Preliminary Geotechnical Assessment Report

80 MCLARIN ROAD, GLENBROOK

For

HD PROJECT 2 LTD

J01798 | Lander Geotechnical Consultants Limited | 13 September 2021

13 September 2021 Ref No: J01798

HD Project 2 Limited
C/- b.powell@harrisongrierson.com

Attention: B. Powell

Dear Bryce

RE: Preliminary Geotechnical Assessment Report for Private Plan Change for 80 McLarin Road, Glenbrook

This report represents the results of the geotechnical investigations and analyses carried out by Lander Geotechnical Consultants Limited for and in accordance with instructions from HD Project 2 Limited with regard to a Private Plan Change submission for 80 McLarin Road, Glenbrook.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact the undersigned.

For and on behalf of Lander Geotechnical Consultants Limited

S.G. Lander
Principal Geotechnical Engineer

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1 EXECUTIVE SUMMARY

To support a Private Plan Change application, Lander Geotechnical Consultants Limited have undertaken a preliminary geotechnical study of the 80 McLarin Road site including intrusive in-ground investigations, site walkover, desktop study and a review of related reports. The site was found to be underlain by a thin mantle of South Auckland Volcanic Field weathered ash, with the majority comprising Puketoka Formation alluvial clays and silts, and Residual East Coast Bays Formation along the northern edge.

Based on our analyses and prevailing site conditions, potential geotechnical hazards on this site including coastal erosion, slope instability, liquefaction susceptibility, tsunami and earthquake risks are considered to be of **low risk** for this site. Volcanic risk should be considered and mitigated on a regional level.

However, there is softer ground in the lower lying (southern) portion of the land holding and consolidation settlement of these deposits induced by applied surcharges from future development may present geotechnical constraints. This will not preclude development from occurring over this area, but will require further site investigations and engineering design at the time of a future Resource Consent.

Land modifications to create a future subdivision remain to be seen, however with appropriate engineering it is foreseeable that such works will not adversely affect prevailing conditions (and therefore should introduce no additional geotechnical hazards).

2 SCOPE OF REPORT

Lander Geotechnical Consultants Limited have been engaged by HD Project 2 Limited to prepare a Preliminary Geotechnical Assessment Report (PGAR) in support of a Private Plan Change (PPC) application.

We understand the plan change seeks to rezone approximately 8 hectares from Future Urban to Urban Residential Land Use under the Auckland Unitary Plan 2016 – Operative in Part (AUP(OP)). The 80 McLarin Road plan change area is legally described as Lot 2 DP 204733 and referred to as 'Glenbrook 2'.

Our work has entailed:

- A review of published geology maps, aerial photograph interpretation and observations of prevailing site geomorphology
- A review of the 'Glenbrook 1' Preliminary Geotechnical Appraisal Report for Private Plan Change by Lander Geotechnical Consultants Limited (refer Section 3 below).
- A field investigation including:
    - The drilling of a series of hand auger boreholes (2 No.) to characterise the steep slopes prevailing in the south-western portions of the site,
    - The drilling of a series of rotary cored machine boreholes (1 No.) to prove soil conditions beyond the reach of hand augers, to depths of approximately 15m (bgl), the installation of a piezometer within the machine borehole for the purposes of groundwater monitoring and one groundwater monitoring round approximately 1 week following the completion of drilling.

    - The execution of 4 no. Cone Penetrometer Tests (CPTs) to rapidly characterise the soils at depth across the site.
- An assessment of slope stability risk on the steeper slopes in the central to south-western portion of the site.
- An assessment of liquefaction risk as outlined in the MBIE, MfE and EQC guideline 'planning and engineering guidance for potentially liquefaction-prone land', September 2017.
- The preparation of a preliminary geotechnical assessment report summarising our findings.

This report is intended to support a PPC application and is not intended to be in a suitable format or of sufficient detail to advance a Resource Consent application(s). Further analysis for a Resource Consent application will need to be undertaken in due course, once earthworks plans are tabled, etc, and the data herein may be introduced into such report(s).

3 RELATED REPORTS

In preparing this report we have reviewed the following report:

- Lander Geotechnical Consultants Limited. *Preliminary Geotechnical Appraisal Report, Kahawai Point, McLarin Road, Glenbrook*. Reference: J00147. Dated: 27 August 2015.

That report addresses the Glenbrook 1 Structure Plan area, north of 80 McLarin Road and is relevant given its close proximity. Two primary geotechnical hazards were identified in that report, being slope stability and liquefaction of fine granular soils during earthquake shaking. It determined that slope instability was low risk inland of the steeper coastal slopes, and high risk along the coastal foreshore margin. Liquefaction potential was considered low.

However, it is important to note that the topographical setting at 80 McLarin is different in that there are no coastal margins, and that the underlying geological setting is largely different from that which exists to the north (i.e. there is a geological boundary in the elevated northern reaches of 80 McLarin – refer 4.2 below).

4 SITE DESCRIPTION, GEOLOGICAL SETTING AND GEOMORPHOLOGY

4.1 Site Description

The site is bound by the Kahawai Point Development to the north, similar rural residential properties to the east and south and the Glenbrook Beach residential properties to the west. The site is currently in green fields for pasture. Several overland flow paths run through the site and are shown on Auckland Councils GIS database, however this will be confirmed by site specific survey by other members of the PPC project team. Generally, overland flows are draining south towards a culvert in the property to the south which outlets into the Glenbrook Beach Beachfront Esplanade Reserve.

Site gradients are generally less than 1(v) in 10(h) in the northern half, however, gradients reach up to around 1(v) in 4(h) in the central to southern reaches of the site.

No existing public service lines are shown to be present within the study area.

The site is located within the Glenbrook Structure Plan. Significant urban residential development (the Kahawai Point development) is presently underway immediately north of 80 McLarin Road, which is understood will expand east and west.

A review of available historic photographs on Auckland Council's online GIS database, Google Earth images and historic images from Retrolens.nz found no obvious or significant land modification on the majority of the study area over the period 1942 to 2021. However, some minor earthworks may have occurred with the infill of a pre-existing overland flow path to ease land gradients (circled blue on inset A), and a manmade drainage ditch is quite well defined in 2021 from the north to the south. Historic aerial photographs dated 1940 and 2021 are inset below.

Inset A: Left: Photograph dated 1942, retrieved from Retrolens.nz, Right: Photograph dated 2021, retrieved from Google Earth.

4.2 Geologic Setting

The GNS digital geological QMaps indicate the site is underlain by two geological units:

- East Coast Bays Formation (ECBF; indicated in orange shading, comprises early Miocene turbidite deposits) comprising alternating sandstone and mudstone with variable volcanic content and interbedded volcanic grits.
- Puketoka Formation (indicated in pale shading, consisting of late Pilocene to Middle Pleistocene alluvial deposits) comprising pumiceous mud, sand and gravel with muddy peat and lignite, rhyolite pumice including non-welded ignimbrite, tephra and alluvial deposits.

Approximately 3km beyond the site to the south are deposits (Basalt and Ash / Tuff soils) of the South Auckland Volcanic Field. It is possible that thin, surficial ash deposits from the South Auckland Volcanic Field may be present overlying Puketoka Formation deposits, particularly in the elevated portions of the site.

The site is approximately 24km west from the Drury Fault and approximately 34km west from the Wairoa North Fault.

Inset B: Published Geology (Institute of Geological and Nuclear Sciences. QMap geology. KMZ file. Available from https://services.arcgisonline.co.nz)

4.3 Geomorphology

Site geomorphology at 80 McLarin Road includes rolling and undulating terrain in the northern half of the site, sloping away from around RL 20m to RL 5m in the southern half of the site. Slopes of up to 1(v) in 4(h) are present in this part of the site which slope toward a lower lying area; see insets C & D below. Several overland flow paths bisect the site however are not deeply incised. There were no obvious visual signs of large scale and/ or recent land / slope instability observed.

Inset C: Rolling and undulating terrain in the northern half of the site.

Inset D: The steeper slopes and low lying land in the southern half of the site.

5 FIELDWORK AND FINDINGS

5.1 Fieldwork Programme

The fieldwork was undertaken in July 2021 and included the drilling of two hand auger boreholes, one machine borehole and four cone penetrometer tests (CPTs). Test positions are detailed on Figure 01, appended. In addition, a geotechnical cross section was measured as depicted on Figure 2.

The machine borehole drilling and CPT contractor was Pro-Drill (Auck) Limited. A piezometer standpipe was installed in the machine borehole and the site was re-visited one week following the completion of drilling to measure groundwater levels under assumed equilibrium conditions.

Detailed logs/ results for all testing are appended. A summary of the test findings is presented below.

5.2 Borehole Findings

5.2.1 Topsoil

Topsoil was encountered at all borehole locations to a depth of 300mm.

5.2.2 Filling

Existing fill was not encountered during our investigation. However, based on historic areas photograph interpretation (refer section 4.1) areas of pre-existing fill should not be discounted, particularly in farm environments and may include offal or rubbish pits, gully infill and fill associated with existing structures.

5.2.3 South Auckland Volcanic Field (Ash) Deposits

South Auckland Volcanic Field weathered ash deposits were encountered in HA01 and HA02 to depths of 2.2m and 0.7m respectively. Ash soils consisted of orange/brown to orange, inorganic, clayey silt soils.

Undrained shear strengths were generally greater than 100kPa indicating these deposits are very stiff to hard.

5.2.4 Puketoka Formation (Alluvial) Soils

Puketoka Formation soils were encountered below the ash deposits in HA01 and HA02 and below the surficial topsoil in MH01. These deposits were generally inorganic, stiff to very stiff, silt and clay materials with some pumiceous content.

However, soft clays have been identified from approximately 3.5 to 7.1m in MH01 which displayed low vane shear readings (<20kPa) and standard penetration testing (SPT) 'N' values of zero. A 150mm thick amorphous (stiff) peat layer was identified from 7.1m depth. This softer layer is also indicated over similar depth in CPT01 nearby.

Silty sands were found in MH01 from 8.7m depth to the end of the borehole at 15m depth. SPT N values within these soils were typically between 6 and 22 blows of the hammer indicating these soils are sometimes loose (e.g. an isolated N value at 14m being very loose), but mostly medium dense to dense.

In CPT tests 01, 02 and 04, sandy soils were inferred from depths between approximately 5m and 7.5m. These deposits extended to beyond the base of these tests (CPT02 and 04 met refusal at depths of 7.5m and 10m within these soils, which may be a transition to ECBF). CPT03 inferred more clayey soils with bands of sands and silts throughout. Ground proving via boreholes will be required on the elevated portions of the site to determine where these soils are ECBF (as per the geology map; refer section 4.2).

5.2.5 Groundwater

Groundwater levels were encountered in HA01 and HA02 at depths of 4.0m and 3.8m below ground level respectively. The piezometer standpipe in MH01 when measured seven days following the completion of drilling, at assumed equilibrium levels, recorded a groundwater level of 6.0m below existing ground level.

6 SLOPE STABILITY

6.1 Methods

Cross Section AA was drawn across the steeper slopes present in the southern portions of the site (as shown on Figure 1). The slope stability assessment was carried out using Slide 2 (2018) software from Roc-Science, using the Morgenstern-Price method for circular slips, which is considered to be the governing mode of failure for our geotechnical model for this site. Planar slips are considered unlikely given the deep soil profile and have therefore been dismissed as a potential failure model.

In accordance with the Auckland Council Code of Practice (ACCoP), the slope stability analysis was assessed under three cases:

- Normal groundwater condition (minimum Factor of Safety (FOS) >1.5 required)
- Extreme (worst credible) groundwater condition (minimum FOS >1.3 required)
- Seismic condition with 150-year event (minimum FOS >1.2 required)

For these analyses, the following table of conservative effective stress and undrained soil parameters were selected based on our experience in similar terrain nearby and the investigations carried out.

Table 1: Soil Properties

Description	Unit Weight (kN/m3)	C' (kPa)	Ø' (degrees)	Undrained Su (kPa)
Ash	17.5	7	32	100
Stiff to Very stiff Puketoka Formation	17.5	5	30	80
Dense Puketoka Formation	17.5	7	35	150
Soft to Firm Puketoka Formation	17.5	1	26	20

6.2 Seismic Analysis

Peak Ground Acceleration (PGA) for seismic analysis is based on the results of the fieldwork and geological setting. The stability assessment has included an allowance for seismic loading with accelerations determined in accordance with NZS1170.5:2004 and the Bridge Manual (SP/M/022, 3rd edition), based on a 50-year working life.

The Peak Ground Acceleration is calculated using the following formula from the Bridge Manual Section 6.2: $PGA = C_{0,1000} \times (R_u/1.3) \times f \times g$

Table 2: Parameters for the Calculation of Peak Ground Acceleration

PGA Parameters	Value	Relevant Standard	Description
1000 year return period co-efficient ($C_{0,1000}$)	0.21	Bridge Manual, Table 6A.1 and Note 1	Return period co-efficient for Waiuku
Importance Level	2	NZS1170.0:2002 Table 3.2	Single family dwellings
Annual Probability of Exceedance	1/500	Bridge Manual, Table 2.3	Annual probability of exceedance for the ULS of earth slopes providing protection to importance level 2 properties
Return Period Factor (R_u)	1.0	NZS1170.5:2004 Table 3.5	Return period factor for 1/500 annual probability of exceedance
Seismic Site Class	C	NZS1170.5:2004 Table 3.2	Shallow soil site – very stiff or hard materials under 60m
Site Subsoil Class Factor (f)	1.33	NZS1170.5:2004 Table 3.1	Class C shallow soil site

The PGA from the above calculations for this site is 0.16g. A seismic reduction factor of 65% was then applied (i.e. reduced by a factor of 0.65), as is generally accepted to give a lower value PGA, which may be adopted due to the very short duration of the acceleration above this. A PGA of 0.104g was therefore used.

6.3 Results and Discussion

The computer stability modelling results are presented in Table 3 and full slope stability outputs are presented in Appendix 5.

Table 3: Slope Stability Assessment Results

Cross Section	Analysis Description	Minimum Required FOS	Resulting FOS
AA	Existing Groundwater Levels (Static)	1.5	3.110
	Elevated Groundwater Levels	1.3	2.150
	Seismic Conditions	1.2	2.339

The resulting factors of safety for the land in its prevailing state along the central to south facing steeper slopes of the site are in excess of the minimum FoS requirements given in the ACCoP. Further

investigations and assessments will be commensurate with the final development proposals (e.g. at Resource Consent stage).

7 POTENTIAL GEOTECHNICAL HAZARDS

It is apparent based on this preliminary work that with appropriate engineering there should be no insurmountable geotechnical hazards that would prevent future residential intensification. Precedence with residential intensification exists to the north (e.g. Kahawai Point), and also upon similar alluvial geology settings elsewhere in the South Auckland region (e.g. Auranga in Karaka and Southern Crossing in Drury).

The perceived geotechnical hazards are addressed in the following sections:

7.1 Slope Stability

The prevailing topography of the site consists of gentle slope gradients across the northern half of the site, whereas steeper gradients of up to 1(v) in 4(h) exist in the steeper central to southern half of the site. Geomorphic observations of these slopes include subtle soil creep which is generally expected on slopes of this nature, particularly where livestock has been grazing.

Our analysis of these slopes shows that global stability is unlikely to be an issue in terms of minimum required factors of safety outlined in ACCoP for residential development (refer discussion and results in section 6). However, it is anticipated that future development may provide land modifications that alter prevailing gradients that will be necessary to facilitate a subdivision, and reassessment of slope stability commensurate with earthworks proposals would be a matter for the Resource Consent phase.

7.2 Compressible Soils and Settlement

Filling or high building loads placed upon areas of soft ground may induce consolidation settlements to occur.

The Puketoka Formation alluvium were generally stiff and inorganic in nature and thereby considered to be relatively incompressible for the most part. However, a layer of comparatively softer soils was encountered in the machine borehole and CPT 01 (from about 3.5 to 7m depth) which is located in the lower lying southern portion of the site. This indicates that potentially compressible soils may be confined to this area, but further investigations would be required at Resource Consent stage to better delineate their extent and geotechnical properties.

While settlement potential present a geotechnical constraint to development, this issue can be dealt with as part of engineering required to form a future subdivision. Further investigations commensurate with a development scheme / earthworks proposal will be undertaken as part of a Resource Consent process, and measures such as undercutting or pre-loading with (or without) geotechnical drainage can provide solutions, together with specific foundation design for buildings where deemed necessary (e.g. rib raft systems, or deep piles, etc).

7.3 Liquefaction and Lateral Spread Potential

7.3.1 Computer Liquefaction Analysis

A seismic liquefaction assessment was carried out using GeoLogismiki CLiq version 1.7 software in terms of earthquake peak ground acceleration (PGA) and magnitude (M_w) by applying the Boulanger and Idriss (2014) CPT-based method which evaluates a soils potential to liquefy based on the soil behaviour type index (I_c) and liquefaction triggering factor (i.e. the factor of safety).

The following assumptions have been made in our analysis:

- The soils at this site are conservatively assumed to be site subsoil Class C due to soil depths exceeding those given in NZS 1170:5:2004, Table 3.2 (i.e. very stiff soils less than 60m depth);
- An importance level 2 building (i.e. single family dwellings).
- A depth of non-liquefiable crust was determined by assessment of conservative groundwater levels and depth of cohesive materials overlying the sandy soils and are as outlined on Table 3 below;
- Clay-like cyclic softening was not applied for this analysis as the borehole logs show generally very stiff and medium plasticity soils which are not considered to be susceptible to liquefaction;

For this assessment, the PGA for a 1/25-year serviceability limit state and 1/500-year ultimate limit state (ULS) earthquake has been calculated in accordance with the NZTA Bridge Manual using the following formula:

$$PGA = C_{0,1000} \times \frac{R_u}{1.3} \times f$$

Where:

Building design life	50 years
Return period factor, R_u	Varies, refer table 4 (NZS 1170:0:2004, Table 3.5)
Return period PGA coefficient, $C_{0,1000}$	0.16 for site subsoil Class C (Bridge Manual Table 6.1A, Waiuku)
Site subsoil class factor, f	1.33 for site Shallow Soil site class (Bridge Manual Section 6.2)
Effective Magnitude, M_{eff}	5.9 (Bridge Manual Table 6.1A, Pukekohe)

Based on the above criteria, the following PGA for various annual exceedance probabilities (AEP) are summarised in Table 4 below, which has been used in the liquefaction assessment.

Table 4: Summary of Design Peak Ground Acceleration (PGA)

Design Case	AEP	R	PGA
Serviceability Limit State (SLS)	1:25	0.25	0.04
Ultimate Limit State (ULS)	1:500	1.0	0.16

Table 5: Computer Liquefaction Analysis Results

CPT test	Assumed Groundwater/ Clay Capping Layer	Design Case	Depth where FOS <1.2	Vertical Settlement (mm)	Liquefaction Potential Index	Liquefaction Severity Number
CPT01 (southern quarter of site)	6m	SLS	NA	0	0	0
		ULS	NA	8	0	0.865
CPT02 (eastern quarter of site)	7m	SLS	NA	0	0	0
		ULS	NA	<1	0	0.023
CPT03 (northern quarter of site)	7m	SLS	NA	0	0	0
		ULS	NA	1.52	0	0.037
CPT04 (western quarter of site)	5m	SLS	NA	0	0	0
		ULS	NA	<1	0	0.067

The Liquefaction Potential Index (LPI) and the Liquefaction Severity Number (LSN) are not more than 0 and 0.865 respectively. The MBIE Module 3 guidelines, Table 5.1, provide that the effects of liquefaction are “insignificant” where LPI=0 and LSN=<10. We therefore consider that the effects of liquefaction for a SLS and ULS earthquake will be insignificant.

The vertical settlements calculated by CLiq were up to 8mm for a ULS state and 0mm for a SLS state, and this is unconcerning.

7.3.2 Lateral Spread

MBIE Module 3 indicates that lateral spread can develop where a factor of safety against liquefaction of less than 1.0 and a free face are present in combination. As shown in Table 5, factors of safety against liquefaction on this site were greater than 1.0. Therefore, lateral spread should be dismissed as a foreseeable natural hazard at 80 McLarin Road.

7.4 Proximity to Faults

Based on a review of the GNS digital geological QMaps, the Drury Fault is approximately 24km east of 80 McLarin Road and the Wairoa North Fault (active) is a further 34km east. The Drury Fault is not

listed on the GNS New Zealand Active Faults Database however, the Wairoa North Fault is listed by GNS as an active fault.

Due to the distance of the site to the Drury and Wairoa North faults (24km to 34km respectively) and the existence of other Urban and Future Urban developments in similar or closer proximity to the Drury Fault, we consider that the fault should not be considered a high impact geotechnical issue to this development.

7.5 Expansive Soils

A phenomenon common to the plastic soils found throughout this region is their expansive nature and tendency to shrink and swell, particularly with seasonal fluctuations of near surface water contents. Geotechnical engineering solutions to expansive soils are provided in MBIE (B1/AS1, amendment 19) and NZS3604, and is an engineering matter for further consideration during Resource Consent and/ or Building Consents.

7.6 Flooding

The Auckland Council Geomaps database indicate that flood plains within the study area are generally confined to the identified overland flow path areas, and we understand these will be assessed by others for this PPC.

7.7 Regional Hazards

7.7.1 Earthquake

As stated above, 80 McLarin Road is located 34km from the nearest active fault (the Wairoa North Fault). Notwithstanding, all future foundations for structures should be seismically designed in accordance with the relevant New Zealand Standards and guidelines.

7.7.2 Tsunami

The site is located approximately 150m from the nearest Tsunami shore exclusion zone as per Auckland Councils Geomaps database (indicated red on Inset E). The site ranges in elevation between 5mRL and 20mRL and therefore, inundation from tsunami should be dismissed as a likely hazard to 80 McLarin Road.

Inset E – Tsunami Shore Exlusion Zone

7.7.3 Volcanic

Number 80 McLarin Road is located relatively close to the South Auckland Volcanic Field, considered to be extinct, and is around 20km from the Auckland Volcanic Field Volcanoes (Matakarua, Manurewa and

Ash Hill mountains in Wiri). Leonard and Roberts (2017)[1] highlights the difficulty in forecasting future eruption timelines and locality in the Auckland Volcanic Field and argue that given the population and extent of economic and urban development in Auckland, avoidance of this hazard is not feasible, but rather risk should be mitigated through contingency and emergency planning at a regional level.

8 CONCLUSIONS

Overall, it is considered that 80 McLarin Road is suitable for the PPC and residential intensification / development. Precedence in the area has been set via intensive development to the north in the adjacent Kahawai Point, and other residential developments in South Auckland in similar geology..

The geotechnical hazards identified in this report, in particular the potential for consolidation settlement to be induced from imposed development surcharges, can be addressed and resolved (where required) in due course through appropriate site investigations and geotechnical design as part of the Resource Consent process.

9 LIMITATIONS

This report has been prepared solely for the use of our client, HD Project 2 Limited, its professional advisers in relation to the specific Private Plan Change brief described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from boreholes which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been considered in the report. To support a Resource Consent application, it is recommended that additional geotechnical investigations and analyses will be required that are commensurate with a future development scheme / earthworks proposal.

For and on behalf of Lander Geotechnical Consultants Limited

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Reviewed by:

S.G. Lander
Principal Geotechnical Engineer
CMEngNZ, CPEng

[1] Leonard, G. A. & Roberts, R. C. Volcanic Hazard from the Auckland Volcanic Field. Proceedings 20th NZGS Geotechnical Symposium. 2017.

Appendix 1

Harrison Grierson Limited Drawings

DEVELOPMENT FEASIBILITY

Concept Masterplan Options Study

80 MCLARIN ROAD
Glenbrook, Auckland

HD PROJECT 2 LIMITED

December 2020

HG

DOCUMENT CONTROL RECORD

CLIENT	HD Project 2 Limited
PROJECT NAME	80 McLarin Road, Glenbrook
PROJECT NO.	A20010091
DOCUMENT	Development Feasibility - Concept Masterplan Options Study
DATE OF ISSUE	22 DECEMBER 2020
STATUS	Final
ORIGINATORS	VBashota VIONA BASOTA - GRADUATE URBAN DESIGNER
REVIEWED	ANTHONY VILE - URBAN DESIGN TECHNICAL LEAD
APPROVED FOR ISSUE	ANTHONY VILE - URBAN DESIGN TECHNICAL LEAD
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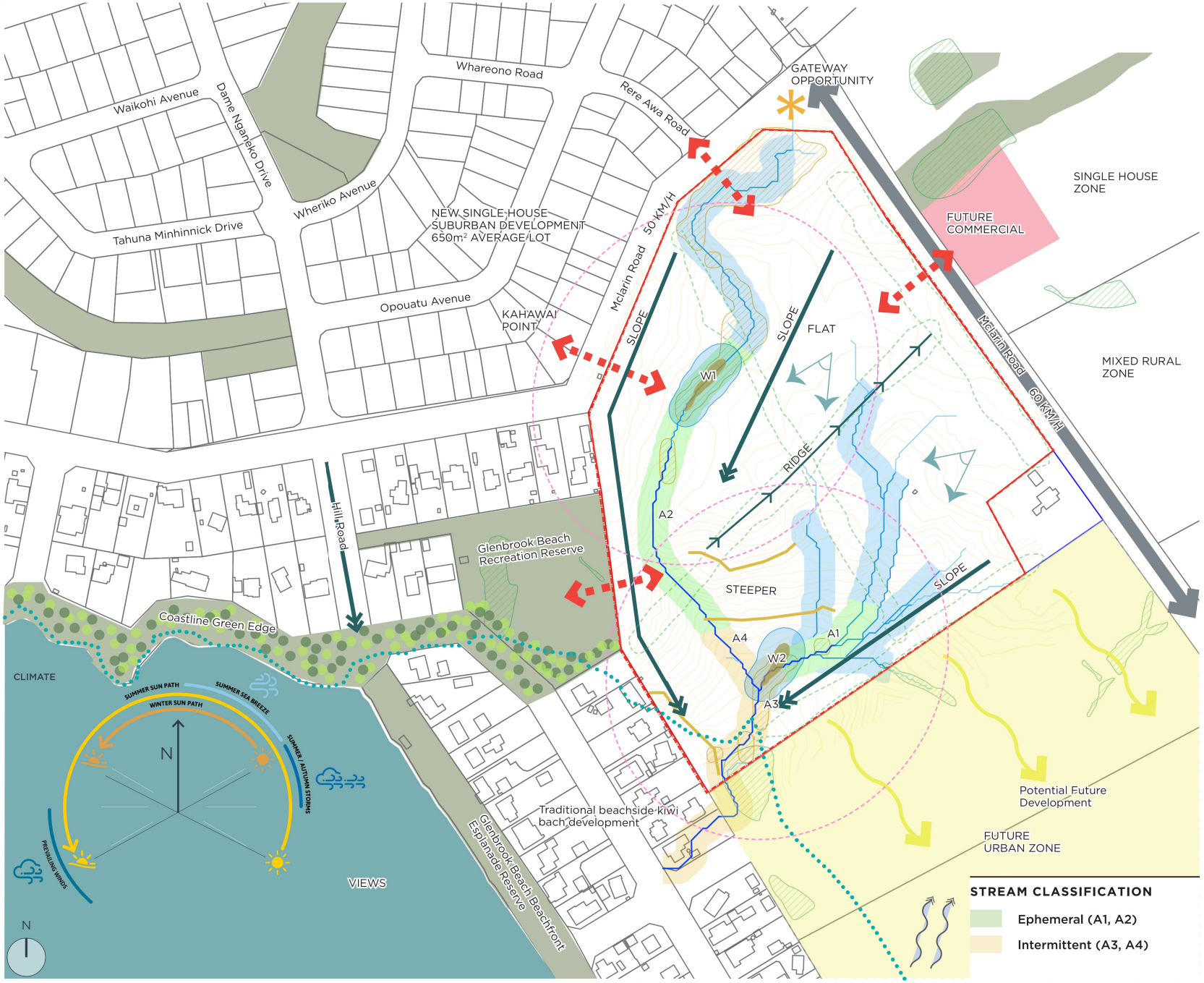


SITE FEATURES

Scale 1:2500 @A3

CONSTRAINTS

- Stream and wetlands, 10m Riparian margin. (Refer Ecologist report)
- Topography and steep slopes.
- No build zones generated by topography and wetlands.
- Management of overland flow paths and potential flooding.
- Accessibility limited.
- Vehicle restricted.
- 1b Soil classification highlights productive soils in the area.
- Public infrastructure may need upgrading (water, wastewater, transportation).
- No public transport.
- The need to upgrade parts of the local rural road network prior to developing the site.

