Geotechnical Assessment Report

JOB NUMBER: 23-1883

Waikato Thoroughbred Racing Greenfield Racing Hub

PROJECT

Waikato Thoroughbred Racing

CLIENT

Substantive Application – REV 6
30 September 2026

23-1883 Waikato Thoroughbred Racing – Greenfield Racing Hub



Prepared for: Waikato Thoroughbred Racing **Project no:** 23-1883

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Revision	Date	Status	Authorised by:
4	02/04/2026	Draft Referral - updated	**Mike Trigger | Environmental and Infrastructure Manager BSc, MEngSc, CPEng, Int PE**
5	17/04/2026	Referral Application	**Mike Trigger | Environmental and Infrastructure Manager BSc, MEngSc, CPEng, Int PE**
6	30/09/2026	Substantive Application	[redacted] **Mike Trigger | Environmental and Infrastructure Manager BSc, MEngSc, CPEng, Int PE**

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EXECUTIVE SUMMARY

Waikato Thoroughbred Racing is proposing a new racing centre with associated development at Pencarrow Road, Tamahere. BCD Group Limited (BCD) has been requested to provide geotechnical engineering services for the project. This report presents a summary of our assessments, provides recommendations, and outlines next steps for Waikato Thoroughbred Racing.

Sufficient geotechnical testing has been undertaken for the substantive fast-track application, and no significant geotechnical issues that would prevent this development from proceeding have been identified. The key risks are liquefaction and shallow groundwater. Both can be managed through design and construction with geotechnical input. Accordingly, no offsite geotechnical effects are anticipated as a result of this development.

	Item	Comments
Our key findings	Services	BeforeUDig and council GIS indicate that there are no public or network utilities within the site or close to the boundary that would be affected by the proposal.
	'Good ground'	The site is not considered to be 'Good Ground' due to the liquefaction and static settlement risk on the site.
	Liquefaction risk	The site is susceptible to liquefaction. The results for Importance Levels 1 to 3 are discussed in Section 6. This risk can be addressed through the implementation of detailed geotechnical design and construction methodologies.
	Lateral spread risk	Primary risk of lateral spread is around ponds. Preliminary assessment indicates that this is low risk. If ponds are deepened then the risk will increase.
	Slope stability risk	We have assessed the slope below Pencarrow Road and a Typical 1.8m deep pond. Both achieve all required factors of safety.
	Expansive soils	The near surface soils are non-cohesive sands or silts. They are not considered to be expansive as defined in B1.
	Settlement	The site has a relatively low static settlement risk due to the underlying sandy soils. However, there are softer clay and silt layers in the soil profile that are compressible. If necessary, these can be managed by excavation and replacement or rolling pre-loads.
	Bearing Strength	For IL2 and IL3 structures, due to liquefaction risk, the bearing capacity of the natural soils is unlikely to govern the foundation design and will therefore require specific design. For light weight IL1 structures, an ultimate geotechnical bearing capacity of (qu) 300kPa may be used for design of shallow foundations with vertical central loads.
Discussion	Earthworks	Some earthworks will be required for the site to form the landscape and provide a level platform for structures. Earthworks discussion is in Section 11.
	Horse Tracks	Track surfaces are yet to be determined. The main consideration will be depth to groundwater. Other key considerations will be subgrade type and strength, which will vary across the track and drainage of surface water.
	Building and Structures	Buildings and structures on the site will need to consider liquefaction risk and consequences appropriate for the importance level, construction type and intended use. Section 12 provides commentary.
	Infrastructure	The sites facilities will have infrastructure such as ponds, stormwater and wastewater systems and in-ground infrastructure. High groundwater and potential for liquefaction are considerations for both design and construction. This is discussed in Section 13.
Next Steps	Post Resource Consent	Future stages will need further geotechnical investigations and assessment as outlined in Section 15 of this report.

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1 INTRODUCTION

Waikato Thoroughbred Racing (WTR) is master planning for a new racecourse at Pencarrow Road, Tamahere. BCD Group Limited (BCD) has been requested to provide geotechnical engineering services for the project. This report presents a summary of our assessments and recommendations for the substantive application.

The subject site is a collection of titles, the legal descriptions and usage follow:

- 636 Pencarrow Road, Tamahere, Hamilton - Section 49 SO 457609 – approximately 37.6 ha
- 592 Pencarrow Road, Tamahere, Hamilton - Lot 1 DP 471383 – approximately 23.8 ha
- 536 Pencarrow Road, Tamahere, Hamilton - Lot 2 DP 471383 – approximately 18.5 ha
- 37 Hooker Road & 38 Duncan Road, Tamahere, Hamilton - Section 2 SO 547526 – approximately 69.7 ha
- 90 Duncan Road, Tamahere, Hamilton - Lot 2 DP 16925 – approximately 14.2 ha



Figure 1: Aerial view of site and surrounding area

The site is within the jurisdictions of Waikato Regional Council (WRC) and Waikato District Council (WDC).

The scope of this assessment was carried out in accordance with our Short Form Agreement dated 11/11/2025 and may be used to help inform Waikato Thoroughbred Racing of the geotechnical risk and geotechnical next steps for the project.

Our assessment addresses the geotechnical natural hazards that are considered relevant for the site and includes a National Policy Statement for Natural Hazards 2025 Assessment (NPS NHA) in Appendix G. The full list of natural hazards from the Regional Infrastructure Technical Specification (RITS) and with the rationale for why the other hazards do not require additional assessment as part of this report.

1.1 Co-ordination

As part of the substantive application, the geotechnical considerations have been co-ordinated with the other relevant disciplines, with the outcomes incorporated within their work.

1.2 Revision History

Revision	Status	Reason
1	Master Planning	Original Document.
2	Master Planning	Updated to reflect draft master plan by Designgroup Stapleton Elliott + COX dated 15 December 2025.
3	Draft Referral	Updated to reflect draft master plan V2 rev 2 by Designgroup Stapleton Elliott + COX dated 24 February 2026 and provide additional comments around a proposed residential subdivision for the Fast Track Referral Application.
4	Draft Referral updates	Updated to include geotechnical investigations at 90 Duncan Road Tamahere and include commentary on ponds near the Waikato Expressway.
5	Referral Application	Updated for Referral Application and inclusion of the updated proposed site layout plan by Designgroup Stapleton Elliott + COX dated April 2026.
6	Substantive Application	Updated for Substantive Application and inclusion of the updated proposed site layout plan by Designgroup Stapleton Elliott + COX dated August 2026.

2 PROJECT DESCRIPTION

The purpose of the project is to create a unique, world class greenfield racing hub designed for horse training, racing and other equine related activities, while bringing the expertise and strength of the local racing fraternity together in a centralised location.

This enables the local racing industry to be more streamlined, competitive, sustainable and future focused while bringing potential international investment and creating a 'destination' for horse racing in New Zealand, also increasing tourism opportunities for the wider region.

A key driver behind the proposed greenfield equine hub and racecourses is enabling the consolidation of four separate racecourse facilities (Te Rapa, Waipa and Cambridge thoroughbred courses, and the Cambridge harness track).

These facilities duplicate assets and resources and, given their current condition require significant levels of upgrades and investment to provide fit-for-purpose facilities that meet the higher standards of the modern-day racecourse experience. The retirement of these areas also frees up significant tracts of land within existing urban areas for future development, increasing housing supply.

To support the development's financial viability and enhance the site's long-term vibrancy as a racing, entertainment, commercial and community precinct, the proposal includes a range of complementary activities on the remaining land. These include equine support services, rural residential housing, a retirement living community, a village centre, commercial development and a bloodstock sales precinct.

The Proposed Site Layout Plan by Designgroup Stapleton Elliott + COX dated August 2026 is included in Appendix A. The plan shows the development area for the project and the location for:

- Four different tracks which include a horse racetrack, training track, slow work track, and trotting track.
- Facilities such as stables and spectator/course management facilities, commercial areas, and sports facilities.
- Infrastructure which consists of three stormwater detention / irrigation storage ponds and track underpasses and a network of internal roads.
- Commercial and Residential Areas.

Preliminary cut and fill depths and volumes associated with the development of the site are discussed in a BCD Civil Report.

3 SITE DESCRIPTION

The site is located in the Tamahere area, approximately 7km southeast of the urban boundary of Hamilton City and 5km northwest of Cambridge. The site location, topography and geological plans are in Appendix B.

The site is zoned rural and is primarily used as a dairy farm. Several farm buildings are present across the site. Vegetation cover across the property is predominantly pasture with medium sized trees scattered predominantly across the southern half of the site with farm tracks generally following the boundaries of the properties and points between buildings. Farm drains are scattered throughout the properties.

The site has several existing access locations from Pencarrow Road, Hooker Road and Duncan Road. The site appears to be relatively level to very gently rolling. However, there is approximately four metres of fall from south-east to north-west. The toe of a rolling hill typical of the Waikato Basin is present adjacent to Pencarrow Road.

Based on LiDAR from LINZ the elevation of the existing ground surface at the site varies from approximately RL[1] 53m to 57m across the general site and RL 54.5m to 59m along the Pencarrow Road corridor boundary.

The site does not have connections to council reticulation for wastewater and stormwater which are likely managed locally within the properties via soakholes, septic tanks and wastewater soakage fields.

[1] Reduced Level to New Zealand Vertical Datum 2016 (NZVD2016)

Overland flow would flow from the south side of the site towards the north. A separate flood assessment has been prepared by BCD.

4 DESKTOP REVIEW

The WDC/WRC GIS system[2] and the GNS website[3] were checked by BCD on 27/11/2025 for mapped natural hazards and buried services. Aerial photographs of the site were reviewed using Retrolens and Google Earth Pro.

4.1 Geological Setting

The 1:63:000 geological map has been reviewed which shows that the sites are underlain by Hinuera Formation. The Hinuera Formation was deposited progressively between 50 and 17 thousand years ago by a braided river system over and around the older hill topography in the Waikato Basin. The Hinuera Formation consists of volcanogenic gravel, sand and silt that can also contain pumice. Surface and subsurface peat or organic silt deposits can be present. There is distinct crossbedding throughout the formation, and soil conditions can be highly variable vertically and laterally.

The low hills of the Waikato Basin consist of several meters of airfall tephra from multiple events, collectively termed the Hamilton Ash, which in turn overlies the pre-Hamilton Ash deposits collectively known as the Walton subgroup.

4.1.1 Close Proximity Active Faults

The GNS active fault database indicates that the nearest active fault is the Kerepehi Fault located approximately 40km northeast to east of the site. The risk of fault rupture is considered low based on current information.

4.2 Historic Aerial Imagery

BCD has reviewed predevelopment imagery on Retrolens and more recent images on Google Earth Pro which indicated that the properties have generally been used for farming. No geological features or ground modification, beyond farming activities were identified.

4.3 Council GIS

The WRC Hazard Portal shows that a Level A Liquefaction desktop study has been conducted for the site. The Level A assessment indicates that the liquefaction risk for the site has been determined to be “Possible”. However, around the elevated areas along Pencarrow Road and Hooker Road located west and south of the site is considered “Unlikely” based on the geology of the area.

We have undertaken a site-specific assessment which is detailed in Section 6.

4.4 Minimum Floor Level and Flooding

The site is located outside the Waikato District Council mapped flood hazard areas. A site-specific flood hazard assessment has been prepared by BCD.

4.5 Buried Services

BeforeUDig and Council GIS indicate that there are no public or network utilities within the site or close to the boundary that would affect the proposal.

[2] Waikato District Council Maps & Maps | Waikato Regional Council
[3] https://data.gns.cri.nz/af/ (checked on 27/03/2025)

5 GEOTECHNICAL INVESTIGATIONS

5.1 Investigation Procedure

The following investigations were undertaken by BCD to evaluate the subsurface conditions at the site on 10-14/11/2025. Investigation data can be found in Appendix C.

- 14x hand augers (HA) up to 3m depth over area of the proposed property.
- 10x cone penetrometer tests (CPT) up to 20m deep over the area of the proposed property.
- Soil permeability tests up to 2m depth for stormwater management.
- Three additional hand augers were undertaken on 18/12/2025.
- Four additional hand augers and two CPT were undertaken on 24/03/2026 on 90 Duncan Road.
- 9x stand pipe piezometers were installed within selected hand augers up to 3m deep[4] with 1x additional Piezometer (P9) extending down to 4.2m deep.

5.2 Subsoil Profile

The subsoil profile encountered at the site is typical of the area surrounding the site and is consistent with the mapped regional geology.

5.2.1 Surficial Soils

The near surface conditions as encountered in the hand augers consist of 100-300mm of Topsoil.

Below the topsoil, the general soil profile consisted of a 0.3m to 0.5m thick layer of stiff to very stiff silts overlying interbedded sands and silts. The sands generally dominated the soil profile and were loose to dense (Hinuera Formation).

Due to poor soil recovery, Scala penetrometer testing was continued below the hand auger depths and is shown on the logs.

HA06 was undertaken on the low-lying hill located near the western boundary. The soil profile consisted of clayey silts through to the base of the investigation.

5.2.2 Deeper soils

The CPTs indicate the deeper soil profile consists of sands, with varying thickness of silt and clay lenses through to the base of the CPTs.

5.3 Groundwater

Groundwater was encountered at depths of 0.9m to 2.8m below ground level (bgl) at the time of the investigation in November. The investigations indicated that groundwater was shallowest on the northeastern part of the site with groundwater progressively deepening towards the west and south. However, the depth variation is also a function of the changes in the ground surface elevation. When converted to reduced levels the groundwater is between RL 52m to 53.4m which is considered typical of spring levels in the area and is likely to be higher following periods of prolonged or intense rainfall.

BCD have installed shallow stand pipe piezometers in selected locations across the site and has periodically monitored them with a dip meter and Solinst Level Loggers over the period from December 2025 to September 2026. We have recorded groundwater variations of up to 1m during the monitoring period.

A more detailed groundwater model has been prepared by WGA Limited using the BCD data.

[4] Waikato Regional Council consent AUTH148356.01.01

Table 1: Piezometer Details

Piezometer Number	Hand Auger Number	Surface RL (m)	Depth (m)	Comments
1	HA01	53.7	3.0	Disestablished 18/12/2025 at landowner request.
2	HA09	53.9	2.1	
3	HA04	56.4	3.0	Dipped dry since 24/03/2026
4	HA05	54.9	3.0	Disestablished 18/12/2025 at landowner request.
5	HA06	58	3.0	Disestablished 18/12/2025 at landowner request.
6	HA08	54.9	1.8	Disestablished 18/12/2025 at landowner request.
7	HA03	54.6	2.1	
8	HA16	52	2.6	
9	HA15	55	4.2	Dipped dry since 24/03/2026
10	HA20	55.8	3	

6 SEISMIC SOIL BEHAVIOUR

6.1 Site Subsoil Class

6.1.1 NZS1170.5

The site subsoil class is considered Class D for structural design in accordance with NZS1170.5. This is in line with the investigations undertaken for this project, mapped regional geology (Hinuera Formation) and published literature by Wotherspoon, L. Jeong, S., (2019).

6.1.2 MBIE Module 11170.5

Geotechnical assessment undertaken in accordance with MBIE Module 1 (2021) does not require a subsoil class to be considered as the module considered all sites to be subsoil class C.

6.1.3 TS1170.5

Following updates to the National Seismic Hazard Model (NSHM) in 2022, Standards New Zealand has released the document TS1170.5:2025. While this standard is not yet referenced in B1/VM1, it can be adopted as an alternative solution and given the likely project programme, it may supersede NZS1170.5 during the development of the precinct.

TS1170.5 adopts subsoil classes I – VII with shear wave velocity, $V_{s(30)}$, the primary property for determining the site class. Section 3.1.3.5 of TS1170.5 provides three separate methods to use in evaluating shear wave velocity;

- 3.1.3.5a) - Method 1 (Measured V_s) – shear wave velocity is established from the surface to 30m depth via direct measurement.
- 3.1.3.5b) - Method 2 (partially measured V_s) - shear wave velocity is established over a cumulative depth of at least 15m with the remaining depth of profile estimated via one of three options.
- 3.1.3.5c) - Method 3 (inferred V_s) – shear wave velocity is inferred from other methods such as CPT or SPT.

As no sCPT testing to 30m depth has been undertaken within the site, we have inferred $V_{s(30)}$ using CPT data completed within the site. Due to the limitations of inferred CPT Vs data, a larger margin of error must be considered.

The time averaged inferred $V_{s(30)}$ results indicate that the site is likely to be considered Site Class V-VII.

In our experience site specific V_s testing is typically higher than the inferred values from CPT. Class VII is also only being reported due to the 30% uncertainty required for the inferred V_s, sensitivity checks using 5% uncertainty for site specific V_s testing do not result in Class VII.

6.1.4 SSSHA

Given the size of the development, and the mixture of building types it is recommended that a Site Specific Seismic Hazard Assessment is undertaken once the development has been approved.

6.2 Liquefaction Assessment

The liquefaction assessment was carried out using CPT data and the software CLiq, produced by GeoLogismiki using the methodology in general accordance with the document MBIE (2021) Module 1 and Module 3. Two performance criteria are specifically analysed: Serviceability Limit State (SLS) and the Ultimate Limit State (ULS). Intermediate level events (IE) have also been considered.

- Boulanger and De Jong 2018 thin layer correction filter has been applied.

- PGA and earthquake magnitude has been taken from MBIE (2021) and NZ1170.5 in conjunction with the NZTA Bridge Manual has been used for seismic cases where existing roads may be affected (for stability modelling in Section 7 only.

Our understanding is the development will have Importance Level 1, 2 and 3 (IL1 to IL3) structures as described in NZS1170.0.

Table 2: Module 1 seismic assessment parameters

Importance Level	Design Life (years)	Earthquake Magnitude	Limit State	Annual Exceedance Probability (AEP)	PGA (g)
2 and 3	50	5.9	SLS	1/25	0.07
1			ULS	1/100	0.14
2			ULS	1/500	0.28
3			ULS	1/1000	0.36

We have also looked at the seismic assessment parameters from TS1170.5 for Site Class VI (worst case) which is shown below.

Table 3: TS1170.5 seismic assessment parameters

Importance level	Design Life (years)	Earthquake Magnitude	Limit State	Annual Exceedance Probability (AEP)	PGA (g)
2 & 3	50	6.6	SLS	1/25	0.03
1		6.8	ULS	1/100	0.09
2		6.8	ULS	1/500	0.20
3		6.9	ULS	1/1000	0.27

6.2.1 Groundwater

The groundwater across the site is variable with respect to the ground surface. For the preliminary assessment, we have adopted a uniform groundwater depth of 1m below ground level. This is generally conservative across the majority of the site except at the location of P2 in the centre of the site.

During future design phases, liquefaction assessments should consider long-term groundwater monitoring results in the relevant areas, and the effects of any proposed cuts and fills in relation to the CPT and groundwater data.

6.2.2 Soil Liquefaction

The results of the liquefaction assessment are summarised in Table 4 and discussed in the following sections. Typical liquefaction analysis plots and maps are included in Appendix D.

For comparison with the MBIE guidelines prepared for residential structures in Canterbury and now referenced in MBIE Module 4 (2021) we have also considered free field settlement in the upper 10m.

Table 4: Liquefaction Settlement Results

Seismic Event	LSN	Effect[1]	Module 1 Total Freefield Settlement (mm)	Upper 10m Freefield Settlement (mm)	Thickness of Non-Liquefiable Crust (m)
SLS	0	Insignificant	0	0	20+
ULS IL1	2 - 20	Insignificant to High	10 – 130	5 – 60	2 – 4
ULS IL2	14 - 46	Mild to Severe	95 – 280	50 – 120	1 – 2
ULS IL3	18 - 49	Moderate to Severe	115 – 320	60 - 130	1 – 2
[1]Refer to Appendix D for consequence of effect description based on the Liquefaction Severity Number (LSN).					

SLS Event

The result of the liquefaction analyses indicates that the site subsoils to a depth of 20m are unlikely to liquefy. The liquefaction effect is anticipated to be insignificant.

IL1 ULS Event

The analysis indicates that during an IL1 ULS seismic event, liquefaction is likely to occur within thin layers of loose sands and silts. Liquefaction induced freefield settlement is likely to be insignificant to high with up to 130mm of settlement occurring within the soil profile and up to 60mm in the upper 10m of the soil profile.

IL2 ULS Event

During a IL2 ULS seismic event, the analyses indicate that liquefaction is likely to occur within thick layers of sands and silts throughout the soil profile. The liquefaction effect is anticipated to be mild in some localised areas along the northern site boundaries (CPT08 and 09). Towards the east half of the site (CPT01, 02, 03, 04, 11 and 12) liquefaction was found to be high to severe with up to 280mm of settlement occurring in these areas under ULS conditions and would result in significant movement of the ground's surface resulting in significant deformation at the ground surface. To the west of the site (CPT05, 06, 07 and 10), liquefaction was found to be high, with up to 200mm settlement occurring.

It is anticipated that some IL2 buildings may be of similar structure and purpose to those referenced in the Canterbury Guidelines; in these circumstances, they would be considered Technical Category (TC) 2 or TC2/TC3 hybrids, which is considered typical for much of the Waikato Basin.

IL3 ULS Event

The IL3 seismic event analysis indicates that liquefaction is likely to be high to severe throughout the site with up to 320mm of liquefaction-induced settlement occurring. Significant deformation of the ground surface is likely to occur. The liquefaction effect is anticipated to be mild to moderate in some localised areas along the northern site boundaries (CPT08 and 09).

TS1170 Comparison

We have undertaken a sensitivity check using the TS1170.5, Class VI soils, for CPT04 as a comparison which is shown in Table 5 below.

Table 5: Module 1 and TS1170.5 Comparison

Seismic Event	MBIE Module 1			TS1170.5 Class VI		
	LSN	Total Freefield Settlement (mm)	Upper 10m settlement (mm)	LSN	Total Freefield Settlement (mm)	Upper 10m settlement (mm)
ULS IL2	40	280	135	32	250	120

Seismic Event	MBIE Module 1			TS1170.5 Class VI		
	LSN	Total Freefield Settlement (mm)	Upper 10m settlement (mm)	LSN	Total Freefield Settlement (mm)	Upper 10m settlement (mm)
ULS IL3	45	320	150	45	320	150

The results indicate that the benefits are generally in the lower severity seismic events.

6.2.3 Liquefaction Induced Lateral Spreading

Lateral spreading is only likely to occur where large excavations for ponds are undertaken. The effects diminish with proximity. We have undertaken a preliminary assessment as part of the Slope Stability assessment in Section 7, which indicates low risk.

A specific assessment of lateral spread in relation to the State highway is not considered necessary as it is more than 200m from the ponds. This is in line with observations of lateral spread in Canterbury. If ponds are to be located within 200m of the state highway a specific check should be undertaken using the seismic criteria applicable to the state highway.

6.2.4 Site Seismic Performance

Based on our assessment, we consider the site to be susceptible to liquefaction. The performance criteria for each Importance level have been discussed below in Table 6 and has incorporated MBIE Canterbury Guidance documents (2012 – 2015), noting that this guideline is for residential, timber-framed buildings and the MBIE Modules (2021) are for structures which do not fit the scope of the guidance documents.

Table 6: Performance Criteria

Importance Level	Performance Level	Technical Category[5]	Differential Settlement (mm)	Likelihood	Consequence level	Risk
1	0 – 2	TC2	55	Possible	Minor	Low
2	1 – 4	TC2 to TC2/3 hybrid	190	Unlikely	Minor to Major	Low to Medium
3	2 – 4	N/A	215	Rare	Major	Medium

For structures outside the scope of the guidance documents, foundations and buildings will need to be specifically engineered to tolerate differential settlement across the building platform without collapse. As recommended within the MBIE Modules (2021), the buildings foundations should be well tied together with no isolated strip or pad foundations. Differential settlement estimates are provided in accordance with Martin et al 1999 as recommended by MBIE.

In line with the National Policy Statement for Natural Hazards 2025 (NPS2025), the likelihood of liquefiable events for importance level 1-3 structures are considered to be unlikely to rare with the consequences being minor for IL1-2 structures and Major for IL2-3 structures. Figure 1 of the NPS2025 considers the risk to be low to medium.

[5] Canterbury technical category applicable for NZS3604 type structures with similar usage to the intent of the Canterbury guidance documents.

7 SLOPE STABILITY

The existing slopes are generally no steeper than 10 degrees and not considered to have a risk of slope instability. This includes the natural slope within the western boundary which runs along Pencarrow Road.

Slope stability assessments have been carried out for two cross sections across the proposed design elements of the site. A summary of the cross section and the design elements interrogated is below. Design slope grades of 1V:2H have been adopted for preliminary checks on pond, swales and battered slopes.

- Typical Pond cross section using a batter of 1V:2H.
- Viewing platform and embankment slope on Pencarrow Road down to the proposed swale.

Stability analyses were carried our utilising the computer software Slide2 by Rocscience. The analyses were carried out using the Morgenstern-Price method for non-circular slip surfaces for six cases. The results of slope stability analyses are presented in terms of factor of safety (FoS) against slope failure. The six cases considered in this assessment are presented below with required FoS in brackets. A site plan showing slope cross section locations and a selection of slope stability outputs are included in Appendix F.

- Case 1 – Long term static conditions (FoS>1.5)
- Case 2 – Elevated water conditions (FoS>1.2)
- Case 2a – Elevated groundwater with dry pond. (FoS.>1.2)
- Case 3 (IL2) and 4 (IL3) – Seismic conditions (FoS>1.0)
- Case 5 –Liquefied/post-seismic conditions (FoS>1.1)

Soil parameters adopted are presented in Table 7.

Table 7: Soil Parameters for Stability Analysis

Soil Unit	Geology	Unit weight, γ (kN/m^3)	Effective Friction angle, ø' (degrees)	Effective cohesion, c' (kPa)	Undrained Shear Strength s_u - Full strength / softened (kPa)
Silt	Hinuera Formation	16	30	3	65/35
Interbedded Sand and silt	Hinuera Formation	17	33	0	N/A
Silt	Hamilton Ashes	16	35	5	100/50
Silt	Walton Subgroup	16	26	3	80/40
Interbedded Sand and silt	Walton Subgroup	17	35	3	N/A

For liquefied conditions, soil layers achieving a FoS of less than 1.1 against liquefaction have been modelled as liquefied soils. Liquefied soil strengths have been modelled with a vertical stress ratio of 0.07 with liquefied layers extending no more than 2 times the height of the proposed pond as recommended by Youd 2018.

Groundwater has been set at 1.0m below existing ground level. We consider this to be the average groundwater level. An elevated groundwater case with a Ru of 0.3 has been considered to assess fluctuations in water level within the ponds from stormwater management. We have also assumed a case where the pond is empty but water levels outside the pond are high.

A road surcharge of 12kPa has been applied to the where Pencarrow Road is located. A temporary 10kPa surcharge has also been applied to a proposed driveway to analyse the effects of vehicle loading on the subject swale slope.

Seismic PGAs used for the assessment have come from MBIE Module 1 and NZS1170.5/NZTA Bridge Manual with Pencarrow road considered an IL3 road.

Table 8: Slope Stability Factor of Safety

Design Case	Minimum Required	Typical Pond Detail	Pencarrow road to Swale	Proposed Driveway to Swale
Static	1.5	2.39	1.89	2.19
Elevated Groundwater	1.3	2.18 1.31 (pond empty)	1.84	2.32
Seismic IL2	1.0	2.72	N/A	2.79
Seismic IL3	1.0	2.24	1.18	N/A
Liquefied/Post Seismic	1.0	4.25	2.20	N/A

The results from the preliminary assessment indicates that all required factors of safety have been met. As plans are further developed, specific assessments should be undertaken.

8 STATIC SETTLEMENT

Primary settlement occurs when soil materials compress and consolidate under static loading, such as filling placed at the ground surface or the weight of a new structure. Soils may also settle over time under their own weight, termed secondary settlement (creep). Secondary settlement is not related to the load or the size of the loading.

Preliminary screening for the potential for static settlement has been undertaken in CPeT-IT. Wide loads can stress soils to considerable depth. We have considered 3 cases applied to the existing ground surface for the preliminary assessment with a widespread load 30m x 30m with 10kPa, 20kPa and 40kPa applied.

Table 9: Static Settlement Estimates

Load	Dimensions WxL (m)	SLS Design Pressure (kPa)	Primary Settlement (mm)	Secondary Settlement (mm)
Widespread Load	30x30	10	8 - 35	7 - 121
		20	15 - 70	
		40	45 - 135	

Typical engineered fills have a load in the order of 18-22kPa per metre of fill placed. Building loads are typically in the order of 5-10kPa per floor depending on structure type. The settlement assessment generally indicates that the highest primary settlements occur below the southern half of the site where CPT04, 05, 10, 09 and 12 are located.

In general, the site has a relatively low static settlement risk due to the underlying sandy soils. However, there are softer clay and silt layers in the soil profile that are compressible. The CPT assessment is generally conservative as it doesn't account for stress history and if pumice soils are present, it overestimates the settlement.

Secondary settlements are generally widespread and not influenced by building or fill loads.

9 BEARING CAPACITY OF NATURAL SOILS

For IL2 and IL3 structures, due to liquefaction risk, the bearing capacity of the natural soils is unlikely to govern the foundation design and will therefore require specific design. Foundation types for the various building typologies are discussed in Section 12 and 14.

For light weight IL1 structures an ultimate geotechnical bearing capacity of (q_u) 300kPa may be used for design of shallow foundations with vertical central loads; however, some shallow ground remediation may be needed, which is typical in Waikato alluvial soils.

10 EXPANSIVE SOILS

Hinuera Formation silts and sands are not considered expansive.

11 EARTHWORKS

11.1 General

Earthworks will be required to level the general site and areas where buildings will be placed. In general, the site has a relatively low static settlement risk due to the underlying sandy soils. Some structures and infrastructure are less tolerable to settlement and further assessment should be undertaken. The most effective means of controlling static settlement will be during bulk earthworks, by using monitoring pins and pre-loading any areas that need further mitigation.

Earthworks can also materially affect the liquefaction assessment. If fill is placed, this will reduce the liquefaction risk, whereas cuts increase the liquefaction risk. This should be considered during design, as area-wide liquefaction mitigation may be more cost-effective where a high density of development is proposed.

The suitability of the surficial silts for use as engineered fill has not been assessed at this point; however, they have a relatively high water content and would likely require significant drying and possibly chemical stabilisation for reuse as engineered fill. Although the underlying sands are saturated, they would have good compaction properties and can be more readily dried. A borrow area could be established with appropriate dewatering considerations.

Overall, fills are considered preferable to cuts where level changes are required, due to the benefits associated with filling and the disadvantages associated with cuts. Further discussion on cut/fills and approximate quantities is discussed within the BCD Civil Report.

11.2 Groundwater and Dewatering

Due to the shallow groundwater depth, it is anticipated that excavations for infrastructure or foundations will extend below the water table in parts of the site. Saturated sands are likely to be encountered in these scenarios, which will impact the stability of the excavations.

The stability of temporary excavations below the groundwater can be managed through, slope design, dewatering, trench shields and temporary retaining, depending on location and depth of the excavation.

Dewatering the shallow groundwater table is unlikely to result in ground surface settlement due to the sandy nature of the zone being dewatered. Water from well points or sump pumps can be diverted away from the excavation and spread over the ground to recharge via infiltration, or to a designated recharge well.

During design phases, dewatering needs will be assessed for compliance with the Waikato Regional Plan and any necessary consent will be obtained.

11.3 Racecourse, Trotting and Training Tracks

Track surfaces have yet to be determined. The track areas have 2 to 3 metres of elevation difference end to end. There are no strict requirements on longitudinal fall for horse tracks, and this level of elevation difference is similar to other established New Zealand tracks.

The groundwater monitoring data is limited and there is potential for higher groundwater levels to be recorded during the wetter months and into September. Given the shallow depth to groundwater, particularly in the vicinity of P2, P6 and P7 we recommend the southern end of the Racecourse, and the northern end of the Training Track have a preliminary design level not less than RL 54.75m to provide approximately 1.5m clearance above the preliminary groundwater level. Levels around the rest of the track should be checked against the groundwater to achieve at least the same clearance.

As more groundwater data becomes available and more information regarding the track build up and track drainage requirements become available these recommendations may change.

Other key considerations will be the subgrade type and strength, which is likely to be variable as the tracks will span areas of sand, silt, and fill and drainage of surface water.

12 RACECOURSE AND COMMERCIAL BUILDINGS AND STRUCTURES

12.1 NZS3604 Changes

NZS3604 is currently under review with the draft issued for comment. The draft contains standard solutions for liquefaction resistant foundations and will likely be finalised before construction commences.

12.2 Importance Level 1

For IL1 buildings, structures such as horse tie up areas, small stables and storage facilities or buildings which are not normally occupied, it may be acceptable to take a risk-based approach depending on their use case and adopt standard foundations designed with an ultimate geotechnical bearing capacity of 300kPa, subject to excavation and replacement of any soft or unsuitable soils and replacement with hardfill.

Where a risk-based approach is not acceptable, or a resilient structure is preferred, TC2 type foundations which include shallow ground improvement or a stiffened structural concrete raft, or TC2 piles can be adopted for NZS3604:2011 structures, or the solutions in the revised NZS3604 may be appropriate.

12.3 Importance Level 2 & 3

For buildings which are IL2, such as offices, amenities, accommodation, industrial sheds etc, the foundation types will depend on the structure type and usage. For example, a small office building that is NZS3604 compliant may be able to adopt liquefaction-resilient foundation solutions from the Canterbury technical guidelines or the updated version of NZS3604.

Structures outside the scope of these documents will require specific risk assessment based on usage and building type. The building code requires that these are designed to avoid collapse or loss of life; however, a higher level of resilience may be readily achievable without significant additional cost.

The preliminary liquefaction assessment indicates that there is not a reliable, non-liquefiable layer, across the site for founding end-bearing piles within the upper 20 metres of the strata.

For IL3 structures such as grandstand or event centres deeper investigations should be considered to determine if piling with screw piles or similar is suitable.

Other options that can be investigated for IL2 and IL3 structures include shallow ground improvement, such as excavate and replace for low-risk structures, or deep ground improvement such as aggregate piers, physical densification piles, or chemical stabilisation piles. The depth of ground improvement will depend on performance and loading requirements.

12.4 Towers

Racecourses often have towers for commentary, lighting and cameras. Foundation systems for these are typically governed by wind loading; however, the temporary loss of support due to liquefaction will need to be considered.

12.5 Bridges

Bridges need to be designed in accordance with the NZTA Bridge Manual where high volumes of traffic can be expected, such as main entrances.

13 RACECOURSE INFRASTRUCTURE

13.1 Ponds

Preliminary slope-stability checks indicate that pond batters of up to 1V:2H, equivalent to approximately 26 degrees, achieve the required factors of safety for all assessed design cases.

The potential for a water pressure imbalance affecting the lining also requires consideration in design. To reduce the pressure differential, it is recommended that ponds are constructed with the edges at or above (applicable if mass filling around the location) the existing ground level at each pond location. A designer may use a unit weight of 9.81kN/m^3 for buoyancy due to water pressure and 17kN/m^3 for buoyancy due to liquefied soil pressure if the pond liner and infrastructure are located below the groundwater.

To steepen or eliminate the batters, pond sides may be constructed with mass concrete blocks or green faced mechanically stabilised earth (MSE) retaining walls. These can also have a ballasting benefit if constructed above the lining system. Timber pole retaining walls are likely to be incompatible with the lining system. Both systems can be terraced to reduce visual impact, and concrete blocks can have custom patterns included.

Construction of ponds may require local dewatering through well pointing or similar.

During design, stability checks will need to be undertaken for each pond and pond geometry and/or retaining wall will be specified as required.

13.2 Stormwater and Wastewater Considerations

The site has a relatively shallow groundwater table, and the upper soils are low permeability based on physical characteristics.

Earthworks will also affect stormwater management solutions as engineered fills are typically low permeability due to compaction. In areas of cut the groundwater will be closer to the surface and may restrict options for stormwater and wastewater management.

13.3 Inground Infrastructure

High groundwater will need to be considered in the design of inground infrastructure, including deep infrastructure such as tanks, pump stations, and underpasses. These will likely require sheet piling and dewatering during construction to enable construction.

Design of these should consider buoyancy of buried infrastructure under both static and liquified conditions. Parameters for these conditions have been provided in Section 13.1 above.

Where inground infrastructure is located within the groundwater table, the effects of acid sulphates will need to be considered. This may mean that some materials such as concrete may be less suitable in these situations.

14 RESIDENTIAL LIFESTYLE BLOCKS AND RETIREMENT VILLAGE

The land within the southern corner of the property between Hooker and Duncan Road is proposed to be subdivided into lifestyle blocks and a retirement village in the latest edition of the master plan. Further geotechnical testing should be completed once the proposed sections have been confirmed and liquefaction assessed using groundwater monitoring in the vicinity of the proposed structures.

14.1 Foundations

The typology of buildings for the lifestyle blocks and the retirement village will likely only be known at a building consent stage for each Lot. However, it is likely that buildings will be designed in general accordance with NZS3604.

The preliminary liquefaction assessment indicates the site is likely TC2 to TC2/TC3 hybrid classification. Both classifications have standard solutions for residential foundations in the Rebuild Canterbury guidelines. In the Waikato Basin the most common are shallow ground improvement and/or structural raft foundations.

For timber floor buildings, NZS3604 is appropriate for TC2, or a surface structure or specific design is appropriate for TC2/TC3 hybrid sites.

For buildings outside the scope of NZS3604 and/or structures considered IL3, specific engineering design will be required. Foundations will need to be designed to be well tied together and act like a raft.

14.2 Stormwater Management Considerations

The site does not have any connections to a council stormwater reticulated network and therefore stormwater will need to be managed on each allotment. The following needs to be considered for the proposed lots:

- Proximity to groundwater.
- Permeability testing should be undertaken to determine a design rate and size of soakage system.
- Where soakage is not suitable, detention tanks will be required to attenuate stormwater at predevelopment rates.
- Below-ground stormwater systems should have the base of the system located no closer than a 1V:1H projection from the base of the building foundations.
- A central stormwater management system may be an option. This is likely to be more feasible for the retirement village where buildings are usually located in close proximity to each other.

14.3 Wastewater Management Considerations

The site is located in a rural setting with no connections to a council-owned wastewater reticulated network available.

On-site wastewater management systems need to be designed in accordance with AS/NZS1547. Systems also need to comply with the minimum setbacks from groundwater, surface water and potable bores as required in the Waikato Regional Plan. Additional guidance on other setbacks is provided in Auckland Council TP58 and GD06.

For preliminary design of wastewater disposal systems, a designer may use Soil Category 3 Loams (as defined in AS/NZS1547) for design. It is recommended that the conservative rate is used for all design cases. Once the location of the wastewater disposal field is known, it is recommended that hand auger testing is undertaken within the proposed area to confirm the soil category and depth to winter groundwater.

15 FUTURE INVESTIGATIONS AND ASSESSMENT

The investigations and assessment in this report have been undertaken to provide a high-level assessment across the site to assist the substantive fast track application.

As the project progresses, additional investigations and assessments will be required to provide more specific commentary with respect to the elements within the development.

We recommend that the next round of investigations and assessment targets the key structures and infrastructure. Assessments should include pond slope stability, detailed settlement assessment, bearing capacity, pile capacity and refined liquefaction assessments.

Additional site investigations are listed in Table 10. Additional testing of the types listed in below will likely be needed at later stages of the development to fill data gaps or achieve a suitable density for design. It is standard for these matters to be considered during the development and building design phases.

Table 10: Indicative Investigations

Stage	Investigation Method	Reason
Post Resource Consent	Seismic Cone Penetration Test (SCPT)	SCPT's allow liquefaction assessment to be undertaken using an alternative method that can be adjusted for pumice content. The SCPT data can be used for a Site-Specific Seismic Hazard Assessment and a TS1170 based site soil subclass, which can be beneficial for both structural and geotechnical design.
	Hand Augers	Shallow soil conditions to assist with bearing capacity and undercut depths, and pavement CBR's.
	Test Pits	Test pits can be used to obtain soils for compaction characteristics and CBR tests on compacted samples.
	Laboratory Testing - Atterberg limits - Particle size Distribution - Pumice content - Compaction testing - Solid density testing - CBR testing	These tests are used to inform the potential re-use of site won materials as engineered fills, and as pavement materials and may reduce construction cost.
	Site Specific Seismic Hazard Model (SSSHM)	Site specific seismic hazard assessments can be used instead of the standardised earthquake data. These can be beneficial for both structural and geotechnical design.
	Dilatometer Testing	Can get in-situ measurements of potential settlement around critical areas and target zones based on CPT assessment.
	Bore Holes	Boreholes are recommended around high-importance structures to obtain samples of any critical layers for lab testing during design.

16 PROFESSIONAL OPINION

Based on the geotechnical assessment, it is our opinion that the proposed development is unlikely to be subject to geotechnical natural hazards in accordance with Section 106 of the Resource Management Act 1991 provided the recommendations in this report are followed.

We do not consider that future residential use of the land is likely to accelerate, worsen or result in material damage to the land or neighbouring properties, provided that proper engineering practices are followed during future development/construction and the development incorporates the recommendations outlined in this report and any subsequent reports.

17 REFERENCES

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18 REPORT LIMITATIONS

The recommendations and opinions made in this report are based upon data from observations made on-site, hand augers, and in-situ soil strength testing at discrete locations. Inferences about the nature and continuity of subsoils away from the exploration holes are made but cannot be guaranteed. Actual conditions onsite may vary more gradually or abruptly than that inferred from the investigations. Steps can be taken to reduce the likelihood of unexpected conditions arising onsite. As the soil conditions are created and vary by natural processes and human activity, the report is based on soil conditions at the time of the investigation. Soil conditions onsite can change, particularly after long periods of time from the date of investigation.

This report has been prepared for our client for their purposes and the regulatory authority in relation to the consent application within the scope of this report. It is based on our understanding of the proposed development. Should any changes to the nature of the development occur, BCD should be asked to provide comment on the ongoing applicability of recommendations made in this report. It is not to be relied upon or used out of context by any other person without reference to BCD Group Ltd. The reliance by other parties on the information or opinions contained in this report shall, without prior review and agreement in writing, be at such parties' sole risk. To avoid misinterpreting this report, we recommend that the assistance of geotechnical professionals familiar with the project and scope of this report is maintained.

Engineering design recommendations have been made based on the information provided to BCD. Should these recommendations be used for construction, BCD are to sight approved Building Consent drawings to ensure compliance with recommendations made within this report. If a Producer Statement 4 or construction observation is required from BCD (see BCD report and/or consent requirements from council), we are to be contacted prior to construction to outline appropriate inspection milestones.

This report covers geotechnical/wastewater/stormwater considerations only. This report does not assess risk of contamination of soils or provide an assessment of flood risk and FFL recommendation. We recommend the proposed works be checked against current District and Regional Council plans or checked by a registered planner.

Appendix A Master Plans

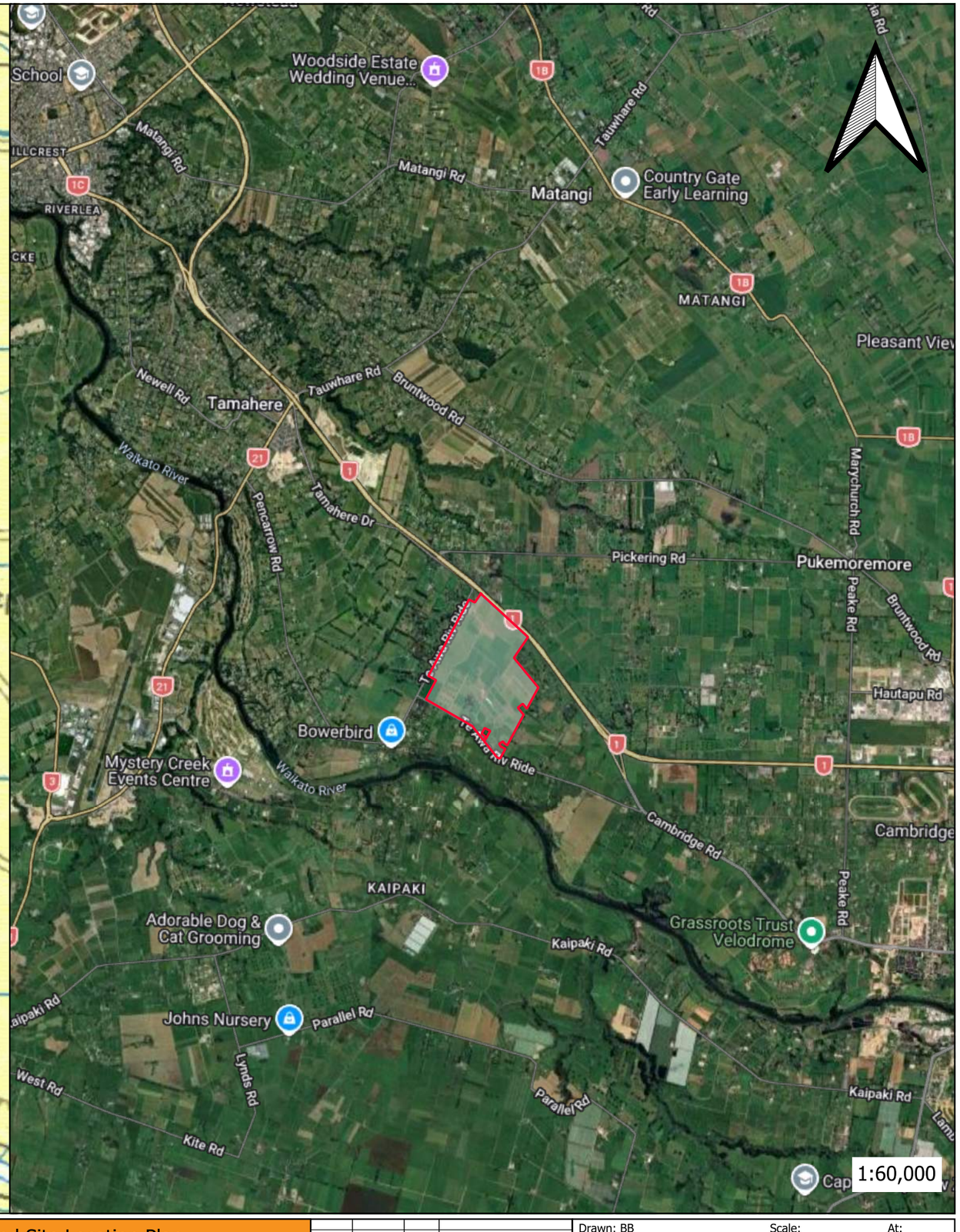
MASTER PLAN - SUBSTANTIVE APPLICATION



COX designgroup stapleton elliott

Appendix B Site Details





Client: WAIKATO THOROUGHBRED RACING TE HAPA - CAMBRIDGE - WAIPA

Contractor

BCD GROUP

Sheet: Geological and Site Location Plan

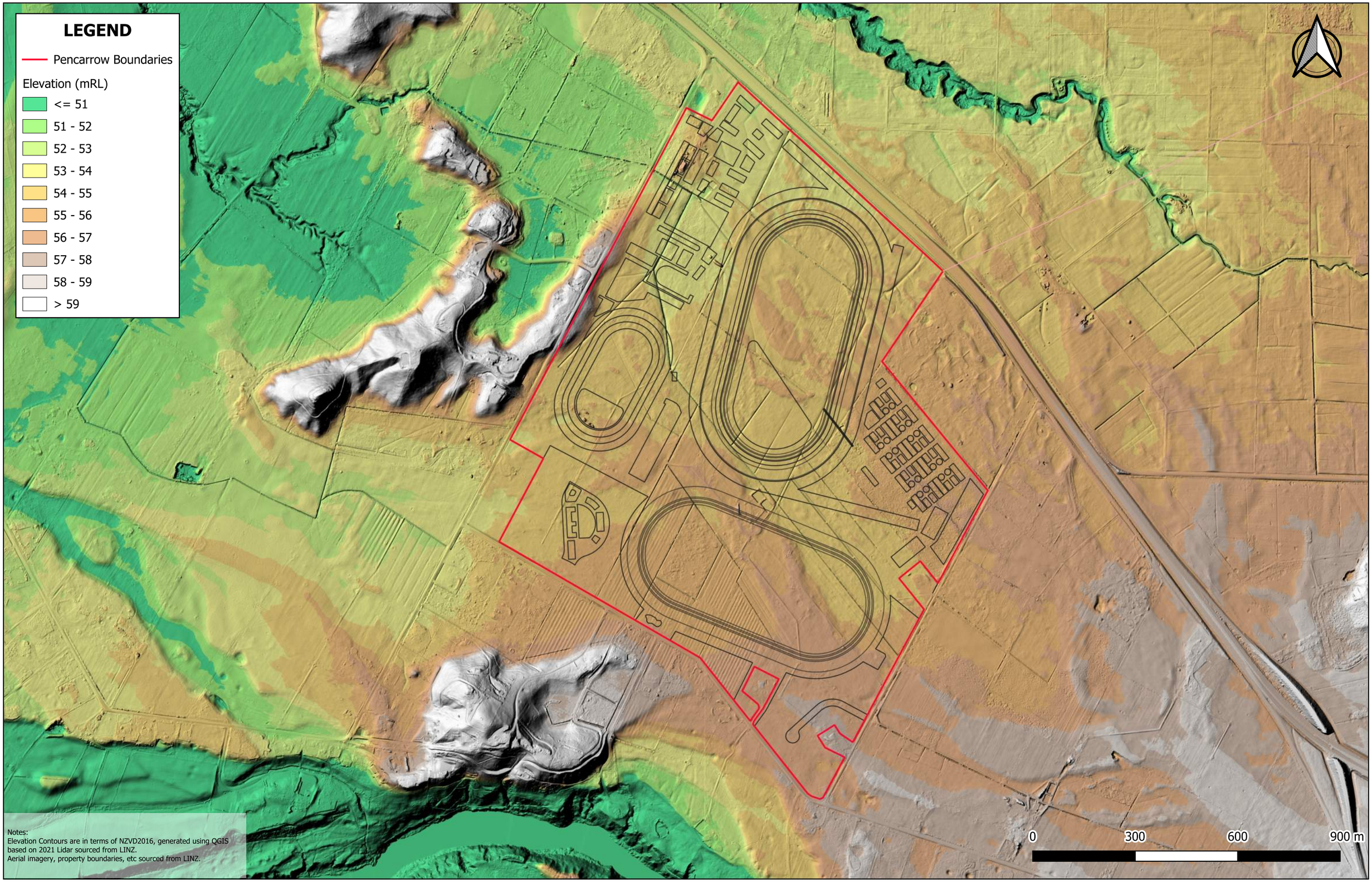
Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
03	17/08	BB	Substantive Application
02	20/02/2026	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: As Shown
At: A3
Job Number: 23-1883
Sheet Number: G-B01
Revision: 03

All dimensions to be verified on site before making any shop drawings or commencing any work

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Notes:
Elevation Contours are in terms of NZVD2016, generated using QGIS based on 2021 Lidar sourced from LINZ.
Aerial imagery, property boundaries, etc sourced from LINZ.

Client: WAIKATO THOROUGHBRED RACING TE RAPA · CAMBRIDGE · WAIPA

Contractor

BCD GROUP

Sheet: Elevation Map

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
03	17/08/2026	BB	Substantive Application
02	20/02/2026	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
SCALE: 1:10000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-B02	03

All dimensions to be verified on site before making any shop drawings or commencing any work

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Appendix C Investigation Data

LEGEND

- Pencarrow Boundaries

Internal Site Fetures

- Internal Drain Lines
- internal roads

Contours (NZVD2016)

- 1m Contour
- 0.5m Contour

Investigations

- Cone Penetration Test (CPT)
- Hand Auger (HA)

HA16 HA01 CPT01 HA07 CPT08 HA08 HA06 CPT06 HA02 CPT02 HA13 HA17 CPT11 HA14 CPT07 HA05 CPT05 HA15 CPT03 HA09 HA18 HA19 HA01 CPT12 CPT09 HA20 HA12 CPT10 HA11 HA10 CPT04 HA04

0 200 400 600 m

Notes:
Elevation Contours are in terms of NZVD2016, generated using QGIS based on 2021 Lidar sourced from LINZ.
Aerial imagery, property boundaries, etc sourced from LINZ.

Client: WAIKATO THOROUGHBRED RACING — TE RAPA · CAMBRIDGE · WAIPA

Contractor

BCD GROUP

Sheet: Geotechnical Investigation Plan - Sheet 1

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

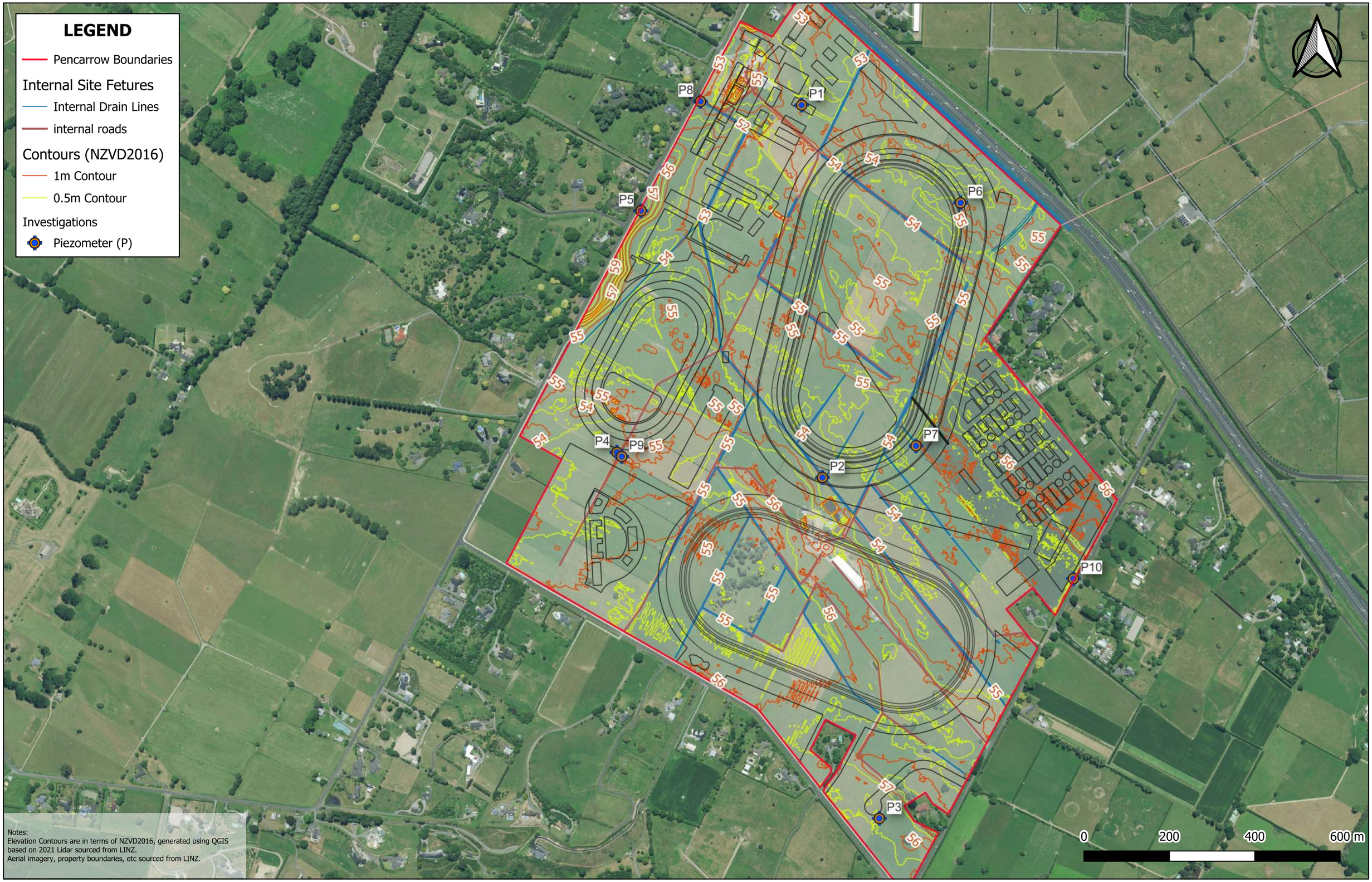
Revision	Date	By	Reason
04	26/03/2026	BB	Fast Track Referral Application
03	27/02/2026	BB	Fast Track Referral Application
02	16/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
SCALE: 1:8000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-C01	04

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Client: WAIKATO THOROUGHBRED RACING — TE RAPA · CAMBRIDGE · WAIPA

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Sheet: Geotechnical Investigation Plan - Sheet 2

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
04	27/03/2026	BB	Fast Track Referral Application
03	27/02/2026	BB	Fast Track Referral Application
02	16/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
SCALE: 1:8000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-C02	04

All dimensions to be verified on site before making any shop drawings or commencing any work

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Soil Description

Log Identification: HA01

R.L.
NZVD2016: 54m

Coordinates (NZTM):
N: 5807874.40, E: 1809849.35

Field Test Data

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS	0				1		
								1		
		SILT with some fine sand; light grey. Stiff, moist, sensitive, non-plastic.	Hinuera Formation					2		
					94	15	6.2	3		
	0.5			0.5				3		
		Silty fine **SAND**; light grey with trace orange mottles. Medium dense, moist.						3		
								4		
								5		
								4		
	1.0	Sandy **SILT**; light grey. Very stiff, moist, moderately sensitive to sensitive, moist, non-plastic.		1.0				3		
								6		
					106	18	5.8	4		
		- Becomes wet.						5		
								4		
	1.5			1.5	115	42	2.7	5		
								5		
		- Becomes saturated.			179	30	5.9	7		
		- Contains trace subrounded medium pumice gravels.						4		
	2.0			2.0						
		- Colour includes trace orange mottles.			197	38	5.2			
	2.5			2.5						
		- Sand becomes absent			109	30	3.6			
	3.0	**End of hand auger at 3.0m** - Target depth.		3.0						
	3.5			3.5						
	4.0			4.0						
	4.5			4.5						
	5.0			5.0						
	5.5	Groundwater encountered at 1.7m during testing.		5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 13/11/2025
Logged By: SC
Checked By: LR

Soil Description

Log Identification: HA02

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807506.46, E: 1810136.80

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
Hand Auger (50mm)		**TOPSOIL**; dark brown. Moist.	TS	
		SILT with trace fine sand; orange brown. Stiff to very stiff, moist, sensitive, non-plastic.	Hinuera Formation	
	0.5	- Colour becoming greyish orange.		0.5
		Silty fine **SAND**; light grey. Loose to dense, wet		
	1.0	- Becoming saturated - Sand becoming fine to medium.		1.0
		Gravelly fine to medium **SAND**; greyish brown. Medium dense to dense saturated. Gravels fine to medium and subrounded		
	1.5			1.5
		Sandy **SILT**; light greyish brown. Stiff, insensitive, saturated slightly plastic.		
	2.0			2.0
		Fine to medium **SAND**; greyish brown. Medium dense, saturated.		
		End of hand auger at 2.2m - Continual collapse.		
	2.5			2.5
	3.0			3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5	Groundwater encountered at 0.9m after testing.		5.5

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
				1		
				2		
				2		
	83	15	5.5	2		
				1		
0.5				1		
	182	35	5.2	3		
				2		
				3		
1.0				3		
				4		
				4		
				7		
				9		
1.5				9		
				10		
				5		
				4		
	64	42	1.5	5		
				7		
2.0				5		
				5		
				6		
				6		
2.5				5		
				6		
				6		
				4		
				3		
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 13/11/2025
Logged By: OT
Checked By: LR

Soil Description

Log Identification: HA03

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807064.54, E: 1810112.59

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)		**TOPSOIL**; dark brown. Moist.	TS
		Sandy **SILT**; light orange brown with orange streaks. Stiff, moist, moderately sensitive, slightly plastic.	Hinuera Formation
		- becoming moderately plastic and wet.	
	0.5	Silty fine **SAND**; light greyish brown with orange mottles. Loose to medium dense, wet.	
		Sandy **SILT**; light grey. Very stiff, wet, sensitive, moderately plastic. Sand is fine.	
	1.0	Silty fine to medium **SAND**; light grey. Loose to dense, saturated.	
	1.5	- 10mm thick organic silt.	
		Sandy **SILT**; light brown. Stiff to very stiff*, saturated, slightly plastic.	
	2.0	**End of hand auger at 2.0m** - No sample retained.	
	2.5		
	3.0		
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count
				2
				3
				2
	98	30	3.3	2
0.5				4
				2
				2
				2
				4
1.0	106	23	4.7	8
				5
				4
				4
				3
1.5				5
				4
				3
				8
				6
2.0				5
				8
				6
				4
				8
2.5				9
				4
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				

Plot of Scala results: Very loose (1) | Loose (2–3) | Medium Dense (4–6) | Dense (7–10)

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 12/11/2025
Logged By: OT
Checked By: LR

Soil Description

Log Identification: HA04

R.L.
NZVD2016: 54m

Coordinates (NZTM):
N: 5806205.72, E: 1810032.91

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
Hand Auger (50mm)	0.0	**TOPSOIL**; dark brown. Moist.	TS	0.0
		Sandy **SILT**; orange brown. Stiff to very stiff, moist, insensitive to moderately sensitive. Sand is fine.	Hinuera Formation	
	0.5			0.5
		Fine to medium **SAND** with some silt; light orange brown. Loose to dense, moist.		
	1.0	- Sand becoming medium to coarse. Containing reddish orange staining.		1.0
		Gravelly coarse **SAND**; light brownish grey. Dense, moist to wet.		
	1.5			1.5
Hand Auger (100mm)	2.0	End of 50mm hand auger at 2.0m - Obstruction due to gravels. Hole rebored with 100mm auger.		2.0
	2.5	- Becoming saturated.		2.5
		SILT; light orange brown. Stiff, saturated, slightly plastic.		
	3.0			3.0
		End of hand auger at 3.2m - Target depth.		
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5	Groundwater encountered at 2.7m during testing.		5.5

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity
0.0			
	121	42	2.9
0.5			
	61	38	1.6
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			
5.5			

Scala Penetrometer (blows per 100mm drop)

Blow count	Plot of Scala results (0 1 2 3 4 5 6 7 8 9 10; Very loose, Loose, Medium Dense, Dense)
2	
2	
2	
3	
1	
1	
2	
2	
2	
3	
6	
17	
11	
11	
8	
12	
12	
10	
10	
6	
6	
4	
3	
5	
3	
4	
3	
1	
2	

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 10/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA05

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807062.36, E:1809416.68

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS	0
	0.5	**SILT**; dark orange brown. Very stiff, moist, moderately sensitive, slightly plastic.	Hinuera Formation	0.5
	1.0	Fine to medium **SAND** with trace silt; orange brown. Loose to dense, moist.		1.0
	1.5	- Sand becoming medium to coarse.		1.5
	2.0	- containing trace fine to medium subrounded gravel. Colour becoming light greyish brown.		2.0
	2.5	- Becoming wet. **SILT**; light grey. Stiff to very stiff*, moist to wet, slightly plastic.		2.5
	3.0	- Becoming saturated. Silty medium **SAND**; light grey. Medium dense, saturated. **End of hand auger at 3.0m** - Target depth.		3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5	Groundwater encountered at 2.7m during testing.		5.5

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
0				1		
				1		
				2		
				3		
0.5	182	45	4.0	1		
				1		
				1		
				1		
				2		
1.0				5		
				9		
				9		
				8		
				7		
1.5				6		
				8		
				4		
				4		
				5		
2.0				5		
				6		
				5		
				5		
				5		
2.5				6		
				3		
				3		
				4		
				5		
3.0				4		
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 14/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA06

R.L.
NZVD2016: 58m

Coordinates (NZTM):
N: 5807604.09, E: 1809477.59

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results: Very loose 0–1, Loose 2–3, Medium Dense 4–5, Dense 6–7, Dense 8–9–10	Groundwater Level
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS	0						
	0.5	Clayey **SILT**; dark brown. Stiff to very stiff, moist, insensitive to sensitive, slightly plastic.	Walton Subgroup	0.5	182	68	2.7			
	1.0	- Becoming light brown.		1.0	174	91	1.9			
	1.5			1.5	197	106	1.9			
	2.0			2.0	166	68	2.4			
	2.5			2.5	166	53	3.1			
	3.0	- becoming moderately plastic.		3.0	144	45	3.2			
	3.5			3.5	136	45	3.0			
	4.0			4.0	76	23	3.3			
	4.5			4.5	76	30	2.5			
	5.0	**End of hand auger at 3.0m** - Target depth.		5.0						
	5.5	Groundwater not encountered during testing		5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 14/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA07

R.L.
NZVD2016: 54m

Coordinates (NZTM):
N: 5807673.70, E: 1809818.62

Investigation method: Hand Auger (50mm)

Depth (meters)	Field Description	Geological Unit
0.0	**TOPSOIL**; dark brown. Moist.	TS
	SILT; light orange brown. Stiff to very stiff, moist, moderately sensitive to sensitive, non-plastic.	Hinuera Formation
0.5	- colour becoming light brown with trace orange mottles.	
	Fine to medium **SAND**; light grey with trace orange mottles. Loose to dense, moist.	
1.0	- 100mm thick SILT lens. - Sand becoming silty fine sand.	
1.5		
2.0	- Becoming wet. - Becoming saturated.	
2.5		
	End of hand auger at 2.8m - No sample retained.	
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
	Groundwater encountered at 2.2m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity
0.0			
	106	23	4.7
0.5			
	91	38	2.4
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			
5.5			

Scala Penetrometer (blows per 100mm drop)

Blow count	Plot of Scala results (0 1 2 3 4 5 6 7 8 9 10)
1	Very loose
2	
2	
2	Loose
2	
4	
2	
1	
2	
5	Medium Dense
6	
4	
5	
5	
4	
5	
5	
6	
5	
9	Dense
6	
7	
7	
6	
8	
5	
6	
7	
6	

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 14/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA08

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807643.79, E: 1810221.65

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS
		SILT with trace fine sand; orange brown. Stiff, dry to moist, sensitive, non-plastic to slightly plastic.	Hinuera Formation
	0.5	**SILT**; light grey. Very stiff, moist, sensitive, slightly plastic.	
	1.0	- Becoming sandy and moist to wet.	
		Silty fine to coarse **SAND**; light grey. Loose to dense, saturated.	
	1.5	- Colour becomes reddish brown. - Colour becomes brownish grey.	
	2.0	**End of hand auger at 1.8m** - Continual collapse.	
	2.5		
	3.0		
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.2m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count
0				1
				2
				2
	95	23	4.2	2
				2
0.5				2
	148	30	4.9	4
				2
	156	20	7.9	2
1.0				4
				2
				4
				5
				6
1.5				12
				13
				15
				6
				4
				3
2.0				4
				3
				4
				6
				3
2.5				5
				7
				5
				5
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				

Scala Penetrometer (blows per 100mm drop)

Plot of Scala results: Very loose | Loose | Medium Dense | Dense (0 1 2 3 4 5 6 7 8 9 10)

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 13/11/2025
Logged By: OT
Checked By: LR

Soil Description

Log Identification: HA09

R.L.
NZVD2016: 54m

Coordinates (NZTM):
N: 5806999.101, E: 1809890.037

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS
		SILT; light orange brown with orange streaks. Stiff to very stiff*, dry, non-plastic.	Hinuera Formation
	0.5	Fine **SAND**; light orange grey. Medium dense, moist.	
		Sandy **SILT**; light orange grey. Stiff to very stiff, moist, moderately sensitive to sensitive, slightly plastic.	
	1.0	- Colour becoming brownish grey.	
	1.5	Fine **SAND** with some silt; light grey. Medium dense to dense, saturated.	
		- poor sample return	
	2.0	**End of hand auger at 2.0m** - No sample retained.	
	2.5		
	3.0		
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.5m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop)
0				2	Plot of Scala results: Very loose / Loose / Medium Dense / Dense (0 1 2 3 4 5 6 7 8 9 10)
				3	
				1	
				2	
				3	
0.5				5	
				4	
				4	
	189	30	6.3	5	
				4	
1.0				4	
				3	
	61	23	2.7	2	
				2	
1.5				4	
				6	
				6	
				6	
				10	
2.0				7	
				9	
				10	
				7	
				7	
2.5				6	
				7	
				8	
				5	
3.0				5	
3.5					
4.0					
4.5					
5.0					
5.5					

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 12/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA10

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5806635.13, E: 1810217.40

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS	0
	0.5	Sandy **SILT**; dark orange brown. Stiff*, moist, slightly plastic. Sand is fine. - colour becoming light orange brown with orange mottling.	Hinuera Formation	0.5
		Silty fine **SAND**; light brown with orange streaks. Loose, moist.		
	1.0	Sandy **SILT**; light brownish grey. Very stiff, moist, sensitive, slightly plastic.		1.0
	1.5	Silty fine to medium **SAND**; light brownish grey. Medium dense to dense, moist.		1.5
	2.0	- Colour includes orange mottling and brown streaks. - Colour becoming dark brown. - Becoming wet. - Becoming saturated. - Sand becoming fine		2.0
	2.5			2.5
	3.0	**End of hand auger at 2.7m** - No sample retained.		3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5	Groundwater encountered at 2.1m during testing.		5.5

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
0				4		
				3		
				2		
				2		
0.5				1		
				4		
				2		
				3		
	159	23	7.0	2		
1.0				3		
				6		
				8		
				17		
				18		
1.5				8		
				16		
				12		
				6		
				7		
2.0				8		
				6		
				10		
				12		
				12		
2.5				18		
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 12/11/2025
Logged By: OT
Checked By: LR

Soil Description

Log Identification: HA11

R.L.
NZVD2016: 56m

Coordinates (NZTM):
N: 5806630.24, E: 1809912.81

Investigation method: Hand Auger (50mm)

Depth (meters)	Field Description	Geological Unit
	Sandy **TOPSOIL**; dark brown. Moist.	TS
	Fine to medium **SAND** with some silt; greyish brown orange brown mottling. Loose to dense, moist.	Hinuera Formation
0.5		
	- Sand becoming coarse and containing trace fine subrounded to sub angler gravel. Containing orange brown staining.	
1.0	- Sand becoming fine to medium and wet.	
1.5	**SILT**; whitish grey. Stiff, moist, moderately sensitive, slightly plastic.	
	Fine **SAND** with some silt; light brown. Loose to medium dense, wet to saturated.	
	- becoming saturated.	
2.0	**SILT** with trace fine sand; light grey with dark brown speckles. Stiff to very stiff*, moist to wet, slightly plastic.	
	Fine to medium **SAND**; light grey. Medium dense, saturated.	
2.5		
	End of hand auger at 2.7m - Continual collapse	
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
	Groundwater encountered at 1.7m after testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop)
				3
				4
				5
				3
				5
0.5				8
				4
				5
				5
				5
1.0				8
				9
				4
				5
				6
1.5	91	30	3.0	6
				4
				5
				5
				2
2.0				1
				4
				5
				7
				6
2.5				5
				5
				5
				4
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				

Scala Penetrometer (blows per 100mm drop)

Plot of Scala results

Blow count: 0 1 2 3 4 5 6 7 8 9 10

Very loose | Loose | Medium Dense | Dense

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883

Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)

Calibration Expiry Date: 5/08/2026

Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 10/11/2025

Logged By: SL **Checked By: LR**

Soil Description

Log Identification: HA12

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5806676.19, E: 1809501.35

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)	0	**TOPSOIL**; dark brown. Moist.	TS
	0.5	**SILT**; light orange grey. Very Stiff, dry to moist, moderately sensitive, slightly plastic.	Hinuera Formation
	1.0	Silty medium **SAND**; light greyish brown with dark orange brown inclusions. Medium dense, moist.	
	1.5	Medium to coarse **SAND** with trace silt; Light greyish brown. Medium dense, wet. - Becoming wet to saturated.	
	2.0	Fine to medium **SAND**; light grey. Loose to medium dense, wet to saturated. Dilatant.	
	2.5	Sandy **SILT**; light grey. Stiff, wet to saturated, moderately sensitive, slightly plastic. Dilatant. - 50mm fine sand lens. - 50mm organic silt lens	
	3.0	Silty fine **SAND**; light grey with orange mottling. Medium dense to dense, saturated - Silt absent. Sand becoming coarse and dark brown. **End of hand auger at 2.9m** - No sample retained.	
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.8m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
0				2		
				4		
				2		
				3		
0.5				1		
	166	42	3.9	3		
				6		
				5		
				5		
1.0				5		
				6		
				4		
				5		
1.5				6		
				4		
				3		
				4		
				4		
2.0				4		
				2		
				3		
				2		
	53	23	2.3	4		
2.5				6		
				7		
				6		
				9		
				10		
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 10/11/2025
Logged By: SL **Checked By: LR**

Soil Description

Log Identification: HA13

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807337.17, E:1809796.55

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
Hand Auger (50mm)		**TOPSOIL**; dark brown. Moist.	TS	
	0.5	Silty fine to medium **SAND**; light brown with orange streaks. Loose to medium dense, moist - Silt absent. Sand becomes fine.	Hinuera Formation	0.5
	1.0	**SILT**; light brown. Very Stiff, most, sensitive, slightly plastic.		1.0
	1.5	Fine to medium **SAND**; light grey. Medium dense to dense, wet. - becomes saturated.		1.5
	2.0	**SILT**; light grey. Stiff to very stiff*, saturated, slightly plastic. - 50mm organic silt lens.		2.0
	2.5	**End of hand auger at 2.2m** - No sample retained.		2.5
	3.0			3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5	Groundwater encountered at 1.6m during testing.		5.5

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count
				3
				1
				2
				4
				3
0.5				4
				4
				4
				3
1.0				4
	136	30	4.5	3
				3
				6
				9
1.5				10
				12
				7
				5
				6
2.0				6
				3
				4
				3
				6
2.5				9
				7
				7
				7
				8
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				

Scala Penetrometer (blows per 100mm drop) — Plot of Scala results: Very loose (0–1), Loose (2–3), Medium Dense (4–5), Dense (6–10)

Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 14/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA14

R.L.
NZVD2016: 55m

Coordinates (NZTM):
N: 5807208.26, E: 1809494.55

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)	0	**TOPSOIL**; dark brown with trace fine to medium subangular gravel. Dry.	TS
	0.5	**SILT** with trace fine sand; greyish brown with light grey, orange brown and dark brown streaks. Stiff to very stiff, moist, moderately sensitive, slightly plastic.	Hinuera Formation
	1.0	- Becoming sandy and moist to wet. Sand is fine. - 100mm thick organic silt layer; dark brown.	
	1.5	Coarse **SAND** with some silt; light grey. Loose to medium dense, moist to wet. - Becoming saturated.	
	2.0	Sandy **SILT**; light grey. Stiff to very stiff*, wet, non-plastic.	
	2.5	Silty fine **SAND**; light grey. Medium dense to dense, wet. - becoming saturated.	
	3.0	**End of hand auger at 2.4m** - No sample retained.	
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.5m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop)	Groundwater Level
0				2 2 2 2 2	
0.5	182	30	6.0	2 3 3	
	91	15	6.0	4 4	
1.0				3 4 7 4 3	
1.5				3 3 3 6 OB	
2.0				OB 5 4 6 6	
2.5				9 6 7 7	
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					

Plot of Scala results: Very loose (0–1), Loose (1–3), Medium Dense (4–6), Dense (7–10)

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil. * refers to consistency based on diagnostic features
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 14/11/2025
Logged By: SL
Checked By: LR

Soil Description

Log Identification: HA15

R.L.
NZVD2016: 55m

Coordinates (NZTM):
5807052.6N, 1809428.7E

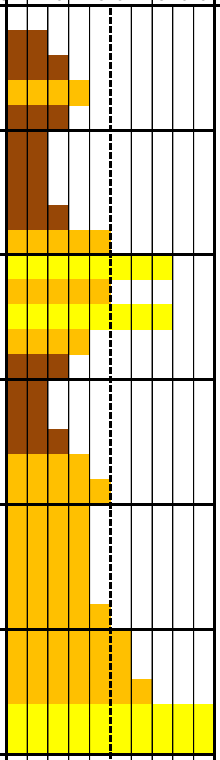
Investigation method	Depth (meters)	Field Description	Geological Unit
		TOPSOIL; dark brown. Dry.	TS
		SILT, with trace sand; light orangish brown. Firm, dry, non-plastic. Sand is fine.	Hinuera Formation
	0.5	Fine to medium **SAND**, with trace gravel; light brown. Loose, dry. Gravel is fine, sub-rounded.	
		- at 0.8m, sand becomes fine to coarse.	
	1.0	Medium to coarse **SAND**, with trace gravel; brown. Medium dense to dense, moist. Gravel is fine to medium, sub-rounded.	
Hand Auger (50mm)	1.5	- at 1.5m, 50mm light brown silt lense.	
		- at 1.7m, 50mm light brown silt lense.	
	2.0	Fine to medium **SAND**; light brown. Medium dense, moist.	
		- at 2.1m, 50mm light brown silt lense.	
	2.5	-at 2.5m, becomes light grey.	
		- at 2.8m, contains some fine to medium, sub-rounded gravel.	
	3.0	- End of 50mm hand auger at 3.0m - Target depth. 100mm hand auger continued	
Hand Auger (100mm)	3.5		
	4.0	- at 4.0m, becoming wet - at 4.1m, becoming saturated	
		End of 100mm hand auger at 4.2m - No sample retained.	
	4.5		
	5.0		
	5.5	Groundwater encountered at 4.1m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity
0.5	79	24	3.3

Scala Penetrometer (blows per 100mm drop)

Blow count
2
3
4
3
2
2
2
3
5
8
5
8
4
3
2
2
3
4
5
4
4
4
4
5
6
6
7
10
13



Groundwater Level

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)
Calibration Expiry Date: 5/08/2026
Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 18/12/2025
Logged By: EB **Checked By: BB**

Soil Description

Log Identification: HA16

R.L. **NZVD2016**: 53m

Coordinates (NZTM): 5807883.2N, 1809613.1E

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Blow count	Scala Penetrometer (blows per 100mm drop) Plot of Scala results: Very loose 0 1 / Loose 2 3 / Medium Dense 4 5 6 7 / Dense 8 9 10	Groundwater Level
Hand Auger (50mm)		**TOPSOIL**; light brown. Dry.	FILL							
		Sandy **SILT**; light brown. Very stiff*, dry to moist, non-plastic. Sand is medium to coarse. Pale grey and orange inclusions.								
	0.5	Sandy **SILT**; pale brownish grey. Very stiff, moist, slightly plastic, sensitive. Sand is medium to coarse. Orange inclusions.		0.5	106	23	4.7			
					121	30	4.0			
	1.0	**SILT**, with trace clay and sand; light brown. Firm, moist, moderately plastic, moderately sensitive. Sand is coarse. Black streaks.		1.0						
					91	30	3.0			
	1.5	**SILT**, with some clay; light orange brown. Very stiff, Saturated, moderately plastic, sensitive.	Walton Subgroup	1.5						
	2.0	Clayey **SILT**, pale orange brown. Firm to very stiff, moist, moderately plastic, sensitive.		2.0	106	15	7.0			
	2.5	Clayey **SILT**, grey. Firm, moist, moderately plastic, extra sensitive.		2.5	98	8	13.0			
		End of Hand Auger at 2.7m - No sample return								
	3.0	* strength inferred from field characteristics.		3.0	15	8	2.0			
	3.5			3.5						
	4.0			4.0						
	4.5			4.5						
	5.0			5.0						
	5.5	Groundwater encountered at 1.5m during testing.		5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883

Client: WTR Waikato Thoroughbred Racing

Shear Vane ID:3294 (19mm blade)

Calibration Expiry Date: 5/08/2026

Shear Vane Factors: A: 1.513

Location: Pencarrow Road / Hooker Road / Duncan Road

Date Of Investigation: 18/12/2025

Logged By: EB **Checked By: BB**

Soil Description

Log Identification: HA17

R.L. **NZVD2016**: 55.2m

Coordinates (NZTM): E: 1810288.67, N: 5807259.7

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)		**TOPSOIL**; dark brown. Dry to moist.	TS
		Sandy **SILT**; light greyish orange. Stiff* to very stiff*, moist, non-plastic.	Hinuera Formation
	0.5	Fine to coarse **SAND**; orange brown. Loose to dense, moist.	
	1.0	- Containing trace fine sub-rounded gravel.	
	1.5	Medium to coarse **SAND** with trace gravel and trace silt; light greyish brown. Very loose to medium dense, wet.	
		- Colour becoming dark brown, wet to saturated.	
	2.0	**End of hand auger at 1.9m** - No sample retained.	
	2.5		
	3.0		
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.8m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count	Groundwater Level
				2 2 3 5	
0.5				5 3 4 3 5	
1.0				4 6 6 10 3	
1.5				1 2 5 4 4	
2.0				0.5 0.5 3 2 2	
2.5				1 1 2 3 3	
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					

Plot of Scala results: Very loose (0 1) | Loose (2 3) | Medium Dense (4 5 6 7) | Dense (8 9 10)

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883

Client: WTR Waikato Thoroughbred Racing

Shear Vane ID: N/A

Calibration Expiry Date: N/A

Shear Vane Factors: A: N/A

Location: 90 Duncan Road, Tamahere

Date Of Investigation: 24/03/2026

Logged By: SL **Checked By: BB**

Soil Description

Log Identification: HA18

R.L.
NZVD2016: 56m

Coordinates (NZTM):
E: 1810519.89, N: 5806968.2

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm)	0.0	**TOPSOIL**; brown. Dry.	TS
		Silty fine to medium **SAND**; orange brown. Loose to medium dense, dry.	Hinuera Formation
	0.5	Gravelly **SAND**; orange brown. Loose, dry to moist.	
		End of hand auger at 0.6m - Obstruction.	
	1.0		
	1.5		
	2.0		
	2.5		
	3.0		
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater not encountered during testing	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose 0 1 / Loose 2 3 / Medium Dense 4 5 6 / Dense 7 8 9 10)	Groundwater Level
0.0				1 1 3 4 3		
0.5				2 2 2 1 1		
1.0				1 2 3 3 5		
1.5				6 7 5 3 5		
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID: N/A
Calibration Expiry Date: N/A
Shear Vane Factors: A: N/A

Location: 90 Duncan Road, Tamahere

Date Of Investigation: 24/03/2026
Logged By: SL **Checked By: BB**

Soil Description

Log Identification: HA19

R.L.
NZVD2016: 55.5m

Coordinates (NZTM):
E: 1810295.77 , N: 5806963.2

Investigation method	Depth (meters)	Field Description	Geological Unit
		TOPSOIL; brown. Dry	TS
Hand Auger (50mm)		**SILT** with trace sand; light greyish orange. Very stiff*, dry, non-plastic.	Hinuera Formation
	0.5	Silty fine to coarse **SAND**; light grey with minor orange brown staining. Medium dense, moist.	
	1.0	**SILT** with trace sand, light grey. Stiff* to very stiff*, moist to wet, dilatant. Sand is fine to medium.	
	1.5	Fine to medium **SAND**; light grey. Medium dense, wet. - Colour becoming brown, moist. - Colour becoming light grey, wet.	
	2.0	- becoming saturated. - becoming very loose. Poor sample return between 2.0m - 3.0m	
	3.0	**End of hand auger at 3.0m** - Target depth.	
	3.5		
	4.0		
	4.5		
	5.0		
	5.5	Groundwater encountered at 1.9m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count	Groundwater Level
				1	
				2	
				5	
0.5				6	
				5	
				5	
				5	
				5	
1.0				2	
				4	
				3	
				7	
				6	
1.5				5	
				6	
				7	
				6	
				6	
2.0				3	
				OB	
				OB	
				1	
				1	
2.5				1	
				4	
				6	
				4	
3.0				5	
3.5					
4.0					
4.5					
5.0					
5.5					

Plot of Scala results: Very loose | Loose | Medium Dense | Dense; 0 1 2 3 4 5 6 7 8 9 10

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID: N/A
Calibration Expiry Date: N/A
Shear Vane Factors: A: N/A

Location: 90 Duncan Road, Tamahere

Date Of Investigation: 24/03/2026
Logged By: SL **Checked By: BB**

Soil Description

Log Identification: HA20

R.L.
NZVD2016: 55.8m

Coordinates (NZTM):
E: 1810486.29, N: 5806767.1

Investigation method	Depth (meters)	Field Description	Geological Unit
Hand Auger (50mm/100mm)	0.0	**TOPSOIL**; dark brown. Moist.	TS
	0.5	Fine to coarse **SAND**; orange brown. Loose, moist.	Hinuera Formation
		SILT; light grey. Stiff, moist, slightly plastic.	
	1.0	Coarse **SAND**; light brownish grey. Medium dense, moist.	
	1.5	- Becoming moist to wet.	
	2.0	Medium to coarse **SAND** with trace silt; light grey with green staining. Loose to dense.	
	3.0	**End of hand auger at 3.0m** - Target depth.	
	5.5	Groundwater encountered at 2m during testing.	

