INITIA

GEOTECHNICAL SPECIALISTS

SAM PROPERTY

BLACK SWAMP ROAD, MANGAWHAI

GEOTECHNICAL ASSESSMENT REPORT FOR A PROPOSED PLAN CHANGE

INITIA REF P-001431 REV B

SEPTEMBER 2024

Contents

1. Introduction

1.1 General

Initia Limited has been engaged by SAM Property Ltd to undertake limited geotechnical investigations and to provide preliminary geotechnical assessment of the proposed Plan Change Application for land at Black Swamp Road, Mangawhai.

This Geotechnical Assessment Report (GAR) has been prepared to provide geotechnical advice to support submission for a *Proposed Plan Change (PPC) application* to Kaipara District Council. Conclusions and advice presented in this report are based on Initia site-specific geotechnical investigations which are presented as part of this report.

It must be noted that the Plan Change area covers a much larger area than the site extents recently investigated by Initia. We understand that the area to the south of Black Swamp Road has been assessed by another geotechnical consultant. Accordingly, Initia will not comment on this block of land. Based on the proposed Plan Change zone map provided to us by Aspire Consulting Engineers, the site will split into the following development categories:

- Rural Lifestyle Zone (146,870m^2)
- Large Lot Residential (66,950m^2)
- Low Density Residential (513,630m^2)
- Medium Density Residential (125,650m^2)
- Neighbourhood Centre Zone (26,550m^2)
- Mixed Use Zone (22,350,^{2})

An extract of this plan is presented in Figure 1-2 below.

Figure 1-1 Proposed Plan Change Zoning

This report outlines the findings from an initial geotechnical desktop study and result of recent site-specific investigations undertaken by Initia. This information has been used to review the ground conditions of the site for the proposed plan change and to provide comment on the likely implication any geotechnical hazards may have on the development of this site in the future.

1.2 Scope of Work

Given that this is for a Plan Change, we have assessed the site for the typical geotechnical constraints that may affect developments.

Our scope of work for the project is outlined below:

- Site specific ground investigations.
- Development of a subsurface model of the site.
- Earthwork considerations and reusability of encountered subsoils.
- Assessment of the site subsoil class in accordance with NZS1170.5.
- Liquefaction susceptibility and consequential effects.
- Road pavement and floor slab considerations.

General comments and advice are provided for ground improvement works, liquefaction and consequential effects and/or for risks related to foundation design. Detailed design of those elements is however outside the scope of works covered in this report but should be carried out for any Resource and Building Consent applications in the future.

1.3 Project Overview

1.3.1 Site Description

The proposed site is located off Black Swamp Road, Mangawhai, and is legally identified as Lot 1 DP 29903, Lot 3 DP 177202, and Section 3 Block IV Mangawhai SD. The site is located approximately 1.5 km from the Mangawhai township.

The site is currently utilised as farmland used for grazing cattle. The neighbouring properties are used for agricultural purposes. A minor estuary of the Mangawhai Harbour is located approximately 60 m from the southern boundary. A site location plan showing the site area assessed by Initia is presented in 2 below. As discussed previously the additional Plan Change area to the south of Black Swamp Rd is being assessed by another geotechnical consultant.

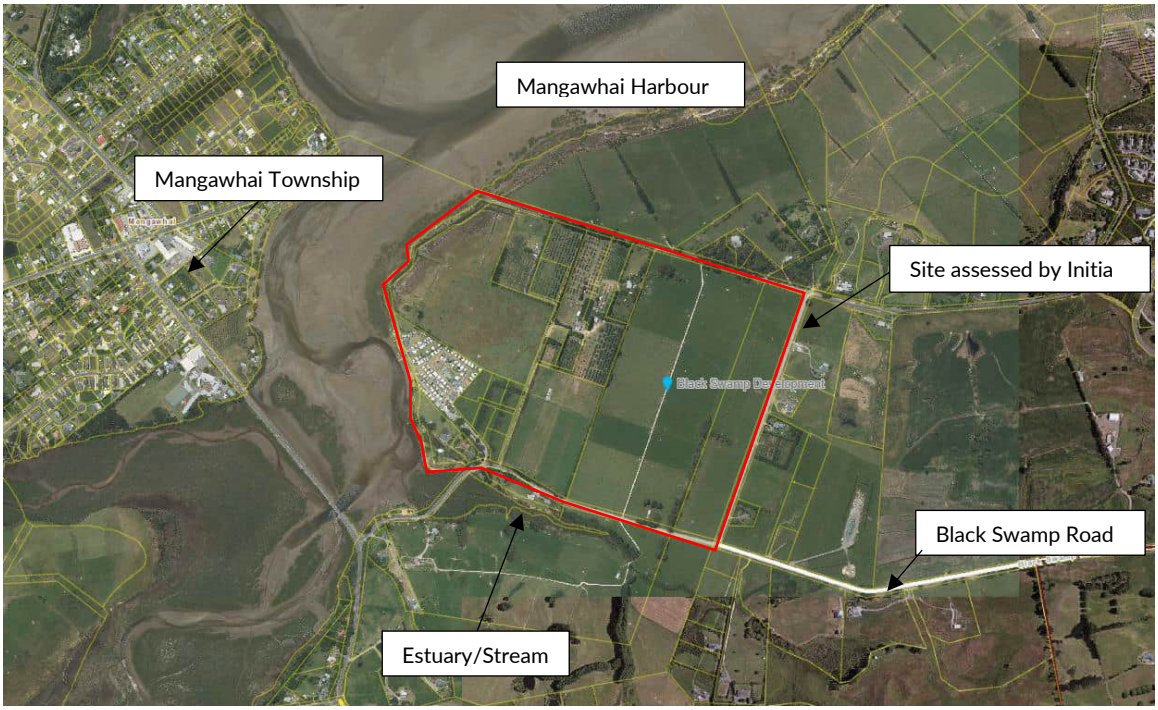

Figure 1-2: Black Swamp Road Proposed Plan Change area assessed by Initia (Kaipara GIS excerpt)

2. Geological Overview and Site Investigation

2.1 Published Geology

Based on review of the published geological map and our general knowledge of ground conditions in the area, the site is mapped as being underlain by Late Pleistocene River deposits (OIS5), which are typically described as poorly consolidated mud, sand, gravel and peat deposits of alluvial, swamp and estuarine origins. Holocene River deposits are mapped to the north of the subject site, which is typically described as unconsolidated to poorly consolidated mud, sand, gravel and peat deposits of alluvial, colluvial and lacustrine origins.

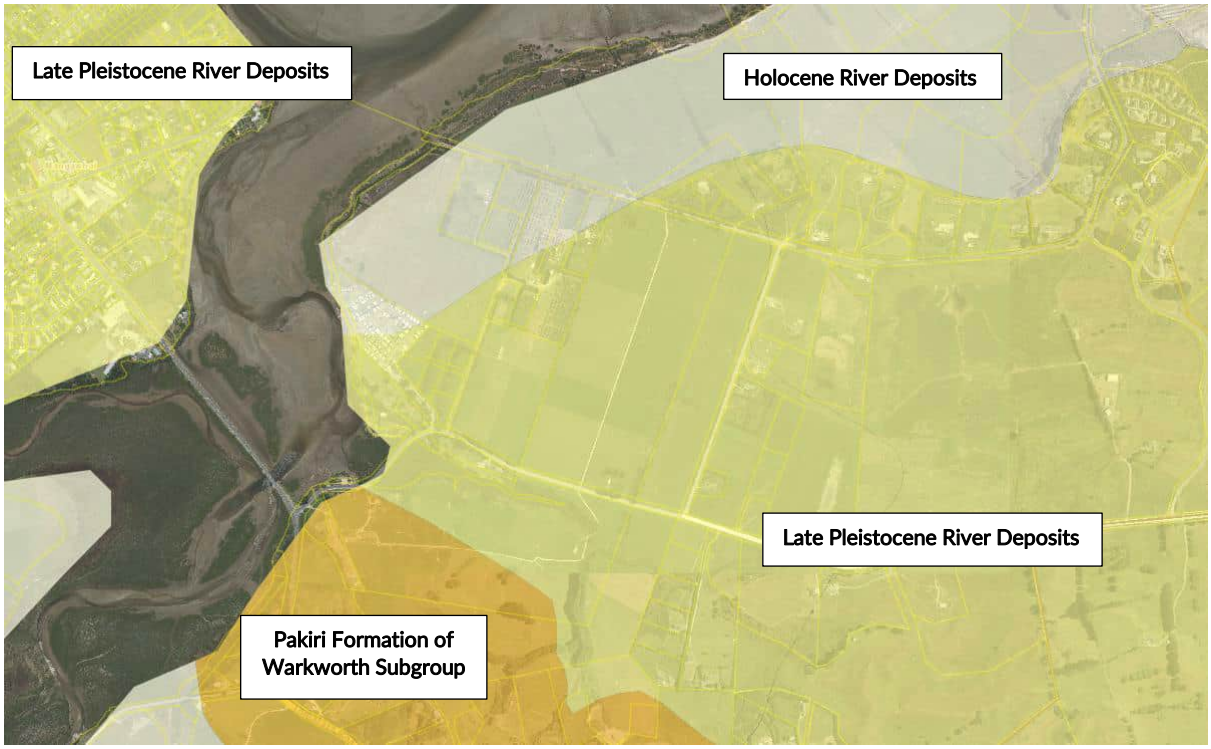

Figure 2-1: Mangawhai Geological Map Excerpt (Sourced: GNS Webapp)

2.2 Ground Investigation

Initia has undertaken two rounds of ground investigations at the site area that we are assessing:

- The first round of ground investigation was carried out on the 22nd June 2022. Investigations comprised 12 no. Test Pits dug by a local contractor and 12 no. Cone Penetration Tests undertaken by Underground Investigations Ltd.
- A second round of ground investigation was carried out between 21st and 22nd of February 2024 included 22 no. Test Pits dug by a local contractor and 18 no. Cone Penetration Tests undertaken by Underground Investigations Ltd.

The test pits were undertaken under the supervision of an Initia geotechnical engineer who logged the arisings in general accordance with the NZGS guidelines. Upon completion the test pits were backfilled using excavated spoil and track rolled.

All investigation locations were surveyed using a handheld GPS unit. The site investigation locations are shown on Figure 1431-G01 in Appendix A. The test pit and cone penetration test logs are attached in Appendix B. A summary of the investigations is outlined in Table 2-1 below.

Table 2-1: Geotechnical Investigation Summary

Site Investigation ID	Coordinates[1]		Ground Surface Elevation[2] (mRL)	Termination Depth (mbgl)
	Easting (mE)	Northing (mN)		
TP01	1743276.2	6000781.6	7.0	1.9
TP02	1743096.5	6000761.6	5.0	2.7
TP03	1743341.2	6000695.3	7.0	2.7
TP04	1743164.7	6000647.9	6.0	1.7
TP05	1743065.4	6000585.5	5.0	2.3
TP06	1743267.7	6000554.9	7.0	2.1
TP07	1743166.5	6000464.5	6.0	2.2
TP08	1742997.4	6000422.9	7.0	2.3
TP09	1743180.8	6000356.8	6.0	2.0
TP10	1742934.0	6000345.4	7.0	2.3
TP11	1743142.7	6000250.3	6.0	2.1
TP12	1743057.5	6000204.3	6.0	2.0
TP101	1743393.1	6000718.7	6.2	3.0
TP102	1743193.8	6000843.6	6.3	3.0
TP103	1743044.5	6000790.7	4.5	2.8
TP104	1743066.8	6000684.5	4.5	2.4
TP105	1743008.6	6000588.2	4.4	2.2
TP106	1743100.9	6000515.1	4.7	2.8
TP107	1743050.6	6000355.7	4.2	2.2
TP108	1742898.7	6000408.0	4.2	2.3
TP109	1742845.5	6000263.8	3.4	1.6
TP110	1742947.4	6000239.1	3.7	2.3
TP111	1743130.3	6000175.9	3.8	1.8
TP112	1743220.7	6000175.1	3.7	2.0
TP113	1743246.7	6000320.0	4.2	2.1
TP114	1743345.5	6000542.6	7.0	2.4
TP115	1742818.4	6000276.9	3.6	2.2
TP116	1742882.6	6000446.2	4.4	2.2
TP117	1742787.1	6000364.2	4.0	2.3
TP118	1742824.5	6000460.1	4.5	2.1
TP119	1742681.2	6000356.8	3.4	2.0
TP120	1742741.6	6000491.9	4.2	1.8
TP121	1743252.3	6000426.3	4.6	2.3
TP122	1743195.0	6000728.8	4.7	2.3
CPT01	1743058.3	6000846.8	3.0	29.2
CPT02	1743411.6	6000768.1	7.7	0.9
CPT03	1743182.1	6000732.2	4.6	10.1
CPT04	1743005.9	6000672.8	4.4	0.7
CPT05	1743344.8	6000584.9	6.0	0.6
CPT06	1743134.3	6000527.8	4.5	0.6
CPT07	1742942.2	6000503.8	4.5	1.0
CPT08	1743280.4	6000397.0	4.5	0.7
CPT09	1743079.1	6000368.5	4.2	1.3

Site Investigation ID	Coordinates[1]		Ground Surface Elevation[2] (mRL)	Termination Depth (mbgl)
	Easting (mE)	Northing (mN)		
CPT10	1743004.0	6000295.3	4.1	17.4
CPT11	1742852.4	6000258.3	3.5	28.8
CPT12	1743194.9	6000165.8	3.7	13.9
CPT101	1743294.8	6000811.6	6.3	9.1
CPT102	1743106.6	6000775.9	4.6	1.1
CPT103	1743393.2	6000721.8	6.3	8.8
CPT104	1743247.7	6000655.3	5.0	1.2
CPT105	1743153.6	6000648.3	4.4	0.8
CPT106	1743008.4	6000589.7	4.6	3.2
CPT107	1743065.9	6000453.9	4.1	0.5
CPT108	1743225.5	6000490.4	4.6	19.9
CPT110	1743244.4	6000321.7	4.2	13.3
CPT112	1743094.2	6000184.5	3.9	13.8
CPT113	1742944.3	6000240.8	3.7	3.8
CPT115	1742882.3	6000444.8	4.5	6.9
CPT117	1742791.8	6000372.1	4.1	6.6
CPT118	1742687.8	6000359.1	3.4	4.2

Notes: 1. Coordinate System: NZTM2000. Coordinates determined using handheld GPS (+/-500mm).
2. Datum: NZTM2000. Reduced levels determined using site contours (+/-500mm).

It should be noted that have not undertaken any geotechnical investigation in the fields adjacent to the Riverside Holiday Park and the Estuary at the time of writing this report. A plan showing our test locations is presented in Appendix A.

3. Geotechnical Ground Conditions

The geotechnical model presented in this report is based on available information obtained from recent geotechnical investigation. The nature and continuity of the subsoils away from the available site investigation is inferred and it must be appreciated that the actual conditions may vary from the assumed model.

3.1 Geological Units and Site Stratigraphy

Results and interpretation of the geotechnical investigations indicated the subsurface conditions at the site consists of Late Pleistocene River Deposits, which comprise the following:

- Topsoil (**TS**), encountered as black SILT, with some rootlets, firm, non-plastic. The topsoil was generally between 200 to 400 mm thick.
- Late Pleistocene River Deposits (**Riv1**, **Riv2** and **Riv3**).
  - **Riv1**: Black organic sandy SILT/ fibrous Peat, soft, non-plastic, moist. This unit directly underlies the topsoil layer and varies between 200 mm to 1200 mm thick, with an average thickness of 500 mm.
  - **Riv2**: Brown HARDPAN SAND, moist, strongly cemented, breaks into large blocks. This hardpan layer typically underlies the organic sandy SILT and is generally between 100 mm to 800 mm thick, with an average of 400 mm thick. Hardpan is typical on low lying areas of Mangawhai such as the subject site. Hardpan consists of chemically altered soils that form a dense and relatively impermeable layer of cemented soil typically within 1 to 2 m of the ground surface. Groundwater can become perched at the surface of this layer due to its impermeable nature.
  - **Riv3**: Brown/grey SAND, moist to wet, uniformly graded, fine to medium, tightly packed. This unit underlies the hardpan unit and extends to an unproven depth below the existing ground surface (expected to extend to bedrock at significant depths).

A summary of the site stratigraphy and layer thicknesses, a description of the various units and measured in situ strength test results are presented in Table 3-1 below. Two geological sections through the site are presented in Appendix A.

Table 3-1: Site Stratigraphy and In Situ Testing Summary

Geol. Unit	Soil type and description	Depth to top of unit (mbgl)	Layer thickness (m) [Typical]	Cone resistance typical range [Typical] q_c (MPa)
Topsoil	Black, SILT with some rootlets. Firm, non-plastic, moist.	0.0	0.2 – 0.4 [0.3]	1 - 2
Late Pleistocene River Deposits	**Riv1:** Black organic sandy SILT / Fibrous PEAT, soft, moist, high organic content.	0.2 – 0.4	0.2 – 1.2 [0.5]	0.5 – 1
	Riv2: Brown HARDPAN SAND, strongly cemented, moist.	0.4 – 1.4	0.1 – 0.8 [0.4]	25 – 50 [30]
	Riv3: Brown/grey SAND, tightly packed, fine to medium, moist to wet.	0.2 – 1.6	Unproven.	5 – 20 [8]

We have never investigated the land to the North, adjacent to the campground and estuary.

The geological map indicates that a younger soil type comprising Holocene River deposits is present in this Zone of the Plan Change. In addition, this area of the site is subjected to Coastal Inundation overlay due to its proximity to the coastline and lower elevation. However, given the geological unit, we would expect this area to comprise of interbedded Sands and Silts, and maybe pockets/layers of organic material.

3.2 Groundwater

Groundwater levels were recorded within the Initia test pits. The groundwater was recorded between 0.4 to 2.2 m below the existing ground level (begl) with a typical groundwater level of 1.5 m begl.

The groundwater results indicate the regional groundwater level at the site is likely controlled by the Mangawhai Harbour with a gentle gradient inland. The measured groundwater elevation will likely fluctuate up to 1 m in response to rainfall, seasonal trends and tidal fluctuations.

Given the presence of the hardpan layer, surface groundwater may get perched on this layer during the winter months.

For the purposes of liquefaction assessment, a typical groundwater depth of 1.5 m below existing ground level has been adopted.

4. Geotechnical Considerations for Potential Future Development

4.1 General

The following geotechnical considerations are considered relevant to the proposed plan change of the proposed site to the north of Black Swamp Road only:

- Earthwork considerations and ground improvement.
- Site subsoil class and seismicity.
- Liquefaction susceptibility and consequential effects.
- Foundation considerations for residential dwellings.
- Settlements due to proposed filling and other surcharging (e.g. building loads).
- Road Pavement and floor slabs.

The principle geotechnical risk that will constrain development at the site is settlement and the low bearing capacity of the soft compressible organic SILT & fibrous PEAT layers (Riv1) of the Late Pleistocene River deposits.

The recommendations and opinions contained in this report are based on geotechnical investigation undertaken to date. However, it must be appreciated that the actual conditions may vary from the assumed model. Should ground conditions differ to those outlined in this report, the recommendations within this report should be reviewed.

4.2 Earthworks Considerations

It is understood that any development would need to undertake bulk earthworks for the site and construct civil infrastructure (services and roading) to facilitate building at the site.

The upper Late Pleistocene River deposits soft organic sandy SILT & Fibrous PEAT (Riv1) is an organic rich material comprising of very low strength and prone to high settlements. The soft nature of this material means it is not a suitable building platform material or infrastructure such as roads/footpaths.

It is recommended that the soft organic sandy SILT & Fibrous PEAT (Riv1) layer is undercut and replaced over all development platforms and proposed infrastructure zones. This ground improvement will mitigate the major geotechnical risks to the project. The soft organic sandy SILT & Fibrous PEAT (Riv1) layer is typically 200 mm to 1200 mm thick, with a typical thickness of 500 mm. This layer should be excavated and replaced with imported compacted engineered fill.

4.2.1 Reusability of Site Won Material

Potential use for the material excavated from site are detailed in Table 4-1.

Table 4-1: Summary of reusability of site won fill materials

Geological unit	Extent of material on site	Potential re-uses for fill
Topsoil	Approximately 200 to 400 mm thick across the site.	Landscaping fill
Late Pleistocene River deposits Organic sandy SILT / Fibrous PEAT (**Riv1**)	Directly underlying topsoil from approximately 200 to 1200mm thick.	Landscaping fill

4.2.2 Acid Sulphate

The Pleistocene River Deposit organic sandy SILT / Fibrous PEAT (Riv1) contains significant amount of organic matter that may have been influenced by seawater during times of high sea levels. These soils may contain sulphate and sulphide rich soils and groundwater which can present a risk to concrete and proposed infrastructure. It is recommended that the organic soil is excavated and replaced, which will mitigate any acid sulphate risk to the project.

4.2.3 Engineered Fill Specification

Earthworks should be undertaken in accordance with the recommendations in NZS 4431:1989 and NZS4404:2010.

It is considered that fill will be required to both replace the organic sandy SILT & Fibrous PEAT material (Riv1) and to potentially raise the site levels to mitigate flood risk. Prior to any filling works being undertaken, all topsoil, and any other unsuitable materials should be stripped from the area of proposed filling and stockpiled for later use or disposed of offsite. Testing and certification of any placed material would be required. Preliminary compaction criteria for cohesive and granular fill material are detailed below:

Cohesive Fill

Undrained Shear Strength	Minimum value: Average value:	120 kPa 140 kPa (5 consecutive tests)
And		
Air voids	Maximum value: Average value:	12% 10 % (5 consecutive tests)

Granular fill

Maximum Dry Density (MDD):	Minimum density:	92% MDD
	Average CIV:	95% (5 consecutive tests)
Or		
Clegg Hammer (CIV):	Average Clegg Impact Value (CIV): 25 (5 consecutive tests)	
	Minimum Clegg Impact Value (CIV): 22	

Exposed subgrade should be protected from excessive plant movements and surface water ingress to reduce the risk to strength loss which may result in the requirement for undercutting and additional filling. Material proposed to use as fill on site should be reviewed by the geotechnical engineer prior to importing to site.

