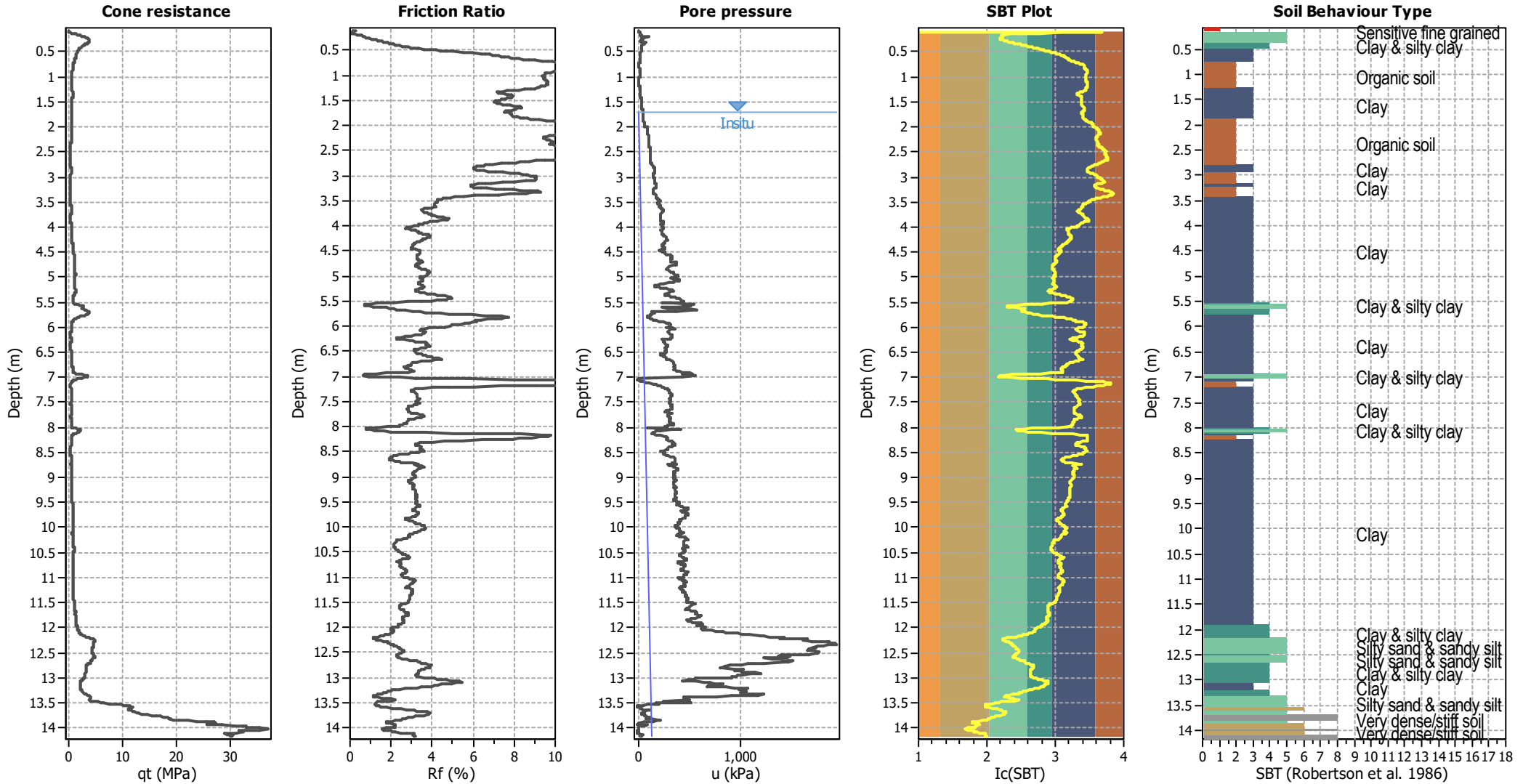
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.20 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



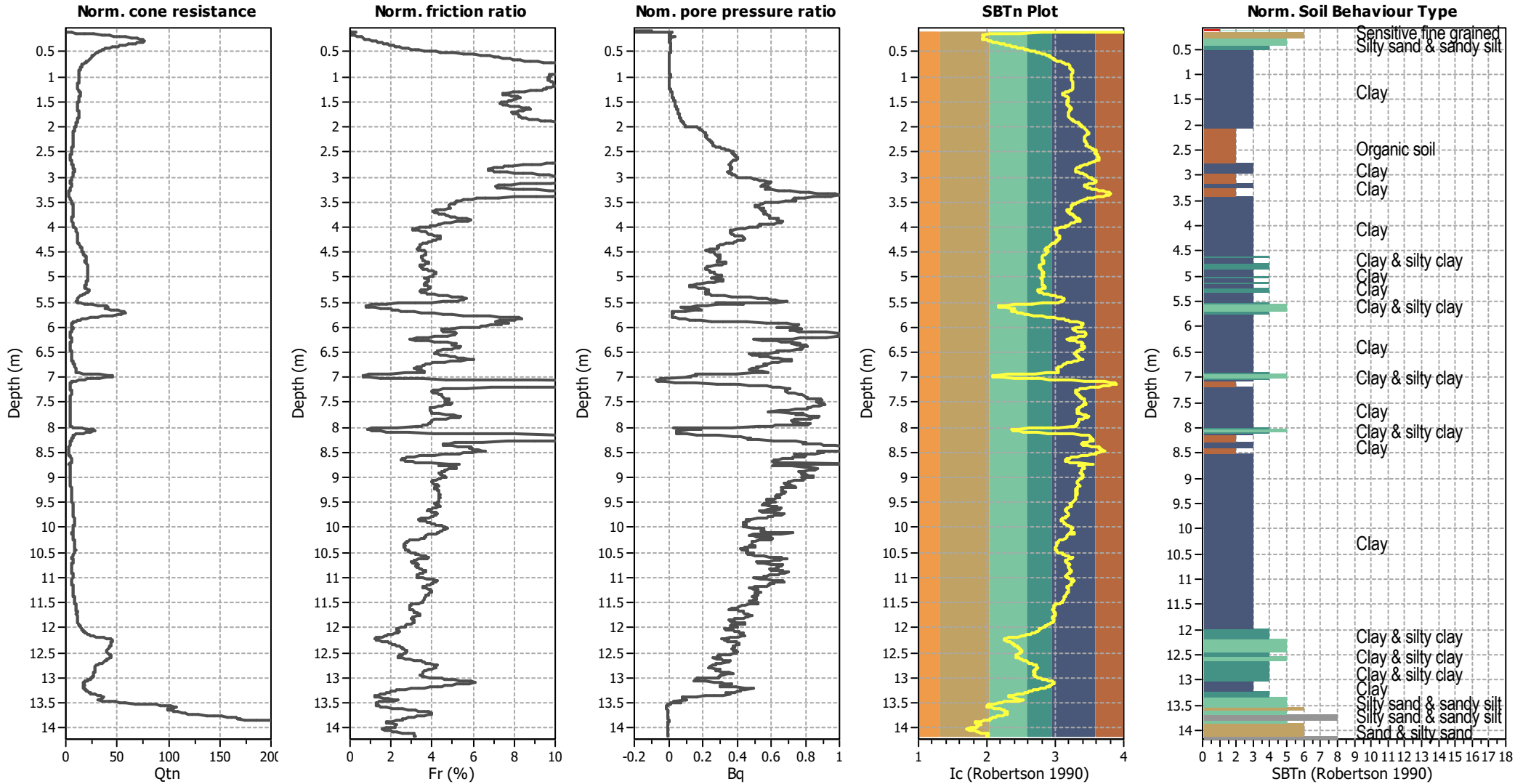
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



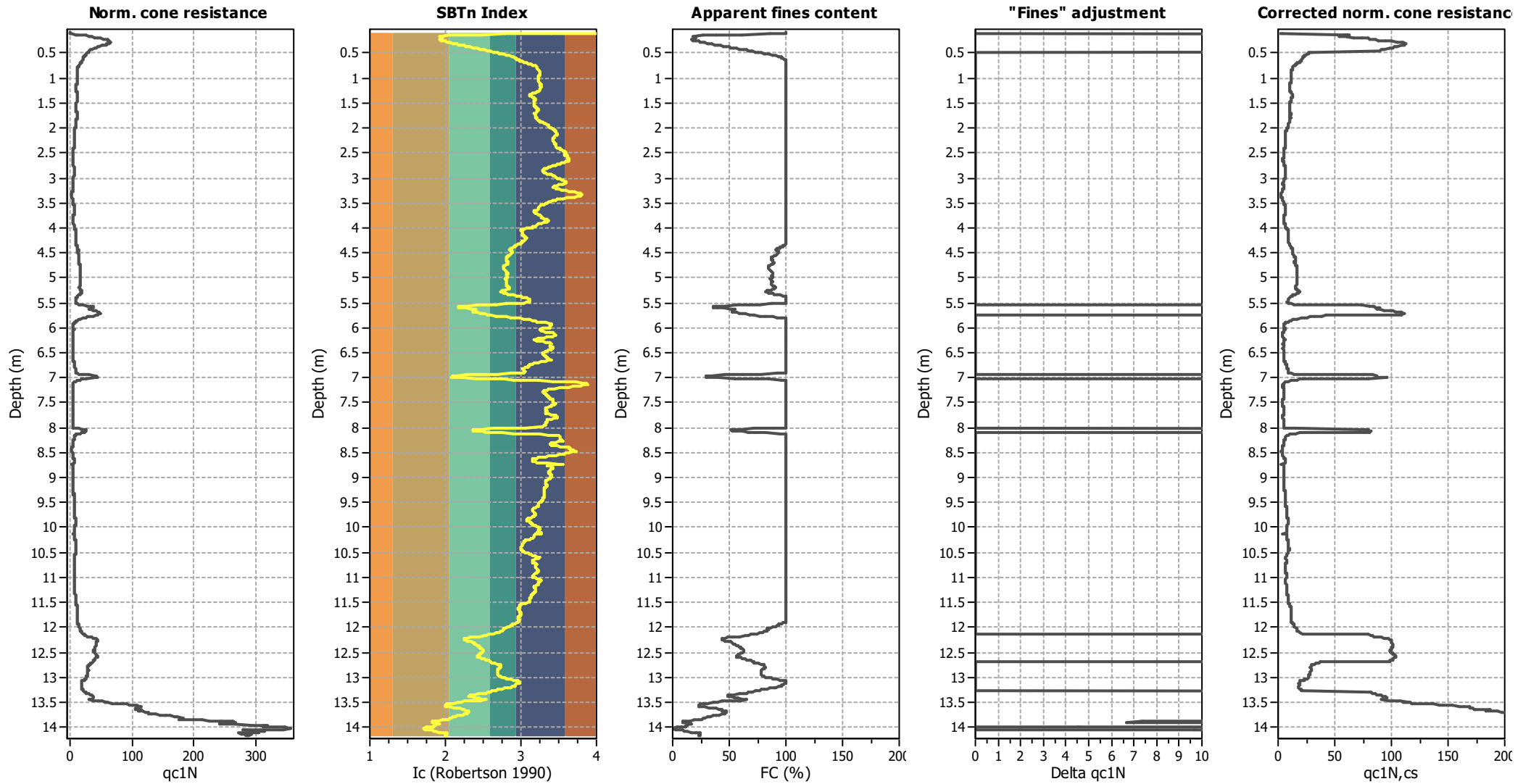
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

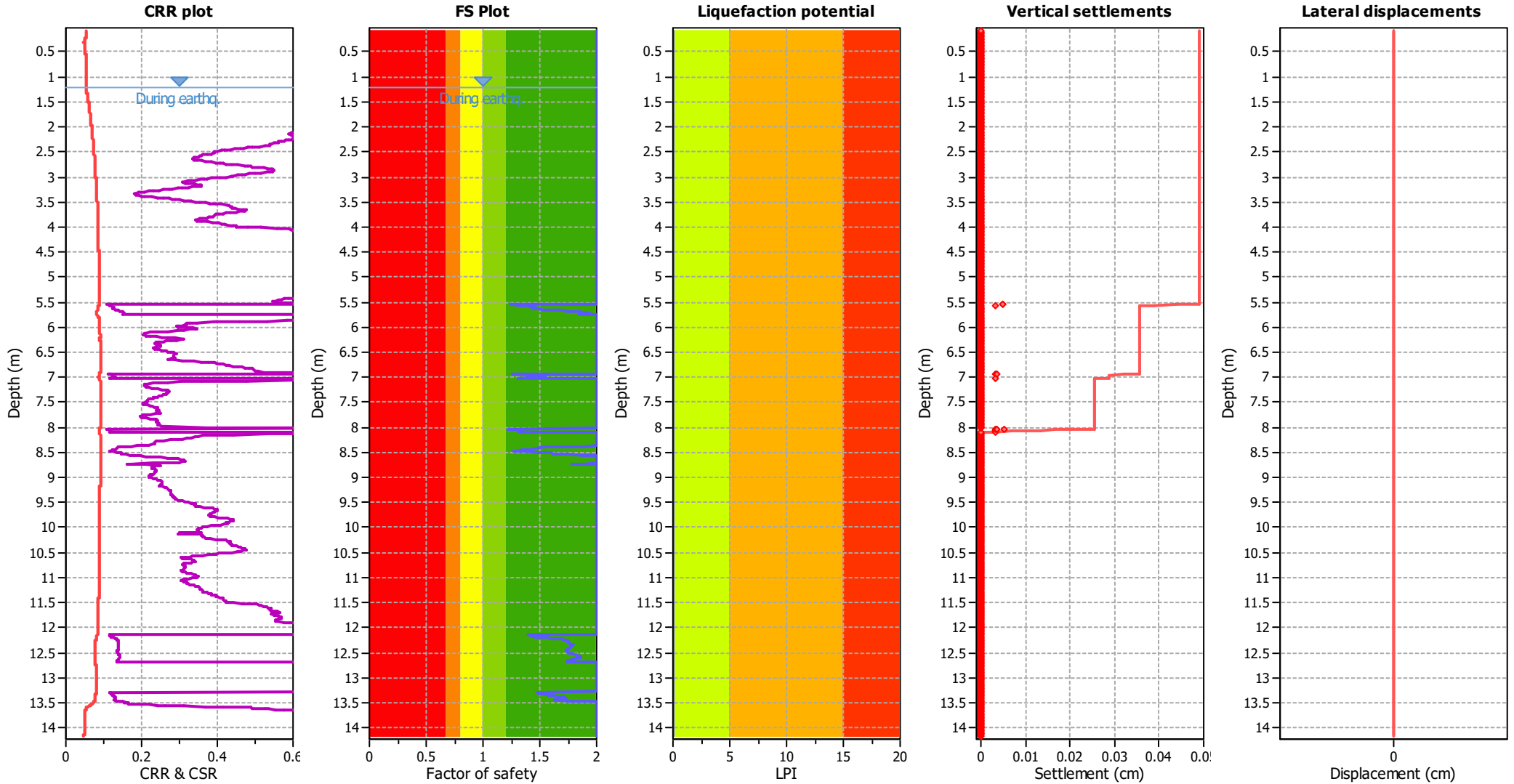


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

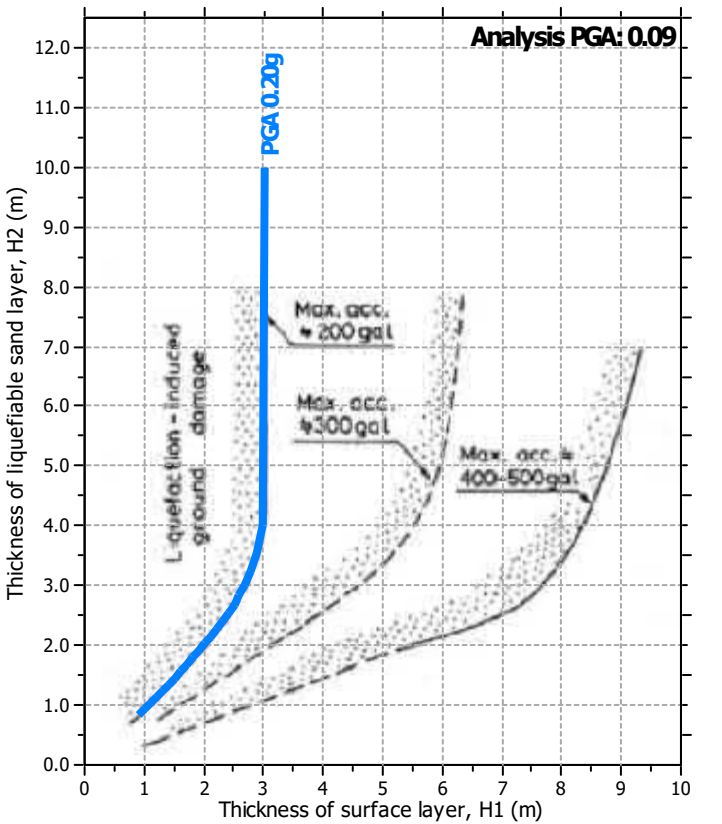
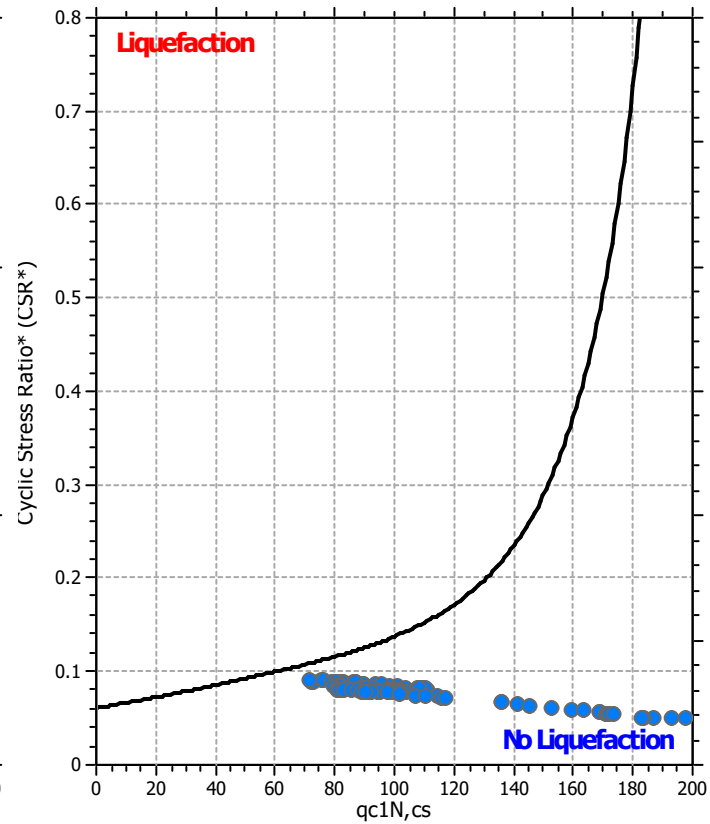
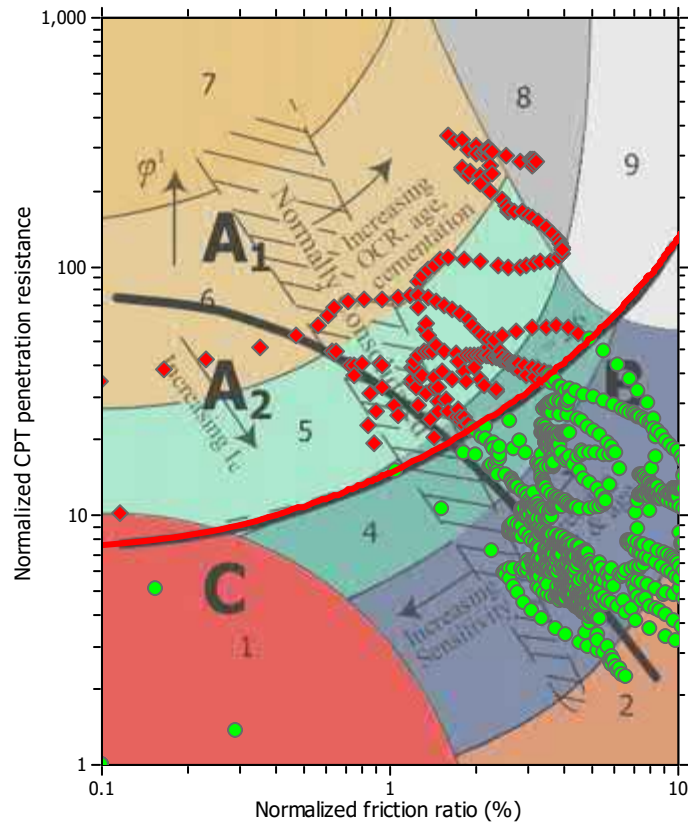
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

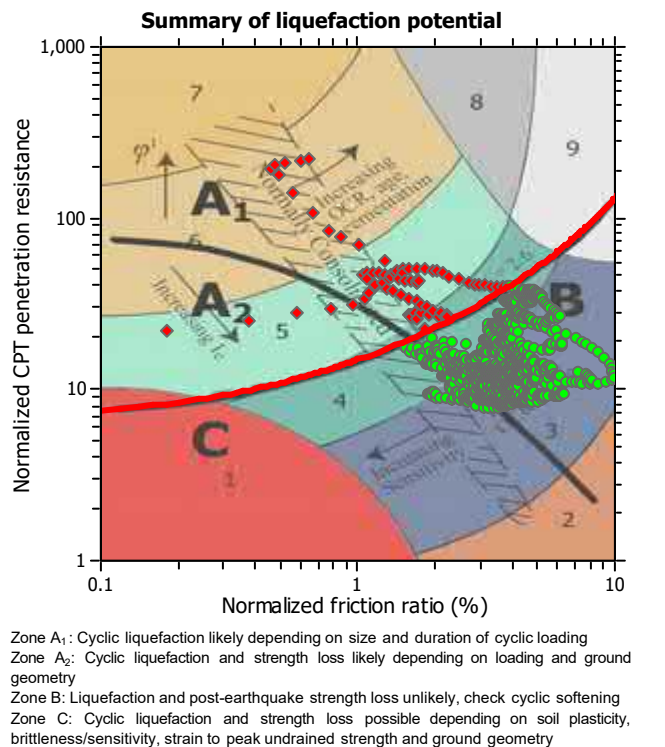
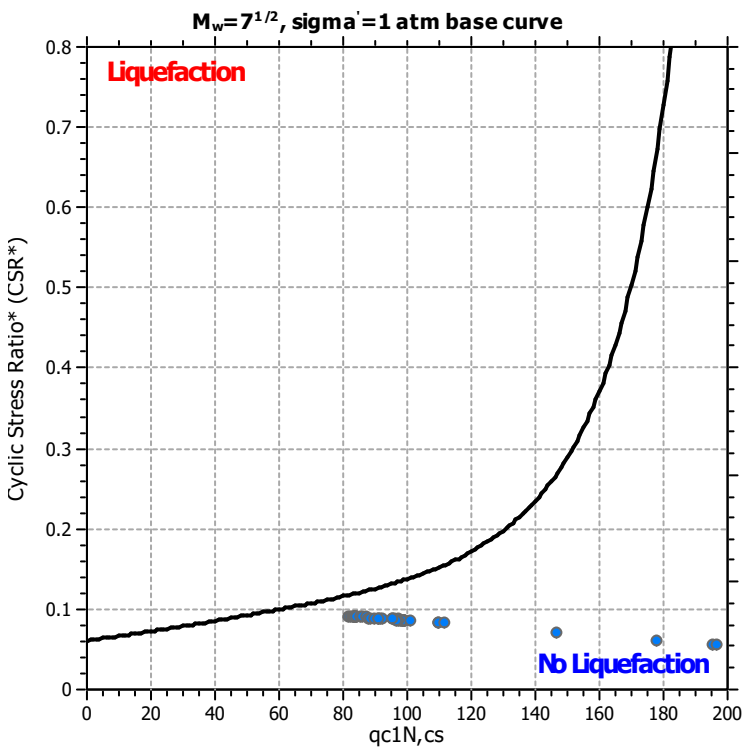
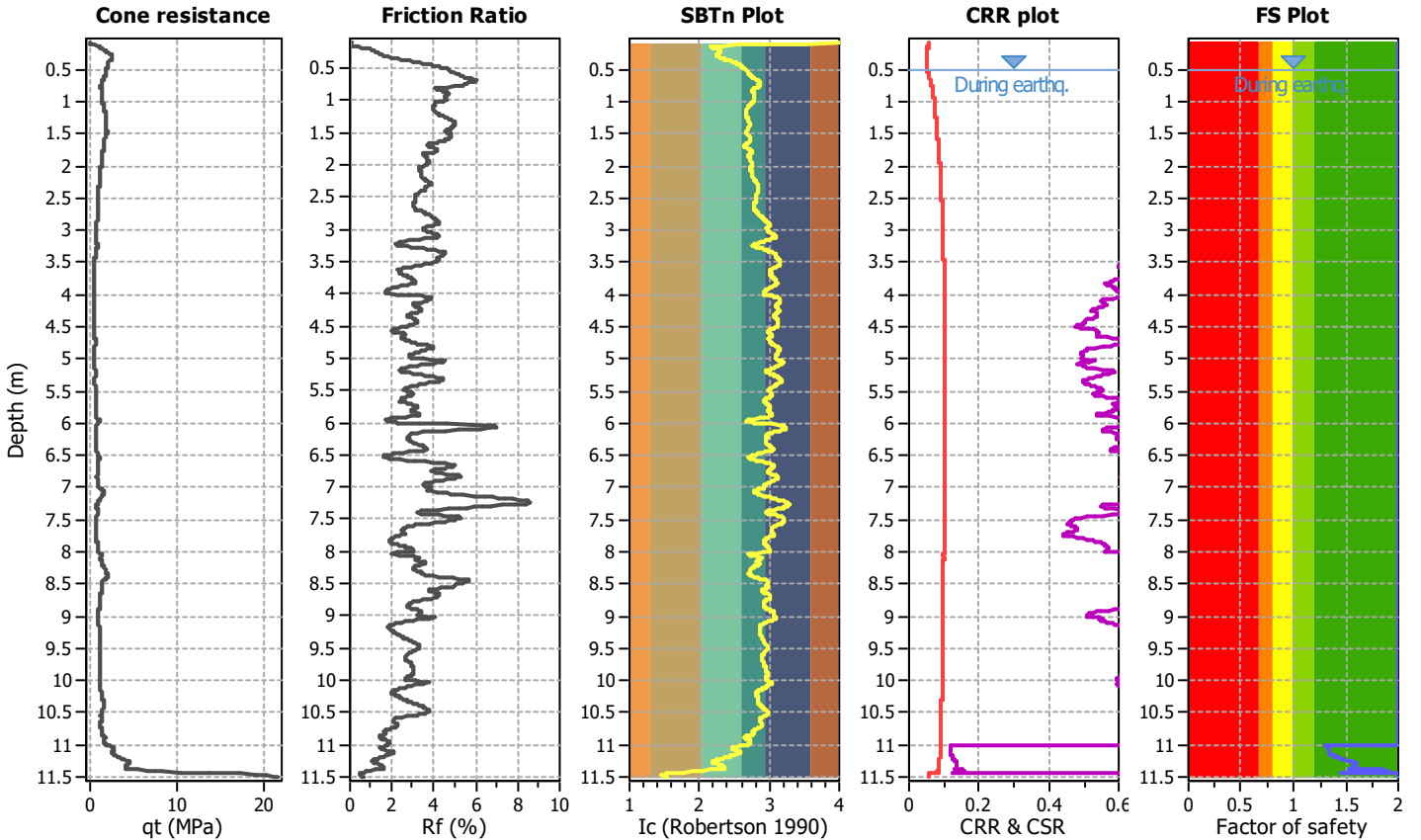
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT6-1/100**

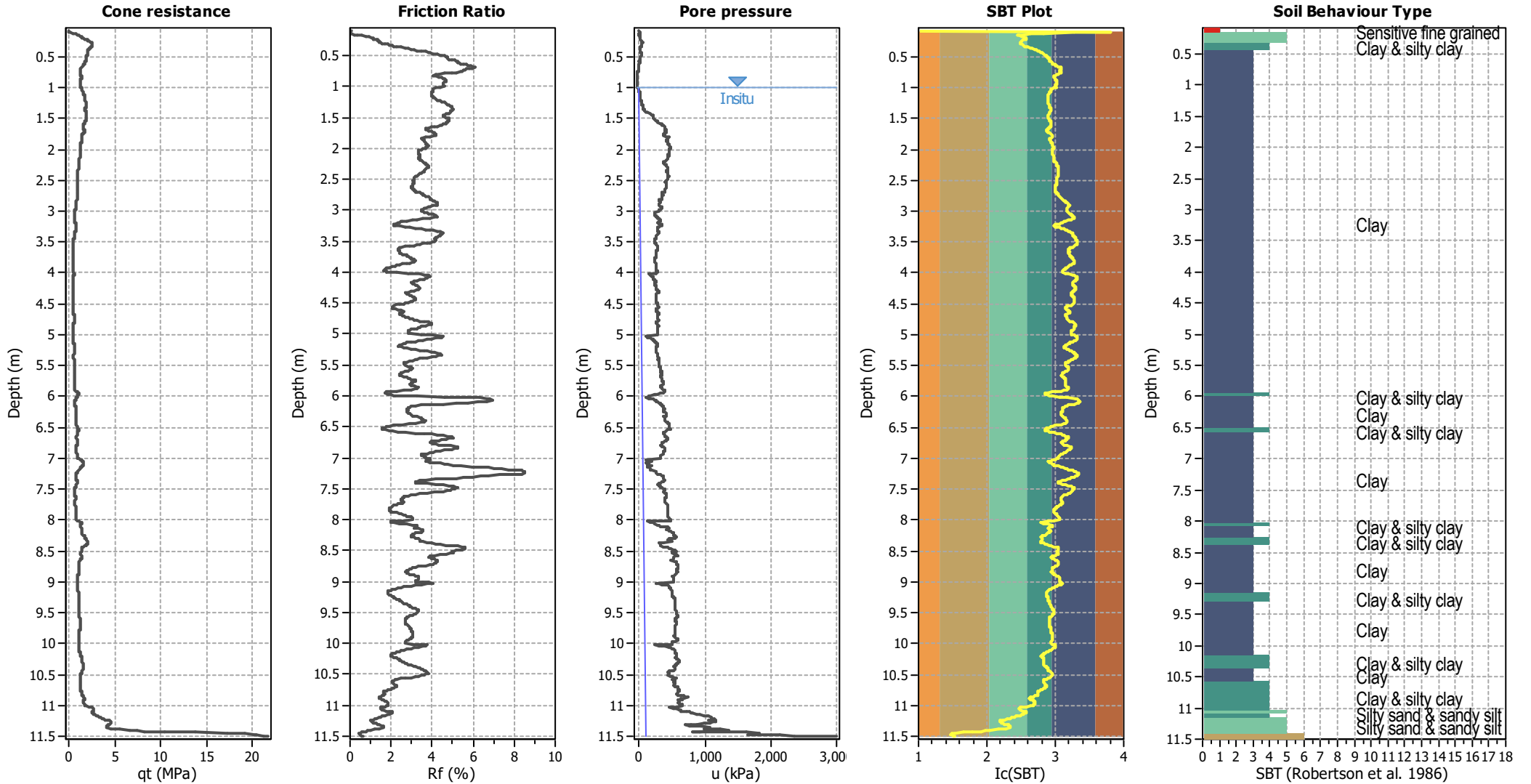
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

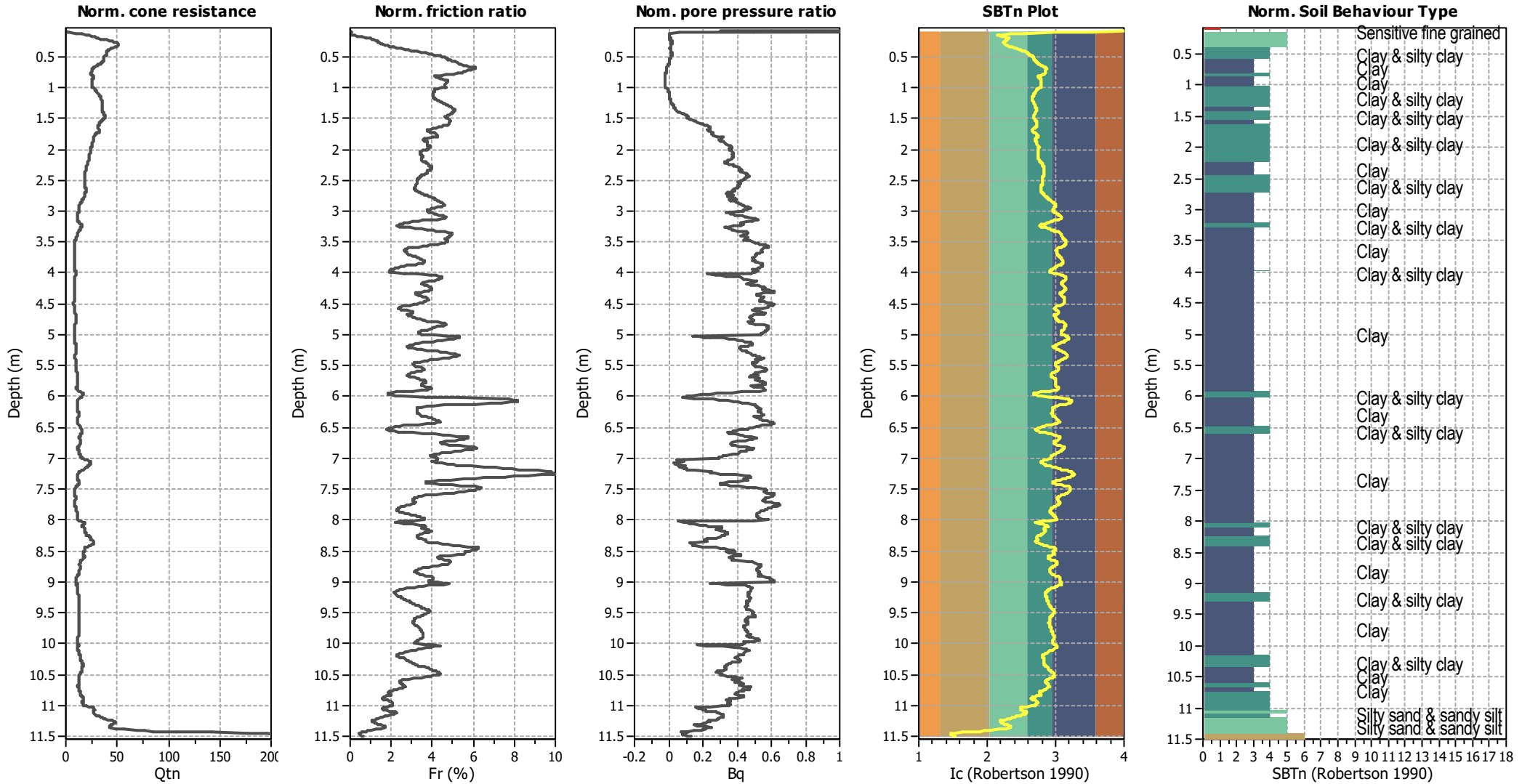
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



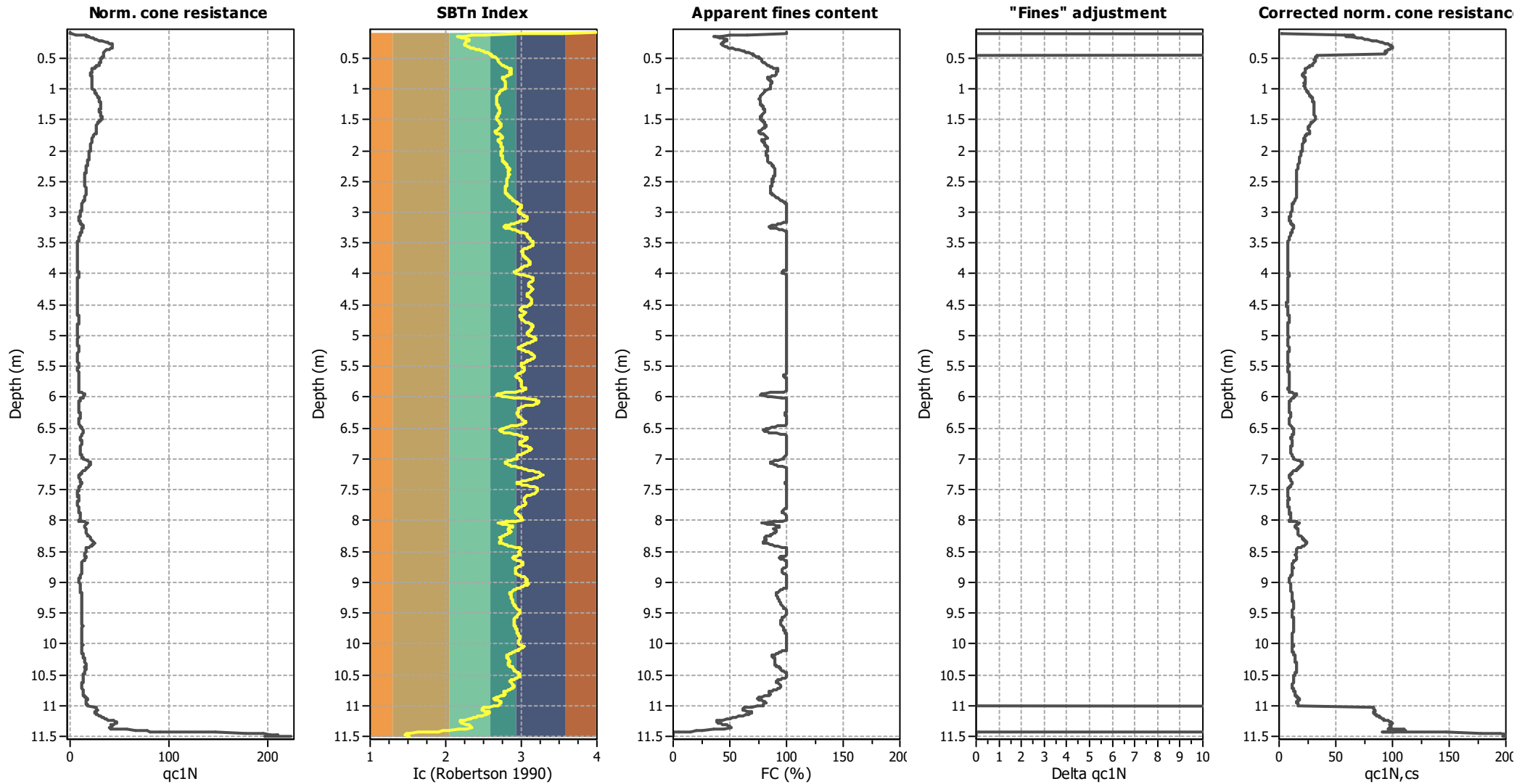
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

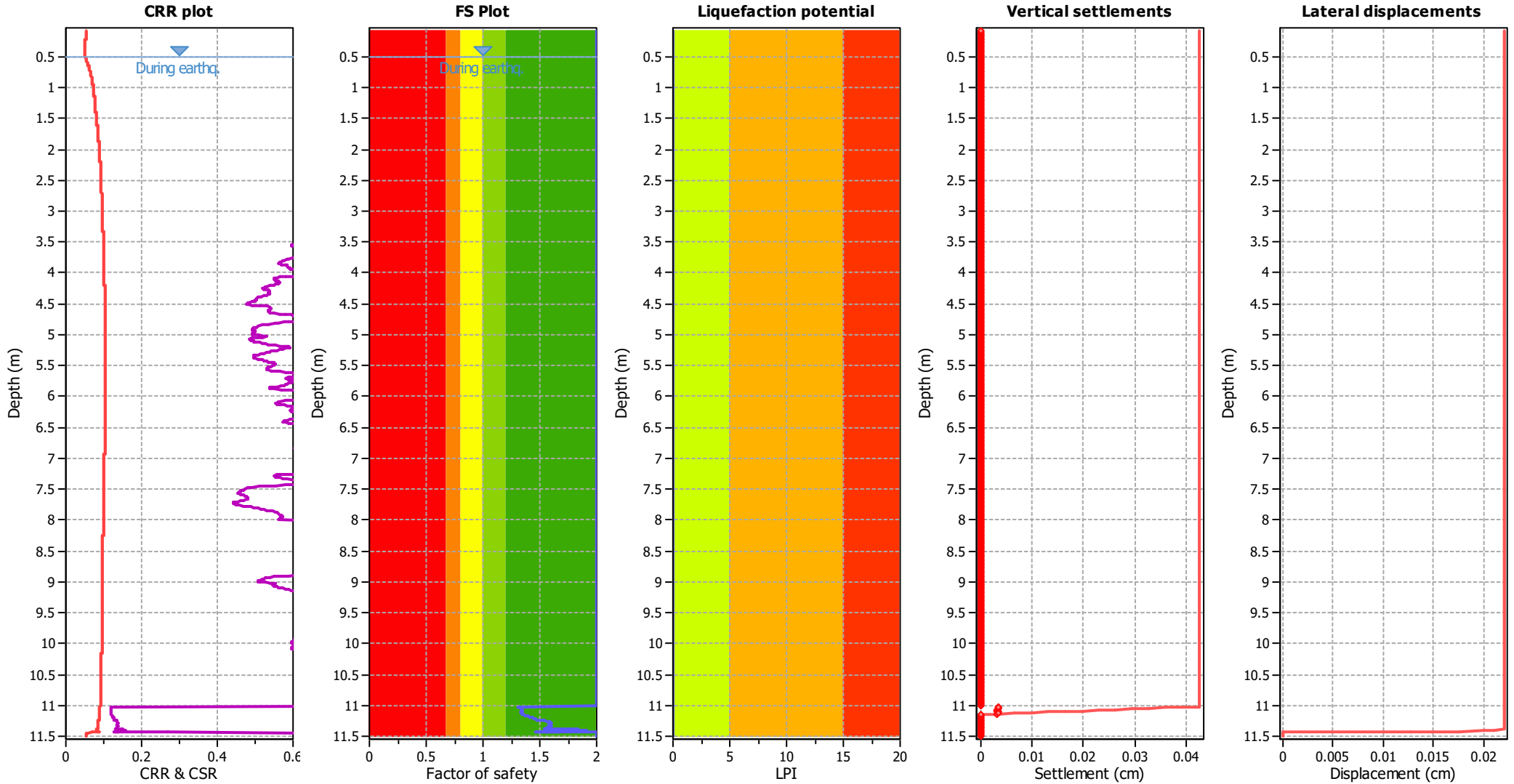
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

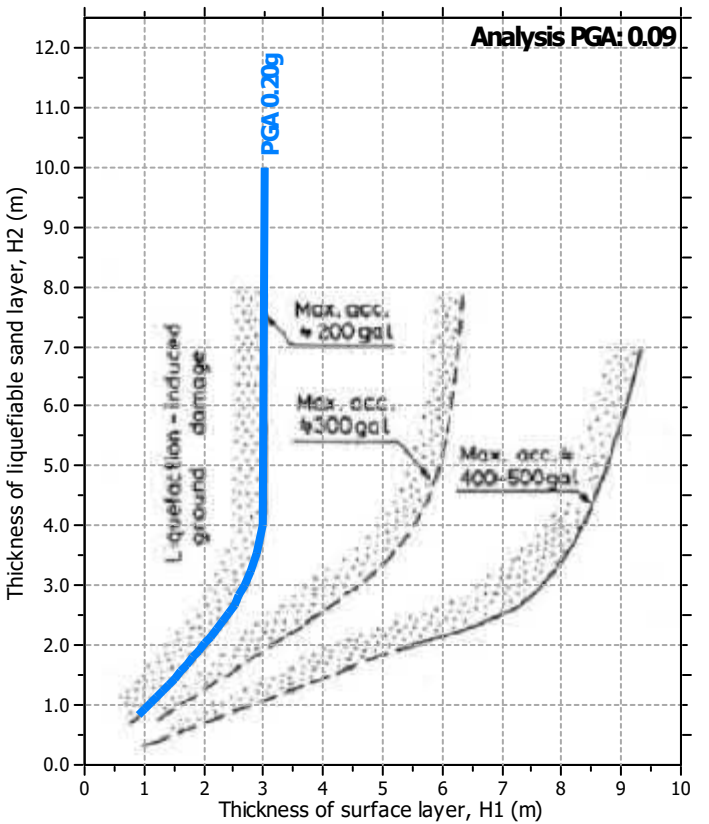
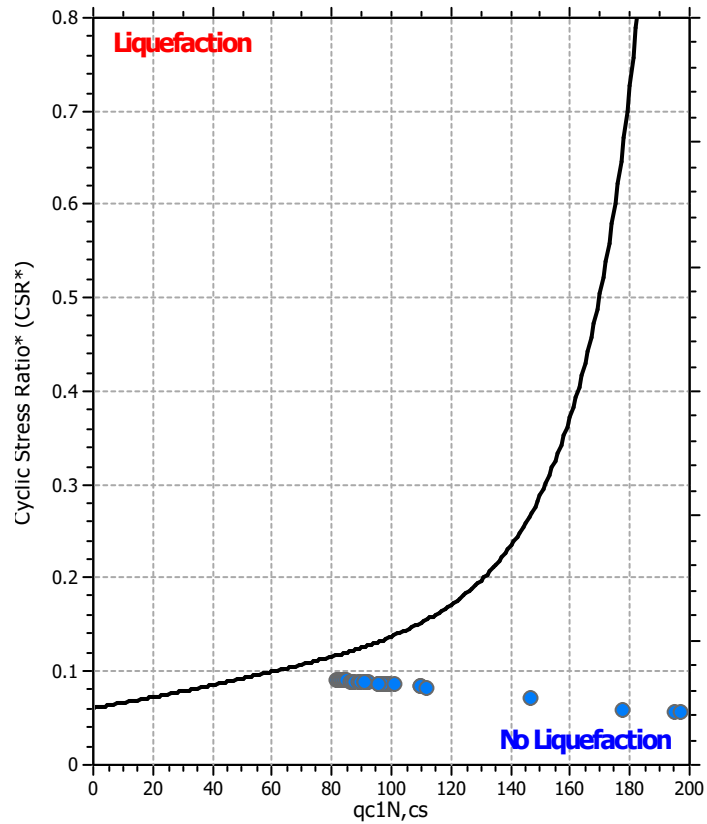
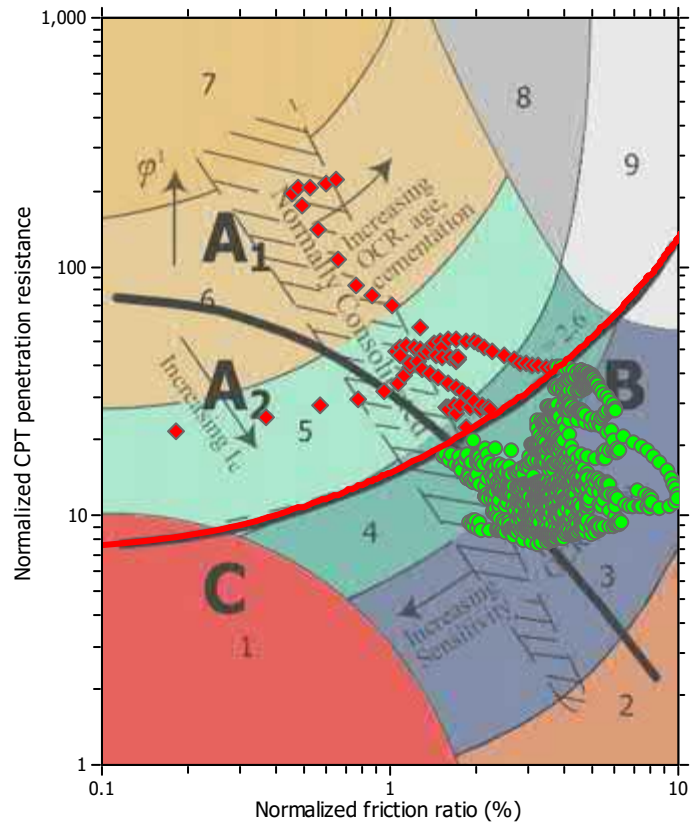
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on $I_c$ value	$I_c$ cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A



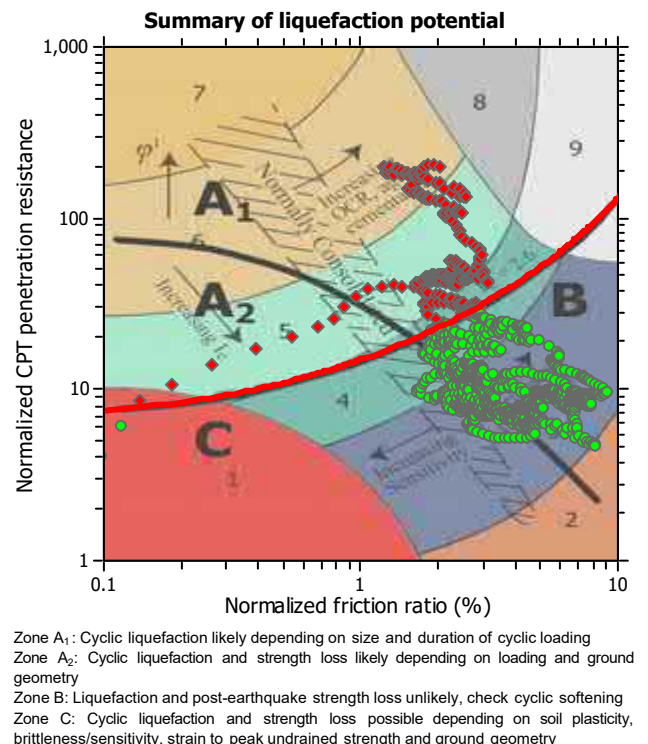
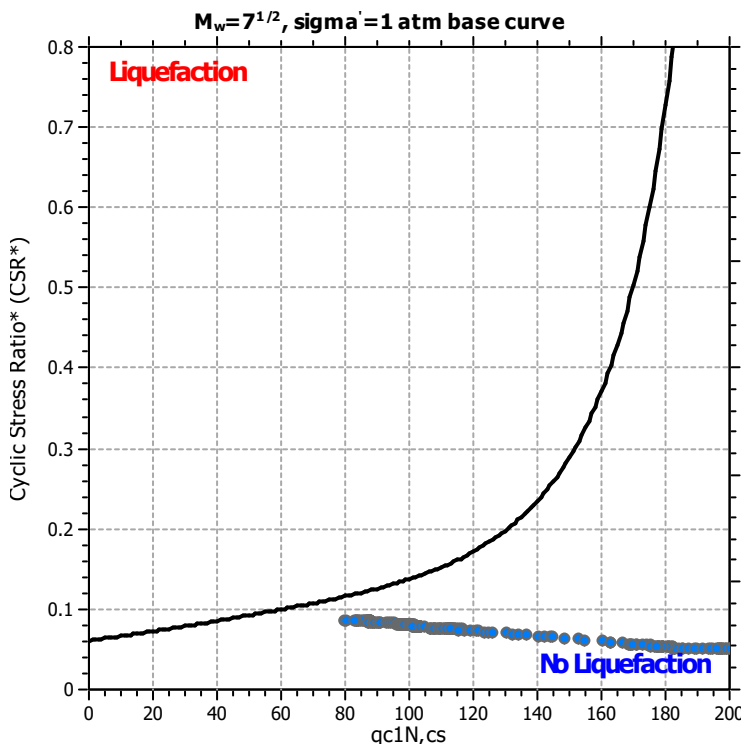
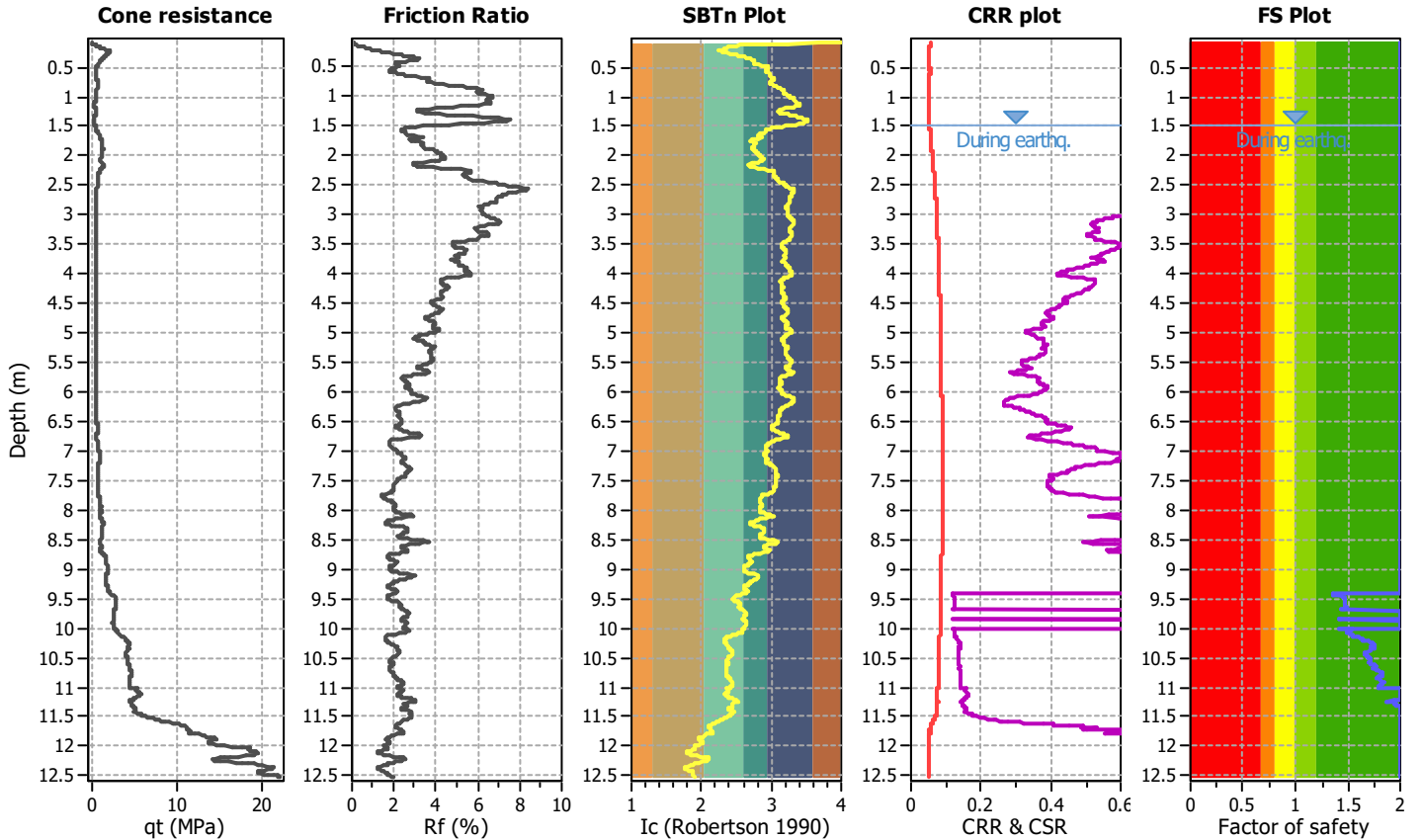
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT7-1/100**

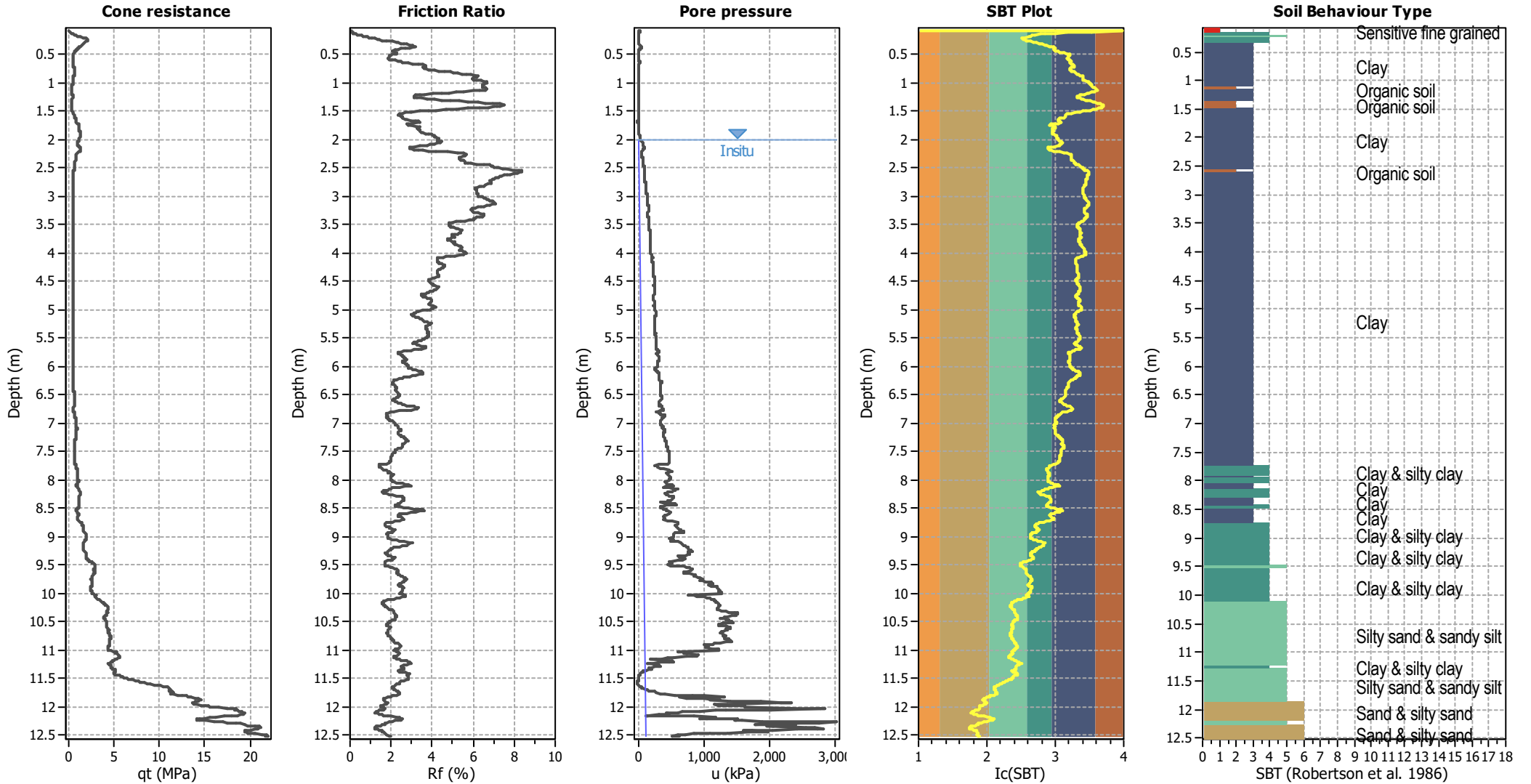
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



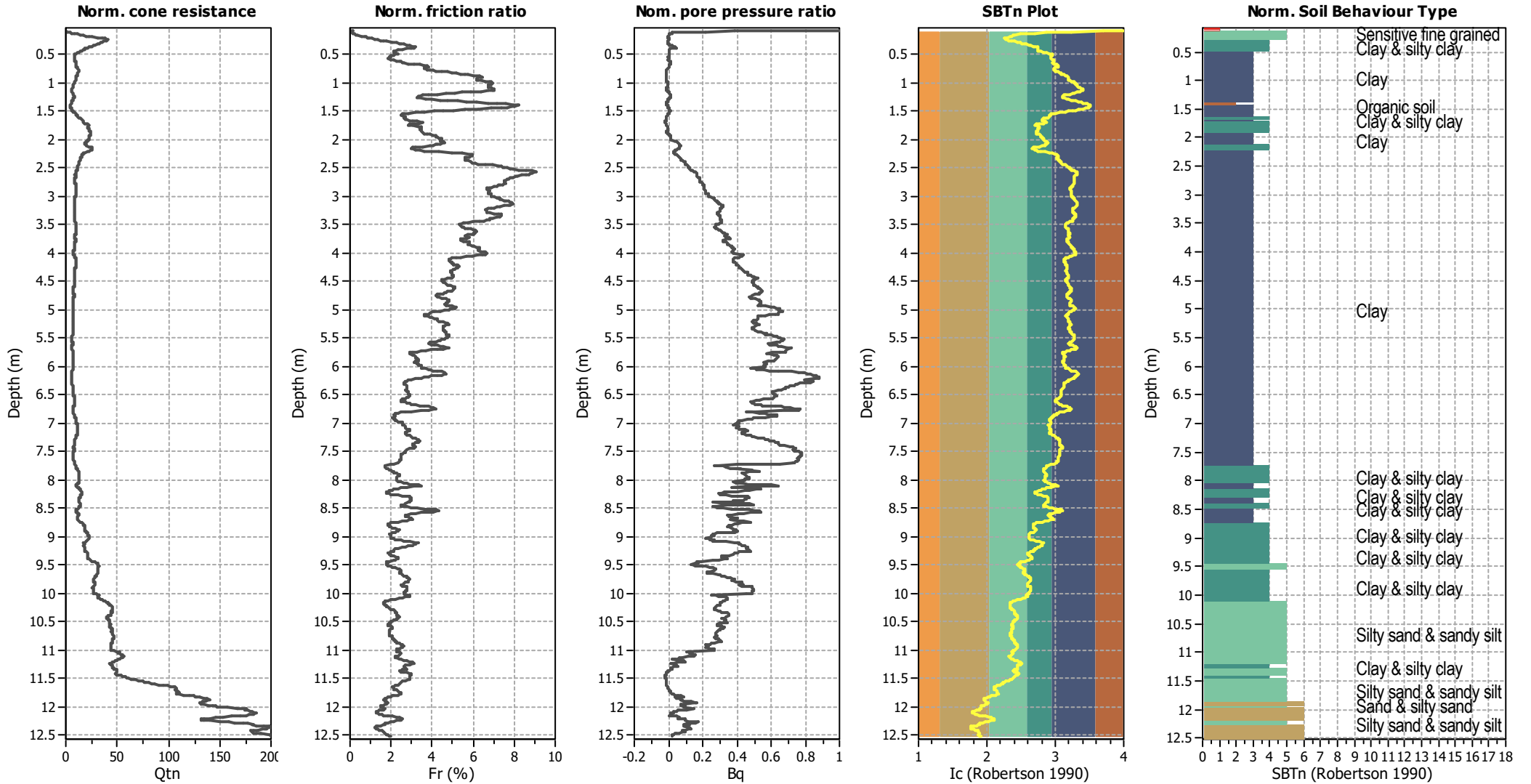
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>g</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



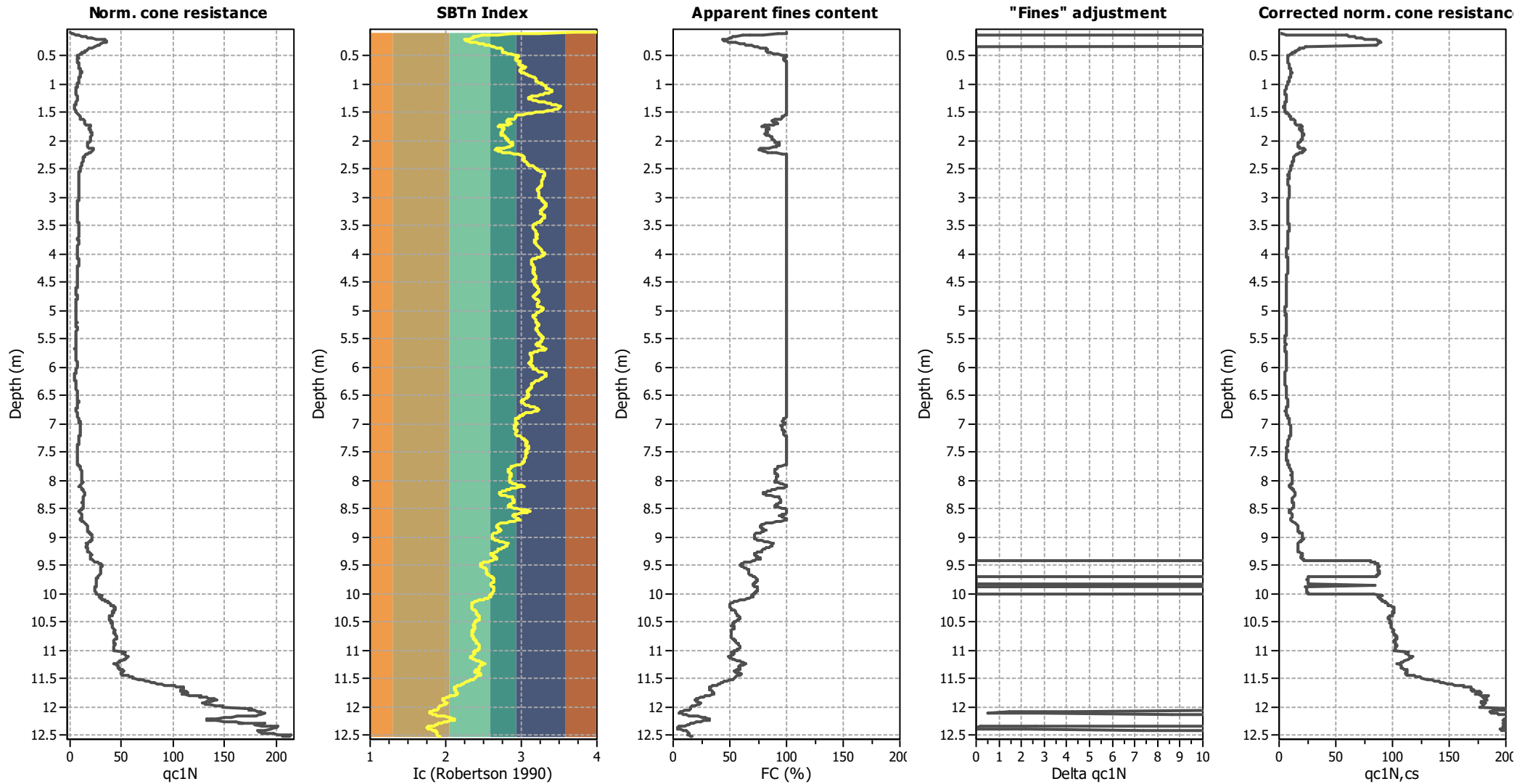
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