Field Test Data

Depth (meters)	Peak Vane Shear Strength (kPa)	Residual Vane Shear Strength (kPa)	Sensitivity	Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
0.0				HW, 4, 3, 2		
0.5				2, 2, 3, 3, 5		
1.0				5, 6, 6, 5, 6		
1.5				6, 5, 6, 5, 5		
2.0				OB, OB, 3, 4, 4		
2.5				7, 8, 7, 8, 8		
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						

Notes:
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. OB refers to hand auger over bored. HW refers to scala falling under the weight of the hammer. TS refers to topsoil.
3. Soils have been described in general accordance with NZ Geomechanics Society "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", December 2005
4. Vane shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "Guideline for Hand Held Shear Vane Test", August 2001.
5. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.
6. Coordinates (where reported) are presented in NZTM2000 to an accuracy of ±5m.
7. Shear vane results are multiplied by factor A and plus factor B where applicable

BCD GROUP

Job Number: 23-1883
Client: WTR Waikato Thoroughbred Racing

Shear Vane ID: N/A
Calibration Expiry Date: N/A
Shear Vane Factors: A: N/A

Location: 90 Duncan Road, Tamahere

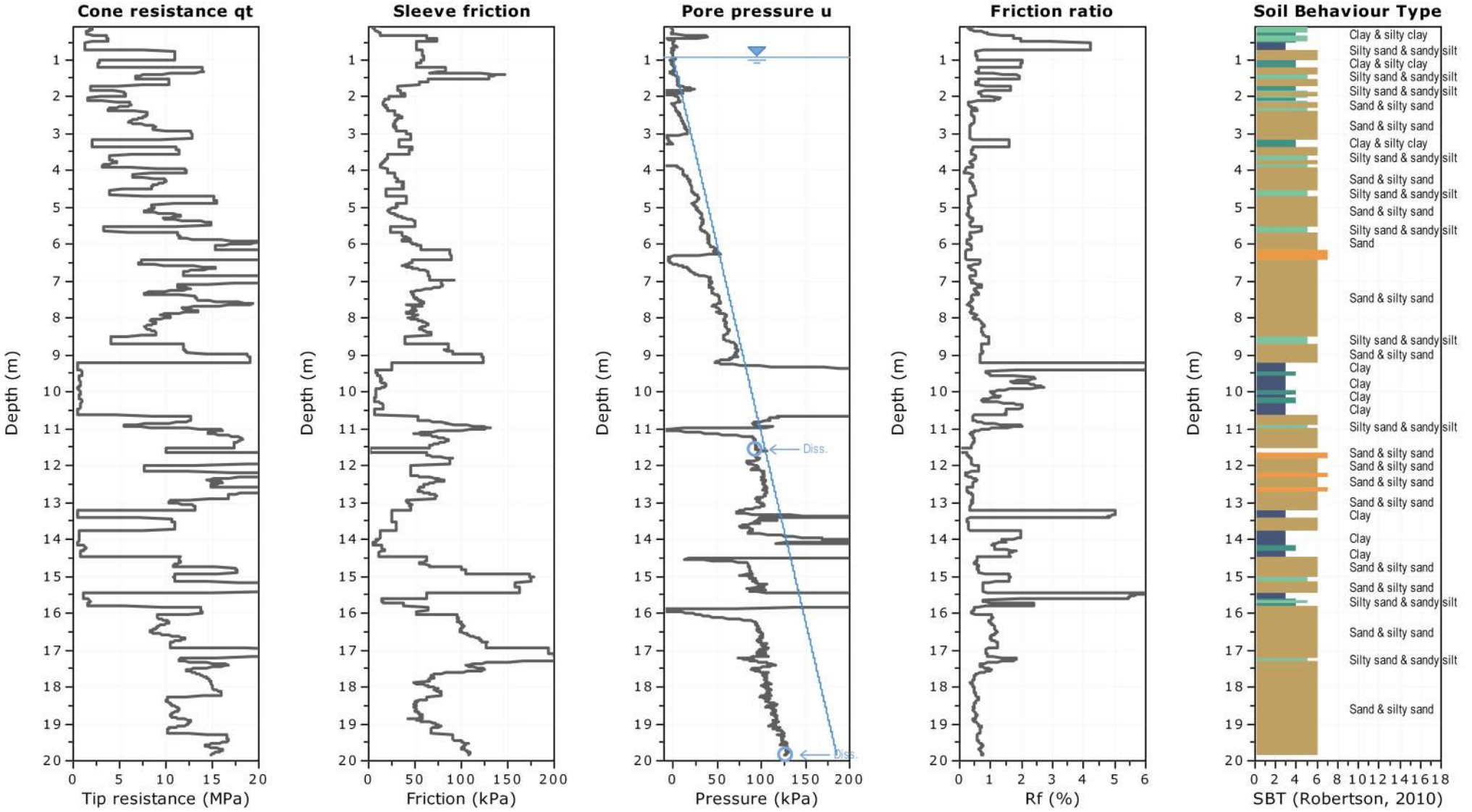
Date Of Investigation: 24/03/2026

Logged By: SL **Checked By: BB**

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CPT: 01
Total depth: 19.84 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 0.93 m
Coords: X:1809851.42, Y:5807879.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

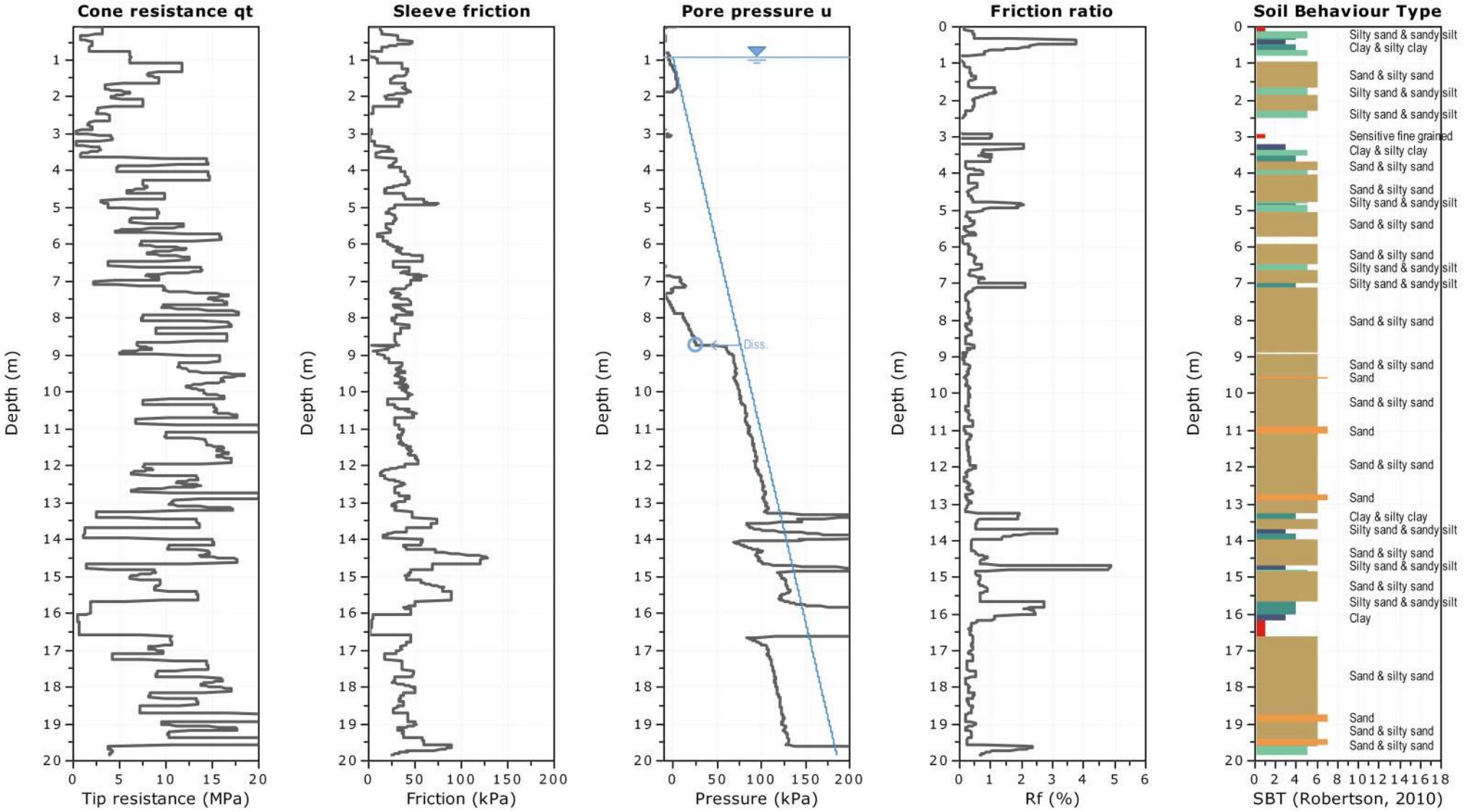
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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https://www.bcdgroup.nz/

CPT: 02
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 0.93 m
Coords: X:1810134.72, Y:5807503.19
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

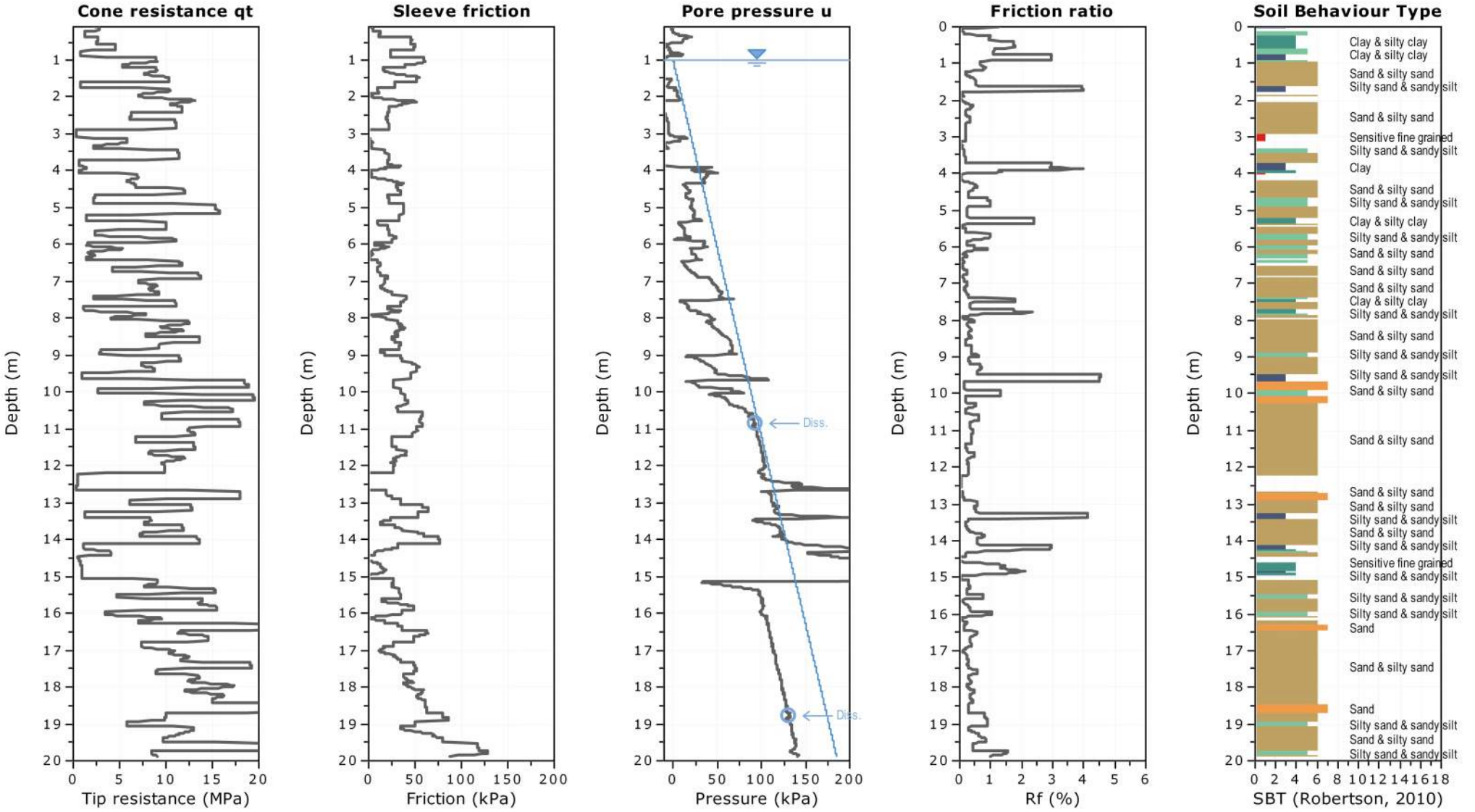
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 03
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.00 m
Coords: X:1810111.74, Y:5807067.73
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

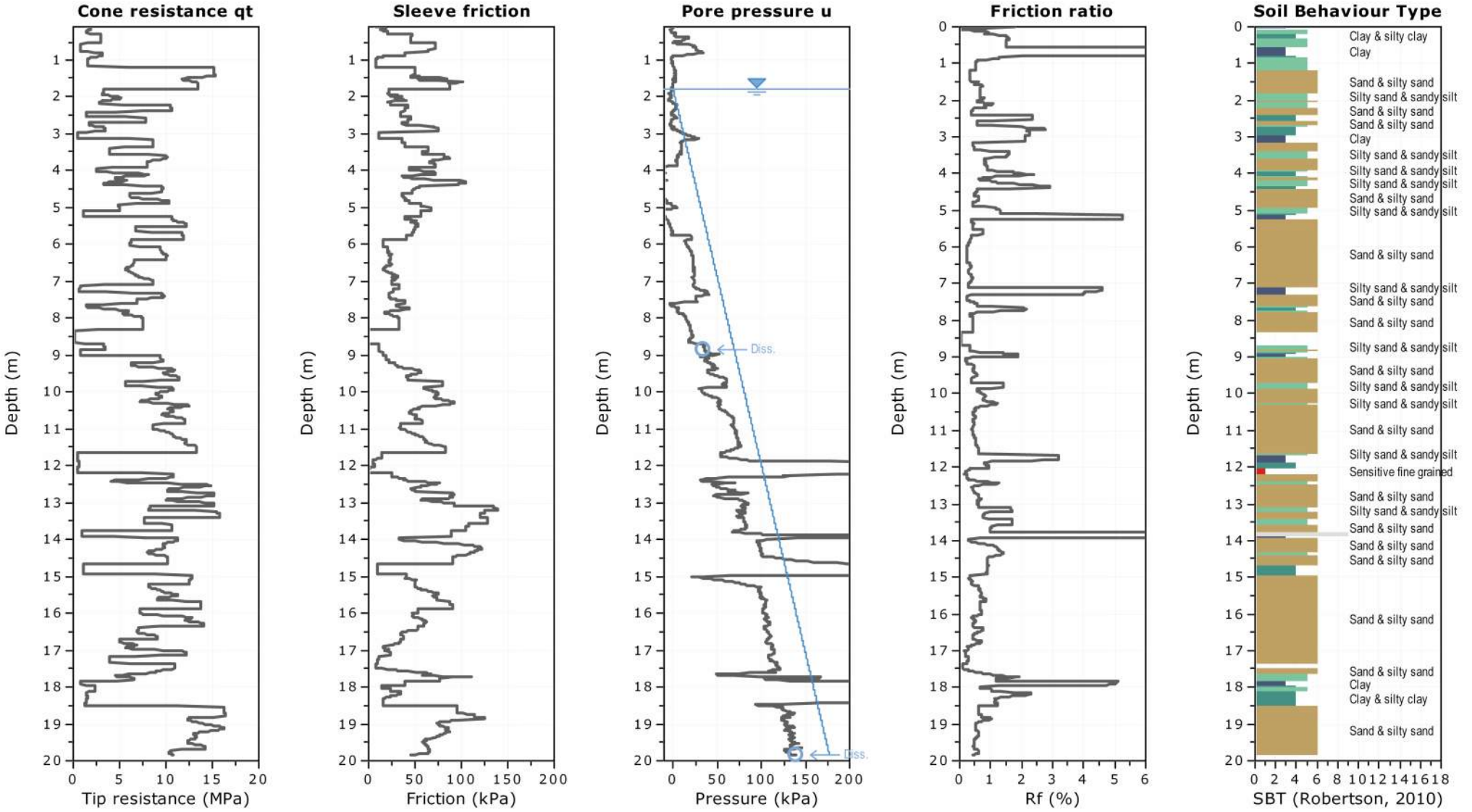
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 04
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.78 m
Coords: X:1810037.64, Y:5806248.35
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

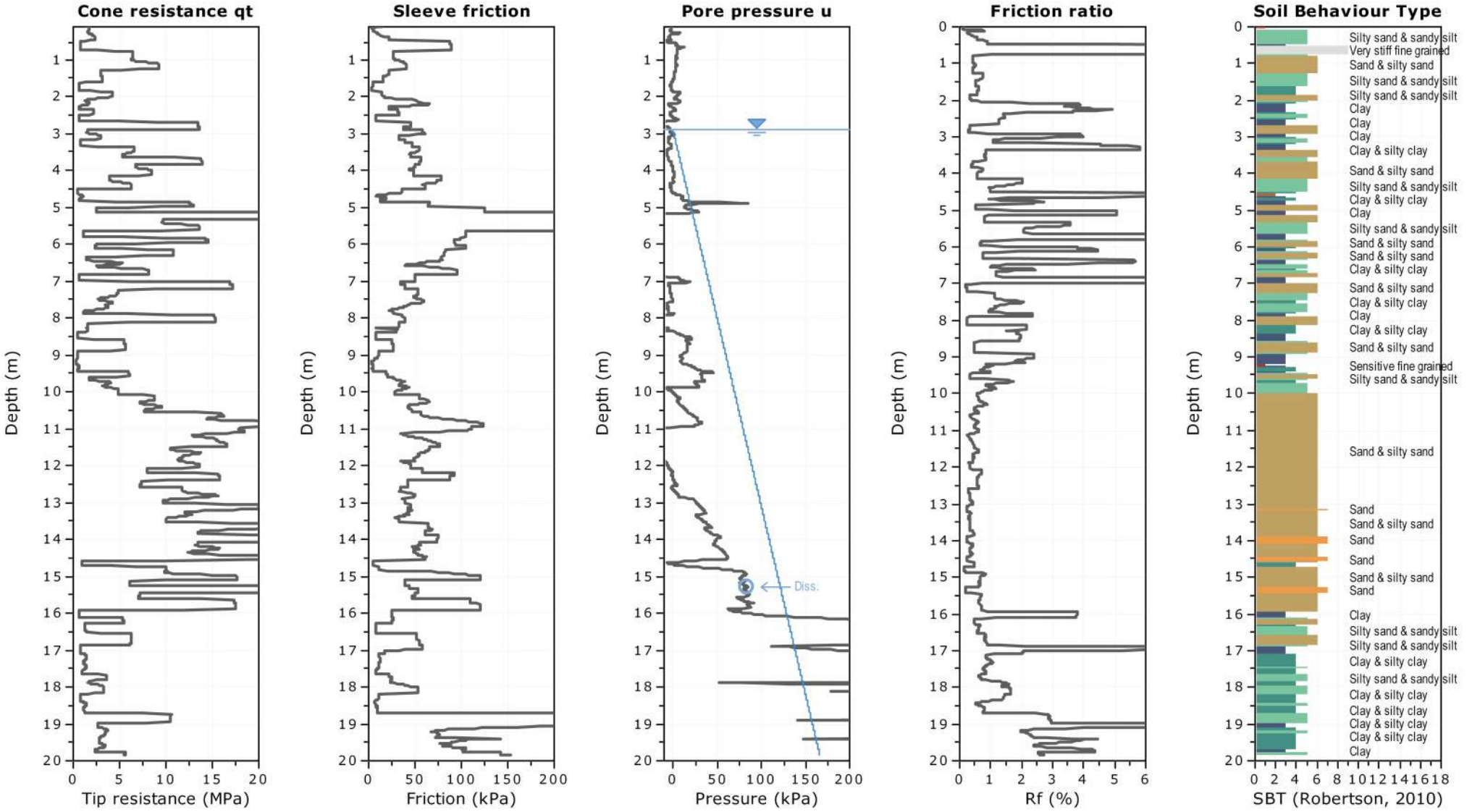
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 05
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 2.90 m
Coords: X:1809405.49, Y:5807048.97
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

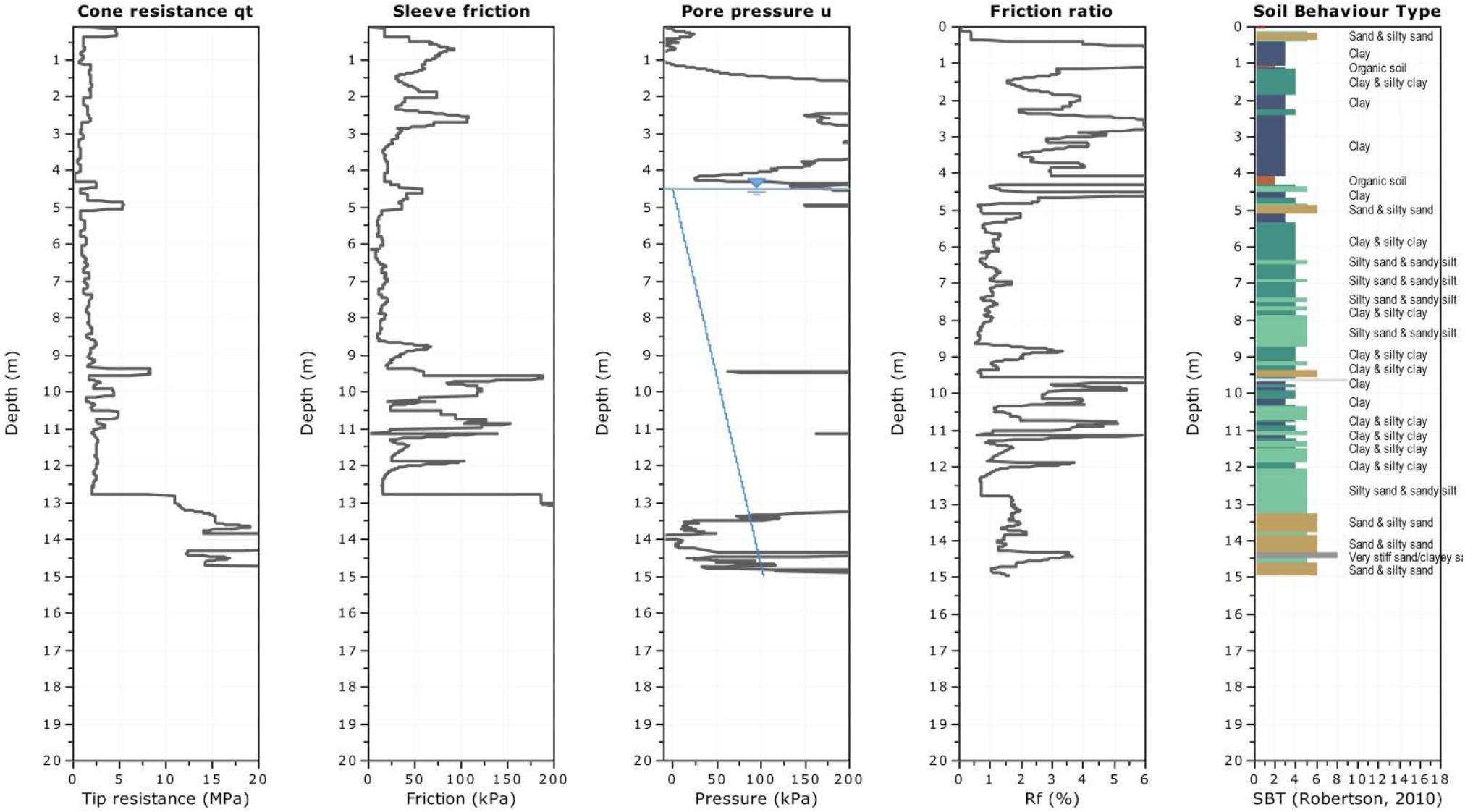
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 06
Total depth: 14.96 m, Date: 19/11/2025
Surface Elevation: 58.00 m, Est. GWL: 4.50 m
Coords: X:1809471.71, Y:5807600.07
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

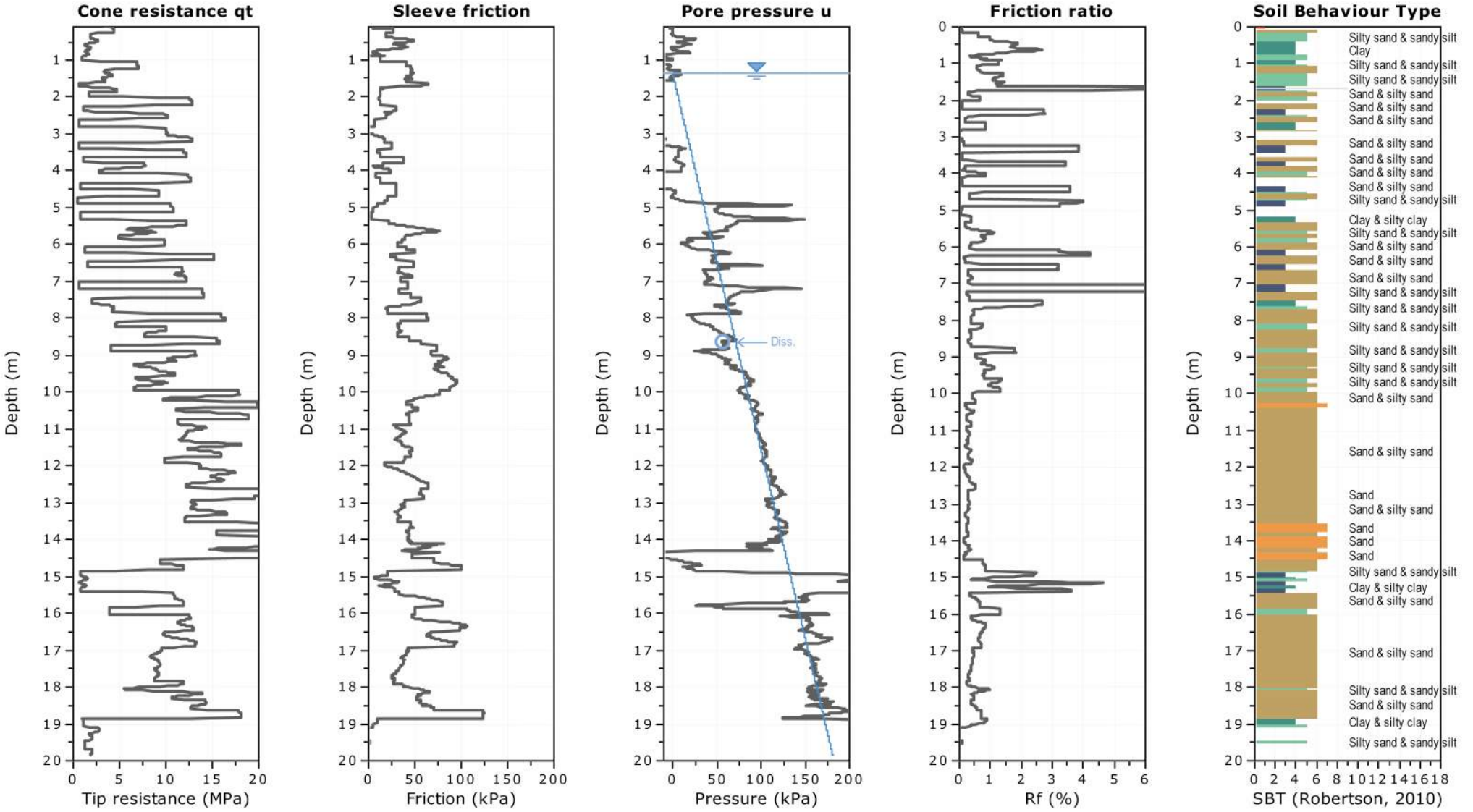
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 07
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.38 m
Coords: X:1809744.75, Y:5807176.51
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

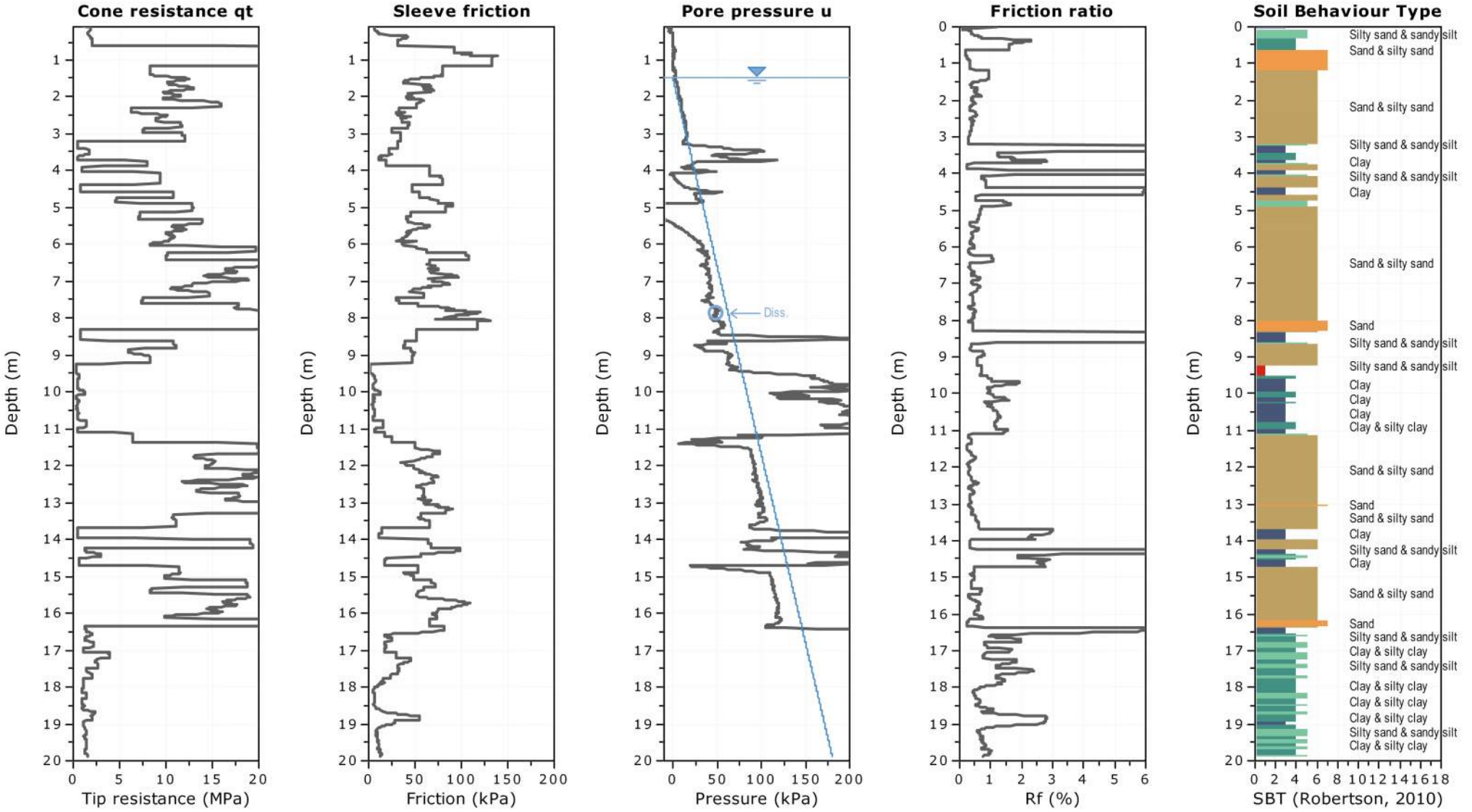
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 08
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.50 m
Coords: X:1810229.77, Y:5807646.78
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

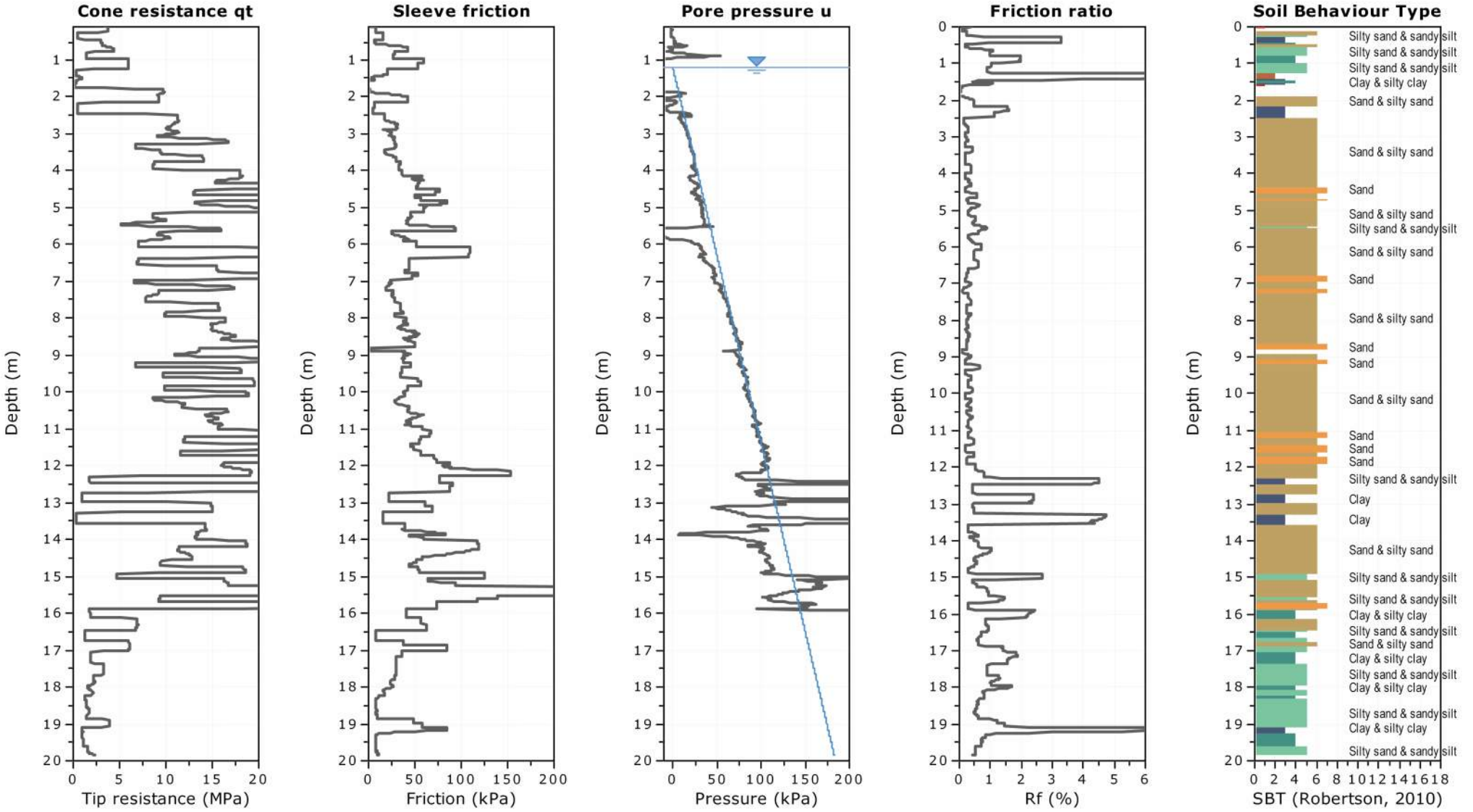
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 09
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.20 m
Coords: X:1810117.05, Y:5806746.63
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

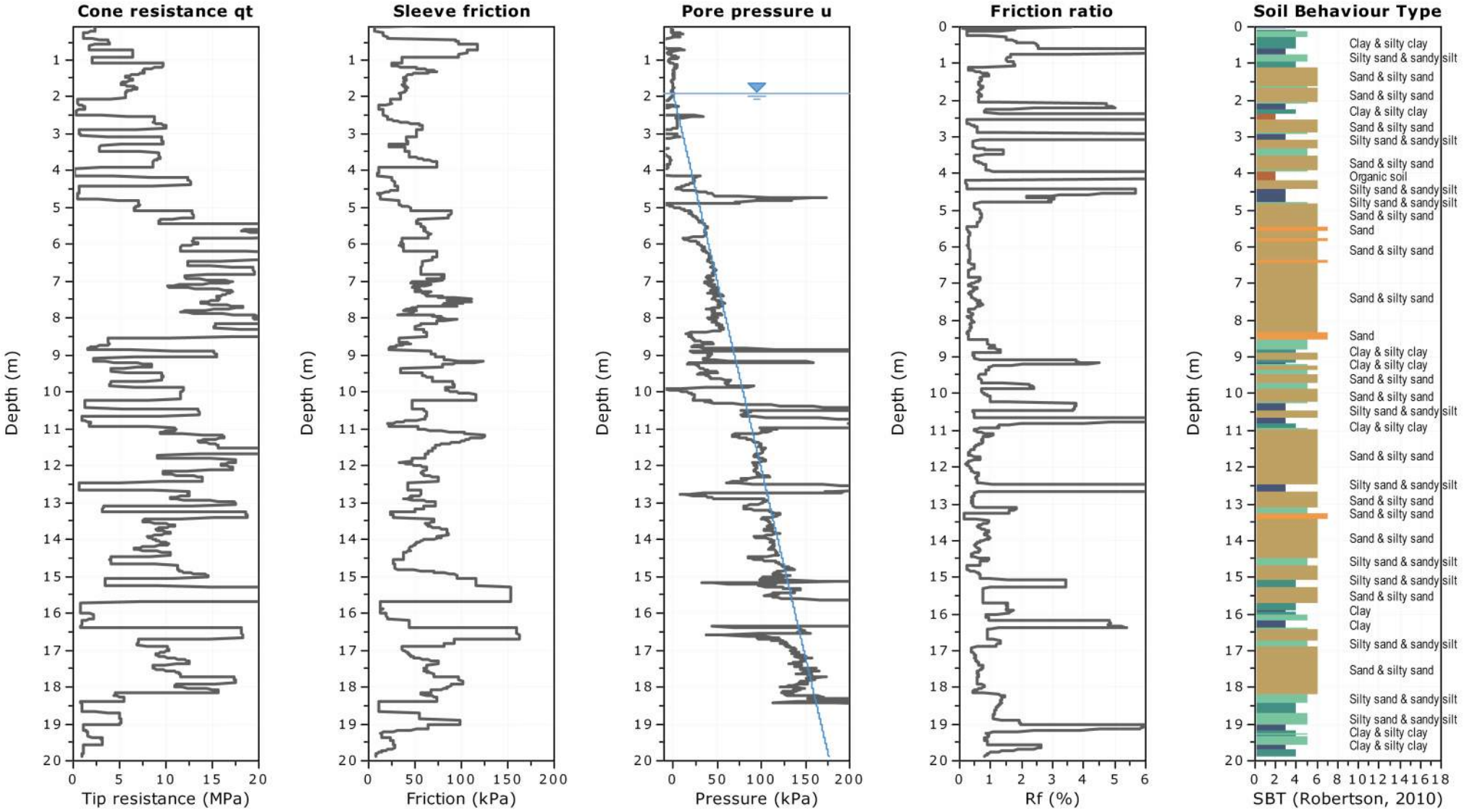
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 10
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.90 m
Coords: X:1809674.00, Y:5806659.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

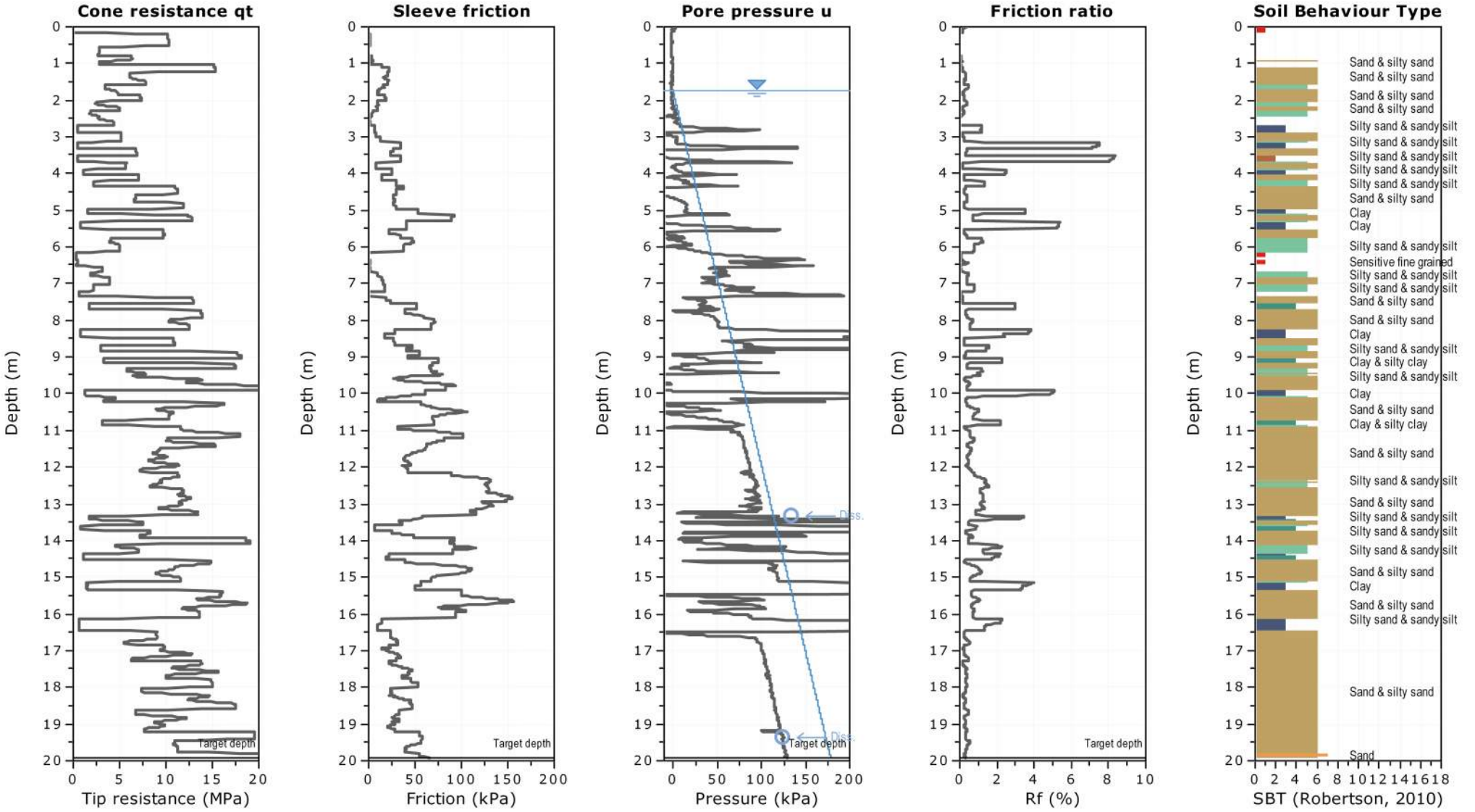
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 11
Total depth: 19.91 m, Date: 24/03/2026
Surface Elevation: 55.05 m, Est. GWL: 1.73 m
Coords: X:1810286.10, Y:5807257.05
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

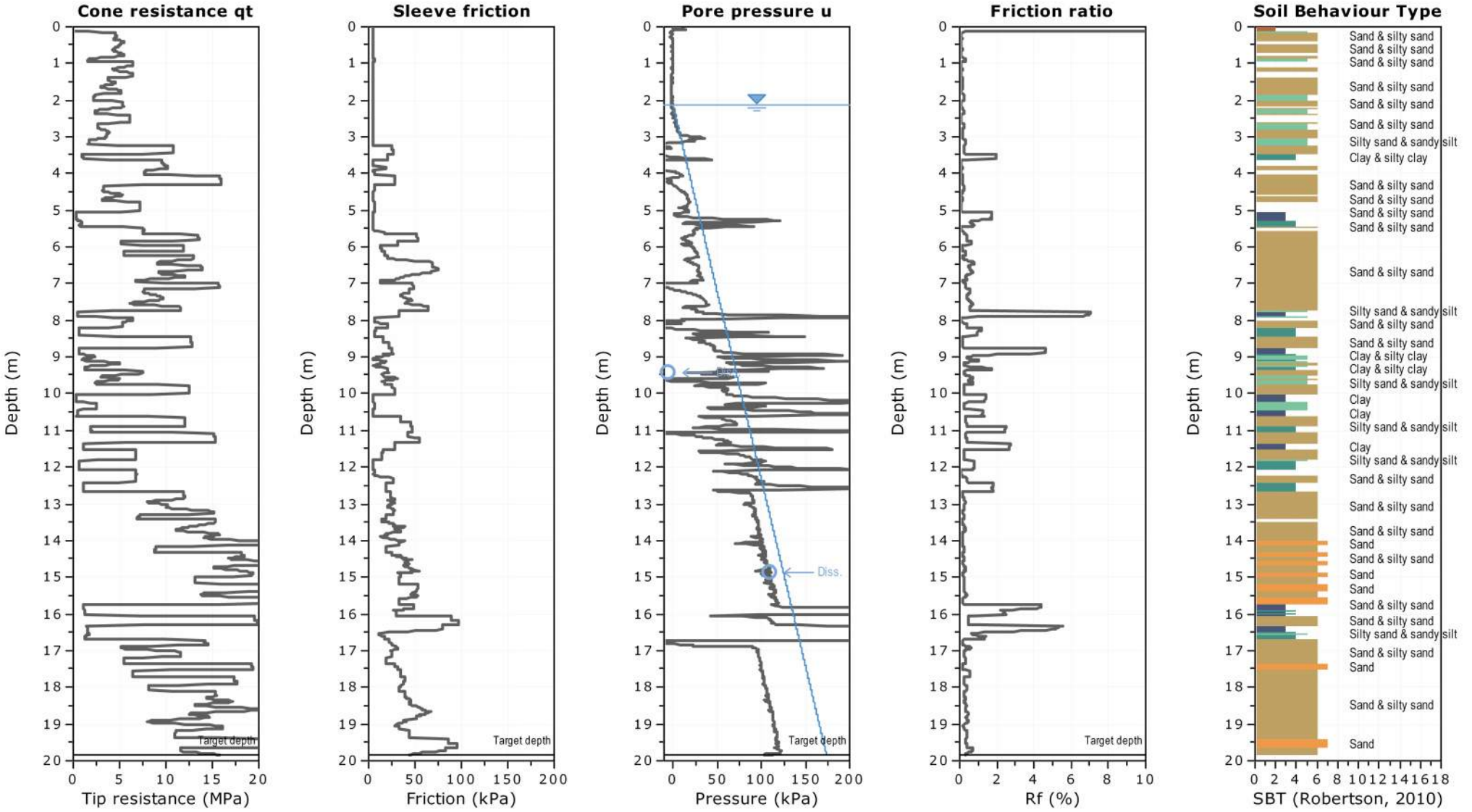
Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



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CPT: 12
Total depth: 19.85 m, Date: 24/03/2026
Surface Elevation: 55.74 m, Est. GWL: 2.12 m
Coords: X:1810460.84, Y:5806859.70
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: Waikato Thoroughbred Racing | 23-1883
Location: Pencarrow, Hooker and Duncan Road, Tamahere



13-11-2025 Groundwater Depth Below Ground Level (m)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- 2.25 - 2.50
- 2.50 - 2.75
- > 2.75

13-11-2025 Groundwater Elevation (mRL)

- <= 50.25
- 50.25 - 50.50
- 50.50 - 50.75
- 50.75 - 51.00
- 51.00 - 51.25
- 51.25 - 51.50
- 51.50 - 51.75
- 51.75 - 52.00
- 52.00 - 52.25
- 52.25 - 52.50
- 52.50 - 52.75
- 52.75 - 53.00
- 53.00 - 53.25
- 53.25 - 53.50
- 53.50 - 53.75
- > 53.75

Notes:
The maps are based on results of discrete points and and are subject to change with addtional investigations.
Groundwater monitoring for 90 Duncan Road is not included as testing was not undertaken on site untill has not been shown within 90 Duncan Road as testing wasn not undertaken untill 24-03-2026

Client: WAIKATO THOROUGHBRED RACING TE RAPA · CAMBRIDGE · WAIPA

Contractor:

BCD GROUP

Sheet: Groundwater Map - 13-11-2025

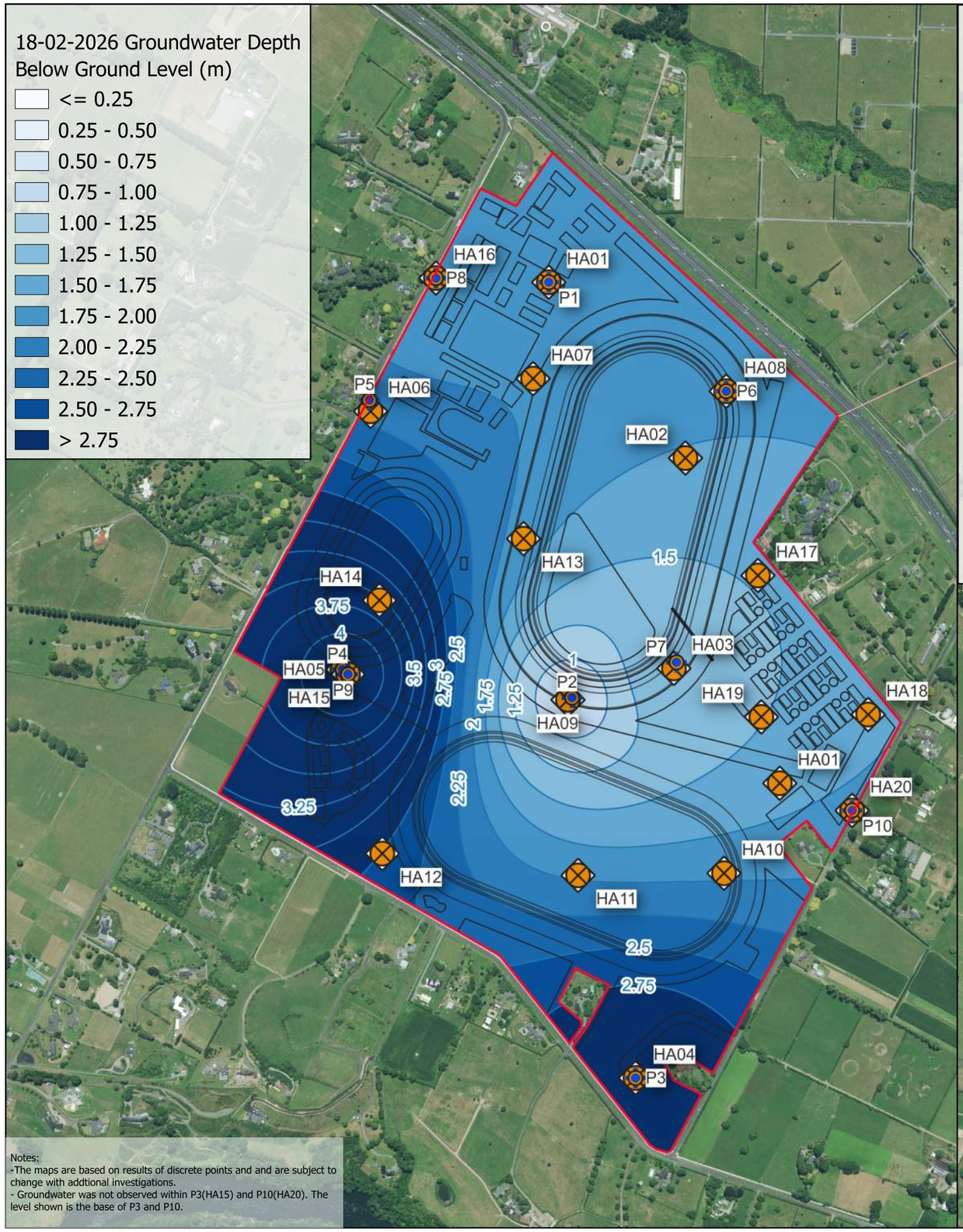
Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

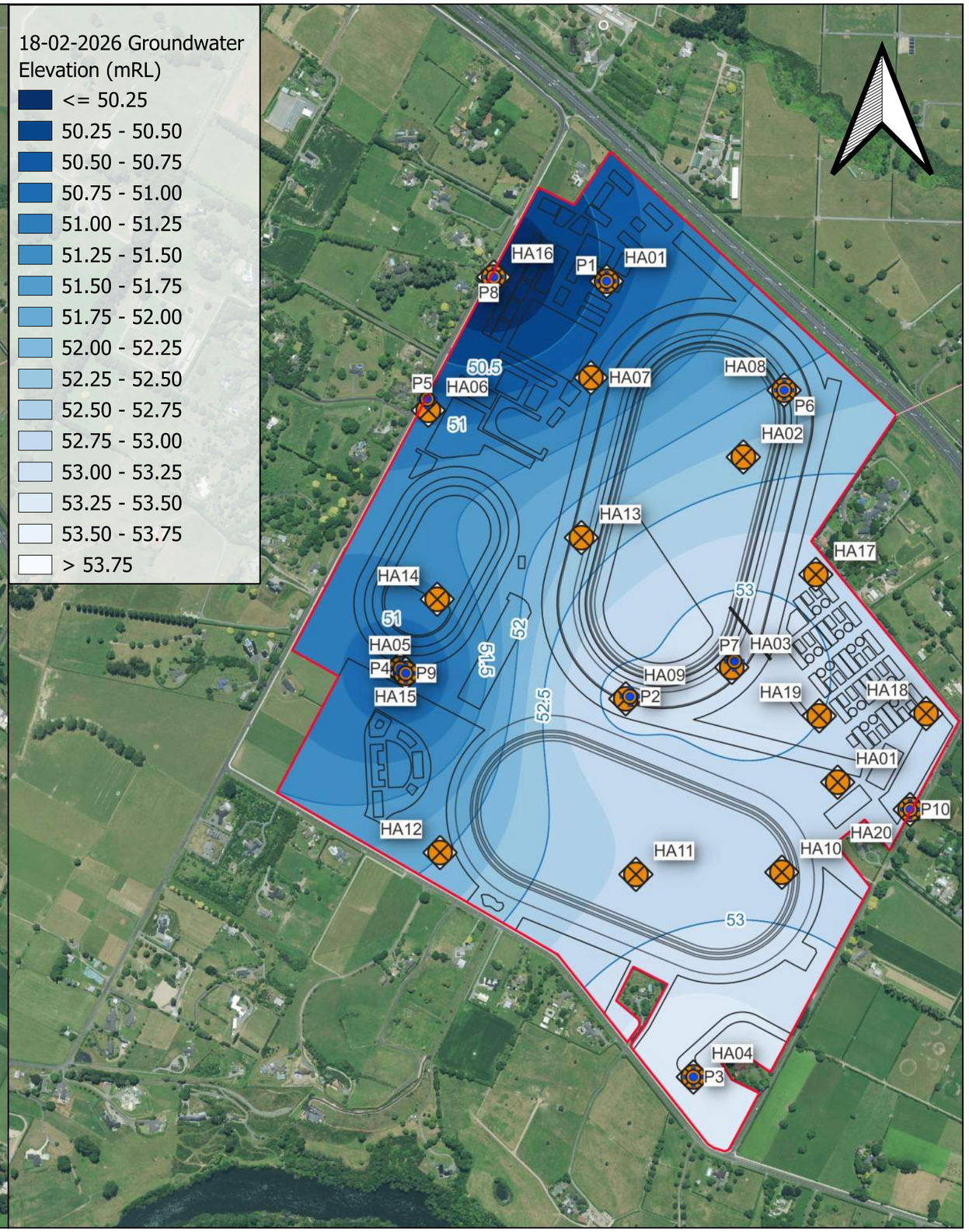
Revision	Date	By	Reason
04	17/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	17/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3
Job Number: 23-1883
Sheet Number: G-C03
Revision: 04

All dimensions to be verified on site before making any shop drawings or commencing any work

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Notes:
-The maps are based on results of discrete points and and are subject to change with addtional investigations.
- Groundwater was not observed within P3(HA15) and P10(HA20). The level shown is the base of P3 and P10.

Client: WAIKATO THOROUGHBRED RACING — TE RAPA · CAMBRIDGE · WAIPA

Contractor

BCD GROUP

Sheet: Groundwater Map - 18-02-2026

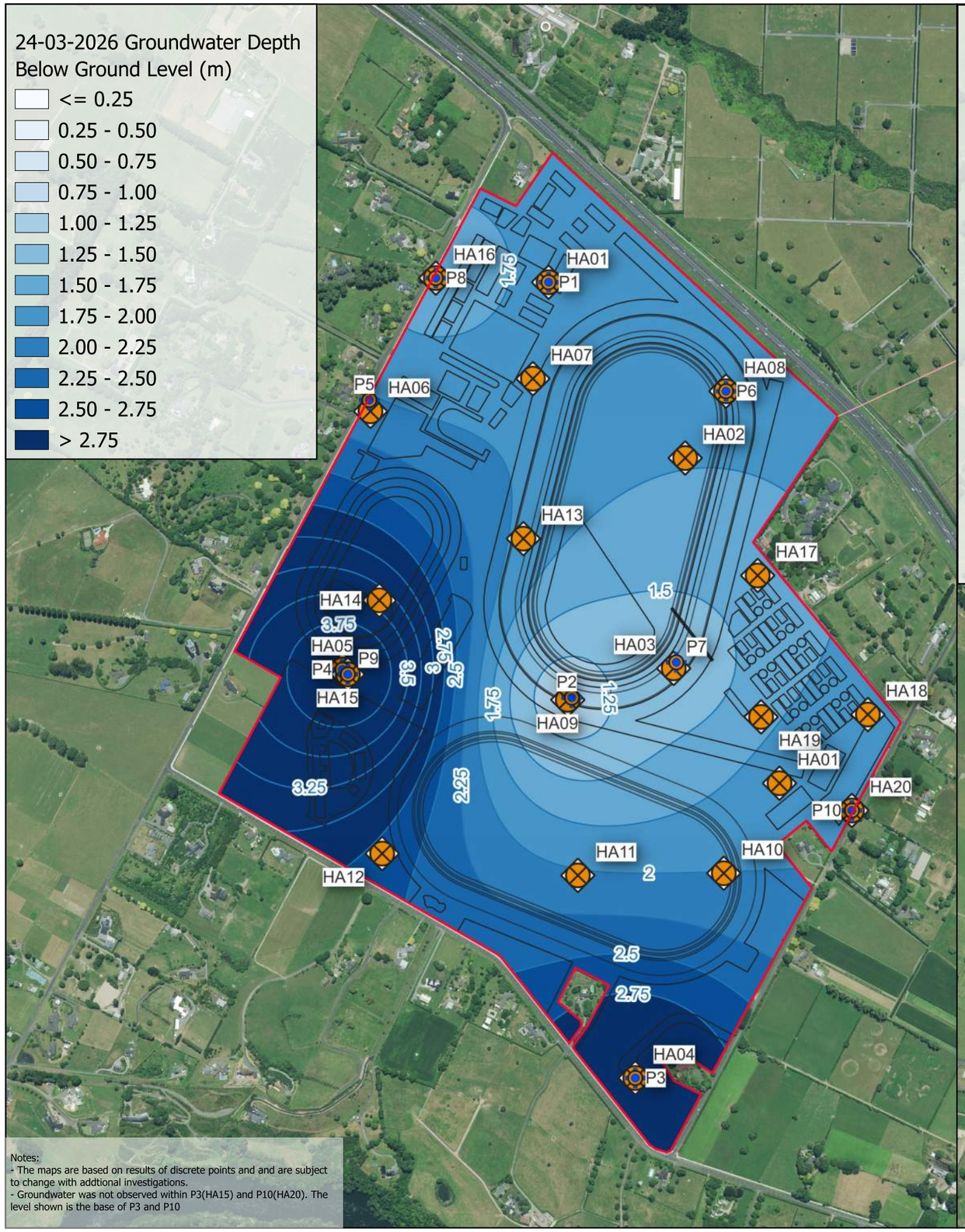
Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

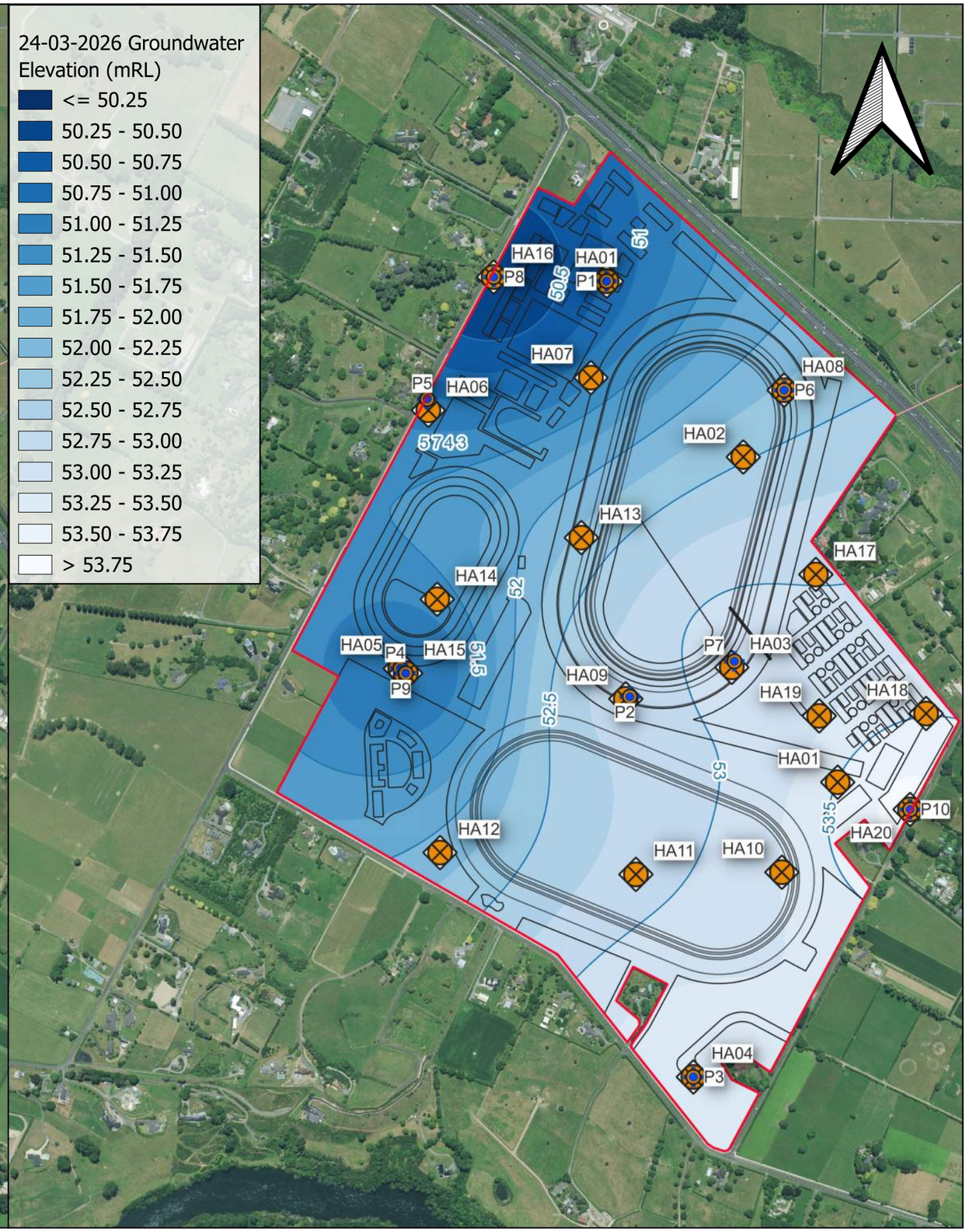
Revision	Date	By	Reason
04	17/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	17/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3
Job Number: 23-1883
Sheet Number: G-C04
Revision: 04

All dimensions to be verified on site before making any shop drawings or commencing any work

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Notes:
- The maps are based on results of discrete points and and are subject to change with addtional investigations.
- Groundwater was not observed within P3(HA15) and P10(HA20). The level shown is the base of P3 and P10

Client: WAIKATO THOROUGHBRED RACING TE RAPA · CAMBRIDGE · WAIPA

Contractor

BCD GROUP

Sheet: Groundwater Map - 24-03-2026

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
02			
01	25/11/2025	BB	Fast Track Referral Application

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-C05	02

All dimensions to be verified on site before making any shop drawings or commencing any work

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20-07-2026 Groundwater Depth Below Ground Level (m)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- 2.25 - 2.50
- 2.50 - 2.75
- > 2.75

20-07-2026 Groundwater Elevation (mRL)

- <= 50.25
- 50.25 - 50.50
- 50.50 - 50.75
- 50.75 - 51.00
- 51.00 - 51.25
- 51.25 - 51.50
- 51.50 - 51.75
- 51.75 - 52.00
- 52.00 - 52.25
- 52.25 - 52.50
- 52.50 - 52.75
- 52.75 - 53.00
- 53.00 - 53.25
- 53.25 - 53.50
- 53.50 - 53.75
- > 53.75

Notes:
- The maps are based on results of discrete points and and are subject to change with addtional investigations.
- Groundwater was not observed within P3(HA15) and P10(HA20). The Level Shown is the base of P3 and P10

Client: WTR WAIKATO THOROUGHBRED RACING TE RAPA · CAMBRIDGE · WAIPA

Contractor

BCD GROUP

Sheet: Groundwater Map - 20-07-2026

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
01	17/08/2026	BB	Fast Track Referral Application

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3

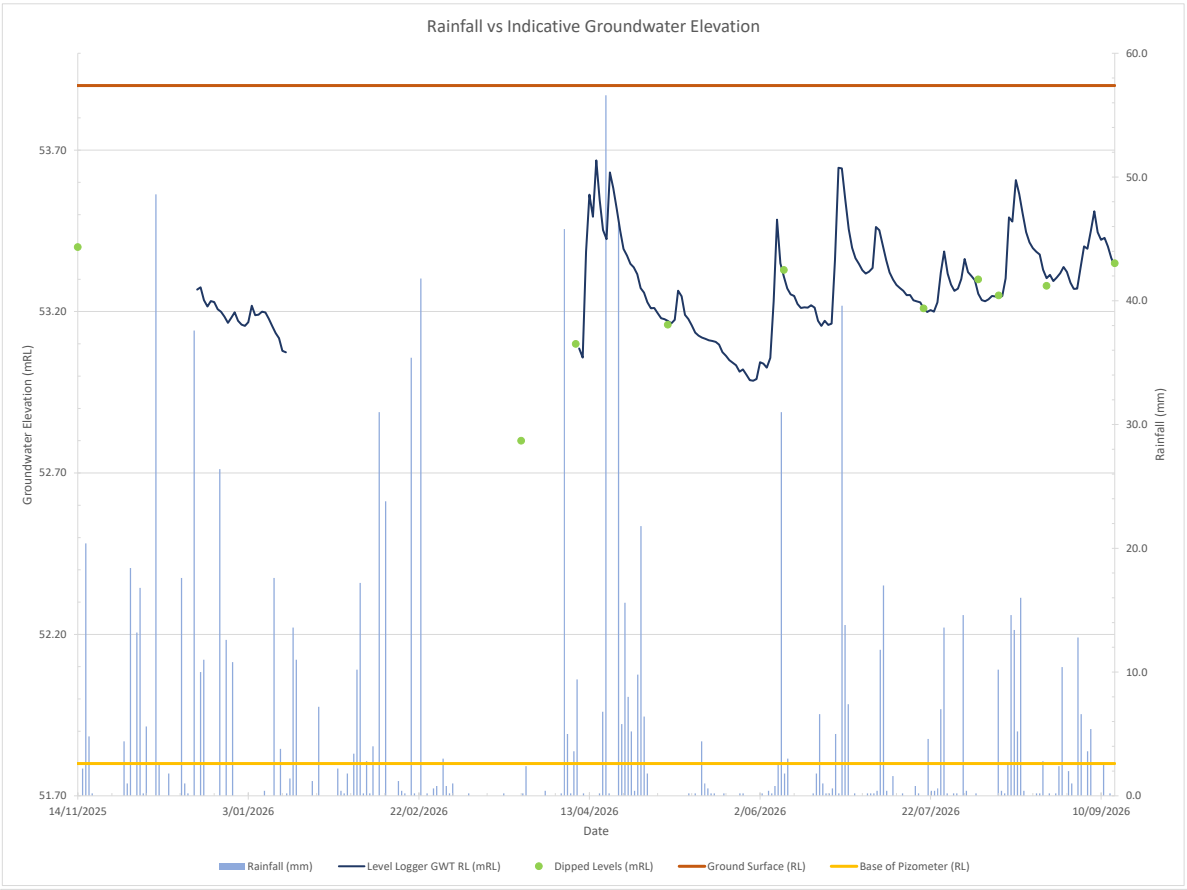
Job Number:	Sheet Number:	Revision:
23-1883	G-C06	01

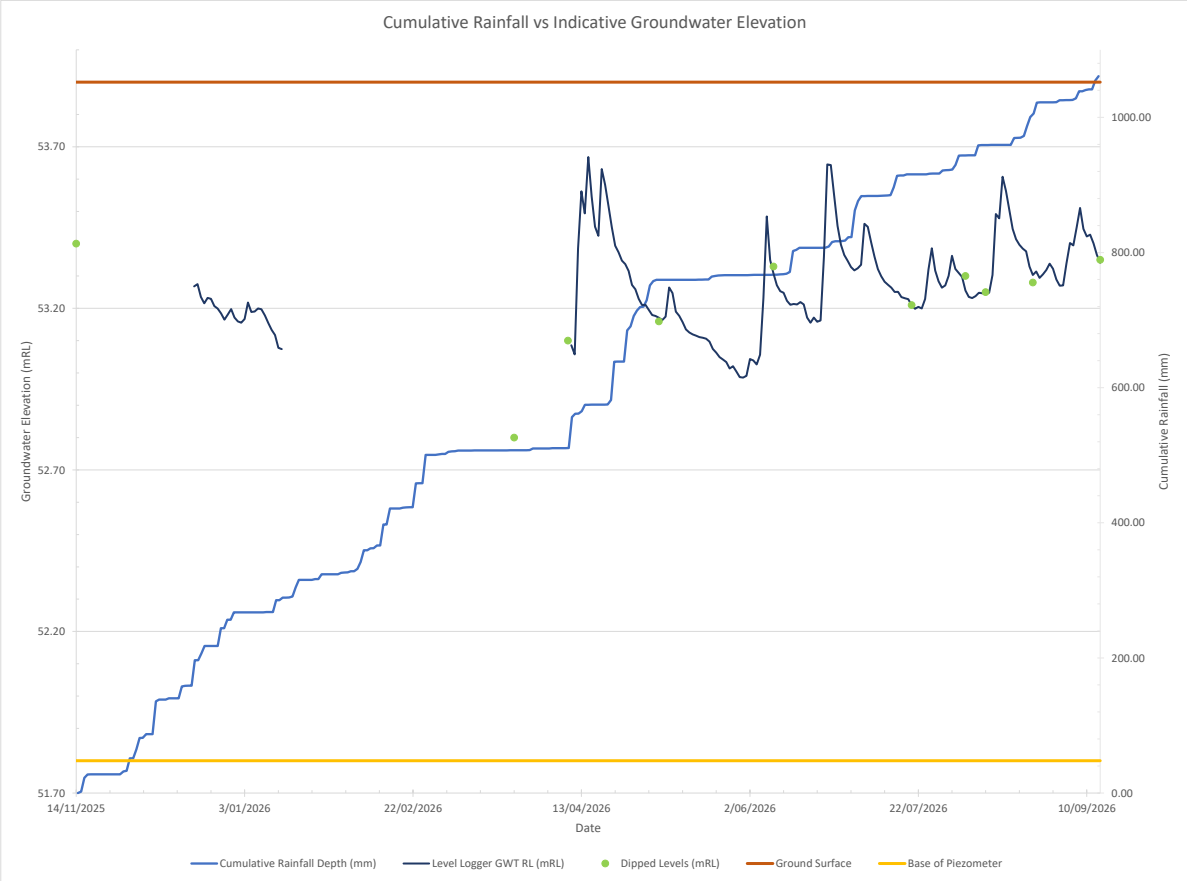
All dimensions to be verified on site before making any shop drawings or commencing any work

