James Bridge

Fraser Thomas

ENGINEERS • RESOURCE MANAGERS • SURVEYORS

25 PUNAWAITAI ROAD,
POURERERE (STAGE 3)

ONSITE WASTEWATER TREATMENT AND DISPOSAL REPORT

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ONSITE WASTEWATER TREATMENT & DISPOSAL

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JAMES BRIDGE

ONSITE WASTEWATER TREATMENT AND DISPOSAL REPORT

25 PUNAWAITAI ROAD, POURERERE (STAGE 3)

1.0 INTRODUCTION

Following instruction from James Bridge, Fraser Thomas has completed an assessment of onsite wastewater management for Stage 3 of the proposed rural residential subdivision at 25 Punawaitai Road, Pourerere, in support of a resource consent application.

This report covers the following:

- A review of the wastewater management development criteria and rules for the site, comprising a review of Hawke's Bay Regional Council (HBRC) Resource Management Plan (RMP) requirements
- A review of the Geotechnical report for the site
- A desktop study to assess areas suitable for effluent disposal within the lot in Stage 3
- A preliminary site investigation, comprising walkover and shallow boreholes to identify effluent disposal areas and constraints such as effluent volume/flow, soil type, slope stability and application rates
- An estimate of wastewater flows for each lot, based on assumed house sizes and numbers of bedrooms
- Drawings that show the available effluent disposal area with setbacks from boundaries, surface water and buildings
- An Assessment of Environmental Effects of all onsite effluent disposal systems, including the Nitrogen loading from Stage 1-2, based on a desktop comparison of the current farming land use

This report does not cover the onsite wastewater management for Stages 1 and 2.

2.0 PROPOSED DEVELOPMENT

It is understood that stage 3 of the proposed development will consist of a rural residential subdivision of approximately 50 lots with associated access roading and infrastructure, which includes:

- Access to all lots will be obtained via Punawaitai Road and the new right of way, constructed in association with subdivision consent RM180160 (Stage 1-2).
- Each of the lots will be provided with an independent private onsite water supply
- Each of the lots will be provided with independent private onsite wastewater treatment and disposal
- Each of the lots will be provided with an independent private onsite stormwater disposal system
- Stormwater runoff from the shared access road will be managed via a network of roadside swales, culverts and a dry detention basin
- Stage 3 fire fighting water supply will be via a storage tank and pumped reticulated fire water supply main and fire hydrants throughout the stage.

3.0 REGULATORY REQUIREMENTS

Statutory documents relevant to this situation are:

- Resource Management Act 1991
- Hawke's Bay Regional Resource Management Plan

3.1 RESOURCE MANAGEMENT ACT 1991

Under Section 15 of the Resource Management Act, discharge of contaminants into the environment requires resource consent unless that discharge is allowed by a rule under a regional plan.

3.2 HAWKE'S BAY REGIONAL RESOURCE MANAGEMENT PLAN

The Hawke's Bay Regional Resource Management Plan (HBRMP) table 6.2.1 sets out the rules as they applied to the discharge fo domestic swage to land is included in the table below.

6.2.1 DOMESTIC SEWAGE - DISCHARGES TO LAND

Rule	Activity	Classification	Conditions/Standards/Terms
37 **New**[113] **sewage systems** *Refer POL 16, 71, 75*	Except as provided for in Rule 35 or Rule 36, the discharge of contaminants (including greywater) onto or into land, and any ancillary discharge of contaminants into air, from a new sewage system.	**Permitted**	a. Where the wastewater receives no more than advanced primary treatment, the discharge shall be onto or into a property with a land area of no less than 2500m^2. aA. Where the wastewater receives more than advanced primary treatment then: i. the discharge shall be onto or into a property with a land area of no less than 1000m^2; and ii. the net site area to discharge volume ratio shall not be less than 1.5 m^2 per litre per day [114]. b. The rate of discharge of sewage (including greywater) shall not exceed 2 m^3/d, averaged over any 7 day period. c. The treatment and disposal system shall be designed to cater for the peak daily loading. d. The discharge shall not occur over the Heretaunga Plains or Ruataniwha Plains unconfined aquifer as shown in Schedule IV. e. The discharge and land treatment field shall not be within 20 m of any surface water body (including any stormwater open drain or roadside drain), or any tile drain or within 1.5 metres of any property boundary. eA. The system shall be designed and installed in accordance with the requirements specified in Figure 6. f. There shall be no surface ponding as a result of the discharge, or direct discharge into any water body. g. The discharge shall be distributed evenly over the entire disposal area. h. There shall be no increase in the concentration of pathogenic organisms in any surface water body as a result of the discharge. i. At the time of installation and commencement, the discharge shall not occur within 30 m of any bore drawing groundwater from an unconfined aquifer into which any contaminant may enter as a result of the discharge. j. The point of discharge shall be no less than 600 mm above the highest seasonal groundwater table.

			k. The discharge shall not result in, or contribute to, a breach of the "Drinking Water Quality Standards for New Zealand" (Ministry of Health, 2005 (Revised 2008)) in any groundwater body after reasonable mixing. l. The discharge shall not cause any emission of offensive or objectionable odour, or release of noxious or dangerous gases (including aerosols) beyond the boundary of the subject property or on any public land. m. For discharges using pit privies: i. the privy shall be constructed in soil with an infiltration rate not exceeding 150 mm/h, and ii. the privy shall not be the primary wastewater system for any permanently occupied dwelling. n. The system shall be designed, constructed, operated and maintained in a manner which ensures that there is no clogging of the disposal system or soils. nA. The discharge shall not be into a trench or bed disposal system constructed in category 5 or 6[115] soil except where wastewater receives at least secondary treatment.
			o. Where the wastewater receives secondary treatment or better, the discharge shall not exceed 20 g/m3 of BOD, and 30 g/m3 of suspended solids. p. The wastewater treatment and land application system shall be maintained in accordance with the manufacturer's instructions, or if no manufacturer's instructions exist, in accordance with the best management practice as described in AS/NZS 1547, or TP58: On-site Wastewater Systems: Design and Management Manual (Auckland Regional Council Technical Publication No. 58), or other alternative recognised onsite wastewater design manuals. A schedule of maintenance shall be kept, and this schedule shall be available for inspection by the Regional Council upon request. q. The discharge shall not be disposed of by way of spray irrigation. r. The discharge shall not be into a raised bed.

113 NOTE: New sewage systems include those systems installed after this Plan becomes operative, as well as those lawfully established sewage systems that have been modified or replaced since 1 January 2012.

114 NOTE: The net site area to discharge volume ratio can be calculated by dividing the net site area by the expected daily wastewater volume. If the answer is less than 1.5, the discharge does not comply with this condition.

e.g. a 1000 m2 property with a three bedroom home on it with maximum daily discharge volume of 1200 L (6 people at 200 L/p/d) has a ratio of 0.83 (1000/1200). This discharge would not comply with this condition.

115 A category 5 soil is a light clay, permeability (Ksat) can range generally between 0.5 m/d (strongly structured) and <0.06 m/d (weakly structured or massive) and the soil is poorly drained. Clay content of approximately 35- 40%. Category 6 soils are medium to heavy clays that are very poorly drained. The permeability of category 6 soils is generally less than 0.06 m/d. Clay content of over 40%.

ADVISORY NOTES TO SECTION 6.6.4:

1. Non compliance with rules - If any of the rules in this section cannot be complied with, then the activity is a discretionary activity under Rule 52.
2. Levels of treatment – For the purposes of the Rules in this section, primary treatment, advanced primary treatment, and secondary treatment are defined as follows:
   - "Primary treatment" – The settlement or separation of sludge, scum and other settleable solids, e.g. a single or double chamber septic tank.
   - "Advanced primary treatment" – Primary treatment with the addition of an effluent filter screen.
   - "Secondary treatment" – Treatment of settled overflow from primary treatment, or advanced primary treatment, by aerobic biological or physical biological processes.

Table 6.1 from the HBRMP defines the flow allowances for wastewater systems as below.

6.1 DESIGN FLOW ALLOWANCES FOR SEWAGE SYSTEMS

Source	Minimum wastewater flow allowance in L/person/day	
	Onsite roof water tank supply	**Reticulated community/bore water supply**
Households	180	200
Households (blackwater only)	60	60
Households (greywater only)	90	120
Motels/hotels - Guests, resident staff - Non-resident staff - Reception rooms - Bar trade (per customer) - Restaurant (per diner)	 220 30 20-30 20 25-30	 220 30 20-30 20 25-30
Community halls - Banqueting - Meetings	 20 10	 30 15
Tea rooms (per customer) -Without restroom facilities -With restroom facilities	 10 15	 15 25
School (pupils plus staff)	15-30	15-30
Rural factories, shopping centres	30	50
Camping grounds - fully serviced -recreation areas	 100 50	 130 65

NOTE: For the purposes of determining building occupancy, Hawke's Bay Regional Council adopts an occupancy of 2 people per room, excluding bathrooms, kitchens, laundries and any other room that cannot feasibility be used as a bedroom

Table 6.2 from the HBRMP defines the DIR for disposal given various soil categories as below.

6.2 IRRIGATION SYSTEMS

Maximum design irrigation rates for irrigation systems

Soil category	Soil texture	Design irrigation rate (mm/day)
1	Gravels and sands	5
2	Sandy loams	5
3	Loams	4
4	Clay loams	3.5
5	Light clays	3
6	Medium to heavy clays	2

Design specifications for Irrigation systems from AS/NZS 1547 are:

a) Irrigation lines placed on the surface shall be pinned to the surface and covered with at least 100 mm depth of media.
b) Subsurface irrigation lines shall be installed at a maximum depth of 200 mm below ground level and covered with at least 100 mm depth of cover.
c) Maximum spacing of 600 mm in Category 1 and 2 soils and 1000 mm in all other soil categories, as defined by AS/NZS 1547.
d) Secondary treated wastewater shall be applied evenly across the entire land treatment field.
e) On sloping ground the design irrigation rate (DIR) shall be decreased to ensure that effluent migration down slope is taken up adequately within the top soil and plant root system. Required reductions according to slope are as follows:
    i) Flat slopes and up to 10% - no reduction;
    ii) 10% to 20% - reduction in DIR value of 20%;
    iii) 20% to 30% - reduction in DIR value of 50%; and
    iv) >30% - specialist advice required.

4.0 SITE EVALUATION

The subject site (Stage 3 of the Proposed Subdivision) is part of the parent property legally defined as 25 Punawaitai Rd, Pourerere, Lot 1 DP 27067. The property area is 382.2ha, and the site is 18.32ha.

The site is located east of Punawaitai Road and is bounded by an open drain to the west and a stream that runs about the northern and eastern boundaries of the site. The site is flat and is situated northeast of Stage 1-2 development with access via a private road constructed as part of Stage 1-2 (Figures 1 and 2).

The open drain and the watercourse join at the southern corner of the site before discharging into the sea, approximately 1km from the site.

Within the site, there will be a network of road drains, culverts and a detention basin for stormwater management.

The site is free from flooding.

5.0 SOIL EVALUATION

Land Development and Engineering Ltd (LDE) undertook a geotechnical investigation and appraisal on 2 July 2021. A copy of the report is appended.

According to the LDE report, the site soil veneer comprises predominantly moderate to high strength alluvial clays and silts with minor intermittent sand layers. This is consistent with the previous Stage 1-2 investigations. The topsoil layer is approximately 0.25-0.30m deep. Groundwater was not encountered throughout the majority of the boreholes up to what depth.

A site and soil investigation was undertaken by Fraser Thomas Environmental Engineers on 20 April 2022. We encountered similar soil conditions during our site visit.

According to AS/NZS1547:2012, the soil at the site is considered to be Category 5 to 6. For the purpose of this assessment, we have conservatively adopted Soil Category 6 across the site. Hand auger locations are shown on drawings 23828/3/400 and bore logs are attached.

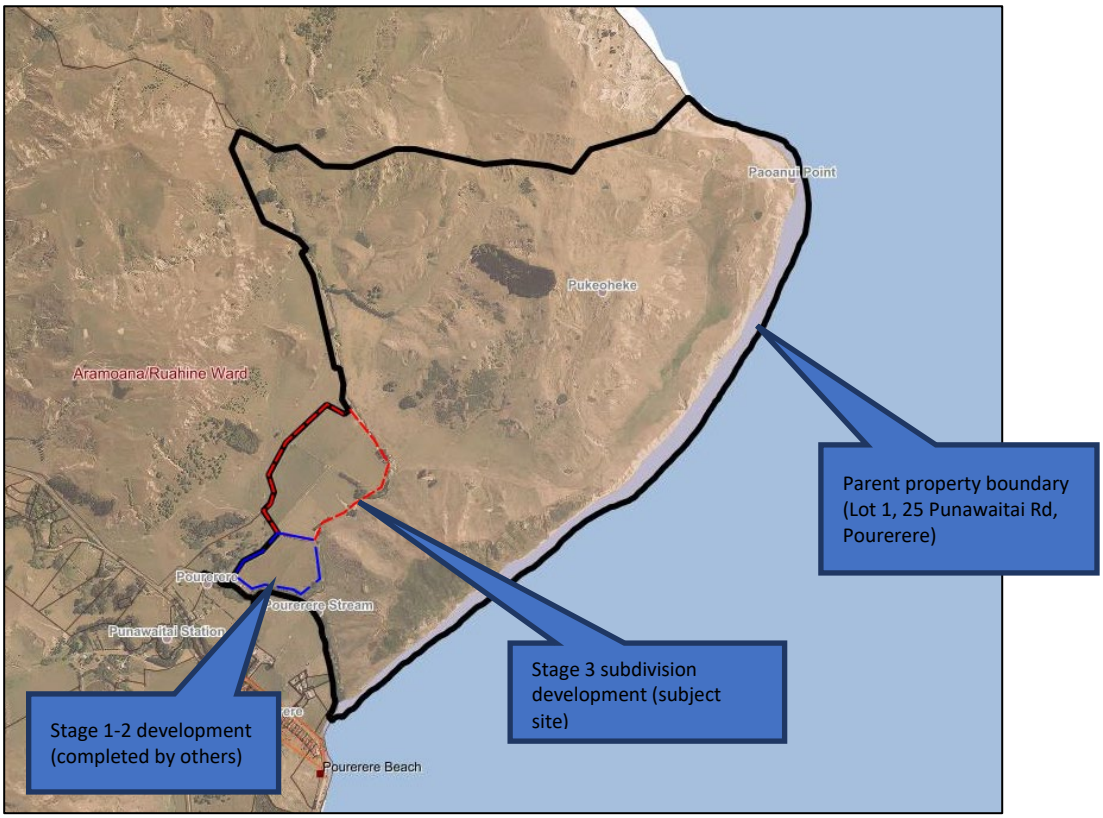


Figure 1: Subject site locality map with the parent property boundary

Figure 2: 2015 Aerial imagery showing a gully to the northwest of the subject site

6.0 DESIGN FLOW ASSESSMENT

This report assesses the proposed onsite wastewater system against the HBRC RMP Permitted Activity standards.

6.1 HOUSE SIZES

For this assessment, we have assumed that all the houses are three-bedroom.

6.2 OCCUPANCY

To determine building occupancy, Hawke's Bay Regional Council adopts an occupancy of 2 people per room, excluding bathrooms, kitchens, laundries and any other room that cannot be used as a bedroom.

Therefore, we adopted a peak occupancy of 6 persons for a three-bedroom house.

6.3 UNIT FLOW RATES

All houses are proposed to have rainwater tanks. We have adopted a design wastewater flow of 180L/person/day.

6.4 WASTEWATER PRODUCTION

Based upon the above assumptions, the maximum discharge from each house has been assumed to comprise:

6 people x 180L/day = 1080L/day per lot

Actual wastewater production or occupancy may vary and would need to be assessed at the Building Consent stage. However, this figure is considered to be appropriate for preliminary assessment of the available land for wastewater irrigation purposes.

7.0 WASTEWATER TREATMENT SYSTEM

The majority of the lots are less than 2,500m^2. HBRC RMP Rule 37(a) and (aA) stipulates that secondary treatment is required for a property with a land area less than 2,500m^2.

The rate of discharge of sewage (including greywater) shall not exceed 2m^3/d, averaged over any seven days.

Rule 37(o) requires pre-treatment of effluent to a standard not to exceed concentrations of 20g/m3 of Biological Oxygen Demand and 30g/m3 of suspended solids, i.e. secondary treatment or better.
The specific design of the wastewater treatment measures will be required for each of the proposed dwellings in accordance with AS/NZS1547:2012 at the Building Consent stage.

Tertiary treatment of effluent - via UV or Ozone disinfection – is generally not considered necessary for these sites as there is sufficient buffer from the disposal areas identified to any watercourse or groundwater. However, a tertiary system may be chosen by the individual lot owners when building on their sites.

8.0 LAND APPLICATION SYSTEM

This assessment is based on a subsurface drip irrigation system. Other land application systems will require further evaluation and design at Building Consent Stage.

Dripline design will depend on the requirements of each lot and should typically include flush valves at the lowest point in the irrigation system, air release valves at high points as well as a vacuum release valve at the outlet of the pumping chamber. An anti-siphon valve may be required on some sites to prevent the system from siphoning. Pressure compensating driplines are preferred.

8.1 SETBACK REQUIREMENTS

The following setbacks have been allowed in the assessment:

- 20 m of any surface water body (including any stormwater open-drain, roadside drain or any tile drain)
- 1.5 metres of any property boundary
- 3.0m from any building
- 30 m of any bore drawing groundwater from an unconfined aquifer into which any contaminant may enter as a result of the discharge

The nearest well (No. 1953) is located within Lot 2 DP 326476 on the opposite side of the watercourse. This well is approximately 150m and 480m from Stage 1 and 3 boundaries, respectively.

8.2 ASSUMPTIONS

The area available for effluent disposal on each lot has been estimated based on the above setbacks and the following assumptions:

- Access, parking and turning areas can be provided within the 20m setback from the road drains
- 6m x 6m garage with a single or double vehicle crossing as required
- All buildings are 3m away from boundaries
- 33% reserve effluent dispoal area
- Drip irrigation rate 2mm/day for Soil Category 6
- Assumed building areas and dimensions are shown in Table 1 below

Table 1: Building Areas and Dimensions

	Average floor area (m2)	Setback from boundaries (m)	Dimensions (m)
Three bedroom	150	3	10 x 15
Four bedroom	200	3	10 x 20

An assessment of the available effluent disposal areas for three and four-bedroom dwellings are shown in Tables 2 and 3.

8.3 AVAILABLE EFFLUENT DISPOSAL AREA

An assessment of the available effluent disposal areas for three and four-bedroom dwellings are shown in Tables 2 and 3 and are summarised below:

- All of the lots in Stage 3 can accommodate a three-bedroom dwelling within the permitted activity standards.
- 40 lots in Stage 3 can accommodate a four-bedroom dwelling within the permitted activity standards.
- 8 lots in Stage 3 can not accommodate a four-bedroom dwelling within the permitted activity standards.
- Where the permitted activity standards can not be met, resource consent will be required at the building development stage.

9.0 PLANTING

Dense planting of the wastewater disposal area at four plants per square meter is recommended to ensure that effluent is disposed of in a well-vegetated area and transpired via the plants.

10.0 ONGOING MANAGEMENT

The wastewater treatment and land application system shall be maintained in accordance with the manufacturer's instructions and in accordance with the best management practice as described in AS/NZS 1547.

Records of all maintenance carried out should be retained and made available on the site for inspection by Council Officers or their agent.

Table 2: Available Effluent Disposal Areas for a three-bedroom dwelling

Stage	Lot Number	Total available disposal area	OSWW disposal field required (with 33% reserve)	Comply
3	1	1150	718	yes
3	2	1050	718	yes
3	3	1060	718	yes
3	4	840	718	yes
3	5	960	718	yes
3	6	980	718	yes
3	7	960	718	yes
3	8	1000	718	yes
3	9	1020	718	yes
3	10	1080	718	yes
3	11	1220	718	yes
3	12	980	718	yes
3	13	960	718	yes
3	14	730	718	yes
3	15	na	718	na
3	16	720	718	yes
3	17	970	718	yes
3	18	na	718	na
3	19	3250	718	yes
3	20	3060	718	yes
3	21	1320	718	yes
3	22	2070	718	yes
3	23	970	718	yes
3	24	960	718	yes
3	25	960	718	yes
3	26	960	718	yes
3	27	960	718	yes
3	28	960	718	yes
3	29	980	718	yes
3	30	1280	718	yes
3	31	990	718	yes
3	32	1030	718	yes
3	33	1000	718	yes
3	34	730	718	yes
3	35	990	718	yes
3	36	980	718	yes
3	37	1010	718	yes
3	38	1000	718	yes
3	39	980	718	yes
3	40	970	718	yes
3	41	760	718	yes
3	42	900	718	yes

3	43	970	718	yes
3	44	870	718	yes
3	45	780	718	yes
3	46	970	718	yes
3	47	970	718	yes
3	48	960	718	yes
3	49	970	718	yes
3	50	1000	718	yes

Table 3: Available Effluent Disposal Areas for a four-bedroom dwelling

Stage	Lot Number	Total available disposal area	OSWW disposal field required (with 33% reserve)	Comply
3	1	1150	958	yes
3	2	1050	958	yes
3	3	1060	958	yes
3	4	840	958	no
3	5	960	958	yes
3	6	980	958	yes
3	7	960	958	yes
3	8	1000	958	yes
3	9	1020	958	yes
3	10	1080	958	yes
3	11	1220	958	yes
3	12	980	958	yes
3	13	960	958	yes
3	14	730	958	no
3	15	na	958	yes
3	16	720	958	no
3	17	970	958	yes
3	18	na	958	yes
3	19	3250	958	yes
3	20	3060	958	yes
3	21	1320	958	yes
3	22	2070	958	yes
3	23	970	958	yes
3	24	960	958	yes
3	25	960	958	yes
3	26	960	958	yes
3	27	960	958	yes
3	28	960	958	yes
3	29	980	958	yes
3	30	1280	958	yes
3	31	990	958	yes
3	32	1030	958	yes
3	33	1000	958	yes
3	34	730	958	no
3	35	990	958	yes
3	36	980	958	yes
3	37	1010	958	yes
3	38	1000	958	yes
3	39	980	958	yes
3	40	970	958	yes
3	41	760	958	no

3	42	900	958	no
3	43	970	958	yes
3	44	870	958	no
3	45	780	958	no
3	46	970	958	yes
3	47	970	958	yes
3	48	960	958	yes
3	49	970	958	yes
3	50	1000	958	yes

11.0 NUTRIENT LOADING

The estimated nutrient loading from the proposed onsite wastewater disposal has been calculated as below:

- The typical secondary effluent nitrogen concentration expected = 40 g N/m3
- An average flow from a 3-bedroom dwelling = 1080 L/day/lot
- The nitrogen loading from a 3-bedroom dwelling with secondary treatment = 43.2 g N/day
- Table 4 summarises the estimated nitrogen loading from the proposed onsite wastewater disposal and assesses the cumulative effluent nitrogen loading across stages 1 and 3 of the development.

Table 4: Estimated nitrogen loading from the proposed onsite wastewater disposal

	Number of Lots	Total effluent annual nitrogen (kg N)	Site Area (ha)	Nitrogen loading from On-site effluent disposal (kg N/ha/year)
Stage 1	21	331	5.9	**56**
Stage 3	48	757	18.0	**42**

For comparison, Hawke's Bay Regional Resource Management Plan Section 6.4.2 Rule 13: use of compost, biosolids & other soil conditioners, states that:

The discharge of contaminants into the air, or onto or into the land, arising from the storage, transfer, treatment, mixing or use of compost, biosolids and other (solid or liquid) organic material for soil conditioning purposes, including paunch grass, apex meal, stockyard scrapings, grape marc, compost (except as regulated by Rule 2848) and poultry manure.

The Permitted Activity Rule allows that where the material is discharged onto grazed pasture, the application rate shall not exceed **150 kg N/ha/year**.

Therefore the proposed development will result in a lower cumulative nitrogen load over the site stages 1 and 3 compared to its current use as grazed pasture, i.e. 42-56 kg N/ha/year compared to 150 kg N/ha/year.

12.0 RECEIVING ENVIRONMENT

The site is adjacent to two tributaries of the Pourerere Stream, which flows through the Pourerere township toward the sea, approximately 600m from the site. The full extent of the ecological condition is unknown.

The landscape assessment for the development described the broader receiving environment to the subject site, related to Pourerere Stream and the eastern coastline, as a moderate-high natural character. In contrast, in the localised area within 750m of the site, the natural character is considered moderate in Pourerere Stream and low in the tributaries. The landscape report notes:

> *"85. The hydrology of Pourerere Stream and its two tributaries (surrounding the site) are modified, as original native vegetation cover of coastal forest and wetlands have been cleared for farming since European ownership. While most of the course and channel of the waterways appear unmodified, some channelling and straightening of a tributary have*

occurred north of the application site to facilitate drainage through farmland. Farm tracks also cut across watercourses.

86. The habitat composition of the waterways has been highly modified, particularly the tributary west of the site. Riparian vegetation is generally scarce, and pastoral grasses dominate the riparian margins (Figure 12). The northern bank of Pourerere Stream will be enhanced by some restoration planting adjacent to the initial Punawaitai Road subdivision as part of consented development. However, overall, historic modifications reduce the natural character of the waterways and the inland coastal environment in this area."

13.0 ASSESSMENT OF ENVIRONMENTAL EFFECTS

13.1 INTRODUCTION

This section provides an assessment of the environmental effects of the proposed onsite wastewater treatment and disposal systems.

No actual negative effects are perceived with respect to effluent disposal. The level of wastewater treatment and low application rate is such that the soils at the irrigation site will be able to receive and further treat any residual contaminants in a sustainable manner with no net offsite effects. Hence, this section focuses on potential effects.

13.2 SURFACE WATER

The effluent disposal fields are proposed to be located with 20m setbacks from the watercourses, including the tributaries of Pourerere Stream.

All effluent will be highly treated before discharge. It will contain less than 20g/m3 of Biological Oxygen Demand and 30g/m3 of suspended solids. It will then be discharged via subsurface drip irrigation to soils at a low application rate of 2 mm/day into the 200 to 300mm topsoil layer.

The majority of the effluent will be transpired by the dense vegetation proposed, with a smaller proportion of the effluent seeping into the category 5 or 6 subsoils found at the site. These subsoils have low permeability, so any effluent will pass slowly through the subsoil profile enabling the adsorption of bacteria, viruses and nutrients into the soil matrix.

The 20m setback from effluent disposal areas to the stream adopted gives assurance that the likelihood of seepage of or discharge of treated effluent to the stream will not occur, provided the wastewater systems are installed and maintained in accordance with this report, NZS1547 and the manufacturer's operations and maintenance requirements.

Ultraviolet disinfection of effluent prior to disposal will be required where the setback from the watercourses, including the stream, cannot comply with the setback requirements of the HBRC RMP and NZS1547. This will ensure that in any case where the 20 m setback cannot be provided, that in the unlikely occurrence of any effluent seeping or discharging into any watercourse will have only a minor effect on the water quality and the receiving environment.

Irrigation will occur irrespective of rainfall. Irrigation could occur during a rain event, but given the conservative application rate, it is our opinion that the 'breakout' of effluent with rainfall-runoff will not occur.

Hence any effects from effluent disposal on surface waters and the receiving environments are assessed to be no more than minor.

13.3 GROUNDWATER

In summer, the evapotranspiration rate will exceed the effluent discharge rate, so no net effluent transport to groundwater is expected. In winter, the evapotranspiration rate will be less than the discharge, and some effluent may pass to groundwater. However, the nitrogen load is less than the allowable load for a dairy farm, so most nitrogen is expected to be taken up by the effluent disposal area plants and no net increase in nitrogen to groundwater is expected.

Groundwater was not encountered throughout the majority of the boreholes at up to 2.0m depth.

Any effects from effluent disposal on groundwater and groundwater receiving environments are assessed to be no more than minor.

13.4 SOILS

Potential effects on soils from effluent disposal are summarised as follows:

- The soils will be loaded at a conservative rate of 2 mm/day.
- The treated effluent discharged to land will be of "secondary treatment quality, with BOD_5 20g/m3 of Biological Oxygen Demand and 30g/m3 of suspended solids.
- The total average nitrogen load will be less than the HBRC RMP allowable load of 150kgN/ha/pa.

No net increase in nitrogen loading is expected to occur due to the discharge of treated effluent.

Minimal disturbance to the environment is expected as a result of the earthworks associated with the installation of the wastewater pipe network, treatment plant and irrigation pump station below ground.

The earthworks, erosion and sediment control will follow current best practices. The installers will appropriately dispose of leftover soil from the construction phase and ensure rapid planting and the establishment of a protective grass cover over topsoil in the irrigation area.

13.5 MANA WHENUA VALUES

It is understood that the consultation process is being undertaken by the applicant and that a Culture Impact Assessment will be required.

Matters related to the potential adverse effects of the discharge from the onsite wastewater system that impact Mana Whenua values are identified and addressed as follows.

It is understood that Pourerere and its neighbouring beaches have a significant cultural value to the people of Tamatea and Heretaunga. Mana Whenua has gathered Kaimoana all along this coast for many years. Therefore, it is important that these areas are protected and preserved for future generations.

The 20m setback from effluent disposal areas to the stream adopted gives assurance that the likelihood of seepage of or discharge of treated effluent to the stream will not occur, provided the secondary treatment effluent disposal systems are installed and maintained in accordance with this report, NZS1547 and the manufacturer's operations and maintenance requirements.

In our opinion, the nutrient loading from the onsite effluent disposal systems throughout the proposed development will have no more than a minor effect on the receiving environment as the nutrient loadings will be less than presently allowed for, given its current use as farm pasture.

Hence, it is our opinion that there will be no impact on Mana Whenua values from the proposed wastewater treatment and effluent disposal system.

13.6 STABILITY

The majority of the site is flat except for the steep banks adjacent to the stream and the batter slope of the stormwater detention basin. The 20m setback excludes any effluent disposal in these areas.

The design and installation of the wastewater effluent disposal area need to follow the recommendations in the LDE Geotechnical report, mainly 3m away from all footings and 1.5 times the height of any retaining walls.

13.7 VISUAL EFFECTS

Potential visual effects for the proposed treatment plants will be mitigated by the following:

- The proposed wastewater treatment plants will be compact, with tankage being installed in-ground.
- The effluent disposal area will comprise irrigation lines installed subsurface that will be covered in grasses and plant vegetation within a short timeframe.
- All air valves, control valves and flushing valves will be installed in surface-mounted protected valve chambers.

13.8 ODOUR

The proposed wastewater treatment plants will only generate an odour comparable to that of a conventional septic tank, and no negative effects are anticipated.

13.9 NOISE

The wastewater treatment plants proposed will be located in largely in-ground tanks, and all pumps will be submersible and make little detectable noise apart from a local hum.

13.10 MAINTENANCE ATTENDANCE

The entire wastewater system will be inspected by the contracted service provider in accordance with NZS1547 as appropriate for the plants installed. The effluent disposal area shall be inspected at least annually to check for breakages in tandem with any planting maintenance that may be required.

13.11 NEIGHBOURHOOD IMPACTS

The site is located within a Rural Zone, and the proposed wastewater treatment plants and disposal areas are isolated from neighbouring residential properties. Therefore, no impact on the neighbourhood is perceived.

The most apparent risk to the residents is the possibility of coming into contact with treated effluent from the treatment plants. To mitigate this effect, effluent disposal fields will be marked and possibly fenced off. These details will be confirmed at the building consent stage for each lot.

13.12 ALTERNATIVES

There is no public wastewater system in the area. Onsite wastewater treatment and disposal are considered to be the most appropriate solution for the development.

14.0 CONCLUSIONS

Based on our site investigation and the above assessment, we conclude that:

1. According to AS/NZS1547:2012, the soil at the site is considered to be Category 5 to 6
2. The specific design of the wastewater treatment measures will be required for each of the proposed dwellings at the Building Consent stage per AS/NZS1547:2012 and Hawke's Bay Regional Resource Management Plan.
3. All of the lots in Stage 3 can accommodate a three-bedroom dwelling within the permitted activity standards.
4. 40 lots in Stage 3 can accommodate a four-bedroom dwelling within the permitted activity standards.
5. 8 lots in Stage 3 can not accommodate a four-bedroom dwelling within the permitted activity standards.
6. Where the permitted activity standards can not be met, resource consent will be required at the building development stage.
7. Dense planting of the wastewater disposal area at four plants per square meter is recommended to ensure that effluent is disposed to a well-vegetated area and transpired via the plants.
8. The wastewater treatment and land application system shall be maintained in accordance with the manufacturer's instructions, following the best management practice described in AS/NZS 1547. The land owner shall be required to enter into a maintenance agreement with a suitably experienced contractor to maintain the system.
9. The proposed development will result in a lower cumulative effluent nitrogen loading over the site compared to its current use as grazed pasture, i.e. 42-56 kg N/ha/year compared to 150 kg N/ha/year.
10. Overall, it is our opinion that there are no actual adverse effects with respect to the onsite wastewater treatment and effluent disposal and that the potential environmental impacts are no more than minor.

15.0 LIMITATIONS

The professional opinion expressed herein has been prepared solely for, and is furnished to our client, James Bridge, and for the information of Central Hawke's Bay District and Hawke's Bay Regional Councils, on the express condition that it will only be used for the purpose for which it is intended.

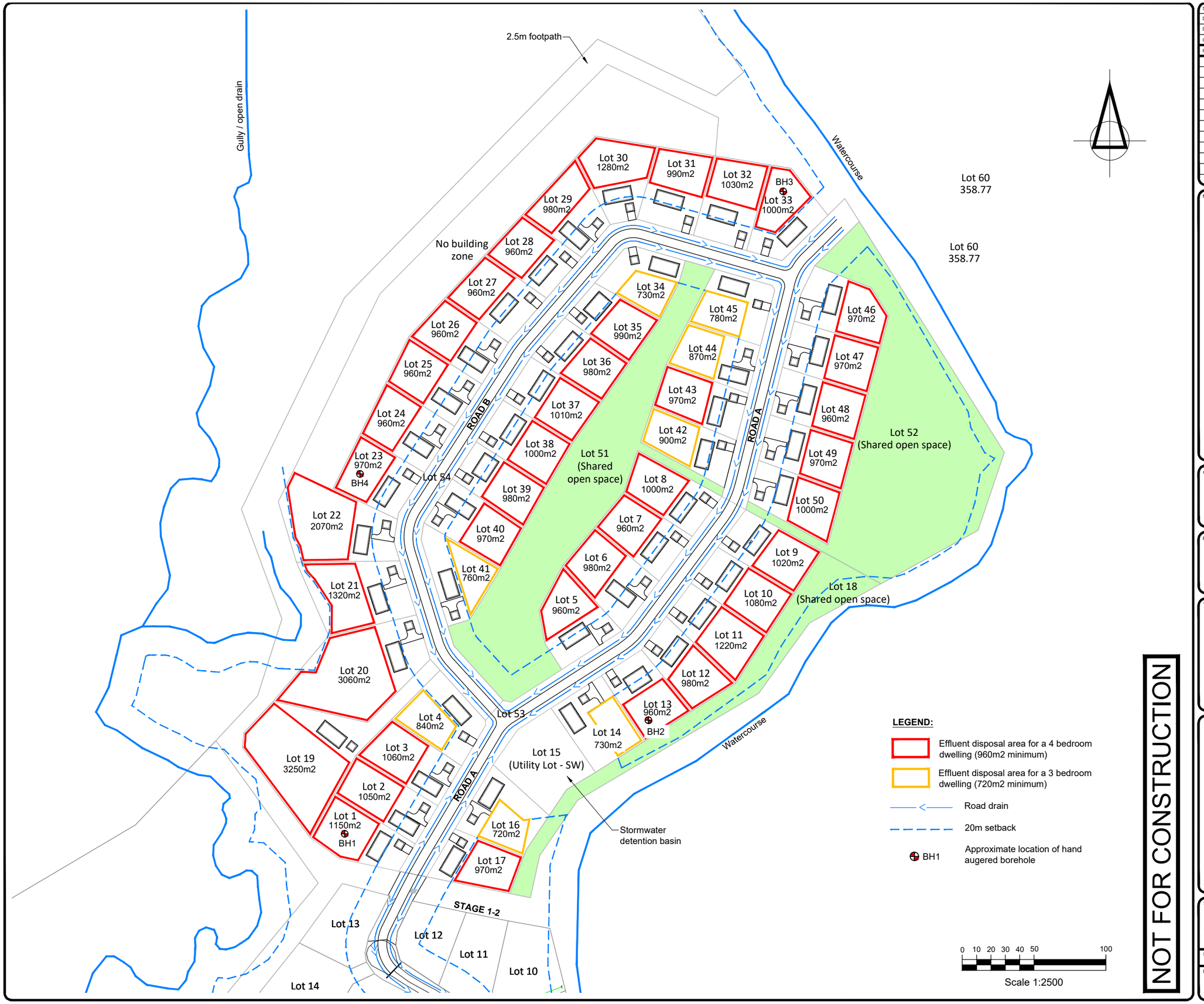
No liability is accepted by this firm or by any Principal, or Director, or any servant or agent of this firm, in respect of its use by any other person, and any other person who relies upon any matter contained in this report does so entirely at its own risk. This disclaimer shall apply notwithstanding that this report may be made available to any person by any person in connection with any application for permission or approval, or pursuant to any requirement of law.

We do not assume any liability for misrepresentation or items not visible, accessible or present at the subject site during the time of the site inspection; or for the validity or accuracy of any

information provided by our client or third parties that have been utilised in the preparation of this report.

The conclusions and recommendations expressed herein should be read in conjunction with the remainder of this report and should not be referred to out of context with the remainder of this report.

Drawings



NOT FOR CONSTRUCTION

SURVEYED	JBSURVEY	06/21	APPROVED / DATE
DESIGNED			GDM
DRAWN	SN	JUN 22	JUNE 2022
CHECKED			

REVISION	CHANGES	CHECKED	DATE
A	LEGEND	SN	14/06/22
B	EXCLUDED STAGE 1-2	SN	11/07/22
C	ADDED BUILDINGS & EASEMENT	SN	22/07/22
D	MODIFIED BOUNDARIES	SN	01/08/22
E	LOT 20, 21 & 22	SN	08/08/22

NOTES

- Coordinate is in terms of HB2000
- Levels are in terms of NZVD2016
- Control mark: OIS VIII DP 27064 RL6.99m
- Final positioning of proposed pond and road layout against property boundaries to be confirmed at detailed design
- Soil Category 5-6 (NZS1547:2012)
- 200m2 dwelling
- 6mx6m garage
- Buildings are 3m away from boundary

CLIENT

JAMES BRIDGE

PROJECT

25 PUNAWAITAI ROAD
POURERERE

TITLE

STAGE 3
ONSITE WASTEWATER
AVAILABLE EFFLUENT
DISPOSAL AREA

Fraser Thomas

ENGINEERS • RESOURCE MANAGERS • SURVEYORS

AUCKLAND 09 278 7078
NAPIER 06 211 2766
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STATUS

RESOURCE CONSENT

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:2500 (A3)

DRAWING No 23828/3/400 REVISION E

X:\23828 J Bridge 25 Punawaitai Rd, Pourerere\07 CAD\03 Drawings\STAGE 3\C23828-3-400.dwg, DWG To PDF.pc3

Appendix A

Available Wastewater Areas Calculations

Pressure Compensated Dripper Irrigation System Design (3 bedroom)

Job Number:	23828	Date:	10/06/2022
		By:	SN

Design Flowrate

Type Of Dwelling	B	**Comments** (See Reference Sheet)
	Hoseholds with standard fixtures	
Roof Water Supply ?	Yes	
Designated Flow Allowance	180	**HBRC Figure 6**

Occupancy

Total area of extra rooms (m^2)	0	(rooms beyond those allocated as dining lounge and bedrooms eg.family, recreation, games, office, study, sewing, work)
Smallest designated bedroom (m^2)		
Design occupancy for additional rooms	0	
Number Of Bedrooms	3	
Bedroom Occupancy	6	**HBRC adopts 2 ppl per room**
Occupants from additional rooms:	0	
Total Design Occupancy	6	
Total Design Flow (L/d)	1080	

Site Requirements

Soil Type	6	Medium to heavy clay (HBRC 6.2.1)
Design Loading Rate (mm/d)	2	
Area Required (m^2)	540	
Reserve Area Required (%)	33	Usually 33% to 100% (See Reference Sheet)
Reserve Area (m^2)	178	
Total Area Required (m^2)	718	
Site Slope (%)	3	

Pressure Compensated Dripper Irrigation System Design (4 bedroom)

Job Number:	23828	Date:	10/06/2022
		By:	SN

Design Flowrate

		Comments
Type Of Dwelling	B	(See Reference Sheet)
	Hoseholds with standard fixtures	
Roof Water Supply ?	Yes	
Designated Flow Allowance	180	**HBRC Figure 6**

Occupancy

Total area of extra rooms (m^2)	0	(rooms beyond those allocated as dining lounge and bedrooms eg.family, recreation, games, office, study, sewing, work)
Smallest designated bedroom (m^2)		
Design occupancy for additional rooms	0	
Number Of Bedrooms	4	
Bedroom Occupancy	8	**HBRC adopts 2 ppl per room**
Occupants from additional rooms:	0	
Total Design Occupancy	8	
Total Design Flow (L/d)	1440	

Site Requirements

Soil Type	6	Medium to heavy clay (HBRC 6.2.1)
Design Loading Rate (mm/d)	2	
Area Required (m^2)	720	
Reserve Area Required (%)	33	Usually 33% to 100% (See Reference Sheet)
Reserve Area (m^2)	238	
Total Area Required (m^2)	958	
Site Slope (%)	3	

Pressure Compensated Dripper Irrigation System Design (3 bedroom)

Job Number: 23828
Date: 9/08/2022
By: SN

Stage	Lot Number	Total available disposal area	OSWW disposal field required (with 33% reserve)	Comply
3	1	1150	718	yes
3	2	1050	718	yes
3	3	1060	718	yes
3	4	840	718	yes
3	5	960	718	yes
3	6	980	718	yes
3	7	960	718	yes
3	8	1000	718	yes
3	9	1020	718	yes
3	10	1080	718	yes
3	11	1220	718	yes
3	12	980	718	yes
3	13	960	718	yes
3	14	730	718	yes
3	15	na	718	na
3	16	720	718	yes
3	17	970	718	yes
3	18	na	718	na
3	19	3250	718	yes
3	20	3060	718	yes
3	21	1320	718	yes
3	22	2070	718	yes
3	23	970	718	yes
3	24	960	718	yes
3	25	960	718	yes
3	26	960	718	yes
3	27	960	718	yes
3	28	960	718	yes
3	29	980	718	yes
3	30	1280	718	yes
3	31	990	718	yes
3	32	1030	718	yes
3	33	1000	718	yes
3	34	730	718	yes
3	35	990	718	yes
3	36	980	718	yes
3	37	1010	718	yes
3	38	1000	718	yes
3	39	980	718	yes
3	40	970	718	yes
3	41	760	718	yes
3	42	900	718	yes
3	43	970	718	yes
3	44	870	718	yes
3	45	780	718	yes
3	46	970	718	yes
3	47	970	718	yes
3	48	960	718	yes
3	49	970	718	yes
3	50	1000	718	yes

Note:
Assume driveway and turning area is available within the 20m setback from the road drain
Assume 3 bedroom 150m2 floor area and a 6mx6m garage
All buildings are 3m away from boundaries

Pressure Compensated Dripper Irrigation System Design (4 bedroom)

Job Number: 23828
Date: 2/08/2022
By: SN

Stage	Lot Number	Total available disposal area	OSWW disposal field required (with 33% reserve)	Comply
3	1	1150	958	yes
3	2	1050	958	yes
3	3	1060	958	yes
3	4	840	958	no
3	5	960	958	yes
3	6	980	958	yes
3	7	960	958	yes
3	8	1000	958	yes
3	9	1020	958	yes
3	10	1080	958	yes
3	11	1220	958	yes
3	12	980	958	yes
3	13	960	958	yes
3	14	730	958	no
3	15	na	958	yes
3	16	720	958	no
3	17	970	958	yes
3	18	na	958	yes
3	19	3250	958	yes
3	20	3060	958	yes
3	21	1320	958	yes
3	22	2070	958	yes
3	23	970	958	yes
3	24	960	958	yes
3	25	960	958	yes
3	26	960	958	yes
3	27	960	958	yes
3	28	960	958	yes
3	29	980	958	yes
3	30	1280	958	yes
3	31	990	958	yes
3	32	1030	958	yes
3	33	1000	958	yes
3	34	730	958	no
3	35	990	958	yes
3	36	980	958	yes
3	37	1010	958	yes
3	38	1000	958	yes
3	39	980	958	yes
3	40	970	958	yes
3	41	760	958	no
3	42	900	958	no
3	43	970	958	yes
3	44	870	958	no
3	45	780	958	no
3	46	970	958	yes
3	47	970	958	yes
3	48	960	958	yes
3	49	970	958	yes
3	50	1000	958	yes

Note:
Assume driveway and turning area is available within the 20m setback from the road drain
Assume 4 bedroom 200m2 floor area and a 6mx6m garage
All buildings are 3m away from boundaries

Appendix B

Borehole Logs

BOREHOLE & TESTPIT LOGS FOR EFFLUENT DISPOSAL INVESTIGATIONS

HAND AUGER LOG

SHEET 1 OF 2

BOREHOLE NO'S 1, 2, 3

PROJECT: 25 PUNAWAITAI ROAD

PROJECT NO. POURERERE 23828

CO-ORDINATES

Date Drilled: **20 APRIL 2022**

Logged by: **S NGUYEN**

Checked:

Fraser Thomas

BOREHOLE NO: BH1

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0 – 0.1			TOPSOIL. Silt. Dark grey and moist.
0.1 – 0.2			SILT. Dark grey and moist.
0.2 – 0.7			Silty CLAY. Mid brown, mottled orange and moist. Plastic
0.7 – 1.5			Becoming CLAY. Light brown and moist. Plastic and massive.
1.5			EOB @ 1.5m

REMARKS: No GW observed during augering.
NZS1547 soil category 6.

BOREHOLE NO: BH2

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0 – 0.1			TOPSOIL. Silt. Dark grey and moist.
0.1 – 1.0			Silty CLAY. Mid brown, mottled orange and moist. Plastic.
1.0 – 1.5			Becoming CLAY. Light brown and moist. Plastic and massive.
1.5			EOB @ 1.5m

REMARKS: No GW observed during augering.
NZS1547 soil category 6.

BOREHOLE NO: BH3

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0 – 0.3			TOPSOIL. Silt. Dark grey and friable.
0.3 – 0.4			Sandy SILT. Grey and moist.
0.4 – 0.7			SILT. Grey, mottled orange and most. Plastic.
0.7 – 1.0			Silty CLAY. Mid brown, mottled orange and moist. Plastic.
1.0 – 1.5			Becoming CLAY. Light brown and moist. Plastic and massive.
1.5			EOB @ 1.5m

REMARKS: No GW observed during augering.
NZS1547 soil category 6.

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BOREHOLE & TESTPIT LOGS FOR EFFLUENT DISPOSAL INVESTIGATIONS

Fraser Thomas

HAND AUGER LOG

SHEET 2 OF 2

BOREHOLE NO'S 4

PROJECT: 25 PUNAWAITAI ROAD

PROJECT NO. POURERERE 23828

CO-ORDINATES

Date Drilled: **20 APRIL 2022**

Logged by: **S NGUYEN**

Checked:

BOREHOLE NO: BH4

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0			
0.1			TOPSOIL. Silt. Dark grey and moist. Good structure.
0.2			
0.3			Clayey SILT. Mid brown, mottled orange and moist. Some structure.
0.4			
0.5			
0.6			
0.7			Silty CLAY. Light brown mottle orange and moist. Plastic and becoming massive.
0.8			
0.9			
1.0			
1.1			
1.2			
1.3			
1.4			
1.5			EOB @ 1.5m

REMARKS: No GW observed during augering.
NZS1547 soil category 6.

BOREHOLE NO:

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0			
0.1			
0.2			
0.3			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			
1.0			
1.1			
1.2			
1.3			
1.4			
1.5			

REMARKS:

BOREHOLE NO:

DEPTH (m)	GRAPHICAL LOG	GWL	DESCRIPTION OF STRATA
0.0			
0.1			
0.2			
0.3			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			
1.0			
1.1			
1.2			
1.3			
1.4			
1.5			

REMARKS:

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Appendix C

Geotechnical Report

GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED STAGE 3 SUBDIVISION AT PUNAWAITAI ROAD, POURERERE

Project Reference: 14668.2 Revision.1
9 August 2021

Change Log Report			
Release Version	Date Made	Author	Details
Initial	02/07/2021	Robert Loomes	• Release of report for general issue.
Revision.1	9/08/2021	Robert Loomes	• Amend report to reflect new Lot configuration scheme dated 03/08/21. Lot and scheme references updated throughout accordingly. Replace relevant appendix documents with superseding versions. • Update Section 6.5 “Ground Shrinkage and Swelling Potential” to incorporate the content within the separately issued Geotechnical Addendum issued 26/07/21. This addendum can now be considered superseded. • Update Section 7.3 “Preliminary Foundation Design & Construction” – namely, foundation deepening requirements reduced from 0.8m bgl → 0.6m bgl.

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1 EXECUTIVE SUMMARY

Based on the investigation and appraisal of the site reported herein, the proposed subdivision area has been assessed as stable and is generally considered to be feasible for construction in accordance with the NZ Building Code and relevant codes of practice, providing that the recommendations of this report are adhered to. The following key conclusions and recommendations with respect to the proposed development are set out below.

A 10m building setback from any significant slope crest belonging to adjacent tributaries or undeveloped encroaching gullies (proposed Lots 11 & 15) has been specified in order to isolate the future buildings from both potential slope instability AND lateral spreading potential. This setback is unlikely to significantly restrict desirable building locations, however construction within this zone could be allowed following further building-specific geotechnical testing to establish whether any additional foundation enhancements are needed.

Ground with a Geotechnical Ultimate Bearing Capacity (GUBC) of at least 300kPa (allowable bearing pressure of at least 100kPa) is generally encountered throughout the majority of the property, however some lower strength near-surface soils were also sporadically identified. As such it is considered appropriate for resource consent purposes that all Lot developments should assume an available GUBC of 210kPa (70kPa allowable) for foundation design, unless refined on the basis of building-specific testing expected to be required during the building consent process.

Based on the available bearing capacities and potential expansivity of the near-surface soils we recommend the following foundation options to be suitable for development within the assessed Lots. Note that the below options specifically refer to buildings placed outside of the specified 10m slope building setback.

1. A Specifically Engineered Design (SED) timber-piled and timber-floored foundation system, designed to the available bearing capacity denoted above AND deepened to a minimum of 0.6m bgl in order to mitigate against the expansivity potential of the bearing soils. In lieu of SED, all piles can be constructed as anchor piles, including connection details (the 0.6m minimum requirement still applies).
2. Conventional NZS3604 (2011) shallow concrete floor foundations (e.g. strip footing, slab-on-grade) on a conventional topsoil hardfill replacement (0.25-0.6m bgl) provided that the foundation footings are widened by a factor of 1.43 (i.e. nominal 165mm wide strip footings increased to approximately 240mm) AND foundation footings deepened to a minimum of 0.6m bgl in order to address the available bearing capacity and expansivity potential of the bearing soils.
3. Conventional waffle-slab systems (including proprietary waffle designs e.g. Cupolex, Ribraft, X-Pod, Q-Pod, etc), provided that are designed to the available bearings

capacities and are confirmed suitable to allow for potential expansivity effects beneath the building.

All other geotechnical hazards at the site have been assessed as either not present or of acceptable risk provided that the various mitigation measures, relevant inspection & certification of the undercut / hardfill / foundation excavations, and good practice recommendations made in this report are adopted.

2 INTRODUCTION

Land Development & Engineering (LDE) Ltd was engaged by Bridge Farming Partnership to undertake a geotechnical investigation for Stage 3 of the ongoing subdivision development located at Punawaitai Road, Pourerere (Figure 1). The parent property is legally identified as Lot 1 DP 27067. LDE have previously issued a series of reports relating to the broader subdivision development at the property as follows:

- LDE Geotechnical Investigation Report entitled *"Proposed Subdivision, 22/23 Punawaitai Road, Pourerere"*, reference 14668, dated 10 October 2018.
- LDE letter entitled *"Addendum Geotechnical Subdivision Report, 22 Punawaitai Road, Pourerere"*, reference 14668, dated 3 July 2019.
- LDE report entitled *"Desktop Geotechnical Assessment, Stage 3 – Punawaitai Road, Pourerere"*, reference 19704, dated 17 May 2021.

This report is intended to present the detailed geotechnical component of the Stage 3 assessment completely i.e. all key geotechnical information related to Stage 3 is contained herein, and need not be read in conjunction to any previously released geotechnical report related to the Pourerere subdivision.

Specifically, Stage 3 of the development is situated to the north-northeast of the Stage 1-2 area (Figure 2) and comprises a block of approximately 48 proposed new Lots of various sizes for residential development, with additional Lots accommodating proposed communal open spaces, utility areas and accessways (Figure 3). Furthermore, a degree of depression infilling is expected to be undertaken within some minor gullies encroaching into the Lots.

The geotechnical information recovered during this investigation is intended to inform the overall development in terms of feasibility and be incorporated into the relevant subsequent design configurations as necessary.

The purpose of the investigation was to determine the geotechnical suitability of the proposed new Lots, assess the risk of any applicable hazards (either affecting Stage 3 as a whole or within individual Lots as observed), and to provide engineering recommendations for foundation

options to address any areas of insufficient bearing capacity. This report has been prepared in support of a resource consent application to Central Hawke's Bay District Council (CHBDC).

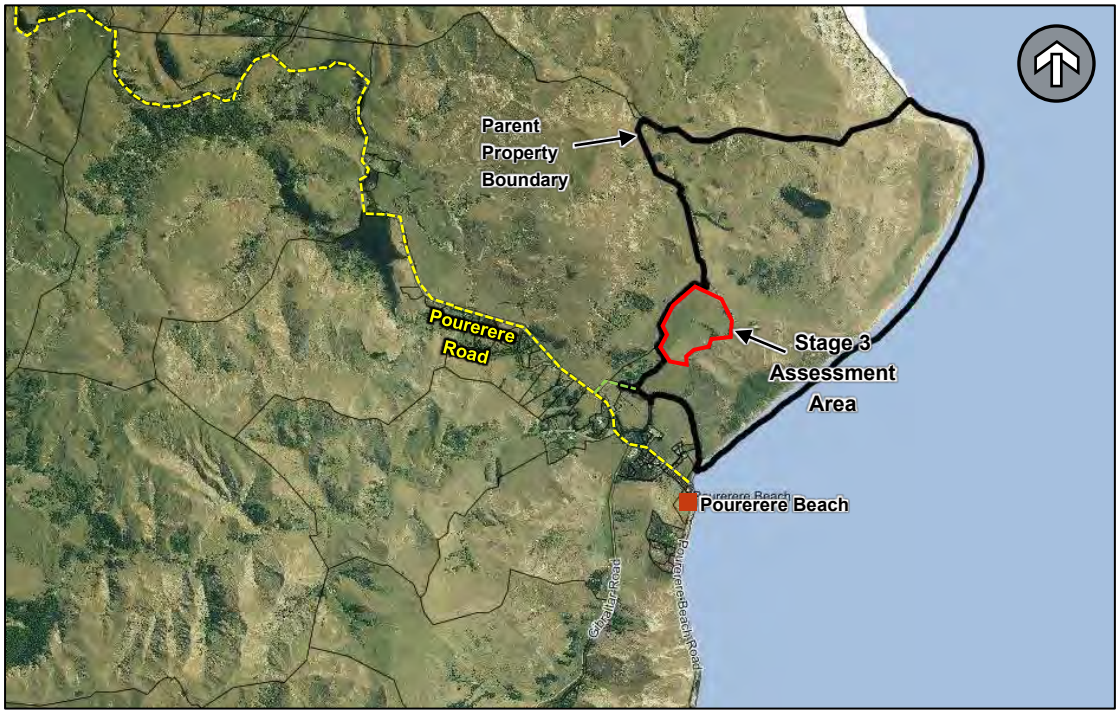

Figure 1: Location of the subject site in relation to Pourerere Beach and surrounding landmarks (Source: CHBDC Intramaps[1]).