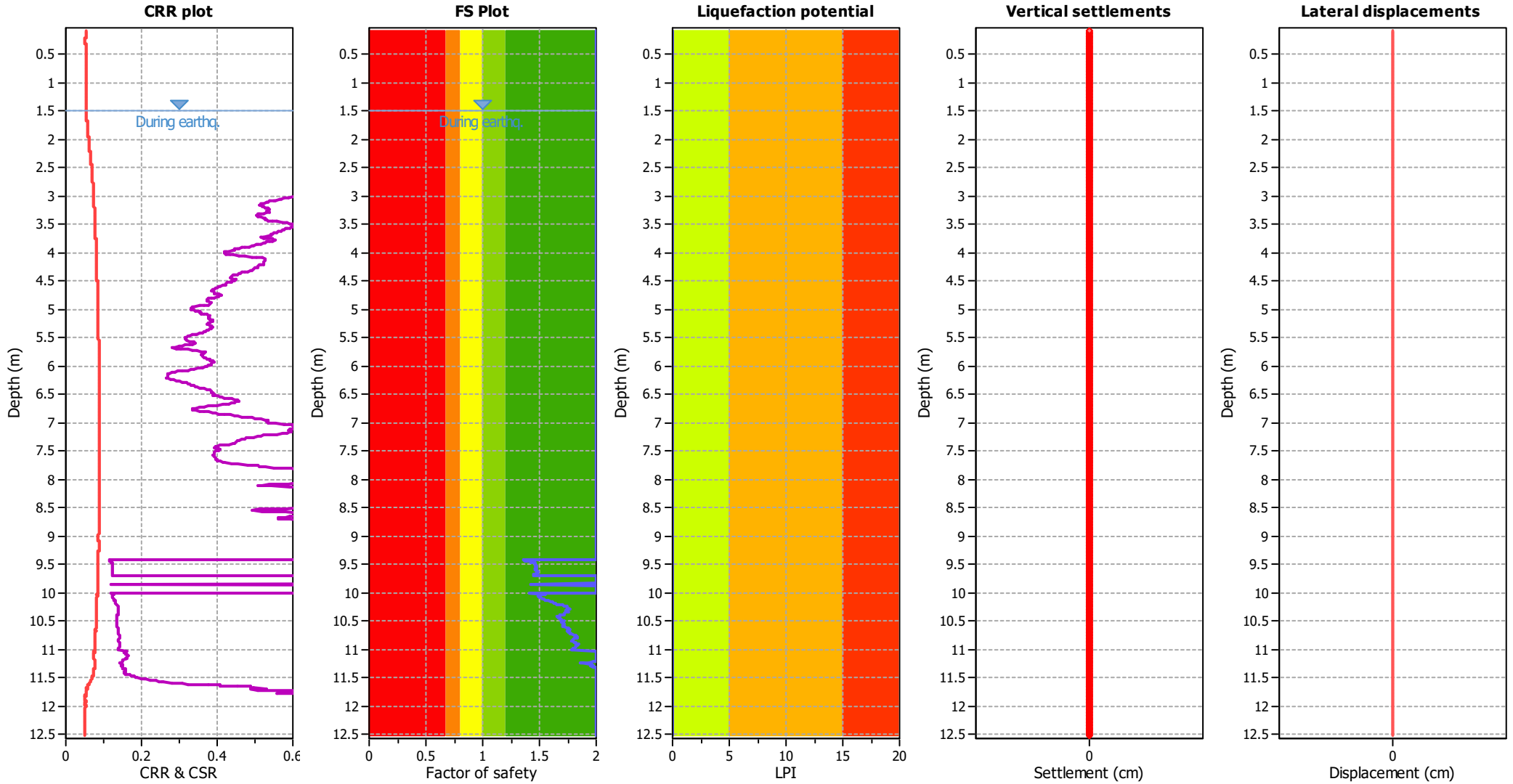


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

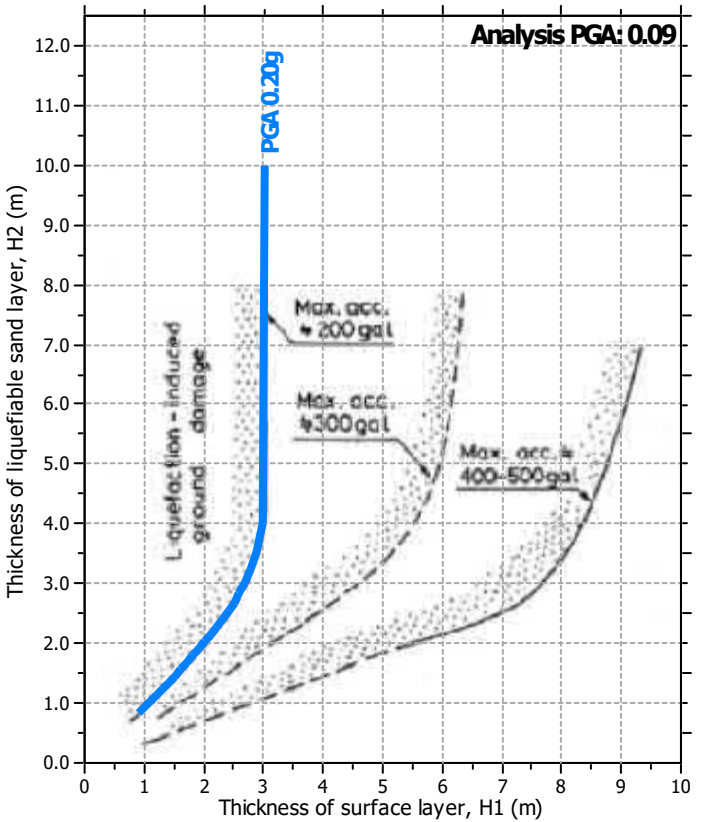
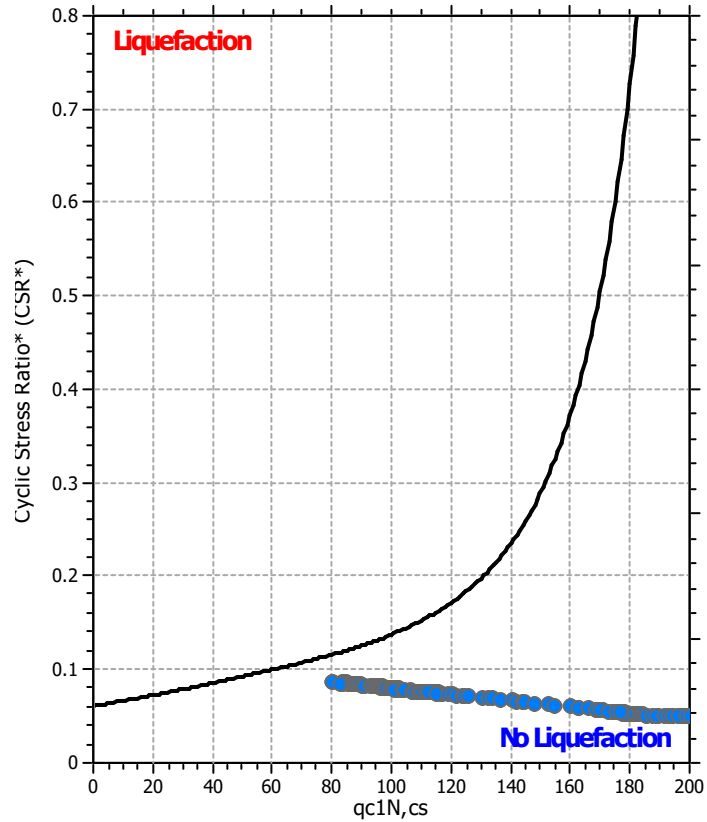
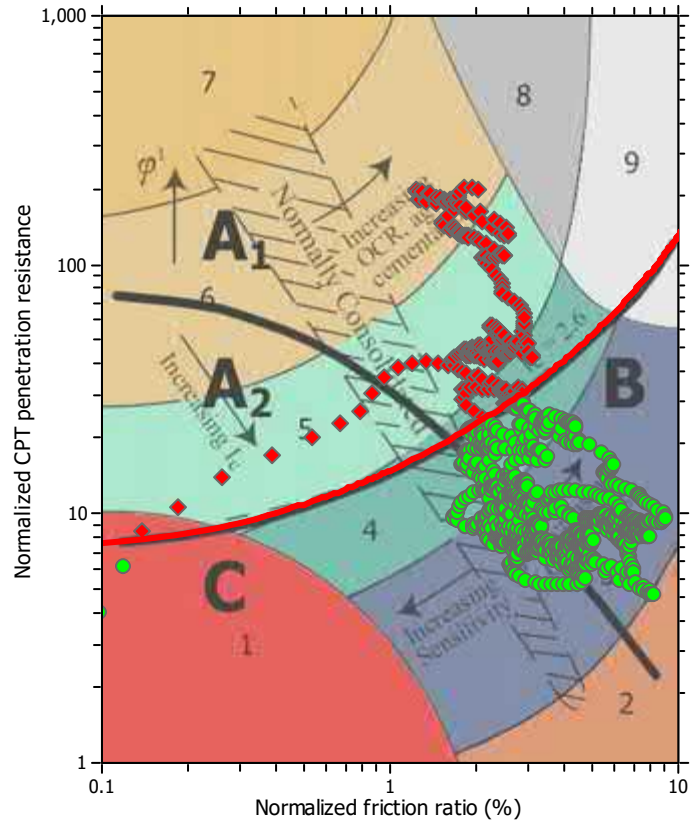
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

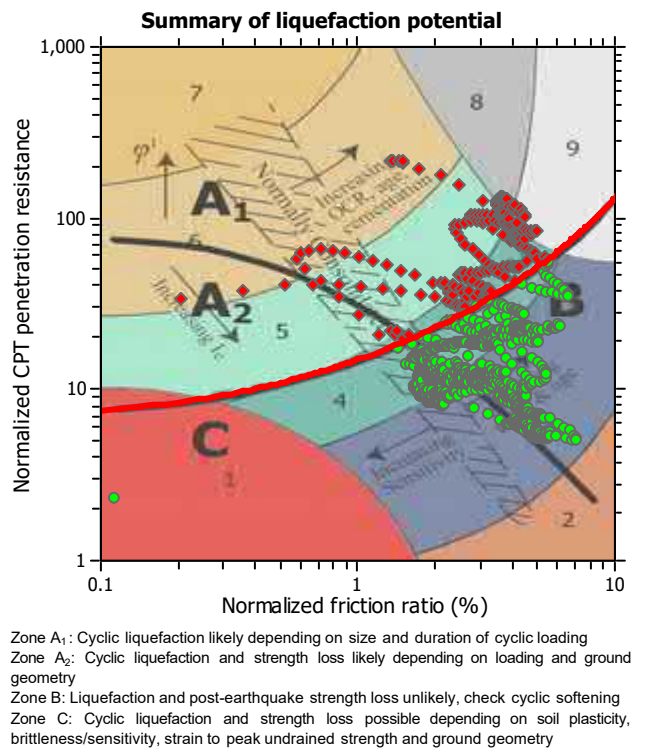
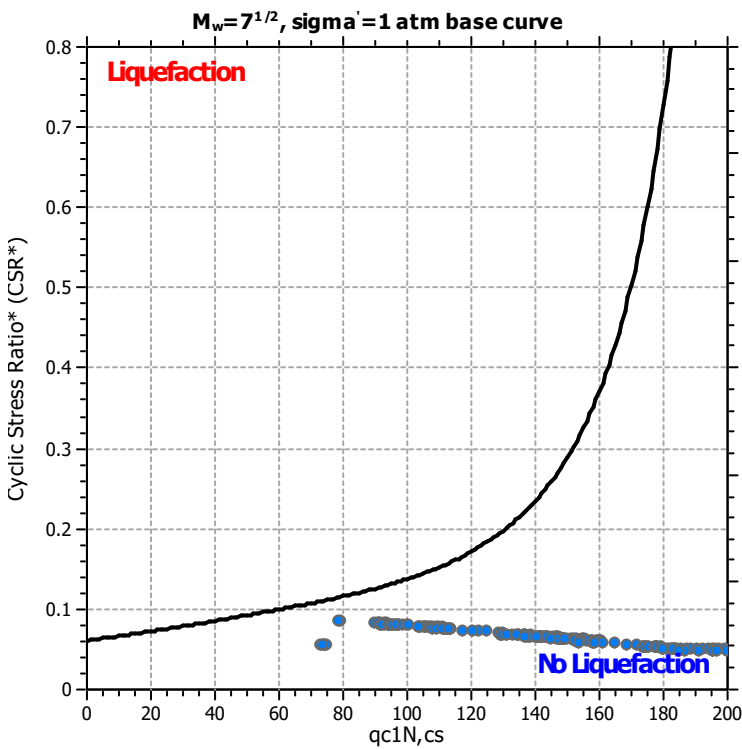
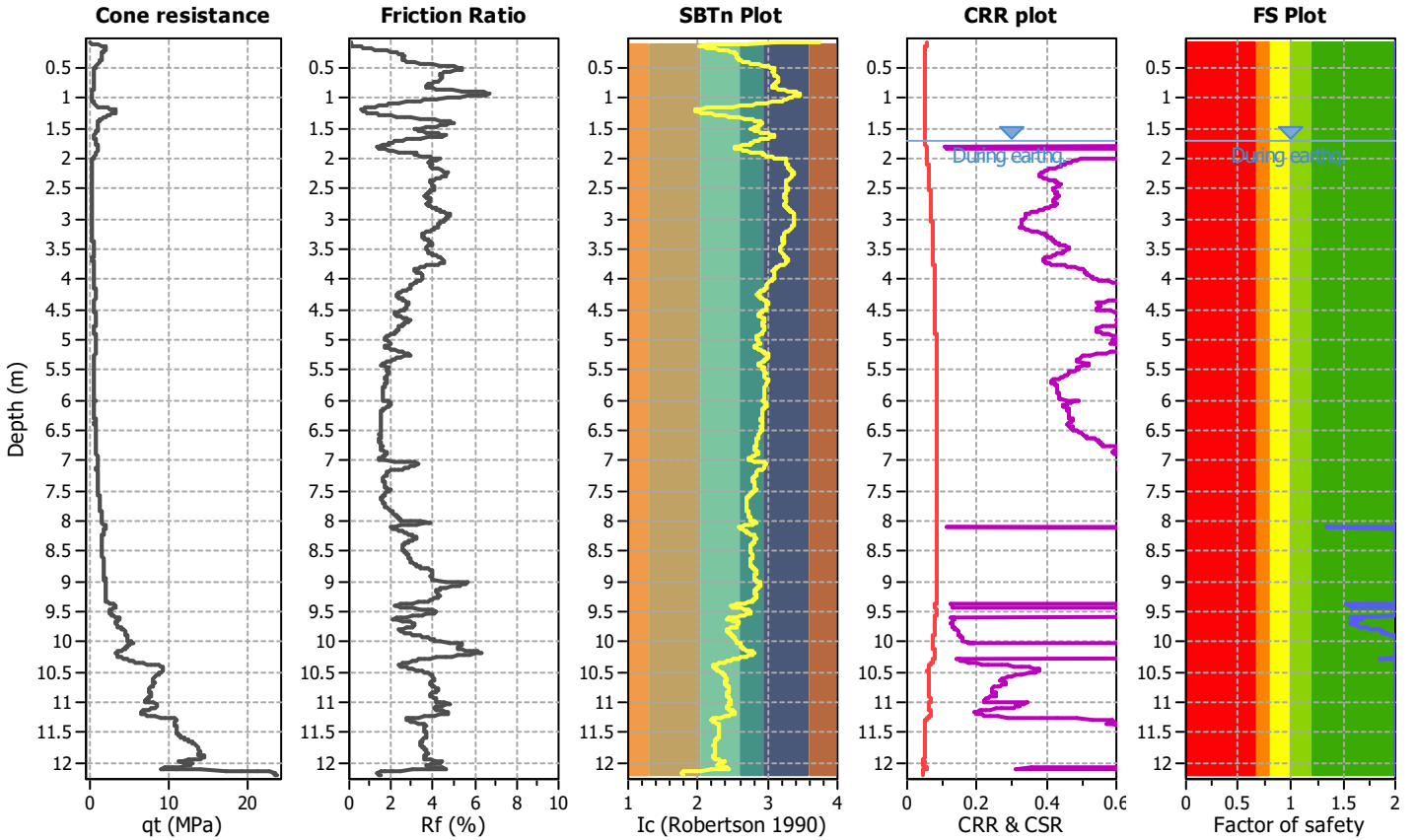
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT8-1/100**

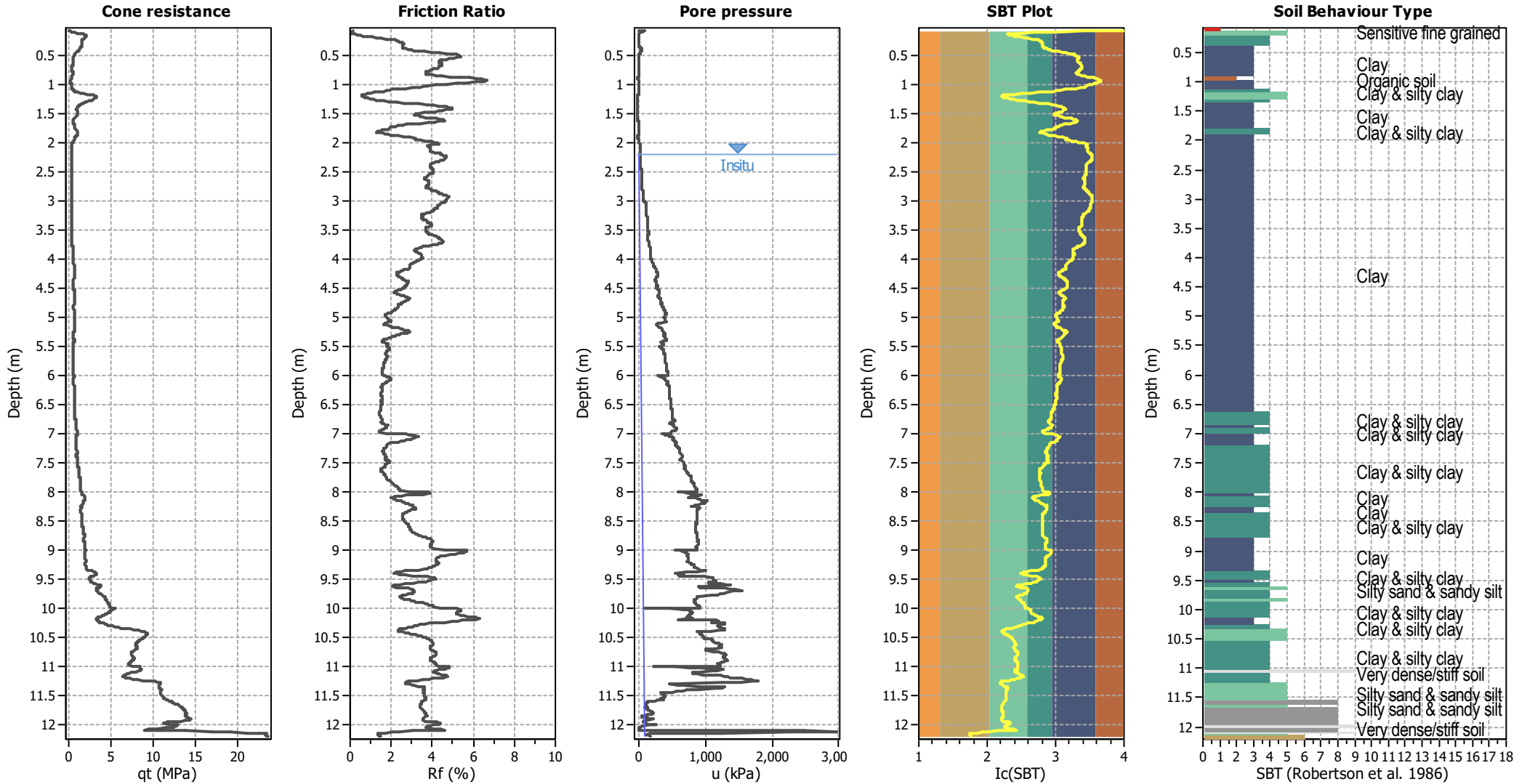
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

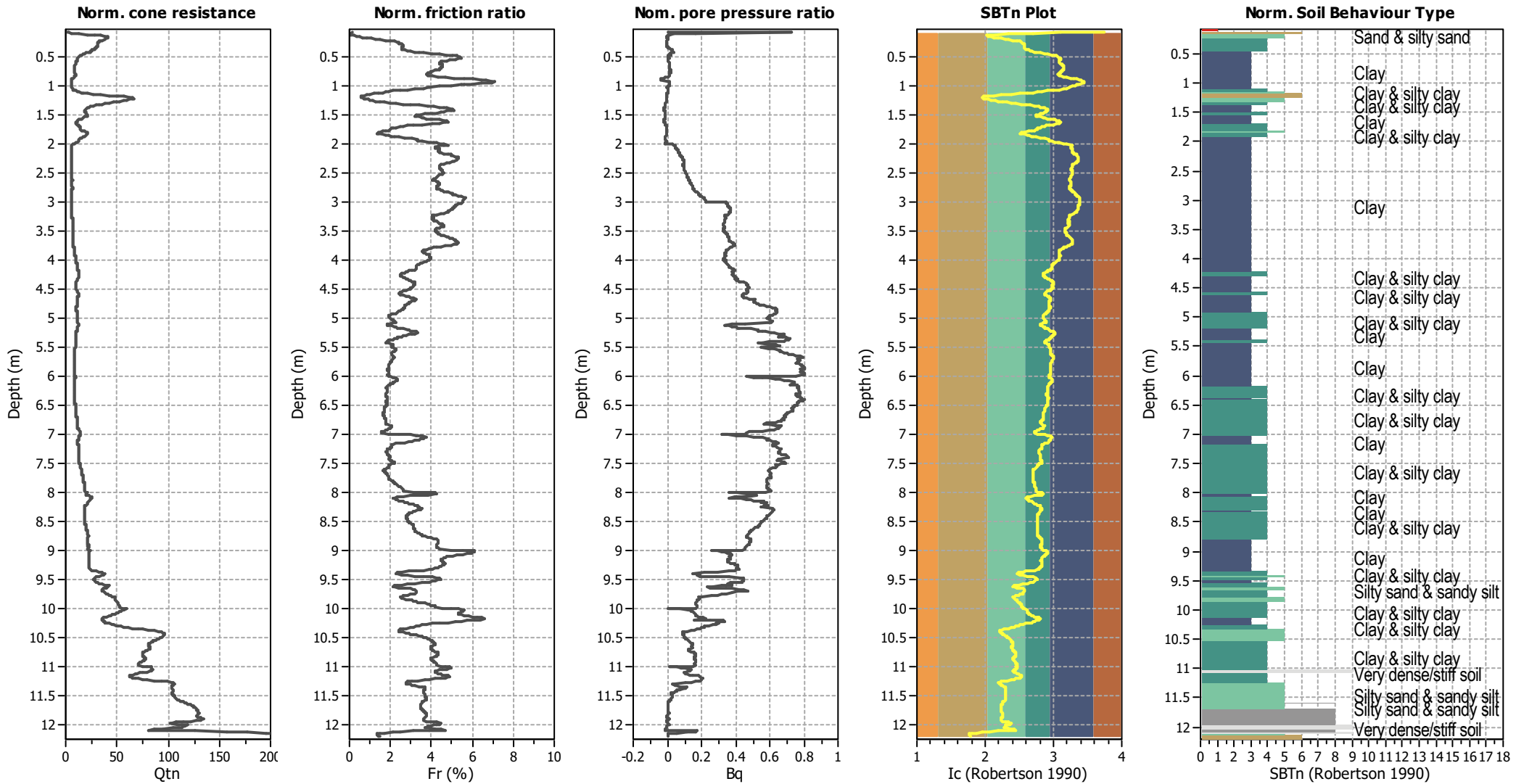
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



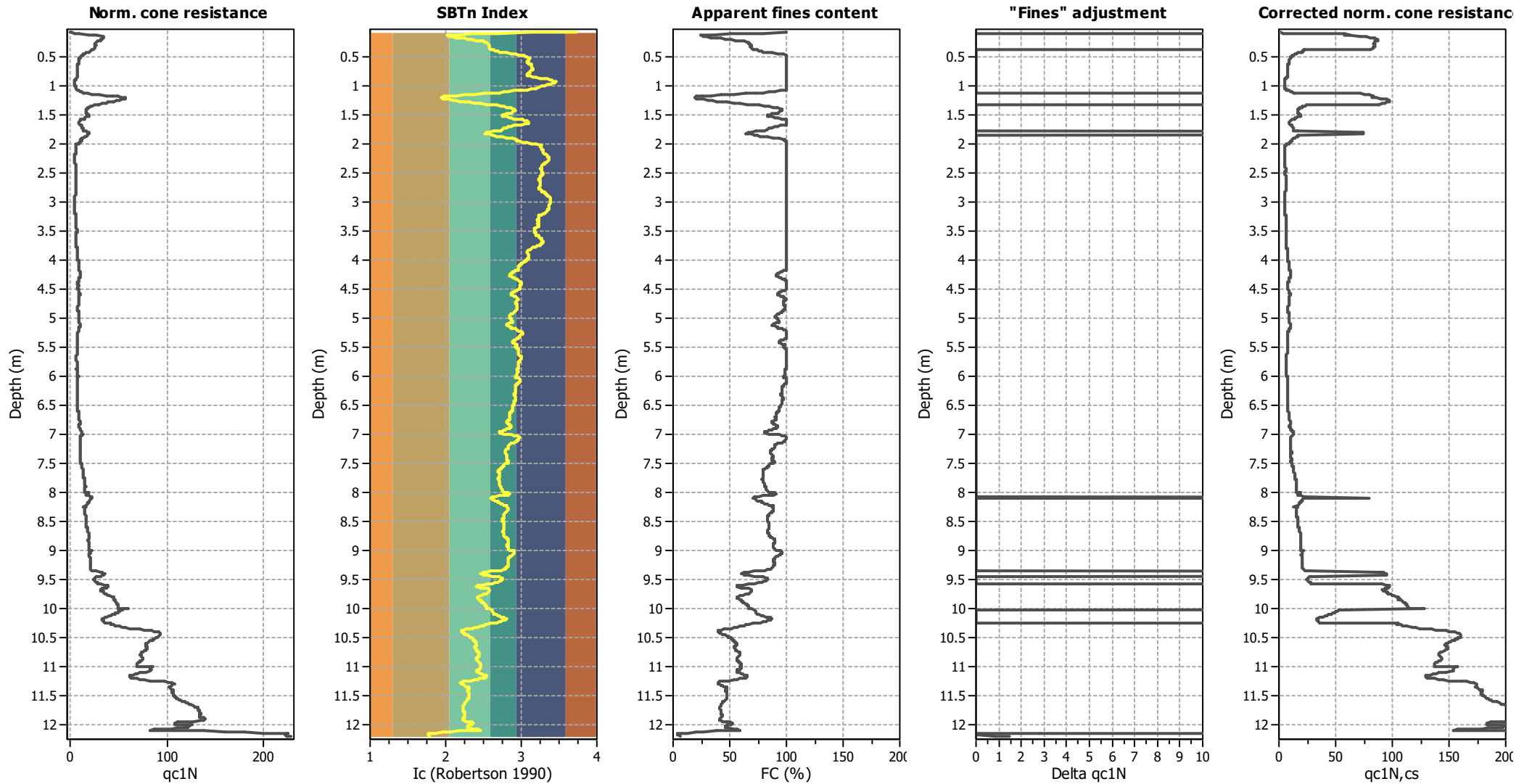
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

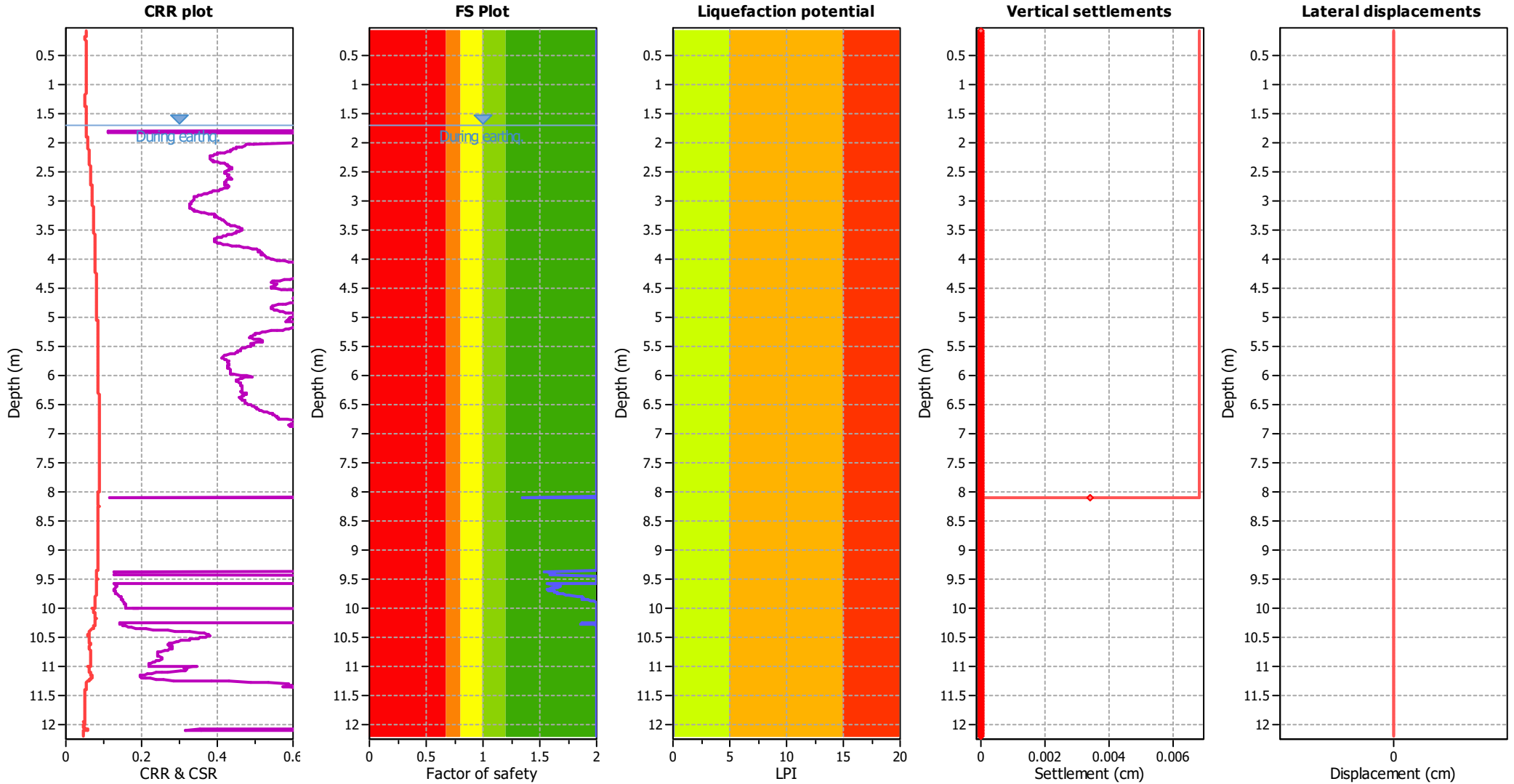
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

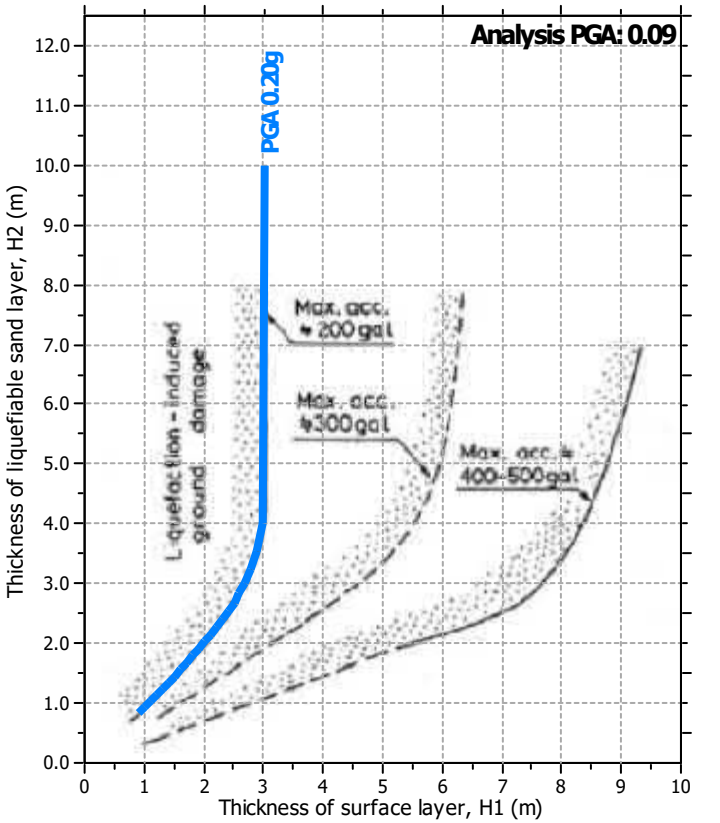
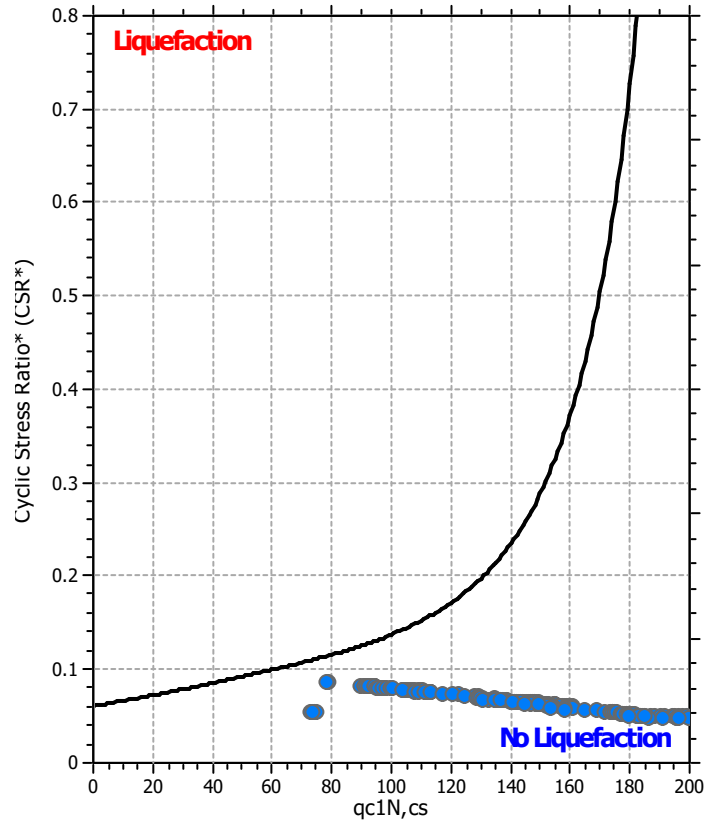
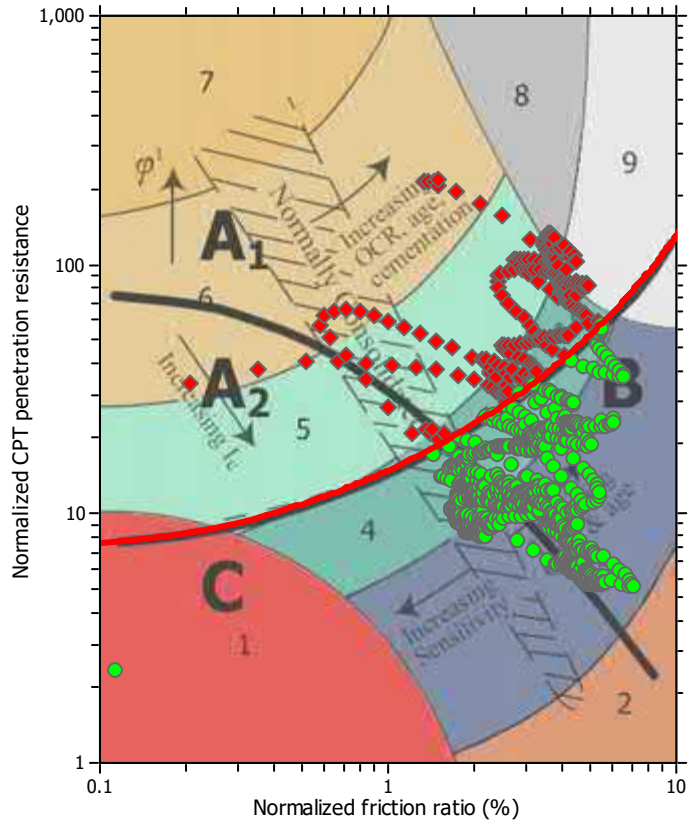
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



**LIQUEFACTION ANALYSIS REPORT**

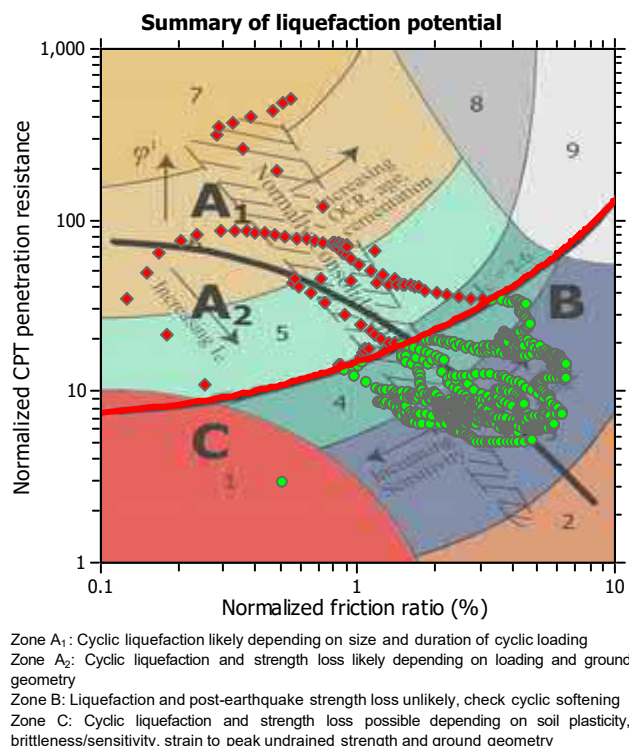
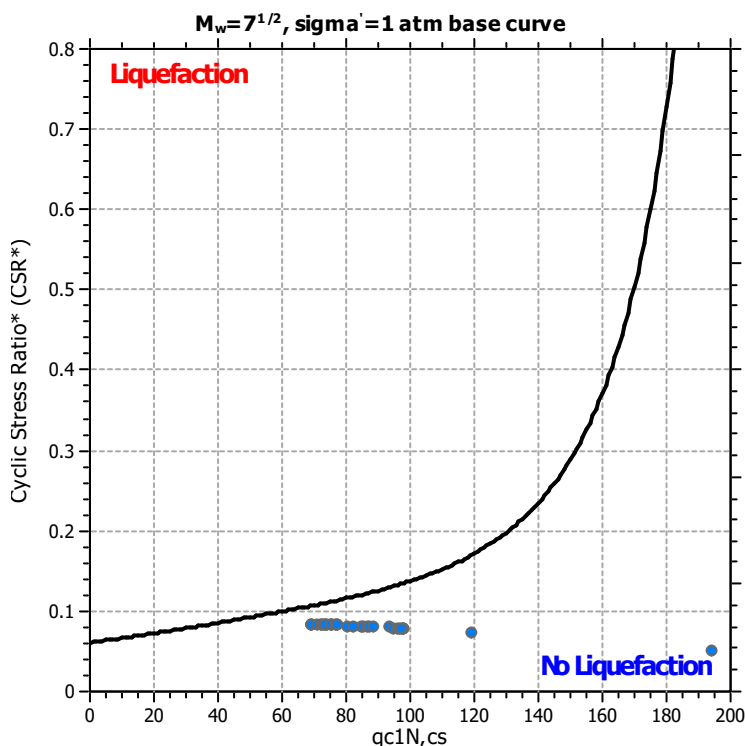
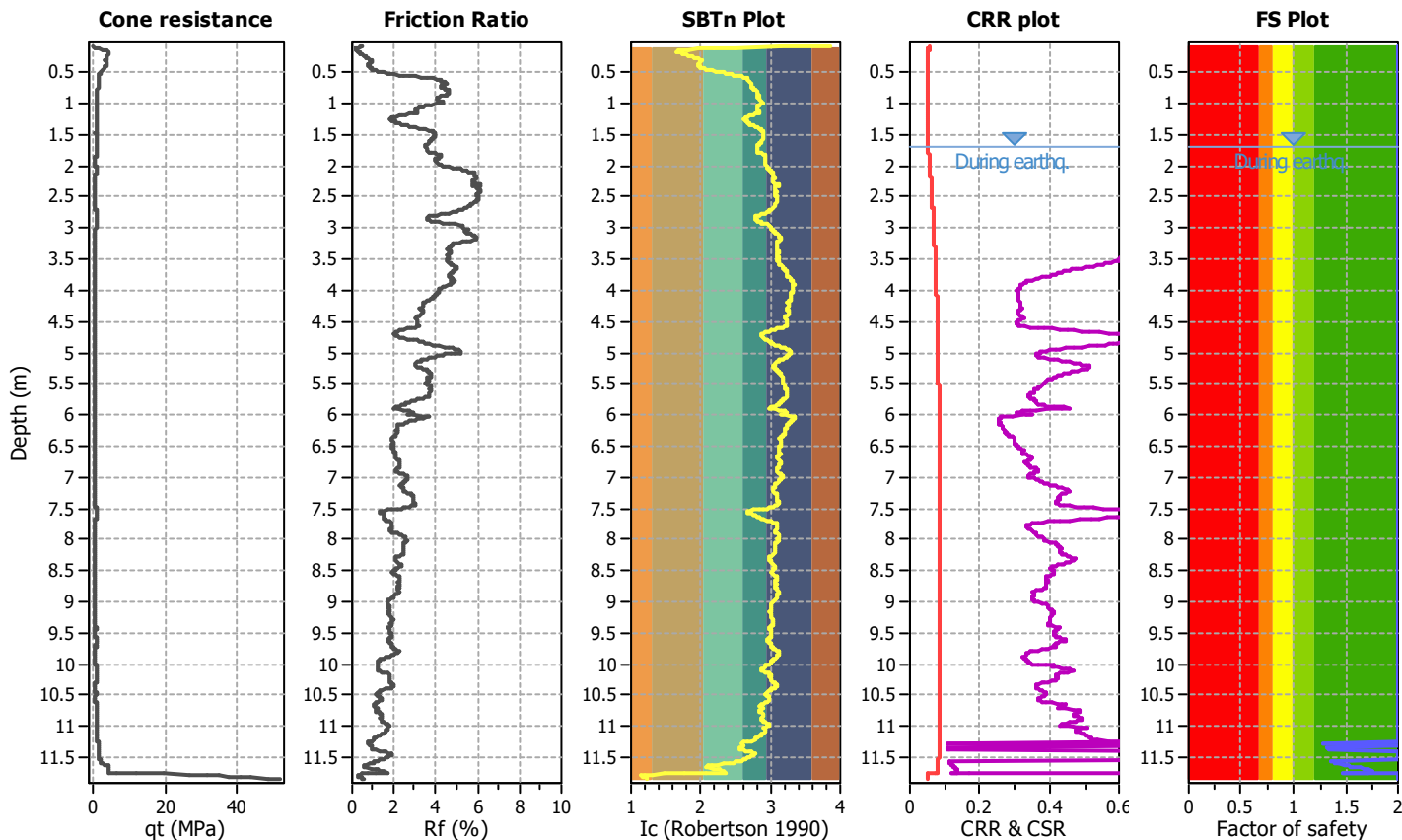
**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

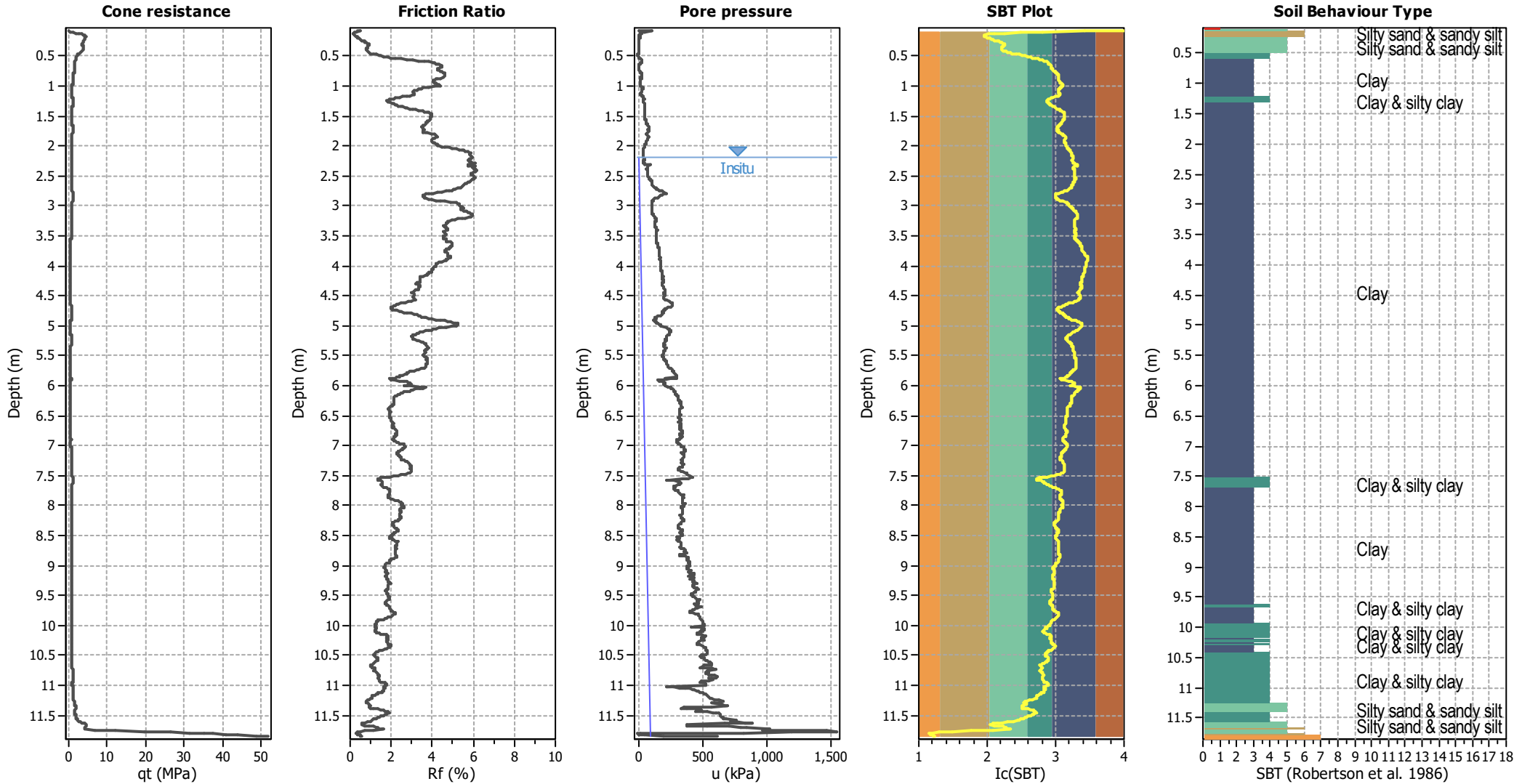
**CPT file : CPT9-1/100**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



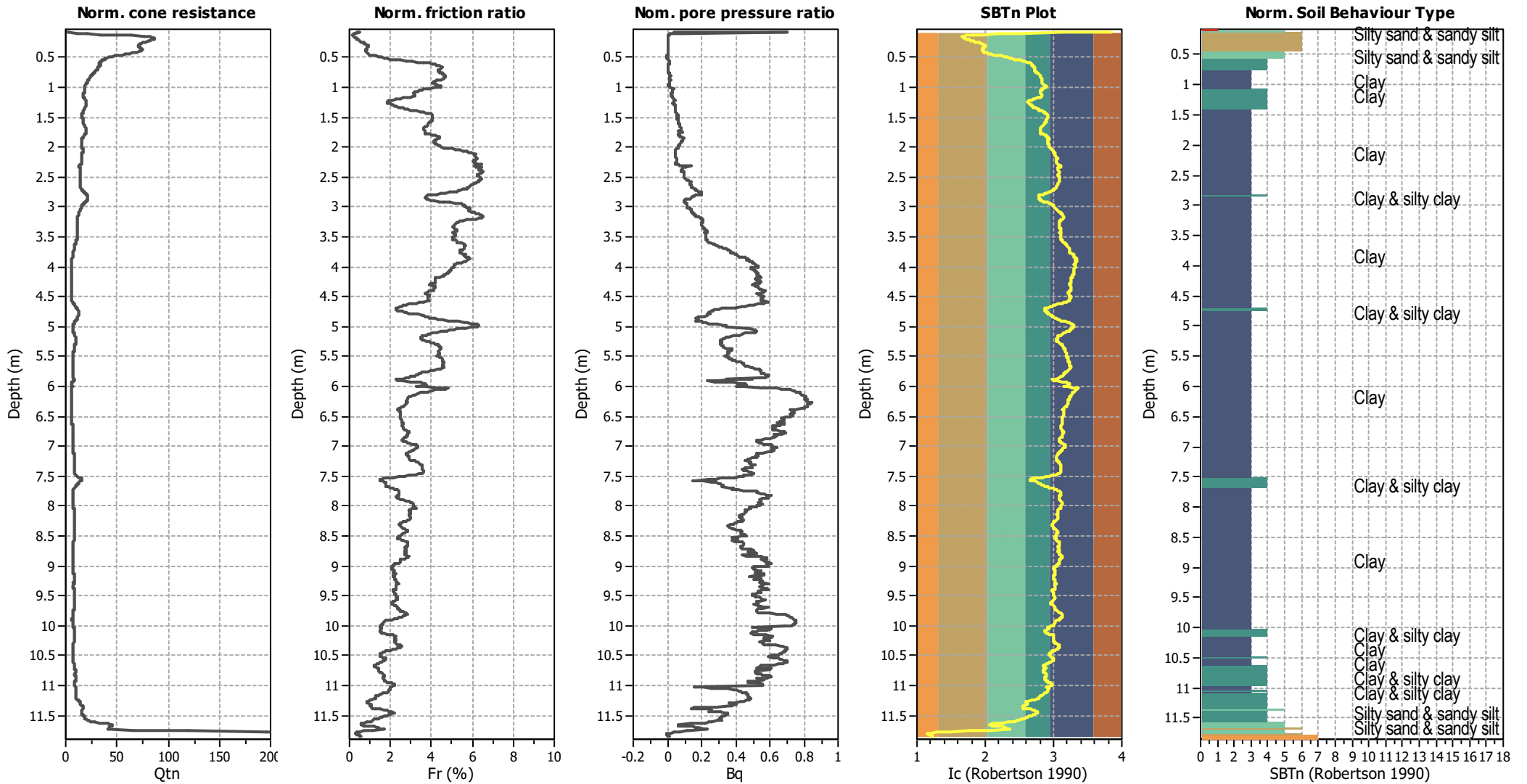
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



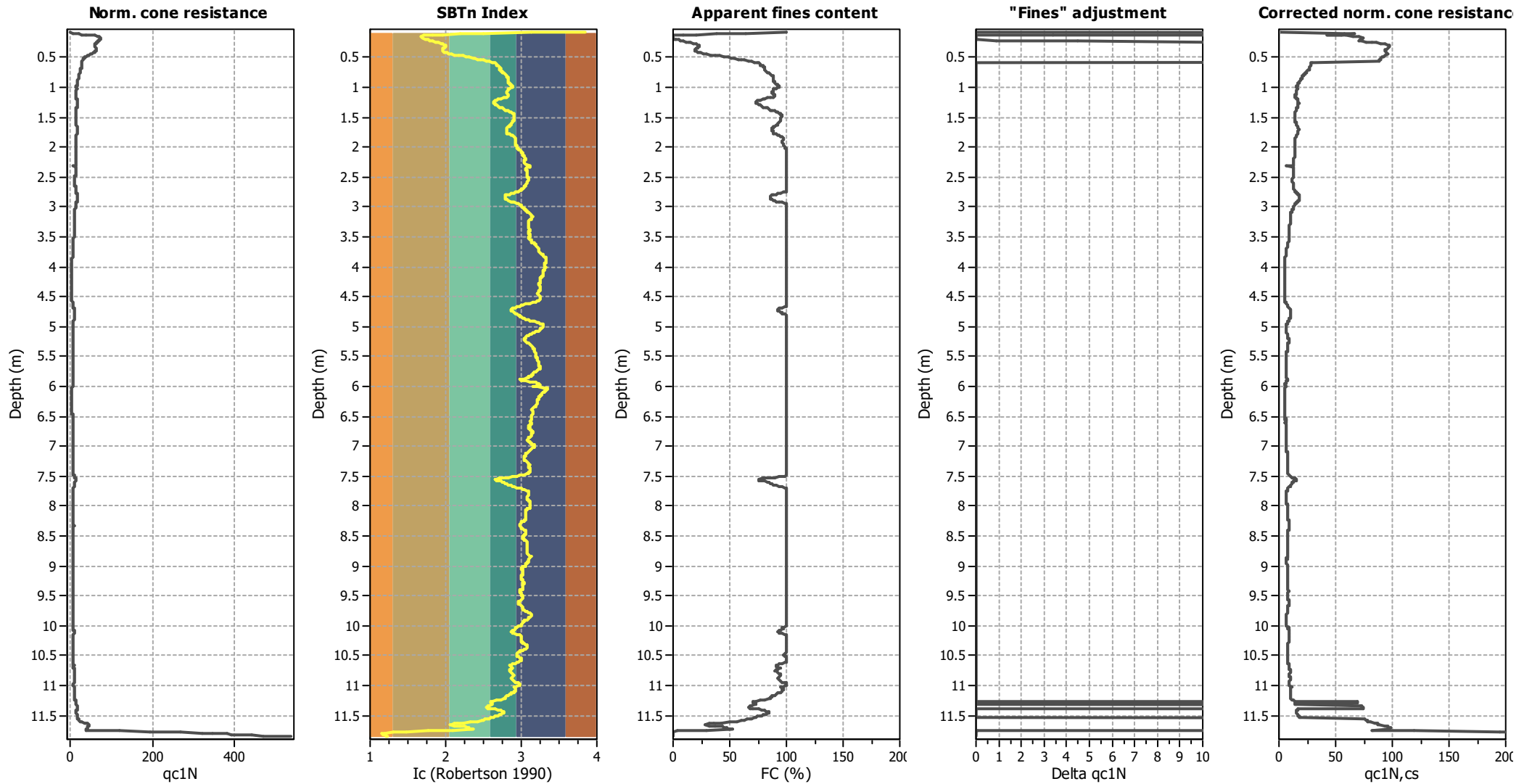
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

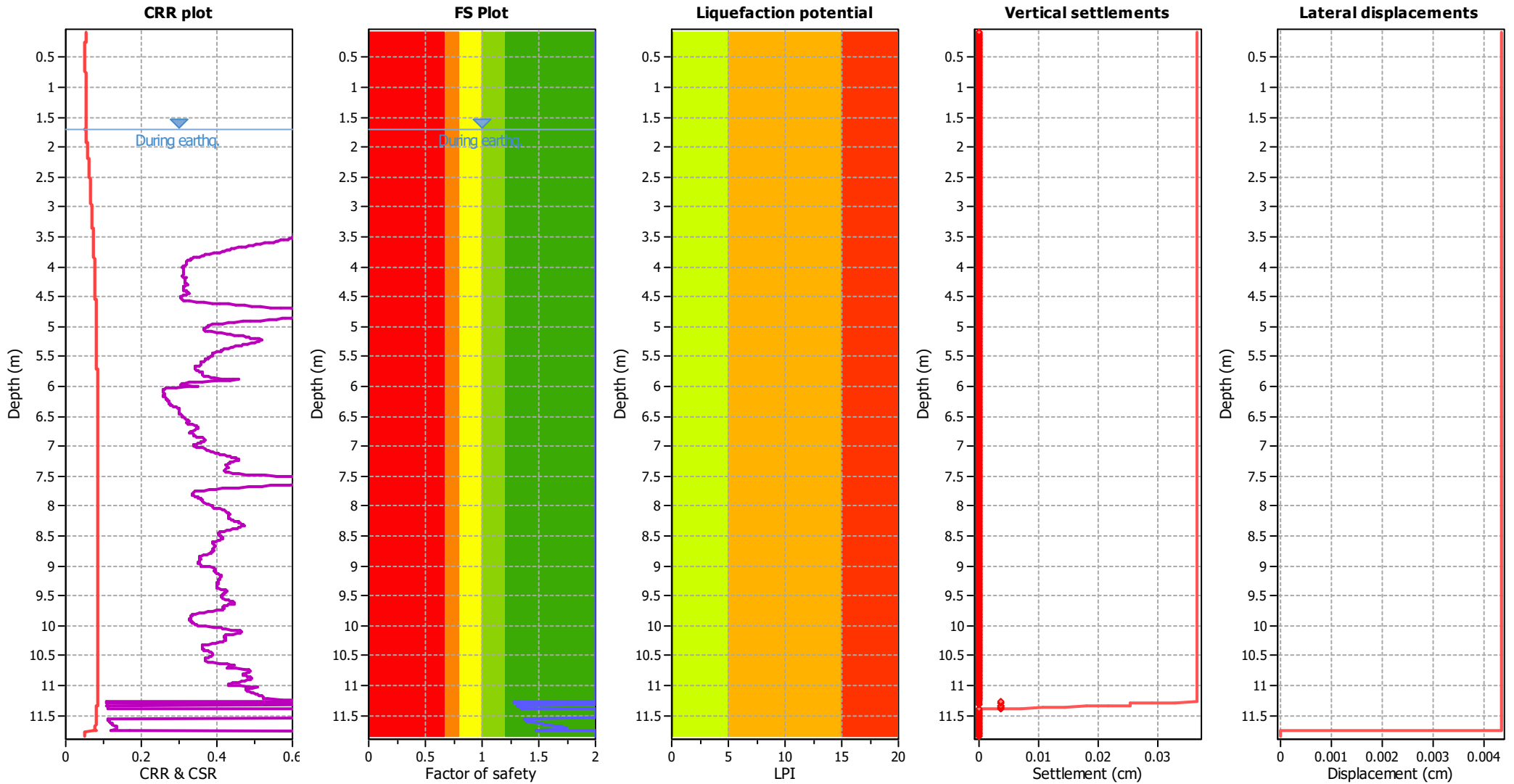


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

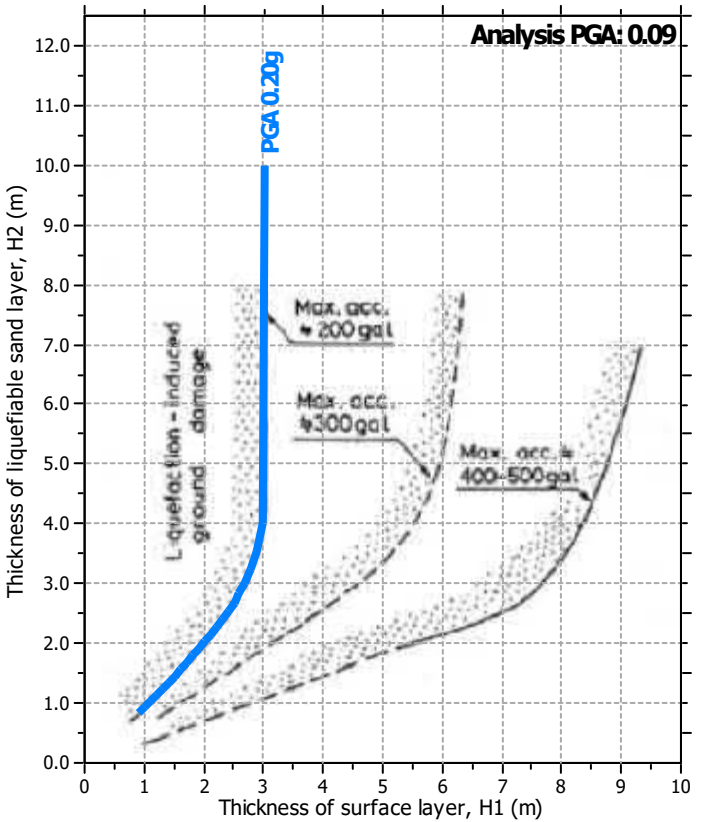
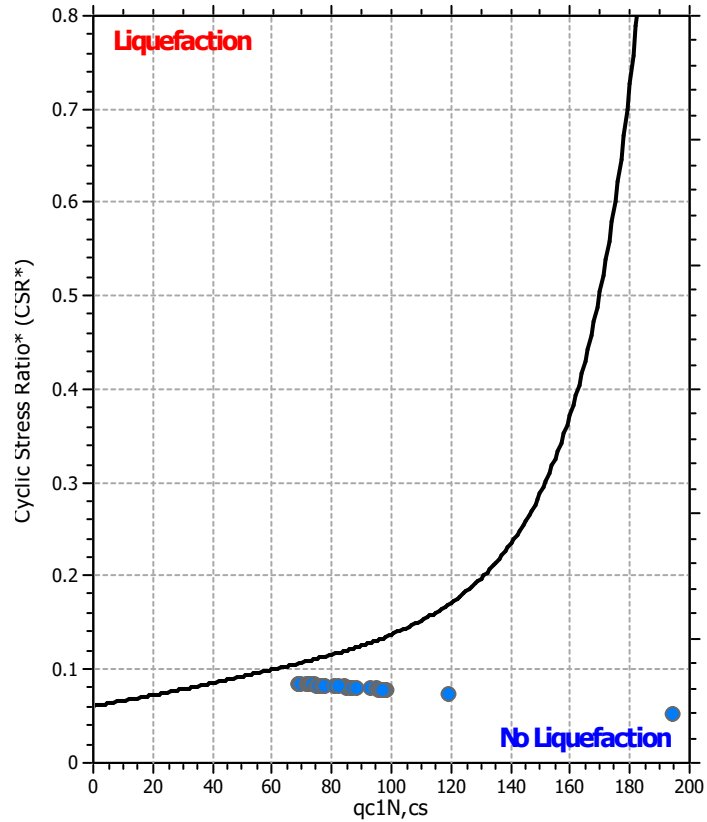
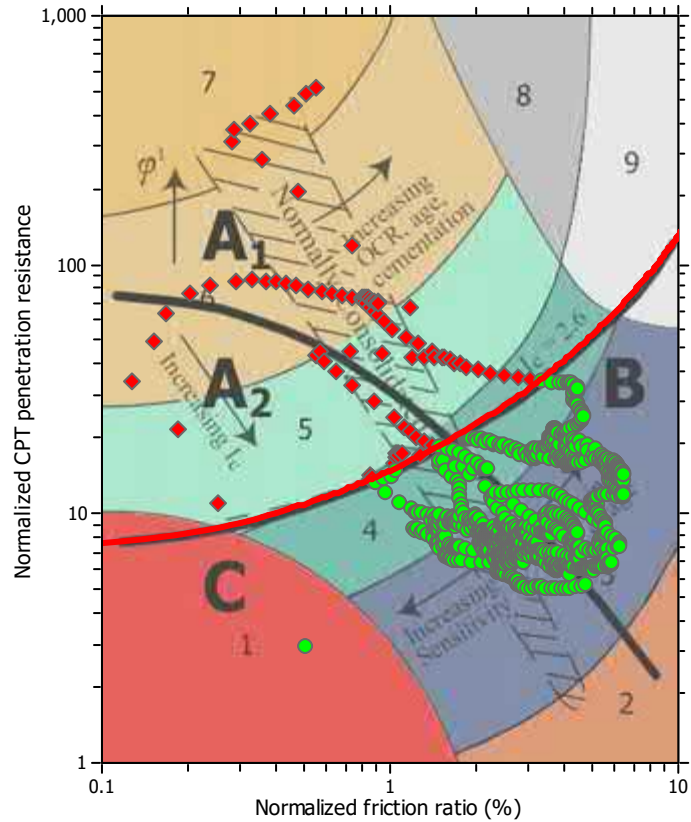
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

**LIQUEFACTION ANALYSIS REPORT**

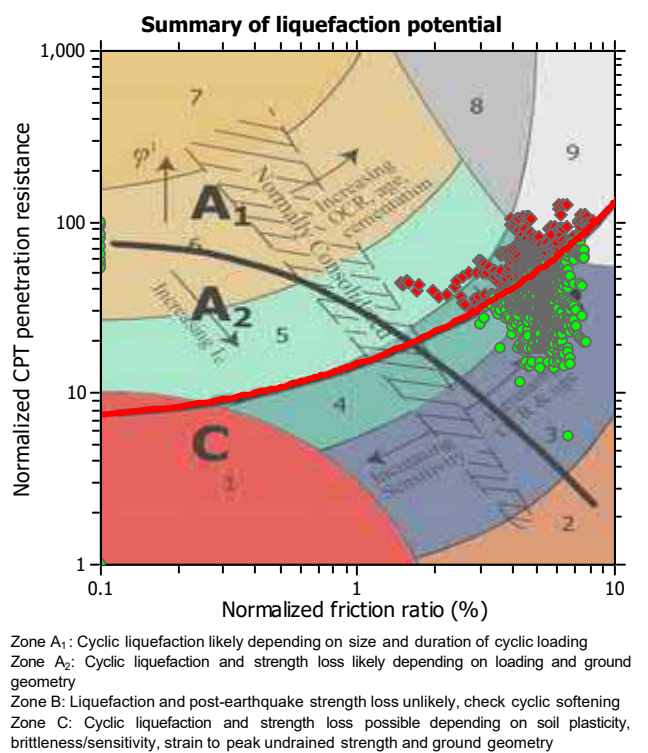
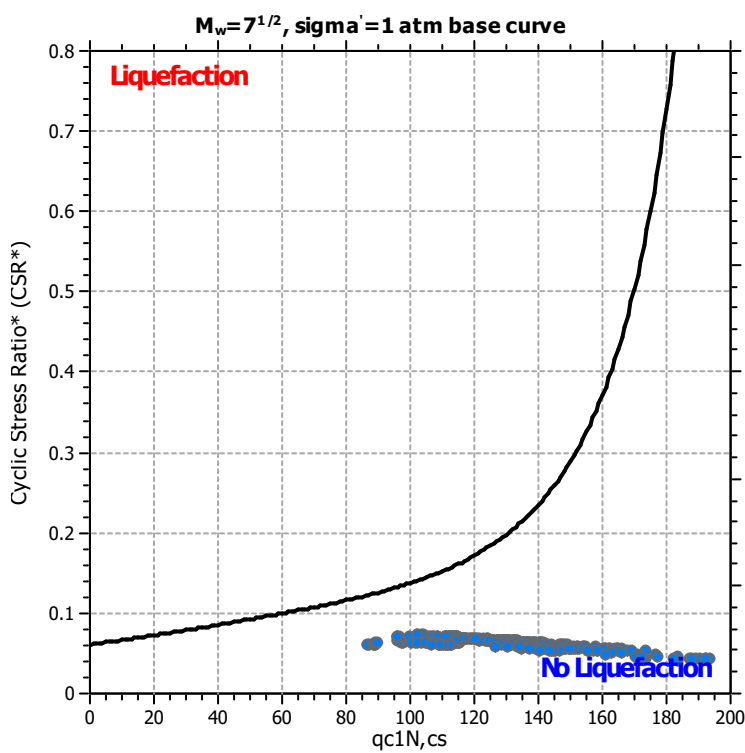
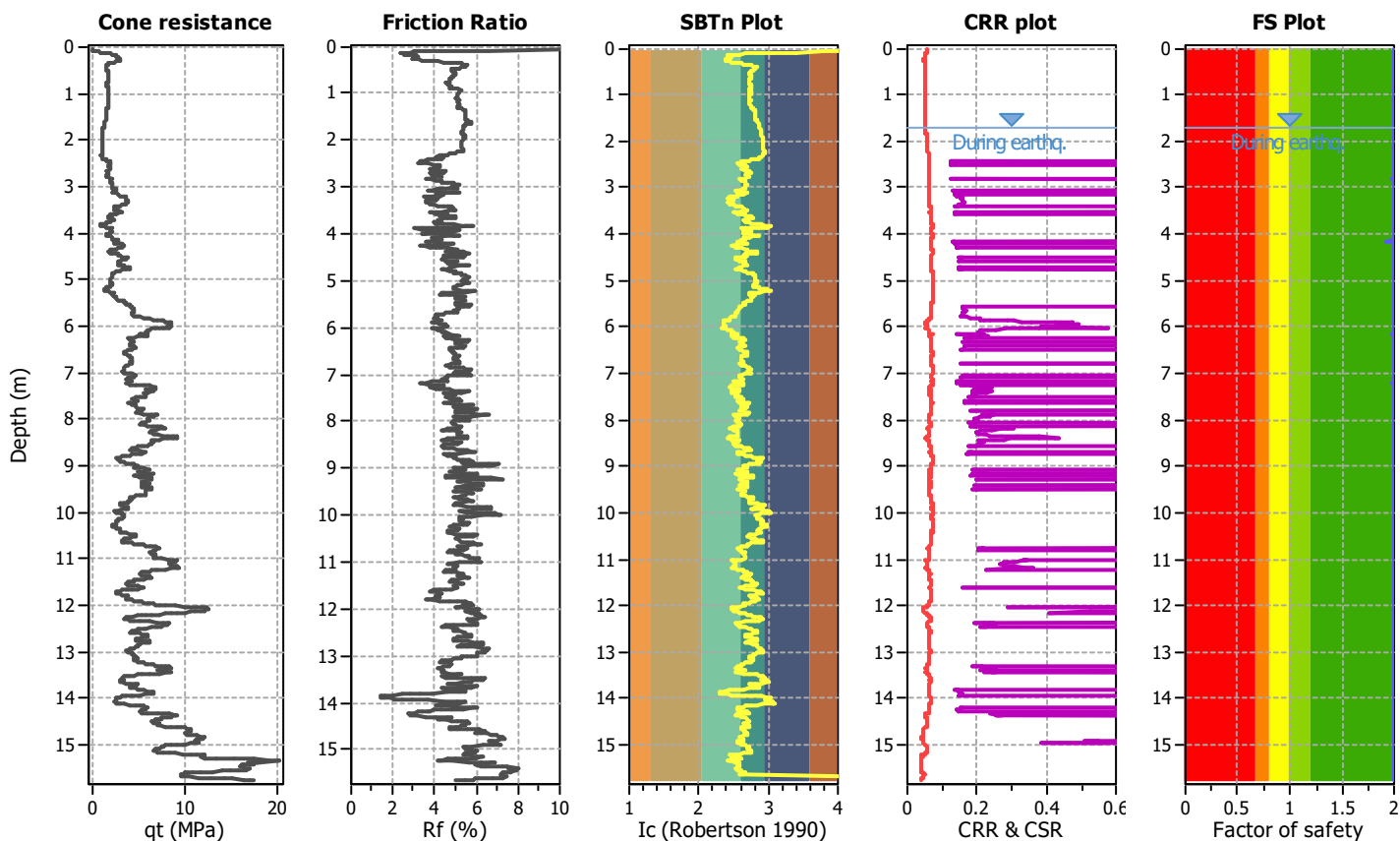
**Project title : Warkworth South Plan Change**

**Location : 48 Valerie Close, Warkworth**

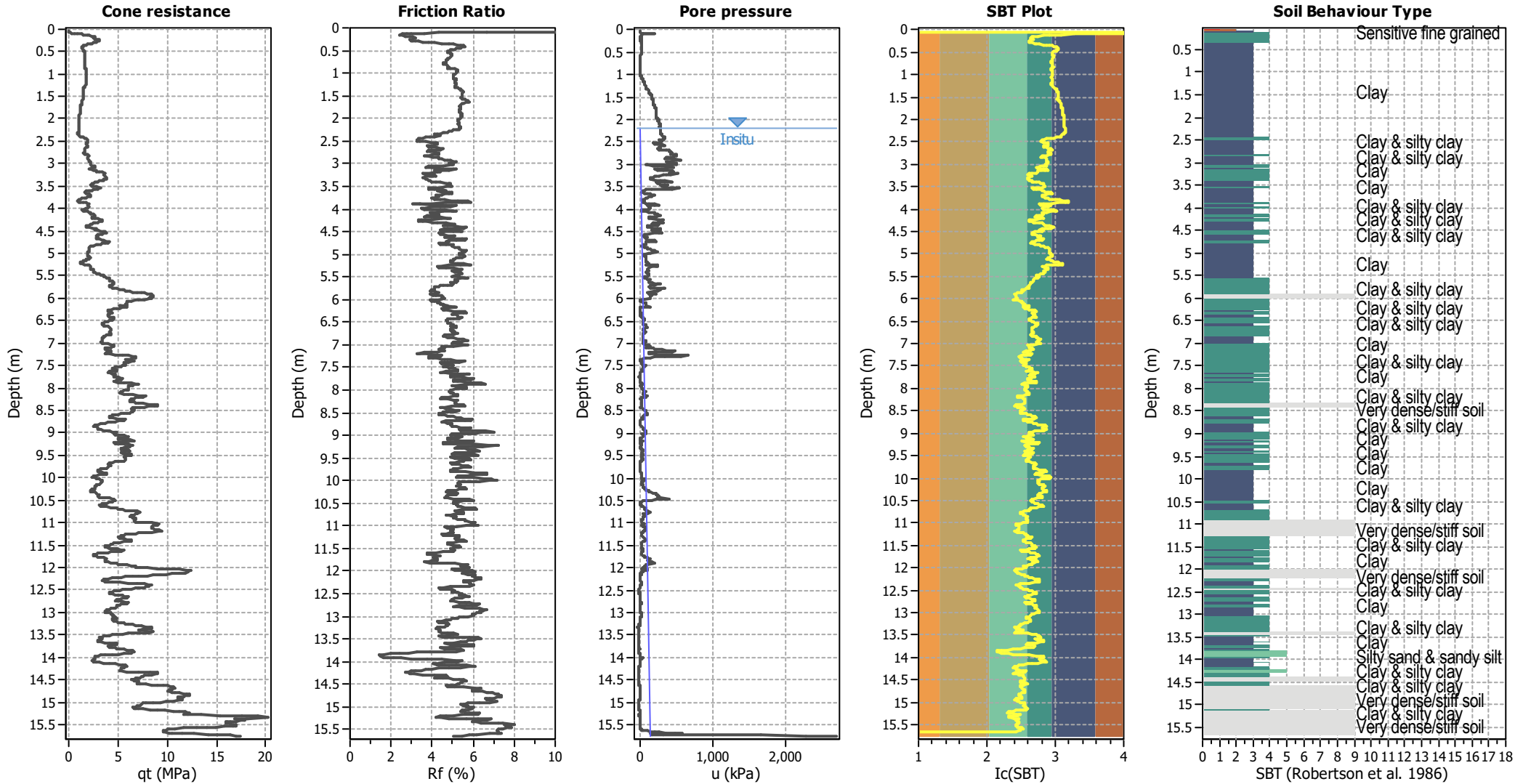
**CPT file : CPT10-1/100**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 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:	15.00 m
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