The copyright of this drawing remains with BCD Group

Project: Waikato Thoroughbred Racing - Greenfield
Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

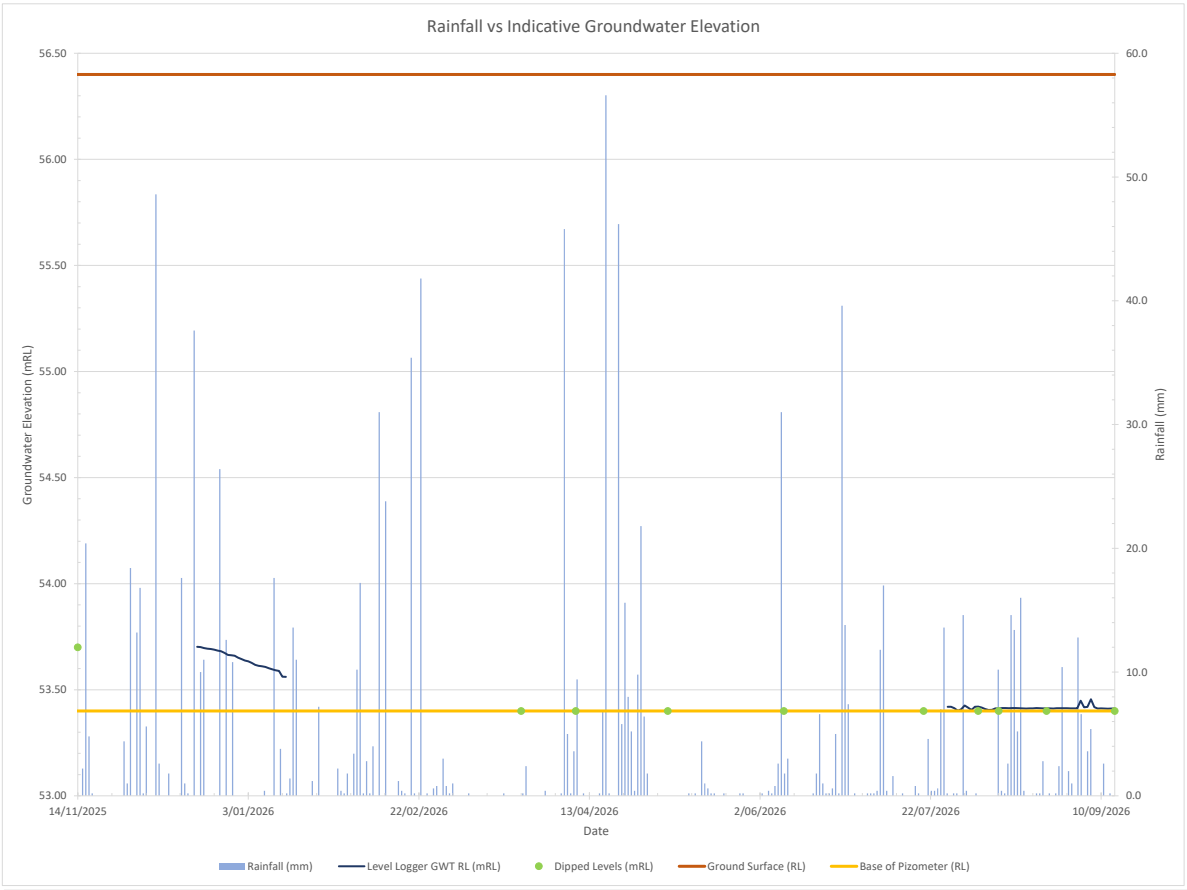
Piezometer Number: P2(HA09)
Depth BGL (m): 2.1
Surface Level (mRL): 53.9
Eastings (x): 1809898.7
Northings (y): 5807003.6
Status: Active

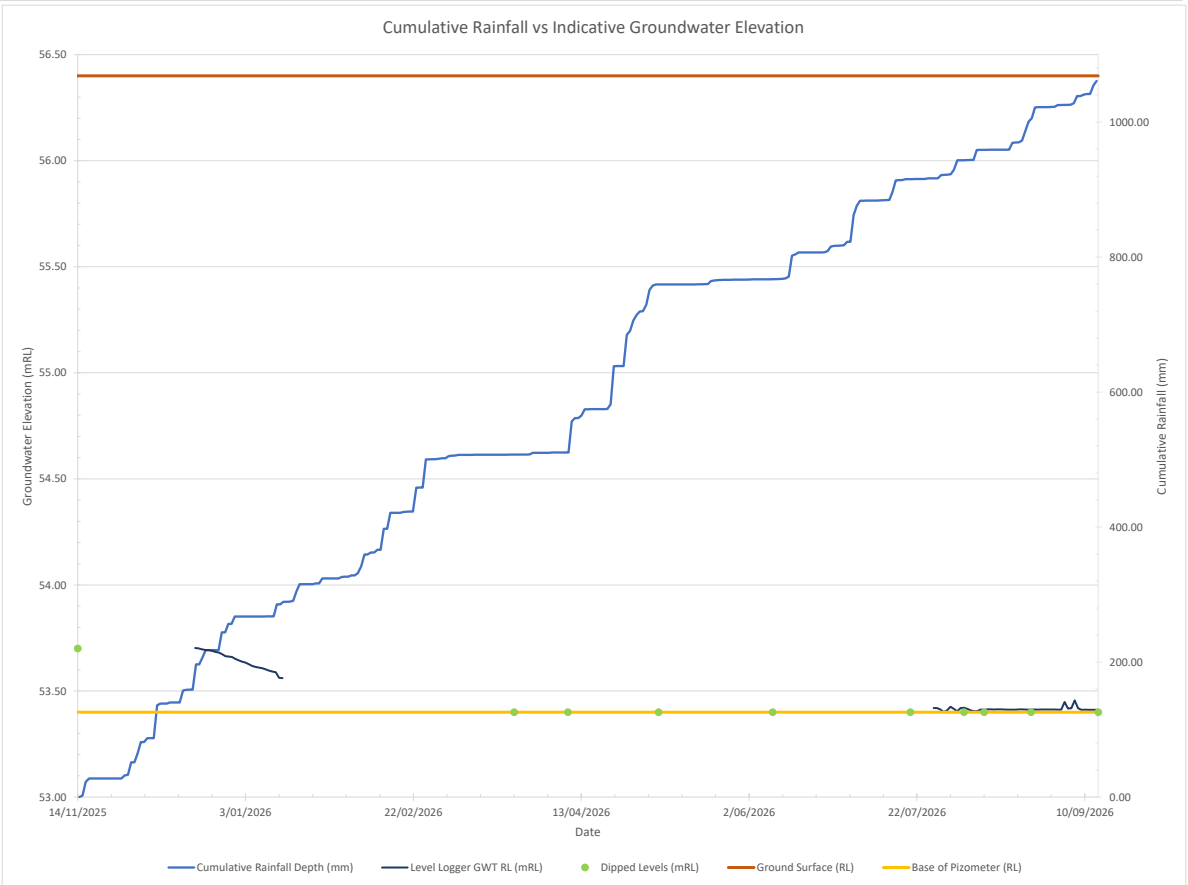




Project: Waikato Thoroughbred Racing - Greenfield
Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

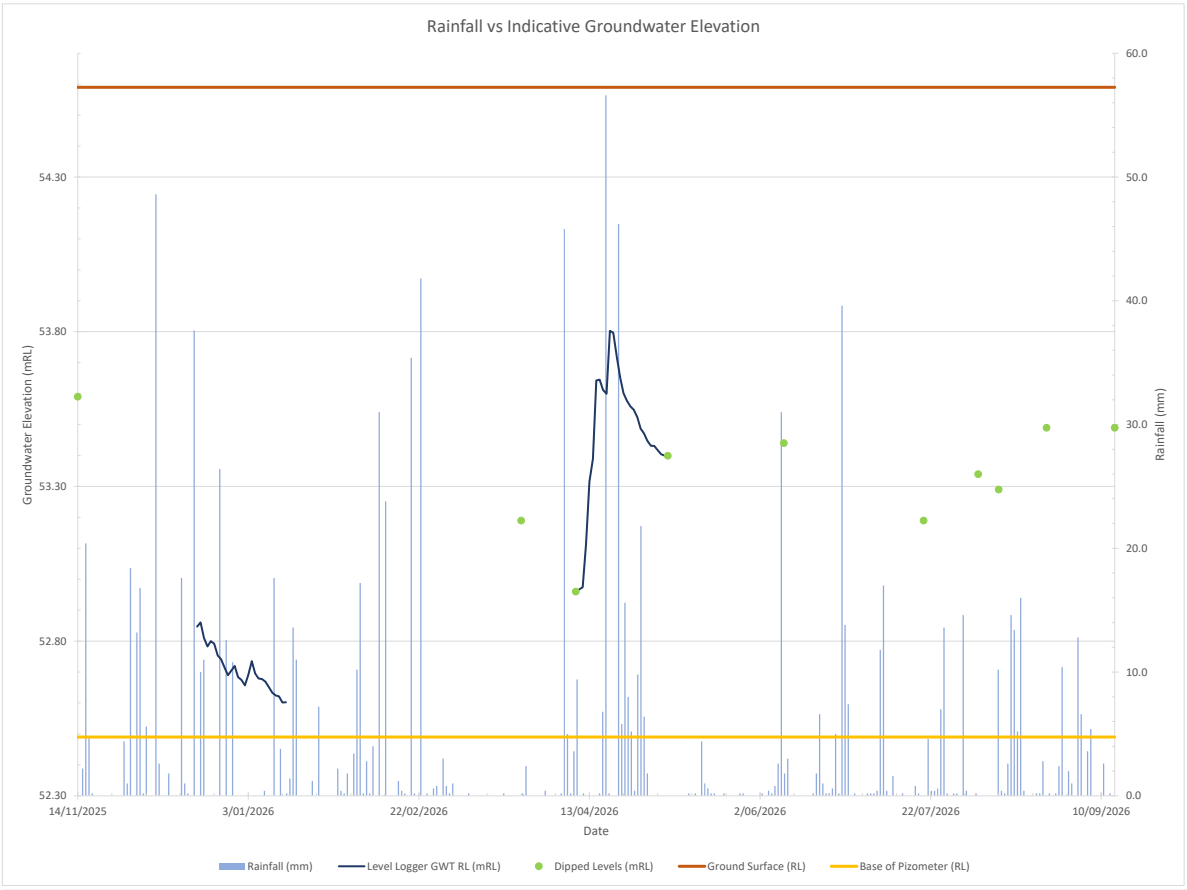
Piezometer Number: P3(HA04)
Depth BGL (m): 3
Surface Level (mRL): 56.4
Eastings (x): 1810031.9
Northings (y): 5806206.3
Status: Active

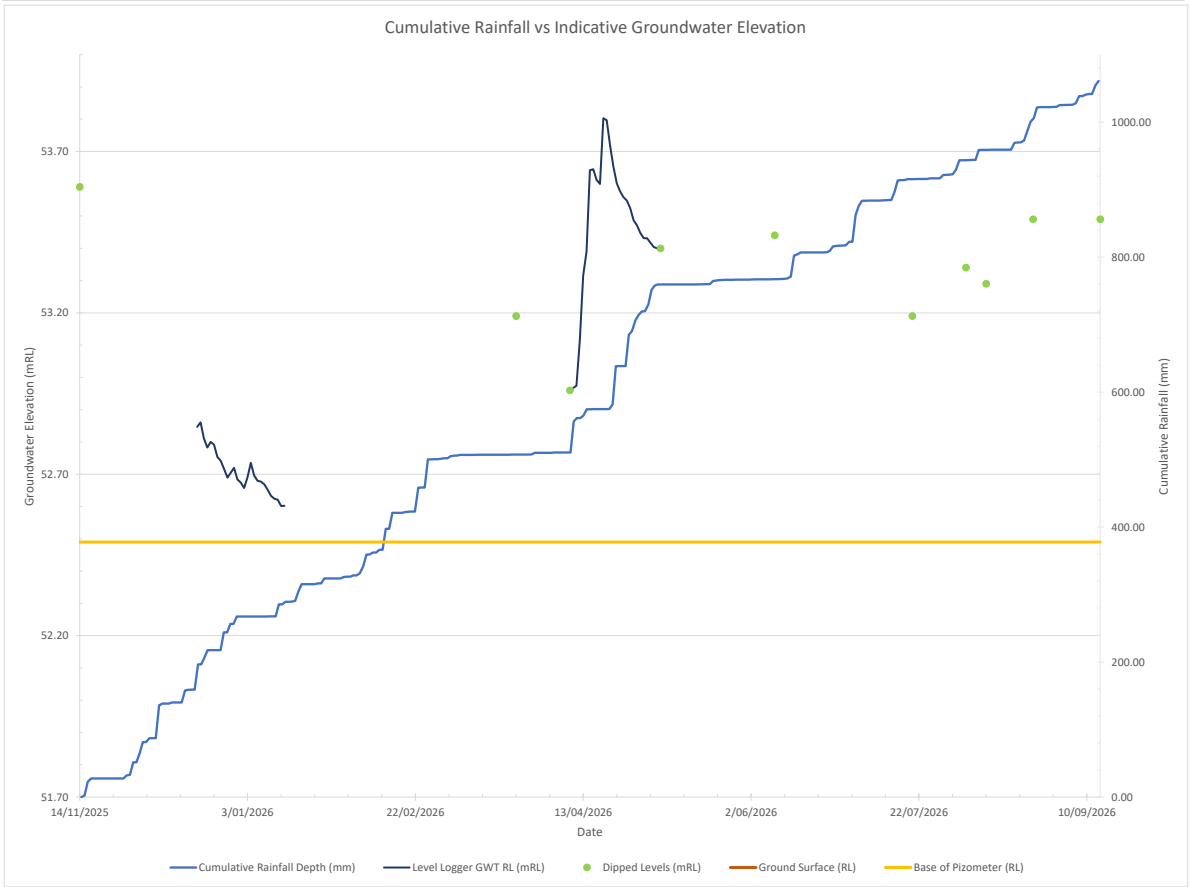




Project: Waikato Thoroughbred Racing - Greenfield
Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

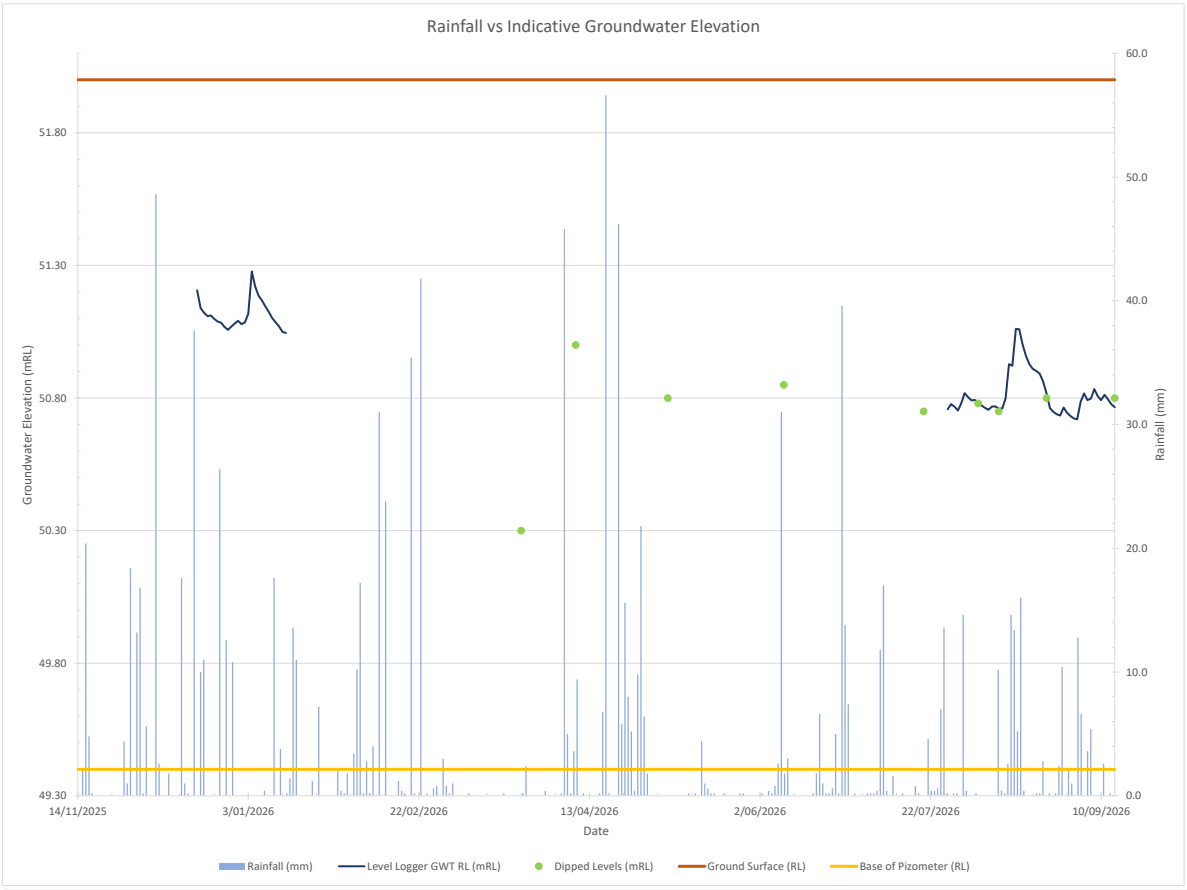
Piezometer Number: P7(HA03)
Depth BGL (m): 2.1
Surface Level (mRL): 54.59
Eastings (x): 1810117.9
Northings (y): 5807077.7
Status: Active

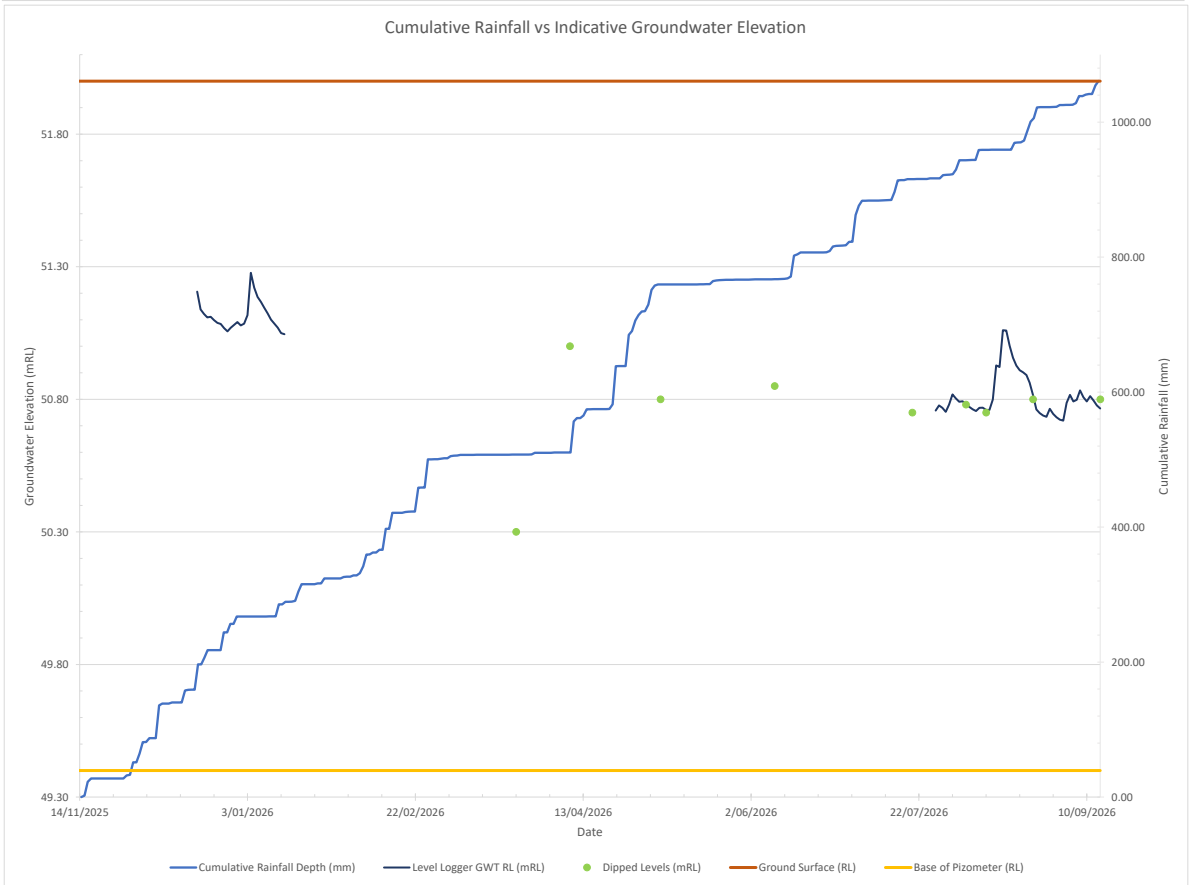




Project: Waikato Thoroughbred Racing - Greenfield
Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

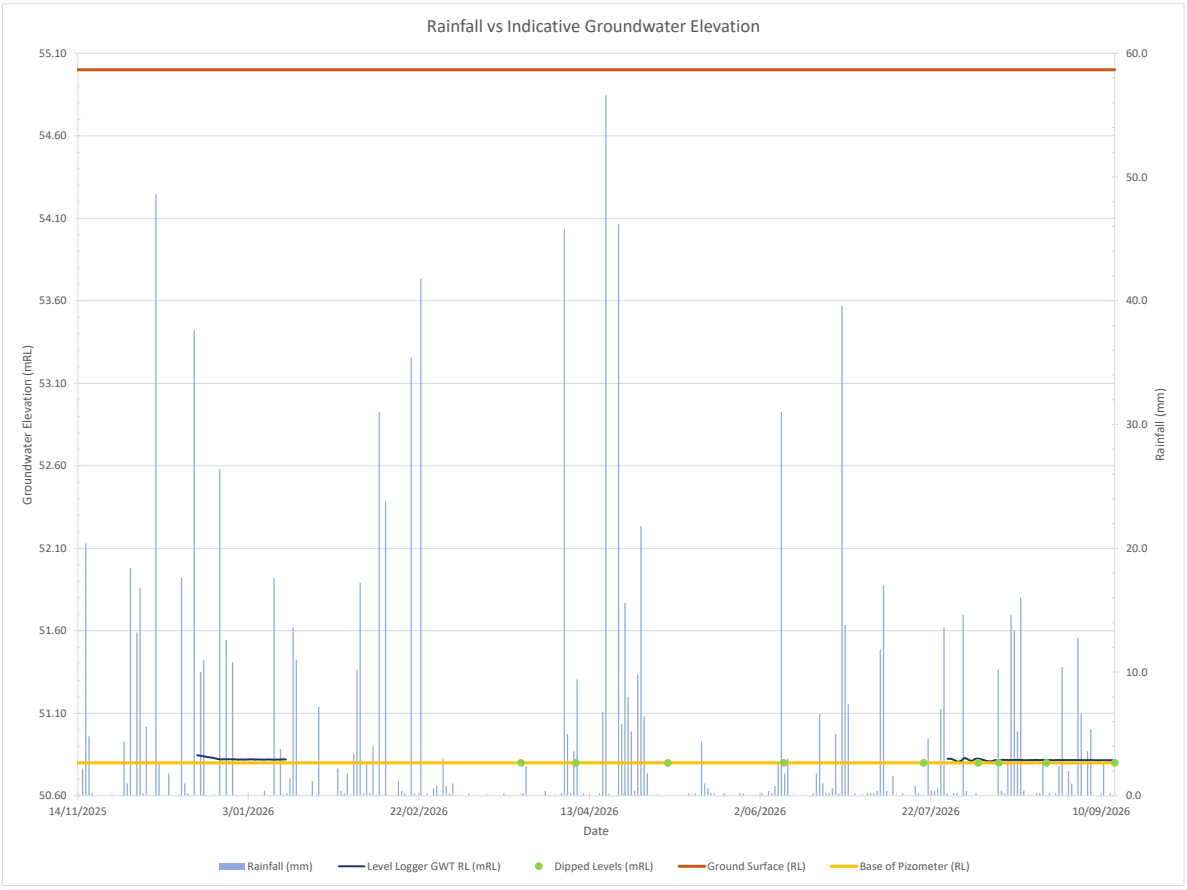
Piezometer Number: P8(HA16)
Depth BGL (m): 2.6
Surface Level (mRL): 52
Eastings (x): 1809613.2
Northings (y): 5807883.2
Status: Active

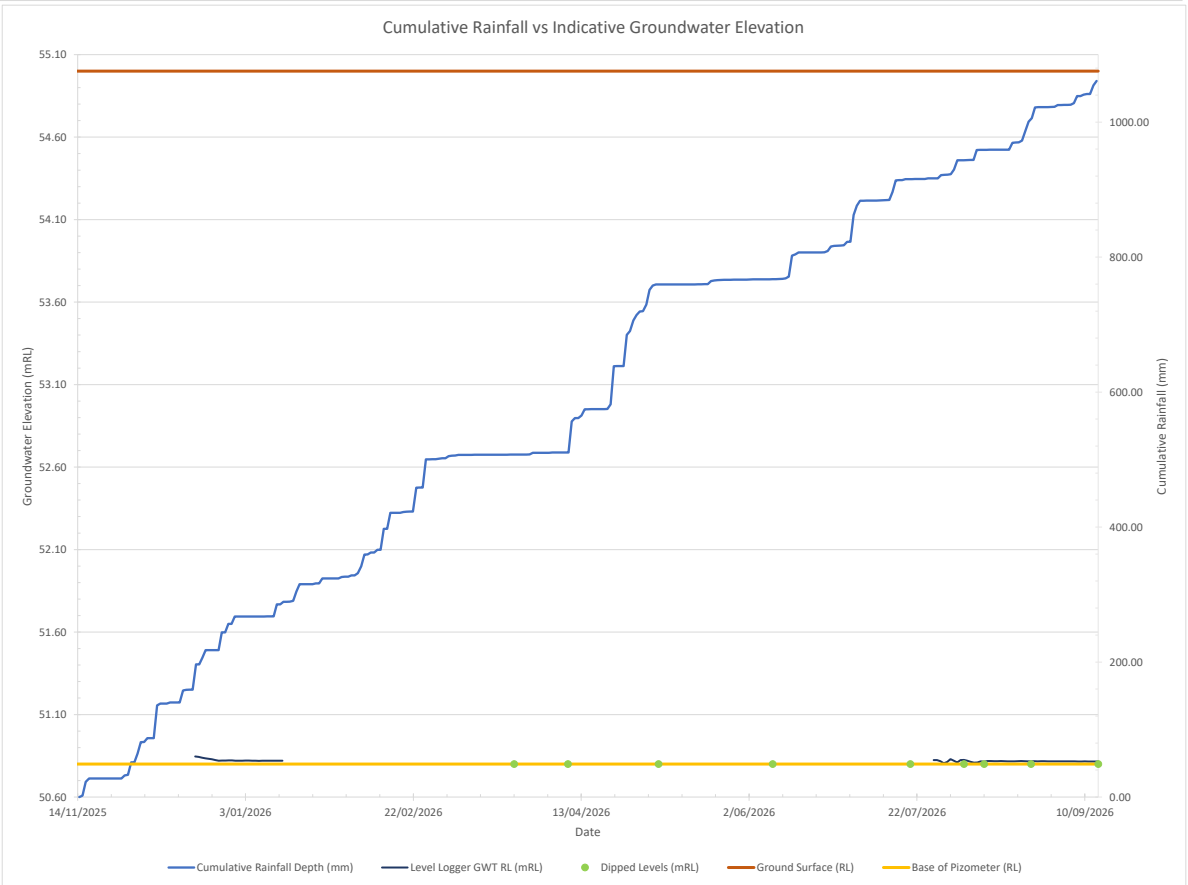




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Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

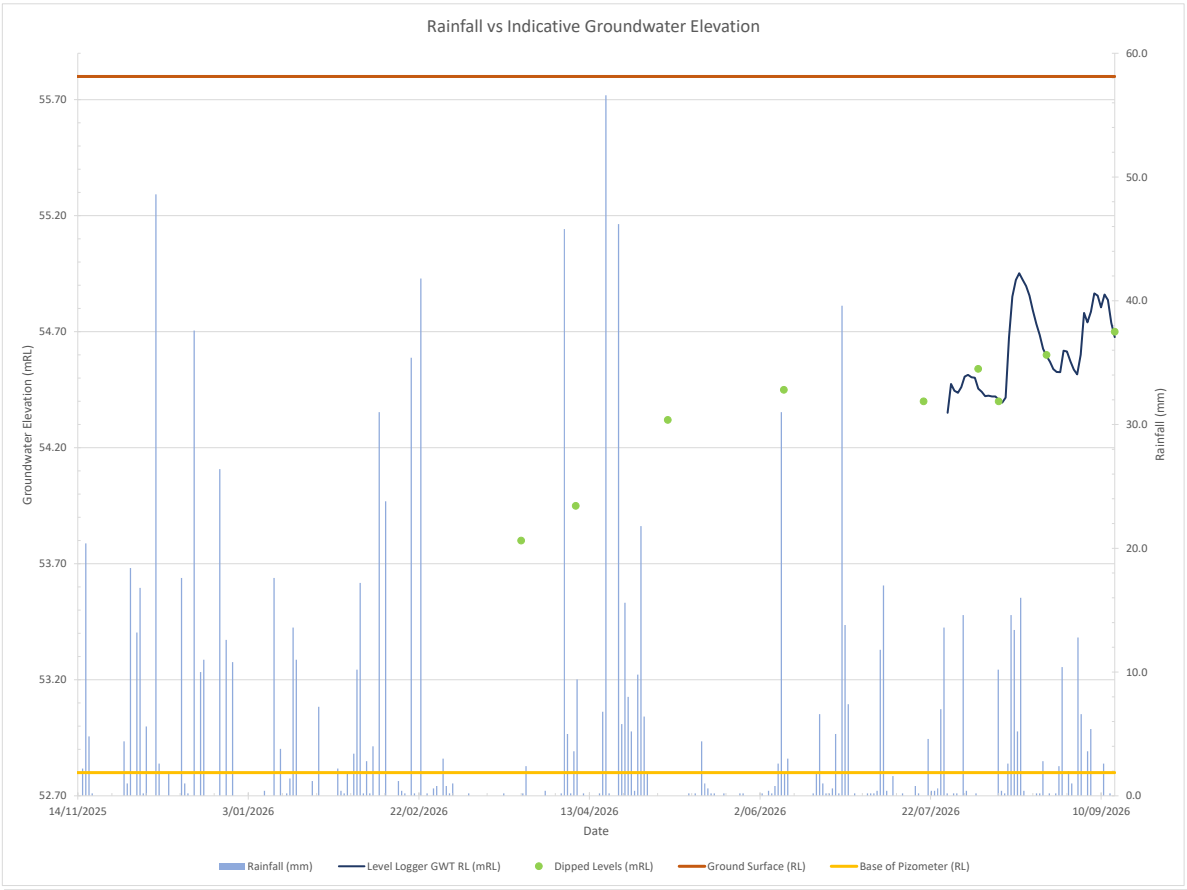
Piezometer Number: P9(HA15)
Depth BGL (m): 4.2
Surface Level (mRL): 55
Eastings (x): 1809428.7
Northings (y): 5807052.6
Status: Active

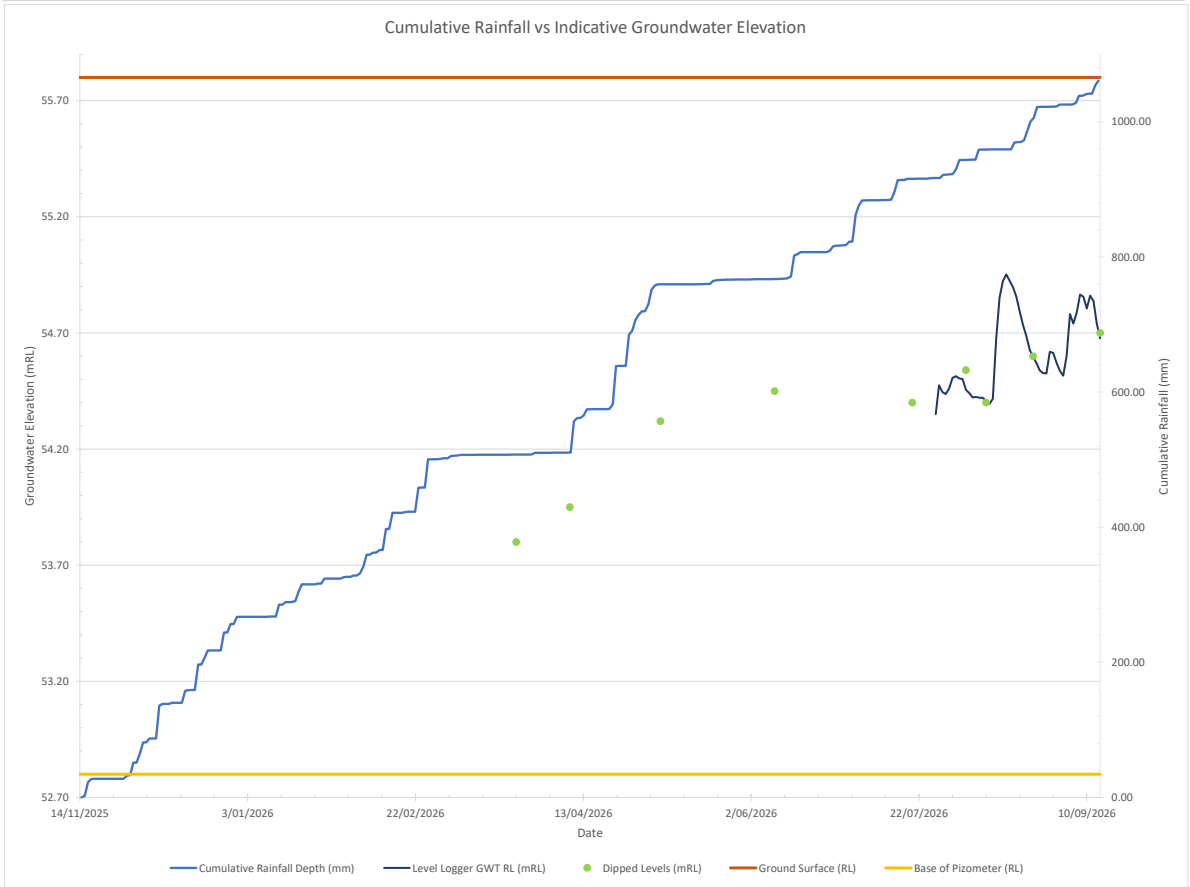




Project: Waikato Thoroughbred Racing - Greenfield
Project Number: 23-1883
Prepared By: BB
Date Printed: 29/09/2026

Piezometer Number: P10(HA20)
Depth BGL (m): 3
Surface Level (mRL): 55.8
Eastings (x): 1810486.3
Northings (y): 5806767.1
Status: Active





Appendix D Liquefaction Assessment

Liquefaction Analysis Procedure

Liquefaction can occur in saturated soils during earthquakes and results in soil strength loss. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded fine-grained cohesionless materials. lose to medium dense gravels, sands, silty sands, low-plasticity silts, and some low-plasticity clays are also potentially liquefiable.

Soil liquefaction can manifest at the ground surface and result in ground deformation and differential settlement, foundation bearing failure, ground rupture or ejecta of water and soil at the ground surface. Where slopes or free faces are present lateral spreading or slope failures can also occur.

Performance Levels from Liquefaction Analyses from MBIE (2021) Module 3 Guidelines

Parameter (LSN)	Performance Level	Effect	Consequence
<10	L0	Insignificant	No significant excess pore water pressures (no liquefaction).
5 – 15	L1	Mild	Limited excess pore water pressures; negligible deformation of the ground and small settlements. Structural damage unlikely to occur.
10 – 25	L2	Moderate	Liquefaction occurs in layers of limited thickness (small proportion of the deposit, say 10 percent or less) and lateral extent; ground deformation results relatively small in differential settlements. Some structural damage may occur.
15 – 35	L3	High	Liquefaction occurs in significant portion of the deposit (30% - 50 %) resulting in transient lateral displacements, moderate differential movements, and settlement in the order of 100mm to 200mm. Structural damage likely to occur.
>30	L4	Severe	Complete liquefaction develops in most of the deposit resulting in large lateral displacements of the ground, excessive differential settlements and total settlement of over 200mm. Large structural damage likely to occur.
	L5	Very Severe	Liquefaction resulting in lateral spreading (flow), large permanent lateral ground displacements and/or significant ground distortion (lateral strains/stretch, vertical offsets and angular distortion). Severe structural damage likely to occur.

Differential Settlement

Differential settlements in liquefied soils are typically assumed to be proportional to the estimated total free field settlement. For evaluation of differential settlement, MBIE (2021) Module 3 references the Guidelines for Analysing and Mitigating Liquefaction Hazards in California (Martin & Lew, 1999).

Lateral Spreading

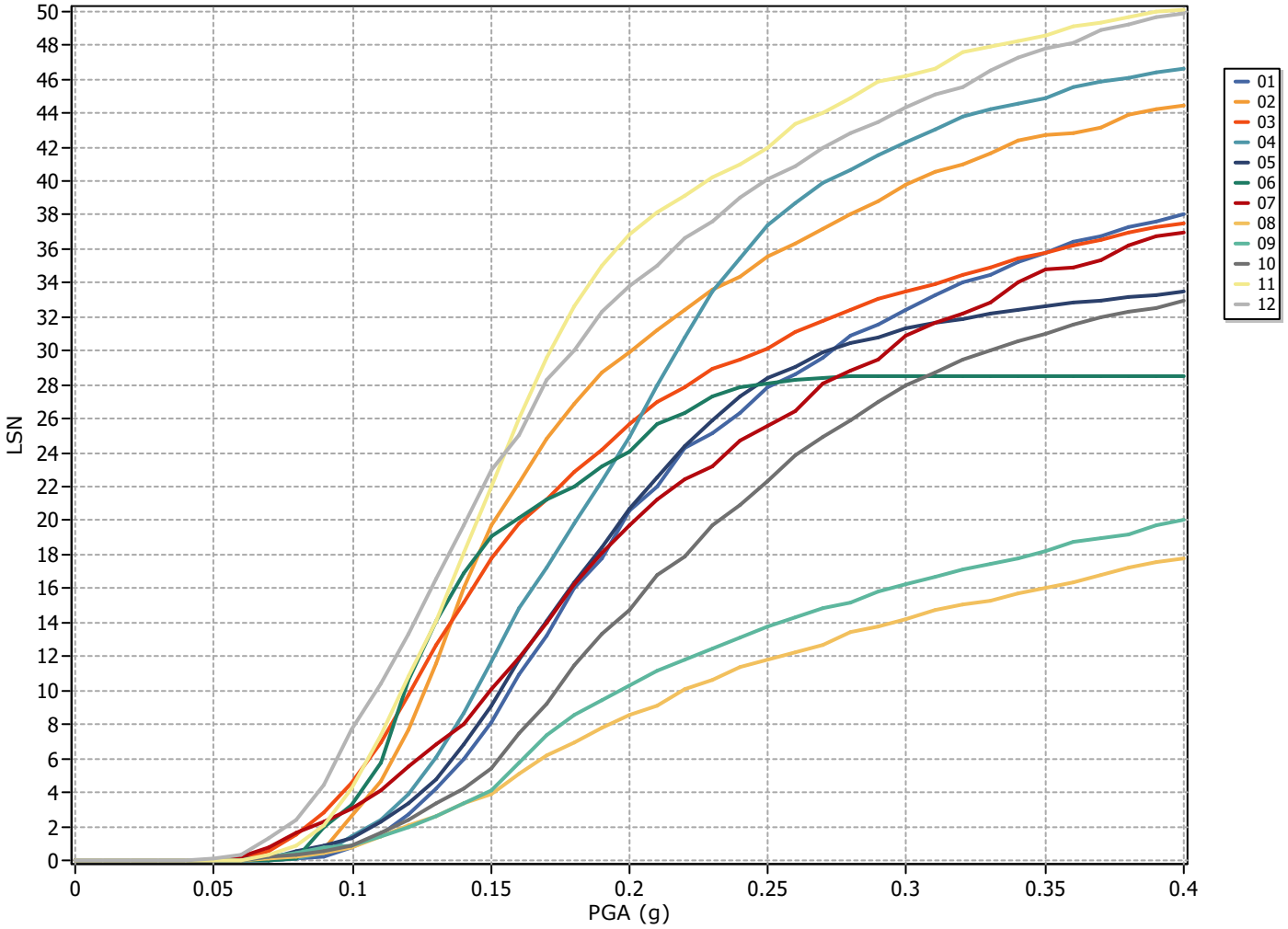
Lateral spreading during a seismic event is typically associated with the movement of a soil mass towards a free face or slope (i.e. gully or river). The magnitude of lateral displacement decreases with distance from the free face or slope. Where a significant difference in lateral spreading magnitude occurs at a site, 'stretching' of foundations can cause significant damage. Lateral spreading can result in significant lateral displacements and lateral pressure to buried structures or piles within the zone of lateral movement.

Non-Liquefiable Crust

Work from Ishihara (1985) and observations after the Canterbury earthquakes from Bowen (2013) and Henderson (2013) consider the benefits of a non-liquefiable crust of 3.5 to 4.0m has major benefits to foundation performance and is sufficient to prevent liquefaction induced damage even with significant thickness of liquefied soil below. Also, once the non-liquefiable crust is greater than 2.5m, sand boils or differential settlements still may be expected in this situation, however adequate bearing capacity for timber framed houses is likely to be maintained.

PGA Based Parametric Analysis

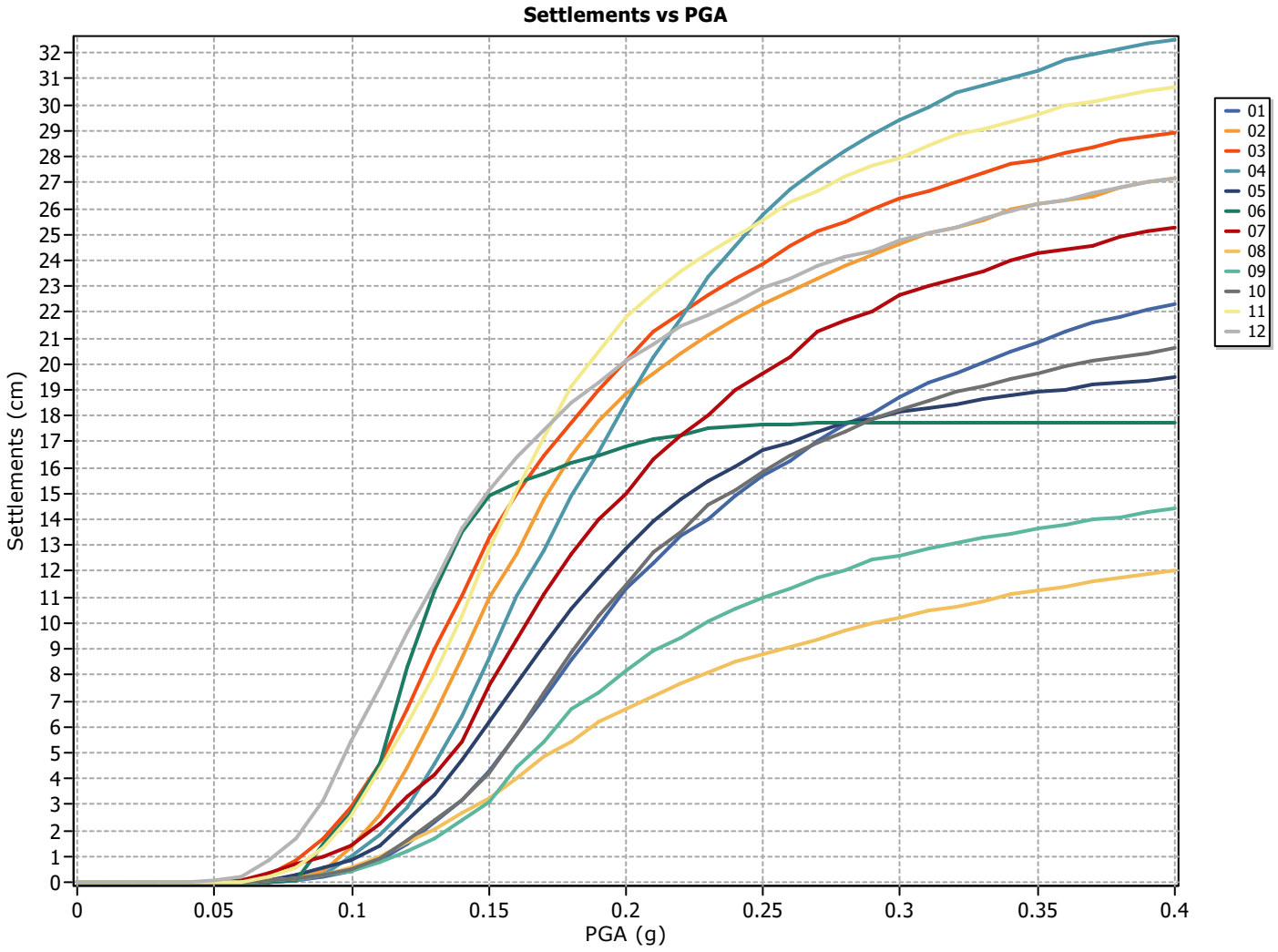
Liquefaction Severity Number vs PGA



:: CPT main liquefaction parameters details ::

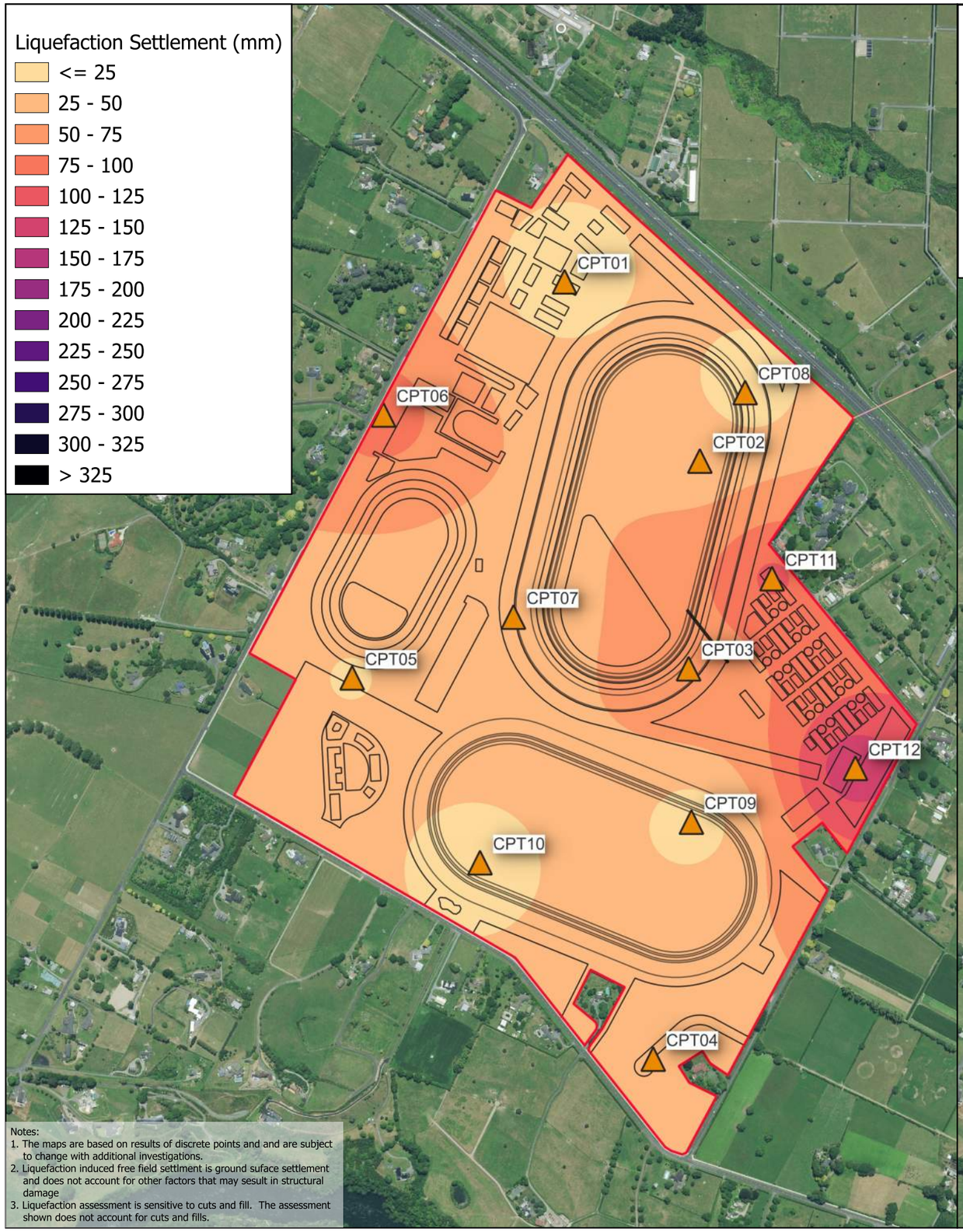
CPT Name	Assesment method	Earthquake Mag.	GWT in situ (m)	GWT earthq. (m)
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02	Boulanger & Idriss (2014)	5.90	1.00	1.00
03	Boulanger & Idriss (2014)	5.90	1.00	1.00
04	Boulanger & Idriss (2014)	5.90	1.00	1.00
05	Boulanger & Idriss (2014)	5.90	1.00	1.00
06	Boulanger & Idriss (2014)	5.90	1.00	1.00
07	Boulanger & Idriss (2014)	5.90	1.00	1.00
08	Boulanger & Idriss (2014)	5.90	1.00	1.00
09	Boulanger & Idriss (2014)	5.90	1.00	1.00
10	Boulanger & Idriss (2014)	5.90	1.00	1.00
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12	Boulanger & Idriss (2014)	5.90	1.00	1.00

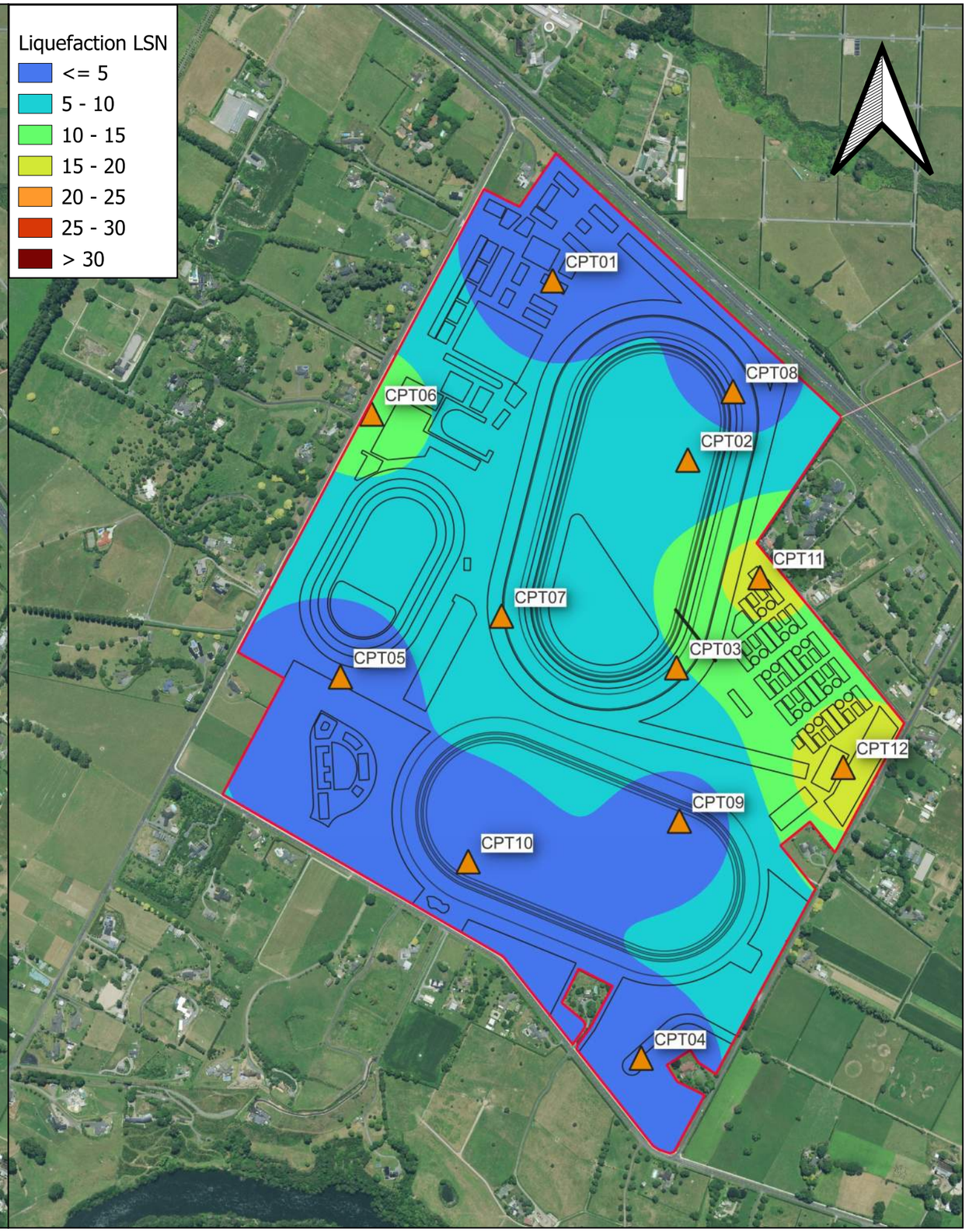
PGA Based Parametric Analysis



:: CPT main liquefaction parameters details ::

CPT Name	Assesment method	Earthquake Mag.	GWT in situ (m)	GWT earthq. (m)
01	Boulanger & Idriss (2014)	5.90	1.00	1.00
02	Boulanger & Idriss (2014)	5.90	1.00	1.00
03	Boulanger & Idriss (2014)	5.90	1.00	1.00
04	Boulanger & Idriss (2014)	5.90	1.00	1.00
05	Boulanger & Idriss (2014)	5.90	1.00	1.00
06	Boulanger & Idriss (2014)	5.90	1.00	1.00
07	Boulanger & Idriss (2014)	5.90	1.00	1.00
08	Boulanger & Idriss (2014)	5.90	1.00	1.00
09	Boulanger & Idriss (2014)	5.90	1.00	1.00
10	Boulanger & Idriss (2014)	5.90	1.00	1.00
11	Boulanger & Idriss (2014)	5.90	1.00	1.00
12	Boulanger & Idriss (2014)	5.90	1.00	1.00





Notes:
1. The maps are based on results of discrete points and and are subject to change with additional investigations.
2. Liquefaction induced free field settlment is ground suface settlement and does not account for other factors that may sesult in structural damage
3. Liquefaction assessment is sensitive to cuts and fill. The assessment shown does not account for cuts and fills.

Client: WTR WAIKATO THOROUGHBRED RACING — TE HAPA · CAMBRIDGE · WAIPA

Contractor:

BCD GROUP

Sheet: IL1 - Liquefaction Map

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
04	24/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	16/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB / Engineer: BB	Scale: 10,000	At: A3
Job Number:	Sheet Number:	Revision:
23-1883	G-D01	04

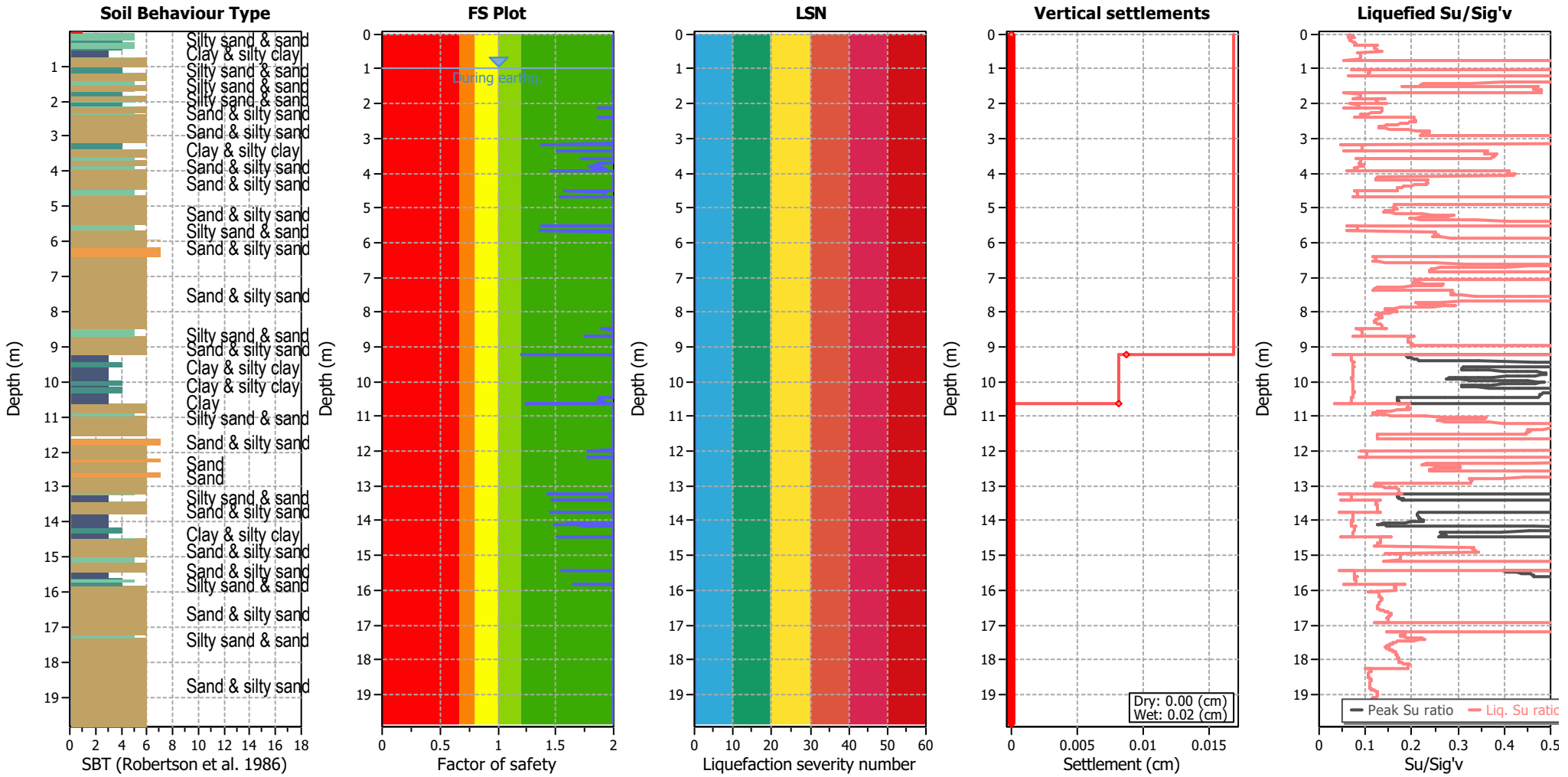
All dimensions to be verified on site before making any shop drawings or commencing any work

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 01 SLS
Total depth: 19.84 m

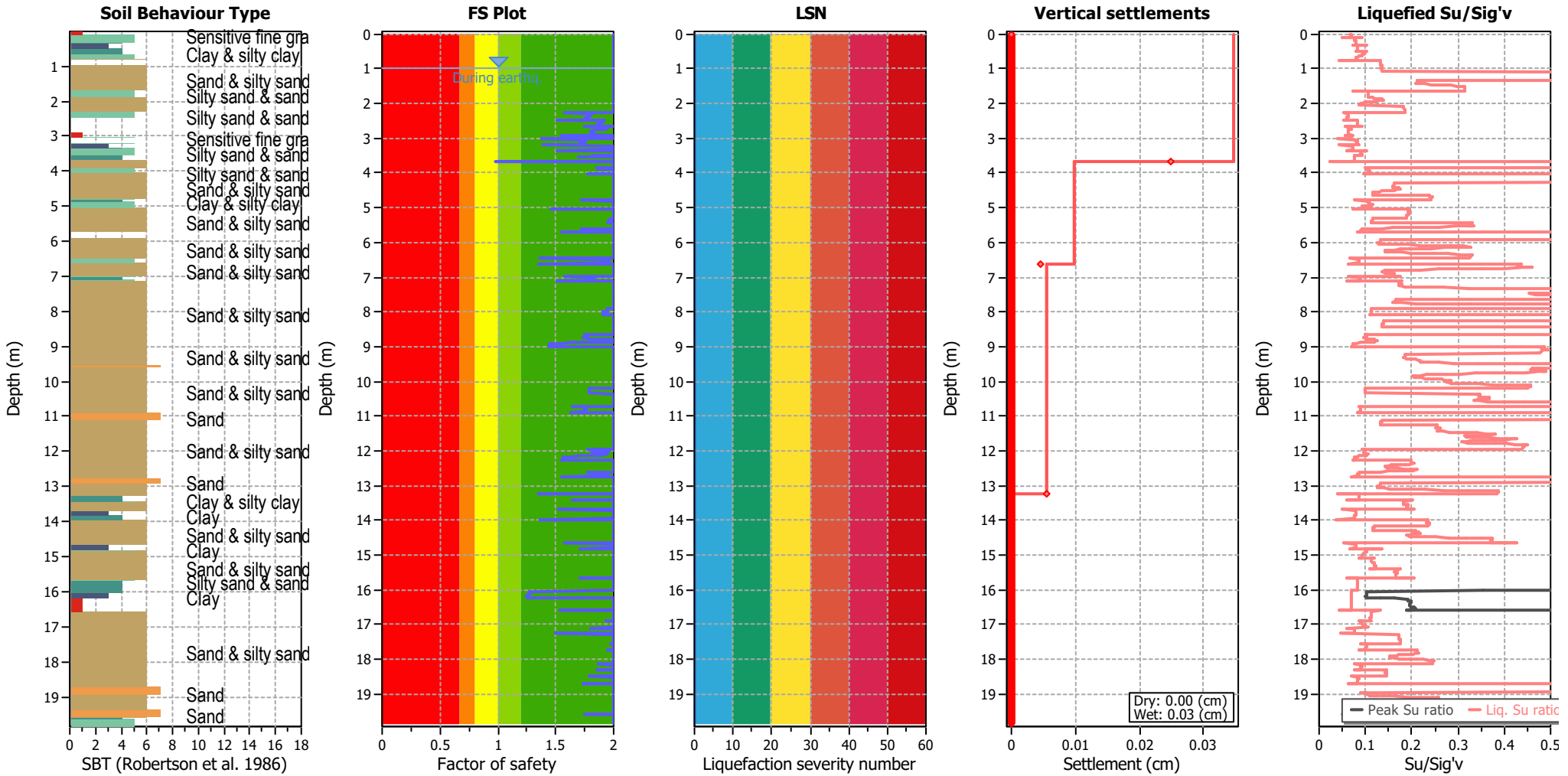


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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 02 SLS
Total depth: 19.85 m

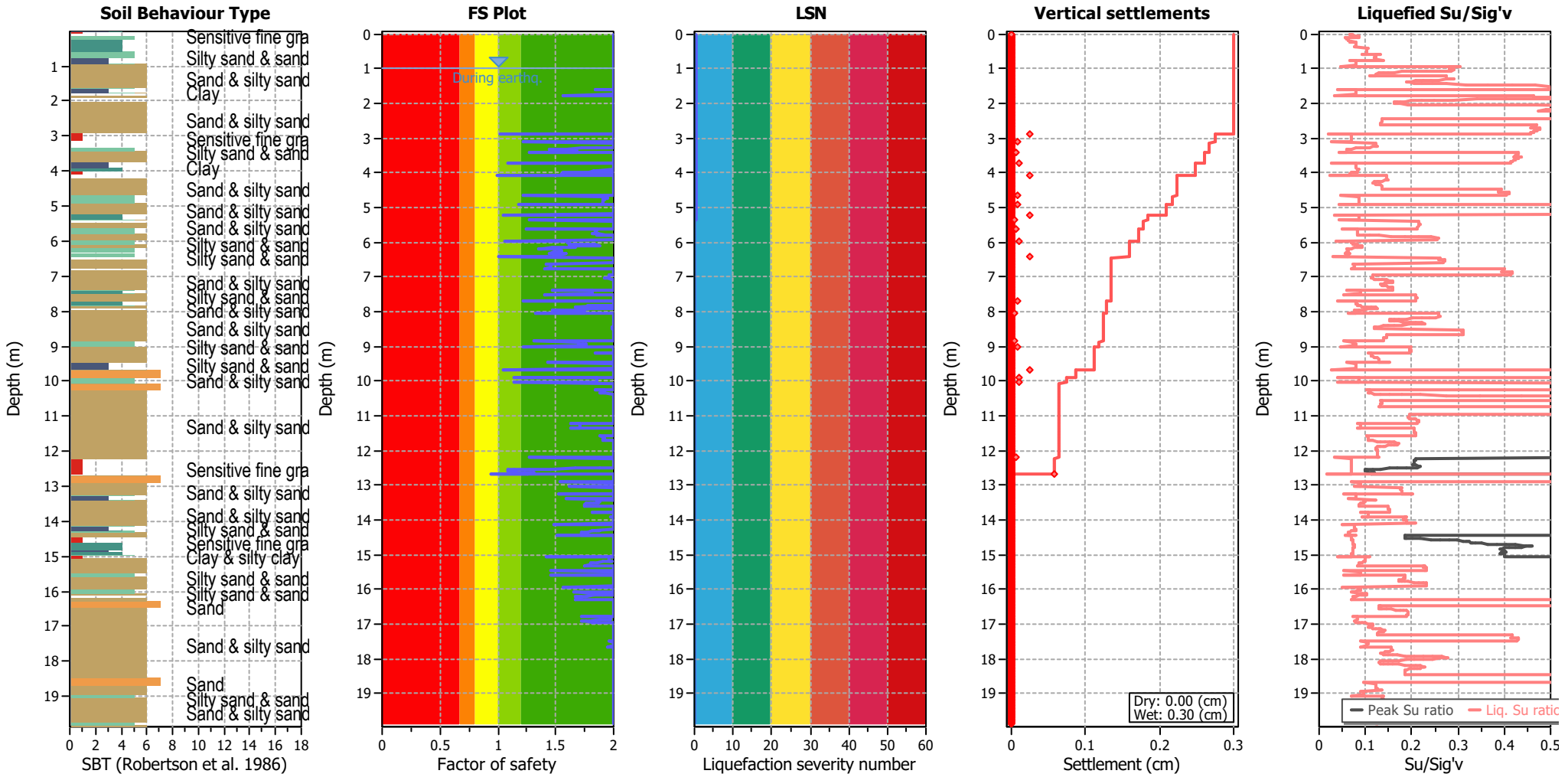


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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 03 SLS
Total depth: 19.87 m

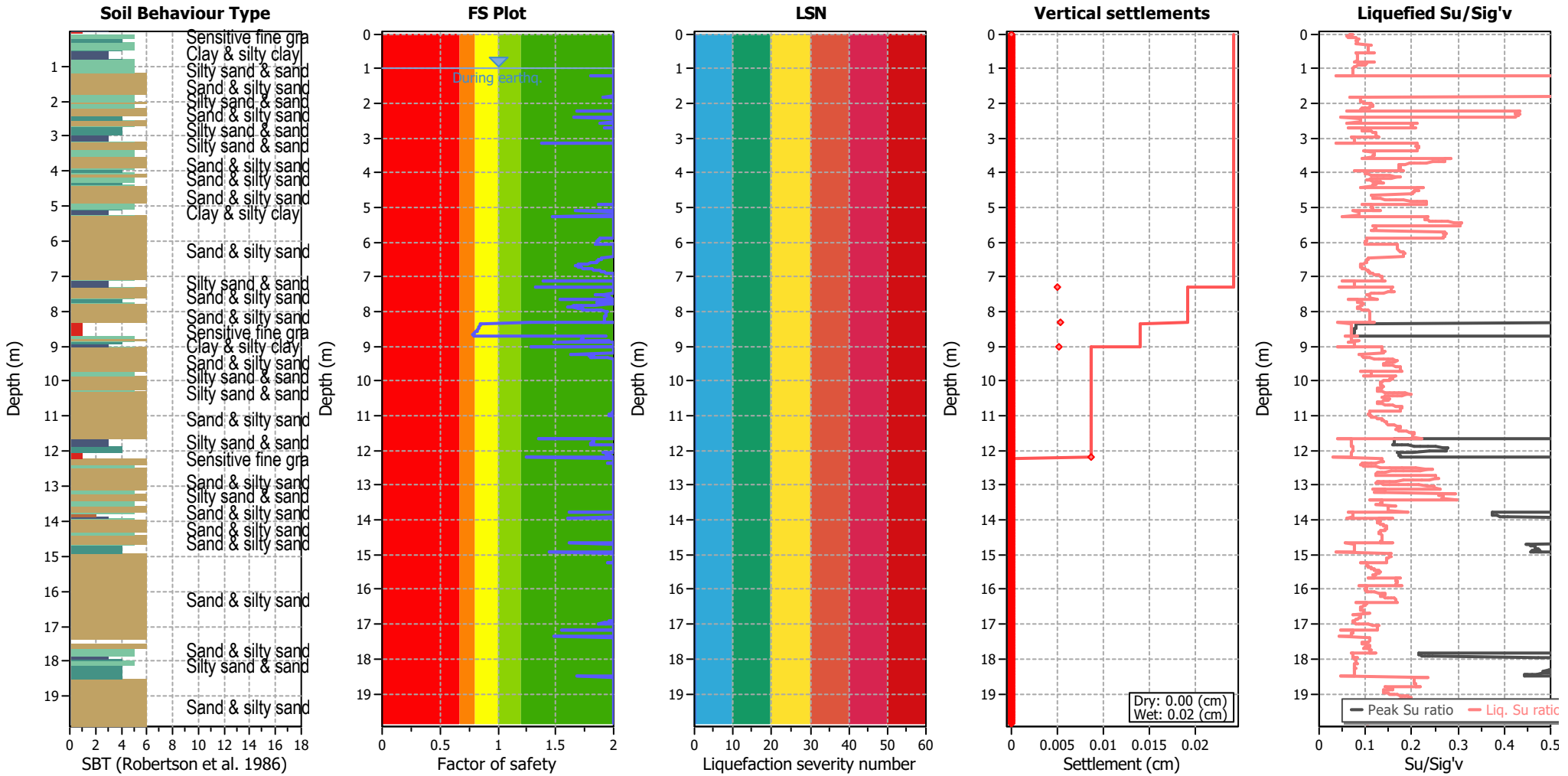


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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 04 SLS
Total depth: 19.86 m

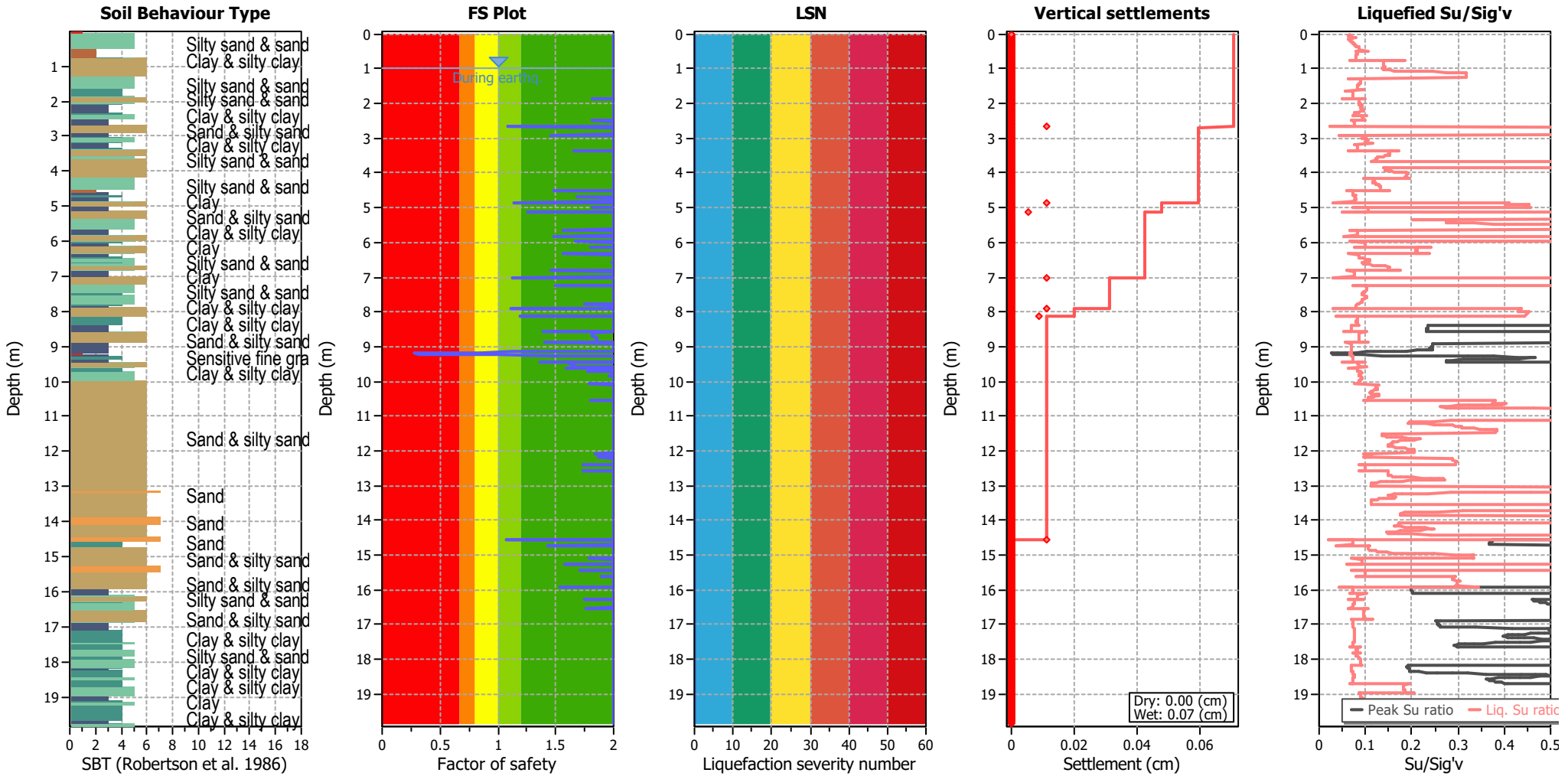


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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 05 SLS
Total depth: 19.85 m

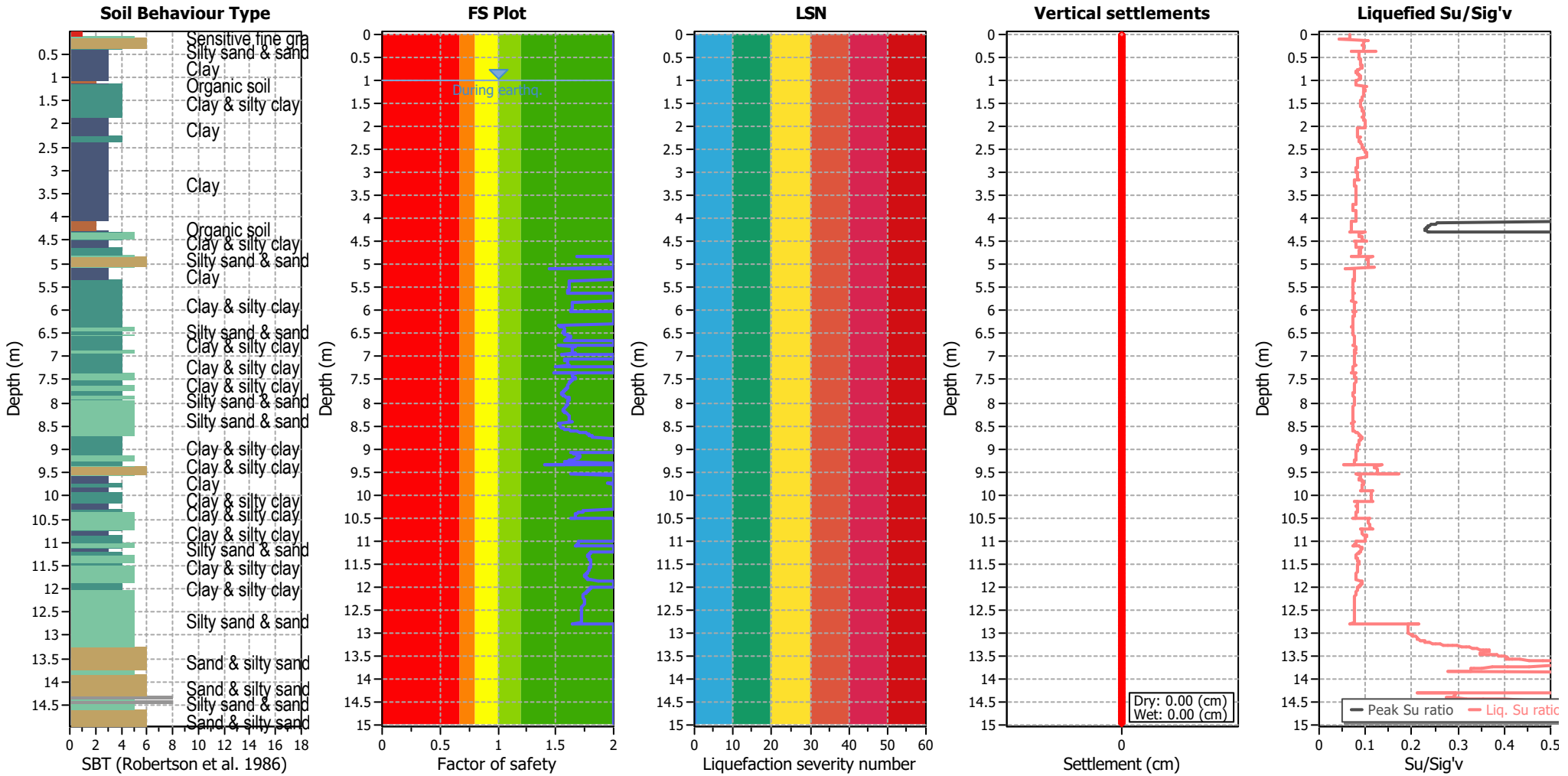


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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 06 SLS
Total depth: 14.96 m