OPPORTUNITIES

- High quality residential development.
- Strong place/identity derived from the surrounding ecology.
- Extend existing urban development area (proximity to newly created residential development).
- Create neighbourhood centre adjacent the commercial zone.
- Enable beachside living to relocate from inundation zones.
- Enhance neighbourhood accessibility, connectivity, and walkability.
- Promote walking and cycling as local means of transport.
- Create connections to waterfront reserve and residential development.
- Provide connections to open space/reserves.
- Restoration and enhancement of natural environment.
- Utilise ecological corridors as amenity and character defining elements of place.
- Integrate stormwater management as landscape features within roads/open spaces.
- Enhance stormwater management and infrastructure.
- Work with topography to minimise the scale of earthworks and retaining.
- Provide further housing choices for the community.
- Adjacent to Waiuku and Taihiki River.
- Potential for views - exaggerate View shafts (to the Manukau and mountains - Waitakere Ranges).
- Slow McLaren Road to 50km/h increasing road safety.
- Economic, social and community benefits.
- Create diversity in Glenbrook market.

KEY

- Site Boundary
- Overland Flow Path*
- W — Wetland*
- 10m Wetland Setback
- 100m Wetland Setback
- Floodplain*
- Potential Wetland within 100m of Site
- Possible 10m Riparian Margin - TBC
- Steep Terrain
- Existing shelterbelts drip line
- Major views
- Prevailing wind
- Connections
- 100y Return 2m Sea Level Rise [3]

* (Note: Refer to Ecologist Report)

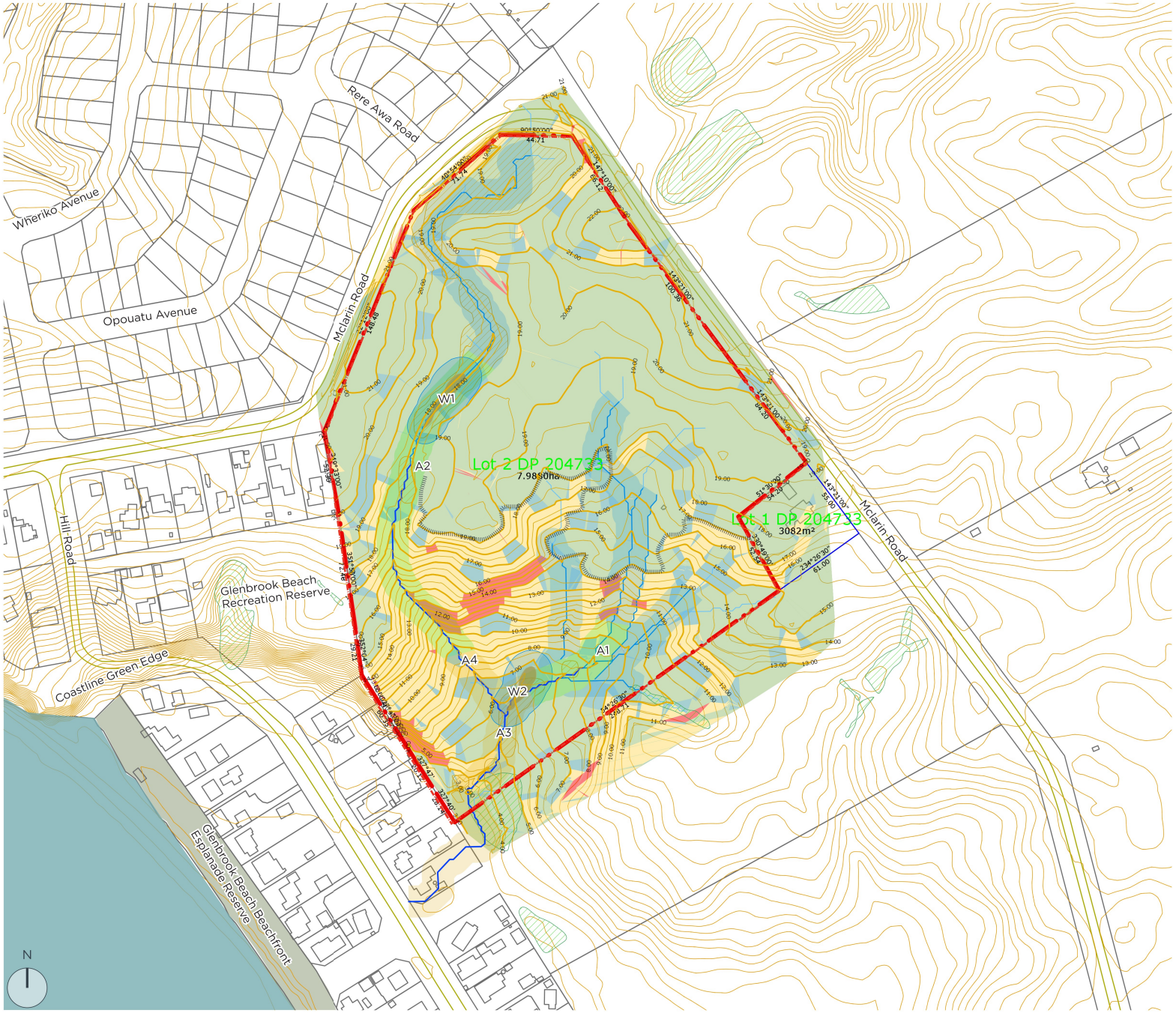
HARRISON GRIERSON

22/12/20

80 MCLARIN ROAD, GLENBROOK A20010091

SLOPE ANALYSIS

Scale 1:2500 @A3



1:2.5K 0 100 200 300

KEY

- Site Boundary
- Water courses (NOTE: Refer to Ecologist Report)
- Wetland
- 10m Wetland Setback
- Floodplain
- Potential Wetland within 100m of Site
- Possible 10m Riparian Margin - TBC
- Contours
- < 1:12
- 1:10 - 1:12
- 1:5 - 1:12
- > 1:2

SLOPE ANALYSIS

Scale 1:2500 @A3

1. Area of mixed use potential.*
2. Potential for higher density.
3. Flexible lots - 30m back to back.
4. 600m² - 450m² lots stand alone.
5. 600m² lots
6. Steep slopes larger lots.
7. No development - wetland.
8. Large lot single house.

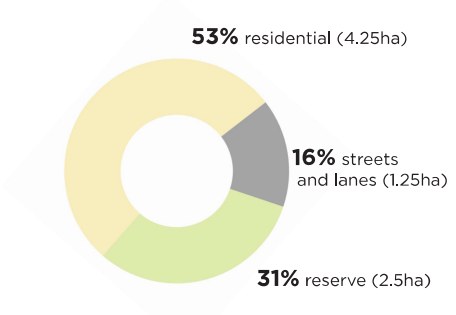
* Contingent on wetland classification.

OPTION 1

Scale 1:2500 @A3

Total Site Area	**8 ha**
Gross Site Area	8 ha
Net Developable Area	4.25 ha
Residential	4.25 ha
Streets and lanes	1.25 ha
Reserve	2.5 ha

55-60 dwellings 14 DPH (Net)



LAND USE COVERAGE

Note:

- Concept Masterplan for feasibility discussion purposes only. Design layouts and yields are indicative and subject to revision based on further detail analysis, further design development, inputs from council and other consultants.
- Stream A2 & A4 maintained and revegetated as primary stormwater and amenity feature.

KEY MOVES

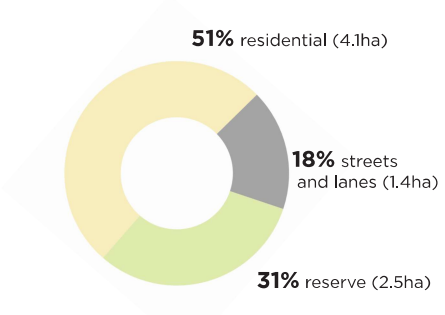
1. Possible connection to Rere Awa Road.
2. Reserve edge crescent with pedestrian/cycle path.
3. Assume 50 km/h McLarin Road.
4. Lot access from McLarin Road.
5. Connection to the existing reserve.
6. Stormwater in existing wetland W2.
7. Align with existing lot boundaries.
8. Street avoid steep slopes follow easiest gradient less than 1:10.
9. Stormwater wetland or recreational reserve when dry.
10. Average lot size -800m².
11. Higher density closer to the future commercial zone - 400m² lots.
12. Larger lots where steeper.
13. Possible pedestrian/cycle connection.

OPTION 1B

Scale 1:2500 @A3

Total Site Area	**8 ha**
Gross Site Area	8 ha
Net Developable Area	4.1 ha
Residential	4.1 ha
Streets and lanes	1.4 ha
Reserve	2.5 ha

70-75 dwellings 18 DPH (Net)



LAND USE COVERAGE

Note:
- Concept Masterplan for feasibility discussion purposes only. Design layouts and yields are indicative and subject to revision based on further detail analysis, further design development, inputs from council and other consultants.
- Stream A2 & A4 maintained and revegetated as primary stormwater and amenity feature.

KEY MOVES

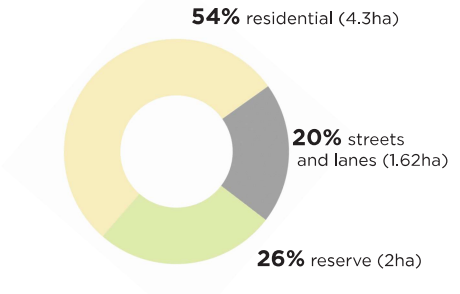
1. Possible connection to Rere Awa Road.
2. Reserve edge crescent with pedestrian/cycle path.
3. Assume 50 km/h McLarin Road.
4. Lot access from McLarin Road.
5. Connection to the existing reserve.
6. Stormwater in existing wetland W2.
7. Align with existing lot boundaries.
8. Street on steeper areas.
9. Stormwater wetland or recreational reserve when dry.
10. Average lot size - 650m².
11. Higher density closer to the future commercial zone - 400m² lots.
12. Larger lots where steeper.
13. Possible pedestrian/cycle connection.

OPTION 2

Scale 1:2500 @A3

Total Site Area	**8 ha**
Gross Site Area	8 ha
Net Developable Area	4.3 ha
Residential	4.3 ha
Streets and lanes	1.62 ha
Reserve	2 ha

75-80 dwellings some lane access zero lot
16-18 DPH (Net)



LAND USE COVERAGE

Note:
- Concept Masterplan for feasibility discussion purposes only. Design layouts and yields are indicative and subject to revision based on further detail analysis, further design development, inputs from council and other consultants.
- Stream A2 & A4 maintained and revegetated as primary stormwater and amenity feature.

KEY MOVES

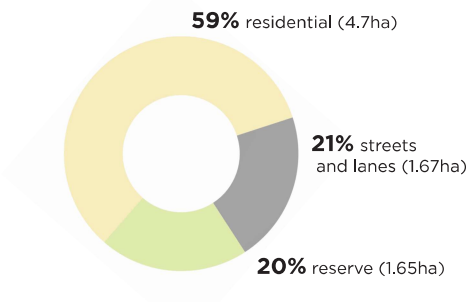
1. Possible connection to Rere Awa Road.
2. Reserve edge street with pedestrian/cycle path.
3. Assume 50 km/h McLarin Road.
4. Lot access from McLarin Road.
5. Connection to the existing reserve.
6. Stormwater in existing wetland W2.
7. Lot backing on to the reserve.
8. Street on steeper areas.
9. Stormwater wetland or recreational reserve when dry.
10. Average lot size - 600m².
11. Higher density closer to the future commercial zone 250- 450m² zero lots and two storeys.
12. Larger lots where steeper.
13. Possible pedestrian/cycle connection.

OPTION 2B

Scale 1:2500 @A3

Total Site Area	**8 ha**
Gross Site Area	8 ha
Net Developable Area	4.7 ha
Residential	4.7 ha
Streets and lanes	1.67 ha
Reserve	1.65 ha

90-100 dwellings some lane access zero lot
19-20 DPH (Net)



LAND USE COVERAGE

Note:
- Concept Masterplan for feasibility discussion purposes only. Design layouts and yields are indicative and subject to revision based on further detail analysis, further design development, inputs from council and other consultants.
- Stream A2 & A4 maintained and revegetated as primary stormwater and amenity feature.

KEY MOVES

1. Align access with Rere Awa Road.
2. Reserve edge to W2 and W1 with pedestrian/ cycle path.
3. Assume 50 km/h McLarin Road.
4. Lot access from McLarin Road.
5. Connection to the existing reserve.
6. Stormwater in existing wetland W2.
7. Lot backing on to the reserve.
8. Street on steeper areas.
9. Stormwater wetland or recreational reserve when dry.
10. Average lot size - 450m².
11. Higher density closer to the future commercial zone 250- 450m² zero lots with rear access lanes and potential for two storeys.
12. Larger lots where steeper.
13. Stream incorporated into lots.
14. Possible Future Commercial/Mixed Use.
15. Flexible lot layout based on typology.

Appendix 2

Lander Geotechnical Consultants Limited Drawings

Figure 01: Site Plan

Figure 02: Cross Section AA

Legend and/or Notes:

- Hand Auger Borehole
- Machine Borehole
- Cone Penetration Test
- Cross Section

BASE PLAN: AUCKLAND COUNCIL GEOMAPS DATABASE [RETRIEVED 30.07.21]

revision	description	drawn	approved	date

0 37.5 75.0 112.5 150.0
Horizontal Scale (metres)
0 37.5 75.0 112.5 150.0
Vertical Scale (metres)

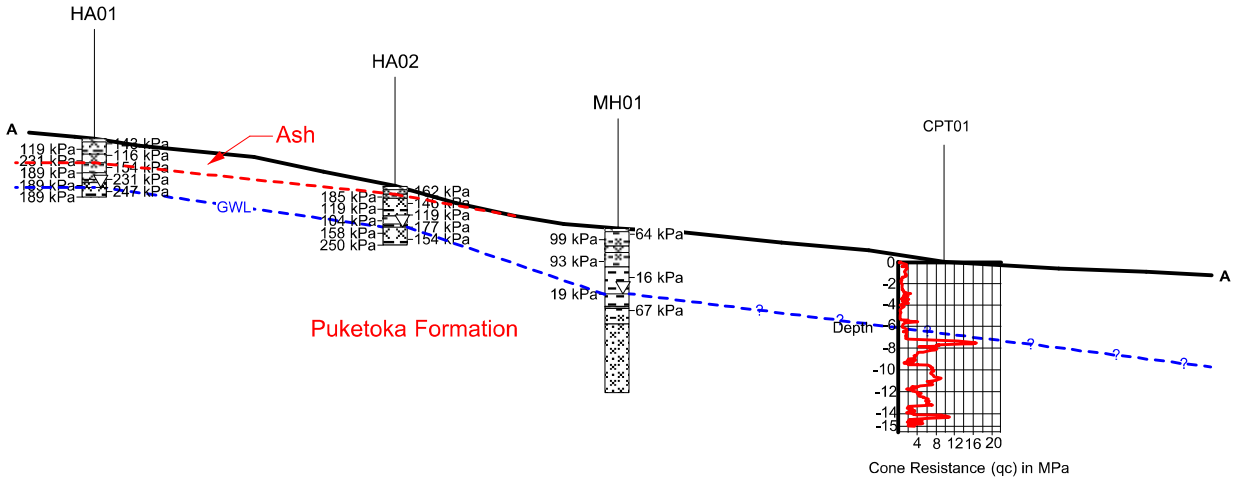
drawn	PL
approved	SL
date	30.07.21
scale	1:2500
original size	A3

LANDER geotechnical

client:	HD PROJECT 2 LIMITED
project:	80 MCLARIN ROAD, GLENBROOK
title:	SITE INVESTIGATION PLAN
project no:	J 01798
figure no:	01

Legend and/or Notes:

- Topsoil
- Fill
- Clayey silt
- Silty clay
- Sandy silt
- Silty sand



revision	description	drawn	approved	date

0 10.0 20.0 30.0
Horizontal Scale (metres)
0 10.0 20.0 30.0
Vertical Scale (metres)

drawn	PL
approved	SL
date	30.07.21
scale	1:500
original size	A3

LANDER geotechnical

client: HD PROJECT 2 LIMITED
project: 80 MCLARIN ROAD, GLENBROOK
title: CROSS SECTION AA
project no: J 01798
figure no: 02

Template revision: 1:500 (10/12/14)

Appendix 3

Borehole Records

Machine Borehole Records

Hand Auger Borehole Records

CPT Results

Client : HD PROJECT 2 LTD

Project Location : 80 MCLARIN ROAD, GLENBROOK

Job Number: J01798

Machine Borehole No. MH 01

Sheet 01 of 02

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2007	AH	AH	23.07.21	23.07.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy: Puketoka Formation

CORE DESCRIPTION	Depth (m)	DEFECTS	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
TOPSOIL		Lockable toby; Bentonite seal				
silty CLAY, trace fine sand, orange streaked orange/ brown. Firm, moist, medium plasticity, insensitive	0.5		90			64/48 1.3
becoming grey streaked orange/brown becoming stiff	1.0		90			99/61 1.6
becoming dark grey mottled orange/brown, with fine to medium sand becoming firm, moderately sensitive	1.5		100		Sample 1 Disturbed 1.25-1.5m	45/16 2.8
clayey SILT, dark grey/purple. Firm,moist, medium plasticity, moderately sensitive, with trace organic staining	2.0		SPT			SPT at 1.5-1.95m 0/1/2 N=3
silty CLAY, dark grey/purple. Stiff, moist, medium to high plasticity, moderately sensitive becoming orange streaked grey	2.5		86			
	3.0		SPT			93/29 3.2 SPT at 3.0-3.45m 2/1/3 N=4
CLAY, grey streaked orange. Soft, moist, high plasticity, sensitive at 3.6m, with trace organic inclusions, with trace pumice	3.5	Gravel backfill; Piezometer screened from 1.0m to 15.0m				
	4.0		100			
	4.5		SPT			16/3 5.3 SPT at 4.5-4.95m 0/0/0 N=0
without pumice	5.0					
	5.5		95			
	6.0	Groundwater level measured 29.07.21: 6.0m	SPT			19/3 6.3 SPT at 6.0-6.45m 0/0/0 N=0
	6.5					
amorphous PEAT, black. Very stiff, moist, no to low plasticity, sensitive	7.0		100			
silty CLAY, with trace fine sand, dark grey mottled brown. Stiff, moist, medium to high plasticity, sensitive	7.5					67/10 6.7 SPT at 7.5-7.95m 0/1/2 N=3
	8.0		100			

Groundwater/ Piezometer; Drilling Method & Casing: Open Barrel

LANDER geotechnical

Comments:

Driller: Pro-Drill Rig: Digger

Drilling Fluid: water

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : HD PROJECT 2 LTD

Project Location : 80 MCLARIN ROAD, GLENBROOK

Job Number: J01798

Machine Borehole No. MH 01

Sheet 02 of 02

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2007	AH	AH	23.07.21	23.07.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy: Puketoka Formation

CORE DESCRIPTION	Depth (m)	DEFECTS	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
silty SAND, grey streaked orange. Medium dense, moist, no plasticity	8.5	Gravel backfill →	62			SPT at 9.5-9.95m 5/10/12 N=22
	9.0	Screened from 1.0m to 15.0m →	70			
	9.5		SPT			
	10.0				Sample 2 Distubed 10.2-11m	
	10.5		57			
	11.0		SPT			SPT at 11-11.45m 2/4/7 N=11
	11.5					
	12.0		57			
	12.5		SPT			SPT at 12-12.45m 1/1/5 N=6
	13.0					
become grey streaked orange/brown, with trace limonite	13.5		100			
	14.0		SPT			SPT at 14-14.45m 1/1/1 N=2
with minor limonite	14.5					
without limonite			100			
	15.0		SPT			SPT at 15-15.45m 2/4/4 N=8
EOB at 15.0m. Target depth.	15.5					
	16.0					

Groundwater/Piezometer

Drilling Method & Casing: Open Barrel; Triple Tube

LANDER geotechnical

Comments:

Drilling Fluid: water

Checked: RZ

Driller: Pro-Drill

Rig: Digger

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

LANDER geotechnical	client:	HD Project 2 Limited	project no:	figure no:
	project:	80 McLarin Road	J01798	Figure 1
		Glenbrook	compiled:	date:
	title:	MH01	RZ	23.07.21

Client : HD PROJECT 2 LIMITED

Project Location : 80 MCLARIN ROAD, GLENBROOK

Job Number: J01798

Auger Borehole No. HA01

Sheet 1 of 2

Vane Head:	Logged By:	Processor :	Date:
1750	PL	PL	30.07.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
slightly clayey SILT, orange/brown. Very stiff, moist, low to no plasticity, sensitive [ASH]	0.5	143/31	4.6	
	1.0	119/23	5.2	
clayey SILT with trace fine sand, orange/brown. Very stiff, moist, no plasticity, moderately sensitive	1.5	116/39	3.0	
becoming moist to wet				
becoming hard, sensitive becoming orange/grey	2.0	231/54	4.3	
silty CLAY with minor fine sand, orange streaked orange/grey. Very stiff, moist, medium to low plasticity, moderately sensitive [PUKETOKA FORMATION]	2.5	154/58	2.7	
	3.0	189/58	3.3	
sandy SILT with trace clay, grey and orange streaked light grey. Very stiff, wet, no plasticity, moderately sensitive				
becoming hard	3.5	231/73	3.2	
silty CLAY with trace fine sand, orange streaked light grey. Very stiff, wet, medium plasticity, moderately sensitive				
clayey SILT with trace fine sand, orange streaked light grey. Very stiff, saturated, low plasticity, moderately sensitive	4.0	189/96	2.0	
becoming hard	4.5	247/96	2.6	
at 5.0m, becoming very stiff				
EOB at 5.0m. Target Depth.	5.0	189/81	2.3	
	5.5			
	6.0			

Standing Water Level: ▽ at 4.0

LANDER geotechnical

Comments:
Groundwater encountered at 4.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: TT

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : HD PROJECT 2 LIMITED

Project Location : 80 MCLARIN ROAD, GLENBROOK

Job Number: J01798

Auger Borehole No. HA02

Sheet 2 of 2

Vane Head:	Logged By:	Processor :	Date:
1750	PL	PL	30.07.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
clayey SILT, orange/brown. Very stiff, moist, low plasticity, moderately sensitive [ASH]	0.5		162/81	2.0	
silty CLAY with trace fine sand, orange/light grey. Very stiff, moist, medium plasticity, insensitive [PUKETOKA FORMATION]	1.0		185/112	1.7	
clayey SILT with trace fine sand, white streaked brown/light grey. Very stiff, moist, low plasticity, insensitive					
becoming orange streaked light grey	1.5		146/77	1.9	
	2.0		119/81	1.5	
	2.5		119/73	1.6	
silty CLAY with trace fine sand, orange streaked light grey. Very stiff, moist, medium to low plasticity, insensitive	3.0		104/77	1.4	
clayey SILT with trace fine sand, orange streaked light grey. Very stiff, moist, low plasticity, insensitive	3.5	▽	177/112	1.6	
becoming saturated	4.0		158/96	1.6	
	4.5		154/89	1.7	
with minor fine sand					
at 5.0m, becoming hard, sensitive	5.0		250/39	6.5	
EOB at 5.0m. Target Depth.	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 3.8m.
UTP = unable to penetrate.
EOB = end of borehole.

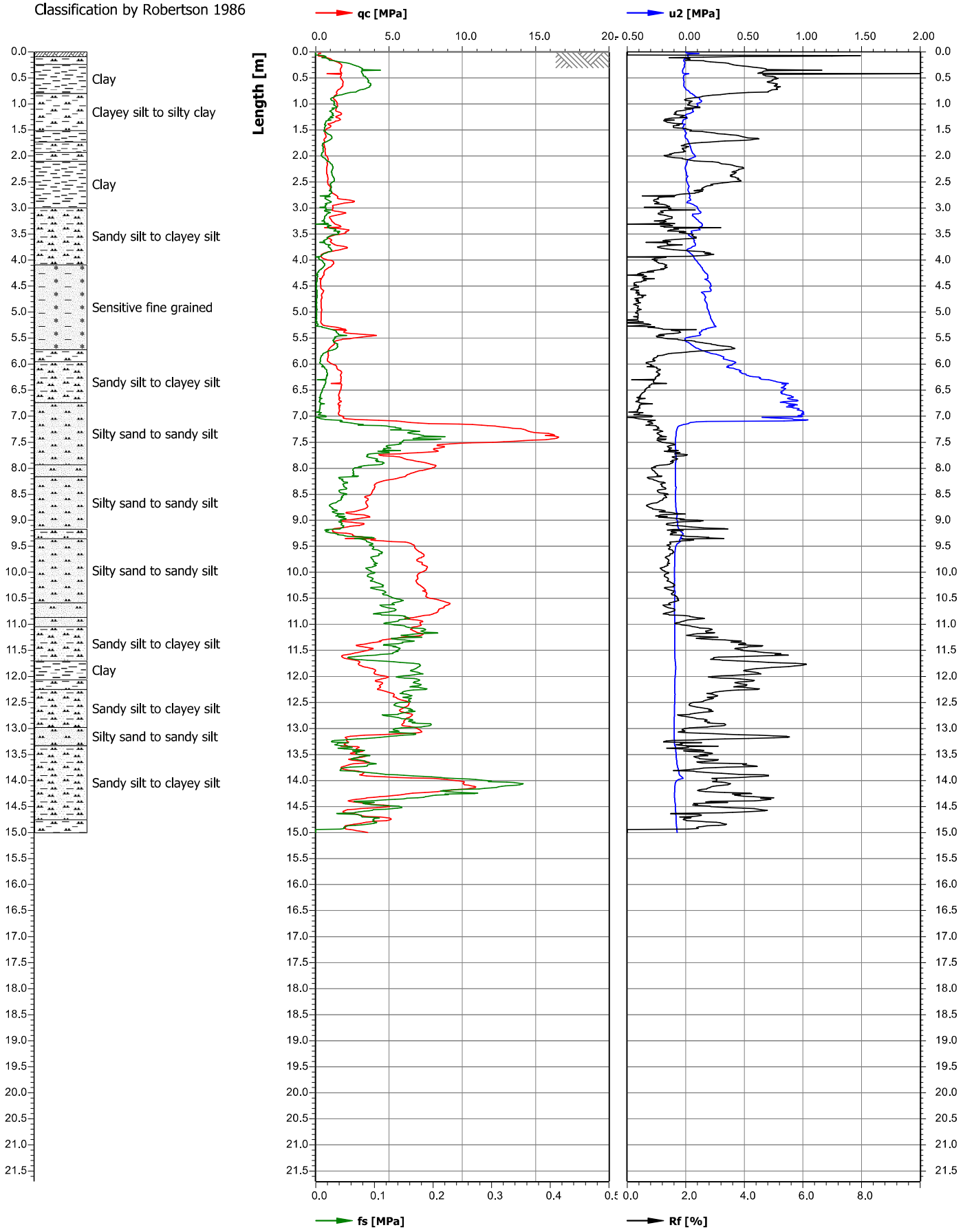
Borehole Diameter: 50mm

Checked: TT

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

PRO-DRILL SPECIALIST DRILLING ENGINEERS	Project name: Landers80McLarinRoad	Date investigation: 20/07/2021	
	Test name: CPT01	Cone name: S10CFIIP.1920	
Test location name	Client: Lander Geotechnical	Net surface area quotient of ...: 0.800/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			

