

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED DWELLING

**35A VICTORIA AVENUE,
WHAKATANE**

CHRISTINA TAY

Reference: 231001
Prepared: 4 October 2023
Issued to: Christina Tay
101/13 Surrey Crescent
Grey Lynn
Auckland 1021
christina.tay@outlook.com

1. INTRODUCTION

This report presents the findings of a geotechnical investigation carried out for a proposed dwelling at 35a Victoria Avenue, Whakatane.

The purpose of our investigation was to assess subsoil conditions, quantify various geotechnical risks and determine the geotechnical suitability of the site for residential development. We have also been asked to make recommendations regarding suitable foundation and stormwater management options.

This report has been prepared for Christina Tay in accordance with our proposal letter dated 1 August 2023 and subject to a geotechnical review of the final plans, may be used in support of an application to Whakatane District Council (WDC) for building consent approval in respect of the proposed development as described herein.

2. SITE DESCRIPTION

2.1 General

The subject site (legally described as Lot 2 DP 586717) is located on the southern side of 35a Victoria Avenue, Whakatane. It comprises an irregular shaped property with a surveyed area of 414 m².

The property is gently sloping and predominantly grass covered. No buildings currently occupy the site. A concrete driveway provides vehicle access from the road front to the north-western corner of the site.

The WDC GIS viewer indicates the site is mostly between RL 5.0 and 5.5 m (Moturiki Datum).

A site plan is attached, drawing number 231001/1.

2.2 Utilities

A review of the WDC GIS viewer indicates that a reticulated wastewater pipe is located within the road reserve on the northern side of Victoria Avenue. It is understood that a lateral connection has been installed as part of subdivision and is available to the site.

No public stormwater connection is available to the property. On this basis, it is expected that on-site disposal will be required.

3. GEOLOGY AND GEOMORPHOLOGY

The Geological Map of Rotorua¹ shows the subject site to be underlain by Holocene aged beach deposits of the Tauranga Group. The beach deposits are described as marine gravel, sand and mud on modern beaches.

A review of the GNS Active Faults Database indicates the nearest active fault is the Whakatane Fault which is located approximately 350 m to the west of the property.

1 Leonard, G.S.; Begg, J.G.; Wilson, C.J.N. (compilers) 2010. Geology of the Rotorua Area. Institute of Geological and Nuclear Sciences 1:250 000 Geological Map 5. 1 Sheet + 102p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

4. EXISTING GEOTECHNICAL INFORMATION

4.1 Geotechnical Reports

We are not aware of any existing geotechnical reports relating to the property. It is understood that a geotechnical report was not required as part of the previous subdivision from the road front lot.

4.2 New Zealand Geotechnical Database

A review of the New Zealand Geotechnical Database (NZGD) indicates that the nearest recorded geotechnical data is located approximately 50 m to the north of the subject site. The CPT and hand auger borehole data have been reviewed and considered in the preparation of this report.

4.3 Natural Hazards -

4.3.1 Liquefaction Hazard

The Bay of Plenty (BOP) Natural Hazards Viewer indicates that the site has been mapped within an area where *'Liquefaction is Possible'*.

4.3.2 Flood Hazard

The site is not located within a Flood Protection and Drainage Bylaw Applicable Area. It is understood the site is not located within a mapped flood hazard; however, a site-specific flood hazard assessment is outside the scope of this report. The minimum floor levels (if applicable) should be confirmed with the consenting authority during detailed design.

5. PROPOSED DEVELOPMENT

We have not been supplied with detailed design drawings for the proposed development; however, based on discussions with our client and observations on site, it is understood that the proposed development will comprise the construction or siting of a single level lightweight dwelling at the approximate centre of the property. The dwelling will comprise a suspended timber floor supported on timber pile foundations.

The approximate location of the proposed building platform is shown on the attached site plan, drawing number 231001/1.

6. SITE INVESTIGATION

Our site investigation was undertaken in September and October 2023 and comprised the following:

- A walk over appraisal of the site;
- 4 hand auger boreholes to depths between 2.0 and 4.2 m;
- 3 Scala penetrometer tests from the ground surface, immediately adjacent to selected hand auger boreholes;
- 2 cone penetration tests (CPT's) to a target depth of 15 m;
- 1 falling head soakage test; and
- The measurement of groundwater levels in the boreholes (where encountered).

The approximate locations of all test positions are shown on our attached site plan, drawing number 231001/1. The borehole logs, Scala penetrometer, soakage and CPT results are also attached. The soil descriptions given on the logs are in general accordance with the New Zealand Geotechnical Society's

“Field Description of Soil and Rock”. The groundwater levels were measured following drilling and are indicated on the borehole logs.

7. GROUND MODEL

7.1 Subsoil Conditions

Detailed descriptions of the subsoils encountered in the boreholes are attached. The subsoils were generally found to comprise:

- **Topsoil (300 to 400 mm thick);** comprising organic silt, overlying:
- **Beach Deposits;** consisting of loose to dense, grey and greyish brown fine sand.

Scala penetrometer tests were carried out from the ground surface immediately adjacent to selected hand auger boreholes to confirm the relative density of the shallow granular subsoils. The granular soils typically achieved values between 1 and 3 blows per 100 mm over the upper 1.5 m before increasing to between 4 and 7 blows per 100 mm to depths of 2.7 and 2.3 m in SP1 and SP2, respectively, and to the termination of testing (1.9 m) in SP3. The sands over the remainder of the tested depth in SP1 (3.9 m) and SP2 (2.9 m) are dense with blow counts between 8 and 11 blows per 100 mm.

The interpreted CPT data indicates the soil profile generally comprises sand mixtures with cone resistance values of 5 to 10 MPa over the upper 3.0 m. The sands over the remainder of the tested depth (15 m) generally increase in density with cone resistance values between 10 and 30 MPa.

7.2 Groundwater Conditions

Groundwater was encountered at a depth of 4.0 m or approximately RL 1.0 m (Moturiki Datum) in hand auger borehole HA01 during our time on site. Groundwater was not encountered within the tested depth of the remaining boreholes. This correlates well with the measured groundwater table following completion of the CPT's and an increase in porewater pressure observed at depths of 3.3 and 3.9 m in CPT-02 and CPT-01, respectively. These depths are considered representative of typical elevated groundwater conditions given the recent period of wet weather; however, the groundwater level may be temporarily higher following times of heavy or prolonged rainfall.

8. GEOTECHNICAL ASSESSMENT

8.1 Seismic Site Subsoil Category

Based on a review of available CPT data, the seismic site subsoil category is assessed as being Class D (Deep Soils) in accordance with NZS 1170.5.

8.2 Liquefaction Analysis

8.2.1 Introduction

Liquefaction is the process where saturated sand and silt grains temporarily lose strength and act as a fluid. This effect can be caused by a build-up of excess pore water pressure due to earthquake shaking and can result in significant damage to buildings and infrastructure.

For liquefaction and/or lateral spreading to occur, the subsoils must have the following properties:

- loose (compacted soils tend not to liquefy)
- sandy or silty (clays and gravels tend not to liquefy)

- saturated (only soils below the ground water table are susceptible to liquefaction)

Whakatane is an area considered at high risk of seismic hazard. A review of the GNS Active Faults Database indicates the nearest active fault is located approximately 350 m to the west of the subject site. The relatively young deposits beneath the subject site comprise loose to dense, saturated, granular soils which are considered susceptible to liquefaction which may be triggered during a sufficiently large seismic event.

8.2.2 Analysis Methodology

The liquefaction susceptibility was analysed using CPT testing data imported into the GeoLogismiki software package CLiq (Version 3.5.2.8). The following assessment methodologies have been applied:

- Analysis Methods – Idriss and Boulanger (2014)
- Fines Correction Method – Robertson and Wride (1998)
- Settlement Estimates – Zhang et al (2002)

The following design cases have been considered for the liquefaction assessment:

- **Serviceability Limit State (SLS)** - loads a building or structure is likely to be subjected to more frequently during its design life. A building should be readily repairable when subjected to SLS loads. SLS loads are based on a one in 25-year earthquake.
- **Intermediate** - loads a building or structure is likely to be subjected to during the design life of the structure. This design scenario is considered optional.
- **Ultimate Limit State (ULS)** - loads a building or structure may be subjected to during a large (severe), relatively rare event. A building should be designed to lower the risk of collapse, and therefore minimise the risk or protect life safety to human life when subjected to ULS loads. ULS loads are based on a one in 500-year earthquake.

The ground motion parameters were obtained from Table A1 in Module 1 of the MBIE Earthquake geotechnical engineering practice guidance assuming an importance level 2 structure.

The details of the earthquake design load scenarios are outlined below.

Table 8.2.2 Earthquake Design Scenarios

Design Condition	Annual Probability of Exceedance	Magnitude (M)	Peak Ground Acceleration
SLS	1/25	6.1	0.11 g
Intermediate	1/50	6.1	0.15 g
ULS	1/500	6.1	0.44 g

The results of the liquefaction analysis are discussed below.

8.2.3 Liquefaction Induced Settlement

The results indicate that during an SLS earthquake event negligible settlement (<5 mm) is predicted (refer Table 8.2.3 for details). The liquefaction potential index is classified as low risk with little to no expression of liquefaction (i.e. sand boils or ejecta) expected at the surface.

During a ULS earthquake event, approximately 60 to 70 mm of settlement due to liquefaction is predicted over the tested depth (15 m) with 10 to 15 mm occurring within the upper 10 m. The liquefaction potential index is classified as low risk with minor expression of liquefaction expected at the surface (i.e. sand boils or ejecta). The analysis indicates that the potentially liquefiable soils below the groundwater are generally below 10 m where cone resistance values of 15 MPa or less were encountered.

Analyses were also completed for an optional intermediate level event (1 in 50 years) as this size of event should be expected to occur at least once during the design lifetime of the building. Settlements of less than 5 mm were predicted for this event with little to no expression of the liquefaction predicted at the surface.

Differential settlements in the order of one half to two thirds of the estimated values may be expected at the ground surface. The liquefaction analysis outputs are attached with results summarised below.

Table 8.2.3 Summary of Liquefaction Induced Settlement

Test	SLS Design Condition			50 Year Design Condition			ULS Design Condition		
	Vertical Settlement (mm)	LPI	LSN	Vertical Settlement (mm)	LPI	LSN	Vertical Settlement (mm)	LPI	LSN
CPT-01	<5	Low risk	Little to no expression of liquefaction	<5	Low risk	Little to no expression of liquefaction	60	Low risk	Little to no expression of liquefaction
CPT-02	<5	Low risk	Little to no expression of liquefaction	<5	Low risk	Little to no expression of liquefaction	70	Low risk	Little to no expression of liquefaction

The liquefaction analysis outputs are attached.

8.2.4 Liquefaction Induced Lateral Spreading

Lateral spreading is the lateral displacement of gently sloping ground caused by earthquake induced liquefaction. The site is located more than 400 m from the Whakatane River. We are not aware of any open drains within 200 m of the subject site. On this basis, we consider the site to be at low risk of lateral displacement during a seismic design event.