4.3 Seismic Considerations

4.3.1 Site Subsoil Class

The site is underlain by Late Pleistocene River deposits to proven depths greater than 20 m. An historic well drilled in close proximity to the area indicates the depth to bedrock is up to 60 m below ground level. Based on our knowledge, the area is expected to be underlain by soils overlying rock to a depth expected to be greater than 50 to 60 m. On these bases, the site should be considered **Site Subsoil Class D – Deep Soil**, in accordance with NZS1170.5:2004.

4.3.2 Design Seismic Parameters

Design peak ground acceleration and associated magnitude for serviceability (SLS), intermediate (ILS) and ultimate (ULS) limit states have been estimated in accordance with MBIE Geotechnical Module 1 guidelines and NZTA Bridge Manual 3rd Edition, 3rd Amendment, based on the following design assumptions:

- Design Life of 50 years.
- Importance Level IL2 (normal structures and structures not in other importance levels).
- Annual probability of exceedance for SLS of 1 in 25 years.
- Annual probability of exceedance for ILS of 1 in 100 years.
- Annual probability of exceedance for ULS of 1 in 500 years.

The design seismic parameters to be adopted for design are presented in Table 4-2 below.

Table 4-2: Design Peak Ground Acceleration (PGA) and associated magnitude (M_w) Summary

Design Seismic Parameters	Serviceability Limit State (SLS)	Intermediate Limit State (ILS)	Ultimate Limit State (ULS)
Peak Ground Acceleration (PGA)	0.05	0.09	0.19
Effective Earthquake Magnitude (M_w)	5.9	5.9	6.5

4.4 Liquefaction

Liquefaction occurs when soil loses shear resistance under cyclic loading (cyclic shear strains). For liquefaction to develop, the following conditions must be present:

- Material with the potential to densify under cyclic loading (typically loose sand).
- Saturated ground (i.e. material beneath the groundwater table).
- Sufficient cyclic shear loading (usually due to a seismic event).

A liquefaction triggering assessment was undertaken using the site-specific CPT data and CLiq software package. The Boulanger & Idriss (2014) method was adopted with an assumed groundwater level of 1.5 m begl. The default Soil Behaviour Type Index cut-off I_c = 2.6 was adopted when assessing the liquefaction susceptibility of soils.

Based on the site investigation and interpreted stratigraphic units, the saturated sands of the Late Pleistocene River Deposits (Riv3) are considered susceptible to liquefaction based on their composition and location beneath the ground water table.

The general performance levels for potentially liquefied deposits at the site are estimated, in accordance with the MBIE Guidelines Module 3, based on the review of the liquefaction severity number (LSN), liquefaction potential index (LPI) and free field settlements estimated by the Zhang et al (2002) method. The LSN and LPI values are damage indices that quantify liquefaction induced damage by combining effects of the severity of liquefaction, thickness of identified liquefied soils and their location within the soil profile. Table 4-3 presents a summary of the liquefaction susceptibility and triggering assessment results for SLS, ILS and ULS design cases based on the site-specific CPT data.

Table 4-3: Liquefaction Assessment Summary

Design Case Scenario	LSN [Typical]	LPI [Typical]	Index Settlement [Typical] (mm)	Performance Level (MIBE Guidelines Module 3)
25-year (SLS)	0	0	0	L0 (Insignificant)
100-year (ILS)	<1	0	<5	L0 (Insignificant)
500-year (ULS)	10 – 35 [20]	5 – 15 [7]	50 – 200 [100]	L2 (Moderate) to L3 (High)

Note: LSN = Liquefaction Severity Number, LPI = Liquefaction Potential Index

Based on the MBIE guidelines and the analyses results, the LSN, LPI and index settlement classifications indicates that the site has an insignificant risk of liquefaction occurring under a SLS (25-year) and ILS (100-year) seismic events. The analysis indicates a moderate to high risk of liquefaction under an ULS (500-year) seismic loading.

Liquefaction under ULS loading could result in vertical settlements on the order of 100 to 200 mm, this range is in general accordance with the settlements estimated using the Zhang et al (2002) method. It is noted that the predicted settlements should be treated as proxy for damage only and do not reflect a reliable estimate of actual settlements. The liquefaction assessment outputs are presented in Appendix C (for the ULS case only).

The predicted liquefaction under ULS seismic loading events could lead to moderate to significant damage of the building foundations and floor slab, therefore, liquefaction mitigation measures are recommended for the proposed development.

The Late Pleistocene Age River deposit soft organic sandy SILT & fibrous PEAT (Riv1) is expected to be susceptible to cyclic softening from seismic loading. Cyclic softening is the reduction in strength of soft "clay-like" soils under cyclic loading. The cyclic softening hazard is expected to be mitigated through excavation and replacement of this layer.

It is assumed that the organic sandy SILT & fibrous PEAT (Riv1) layer will be excavated and replaced with compacted engineered fill. The compacted engineered fill and the underlying hardpan layer will aid to 'raft over' any underlying liquefaction effects to lower the potential risk to foundation performance in an earthquake event.

Lateral Spread Assessment

Given the significant distance to any free face and the absence of sloping ground there is a low risk of lateral spread effects at the proposed site. Nevertheless, a lateral stretch assessment has been undertaken to assess the effect of the estuary located approximately 60 m south of our nearest investigation location, with an assumed free face of 2m. The lateral spread assessment indicates <10 mm of lateral displacement would occur at this investigation point. Given that the PPC is indicating development areas close to the estuary, it is highly likely that a buffer zone may have to be applied to the estuary to prevent property being adversely affected by lateral spread.

Alternatively, detail ground improvements can be designed to fully mitigate this risk.

Liquefaction Mitigation Away from the Estuary

Assuming the organic sandy SILT & fibrous PEAT (Riv1) layer is excavated and replaced with compacted engineered fill. The ground improvement of compacted engineered fill and the underlying hardpan layer will help to mitigate underlying liquefaction effects. In addition to this ground improvement the proposed residential structures should be designed to accommodate vertical movements due to liquefaction under seismic loading. Based on the predicted liquefaction induced vertical settlements between 100 and 200 mm, it is recommended that a TC2 foundation system is utilised to mitigate the risk of liquefaction effects (in accordance with Canterbury Residential MBIE technical Guidance – Part A).

4.5 Road Pavements

All topsoil and soft organic sandy SILT & fibrous PEAT (Riv1) material should be excavated and replaced with compacted engineered fill beneath all infrastructure. The pavements founded on the engineered fill should achieve a subgrade CBR of 4% across the majority of the site.

Undercutting of any weak, organic materials identified during construction may be required where present. The prepared subgrade should be inspected, and proof rolled under the supervision of a geotechnical engineer prior to placing subbase/basecourse layers.

It is important that the subgrade be protected from trafficking and disturbance during construction, particularly during the winter months and periods of poor weather. Subgrade stabilisation, upper 300 mm, could also be undertaken to reduce subbase/basecourse layer thicknesses. Drainage should also be maintained to ensure water does not pond at the subgrade/sub-base or basecourse interface during construction.

5. Further Works

The scope of geotechnical investigations and analyses undertaken to date has been suitable to support a due diligence and proposed plan change only. Additional geotechnical investigations, analyses and reporting will be required to support the design and Resource Consenting of earthworks, pavements and building foundations. The extent of work depends upon the nature and extent of final proposed development, but it is expected to include:

- Additional investigations in the area adjacent to the holiday park and estuary
- Inputs into an earthworks specification
- Specific foundation design and construction specifications should be assessed at detailed design, based on the proposed development.
- Review and comment on other geotechnical aspects on the future structural and civil drawings should also be provided prior to Resource and Building Consent.

6. Conclusions

The following key geotechnical conclusions can be made to support the *Proposed Plan Change (PPC) application* for the Black Swamp development in Managwhai:

Subsurface Conditions

1. The site is covered by a thin layer of topsoil. The topsoil is underlain by Late Pleistocene River Deposits Formation comprising of organic sandy SILT/ fibrous PEAT between 200 to 1200 mm thick. A strongly cemented hardpan SAND layer underlies the organic silt / fibrous PEAT between 100 to 800 mm thick. Tightly packed SAND underlies the hardpan layer for significant depth (depth unproven by current ground investigations).
2. Observations within the completed ground investigations indicate that a groundwater level likely sits approximately at 1.5 m below the existing ground level.

Earthwork Conditions

3. The upper topsoil and organic sandy SILT/Fibrous PEAT (Riv1) are organic rich materials with a low strength and will be prone to high settlements when loaded. This material is unsuitable for proposed development building platforms and infrastructure. It is recommended that this material is excavated and replaced with engineered fill. This will mitigate the major geotechnical risks to the project.
4. The Organic sandy SILT / Fibrous PEAT (Riv1) may contain sulphate and sulphide rich soils which can present a risk to concrete and proposed infrastructure. It is recommended that the organic soil is excavated and replaced, which will mitigate any acid sulphate risk to the project.
5. Proposed engineered fill specification is presented in section 4.2.3.

Seismic Considerations

6. We consider the site to be of Site Subsoil 'Class D – Deep Soils'.
7. The sites geotechnical seismic design parameters are presented in Table 4-2.
8. The sandy Holocene Aged and Late Pleistocene River Deposits (Riv3) are considered susceptible to liquefaction due to material composition and groundwater depth.
9. The results of the liquefaction analysis indicate there is negligible risk of liquefaction under a SLS & ILS seismic event.
10. Under a ULS seismic event the liquefaction assessment indicates a moderate to high risk of liquefaction. The predicted liquefaction induced settlement of 100 to 200 mm could lead to damage of the proposed buildings foundations and floor slabs.
11. A buffer zone may be required adjacent to the estuary to prevent a lateral spread affecting property, alternatively, ground improvements can be designed to mitigate this risk
12. It is recommended that a TC2 foundation system is utilised to mitigate the risk of liquefaction effects away from the lateral spread zones. The TC2 foundation system should comprise of one of the options detailed in Part A of the MBIE Technical Guidance.

Pavements and Subgrade Preparation

13. Assuming all topsoil and soft organic sandy SILT & fibrous PEAT (Riv1) material is excavated and replaced with compacted engineered fill, all infrastructure founded on the engineered fill should achieve a subgrade CBR of 4% across the majority of the site.
14. The prepared subgrade should be inspected, and proof rolled under the supervision of a geotechnical engineer prior to placing sub-base/basecourse layers.

7. Applicability

This report has been prepared for our client, SAM Property, with respect to the brief provided to us. The advice and recommendations presented in this report should not be applied to any other project or used in any other context without prior written approval from Initia Limited.

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Document control record

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Revision	Date	Revision detail	Author	Reviewer	Approved by
A	26/03/24	Draft for client review	A. McDonald	A. Pomfret	A. Pomfret
B	24/09/24	Draft for client review	A. Pomfret	A. Pomfret	A. Pomfret
Current Revision		B			

Appendix A Figures

LEGEND

INITIA INVESTIGATIONS (FEB 2024)

CPT101 — CONE PENETRATION TEST

TP101 — TEST PIT

INITIA INVESTIGATIONS (JUN 2022)

CPT01 — CONE PENETRATION TEST

TP01 — TEST PIT

SITE BOUNDARY

0.5 EXISTING GROUND CONTOUR (0.5m INTEVAL)

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: MOUNT EDEN 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO DATED JAN 2024.
5. PROPERTY BOUNDARY TAKEN FROM KOORDINATES DATE 2017.

SCALE A3 1:3,000

0 40 80 120 160m

BLACK SWAMP ROAD

RAYMOND BULL ROAD

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
B	ADDITIONAL INVESTIGATION (22/03/2024)	AM	GG	AM
A	INVESTIGATION LOCATION (17/06/2022)	AM	JG	AM

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052

Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

SAM PROPERTY LTD

BLACK SWAMP ROAD, MANGAWHAI

GEOTECHNICAL INVESTIGATION LOCATION PLAN

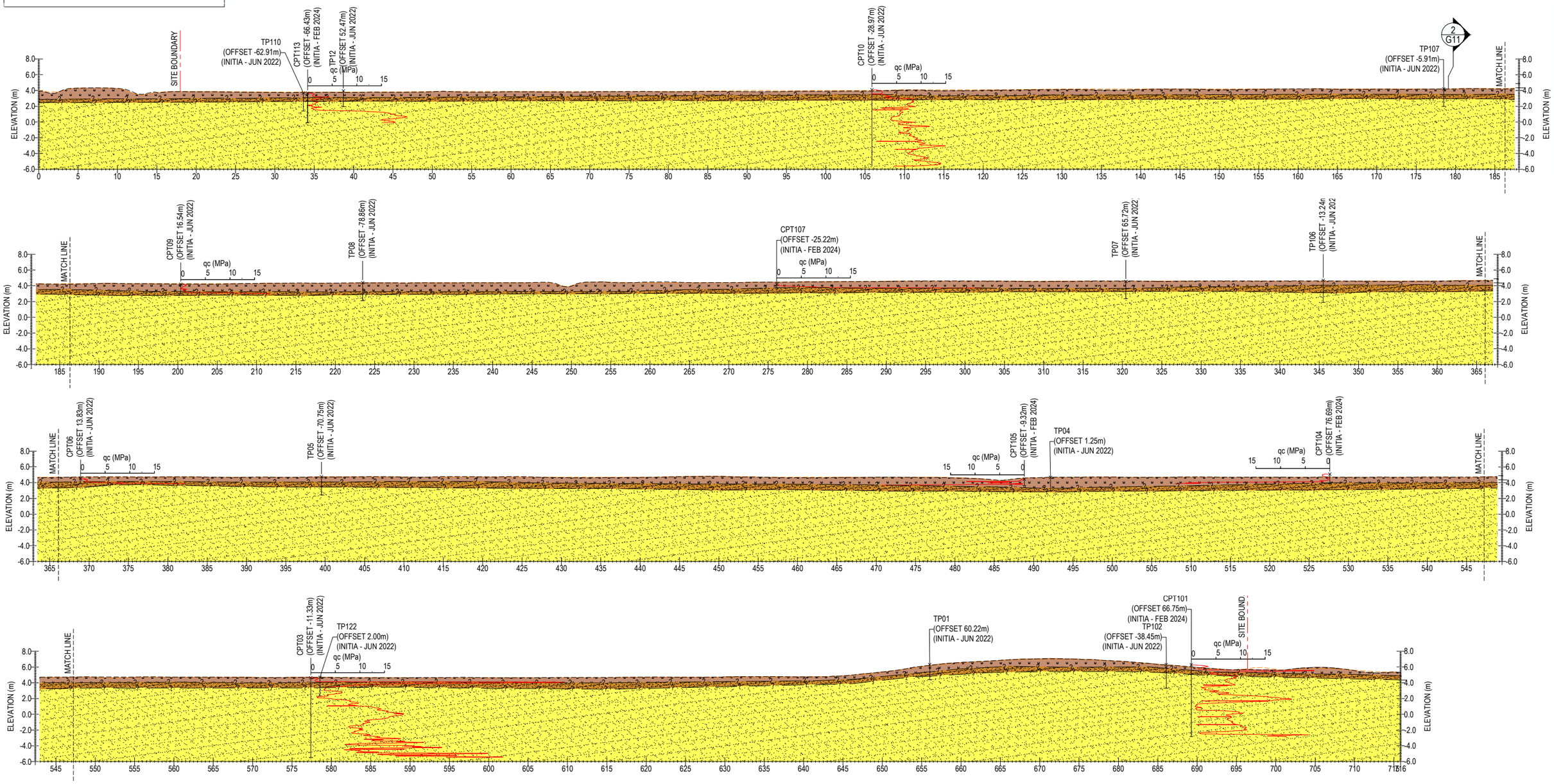
Initia Project ref: P-001431

Figure Number 1431-G01

Revision B

LEGEND

- TOPSOIL AND SOFT ORGANIC SANDY SILT
- LATE PLEISTOCENE RIVER DEPOSIT HARDPAN CEMENTED SAND
- LATE PLEISTOCENE RIVER DEPOSIT TIGHTLY PACKED SAND
- SURVEY TOPO (04 JAN 2024)
- LIDAR CONTOUR (LINZ - 2020)
- INFERRED GEOLOGICAL BOUNDARY



SCALE A3 1:500

2 / G11 — 1 / G01 SECTION
SCALE 1: 500 (A3)

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (22/03/2024)	AMD	GG	

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APPROVED:
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Scale AS SHOWN
Original Size A3

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SAM PROPERTY LTD

BLACK SWAMP ROAD, MANGAWHAI

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 1

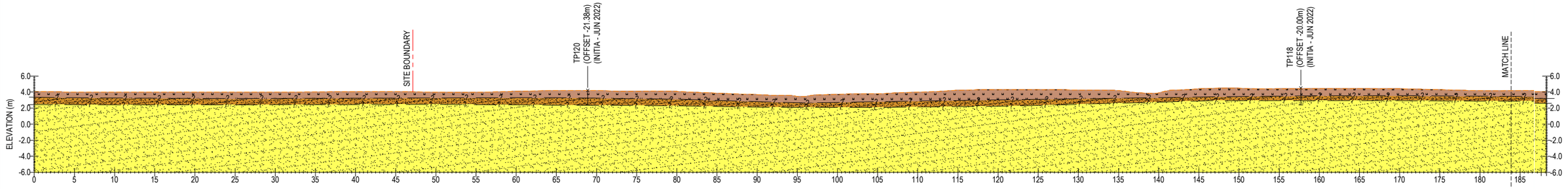
Initia Project ref: P-001431
Figure Number 1431-G10
Revision A

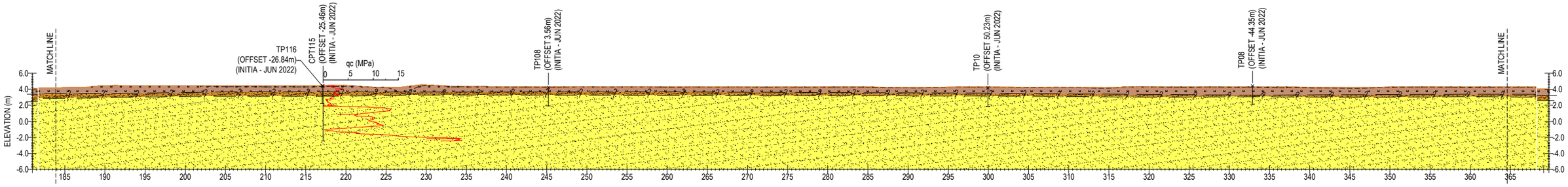
D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - 1401_1500\P-001431 - BLACK SWAMP DEVELOPMENT\CAD\2. WORKING FILES\1431-G10_G11.DWG, 3/25/2024 12:26 PM

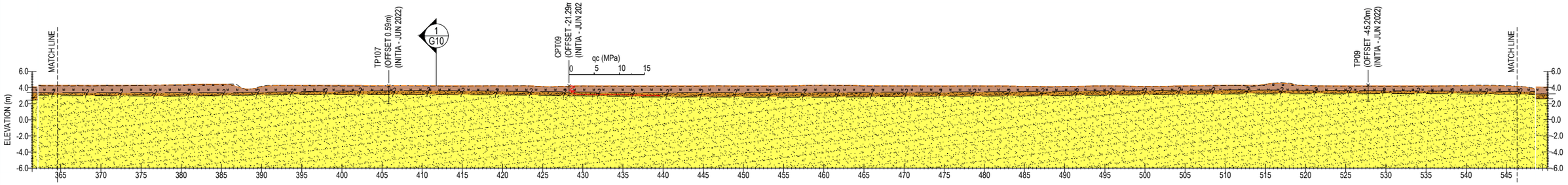
LEGEND

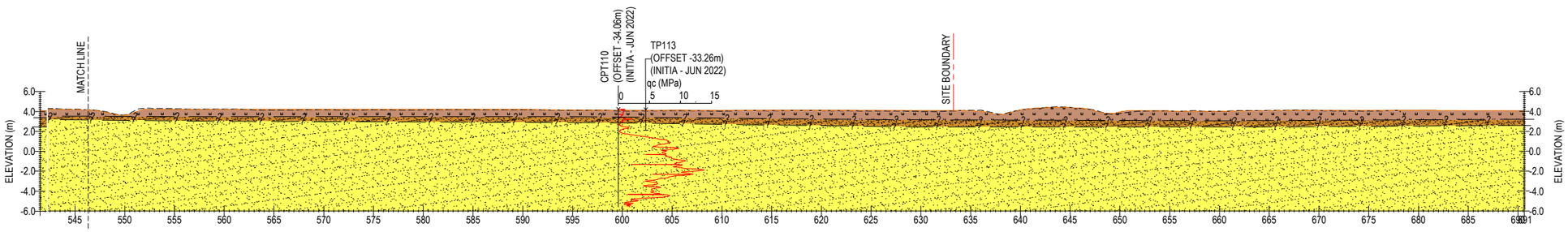
SURVEY TOPO (04 JAN 2024)

LIDAR CONTOUR (LINZ - 2020)









SCALE A3 1:500

0 5 10 15 20 25m

2 G01 SECTION

SCALE 1: 500 (A3)

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (22/03/2024)	AMD	GG	

NOT FOR CONSTRUCTION

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APPROVED:

DATE:

Scale AS SHOWN Original Size A3

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SAM PROPERTY LTD

BLACK SWAMP ROAD, MANGAWHAI

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 2

Initia Project ref: P-001431

Figure Number 1431-G11

Revision A

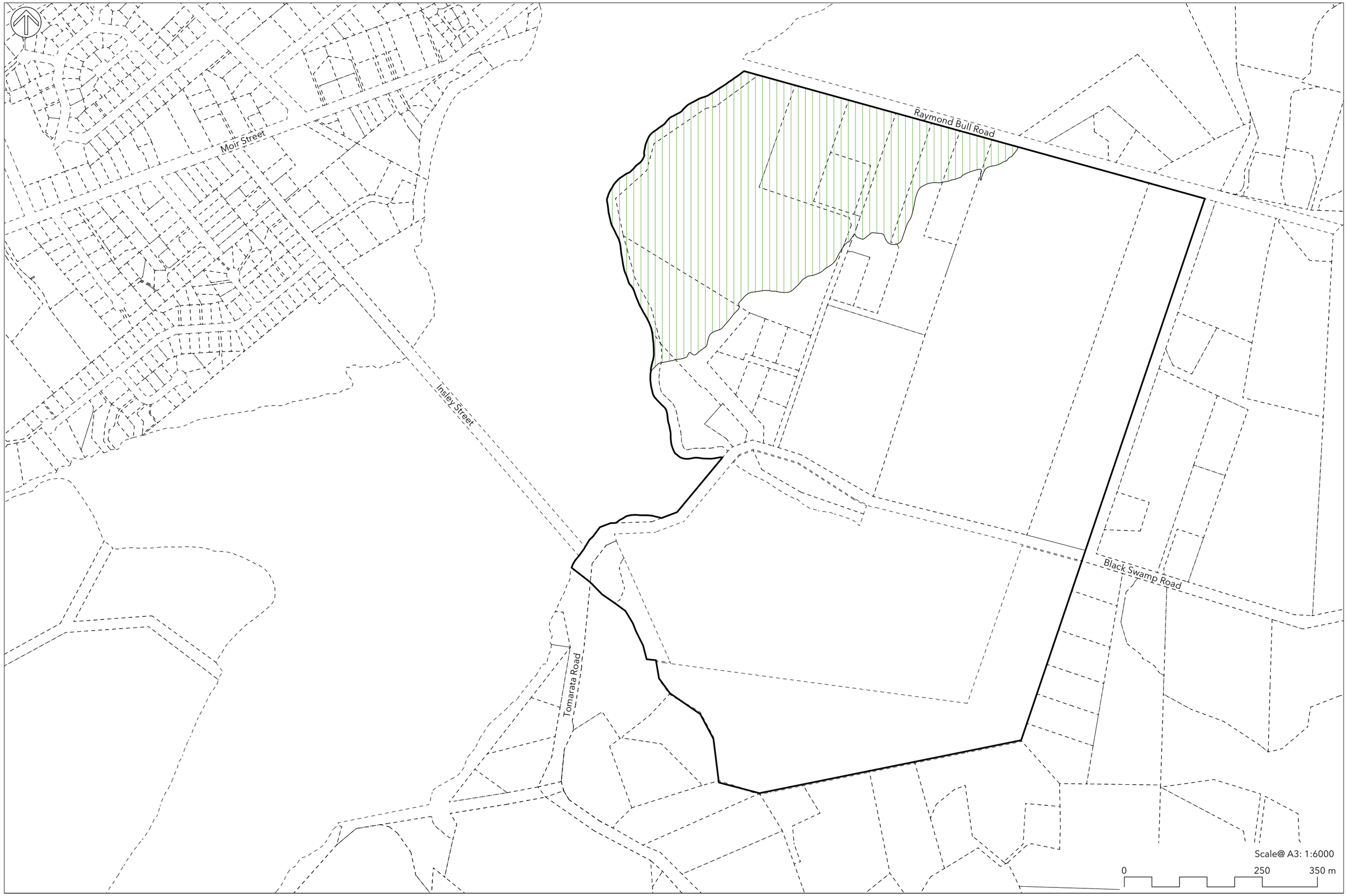
D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - 1401_1500\P-001431 - BLACK SWAMP DEVELOPMENT\CAD\2. WORKING FILES\1431-G10_G11.DWG, 3/25/2024 12:53 PM

Develpment Area - Mangawhai East

DEVELOPMENT AREA

13-Sep-24

ISSUE DATE / REF # - A

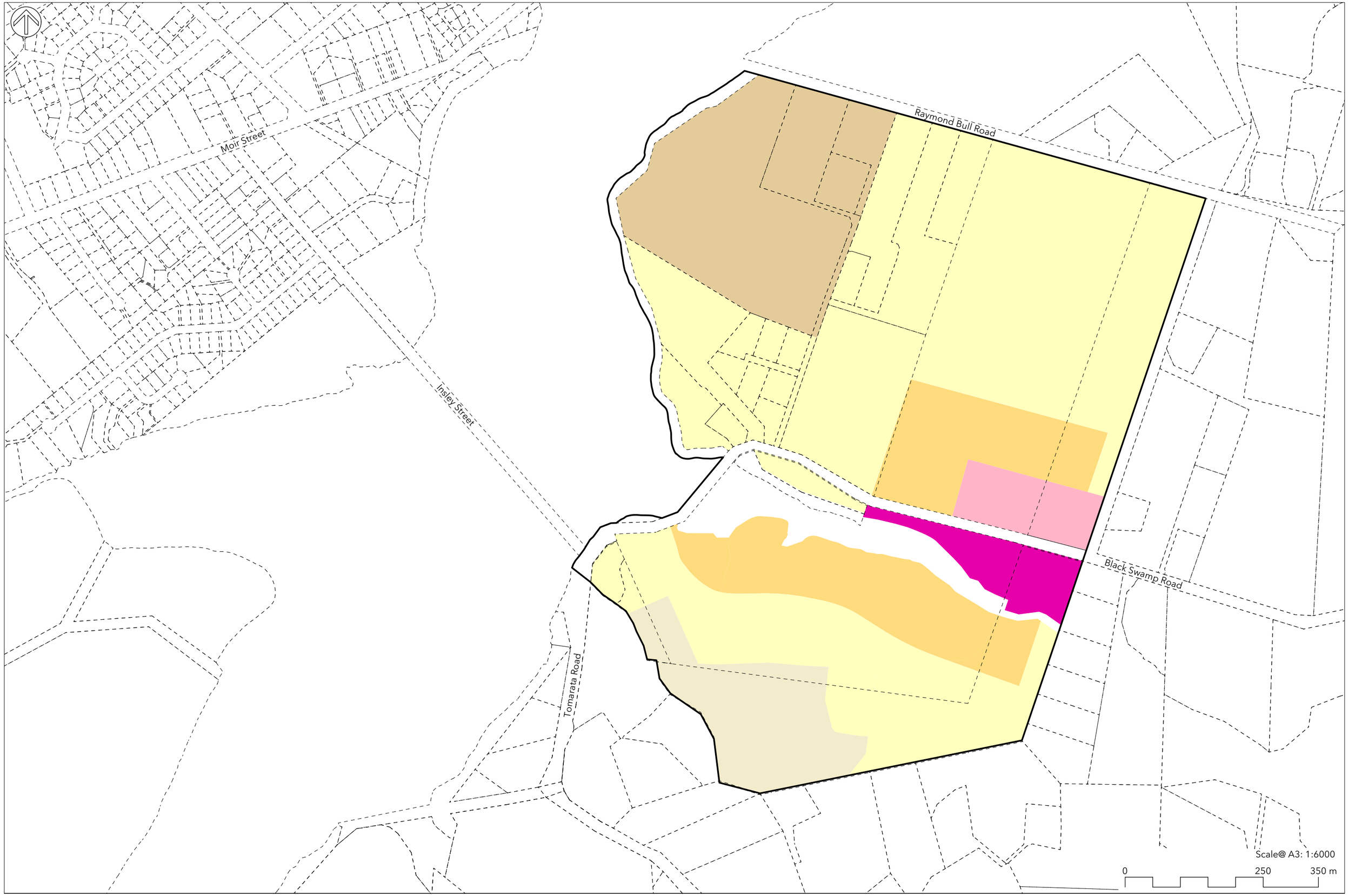


Coastal Inundation Overlay

PROPOSED COASTAL INUNDATION OVERLAY MAP

13-Sep-24

ISSUE DATE / REF # - A



Neighbourhood Centre Zone
Mixed Use Zone
Large Lot Residential
Low Density Residential
Medium Density Residentiall
Rural Lifestyle Zone

PROPOSED ZONING MAP
MANGAWHAI EAST

13-Sep-24
ISSUE DATE / REF # - A

Appendix B Ground Investigation Logs

TEST PIT LOG

HOLE NO.: TP01

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743276mE, 6000782mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Non-plastic; moist.		0.2	TS S TS TS TS S			
Late Pleistocene river deposits Silty SAND, with some clay; light orange brown. Low plasticity; moist; sand, fine; Tightly packed. 0.5m: grades to light brown 0.7m: grades to brown		0.4 0.6 0.8 1.0				
SAND; light orange brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		1.2 1.4 1.6 1.8				02/06/2022 ▼
EOH: 1.90m		2.0 2.2 2.4 2.6 2.8				

REMARKS

Water inflow at base of test pit. Test pit terminated at 1.9mbgl at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP02

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743097mE, 6000762mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 5m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values	WATER
Topsoil: Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS			
PEAT (FIBROUS); dark brown. Soft; moist; contains minor kauri gum, kauri logs and rootlets.		0.2 – 0.8				22/06/2022 ▼
Pleistocene River Deposits: SAND, with some silt, with trace rootlets; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		0.8 – 1.5				
SAND; brown. Moist to wet; uniformly graded; sand, fine to medium; Tightly packed.		1.5 – 2.7				
EOH: 2.70m		2.7				

REMARKS

Water inflow at sides of test pit at 0.6mbgl and 2.5mbgl. Test pit terminated at 2.7mbgl at target depth.

WATER
- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP03

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743341mE, 6000695mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits SAND; light orange brown with light grey mottles and orange veins. Moist; uniformly graded; sand, fine to medium; Tightly packed.		0.2 0.4 0.6				
0.8m: grades to light orangish brown		0.8 1.0 1.2 1.4 1.6				
1.8m: grades to light brownish light grey		1.8 2.0 2.2 2.4 2.6				
EOH: 2.70m		2.8				Groundwater Not Encountered

REMARKS

No groundwater encountered. Test pit terminated at 2.7mbgl at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP04

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743165mE, 6000648mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits PEAT (FIBROUS); dark brown. Soft; moist; contains minor kauri gum, kauri logs and rootlets.		0.2 0.4 0.6 0.8 1.0 1.2				22/06/2022
SAND, with some silt, with trace rootlets; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		1.4				
EOH: 1.70m		1.6 1.8 2.0 2.2 2.4 2.6 2.8				

REMARKS

Water inflow at sides of test pit at 0.7mbgl. Test pit terminated at 1.7mbgl at due to water level.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP05

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743065mE, 6000585mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 5m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil	Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0 – 0.2	TS
Late Pleistocene river deposits	Organic sandy SILT; dark brown. Soft; non-plastic; moist; sand, fine.		0.2 – 0.4	TS
	SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		0.4 – 0.8	
	SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		0.8 – 2.3	
	EOH: 2.30m		2.3	

SCALA PENETROMETER (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18

VANE SHEAR STRENGTH (kPa) Vane: 50, 100, 150, 200; Values

WATER: 22/06/2022

REMARKS

Water inflow at sides of test pit at 0.7mbgl and base of test pit at 2.3mbgl. Test pit terminated at 2.3mbgl at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP06

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743268mE, 6000555mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Organic sandy SILT; dark brown. Soft; non-plastic; moist to wet; sand, fine.		0.2 0.4 0.6 0.8 1.0				22/06/2022
SAND, with some silt; brown. Dry to moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		1.2 1.4 1.6 1.8				
SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		2.0				
EOH: 2.10m		2.2 2.4 2.6 2.8				

REMARKS

Water inflow at sides of test pit at 0.9mbgl. Test pit terminated at 2.1mbgl at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP07

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743166mE, 6000464mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits PEAT (FIBROUS); dark brown. Soft; moist; contains minor kauri gum, kauri logs and rootlets.		0.4				22/06/2022
SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		0.8				
SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		1.2				
EOH: 2.20m		2.2				

REMARKS

Water inflow at sides of test pit at 0.4mbgl. Tes pit terminated at 2.2mbgl at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP08

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742997mE, 6000423mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits	Organic sandy SILT; dark brown. Soft; non-plastic; moist; sand, fine.		0.2 – 1.0				22/06/2022
	SAND; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks.		1.0 – 1.2				
	SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		1.2 – 2.0				
	2.0m: grades to light yellow brown		2.0 – 2.2				
	EOH: 2.30m		2.2 – 2.8				

REMARKS

Water inflow at sides of test pit at 1mbgl and 2mbgl. Test pit terminated at 2.3mbgl at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP09

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743181mE, 6000357mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil	Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS
Late Pleistocene river deposits	Organic sandy SILT; dark brown. Soft; non-plastic; moist; sand, fine.		0.2	
	SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		0.4	
	SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		0.6	
	SAND; light grey. Wet; uniformly graded; sand, fine to medium; Loosely packed.		0.8	
	EOH: 2.00m		1.0	
			1.2	
			1.4	
			1.6	
			1.8	
			2.0	
			2.2	
			2.4	
			2.6	
			2.8	

SCALA PENETROMETER (Blows / 0mm): 2 4 6 8 10 12 14 16 18

VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER: 22/06/2022

REMARKS

Water inflow and collapse at sides of test pit at 1.5mbgl. Test pit terminated at 1.5mbgl due to hole collapse.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP10

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742934mE, 6000345mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits	Organic sandy SILT; dark brown. Soft; non-plastic; moist; sand, fine.		0.2 – 0.6				
	SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks down into blocks. Tightly packed.		0.6 – 0.8				
	SAND; light orange brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		0.8 – 2.2				22/06/2022
	EOH: 2.30m		2.2				

REMARKS

Water inflow at sides of test pit at 2mbgl. Test pit terminated at 2.3mbgl at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP11

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743143mE, 6000250mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND
Topsoil	Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	
Late Pleistocene river deposits	Organic sandy SILT; dark brown. Soft; non-plastic; moist; sand, fine.		0.2	
	SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks down into blocks. Tightly packed.		0.4	
	SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		0.6	
	SAND; light grey. Wet; uniformly graded; sand, fine to medium; Loosely packed.		0.8	
	EOH: 2.10m		1.0	
			1.2	
			1.4	
			1.6	
			1.8	
			2.0	
			2.2	
			2.4	
			2.6	
			2.8	

SCALA PENETROMETER (Blows / 0mm): 2 4 6 8 10 12 14 16 18

VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER: 22/06/2022

REMARKS

Water inflow and collapse at sides of test pit at 1.7mbgl. Test pit terminated at 2.1mbgl due to hole collapse.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP12

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743058mE, 6000204mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN Hitachi
OPERATOR: Flynn
START DATE: 22/06/2022
END DATE: 22/06/2022
LOGGED BY: KNB
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with some rootlets; dark brown. Firm; non-plastic; moist.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Organic sandy SILT; dark brown. Soft; moist; sand, fine.		0.2				
SAND, with some silt; brown. Moist; HARDPAN. Strongly cemented, breaks into blocks. Tightly packed.		0.4 0.6 0.8				
SAND; brown. Moist; uniformly graded; sand, fine to medium; Tightly packed.		1.0 1.2 1.4 1.6				
SAND; light orange brown. Moist; uniformly graded; sand, fine to medium; tightly packed.		1.8				
EOH: 2.00m		2.0 2.2 2.4 2.6 2.8				22/06/2022 ▼

REMARKS

Water inflow at base of test pit. Test pit terminated at 2mbgl at target depth.

WATER
- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP101

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743393mE, 6000719mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6.2m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets, with trace sand; dark brown. Firm; non-plastic; moist.		0.0 – 0.4	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Sandy SILT, with some orangics; dark brown. Firm; non-plastic; moist; sand, fine to medium; Orangics, rootlets.		0.4 – 0.6				
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed. 1.0m: grades to grey.		0.6 – 2.8				
EOH: 3.00m		2.8				

REMARKS

Water inflow at 2 m and pooling at base of test pit. Test pit terminated at 3 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP102

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743194mE, 6000844mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 6.3m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.4	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	Groundwater Not Encountered
Late Pleistocene river deposits Sandy SILT; orange. Firm; non-plastic; moist; sand, fine to medium.		0.4 – 1.0				
Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		1.0 – 1.2				
SAND; dark brown. Moist; HARDPAN. Strongly cemented.		1.2 – 1.4				
SAND; brown. Moist; uniformly graded; sand, fine to medium, tightly packed.		1.4 – 3.0				
EOH: 3.00m						

REMARKS

No Groundwater encountered. Test pit terminated at 3 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP103

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743045mE, 6000791mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.5m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; organic, roots and wood; sand, fine to medium.	B	0.2 – 0.4	
Silty SAND; brown. Non-plastic; moist; sand, fine to medium; densely packed.		0.4 – 0.8	
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.8 – 1.2	
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.2 – 2.8	
EOH: 2.80m		2.8	

SCALA PENETROMETER (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18

VANE SHEAR STRENGTH (kPa) Vane: 50, 100, 150, 200 — Values

WATER

REMARKS

Water inflow at 1.2 m and pooling at base of test pit. Test pit terminated at 2.8 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Ver 2. Generated with CORE-GS by Geroc - Test Pit_Initia - 12/03/2024 4:22:20 pm

Checked By: APK

TEST PIT LOG

HOLE NO.: TP104

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743067mE, 6000685mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.5m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.4	TS			
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, Fibrous roots and large kauri logs; sand, fine to medium.		0.4 – 1.0				
SAND; dark brown. Wet; HARDPAN, strongly cemented.		1.0 – 1.8				▽
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.8 – 2.4				
EOH: 2.40m		2.4				

REMARKS

Water inflow at 1 m and pooling at base of test pit. Test pit terminated at 2.4 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP105

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743009mE, 6000588mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.4m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS			
Late Pleistocene river deposits	Organic SILT, with some sand; dark brown. Soft; non-plastic; moist; Organic, Fibrous roots; sand, fine to medium.		0.2 – 0.6				
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.6 – 1.4				
	SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed. EOH: 2.20m		1.4 – 2.2				▽

Scala penetrometer scale: 2, 4, 6, 8, 10, 12, 14, 16, 18
Vane shear strength (kPa) scale: 50, 100, 150, 200; Vane: Values

REMARKS

Water inflow at 2.1 m and pooling at base of test pit. Test pit terminated at 2.2 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP106

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743101mE, 6000515mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)
Topsoil	SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2
Late Pleistocene river deposits	Organic SILT, with some sand; black. Firm; non-plastic; moist; Organic, Fibrous roots; sand, fine to medium.	B	0.2 – 0.4
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6
	SAND; greyish brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.6 – 2.2
	EOH: 2.80m		2.2

LEGEND

SCALA PENETROMETER (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18

VANE SHEAR STRENGTH (kPa) — Vane: 50, 100, 150, 200 — Values

WATER

REMARKS

Water inflow at 2.2 m and pooling at base of test pit. Test pit terminated at 2.3 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP107

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743051mE, 6000356mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.2m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.2 – 0.6				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.6 – 1.0				
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.0 – 2.2				
EOH: 2.20m		2.2 – 2.8				

REMARKS

Water inflow at 2.1 m and pooling at base of test pit. Test pit terminated at 2.2 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP108

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742899mE, 6000408mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.2m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits	Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.2 – 0.4				
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6				
	SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.6 – 2.0				▽
	EOH: 2.30m		2.0 – 2.8				

REMARKS

Water inflow at 2 m and pooling at base of test pit. Test pit terminated at 2.3 m at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP109

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742846mE, 6000264mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.4m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil Sandy SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Oragnic SILT; black. Firm; non-plastic; moist; Oragnic, fibrous roots.		0.2 – 0.4				
SAND; reddish brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6				
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.6 – 1.6				
EOH: 1.60m		1.6 – 2.8				

REMARKS

Water inflow at 1.6 m and pooling at base of test pit. Test pit terminated at 1.6 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP110

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742947mE, 6000239mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil	SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS
Late Pleistocene river deposits	Orangic sandy SILT; black. Soft; non-plastic; moist; Orangic, rootlets, sand, fine to medium.		0.2 – 0.4	TS / ×
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 1.0	
	SAND; dark brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.0 – 2.30	
	EOH: 2.30m			

SCALA PENETROMETER (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18

VANE SHEAR STRENGTH (kPa) — Vane: 50, 100, 150, 200 — Values

WATER

REMARKS

Water inflow at 2 m and pooling at base of test pit. Test pit terminated at 2.3 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP111

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743130mE, 6000176mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.8m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)		SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS			
Late Pleistocene river deposits	Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.2 – 0.4				
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6				
	SAND; grey. Wet; uniformly graded; sand, fine to medium, loosely packed.		0.6 – 1.8				▽
	EOH: 1.80m		1.8				

Scala penetrometer scale: 2, 4, 6, 8, 10, 12, 14, 16, 18
Vane shear strength (kPa) scale: 50, 100, 150, 200; Vane: Values

REMARKS

Water inflow at 1.6 m and pooling at base of test pit. Test pit terminated at 1.8 m due to wall collapse and significant undermining.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP112

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743221mE, 6000175mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil	SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0	TS
Late Pleistocene river deposits	Organic SILT; black. Soft; non-plastic; moist; Organic, fibrous roots.		0.2	
	SAND; brown. Moist; HARDPAN, strongly cemented.		0.4	
	SAND; grey. Wet; uniformly graded; sand, fine to medium, Loosely packed.		0.6	
			0.8	
			1.0	
			1.2	
			1.4	
			1.6	
			1.8	
	EOH: 2.00m		2.0	
			2.2	
			2.4	
			2.6	
			2.8	

SCALA PENETROMETER (Blows / 0mm): 2 4 6 8 10 12 14 16 18

VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values

WATER: Groundwater Not Encountered

REMARKS

Test pit terminated at 2 m due to pit wall collapse.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP113

