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Proposed Residential Subdivision

Middle Road, Havelock North

PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT

CDL Land New Zealand Ltd




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Napier

6 Ossian Street
Ahuriri
Napier 4110
New Zealand
www.cmwgeosciences.com

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| Prepared by | Izzy Atchley, Senior Engineering Geologist  |
| Reviewed by | Tom Bunny, Associate Geotechnical Engineer CMEngNZ, CPEng  |
| Authorised by | Robert Taylor, Principal Geotechnical Engineer CMEngNZ, CPEng  |

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1.0 INTRODUCTION

CMW Geosciences (CMW) was engaged by CDL Land New Zealand Ltd to carry out a preliminary geotechnical assessment of land for future residential development under the Fast-Track Approvals Act 2024 (FTAA) between Te Aute and Middle Road, Havelock North. This report is submitted in support of CDL's Referral Application (Application) under the FTAA. The project is for the residential development of approximately 300 - 350 lots at 92, 108, 148 Middle Road and 139 Te Aute Road in Havelock North and is referred to as the 'Middle Road' project.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced NAP2025-0024AA, Rev 0 dated 30 October 2025.

This report presents a summary of the geological setting, geotechnical hazards and constraints for the proposed residential subdivision and provides preliminary recommendations for further investigation, likely ground improvement and typical foundations that may be anticipated.

The assessment is based on an indicative concept plan, noting that detailed design will be undertaken as part of a future substantive application should the project be accepted for referral to the Fast-track process.

2.0 STATEMENT OF QUALIFICATIONS AND EXPERIENCE

2.1 Izzy Atchley (Author)

I am a Senior Engineering Geologist at CMW Geosciences Ltd. (CMW). CMW is a specialised geotechnical consultancy specialising in geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since February 2022.

I hold the qualifications of Bachelor of Science in Geology, a Postgraduate Diploma in Engineering Geology and a Master of Engineering Management; all from the University of Canterbury, which I completed in 2016. I am a membership of the New Zealand Geotechnical Society and Engineering NZ.

I have 9 years of professional experience in geotechnical consulting, including working on a range of development projects. My experience includes planning, scoping, managing and undertaking a variety of ground investigations for medium to large scale developments, construction monitoring and quality assurance, geotechnical analysis and reporting.

I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

2.2 Tom Bunny (Project Principal / Reviewer)

I am an Associate Geotechnical Engineer at CMW Geosciences Ltd. (CMW). CMW is a specialised geotechnical consultancy specialising in geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since June 2025.

I hold the qualifications of Bachelor of Science in Geology, a Postgraduate Diploma in Engineering Geology, both from the University of Canterbury which I completed in 2002. I am a Chartered Professional Engineer (CPEng) and Chartered Member of Engineering New Zealand (CMEngNZ).

I have 23 years of professional experience in geotechnical consulting, including 10 years in Hawkes Bay. My experience includes project management, site investigation, assessment, geotechnical design and construction verification. I have experience in land development for Plan Change and providing geotechnical support for Resource and Building Consent.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand’s Code of Conduct for Expert Witnesses Practice Note 2023.

2.3 Robert Taylor (Report Reviewer)

I am a Principal Geotechnical Engineer at CMW Geosciences (CMW). CMW is a specialist geotechnical consultancy delivering first-class geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since February 2016.

I hold the qualification of a Bachelor of Earth Science, a Bachelor of Civil Engineering with honours and a Master of Engineering Science (Geotechnical) from the University of Waikato (2005), the University of Southern Queensland (2014) and the University of New South Wales (2019) respectively. I am a Chartered Professional Engineer (CPEng) in the field of Geotechnical Engineering, Chartered Member of the Engineering New Zealand (CMEng), a member of New Zealand Geotechnical Society (NZGS), a member of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and a member of New Zealand Society on Large Dams (NZSOLD).

I have 20 years of professional experience investigating ground conditions across Australia and New Zealand and implementing practical design solutions for a multitude of projects. I have considerable experience in soft soil engineering and liquefiable soils.

I confirm that, in my capacity as an independent reviewer of this report, I have read and abide by the Environment Court of New Zealand’s Code of Conduct for Expert Witness Practice Note 2023.

3.0 DESCRIPTION OF THE APPLICATION SITE

3.1 General

The application site is located at 92, 108, 148 Middle Road and 139 Te Aute Road in Havelock North (site). The site is held in five separate titles and consists of a combined area of approximately 30.6ha. The site is relatively flat and currently used for rural residential and grazing purposes with three existing dwellings. **Figure 1** shows the site extent within the context of Havelock North.



Figure 1: Site Shown in Red Outline

The site is on the southwest side of Havelock North, approximately 900m south of the town centre, which contains a range of retail and commercial uses. The wider land uses to the north, east and west of the site are predominantly suburban residential in character, with a retirement village to the northwest and larger rural landholdings to the southwest.

A separate 3.3ha rural residential landholding at 80 and 84 Middle Road, known as the **McKenna Block**, is located immediately to the east of the site adjacent to the Herehere Stream (Figure 1). This landholding is in separate ownership and does not form part of the application site at the time of lodgement. However, given the McKenna Block's proximity and relationship to the Middle Road site, the landholding has been considered at a high level within this assessment.

The Planning Overview Report and other technical assessments prepared to support the referral application under the FTAA provides a comprehensive description of the site and its context. With respect to matters relating to geotechnical engineering the comments in Sections 3.2 and 3.3 can be made.

3.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on the attached plan, shown as **Drawing 1**.

The site is relatively flat to gently sloping, with reference to the Hastings District Council lidar information¹. The Northern boundary along Te Aute Road is at RL8.5m (NZVD2016) and has a natural fall to the southeast toward a shallow drain within the middle of the site at RL8m. The southern boundary along Middle Road is at RL10m and falls to the northwest toward the same drain.

The shallow drain runs southwest to northeast and discharges into the Herehere Stream.

¹ <https://mapping.hdc.govt.nz/intramaps22A>

The Herehere Stream is located along the northeastern boundary of the site, which is situated at approximately RL6.0m. This stream is channelised and up to 2m to 3m deep in places. The Karamu Stream is located approximately 150m northwest of the site and sits at approximately RL5.0m.

The property at 148 Middle Road appears to have undergone previous earthworks associated with CDL's Iona development. This includes stripping of topsoil, temporary stockpiles and the construction of a stormwater basin to service that development.

The landform beyond the site to the north, northeast and west are generally flat at similar grades to the proposed development. To the immediate east/ southeast the site grades moderately upward reaching a maximum RL of approximately RL25m adjacent to Iona Road, approximately 500m from the site. The landform continues to grade upwards for several hundreds of meters beyond this.

3.3 Site History

Based on our review of the historic aerial imagery², the landform appears to have undergone minor modifications, with the following land changes noted:

- 1949 (earliest available image): The majority of the site and immediate surrounding area appears to be in orchard with the surrounding area to the west being pastoral. The dwellings at 92 and 148 Middle Road appear to be present.
- 1964: The majority of the site appears to be in pasture.
- 1994: Little change to the direct site, the majority of the site is still in pasture and the dwellings at 92 and 148 Middle Road are still present. Residential development to the east and south has increased.
- 2003: The dwelling at 139 Te Aute Road has been constructed and the site is used for orcharding. The rest of the site is in pasture. More intensive residential development to the east and south of the site has taken place.
- 2025: some earthworks have been undertaken to 148 Middle Road including removing of the existing dwelling
- The site itself has remained relatively unchanged over the last 70 years.

4.0 DESCRIPTION OF THE PROPOSAL

The Middle Road project will provide for the residential subdivision of the site to enable the development of approximately 300 – 350 lots. The intended subdivision layout will provide for a range of lot sizes to enable conventional residential development along with medium density development opportunities. An indicative concept plan has been prepared to inform the referral application and is provided as **Figure 2**. The development is supported by integrated three-waters and transport infrastructure, together with an interconnected open space network.

A full description of the Middle Road Project is provided in the Planning Overview Report submitted in support of the Referral Application. The proposal and the geotechnical matters addressed in this report are based on an indicative concept design prepared for referral purposes. Detailed design and refinement of geotechnical matters will be undertaken as part of the substantive application process should the project proceed. For assessment completeness, this report has also had regard to a potential extension of the Middle Road development across the adjoining McKenna Block (McKenna Block Extension at **Figure 1**).

² <https://retrolens.co.nz/> & Google Earth Pro



Figure 2: Concept Plan

With respect to matters relating to geotechnical engineering the project is summarised as follows:

- The current landform are likely to be modified to form level lots by utilising cut to fill earthworks. The draft earthwork plans indicate approximately 140,000m³ of earthworks comprising predominantly onsite cut-to-fill, with cut and fill thicknesses of up to approximately 2.0m . This includes approximately 40,000m³ of imported material.
- Indicative stormwater dry basins are proposed towards the northern and southern ends of the site (refer to Figure 2), covering an area of approximately 5 hectares. Concentrated stormwater flows from roads and future lots will be attenuated before being discharged. The stormwater basins are likely to be formed predominately in cut.
- Wastewater will be connected to the existing reticulated council public network.

5.0 GROUND CONDITIONS

5.1 Previous Geotechnical Investigations

WSP and CMW have previously completed geotechnical investigations near the site with the results presented in the following reports:

- WSP, Iona Road and Middle Road Subdivision, Geotechnical Due Diligence Report (ref. 2-S5334.02/20/01 Rev 0, dated 17 November 2020)
- CMW, Preliminary Geotechnical Appraisal Report, 139 Te Aute Road, Havelock North (ref. NAP2024-0002AD Rev 0, dated 31 July 2024)

From those reports, the following geotechnical investigations were undertaken directly at the site:

- 10 Cone Penetrometer Tests and twinned Test Pits across the entire site (WSP 2020)
- 3 Cone Penetrometer Tests with twinned hand auger tests at 139 Te Aute Road (CMW 2024)

The approximate locations of the relevant investigation referred to above are shown on **Drawing 01**, and a copy of the investigation logs are presented in **Appendix C** and referenced through this report.

5.2 Published Geology

The published geological map³ of the area, as shown in Figure 3 below, depicts the regional geology for the area as comprising:

- Holocene aged alluvial and fan deposits, described as “*alluvial gravel, sand, silt and mud*” (htz)
- On the south-western side of the site, Holocene alluvial deposits overlap early Pleistocene aged “*conglomerate, sandstone and siltstone, fossiliferous and pumiceous sandstone and ignimbrite*” of the Kidnappers group (K).

Some superficial depths of fill may be present as a result of previous and existing land use activities.

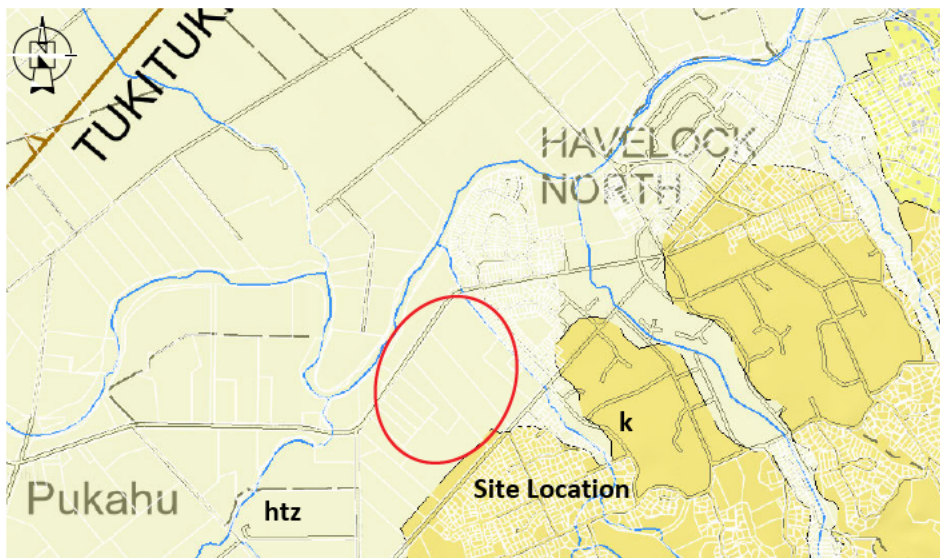


Figure 3: Regional Geology (sourced from GNS, Geological Map 7a)

5.3 Preliminary Ground Model

Due to the depositional environment, the alluvial deposits appear to vary in both composition and extent across the site. However, the site can be generalised as comprising a topsoil layer underlain by interbedded Holocene alluvial soils comprising soft to stiff silts and clays with medium dense to very dense sands and medium dense gravels from 12m to 15m depth.

³ Geological and Nuclear Sciences, 1:75,000 Geological Map 7a, Geological map of the Napier-Hastings urban area

Organic deposits were also encountered within the alluvial deposits as part of the WSP investigation to depths of up to 3.0m bgl and could be encountered elsewhere.

5.4 Groundwater

Groundwater encountered during the WSP investigations in late spring (November 2020), varied between 1.0 to 3.0 m bgl (below ground level) in investigation locations. Evidence of perched groundwater was observed in places above low-permeability clay soils.

Groundwater encountered during the CMW investigations in early winter (June 2024), varied between approximately 1.5 to 2.2m bgl (below ground level).

The nearby Karamu Stream and Herehere Stream will define the groundwater level assuming hydrostatic conditions.

Review of the Hawkes Bay Regional Council well database⁴ presented the results of several deep boreholes and wells. The data showed that artesian groundwater conditions were present in isolated locations across the site where well screens were installed within deep gravels (assumed aquifer) underlying silts and clays (assumed aquitard) between 12m and 16m below ground level with groundwater recorded up to 1.5m above ground level.

A conservative groundwater depth of 1.0m bgl has been adopted for the geotechnical analysis.

6.0 GEOTECHNICAL HAZARD ASSESSMENT & RECOMMENDATIONS

6.1 Context

The National Policy Statement for Natural Hazards (NPS-NH) sets the national framework and expectations for how natural hazards and risk must be identified and managed across all councils. Section 106 of the Resource Management Act⁵ (RMA) is the statutory tool that councils must use at subdivision consent level to apply those hazard- risk principles to development proposals.

Both require an assessment of the risk from natural hazards to be carried out when considering the granting of subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land or structures (consequences).

The following sections of this report provide an assessment of the geohazards relevant to this site and prove the basis for the Natural Hazards Risk Assessment presented in **Appendix D**.

6.2 Seismicity

6.2.1 Seismic Site Subsoil Category

The geological units encountered beneath the site comprise of soil strength materials, which with respect to the seismic site subsoil category defined in Section 3.1.3 of NZS1170.5, is defined as having a UCS < 1MPa.

Based on the site location, anticipated ground conditions and knowledge of the regional geology in the area coupled with the fact that the depth to bedrock at this location is not known or proven, the preliminary site subsoil category is assessed as 'Class D' (deep soils) in general accordance with NZS1170.5:2004.

⁴ <https://hbrcopendata-hbrc.opendata.arcgis.com/datasets/hbrc-wells-database/explore>

⁵ Resource Management Act (1991), as of 29 October 2019

6.2.2 Seismic Design Parameters

Seismic Peak Ground Acceleration (PGA) values and earthquake magnitude for geotechnical analyses were assessed in general accordance with NZGD guidance⁶. The serviceability limit state (SLS) and ultimate limit state (ULS) peak ground accelerations (PGAs) were assessed based on a 50-year design life and an importance level (IL) 2 structure in accordance with the New Zealand Building Code⁷.

The PGAs and earthquake magnitudes for geotechnical assessment at this site are presented in Table 1.

Table 1: Design Peak Ground Acceleration (PGA) for Various Limit States

| Limit State | AEP | PGA (g) | Magnitude _{eff} |
|-------------|-------|---------|--------------------------|
| SLS | 1/25 | 0.12 | 6.4 |
| ULS | 1/500 | 0.58 | 7.1 |

Note: AEP = annual exceedance probability

6.3 Fault Rupture

The Institute of Geological and Nuclear Sciences (GNS) Active Faults Database⁸ suggests there are no known active fault that extend across the site, with the nearest active fault being the Te Mata Fault Zone, located approximately 2.3km to the south of the site with a recurrence interval 5,000-10,000 years. As such, the risk of fault rupture to the proposed development is low.

6.4 Liquefaction and Lateral Spread

6.4.1 Overview

Liquefaction occurs in loose saturated cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-ups, soil grains moving into suspension and temporary loss of strength causing vertical ground deformation.

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which at shallow depths can give rise to lateral spreading where a free face is present within the vicinity of the site or across the sloping ground. For lateral spread to occur, liquefaction must develop within shallow continuous soil layers that extend a sufficient length and width towards a free face or across sloping ground.

A review of the Hawkes Bay Regional Council online hazard portal⁹ indicates that most of the site is classed as having a “medium” liquefaction vulnerability whereby liquefaction damage is ‘possible’. There is a zone, approximately 50m wide running parallel to Middle Road in the site that is described as “low” whereby “liquefaction damage is unlikely”, this correlates to the slightly elevated ground where the regional geology map identifies the site as being underlain by the Kidnappers Group.

A preliminary liquefaction assessment was undertaken using the existing raw data from the CPT tests to further define the liquefaction vulnerability.

⁶ NZ Geotechnical Society publication “Earthquake geotechnical engineering practice, Module 1: Overview of the standards”, (November 2021)

⁷ Ministry of Business, Innovation and Employment (1992) NZ Building Code Handbook, Third Edition, Amendment 13 (effective from 14 February 2014).

⁸ <https://data.gns.cri.nz/af/>

⁹ <https://gis.hbrc.govt.nz/Hazards/>

6.4.2 Methodology

In accordance with MBIE/NZGS guidance the liquefaction susceptibility of the soils at this site was assessed with respect to geological age and compositional (soil fabric and density) criteria, based on the following assumptions:

- Only saturated soils below the groundwater level within each CPT was modelled as being susceptible to liquefaction.
- In accordance with MBIE/NZGS guidance and in the absence of site-specific shear wave velocity measurements, no aging / strength gain factor has been applied.
- Soils are also classified with respect to their grain size and plasticity to assess liquefaction susceptibility.
- For this project, a cut-off threshold soil behaviour type index value (I_c) of 2.6 was used to distinguish between liquefiable ($I_c < 2.6$) and non-liquefiable ($I_c > 2.6$) soils.
- Specific liquefaction analyses were undertaken adopting design PGAs above, using the software package CLiq and the Boulanger and Idriss (2014) method. The cyclic stress ratio (CSR), being a function of the earthquake magnitude for the design return period event, was compared to the cyclic resistance ratio (CRR), being a function of the CPT cone resistance (q_c) and friction ratio (Fr).
- Free-field liquefaction induced settlements were determined in accordance with Zhang et al. (2002).
- Analyses were undertaken from existing ground level to calculate 'free-field' settlements.
- Global Lateral spreading analyses was undertaken on CPT Tests within 150m from the Herehere Stream as a preliminary assessment. Lateral stretch will be assessed in subsequent stages during detailed design.

6.4.3 Preliminary Liquefaction Results

The results of our preliminary liquefaction assessment undertaken using the existing data is outlined in Table 2 below. These tests were all undertaken within the Holocene aged alluvial deposits which are shown to also extend across the majority of the site.

Table 2: Preliminary Liquefaction Results

| CPT Reference | SLS | | ULS | |
|---------------|-----------------|------------------------------|-----------------|------------------------------|
| | Settlement (mm) | Depth to Liquefied Layer (m) | Settlement (mm) | Depth to Liquefied Layer (m) |
| CPT01 | 10 | 4.25 | 60 | 1 |
| CPT02 | 15 | 4.5 | 125 | 1 |
| CPT03 | 12 | 4 | 60 | 1 |
| CPT09 | 9 | 4 | 150 | 1 |
| CPT10 | 6 | 3.5 | 40 | 1.25 |
| CPT11 | 6 | 3.0 | 60 | 2 |
| CPT12 | 6 | 3.25 | 35 | 1 |
| CPT13 | 12 | 5.5 | 85 | 1.2 |
| CPT14 | 15 | 3.5 | 50 | 1.2 |
| CPT15 | 9 | 4 | 60 | 1.2 |
| CPT16 | 0.6 | 2.8 | 40 | 2.4 |
| CPT17 | 17 | 2.7 | 65 | 2.4 |

| CPT Reference | SLS | | ULS | |
|---------------|-----------------|------------------------------|-----------------|------------------------------|
| | Settlement (mm) | Depth to Liquefied Layer (m) | Settlement (mm) | Depth to Liquefied Layer (m) |
| CPT18 | 6 | 1.7 | 40 | 1.7 |

The results of the assessment indicate that the site is considered to be susceptible to liquefaction vertical settlement risk. Liquefaction is possible within discrete layers in both a SLS and ULS event as outlined in Table 2. The outputs of the liquefaction analysis are provided in **Appendix E**.

6.4.3.1 Lateral Spread

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where proposed fill embankments are proposed over liquefied soils. The Herehere Stream consists of a 2m free-face height and will be subject to lateral displacement. It is assumed some existing open drains will likely be incorporated into the piped stormwater management system for the site and therefore excluded.

We anticipate a building setback will be required adjacent to the Herehere stream subject to site specific design and to be quantified at subdivision consent. Provisional building setback of 20m from stream bank crest to be adopted in accordance with MBIE Part C (Minor to Moderate global lateral movement 0 to 300mm). Outside of this zone vertical settlement TC2 & TC3 foundation solutions may be appropriate.

6.4.4 Risk Based Assessment

A preliminary assessment for liquefaction vertical settlement and lateral spread has been undertaken to classifying the liquefaction potential of the site using the pre-existing CMW and WSP investigation data.

The site can be considered to have a ‘moderate’ liquefaction potential. Based on the magnitude of potential SLS and ULS liquefaction induced settlements, the foundation solution for the site likely ranges between a TC2 foundations solution and a TC2/TC3 hybrid solution as outlined in the MBIE technical guidance¹⁰.

Lateral spread risk is present adjacent to the Herehere stream where a 2m high free face is present. The lateral spread risk zones will likely require a TC2/TC3 foundation solution .

The site may be divided into liquefaction hazard zones requiring different foundation solutions to suit the magnitude of predicted settlements/ lateral spread. The magnitude and extent of these hazard zones will be subject to further investigation, analyses and design as described in Section 7.0.

Despite the predicted risk of vertical and lateral spreading risk, current development MBIE Guidelines adopt tolerable levels of displacement relative to the engineered foundation solution. The site is suitable for residential development provided specific foundation design be undertaken to mitigate effects.

6.4.5 Liquefaction Mitigation Measures

With respect to the predicted ground response outlined in Section 6.4.3 and 6.4.4, to meet the ULS requirements of the NZ Building Code, buildings must be designed for collapse avoidance.

It is expected that the range of predicted ground movement under a ULS event can be readily incorporated into the structural design to ensure the “no collapse” condition can be met, however, this will need to be preceded by further site-specific investigation, analyses and design, considering the most relevant seismic loading standard/guidance.

¹⁰ MBIE (2012), Part A Technical Guidance

The 'lateral spread risk' zone will require further site specific investigations and analyses to better define the zone and further quantify lateral displacements. It is anticipated that building foundations may be specifically designed to accommodate the magnitude of lateral displacement anticipated. In some instances, construction of lateral spread mitigation measures, such as shear keys or inground retaining, may be adopted during subdivision earthworks to reduce lateral displacements to within tolerable limits for conventional timber-framed dwellings.

Despite the liquefaction and lateral spread risk, it is anticipated that there are design solutions that can be utilised to facilitate residential development across the site.

6.5 Slope Stability

A review of the Hawkes Bay Hazard Portal indicates that the site is located outside of any mapped landslide risk areas. The majority of the site and surrounding area is near level to gently graded and therefore not considered at risk of slope instability.

Land instability may be present adjacent to the Herehere Stream due to stream erosion and over steep batter slopes. Slope stability risk adjacent to the Herehere stream should be quantified following site specific testing and assessment as part of subdivision consent to determine appropriate setbacks for buildings, structures and infrastructure if required. Any recommended setbacks to address geotechnical findings and recommendations will be provided as part of detailed design at the substantive application phase of the project.

6.6 Load-Induced Settlement

Load induced settlement occurs in soils that are subject to static loading (e.g., by fill and/or building loads) where the magnitude of settlement is governed by the soil stiffness and the load applied.

The natural subsoils are anticipated to generally comprise soft to stiff silts and clays, and medium dense to dense sands and gravels which are not considered to be prone to significant or excessive static settlements for typical at-grade residential buildings.

The provided preliminary earthworks plans show that fill is typically 0.5m thick with up to 2.0m in localised areas, typically around the perimeter of the site. Settlements in response to up to 2m of fill placement are anticipated to be less than 50mm with the majority of this settlement expected to occur during construction. As such, post-earthwork differential settlements are expected to be within NZ Building Code recommended tolerances of 1:240.

Some localised soft alluvium and buried topsoil is anticipated to underlie the site in some areas. As such, where these deposits are identified during bulk earthworks, it is recommended that they are over-excavated and backfilled with engineered fill. Geotextile and geogrid will also likely be required. The presence of perched groundwater in these areas may require temporary dewatering to allow for compaction.

6.7 Foundations

Subject to site specific testing, we anticipate that the natural ground below the topsoil layer will be suitable to support shallow residential building foundations design for a geotechnical ultimate bearing capacity of at least 200kPa. Following bulk earthworks, foundations located in engineered fill, a geotechnical ultimate bearing capacity of up to 300kPa is expected to be available.

6.8 Dry Basin Stormwater Management

The proposed dry basins should be suitable for development provided construction in accordance with site specific engineering design detailed design at the substantive application phase of the project.

7.0 STATEMENT OF SUITABILITY – CONCLUSIONS

Based on preliminary findings from preexisting site tests the site is suitable for residential development in accordance with MBIE Parts A & C Technical Guidance subject to NZS3604 loads and pending further site-specific testing and assessment.

The site is at risk to various levels of liquefaction induced vertical settlement and lateral spread risks adjacent to Herehere Stream and localised ground bearing risk.

Mitigation measures will include typical or enhanced foundations with ground improvement in accordance with MBIE Part A-C: technical guidance and ground improvement in accordance with NZGS Module 5. All earthworks should be undertaken in accordance NZS4431:2022.

8.0 FURTHER WORK

Site specific geotechnical investigations, analysis and reporting will be required as part of any future substantive application for subdivision consent to confirm the assumptions and recommendations in this report, and to support future subdivision resource consent applications. Geotechnical investigations are likely to comprise:

- Advancing a series of CPTs to depths of between 15m and 30m to further define the liquefaction hazard vertical settlement and lateral spread risk and assist with static settlement analyses;
- Machine boreholes to depths of up to 20m to visually observe the deeper soil conditions, facilitate soils sampling and calibrate the CPT data;
- A series of test pits to depths of up to 4m with associated shear vane and/or dynamic cone penetrometer test to further define the ground model, facilitate soil sampling and define extent of alluvium;
- A suite of laboratory testing such as particle size distribution and Maximum Dry Density (compaction curves) to assist with geotechnical analyses and to inform earthworks recommendations.
- Further material testing may be required for ground improvement such as reinforced fills and rigid inclusions as design develops.

CMW would be pleased to provide further assistance with any or all of the above.

9.0 CLOSURE

This report has been prepared for use by CDL Land New Zealand Ltd in relation to the proposed Fast-track referral application for a proposed subdivision at Middle Road, Havelock North in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than CDL Land New Zealand Ltd seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

Environmental matters are not covered


Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

APPENDIX A

Drawings

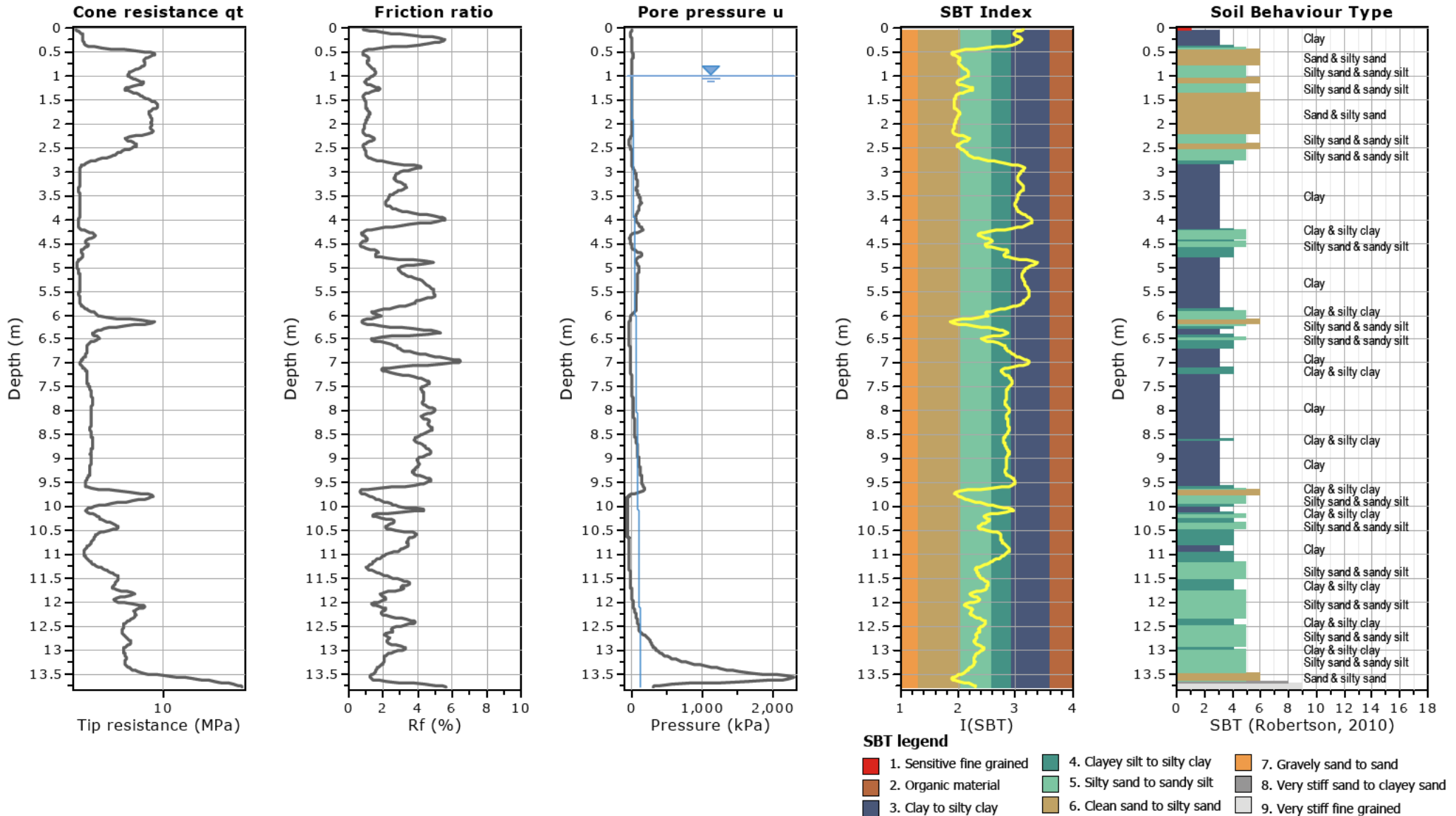


| | | | |
|---|----------|-----------|----------|
|  CMW Geosciences Great People Practical Solutions | CLIENT: | DRAWN: | PROJECT: |
| | PROJECT: | CHECKED: | DRAWING: |
| | TITLE: | REVISION: | SCALE: |
| | | DATE: | SHEET: |

APPENDIX B

Historic Site Investigation Data

Project: _____
 Location: _____
 Cone Type: _____
 Cone Operator: _____

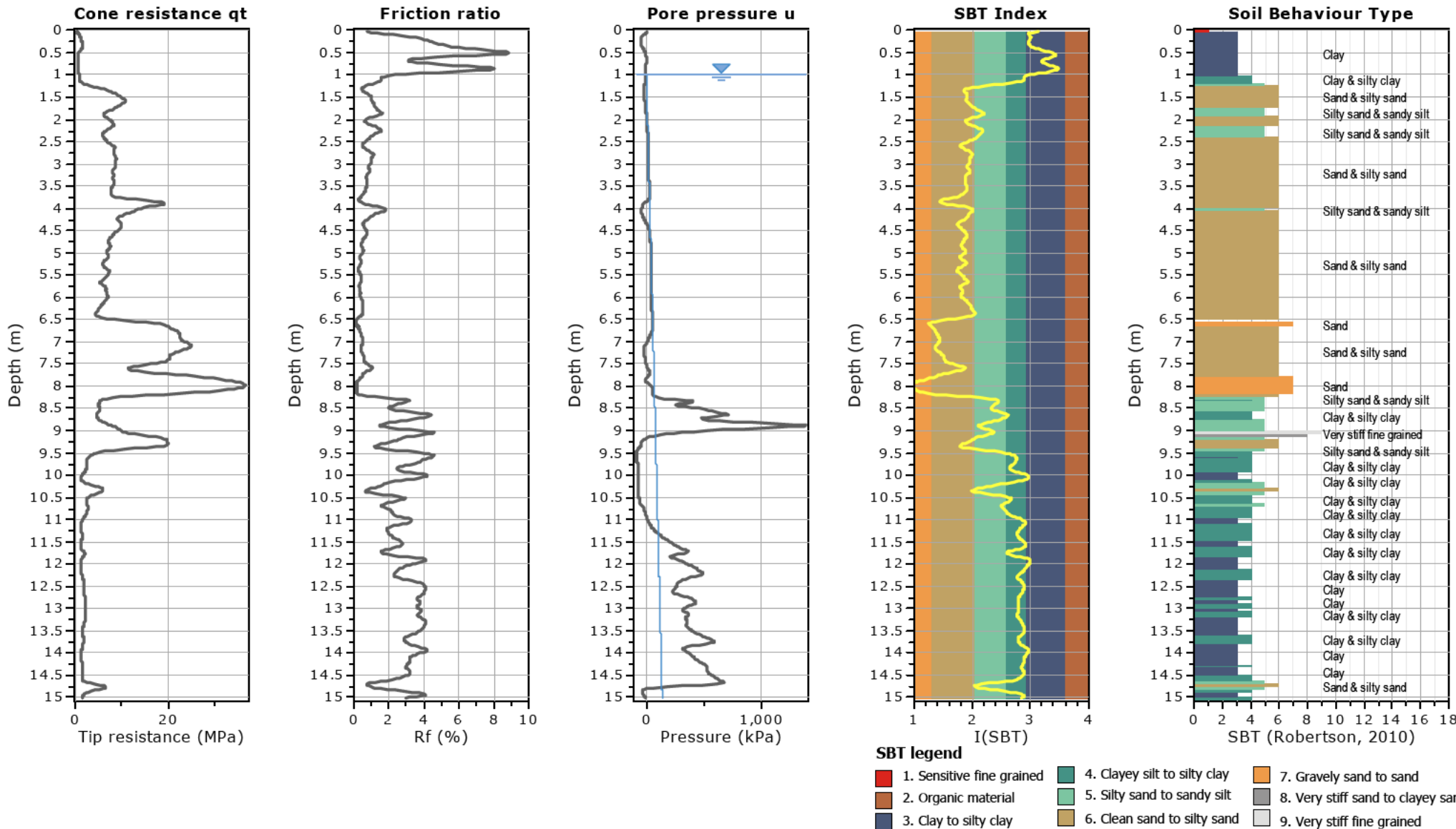


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Location:

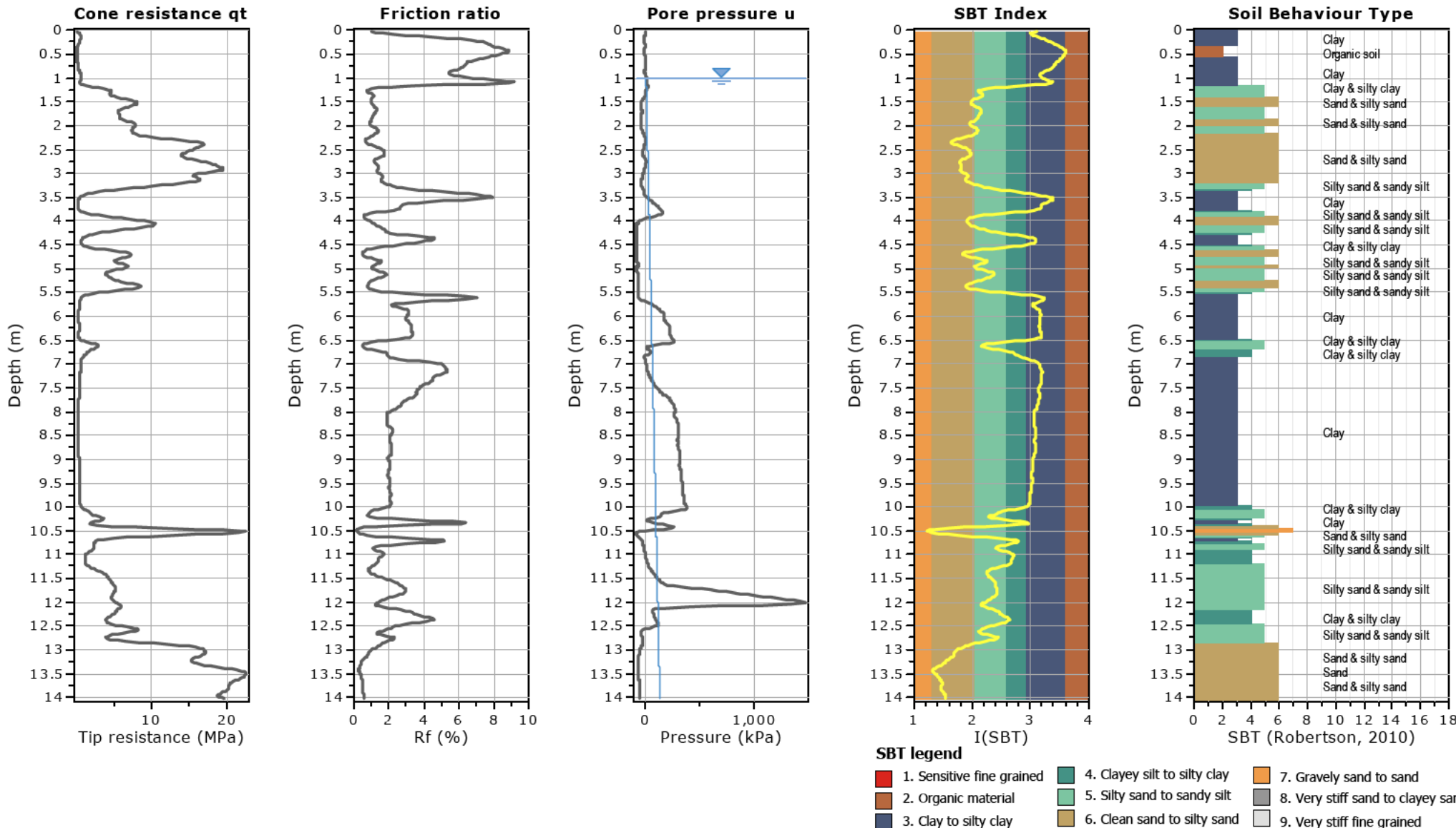
Cone Type:

Cone Operator:



Project:
 Location:

Cone Type:
 Cone Operator:

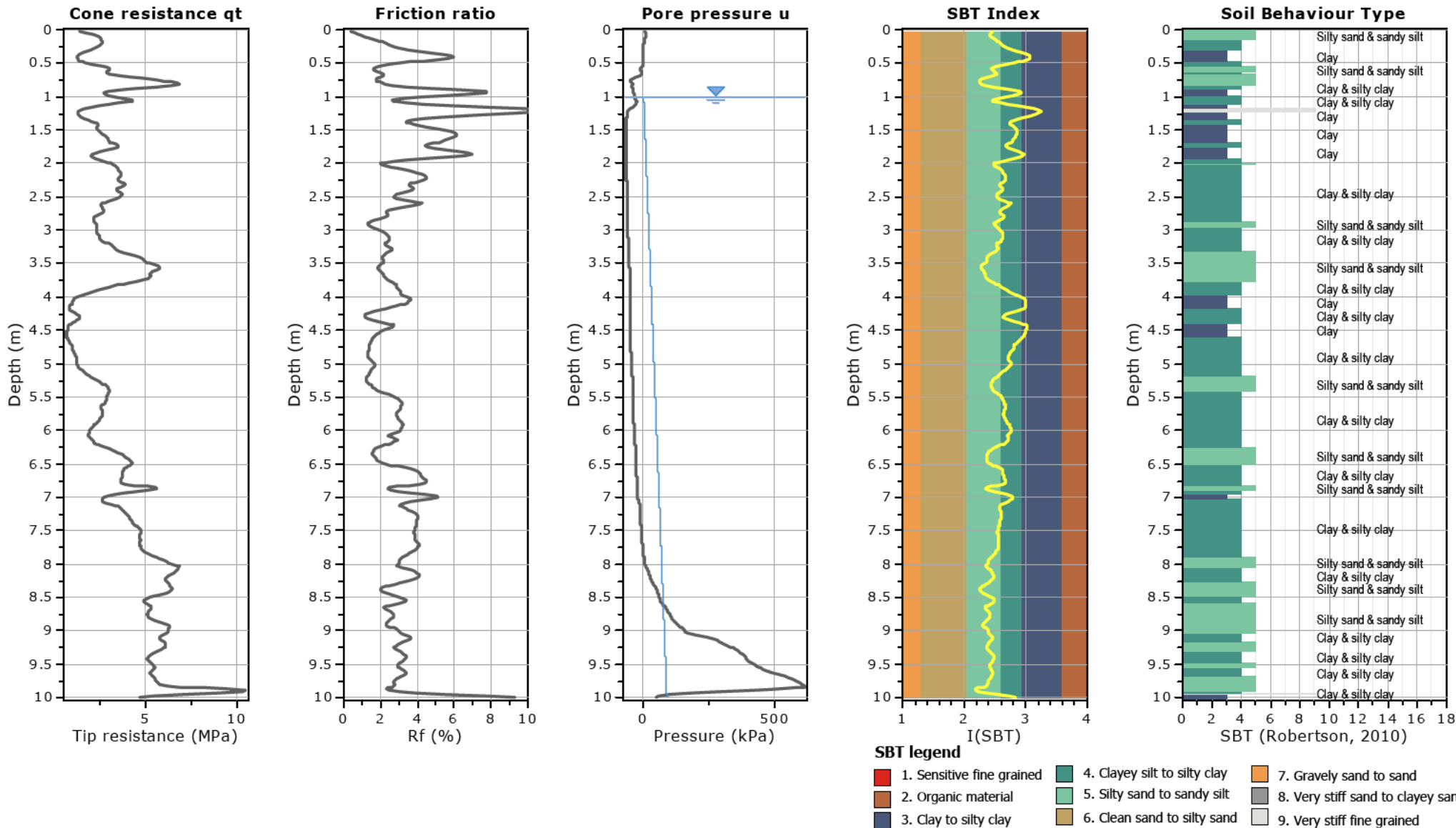


Project:

Location:

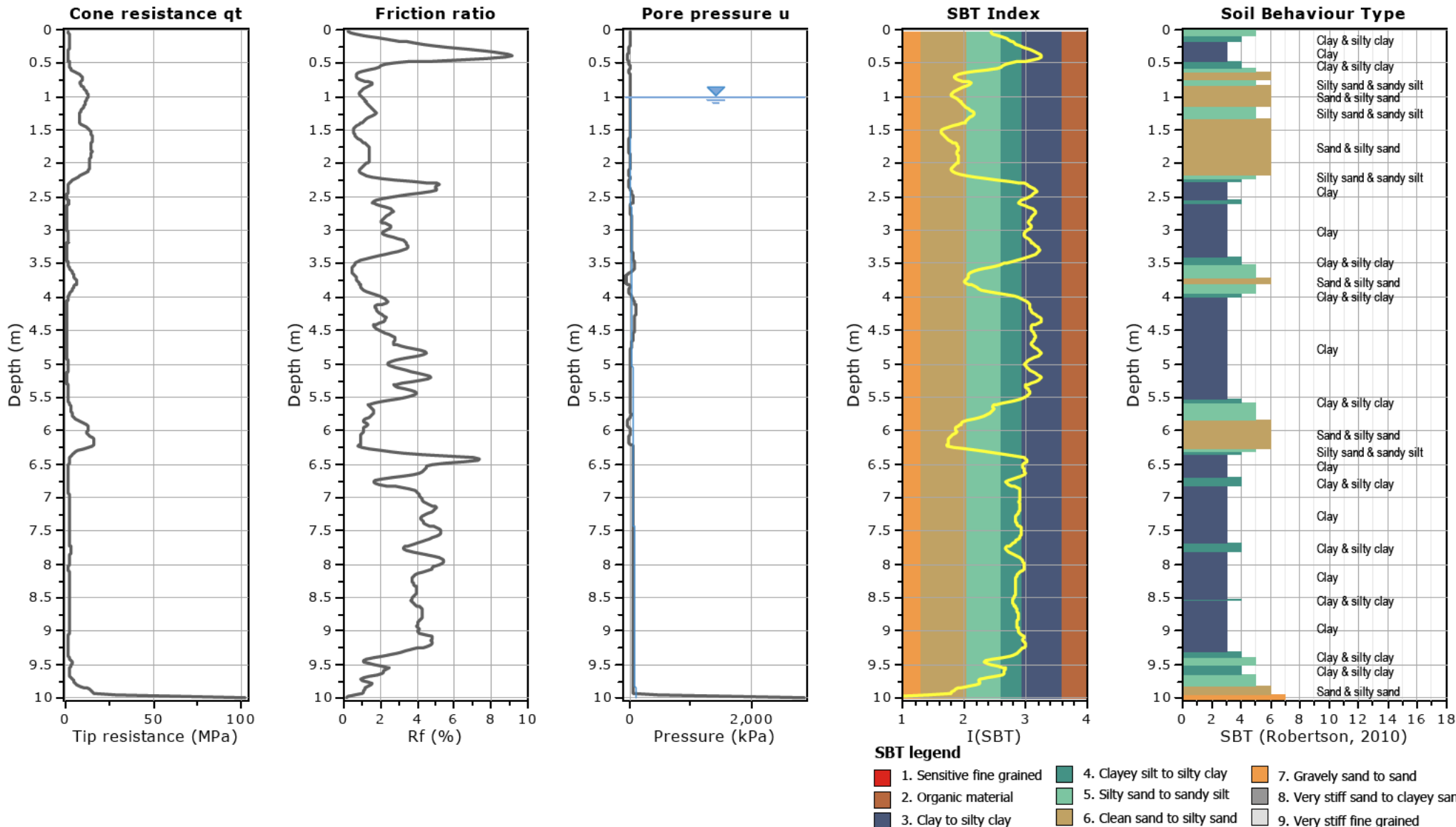
Cone Type:

Cone Operator:



Project:
Location:

Cone Type:
 Cone Operator:

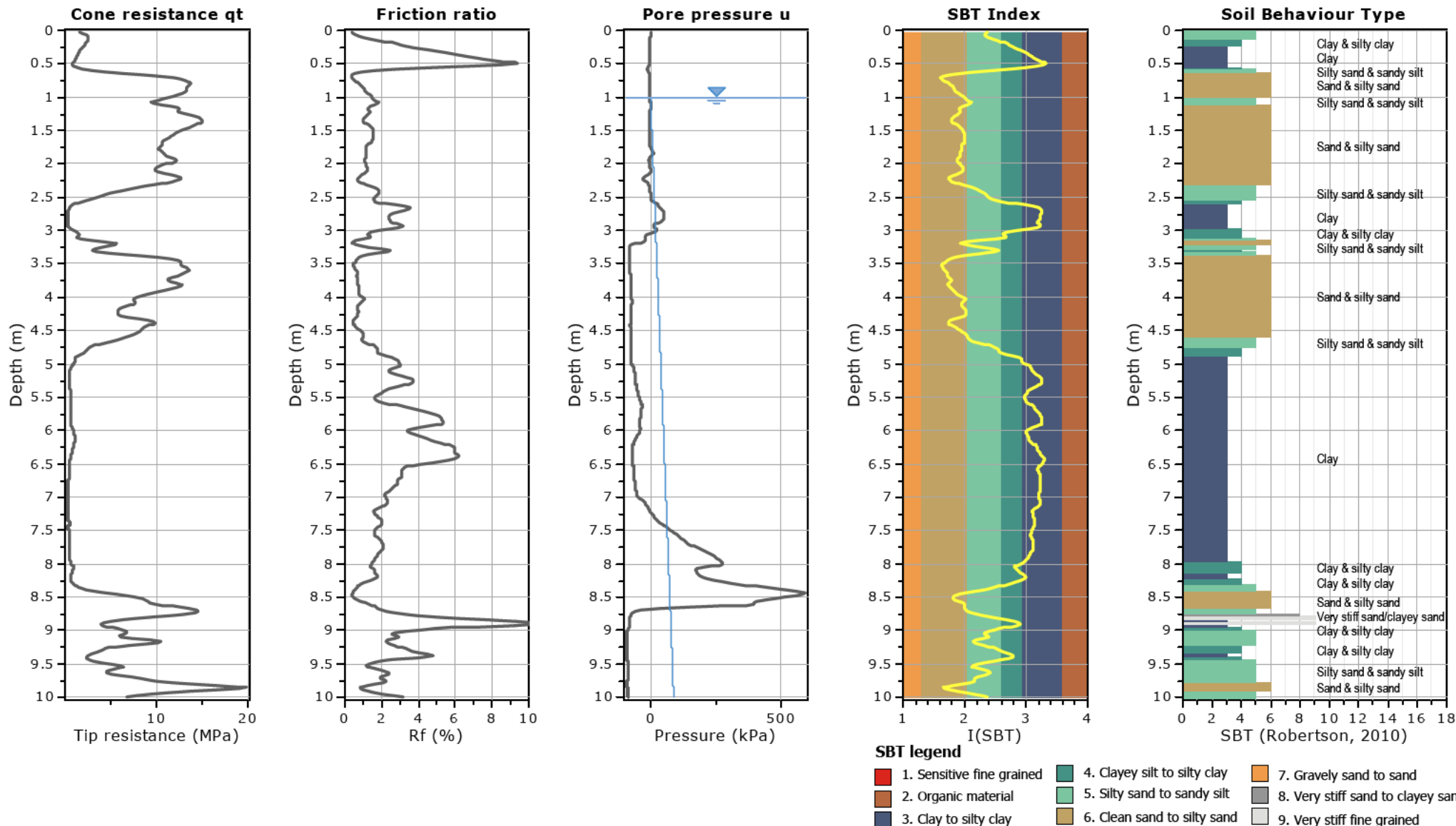


Project:

Location:

Cone Type:

Cone Operator:

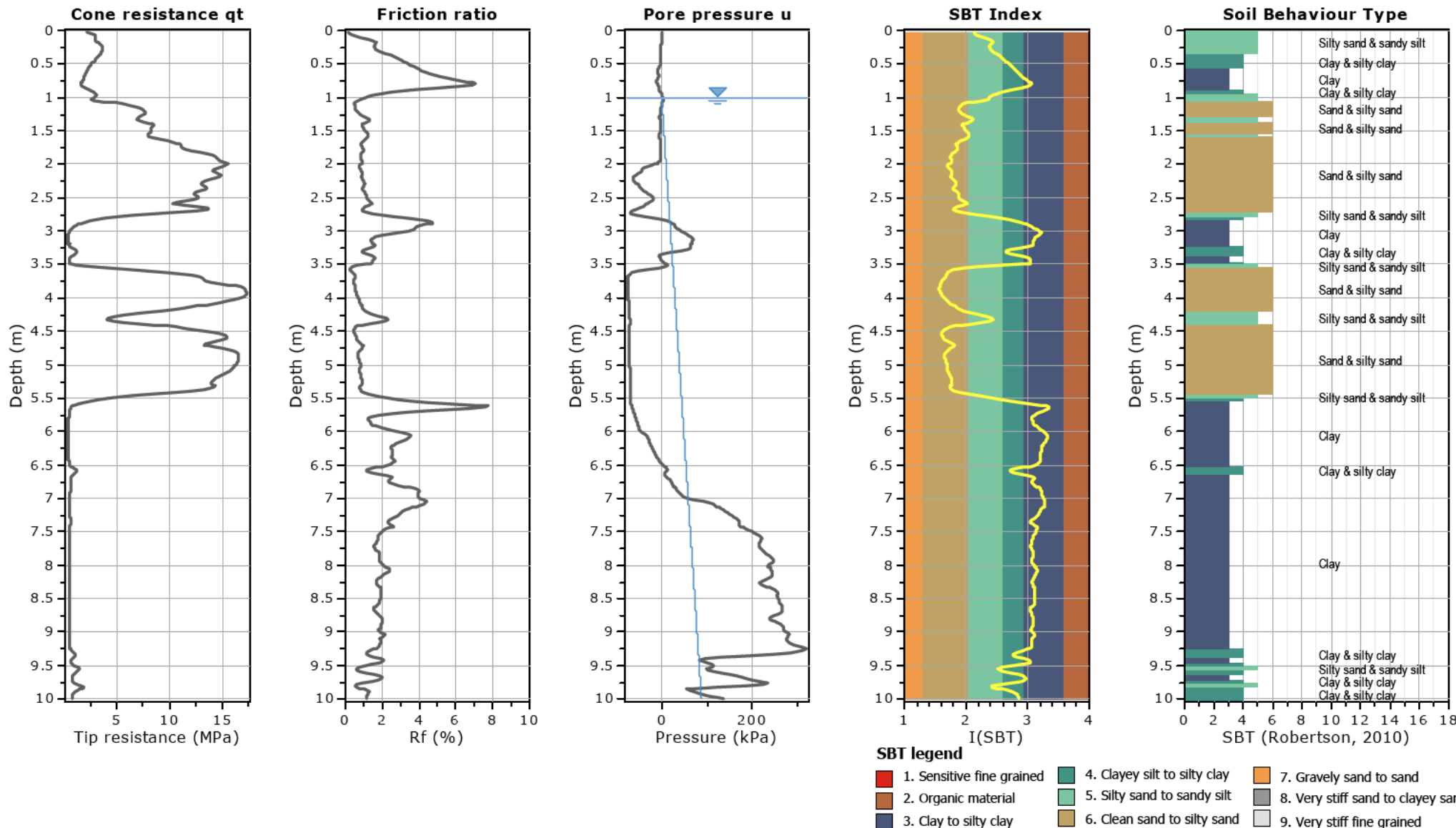


Project:

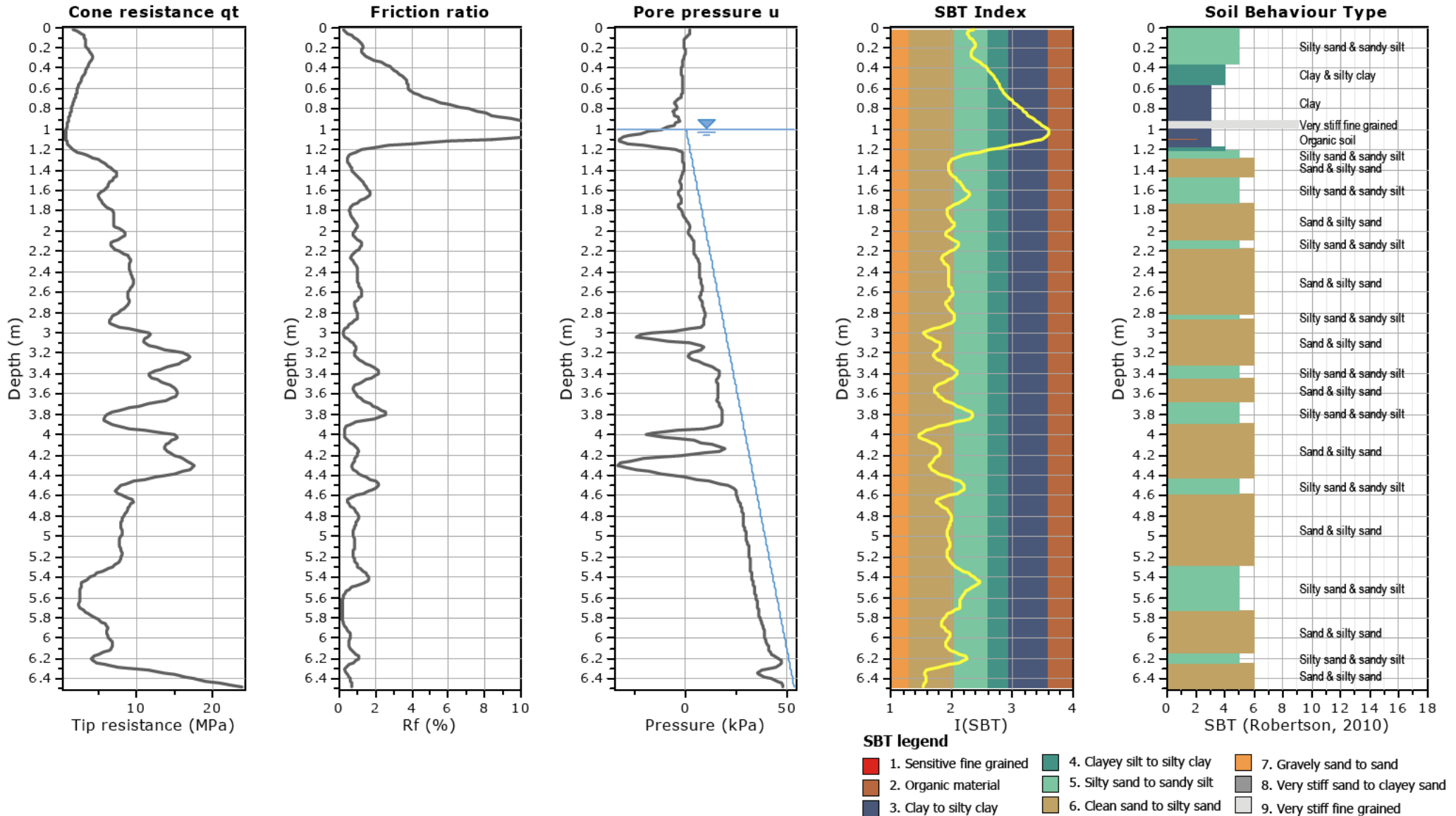
Location:

Cone Type:

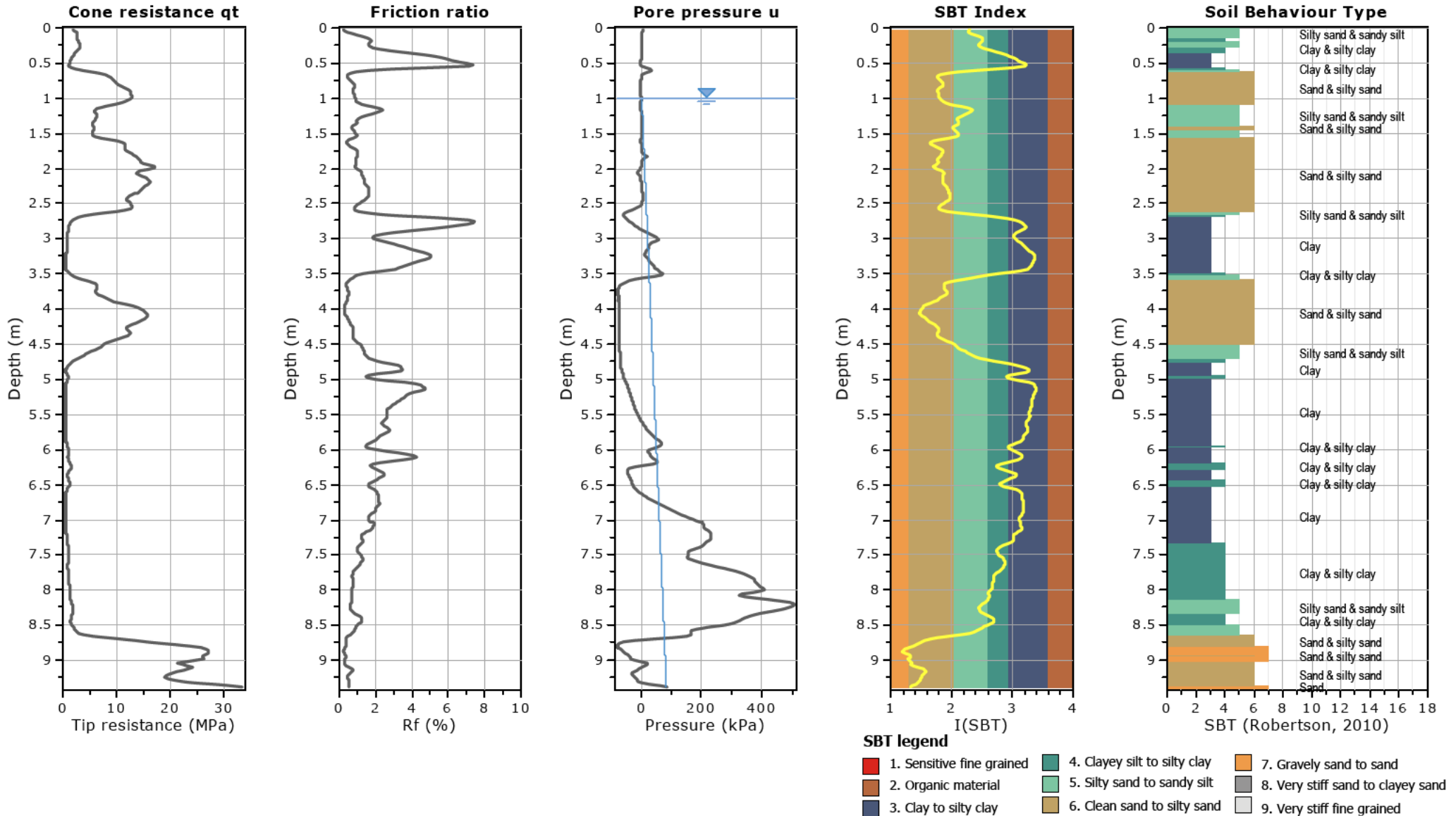
Cone Operator:



Project:
 Location:

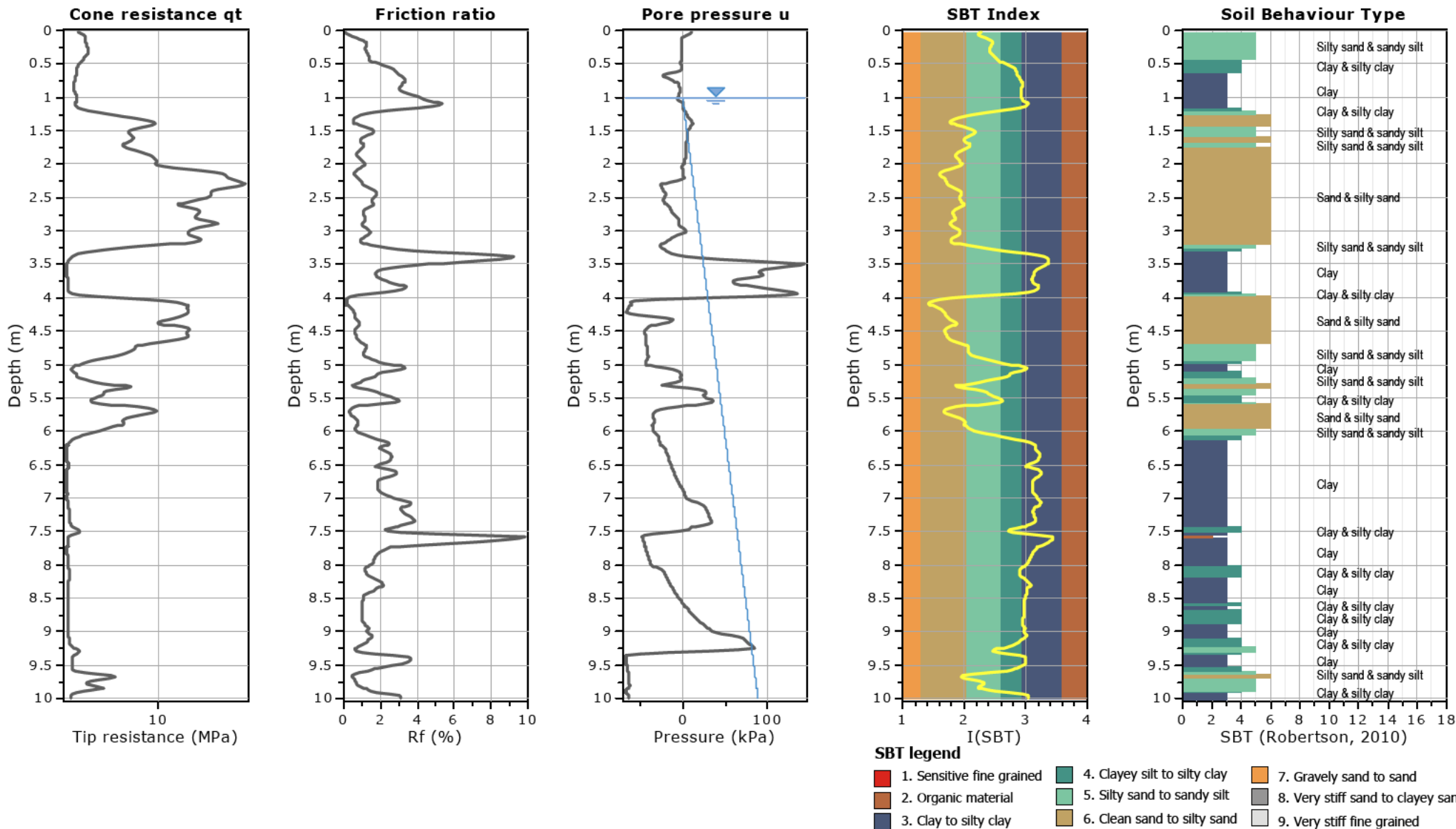


Project: _____ Cone Type: _____
 Location: _____ Cone Operator: _____

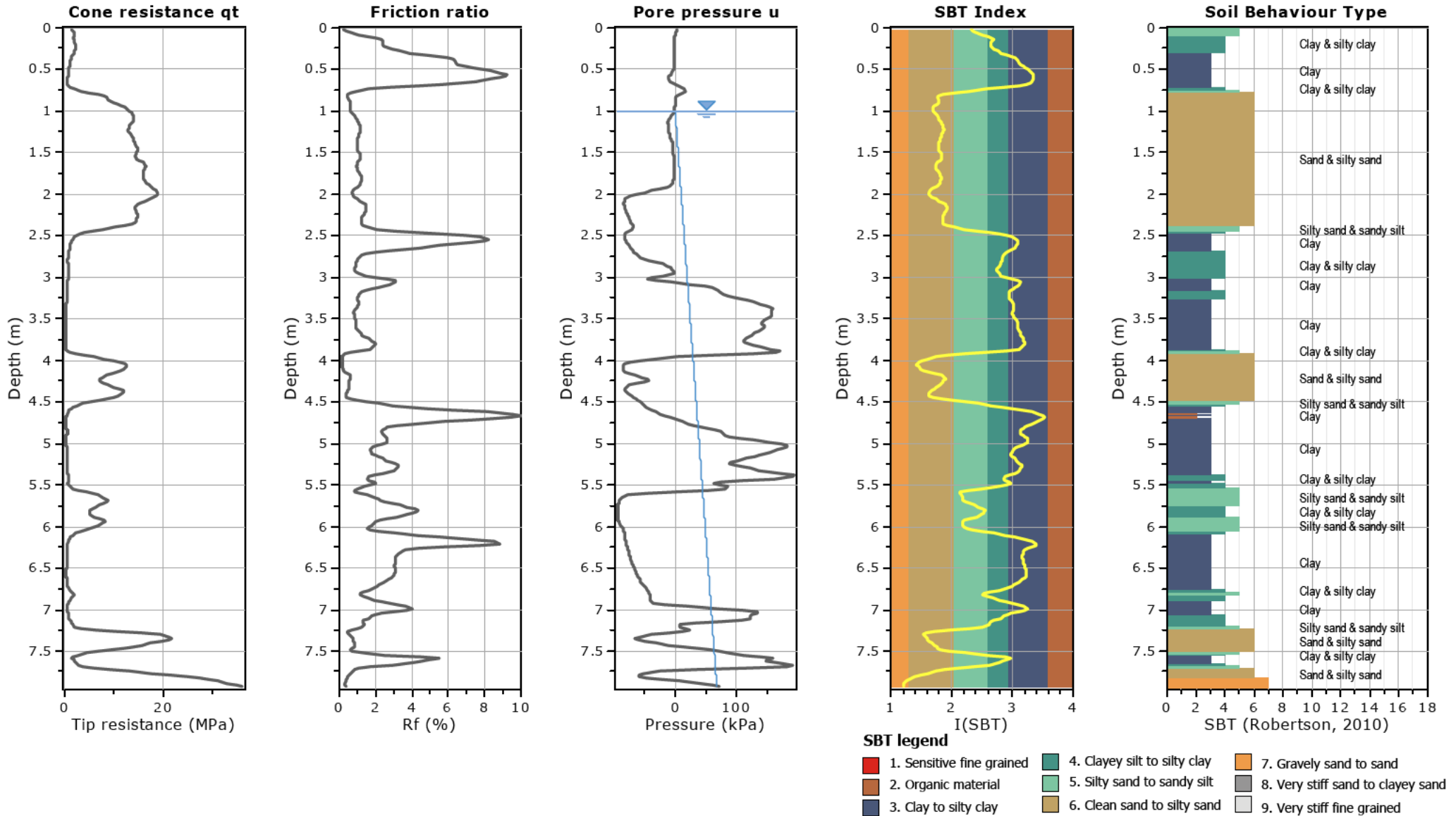


Project:
Location:

Cone Type:
 Cone Operator:

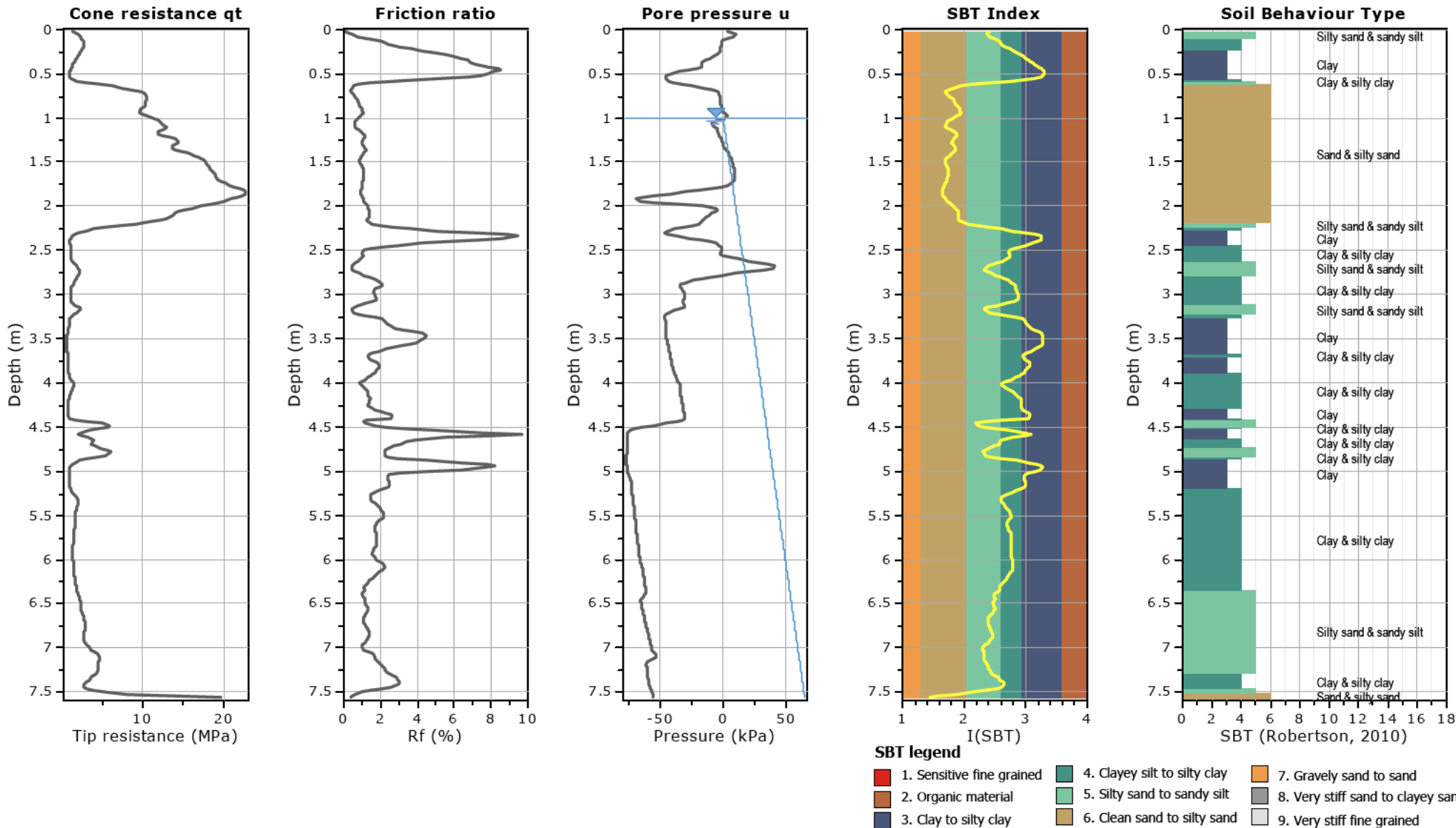


Project: _____
 Location: _____
 Cone Type: _____
 Cone Operator: _____



Project:
Location:

Cone Type:
 Cone Operator:

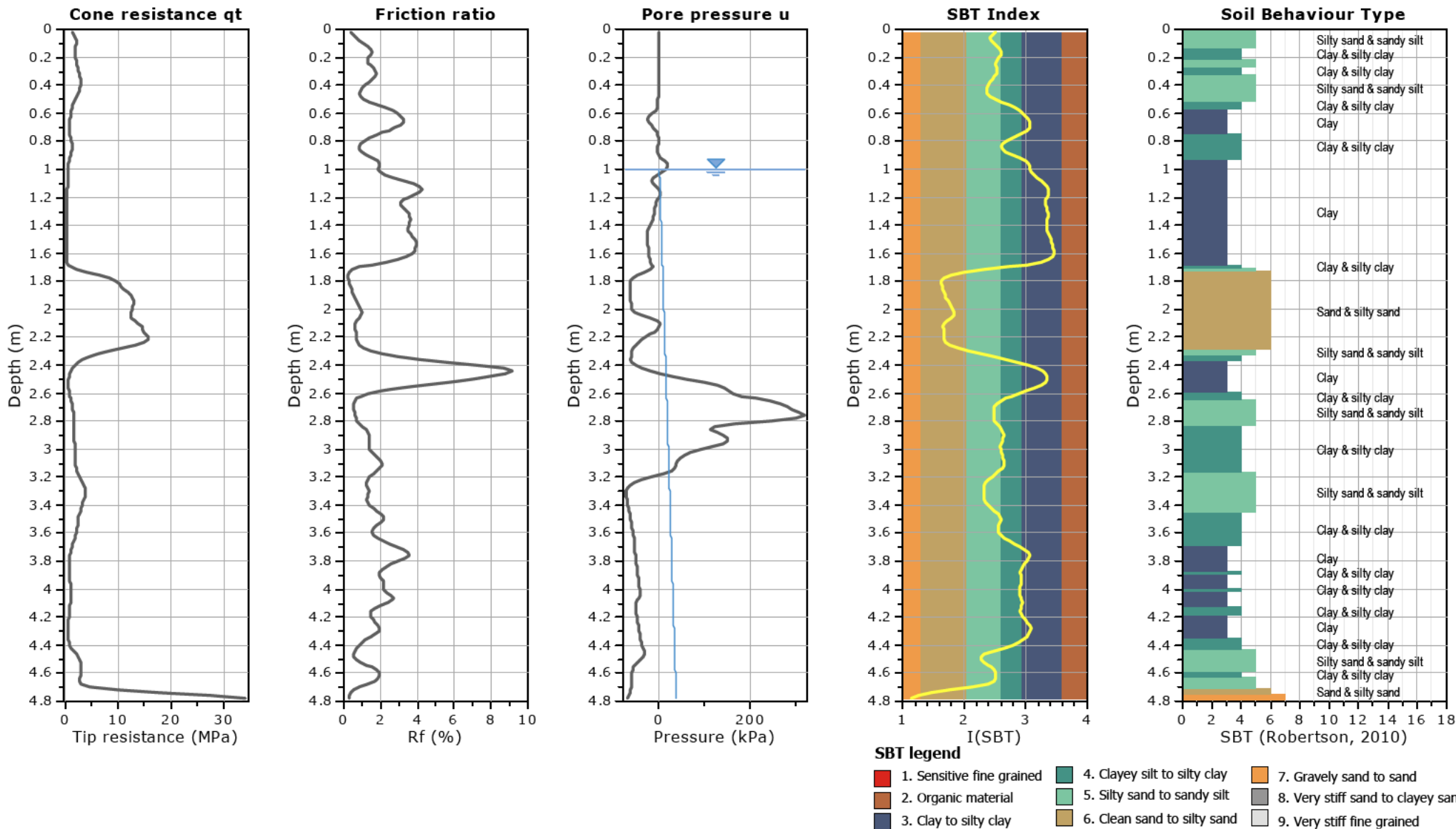


Project:

Location:

Cone Type:

Cone Operator:



APPENDIX C

Natural Hazard Risk Assessment

NATURAL HAZARDS RISK ASSESSMENT FOR LAND SUBDIVISION

PROPOSED RESIDENTIAL SUBDIVISION, MIDDLE ROAD, HAVELOCK NORTH

1 CONTEXT

The National Policy Statement for Natural Hazards (NPS-NH) sets the national framework and expectations for how natural hazards and risk must be identified and managed across all councils. Section 106 of the Resource Management Act¹ (RMA) is the statutory tool that councils must use at subdivision consent level to apply those hazard- risk principles to development proposals.

Both require an assessment of the risk from natural hazards to be carried out when considering the granting of subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land or structures (consequences).

Section 2 of the RMA defines natural hazards as any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

This appendix to CMW report reference NAP2025-0024AB Rev 0 sets out the criteria for and presents the results of an assessment of the geotechnical-related natural hazards associated with this proposed subdivision development. The remaining hazards, i.e. tsunami, wind, drought, fire and flooding hazards are not covered by this assessment.

2 BASIS OF ASSESSMENT

2.1 Risk Classification

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk table is used to help assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1.

| Table B1: Natural Hazard Risk Classification | | | | | | |
|--|---------------------|--------------------|-------------|-----------------|-----------------|-------------------|
| Risk Matrix | | Consequence | | | | |
| | | Insignificant 1 | Minor 2 | Moderate 3 | Major 4 | Catastrophic 5 |
| Likelihood | Almost Certain 5 | Medium 5 | High 10 | Very high 15 | Extreme 20 | Extreme 25 |
| | Likely 4 | Low 4 | Medium 8 | High 12 | Very high 16 | Extreme 20 |
| | Moderate 3 | Low 3 | Medium 6 | Medium 9 | High 12 | Very high 15 |

¹ Resource Management Act (1991), as of 29 October 2019

Table B1: Natural Hazard Risk Classification

| Risk Matrix | | Consequence | | | | |
|---------------|-----------|--------------------|---------------|---------------|-------------|-------------------|
| | | Insignificant 1 | Minor 2 | Moderate 3 | Major 4 | Catastrophic 5 |
| Unlikely 2 | Rare 1 | Very low 2 | Low 4 | Medium 6 | Medium 8 | High 10 |
| | | Very low 1 | Very low 2 | Low 3 | Low 4 | Medium 5 |

2.2 Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification.

Table B2: Qualitative Natural Hazard Likelihood Definitions

| | | |
|---|----------------|---|
| 1 | Rare | The natural hazard is not expected to occur during the design life of the project |
| 2 | Unlikely | The natural hazard is unlikely, but may occur during the design life |
| 3 | Moderate | The natural hazard will probably occur at some time during the life of the project |
| 4 | Likely | The natural hazard is expected to occur during the design life of the project |
| 5 | Almost Certain | The natural hazard will almost definitely occur during the design life of the project |

2.3 Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification.

Table B3: Qualitative Natural Hazard Consequence Definitions

| | | |
|---|---------------|--|
| 1 | Insignificant | Very minor to no damage, not requiring any repair, no people at risk, no economic effect to landowners. |
| 2 | Minor | Minor damage to land only, any repairs can be considered normal property maintenance no people at risk, very minor economic effect. |
| 3 | Moderate | Some damage to land requiring repair to reinstate within few months, minor cosmetic damage to buildings being within relevant code tolerances, does not require immediate repair, no people at risk, minor economic effect. |
| 4 | Major | Significant damage to land requiring immediate repair, damage to buildings beyond serviceable limits requiring repair, no collapse of structures, perceptible effect to people, no risk to life, considerable economic effect. |
| 5 | Catastrophic | Major damage to land and buildings, possible structure collapse requiring replacement, risk to life, major economic effect, or possible site abandonment. |

2.4 Risk Acceptance

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

Therefore, to give this qualitative natural hazard risk assessment some relevance to more commonly adopted numerical or quantitative geotechnical assessment techniques, a residual risk rating of very low to medium (risk value = 1 to 9 inclusive) is considered an acceptable result for the proposed subdivision development.

A risk rating of high to extreme (risk value ≥ 10) is considered an unacceptable result for the proposed subdivision development.

3 RISK ASSESSMENT

The natural hazards relevant to this proposed subdivision development and adjacent, potentially affected land have been assessed with respect to the criteria outlined above.

Assessment is based on proposed post development ground conditions with and without any geotechnical controls. The latent risk was first assessed with the site in its proposed developed state to consider the risks to the development and surrounding land, including assessment of land modifications from the pre-existing natural state, without any implemented geotechnical controls. The specific geotechnical mitigation measures and engineering design solutions outlined in the table below and CMW report, where relevant, were then considered to determine the natural hazard residual risk remaining after the proposed controls have been implemented.

Results of this assessment are presented in Table C1 below.

| Table C1: Natural Hazard Risk Assessment Results | | | | | | | | |
|--|--|--|-------------|-------------|---|--|-------------|-------------|
| RMA S2 Hazard | Description | Proposed Site Latent Risk of Damage to Land / Structures | | | Comments and Geotechnical Control | Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented | | |
| | | Likelihood | Consequence | Risk Rating | | Likelihood | Consequence | Risk Rating |
| Earthquake | Fault Rupture | 1 | 3 | Low 3 | The closest known active fault is approximately 2km to the site. Site is located outside of fault avoidance zone. | 1 | 3 | Low 3 |
| | Liquefaction Induced Flooding and/ or Subsidence | 3 | 4 | High 12 | Specific foundation design, ground improvement or locate buildings / sensitive | 1 | 4 | Low 4 |

Table C1: Natural Hazard Risk Assessment Results

| RMA S2 Hazard | Description | Proposed Site Latent Risk of Damage to Land / Structures | | | Comments and Geotechnical Control | Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented | | |
|---------------|---|--|-------------|-------------|--|--|-------------|-------------|
| | | Likelihood | Consequence | Risk Rating | | Likelihood | Consequence | Risk Rating |
| | | | | High 12 | infrastructure within low liquefaction risk zone | | | |
| | Lateral Spread | 3 | 4 | High 12 | Locate buildings outside of lateral spread risk zone, Specific foundation design, lateral spread mitigation measures | 1 | 4 | Low 4 |
| Erosion | Cut Batters | 3 | 3 | Medium 9 | Max 1(V):2.5(H) gradient without further investigation and analysis | 1 | 3 | Low 4 |
| | Fill Batters | 3 | 3 | Medium 9 | Max 1(V):2.5(H) gradient without further investigation and analysis | 1 | 3 | Low 4 |
| Landslip | Global Slope Instability along Herehere Stream boundary | 3 | 3 | Medium 9 | Building restriction lines to be nominated following specific investigation and analysis. | 2 | 3 | Medium 6 |
| | Bearing Capacity Failure | 2 | 4 | Medium 8 | Undercut and replace any unsuitable near surface soils such as peat and historic fill | 1 | 4 | Low 4 |
| Subsidence | Soft Soils | 2 | 3 | Medium 6 | Undercut and remove soft alluvium /peat or preload to reduce excessive static settlements. Geotechnical Engineer to observe building platform preparation. | 1 | 3 | Low 3 |

Notes:

Assessments include the impact of the proposed subdivision work on adjacent properties.

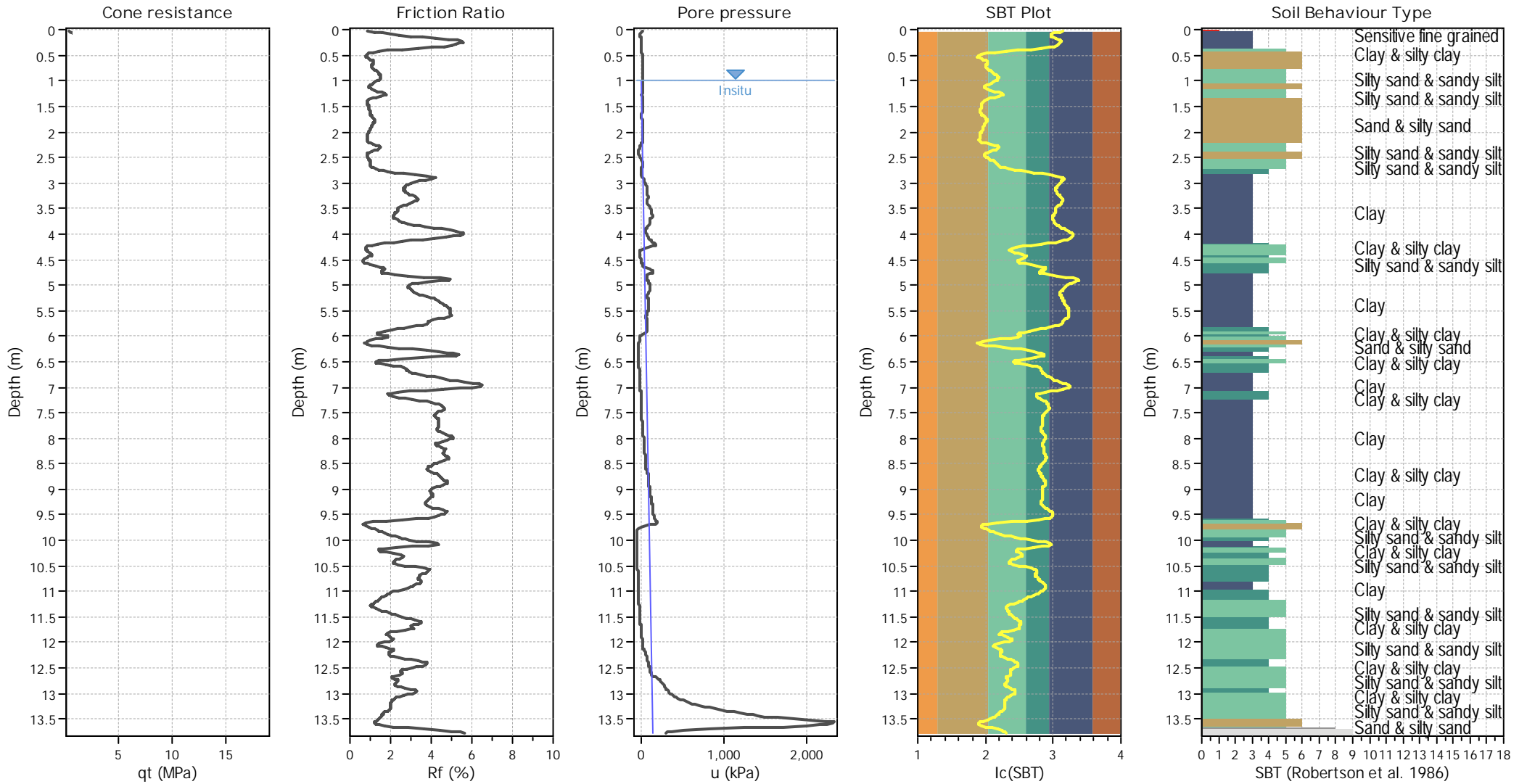
The following reference(s) contain information on the hazards contained in this assessment and the non-geotechnical hazards that have not been included:

- Hawke’s Bay Hazard Portal, <https://gid.hbrc.govt.nz/hazards/>

APPENDIX D

Liquefaction Analysis

CPT basic interpretation plots



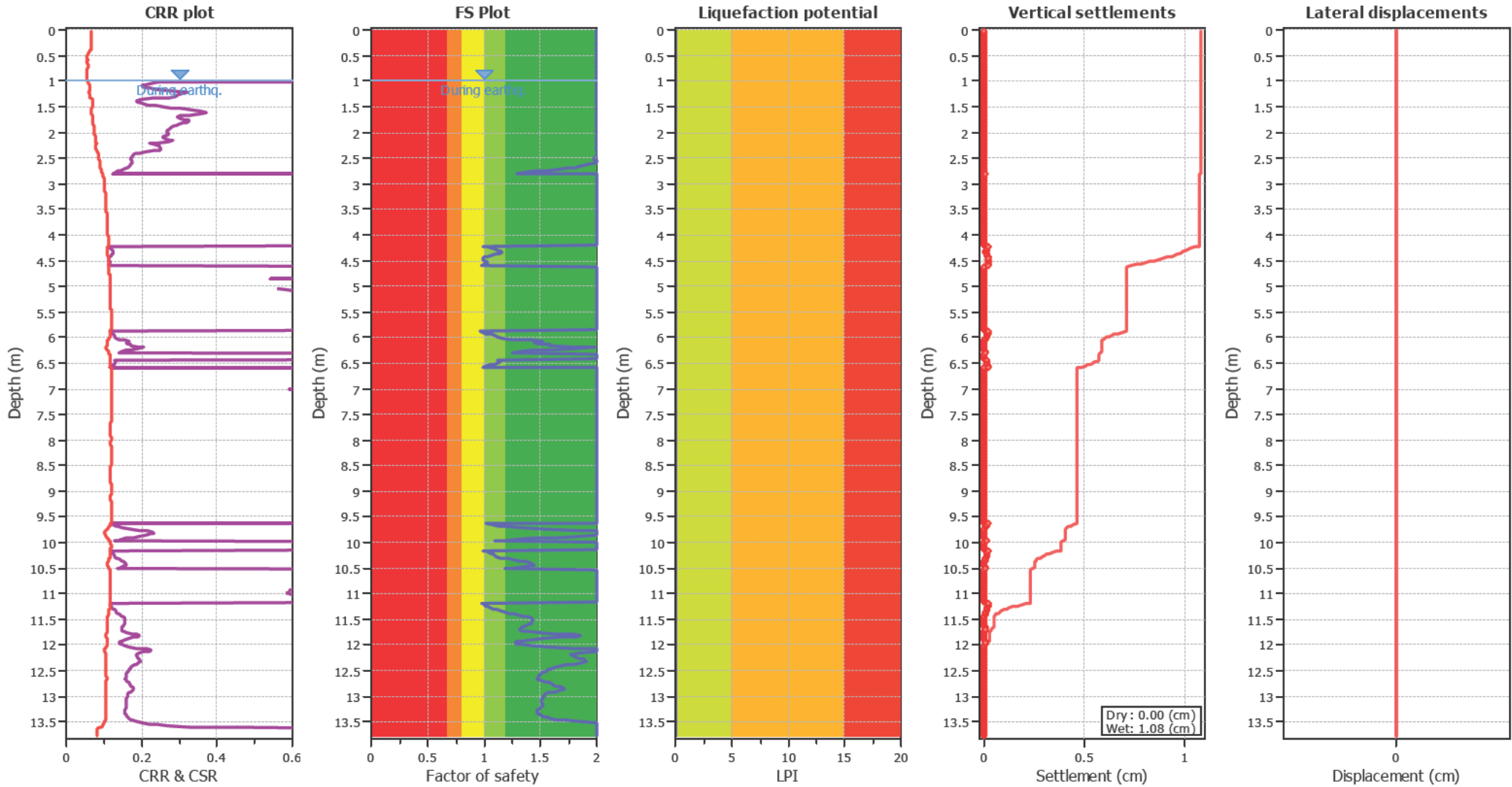
Input parameters and analysis data

| | | | | | |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
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| 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 _G applied: | Yes |
| Earthquake magnitude M _w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
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| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

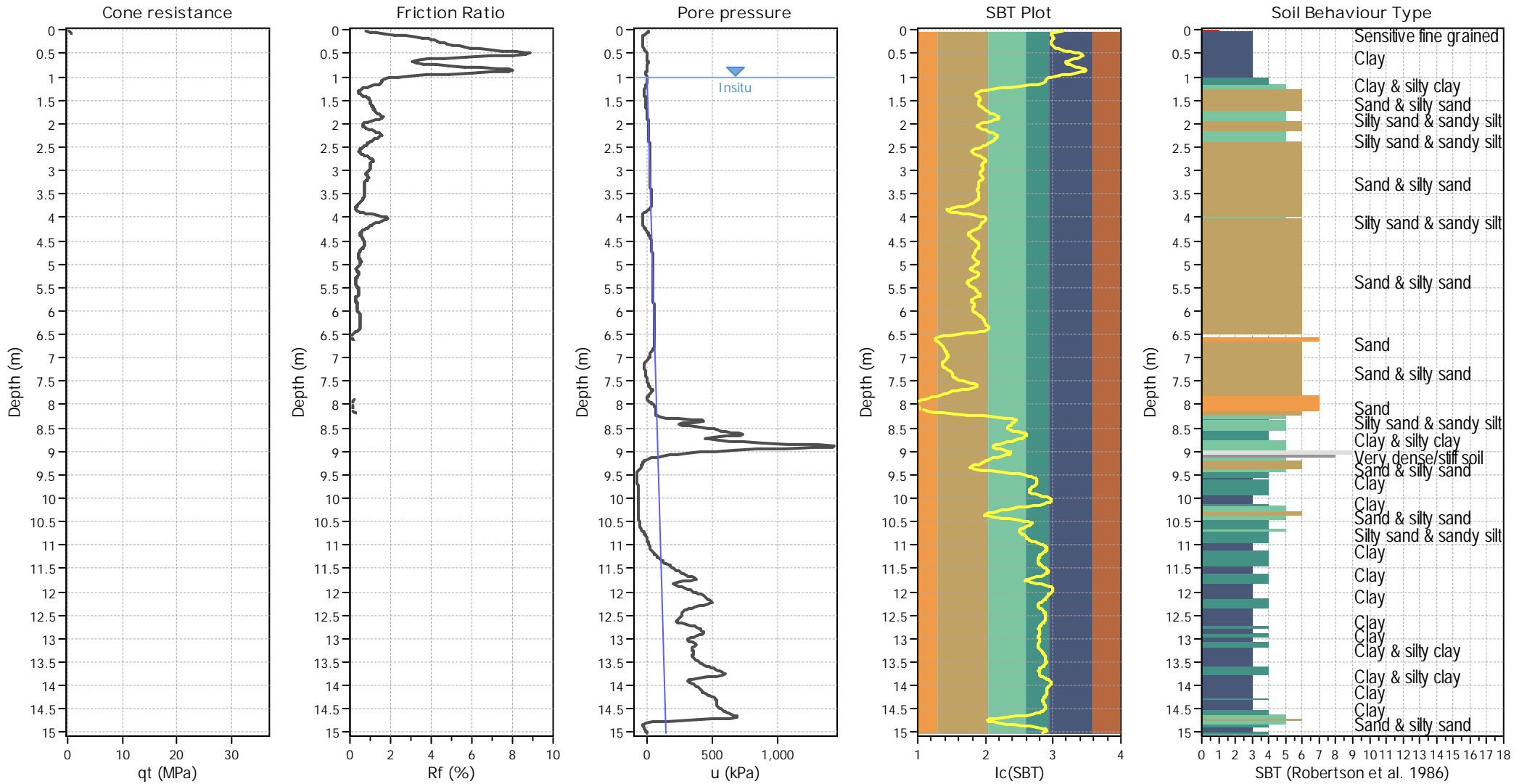
F.S. color scheme

- 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

CPT basic interpretation plots



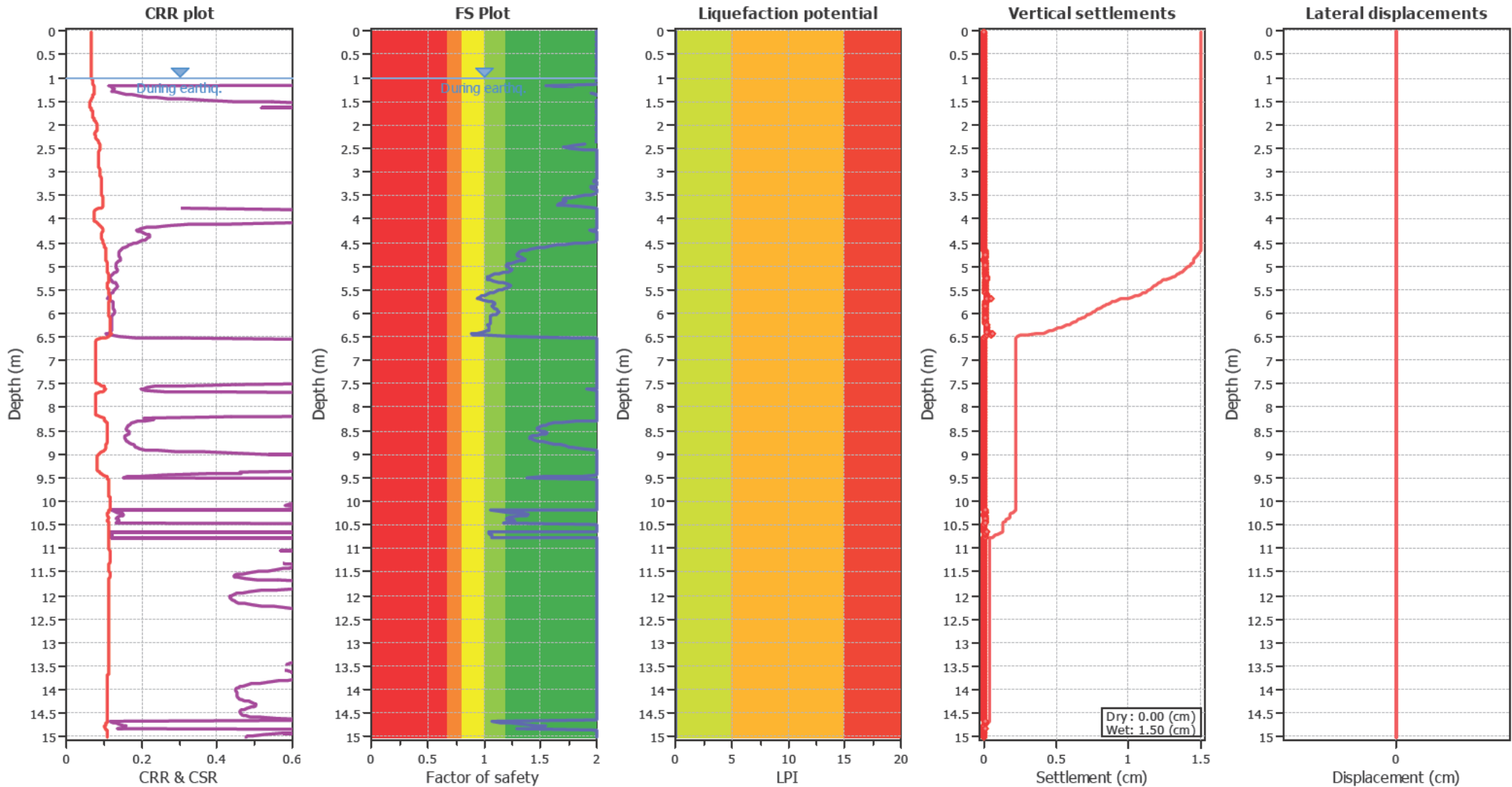
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
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Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
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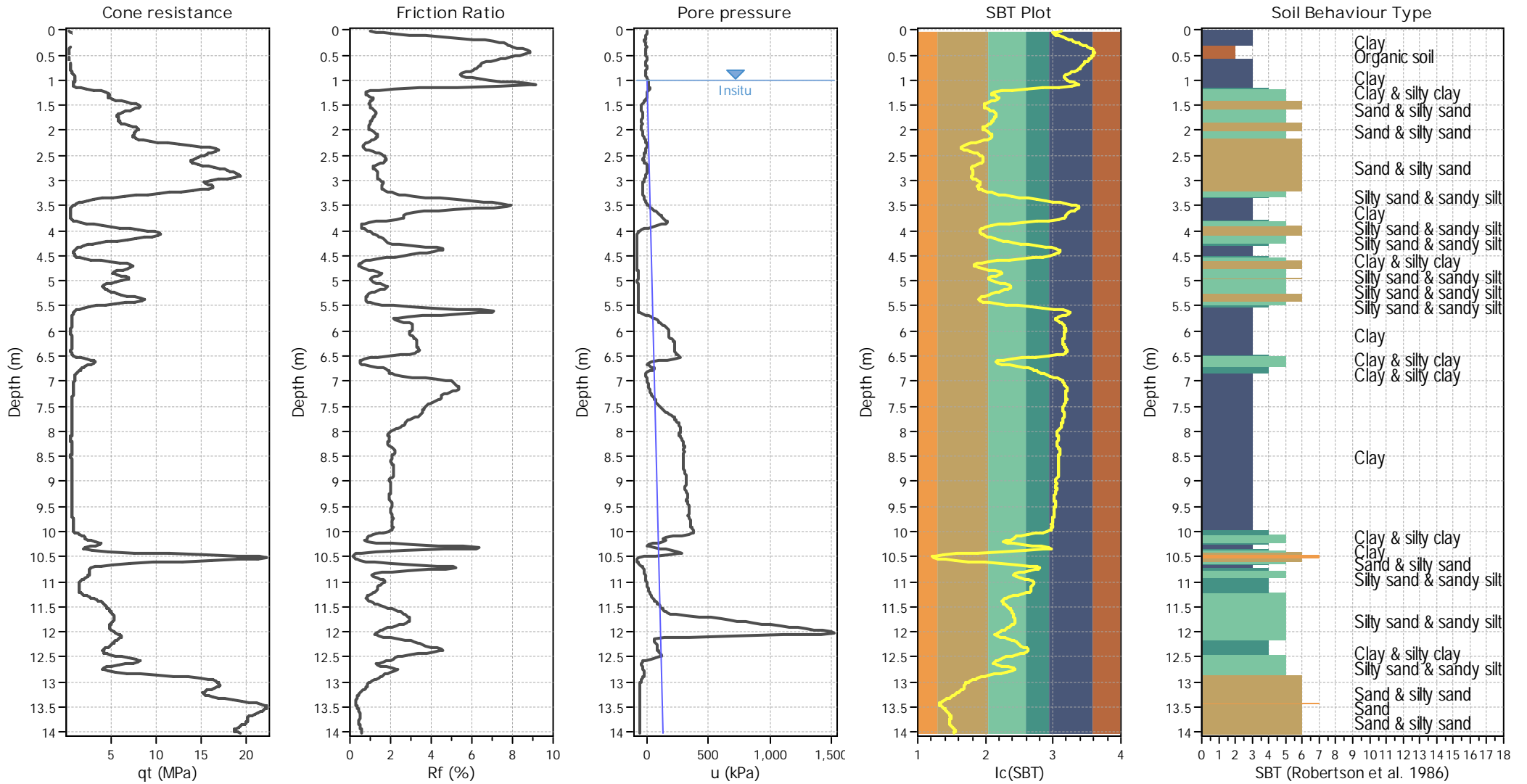
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- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



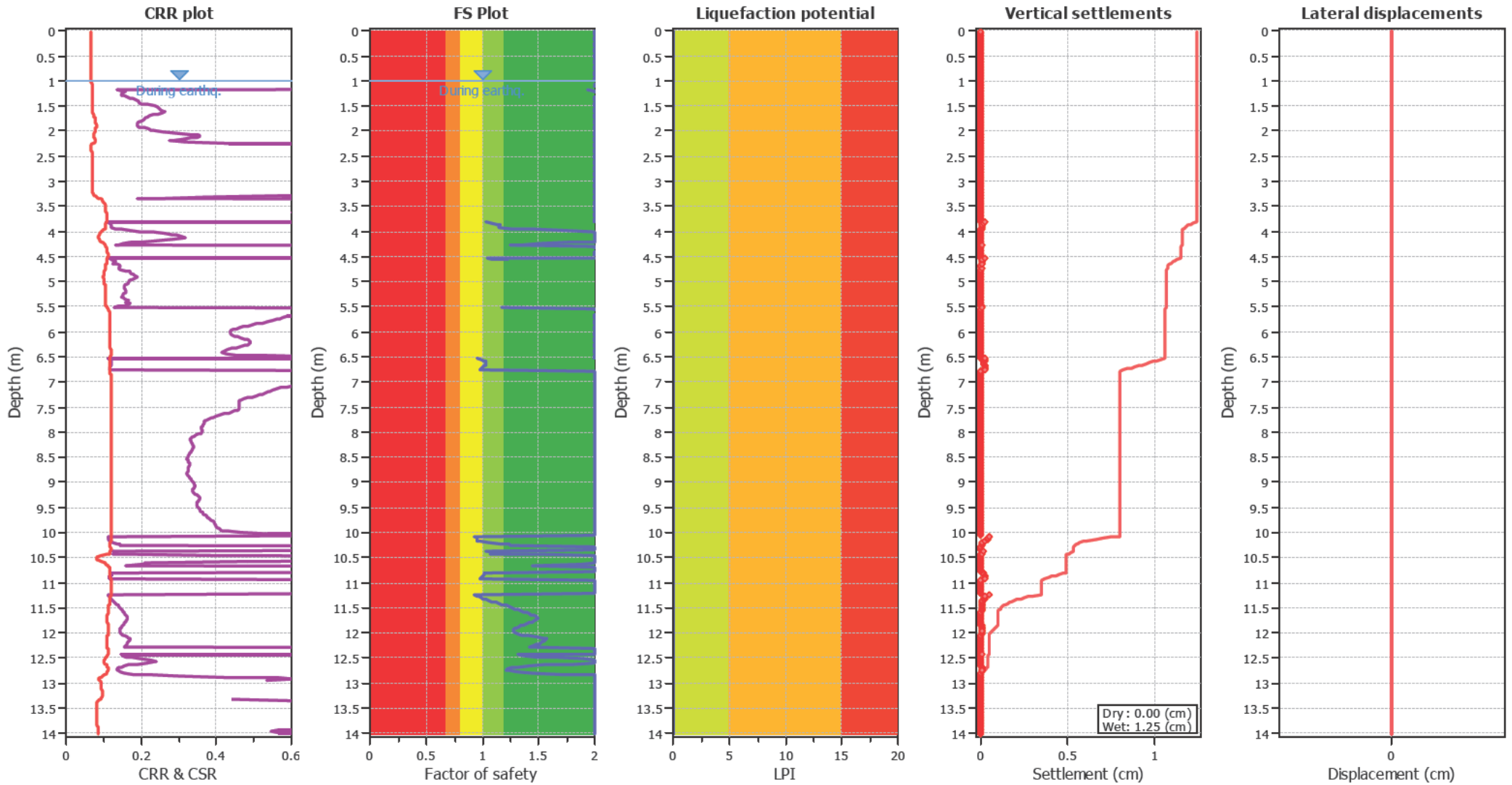
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| | | | | | |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
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| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