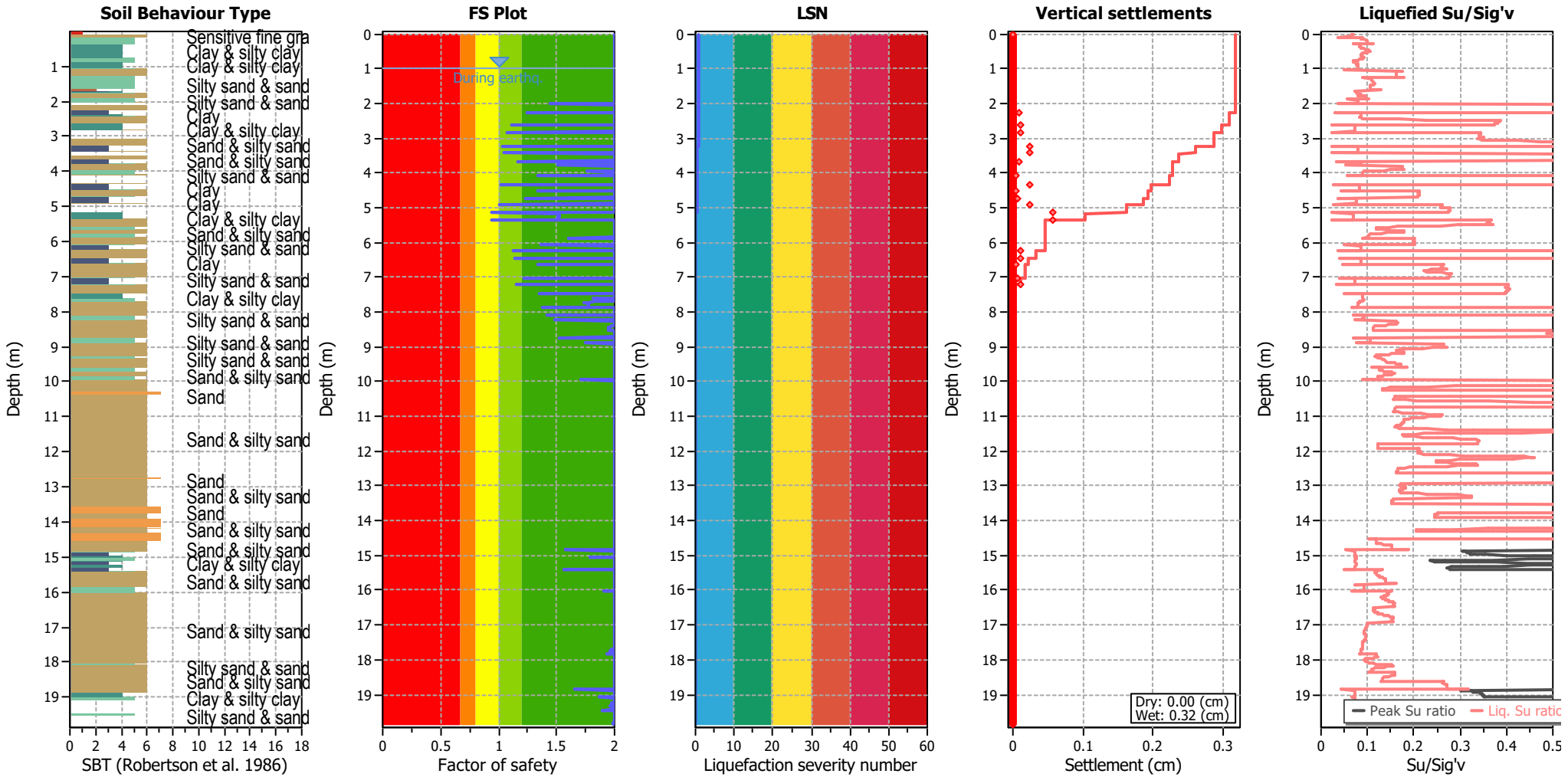


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 07 SLS
Total depth: 19.86 m

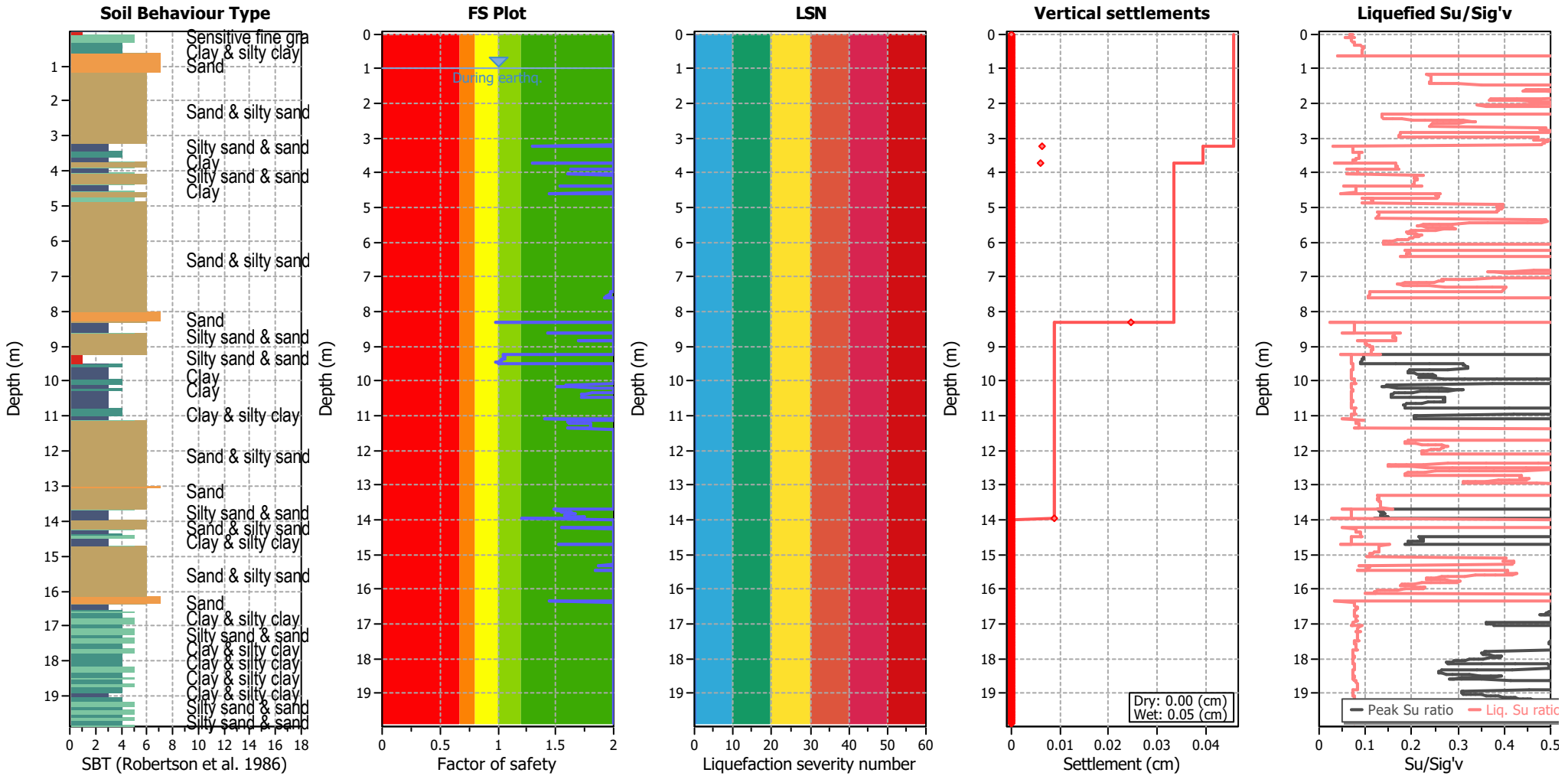


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 08 SLS
Total depth: 19.87 m

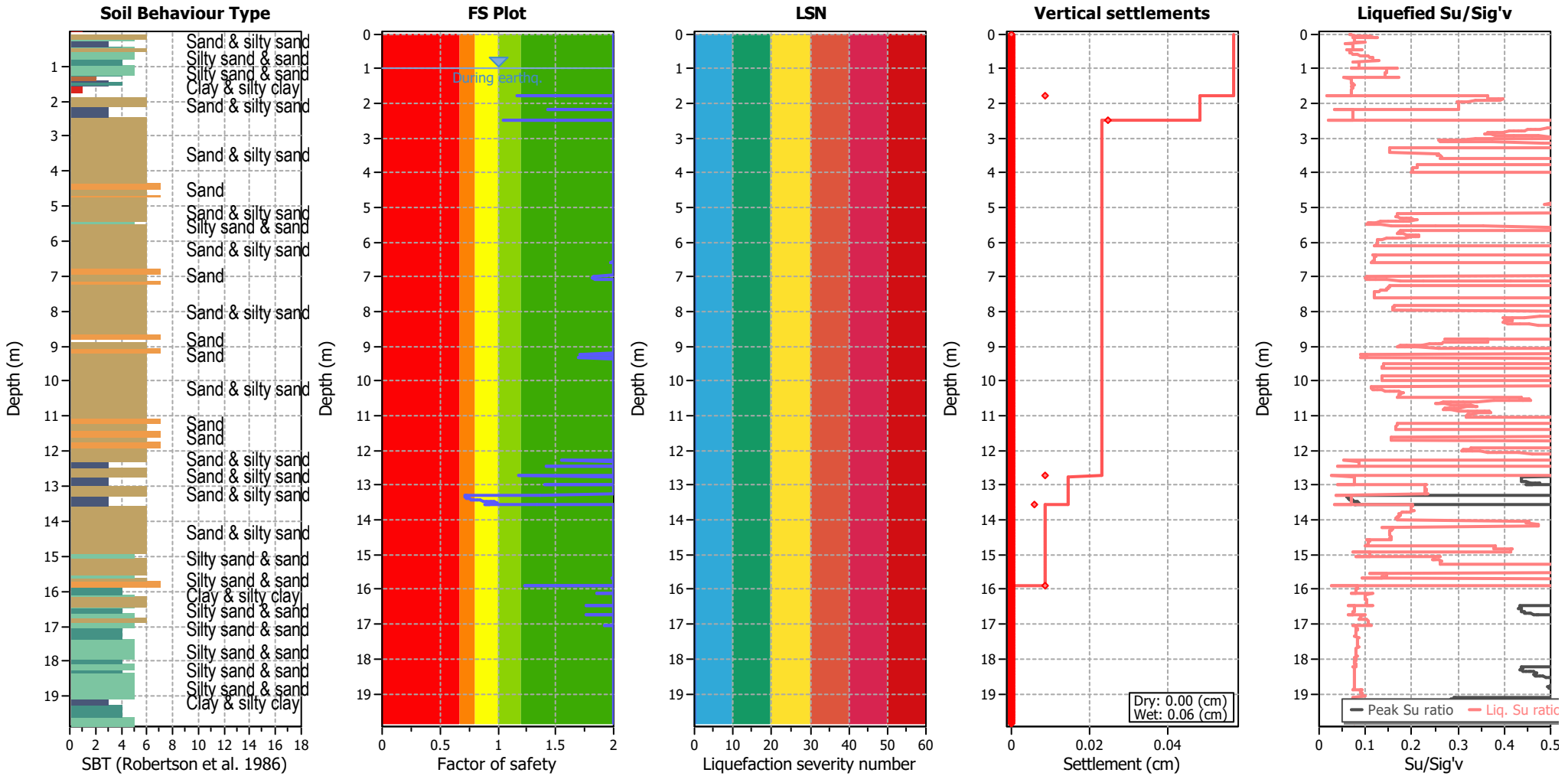


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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 09 SLS
Total depth: 19.86 m

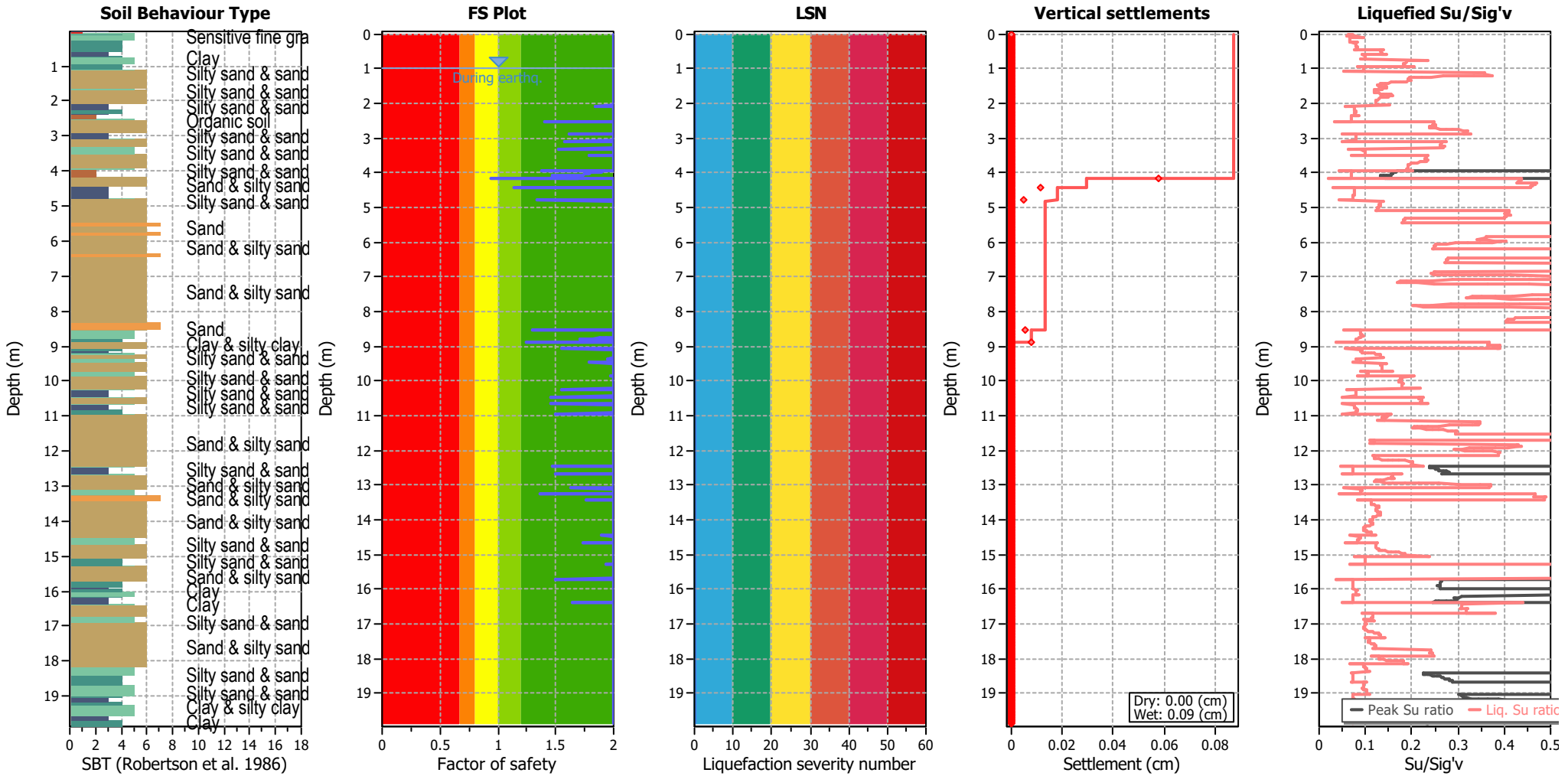


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
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Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 10 SLS
Total depth: 19.87 m

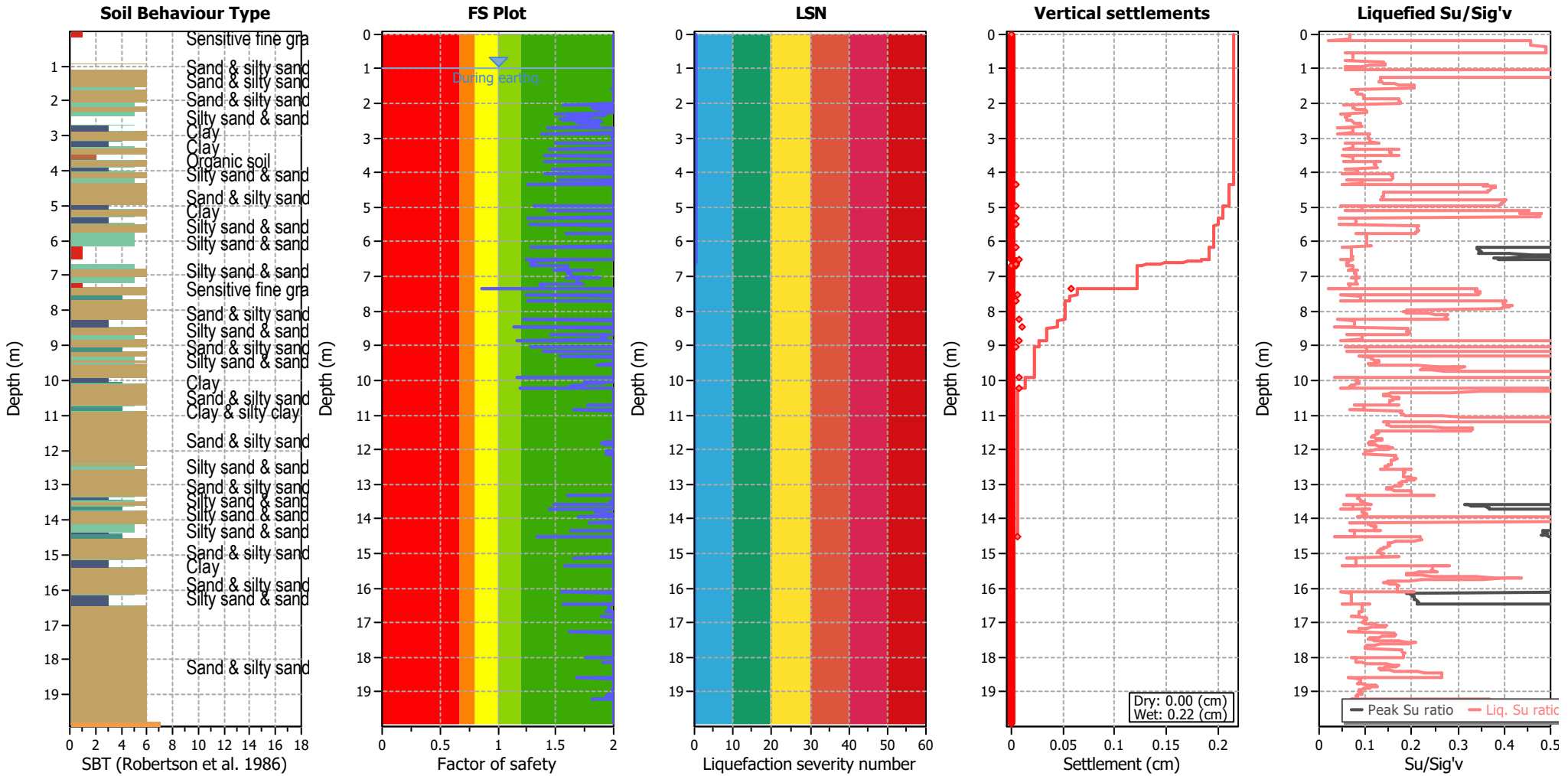


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 11 SLS
Total depth: 19.91 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.07	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

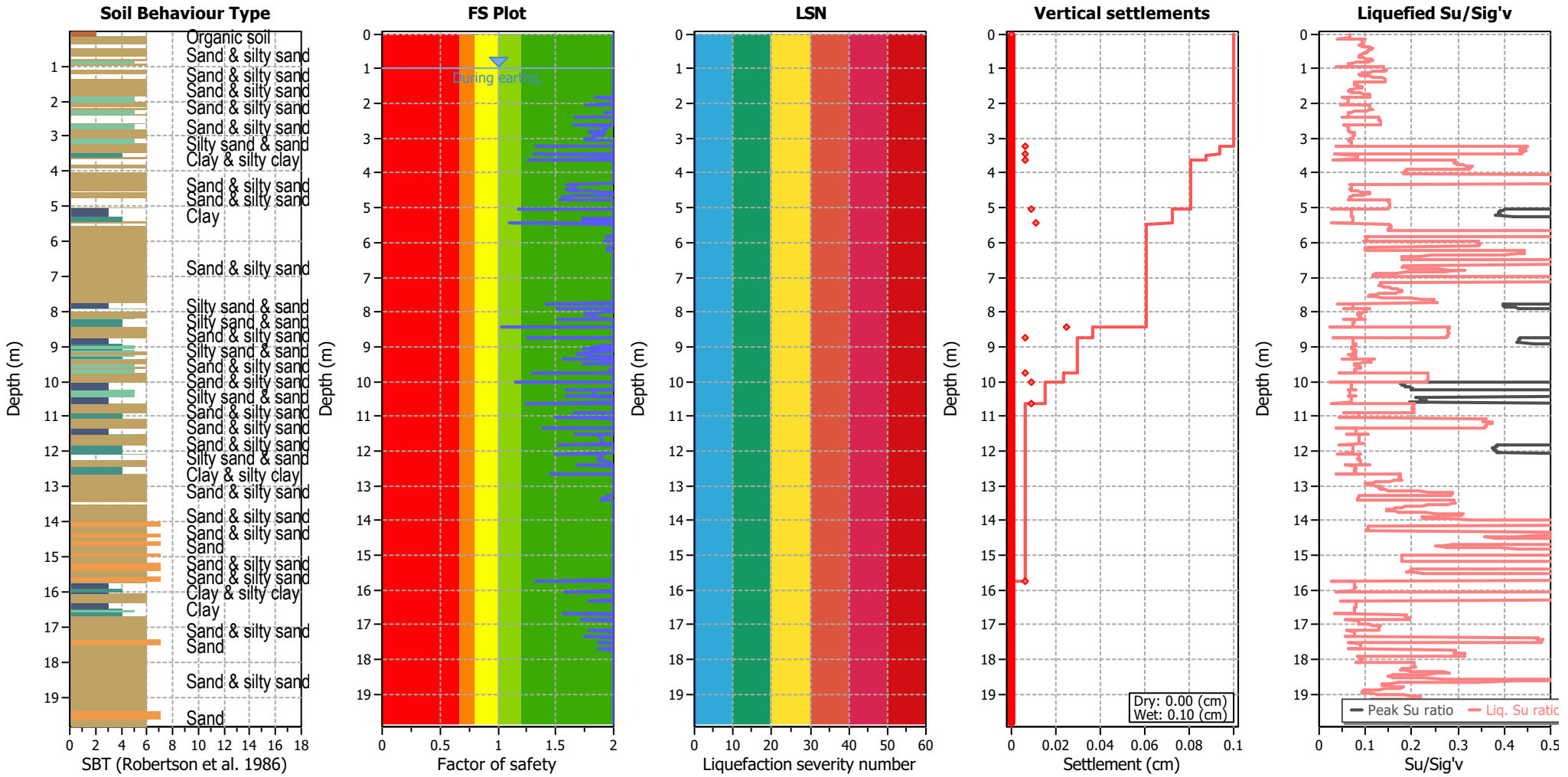
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Project: **Waikato Thoroughbred Racing | 23-1883**

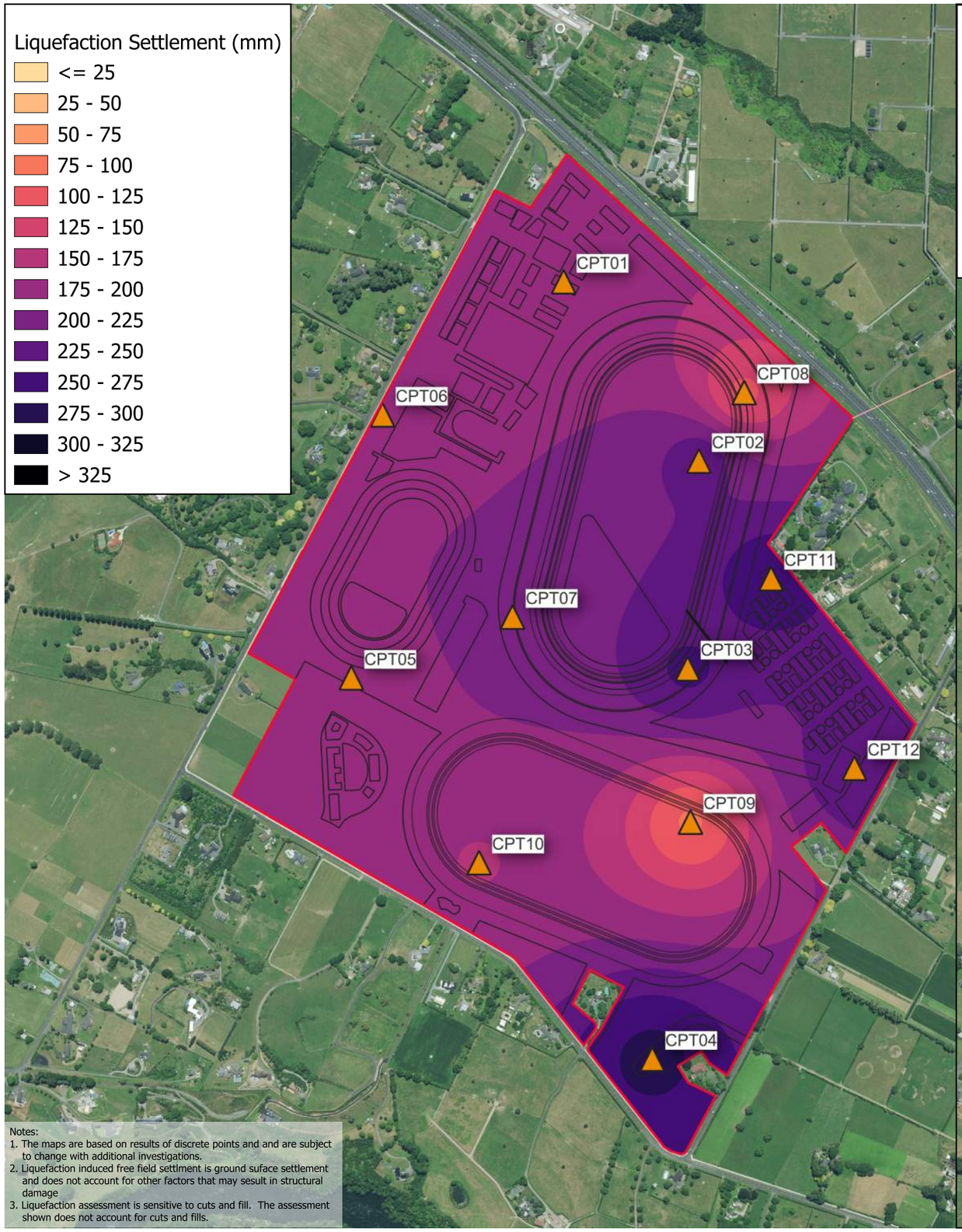
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 12 SLS

Total depth: 19.85 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.06	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		





Notes:
1. The maps are based on results of discrete points and and are subject to change with additional investigations.
2. Liquefaction induced free field settlment is ground suface settlement and does not account for other factors that may sesult in structural damage
3. Liquefaction assessment is sensitive to cuts and fill. The assessment shown does not account for cuts and fills.

Client: WAIKATO THOROUGHBRED RACING — TE RAPA · CAMBRIDGE · WAIPA

Contractor

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Sheet: IL2 - Liquefaction Map

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
04	24/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	25/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-D02	04

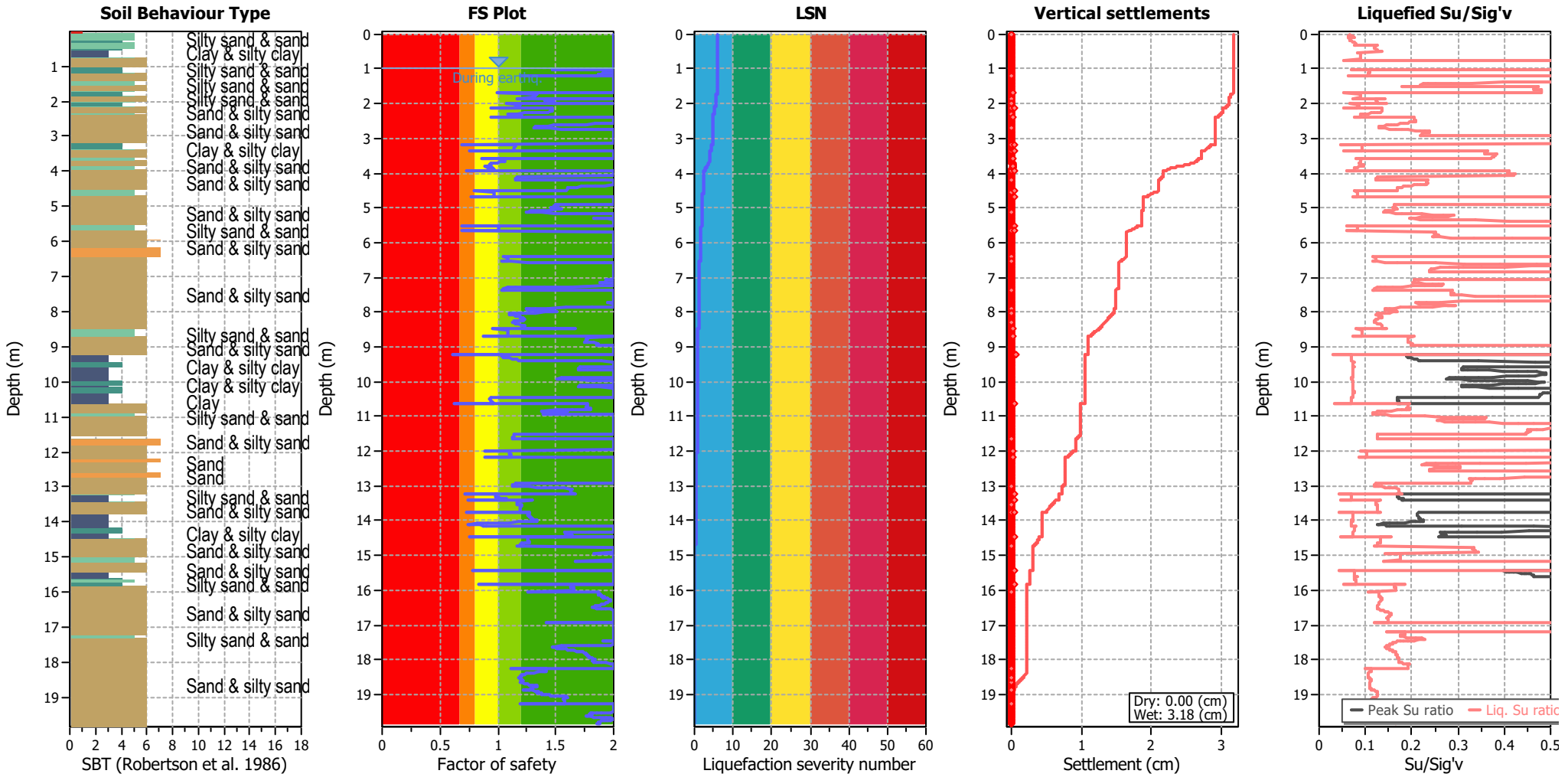
All dimensions to be verified on site before making any shop drawings or commencing any work

The copyright of this drawing remains with BCD Group

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 01 IL1
Total depth: 19.84 m

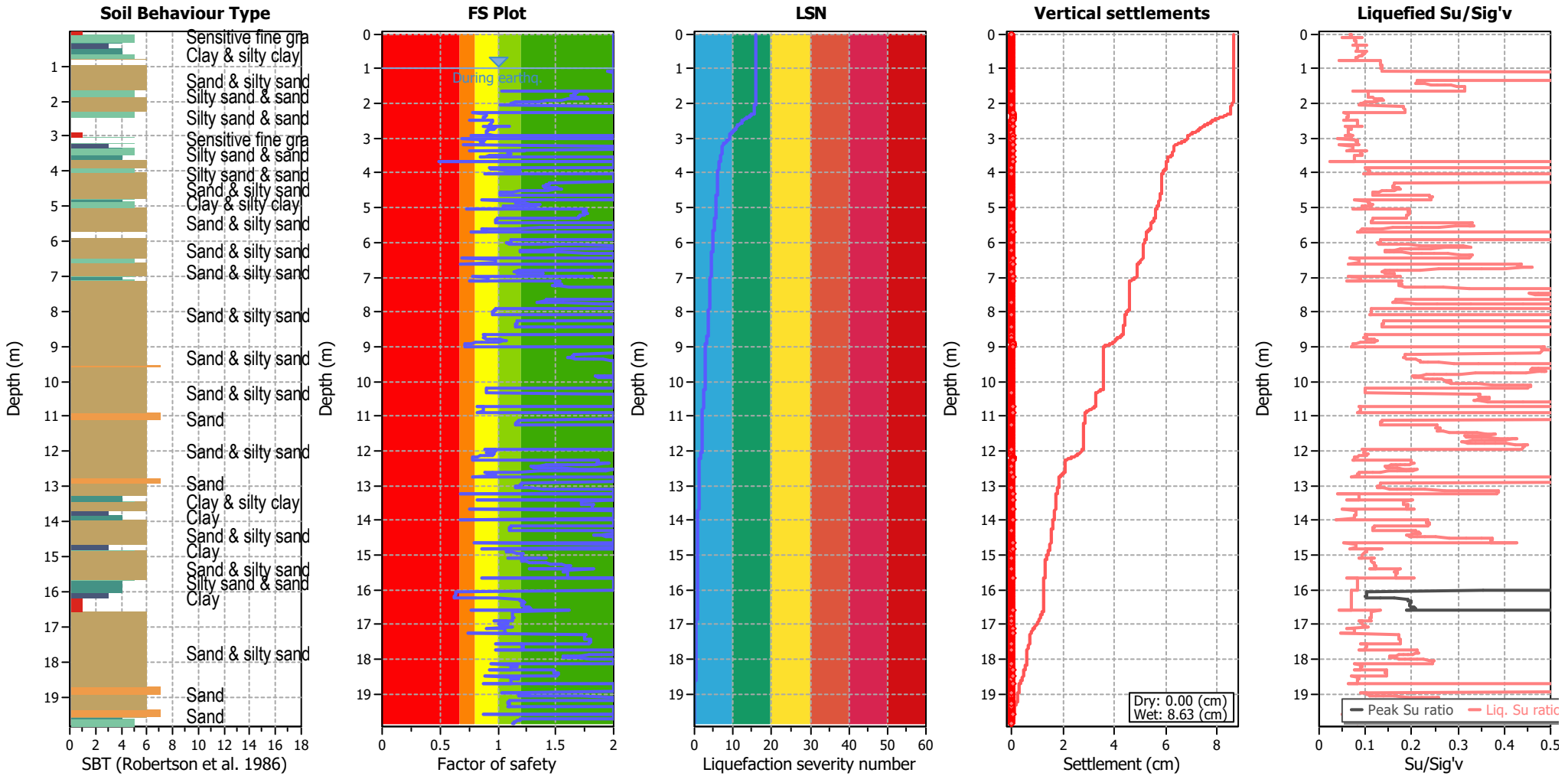


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 02 IL1
Total depth: 19.85 m

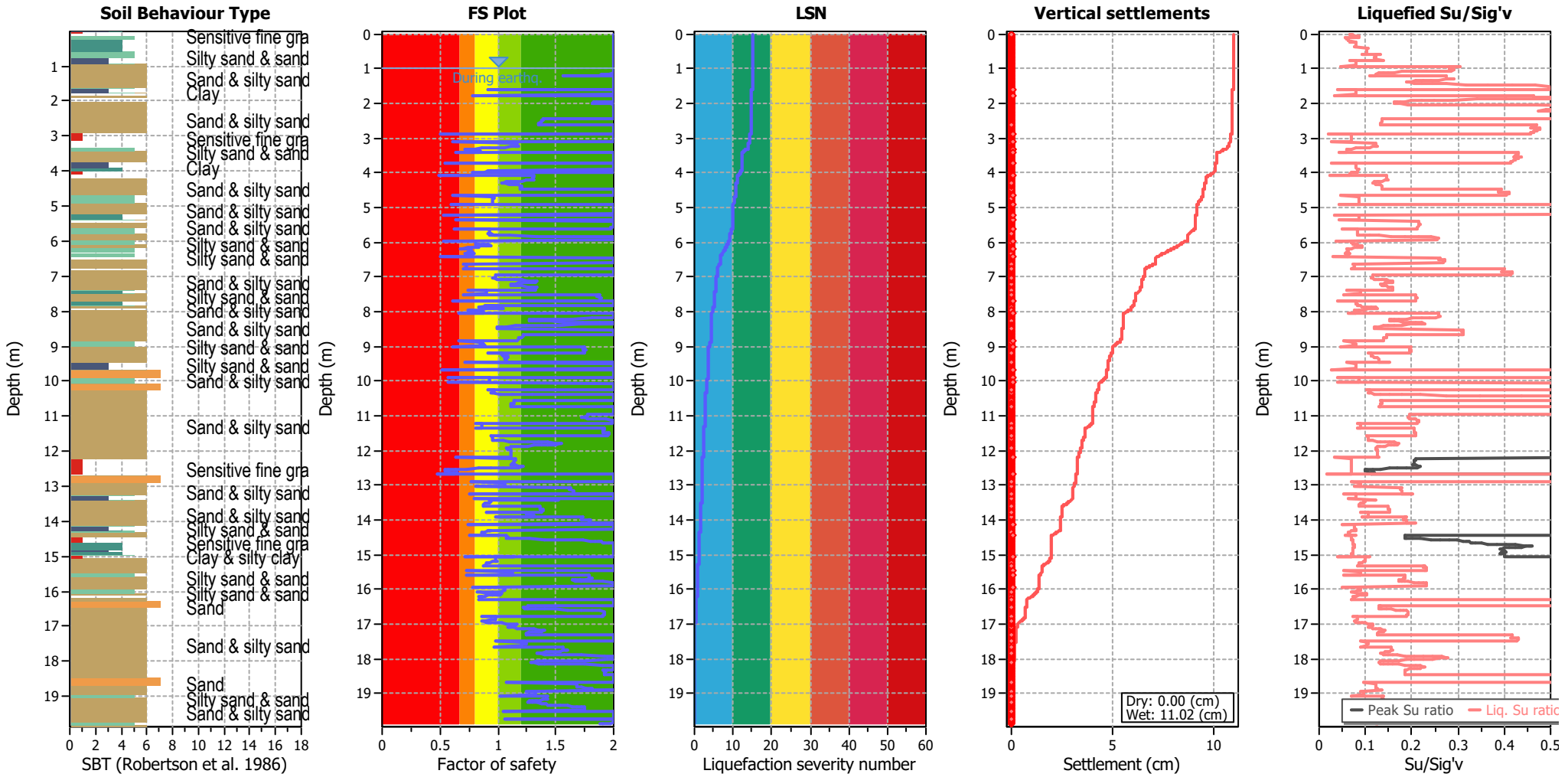


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 03 IL1
Total depth: 19.87 m

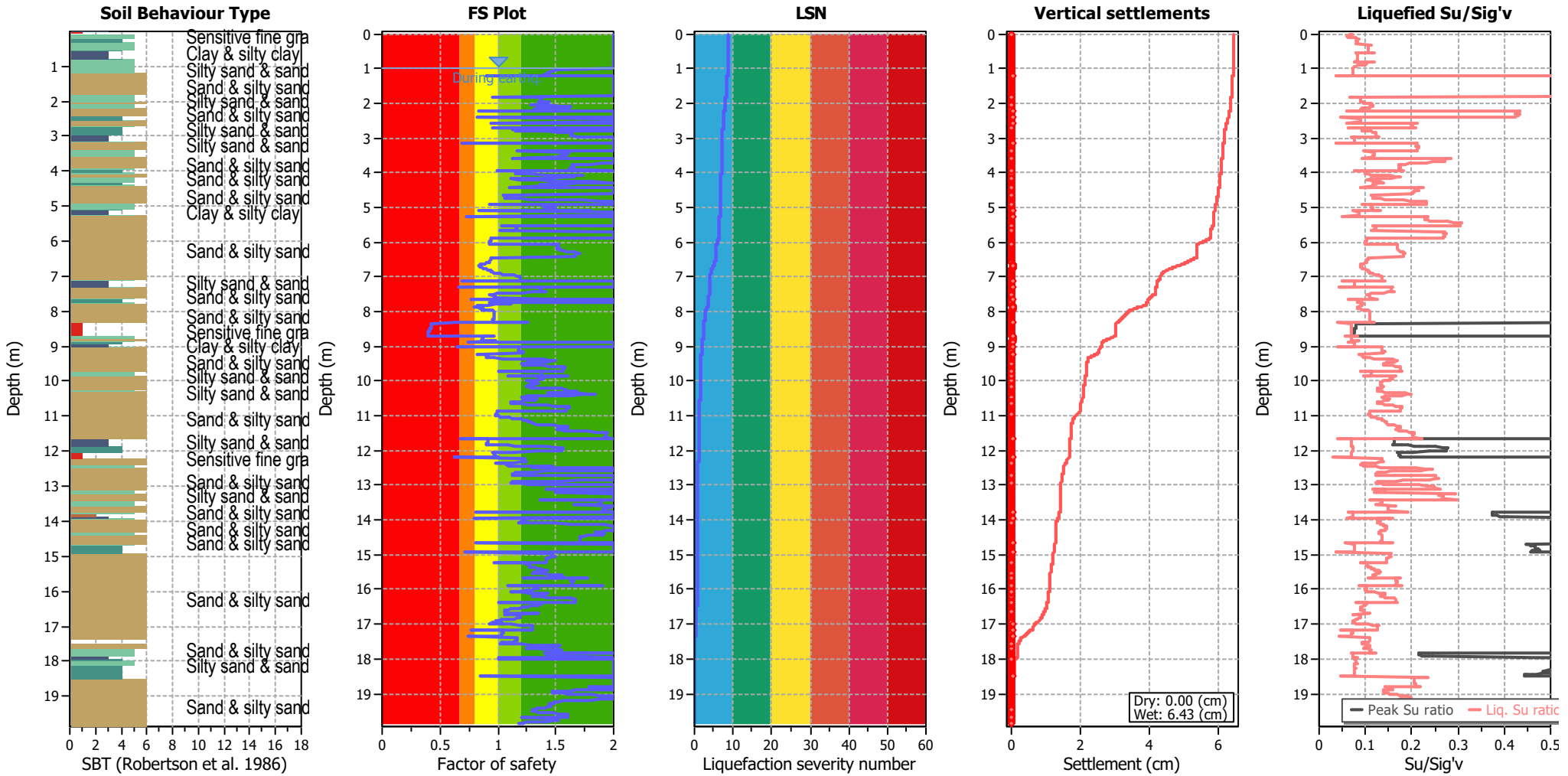


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 04 IL1
Total depth: 19.86 m

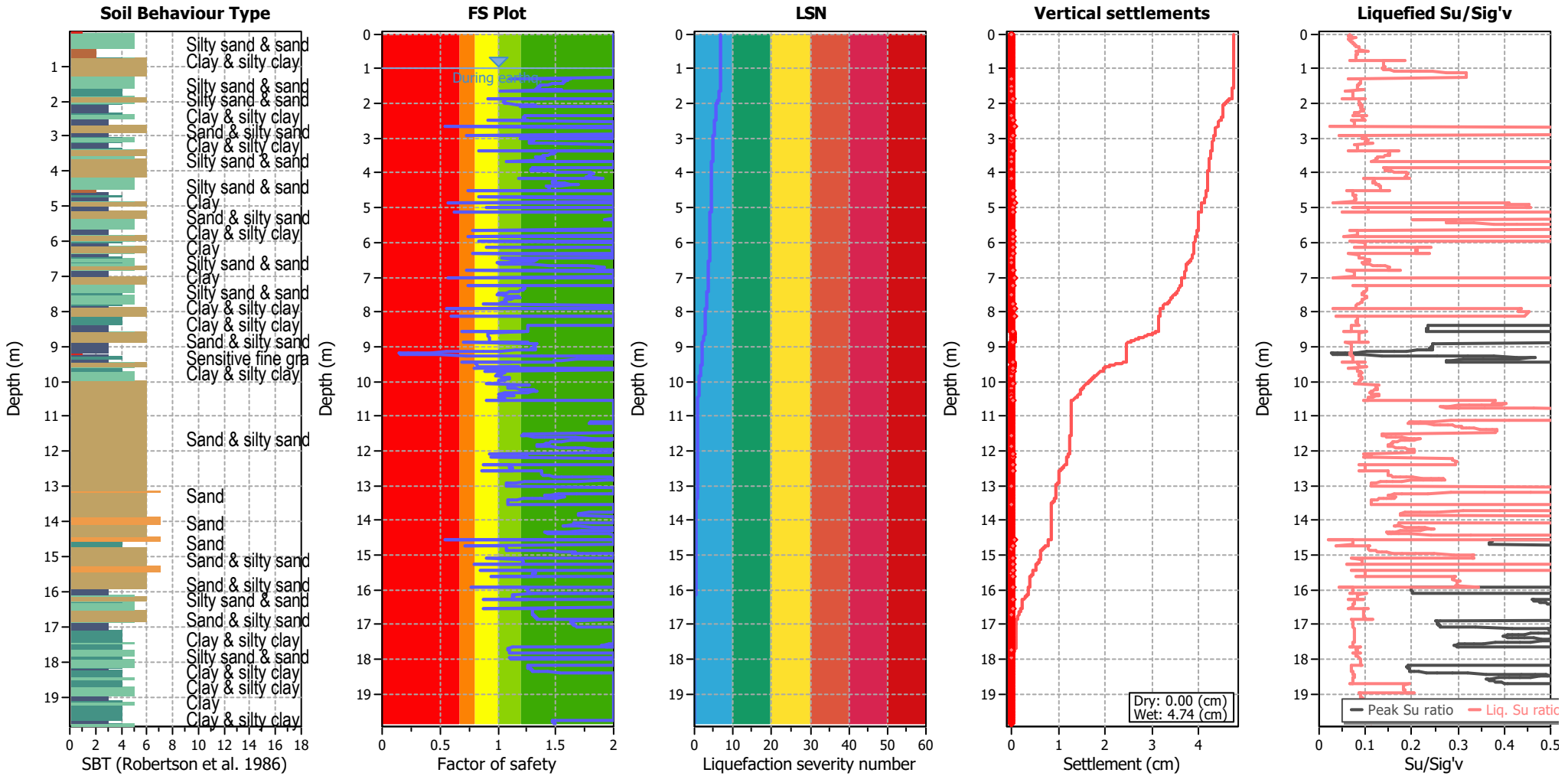


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 05 IL1
Total depth: 19.85 m

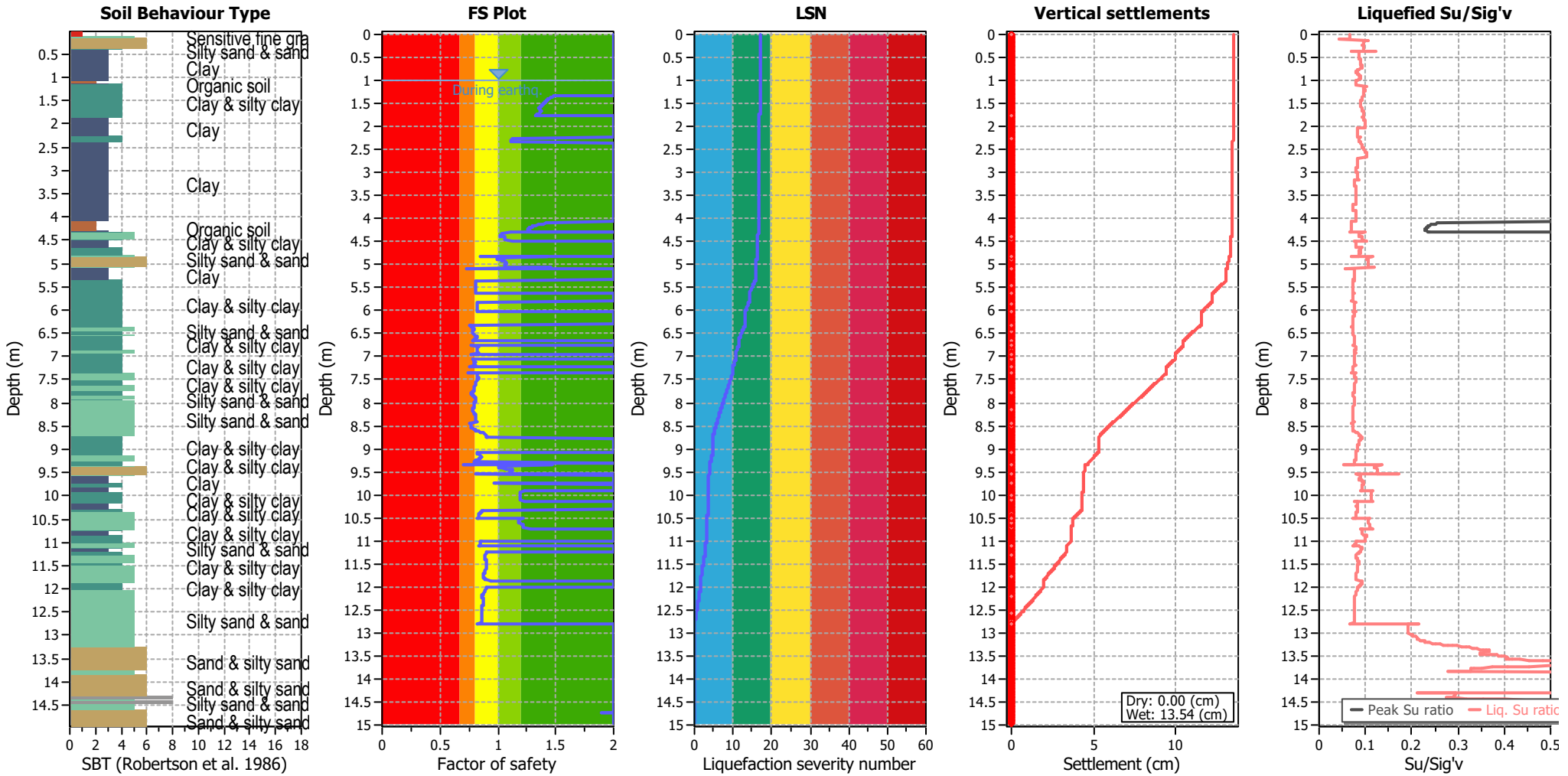


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 06 IL1
Total depth: 14.96 m

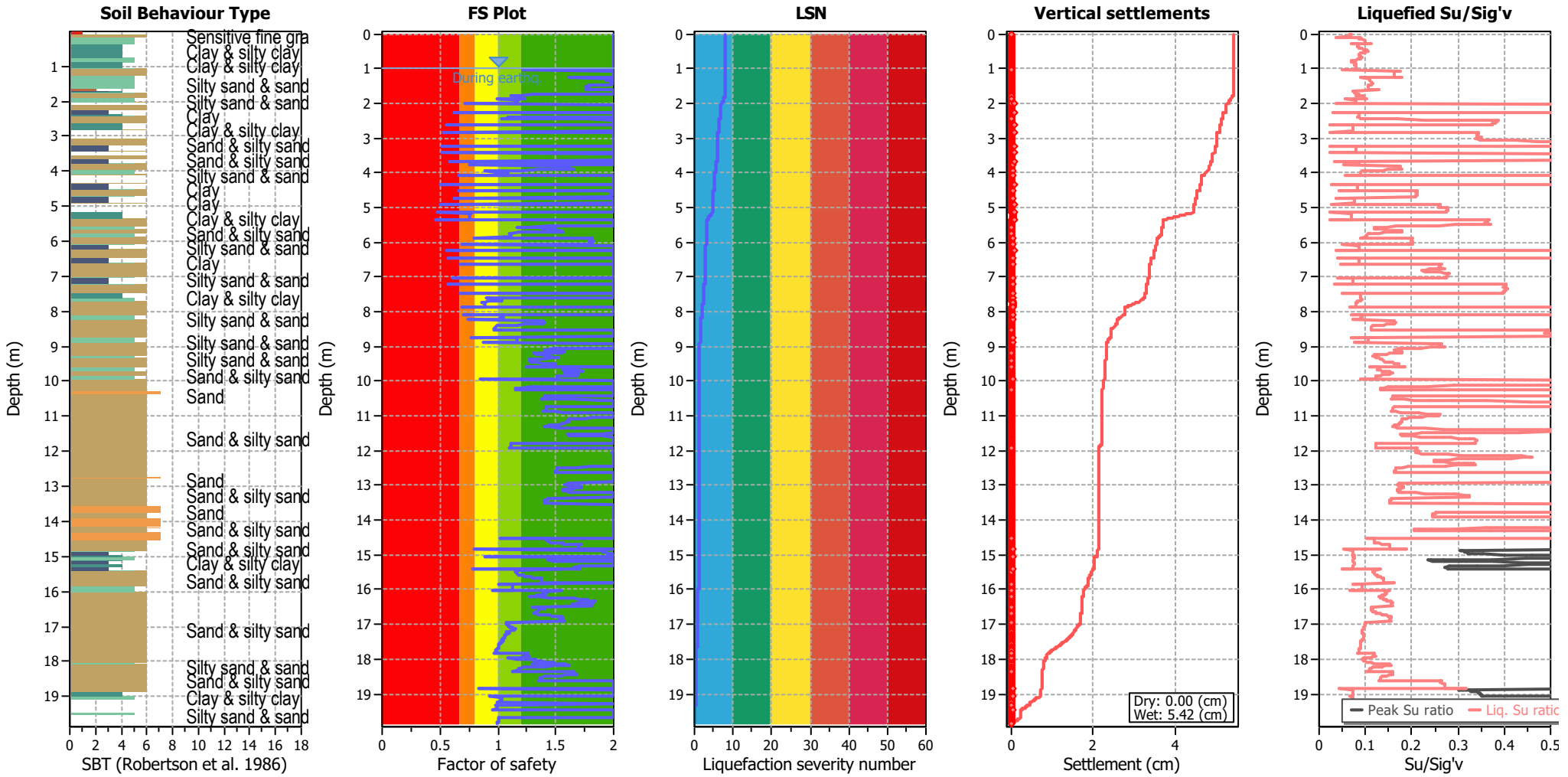


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 07 IL1
Total depth: 19.86 m

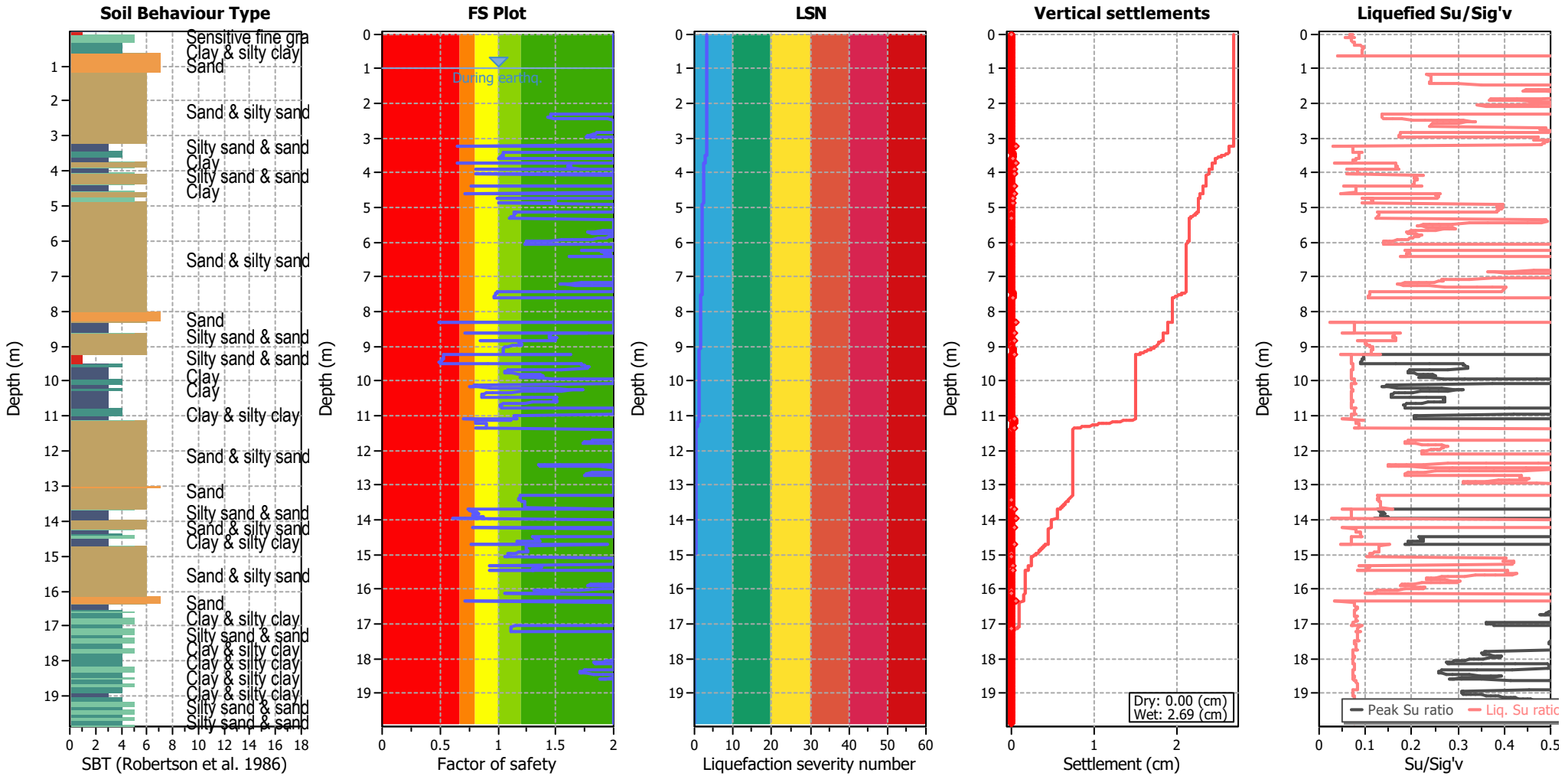


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 08 IL1
Total depth: 19.87 m

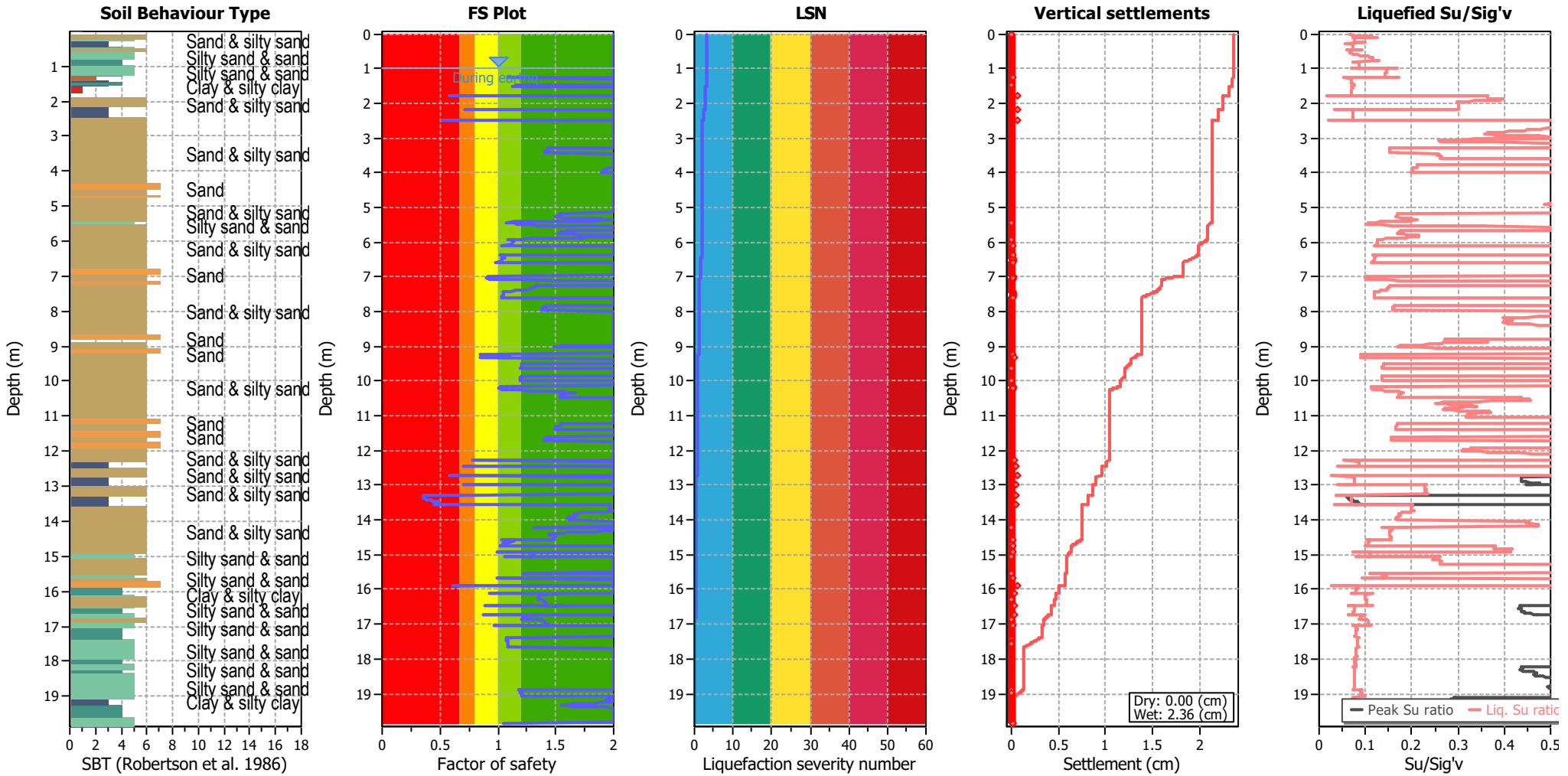


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 09 IL1
Total depth: 19.86 m

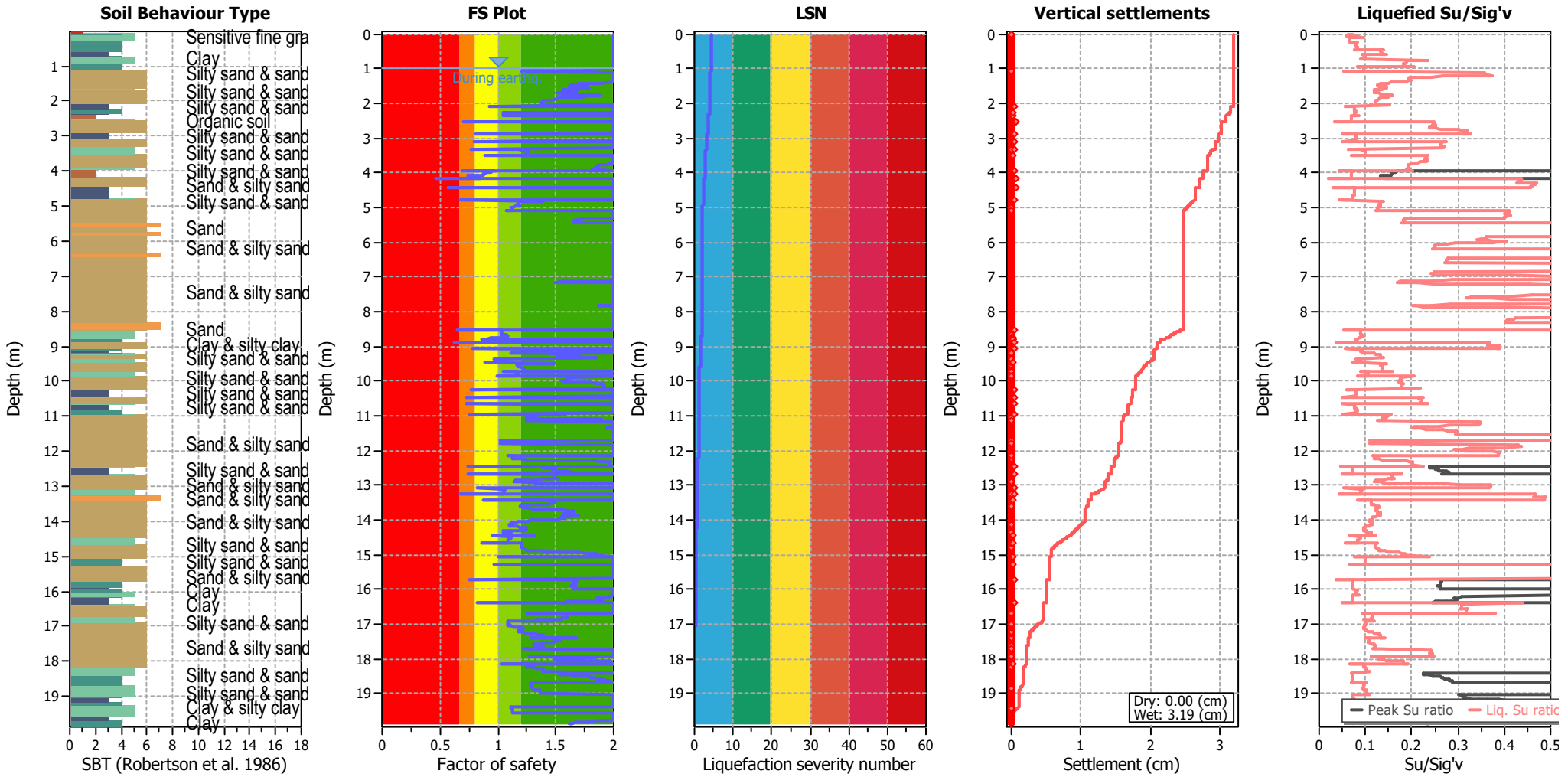


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 10 IL1
Total depth: 19.87 m

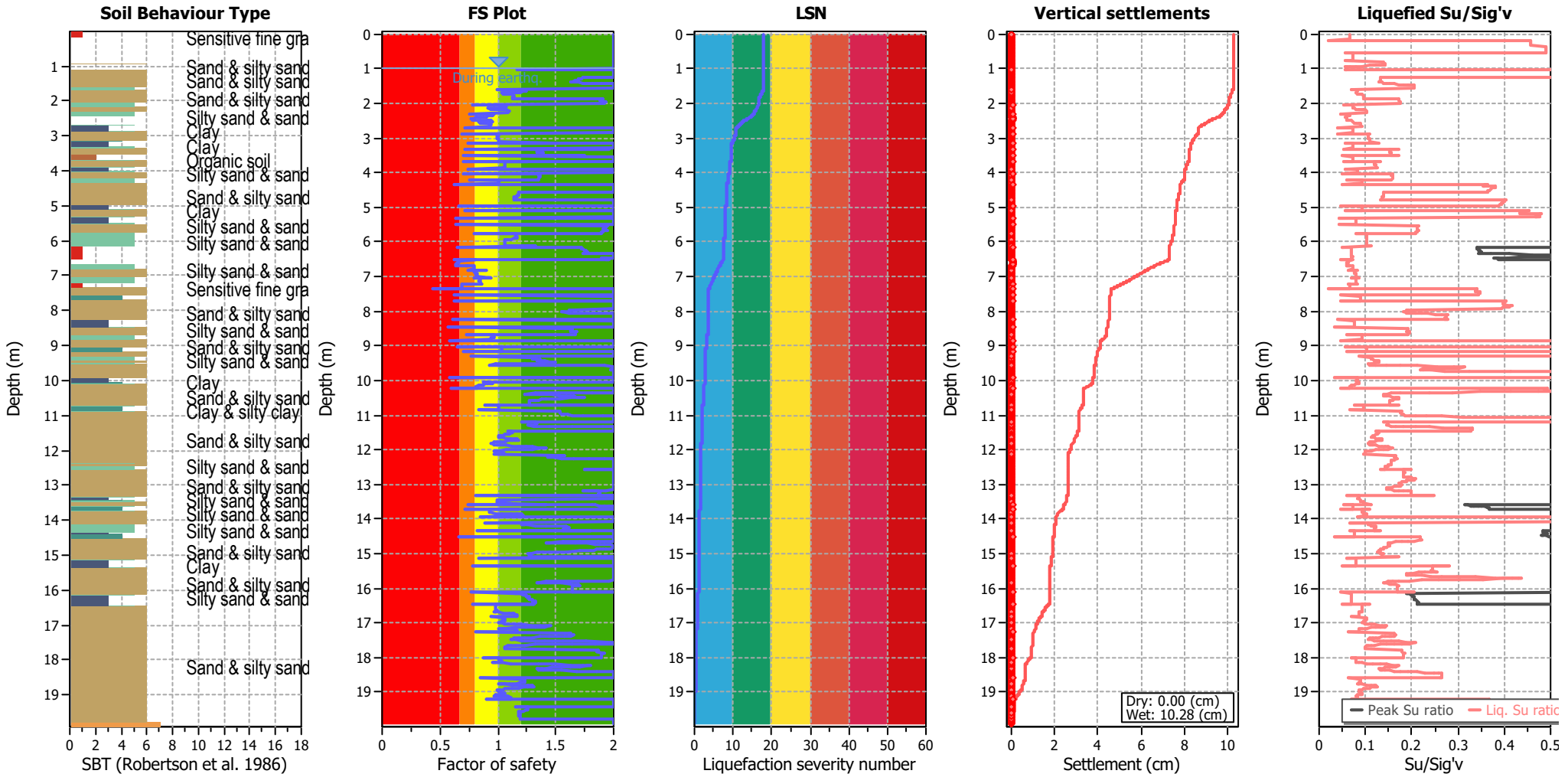


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 11 IL1
Total depth: 19.91 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

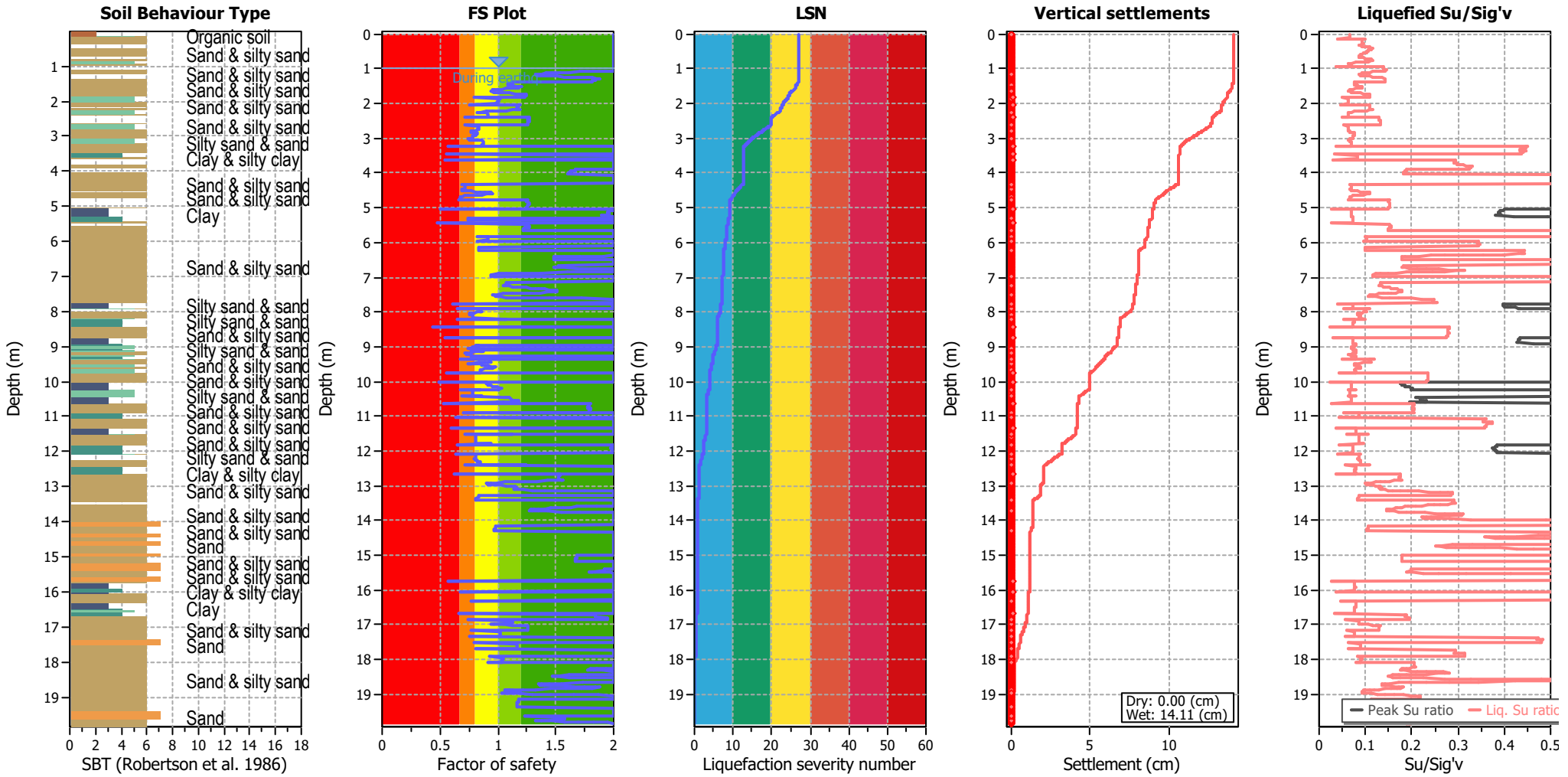
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Project: **Waikato Thoroughbred Racing | 23-1883**

Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 12 IL1

Total depth: 19.85 m

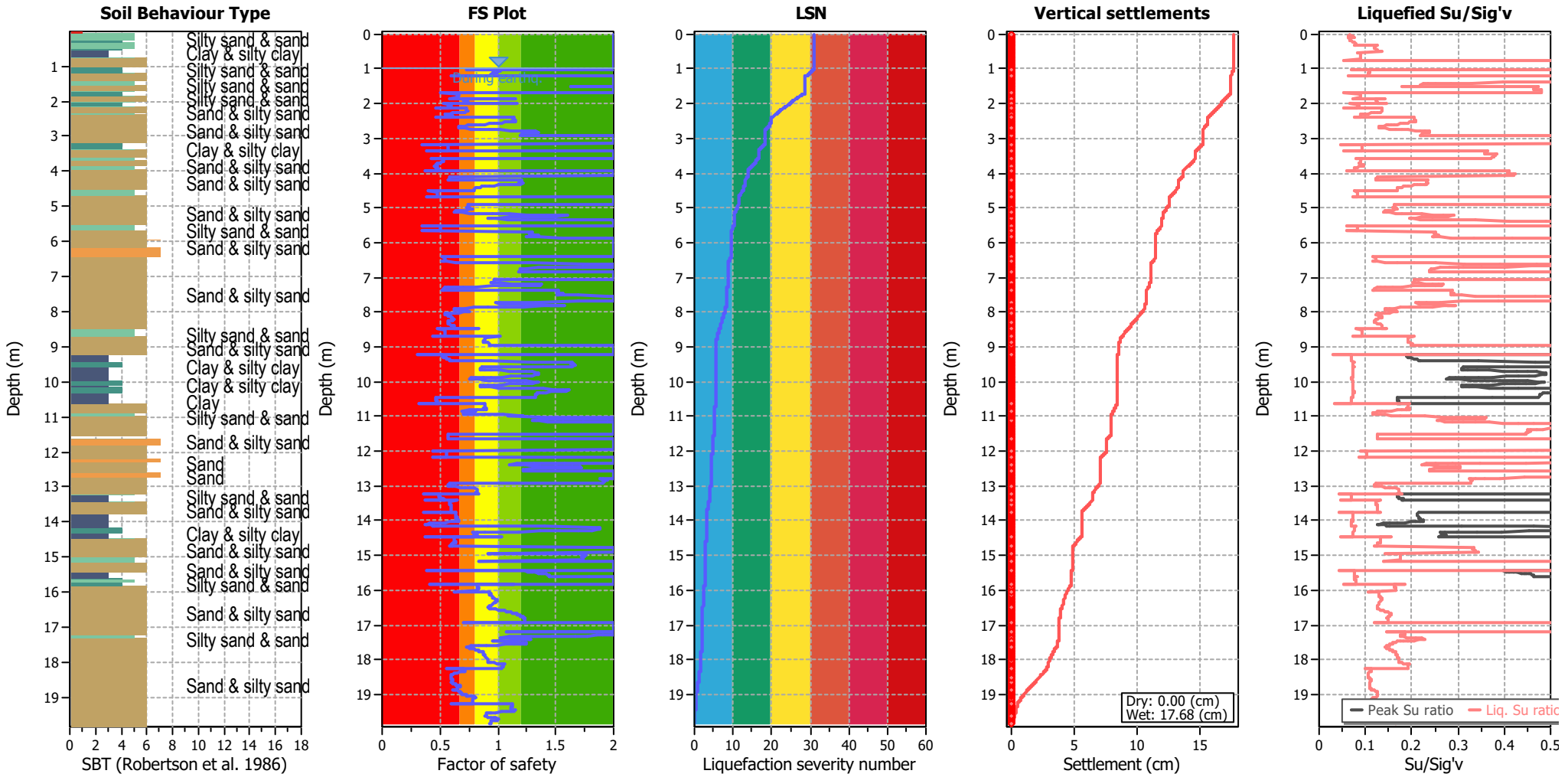


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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.14	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 01 IL2
Total depth: 19.84 m