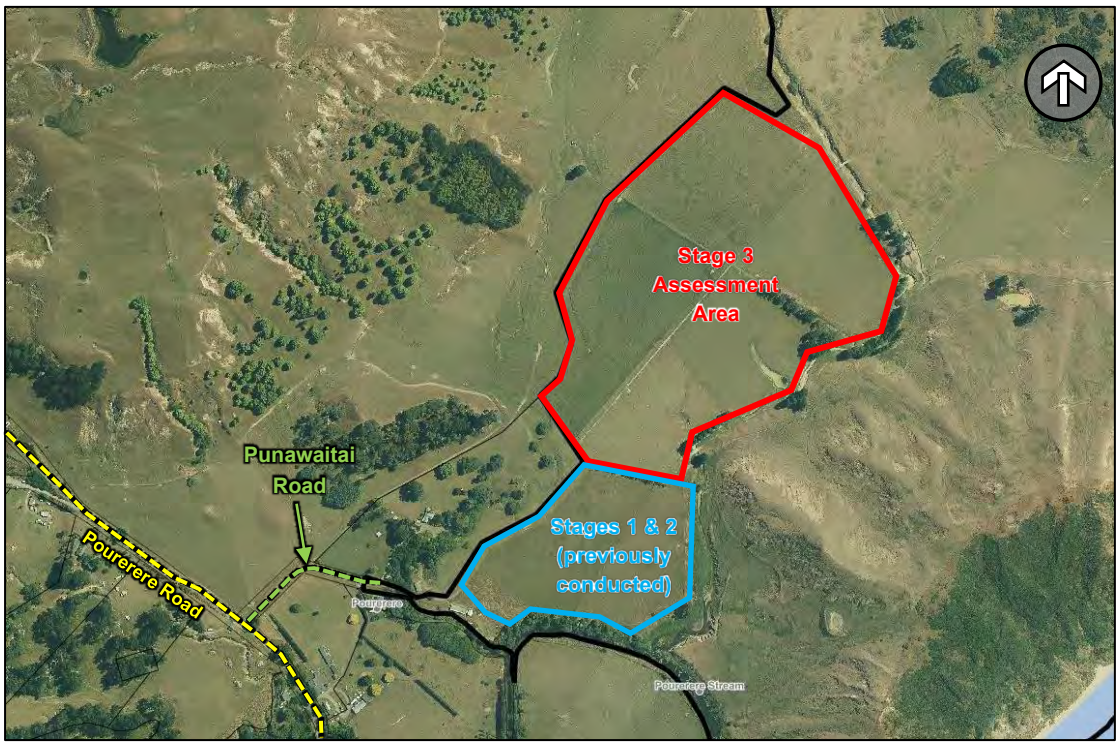

Figure 2: Closer view of subject site and relevant assessment areas (Source: CHBDC Intramaps[2]).

[1] Central Hawke's Bay District Council Intramaps (https://maps.chbdc.govt.nz/IntraMaps90/default.htm)
[2] Central Hawke's Bay District Council Intramaps (https://maps.chbdc.govt.nz/IntraMaps90/default.htm)

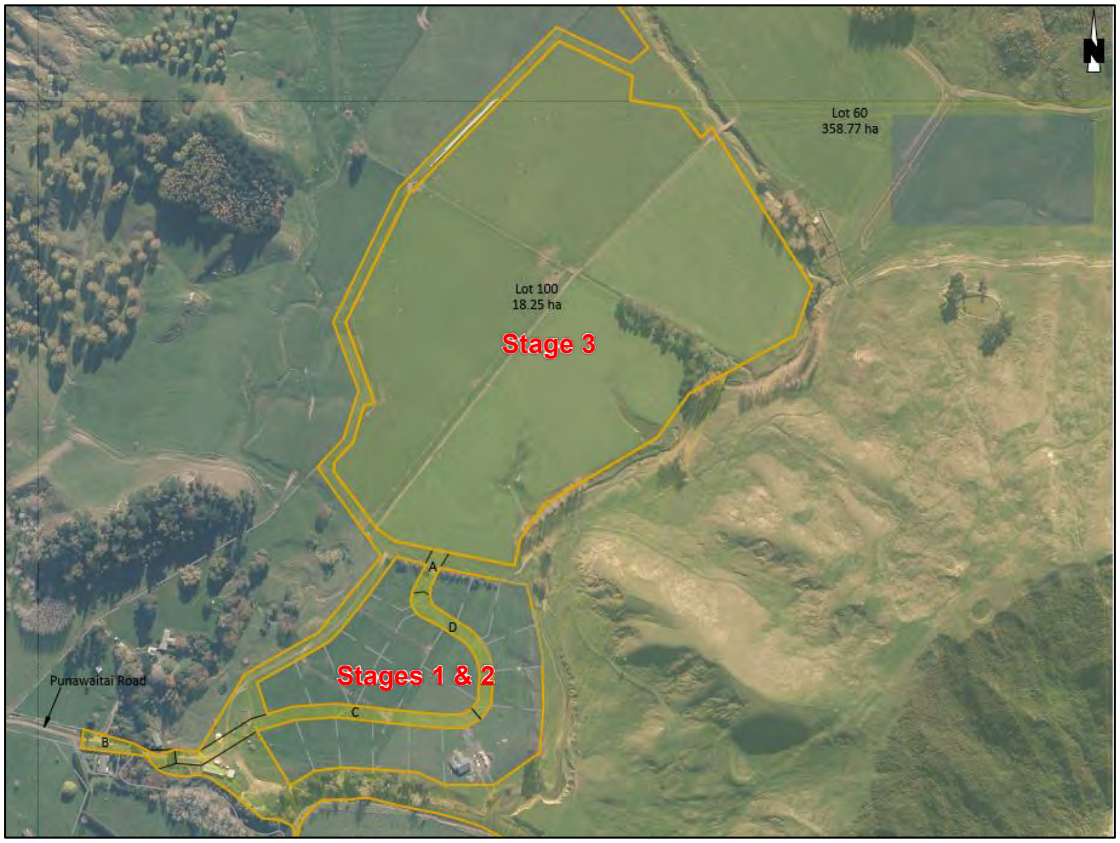

Figure 3: Clip of proposed Stage 3 subdivision development in relation to existing Stages 1 & 2 (Source: client supplied document; included in Appendix E).

Figure 4: Image of proposed lots in development Stages 3a-3c (Source: client supplied document; included in Appendix E).

3 DESKTOP REVIEW

Google Earth[3], Hawke's Bay Regional Council Hazards Portal[4], GNS Active Faults Database[5], GNS Online Geological Map[6], Landcare Research Soils Map[7], and Retro Lens Historical Image Resource[8] were reviewed as a part of this desktop study and indicated the following key points:

3.1 Soils Map

The soils map for the area indicates that the near surface soils consist of deep (>100cm to underlying bedrock / hard soil), poorly drained, Gley Soils, with a high moisture content within the topmost 1m of the soil column. This soil zoning encompasses all Stages 1-3 and is generally consistent with the investigation findings.

3.2 Published Geology

The 1:250,000 geological map of the region[9] shows the site as being underlain by Holocene Alluvial deposits, comprising 'poorly consolidated alluvial gravel, sand and mud'.

No active faults are shown to be within the area surrounding the site[10]. The nearest active faults are a series of faults belonging to the Poukawa Fault Zone situated approximately 18km to the west of the subject site.

3.3 Liquefaction

The site is located within a 'high' liquefaction vulnerability zone[11], extending from the previously assessed Stages 1 & 2 within the southern adjacent land. The detailed liquefaction assessment carried out for the previous Stages (refer to introduction section of this report and previously conducted investigations) indicated that the site generally has a low to minor susceptibility to liquefaction, with a conservative set-back of 25m from the banks of the watercourses specified to allow for potential lateral spreading effects induced by the nearby Pourerere Stream and connecting tributaries.

[3] Google Earth Pro (Google Earth 2019).
[4] Hawkes Bay Regional Council Portal (https://hbmaps.hbrc.govt.nz/hazards/)
[5] GNS Online Active Fault Database (http://data.gns.cri.nz/af/)
[6] GNS Online Geological Map of New Zealand (http://data.gns.cri.nz/geology/)
[7] Land Care Research Soils Map (https://smap.landcareresearch.co.nz/)
[8] Retrolens Historical Image Resource (https://retrolens.co.nz/)
[9] Lee, J.M.; Townsend, D.; Bland, K.; Kamp, P.J.J. (compilers) 2011: "Geology of the Hawke's Bay area: scale 1:250,000 geological map 8.
[10] Landridge, R.M; Ries, W.F, 2015. Active Fault Mapping and Fault Avoidance Zones for Central Hawkes Bay District: 2013 Update; *GNS Science Consultancy Report 2013/151.*
[11] BJ Rosser & S Dellow (compilers) GNS 2017, Assessment of liquefaction risk in the Hawke's Bay. Volume 1: The liquefaction hazard model.

As considered appropriate for the scale of the proposed development, a deep liquefaction assessment has been conducted specific to the Stage 3 Lots. This assessment is presented in Section 6.3 below.

3.4 Coastal Hazards & Tsunami

The proposed development area is generally located outside of the HBRC coastal hazard zones but is located within the 'near source' tsunami inundation zone in a similar way to the existing lowland areas within the Pourerere coastal community[12].

3.5 Historical Imagery

A review of available historical imagery of the site[13][14] indicates that the Stage 3 area has remained largely unchanged since at least the 1950's and appears to have been used solely for light agricultural purposes, including grazing and cropping. The meandering stream situated outside of the western boundary of the assessment area does appear to be much more pronounced in the 1952 image below (Figure 5) and appears to have been partially infilled during the years up to 1980 (Figure 6). The areas of suspected sediment infilling partially encroach into the rear western boundaries of proposed Lots 20-22. No other proposed Lots are indicated to overly the remaining infilled areas.

Other than the currently observable gullies across proposed Lots 11 & 15, no transient gullies or other notable water courses can be seen developing/receding within the proposed Lot areas throughout the periodic images taken over the 1950-2021 time frame.

[12] Hawkes Bay Regional Council Portal (https://hbmaps.hbrc.govt.nz/hazards/)
[13] Google Earth Pro (Google Earth 2019).
[14] Retrolens Historical Image Resource (https://retrolens.co.nz/)

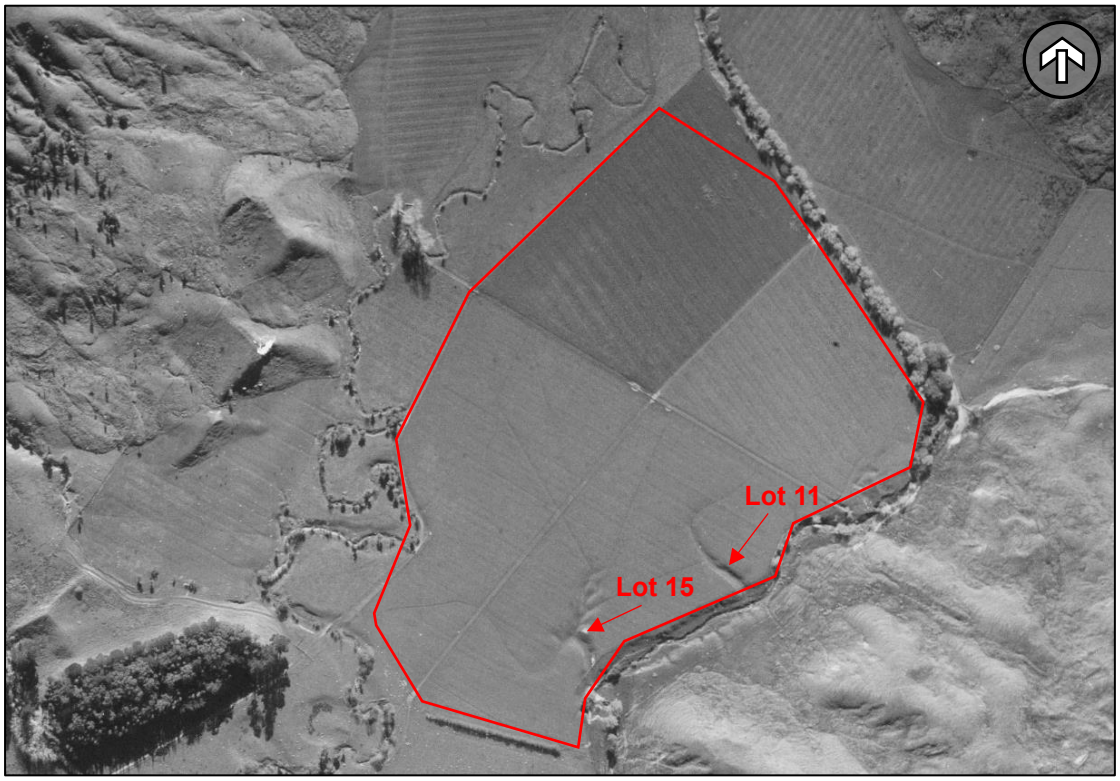

Figure 5: Historical **1952** image of the proposed Stage 3 development area, indicating that the site appears largely unchanged when compared to current observable conditions. Note the same gullies present within the Lots 11 & 15 areas. Image Source: Retro Lens Historical Image Resource[15].

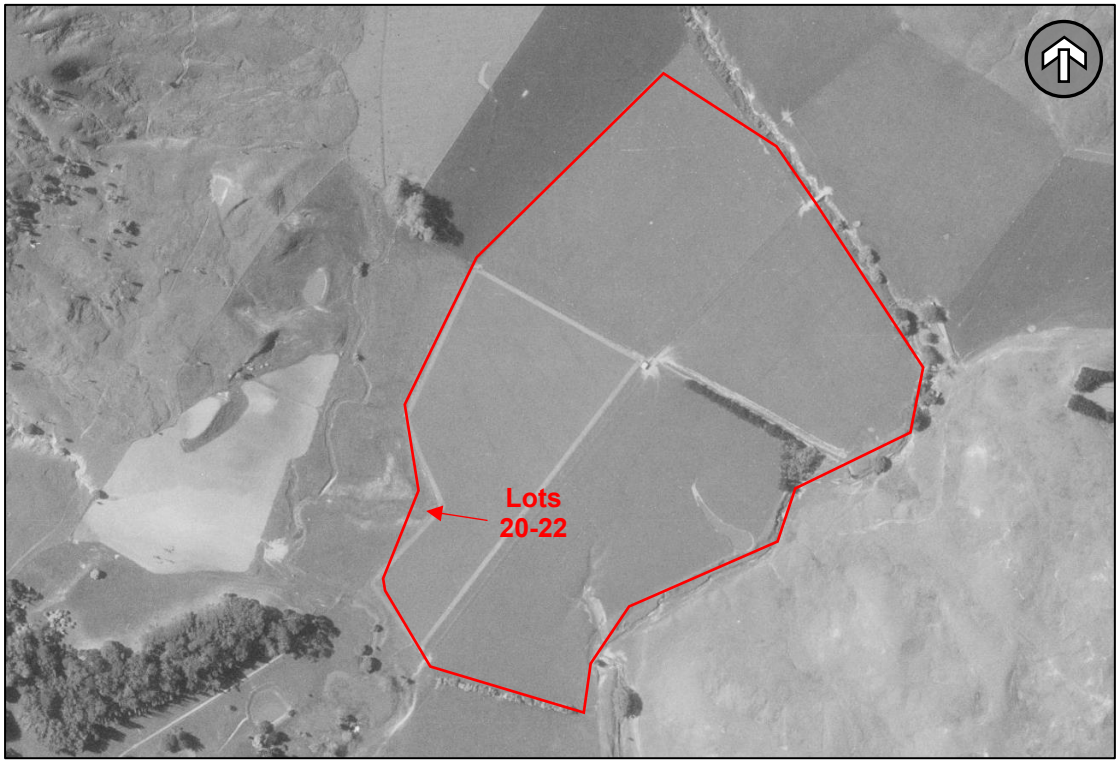

Figure 6: Historical **1980** image of the proposed Stage 3 development area. Note the meandering stream to the west becoming less pronounced (consistent with current conditions) and appearing to have been partially infilled, particularly in the northern area of the previous stream extents. Image Source: Retro Lens Historical Image Resource.

[15] Retrolens Historical Image Resource (https://retrolens.co.nz/)

4 SITE SETTING

The subject site is located at Punawaitai Road, Pourerere – a small beach township surrounded by rural farmland located approximately 29km to the southeast of Waipukurau. The assessed Stage 3 area is situated to the north-northeast of the Stage 1-2 block (refer Figure 2), and is currently used for light agricultural purposes.

The Stage 3 land surface generally comprises a flat to gently sloping lightly grassed alluvial plain (Figures 7-10) - similar in nature to the Stage 1-2 land – and surrounded by elevated broad hill/ridge landforms to the west, north, and east. The coast lies approximately 750-1000m to the southeast of the area. The Stage 3 area is currently free of any buildings, with the only structures being light fences installed and intersecting in the central Stage area.

Figure 7: Typical view of the general ground conditions across the site. Photograph was taken from the central – eastern area (~Lots 8-9) towards the southwest. Note the elevated landform to the east.

Figure 8: View of the tree line in the eastern Lot area.

Figure 9: View of the site taken from the southwestern (~Lots 19-20) area towards the northeast. Note the northern elevated landforms illustrating the wider topography north of the site.

Figure 10: View of the site taken from the southwestern (~Lots 42 & 50) towards the northeast.

The Pourerere Stream is situated ~275-850m to the south of the Stage 3 plot, which outlets to the nearby coast. A tributary to the stream is located along the northeastern and southeastern edges of the adjacent sides of the Stage 3 area, with lateral minor gullies / overland flowpaths entering the site on proposed Lots 11 (Figure 11) and Lot 15 (Figure 12). An overland flow path is also present adjacent to the proposed Lot 20-22 area to the west, which is the predominantly dry remains of the more prominent meandering stream that can be observed in the historical imagery above (refer Figure 5). No evidence of the old stream extents or younger sediment deposits can be seen encroaching into the vicinity of the proposed Lot areas from the ground surface.

No other significant geomorphic features were identified during the investigation.

Figure 11: View of the water-filled gully encroaching into proposed **Lot 11**. The depth of gully is in the order of 1-1.5m below ground level.

Figure 12: View of the dry gully encroaching into proposed **Lot 15**. The depth of gully is in the order of 1-2m below ground level.

5 GROUND CONDITIONS

5.1 General

The nature of the ground beneath the site is summarised below and in the appended logs. It is based on an integration of published and unpublished data, the geomorphology of the site, and subsurface investigations carried out at discrete locations. The nature of the ground between the investigation points is inferred and may vary from that described. For details of the materials encountered and measurements of their respective strengths please review the appended investigation logs.

5.2 Subsurface Investigations

Our investigation of the site included the following ground investigation work:

- Twenty (20) 50mm hand augered boreholes were undertaken to target depths generally between 2-4m (or refusal) across the Stage 3 Lots and accessway alignment. Measurements of the undrained shear strength were taken at 200mm intervals within cohesive soils encountered down through the boreholes using a calibrated shear vane.
- Twenty (20) accompanying Dynamic Cone Penetrometer (DCP) tests put down alongside the hand augered boreholes, to target depths generally between 2-4m (or refusal) with measurements taken in 50mm increments, each forming a Test Site (TS) with the borehole. Note that the Test Sites formed along the accessway (AW) alignment have been labelled separately e.g. “AW01”.
- Six (6) electronic Cone (piezocone) Penetration Tests (CPT) were undertaken using a specialist rig to completion depths of 15-17m.

The locations of the subsurface investigations are shown in Figure 13 below and on the Geotechnical Investigation Plan in Appendix A. Logs of the boreholes, penetrometer tests, and CPT profiles are presented in Appendix B. The field work was completed in June (winter conditions).

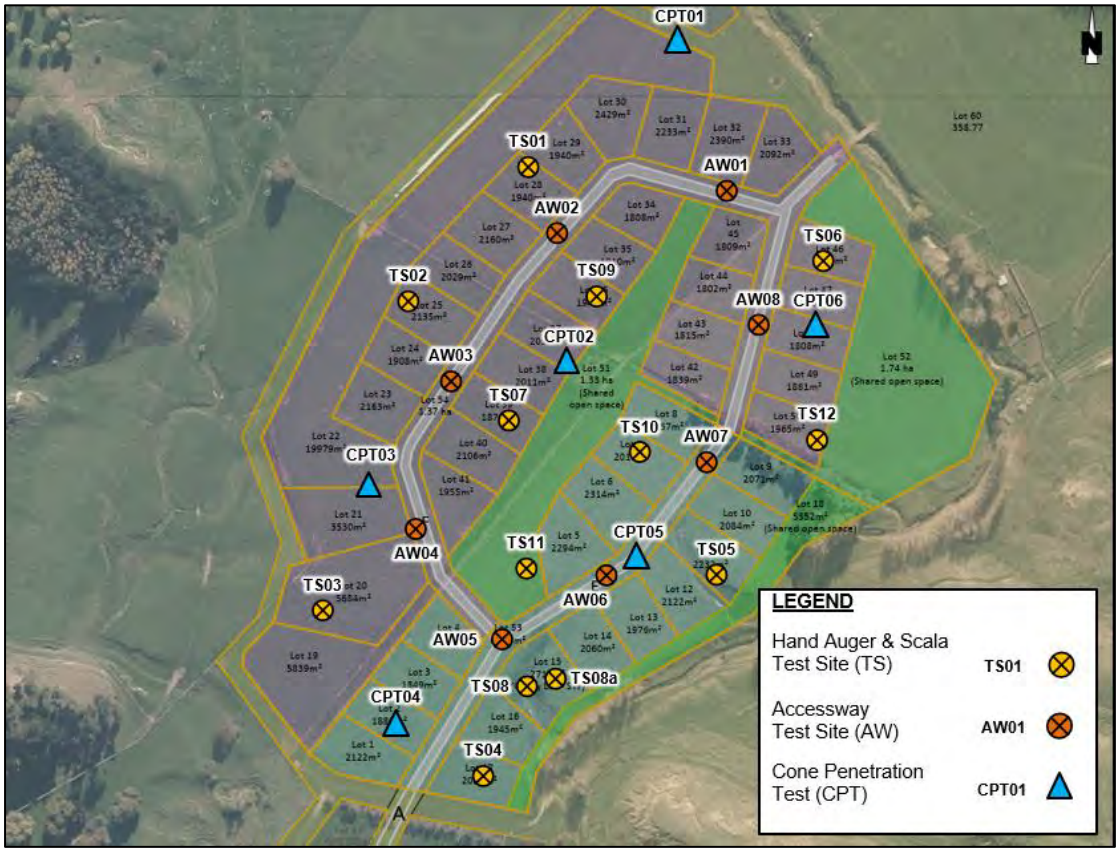

Figure 13: Geotechnical Investigation Plan showing location of investigation points across the proposed Stage 3 development.

5.3 Subsurface Conditions

In summary, our investigations generally encountered a soil veneer comprising of predominantly moderate to high strength alluvial clays and silts with minor intermittent sand layers. The soils identified were generally consistent with the previous Stage 1-2 investigations, and reflective of the “sand and mud” deposits shown on the published geology for the site. The materials in all test locations indicated a generally consistent profile with no significant bands of isolated material suggestive of non-uniform substrate conditions or significant soil boundaries beneath the site.

In summary, the investigations indicate that the site is underlain by a surface layer of organic clayey SILT **(Topsoil)**, extending down to average depths of 0.25-0.30m below ground level (bgl), but up to 0.6m within TS01.

Underlying the topsoil, the investigations generally encountered cohesive layers of moderate to high strength (stiff to very stiff) SILT/CLAY mixtures **(Alluvium)**, extending down to the borehole completion depths between 1m and 3m bgl (auger refusal generally occurring due to swelling soil and poor recovery). The soils are indicated to trend towards relatively lower strengths beneath 2m bgl as the moisture content of the soils begin to increase.

Intermittent SAND-dominated layers were also identified beneath the site, most notably present within TS02, TS03, & TS05, and generally present between 1m and 2m bgl. As these Test Site locations are within relative proximity to the adjacent watercourses, it is likely that these sandier layers are representative of sediments deposited during the meandering of these streams, with the finer silts and clays being derived from the accumulation of more wide-spread periodic deposition of the alluvial plain. TS08 was conducted within the base of the Lot 15 encroaching gully (approximately 2m below the alluvial plain level) with the materials retrieved being generally consistent with the silt/clay mixtures identified elsewhere – with a higher moisture content and slight organic odour at depth indicating the development of organics within the gully's anaerobic soil conditions.

The CPT investigation data supports the above description of the near-surface soil profile with the moderate strength (2-4 MPa) silt/clay mixtures and intermittent sands being presented within the upper 2-3m of the soil column. Similar silt/clay mixtures are indicated to consistently extend down to the CPT completion depths (15-17m bgl), however note that the relative soil strength is indicated to decrease from approximately 2m bgl and becoming consistently <1MPa beneath this depth. It is also worth noting that overall significantly less sand layers are indicated to be present within the soil profile when compared to the previously conducted Stage 1-2 testing, with only a few intermittent sand layers being present and generally being only 0.2-0.5m in thickness (particularly noticeable within CPT04). This is likely due to the increased distance from the main Pourerere Stream and it's associated overbank deposits to the south.

Layers of softer organics were also occasionally interpreted by the CPT software within the 2-4m clays, most notably within CPT02 & CPT06. Although adjacent Test Site retrieval of these soils at the correlating depths was limited, no significant organic materials were discerned outside of the Lot 15 gully base.

5.4 Soil Moisture Profile and Groundwater Conditions

The hand augered boreholes indicated that the soils beneath the building site were generally moist, and periodically becoming wet from approximately 2m bgl. Groundwater was not encountered throughout the majority of the boreholes, however TS08 was conducted within the base of the Lot 15 gully and encountered the groundwater table at 1.6m depth (approximately 3.6m depth below the surrounding alluvial plain).

Groundwater was also measured at the completion of each CPT test, variably lying between 1.08m and 5.35m bgl. The variability of the measured groundwater is likely to be heavily affected by the low permeability of the cohesive clays and silts beneath the site, with the piezometric surface of the groundwater (i.e. potential surface of water table provided the unconfined ability to rise) likely lying somewhere between 1-3m bgl.

The moisture content of the near surface soils is expected to be higher during the winter months or extended periods of wet weather resulting in their saturation at times. The extent of the wetting front will be dependent on the duration of the period of rainfall but may extend down some 0.5m to 1m of the surface. Similarly, the groundwater table is expected to rise some 0.5m to 1m during extended periods of wet weather. In our opinion complete saturation of the ground is a possibility but is generally unlikely to occur.

5.5 Seismic Subsoil Category

Based on the wider topography in correlation with the conducted deep CPT tests, we generally expect the cohesive soils beneath the site to exceed 60m depth before encountering intact underlying bedrock, thereby classifying the site as a Class D Deep or Soft Soil site as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5: Earthquake actions – New Zealand". This assessment is further supported by previous deep testing up to 25m bgl within the Stage 1-2 area and the soil classification determined within the associating Stage 1-2 "*Addendum Geotechnical Subdivision Report"* (refer to introduction section of this report and previously conducted investigations).

6 Natural Hazards & Ground Deformation Potential

6.1 General

This section summarises our assessment of the natural hazards within the property as generally defined in Section 106 of the Resource Management Act (1991 and subsequent amendments) and the Building Act (2004) and the potential risk that these present to the proposed building in terms of vertical and lateral ground deformation.

This section also includes our assessment of ground beneath the building site which is outside the definition of "Good Ground" as defined by the Compliance Document for the NZ Building Code, NZS3604 (2011) "Timber Framed Buildings" and NZS4229 (2013) "Concrete Masonry Buildings Not Requiring Specific Engineering Design". This is any ground which could foreseeably experience movement of 25mm or greater for any reason including one or a combination of compressible ground, land instability, ground creep, subsidence, liquefaction, seasonal swelling and shrinking, frost heave, changing groundwater level, erosion, dissolution of soil in water, and the effect of tree roots.

6.2 Earthquake Hazards

6.2.1 Earthquake Shaking

The site is located in a region of high seismicity. As such, the site can be expected to be subject to high levels of earthquake shaking generated by large distant earthquakes every 20 to 25

years, with a 10% probability of a significant local earthquake occurring within the 50 year design life of the structure. Potential ground deformation resulting from earthquake shaking is discussed in the following sections.

The New Zealand Geotechnical Society (NZGS) and Ministry of Business Innovation & Environment (MBIE) released guidelines for Earthquake Geotechnical Engineering Practice in New Zealand (Module 1, Rev 0, 31 May 2017) for adopting a revised methodology via the NZTA Bridge Manual (2014) for determining peak ground accelerations under Section 175 of the Building Act. Current best practice in seismic design and ground performance is to adopt this methodology over NZS1170.5 (2004).

However, the GNS Report 2015-186 Assessment of Liquefaction Risk In Hawke's Bay provides seismic results from the updated National Seismic Hazard Model for specific use in liquefaction assessments within the wider Waipukarau region. These results are considered to be the closest and most reliable results available for the subject site. The paired magnitude and peak ground accelerations from Tables 5.1 and 5.2 respectively in Volume 1 of the aforementioned report should be adopted should a detailed liquefaction analysis be carried out.

Taking the return period values from Tables 6.6 and 6.7 for a Serviceability Limit State (SLS) earthquake event (25 years), a magnitude of 6.0 and a peak ground acceleration of 0.17g is recommended to be used. Using the same tables, an Ultimate Limit State (ULS) earthquake event (return period of 500 years), a magnitude of 6.3 and a peak ground acceleration of 0.47g should be used.

The forgoing SLS and ULS events correspond to design event return periods of 1/25 years and 1/500 years respectively. To inform the seismic liquefaction analysis reported herein, a design event return period of 1/100 years has also been considered, which corresponds to a paired PGA value of 0.29g and magnitude of 6.1 to define a Mid-range Limit State (MLS) earthquake event.

6.2.2 Fault Line Surface Rupture

The GNS NZ Geology Webmap and Active Faults Database[16] do not show any faults passing beneath the site. There also does not appear to be any surface expressions which would indicate the presence of an active fault line beneath or within close proximity to the site. We therefore consider that the surface fault line rupture risk to be low.

[16] http://data.gns.cri.nz/geology/ and http://data.gns.cri.nz/af/

6.3 Liquefaction

Liquefaction is the term used to describe the severe strength loss which can occur when saturated loose to medium dense sands and low plasticity silts/clays are subject to seismic shaking. In addition to strength loss, liquefaction may also result in the expulsion of sand, silt and water at the surface, post seismic settlement, and in lateral movement towards areas of lower elevation such as rivers or streams, referred to as lateral spreading. Differences in the level of underlying liquefaction due to variations in the ground can result in differential surface settlement. In addition, significant building settlement can occur due to the severe loss of strength and subsequent bearing capacity of the ground.

The site is underlain by majority cohesive clays and silts, with thin intermittent sand layers within the upper 10m of the soil column. These sands layers are likely to correspond with the majority of the liquefaction potential beneath the site.

Analyses have been carried out to determine:

- What material layers beneath the site are likely to be prone to liquefaction under SLS, MLS, and ULS seismic shaking.
- The severity of surface damage due to liquefaction.
- The potential magnitude of surface settlement due to consolidation of the liquefied layers.

The analyses adopted the data from each CPT using geotechnical software (CLiq). The analyses have been undertaken for SLS, MLS, and ULS design earthquake PGA values presented in Section 6.2. The results of the analyses are presented in Appendix C. Groundwater depths of 1m have been adopted for the liquefaction modelling under seismic influences in order to conservatively consider the behaviour of the groundwater surface beneath the site, as well as considering the effects of potential future sea level rise over the intended design life of the development.

As the site is located in close proximity of the ~2m deep adjacent tributary to the Pourerere Stream is located along the northeastern and southeastern outside adjacent sides of the Stage 3 area, which marginally constitutes a significant “free-faced” slope. As such, lateral spreading effects and calculations have also been performed to assess the effects of the nearby tributary during seismic events. As the old meandering stream remains to the south-southwest of the area (refer Figure 6) is relatively shallower (up to ~1m) with more gentle sloping banks, this is not considered likely to induce lateral spreading effects, and therefore no additional calculations have been performed.

We have calculated the liquefaction potential of soils at site using the “simplified procedure” as summarised by the “Updated NCEER” method (Youd et al, 2001), and recommended by the New Zealand Geotechnical Society Guidelines and Modules (NZGS; 2010, 2016). Liquefaction-induced free-field vertical volumetric strains were estimated for the design seismic events using the method of Boulanger & Idriss (2014) and the method of Zhang et al. (2002) as recommended by the MBIE Guidelines for seismic design.

Default assessment values were utilised within CLiq during the liquefaction analyses. These include, but are not limited to, assuming the existing ground is level, utilising an Ic cut-off of 2.6, applying clean sand and overburden corrections, automatic calculations for soil unit weights, and weighting factors for ‘Ev’ and applying automatic corrections to the input data at soil transition layers to compensate for the interbedded nature of the subsoils and associated dampening effects within the soil column in comparison to cumulative totals.

6.3.1 Layers Subject to Liquefaction

6.3.1.1 Serviceability Limit State Conditions

Negligible potential for liquefaction is predicted for a Serviceability Limit State event, with near-zero return values for LPI and LSN, and with theoretical vertical settlements of up to 5mm. An overall ‘low’ value of liquefaction probability was returned.

6.3.1.2 Ultimate Limit State Conditions

The analysis results show that the site remains at a low potential for liquefaction manifestation during an Ultimate Limit State event, with approximate return values of up to for LPI, up to 6 for LSN, and vertical settlements in the order of 5-15mm. The overall liquefaction probability was indicated to remain ‘low’.

It is important to note that the layers that are indicated to comprise the majority of the liquefaction potential beneath the site are thin sand layers generally <0.5m in thickness. Therefore the CPT subsoil profiles showing increased sand intermittents i.e. CPT04, are shown to be in the higher range of potential liquefaction manifestation across the site. Figure 14 below presents the liquefaction representation within CPT04 specifically, highlighting the liquefaction prone sand layers.

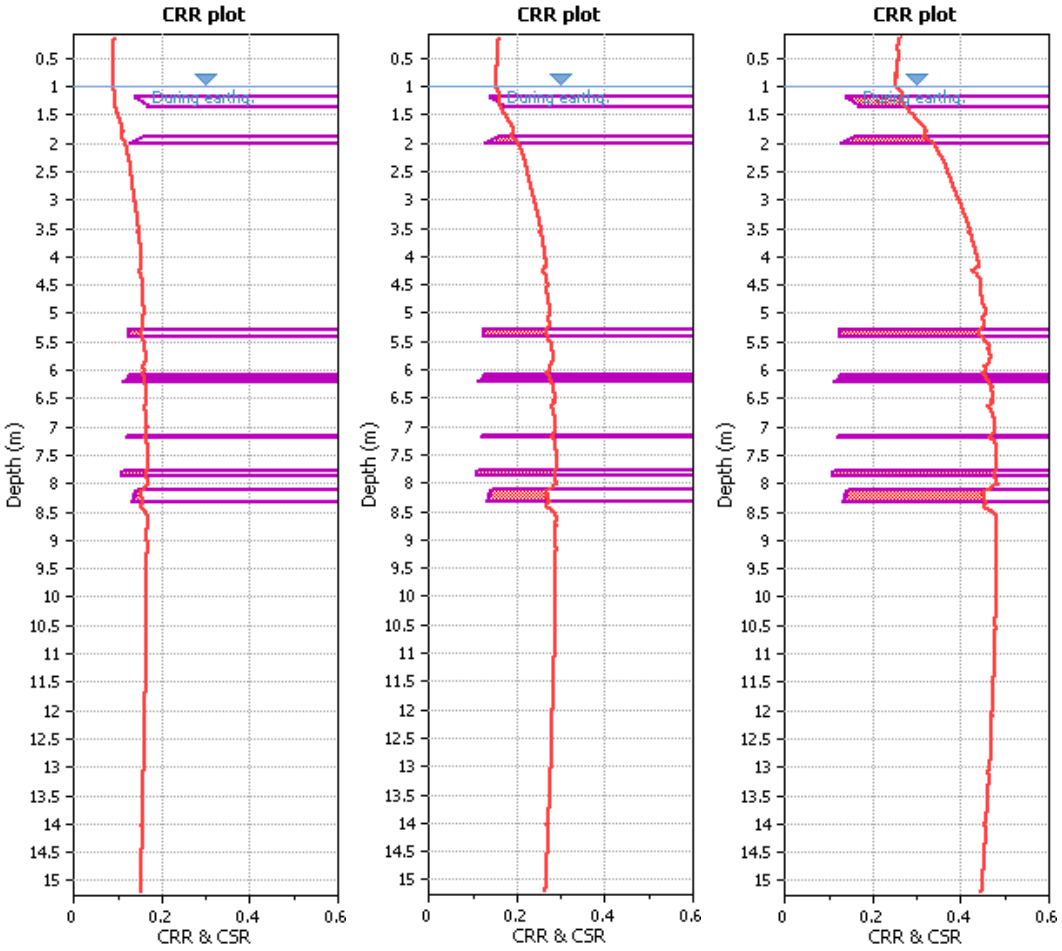

Figure 14: Representative profile of soil layers in CPT04 under SLS (left), MLS (middle), and ULS (right) seismic conditions, showing the layers susceptible to liquefaction. Note the susceptible layers predominantly corresponding to the intermittent sand layers within the CPT profile.

6.3.1.3 Mid-range Limit State Conditions

The MLS LSN and vertical settlement values are shown as being approximately midway between SLS and ULS conditions, with the returned liquefaction predictor values and overall the liquefaction probability of the site remaining low.

6.3.2 Liquefaction Severity Number (LSN)

The Liquefaction Severity Number[17] provides an indication of the likely future performance of the site due to underlying liquefaction. The determination of the number takes into account the thickness of the layers subject to liquefaction and their proximity to the surface. The magnitude of land damage that may be expected has been categorised into ranges (Table 1 below).

[17] Tonkin and Taylor (2013) Liquefaction vulnerability study, Tonkin and Taylor Report 52020.0200/v1.0. February 2013. 52 pages and 14 appendices.

Table 1: LSN ranges and observed land effects.

LSN Range*	Predominant performance based on actual observations
0-10	Little to no expression of liquefaction, minor effects
10-20	Minor expression of liquefaction, some sand boils
20-30	Moderate expression of liquefaction, with some sand boils and some structural damage
30-40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40-50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlement of structures
>50	Severe damage, extensive evidence of liquefaction at the surface, severe total and differential settlements affecting structures, damage to services.

* LSN is an approximate indicator of liquefaction effects and do not always reflect the actual liquefaction from seismic events. Note that the LSN estimates average ground performance and that a range can occur in each category i.e. some buildings may incur significant damage within the 0-10 range and some buildings may suffer no damage in LSN >30 areas.

Analyses of the data from the CPT put down within the site return an approximate LSN value of <1 in SLS conditions, up to 4 in MLS conditions, and up to 6 in ULS conditions. This indicates that negligible to little expression of liquefaction, with minor effects are expected to occur within all design seismic events up to the ULS level of shaking.

6.3.3 Surface Settlement from Liquefaction

Analyses of the potential settlement that could potentially occur following the liquefaction of the sand and silt layers beneath the site have been carried out using CLiq software. The predicted settlements at the surface[18] of the site as a result of possible future SLS, MLS, and ULS earthquake events are summarised in Table 2 below. The MBIE guidelines reference 'index' values of settlement, this being the settlement occurring within 10m of the ground surface. Accordingly, for reference and comparison with the MBIE Technical Categories, the 10m depth limited values are presented in squared brackets.

Table 2: Potential surface settlements* due to liquefaction following a 1m seismic groundwater depth. 'Index' settlement within 10m of the surface in brackets. All results rounded to nearest 5mm.

CPT No.	**Settlement (mm) for Serviceability Limit State (1/25 Yr) Event (M6.2, 0.14g)**	**Settlement (mm) for MLS (1/100 Yr) Event (M6.3, 0.25g)**	**Settlement (mm) for Ultimate Limit State (1/500 Yr) Event (M6.5, 0.42g)**
CPT01	<5 [<5]	5 [5]	10 [10]
CPT02	<5 [<5]	<5 [<5]	<5 [<5]
CPT03	<5 [<5]	<5 [<5]	5 [5]
CPT04	5 [5]	10 [10]	15 [15]
CPT05	5 [5]	5 [5]	5 [5]
CPT06	<5 [<5]	<5 [<5]	<5 [<5]

*Calculation assumes no sand boils are present. When sand boils are present, the estimated total settlement is unpredictable.

[18] Note: Settlement of the ground surface only. This excludes potential for additional building settlement due to bearing capacity reduction as a result of liquefaction.

Note that zero difference in vertical settlement is evident in terms of full column settlements compared to indexed 10m settlements, indicating that the expected manifestation of liquefaction effects expected beneath the site is essentially occurring entirely within the upper 10m of the soil column.

In summary, theoretical vertical settlements in the order of 5-15mm can be expected to occur during design seismic events from SLS to ULS. This magnitude of settlement is within the typically acceptable limit of 25mm accepted by the Compliance Document for the NZ Building Code, and within the equivalent TC1-like Technical Category for residential ground performance.

6.3.4 Lateral Spreading

Lateral spreading typically occurs in sloping ground or level ground close to waterways (e.g. riverbanks, streams, drainage channels). Even a very gentle slope in the ground (of several degrees) will influence the cyclic loads acting on the soil mass during earthquake events which will drive the soil to move in the down-slope direction.

The appendices to the GNS Report 2015-186 Assessment of Liquefaction Risk in the Hawke's Bay give an indication whether lateral spreading is likely to occur at a particular site. Our assessment follows their assessment discussed within the report appendices and uses Table 5.1 (referring to tributary streams 2-3m in depth) of the Appendices, and the relationship between the distance from the top of the bank and the calculated vertical settlement (primary factor) and LSN values (secondary factor) for the site. Table 5.1 is reproduced in Table 3 below.

Table 3: Reproduction of Table 5.1 of Appendices volume of GNS report 2015/186. Note that the indicative settlement values are used as a proxy threshold for determining whether lateral spreading is likely to occur at the corresponding distance from the river bank. The greater the distance from the river bank, the greater the calculated settlement values need to be to produce theoretical lateral spreading.

Distance from tributary bank	Vertical settlement (mm)	LSN
0 to 10m	>25	>7
10 to 25m	>50	>15
25 to 50m	>75	>20
50 to 100m	>150	>25

As the majority of the proposed Lots are within the potentially triggering range (generally within 100m of 2-3m high tributaries or similar watercourses) from existing free face crests of the adjacent tributary streams, lateral spreading effects and calculations have been performed to assess the potential lateral spread movement across the site (Table 4). As the old meandering

stream remains to the south-southwest of the area (refer Figure 6) is relatively shallow (up to ~1m) with more gentle sloping banks, this is not considered likely to induce lateral spreading effects, and therefore no additional calculations have been performed.

Table 4: Summary of CPT data: Approximate distance to nearest free-face ; theoretical vertical settlements due to liquefaction and LSN values for SLS and ULS events. 'Index' settlement within 10m of the surface in brackets.

CPT No.	Distance to Crest of Nearest Free Face (m)	Predicted Settlement (mm) for SLS (25 Yr) Event (M6.0, 0.17g)	SLS LSN	Predicted Settlement (mm) for ULS (500 Yr) Event (M6.3, 0.47g)	ULS LSN
CPT01	50m	<5 [<5]	<1	10 [10]	6
CPT02	230m**	<5 [<5]	<1	<5 [<5]	<1
CPT03	240m**	<5 [<5]	<1	5 [5]	3
CPT04	95m	5 [5]	1	15 [15]	6
CPT05	100m	5 [5]	<1	5 [5]	<1
CPT06	100m	<5 [<5]	<1	<5 [<5]	<1

* All values rounded to nearest 10mm.
** CPTS conducted beyond 100m from nearest crest are not considered for lateral spreading potential.

The guideline conditions as illustrated in Tables 3 and 4 indicate that lateral spreading is not expected to strongly manifest at the site during seismic events up to ULS level as the vertical settlements (primary relationship) and LSN values (secondary relationship) are well below the predicted threshold targets in relation to the distance of the test locations to the 'free-faces'. Typically, indicated vertical settlements and liquefaction predictors should be relatively proportional to the lateral displacement values i.e. if the site is low to moderately susceptible to liquefaction, then significant lateral spreading should also be expected to be low to moderate. It should be noted that lateral spreading predictors are less robust than vertical settlements and overall liquefaction susceptibility calculations, and that the influence of natural "free face" slopes is difficult to appraise with a high degree of accuracy and hence has the greatest degree of uncertainty.

Although the site does not appear to be at risk of significant lateral spreading based on the investigation findings, the CPTs were conducted at least 50m away from the nearby tributary. As parts of the proposed new Lot boundary essentially border the tributary bank (particularly Lots 9-17), consideration has been given for potential buildings constructed within closer proximity to the free face crest. Table 3 above indicates that the **0-10m zone** from the bank crest would expect vertical settlements in the order to >25mm and a corresponding LSN of >7 in order to expect lateral spreading effects to manifest. Although no direct testing was conducted within this proximity zone during this investigation, maximum predictors of 15mm

and 6 LSN (CPT04) are indicated to occur at the site, which would be lower than – but approaching the threshold of – the associating lateral spreading criterion. Similarly, the **10-25m zone** from the nearest bank crest would expect vertical settlements in the order to >50mm and a corresponding LSN of >15 in order to expect lateral spreading effects to manifest. Again, direct testing within this proximity zone was limited, however Tests Sites put down close to or marginally within this zone indicate that the soils remain relatively consistent with the remainder of the site. This lateral spreading criterion within this proximity zone appear to be orders of magnitude above what is predicted to occur across the site.

Based on the foregoing, it is considered that buildings constructed within the **0-10m** proximity zone from the nearest slope crest should be conservatively considered to have a **non-zero** risk of experiencing lateral spreading effects beneath the building. It is considered reasonable to include the crests of the Lot 11 and Lot 15 gullies within this risk assessment until the planned infilling process is undertaken to alleviate this risk. Buildings within the **10-25m** proximity zone from the nearest slope crest are not considered at risk of lateral spreading effects based on the investigation findings. However if during subsequent building-specific testing the soils beneath any specific building are considered to be particularly more prone to liquefaction and lateral spreading, lateral spreading considerations should extend into the 10-25m zone.

As such, it is considered appropriate that all inhabitable building foundations within 10m of any significant crest slope (tributaries, gullies) >1V:4H (14° from the horizontal) should incorporate a level of liquefaction tolerance equivalent to TC-2 foundation systems, unless the risk is otherwise discounted during building-specific geotechnical testing.

6.3.5 Sensitivity Checks

A series of sensitivity checks were undertaken as part of the analyses to determine the effect of the various transition layer and interbedded soil layer influences, as well as the effect of the groundwater assumption for the site.

Note that a conservative 1m groundwater depth has been adopted into the liquefaction model of the site. The effects under a less conservative groundwater check of 2m bgl marginally reduces the liquefaction potential of the site, with maximum vertical settlements limited to less than 10mm, and LSN values reduced to <2. The adoption of the 2m groundwater depth is closer to the expected average site conditions over the next ~50 years. These reduced results give further confidence that the potential liquefaction manifestation at the site (including vertical settlements and lateral spreading) is low.

The deselection of the auto transition layer and ‘Ev’ effects in isolation both resulted relatively significant trends towards greater near-surface vertical settlements and greater liquefaction manifestation effects, particularly during seismic events larger than SLS (MLS and ULS).

Specifically, the above checks induced on SLS events resulted in vertical settlements in the order of 20-25mm, with LSN (up to 5) values and overall liquefaction probability classification remaining low. Under both MLS and ULS events, the checks resulted in vertical settlements in the order of 30-35mm, with LSN (up to 10) values and overall liquefaction probability classification remaining low. The predictor increases are notable and indicates that there is at least some sensitivity to liquefaction response beneath the site – however it is considered that these checks in combination with the conservative 1m groundwater adoption is an over-conservative approach to modelling the site holistically. It is our professional opinion that the total liquefaction susceptibility of the site is expected to be low, and the any liquefaction effects that may manifest is likely to be within conventional shallow foundation tolerances (outside of the 10m proximity zone outlined in Section 6.3.4 above)

6.3.6 Liquefaction Conclusions

Based on the overall 'low' potential susceptibility to liquefaction (LPI), low calculated vertical settlements, low prediction of ground damage and liquefaction effects at the ground surface (LSN, severity); it is considered that the site has an overall low susceptibility to liquefaction at the SLS and MLS levels, which is supported by the theoretically 'low' liquefaction severity (LSN) values, and reasonable sensitivity check responses.

However based on the investigation data, the 0-10m zone from any significant crest slopes (tributaries, gullies) >1V:4H (14° from the horizontal) is considered to have a non-zero risk of experiencing significant lateral spreading effects. As such, it is considered appropriate that all inhabitable building foundations within the 10m slope proximity zone should incorporate a level of liquefaction tolerance equivalent to TC2 foundation systems (i.e. timber-piles, enhanced waffle-slabs, engineered gravel rafts), unless the risk is otherwise discounted during building-specific geotechnical testing.

6.4 Compressible Ground and Consolidation Settlement

The organic clayey SILT (topsoil) encountered beneath the site down to 0.25-0.60m bgl is expected to be subject to consolidation due to loading. This layer will need to be removed from the underside of any foundation footing or slab in order to avoid long term deformation of the building. Apart from this surficial layer, there does not appear to be any compressible ground beneath the building site as defined by NZS3604 (2011).

Additionally a minor amount of organic content may have developed within the soils beneath the Lot 11 & Lot 15 encroaching gullies. As these gullies are expected to be infilled during the bulk development of the Lot, settlement allowances should be considered beneath these areas (refer Section 7.2.1 below for preliminary infilling recommendations).

Two of the CPT profiles (CPT02 & CPT06) also partially interpreted the identified clay layers between approximately 2-4m as being an organic-containing soil, which is typically prone to significant long-term decomposition and settlement. Although adjacent Test Site retrieval of these soils at the correlating depths was limited, no significant organic materials were discerned outside of the Lot 15 gully base. It is noted that the CPT modelling software tends to over-predict on the classification of particularly soft clays, with hand-augered physical retrieval of materials being CPT-classified as “organic” rarely verifying the materials as containing any notable organic material. As such, the clay layer is not considered to be significantly organic, and this layer is not considered at any risk of decomposition-induced settlement.

In addition, based on the intended residential nature of the overall development, the Lots are generally expected to accommodate conventional lightweight residential building loads which are typically predominantly dispersed within the upper 2-2.5m of the soil column. This is reinforced by a simplified settlement check via CPeT-IT v3.0 on CPT02 (the thickest theoretical organic layer) which indicated primary, consolidation, and total settlements over the design life of standard building sizes and loads to be within conventional tolerances. As such, we consider that the risk of organic-decomposition induced settlement beneath the Stage 3 Lots to be insignificant, however this should be reassessed specific to the findings of the structure-specific testing expected to be required by Central Hawke’s Bay District Council in support of building consent application(s), particularly if any two story heavy building construction is proposed.

6.5 Ground Shrinkage and Swelling Potential

Plastic soils can be subject to shrinkage and swelling due to soil moisture content variations which can result in apparent heaving and settlement of buildings, particularly between seasons. The Test Site soil descriptions identify the near-surface soils as generally ranging between low and high plasticity. During field testing soil samples were taken at two points (Figure 15) between 0.4-0.8m depth within the proposed Stage 3 development area. Laboratory analyses were conducted on each sample in order to accurately determine the following soil characteristics:

1. Particle Size Distribution (hydrometer method)
2. Atterberg Limits (liquid limit; plastic limit; derived plasticity index)
3. Linear Shrinkage Percentage.

All tests were conducted in accordance with NZS 4402:2.2:1986. The results of the soil tests are included in Appendix D.

Figure 15: Soil Analysis sample locations taken from within the Stage 3 area.

The particle size distributions of the samples indicate that the soils can be classified as clayey (25-40%) SILT (55-60%), with minor sand (5-15%) in accordance with current NZGS Guidelines (2005). Note that this that this is a refinement of the general silty CLAY field descriptions used throughout the majority of the Stage 3 investigation points, although it should also be noted that >30% clay in a sample will tend to result in clay-like behaviour of the soil.

The Atterberg Limit test results for the samples yielded the following:

- Liquid Limit: 50-79% (approximating or exceeding the NZS3604:2011 limiting value of 50%).
- Plastic Limit: 20-27%
- Plasticity Index: 30-52%
- Natural Water Content (at time of sampling): 22-30%

The above soil limit results equate to soils having a high plasticity and inferred expansivity potential.

However, the laboratory test results yielded linear shrinkage values of 12-15%, presenting the potential soil mass change between various soil moisture states i.e. potential volume change between extreme shrink (dry) and swell (saturated) soil conditions. This value is relatively moderate in terms of the severeness of the shrink/swell effects, with NZS3604:2011 having a limiting value of 15% for the definition of expansive soils.

Similarly, if the modified plasticity index (I'*p*) is adopted, which considers the amount of clay within the soils in relation to the total plasticity index, then the samples would be considered to have a 'Low' volume change potential.

Based on the numerical soil characteristics related to soil expansivity potential, we consider that the Stage 3 near-surface soils are very likely to undergo a degree of seasonal ground shrinkage and swelling behaviour. However the effects of these soil behaviours are indicated to be relatively minor. This is likely due to the soils having lesser clay proportions than indicated within the initial field descriptions, which typically have the greatest influence towards shrink/swell manifestations. Nevertheless the Stage 3 soils are still considered to be at least moderately expansive, and therefore modifications to the foundation designs are required to allow for the expansive effects to occur beneath the buildings. Consideration of these effects have been factored into preliminary foundation recommendations presented in Section 7.3 below.

6.6 Tree Root Deformation

Trees within close proximity to buildings can result in potentially significant building damage due to heaving as a result of tree root growth, and also settlement due to soil shrinkage from the moisture uptake of the roots.

There are a number of medium to large sized trees situated along the border of proposed Lots 8, 9, 42, & 50. It is considered that these trees may have the potential to result in soil settlement due to the uptake of water from the tree roots or ground heave from tree root growth. It is recommended that any building foundation should setback at least **5m** from the base of the trees **unless** the detrimental effects of the root growth be mitigated by deepening the foundation footings beyond the primary effect zone of the root system. A 1m bgl founding depth is considered suitable for this purpose. Alternative mitigation measures may be able to be facilitated if necessary upon review of the specific building configuration and design.

6.7 Slope Stability

A detailed slope stability assessment was outside of our scope of works.

Due to the observed moderate and potentially unstable slopes belonging to parts of the tributary stream and lateral gullies encroaching into Lots 11 & 15, conservative building setbacks are recommended in order to isolate the building from potential slope instability and the development of long term soil creep. The recommended building setback is as follows:

- 10m back from the crest of any crest / break of slope greater steeper than 1V:4H (18° from the horizontal).

This setback may be able to be refined at the building consent stage following the completion of a detailed slope stability assessment and foundation appraisal.

6.8 Conclusions

From our assessment of the natural hazard and ground deformation risks presented to the proposed development we consider that a building can be safely located on the site, provided that the recommendations given in Section 7 are adhered to.

7 Engineering Recommendations

7.1 General

It should be appreciated that the recommendations given below are based on the surface and subsurface conditions encountered at the time of the investigation. In addition to the possible variations in the subsurface conditions away from the investigation points within and around the site, changes to the site levels can have a dramatic effect on the recommendations given. We should be contacted immediately should the ground conditions encountered vary from that described in this report.

7.2 Site Development

As the site is essentially flat (<5°), no significant developmental earthworks are expected to be carried out across the majority of the Lots in order to form the building platforms at the site, beyond the excavation and removal of the topsoil from within the building footprints and the expected infilling of Lot 11 & Lot 15 encroaching gullies.

7.2.1 Gully Infilling

A degree of gully infilling is expected to be undertaken, which should be preceded by a specific filling design plan separate to this report, particularly as the infilled areas are intended to be able to accommodate inhabited dwellings in the future. TS08 has been conducted within the base of the Lot 15 gully, which gives some indication of the underlying soil strength and material content. Careful consideration should be given in regard to the effects of the underlying soils under the induced weight of the applied fill overburden. A degree of consolidation settlement can be expected to occur within the soil layers beneath the fill.

If considered necessary during the specific design of the infill process, an appropriate amount of time should be allowed to pass after the fill placement and before further overlying development of the infilled areas - this is to ensure that any underlying soils undergo the majority of their potential consolidation prior to the placement of any overlying structure. Note

that the consolidation process may take years to occur due to the low permeability of the underlying clays resulting in an expected very slow pore-water dissipation process. This process could be accelerated with the addition of sub-surface wick drains or equivalent measures such as over-filling during construction.

7.2.2 Site Contouring and Topsoiling

Any developed cut-slopes or fill-slopes should be covered with topsoil a minimum of 0.10m thick to prevent the ground from drying out readily resulting in the development of cracks. This is particularly important for the fill materials that are particular to this site due to their high reactivity (shrink – swell behaviour).