Classification by Robertson 1986



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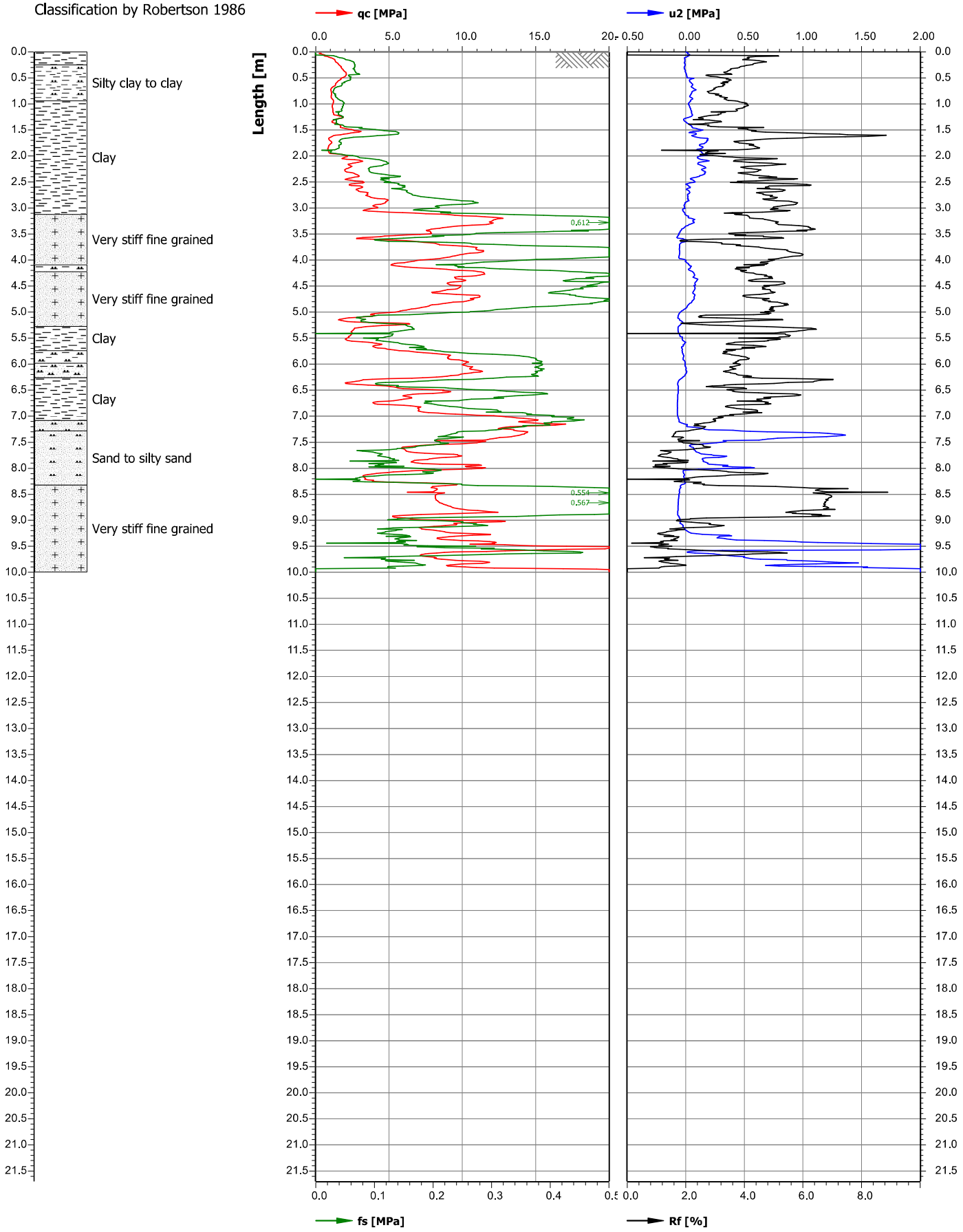
	Test name: CPT02	Cone name: S10CFIIP.1920	
Test location name	Client: Lander Geotechnical	Net surface area quotient of ...: 0.800/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			



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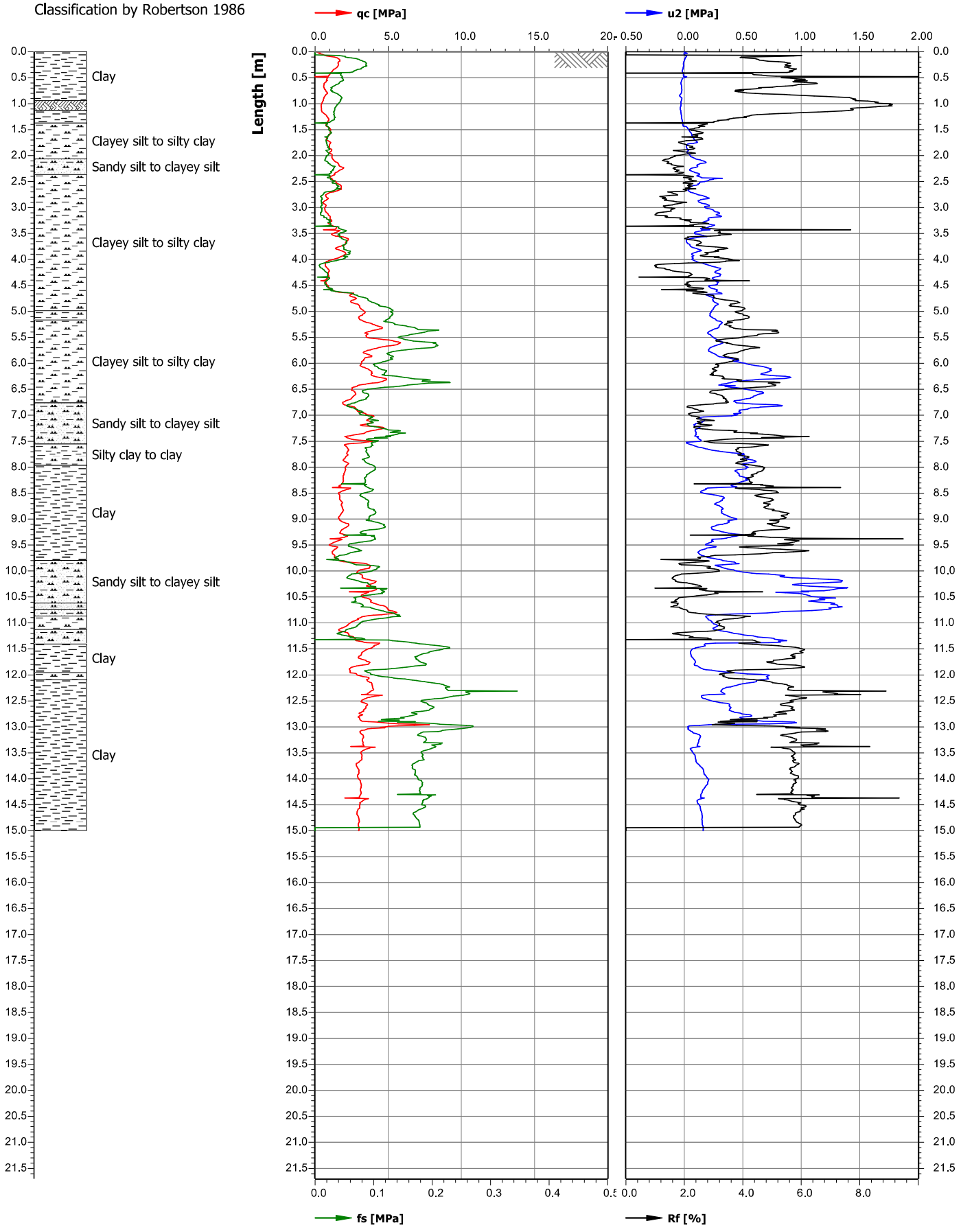
	Test name: CPT03	Cone name: S10CFIIP.1920	
Test location name:	Client: Lander Geotechnical	Net surface area quotient of ...: 0.800/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors:	Fig. no.:	
Z value [m]: 0.00	Project engineer:	Scale: 1:100	Page: 1/1
Remarks1			



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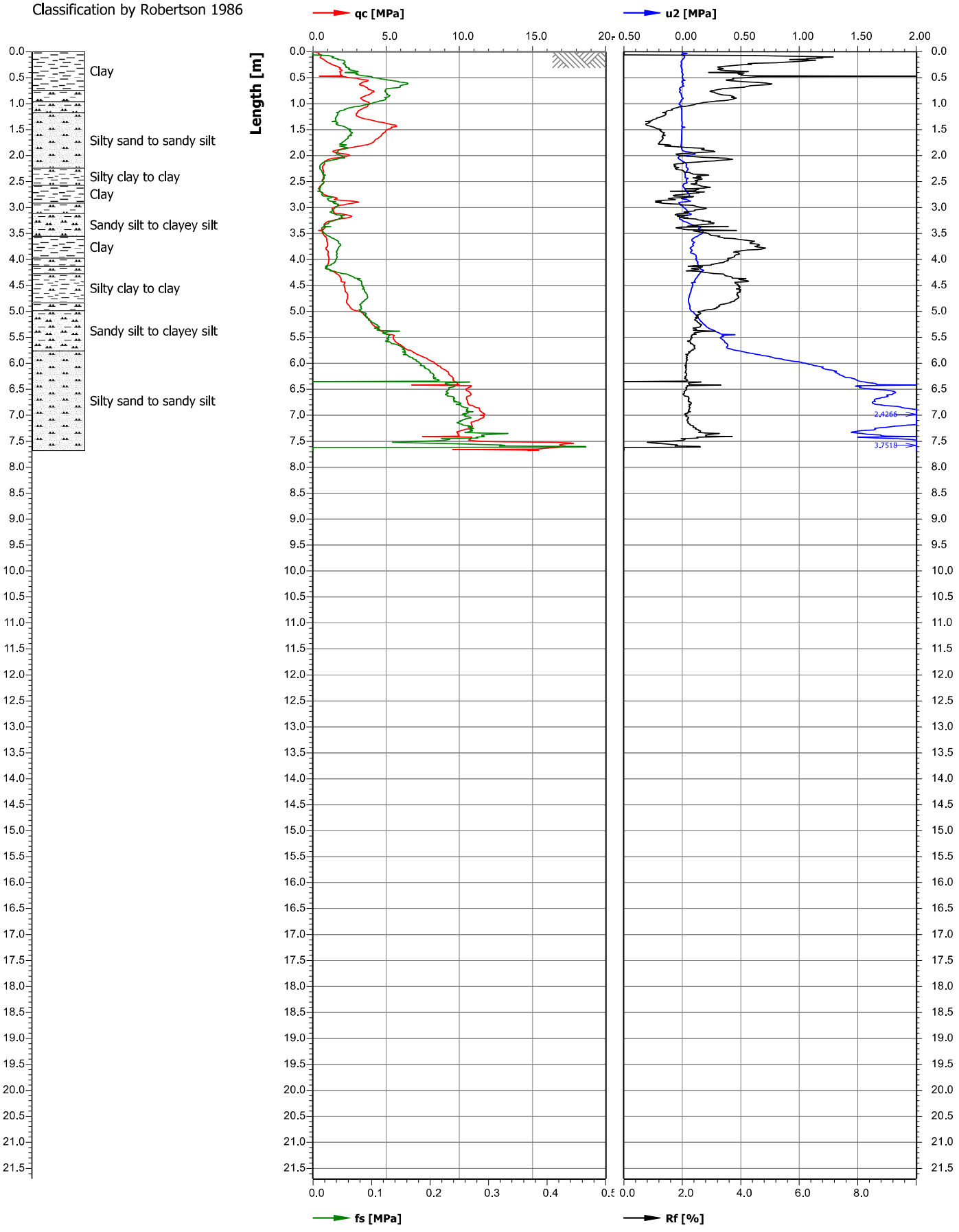
	Test name: CPT04	Cone name: S10CFIIP.1920	
Test location name	Client: Lander Geotechnical	Net surface area quotient of ...: 0.800/0.000	Nominal surface area of cone...: 10.0/150.0
X coordinate [m]/Y coordinat...: 0.00/0.00	Project contractors	Fig. no.:	
Z value [m]: 0.00	Project engineer	Scale: 1:100	Page: 1/1
Remarks1			



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SoilSolutions

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2171 AL Sassenheim
The Netherlands

T +31 71 301 9251
E info@eijkelkamp-geopoint.com
I eijkelkamp-geopoint.com

Cone Calibration Certificate

Certificate:	**GS-1920-002**	
Instrument Type:	Electric Subtraction Cone	
Model:	S10-CFIIP	
Serial number:	1920	
Calibration date:	10-05-2021	
Client:	Pro Drill (Auck) Ltd	
Calibrated by:	M.de Bruin	
Calibration instruments		
Manufacturer:	Hottinger Baldwin Messtechnik GmbH	
HBM certificate NMi certificate	2461165.00501	
Calibration conditions		
Ambient temperature:	20.4	°C
Atmospheric pressure:	1005	mBar
Cone specifications		
Cone base area:	1000	mm2
Load tip resistance (nom.):	50	kN
Friction sleeve area:	15000	mm2
Load tip + local friction (nom.):	50	kN
Load local friction (nom.):	15	kN
Load pore pressure (nom.):	5	MPa
Inclination (nom.):	+/- 20	°
Temperature compensation (all channels):	0...+40	°C
Maximum overload capacity (all channels):	50	%
Cone area ratio (a):	0.80	
Max. Inaccuracy, relative to measurement value:	1.0	%

	Tip:		Sleeve:		Pore Pressure:		Inclinometer:		
	qc in kN	mV	fs in kN	mV	MPa	mV	Degrees	X (mV)	Y (mV)
Zero points:		0257		0243		0203			
	0	0	0	0	0	0	0	2444	2396
	5	0368	5	0368	1.0	1977	-20	0429	0387
	10	0737	10	0736	2.0	3957	20	4431	4429
	15	1105	15	1103	3.0	5928			
	20	1475	20	1472	4.0	7908			
	25	1842	25	1838	5.0	9797			
	30	2209	30	2205					
	35	2574	35	2569					
	40	2939	40	2934					
	45	3305	45	3300					
	50	3668	50	3663					

Max. error, abs. qc:	35 kPa
Max. error, abs. fs:	2 kPa
Max. error, abs. u2:	10 kPa
Max. error, abs. I:	1 °

This calibration is compliant with Eijkelkamp GeoPoint SoilSolutions internal quality system, internal calibration procedures and meets the requirements of NEN2649, NEN-EN-ISO 22476-1, NORSOK G-001, ISSMFE and ASTM using calibration equipment traceable to (Inter-)National Standards.

Approved by: B. Kop
Date: 10-05-2021

Appendix 4

Computer Liquefaction Analysis Results

Lander Geotechnical Consultants Limited
Level 3, 3 Osterley Way
P O Box 97 385, Manukau, Auckland 2241
www.landergeotechnical.co.nz

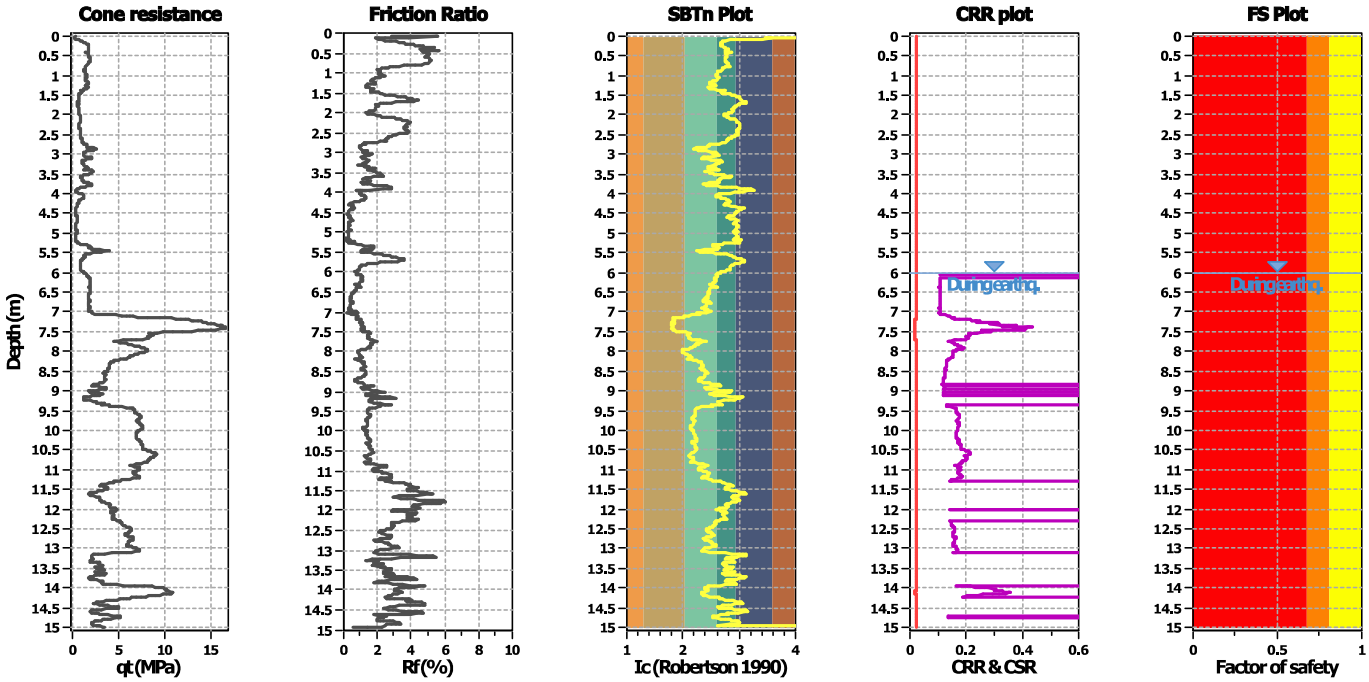
LIQUEFACTION ANALYSIS REPORT

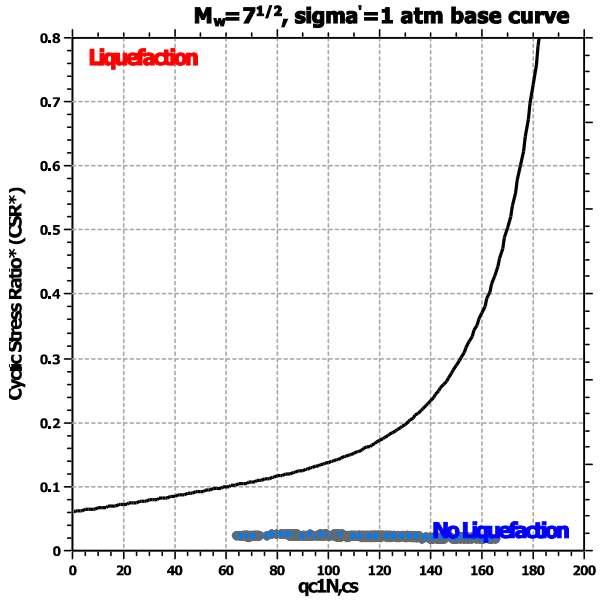
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : SLS (1/25)**

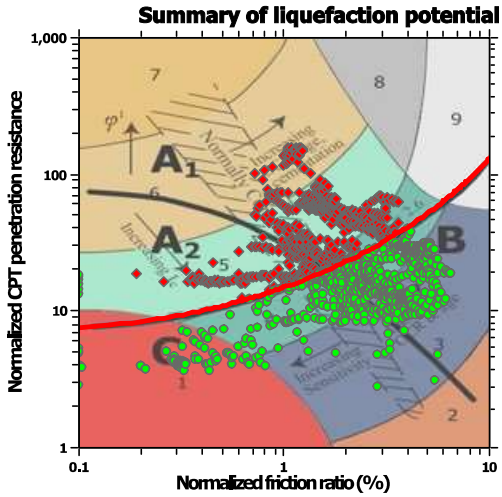
CPT file : CPT01 (southern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 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:	0.04	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

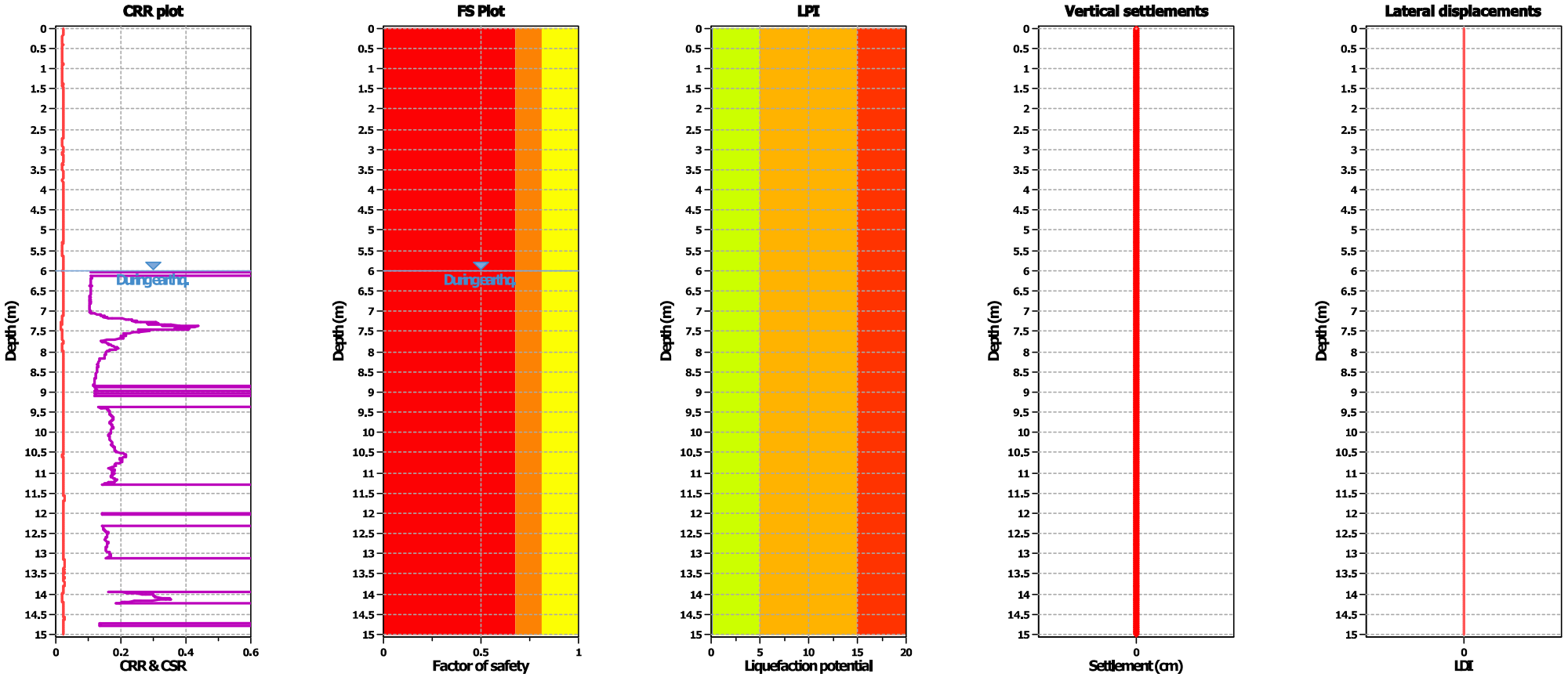






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

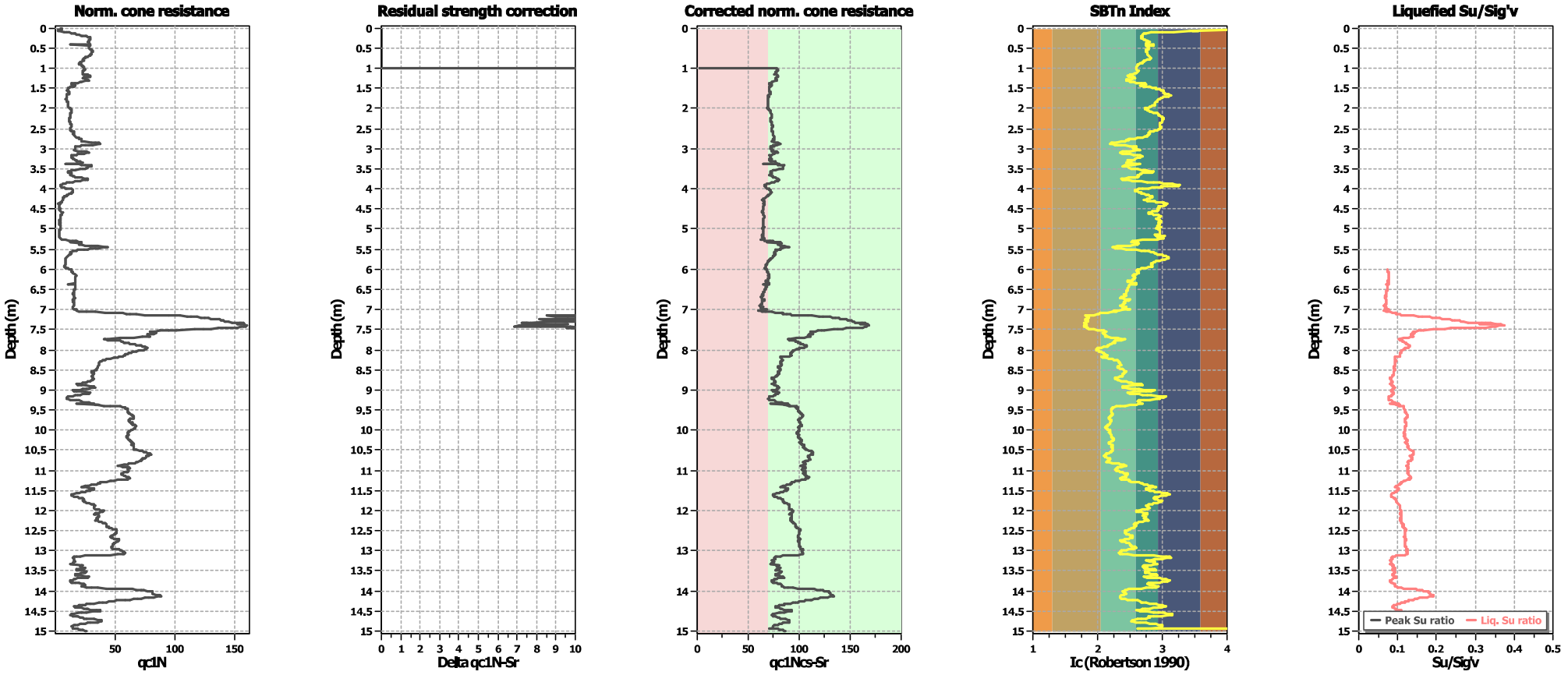
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