SBT legend

| | | |
|---------------------------|-----------------------------|----------------------------|
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Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

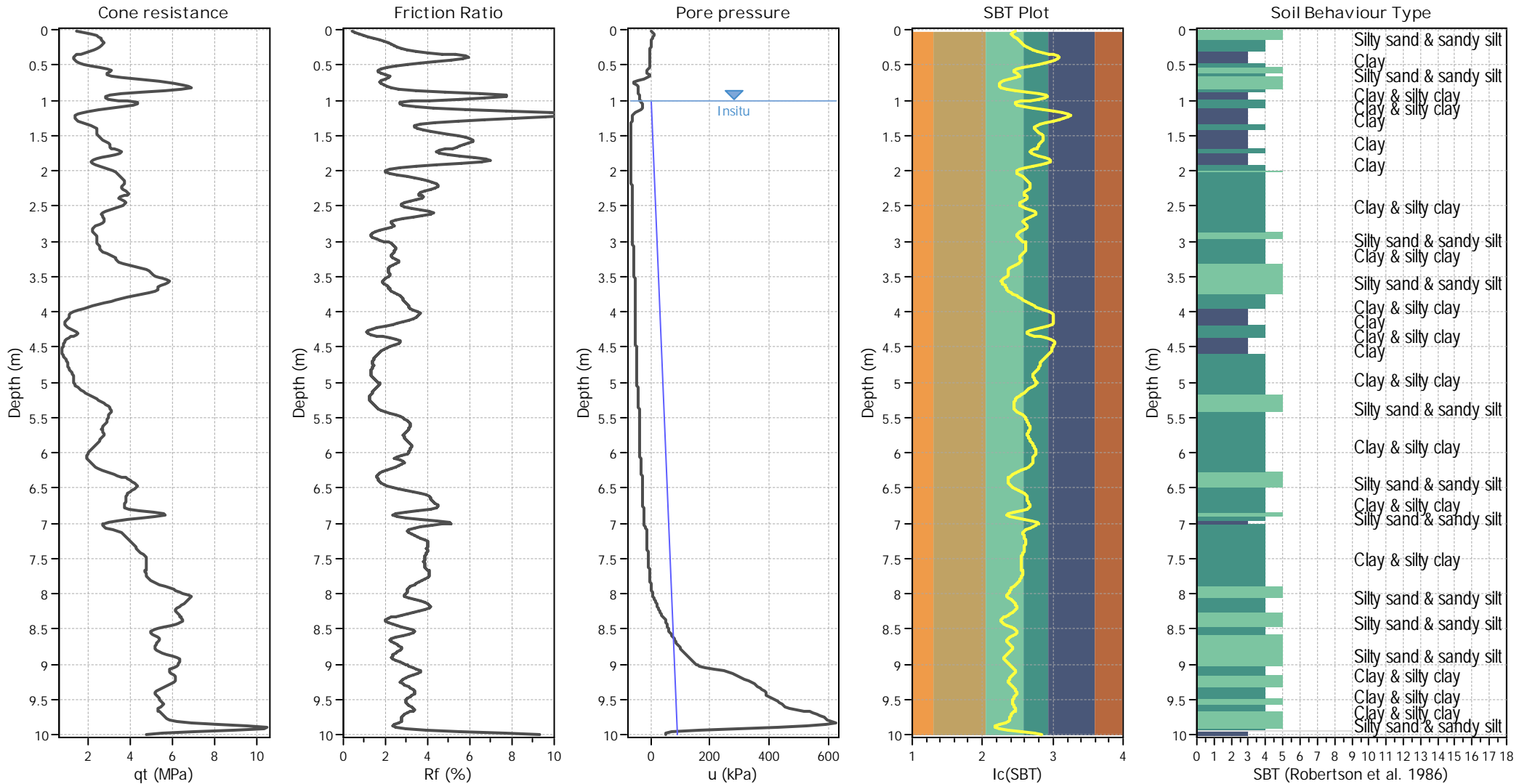
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CPT basic interpretation plots



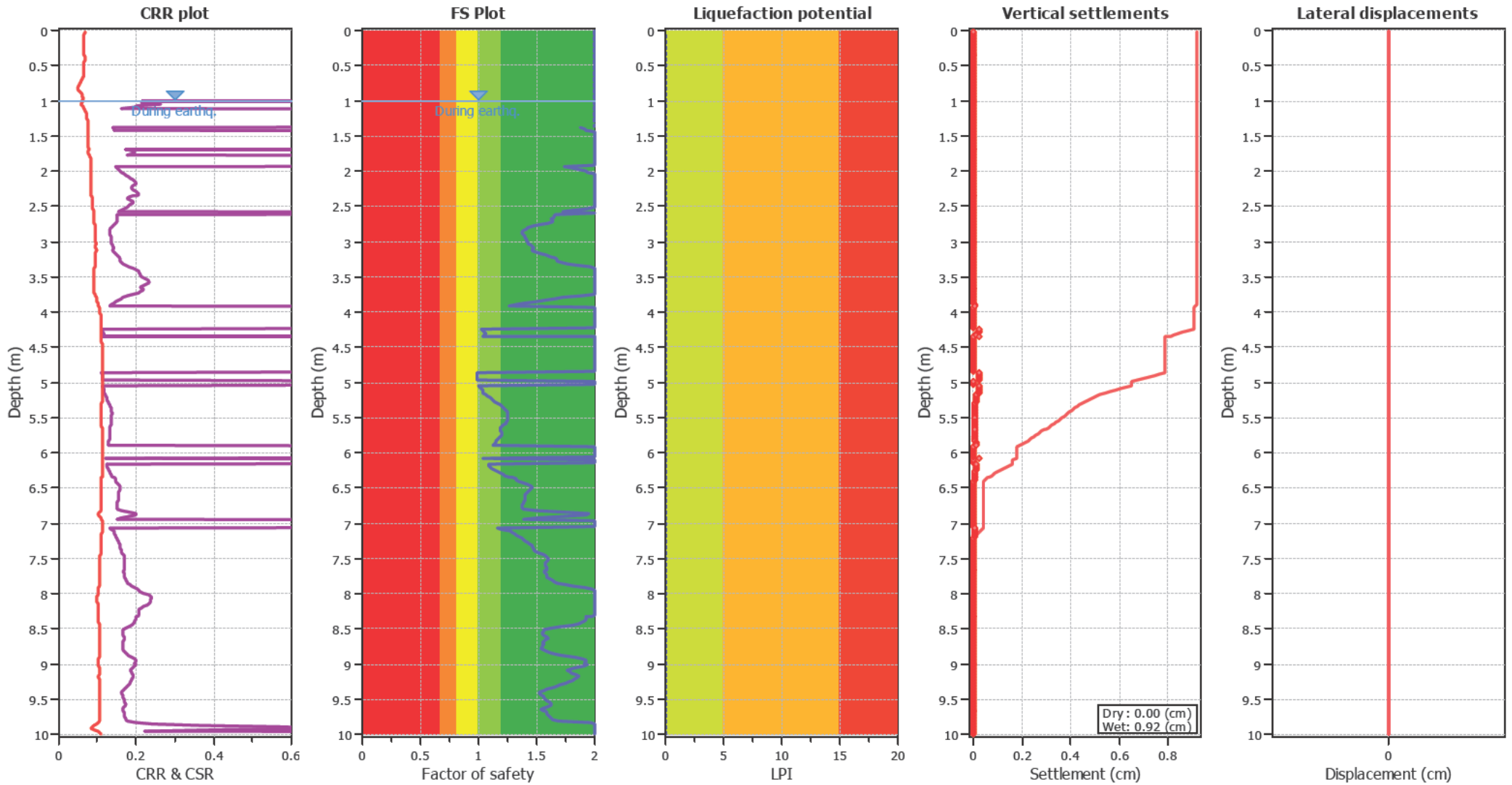
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
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Liquefaction analysis overall plots



Input parameters and analysis data

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| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

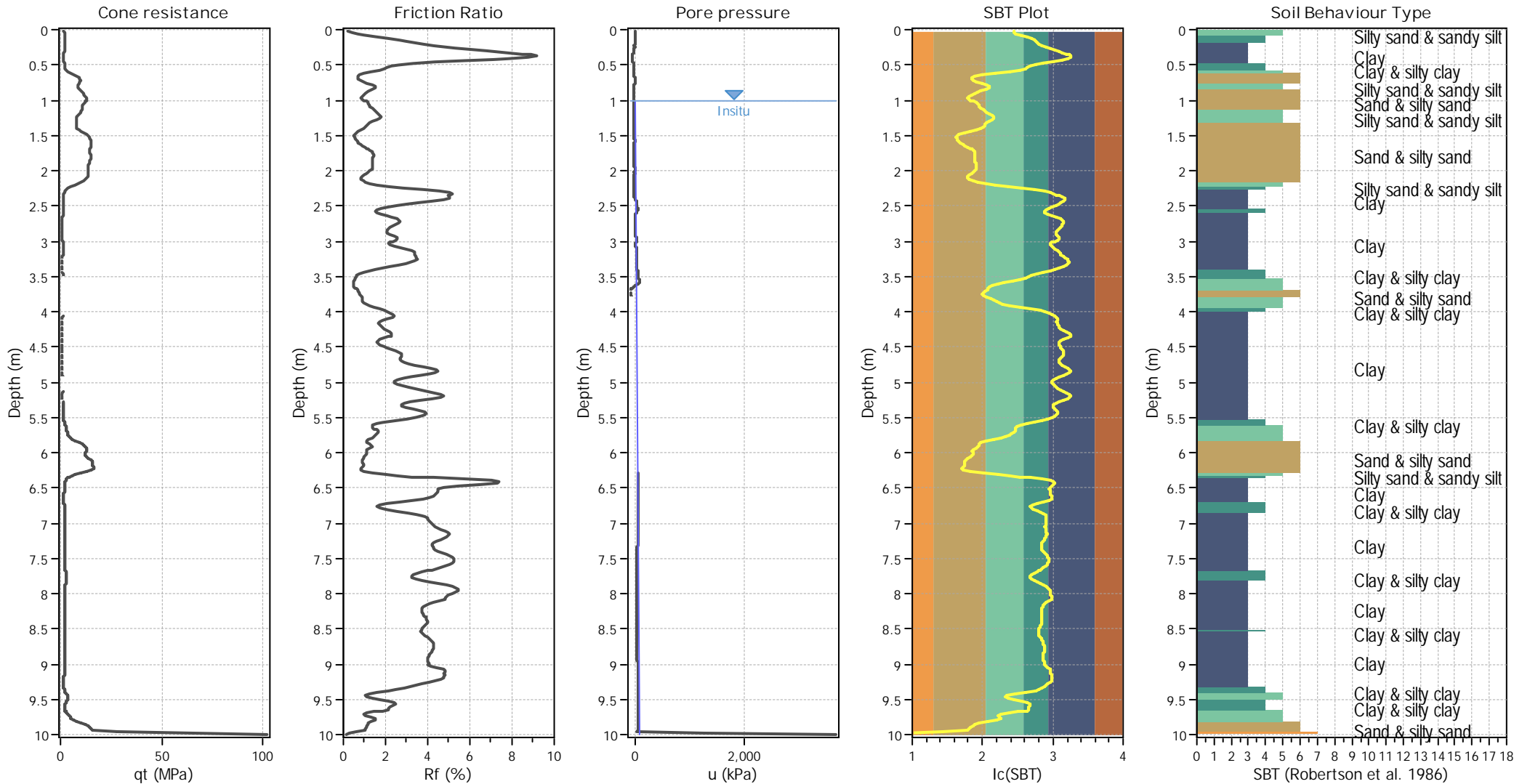
F.S. color scheme

- 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

CPT basic interpretation plots



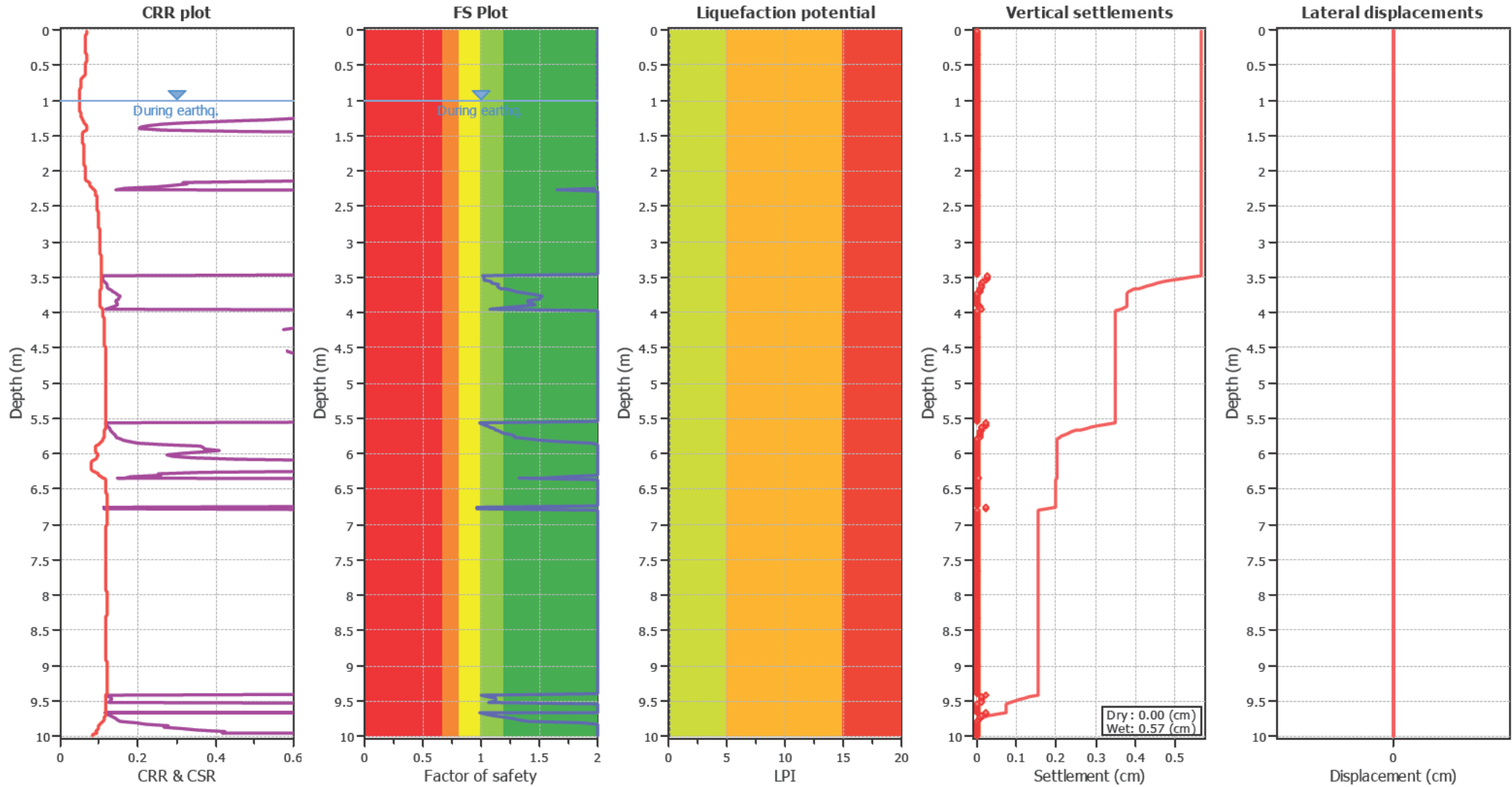
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

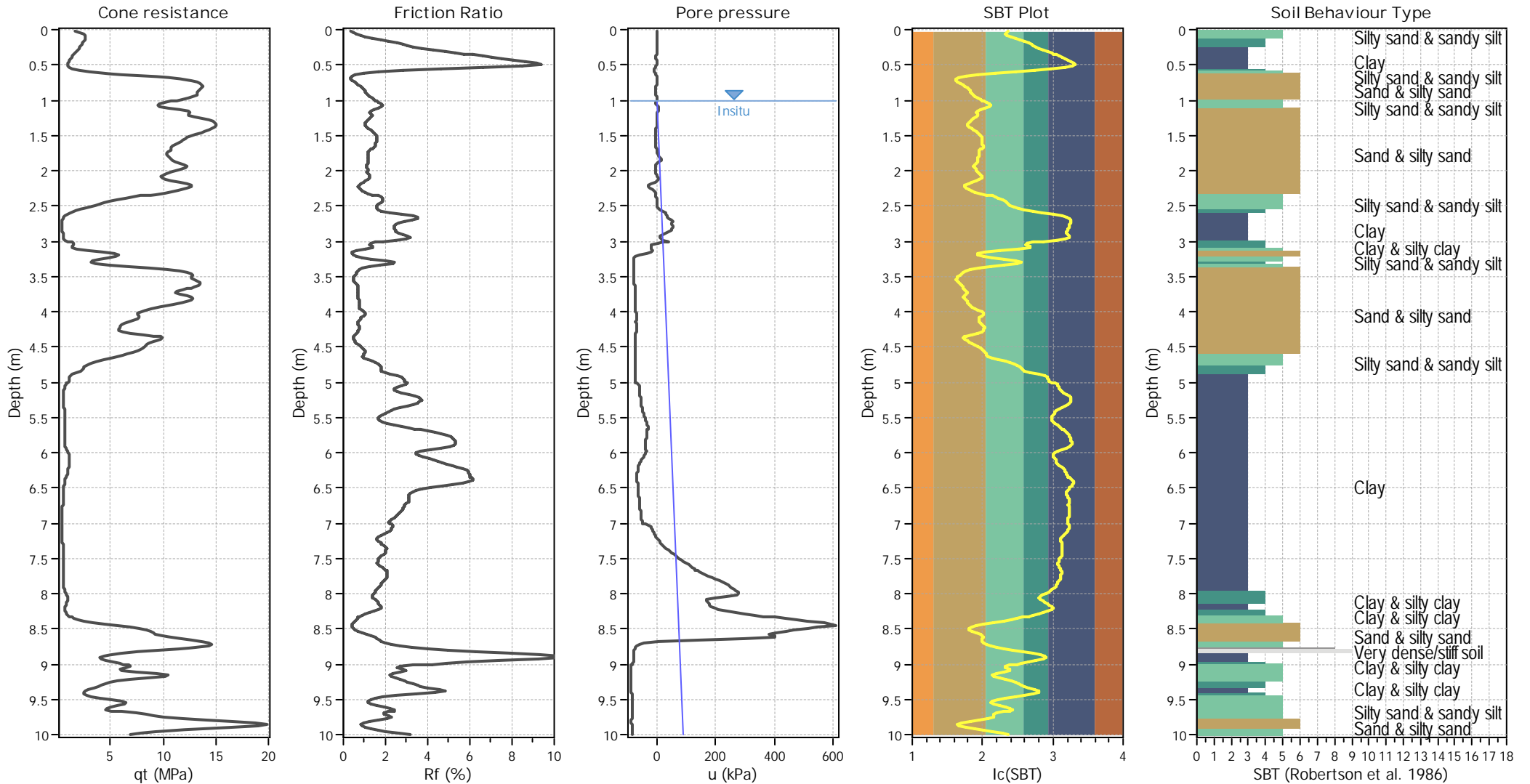
F.S. color scheme

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- 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

CPT basic interpretation plots



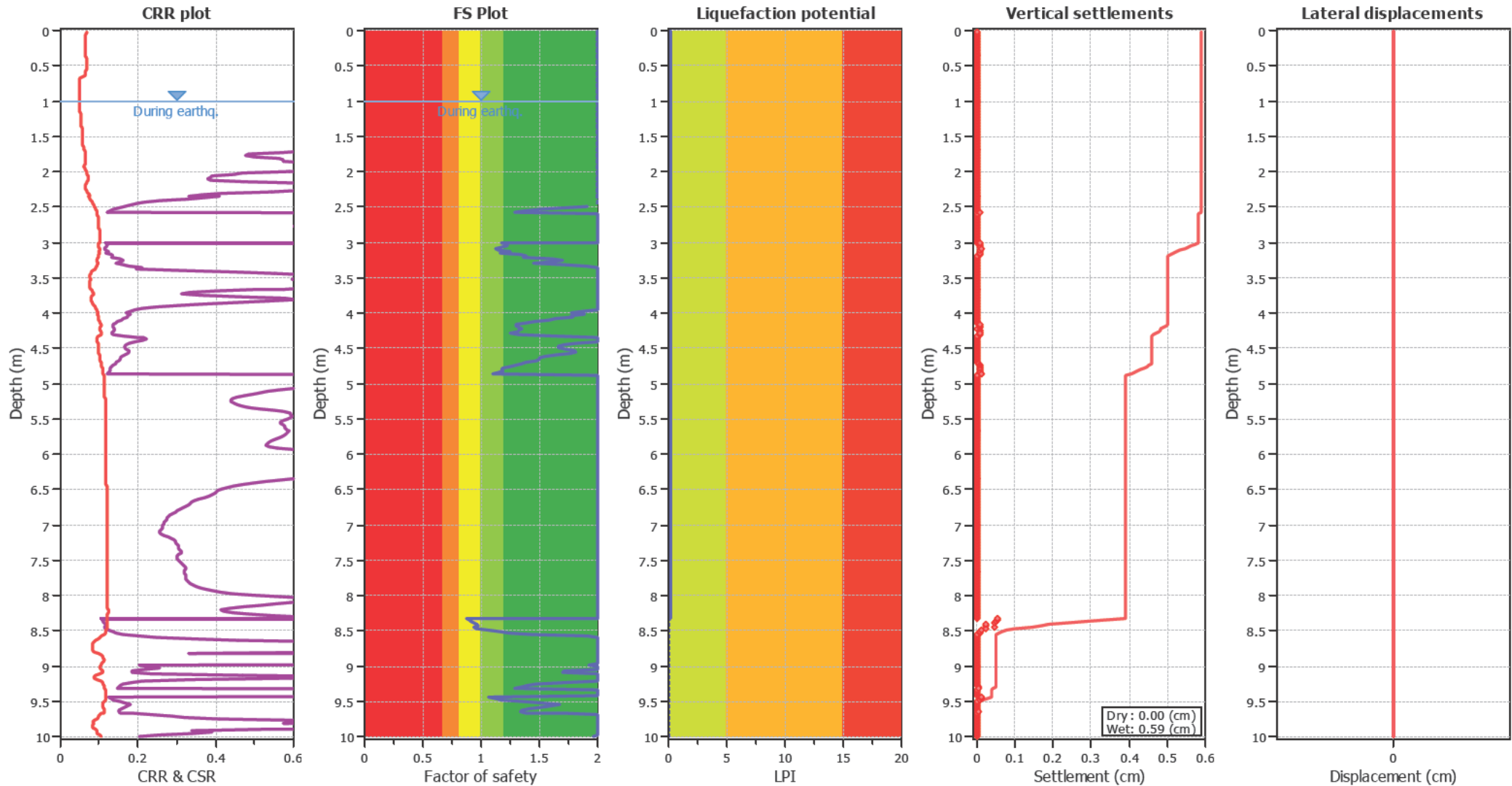
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

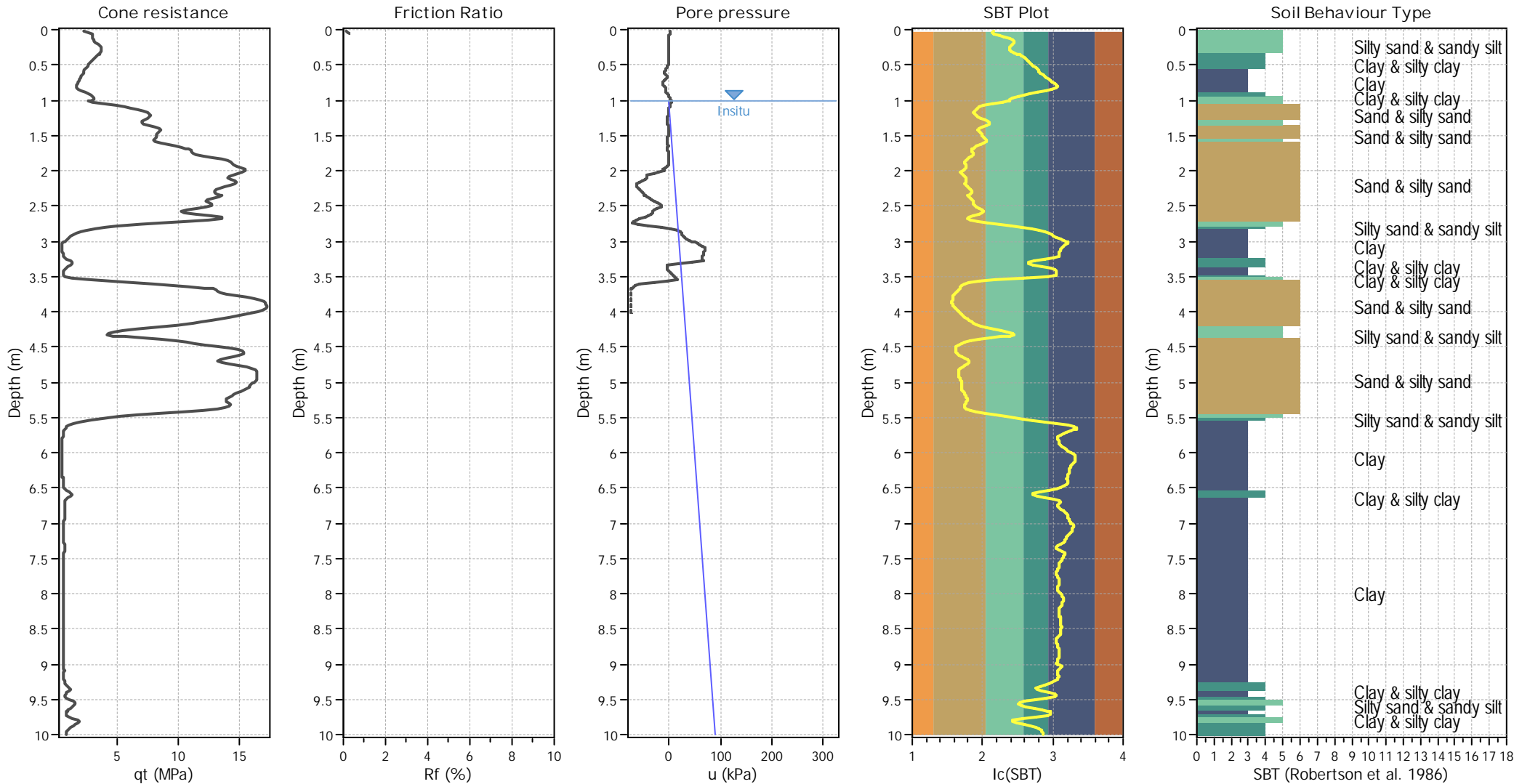
F.S. color scheme

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- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



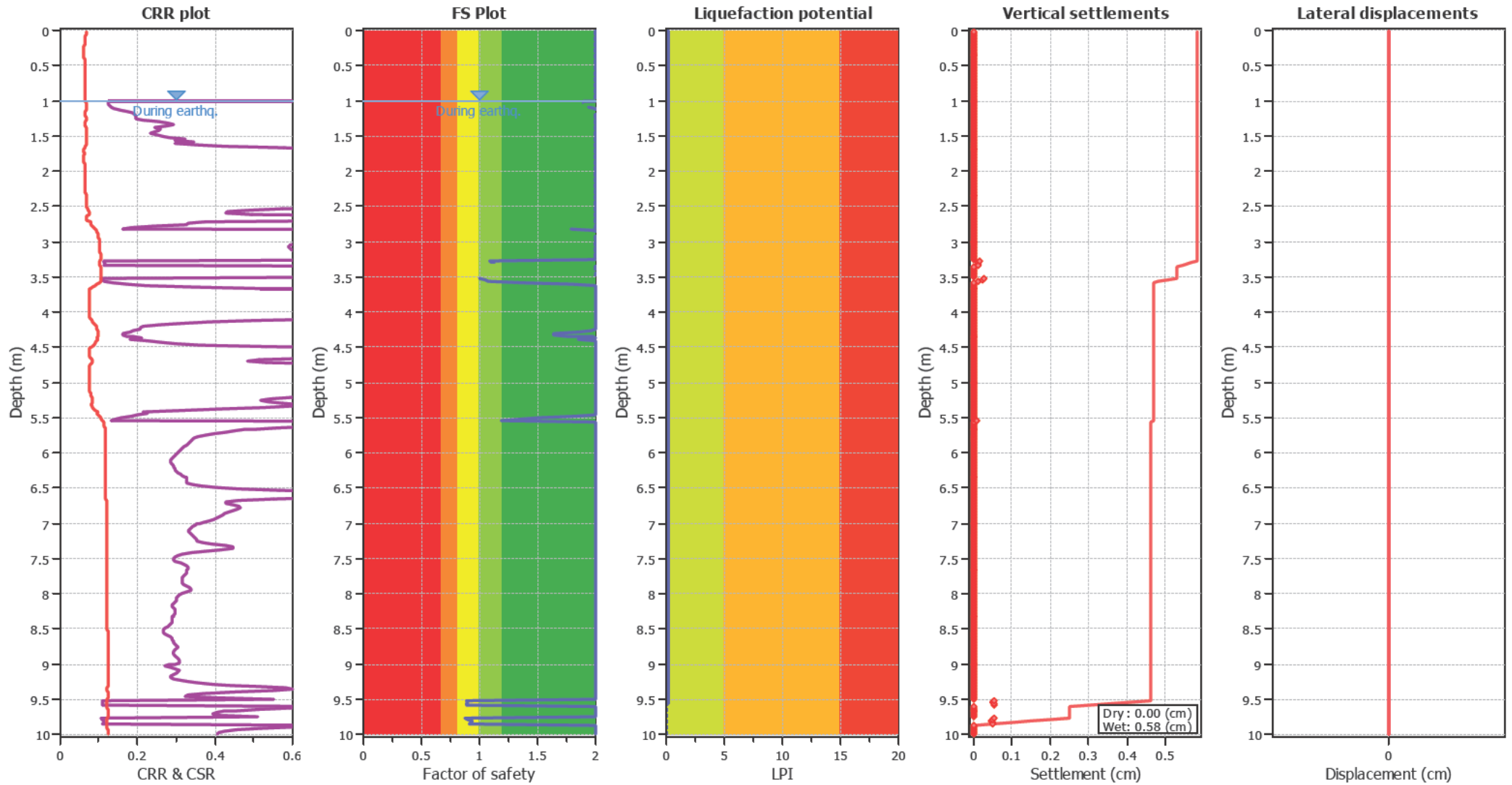
Input parameters and analysis data

| | | | | | |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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 _G applied: | Yes |
| Earthquake magnitude M _w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

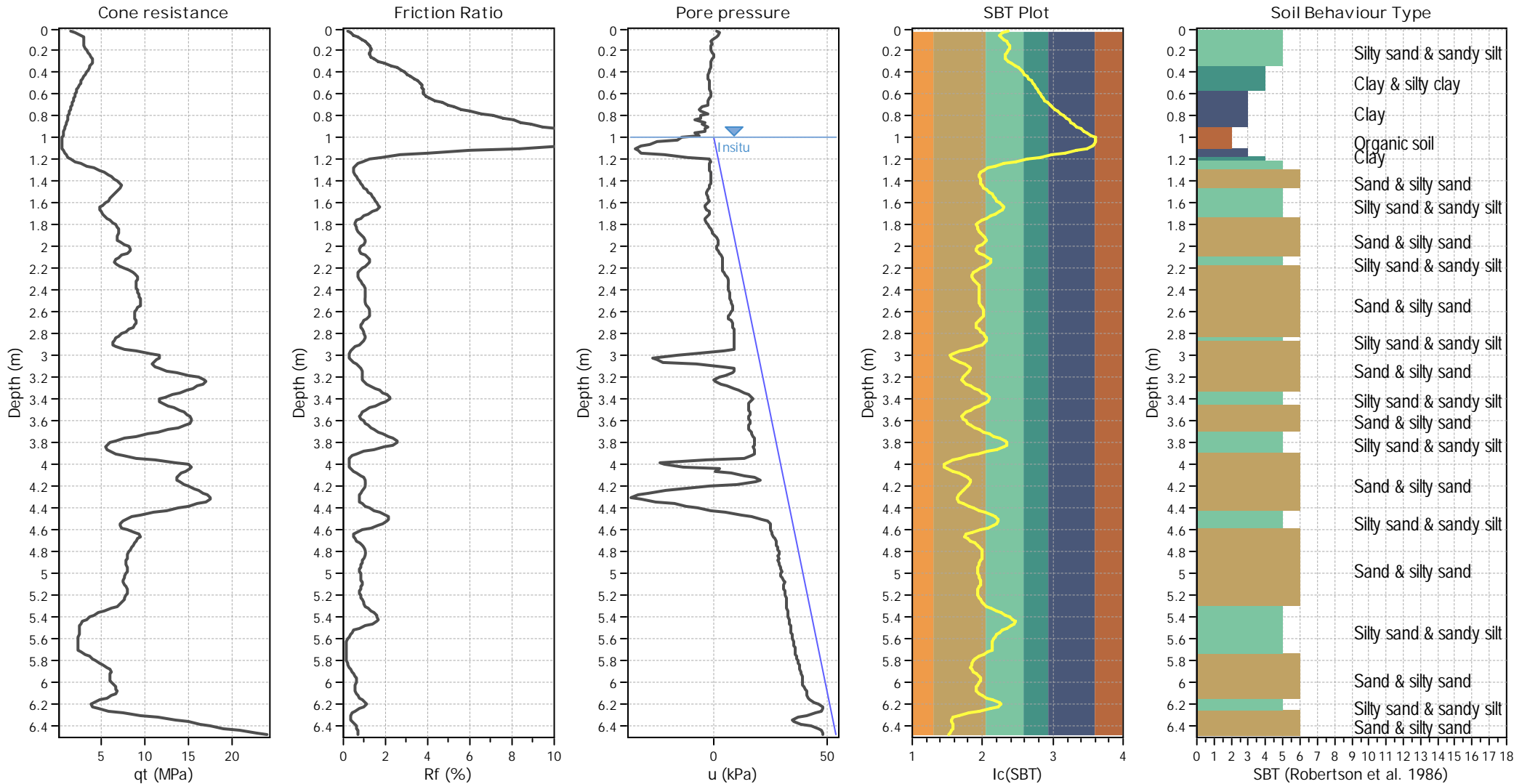
F.S. color scheme

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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