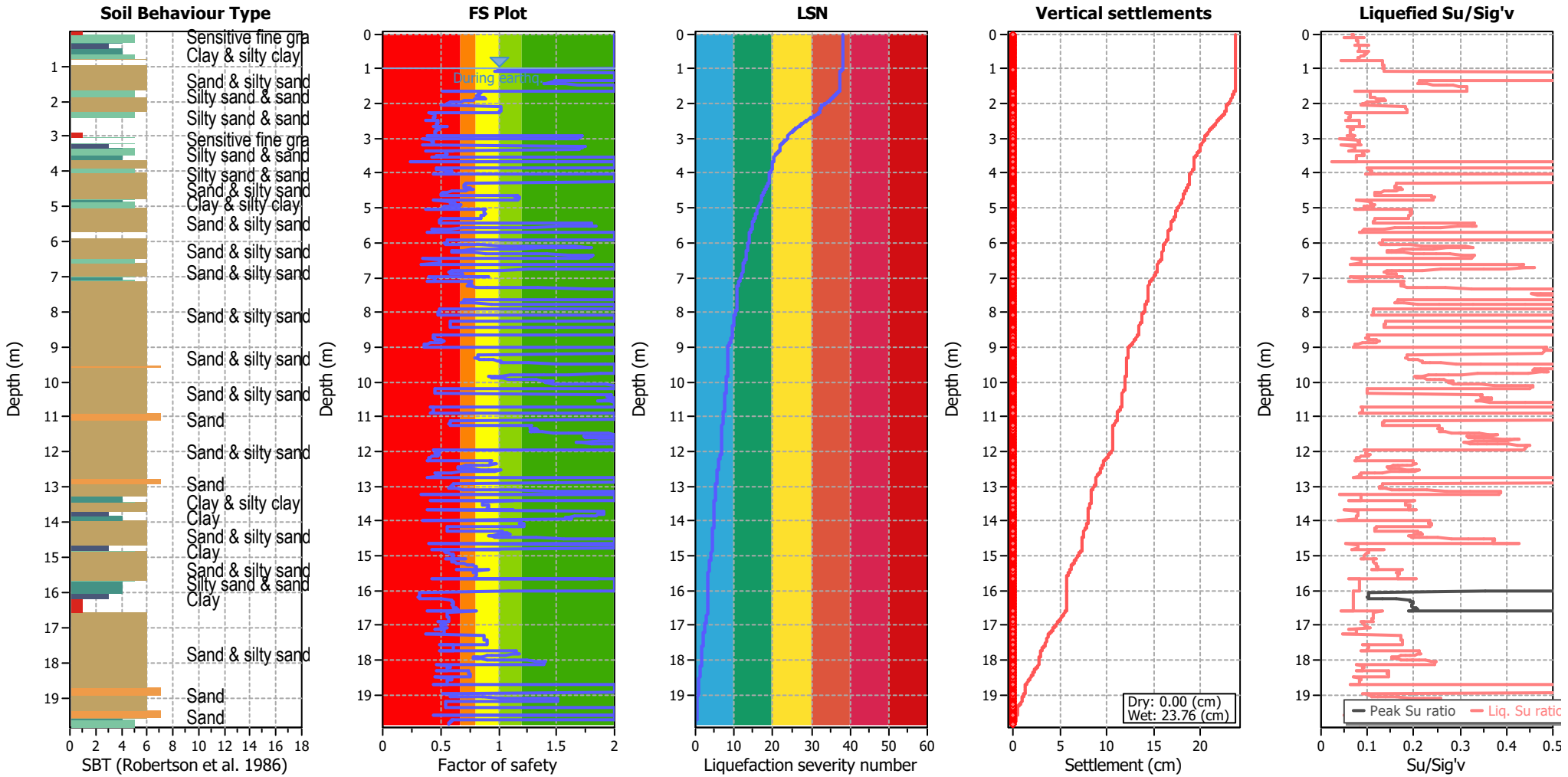


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 02 IL2
Total depth: 19.85 m

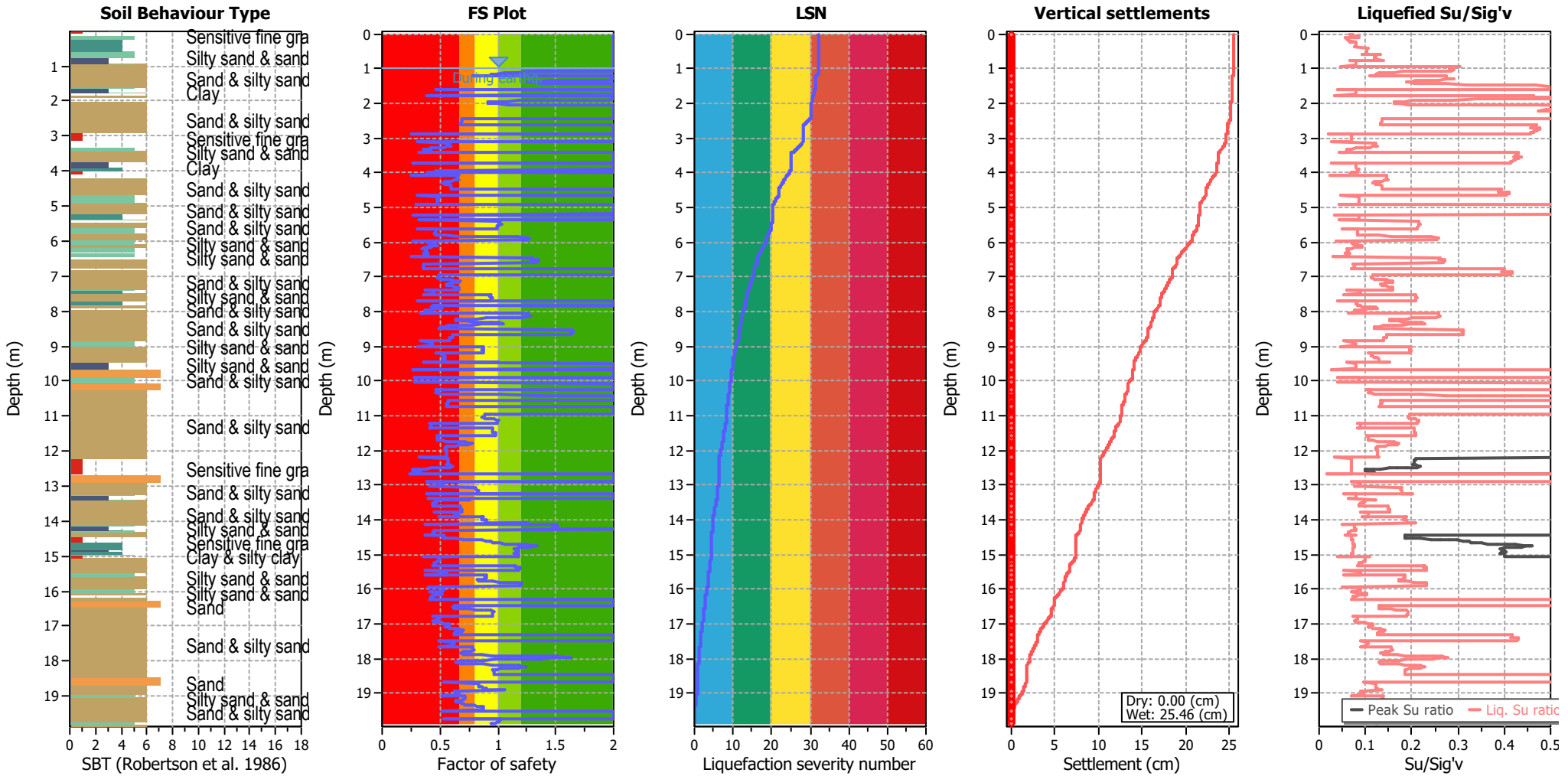


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 03 IL2
Total depth: 19.87 m

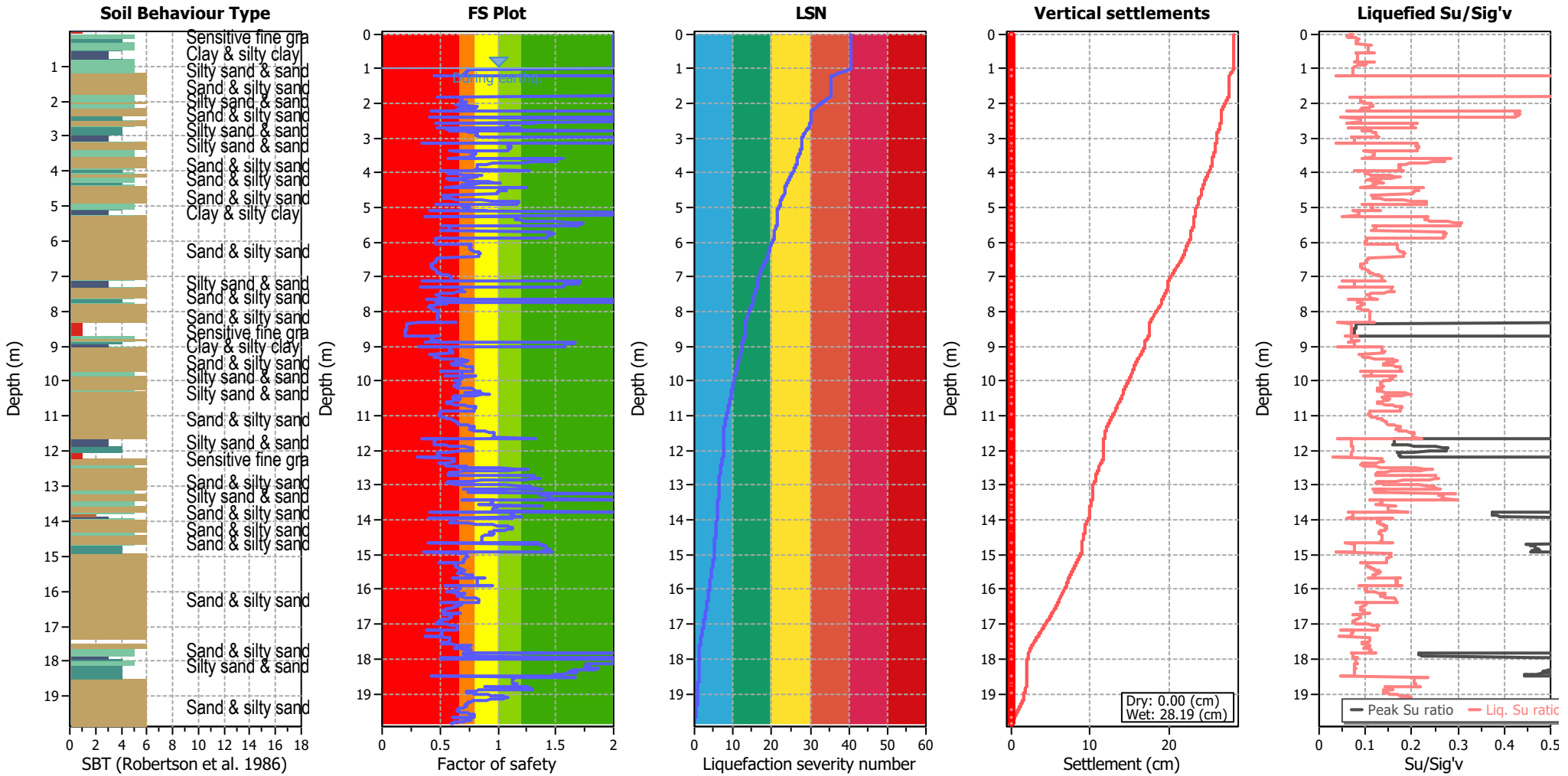


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 04 IL2
Total depth: 19.86 m

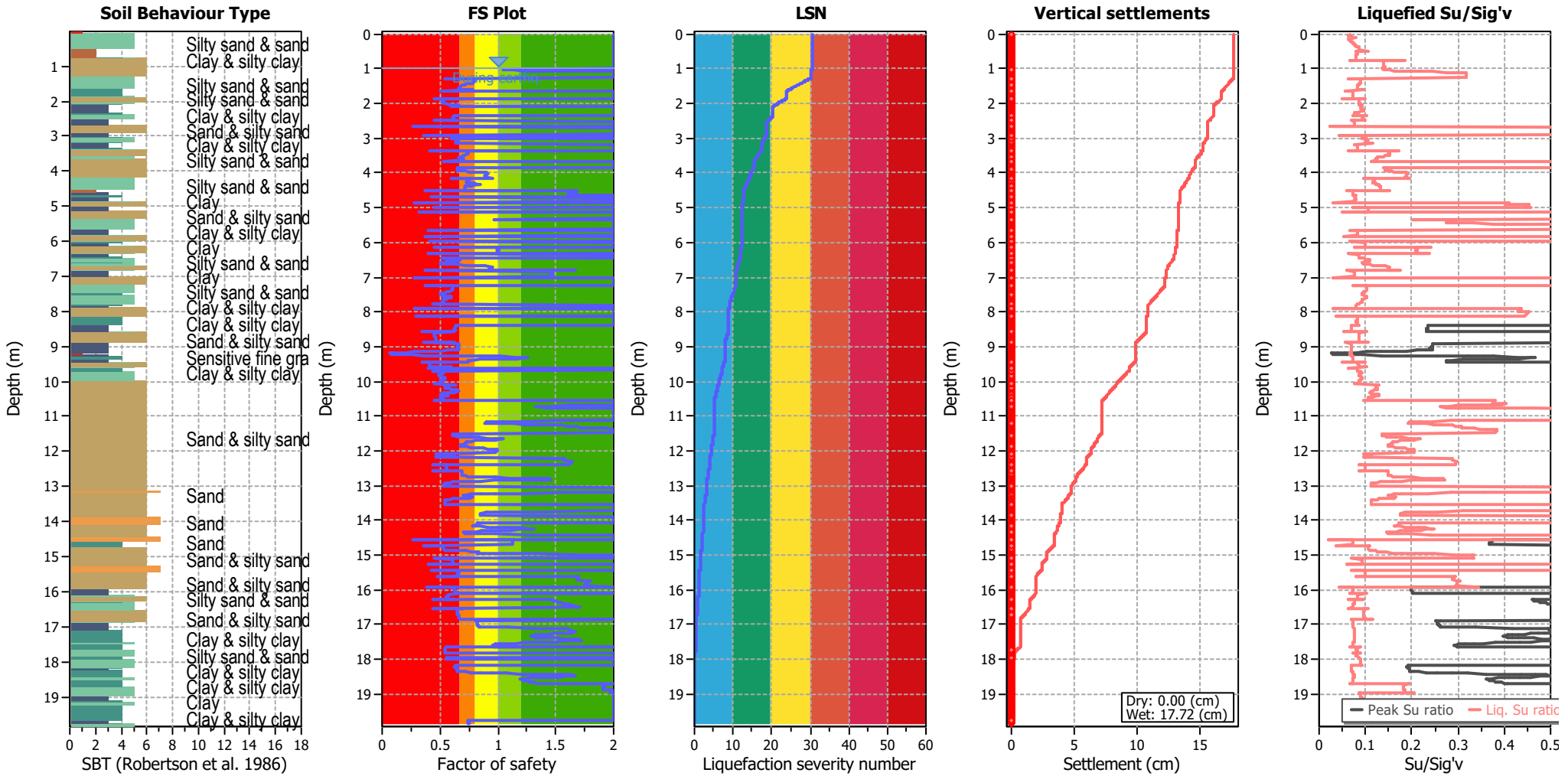


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 05 IL2
Total depth: 19.85 m

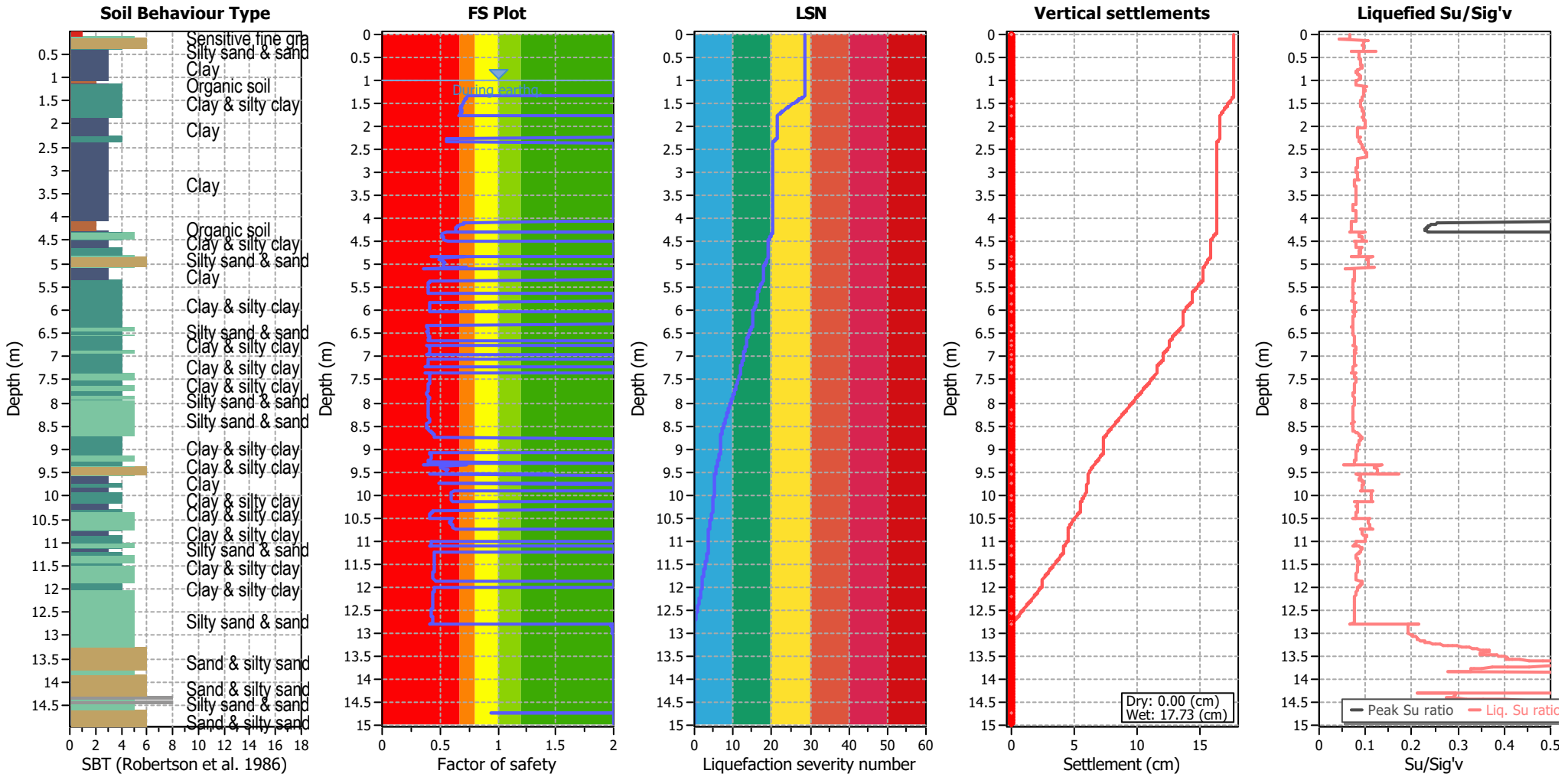


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 06 IL2
Total depth: 14.96 m

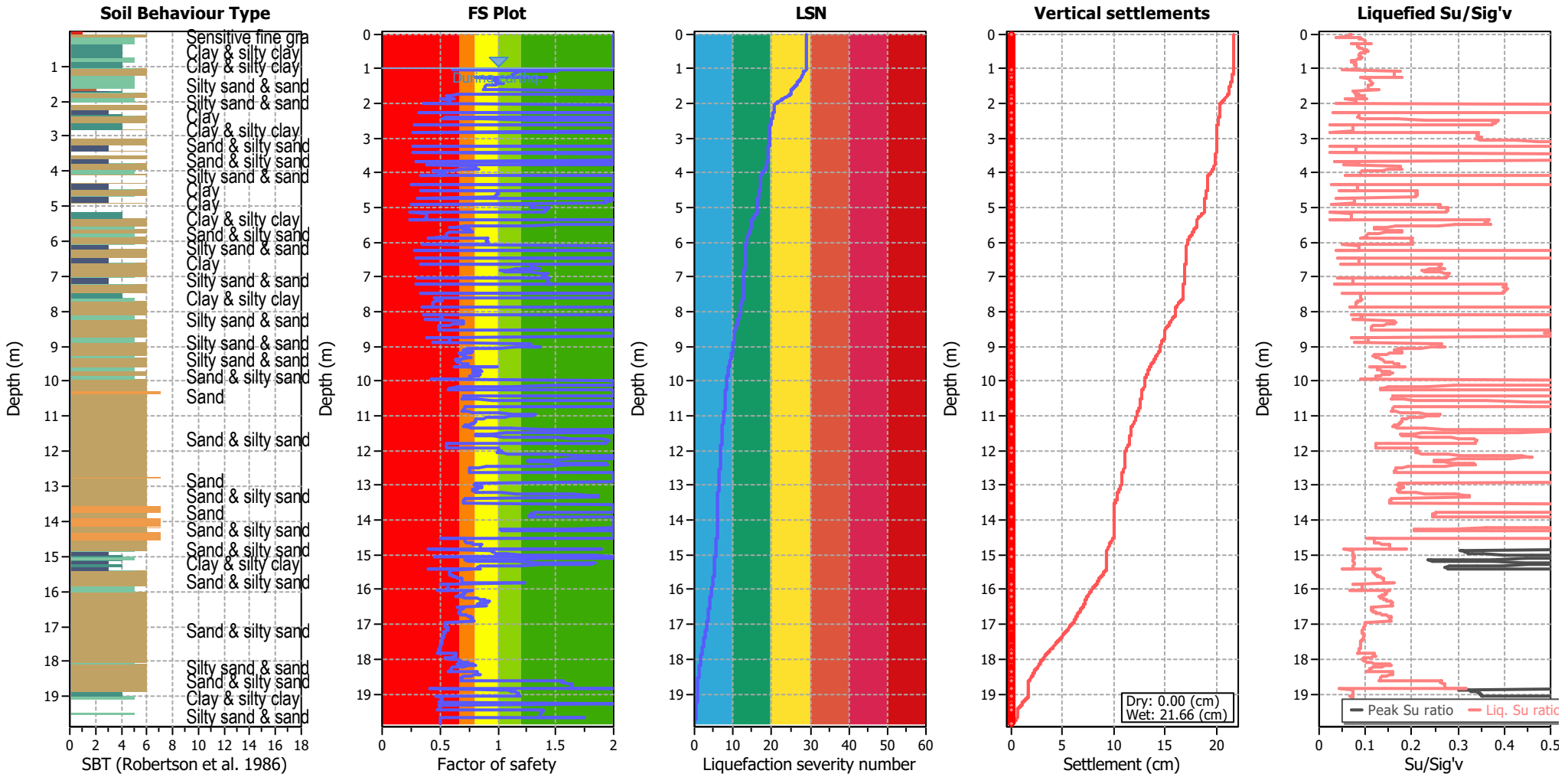


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 07 IL2
Total depth: 19.86 m

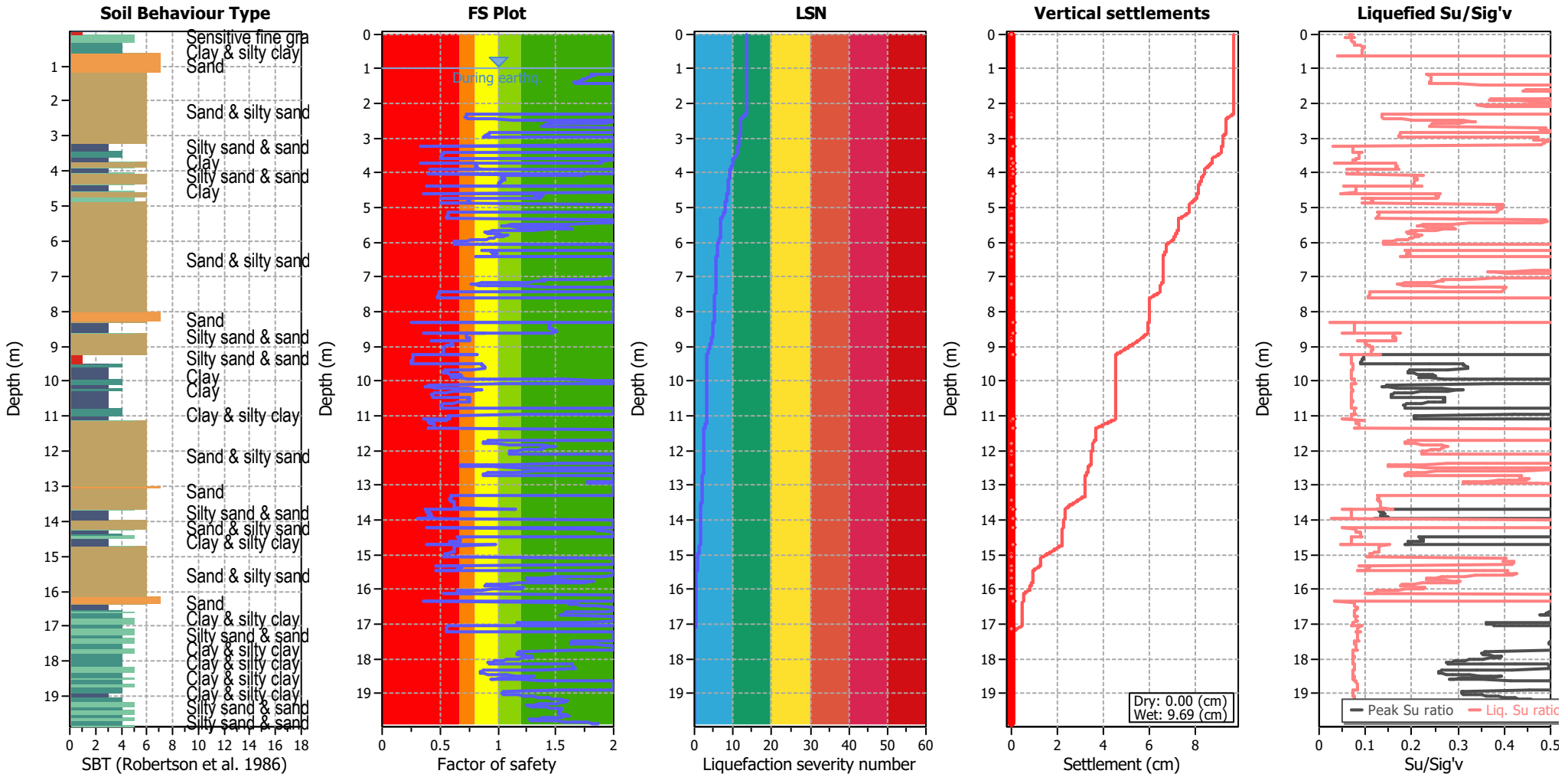


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 08 IL2
Total depth: 19.87 m

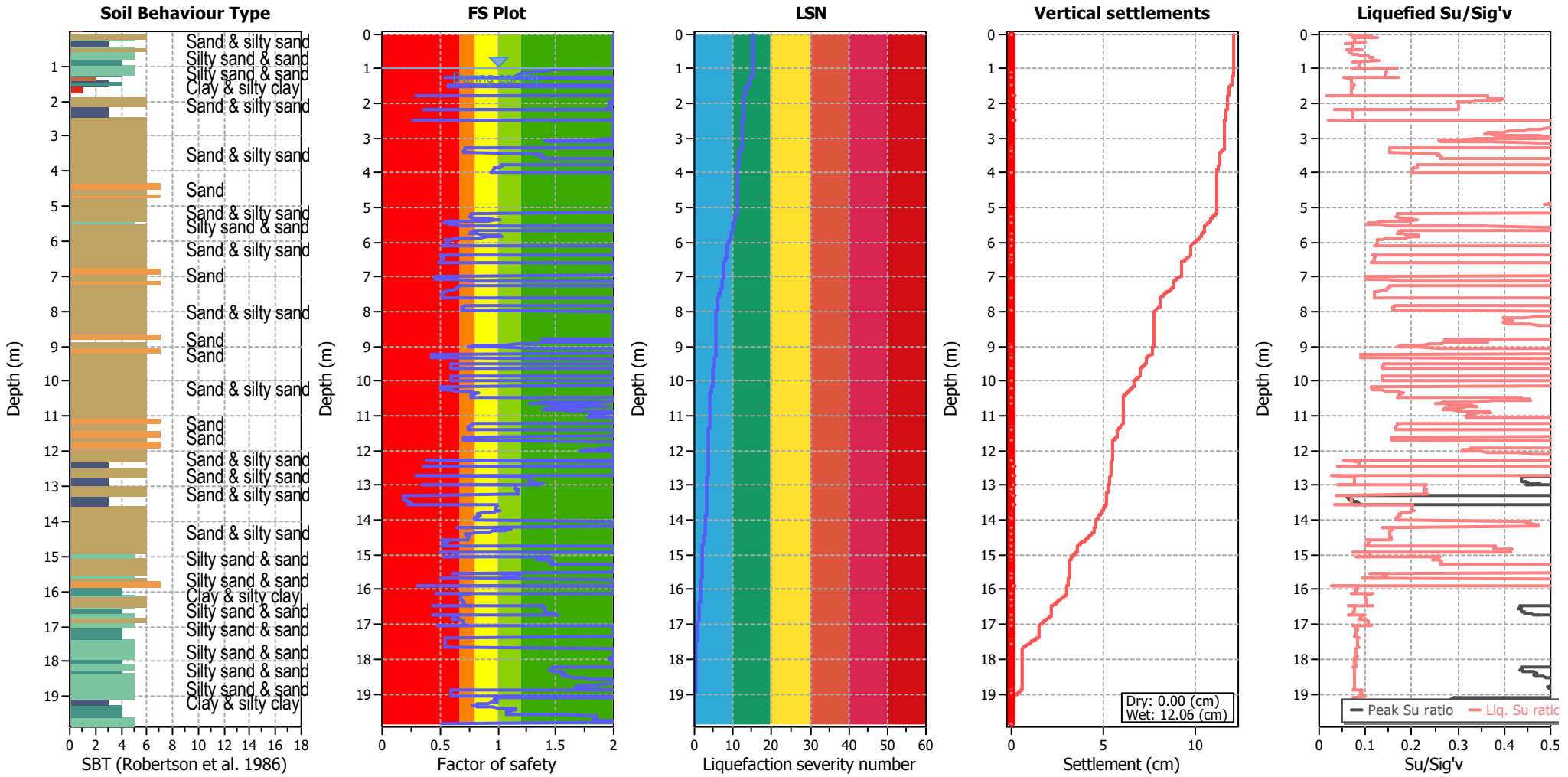


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 09 IL2
Total depth: 19.86 m

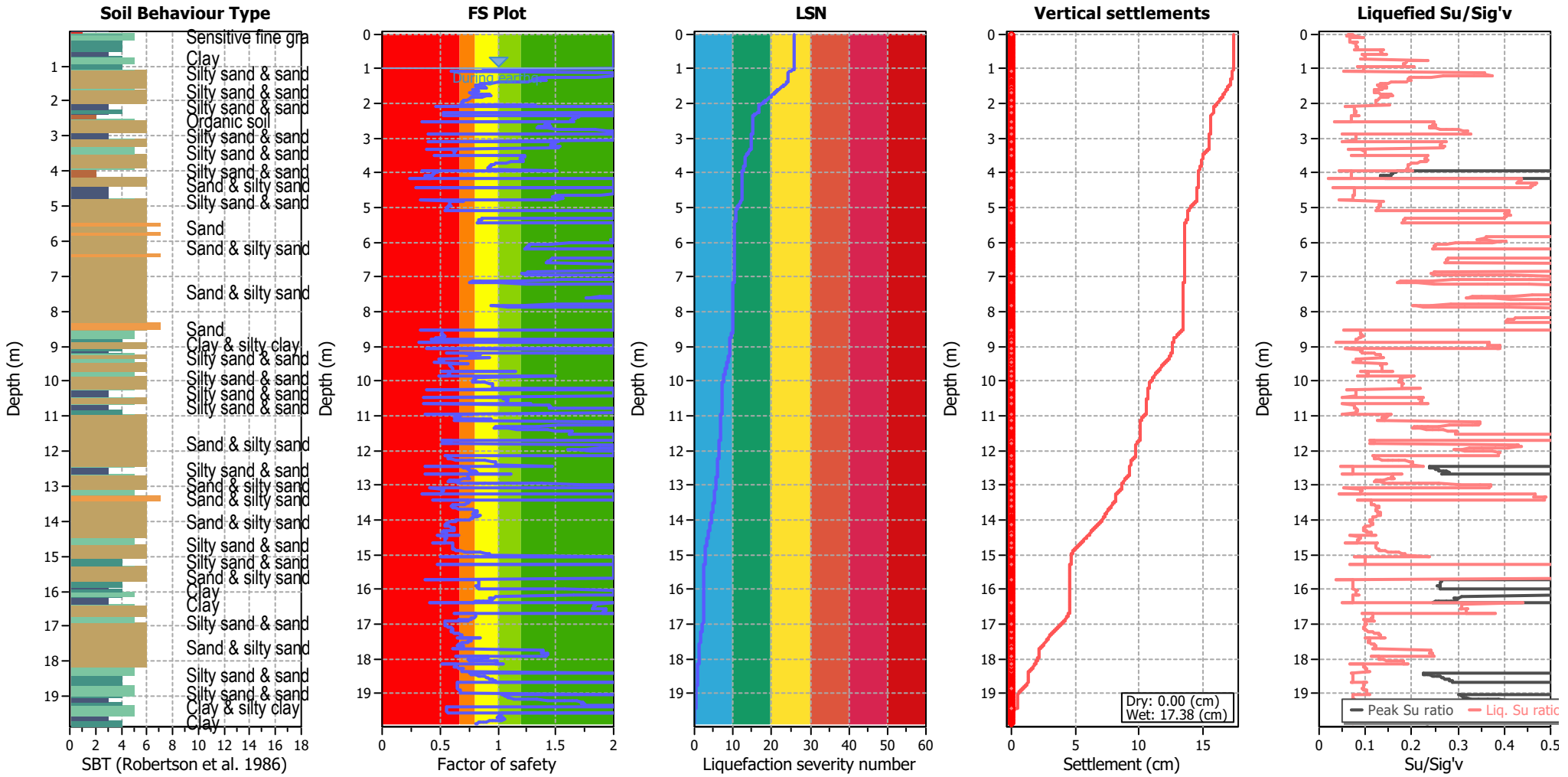


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 10 IL2
Total depth: 19.87 m

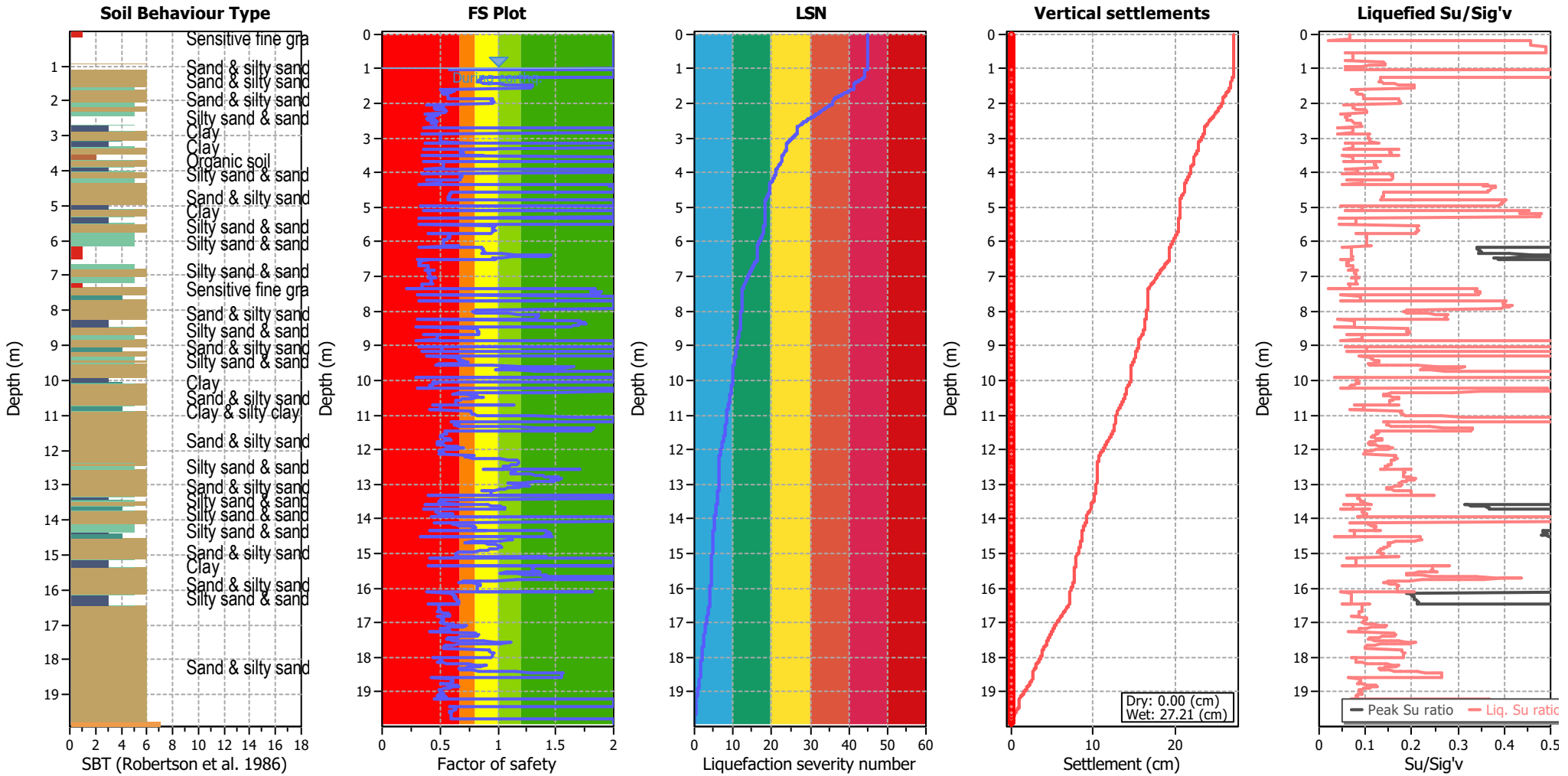


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 11 IL2
Total depth: 19.91 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

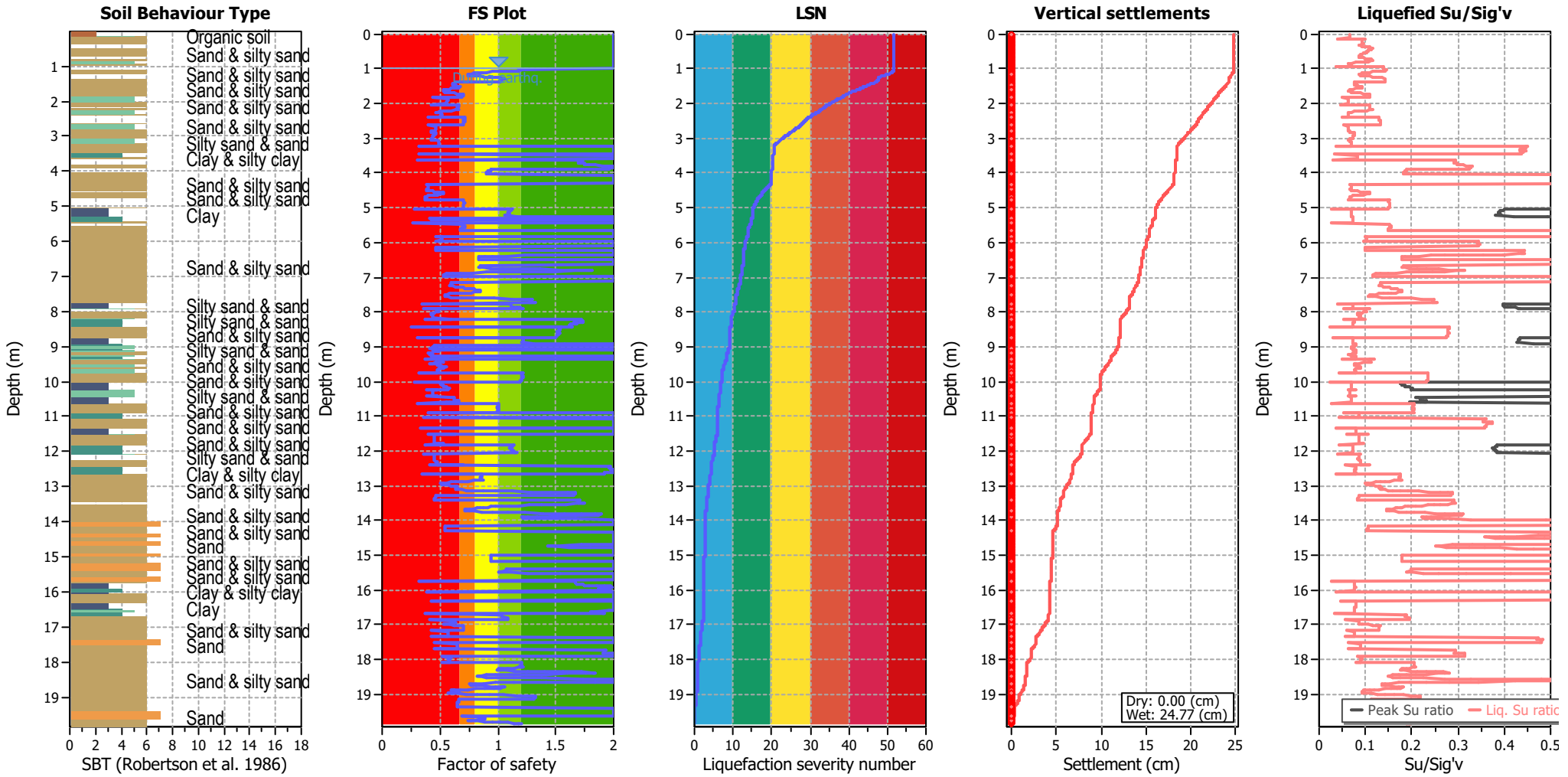
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Project: **Waikato Thoroughbred Racing | 23-1883**

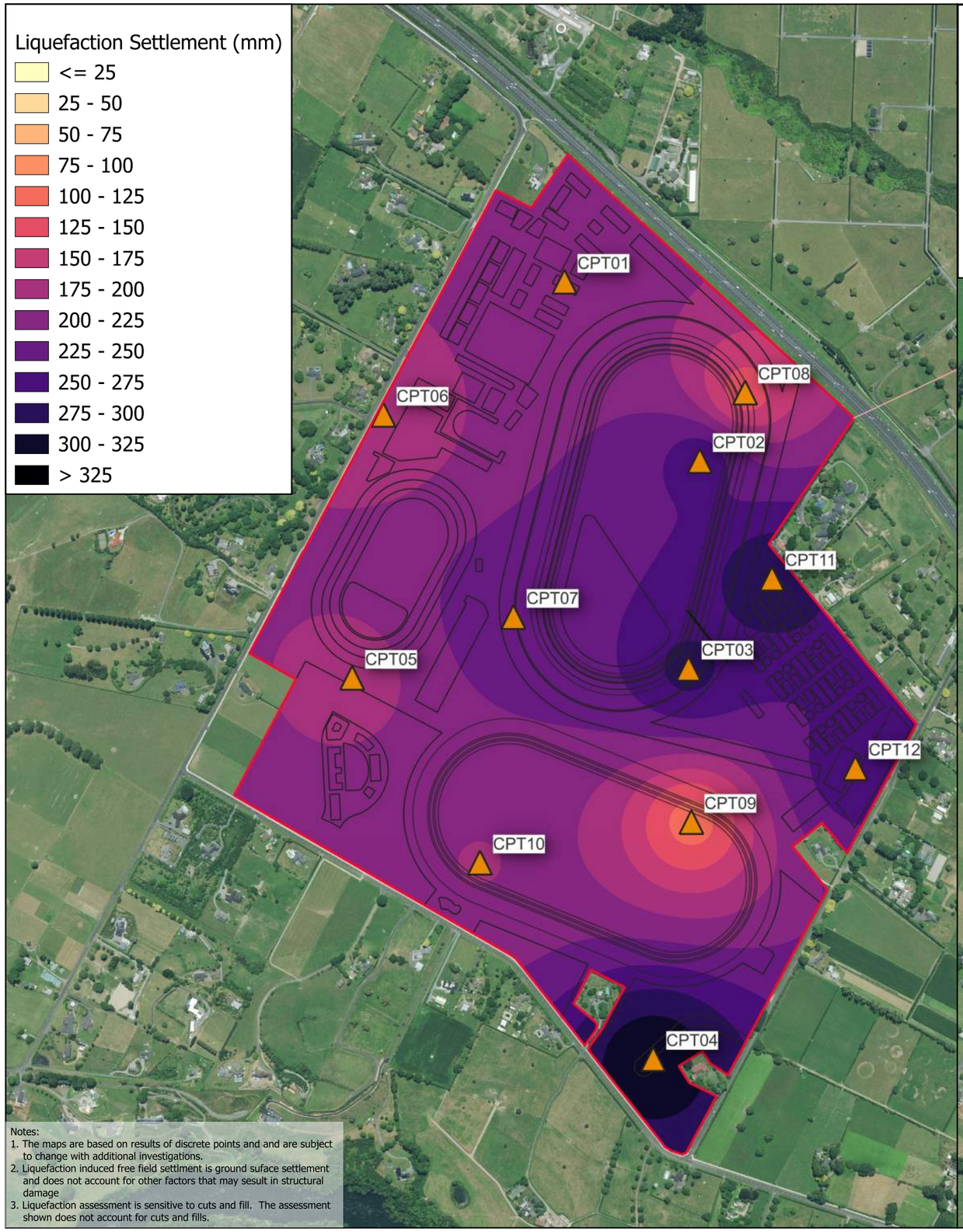
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

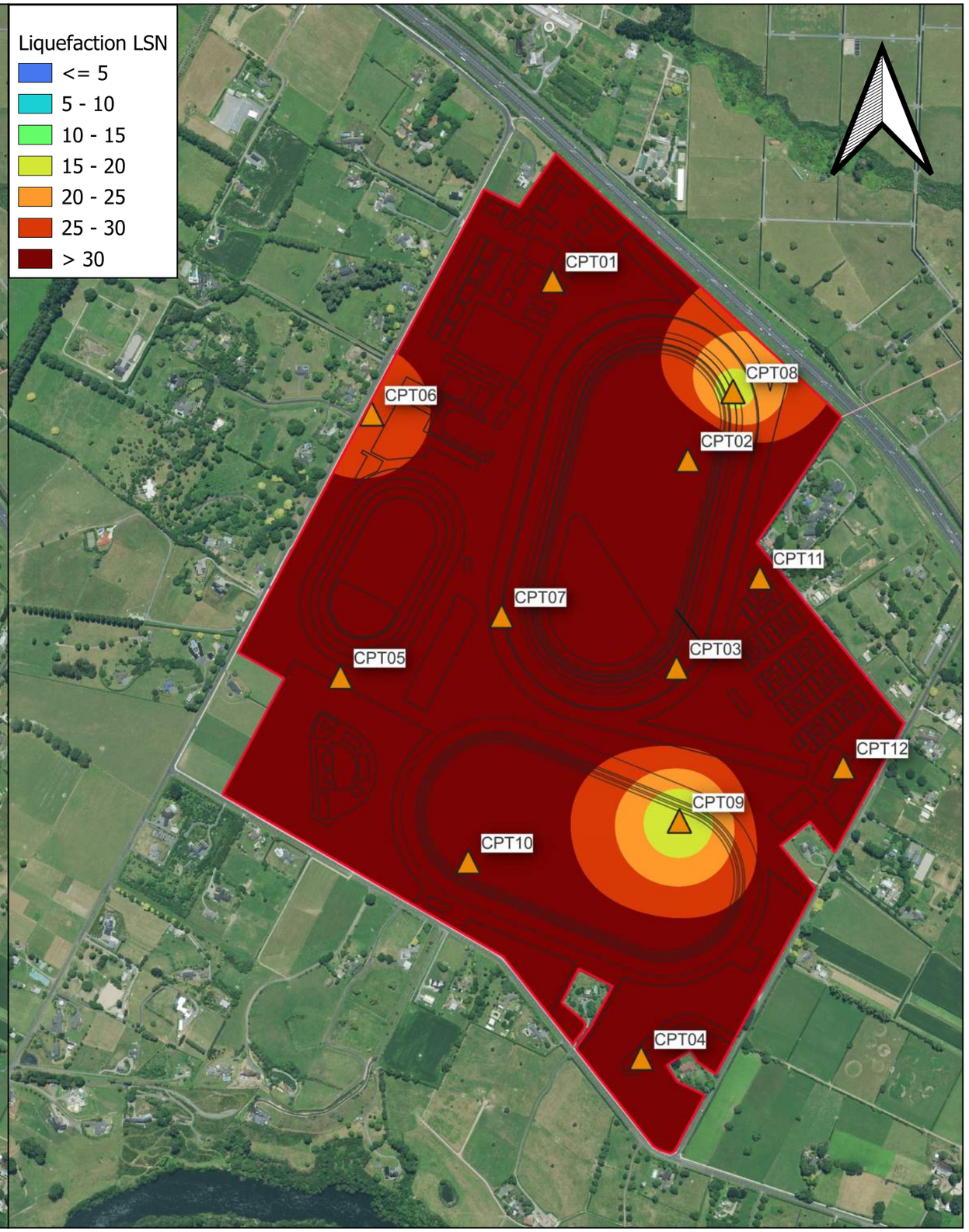
CPT: 12 IL2

Total depth: 19.85 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		





Notes:
1. The maps are based on results of discrete points and and are subject to change with additional investigations.
2. Liquefaction induced free field settlment is ground suface settlement and does not account for other factors that may sesult in structural damage
3. Liquefaction assessment is sensitive to cuts and fill. The assessment shown does not account for cuts and fills.

Client: WAIKATO THOROUGHBRED RACING — TE RAPA · CAMBRIDGE · WAIPA

Contractor:

BCD GROUP

Sheet: IL3 - Liquefaction Map

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
04	24/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	25/11/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-D03	04

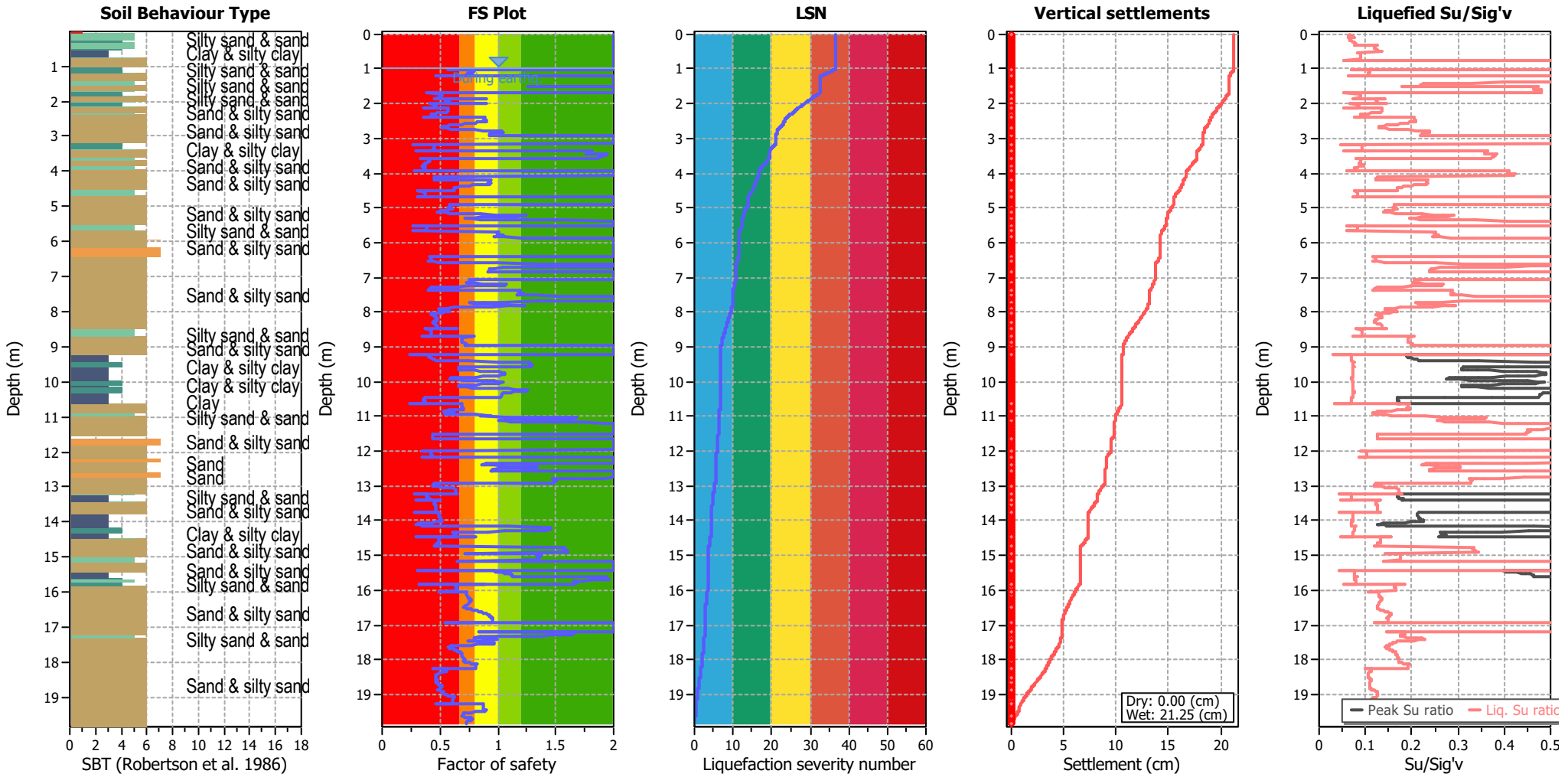
All dimensions to be verified on site before making any shop drawings or commencing any work

The copyright of this drawing remains with BCD Group

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 01 IL3
Total depth: 19.84 m

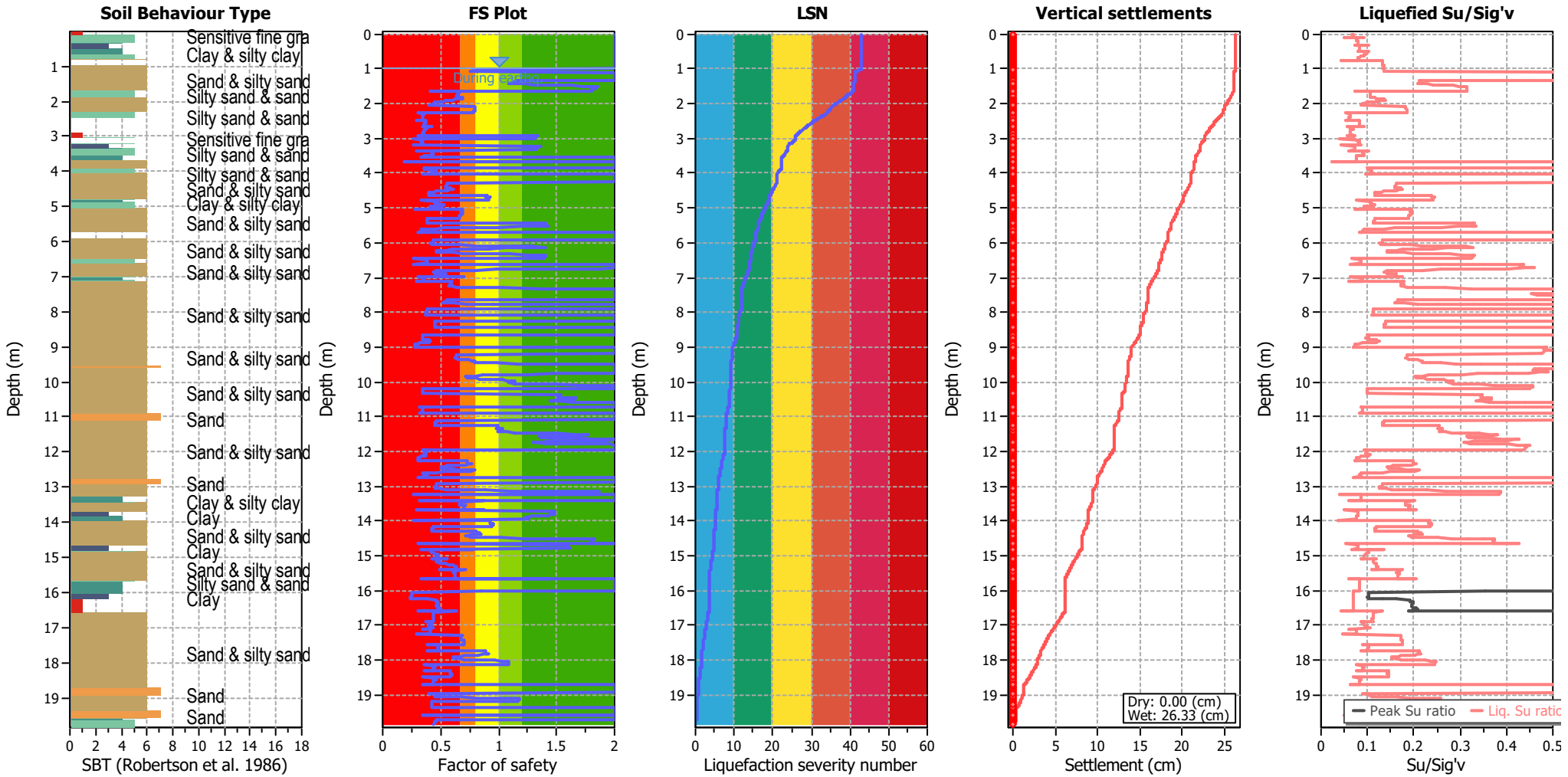


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 02 IL3
Total depth: 19.85 m

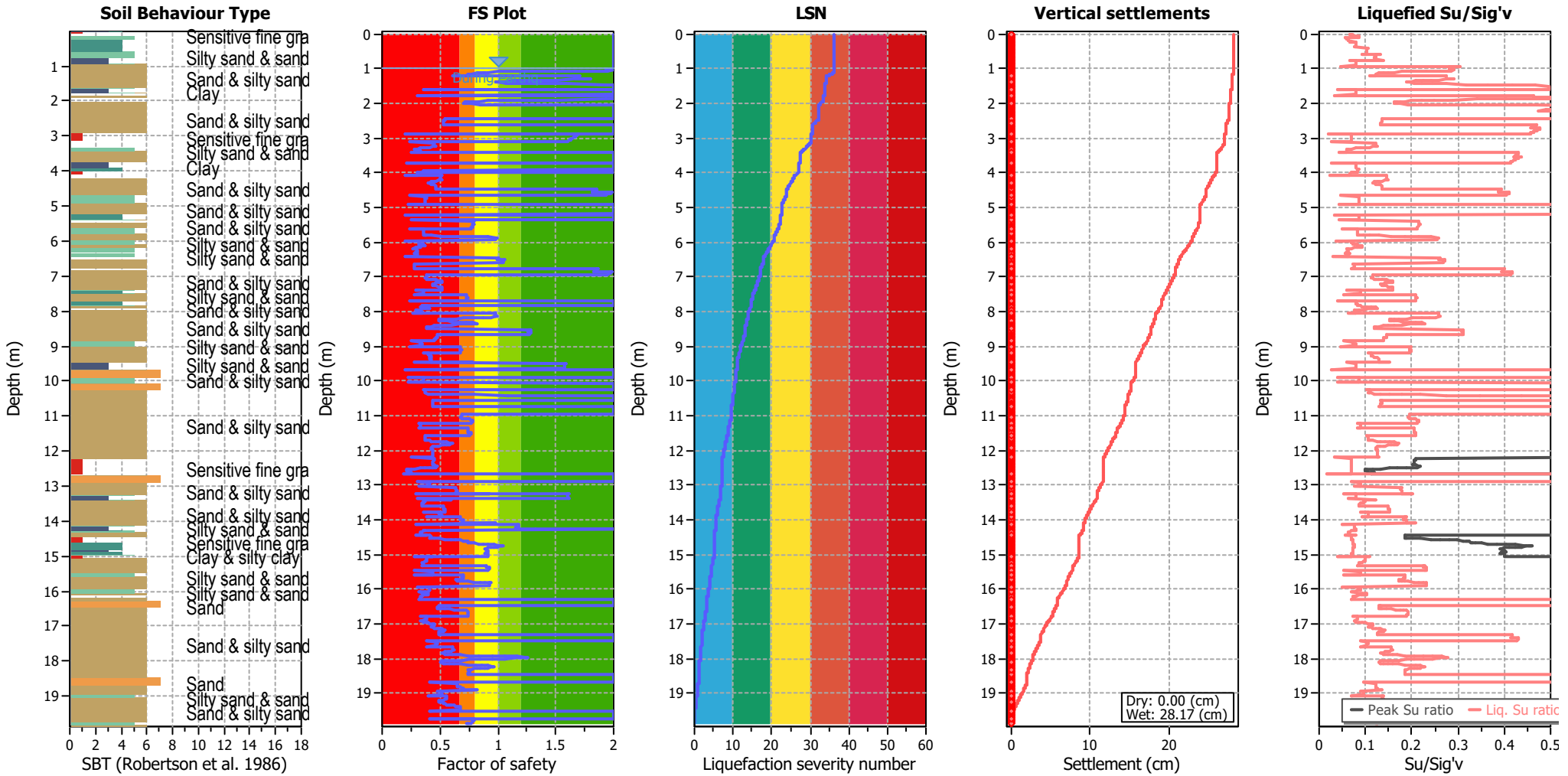


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 03 IL3
Total depth: 19.87 m

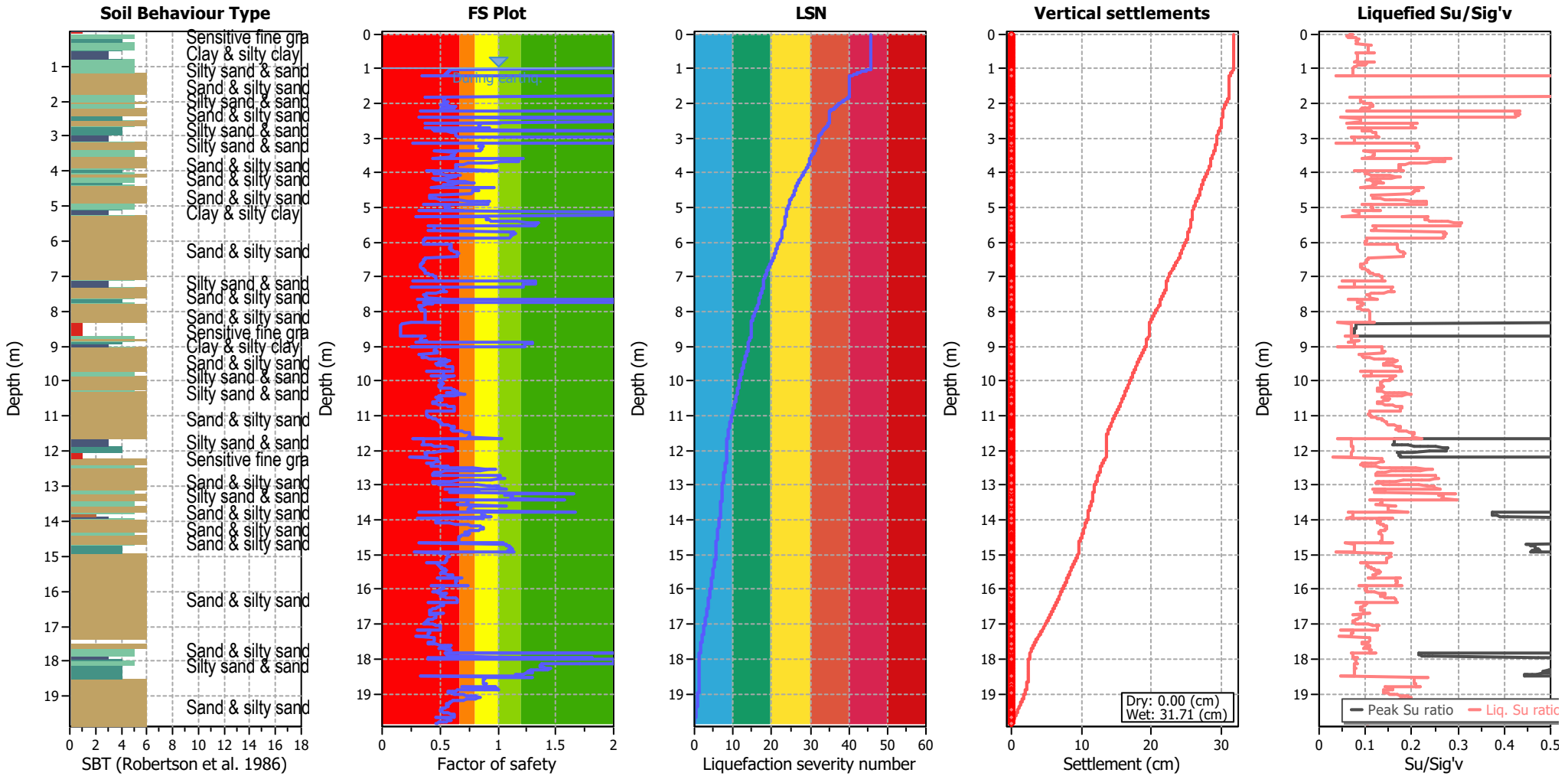


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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 04 IL3
Total depth: 19.86 m

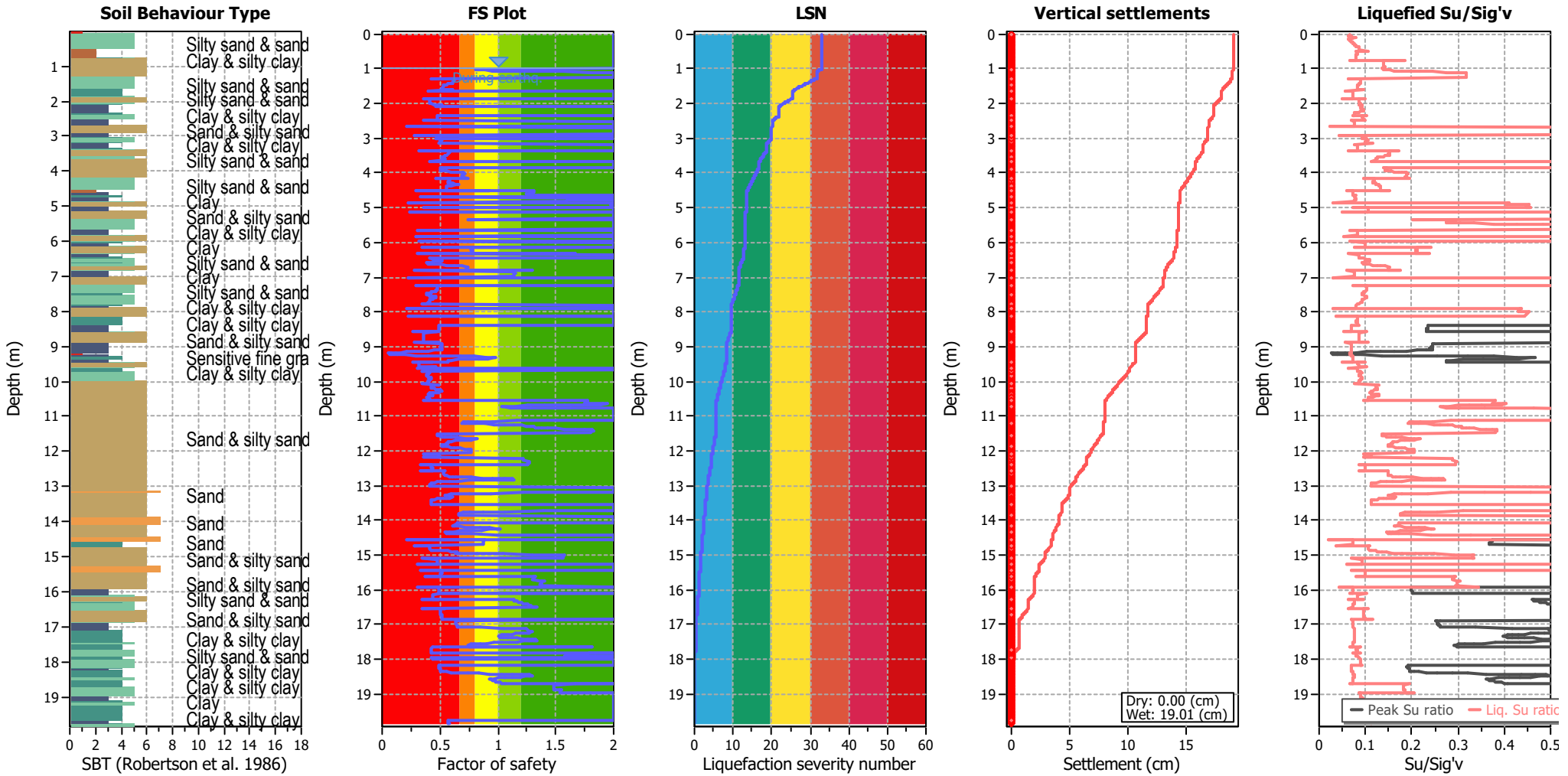


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 05 IL3
Total depth: 19.85 m

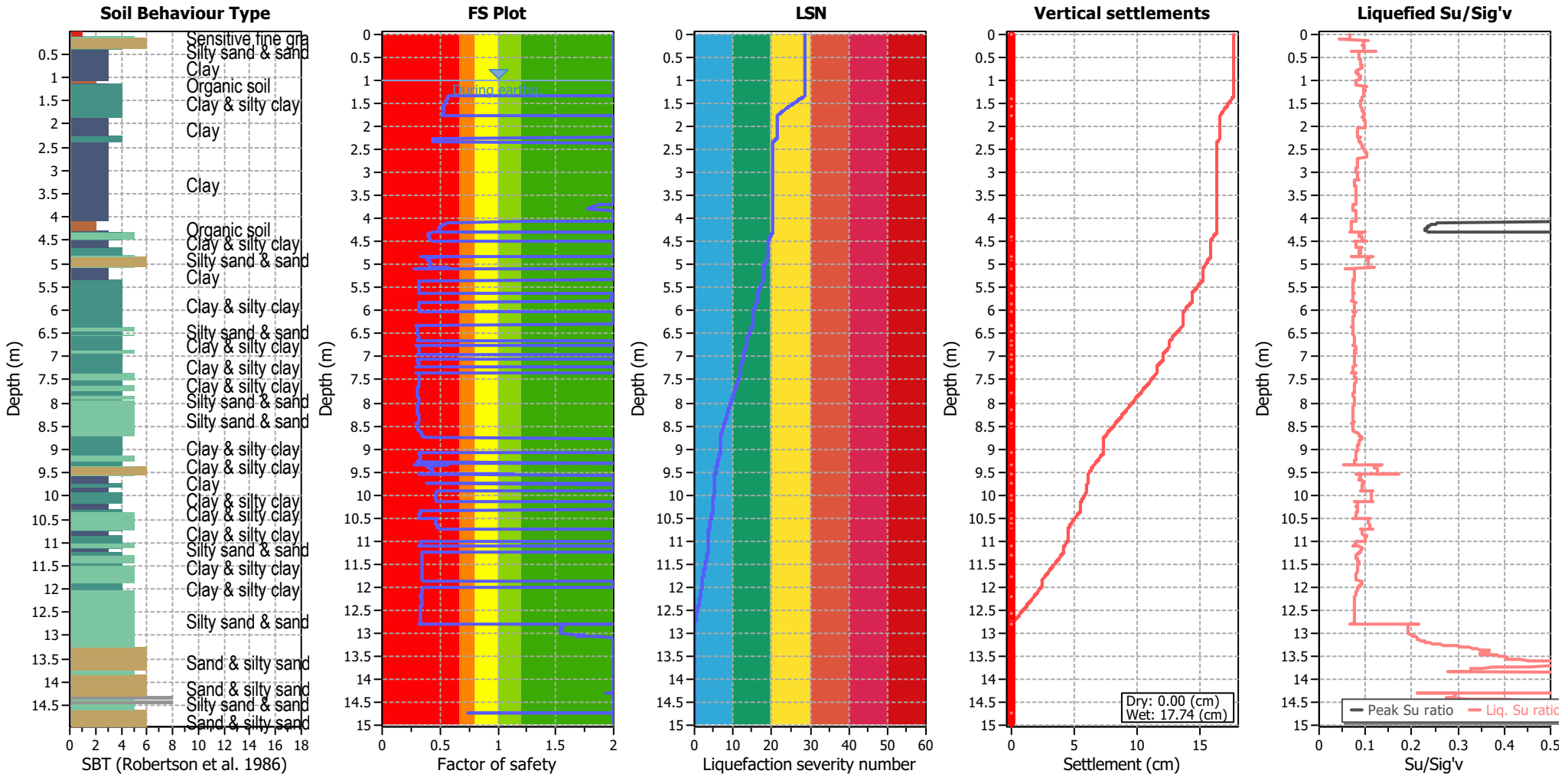


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 06 IL3
Total depth: 14.96 m

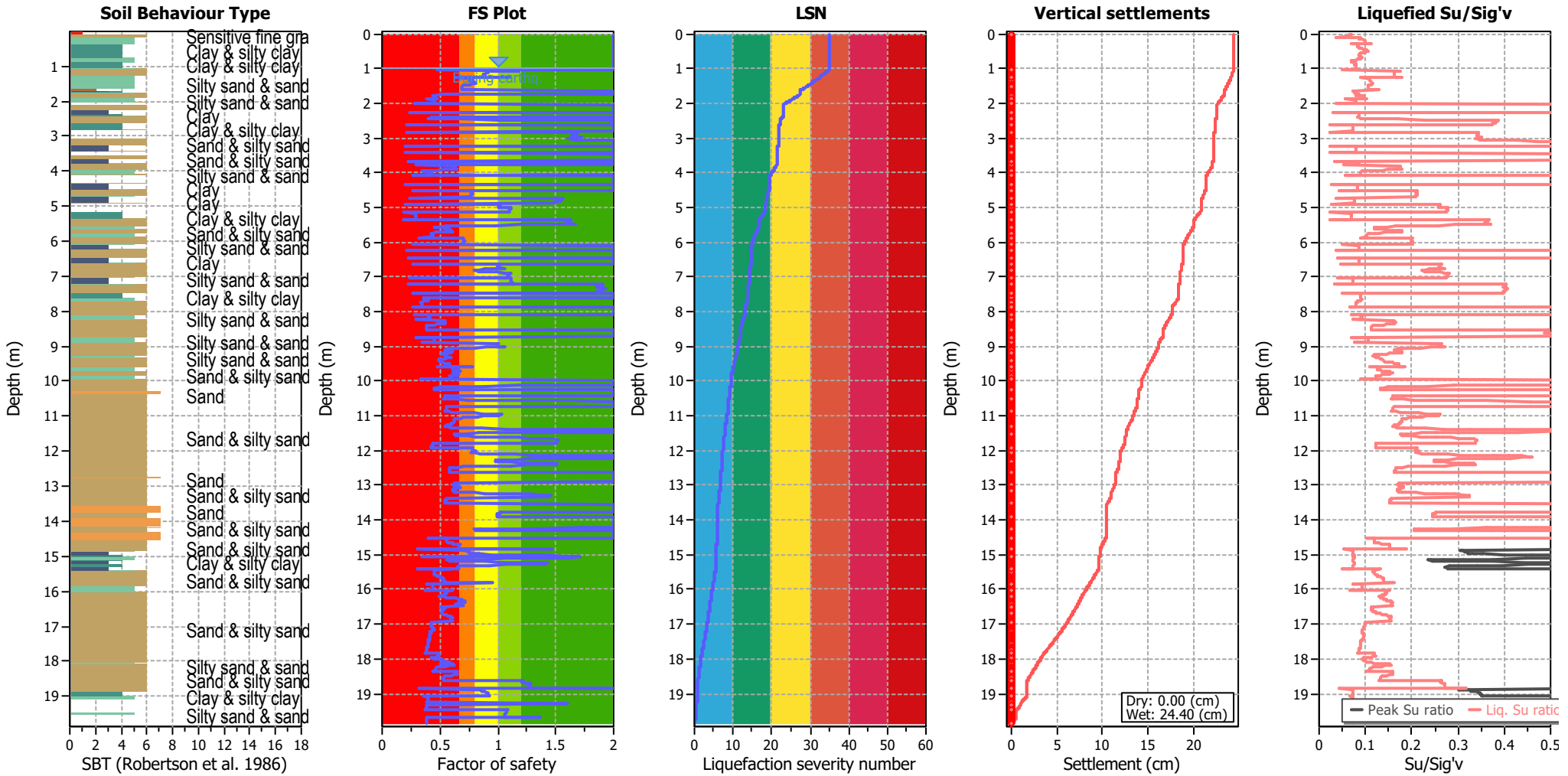


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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 07 IL3
Total depth: 19.86 m

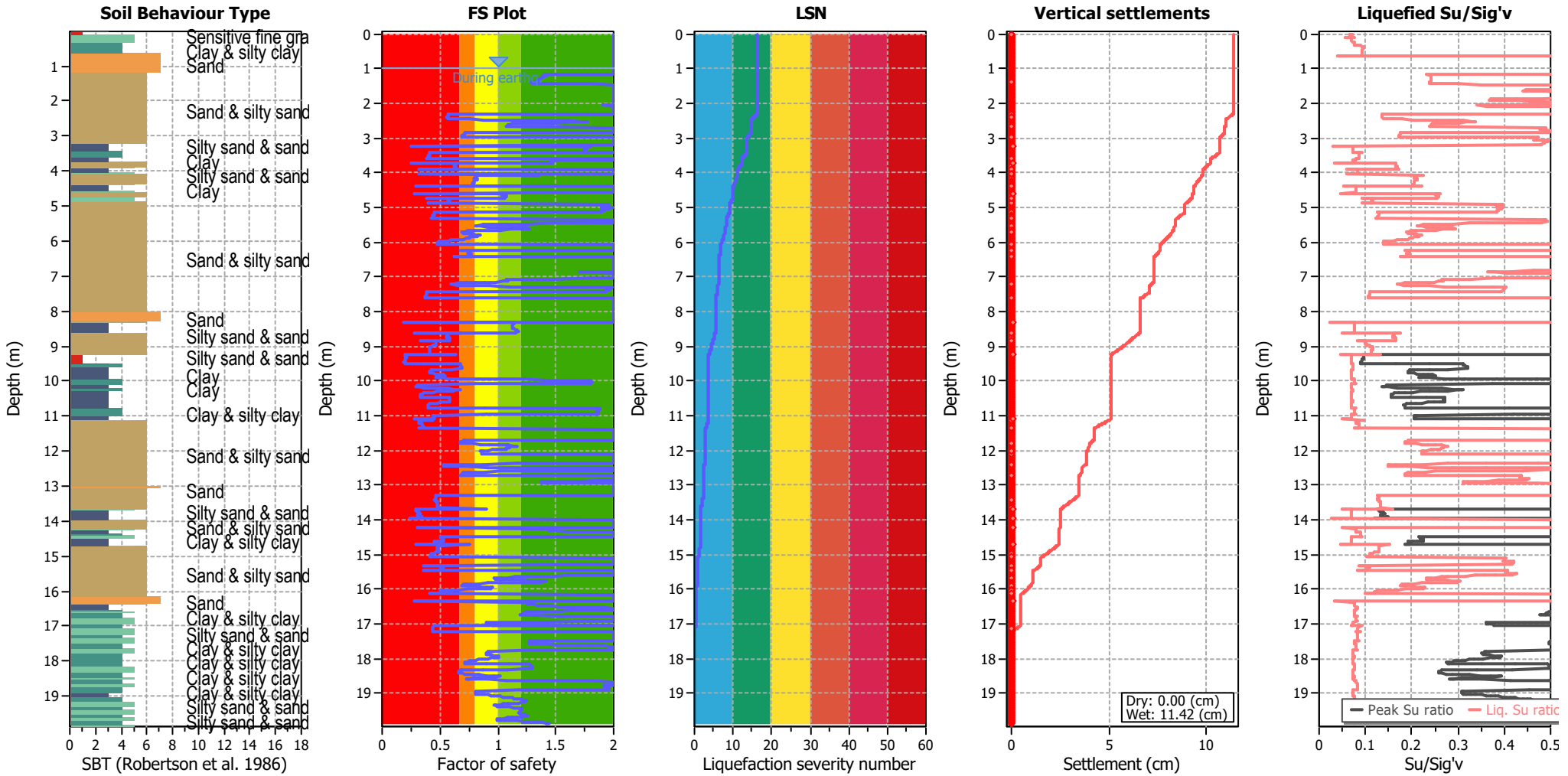


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 08 IL3
Total depth: 19.87 m