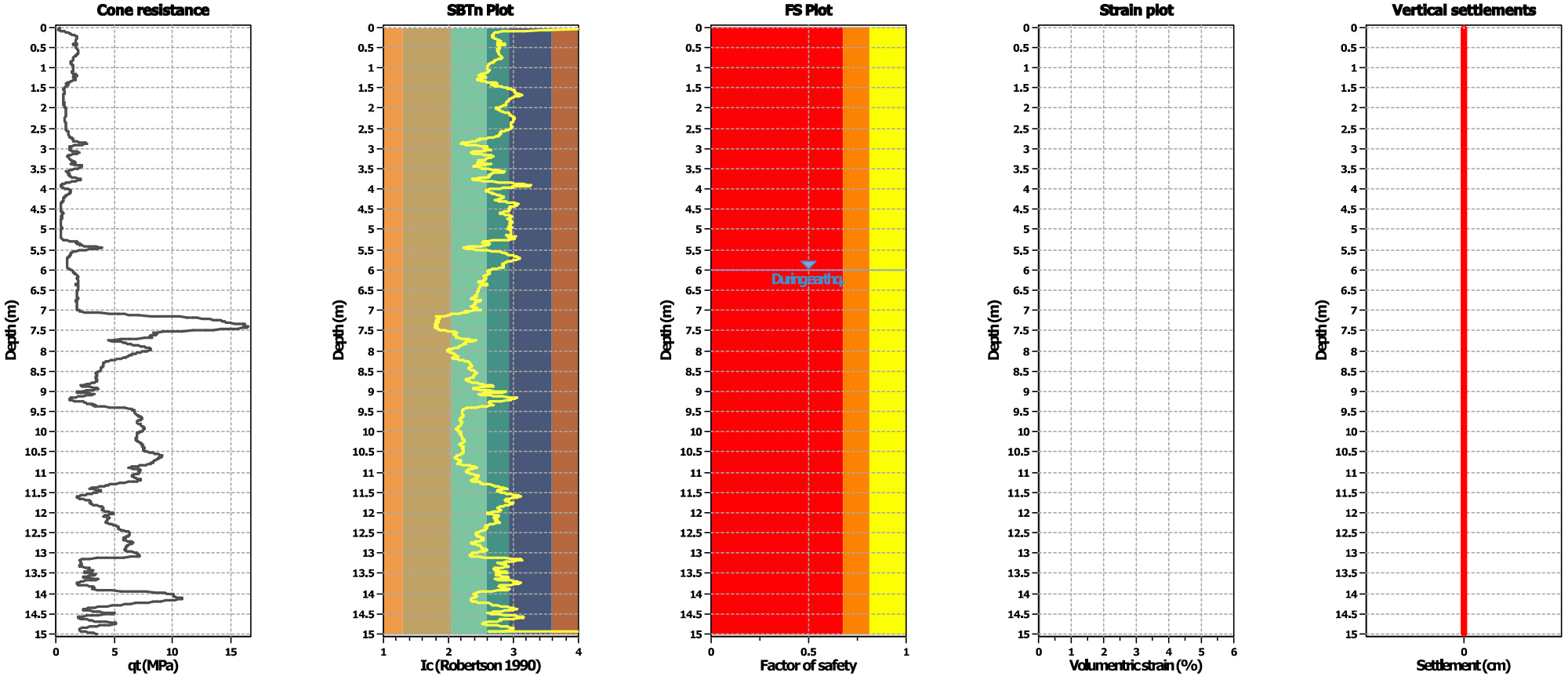
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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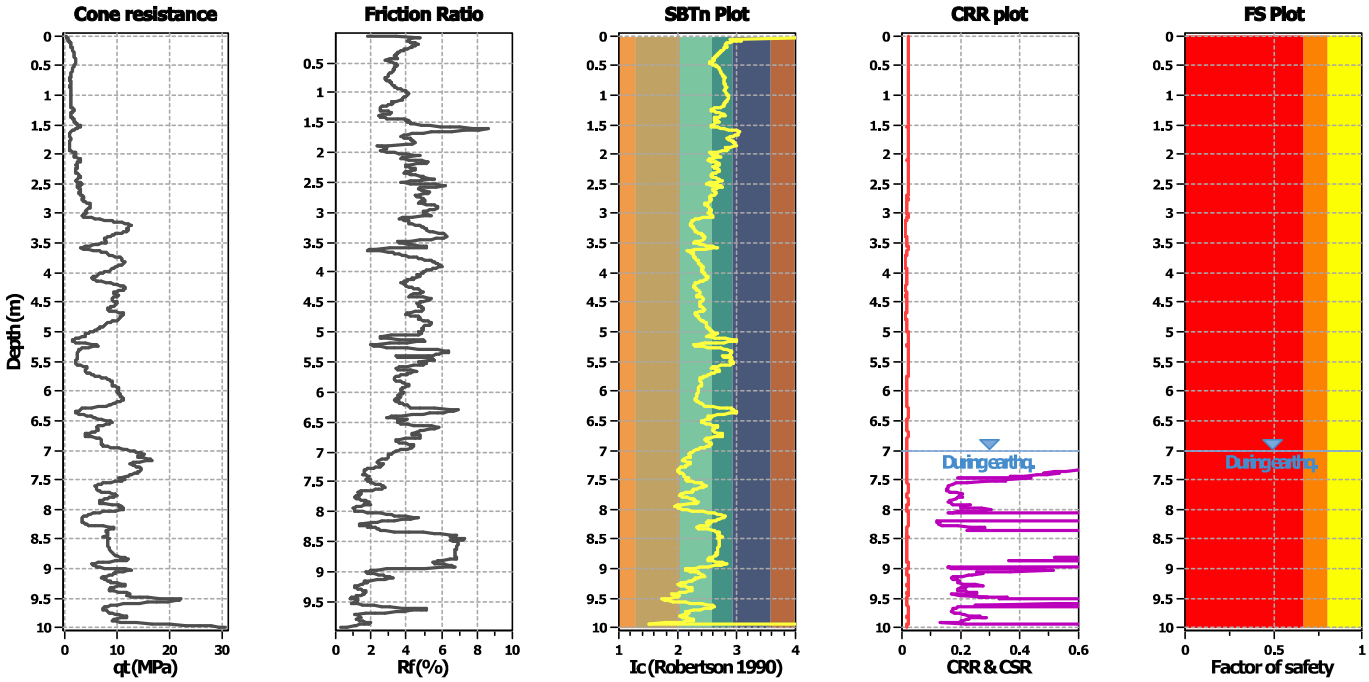
LIQUEFACTION ANALYSIS REPORT

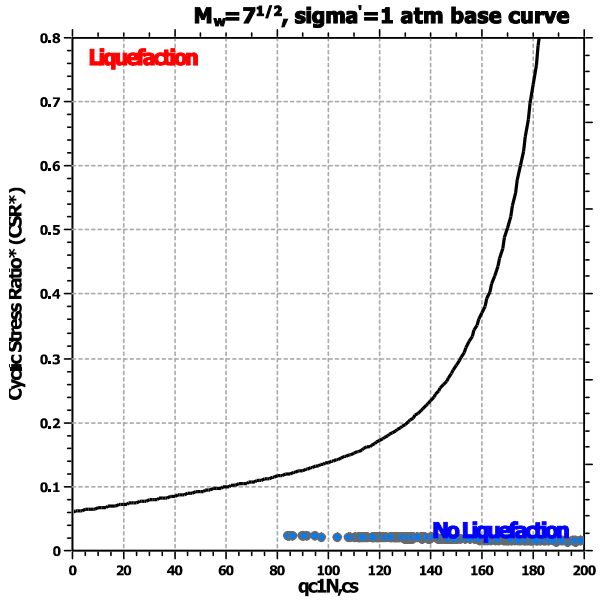
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : SLS (1/25)**

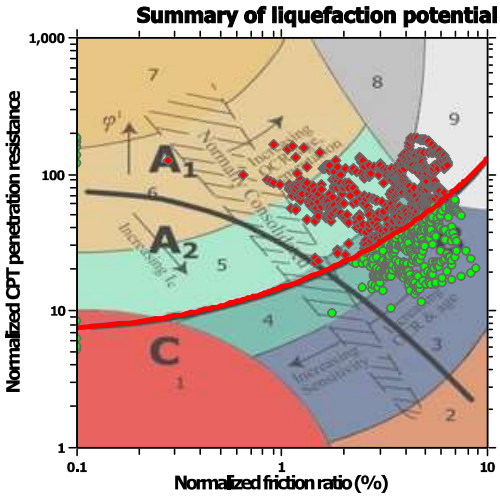
CPT file : CPT02 (eastern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 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:	0.04	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

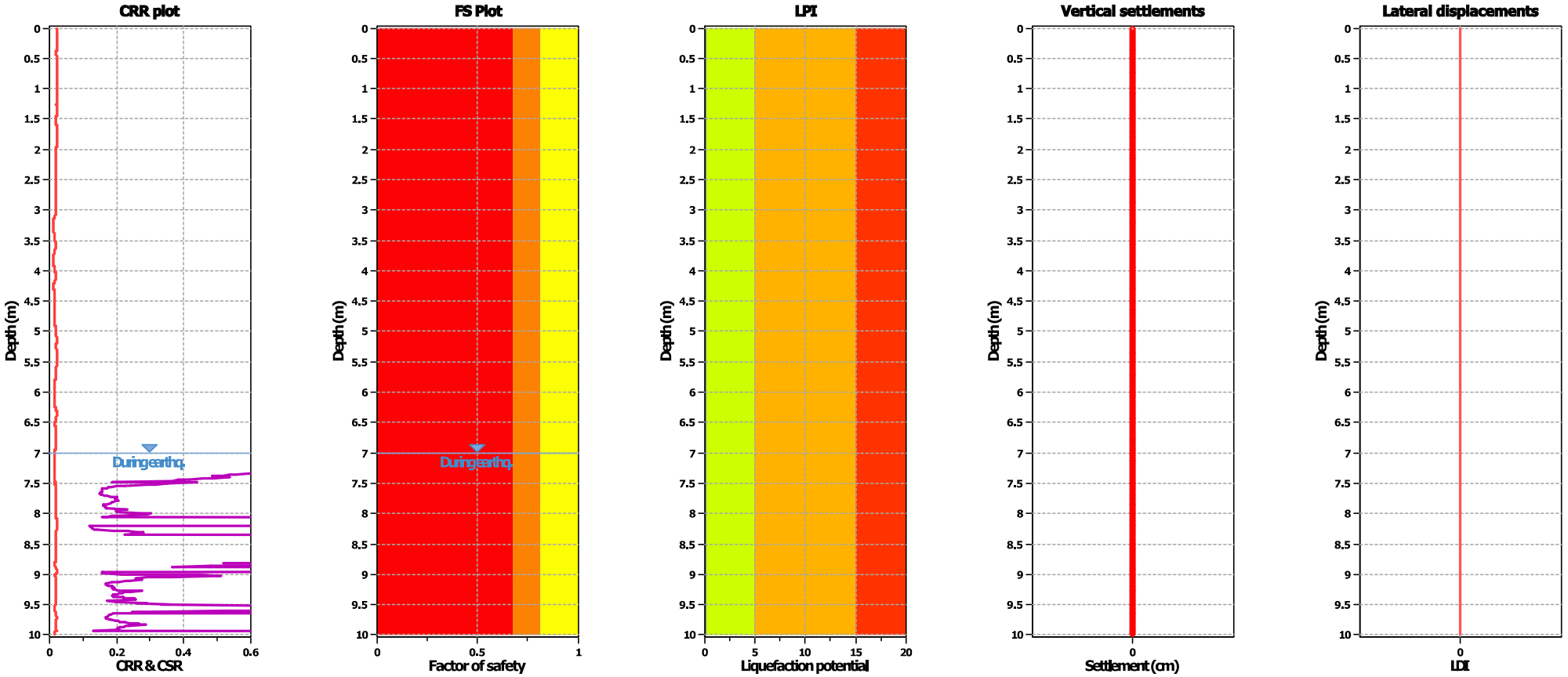






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

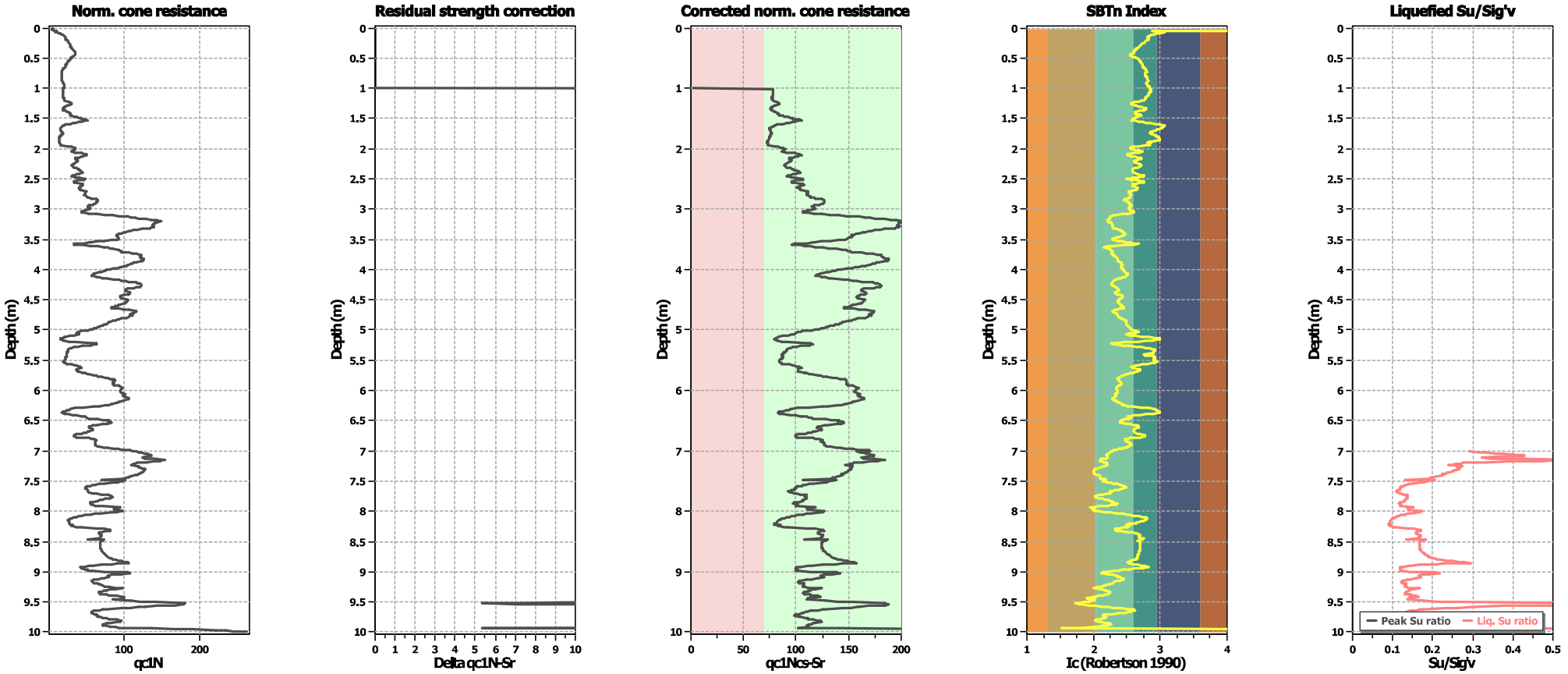
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

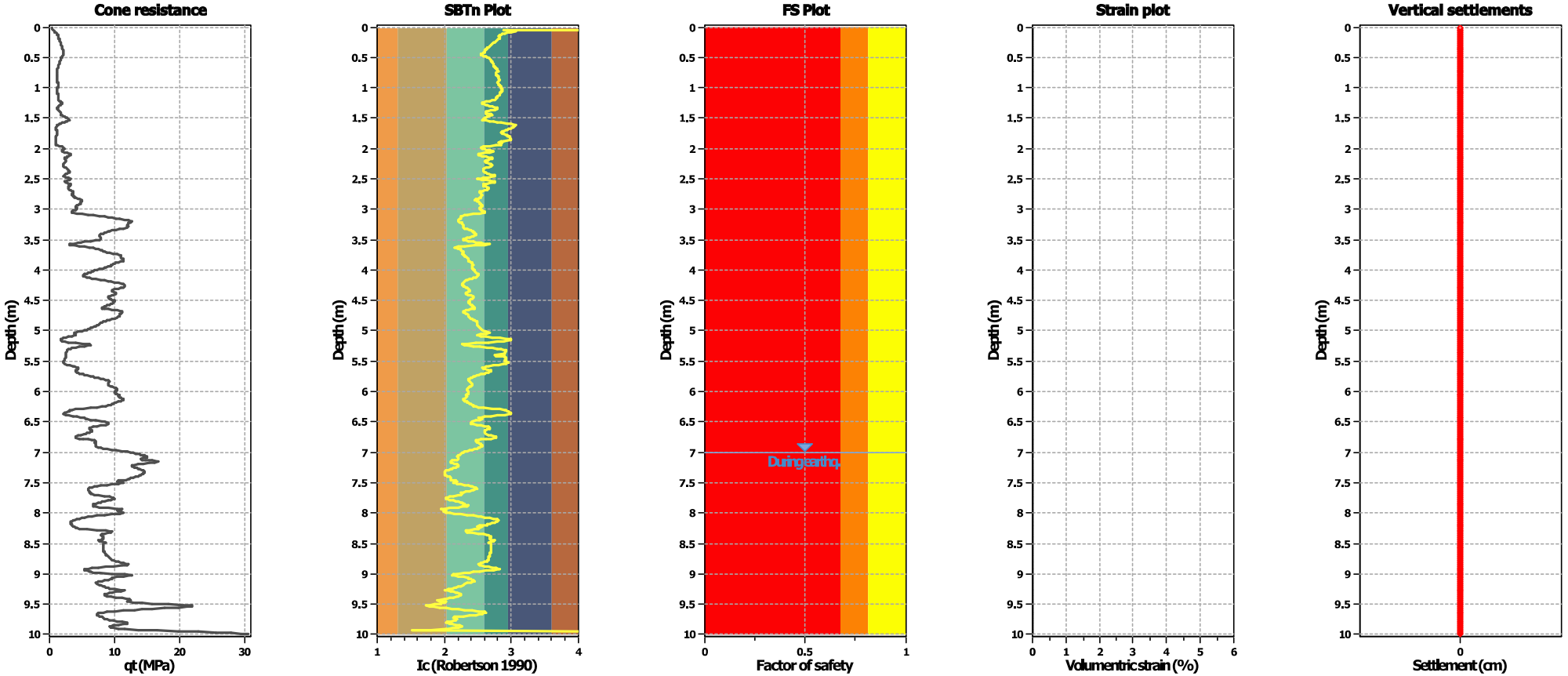
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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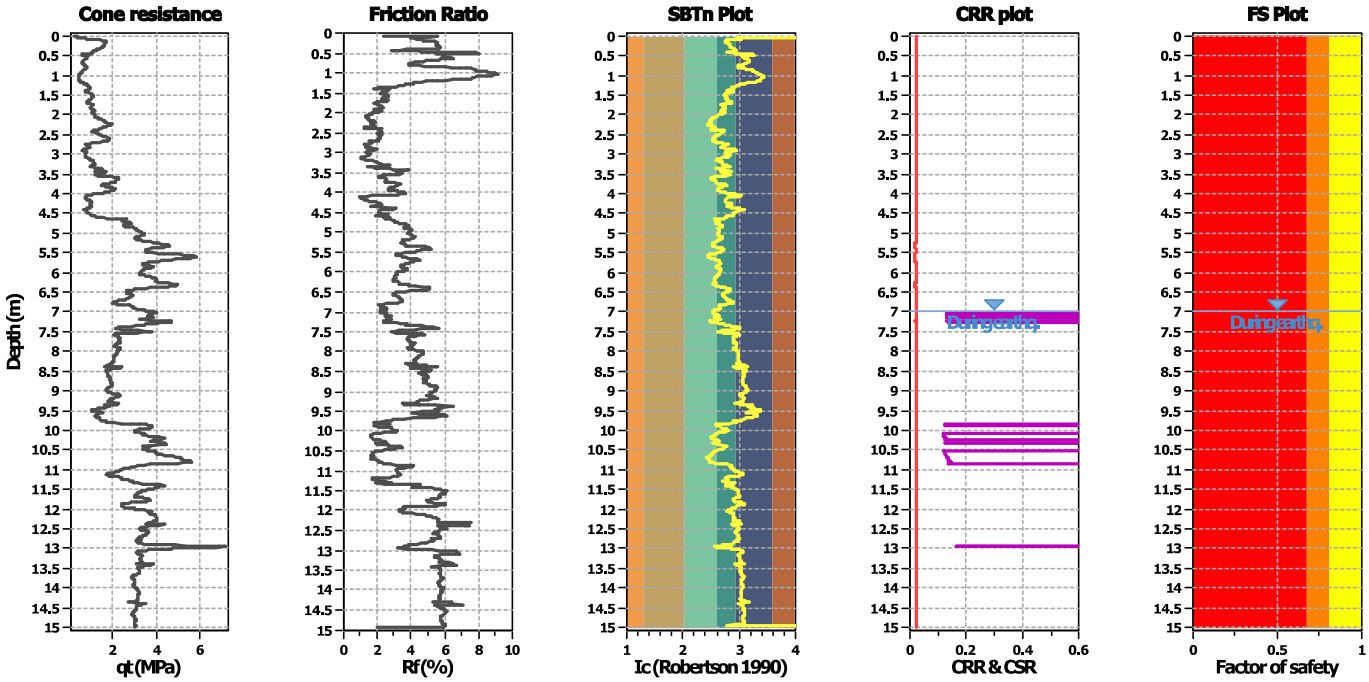
LIQUEFACTION ANALYSIS REPORT

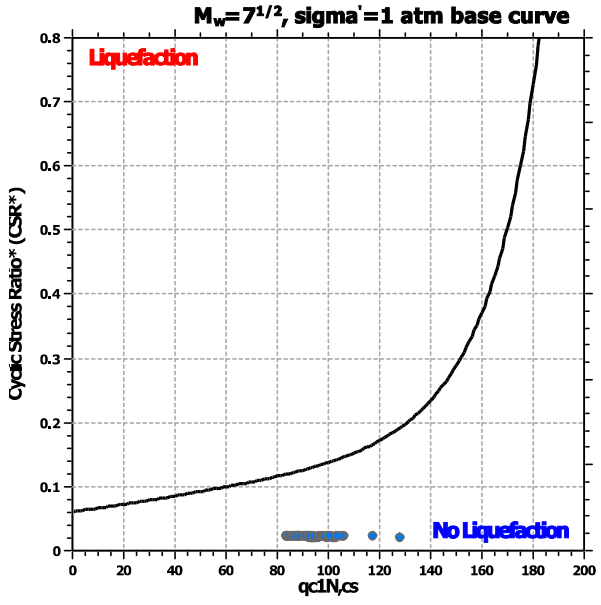
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : SLS (1/25)**

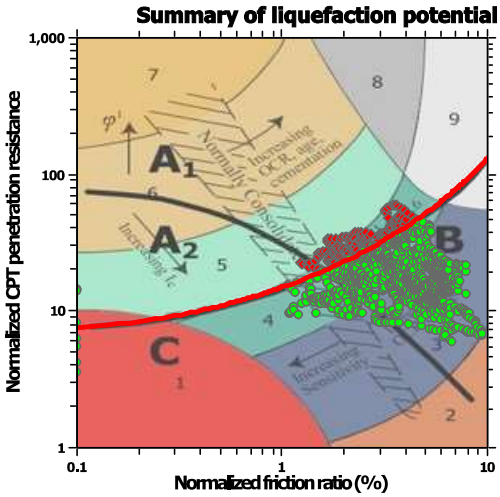
CPT file : CPT03 (northern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 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:	0.04	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

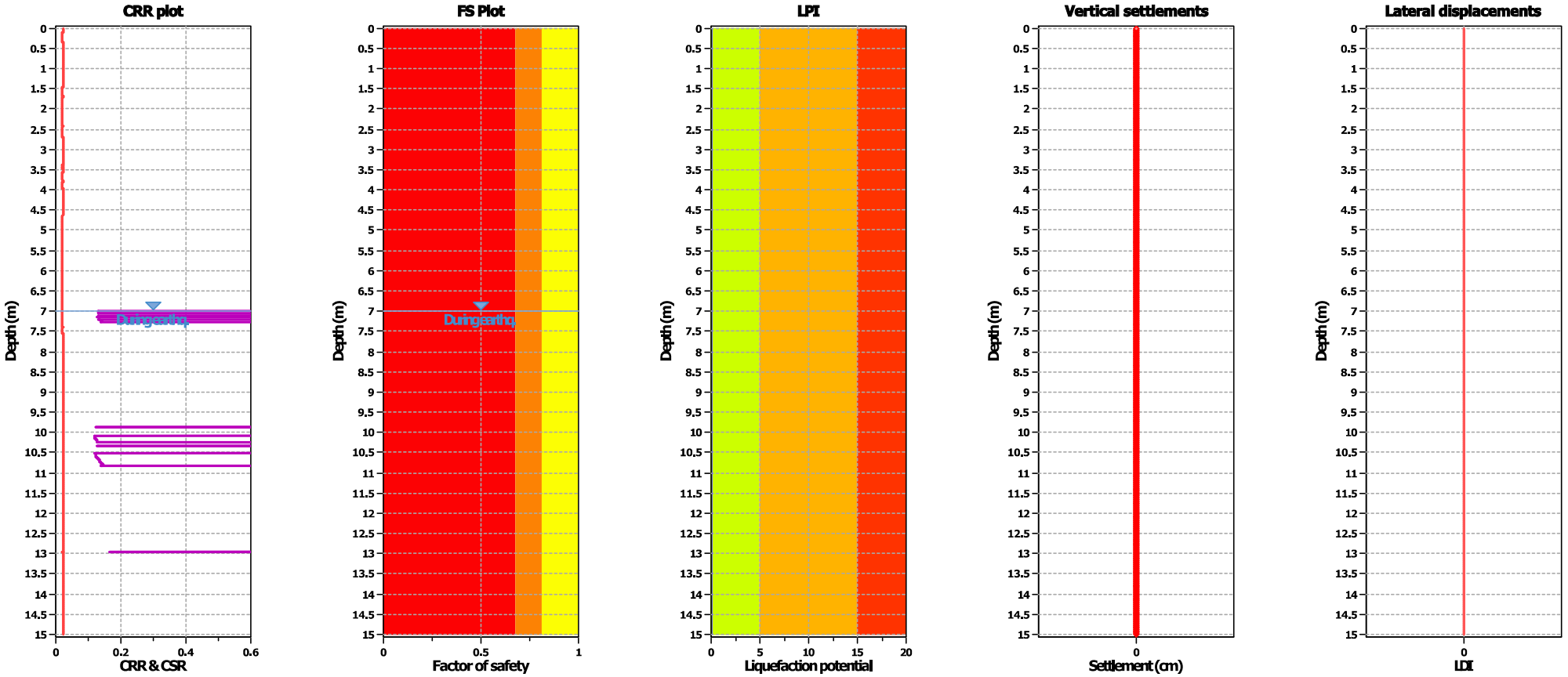






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

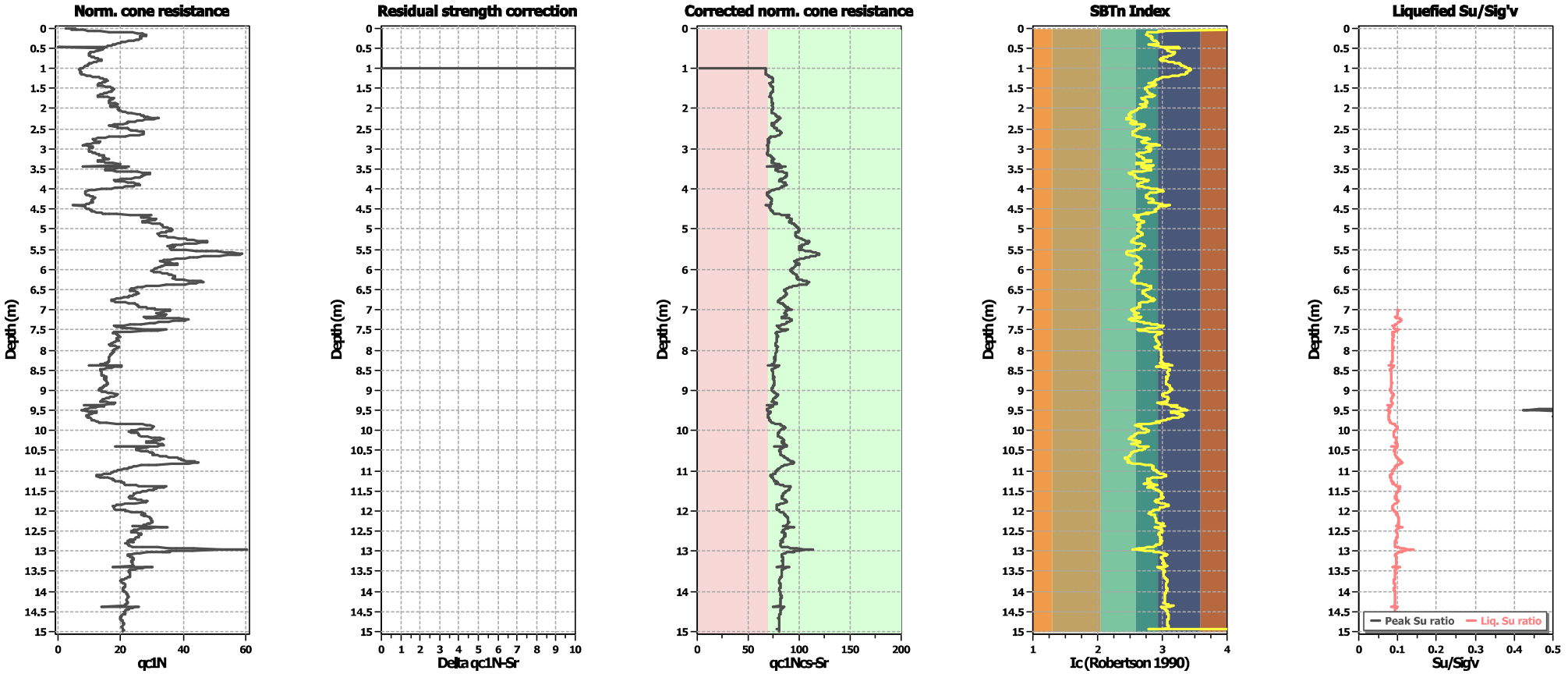
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