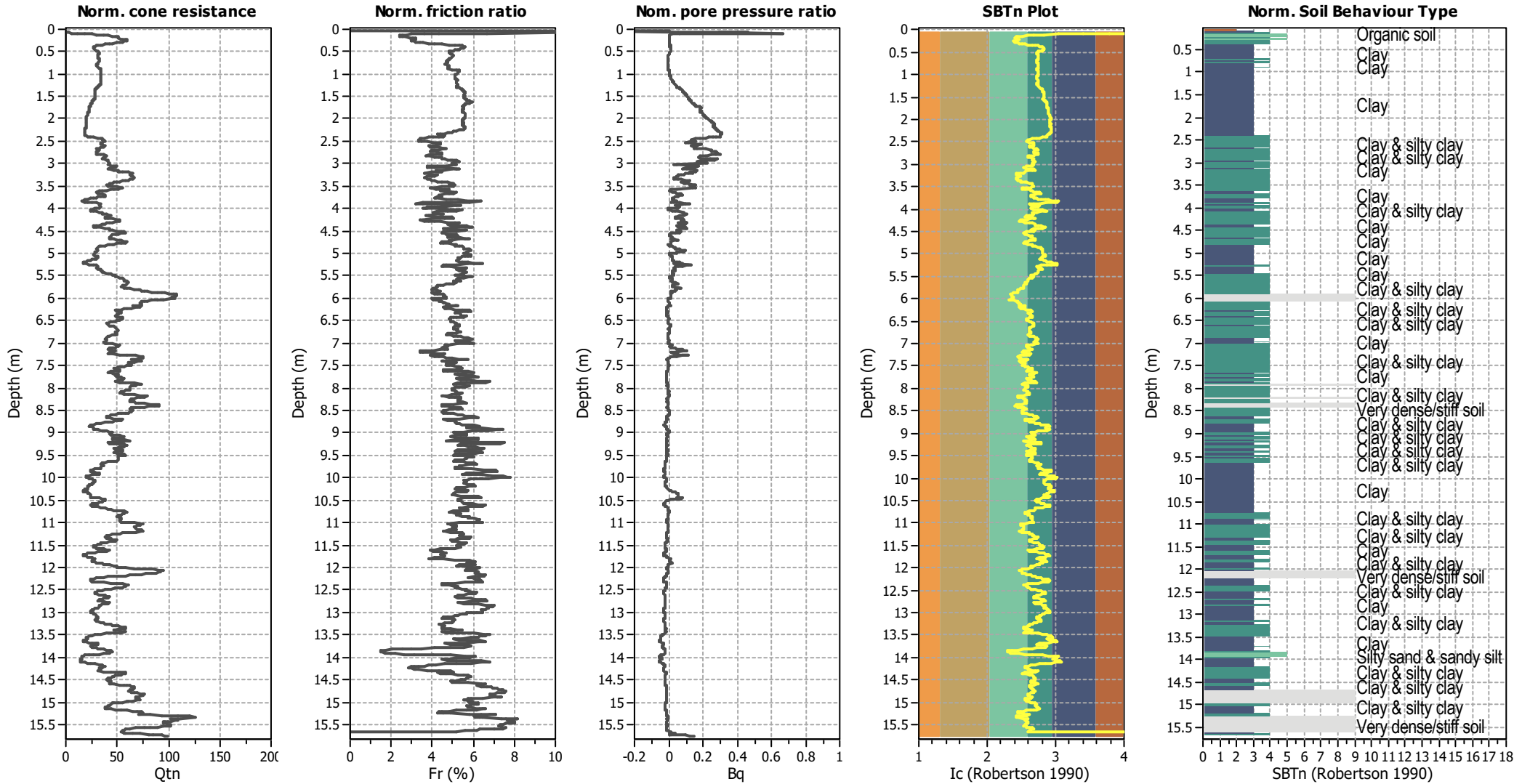
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



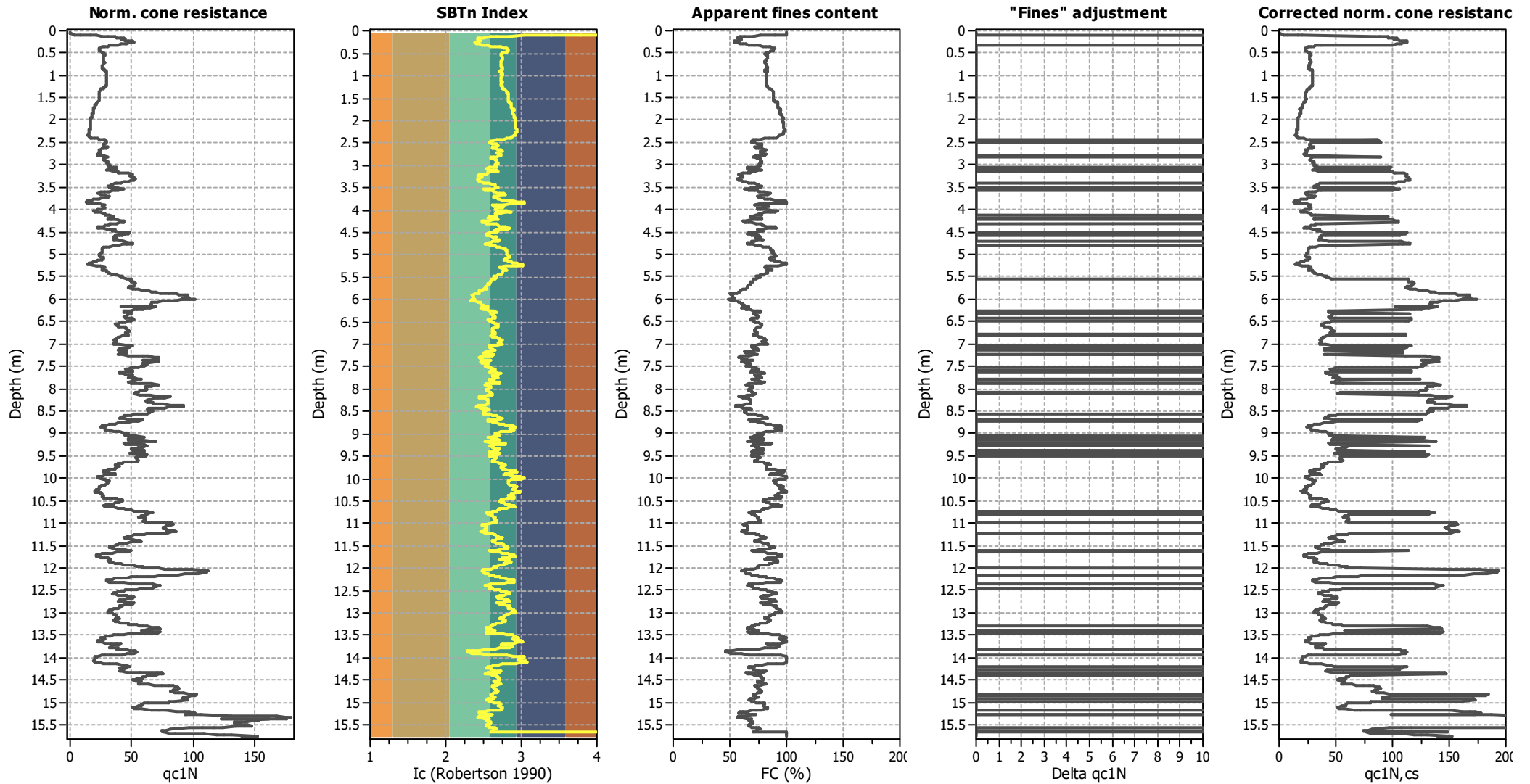
**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

**SBTn legend**

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

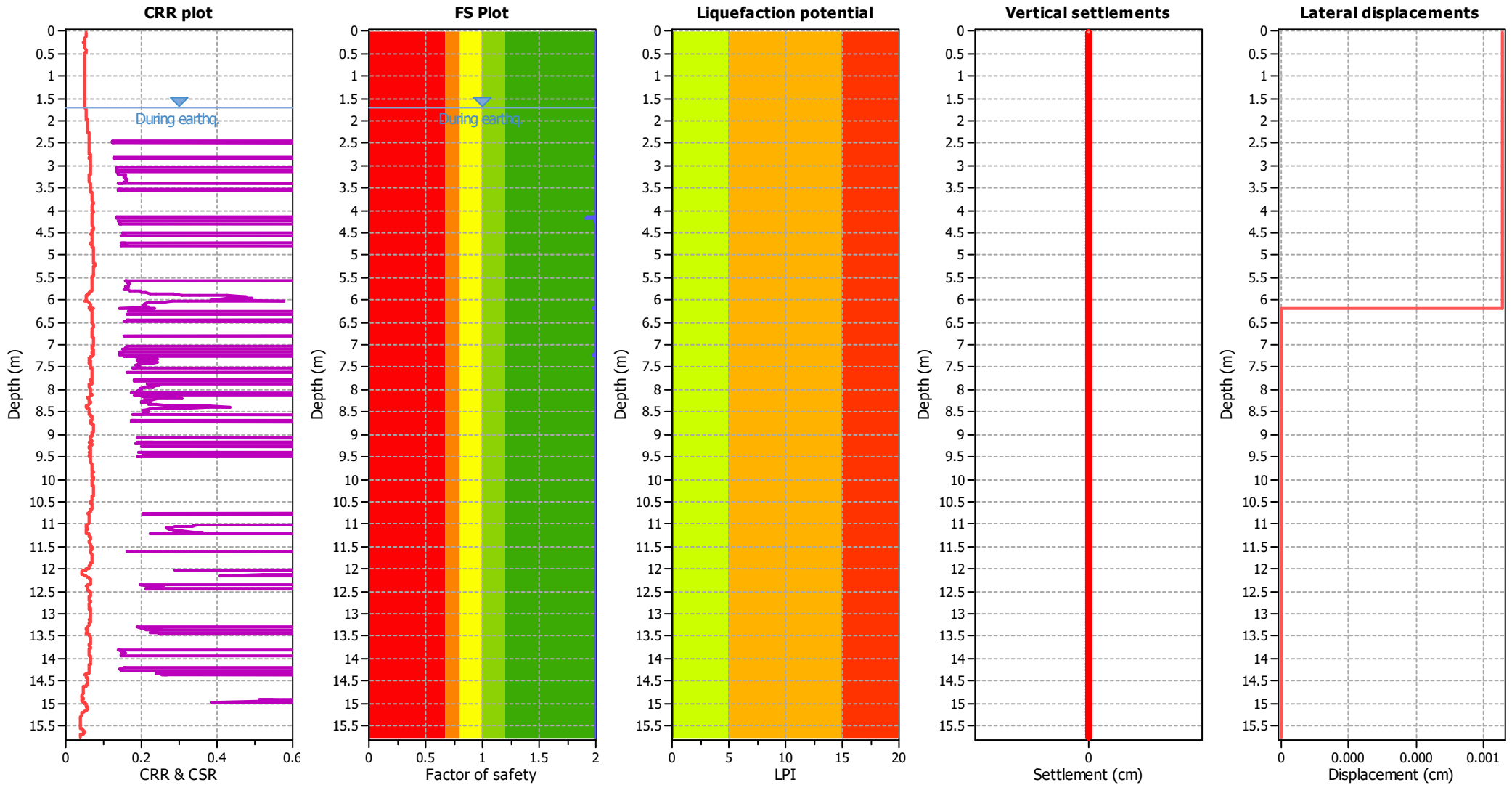
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m

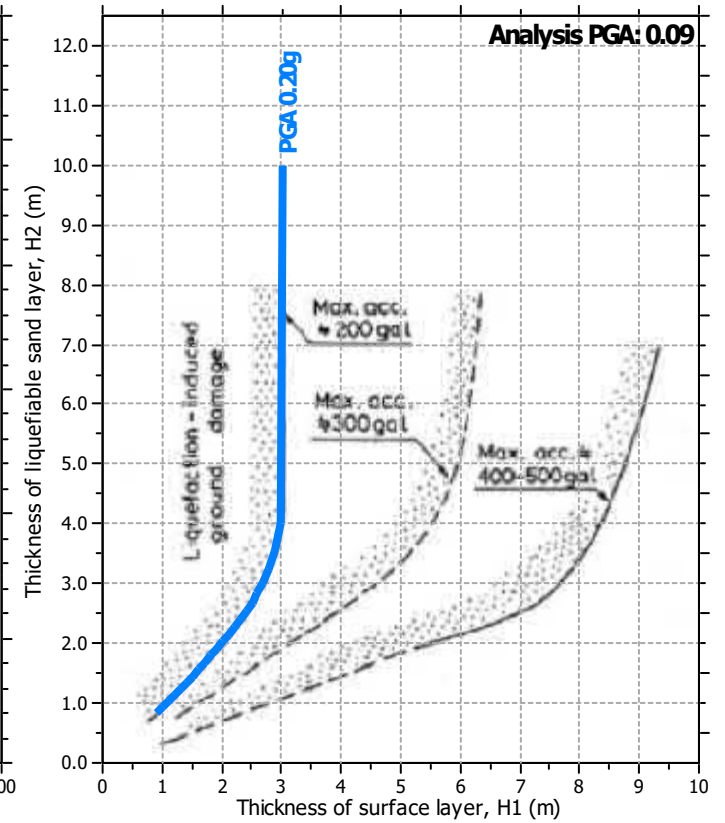
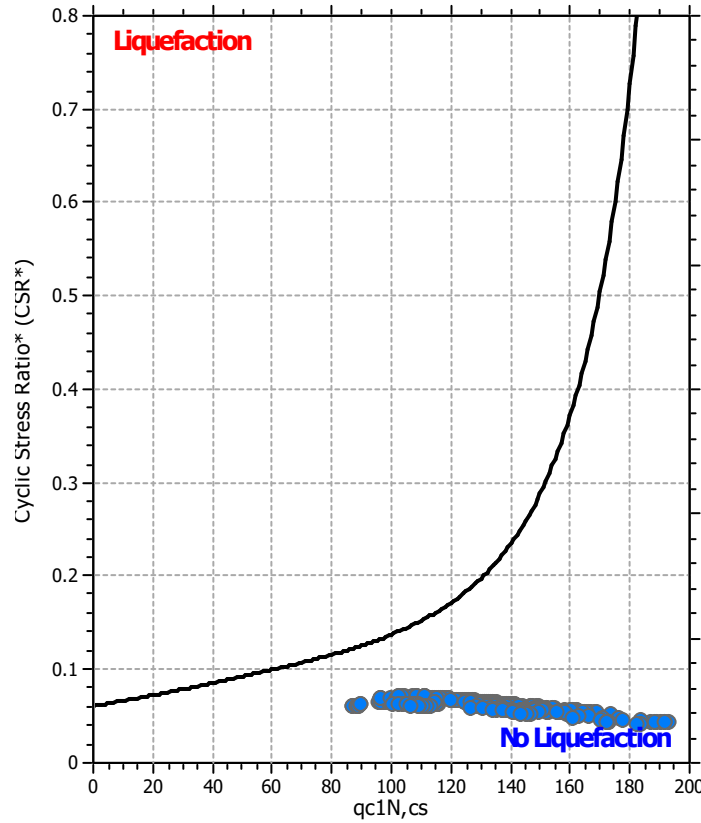
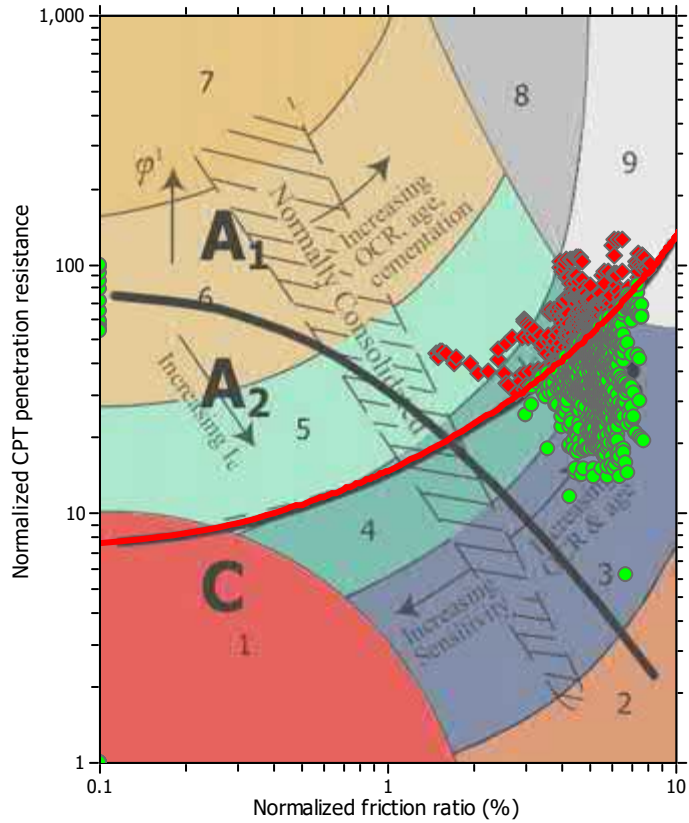
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	15.00 m



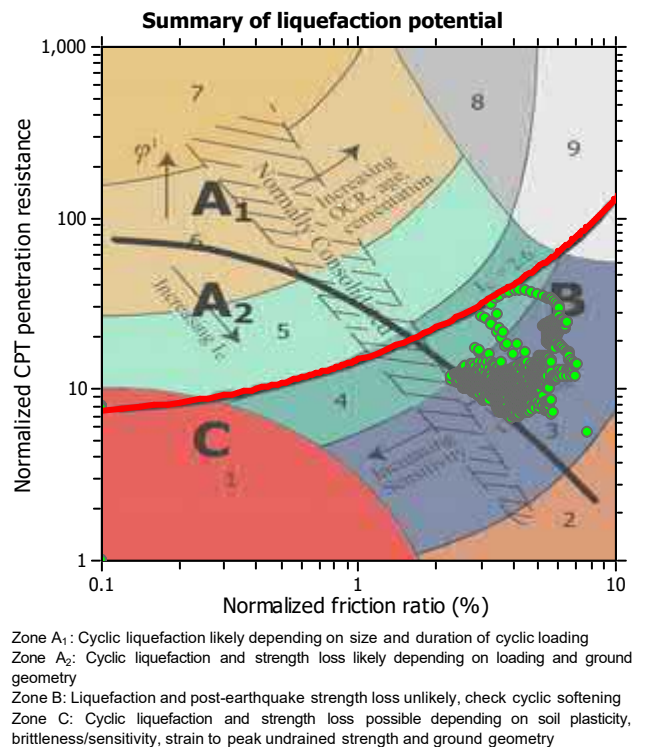
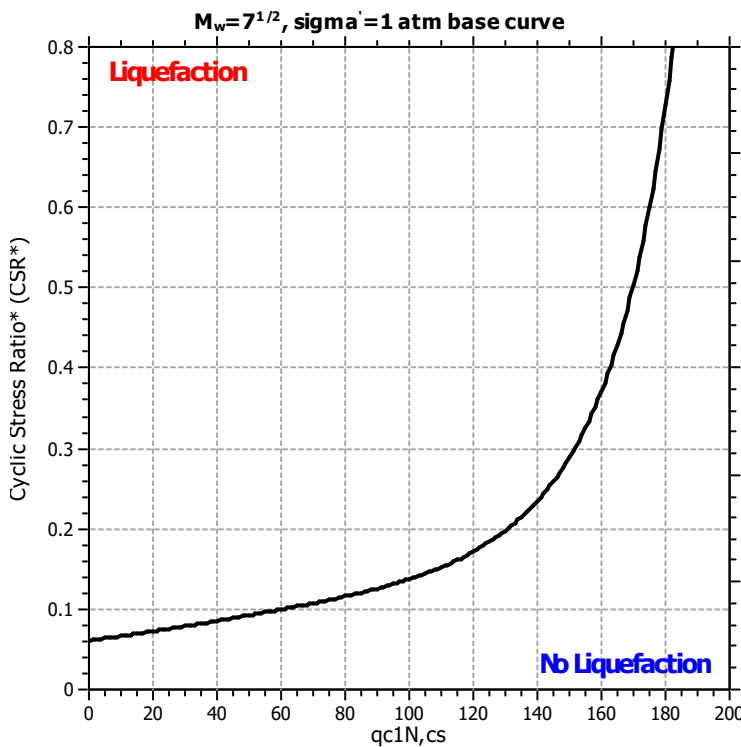
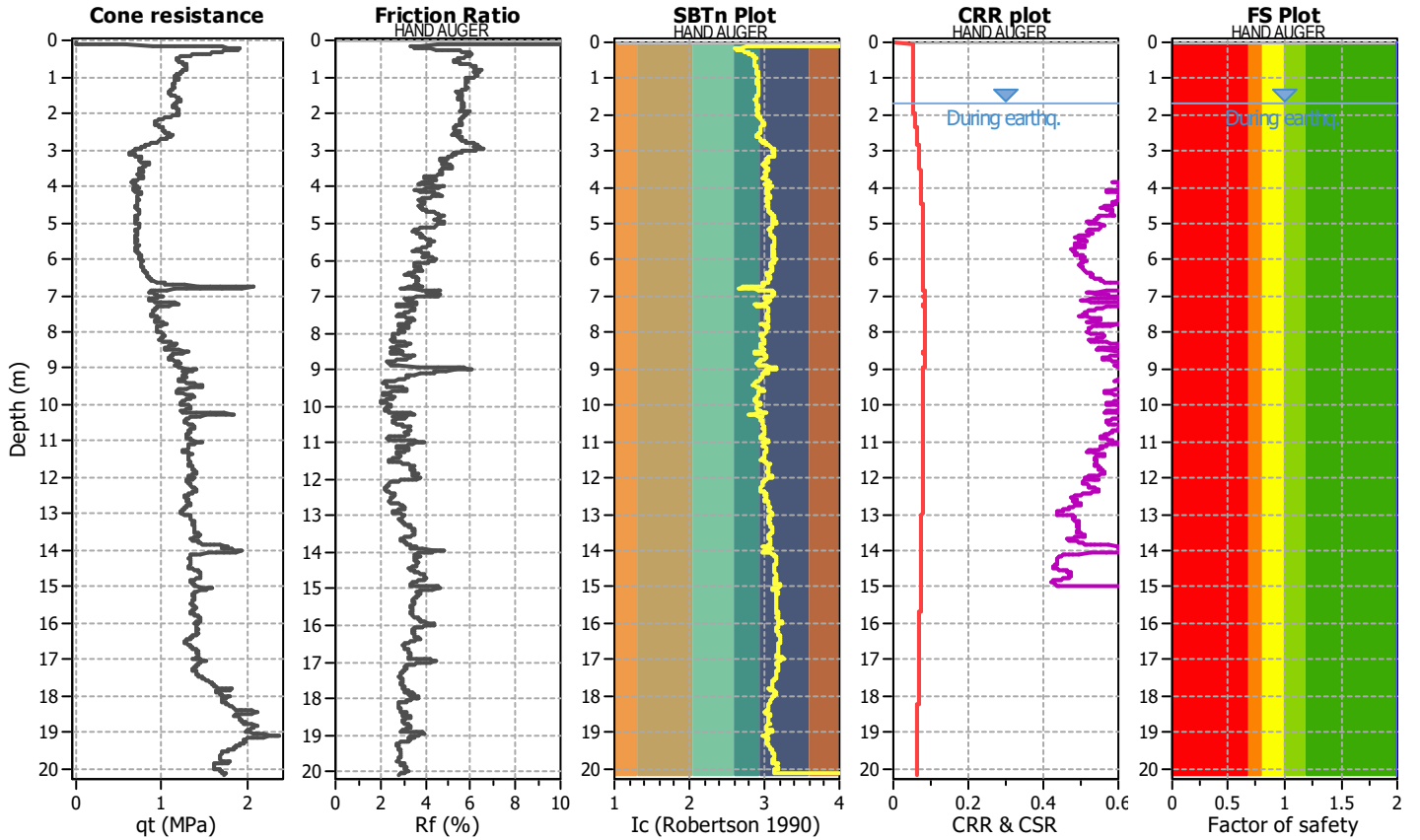
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT11-1/100**

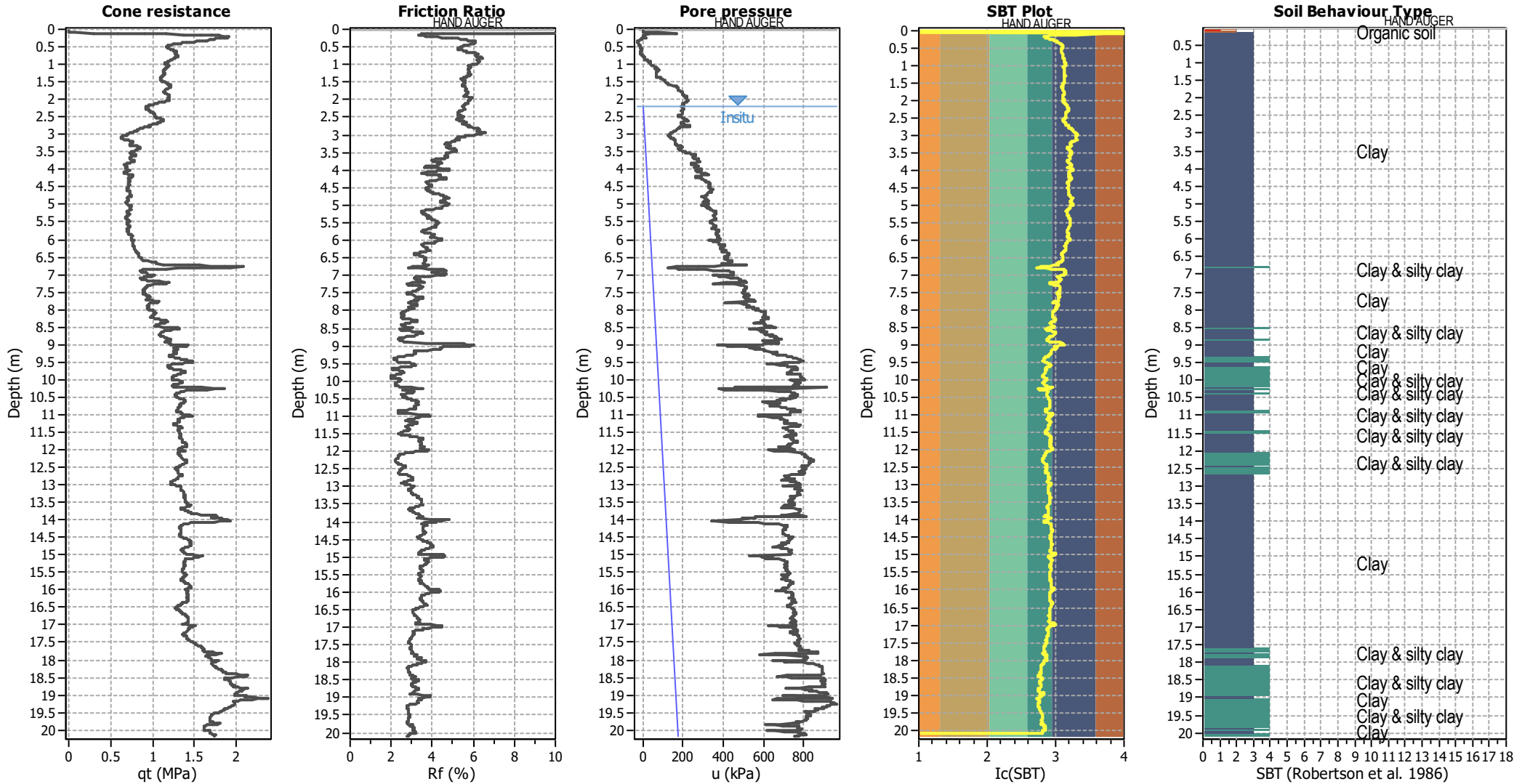
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.22 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	15.00 m
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



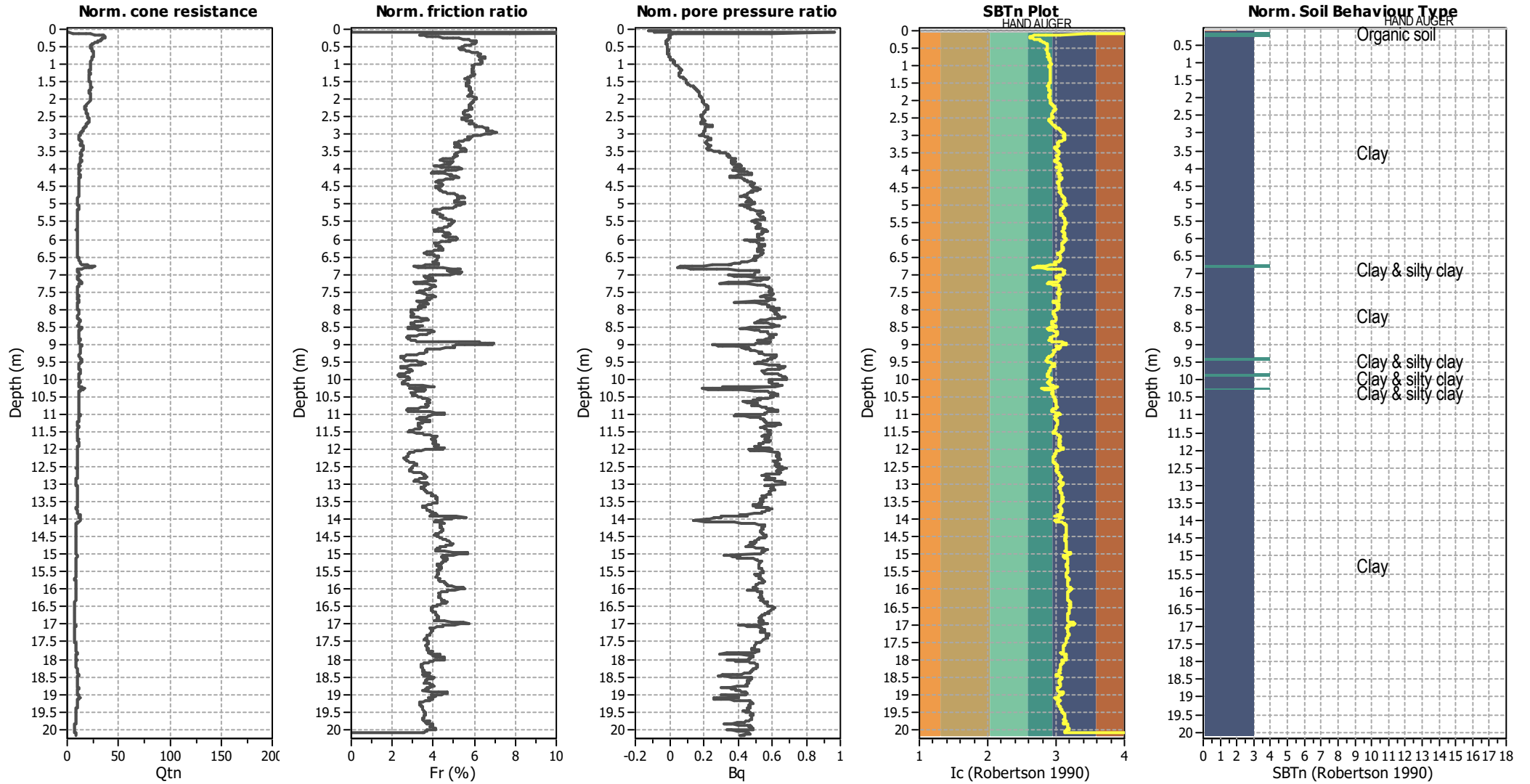
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.22 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



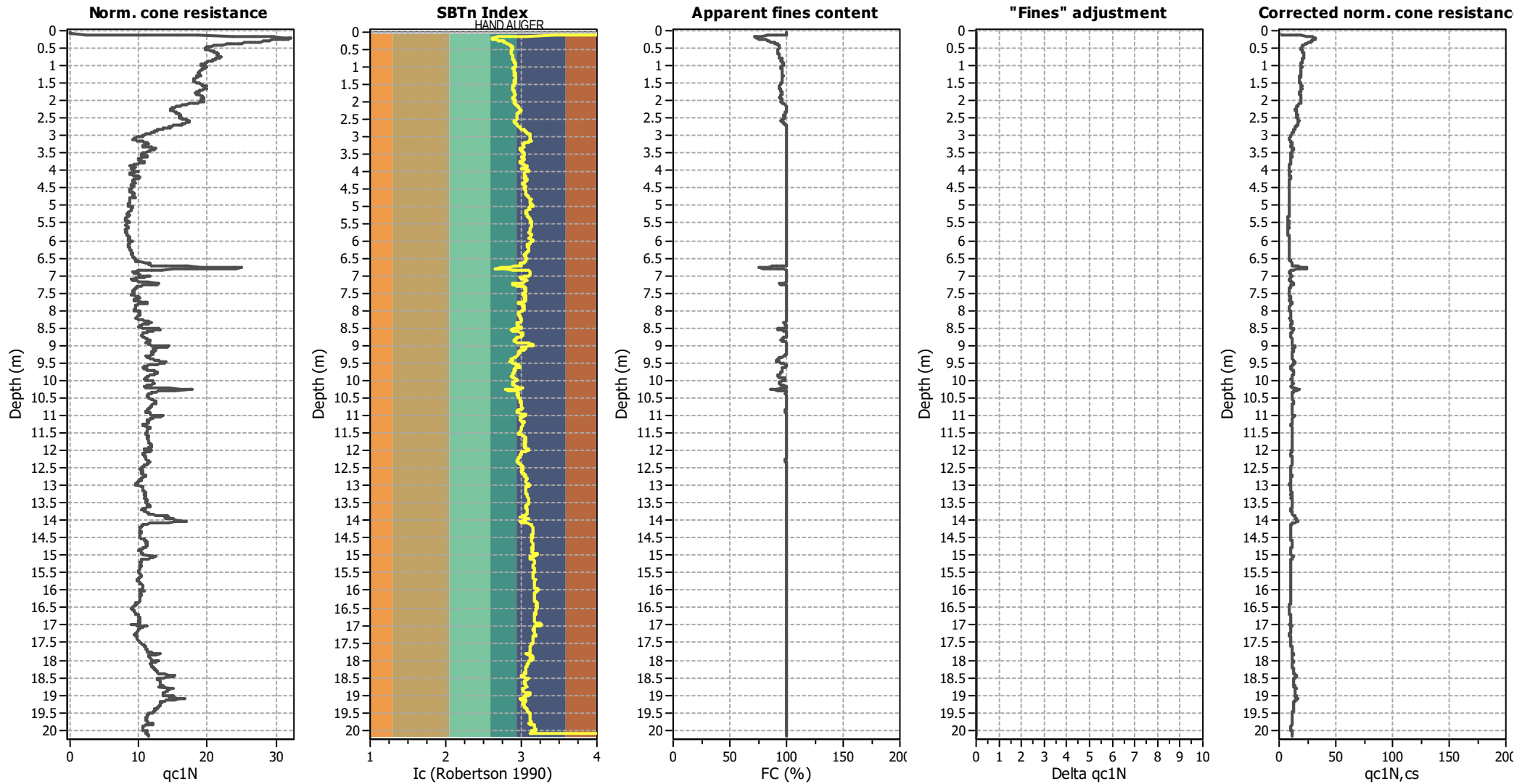
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.22 m	Fill height:	N/A	Limit depth:	15.00 m

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

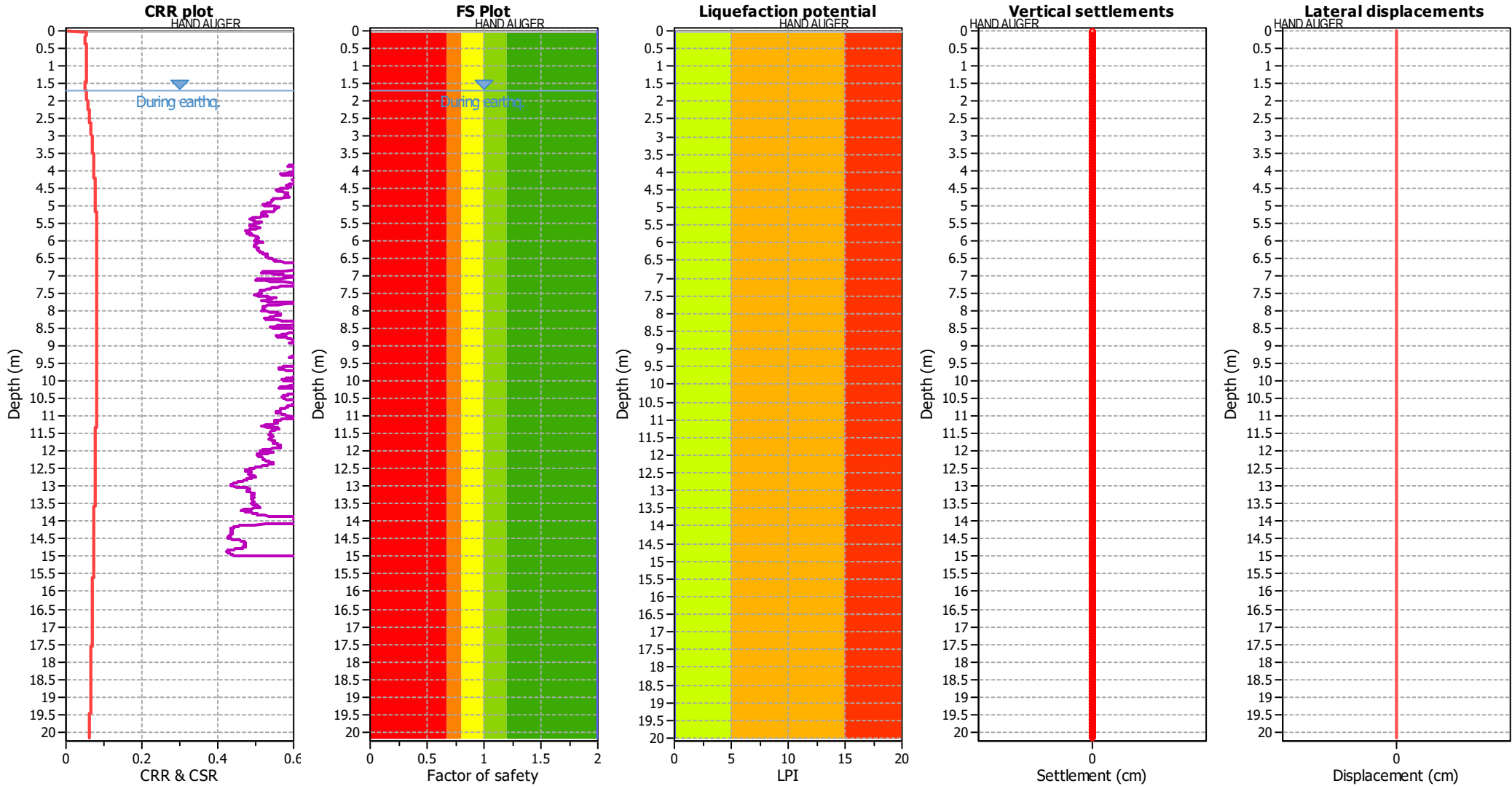


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.22 m	Fill height:	N/A	Limit depth:	15.00 m



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.22 m	Fill height:	N/A	Limit depth:	15.00 m

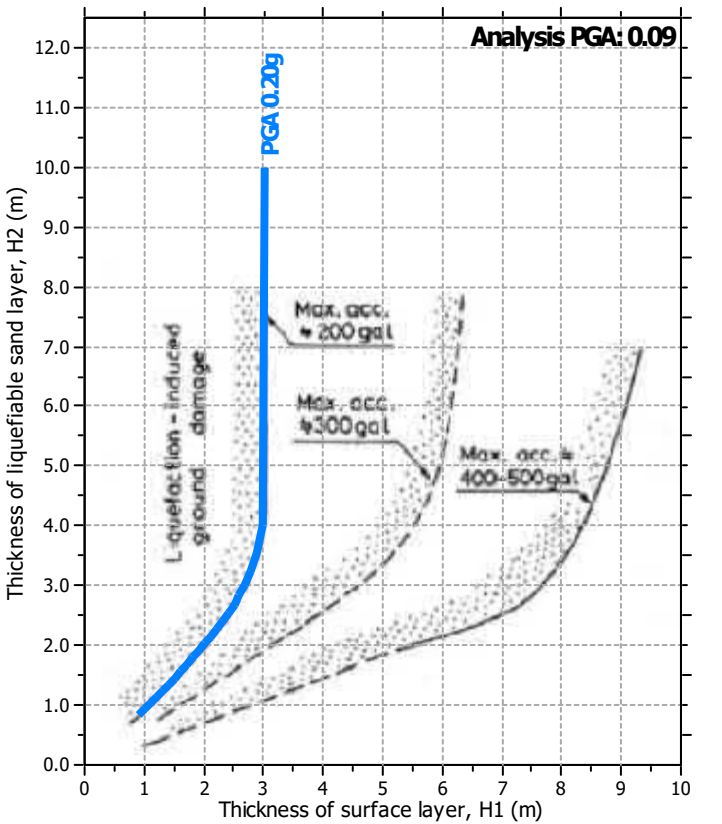
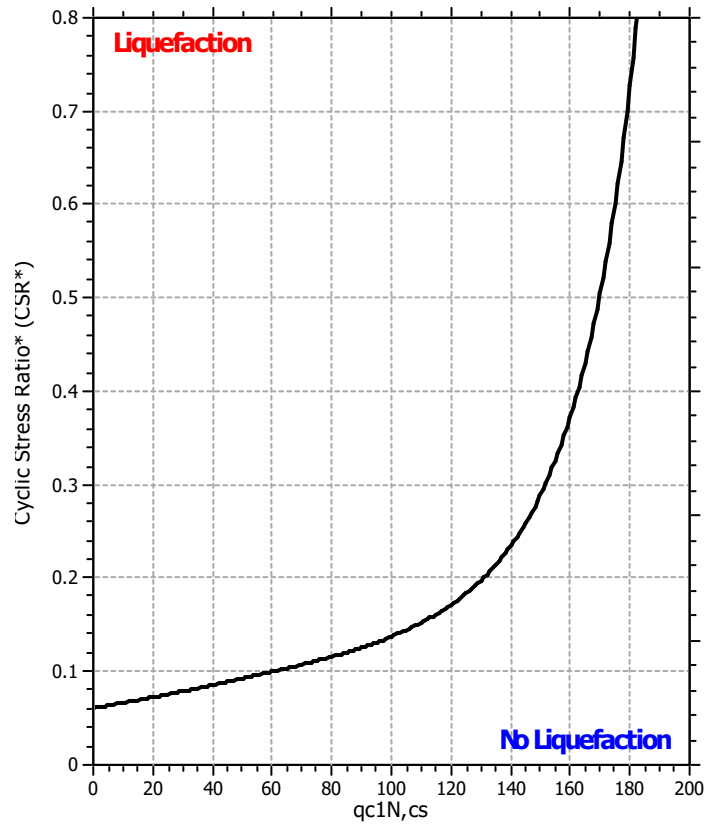
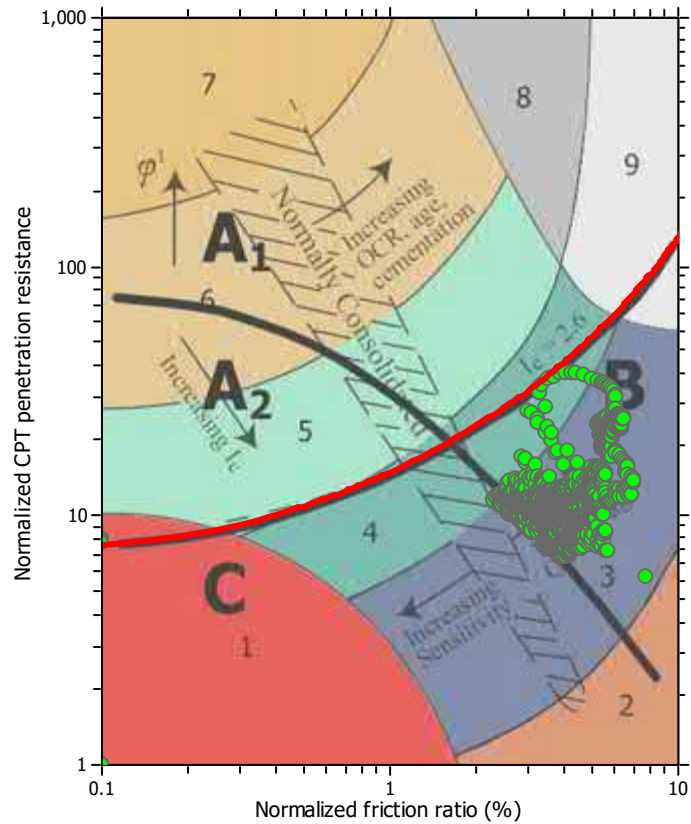
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	2.22 m	Fill height:	N/A	Limit depth:	15.00 m

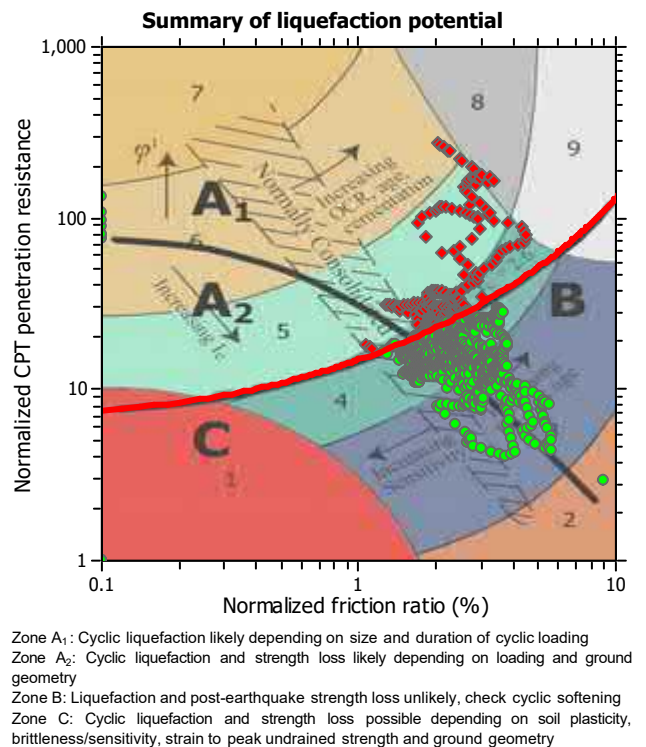
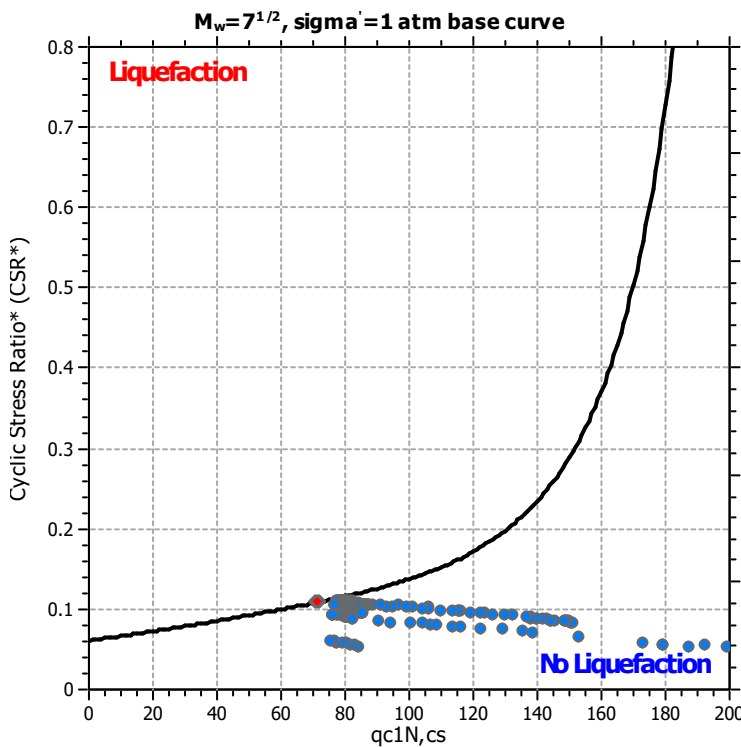
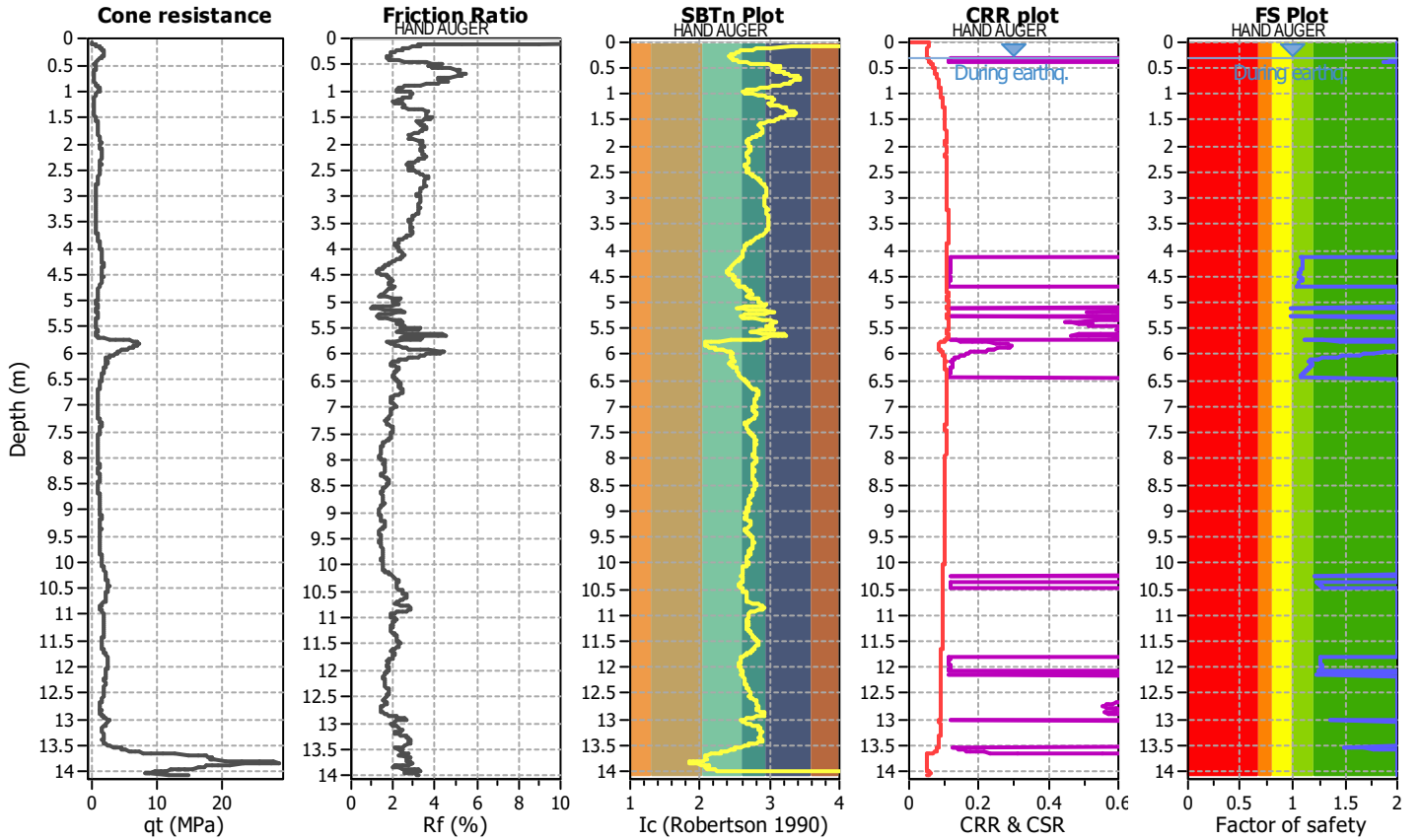
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT12-1/100**

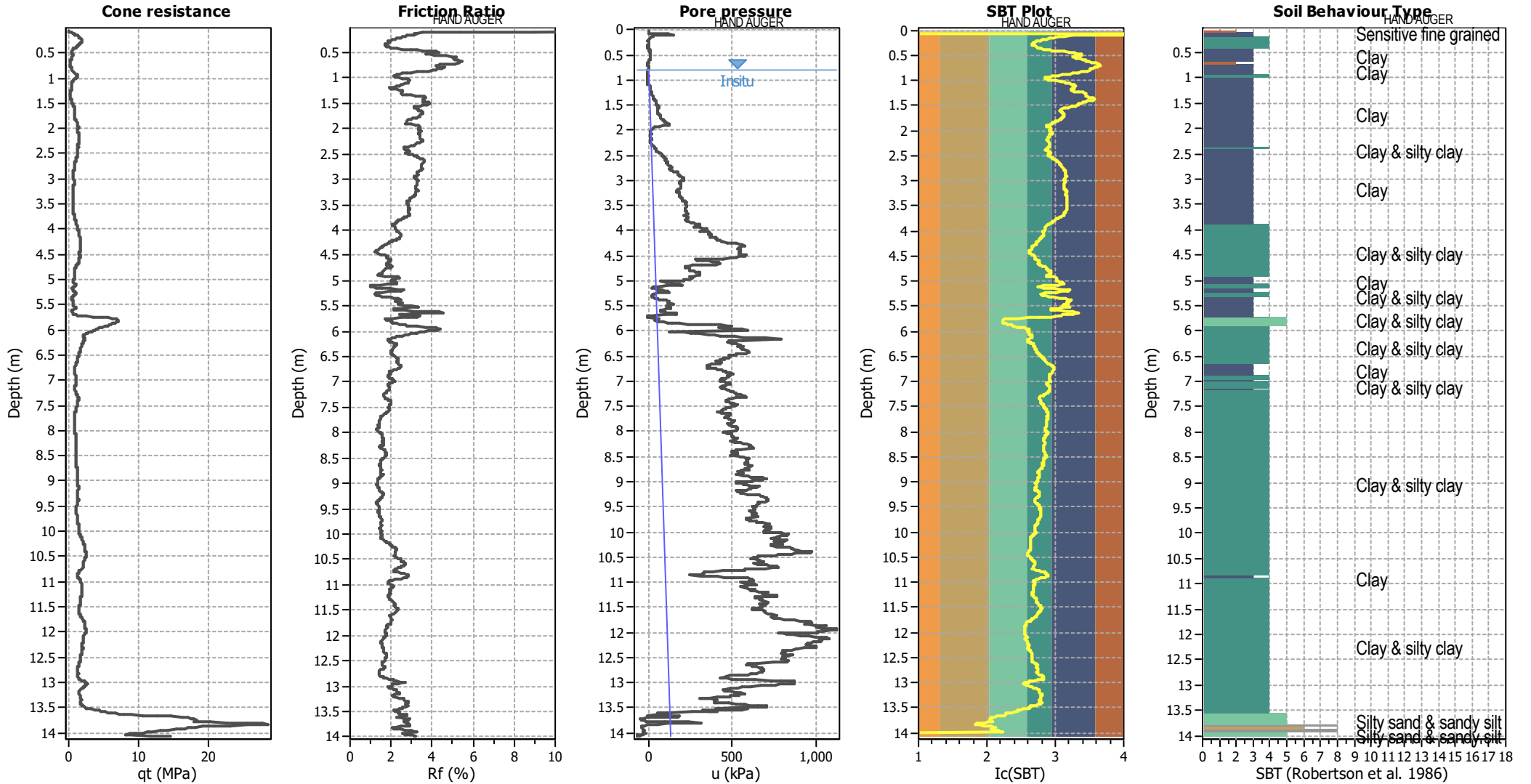
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.30 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



#### Input parameters and analysis data

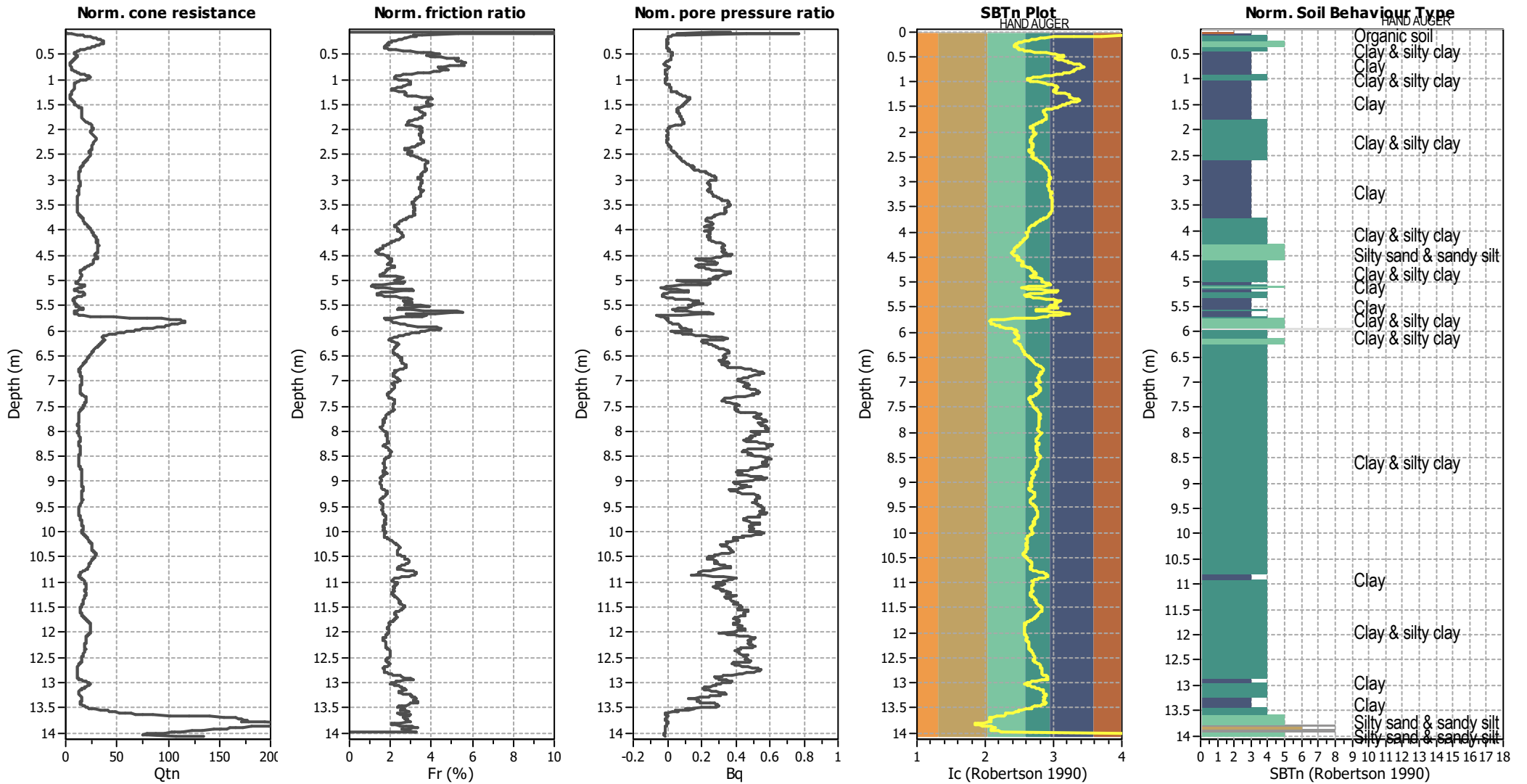
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



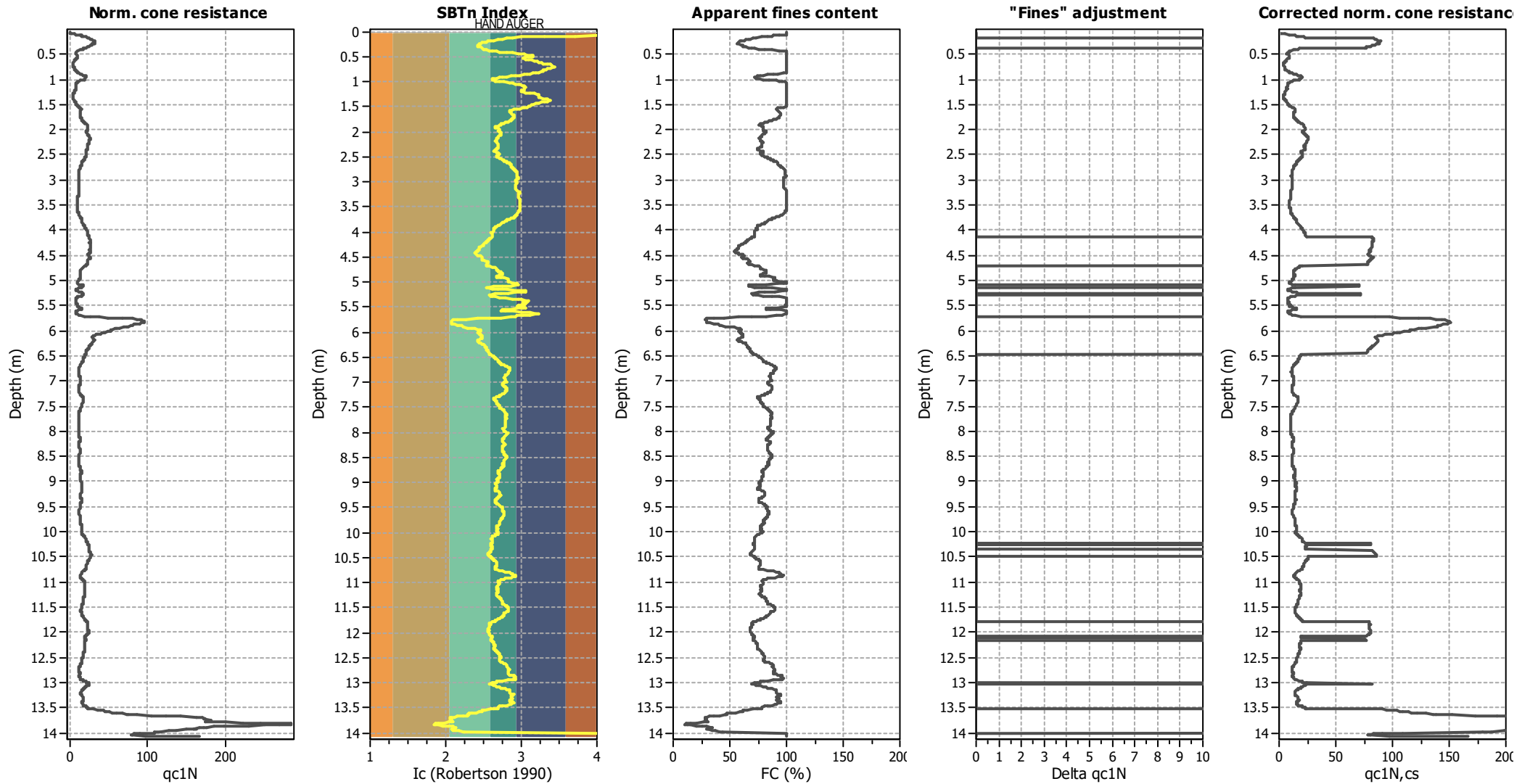
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

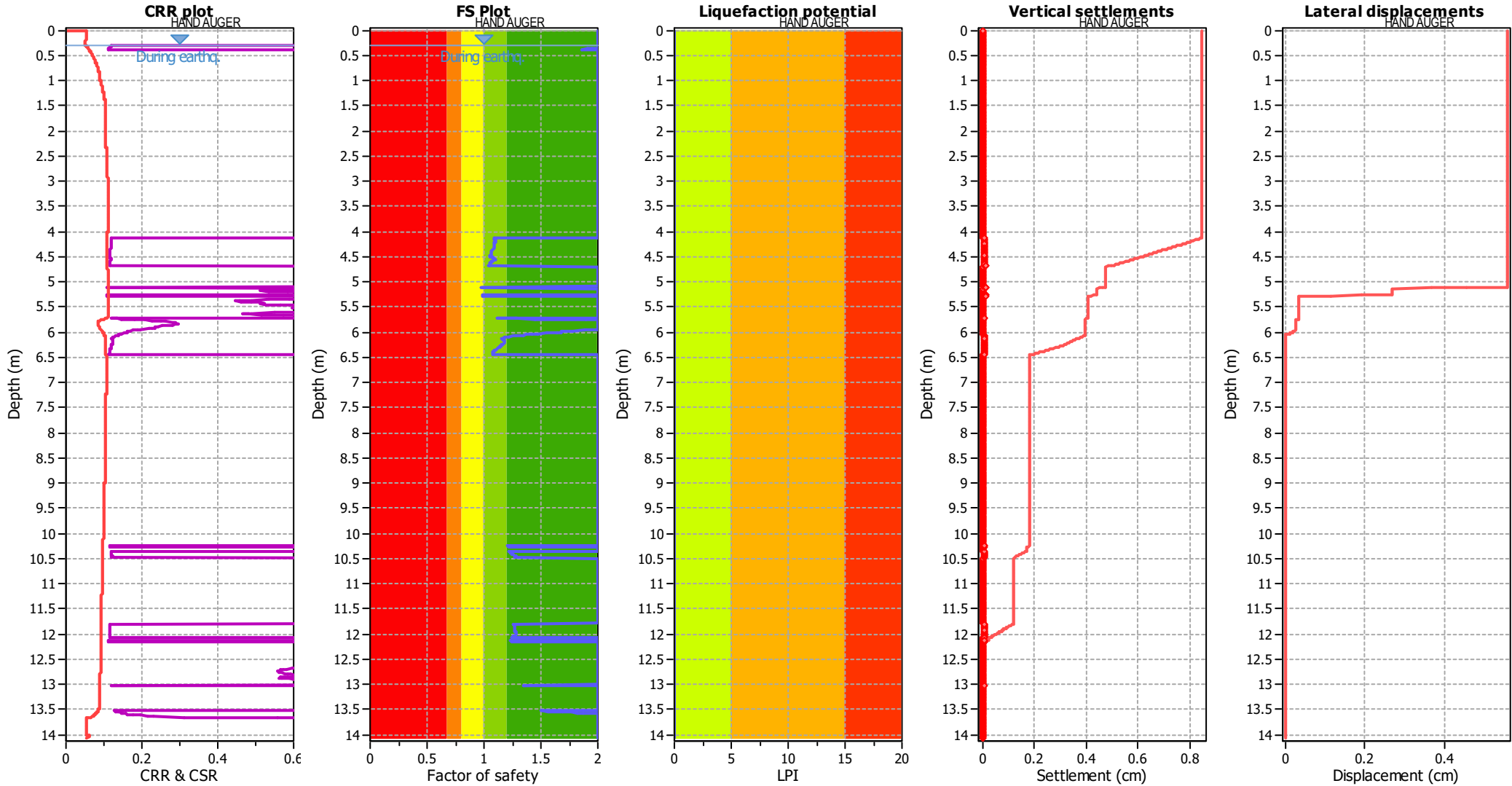
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_v$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A

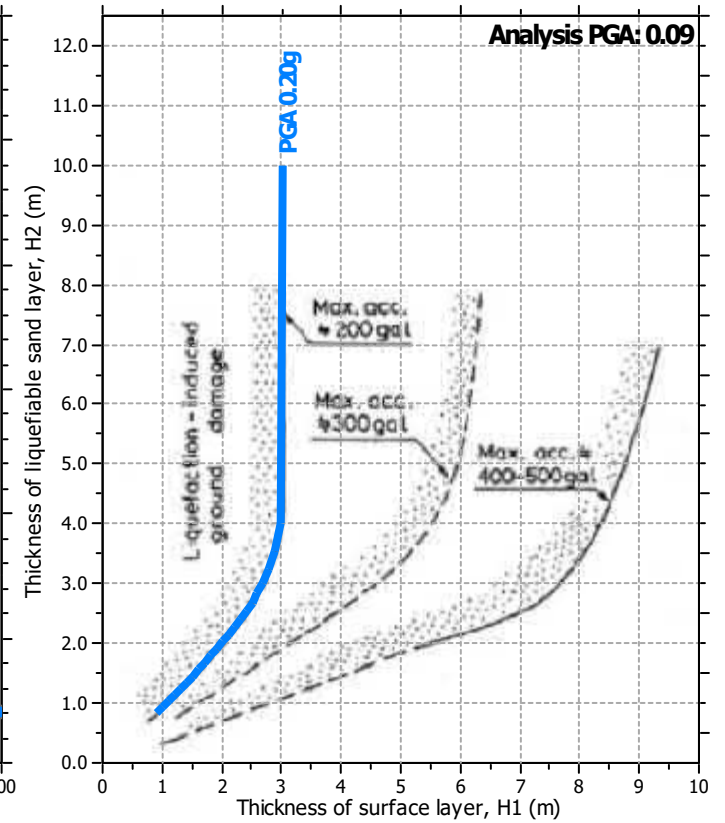
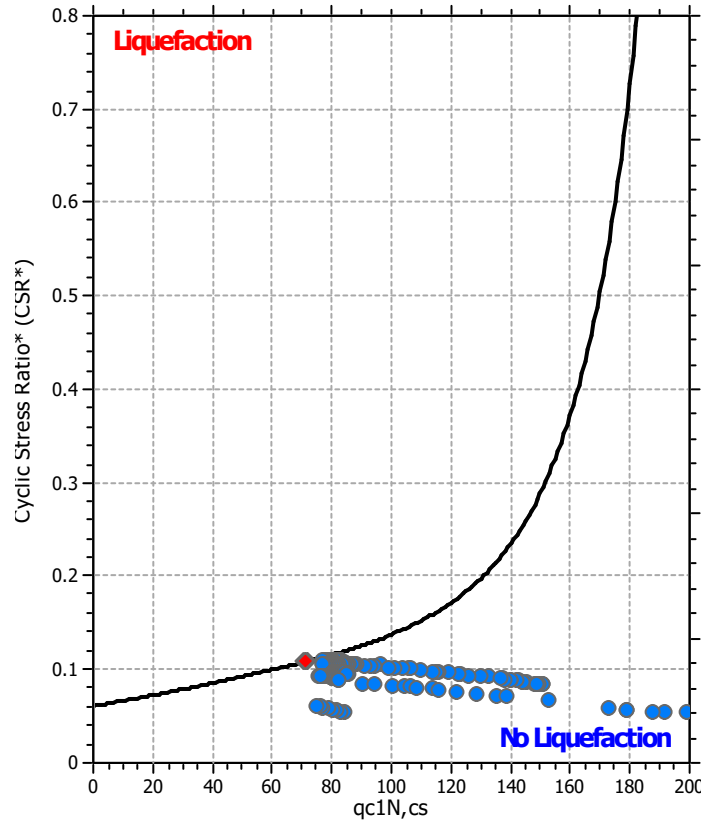
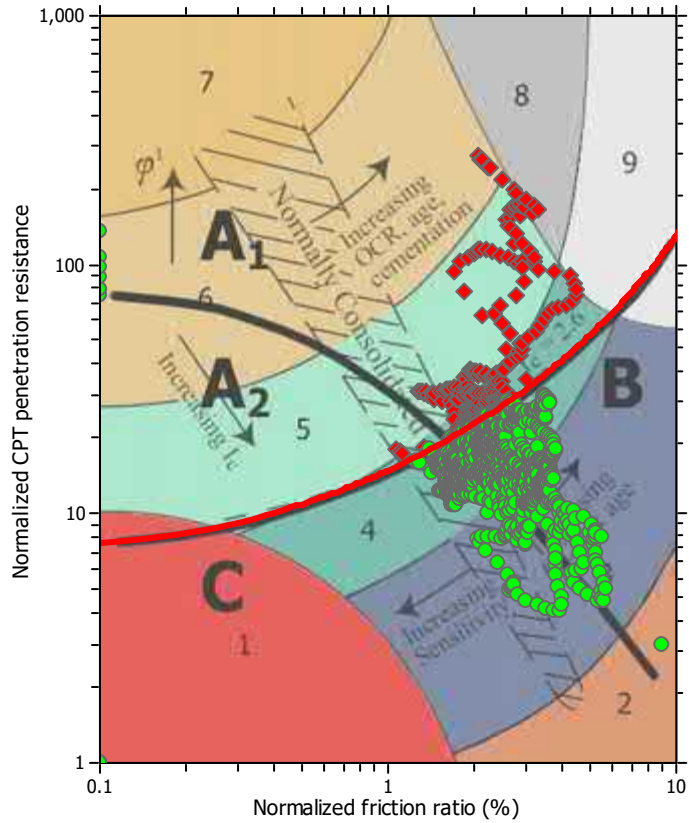
#### F.S. color scheme