9. RECOMMENDATIONS

9.1 Foundations

The subsoils at this site were found to comprise a 300 to 400 mm thick layer of topsoil overlying loose to dense beach deposits. The natural sands beneath the topsoil have an assessed geotechnical ultimate bearing capacity of less than 300 kPa and the deeper soils below the groundwater table are potentially susceptible to liquefaction meaning that the founding conditions are outside the criteria for “Good Ground” given in NZS 3604:2011.

Based on our analysis, liquefaction induced settlements under a SLS design event are estimated to be negligible, while under the ULS design conditions less than 25 mm of settlement can be expected over the upper 10 m. Comparing these results with the information provided in the MBIE Guidance for construction and repair of residential buildings in the Canterbury region following the 2010 earthquake sequence, gives the equivalent of a TC1 site.

Given the ground conditions, locally deepened but effectively shallow timber pile foundations per NZS 3604:2011 with a reduced geotechnical ultimate bearing capacity are considered appropriate to meet code requirements.

Shallow pile foundations should be embedded a minimum depth of 450 mm below cleared ground level and at least 200 mm into natural ground where a geotechnical ultimate bearing capacity of at least 200 kPa

can be assumed. Foundation depths should not exceed 1.5 m to ensure adequate clearance from the deeper potentially liquefiable soils is maintained.

Specific foundation design by a CPEng (Structural) will be required with review by a Geo-Professional².

All excavated pile holes should be inspected at the time of construction to check for soft/loose spots as may naturally occur and to confirm clearance below fill.

9.2 Earthworks

The proposed building platform is near level and it is understood that no cut or fill earthworks will be required. The proposed dwelling will comprise a suspended timber floor supported on shallow timber pile foundations. All existing topsoil and fill may remain in place to that area, provided all surface vegetation has been removed, the required sub floor clearance is provided and the piles are embedded to the required minimum depths as discussed in the foundations section above.

9.3 Stormwater Management

The site is considered geotechnically suitable for disposal of stormwater runoff via on-site ground soakage. The soakage system should be located a sufficient distance from building foundations and the property boundaries.

Soakage testing was conducted within the underlying natural soils to a depth of 1.7 m. Analysis of the falling head test data provided a soakage rate of 1,998 L/hr/m². For design purposes a soakage rate reduction factor of 0.5 should be applied.

Concentrated stormwater flows should not be allowed to discharge onto or into the ground close to the proposed dwelling as this could be detrimental to foundation conditions.

9.4 Plan Review

Detailed development plans should be reviewed when they are available. This should include geotechnical review of the building layout, foundation design and the stormwater disposal methodology/system location prior to building consent. This is to ensure that the information used as the basis of this report is consistent with final development proposals and that the recommendations outlined in this report have been interpreted correctly.

9.5 Construction Inspections

Geotechnical inspection of the pile foundations will be required at the time of construction. This is to confirm expected ground conditions and to ensure compliance with the recommendations contained in this report.

It is the Client's responsibility to ensure that we are notified of any required inspections and that we are given adequate notice to carry out the inspections (at least 48 hours). We will issue a certification letter upon successful completion of the inspected works.

² Chartered Professional Engineer specialising in geotechnical engineering (CPEng (Geotech)) or Professional Engineering Geologist (PEngGeol), both as administered by Engineering NZ.

10. LIMITATIONS

The recommendations and opinions contained in this report are based on the subsoils encountered at discrete test locations. We have made assumptions about the nature of the ground conditions across the rear of the site based on this limited subsoil information and actual ground conditions may vary from those assumed in this report. If any variations from the assumed ground conditions are found to exist during construction the matter should be referred to Geoconsult.

This report has been prepared solely for the benefit of Christina Tay as our client and her nominated agents for the purposes of the specific brief as stated in this report. Geoconsult accepts no liability in respect to any matters arising from the use of the information given in this report by any other person or organisation or for any other purpose except that it may be relied upon by Council in support of an application for building consent approval for the proposed development as described herein.

GEOCONSULT

Author: **Mark McDonald**
Senior Engineering Geologist
BSc Geology

Signed: 

Reviewed: **Jordan Howie**
Senior Engineering Geologist
BSc MEngSc CMEngNZ (PEngGeol)





Signed: 



Notes:

1. LOCATIONS OF ALL FEATURES ARE APPROXIMATE ONLY.
2. THIS DRAWING IS BASED ON WHAKATANE DISTRICT COUNCIL GIS PHOTOGRAPHY.
3. DRAWING NOT TO BE USED FOR CONSTRUCTION PURPOSES.

Key:

-  HAND AUGER BOREHOLE
-  SCALA PENETROMETER TEST
-  SOAKAGE TEST
-  CONE PENETRATION TEST (CPT)

REV:	DESCRIPTION:	BY:	DATE:
-	-	-	-

STATUS: **NOT FOR CONSTRUCTION**



GEOCONSULT
 489 OTUMOETAI ROAD, TAURANGA 3110
 P: 07 281 1314 W: www.geoconsult.co.nz

PROJECT:
 CHRISTINA TAY
 PROPOSED DWELLING

SITE:
 35A VICTORIA AVENUE,
 WHAKATANE

TITLE:
 SITE PLAN

SCALE AT A3:	DATE:	DRAWN:	CHECKED:
1 : 200	OCT 2023	AD	JTH
SHEET NO:	DRAWING NO:	REVISION:	
1 OF 1	231001/1	-	









BOREHOLE LOG

HA01

Drill Method: Hand Auger
Hole Dia: 50mm
Date Drilled: 14/09/2023

Drilled By: BM
Logged By: BM
Checked By: MM

PROJECT NO: 231001
PROJECT: 35a Victoria Avenue, Whakatane

DRILLING		SUBSURFACE PROFILE				SAMPLES		UNDRAINED SHEAR STRENGTH		FIELD TESTS			
Geology	Method	% Recovery	Depth (m)	Symbols	SOIL/ROCK DESCRIPTION	Depth (m)	Groundwater	Depth (m)	Type	● Peak (kPa) ● 0 50 100 150 200 <hr/> □ Residual (kPa) □ 0 50 100 150 200		SPT N Value	Others
*	HAND AUGER		0.0		Ground Surface Organic SILT; dark brown. Dry, low plasticity.								
			1.0		Fine SAND; light brown. Loose, dry to moist, poorly graded.								
BEACH DEPOSITS	HAND AUGER		2.0		- light brownish grey								
			3.0		- light grey, dry, medium dense								
			4.0		- dense								
			4.0		- moist								
			4.0		- wet								
			4.0		- saturated								
			5.0		End of Borehole at 4.2m (Target Depth)		14/09/2023						

Remarks: *TOPSOIL

BOREHOLE LOG

HA02

Drill Method: Hand Auger
Hole Dia: 50mm
Date Drilled: 14/09/2023

Drilled By: BM
Logged By: BM
Checked By: MM

PROJECT NO: 231001
PROJECT: 35a Victoria Avenue, Whakatane

Geology	DRILLING		SUBSURFACE PROFILE				SAMPLES		UNDRAINED SHEAR STRENGTH			FIELD TESTS				
	Method	% Recovery	Depth (m)	Symbols	SOIL/ROCK DESCRIPTION	Depth (m)	Groundwater	Depth (m)	Type	● Peak (kPa) ● 0 50 100 150 200			SPT N Value	Others		
					Ground Surface					□ Residual (kPa) □ 0 50 100 150 200						
*	BEACH DEPOSITS HAND AUGER	100	0.0	●●●●●●●●●●	Organic SILT; dark brown. Dry, low plasticity.		GROUNDWATER NOT ENCOUNTERED									
			1.0	●●●●●●●●●●	Fine SAND; light brown. Loose, dry to moist, poorly graded.											
			2.0	●●●●●●●●●●	- light greyish brown, dry - medium dense											
			3.0	●●●●●●●●●●	- dense - dry to moist											
			3.0		End of Borehole at 3.0m (Target Depth)											
			4.0													
			5.0													

Remarks: *TOPSOIL

BOREHOLE LOG

HA03

Drill Method: Hand Auger
Hole Dia: 50mm
Date Drilled: 14/09/2023

Drilled By: BM
Logged By: BM
Checked By: MM

PROJECT NO: 231001
PROJECT: 35a Victoria Avenue, Whakatane

Geology	DRILLING		SUBSURFACE PROFILE				SAMPLES		UNDRAINED SHEAR STRENGTH		FIELD TESTS		
	Method	% Recovery	Depth (m)	Symbols	SOIL/ROCK DESCRIPTION	Depth (m)	Groundwater	Depth (m)	Type	● Peak (kPa) ● 0 50 100 150 200		SPT N Value	Others
			0.0	Ground Surface									
*	HAND AUGER			●	Organic SILT; dark brown. Dry, low plasticity.		GROUNDWATER NOT ENCOUNTERED						
BEACH DEPOSITS		100	●	Fine SAND; light brown. Loose, dry to moist, poorly graded.									
			1.0	□	- light greyish brown, dry								
			2.0	□	- light grey, medium dense								
			2.0		End of Borehole at 2.0m (Target Depth)								
			3.0										
			4.0										
			5.0										

Remarks: *TOPSOIL



BOREHOLE LOG

HA04

Drill Method: Hand Auger
Hole Dia: 50mm
Date Drilled: 04/10/2023

Drilled By: DS
Logged By: DS
Checked By: MM

PROJECT NO: 231001
PROJECT: 35a Victoria Avenue, Whakatane

DRILLING		SUBSURFACE PROFILE				SAMPLES		UNDRAINED SHEAR STRENGTH		FIELD TESTS	
Geology	Method	% Recovery	Depth (m)	Symbols	SOIL/ROCK DESCRIPTION	Depth (m)	Groundwater	Depth (m)	Type	● Peak (kPa) ● 0 50 100 150 200 □ Residual (kPa) □ 0 50 100 150 200	
BEACH DEPOSITS		HAND AUGER									
*		100	0.0		Ground Surface Organic SILT; dark brown. Dry, low plasticity.						
			1.0		Fine SAND; light brown. Loose, dry to moist, poorly graded.		GROUNDWATER NOT ENCOUNTERED				
			2.0		End of Borehole at 1.75m (Target Depth)						
			3.0								
			4.0								
			5.0								