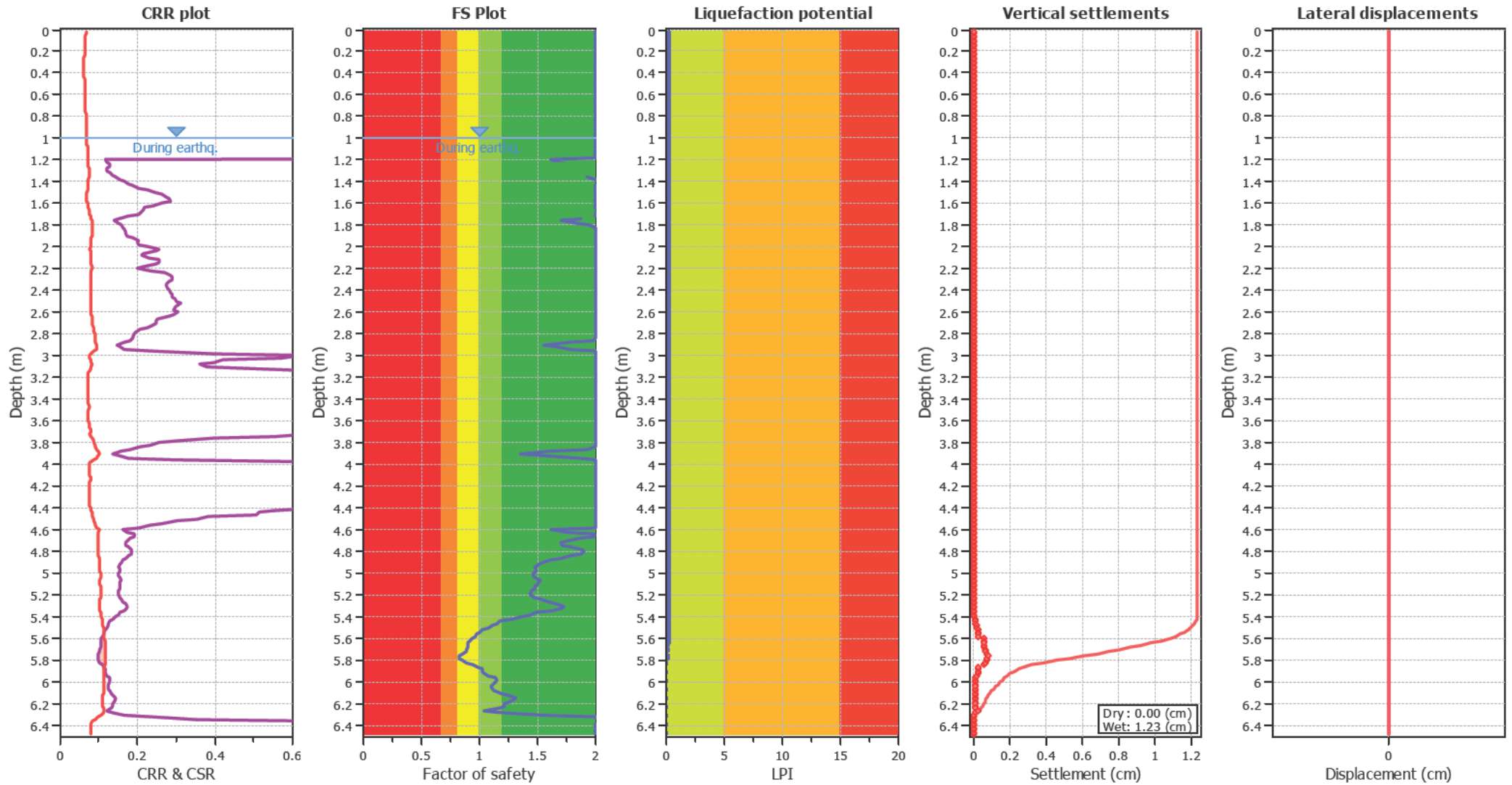
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

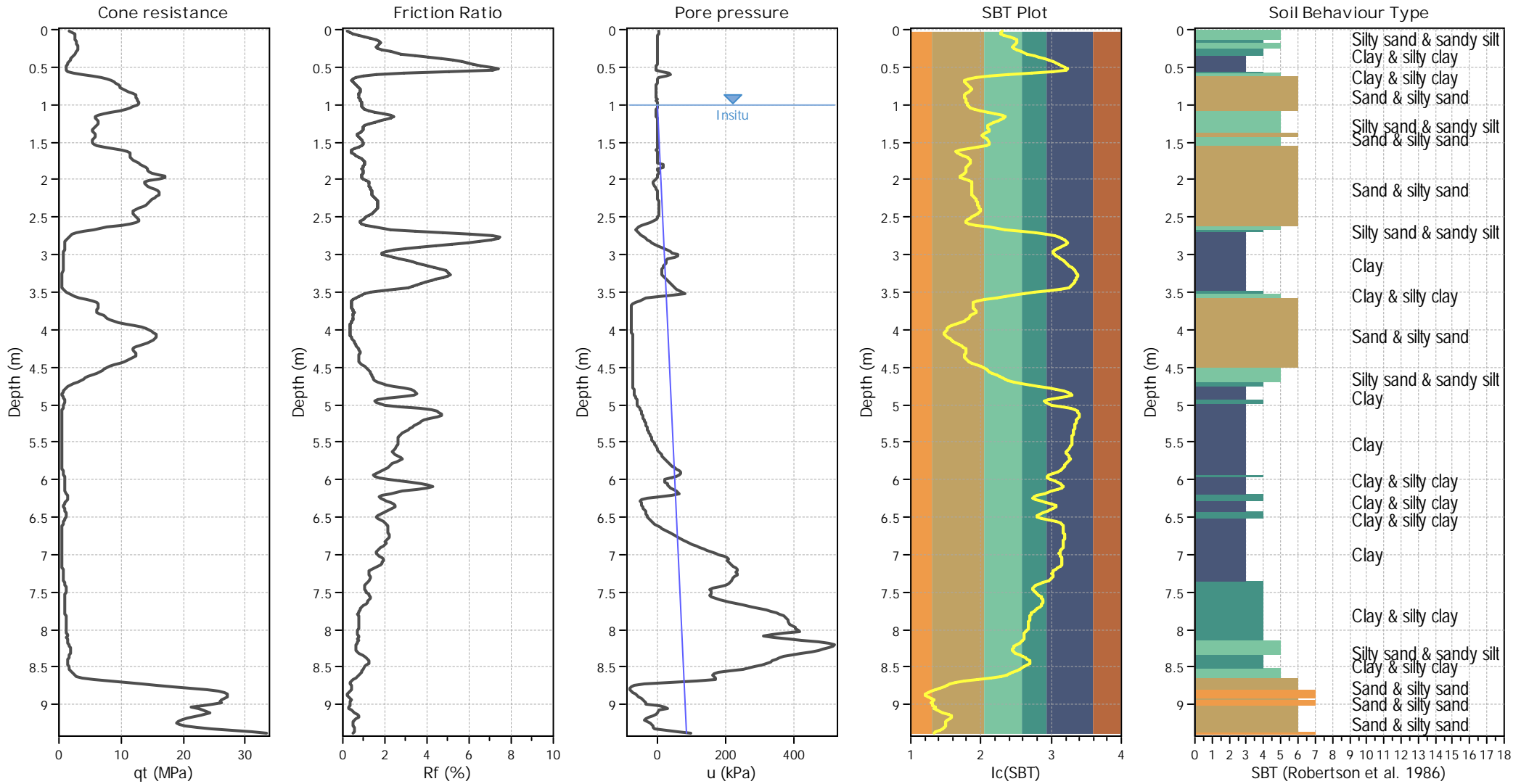
F.S. color scheme

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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



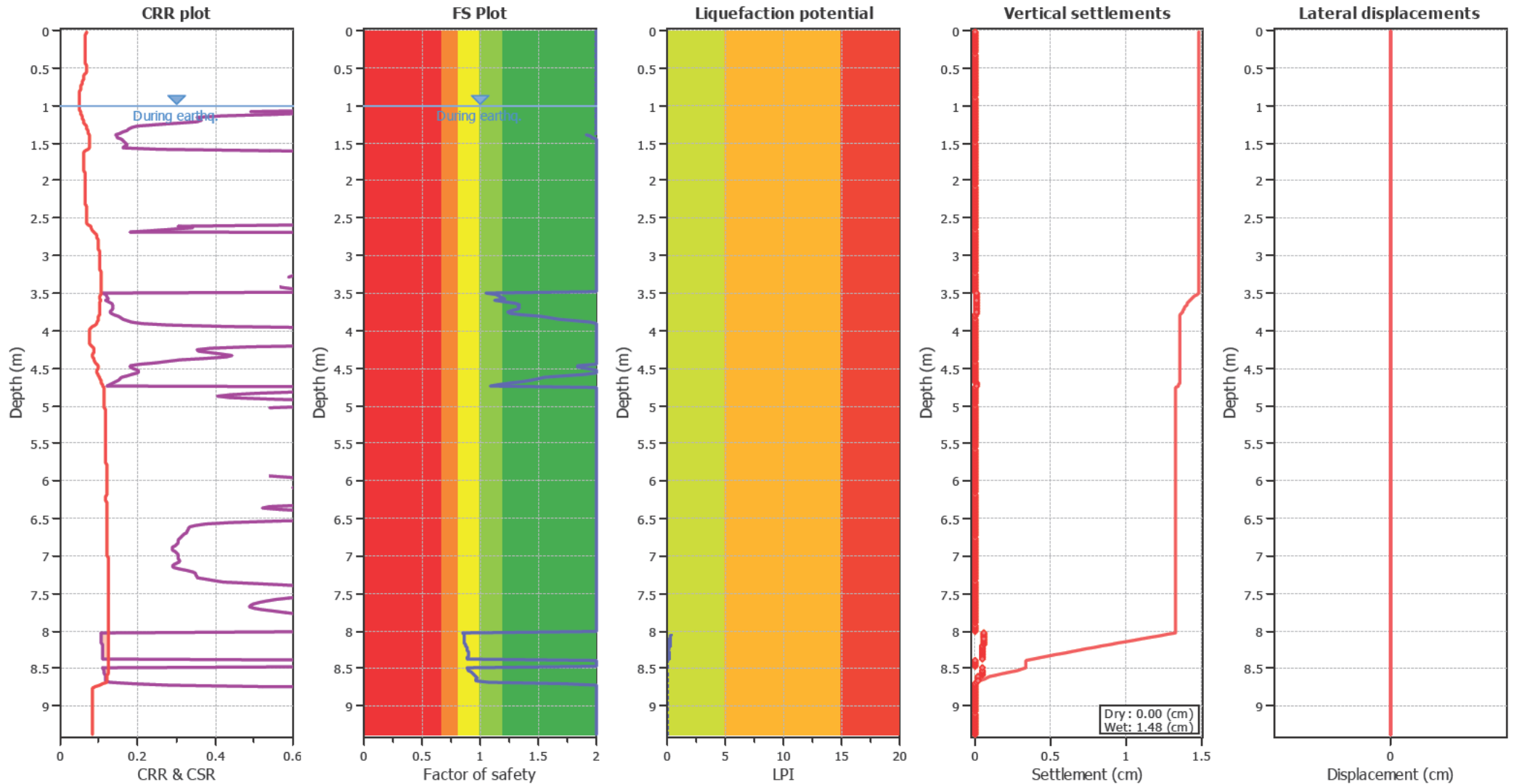
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_{σ} applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

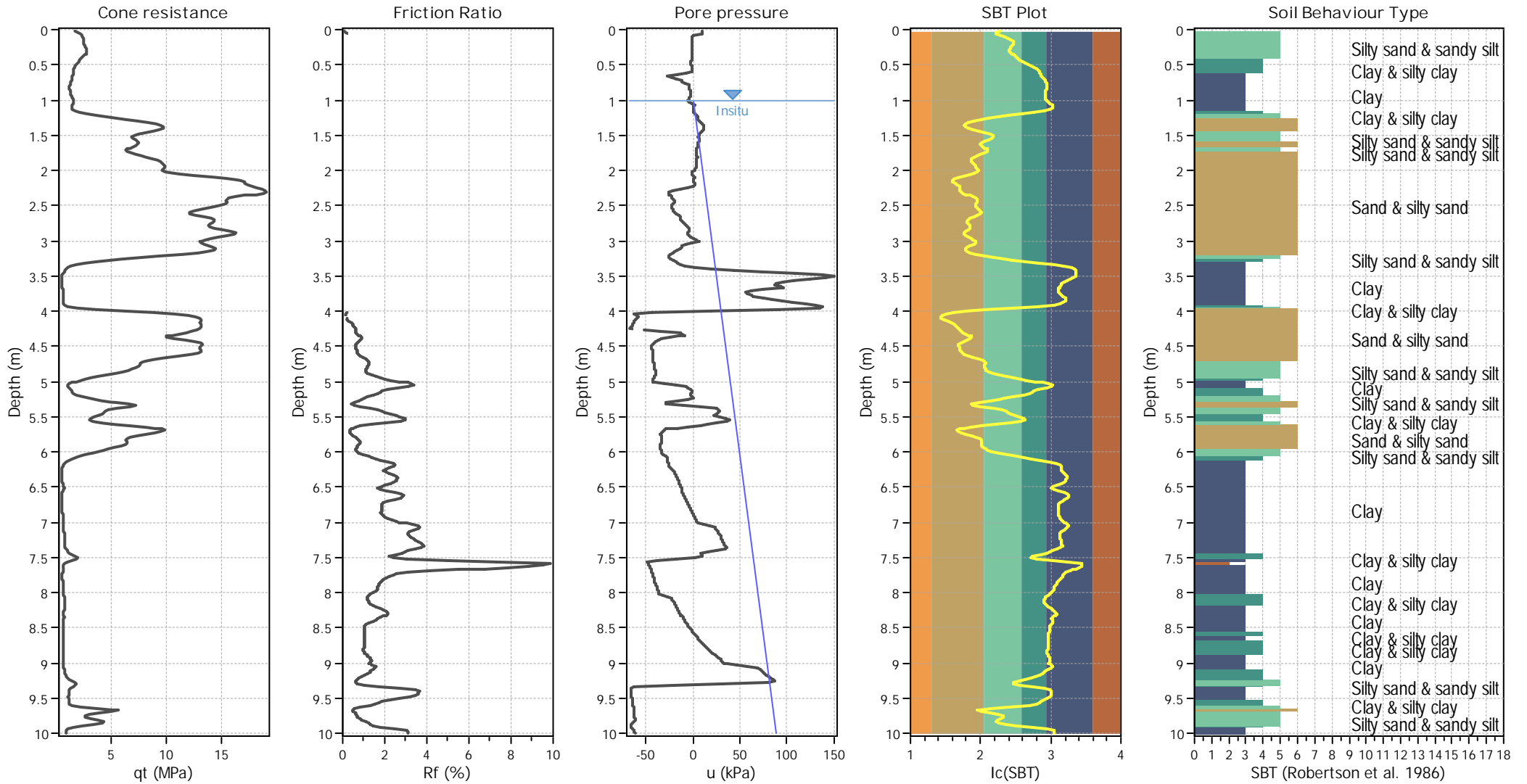
F.S. color scheme

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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



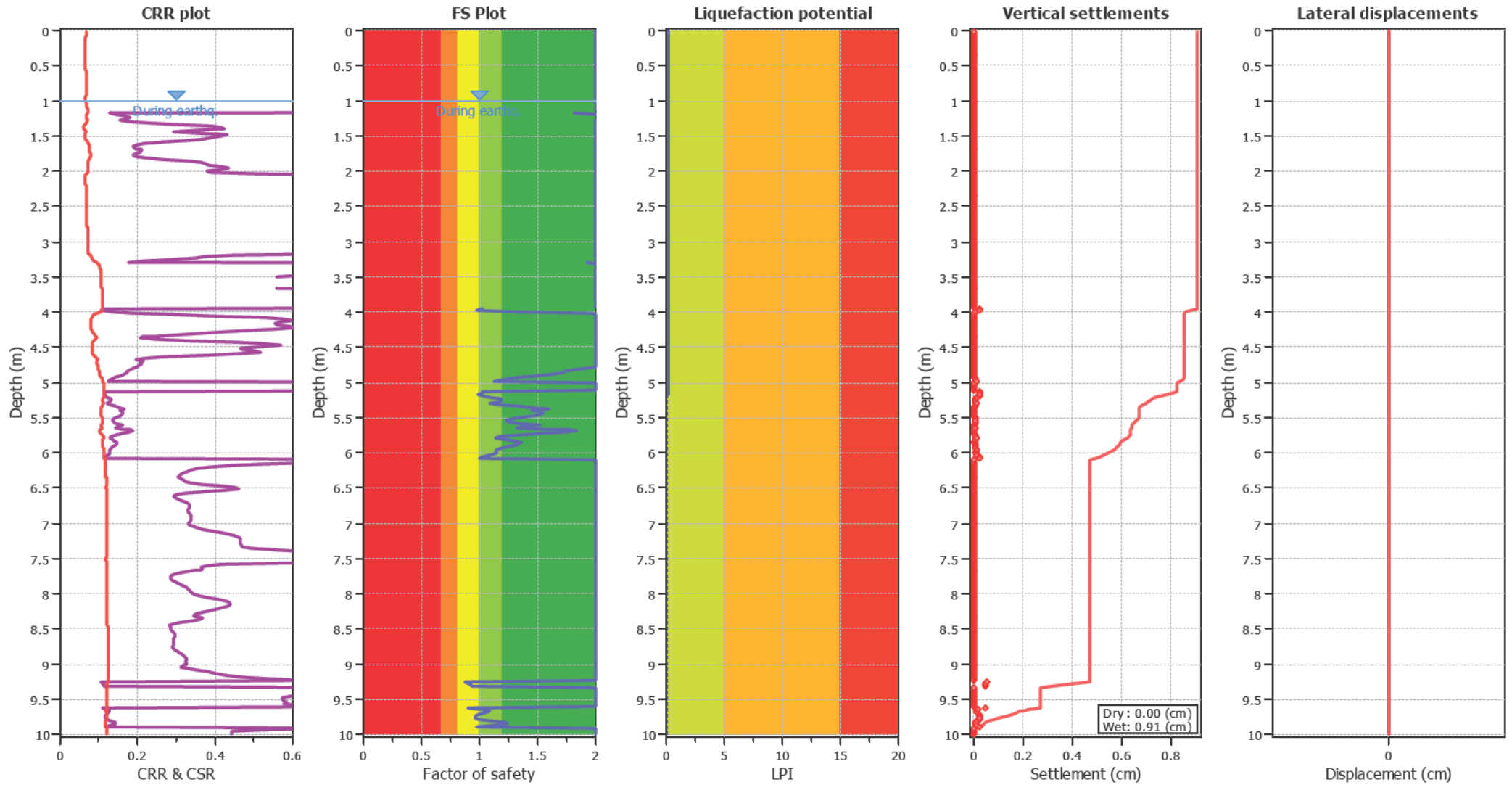
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

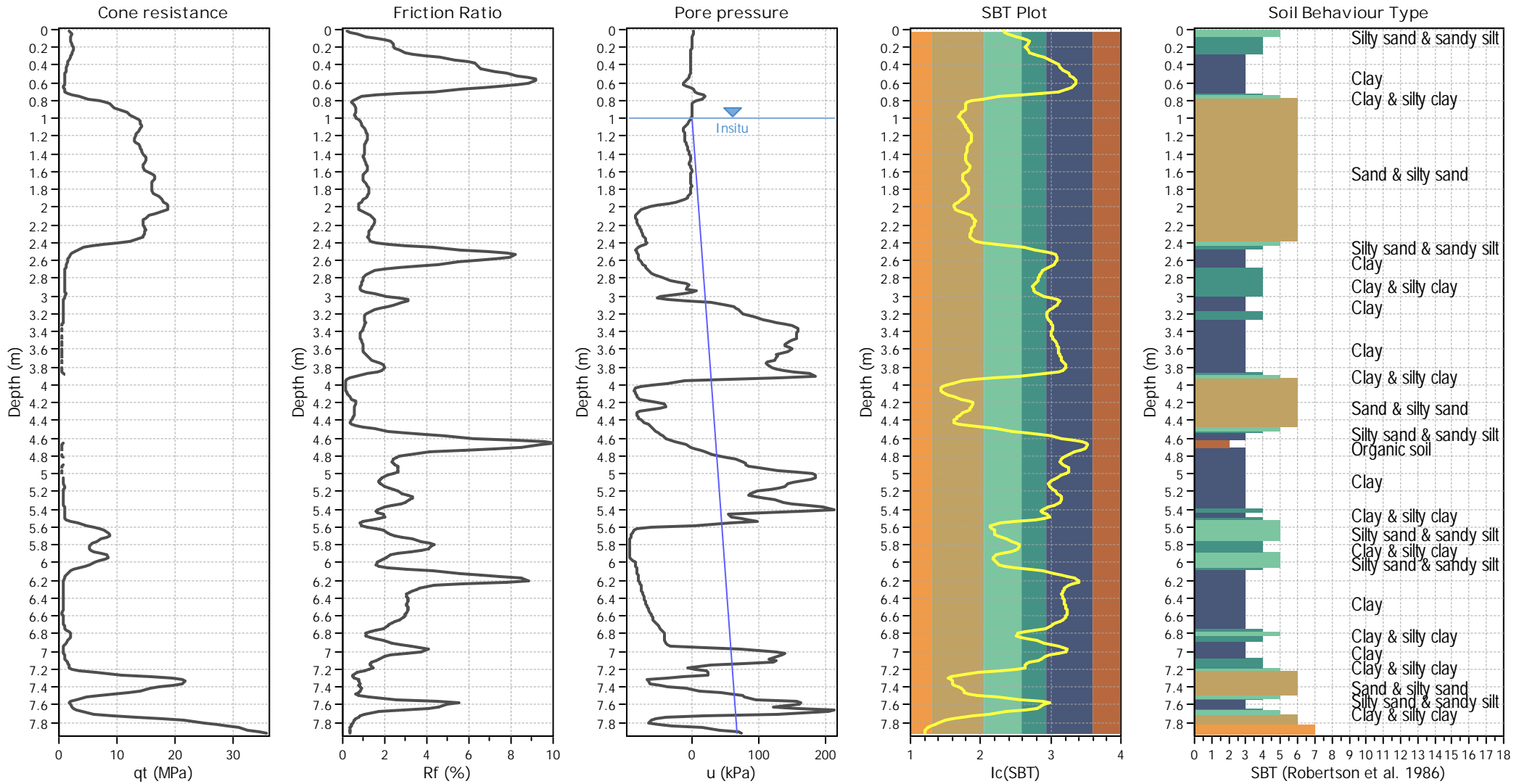
F.S. color scheme

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- Unlike to liquefy
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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



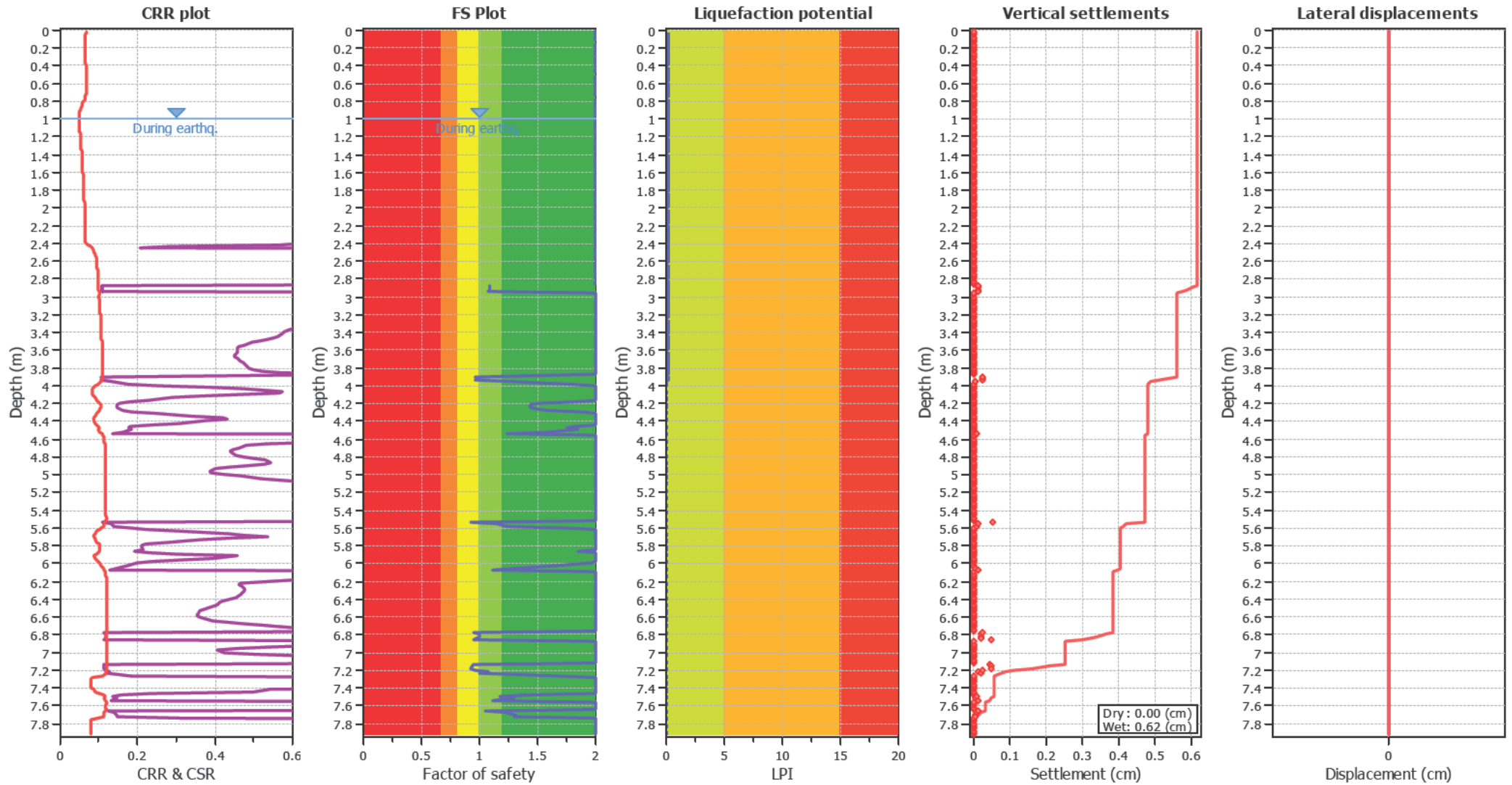
Input parameters and analysis data

| | | | | | |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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 _G applied: | Yes |
| Earthquake magnitude M _w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

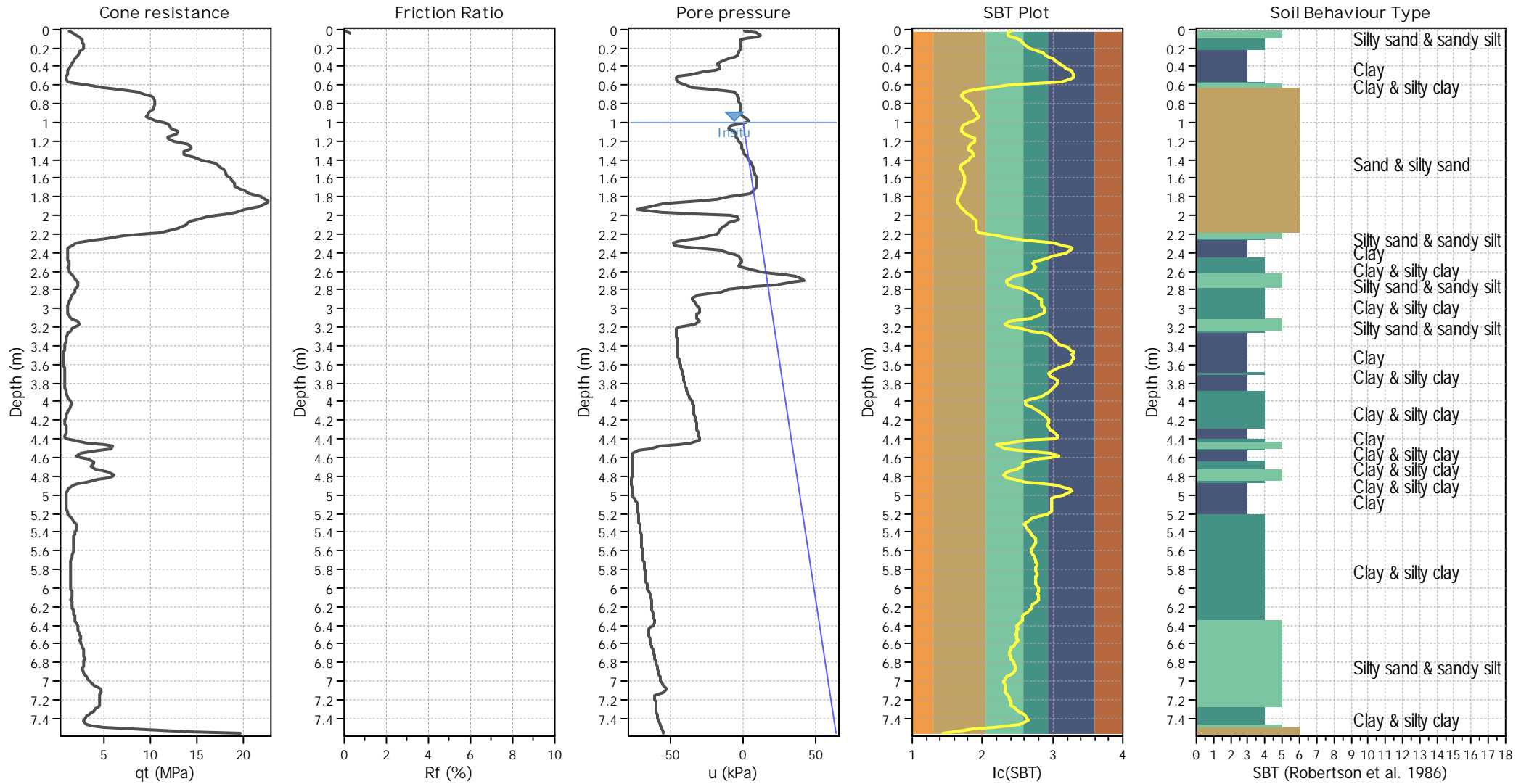
F.S. color scheme

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LPI color scheme

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- Low risk

CPT basic interpretation plots



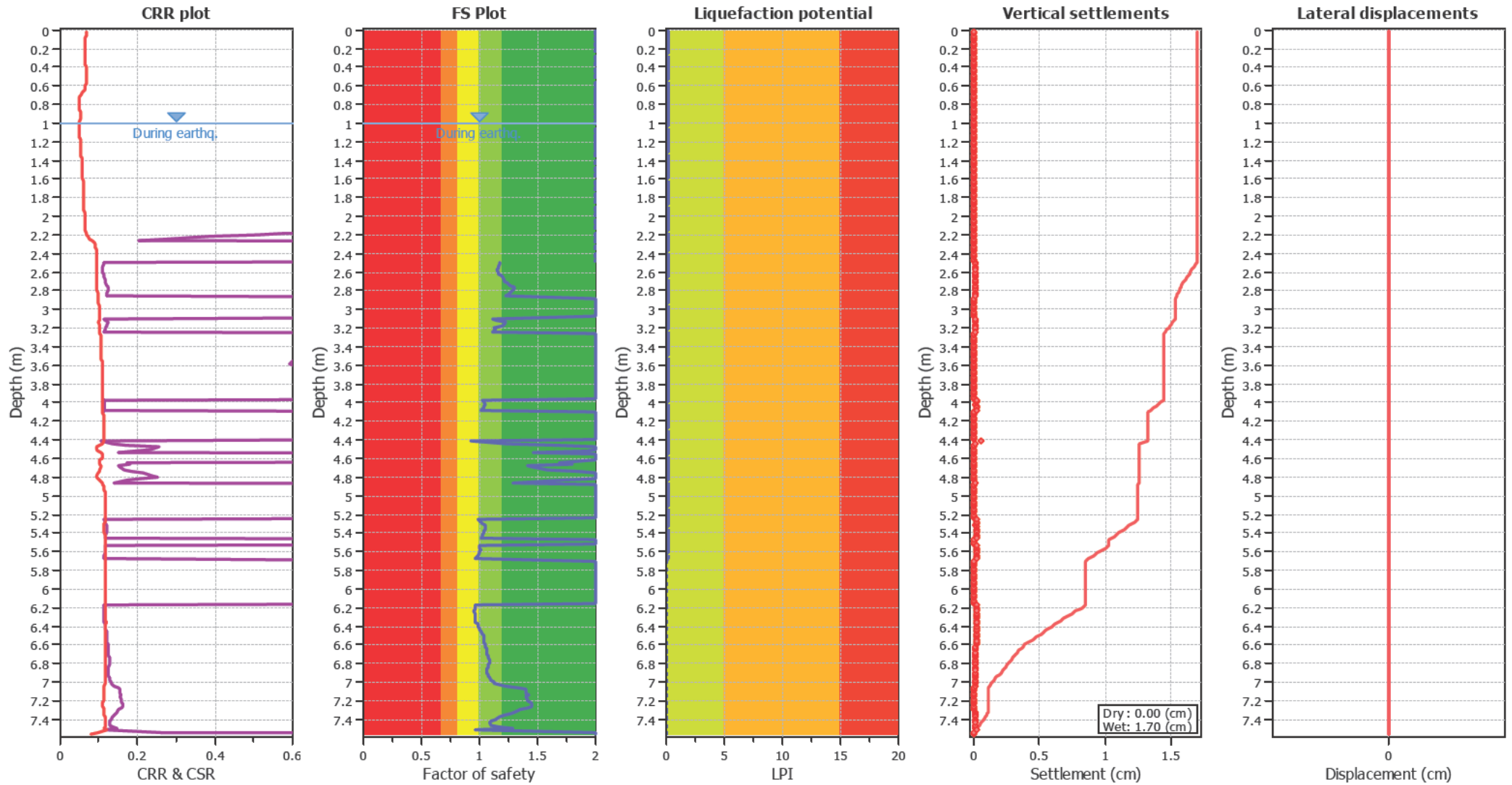
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