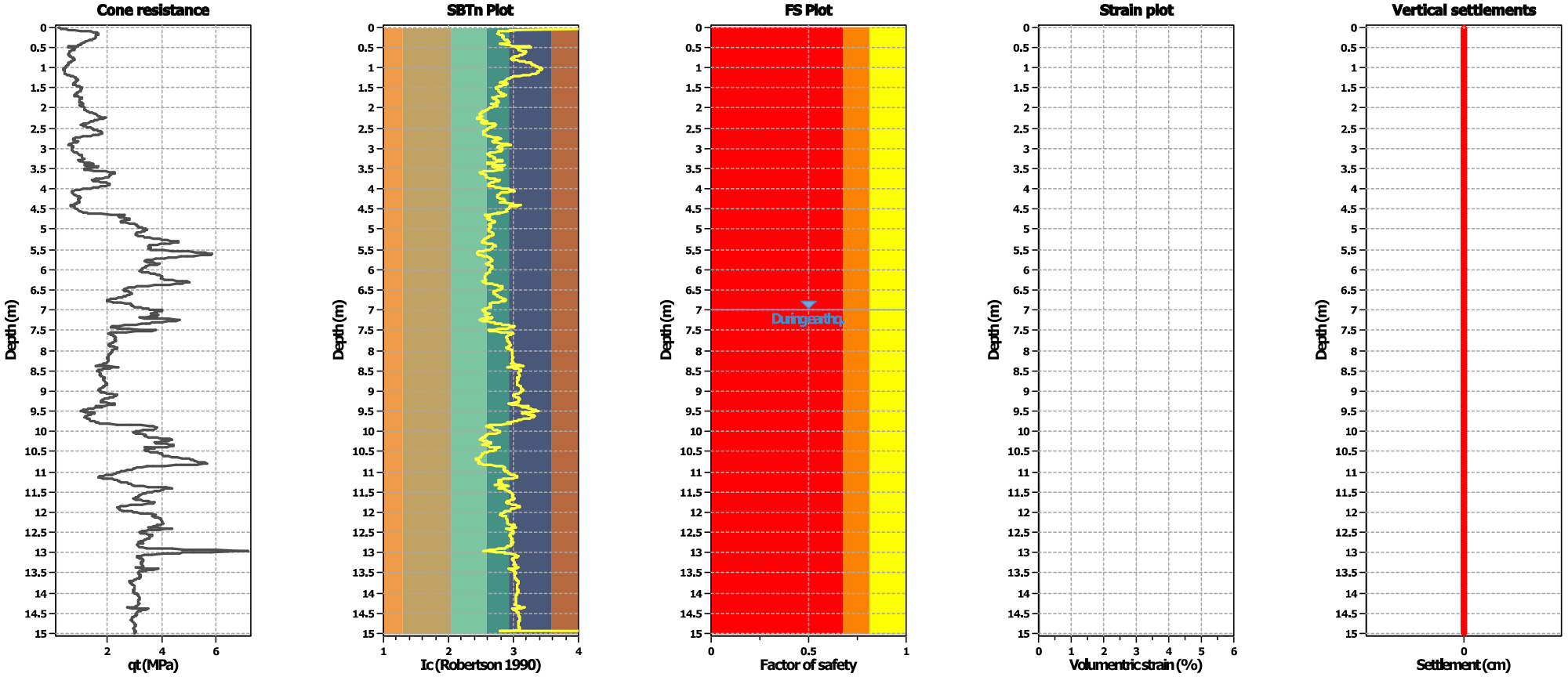
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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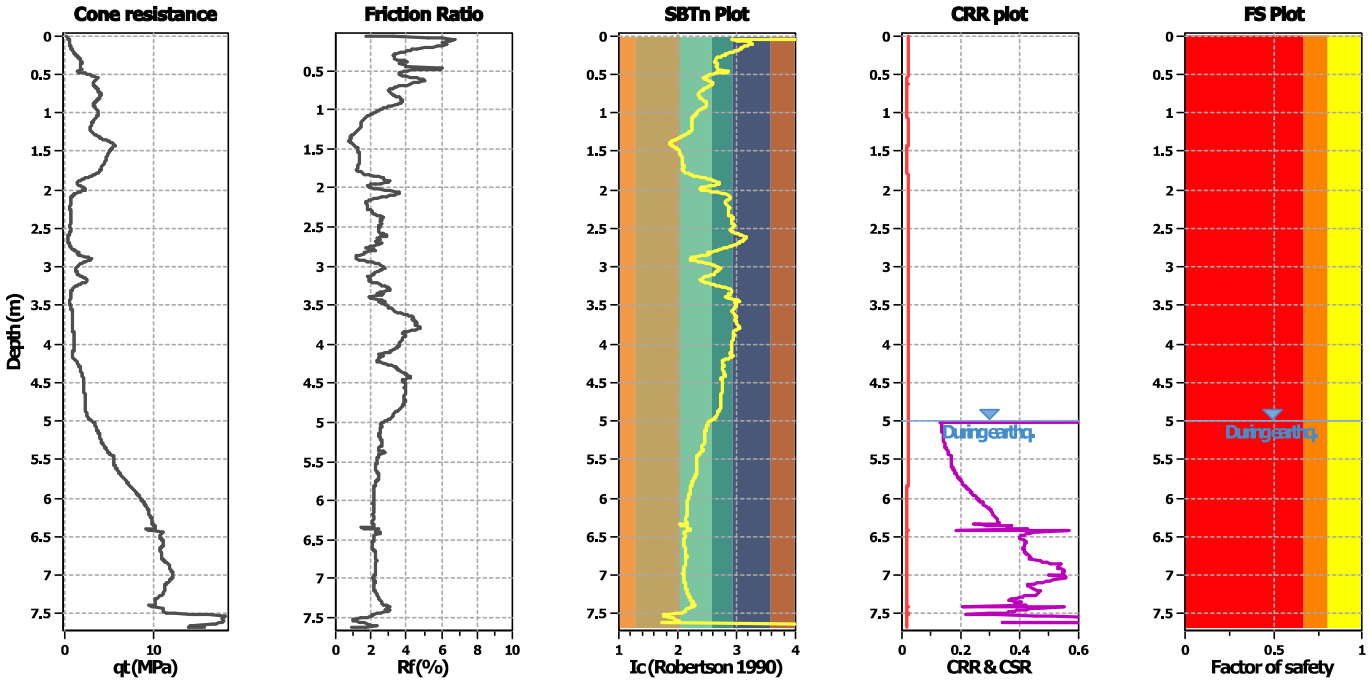
LIQUEFACTION ANALYSIS REPORT

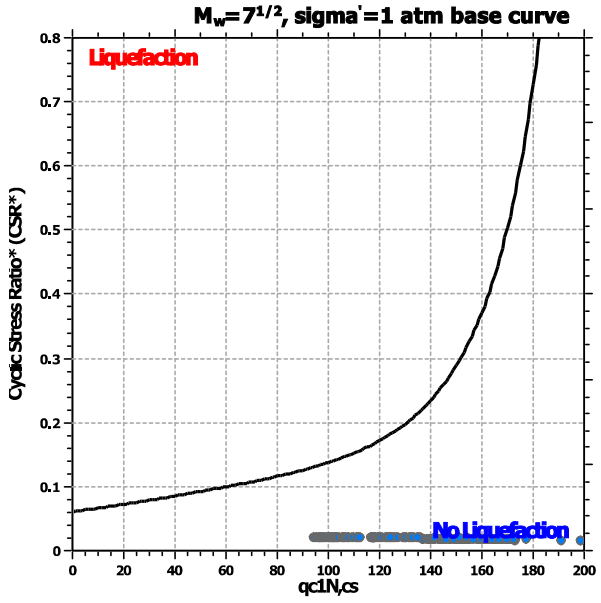
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : SLS (1/25)**

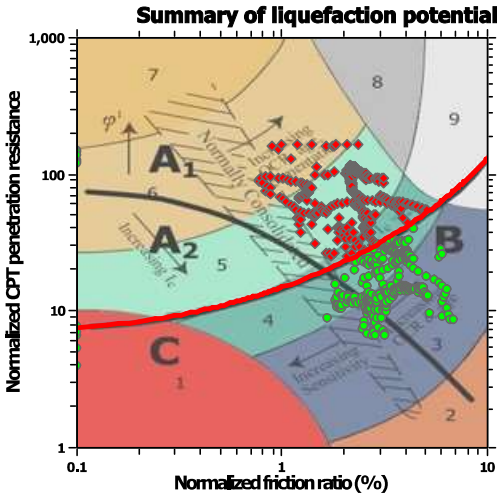
CPT file : CPT04 (western quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 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:	0.04	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

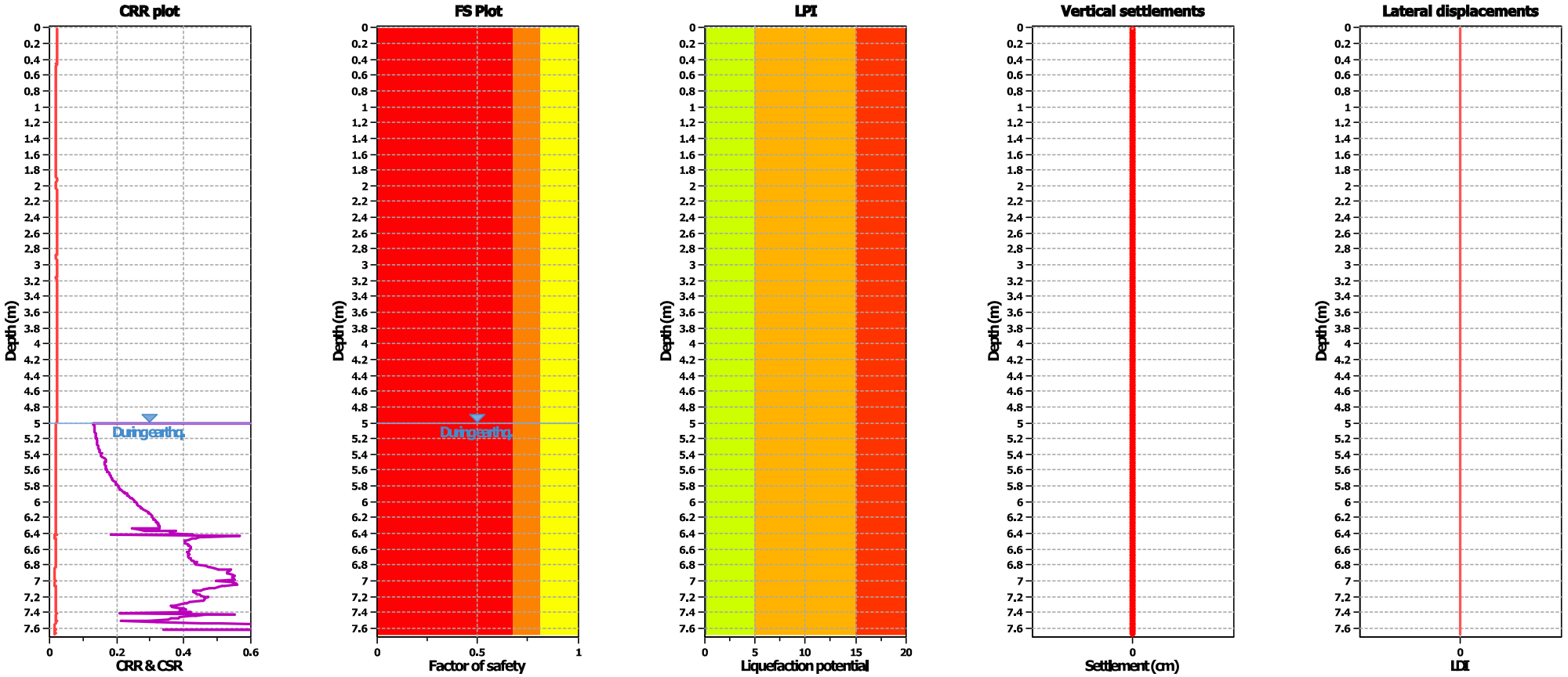






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

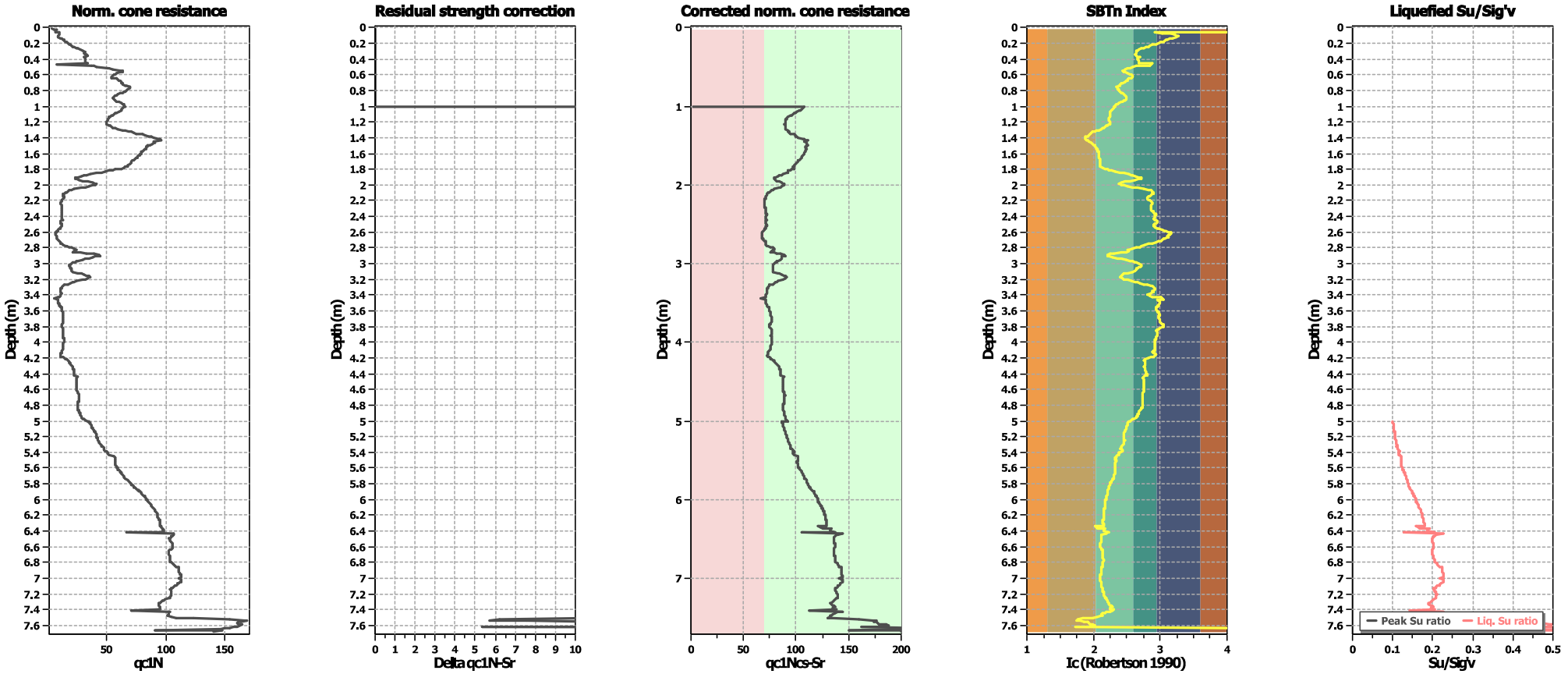
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

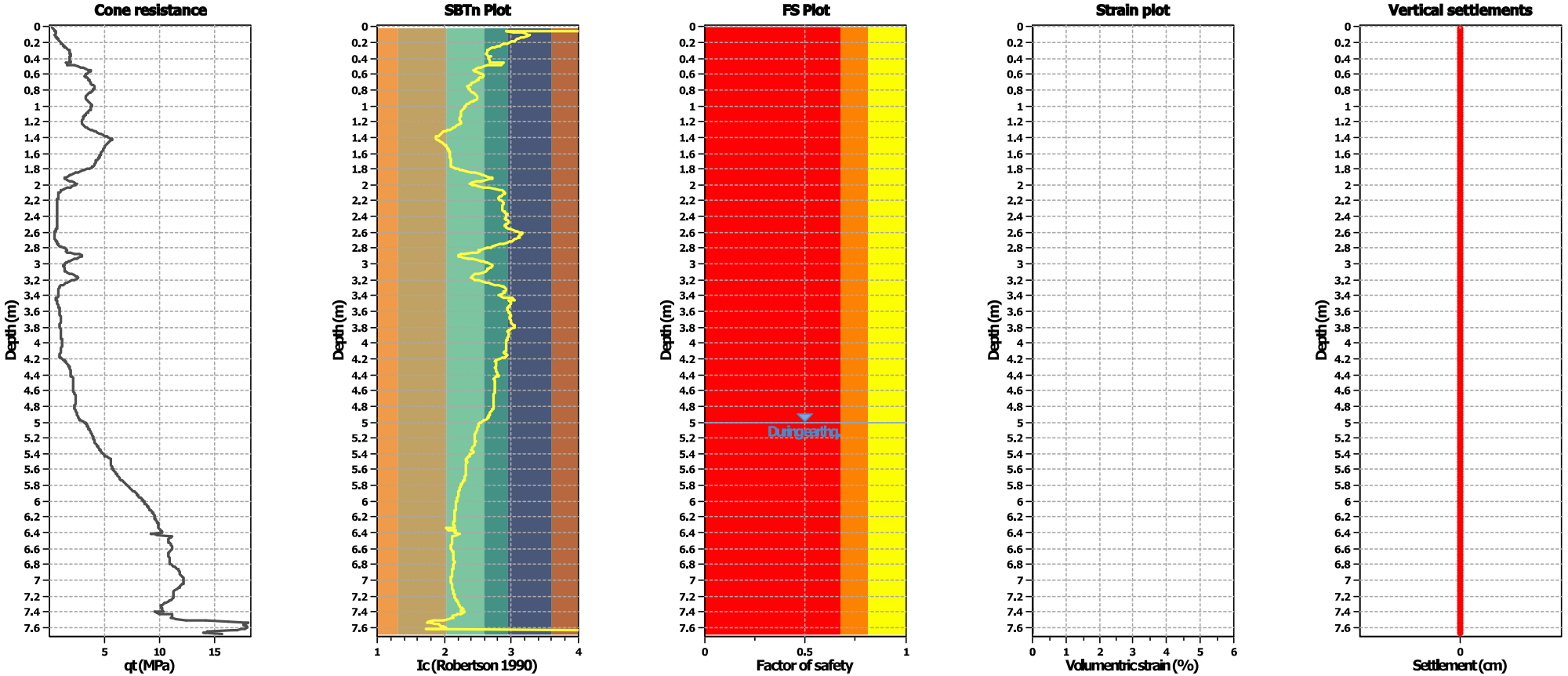
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.04	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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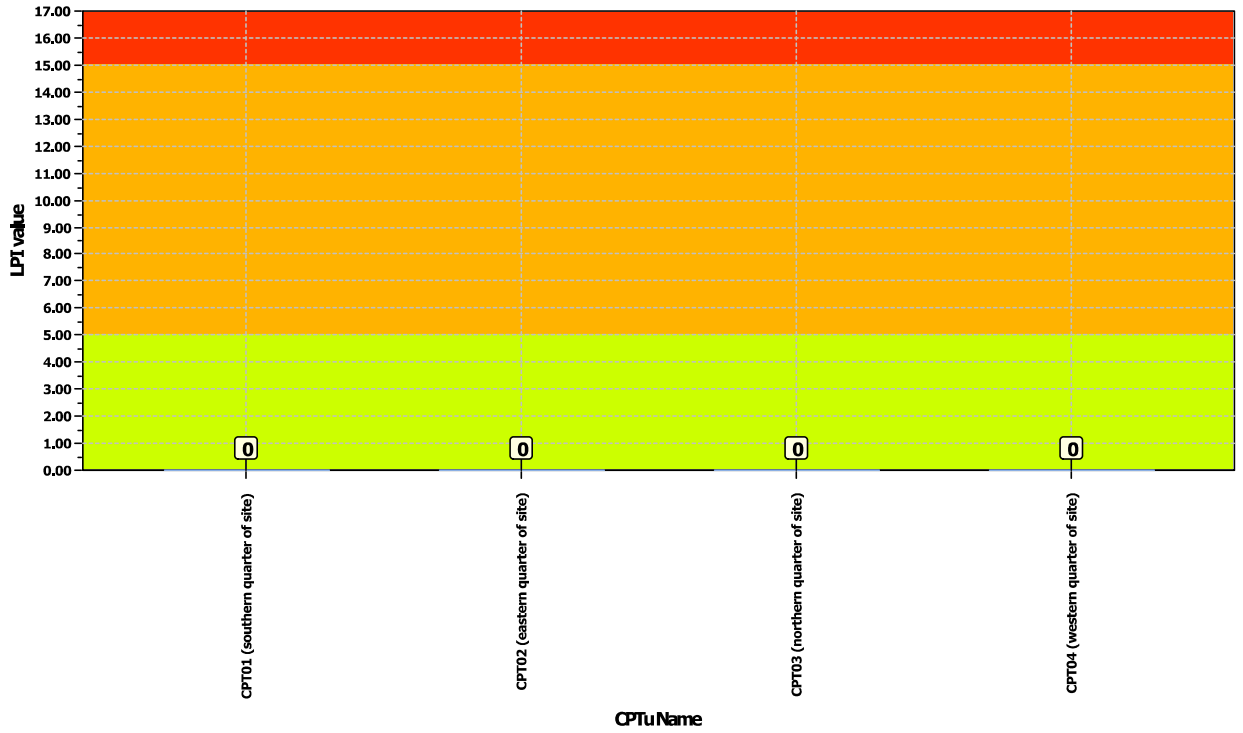
Project title : J01798 - 80 McLarin Road, Glenbrook

Location : SLS (1/25)

Overall Liquefaction Potential Index report



LPI color scheme

- Very high ris
- High risl
- Low risl

Basic statistics

Total CPT number:

100% low ris

0% high ris

0% very high ris

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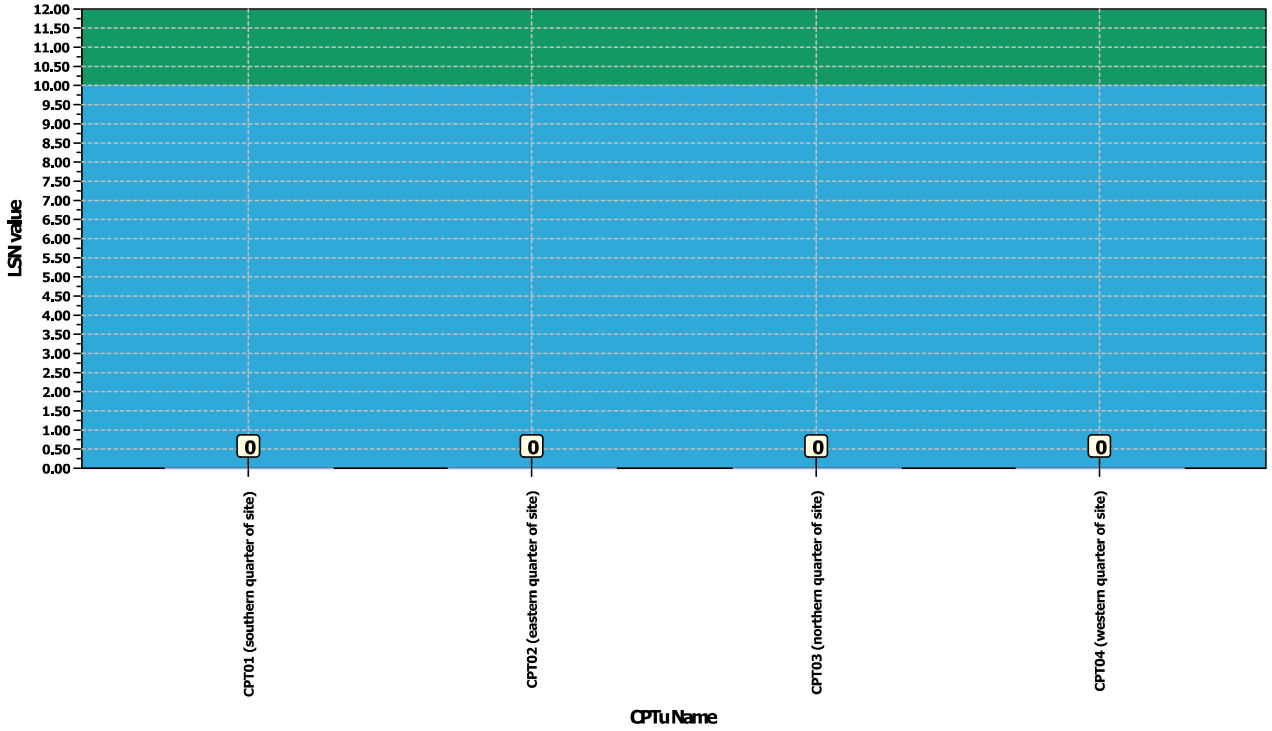
Project title : J01798 - 80 McLarin Road, Glenbrook

Location : SLS (1/25)

Overall Liquefaction Severity Number report



LSN color scheme

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

Basic statistics

Total CPT number:

100% little liquefacti

0% minor liquefacti

0% moderate liquefacti

0% moderate to major liquefac

0% major liquefacti

0% severe liquefacti

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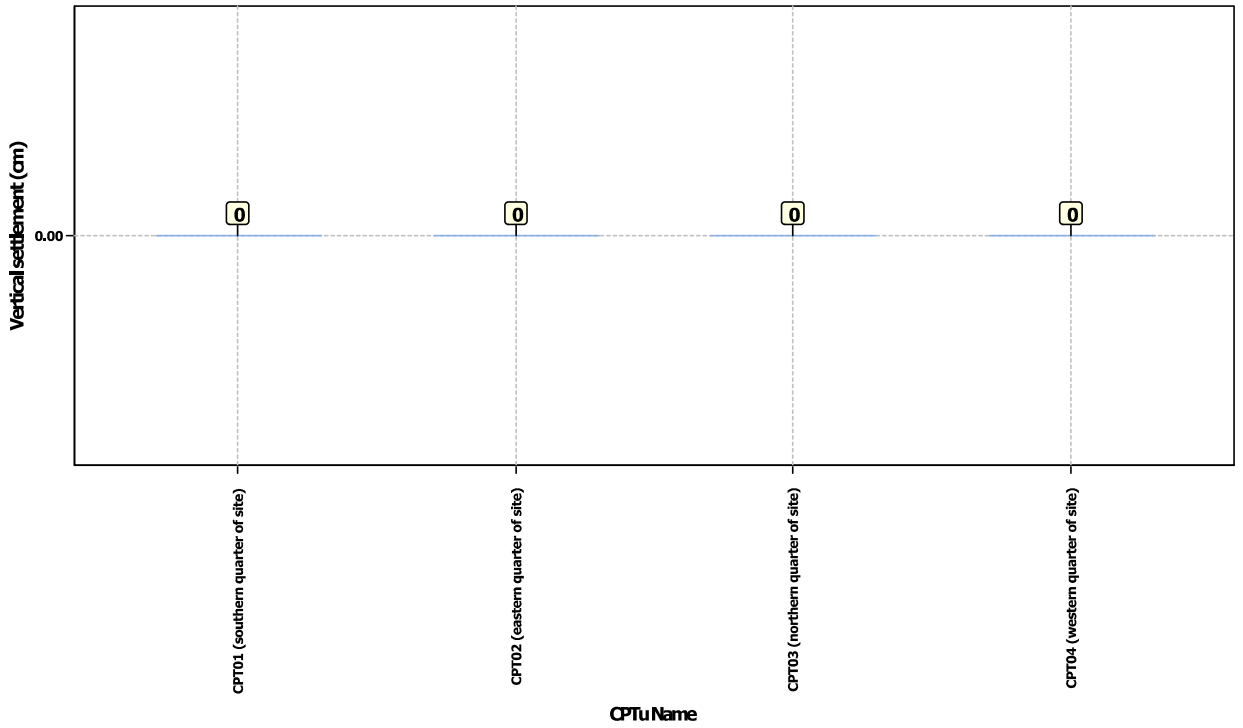
Project title : J01798 - 80 McLarin Road, Glenbrook

Location : SLS (1/25)