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743247mE, 6000320mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.2m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS			
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots and wood; sand, fine to medium.		0.2 – 0.4				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6				
SAND; brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.6 – 0.8				
1.4m: grades to grey and loosely packed.		0.8 – 1.0				
		1.0 – 1.2				
		1.2 – 1.4				
		1.4 – 1.6				
		1.6 – 1.8				
		1.8 – 2.0				
EOH: 2.10m		2.0 – 2.2				
		2.2 – 2.4				
		2.4 – 2.6				
		2.6 – 2.8				

SCALA PENETROMETER (Blows / 0mm): 2 4 6 8 10 12 14 16 18

VANE SHEAR STRENGTH (kPa) — Vane: 50 100 150 200 — Values

REMARKS

Water inflow at 2.1 m and pooling at base of test pit. Test pit terminated at 2.1 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP114

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743346mE, 6000543mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil	SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	Groundwater Not Encountered
Late Pleistocene river deposits	SAND; dark brown. Moist; sand, fine to medium, tightly packed.		0.2 – 0.4				
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.4 – 0.6				
	SAND; greyish brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.6 – 2.4				
	EOH: 2.40m		2.4 – 2.8				

REMARKS

No groundwater encountered. Test pit terminated at 2.4 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [ ] Hand Auger
- [x] Test Pit

TEST PIT LOG

HOLE NO.: TP115

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742818mE, 6000277mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.2 – 0.6				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.6 – 0.8				
SAND; grey. Wet; uniformly graded; sand, fine to medium, tightly packed.		0.8 – 2.2				
EOH: 2.20m		2.2				

REMARKS

Water inflow at 2.2 m and pooling at base of test pit. Test pit terminated at 2.2 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP116

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742883mE, 6000446mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.4m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.4	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits SAND; reddish brown. Moist; HARDPAN, strongly cemented.		0.4 – 1.0				
SAND; greyish brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.0 – 2.2				▷
EOH: 2.20m		2.2				

REMARKS

Water inflow at 2.2 m and pooling at base of test pit. Test pit terminated at 2.2 m at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP117

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742787mE, 6000364mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND
Topsoil	SILT, with some rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS
Late Pleistocene river deposits	Organic SILT, with some sand; black. Firm; non-plastic; moist; organic, fibrous roots; sand, fine to medium.		0.2 – 0.6	
	SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.6 – 1.0	
	SAND; greyish brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.0 – 2.3	
	EOH: 2.30m		2.3	

SCALA PENETROMETER (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18

VANE SHEAR STRENGTH (kPa) Vane: 50, 100, 150, 200 — Values

WATER

REMARKS

Water inflow at 2.1 m and pooling at base of test pit. Test pit terminated at 2.3 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP118

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742825mE, 6000460mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.5m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.4	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Organic SILT, with some sand; black. Soft; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.4 – 0.8				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.8 – 1.0				
SAND; light brown. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.0 – 2.0				▽
EOH: 2.10m		2.0				

REMARKS

Water inflow at 2 m and pooling at base of test pit. Test pit terminated at 2.1 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP119

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742681mE, 6000357mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 3.4m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS			
Late Pleistocene river deposits Organic SILT, with some sand; black. Firm; non-plastic; moist; Organic, fibrous roots; sand, fine to medium.		0.2 – 0.8	TS			
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.8 – 1.6				
SAND; light brown. Wet; uniformly graded; sand, fine to medium, tightly packed. EOH: 2.00m		1.6 – 2.0				Groundwater Not Encountered

Scala Penetrometer: 2, 4, 6, 8, 10, 12, 14, 16, 18
Vane Shear Strength (kPa) – Vane: 50, 100, 150, 200 | Values

REMARKS

No groundwater encountered. Test pit terminated at 2 m at target depth.

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP120

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1742742mE, 6000492mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.2m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 22/02/2024
END DATE: 22/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS			
Late Pleistocene river deposits Sandy SILT, with some organics; black. Soft; non-plastic; moist; sand, fine to medium; Organics, rootlets.		0.2 – 0.8				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		0.8 – 1.6				
SAND; light brown. Wet; uniformly graded; sand, fine to medium, tightly packed. 1.7m: grades to grey. EOH: 1.80m		1.6 – 1.8				Groundwater Not Encountered

Scala Penetrometer (Blows / 0mm): 2, 4, 6, 8, 10, 12, 14, 16, 18
Vane Shear Strength (kPa) — Vane: 50, 100, 150, 200; Values

REMARKS

No groundwater encountered. Test pit terminated at 1.8 m at target depth.

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP121

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743252mE, 6000426mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.6m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Topsoil SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Late Pleistocene river deposits Silty PEAT (FIBROUS), with some sand; black. Soft; non-plastic; moist; peat (Fibrous), roots and kauri logs; sand, fine to medium.		0.2 – 1.0				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		1.0 – 1.2				
SAND; brownish grey. Saturated; uniformly graded; sand, fine to medium, tightly packed. EOH: 2.30m		1.2 – 2.3				▽

REMARKS

Water inflow at 2.2 m and pooling at base of pit. Test pit terminated at 2.3 m at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

TEST PIT LOG

HOLE NO.: TP122

CLIENT: Sam Property Limited
PROJECT: Mangawhai DD
SITE LOCATION: Raymond Bull Rd
Project Ref.: P-001431

CO-ORDINATES: 1743195mE, 6000729mN
Co-ordinate system: NZTM2000
Location method: GPSH
ELEVATION: 4.7m
Datum: NZTM
Level method: CONTOUR
CONTRACTOR: Local Contractor
MACHINE: Zaxis 130 LCN
OPERATOR: Luke
START DATE: 21/02/2024
END DATE: 21/02/2024
LOGGED BY: AJM
CHECKED BY: APK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 50 100 150 200 Values	WATER
Topsoil SILT, with minor rootlets; black. Firm; non-plastic; moist.		0.2	TS			
Late Pleistocene river deposits Silty sandy PEAT (FIBROUS); black. Soft; non-plastic; moist; peat (Fibrous), roots and kauri logs; sand, fine to medium.		0.4 0.6 0.8 1.0				
SAND; dark brown. Moist; HARDPAN, strongly cemented.		1.2 1.4				▽
SAND; brownish grey. Wet; uniformly graded; sand, fine to medium, tightly packed.		1.6 1.8 2.0 2.2				
EOH: 2.40m 2.3m: grades to grey.		2.4 2.6 2.8				

REMARKS

Water inflow at 1.2 m and pooling at base of pit. Test pit terminated at 2.4 m at target depth.

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: APK

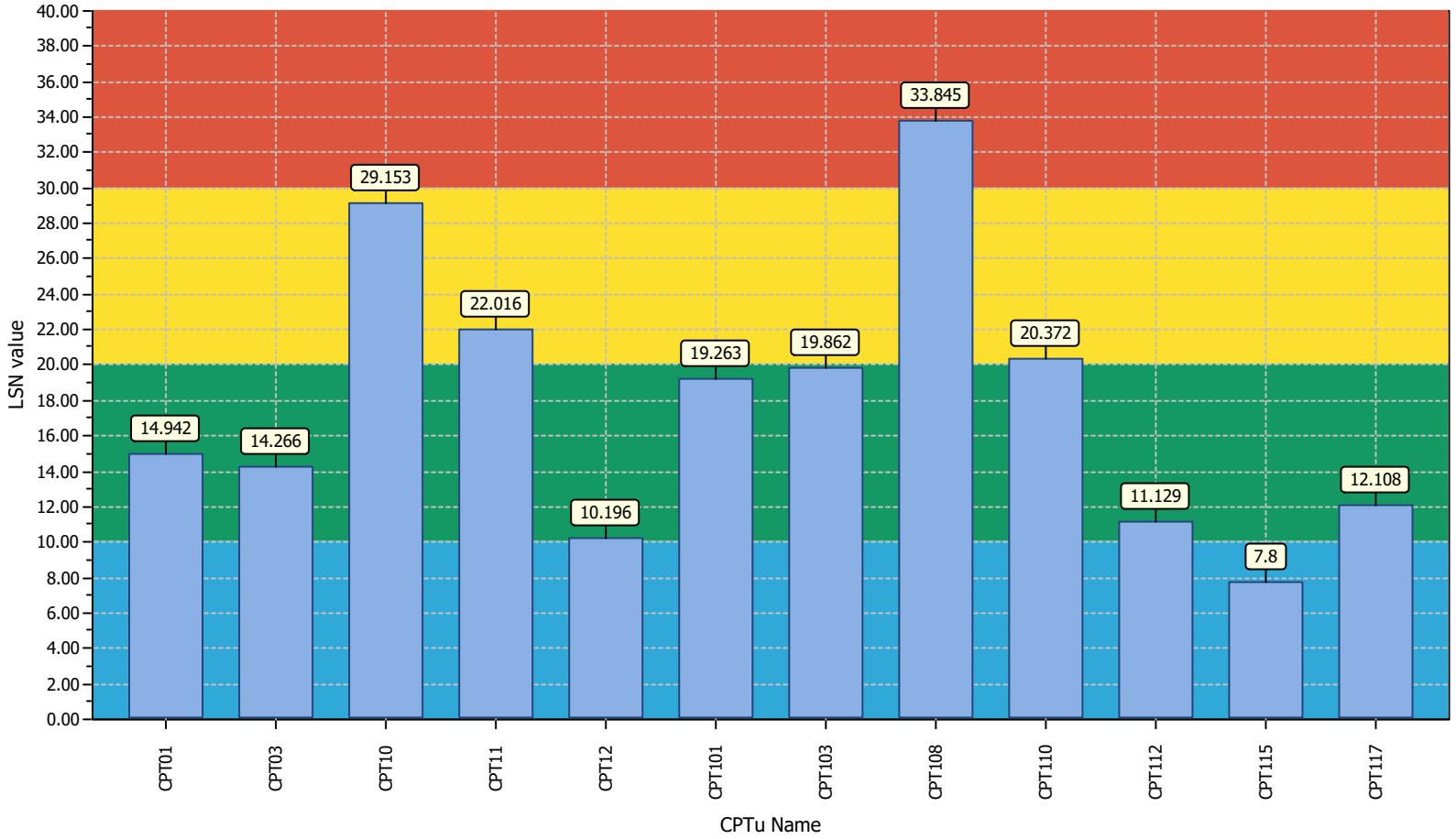
Appendix C Liquefaction Assessment (CLiq)

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project title : P-001431

Location : Black Swamp Road, Mangawhai

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: 12

8% little liquefaction

58% minor liquefaction

25% moderate liquefaction

8% moderate to major liquefaction

0% major liquefaction

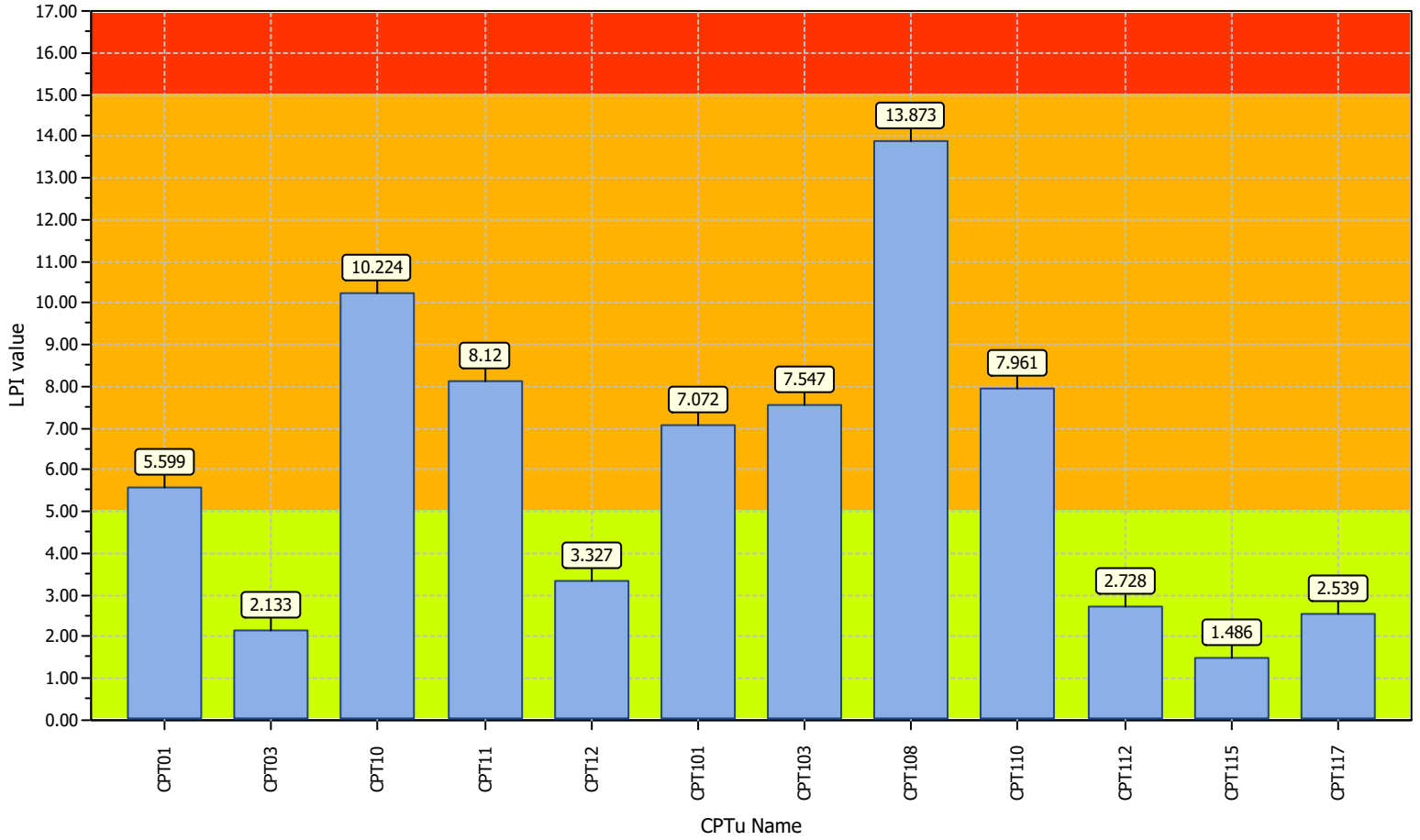
0% severe liquefaction

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project title : P-001431

Location : Black Swamp Road, Mangawhai

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

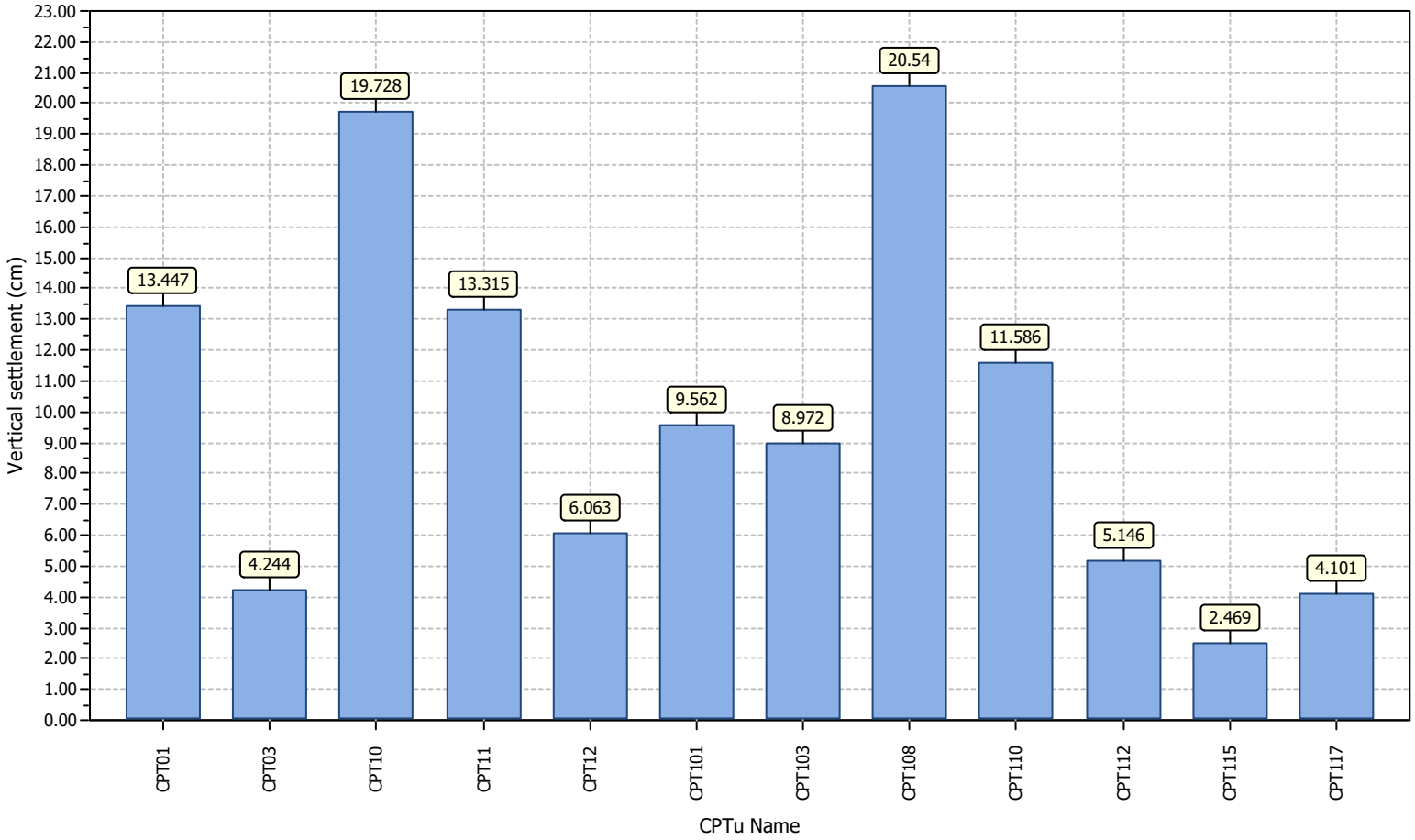
Total CPT number: 12
42% low risk
58% high risk
0% very high risk