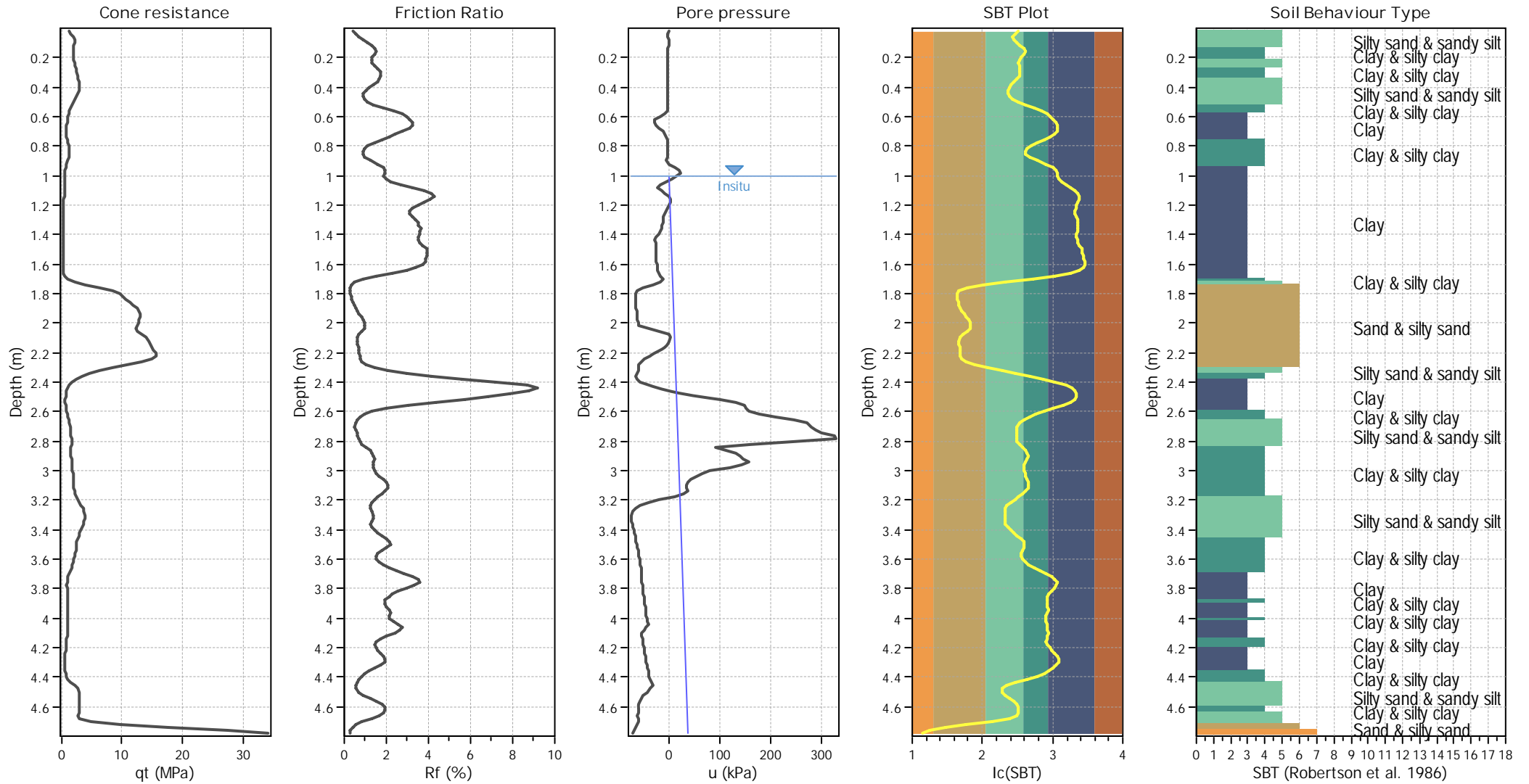
F.S. color scheme

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LPI color scheme

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- Low risk

CPT basic interpretation plots



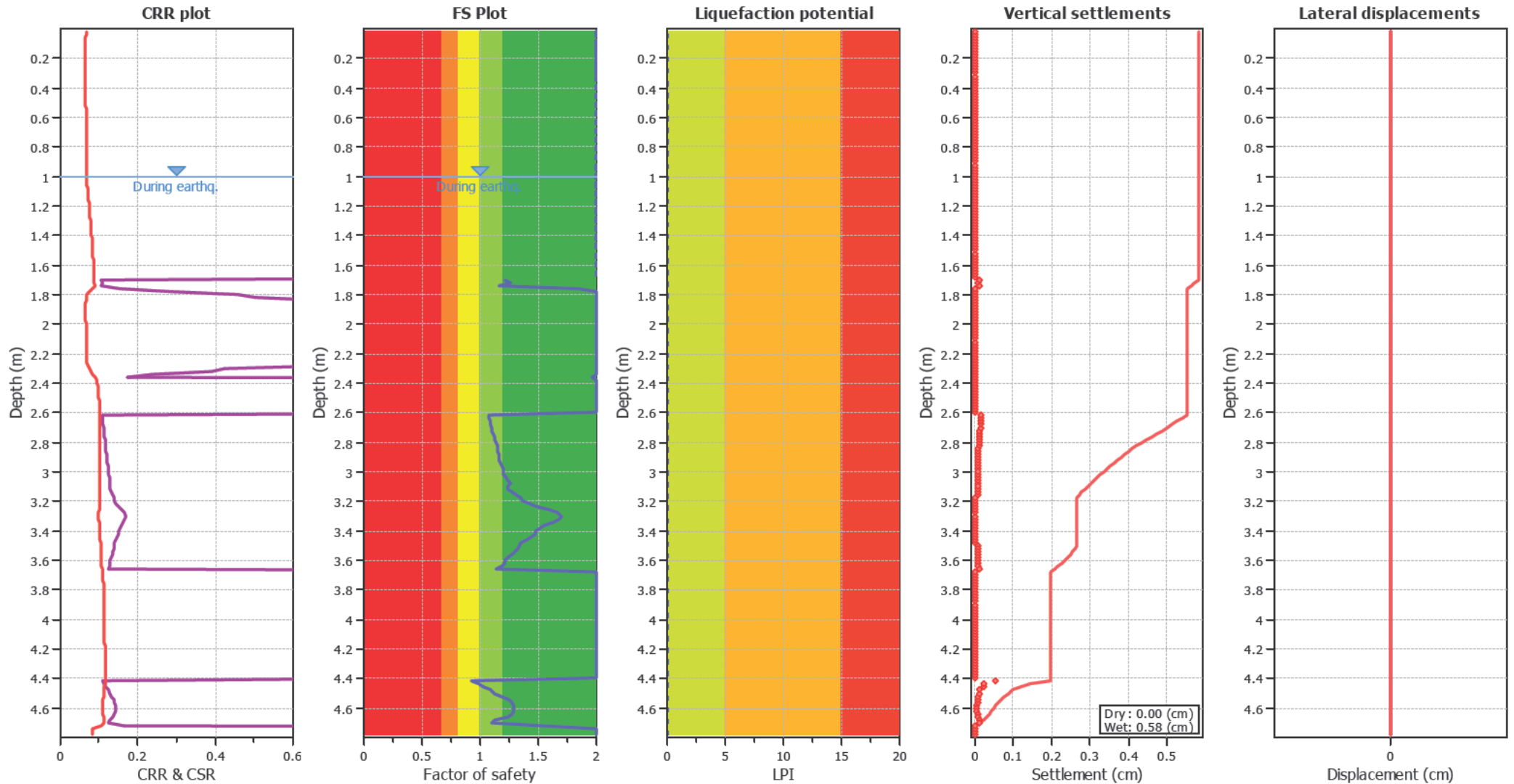
Input parameters and analysis data

| | | | | | |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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 _G applied: | Yes |
| Earthquake magnitude M _w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_{σ} applied: | Yes |
| Earthquake magnitude M_w : | 6.40 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.12 | Use fill: | No | Limit depth applied: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | N/A |

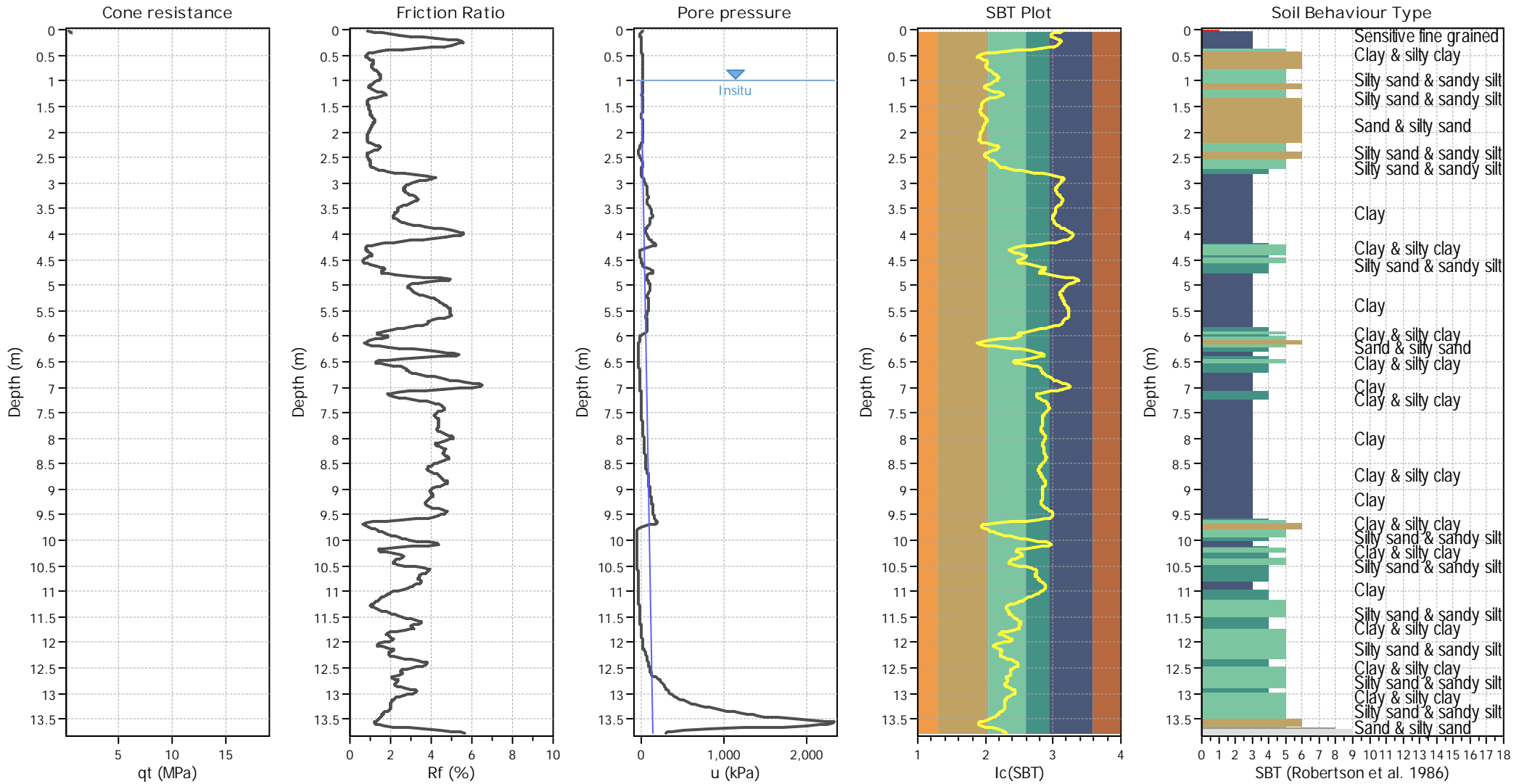
F.S. color scheme

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LPI color scheme

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- High risk
- Low risk

CPT basic interpretation plots



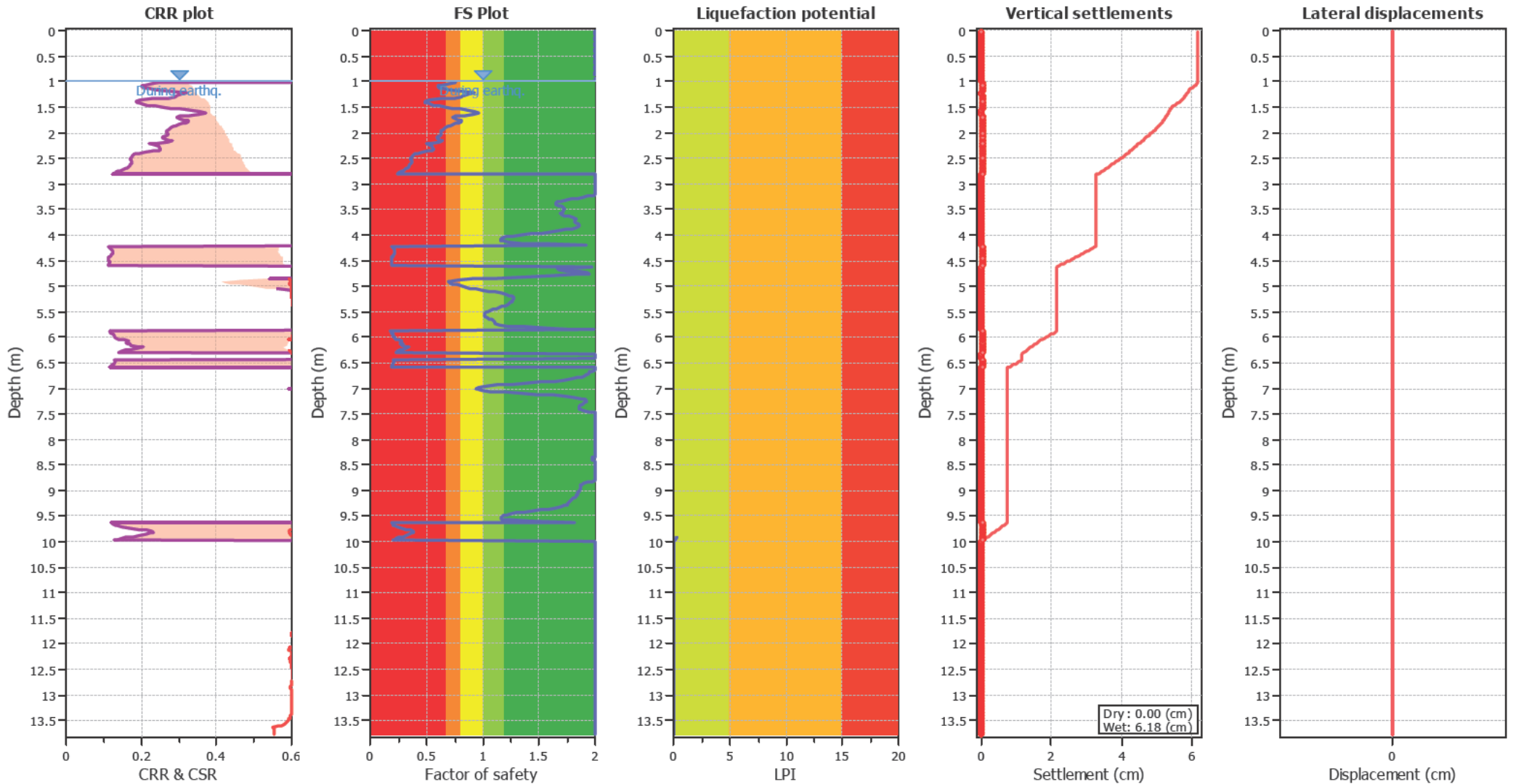
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

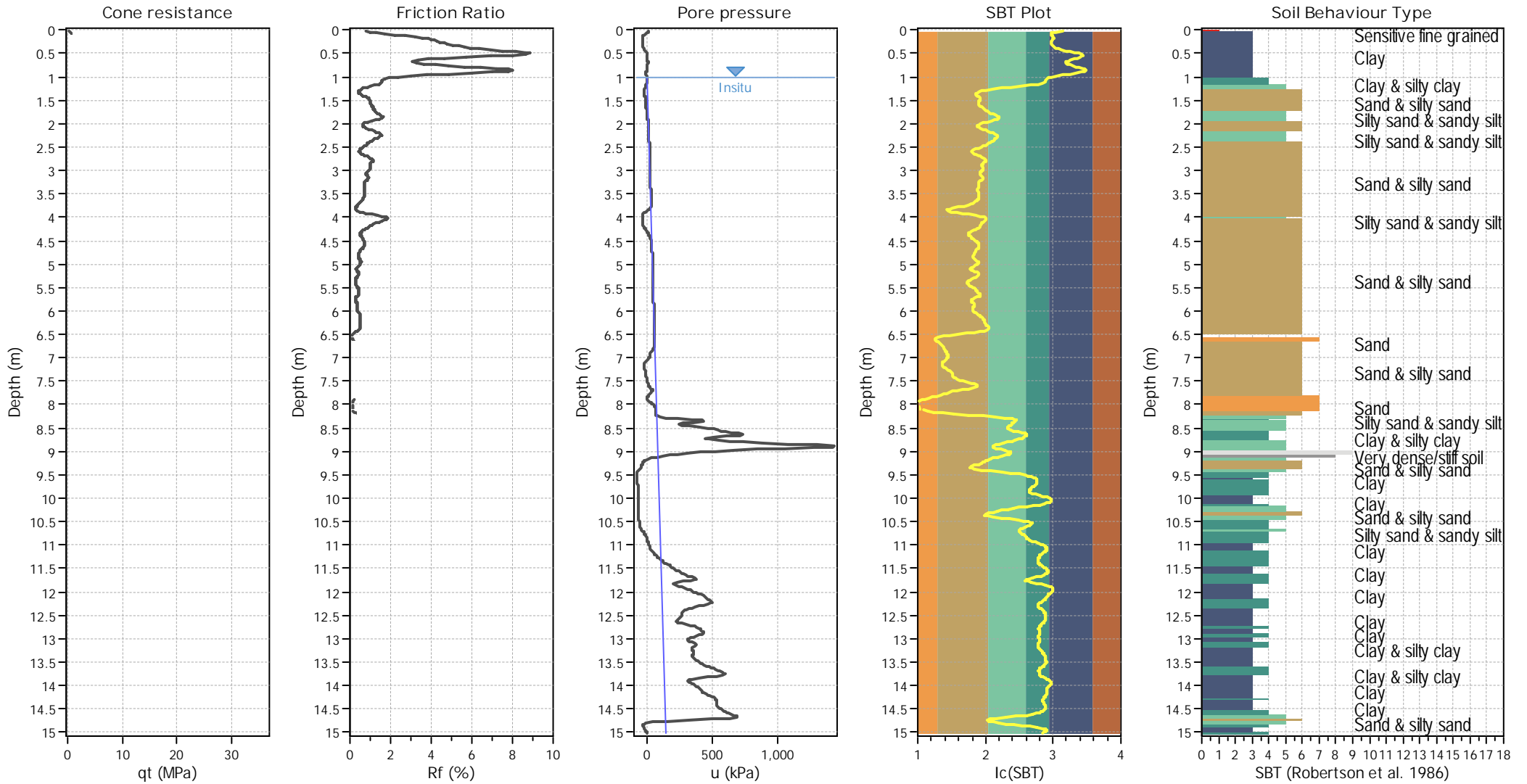
F.S. color scheme

- 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

CPT basic interpretation plots



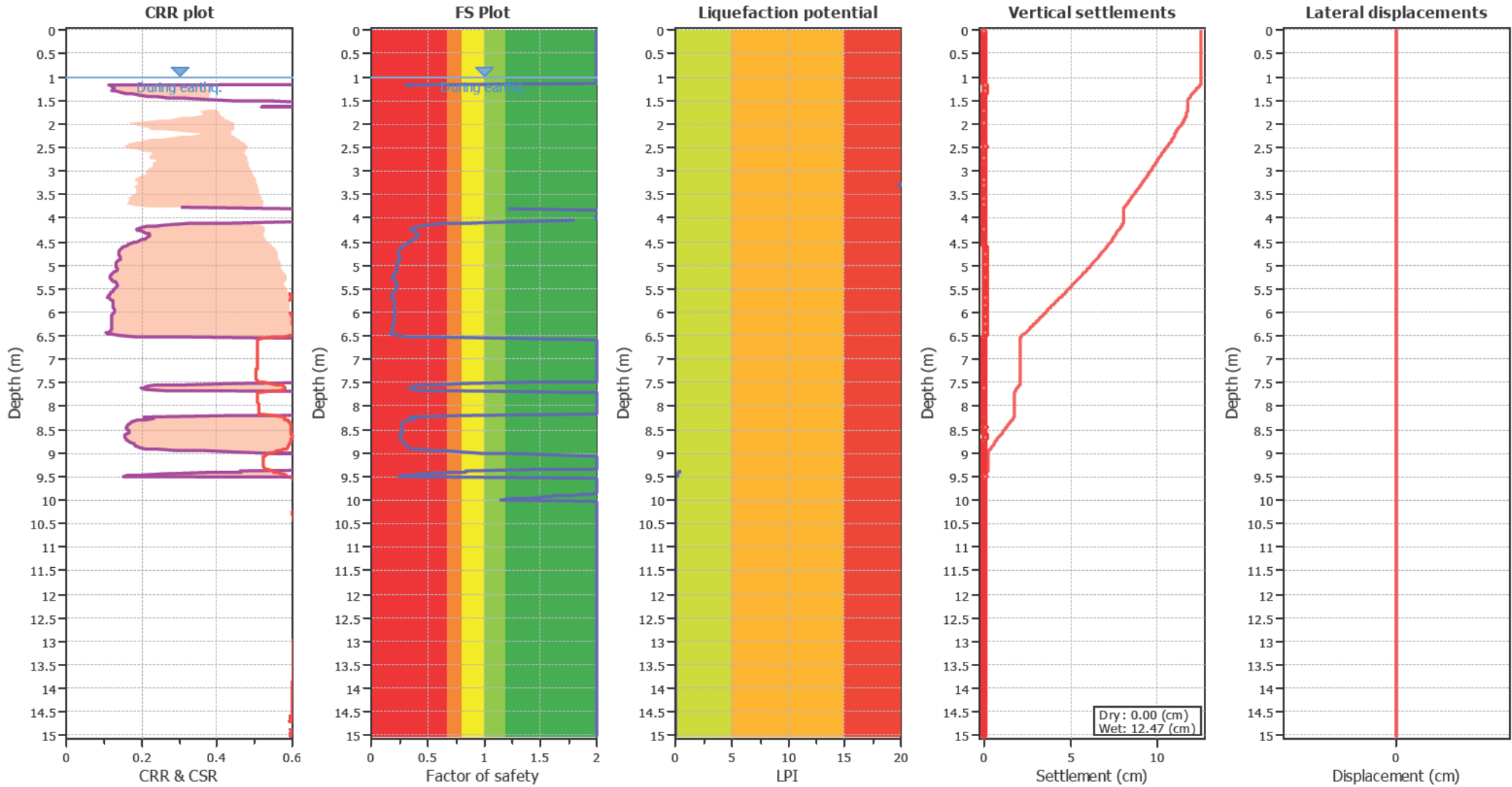
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_g applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

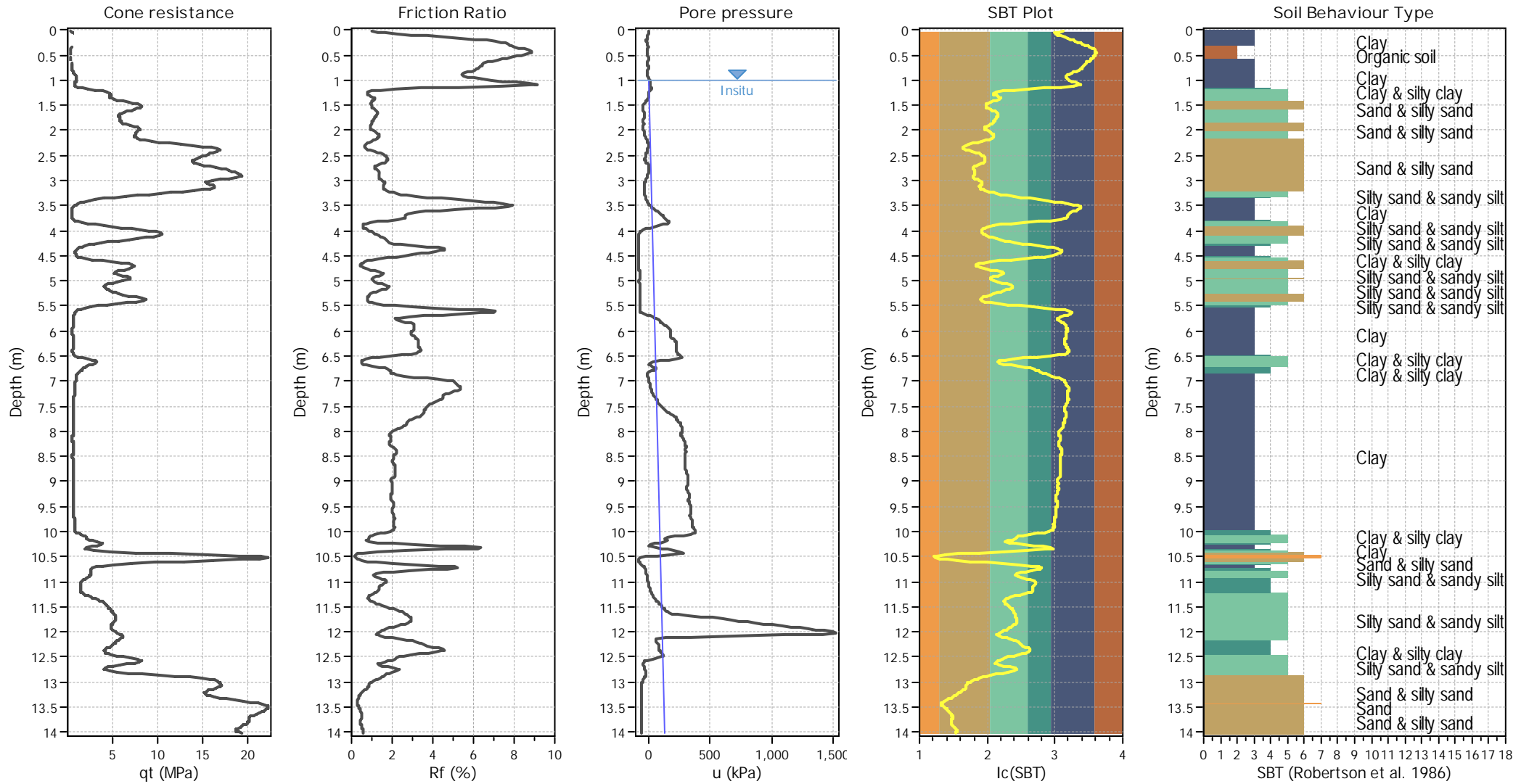
F.S. color scheme

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- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



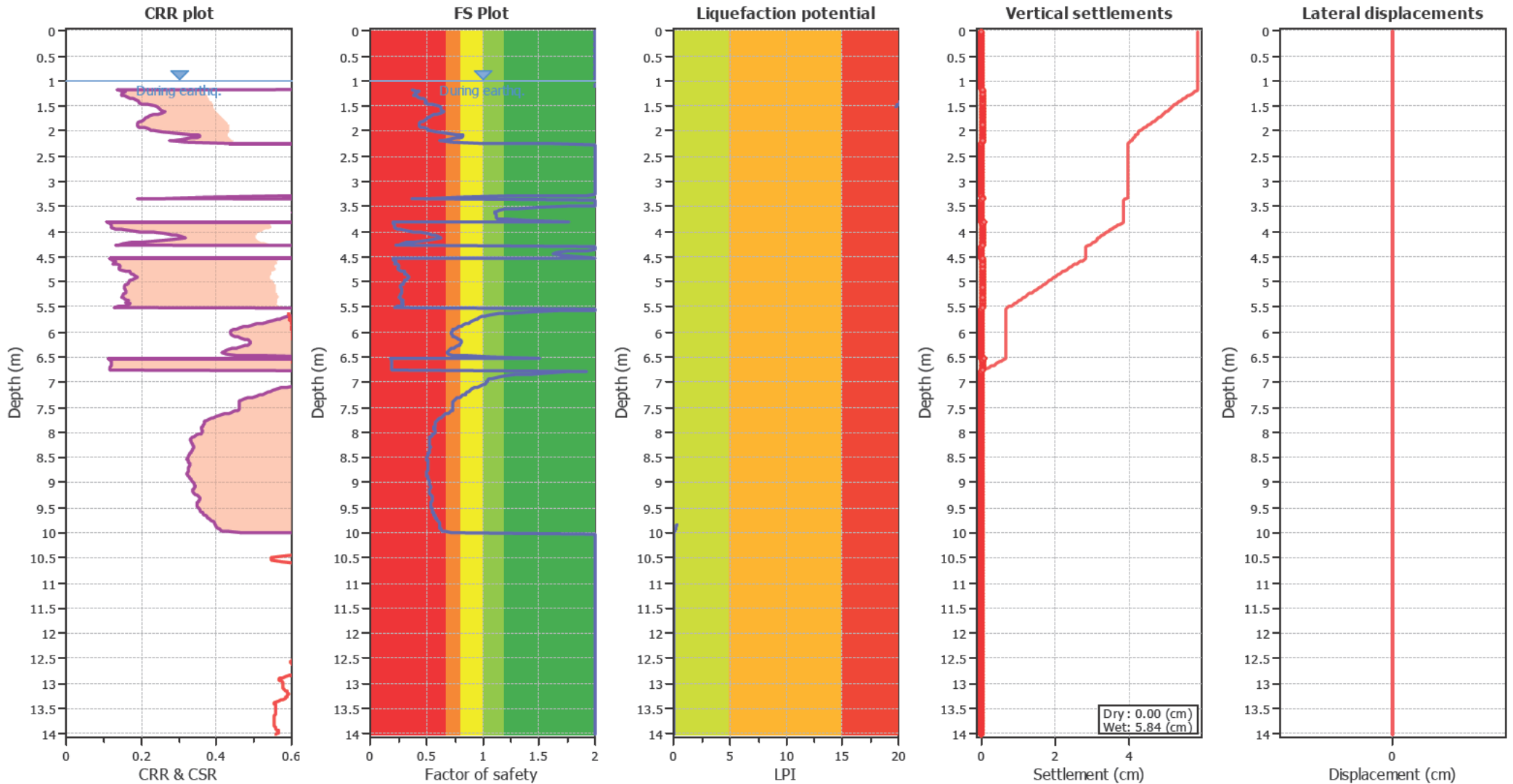
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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SBT legend

| | | |
|---------------------------|-----------------------------|----------------------------|
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| 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



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

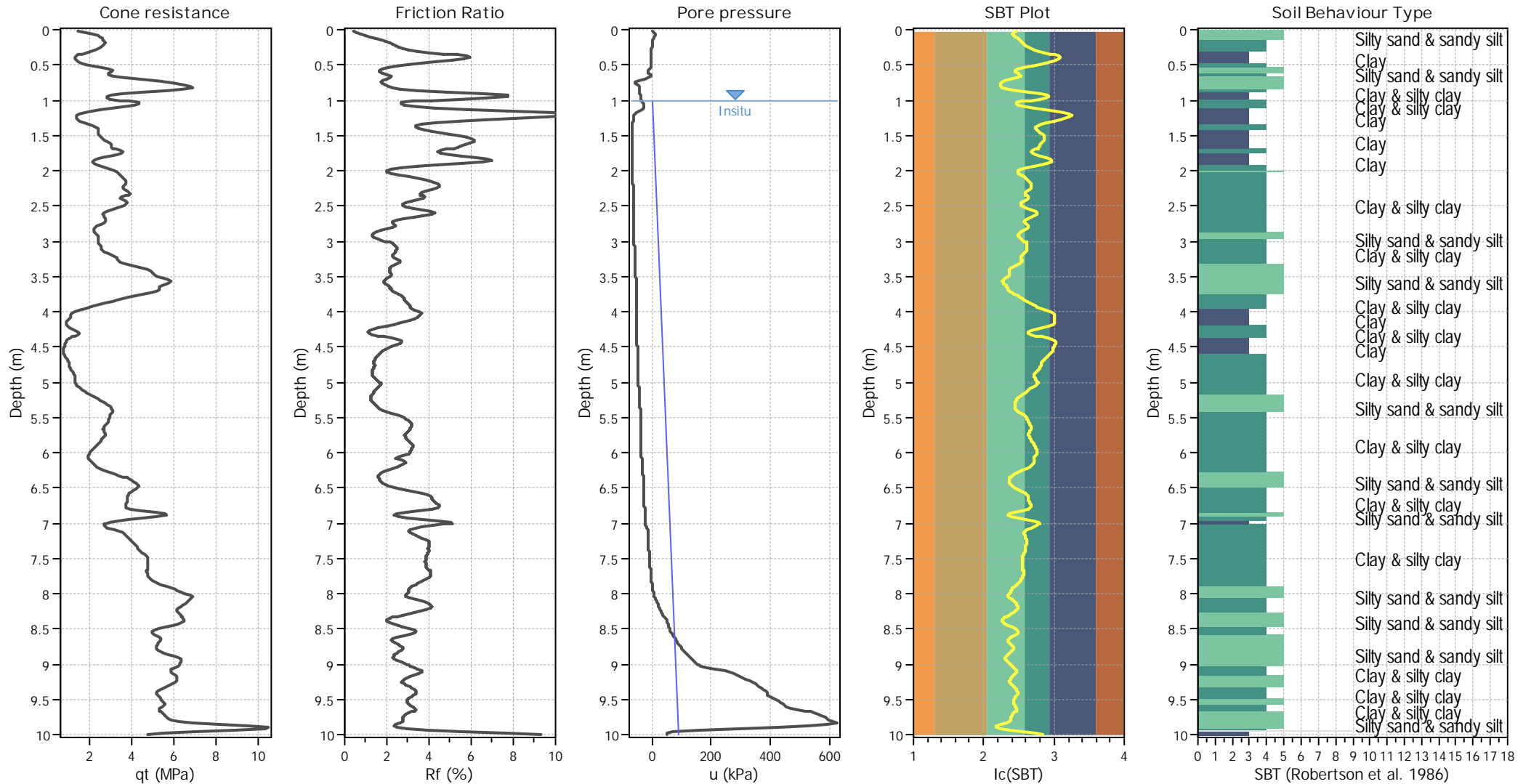
F.S. color scheme

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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



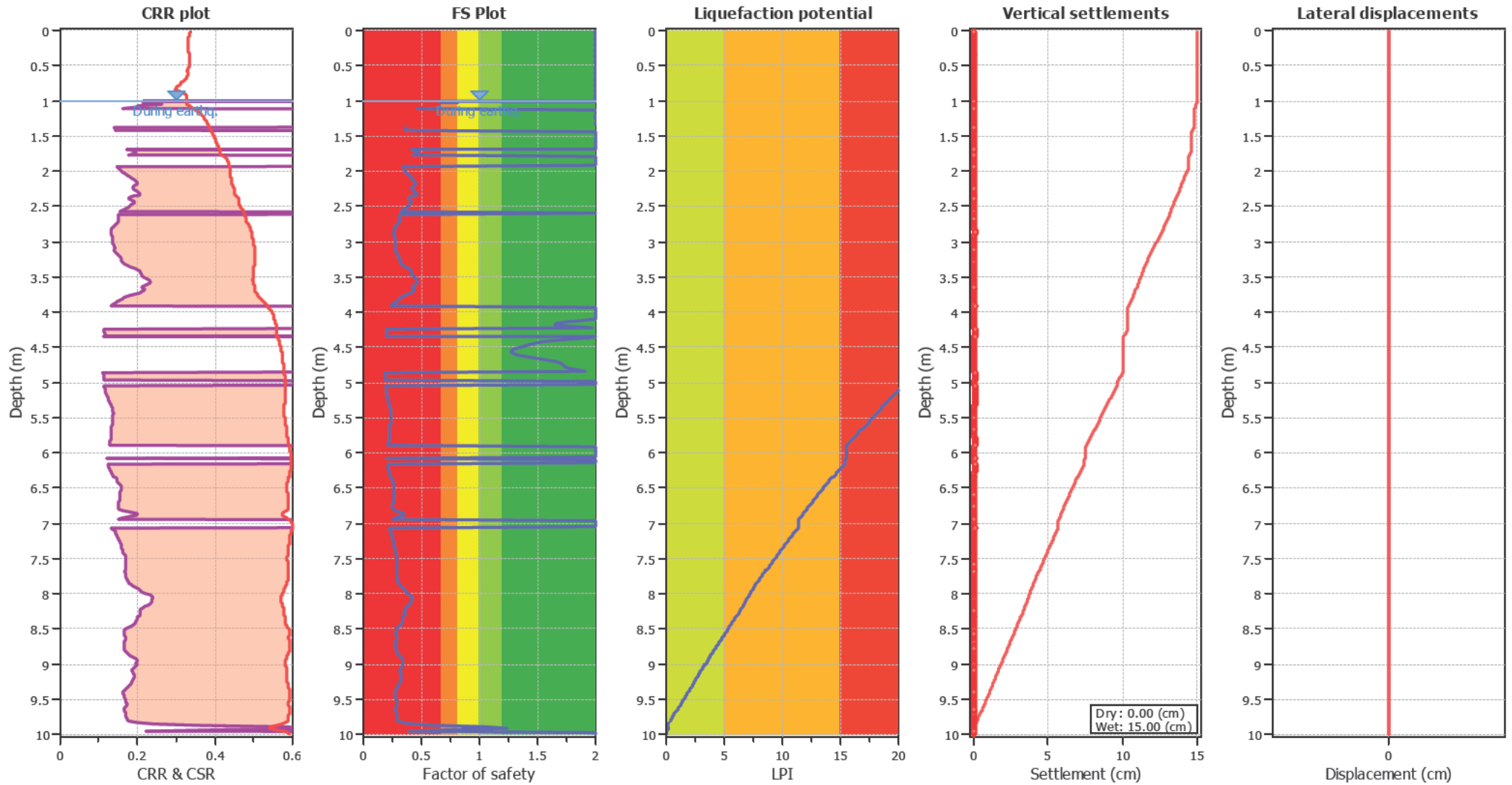
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | |
|--------------------------------|-------------------|---------------------------|--------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m |
| Fines correction method: | B&I (2014) | Average results interval: | 3 |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT |
| Peak ground acceleration: | 0.58 | Use fill: | No |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A |

| | |
|-----------------------------|-------------|
| Fill weight: | N/A |
| Transition detect. applied: | No |
| K_σ applied: | Yes |
| Clay like behavior applied: | Sand & Clay |
| Limit depth applied: | Yes |
| Limit depth: | 10.00 m |