Overall vertical settlements report



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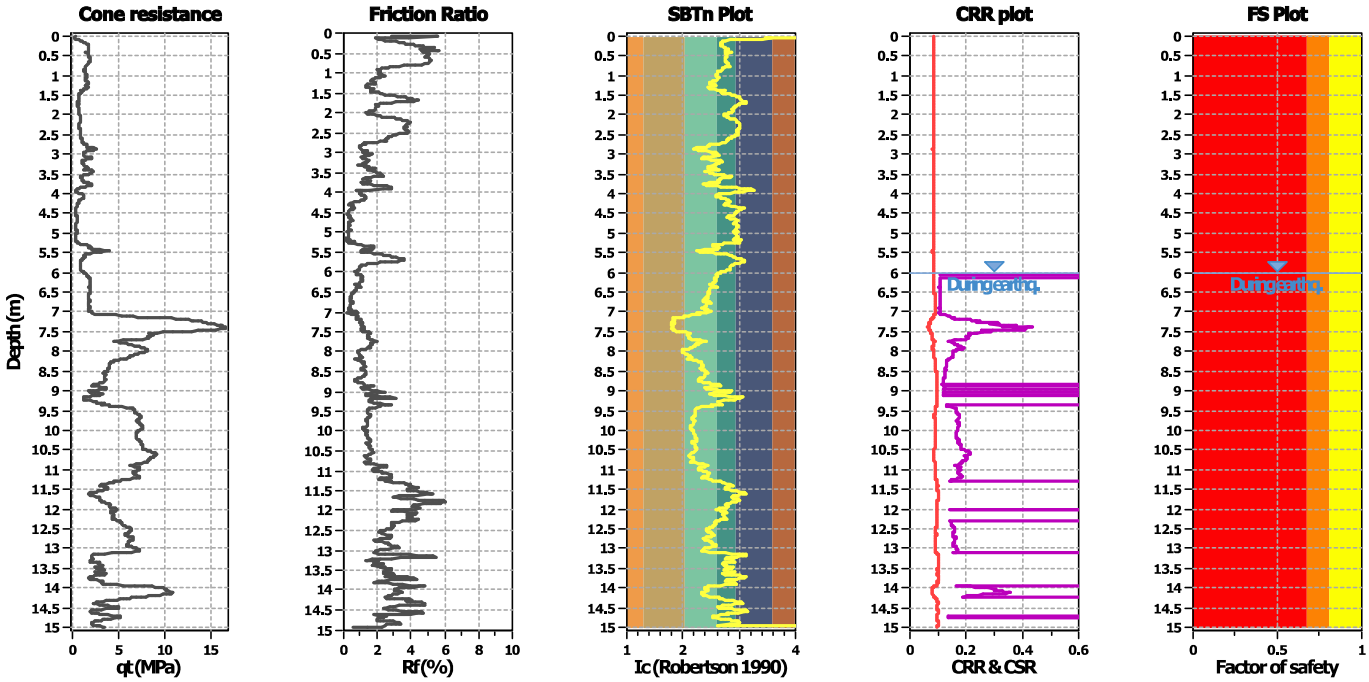
LIQUEFACTION ANALYSIS REPORT

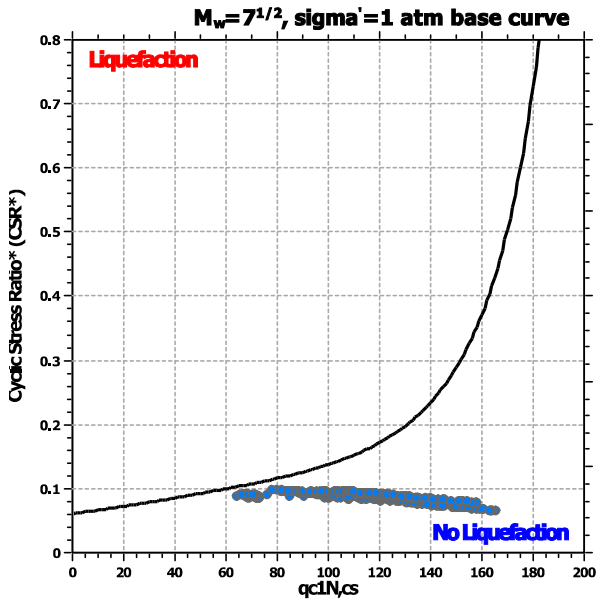
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : ULS (1/500)**

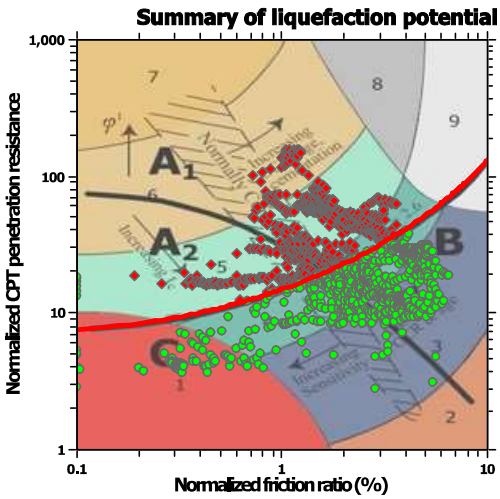
CPT file : CPT01 (southern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 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:	0.16	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

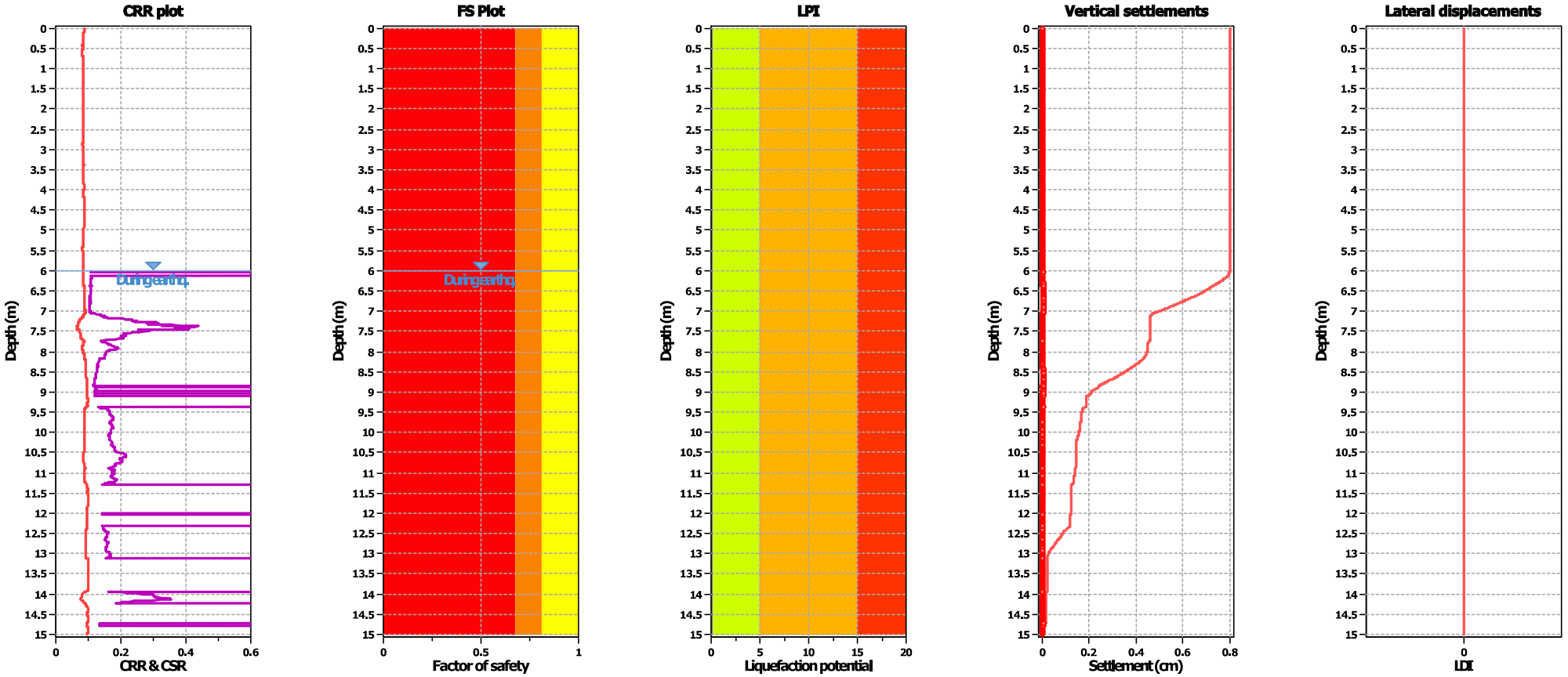






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

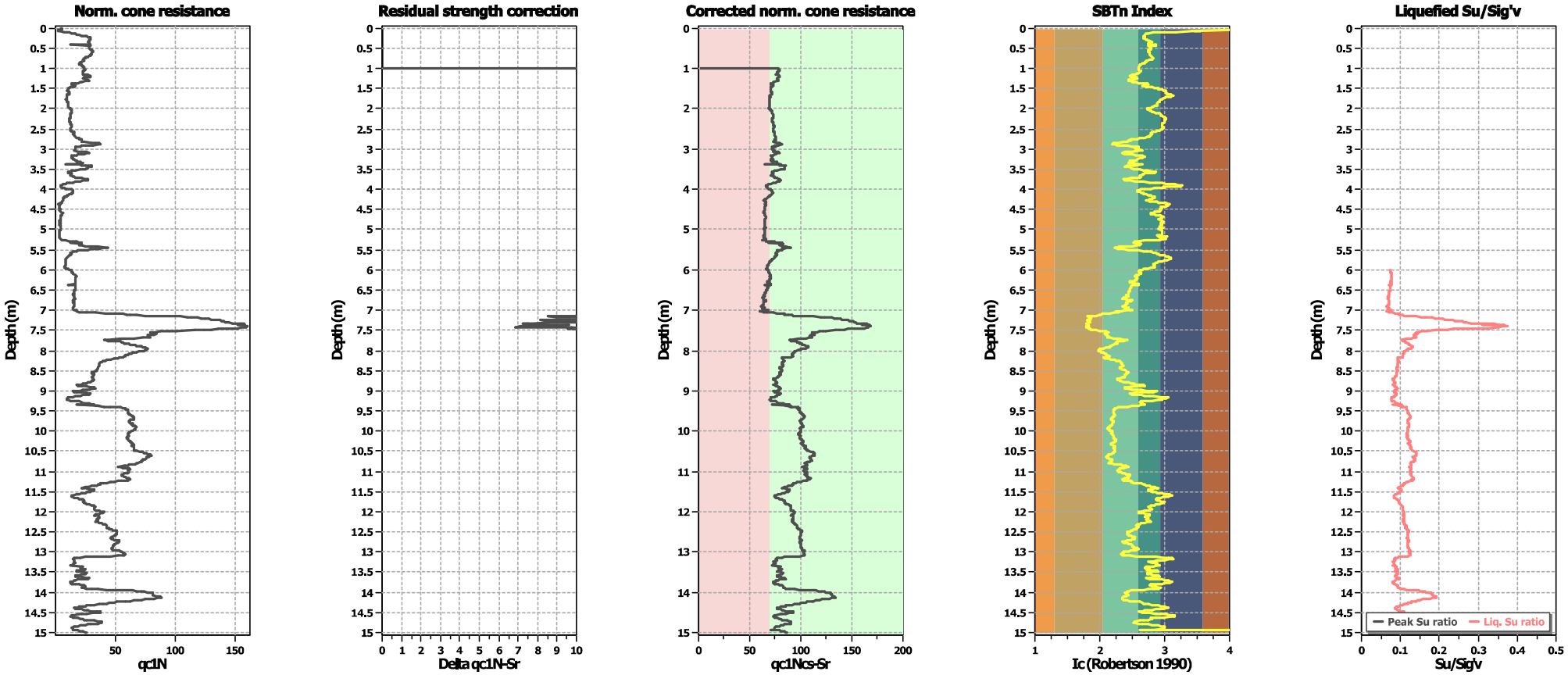
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

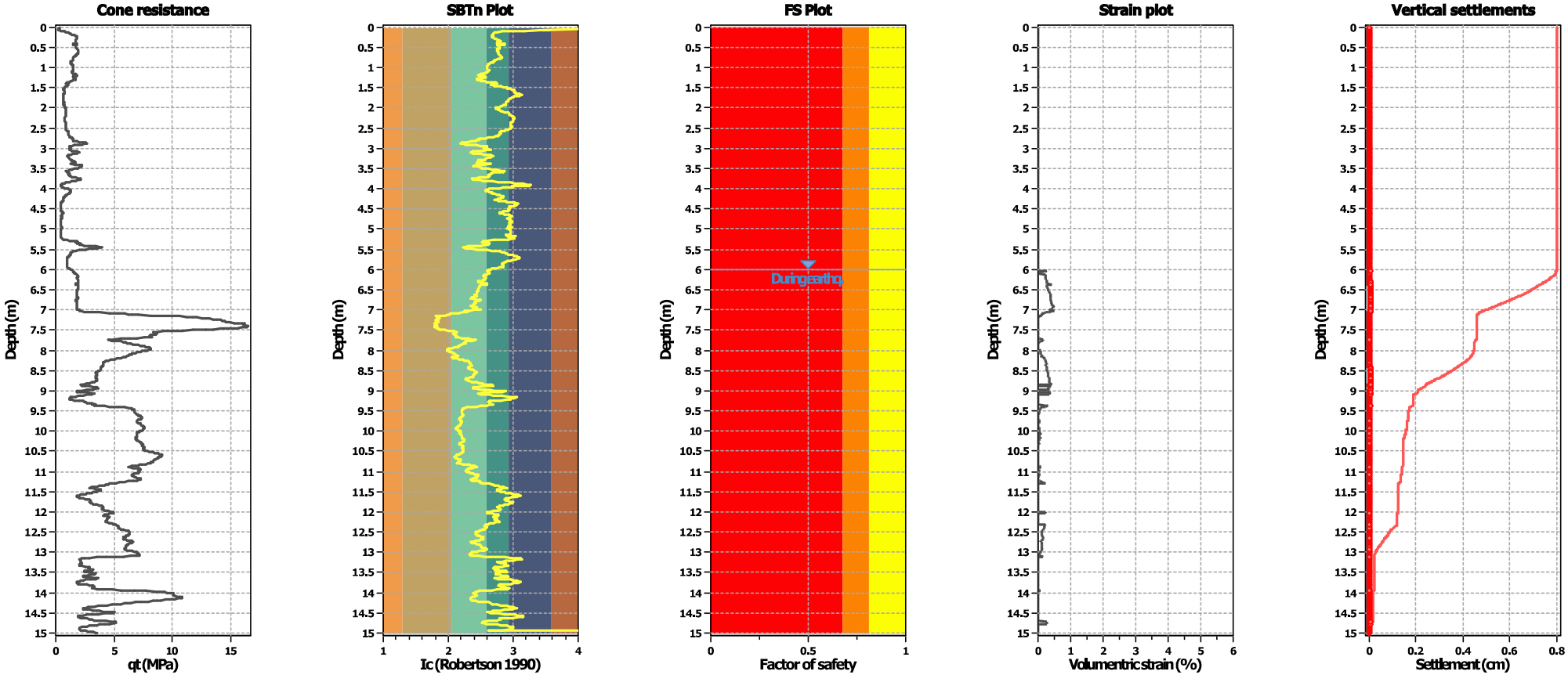
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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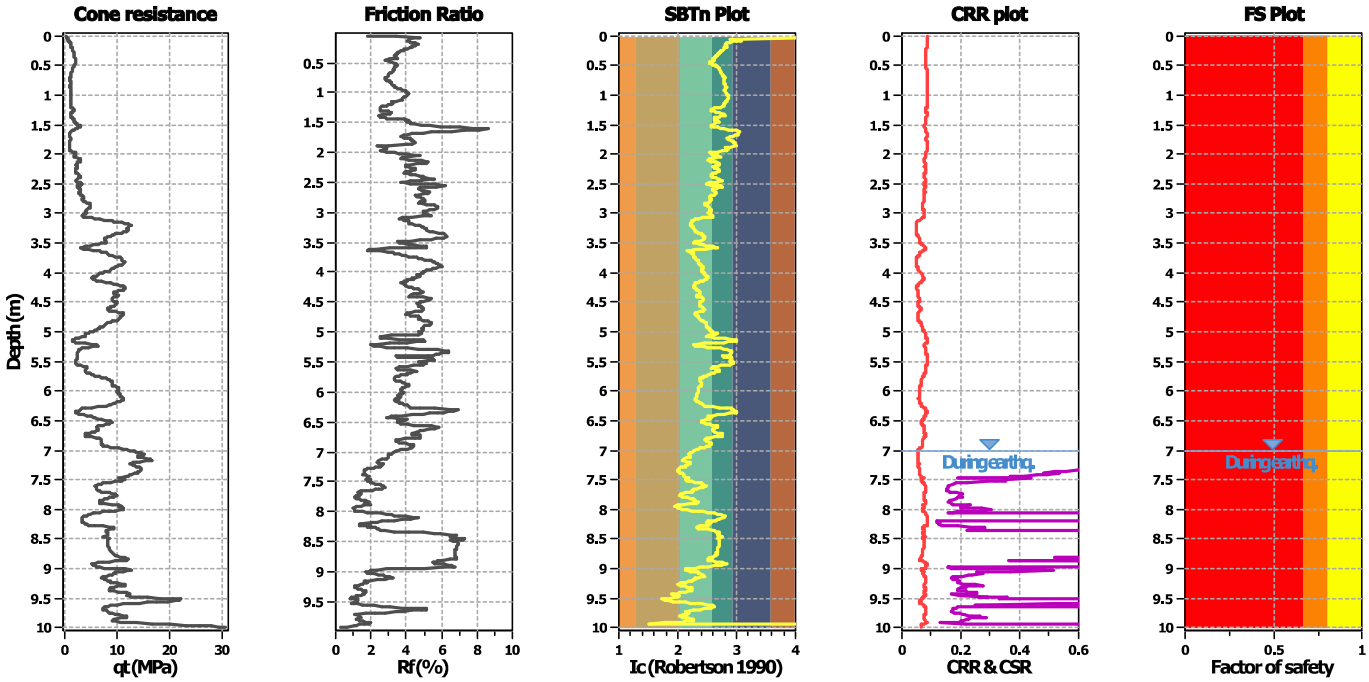
LIQUEFACTION ANALYSIS REPORT

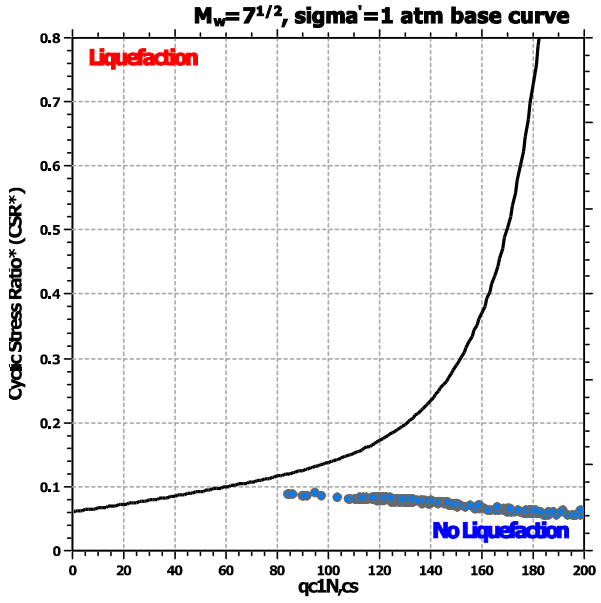
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : ULS (1/500)**

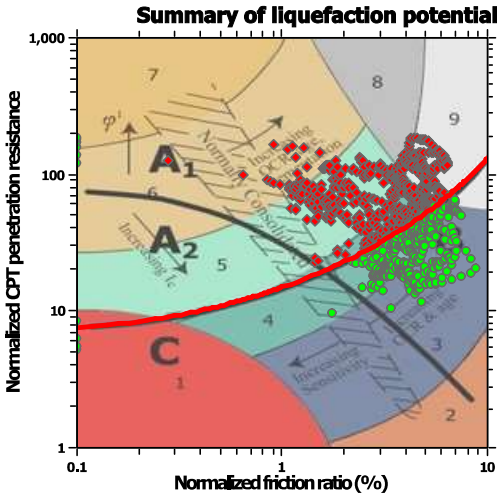
CPT file : CPT02 (eastern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 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:	0.16	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

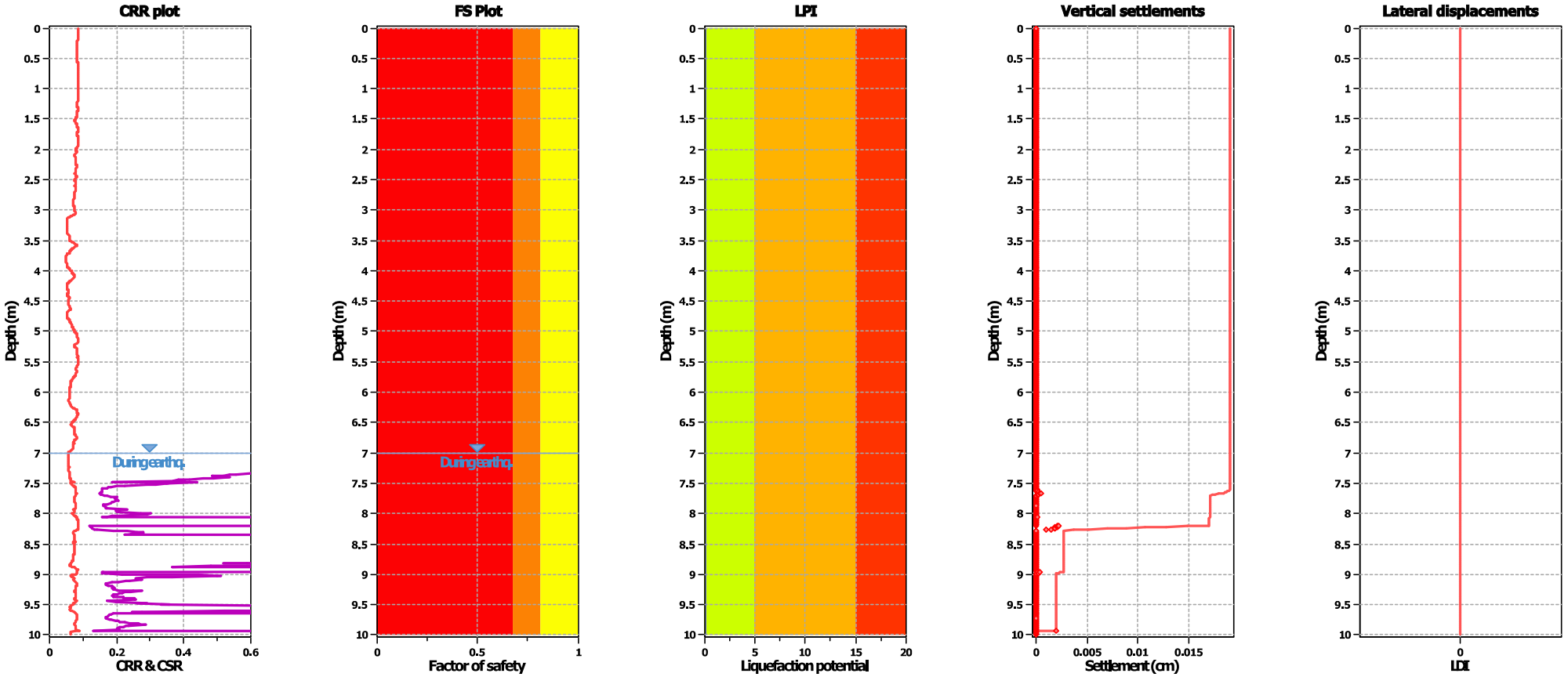






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

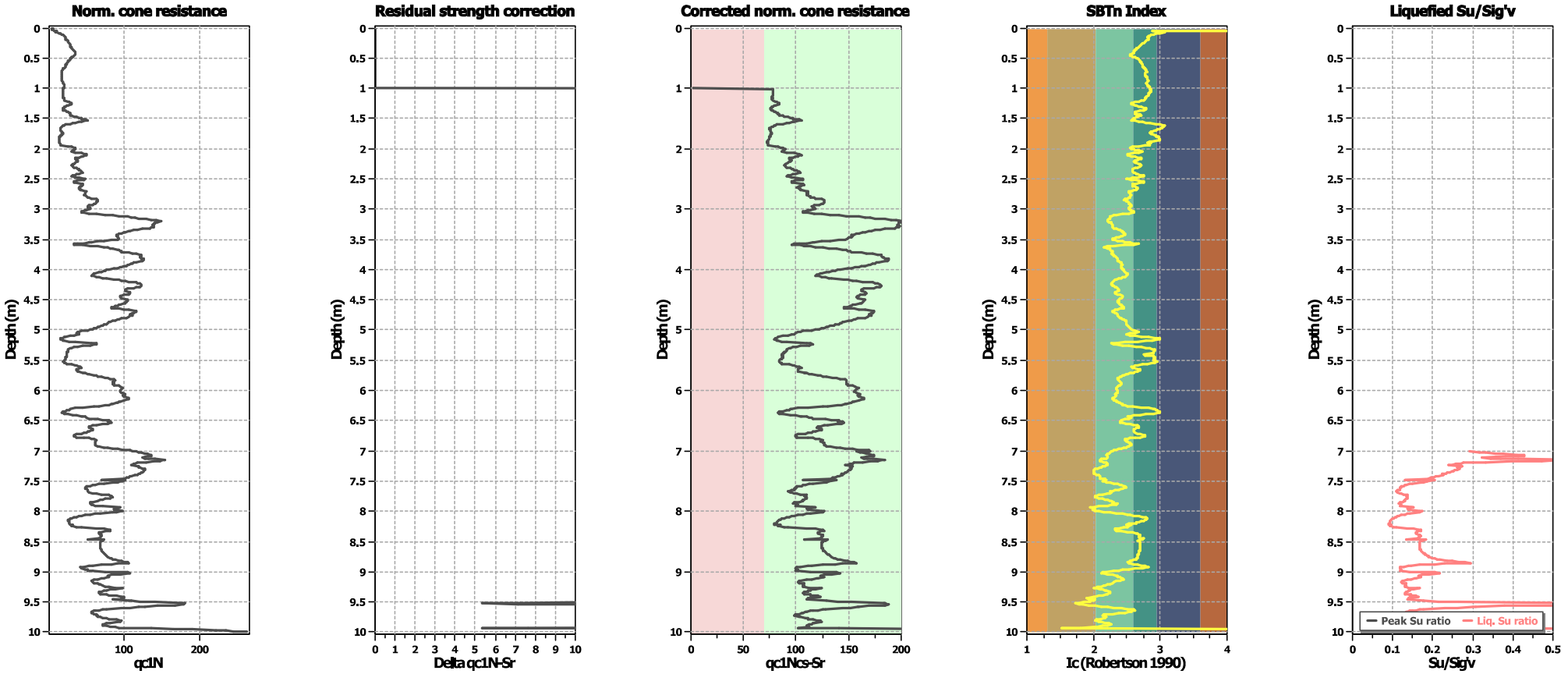
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