The finished ground level should be graded so that water cannot pond against, beneath or around the building for the economic life of structure. To achieve this it will be important that the building platform beneath the topsoil grades away from the site.

Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

7.2.3 Access Road Construction

Careful consideration should be given to any earthworks conducted to create the proposed access road as presented within the current scheme plan (Figure 3), which should include topsoil stripping and the compaction of replacement fill in layers. Geotechnical testing (refer to Appendix B: AW01-08) has been conducted along the proposed road alignment (Figure 16) and should be referred to during the civil design of the road.

Based on our interpretation of the investigation findings, we recommend that the proposed road formation can be designed to a CBR value of 3%.

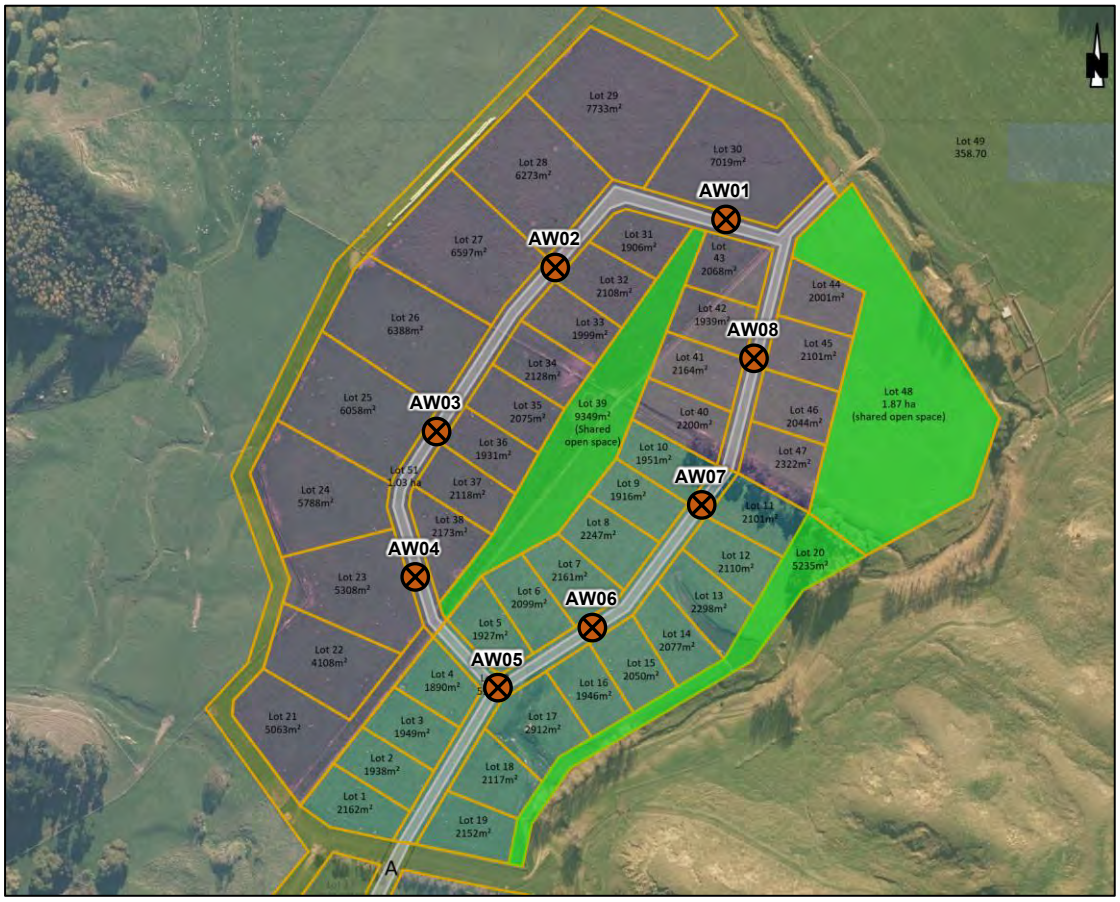

Figure 16: Location of accessway (AW) investigation points conducted along the proposed road alignment. (Source: client supplied document, with investigation points overlay).

The table drain for the access road should be sized to provide sufficient capacity for a 1:100 year rainfall event. Culvert pipes should be placed at regular intervals down along the access road, with discharge to the convex slope (i.e. side spurs) rather than the concave gully areas, unless water is discharged to an existing watercourse. Culvert pipes should extend well clear of any fill. Adequate protection at the discharge point should be set in place.

7.3 Preliminary Foundation Design & Construction Recommendations

Given the information recovered on the site, we consider that most conventional shallow foundation systems would be appropriate for this site, provided they are modified for the available bearing capacities and potentially expansive soils identified beneath the site, as detailed below.

Ground with a Geotechnical Ultimate Bearing Capacity (GUBC) of at least 300kPa (allowable bearing pressure of at least 100kPa) is generally encountered throughout the majority of the Test Sites, however some lower strength near-surface soils were also identified (most notably TS02-Lot 25, TS12-Lot 50, and AW05). As such it is considered appropriate for resource consent purposes that all Lot developments should assume an available GUBC of 210kPa

(70kPa allowable) for foundation design, unless redefined with building specific testing expected to be required during the subsequent building consent process.

Based on the available bearing capacities and potential expansivity of the near-surface soils we recommend the following foundation options to be suitable for development within the assessed Lots. Note that the below options specifically refer to buildings placed outside of the 10m slope proximity zone specified within Sections 6.3 & 6.7:

1. A Specifically Engineered Design (SED) timber-piled and timber-floored foundation system, designed to the available bearing capacity denoted above AND deepened to a minimum of 0.6m bgl in order to mitigate against the expansivity potential of the bearing soils. In lieu of SED, all piles can be constructed as anchor piles, including connection details (the 0.6m minimum requirement still applies).
2. Conventional NZS3604 (2011) shallow concrete floor foundations (e.g. strip footing, slab-on-grade) on a conventional topsoil hardfill replacement (0.25-0.6m bgl) provided that the foundation footings are widened by a factor of 1.43 (i.e. nominal 165mm wide strip footings increased to approximately 240mm) AND foundation footings deepened to a minimum of 0.6m bgl in order to address the available bearing capacity and expansivity potential of the bearing soils.
3. Conventional waffle-slab systems (including proprietary waffle designs e.g. Cupolex, Ribraft, X-Pod, Q-Pod, etc), provided that are designed to the available bearings capacities and are confirmed suitable to allow for potential expansivity effects beneath the building.

Note that the above designs may not be suitable for buildings situated within the 10m slope proximity zone. It is recommended that further geotechnical testing be undertaken for all proposed buildings within this zone in order to assess and mitigate against potential lateral spreading and slope instability effects.

All topsoil present beneath any floor slab (Options 2 & 3 above) will need to be removed from the footprint area and replaced with engineered fill to minimise the potential for differential settlement which could have an adverse effect on the building. For conventional waffle slab systems (Option 3) The excavation for the replacement fill should extend beyond the footprint of the building by at least 1.0m to provide the lateral support for the building loads.

As the fill beneath the slab is to support the loads of the building it will need to be certified by a Chartered Geotechnical Professional Engineer or Professional Engineering Geologist in accordance with NZS4431 (1989), as required by NZS3604 (2011) “Timber Framed Buildings” and NZS4229 (2013) “Concrete Masonry Buildings Not Requiring Specific Engineering Design”. If certification is not achieved, specific engineering design will be required to comply with the NZ Building Code.

Following an inspection of the excavation by the certifying Engineer (LDE) or their representative, its base should be compacted prior to the placement of the new fill. The replacement fill should comprise suitable well graded granular material (GAP 40 or 65), placed uniformly into the excavation in layers not exceeding 150mm in thickness. The fill should be placed at the optimum moisture content recommended by the suppliers of the material. Alternatively, the material should be inspected and approved as suitable material by the certifying Engineer or their representative. Material which is wet or saturated should not be placed into the excavation unless that is the optimum moisture content for the fill.

The fill should be compacted to achieve the minimum strengths given in Table 5 below.

Table 5: Recommended Fill Compaction Criteria

Dynamic penetrometer (non-cohesive fill)		
	Average value not less than	3 blows/50mm
	Minimum single value	2 blows/50mm

Compaction should be carried out using 5 - 7 passes over each lift with a vibratory steel drum roller. Compaction using a Bobcat, excavator, truck or other vehicle other than a compactor is not likely to achieve the required strength for the fill to be certified.

Provision should be made to ensure that the earthworks are conducted with due respect for the weather. The fill should not be placed into a saturated excavation, especially if ponded water is present.

Vibration compaction should not be used if the base of the excavation is wet or if the fill is wet of optimum otherwise the fill strength may be significantly reduced from the resultant moisture uptake until the excess pore pressures have dissipated. The time for this to occur is variable, but is likely to take more than one day.

7.4 Verification Checks

7.4.1 Fill Placed beneath Foundations

As required by NZS3604 (2011) and NZS4229 (2013), any fill beneath the building will need to be certified by a Chartered Professional Engineer or Professional Engineering Geologist in accordance with NZS4431 (1989). A “Certificate of Suitability of Earthfill for Residential Development” will also be required in accordance with NZS3604 (2011) and NZS4229 (2013).

In order for the fill to be certified, the excavation will need to be inspected by the certifying Engineer or Engineer’s representative to ensure that all compressible materials are removed prior to the placement of the new fill.

Verification strength testing of the backfill by the certifying Engineer or Engineer's representative will also be required to ensure that the minimum fill strengths specified in this report have been achieved.

7.4.2 Foundation Excavations

Verification testing of the ground by a Suitably Qualified Professional is recommended to ensure that the ground conditions at the base of the foundation excavations are as described in this report, and that all unsuitable and loose materials have been removed as required by NZS3604 (2011) and NZS4229 (2013). We should be contacted immediately if these conditions vary from that described in this report. Deepening of the foundations or a modification to the recommendations or design may be required.

7.5 Surface Water Disposal

It is important to ensure that all surface water from roof, paved and retaining wall areas is appropriately collected and discharged to a suitable point sufficiently away from any of the proposed building areas and any areas of fill. Discharge of stormwater into the nearby tributaries is considered appropriate providing that the discharge point is protected to inhibit erosion.

The stormwater system for each building should be operational as soon as the roof is in place. This is to ensure that the ground within the vicinity of the building is not compromised by the negative effects and potential consequences of soil saturation.

7.6 Effluent Disposal

On-site treatment and disposal of wastewater will be required and should be carried out in accordance with AS/NZS1547 (2012).

Due to low permeability of the near-surface soils it is considered that conventional absorption trench or secondary treatment drip irrigation fields may be used, provided that they are modified for the underlying clayey soils.

We recommend that effluent disposal fields be located at least 3m away from all footings and 1.5 times the height of any retaining walls.

We recommend that as-built drawings be prepared documenting the position of the effluent treatment system, including all connecting pipe work.

7.7 Service Pipes

All service pipes, stormwater structures, and culverts should be designed and constructed to ensure adequate capacity, strength, and water tightness to prevent leakage into the platform through blockage, running under pressure, or structural failure.

All service pipes installed within the fill should be flexible, or flexibly joined, so that they may deflect without breaking if the ground settles. A record should be kept of the position, type, and size of all subsoil drains, and in particular of their outlets.

7.8 Garden Trees and Shrubs

We consider that that gardens and trees can be established adjacent to the building, however due to the detrimental effect that these can have on the building (particularly trees) we suggest the following be taken into consideration:

- The development of the gardens should not interfere with any subfloor ventilation or the drainage system for the building.
- Care should be taken to avoid the over watering of gardens close to building footings.
- To reduce the potential for heave damage associated with tree root growth or foundation settlement due to soil shrinkage due to moisture uptake by the trees, trees should be planted a minimum of 0.5 times the mature height of the tree away from the foundation.

7.9 Site Maintenance

Prompt repair of plumbing leaks should be undertaken. Blocked, broken or faulty spouting should be attended to immediately.

The discharge of uncontrolled surface water over the site and surrounding areas should be avoided at all costs.

8 Other Considerations

This report has been prepared exclusively for Bridge Farming Partnership with respect to the particular brief given to us in support of a resource consent application to Central Hawke's Bay District Council. Information, opinions and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any other third party.

This report was prepared in general accordance with current standards, codes and practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods, and subsurface investigations at discrete locations. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from that described in this report.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

For and on behalf of LDE Ltd

Report prepared by:

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Report reviewed & authorised by:

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Chartered Professional Engineering Geologist

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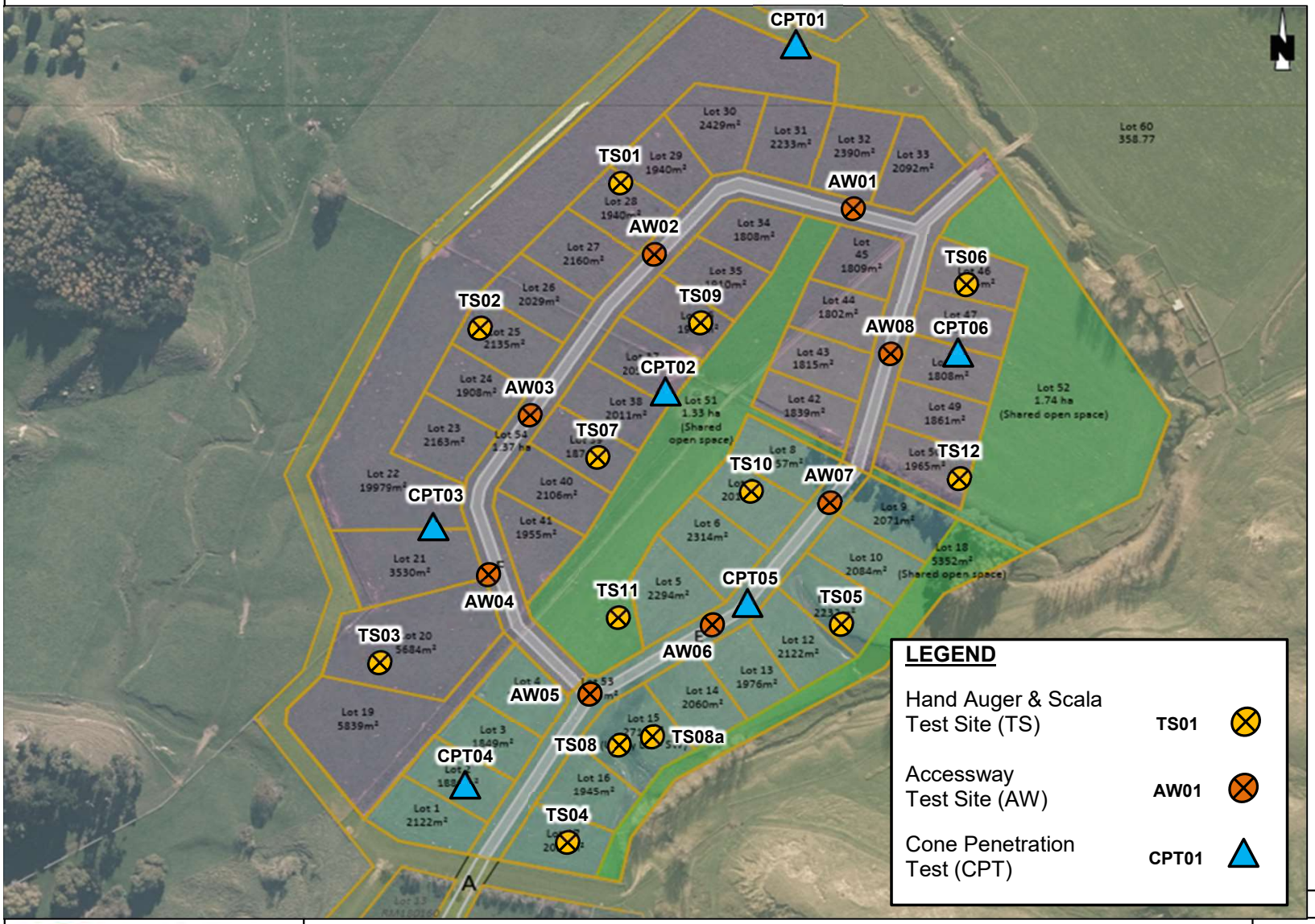
APPENDIX A

GEOTECHNICAL INVESTIGATION PLAN



LDE LAND DEVELOPMENT & ENGINEERING LTD.

Lot 1 DP 27067 Punawaitai Road, Pourerere
Stage 3 Geotechnical Investigation Plan

DRAWN	RL
CHECKED	DD
DATE	9-Aug-21
PROJECT	14668.2

APPENDIX B

SUBSURFACE INVESTIGATION DATA

Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW01**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555477mN, 1930044mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; light brownish grey. Stiff; moist to wet; low plasticity; sand, fine; trace rootlets.	Topsoil
0.5	Silty CLAY; yellowish grey with light orange mottles. Stiff to hard; moist; low plasticity.	Holocene Alluvial Deposits
0.6	0.6m: High plasticity.	
0.8	0.8m - 1.0m: Friable.	
1.1	1.1m: Trace iron nodules, dark brown, fine.	
1.2	1.2m - 2.0m: CLAY; light grey with dark orange mottles. Stiff to hard; moist; high plasticity.	
1.8	1.8m: Wet.	

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm) — 2, 4, 6, 8

Shear Vane, Su (kPa) — 50, 100, 150, 200

Depth (m)	Test Values
0.0	98 / 27
0.5	55 / 29
0.6	127 / 58
0.8	202+
1.0	202+
1.1	202+
1.2	202+
1.5	190 / 40
1.8	170 / 59
2.0	91 / 40

Hole Depth: 2.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW02**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555447mN, 1929939mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL/LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; low plasticity; sand, fine; trace rootlets.	Topsoil
0.5	Silty CLAY; light yellowish grey with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
0.8	0.8m - 1.1m: CLAY; light grey with light orange mottles. Very stiff; moist; high plasticity. 0.9m: Trace nodules, dark brownish grey, fine. 1.0m: Heavy mottling.	
1.1	Sandy SILT; light yellowish grey with light orange mottles. Very stiff to hard; moist; non-plastic; sand, fine.	
1.8	CLAY, with some silt; light grey with light orange mottles. Stiff to very stiff; moist to wet; high plasticity; trace iron nodules, dark reddish brown, fine. 1.8m: Wet; minor sand, fine; wet.	
2.0		
2.5		
3.0		
3.5		
4.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	104 / 32
1.0	127 / 40
1.5	120 / 45
2.0	157 / 48
2.5	143 / 55
3.0	202+
3.5	202+
4.0	164 / 43
	104 / 40
	79 / 43

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW03**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555341mN, 1929845mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH/LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets; trace charcoal, fine.	Topsoil
0.5	Silty CLAY, with minor sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits
1.0	0.7m - 2.2m: CLAY; light grey with light orange mottles. High plasticity.	
1.5	1.9m: Wet.	
2.0	2.0m - 2.1m: Silty CLAY; dark orange. Stiff; low plasticity.	
2.5		
3.0		
3.5		
4.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	127 / 48
1.0	134 / 67
1.5	136 / 61
2.0	147 / 64
2.5	176 / 56
3.0	187+
3.5	187+
4.0	187+
	80 / 32
	83 / 52

Hole Depth: 2.20m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW04**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555232mN, 1929809mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL/LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; low plasticity; sand, fine; trace rootlets.	Topsoil
	Silty CLAY; light yellowish brown. Very stiff; moist; high plasticity.	Holocene Alluvial Deposits
0.4	0.4m: Minor sand, fine.	
0.6	0.6m: Sand absent.	
1.0	1.0m - 2.0m: CLAY; light grey with light orange mottles. Very stiff to hard; moist; high plasticity.	
1.2	1.2m: Trace nodules, dark brownish grey, fine.	
1.5	1.5m: Heavy mottling.	
1.7	1.7m: Wet.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	89 / 29
	118 / 40
	104 / 36
	156 / 58
1.0	202+
	185 / 32
	170 / 43
1.5	137 / 43
	130 / 48
2.0	87 / 43
2.5	
3.0	
3.5	
4.0	

Hole Depth: 2.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW05**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555114mN, 1929850mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; non-plastic; sand, fine.	Topsoil
0.5	Clayey SILT; light yellowish brown with lioght orange mottles. Stiff; wet; low plasticity.	Holocene Alluvial Deposits
0.8	0.8m: High plasticity.	
0.9	0.9m - 1.9m: CLAY; light grey with light orange mottles. Very stiff; dry to moist.	
1.2	1.2m: Moist.	
1.4	1.4m: Some silt.	
1.8	1.8m: Moist to wet.	
1.9	1.9m - 2.0m: SAND, with some silt; light yellowish grey. Dense; moist to wet; sand, fine.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.0	78 / 23
0.5	94 / 29
1.0	63 / 35
1.5	115 / 43
2.0	199 / 29
2.5	189 / 26
3.0	190 / 20
3.5	196 / 35
4.0	195 / 30
	150 / 58

Hole Depth: 2.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW06**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555196mN, 1929961mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; dry to moist; low plasticity; sand, fine; Trace rootlets.	Topsoil
0.5	Silty CLAY; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
0.7	0.7m - 2.0m: CLAY; light grey with light orange mottles. High plasticity.	
1.0	1.0m: Dry to moist.	
1.2	1.2m: Moist; trace iron nodules, dark reddish brown, fine.	
1.8	1.8m: Moist to wet.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.0	104 / 29
0.5	141 / 43
1.0	98 / 36
1.0	104 / 40
1.0	190 / 58
1.2	190 / 30
1.5	199 / 33
1.5	185 / 43
1.8	147 / 46
2.0	120 / 50

Hole Depth: 2.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW07**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555271mN, 1930027mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; dry to moist; non-plastic; sand, fine; trace rootlets.	Topsoil
	Silty CLAY; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
0.6	0.6m - 2.0m: CLAY; light grey with light orange mottles. High plasticity.	
1.0	1.0m: Trace iron nodules, dark reddish brown, fine.	
	1.1m: Dry to moist.	
	1.2m - 1.4m: Minor sand, fine.	
	1.3m: Moist.	
1.7	1.7m: Wet.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	130 / 36
	108 / 42
	112 / 46
	118 / 58
1.0	180 / 55
	202+
	173 / 46
1.5	151 / 52
	92 / 32
2.0	68 / 35
2.5	
3.0	
3.5	
4.0	

Hole Depth: 2.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**AW08**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555376mN, 1930064mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	RL/LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2523

Depth (m)	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm)	In-situ Testing: Shear Vane, Su (kPa)	Test Values
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; low plasticity; sand, fine; trace rootlets.	Topsoil				104 / 29
0.5	CLAY; light grey with light orange mottles. Very stiff to hard; moist; high plasticity.	Holocene Alluvial Deposits				114 / 45
						115 / 55
	0.8m: Heavily mottled.					118 / 43
1.0	1.0m: Trace iron nodules, dark reddish brown, fine.					115 / 55
	1.2m: Minor sand, fine.					202+
	1.4m: Moist to wet.					202+
1.5	1.6m: Wet.					108 / 43
						78 / 40
2.0						85 / 35
2.5						
3.0						
3.5						
4.0						

Groundwater Not Encountered

In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) — 2, 4, 6, 8

In-situ Testing: Shear Vane, Su (kPa) — 50, 100, 150, 200

Depth (m): -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0

Hole Depth: 2.00m

Termination: Reached target depth

Remarks: 0.4-0.8m bgl: soil sample retrieved for expansivity laboratory testing.

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**TS01**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555502mN, 1929904mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
0.5		
1.0	Clayey SILT; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
	CLAY; light grey with light orange mottles. Very stiff to hard; moist; high plasticity. 1.1m - 1.2m: Sandy SILT. 1.2m: Minor sand, fine.	
1.5		
	1.9m: Some sand, fine to medium.	
2.0		
2.5		
3.0		
3.5		
4.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values
149 / 60
141 / 32
UTP
205+
190 / 76
161 / 67
123 / 29
184 / 82

Depth (m): -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0

Hole Depth: 2.20m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS02**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555403mN, 1929813mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; trace rootlets.	Topsoil
0.5	Silty CLAY, with minor sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits
0.8	0.8m - 1.0m: CLAY; light grey with light orange mottles. High plasticity.	
1.0	Silty SAND; light yellowish grey with light orange mottles. Dense; dry to moist; sand, fine to medium.	
1.5	CLAY, with minor silt; light grey with light orange mottles. Very stiff; moist; high plasticity.	
1.7	Sandy SILT; light greyish brown with dark orange mottles. Stiff; moist; non-plastic; sand, fine to medium.	
2.0	Silty CLAY; light grey with light orange mottles. Stiff; moist; low plasticity.	
1.9	1.9m: Wet.	
2.2		

Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	134 / 48
0.5	168 / 67
0.5	182 / 60
1.5	160 / 69
1.7	86 / 43
2.0	67 / 37
2.0	64 / 35
2.0	65 / 40

Hole Depth: 2.20m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**TS03**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555175mN, 1929742mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
	Silty CLAY, with some sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits
0.4	0.4m: Minor sand.	
0.8	0.8m - 1.2m: CLAY; light grey with light orange mottles. High plasticity.	
1.2	Silty SAND; light grey with light orange mottles. Medium dense; dry to moist; sand, fine to medium.	
1.6	CLAY, with minor silt; light grey with light orange mottles. Very stiff; moist; high plasticity.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values	Depth (m)
154 / 51	-0.5
160 / 67	
187+	
134 / 60	-1.0
134 / 60	
147 / 40	-1.5
163 / 67	
147 / 80	-2.0

Hole Depth: 1.90m

Termination: Borehole swelling, low recovery

Remarks: 0.4-0.8m bgl: soil sample retrieved for expansivity laboratory testing.

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS04**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555047mN, 1929854mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
	Sandy SILT, with some clay; light yellowish brown with light orange mottles. Very stiff; moist; non-plastic; sand, fine.	Holocene Alluvial Deposits
0.4	0.4m - 2.1m: Clayey SILT, with some sand; light grey with light orange mottles. Low plasticity; sand, fine.	
0.6	0.6m: Minor sand.	
1.0	1.0m: Dry to moist.	
1.5	1.5m: Some sand, fine to medium.	
1.9	1.9m: Moist; some sand, fine.	
2.1	Silty CLAY, with minor sand; light grey with light orange mottles. Very stiff; moist; high plasticity; sand, fine.	

Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm) — 2, 4, 6, 8

Shear Vane, Su (kPa) — 50, 100, 150, 200

Depth (m)	Test Values
0	174 / 37
0.5	187+
	166 / 61
	187+
1.0	187+
	187+
1.5	187+
	184 / 64
	174 / 56
2.0	144 / 53
	127 / 53
	144 / 67
2.5	
3.0	
3.5	
4.0	

Hole Depth: 2.30m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS05**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555191mN, 1930025mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) 2 4 6 8 / Shear Vane, Su (kPa) 50 100 150 200	Test Values	Depth (m)
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil	Groundwater Not Encountered			0.0
0.5	Silty CLAY, with some sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits			127 / 64	-0.5
	0.8m: Light grey with light orange mottles. Moist.				107 / 64	
	0.9m: Some sand, fine to medium.				107 / 60	
1.0	Silty SAND; light grey with light orange mottles. Dense; dry to moist; sand, fine to medium.				187+	-1.0
1.5	1.5m: Interbedded with thin silt lenses, light grey.					-1.5
2.0						-2.0
2.5						-2.5
3.0						-3.0
3.5						-3.5
4.0						-4.0

Hole Depth: 1.60m **Termination:** Auger spin on dense sand

Remarks: Investigation points taken from crest of adjacent gully (gully floor testing unsuitable due to water)..

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

Vane peak | Vane residual | Vane UTP | Standing water level | Groundwater inflow | Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger + Scala

Test ID:	**TS06**				
Project ID:	14668.2				
Sheet:	1 of 1				
Client:	Bridge Farming Partnership	**Coordinates:**	5555422mN, 1930110mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; dry; non-plastic; sand, fine; trace rootlets.	Topsoil
0.5	Clayey SILT; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
1.5	CLAY; light grey with light orange mottles. Very stiff; moist to wet; high plasticity.	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values
104 / 51
105 / 50
157 / 67
161 / 73
133 / 61
141 / 63
145 / 67
123 / 64

Hole Depth: 2.00m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS07**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555312mN, 1929881mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
0.5	Silty CLAY, with minor sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits
0.7	0.7m - 2.2m: CLAY; light grey with light orange mottles. High plasticity.	
2.2		
4.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	131 / 47
0.5	131 / 51
0.5	187+
1.0	187+
1.0	187+
1.5	171 / 56
1.5	144 / 53
2.0	127 / 61
2.0	118 / 59
2.0	94 / 51

Hole Depth: 2.20m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS08**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555107mN, 1929893mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology	Water	In-situ Testing: Shear Vane, Su (kPa)	Test Values
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil			
0.5	Silty CLAY; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits			167 / 56 176 / 67
	0.7m: With minor sand; dark orange mottles. Sand, fine to medium.				184 / 67
1.0	Clayey SILT; light grey with light orange mottles. Stiff to very stiff; moist to wet; low plasticity.				111 / 51 79 / 18
	1.3m - 2.4m: SILT, with minor sand. Wet; low plasticity; sand, fine to medium.				51 / 18
1.5	1.6m: Water table.		▼		70 / 19
	1.8m - 2.5m: Bluish grey.				132 / 21
2.0	2.2m: Organic odor.				143 / 44 105 / 44
2.5	SAND, with some silt, with trace gravel; bluish grey. Dense; saturated; sand, fine to coarse; gravel, fine; organic odor.				UTP
3.0					
3.5					
4.0					

In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) 2 4 6 8

Shear Vane, Su (kPa) 50 100 150 200

Hole Depth: 2.50m **Termination:** Auger spin on dense sand

Remarks: Investigation point started from base of gully approximately 2m below surrounding ground level..

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

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

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS08a**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555119mN, 1929903mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology	Test Values
0.0	Moderately organic clayey SILT; dark brown. Stiff; moist; low plasticity; trace rootlets.	Topsoil	
0.5	CLAY; light yellowish brown with light orange mottles. Hard; moist; low plasticity.	Holocene Alluvial Deposits	205+ 201 / 85 205+
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Hole Depth: 1.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS09**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555402mN, 1929948mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with minor sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
0.5	CLAY; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity.	Holocene Alluvial Deposits
1.0	Sandy SILT; light grey with light orange mottles. Very stiff to hard; moist; low plasticity; sand, fine.	
1.5	CLAY; light grey with light orange mottles. Very stiff; moist; high plasticity. 1.8m: Moist to wet.	
2.0		
2.5		
3.0		
3.5		
4.0		

Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.5	170 / 61
1.0	196 / 85
1.5	161 / 67
2.0	205+
2.5	205+
3.0	205+
3.5	205
4.0	143 / 67
	123 / 59
	146 / 94

Hole Depth: 2.20m **Termination:** Reached target depth

Remarks:

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

Vane peak | Vane residual | Vane UTP | Standing water level | Groundwater inflow | Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS10**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555282mN, 1929975mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
	Silty CLAY, with minor sand; light yellowish brown with light orange mottles. Very stiff; dry; low plasticity; sand, fine.	Holocene Alluvial Deposits
0.5	0.4m - 1.7m: CLAY; light grey with light orange mottles. High plasticity.	
1.5	1.4m - 1.5m: SAND, fine to medium.	

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values
147 / 61
171 / 53
187+
166 / 67
152 / 56
187+
174 / 67
160 / 53

Depth (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0

Hole Depth: 1.70m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS11**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555200mN, 1929892mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	CH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	2856

Depth (m)	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) 2 4 6 8 / Shear Vane, Su (kPa) 50 100 150 200	Test Values	Depth (m)
0.0	Moderately organic clayey SILT, with some sand. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil	Groundwater Not Encountered			0.0
0.5	Silty CLAY, with minor sand; light yellowish brown with light orange mottles. Very stiff; moist; low plasticity; sand, fine.	Holocene Alluvial Deposits			91 / 43 128 / 53 154 / 76	-0.5
1.0	0.9m - 1.3m: CLAY; light grey with light orange mottles. High plasticity; <20% recovery, borehole swelling.				166 / 67 187+ 187+	-1.0
1.5						-1.5
2.0						-2.0
2.5						-2.5
3.0						-3.0
3.5						-3.5
4.0						-4.0

Hole Depth: 1.30m

Termination: Borehole swelling, low recovery

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: Ø50mm Hand Auger

Test ID:	**TS12**
Project ID:	14668.2
Sheet:	1 of 1

Client:	Bridge Farming Partnership	**Coordinates:**	5555297mN, 1930090mE	**Test Date:**	23/06/2021
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	LH
Location:	Lot 1 DP 27067 Punawaitai Road, Pourerere	**Elevation:**	Ground	**Checked By:**	DD
Test Site:	Refer to GIP	**Located By:**	GIS	**Vane ID:**	3051

Depth (m)	Material Description	Geology
0.0	Moderately organic clayey SILT, with some sand; dark brown. Stiff; moist; non-plastic; sand, fine; trace rootlets.	Topsoil
0.5	Clayey SILT; light yellowish brown with light orange mottles. Stiff to very stiff; moist; low plasticity.	Holocene Alluvial Deposits
1.0	CLAY; light grey with light orange mottles. Very stiff; moist to wet; high plasticity.	
1.5		
1.9	1.9m - 2.0m: SAND. Sand, fine to coarse; pumiceous.	
2.0		
2.2	2.2m - 2.4m: SAND; greyish orange. Moist to wet; sand, fine to coarse.	
2.5	SILT; light grey with light orange mottles. Very stiff; wet; low plasticity.	
3.0		
3.5		
4.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Depth (m)	Test Values
0.0	117 / 56
0.5	61 / 37
	111 / 53
1.0	132 / 60
	180 / 79
1.5	129 / 50
	132 / 50
2.0	102 / 59
	100 / 35
2.5	117 / 60
	129 / 44
3.0	146 / 79
3.5	
4.0	

Hole Depth: 3.00m

Termination: Reached target depth

Remarks:

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

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Cone Penetration Test (CPTu) Log

Test ID: CPT-01

Depth (m) | Cone resistance, qc (MPa) | Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa | Inclination (°) | Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT | SBT Description (filtered) | RL (m)

Pore Pressure (u2), kPa: ▽ = Water level ○ = Dissipation test

GWL measured 5.35m

SBT Description (filtered):

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

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LDE LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Ground water level located at 5.35m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555590mN
Easting:	1930013mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-01

Project ID:	14668
Depth:	15.52m
Sheet:	1 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Log

Test ID: CPT-01

Cone resistance, qc (MPa) / Sleeve friction, fs (kPa)

Pore Pressure (u2), kPa — = Water level, = Dissipation test

Inclination (°) / Penetration speed (cm/s)

Friction ratio, Rf (%)

SBT

Depth (m)	SBT Description (filtered)	RL (m)
11	Silt mixtures: clayey silt & silty clay	-11
12	Silt mixtures: clayey silt & silty clay	-12
13	Silt mixtures: clayey silt & silty clay	-13
14	Silt mixtures: clayey silt & silty clay	-14
15	Silt mixtures: clayey silt & silty clay	-15
	Silt mixtures: clayey silt & silty clay	
	Silt mixtures: clayey silt & silty clay	
	EOH: 15.52m	
16		-16
17		-17
18		-18
19		-19
20		-20

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 5.35m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555590mN
Easting:	1930013mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-01

Project ID:	14668
Depth:	15.52m
Sheet:	2 of 2
Date:	23/06/2021

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Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01

Depth (m) | Normalised cone resistance, Qt | Undrained shear strength, su (kPa) Nkt = 15 / Sensitivity | Friction Angle (°) / SPT N60 (blows/300mm) | Soil Behaviour Type Index, Ic | SBTn | SBTn Description (filtered) | RL (m)

Normalised cone resistance, Qt: 50, 100, 150, 200, 250, 300, 350
766>>
803>>
583>>
406>>

Undrained shear strength, su (kPa) Nkt = 15: 50, 100, 150, 200, 250
Sensitivity: 1, 2, 3, 4, 5

Friction Angle (°): 30, 35, 40, 45, 50
SPT N60 (blows/300mm): 10, 20, 30, 40, 50

Soil Behaviour Type Index, Ic: 1, 2, 3, 4, 5

SBTn: 2, 4, 6, 8

Depth (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

RL (m): -1, -2, -3, -4, -5, -6, -7, -8, -9, -10

SBTn Description (filtered):

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

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LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 5.35m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555590mN
Easting:	1930013mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

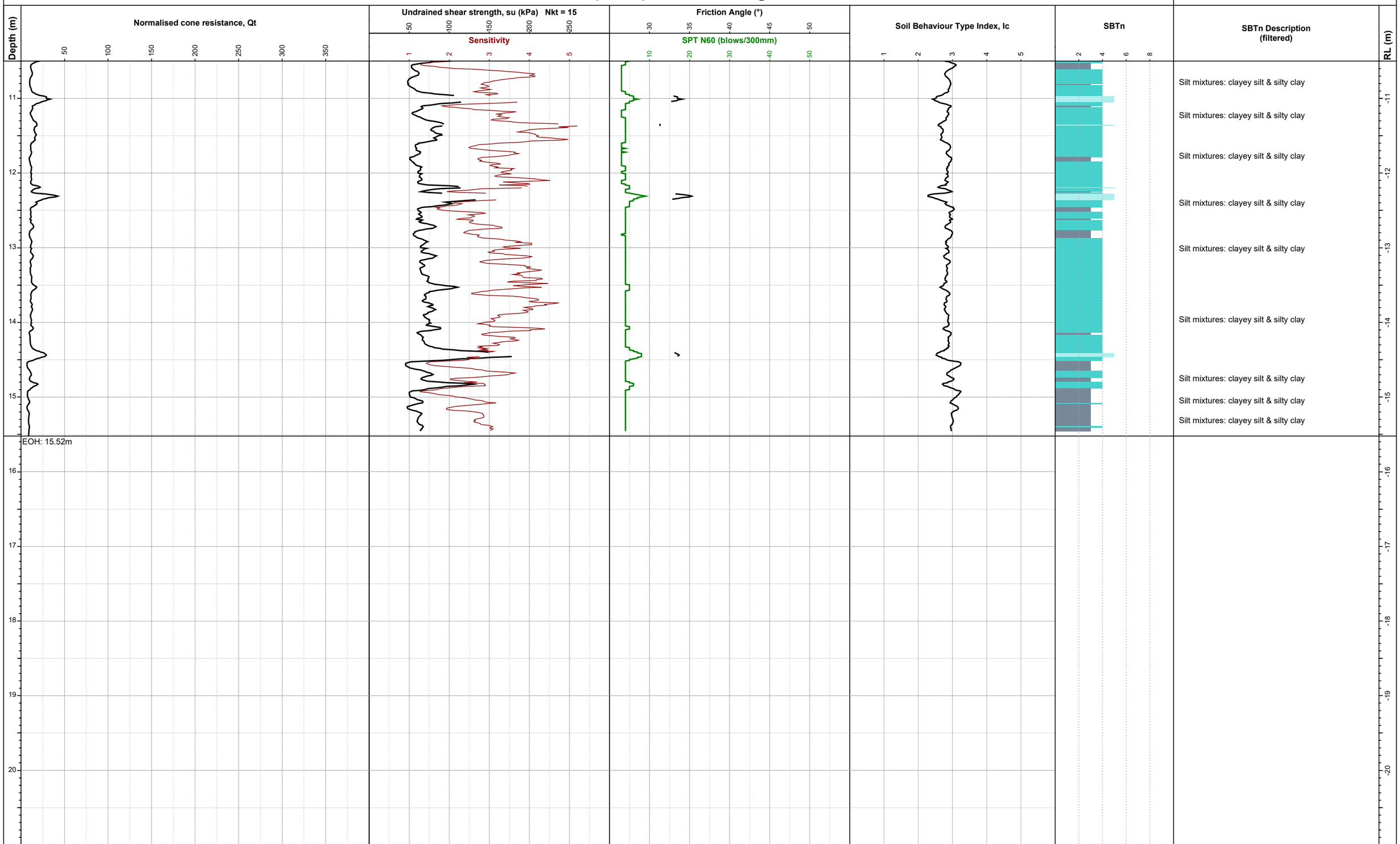
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-01

Project ID:	14668
Depth:	15.52m
Sheet:	1 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01



LDE LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Ground water level located at 5.35m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555590mN
Easting:	1930013mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-01

Project ID:	14668
Depth:	15.52m
Sheet:	2 of 2
Date:	23/06/2021

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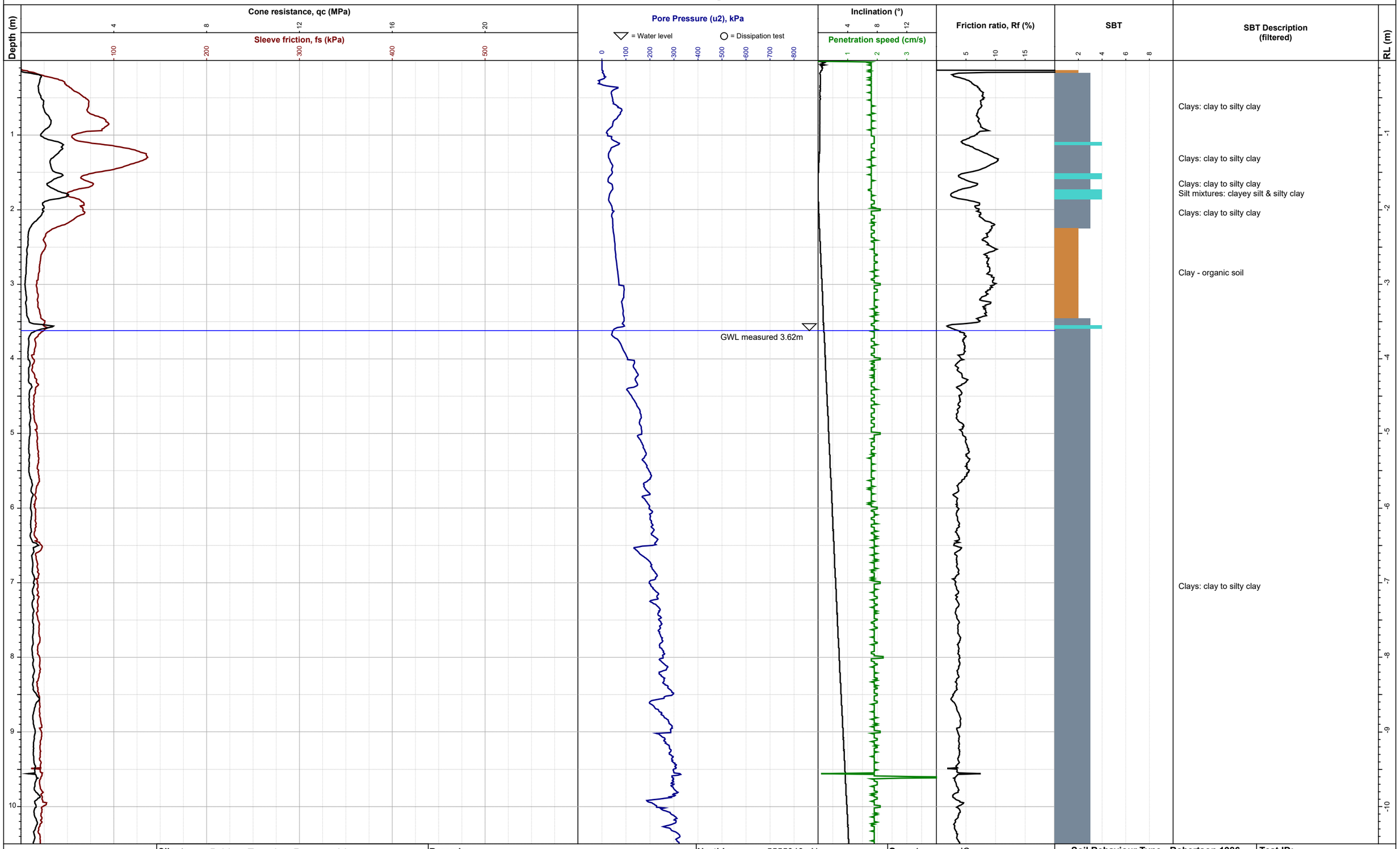
Cone Penetration Test (CPTu) Log

Test ID: CPT-02



Client:	Bridge Farming Partnership	**Remarks:** Ground water level located at 3.62m Test according to ISO 22476-1:12	**Northing:** 5555348mN	**Operator:** JC	**Test ID:** CPT-02
Project:	Geotechnical Investigation	**Termination Reason:** Target depth	**Easting:** 1929926mE	**Rig:** TG63-150 Pagani	**Project ID:** 14668
Location:	Punawaitai Road, Pourerere		**System:** NZTM	**Cone ID:** MKs650	**Depth:** 15.21m
			Elevation: Ground	**Type:** PC	**Sheet:** 1 of 2
			Located By: Pagani GPS	**Cone Area:** 10 cm²	**Date:** 23/06/2021
			Location:	**Sleeve Area:** 150 cm²	
				Area Ratio: 0.7864	

Soil Behaviour Type - Robertson 1986

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

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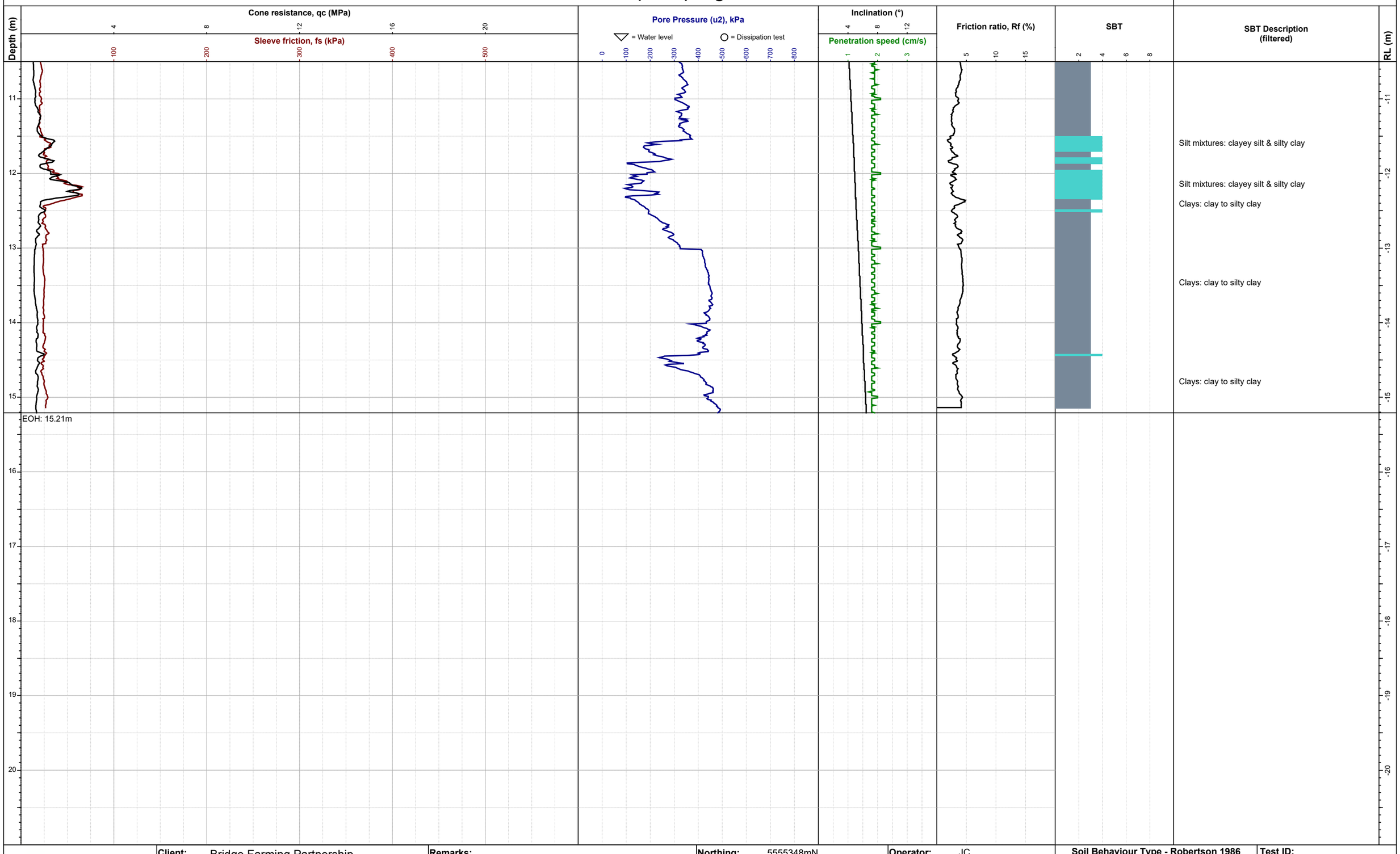
Cone Penetration Test (CPTu) Log

Test ID: CPT-02



Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:45 AM

LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Ground water level located at 3.62m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555348mN
Easting:	1929926mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

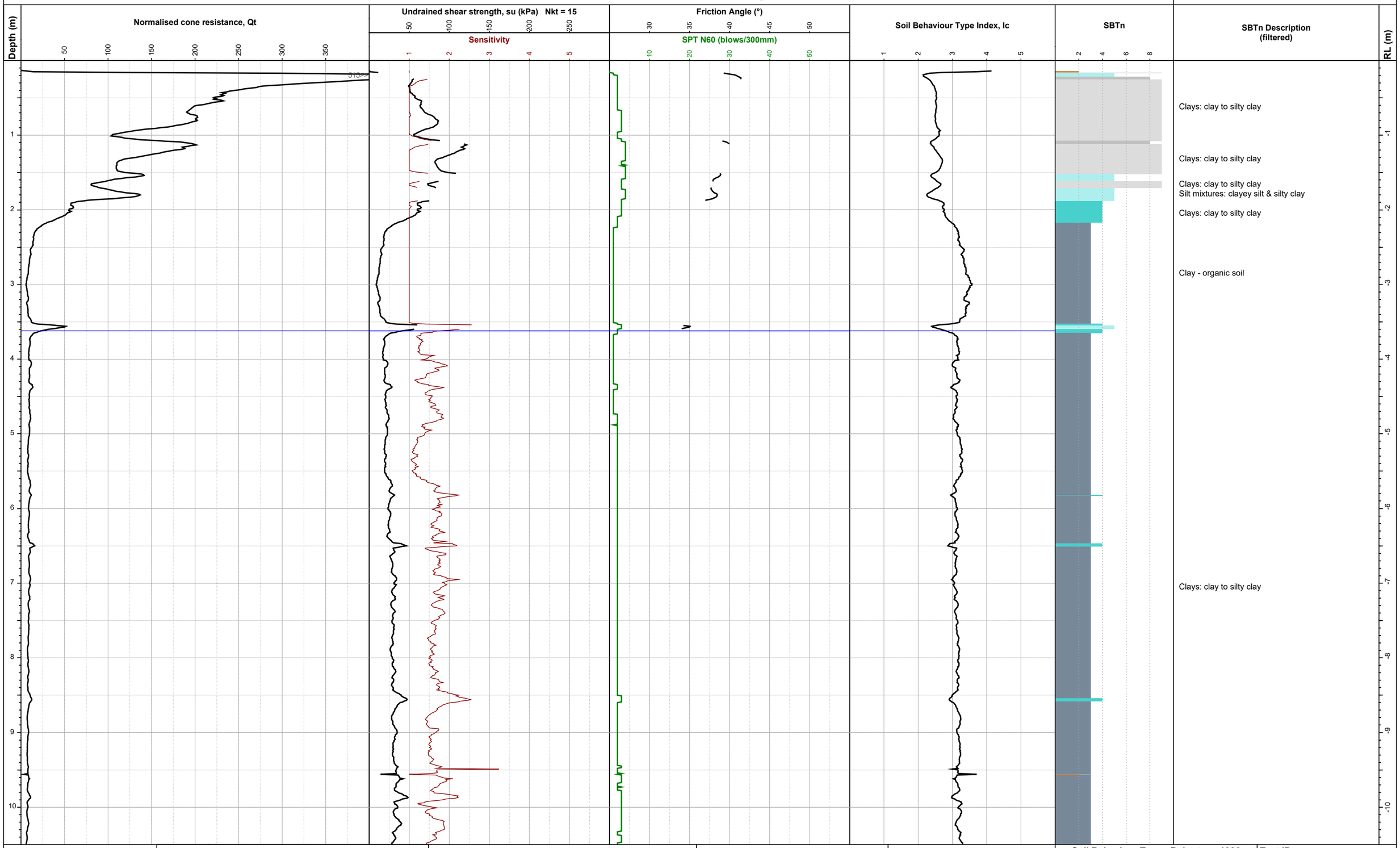
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-02

Project ID:	14668
Depth:	15.21m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-02**



Client:	Bridge Farming Partnership	**Remarks:** Ground water level located at 3.62m Test according to ISO 22476-1:12	**Northing:** 5555348mN	**Operator:** JC	**Test ID:** CPT-02
Project:	Geotechnical Investigation	**Termination Reason:** Target depth	**Easting:** 1929926mE	**Rig:** TG63-150 Pagani	**Project ID:** 14668
Location:	Punawaitai Road, Pourerere		**System:** NZTM	**Cone ID:** MKs650	**Depth:** 15.21m
			Elevation: Ground	**Type:** PC	**Sheet:** 1 of 2
			Located By: Pagani GPS	**Cone Area:** 10 cm²	**Date:** 23/06/2021
			Location:	**Sleeve Area:** 150 cm²	
				Area Ratio: 0.7864	

Soil Behaviour Type - Robertson 1986

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

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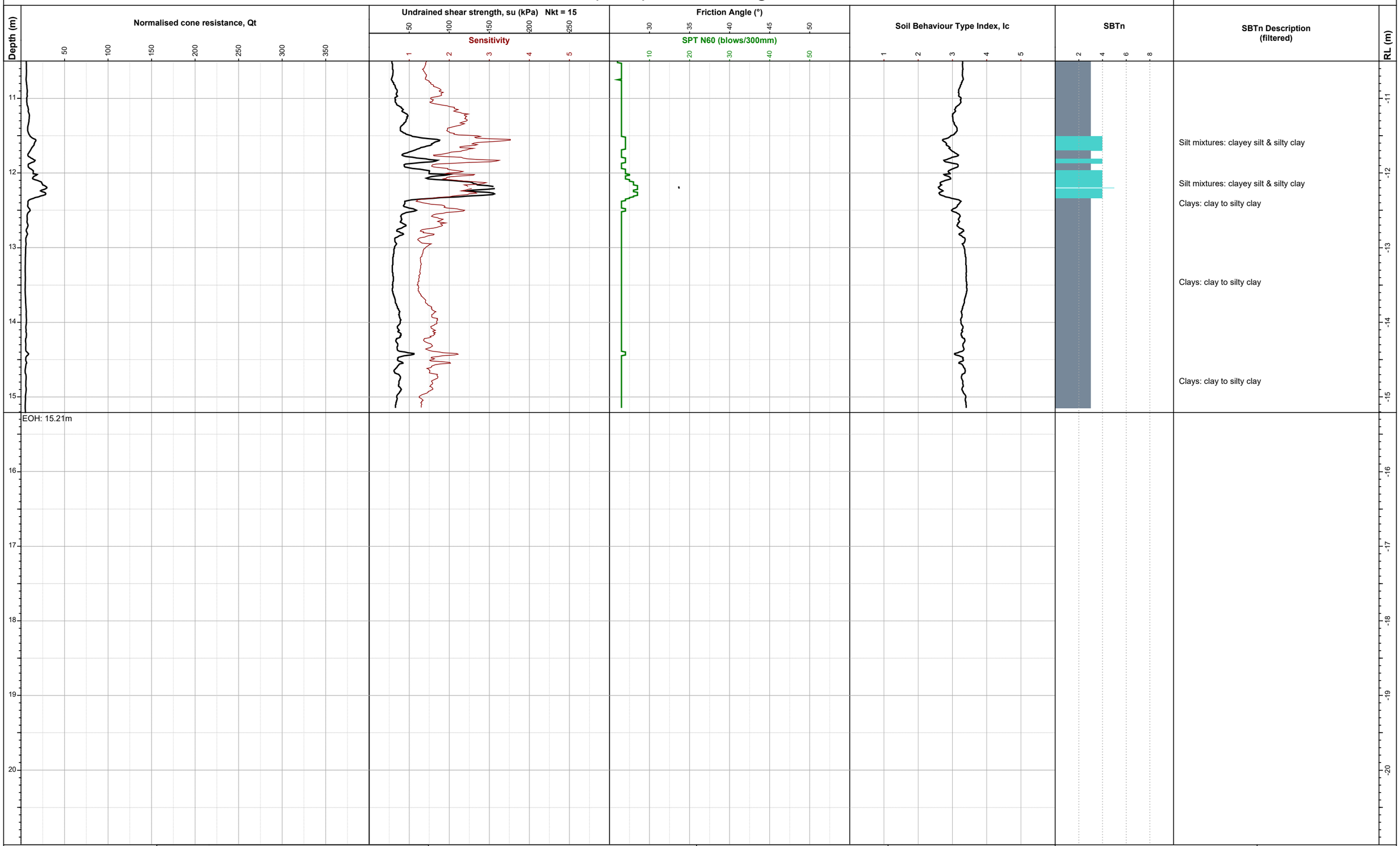
Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-02



LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Ground water level located at 3.62m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555348mN
Easting:	1929926mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-02

Project ID:	14668
Depth:	15.21m
Sheet:	2 of 2
Date:	23/06/2021

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Cone Penetration Test (CPTu) Log

Test ID: CPT-03

Cone resistance, qc (MPa) | Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa | Inclination (°) | Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT

= Water level | = Dissipation test

GWL measured 1.08m

Depth (m)	SBT Description (filtered)	RL (m)
0	Clays: clay to silty clay	
	Silt mixtures: clayey silt & silty clay	
1	Clays: clay to silty clay	-1
	Sand mixtures: silty sand to sandy silt	
	Silt mixtures: clayey silt & silty clay	
2		-2
3		-3
4	Clays: clay to silty clay	-4
5		-5
6	Silt mixtures: clayey silt & silty clay	-6
	Silt mixtures: clayey silt & silty clay	
7	Clays: clay to silty clay	-7
	Silt mixtures: clayey silt & silty clay	
8	Clays: clay to silty clay	-8
	Silt mixtures: clayey silt & silty clay	
	Clays: clay to silty clay	
	Silt mixtures: clayey silt & silty clay	
9	Clays: clay to silty clay	-9
	Silt mixtures: clayey silt & silty clay	
10	Clays: clay to silty clay	-10
	Silt mixtures: clayey silt & silty clay	

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 1.08m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555268mN
Easting:	1929779mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-03

Project ID:	14668
Depth:	15.2m
Sheet:	1 of 2
Date:	23/06/2021

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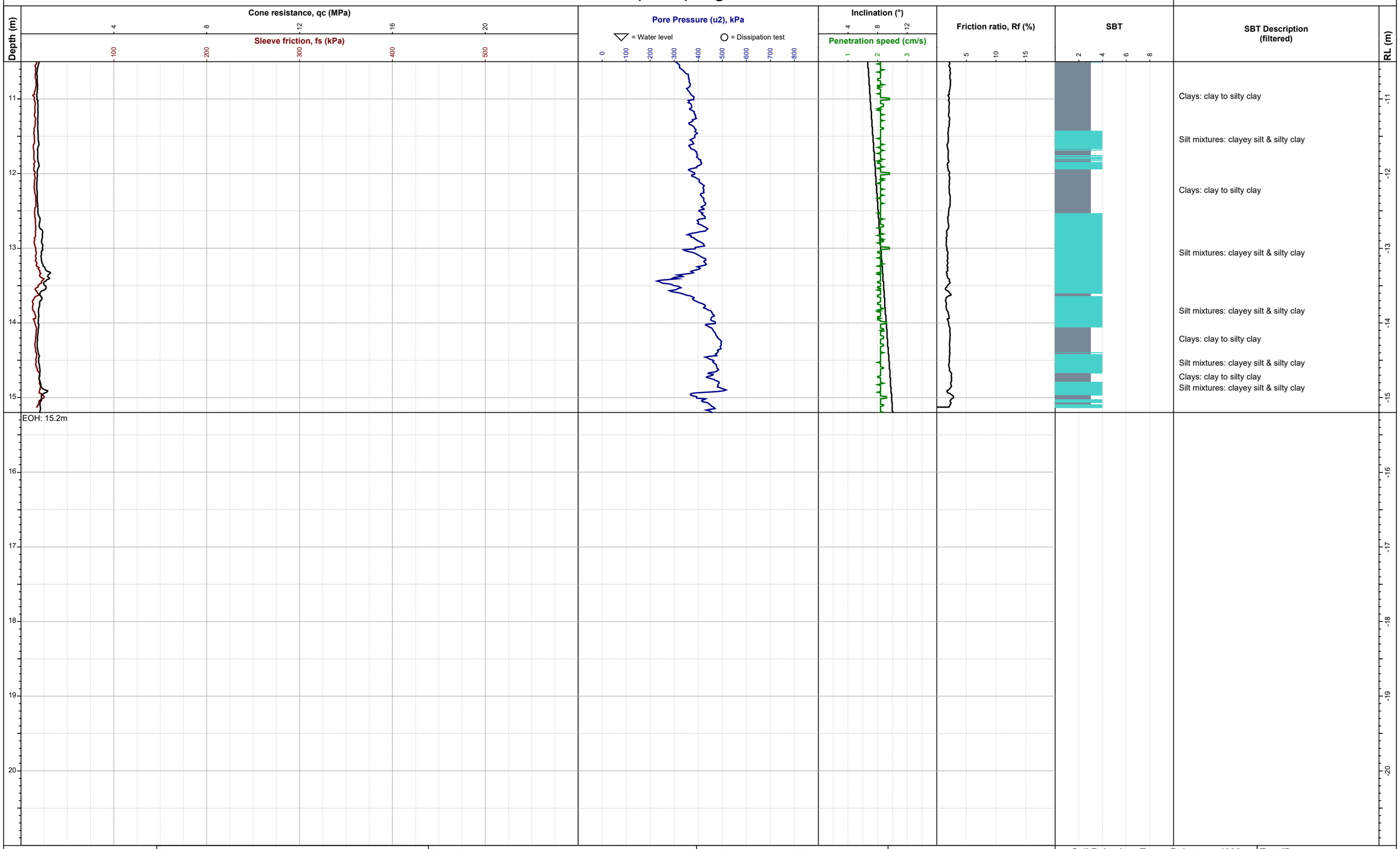
Cone Penetration Test (CPTu) Log

Test ID: CPT-03



Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:47 AM

Client:	Bridge Farming Partnership	**Remarks:** Ground water level located at 1.08m Test according to ISO 22476-1:12	**Northing:**	5555268mN	**Operator:**	JC	**Test ID:** CPT-03
Project:	Geotechnical Investigation	**Termination Reason:** Target depth	**Easting:**	1929779mE	**Rig:**	TG63-150 Pagani	**Project ID:** 14668
Location:	Punawaitai Road, Pourerere		**System:**	NZTM	**Cone ID:**	MKs650	**Depth:** 15.2m
			Elevation:	Ground	**Type:**	PC	**Sheet:** 2 of 2
			Located By:	Pagani GPS	**Cone Area:**	10 cm²	**Date:** 23/06/2021
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.7864	

Soil Behaviour Type - Robertson 1986

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

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03

Normalised cone resistance, Qt

Undrained shear strength, su (kPa) Nkt = 15

Sensitivity

Friction Angle (°)

SPT N60 (blows/300mm)

Soil Behaviour Type Index, Ic

SBTn

928>>
873>>
612>>
497>>
549>>
457>>

Depth (m)	SBTn Description (filtered)	RL (m)
0	Clays: clay to silty clay	
	Silt mixtures: clayey silt & silty clay	
1	Clays: clay to silty clay	-1
	Sand mixtures: silty sand to sandy silt	
	Silt mixtures: clayey silt & silty clay	
2		-2
3		-3
4	Clays: clay to silty clay	-4
5		-5
6	Silt mixtures: clayey silt & silty clay	-6
	Silt mixtures: clayey silt & silty clay	
7	Clays: clay to silty clay	-7
	Silt mixtures: clayey silt & silty clay	
8	Clays: clay to silty clay	-8
	Silt mixtures: clayey silt & silty clay	
	Clays: clay to silty clay	
	Silt mixtures: clayey silt & silty clay	
9	Clays: clay to silty clay	-9
	Silt mixtures: clayey silt & silty clay	
10	Clays: clay to silty clay	-10
	Silt mixtures: clayey silt & silty clay	

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 1.08m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555268mN
Easting:	1929779mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

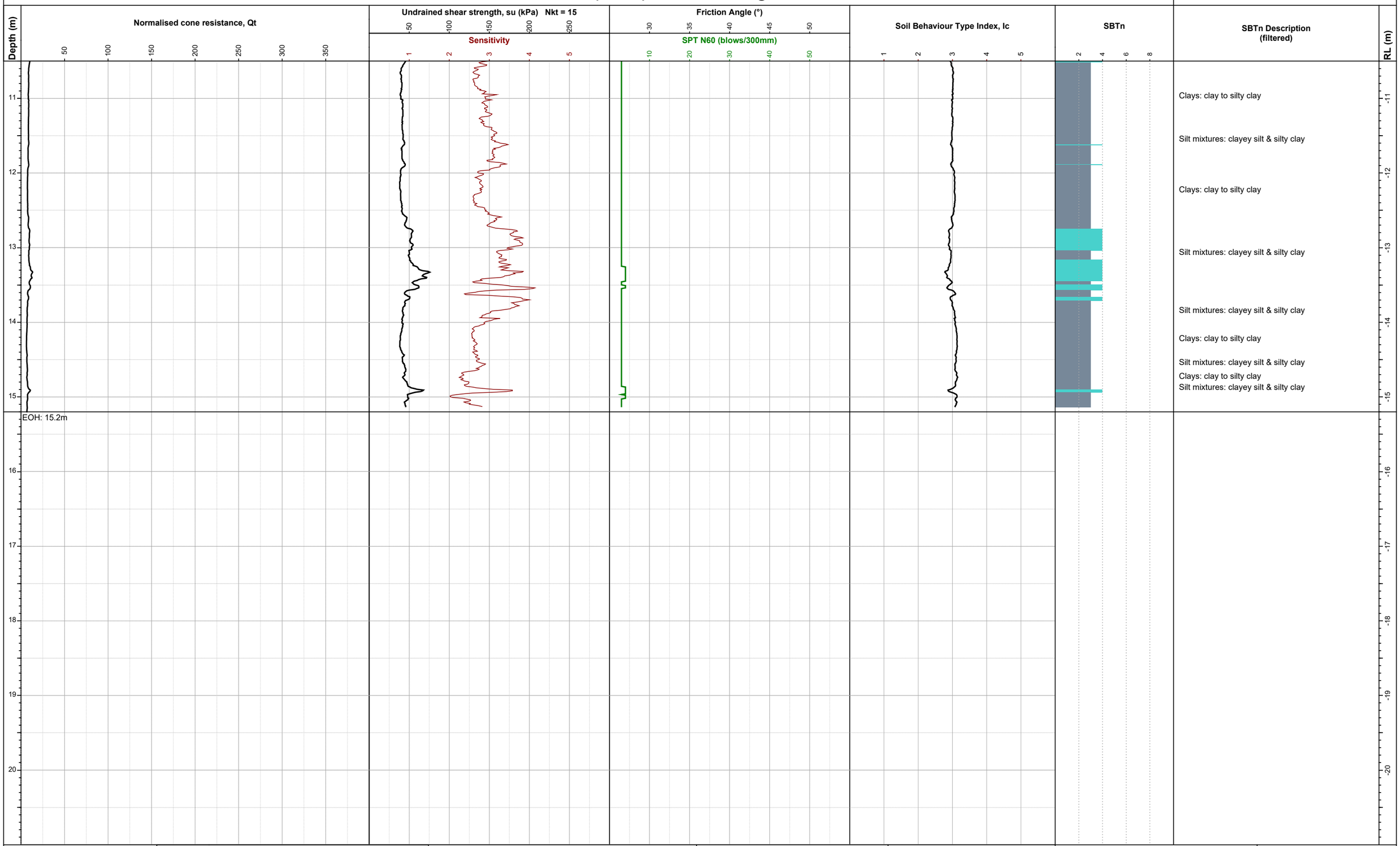
Test ID: CPT-03

Project ID:	14668
Depth:	15.2m
Sheet:	1 of 2
Date:	23/06/2021

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:47 AM

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03



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LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 1.08m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555268mN
Easting:	1929779mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-03

Project ID:	14668
Depth:	15.2m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Log

Test ID: CPT-04

Depth (m)

Cone resistance, qc (MPa) / Sleeve friction, fs (kPa)

Pore Pressure (u2), kPa — = Water level — = Dissipation test

Inclination (°) / Penetration speed (cm/s)

Friction ratio, Rf (%)

SBT

SBT Description (filtered)	RL (m)
Clays: clay to silty clay	-1
Silt mixtures: clayey silt & silty clay	
Clays: clay to silty clay	
Silt mixtures: clayey silt & silty clay	-2
Clays: clay to silty clay	-3
Clays: clay to silty clay	-4
Silt mixtures: clayey silt & silty clay	
Silt mixtures: clayey silt & silty clay	-5
Silt mixtures: clayey silt & silty clay	
Silt mixtures: clayey silt & silty clay	-6
Sand mixtures: silty sand to sandy silt	
Silt mixtures: clayey silt & silty clay	
Silt mixtures: clayey silt & silty clay	-7
Sand mixtures: silty sand to sandy silt	
Silt mixtures: clayey silt & silty clay	
Silt mixtures: clayey silt & silty clay	-8
Sand mixtures: silty sand to sandy silt	
Silt mixtures: clayey silt & silty clay	-9
Silt mixtures: clayey silt & silty clay	-10

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.21m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555089mN
Easting:	1929792mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-04

Project ID:	14668
Depth:	15.2m
Sheet:	1 of 2
Date:	23/06/2021

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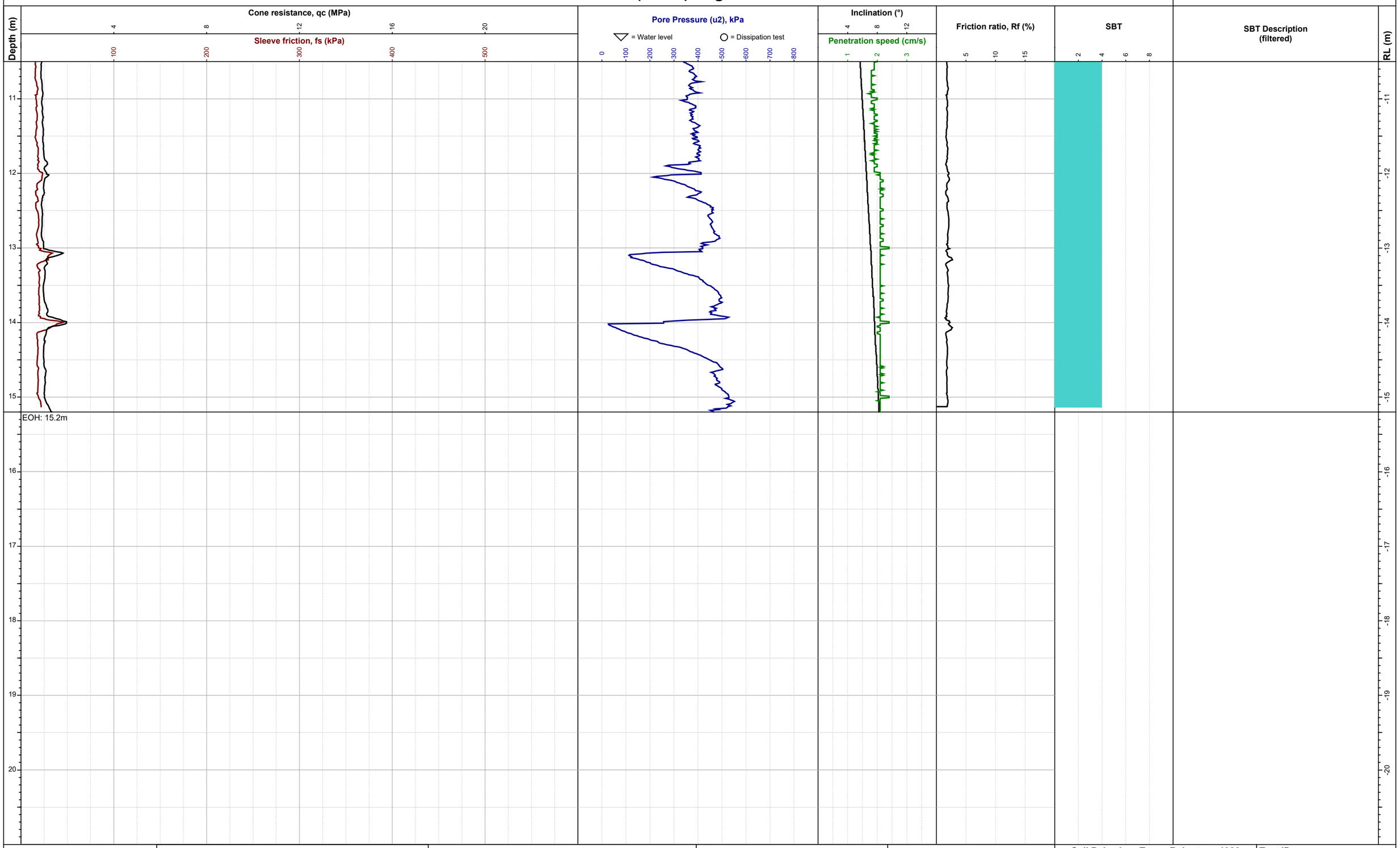
Cone Penetration Test (CPTu) Log

Test ID: CPT-04



Client:	Bridge Farming Partnership	**Remarks:** Collapse of hole at 3.21m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	5555089mN	**Operator:**	JC	**Test ID:** CPT-04
Project:	Geotechnical Investigation	**Termination Reason:** Target depth	**Easting:**	1929792mE	**Rig:**	TG63-150 Pagani	**Project ID:** 14668
Location:	Punawaitai Road, Pourerere		**System:**	NZTM	**Cone ID:**	MKs650	**Depth:** 15.2m
			Elevation:	Ground	**Type:**	PC	**Sheet:** 2 of 2
			Located By:	Pagani GPS	**Cone Area:**	10 cm²	**Date:** 23/06/2021
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.7864	

Soil Behaviour Type - Robertson 1986

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

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:49 AM

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-04

Normalised cone resistance, Qt

Undrained shear strength, su (kPa) Nkt = 15

Sensitivity

Friction Angle (°)

SPT N60 (blows/300mm)

Soil Behaviour Type Index, Ic

SBTn

SBTn Description (filtered)

Depth (m)

RL (m)

575>>
427>>

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

LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.21m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555089mN
Easting:	1929792mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

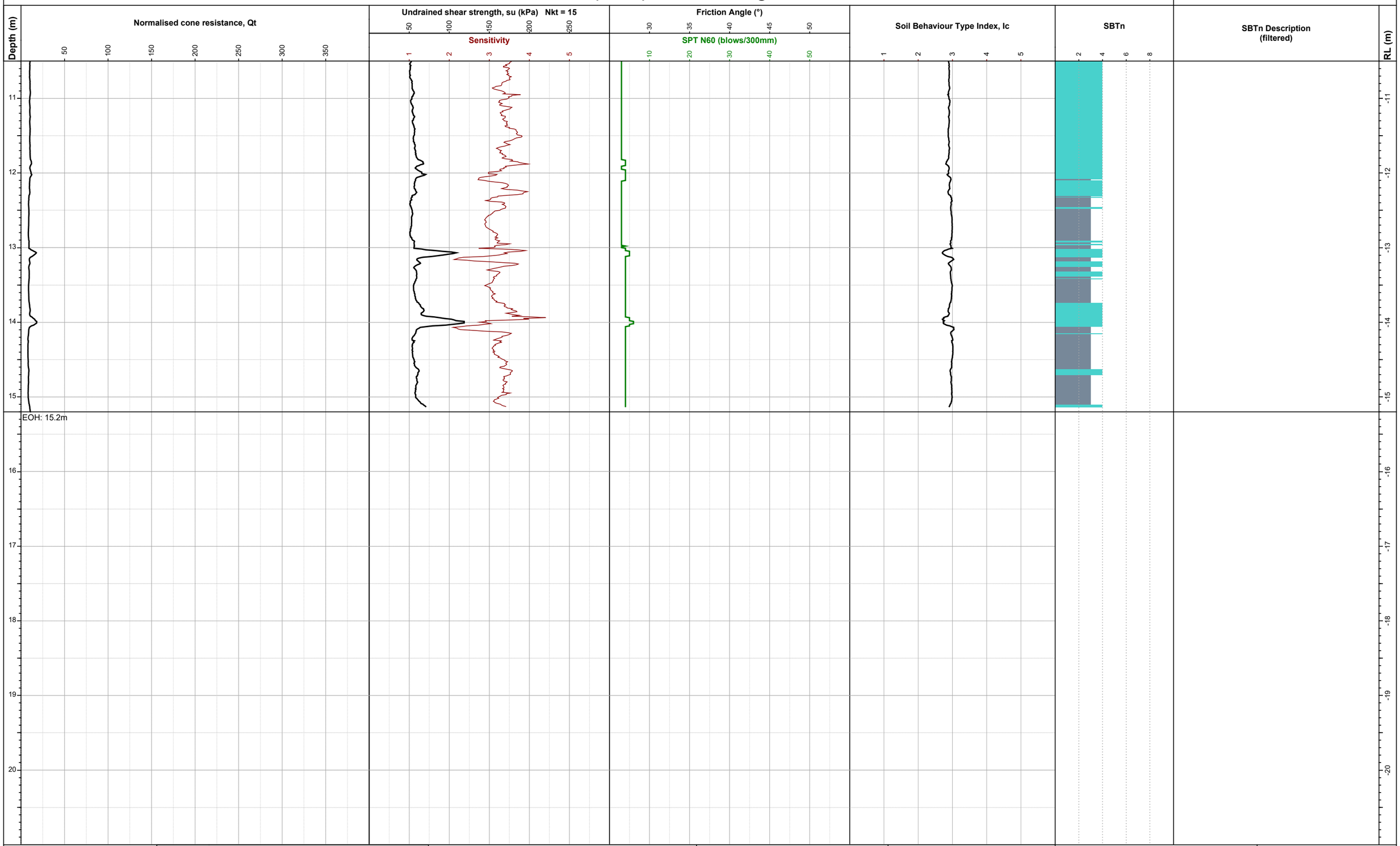
Test ID: CPT-04

Project ID:	14668
Depth:	15.2m
Sheet:	1 of 2
Date:	23/06/2021

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:49 AM

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-04



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LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.21m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555089mN
Easting:	1929792mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-04

Project ID:	14668
Depth:	15.2m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Log

Test ID: CPT-05

Cone resistance, qc (MPa) / Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa (= Water level, = Dissipation test) | Inclination (°) / Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT

Depth (m)	SBT Description (filtered)	RL (m)
0	Clays: clay to silty clay	
1	Silt mixtures: clayey silt & silty clay	-1
2		-2
3	Clays: clay to silty clay	-3
4		-4
5	Silt mixtures: clayey silt & silty clay	-5
5	Clays: clay to silty clay	
6	Clays: clay to silty clay Silt mixtures: clayey silt & silty clay Sand mixtures: silty sand to sandy silt	-6
6	Sand mixtures: silty sand to sandy silt	
7	Silt mixtures: clayey silt & silty clay Sand mixtures: silty sand to sandy silt	-7
8	Silt mixtures: clayey silt & silty clay	-8
9	Silt mixtures: clayey silt & silty clay Silt mixtures: clayey silt & silty clay Silt mixtures: clayey silt & silty clay	-9
10	Silt mixtures: clayey silt & silty clay	-10

LDE LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.96m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555196mN
Easting:	1929970mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-05

Project ID:	14668
Depth:	15.2m
Sheet:	1 of 2
Date:	23/06/2021

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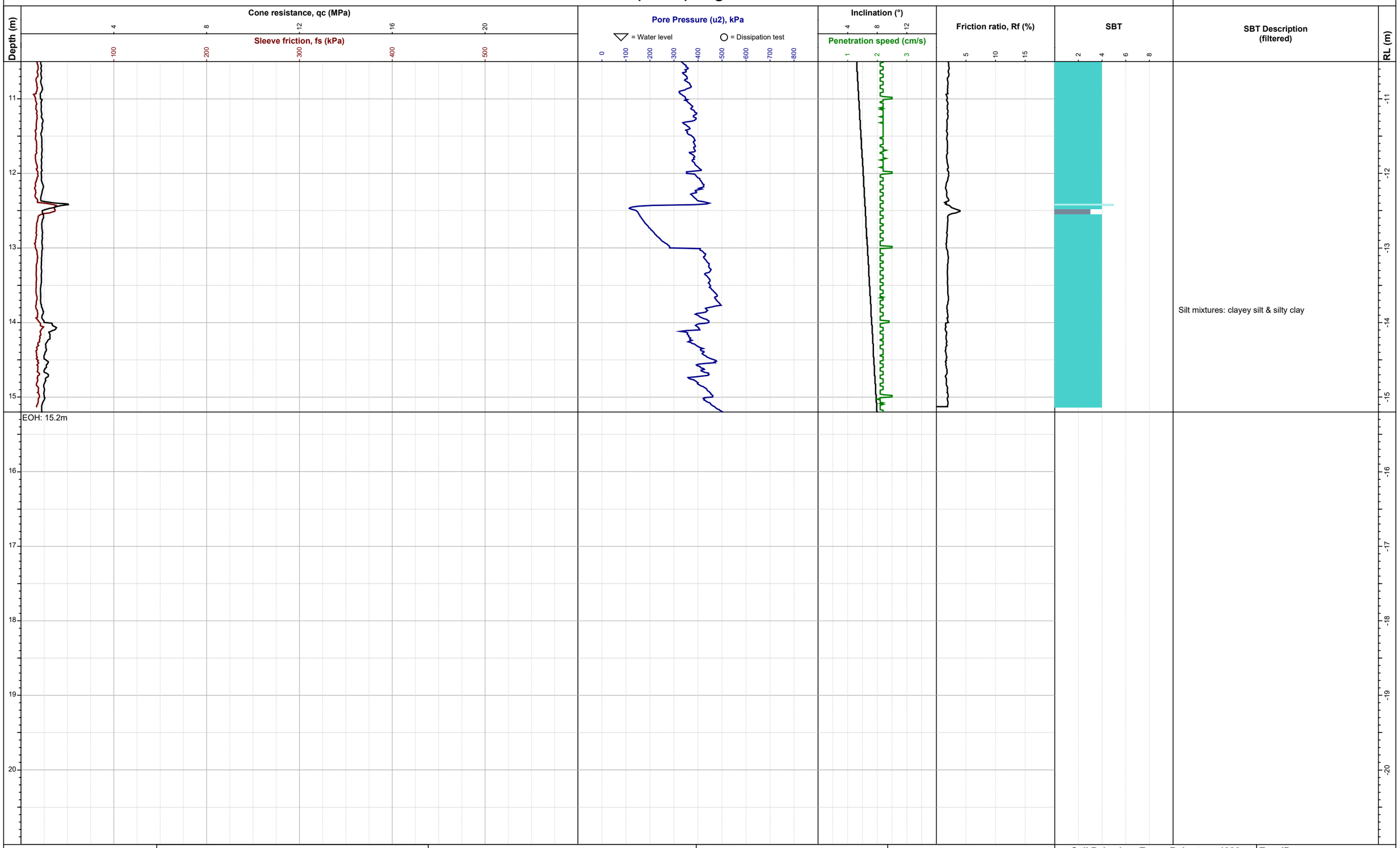
Cone Penetration Test (CPTu) Log

Test ID: CPT-05



Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:51 AM

LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.96m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555196mN
Easting:	1929970mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

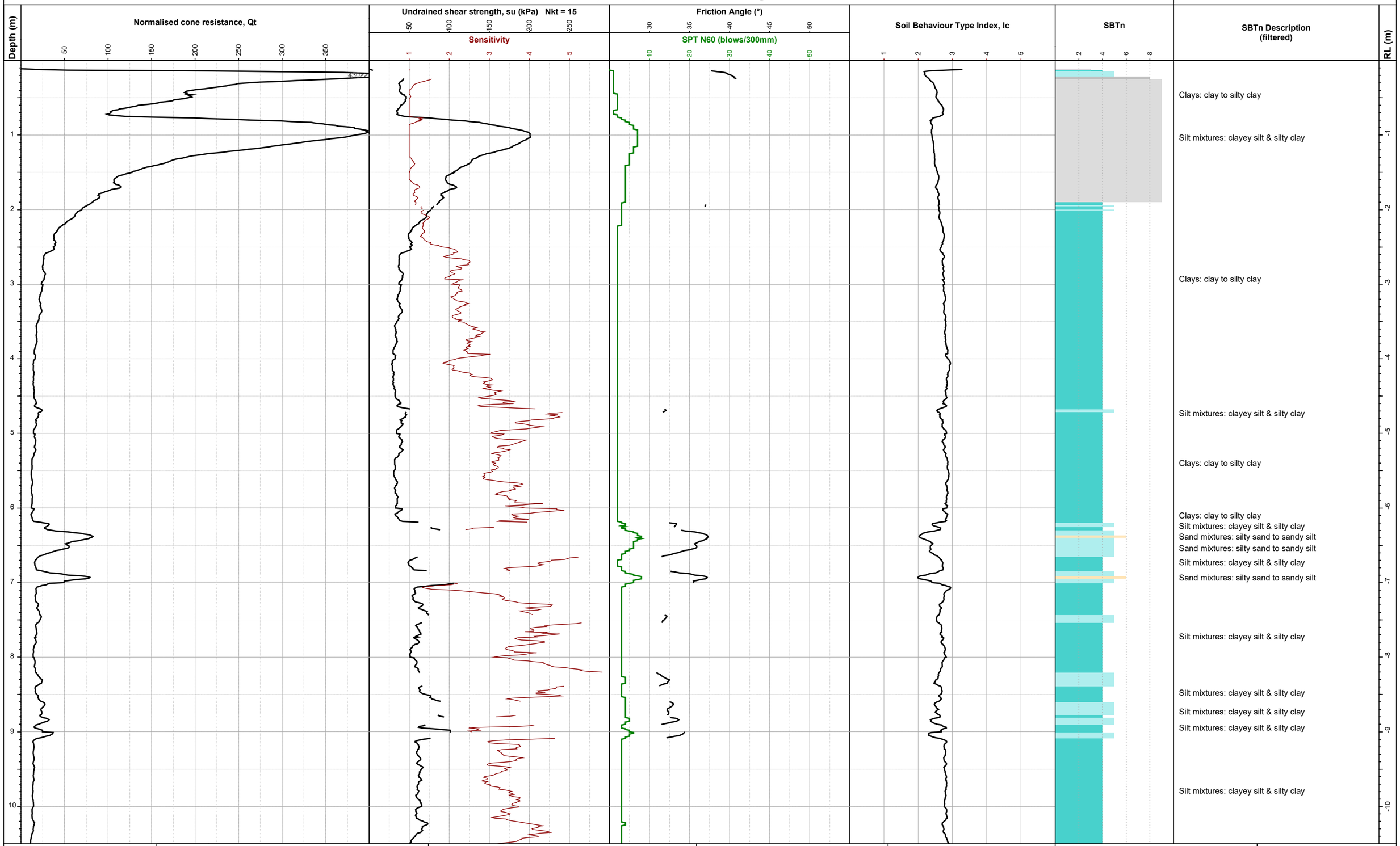
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05

Project ID:	14668
Depth:	15.2m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-05**



Client:	Bridge Farming Partnership	**Remarks:** Collapse of hole at 3.96m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:** 5555196mN	**Operator:** JC	**Test ID:** CPT-05
Project:	Geotechnical Investigation	**Termination Reason:** Target depth	**Easting:** 1929970mE	**Rig:** TG63-150 Pagani	**Project ID:** 14668
Location:	Punawaitai Road, Pourerere		**System:** NZTM	**Cone ID:** MKs650	**Depth:** 15.2m
			Elevation: Ground	**Type:** PC	**Sheet:** 1 of 2
			Located By: Pagani GPS	**Cone Area:** 10 cm²	**Date:** 23/06/2021
			Location:	**Sleeve Area:** 150 cm²	
				Area Ratio: 0.7864	

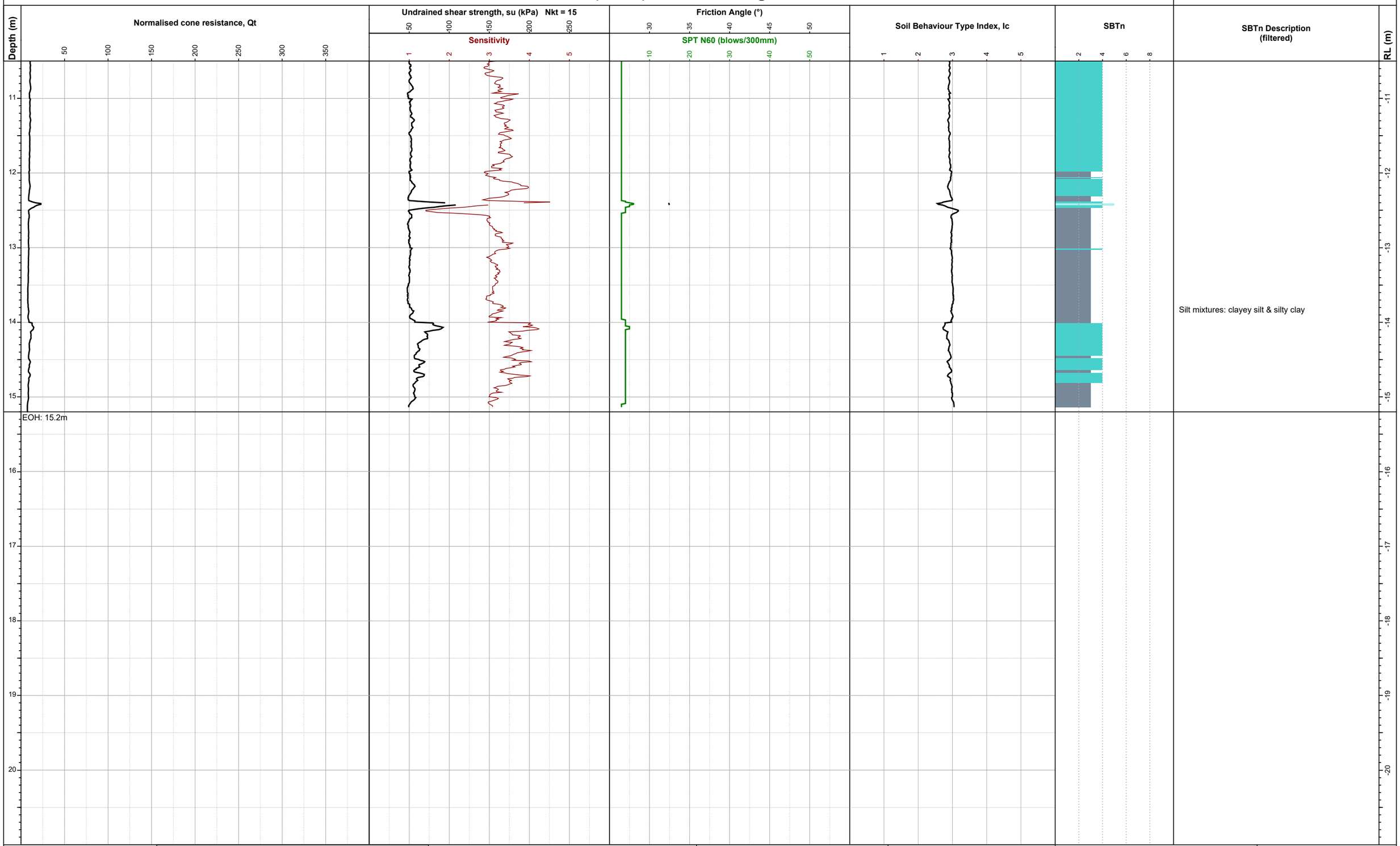
Soil Behaviour Type - Robertson 1986

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

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:51 AM

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-05



Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:52 AM

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Collapse of hole at 3.96m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555196mN
Easting:	1929970mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

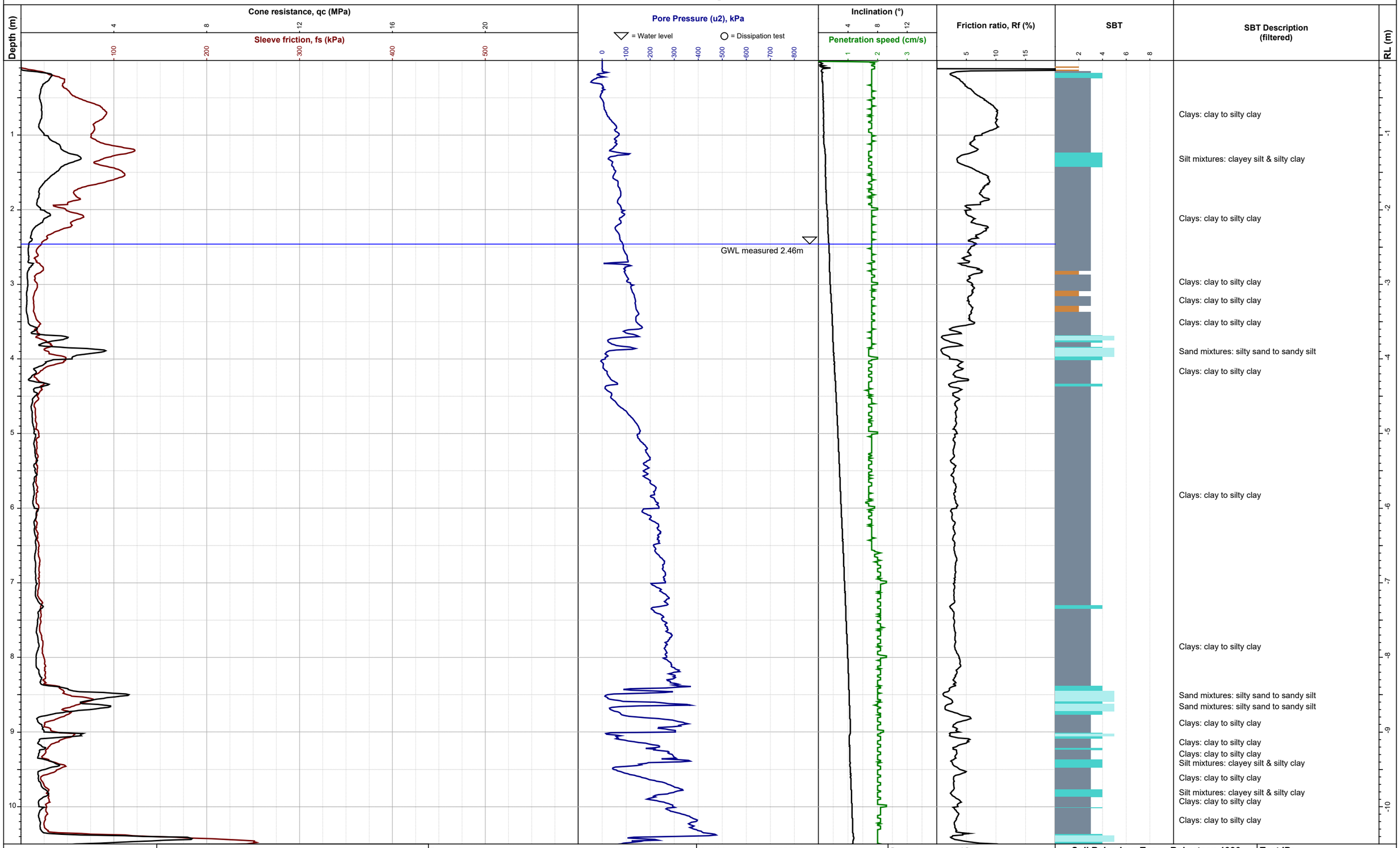
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05

Project ID:	14668
Depth:	15.2m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Log

Test ID: CPT-06



Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:53 AM

LAND DEVELOPMENT & ENGINEERING

Client:	Bridge Farming Partnership
Project:	Geotechnical Investigation
Location:	Punawaitai Road, Pourerere

Remarks:
Ground water level located at 2.46m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555375mN
Easting:	1930105mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-06

Project ID:	14668
Depth:	16.98m
Sheet:	1 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Log

Test ID: CPT-06

Cone resistance, qc (MPa) / Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa (= Water level, = Dissipation test) | Inclination (°) / Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT

Depth (m)	SBT Description (filtered)	RL (m)
11	Clays: clay to silty clay	-11
	Clays: clay to silty clay Silt mixtures: clayey silt & silty clay	
12	Clays: clay to silty clay	-12
	Clays: clay to silty clay	
13	Silt mixtures: clayey silt & silty clay	-13
	Silt mixtures: clayey silt & silty clay Silt mixtures: clayey silt & silty clay Clays: clay to silty clay	
14	Clays: clay to silty clay	-14
15	Clays: clay to silty clay Silt mixtures: clayey silt & silty clay	-15
	Silt mixtures: clayey silt & silty clay	
16	Clays: clay to silty clay	-16
17	EOH: 16.98m	-17
18		-18
19		-19
20		-20

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:53 AM

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 2.46m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555375mN
Easting:	1930105mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-06

Project ID:	14668
Depth:	16.98m
Sheet:	2 of 2
Date:	23/06/2021

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-06

Normalised cone resistance, Qt

Undrained shear strength, su (kPa) Nkt = 15

Sensitivity

Friction Angle (°)

SPT N60 (blows/300mm)

Soil Behaviour Type Index, Ic

SBTn

SBTn Description (filtered)

Depth (m)

RL (m)

940>>
471>>

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

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 2.46m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555375mN
Easting:	1930105mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-06

Project ID:	14668
Depth:	16.98m
Sheet:	1 of 2
Date:	23/06/2021

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:53 AM

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-06

Depth (m) | Normalised cone resistance, Qt | Undrained shear strength, su (kPa) Nkt = 15 / Sensitivity | Friction Angle (°) / SPT N60 (blows/300mm) | Soil Behaviour Type Index, Ic | SBTn | SBTn Description (filtered) | RL (m)

Clays: clay to silty clay

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

Clays: clay to silty clay

Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

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

Clays: clay to silty clay

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

Silt mixtures: clayey silt & silty clay

Clays: clay to silty clay

EOH: 16.98m

Generated with CORE-GS by Geroc - CPT Combined A3 v0 (new) - 28/06/2021 10:02:54 AM

LDE LAND DEVELOPMENT & ENGINEERING

Client: Bridge Farming Partnership

Project: Geotechnical Investigation

Location: Punawaitai Road, Pourerere

Remarks:
Ground water level located at 2.46m
Test according to ISO 22476-1:12

Termination Reason:
Target depth

Northing:	5555375mN
Easting:	1930105mE
System:	NZTM
Elevation:	Ground
Located By:	Pagani GPS
Location:	

Operator:	JC
Rig:	TG63-150 Pagani
Cone ID:	MKs650
Type:	PC
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.7864

Soil Behaviour Type - Robertson 1986

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

Test ID: CPT-06

Project ID:	14668
Depth:	16.98m
Sheet:	2 of 2
Date:	23/06/2021

APPENDIX C

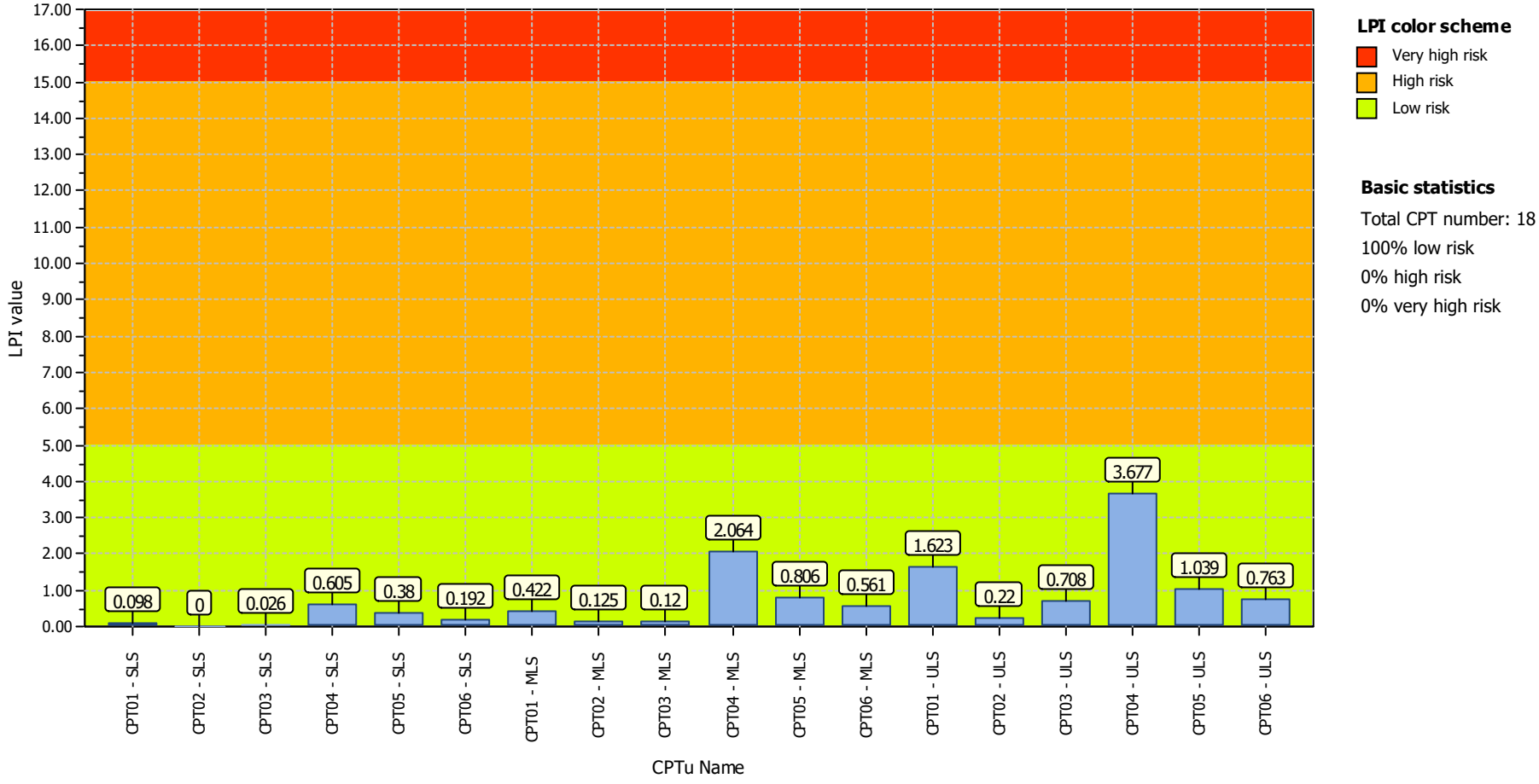
LIQUEFACTION ANALYSES

LDE Ltd
15 Hardinge Road
Ahuriri, Napier
www.lde.co.nz

Project title : Liquefaction Analyses for Proposed Subdivision

Location : "Stage 3" Punawaitai Road, Pourerere

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

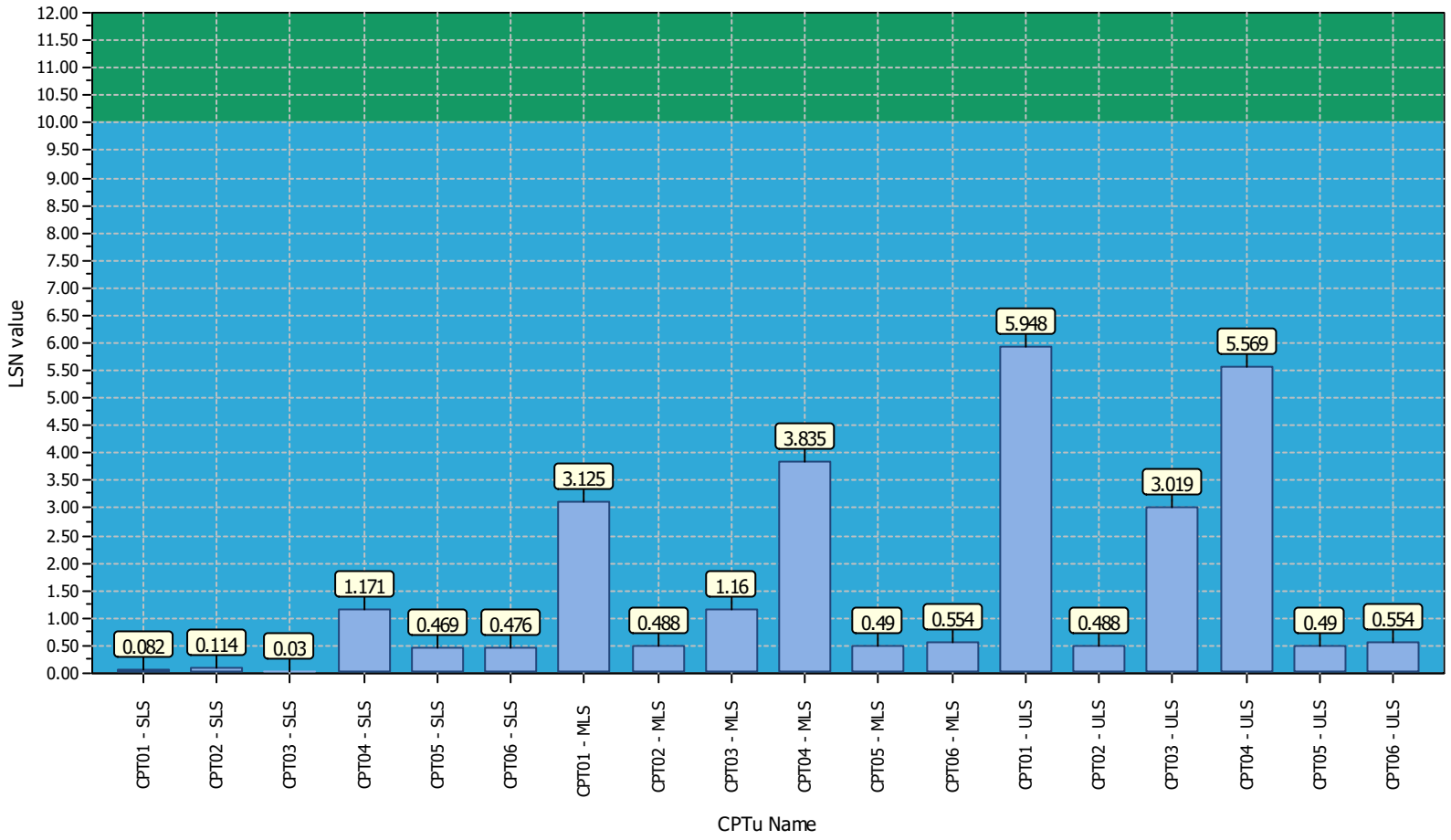
Total CPT number: 18
100% low risk
0% high risk
0% very high risk