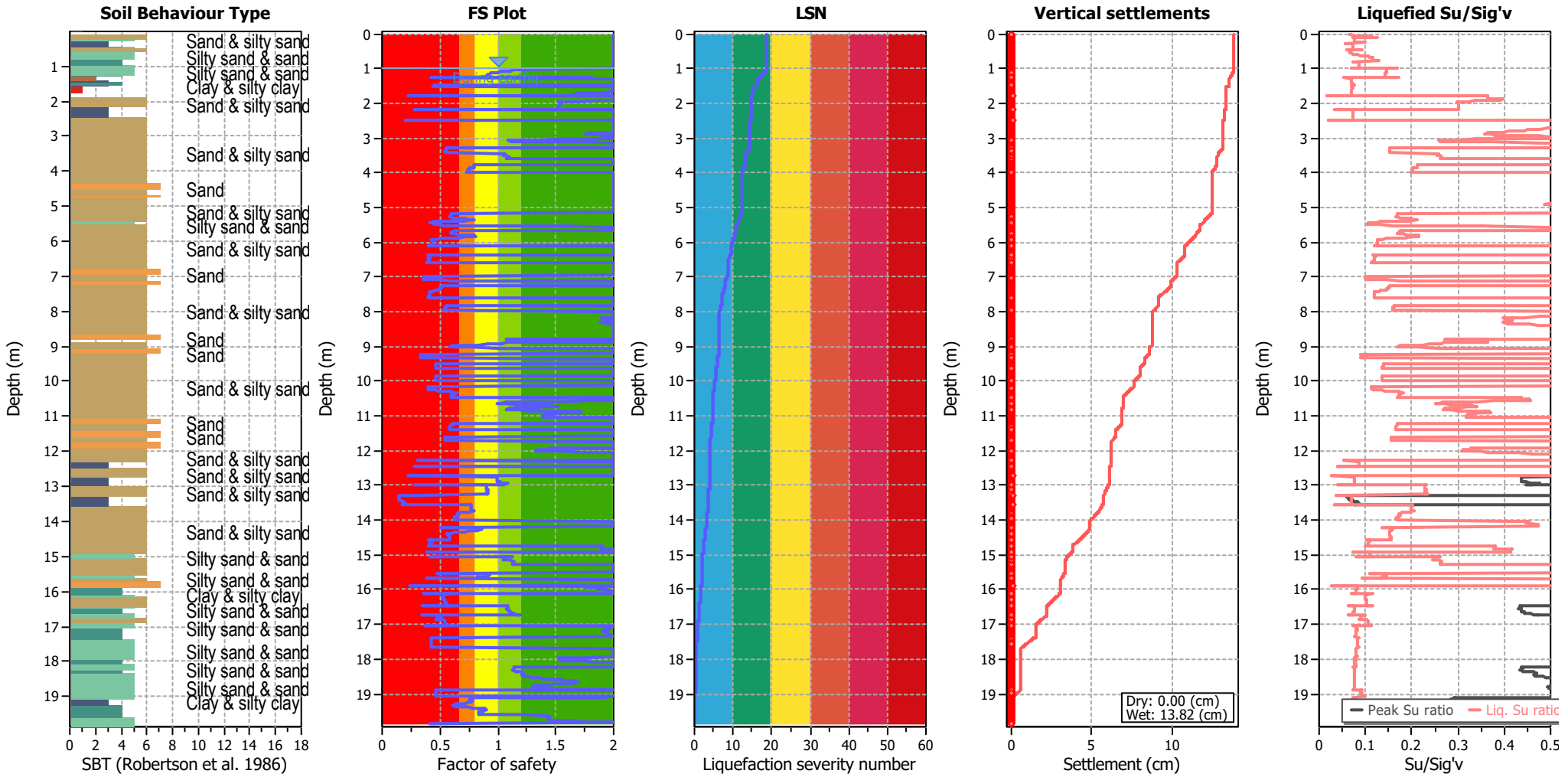


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 09 IL3
Total depth: 19.86 m

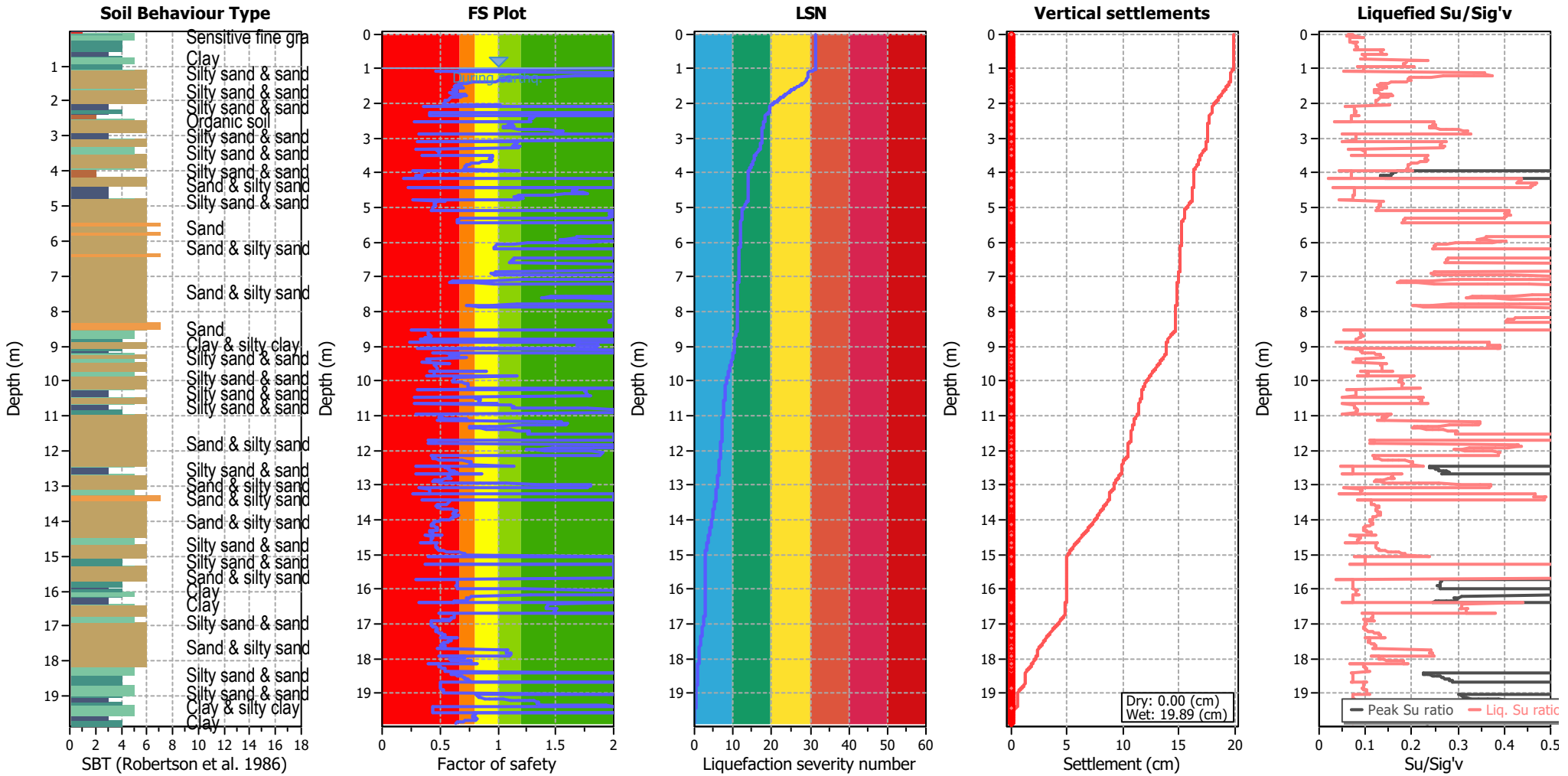


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 10 IL3
Total depth: 19.87 m

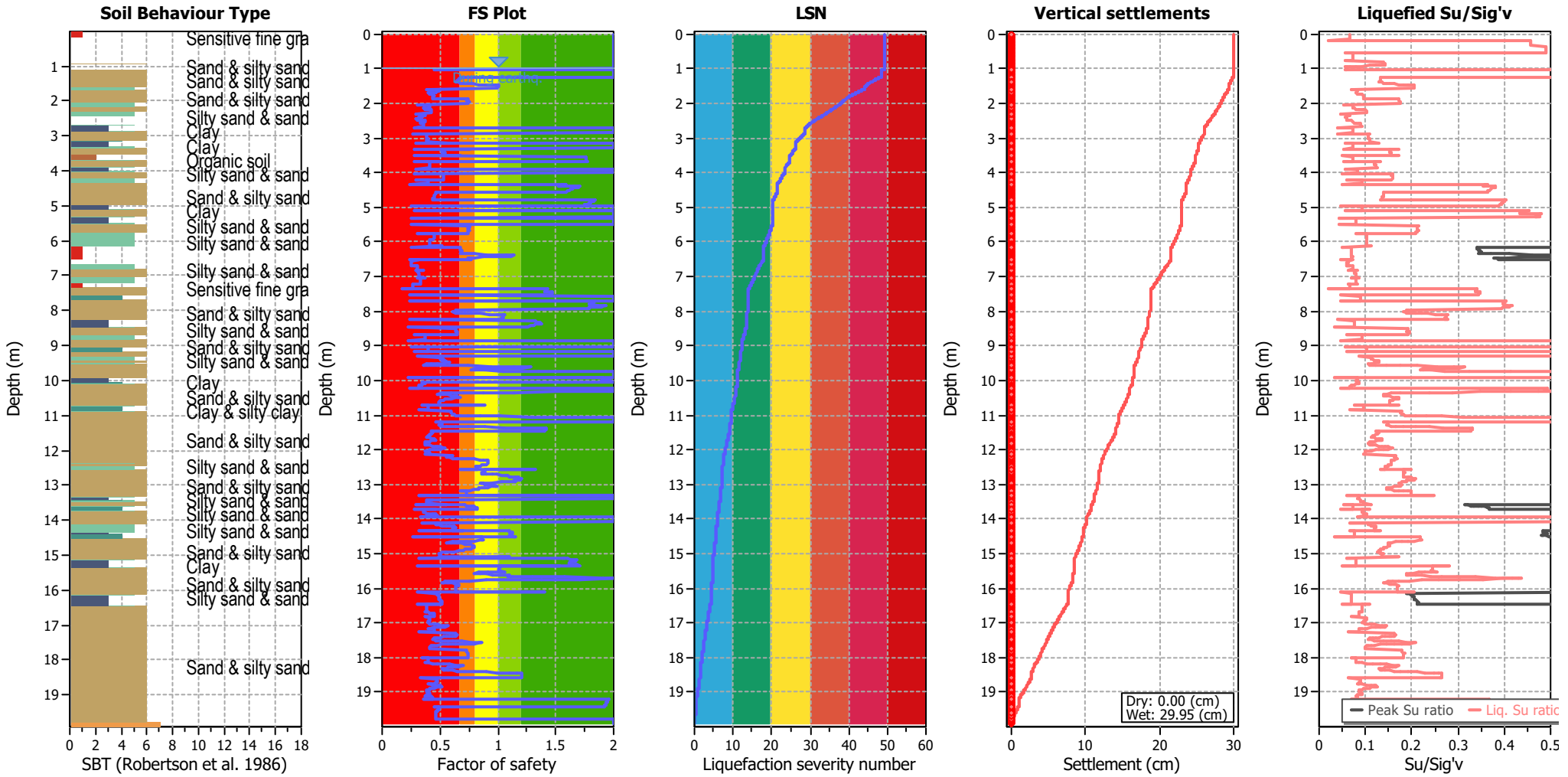


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

CPT: 11 IL3
Total depth: 19.91 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

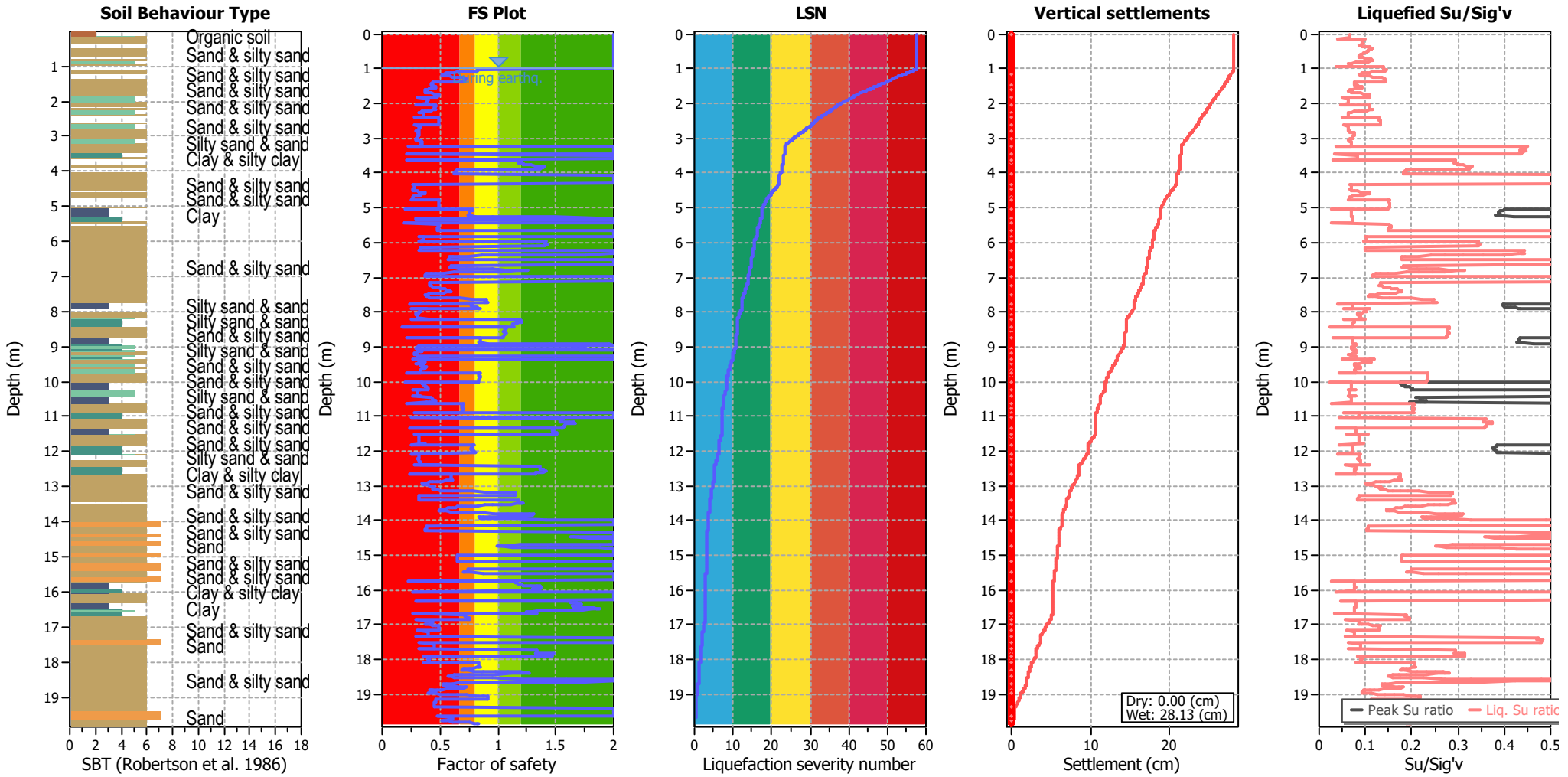
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Project: **Waikato Thoroughbred Racing | 23-1883**

Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

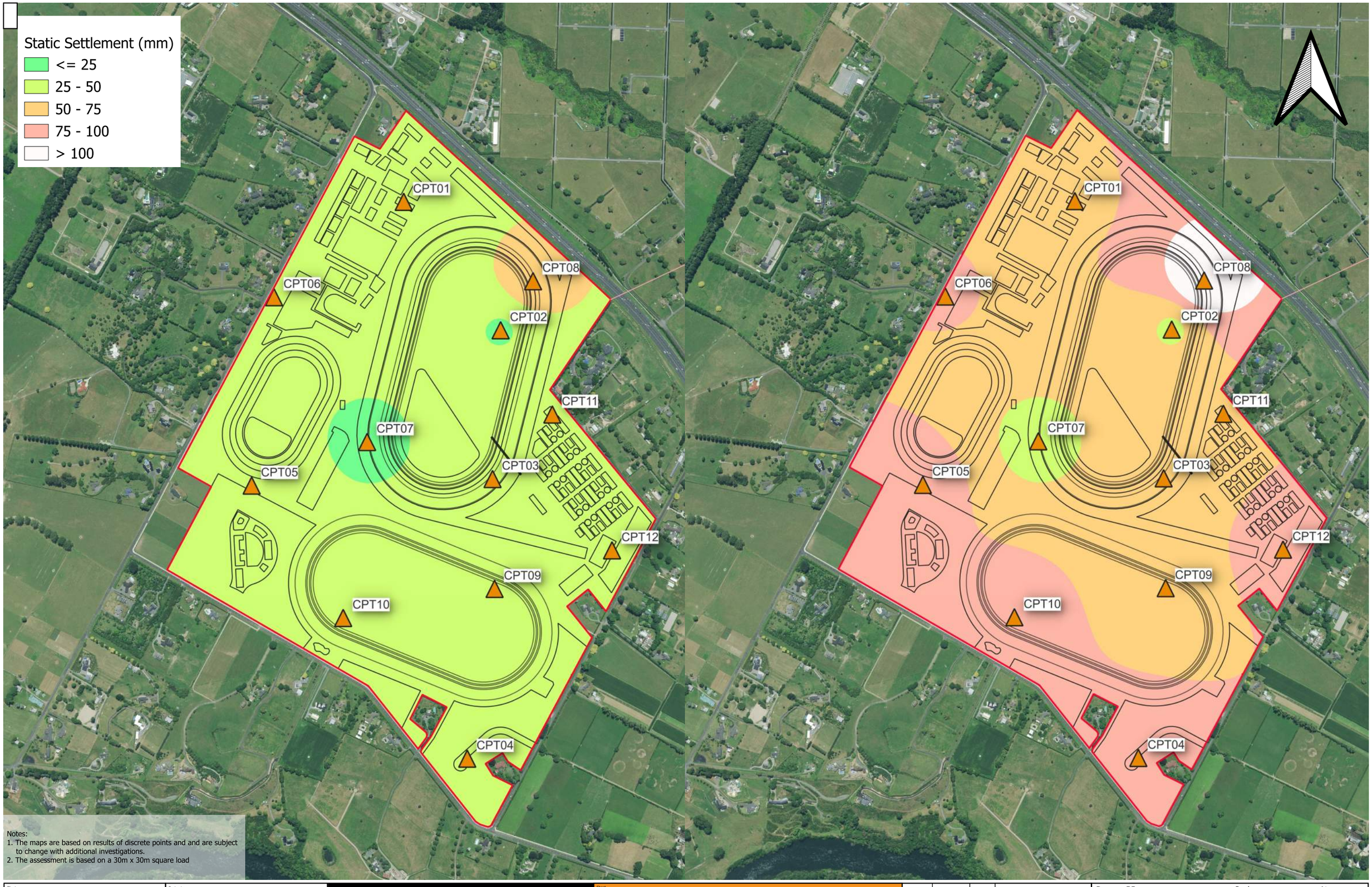
CPT: 12 IL3

Total depth: 19.85 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Appendix E Settlement Assessment



Client: WAIKATO THOROUGHBRED RACING — TE HAPA · CAMBRIDGE · WAIPA

Contractor:

BCD GROUP

Sheet: Static Settlment Map - 20kPa & 40kPa Loads

Project Title: Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
04	24/08/2026	BB	Substantive Application
03	27/02/2026	BB	Fast Track Referral Application
02	16/12/2025	BB	Master Planning
01	25/11/2025	BB	Master Planning

Drawn: BB
Engineer: BB
Scale: 10,000
At: A3

Job Number:	Sheet Number:	Revision:
23-1883	G-E01	04

All dimensions to be verified on site before making any shop drawings or commencing any work

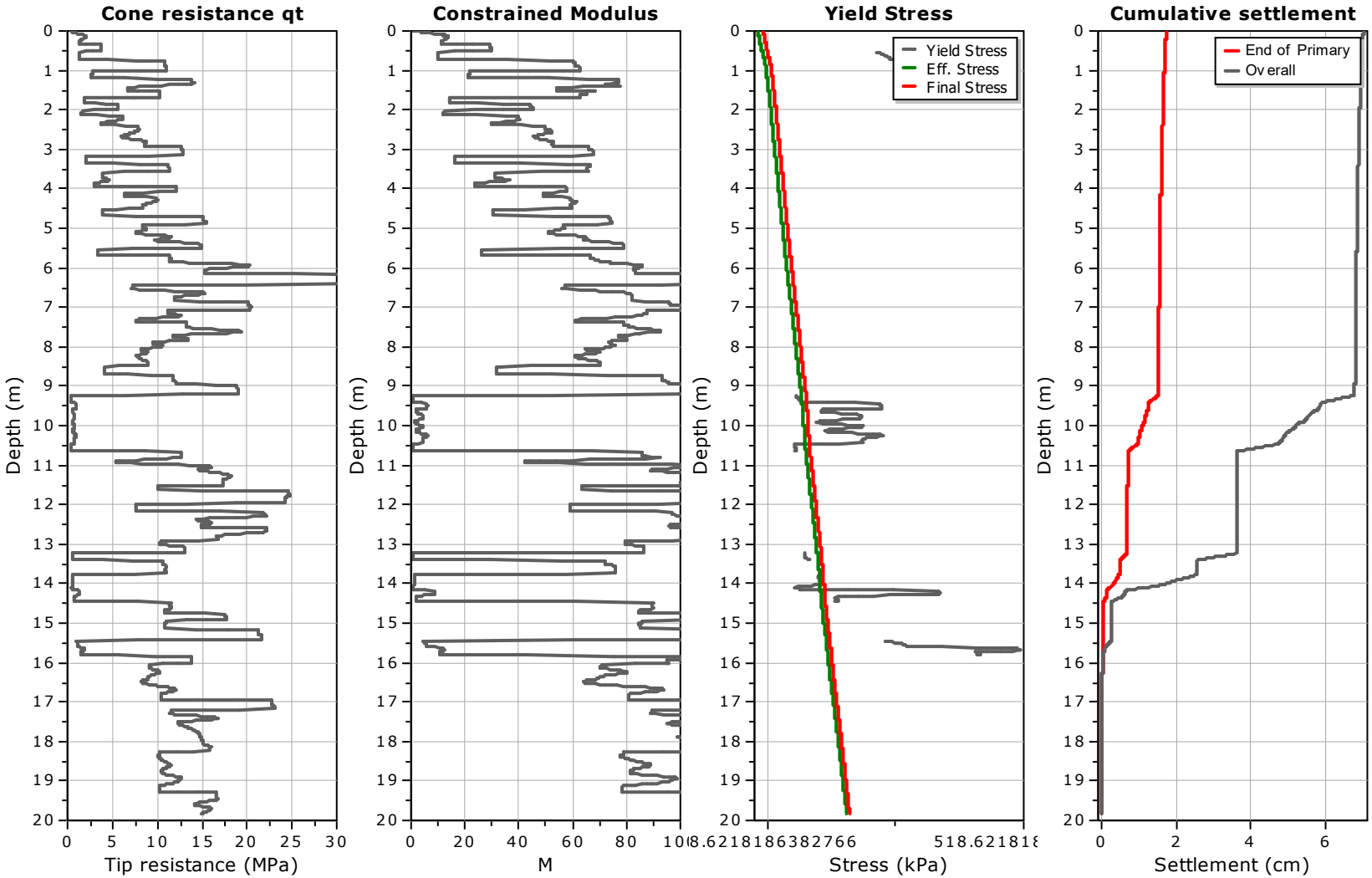
The copyright of this drawing remains with BCD Group

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CPT: 01
Total depth: 19.84 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 0.93 m
Coords: X:1809851.42, Y:5807879.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.76
Total secondary settlement: 5.28

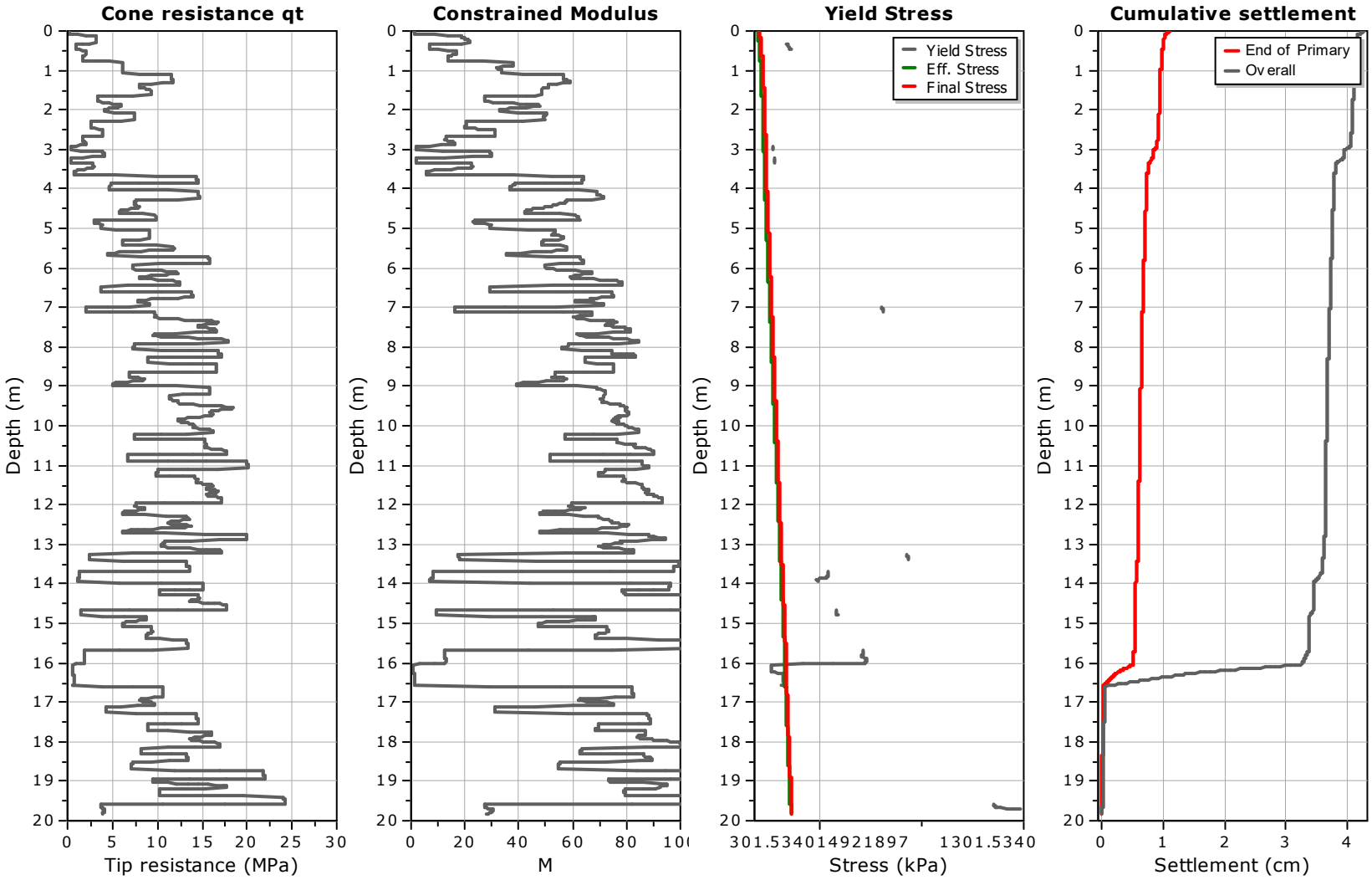
Total calculated settlement: 7.04

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CPT: 02
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 0.93 m
Coords: X:1810134.72, Y:5807503.19
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 1.12
Total secondary settlement: 3.15

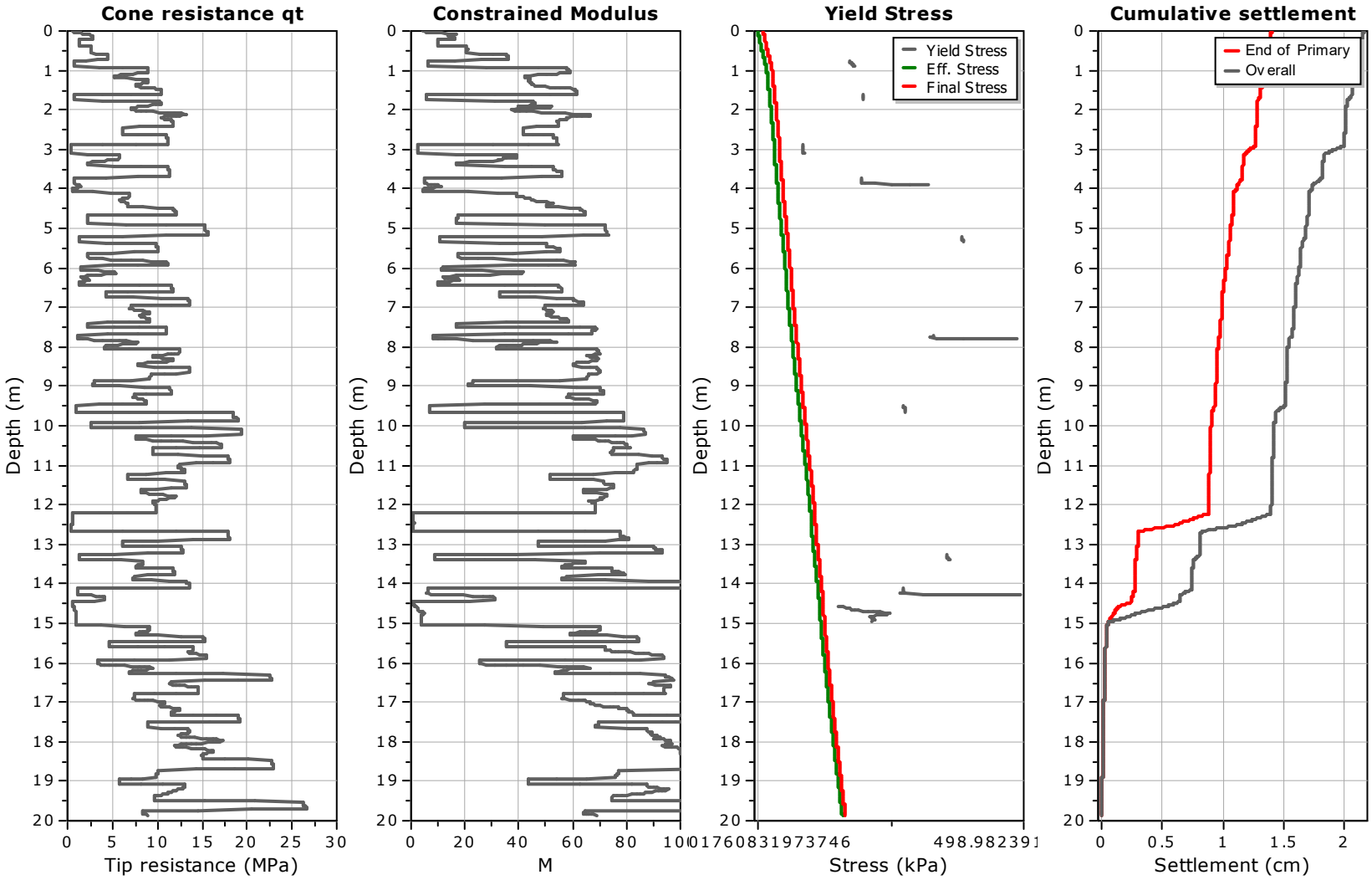
Total calculated settlement: 4.27

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CPT: 03
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.00 m
Coords: X:1810111.74, Y:5807067.73
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.40
Total secondary settlement: 0.76

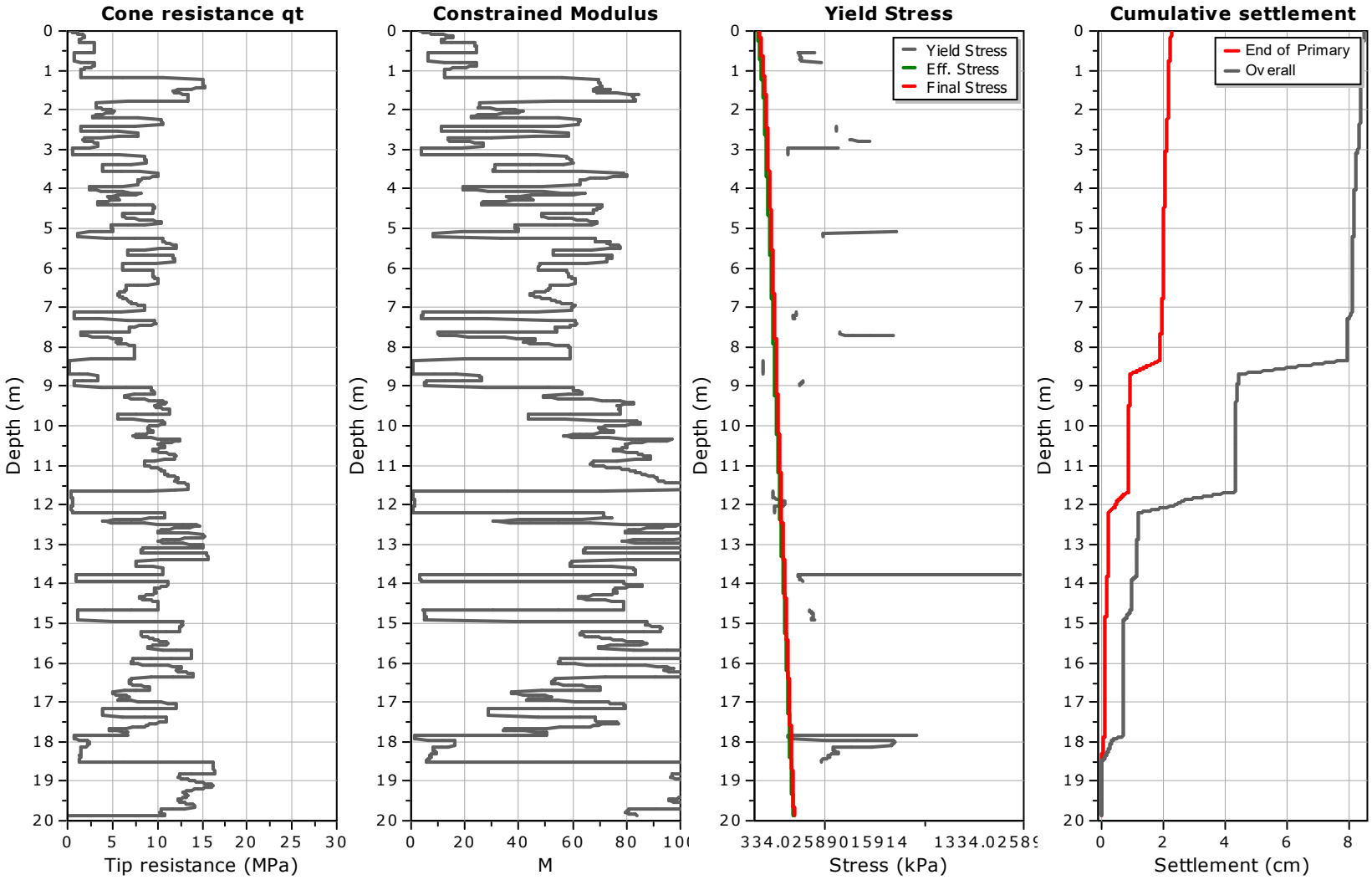
Total calculated settlement: 2.16

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CPT: 04
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.78 m
Coords: X:1810037.64, Y:5806248.35
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

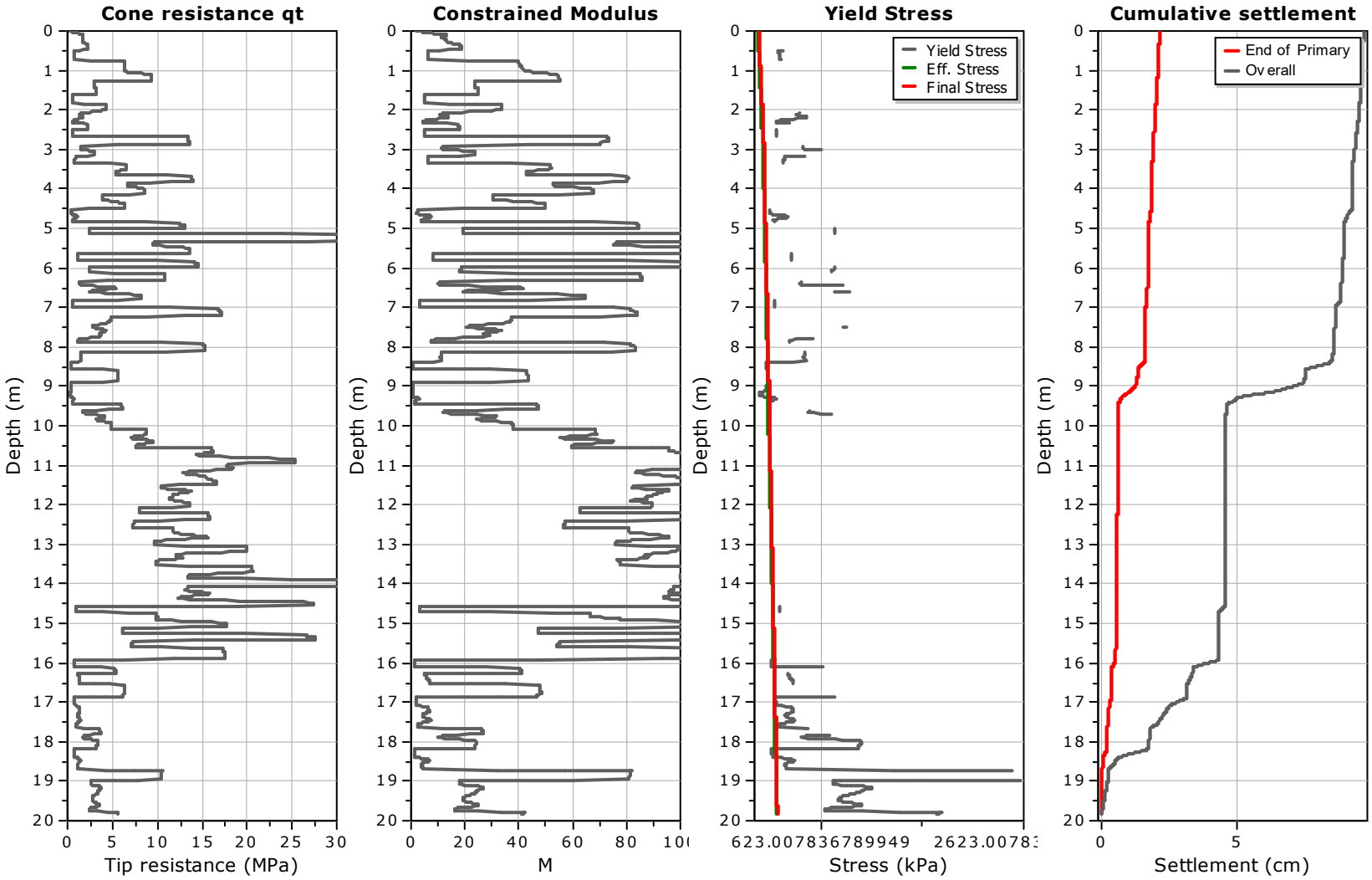
where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 2.27
Total secondary settlement: 6.24

Total calculated settlement: 8.51

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 2.17
Total secondary settlement: 7.53

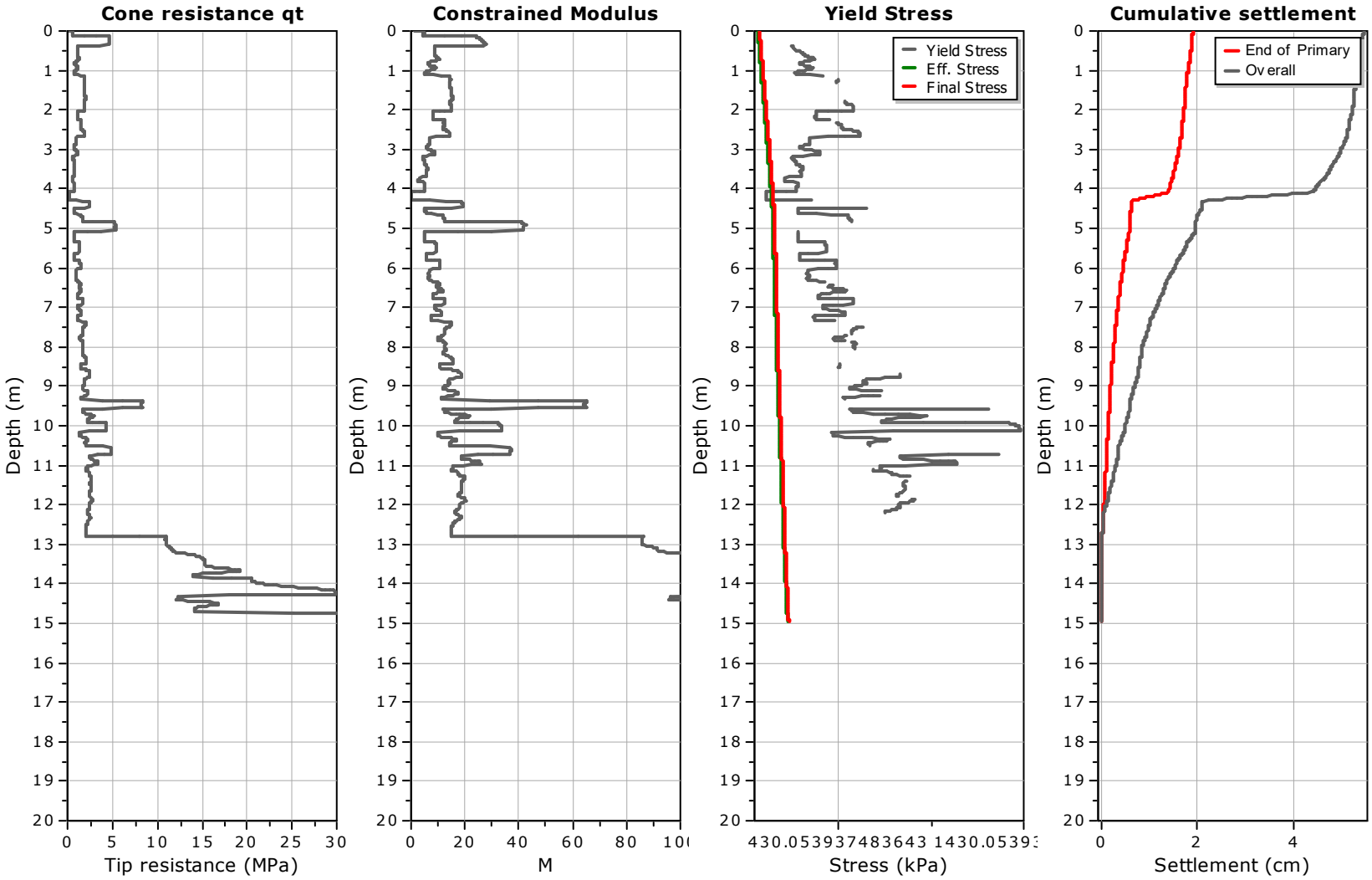
Total calculated settlement: 9.69

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CPT: 06
Total depth: 14.96 m, Date: 19/11/2025
Surface Elevation: 58.00 m, Est. GWL: 4.50 m
Coords: X:1809471.71, Y:5807600.07
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.91
Total secondary settlement: 3.55

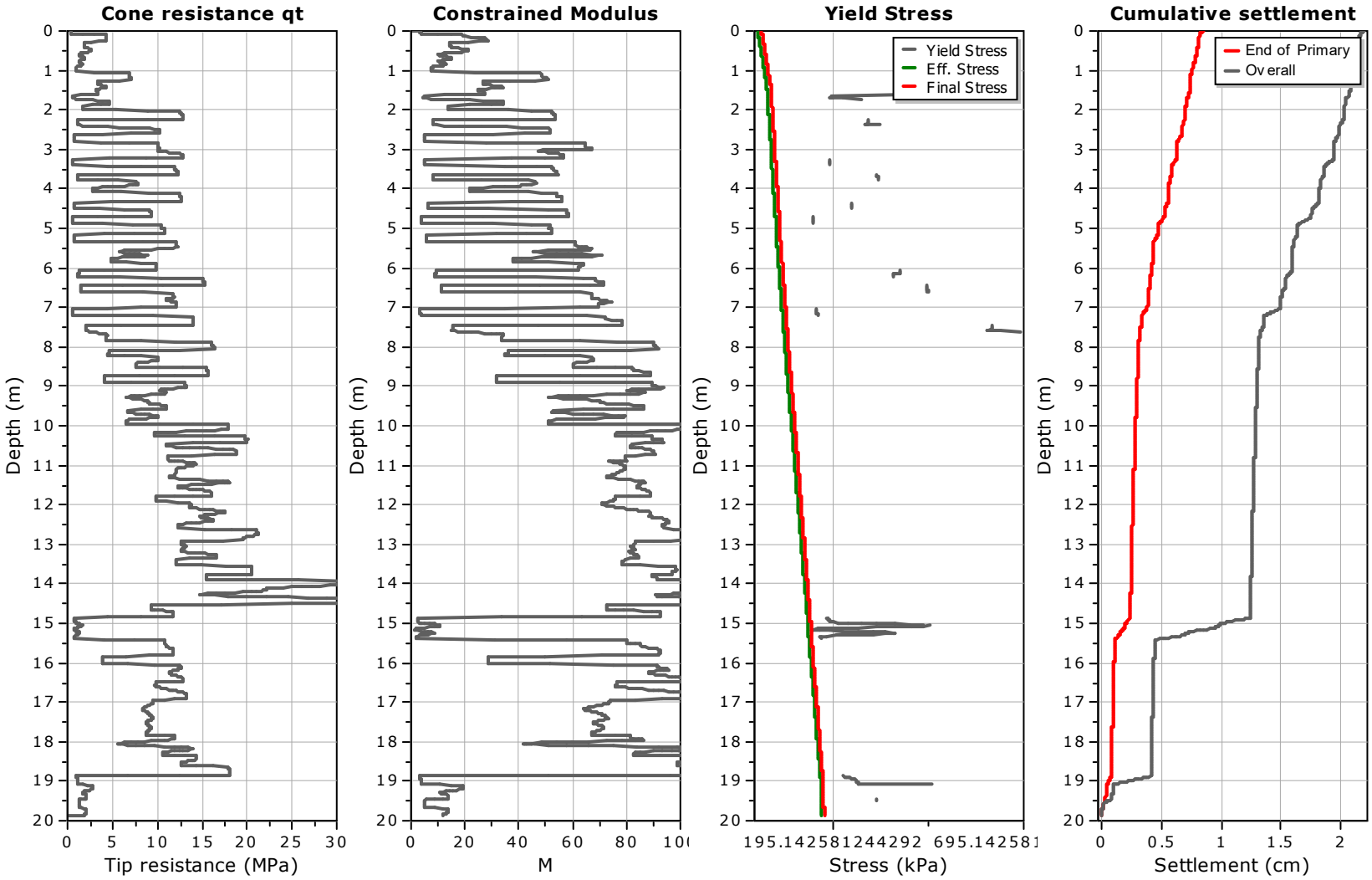
Total calculated settlement: 5.46

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CPT: 07
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.38 m
Coords: X:1809744.75, Y:5807176.51
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 0.85
Total secondary settlement: 1.34

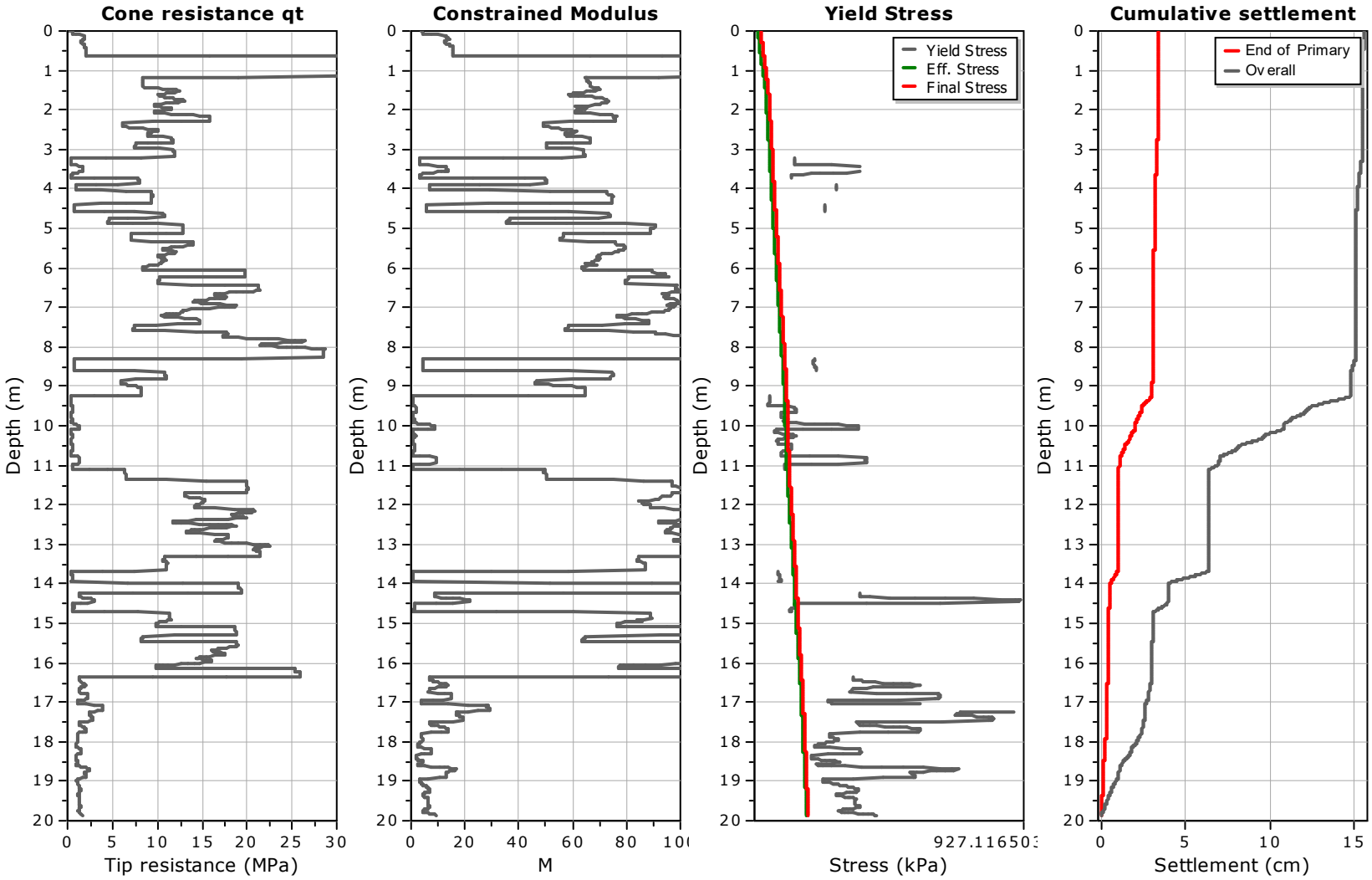
Total calculated settlement: 2.19

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CPT: 08
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.50 m
Coords: X:1810229.77, Y:5807646.78
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 3.41
Total secondary settlement: 12.15

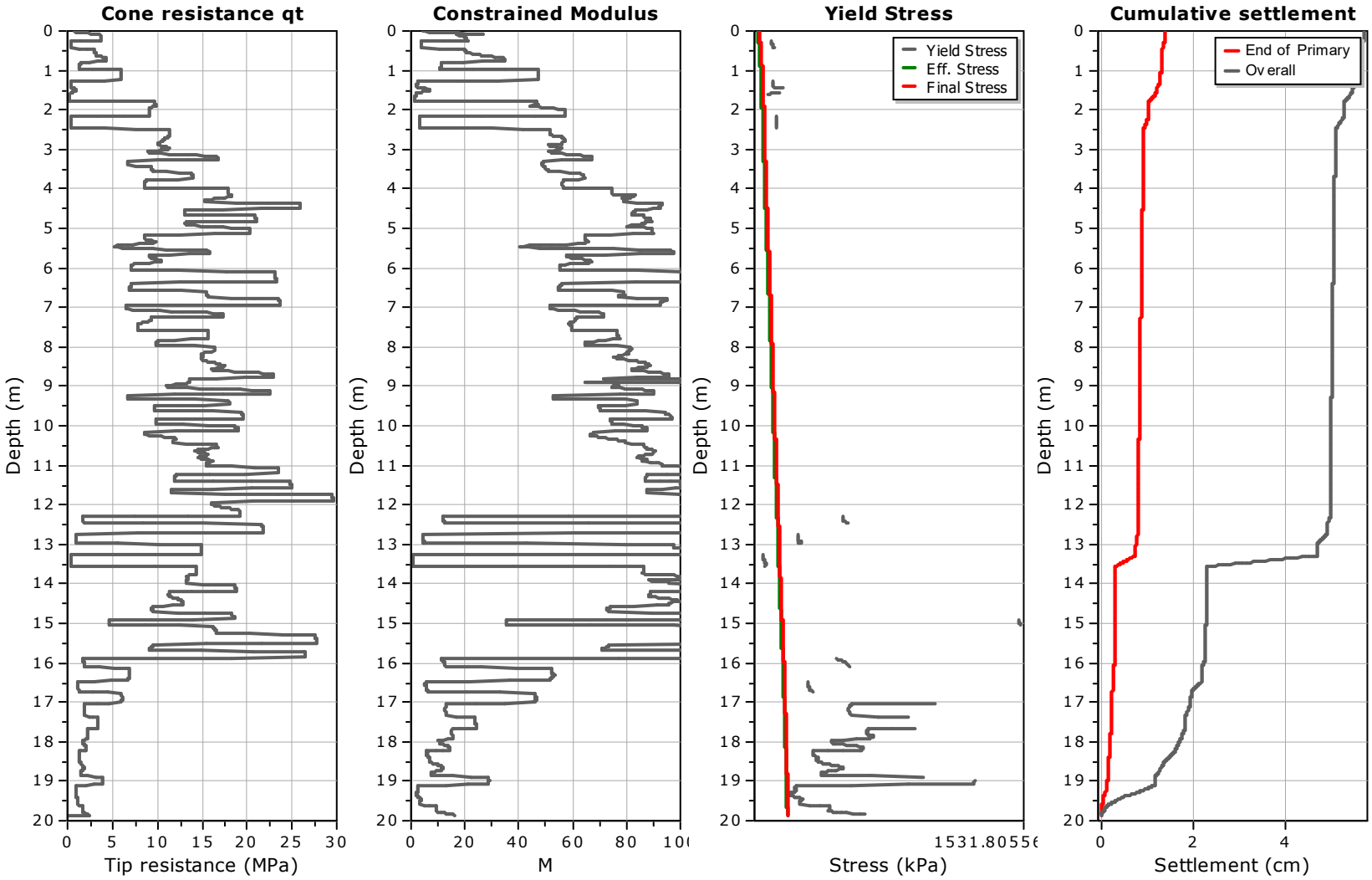
Total calculated settlement: 15.56

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CPT: 09
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.20 m
Coords: X:1810117.05, Y:5806746.63
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.39
Total secondary settlement: 4.30

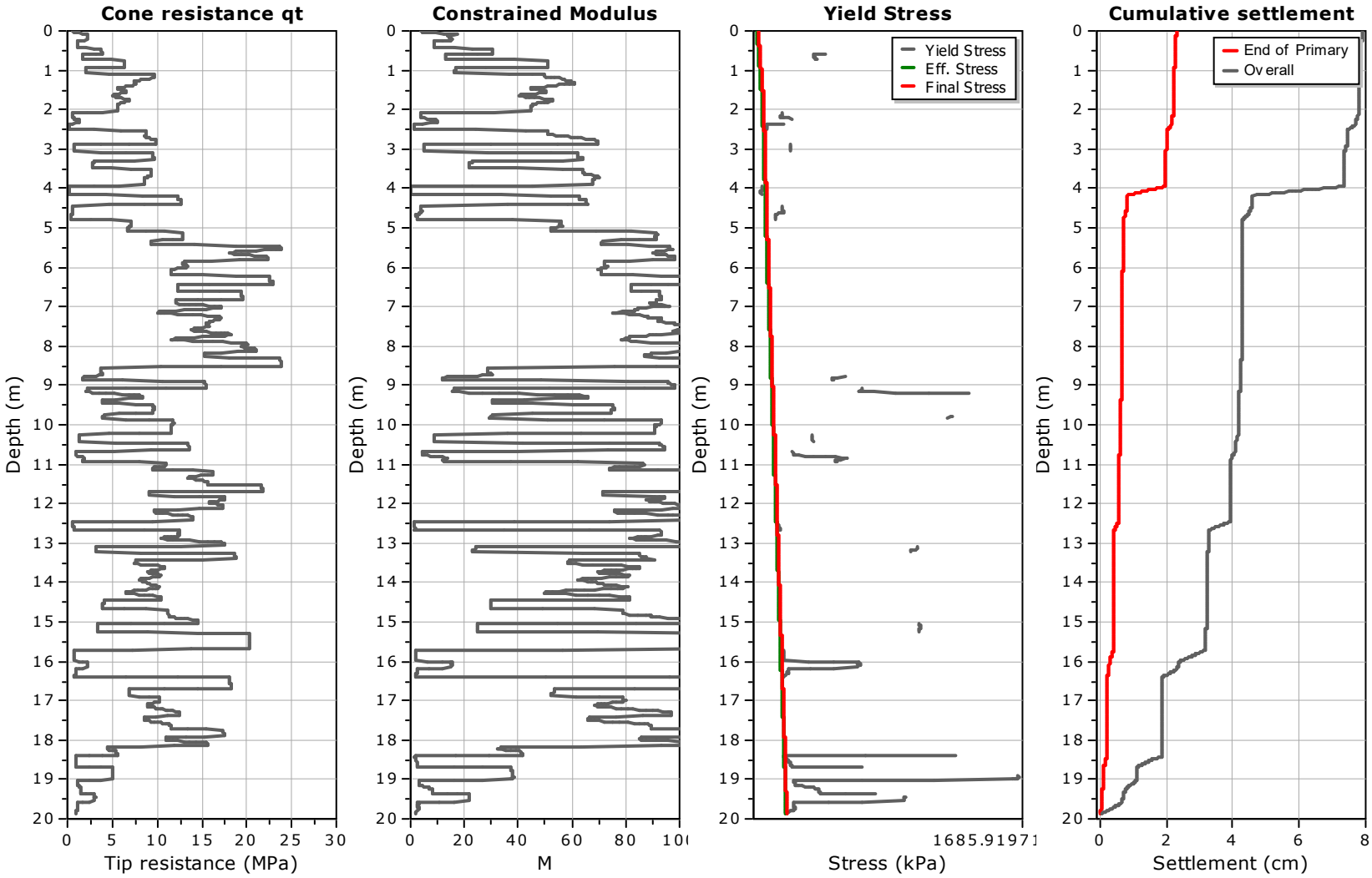
Total calculated settlement: 5.69

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CPT: 10
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.90 m
Coords: X:1809674.00, Y:5806659.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 2.31
Total secondary settlement: 5.60

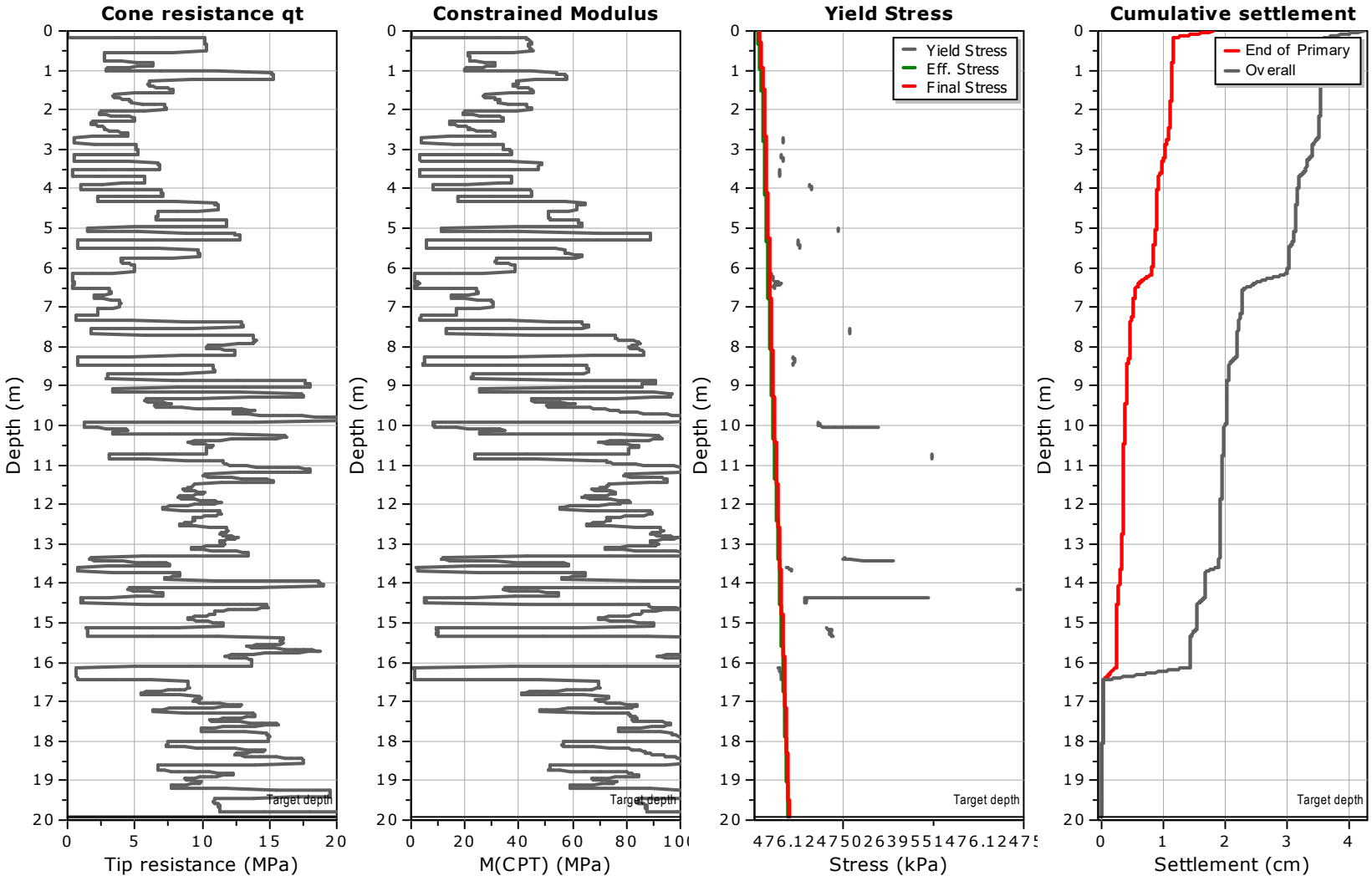
Total calculated settlement: 7.90

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CPT: 11
Total depth: 19.91 m, Date: 24/03/2026
Surface Elevation: 55.05 m, Est. GWL: 1.73 m
Coords: X:1810286.10, Y:5807257.05
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.82
Total secondary settlement: 2.43

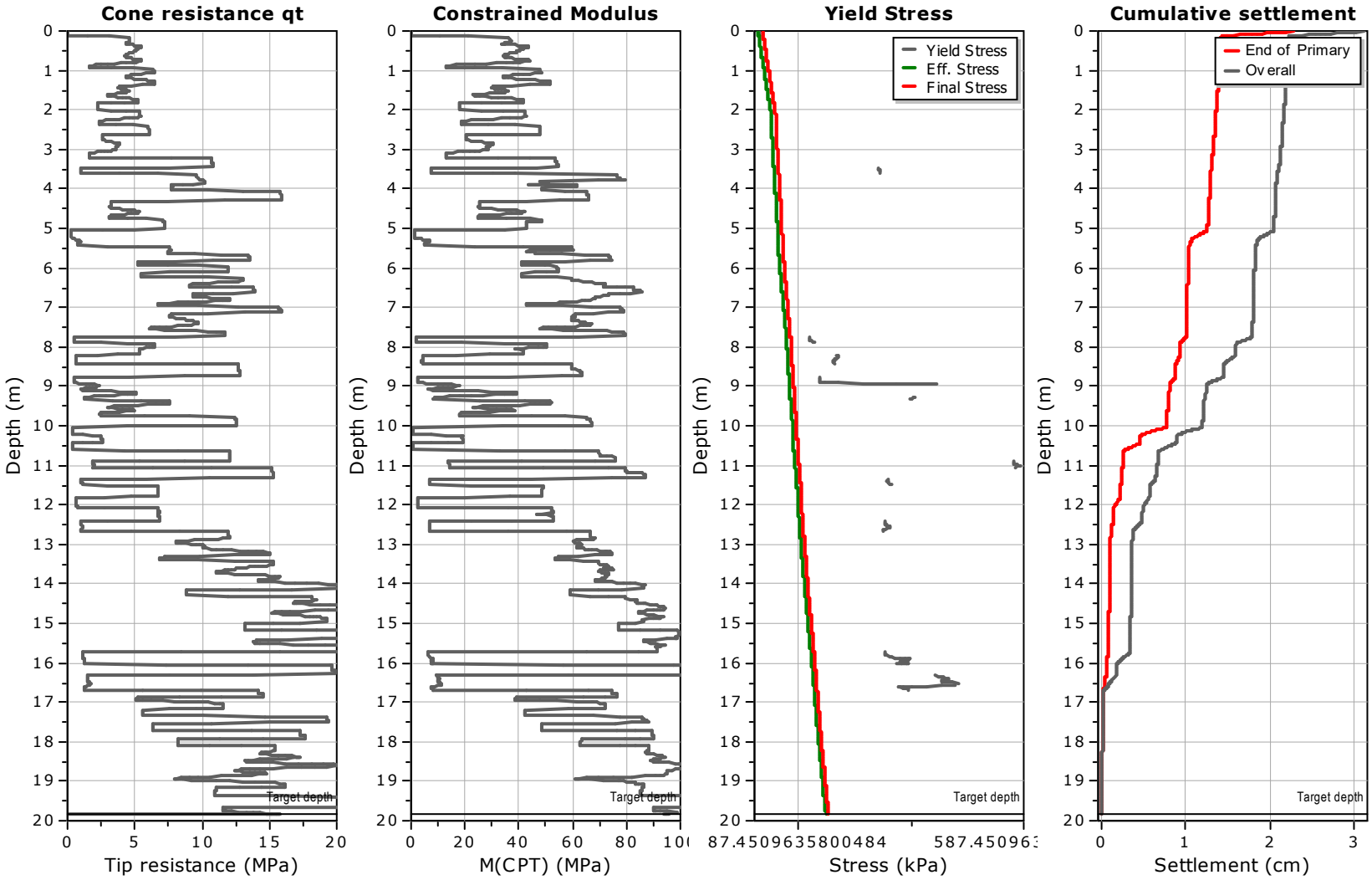
Total calculated settlement: 4.26

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CPT: 12
Total depth: 19.85 m, Date: 24/03/2026
Surface Elevation: 55.74 m, Est. GWL: 2.12 m
Coords: X:1810460.84, Y:5806859.70
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 2.29
Total secondary settlement: 0.82

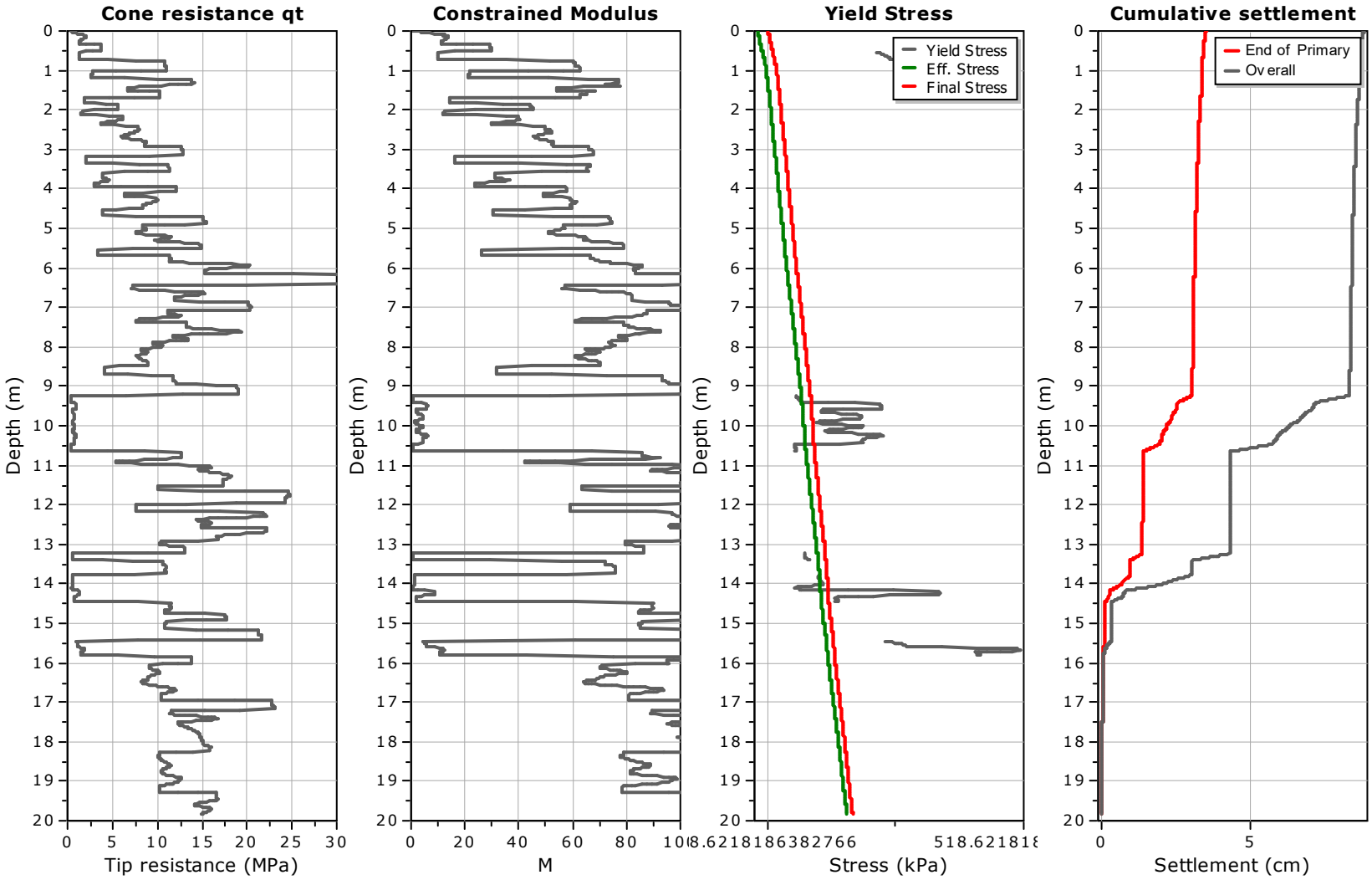
Total calculated settlement: 3.11

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CPT: 01
Total depth: 19.84 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 0.93 m
Coords: X:1809851.42, Y:5807879.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 3.52
Total secondary settlement: 5.28

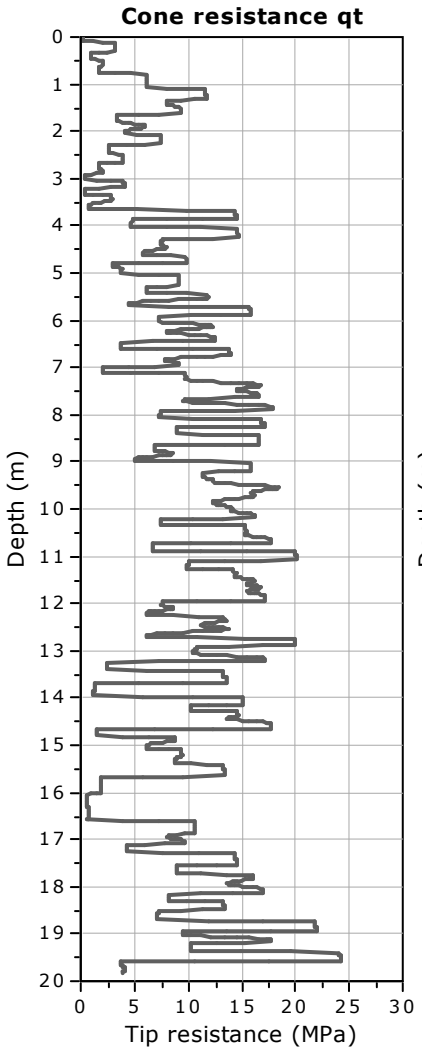
Total calculated settlement: 8.80

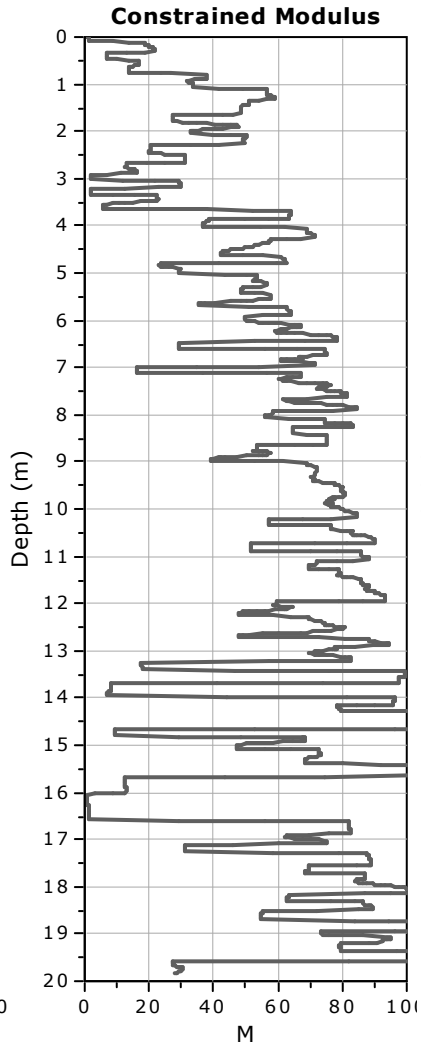
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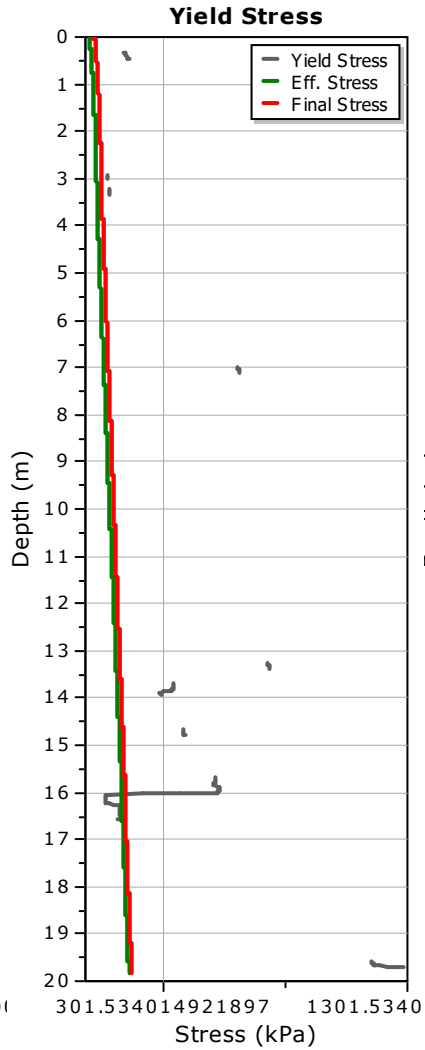
CPT: 02
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 0.93 m
Coords: X:1810134.72, Y:5807503.19
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

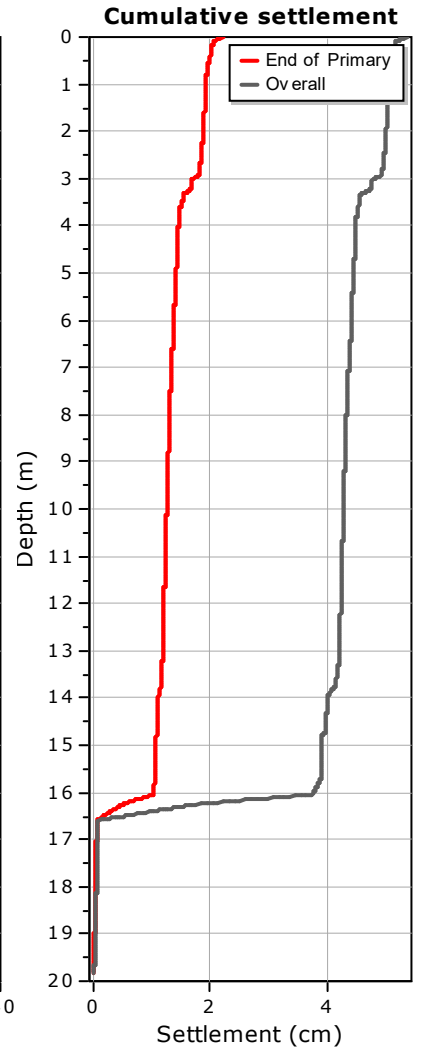
Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*









Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 2.24
Total secondary settlement: 3.15