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.80 m	Fill height:	N/A	Limit depth:	N/A



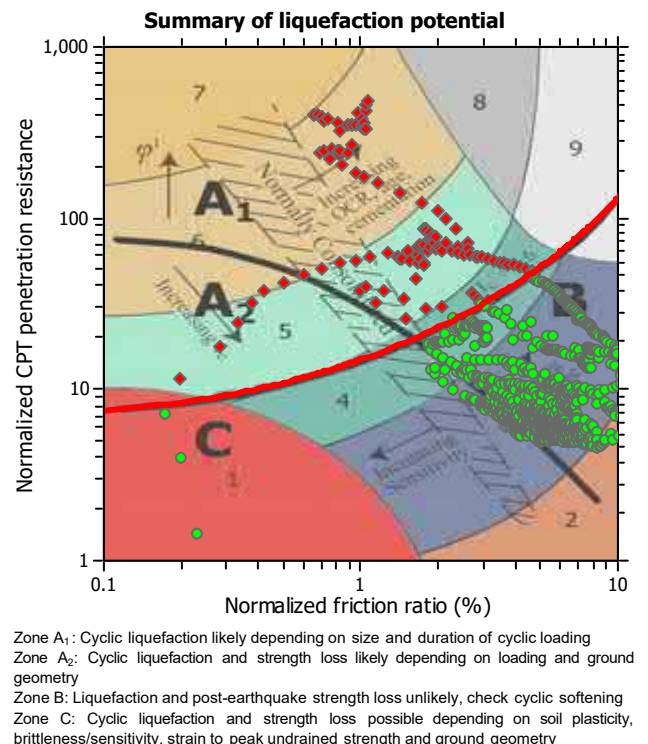
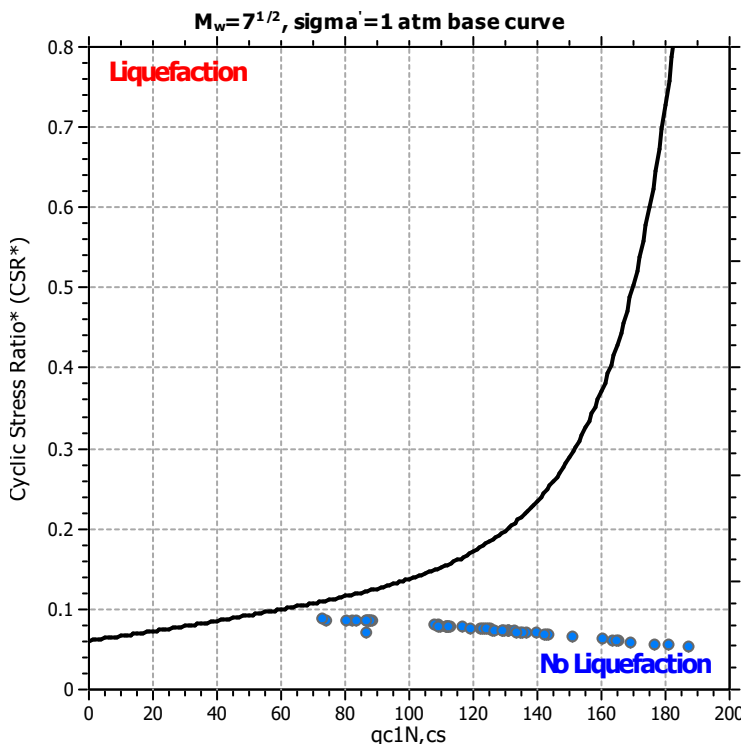
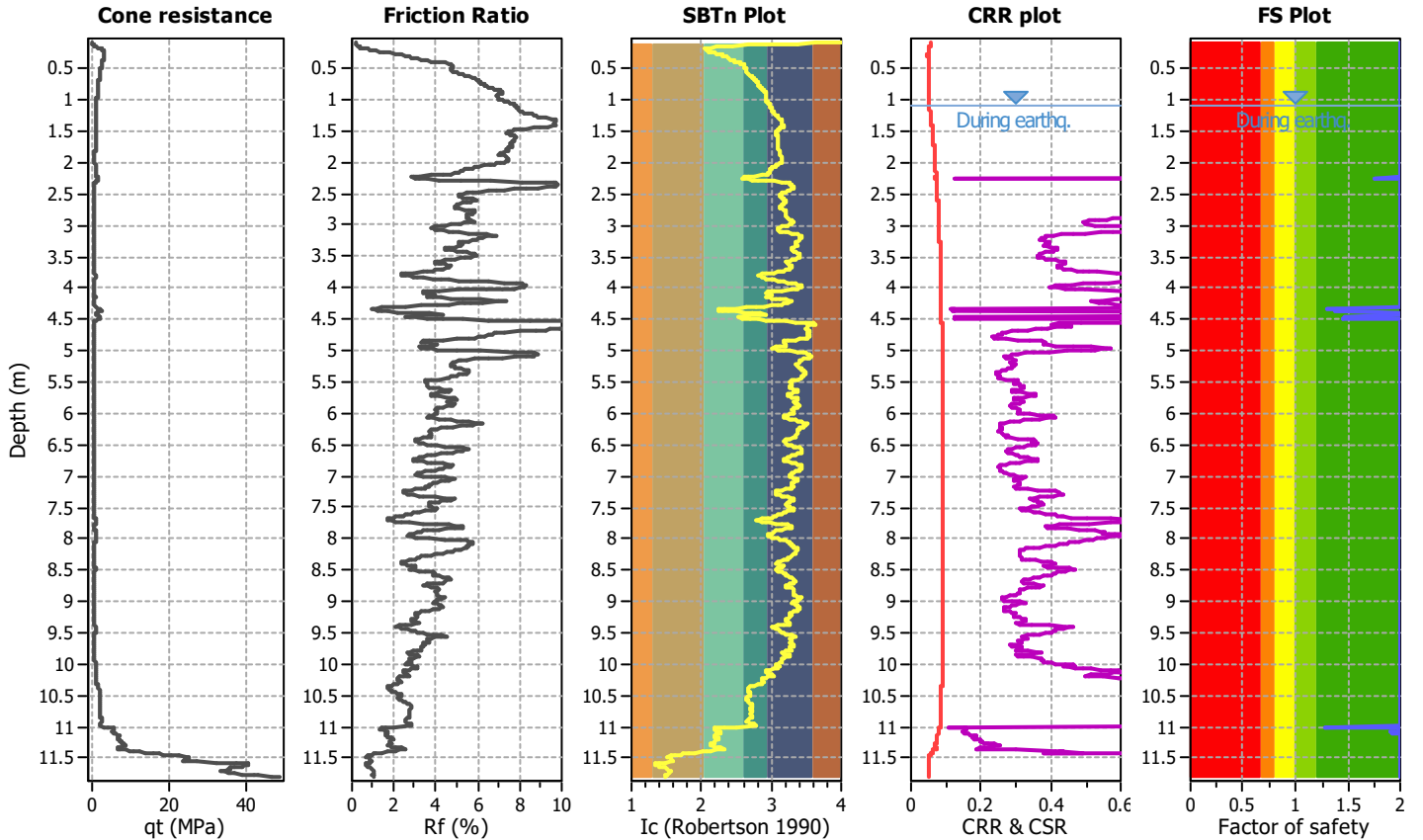
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT13-1/100**

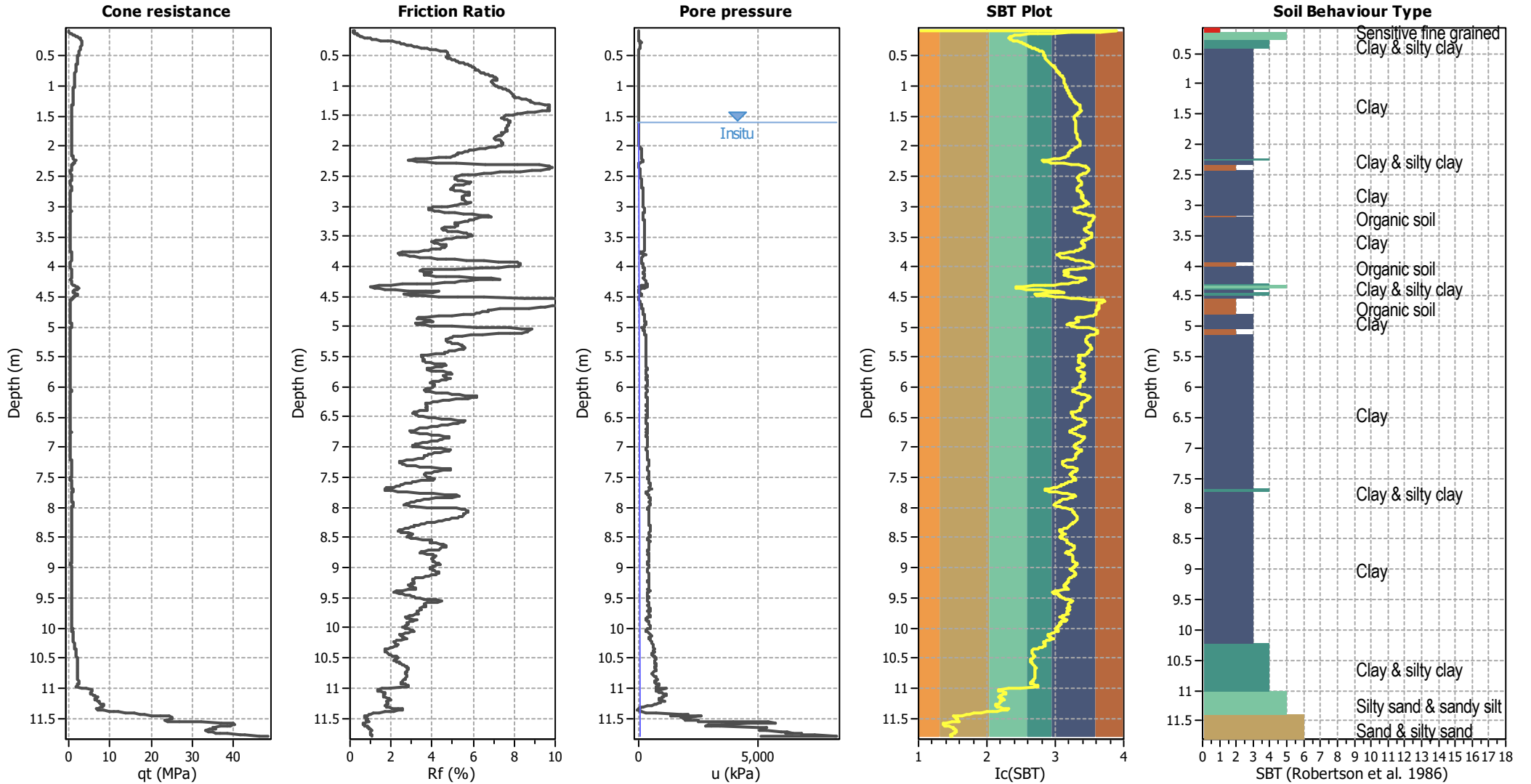
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.10 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



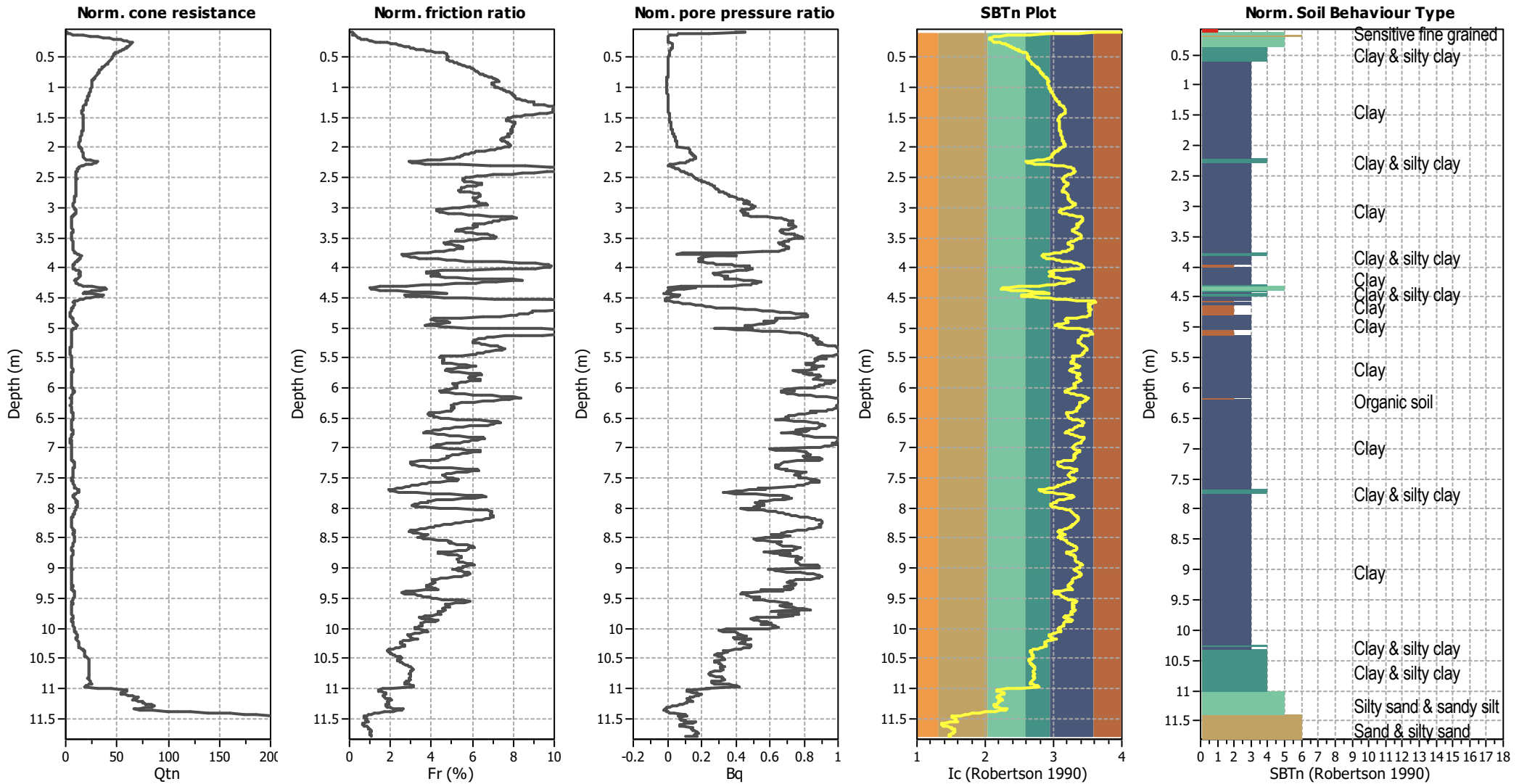
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



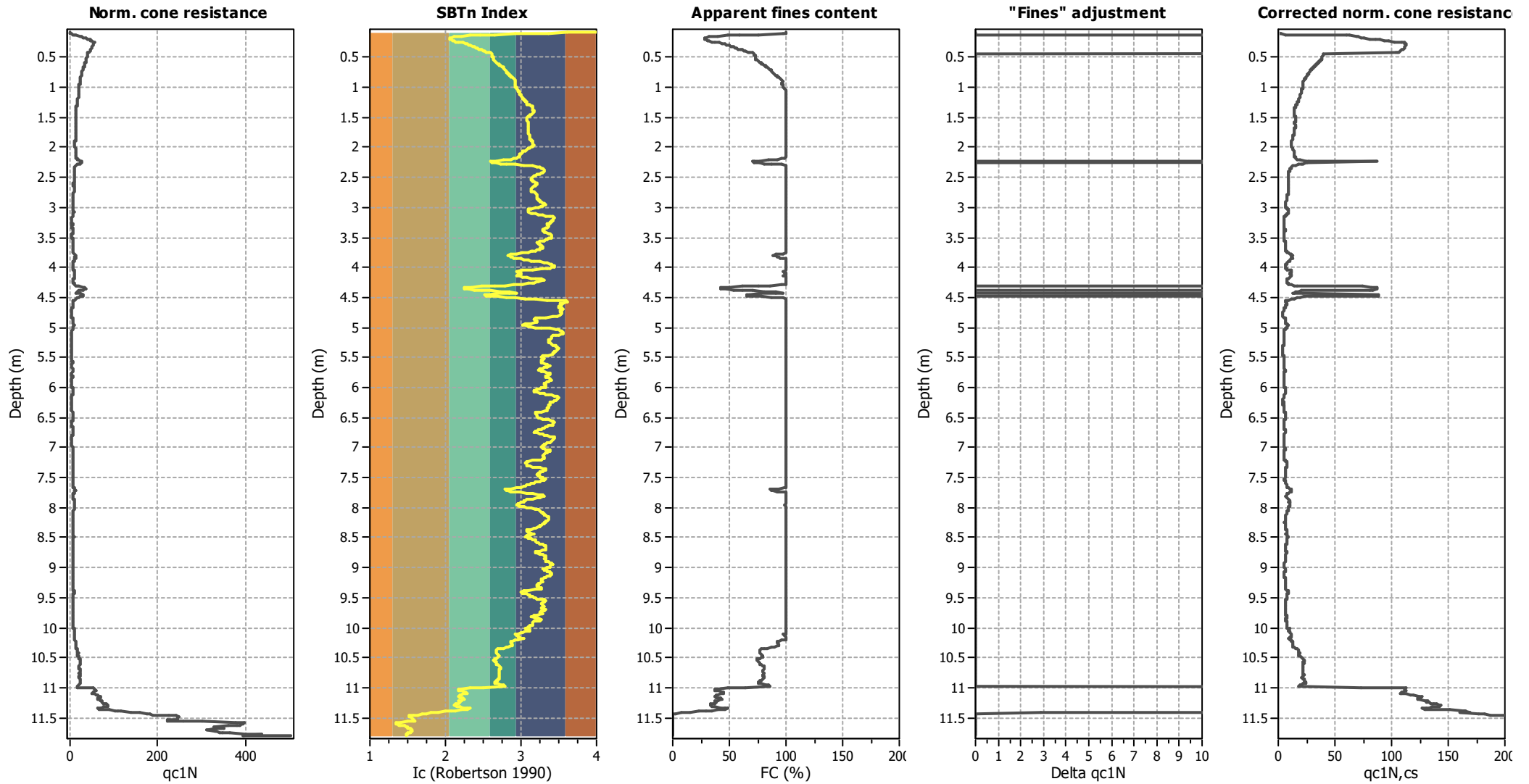
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

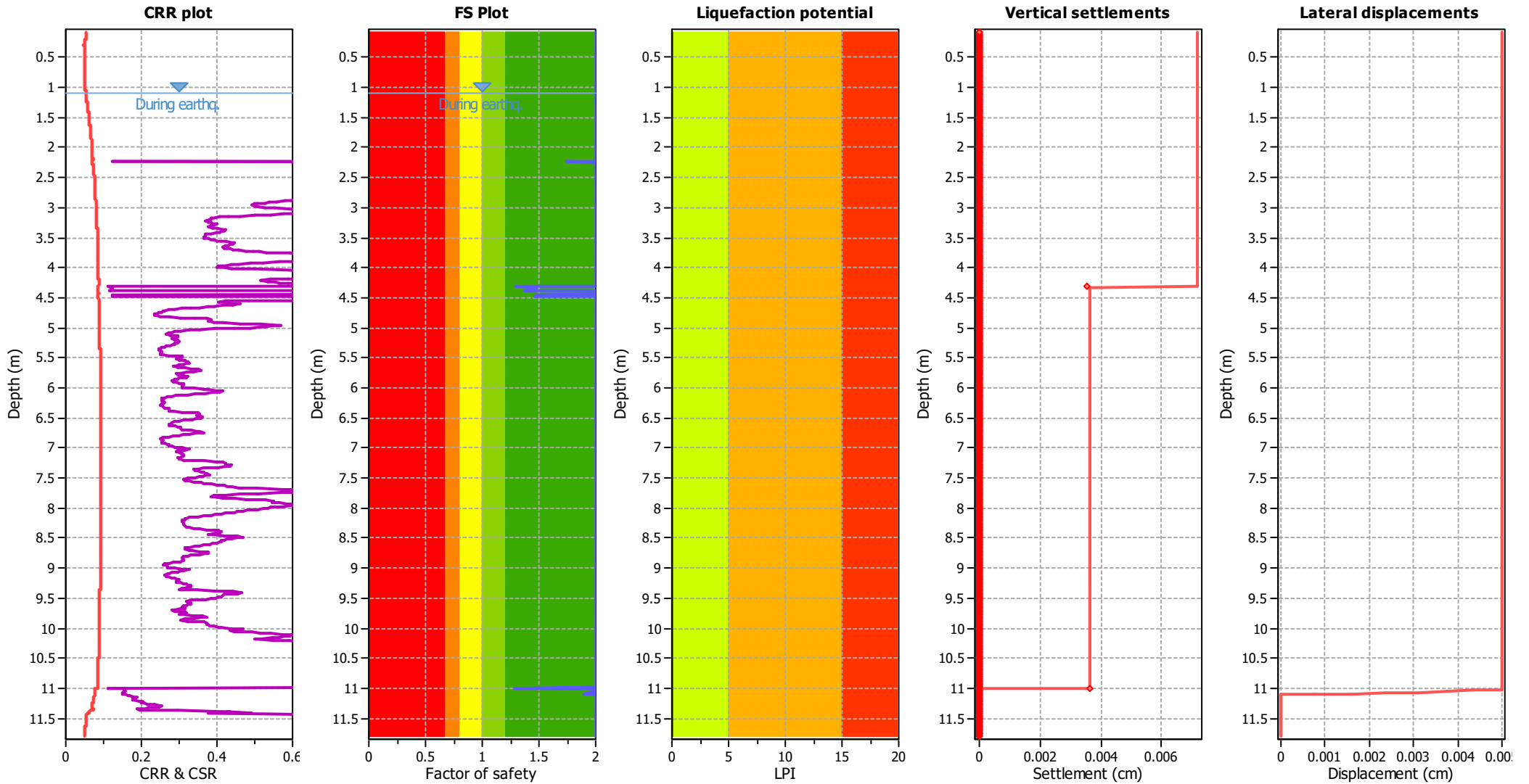


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

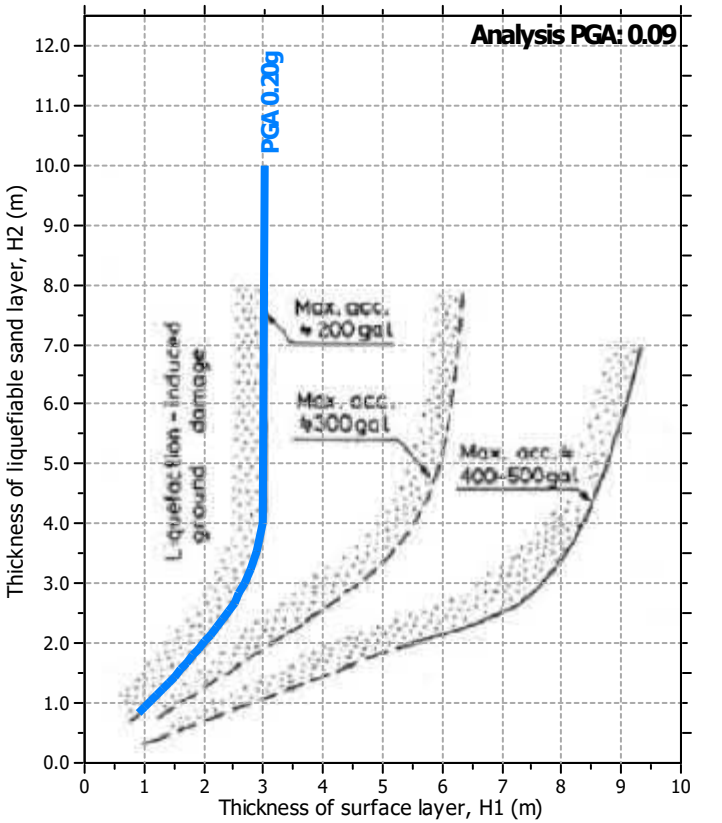
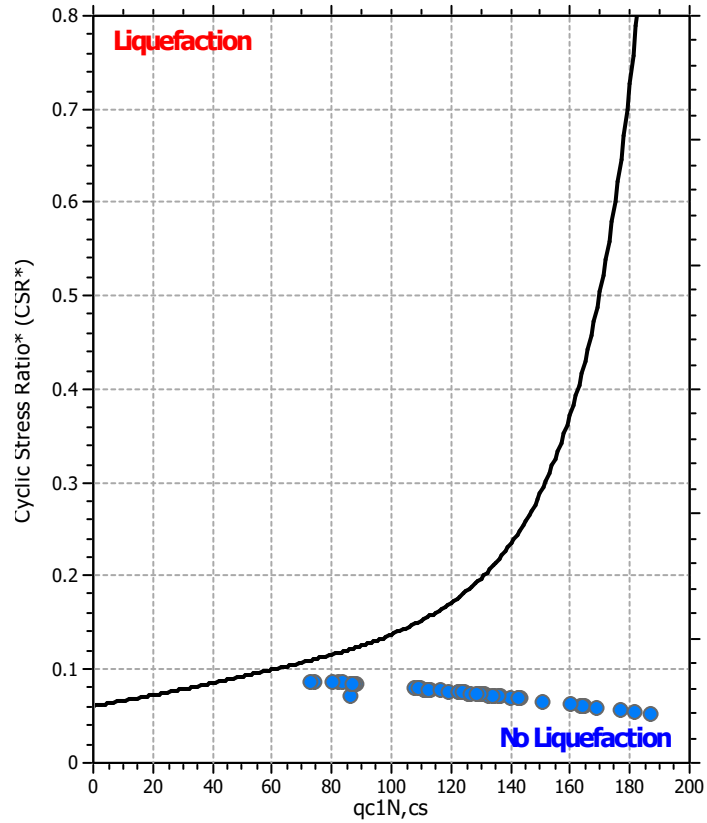
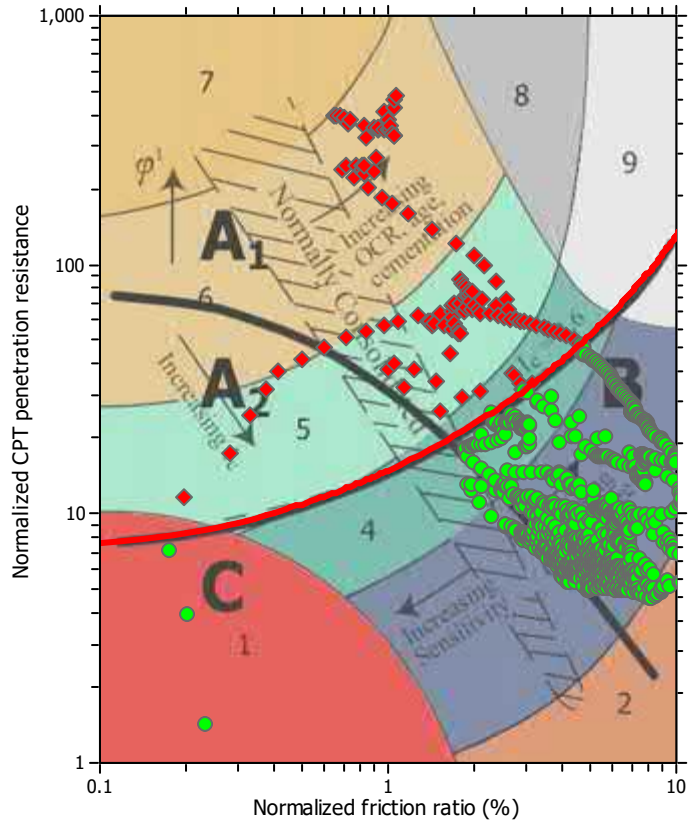
#### F.S. color scheme

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

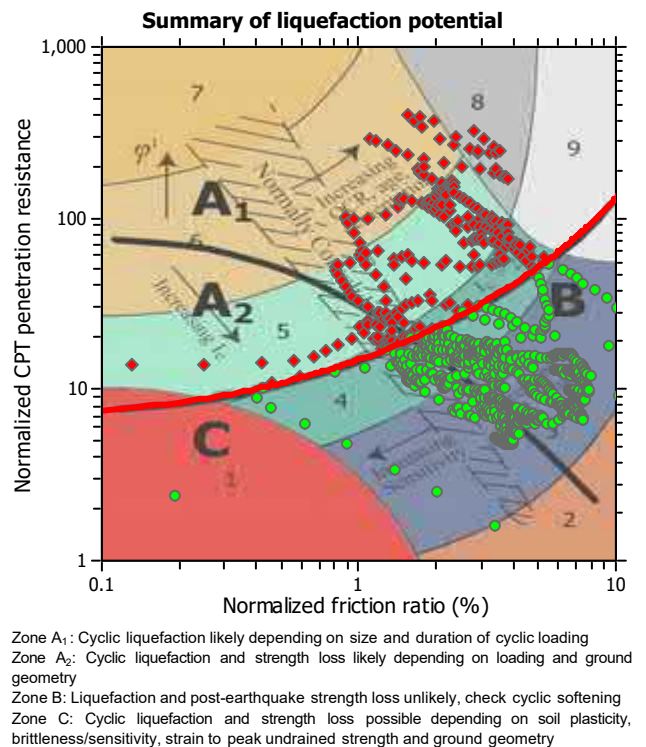
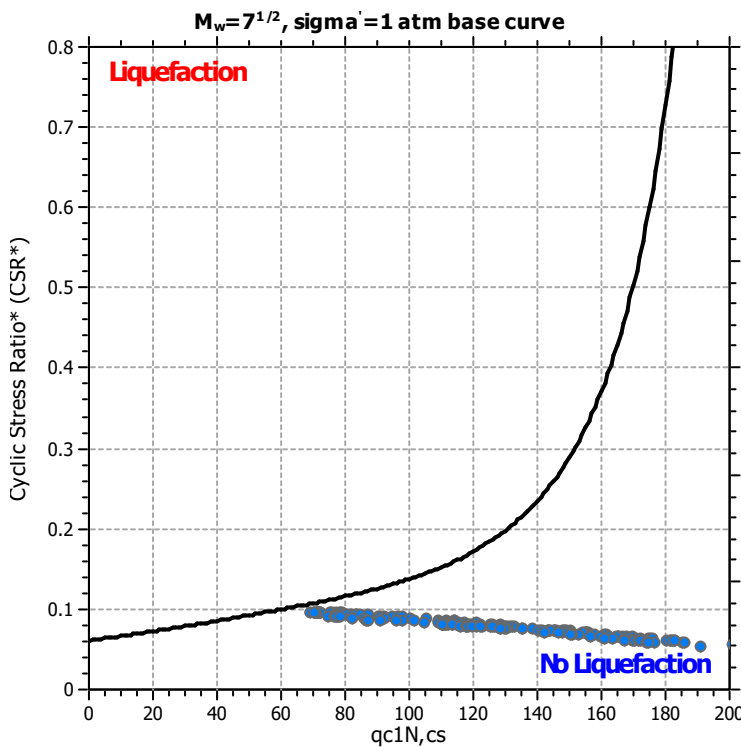
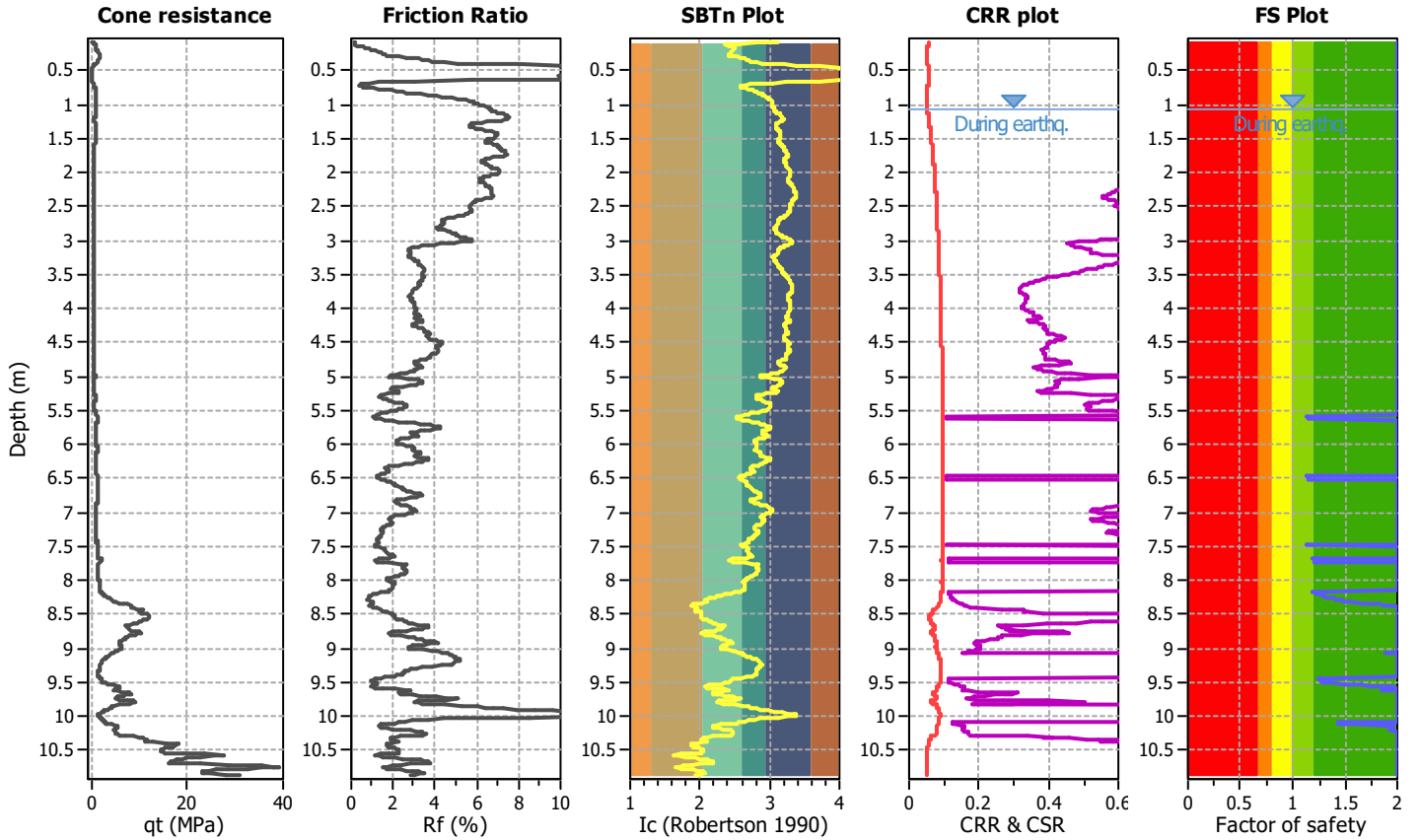
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT14-1/100**

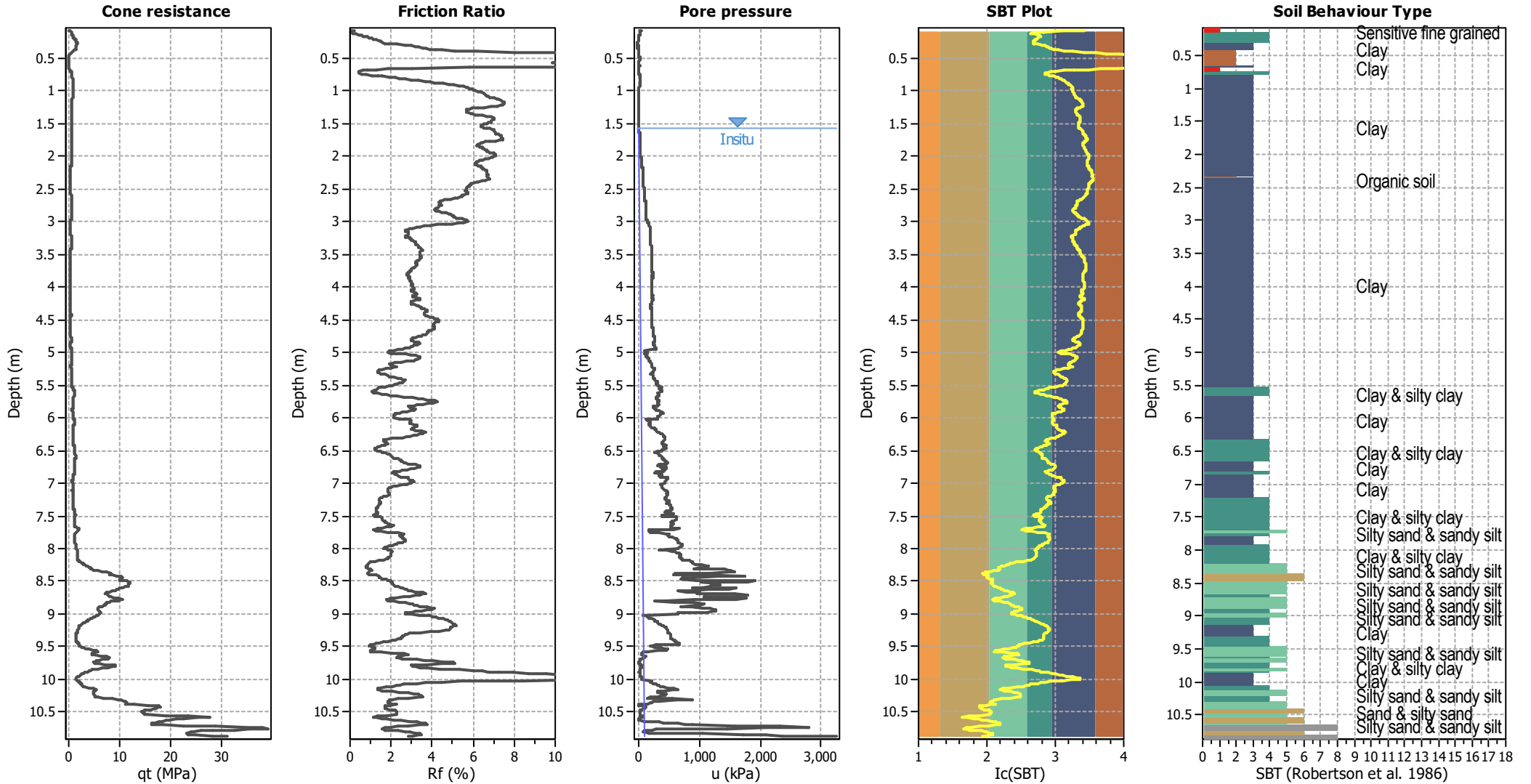
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.58 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.08 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 $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No		



### CPT basic interpretation plots



#### Input parameters and analysis data

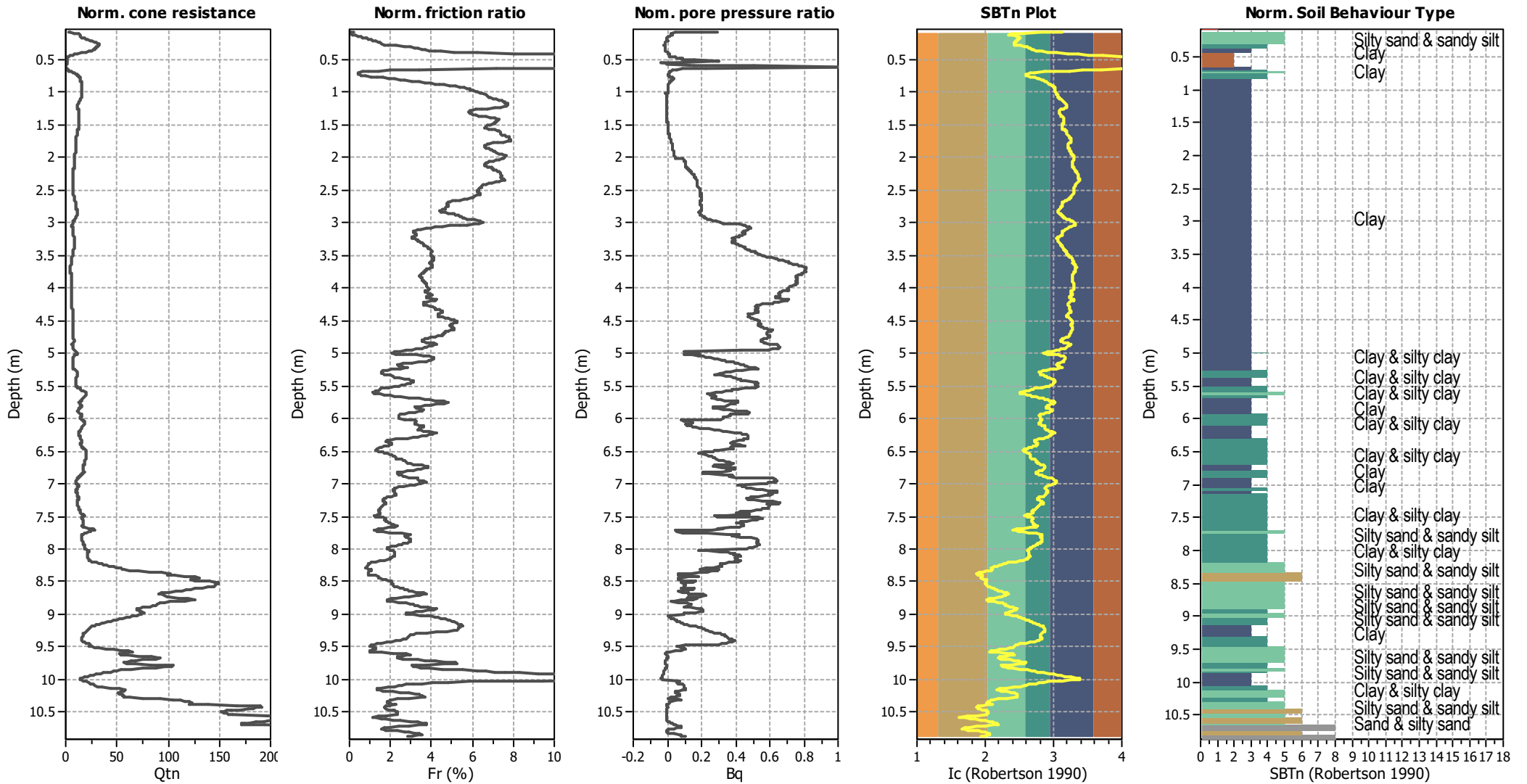
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained



### CPT basic interpretation plots (normalized)



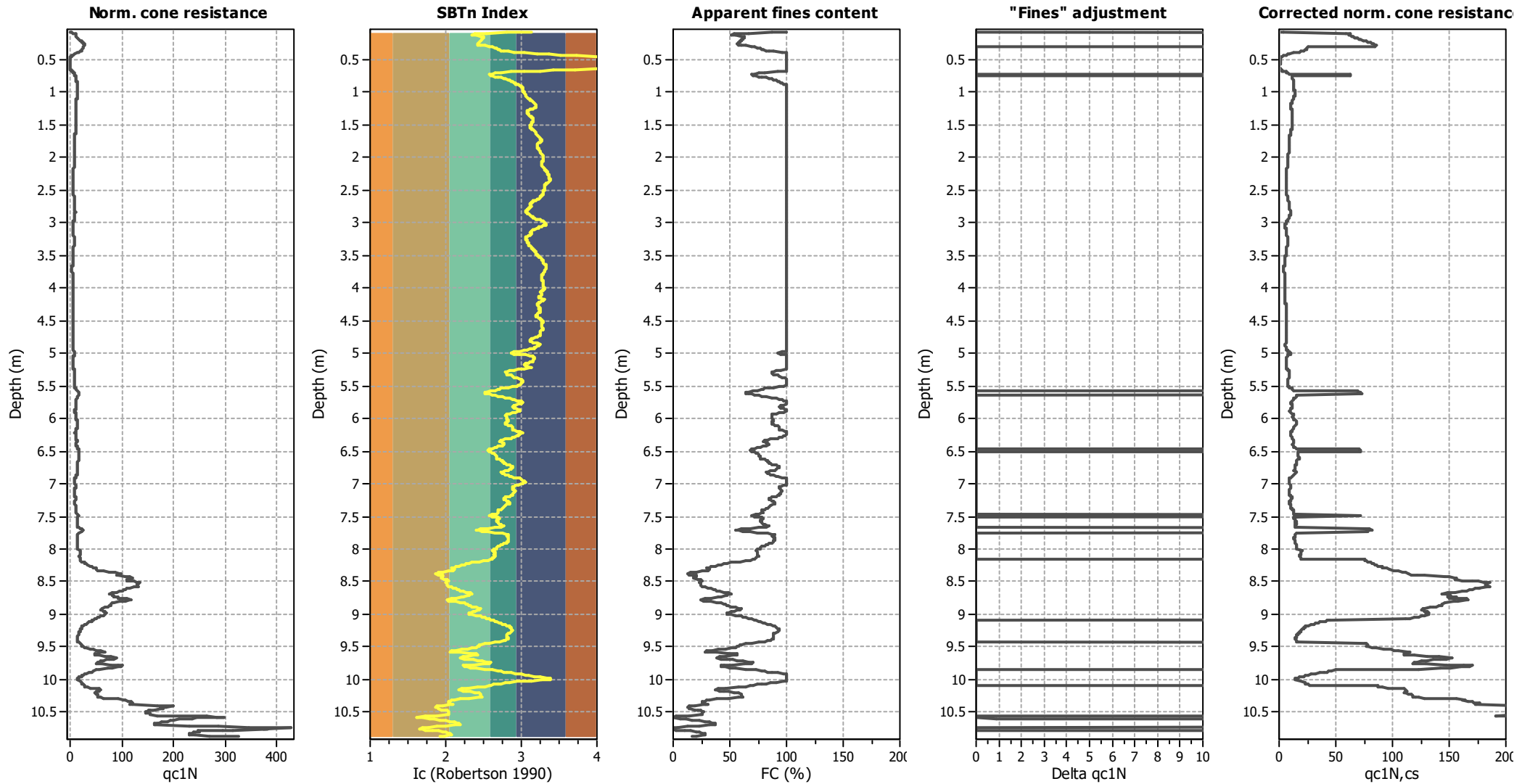
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>o</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

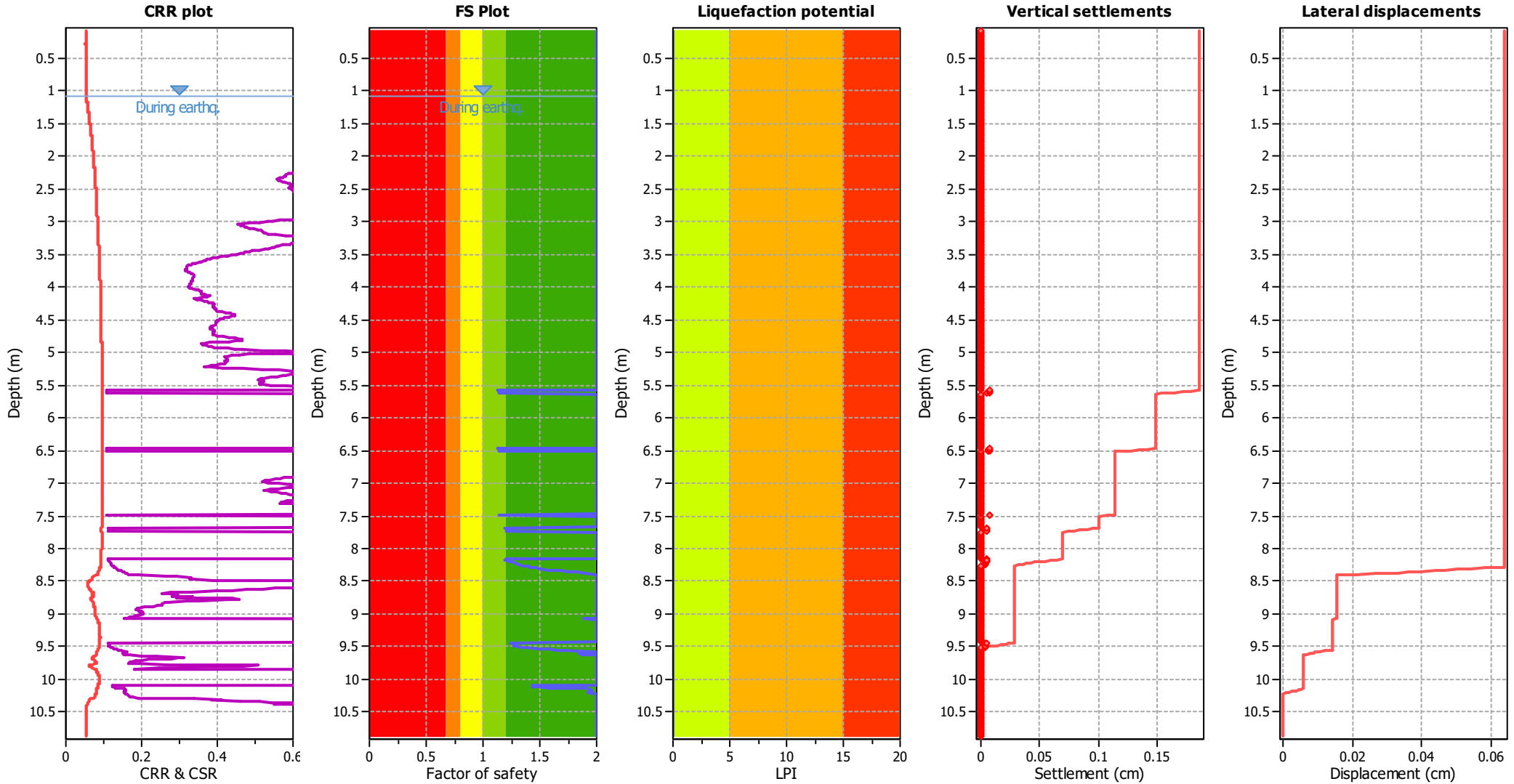
### Liquefaction analysis overall plots (intermediate results)



#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_0$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A

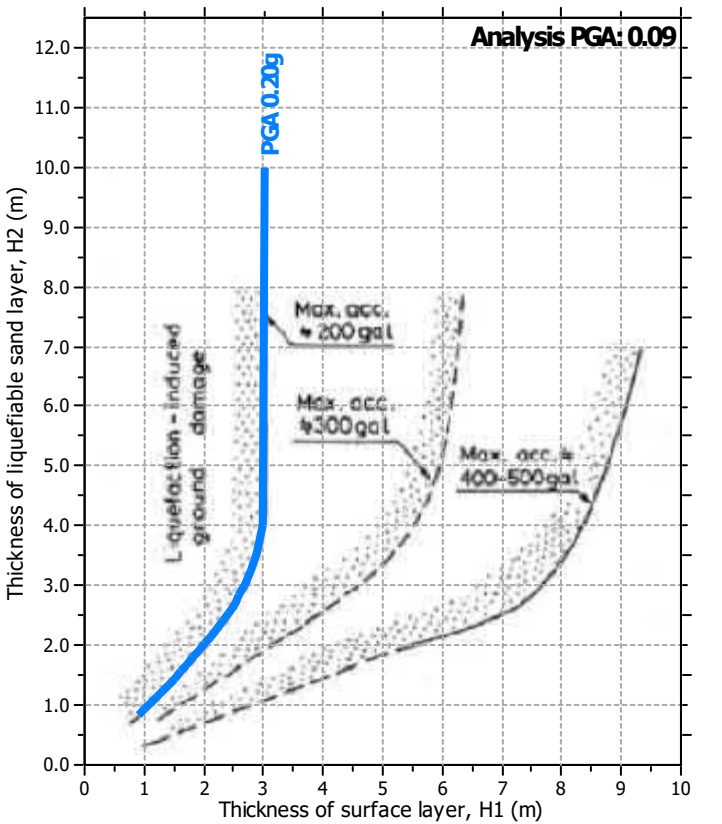
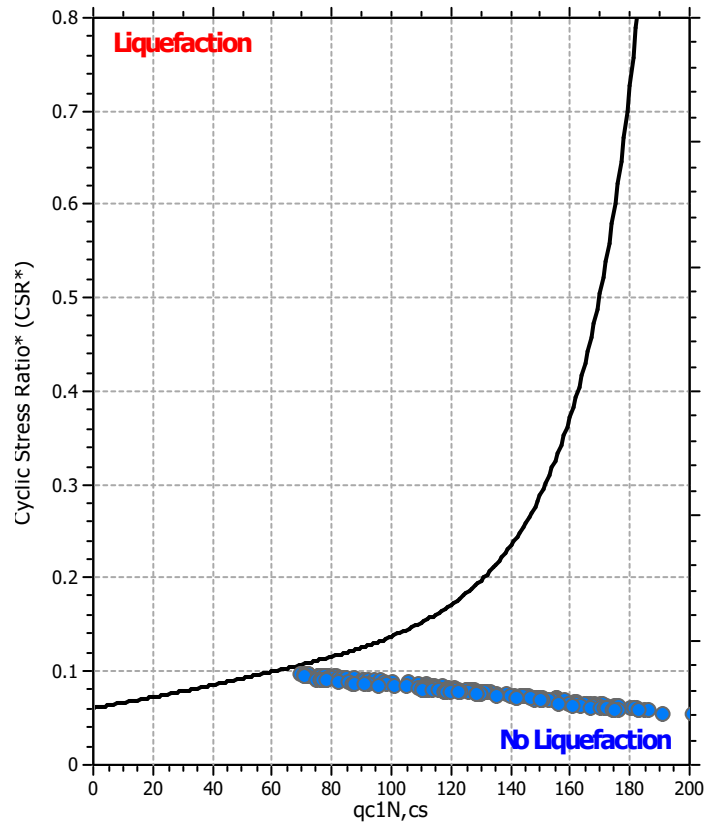
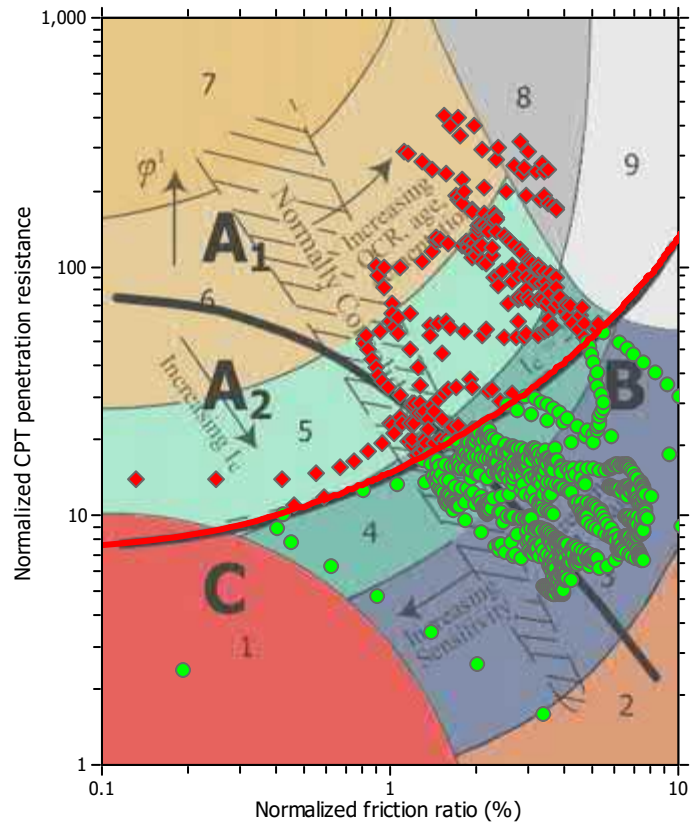
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.08 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\phi}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.58 m	Fill height:	N/A	Limit depth:	N/A



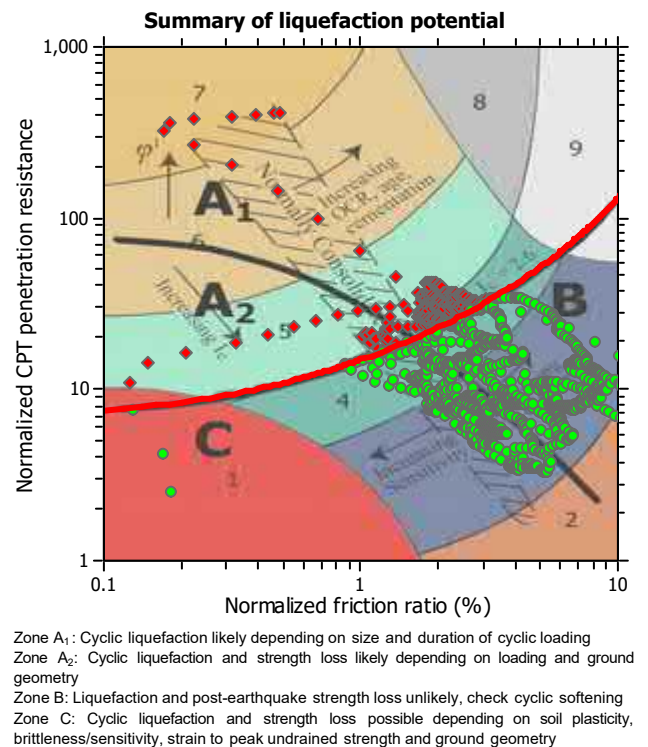
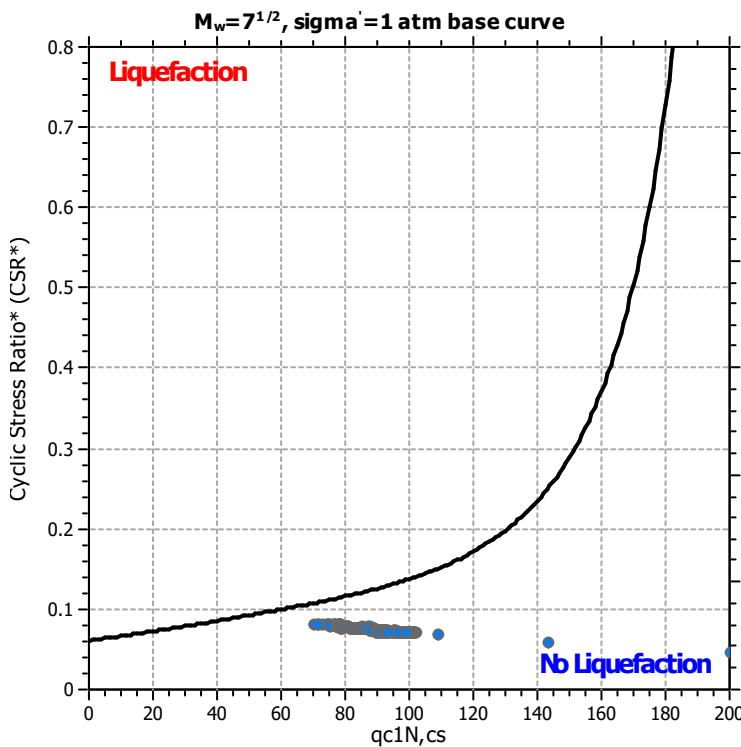
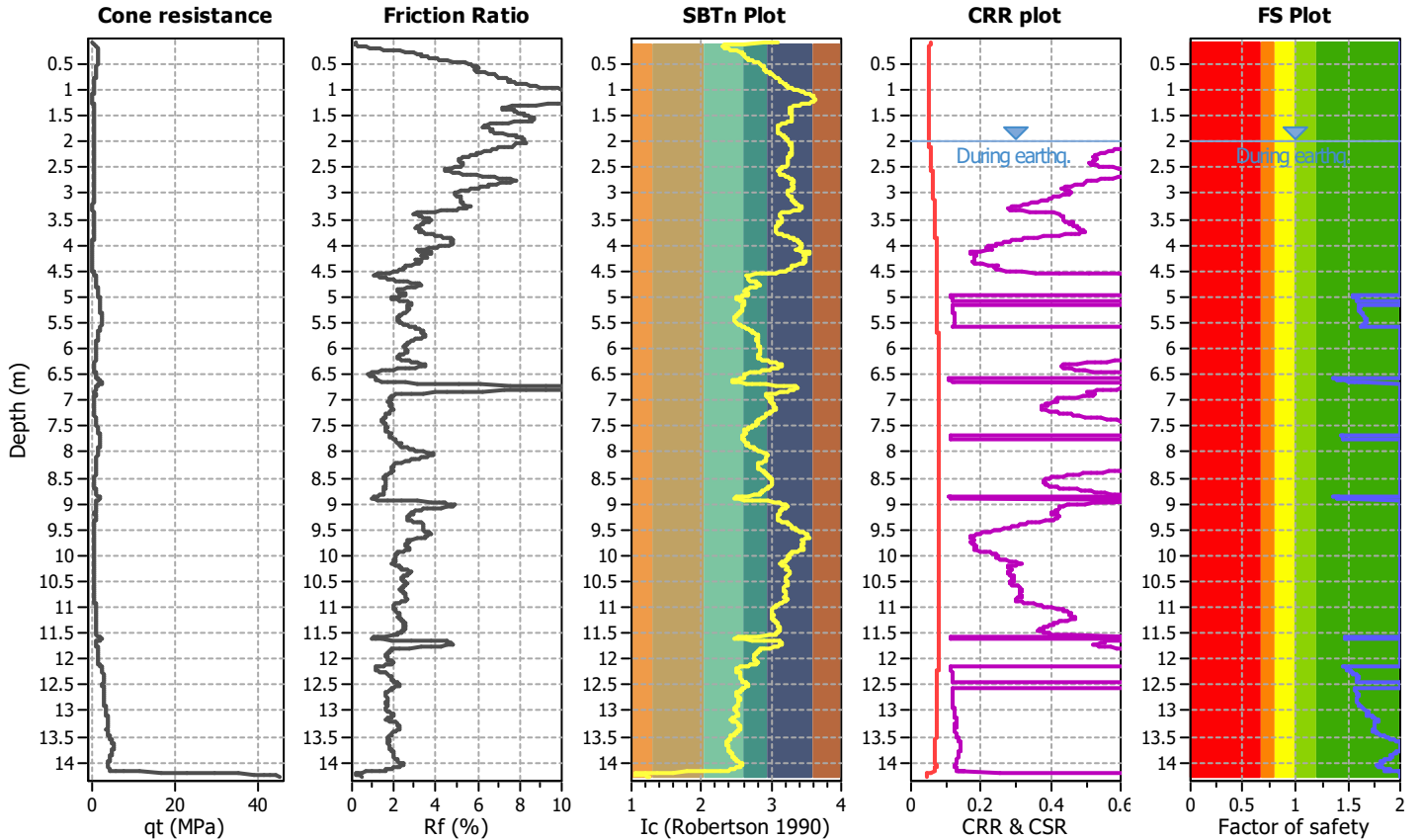
**LIQUEFACTION ANALYSIS REPORT**

**Project title : Warkworth South Plan Change**  
**CPT file : CPT15-1/100**

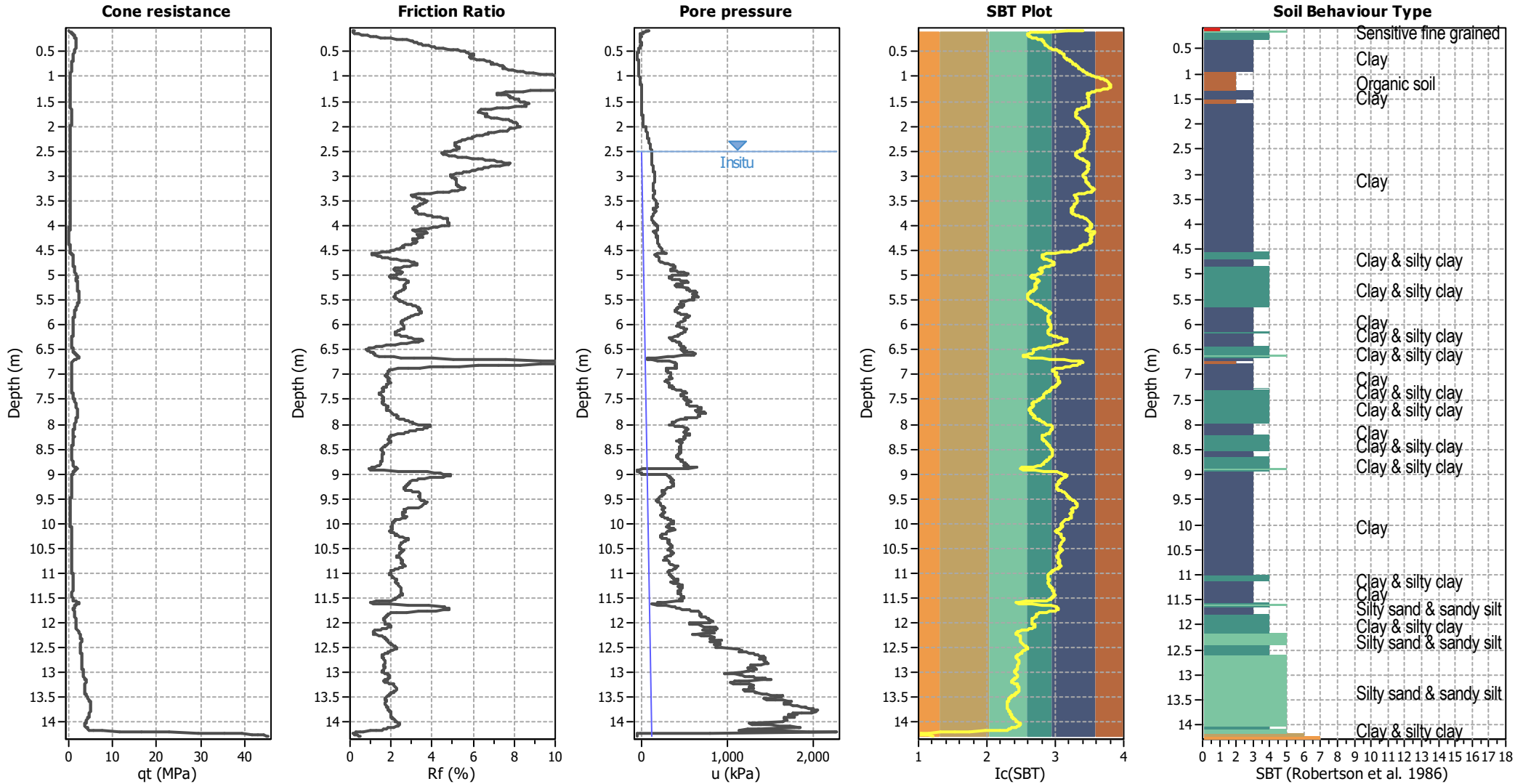
**Location : 48 Valerie Close, Warkworth**

**Input parameters and analysis data**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	applied:	Sand & Clay
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	$K_\sigma$ applied:	No	MSF method:	Method based