LDE Ltd
15 Hardinge Road
Ahuriri, Napier
www.lde.co.nz

Project title : Liquefaction Analyses for Proposed Subdivision

Location : "Stage 3" Punawaitai Road, Pourerere

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: 18

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

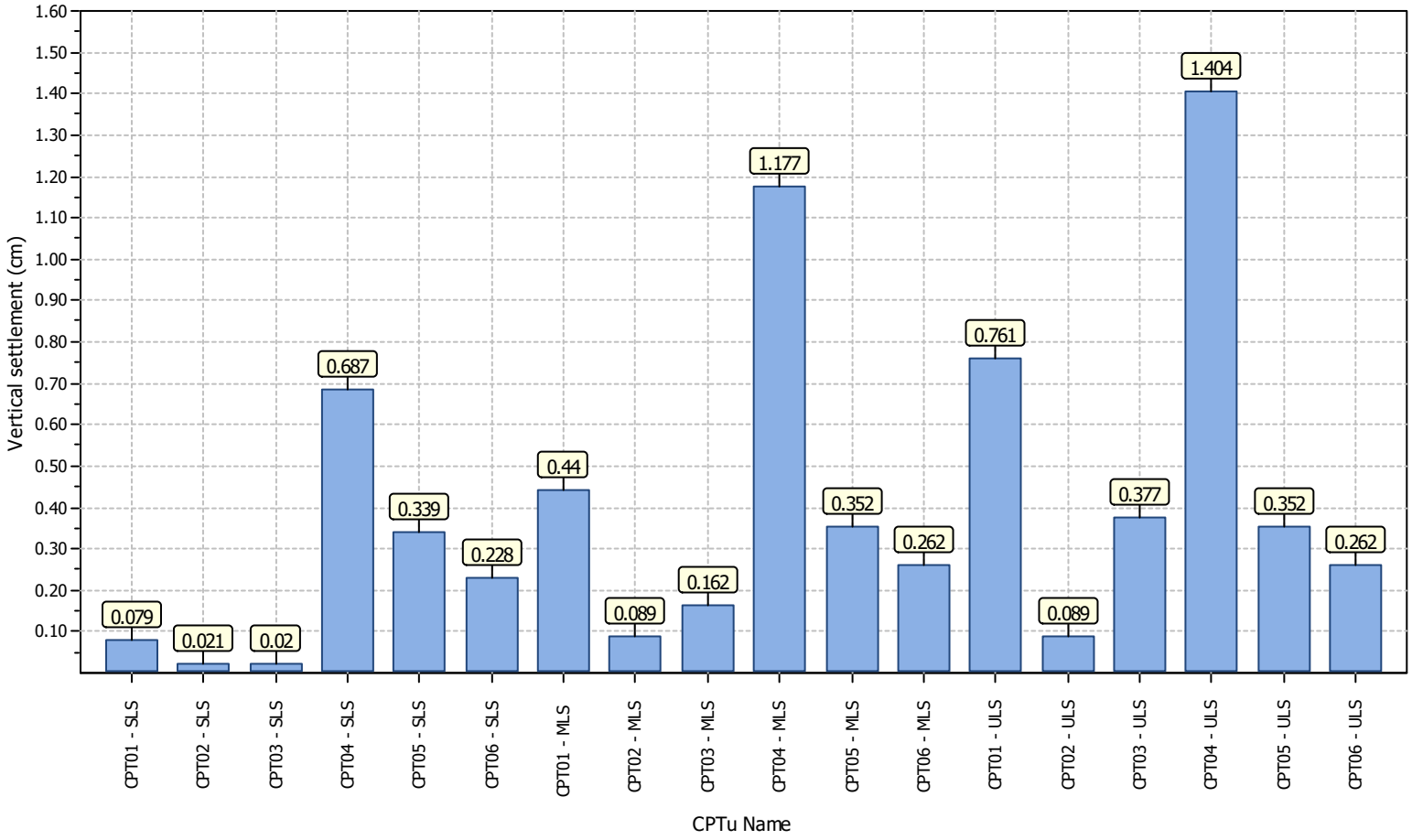
0% severe liquefaction

LDE Ltd
15 Hardinge Road
Ahuriri, Napier
www.lde.co.nz

Project title : Liquefaction Analyses for Proposed Subdivision

Location : "Stage 3" Punawaitai Road, Pourerere

Overall vertical settlements report

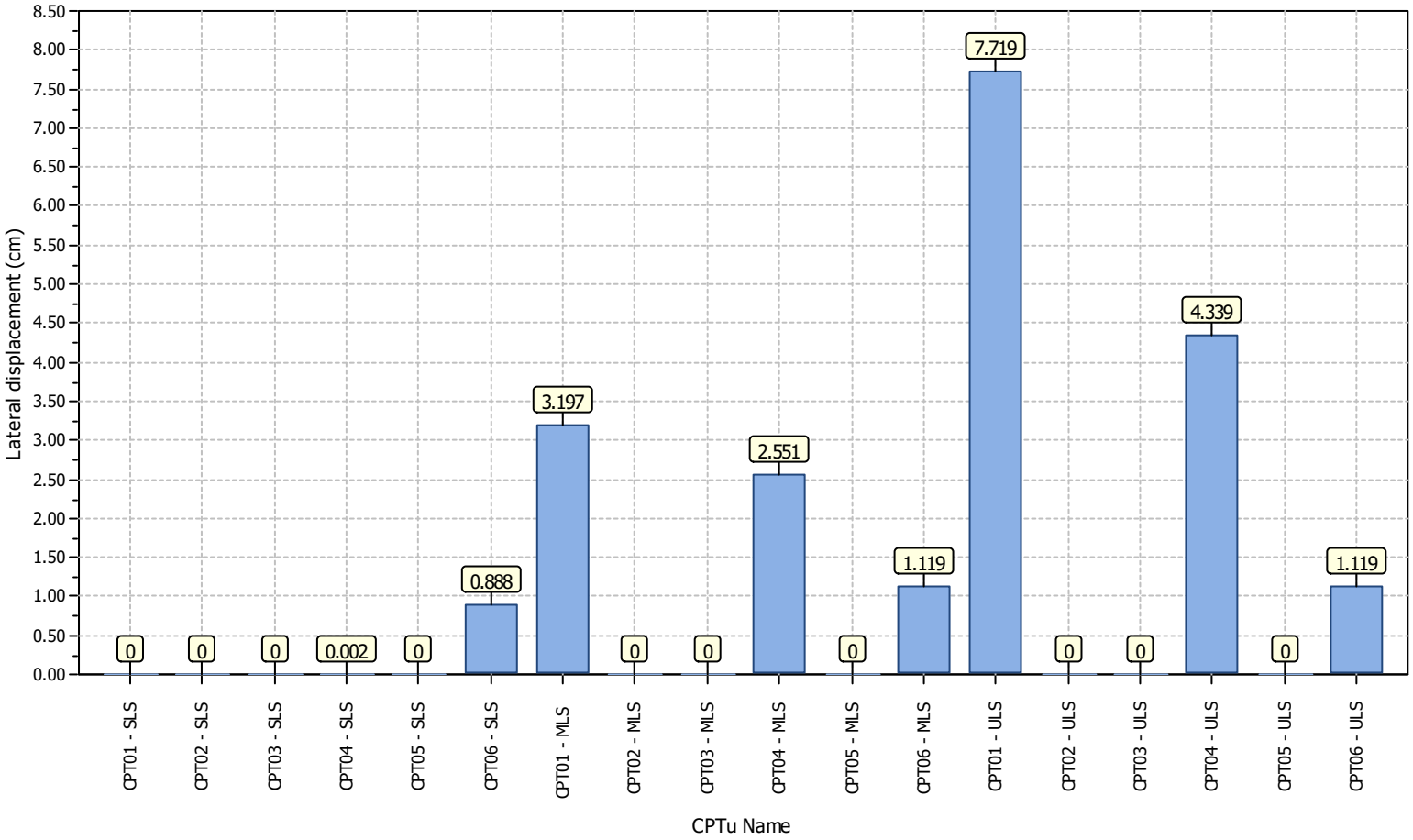


LDE Ltd
15 Hardinge Road
Ahuriri, Napier
www.lde.co.nz

Project title : Liquefaction Analyses for Proposed Subdivision

Location : "Stage 3" Punawaitai Road, Pourerere

Overall lateral displacements report

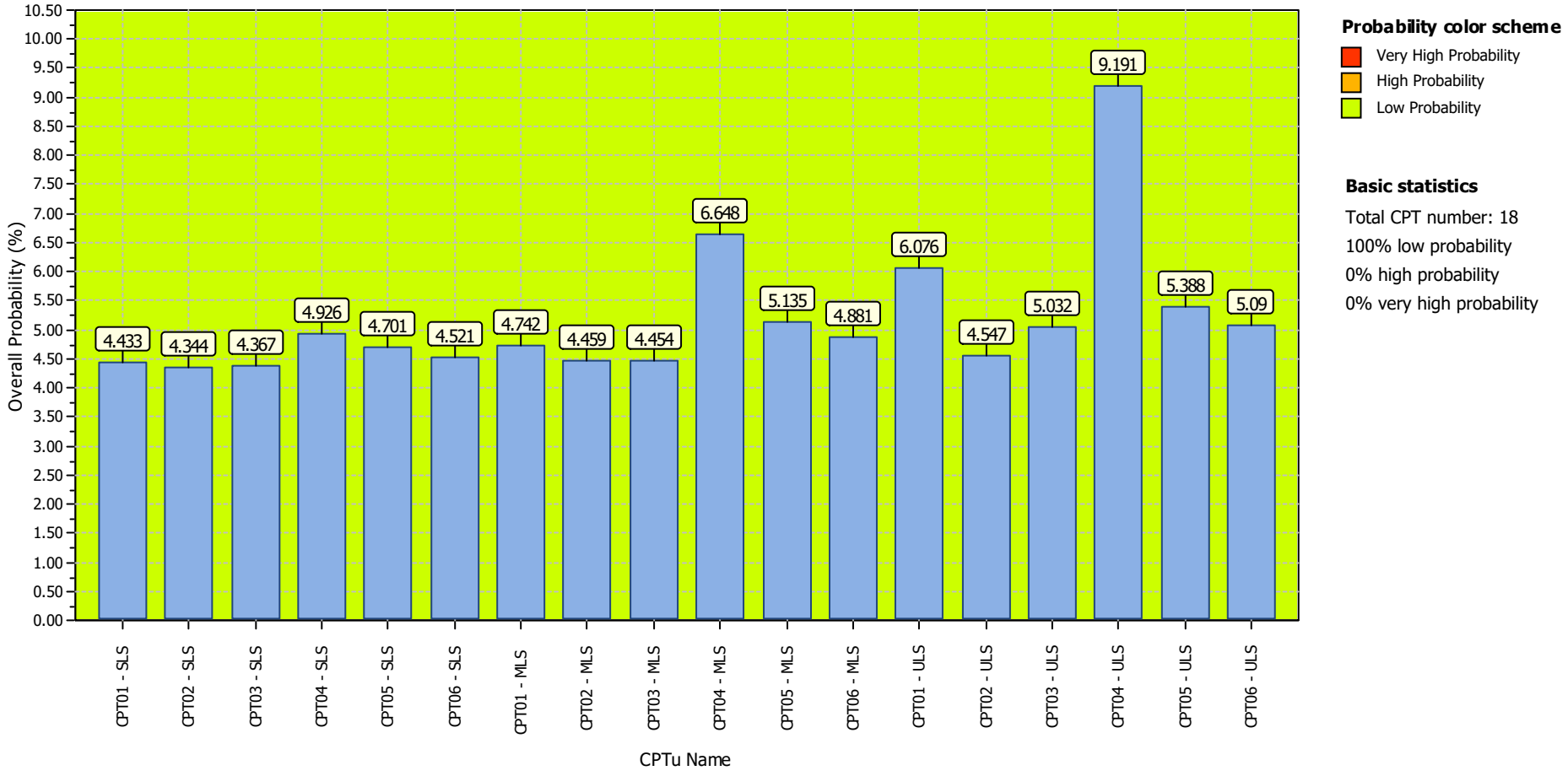


LDE Ltd
15 Hardinge Road
Ahuriri, Napier
www.lde.co.nz

Project title : Liquefaction Analyses for Proposed Subdivision

Location : "Stage 3" Punawaitai Road, Pourerere

Overall Probability for Liquefaction report



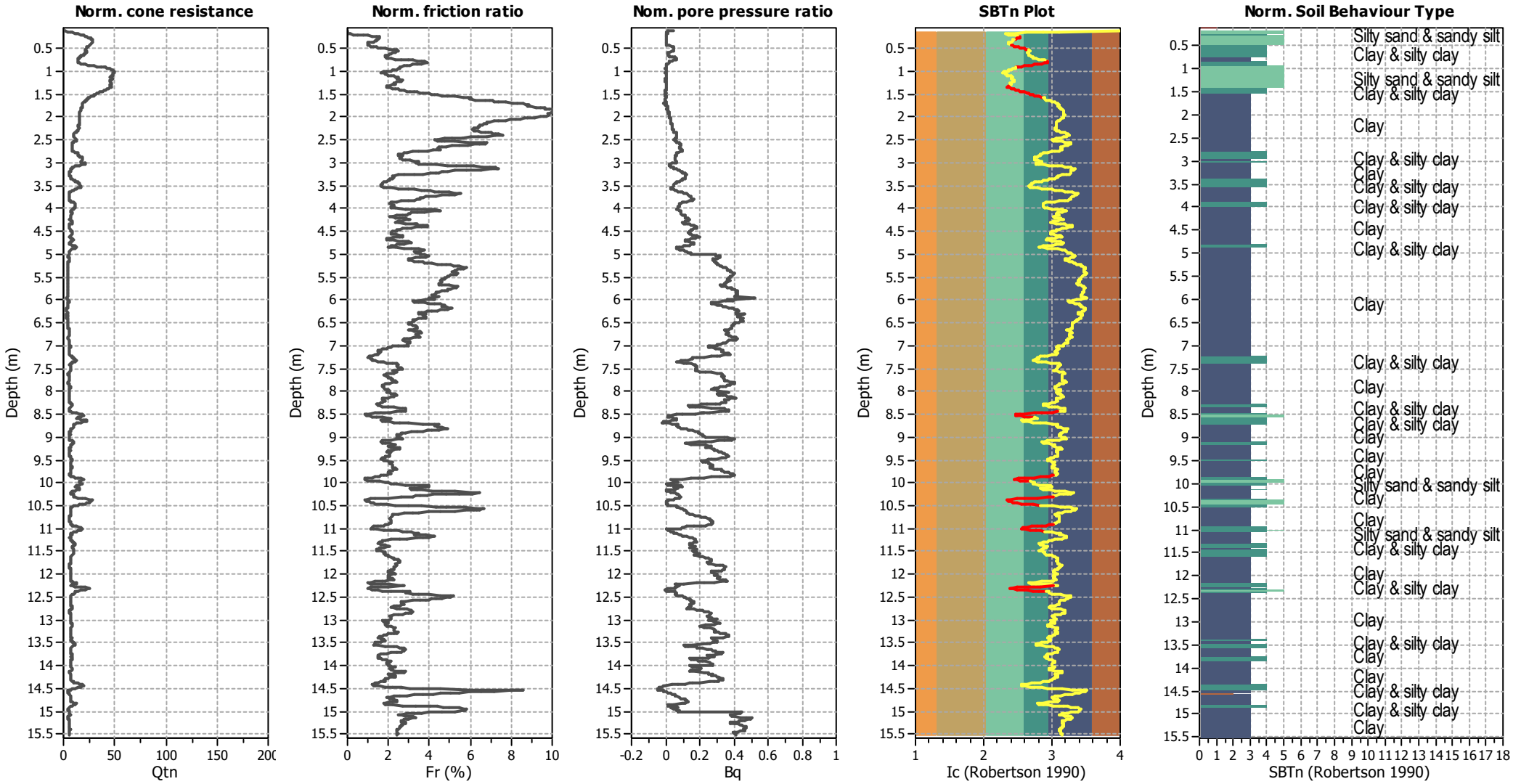
Probability color scheme

- Very High Probability
- High Probability
- Low Probability

Basic statistics

Total CPT number: 18
100% low probability
0% high probability
0% very high probability

CPT basic interpretation plots (normalized)



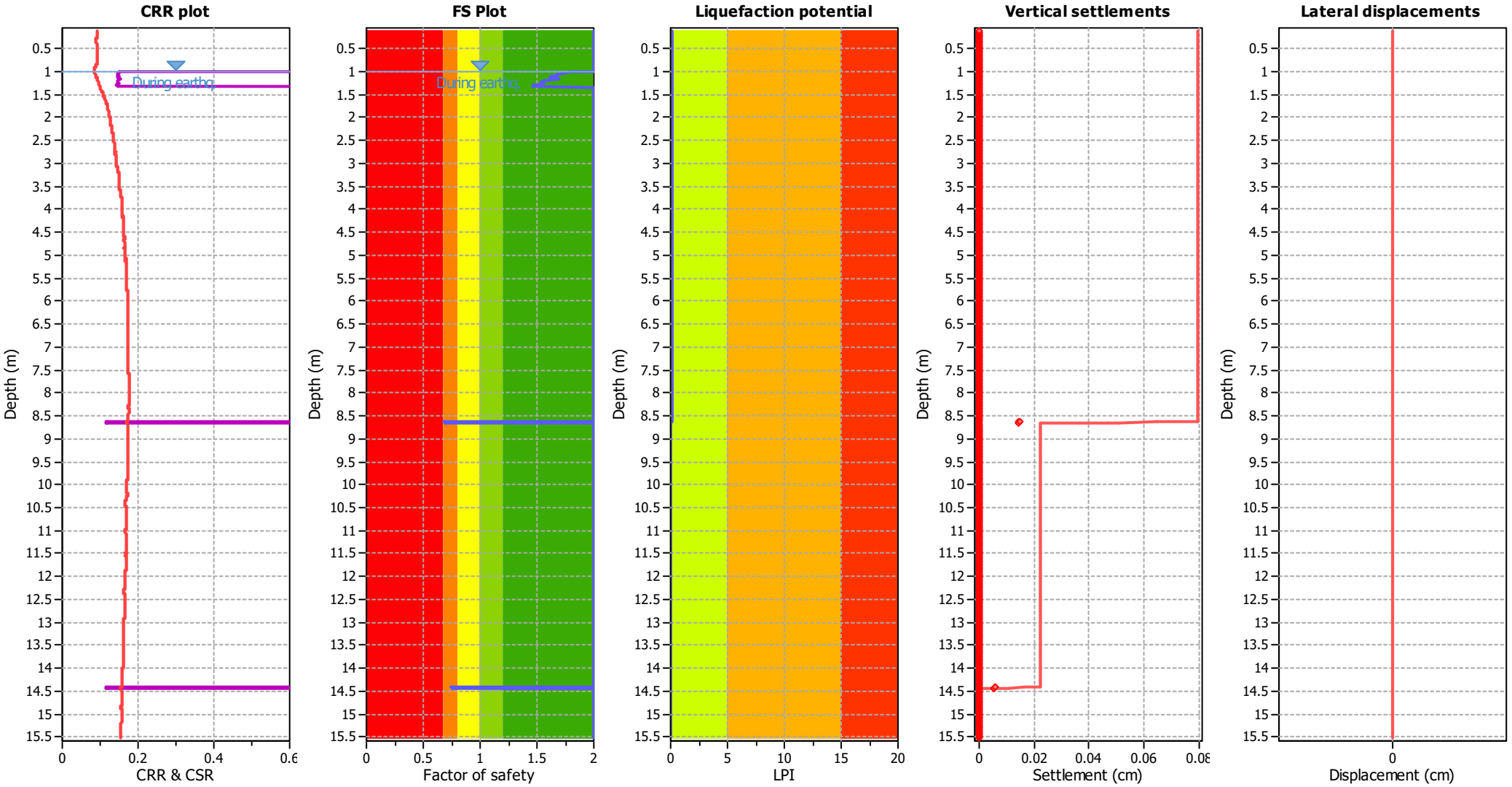
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

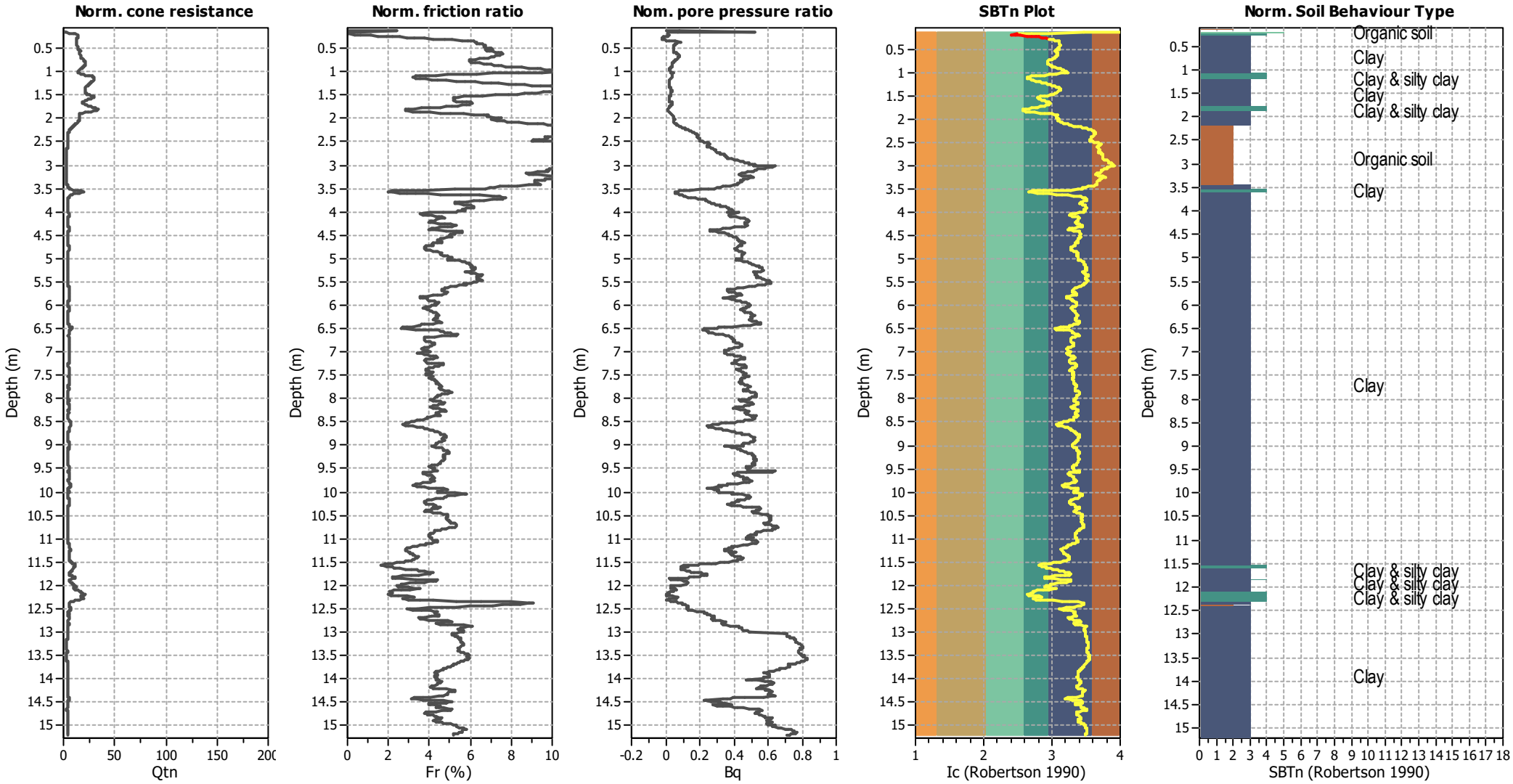
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



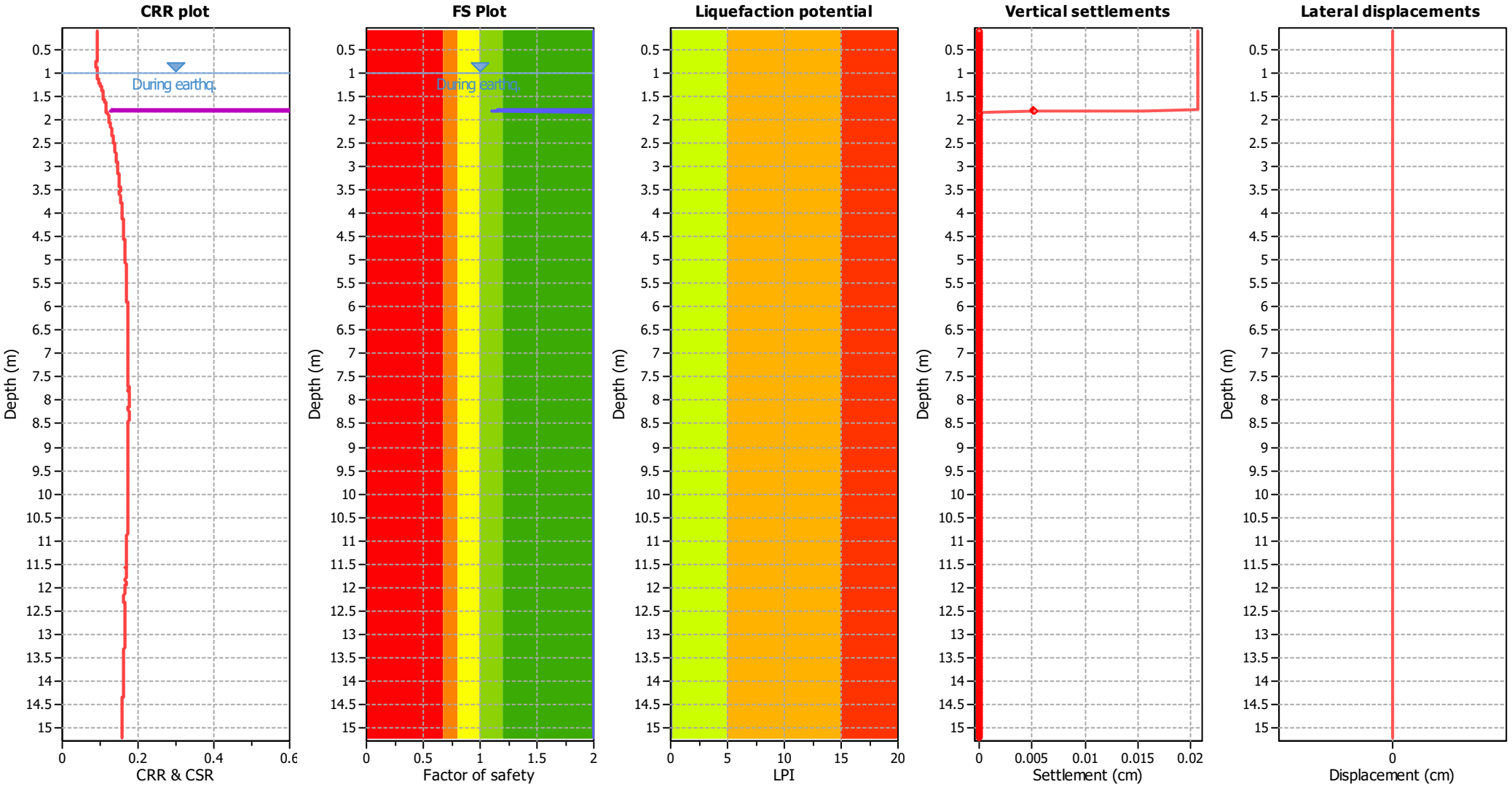
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

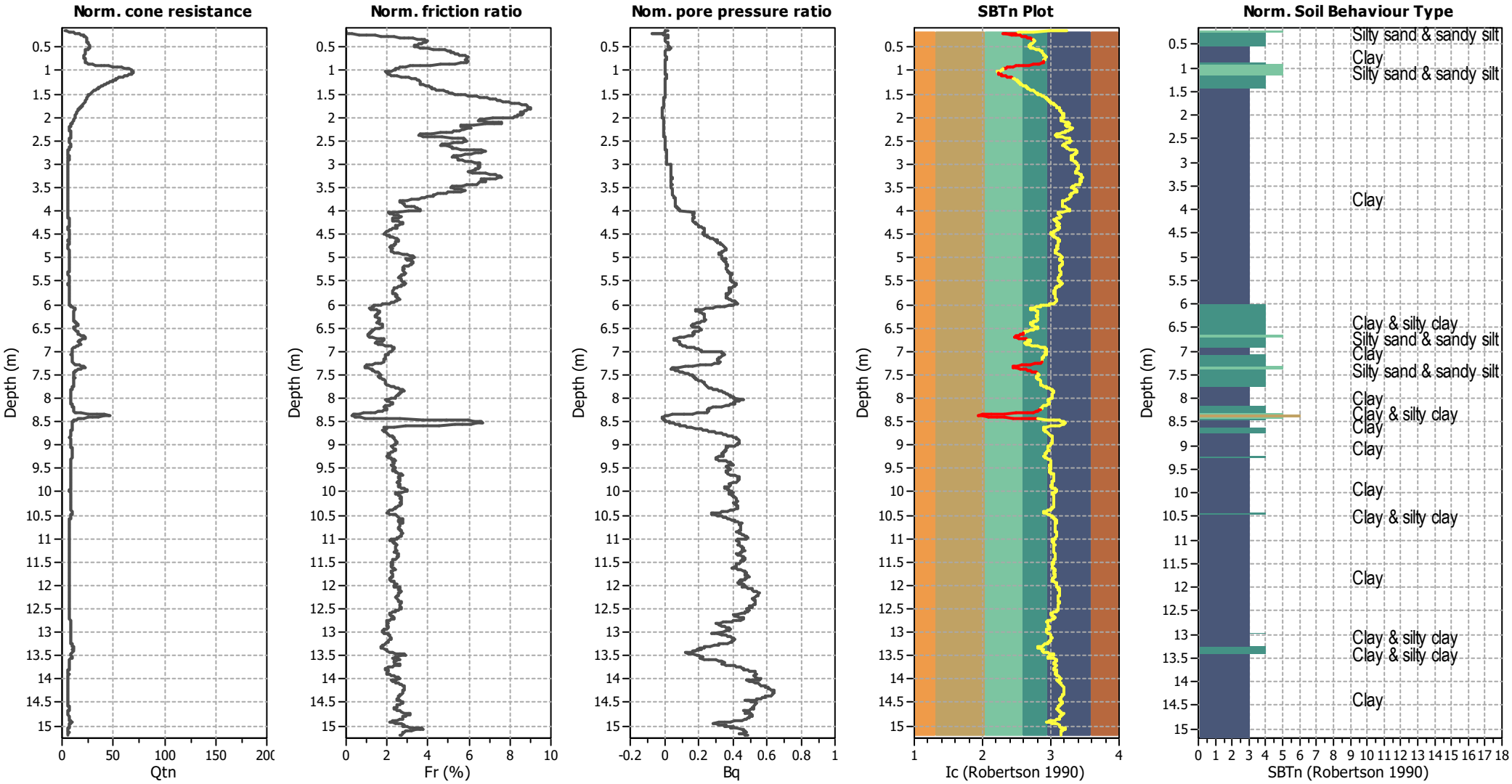
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



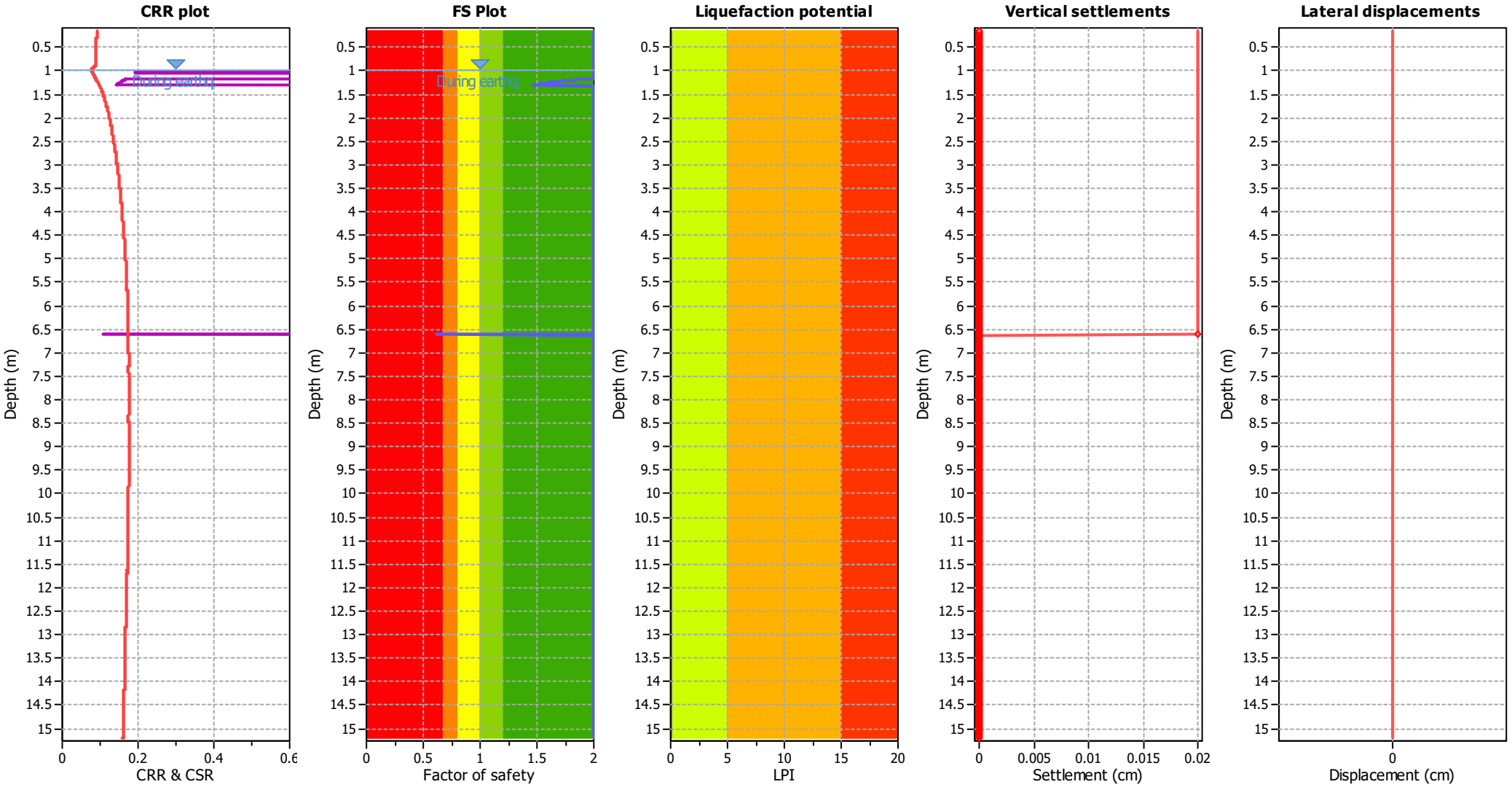
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.08 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.08 m	Fill height:	N/A	Limit depth:	N/A

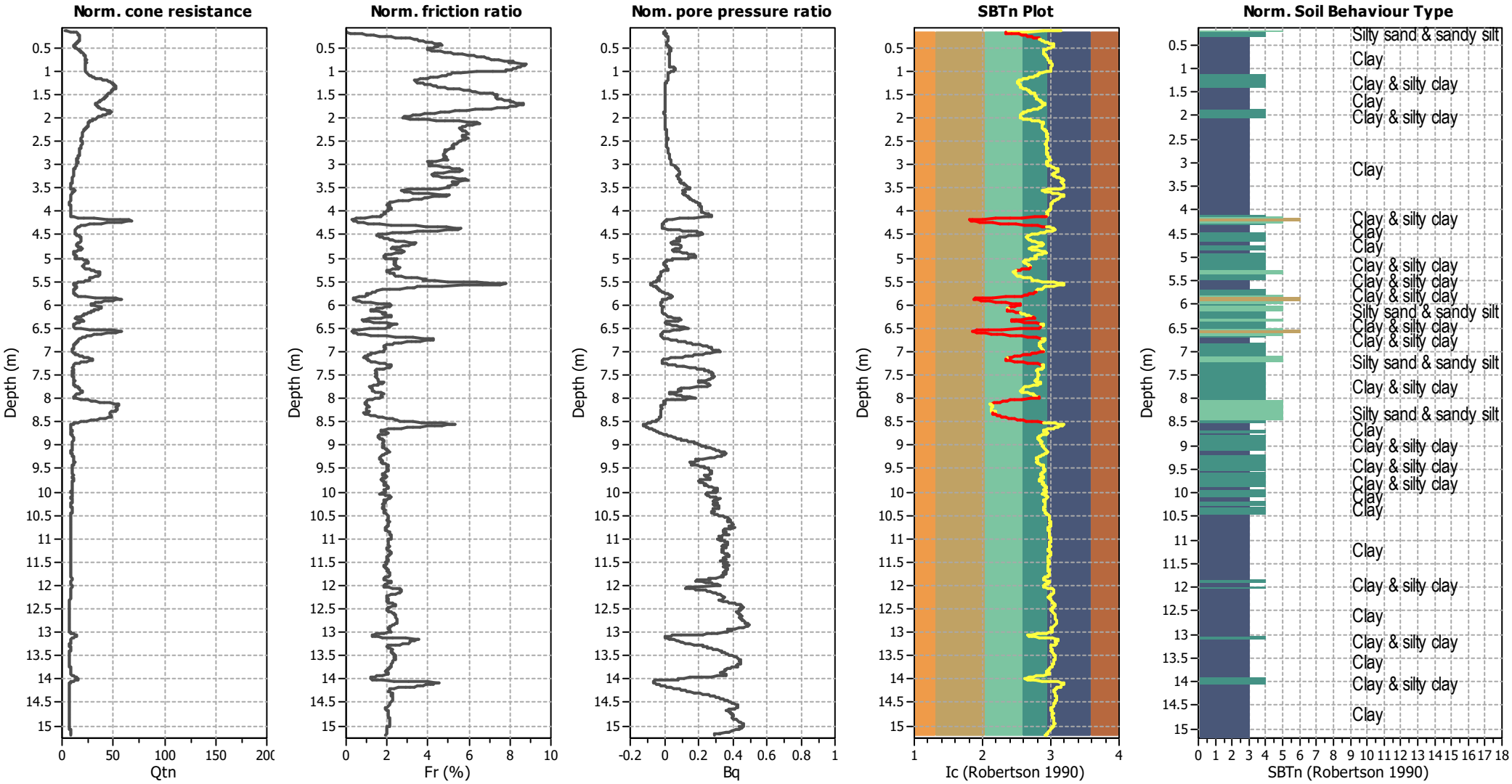
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



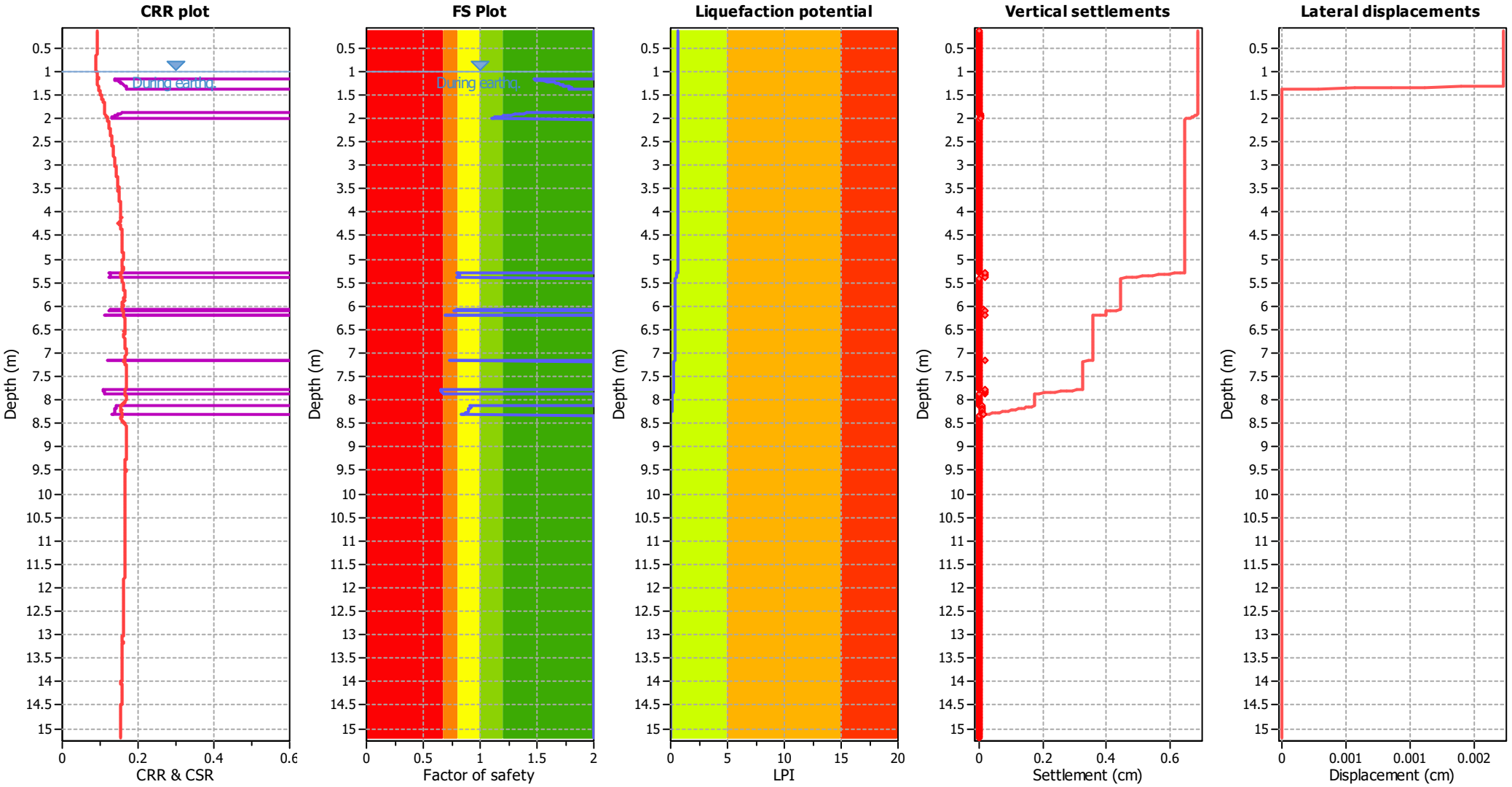
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

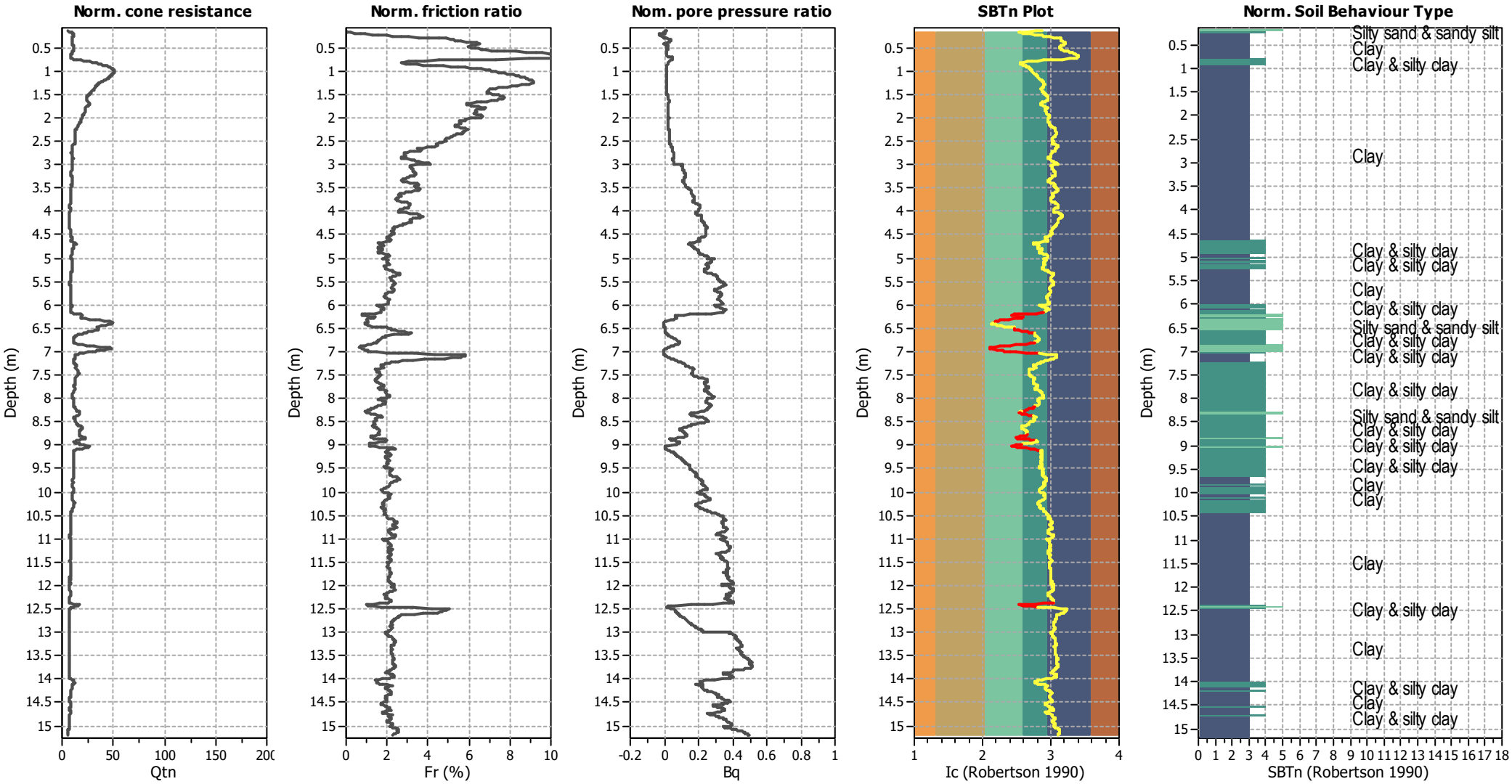
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



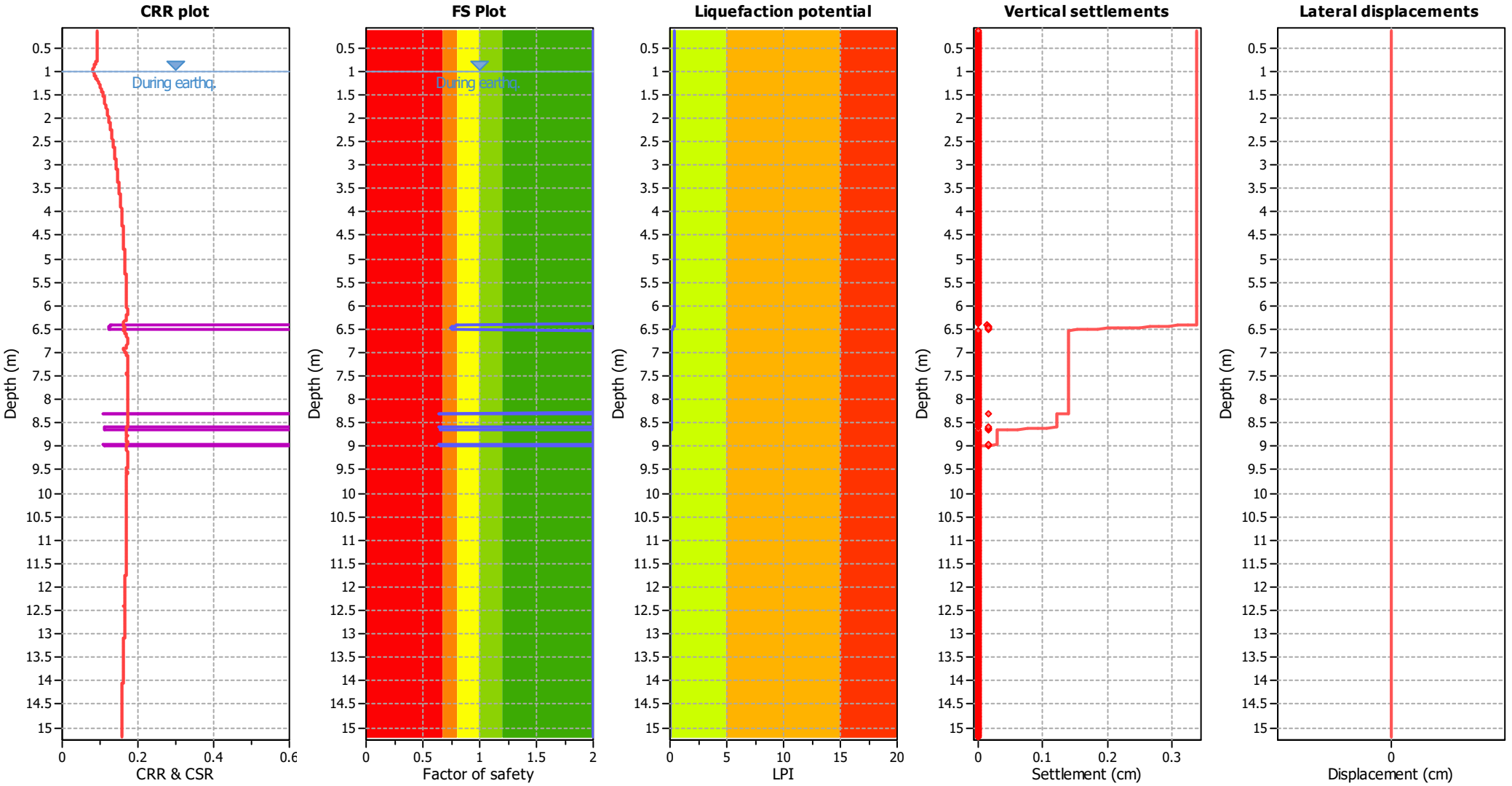
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

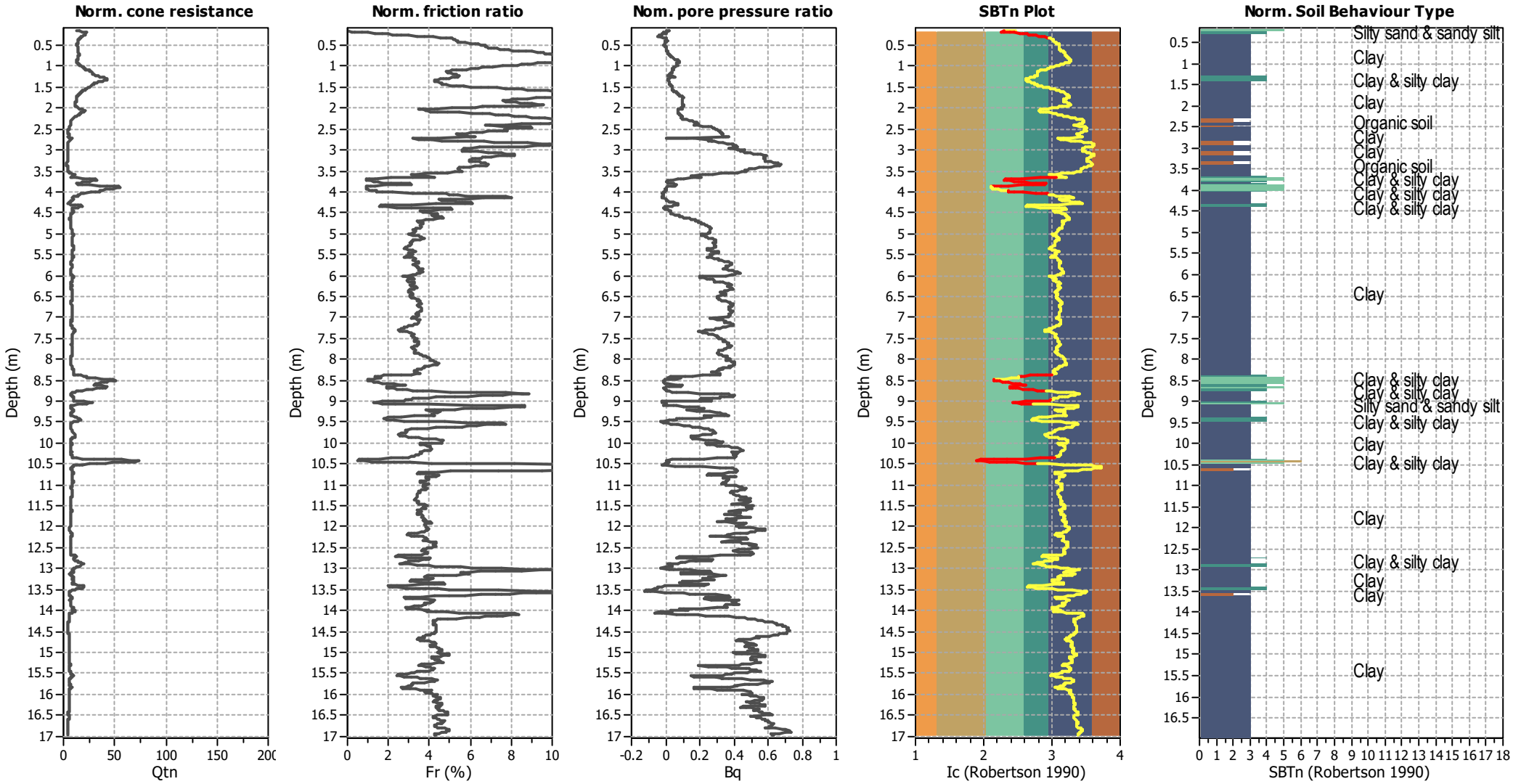
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



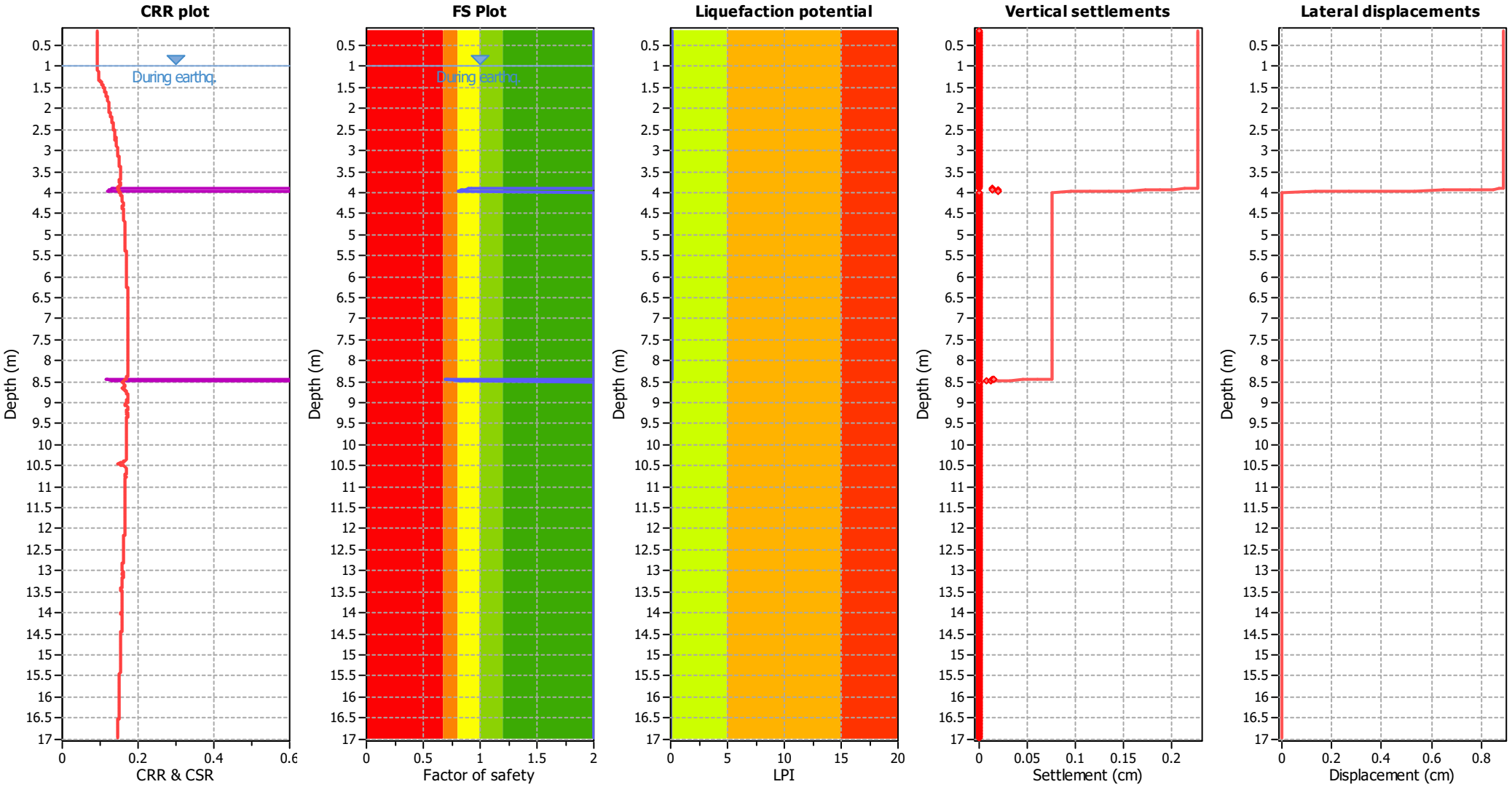
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.17	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

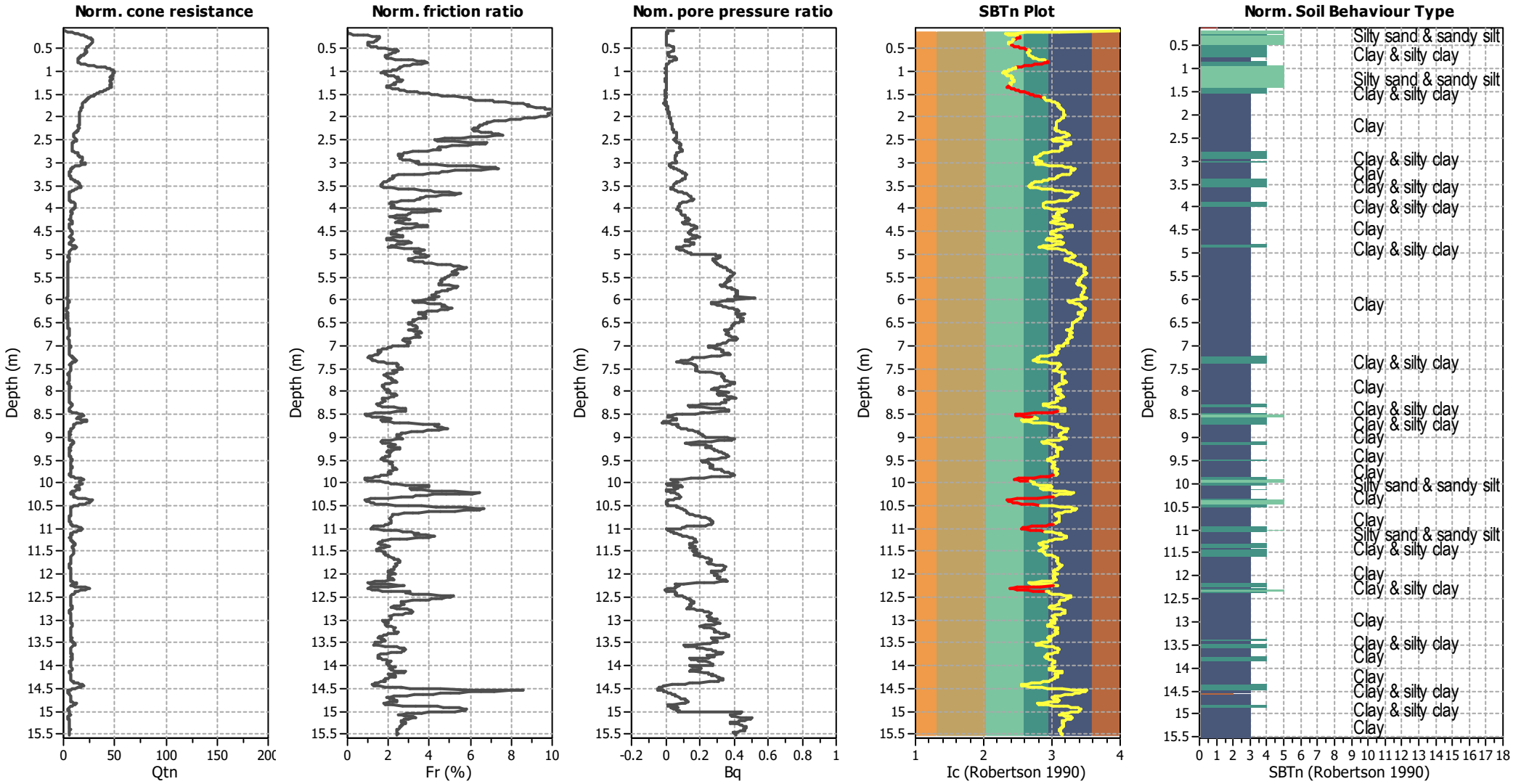
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