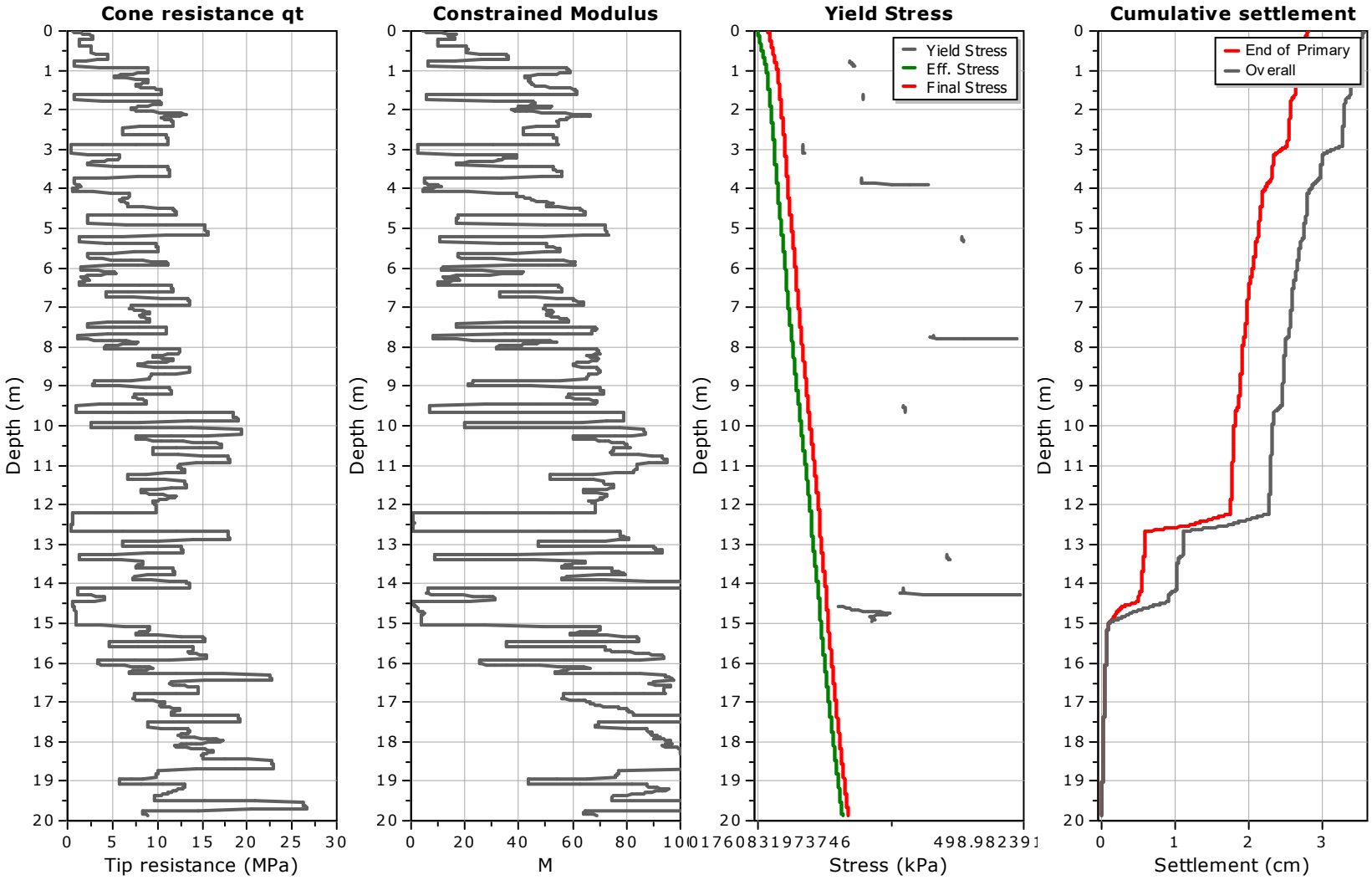
Total calculated settlement: 5.39

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CPT: 03
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.00 m
Coords: X:1810111.74, Y:5807067.73
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 2.81
Total secondary settlement: 0.76

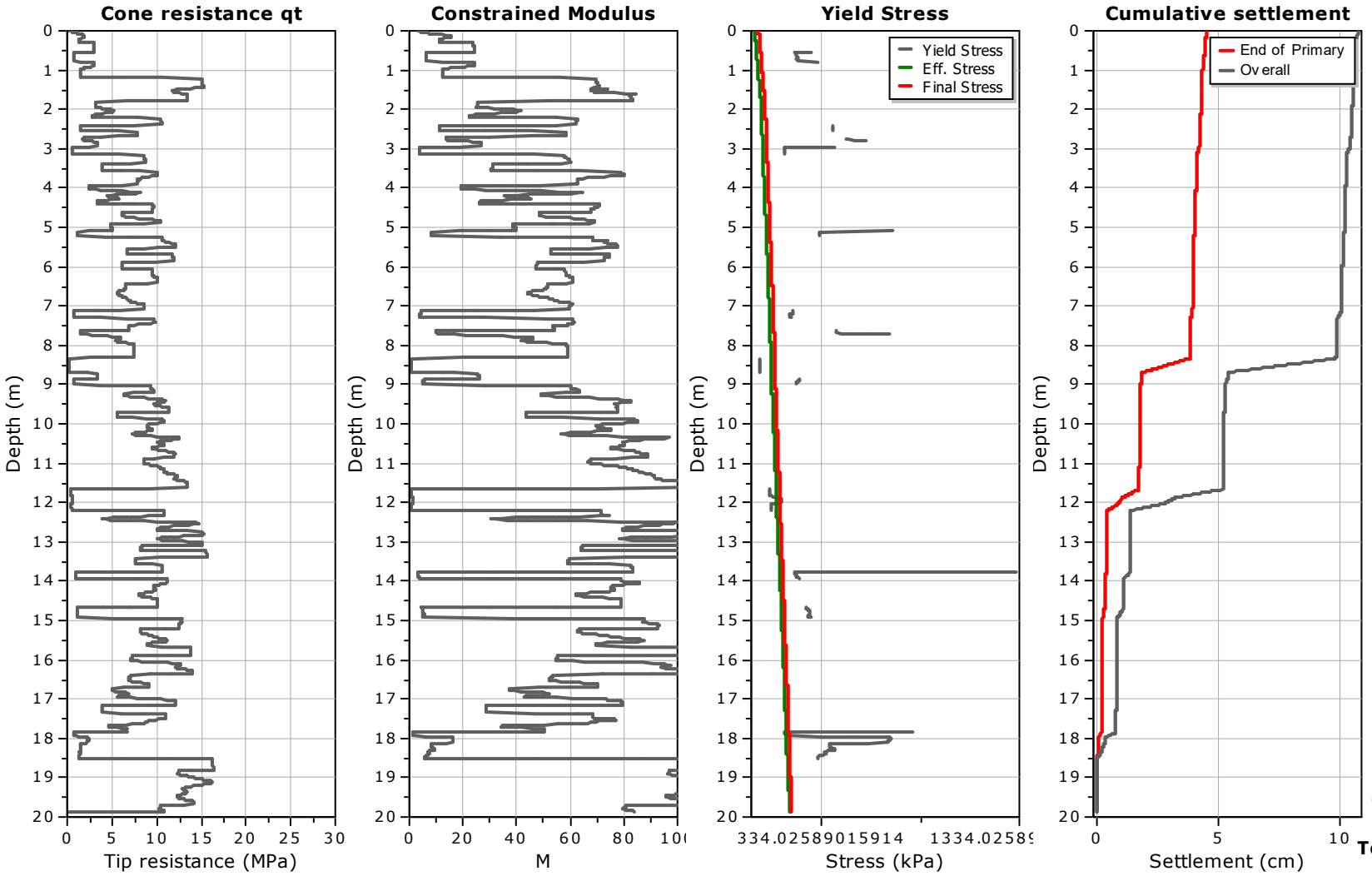
Total calculated settlement: 3.56

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CPT: 04
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.78 m
Coords: X:1810037.64, Y:5806248.35
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 4.54
Total secondary settlement: 6.24

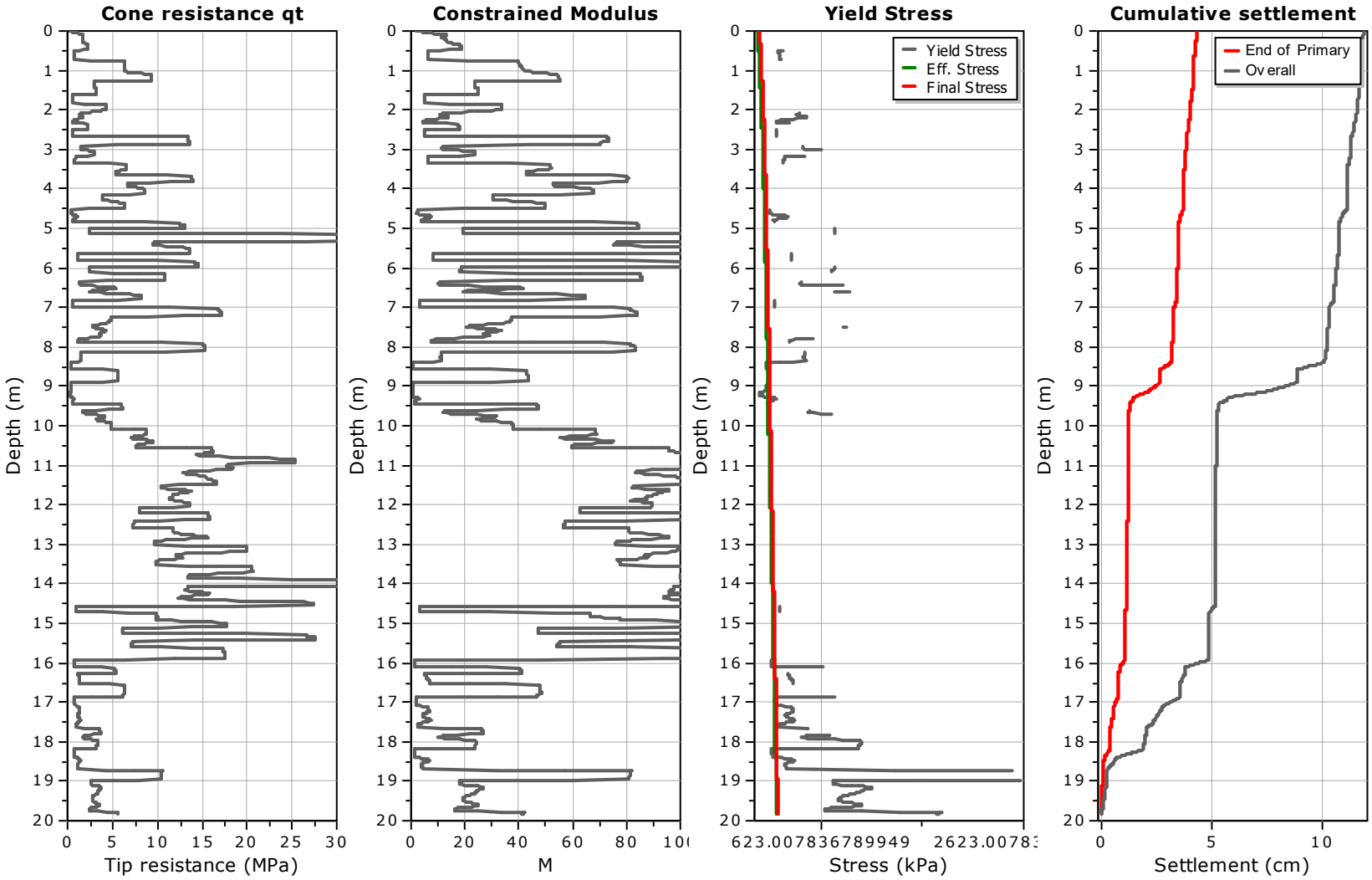
Total calculated settlement: 10.78

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CPT: 05
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 2.90 m
Coords: X:1809405.49, Y:5807048.97
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 4.33
Total secondary settlement: 7.53

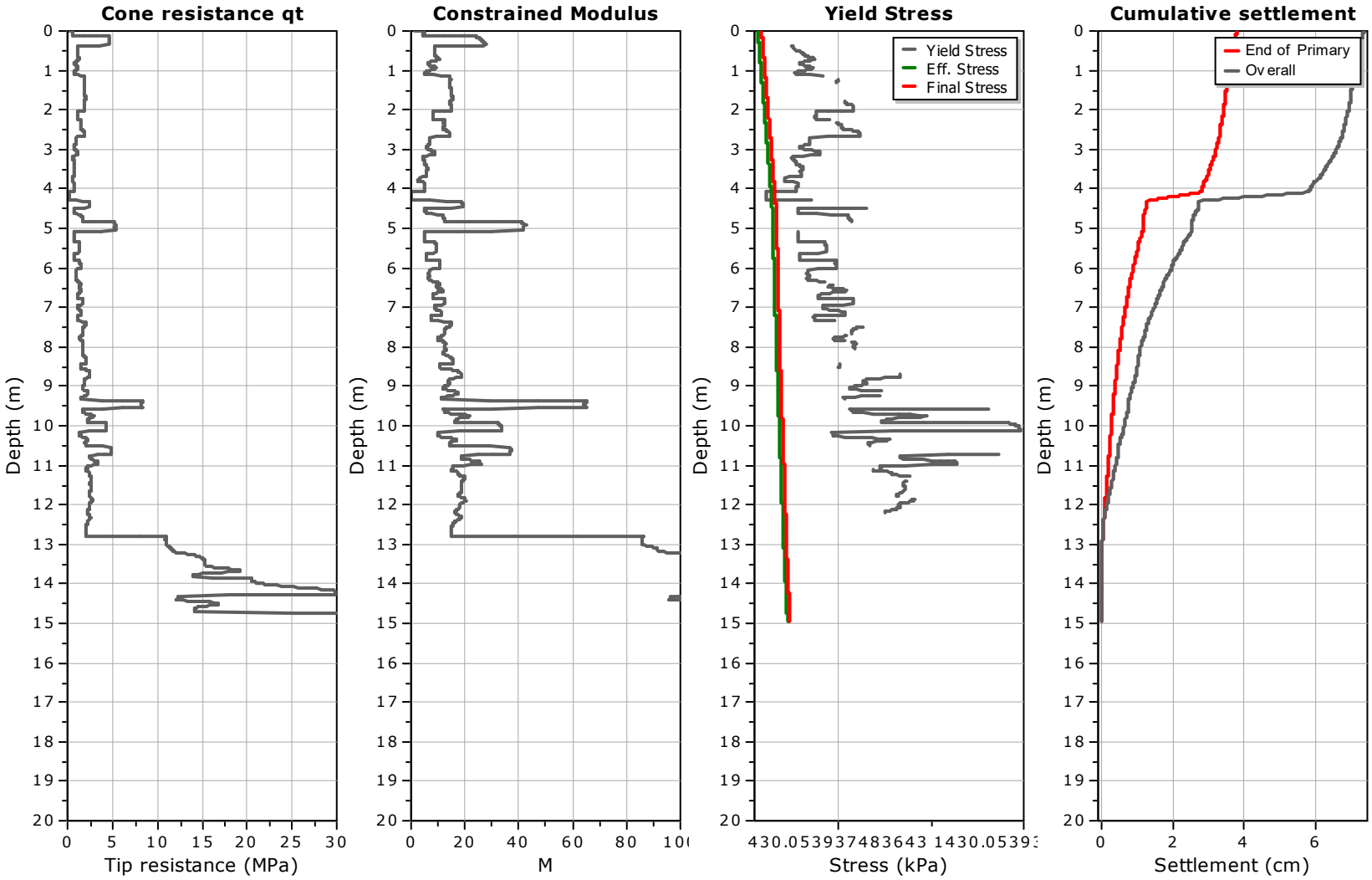
Total calculated settlement: 11.86

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CPT: 06
Total depth: 14.96 m, Date: 19/11/2025
Surface Elevation: 58.00 m, Est. GWL: 4.50 m
Coords: X:1809471.71, Y:5807600.07
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 38.1
Total secondary settlement: 35.5

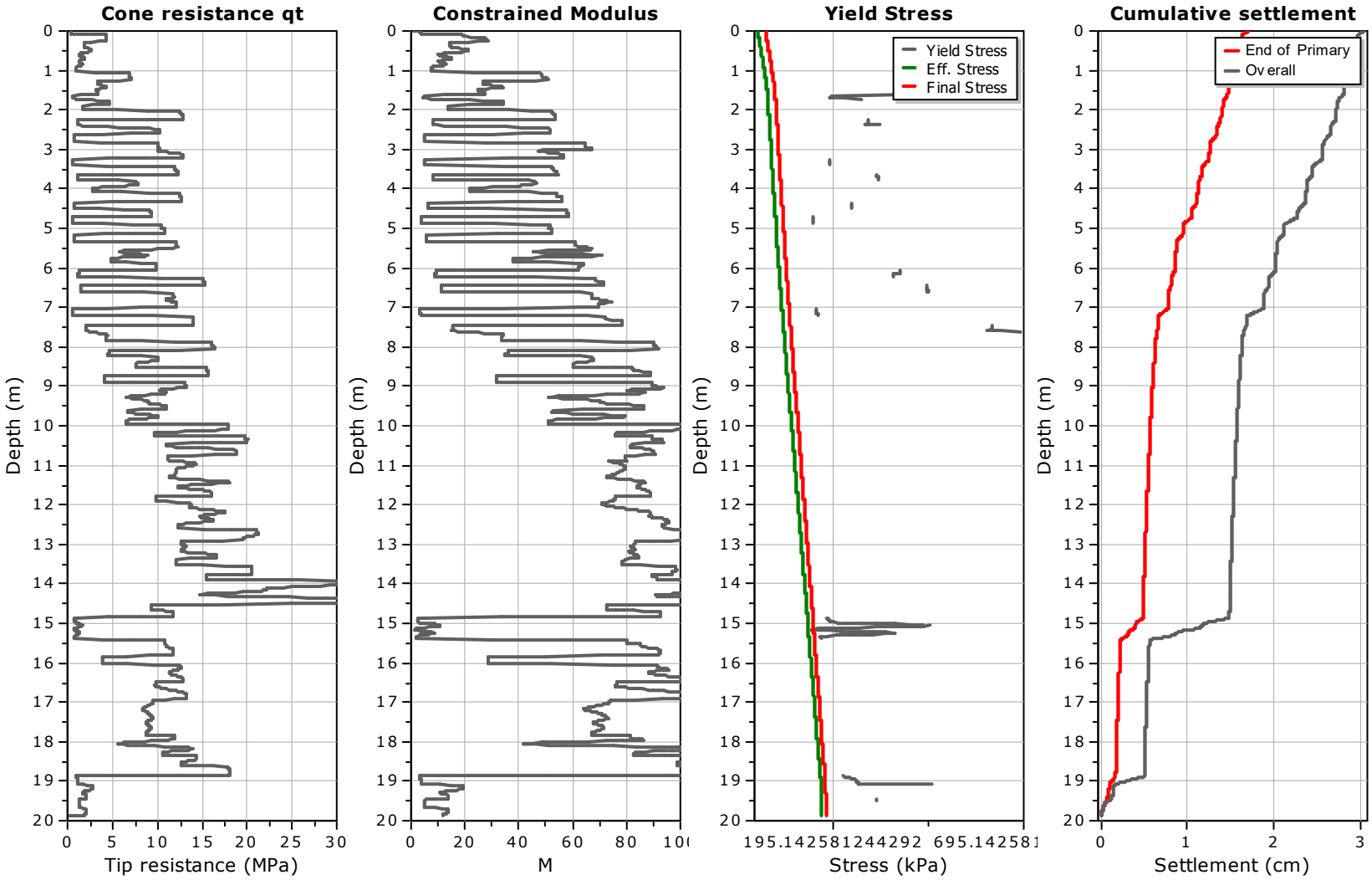
Total calculated settlement: 73.7

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CPT: 07
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.38 m
Coords: X:1809744.75, Y:5807176.51
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 1.71
Total secondary settlement: 1.34

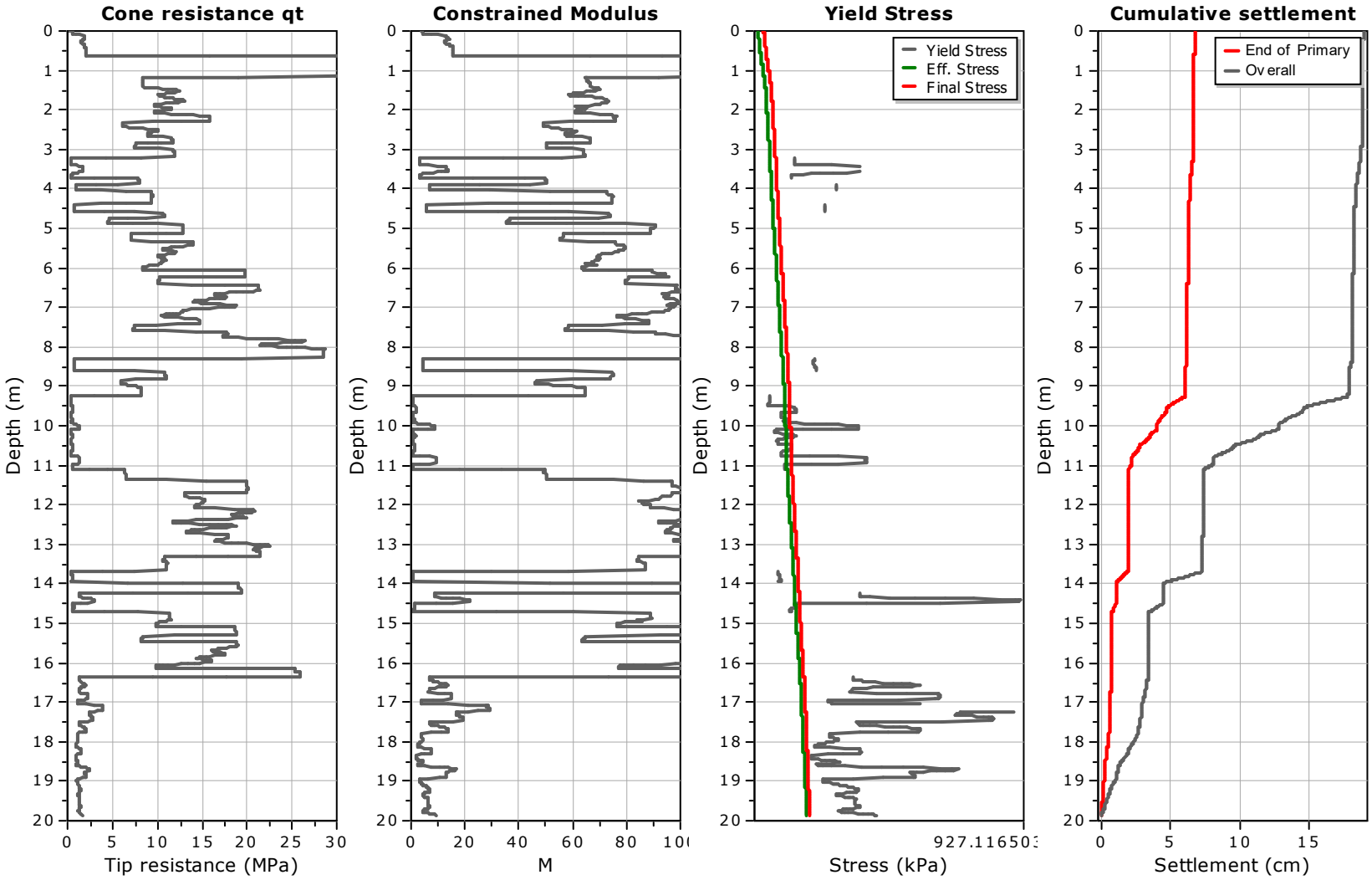
Total calculated settlement: 3.05

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CPT: 08
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.50 m
Coords: X:1810229.77, Y:5807646.78
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 6.82
Total secondary settlement: 12.15

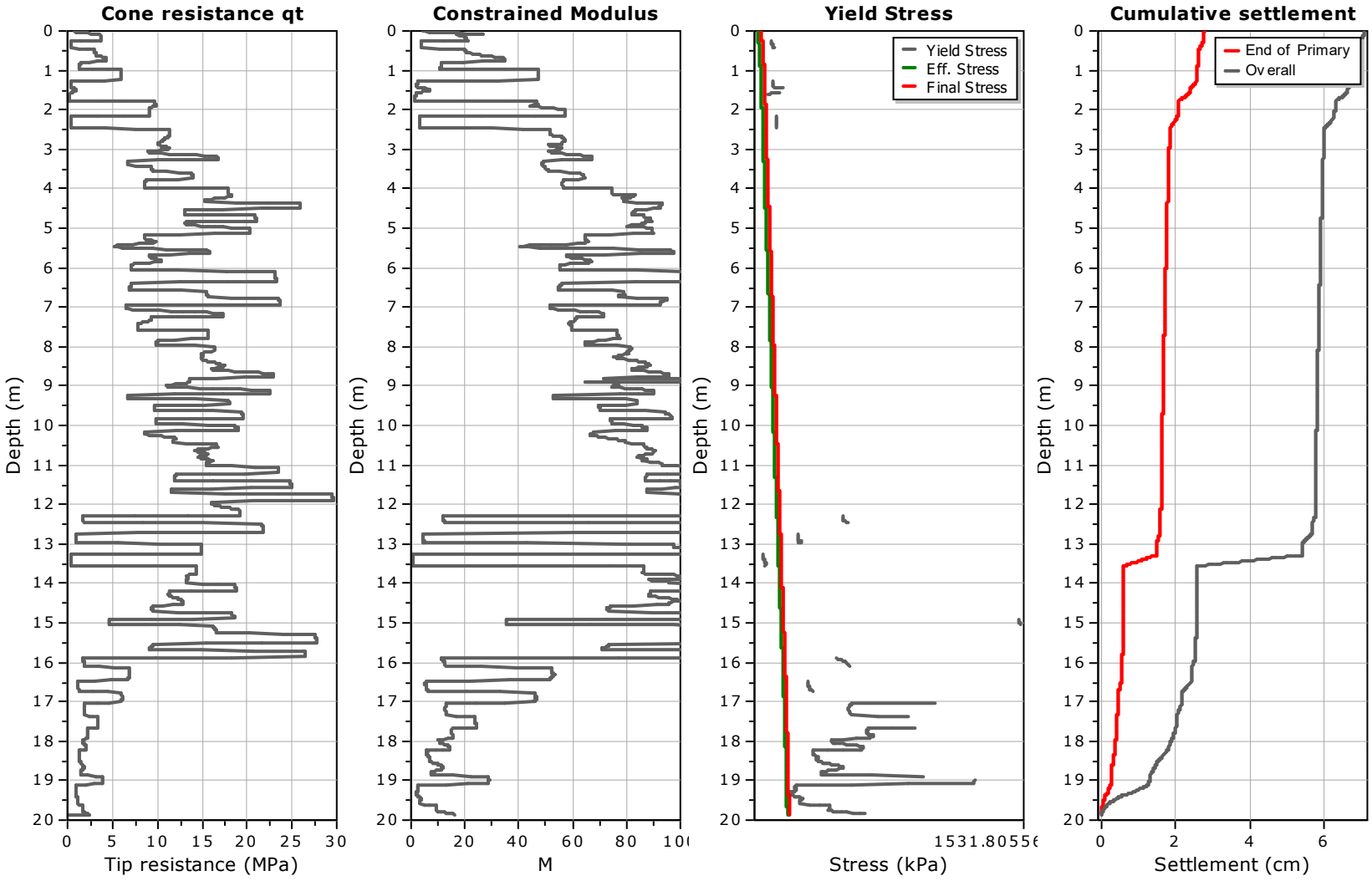
Total calculated settlement: 18.97

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CPT: 09
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.20 m
Coords: X:1810117.05, Y:5806746.63
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 2.77
Total secondary settlement: 4.30

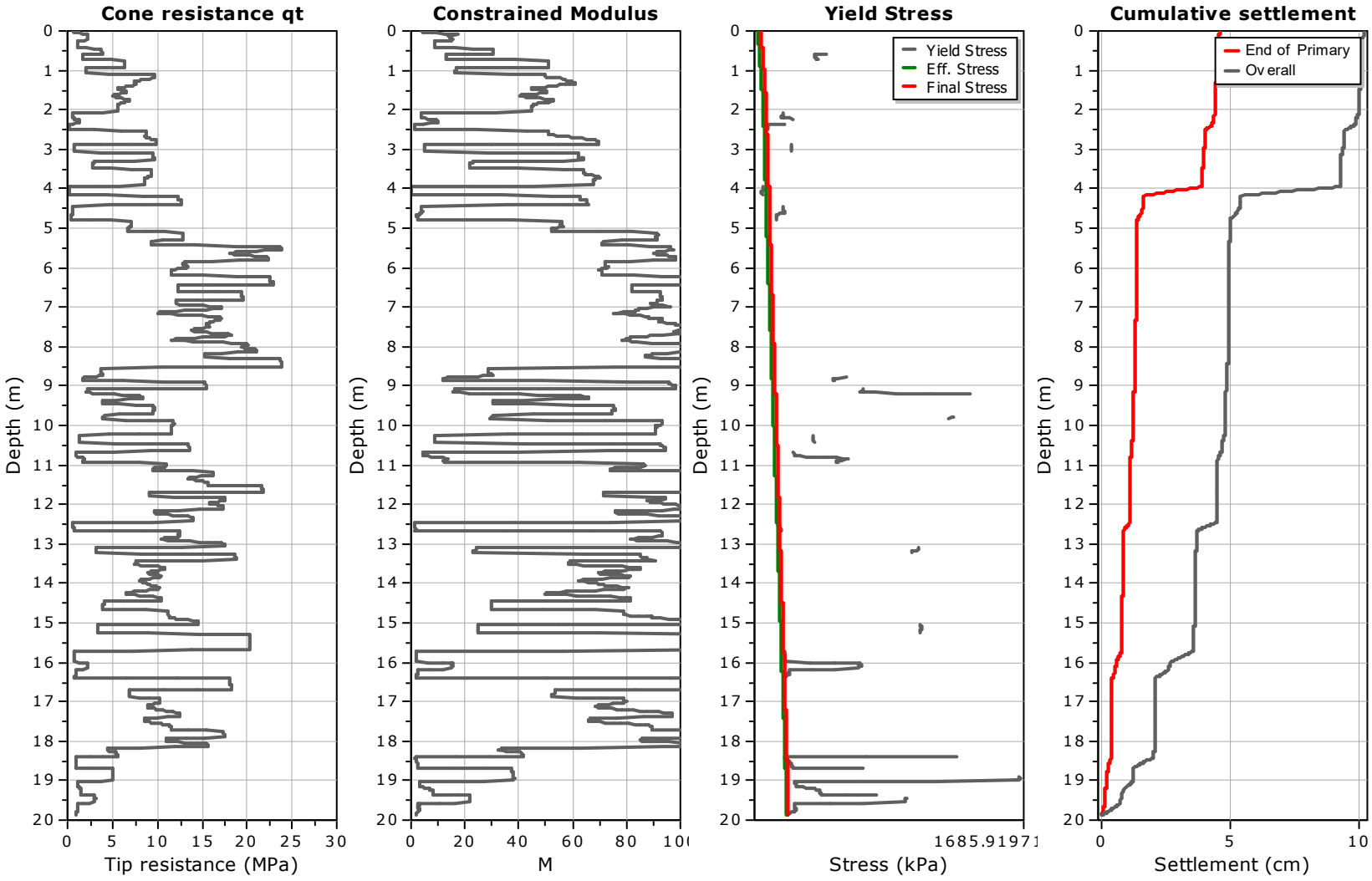
Total calculated settlement: 7.07

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CPT: 10
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.90 m
Coords: X:1809674.00, Y:5806659.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 4.61
Total secondary settlement: 5.60

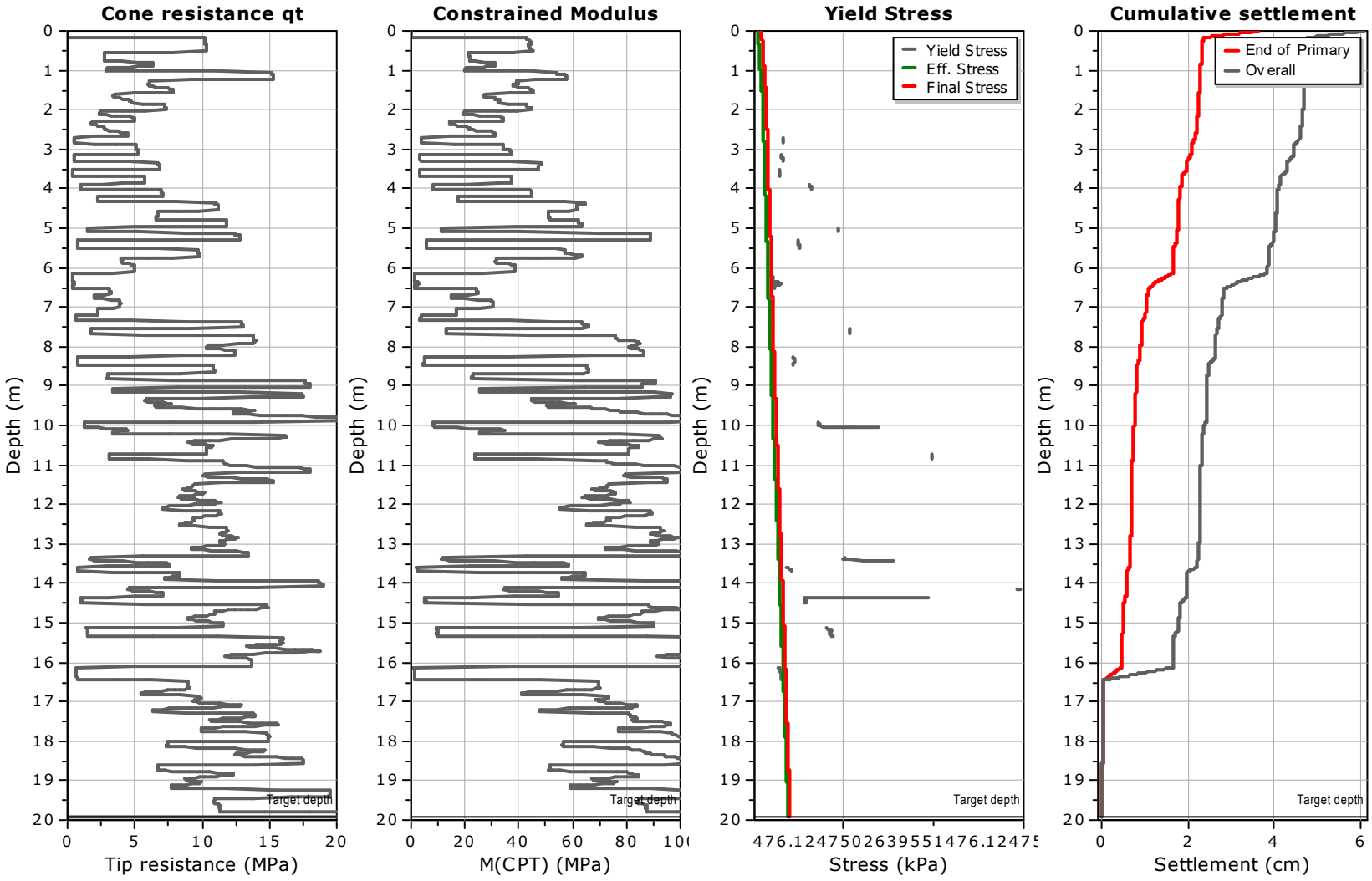
Total calculated settlement: 10.21

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CPT: 11
Total depth: 19.91 m, Date: 24/03/2026
Surface Elevation: 55.05 m, Est. GWL: 1.73 m
Coords: X:1810286.10, Y:5807257.05
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 3.64
Total secondary settlement: 2.43

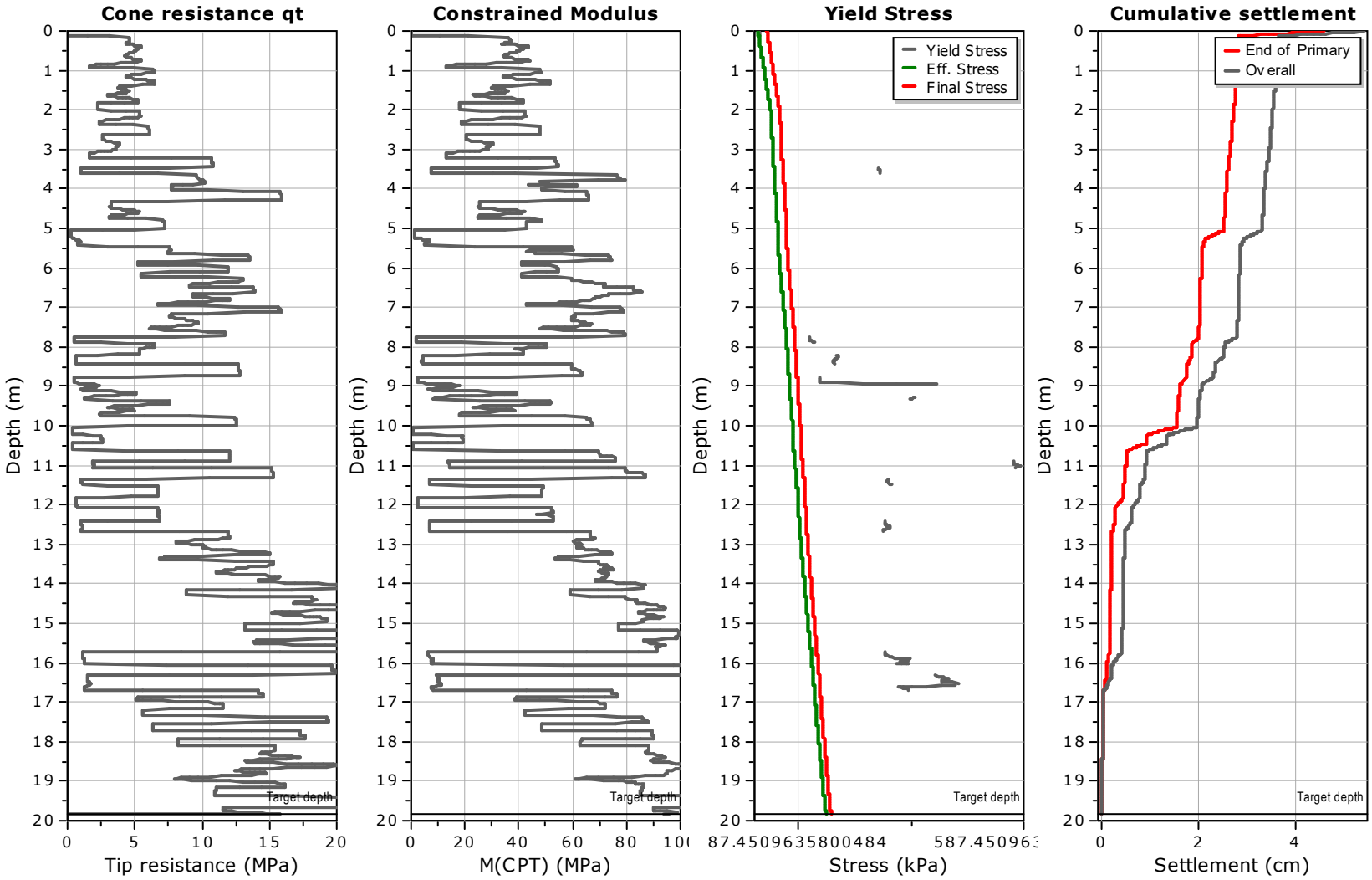
Total calculated settlement: 6.08

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CPT: 12
Total depth: 19.85 m, Date: 24/03/2026
Surface Elevation: 55.74 m, Est. GWL: 2.12 m
Coords: X:1810460.84, Y:5806859.70
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 20.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 4.57
Total secondary settlement: 0.82

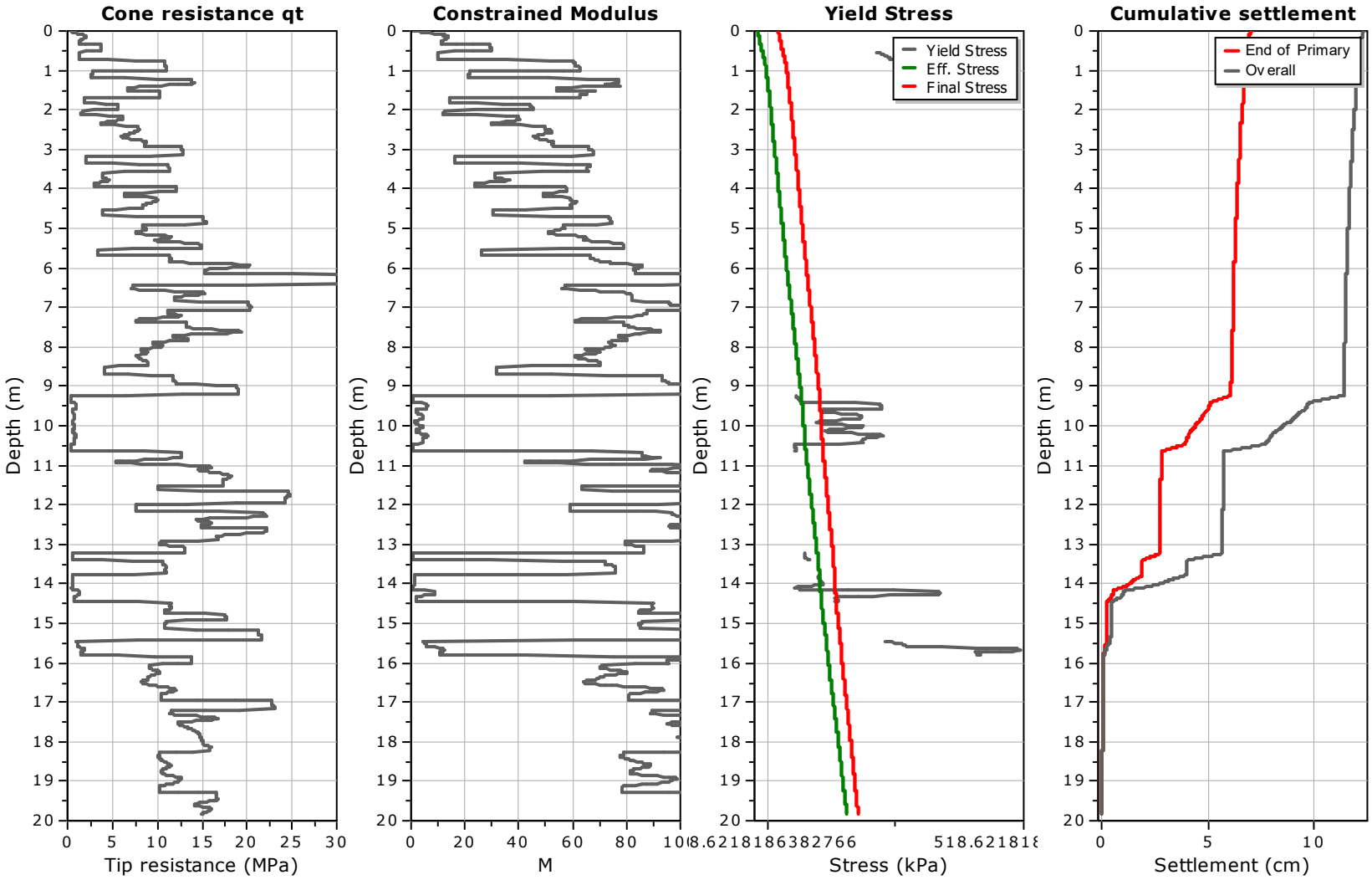
Total calculated settlement: 5.40

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CPT: 01
Total depth: 19.84 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 0.93 m
Coords: X:1809851.42, Y:5807879.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

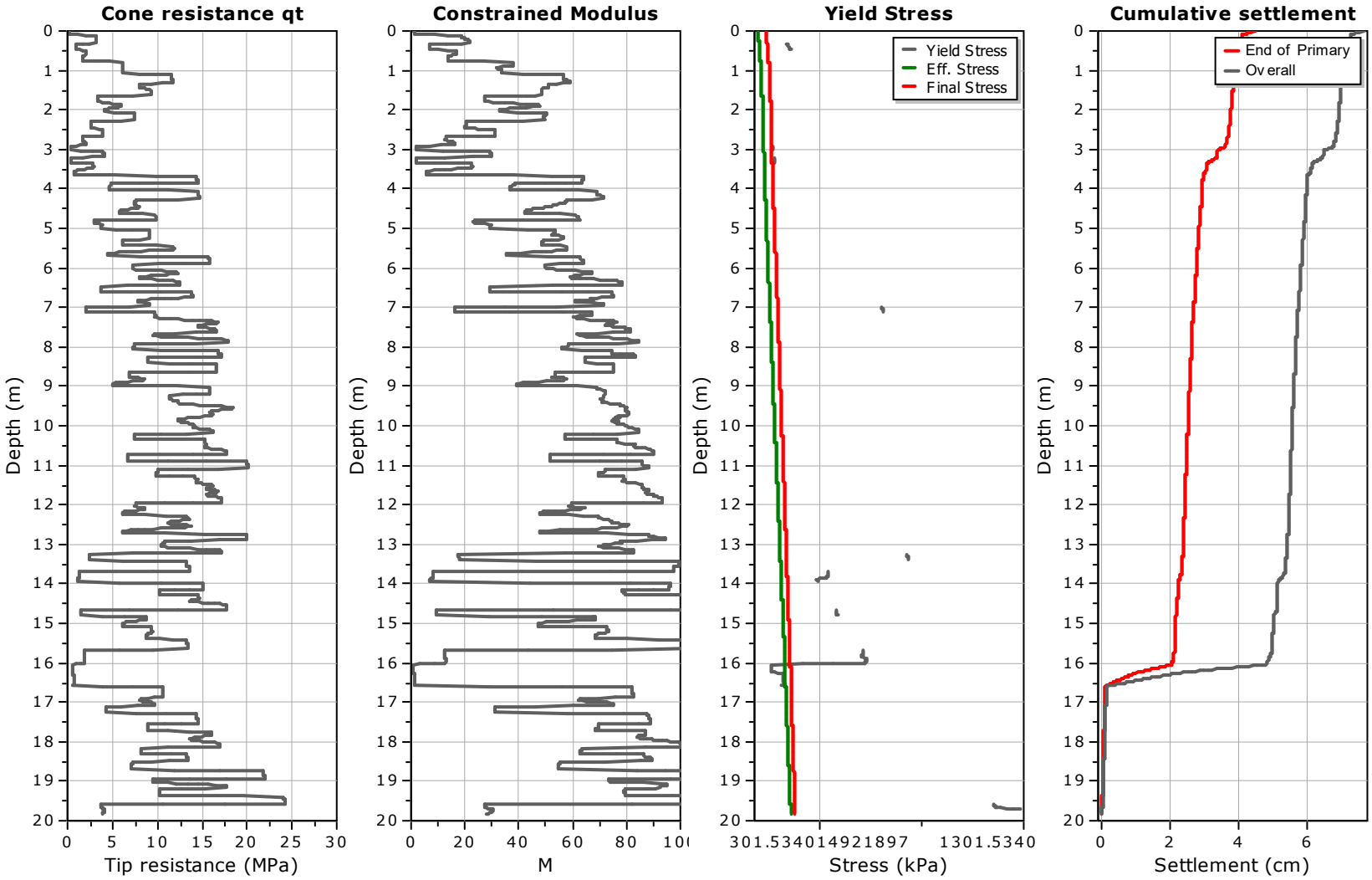
where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 7.05
Total secondary settlement: 5.28

Total calculated settlement: 12.33

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 4.48
Total secondary settlement: 3.15

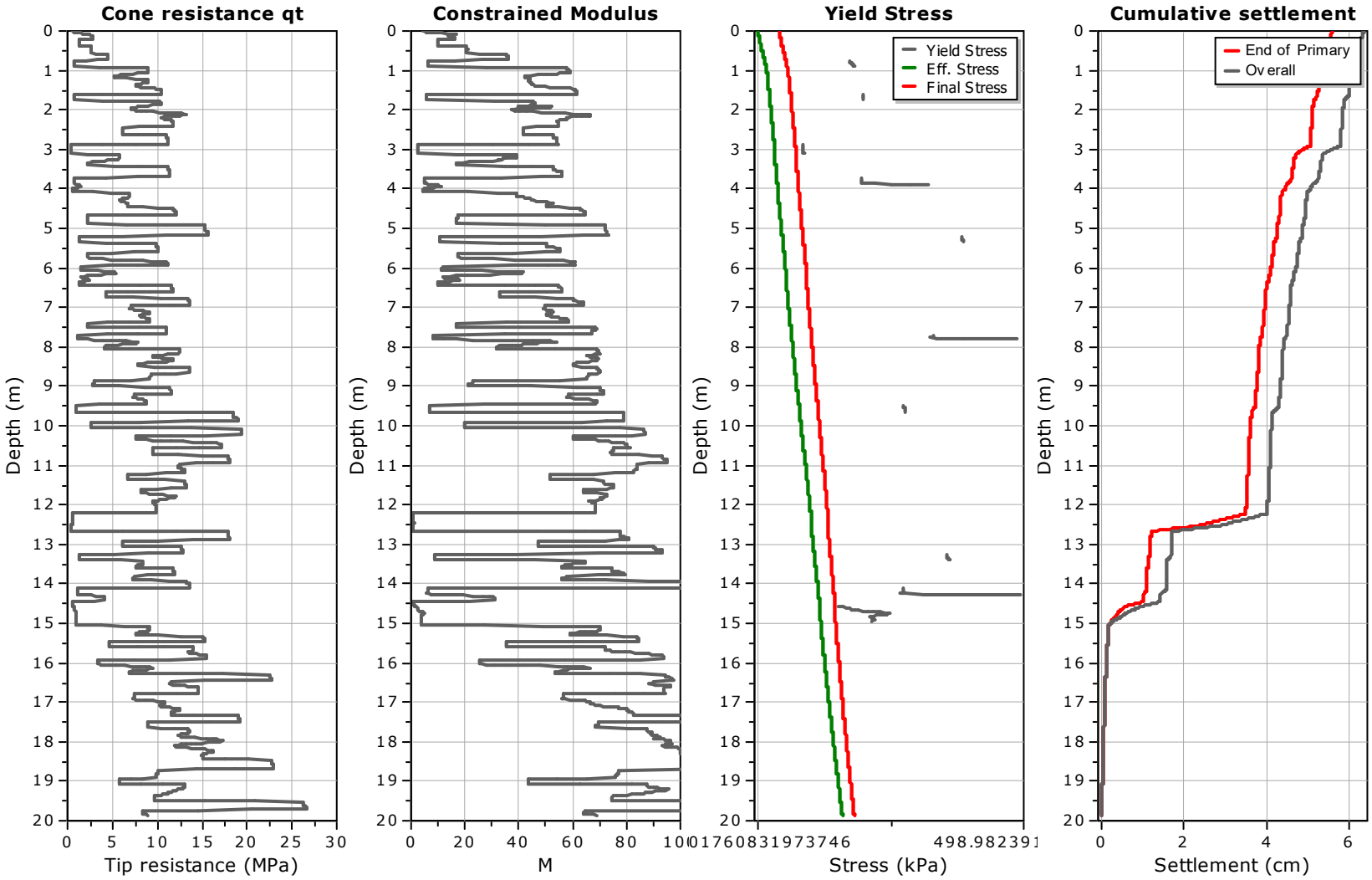
Total calculated settlement: 7.63

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CPT: 03
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.00 m
Coords: X:1810111.74, Y:5807067.73
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 5.61
Total secondary settlement: 0.76

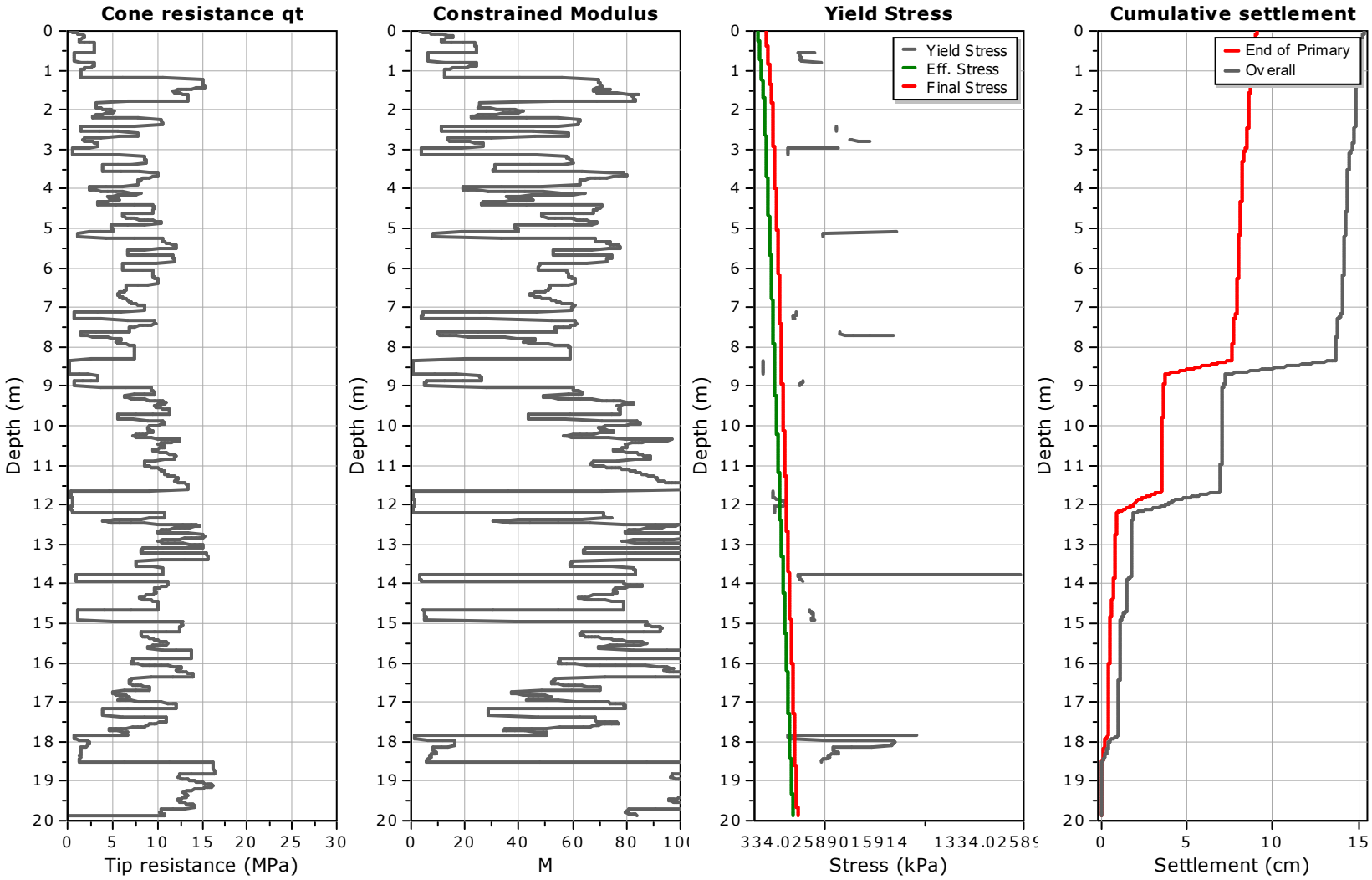
Total calculated settlement: 6.37

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CPT: 04
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.78 m
Coords: X:1810037.64, Y:5806248.35
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 9.08
Total secondary settlement: 6.24

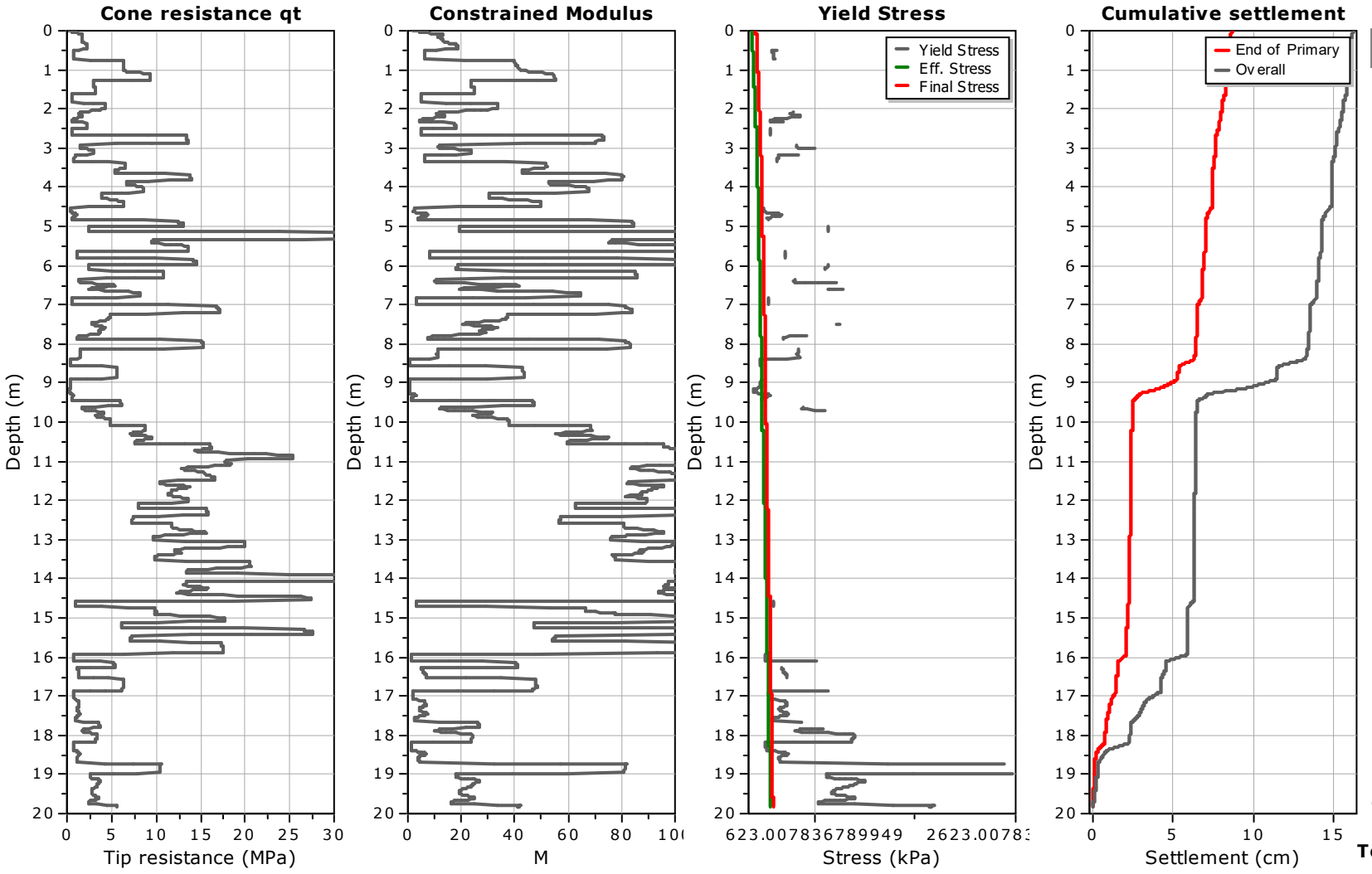
Total calculated settlement: 15.32

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CPT: 05
Total depth: 19.85 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 2.90 m
Coords: X:1809405.49, Y:5807048.97
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 8.66
Total secondary settlement: 7.53

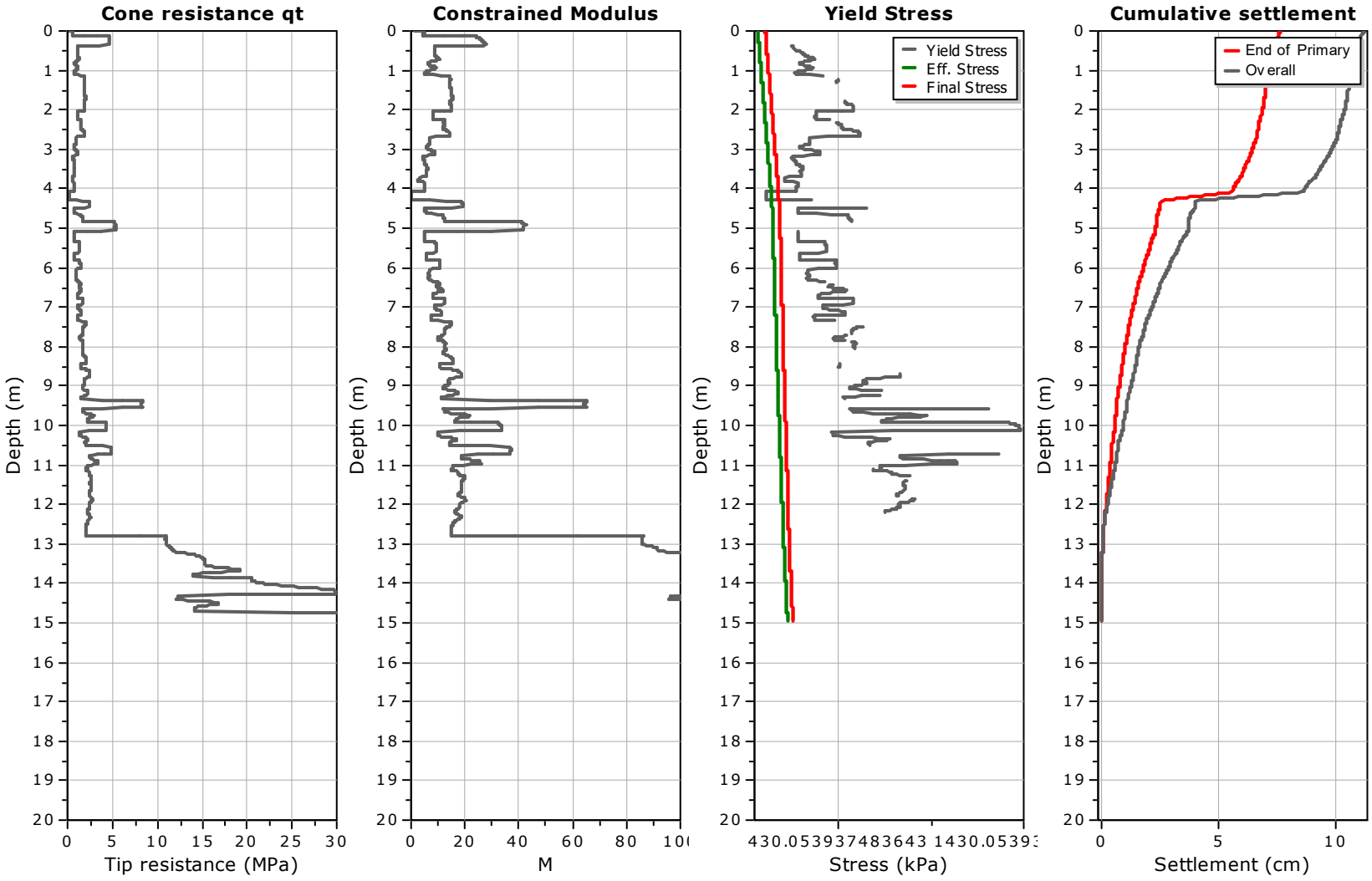
Total calculated settlement: 16.19

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CPT: 06
Total depth: 14.96 m, Date: 19/11/2025
Surface Elevation: 58.00 m, Est. GWL: 4.50 m
Coords: X:1809471.71, Y:5807600.07
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 7.66
Total secondary settlement: 3.55

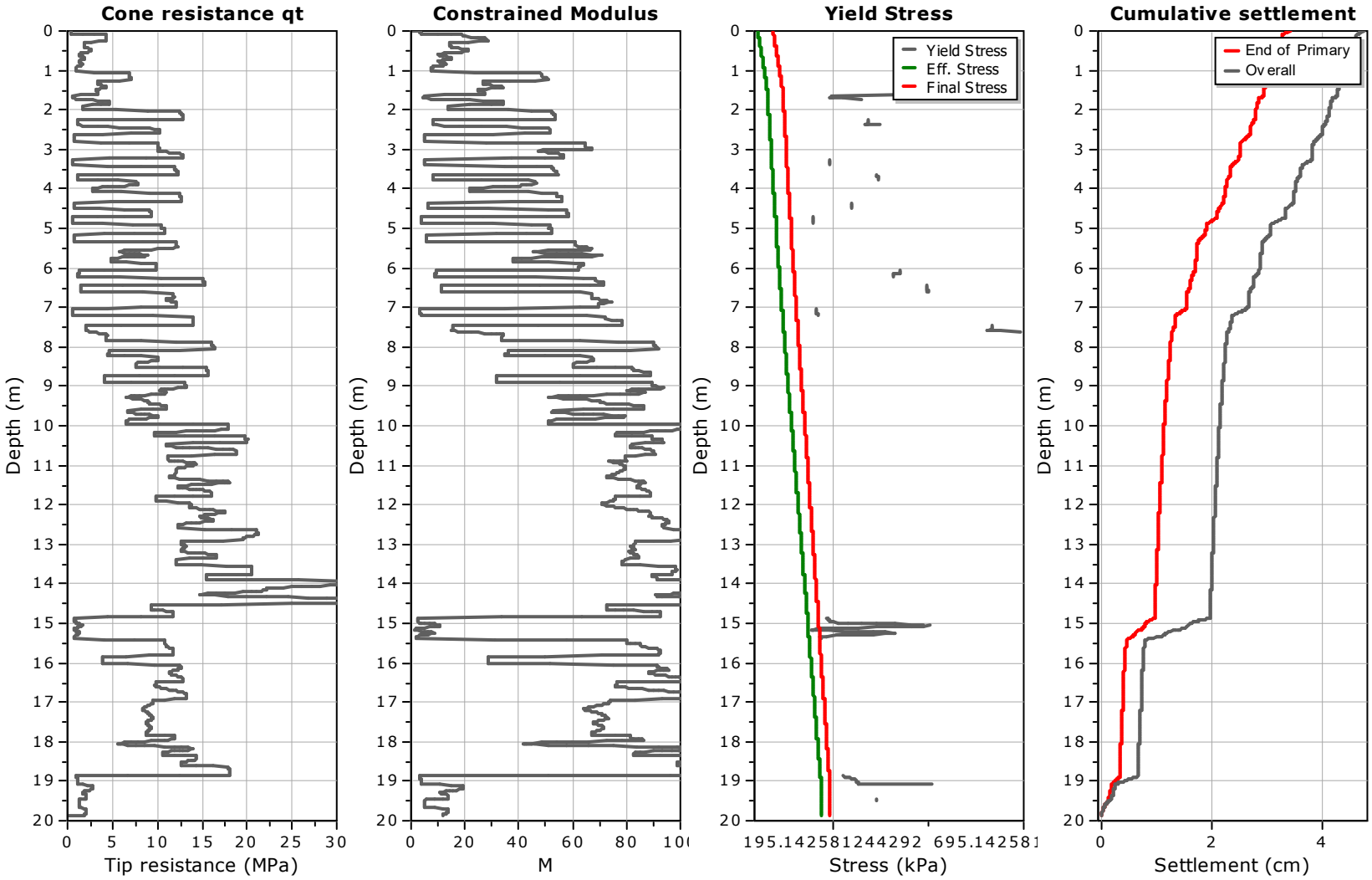
Total calculated settlement: 11.21

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CPT: 07
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.38 m
Coords: X:1809744.75, Y:5807176.51
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 3.41
Total secondary settlement: 1.34

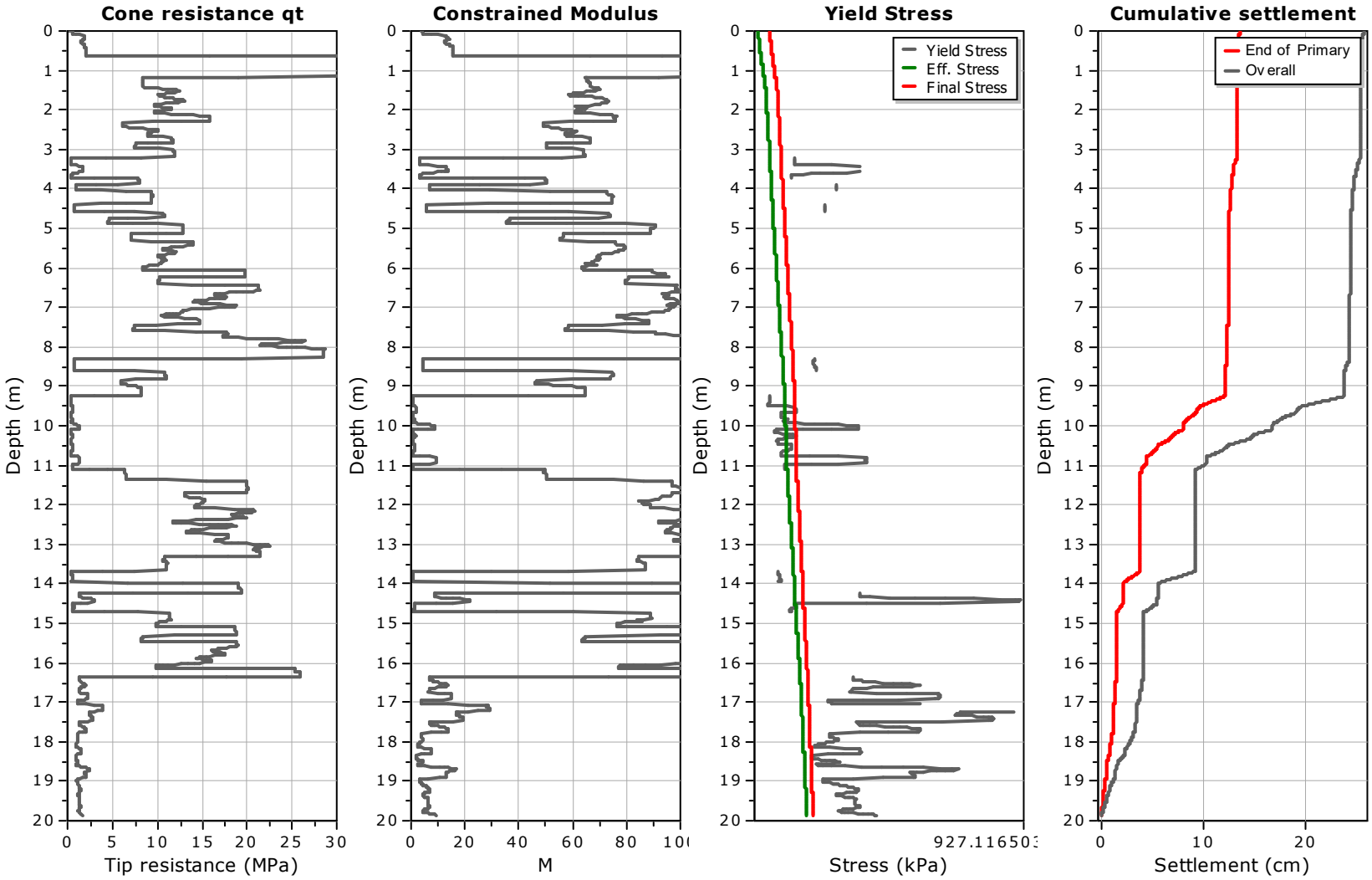
Total calculated settlement: 4.75

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CPT: 08
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.50 m
Coords: X:1810229.77, Y:5807646.78
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 13.63
Total secondary settlement: 12.15

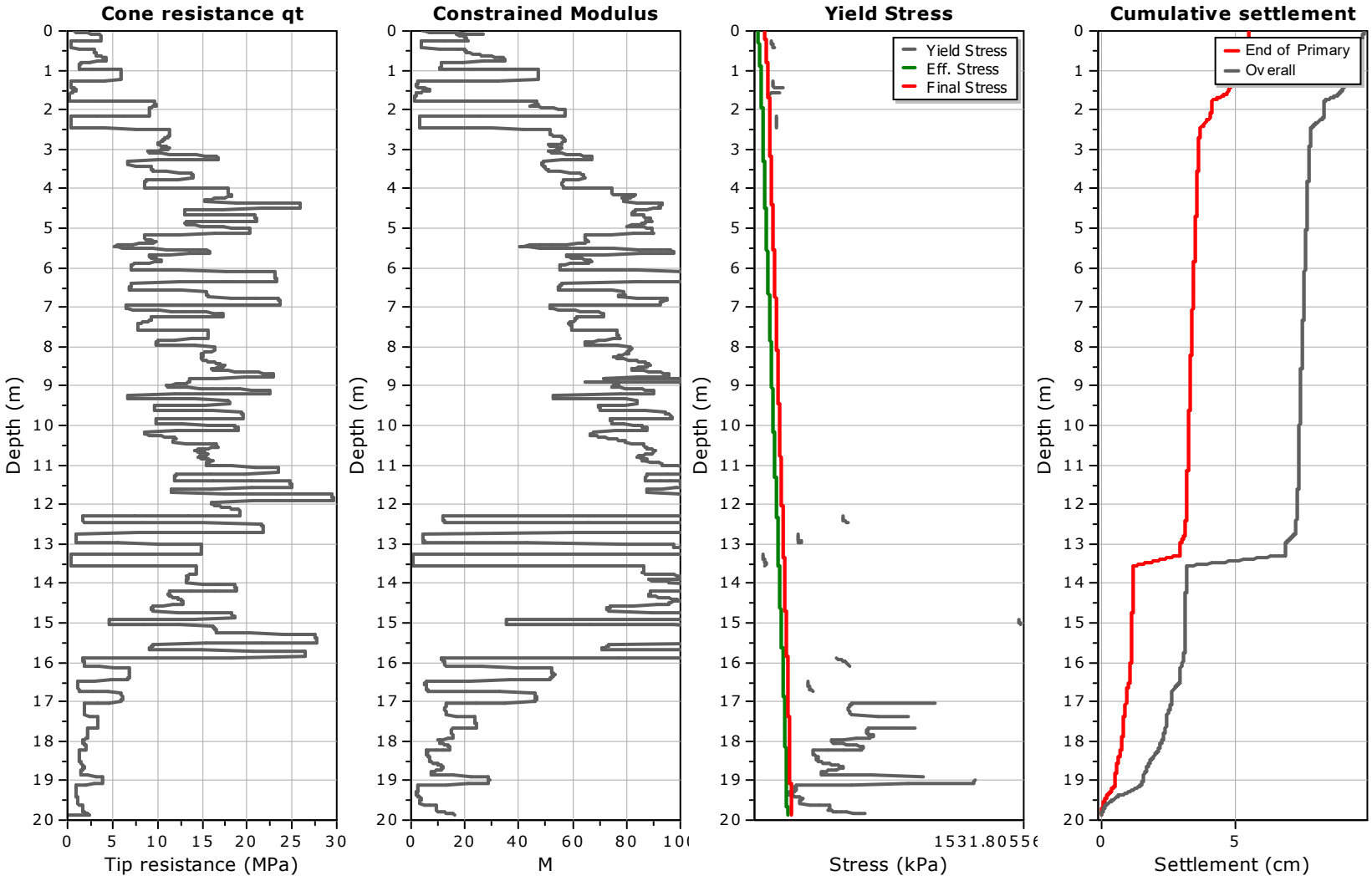
Total calculated settlement: 25.78

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CPT: 09
Total depth: 19.86 m, Date: 19/11/2025
Surface Elevation: 54.00 m, Est. GWL: 1.20 m
Coords: X:1810117.05, Y:5806746.63
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 5.55
Total secondary settlement: 4.30

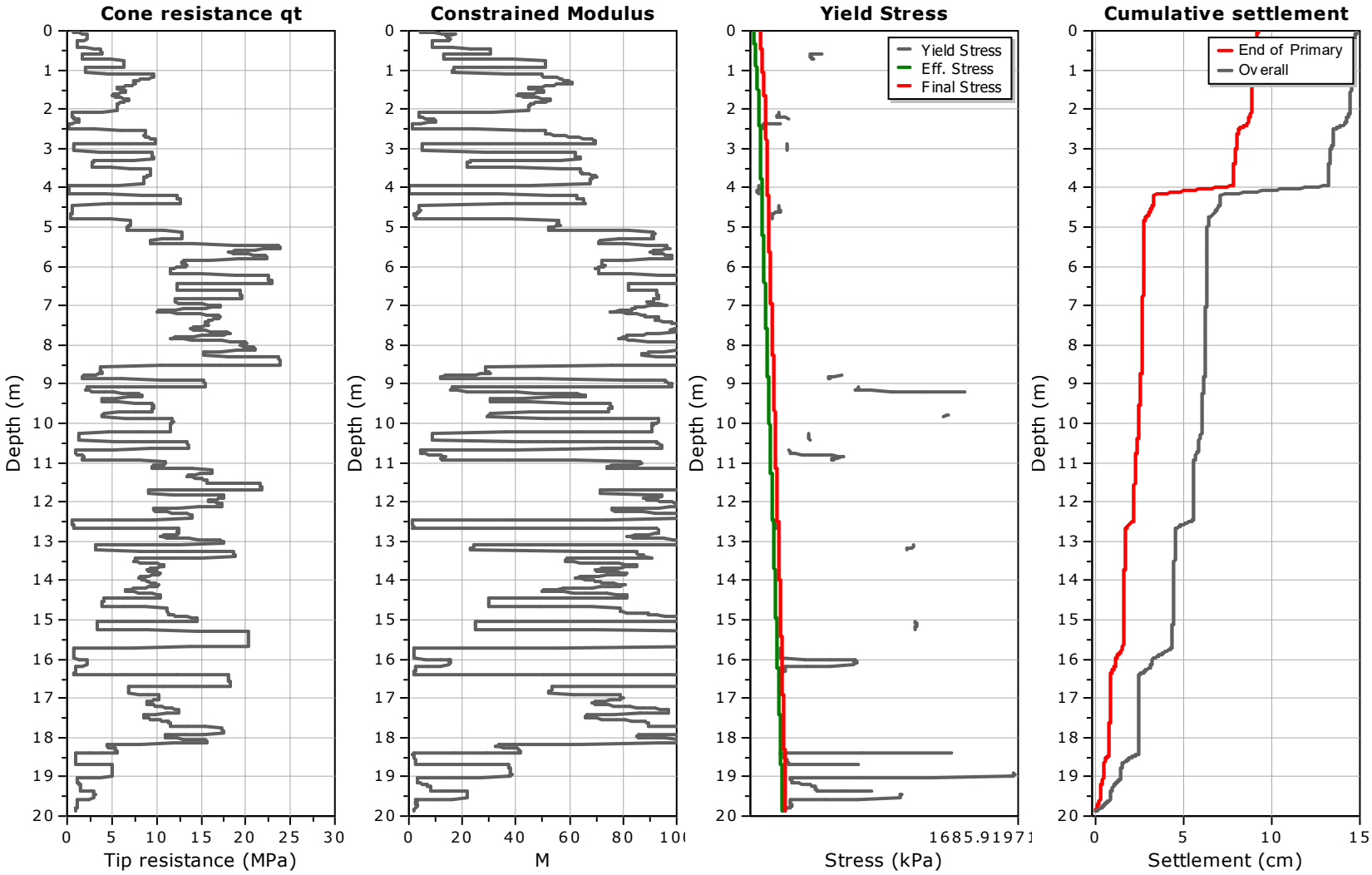
Total calculated settlement: 9.85

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CPT: 10
Total depth: 19.87 m, Date: 19/11/2025
Surface Elevation: 55.00 m, Est. GWL: 1.90 m
Coords: X:1809674.00, Y:5806659.30
Cone Type: P-TC000939
Cone Operator: G.Lannam (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Total primary settlement: 9.23
Total secondary settlement: 5.60