Remarks: *TOPSOIL

Sheet: 1 of 1

SCALA PENETROMETER TEST PROBE

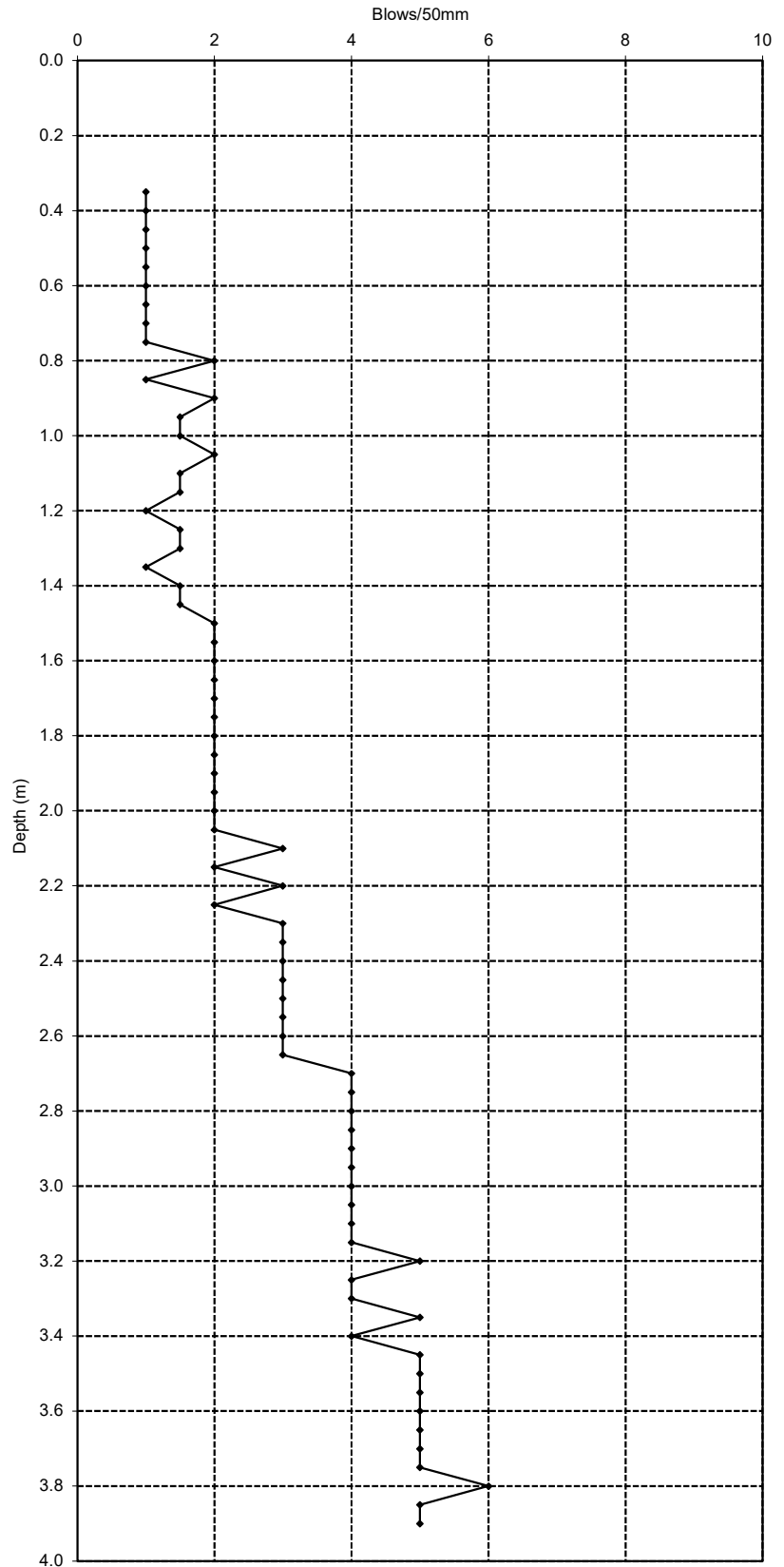
No. **SP1**

Test Location: HA01
 N:
 E:
 Elevation:
 Datum:

Tested: BM
 Logged: BM
 Checked: MM
 Date: 14/09/2023

Job Reference: 231001
 Project: Proposed Dwelling
 Location: 35a Victoria Avenue, Whakatane
 Client: Christina Tay

Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm
0.05		3.05	4	6.05	
0.10		3.10	4	6.10	
0.15		3.15	4	6.15	
0.20		3.20	5	6.20	
0.25		3.25	4	6.25	
0.30		3.30	4	6.30	
0.35	1	3.35	5	6.35	
0.40	1	3.40	4	6.40	
0.45	1	3.45	5	6.45	
0.50	1	3.50	5	6.50	
0.55	1	3.55	5	6.55	
0.60	1	3.60	5	6.60	
0.65	1	3.65	5	6.65	
0.70	1	3.70	5	6.70	
0.75	1	3.75	5	6.75	
0.80	2	3.80	6	6.80	
0.85	1	3.85	5	6.85	
0.90	2	3.90	5	6.90	
0.95	1.5	3.95		6.95	
1.00	1.5	4.00		7.00	
1.05	2	4.05		7.05	
1.10	1.5	4.10		7.10	
1.15	1.5	4.15		7.15	
1.20	1	4.20		7.20	
1.25	1.5	4.25		7.25	
1.30	1.5	4.30		7.30	
1.35	1	4.35		7.35	
1.40	1.5	4.40		7.40	
1.45	1.5	4.45		7.45	
1.50	2	4.50		7.50	
1.55	2	4.55		7.55	
1.60	2	4.60		7.60	
1.65	2	4.65		7.65	
1.70	2	4.70		7.70	
1.75	2	4.75		7.75	
1.80	2	4.80		7.80	
1.85	2	4.85		7.85	
1.90	2	4.90		7.90	
1.95	2	4.95		7.95	
2.00	2	5.00		8.00	
2.05	2	5.05		8.05	
2.10	3	5.10		8.10	
2.15	2	5.15		8.15	
2.20	3	5.20		8.20	
2.25	2	5.25		8.25	
2.30	3	5.30		8.30	
2.35	3	5.35		8.35	
2.40	3	5.40		8.40	
2.45	3	5.45		8.45	
2.50	3	5.50		8.50	
2.55	3	5.55		8.55	
2.60	3	5.60		8.60	
2.65	3	5.65		8.65	
2.70	4	5.70		8.70	
2.75	4	5.75		8.75	
2.80	4	5.80		8.80	
2.85	4	5.85		8.85	
2.90	4	5.90		8.90	
2.95	4	5.95		8.95	
3.00	4	6.00		9.00	



Remarks:

SCALA PENETROMETER TEST PROBE

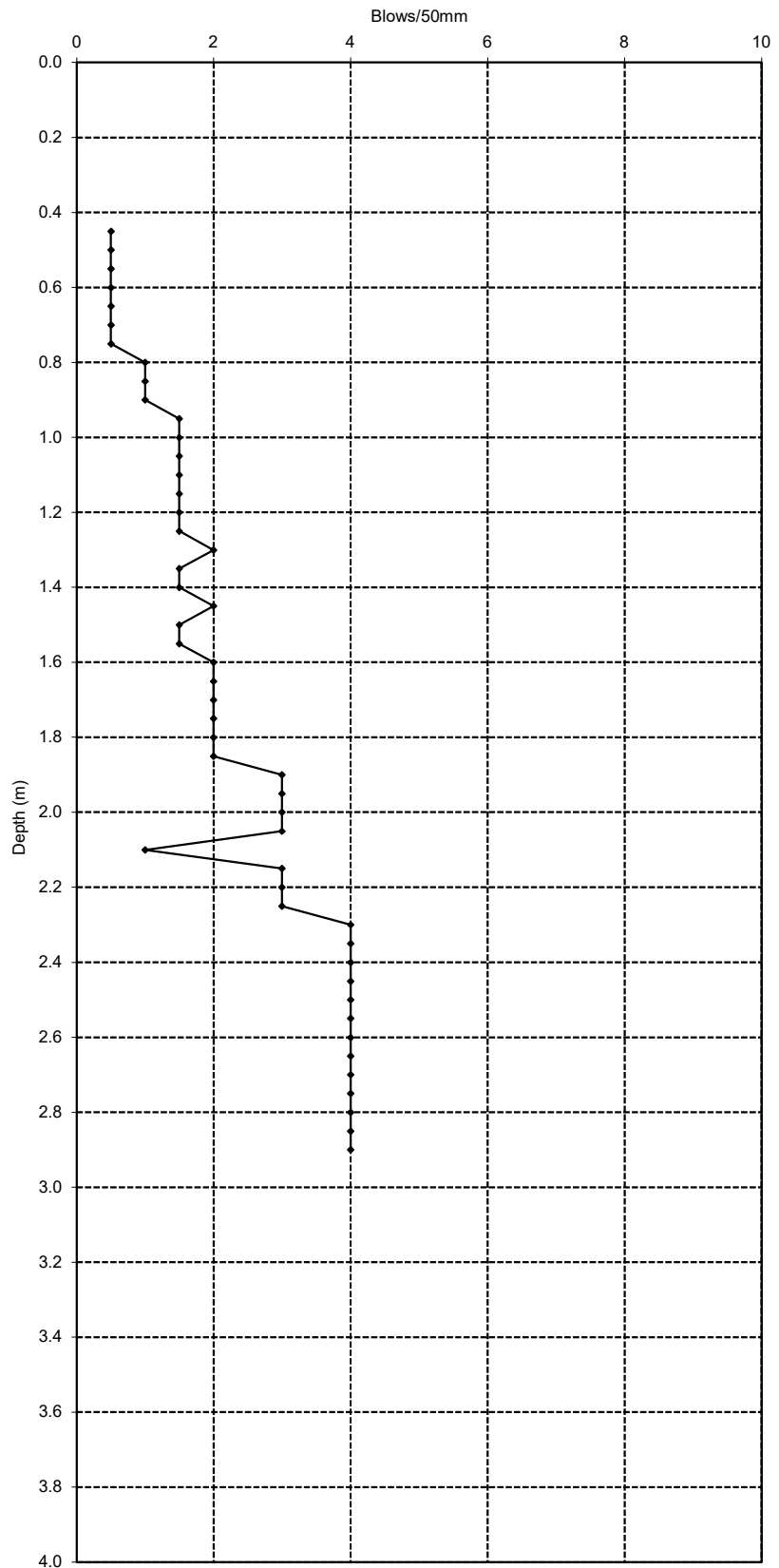
No. **SP2**

Test Location: HA02
 N:
 E:
 Elevation:
 Datum:

Tested: BM
 Logged: BM
 Checked: MM
 Date: 14/09/2023

Job Reference: 231001
 Project: Proposed Dwelling
 Location: 35a Victoria Avenue, Whakatane
 Client: Christina Tay

Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm
0.05		3.05		6.05	
0.10		3.10		6.10	
0.15		3.15		6.15	
0.20		3.20		6.20	
0.25		3.25		6.25	
0.30		3.30		6.30	
0.35		3.35		6.35	
0.40		3.40		6.40	
0.45	0.5	3.45		6.45	
0.50	0.5	3.50		6.50	
0.55	0.5	3.55		6.55	
0.60	0.5	3.60		6.60	
0.65	0.5	3.65		6.65	
0.70	0.5	3.70		6.70	
0.75	0.5	3.75		6.75	
0.80	1	3.80		6.80	
0.85	1	3.85		6.85	
0.90	1	3.90		6.90	
0.95	1.5	3.95		6.95	
1.00	1.5	4.00		7.00	
1.05	1.5	4.05		7.05	
1.10	1.5	4.10		7.10	
1.15	1.5	4.15		7.15	
1.20	1.5	4.20		7.20	
1.25	1.5	4.25		7.25	
1.30	2	4.30		7.30	
1.35	1.5	4.35		7.35	
1.40	1.5	4.40		7.40	
1.45	2	4.45		7.45	
1.50	1.5	4.50		7.50	
1.55	1.5	4.55		7.55	
1.60	2	4.60		7.60	
1.65	2	4.65		7.65	
1.70	2	4.70		7.70	
1.75	2	4.75		7.75	
1.80	2	4.80		7.80	
1.85	2	4.85		7.85	
1.90	3	4.90		7.90	
1.95	3	4.95		7.95	
2.00	3	5.00		8.00	
2.05	3	5.05		8.05	
2.10	1	5.10		8.10	
2.15	3	5.15		8.15	
2.20	3	5.20		8.20	
2.25	3	5.25		8.25	
2.30	4	5.30		8.30	
2.35	4	5.35		8.35	
2.40	4	5.40		8.40	
2.45	4	5.45		8.45	
2.50	4	5.50		8.50	
2.55	4	5.55		8.55	
2.60	4	5.60		8.60	
2.65	4	5.65		8.65	
2.70	4	5.70		8.70	
2.75	4	5.75		8.75	
2.80	4	5.80		8.80	
2.85	4	5.85		8.85	
2.90	4	5.90		8.90	
2.95	4	5.95		8.95	
3.00	4	6.00		9.00	



Remarks:

SCALA PENETROMETER TEST PROBE

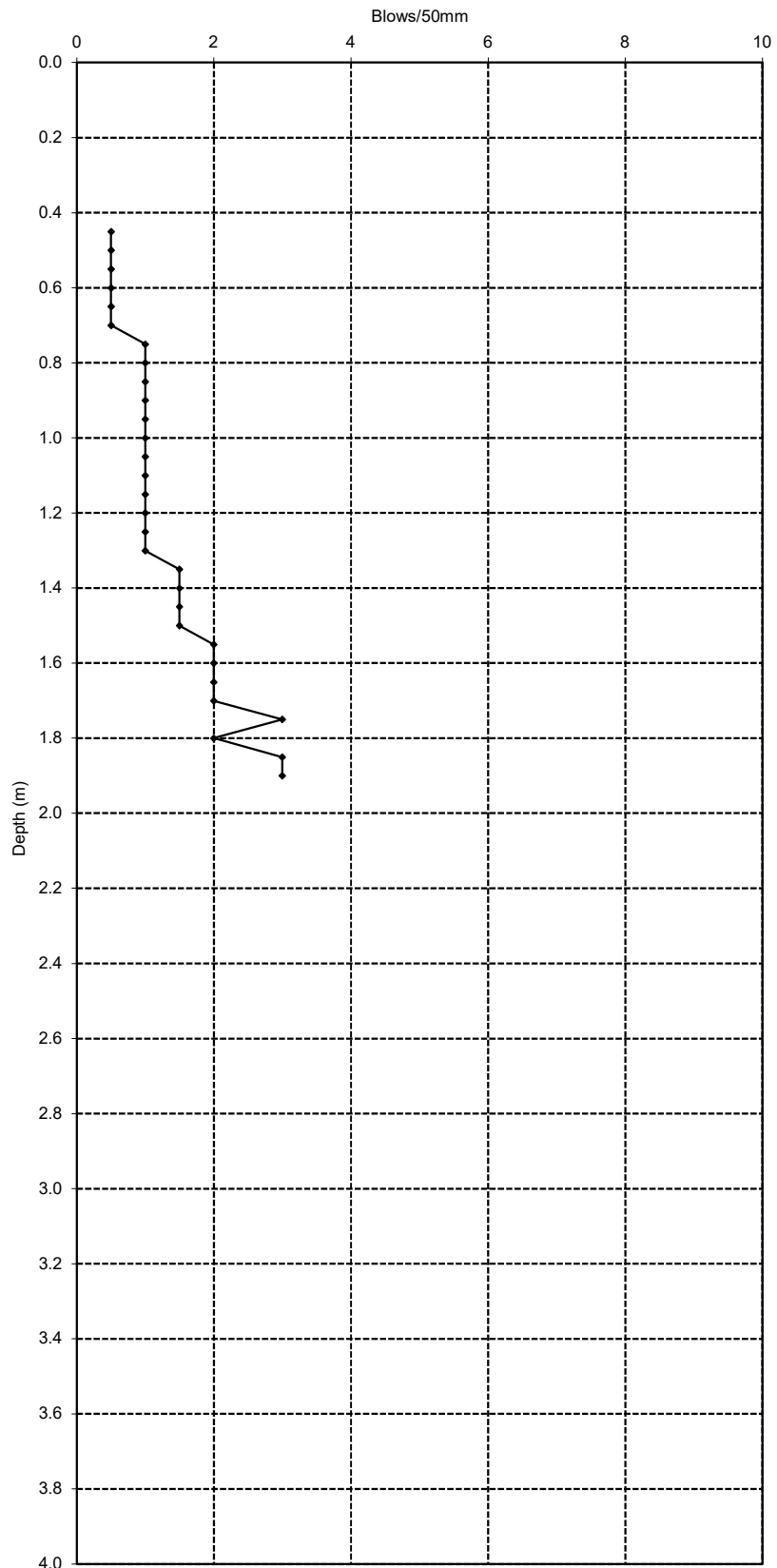
No. **SP3**

Test Location: HA03
 N:
 E:
 Elevation:
 Datum:

Tested: BM
 Logged: BM
 Checked: MM
 Date: 14/09/2023

Job Reference: 231001
 Project: Proposed Dwelling
 Location: 35a Victoria Avenue, Whakatane
 Client: Christina Tay

Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm	Depth (m)	Blows/ 50 mm
0.05		3.05		6.05	
0.10		3.10		6.10	
0.15		3.15		6.15	
0.20		3.20		6.20	
0.25		3.25		6.25	
0.30		3.30		6.30	
0.35		3.35		6.35	
0.40		3.40		6.40	
0.45	0.5	3.45		6.45	
0.50	0.5	3.50		6.50	
0.55	0.5	3.55		6.55	
0.60	0.5	3.60		6.60	
0.65	0.5	3.65		6.65	
0.70	0.5	3.70		6.70	
0.75	1	3.75		6.75	
0.80	1	3.80		6.80	
0.85	1	3.85		6.85	
0.90	1	3.90		6.90	
0.95	1	3.95		6.95	
1.00	1	4.00		7.00	
1.05	1	4.05		7.05	
1.10	1	4.10		7.10	
1.15	1	4.15		7.15	
1.20	1	4.20		7.20	
1.25	1	4.25		7.25	
1.30	1	4.30		7.30	
1.35	1.5	4.35		7.35	
1.40	1.5	4.40		7.40	
1.45	1.5	4.45		7.45	
1.50	1.5	4.50		7.50	
1.55	2	4.55		7.55	
1.60	2	4.60		7.60	
1.65	2	4.65		7.65	
1.70	2	4.70		7.70	
1.75	3	4.75		7.75	
1.80	2	4.80		7.80	
1.85	3	4.85		7.85	
1.90	3	4.90		7.90	
1.95		4.95		7.95	
2.00		5.00		8.00	
2.05		5.05		8.05	
2.10		5.10		8.10	
2.15		5.15		8.15	
2.20		5.20		8.20	
2.25		5.25		8.25	
2.30		5.30		8.30	
2.35		5.35		8.35	
2.40		5.40		8.40	
2.45		5.45		8.45	
2.50		5.50		8.50	
2.55		5.55		8.55	
2.60		5.60		8.60	
2.65		5.65		8.65	
2.70		5.70		8.70	
2.75		5.75		8.75	
2.80		5.80		8.80	
2.85		5.85		8.85	
2.90		5.90		8.90	
2.95		5.95		8.95	
3.00		6.00		9.00	

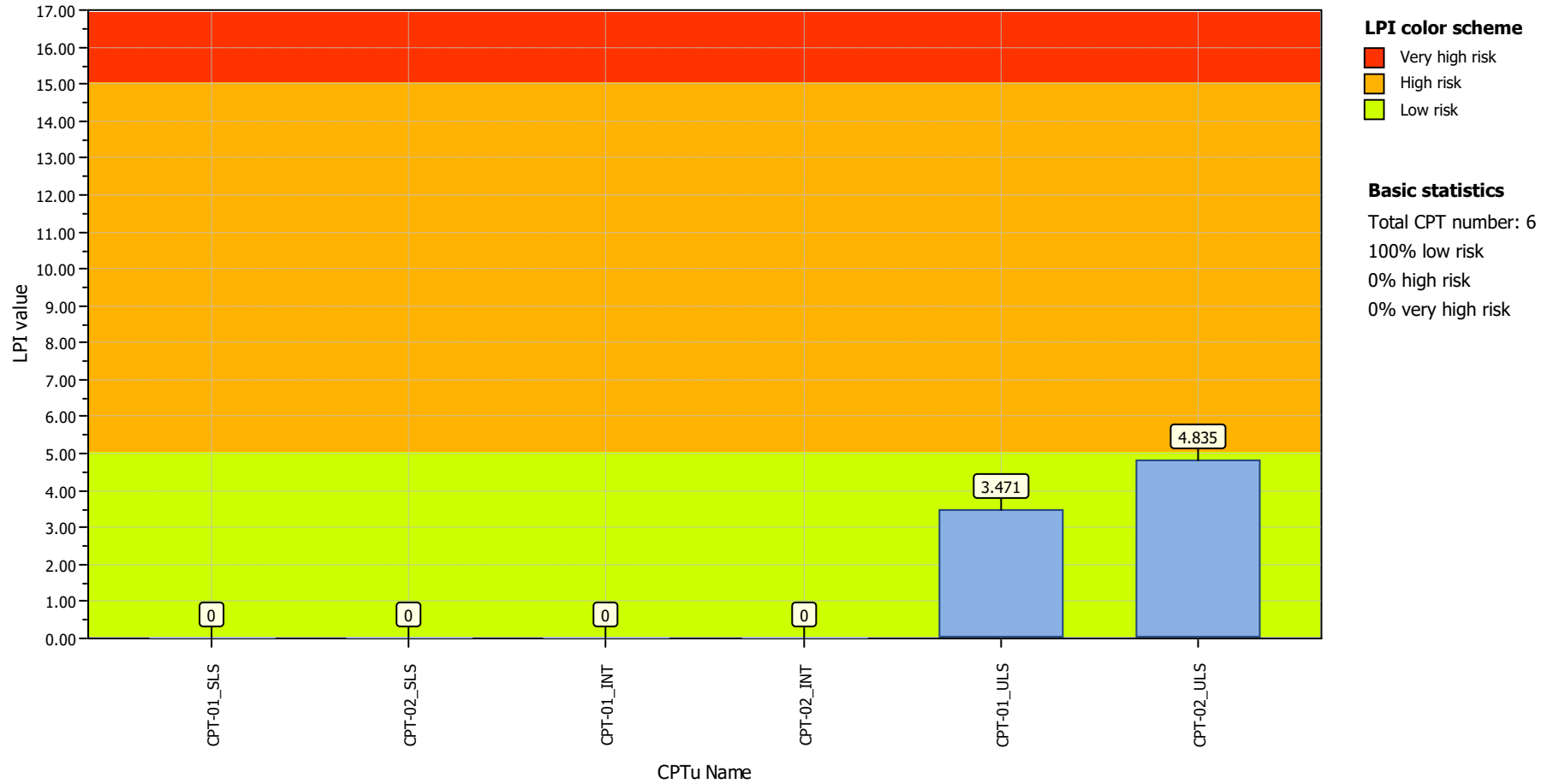


Remarks:

Project title : Liquefaction Analysis

Location : 35a Victoria Avenue, Whakatane

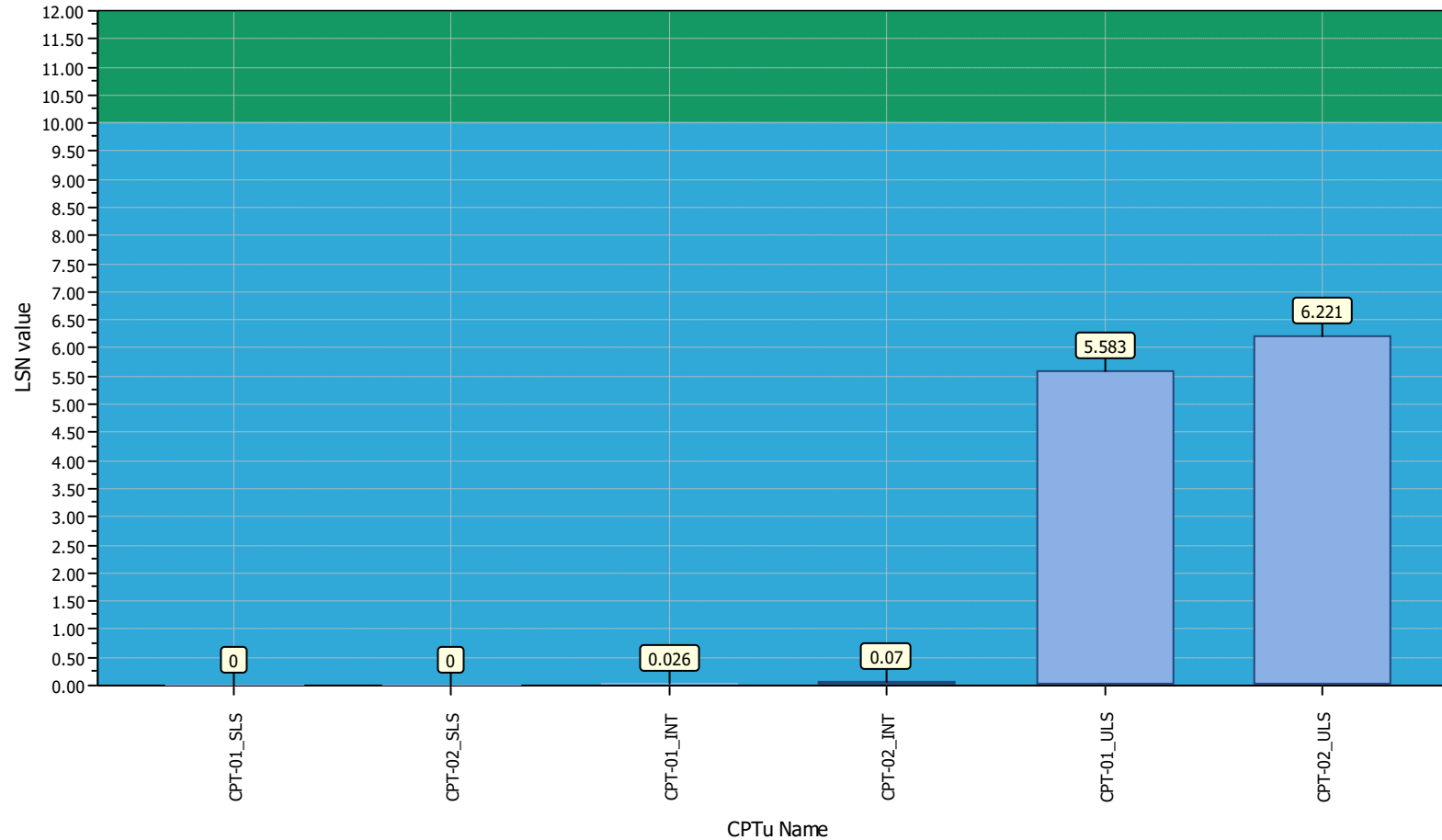
Overall Liquefaction Potential Index report



Project title : Liquefaction Analysis

Location : 35a Victoria Avenue, Whakatane

Overall Liquefaction Severity Number report



LSN color scheme

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

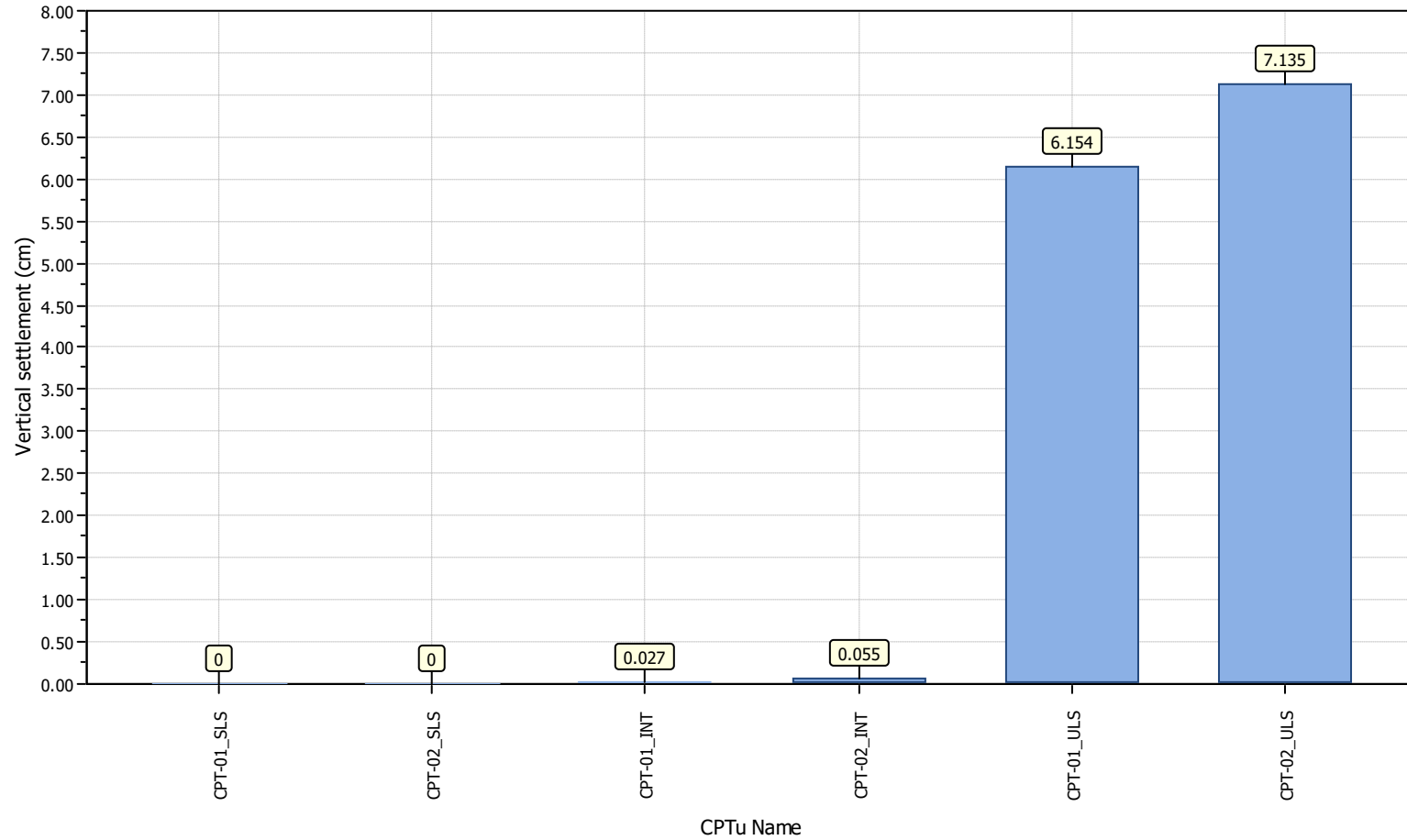
Basic statistics

- Total CPT number: 6
- 100% little liquefaction
- 0% minor liquefaction
- 0% moderate liquefaction
- 0% moderate to major liquefaction
- 0% major liquefaction
- 0% severe liquefaction