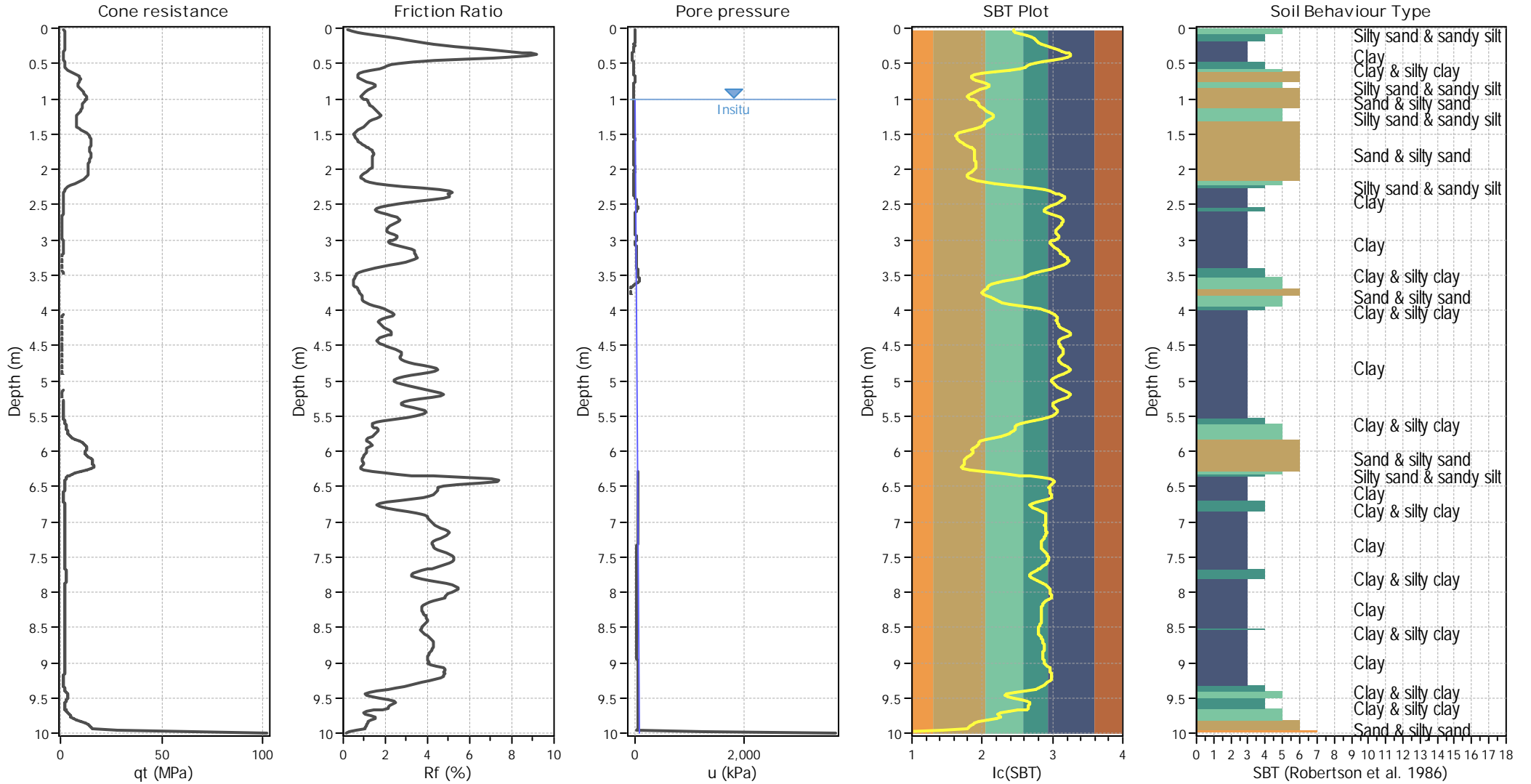
F.S. color scheme

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LPI color scheme

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- High risk
- Low risk

CPT basic interpretation plots



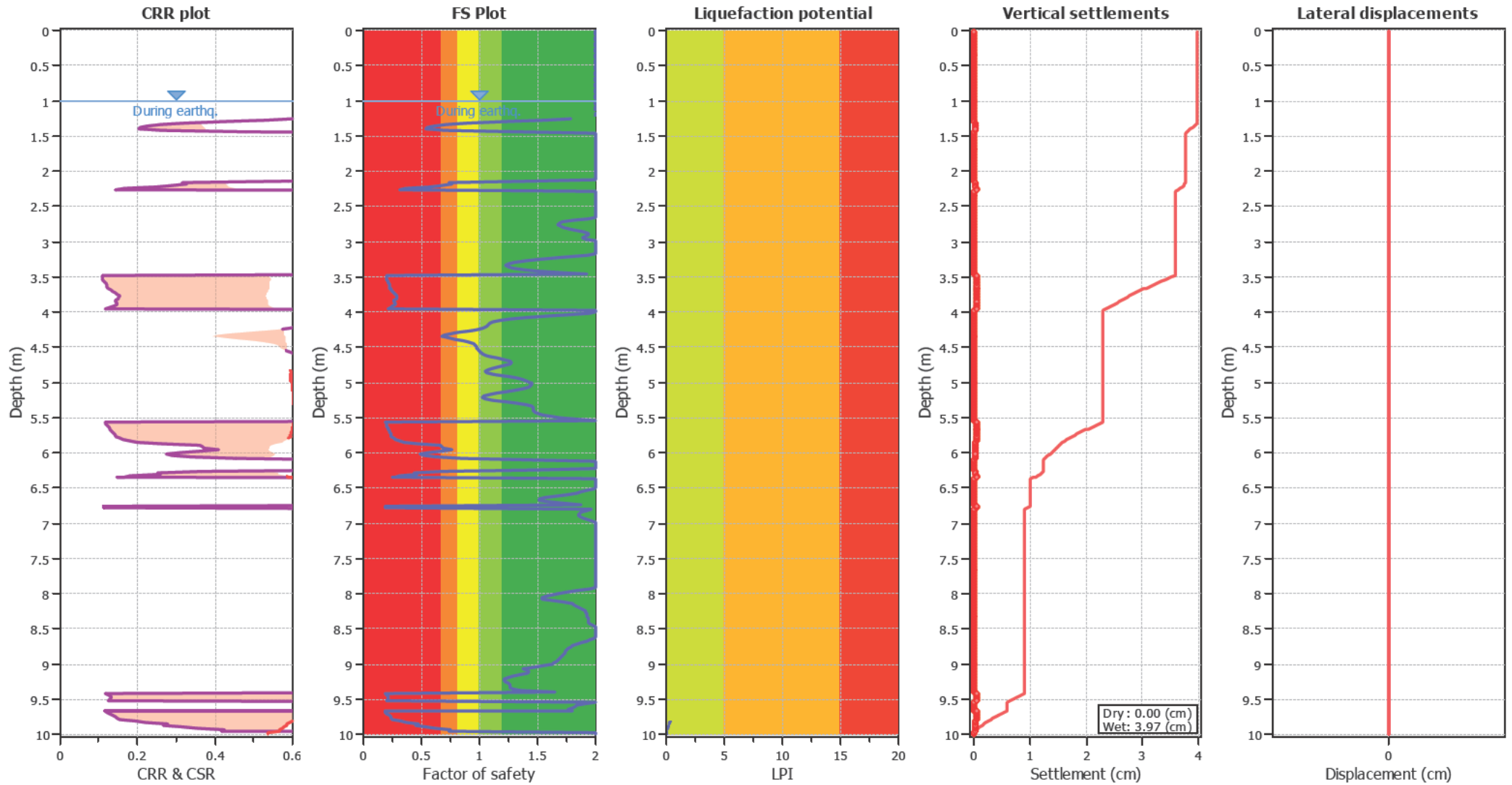
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
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| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | K_{σ} applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

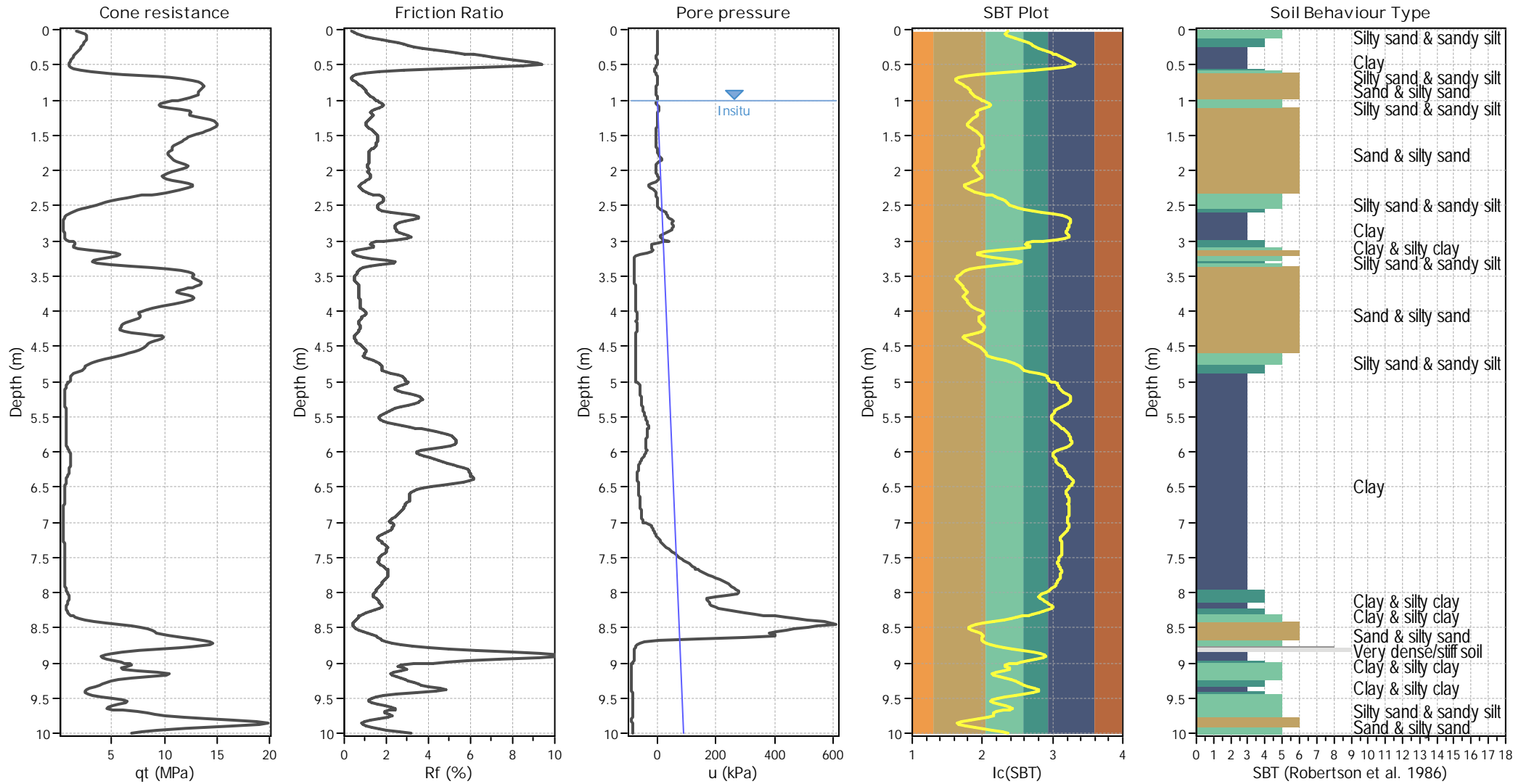
F.S. color scheme

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LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots



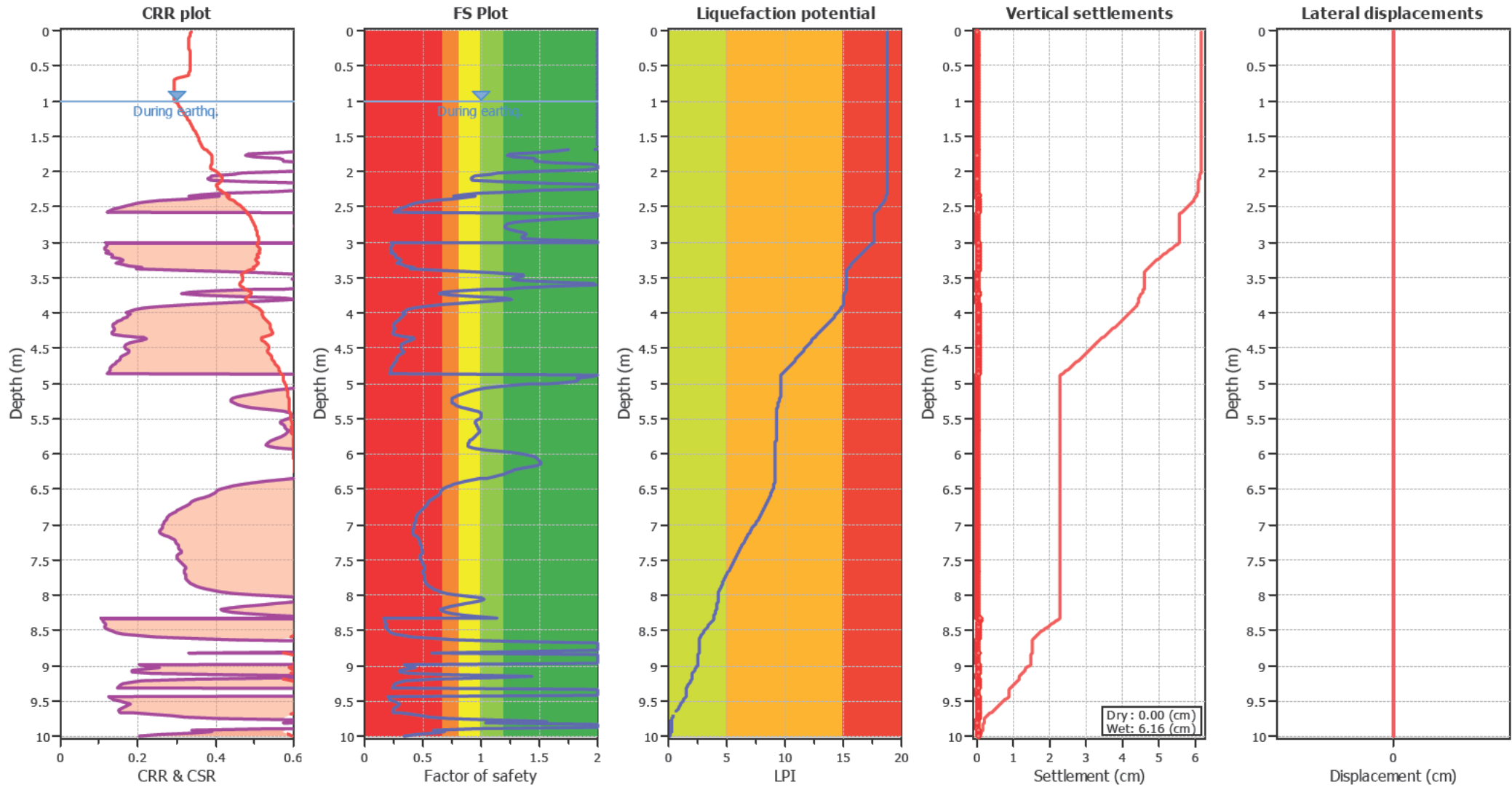
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
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SBT legend

| | | |
|---------------------------|-----------------------------|----------------------------|
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Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

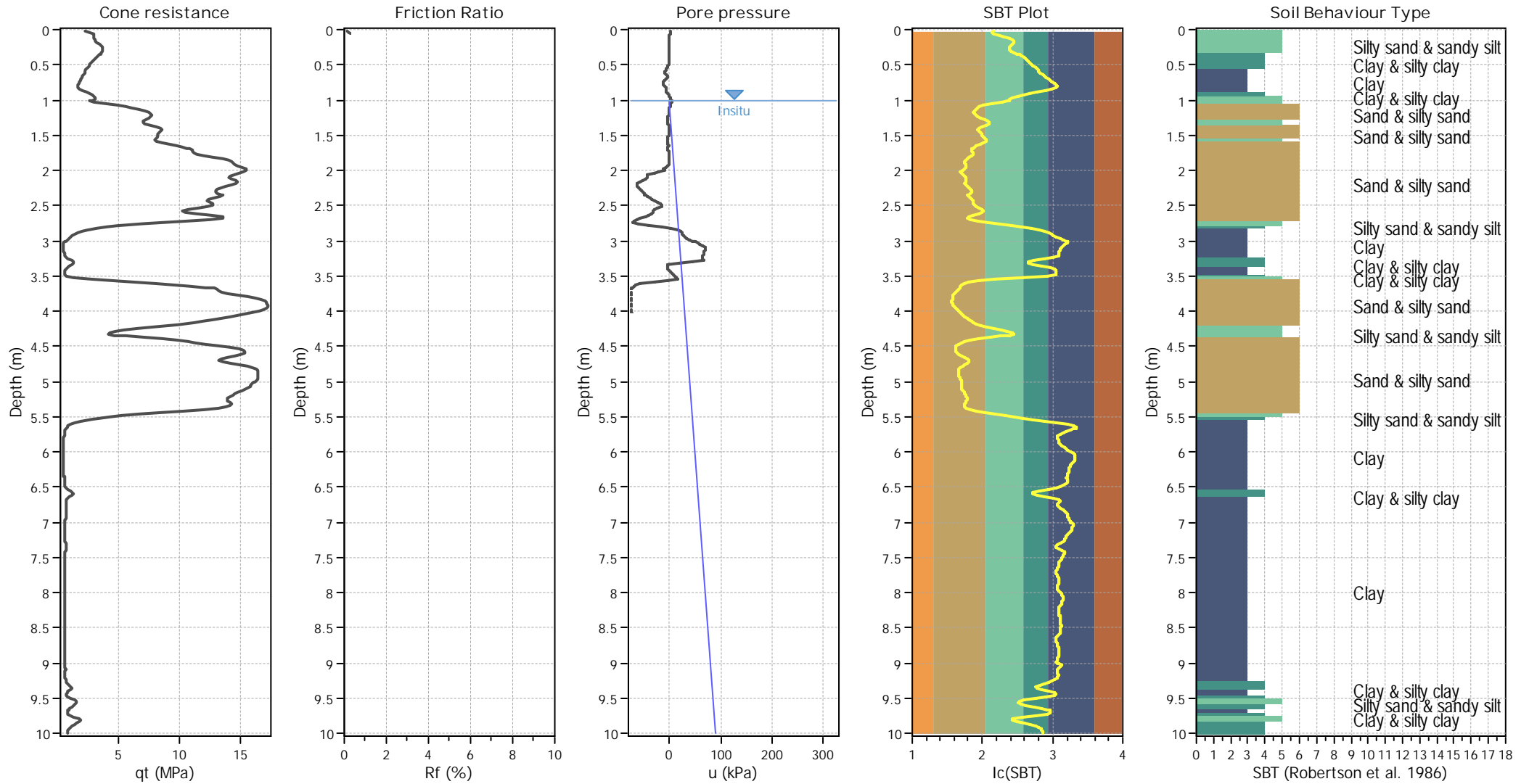
F.S. color scheme

- Almost certain it will liquefy
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- 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

CPT basic interpretation plots



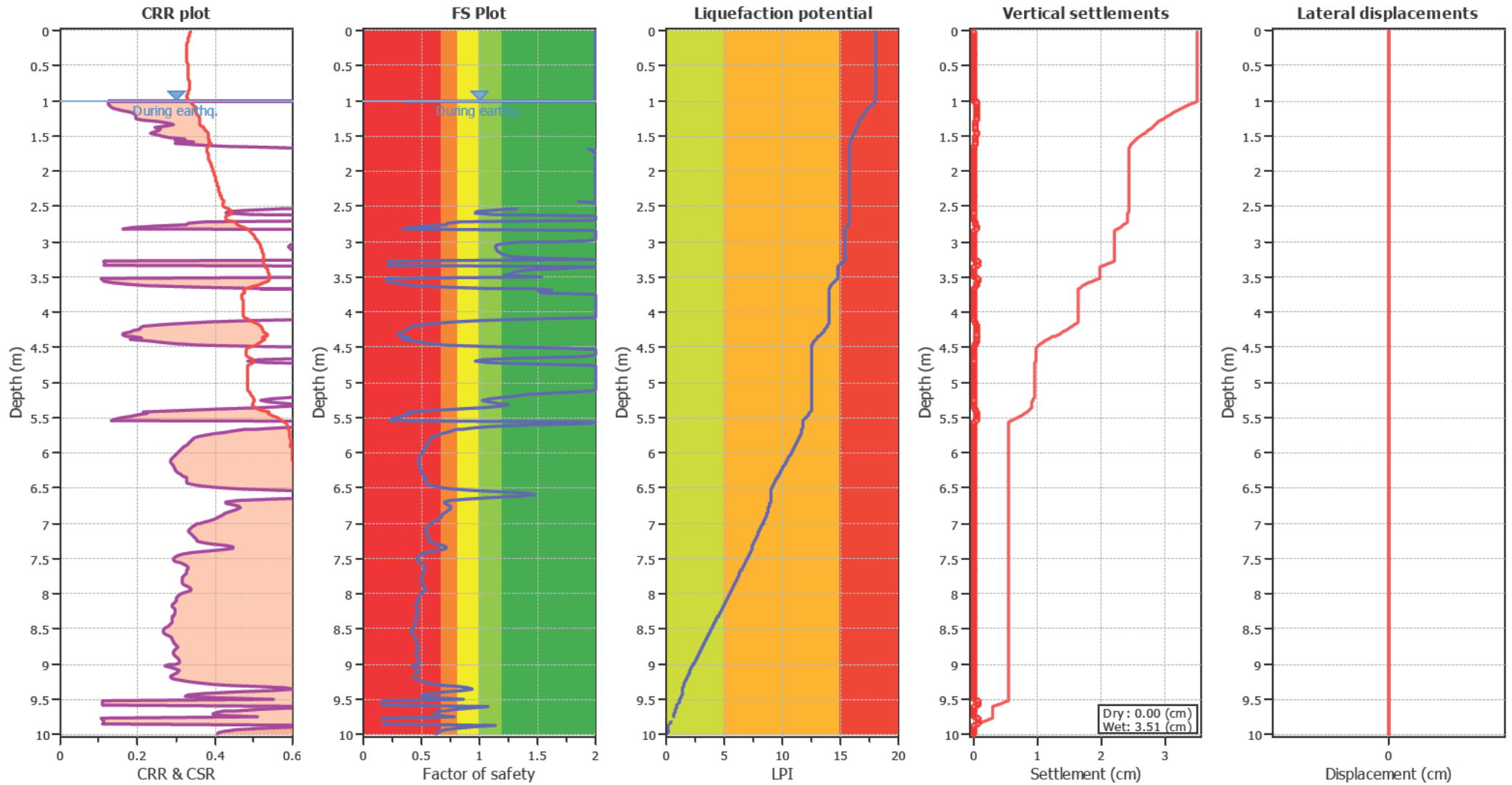
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 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_{σ} applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
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| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

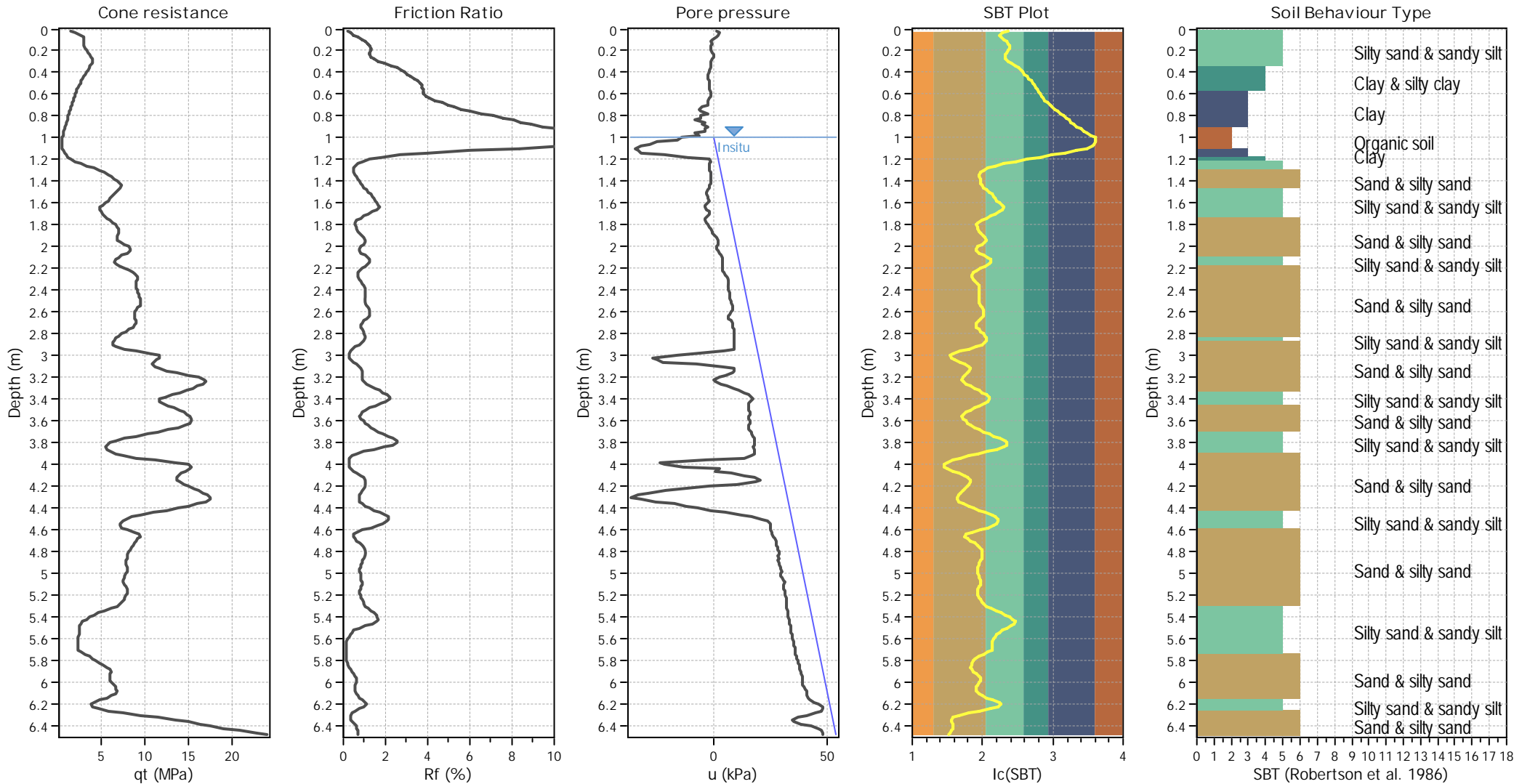
F.S. color scheme

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LPI color scheme

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- High risk
- Low risk

CPT basic interpretation plots



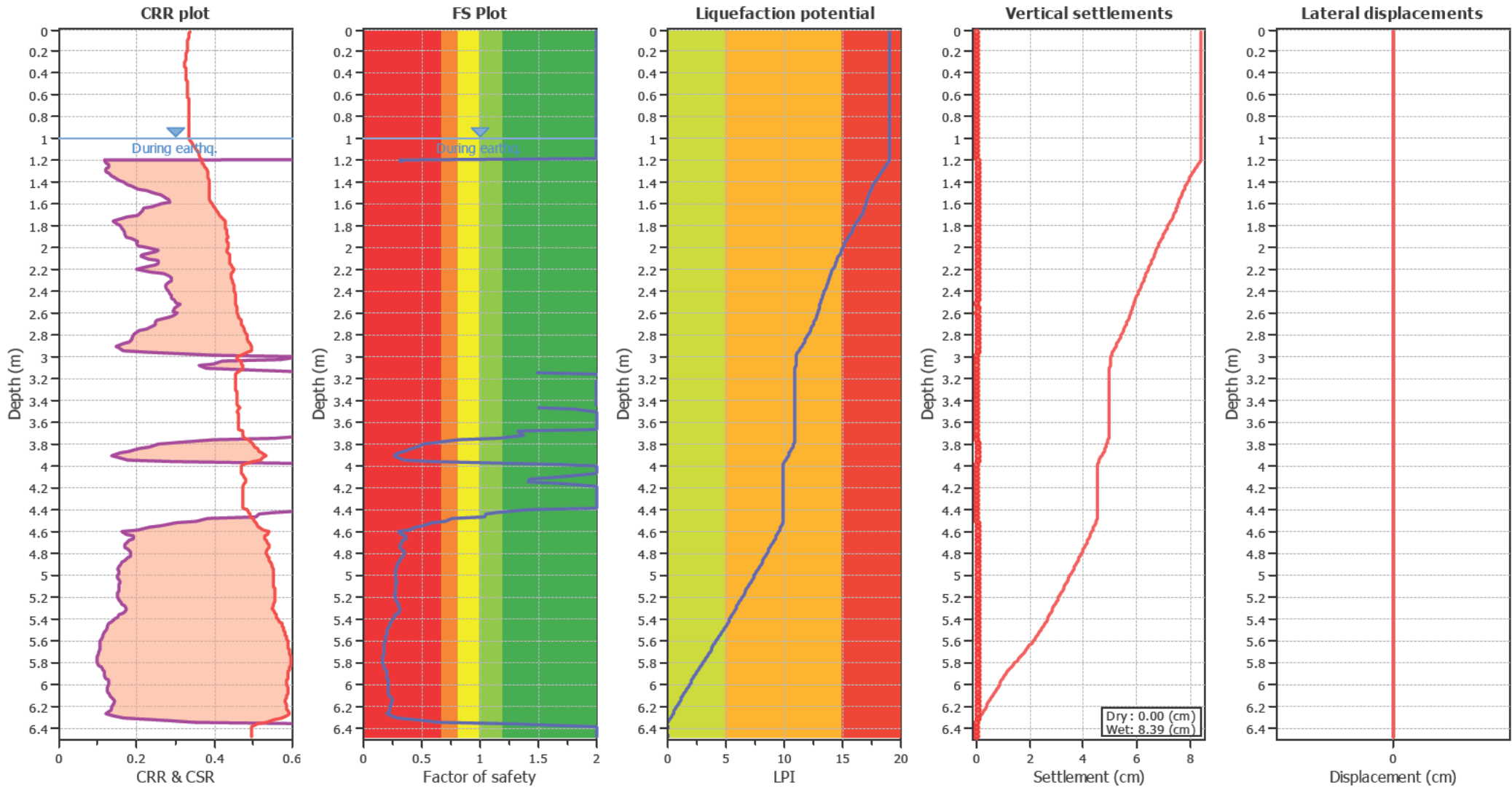
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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SBT legend

| | | |
|---------------------------|-----------------------------|----------------------------|
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| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWL (erthq.): | 1.00 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_f applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
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| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

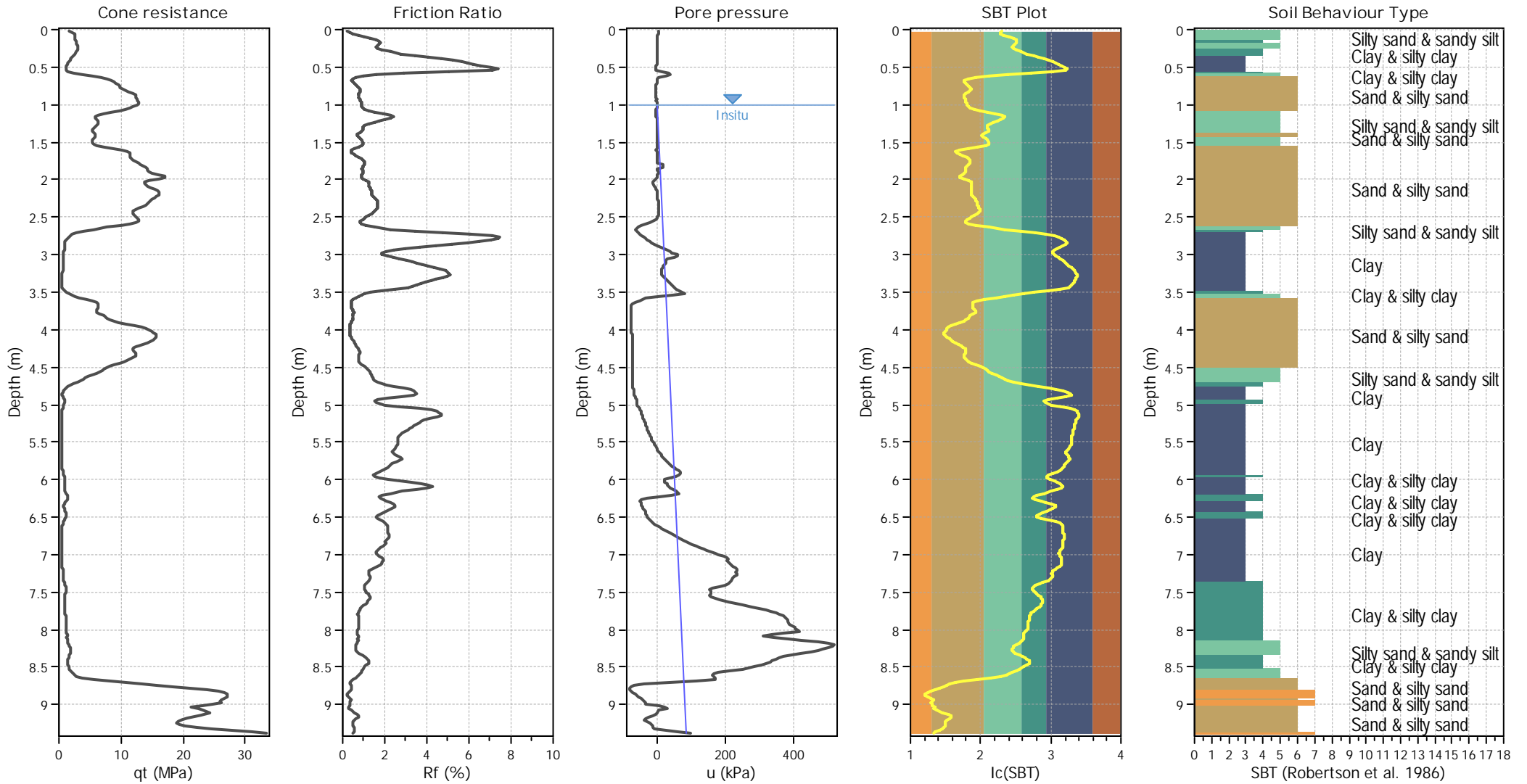
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LPI color scheme