### CPT basic interpretation plots



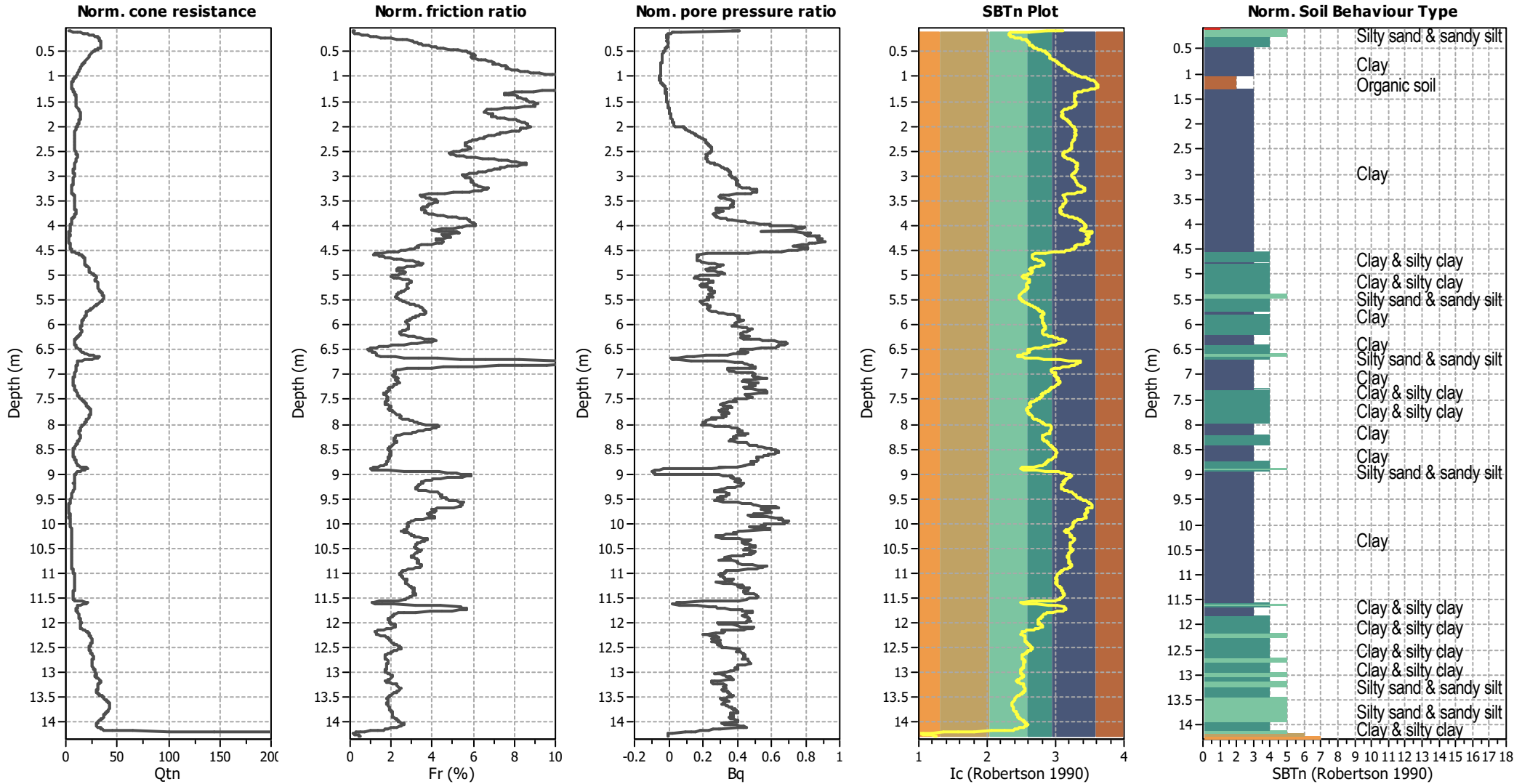
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>0</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### CPT basic interpretation plots (normalized)



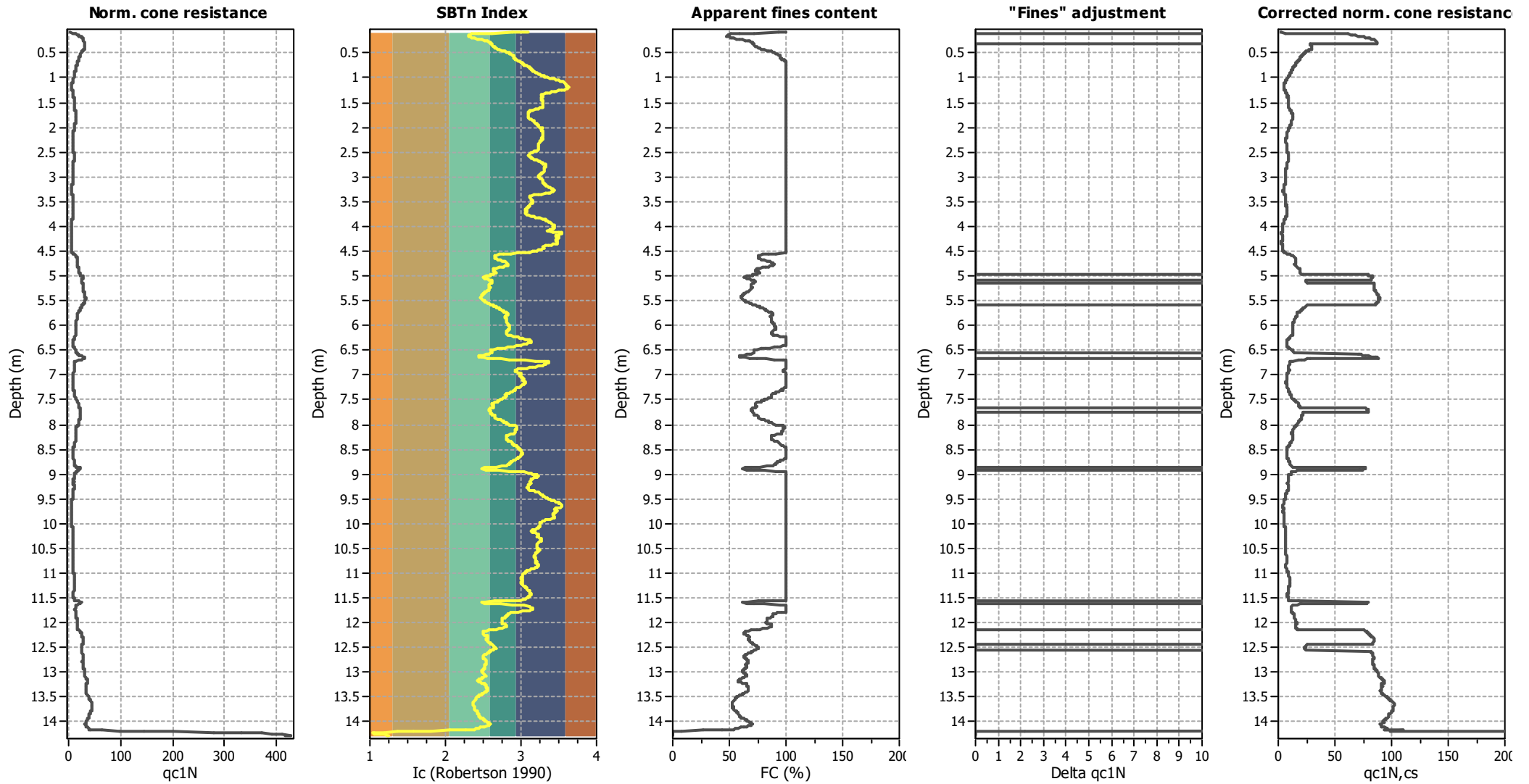
#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_p$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

#### SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

### Liquefaction analysis overall plots (intermediate results)

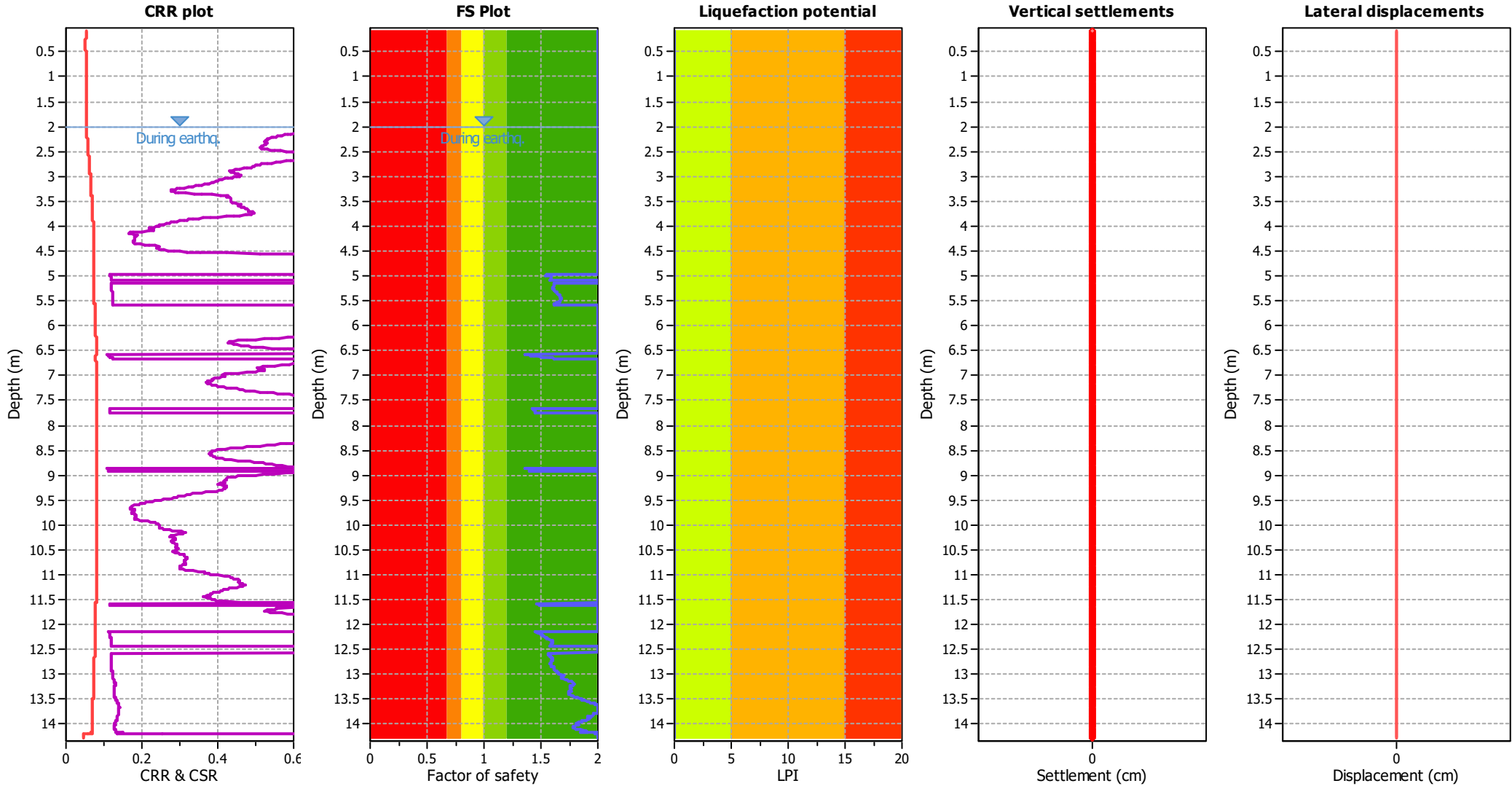


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	No
Earthquake magnitude M <sub>w</sub> :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A



### Liquefaction analysis overall plots



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

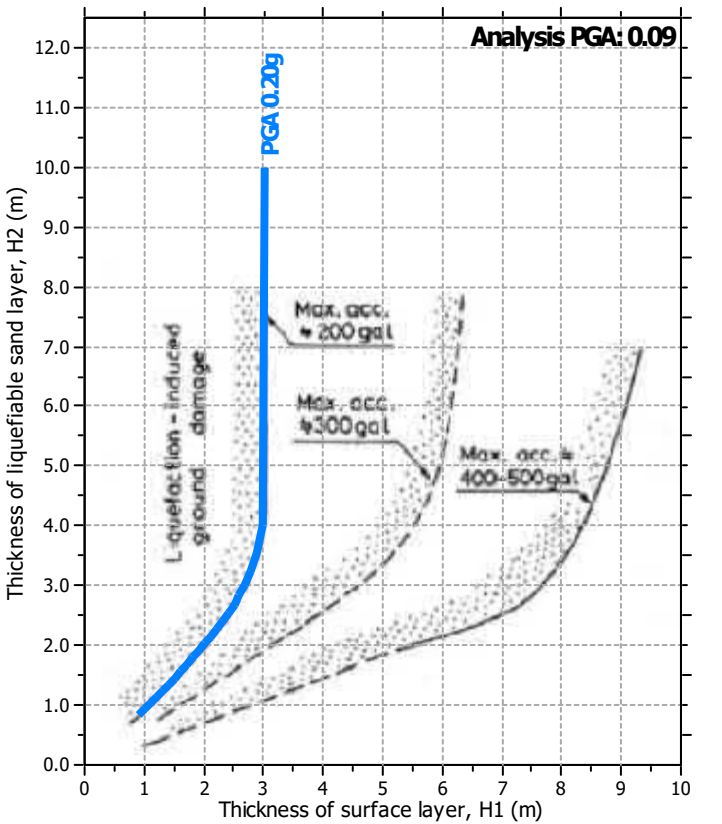
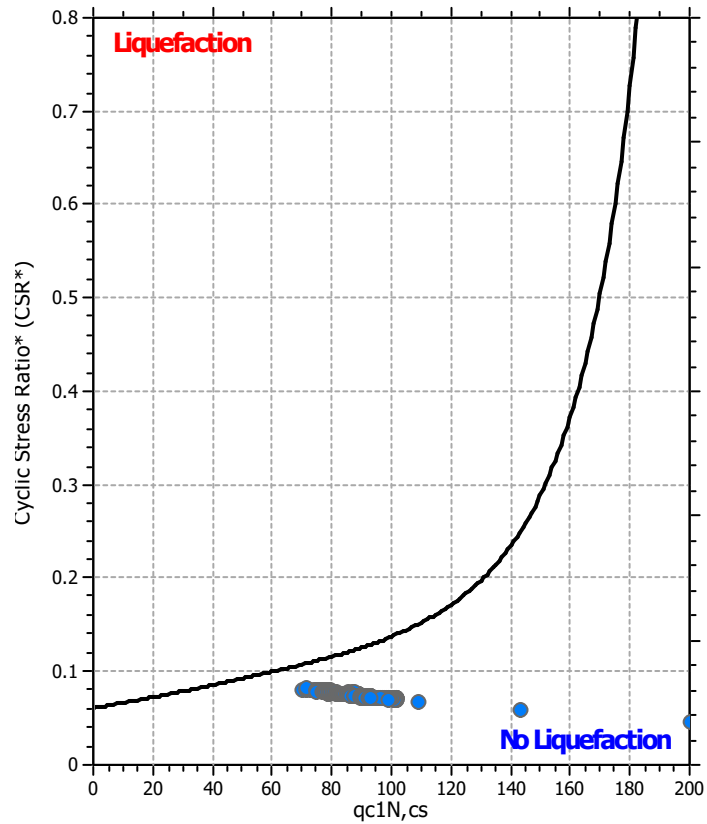
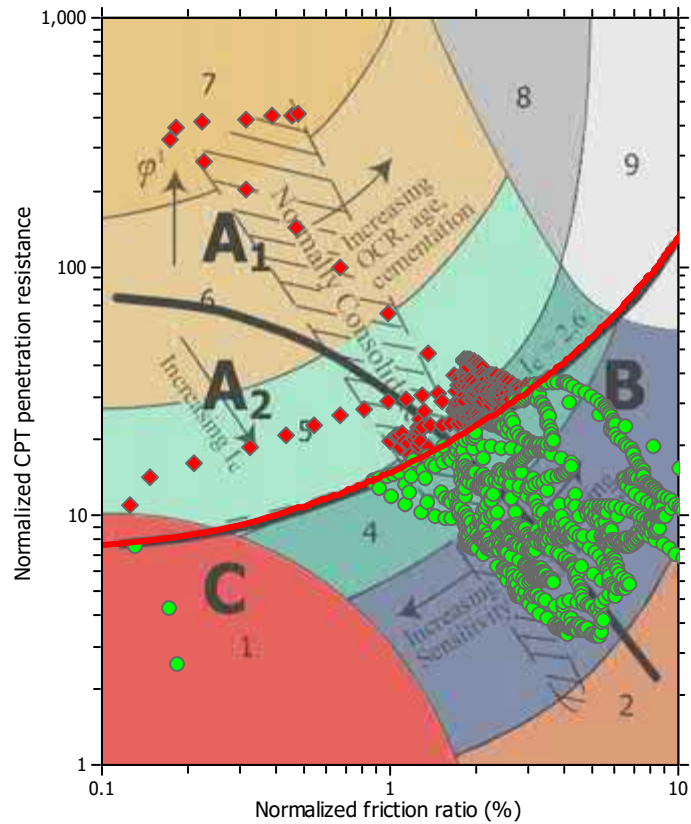
**F.S. color scheme**

- 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

### Liquefaction analysis summary plots

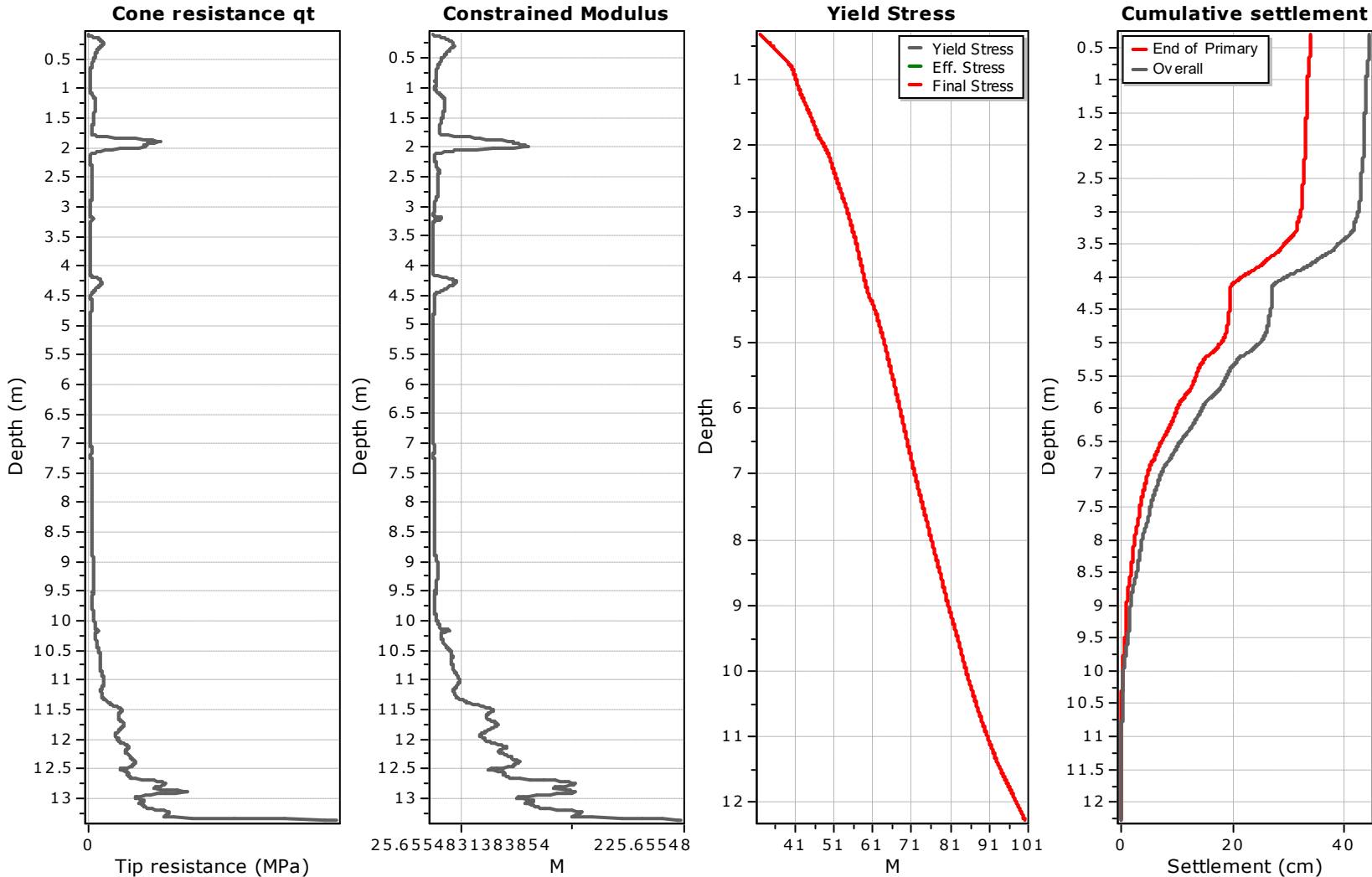


#### Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_v$ applied:	No
Earthquake magnitude $M_w$ :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.09	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

## APPENDIX E CONSOLIDATION ANALYSIS

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation



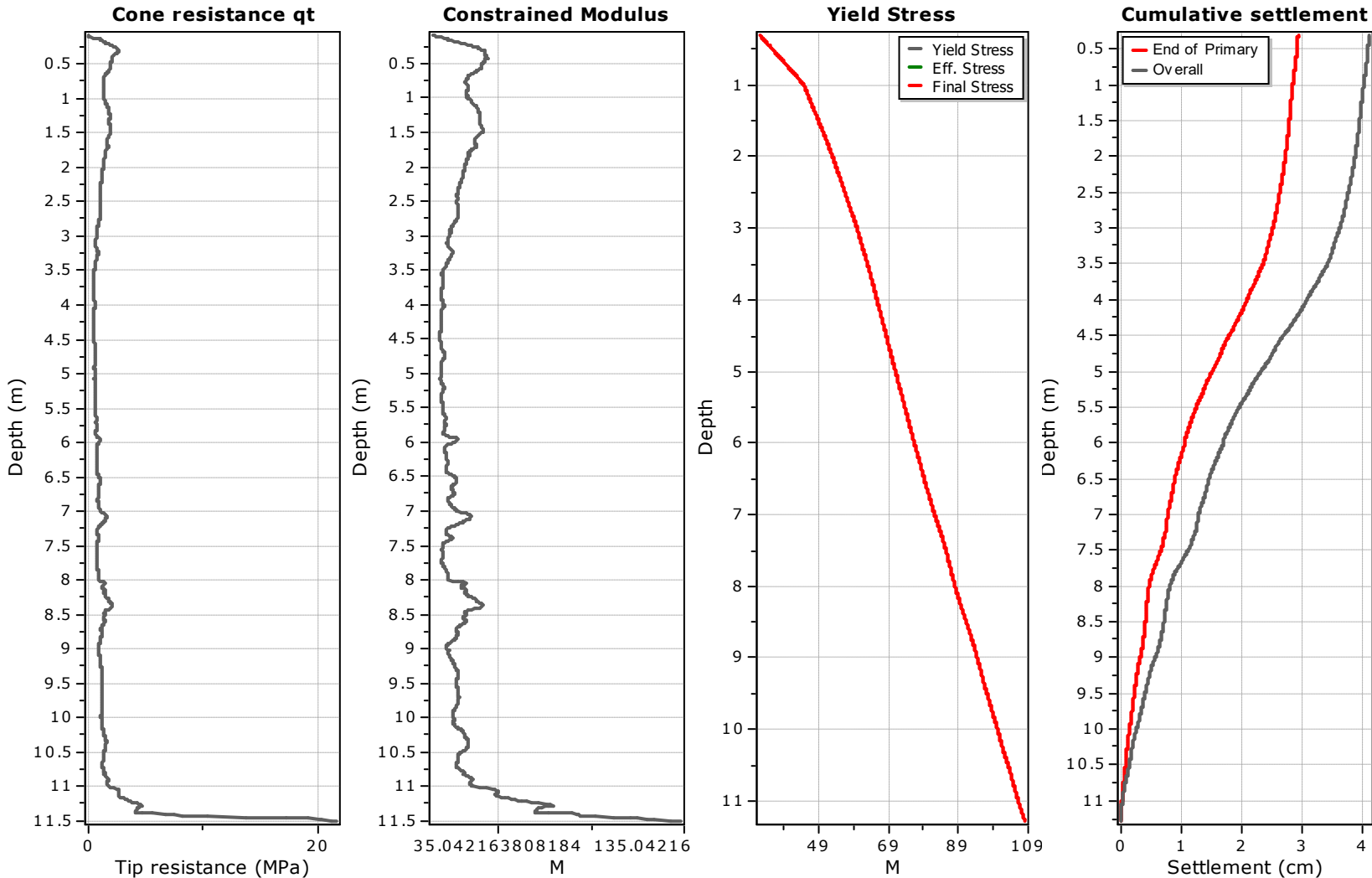
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1197	12.26	12.27	0.01	11.96	16.72	64.46	0.61	0.000	0.000	0.000
1198	12.27	12.28	0.01	11.97	16.71	66.19	0.61	0.000	0.000	0.000

**Total primary settlement: 33.92****Total secondary settlement: 10.56****Total calculated settlement: 44.47****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 2.93**

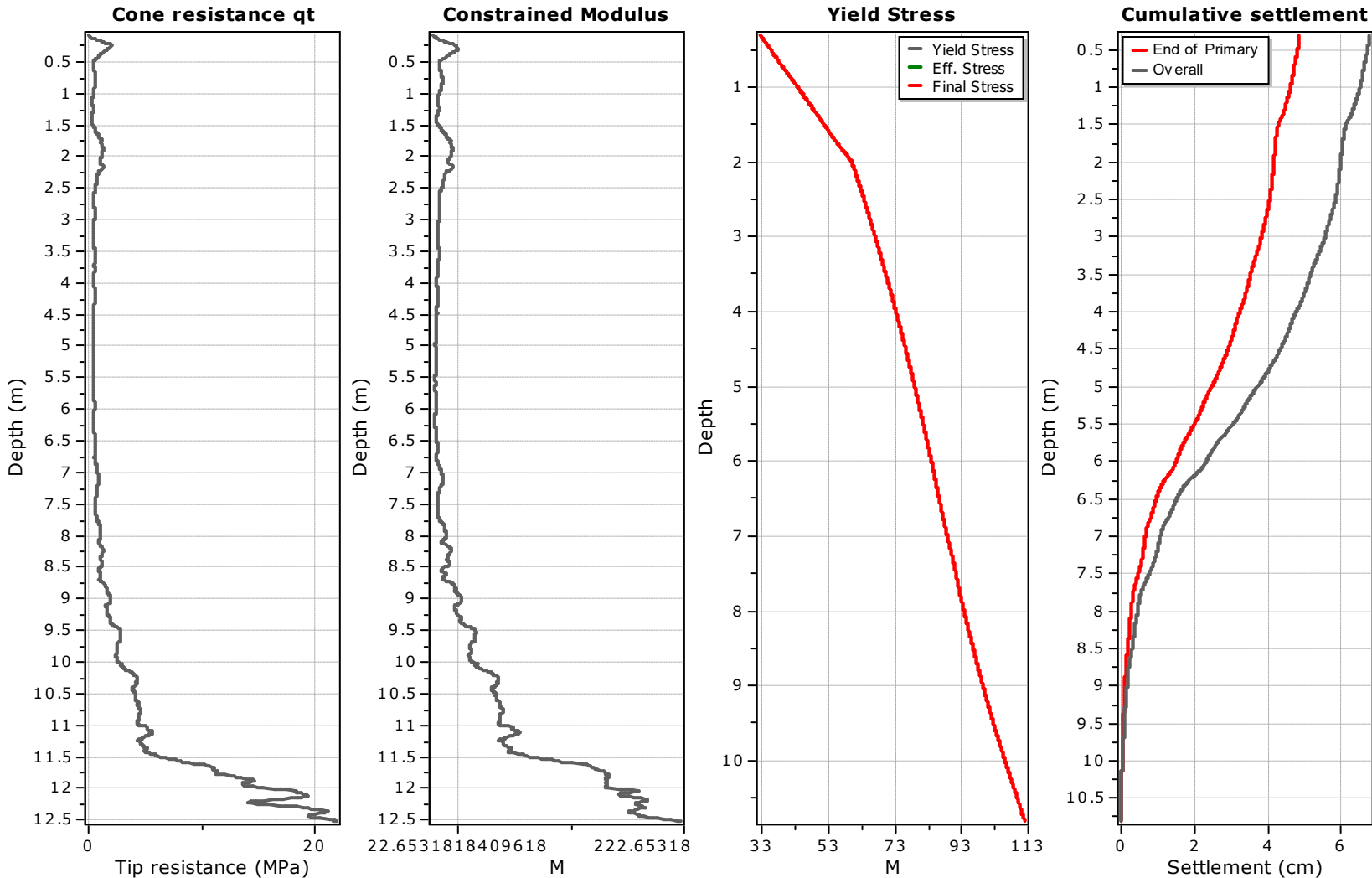
**Total secondary settlement: 1.17**

**Total calculated settlement: 4.10**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 4.86**

**Total secondary settlement: 1.91**

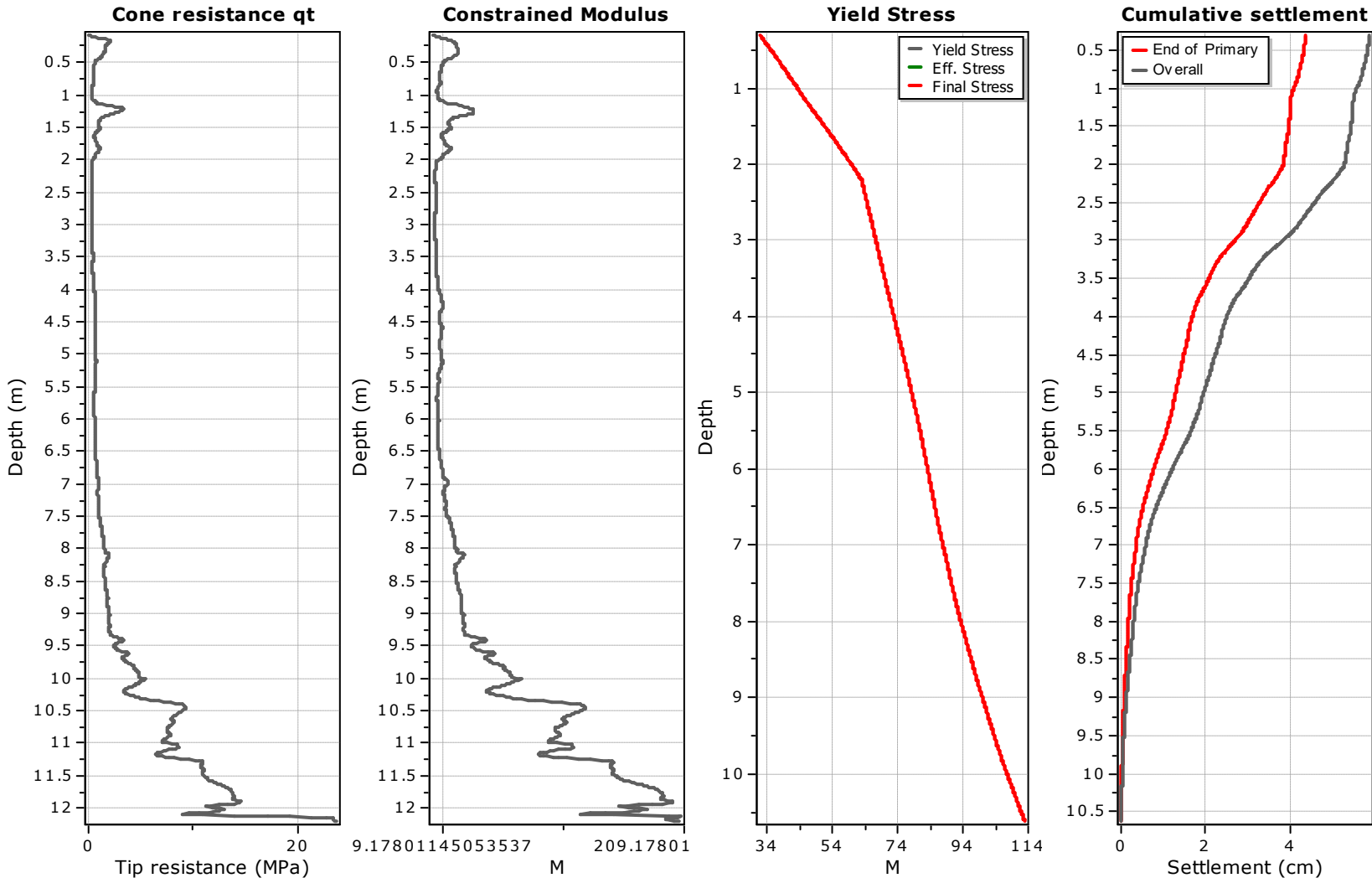
**Total calculated settlement: 6.76**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

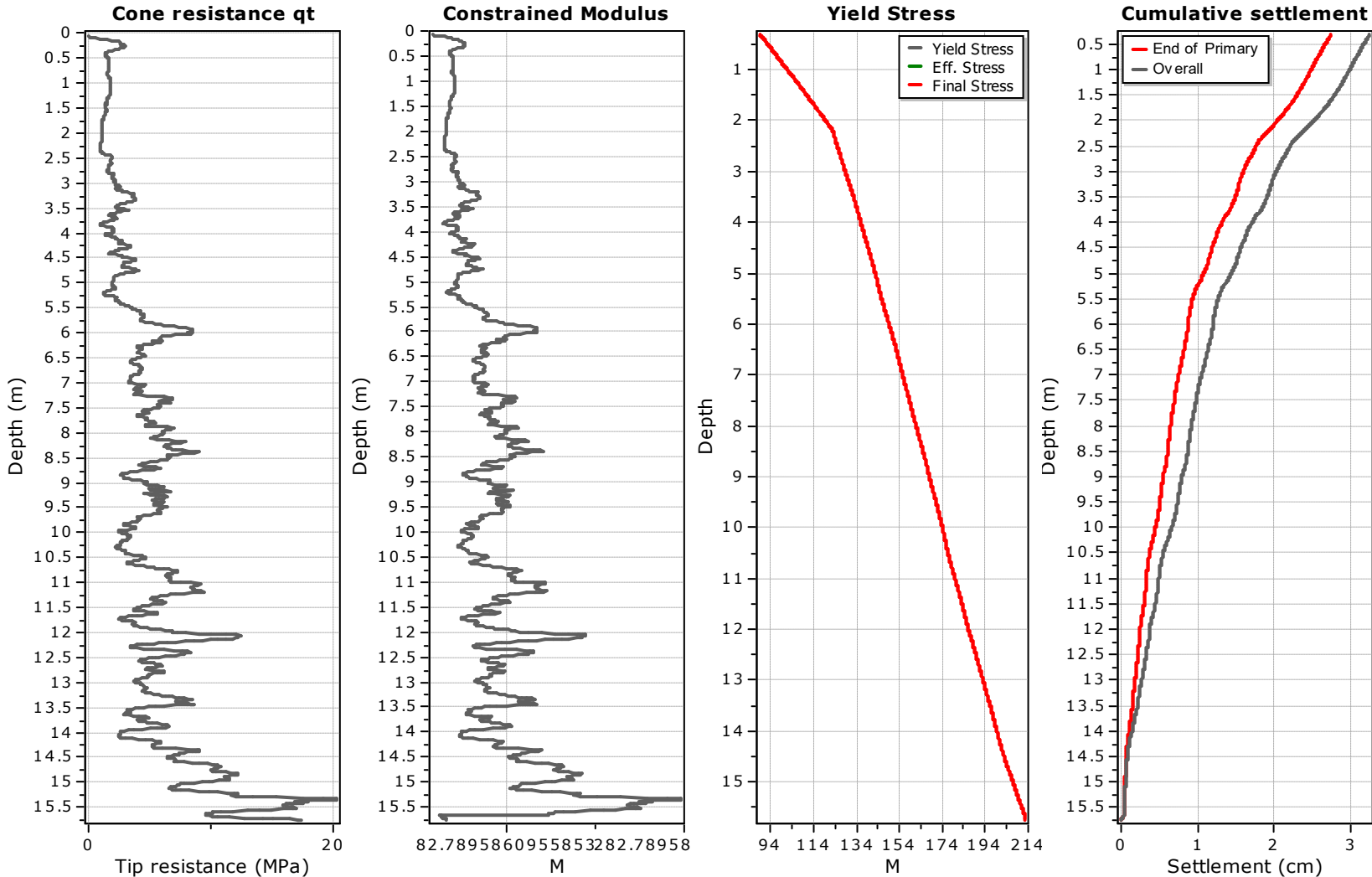
Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1013	10.42	10.43	0.01	10.13	19.11	124.65	0.69	0.000	0.000	0.000
1014	10.43	10.44	0.01	10.13	19.09	126.22	0.69	0.000	0.000	0.000
1015	10.44	10.45	0.01	10.14	19.08	127.23	0.69	0.000	0.000	0.000
1016	10.45	10.46	0.01	10.15	19.07	127.46	0.69	0.000	0.000	0.000
1017	10.46	10.47	0.01	10.16	19.05	127.38	0.69	0.000	0.000	0.000
1018	10.47	10.48	0.01	10.18	19.04	127.05	0.69	0.000	0.000	0.000
1019	10.48	10.49	0.01	10.19	19.03	126.19	0.69	0.000	0.000	0.000
1020	10.49	10.50	0.01	10.20	19.01	125.19	0.69	0.000	0.000	0.000
1021	10.50	10.51	0.01	10.21	19.00	123.99	0.69	0.000	0.000	0.000
1022	10.51	10.52	0.01	10.21	18.99	122.94	0.69	0.000	0.000	0.000
1023	10.52	10.53	0.01	10.22	18.97	121.88	0.69	0.000	0.000	0.000
1024	10.53	10.54	0.01	10.23	18.96	120.20	0.69	0.000	0.000	0.000
1025	10.54	10.55	0.01	10.24	18.95	118.89	0.69	0.000	0.000	0.000
1026	10.55	10.56	0.01	10.26	18.93	116.99	0.69	0.000	0.000	0.000
1027	10.56	10.57	0.01	10.27	18.92	115.67	0.69	0.000	0.000	0.000
1028	10.57	10.58	0.01	10.28	18.91	113.97	0.69	0.000	0.000	0.000
1029	10.58	10.59	0.01	10.29	18.89	112.86	0.69	0.000	0.000	0.000
1030	10.59	10.60	0.01	10.29	18.88	111.54	0.69	0.000	0.000	0.000
1031	10.60	10.61	0.01	10.30	18.87	110.39	0.69	0.000	0.000	0.000
1032	10.61	10.62	0.01	10.31	18.85	109.30	0.69	0.000	0.000	0.000
1033	10.62	10.63	0.01	10.32	18.84	108.62	0.69	0.000	0.000	0.000

**Total primary settlement: 4.35****Total secondary settlement: 1.51****Total calculated settlement: 5.86****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 83.25 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: No  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

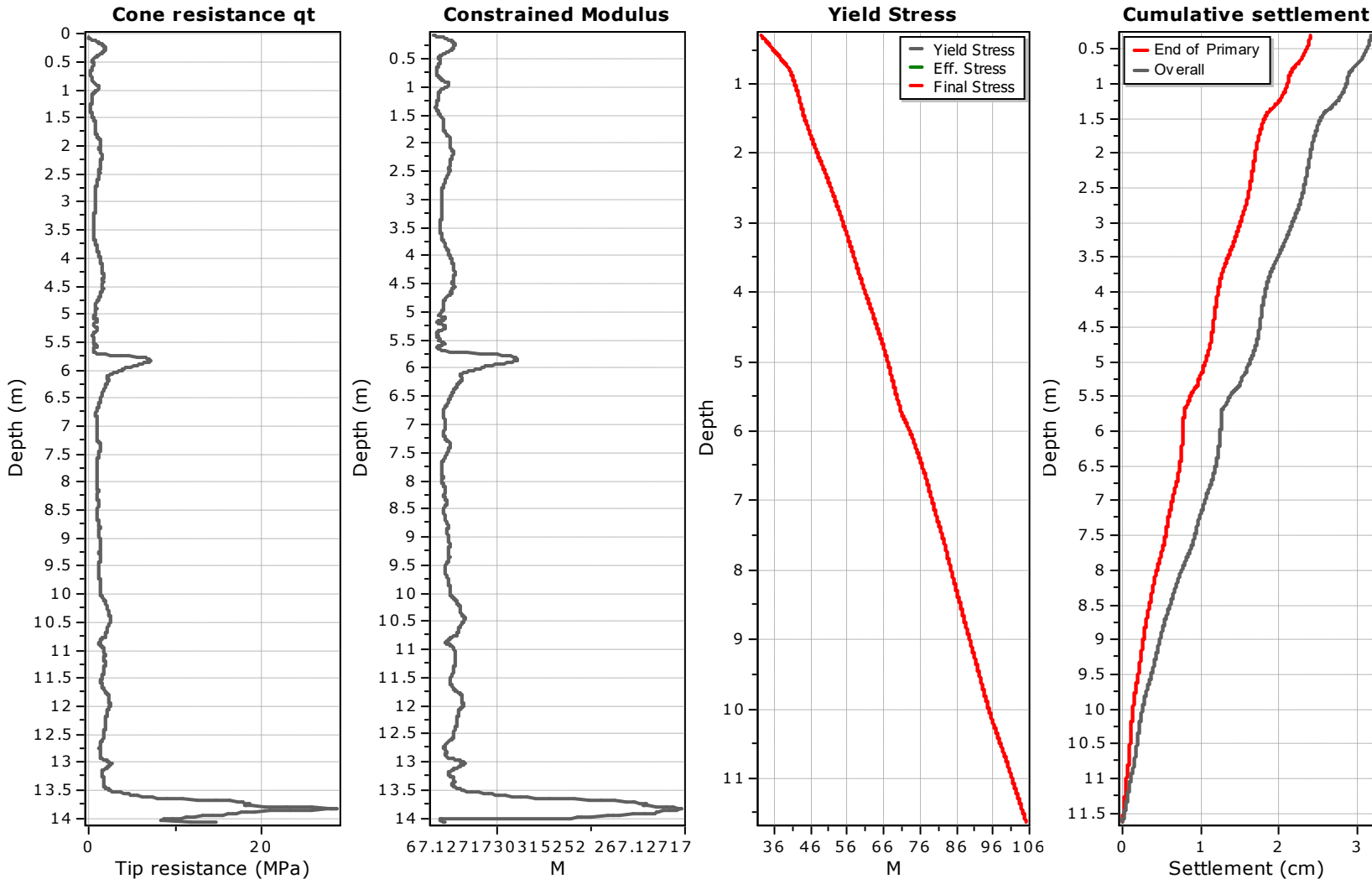
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1519	15.48	15.49	0.01	15.19	39.75	223.22	0.48	0.000	0.000	0.000
1520	15.49	15.50	0.01	15.20	39.72	226.62	0.48	0.000	0.000	0.000
1521	15.50	15.51	0.01	15.21	39.69	229.47	0.48	0.000	0.000	0.000
1522	15.51	15.52	0.01	15.21	39.66	233.06	0.48	0.000	0.000	0.000
1523	15.52	15.53	0.01	15.22	39.63	233.24	0.48	0.000	0.000	0.000
1524	15.53	15.54	0.01	15.23	39.60	228.66	0.48	0.000	0.000	0.000
1525	15.54	15.55	0.01	15.24	39.57	217.12	0.48	0.000	0.000	0.000
1526	15.55	15.56	0.01	15.26	39.54	204.93	0.47	0.000	0.000	0.000
1527	15.56	15.57	0.01	15.27	39.51	191.54	0.47	0.000	0.000	0.000
1528	15.57	15.58	0.01	15.28	39.48	178.00	0.47	0.000	0.000	0.000
1529	15.58	15.59	0.01	15.29	39.45	159.80	0.47	0.000	0.000	0.000
1530	15.59	15.60	0.01	15.29	39.42	146.45	0.47	0.000	0.000	0.000
1531	15.60	15.61	0.01	15.30	39.39	138.30	0.47	0.000	0.000	0.001
1532	15.61	15.62	0.01	15.31	39.36	136.55	0.47	0.000	0.000	0.001
1533	15.62	15.63	0.01	15.32	39.34	133.65	0.47	0.000	0.000	0.001
1534	15.63	15.64	0.01	15.34	39.31	130.28	0.47	0.000	0.000	0.001
1535	15.64	15.65	0.01	15.35	39.28	129.17	0.47	0.000	0.000	0.001
1536	15.65	15.66	0.01	15.36	39.25	129.40	0.47	0.000	0.000	0.001
1537	15.66	15.67	0.01	15.37	39.22	8.40	0.47	0.005	0.000	0.005
1538	15.67	15.68	0.01	15.38	39.19	8.56	0.47	0.005	0.000	0.005
1539	15.68	15.69	0.01	15.38	39.16	8.85	0.47	0.004	0.000	0.004
1540	15.69	15.70	0.01	15.39	39.13	9.15	0.47	0.004	0.000	0.004
1541	15.70	15.71	0.01	15.40	39.10	10.08	0.47	0.004	0.000	0.004
1542	15.71	15.72	0.01	15.41	39.07	11.19	0.47	0.003	0.000	0.003
1543	15.72	15.73	0.01	15.43	39.04	12.48	0.47	0.003	0.000	0.003
1544	15.73	15.74	0.01	15.44	39.01	13.29	0.47	0.003	0.000	0.003
1545	15.74	15.75	0.01	15.45	38.98	14.47	0.47	0.003	0.000	0.003
1546	15.75	15.76	0.01	15.46	38.95	15.06	0.47	0.003	0.000	0.003

**Total primary settlement: 2.73****Total secondary settlement: 0.50****Total calculated settlement: 3.24****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \cdot \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation



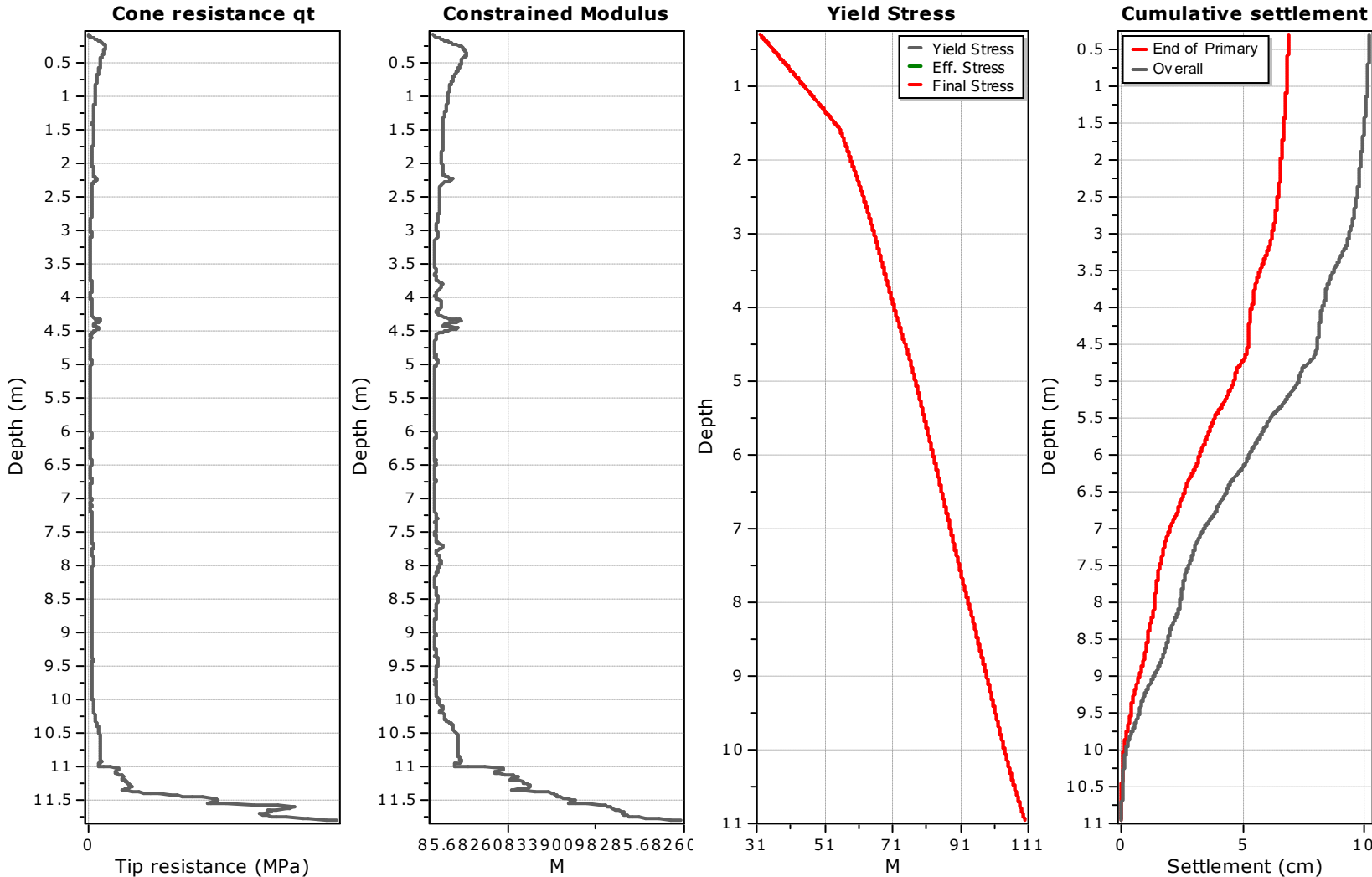
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1105	11.34	11.35	0.01	11.04	17.89	21.68	0.65	0.001	0.001	0.002
1106	11.35	11.36	0.01	11.05	17.88	21.54	0.65	0.001	0.001	0.002
1107	11.36	11.37	0.01	11.06	17.86	21.49	0.65	0.001	0.001	0.002
1108	11.37	11.38	0.01	11.07	17.85	21.45	0.65	0.001	0.001	0.002
1109	11.38	11.39	0.01	11.09	17.84	21.33	0.65	0.001	0.001	0.002
1110	11.39	11.40	0.01	11.10	17.82	21.17	0.65	0.001	0.001	0.002
1111	11.40	11.41	0.01	11.11	17.81	21.02	0.65	0.001	0.001	0.002
1112	11.41	11.42	0.01	11.12	17.80	20.93	0.65	0.001	0.001	0.002
1113	11.42	11.43	0.01	11.13	17.79	20.77	0.65	0.001	0.001	0.002
1114	11.43	11.44	0.01	11.13	17.77	20.53	0.65	0.001	0.001	0.002
1115	11.44	11.45	0.01	11.14	17.76	20.17	0.65	0.001	0.001	0.002
1116	11.45	11.46	0.01	11.15	17.75	19.76	0.65	0.001	0.001	0.002
1117	11.46	11.47	0.01	11.16	17.73	19.40	0.64	0.001	0.001	0.002
1118	11.47	11.48	0.01	11.18	17.72	19.12	0.64	0.001	0.001	0.002
1119	11.48	11.49	0.01	11.19	17.71	18.95	0.64	0.001	0.001	0.002
1120	11.49	11.50	0.01	11.20	17.70	18.66	0.64	0.001	0.001	0.002
1121	11.50	11.51	0.01	11.21	17.68	18.36	0.64	0.001	0.001	0.002
1122	11.51	11.52	0.01	11.21	17.67	17.95	0.64	0.001	0.001	0.002
1123	11.52	11.53	0.01	11.22	17.66	17.71	0.64	0.001	0.001	0.002
1124	11.53	11.54	0.01	11.23	17.64	17.53	0.64	0.001	0.001	0.002
1125	11.54	11.55	0.01	11.24	17.63	17.47	0.64	0.001	0.001	0.002
1126	11.55	11.56	0.01	11.26	17.62	17.39	0.64	0.001	0.001	0.002
1127	11.56	11.57	0.01	11.27	17.60	17.36	0.64	0.001	0.001	0.002
1128	11.57	11.58	0.01	11.28	17.59	17.43	0.64	0.001	0.001	0.002
1129	11.58	11.59	0.01	11.29	17.58	17.63	0.64	0.001	0.001	0.002
1130	11.59	11.60	0.01	11.29	17.57	17.86	0.64	0.001	0.001	0.002
1131	11.60	11.61	0.01	11.30	17.55	18.09	0.64	0.001	0.001	0.002
1132	11.61	11.62	0.01	11.31	17.54	18.28	0.64	0.001	0.001	0.002
1133	11.62	11.63	0.01	11.32	17.53	18.53	0.64	0.001	0.001	0.002

**Total primary settlement: 2.40****Total secondary settlement: 0.78****Total calculated settlement: 3.18****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 27.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

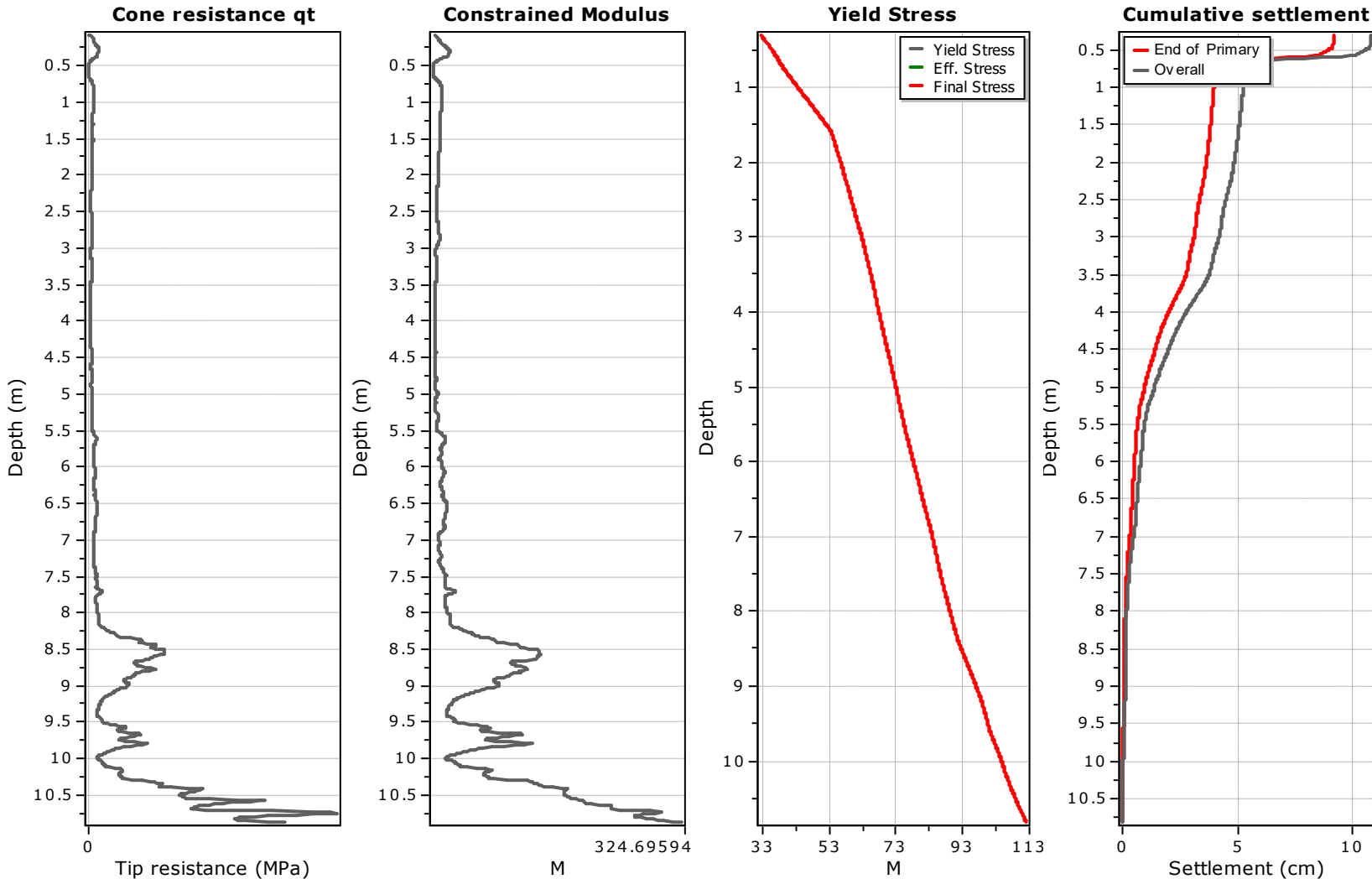
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1059	10.88	10.89	0.01	10.59	18.49	30.45	0.67	0.001	0.001	0.001
1060	10.89	10.90	0.01	10.60	18.48	30.54	0.67	0.001	0.001	0.001
1061	10.90	10.91	0.01	10.61	18.47	30.99	0.67	0.001	0.001	0.001
1062	10.91	10.92	0.01	10.62	18.45	31.85	0.67	0.001	0.001	0.001
1063	10.92	10.93	0.01	10.63	18.44	32.30	0.67	0.001	0.001	0.001
1064	10.93	10.94	0.01	10.63	18.43	31.57	0.67	0.001	0.001	0.001
1065	10.94	10.95	0.01	10.64	18.41	29.73	0.67	0.001	0.001	0.001
1066	10.95	10.96	0.01	10.65	18.40	27.63	0.67	0.001	0.001	0.001
1067	10.96	10.97	0.01	10.66	18.39	25.73	0.67	0.001	0.001	0.001

**Total primary settlement: 6.87****Total secondary settlement: 3.31****Total calculated settlement: 10.18****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 27.50 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: No  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 9.18**

**Total secondary settlement: 1.62**

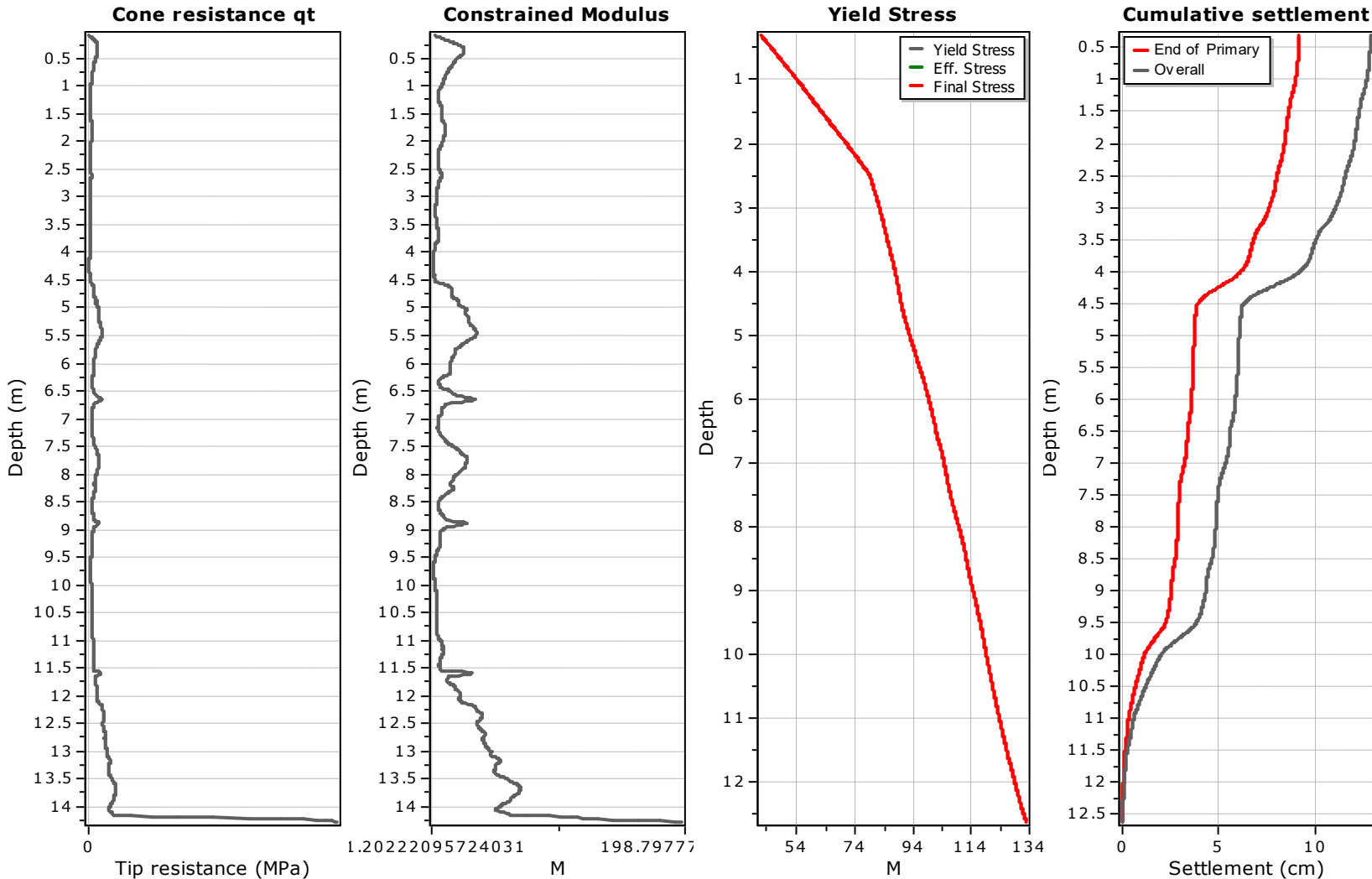
**Total calculated settlement: 10.80**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
Footing width: 20.00 (m)  
L/B: 1.0  
Footing pressure: 37.50 (kPa)  
Embedment depth: 0.30 (m)  
Footing is rigid: No  
Remove excavation load: No  
Apply 20% rule: Yes  
Calculate secondary settlements: Yes  
Time period for primary consolidation: 6 months  
Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

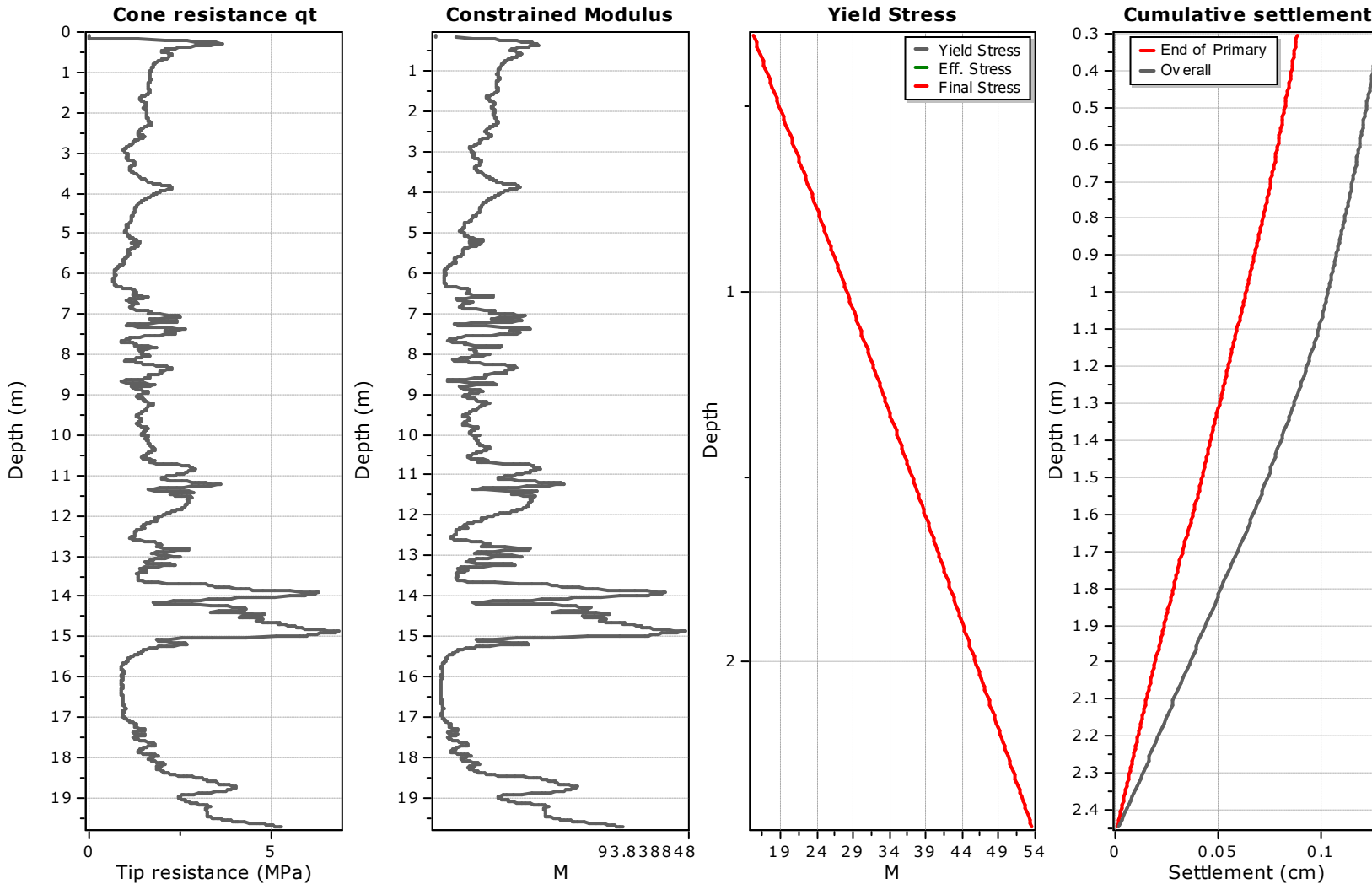
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	$I_z$	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1197	12.26	12.27	0.01	11.96	22.80	35.09	0.61	0.001	0.001	0.001
1198	12.27	12.28	0.01	11.97	22.78	35.46	0.61	0.001	0.001	0.001
1199	12.28	12.29	0.01	11.98	22.77	35.89	0.61	0.001	0.001	0.001
1200	12.29	12.30	0.01	11.99	22.75	36.42	0.61	0.001	0.001	0.001
1201	12.30	12.31	0.01	12.01	22.73	37.21	0.61	0.001	0.001	0.001
1202	12.31	12.32	0.01	12.02	22.72	38.02	0.61	0.001	0.001	0.001
1203	12.32	12.33	0.01	12.03	22.70	38.72	0.61	0.001	0.001	0.001
1204	12.33	12.34	0.01	12.04	22.68	39.09	0.60	0.001	0.001	0.001
1205	12.34	12.35	0.01	12.04	22.67	39.28	0.60	0.001	0.001	0.001
1206	12.35	12.36	0.01	12.05	22.65	39.25	0.60	0.001	0.001	0.001
1207	12.36	12.37	0.01	12.06	22.63	39.11	0.60	0.001	0.001	0.001
1208	12.37	12.38	0.01	12.07	22.62	39.00	0.60	0.001	0.001	0.001
1209	12.38	12.39	0.01	12.09	22.60	38.76	0.60	0.001	0.001	0.001
1210	12.39	12.40	0.01	12.10	22.58	38.36	0.60	0.001	0.001	0.001
1211	12.40	12.41	0.01	12.11	22.57	37.88	0.60	0.001	0.001	0.001
1212	12.41	12.42	0.01	12.12	22.55	37.62	0.60	0.001	0.001	0.001
1213	12.42	12.43	0.01	12.13	22.53	37.47	0.60	0.001	0.001	0.001
1214	12.43	12.44	0.01	12.13	22.51	37.38	0.60	0.001	0.001	0.001
1215	12.44	12.45	0.01	12.14	22.50	37.13	0.60	0.001	0.001	0.001
1216	12.45	12.46	0.01	12.15	22.48	36.62	0.60	0.001	0.001	0.001
1217	12.46	12.47	0.01	12.16	22.46	36.01	0.60	0.001	0.001	0.001
1218	12.47	12.48	0.01	12.18	22.45	35.43	0.60	0.001	0.001	0.001
1219	12.48	12.49	0.01	12.19	22.43	35.11	0.60	0.001	0.001	0.001
1220	12.49	12.50	0.01	12.20	22.41	34.77	0.60	0.001	0.001	0.001
1221	12.50	12.51	0.01	12.21	22.40	34.57	0.60	0.001	0.001	0.001
1222	12.51	12.52	0.01	12.21	22.38	34.47	0.60	0.001	0.001	0.001
1223	12.52	12.53	0.01	12.22	22.36	34.71	0.60	0.001	0.001	0.001
1224	12.53	12.54	0.01	12.23	22.35	35.13	0.60	0.001	0.001	0.001
1225	12.54	12.55	0.01	12.24	22.33	35.62	0.60	0.001	0.001	0.001
1226	12.55	12.56	0.01	12.26	22.31	36.10	0.60	0.001	0.001	0.001
1227	12.56	12.57	0.01	12.27	22.30	36.46	0.59	0.001	0.001	0.001
1228	12.57	12.58	0.01	12.28	22.28	36.74	0.59	0.001	0.001	0.001
1229	12.58	12.59	0.01	12.29	22.26	36.88	0.59	0.001	0.001	0.001
1230	12.59	12.60	0.01	12.29	22.25	37.02	0.59	0.001	0.001	0.001
1231	12.60	12.61	0.01	12.30	22.23	37.31	0.59	0.001	0.001	0.001
1232	12.61	12.62	0.01	12.31	22.22	37.77	0.59	0.001	0.001	0.001
1233	12.62	12.63	0.01	12.32	22.20	38.30	0.59	0.001	0.001	0.001

**Total primary settlement: 9.17****Total secondary settlement: 3.70****Total calculated settlement: 12.87****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
$I_z$ :	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 10.00 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