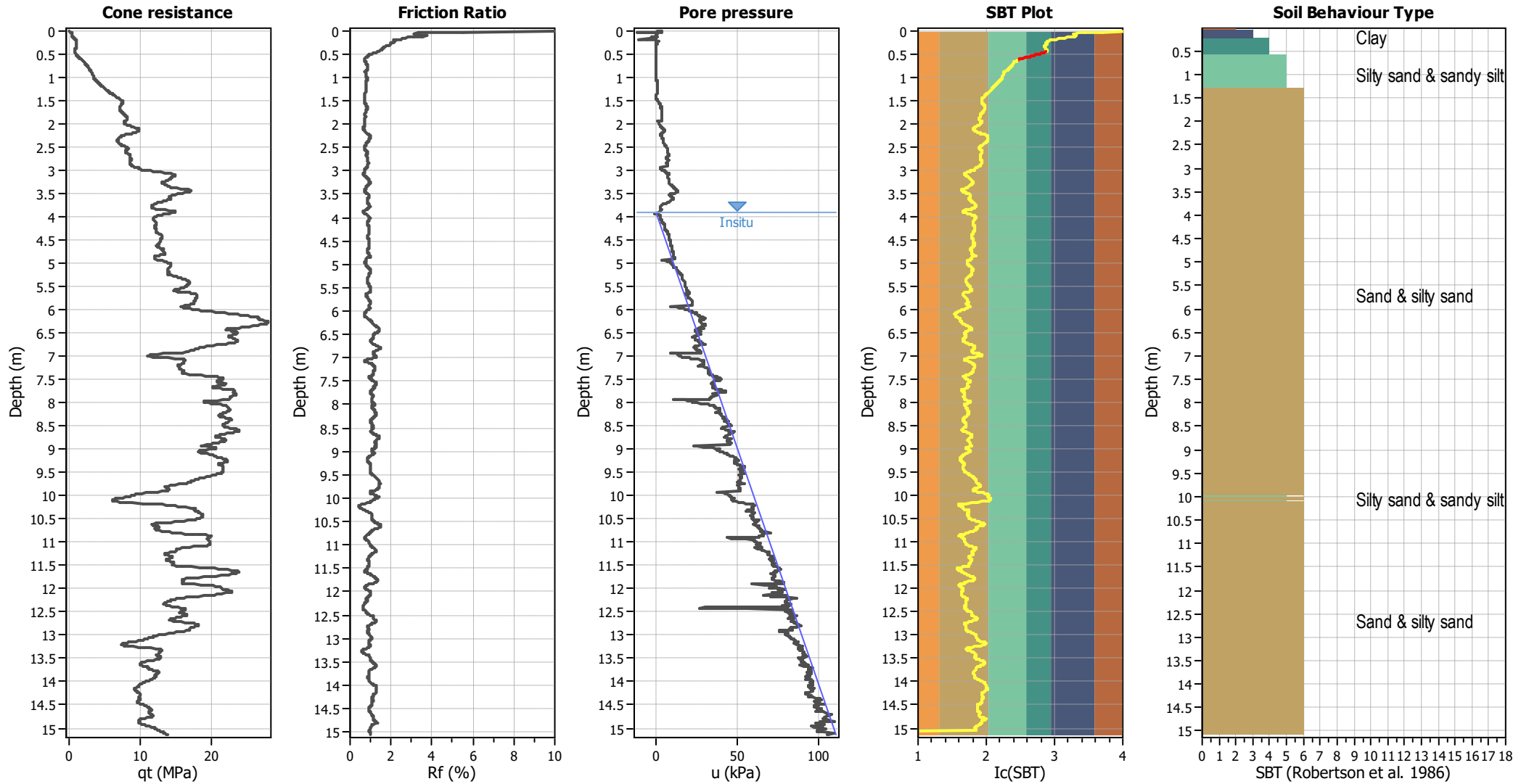
Project title : Liquefaction Analysis

Location : 35a Victoria Avenue, Whakatane

Overall vertical settlements report



CPT basic interpretation plots



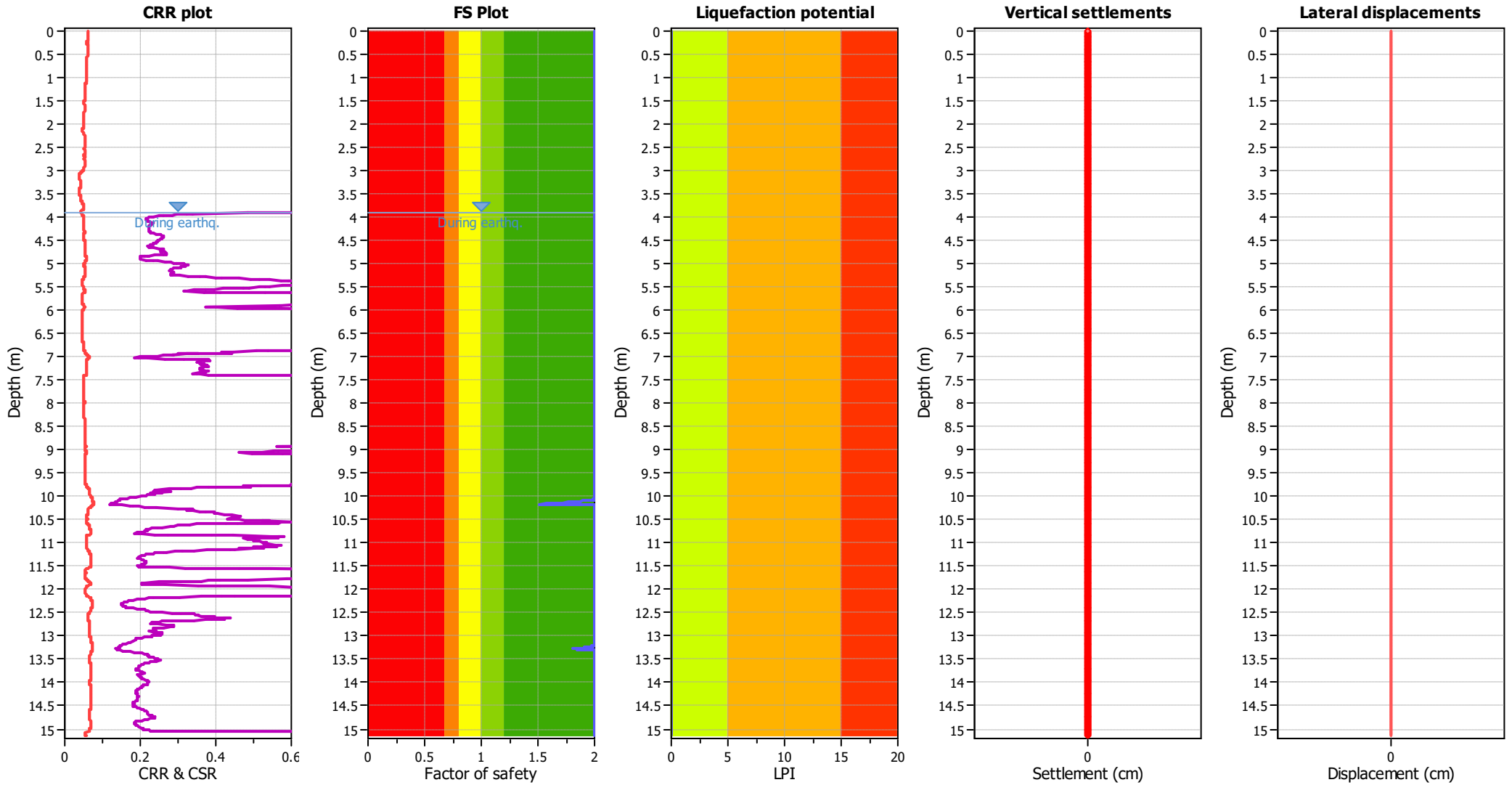
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _q applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.90 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.):	3.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.90 m	Fill height:	N/A	Limit depth:	N/A

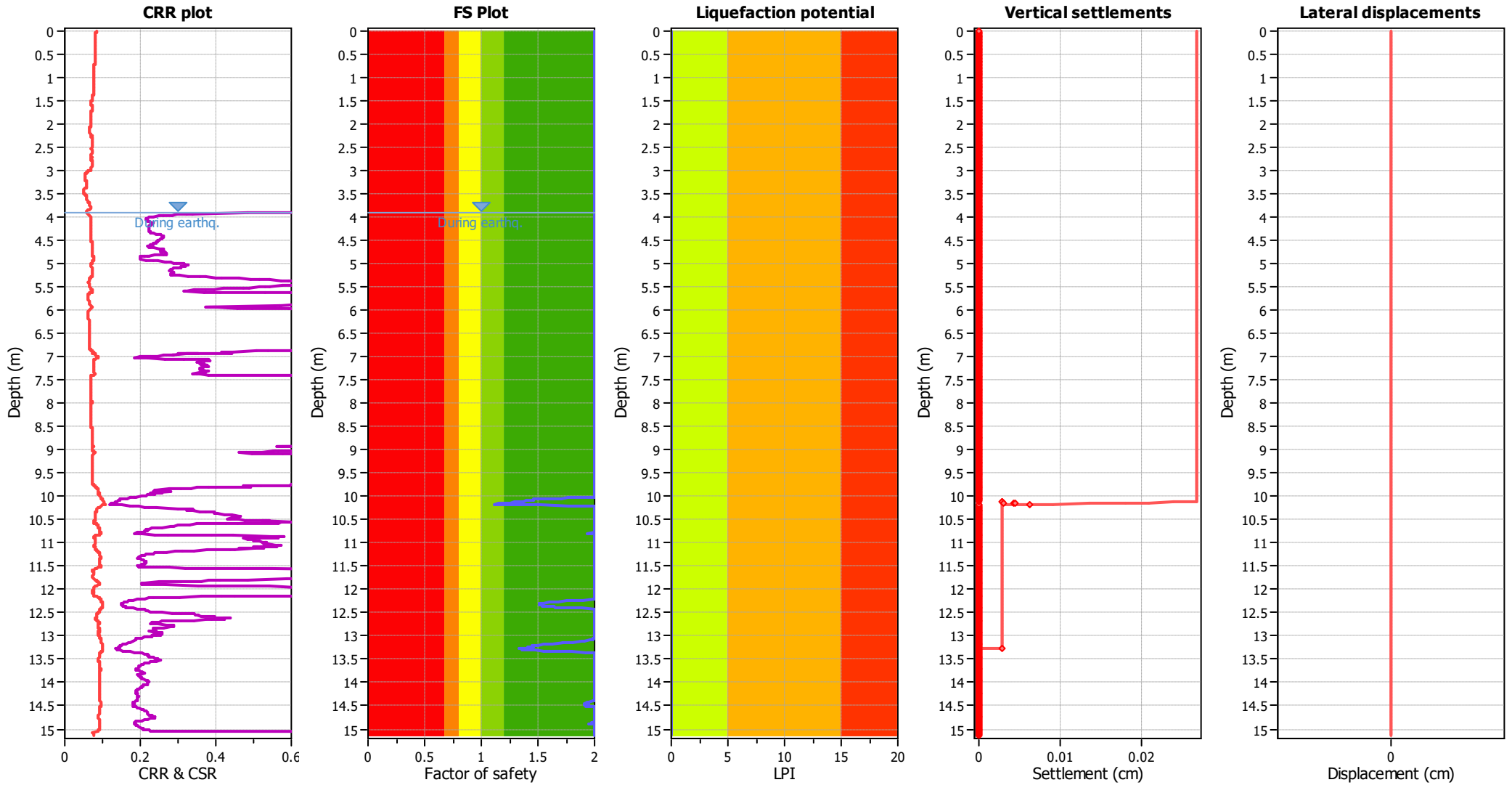
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	3.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.90 m	Fill height:	N/A	Limit depth:	N/A