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CPT basic interpretation plots



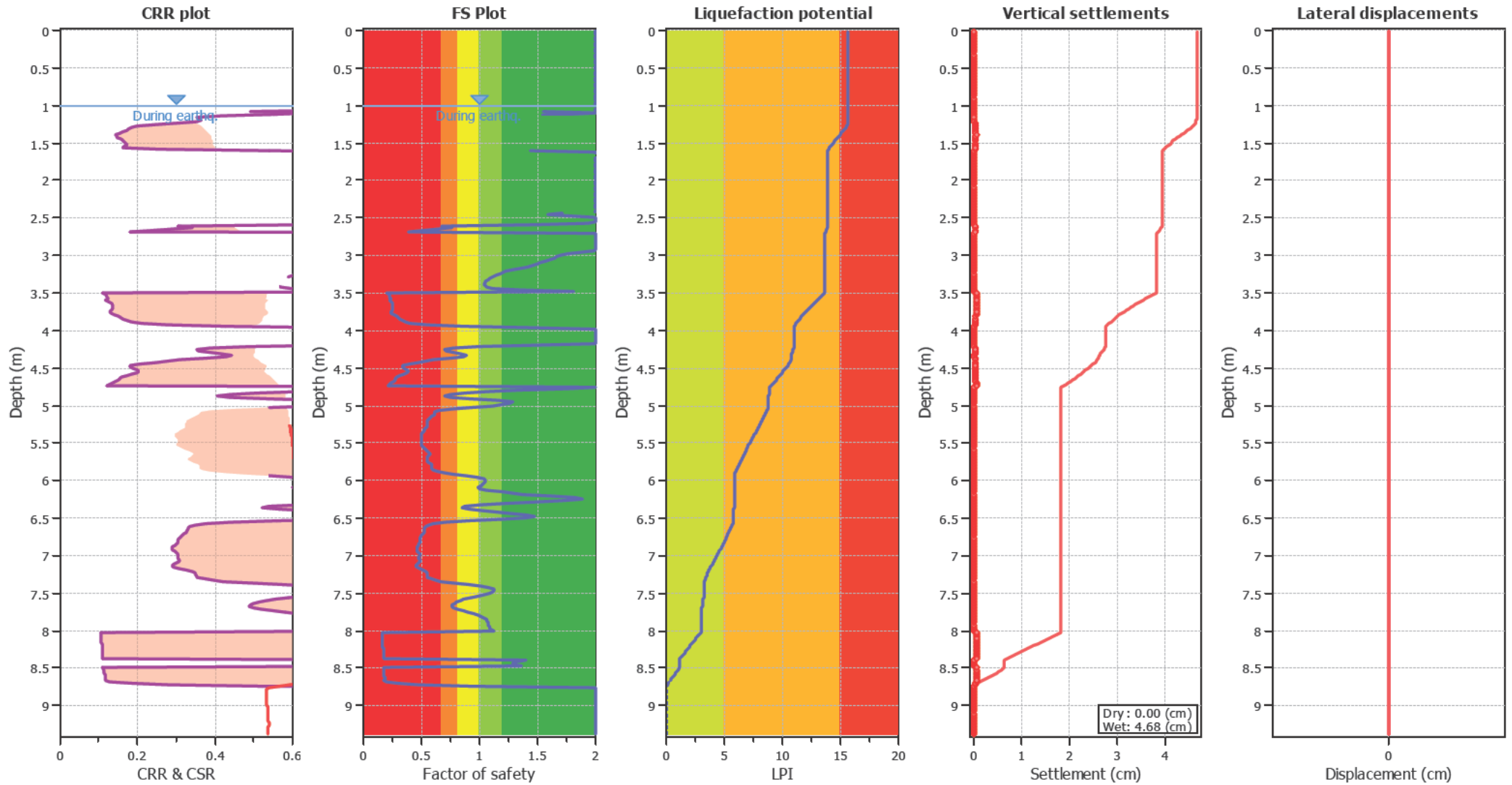
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
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SBT legend

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Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
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| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

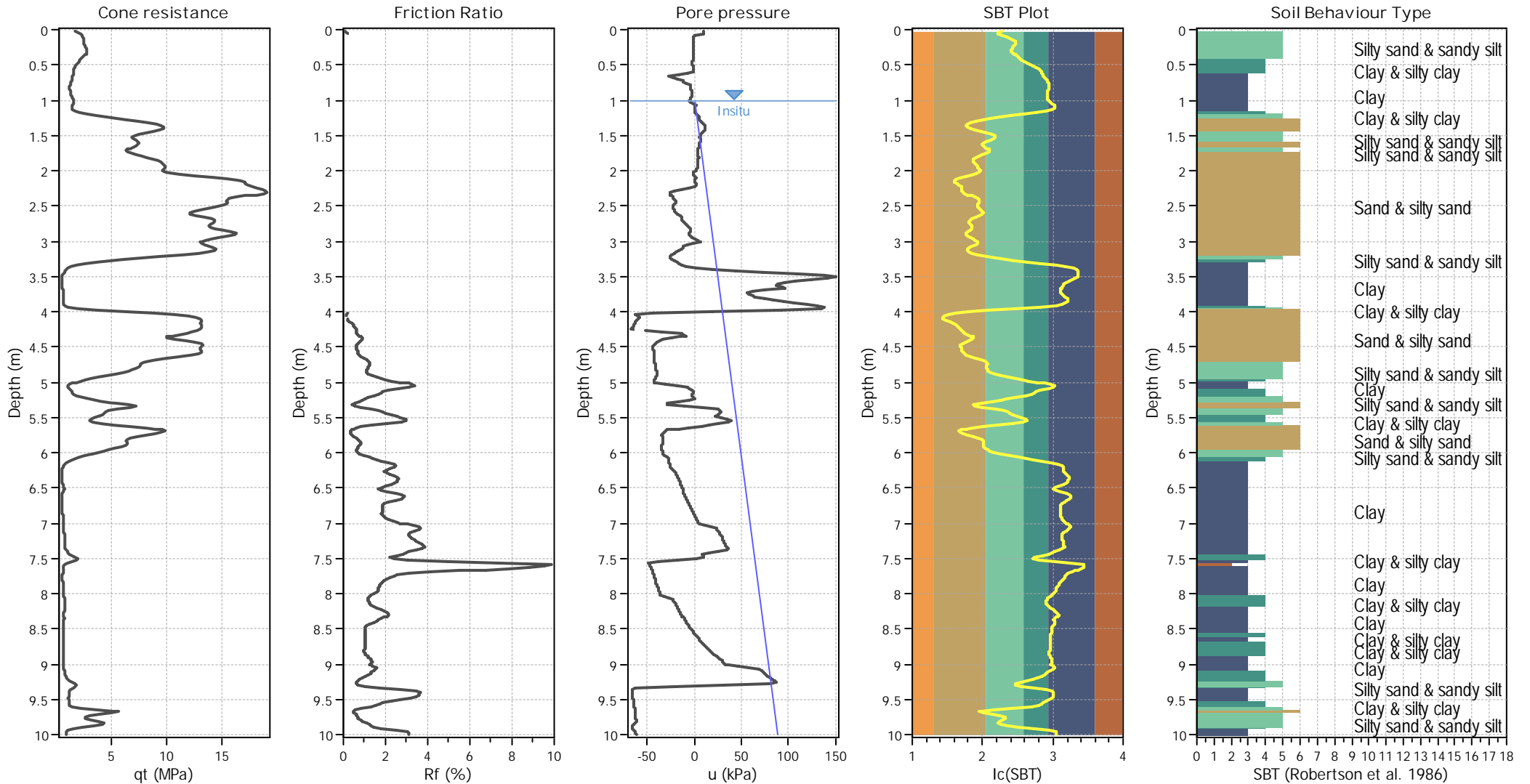
F.S. color scheme

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CPT basic interpretation plots



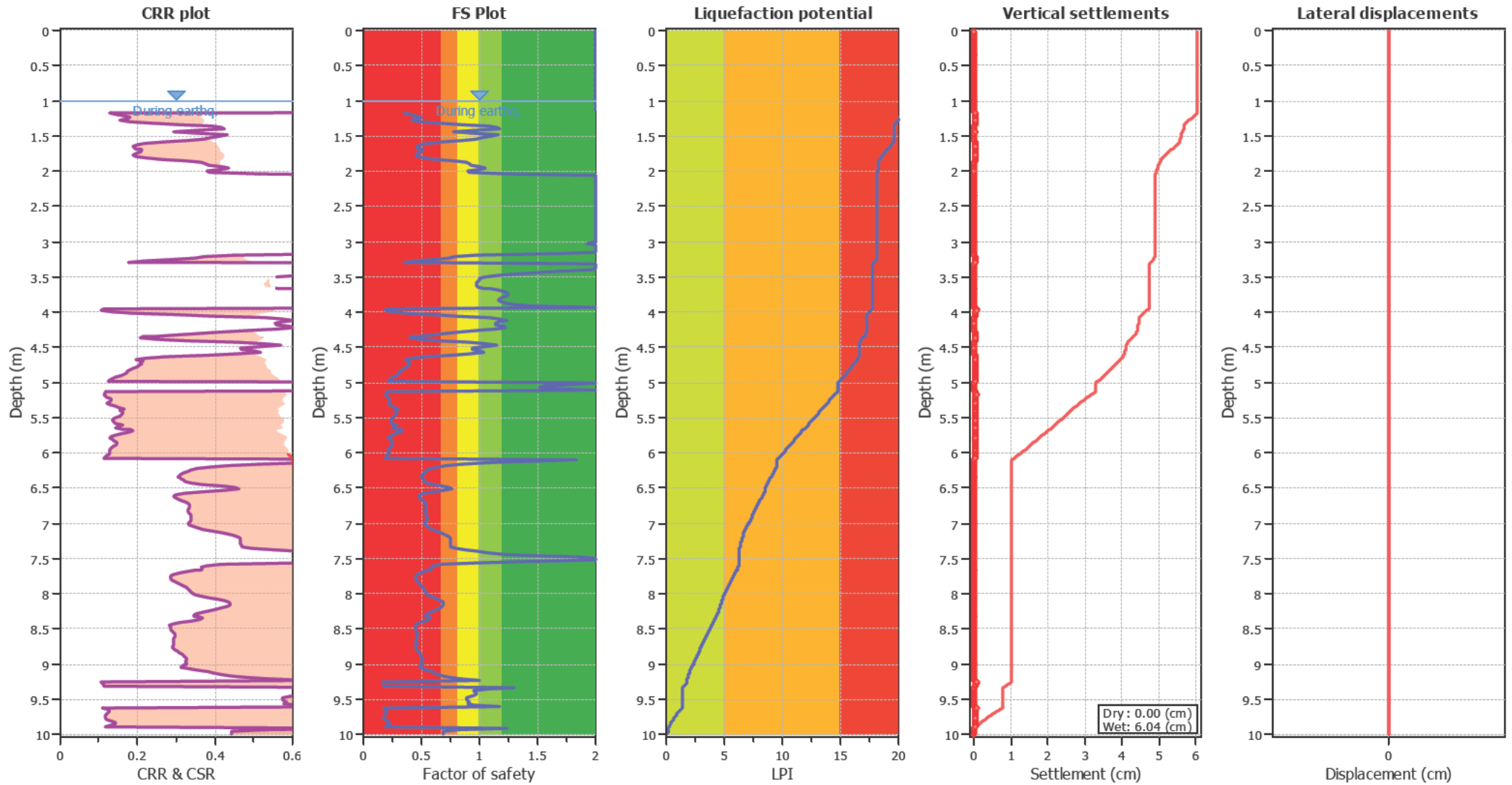
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SBT legend

| | | |
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Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
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| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 m |

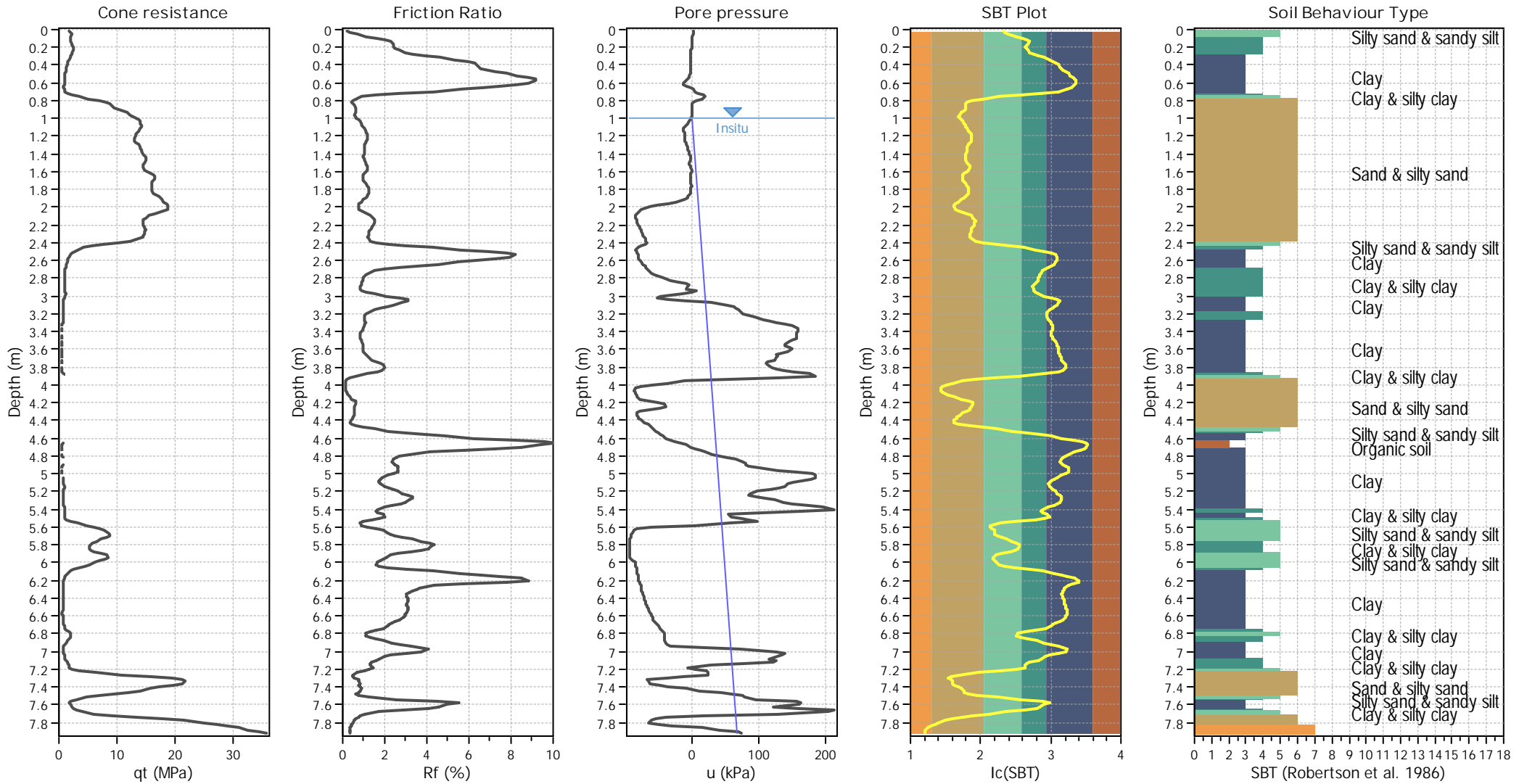
F.S. color scheme

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LPI color scheme

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CPT basic interpretation plots



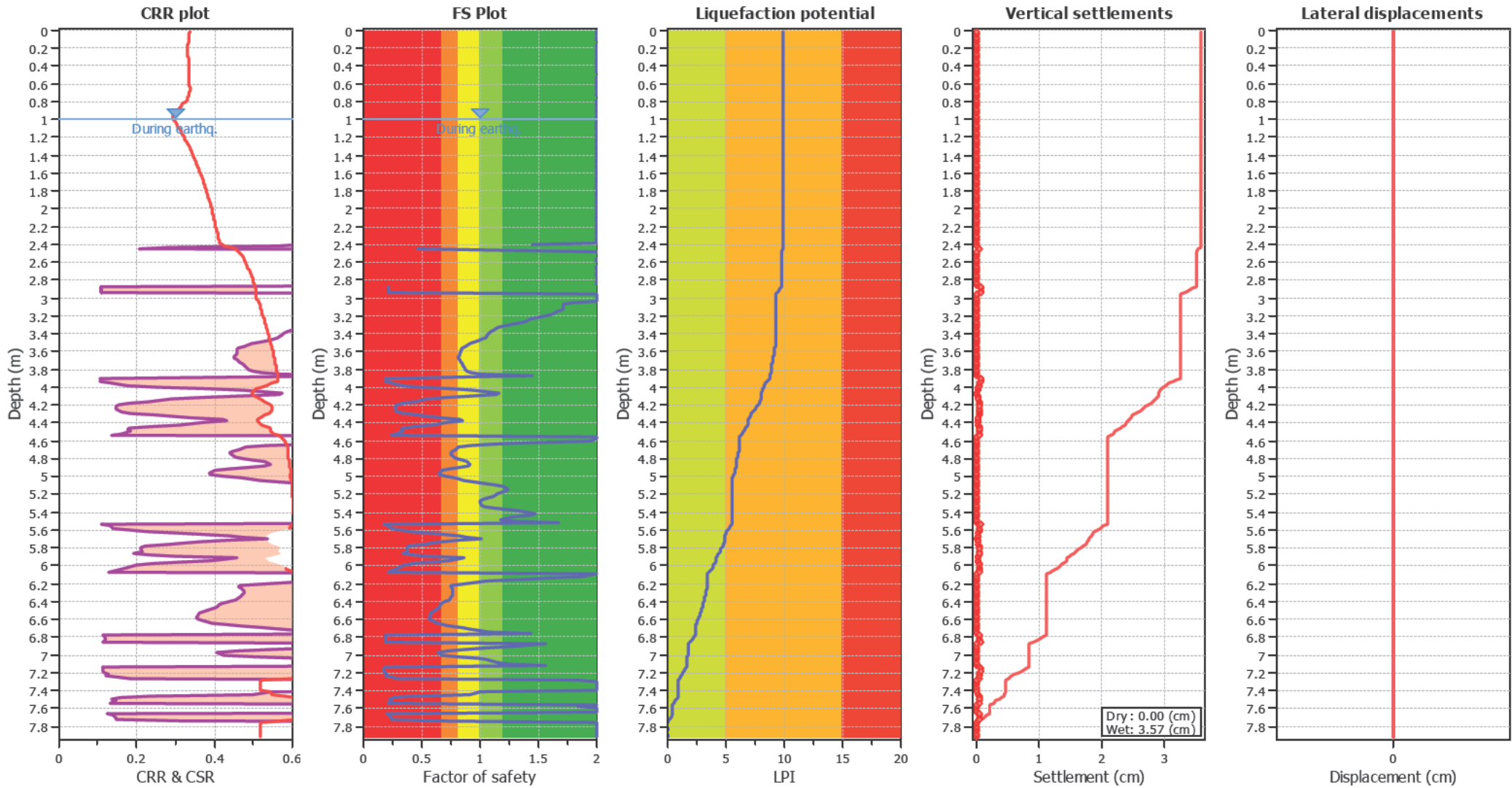
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| | | | | | |
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| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | K_G applied: | Yes |
| Earthquake magnitude M_w : | 7.10 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sand & Clay |
| Peak ground acceleration: | 0.58 | Use fill: | No | Limit depth applied: | Yes |
| Depth to water table (insitu): | 1.00 m | Fill height: | N/A | Limit depth: | 10.00 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 |

Liquefaction analysis overall plots



Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (earthq.): | 1.00 m | Fill weight: | N/A |
| Fines correction method: | B&I (2014) | Average results interval: | 3 | Transition detect. applied: | No |
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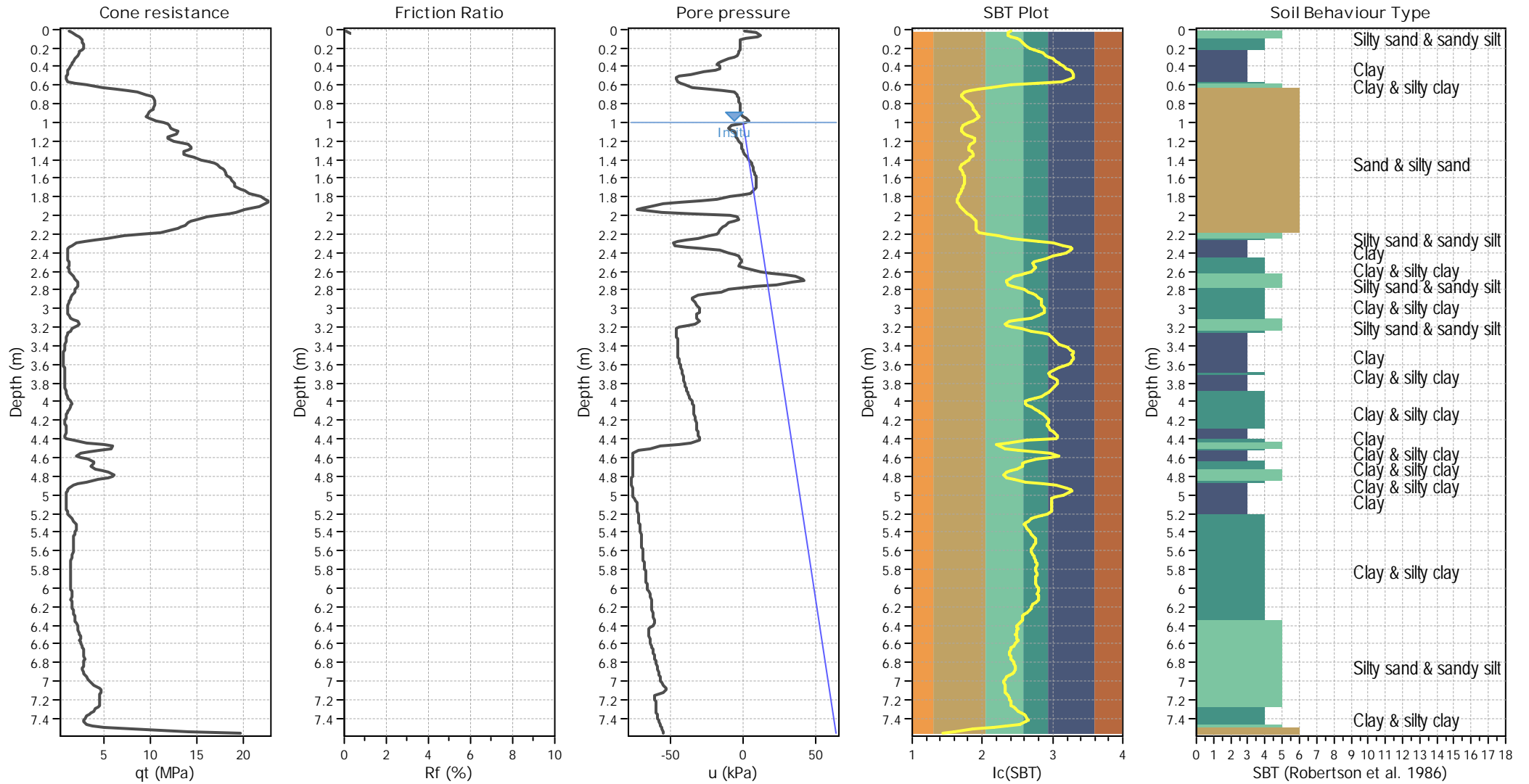
F.S. color scheme

- 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

CPT basic interpretation plots



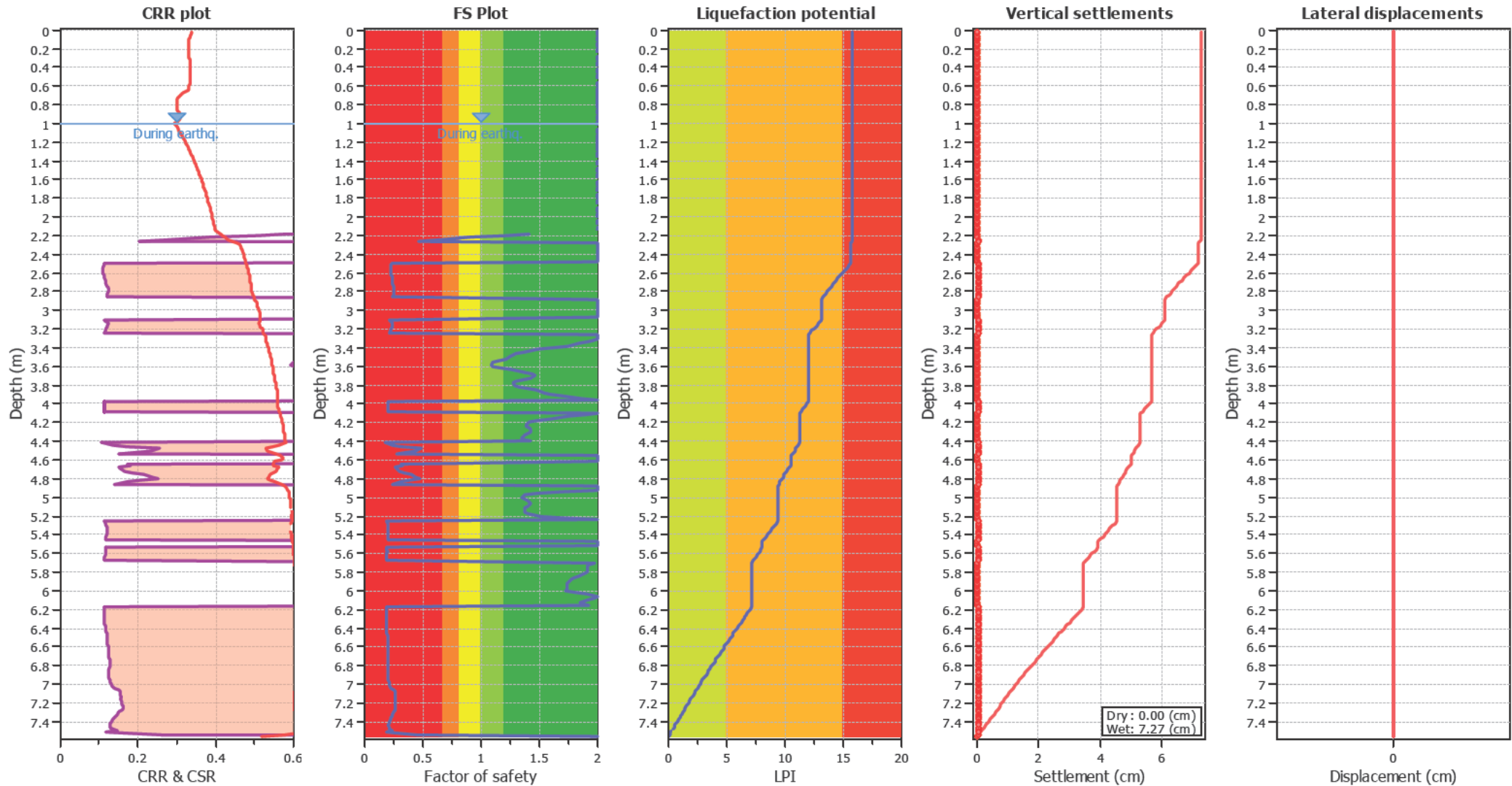
Input parameters and analysis data

| | | | | | |
|--------------------------------|-------------------|---------------------------|--------------|-----------------------------|-------------|
| Analysis method: | B&I (2014) | Depth to GWT (erthq.): | 1.00 m | Fill weight: | N/A |
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Liquefaction analysis overall plots



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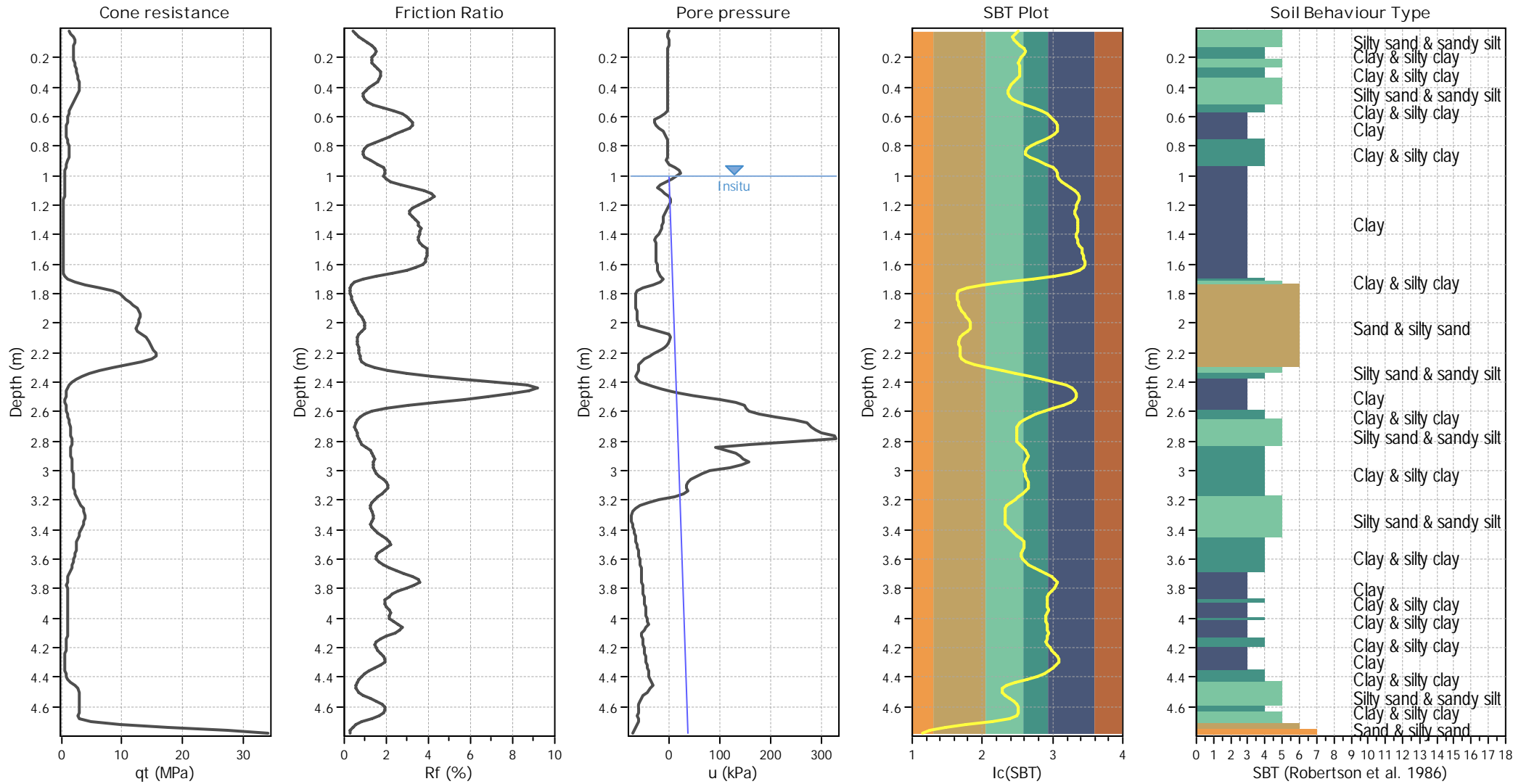
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CPT basic interpretation plots



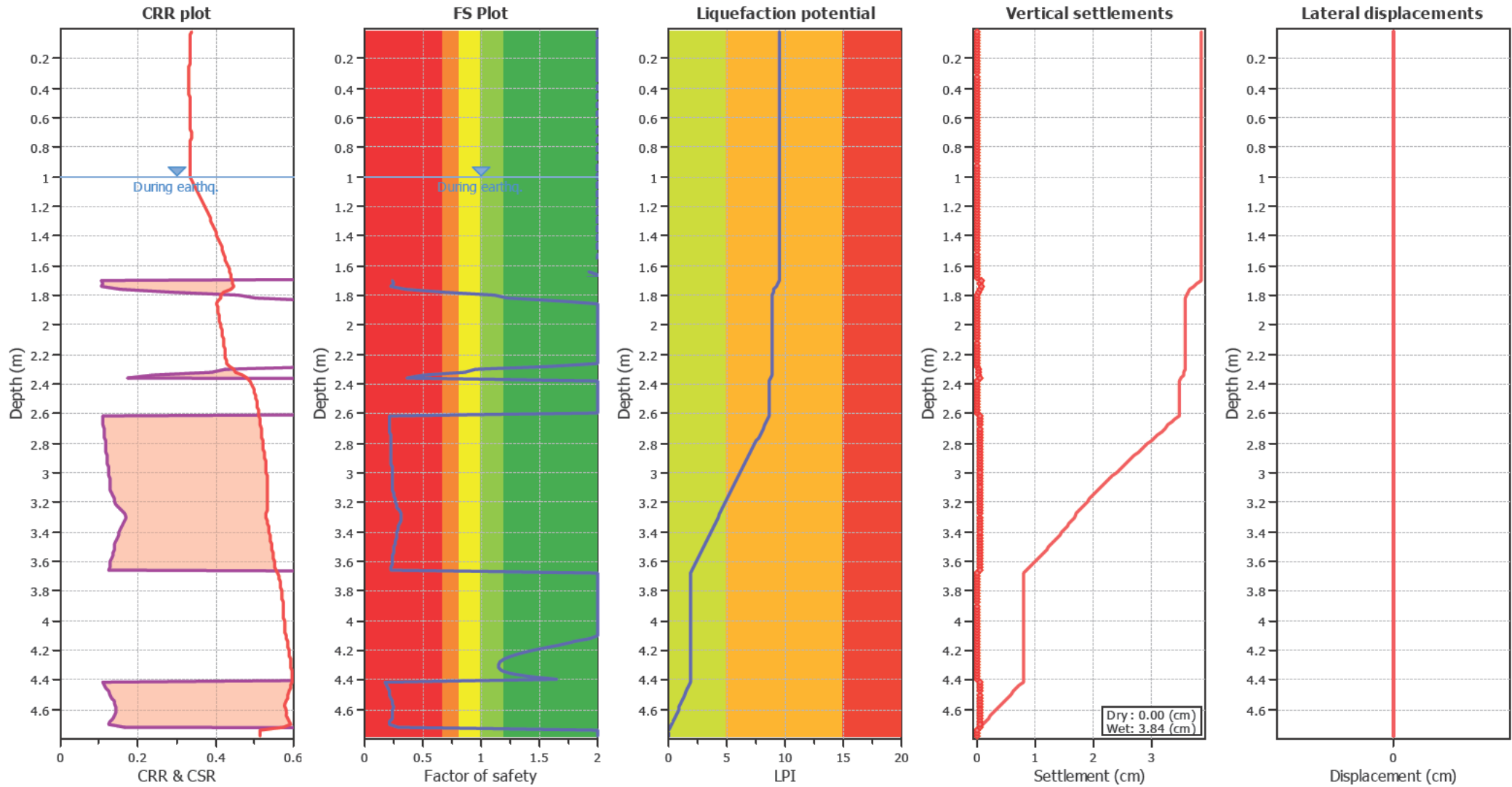
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Liquefaction analysis overall plots



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Napier

6 Ossian Street
Ahuriri
Napier 4110
New Zealand

www.cmwgeosciences.com