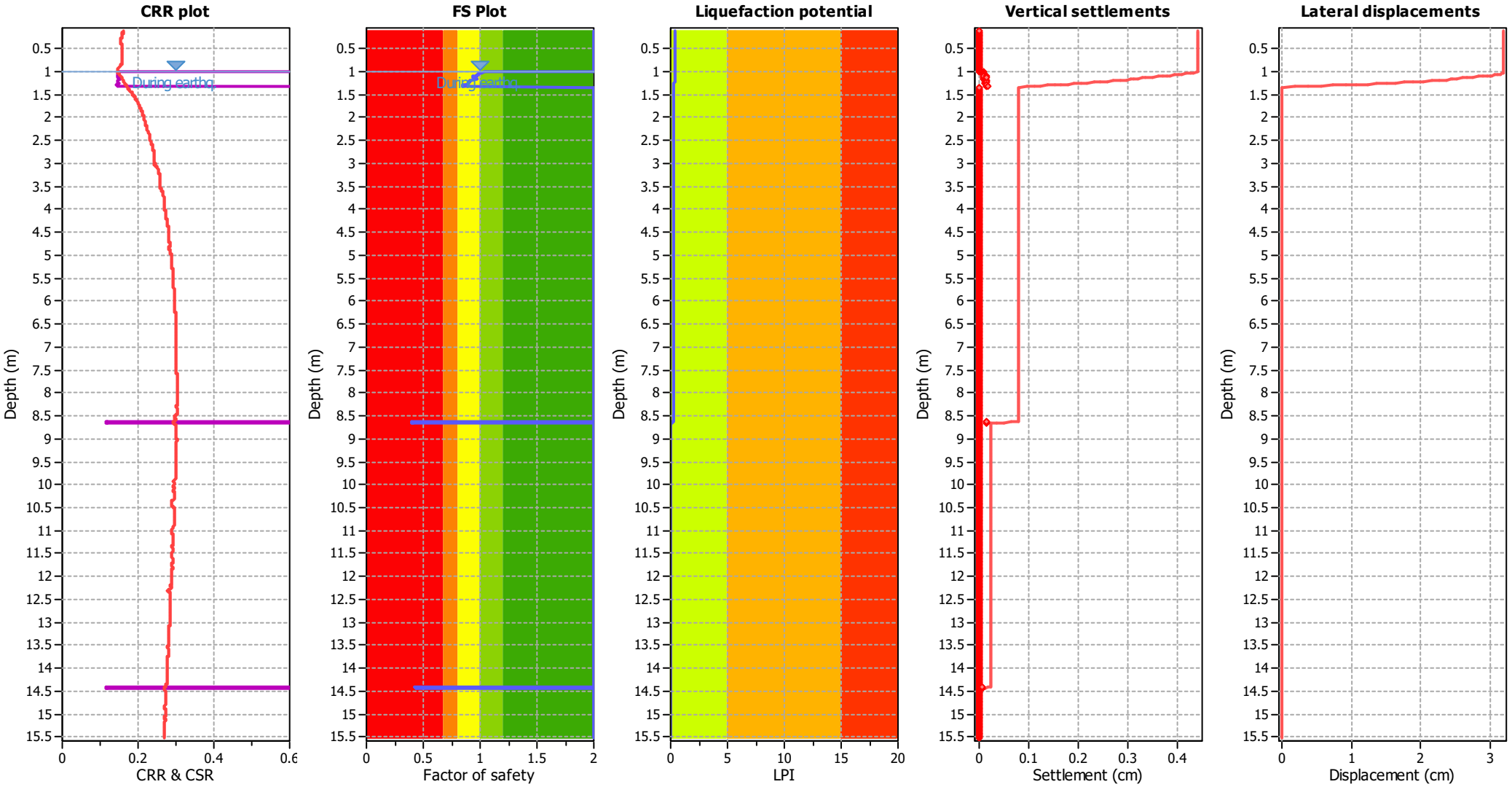
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

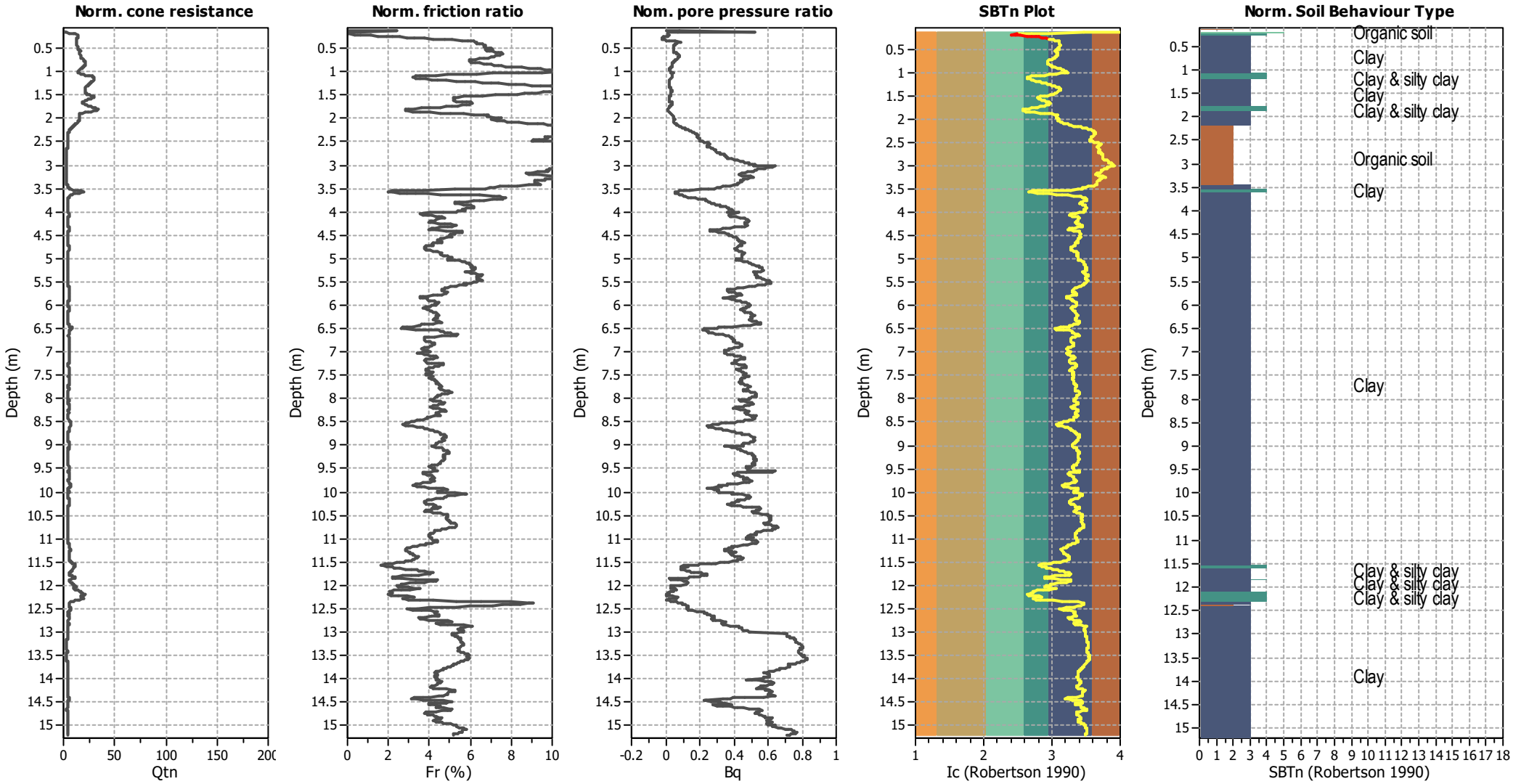
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



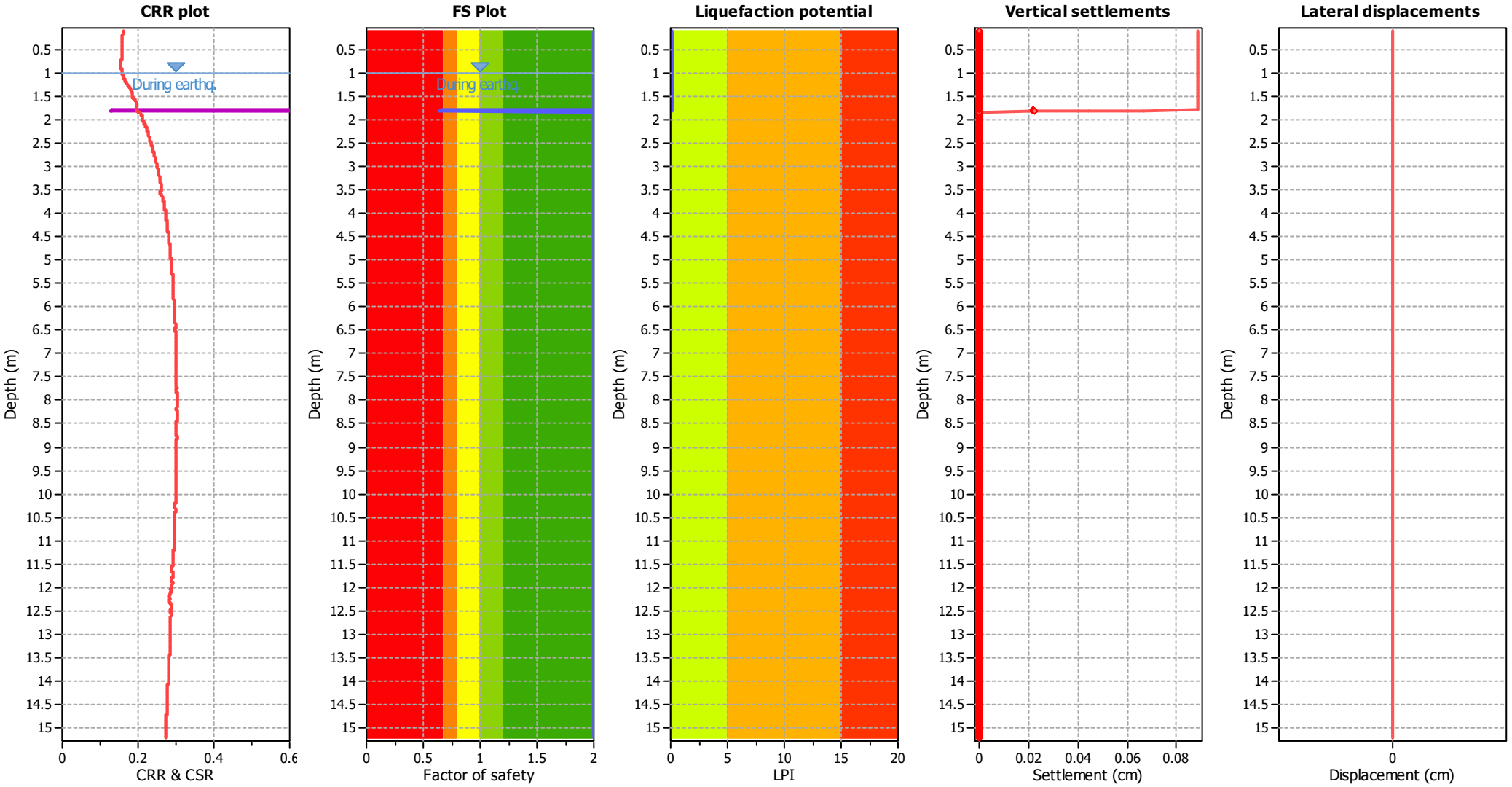
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

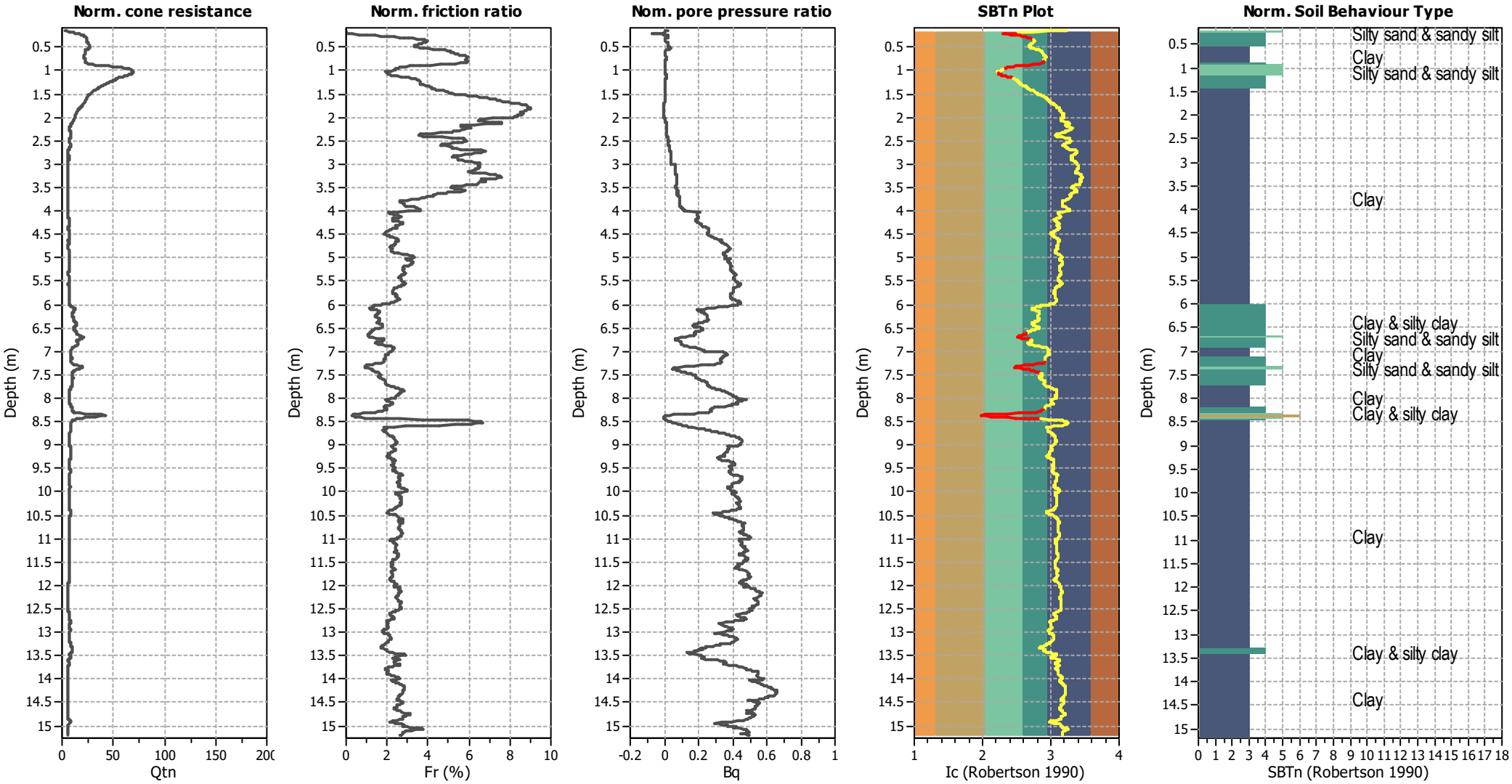
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



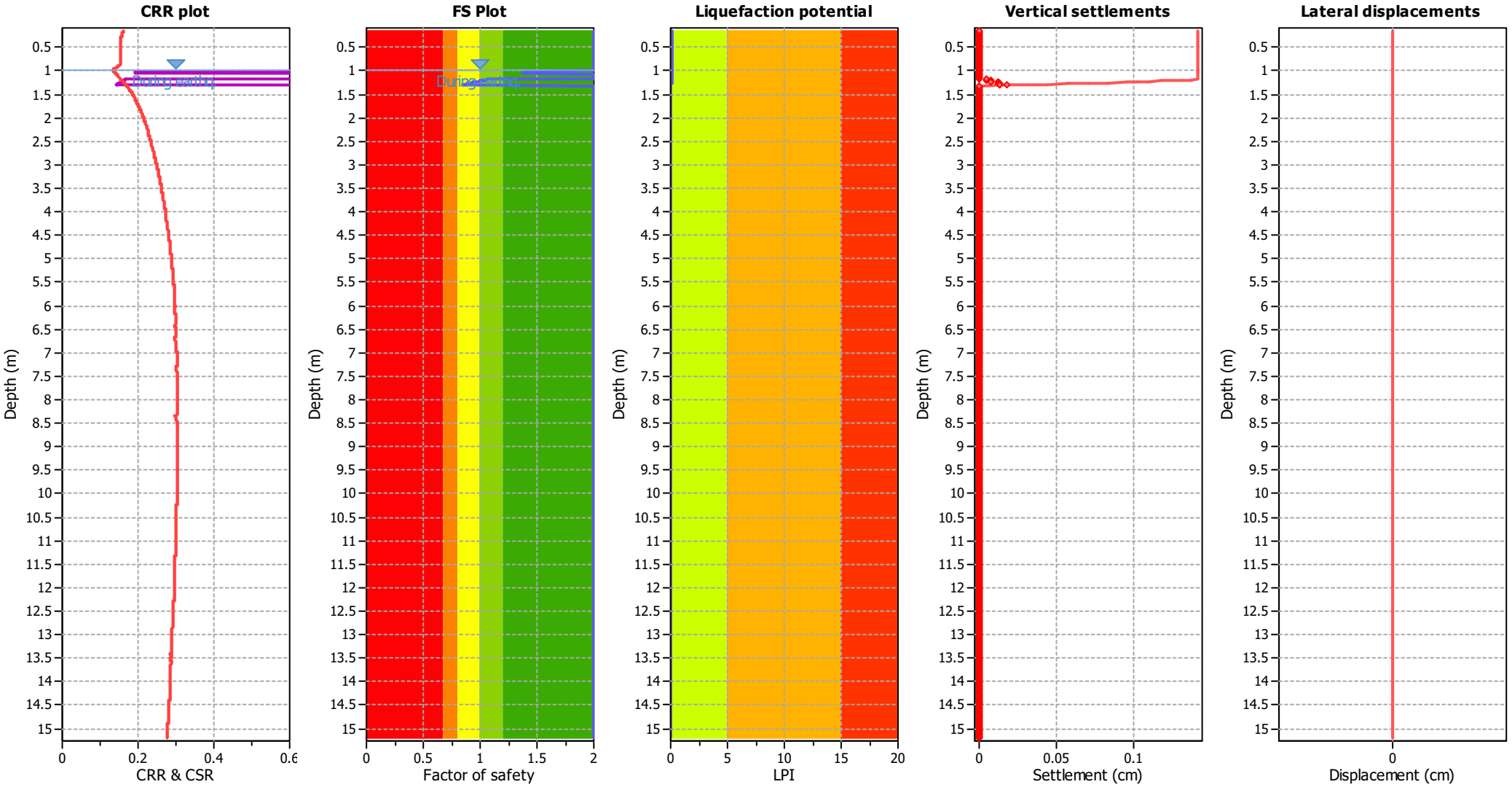
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

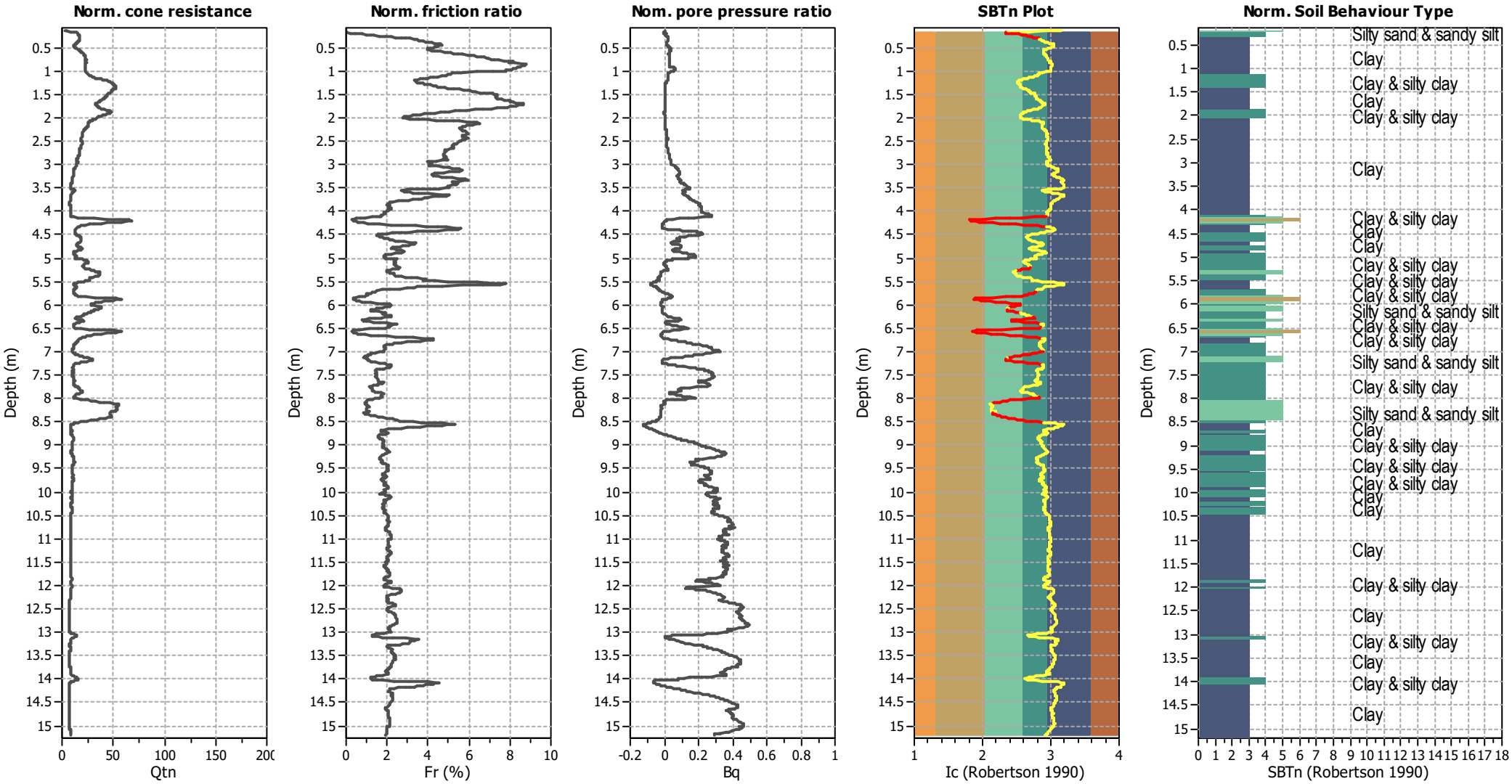
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



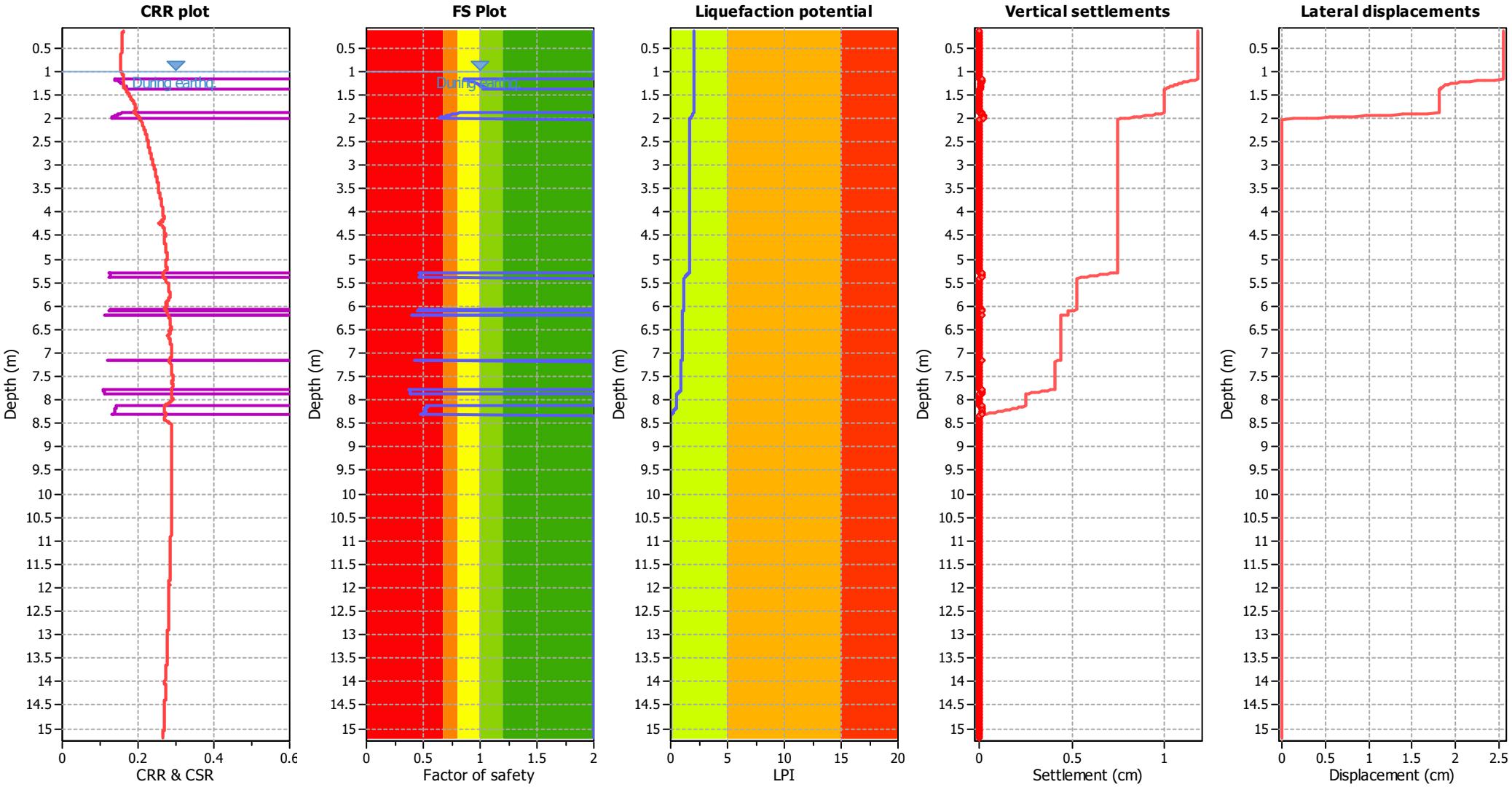
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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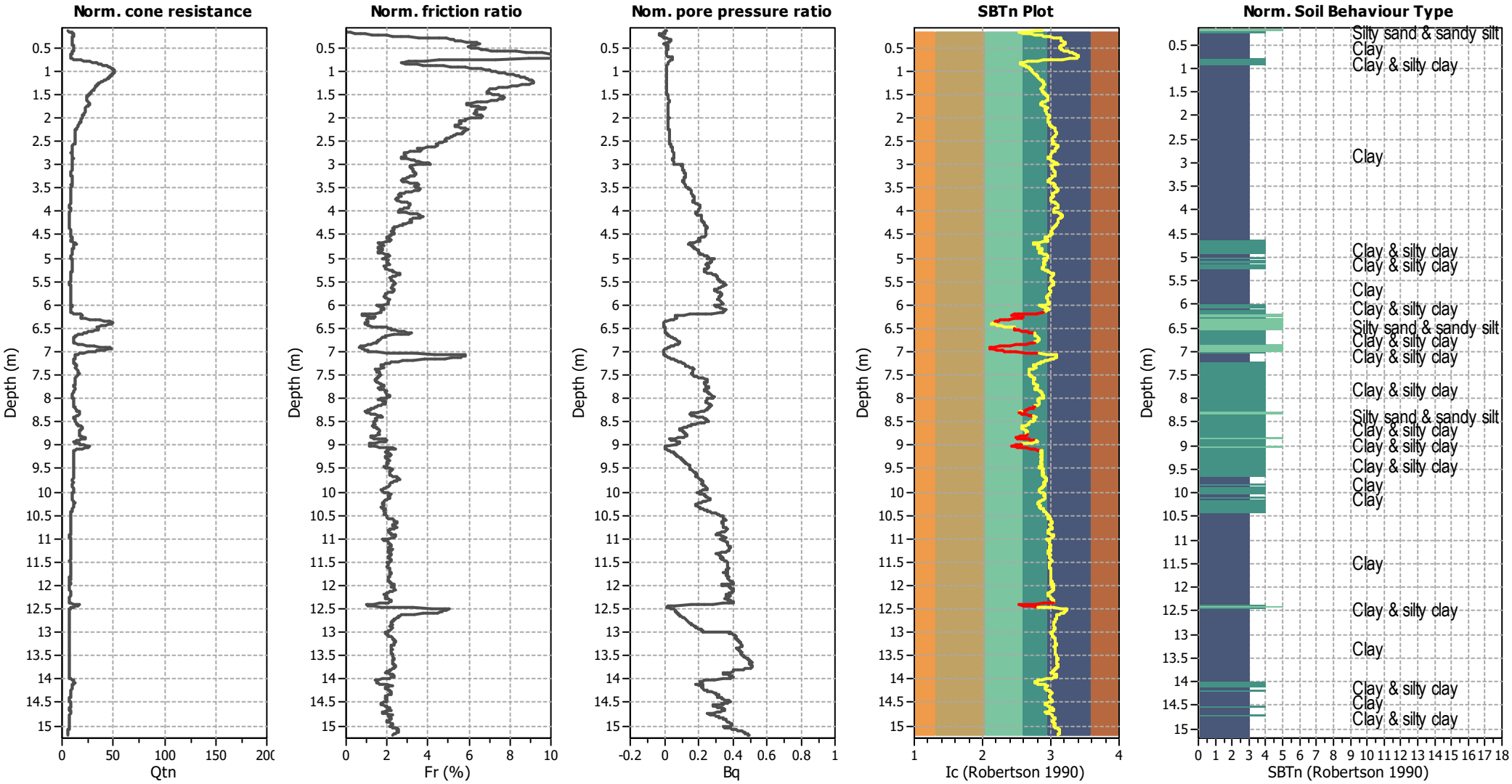
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



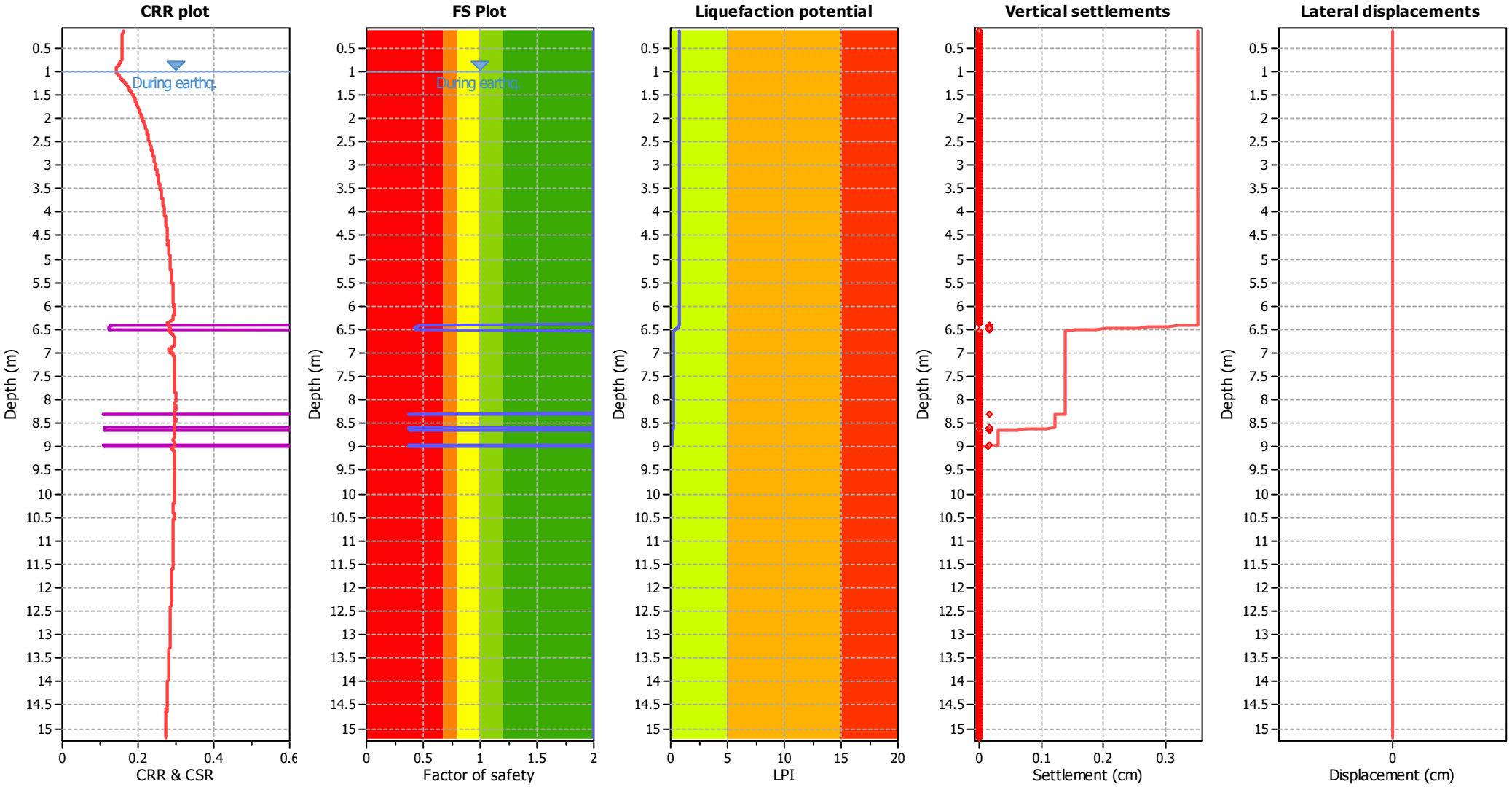
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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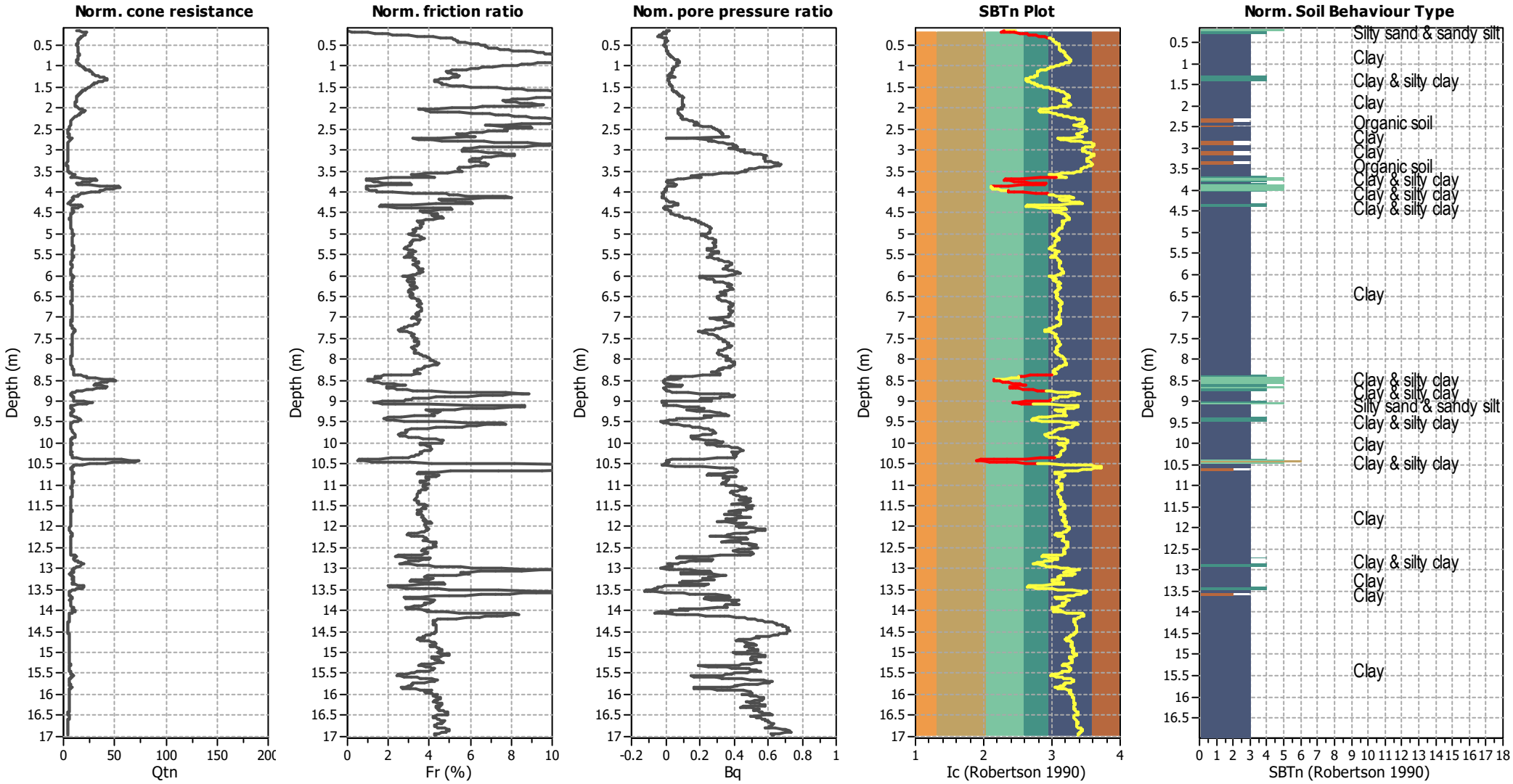
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



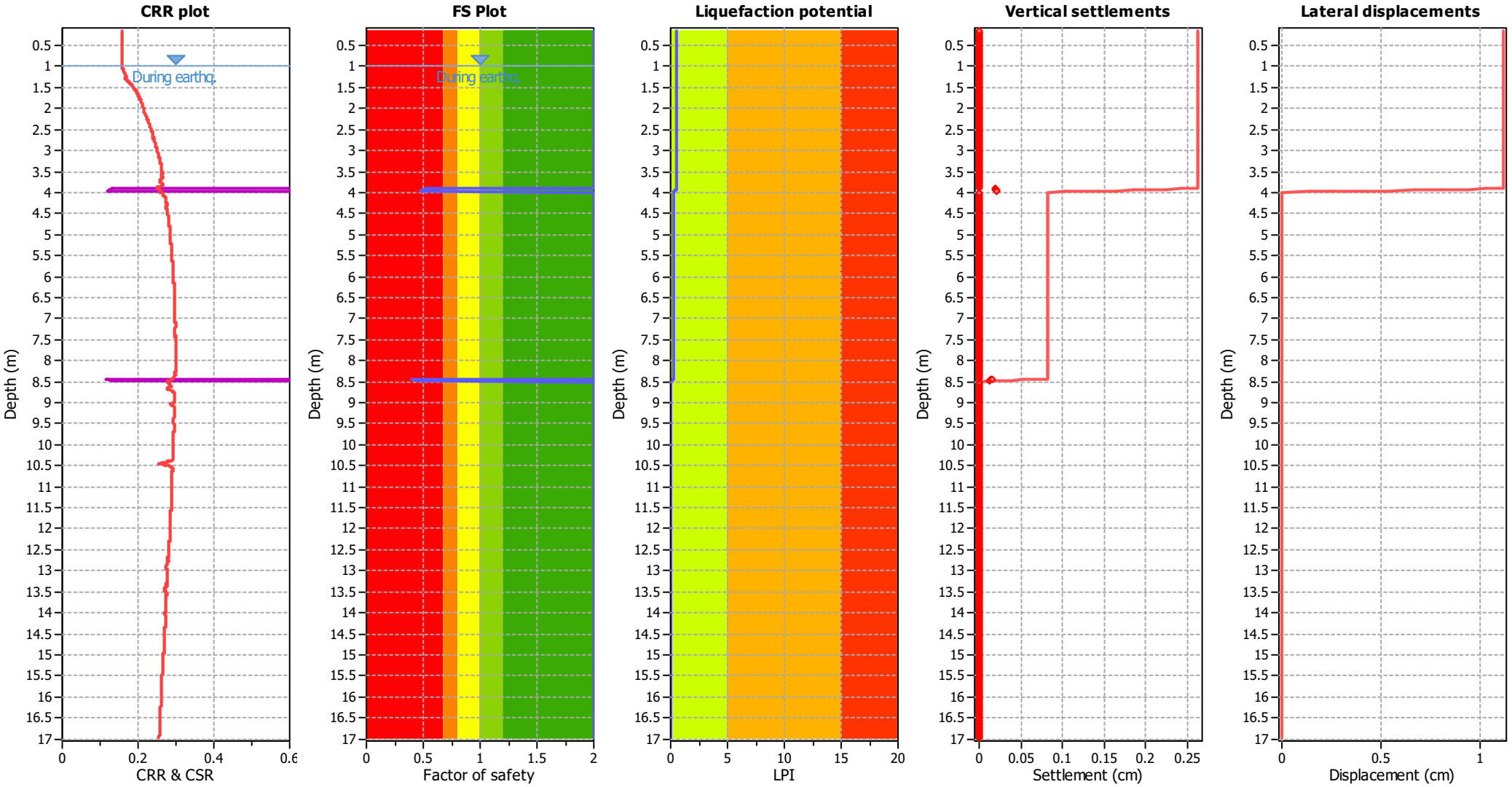
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

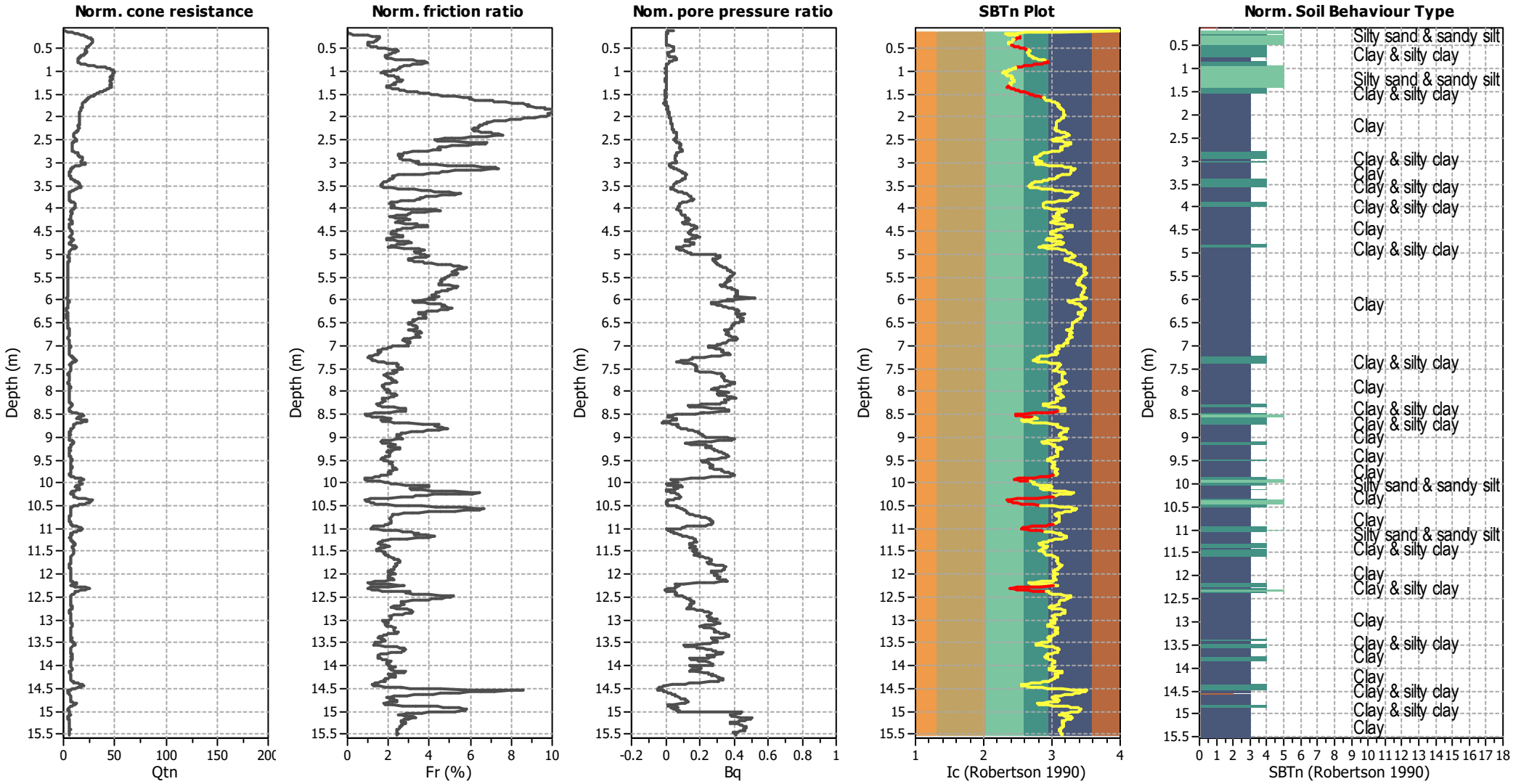
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



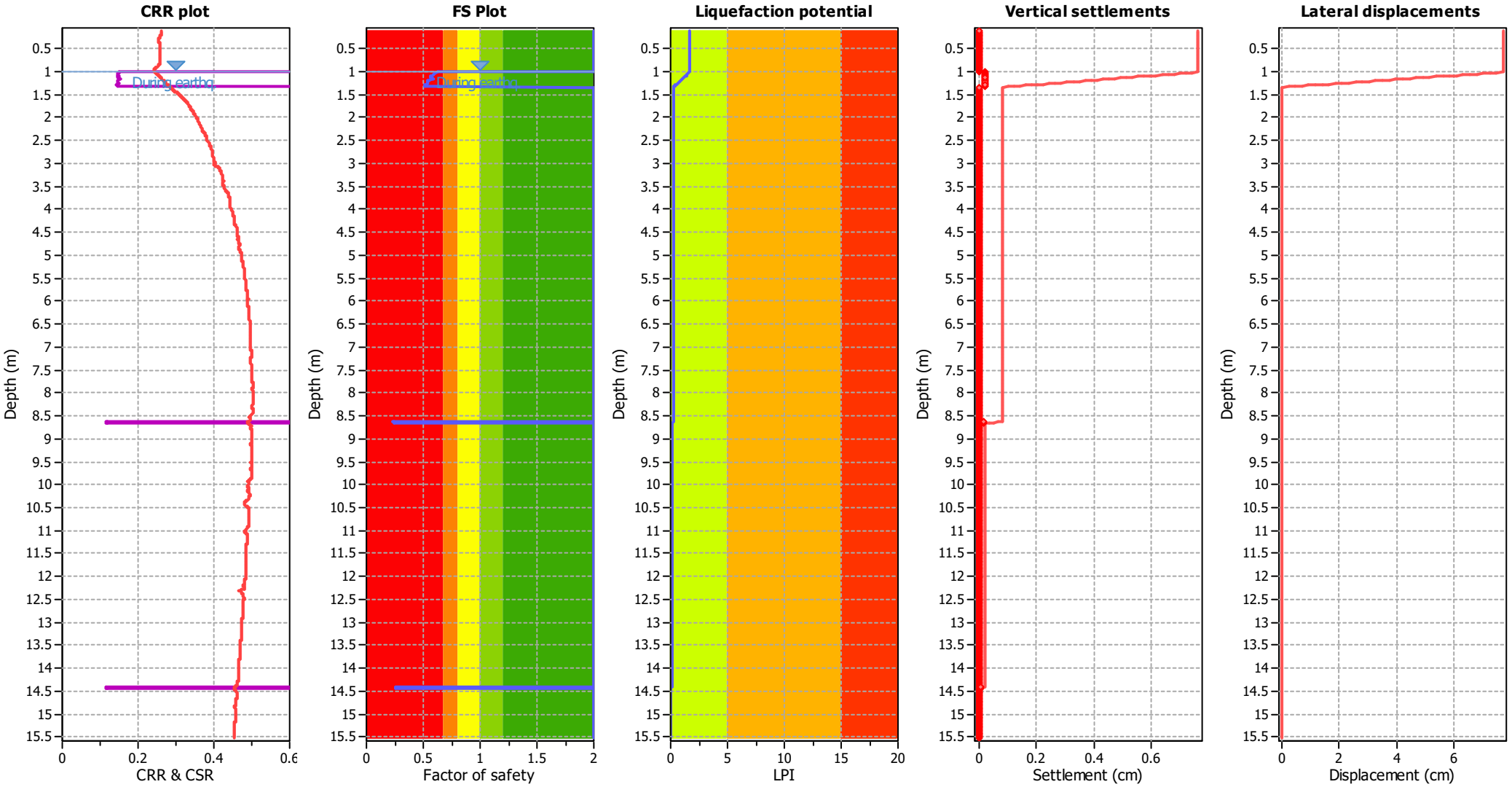
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.35 m	Fill height:	N/A	Limit depth:	N/A

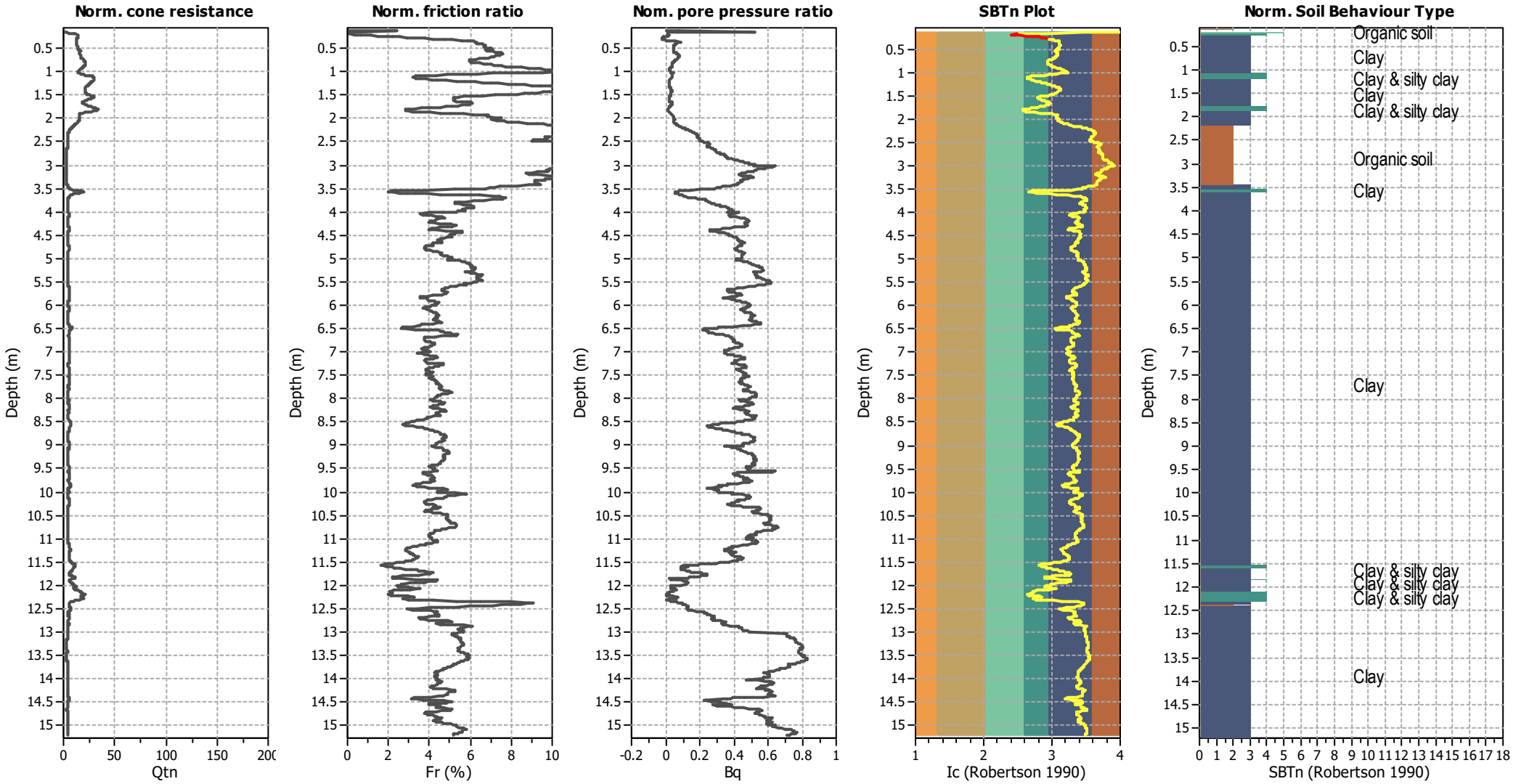
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



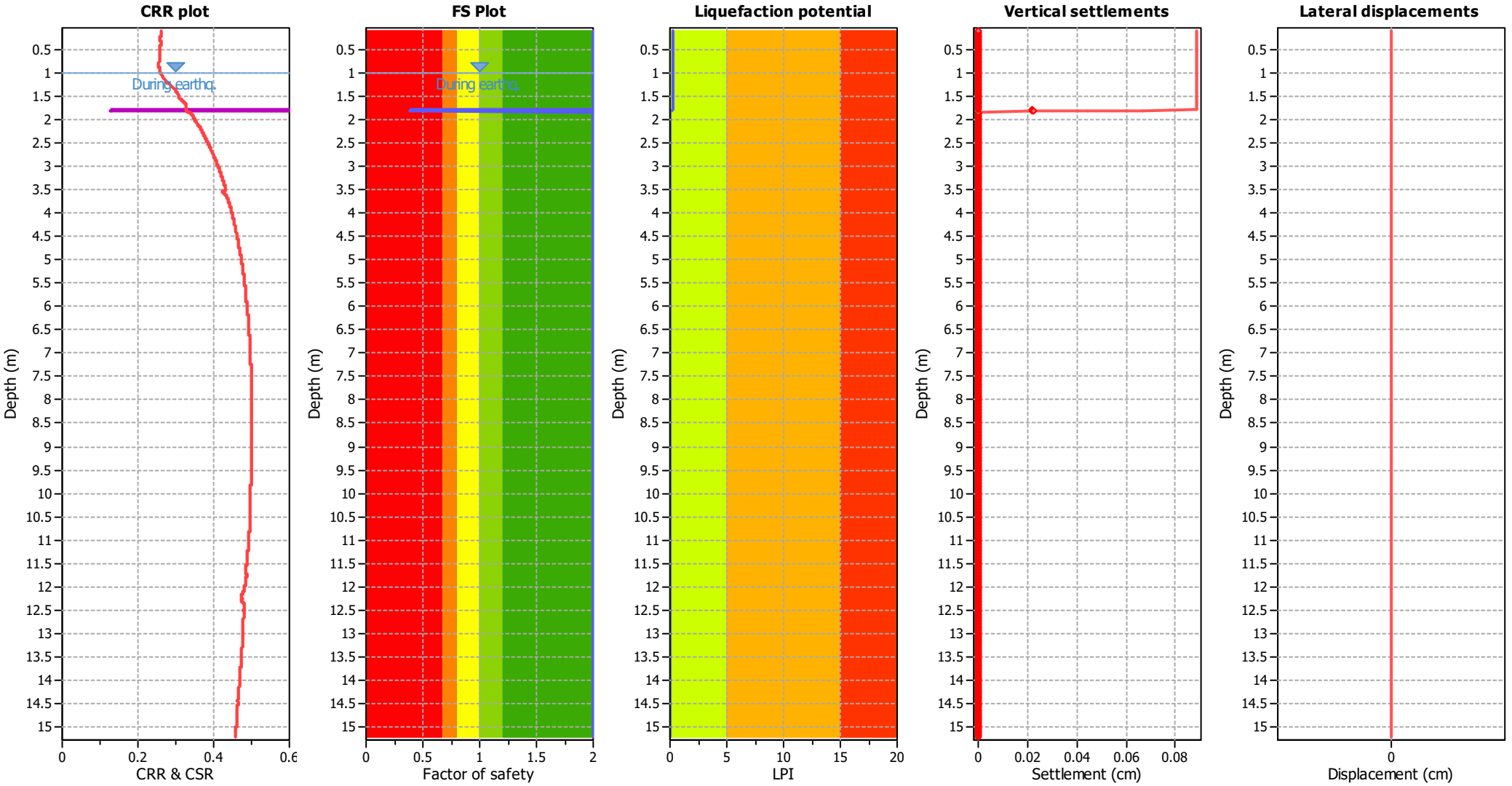
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.62 m	Fill height:	N/A	Limit depth:	N/A

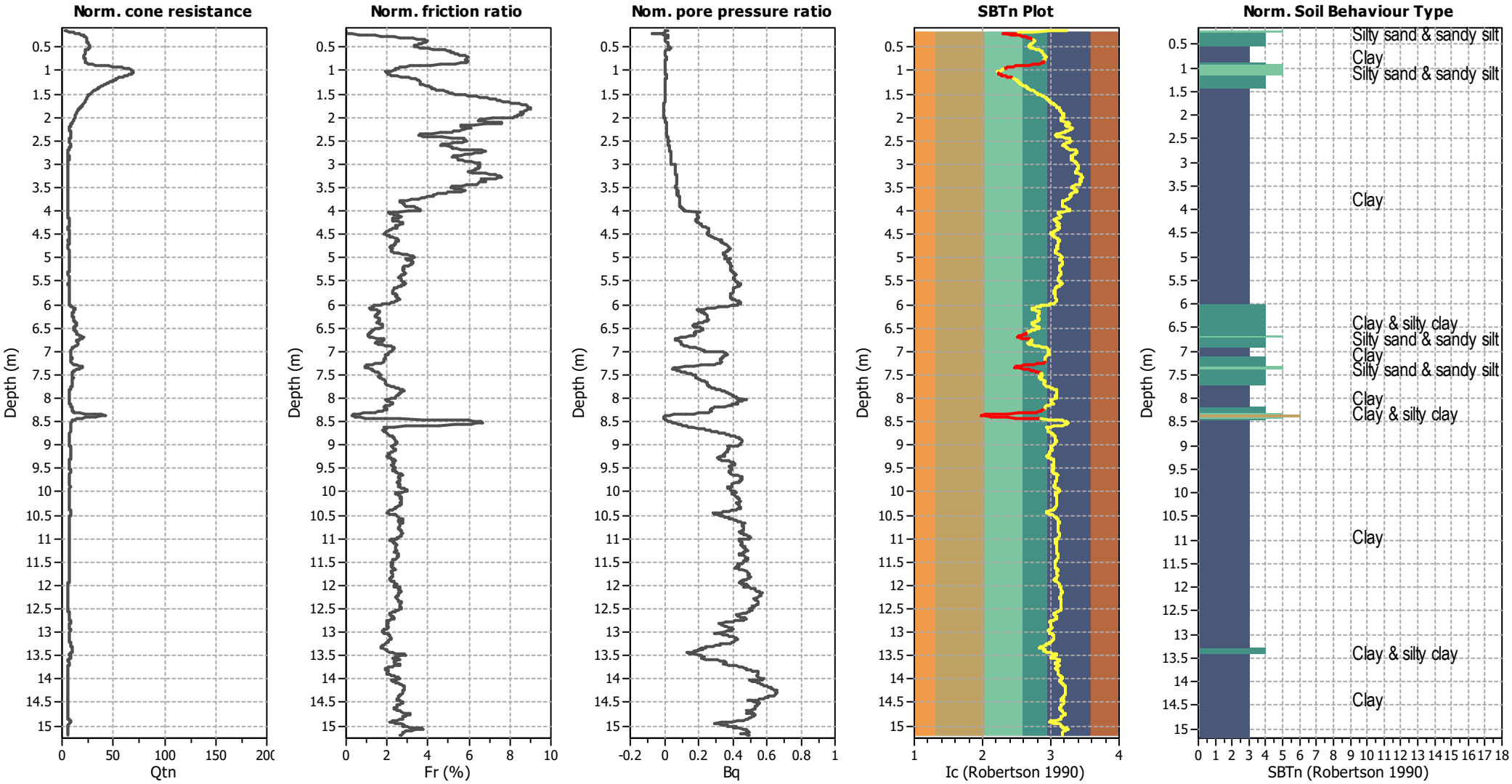
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