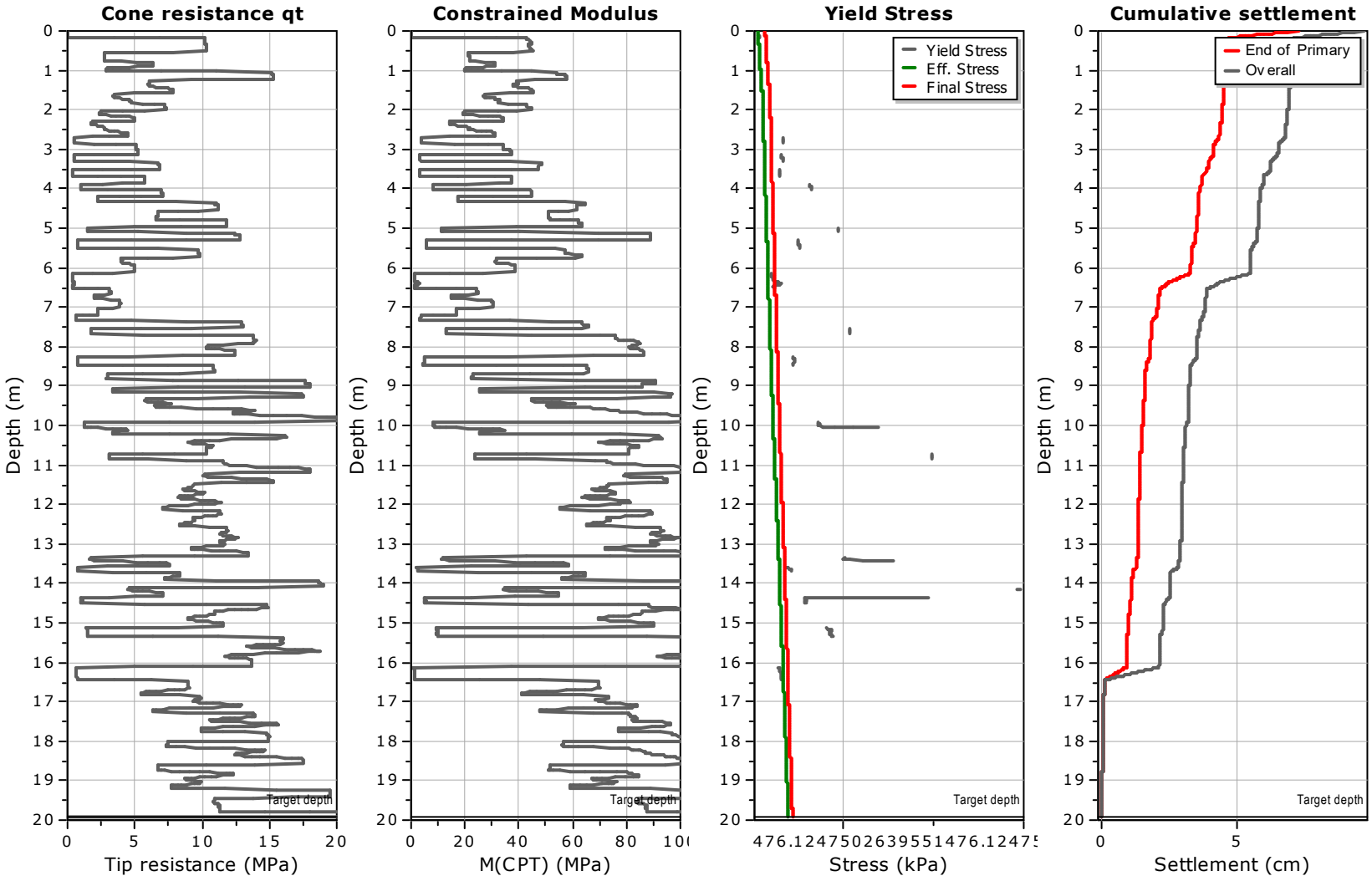
Total calculated settlement: 14.83

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CPT: 11
Total depth: 19.91 m, Date: 24/03/2026
Surface Elevation: 55.05 m, Est. GWL: 1.73 m
Coords: X:1810286.10, Y:5807257.05
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm

Total primary settlement: 7.29
Total secondary settlement: 2.43

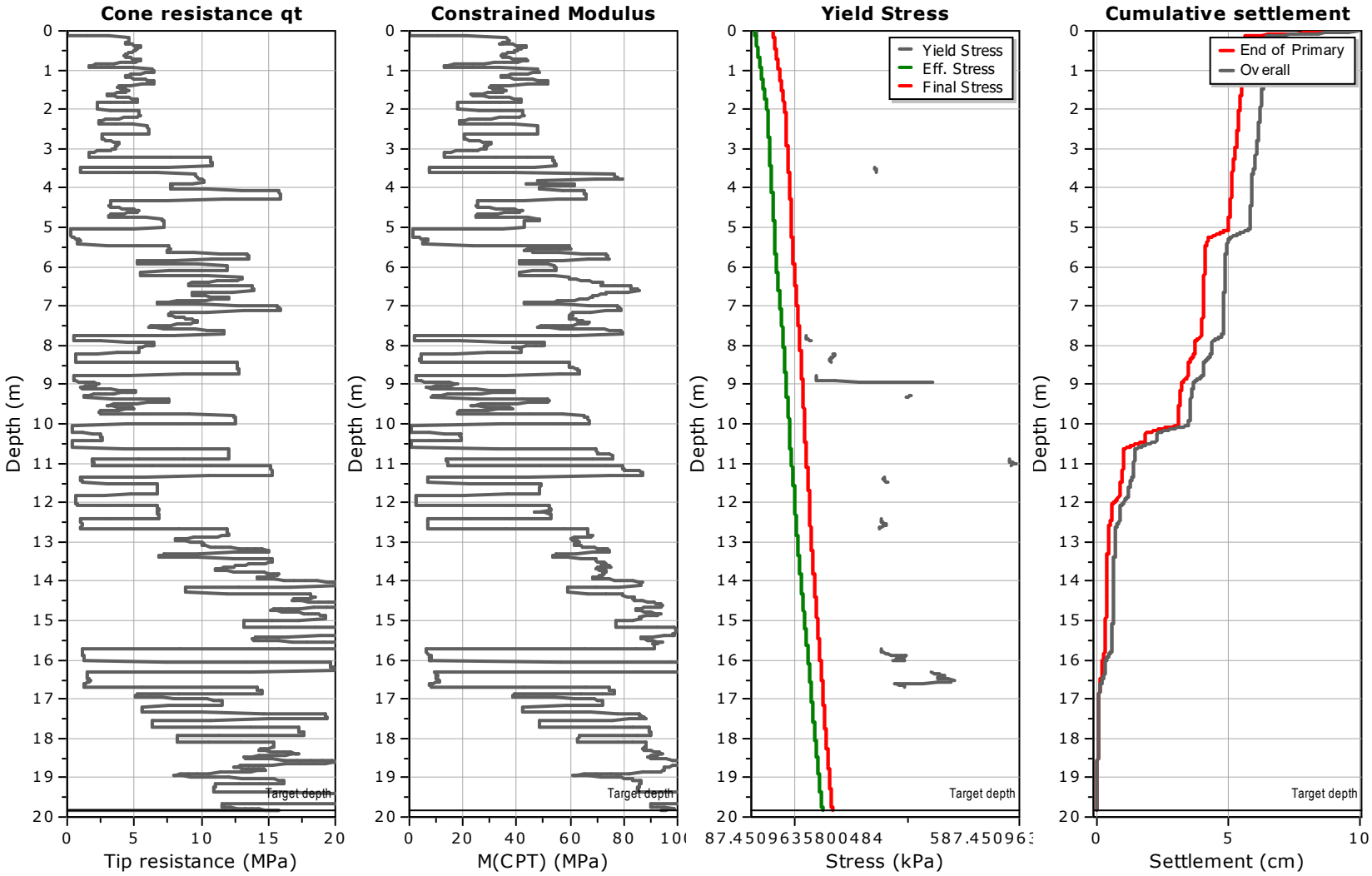
Total calculated settlement: 9.72

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CPT: 12
Total depth: 19.85 m, Date: 24/03/2026
Surface Elevation: 55.74 m, Est. GWL: 2.12 m
Coords: X:1810460.84, Y:5806859.70
Cone Type: P-TC000939
Cone Operator: B.Buxton (GroundLink)

Project: **Waikato Thoroughbred Racing | 23-1883**
Location: **Pencarrow, Hooker and Duncan Road, Tamahere**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.00 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 1 months
Time period for second. settlements: 599 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

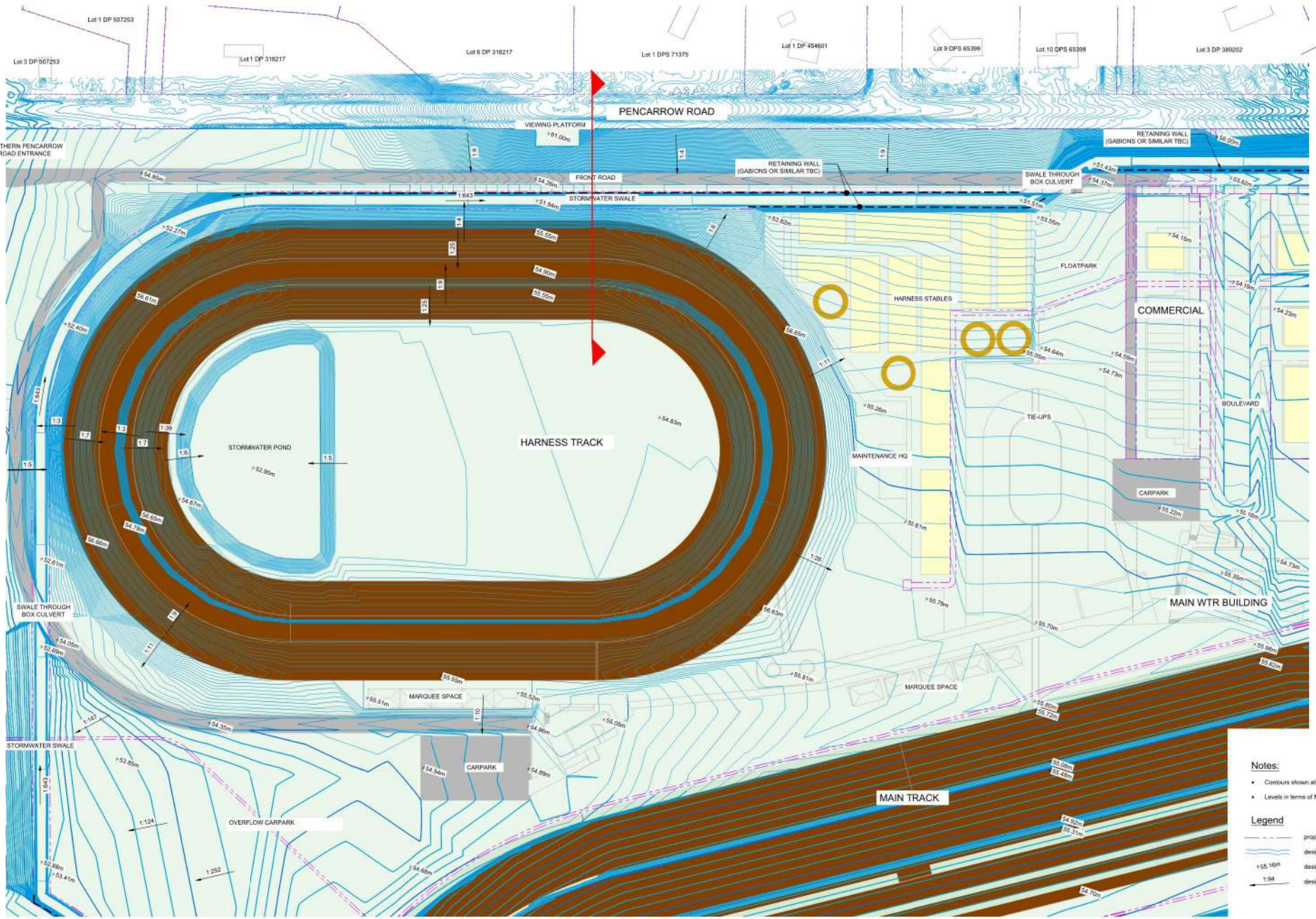
$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

Settlement Results in cm
Total primary settlement: 9.14
Total secondary settlement: 0.82

Total calculated settlement: 9.97

Appendix F Slope Stability



WAIKATO THOROUGHBRED RACING

BCD GROUP

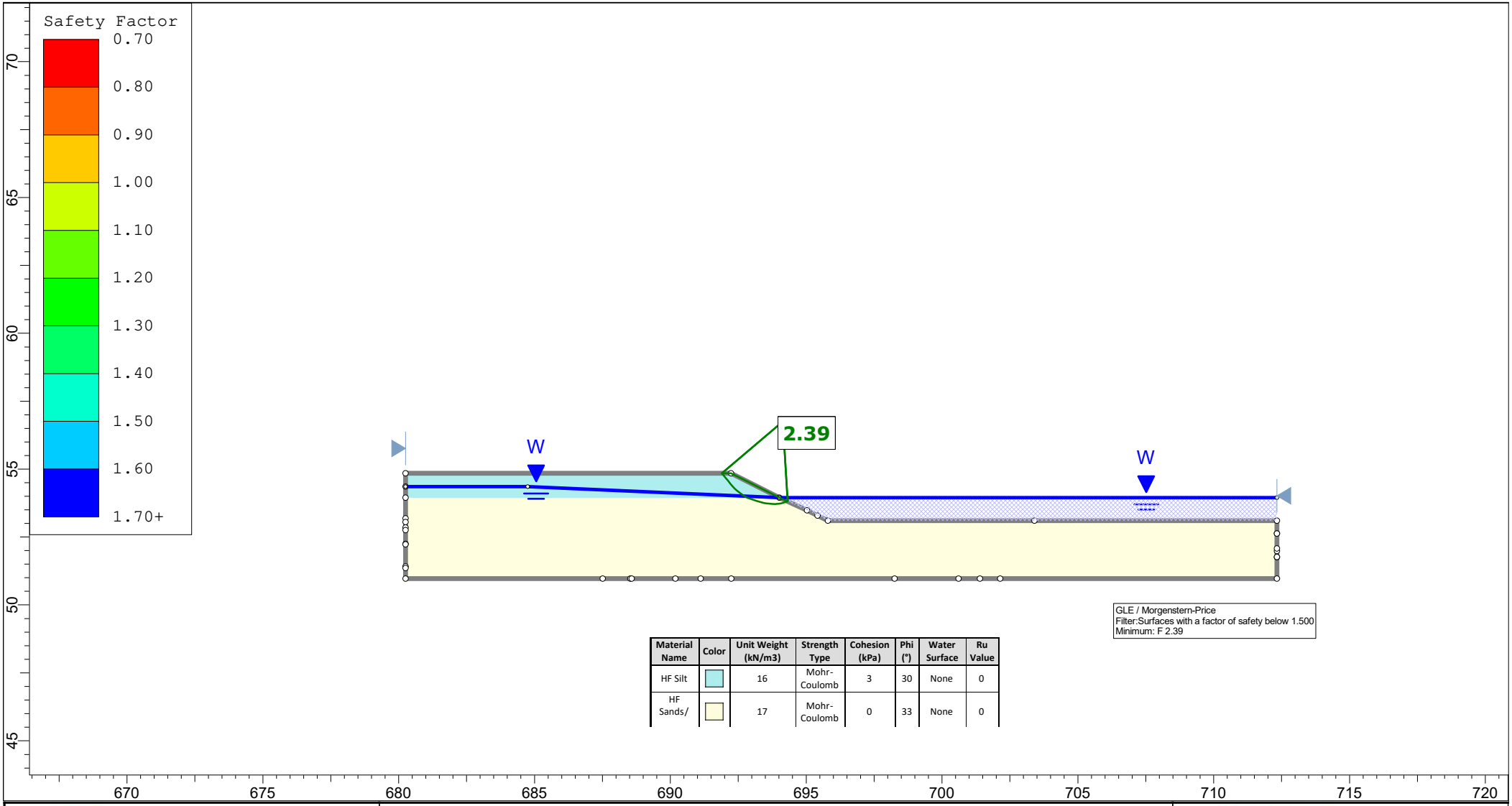
Slope Stability Sections

Waikato Thoroughbred Racing
Pencarrow, Hooker & Duncan Roads

Revision	Date	By	Reason
01	27/08/2026	BB	Substantive Application

Drawn: BB
Engineer: BB
SCALE: 1:4000
At: A3
Job Number: 23-1883
Sheet Number: G-F01
Revision: 01

P:\23-1883 Waikato Thoroughbred Racing\060 BCD Geotechnical\061 Calculations\5 Slope stability\23-1883 Slope Stability.slmd



GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.500
Minimum: F 2.39

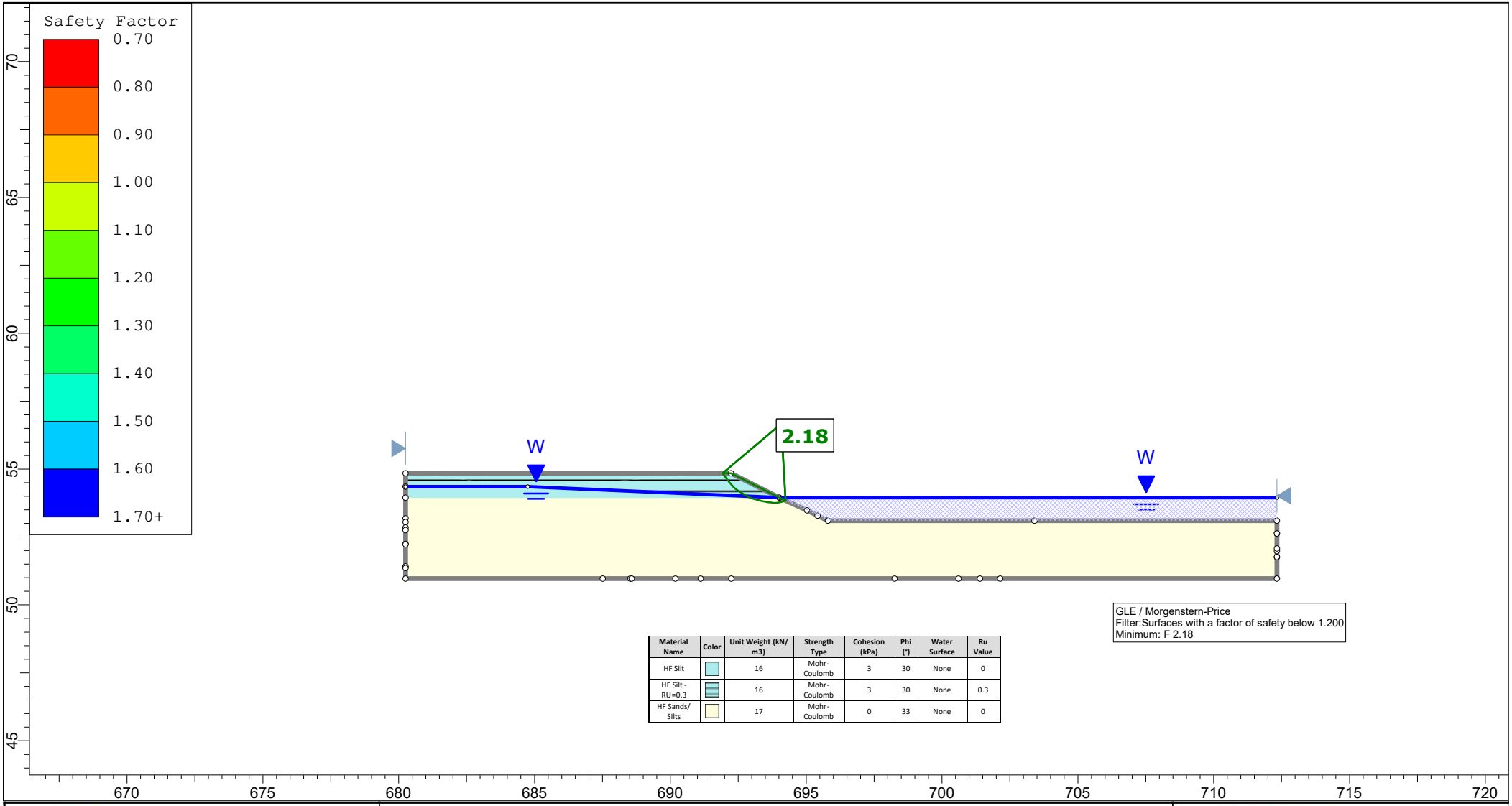
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
HF Silt		16	Mohr-Coulomb	3	30	None	0
HF Sands/		17	Mohr-Coulomb	0	33	None	0

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Typical Pond 1:2 - Static
Drawn By	BB
Scale	1:200
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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P:\23-1883 Waikato Thoroughbred Racing\060 BCD Geotechnical\061 Calculations\5 Slope stability\23-1883 Slope Stability.slmd



GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.200
Minimum: F 2.18

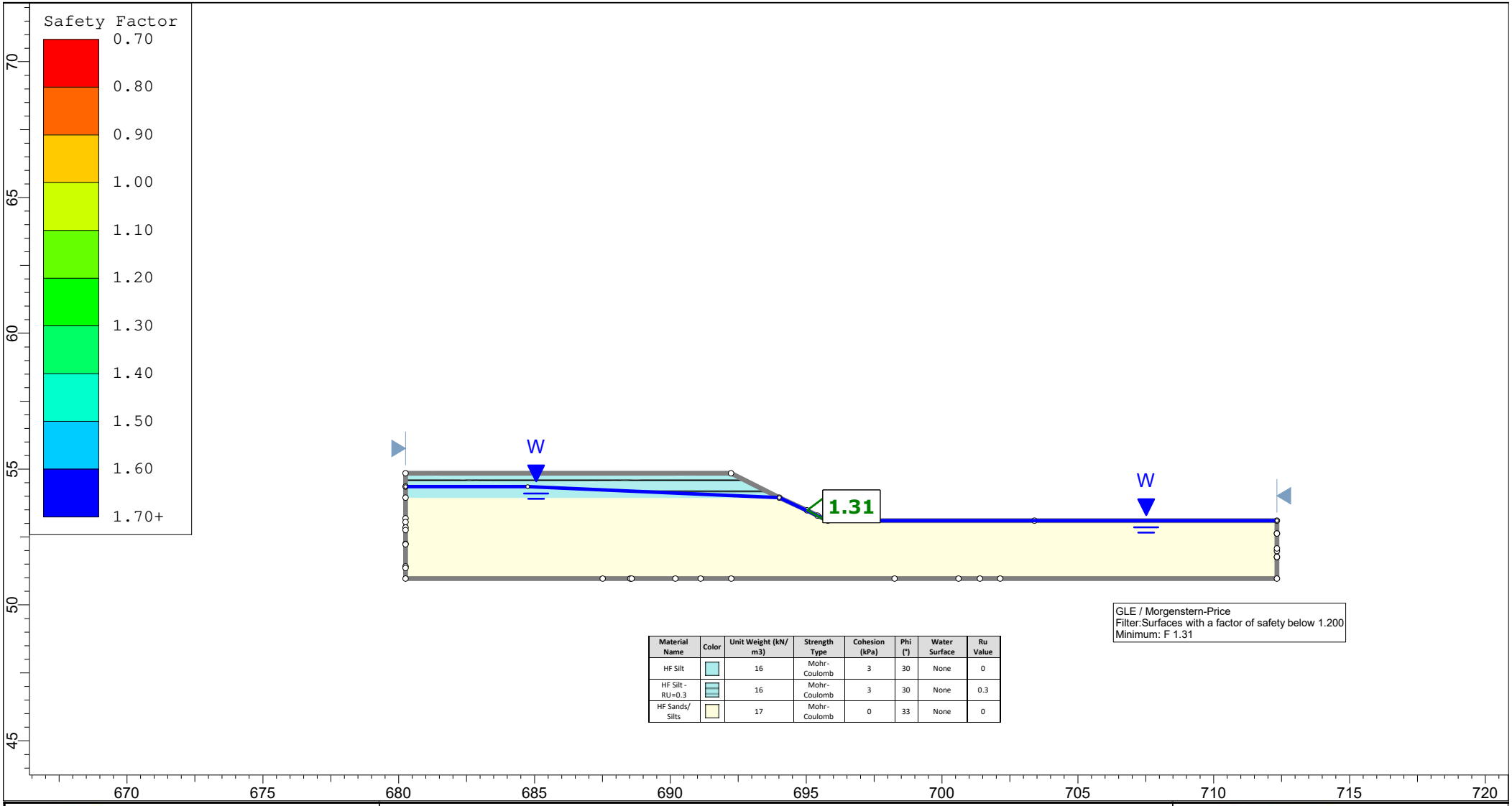
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
HF Silt		16	Mohr-Coulomb	3	30	None	0
HF Silt - RU=0.3		16	Mohr-Coulomb	3	30	None	0.3
HF Sands/ Silts		17	Mohr-Coulomb	0	33	None	0

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Typical Pond 1:2 - Elevated GW
Drawn By	BB
Scale	1:200
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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P:\23-1883 Waikato Thoroughbred Racing\060 BCD Geotechnical\061 Calculations\5 Slope stability\23-1883 Slope Stability.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
HF Silt		16	Mohr-Coulomb	3	30	None	0
HF Silt - RU=0.3		16	Mohr-Coulomb	3	30	None	0.3
HF Sands/ Silts		17	Mohr-Coulomb	0	33	None	0

GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.200
Minimum: F 1.31

SLIDEINTERPRET 9.042

Project: WTR Greenfield

Analysis Description: Typical Pond 1:2 - Empty Pond

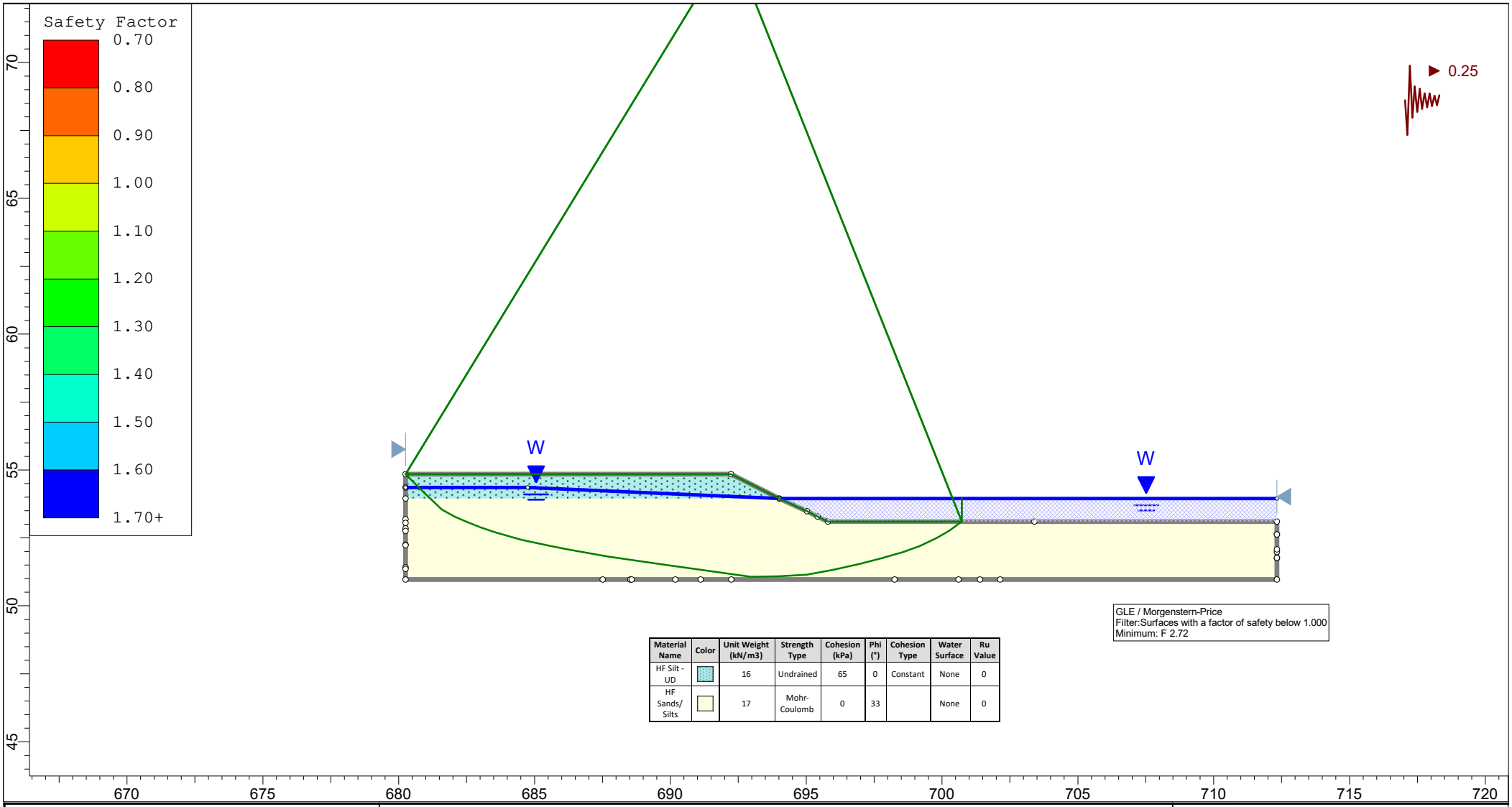
Drawn By: BB

Scale: 1:200

Date: 23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.000
Minimum: F 2.72

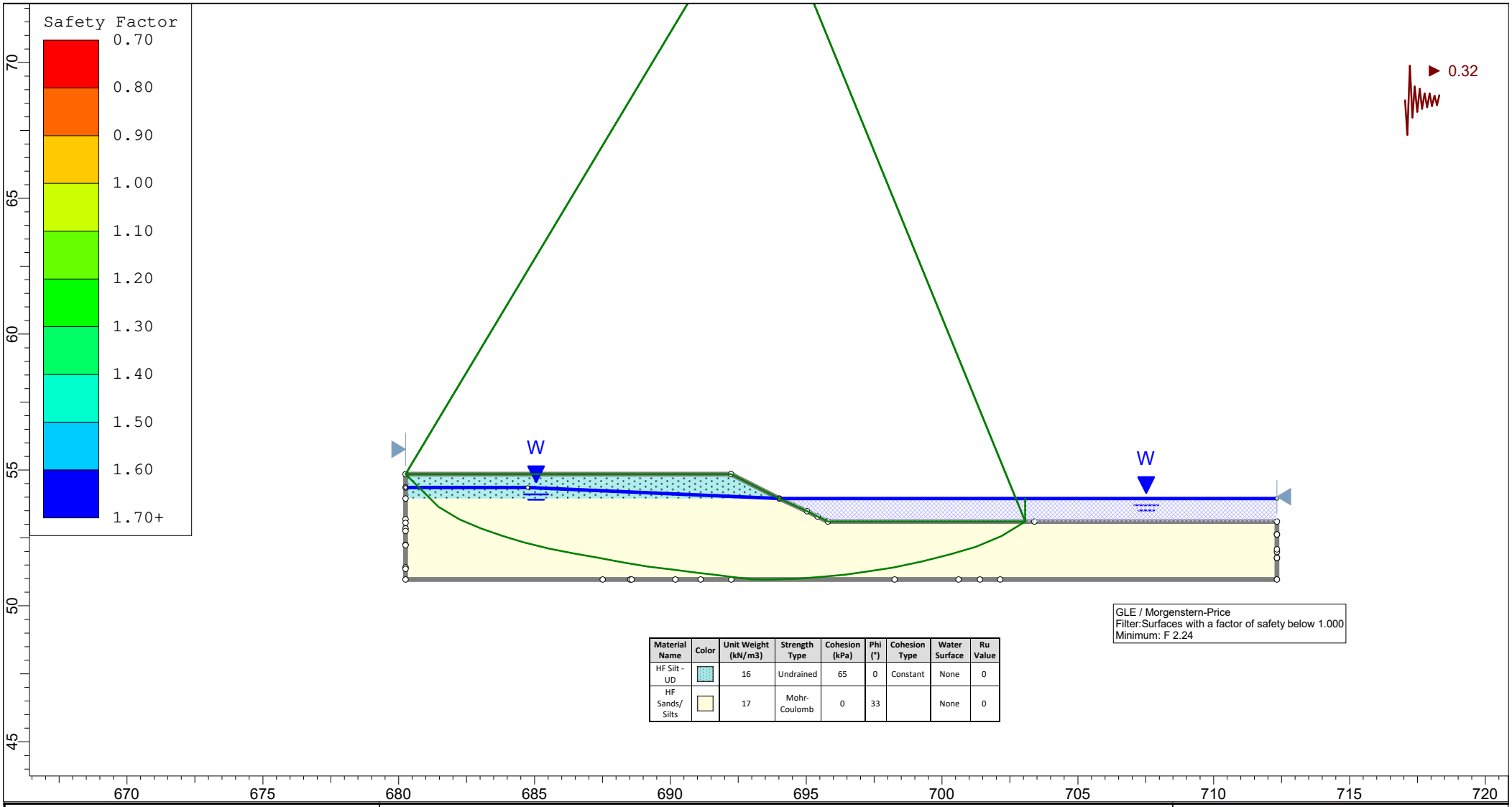
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface	Ru Value
HF Silt - UD		16	Undrained	65	0	Constant	None	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33		None	0

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Typical Pond 1:2 - IL2 Seismic
Drawn By	BB
Scale	1:200
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.000
Minimum: F 2.24

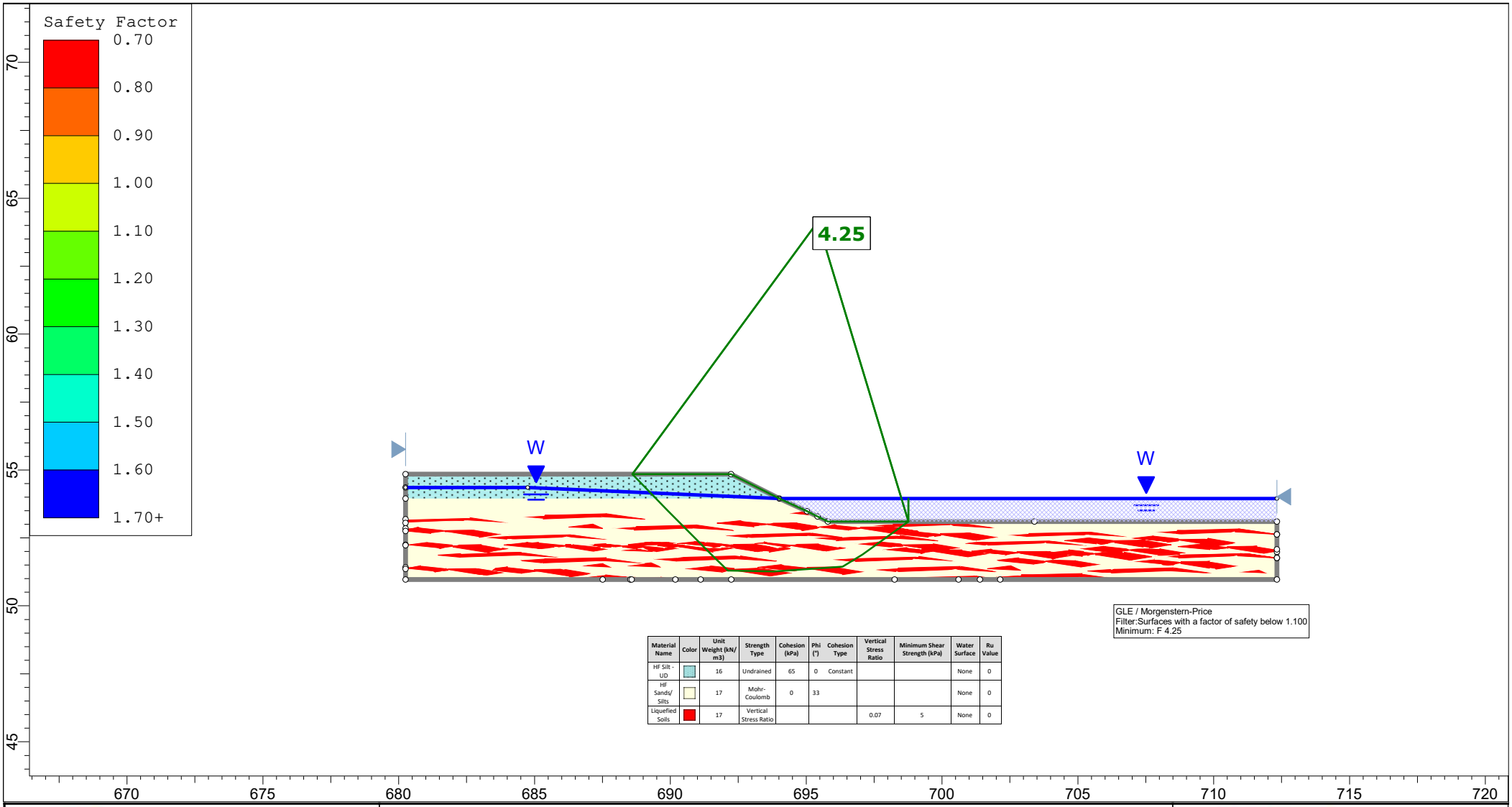
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface	Ru Value
HF Silt - UD		16	Undrained	65	0	Constant	None	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33		None	0

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Typical Pond 1:2 - IL3 Seismic
Drawn By	BB
Scale	1:200
Date	23/08/2026, 9:18:05 am

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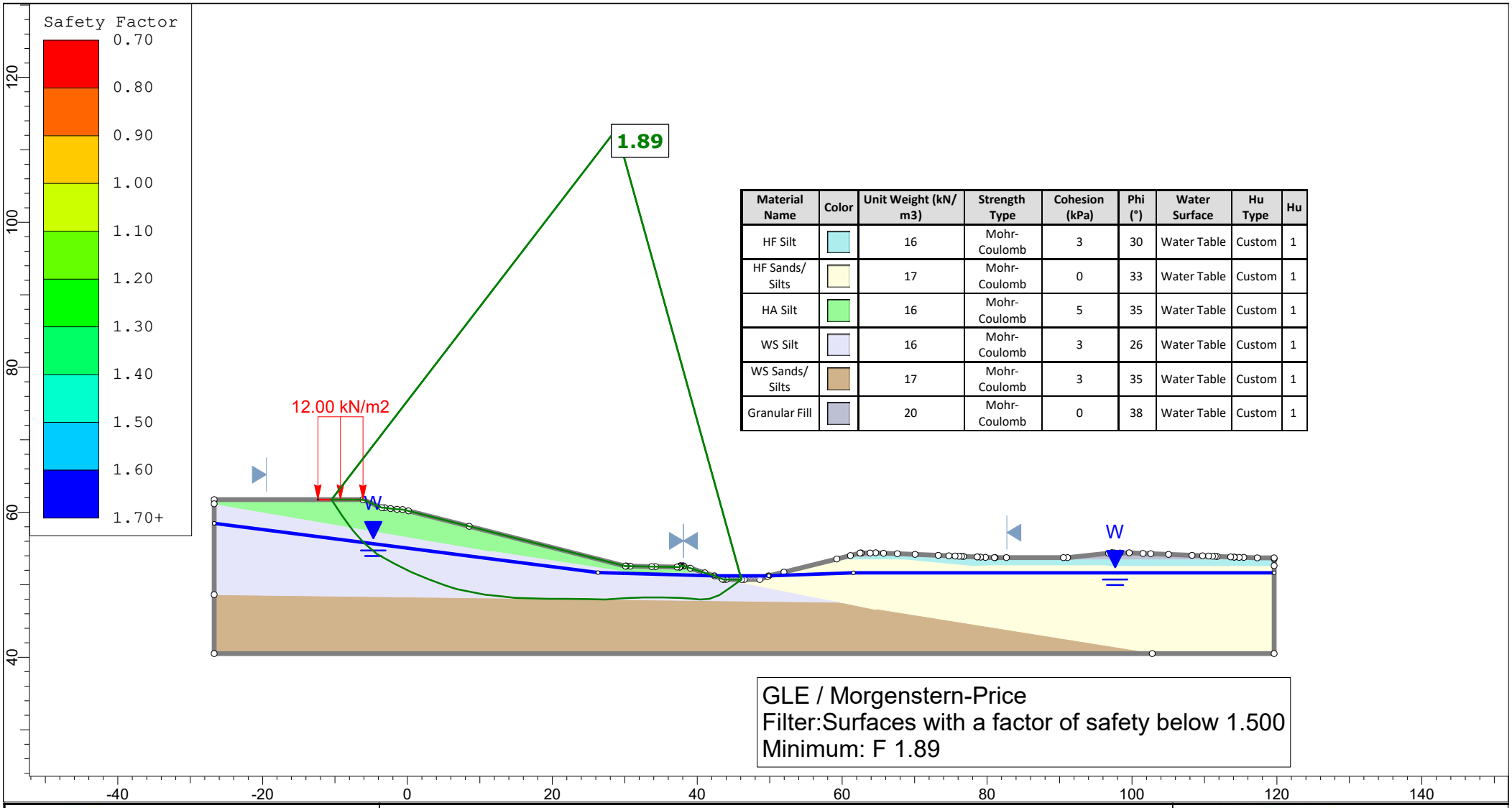
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Vertical Stress Ratio	Minimum Shear Strength (kPa)	Water Surface	Ru Value
HF Silt - UD		16	Undrained	65	0	Constant			None	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33				None	0
Liquefied Soils		17	Vertical Stress Ratio				0.07	5	None	0

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Typical Pond 1:2 - Post liquified
Drawn By	BB
Scale	1:200
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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P:\23-1883 Waikato Thoroughbred Racing\060 BCD Geotechnical\061 Calculations\5 Slope stability\23-1883 Slope Stability.slmd



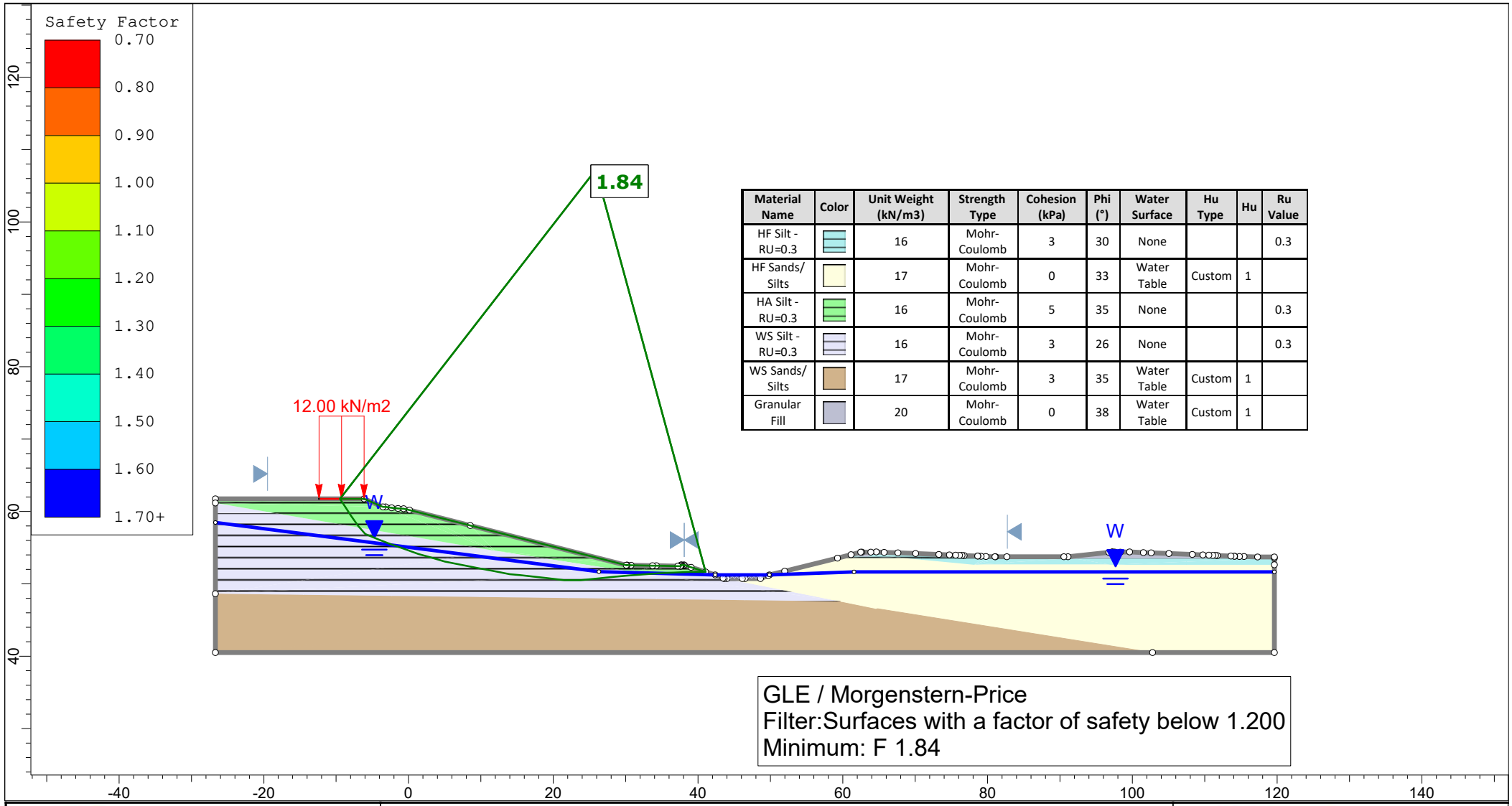
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
HF Silt		16	Mohr-Coulomb	3	30	Water Table	Custom	1
HF Sands/ Silts		17	Mohr-Coulomb	0	33	Water Table	Custom	1
HA Silt		16	Mohr-Coulomb	5	35	Water Table	Custom	1
WS Silt		16	Mohr-Coulomb	3	26	Water Table	Custom	1
WS Sands/ Silts		17	Mohr-Coulomb	3	35	Water Table	Custom	1
Granular Fill		20	Mohr-Coulomb	0	38	Water Table	Custom	1

GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.500
Minimum: F 1.89

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Pencarrow Road to Swale - Static
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

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Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu	Ru Value
HF Silt - RU=0.3		16	Mohr-Coulomb	3	30	None			0.3
HF Sands/ Silts		17	Mohr-Coulomb	0	33	Water Table	Custom	1	
HA Silt - RU=0.3		16	Mohr-Coulomb	5	35	None			0.3
WS Silt - RU=0.3		16	Mohr-Coulomb	3	26	None			0.3
WS Sands/ Silts		17	Mohr-Coulomb	3	35	Water Table	Custom	1	
Granular Fill		20	Mohr-Coulomb	0	38	Water Table	Custom	1	

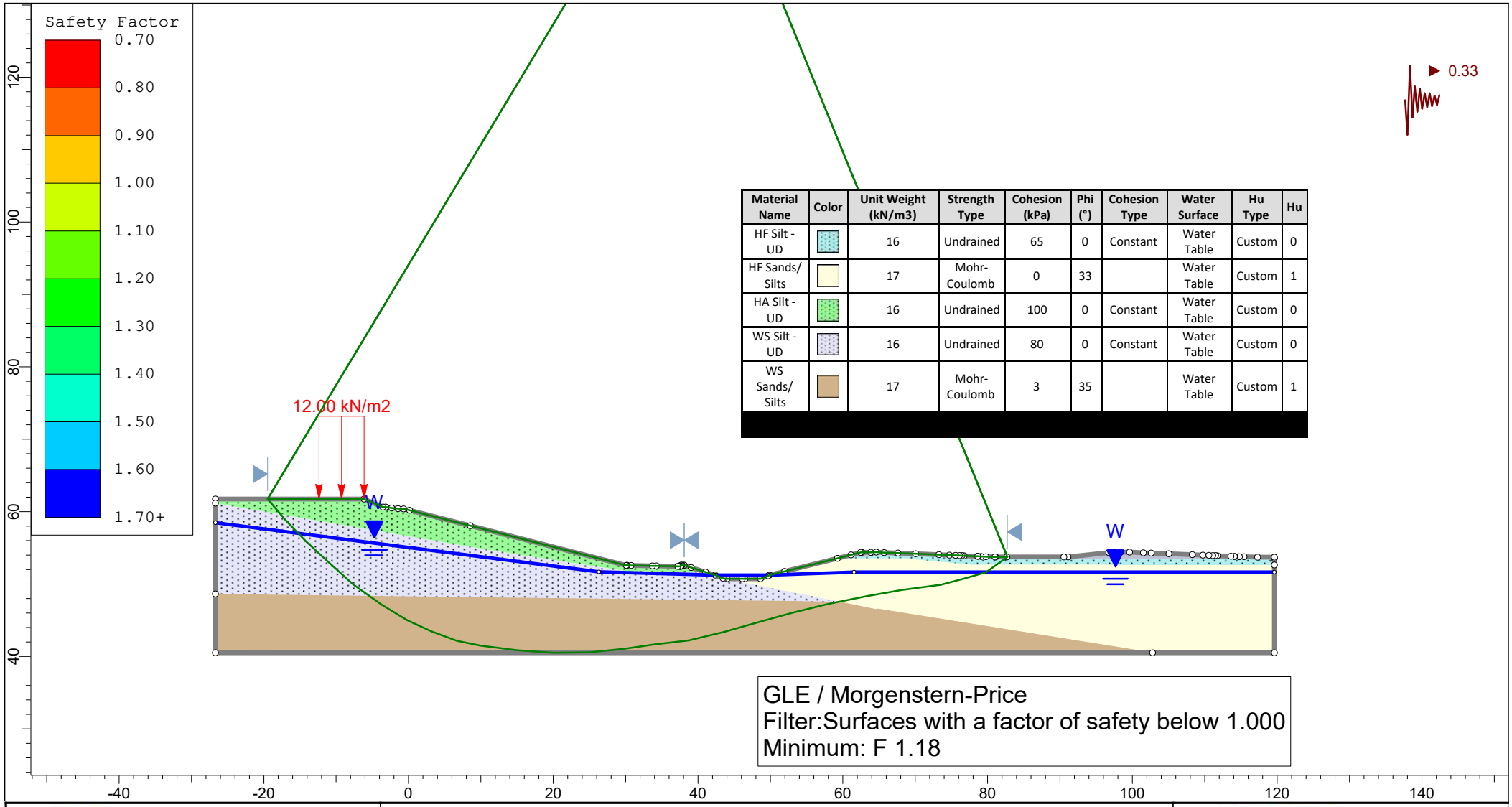
GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.200
Minimum: F 1.84

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Pencarrow Road to Swale - Elevated GW
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface	Hu Type	Hu
HF Silt - UD		16	Undrained	65	0	Constant	Water Table	Custom	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33		Water Table	Custom	1
HA Silt - UD		16	Undrained	100	0	Constant	Water Table	Custom	0
WS Silt - UD		16	Undrained	80	0	Constant	Water Table	Custom	0
WS Sands/ Silts		17	Mohr-Coulomb	3	35		Water Table	Custom	1

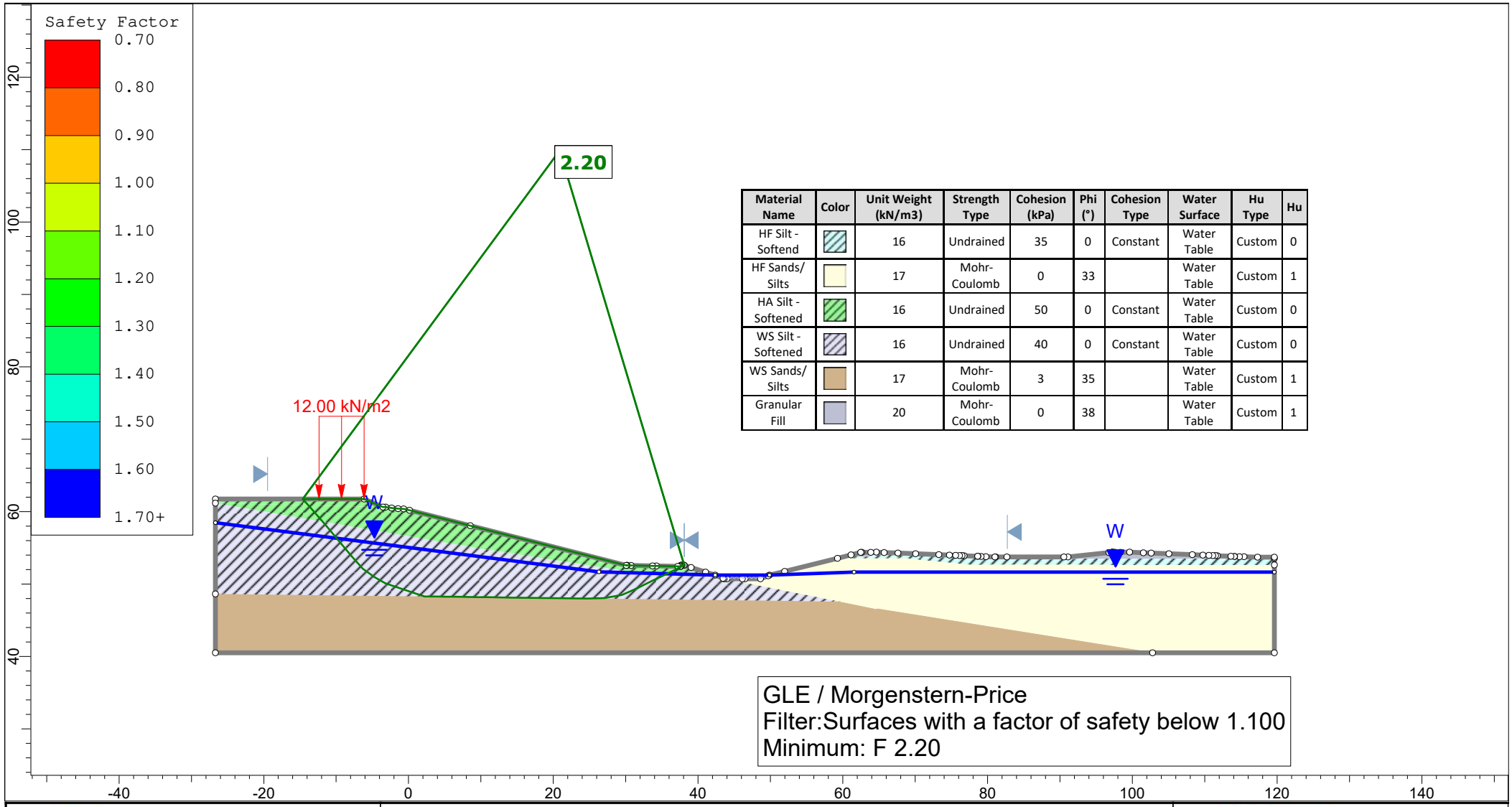
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SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Pencarrow Road to Swale - Seismic
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

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Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface	Hu Type	Hu
HF Silt - Softend		16	Undrained	35	0	Constant	Water Table	Custom	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33		Water Table	Custom	1
HA Silt - Softened		16	Undrained	50	0	Constant	Water Table	Custom	0
WS Silt - Softened		16	Undrained	40	0	Constant	Water Table	Custom	0
WS Sands/ Silts		17	Mohr-Coulomb	3	35		Water Table	Custom	1
Granular Fill		20	Mohr-Coulomb	0	38		Water Table	Custom	1

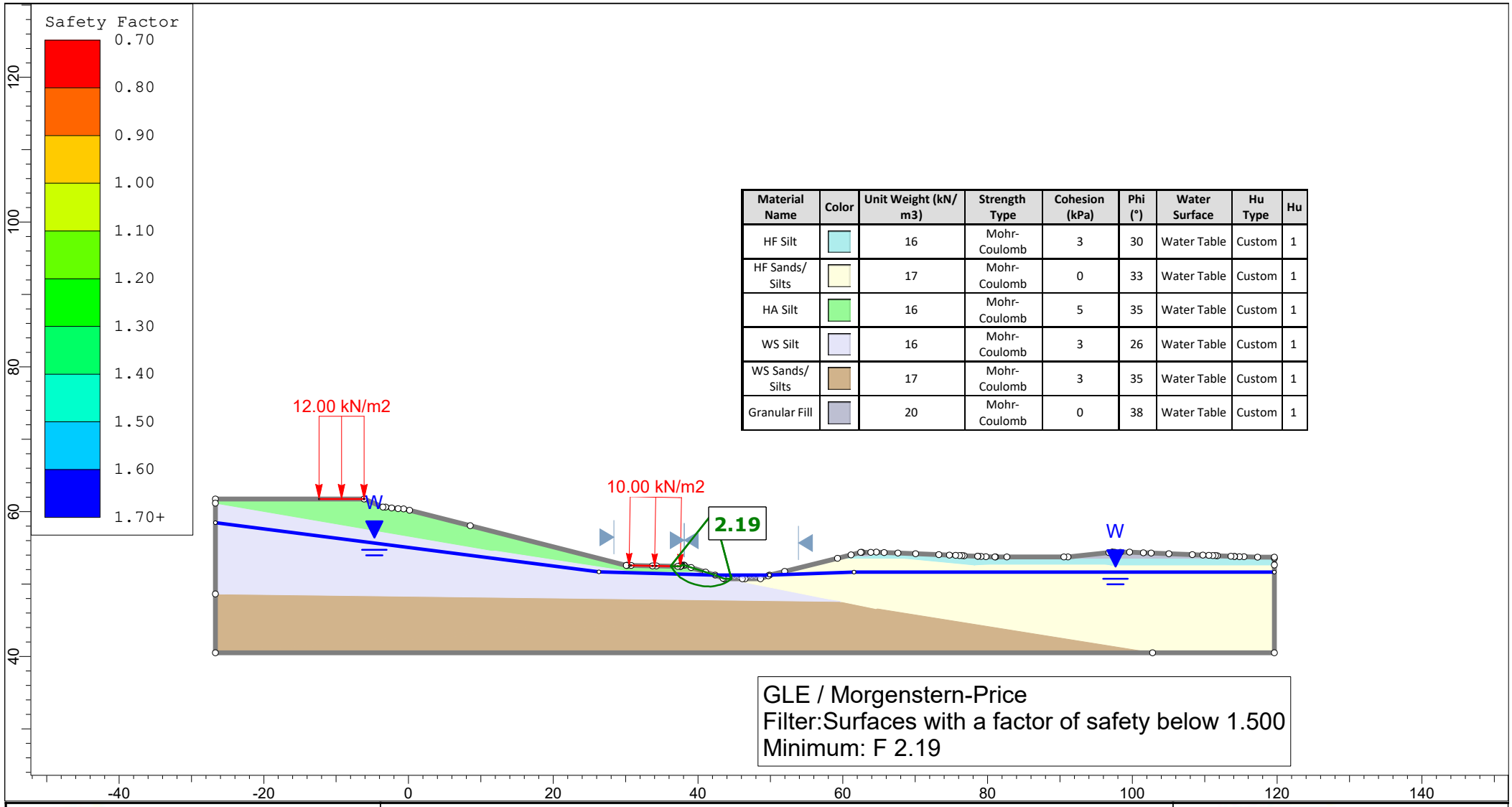
GLE / Morgenstern-Price
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Minimum: F 2.20

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Pencarrow Road to Swale - Post Seismic
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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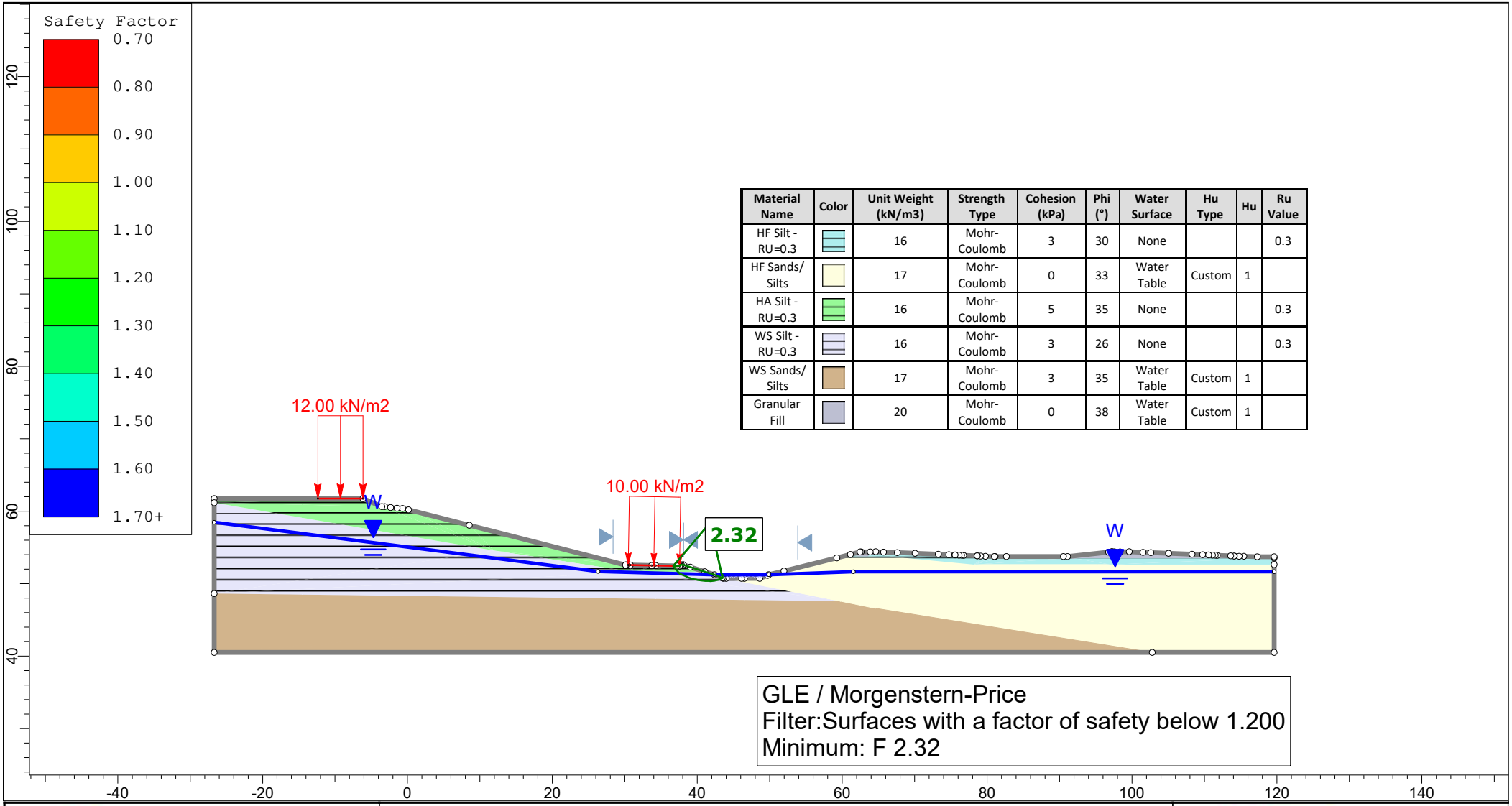
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
HF Silt		16	Mohr-Coulomb	3	30	Water Table	Custom	1
HF Sands/ Silts		17	Mohr-Coulomb	0	33	Water Table	Custom	1
HA Silt		16	Mohr-Coulomb	5	35	Water Table	Custom	1
WS Silt		16	Mohr-Coulomb	3	26	Water Table	Custom	1
WS Sands/ Silts		17	Mohr-Coulomb	3	35	Water Table	Custom	1
Granular Fill		20	Mohr-Coulomb	0	38	Water Table	Custom	1

GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.500
Minimum: F 2.19

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Proposed accessway to Swale - Static
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

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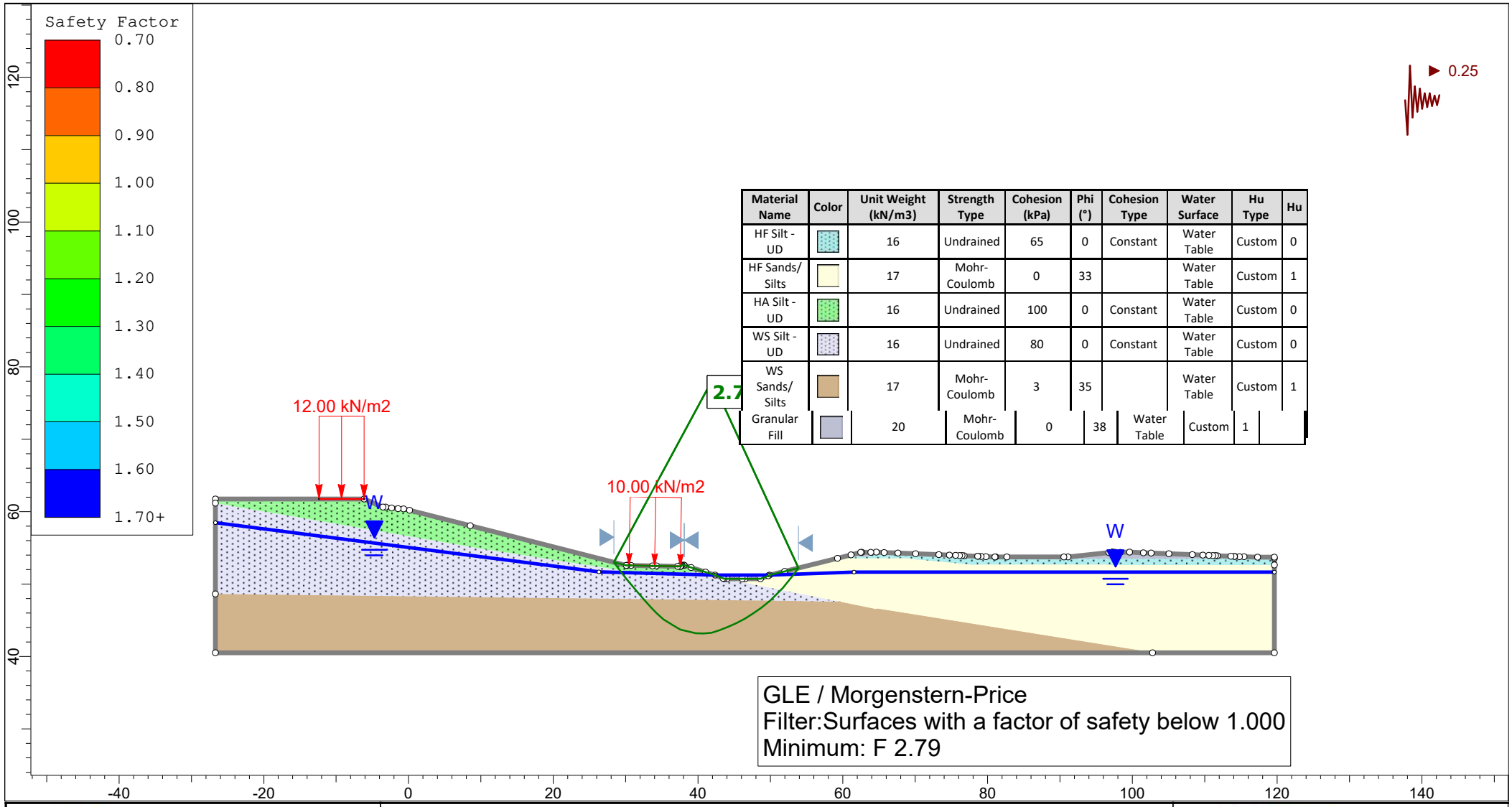
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu	Ru Value
HF Silt - RU=0.3		16	Mohr-Coulomb	3	30	None			0.3
HF Sands/ Silts		17	Mohr-Coulomb	0	33	Water Table	Custom	1	
HA Silt - RU=0.3		16	Mohr-Coulomb	5	35	None			0.3
WS Silt - RU=0.3		16	Mohr-Coulomb	3	26	None			0.3
WS Sands/ Silts		17	Mohr-Coulomb	3	35	Water Table	Custom	1	
Granular Fill		20	Mohr-Coulomb	0	38	Water Table	Custom	1	

GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.200
Minimum: F 2.32

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Proposed accessway to Swale - Elevated GW
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

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Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface	Hu Type	Hu
HF Silt - UD		16	Undrained	65	0	Constant	Water Table	Custom	0
HF Sands/ Silts		17	Mohr-Coulomb	0	33		Water Table	Custom	1
HA Silt - UD		16	Undrained	100	0	Constant	Water Table	Custom	0
WS Silt - UD		16	Undrained	80	0	Constant	Water Table	Custom	0
WS Sands/ Silts		17	Mohr-Coulomb	3	35		Water Table	Custom	1
Granular Fill		20	Mohr-Coulomb	0	38	Water Table	Custom	1	

GLE / Morgenstern-Price
Filter:Surfaces with a factor of safety below 1.000
Minimum: F 2.79

SLIDEINTERPRET 9.042

Project	WTR Greenfield
Analysis Description	Proposed accessway to Swale - Seismic
Drawn By	BB
Scale	1:750
Date	23/08/2026, 9:18:05 am

WAIKATO THOROUGHBRED RACING
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Appendix G National Policy Statement for Natural Hazards 2025

NATIONAL POLICY STATEMENT OF NATURAL HAZARDS, 2025

This National Policy Statement provides direction under the Resource Management Act 1991 for managing natural hazard risk associated with subdivision, use and development. It must be applied to flooding, landslips, coastal erosion, coastal inundation, active faults, liquefaction, and tsunami, and decision-makers may choose to use the same approach for other hazards.

Natural hazard risks are expected to change over time, including through the effects of climate change. Consistent national direction helps reduce vulnerability and supports resilience.

The National Policy Statement requires decision-makers to assess risk using a risk matrix and manage it proportionately. Very high risk must be avoided, and other risks managed through mitigation measures. Decisions must be based on the best available information, even where that information is uncertain or incomplete.

The National Policy Statement applies to the following hazards:

(a) Flooding;

(b) Landslips;

(c) Coastal erosion;

(d) Coastal inundation;

(e) Active faults;

(f) Liquefaction; and

(g) Tsunami.

Risk Matrix:

Consequence Level	Likelihood Level: Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
ARI (years):	Up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
AEP:	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

Risk = Likelihood x Consequence

Likelihood:

Likelihood level	Annual exceedance probability (AEP)	Average recurrence interval (ARI) or 'return period'
Almost Certain	10% or more	Up to and including 10 years
Very Likely	10% to 5%	Over 10 and up to and including 20 years
Likely	5% to 2%	Over 20 and up to and including 50 years
Possible	2% to 1%	Over 50 and up to and including 100 years
Unlikely	1% to 0.2%	Over 100 and up to and including 500 years
Rare	0.2% to 0.02%	Over 500 and up to and including 5,000 years
Very Rare	Less than 0.02%	More than 5,000 years

Consequence:

Consequence level	Damage to property	Potential for injury or fatalities
Catastrophic	Severe damage to land and building(s), potential for collapse or total destruction of structures/ Building(s) need to be demolished, rebuilt or relocated.	High threat to life safety, with probable fatalities and/or critical injuries.
Major	Major damage to land and building(s), including structural damage. Loss of use and substantial repair required.	Unsafe for people, with potential for many injuries and/or fatalities.
Moderate	Some damage to land and non-structural damage to building(s). Limited loss of use, repairs required.	Unsafe for people, with potential for injuries, although expected to be minor.
Minor	Minor damage to land and building(s). No loss of use, minimal repairs required.	Isolated minor injuries possible.
Negligible	No loss of use, no building repairs required.	No injuries.

PROJECT:	**Waikato Thoroughbred Racing – Greenfields**	**JOB NUMBER:**	**23-1883**
CLIENT:	**Waikato Thoroughbred Racing Inc**	**DATE / REVISION:**	**September 30, 2026 / Revision 1**

Natural hazard risk to people and property associated with subdivision use and development:

Hazard	Pre-development			Comment / Controls	Post Development		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Flooding[1]	Almost Certain	Negligible	Low	Based on hydraulic modelling of the existing site, flooding occurs in localized low-lying areas of the site, and around existing farm drains. This flooding is expected given the upstream catchment and generally flat catchment. We would consider flooding to some extent to be very likely to occur but the consequence levels to be negligible based on the use and large areas of the site not affected by flooding. In the post developed scenario, hydraulic modelling shows a similar level of flood risk. The inherent risk of flooding occurring remains to similar to the existing but equally, the site is being designed to store excess flood waters in storage ponds and swales, mimicking the existing scenario but in a more controlled manner. We consider the residual risk to be equal or lower to the existing scenario.	Likely	Negligible	Low
Landslip[2]	Unlikely	Negligible	Low	The site is generally near-level to gently undulating, with the exception of a 7 to 20 degree, 5.5m high slope adjacent to Pencarrow Road. Surficial soil creep is present on the slope. No evidence of deeper instability is present.	Unlikely	Negligible	Low

Hazard	Pre-development			Comment / Controls	Post Development		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
				Slope engineering will be required for ponds and reshaping the Pencarrow Road slope. Geotechnical assessment required during design.			
Coastal Erosion[3]	Very Rare	Negligible	Low	The site is located approximately 30km from the nearest coastline.	Very Rare	Negligible	Low
Coastal Inundation[3]	Very Rare	Negligible	Low	The site is inland; no further assessment is required.	Very Rare	Negligible	Low
Active Faults[2]	Rare	Minor	Low	The GNS active fault database indicates that the nearest active fault is the Kerepehi Fault, approximately 40km from the site.	Rare	Minor	Low
Liquefaction[2] 1/500 Year Event	Unlikely	Moderate	Medium	The site is underlain by alluvial sands and has a high groundwater table. BCD has assessed liquefaction for IL1 through to IL3 buildings. This can be managed using the methods outlined in the geotechnical report.	Unlikely	Negligible	Low
Liquefaction[2] – 1/1000 Year Event	Rare	Major	Medium		Rare	Minor	Low

Hazard	Pre-development			Comment / Controls	Post Development		
	Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Tsunami	Very rare	Negligible	Low	The site is located approximately 30km from the nearest coastline.	Very rare	Negligible	Low

Notes:

1. Refer to Flood Report by BCD Group Limited dated 1st October 2026-
2. Refer to Geotechnical Report by BCD Group Limited dated 30th September 2026
3. Site-specific coastal assessment not required

The CoLAB Regional Infrastructure Technical Specification (RITS) 2025 provides guidance on potential geotechnical hazards. Even if the risk is considered to not be relevant for the site, a brief description why should be provided in a GAR, the table below provides compliance with the RITS.

Geotechnical Hazard	Comment
Weak Foundation Soils	Addressed in this report
Excessive ground settlement	Addressed in this report
Shallow groundwater table	Addressed in this report
Retaining structures and surcharge	Addressed in this report
Slope stability	Addressed in this report
Rockfalls	There are no rocky outcrops, or steep cliffs present within or near the site.
Presence of existing non-engineered fill	Addressed in this report
Existing and/or proposed engineered fill	Addressed in this report
Existing and/or proposed cuts / ground lowering	Addressed in this report
Existing and/or proposed stabilised slopes (MSE, soil nails etc.)	Not anticipated for this development
Land erosion (coastlines, river/stream banks, lakeshore)	Rivers and streams do not flow through or near the site therefore land erosion is unlikely to be a risk to the site.
Internal erosion (groundwater movement through erodible soils)	Site has high groundwater table and is not prone to high lateral flows.
Surface erosion (exposed erodible soils, particularly during construction)	Refer to BCD Erosion and Sediment Control Plan.
Geothermal hazards	Site is not located within a geothermal area.
Expansive soils	Addressed in this report
Collapsible soils	Collapsable soils are not present in area.
Seismicity – ground rupture / faults	Addressed in this report
Seismicity – liquefaction and lateral spreading	Addressed in this report
Seismicity – cyclic softening of 'clay-like' soils	Addressed in this report
Seismicity – tectonic subsidence	Not within a tectonic subsidence zone
Inundation (surface and/or groundwater flooding)	Refer BCD Flood Hazard Report.
Ground contamination (soil and groundwater)	Refer BCD Contaminated Site Management Plan.
Ground soakage for stormwater disposal	Refer BCD Civil report.
On-site effluent disposal	Refer BCD Civil Report.
Tsunami / seiches	The site is not near coast or large lake.
Volcanic eruptions	The site is not within an active volcanic zone.
Subsidence	The site is not within a known subsidence area.
Active or former mining (including quarries)	There is no known active or former mining/quarries within the site or neighbouring the site.
Other - Acid Sulphate Soils	Refer BCD Acid Sulphate Soils Report.

Appendix H Statement of Professional Opinion (Form1A)

FORM 1A: STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION

Development: Waikato Thoroughbred Racing Greenfield Racing Hub

Owner/Developer: Waikato Thoroughbred Racing

Location: 592, 536, 636 Pencarrow Road, 37 Hooker Road & 38, 90 Duncan Road, Tamahere, Hamilt

I, Michael David Trigger *(Full name)*

of BCD Group Limited, 220 Tristram Street, Hamilton *(Name and address of firm)*

hereby confirm that:

I am a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the owner / developer as the geo-professional on the above development.

Site investigations have been carried out under my direction and are described in my report.

I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:

Master Plan - Substantive Application V12 by Designgroup Stapleton Elliott + COX dated 20/08/26.

(Insert reference to all drawings including dates of latest amendments)

I confirm that I have considered the level of complexity, which I believe to be Level 3. I confirm that I am suitably qualified and experienced to undertake the geotechnical assessment for this level of complexity.

In my professional opinion, not to be constructed as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, providing that:

The recommendations within the BCD Group Limited Geotechnical Assessment Report for Waikato Thoroughbred Racing Greenfield Racing Hub Rev 6, dated 28/08/2026 are followed.

(Continue on additional page if required)

This professional opinion is furnished to the Council and the owner/developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling.

Signed: [redacted] Michael David Trigger **Dated:** 30/09/2026

Council's property file/LIM has been reviewed for relevant information. ☐