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project title : P-001431

Location : Black Swamp Road, Mangawhai

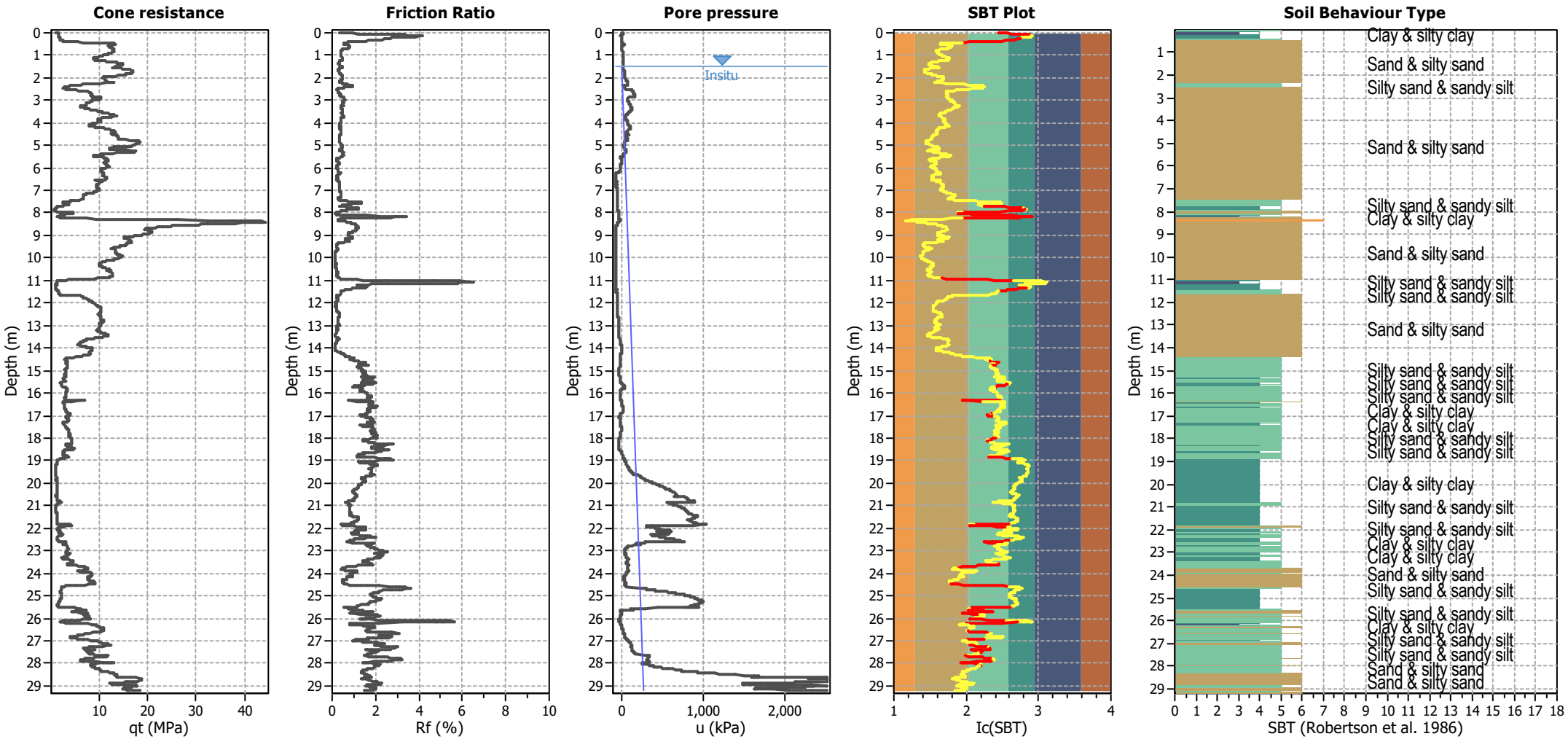
Overall vertical settlements report



Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT01
Total depth: 29.20 m

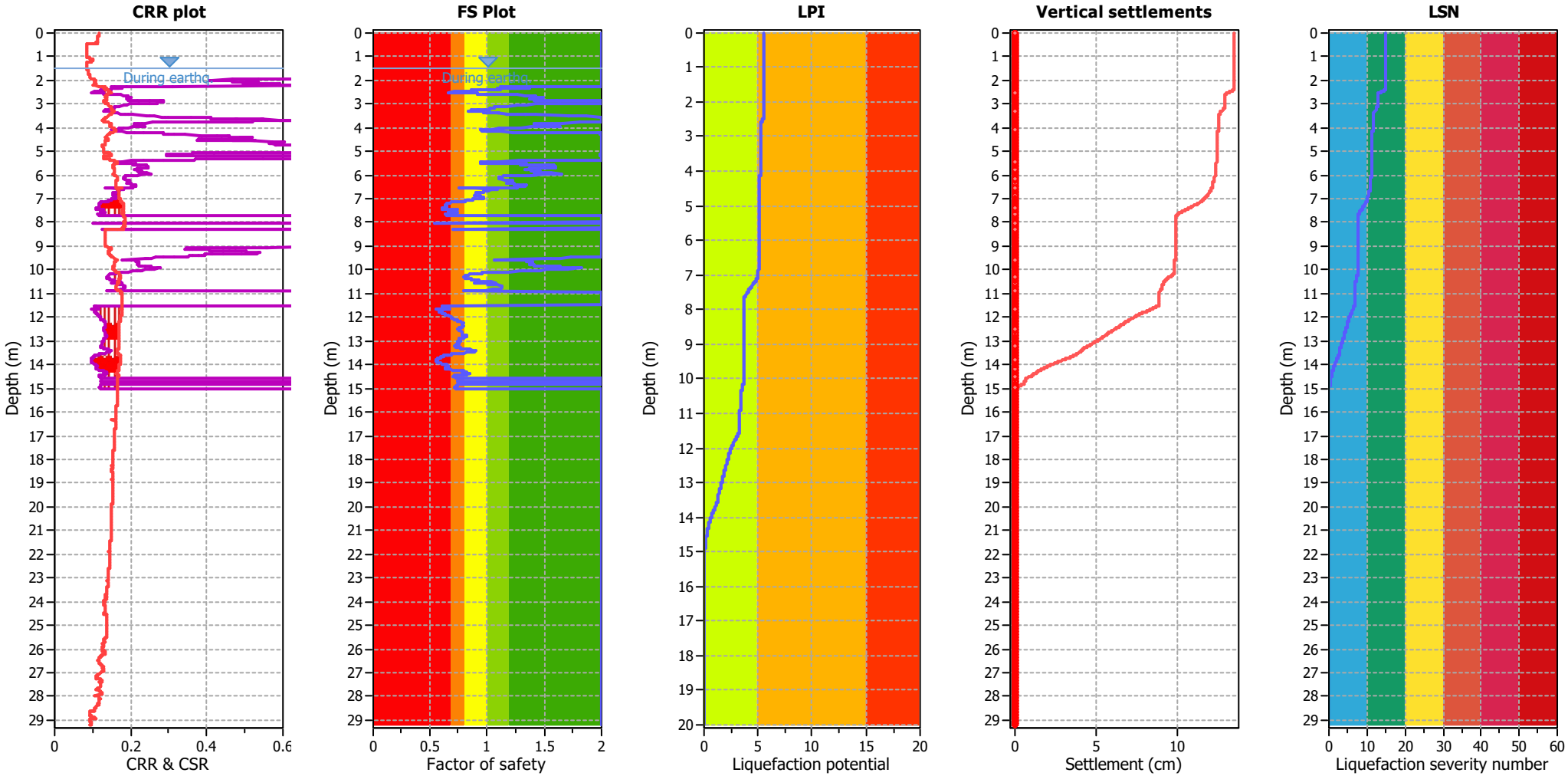


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT01
Total depth: 29.20 m

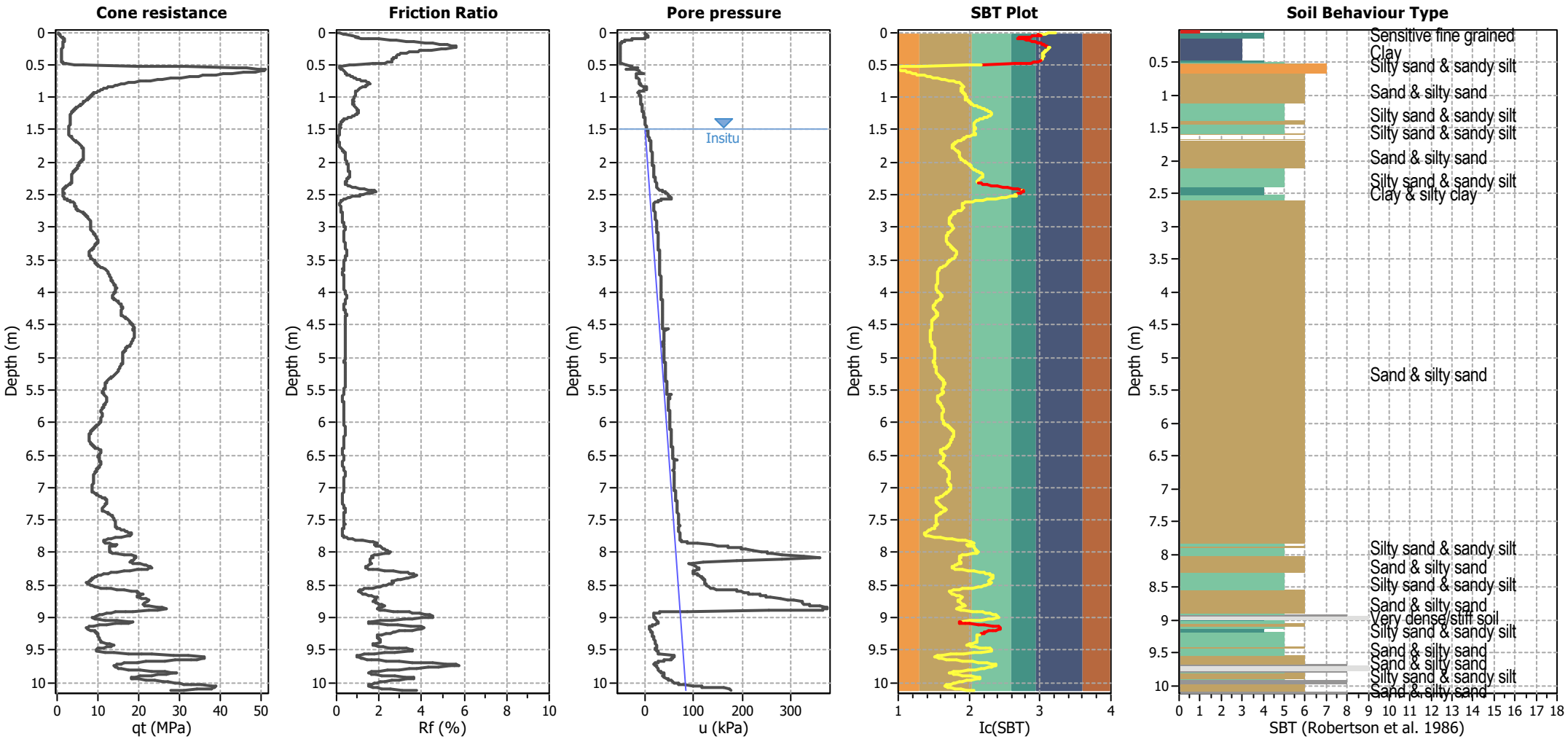


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT03
Total depth: 10.12 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
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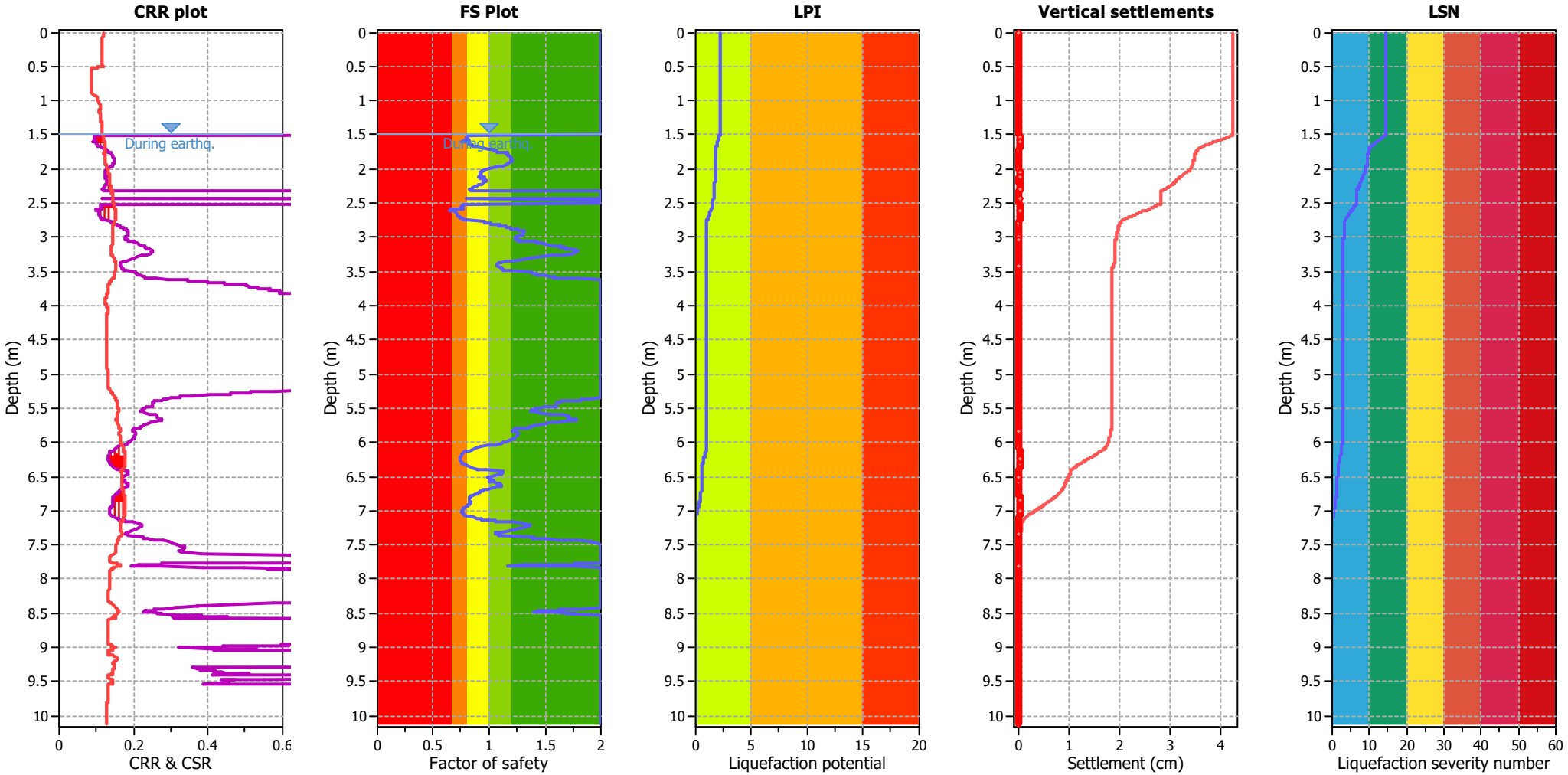
Initia.co.nz

Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT03
Total depth: 10.12 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
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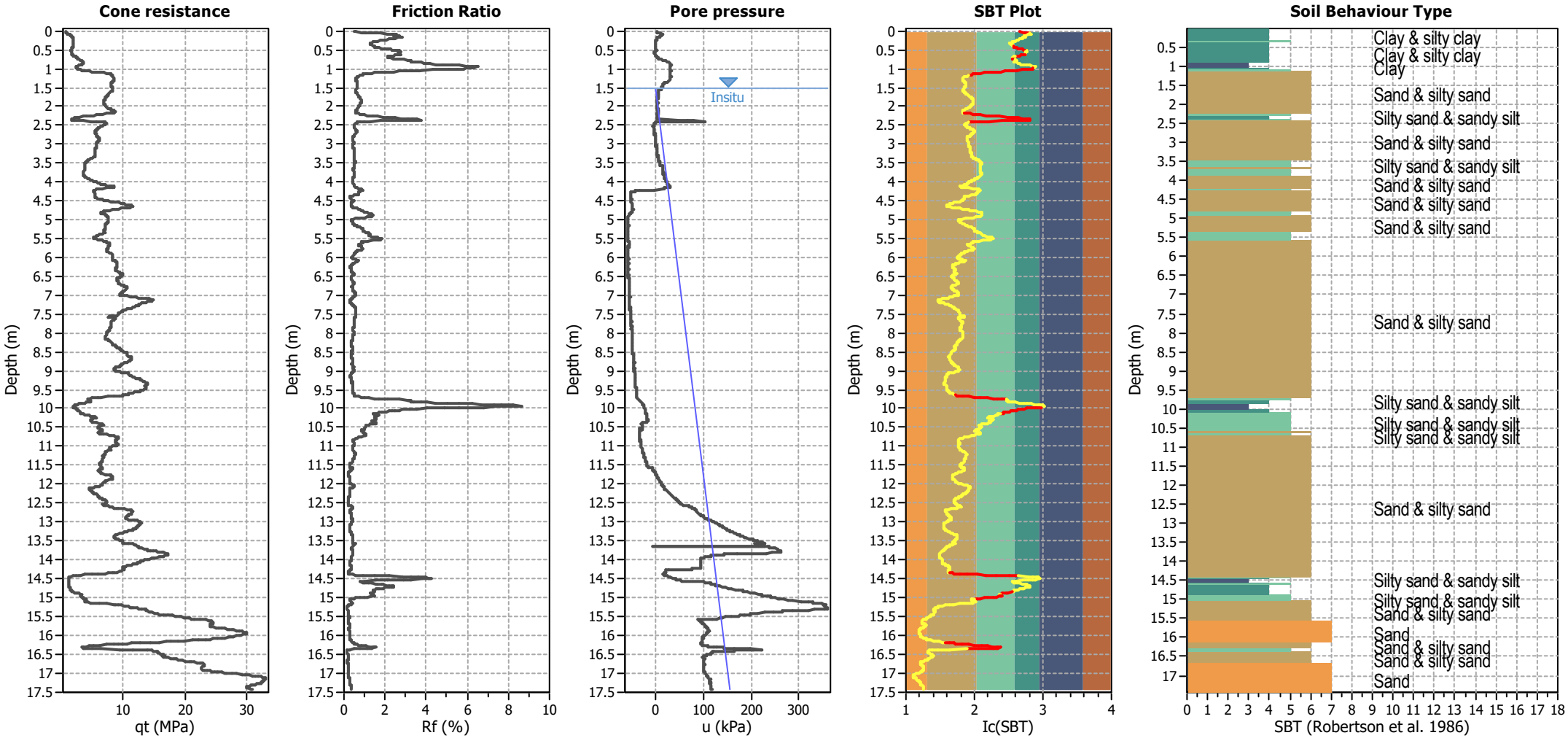
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT10
Total depth: 17.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
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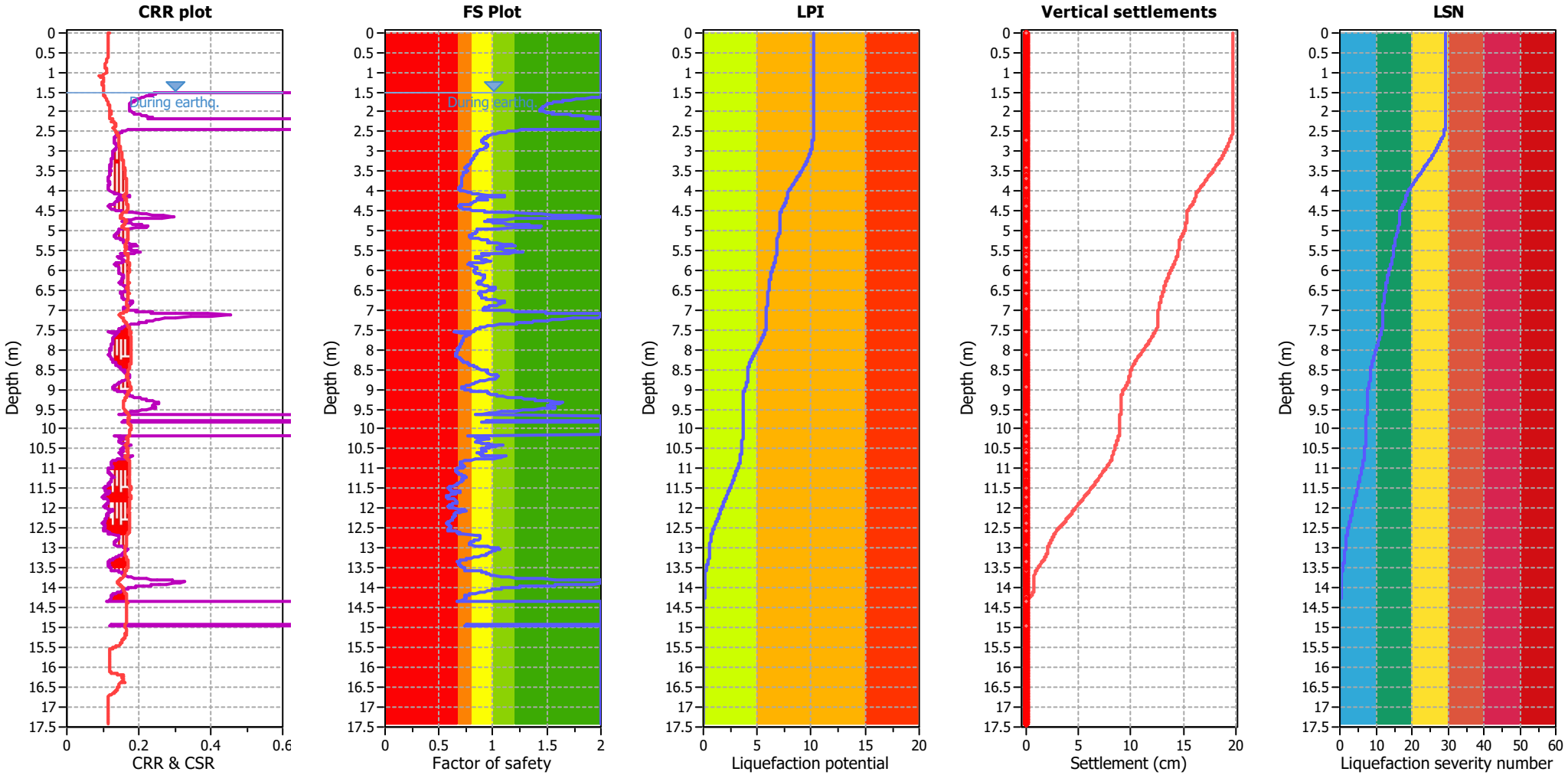
Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT10
Total depth: 17.44 m