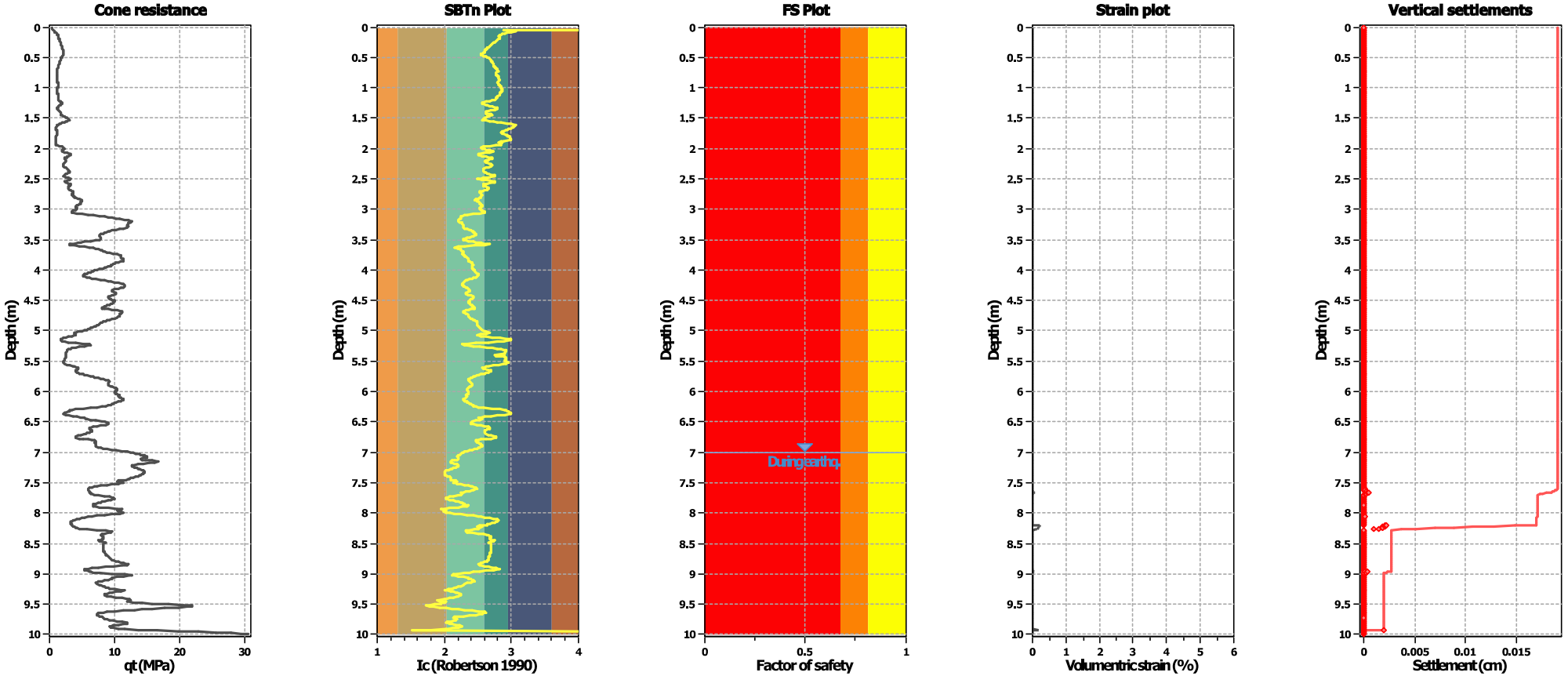
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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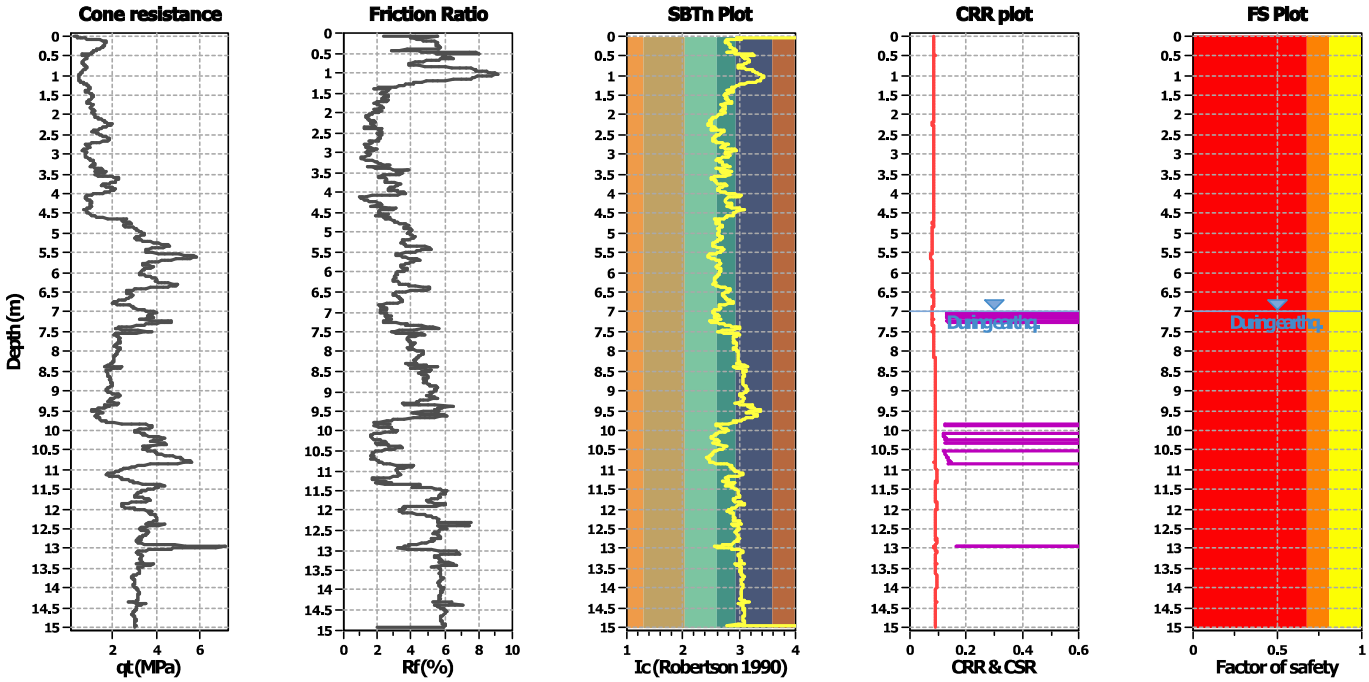
LIQUEFACTION ANALYSIS REPORT

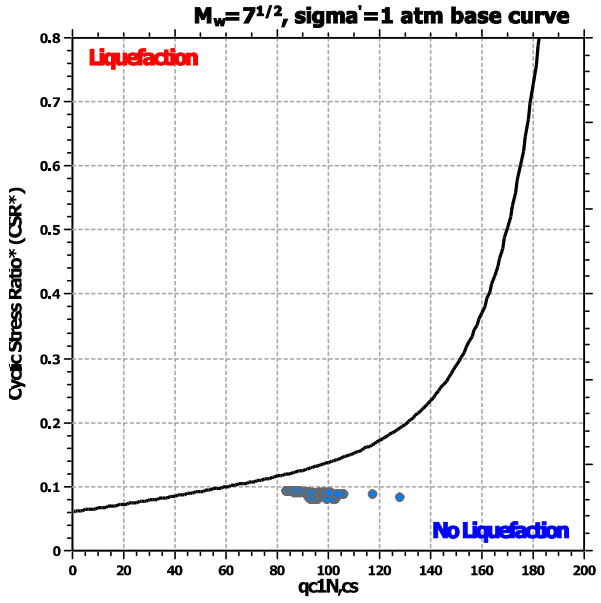
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : ULS (1/500)**

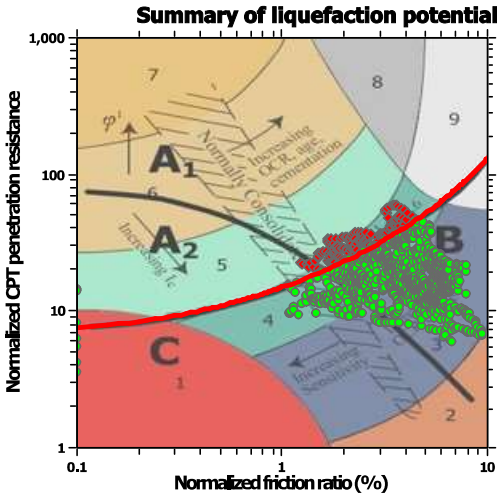
CPT file : CPT03 (northern quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 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:	0.16	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

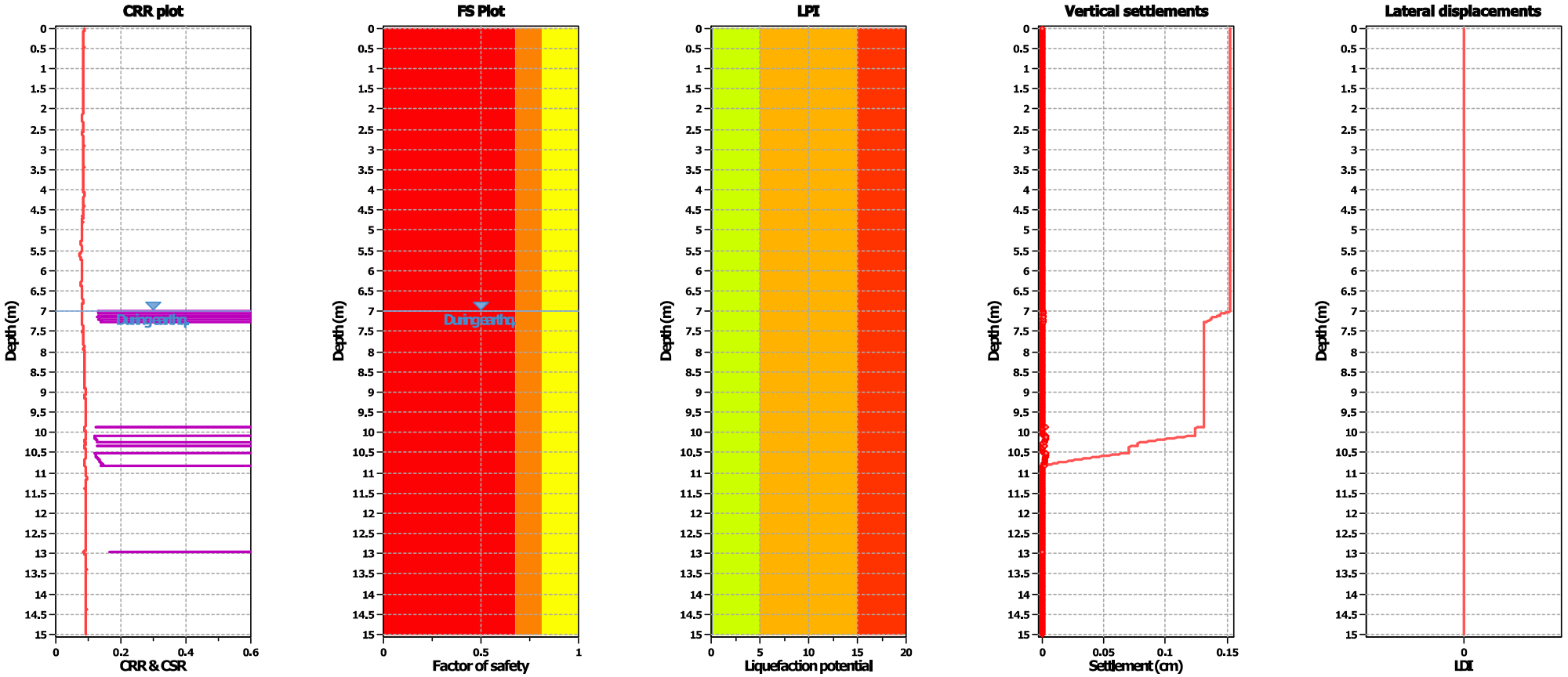






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

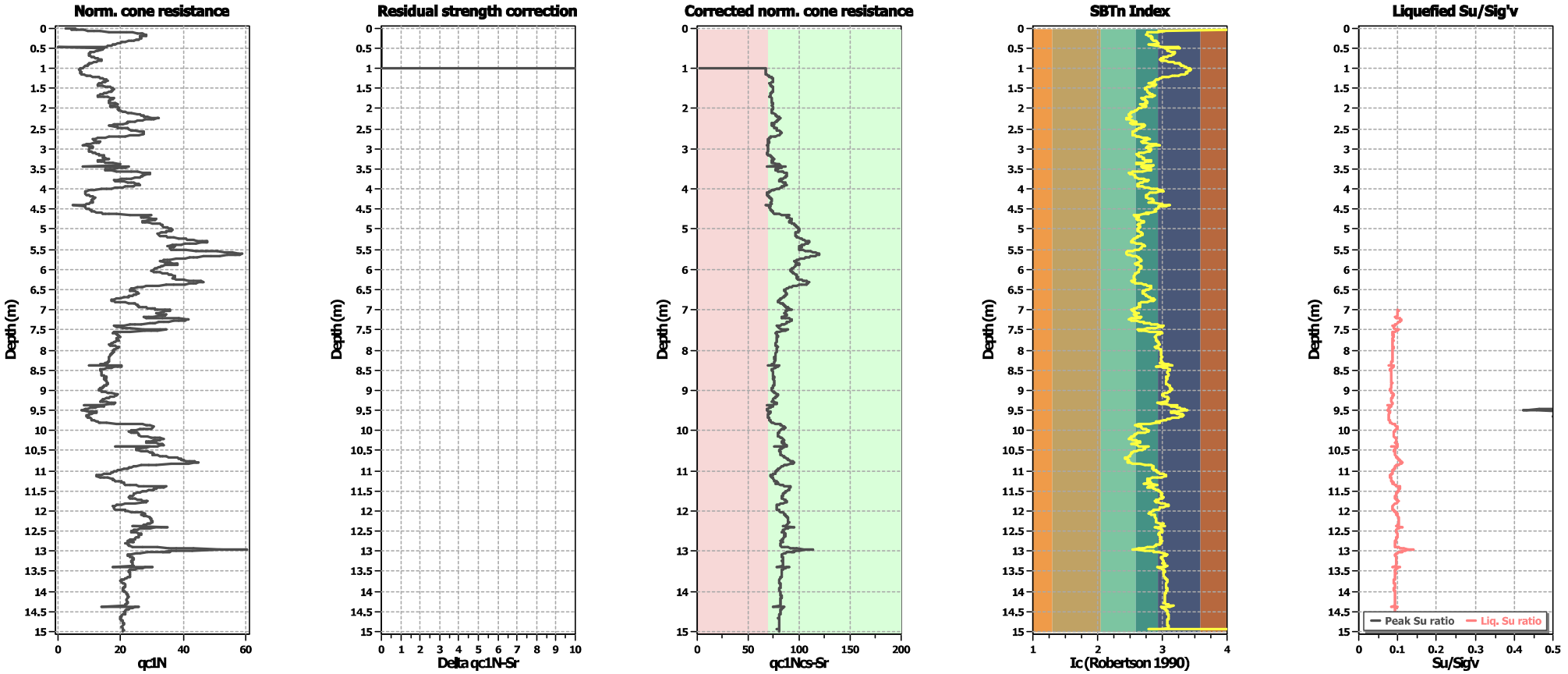
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

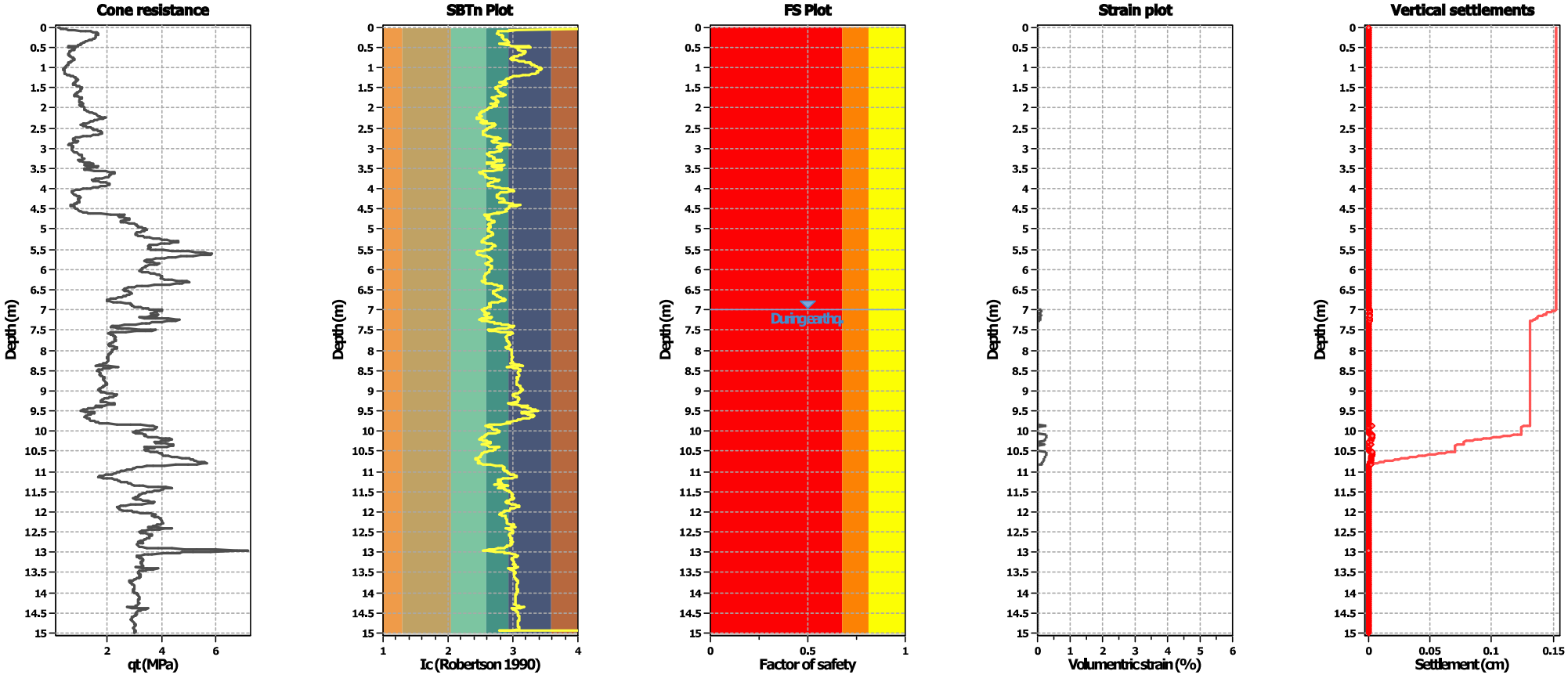
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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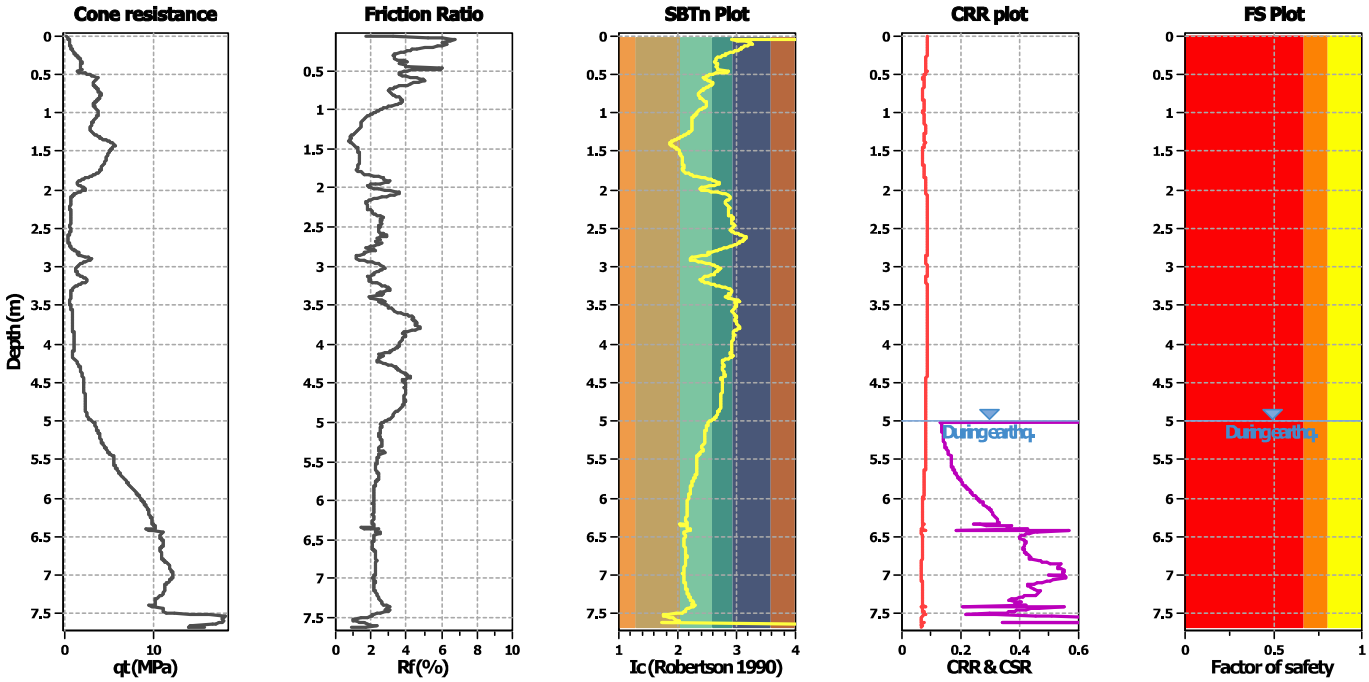
LIQUEFACTION ANALYSIS REPORT

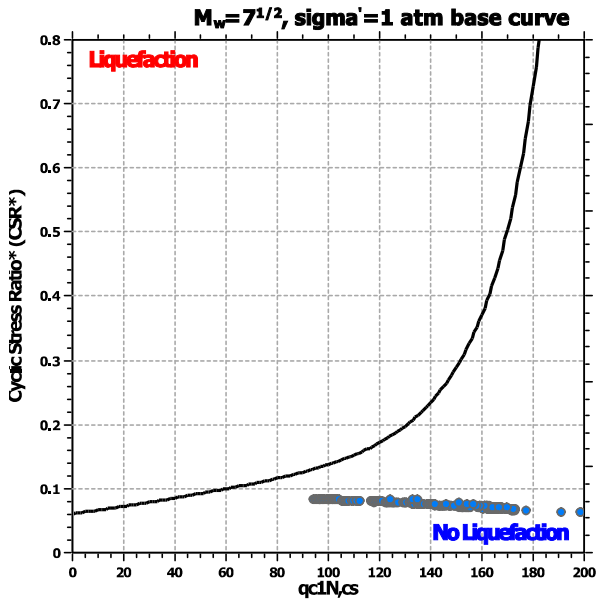
Project title : J01798 - 80 McLarin Road, Glenbrook **Location : ULS (1/500)**

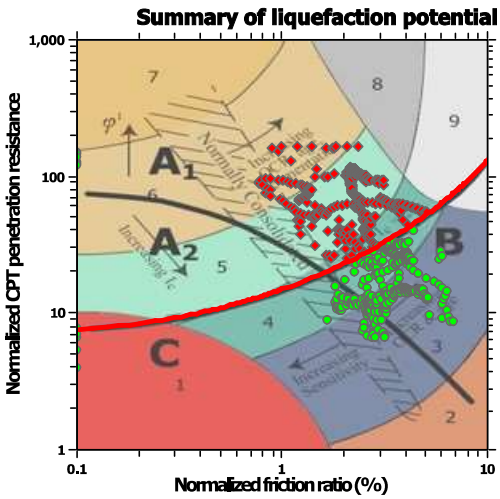
CPT file : CPT04 (western quarter of site)

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 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:	0.16	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

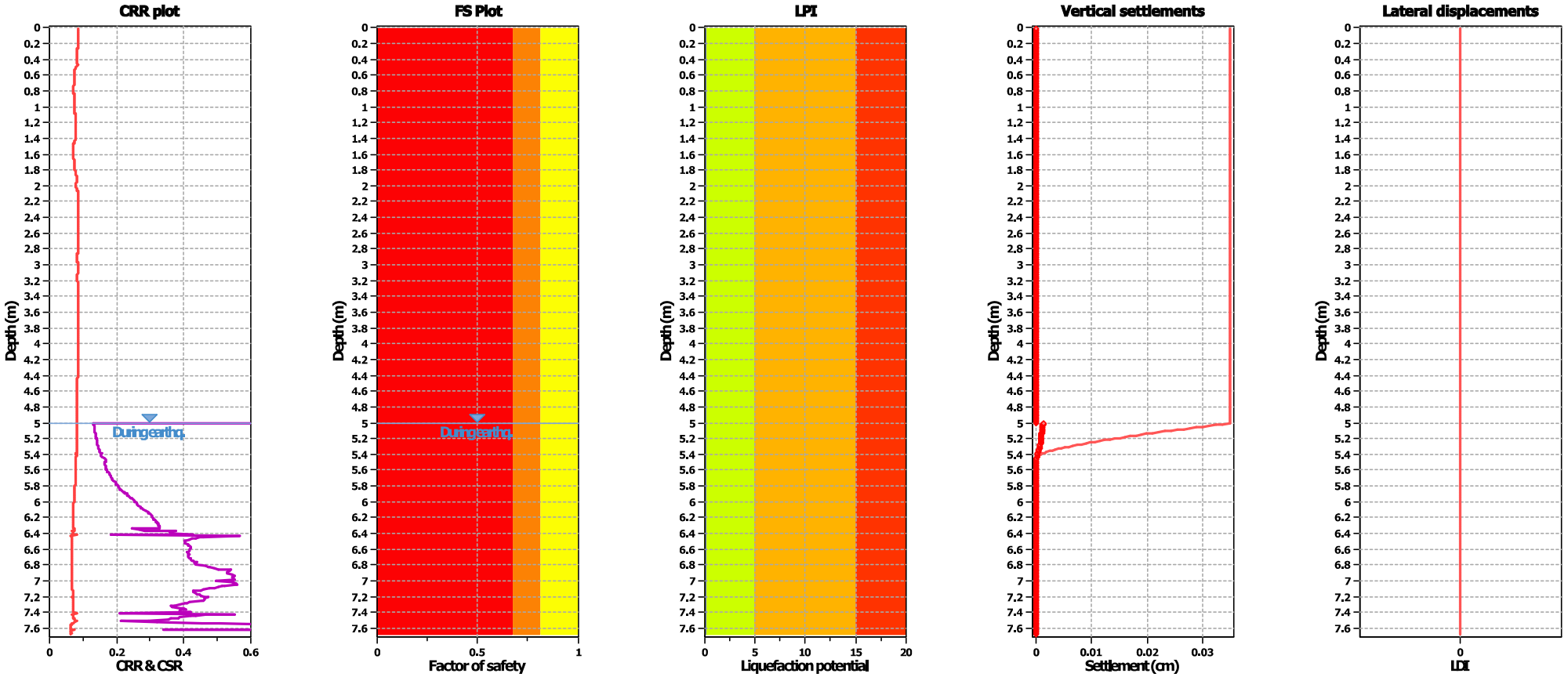






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

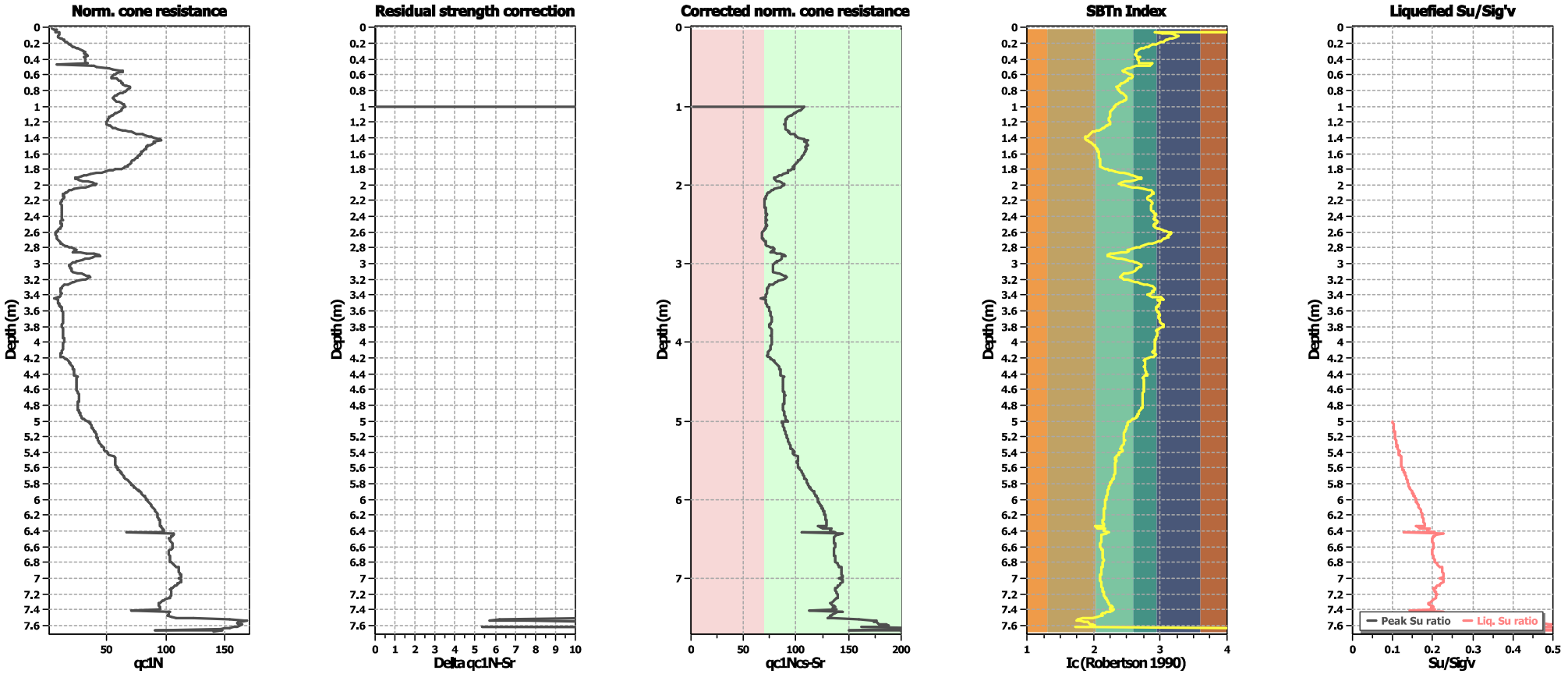
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