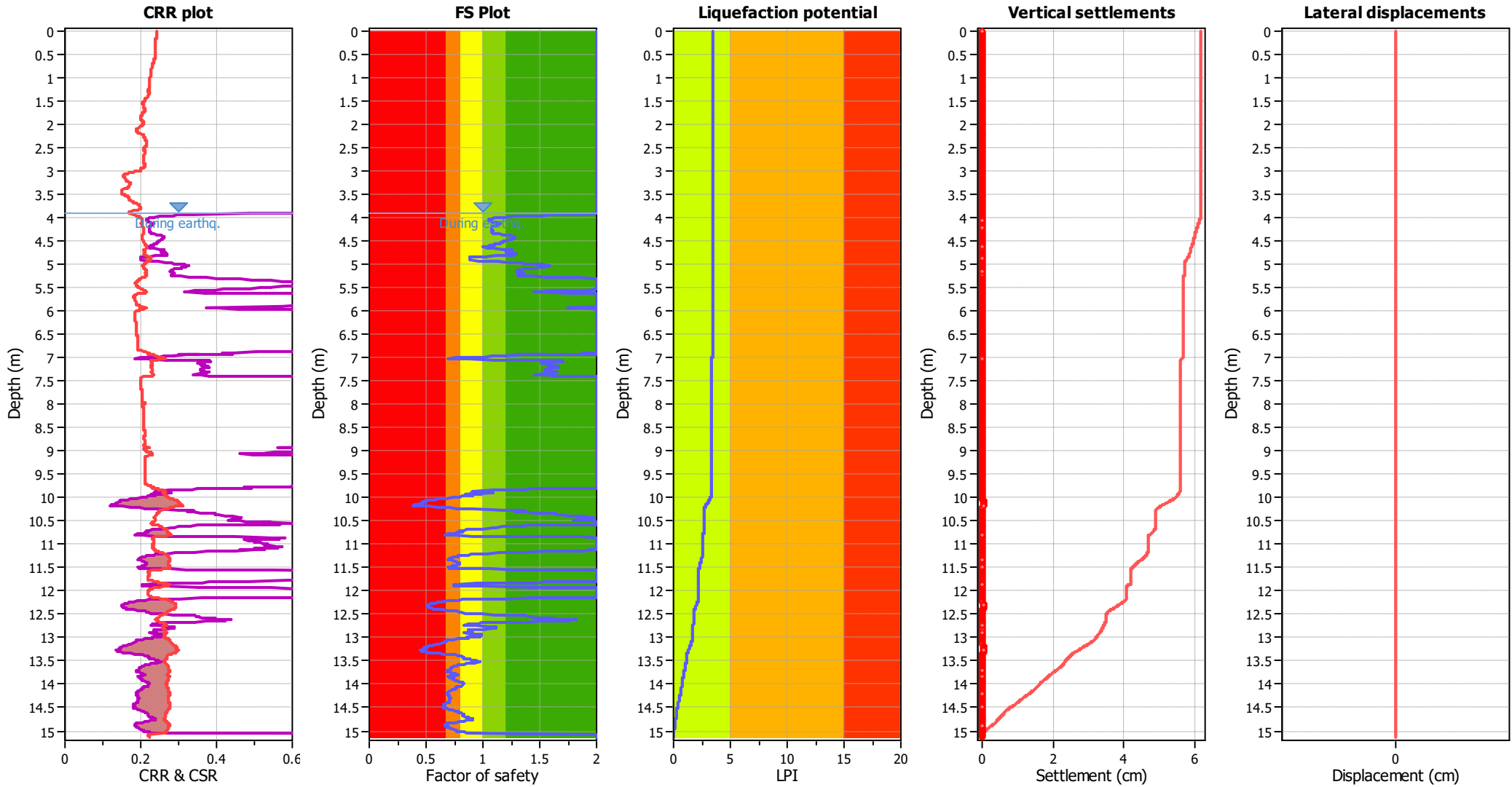
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	3.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.90 m	Fill height:	N/A	Limit depth:	N/A

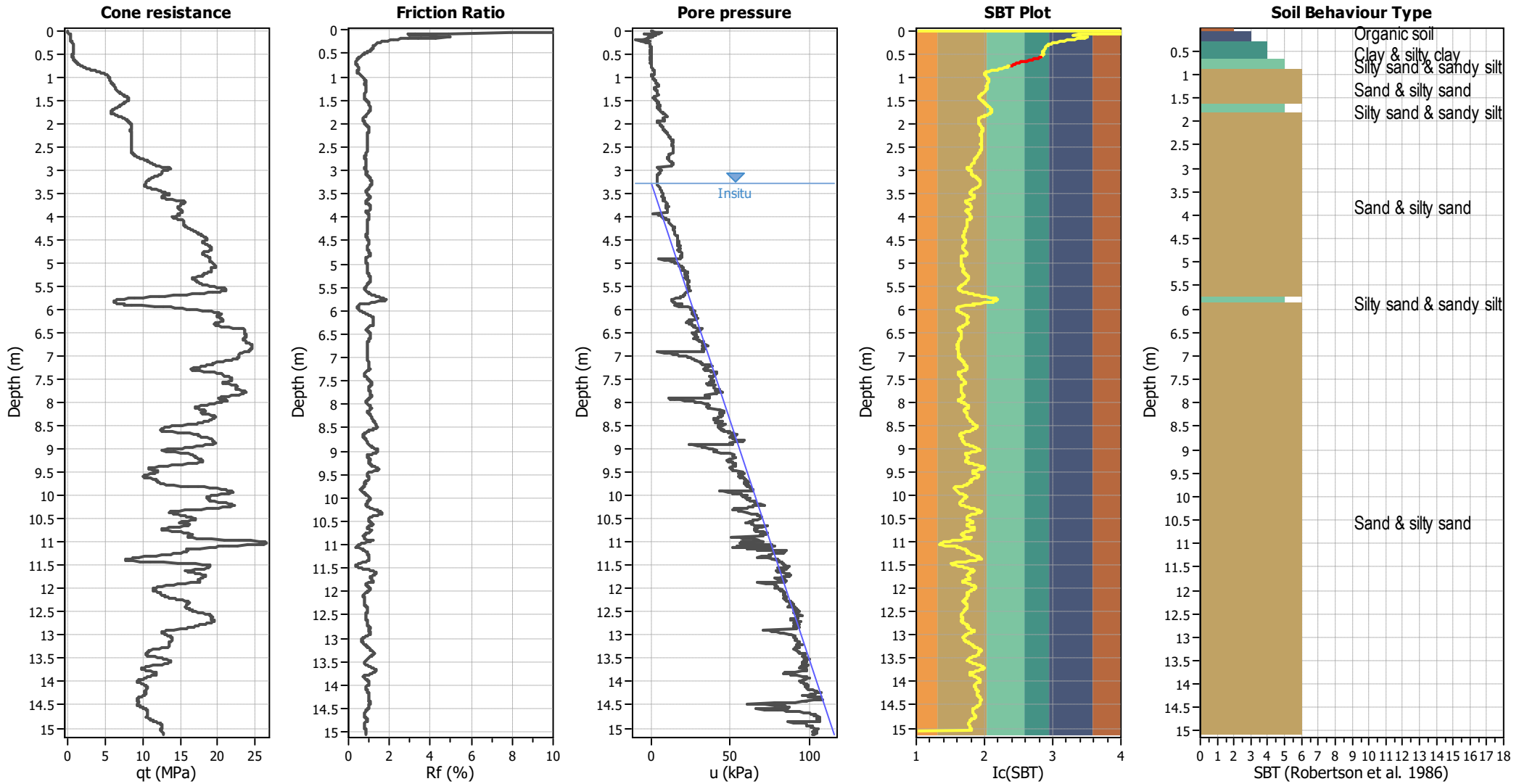
F.S. color scheme

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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



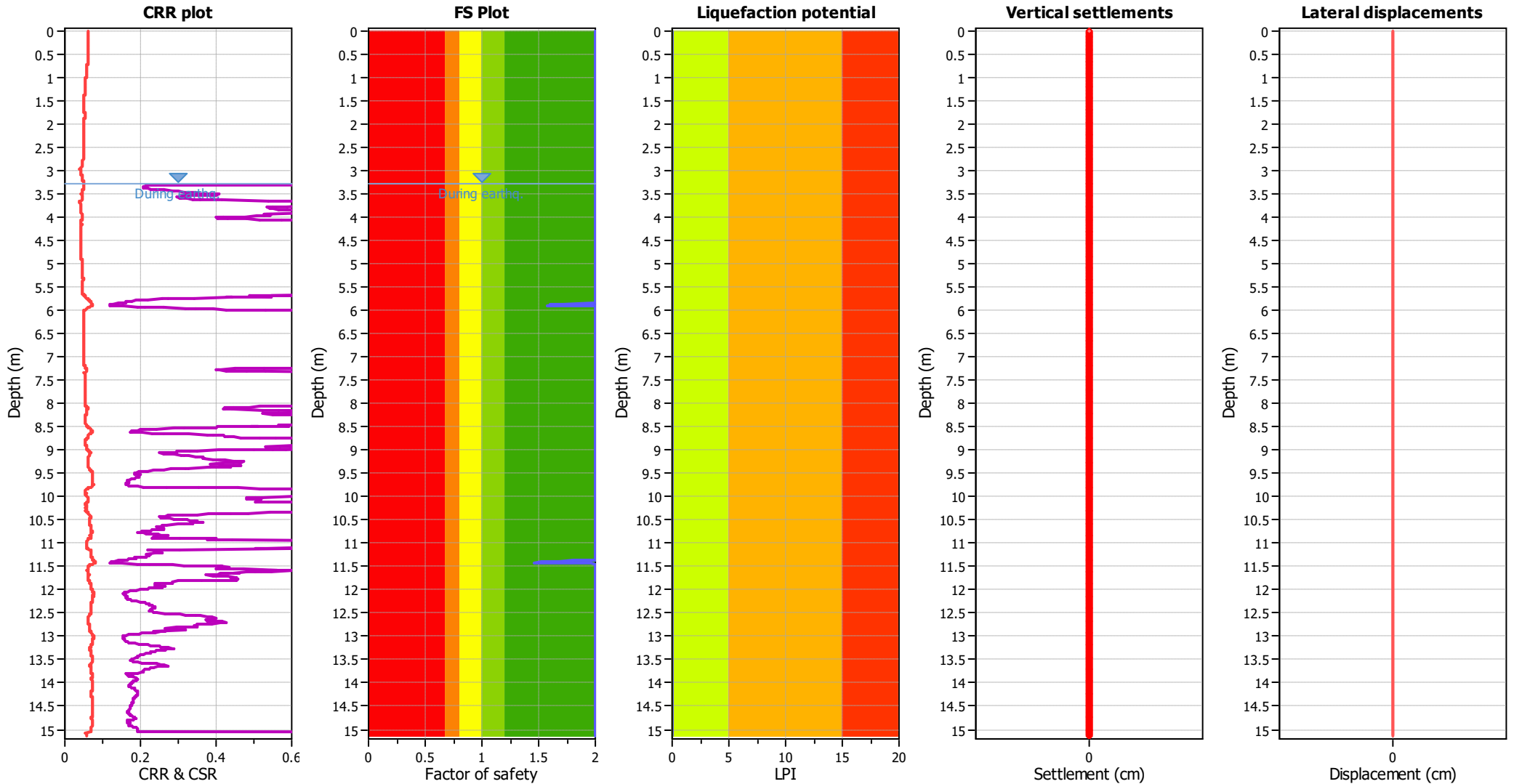
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _q applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.30 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.):	3.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.30 m	Fill height:	N/A	Limit depth:	N/A