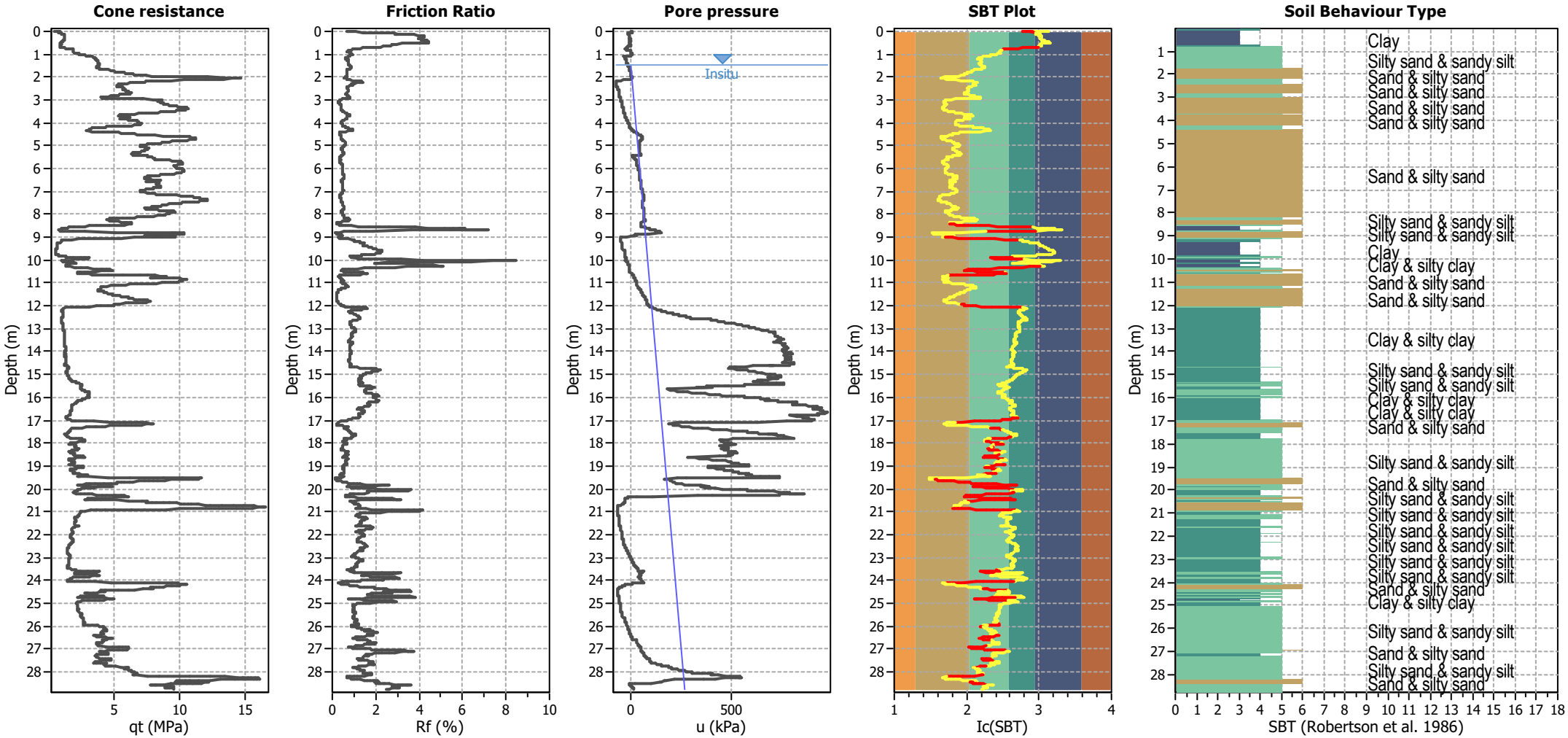


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT11
Total depth: 28.76 m

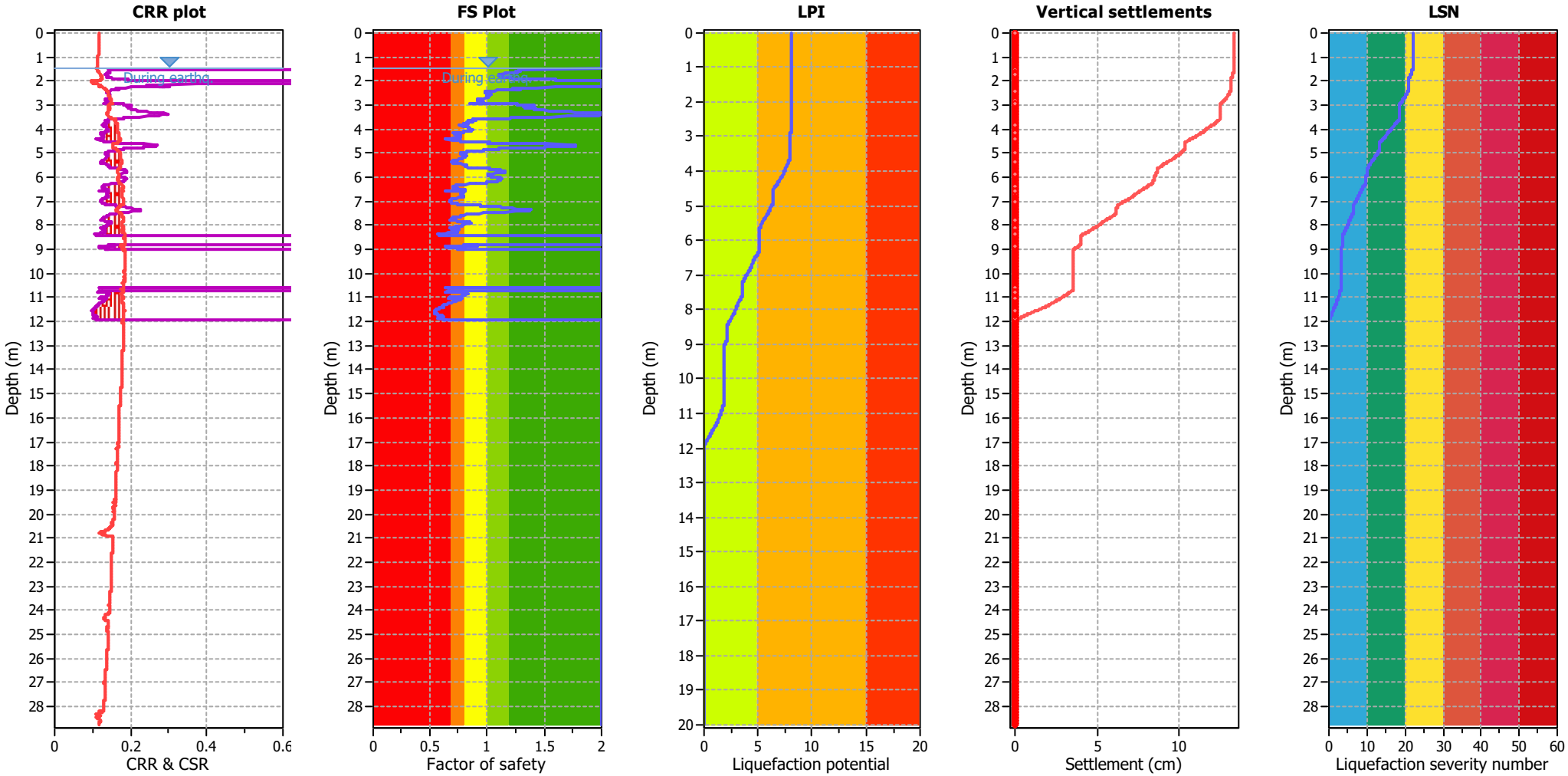


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

Initia Ltd
Unit 6, Level 1/114 Saint Georges Bay Road, Parnell, Auckland 1052
Initia.co.nz

Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT11
Total depth: 28.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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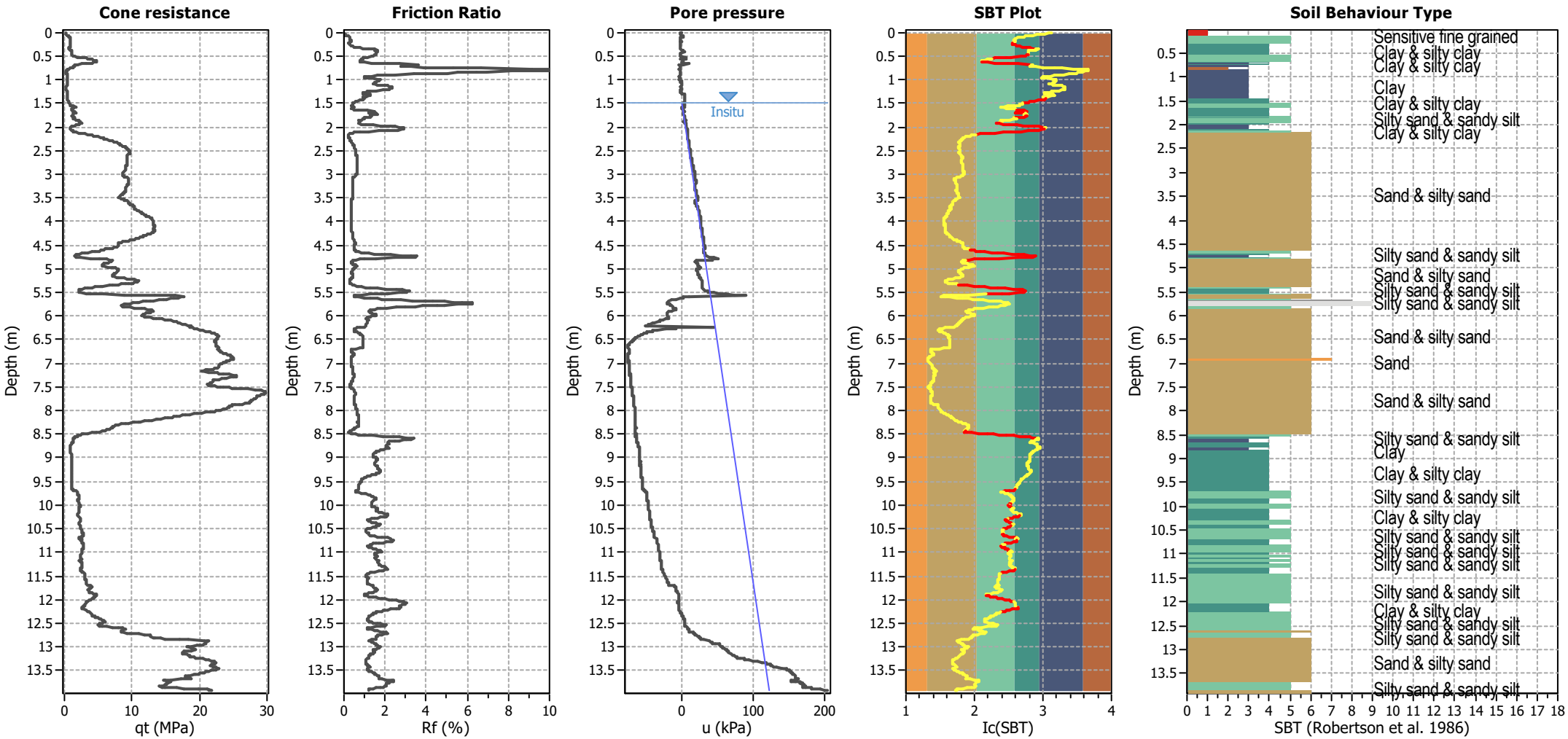
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT12
Total depth: 13.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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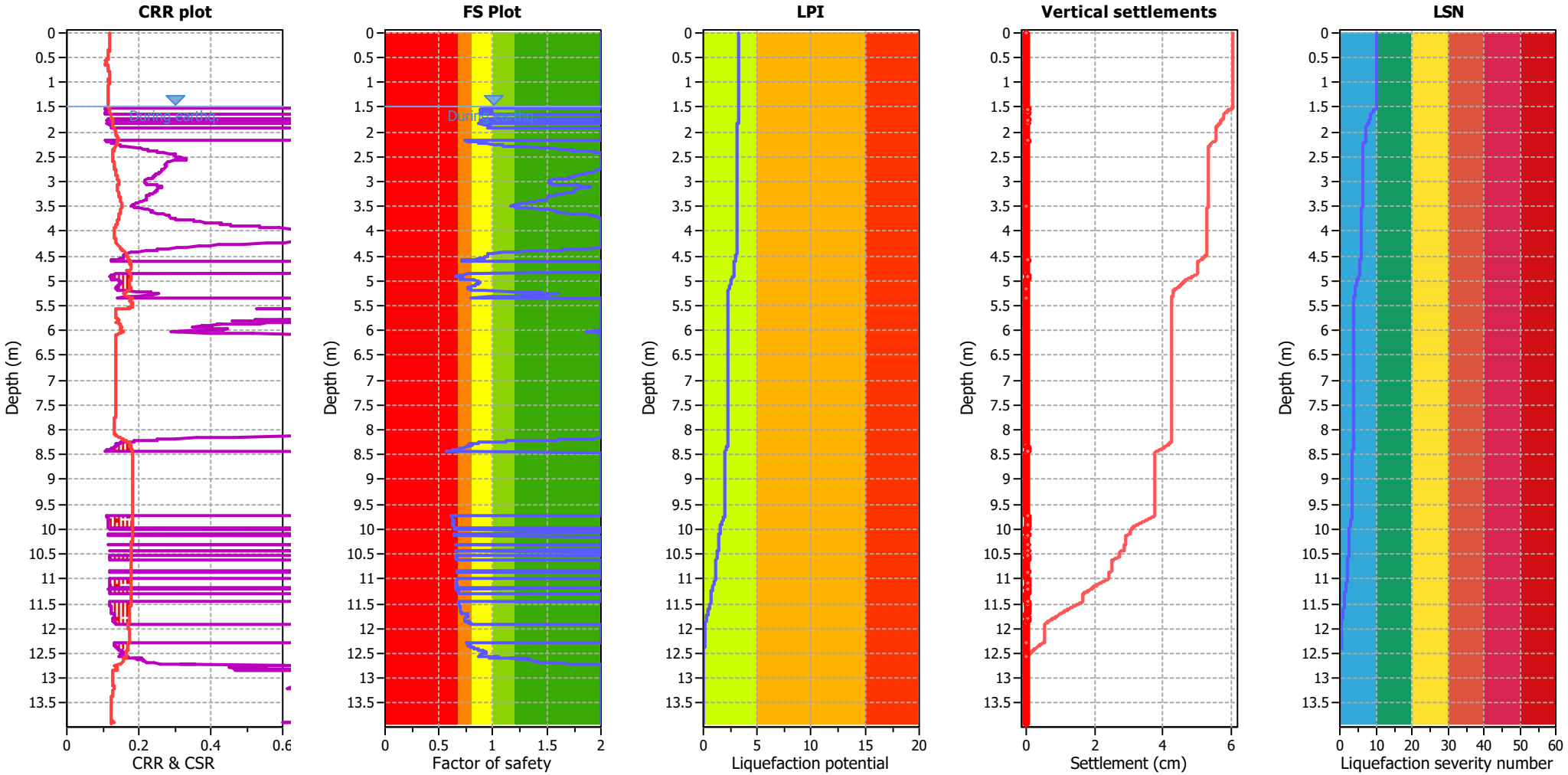
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT12
Total depth: 13.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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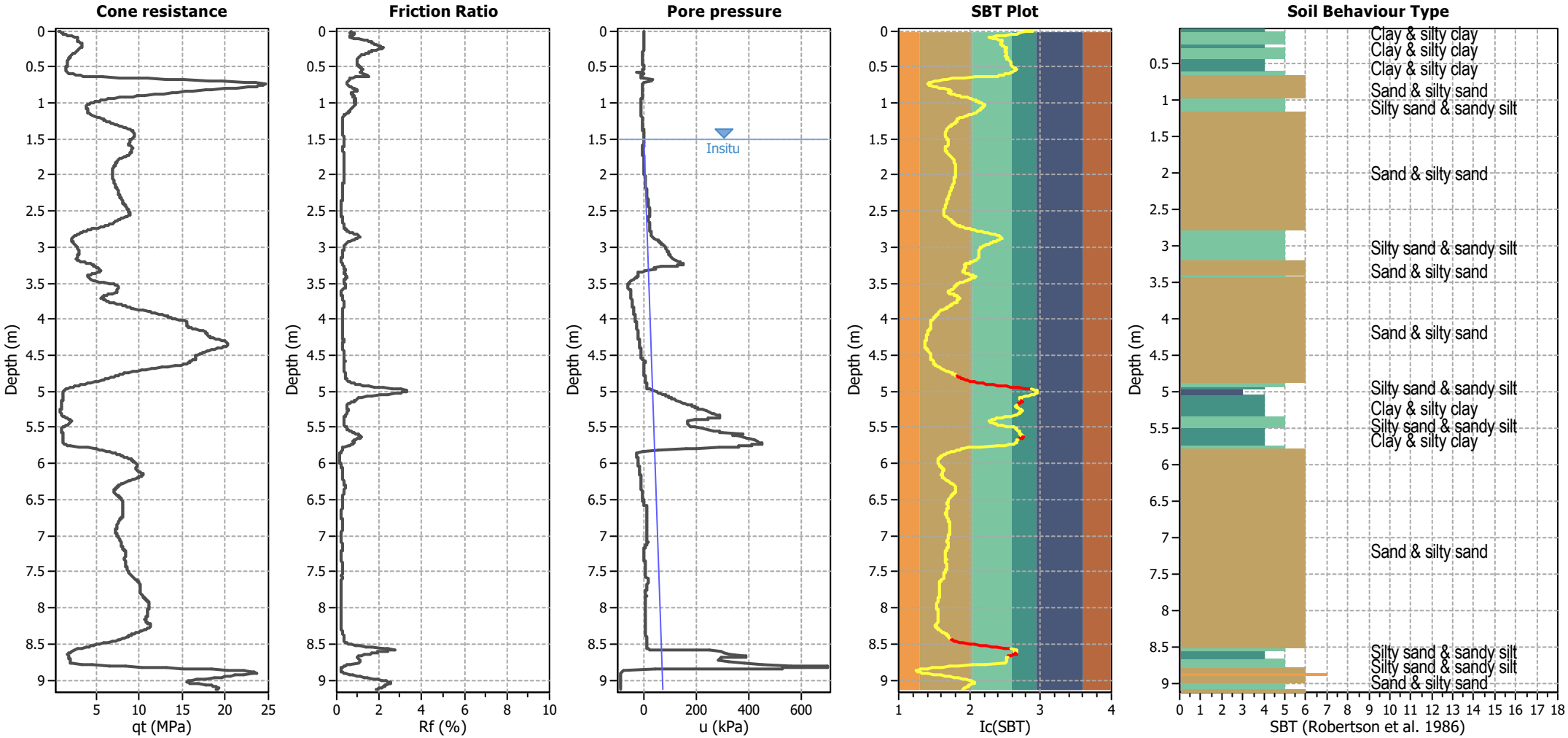
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT101
Total depth: 9.13 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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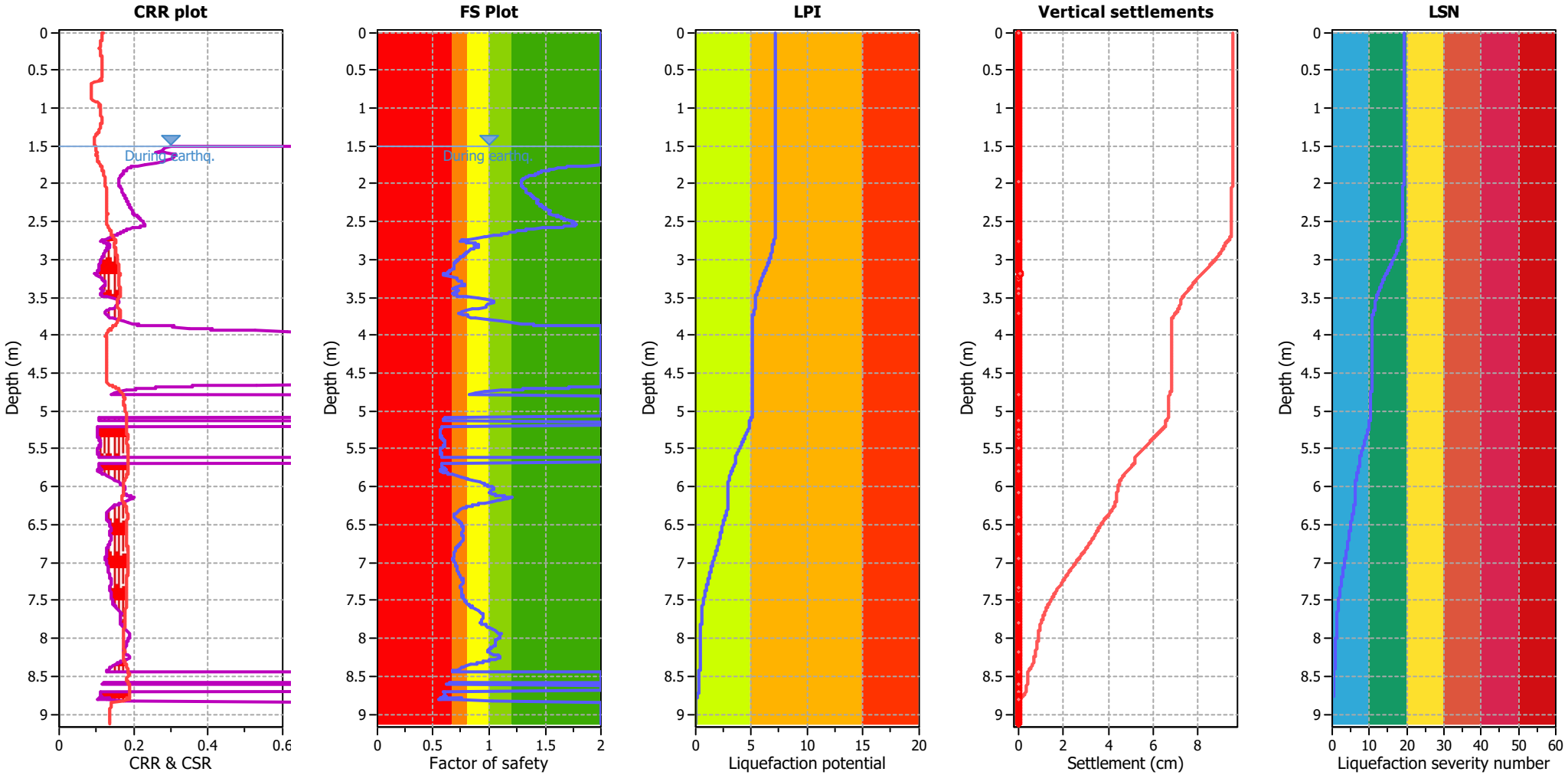
Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT101
Total depth: 9.13 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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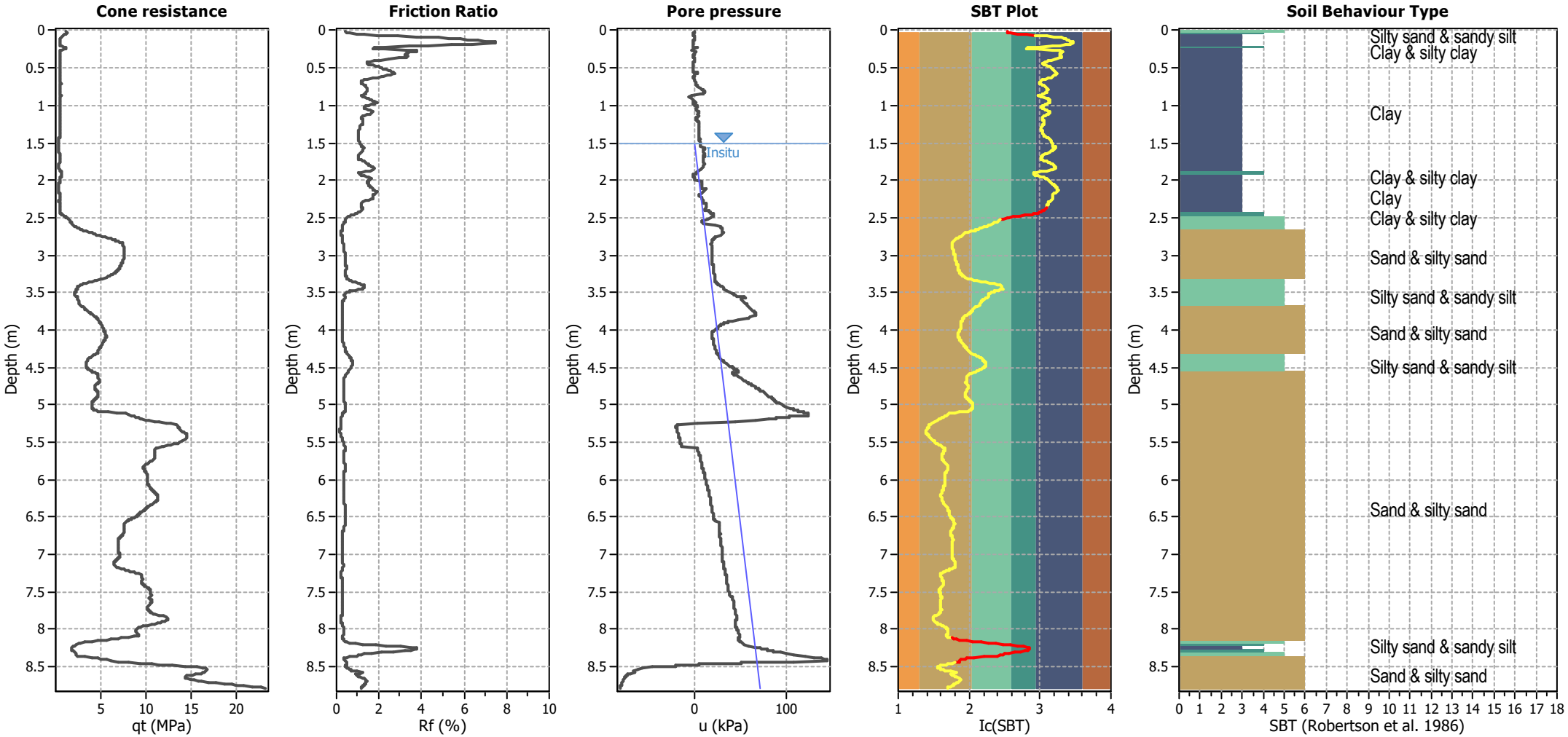
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT103
Total depth: 8.79 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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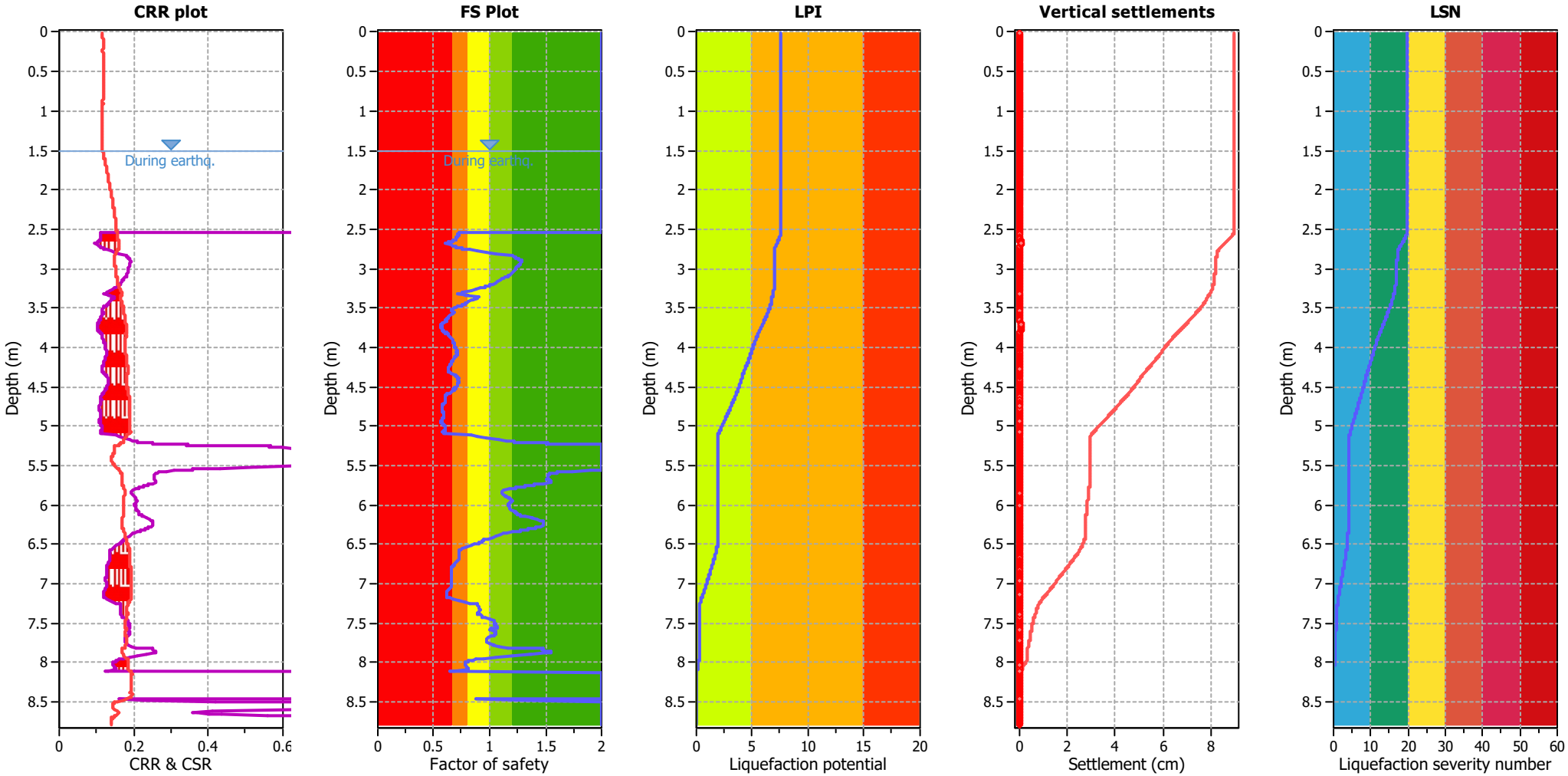
Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT103
Total depth: 8.79 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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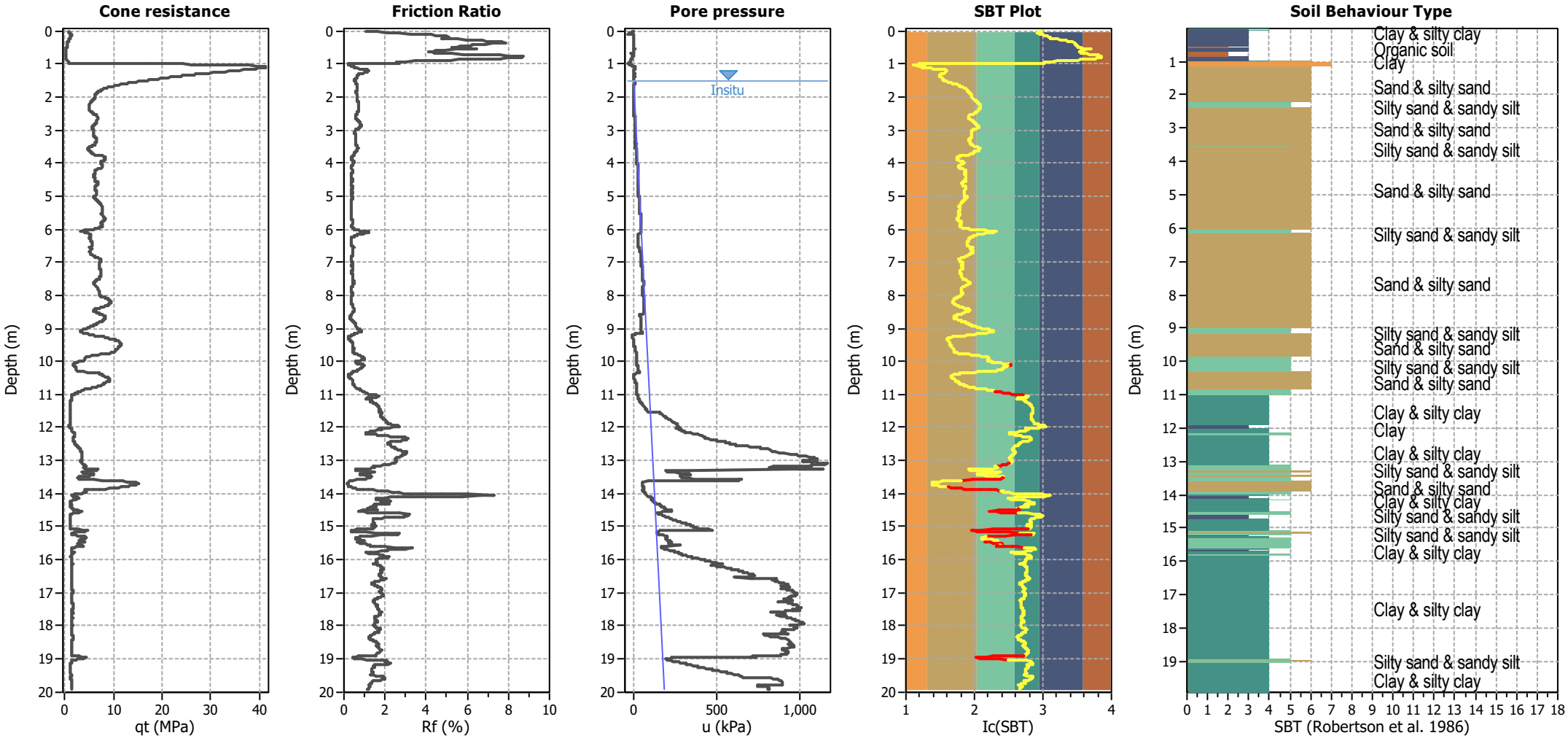
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT108
Total depth: 19.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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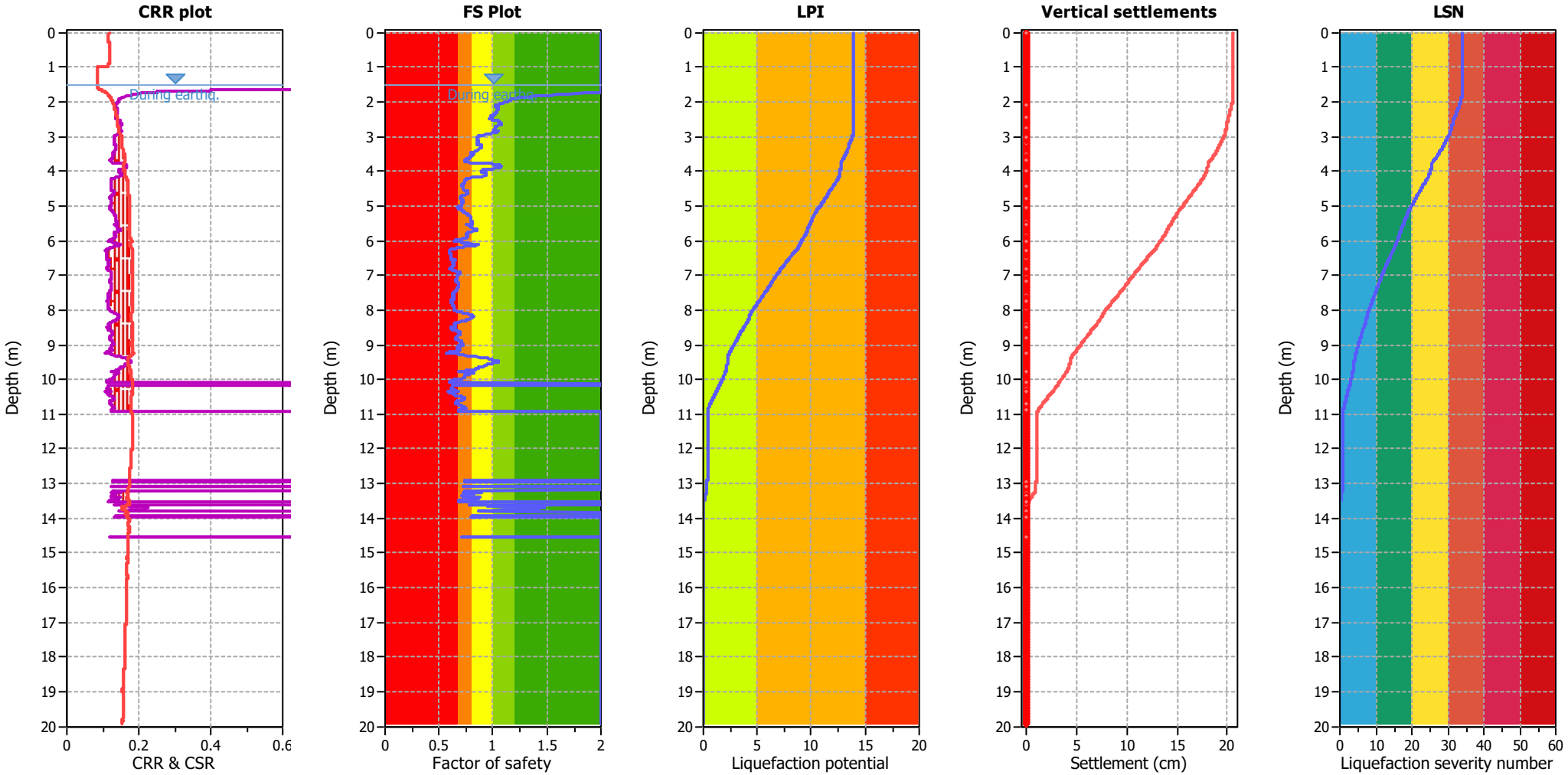
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT108
Total depth: 19.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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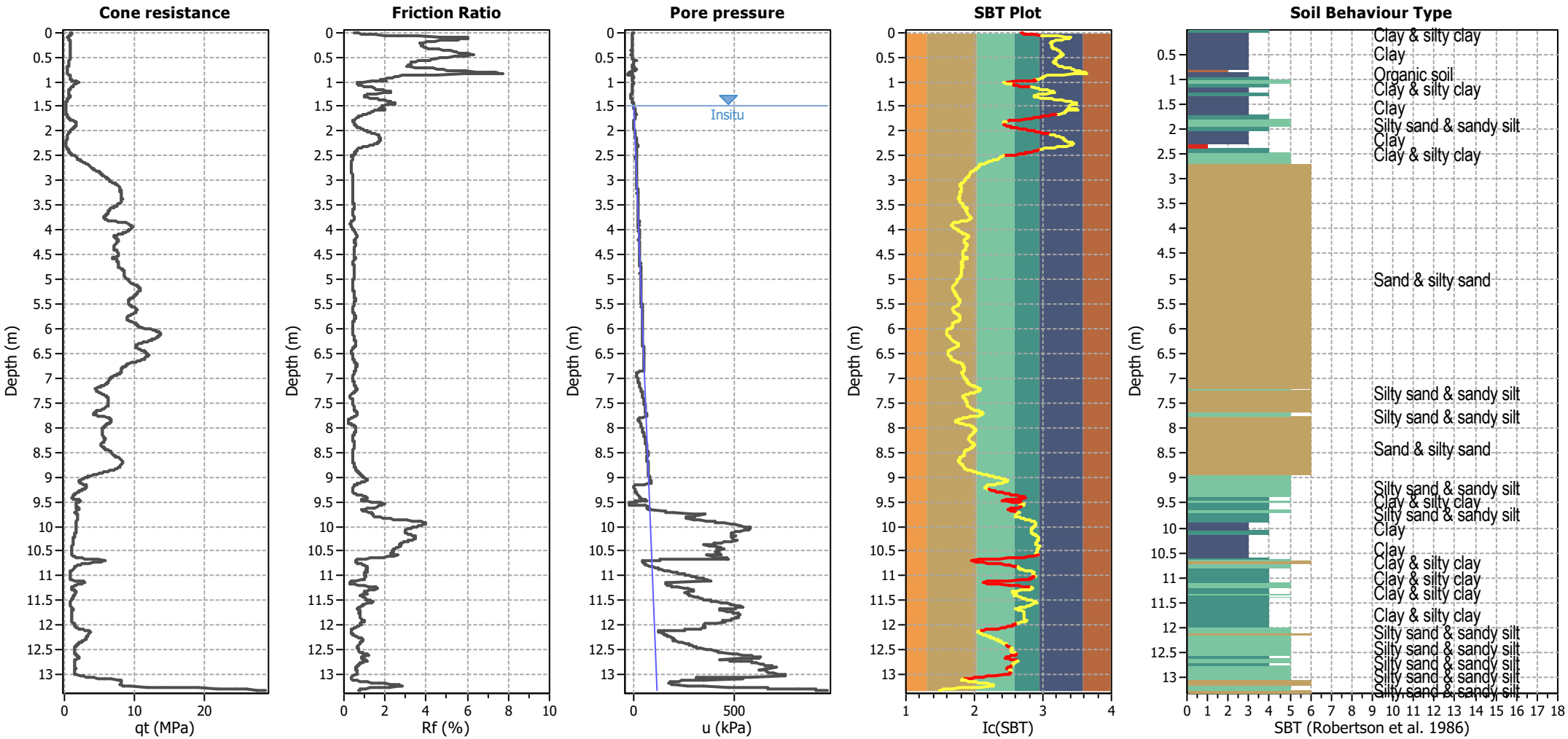
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT110
Total depth: 13.32 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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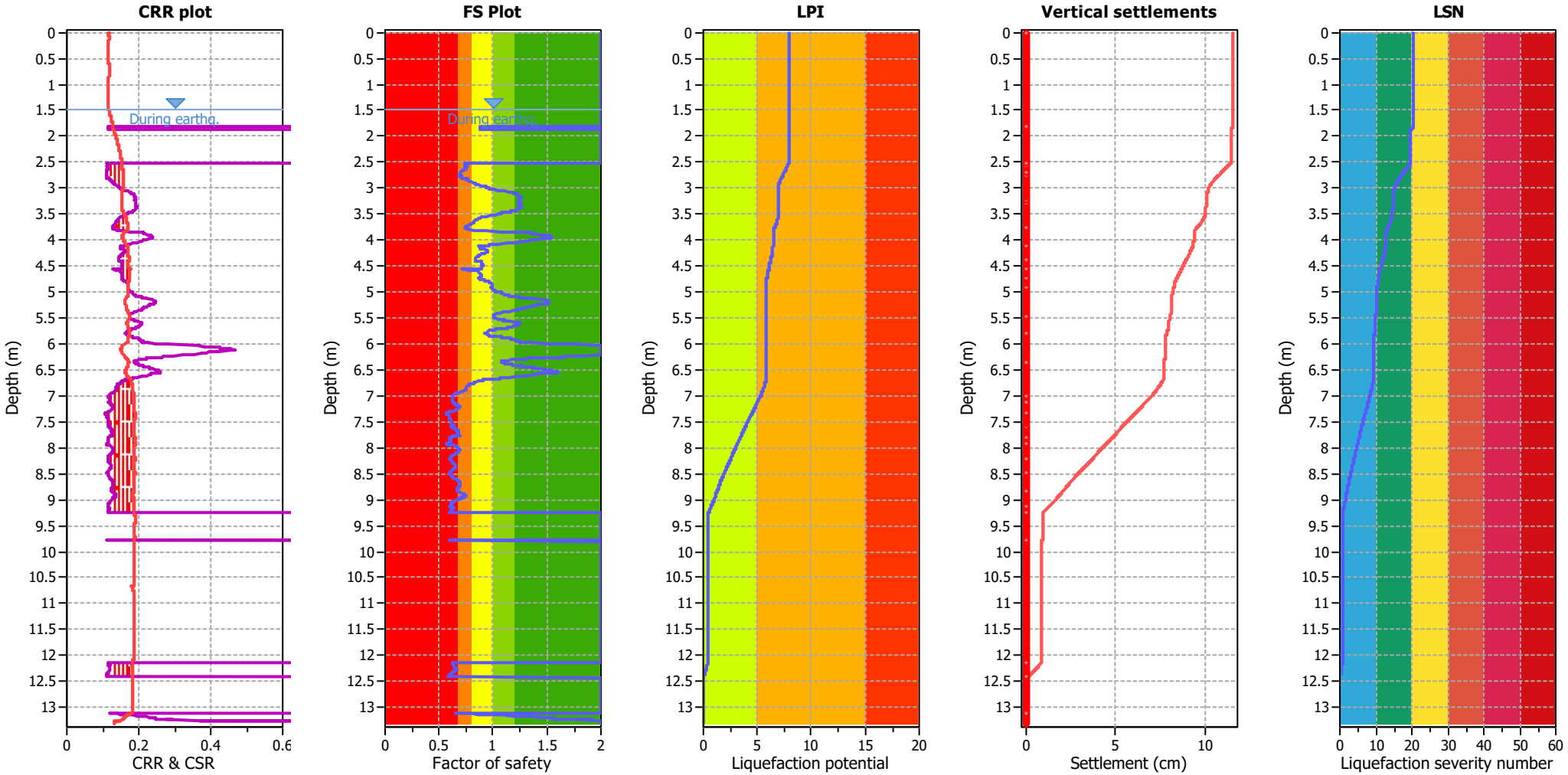
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT110
Total depth: 13.32 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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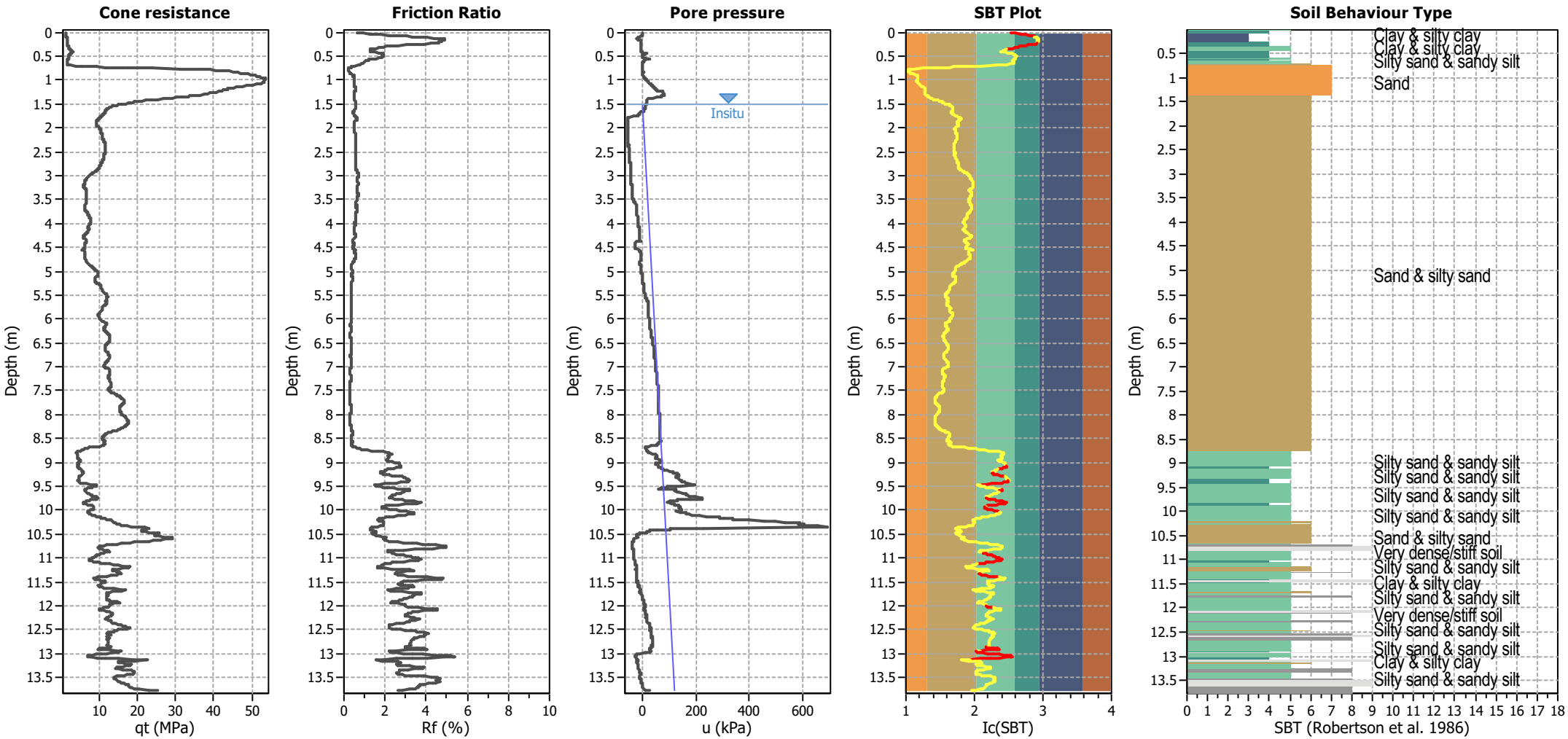
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT112
Total depth: 13.77 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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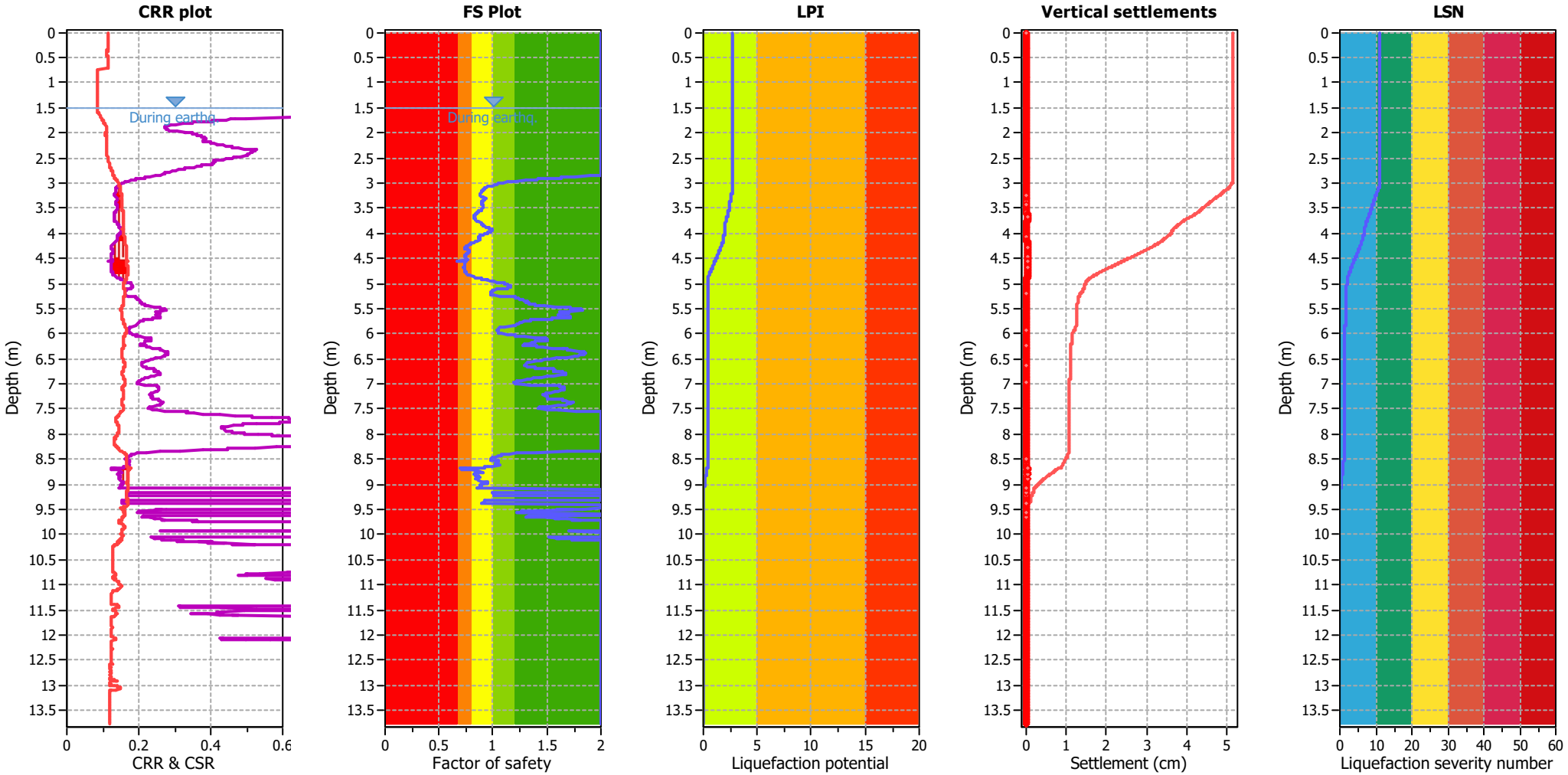
Project: **P-001431**
Location: **Black Swamp Road, Mangawhai**

CPT: CPT112
Total depth: 13.77 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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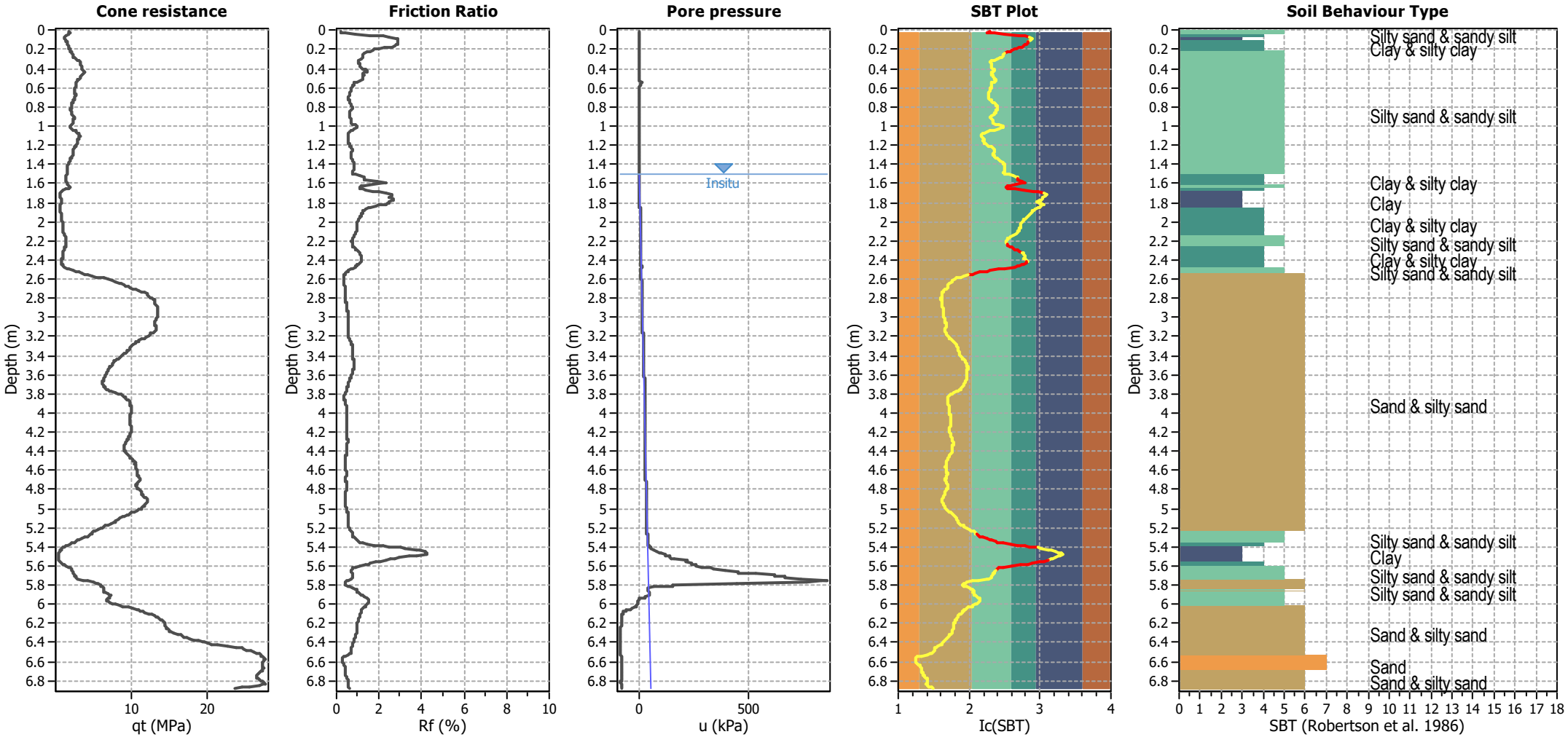
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT115
Total depth: 6.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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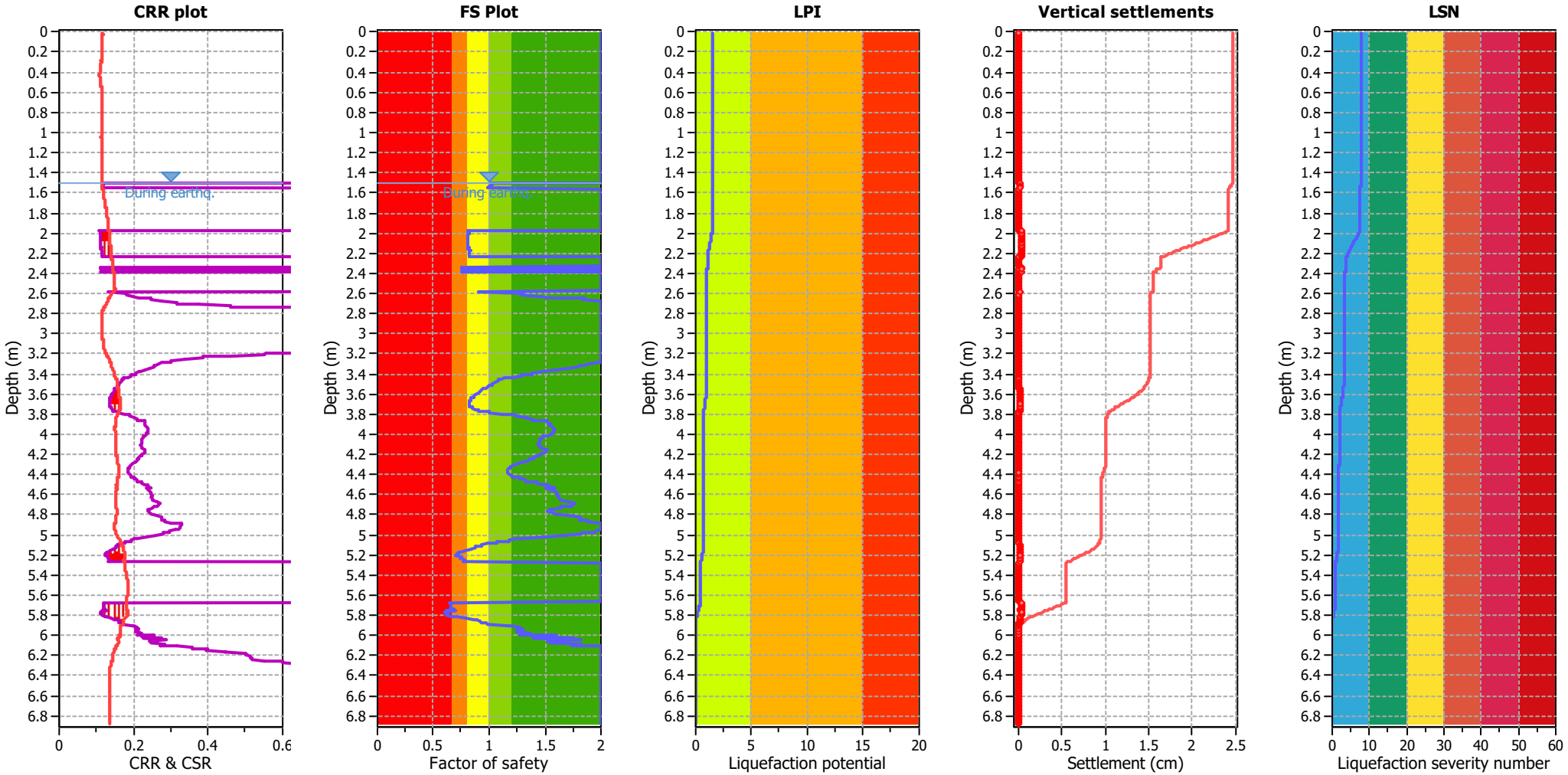
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT115
Total depth: 6.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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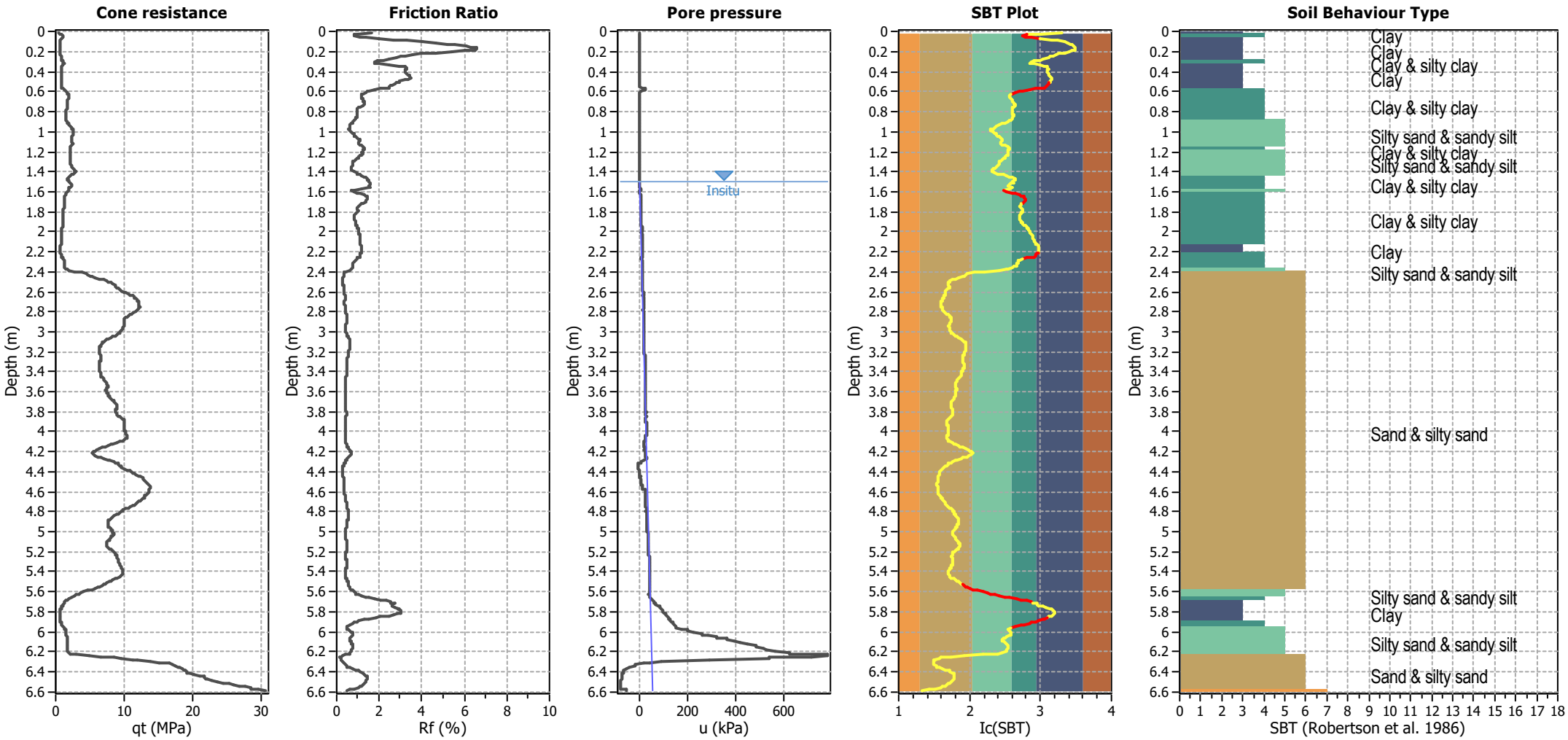
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT117
Total depth: 6.59 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		

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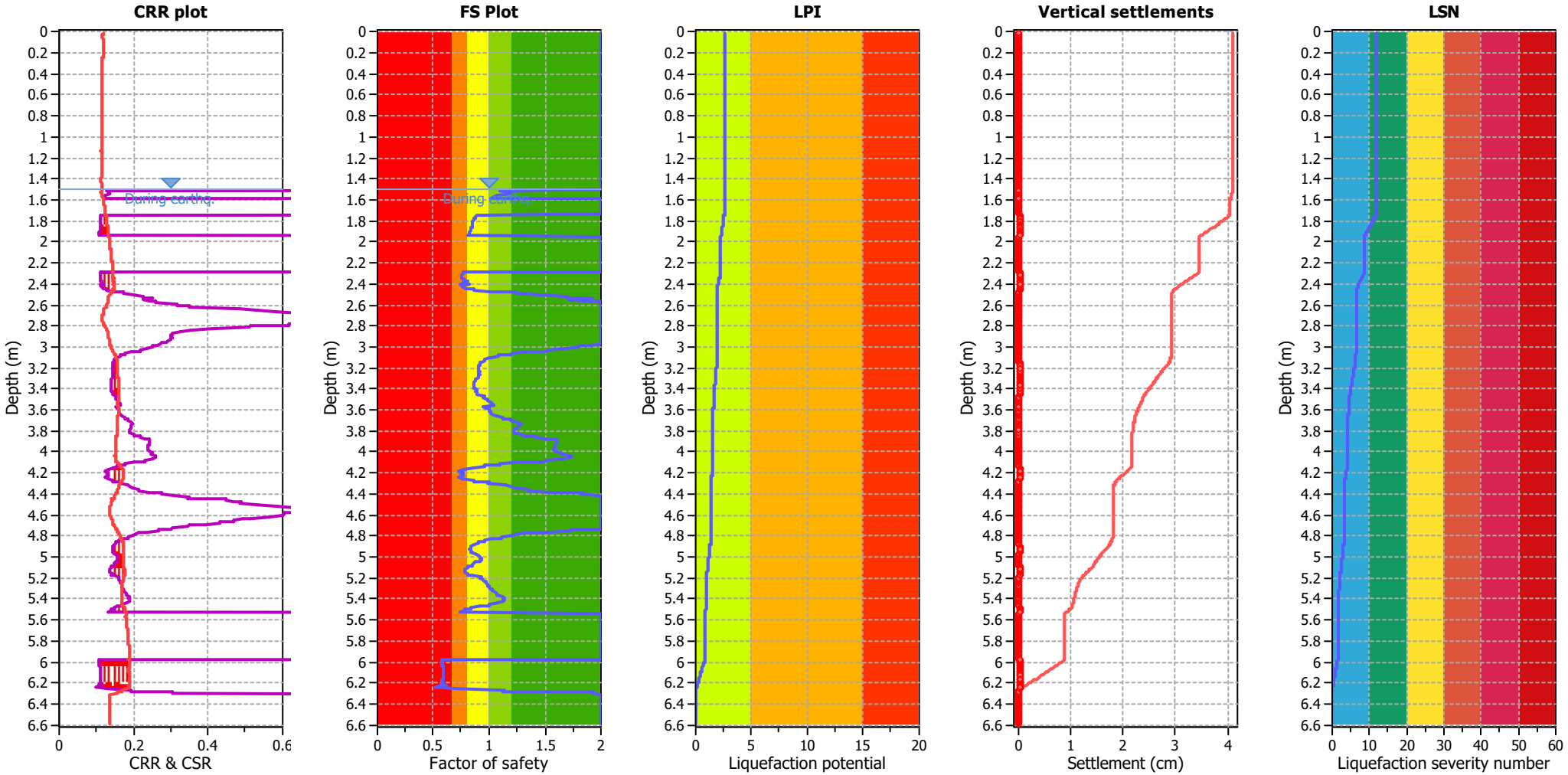
Project: P-001431
Location: Black Swamp Road, Mangawhai

CPT: CPT117
Total depth: 6.59 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	15.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	No		