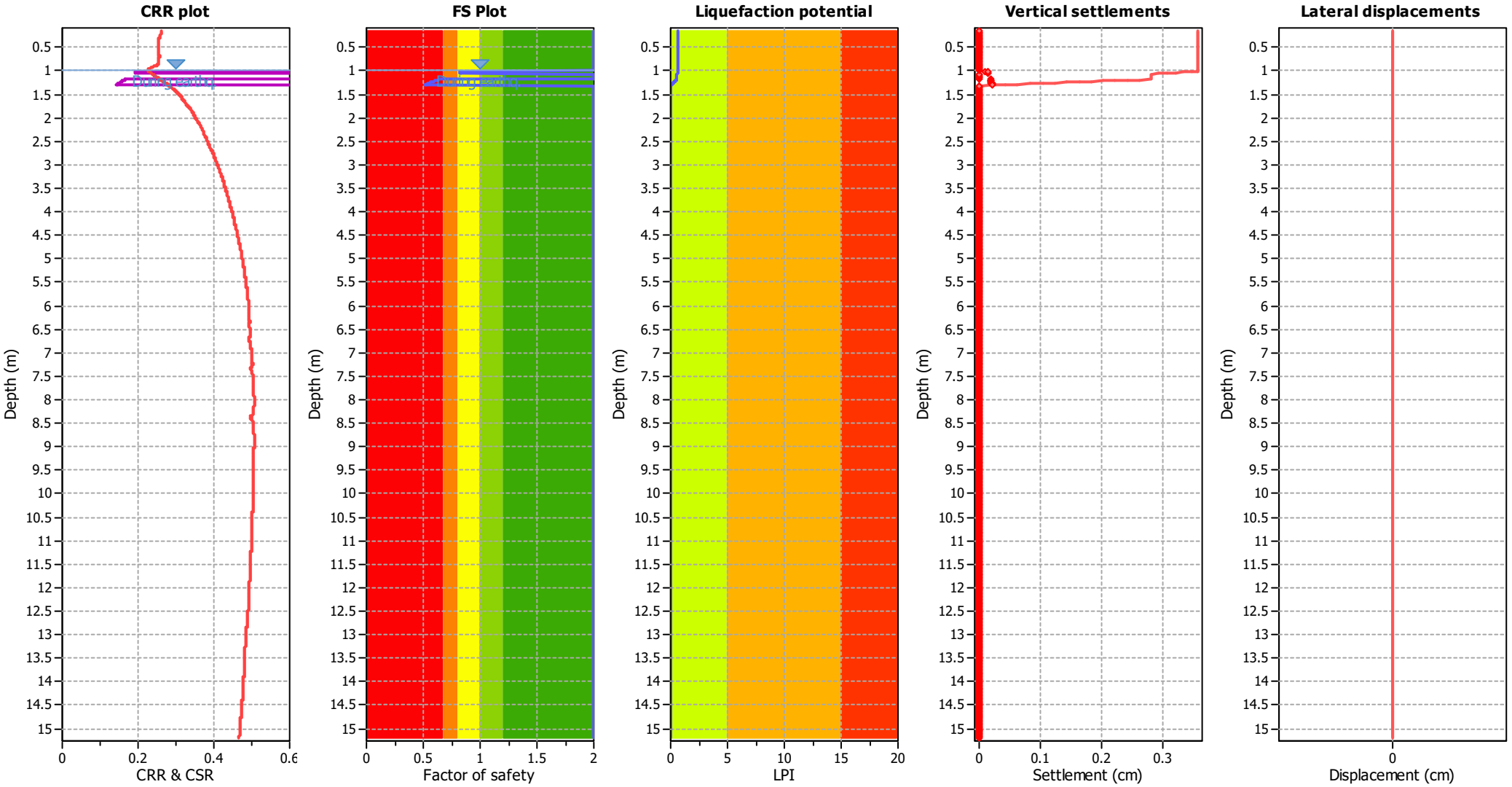
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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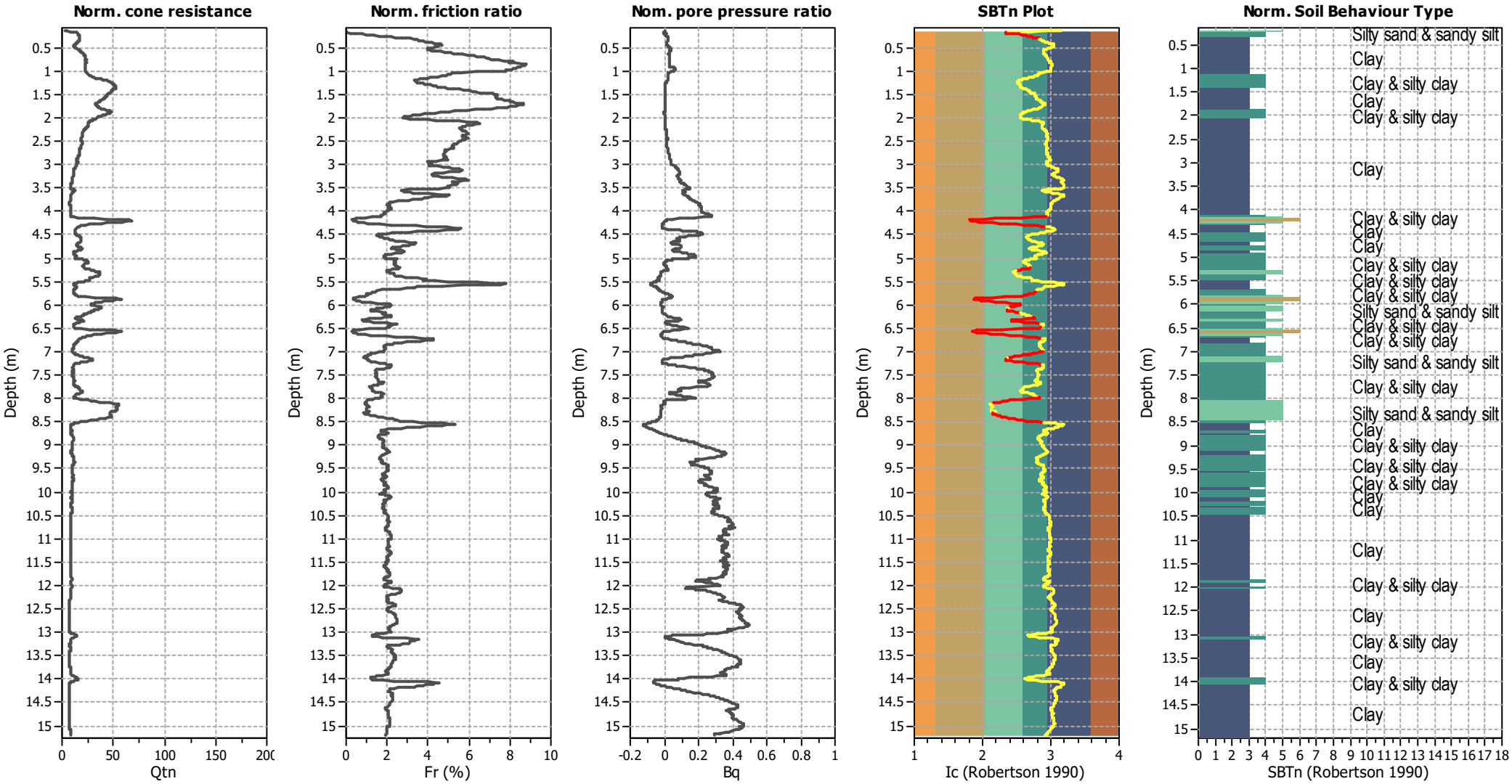
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



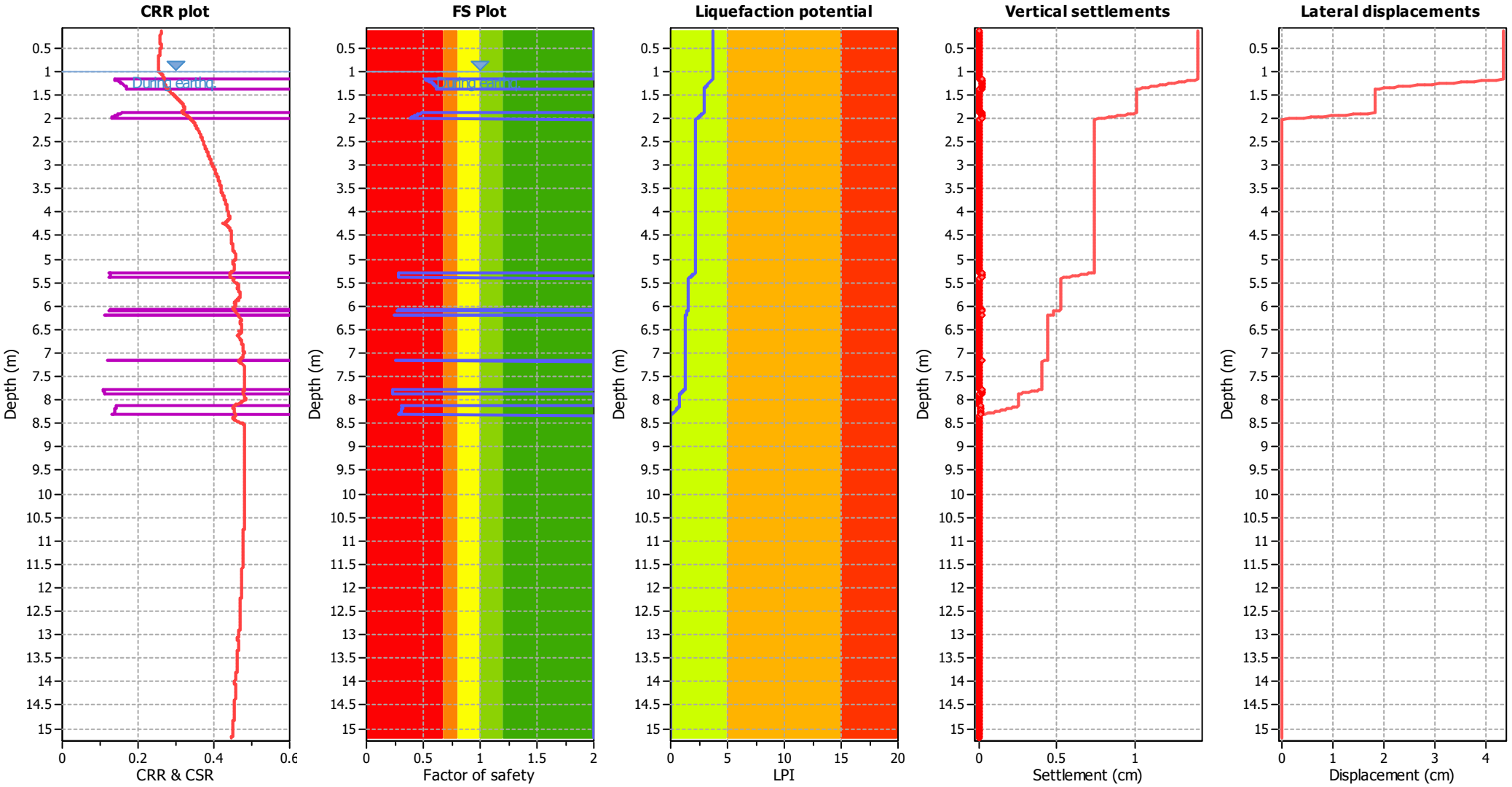
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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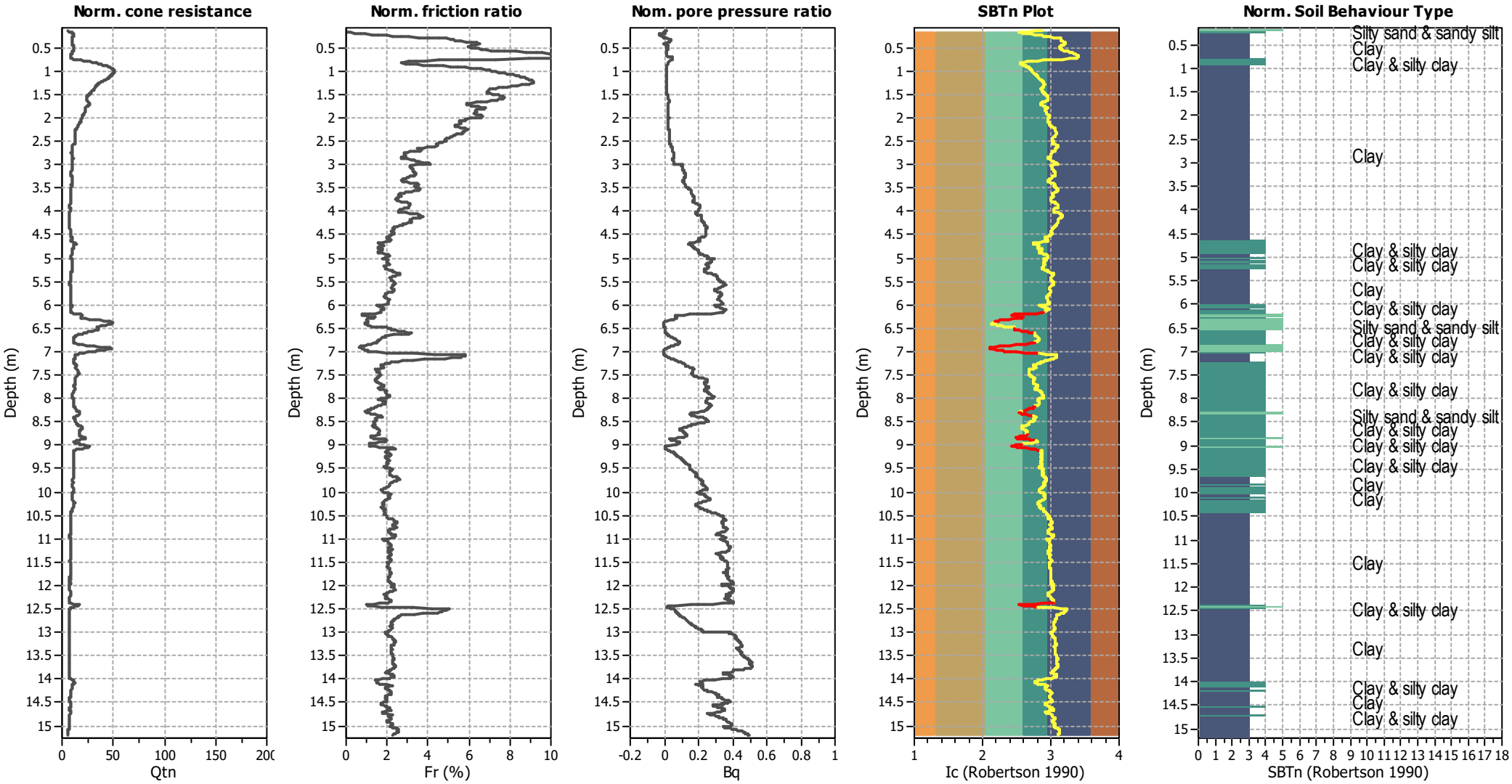
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



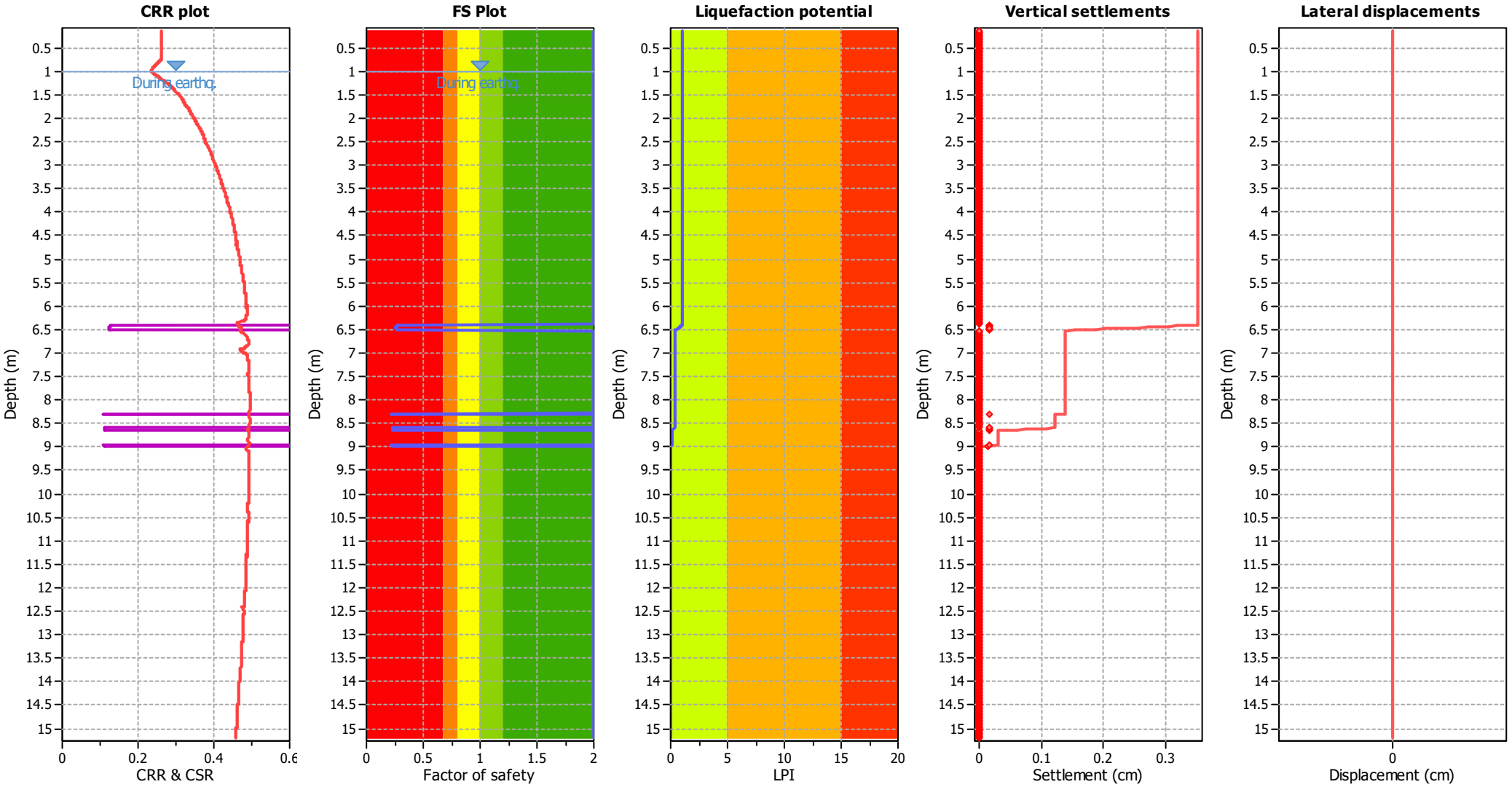
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

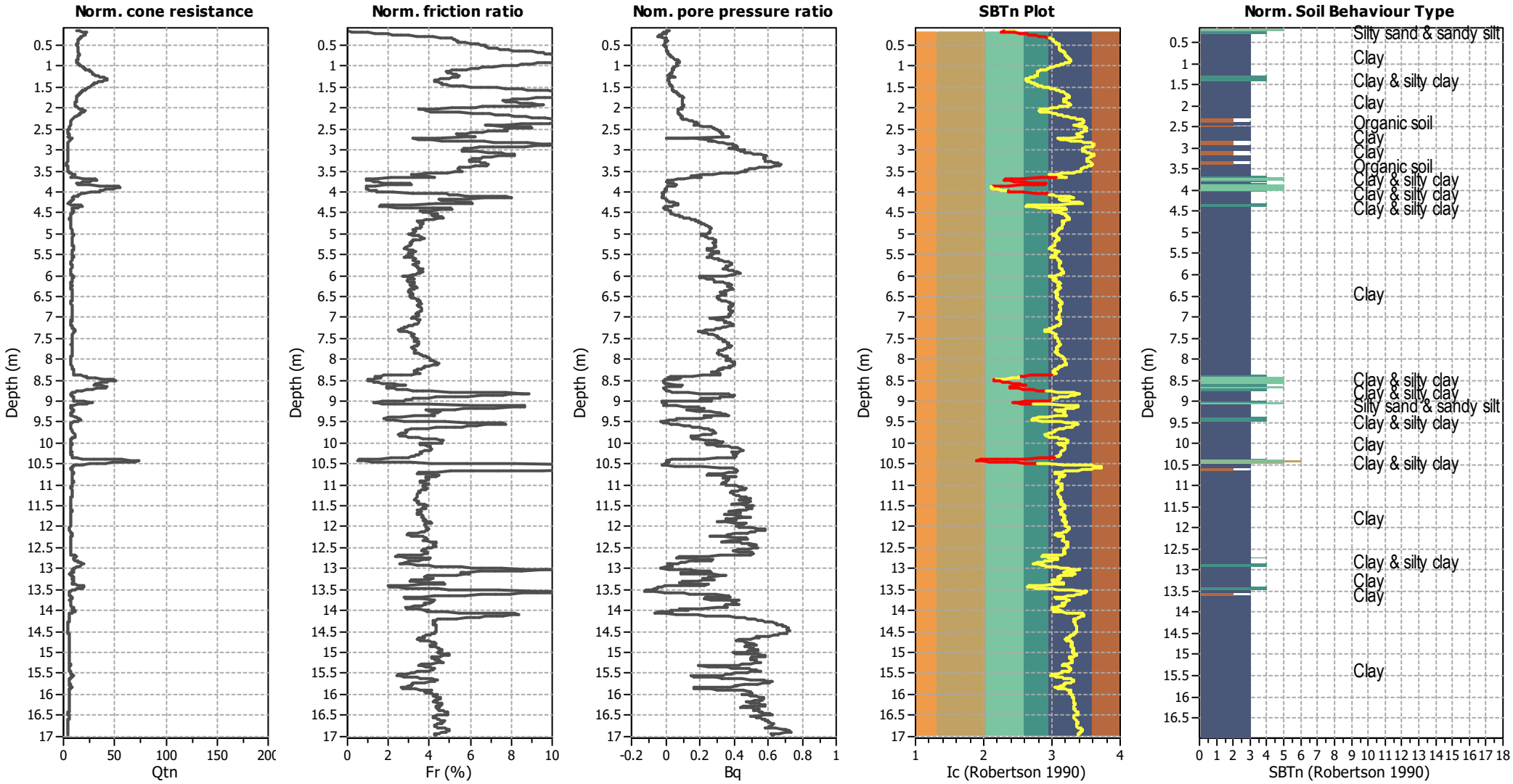
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plots (normalized)



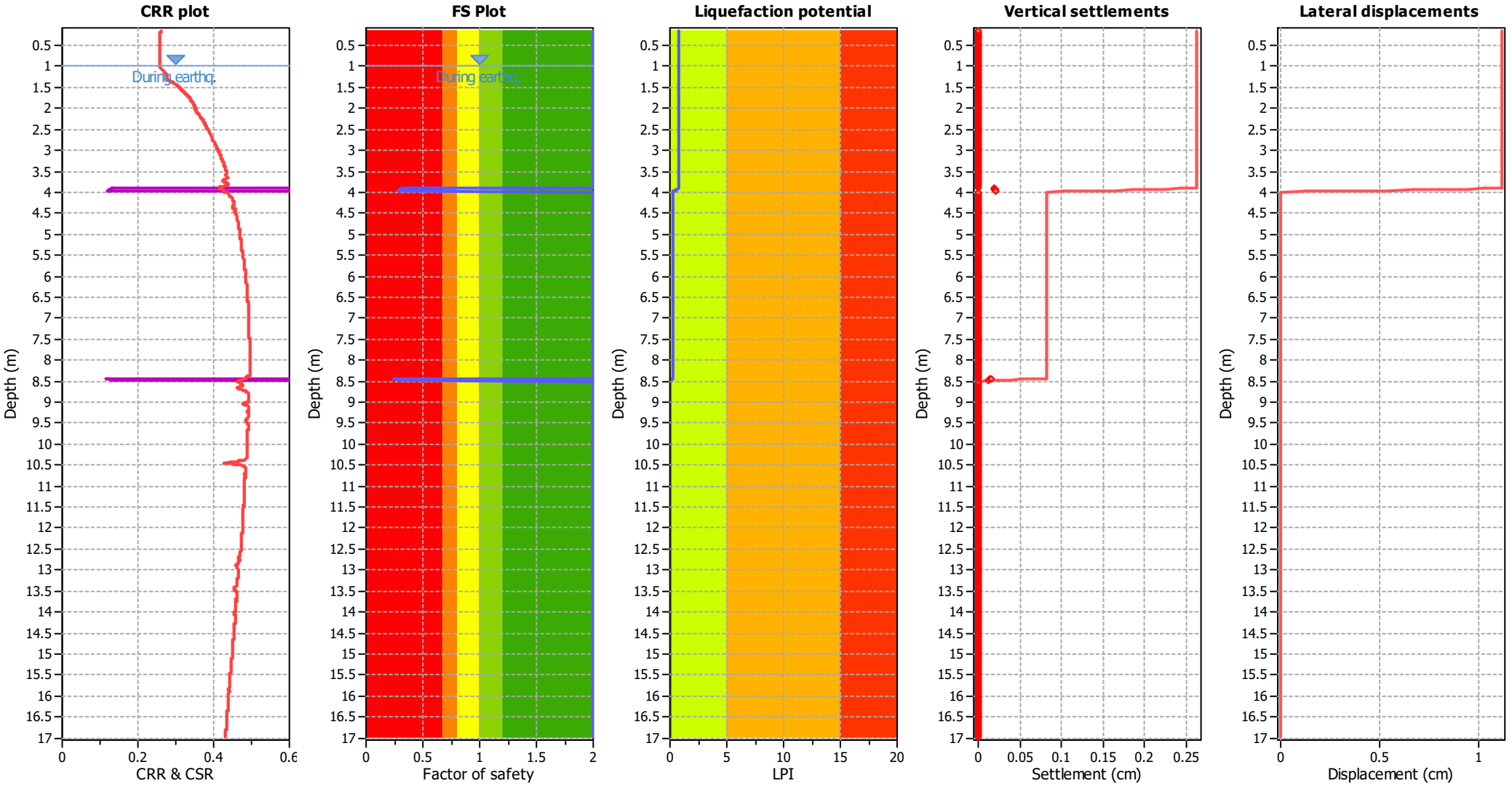
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.47	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.46 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

APPENDIX D

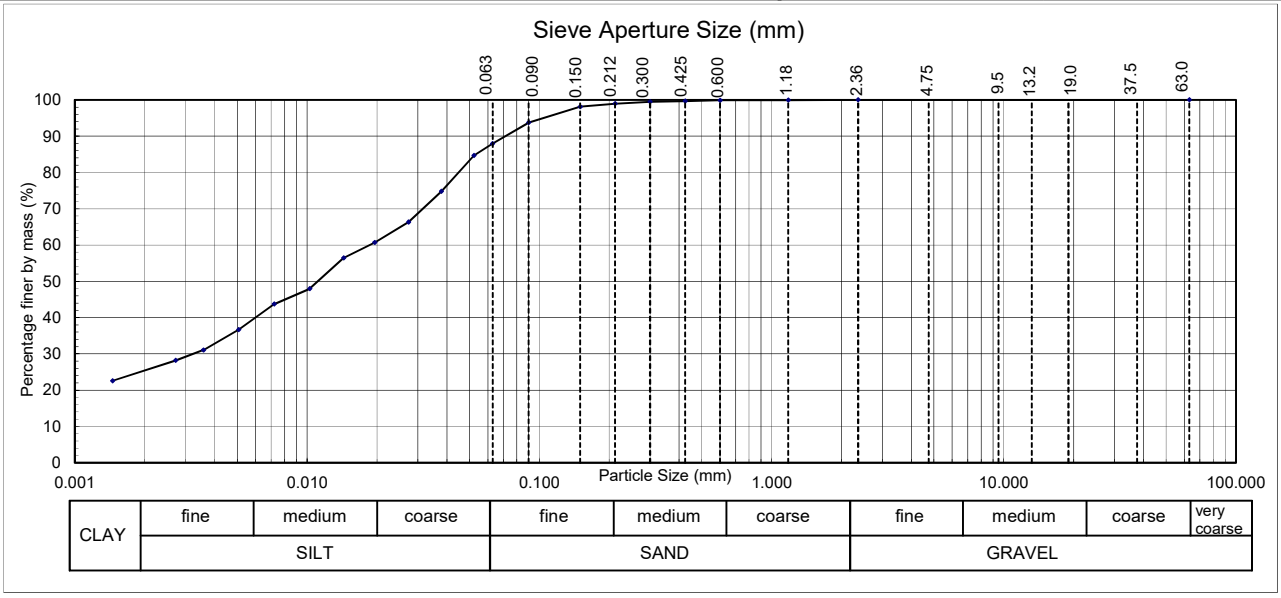
LABORATORY TEST RESULTS FOR EXPANSIVITY

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Reference Test Pourere**
Location :	**Pourere**
Client :	**Land & Exploration Ltd**
Client/Sample Ref :	**Reference Test Pourere**
Contractor :	**Land & Exploration Ltd**
Test Pit No:	**3** Depth: **0.5-0.8 metres**
Sampled by :	**Robert Loomes**
Date received :	**30/06/2021**
Sampling method :	**Unknown**
Sample condition :	**As received, sealed, moist**
Sample description :	**Silty CLAY, some sand; greyish brown, orange mottles.**
Solid Particle Density (t/m^3):	**2.70 Assumed**
Water Content (as received):	**22.0 %**

Project No:	2-L0074.09
Lab Ref No:	NA4566.1
Client Ref:	AW03

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	0.0522	85	0.0072	44
37.5	--	2.36	100	0.212	99	0.0379	75	0.0051	37
19.0	--	1.18	100	0.150	98	0.0274	66	0.0036	31
13.2	--	0.600	100	0.090	94	0.0196	61	0.0027	28
9.5	--	0.425	100	0.063	88	0.0144	56	0.0015	23
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0103	48		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip) **All information supplied by Client**

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 9/07/2021 **This report may only be reproduced in full**

Date Reported: 12/07/2021

D Crawford

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 13/07/2021

D Crawford

ACCREDITED IANZ TESTING LABORATORY

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

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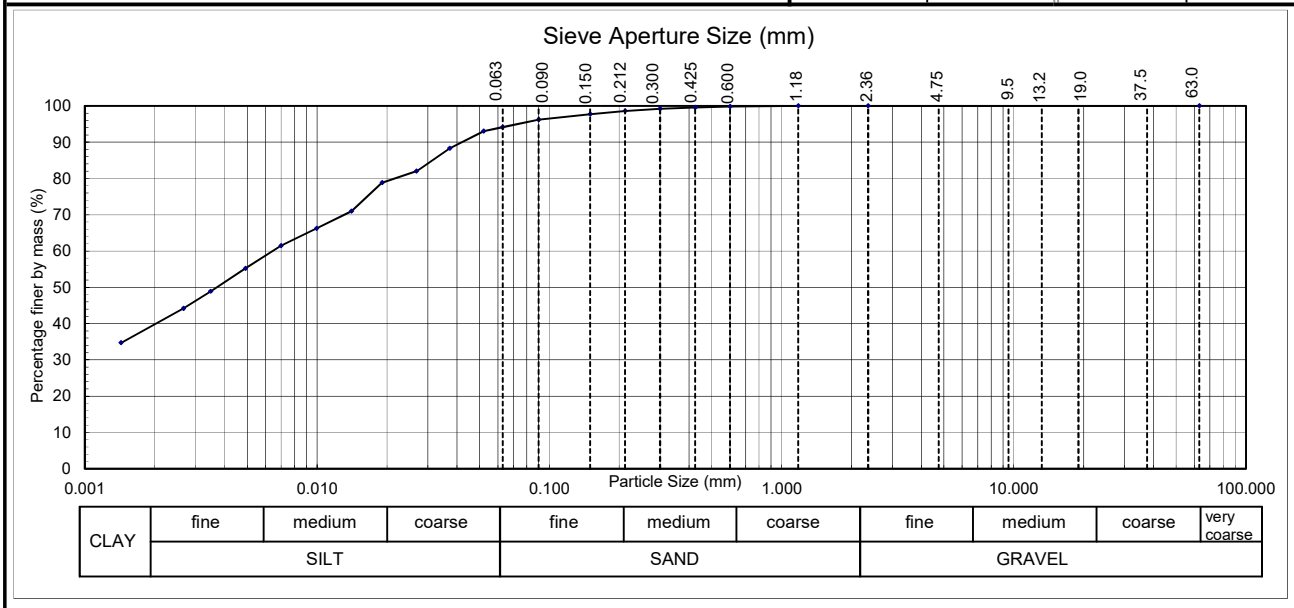
Telephone +64 6 349 6640
Website www.wsp.com/nz

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Reference Test Pourere**
Location :	**Pourere**
Client :	**Land & Exploration Ltd**
Client/Sample Ref :	**Reference Test Pourere**
Contractor :	**Land & Exploration Ltd**
Test Pit No:	**6** Depth: **0.5-0.8 metres**
Sampled by :	**Robert Loomes**
Date received :	**30/06/2021**
Sampling method :	**Unknown**
Sample condition :	**As received, sealed, moist**
Sample description :	**Silty CLAY, some sand; blueish grey, orange/brown mottles.**
Solid Particle Density (t/m^3):	**2.70 Assumed**
Water Content (as received):	**30.1 %**

Project No:	2-L0074.09
Lab Ref No:	NA4566.2
Client Ref:	AW06

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	0.0522	93	0.0070	62
37.5	--	2.36	100	0.212	99	0.0373	88	0.0049	55
19.0	--	1.18	100	0.150	98	0.0268	82	0.0035	49
13.2	--	0.600	100	0.090	96	0.0190	79	0.0027	44
9.5	--	0.425	100	0.063	94	0.0141	71	0.0014	35
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0100	66		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip) **All information supplied by Client**

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 9/07/2021 **This report may only be reproduced in full**

Date Reported: 12/07/2021

D Crawford

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 13/07/2021

D Crawford

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PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Reference Test Pourere
Location :	Pourere
Client :	Land & Exploration Ltd
Contractor :	Land & Exploration Ltd
Sampled by :	Robert Loomes
Date sampled :	23/06/2021
Sampling method :	Unknown
Sample description :	Silty CLAY, some sand; greyish brown, orange mottles.
Sample condition :	As received

Project No :	2-L0074.09
Lab Ref No :	NA4566.3
Client Ref No :	AW03

Test Results	
Liquid Limit :	50
Plastic Limit :	20
Plasticity Index :	30
Natural Water Content :	22.0 %

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Whole soil
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	All information supplied by Client

Date tested : 7/07/2021
Date reported : 13/07/2021

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IANZ Approved Signatory
D Crawford
Designation : *Senior Civil Engineering Technician*
Date : 13/07/2021

D Crawford

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PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Reference Test Pourere
Location :	Pourere
Client :	Land & Exploration Ltd
Contractor :	Land & Exploration Ltd
Sampled by :	Robert Loomes
Date sampled :	23/06/2021
Sampling method :	Unknown
Sample description :	Silty CLAY, some sand; blueish grey, orange/brown mottles.
Sample condition :	As received

Project No :	2-L0074.09
Lab Ref No :	NA4566.4
Client Ref No :	AW06

Test Results

Liquid Limit :	79
Plastic Limit :	27
Plasticity Index :	52
Natural Water Content :	30.1 %

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Whole soil
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	All information supplied by Client

Date tested : 7/07/2021
Date reported : 13/07/2021

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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IANZ Approved Signatory
D Crawford
Designation : *Senior Civil Engineering Technician*
Date : 13/07/2021

D Crawford

ACCREDITED IANZ TESTING LABORATORY

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SAND EQUIVALENT TEST REPORT

Project :	Reference Test Pourere
Location :	Pourere
Client :	Land & Exploration Ltd
Contractor :	Land & Exploration Ltd
Sampled by :	Robert Loomes
Date sampled :	23/06/21
Sampling method :	Unknown
Sample description :	Silty CLAY, some sand
Sample condition :	As received, sealed, moist
Source :	Unknown

Project No :	2-L0074.09
Lab Ref No :	NA4566.5
Client Ref No :	AW03, AW06

Test Results

	AW03	AW06
Linear Shrinkage %	13	15

Whole sample tested in natural state

Test Method

NZS 4402 : 1986, Test 2.6

Date tested : 7/07/2021
Date reported : 13/07/2021

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
This report may only be reproduced in full
All information supplied by Client

IANZ Approved Signatory

D Crawford
Designation : *Senior Civil Engineering Technician*
Date : 13/07/2021

D Crawford

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APPENDIX E

CLIENT SUPPLIED DOCUMENTS

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02 ha

Stage 3a

Stage 3b

Stage 3c

Notes:

1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

PROPOSED SUBDIVISION OF

LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX

TO BE CREATED FROM THE SUBDIVISION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:2500
DRAWING NUMBER BRIDGE03-S1	SIZE A3

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 60*	*A, B, C, D*	*LOT 100*

Proposed Amalgation Condition (S220(1)(b)(ii)):

That Lot 60 hereon and Lot 22 DP XXXXXX be held in the same Record of Title.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3A OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVISION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:12500
DRAWING NUMBER BRIDGE03-S2	SIZE A3

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 60*	*A, B, C, D*	*LOT 100*

Proposed Amalgation Condition (S220(1)(b)(ii)):

That Lot 60 hereon and Lot 22 DP XXXXXX be held in the same Record of Title.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3A OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVISON OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:4000
DRAWING NUMBER BRIDGE03-S3	SIZE A3

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02 ha

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 53*	*E*	*LOTS 1-18 & 200*

Proposed Amalgation Condition (S220(1)(b)(i)):

That Lot 53 hereon be transferred to the owners of Lot 60 DP XXXXXX and Lot 22 DP XXXXXX and that one Record of Title be issued to include all parcels.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3B OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVSION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:2500
DRAWING NUMBER BRIDGE03-S4	SIZE A3

Local Authority: Central Hawke's Bay District Council

Zoning: Rural

Comprised In: RT not yet issued

Total Area: 377.02

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 53*	*E*	*LOTS 1-18 & 200*

Proposed Amalgation Condition (S220(1)(b)(i)):

That Lot 53 hereon be transferred to the owners of Lot 60 DP XXXXXX and Lot 22 DP XXXXXX and that one Record of Title be issued to include all parcels.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3B OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVISION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:1500
DRAWING NUMBER BRIDGE03-S5	SIZE A3

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02 ha

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 54*	*F*	*LOTS 19-52*

Proposed Amalgation Condition (S220(1)(b)(i)):

That Lot 54 hereon be transferred to the owners of Lot 60 DP XXXXXX, Lot 53 DP XXXXXX and Lot 22 DP XXXXXX and that one Record of Title be issued to include all parcels.

Stage 3a

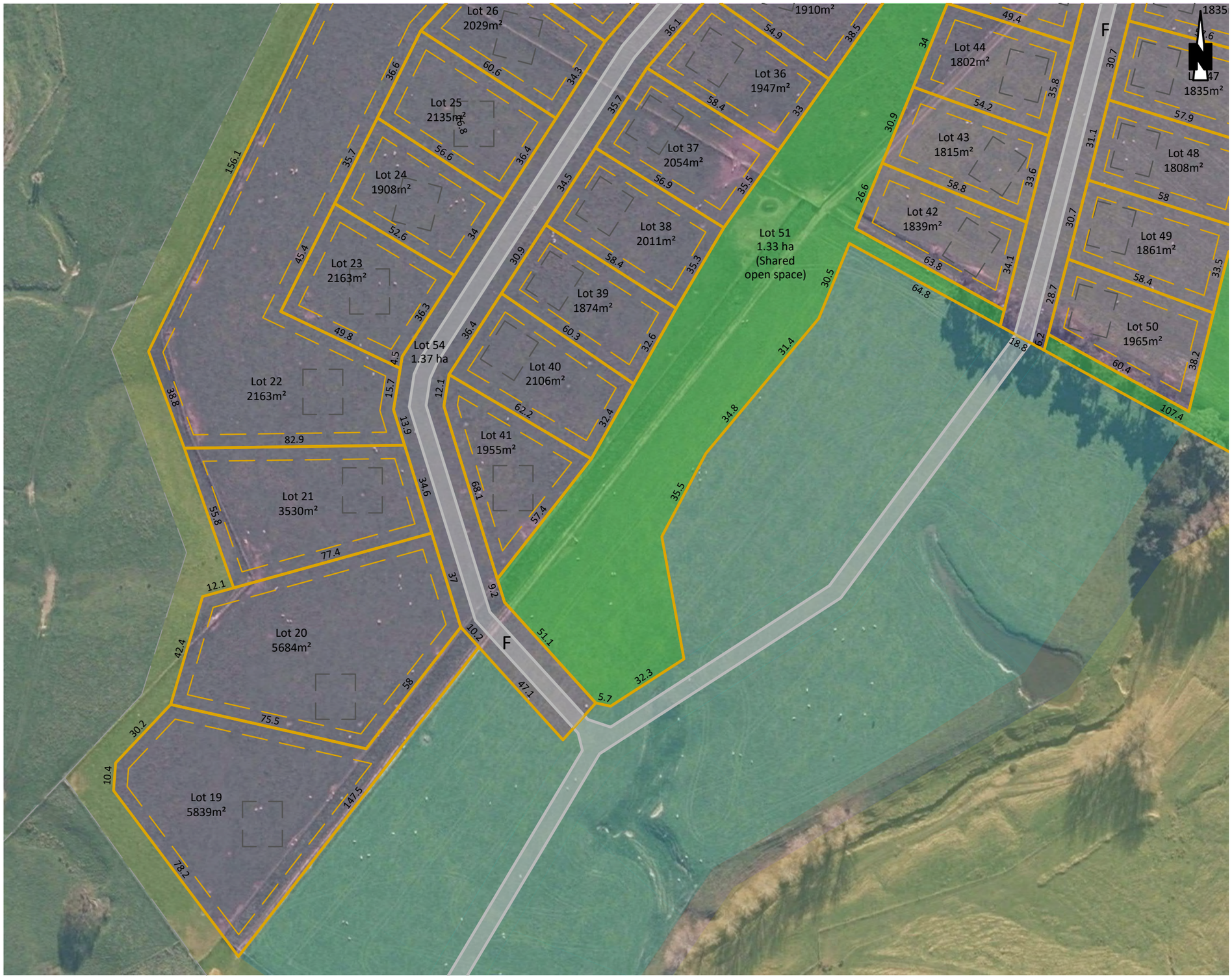
Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3C OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVSION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:2500
DRAWING NUMBER BRIDGE03-S6	SIZE A3



Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02 ha

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 54*	*F*	*LOTS 19-52*

Proposed Amalgation Condition (S220(1)(b)(i)):

That Lot 54 hereon be transferred to the owners of Lot 60 DP XXXXXX, Lot 53 DP XXXXXX and Lot 22 DP XXXXXX and that one Record of Title be issued to include all parcels.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3C OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVSION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:1500
DRAWING NUMBER BRIDGE03-S7	SIZE A3

Local Authority:	Central Hawke's Bay District Council
Zoning:	Rural
Comprised In:	RT not yet issued
Total Area:	377.02 ha

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
RIGHT OF WAY *RIGHT TO CONVEY ELECTRICITY, TELECOMMUNICATIONS & COMPUTER MEDIA* *RIGHT TO DRAIN STORMWATER* *RIGHT TO CONVEY WATER*	*LOT 54*	*F*	*LOTS 19-52*

Proposed Amalgation Condition (S220(1)(b)(i)):

That Lot 54 hereon be transferred to the owners of Lot 60 DP XXXXXX, Lot 53 DP XXXXXX and Lot 22 DP XXXXXX and that one Record of Title be issued to include all parcels.

Stage 3a

Stage 3b

Stage 3c

Notes:
1. Changes may occur to the layout of the proposal shown as a result of the Resource Consent Conditions.
2. Areas and dimensions on this plan may be subject to change following field survey.
3. This plan has been prepared only for the purpose of illustrating an application for resource consent. It should not be used for any other purpose.

STAGE 3C OF THE PROPOSED SUBDIVISION OF
LOT 2 DP XXXXXX AND LOT 22 DP XXXXXX
TO BE CREATED FROM THE SUBDIVSION OF LOT 1 DP 27067

James Bridge	DATE 3 August 2021
62 Punawaitai Road Pourerere	SCALE 1:1500
DRAWING NUMBER BRIDGE03-S8	SIZE A3

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Appendix D

Landscape Assessment

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POURERERE SUBDIVISION

PUNAWAITAI ROAD
POURERERE
JAMES BRIDGE

18 May 2021

Prepared by

Hudson Associates

Landscape Architects

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EXECUTIVE SUMMARY

1. It is proposed that an area of rural zoned land at the eastern end of Punawaitai Road, in Pourerere, is to be subdivided into 45 lots for residential use. The proposal does not meet all the relevant standards and terms to be a **Controlled Activity** and therefore it is considered as a **Discretionary Subdivision Activity**.

2. The proposal has the potential to result in effects on the three factors of landscape character, natural character, and visual amenity. These three factors are assessed at the broad scale and the localised scale.

3. The method used to assess effects on these three factors is firstly to establish a baseline of the existing rating for each factor: Landscape, Natural Character, Visual Amenity. The effect of the change caused by the proposed development is then assessed. The results (Tables p37) are that the change will result in landscape effects which will be Low – Moderate, Natural Character effects which will be Very Low and Visual Amenity effects which will vary from Low to Moderate. Cumulative effects are assessed as Low.

4. The ratings are assessed using the NZILA seven point rating scale that ranges from Very Low to Very High (Table 1 page 13). This scale equates to the RMA 4 step rating scale of Less than Minor, Minor, More than Minor and Significant (Table 2). When the results of the application site seven point assessment are equated to the RMA rating scale, all effects are assessed as Minor or Less than Minor.

5. Pourerere is recognisable for its rural character and as a quiet coastal town, with clusters of residential dwellings. The key attractions of the settlement are proximity and access to the beach plus the small scale low key atmosphere of the Settlement. These will not be changed with the proposed development, which is located on the valley north of the existing Settlement and adjacent to a recently approved subdivision for 20 houses at the end of Punawaitai Road.

6. Whle the proposed development will have smaller lots than the District Plan Controlled Activity Standard of 4,000m2, the design of the subdivision means that it will have similar effects to all lots being 4000m2 lots. A mix of smaller lots are appropriate for the enclosed, intimate setting, with rural character remaining dominant. The proposal will be in-keeping with the existing character of the township and recently consented subdivision on the adjacent land and will become an extension of this, while the dominant landscape character of tall pastural hillsides enclosing small flat valleys close to the coast will remain.

7. The following factors contribute to reducing potential adverse effects of the proposal on the landscape character and natural character, as well as visual amenity:
    - The presence of an existing township and subdivision.
    - Containment of the site provided by the local landform and dominate hills.
    - A lot layout which places larger lots (over 4000m^2) and open spaces on the perimeter of the proposal, at the interface with remaining farming activity.
    - The proposed subdivision includes a Residential Zone performance standard for building height limits
    - A colour and reflectivity scheme which will be incorporated as a covenant on the lot titles.
    - Limited earthworks due to the flatness of the site.
    - Riparian planting along the Pourerere Stream tributary, east of the site.

8. The site lies within the coastal environment as shown on the RCEP, but as it is over 600m from the active beach and separated by a 110m high hill, the effects on coastal natural character are assessed as minimal. A small tributary (Makurapata Stream) to the Pouererere Stream passes along the site's eastern boundary and this is currently degraded and grazed. Riparian revegetation is planned which will enhance the stream and improve its natural character.

9. Overall, it is considered that the proposed subdivision is appropriate from a landscape perspective and would result in similar effects to a subdivision with 4000m² lots.

INTRODUCTION

10. The following assessment of landscape character, natural character and visual amenity effects has been prepared as one of the specialist reports to support an Assessment of Environmental Effects ("**AEE**") for the application of resource consent by James Bridge ("**the Applicant**") for the Punawaitai Road subdivision.

11. Several key terms have been used in this report. *Attachment 1* provides the definitions for these terms.

THE PROPOSAL

12. The Applicant is applying for resource consent to subdivide an area of land located in Pourerere. The subject site for the proposed 45 lots is 18.32ha, leaving a balance lot from Lot 1 DP 27067 of 358ha (*Figure 1*).

Figure 1 application site area 18.32ha

13. The site is located to the north-east of Punawaitai Road, north of Pourerere Stream and west of the coast (South Pacific Ocean). Access to all lots will be obtained from the end of Punawaitai Road. The road is being upgraded as part of the prior subdivision to serve the new and proposed lots. The property is located within the rural zone of the Central Hawke's Bay District Plan.

14. It is proposed to undertake subdivision for the purpose of creating 45 separate titles for residential development, two access lots, three open space lots, and one balance farm lot. Residential lots sizes will range from 1906m^2 to 7733m^2, averaging at 2969m^2 (with a balance lot of 358.70ha). Lots larger than 4000m^2 (10 of the 45 lots), and open

spaces, are on the perimeter of the proposal at the interface with remaining farming activity. The subdivision will be undertaken in three stages (*Figure 2*).

15. All proposed lot boundaries are located at least 10m from the banks of the eastern tributary of Pourerere Stream to allow for potential future track access and planting along the stream banks. It is proposed that the Pourerere Stream tributary will be revegetated with low level planting.

16. Covenants on the new lots will ensure that colours (and their reflectivity) used for dwellings are consistent with the surrounding landscape (*Attachment 2*). In addition, it is proposed that all residences will be restricted to the residential zone building height of 8m.

17. Under the District Plan, subdivision for the purpose of creating additional allotments within the rural zone is provided for as a Controlled Activity, provided that the relevant standards and terms for subdivision and land development within the zone are met.

18. The proposed subdivision is unable to comply with the minimum lot area of 4000m² (35 of the 45 residential lots are under 4000m²), and roading access requirements. Therefore, the subdivision is required to be considered as a **Discretionary Subdivision Activity**.

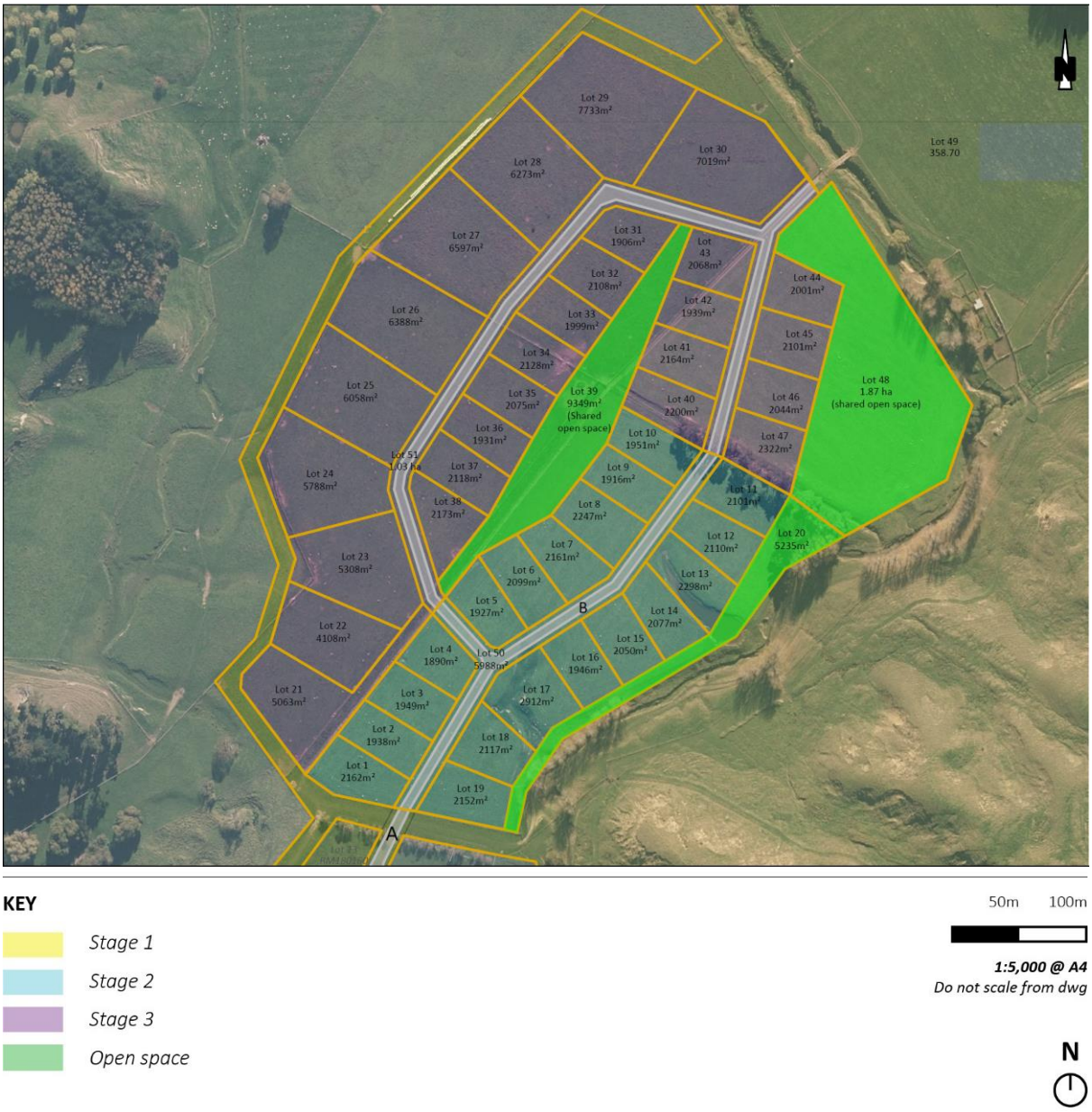

Figure 2: Proposal Plan.

THE STATUTORY CONTEXT

19. The Resource Management Act 1991 ("**RMA**"), the New Zealand Coastal Policy Statement 2010 ("**NZCPS**"), the Hawke's Bay Regional Resource Management Plan ("**HBRRMP**"), the Hawke's Bay Regional Coastal Environment Plan ("**HBRCEP**"), and the Central Hawke's Bay District Plan ("**CHBDP**") provide the statutory context for the application.

Resource Management Act

20. Part 2, Section 6 of the RMA sets out "matters of national importance", while Section 7 sets out "other matters". Considered in relation to this application are Section 6(a) which requires the preservation of natural character, Section 6(b) which requires the protection of outstanding natural features and landscapes, Section 7(c) which requires that regard is given to the maintenance and enhancement of amenity values, and Section 7(f) which requires that regard is given to the maintenance and enhancement of quality of the environment.

New Zealand Coastal Policy Statement 2010

21. The RCEP maps show the site as falling within the coastal environment, but being over 600m from the beach and partially separated by a hill, the effects on Landscape and Natural Character of the coastal environment are minimal. Additionally, the coastal environment is not mapped as outstanding for either landscape or natural character, so significant adverse effects need to be avoided. It is considered that no significant landscape or natural character effects occur.

Hawke's Bay Regional Resource Management Plan

22. The Regional Resource Management Plan is the most significant resource planning document for all resource users in the Hawke's Bay. It includes the Regional Policy Statement and sets out a policy framework for managing resource use activities in an integrated manner across the whole of the Hawke's Bay region.