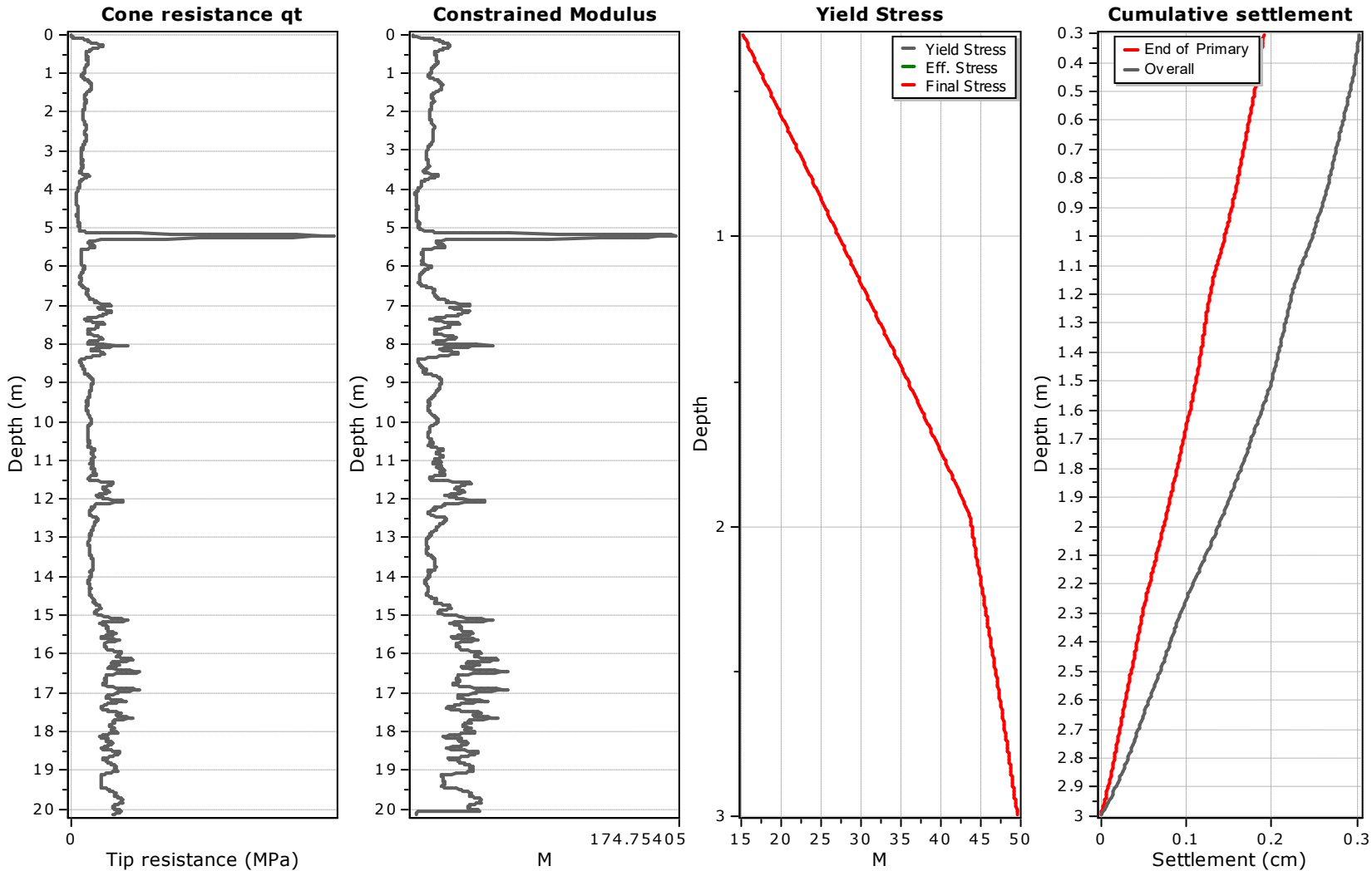
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
185	2.14	2.15	0.01	1.84	9.14	21.99	0.91	0.000	0.000	0.001
186	2.15	2.16	0.01	1.85	9.13	22.17	0.91	0.000	0.000	0.001
187	2.16	2.17	0.01	1.86	9.12	22.31	0.91	0.000	0.000	0.001
188	2.17	2.18	0.01	1.88	9.11	22.40	0.91	0.000	0.000	0.001
189	2.18	2.19	0.01	1.89	9.10	22.39	0.91	0.000	0.000	0.001
190	2.19	2.20	0.01	1.90	9.09	22.35	0.91	0.000	0.000	0.001
191	2.20	2.21	0.01	1.91	9.08	22.30	0.91	0.000	0.000	0.001
192	2.21	2.22	0.01	1.92	9.07	22.25	0.91	0.000	0.000	0.001
193	2.22	2.23	0.01	1.93	9.06	22.34	0.91	0.000	0.000	0.001
194	2.23	2.24	0.01	1.94	9.05	22.53	0.91	0.000	0.000	0.001
195	2.24	2.25	0.01	1.95	9.04	22.76	0.90	0.000	0.000	0.001
196	2.25	2.26	0.01	1.96	9.03	22.99	0.90	0.000	0.000	0.001
197	2.26	2.27	0.01	1.97	9.02	23.22	0.90	0.000	0.000	0.001
198	2.27	2.28	0.01	1.98	9.01	23.36	0.90	0.000	0.000	0.001
199	2.28	2.29	0.01	1.99	9.00	23.26	0.90	0.000	0.000	0.001
200	2.29	2.30	0.01	2.00	8.99	23.02	0.90	0.000	0.000	0.001
201	2.30	2.31	0.01	2.00	8.98	22.74	0.90	0.000	0.000	0.001
202	2.31	2.32	0.01	2.02	8.97	22.50	0.90	0.000	0.000	0.001
203	2.32	2.33	0.01	2.02	8.96	22.17	0.90	0.000	0.000	0.001
204	2.33	2.34	0.01	2.04	8.95	21.80	0.89	0.000	0.000	0.001
205	2.34	2.35	0.01	2.04	8.94	21.42	0.89	0.000	0.000	0.001
206	2.35	2.36	0.01	2.06	8.93	21.05	0.89	0.000	0.000	0.001
207	2.36	2.37	0.01	2.06	8.92	20.72	0.89	0.000	0.000	0.001
208	2.37	2.38	0.01	2.08	8.91	20.44	0.89	0.000	0.000	0.001
209	2.38	2.39	0.01	2.08	8.90	20.21	0.89	0.000	0.000	0.001
210	2.39	2.40	0.01	2.10	8.88	20.06	0.89	0.000	0.000	0.001
211	2.40	2.41	0.01	2.10	8.87	19.78	0.89	0.000	0.000	0.001
212	2.41	2.42	0.01	2.12	8.86	19.50	0.89	0.000	0.000	0.001
213	2.42	2.43	0.01	2.13	8.85	19.22	0.89	0.000	0.000	0.001
214	2.43	2.44	0.01	2.13	8.84	19.13	0.88	0.000	0.000	0.001
215	2.44	2.45	0.01	2.15	8.83	19.08	0.88	0.000	0.000	0.001

**Total primary settlement: 0.09****Total secondary settlement: 0.04****Total calculated settlement: 0.13****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 10.00 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation



**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 0.19**

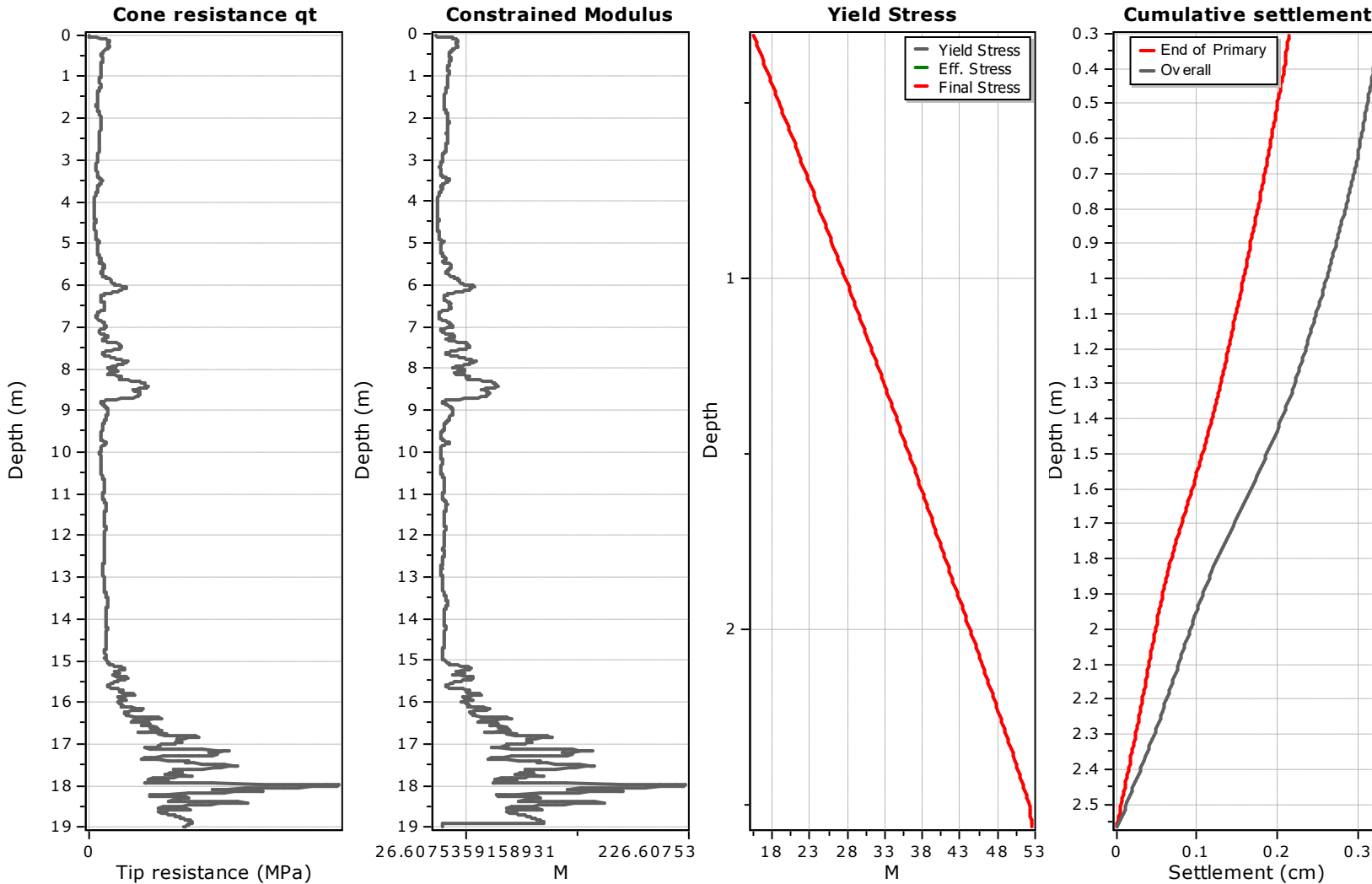
**Total secondary settlement: 0.11**

**Total calculated settlement: 0.30**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 10.00 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 0.21**

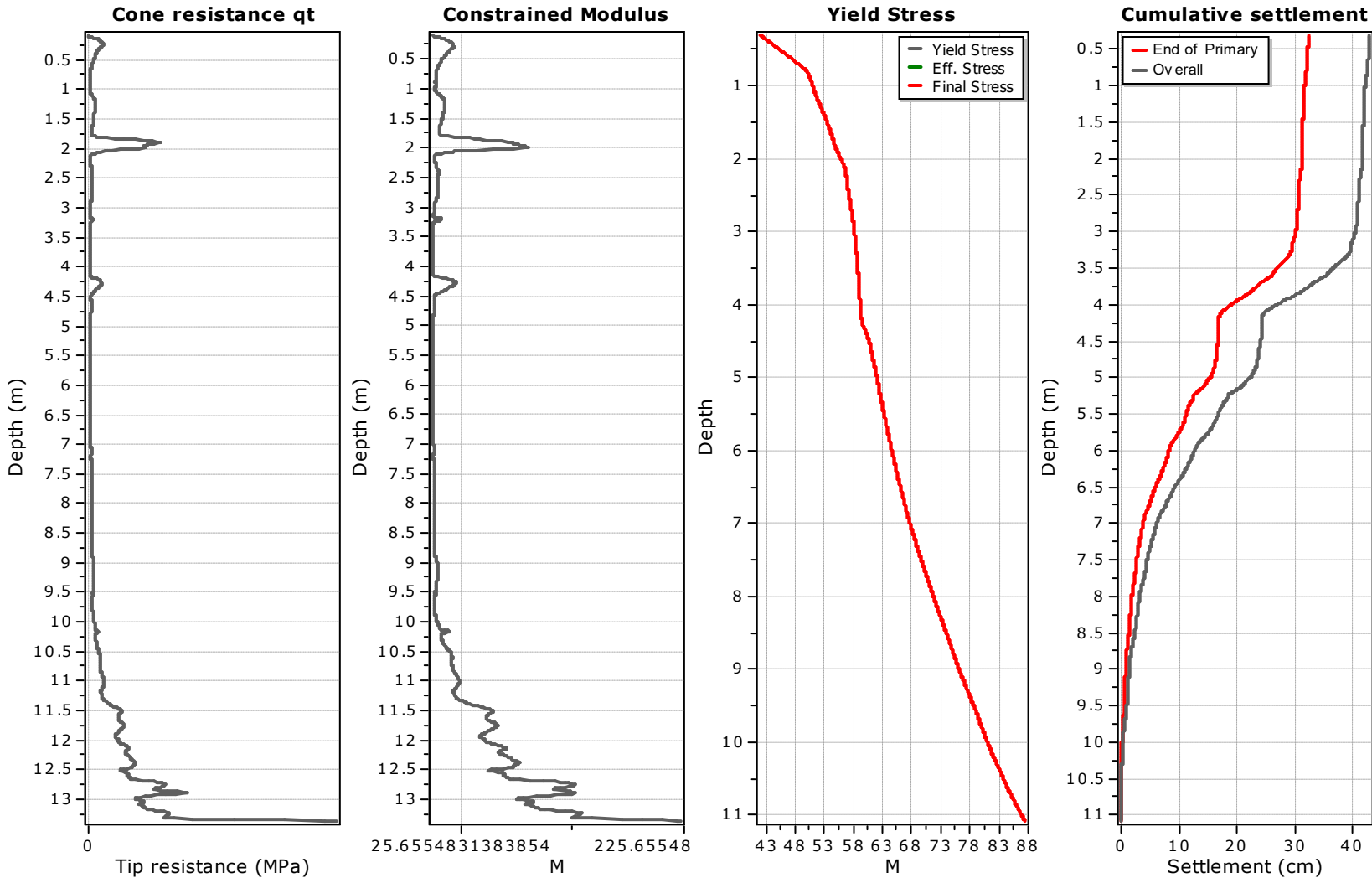
**Total secondary settlement: 0.11**

**Total calculated settlement: 0.32**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 37.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

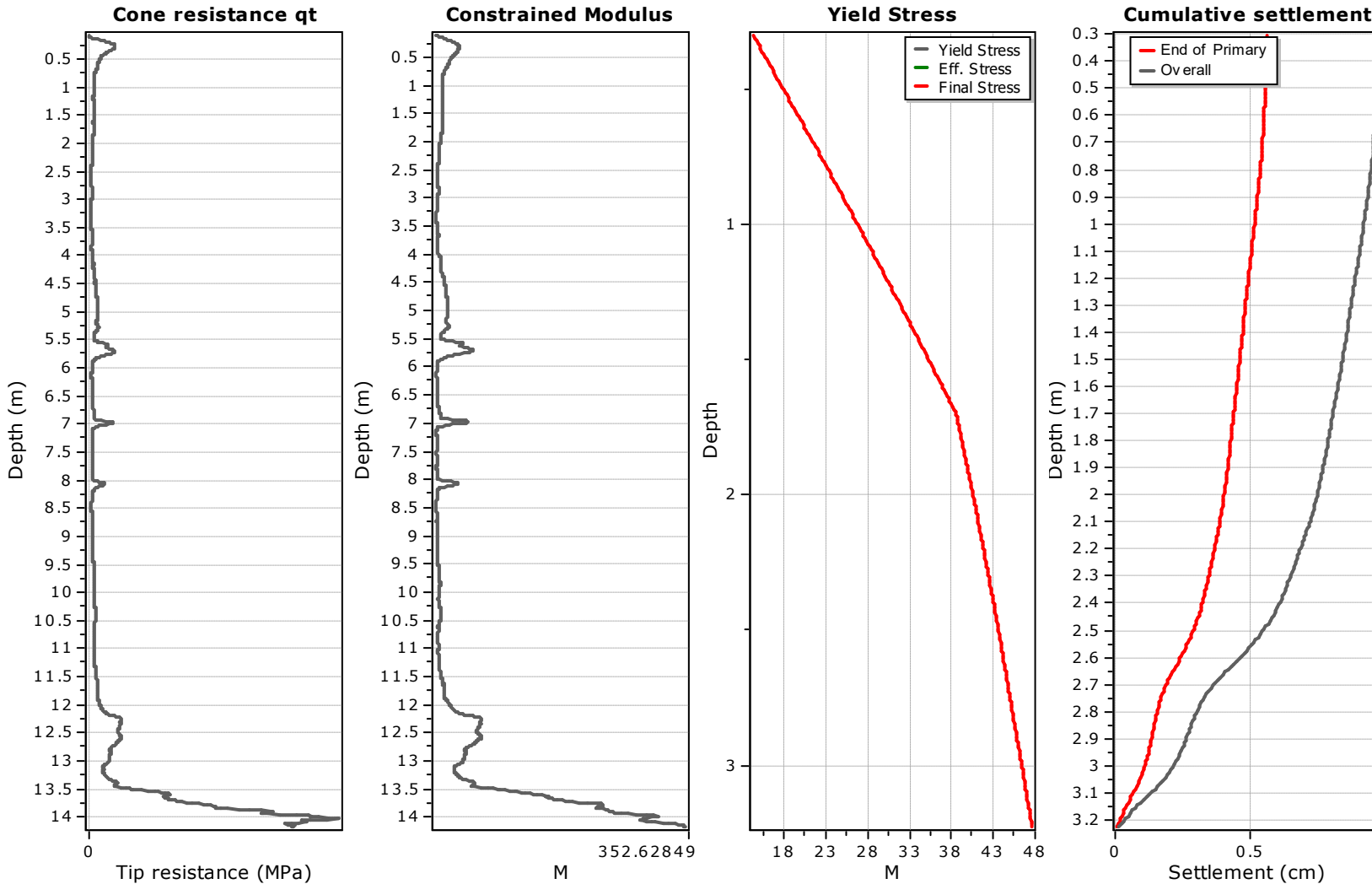
Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1059	10.88	10.89	0.01	10.59	14.77	20.17	0.39	0.001	0.001	0.001
1060	10.89	10.90	0.01	10.60	14.76	20.55	0.39	0.001	0.001	0.001
1061	10.90	10.91	0.01	10.61	14.75	20.94	0.39	0.001	0.001	0.001
1062	10.91	10.92	0.01	10.62	14.74	21.33	0.39	0.001	0.001	0.001
1063	10.92	10.93	0.01	10.63	14.73	21.75	0.39	0.001	0.001	0.001
1064	10.93	10.94	0.01	10.63	14.73	22.13	0.39	0.001	0.001	0.001
1065	10.94	10.95	0.01	10.64	14.72	22.51	0.39	0.001	0.001	0.001
1066	10.95	10.96	0.01	10.65	14.71	22.78	0.39	0.001	0.001	0.001
1067	10.96	10.97	0.01	10.66	14.70	23.03	0.39	0.001	0.001	0.001
1068	10.97	10.98	0.01	10.68	14.69	23.26	0.39	0.001	0.001	0.001
1069	10.98	10.99	0.01	10.69	14.68	23.42	0.39	0.001	0.001	0.001
1070	10.99	11.00	0.01	10.70	14.67	23.51	0.39	0.001	0.001	0.001
1071	11.00	11.01	0.01	10.71	14.66	23.80	0.39	0.001	0.001	0.001
1072	11.01	11.02	0.01	10.71	14.65	24.12	0.39	0.001	0.001	0.001
1073	11.02	11.03	0.01	10.72	14.64	24.35	0.39	0.001	0.001	0.001
1074	11.03	11.04	0.01	10.73	14.63	24.26	0.39	0.001	0.001	0.001
1075	11.04	11.05	0.01	10.74	14.63	24.01	0.39	0.001	0.001	0.001
1076	11.05	11.06	0.01	10.76	14.62	23.69	0.39	0.001	0.001	0.001
1077	11.06	11.07	0.01	10.77	14.61	23.25	0.39	0.001	0.001	0.001
1078	11.07	11.08	0.01	10.78	14.60	22.85	0.39	0.001	0.001	0.001
1079	11.08	11.09	0.01	10.79	14.59	22.46	0.39	0.001	0.001	0.001

**Total primary settlement: 32.28****Total secondary settlement: 10.51****Total calculated settlement: 42.80****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 10.00 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
277	3.06	3.07	0.01	2.77	8.16	1.71	0.82	0.005	0.005	0.009
278	3.07	3.08	0.01	2.77	8.15	1.61	0.81	0.005	0.005	0.010
279	3.08	3.09	0.01	2.79	8.14	1.53	0.81	0.005	0.005	0.010
280	3.09	3.10	0.01	2.79	8.12	1.44	0.81	0.006	0.005	0.011
281	3.10	3.11	0.01	2.81	8.11	1.40	0.81	0.006	0.006	0.011
282	3.11	3.12	0.01	2.81	8.10	1.40	0.81	0.006	0.006	0.011
283	3.12	3.13	0.01	2.83	8.09	1.48	0.81	0.005	0.005	0.011
284	3.13	3.14	0.01	2.83	8.08	1.57	0.81	0.005	0.005	0.010
285	3.14	3.15	0.01	2.85	8.07	1.70	0.81	0.005	0.005	0.009
286	3.15	3.16	0.01	2.85	8.06	1.78	0.81	0.005	0.004	0.009
287	3.16	3.17	0.01	2.87	8.05	1.87	0.80	0.004	0.004	0.009
288	3.17	3.18	0.01	2.88	8.04	1.92	0.80	0.004	0.004	0.008
289	3.18	3.19	0.01	2.88	8.03	1.91	0.80	0.004	0.004	0.008
290	3.19	3.20	0.01	2.90	8.02	1.82	0.80	0.004	0.004	0.009
291	3.20	3.21	0.01	2.90	8.01	1.68	0.80	0.005	0.005	0.010
292	3.21	3.22	0.01	2.92	8.00	1.58	0.80	0.005	0.005	0.010
293	3.22	3.23	0.01	2.92	7.99	1.44	0.80	0.006	0.006	0.011

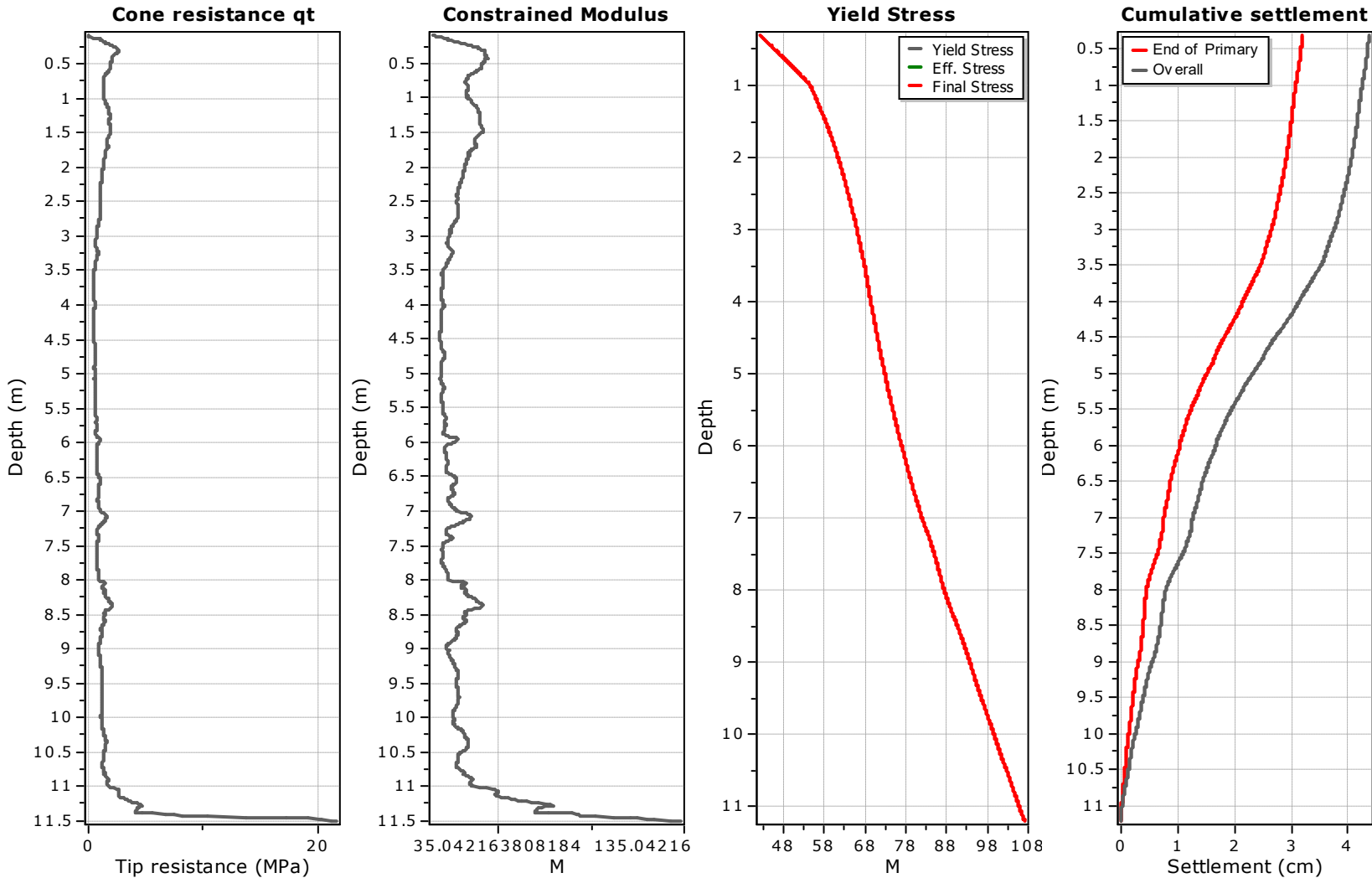
**Total primary settlement: 0.56**  
**Total secondary settlement: 0.41**

**Total calculated settlement: 0.97**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 2.0
- Footing pressure: 37.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

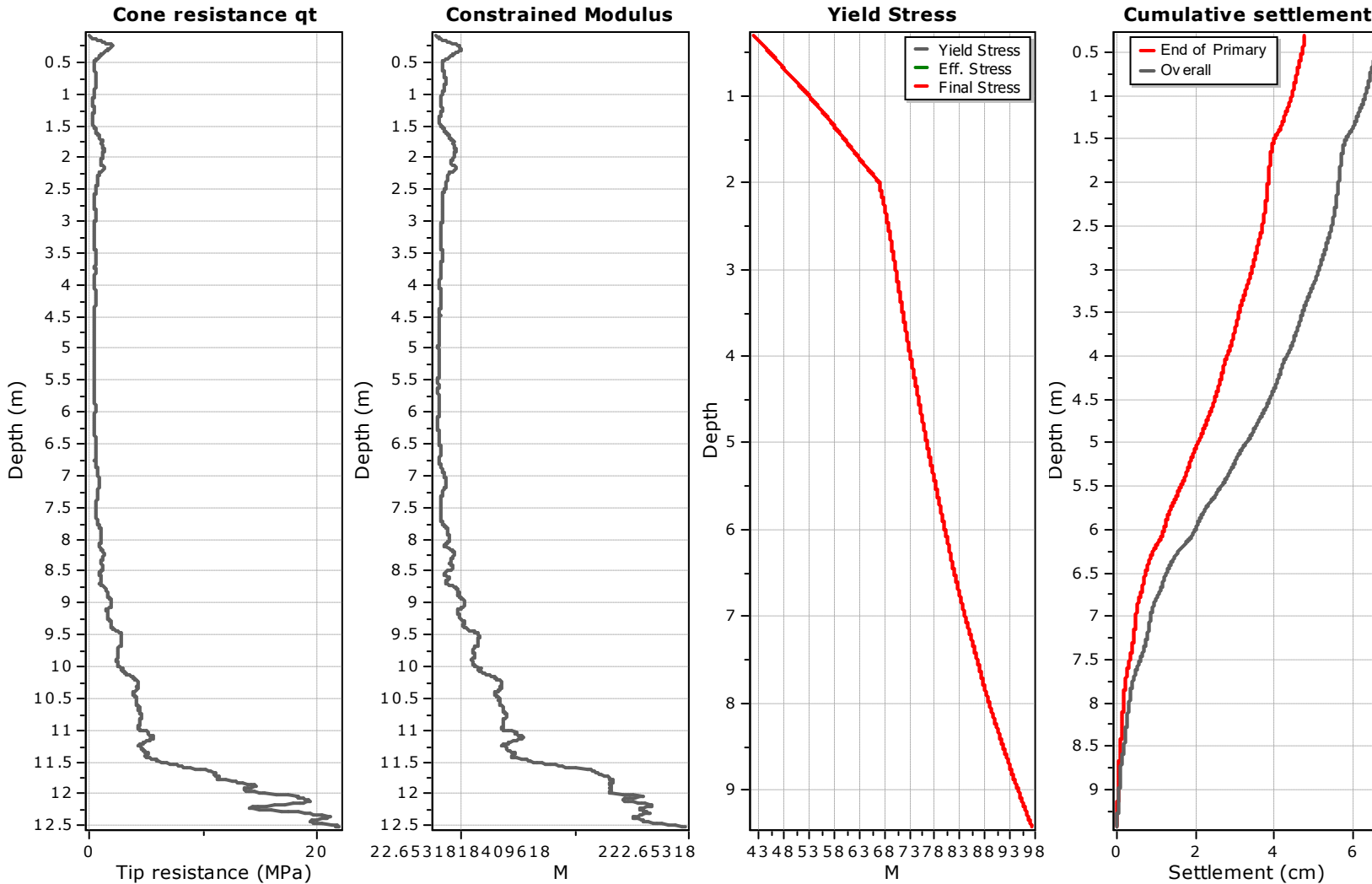
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	$I_z$	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1059	10.88	10.89	0.01	10.59	18.18	21.14	0.48	0.001	0.001	0.002
1060	10.89	10.90	0.01	10.60	18.16	21.58	0.48	0.001	0.001	0.002
1061	10.90	10.91	0.01	10.61	18.15	21.51	0.48	0.001	0.001	0.002
1062	10.91	10.92	0.01	10.62	18.14	21.09	0.48	0.001	0.001	0.002
1063	10.92	10.93	0.01	10.63	18.13	20.52	0.48	0.001	0.001	0.002
1064	10.93	10.94	0.01	10.63	18.12	20.15	0.48	0.001	0.001	0.002
1065	10.94	10.95	0.01	10.64	18.11	19.87	0.48	0.001	0.001	0.002
1066	10.95	10.96	0.01	10.65	18.10	19.78	0.48	0.001	0.001	0.002
1067	10.96	10.97	0.01	10.66	18.09	19.95	0.48	0.001	0.001	0.002
1068	10.97	10.98	0.01	10.68	18.08	20.44	0.48	0.001	0.001	0.002
1069	10.98	10.99	0.01	10.69	18.07	21.09	0.48	0.001	0.001	0.002
1070	10.99	11.00	0.01	10.70	18.06	21.55	0.48	0.001	0.001	0.002
1071	11.00	11.01	0.01	10.71	18.05	21.76	0.48	0.001	0.001	0.002
1072	11.01	11.02	0.01	10.71	18.04	24.82	0.48	0.001	0.001	0.001
1073	11.02	11.03	0.01	10.72	18.03	28.37	0.48	0.001	0.001	0.001
1074	11.03	11.04	0.01	10.73	18.02	32.30	0.48	0.001	0.001	0.001
1075	11.04	11.05	0.01	10.74	18.01	33.41	0.48	0.001	0.000	0.001
1076	11.05	11.06	0.01	10.76	18.00	34.16	0.48	0.001	0.000	0.001
1077	11.06	11.07	0.01	10.77	17.99	34.66	0.48	0.001	0.000	0.001
1078	11.07	11.08	0.01	10.78	17.98	34.91	0.48	0.001	0.000	0.001
1079	11.08	11.09	0.01	10.79	17.97	34.88	0.48	0.001	0.000	0.001
1080	11.09	11.10	0.01	10.79	17.96	34.42	0.48	0.001	0.001	0.001
1081	11.10	11.11	0.01	10.80	17.95	33.87	0.48	0.001	0.001	0.001
1082	11.11	11.12	0.01	10.81	17.94	33.45	0.48	0.001	0.001	0.001
1083	11.12	11.13	0.01	10.82	17.93	33.54	0.48	0.001	0.001	0.001
1084	11.13	11.14	0.01	10.84	17.92	34.12	0.48	0.001	0.001	0.001
1085	11.14	11.15	0.01	10.85	17.91	35.28	0.48	0.001	0.001	0.001
1086	11.15	11.16	0.01	10.86	17.90	36.79	0.48	0.000	0.000	0.001
1087	11.16	11.17	0.01	10.87	17.89	38.55	0.48	0.000	0.000	0.000
1088	11.17	11.18	0.01	10.88	17.88	40.24	0.48	0.000	0.000	0.000
1089	11.18	11.19	0.01	10.88	17.86	41.98	0.48	0.000	0.000	0.000
1090	11.19	11.20	0.01	10.89	17.85	43.78	0.48	0.000	0.000	0.000
1091	11.20	11.21	0.01	10.90	17.84	45.82	0.48	0.000	0.000	0.000
1092	11.21	11.22	0.01	10.91	17.83	47.87	0.48	0.000	0.000	0.000

**Total primary settlement: 3.20****Total secondary settlement: 1.17****Total calculated settlement: 4.37****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
$I_z$ :	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 37.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation



**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 4.76**

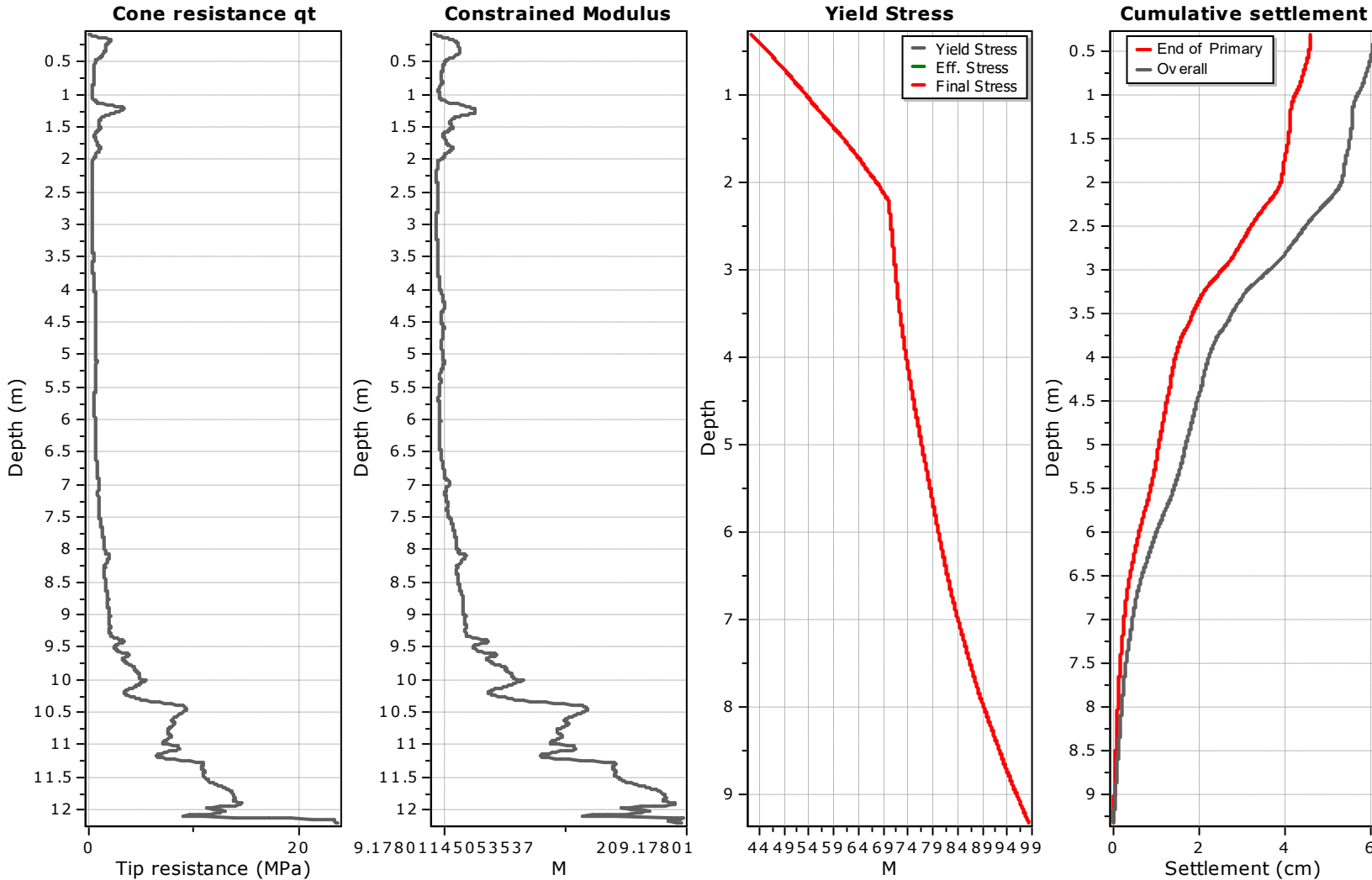
**Total secondary settlement: 1.88**

**Total calculated settlement: 6.64**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
Footing width: 20.00 (m)  
L/B: 1.0  
Footing pressure: 37.50 (kPa)  
Embedment depth: 0.30 (m)  
Footing is rigid: Yes  
Remove excavation load: No  
Apply 20% rule: Yes  
Calculate secondary settlements: Yes  
Time period for primary consolidation: 6 months  
Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

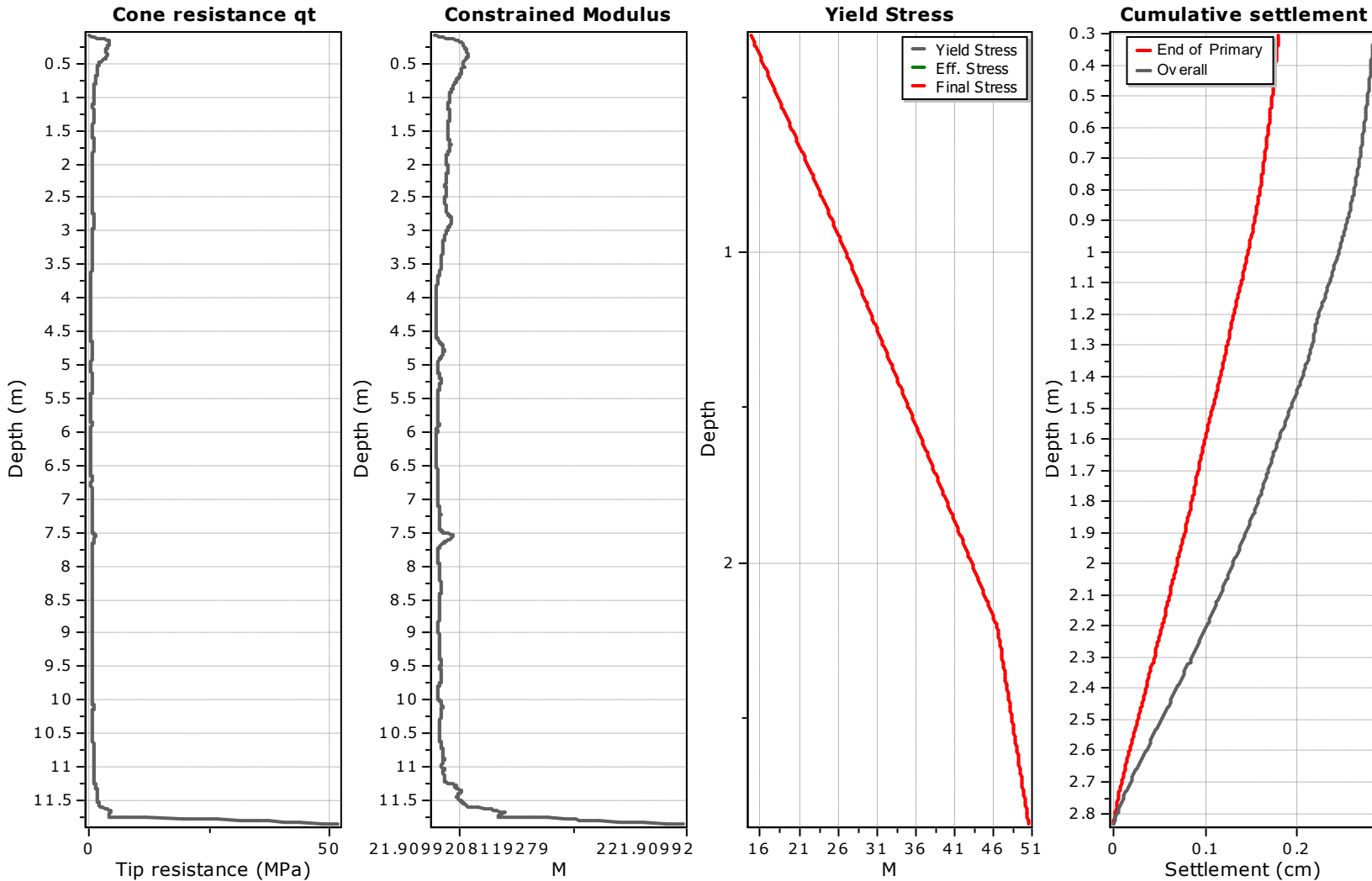
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
875	9.04	9.05	0.01	8.74	16.68	25.48	0.44	0.001	0.001	0.001
876	9.05	9.06	0.01	8.76	16.67	25.25	0.44	0.001	0.001	0.001
877	9.06	9.07	0.01	8.77	16.66	25.10	0.44	0.001	0.001	0.001
878	9.07	9.08	0.01	8.78	16.65	25.00	0.44	0.001	0.001	0.001
879	9.08	9.09	0.01	8.79	16.64	24.83	0.44	0.001	0.001	0.001
880	9.09	9.10	0.01	8.79	16.62	24.82	0.44	0.001	0.001	0.001
881	9.10	9.11	0.01	8.80	16.61	24.85	0.44	0.001	0.001	0.001
882	9.11	9.12	0.01	8.81	16.60	25.02	0.44	0.001	0.001	0.001
883	9.12	9.13	0.01	8.82	16.59	25.18	0.44	0.001	0.001	0.001
884	9.13	9.14	0.01	8.84	16.58	25.38	0.44	0.001	0.001	0.001
885	9.14	9.15	0.01	8.85	16.57	25.53	0.44	0.001	0.001	0.001
886	9.15	9.16	0.01	8.86	16.55	25.66	0.44	0.001	0.001	0.001
887	9.16	9.17	0.01	8.87	16.54	25.83	0.44	0.001	0.001	0.001
888	9.17	9.18	0.01	8.88	16.53	26.06	0.44	0.001	0.001	0.001
889	9.18	9.19	0.01	8.88	16.52	26.29	0.44	0.001	0.001	0.001
890	9.19	9.20	0.01	8.89	16.51	26.34	0.44	0.001	0.001	0.001
891	9.20	9.21	0.01	8.90	16.50	26.33	0.44	0.001	0.001	0.001
892	9.21	9.22	0.01	8.91	16.49	26.24	0.44	0.001	0.001	0.001
893	9.22	9.23	0.01	8.93	16.47	26.17	0.44	0.001	0.001	0.001
894	9.23	9.24	0.01	8.94	16.46	26.00	0.44	0.001	0.001	0.001
895	9.24	9.25	0.01	8.95	16.45	25.86	0.44	0.001	0.001	0.001
896	9.25	9.26	0.01	8.96	16.44	25.77	0.44	0.001	0.001	0.001
897	9.26	9.27	0.01	8.96	16.43	25.84	0.44	0.001	0.001	0.001
898	9.27	9.28	0.01	8.97	16.42	26.02	0.44	0.001	0.001	0.001
899	9.28	9.29	0.01	8.98	16.41	26.22	0.44	0.001	0.001	0.001
900	9.29	9.30	0.01	8.99	16.39	26.42	0.44	0.001	0.001	0.001
901	9.30	9.31	0.01	9.01	16.38	26.57	0.44	0.001	0.001	0.001
902	9.31	9.32	0.01	9.02	16.37	26.68	0.44	0.001	0.001	0.001
903	9.32	9.33	0.01	9.03	16.36	26.86	0.44	0.001	0.001	0.001

**Total primary settlement: 4.61****Total secondary settlement: 1.48****Total calculated settlement: 6.09****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 10.00 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

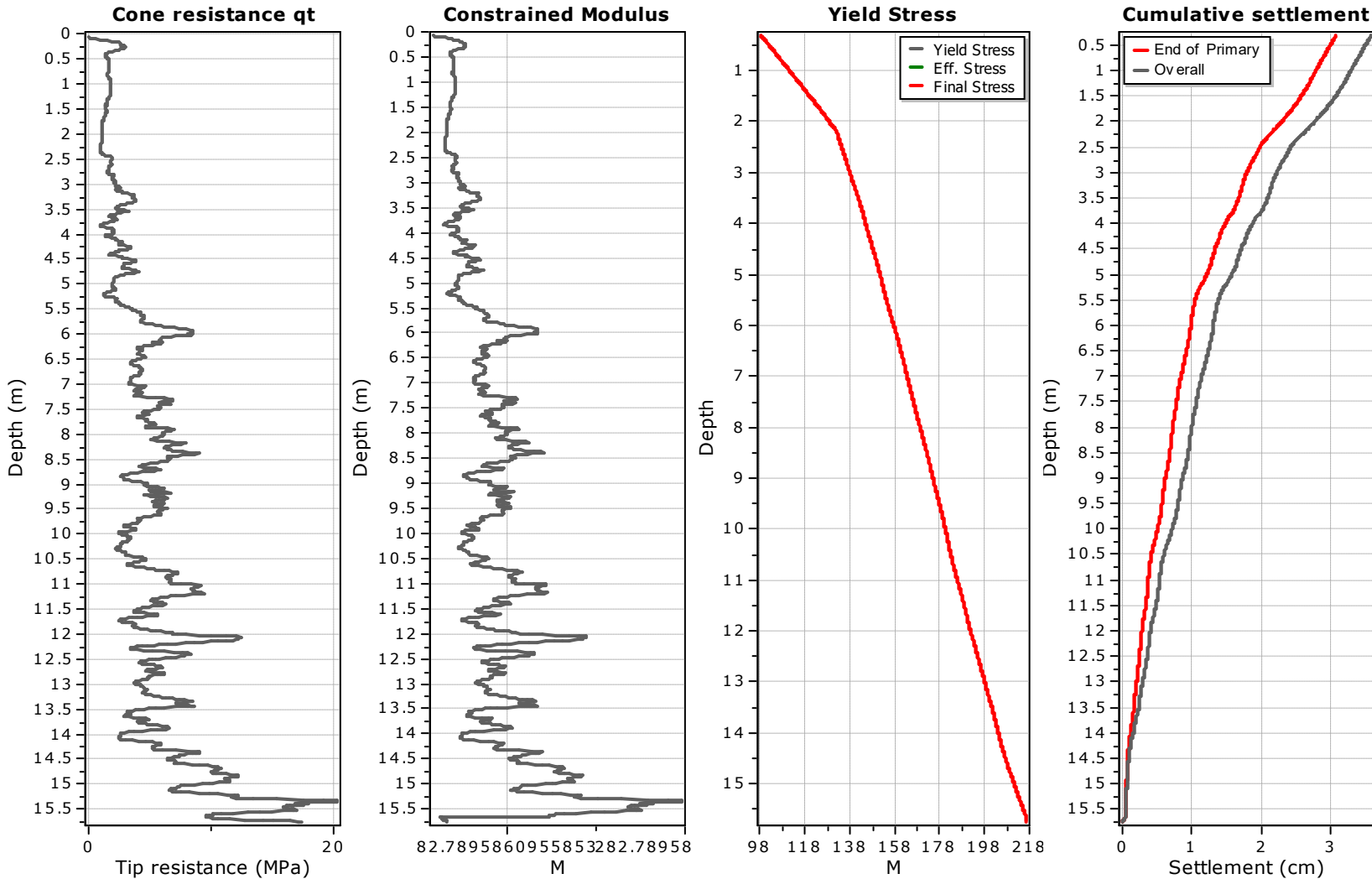
Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
231	2.60	2.61	0.01	2.31	8.66	9.88	0.87	0.001	0.001	0.002
232	2.61	2.62	0.01	2.31	8.65	9.97	0.86	0.001	0.001	0.002
233	2.62	2.63	0.01	2.33	8.64	10.02	0.86	0.001	0.001	0.002
234	2.63	2.64	0.01	2.33	8.63	10.02	0.86	0.001	0.001	0.002
235	2.64	2.65	0.01	2.35	8.62	10.07	0.86	0.001	0.001	0.002
236	2.65	2.66	0.01	2.35	8.60	10.17	0.86	0.001	0.001	0.002
237	2.66	2.67	0.01	2.37	8.59	10.26	0.86	0.001	0.001	0.002
238	2.67	2.68	0.01	2.38	8.58	10.36	0.86	0.001	0.001	0.002
239	2.68	2.69	0.01	2.38	8.57	10.52	0.86	0.001	0.001	0.002
240	2.69	2.70	0.01	2.40	8.56	10.67	0.86	0.001	0.001	0.002
241	2.70	2.71	0.01	2.40	8.55	10.87	0.85	0.001	0.001	0.002
242	2.71	2.72	0.01	2.42	8.54	11.07	0.85	0.001	0.001	0.002
243	2.72	2.73	0.01	2.42	8.53	11.32	0.85	0.001	0.001	0.001
244	2.73	2.74	0.01	2.44	8.52	11.57	0.85	0.001	0.001	0.001
245	2.74	2.75	0.01	2.44	8.51	11.83	0.85	0.001	0.001	0.001
246	2.75	2.76	0.01	2.46	8.50	12.18	0.85	0.001	0.001	0.001
247	2.76	2.77	0.01	2.46	8.48	12.64	0.85	0.001	0.001	0.001
248	2.77	2.78	0.01	2.48	8.47	13.18	0.85	0.001	0.001	0.001
249	2.78	2.79	0.01	2.48	8.46	13.76	0.85	0.001	0.001	0.001
250	2.79	2.80	0.01	2.50	8.45	14.33	0.85	0.001	0.001	0.001
251	2.80	2.81	0.01	2.50	8.44	14.93	0.84	0.001	0.001	0.001
252	2.81	2.82	0.01	2.52	8.43	15.32	0.84	0.001	0.001	0.001
253	2.82	2.83	0.01	2.52	8.42	15.56	0.84	0.001	0.001	0.001
254	2.83	2.84	0.01	2.54	8.41	15.53	0.84	0.001	0.001	0.001

**Total primary settlement: 0.18****Total secondary settlement: 0.10****Total calculated settlement: 0.28****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 93.25 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

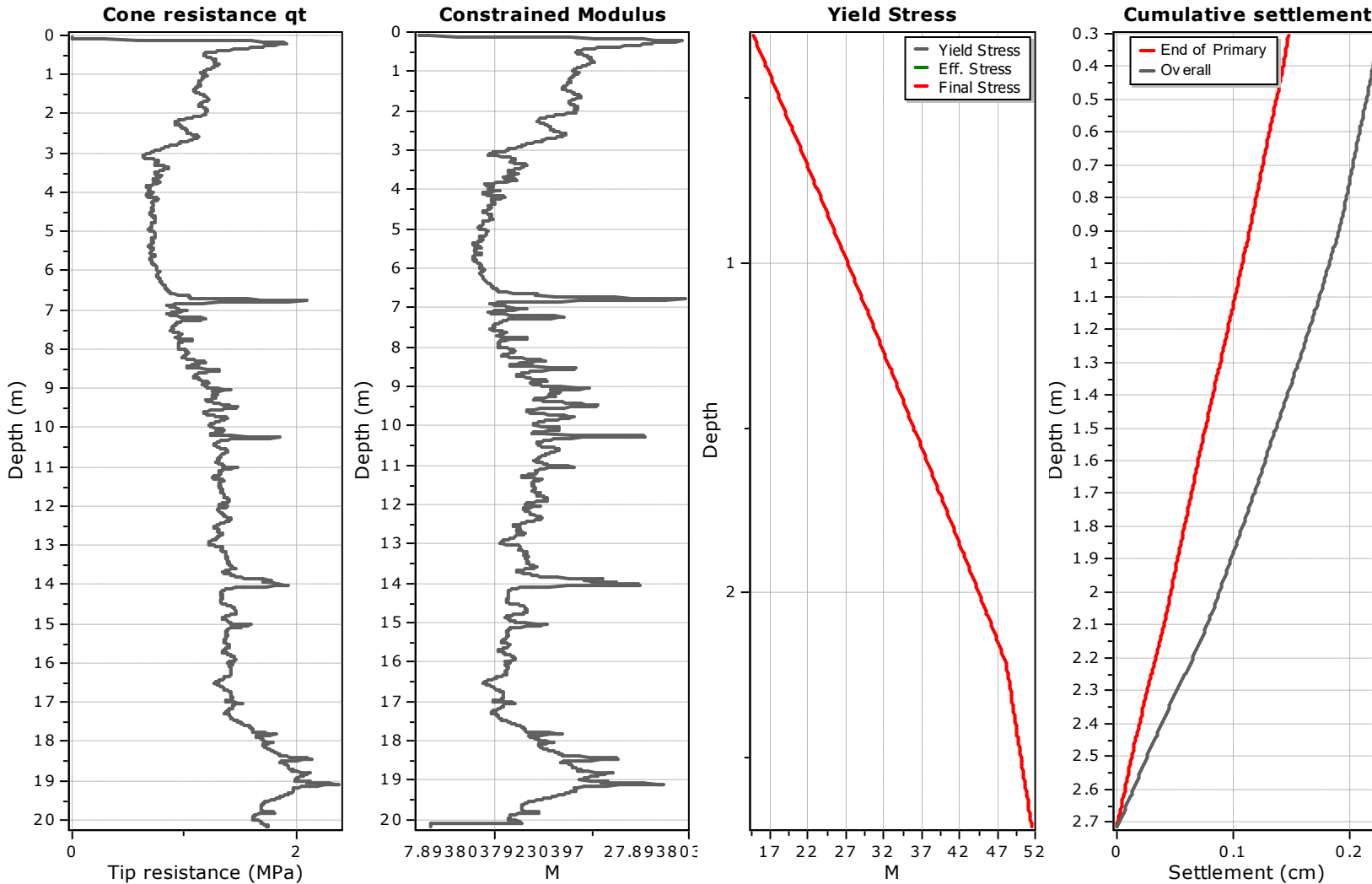
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1519	15.48	15.49	0.01	15.19	44.53	223.22	0.48	0.000	0.000	0.000
1520	15.49	15.50	0.01	15.20	44.49	226.62	0.48	0.000	0.000	0.000
1521	15.50	15.51	0.01	15.21	44.46	229.47	0.48	0.000	0.000	0.000
1522	15.51	15.52	0.01	15.21	44.43	233.06	0.48	0.000	0.000	0.000
1523	15.52	15.53	0.01	15.22	44.39	233.24	0.48	0.000	0.000	0.000
1524	15.53	15.54	0.01	15.23	44.36	228.66	0.48	0.000	0.000	0.000
1525	15.54	15.55	0.01	15.24	44.33	217.12	0.48	0.000	0.000	0.000
1526	15.55	15.56	0.01	15.26	44.29	204.93	0.47	0.000	0.000	0.000
1527	15.56	15.57	0.01	15.27	44.26	191.54	0.47	0.000	0.000	0.000
1528	15.57	15.58	0.01	15.28	44.23	178.00	0.47	0.000	0.000	0.000
1529	15.58	15.59	0.01	15.29	44.19	159.80	0.47	0.000	0.000	0.000
1530	15.59	15.60	0.01	15.29	44.16	146.45	0.47	0.000	0.000	0.000
1531	15.60	15.61	0.01	15.30	44.13	138.30	0.47	0.000	0.000	0.001
1532	15.61	15.62	0.01	15.31	44.09	136.55	0.47	0.000	0.000	0.001
1533	15.62	15.63	0.01	15.32	44.06	133.65	0.47	0.000	0.000	0.001
1534	15.63	15.64	0.01	15.34	44.03	130.28	0.47	0.000	0.000	0.001
1535	15.64	15.65	0.01	15.35	43.99	129.17	0.47	0.000	0.000	0.001
1536	15.65	15.66	0.01	15.36	43.96	129.40	0.47	0.000	0.000	0.001
1537	15.66	15.67	0.01	15.37	43.93	8.40	0.47	0.005	0.000	0.005
1538	15.67	15.68	0.01	15.38	43.90	8.56	0.47	0.005	0.000	0.005
1539	15.68	15.69	0.01	15.38	43.86	8.85	0.47	0.005	0.000	0.005
1540	15.69	15.70	0.01	15.39	43.83	9.15	0.47	0.005	0.000	0.005
1541	15.70	15.71	0.01	15.40	43.80	10.08	0.47	0.004	0.000	0.004
1542	15.71	15.72	0.01	15.41	43.76	11.19	0.47	0.004	0.000	0.004
1543	15.72	15.73	0.01	15.43	43.73	12.48	0.47	0.004	0.000	0.004
1544	15.73	15.74	0.01	15.44	43.70	13.29	0.47	0.003	0.000	0.003
1545	15.74	15.75	0.01	15.45	43.67	14.47	0.47	0.003	0.000	0.003
1546	15.75	15.76	0.01	15.46	43.63	15.06	0.47	0.003	0.000	0.003

**Total primary settlement: 3.06****Total secondary settlement: 0.50****Total calculated settlement: 3.57****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 10.00 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

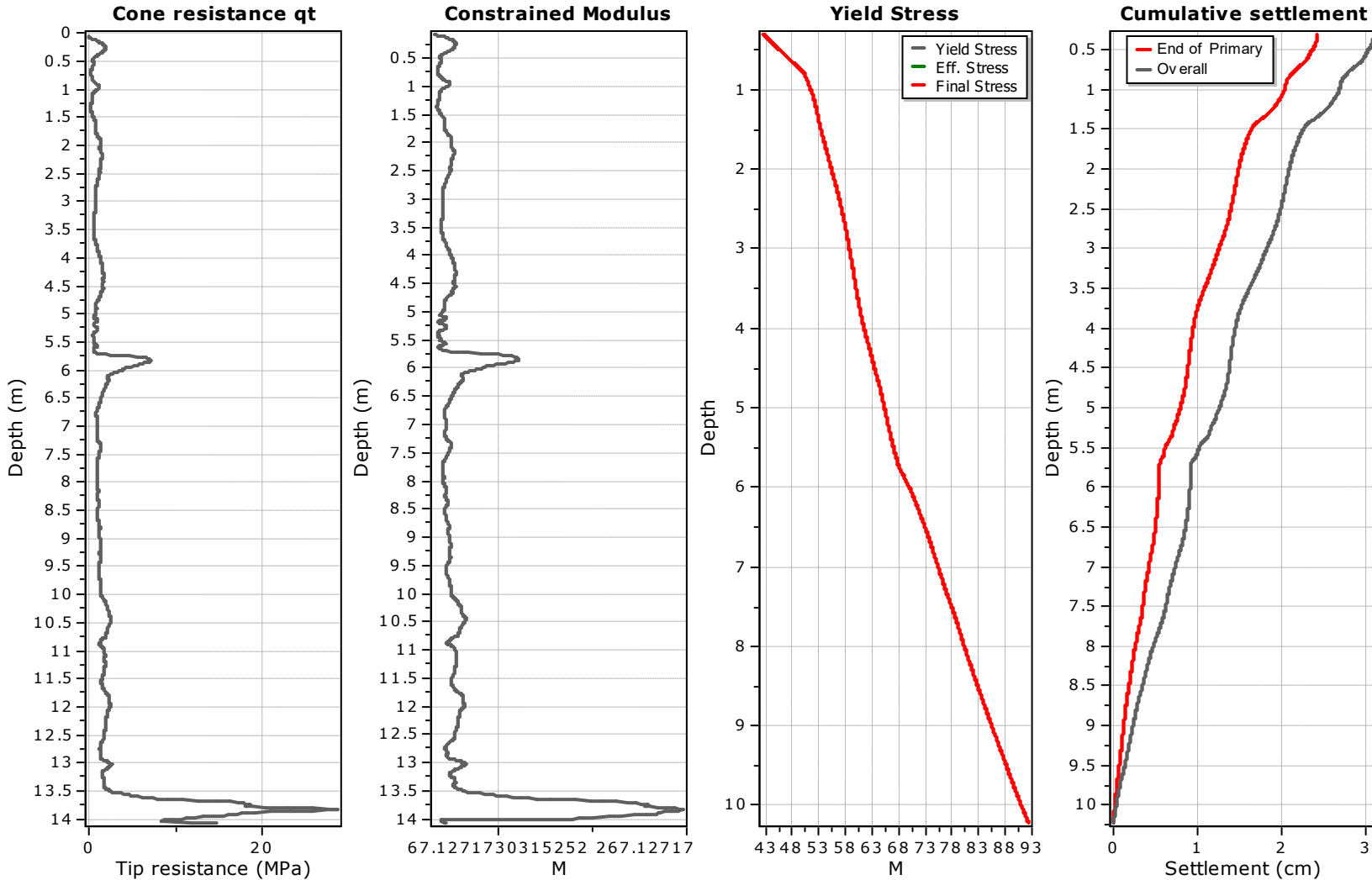
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
231	2.60	2.61	0.01	2.31	8.66	15.15	0.87	0.001	0.001	0.001
232	2.61	2.62	0.01	2.31	8.65	15.05	0.86	0.001	0.001	0.001
233	2.62	2.63	0.01	2.33	8.64	14.94	0.86	0.001	0.001	0.001
234	2.63	2.64	0.01	2.33	8.63	14.77	0.86	0.001	0.001	0.001
235	2.64	2.65	0.01	2.35	8.62	14.61	0.86	0.001	0.001	0.001
236	2.65	2.66	0.01	2.35	8.60	14.45	0.86	0.001	0.001	0.001
237	2.66	2.67	0.01	2.37	8.59	14.35	0.86	0.001	0.001	0.001
238	2.67	2.68	0.01	2.38	8.58	14.25	0.86	0.001	0.001	0.001
239	2.68	2.69	0.01	2.38	8.57	14.15	0.86	0.001	0.001	0.001
240	2.69	2.70	0.01	2.40	8.56	14.02	0.86	0.001	0.001	0.001
241	2.70	2.71	0.01	2.40	8.55	13.66	0.85	0.001	0.001	0.001
242	2.71	2.72	0.01	2.42	8.54	13.30	0.85	0.001	0.001	0.001

**Total primary settlement: 0.15****Total secondary settlement: 0.08****Total calculated settlement: 0.22****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 37.50 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation



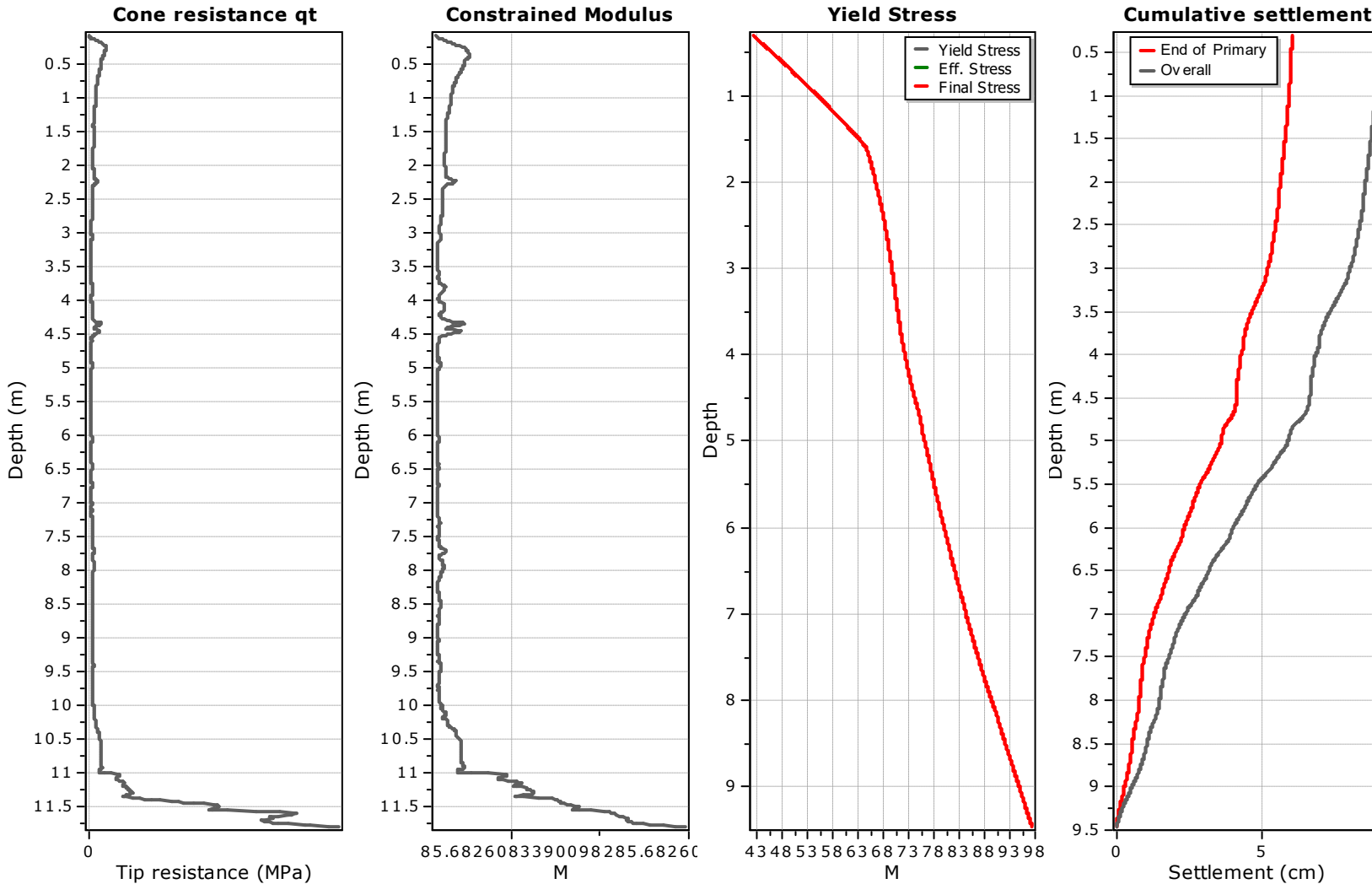
**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
967	9.96	9.97	0.01	9.66	15.67	18.03	0.42	0.001	0.001	0.002
968	9.97	9.98	0.01	9.68	15.66	17.86	0.42	0.001	0.001	0.002
969	9.98	9.99	0.01	9.69	15.65	17.64	0.42	0.001	0.001	0.002
970	9.99	10.00	0.01	9.70	15.64	17.54	0.42	0.001	0.001	0.002
971	10.00	10.01	0.01	9.71	15.63	17.32	0.42	0.001	0.001	0.002
972	10.01	10.02	0.01	9.71	15.62	17.27	0.42	0.001	0.001	0.002
973	10.02	10.03	0.01	9.72	15.61	17.34	0.42	0.001	0.001	0.002
974	10.03	10.04	0.01	9.73	15.60	17.81	0.42	0.001	0.001	0.002
975	10.04	10.05	0.01	9.74	15.59	18.31	0.42	0.001	0.001	0.002
976	10.05	10.06	0.01	9.76	15.58	19.07	0.42	0.001	0.001	0.002
977	10.06	10.07	0.01	9.77	15.57	19.86	0.42	0.001	0.001	0.002
978	10.07	10.08	0.01	9.78	15.56	20.56	0.41	0.001	0.001	0.001
979	10.08	10.09	0.01	9.79	15.55	21.02	0.41	0.001	0.001	0.001
980	10.09	10.10	0.01	9.79	15.54	21.41	0.41	0.001	0.001	0.001
981	10.10	10.11	0.01	9.80	15.53	21.87	0.41	0.001	0.001	0.001
982	10.11	10.12	0.01	9.81	15.52	22.39	0.41	0.001	0.001	0.001
983	10.12	10.13	0.01	9.82	15.51	23.11	0.41	0.001	0.001	0.001
984	10.13	10.14	0.01	9.84	15.50	23.68	0.41	0.001	0.001	0.001
985	10.14	10.15	0.01	9.85	15.48	24.09	0.41	0.001	0.001	0.001
986	10.15	10.16	0.01	9.86	15.47	24.32	0.41	0.001	0.001	0.001
987	10.16	10.17	0.01	9.87	15.46	24.66	0.41	0.001	0.001	0.001
988	10.17	10.18	0.01	9.88	15.45	25.11	0.41	0.001	0.001	0.001
989	10.18	10.19	0.01	9.88	15.44	25.42	0.41	0.001	0.001	0.001
990	10.19	10.20	0.01	9.89	15.43	25.86	0.41	0.001	0.001	0.001
991	10.20	10.21	0.01	9.90	15.42	26.29	0.41	0.001	0.001	0.001
992	10.21	10.22	0.01	9.91	15.41	26.84	0.41	0.001	0.001	0.001
993	10.22	10.23	0.01	9.93	15.40	27.25	0.41	0.001	0.001	0.001

**Total primary settlement: 2.43****Total secondary settlement: 0.67****Total calculated settlement: 3.10****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 20.00 (m)
- L/B: 1.0
- Footing pressure: 37.50 (kPa)
- Embedment depth: 0.30 (m)
- Footing is rigid: Yes
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: Yes
- Time period for primary consolidation: 6 months
- Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
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**Total primary settlement: 6.01**

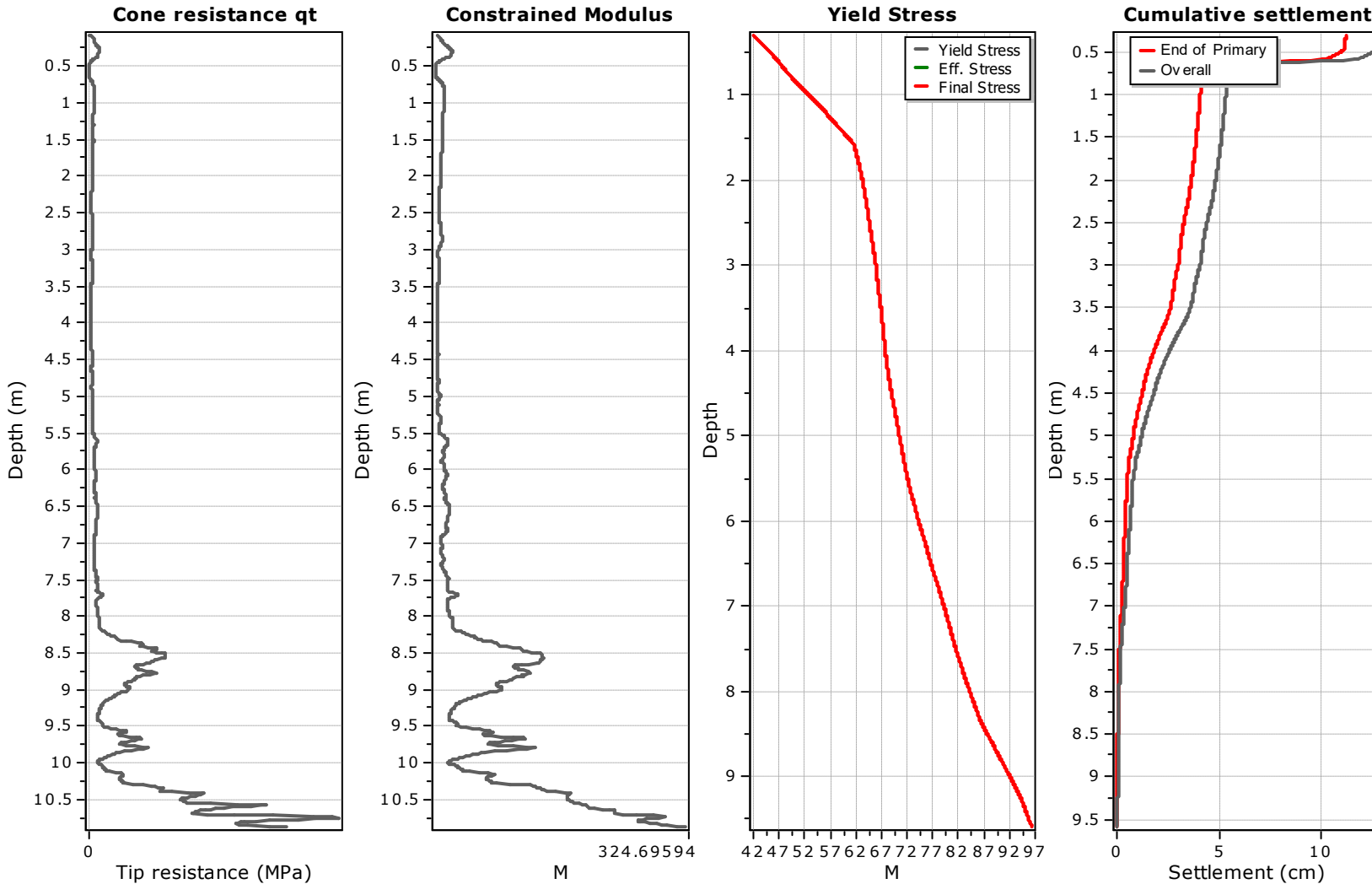
**Total secondary settlement: 2.97**

**Total calculated settlement: 8.98**

**Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 37.50 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

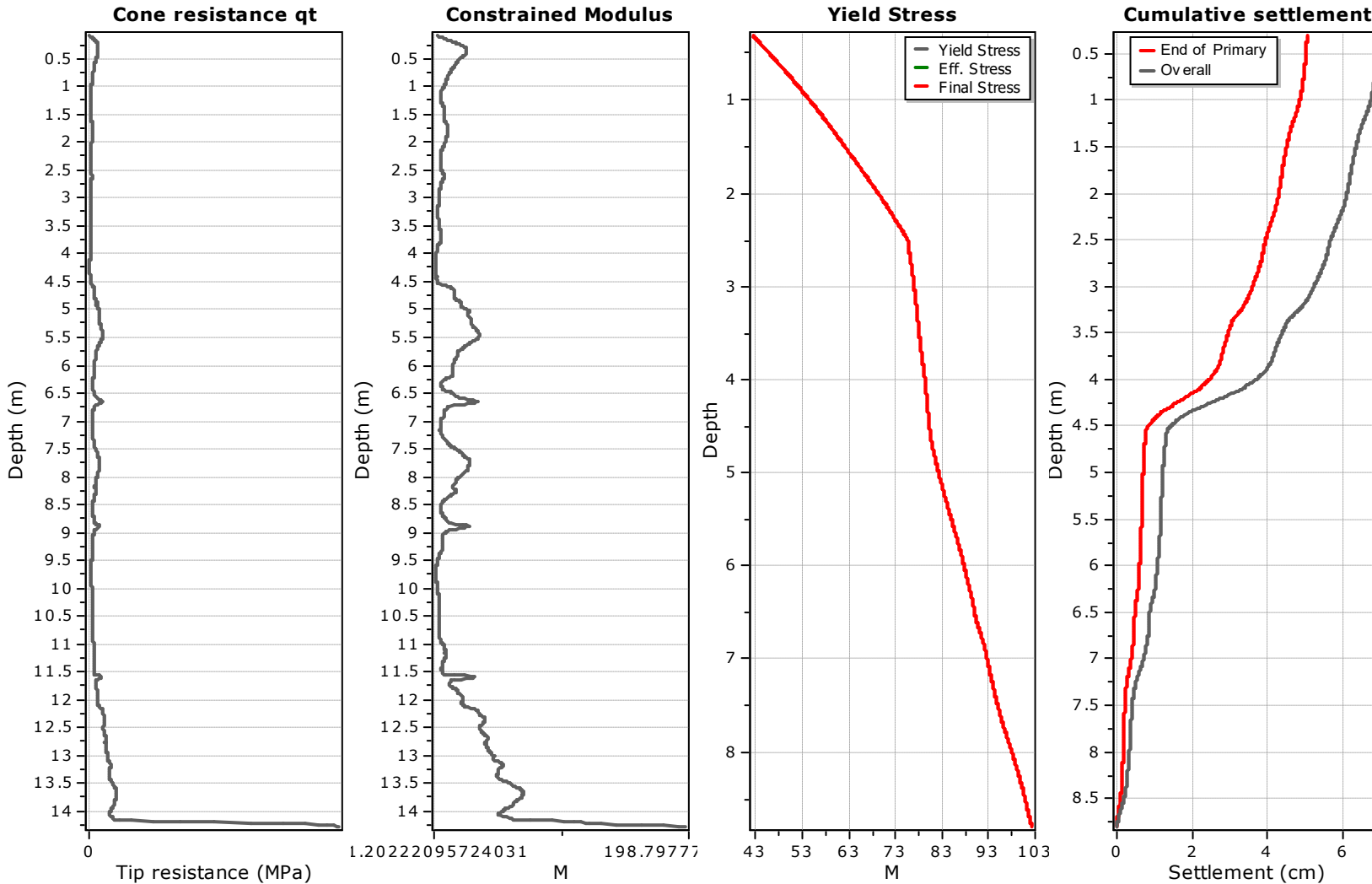
Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
921	9.50	9.51	0.01	9.21	16.16	29.22	0.43	0.001	0.000	0.001
922	9.51	9.52	0.01	9.21	16.15	32.96	0.43	0.000	0.000	0.000
923	9.52	9.53	0.01	9.22	16.14	39.13	0.43	0.000	0.000	0.000
924	9.53	9.54	0.01	9.23	16.13	47.12	0.43	0.000	0.000	0.000
925	9.54	9.55	0.01	9.24	16.12	55.98	0.43	0.000	0.000	0.000
926	9.55	9.56	0.01	9.26	16.10	62.30	0.43	0.000	0.000	0.000
927	9.56	9.57	0.01	9.27	16.09	66.04	0.43	0.000	0.000	0.000
928	9.57	9.58	0.01	9.28	16.08	68.98	0.43	0.000	0.000	0.000
929	9.58	9.59	0.01	9.29	16.07	72.42	0.43	0.000	0.000	0.000

**Total primary settlement: 11.16****Total secondary settlement: 1.60****Total calculated settlement: 12.76****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep



**Settlements calculation according to theory of elasticity\***



**Calculation properties**

Footing type: Rectangular  
 Footing width: 20.00 (m)  
 L/B: 1.0  
 Footing pressure: 37.50 (kPa)  
 Embedment depth: 0.30 (m)  
 Footing is rigid: Yes  
 Remove excavation load: No  
 Apply 20% rule: Yes  
 Calculate secondary settlements: Yes  
 Time period for primary consolidation: 6 months  
 Time period for second. settlements: 600 months

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where  $t_p$  is the duration of primary consolidation

**:: Tabular results ::**

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
829	8.58	8.59	0.01	8.29	17.25	4.55	0.46	0.004	0.004	0.007
830	8.59	8.60	0.01	8.29	17.23	4.62	0.46	0.004	0.004	0.007
831	8.60	8.61	0.01	8.30	17.22	4.69	0.46	0.004	0.004	0.007
832	8.61	8.62	0.01	8.31	17.21	4.72	0.46	0.004	0.004	0.007
833	8.62	8.63	0.01	8.32	17.19	4.74	0.46	0.004	0.004	0.007
834	8.63	8.64	0.01	8.34	17.18	4.77	0.46	0.004	0.004	0.007
835	8.64	8.65	0.01	8.35	17.17	4.85	0.46	0.004	0.003	0.007
836	8.65	8.66	0.01	8.36	17.16	5.00	0.46	0.003	0.003	0.007
837	8.66	8.67	0.01	8.37	17.14	5.19	0.46	0.003	0.003	0.007
838	8.67	8.68	0.01	8.38	17.13	5.40	0.46	0.003	0.003	0.006
839	8.68	8.69	0.01	8.38	17.12	5.57	0.46	0.003	0.003	0.006
840	8.69	8.70	0.01	8.39	17.11	5.70	0.46	0.003	0.003	0.006
841	8.70	8.71	0.01	8.40	17.09	6.06	0.46	0.003	0.003	0.006
842	8.71	8.72	0.01	8.41	17.08	6.57	0.46	0.003	0.003	0.005
843	8.72	8.73	0.01	8.43	17.07	7.17	0.46	0.002	0.002	0.005
844	8.73	8.74	0.01	8.44	17.06	7.50	0.45	0.002	0.002	0.005
845	8.74	8.75	0.01	8.45	17.04	7.86	0.45	0.002	0.002	0.004
846	8.75	8.76	0.01	8.46	17.03	8.22	0.45	0.002	0.002	0.004
847	8.76	8.77	0.01	8.46	17.02	8.55	0.45	0.002	0.002	0.004
848	8.77	8.78	0.01	8.47	17.01	8.86	0.45	0.002	0.002	0.004
849	8.78	8.79	0.01	8.48	17.00	9.08	0.45	0.002	0.002	0.004
850	8.79	8.80	0.01	8.49	16.98	9.45	0.45	0.002	0.002	0.004
851	8.80	8.81	0.01	8.51	16.97	9.87	0.45	0.002	0.002	0.003

**Total primary settlement: 5.06****Total secondary settlement: 1.89****Total calculated settlement: 6.95****Abbreviations**

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing imposed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$ :	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlements due to creep

**APPENDIX F**  
**GEOTECHNICAL ASSESSMENT OF**  
**1768 STATE HIGHWAY ONE**



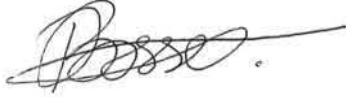

Stefan Richardson

**GEOTECHNICAL ASSESSMENT REPORT FOR SUITABILITY OF  
PLAN CHANGE**

1768 State Highway 1, Warkworth

**Project Reference: 20182  
29 June 2022**

## DOCUMENT CONTROL

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**APPENDIX A: GEOTECHNICAL INVESTIGATION PLAN**

**APPENDIX B: GEOTECHNICAL INVESTIGATION DATA**

**APPENDIX C: STABILITY ANALYSES**

# 1 INTRODUCTION

Land Development and Engineering Ltd (LDE) has been instructed by Stefan Richards to undertake a Geotechnical Engineering Feasibility Assessment for a proposed structure plan change and private plan change from rural zoning to an urban zoning. The subject site is located south of Warkworth township. Our scope was to carry out a limited geotechnical investigation, desktop study and review of available geotechnical information, and provide an initial geotechnical assessment on the potential constraints of the site regarding the proposed future urban zones as outlined in the Warkworth Structure Plan Change 2019.