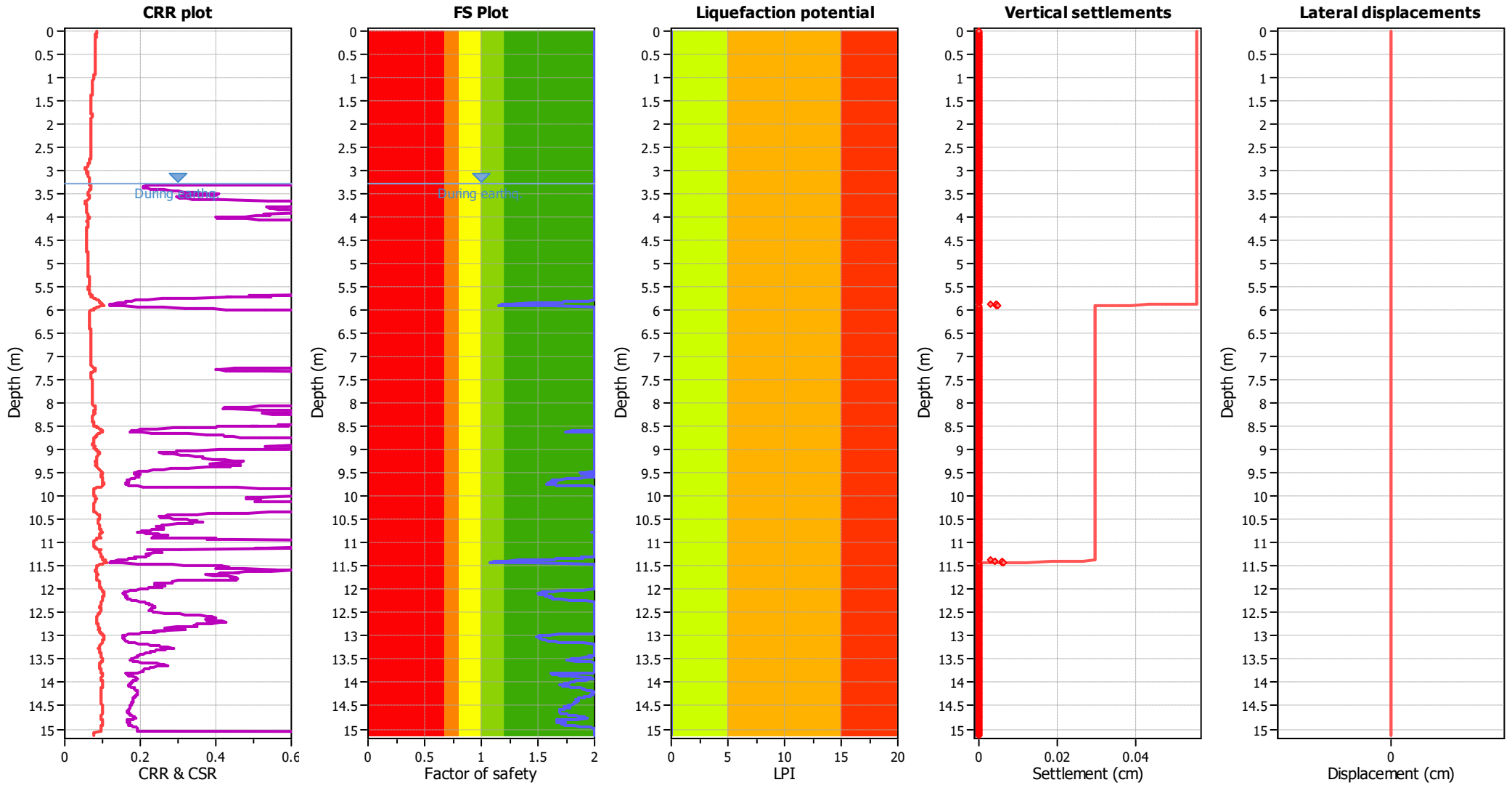
F.S. color scheme

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- Unlike to liquefy
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LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	3.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.30 m	Fill height:	N/A	Limit depth:	N/A

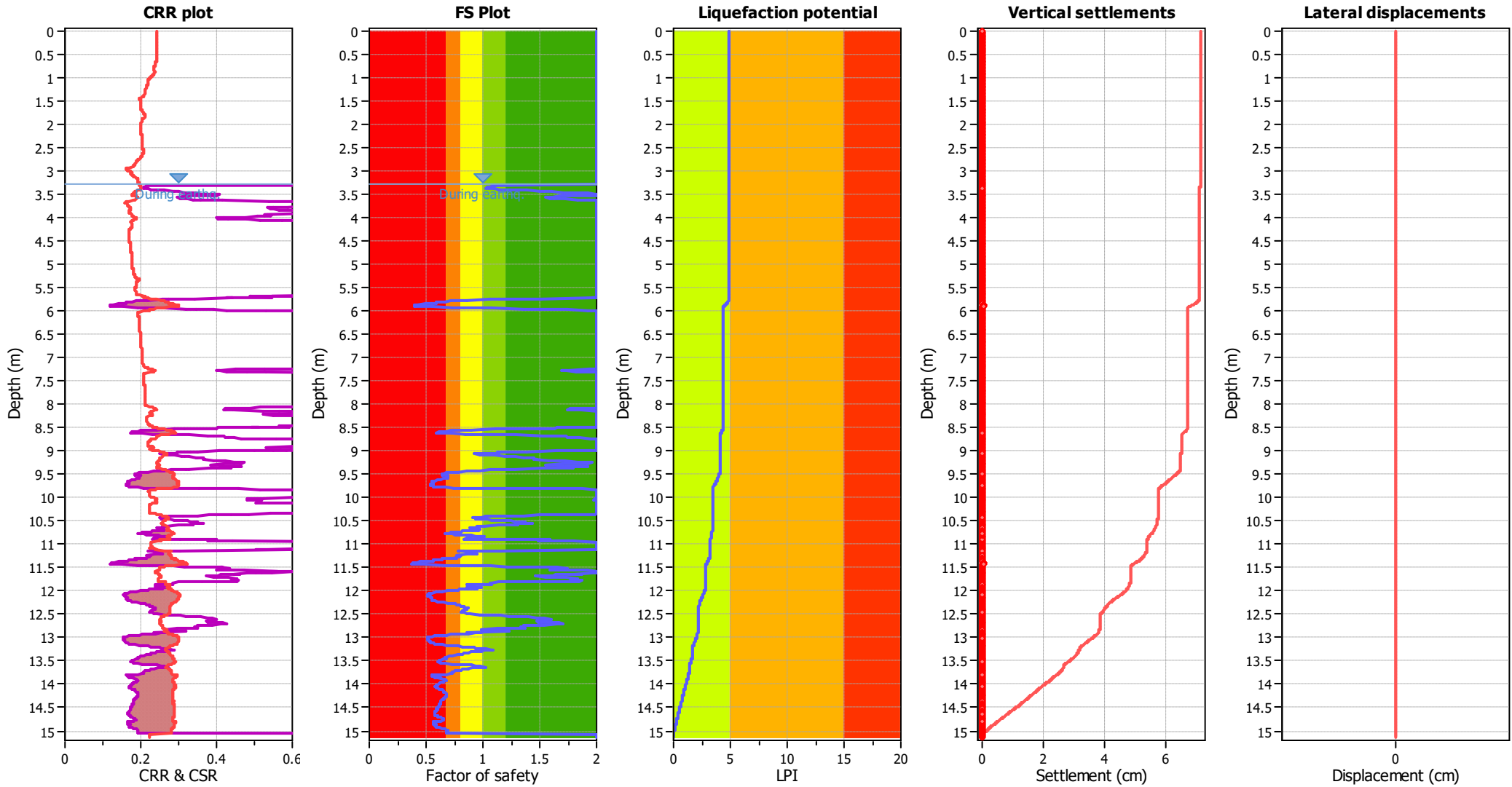
F.S. color scheme

- 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.30 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

FALLING HEAD SOAKAGE TEST

Test Hole Diameter	0.1	m
D Test Hole Depth	1.7	m
B Base Area	0.01	m ²
C Circumference	0.314	m
Groundwater Level	4.0m	m
Considered Average	5.55E-04	1998
Design Rate (x 0.5)	2.77E-04	999
	m ³ /m ² /sec	litres/m ² /hour

Test Date	4/10/2023
Test Reference	S-1
Geconsult Reference	231001
Site Address	35a Victoria Avenue, Whakatane
Project	Proposed Dwelling
Testing Engineer	DS

Notes: Testing terminated once test hole drained of water
Struckout values not included in measured average

Time	Water Level BGL	Water depth	Time Step		Depth Step		Volume Soaked	Soakage surface area	Soakage Rate	
T	d	D-d	t0	t1	h0	h1	V=(h0-h1)*B	A=(C*(h0+h1)/2)+B	SR=V/A/(t1-t0)	SR*60*60*1000
sec	m	m	sec	sec	m	m	m ³	m ²	m ³ /m ² /sec	litres/m ² /hour
0	0.01	1.69	-							
2	0.04	1.66	0	2	1.69	1.66	2.01E-04	5.35E-01	1.88E-04	676.81
10	0.56	1.14	2	10	1.66	1.14	4.12E-03	4.48E-01	1.15E-03	4132.97
20	0.83	0.87	10	20	1.14	0.87	2.10E-03	3.24E-01	6.48E-04	2332.57
30	1.05	0.65	20	30	0.87	0.65	1.72E-03	2.48E-01	6.93E-04	2495.43
40	1.21	0.49	30	40	0.65	0.49	1.32E-03	1.87E-01	7.05E-04	2537.30
50	1.34	0.36	40	50	0.49	0.36	9.56E-04	1.42E-01	6.75E-04	2431.57
60	1.42	0.28	50	60	0.36	0.28	7.01E-04	1.08E-01	6.46E-04	2326.96
70	1.48	0.22	60	70	0.28	0.22	4.74E-04	8.49E-02	5.58E-04	2008.14
80	1.54	0.16	70	80	0.22	0.16	3.99E-04	6.74E-02	5.92E-04	2129.48
90	1.57	0.13	80	90	0.16	0.13	2.68E-04	5.41E-02	4.95E-04	1781.71
100	1.60	0.10	90	100	0.13	0.10	2.09E-04	4.46E-02	4.69E-04	1687.10
110	1.62	0.08	100	110	0.10	0.08	2.10E-04	3.62E-02	5.82E-04	2093.75
120	1.64	0.06	110	120	0.08	0.06	1.13E-04	2.97E-02	3.81E-04	1369.98
130	1.65	0.05	120	130	0.06	0.05	9.97E-05	2.55E-02	3.92E-04	1410.24
140	1.66	0.04	130	140	0.05	0.04	9.58E-05	2.16E-02	4.45E-04	1600.58
150	1.67	0.03	140	150	0.04	0.03	7.46E-05	1.81E-02	4.11E-04	1480.52
160	1.68	0.02	150	160	0.03	0.02	6.13E-05	1.54E-02	3.97E-04	1429.74
170	1.69	0.01	160	170	0.02	0.01	9.42E-05	1.23E-02	7.65E-04	2755.10
180	1.70	0.00	170	180	0.01	0.00	5.42E-05	9.35E-03	5.80E-04	2087.39