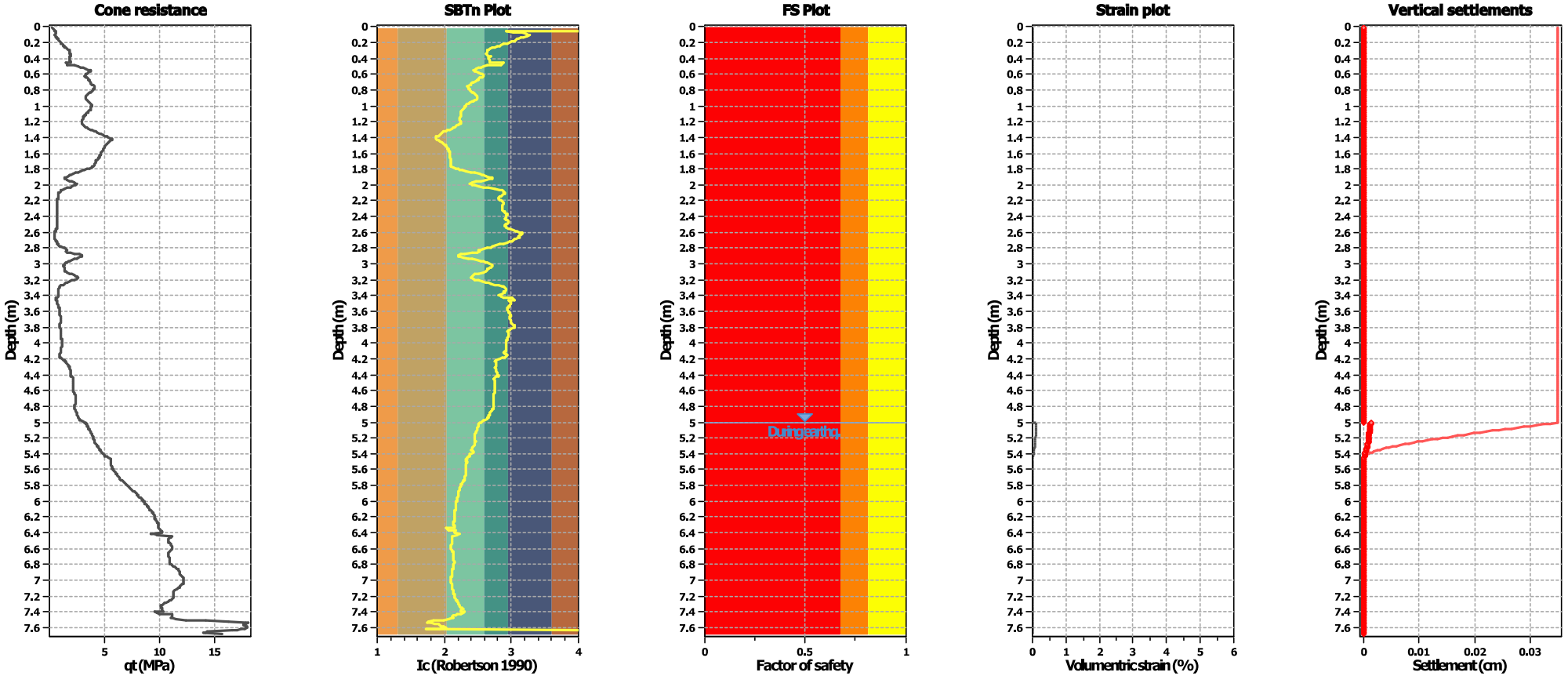
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interva	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.16	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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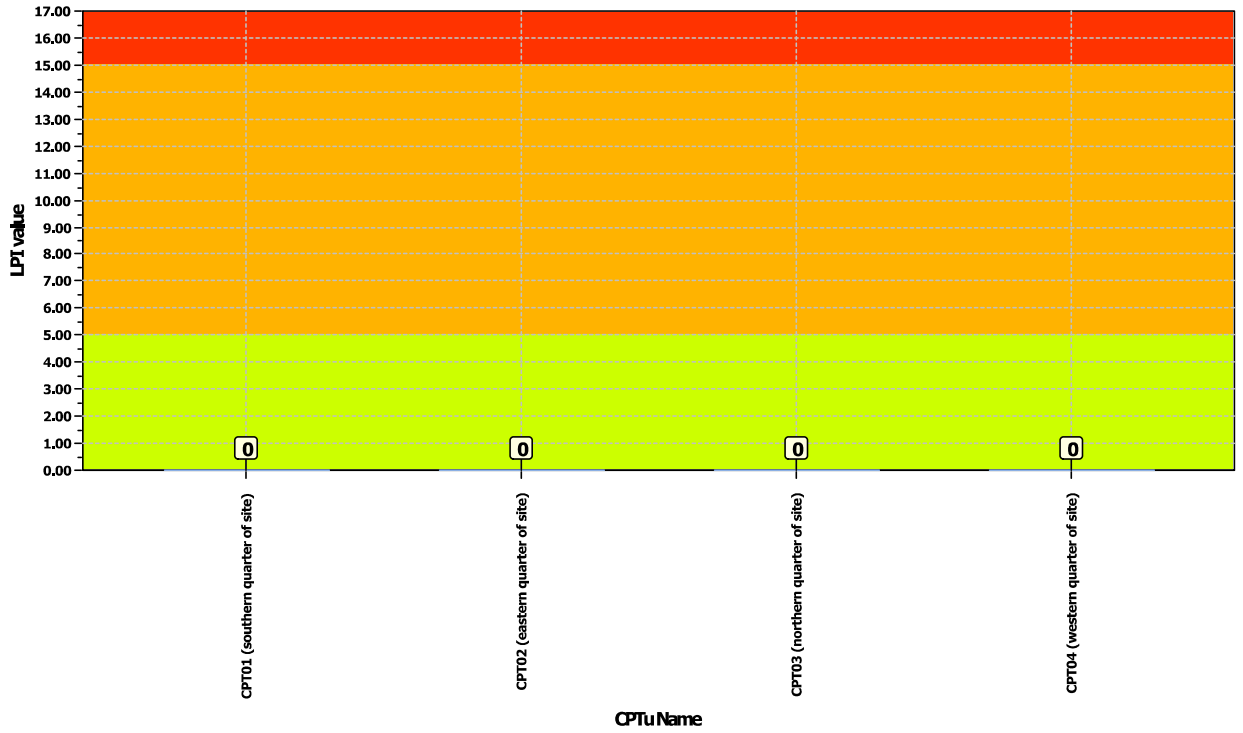
Project title : J01798 - 80 McLarin Road, Glenbrook

Location : ULS (1/500)

Overall Liquefaction Potential Index report



LPI color scheme

- Very high ris
- High risl
- Low risl

Basic statistics

Total CPT number:

100% low ris

0% high ris

0% very high ris

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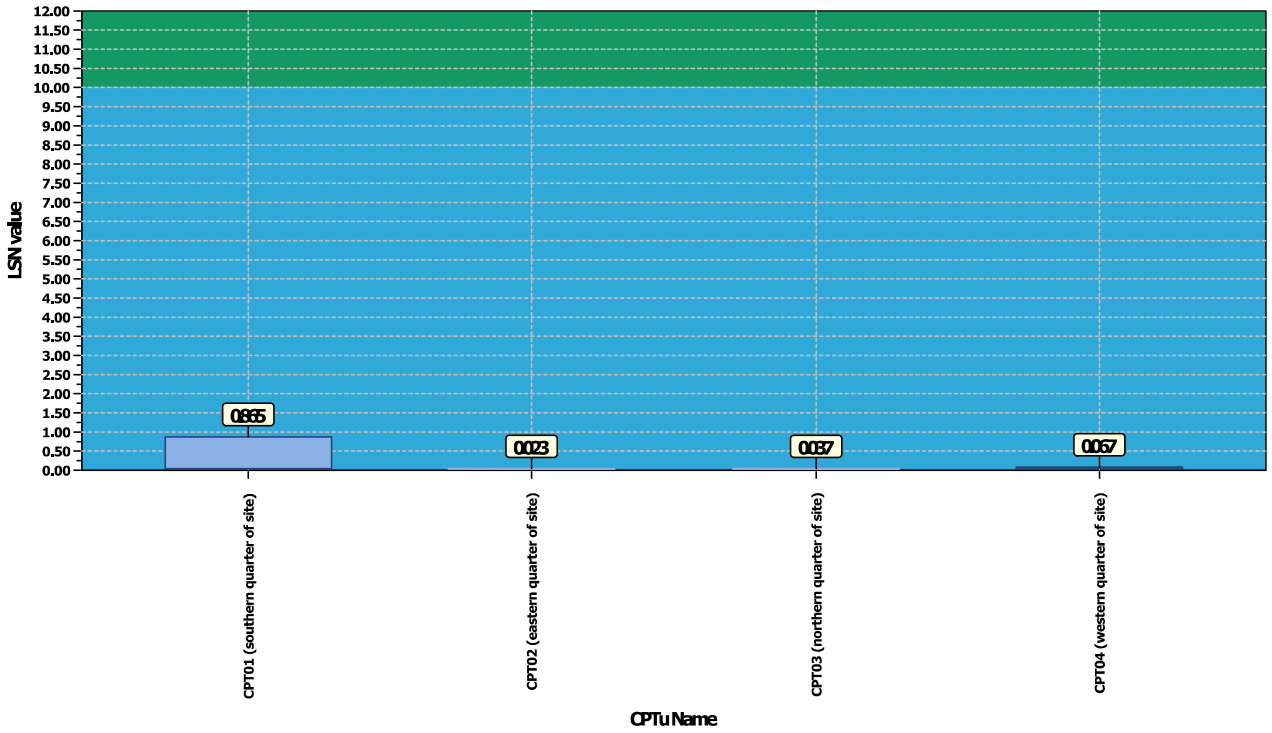
Project title : J01798 - 80 McLarin Road, Glenbrook

Location : ULS (1/500)

Overall Liquefaction Severity Number report



LSN color scheme

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

Basic statistics

Total CPT number:

100% little liquefacti

0% minor liquefacti

0% moderate liquefacti

0% moderate to major liquefac

0% major liquefacti

0% severe liquefacti

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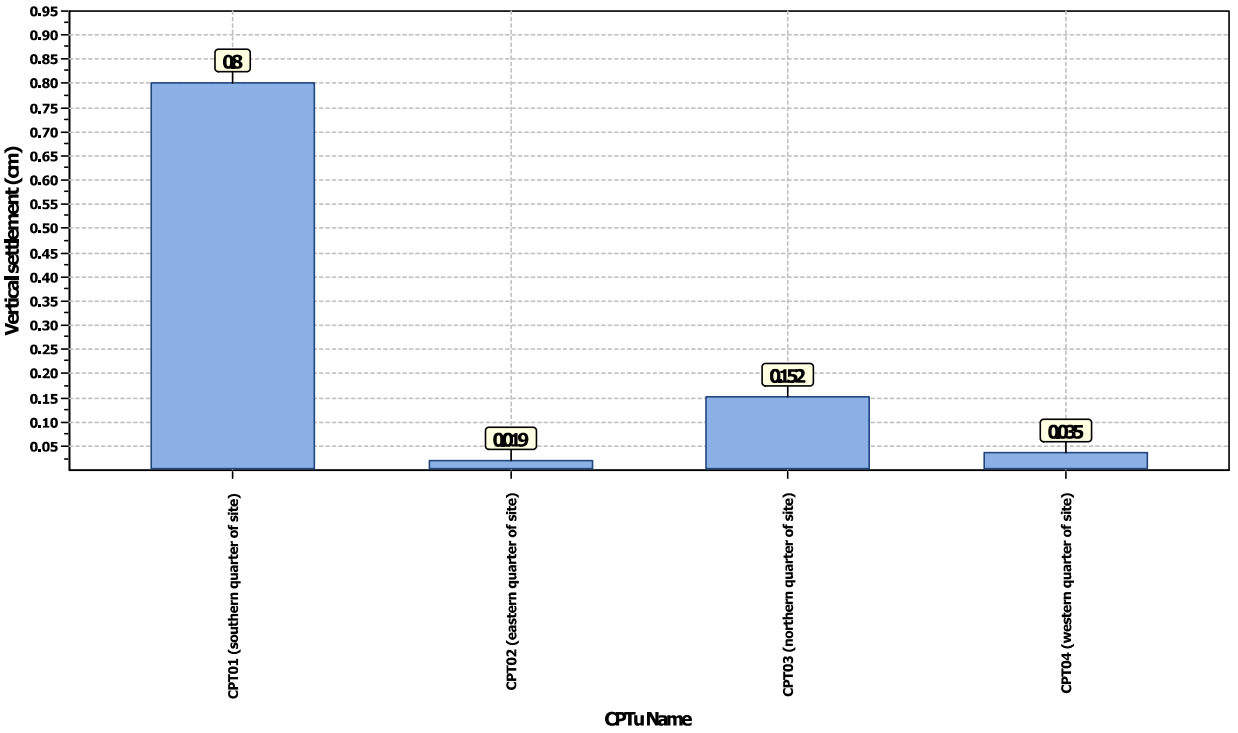
www.landergeotechnical.co.nz

Project title : J01798 - 80 McLarin Road, Glenbrook

Location : ULS (1/500)

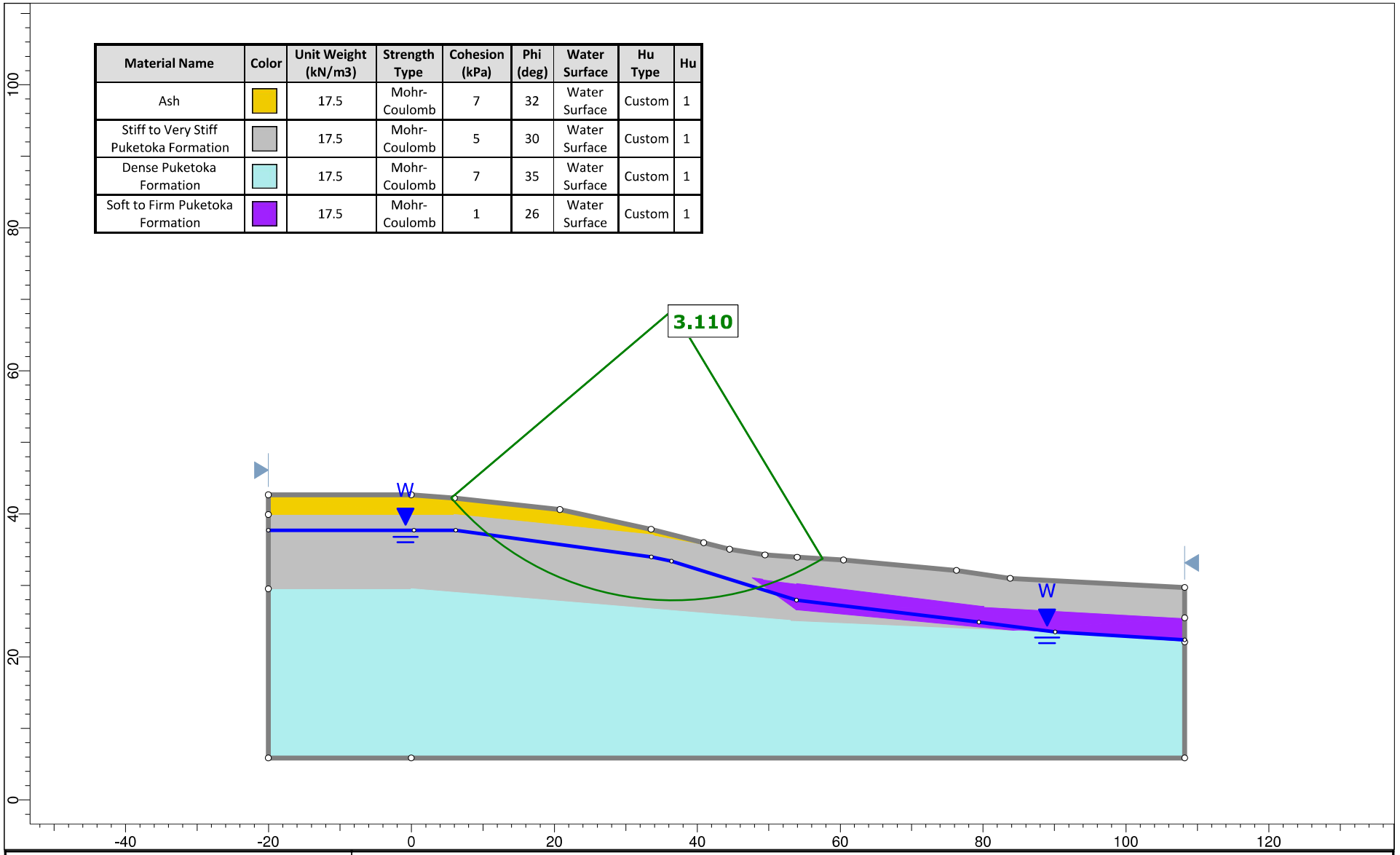
Overall vertical settlements report



Appendix 5

Slope Stability Results

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Ash		17.5	Mohr-Coulomb	7	32	Water Surface	Custom	1
Stiff to Very Stiff Puketoka Formation		17.5	Mohr-Coulomb	5	30	Water Surface	Custom	1
Dense Puketoka Formation		17.5	Mohr-Coulomb	7	35	Water Surface	Custom	1
Soft to Firm Puketoka Formation		17.5	Mohr-Coulomb	1	26	Water Surface	Custom	1

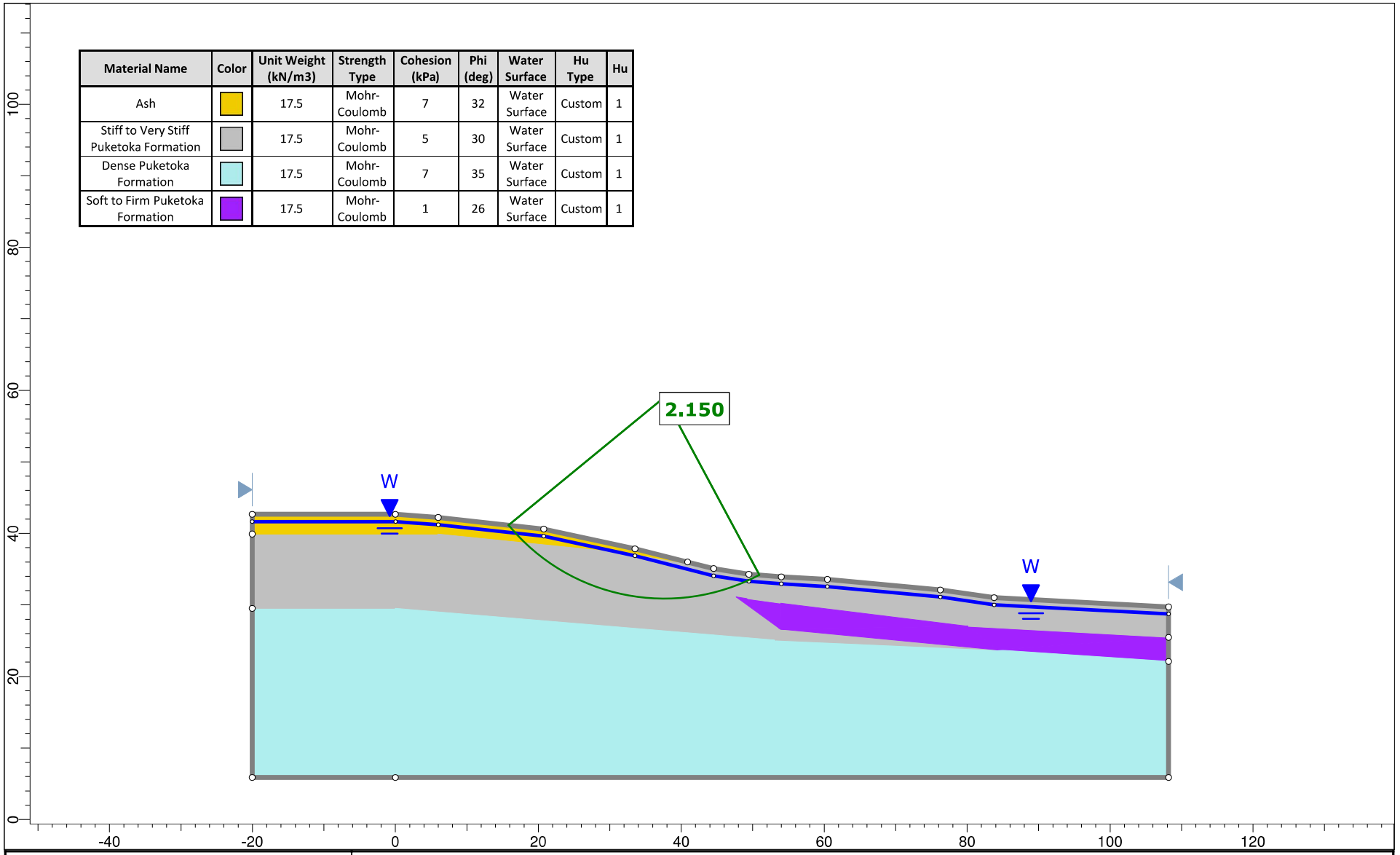


LANDER geotechnical

SLIDEINTERPRET 9.018

Analysis Description	XSAA - Existing Slope - Prevailing GW		
Cross Section	Cross Section AA	Case No.	Project: J01798 - 80 McLarin Road, Glenbrook
Drawn By	TT	F.O.S Filter	Company: Lander Geotechnical Consultants Limited
Date	10/09/2021	Scale 1:750	*File Name*: J01798_210805_XSAA.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Ash		17.5	Mohr-Coulomb	7	32	Water Surface	Custom	1
Stiff to Very Stiff Puketoka Formation		17.5	Mohr-Coulomb	5	30	Water Surface	Custom	1
Dense Puketoka Formation		17.5	Mohr-Coulomb	7	35	Water Surface	Custom	1
Soft to Firm Puketoka Formation		17.5	Mohr-Coulomb	1	26	Water Surface	Custom	1

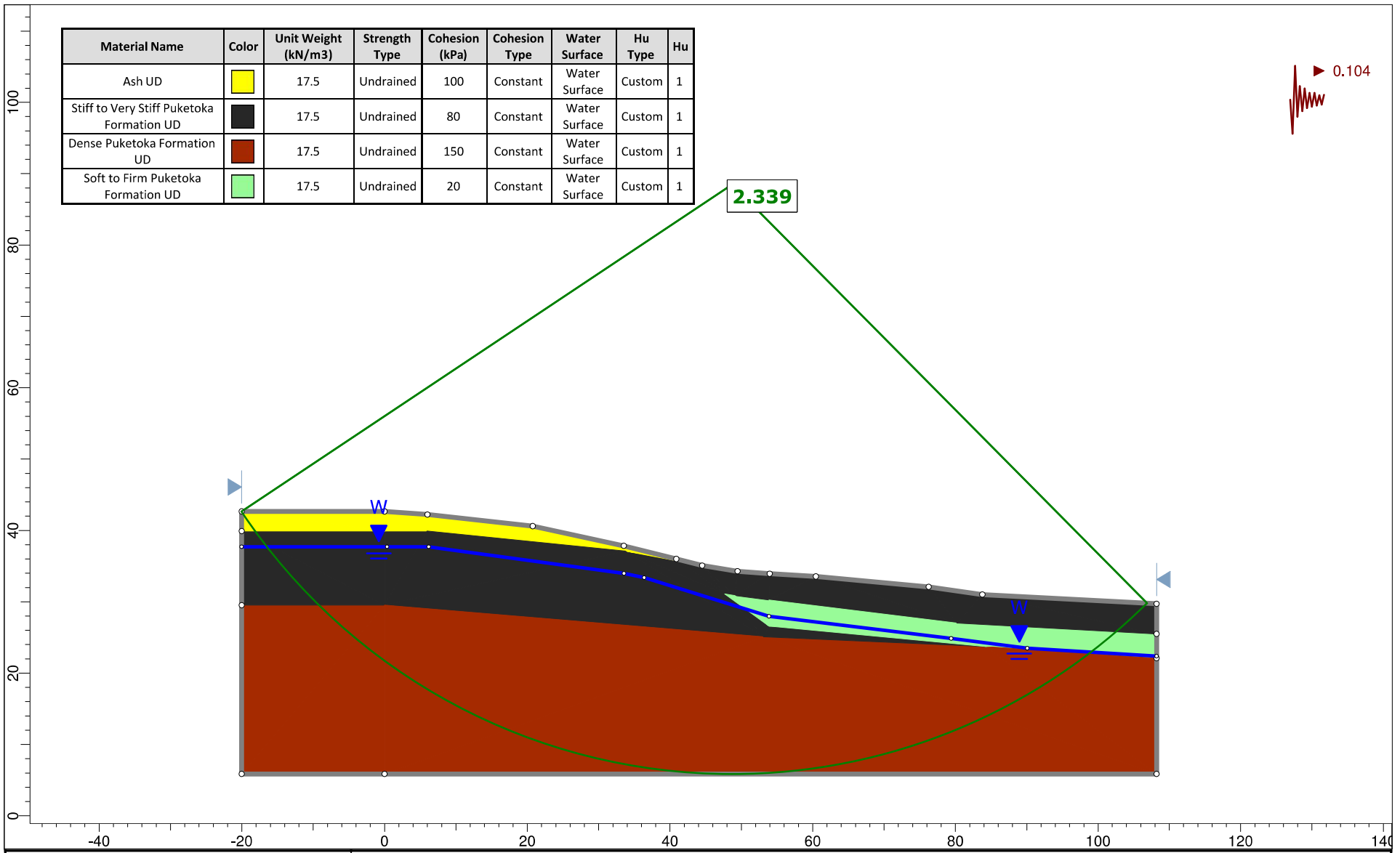


LANDER geotechnical

SLIDEINTERPRET 9.018

Analysis Description	XSAA - Existing Slope - Elevated GW				
Cross Section	Cross Section AA	Case No.		Project	J01798 - 80 McLarin Road, Glenbrook
Drawn By	TT	F.O.S Filter		Company	Lander Geotechnical Consultants Limited
Date	10/09/2021	Scale	1:750	*File Name*	J01798_210805_XSAA.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Cohesion Type	Water Surface	Hu Type	Hu
Ash UD		17.5	Undrained	100	Constant	Water Surface	Custom	1
Stiff to Very Stiff Puketoka Formation UD		17.5	Undrained	80	Constant	Water Surface	Custom	1
Dense Puketoka Formation UD		17.5	Undrained	150	Constant	Water Surface	Custom	1
Soft to Firm Puketoka Formation UD		17.5	Undrained	20	Constant	Water Surface	Custom	1



LANDER geotechnical

SLIDEINTERPRET 9.018

Analysis Description	XSAA - Existing Slope - Seismic				
Cross Section	Cross Section AA	Case No.		Project	J01798 - 80 McLarin Road, Glenbrook
Drawn By	TT	F.O.S Filter		Company	Lander Geotechnical Consultants Limited
Date	10/09/2021	Scale	1:750	*File Name*	J01798_210805_XSAA.slmd