We acknowledge that this Geotechnical Report will be used in support of an application to Auckland Council for a proposed plan change of the property.

# 2 SITE DESCRIPTION

The property is legally described as “Pt Allot 64 Psh of Mahurangi SO 891E, Pt Allot 72 Psh of Mahurangi SO 891E, Pt Allot 73 Psh of Mahurangi SO 891E” and is approximately 13.5 hectares with two thirds of the land parcel falling within the Future Urban Zone of Warkworth, as shown on the appended wider plan change extent. The subject property is in a rural setting and bounded by farmlets to the east, west and south with site access off State Highway 1 to the north. A prominent water course flows adjacent to the western boundary towards State Highway 1 and is a tributary to the Mahurangi River watershed (Figure 1).

The current land use comprises pastoral farmland, a rural residential dwelling and implementation sheds. A large stand of native bush covers the southern hillslopes adjacent to the neighbouring Avice Millar Scenic Reserve.

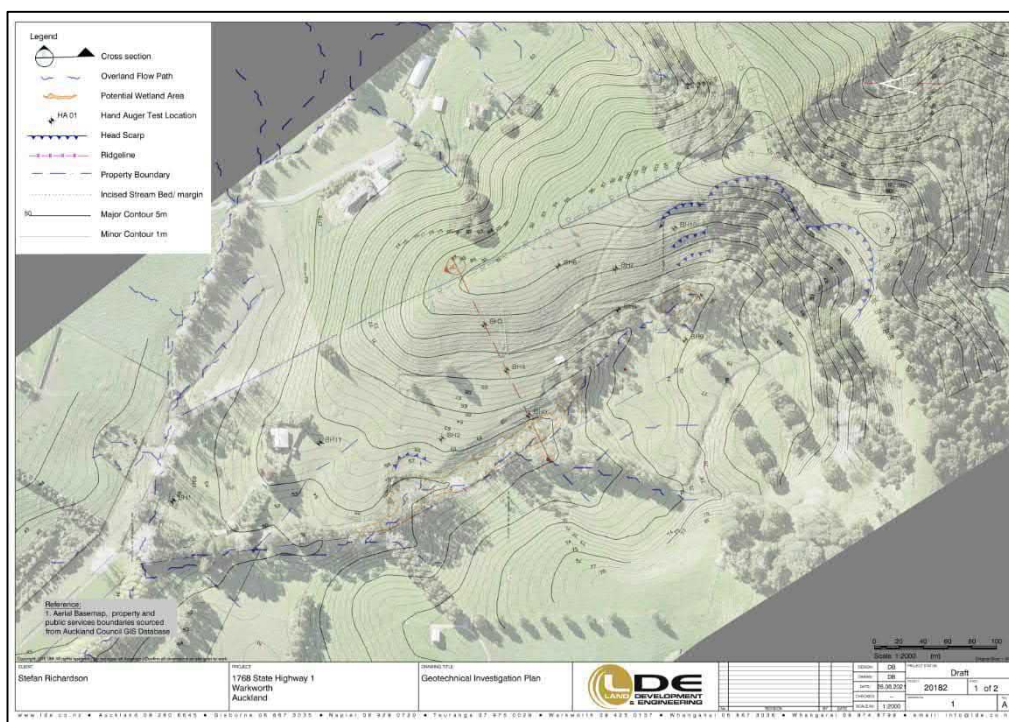


Figure 1: Geotechnical Investigation Plan.

### 3 PROPOSED PLAN CHANGE ZONING

The plan change area is proposed to comprise a combination of Residential Urban, Residential Single House and Large Lot Living, while part of the site will remain in the current zoning classification. At the time of preparation, the final scheme plan had not yet been finalised. It is understood that this assessment is intended to help inform the masterplan planning process.

### 4 DESKTOP STUDY & PREVIOUS REPORTS

A review of existing site information was conducted. It included the review of geotechnical and environmental information held by Auckland Council, and a review of the following relevant geotechnical assessment reports:

- Auckland Council (2019) - *“Geotechnical and Coastal Hazards Assessment, Warkworth Structure Change”*
- Tonkin & Taylor, ref. 29129.001 (2013) report titled *“Geotechnical Desk Study North and North-West Auckland Rural Urban Boundary Project (DRAFT V2)”*

The T&T report provides a general baseline geotechnical desktop assessment of the wider Auckland Unitary Plan change in which the study site is included. The Auckland Council report is a more specific review for the wider Warkworth Structure change and provides a summary of the suitability of the land for development based on the geotechnical issues that are present.

The reports comment on geotechnical hazards including slope instability and liquefaction potential of the underlying geological units, with the T&T report assigning areas of low, medium, and high Instability Potential, which is dependent on slope geometry and underlying geology. The study site's low-lying slope falls within the Low category while the steeper slopes towards the south are likely Medium to high-risk areas, with an existing surface expression of a slip.

The same classification terminology of low, medium, and high is applied for Liquefaction Potential, in which Warkworth is deemed to be low (Cunnigham & Speight, 2013).

A review of the Auckland Council GeoMaps website indicates that small portions of the low-lying areas at the north-western end of the study area, and those directly adjacent to overland flow paths and/or water courses are sensitive to surface flooding. The native bush adjacent to the Avice Miller Reserve is marked as being an area of ecological significance.

## 5 GEOLOGY

### 5.1 General

The 1:250,000 geological map for the site (source: GNS Science Web Map) indicates that the site is underlain Pakiri Formation Residual Soils and Pleistocene alluvium. In addition to this our investigation encountered Holocene alluvial deposits adjacent to the water courses on site. The following descriptions summarize the soils encountered within each unit.

### 5.2 Alluvium (Holocene, Q1a)

Holocene alluvium (0.0-0.014 Mya) is a common deposit located adjacent to stream margins and water courses, it can comprise of highly compressible, organic rich, soft to firm silts and clays. Generally, these units are deemed unsuitable for construction purposes and are removed from sites prior to development or are earmarked for parks, open spaces, and riparian margins.

### 5.3 Pleistocene Alluvium ((Undifferentiated Tauranga Group Alluvium (Pleistocene, 1Qa))

Generally, the low-lying, low relief regions of the property adjacent to State Highway 1 are inferred to be underlain by Pleistocene aged (mid to late Pleistocene epoch (0.014 – 0.128 Mya) alluvial soils of the Tauranga Group.

Tauranga Group (alluvium) tends to comprise of predominantly pumiceous sand, silt, mud and clay with interbedded gravels and peat (organics). They have generally been deposited by fluvial processes and are often associated with river and stream margins. These materials are highly variable in strength and can range from being soft to hard in consistency. Generally, these materials are not highly compressible unless weaker materials and organics are present, which can be compressible if subject to concentrated heavy loading.

### 5.4 Pakiri Formation of the Waitemata Group (Miocene, Mwp)

Miocene aged (5.33 - 23.8 Mya) volcanoclastic sedimentary rocks comprising of alternating, thick-bedded, volcanic rich coarse grained, graded sandstone and siltstone with volcanoclastic grit beds. The residual soils generally comprise of silty clays and silts with varying degrees of sand and gravels. The near surface soils tend to be bright orange, red, pink, and purple in colour. These deposits typically comprise weak to very weak sandstones and siltstone with the underlying rock generally very weak to weak i.e., 1-2MPa.

## 6 GEOMORPHOLOGY

A geomorphological assessment of the site was conducted using a combination of aerial photographs, a site walkover assessment by an Engineering Geologist, and the LINZ digital elevation model (DEM). The aerial

photography review included images from Auckland Council GeoMaps, Google Earth Imagery and the Retrolens historical database.

A summary of the on-site features is shown on the attached Geotechnical Investigation Plan 20182-1, located in Appendix A. In general, the property falls from the south from a prominent west-east trending ridgeline along the southern boundary. An intersecting spur crest forms the eastern boundary and gradually dips northward. A prominent back scarp feature is visible within the north facing flank of the southern ridgeline and is mimicked on the opposing slopes on the other side of the bisecting stream. A central ephemeral stream starts within the gully head of the back scarp feature and flows to the north where it intersects another stream from the adjacent property, before draining towards the Mahurangi river in the north. Along the stream margin a shallow slump is visible adjacent to one of the stream margins in the low-lying regions. Along both the flanks of the ridgeline, there appears to be evidence of shallow soil creep in the form of small terracettes; these features have likely been exacerbated through the effects of long-term grazing.

## 7 GROUND CONDITIONS

### 7.1 Subsurface Investigation

The fieldwork was undertaken on the 19th and 20th of July 2021 and comprised of the following:

1. A site walkover assessment by an Engineering Geologist, including the inspection of exposures of underlying geology.
2. A qualitative slope stability assessment, based on existing geomorphology and evidence for historical slope failure.
3. Put down a suite of 10 hand augured boreholes to depths of between 2 to 5m across the property with measurement of the undrained shear strength taken in 200 mm intervals.
4. Scala Penetrometer testing (DCP Testing) from the base of a select few boreholes to obtain information on the deeper soil profile, with Scala blow counts recorded every 50mm.

The soils encountered during the site investigation were described in general accordance with NZGS Soil and Rock Description Guidelines. The locations of the subsurface investigations are displayed on the Geotechnical Investigation Plan in Appendix A. Logs of the boreholes and penetrometer tests are presented in Appendix B.

Additionally, a (E-W oriented) cross section was prepared perpendicular to the north-south trending ridgeline to assess the subsurface geological profile (Appendix A).

### 7.2 Preliminary Borehole Findings

Residual soils of the Pakiri Formation underly most of the study area, including the ridges and hill-sites, while Pleistocene alluvial deposits underly the north-western extends of the proposed plan change zone. Holocene alluvial



deposits are likely present in and adjacent to streams and any potential wetland areas. The following summarizes the site-specific findings, or the hand-auger investigations conducted:

- Topsoil was encountered across the site at a depth of between 100mm and 300mm.
- The natural Pakiri Formation soils generally comprised of orange, red and light grey silty clay to sandy silts, and clayey silts with varying degrees of sand extending down to at least 5.0mbgl. Trace coarse siltstone and sandstone gravels were encountered at 1.2mbgl and 2.6mbgl, respectively within BH5. Measurements of the undrained shear strength within the unit typically returned readings of between 65kPa to more than 222kPa indicating that the deposits are stiff to hard.
- Pleistocene Alluvium and the Holocene alluvium generally comprise of stiff to very stiff and highly plastic bluish grey clay, with shear vane readings returning values ranging from 87 to 182 KPa. Black fibrous organics (e.g. wood) was found in variable amounts throughout the soil profile and a buried log/peat layer was encountered at 2.8 m within BH1. (e.g. wood).
- Scala penetrometer tests were driven from the base of BH3, BH4 and BH5. Measured blow counts per 50mm ranged from 2 to 7 up to a depth of 6.8m in BH3. In BH4 and 5 blow counts ranged from 2 to 10 up to depths of 6.85m and 6.4m, respectively, where refusal was reached.

### 7.3 Groundwater Conditions

Groundwater was encountered in boreholes adjacent to stream margins or within the Pleistocene alluvium (Tauranga Formation), but not along the ridgeline. The depth to groundwater table observed on-site is summarized in Table 1. Fluctuations in the ground-water table are to be expected in response to precipitation and water-levels in adjacent streams.

The groundwater levels were measured in mid-winter, following moderate to heavy rainfall. It is thus assumed that the observed groundwater level was close to the yearly maximum. Drier conditions during the summer months may result in the groundwater level to be up to 1 m lower than encountered during the investigation.

Table 1: Groundwater seepage depths encountered on the day of drilling.

Date	Borehole ID									
	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9	BH10
19-20/07/21	-	-	-	3	2.55	-	-	2.6	2.5	2.7
27/07/2021	2.8	2.4	-	-	-	-	-	-	-	-

### 7.4 Seismic Subsoil Category

Based on the investigation data and on-site conditions we consider that different areas of the site are either Class C or D (Shallow Soil and Deep or Soft Soil) as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5:

Earthquake actions – New Zealand”. The low-lying regions which contain low strength clays, silts and peat are deemed to be Class D (deep or soft soil) while the mid-slopes to upper slopes containing Pakiri Formation tend to exhibit Class C (shallow soil) characteristics

## 8 GEOTECHNICAL CONSIDERATIONS

### 8.1 General

This section summarises our assessment of the natural hazards within the property as broadly required by Section 106 of the Resource Management Act (1991 and subsequent amendments), including geotechnical hazards given Section 71(3) of the Building Act (2004), and as required by the Unitary Plans rules, Chapter E.36 Natural Hazards and Flooding. This includes erosion, inundation, subsidence, earthquake, and slippage. The latter are also recognised in the Auckland Council Unitary Plan (2016) and mentioned in the T&T and Auckland Council reports as being a natural hazard affecting the study site and future changes within Auckland. This section presents the results of the hazards identified within the study site to a level appropriate for the proposed zoning change. Further assessment is needed prior to subdivision, following more detailed analysis.

### 8.2 Slope Stability Analysis

The stability of the site has been assessed based on the geomorphology of the surrounding slopes and numerical stability analyses carried out using specialist geotechnical software on a cross section developed of the underlying engineering geology. The location of the cross section is shown on the Geotechnical investigation Plan with the subsurface geology shown on Geological Cross Section A-A' both presented in Appendix A.

#### 8.2.1 Assessment Methodology

The stability of the site has been assessed based on the following aspects:

- geomorphology of the surrounding slopes
- historical imagery (ref. to Section 2.2)
- LiDAR data
- numerical slope stability analysis using specialist geotechnical software (RocScience Slide 2018).

The analyses methods of Spencer and GLE/Morgenstern-Price were adopted within the stability analysis and included the following four scenarios:

- A static scenario representing the assumed long-term conditions of the site, while adopting the assumed Extreme Groundwater Conditions.
- A seismic scenario for an earthquake event, using undrained soil parameters for cohesive soils and a design peak ground acceleration of 0.1g.

Factor of Safety criteria have been adopted from Auckland Council's Code of Practice for Land Development and Subdivision, Section 2: Earthworks and Geotechnical Requirements, and are shown in Table 2 below. The seismic loads used in the analyses were those defined in the NZTA Bridge Manual for the Auckland region.

Hard

Table 2: Minimum Factor of Safety requirements adopted for the analysis.

Slope Case*	Minimum Factor of Safety (FoS)
Normal Groundwater Conditions	1.5
Extreme Groundwater Conditions	1.3
Seismic Load (150-year ARI)	1.2

\*As stipulated in Auckland Council COP for "Land development and Subdivision".

The soil strength parameters used in the analyses are shown in the appended slope stability analysis print outs and were generally derived from published and unpublished correlation charts and tables for the materials encountered during the investigation. Consideration has been given to the behaviour of the materials with long-term loading, and their strength under likely worst case moisture content levels.

## 8.2.2 Stability Assessment

As the proposed development is generally situated on a gently undulating slope with steeper side slopes along the northern (>35°) and eastern boundaries (>20°), a stability assessment has been carried out on the slope within the proposed residential single house zone.

There is geomorphological evidence of instability on the slopes surrounding the site; most notably, a large circular feature in the landscape to the south, within the gully head. Additionally, there is evidence of slope instability along the interface between the soil mantle and inferred bedrock in the form of a distinctive headscarp feature and a horizontal mid-slope platform. There is no other evidence to suggest deep-seated instability, although some shallow evidence of soil creep is seen on the steeper grazed slopes at the site (above 15°). Terracettes have formed perpendicular to the slope because of soil creep and is likely to be ongoing because of gravity and the plasticity of the underlying soils. Generally, these features have been exacerbated by long-term grazing of animals.

The result of the stability analysis show that the slope is fundamentally stable with all the factors of safety meeting or exceeding those stipulated in the ACoP, shown in Table 2 above. Specifically, under normal ground water conditions the slope has a global FoS of 1.97, under extreme groundwater conditions the FOS decreases to 1.81 and under seismic conditions, the FOS decreases to 1.46.

Overall, the FoS values suggest that the slope within the single house residential zone is unlikely to experience deep-seated instability. However, further site-specific assessment is required considering any proposed earthworks, loadings from dwellings and the overall development. In addition, the area proposed as large lot living is likely to require building platform specific stability analysis at the time of subdivision.

As observed on site a deeper-seated slip was observed within the gully head of the proposed large lot living zone. Further analysis is required to understand the failure mechanism of the instability and possible methods of remediation. At present possible building platforms could be located on the intact slopes at the top of the ridge line with the instability extent being planted out or kept as grasslands.

### **8.3 Ground Shrinkage and Swelling Potential (Expansivity)**

Plastic soils can be subject to shrinkage and swelling caused by moisture content variations which can result in apparent heaving and settlement of buildings, particularly between seasons. The magnitude of movement is a function of the reactivity of the clay minerals and the amount of clay as a fraction near surface soils. These factors are in turn associated with geological origin and the degree and nature of in-situ weathering.

Soil types and expansivity have been determined based upon visual characteristics observed during the drilling of the hand augers and classified in accordance with AS2870:2011 and are summarized for each unit below. It is recommended for the soil class to be confirmed via laboratory testing at the resource consent stage.

#### **8.3.1 Pakiri Formation**

Based on the visual characteristics of the Pakiri Formation residual soils on the hill slopes of the site are assessed as being moderately reactive i.e., susceptible to seasonal soil shrinkage and swelling. (Class M in terms of AS2870:2011).

#### **8.3.2 Pleistocene and Holocene Alluvial Deposits**

Alluvial deposits and Pleistocene alluvium within the stream margins and low-lying regions were visually assessed as being highly reactive (class H1 to H2 in terms of AS2870:2011).

### **8.4 Inundation**

A review of Auckland Council GIS database indicates that low-lying regions at the north-western end of the study area are susceptible to flooding. It is thus recommended that a flood assessment should be conducted at the subdivision stage to inform the location of residential houses adjacent to stream margins and allow for appropriate design of foundation and earthworks.

### **8.5 Seismic Hazard**

The site is in a region of low seismicity. Accordingly, the potential deformations associated with earthquake shaking are expected to be low to negligible. The GNS NZ Geology Web Map and Active Faults Database does not show any active faults nearby and there is no surface expression that indicates the presence of an active fault within proximity to the site. According to the Active Faults Database (GNS Science) the Waikoupua Fault in the Hunua Ranges, 70km south of the study site is the nearest active fault.

## 8.6 Settlement

Sediments that are rich in organic material, such as those found within alluvium and Pleistocene alluvium adjacent to the stream margins tend to settle in response to static loading and as such will require further, site-specific assessment at the design phase.

## 8.7 Liquefaction and Lateral Spreading

Liquefaction is the term used to describe the temporary, but substantial loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subject to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground, and structure settlement, and in lateral (spreading) of the ground. Lateral spreading typically occurs in sloping ground close to waterways which have an exposed free-face (e.g. riverbank, streams etc.) due to soil liquefaction at relatively shallow depths, resulting in large permanent ground displacements.

Due to the low seismicity expected in the region and the cohesive nature of most of the soils encountered in the study area, the 2013 Tonkin & Taylor (T&T) report (ref. 29129.001) suggested the site to be located within a low liquefaction risk zone.

Based on the findings of the preliminary site-specific ground investigations presented in section 7.2 we consider the Pakiri Formation soils to be unlikely to liquefy in any seismic scenario. Granular soils, such as those identified in low-lying areas underlain by the Pleistocene alluvium and/or Holocene Alluvium may be subject to liquefaction and/or lateral spreading hazard. While the seismic hazard in the region is low, further soil testing and numerical liquefaction assessment should be conducted at a more detailed design or resource consent stage.

## 8.8 Erosion

The silty and sandy units within Pakiri Formation soils are known to be slightly dispersive in nature which can lead to the development of tunnel gully erosion. Tunnel gully erosion occurs when dispersive soils such as silts, clays and fine sands interact with water which cause dissolution of the soil and the fines washing away. This can lead to underground cavities or shallow sink holes developing.

Although no tunnel gully features were observed within the site during the site walkover and investigation, the presence can often be hidden by vegetation and grass, and only become visible after collapse.

Often such features are exposed during standard earthworks as part of the wider subdivision development and can be managed by standard engineering controls, in consultation with a Geotechnical Engineer.



## 9 GEOTECHNICAL COMMENT AND RECOMMENDATIONS

This geotechnical assessment is based on a desktop study of existing site information , a site walkover and qualitative stability assessment carried out by an Engineering Geologist and a limited geotechnical investigation. The recommendations and comments provided below are based on this assessment alone and should be confirmed and refined once a full concept plan for the site has been formulated.

Based on the initial findings of this Geotechnical Assessment, we consider the area suitable for the proposed plan change. It is understood that detailed Geotechnical investigation and design is to be undertaken at resource consent stage, which will take into consideration the proposed residential dwellings and provide further foundation and development recommendations. Further investigations should build on the initial findings presented in this assessment and should consider geotechnical risks to the development which may include, but are not limited to, site instability, a low groundwater-table and soil saturation, soft, compressible, and weak ground, earthworks modelling and laboratory testing.

We agree with the Auckland Council report that areas susceptible to instability can be used for low density housing such as the proposed large lot living. Furthermore, areas containing soft compressible ground with low bearing capacity will either require ground improvements or could be readily utilised for opens spaces. Alternatively light weight buildings with specifically designed foundations that can tolerate differential settlements may be constructed in these areas.

This assessment assumes that development adjacent to or on those areas identified as having instability issues or soft compressible ground will be further assessed and that the hazards remediated in consultation with a Chartered Geotechnical Engineer at the time of development.

Additionally, in line with the Tonkin & Taylor report 2013, the low-lying region of the site is likely having a low potential, for liquefaction, however, we recommend further analysis at subdivision stage as alluvial materials commonly containing liquefiable layers. Zones subject to liquefaction or areas with soft compressible ground adjacent to stream and river margins can be utilised as open spaces and riparian margins, as mentioned in the Auckland Council Geotechnical and Coastal Hazard Assessment.

## 10 CONCLUSION

We conclude that the geotechnical hazards presented on the site can be maintained or controlled through standard engineering design and investigation to manage the risk posed by these hazards, as is common practice across the wider Auckland region for such developments. Further investigation and design are recommended to be undertaken once a scheme plan has been finalised.

## 11 LIMITATIONS

This report has been prepared exclusively for Stefan Richardson with respect to the particular brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

The ground conditions presented in this report is based on the tests undertaken at discrete locations across the site. Ground conditions may change suddenly over short distances resulting in variations between test positions across the site.

This report was prepared in general accordance with current standards, codes, and practice at the time of this report. These may be subject to change.

## 12 REFERENCES

- Cunnigham, M., & Speight, N. H. (2013). *Geotechnical Desk Study, North and North-west Auckland Urban Boundary Project (DRAFT V2)*. Auckland: Tonkin & Taylor Ltd.
- GNS SCIENCE INTERNATIONAL LIMITED. (2021, November). *GNS Science - Geology Web Map*. Retrieved from <https://data.gns.cri.nz/geology/>
- Hayward, B. (2017). *Out of the Ocean and Into the Fire*. Auckland: Geoscience Society of New Zealand.
- Roberts, R. (2019). *Geotechnical and coastal hazards assessment*. Auckland: Auckland Council.

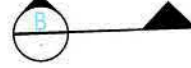
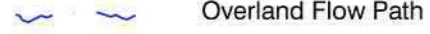

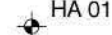


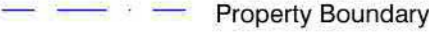
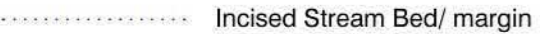

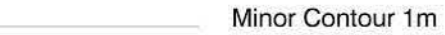
**APPENDIX A**

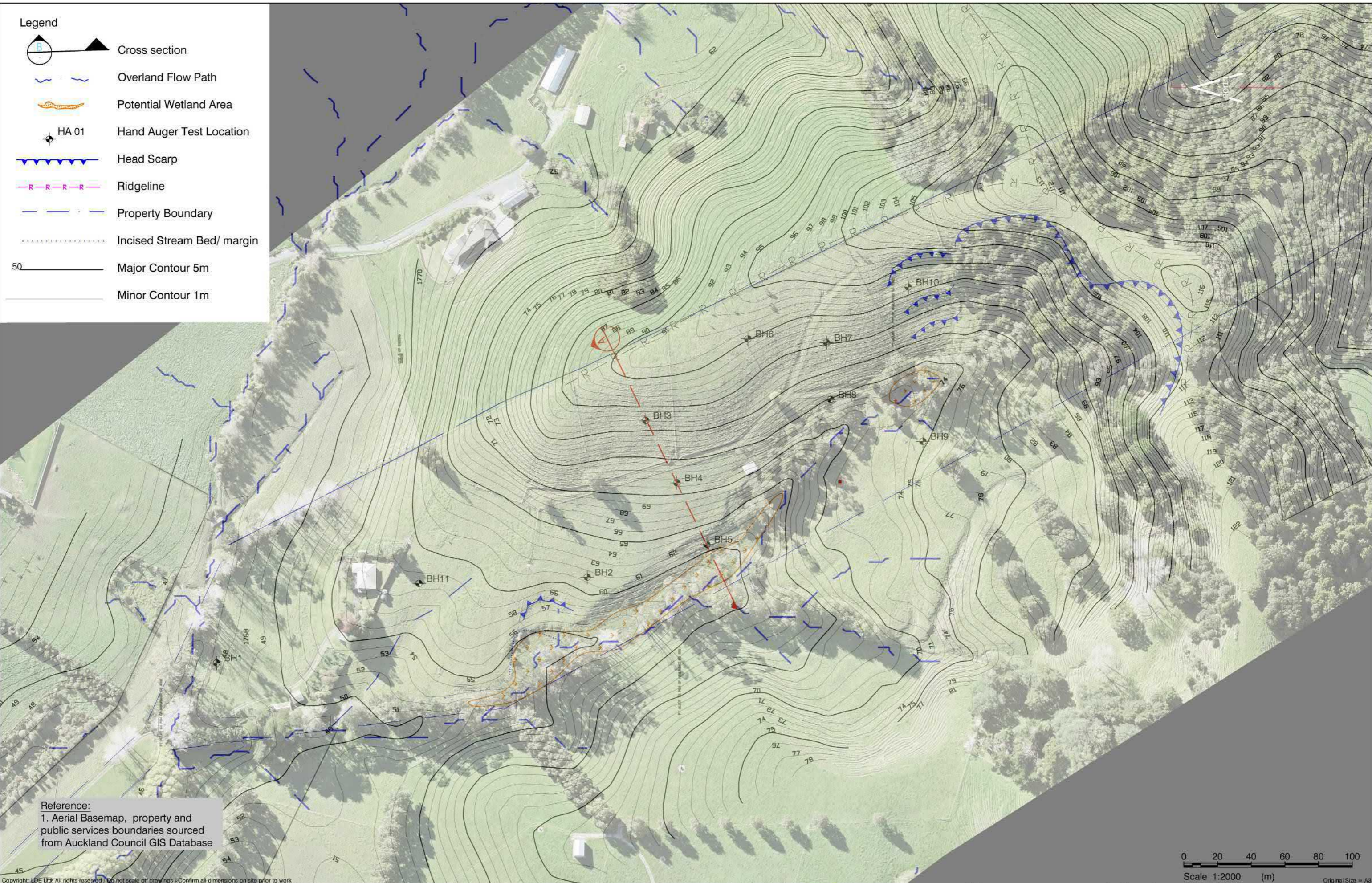
**GEOTECHNICAL INVESTIGATION PLAN**

**& CROSS SECTION**

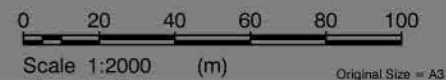


Legend

-  Cross section
-  Overland Flow Path
-  Potential Wetland Area
-  HA 01
-  Head Scarp
-  Ridgeline
-  Property Boundary
-  Incised Stream Bed/ margin
-  Major Contour 5m
-  Minor Contour 1m



Reference:  
1. Aerial Basemap, property and public services boundaries sourced from Auckland Council GIS Database



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CLIENT	PROJECT
Stefan Richardson	1768 State Highway 1 Warkworth Auckland

DRAWING TITLE
Geotechnical Investigation Plan



DESIGN:	DB
DRAWN:	DB
DATE:	28.08.2021
CHECKED:	--
SCALE A3:	1:2000

PROJECT STATUS:	Draft	
PROJECT:	20182	SHEET: 1 of 2
DRAWING No:	1	REV: A



## **APPENDIX B**

### **HAND AUGER BORE LOGS**





# Hand Auger Borehole Log

Test ID: **BH1**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5968015mN, 1748291mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 20/07/2021  
 Logged By: CS  
 Checked By: GH  
 Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	In-situ Testing				Test Values	Depth (m)
				Dynamic Cone Penetrometer (blows / 50mm)					
				Shear Vane, Su (kPa)					
				2	4	6	8		
				50	100	150	200		
0.0 - 0.1		Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil						
0.1 - 0.2		Clayey SILT, with trace fine sand; orange. Very stiff, moist, high plasticity.	Pleistocene river and hillslope deposits - Tauranga Group					143 / 76	
0.2 - 0.3		Trace organics. Organics, rootlets.						146 / 83	
0.3 - 0.4		Grey mottling.						146 / 87	
0.4 - 0.5								149 / 78	
0.5 - 0.6								143 / 67	
0.6 - 0.7		Grey, with dark orange mottling.						172 / 103	
0.7 - 0.8								153 / 95	
0.8 - 0.9		CLAY, with trace silt; grey. Very stiff, wet, high plasticity. Groundwater seepage.						87 / 43	
0.9 - 1.0								127 / 79	
1.0 - 1.1								127 / 48	
1.1 - 1.2		Trace organics. Organics, wood.					114 / 72		
1.2 - 1.3							103 / 64		
1.3 - 1.4							95 / 64		
1.4 - 1.5		CLAY with some organics; dark greyish blue. Very stiff, saturated, high plasticity. Organics, wood.					UTP		
1.5 - 1.6							UTP		
1.6 - 1.7		CLAY & WOOD; dark greyish blue. Very stiff, saturated, high plasticity.					UTP		
1.7 - 1.8							UTP		
1.8 - 1.9							UTP		
1.9 - 2.0							UTP		
2.0 - 2.1							UTP		
2.1 - 2.2							UTP		
2.2 - 2.3							UTP		
2.3 - 2.4							UTP		
2.4 - 2.5							UTP		
2.5 - 2.6							UTP		
2.6 - 2.7							UTP		
2.7 - 2.8							UTP		
2.8 - 2.9							UTP		
2.9 - 3.0							UTP		
3.0 - 3.1							UTP		
3.1 - 3.2							UTP		
3.2 - 3.3							UTP		
3.3 - 3.4							UTP		
3.4 - 3.5							UTP		
3.5 - 3.6							UTP		
3.6 - 3.7							UTP		
3.7 - 3.8							UTP		
3.8 - 3.9							UTP		
3.9 - 4.0							UTP		
4.0 - 4.1							UTP		
4.1 - 4.2							UTP		
4.2 - 4.3							UTP		
4.3 - 4.4							UTP		
4.4 - 4.5							UTP		
4.5 - 4.6							UTP		
4.6 - 4.7							UTP		
4.7 - 4.8							UTP		
4.8 - 4.9							UTP		
4.9 - 5.0							UTP		

Hole Depth: 3.80m      Termination: hole collapse

Remarks: Unable to penetrate from 2.8 m due to wood.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

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# Hand Auger Borehole Log

Test ID: **BH10**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967608mN, 1748519mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 20/07/2021  
 Logged By: DB  
 Checked By: GH  
 Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
					2 4 6 8	50 100 150 200		
0.0 - 0.2		Organic SILT; dark brown. Very stiff, moist to wet, low plasticity.	Topsoil				188 / 91	
0.2 - 2.0		Silty CLAY; light orange. Very stiff, moist, high plasticity.	Pakiri Formation				175 / 111	-0.5
0.5							165 / 97	
1.0		Red staining; iron oxide. Light orangish brown.					170 / 103	-1.0
1.5							143 / 78	
2.0							143 / 64	-1.5
2.5		Clayey SILT; orange. Very stiff, wet, low plasticity. Limonite staining.					130 / 72	
3.0		Wet to saturated. Groundwater seepage.		↕			135 / 64	-2.0
3.5		Saturated. Water table.		▼			118 / 52	
4.0							111 / 37	-2.5
4.5							145 / 92	
5.0							175 / 108	-3.0
5.5							127 / 83	
6.0							122 / 75	-3.5
6.5							167 / 79	
7.0							207 / 111	-4.0
7.5							207 / 111	
8.0							UTP	-4.5
8.5								-5.0

Hole Depth: 3.60m      Termination: striking bedrock

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate



# Hand Auger Borehole Log

Test ID: **BH11**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967884mN, 1748339mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 20/07/2021  
 Logged By: CS  
 Checked By: GH  
 Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
		Organic SILT; dark brown. Very stiff, moist.	Topsoil					
0.5		Silty CLAY; light orangish brown. Very stiff, moist, high plasticity. Light orange	Pakiri Formation				154 / 89	
							162 / 106	-0.5
							178 / 114	
							176 / 108	
1.0							167 / 99	-1.0
							183 / 111	
1.2		1.2m: Wet						
1.5								-1.5
2.0								-2.0
2.5								-2.5
3.0								-3.0
3.5								-3.5
4.0								-4.0
4.5								-4.5
5.0								-5.0

**Hole Depth:** 1.40m      **Termination:** target depth

**Remarks:** Hole drilled to 1.7 m target depth to confirm material consistent with BH2.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

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# Hand Auger Borehole Log

Test ID: **BH2**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

**Client:** Stefan Richardson  
**Project:** State Highway 1, 1768  
**Location:** 1768 State Highway 1, Warkworth  
**Test Site:** Refer to site plan

**Coordinates:** 5967798mN, 1748346mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Phone GPS

**Test Date:** 20/07/2021  
**Logged By:** CS  
**Checked By:** GH  
**Vane ID:** 835

Depth (m)	Graphic Log	Material Description	Geology	In-situ Testing				Test Values	Depth (m)
				Dynamic Cone Penetrometer (blows / 50mm)					
				Shear Vane, Su (kPa)					
				2	4	6	8		
				50	100	150	200		
0.0 - 0.2		Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil						
0.2 - 1.5		Silty CLAY; orange. Very stiff, moist, high plasticity.	Pakiri Formation					159 / 95	
0.5								178 / 99	-0.5
0.8								191 / 119	
1.0								162 / 94	
1.2								175 / 122	-1.0
1.4								178 / 130	
1.5		Wet. Groundwater seepage.						148 / 79	-1.5
1.8								151 / 78	
2.0		SILT & CLAY; reddish orange. Very stiff, wet, high plasticity.						143 / 64	-2.0
2.2								191 / 48	
2.4		SILT, with some clay; light orange. Very stiff, wet, low plasticity.						127 / 79	-2.5
2.6		Hard, saturated.						UTP	
2.8								UTP	
3.0									-3.0
3.5									-3.5
4.0									-4.0
4.5									-4.5
5.0									-5.0

**Hole Depth:** 2.60m      **Termination:** hard material  
**Remarks:** Groundwater seepage at 1.5 m, water table at 2.5 m.  
 Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

- Vane peak      ▼ Standing water level
- Vane residual      ◁ Groundwater inflow
- ◆ Vane UTP      ▷ Groundwater outflow

UTP = Unable to Penetrate



# Hand Auger Borehole Log

Test ID: **BH3**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967763mN, 1748440mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 19/07/2021  
 Logged By: CS  
 Checked By: GH  
 Vane ID: 835

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)		
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					50	100	150	200		
0.0 - 0.5		Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil						172 / 65	
0.5 - 1.0		Silty CLAY; light orangish brown. Very stiff, moist, high plasticity.	Pakiri Formation						207 / 103	-0.5
1.0 - 1.5		Insensitive.							191 / 124	-1.0
1.5 - 2.0		Red and white. Limonite staining.							188 / 126	-1.5
2.0 - 2.5		Reddish orange, with white flecking.							156 / 87	-2.0
2.5 - 3.0		Clayey SILT; red. Very stiff, moist, high plasticity.							207 / 151	-2.5
3.0 - 3.5									180 / 143	-3.0
3.5 - 4.0									175 / 114	-3.5
4.0 - 4.5									175 / 118	-4.0
4.5 - 5.0									170 / 114	-4.5
5.0 - 5.5									176 / 162	-5.0
5.5 - 6.0								162 / 143	-5.5	
6.0 - 6.5								207 / 148	-6.0	
6.5 - 7.0								191 / 127	-6.5	
7.0 - 7.5								162 / 126	-7.0	
7.5 - 8.0								191 / 138	-7.5	
8.0 - 8.5								148 / 111	-8.0	
8.5 - 9.0								154 / 111	-8.5	
9.0 - 9.5								175 / 127	-9.0	
9.5 - 10.0								148 / 121	-9.5	
10.0 - 10.5								207 / 146	-10.0	
10.5 - 11.0								159 / 143	-10.5	
11.0 - 11.5								191 / 143	-11.0	
11.5 - 12.0									-11.5	
12.0 - 12.5									-12.0	
12.5 - 13.0									-12.5	
13.0 - 13.5									-13.0	
13.5 - 14.0									-13.5	
14.0 - 14.5									-14.0	
14.5 - 15.0									-14.5	
15.0 - 15.5									-15.0	
15.5 - 16.0									-15.5	
16.0 - 16.5									-16.0	
16.5 - 17.0									-16.5	
17.0 - 17.5									-17.0	

Hole Depth: 4.70m      Termination: target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

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# Hand Auger Borehole Log

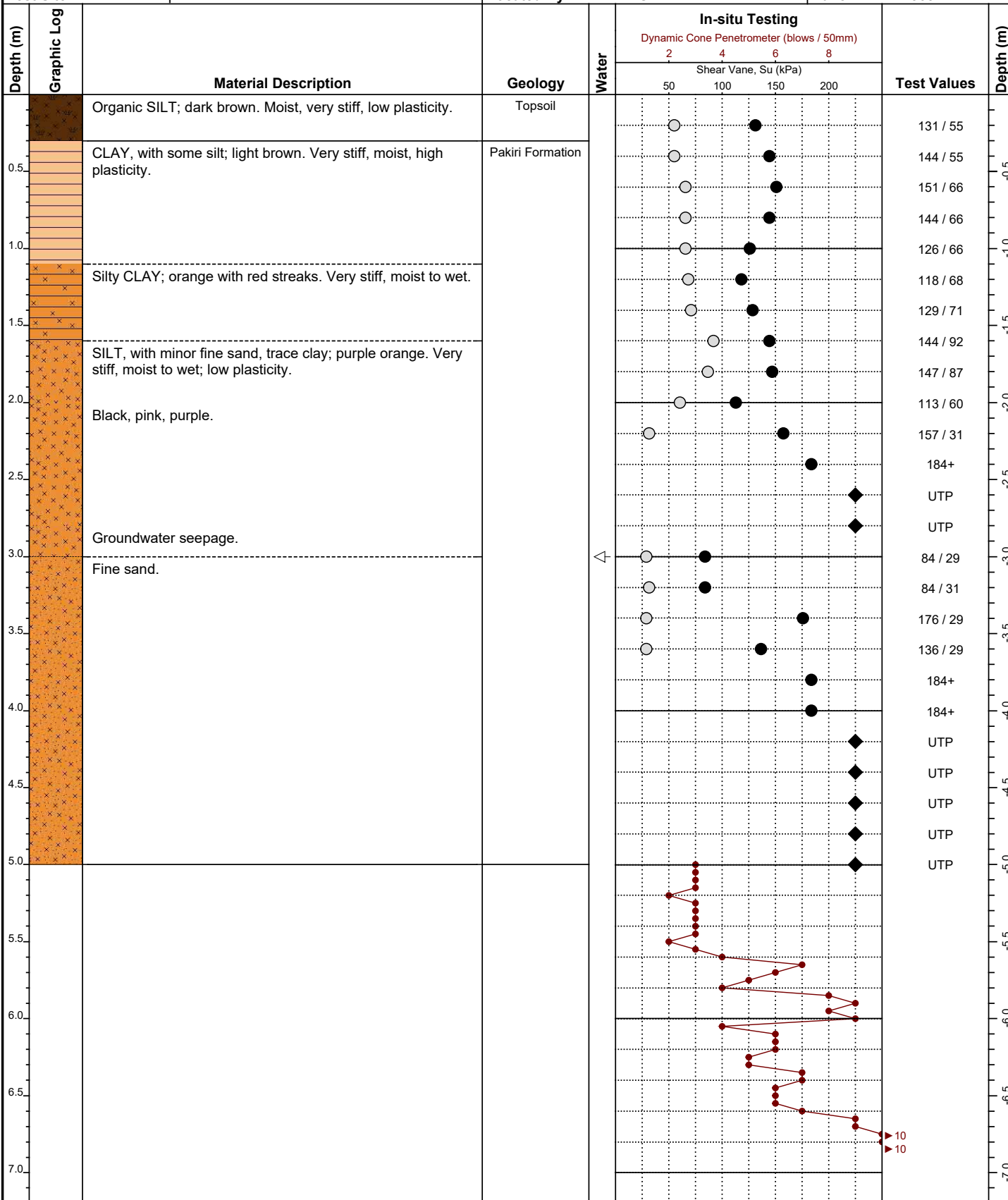
Test ID: **BH4**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967745mN, 1748402mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 19/07/2021  
 Logged By: DB  
 Checked By: GH  
 Vane ID: 3091



Hole Depth: 5.00m Termination: target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate



# Hand Auger Borehole Log

Test ID: **BH5**

Project ID: 20182

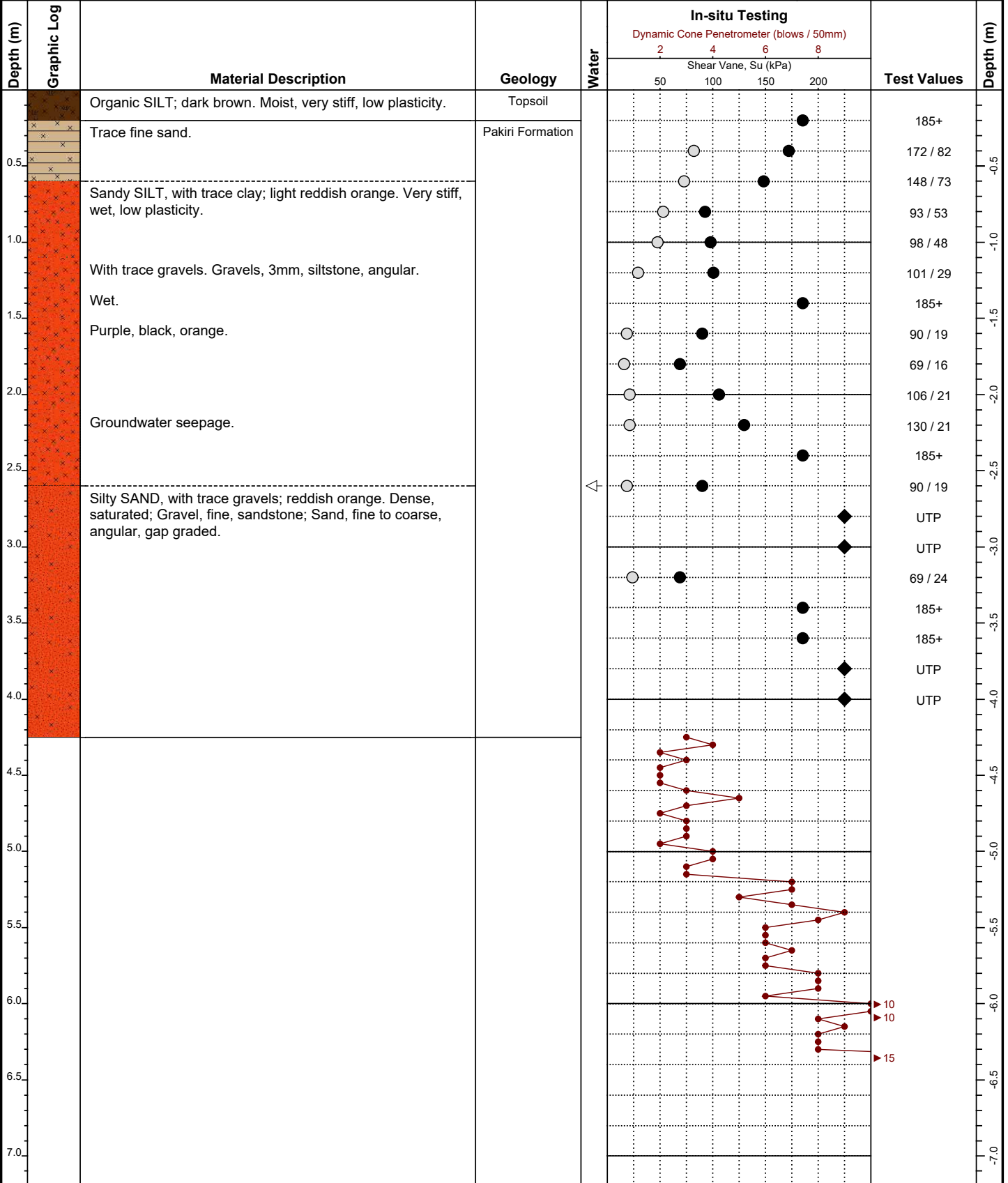
Sheet: 1 of 1

Method:

**Client:** Stefan Richardson  
**Project:** State Highway 1, 1768  
**Location:** 1768 State Highway 1, Warkworth  
**Test Site:** Refer to site plan

**Coordinates:** 5967729mN, 1748366mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Phone GPS

**Test Date:** 19/07/2021  
**Logged By:** DB  
**Checked By:** GH  
**Vane ID:** 2908



**Hole Depth:** 4.25m      **Termination:** hard material

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

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# Hand Auger Borehole Log

Test ID: **BH6**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967703mN, 1748488mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 19/07/2021  
 Logged By: DB  
 Checked By: GH  
 Vane ID: 3091

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)			
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					50	100	150	200			
0.0 - 0.1	[Dark brown soil]	Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil								
0.1 - 1.4	[Light brown soil with 'x' pattern]	CLAY & SILT; light brown. Very stiff, moist, high plasticity.	Pakiri Formation								
1.4 - 1.6	[Dark brownish orange soil]	Dark brownish orange. Trace limonite staining.									
1.6 - 2.5	[Red soil with 'x' pattern]	SILT, with minor sand, minor clay; red, orange. Very stiff, moist, low plasticity.		Groundwater Not Encountered							
2.5 - 3.0	[Pink soil with 'x' pattern]	Trace fine sand; pink, orange, white.									
0.1						168	76				
0.2						144	71				
0.3						157	73				
0.4						147	68				
0.5						157	71				
0.6						184+					
0.7						131	94				
0.8						105	37				
0.9					72	29					
1.0					94	26					
1.1					68	29					
1.2					108	31					
1.3					94	31					
1.4					102	18					
1.5					157	39					

Hole Depth: 3.00m      Termination: target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v5 - 29/06/2022 2:58:40 pm



# Hand Auger Borehole Log

Test ID: **BH7**

Project ID: 20182

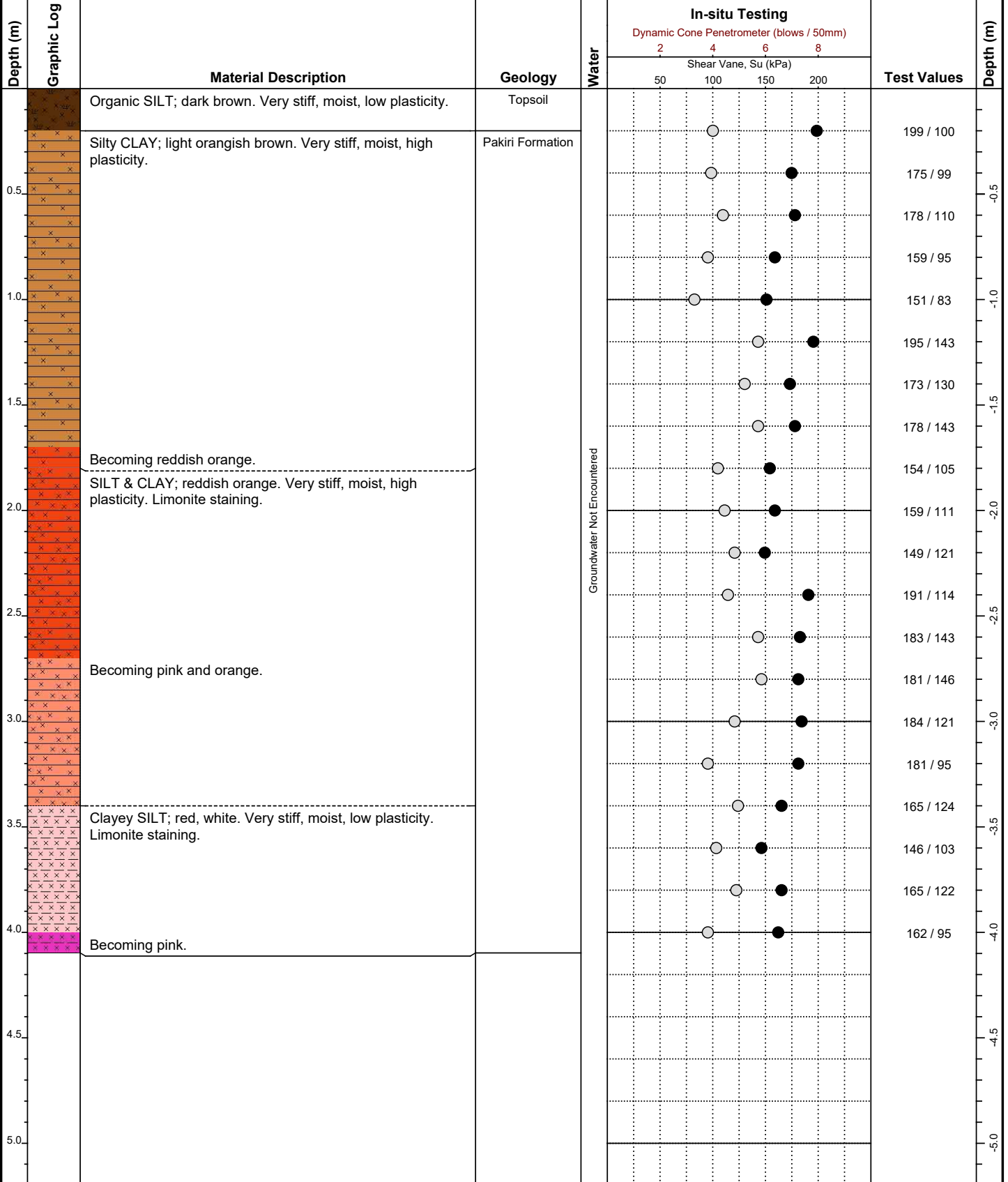
Sheet: 1 of 1

Method:

**Client:** Stefan Richardson  
**Project:** State Highway 1, 1768  
**Location:** 1768 State Highway 1, Warkworth  
**Test Site:** Refer to site plan

**Coordinates:** 5967656mN, 1748486mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Phone GPS

**Test Date:** 19/07/2021  
**Logged By:** CS  
**Checked By:** GH  
**Vane ID:** 835



**Hole Depth:** 4.10m      **Termination:** target depth

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v5 - 29/06/2022 2:58:42 pm



# Hand Auger Borehole Log

Test ID: **BH8**

Project ID: 20182

Sheet: 1 of 1

Method:

**Client:** Stefan Richardson  
**Project:** State Highway 1, 1768  
**Location:** 1768 State Highway 1, Warkworth  
**Test Site:** Refer to site plan

**Coordinates:** 5967649mN, 1748452mE  
**System:** NZTM  
**Elevation:** Ground  
**Located By:** Phone GPS

**Test Date:** 19/07/2021  
**Logged By:** CS  
**Checked By:** GH  
**Vane ID:** 3091

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.1		Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil							
0.1 - 0.5		Silty CLAY; light brown. Very stiff, moist, high plasticity.	Pakiri Formation		○		●		121 / 42	
0.5 - 0.6		Light brownish orange.			○		●		129 / 58	-0.5
0.6 - 0.7		Minor silt; light orange.			○		●		118 / 52	
0.7 - 0.8					○		●		121 / 55	
0.8 - 0.9					○		●		118 / 68	-1.0
0.9 - 1.0					○		●		113 / 59	
1.0 - 1.1					○		●		105 / 55	-1.5
1.1 - 1.2		Trace fine sand; light orange, with red streaks.			○		●		105 / 39	
1.2 - 1.3					○		●		102 / 52	
1.3 - 1.4					○		●		92 / 50	-2.0
1.4 - 1.5					○		●		76 / 26	
1.5 - 1.6					○		●		92 / 42	-2.5
1.6 - 1.7		Silty, with trace fine sand; red, orange and pink.			○		●		66 / 26	
1.7 - 1.8		Wet. Groundwater seepage.		↔	○		●		58 / 21	-3.0
1.8 - 1.9					○		●		85 / 24	
1.9 - 2.0		SILT, with minor fine sand, minor clay; red, with pink and white streaks. Wet.			○		●		105 / 39	-3.5
2.0 - 2.1					○		●		121 / 42	
2.1 - 2.2					○		●		118 / 29	-4.0
2.2 - 2.3					○		●		92 / 42	
2.3 - 2.4					○		●		105 / 42	-4.5
2.4 - 2.5					○		●		118 / 42	
2.5 - 2.6					○		●		121 / 42	-5.0
2.6 - 2.7					○		●		131 / 42	

**Hole Depth:** 4.60m      **Termination:** target depth

**Remarks:**

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

Generated with CORE-GS by Geric - HA/TP Log v5 - 20/06/2022 2:58:43 pm





# Hand Auger Borehole Log

Test ID: **BH9**  
 Project ID: 20182  
 Sheet: 1 of 1

Method:

Client: Stefan Richardson  
 Project: State Highway 1, 1768  
 Location: 1768 State Highway 1, Warkworth  
 Test Site: Refer to site plan

Coordinates: 5967599mN, 1748427mE  
 System: NZTM  
 Elevation: Ground  
 Located By: Phone GPS

Test Date: 19/07/2021  
 Logged By: DB  
 Checked By: GH  
 Vane ID: 3091

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values	Depth (m)		
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)				
					2	4	6	8		
					50	100	150	200		
0.0 - 0.1		Organic SILT; dark brown. Very stiff, moist, low plasticity.	Topsoil							
0.1 - 0.5		CLAY, with minor silt, trace fine sand; light brown. Very stiff, moist, high plasticity.	Pakiri Formation							
0.5 - 1.0		Light orangish brown.								
1.0 - 1.2										
1.2 - 1.4		SILT, with minor clay, minor fine sand; reddish orange. Very stiff, moist to wet, low plasticity.								
1.4 - 1.6		Minor clay, trace fine sand, trace fine gravel. Gravel, sandstone, angular.								
1.6 - 1.8		Pink with red & black streaks. Wet.								
1.8 - 2.0										
2.0 - 2.2										
2.2 - 2.4										
2.4 - 2.6		Groundwater seepage.		↕						
2.6 - 2.8										
2.8 - 3.0		Fine sandy SILT; red. Very stiff, low plasticity to non plastic.								
3.0 - 3.2										
3.2 - 3.4										
3.4 - 3.6										
3.6 - 3.8										
3.8 - 4.0										
4.0 - 4.2										
4.2 - 4.4										
4.4 - 4.6										
4.6 - 4.8										
4.8 - 5.0										

Hole Depth: 3.20m      Termination: target depth

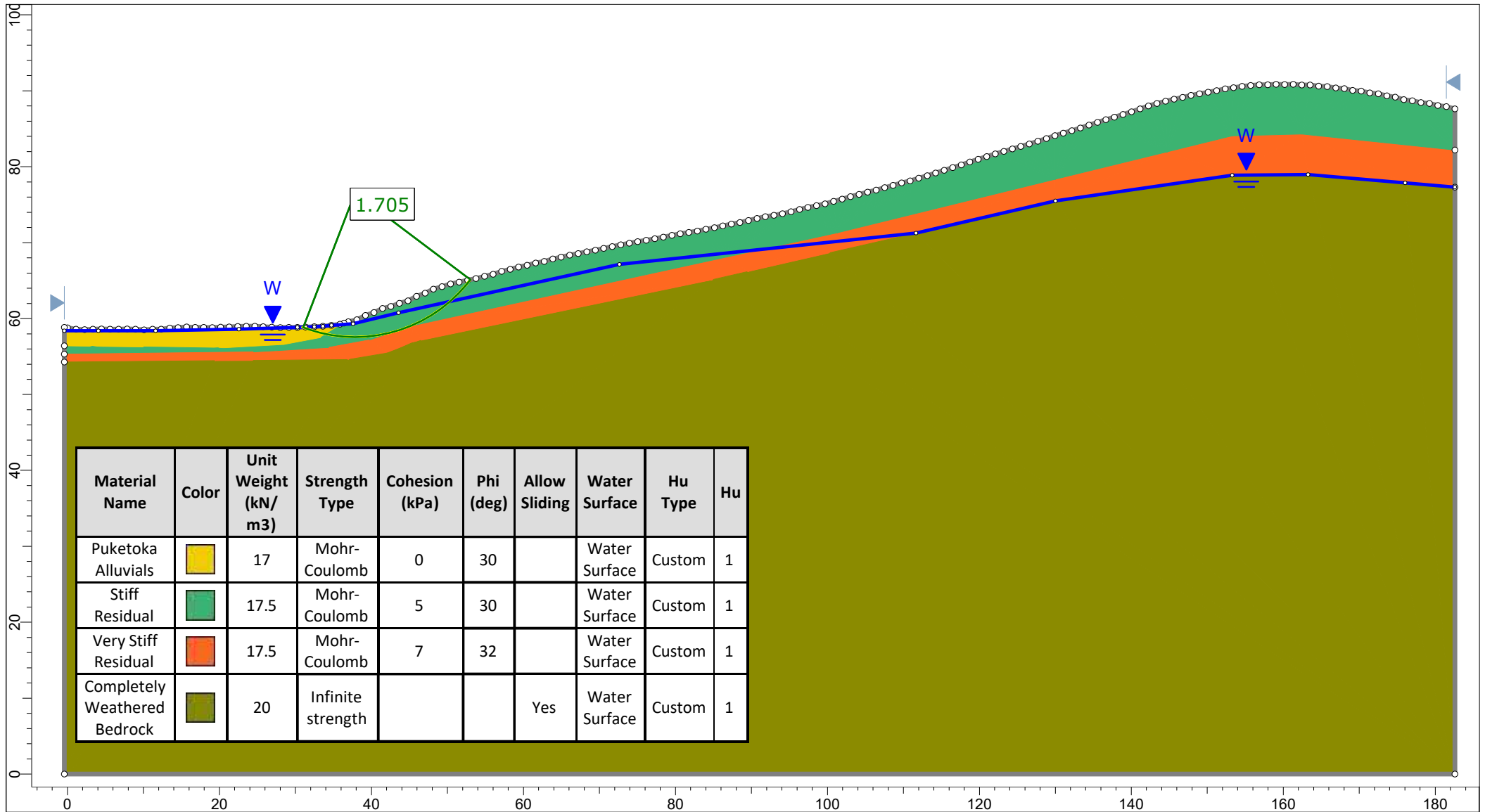
Remarks:





Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).  
 No correlation is implied between shear vane and DCP values.