Regionally significant objectives

23. The Regional Policy Statement contains the following objectives relevant to landscape and the proposed subdivision:

OBJ 4 – Promotion of the preservation of the natural character of the coastal environment and its protection from inappropriate subdivision, use and development.

Hawke's Bay Regional Coastal Environment Plan

24. The Regional Coastal Environment Plan assists the Regional Council in promoting the sustainable management of natural and physical resources of the Hawke's Bay coastal environment.

25. While the site is located approximately 600m from the active coastal margin, Map 122 in the plan identifies that the site is located within the inland coastal environment (*Attachment 3*).

Central Hawke's Bay District Plan

26. The Central Hawke's Bay District Plan is a first-generation plan, which became operative in 2003. One of the functions of the District Plan is to assist the Central Hawke's Bay District Council in managing subdivision.

27. The proposed development is within the Rural Zone, outside of the "Coastal Margin Area".

Non-compliance

28. The District Plan provides for subdivision for the purpose of creating additional allotments in the rural zone as a Controlled Activity, provided the relevant standards and terms are met.

29. The proposed activity does not comply with the following standards for subdivision and development within the Rural Zone:
    - *Rule 9.10(a) – requiring a minimum lot size of 4000m²;*
    - *Rule 9.10(g)(v) – requiring that vehicle access to a road serving more than 10 properties be directly to a road.*
    - *Ruel 9.10(i) – requiring that new roads serving greater than 10 lots be vested in Council, and that private roads have a minimum legal width of 15m, and a carriageway width of 6.2m.*

30. As a result of the above non-compliances, the application must be considered as a **Discretionary Subdivision Activity**.

Relevant objectives and policies

31. The following objectives and policies are considered relevant to this report in relation to landscape and the proposed subdivision:

Rural Zone

4.2.1 Objective – Rural Amenity and Quality of the Environment

A level of rural amenity which is consistent with the range of activities anticipated in the rural areas, but which does not create unpleasant conditions for the District's rural residents; or adversely affect the quality of the rural environment.

4.2.2 Policies

1. *To encourage a wide range of land uses and land management practices in the Rural Zone while maintaining rural amenity.*
3. *To maintain clear distinctions between the urban and rural areas through zoning and the provision of performance standards specific to the rural zone, to assist in protecting the character and quality of the surrounding rural areas.*

4.4.1 Objectives

2. *The margins of wetlands, rivers, lakes and the coast are managed in order to preserve the natural character of these environments and the margins of identified river catchments are managed to enhance water quality.*

4.4.2 Policies

5. *To control activities which have the potential to adversely affect the natural character of coast which is an important contributor to the amenity of the District.*

Subdivision and Financial Contributions

9.4.1 Objective

The maintenance or enhancement of amenity, cultural and significant nature conservation values through the subdivision process.

9.4.2 Policies:

1. *To take the opportunity to protect significant natural features or trees, and indigenous vegetation and habitat through the subdivision process.*
2. *To ensure that works associated with the land subdivision and development avoid or mitigate the adverse impacts on the natural qualities of the environment and on areas of significant nature conservation values.*
3. *To encourage innovative subdivision design consistent with the maintenance of amenity values.*
4. *To provide pedestrian and amenity linkages where useful linkages can be achieved or further developed.*
5. *To avoid or mitigate any adverse visual and physical effects of subdivision and development on the environment, including the appropriate underground reticulation of energy and telecommunication lines in order to protect visual amenities in the area.*

Areas of high natural character and outstanding natural landscapes and features

32. The 2003 District Plan did not consider areas of high natural character or outstanding natural landscape and features.

33. A landscape assessment was undertaken in May 2019 by Hudson Associates[1], as part of the Central Hawke's Bay District Plan review. It recognised Paonui Point as having high and very high natural character (HNC), see *Attachment 4*. It also identified the Pourerere coastline as an outstanding natural feature (ONF) due to its memorable steeply eroded coastal escarpments, high level of expressiveness and aesthetic values and high cultural values, see *Attachment 5*. This area of very high natural character, and the outstanding natural feature is situated along the coast and is approximately 1km east of the site at its closest. This mapping is only included in the Draft District Plan and carries no weight in terms of the current application.

[1] 2019a, 2019b, Hudson.

ASSESSMENT APPROACH AND METHODOLOGY

34. The landscape methodology used for this assessment has been based upon professional practice with reference to the NZILA Best Practice Note: Landscape Assessment and Sustainable Management 10.1[2] and Landscape Assessment from the Quality Planning website.[3]

35. It is current practice to undertake evaluations considering biophysical attributes, sensory/perceptual attributes, and associative attributes (which comprise aspects such as cultural, historical, and recreational values). The existing environment (the localised area and the wider context) is described and characterised in this assessment according to these attributes.

36. The assessment of effects is based on expert judgement and considers physical modifications and subsequent effects on the biophysical environment, as well as effects on the existing character of the site's locality, the site's resilience and capacity, and its sensitivity and vulnerability to the proposed change. The following definitions define the terms landscape resilience, capacity, sensitivity, and vulnerability, and are derived from the NZILA Best Practice Note: Landscape Assessment and Sustainable Management 10.1:[4]
    - **Landscape resilience** is the ability of the landscape to adapt to change whilst retaining its particular character and values.
    - **Landscape capacity** is the amount of change that a landscape can accommodate without substantially altering or compromising its existing character or values.
    - **Landscape sensitivity** is the degree to which the character and values of a particular landscape are susceptible to the scale of external change.
    - **Landscape vulnerability** is the extent to which landscape character and values are at risk from a particular type of change.

37. Effects may arise from changes such as a new use (new or different activities), and/or changes to the existing elements, patterns, and processes in the landscape. Such changes can affect existing character and/or people's appreciation of an area. Visual changes are also considered from identified viewpoints to determine effects on visual amenity.

38. The nature and scale of the proposed changes (often referred to as the magnitude of change) are assessed against the characteristics and values identified in the existing environment to determine the actual and potential effects the proposed changes will

[2] NZILA Education Foundation, 2010
[3] https://www.qualityplanning.org.nz/node/805
[4] NZILA Education Foundation, 2010

have on the existing qualities of the landscape. It is important to note that a large magnitude of change does not necessarily constitute a high level of adverse effect, rather it depends on the qualities and character of the existing environment.

39. An assessment of cumulative effects was also undertaken for landscape character, natural character, and visual amenity, as well as an assessment of the proposal against the relevant statutory provisions.

40. A site visit, to gain an understanding of the site and document its existing environment, was undertaken on 1st March 2021.

41. The assessment uses a seven-point scale to rate effects:

Table 1: Seven-point scale to rate effects

Very Low	Low	Low-Moderate	Moderate	Moderate-High	High	Very High

42. This assessment is primarily concerned with identifying the adverse effects associated with the application, however, it is acknowledged that effects may also be positive or neutral. The NZILA Best Practice Note: Landscape Assessment and Sustainable Management 10.1 does not make comment on how to relate effects rating scales to RMA terminology. This assessment takes the following view as being logical and reflects general practice:

Table 2: Seven point effects rating scale against 4 point RMA case law terminology

Effects rating scale	**RMA terminology**
Very High	More than minor and significant adverse effects
High	More than minor and significant adverse effects
Moderate-High	More than minor (moderate) adverse effects
Moderate	More than minor (moderate) adverse effects
Low-Moderate	Minor adverse effects
Low	Less than minor adverse effects
Very Low	Less than minor adverse effects

43. To assess landscape character, natural character and amenity effects both the magnitude of the change and the sensitivity of the landscape to change are considered and scaled according to the descriptions given in *Table* 3*3*. The assessment of these effects includes mitigation measures mentioned in this report.

Table 3: Landscape character, natural character and amenity effects

SCALE	DESCRIPTION
Very High	Loss/alteration of key characteristics will be fundamental, such that the post-development landscape character will be completely changed.
High	Loss/alteration of key characteristics will be dominant, such that the post-development landscape character will be substantially changed.
Moderate-High	Loss/alteration of key characteristics will be prominent, such that the post-development landscape character will be distinctly changed.
Moderate	Loss/alteration of key characteristics will be apparent, such that the post development landscape character will be obviously changed.
Low-Moderate	Loss/alteration of key characteristics will be evident, such that the post-development landscape character change will be noticeable.
Low	Loss/alteration of key characteristics will be unobtrusive, such that the post-development landscape character will be slightly changed.
Very Low	Loss/alteration of key characteristics will be indiscernible, such that the post-development landscape character will be inconsequentially changed.

Landscape character effects assessment

44. In the NZILA Best Practice Note[5] landscape is defined as "*the cumulative expression of natural and cultural features, patterns and processes in a geographical area, including human perceptions and associations.*"

45. Before assessing the level of effects on landscape, the existing level of landscape character was determined using the seven-point scale. On this scale, an area with very high landscape character will have natural and cultural features, patterns and processes that are well recognised for their biophysical, sensory/perceptual, or associational attributes. Whereas an area with very low landscape character will not be recognised for the above attributes.

46. For the assessment of landscape effects consideration is given to effects on all attributes (biophysical, sensory/perceptual, and associative) in coming to an overall conclusion. Weighting between these three will not necessarily be equal as one factor may be of particular importance and be weighted more strongly than one or both of the other attributes.

47. Landscape character is the distinctive combination of landscape attributes, including form, use, sensory/perceptual qualities, and cultural and social associations, which make one area different from another and gives an area its identity. Land use change can potentially affect existing landscape patterns and processes. The approach to assessing landscape character has been undertaken at two scales: a broad-scale assessment and at a more detailed level focusing on the localised area.

[5] NZILA Education Foundation, 2010

Natural character effects assessment

48. Natural character is the extent to which natural elements, patterns and processes occur, the nature and extent of their perceived naturalness in the landscape and its experiential qualities. Natural character ranges from modified to pristine, with the degree of natural character being highest where there is the least modification. The effect of different types of modification upon natural character varies with context and may be perceived differently by different parts of the community.

49. For the natural character assessment both biophysical attributes and some perceptual attributes are considered. These include transient and ephemeral attributes, darkness of the night sky, wildness, and sounds and smells of the sea/water, with a particular focus on the experience created by biophysical and perceptual attributes. Associative attributes are not taken into consideration as these do not determine levels of natural character. As a first step, the degree of naturalness is established from a science focus, then the area is evaluated in terms of how people would sense and experience the naturalness of that environment.

50. Before assessing the level of effects on natural character, the existing level of natural character was determined using the seven-point scale. On this scale, an area of very high natural character will display an inconsequential change to the pre-modified natural character due to modifications to natural elements, processes and patterns. Whereas an area with very low natural character will demonstrate a fundamental change to the pre-modified natural character due to modifications to natural elements, processes and patterns.

51. To assess natural character effects both the magnitude of the change and the sensitivity of the landscape to change are considered and scaled according to the descriptions given in ***Error! Reference source not found.3***. The assessment of natural character effects includes mitigation measures mentioned in this report.

52. The process to assess natural character involves an understanding of several systems and their associated attributes, including biotic, abiotic and sensory factors. The natural character assessment has been undertaken at two scales; a broad-scale assessment and at a more detailed level focusing on the localised area.

Visual amenity effects assessment

53. Under the RMA (Part 1, 2 Interpretation) 'amenity values' are defined as "*those natural or physical qualities and characteristics of an area that contribute to people's appreciation of pleasantness, aesthetic coherence, and cultural and recreational attributes*." Amenity includes a combination of factors, including ambient noise, air

quality, and recreational and cultural attributes. This assessment considers the visual effects that the proposal would cause to the outlook of the viewing audience.

54. The method used to assess visual effects involves looking at the physical arrangement of the proposal within the existing environment and how a change in this composition is perceived, the scale, type and intensity of change, and the nature of the audience who would experience the change (***Error! Reference source not found.3***).

55. Different viewing audiences tend to have differing levels of sensitivity to visual change, with resident populations generally tending to be more sensitive to change than visitors to an area, for whom views are transient. The biases of individual viewers towards the proposed activity can also be influential on viewer sensitivity.

56. Furthermore, some views may be considered more "sensitive" than others. For example, where there are prominent lookouts or tourist spots which are frequented by many people and are considered a particularly stunning, unique, or rare view. Such views would typically be considered to have a higher level of sensitivity to change than views which are generally not experienced by many people and/or are not considered to exhibit stunning, rare, or unique qualities due to the increased associational value of people's appreciation of these prominent locations.

57. Visual amenity effects (as with those on landscape and natural character) occur on a continuum. The degree of effect on visual amenity can be influenced by several factors, including distance, elevation, angle of view, context, resilience, and capacity of the environment to absorb the change, the site's sensitivity and vulnerability to the proposed change, intervening screening (from structures, landform, or vegetation), and weather conditions (including light). Representative viewpoints aid in understanding potential locations that may result in adverse visual amenity effects.

EXISTING ENVIRONMENT: DESCRIPTION AND CHARACTERISATION

58. The site is in Pourerere. Pourerere is a quiet, rural township on the east coast of the North Island, 35km drive from State Highway 2 at Waipawa (*Figure 3*).

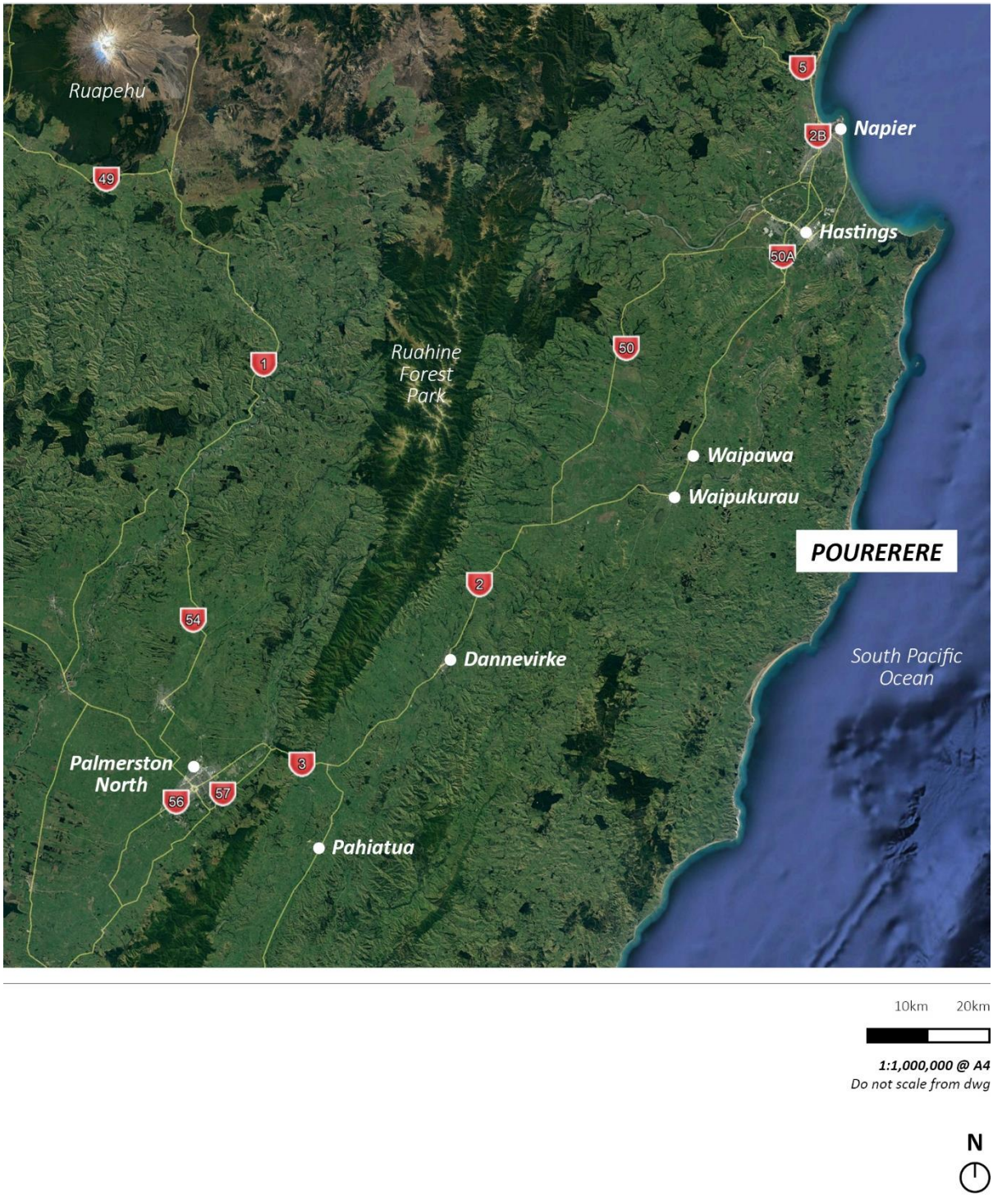

Figure 3: Location Plan.

Figure 4: Scope of Landscape Assessment: Broader Context and Localised Area.

Broader context

59. In this assessment, the broader context (*Figure 4*) ranges from the Mean High Water Springs (MHWS) on the east coast, to approximately 2.5km inland. The scope incorporates the existing residential development in Pourerere, including the campground to the south on the coast, and the wider rural hills which surround the application site.

Existing landscape character

60. It was assessed that the existing landscape character of the broader context is **moderate-high**, with reasons for this conclusion detailed below.

61. The broader context is characterised by rolling, pasture-clad hills, with gently sloping foothills that give way to contained flat plains (*Figure 5*). For the most part, the hillsides and plains have been cleared of native species and now pasture scattered with livestock dominates the landscape.

62. The terrain's formative natural processes are legible through the visibly eroding faces which accumulate on the basin floor. The enveloping, steep, and textured hills provide noticeable shelter in the flat-bottomed basins, and distinctive verticality and enclosure. These expressive attributes provide unique scenic qualities, which contribute to Pourerere's rural character.

Figure 5: Interrelationship between the pasture-covered hills and flats to the north of the application site.

63. Where the hills meet the eastern sea, powerful and active erosion processes carve the rolling hills into steep cliffs. The dynamic patterns created through the erosion processes contributes to the memorability of the area.

64. Pourerere is accessed by a long and windy sealed road with a 100km speed limit, which changes to 50km, before quickly slowing to a 20km speed limit. The low-speed limit reflects the relaxed and slow-paced feel of Pourerere township.

65. Clusters of houses mark the countryside, including along some parts of the coastal and stream edges, to form the quiet seaside township of Pourerere (*Figure 6*). Dwellings are located immediately adjacent to the coast – along Pourerere Beach Road – and at right angles to the coast – along Pourerere Road – on the southern stream flats. To the north, consent has been granted to extend Pourerere settlement into the mouth of the basin which curves inland from the outlet of Pourerere Stream. The intimate scale of the clustered settlement in Pourerere, and the distance from other townships, contributes to the strong sense of remoteness and tranquillity.

Figure 6: Coastal township of Pourerere as viewed from the hillside north of Pourerere Stream.

66. Due to the proximity and access to the beach, Pourerere is a popular camping holiday spot. Right across from the beachfront, a campground is full of permanent holiday

caravans. Space is also provided for self-contained freedom camping further to the south, at Tommy Ireland Point lookout. Visitors and the local community utilise the beach for walking and for water sports including swimming, surfing, fishing, and diving.

67. The coastline of Central Hawke's Bay has always been important to tangata whenua as a source of kai moana for local communities. There is a long history of occupation along the coast and significant pā sites. Strong connections remain for Ngāti Manuhiri and Ngāti Kere.

68. Pourerere is also recognised for its historical associations. For instance, during Captain Cook's second voyage to New Zealand, on 22 October 1773 he anchored off Pourerere Beach and traded with local Māori (*Figure 7*).

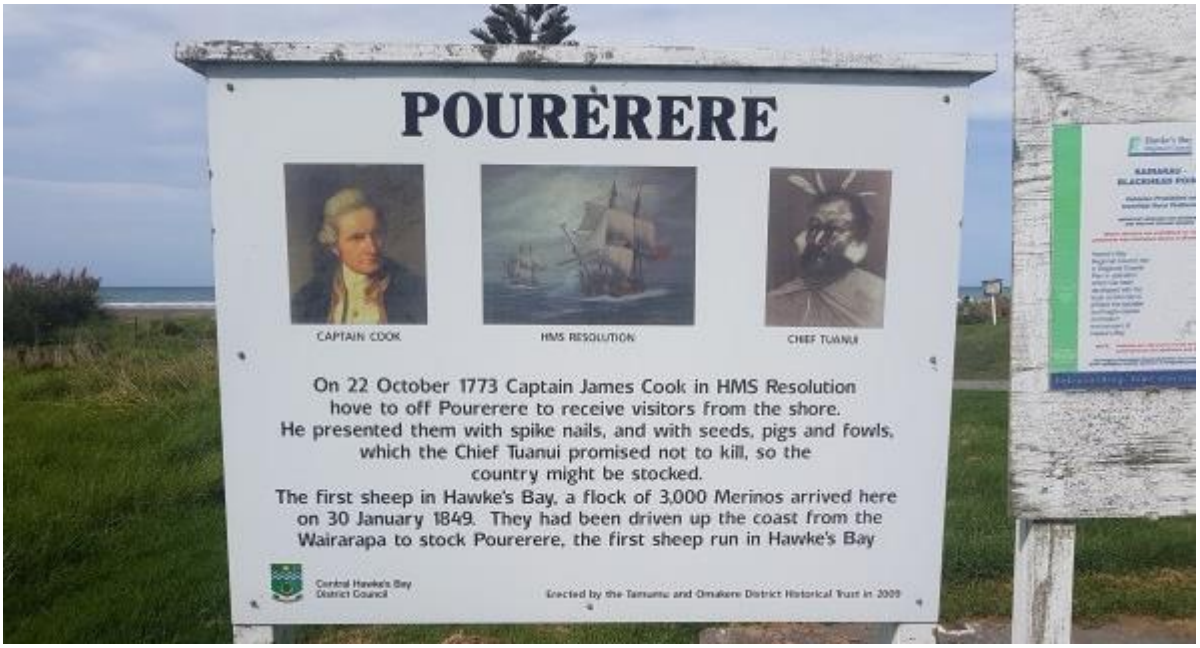

Figure 7: Signage in Pourerere communicating the history of the area.

69. Considering the above biophysical, sensory/perceptual, and associative attributes it is considered that the existing landscape character of the broader context is **moderate-high**.

Existing natural character

70. It was assessed that the existing natural character of the broader context is **moderate-high**, with reasons for this conclusion detailed below.

71. In the broader context, natural character is related to the eastern coastline and Pourerere Stream.

72. Pourerere Stream flows through Pourerere township, widening at the mouth in the low-lying area. The stream then emerges past the thin strip of low-lying dune/backshore[6], at the base of steep coastal cliffs to the north and south, and through the foreshore where it merges with the sea (*Figure 8*). The low-lying coastline to the south has been highly modified to enable road infrastructure, habitation, grassed verges, and beach access (*Figure 9*). The full extent of the ecological condition is unknown.

Figure 8: Pourerere Stream before it meets the ocean.

Figure 9: Road infrastructure, habitation, grassed verges, and beach access behind the foreshore, at Pourerere Beach settlement.

[6] Tonkin & Taylor, 2006

73. However, characteristics of wildness are more apparent near the coast. Closer to the coast, there is a higher degree of natural character due to the legibility of coastal processes in the eroding cliffs. Experiential qualities, including strong smells of the ocean from the coastline, sounds of waves and coastal birds, and the feel of onshore/offshore winds and floating sea spray, contribute to the perceived naturalness. This is slightly impacted by the vehicle access which occurs on the compacted sand. The perceived naturalness is also limited in coastal areas of Pourerere due to the clusters of houses, and associated infrastructure, which discernibly modifies natural elements, processes, and patterns.

74. Light pollution is the broader context is from houses and streetlights along the beach front. Natural darkness of the night sky is therefore very high in the broader context, due to the minimal development, resulting in inconsequential levels of light pollution.

75. Taking into account the above biophysical and sensory attributes it is considered that the existing natural character of the broader context is **moderate-high**.

Localised Area

76. In this assessment, the localised area (*Figure 4*) is within 750m of the application site boundary. It is bounded by the hills in the immediate surroundings, and to south by the far edge of Pourerere Road and Pourerere stream. This area encapsulates the resource consented residential development to the south of the application site, and the adjacent rural environs.

Existing landscape character

77. It was assessed that the existing landscape character of the localised area is **moderate**, with reasons for this conclusion detailed below.

78. The landscape in the localised area is characterised by the Pourerere Stream flats, positioned between the enveloping steep hills – immediately west, north, and east – and the gently sloping stream banks. The enveloping and textured hills create an enclosed and intimate scale (*Figure 10*). Coherence is created by the uniform landcover of pastural grass on the surrounding hills, scattered with pockets of trees along the foothills at the edges of paddocks, which enhances the scenic qualities of the area (*Figure 10*). The visually dominant pasture-cover combined with the sounds of working farm dogs, farm animals also contribute to the rural character of the area.

79. The resource consented residential development, to the south of the site, will result in a contained cluster of residential dwellings when constructed, subservient to the dominant, surrounding hills. Due to the clustered layout of the consented

development, there is a clear distinction between the consented residential lots with the surrounding productive flats and hill country (*Figure 11*).

Figure 10: Application site indicated in red, in relation to the surrounding hills, scattered with trees along the foothills.

Figure 11: Visualisation of the consented residential development, looking north from Pourerere Road. Sourced from the 2019 Landscape Assessment

80. The site is framed by two tributaries of Pourerere Stream. These contribute the expressiveness of the floodplain, but this is limited by the overall lack of riparian habitat. The water shed of the site flows just over 900m to the coast via an unnamed tributary and Pourerere Stream. This direct flow provides a connection between the site and the coast.

81. Aside from the site and localised area being operated as farmland, there are no known cultural, historical, or shared and recognised attributes associated with the localised area.[7]

82. Considering the above biophysical, sensory/perceptual, and associative attributes it is considered that the existing landscape character of the broader context is **moderate.**

Existing natural character

83. It was assessed that the existing natural character of the localised area is **low-moderate**, with reasons for this conclusion detailed below.

84. In the localised area, natural character is considered to be moderate in Pourerere Stream and low in the tributaries along the site's edges.

85. The hydrology of Pourerere Stream and its two tributaries (surrounding the site) are modified, as original native vegetation cover of coastal forest and wetlands have been cleared for farming since European ownership. While most of the course and channel of the waterways appear unmodified, some channelling and straightening of a tributary has occurred north of the application site to facilitate drainage through farmland. Farm tracks also cut across watercourses.

86. The habitat composition of the waterways has been highly modified, particularly the tributary west of the site. Riparian vegetation is generally scarce, and pastural grasses dominate the riparian margins (*Figure 12*). The northern bank of Pourerere Stream will be enhanced by some restoration planting adjacent to the initial Punawaitai Road subdivision as part of consented development. However, overall, historic modifications reduce the natural character of the waterways and the inland coastal environment in this area.

87. A few minor gullies and overland flow paths on the site join the tributary located along the north-eastern and eastern sides of the proposed development.[8] One of these is a small water body of approximately 750m^{2,} within the application site. This overflows

[7] Tangata whenua were consulted as part of the application.
[8] 2021, Dravitzki, D.

into the tributary, 10m from the retention pond.[9] These are already highly modified as they are dammed, pastural, and grazed.

88. It is estimated that there will be high levels of natural darkness of the night sky in the localised area due to a relatively limited degree of consented development and an assumed absence of street lighting.

89. Considering the above sensory and biophysical attributes it is assessed that the existing natural character of the localised area is **low-moderate.**

Figure 12: Pourerere Stream and adjacent tributary leading to the application site. Photo looking west towards the consented subdivision, with the application site in the background to the right.

Existing Visual Amenity

90. The visual catchment (where views of the proposal will be possible), the potential viewing audience, and possible viewer sensitivities, are considered from a representative range of selected viewpoints (*Table 4*). This assists with understanding the existing visual amenity of the area.

91. There are no views of the application site from Pourerere Road or Pourerere beach.[10] The application site is set back over 500m from Pourerere Road and over 750m from Pourerere beach. The application site is not visible from these locations due to the

[9] Aerial appraisal.
[10] Determined based on Google Earth viewshed analysis and confirmed by site visit.

existing undulating topography and screening vegetation. The consented subdivision is also located between the application site and these locations.

Table 4: Possible viewpoints.

LOCATION	Visual Amenity	Description of Visual amenity
V1: Northern dwellings of Punawaitai Road Subdivision	**Moderate**	Vehicle access to the site is provided by the extension to Punawaitai Road. Views towards the application site from the existing northern dwellings of Punawaitai Road will be mostly screened by consented dwellings located on the Punawaitai Road extension. Therefore, only the consented dwellings immediately adjacent to the application site would derive visual amenity from the rural views created by the open pasture fields of the application site, set within the surrounding hills. Viewers are likely to be local residences due to the 'no exit' nature of Punawaitai Road. It is probable that local residences will have high visual sensitivity, as the area will form part of their daily environment, but their visibility of the application site is very limited.
V2: Dwelling at 23 Punawaitai Road	**Moderate**	The proposed lots will be located more than 240m from the nearest non-recently consented residence (23 Punawaitai Road). It is possible that partial views of the application site may exist from the dwelling at 23 Punawaitai Road, although existing vegetation does provide screening. The northern portion of the property at 23 Punawaitai Road abuts the application site and has open views across it The existing visual amenity around the dwelling is potentially derived from sense of solitude and privacy with established vegetation which contains the dwelling screens the consented site, while amenity for the wider property is potentially derived from the views across the open flats of the consented subdivision and the application site plus expansive rural vistas of the pastural hillsides enclosing the valley. These hillsides which will remain unaltered.

		The owner will likely have high visual sensitivity due to their familiarity with the area, and as the area forms part of their daily environment. Their existing visual amenity is assessed as moderate, with the consented subdivision located along their long eastern boundary and more distant views across the flat valley floor of the application site.

ASSESSMENT OF EFFECTS: PROPOSAL

92. This section considers the nature and scale of the proposed change (often referred to as the magnitude of change) against the characteristics and values identified in the landscape baseline section (the *Existing Environment*) to determine if the proposed changes will have adverse effects on the existing qualities of the landscape.

93. The assessment considers physical modifications and subsequent effects on the existing character of the site's locality which may arise from changes such as a new use (new or different activities), and/or changes to the existing patterns, processes, and elements in the landscape. Such changes can affect existing character and and/or people's appreciation of an area. Visual changes are also considered from identified viewpoints to determine effects on visual amenity.

94. The assessment of effects is based on expert judgement and considers the site's resilience, sensitivity, vulnerability to, and capacity for, the proposed change, as well as likely viewer sensitivity, in coming to overall ratings of effects on landscape and natural character, as well as visual amenity. Importantly, a large magnitude of change does not necessarily constitute a high level of adverse effects and is influenced by the qualities and character of the existing environment.

Broader context

95. The following two sections assess the effects of the proposed subdivision on the landscape character and natural character of the broader context.

Landscape character effects

96. It was assessed that the landscape character effects on the broader context will be **low**, with reasons for this conclusion detailed below.

97. The proposed development is situated on the lower plains and, therefore, will be low-lying (due to the topographic characteristics) and subservient (due to the colour and reflectivity palette) to the large scale and elevated enveloping, steep and textured hills of the broader context, ensuring the houses are sympathetic to their surroundings. As

such, the legibility of formative natural processes of the surrounding hills and the distinctive sense of enclosure, will continue to contribute to the unique scenic qualities of Pourerere's rural character.

98. The memorability of the broader context is mainly associated with Pourerere's coast, which is some distance from the proposed subdivision. This lessens the potential of effects from the development on these attributes.

99. The proposal's proximity to the existing township and consented subdivision (both of which contain lots less than 4000m²) will enable the proposed subdivision to become an extension of the already present development. The smaller lots in the proposal are located on the south-east, adjacent to the consented lots to the south. These proposed lots are of a similar size to these consented lots and Pourerere township. Proposed lots which are larger than 4000m^2 are located to the north and north-west of the development, which adjoins the balance lot, which has a more prominent rural character than that of the existing township and consented lots. The development layout has been proposed in this manner to be sympathetic to the character of its surroundings.

100. The township will slightly increase in scale due to the additional of 45 residential lots, however, not to the extent to which it will alter the relaxed, remote and tranquil feel of the area.

101. The proposed subdivision will not affect the other cultural, shared and recognised attributes of the broader context, which are associated with the coastline, due to the substantial distance between the beach and the proposal which is tucked within the enclosed valley.

102. Considering the biophysical, sensory/perceptual, and associative attributes it is considered that the effects on the landscape character of the broader context will be **low**, and lots smaller than 4000m^2 will have similar effects to those lots which are 4000m^2 or greater.

Natural character effects

103. It was assessed that there will be **very low** effects on natural character for the broader context, with reasons for this conclusion detailed below.

104. The proposal is a substantial distance (approximately 600m) from the active coastal margin. The proposal is also separated from the coast by a 110m high hill.

105. The proposal is also over 250m from Pourerere Stream, separated by a consented subdivision. Physical modifications will not be made to Pourerere Stream. Any potential effects on Pourerere Stream, arising via the Pourerere Stream tributary, have been considered at the localised area.

106. The proposal will have a very low effect on the natural darkness of the night sky. While the proposed subdivision will increase the level of lighting in the local context, within the broader scale of Pourerere it is deemed that the natural darkness of the night sky will remain dominant and light pollution will remain unobtrusive.

107. Considering the above biophysical and sensory attributes it is considered that the effects on the natural character of the broader context are **very low**.

Localised area

108. The following two sections assess the effects of the proposed subdivision on the landscape character and natural character of the localised area.

Landscape character effects

109. It was assessed that the landscape character effects on the localised area will be **low-moderate**, with reasons for this conclusion detailed below.

110. As the development is restricted to the basin floor, the coherence created by the uniform landcover of pastural grass on the surrounding hills, scattered with trees along the foothills at the edges of paddocks, will be maintained. At the base of the eastern foothills, along the edge of the proposed subdivision and west of the tributary, a strip of open space has been provided to facilitate access and revegetation.

111. Due to the addition of humanmade structures, including residential dwellings and road infrastructure replacing pastural landcover, the scenic qualities and rural character of the localised area will be reduced. These effects will be localised to the floor of the basin and the overall perception of being in a rural environment will remain. These effects are limited by the proposed colour and reflectivity scheme, and the height restrictions of the building, which ensure the surrounding hills remains dominant.

112. The proposed subdivision will be contained by the hills adjacent to the site. Due to the dominance of the surrounding hills, this proposal will be subservient to the adjacent pasture-covered, hilly terrain. These surrounding hills create an intimate scale in which smaller lot sizes, surrounded by larger lots and open spaces, will appear appropriate and are assessed as having a similar effect on coherence as 4000m² lots.

113. Due to the clustered layout, a clear distinction will remain between the consented residential lots and the productive flats deeper in the valley and the surrounding hill country. In addition, the lots at the interface between the remaining farmland and the residential lots are all over 4000m², or are buffered by open space, lessening effects on rural character.

114. Overall, the connection between the steep surrounding topography, the floodplain, and the tributaries which flow to the coast, will remain.

115. There were no associative attributes identified at the localised scale.

116. Considering the biophysical, sensory/perceptual, and associative attributes it is considered that the effects on the landscape character of the localised area will be

low-moderate, and lots smaller than 4000m^2 will have similar effects to those lots which are 4000m^2 or greater.

Natural Character Effects

117. It was assessed that there will be **very low** effects on natural character for the localised area, with reasons for this conclusion detailed below.

118. Residential development can degrade natural character by placing large buildings and structures within a natural setting. Often these are accompanied by earthworks and cuttings to create a building platform and to construct access roads and driveways. The new roofs and paved areas can increase contaminated stormwater runoff into waterways, and ultimately the marine area.[11] Effects can be mitigated through set backs, riparian planting, limiting or containing the earthworks, and effective stormwater treatment strategies.

119. The lot boundary is set back from the eastern tributary, maintaining the connection between the floodplain and the coast, and to lessen effects on the riparian edge and natural character. It is considered that the proposed subdivision will indiscernibly change the perceived naturalness of the tributaries and their margins due to the proposal's minimum 10m distance from the waterways, and instead perceived naturalness may be improved due to the riparian revegetation. The tributary along the north-eastern and south-eastern sides of the proposed development will be planted with suitable riparian species to improve the ecological values and perceived naturalness of the waterway.

120. The minor gullies and overland flow paths entering the tributary are to be infilled as part of the bulk earthworks for the development. While the hydrology of the tributary may be slightly altered, this is already highly modified. No other biophysical modifications will be made to Pourerere Stream's tributaries.

121. Due to the overall flatness of the proposal area and predominant lack of required earthworks, negative effects from sedimentation run-off during construction are unlikely to arise. Even so, perimeter control silt fences should be utilised along the riparian boundary to mitigate potential sedimentation issues for Pourerere Stream during construction, such as the infill of minor gullies and overland flow paths.

122. The proposal will have a low level of effect on the natural darkness of the night sky due to the introduction of residences. However, it is considered that the natural darkness of the night sky will remain obvious.

[11] http://www.environmentguide.org.nz/issues/natural-character/threats-to-natural-character

123. Considering the above biophysical and sensory attributes it is considered that the effects on the natural character of the localised area are **very low**.

Visual amenity effects

124. It was assessed that the visual effects on the localised area will be **very low** to **low-moderate** for the identified viewpoints, with reasons for this conclusion detailed below.

125. The visibility of the proposal will be affected by a range of factors, including weather conditions, time of day, angle of the sun, the brightness or dullness of the day, the elevation and angle of view, the backdrop, and the viewing distance. The houses which will be built on the proposed lots will be the most visible components of the proposed subdivision. It is assessed that topographic containment of the site, screening from nearby vegetation and proximity to the proposal are the primary factors influencing the effect that the application may have on views.

Table 5: Visual amenity effects for the selected viewpoints

LOCATION	Effect rating	Description of the visual amenity effect.
V1: Northern dwellings of Punawaitai Road Subdivisio n	**Low-moderate**	The consented dwellings adjacent to the proposal would likely derive visual amenity from the rural vistas created by the open pasture-covered fields of the application site, plus the dominance of the steep surrounding pastural hills. The loss of pasture-covered fields within the vista, replaced with residential dwellings would be evident, but the proposed dwellings will be subservient to the prominent hills. Therefore, the dominant characteristics which contribute to visual amenity would be retained.Just as the consented subdivision was accepted as being appropriate in the valley, it is also anticipated that development of a similar nature would continue and be appropriate within the vista. Therefore, visual amenity effects are considered to be **low-moderate**.
V2: Dwelling at 23 Punawaitai Road	**Low-moderate**	As identified, the proposed lots will be located more than 240m from the dwelling at 23 Punawaitai Road. The existing dwelling is surrounded by screening vegetation, and visibility of the application site is low. Visual amenity at this dwelling is likely derived from the shelter/amenity planting surrounding the dwelling at 23 Punawaitai Road and effects on visual amenity from the

		dwelling are anticipated as being low Effects from the northern end of the site of 23 Punawaitai Road will be greater as the current northern aspect of open pastural fields will be changed to housing, as will occur along the eastern boundary because of the consented subdivision. Visual amenity effects on this northern aspect are anticipated as being moderate, with the remaining open views to the northwest reducing any higher anticipated effect. Therefore changes to visual amenity effects caused by subdivision of the application site will range from low to moderate..
V3: Dwellings on Pourerere Road	**Low-**	Visibility of the application site from Pourerere Road will be very limited due to the screening provided by the consented subdivision and the landform east of the application site. The proposed development will appear as part of the consented development and effects on visual amenity from houses along Pourerere Road are assessed as low.

ASSESSMENT OF EFFECTS: CUMULATIVE

126. Cumulative effects are considered to evaluate the potential effect of the current application in conjunction with existing and consented subdivisions, along with other existing modifications. Cumulative effects can impact landscape character, natural character, and visual amenity.

Broader context

127. There is the existing township of Pourerere and consented subdivision in the broader context of the proposal.

Landscape character cumulative effects

128. The proposal will have **low** cumulative effects on the landscape character of the broader context.

129. By incrementally changing the land use from rural production to residential development it increases the influence of housing on the landscape character, within the broader context, noticeably changing the composition of the basin from pasture-clad hills and flat productive plains to pasture-clad hills that give way to settlement on the basin floor.

130. The proposed subdivision will result in more housing in Pourerere. However, as the area already contains a township with lot sizes of less than 4000m² it is considered that the proposal is in-keeping with the existing landscape character of Pourerere. The vicinity of the proposed subdivision to the existing town, enables it to become an extension of Pourerere township and the adjacent consented subdivision.

131. In conjunction with other modifications in the broader context, the proposal will slightly reduce the tranquil and remote qualities of the township. However, this is limited by the containment of development within the valley-basin.

Natural character cumulative effects

132. The proposed subdivision will have **very low** cumulative effects on the natural character of the broader context. Cumulatively this development restores important natural elements such as indigenous riparian vegetation, and ultimately the ecological and hydrological processes associated with these.

Localised area

133. There is a consented subdivision adjacent to the proposal, as well as farm structures, such as sheds and fences.

Landscape character cumulative effects

134. The proposal will have **low-moderate** cumulative effects on the landscape character of the localised area.

135. Through cumulative subdivisions, the volume of structures comparative to the area of pasture-cover will noticeably reduce the rural character of the valley, as residential development starts to collectively occupy a larger portion of the inland basin. Although the rural character in the basin is cumulatively affected, the rural character on the surrounding hills is maintained. Such an effect is similar to other areas in the township where development is concentrated, with rural character diminished in the location of dwellings but still able to be appreciated in the immediate, surrounding context. As such, effects on the rural character are curtailed through preservation of the surrounding hill country.

Natural character cumulative effects

136. The proposed subdivision will have **very low** cumulative effects on the natural character of the localised area.

137. The proposal, in addition to the existing township and the consented development, will have a low level of effect on the natural darkness of the night sky due to the introduction of lighting from houses (with an assumed absence of streetlights).

However, it is considered that the natural darkness of the night sky will remain obvious.

138. For all other matters, the proposed subdivision will have very low cumulative effects on the natural character of the localised area. It has already been assessed (under the natural character assessment) that the proposal will result in no other discernible negative changes to the key characteristics of natural character, with the application site over 500m from the active beach and separated by pastural hills. The natural character is limited to the tributary, which is degraded and grazed, but will be enhanced with riparian planting with the subdivision.

Visual amenity cumulative effects

139. Visual amenity cumulative effects can occur when modifications are seen:
    - sequentially (where two or more areas of modification are seen one after the other as a viewer moves through the landscape but are not present in views from the same viewpoint and cannot be seen at the same time even if the observer turned their head and moved around their arc of view);
    - successively (where two or more areas of modification are present in views from the same viewpoint but cannot be seen at the same time as the viewer needs to turn their head); and
    - simultaneously (where two or more areas of modification are seen at the same time from a viewpoint).

140. The proposed subdivision will be seen within the context of other consented residential development. This consented development is located south of the application site, thereby screening most of the proposed development from the established areas of Pourerere. The surrounding pasture-clad hills will remain the dominant feature of these vistas and draw viewers' eyes upwards and away from the developments.

141. The neighbouring property at 23 Punawaitai Road will be most affected in terms of visual amenity due to its proximity, but the overall cumulative effects are assessed as being **low** for sequential, successive, and simultaneous views due to the limited visibility of the proposal and the colour and reflectivity controls proposed for the application site, see *Attachment 2*.

Effects summary

142. The following tables summarise the existing landscape character, natural character and visual amenity, as well as the effects of the proposal on landscape character, natural character and visual amenity. Overall, the highest level of effect from the proposal will be **low-moderate**.

Table 6: Existing landscape character, natural character and visual amenity.

Scale	Existing landscape character	Existing natural character	Existing visual amenity
Broader context	**Moderate-High**	**Moderate-High**	**Low / Moderate**
Localised area	**Moderate**	**Low-Moderate**	

Table 7: Landscape character, natural character and visual amenity effects.

Scale	Landscape character effects	Natural character effects	Visual amenity effects
Broader context	**Low**	**Very Low**	**Low-Moderate**
Localised area	**Low-Moderate**	**Very Low**	

Table 8: Cumulative effects for landscape character and natural character.

Scale	Cumulative landscape character effects	Cumulative natural character effects
Broader context	**Low**	**Very Low**
Localised area	**Low-moderate**	**Very Low**

Table 9: Cumulative effects for visual amenity.

Sequential	Successive	Simultaneous
Low	**Low**	**Low**

ASSESSMENT OF EFFECTS: AGAINST THE POLICY FRAMEWORK

143. The following section assesses the effects of the proposal against relevant statutory documents.

Resource Management Act (RMA)

144. The preservation of natural character (Section 6(a)) of the coastal environment and rivers and their margins is directed as a matter of national importance under the RMA. As discussed in the analysis earlier in this assessment, effects on natural character have been assessed as being **very low** for the broader context and **very low** for the localised area (refer to "Natural character effects" above and "NZCPS" below).

145. The proposed subdivision does not trigger Section 6(b) as the proposal location is not an identified ONL and is approximately 1km from an ONF identified in the Draft District Plan.

146. The maintenance and enhancement of amenity values of natural and physical resources outlined in Section 7(c), and the maintenance and enhancement of the quality of the environment of natural and physical resources outlined in Section 7(f) are addressed through the landscape character, natural character and visual amenity effects assessment provided in this report, which demonstrates that effects vary between **very low** to **low-moderate**.

New Zealand Coastal Policy Statement 2010 (NZCPS)

175. The NZCPS contains provisions related to the preservation of natural character and the protection of natural features and natural landscapes in the coastal environment.

176. It is considered that the objectives and policies of the NZCPS have been met due to the distance between the proposal and the active coastal margin (600m), and an identified ONF and area of very high natural character (approximately 1km).

Hawke's Bay Regional Resource Management Plan

147. Objective 4 of the Hawke's Bay Regional Policy Statement promotes the preservation of the natural character of the coastal environment. Future development of the lots is not anticipated to have significant adverse effects on the natural character of the coastal environment (refer to "Natural character effects" and "NZCPS" above).

Hawke's Bay Regional Coastal Environment Plan

148. The HBRCEP identifies the application site as being within the coastal environment. However, as noted above, the site is at least 600m from the MHWS and there is also

a 110m high hill between the proposed lots and the MHWS. No adverse effects are anticipated.

Central Hawke's Bay District Plan

149. It is assessed that the lot sizes are appropriate in the proposed location and are considered to have a similar effect to 4000m² lots. Rule 9.10(a) of the District Plan requires a minimum lot size of 4000m² within the rural zone for subdivisions. While 35 of the proposed lots will range from 1906m² to 2298m² the surrounding hills effectively contain the site and create a setting with an intimate scale, ensuring the lot sizes are appropriate for this location. In addition, the smaller lots are clustered within lots larger than 4000m², where the proposal interfaces with rural surroundings.

150. Although the rural character in the basin has low-moderate cumulative effects, the rural character on the surrounding hills is maintained. This creates concentrated development, with rural character diminished in the location of dwellings but still able to be appreciated in the immediate, surrounding context. Development with lots less than 4000m² currently exists in Pourerere township. As such, the proposal will be in-keeping with this existing character, and the vicinity of the proposal to the existing town will enable the proposed subdivision to become an extension of Pourerere township.

151. There are no significant trees, indigenous vegetation, or habitat are located within the application site.

152. The proposed lots are located at least 20m from all tributaries, 250m from Pourerere Stream and 500m from the coast to ensure the preservation of natural character. Furthermore, the landscape character and visual amenity effects assessment provided in this report, demonstrates that effects on these aspects vary between **very low** and **low-moderate**.

153. Overall, it is considered that the relevant objectives and policies in the District Plan have been met.

CONCLUSION

154. Adverse effects at the broader context will be **low** for landscape character, and **very low** for natural character. In the localised area, adverse effects on landscape character will be **low-moderate** and **very low** for natural character. Adverse effects on visual amenity will vary across the three viewpoints and have been assessed as having **very low** to **low-moderate** effects. Cumulative effects will be no more than **low-moderate** in relation to landscape character, natural character and visual amenity.

155. Key characteristics of the dominating pastural hills which contribute to the rural character of the area will remain dominant due to the site's contained setting in a valley floor and the proposal's potential to become an extension of the existing housing. Furthermore, smaller lots will have similar effects to 4000m^2 lots, as smaller lots are appropriate for the enclosed, intimate setting.

156. Design measures, including the lot layout, strategic use of open space, and building height residential performance standards, all contribute to reducing potential landscape character and visual effects of the proposal. Set backs, limited earthworks due to the flatness of the site, and riparian planting also ensure natural character effects are very low in places are enhanced through revegetation.

157. Overall, it is concluded that the proposed subdivision is appropriate in the chosen location.

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REFERENCES

Dravitzki, D. (2021) *Preliminary Geotechnical Assessment: Stage 3 Punawaitai Road, Pourerere.* Report prepared by Development & Engineering for James Bridge.

Hudson, J. (2019a) *Central Hawke's Bay District: Outstanding Natural Landscape Assessment*, Report prepared by Hudson Associates Landscape Architects for the Central Hawke's Bay District Council.

Hudson, J. (2019b) *Natural Character Assessment of the Central Hawkes's Bay Coastal Environment*, Report prepared by Hudson Associates Landscape Architects for the Central Hawke's Bay District Council.

Tonkin & Taylor (2006) *Revised Hazard Zone Determination for Northern and Southern Hawke's Bay Beaches*, Report prepared by Tonkin & Taylor for the Hawke's Bay Regional Council.

ATTACHMENT 1

Key Terms

Several key terms have been used in this report. The following descriptions provide the definitions for these terms as used in this report.

Aesthetic attributes – these include the perceptual qualities of a landscape, such as coherence (e.g., patterns of landcover), vividness and memorability (e.g., visually striking or iconic), scenic qualities, and expressiveness and legibility (e.g., clearly shows the formative natural processes).

Amenity – those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.[12]

Associative attributes – these include spiritual, cultural, and social associations, such as tangata whenua, historic, and shared and recognised associations (e.g., the area may be highly valued for its contribution to local identity and recognised as a special place).

Broader context – ranges from the Mean High Water Springs (MHWS) on the east coast, to approximately 2.5km inland.

Biophysical attributes – these include abiotic and biotic qualities of landscape, such as landform, terrestrial ecology, hydrology, and natural processes.

Landscape – the cumulative expression of natural and cultural features, patterns, and processes in a geographical area, including human perceptions and associations.

Landscape character – is a distinctive combination of landscape attributes, including biophysical, perceptual, and associative elements which make one area different from another and gives an area its identity.

Localised area – includes the more immediate context of the application area, including the application site.

Natural – a range of qualities and features which are created by nature and are distinct from humanmade constructions. Natural may include things such as pasture and exotic trees and wildlife, both wild and domestic. It does not include humanmade structures, roads, or machinery.

[12] RMA definition for "amenity values".

Natural character – as defined in the RMA (Section 6(a)) natural character only relates to the coastal environment and to waterbodies and their margins, rather than the landscape in its entirety. Natural character is the extent to which natural elements, patterns and processes occur, the nature and extent of modification to these and their perceived naturalness. Natural character encapsulates a combination of biophysical and perceptual attributes, and considers the experience created by these.

Natural elements – include water, landform, and vegetation cover.

Natural patterns – the distribution of natural elements over an area.

Natural processes – include the action of rivers, waves, tides, wind and rain, the movement of animals, and the natural succession of plant species.

Visual amenity – those visually apparent natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

ATTACHMENT 2

Colour and Reflectivity Scheme for consented subdivision and application site

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Colour and reflectivity scheme for Pourerere subdivision

The following colour and reflectivity scheme describes the requirements for the selection of roof and wall colours for the buildings to be located within the Punawaitai Road, Pourerere subdivision.

The aim of the colour and reflectivity scheme is to maintain the dominance of natural elements over the built environment in Pourerere. To achieve this aim there is a need to ensure the visual integration of buildings into the landscape, and the colour of buildings can assist with this.

The brighter or lighter the colour of buildings, the greater the contrast and the less they are integrated. To achieve visual integration, colours that are less bright and less contrasting have been selected.

The recommendations have provided for as much choice as possible while ensuring the range is appropriate in the landscape.

Acceptable colours and reflectivity

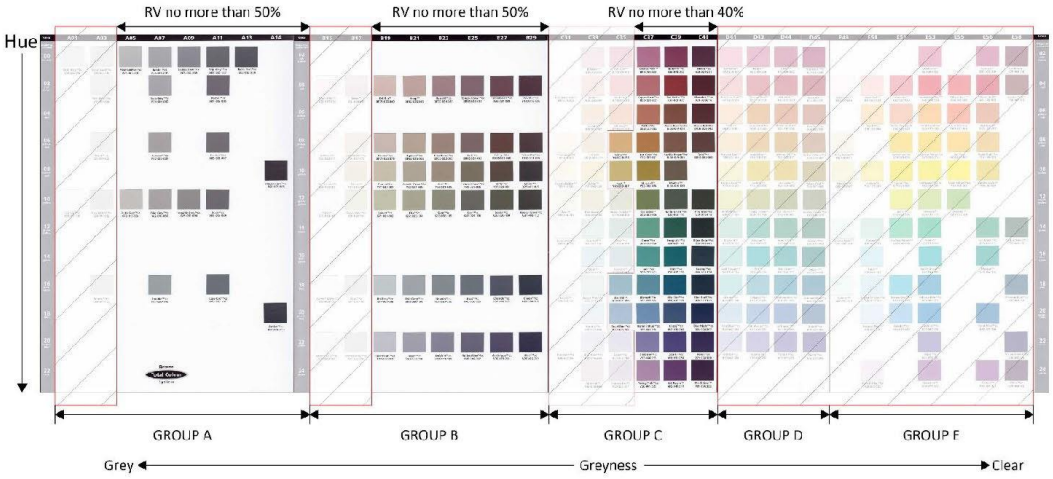
Hue (colour)
All colours from 00 – 24 are acceptable.

Reflective value (RV) of walls
Predominant wall colours should have a RV rating of no more than 60% for greyness groups A and B, and no more than 40% for greyness group C.

Reflective value of roofs
Roofs should have a RV value rating of no more than 40% within greyness groups A, B and C.

These colour qualities are outlined below on the Resene BS5252 (British Standard) colour chart (colours which are unacceptable are cross hatched).

Resene BS5252 colour chart



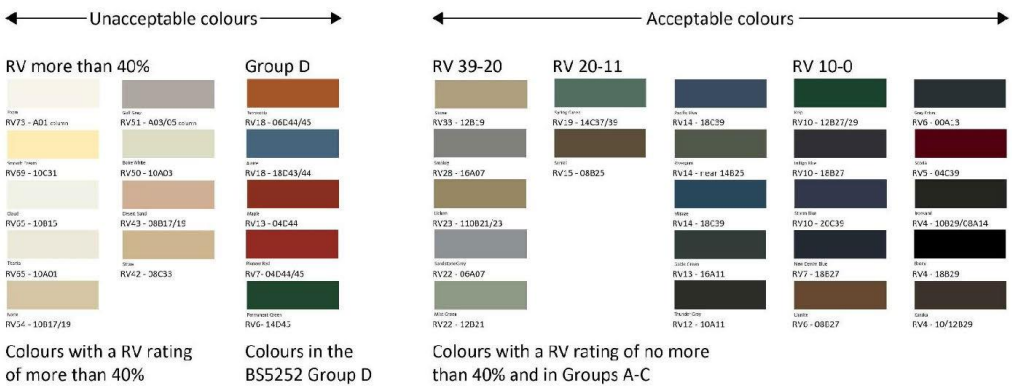
Paint companies other than Resene also provide colour charts with comparable information. The colour range of other company colour charts would be comparable with the recommended reflectivity of no more than 60% for greyness groups A and B, and no more than 40% for group C of the BS52525 chart.

The Colorsteel range of colours has been aligned close to BS5252, with reflective values included. These attributes are shown in the roof colour chart below.

The lighter colours with a RV of more than 40% which are unacceptable are on the left hand side of the chart alongside the colours from the D greyness group. The darker colours with an acceptable RV of no more than 40% and from greyness groups A, B and C are in the right hand columns.

If roofs are to be painted, the colour should be within the recommended range, with an RV of no more than 40%.

Colorsteel roof colour chart



Colours with a RV rating of more than 40%

Colours in the BS5252 Group D

Colours with a RV rating of no more than 40% and in Groups A-C

ATTACHMENT 3:
Hawke's Bay Regional Coastal Environment Plan (Map 122) [13]

[13] Adapted to demonstrate the application site is within the inland coastal environment.

ATTACHMENT 4: Area of High Natural Character (Draft District Plan) [14]

[14] 2019b, Hudson.

ATTACHMENT 5: Outstanding Natural Features (Draft District Plan)[15]

[15] 2019a, Hudson. Adapted to demonstrate the distance from application site.