● Vane peak      ▼ Standing water level  
 ○ Vane residual      ◁ Groundwater inflow  
 ◆ Vane UTP      ▷ Groundwater outflow  
 UTP = Unable to Penetrate

## **APPENDIX C**

### **NUMERICAL SLOPE STABILITY MODELS**

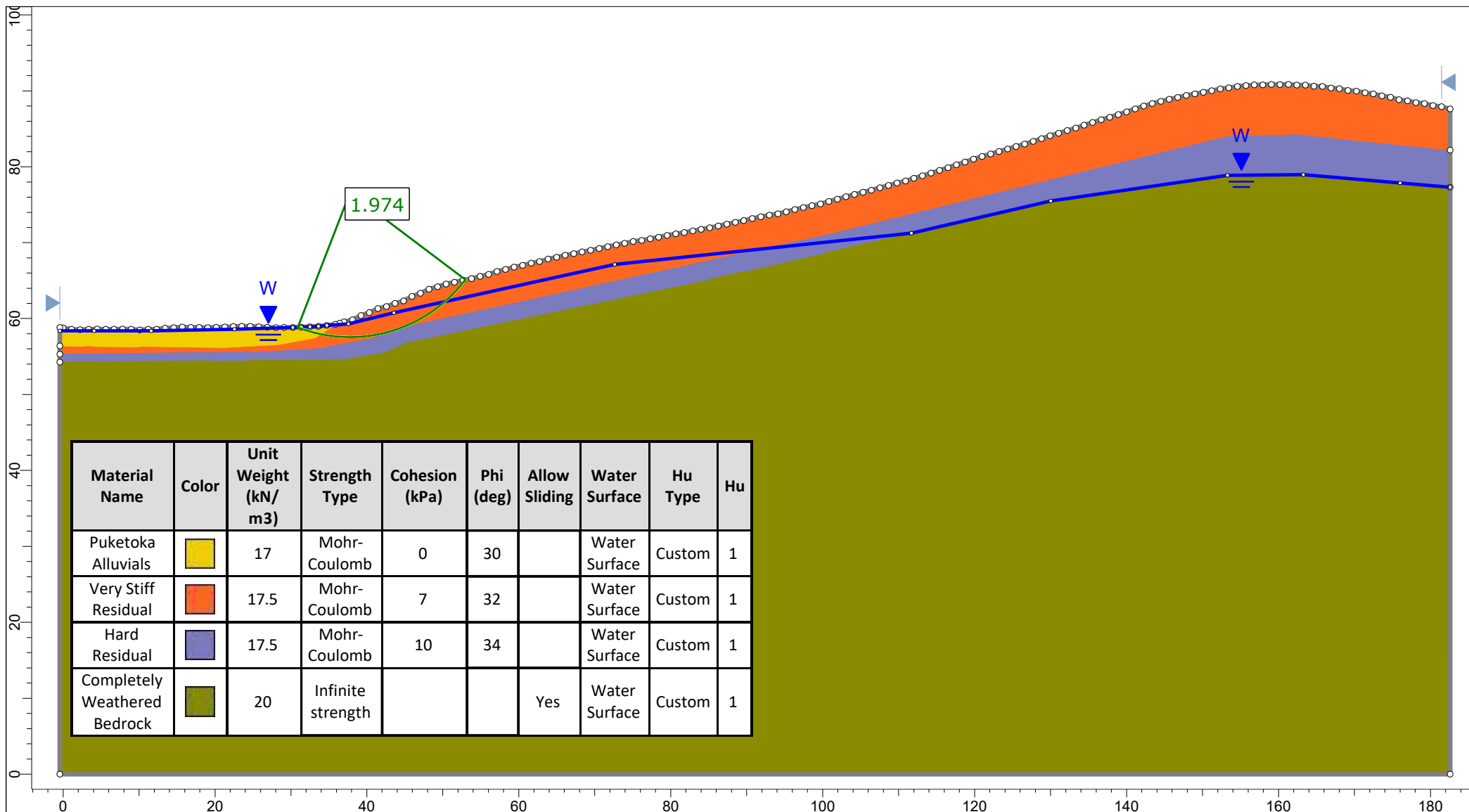






Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Stiff Residual		17.5	Mohr-Coulomb	5	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1



1768 State Highway 1, Warkworth

Normal Groundwater Condition		Sensitive	
Drawn By	Chris Struthers	Company	LDE Ltd
Date	26/07/2021, 9:04:57 am	File Name	20182_a_a'.slmd



Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Hard Residual		17.5	Mohr-Coulomb	10	34		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1



SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Normal Groundwater Condition

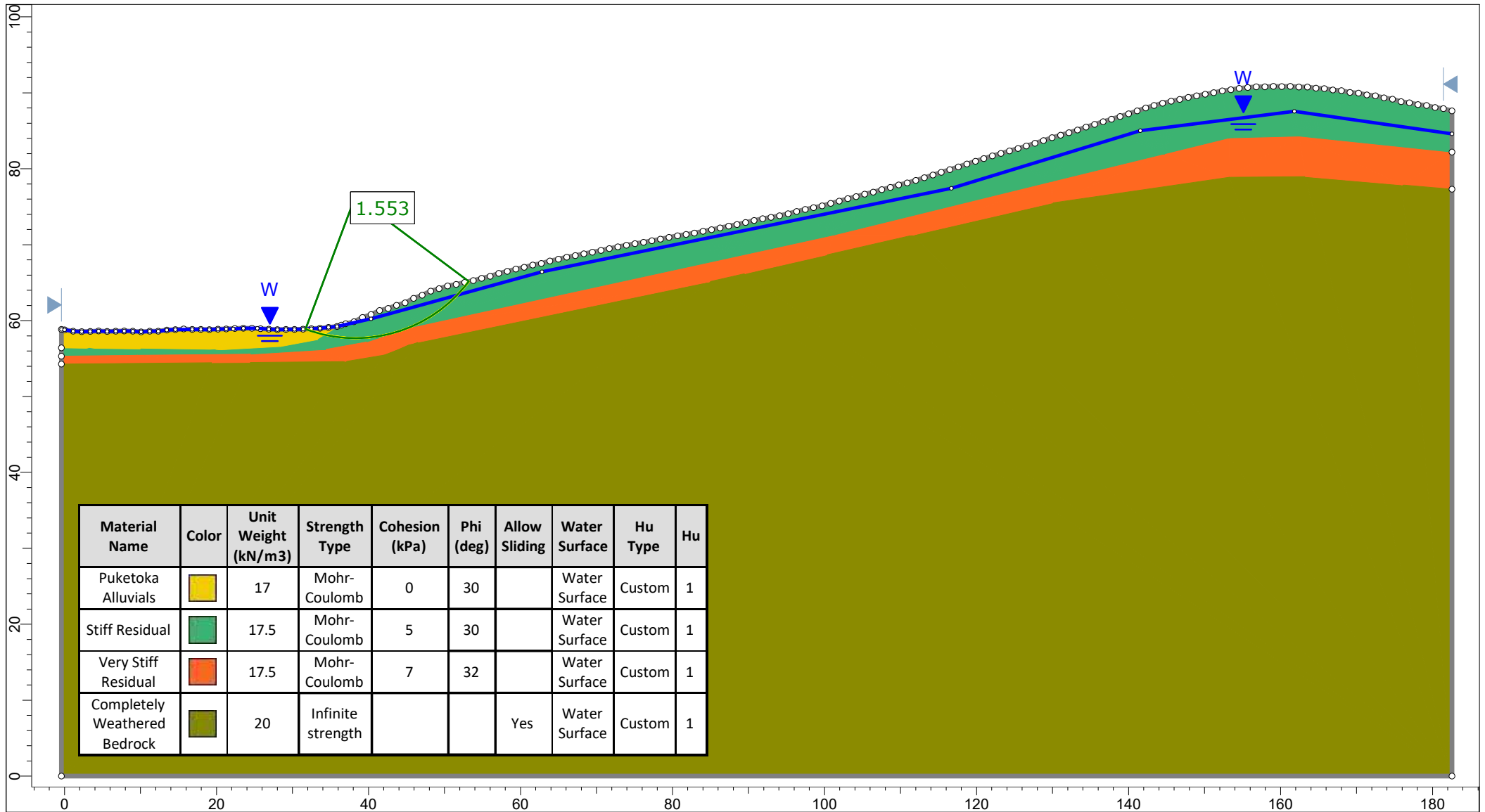
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Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

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SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Extreme (worst credible) groundwater condition

Sensitive

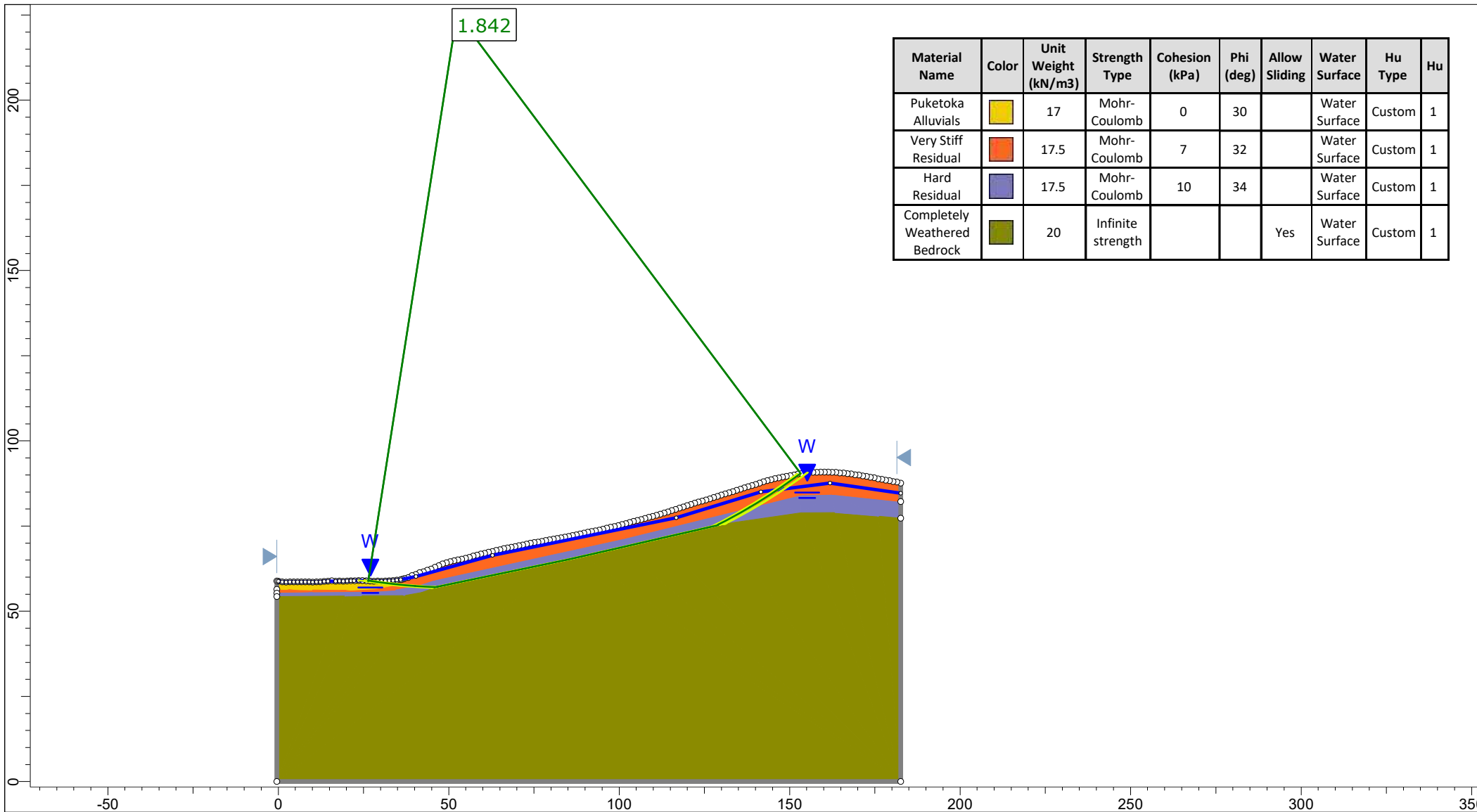
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Company LDE Ltd

Date 26/07/2021, 9:04:57 am

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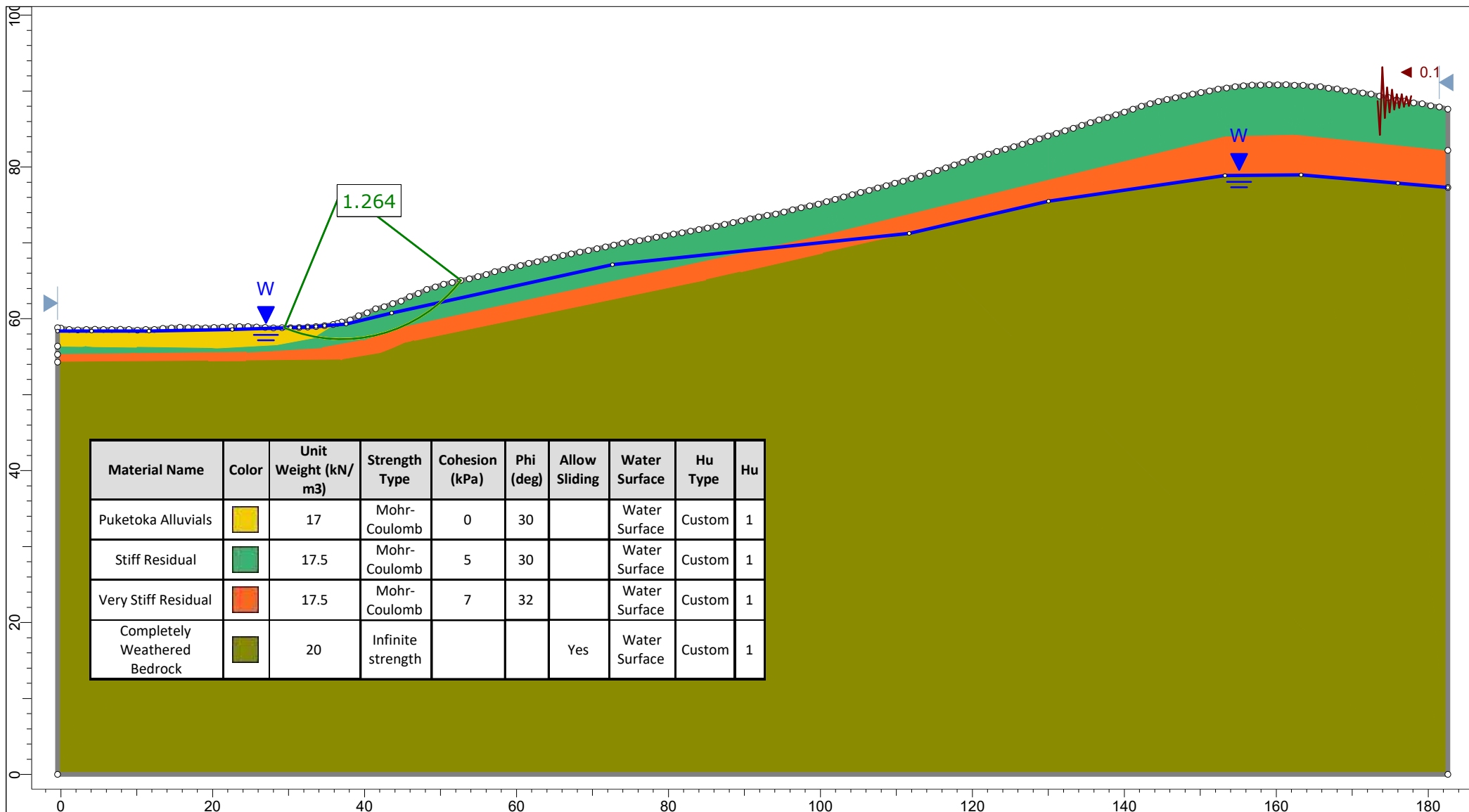
Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials	Yellow	17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Very Stiff Residual	Orange	17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Hard Residual	Blue	17.5	Mohr-Coulomb	10	34		Water Surface	Custom	1
Completely Weathered Bedrock	Green	20	Infinite strength			Yes	Water Surface	Custom	1



SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Extreme (worst credible) groundwater condition		Observed	
Drawn By	Chris Struthers	Company	LDE Ltd
Date	26/07/2021, 9:04:57 am	File Name	20182_a_a'.slmd



1768 State Highway 1, Warkworth

Seismic condition with 150 yr event

Sensitive

Drawn By

Chris Struthers

Company

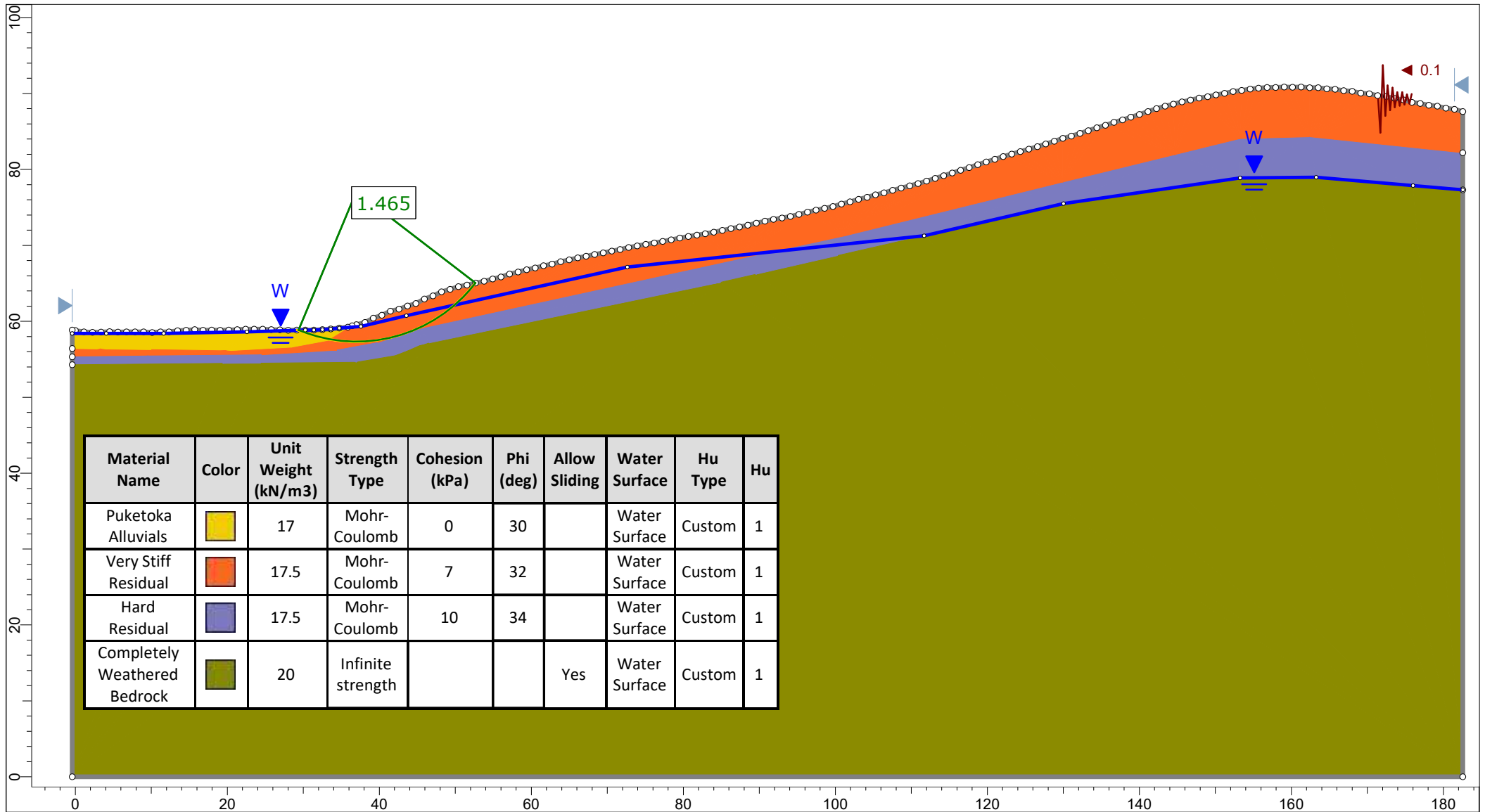
LDE Ltd

Date

26/07/2021, 9:04:57 am

File Name

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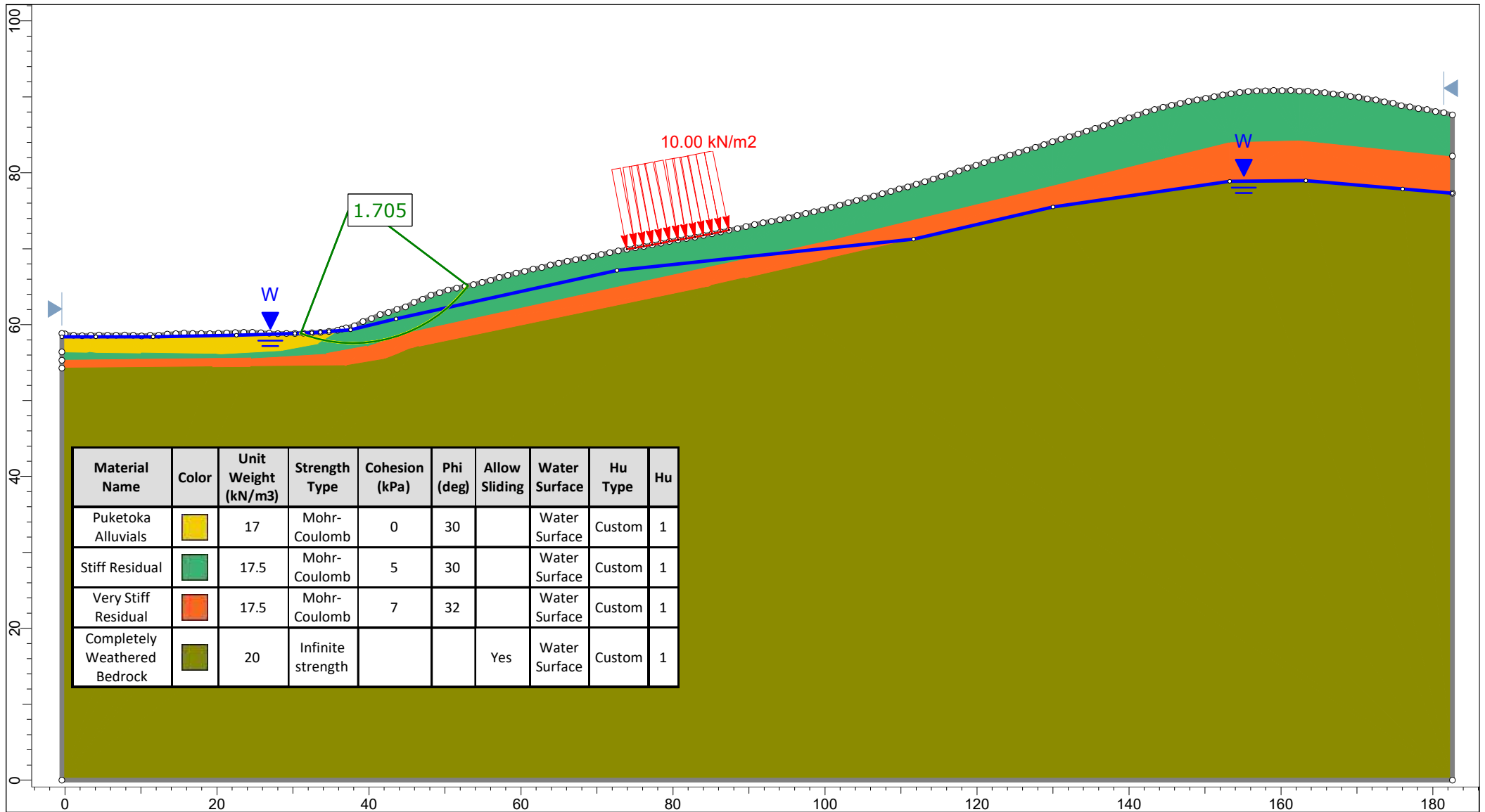


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Hard Residual		17.5	Mohr-Coulomb	10	34		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1



1768 State Highway 1, Warkworth

Seismic condition with 150 yr event		Observed	
Drawn By	Chris Struthers	Company	LDE Ltd
Date	26/07/2021, 9:04:57 am	File Name	20182_a_a'.slmd



Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials	Yellow	17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Stiff Residual	Green	17.5	Mohr-Coulomb	5	30		Water Surface	Custom	1
Very Stiff Residual	Orange	17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Completely Weathered Bedrock	Brown	20	Infinite strength			Yes	Water Surface	Custom	1



SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Normal Groundwater Condition - Structural Load Applied

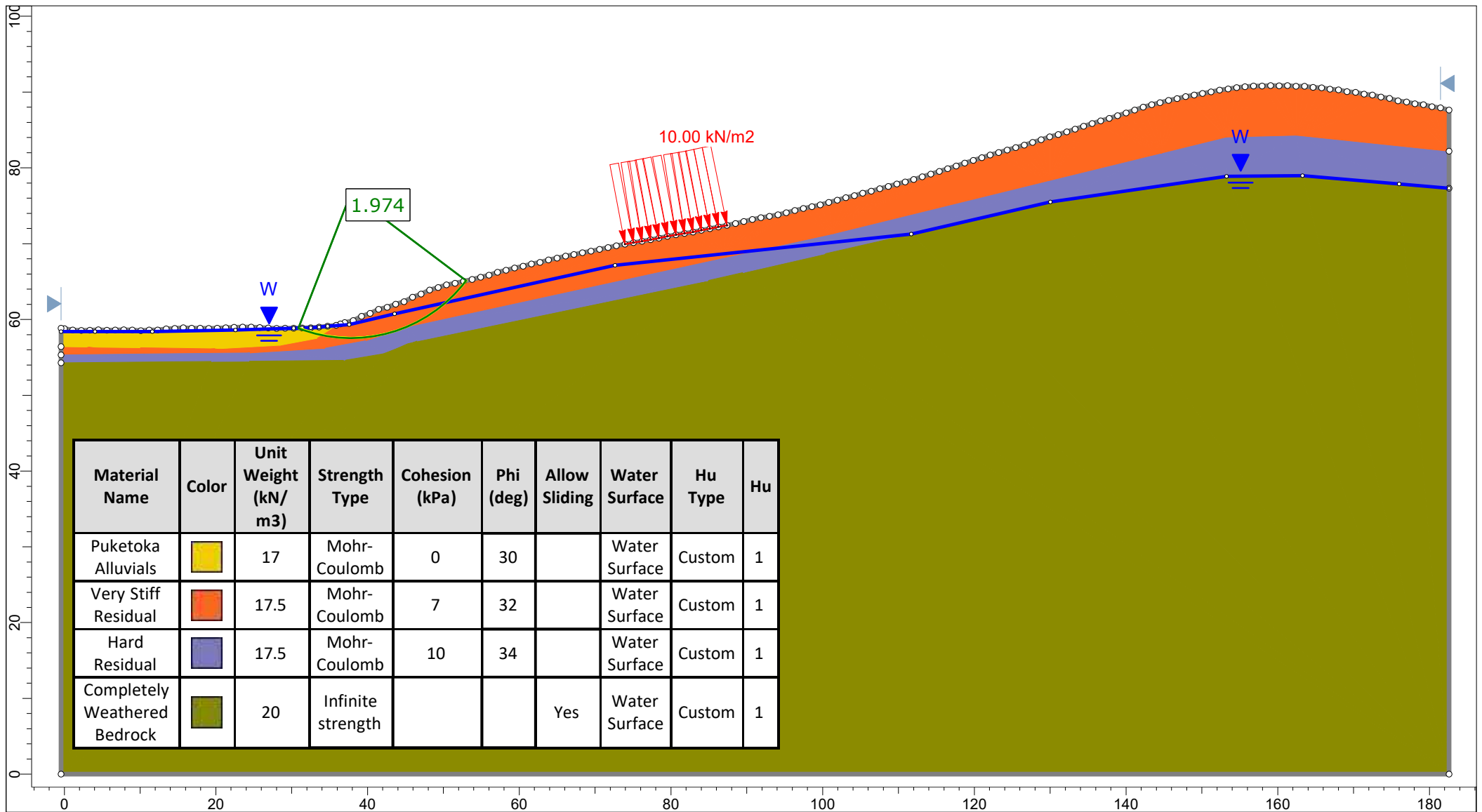
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Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

File Name 20182\_a\_a'.slmd



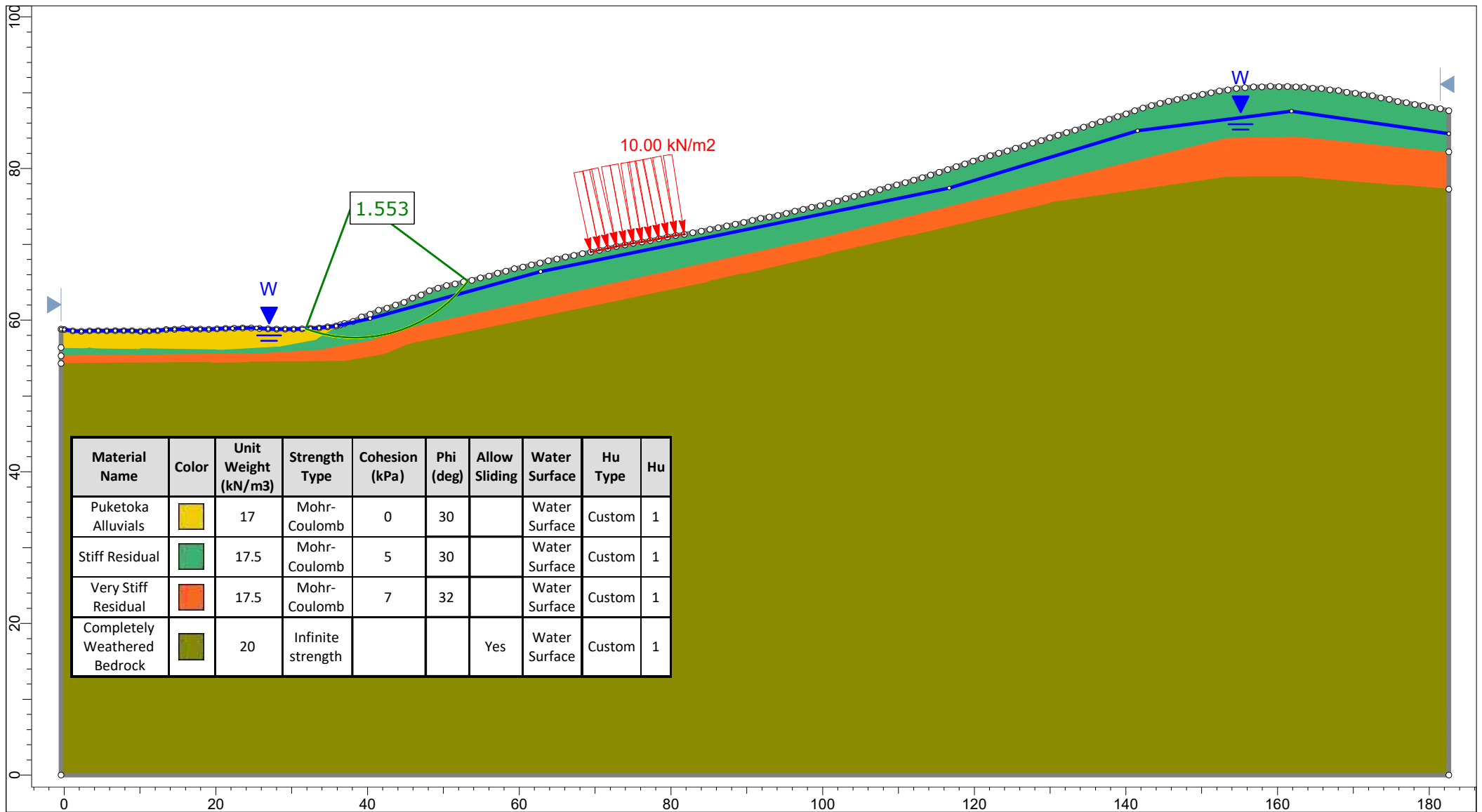
Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Hard Residual		17.5	Mohr-Coulomb	10	34		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1







1768 State Highway 1, Warkworth

Normal Groundwater Condition - Structural Load Applied		Observed
Drawn By	Chris Struthers	Company LDE Ltd
Date	26/07/2021, 9:04:57 am	File Name 20182_a_a'.slmd





Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Stiff Residual		17.5	Mohr-Coulomb	5	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1



SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Extreme (worst credible) groundwater conditions - Structural Load Applied

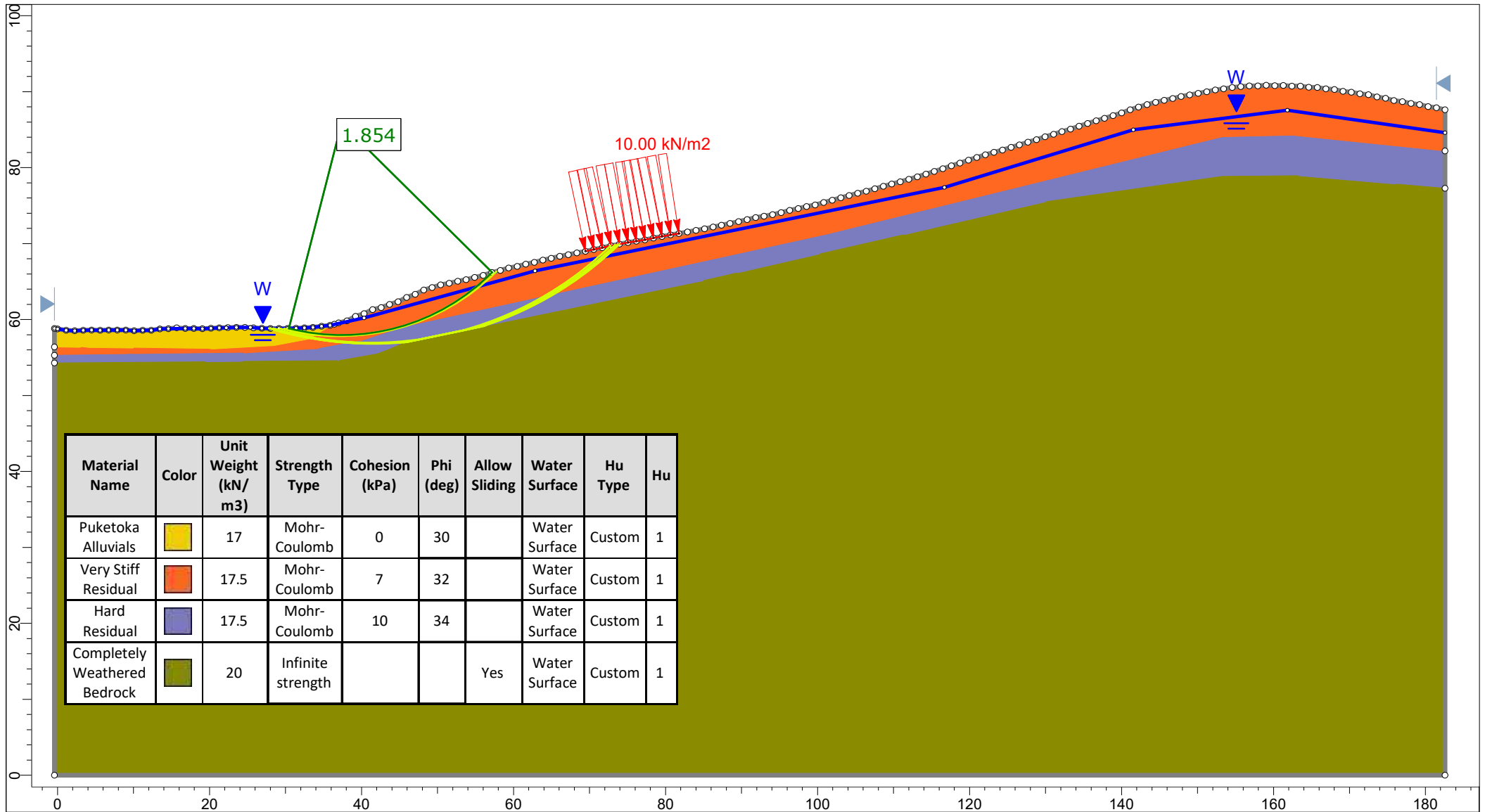
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Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

File Name 20182\_a\_a'.slmd



1768 State Highway 1, Warkworth

Extreme (worst credible) groundwater conditions - Structural Load Applied

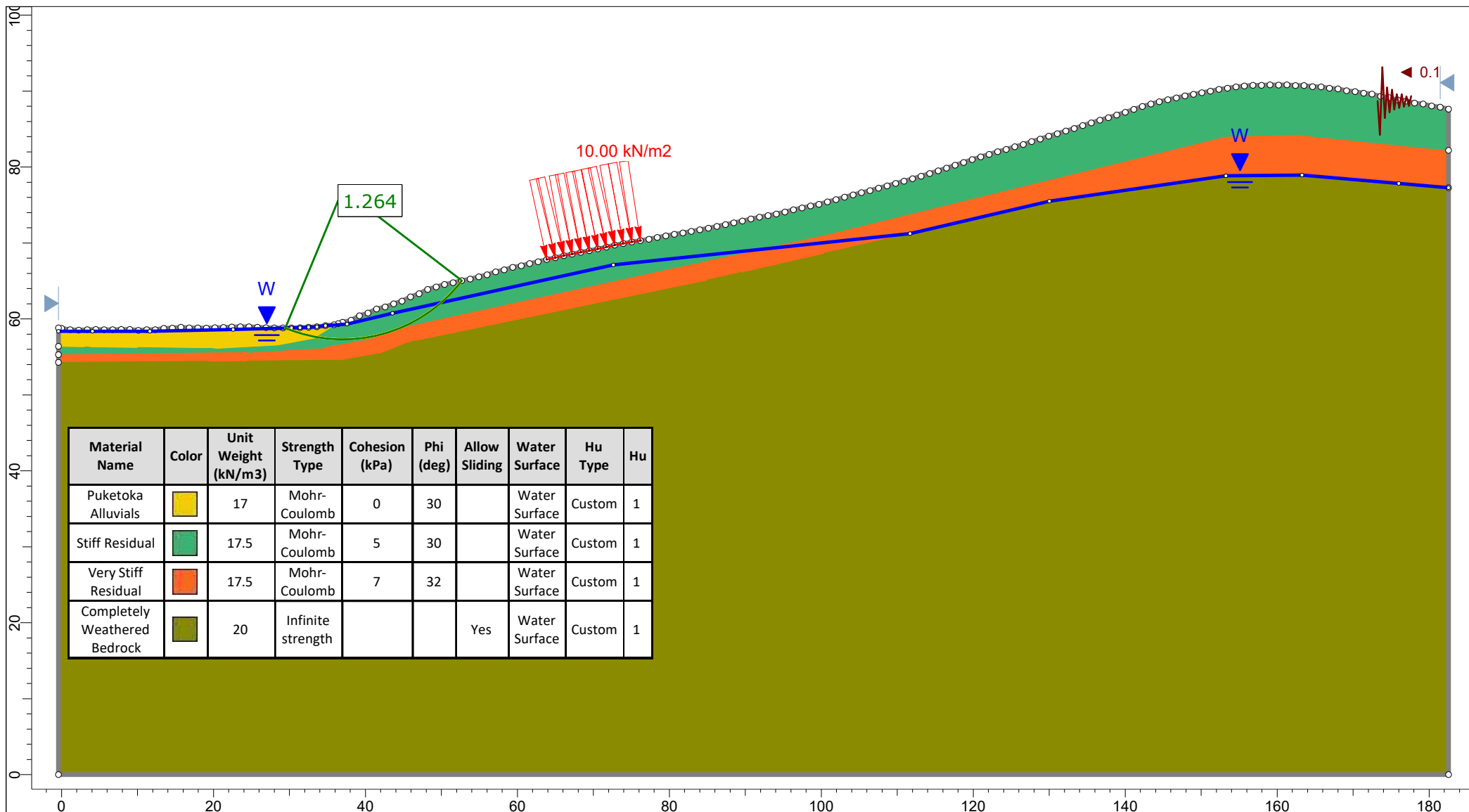
Observed





Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

File Name 20182\_a\_a'.slmd



Material Name	Color	Unit Weight (kN/m <sup>3</sup> )	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu
Puketoka Alluvials		17	Mohr-Coulomb	0	30		Water Surface	Custom	1
Stiff Residual		17.5	Mohr-Coulomb	5	30		Water Surface	Custom	1
Very Stiff Residual		17.5	Mohr-Coulomb	7	32		Water Surface	Custom	1
Completely Weathered Bedrock		20	Infinite strength			Yes	Water Surface	Custom	1



SLIDEINTERPRET 9.008

1768 State Highway 1, Warkworth

Seismic condition with 150 yr event - Structural Load Applied

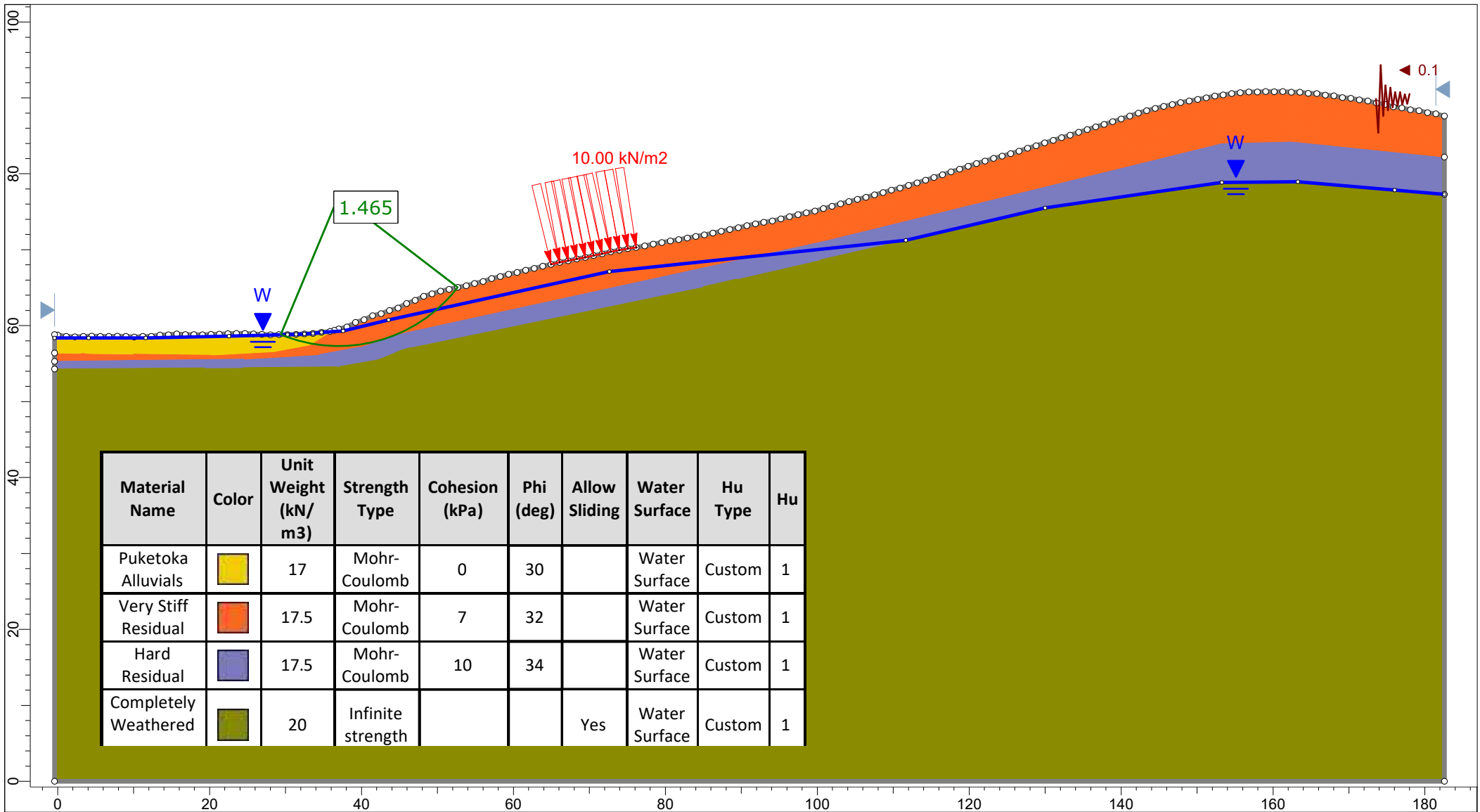
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Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

File Name 20182\_a\_a'.slmd



1768 State Highway 1, Warkworth

Seismic condition with 150 yr event - Structural Load Applied

Observed

Drawn By Chris Struthers

Company LDE Ltd

Date 26/07/2021, 9:04:57 am

File Name 20182\_a\_a'.slmd

## APPENDIX G PERCOLATION TEST REPORT





**Project Reference: 18707**

**5/08/2022**

KA-Waimanawa Partnership Ltd  
12 Viaduct Harbour Avenue  
Warkworth

Attention: KA-Waimanawa Partnership Ltd

Dear Phillip

## **PERCOLATION TESTING RESULTS**

### **Waimanawa Plan Change, Warkworth**

As requested, we have undertaken percolation testing in discrete locations within the Waimanawa Plan Change, West of State Highway One. The testing was conducted in accordance with the methods outlined in GD07:2022 "*Stormwater soakage and groundwater recharge in the Auckland Region*". This letter presents the results of the soakage testing (percolation) and observations made during the testing.

The test locations were chosen based upon the two main geological units identified in our plan change report. The two geological units include Pakiri Formation residual soils that generally comprise of highly plastic clays and silty clays, and Holocene/ Pleistocene Alluvium which generally comprised of silts and clays with varying amounts of sand and organic content. The test locations are presented on the LDE site plan 18707-a and full copies of the test results including geological descriptions, site photos and testing conditions both of which are attached.

No soakage was found using the falling head test method (P05) which was located in Pakiri Formations soils and therefore additional testing was conducted using the Talman-Hallam Permeameter (constant head method). The percolation results for each geological unit are as follows:

Table 1: Summary of Percolation Rates.

Test ID	GD07 Test Method	Geological Unit	Percolation Rate (mm/hr/m2)*	Test Notes
P-01	Talman-Hallam Permeameter (constant head method)	Pakiri Formation	0.06	Clay
P-02			0.24	Clay
P-02a			3.15	Clayey silt encountered at 0.5m, and possible rootlet.
P-03		Alluvium	0.025	Ground Water seepage into hole at 0.5mbgl, likely still recharging from the previous night's rain
P-03a			5.80	Retested hole at 5pm due to inferred recharge. No rainfall had occurred during the day.
P-04	0.62			
P-05	Falling Head	Pakiri Formation	0.00	clay

\* No factor of safety has been applied to the percolation results. A factor of safety may be applied as recommended in GD07:2022. This should be decided by the designer based upon the application and intended purpose/ use of the percolation rates.

This letter should be read and reproduced in its entirety including the limitations to understand the context of the opinions and recommendations given.


This report has been prepared for KA-Waimanawa Partnership Ltd in accordance with the brief given to us or the agreed scope and they will be deemed the exclusive owner on full and final payment of the invoice. Information, opinions, and recommendations contained within this report can only be used for the purposes with which it was intended. LDE accepts no liability or responsibility whatsoever for any use or reliance on the report by any party other than the owner or parties working for or on behalf of the owner, such as local authorities, and for purposes beyond those for which it was intended.

This letter was prepared in general accordance with current standards, codes and best practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from those described in this report.

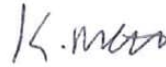
**For and on Behalf of Land Development and Engineering Ltd**

**Report prepared by:**



David Bosse  
*Engineering Geologist*

**Letter reviewed by:**









Kyle Meffan  
*Senior Engineering Geologist*  
MEngNZ

Attached:

LDE site investigation plan, drawing 18707-a, dated 26 July 2022.  
Percolation testing results P-01 to P-05



- Legend**
-  Plan Change Extent December 2020
  -  Property Boundary
  -  Pond
  -  Existing Wetland
  -  Auckland Council Rivers & Streams
  -  P1 Test Location (Percolation)



Copyright: LDE Ltd. All rights reserved / Do not scale off drawings / Confirm all dimensions on site prior to work

CLIENT  
KA-Waimanawa Partnership Limited

PROJECT  
Warkworth South (West of State Highway One)

DRAWING TITLE  
Test Location Plan (Percolation)



DESIGN:	DB
DRAWN:	DB
DATE:	11/07/2022
CHECKED:	KM
SCALE A3:	2000

PROJECT STATUS:		Information	
PROJECT:	18707-a	SHEET:	1 of 1
DRAWING No:	a	REV:	



## SOIL CONSTANT HEAD PERCOLATION TEST

As Per Auckland Council GD07 (Talsma-Hallam Method)

**BOREHOLE No:** P-01

<b>Client:</b> Classic Developments	<b>Project:</b> Percolation Testing - Warkworth South Plan Change (west of Statehighway One)	<b>LDE Project No.:</b> 18707
<b>Project Location:</b> 63 Valerie Cl, Warkworth	<b>Borehole Location:</b> Refer to site photo	
<b>Date:</b> 24/05/2022	<b>Drill method:</b> 100 mm hand auger	<b>Drilled by:</b> DB <b>Logged by:</b> DB

<b>General Information</b>	H = 600 mm D = 110 mm W = 220 mmBGL Reservoir tube internal diameter d = 40 mm	Vegetation at test site: Grass 100mm Auger makes a 110mm Hole Depth to any impermeable layer: N/A mm Pre-test groundwater level: N/A mm Soil conditions at time of excavation: Moist
----------------------------	---	--

Depth (m)	Soil Description	Geology	Test Log							
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)	
Min	Sec									
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	670	-	-	-	
0.05			120	0	7200	658	12	0.0151	0.00000	
0.10			240	0	7200	645	13	0.0163	0.00000	
0.15	CLAY, minor silt; brownish Orange. Moist, high plasticity.	Pakiri Formation	360	0	7200	632	13	0.0163	0.00000	
0.20			480	0	7200	620	12	0.0151	0.00000	
0.25										
0.30										
0.35										
0.40										
0.45										
0.50										
0.55										
0.60										
0.65										
0.70										
0.75										
0.80										
0.85										
0.90										
0.95										
1.00										
1.05										
1.10										
1.15										
1.20										
1.25										
1.30										
1.35										
1.40										
1.45										
1.50										
<b>Q Average (L/s)</b>								<b>0.00000</b>		

Site Photo

N/A	<b>Capacity of test borehole</b>		
	Capacity of bore (L/s)	0.00000	Rate at end of test
	Soakage surface (m2)	0.14	Wetted Area (base of hole and sides )
	Percolation rate (L/min/m2)	0.0	
	FoS for consequences of failure	1.0	Refer to section B.4.0 Table 5
	FoS for testing uncertainty	1.0	Refer to section B.4.0 Table 6
	Total FoS	1.0	
	<b>Factored percolation rate (L/min/m2)</b>	0.0009	or 0.0558 mm/hr/m2
	<b>Additional comments:</b> Testing stopped due to heavy rain resulting in surface water egressing into the test hole. No factors of safety have been applied to the final percolation rates. Suitable safety factors must be selected by the design engineer in accordance with GD07:2021.		





### SOIL CONSTANT HEAD PERCOLATION TEST

**BOREHOLE No: P-02**

As Per Auckland Council GD07 (Talsma-Hallam Method)

<b>Client:</b> Classic Developments	<b>Project:</b> Percolation Testing - Warkworth South Plan Change (west of Statehighway One)	<b>LDE Project No.:</b> 18707
<b>Project Location:</b> 63 Valerie Cl, Warkworth	<b>Borehole Location:</b> Refer to site photo & map	
<b>Date:</b> 11/07/2022	<b>Drill method:</b> 100 mm hand auger	<b>Drilled by:</b> DB <b>Logged by:</b> DB

<b>General Information</b>		
Depth of auger hole	H = 600 mm	Vegetation at test site
Diameter of auger hole	D = 110 mm	100mm Auger makes a 110mm Hole
Depth to water surface in auger hole	W = 260 mmBGL	Depth to any impermeable layer
Reservoir tube internal diameter	d = 40 mm	Pre-test groundwater level
		Soil conditions at time of excavation

Grass, grape vines > 1.5m away	
N/A	mm
N/A	mm
Moist	

Depth (m)	Soil Description	Geology	Test Log							
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)	
			Min	Sec						
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	882	-	-	-	
0.05			30	0	1800	878	4	0.0050	0.00000	
0.10			60	0	1800	865	13	0.0163	0.00001	
0.15	CLAY, some silt; brownish Orange. Moist, high plasticity.	Pakiri Formation	120	0	3600	838	27	0.0339	0.00001	
0.20			180	0	3600	808	30	0.0377	0.00001	
0.25			240	0	3600	778	30	0.0377	0.00001	
0.30										
0.35										
0.40										
0.45										
0.50										
0.55	becoming silty									
0.60										
0.65										
0.70										
0.75										
0.80										
0.85										
0.90										
0.95										
1.00										
1.05										
1.10										
1.15										
1.20										
1.25										
1.30										
1.35										
1.40										
1.45										
1.50										
Q Average (L/s)								0.00001		

Site Photo



**Capacity of test borehole**

Capacity of bore (L/s)	0.00001	Rate at end of test
Soakage surface (m2)	0.13	Wetted Area (base of hole and sides )
Percolation rate (L/min/m2)	0.0	
FoS for consequences of failure	1.0	Refer to section B.4.0 Table 5
FoS for testing uncertainty	1.0	Refer to section B.4.0 Table 6
Total FoS	1.0	
<b>Factored percolation rate (L/min/m2)</b>	0.0040	or 0.2395 mm/hr/m2

**Additional comments:** No factor of safety has been applied to the final loading rates. Suitable safety factors must be selected by the design engineer in accordance with GD07:2021. Test Terminated after 4hrs due to heavy rain showers commencing.



### SOIL CONSTANT HEAD PERCOLATION TEST

As Per Auckland Council GD07 (Talsma-Hallam Method)

**BOREHOLE No:** P-02

**Client:** Classic Developments **Project:** Percolation Testing - Warkworth South Plan Change (west of Statehighway One)

**Project Location:** 63 Valerie Cl, Warkworth **Borehole Location:** Refer to site photo & map

**LDE Project No.:** 18707

**Date:** 12/07/2022 **Drill method:** 100 mm hand auger **Drilled by:** DB **Logged by:** DB

**General Information**

Depth of auger hole	H =	600	mm	Vegetation at test site	Grass, grape vines > 1.5m away
Diameter of auger hole	D =	110	mm	100mm Auger makes a 110mm Hole	
Depth to water surface in auger hole	W =	260	mmBGL	Depth to any impermeable layer	N/A mm
Reservoir tube internal diameter	d =	40	mm	Pre-test groundwater level	N/A mm
				Soil conditions at time of excavation	Moist

Depth (m)	Soil Description	Geology	Test Log							
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)	
			Min	Sec						
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	655	-	-	-	
0.05			15	0	900	638	17	0.0214	0.00002	
0.10			30	0	900	568	70	0.0880	0.00010	
0.15	CLAY, minor silt; brownish Orange. Moist, high plasticity.	Pakiri Formation	45	0	900	460	108	0.1357	0.00015	
0.20			60	0	900	360	100	0.1257	0.00014	
0.25			75	0	900	280	80	0.1005	0.00011	
0.30			90	0	900	178	102	0.1282	0.00014	
0.35										
0.40										
0.45										
0.50	Clayey SILT; orange.									
0.55										
0.60										
0.65										
0.70										
0.75										
0.80										
0.85										
0.90										
0.95										
1.00										
1.05										
1.10										
1.15										
1.20										
1.25										
1.30										
1.35										
1.40										
1.45										
1.50										
<b>Q Average (L/s)</b>								<b>0.00011</b>		

Site Photo



**Capacity of test borehole**

Capacity of bore (L/s)	<b>0.00011</b>	Rate at end of test
Soakage surface (m <sup>2</sup> )	<b>0.13</b>	Wetted Area (base of hole and sides)
Percolation rate (L/min/m <sup>2</sup> )	<b>0.1</b>	
FoS for consequences of failure	<b>1.0</b>	Refer to section B.4.0 Table 5
FoS for testing uncertainty	<b>1.0</b>	Refer to section B.4.0 Table 6
Total FoS	<b>1.0</b>	
<b>Factored percolation rate (L/min/m<sup>2</sup>)</b>	<b>0.0524</b>	or <b>3.1466</b> mm/hr/m <sup>2</sup>

**Additional comments:** No factors of safety has been applied to the final loading rates. Suitable safety factors must be selected by the design engineer in accordance with GD07:2021. A thick grass root was noted in side wall of teh hole at a depth of approximately 300mm at the end of the test.



## SOIL CONSTANT HEAD PERCOLATION TEST

**BOREHOLE No: P-03**

As Per Auckland Council GD07 (Talsma-Hallam Method)

<b>Client:</b> Classic Developments	<b>Project:</b> Percolation Testing - Warkworth South Plan Change (west of Statehighway One)	<b>LDE Project No.:</b> 18707
<b>Project Location:</b> 63 Valerie Cl, Warkworth	<b>Borehole Location:</b> Refer to site photo	
	<b>Coordinates:</b> Eastings: 5968365 Northings: 1747342	
<b>Date:</b> 15/07/2022	<b>Drill method:</b> 100 mm hand auger	<b>Drilled by:</b> DB <b>Logged by:</b> DB

<b>General Information</b>		
Depth of auger hole	H = 600 mm	Vegetation at test site: Grass
Diameter of auger hole	D = 110 mm	100mm Auger makes a 110mm Hole
Depth to water surface in auger hole	W = 320 mmBGL	Depth to any impermeable layer: N/A mm
Reservoir tube internal diameter	d = 40 mm	Pre-test groundwater level: 500 mm
		Soil conditions at time of excavation: Wet

Depth (m)	Soil Description	Geology	Test Log						
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)
Min	Sec								
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	865	-	-	-
0.05			3	0	180	865	0	0.0000	0.00000
0.10			6	0	180	865	0	0.0000	0.00000
0.15			9	0	180	865	0	0.0000	0.00000
0.20			12	0	180	865	0	0.0000	0.00000
0.25	SILT with trace organics; grey. Moist, low plasticity.	Pleistocene	18	0	360	865	0	0.0000	0.00000
0.30			24	0	360	862	3	0.0038	0.00001
0.35			30	0	360	862	0	0.0000	0.00000
0.40			42	0	720	862	0	0.0000	0.00000
0.45			54	0	720	862	0	0.0000	0.00000
0.50	CLAY, trace organics & silt; grey. Wet, high plasticity.	Alluvium	66	0	720	862	0	0.0000	0.00000
0.55			96	0	1800	861	1	0.0013	0.00000
0.60			126	0	1800	861	0	0.0000	0.00000
0.65			156	0	1800	861	0	0.0000	0.00000
0.70			186	0	1800	861	0	0.0000	0.00000
0.75			216	0	1800	861	0	0.0000	0.00000
0.80									
0.85									
0.90									
0.95									
1.00									
1.05									
1.10									
1.15									
1.20									
1.25									
1.30									
1.35									
1.40									
1.45									
1.50									
Q Average (L/s)								0.00000	

Site Image



**Capacity of test borehole**

Capacity of bore (L/s)	0.00000	Rate at end of test
Soakage surface (m <sup>2</sup> )	0.11	Wetted Area (base of hole and sides )
Percolation rate (L/min/m <sup>2</sup> )	0.0	
FoS for consequences of failure	1.0	Refer to section B.4.0 Table 5
FoS for testing uncertainty	1.0	Refer to section B.4.0 Table 6
Total FoS	1.0	
<b>Factored percolation rate (L/min/m<sup>2</sup>)</b>	0.00	or <span style="border: 1px solid black; padding: 2px;">0.0252</span> mm/hr/m <sup>2</sup>

**Additional comments:** No factors of safety has been applied to the final loading rates. Suitable safety factors must be selected by the design engineer. in accordance with GD07:2021. **Heavy rainshowers during the previous night before the commencement of the test.**



### SOIL CONSTANT HEAD PERCOLATION TEST

As Per Auckland Council GD07 (Talsma-Hallam Method)

BOREHOLE No: **P-03a**

<b>Client:</b> Classic Developments	<b>Project:</b> Percolation Testing - Warkworth South Plan Change (west of State highway One)	<b>LDE Project No.:</b> 18707
<b>Project Location:</b> 63 Valerie Cl, Warkworth	<b>Borehole Location:</b> Refer to site photo <b>Coordinates:</b> Eastings: 5968365 Northings: 1747342	
<b>Date:</b> 15/07/2022	<b>Drill method:</b> 100 mm hand auger	<b>Drilled by:</b> DB <b>Logged by:</b> DB

<b>General Information</b>			
Depth of auger hole	H = 600 mm	Vegetation at test site	Grass
Diameter of auger hole	D = 110 mm	100mm Auger makes a 110mm Hole	
Depth to water surface in auger hole	W = 320 mmBGL	Depth to any impermeable layer	N/A mm
Reservoir tube internal diameter	d = 40 mm	Pre-test groundwater level	500 mm
		Soil conditions at time of excavation	Wet

Depth (m)	Soil Description	Geology	Test Log						
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)
			Min	Sec					
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	765	-	-	-
0.05			5	0	300	743	22	0.0276	0.00009
0.10			10	0	300	692	51	0.0641	0.00021
0.15			15	0	300	670	22	0.0276	0.00009
0.20			20	0	300	620	50	0.0628	0.00021
0.25	SILT with trace organics; grey. Moist, low plasticity.	Pleistocene	25	0	300	568	52	0.0653	0.00022
0.30			30	0	300	520	48	0.0603	0.00020
0.35									
0.40	CLAY, trace organics & silt; grey. Wet, high plasticity.	Alluvium							
0.45									
0.50									
0.55									
0.60									
0.65									
0.70									
0.75									
0.80									
0.85									
0.90									
0.95									
1.00									
1.05									
1.10									
1.15									
1.20									
1.25									
1.30									
1.35									
1.40									
1.45									
1.50									
Q Average (L/s)								0.00017	

Site Image



**Capacity of test borehole**

Capacity of bore (L/s)	0.00017	Rate at end of test
Soakage surface (m <sup>2</sup> )	0.11	Wetted Area (base of hole and sides )
Percolation rate (L/min/m <sup>2</sup> )	0.1	
FoS for consequences of failure	1.0	Refer to section B.4.0 Table 5
FoS for testing uncertainty	1.0	Refer to section B.4.0 Table 6
Total FoS	1.0	
<b>Factored percolation rate (L/min/m<sup>2</sup>)</b>	0.10	or 5.7945 mm/hr/m <sup>2</sup>

**Additional comments:** No factors of safety has been applied to the final loading rates. Suitable safety factors must be selected by the design engineer in accordance with GD07:2021. **Second test in the same hole, no rain had occurred all day.**



## SOIL CONSTANT HEAD PERCOLATION TEST

As Per Auckland Council GD07 (Talsma-Hallam Method)

**BOREHOLE No:** P-04

<b>Client:</b> Classic Developments	<b>Project:</b> Percolation Testing - Warkworth South Plan Change (west of Statehighway One)	<b>LDE Project No.:</b> 18707
<b>Project Location:</b> 63 Valerie Cl, Warkworth	<b>Borehole Location:</b> Refer to site photo	
<b>Date:</b> 24/05/2022	<b>Drill method:</b> 100 mm hand auger	<b>Drilled by:</b> DB <b>Logged by:</b> DB

<b>General Information</b>		
Depth of auger hole	H = 700 mm	Vegetation at test site
Diameter of auger hole	D = 110 mm	100mm Auger makes a 110mm Hole
Depth to water surface in auger hole	W = 380 mmBGL	Depth to any impermeable layer
Reservoir tube internal diameter	d = 40 mm	Pre-test groundwater level
		Soil conditions at time of excavation

Depth (m)	Soil Description	Geology	Test Log						
			Time		Interval length (sec)	Level in tube at interval start (mm)	Water level drop over interval (mm)	Volume Infiltrated during interval (L)	Flow rate during interval (L/s)
			Min	Sec					
0.00	Organic SILT; dark brown. Moist, low plasticity.	Topsoil	0	0	-	740	-	-	-
0.05			10	0	600	740	0	0.0000	0.00000
0.10			20	0	600	713	27	0.0339	0.00006
0.15			30	0	600	708	5	0.0063	0.00001
0.20			90	0	3600	656	52	0.0653	0.00002
0.25	CLAY, minor silt; brownish Orange. Moist, high plasticity.	Pleistocene Alluvium	150	0	3600	568	88	0.1106	0.00003
0.30			210	0	3600	514	54	0.0679	0.00002
0.35			270	0	3600	478	36	0.0452	0.00001
0.40			330	0	3600	430	48	0.0603	0.00002
0.45									
0.50									
0.55									
0.60									
0.65									
0.70									
0.75									
0.80									
0.85									
0.90									
0.95									
1.00									
1.05									
1.10									
1.15									
1.20									
1.25									
1.30									
1.35									
1.40									
1.45									
1.50									
<b>Q Average (L/s)</b>								<b>0.00002</b>	

Site Photo



**Capacity of test borehole**

Capacity of bore (L/s)	0.00002	Rate at end of test
Soakage surface (m2)	0.12	Wetted Area (base of hole and sides )
Percolation rate (L/min/m2)	0.0	
FoS for consequences of failure	1.0	Refer to section B.4.0 Table 5 (GD07)
FoS for testing uncertainty	1.0	Refer to section B.4.0 Table 6 (GD07)
Total FoS	1.0	
<b>Factored percolation rate (L/min/m2)</b>	<b>0.0102</b>	or <b>0.6148</b> mm/hr/m2

**Additional comments:** No factors of safety has been applied to the final loading rates. Suitable safety factors must be selected by the design engineer in accordance with GD07:2021.




## STORMWATER PERCOLATION TEST

Client:	Classic Developments	Job No:	18707
Location:	67 Valerie Close	Date:	15/07/22
		Page	1 of 2
Hole No:	P05	Diameter:	0.11 (m) Lo-
Location:	Refer to site plan	Depth:	0.6 (m)
Weather conditions preceding test:		Heavy rainfall	
Details of presoaking:		4hr soak (Winter Conditions)	

Time of Test (min:sec)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
00:00	-	0.40	0.20	0
00:30	0.50	0.40	0.20	0.5
01:00	0.50	0.40	0.20	1
01:30	0.50	0.40	0.20	1.5
02:00	0.50	0.40	0.20	2
02:30	0.50	0.40	0.20	2.5
03:00	0.50	0.40	0.20	3
03:30	0.50	0.40	0.20	3.5
04:00	0.50	0.40	0.20	4
04:30	0.50	0.40	0.20	4.5
05:00	0.50	0.40	0.20	5
06:00	1.00	0.40	0.20	6
07:00	1.00	0.40	0.20	7
08:00	1.00	0.40	0.20	8
09:00	1.00	0.40	0.20	9
10:00	1.00	0.40	0.20	10
12:00	2.00	0.40	0.20	12
14:00	2.00	0.40	0.20	14
16:00	2.00	0.40	0.20	16
18:00	2.00	0.40	0.20	18
20:00	2.00	0.40	0.20	20
25:00	5.00	0.40	0.20	25
30:00	5.00	0.40	0.20	30
35:00	5.00	0.40	0.20	35
40:00	5.00	0.40	0.20	40
45:00	5.00	0.40	0.20	45
50:00	5.00	0.40	0.20	50
55:00	5.00	0.40	0.20	55
00:00	5.00	0.40	0.20	60

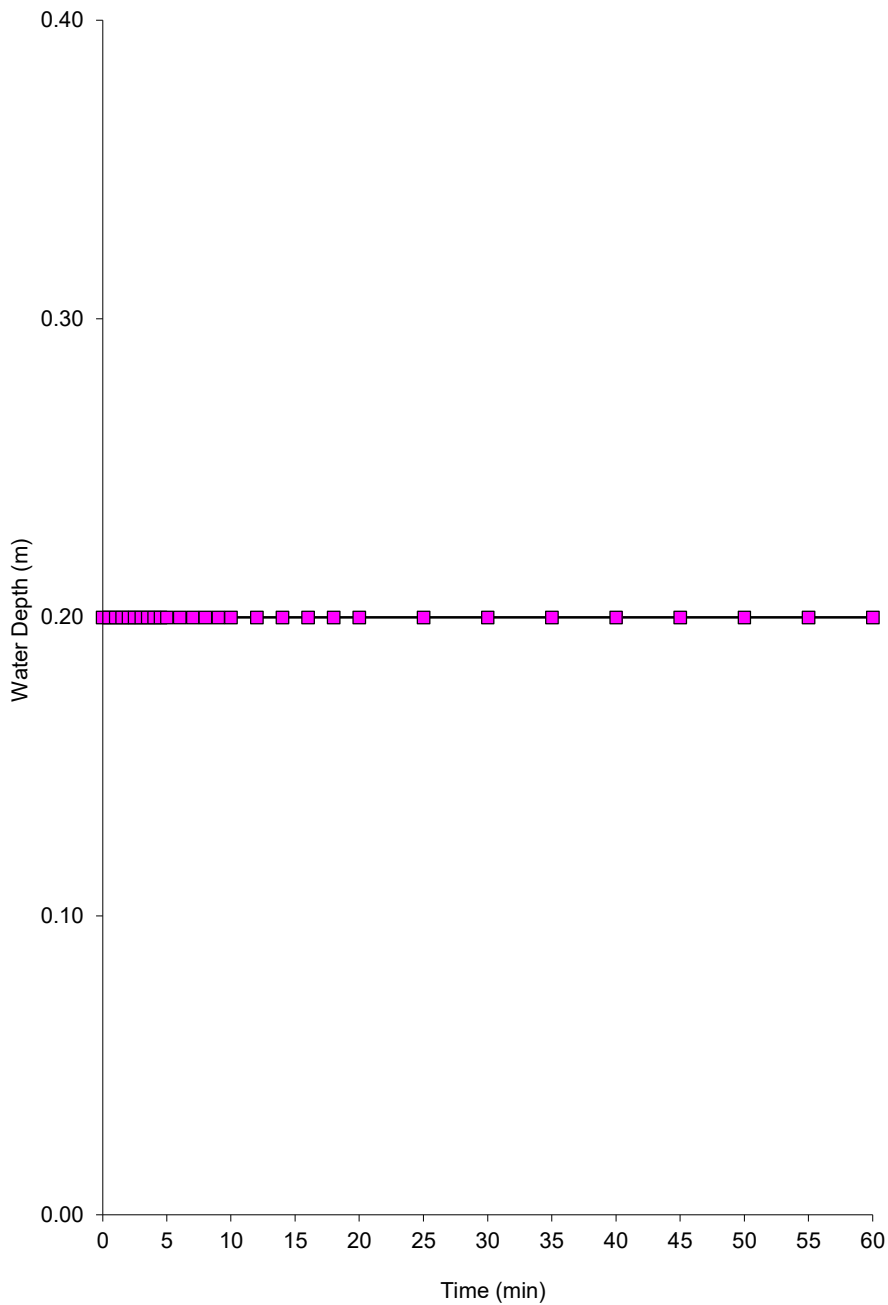
Test P05  
 Gradient 0 m/min  
 Percolation 0.00 L/m<sup>2</sup>/min

	<b>LDE Limited</b> 320 Ti Rakau Dr, Burswood, Auckland 2013 Phone: 09 262 1528	Operator: <span style="background-color: yellow; display: inline-block; width: 50px; height: 15px;"></span> Checked:
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# STORMWATER PERCOLATION TEST

Client:	Classic Developments	Job No:	18707
Location:	67 Valerie Close	Date:	1/01/1904
	0	Page	2 of 2
Hole No:	P05	Diameter:	0.1 (m)
Location:	Refer to site plan	Depth:	0.6 (m)

Water Depth vs Time



LDE Limited  
320 Ti Rakau Dr, Burswood, Auckland 2013  
Phone: 09 262 1528

Operator:   
Checked: