



Onekawa Aquatic Centre -
Geotechnical Assessment

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Table of contents

1	Introduction	2
2	Project Background	3
2.1	Site Description	3
2.2	Proposed Development	3
2.3	Desktop Review	3
3	Site Investigations	4
3.1	Historical Investigations	4
3.2	Current Investigations (2020/21)	5
3.2.1	Hand Augered Boreholes	5
3.2.2	Machine Boreholes	6
3.2.3	Cone Penetration Tests	6
3.2.4	Test Pits	6
3.3	Groundwater Monitoring	7
3.3.1	Piezometer Details	7
3.3.2	Groundwater Levels at the time of borehole drilling	7
3.4	Laboratory Testing	7
3.4.1	Geotechnical Testing	7
4	Subsurface Conditions	9
4.1	Published Geology	9
4.2	Geological Units	9
4.2.1	General	9
4.2.2	Topsoil	10
4.2.3	Fill	10
4.2.4	Upper soft SILT with thin sand lenses	11
4.2.5	Silty SAND	11
4.2.6	Lower firm SILT	11
4.2.7	Medium dense SAND with silt lenses	11
4.2.8	Thin GRAVEL layer	11
4.2.9	Medium dense SAND with silt lenses	12
5	Geotechnical Considerations	12
5.1	Seismic Design Criteria	12
5.2	Liquefaction	13
5.2.1	Liquefaction Susceptibility and Triggering	13
5.2.2	Liquefaction Potential	14
5.2.3	Consequences of Liquefaction	15
5.3	Consolidation settlement beneath the proposed aquatic centre structure	17
5.4	Ground Improvements and Earthworks Considerations	18
5.4.1	Reinforced Aggregate Piers™/Grouted Impact Piers™ (RAP/GIP)	20
5.4.2	Deep Soil Mixing Columns (DSM)	20
5.4.3	Full Displacement Piles (FDP)	20
5.4.4	Preloading	21
5.4.5	In-situ Concrete Mixing	21
5.4.6	Ground Improvements Summary	21
5.4.7	General Earthwork Recommendations	21
6	Preliminary Building Foundation Assessment	23
6.1.1	Shallow Foundations	23
6.1.2	Pile Foundations	23

6.2	Geotechnical Design Parameters	23
6.3	Groundwater and Construction Risks	24
6.4	Pavements	24
6.5	Other Development Considerations	25
6.5.1	Buried Services and pipe bridging	25
7	Recommendations and Further Work	26
8	Conclusions and Recommendations	27
9	Applicability	29
Appendix A :	Figures	
Appendix B :	Field Investigations	
Appendix C :	Laboratory Test Results	
Appendix D :	Liquefaction Analysis	
Appendix E :	Foundation Optioneering Plan	

Executive summary

Tonkin & Taylor Ltd (T+T) was engaged by the Napier City Council (NCC) to conduct a geotechnical and contaminated land assessment at the Onekawa Aquatic Centre, Napier. The aim was to assess four different locations around the site for potential redevelopment of the aquatic centre, possible relocation of netball courts and a location for an extension to the existing gym complex.

Conclusions and recommendations are presented in Section 8 of this report. The table below summarises the key findings. It is important that the information presented be read in conjunction with the relevant detail included in the main body of the report.

Consideration	Outcome
Site geological and environmental setting	<ul style="list-style-type: none"> The site is reclaimed land of generally flat topography. Geological conditions typically comprise fill, silt, sand, and gravel. Groundwater levels ranges from 1 to 3 m begl. <p>[refer Section 1 to 4]</p>
Presence of non-engineered fill	<ul style="list-style-type: none"> Significant filling has been undertaken in areas across the site. The fill encountered across the site is quite variable in nature and ranges in depth from less than 0.6 to 3 m depth (Refer to Figure 5 in Appendix A). Where new structures are proposed, this fill will need to be removed and replaced with suitable materials or removed and reengineered to an appropriate specification. <p>[refer Section 4]</p>
Proposed building locations	<ul style="list-style-type: none"> The general geotechnical issues at each of the proposed building locations are summarised in Table 8.1 of this report. <p>[refer Section 8]</p>
Building foundation/ground improvement options	<ul style="list-style-type: none"> Refer to the optioneering table in Appendix E for foundation/ground improvement options and recommendations for the various building locations around the site.
Seismic issues / Liquefaction	<ul style="list-style-type: none"> The site geology includes sand layers that may be susceptible to liquefaction. The site is considered Class D-Deep Soil in terms of NZS 1170.5. Our ground investigations have shown that layers of sands and silts between 1 and 2.5 m and layers of silty sand between 4 and 10 m are potentially susceptible to liquefaction. Our liquefaction analyses indicate that liquefaction is generally not expected under SLS conditions (1 in 25-year return period). Minor to moderate levels of liquefaction is expected from earthquakes with return periods of 1 in 100 years or greater. A 'non-liquefiable crust' of about 1.0 m is present across the site. Liquefaction risk should be reassessed following confirmation of cut/fill levels. <p>[refer Section 5.2]</p>
Consolidation Settlement	<ul style="list-style-type: none"> The site comprises uncontrolled fill and layers of soft silt. Preliminary consolidation settlements have been assessed based on the CPT data and assumed building loadings. Up to 200 mm of consolidation settlement could occur beneath the proposed buildings, in addition to possible differential settlements. <p>[refer Section 5.3 and 6]</p>
Other development considerations	<ul style="list-style-type: none"> Underground services are present at the site. Allowance for this needs to be made during the design and construction phase of this project. <p>[refer Section 6.5]</p>
Contaminated land	<ul style="list-style-type: none"> T+T has also carried out a contaminated land assessment for this site. Our findings will be issued in a separate report.

1 Introduction

Tonkin & Taylor Ltd (T+T) was engaged by Napier City Council (NCC) to conduct a geotechnical and contaminated land assessment at the Onekawa Aquatic Centre, Napier. The purpose of the assessments was to assess the suitability of four different locations around the site for a potential redevelopment of the aquatic centre. Also considered in our assessment was one location for relocation of the Netballs Courts associated with Option 1 and a location for an extension to the existing gym complex. We understand the outcomes from this report will be used to support preliminary master planning and feasibility assessments of any potential redevelopment or extension works.

Geotechnical services were provided in accordance with our proposal dated 29 October 2020¹ and the variation dated 24 November 2020² and included the following scope of work:

- Review historical investigations and reporting undertaken at the site.
- Undertake geotechnical investigations (supervised by a geotechnical engineering from T+T and logged to NZGS Standards) comprising:
 - Drilling of 8 No. machine boreholes to a maximum depth of approximately 20 m.
 - Establishment of standpipe piezometers in two boreholes.
 - Pushing of 20 No. Cone Penetrometer Tests (CPTs) across the site; and
 - Digging of 22 No. test pits across the site to a maximum depth of about 3 m.
- Develop a ground model based on available published information and the results of the proposed geotechnical investigations; and
- Preparation of this report which will provide the following information:
 - A desktop review and site history.
 - A summary of site geology and subsurface conditions.
 - Groundwater conditions.
 - Results of a liquefaction assessment.
 - Consolidation settlement risks.
 - Ground improvement options.
 - Foundation options and design parameters.
 - Geotechnical design parameters for the swimming pool; and
 - Geotechnical design subgrade California bearing ratio (CBR) for pavement design.

The information will be suitable to develop structural foundation options as well as earthworks plans for planning purposes. Further analyses (outside the scope of this proposal) will likely be required to develop the foundation design and support a Building Consent application. Recommendations for this work will be outlined in this report.

¹ Tonkin & Taylor Ltd (29 October 2020), Offer of Geotechnical and Contamination Assessment – Revision 3. *Onekawa Aquatic Centre – Possible Redevelopment*. Job Ref: 1009171.

² Tonkin & Taylor Ltd (24 November 2020), Variation Order 1. *Onekawa Aquatic Centre – Geotechnical and Contaminated Land*. Job Ref: 1009171.

2 Project Background

2.1 Site Description

The locations investigated on Figure 1 in Appendix A are within the 8.6-hectare Onekawa Park complex, which is bounded by residential properties in the north, east, and south and Maadi Road to the west.

Located in the centre portion of the Onekawa Park is the existing single level Onekawa Aquatic Centre. At the time of writing this report, this facility remains operating to the public for recreational use and swimming lessons. Scattered around this facility, and within the Onekawa Park are various other ancillary buildings, two sets of outdoor sports courts, an outdoor swimming and play area, and the hydro slides. The buildings include the Plunket Community Hub, the Omni Gymnastics Centre, the Onekawa Kindergarten, and tennis clubhouse and courts.

The site is relatively level at an elevation of about RL 12 to 12.5 m. However, in the southern, south eastern, and south western portions of the site, there are a series of grass lined 1 to 1.5 m landscaping mounds and bunds.

2.2 Proposed Development

NCC are currently assessing the suitability of four potential options to redevelop the current aquatic centre (Options one through to four on Figure 1 in Appendix A), relocated netball courts and an extension to the existing gym complex (Option six on Figure 1 in Appendix A). The options proposed by NCC have been summarised below and are as follows:

- Option 1: New aquatic centre and relocation of netball courts.
- Option 2: Redevelopment of part of the existing aquatic centre facility.
- Option 3: Demolition of minor structures for development of new aquatic centre in a similar location.
- Option 4: New aquatic centre (south-western corner).
- Relocation of netball courts associated with Option 1 development; and
- Extension to the Omni Gymnasium Centre.

2.3 Desktop Review

Prior to the 1931 Hawke's Bay Earthquake, the land encompassing Onekawa Park and the wider Onekawa area comprised a shallow lagoon and tidal mudflats zone. During the 1931 earthquake, the land was raised by about 2 m (and become reclaimed grazing land). From conversations with the NCC, we understand following the 1931 earthquake, the site was used as a landfill site for various demolition debris and other refuse.

In 1997 T+T and 2012 Pattle Delamore Partners (PDP) completed site investigations at the site. The report published by PDP³ documents that from about 1932 to the 1950s municipal rubbish was placed at and around the site. The landfilling was split into two categories, one clearly uncontrolled and the other less clearly uncontrolled. Based on the site history (storage of demolition debris) and the PDP investigation report, it is reasonable to infer that landfilling has occurred across the proposed development areas (See Figure 5 in Appendix A for inferred extent), including the delineation undertaken by PDP and that fill materials may potentially be encountered during earthworks.

The initial Onekawa Aquatic Centre facility was constructed in 1973. This was redeveloped in 1998 with the geotechnical investigations and reporting carried out by T+T (Elaborated on in Section 3.1).

³ Pattle Delamore Partners Ltd (June 2012). *Former Landfill, Onekawa: Residential Property Investigation*.

Recent aerial imagery from the NCC Intramaps between 1999 and 2018⁴, indicates the site has undergone relatively minor redevelopments since its initial redevelopment. One of note, is the demolition and filling of the outdoor swimming and diving pool. Figure 2.1 below highlights this change, along with other subtle changes around the site. We expect this fill material will also be encountered during earthworks.



Figure 2.1: Aerial photograph from 1999 (left) showing position of outdoor swimming and diving pool and aerial photograph from 2015 (right) showing this remove and backfilled.

3 Site Investigations

3.1 Historical Investigations

In 1996 T+T was engaged by NCC to undertake a geotechnical assessment for a 'new indoor swimming complex', and in addition to this, PDP prepared a soil investigation report in 2011 detailing the landfilling extent around the site.

Summary of T+T 1996 Investigations:

These investigations comprised 8 No. test pits to a maximum depth of 3.2 m. Shear strength readings were undertaken, where possible in the cohesive material to a depth of about 1.8 m.

The investigations identified fill refuse in several test pits to about 1.5 m and a maximum depth of about 2.7 m. The refuse was described as a mixture of sand and silt that was grey brown and moderately dense and firm to stiff. In one test pit, the refuse contained glass, china, iron, and steel. The material was otherwise generally consistent with the published geology (i.e., estuarine silts and sands).

Three disturbed samples were recovered for laboratory testing. The testing undertaken consisted of water content testing and Atterberg Limits testing⁵.

Summary of PDP 2012 investigations:

In 2012, PDP was engaged by the NCC to undertake site investigations to clarify the probable extent of the landfill, depth of clean cover, and probable risk to human health.

⁴ Napier City Council (January 2021). *Intramaps*. <http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC>

⁵ Tonkin + Taylor (January 1997). *New Indoor Swim/Leisure Complex, Onekawa Park, Napier – Geotechnical Investigation Report*. Job Ref: 82016.

The methodology of these investigations involved drilling 272 No. hand augered boreholes in different locations (including surrounding residential land) of suspected landfill and taking samples where appropriate.

The investigations were used to estimate the extent of the landfill (overlaid on Figure 5 in Appendix A). The report also found that the depth of clean cover is highly variable with no obvious spatial pattern, and that the contaminant concentrations are unlikely to exceed human health guidelines at the ground surface but can exceed guidelines at greater depths⁶.

3.2 Current Investigations (2020/21)

T+T carried out further geotechnical investigations at the project site between 23rd November and 4th of December 2020 and on the 11th of January 2021. The investigations comprised:

- 8 No. machine boreholes.
- 10 No. hand augered boreholes.
- 19 No. cone penetrometer tests (CPTs); and
- 22 No. test pits.

Investigation locations were selected by T+T based on access around the site and the presence of buried services.

The investigation locations were surveyed by handheld GPS and are presented on Figure 1 in Appendix A. Specific details on the investigations are noted below.

3.2.1 Hand Augered Boreholes

The drilling of ten hand augered boreholes was undertaken on the 25th of November 2020 and the 11th of January 2021. The works were carried out by a T+T geotechnical engineer and geologist. In situ shear strength testing was undertaken at regular intervals where possible throughout the soil horizon.

Investigation locations are presented on Figure 1 in Appendix A. Summary borehole logs are presented in Appendix B. The hand augered borehole details are presented in Table 3.1 below.

Table 3.1: Hand Augered Borehole Summary

HA ID	Location (NZTM)		Ground Surface Elevation RL (m)	Depth (m)
	Easting (m)	Northing (m)		
HA1	1934306.05	5619966.64	12.0	1.0
HA2	1934311.84	5619974.95	12.0	1.0
HA3	1934399.35	5619890.41	12.0	1.2
HA4	1934344.71	5619860.18	12.5	1.0
HA5	1934353.41	5619848.35	12.5	1.8
HA6	1934321.93	5619861.61	12.0	1.0
HA7	1934279.18	5619841.32	12.5	0.3
HA8	1934305.18	5619891.76	12.0	0.3
HA9	1934294.18	5619937.23	12.0	1.2
HA10	1934261.91	5619858.53	12.0	0.4

⁶ Pattle Delamore Partners Ltd (June 2012). *Former Landfill, Onekawa: Residential Property Investigation*.

3.2.2 Machine Boreholes

The machine boring of 8 No. vertical boreholes was undertaken over the period between 23 November and 1 December 2020. The works were carried out using a sonic drilling rig, supplied, and operated by Geotech Drilling. The boreholes were advanced from ground level using a hydro-vacuum technique to a depth of 1.5 m for service clearance, then drilling was undertaken down to the end of the hole.

In-situ Standard Penetration Testing (SPT) was carried out at regular (1.5 m) intervals through the soil horizon. All drilling works were completed under the supervision of a T+T geotechnical engineer. The recovered drill core was photographed and logged to NZGS 'Field Description of Soil and Rock' guidelines.

The boreholes were drilled at key locations across the project site; the investigation locations are presented on Figure 1 in Appendix A. Summary borehole logs and core photographs are presented in Appendix B. Summary borehole details are presented in Table 3.2 below.

Table 3.2: Machine Borehole Summary

BH ID	Location (NZTM)		Ground Surface Elevation RL (m)	Depth (m)
	Easting (m)	Northing (m)		
BH01	1934296.78	5620009.42	12.0	19.95
BH02	1934314.54	5619921.89	12.0	19.95
BH03	1934331.39	5619813.26	12.0	15.45
BH04	1934264.36	5619857.32	12.0	12.45
BH05	1934228.94	5619749.61	12.0	19.95
BH06	1934292.36	5619729.63	12.0	19.95
BH07	1934348.88	5619693.59	12.5	16.95
BH08	1934377.03	5619966.64	12.0	15.45

3.2.3 Cone Penetration Tests

The pushing of 19 No. Cone Penetrometer Tests (CPTs) was undertaken by Geotech Drilling between 25th November and 1st December 2020. In all cases, the CPTs were taken to either a target depth of 20 m or 'refusal' which occurred due to the cone terminating on or within a hard, impenetrable strata such as a dense sand layer or a gravel layer.

The CPT locations are presented on Figure 1 in Appendix A. CPT logs are presented in Appendix B.

3.2.4 Test Pits

The excavation of 22 No. test pits was undertaken by Burkett Earthmovers between 25th November and 30th November 2020, under the full-time supervision of a geotechnical engineer from T+T. The test pits were taken to either a target depth of 3.0 mbgl or to collapse of the test walls pit due to groundwater inflow. The ability to excavate the overburden soils was noted by the geotechnical engineer and the test pits were logged to NZGS 'Field Description of Soil and Rock' guidelines.

The test pit locations are presented on Figure 1 in Appendix A. Summary test pit logs and photographs are presented in Appendix B.

3.3 Groundwater Monitoring

3.3.1 Piezometer Details

Slotted pipe groundwater piezometers were installed in 2 No. of the machine boreholes to monitor groundwater levels. Summary details of the piezometer installations are presented in Table 3.3 below.

Table 3.3: Piezometer details summary

Borehole ID	Collar RL (m)	Installation depth (m bgl)	Type	Geological Unit over screened depth
BH01	12.0	2 to 5.5	Flush Toby - Slotted Pipe	Holocene Estuarine Soils
BH05	12.5	2 to 5.5	Standpipe - Slotted Pipe	Holocene Estuarine Soils

3.3.2 Groundwater Levels at the time of borehole drilling

Approximately 30 minutes after completion of each of the boreholes, groundwater levels were recorded using an electronic dip meter. The recorded groundwater levels are presented below in Table 3.4 below.

Table 3.4: Groundwater levels summary

Borehole ID	Depth below ground level (m)
BH01	1.0
BH02	1.2
BH03	1.6
BH04	NA
BH05	2.2
BH06	3.0
BH07	2.1
BH08	2.1

3.4 Laboratory Testing

3.4.1 Geotechnical Testing

Selected samples retrieved during the geotechnical investigations have been tested by T+T subsidiary company Geotechnics Ltd (IANZ accredited).

The purpose of these laboratory tests was to verify our classification of the subsoils at the site, assess the likely consolidation settlement in the upper soft silt layer (Unit 2), and assess the liquefaction potential in the medium dense sandy layer (Unit 3) at the site (See Figure 2, 3, and 4 in Appendix A for the depths of these layers). This is critical to the new aquatic centre's performance.

The following laboratory testing was carried out:

- 5 No. Particle Size Distribution (PSD) tests.
- 6 No. Atterberg Limit tests.
- 6 Water Content tests; and

- 3 No. One – Dimensional Consolidation tests.

Summary details of the one-dimensional consolidation and Atterberg Limit testing is presented in Table 3.5 and Table 3.6 below. Summary details of the Particle Size Distribution testing is presented in Section 5.2.1.

Raw results from the laboratory testing are presented in Appendix C.

Table 3.5: 1-D Consolidation testing summary

Borehole	Sample Depth (m)	Typical Range of Coefficient of consolidation (C_v) ($m^2/year$)	Typical Range of Coefficient of volume compressibility - m_v (m^2/MN)
BH01	10.8 – 10.9	16.0 – 34.0	0.1 – 0.4
BH04	3.4 – 3.5	2.3 – 3.8	0.7 – 1.7
BH05	4.8 – 4.9	1.4 – 3.1	1.1 – 2.1

Table 3.6: Atterberg Limit testing and Moisture Content testing summary.

Borehole	Sample Depth (m)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Moisture Content (%)
BH01	3.0	44	24	20	40
BH03	3.3	61	28	33	61
BH03	9.0	NA	NA	NA	29
BH05	9.0	NA	NA	NA	29
BH06	3.0	55	24	31	46
BH07	9.0	31	NA	NA	27

Note: NA = not attainable (i.e., non-plastic material behaviour)

4 Subsurface Conditions

4.1 Published Geology

The published geological map of the area⁷ indicates that the site is underlain by Holocene estuary deposits. The location of the site in the context of the regional geology is presented on Figure 4.1 below. The geological units are summarised in Section 4.2.

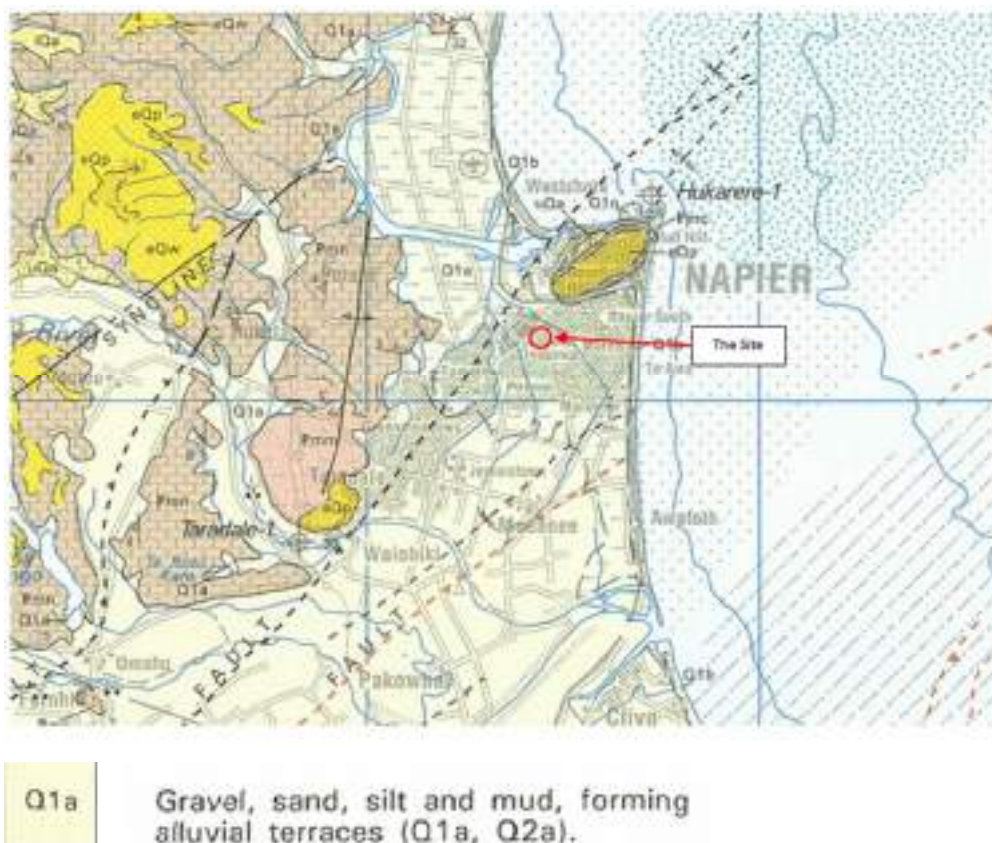


Figure 4.1: Published geology of the Napier area (Lee et al, 2011)

4.2 Geological Units

4.2.1 General

The ground conditions are generally consistent with the published geology of the area and are illustrated on the three geological cross sections (Figure 2 to 4 in Appendix A).

A brief description of each material layer encountered across the site, is shown on the generalised soil profile on Figure 4.2 below and discussed in Section 4.2.2 to 4.2.9. Refer to the following sections and geological cross sections for more detail on the soil profile.

⁷ Lee, J.M.; Bland, K.J.; Townsend, D.B.; Kamp, P.J.J. (compilers) 2011: Geology of the Hawke's Bay area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 8. 1 sheet + 93 p. Lower Hutt, New Zealand. GNS Science.

Unit 1	FILL LAYER
Unit 2	THIN SAND LAYER
Unit 2 Continued	SILT LAYER
Unit 3	SILTY SAND LAYER
Unit 4	SILT LAYER
Unit 5	SAND LAYER WITH SILT LENSES
Unit 6	THIN GRAVEL LAYER
Unit 5 Continued	SAND LAYER WITH SILT LENSES

Figure 4.2: Generalised soil profile of the site (not to scale).

Table 4.1: Summary of subsurface conditions

Unit	Depth to top of unit (m)	Typical thickness (m)	Typical SPT 'N' value	Typical CPT qc range (MPa)
1	0	0.3 – 3	2 – 13	2 – 8
2	0 – 3	2 – 6	0 – 2	0.1 – 0.3
3	4 – 7.5	1.5 – 5.5	3 – 23	3 – 7
4	7.8 – 11.6	2.5 – 4.5	2 – 12	0.3 – 0.6
5	11.5 – 14	2.8 – 7+	2 – 25	0.3 – 2
6	17 – 19	0.5 – 1.5	22 – 25	10 – Refusal

Note* – The gravel layer is unlikely to be continuous over the whole site. It was not encountered in all the boreholes.

4.2.2 Topsoil

A surficial layer of topsoil between 0.15 and 0.3 m thick was encountered only in the western portion of the site. It was typically organic material generally consisting of silt with some rootlets, silt with minor sand or sandy silt.

4.2.3 Fill

Fill was encountered to varying degrees in most investigations across the site. Some of this fill appears to be relatively consistent and placed in a somewhat controlled manner. Elsewhere, particularly the southern section of the site, the fill materials were highly variable in strength and nature. Figure 5 in Appendix A presents our inferred spatial extent of this material, based on the investigations complete at the site. It also presents the extent of landfilling estimated by the PDP 2012 report for comparison.

In this figure, the fill is categorised into three categories:

- Reworked cohesive fill with minor refuse and organics (green area):
This material is typically described in the logs as a silt with some sand, or a mix of sandy silt and sand with a trace of gravel. Shear strength readings ranging from 25 to 127 kPa were recorded and these materials were typically between 0.6 to 1.0 m in thickness.

- Variable Lenses of uncontrolled fill and natural ground (orange area):
This material is typically described in the logs as a silt with some sand with a trace of gravel, or as a silty fine sand. Brick inclusions were noted in one of the test pits. Shear strength readings in this material ranged from 110 kPa to 130 kPa. This material is inferred to extend between 0.3 m and greater than 1 m depth in limited locations.
- Significant fill presence including refuse, steel, and rubble (purple area):
This material is typically described in the logs as a silty fine sand, sandy silt, or a silt with some gravel and a trace rootlets. Shear strength readings ranged from 60 to 190 kPa. This material is inferred to extend between 0.8 and 3 m depth.

Test pits 16 and 17 contained significant amounts of brick, glass, ceramics, large, rusted metal sheeting, and ash. They also encountered a significant presence of uncontrolled groundwater inflow. In test pit 17, gas bubbles were observed bubbling to the surface of the ponded groundwater. It is also worth noting, when drilling in the outside pool area (where the outdoor swimming and diving pool used to be located), the drilling rig was unable to penetrate deeper than 3 m depth and was coring into hard concrete. We believe this is at about the right depth to be the remnants of the old swimming/diving pool.

4.2.4 Upper soft SILT with thin sand lenses

Underlying the layers of fill and topsoil is an estuarine soft silt layer (typically described as bluish grey) containing thin sand lenses. Noting, typically a thin sand layer typically no more than 0.6 m thick mantled the soft silts. Cone tip resistance, q_c , for the silt layers generally ranges between 0.1 and 0.4 MPa, typically about 0.2 MPa indicating that the material is very soft to soft. Vane shear strengths were typically less than 30 kPa in this unit. SPT 'N-values' range between 0 and 1, indicating that the sand, where present is generally very loose.

4.2.5 Silty SAND

A fairly uniform layer of silty sand (typically described as grey to dark grey) with a trace organics (crushed shells and whole shells) underlies the upper soft silt layer. Cone tip resistance, q_c ranges between 0.4 MPa and 20 MPa but typically about 4 to 6 MPa, indicating the material is loose to medium dense. SPT 'N-values' range between 1 and 23, typically about 5 to 12.

4.2.6 Lower firm SILT

A layer of firm silt (typically described as grey to dark grey) underlies the silty sand layer. Cone tip resistance, q_c ranges between 0.5 and 4 MPa, typically about 2 MPa, indicating the material is firm. SPT 'N-values' range between 1 and 23, but typically about 5 to 9 blows.

4.2.7 Medium dense SAND with silt lenses

A layer of medium dense sand (typically described as grey to dark grey) with some silt lenses and a trace organics (crushed shells and whole shells) underlies the firm silt layer. Cone tip resistance, q_c ranges between 2 MPa and 20 MPa, typically about 6 to 8 MPa indicating the material is medium dense. SPT 'N-values' range between 1 and 23, typically about 5 to 9 indicating the silt material is firm.

4.2.8 Thin GRAVEL layer

All the boreholes advanced to 19.95 m identified a thin layer of gravel (typically described as grey to dark grey) underlying the medium dense sand with silt lenses. However, based on CPT data, we have inferred that it appears to be in isolated pockets of the site. Cone tip resistance, q_c values in this layer were refusing at about 20 MPa, indicating this material is dense to very dense. SPT 'N-values' range between 22 and 37.

4.2.9 Medium dense SAND with silt lenses

Below the thin gravel layer (where it was identified), more of the medium dense sand with silt lenses was encountered. The bottom of this layer was not identified.

5 Geotechnical Considerations

The geotechnical recommendations and opinions in this report are based on investigations undertaken at the point locations on Figure 1 in Appendix A. The nature and continuity of the subsoil conditions away from site investigations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

5.1 Seismic Design Criteria

Based on the results of our geotechnical investigations, the published geology, and our experience in the area, we consider that the site should be classified as a Class D – Deep or soft soil site in accordance with NZS1170.5.

We assume the site (and structures – proposed aquatic centre and gym extension) will have a design life of 50 years and are Importance Level 3. This should be confirmed by the structural engineer.

Based on these assumptions, the design events that will need to be assessed as per NZS1170:2004 are as follows:

- SLS (IL3, 25-year return period) – a building should only suffer readily repairable damage that does not affect the continued use of the building. Such damage should be able to be reinstated immediately or in conjunction with normal building maintenance activities.
- ILS (IL3, 100-year return period) – An intermediate event where the building may suffer tolerable damage i.e., used for its intended purpose but with reduced amenity.
- ULS (IL3, 1000-year return period) – to avoid collapse of the structural system and wall movement should not be so excessive as to cause loss of structural integrity or prevent means of safe egress.

Peak Ground Accelerations (PGA) and effective magnitudes have been assessed using PGA and Mw presented in GNS report, dated 2017⁸. Accordingly, the PGA and Mw presented in the GNS report are illustrated in Figure 5.1 below, alongside the design peak accelerations used for the liquefaction assessment presented in Table 5.1.

Table 5.1 The average magnitude of an earthquake contributing to PGA at different return periods.					
Hawke's Bay Sites unweighted Site Class D Average Magnitude Contributions to PGA					
Site Number	Return Period (years)				
	25	100	500	1000	2500
Napier/Hastings	6.2	6.3	6.5	6.6	6.7

Table 5.2 PGA acceleration values from the NSHM for the Heretaunga Plains.					
Hawke's Bay Sites unweighted Site Class D PGA values (g)					
Site	Return Period (years)				
	25	100	500	1000	2500
Napier/Hastings	0.14	0.25	0.42	0.51	0.64

Figure 5.1: Tables 5.1 and 5.2 from GNS report dated 2017.

⁸ Rosser BJ, Dellow GD, compilers. 2017. Assessment of liquefaction risk in the Hawke's Bay Volume 1: The liquefaction hazard model. Lower Hutt (NZ): GNS Science. 108 p. (GNS Science consultancy report; 2015/186).

Table 5.1: Design PGA and magnitude pairings for structures with a design life of 50 years

Load case	Return period	PGA	Earthquake magnitude
Serviceability limit state (SLS, IL3)	25 years	0.14 g	6.2
Intermediate limit state (ILS, IL3)	100 years	0.25 g	6.3
Ultimate limit state (ULS, IL3)	1000 years	0.51 g	6.6

5.2 Liquefaction

Liquefaction occurs when loose, saturated, cohesionless soils are subjected to strong shaking. The strong shaking cause densification, generation of excess pore pressures and the soil undergo partial to near-complete loss of shear strength. Liquefaction, and associated loss of shear strength, can result in bearing capacity yield or failure, and/or horizontal movement of the soil mass (lateral spreading). Release of the liquefied soil to the surface can cause sand boils and settlement.

The occurrence of liquefaction is dependent on several factors including: the intensity and duration of ground shaking, soil density, particle size distribution, and elevation of the groundwater table.

5.2.1 Liquefaction Susceptibility and Triggering

Liquefaction only occurs in some soils. Liquefaction susceptible soils are typically saturated and non-cohesive.

- Sands and low plasticity non-plastic silts are most susceptible to liquefaction⁹;
- Gravels can liquefy if they have a low permeability or are confined by less permeable layers.
- Some fine-grained soils may be susceptible, which are typically low plasticity and high-water content^{10,11}. Bray and Sancio (2006) indicated that soils with plasticity index (PI) greater than 12 are unlikely to liquefy (as they behave in a cohesive manner) under seismic loading; and
- Younger (Holocene) deposits (present in Napier) are likely to be more susceptible to liquefaction than older (Pleistocene) deposits of similar composition, i.e., the age of the deposits is important.

Atterberg Limit testing was used in combination with the Bray and Sancio (2006) method¹⁰ to confirm that a CPT soil classification index (I_c) liquefaction cut-off value of 2.6 is appropriate for the soils at this site.

A further check was carried out using the Boulanger and Idriss (2006)¹¹ method. All test results plotted above the A-line, again indicating that the CPT based liquefaction assessment was appropriately calculating the susceptible and non-susceptible layers. This information has been summarised in Table 5.2 below.

⁹ Bray, K et al, 2014, "Liquefaction effects on buildings in Central Business District of Christchurch", Earthquake Spectra, 30 (1), 85-109.

¹⁰ Bray J.D. and Sancio R.B., 2006, "Assessment of the liquefaction susceptibility of fine-graded soils", Journal of Geotechnical and Geoenvironmental Engineering, 132 (9), 1165–1177.

¹¹ Boulanger R.W. and Idriss I.M., 2006, "Liquefaction Susceptibility Criteria for Silts and Clays", Journal of Geotechnical and Geoenvironmental Engineering, 132 (11), 1412–1426.

Table 5.2: Liquefaction susceptibility check using the Bray and Sancio method

Atterberg Limit testing	Susceptibility to Liquefaction
BH01 – 3 m	Not Susceptible (Same as CPT assessment)
BH03 – 3.35 m	Not Susceptible (Same as CPT assessment)
BH06 – 3.0 m	Not Susceptible (Same as CPT assessment)

Similar to the Atterberg Limit testing, for different soil layers, PSD testing and the Tsuchida (1970) method was used to determine the susceptibility of layers and is presented on Figure 5.2 below. This identified most of the tested samples to lie within or just outside the lower bound range for “most liquefiable soils”. This means the soil at tested depths is likely susceptible to liquefaction and the grading curves are generally consistent with the liquefaction analysis outputs.

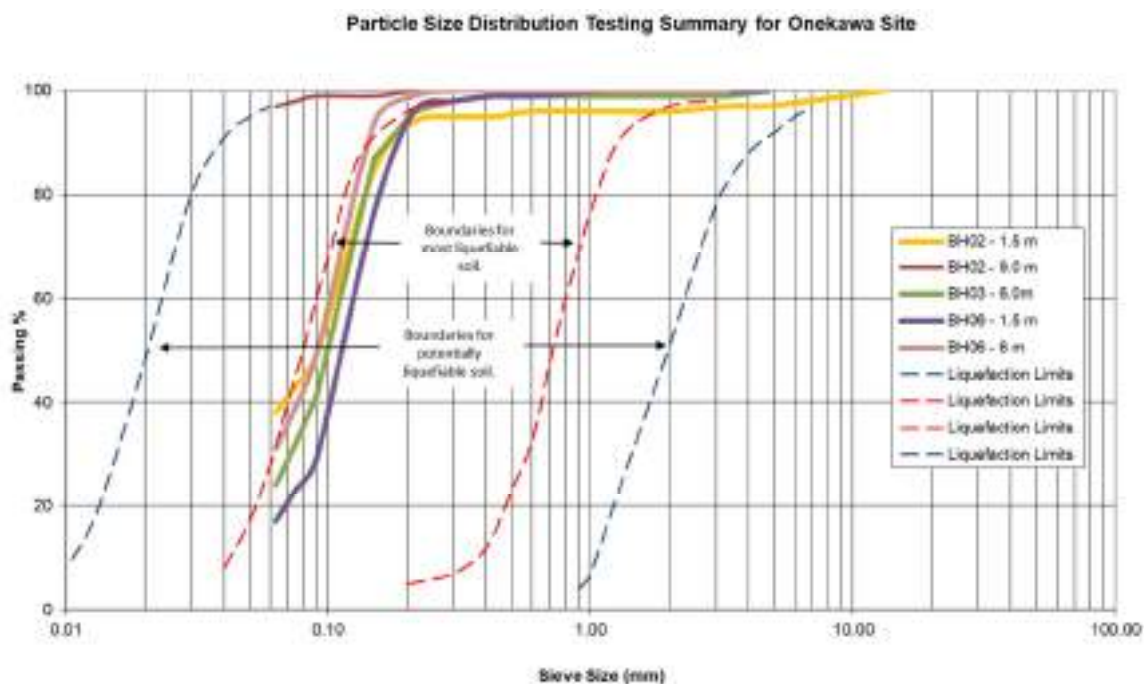


Figure 5.2: PSD testing summary for Onekawa Site.

5.2.2 Liquefaction Potential

The liquefaction potential of the subject site subsoils was assessed using the CPT data collected during the geotechnical investigations and the Boulanger and Idriss (2014) triggering method.

The Boulanger and Idriss (2014) triggering method is based on an empirical relationship with the CPT “qc” and fines content. The fines content of the soil has been inferred using I_c determined from the CPT. The CPT data has been inverse filtered using the procedure proposed by Boulanger and DeJong (2018)¹² for a standard 10 cm² cone to correct for thin layer smoothing effects.

The results and output from the liquefaction assessment are presented in Appendix D. A summary of the results is presented and summarised in Table 5.3 below.

¹² Boulanger, R. W., & DeJong, J. T. (June 2018). Inverse filtering procedure to correct cone penetration data for thin-layer and transition effects. In Cone Penetration Testing 2018: Proceedings of the 4th International Symposium on Cone Penetration Testing (CPT'18), 21-22 June, 2018, Delft, The Netherlands (p. 25). CRC Press.

Table 5.3: Summary of site wide liquefaction risk

SLS, 1/25-year return period	Liquefaction is generally not expected.
ILS, 1/100-year return period	Thin bands of liquefaction (<1 m thick) are generally expected to occur in the sands and silts between 1.0 m and 2.5 m and the silty sand between 4.0 m and 10.0 m across the site. The soils below 10.0 m may be susceptible to liquefaction, however the thick crust will limit surface expression of these effects.
ULS, 1/1000-year return period	Thicker bands showing triggering of liquefaction (<2.0 m thick) are generally expected to occur in the sands and silts between 1.0 m and 2.5 m and the silty sand between 4.0 m and 10.0 m across the site.

The likely consequences from the liquefaction analyses are outlined in Section 5.2.3 below.

5.2.3 Consequences of Liquefaction

5.2.3.1 One dimensional vertical reconsolidation settlement

Liquefaction induced, one dimensional vertical reconsolidation free field settlement has been estimated using the methodology developed by Zhang, Robertson and Brachman and is expected to range between 10 – 170 mm under SLS (1/25) and range between about 30 – 200 mm under ILS (1/100) and about 60 – 200 mm under ULS (1/1000).

It should be noted that these “free-field” settlement estimates do not take account of the influence of structures. Structures may also experience differential settlement if near surface material is lost through sand ejection. This can cause a loss of support or relative movement to part of a building foundation system, which can result in induced stress and associated building and/or foundation damage.

Further analyses should be undertaken to assess the building specific liquefaction induced settlements once layouts/development plans are confirmed.

5.2.3.2 Liquefaction severity number

To give a quantitative indication of the effects of liquefaction that may be observed at the ground surface, the liquefaction severity number (*LSN*) has been utilised. The LSN parameter was developed following the Canterbury Earthquake Sequence (CES) and is based on observations of damage caused to residential land and foundations as a result of liquefaction. The formula used to calculate liquefaction severity number is presented below.

$$LSN = \int \frac{\varepsilon_v}{z} dz$$

Where ε_v is the calculated volumetric densification strain using Idriss & Boulanger (2014) and z is the depth to the layer of interest.

As the value of the LSN increases, so does the risk of severe effects of liquefaction on residential land and buildings. Table 5.4 summarises the correlation of LSN with damage based on observations from the CES.

Table 5.4: Correlation of LSN with damage based on observations from the CES

LSN	Effects and expression of liquefaction on structures and land
0 - 5	Negligible to Minor: No major effects expected
5 – 20	Minor: Generally consistent with acceptable performance under SLS conditions (i.e., little settlement or permanent building damage). Ejection of material can be expected at the ground surface, but likely to be localised in nature.
20 – 40	Moderate: Liquefaction evidence possible. Generally consistent with acceptable performance under ULS conditions (i.e., settlement).
> 40	Severe: High risk of substantial damage to the site and/or building if on shallow foundations.

LSN values calculated using the results from the CPTs range between 1 and 7 for SLS1, 3 and 13 for ILS and 6 and 24 for ULS, indicating there is a minor to moderate risk of liquefaction induced damage under the higher design earthquakes.

Figures 6 and 7 in Appendix A show the range of LSN values and liquefaction induced settlements (under ULS) overlaid on the site plan. The conditions between each CPT have been inferred and this information was used to create a heat map showing zones of higher or lower LSN/settlement values. Generally, there is no observed “step change” in behaviour, i.e., one side of the site is not significantly worse than the other however there are noticeably higher liquefaction induced settlements predicted in the southern end of the site, and correspondingly slightly lower settlements in the north of the site.

Table 5.5 summarises the average LSN and the average one-dimensional reconsolidation settlements for the design level earthquakes.

Table 5.5: Range of (and average) settlement and liquefaction severity values on site wide basis

Seismic Conditions	SLS1	ILS (1/100)	ULS (1/1000)
Liquefaction induced settlement (mm)	10 – 170 (50)	30 – 200 (110)	60 - 200 (130)
LSN	1 – 7 (6)	3 – 13 (15)	6 – 24 (18)

Note* – the average settlement and LSN values in the table above are denoted in brackets.

Considering the nature of the site and the potential consequences of liquefaction on the proposed buildings, the following will need to be managed during the design process.

- One-dimensional settlement (i.e., reconsolidation settlement) and loss of support for foundation elements; and
- Differential settlements due to soil reconsolidation and soil ejecta effects on shallow foundations and pool slab areas.

Discussion and results of the liquefaction assessment is presented in Section 5.2.3.3 below.

5.2.3.3 Liquefaction Induced Settlement

Typically, the estimated liquefaction induced settlement under the ULS case is about 130 mm. Whilst the LSN values are variable (on average about 18), this is typically a function of thin liquefiable layers at shallow depths in the subsoil profile and the non-liquefiable upper silt unit mantling the majority of the site below the fill. The upper liquefiable sand layers (i.e., within 3 m of the ground surface), were generally variable and non-continuous.

Liquefaction ejecta may be possible where liquefaction is induced close to the ground surface (i.e., where the thin upper sands are present). This would exacerbate liquefaction induced settlements and potentially cause damaging differential settlement.

5.2.3.4 Liquefaction Hazard Summary

Overall, there is a minor to moderate liquefaction risk at the site (for all building locations) and this will need to be accounted for in the foundation design at the site.

Accordingly, we recommend the following:

- Limiting areas of cut to maintain the 'non-liquefiable crust' at the site. However, this may not be possible with the construction of the pool excavation. Noting, for some of the proposed options, the pre-existing fill will need to be stripped and replaced due to the uncontrolled material present.
- Fill placement, or construction of a reinforced raft would assist but consideration of other hazards (i.e., consolidation settlement) would need to be recognised; and
- Foundation design would need to give due consideration to liquefaction effects. (i.e., design will need to allow for strength loss and variability in liquefiable layers and account for the variability in settlement across the site).

Lateral spreading is considered a negligible risk at the site due to the lack of an exposed 'free face' (such a stream bank) within 200 m of the site.

5.3 Consolidation settlement beneath the proposed aquatic centre structure

Anecdotal evidence described by a neighbouring property owner stated that the landscape bunds in this area have settled over the last 10 years. Despite this, the existing structures (brick and steel cladding) appear to have performed reasonably well in the last 30 to 40 years with no readily observable signs of settlement damage.

A preliminary CPT-based assessment of consolidation settlement risk based on the proposed aquatic centre's dimensions (rectangular building platform of 70 m by 60 m) was undertaken using the software suite CPeT-IT.

A distributed ground bearing pressure of 10 to 30 kPa has been used to represent a typical pool complex. However, we note that the pool excavation will possibly result in net unloading of portions of the site (which could exacerbate differential settlements) and this should be considered during the design phase.

The laboratory test results presented in Table 5.6 were used to validate this CPT based assessment. The results of this CPT based assessment are presented in Table 5.7.

Table 5.6: Preliminary primary settlement parameters

Unit	Geological unit	Unit Weight (kN/m ³)	Relative depth m begl	Coefficient of Volume Compressibility m _v (m ² /MN)	Coefficient of Consolidation C _v (m ² /year)
2	Upper Soft SILT with Thin Sand Lenses	17	~0 – 6.0	1.1 – 1.2	2.3 – 3.1
3	Silty SAND	18	~3.5 – 10	-	-
4	Lower Firm SILT	18	~8.0 – 13.5	0.16	20
5	Medium Dense SAND with Silt Lenses	19	~11.0 +	-	-
6	Thin GRAVEL Layer	19	~17.5 – 18.5	-	-

Note 1: Layer 1 (Fill) has been ignored, as it is assumed that this layer will be removed/replaced with engineered material.

Note 2: Coefficient of volume compressibility and coefficient of consolidation have been derived based on laboratory testing data.

Table 5.7: Preliminary consolidation settlement estimates

Applied bearing pressure (70m x 60m area)	Estimated consolidation settlements (mm)
10 kPa	20 – 70
20 kPa	70 – 120
30 kPa	100 – 200

By far the most compressible soil layer at the site is Unit 2, the soft silt. This layer is variable in thickness (ranges from about 2 to 6 m thick) across the site and accordingly there is potential for differential settlements to occur. Differential settlement will most likely exceed 1V:500H based on the variability in thicknesses of the compressible layer.

Allowances for consolidation and differential settlement should be made in the foundation design and/or ground improvements. We anticipate that without some form of ground improvement, shallow foundations may not be suitable for new structures at the site. It may be possible to construct small, lightly loaded ancillary single level structures on reinforced raft foundations based on the observations of existing building performance. However, these would be subject to detailed design.

We recommend that further checks of total and differential settlements are undertaken once final site levels and structural loads are confirmed. The structural engineer should be satisfied that the structures can accommodate the estimated settlements and make appropriate allowances in the structural design or adopt ground improvements where necessary.

A trial pad may be of use to confirm the ground response to loading and this is discussed in further detail in the subsequent section.

5.4 Ground Improvements and Earthworks Considerations

The existing fill at the site is highly variable and presents a risk in terms of its unpredictable bearing capacity and settlement performance, and its ability to act as a “crust” to mitigate liquefaction effects within underlying soil layers. Removal of fill and installation of ground improvements will almost certainly be required to control total and differential settlements and provide suitable bearing capacity for the proposed buildings.

The following options could be considered as ground improvement solutions for the four proposed aquatic centre locations:

- Rammed Aggregate Piers™ (RAP) /Grouted Impact Piers (GIP)™;
- Deep soil mixed columns (DSM).
- Full displacement piles as a ground improvement option (FDP); or
- Preloading with shallow foundations.

Ground improvements would need to be designed to reduce the settlement risk to tolerable levels. This would need to be workshopped with the design team and the structural engineer once preliminary design plans are available.

In the case of the first three options, it may be necessary to also densify the sand layer at about 6 m depth to increase the liquefaction resistance, to rely on this unit for founding, even under an intermediate seismic event.

In addition to the ground improvements, earthworks will be required to remove or re-engineer the existing uncontrolled fill. We note, the soil profile over the four proposed aquatic centre locations is variable, with thicker fill identified at building locations two, three and four. Therefore, location one is the more favourable building option.

A schematic summarising the recommended ground improvements and earthworks for the aquatic centre is presented in Figure 5.3 below.

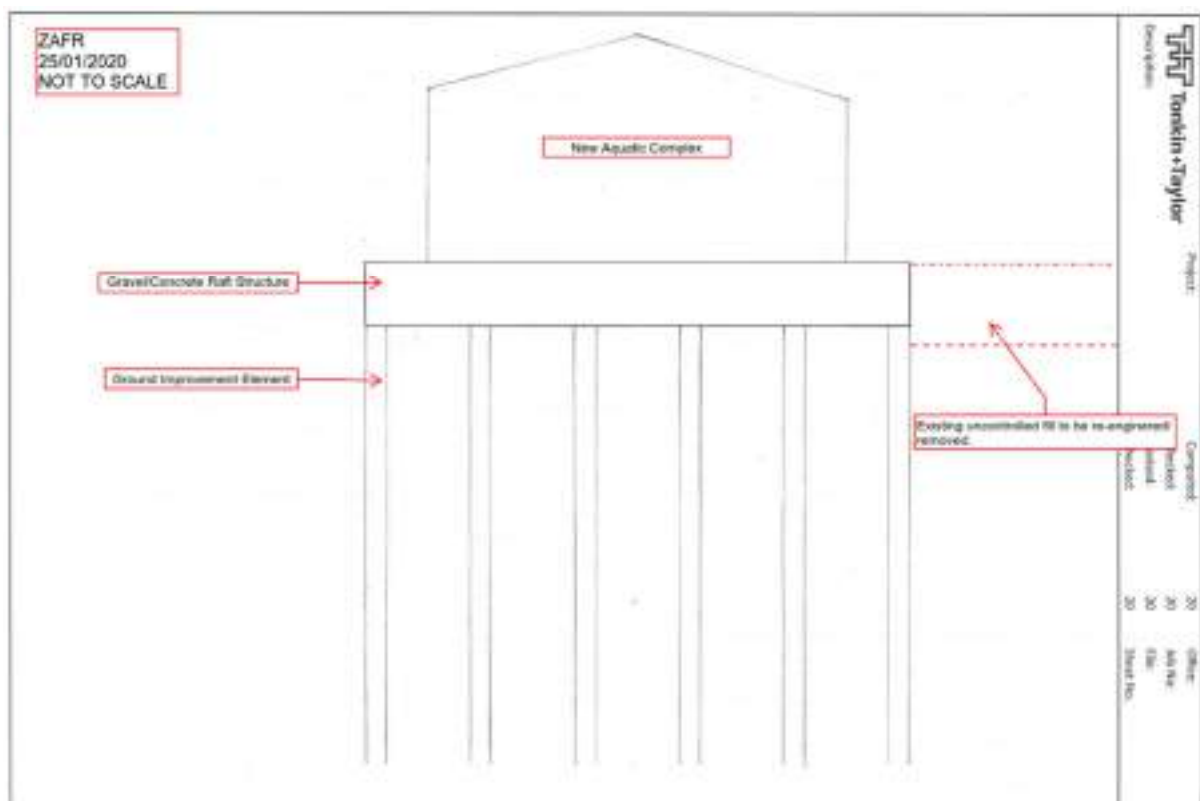


Figure 5.3: Concept schematic of the proposed ground improvements and foundation system below the aquatic centre.

For the proposed gym extension, preloading of the site could be an appropriate ground improvement solution. This is unlikely to be suitable for the proposed aquatic centre options due to the presence of significant underground services below the indicative building locations and the requirement to close of some of the current aquatic centre facilities while the preloading occurs (up

to approximately 2 years without an operating facility). Therefore, preloading may have limited application at the site.

Refer to Appendix E for a detailed summary optioneering table presenting images and discussing the pros/cons of each ground improvement solution.

5.4.1 Reinforced Aggregate Piers™/Grouted Impact Piers™ (RAP/GIP)

RAPs and GIPs differ primarily in the installation methodology and equipment used during construction. RAPs or GIPs are constructed by specialist contractors who:

- Push a mandrel or vibroflot attachment into the ground.
- Feed stone (and in addition grout in the case of GIPs) down the mandrel/vibroflot using an excavator or tele handler; and
- Compact the stone (and grout in the case of GIPs) using a ramming and vibrating action to form a stiff, high-density, vertical pier within the ground.

It is likely that the grid of RAPs/GIPs would be about 6 to 8 m long, at about 2 m spacing (in plan), extending between 1 to 2 m outside the plan area of the proposed buildings. However, this would need be confirmed following further analyses.

5.4.2 Deep Soil Mixing Columns (DSM)

During construction DSM columns are constructed by a specialist contractor who:

- Push a cutting tool into the ground (i.e., auger flights/mixing blades); and
- Inject stabilising binder (i.e., cement or other binders) through hollow mixing shaft in the cutting tool which chemically reacts with the in-situ soils to provide stronger ground.

Deep soil mixing for liquefaction mitigation generally uses a lattice or wall layout. They have a large resistance against horizontal forces. The improved ground restricts shear deformation of the unimproved soil inside reducing potential for liquefaction. Since the DSM improvement can prevent transmission of excess pore water pressure, the area required to be improved outside of the construction is relatively small compared to the densification method.

It is likely the DSM columns would be about 6 to 8 m long with a typical cell spacing of 5 to 6 m, extending between 1 to 2 m outside the plan area of the proposed buildings. The expected performance of the cell spacing layout has been assessed based on currently available literature including Bradley et al. (2013) and Kitazume and Takahashi (2010).

5.4.3 Full Displacement Piles (FDP)

FDP are very similar to DSM columns and are constructed by a specialist contractor who:

- Push a cutting tool into the ground (i.e., auger flight); and
- Simultaneously pushing the displaced soils into the surrounding soil materials and replacement with a binder (i.e., concrete).

They are likely to be a similar length and layout to DSM columns. It is important to note that the piles would be acting as a ground improvement and displacement element as opposed to a traditional bored, reinforced concrete pile. This method has the advantage of no spoil created during the installation process.

5.4.4 Preloading

Pre-loading (i.e., placement of a surcharge load to mimic future building loads) of the gym extension building platform may be considered to allow consolidation to occur prior to the construction of shallow foundations. Magnitude of preload and length of time for preload should be assessed following confirmation of layouts and loads. A rough estimate using indicative building loads indicates a preload hold period of 12 to 24 months with a surcharge of approximately 2 m thickness of fill placed over the area. This would need to be confirmed following further analysis. However, our experience in Hawkes Bay indicates that this estimated hold period duration is likely to be conservative.

Settlement accelerating elements such as vertical wick drains (installed to about 10 m depth) are likely to be a cost-effective measure to accelerate consolidation and could be considered in conjunction with preloading. A trial pad (minimum 5 m by 5 m) could be constructed to validate the settlement predictions if programme and site constraints permit this.

This ground improvement option could be appropriate for the proposed gym extension area, as the construction of a preload embankment would require importation of a large volume of aggregate and could be disruptive to existing pool operations.

5.4.5 In-situ Concrete Mixing

In situ mass cement stabilisation of the upper soft silt layer was considered. Mass stabilisation increases the strength of the in-situ soil through effectively mixing dry binders or slurry grout with the in-situ soils, creating a strengthened "block" of soil over the treated depth. The treatable plan area would extend 1 to 2 m outside the area of the proposed building and indicatively involve 8-10% cement application.

It is likely that the depth of stabilisation required at this site would exceed the feasible treatable depth (~4m bgl). Accordingly, this method is unlikely to be suitable at the subject site.

5.4.6 Ground Improvements Summary

We have summarised the earthworks/ground improvement techniques in Table 5.8 below:

Table 5.8: Ground improvement recommendation summary

Option	Initial feasibility assessment				
	RAP/GIP	DSM Column	FDP	In-situ concrete mixing	Preloading
Aquatic Centre (All Location Options)	Yes	Yes	Yes	No	Unlikely
Gym Extension	Yes	Yes	Yes	No	Yes

5.4.7 General Earthwork Recommendations

At the time of writing this report, the final design ground level of the site is unknown and the preferred location option for the proposed aquatic centre is yet to be confirmed. However, in general, we expect that earthworks will be required to level the area and remediate or remove the existing uncontrolled fill (where present). In some instances, demolition of existing structures will be required to form the building platform for the new complex and we anticipate these areas will require all foundation and existing pool elements to be removed.

Earthworks at this site could include:

- Demolition of existing structures and any below ground obstructions including the former diving pool foundations and existing services (up to about 3 m deep).
- Releveling of surface material over the preferred aquatic centre option, the gym extension and the relocated netball courts to design levels.
- Removal and replacement of existing fill (i.e., replacement with local straight haul gravels or similar materials); or
- Removal and re-engineering of existing fill (i.e., stabilising or blending with cement or other chemical binders).

Based on site observations, the fill materials encountered in some portions of the site could be generally suitable for reuse across the site provided suitable moisture contents can be achieved (green and orange areas on Figure 5 in Appendix A). However, this will need to be confirmed with specific laboratory testing and compaction trials. The purple area on Figure 5 in Appendix A is likely to require careful screening and re-engineering (to an appropriate specification) with the removal of foreign matter (i.e., rusted metal sheeting etc.).

Where new fill is required, all vegetation and topsoil should be removed, and existing fill should be inspected by a geotechnical engineer or removed before fill placement commences. A layer of geotextile may be required to provide suitable separation between the subgrade and overlying engineered fill. Where the pool excavation extends through the overlying uncontrolled fill and onto weaker alluvial sediments, a ground improvement layer such as a layer of heavy geotextile (Bidim A29 or similar) and hardfill will likely be required, or alternatively in situ cement stabilisation, prior to construction of the pool slab. Additionally, a layer of geogrid would assist in compaction of fill onto the relatively weak soils. Details of the improvement layer will need to be confirmed during detailed design.

All fill should be placed and compacted in accordance with a prepared earthwork fill specification and should comprise clean river run or local 'straight haul' gravels. Typical specification criteria include fill placed in layers no greater than 300 mm loose thickness and compacted to greater than 95% of Maximum Dry Density. Cohesive fill from the site or imported materials may be suitable for landscaping fill purposes and should achieve a minimum undrained shear strength of 80 kPa. Given the shallow depth to groundwater, it is unlikely that clay fill would be suitable for use as structural fill unless it is suitably stabilised, which would need to be confirmed with site trials.

It should be noted that the backfill in the investigation test pits may not have achieved density requirements for engineered fill, due to groundwater inflows. If a test pit location is found to be located beneath foundations, then the test pits should be excavated and remediated as required.

Good earthworks practise such as dust suppression, erosion and sediment controls and stabilised entrances will be required to mitigate environmental effects. Particularly, as the site has the potential for contaminated soils and given public interest in the project.

6 Preliminary Building Foundation Assessment

Shallow foundations could be used over the ground improvements to support the aquatic centre/gym extension buildings. The foundations could comprise a series of strip footings or pads interconnected with ground beams, to mitigate differential settlements and resist seismic loadings. Guidance for preliminary geotechnical foundation design is provided below. This will need to be reviewed during detailed design.

6.1.1 Shallow Foundations

Where ground improvements have been completed, buildings could be constructed comprising:

- A series of strip footings or pads interconnected with ground beams, overlying
- A reinforced gravel raft (or load transfer system) with minimum of 400 mm of compacted hardfill; overlying
- Ground improvement elements.

For preliminary design, the bearing capacity parameters provided in Table 6.1 below are considered appropriate. This assumes founding on a reinforced gravel raft or stabilised fill and removal of existing uncontrolled material.

Table 6.1: Preliminary shallow foundation bearing capacity parameters (assumed up to 1m width)

Design Case	Bearing Capacity
Geotechnical Ultimate Capacity	300 kPa
ULS Bearing Pressure	150 kPa
Working Load "Allowable" Bearing Pressure	100 kPa

6.1.2 Pile Foundations

Traditional bored or driven piled foundations are unlikely to be appropriate for the site, for the following reasons:

- A lack of a consistent bearing layer at depth.
- Liquefaction triggering in some of the upper loose sandier soils, meaning deep piles (>15 m) would be required.
- Removal of potentially contaminated soil from bored pile arisings; and
- Noise and vibration considerations in a residential setting, rendering driven pile options unsuitable.

Full displacement piles or other ground improvement techniques may be feasible for this site, as discussed in Section 5.4, above.

6.2 Geotechnical Design Parameters

The preliminary geotechnical soil design parameters are provided in Table 6.2 below to assist with the design of internal pool shell walls and foundations. We recommend that the structural engineer workshops the construction of the foundations and pool excavation and any temporary works with the geotechnical engineer.

Table 6.2: Design Soil Parameters

	Unit weight (γ) (kN/m ³)	Drained cohesion (c') (kPa)	Effective Angle of friction ϕ' (deg)	Young's Modulus (E) (MPa)	Undrained shear strength (Su) (kPa)
Unit 1 – Fill	17	0	30	10	100
Unit 2 – Upper soft silt with thin sand lenses	17	2	26	2	20
Unit 3 – Silty sand	18	0	32	20	N/A

Note: NA = not attainable (i.e., the material is not cohesive)

Groundwater pressures may also affect buried structures, as discussed below.

6.3 Groundwater and Construction Risks

Groundwater levels across the site are variable and range between 1 and 3 m depth, typically about 1.5 m. Therefore, it is likely excavations exceeding approximately 1 m depth will require either continuous pumping in the form of a sump and/or battering or the use of temporary supports (e.g., shields or sheet piles). Table 6.3 below provides an estimation of the radius of the radius of influence for groundwater, based on a permeability of 10^{-5} and the CIRIA Report 113 guidelines¹³.

Table 6.3: Drawdown effects and radius of influence for temporary works

Drawdown (m)	Radius of Influence (m)
1	9
1.5	14
2	19
2.5	24
3	28

Considering the CIRIA guidelines and the potential for up to 3 m of groundwater drawdown, the radius of influence (i.e., over which groundwater is affected) is expected to range between 9 and 28 m. This needs to be considered during the design process. The effects of groundwater drawdown could be mitigated by constructing the new pool facility away from the existing structures on the site. Consideration of groundwater settlement effects should part of a Resource Consent application.

6.4 Pavements

Our site investigation data indicates that the underlying sands and silt are predominantly of low strength. Based on our experience and the ground conditions, a CBR of 2% is considered appropriate for light weight pavements at existing ground level at the subject site. Specific investigation and design will be required for heavy duty pavements. For pavements on engineered fill, we consider that a CBR of 5% suitable for use in design (subject to site specific testing). Undercutting or stabilisation of existing fill will probably be required to facilitate the construction of pavements across much of the site.

We recommend subgrade testing at the detailed design stage to confirm these assumptions in paved or carparking areas.

¹³ S Somerville (1986). CIRIA Report 113 – Control of groundwater for temporary works.

During construction of the pavement areas, the subgrade material should be inspected by a geotechnical engineer to assess any areas that may require undercutting and replacement with compacted hardfill.

Following stripping of the topsoil, the exposed soils may deteriorate, especially following wet weather. It is imperative that the exposed surfaces are not disturbed and sensitive soils are not subject to remoulding. Temporary haul roads (e.g., filter fabric and 300 mm of hardfill) should be used to protect soils from construction traffic. We recommend tracked vehicles only be allowed to pass over unprotected soils, as wheeled vehicles may cause the subgrade to fail and hence require over-excavation, and possibly removal of the subgrade to spoil or to stockpile for drying and re-working to be required.

6.5 Other Development Considerations

6.5.1 Buried Services and pipe bridging

There is a significant number of underground services located at the site, mostly council owned trunk sewer, stormwater but also gas and fibre lines (Figure 6.1 below). Allowance for this needs to be made during the design and construction phases of this project. This may include a combination of pipe bridging, avoidance of areas with underground services or diversion of critical assets, where possible.

We recommend that a full infrastructure assessment and topographical survey is carried out prior to design commencing to confirm invert levels, particularly for the trunk sewer line.



Figure 6.1: Napier City Council Intramaps Service Map.

7 Recommendations and Further Work

We recommend the following additional geotechnical inputs:

- Ongoing monitoring of the two groundwater wells installed on-site to confirm seasonal fluctuations in the groundwater levels across the site. This may be particularly useful for design of buried structures and assessment of groundwater effects for Resource Consent application.
- Detailed settlement assessment once plans and structural loads have been confirmed.
- Detailed assessment of liquefaction on the structure following confirmation of the cut/fill levels and foundation systems.
- Detailed assessment for ground improvement/preload design will be required during detailed design stages once site layouts and levels have been confirmed.
- Detailed assessment of groundwater including temporary drawdown effects, this may be required to support the development Resource Consent.
- Construction observations and quality assurance relating to any geotechnical site works or construction.

8 Conclusions and Recommendations

Geotechnical and contamination investigations and reporting have been completed to support the preliminary design of a new aquatic centre facility, gym extension and sports courts relocations in the Onekawa Park, Napier. Table 8.1 and the following points summarise the main conclusions of the investigation and results of our geotechnical engineering analysis.

Table 8.1: Conclusions of the different building locations

Building Option	Relative Risk	Opportunity
1	<ul style="list-style-type: none"> • Demolition of tennis courts required. • Limited extent of uncontrolled fill • 	<ul style="list-style-type: none"> • Limited presence of underground services • Low Liquefaction risk. • Limited reworking of fill materials required. • Preloading could be undertaken.
2	<ul style="list-style-type: none"> • Significant uncontrolled fill presence. • Demolition of part of the existing aquatic facilities. • Minor to moderate Liquefaction risk. • Consolidation settlement risk. • Assets to be relocated. 	<ul style="list-style-type: none"> • Close to existing facility. • Site is relatively level with minimal cut/fill required.
3	<ul style="list-style-type: none"> • Significant uncontrolled fill presence. • Demolition of surrounding buildings and former diving pool area required. • Minor to moderate Liquefaction risk. • Consolidation settlement risk. 	<ul style="list-style-type: none"> • Close to existing facility. • Site is relatively level with minimal cut/fill required.
4	<ul style="list-style-type: none"> • Deep uncontrolled fill presence/most significant earthworks required to level site. • Significant number of existing underground services. • Moderate Liquefaction risk. • Restricted access to current facilities during construction. • Possible landfill gas and variable materials to sort and remove. • Consolidation settlement risk. 	<ul style="list-style-type: none"> • Limited demolition of existing structures required. • Landscaping material on the area could be moved elsewhere on site. •
5- Relocated netball courts	<ul style="list-style-type: none"> • No deep geotechnical investigations. • Some cut and fill required to level the area. • Some uncontrolled fill present. 	<ul style="list-style-type: none"> • Low number of underground services. • Existing fill could potentially be stabilised/reused. • No building development expected in this area.
6-Gym Extension	<ul style="list-style-type: none"> • Highest potential for total differential settlements. • Existing buildings and infrastructure in close proximity to development site. 	<ul style="list-style-type: none"> • Low number of underground services. • Lower Liquefaction risk. • No demolition of existing structures required. • Preloading could be undertaken.

- 1 This report provides a preliminary overview of the geological site conditions for the proposed aquatic centre, gym extension and relocated netball courts, and provides preliminary geotechnical recommendations and optioneering for the concept design of earthworks and foundations.
- 2 The site is underlain by Holocene estuarine deposits with interbedded layers of sands, silts, and gravels. Variable thicknesses of non-engineered fill including demolition rubble were encountered in areas across the site.
- 3 We consider the site should be classified as Class D – Deep or Soft Soil Site in accordance with NZS 1170.5:2004.
- 4 Without ground improvements, the site is subject to the following geotechnical risks:
 - a. Minor to moderate risk of liquefaction for 100 to less than 1000-year return period events (at which lenses of material are likely to liquefy). The main consequences of liquefaction that will need to be addressed are:
 - i. Consolidation and differential settlement across the site.
 - ii. Potential liquefaction ejecta where there are penetrations through the soil crust (e.g., through the pool slab); and
 - iii. Loss of support in founding layers within the upper sand units.
 - b. Significant total and differential settlement of the underlying fill and soft compressible silt layers due to loads imparted by additional filling or new structures. This is a critical geotechnical risk at the site.
 - c. Variable and unpredictable performance of the existing non-engineered fill. Treatment or removal of these materials will be required across much of the site, some of this material may be suitable for re-use but will need to be screened of any demolition rubble material, other foreign matter, and unsuitable soils. Alternatively, a stabilisation option could be considered.
- 5 This site will require some form of ground improvement if shallow foundations are to be adopted to control settlements and to potentially densify the upper sand layers to prevent liquefaction. The various ground improvement methods have been listed in Section 5.4 with the pros/cons discussed in the summary optioneering table presented in Appendix E.
- 6 An alternative option of preloading (possibly with wick drains) could be adopted for buildings away from existing infrastructure.
- 7 Shallow foundations could be constructed over ground improvement elements with a reinforced gravel raft below foundation elements. Pool foundations may bear close to the soft silt unit, so a ground improvement layer such as heavy geotextile/geogrid and a hardfill raft may be required beneath the pool slab. Detailed design (and collaboration with structural engineer) will need to be undertaken to confirm appropriate foundation solutions.
- 8 Specific bridging or diversions may be required to found above exiting council owned services, or diversion of these services.
- 9 A CBR of 2% is considered appropriate for pavement design on natural ground at existing ground level, this should be confirmed with testing during construction (and during design stage if required).
- 10 Further geotechnical analyses including ground improvement/preload design will be required during detailed design once site layouts and levels have been confirmed.
- 11 Further work will be required to support foundation design or Building/Resource Consents for new structures on site. This is expected to comprise detailed settlement estimates, assessment of groundwater effects, foundation design, pipe bridging (if required) and design of any temporary or permanent support for the pool shell.

9 Applicability

This report has been prepared for the exclusive use of our client Napier City Council , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

The liquefaction susceptibility analysis has been undertaken using empirical procedures developed from various liquefaction databases and case histories. Earthquakes are unique and impose different levels of shaking in different directions on different sites. The results of the liquefaction analyses and estimates of the consequences presented within this report are based on regional seismic demand and published analysis methods. It is important to understand actual performance may vary from that calculated.

During excavation and construction, the site should be examined by an engineer competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. We would be pleased to provide this service to you and believe your project would benefit from the continuity. However, it is important that we be contacted if there is any variation in subsoil conditions from those described in the report.

Tonkin & Taylor Ltd

Report prepared by:




Zach Frame
Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



PP John Leeves
Project Director

Reviewed by:



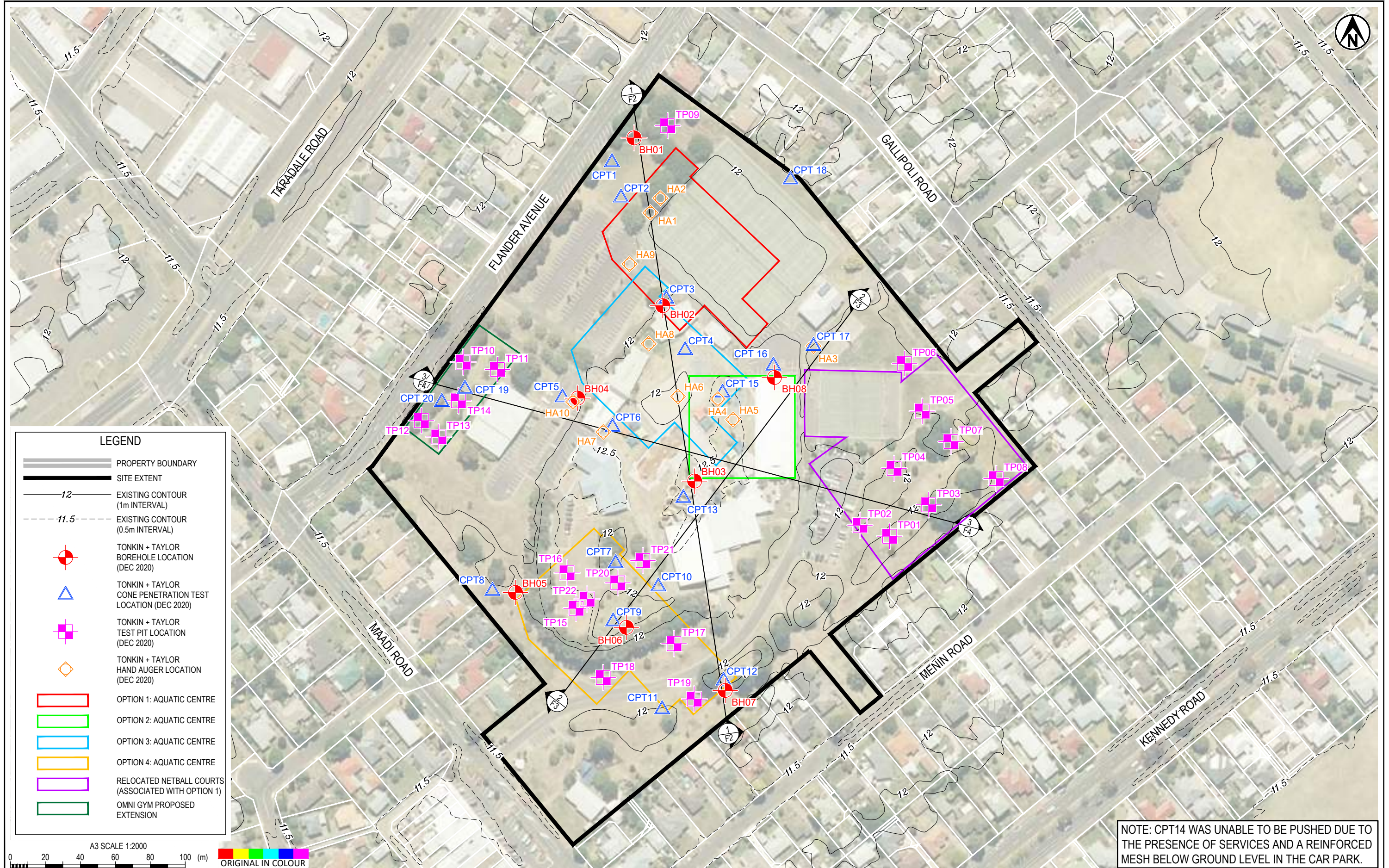
Jamie Yule
Engineering Geologist and Project Manager

ZAFR

t:\auckland\projects\1009171\issueddocuments\210714 geotechnical assessment final report_v3.docx

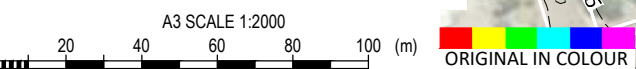
Appendix A: Figures

- Figure 1 – Site Plan.
- Figure 2 – Engineering Geological Cross Section (1).
- Figure 3 – Engineering Geological Cross Section (2).
- Figure 4 – Engineering Geological Cross Section (3).
- Figure 5 – Engineering Geology Plan.
- Figure 6 – Summary of free field one dimensional reconsolidation for ULS levels of shaking.
- Figure 7 – Summary of liquefaction severity number for ULS levels of shaking.



LEGEND

- PROPERTY BOUNDARY
- SITE EXTENT
- EXISTING CONTOUR (1m INTERVAL)
- EXISTING CONTOUR (0.5m INTERVAL)
- TONKIN + TAYLOR BOREHOLE LOCATION (DEC 2020)
- TONKIN + TAYLOR CONE PENETRATION TEST LOCATION (DEC 2020)
- TONKIN + TAYLOR TEST PIT LOCATION (DEC 2020)
- TONKIN + TAYLOR HAND AUGER LOCATION (DEC 2020)
- OPTION 1: AQUATIC CENTRE
- OPTION 2: AQUATIC CENTRE
- OPTION 3: AQUATIC CENTRE
- OPTION 4: AQUATIC CENTRE
- RELOCATED NETBALL COURTS (ASSOCIATED WITH OPTION 1)
- OMNI GYM PROPOSED EXTENSION



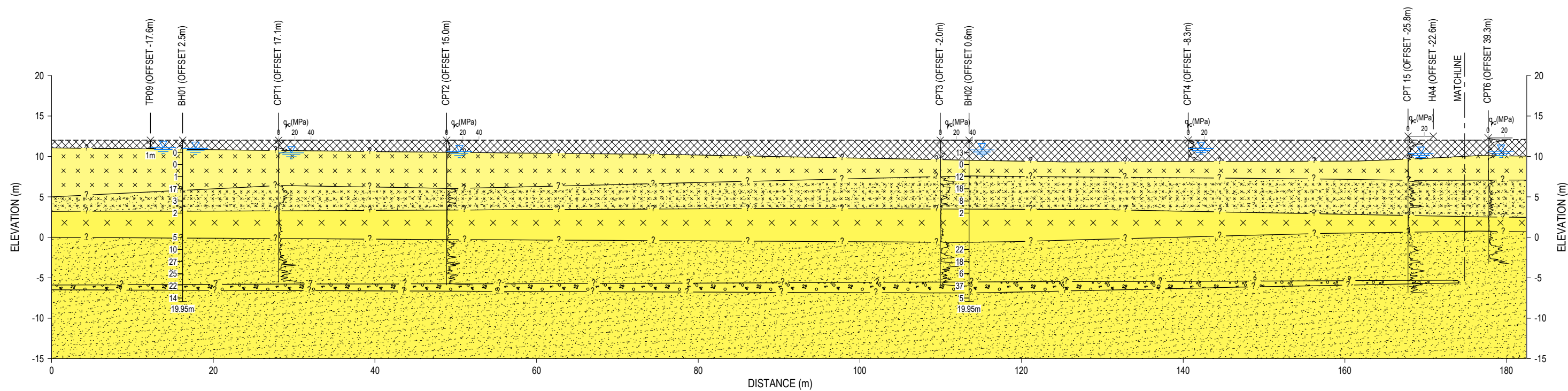
NOTE: CPT14 WAS UNABLE TO BE PUSHED DUE TO THE PRESENCE OF SERVICES AND A REINFORCED MESH BELOW GROUND LEVEL IN THE CAR PARK.

NOTES:

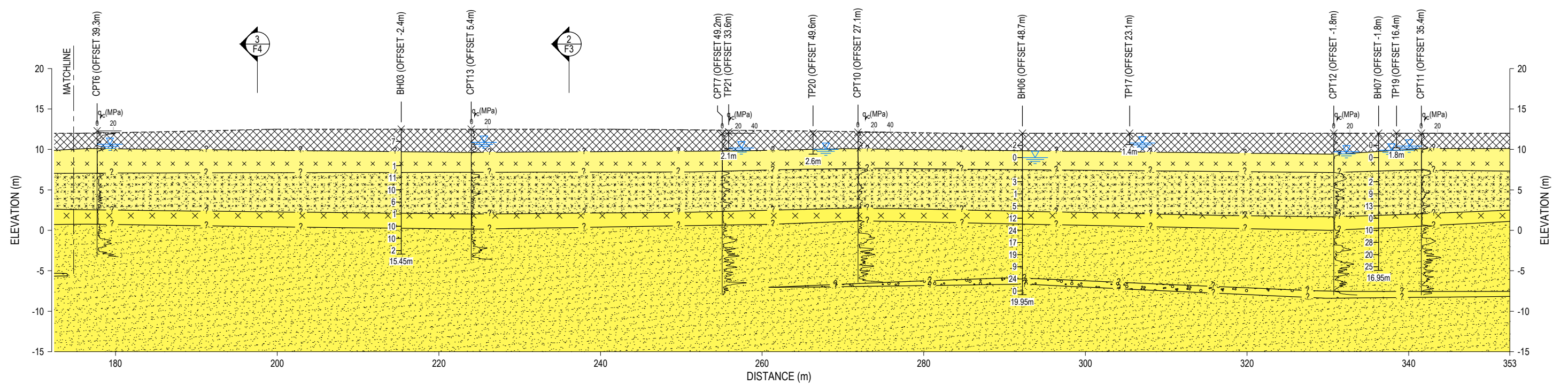
- AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/53401-hawkes-bay-03m-rural-aerial-photos-2014-2015/>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 21/12/2020.
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- EXISTING CONTOUR COPIED FROM NAPIER CITY COUNCIL GIS <http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC> DATED 09 DEC 2020.
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- LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962

PROJECT No. 1009171		
DESIGNED	ZAFR	Jan.21
DRAWN	JC	Jan.21
CHECKED	WC	Jan.21
JWY 14/07/2021		
APPROVED	DATE	

CLIENT	NAPIER CITY COUNCIL
PROJECT	ONEKAWA AQUATIC CENTRE
TITLE	GEOTECHNICAL INVESTIGATION SITE INVESTIGATION PLAN
SCALE (A3)	1:2000
FIG No.	FIGURE 1
REV	2



SECTION 1 F1
SCALE 1:500



SECTION 1 F1 CONTINUED
SCALE 1:500

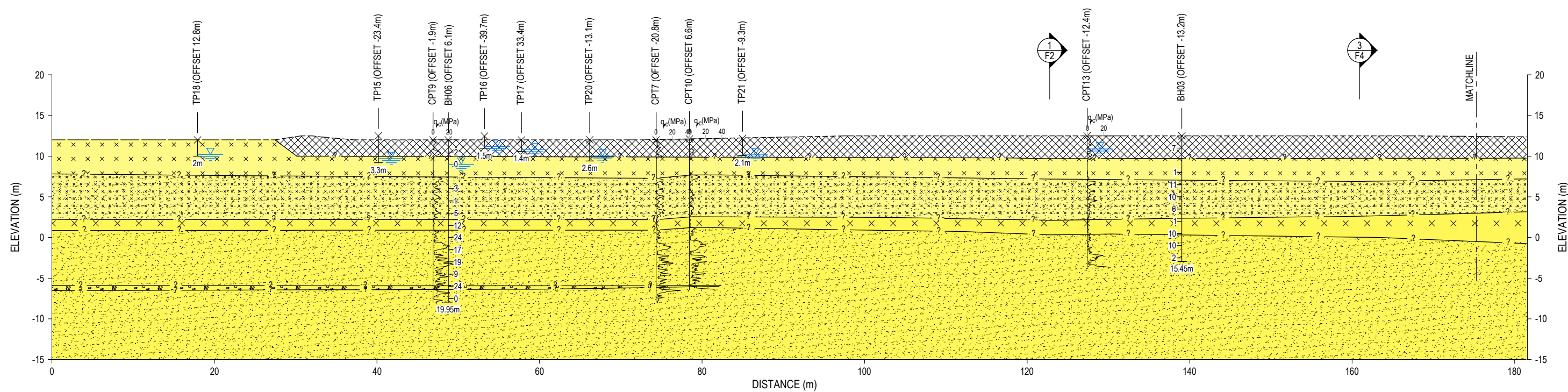
NOTE: FOR LEGEND PLEASE REFER TO FIGURE 3



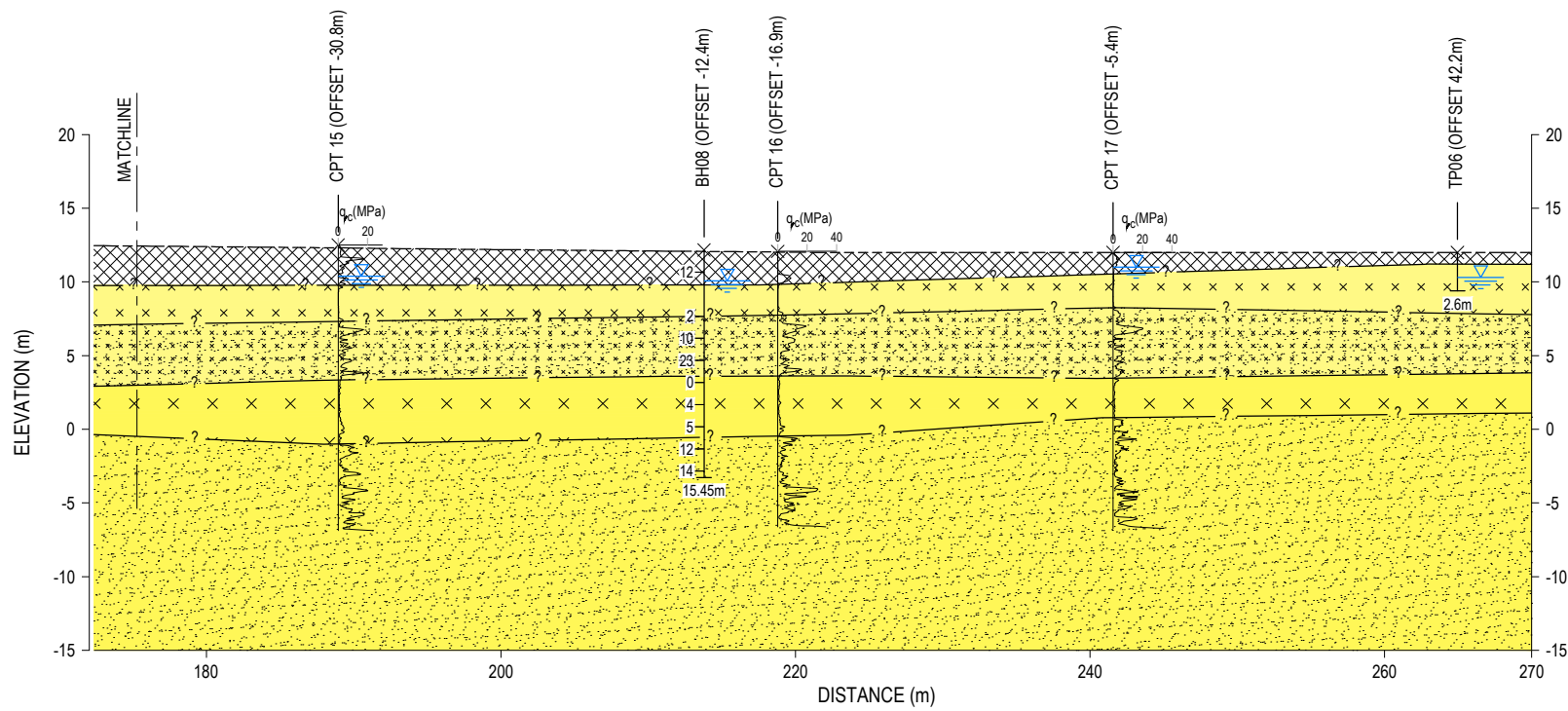
- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
 2. EXISTING GROUND PROFILE BASED ON EXISTING CONTOURS COPIED FROM NAPIER CITY COUNCIL GIS <<http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC>> DATED 09 DEC 2020.
 3. LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962
 4. GEOLOGICAL BOUNDARY IS INFERRED ONLY AND BASED ON THE INTERPRETATION OF GEOLOGICAL INVESTIGATIONS AT DISCRETE LOCATIONS, VARIATION ON ACTUAL GEOLOGICAL BOUNDARIES BETWEEN INVESTIGATION LOCATIONS MAY EXIST.

PROJECT No. 1009171		
DESIGNED	ZAFR	Feb.21
DRAWN	JC	Feb.21
CHECKED	WC	Jan.21
JWY		25/01/2021
APPROVED	DATE	

CLIENT	NAPIER CITY COUNCIL
PROJECT	ONEKAWA AQUATIC CENTRE
TITLE	GEO TECHNICAL INVESTIGATION GEOLOGICAL CROSS SECTION 1
SCALE (A3)	1:500
FIG No.	FIGURE 2
REV	1



SECTION 2 F1
SCALE 1:500



SECTION 2 F1 CONTINUED
SCALE 1:500

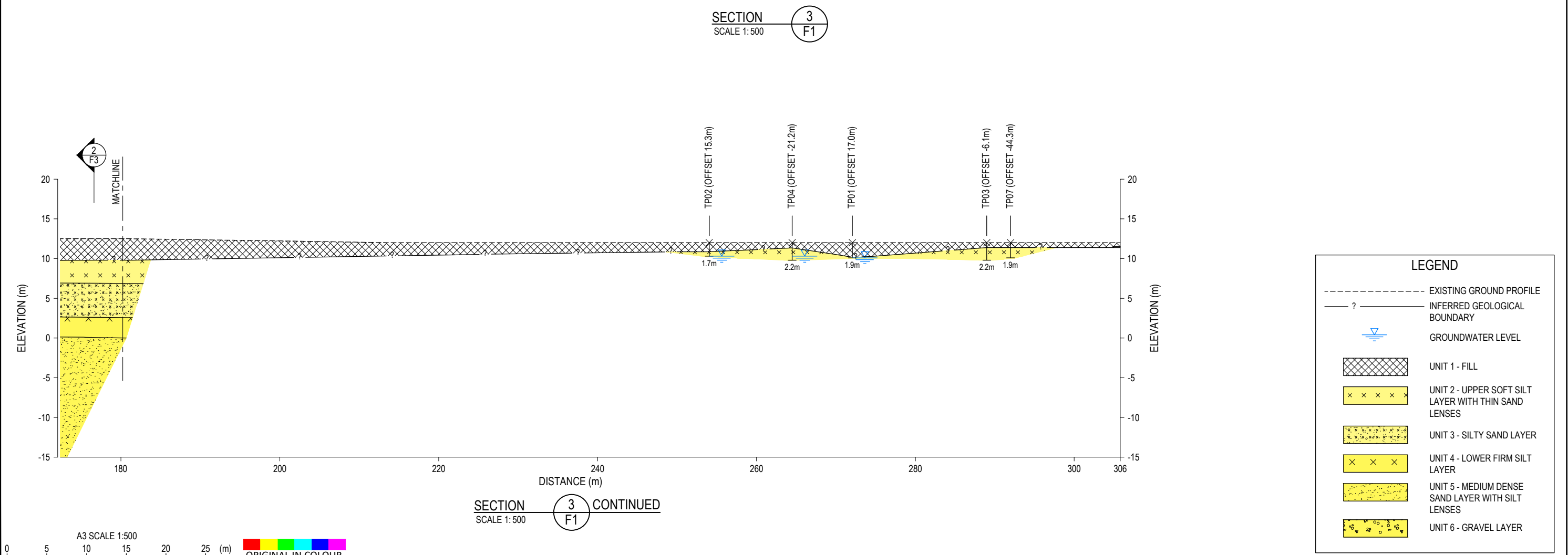
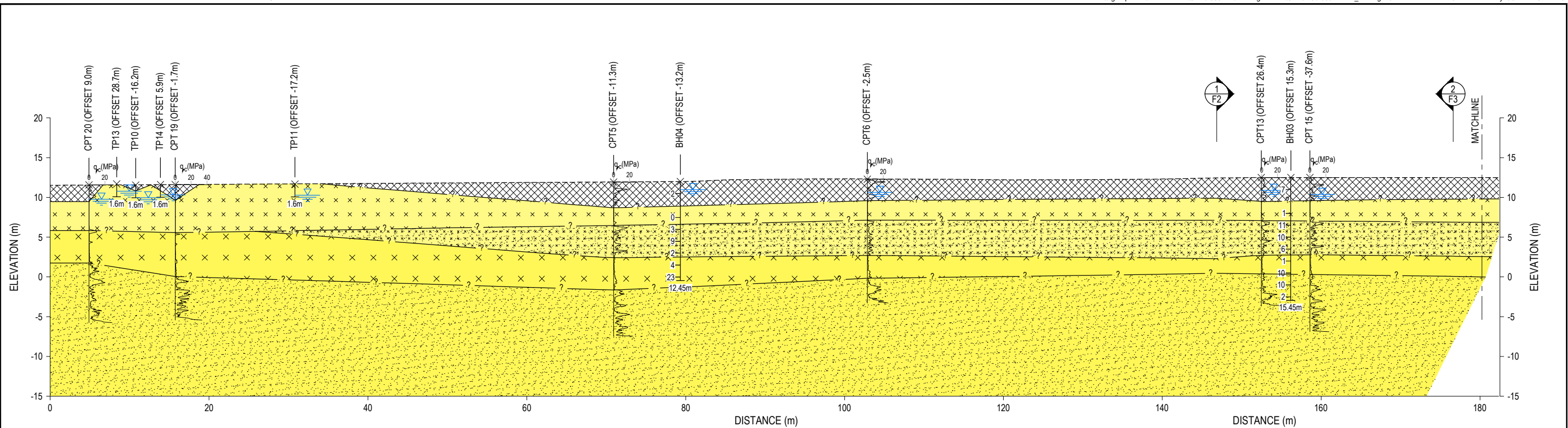
LEGEND	
	EXISTING GROUND PROFILE
	INFERRED GEOLOGICAL BOUNDARY
	GROUNDWATER LEVEL
	UNIT 1 - FILL
	UNIT 2 - UPPER SOFT SILT LAYER WITH THIN SAND LENSES
	UNIT 3 - SILTY SAND LAYER
	UNIT 4 - LOWER FIRM SILT LAYER
	UNIT 5 - MEDIUM DENSE SAND LAYER WITH SILT LENSES
	UNIT 6 - GRAVEL LAYER



- NOTES:
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
 - EXISTING GROUND PROFILE BASED ON EXISTING CONTOURS COPIED FROM NAPIER CITY COUNCIL GIS <http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC> DATED 09 DEC 2020.
 - LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962
 - GEOLOGICAL BOUNDARY IS INFERRED ONLY AND BASED ON THE INTERPRETATION OF GEOLOGICAL INVESTIGATIONS AT DISCRETE LOCATIONS, VARIATION ON ACTUAL GEOLOGICAL BOUNDARIES BETWEEN INVESTIGATION LOCATIONS MAY EXIST.

PROJECT No. 1009171		
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JWY		25/01/2021
APPROVED	DATE	

CLIENT	NAPIER CITY COUNCIL	
PROJECT	ONEKAWA AQUATIC CENTRE	
TITLE	GEOTECHNICAL INVESTIGATION GEOLOGICAL CROSS SECTION 2	
SCALE (A3)	1:500	FIG No. FIGURE 3
REV	1	



LEGEND

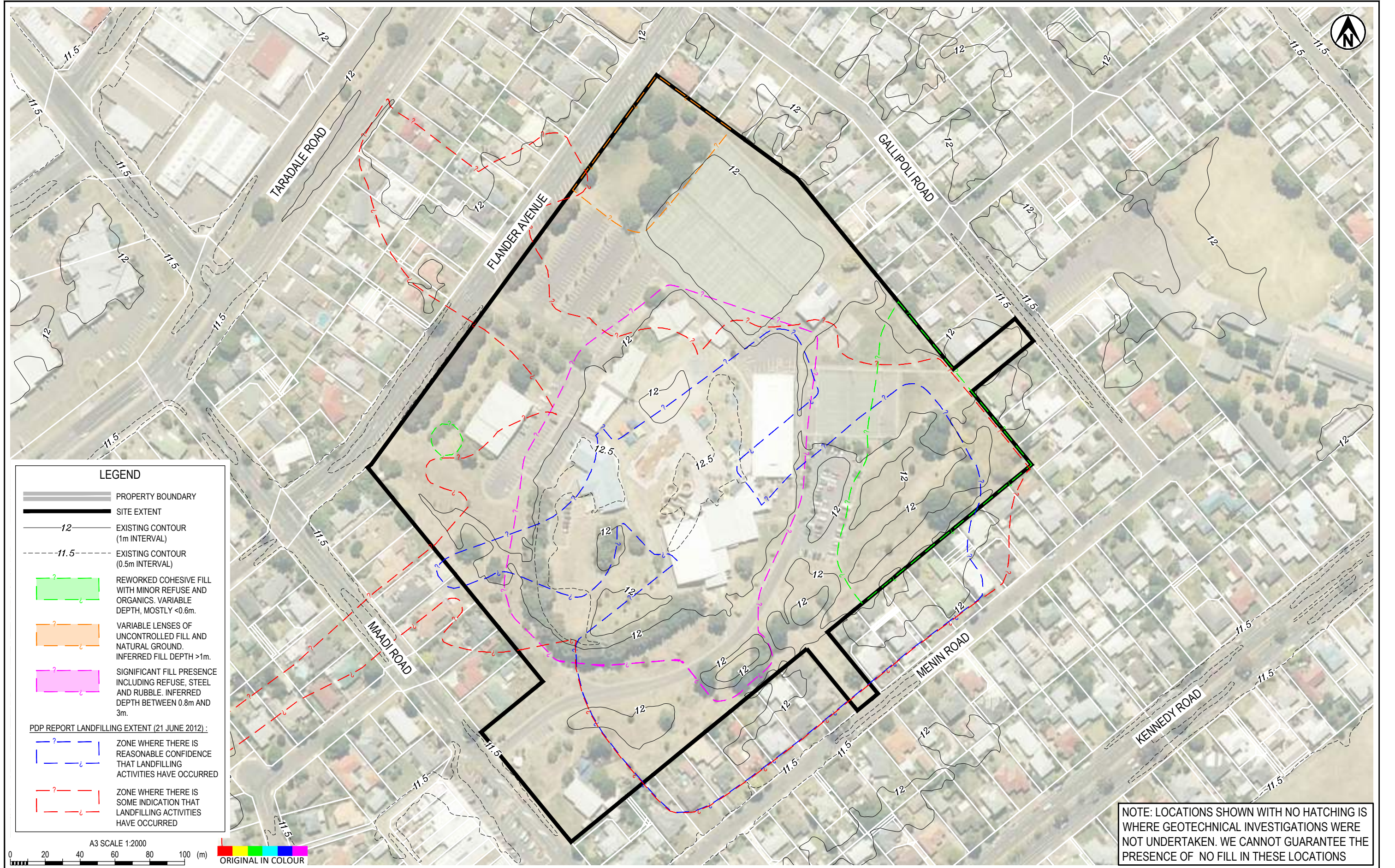
- EXISTING GROUND PROFILE
- ? - INFERRED GEOLOGICAL BOUNDARY
- △ GROUNDWATER LEVEL
- [Cross-hatch pattern] UNIT 1 - FILL
- [Yellow with 'x' pattern] UNIT 2 - UPPER SOFT SILT LAYER WITH THIN SAND LENSES
- [Yellow with 'x' pattern] UNIT 3 - SILTY SAND LAYER
- [Yellow with 'x' pattern] UNIT 4 - LOWER FIRM SILT LAYER
- [Yellow with 'x' pattern] UNIT 5 - MEDIUM DENSE SAND LAYER WITH SILT LENSES
- [Yellow with 'x' pattern] UNIT 6 - GRAVEL LAYER



- NOTES:
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
 - EXISTING GROUND PROFILE BASED ON EXISTING CONTOURS COPIED FROM NAPIER CITY COUNCIL GIS <http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC> DATED 09 DEC 2020.
 - LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962
 - GEOLOGICAL BOUNDARY IS INFERRED ONLY AND BASED ON THE INTERPRETATION OF GEOLOGICAL INVESTIGATIONS AT DISCRETE LOCATIONS, VARIATION ON ACTUAL GEOLOGICAL BOUNDARIES BETWEEN INVESTIGATION LOCATIONS MAY EXIST.

PROJECT No. 1009171		
DESIGNED	ZAFR	Feb.21
DRAWN	JC	Feb.21
CHECKED	WC	Jan.21
JWY		25/01/2021
APPROVED	DATE	

CLIENT	NAPIER CITY COUNCIL	
PROJECT	ONEKAWA AQUATIC CENTRE	
TITLE	GEOTECHNICAL INVESTIGATION GEOLOGICAL CROSS SECTION 3	
SCALE (A3)	1:500	FIG No. FIGURE 4
REV	1	



LEGEND

- PROPERTY BOUNDARY
- SITE EXTENT
- EXISTING CONTOUR (1m INTERVAL)
- EXISTING CONTOUR (0.5m INTERVAL)
- REWORKED COHESIVE FILL WITH MINOR REFUSE AND ORGANICS. VARIABLE DEPTH, MOSTLY <0.6m.
- VARIABLE LENSES OF UNCONTROLLED FILL AND NATURAL GROUND. INFERRED FILL DEPTH >1m.
- SIGNIFICANT FILL PRESENCE INCLUDING REFUSE, STEEL AND RUBBLE. INFERRED DEPTH BETWEEN 0.8m AND 3m.

PDP REPORT LANDFILLING EXTENT (21 JUNE 2012):

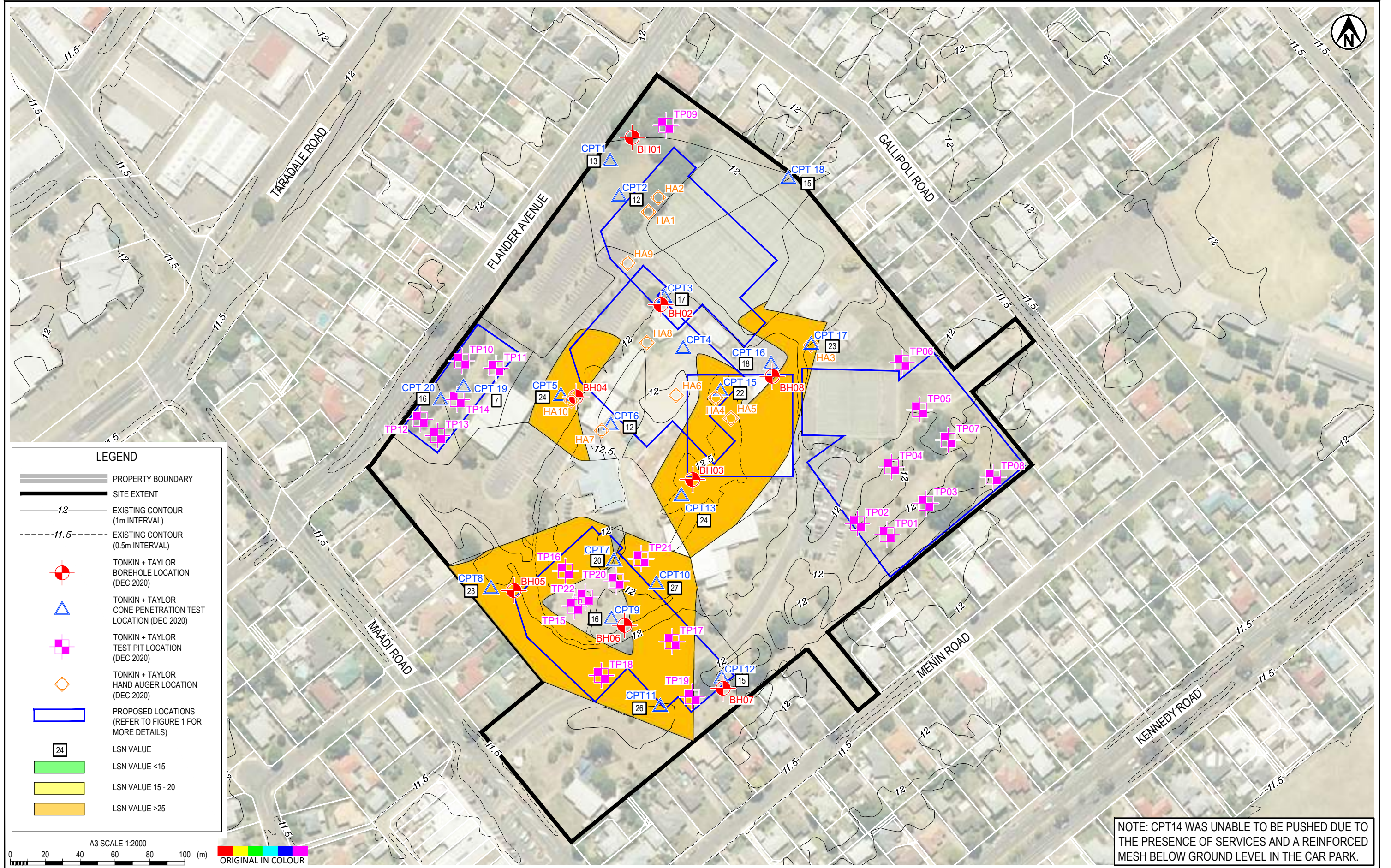
- ZONE WHERE THERE IS REASONABLE CONFIDENCE THAT LANDFILLING ACTIVITIES HAVE OCCURRED
- ZONE WHERE THERE IS SOME INDICATION THAT LANDFILLING ACTIVITIES HAVE OCCURRED

A3 SCALE 1:2000

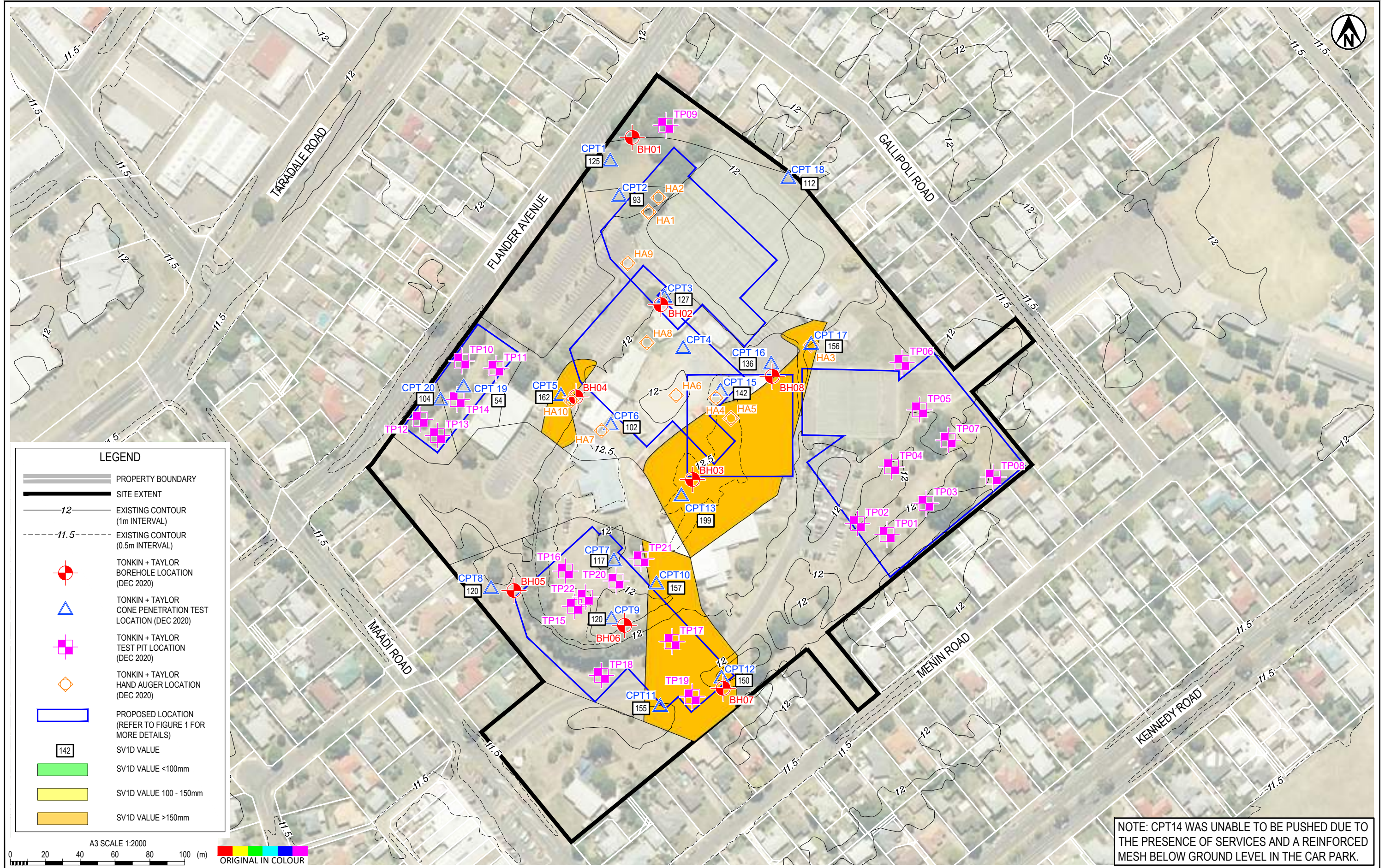
ORIGINAL IN COLOUR

NOTE: LOCATIONS SHOWN WITH NO HATCHING IS WHERE GEOTECHNICAL INVESTIGATIONS WERE NOT UNDERTAKEN. WE CANNOT GUARANTEE THE PRESENCE OF NO FILL IN THESE LOCATIONS

<p>NOTES:</p> <ol style="list-style-type: none"> AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/53401-hawkes-bay-03m-rural-aerial-photos-2014-2015/>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 21/12/2020. PROPERTY BOUNDARY SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/51571-nz-parcels/>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 09/12/2020. EXISTING CONTOURS COPIED FROM NAPIER CITY COUNCIL GIS <http://www.gis.napier.govt.nz/IntraMaps80/?project=NCC> DATED 09 DEC 2020. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000). LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962 	<p>PROJECT No. 1009171</p>		<p>CLIENT NAPIER CITY COUNCIL</p>	
	<p>DESIGNED ZAFR Jan.21</p>	<p>DRAWN JC Jan.21</p>	<p>PROJECT ONEKAWA AQUATIC CENTRE</p>	
	<p>CHECKED WC Jan.21</p>	<p>TITLE GEOTECHNICAL INVESTIGATION ENGINEERING GEOLOGY PLAN</p>		
	<p>JWY 25/01/2021</p>		<p>SCALE (A3) 1:2000</p>	
<p>APPROVED DATE</p>		<p>FIG No. FIGURE 5</p>		<p>REV 1</p>



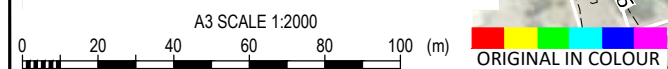
PROJECT No. 1009171		CLIENT NAPIER CITY COUNCIL
DESIGNED ZAFR Feb.21	DRAWN JC Feb.21	PROJECT ONEKAWA AQUATIC CENTRE
CHECKED WC Feb.21		TITLE SUMMARY OF FREE FIELD ONE DIMENSIONAL RECONSOLIDATION FOR ULS LEVELS OF SHAKING (0.51G, 6.6)
APPROVED JWY 16/02/2021		SCALE (A3) 1:2000
DATE		FIG No. FIGURE 6
		REV 1



LEGEND

- PROPERTY BOUNDARY
- SITE EXTENT
- EXISTING CONTOUR (1m INTERVAL)
- EXISTING CONTOUR (0.5m INTERVAL)
- TONKIN + TAYLOR BOREHOLE LOCATION (DEC 2020)
- TONKIN + TAYLOR CONE PENETRATION TEST LOCATION (DEC 2020)
- TONKIN + TAYLOR TEST PIT LOCATION (DEC 2020)
- TONKIN + TAYLOR HAND AUGER LOCATION (DEC 2020)
- PROPOSED LOCATION (REFER TO FIGURE 1 FOR MORE DETAILS)
- SV1D VALUE
- SV1D VALUE <100mm
- SV1D VALUE 100 - 150mm
- SV1D VALUE >150mm

NOTE: CPT14 WAS UNABLE TO BE PUSHED DUE TO THE PRESENCE OF SERVICES AND A REINFORCED MESH BELOW GROUND LEVEL IN THE CAR PARK.



NOTES.

1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/53401-hawkes-bay-03m-rural-aerial-photos-2014-2015/>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 21/12/2020.
2. PROPERTY BOUNDARY SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/51571-nz-parcels/>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 09/12/2020.
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4. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
5. LEVEL DATUM: LINZ (MSL) NAPIER VERTICAL DATUM 1962

PROJECT No. 1009171		
DESIGNED	ZAFR	Feb.21
DRAWN	JC	Feb.21
CHECKED	WC	Feb.21
JWY		16/02/2021
APPROVED	DATE	

CLIENT	NAPIER CITY COUNCIL
PROJECT	ONEKAWA AQUATIC CENTRE
TITLE	SUMMARY OF LIQUEFACTION SEVERITY NUMBER FOR ULS LEVELS OF SHAKING (0.51G, 6.6)
SCALE (A3)	1:2000
FIG No.	FIGURE 7
REV	1

Appendix B: Field Investigations

- Hand Augered Borehole Logs
- Machine Borehole Logs
- CPT Logs
- Test Pit Logs

HAND AUGER LOG

HOLE Id: **HA01**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887928995541 WGS84 -39.5049309983664	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ICHW CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION															
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
				0	1	2	3	4	5	6	7	8	9												
Fill															A+M @ 0.10m						M	S-F			SILT, some sand, trace gravel and clay; greyish brown. Soft to firm, moist, low plasticity; sand, fine; gravel fine to coarse, includes sub-angular, sandstone and concrete. Contains rootlets.
Holocene Estuarine	100	HA														0.5								Sandy SILT, trace clay and rootlets; brownish grey, minor orange brown flecks. Soft to firm, moist, low plasticity. Trace shell fragments, <2mm diameter.	
																1.0								0.9m: sand becomes medium, less silt towards base of hole.	
																1.0								1m: END OF BOREHOLE	

COMMENTS: Target depth reached.

Hole Depth
1m

Scale 1:10

CORE PHOTOS

BOREHOLE No.: **HA01**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.887928995541 -39.5049309983664	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ICHW
			CHECKED: JWY


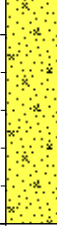


0.00-1.00m

HAND AUGER LOG

HOLE Id: **HA02**
SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887992017615 WGS84 -39.5048540428627	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ICHW
		CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION													
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
				0	1	2	3	4	5	6	7	8	9										
Top Soil																							Organic SILT, minor sand, trace rootlets; dark brown. Firm, moist.
Holocene Estuarine	100	HA												A+M @ 0.20m		0.5		M		F		SILT, some sand, trace gravel; greyish brown. Soft to firm, moist, low plasticity; gravel, fine to medium, sandstone.	
														A+M @ 0.70m					S-F		Sandy SILT, trace clay and rootlets; brownish grey. Soft to firm, moist, low plasticity. Trace shell fragments, <2mm diameter.		
																1.0			L		Fine to medium SAND, trace silt; greyish brown. Loosely packed, moist, uniformly graded.		
																1.5						1m: END OF INVESTIGATION	

COMMENTS: Target depth reached.

Hole Depth 1m

Scale 1:10

CORE PHOTOS

BOREHOLE No.: **HA02**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.887992017615 -39.5048540428627	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ICHW
			CHECKED: JWY



0.00-1.00m

HAND AUGER LOG

HOLE Id: **HA03**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: WGS84 176.88904997339 -39.505580021635	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ICHW CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION																							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations											
				0	1	2	3	4	5	6	7	8	9																				
Topsoil																							Sandy SILT; dark brown. Firm, moist.										
Fill	100	HA												A+M @ 0.20m									S-F	Sandy SILT, trace gravel; brownish grey. Soft to firm, moist. low plasticity; gravel, fine to coarse, sandstone. Contains ceramics and glass fragments, asphalt and ash.									
														A+M @ 0.60m																	Fine SAND, some silt; brownish grey. Tightly packed, moist, uniformly graded. Contains ceramic fragments and ash.		
														A+M @ 1.10m																			SILT, some sand, trace clay; brownish grey. Soft to firm, moist, medium plasticity. Contains ceramic fragments.
																							1.2m: END OF INVESTIGATION										

COMMENTS: Target depth reached.

Hole Depth
1.2m

Scale 1:10

CORE PHOTOS

BOREHOLE No.: **HA03**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.88904997339 -39.505580021635	DRILL TYPE: Hand auger	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: HA	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ICHW
			CHECKED: JWY



0.00-1.20m

HAND AUGER LOG

HOLE Id: HA04
SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: WGS84 176.888431 -39.505873	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021 HOLE FINISHED: 11/01/2021
R.L.: 12.50m	DRILL METHOD: HA	DRILLED BY: T+T
DATUM: NAPIHT1962		LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL					ENGINEERING DESCRIPTION																		
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)									TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
				0	1	2	3	4	5	6	7	8											9
Fill		100	HA										A+M @ 0.05m										Silty, fine SAND, trace gravel; light brown. Tightly packed, dry, well graded. Gravel; fine to coarse. Contains glass, brick and ceramic fragments.
														A+M @ 0.50m	12	0.5							
													A+M @ 1.00m										1m: END OF INVESTIGATION

COMMENTS: Refusal at 1 m.

Hole Depth 1m

HandAugerLog - 19/01/2021 2:27:29 pm - Produced with Core-GS by GeRoc

Scale 1:10

Rev.: A

CORE PHOTOS

BOREHOLE No.: **HA04**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.888431 -39.505873	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.:	12.50m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM:	NAPIHT1962		LOGGED BY: ZAFR CHECKED: JWY



0.00-1.00m



Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA05**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.888538 DRILL TYPE: Hand auger HOLE STARTED: 11/01/2021
WGS84 -39.505976

R.L.: 12.50m DRILL METHOD: HA HOLE FINISHED: 11/01/2021

DATUM: NAPIHT1962 LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION														
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION			WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)					TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations				
						0	1	2	3	4	5	6	7	8	9				10		15	20	25	
Fill				100	HA												D	L						Silty, fine SAND, minor gravel; light grey. Loosely packed, dry, well graded. Gravel; fine to medium. Contains shell glass and brick fragments.
Holocene Estuarine																	M							0.7 - 1.5m: bitumen present at 0.7m. Becomes dark brown, mottled orange. Moist.
Holocene Estuarine																		F						Sandy SILT; brown. Firm, moist, low plasticity. Sand; fine.
Holocene Estuarine																								1.8m: END OF INVESTIGATION

COMMENTS: Hand auger terminated as target depth reached.

Hole Depth
1.8m

Scale 1:10

HandAugerLog - 19/01/2021 2:27:31 pm - Produced with Core-GS by GeRoc
Box 1, 0.0-1.8m

CORE PHOTOS

BOREHOLE No.: **HA05**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.888538 -39.505976	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.:	12.50m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ZAFR
			CHECKED: JWY



0.00-1.80m

HAND AUGER LOG

HOLE Id: **HA06**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.888166 WGS84 -39.505869	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION														
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
				0	1	2	3	4	5	6	7	8	9											
Fill		100	HA											A+M @ 0.20m										Fine SAND, some silt, minor gravel; light brown. Tightly packed, dry, well graded. Gravel; fine to coarse.
				A+M @ 0.50m		0.5																	Fine SAND, some silt, minor gravel and cobbles; greyish brown. Tightly packed, moist, gap graded; gravel, fine to coarse. Cobbles; fine.	
														A+M @ 1.00m		1.0								1m: END OF INVESTIGATION

COMMENTS: Refusal at 1 m.

Hole Depth
1m

Scale 1:10

CORE PHOTOS

BOREHOLE No.: **HA06**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.888166 -39.505869	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.:	12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ZAFR
			CHECKED: JWY



0.00-1.00m

HAND AUGER LOG


PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887680 WGS84 -39.506068	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.: 12.50m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations				
				0	1	2	3	4	5	6	7	8	9														
Fill		100	HA												A+M @ 0.20m												Fine SAND some silt, minor gravel; light brown. Tightly packed, dry, gap graded. Contains minor glass fragments.
																12	0.5										0.3m: END OF INVESTIGATION
																	1.0										
																	1.5										

COMMENTS: No core photo taken as only shallow surface hand auger. Refusal at 0.3 m.

Hole Depth
0.3m

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887956416958 WGS84 -39.5056045022811	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION													
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
				0	1	2	3	4	5	6	7	8	9										
Fill		100	HA												Glass & ACM @ 0.20m				D	D			Fine SAND, some silt and gravel; light brown. Tightly packed, dry, gap graded. Gravel; fine to coarse.
																	0.5						0.3m: END OF INVESTIGATION
																	1.0						
																	1.5						

COMMENTS: No core photo taken as only shallow surface hand auger. Refusal at 0.3 m.

Hole Depth
0.3m

Scale 1:10

HAND AUGER LOG

HOLE Id: **HA09**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887806002406 WGS84 -39.5052000013893	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ZA FR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION															
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
				0	1	2	3	4	5	6	7	8	9												
Fill															A+M @ 0.20m						D	D			Silty, fine SAND, minor gravel; light brown. Tightly packed, dry, well graded. Gravel, fine.
Holocene Estuarine		100	HA												A+M @ 0.50m		0.5				M	L			Fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.
																A+M @ 1.00m		1.0				S			SILT; grey. Soft, moist, low plasticity.
																								1.15m: END OF INVESTIGATION	

COMMENTS: Refusal at 1.15 m.

Hole Depth
1.15m

Scale 1:10

HandAugerLog - 19/01/2021 2:27:38 pm - Produced with Core-GS by GeRoc

Rev.: A

CORE PHOTOS

BOREHOLE No.: **HA09**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (WGS84)	176.887806002406 -39.5052000013893	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.:	12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM:	NAPIHT1962		DRILLED BY: T+T
			LOGGED BY: ZAFR
			CHECKED: JWY



0.00-1.15m

HAND AUGER LOG

HOLE Id: HA10

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.887470997194 WGS84 -39.5059200391896	DRILL TYPE: Hand auger	HOLE STARTED: 11/01/2021
R.L.: 12.00m	DRILL METHOD: HA	HOLE FINISHED: 11/01/2021
DATUM: NAPIHT1962		DRILLED BY: T+T
		LOGGED BY: ZAFR CHECKED: JWY

GEOLOGICAL										ENGINEERING DESCRIPTION														
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)										TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
				0	1	2	3	4	5	6	7	8	9											
Fill		100	HA												A+M @ 0.20m					M	D			Silty, fine SAND, trace gravel; light brown. Tightly packed, moist, gap graded. Gravel, fine to coarse.
																	0.5							0.35m: END OF INVESTIGATION
																	1.0							
																	1.5							

COMMENTS: No core photo taken as only shallow surface hand auger. Refusal at 0.35 m.

Hole Depth
0.35m

Scale 1:10

BOREHOLE LOG

BOREHOLE No.:

BH01

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 27/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5620009.42 mN
 (NZTM2000) 1934296.78 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.		UW	US	HVAC	0		11	0.5										
	Fine to medium SAND; brown. Very loose, wet, uniformly graded.		UW	US	SPT	30	0/0 0/0 0/0 N=0		1.5										
	SILT, trace sand; grey. Very soft, moist, non-plastic; sand, fine.		UW	US	SNC	100		10	2.0				1.95m: Glass jar and asbestos sample						
	SILT, trace clay; grey. Very soft, moist, low to moderate plasticity.		UW	US	SPT	100	0/1 0/0 0/0 N=0	9	3.0										
	Sandy SILT, trace shell fragments; grey. Very soft, moist, low plasticity. Sand; fine.		UW	US	SNC	100		8	3.5				3.45m: Glass jar sample only						
	SILT, trace clay; grey. Very soft, moist, low plasticity. 4.00m: Becomes moderate plasticity.		UW	US	SPT	100	0/0 0/0 0/1 N=1		4.5										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 1, 0.0-4.3m

27/11/2020

BOREHOLE LOG

BOREHOLE No.:

BH01

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 27/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5620009.42 mN
 (NZTM2000) 1934296.78 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	Sandy SILT, trace shell fragments; grey. Very soft, moist, low plasticity; sand, fine.				SNC	100			5.5										
	Silty, fine SAND; grey. Very loose, moist, uniformly graded. Minor shell inclusions.				SNC	100			6.0										
	Fine SAND, minor silt; grey. Medium dense, moist, uniformly graded. Minor shell inclusions.				SPT	100	2/3 4/4 3/6 N=17		6.5										
	6.45m: Becomes wet.								7.0										
	7.00m: Becomes moist, slightly dilatant.				SNC	100			7.5										
	7.50m: Becomes very loose to loose.				SPT	60	1/1 1/0 1/1 N=3		8.0										
	SILT, trace fine sand and shell fragments; grey. Soft, moist, non-plastic to low plasticity.				SNC	100			8.5										
	Silty, fine SAND; grey. Very loose, moist, uniformly graded. Minor shell fragments.				SPT	80	0/0 0/0 1/1 N=2		9.0										
					SNC	100			9.5										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 2, 4, 3-7.0m

Box 3, 7.0-10.0m

BOREHOLE LOG

BOREHOLE No.:

BH01

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 27/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5620009.42 mN
 (NZTM2000) 1934296.78 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	SILT, minor sand; grey. Very soft, moist, low to medium plasticity.		UW	US	SNC	100			10.5	X									
	Sandy SILT; grey. Firm, moist, non-plastic; sand, fine.		UW	US	PT	100			10.5	X									
	10.5-10.95m: Push tube.								10.5	X									
	Silty, fine SAND; grey. Loose, moist, poorly graded.		UW	US	SNC	100			11.0	X									
	SILT; grey. Soft, moist, low plasticity.		UW	US	SNC	100			11.5	X									
	Fine SAND, some silt; grey. Loose, moist, uniformly graded.		UW	US	SPT	100		1/1 2/1 1/1 N=5	12.0	X									
	Sandy SILT; grey. Firm to stiff, moist, low plasticity; sand, fine.		UW	US	SNC	100			12.5	X									
	Silty, fine SAND; grey. Medium dense, moist, uniformly graded.		UW	US	SPT	100		2/0 1/3 4/2 N=10	13.0	X									
	SILT, trace sand; grey. Firm to stiff, non-plastic. Sand; fine.		UW	US	SNC	100			13.5	X									
Fine SAND; grey. Medium dense, moist, uniformly graded. Minor shell inclusions.		UW	US	SNC	100			14.0	X										
		UW	US	SNC	100			14.5	X										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 4, 10.0-13.0m

BOREHOLE LOG

BOREHOLE No.:

BH01

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 27/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5620009.42 mN
 (NZTM2000) 1934296.78 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	Fine SAND, some silt; dark grey. Medium dense, moist, uniformly graded. Minor shell inclusions.				SPT	100	3/3 5/5 7/10 N=27		15.5										
	15.45m: Grades to minor silt.				SNC	100			16.0										
	Fine SAND, minor silt; grey. Medium dense, moist, uniformly graded.								16.5										
	Silty, sandy, fine GRAVEL; grey. Medium dense, moist, well graded. Gravel, greywacke, rounded to subrounded. Sand fine to medium.				SPT	100	0/7 6/5 5/9 N=25		17.0										
	16.95m: Grades to gravel, fine to medium.				SNC	100			17.5										
	Fine SAND; grey. Medium dense, moist, uniformly graded.								18.0										
	Sandy, fine GRAVEL; grey. Medium dense, moist, uniformly graded; sand, fine to medium.				SPT	100	7/9 8/6 4/4 N=22		18.5										
	SILT, trace sand; grey. Very stiff, moist, non-plastic to low plasticity; sand, fine.							19.0											
	SILT; grey. Very stiff, moist, non-plastic to low plasticity.				SNC	100			19.5										
	19.50m: becomes stiff.				SPT	100	0/1 2/5 3/4 N=14		19.5										
	19.95m: END OF BOREHOLE																		

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 5, 13.0-16.0m

Box 6, 16.0-19.0m

Box 7, 19.0-20.0m

CORE PHOTOS

BOREHOLE No.: **BH01**
SHEET: 1 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5620009.42 mN 1934296.78 mE	DRILL TYPE:	HOLE STARTED: 27/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.30m



4.30-7.00m

CORE PHOTOS

BOREHOLE No.: **BH01**

SHEET: 2 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5620009.42 mN 1934296.78 mE	DRILL TYPE:	HOLE STARTED: 27/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.00-10.00m



10.00-13.00m

CORE PHOTOS

BOREHOLE No.: **BH01**
 SHEET: 3 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5620009.42 mN 1934296.78 mE	DRILL TYPE:	HOLE STARTED: 27/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd LOGGED BY: ZAFR CHECKED: JWY



13.00-16.00m



16.00-19.00m

CORE PHOTOS

BOREHOLE No.: **BH01**
 SHEET: 4 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5620009.42 mN 1934296.78 mE	DRILL TYPE:	HOLE STARTED: 27/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



19.00-19.95m



BOREHOLE LOG

BOREHOLE No.:

BH02

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619921.89 mN
 (NZTM2000) 1934314.54 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.		UW MW SW CW	US MS SS CS ES EW	HVAC	0		11											
	Fine to medium SAND; greyish brown. Medium dense, moist, uniformly graded.				SPT	100	1/1 3/4 3/3 N=13		1.5										
	Silty, fine to medium SAND; grey. Medium dense, moist, uniformly graded.								10					1.95m: Glass jar and asbestos sample					
	SILT, minor clay; grey. Very soft to soft, moist, moderate plasticity.				SNC	100			2.5										
	3.00m: Becomes very soft.				SPT	100	0/0 0/0 0/0 N=0		9										
	Sandy SILT; grey. Very soft, moist, non-plastic; sand, fine to medium. Some shell inclusions.								3.5					3.45m: Glass jar sample only					
	SILT, minor clay; grey. Very soft, moist, moderate plasticity.				SNC	100			8										
	SILT, trace sand; grey. Very soft, moist, non-plastic; sand, fine.								4.0										
Fine SAND; grey. Medium dense, moist, uniformly graded.				SPT	100	1/2 3/2 3/4 N=12		4.5											

COMMENTS:

Hole Depth
19.95m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH02

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619921.89 mN
 (NZTM2000) 1934314.54 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	Fine to coarse SAND; grey. Medium dense, moist, well graded. Minor shell inclusions.				SNC	100			5.5										
	Silty, fine SAND; grey. Medium dense, moist, uniformly graded. Minor shell inclusions.				SPT	100	1/2 3/4 5/6 N=18		6.0										
	7.50m: Becomes loose.				SNC	100			7.0										
					SPT	100	0/1 0/1 3/4 N=8		7.5										
	Sandy SILT; grey. Firm, moist, non-plastic; sand, fine. Minor shell inclusions.				SNC	100			8.0										
	SILT, some fine sand; grey. Soft, moist, low plasticity.				SPT	100	0/0 0/1 1/0 N=2		9.0										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 2, 4, 5, 7, 2m

Box 3, 7, 2-10.0m



BOREHOLE LOG

BOREHOLE No.:

BH02

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619921.89 mN
 (NZTM2000) 1934314.54 mE

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

DIRECTION:
 ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)							
Holocene Estuarine	[CONT] SILT, some fine sand; grey. Soft, moist, low plasticity.				SNC	100			10.5	X										
	10.5-10.95m: Push tube (Unable to recover sample).				PT	0			11.0	X										
	Sandy SILT; grey. Soft to firm, moist, non-plastic. Sand; fine.				SNC	100			11.5	X										
	SILT; grey. Soft to firm, moist, low plasticity.								12.0	X										
	12.0-12.45m: Push tube.				PT	100			12.5	X										
	Fine SAND, trace silt; grey. Medium dense, moist, uniformly graded.								13.0	X										
	Sandy SILT; grey. Soft to firm, moist, low plasticity; sand, fine.					SNC	100		13.5	X										
	Fine SAND, trace silt; grey. Medium dense, moist, uniformly graded.					SPT	100	4/3 3/4 4/11 N=22	14.0	X										
	Silty, fine SAND; grey. Medium dense, moist, uniformly graded.					SNC	100		14.5	X										
	SILT; grey. Stiff to very stiff, moist, low plasticity.									X										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 4, 10.0-12.5m

BOREHOLE LOG

BOREHOLE No.:

BH02

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 27/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619921.89 mN
 (NZTM2000) 1934314.54 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	Fine SAND, minor silt; dark grey. Medium dense, moist, uniformly graded. Minor shell fragments.				SPT	100	3/4 6/3 4/5 N=18		15.5									
	16.50m: Becomes loose.				SNC	100			16.0									
					SPT	100	0/0 0/1 2/3 N=6		16.5									
	Silty, sandy, fine to medium GRAVEL; dark grey. Dense, well graded; sand, fine to medium. Minor shell fragments.				SNC	100			17.0									
					SPT	100	3/5 9/11 10/7 N=37		18.0									
	Sandy SILT; grey. Firm to stiff, moist, low plasticity; sand, fine.				SNC	100			18.5									
	19.95m: END OF BOREHOLE				SPT	100	1/0 1/0 1/3 N=5		19.5									

COMMENTS:

Hole Depth
19.95m

Scale 1:25

CORE PHOTOS

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619921.89 mN 1934314.54 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.30m



4.30-7.15m

CORE PHOTOS

BOREHOLE No.: **BH02**

SHEET: 2 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619921.89 mN 1934314.54 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.15-10.00m



10.00-12.80m

CORE PHOTOS

BOREHOLE No.: **BH02**
 SHEET: 3 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619921.89 mN 1934314.54 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



12.80-15.75m



15.75-18.80m

CORE PHOTOS

BOREHOLE No.: **BH02**

SHEET: 4 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619921.89 mN 1934314.54 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 27/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



18.80-19.95m



BOREHOLE LOG

BOREHOLE No.:

BH03

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 30/11/2020

FINISH DATE: 30/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619813.26 mN
 (NZTM2000) 1934331.39 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS																
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.				HVAC	0													
	Fine SAND, some silt; brown, mottled grey. Loose, moist, uniformly graded.				SPT	100	1/1 1/2 2/2 N=7		1.5										
	SILT, minor sand; brown. Firm, moist, low plasticity. Sand; fine. 2.00m: rusted metal fragments.								2.0					1.95m: Glass jar and asbestos sample					
	Sandy SILT; brown. Firm, moist, non-plastic. Sand; fine.				SNC	100			2.5										
	Fine SAND; brown. Loose, moist, uniformly graded. 2.80m: becomes grey.								3.0										
	3.0-3.45m: Push tube.				PT	100	Push tube @ 3.00m		3.0										
SILT, minor clay; grey. Very soft, moist, moderately plastic.				SNC	100			3.5					3.45m: Glass jar and asbestos sample						
				SPT	100	1/1 0/1 0/0 N=1		4.5											

COMMENTS:

Hole Depth
15.45m

Scale 1:25



BOREHOLE LOG

BOREHOLE No.:

BH03

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 30/11/2020

FINISH DATE: 30/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619813.26 mN
 (NZTM2000) 1934331.39 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering <small>UW MW SW CW</small>	Rock Strength <small>US MS SS ES EW</small>	Sampling Method Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%) <small>25 50 75</small>	Water Level	Casing	Installation	Core Box No			
									Defect Log <small>2000 1000 500 200 100 50 20</small>	Fracture Spacing (mm)	RQD (%)									
Holocene Estuarine	Silty, fine SAND; grey. Loose, moist, uniformly graded. Minor shell inclusions. 6.00m: Becomes medium dense.			SNC	100		5.5													
				SPT	100	0/1 1/3 3/4 N=11	6.0													
				SNC	100		7.0													
				SPT	100	1/2 2/2 3/3 N=10	7.5													
				SNC	100		8.5													
	9.00m: Becomes loose.			SPT	100	1/1 2/1 2/1 N=6	9.0													
				SNC	100		9.5													

COMMENTS:

Hole Depth
15.45m

Scale 1:25

Box 2, 4.0-7.5m

Box 3, 7.5-9.5m



BOREHOLE LOG

BOREHOLE No.:

BH03

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 30/11/2020

FINISH DATE: 30/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619813.26 mN
 (NZTM2000) 1934331.39 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS																
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Holocene Estuarine	SILT; grey. Soft, moist, low plasticity.		UW	US	SNC	100			10.5		2000								
	SILT, trace sand; grey. Very soft, moist, low plasticity.		UW	US	SPT	100	0/0 0/0 0/1 N=1		11.0		2000								
	SILT, some sand; grey. Soft to firm, moist, non-plastic.		UW	US	SNC	100			11.5		2000								
	Sandy SILT; grey. Stiff, moist, non-plastic; sand, fine. Trace shell fragments.		UW	US	SPT	100	1/1 2/1 3/4 N=10		12.0		2000								
	SILT, minor sand; grey. Stiff, moist, low plasticity. Sand; fine.		UW	US	SNC	100			12.5		2000								
	SILT, some sand; grey. Firm, moist, low plasticity. Sand; fine.		UW	US	SPT	100	1/1 0/3 4/3 N=10		13.0		2000								
	Fine SAND, minor silt; grey. Medium dense, wet, uniformly graded. Minor shell fragments.		UW	US	SNC	100			13.5		2000								

COMMENTS:

Hole Depth
15.45m

Scale 1:25

Box 4, 9.5-12.0m

Box 5, 12.0-14.8m

Rev.: A



Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:

BH03

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 30/11/2020

FINISH DATE: 30/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
JOB No.: 1009171.0000
LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619813.26 mN
(NZTM2000) 1934331.39 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
R.L. COLLAR:
DATUM: NAPIHT1962
SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS																
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
			UW US MS MW CW	US MS MW CW EW							2000 1000 500 200 100 50 20		25 50 75						
Holocene Estuarine	[CONT] Fine SAND, minor silt; grey. Very loose, wet, uniformly graded. Minor shell fragments.				SPT	100	0/0 0/2 0/0 N=2												Box 6, 14.8-15.5m
	15.45m: END OF BOREHOLE							15.5											
								16.0											
								16.5											
								17.0											
								17.5											
								18.0											
								18.5											
								19.0											
								19.5											

COMMENTS:

Hole Depth
15.45m

Scale 1:25

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619813.26 mN 1934331.39 mE	DRILL TYPE:	HOLE STARTED: 30/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 30/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.00m



4.00-7.50m

CORE PHOTOS

BOREHOLE No.: **BH03**
SHEET: 2 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619813.26 mN 1934331.39 mE	DRILL TYPE:	HOLE STARTED: 30/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 30/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.50-9.45m



9.45-12.00m

CORE PHOTOS

BOREHOLE No.: **BH03**

SHEET: 3 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619813.26 mN 1934331.39 mE	DRILL TYPE:	HOLE STARTED: 30/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 30/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



12.00-14.80m



14.80-15.45m

BOREHOLE LOG

BOREHOLE No.:

BH04

SHEET: 1 OF 3

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 01/12/2020

FINISH DATE: 01/12/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619857.32 mN
 (NZTM2000) 1934264.36 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.		UW	US	HVAC	0		11	0.5									
	Fine SAND; brownish grey. Very loose, wet, uniformly graded. Minor shell inclusions.				SPT	50	0/0 1/0 1/0 N=2		1.5									
	Fine SAND, minor clay; grey. Very loose, wet, uniformly graded. Minor shell inclusions.							10	2.0				1.95m: Glass jar + asbestos					
	SILT, trace sand; grey. Very soft, moist, non-plastic. Minor shell inclusions.				SNC	100			2.5									
	3.0-3.45m: Push tube sample.				PT	0	Push tube @ 3.00m	9	3.0				3.00m: Glass jar + asbestos					
	SILT, minor clay; grey. Very soft, moist, low to moderate plasticity. Minor shell inclusions.								3.5				3.45m: Glass jar					
	Sandy SILT; grey. Very soft, moist, non-plastic; sand, fine. Minor shell inclusions.				SNC	100		8	4.0									
	SILT, minor clay; grey. Very soft, moist, low to moderate plasticity.				SPT	100	0/0 0/0 0/0 N=0		4.5									

COMMENTS:

Hole Depth
12.45m

Scale 1:25



BOREHOLE LOG

BOREHOLE No.:

BH04

SHEET: 2 OF 3

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 01/12/2020

FINISH DATE: 01/12/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619857.32 mN
 (NZTM2000) 1934264.36 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	[CONT] SILT, minor clay; grey. Very soft, moist, low to moderate plasticity.				SNC	100			5.5										
	6.00m: Becomes soft.				SPT	100	0/0 1/0 1/1 N=3		6.0										
	Sandy SILT; grey. Soft to firm, moist, non-plastic; sand, fine. Minor shell inclusions.				SNC	100			6.5										
	7.50m: Becomes stiff.				SPT	100	1/0 3/2 2/2 N=9		7.5										
	Fine SAND, some silt; dark grey. Loose, moist, uniformly graded. Minor shell inclusions.				SNC	100			8.0										
	8.50m: organics present.				SNC	100			8.5										
	9.00m: Becomes very loose.				SPT	100	0/0 0/0 0/2 N=2		9.0										
	Sandy SILT; dark grey. Soft, moist, non-plastic. Sand; fine.				SNC	100			9.5										

COMMENTS:

Hole Depth
12.45m

Scale 1:25

Box 2, 4, 5-7, 0m

Box 3, 7, 0-10, 0m



BOREHOLE LOG

BOREHOLE No.:

BH04

SHEET: 3 OF 3

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 01/12/2020

FINISH DATE: 01/12/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619857.32 mN
 (NZTM2000) 1934264.36 mE

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

DIRECTION:
 ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	SILT, some sand; dark grey. Very soft, moist, non-plastic; sand, fine.				SNC	100			10.5										
	10.50m: Becomes soft to firm.				SPT	100	2/1 0/1 1/2 N=4												
Holocene Estuarine	Silty, fine SAND; dark grey. Loose, moist, uniformly graded.				SNC	100			11.0										
	12.00m: Becomes medium dense.				SPT	100	1/0 2/6 7/8 N=23												
	12.45m: END OF BOREHOLE								12.5										
									13.0										
									13.5										
									14.0										
									14.5										

COMMENTS:

Hole Depth
12.45m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH04**
 SHEET: 1 OF 2

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619857.32 mN 1934264.36 mE	DRILL TYPE:	HOLE STARTED: 01/12/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 01/12/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.50m



4.50-7.00m

CORE PHOTOS

BOREHOLE No.: **BH04**
 SHEET: 2 OF 2

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619857.32 mN 1934264.36 mE	DRILL TYPE:	HOLE STARTED: 01/12/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 01/12/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.00-10.00m



10.00-12.45m

BOREHOLE LOG

BOREHOLE No.:

BH05

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 24/11/2020

FINISH DATE: 24/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre

JOB No.: 1009171.0000

LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619749.61 mN
(NZTM2000) 1934228.94 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m

R.L. COLLAR:

DATUM: NAPIHT1962

SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)							
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.		UW	US	HVAC	0		11	0.5		2000			0.50m: Glass jar and asbestos sample						
	Silty, fine to medium SAND; greyish brown. Very loose, moist, uniformly graded.		UW	US	SPT	100	0/1 0/1 0/0 N=1	10	1.5		600			1.50m: Glass jar only						
	2.5-3.0m: CORE LOSS.		UW	US	SNC	52		9	2.0		400			1.95 - 2.50m: Glass jar and asbestos sample						
	Fine to medium SAND, some silt; brown. Very loose, saturated, uniformly graded.		UW	US	SPT	100	0/0 0/0 0/0 N=0	8	3.0		200									
	SILT, minor clay and sand; grey. Very soft, moist, low to moderate plasticity; sand, fine.		UW	US	SNC	100		7	3.5		100				3.45 - 4.50m: Glass jar and asbestos sample					
	4.5-5.0m: Push tube.		UW	US	PT	100		6	4.5											

COMMENTS:

Hole Depth
19.95m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH05

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 24/11/2020

FINISH DATE: 24/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619749.61 mN
 (NZTM2000) 1934228.94 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	SILT, some clay; grey. Very soft, moist, moderate plasticity. Some shell fragments.		UW	US	SNC	100			5.5	X								Box 1, 0.0-5.3m
	Interbedded SILT and SAND; grey. Very soft (Silt) and very loose (Sand), moist, low plasticity/uniformly graded.		UW	US	SPT	100	0/0 0/0 0/1 N=1		6.0	X								
	SILT, some clay; grey. Very soft, moist, low to moderate plasticity.		UW	US	SNC	100			6.5	X								
	Interbedded SILT and SAND; grey. Very soft (Silt) and very loose (Sand), moist, low plasticity/uniformly graded.		UW	US	SNC	100			7.0	X								
	Fine SAND, trace silt; greyish brown streaked orange. Very loose, moist, uniformly graded.		UW	US	SNC	100			7.5	X								
	Silty, fine to medium SAND; grey. Very loose, moist, uniformly graded.		UW	US	SPT	100	1/1 2/0 0/0 N=2		8.0	X								
	Silty, fine to medium SAND; grey. Very loose, moist, uniformly graded.		UW	US	SNC	100			8.5	X								
	Fine to medium SAND, some silt; grey. Loose, uniformly graded. Some shell fragments.		UW	US	SPT	100	1/1 1/1 2/2 N=6		9.0	X								
SILT, trace clay, minor sand; grey. Firm, moist, low to medium plasticity; sand, fine.		UW	US	SNC	100			9.5	X									

COMMENTS:

Hole Depth
19.95m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH05

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 24/11/2020

FINISH DATE: 24/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre

JOB No.: 1009171.0000

LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619749.61 mN
(NZTM2000) 1934228.94 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m

R.L. COLLAR:

DATUM: NAPIHT1962

SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						
Holocene Estuarine	[CONT] SILT, minor sand; grey. Firm, moist, low plasticity; sand, fine.		UW	US	SNC	100			10.5										
	Fine to medium SAND, minor silt; grey. Very loose, moist, uniformly graded.		UW	US	SPT	100	0/0 0/0 0/1 N=1		11.0										
	Silty, fine to medium SAND; grey. Very loose, moist, uniformly graded.		UW	US	SNC	100			11.5										
Holocene Estuarine	Silty, fine SAND; grey. Dense, moist, uniformly graded.		UW	US	SPT	100	3/4 6/9 9/9 N=33		12.0										
	Medium SAND; grey. Dense, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100			12.5										
	Fine SAND, minor silt; grey. Dense, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100			13.0										
	Silty, fine SAND; grey Medium dense, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100			13.5										
	Medium SAND; grey. Medium dense, moist, uniformly graded.		UW	US	SPT	100	1/1 1/7 8/8 N=24		14.0										
	Medium SAND, trace silt; grey. Medium dense, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100			14.5										

COMMENTS:

Hole Depth
19.95m

Scale 1:25



BOREHOLE LOG

BOREHOLE No.:

BH05

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 24/11/2020

FINISH DATE: 24/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619749.61 mN
 (NZTM2000) 1934228.94 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	Fine SAND, trace silt; grey. Medium dense, moist, uniformly graded.		UW	US	SPT	100	1/2 4/6 6/10 N=26	15.5											
	Fine to medium SAND, trace silt; grey. Medium dense to dense, moist, uniformly graded.		UW	US	SNC	100		16.0											
	Fine to medium SAND, trace silt; grey. Medium dense to dense, moist, uniformly graded.		UW	US	SPT	100	3/4 6/7 9/11 N=33	16.5											
	Fine SAND, some silt; grey. Dense, moist, uniformly graded.		UW	US	SNC	100		17.0											
	Fine to coarse SAND, some gravel; grey. Dense, moist, well graded; gravel, fine, greywacke. subrounded. Some shell fragments.		UW	US	SPT	100	10/11 13/15 15/7 N>=50	18.0											
	SILT; grey. Stiff, moist, low plasticity.		UW	US	SNC	100		18.5											
	SILT, minor clay; grey. Stiff, moist, medium plasticity.		UW	US	SNC	100		19.0											
	SILT, minor clay, trace sand; grey. Firm, moist, medium plasticity.		UW	US	SPT	100	0/0 0/0 2/3 N=5	19.5											
	19.95m: END OF BOREHOLE																		

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 5, 13.4-16.2m

Box 6, 16.2-18.9m

Box 7, 18.9-20.0m

CORE PHOTOS

BOREHOLE No.: **BH05**
SHEET: 1 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619749.61 mN 1934228.94 mE	DRILL TYPE:	HOLE STARTED: 24/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 24/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-5.25m



5.25-7.95m

CORE PHOTOS

BOREHOLE No.: **BH05**
 SHEET: 2 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619749.61 mN 1934228.94 mE	DRILL TYPE:	HOLE STARTED: 24/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 24/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.95-10.50m



10.50-13.35m

CORE PHOTOS

BOREHOLE No.: **BH05**
 SHEET: 3 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619749.61 mN 1934228.94 mE	DRILL TYPE:	HOLE STARTED: 24/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 24/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



13.35-16.20m



16.20-18.90m

CORE PHOTOS

BOREHOLE No.: **BH05**

SHEET: 4 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619749.61 mN 1934228.94 mE	DRILL TYPE:	HOLE STARTED: 24/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 24/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



18.90-19.95m

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre

JOB No.: 1009171.0000

LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619729.63 mN
(NZTM2000) 1934292.36 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m

R.L. COLLAR:

DATUM: NAPIHT1962

SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.		UW	US	HVAC	0		11											
	Fine SAND; greyish brown. Very loose, moist, uniformly graded. Minor shell fragments.		UW	US	SPT	100	0/0 1/0 0/1 N=2	10	1.5				0.10m: Glass jar and asbestos sample 0.50m: Glass jar and asbestos sample 1.00m: Glass jar and asbestos sample 1.50m: Glass jar and asbestos sample 1.95m: Glass jar and asbestos sample						
	SILT, minor clay; grey. Very soft, moist, moderate plasticity. Minor shell fragments. 2.80m: becomes light grey.		UW	US	SNC	100		9	2.0				3.00m: Glass jar and asbestos sample						
	SILT, trace clay; light grey. Very soft, moist, moderate plasticity. Some shell fragments.		UW	US	SPT	100	0/0 0/0 0/0 N=0	8	3.0				3.45m: Glass jar sample						
	4.5-5.0m: Push tube.		UW	US	SNC	100		7	3.5										
			UW	US	PT	0	Push tube @ 4.50m		4.5										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619729.63 mN
 (NZTM2000) 1934292.36 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	Silty, fine SAND; grey. Very loose, wet, uniformly graded, dilatant. Minor shell fragments.		UW	US	SNC	100			5.5									
	Fine SAND, minor silt; grey. Very loose, moist, uniformly graded.		UW	US	SPT	100	0/0 0/1 2/0 N=3		6.0									
	Silty, fine SAND; grey. Very loose, wet, uniformly graded. Some shell fragments.		UW	US					6.5									
	Fine SAND, trace silt; grey. Very loose, wet, uniformly graded. Minor shell fragments.		UW	US	SNC	100			7.0									
	Fine SAND, some silt; grey. Very loose, moist, uniformly graded. Minor shell fragments.		UW	US	SPT	100	0/0 0/0 0/1 N=1		7.5									
	Silty, fine SAND; grey. Very loose, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100			8.0									
	9.00m: Becomes loose.		UW	US	SPT	100	0/1 2/1 1/1 N=5		9.0									
	SILT, trace clay; grey. Firm, moist, low plasticity.		UW	US	SNC	100			9.5									

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 2, 4, 2-7, 2m

Box 3, 7, 2-9, 9m

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619729.63 mN
 (NZTM2000) 1934292.36 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)						Description & Additional Observations
Holocene Estuarine	SILT; grey. Firm, moist, low plasticity. Some shell fragments.		UW	US	SNC	100			10.5	X									
	SILT, some sand; grey. Stiff, moist, low plasticity; sand, fine. Some shell fragments.		UW	US	SPT	100	1/0 1/3 3/5 N=12		11.0	X									
	Silty, fine SAND; grey. Medium dense, moist, uniformly graded. Trace shell fragments.		UW	US	SNC	100			11.5	X									
	11.90m: organics.		UW	US	SNC	100			12.0	X									
	Fine to medium SAND; dark grey. Medium dense, wet, uniformly graded. Minor shell fragments.		UW	US	SPT	100	1/3 5/6 6/7 N=24		12.5	X									
	Fine SAND, trace silt; dark grey. Medium dense, wet, uniformly graded. Minor shell fragments.		UW	US	SNC	100			13.0	X									
	SILT; grey. Stiff to very stiff, moist, non-plastic. Minor shell fragments.		UW	US	SPT	100	2/5 6/5 3/3 N=17		13.5	X									
	Fine to medium SAND, some silt; grey. Medium dense, wet, uniformly graded. Minor shell fragments.		UW	US	SNC	100			14.0	X									
14.80m: Medium SAND; dark grey.		UW	US	SNC	100			14.5	X										

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 4, 9, 9, 12.8m



BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619729.63 mN
 (NZTM2000) 1934292.36 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)							
Holocene Estuarine	Fine SAND, minor silt; grey. Medium dense, moist, uniformly graded. Some shell fragments.		UW	US	SPT	100	1/2 5/5 5/4 N=19	15.5												
	Fine to medium SAND, minor silt. Medium dense, moist, uniformly graded. Some shell fragments.		UW	US	SNC	100		16.0												
	Fine to medium SAND, some silt. Loose, moist, uniformly graded. Some shell fragments.		UW	US	SPT	100	1/1 1/1 3/4 N=9	16.5												
	Silty, fine to medium SAND. Loose, moist, uniformly graded. Some shell fragments.		UW	US	SNC	100		17.0												
	SILT; grey. Stiff, moist, low to medium plasticity.		UW	US	SNC	100		17.5												
	Gravelly, fine to medium SAND; dark grey. Medium dense, moist; sand, well graded; gravel, fine. Some shell fragments.		UW	US	SPT	100	4/7 6/7 5/6 N=24	18.0												
	SILT; grey. Stiff to very stiff, moist, low to medium plasticity.		UW	US	SNC	100		18.5												
	Medium SAND; grey. Medium dense, moist, uniformly graded.		UW	US	SNC	100		19.0												
	Sandy SILT; grey. Soft, moist, non-plastic; sand, fine.		UW	US	SPT	100	1/1 0/0 0/0 N=0	19.5												
19.50m: very soft.																				
19.95m: END OF BOREHOLE																				

COMMENTS:

Hole Depth
19.95m

Scale 1:25

Box 5, 12.8-15.6m

Box 6, 15.6-18.0m

Box 7, 18.0-20.0m

CORE PHOTOS

BOREHOLE No.: **BH06**
SHEET: 1 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619729.63 mN 1934292.36 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.20m



4.20-7.20m

CORE PHOTOS

BOREHOLE No.: **BH06**
SHEET: 2 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619729.63 mN 1934292.36 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.20-9.90m



9.90-12.80m

CORE PHOTOS

BOREHOLE No.: **BH06**
 SHEET: 3 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619729.63 mN 1934292.36 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



12.80-15.60m



15.60-18.00m

CORE PHOTOS

BOREHOLE No.: **BH06**

SHEET: 4 OF 4

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619729.63 mN 1934292.36 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



18.00-19.95m

BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619693.59 mN
 (NZTM2000) 1934348.88 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.50m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)					
Fill	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.				HVAC	0		12	0.5									
	1.5-1.95m: CORE LOSS.				SPT	0	0/0 0/0 0/0 N=0	11	1.5									
Holocene Estuarine	Silty, fine to medium SAND; brown to dark brown, mottled orange. Very loose, moist, uniformly graded.				SNC	100		10	2.0				1.95m: Glass jar and asbestos sample					
	Fine to medium SAND, some silt; brown to dark brown, mottled orange. Very loose, moist, uniformly graded.				SPT	100	0/0 0/0 0/0 N=0	9	3.0				2.70m: Glass jar and asbestos sample					
	SANDY SILT, trace clay; grey. Very soft, moist, low to medium plasticity. Sand; fine to medium. Minor shell fragments present.				SNC	100		9	3.5				3.45m: Glass Jar sample					
	SILT, minor sand, trace clay; grey. Very soft, moist, low to medium plasticity. Sand; fine to medium. Minor shell fragments present.				PT	60		8	4.5									
	4.5-5.0m: Push tube.								8									

25/11/2020: on completion

COMMENTS:

Hole Depth
16.95m

Scale 1:25

Box 1, 0.0-4.5m

Rev.: A



BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619693.59 mN
 (NZTM2000) 1934348.88 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.50m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS														
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering US MS MW CW CU	Rock Strength US MS MW CW CU	Sampling Method Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box No
Holocene Estuarine	Fine to medium SAND; grey. Very loose, saturated, uniformly graded. Some shell fragments present. 5.30m: Becomes moist to wet.			SNC	100		5.5										
	Silty, fine to medium SAND; grey. Very loose, moist, uniformly graded. Some shell fragments present.			SPT	100	0/0 1/0 0/1 N=2	6.0										
	Fine to medium SAND, trace silt; grey. Very loose, moist, uniformly graded. Some shell fragments present. 7.50m: Becomes loose to medium dense.			SNC	100		7.0										
				SPT	100	2/2 2/2 2/3 N=9	7.5										
	Fine to medium SAND, minor silt and organics; grey. Loose, moist, uniformly graded. Some shell fragments present. 7.95m: 5mm thick organic layer.			SNC	100		8.0										
				SPT	100	0/0 2/4 3/4 N=13	9.0										
	Fine to medium SAND, some silt, minor organics; grey. Medium dense, moist, uniformly graded. Some shell fragments present.			SNC	100		9.5										

COMMENTS:

Hole Depth
16.95m

Scale 1:25



BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619693.59 mN
 (NZTM2000) 1934348.88 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.50m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	[CONT] Fine to medium SAND, some silt, minor organics; grey. Medium dense, moist, uniformly graded. Some shell fragments present.		UW	US	SNC	100												
	SILT, trace sand; grey. Soft, moist, low plasticity; sand, fine. Some shell fragments.		UW	US	SPT	100	2/0 0/0 0/0 N=0	10.5										
	SILT, minor sand; grey. Very soft, moist, low plasticity; sand, fine. Some shell fragments.		UW	US	SPT	100	0/2 1/3 3/3 N=10	12.0										
	Silty, fine SAND; grey. Medium dense, moist, uniformly graded. Some shell fragments.		UW	US	SPT	100	0/2 1/3 3/3 N=10	12.5										
	SILT, some sand; grey, streaked dark grey. Stiff, moist, medium plasticity. Sand; fine to medium. Some shell fragments.		UW	US	SNC	100		13.0										
	Sandy SILT; grey. Stiff, moist, medium plasticity. Sand; fine to medium. Some shell fragments.		UW	US	SNC	100		13.5										
	Fine to medium SAND; grey. Medium dense, moist, uniformly graded.		UW	US	SPT	100	2/5 6/6 8/8 N=28	14.0										
	Silty fine to medium SAND; grey. Medium dense, moist, uniformly graded. Some shell fragments.		UW	US	SNC	100		14.5										

COMMENTS:

Hole Depth
16.95m

Scale 1:25

General Log - 20/11/2021 12:07:33 pm - Produced with Core-GS by GeRoc

Box 4, 10.5-13.2m

Box 3, 8.0-10.5m



BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619693.59 mN
 (NZTM2000) 1934348.88 mE

R.L. GROUND: 12.50m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

DIRECTION:
 ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS																
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
			UW MW CW	US MS CS	US MS CS EW	SPT					2000 600 600 600 200 20		25 50 75						
Holocene Estuarine	Fine SAND, minor silt; grey. Medium dense, moist to wet, uniformly graded, Minor shell fragments present.				SPT	100	0/1 2/4 6/8 N=20	-3	15.5										
	Fine to medium SAND, minor silt; grey. Medium dense, moist to wet, uniformly graded, Minor shell fragments present.				SNC	100			16.0										
					SPT	100	2/3 5/6 6/8 N=25	-4	16.5										
16.95m: END OF BOREHOLE								17.0											
								17.5											
								18.0											
								18.5											
								19.0											
								19.5											

COMMENTS:

Hole Depth
16.95m

Scale 1:25

Rev.: A

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619693.59 mN 1934348.88 mE	DRILL TYPE:	HOLE STARTED: 23/11/2020
R.L.:	12.50m	DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-4.50m



4.50-7.95m

CORE PHOTOS

BOREHOLE No.: **BH07**

SHEET: 2 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619693.59 mN 1934348.88 mE	DRILL TYPE:	HOLE STARTED: 23/11/2020
R.L.:	12.50m	DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.95-10.45m

10.45-13.20m

CORE PHOTOS

BOREHOLE No.: **BH07**

SHEET: 3 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619693.59 mN 1934348.88 mE	DRILL TYPE:	HOLE STARTED: 23/11/2020
R.L.:	12.50m	DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



13.20-16.05m



16.05-16.95m

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 1 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619875.47 mN
 (NZTM2000) 1934377.03 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS																
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Fill	0.0-1.5m: NO RECOVERY - hydrovac. Refer to nearby test pit/hand auger logs for shallow subsoil information.				HVAC	0													
	Gravelly, fine to coarse SAND; dark grey. Medium dense, moist, uniformly graded. Some pumice fragments.				SPT	100	0/0 2/3 4/3 N=12		1.5					0.50m: Glass jar and asbestos sample 1.10m: Glass jar and asbestos sample 1.95m: Glass jar and asbestos sample					
Holocene Estuarine	Fine to medium SAND; grey. Medium dense, moist, uniformly graded. Minor shell fragments.								2.0										
	2.4-3.0m: CORE LOSS.				SNC	42			2.5										
	3.0-3.45m: Push tube.				PT	100	Push tube @ 3.00m		3.0										
	SILT; grey. Soft, moist, low to moderate plasticity. Minor shell fragments.								3.5					3.45m: Glass jar and asbestos sample					
	Sandy SILT; grey. Soft, moist, low plasticity; sand, fine. Some shell fragments.					SNC	100		4.0										
	Fine SAND; grey. Loose, moist to wet, uniformly graded.								4.5										
	Medium SAND; grey. Very loose, moist to wet, uniformly graded. Some shell fragments.				SPT	100	1/0 0/0 1/1 N=2		4.5										

COMMENTS:

Hole Depth
15.45m



BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 2 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619875.47 mN
 (NZTM2000) 1934377.03 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	[CONT] Medium SAND; grey. Very loose, moist to wet, uniformly graded. Some shell fragments.				SNC	100			5.5									
	Fine to medium SAND; grey. Very loose, moist to wet, uniformly graded. Some shell fragments.				SNC	100			6.0									
	Fine SAND; grey. Medium dense, moist to wet, uniformly graded. Some shell fragments.				SPT	100	1/2 2/3 3/2 N=10		6.5									
	Silty, fine SAND; grey. Medium dense, uniformly graded. Some shell fragments.				SNC	100			7.0									
	7.50m: Becomes medium dense.				SPT	100	2/2 2/6 8/7 N=23		7.5									
	Sandy SILT; grey. Soft, low plasticity. Sand; fine. Some shell fragments.				SNC	100			8.5									
	SILT, minor sand; grey. Very soft, moist, low to medium plasticity. Sand; fine. Minor shell fragments.				SPT	100	0/0 0/0 0/0 N=0		9.0									
					SNC	100			9.5									

COMMENTS:

Hole Depth
15.45m

Scale 1:25



BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 3 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619875.47 mN
 (NZTM2000) 1934377.03 mE

DIRECTION:
 ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)					
Holocene Estuarine	SILT, minor sand; grey. Soft to firm, moist, low to medium plasticity. Sand; fine. Minor shell fragments.		UW	US	SNC	100	0/0 0/1 1/2 N=4	10.5										
	Sandy SILT; grey. Soft to firm, moist, low plasticity; sand, fine. Minor shell fragments.		UW	US	SPT	100		11.0										
	12.00m: Becomes firm.		UW	US	SNC	100		11.5										
			UW	US	SPT	100	0/0 1/0 1/3 N=5	12.0										
	Medium SAND, minor silt. Loose, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100		12.5										
	Fine SAND, some silt. Loose, moist, uniformly graded. Minor shell fragments.		UW	US	SNC	100		13.0										
	Fine SAND, minor silt. Medium dense, moist, uniformly graded. Minor shell fragments.		UW	US	SPT	100	1/2 3/3 3/3 N=12	13.5										
	Interbedded SILT and SAND; grey. Stiff (Silt), medium dense (sand), moist, low plasticity, uniformly graded.		UW	US	SNC	100		14.0										
SILT, trace clay; grey. Stiff, moist, medium plasticity.		UW	US	SNC	100		14.5											

COMMENTS:

Hole Depth
15.45m

Scale 1:25

Box 3, 8.0-11.0m

Box 4, 11.0-14.0m



BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 4 OF 4

DRILLED BY: Drew

LOGGED BY: ZAFR

CHECKED: JWY

START DATE: 25/11/2020

FINISH DATE: 25/11/2020

CONTRACTOR: Geotech Drilling Ltd

PROJECT: Napier Aquatic Centre
 JOB No.: 1009171.0000
 LOCATION: Maadi Road, Onekawa

CO-ORDINATES: 5619875.47 mN
 (NZTM2000) 1934377.03 mE

R.L. GROUND: 12.00m
 R.L. COLLAR:
 DATUM: NAPIHT1962
 SURVEY: Handheld GPS

DIRECTION:
 ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering <small>UW MW SW CW US MS SS CS US MS SS CS EW</small>	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%) <small>25 50 75</small>	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm) <small>2000 1000 500 200 100 50 20</small>	RQD (%)	Description & Additional Observations					
Holocene Estuarine	Fine to medium SAND, minor silt; grey. Medium dense, moist, uniformly graded. Some shell fragments.			SPT	100	1/1 0/4 10/0 N=14											Box 5, 14.0-15.5m	
	15.45m: END OF BOREHOLE							15.5										
								16.0										
								16.5										
								17.0										
								17.5										
								18.0										
								18.5										
								19.0										
								19.5										

COMMENTS:

Hole Depth
15.45m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH08**
 SHEET: 1 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619875.47 mN 1934377.03 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



0.00-5.25m



5.25-7.95m

CORE PHOTOS

BOREHOLE No.: **BH08**

SHEET: 2 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619875.47 mN 1934377.03 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



7.95-10.95m



10.95-13.95m

CORE PHOTOS

BOREHOLE No.: **BH08**

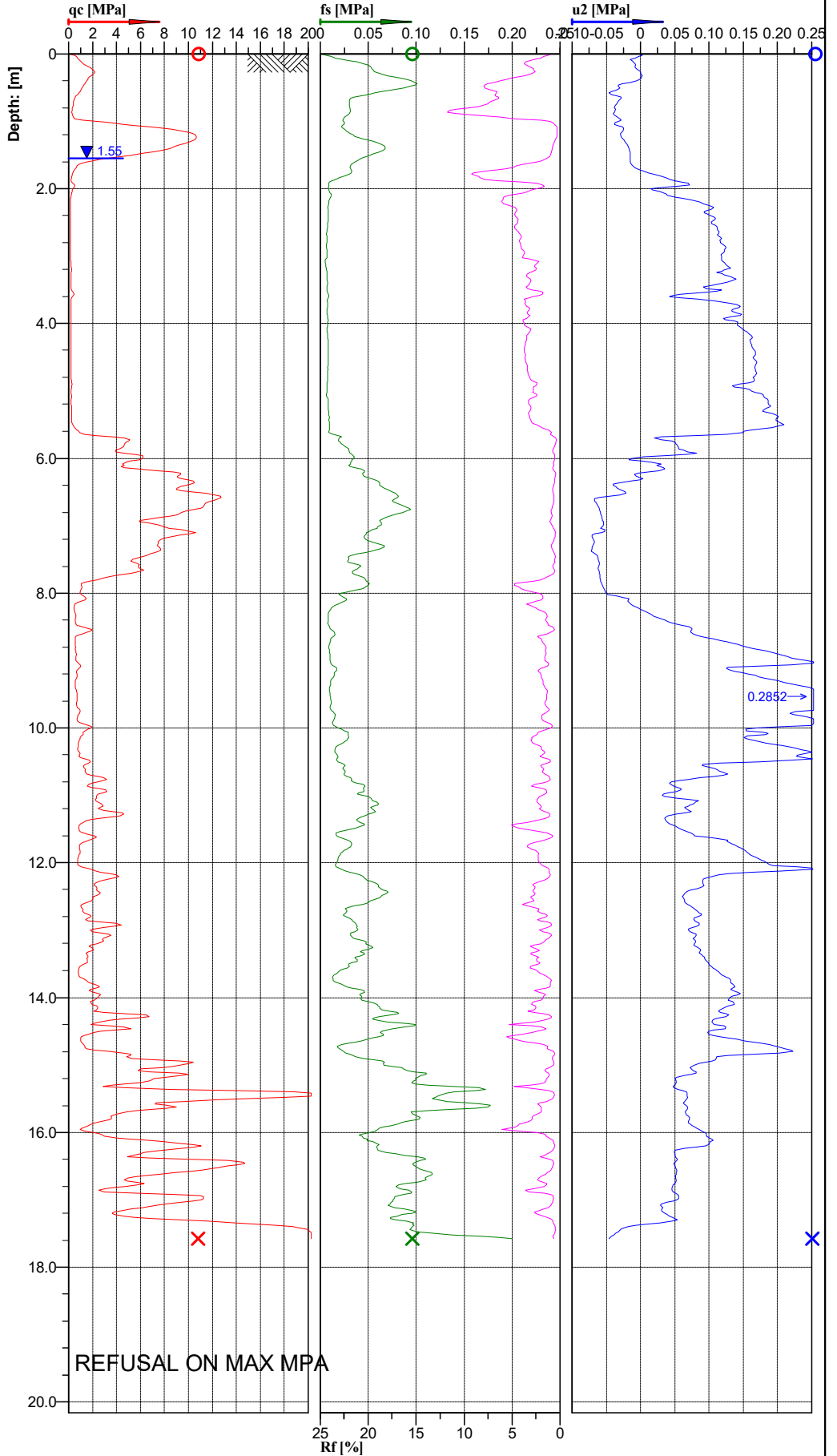
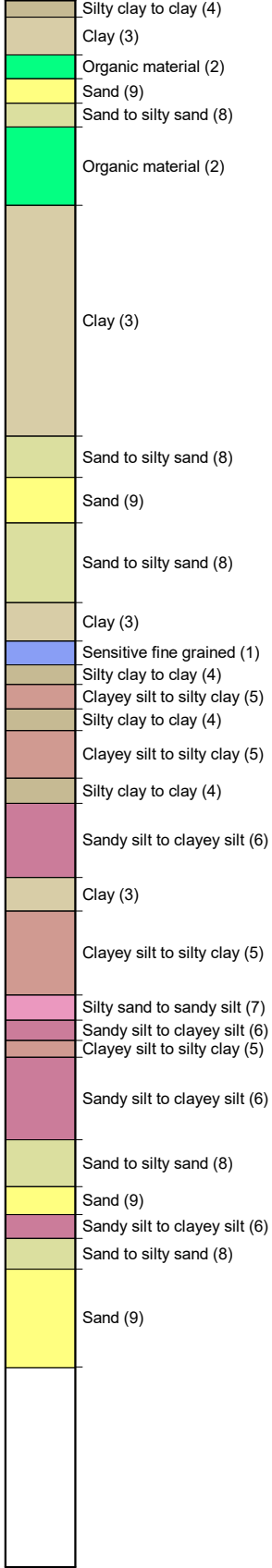
SHEET: 3 OF 3

PROJECT: Napier Aquatic Centre		LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: (NZTM2000)	5619875.47 mN 1934377.03 mE	DRILL TYPE:	HOLE STARTED: 25/11/2020
R.L.:	12.00m	DRILL METHOD: RC	HOLE FINISHED: 25/11/2020
DATUM:	NAPIHT1962		DRILLED BY: Geotech Drilling Ltd
			LOGGED BY: ZAFR CHECKED: JWY



13.95-15.45m

Classification by Robertson 1986

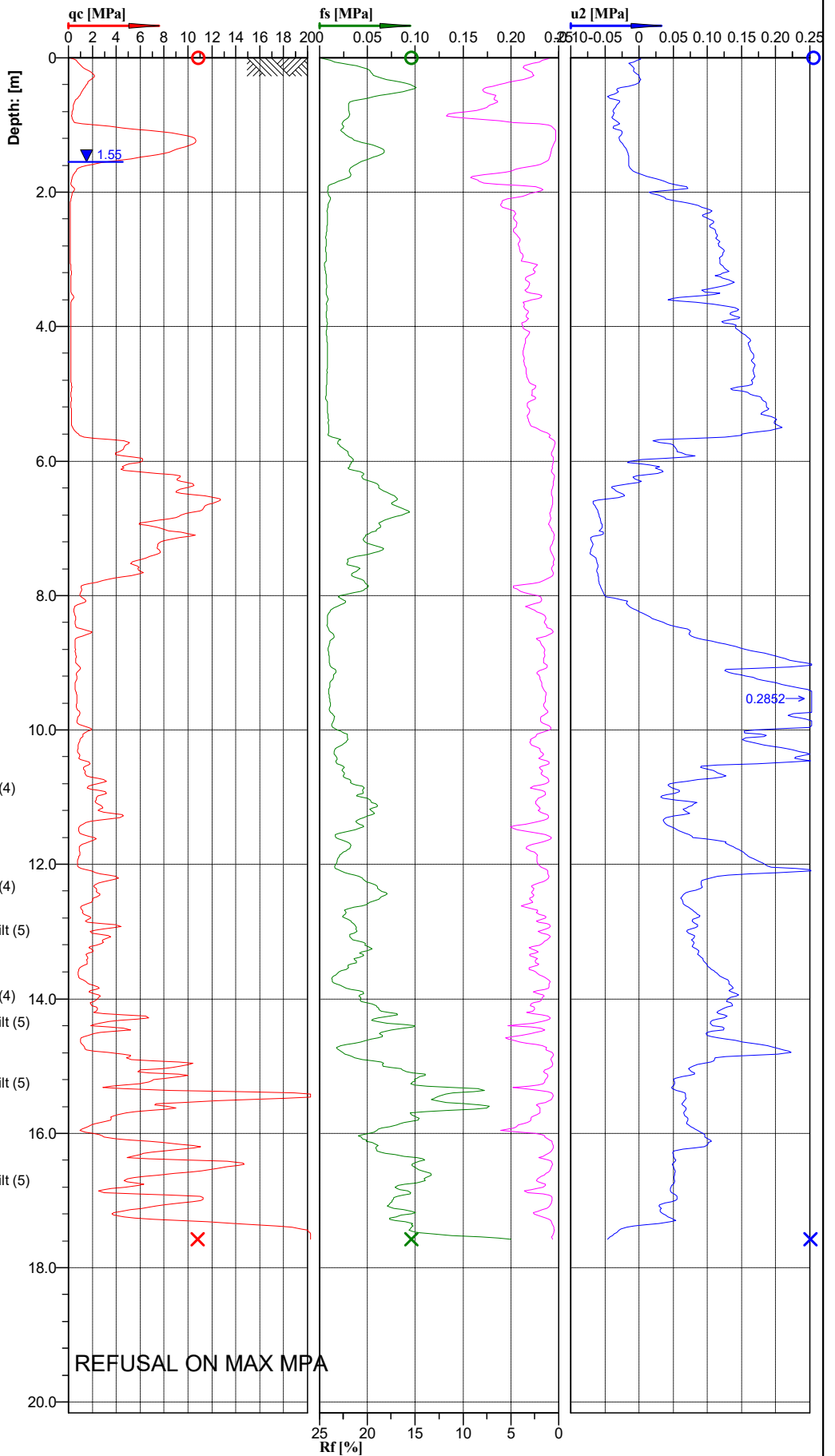
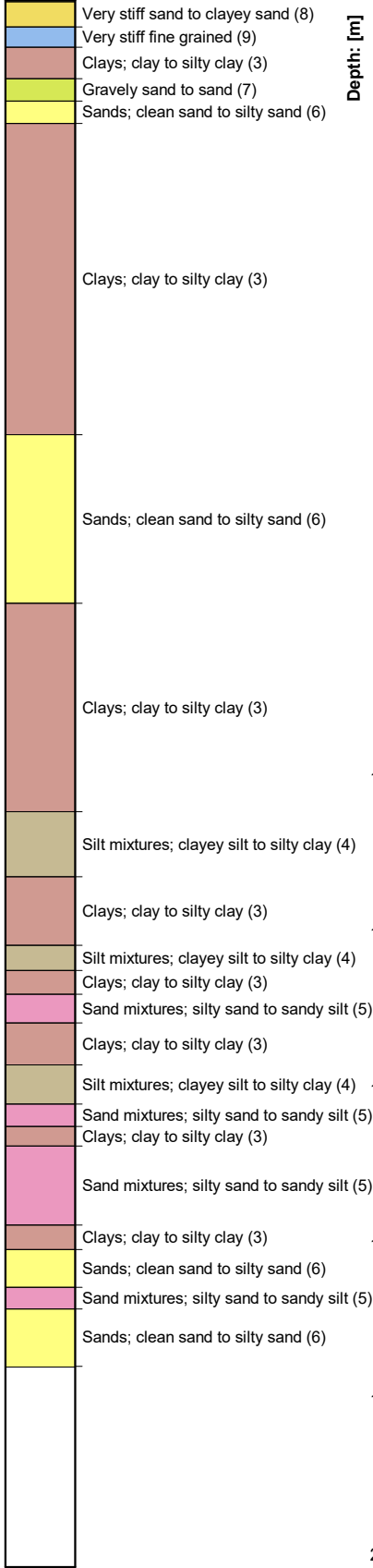


Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50468, E 176.88766			File: CPT01.cpt

Classification by Robertson 1990



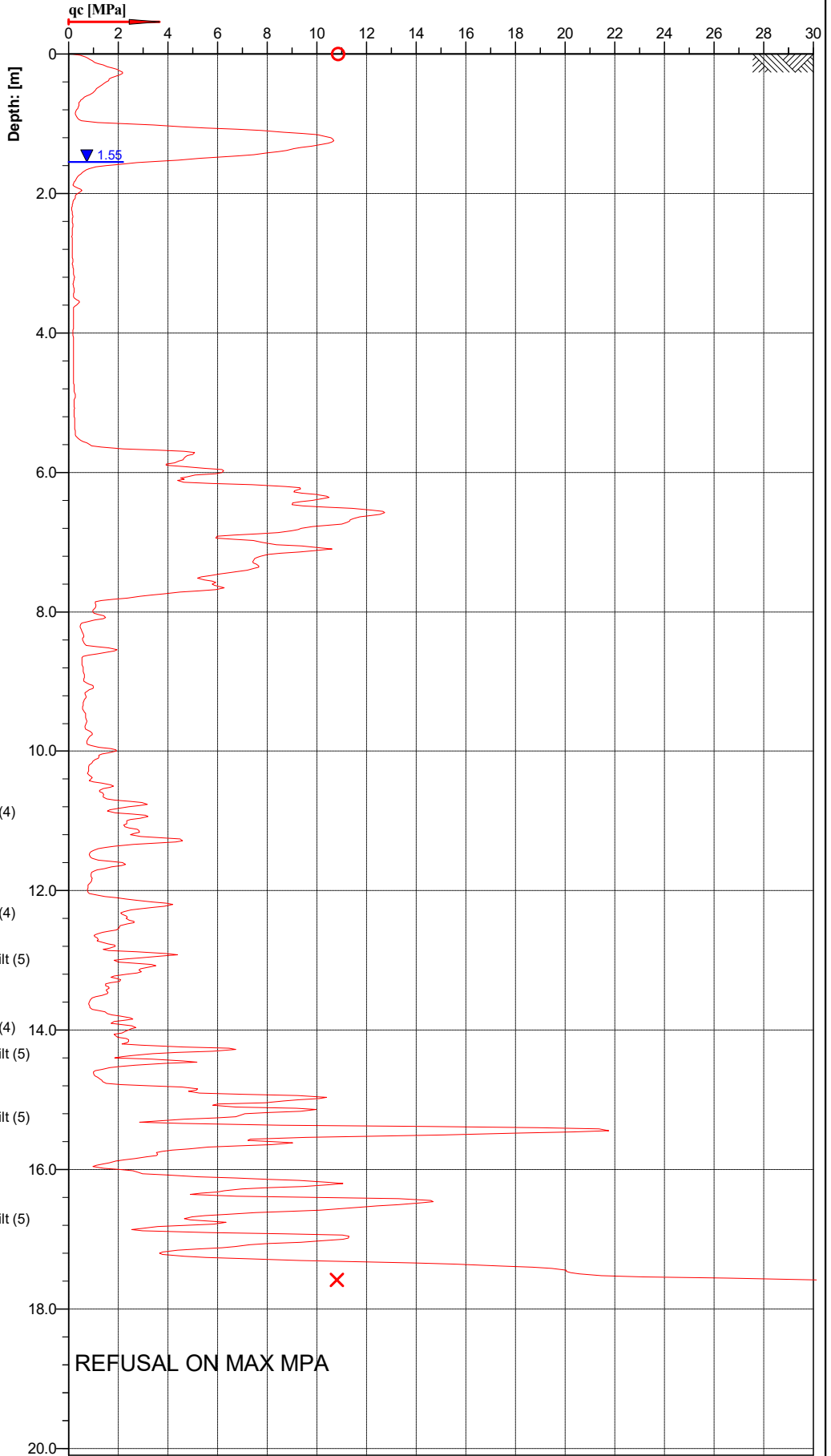
Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50468, E 176.88766			File: CPT01.cpt

**Classification by
Robertson 1990**

- Very stiff sand to clayey sand (8)
- Very stiff fine grained (9)
- Clays; clay to silty clay (3)
- Gravely sand to sand (7)
- Sands; clean sand to silty sand (6)



- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)
- Clays; clay to silty clay (3)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)
- Sand mixtures; silty sand to sandy silt (5)
- Sands; clean sand to silty sand (6)

REFUSAL ON MAX MPA

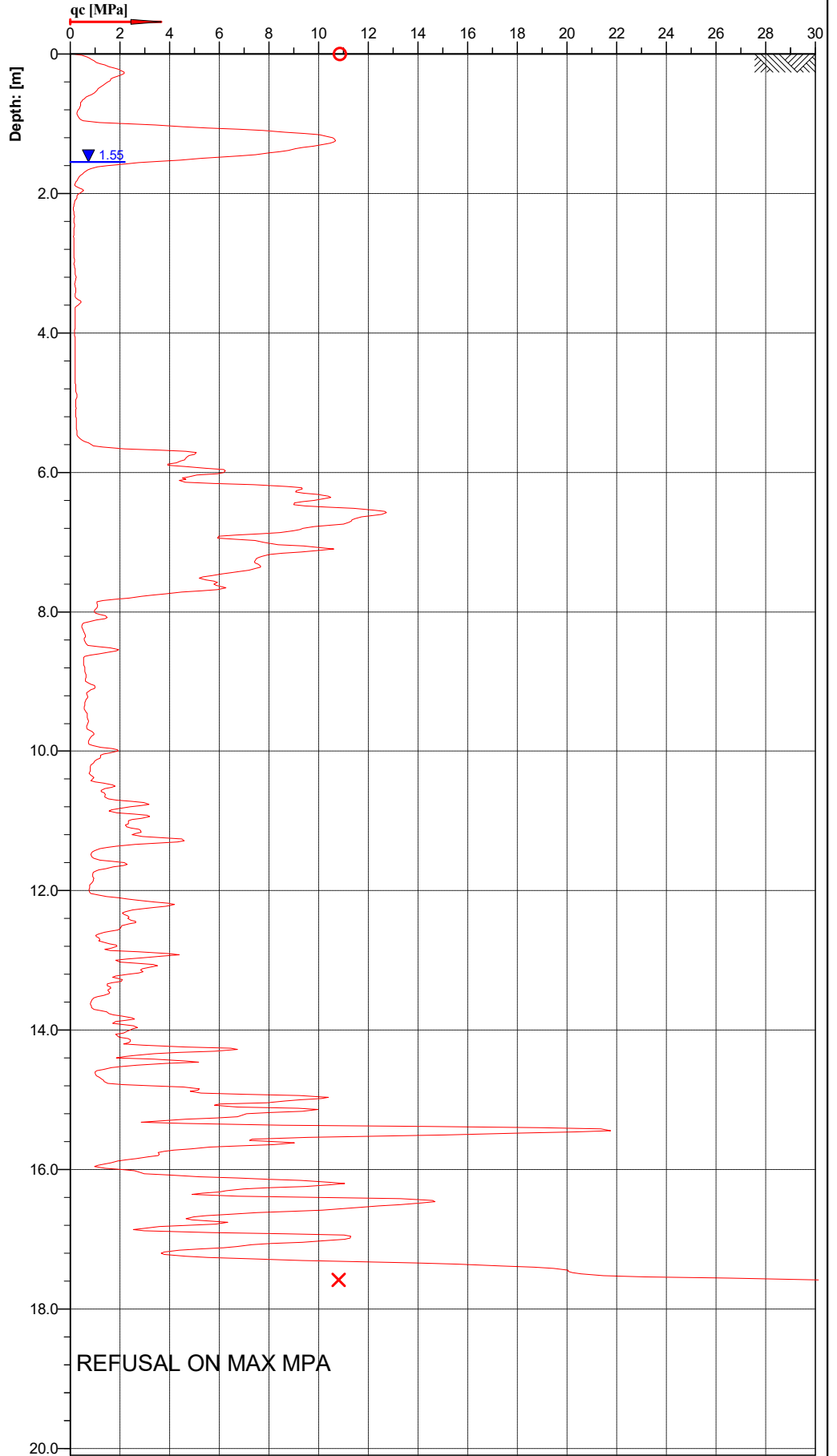
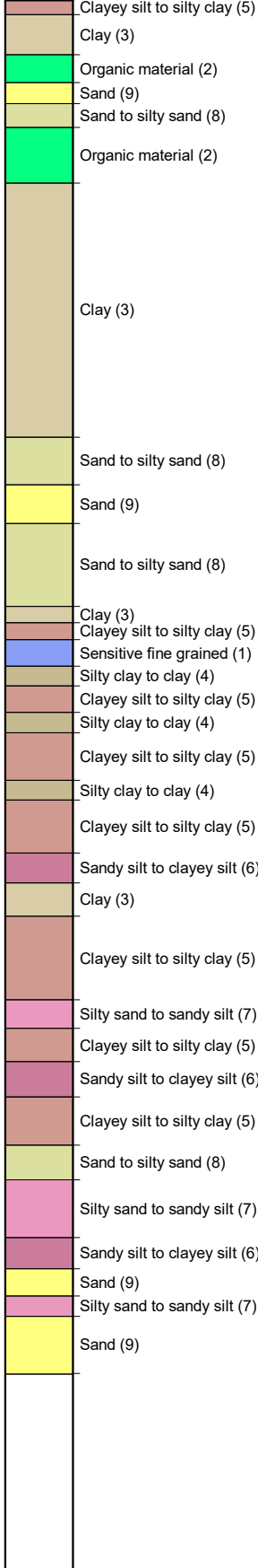


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50468, E 176.88766		File: CPT01.cpt	

**Classification by
Robertson 1986**

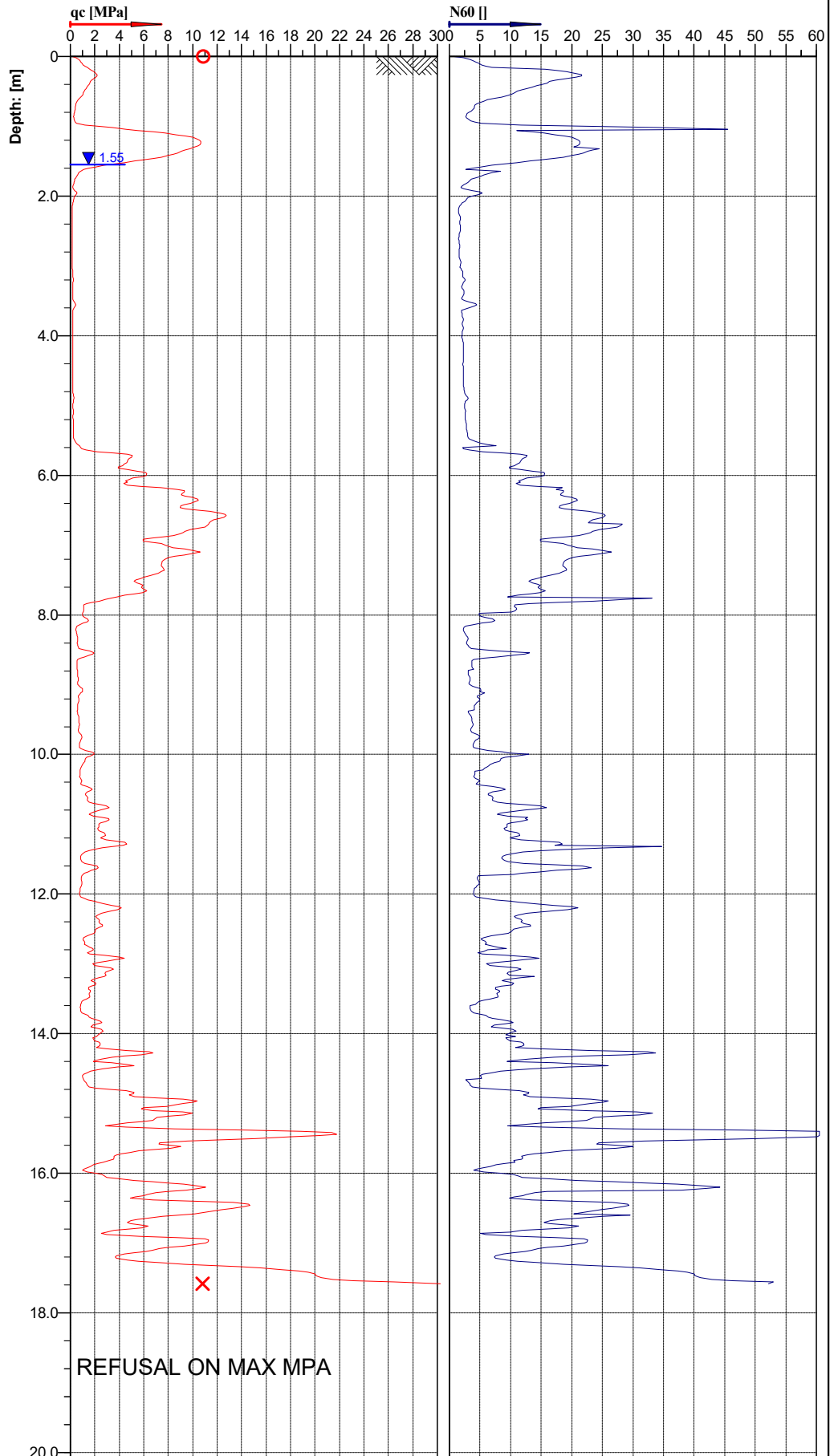
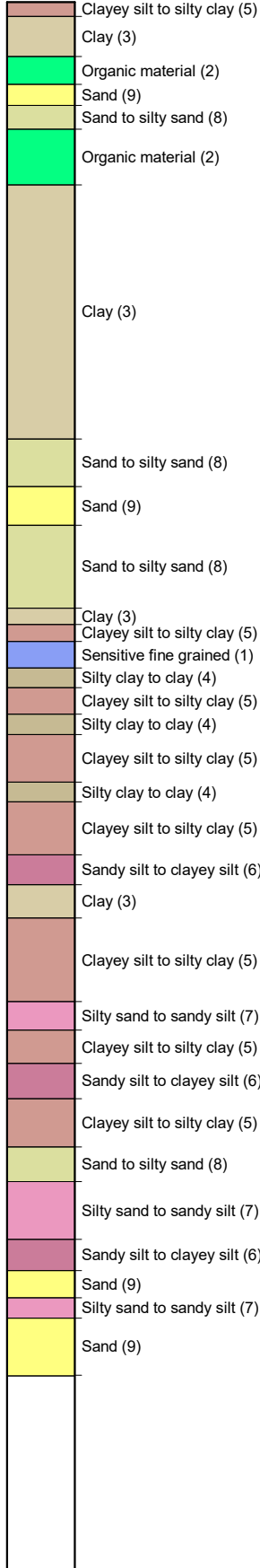


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50468, E 176.88766		File: CPT01.cpt	

**Classification by
Robertson 1986**

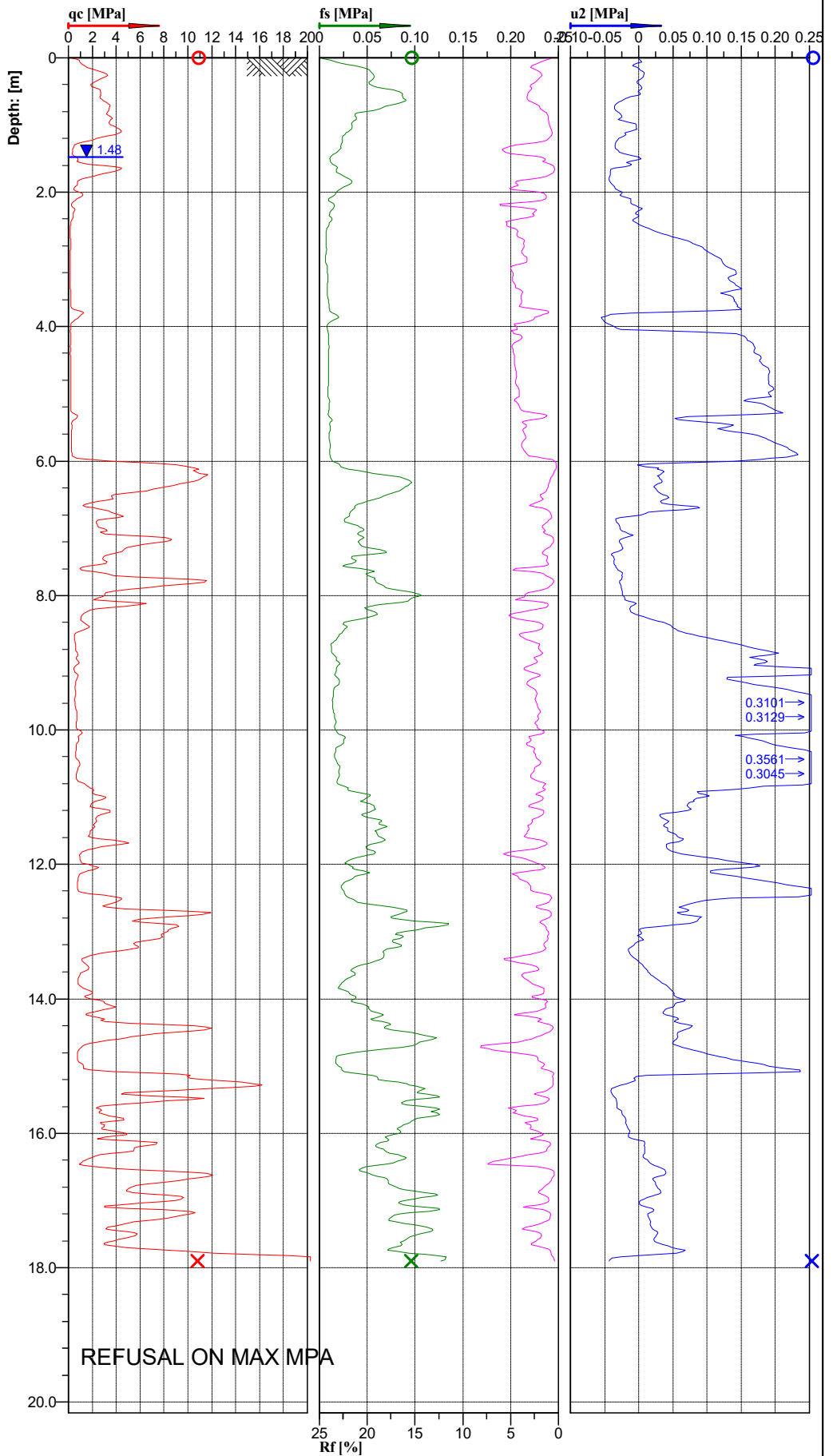
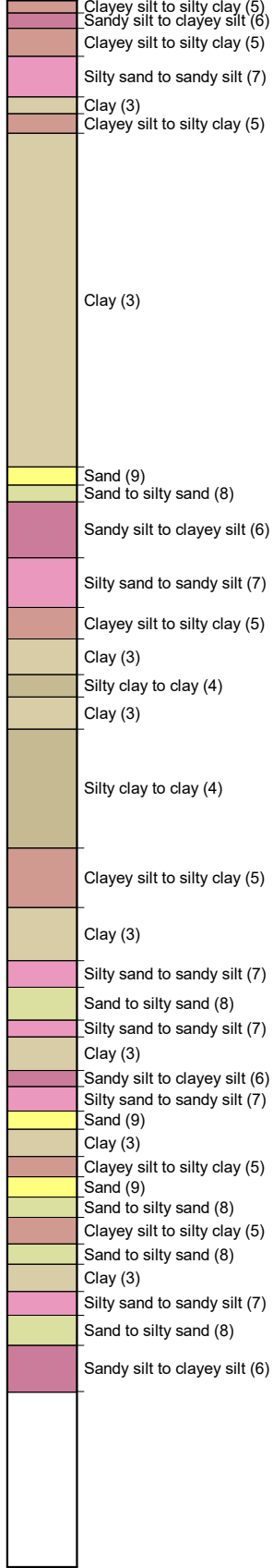


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT01
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50468, E 176.88766				File:	CPT01.cpt		

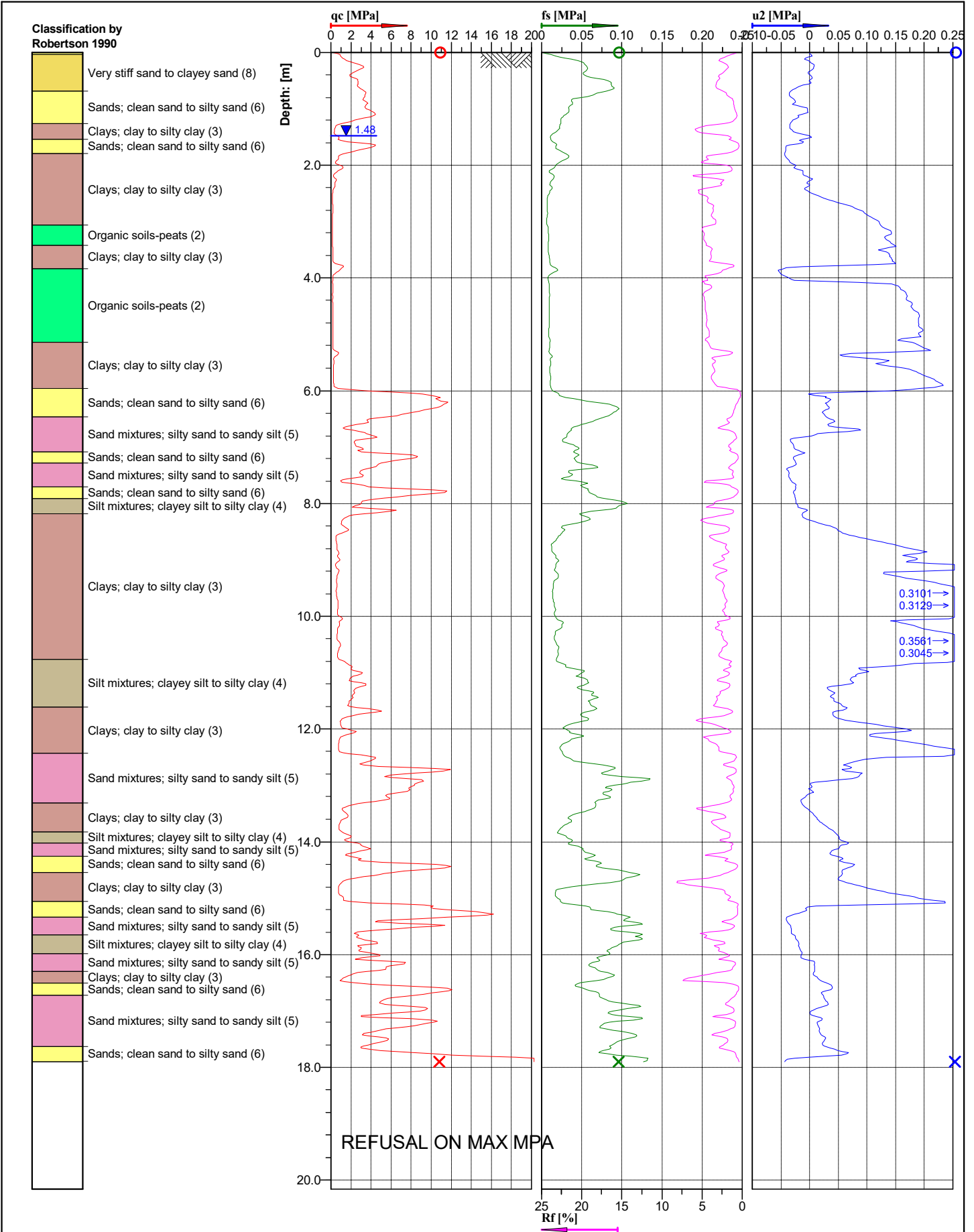
Classification by Robertson 1986



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



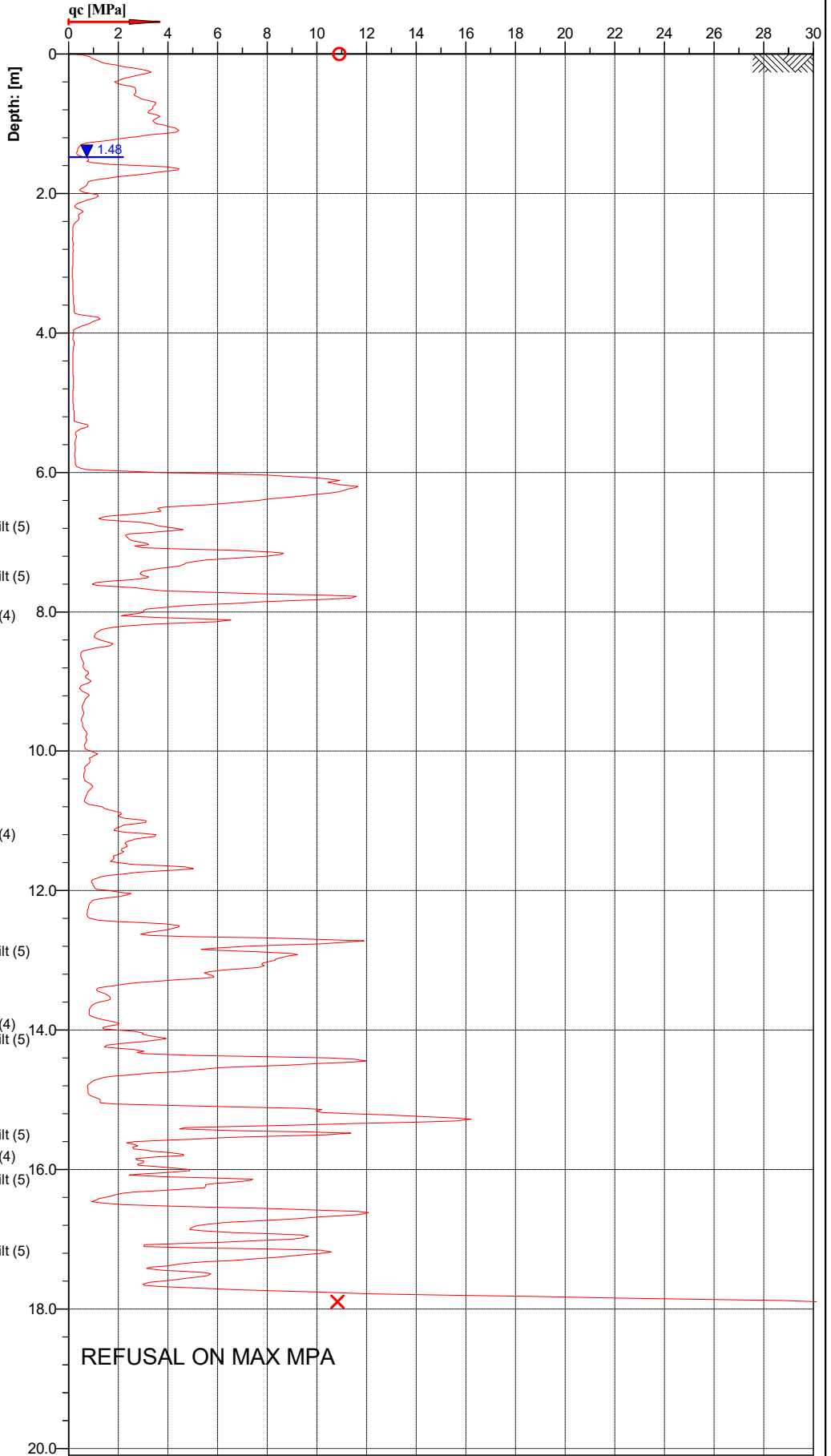
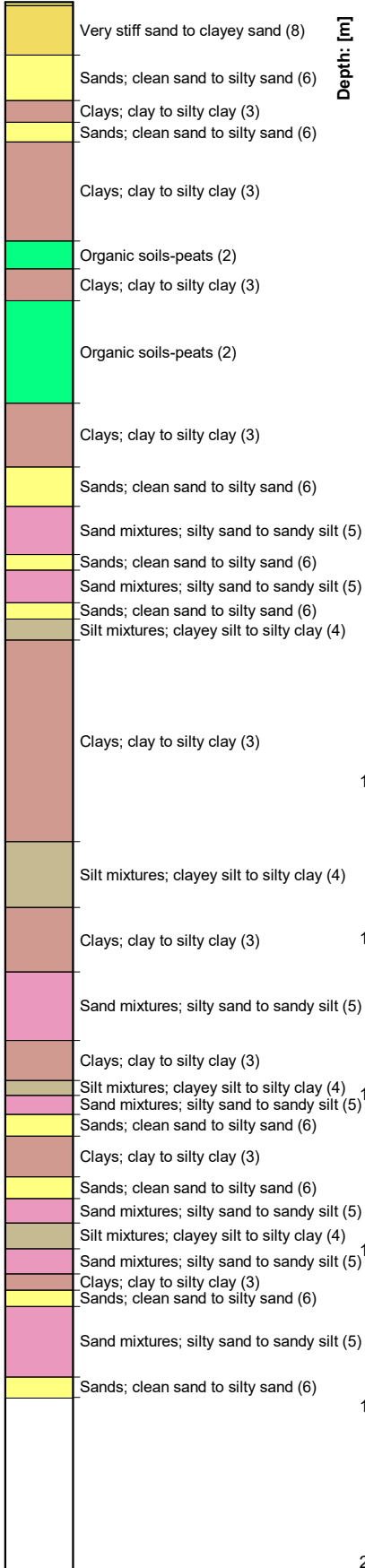
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Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50486, E 176.88773		File: CPT02A.cpt	



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02A
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50486, E 176.88773		File: CPT02A.cpt	

Classification by Robertson 1990

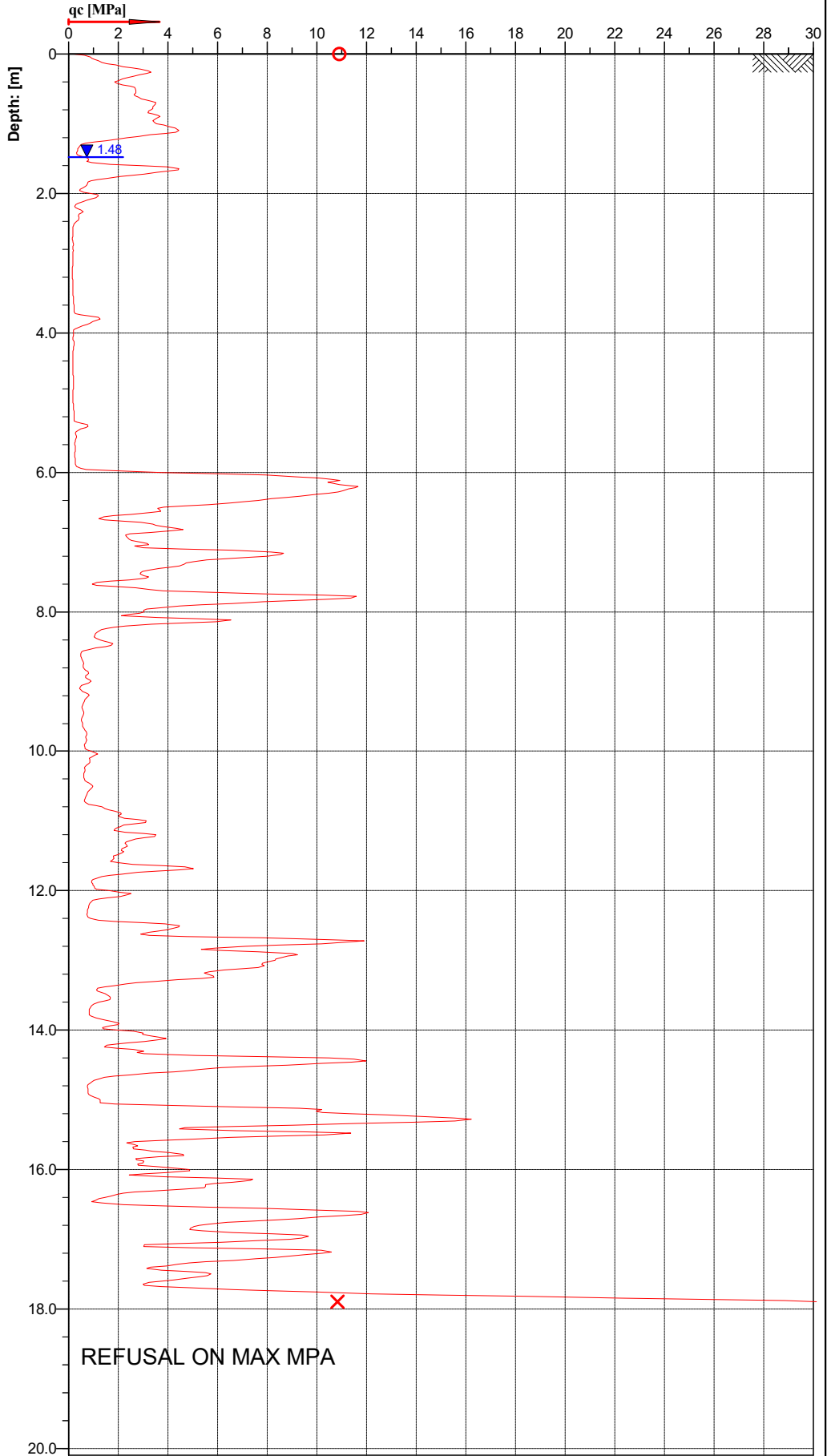
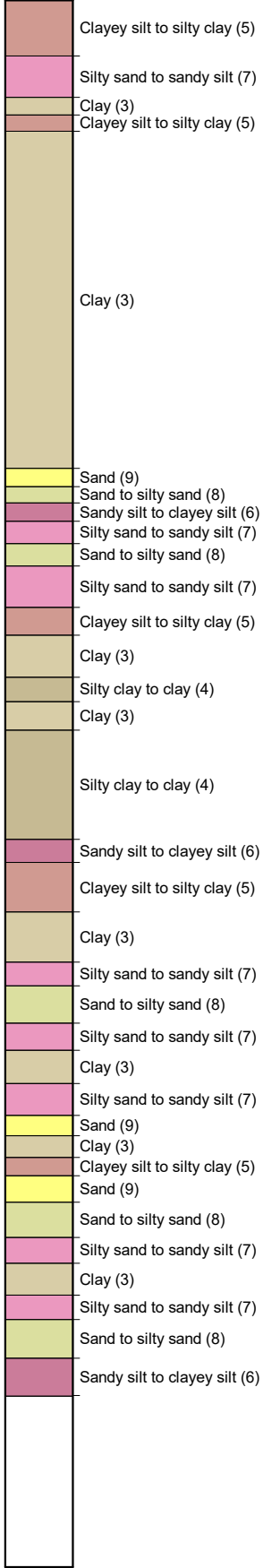


Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02A
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50486, E 176.88773		File: CPT02A.cpt	

**Classification by
Robertson 1986**



REFUSAL ON MAX MPA

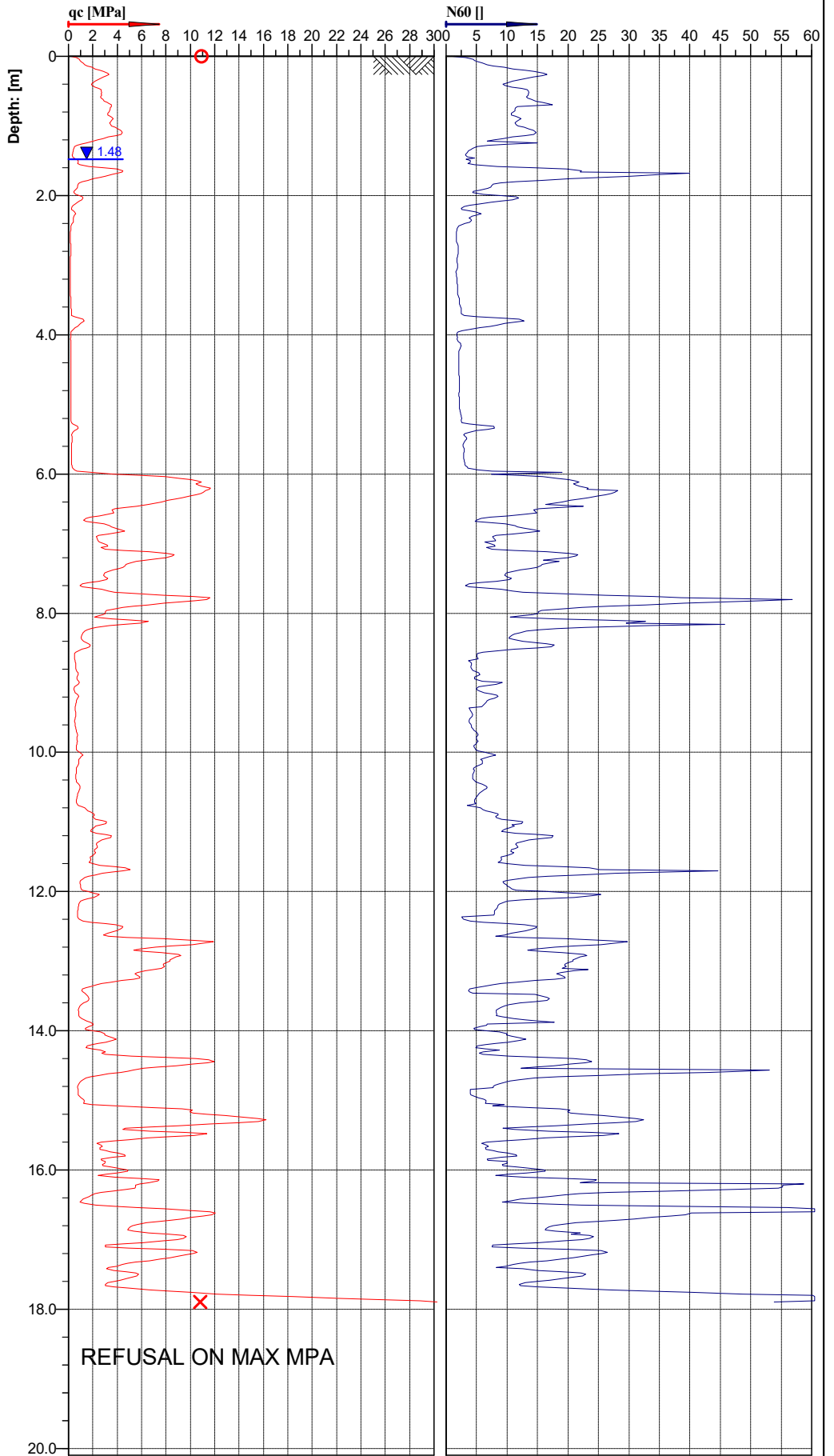
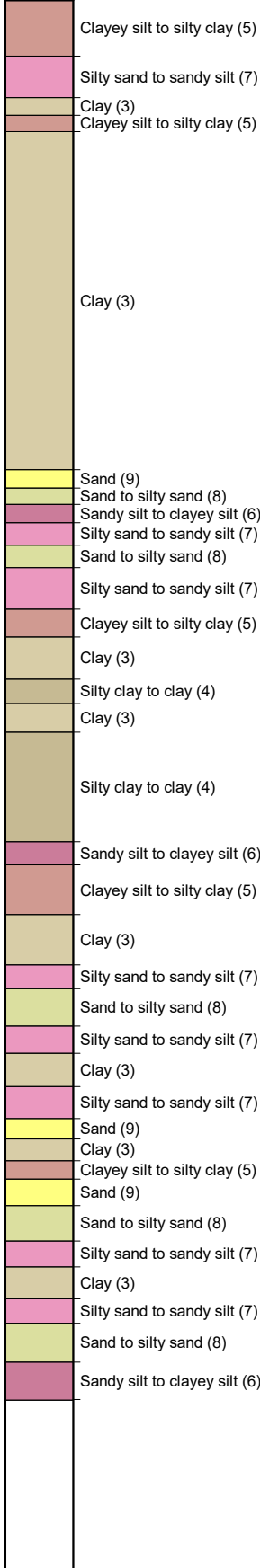


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02A
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE	Page: 1/1		Fig.:
S 39.50486, E 176.88773			File: CPT02A.cpt

**Classification by
Robertson 1986**

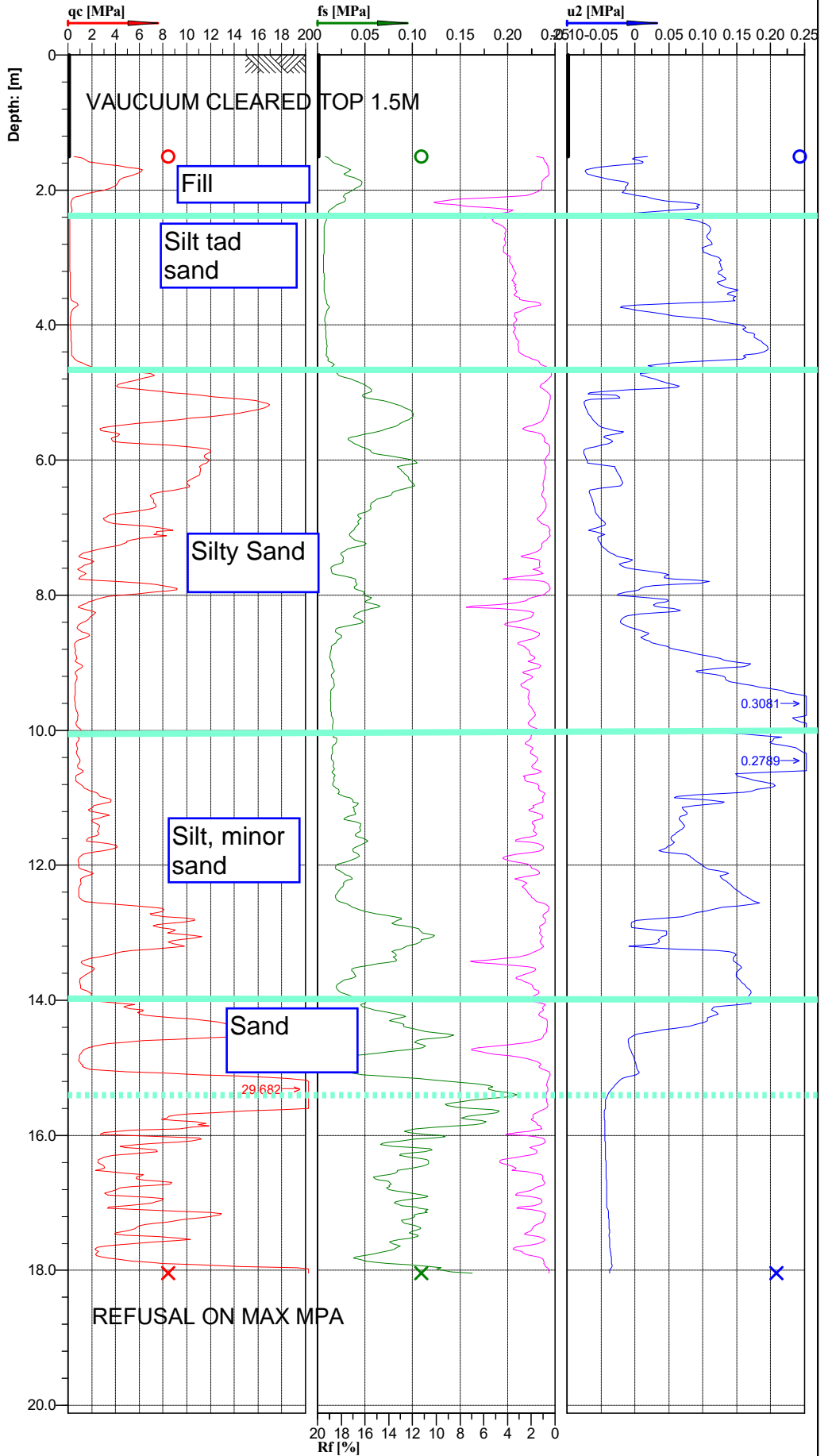
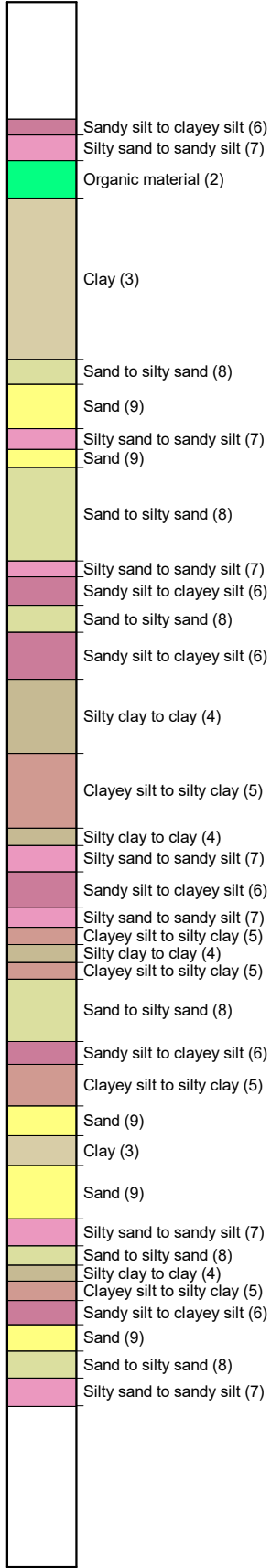


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



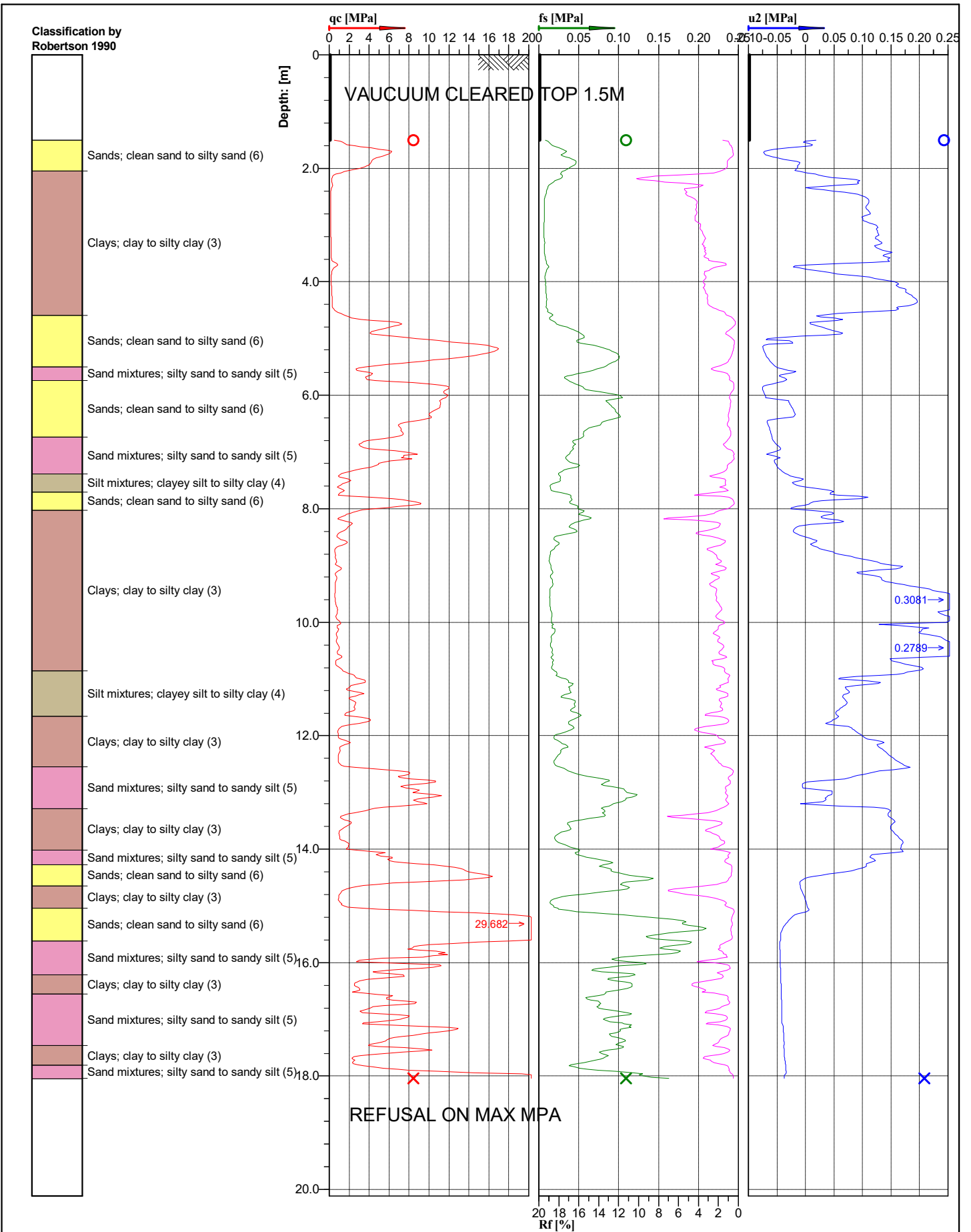
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Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50486, E 176.88773			File:	CPT02A.cpt		

Classification by Robertson 1986



Cone No: 5550
 Tip area [cm2]: 10
 Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT03
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50537 E 176.88806		File: CPT03.cpt	

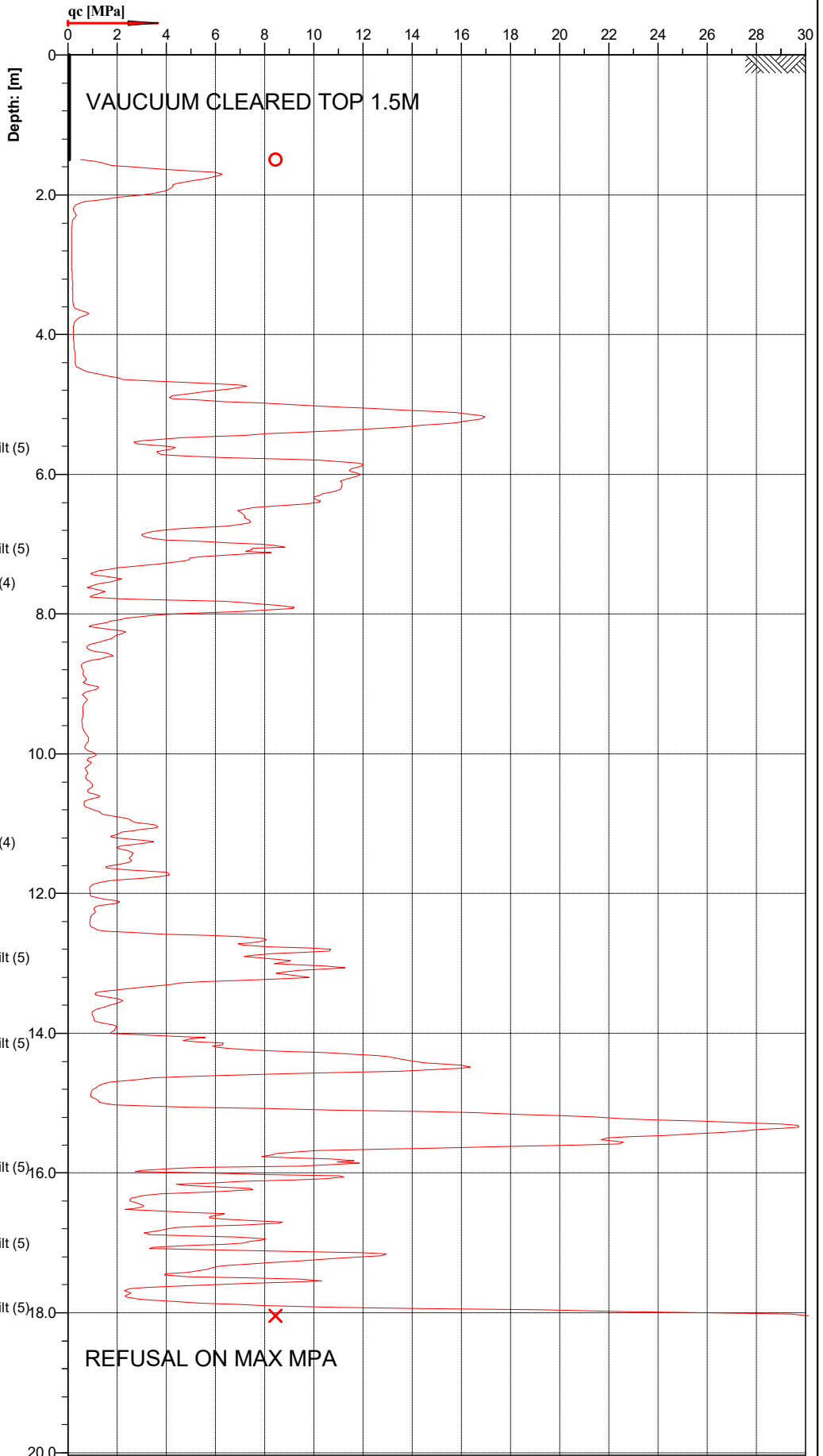
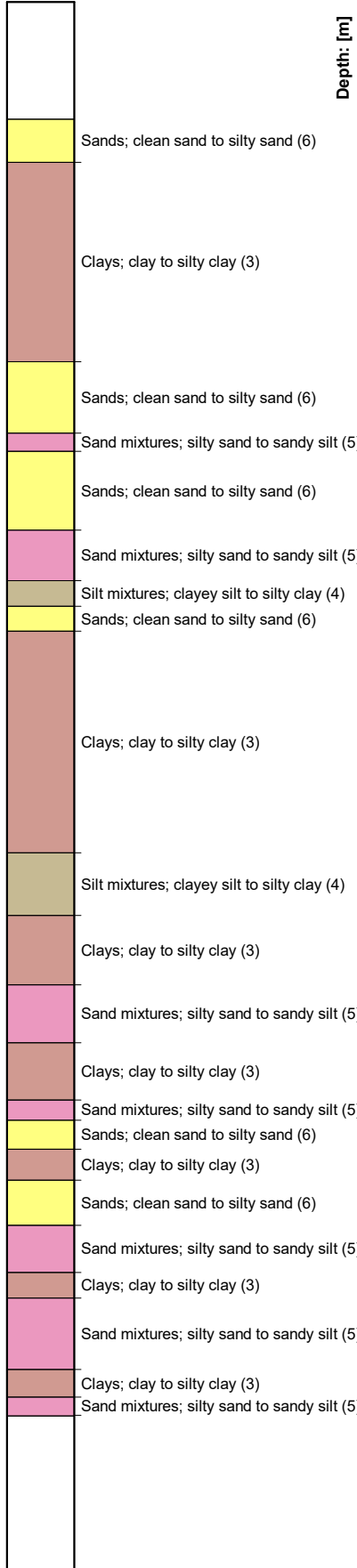



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50537 E 176.88806			File:	CPT03.cpt		

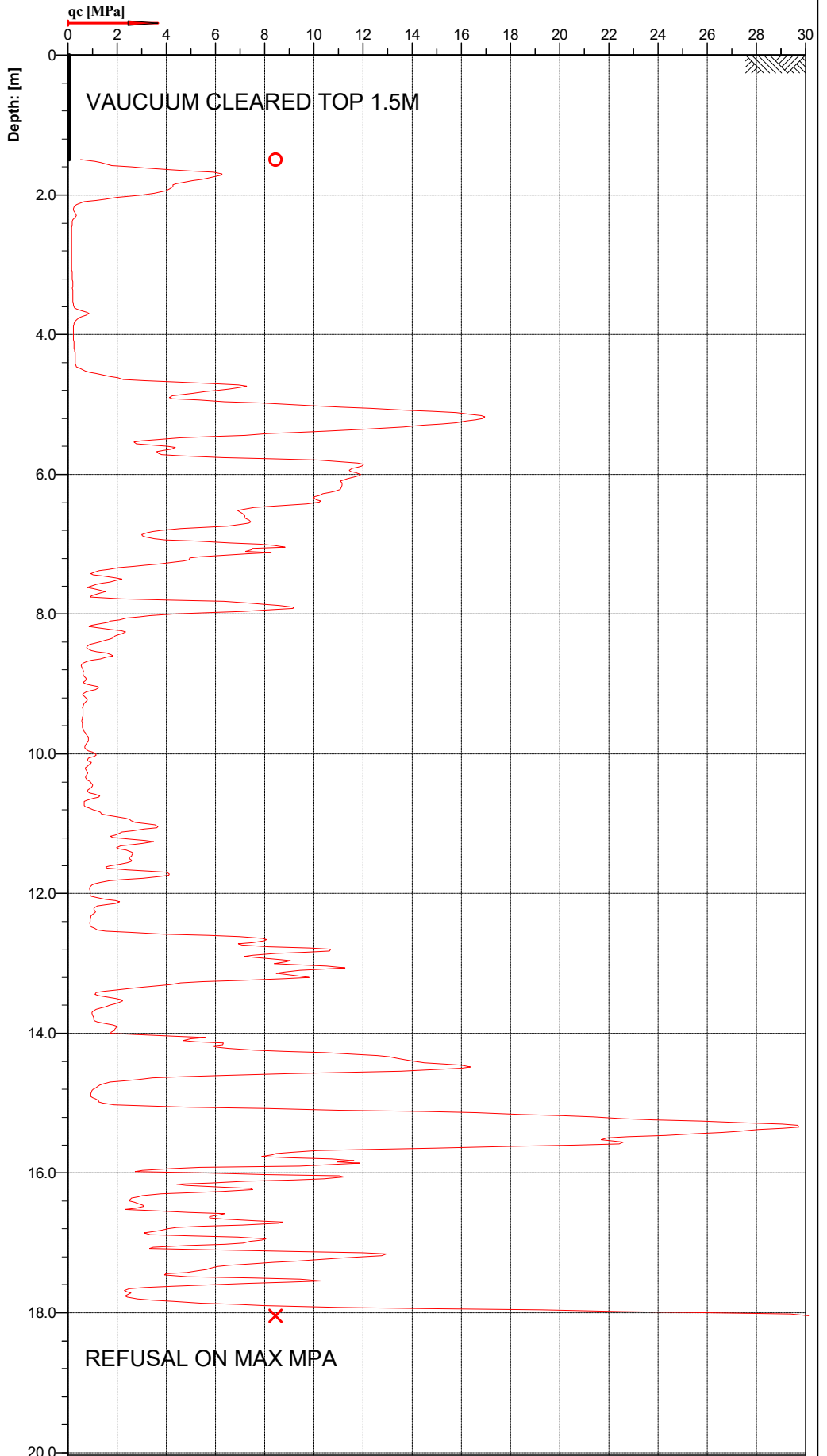
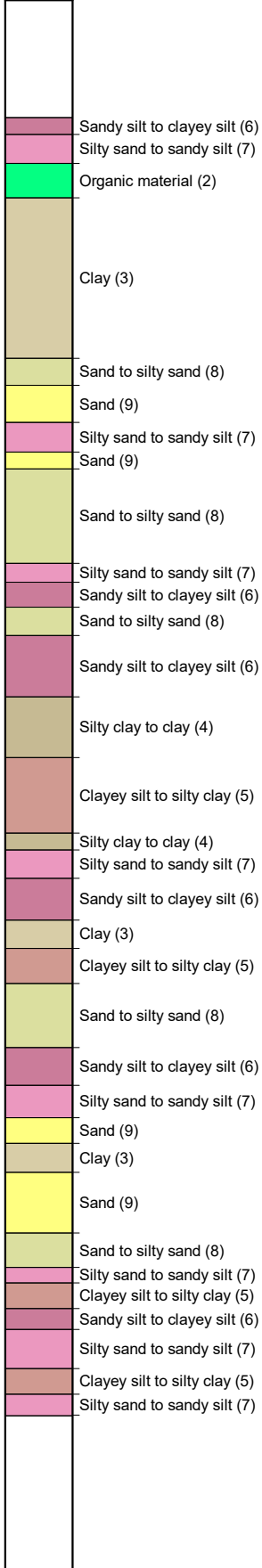
Classification by
Robertson 1990



u2

 Cone No: 5550
 Tip area [cm2]: 10
 Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT03
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	S 39.50537 E 176.88806		Page: 1/1
			File: CPT03.cpt

**Classification by
Robertson 1986**

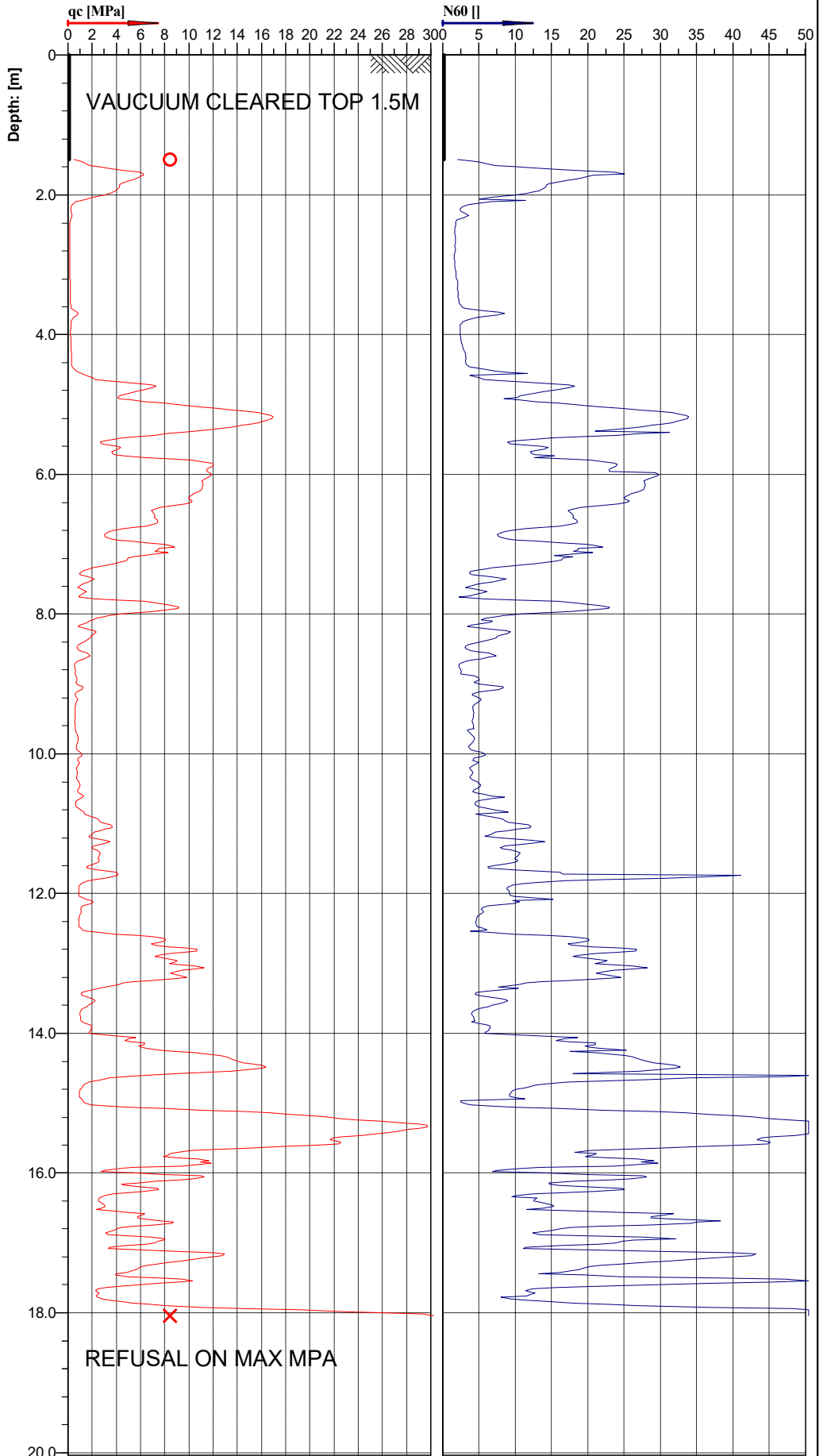
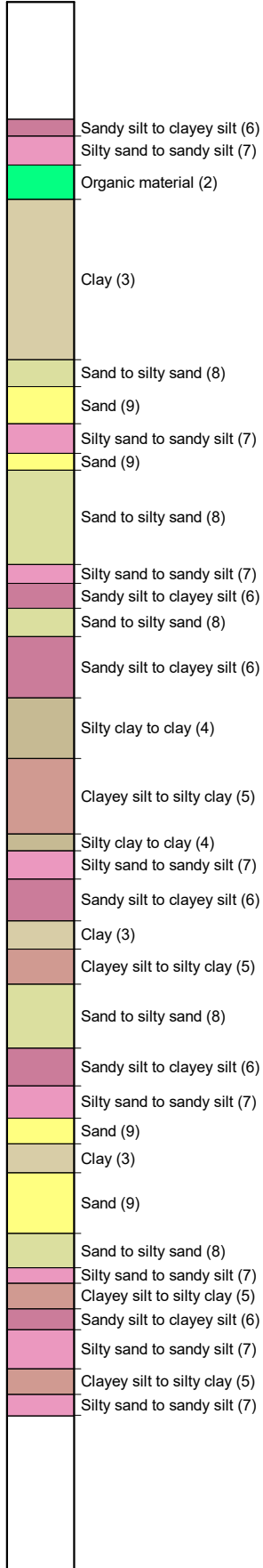


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT03
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50537 E 176.88806		File: CPT03.cpt	

**Classification by
Robertson 1986**



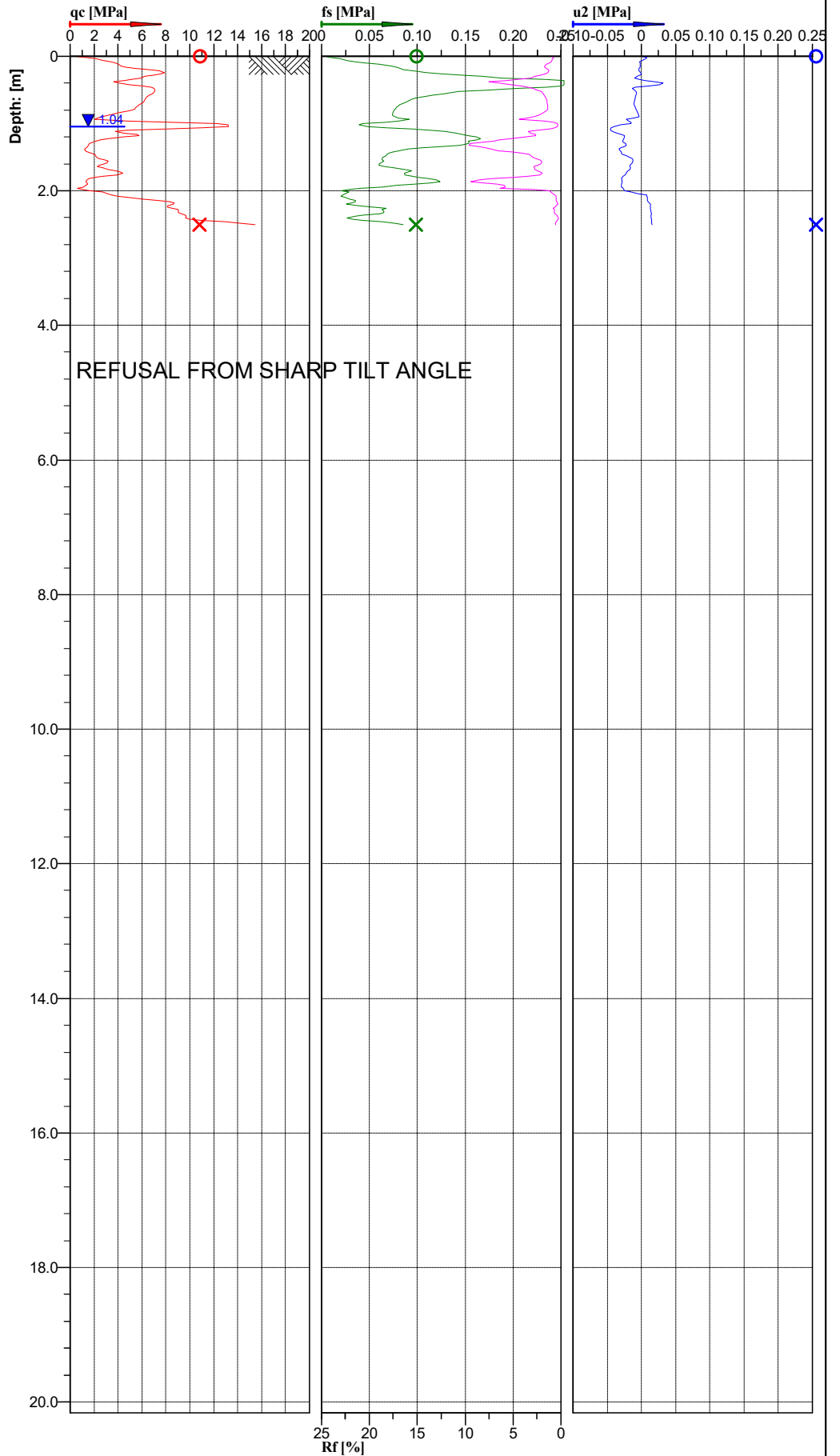
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50537 E 176.88806			File:	CPT03.cpt		

**Classification by
Robertson 1986**

- Silty sand to sandy silt (7)
- Sand (9)
- Clay (3)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)



REFUSAL FROM SHARP TILT ANGLE



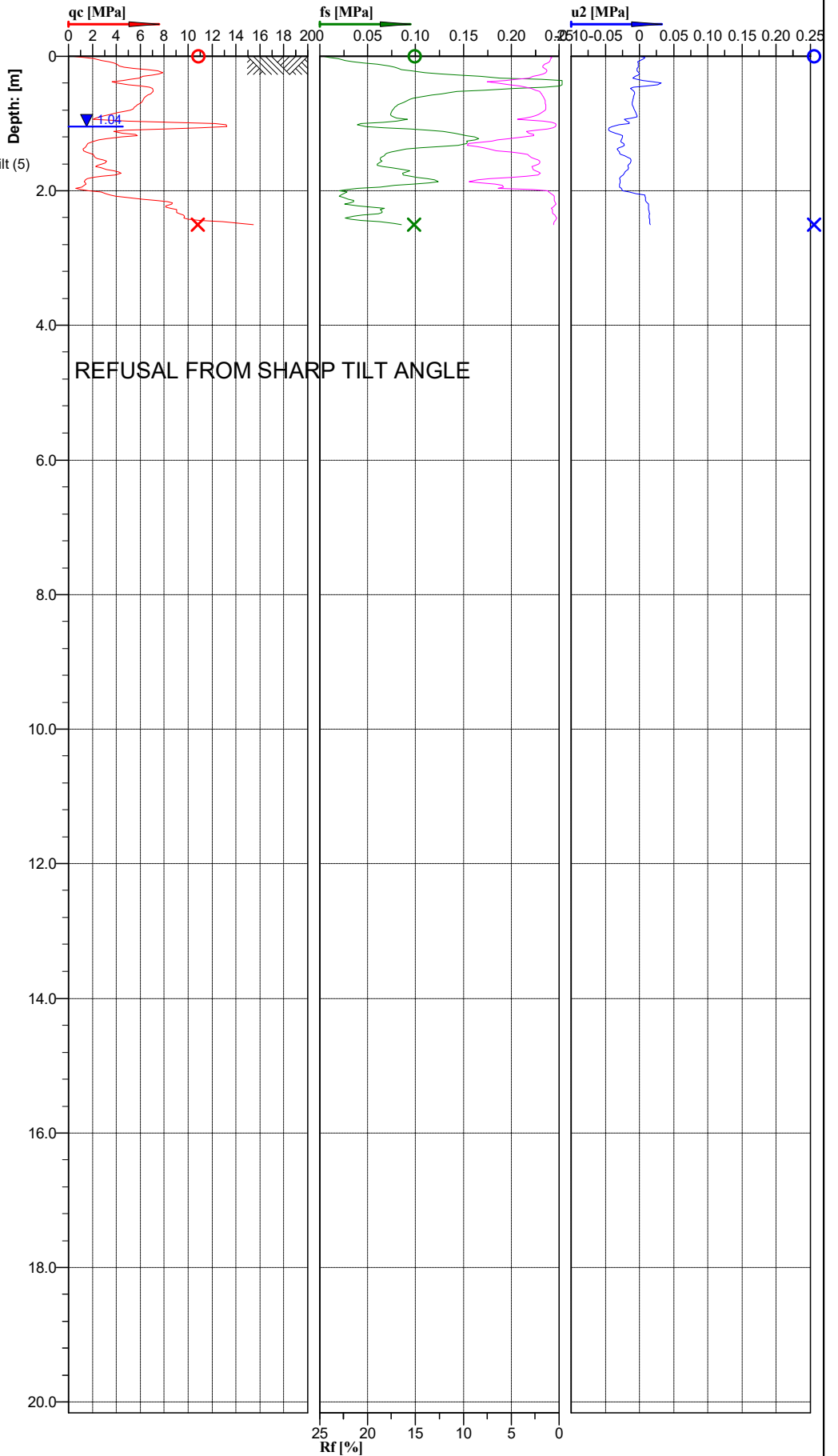
Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT04
Project ID:	Client: TONKIN + TAYLOR ILTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50563, E 176.88820		File: CPT04.cpt	

**Classification by
Robertson 1990**

- Very stiff sand to clayey sand (8)
- Sands; clean sand to silty sand (6)
- Very stiff fine grained (9)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)



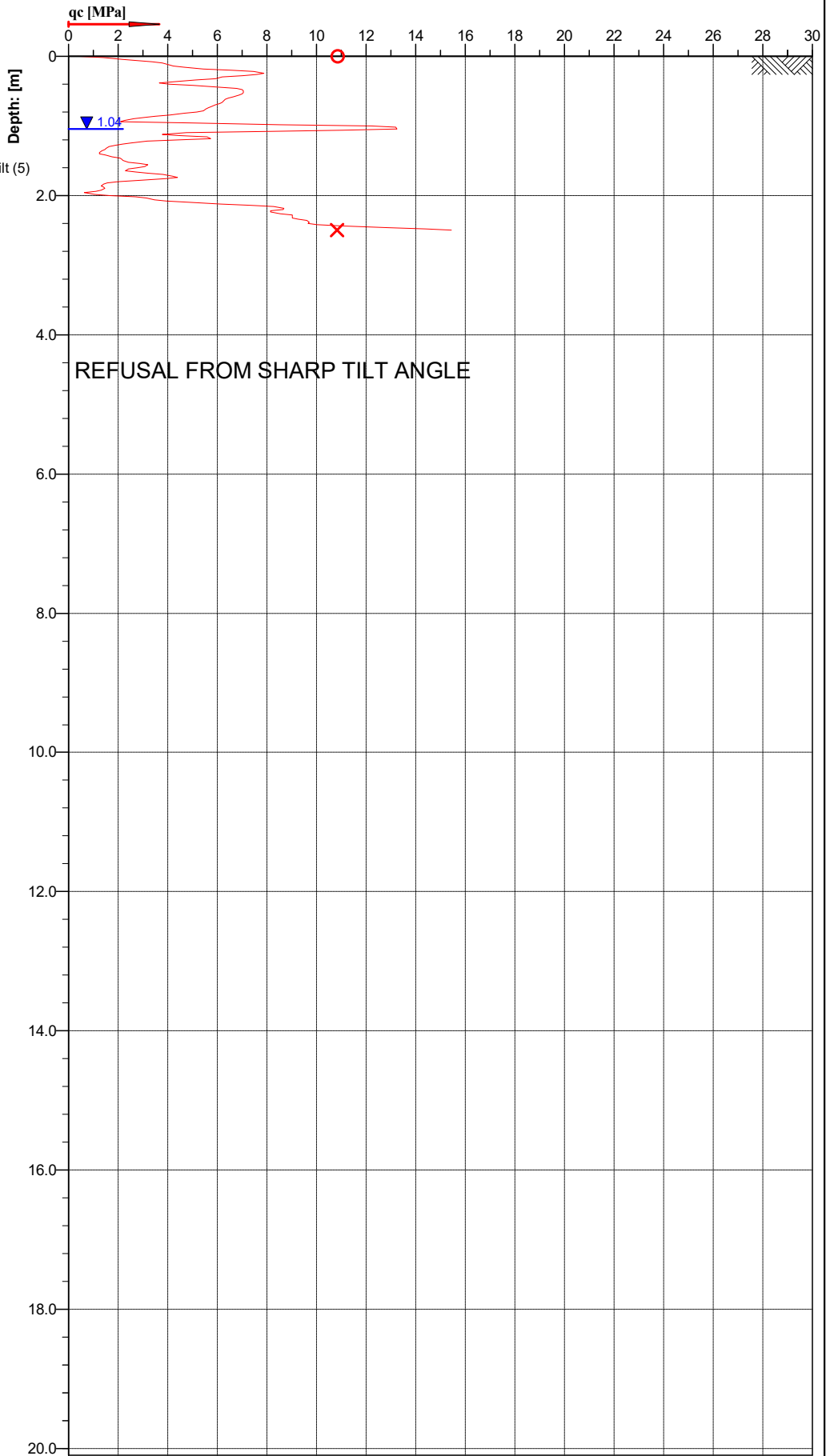
Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT04
Project ID:	Client: TONKIN + TAYLOR ILTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50563, E 176.88820		File: CPT04.cpt	

**Classification by
Robertson 1990**

- Very stiff sand to clayey sand (8)
- Sands; clean sand to silty sand (6)
- Very stiff fine grained (9)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)



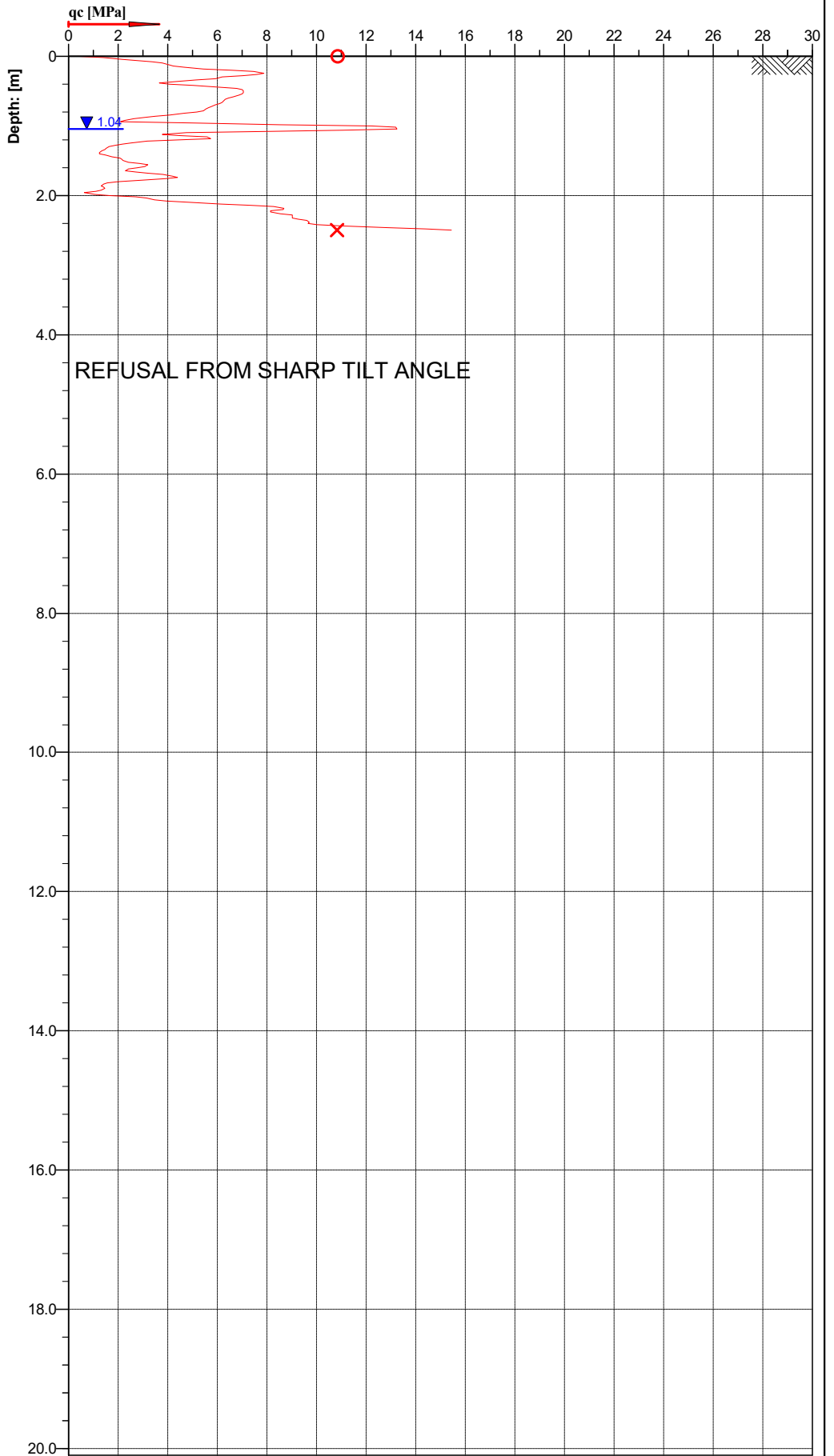
Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT04
Project ID:	Client: TONKIN + TAYLOR ILTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50563, E 176.88820		File: CPT04.cpt	

**Classification by
Robertson 1986**

- Silty sand to sandy silt (7)
- Sand (9)
- Clay (3)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)



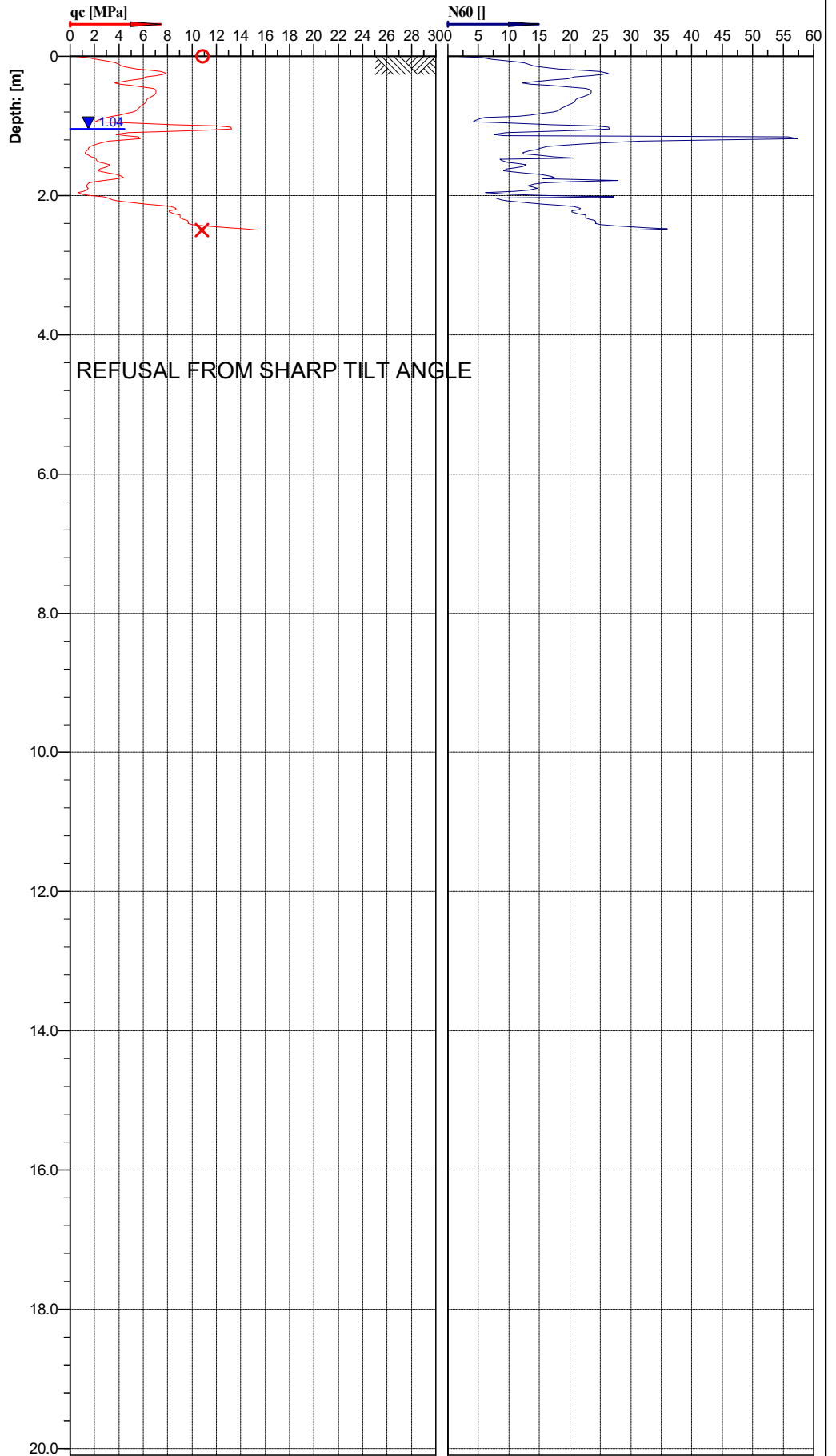
Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT04
Project ID:	Client: TONKIN + TAYLOR ILTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50563, E 176.88820		File: CPT04.cpt	

**Classification by
Robertson 1986**

- Silty sand to sandy silt (7)
- Sand (9)
- Clay (3)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)



REFUSAL FROM SHARP TILT ANGLE

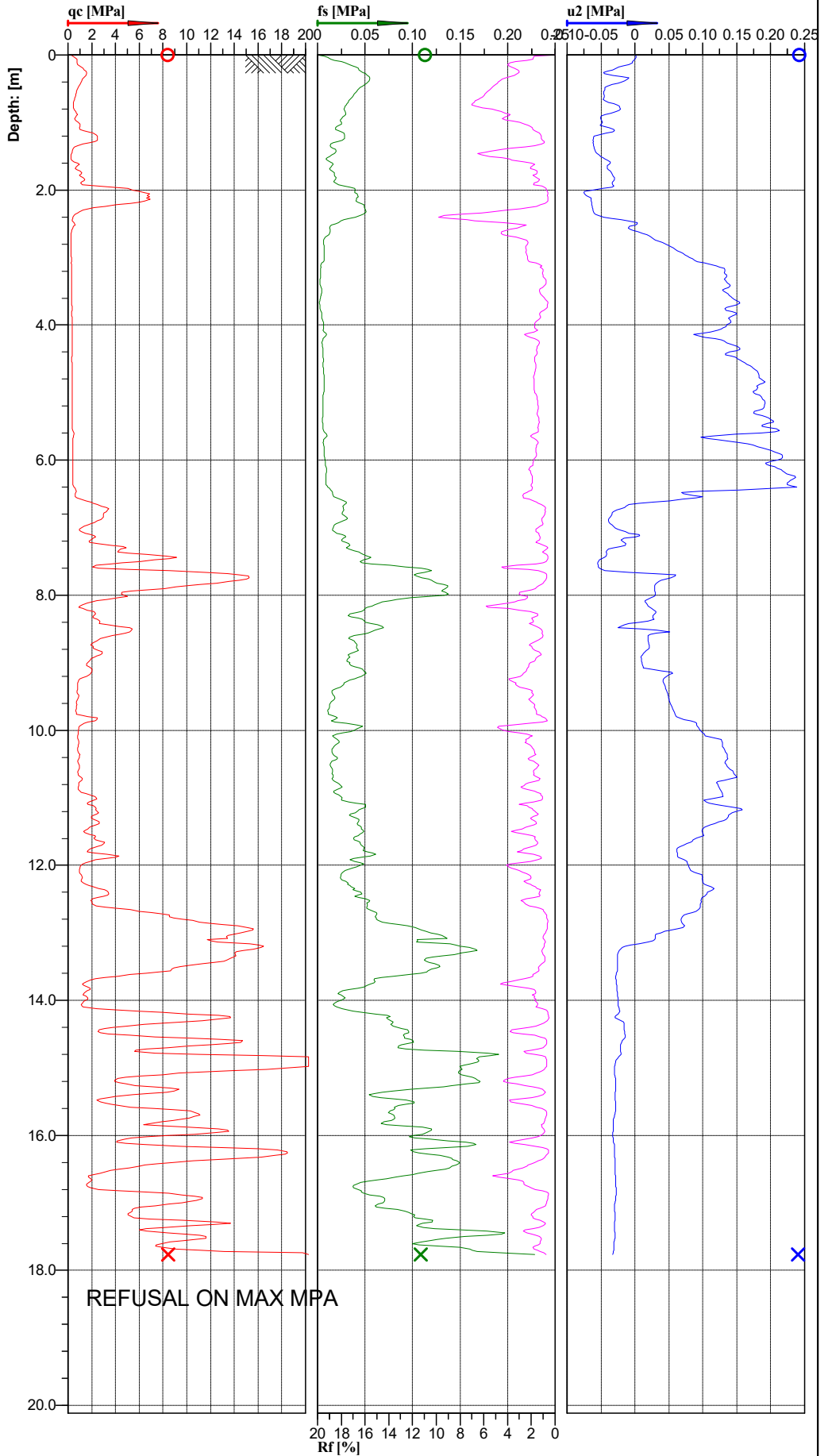
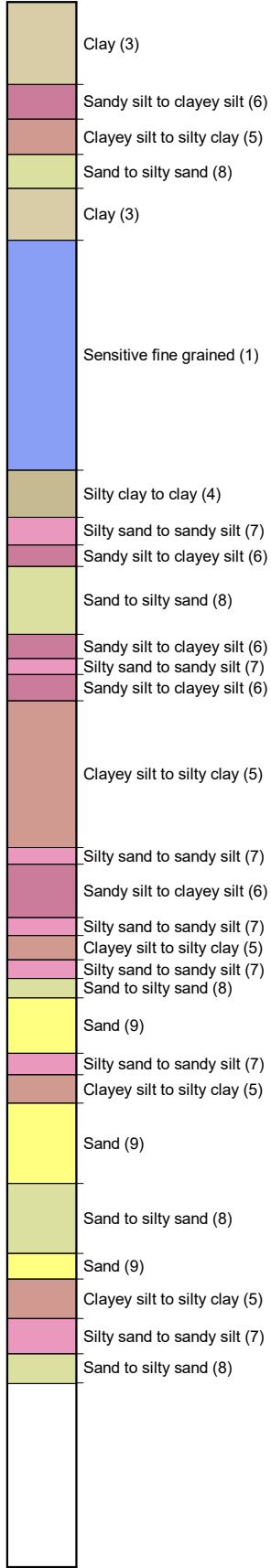


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT04
Project ID:		Client:	TONKIN + TAYLOR ILTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50563, E 176.88820			File:	CPT04.cpt		

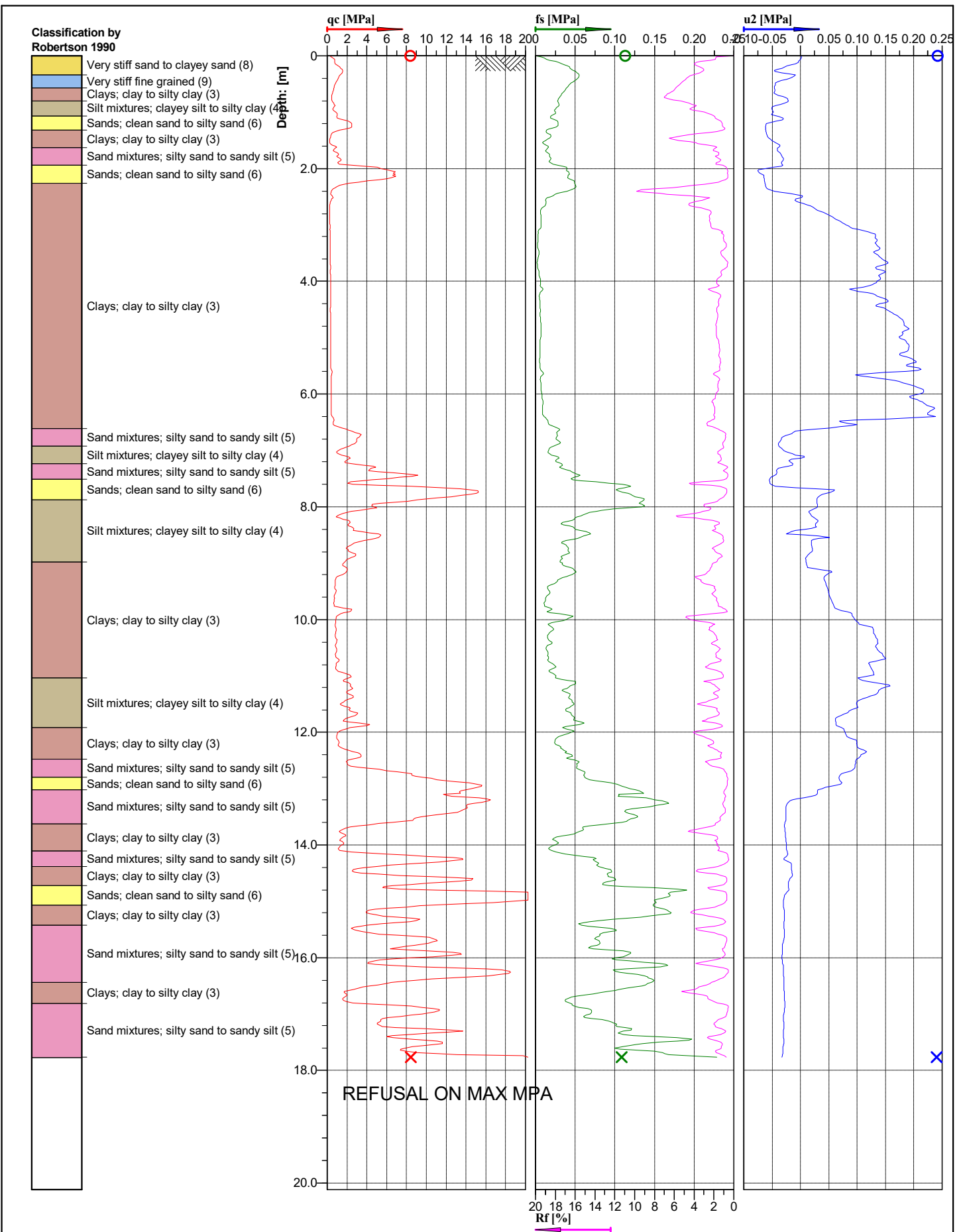
**Classification by
Robertson 1986**



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT05
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50590 E 176.88740			File:	CPT05.cpt		

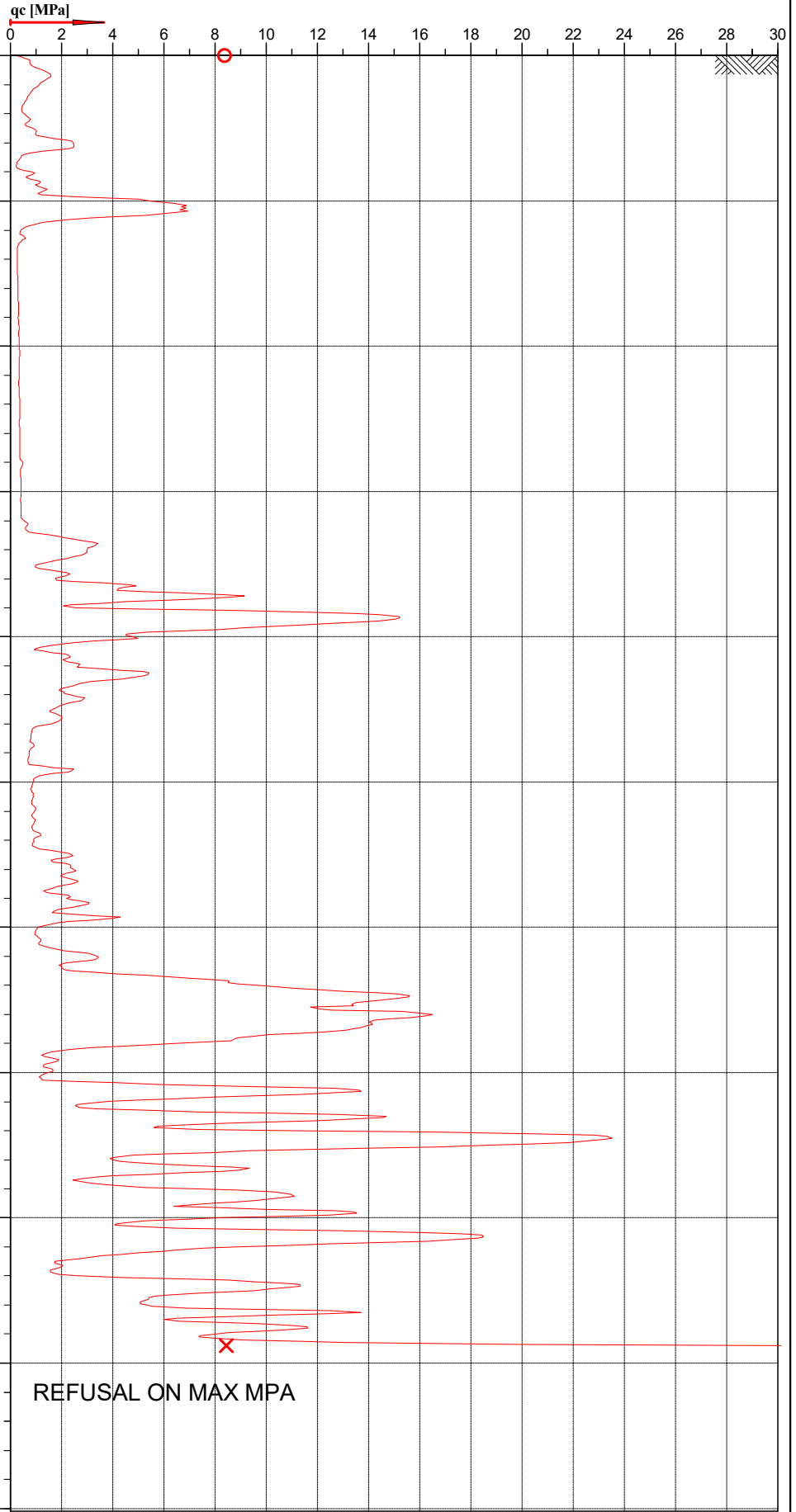


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT05
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50590 E 176.88740		File: CPT05.cpt	

**Classification by
Robertson 1990**

- Very stiff sand to clayey sand (8)
- Very stiff fine grained (9)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Sands; clean sand to silty sand (6)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)
- Sands; clean sand to silty sand (6)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Clays; clay to silty clay (3)
- Silt mixtures; clayey silt to silty clay (4)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sands; clean sand to silty sand (6)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)
- Clays; clay to silty clay (3)
- Sand mixtures; silty sand to sandy silt (5)

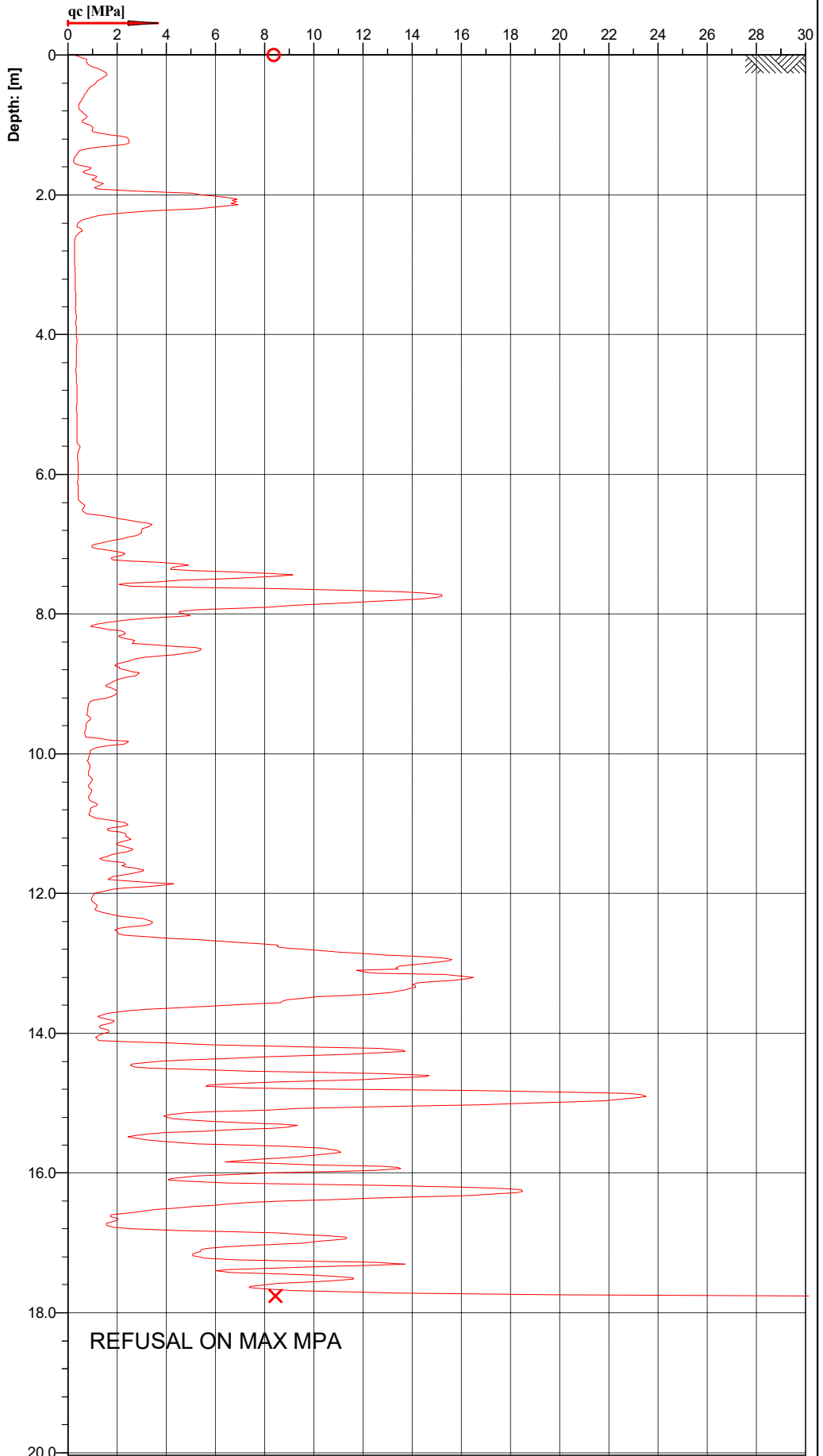
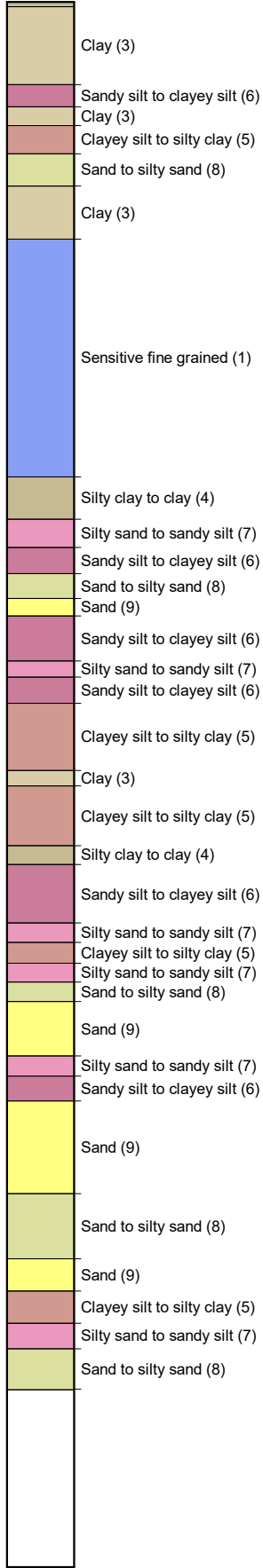


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT05
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	S 39.50590 E 176.88740		Page: 1/1
			File: CPT05.cpt

**Classification by
Robertson 1986**

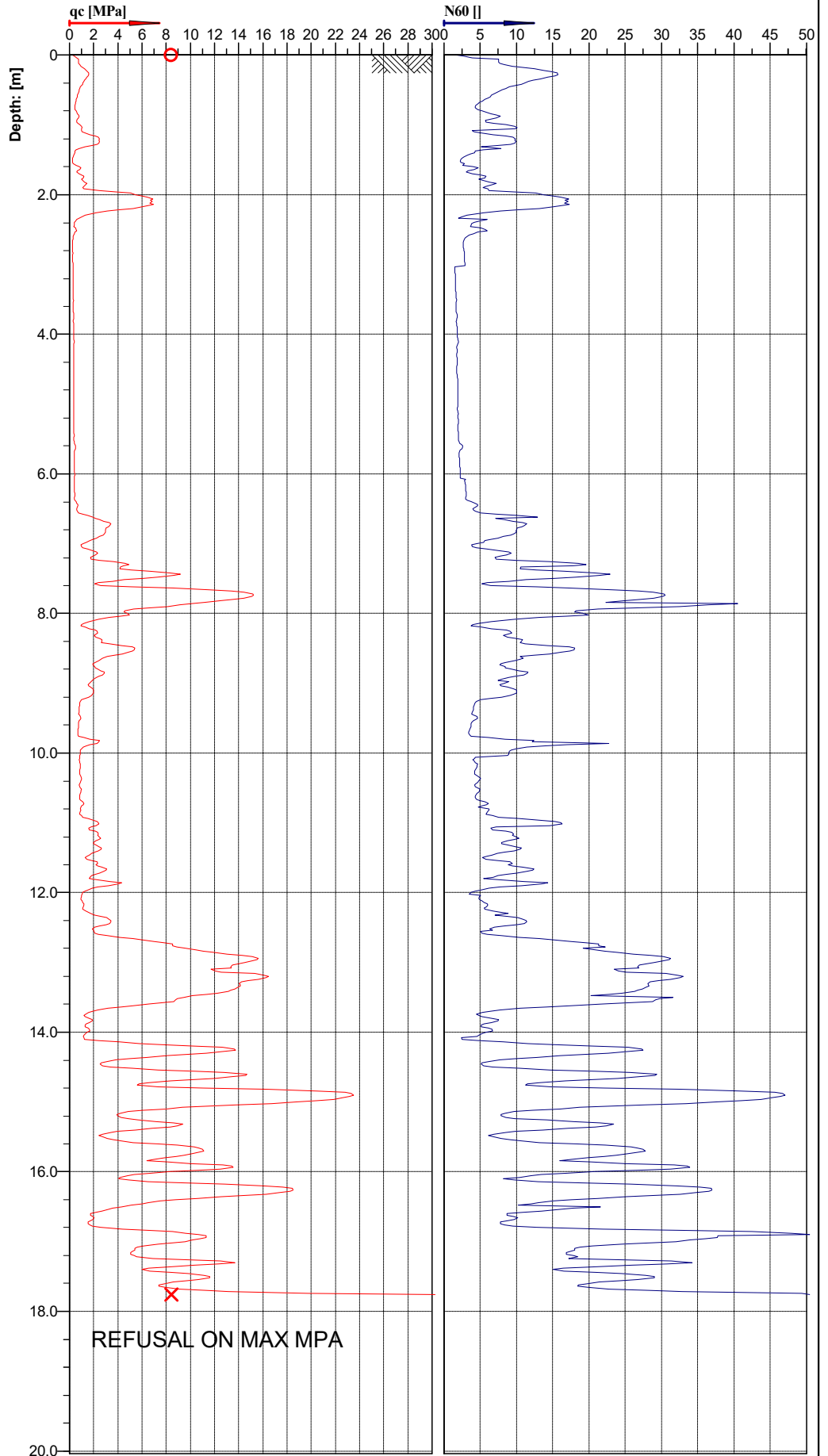
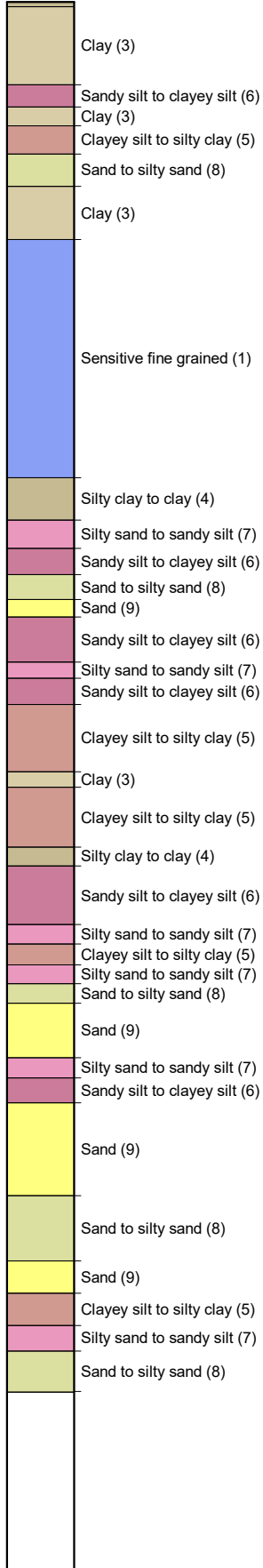


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT05
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50590 E 176.88740		File: CPT05.cpt	

**Classification by
Robertson 1986**

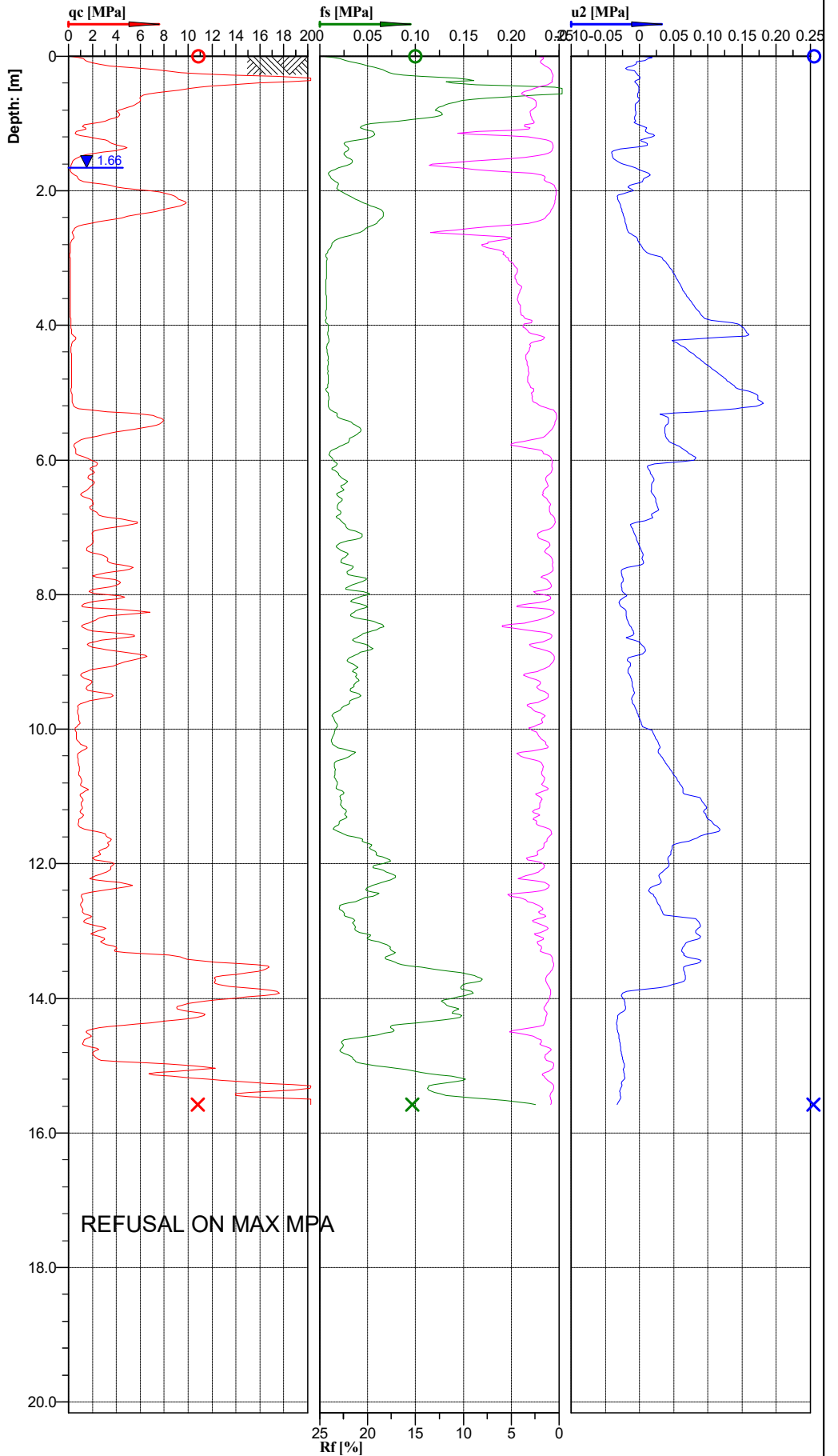
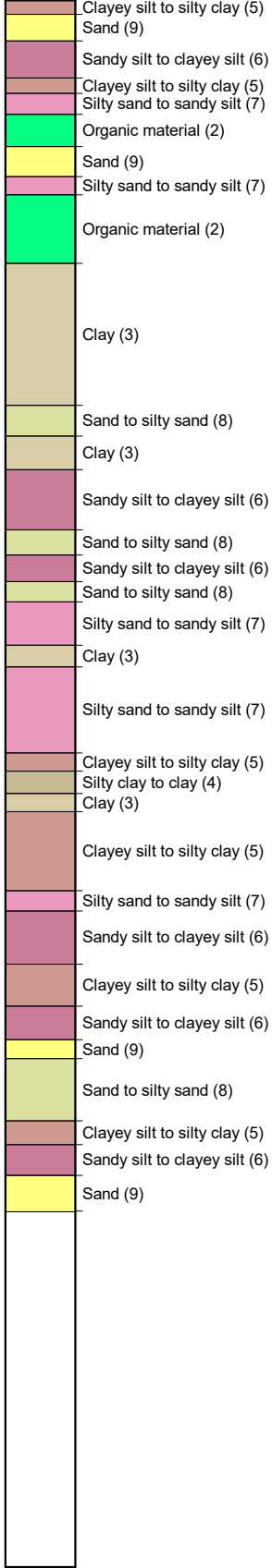


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT05
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50590 E 176.88740			File:	CPT05.cpt		

Classification by Robertson 1986



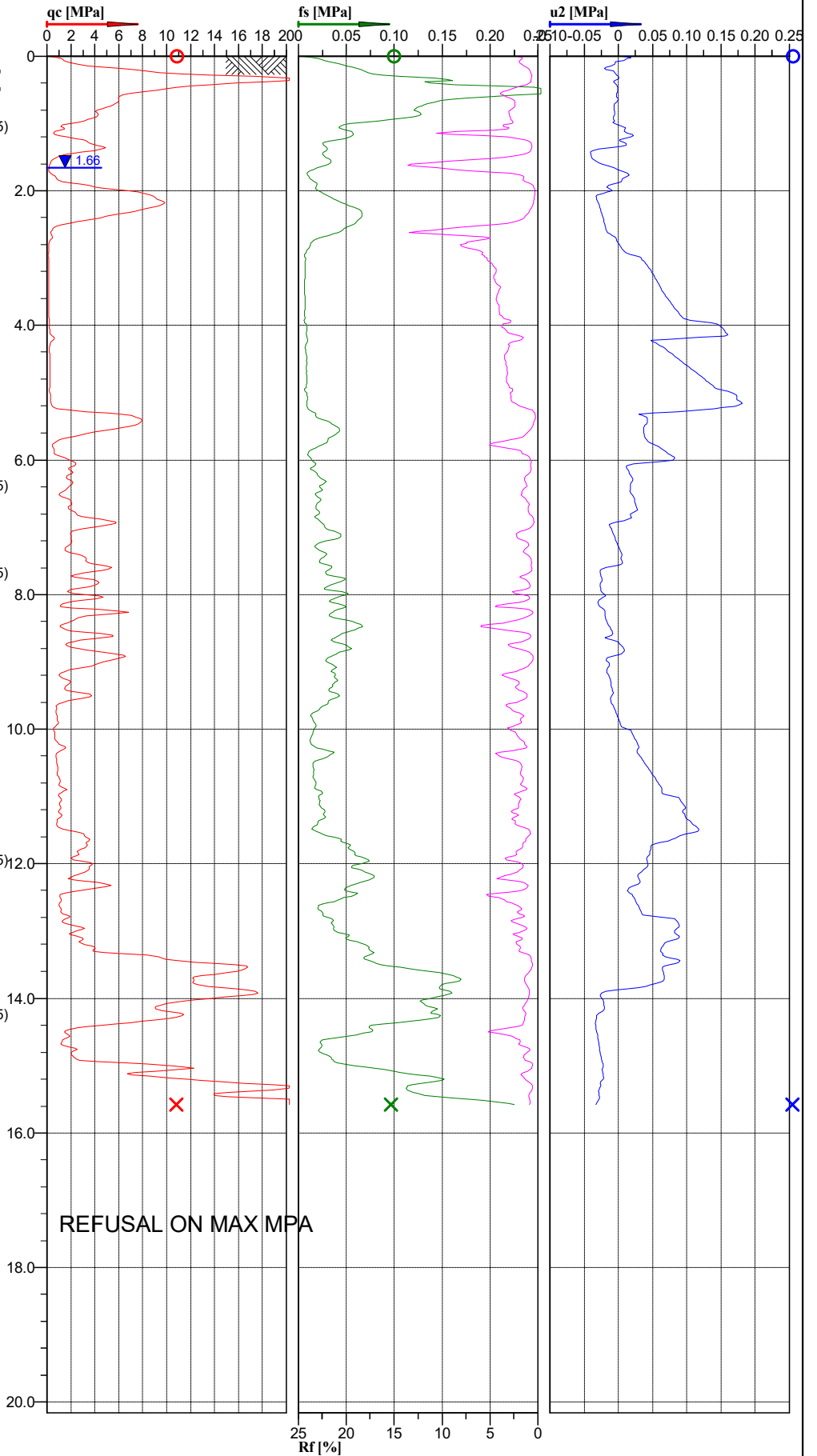
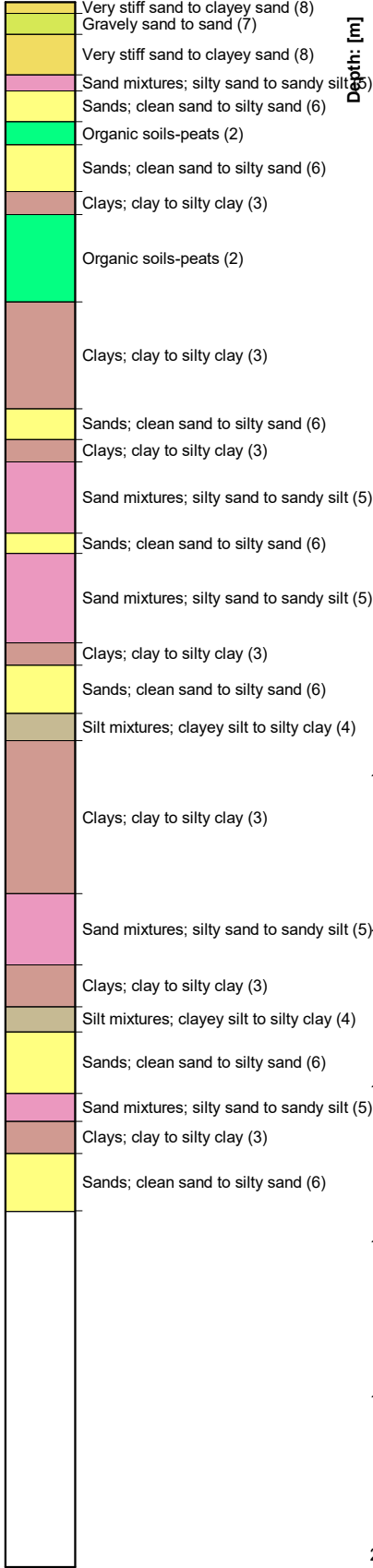
REFUSAL ON MAX MPA



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT06
Project ID:	Client: TONKIN + TAYLOR	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50604, E 176.88774		File: CPT06.cpt	

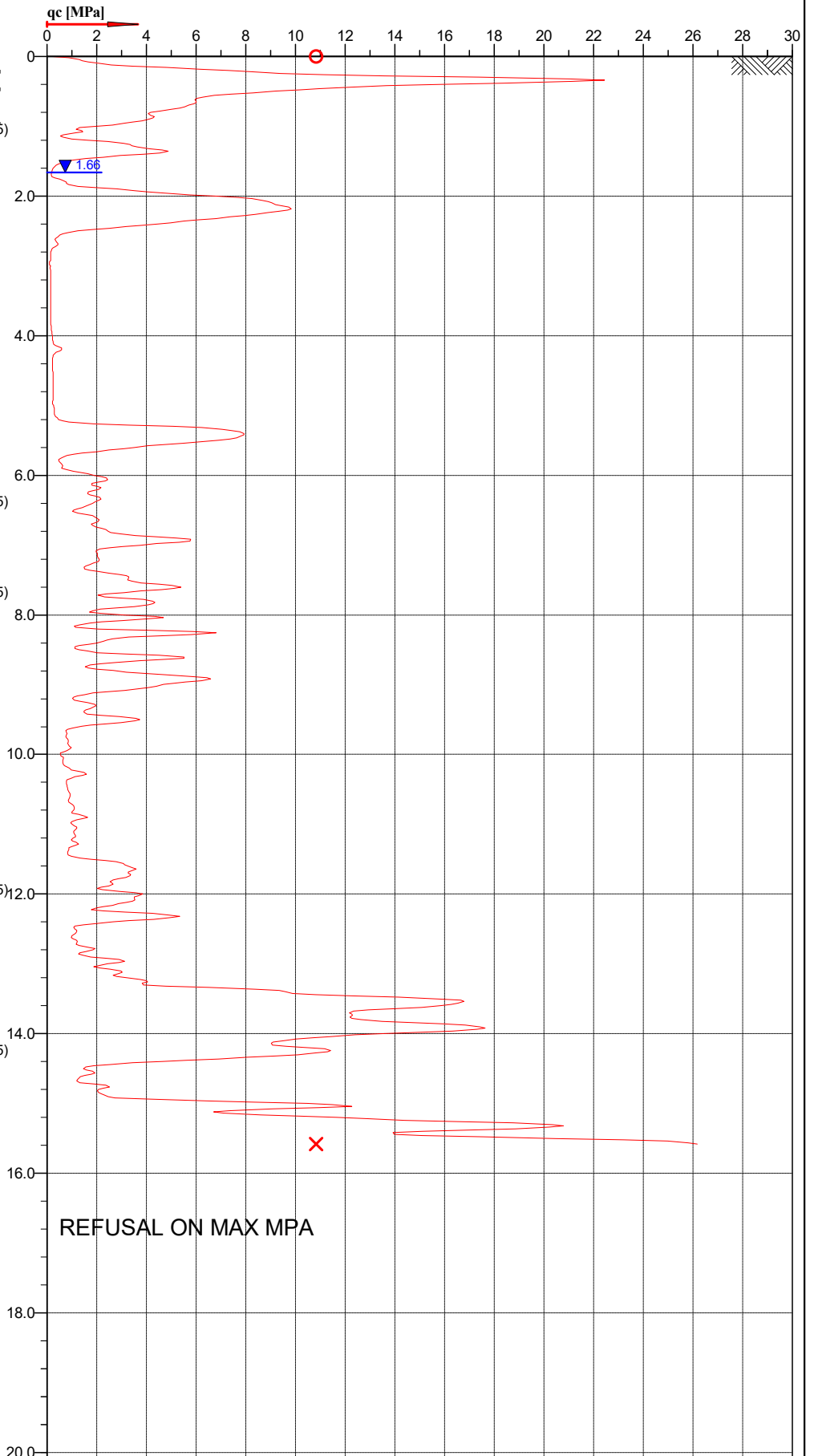
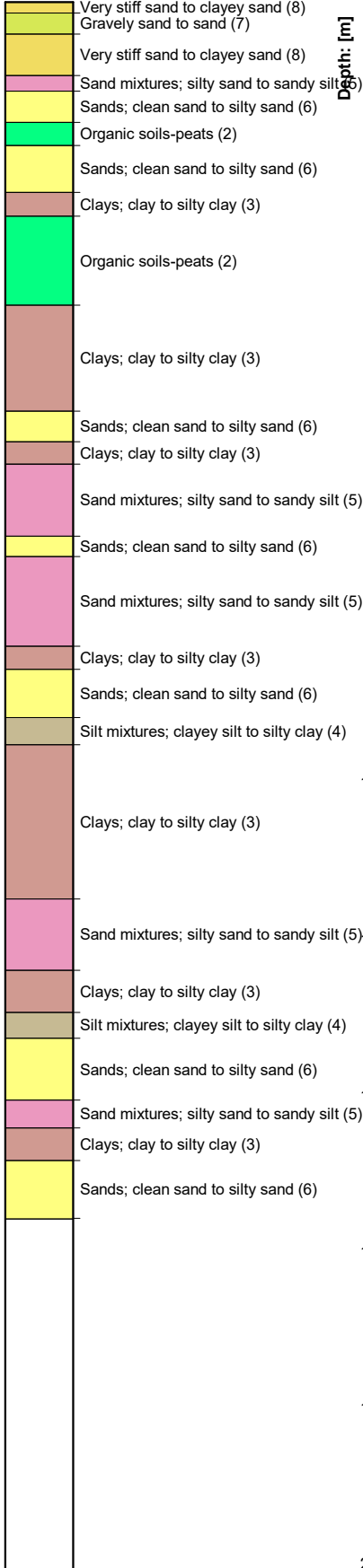
Classification by Robertson 1990



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT06
Project ID:	Client: TONKIN + TAYLOR	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50604, E 176.88774			File: CPT06.cpt

**Classification by
Robertson 1990**



REFUSAL ON MAX MPA

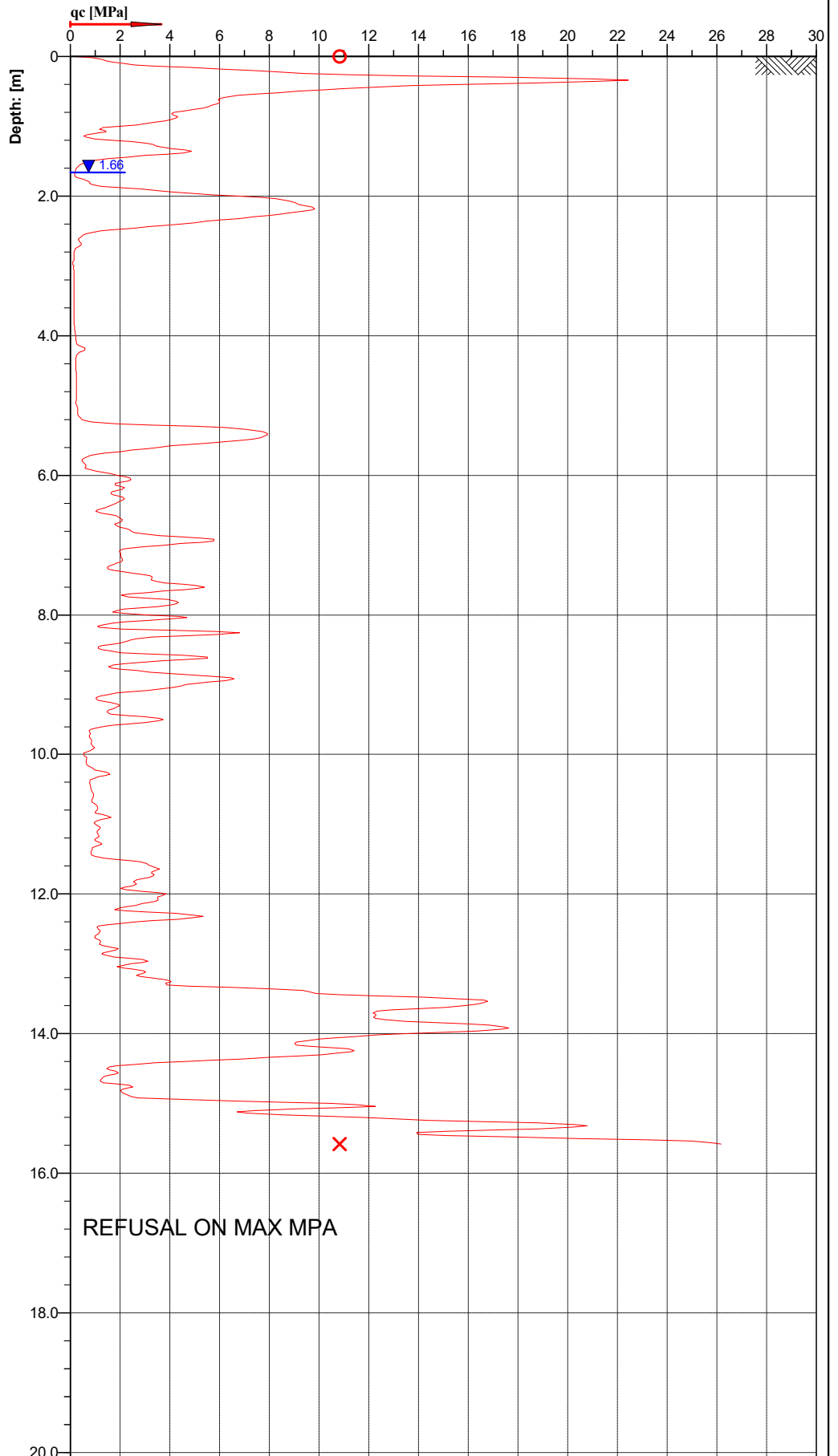
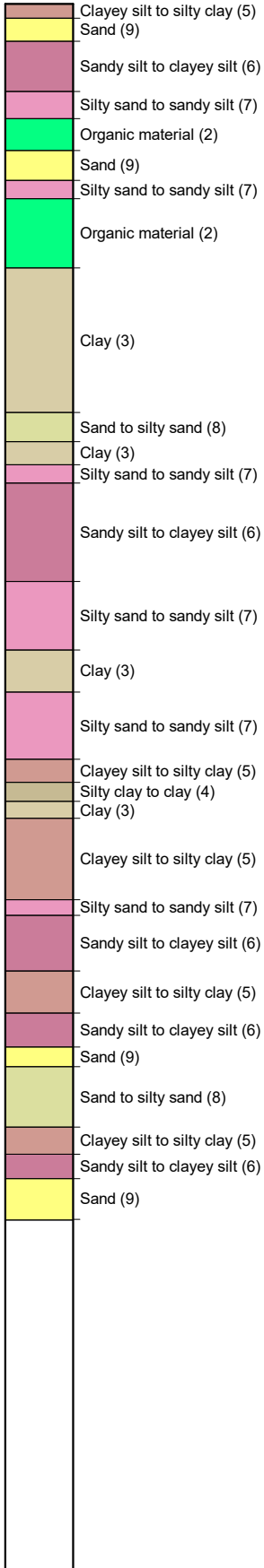


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT06
Project ID:	Client: TONKIN + TAYLOR	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50604, E 176.88774		File: CPT06.cpt	

**Classification by
Robertson 1986**

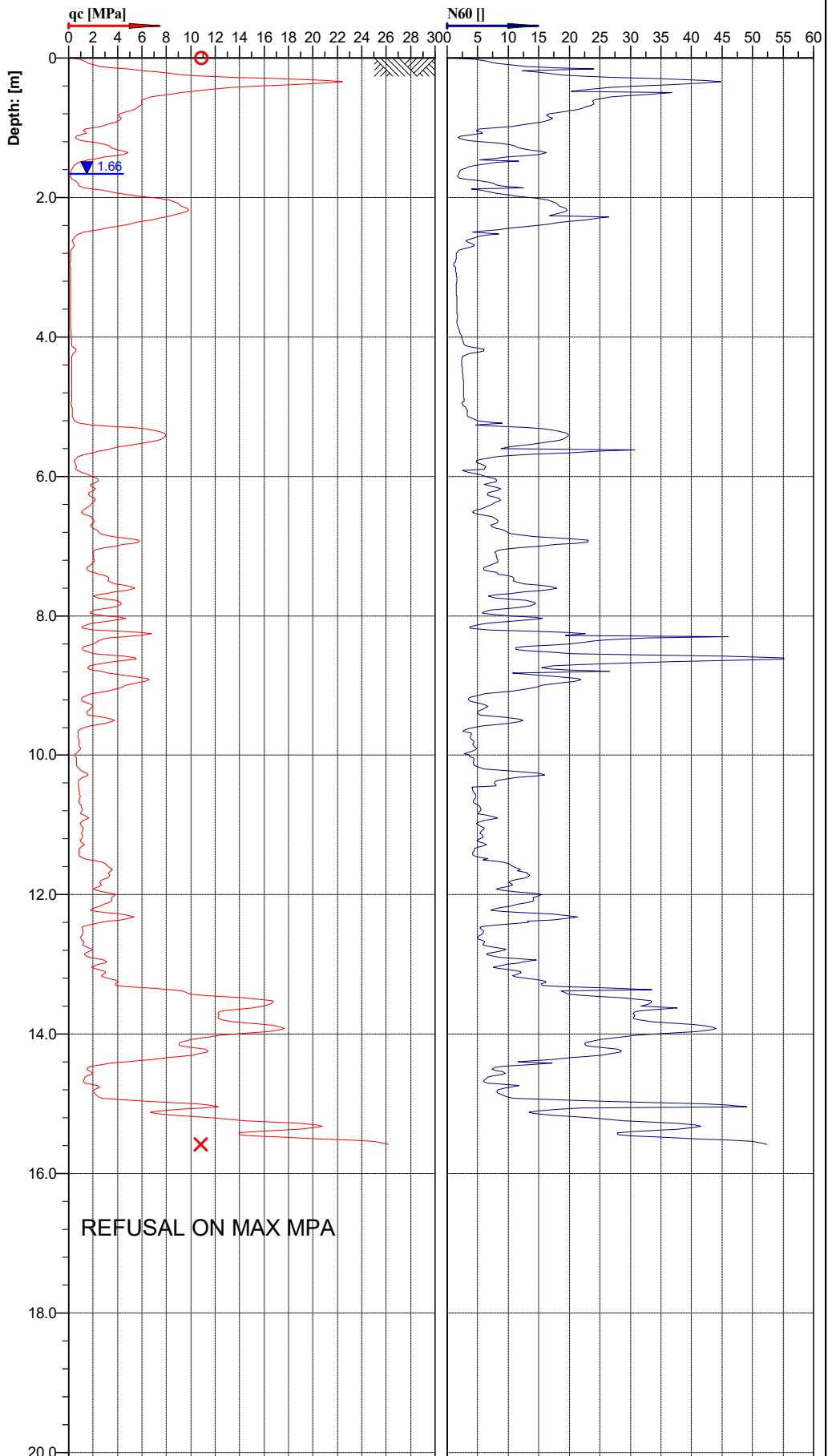
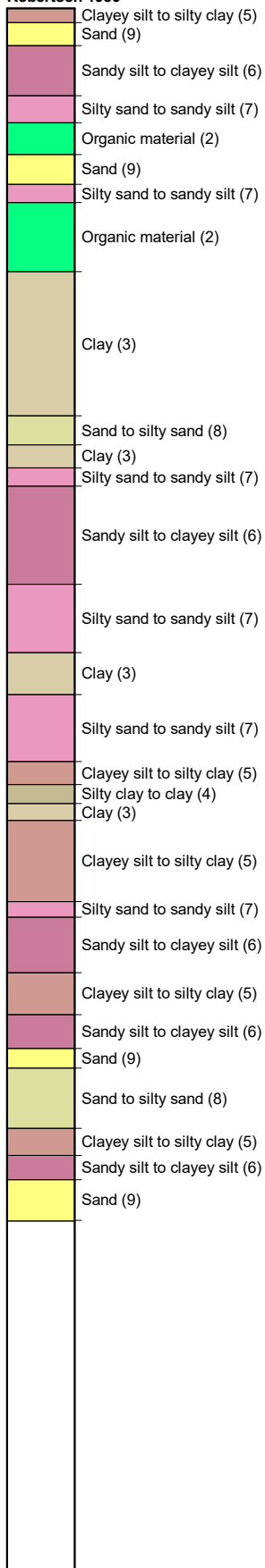


Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT06
Project ID:		Client:	TONKIN + TAYLOR	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50604, E 176.88774			File:	CPT06.cpt		



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Classification by Robertson 1986

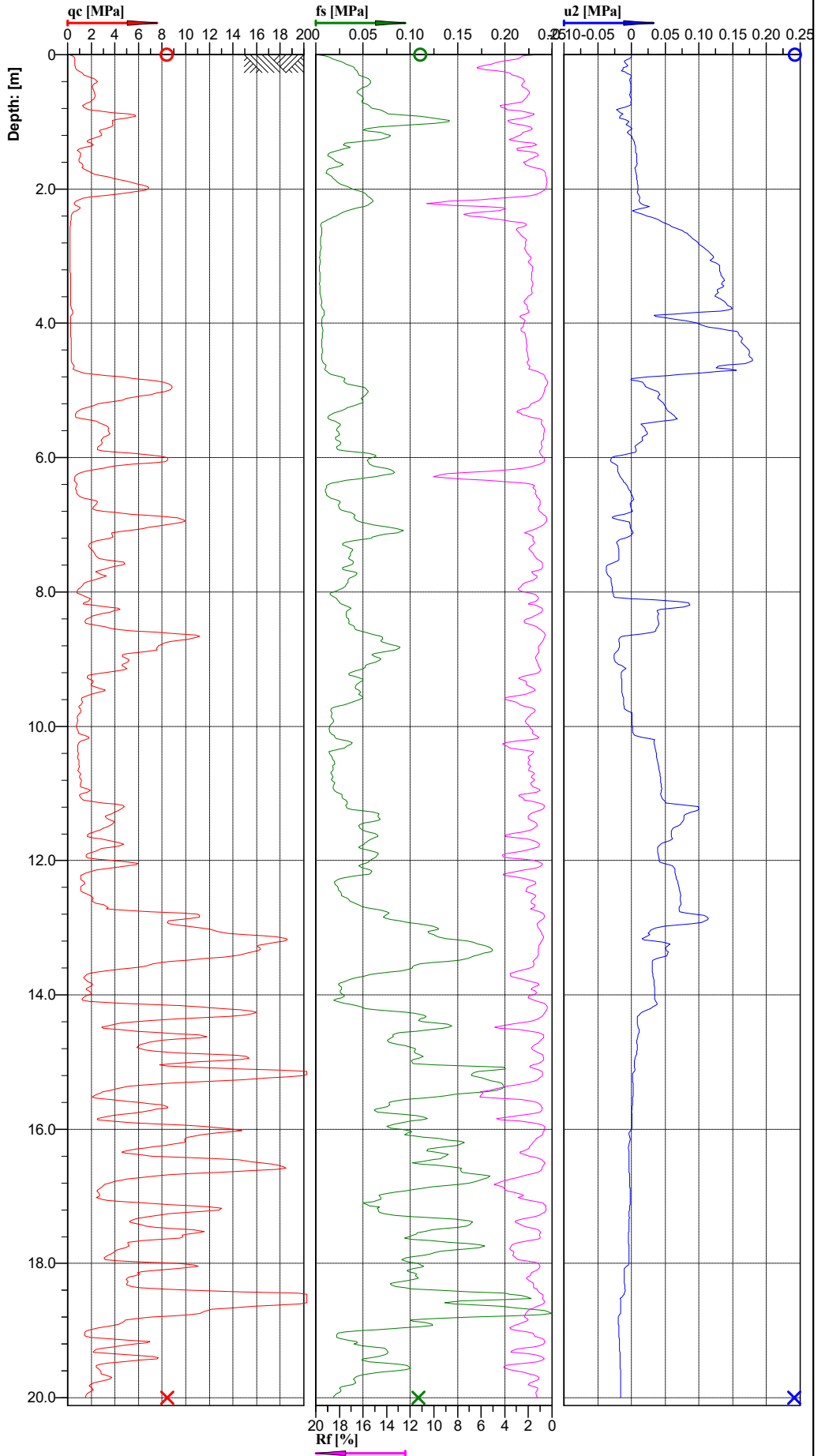


Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT06
Project ID:	Client: TONKIN + TAYLOR	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE	S 39.50604, E 176.88774	Page: 1/1	Fig.:
File: CPT06.cpt			

Classification by Robertson 1986

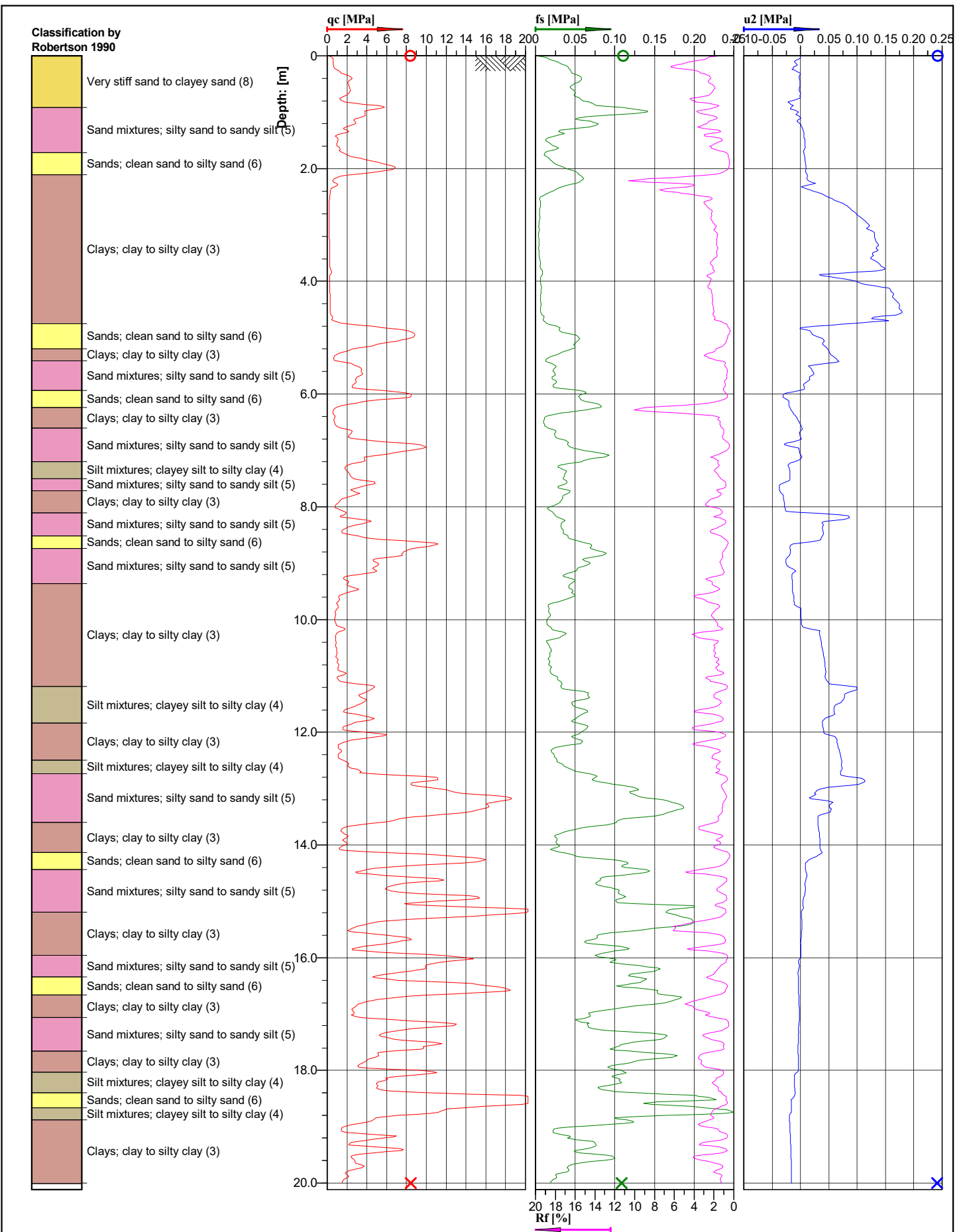
- Clay (3)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sensitive fine grained (1)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sand (9)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand (9)
- Clay (3)
- Sand to silty sand (8)
- Sand (9)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT07
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50674 E 176.88780		File: CPT07.cpt	

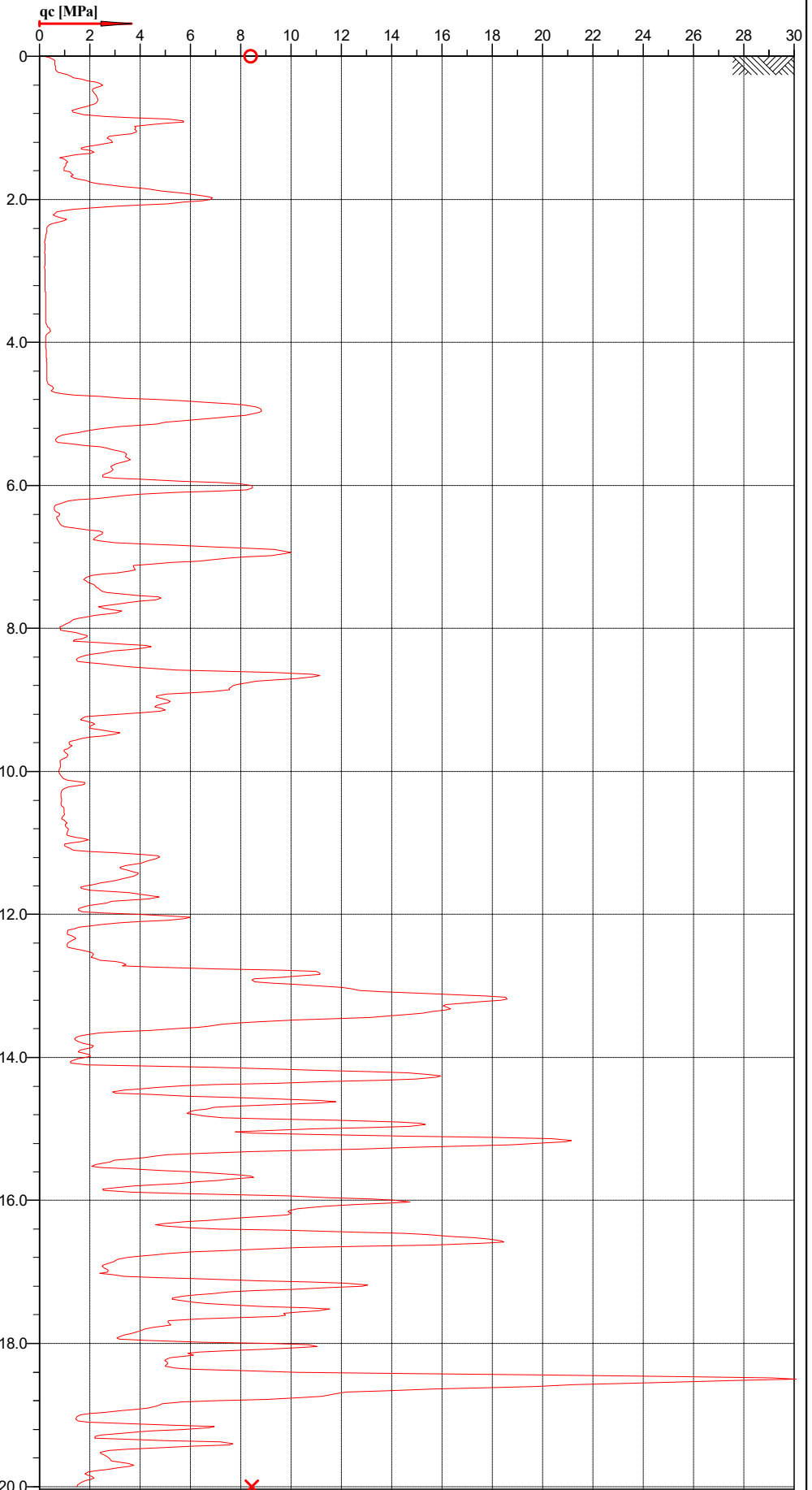


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT07
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50674 E 176.88780				File:	CPT07.cpt		

**Classification by
Robertson 1990**



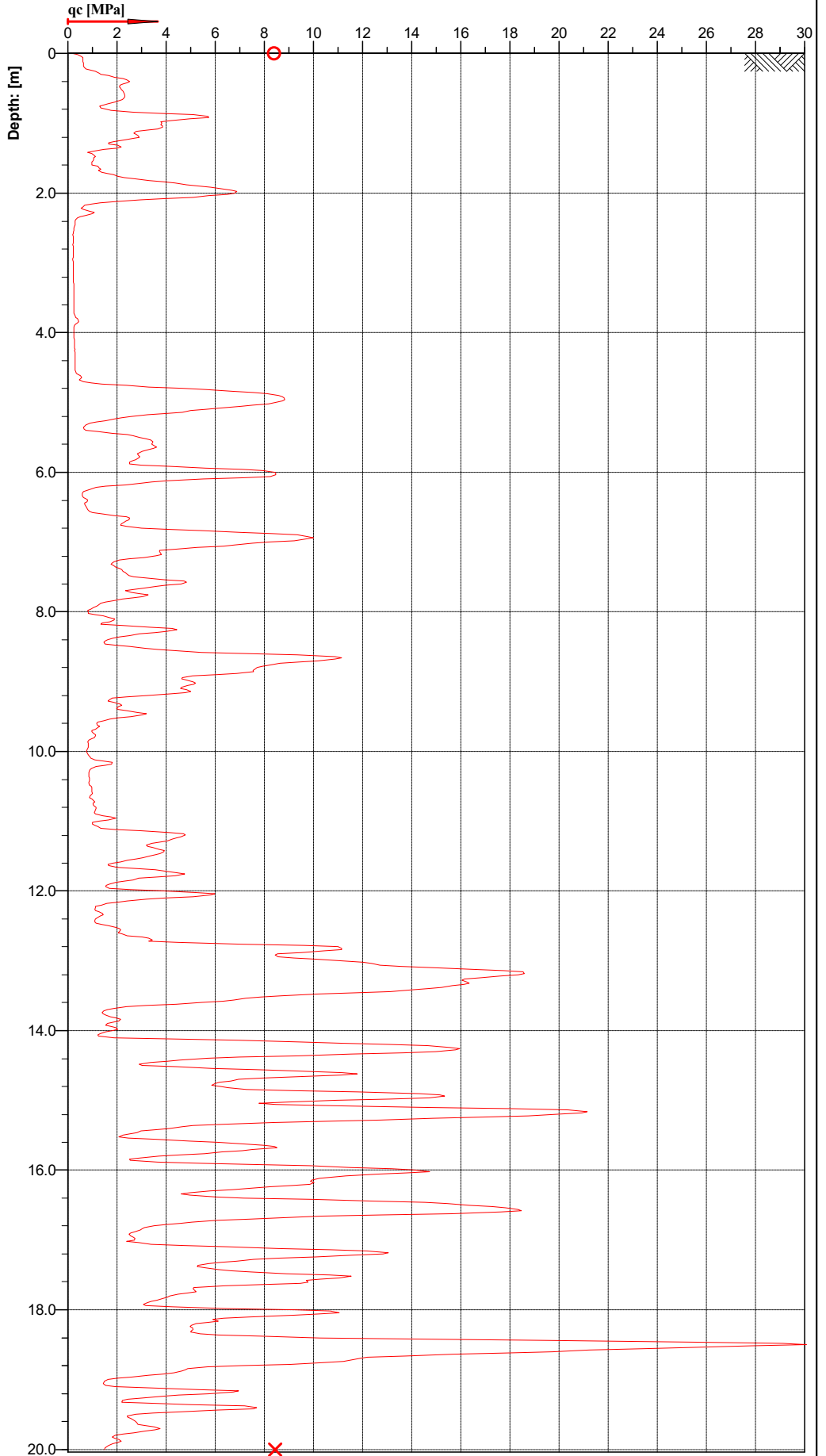
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT07
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50674 E 176.88780		File: CPT07.cpt	

**Classification by
Robertson 1986**

- Clay (3)
- Sandy silt to clayey silt (6)
- Silty clay to clay (4)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sensitive fine grained (1)
- Sand to silty sand (8)
- Silty clay to clay (4)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand (9)
- Clay (3)
- Sand to silty sand (8)
- Sand (9)
- Silty clay to clay (4)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)



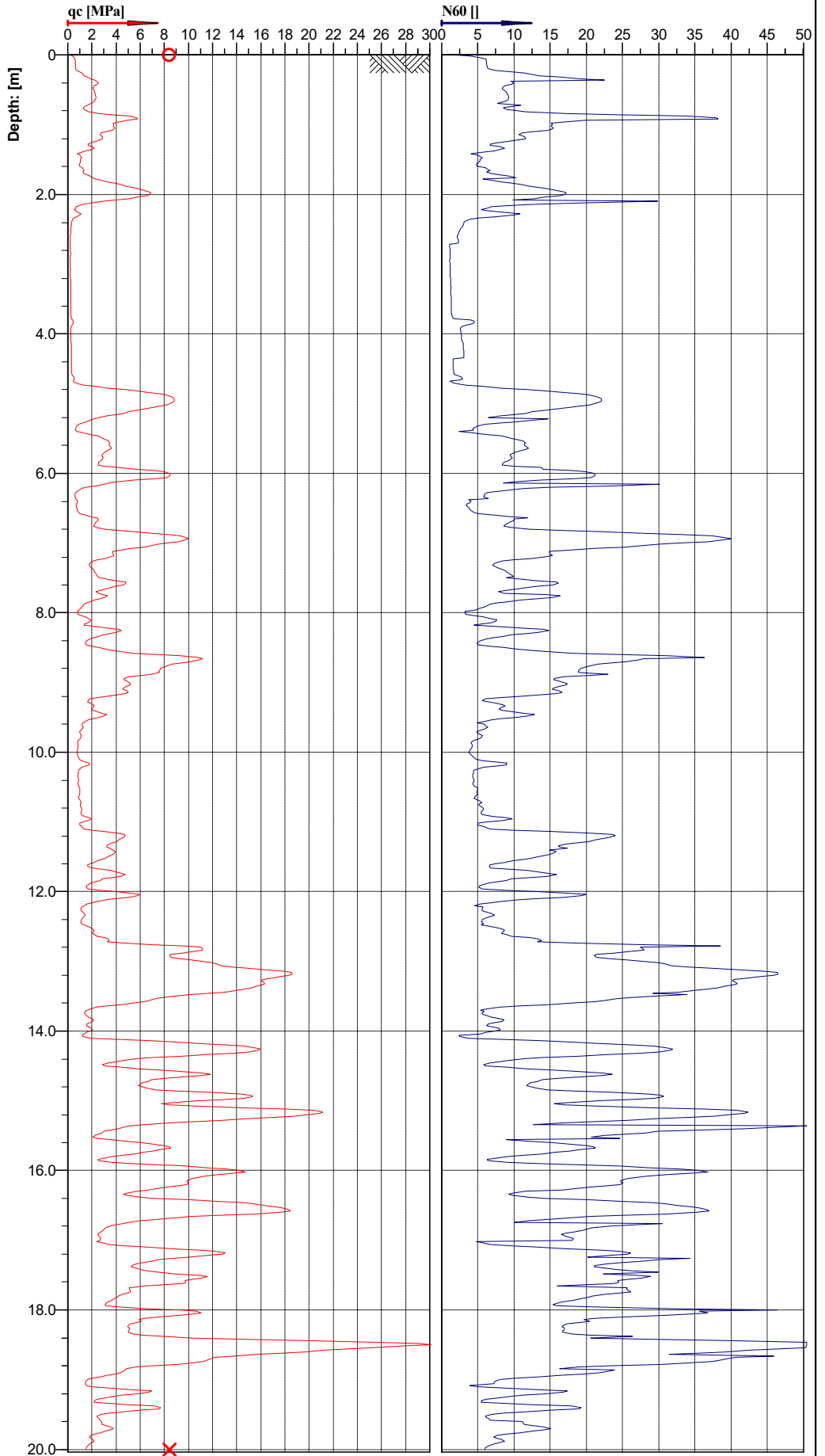
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT07
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
				S 39.50674 E 176.88780		File:	CPT07.cpt

**Classification by
Robertson 1986**

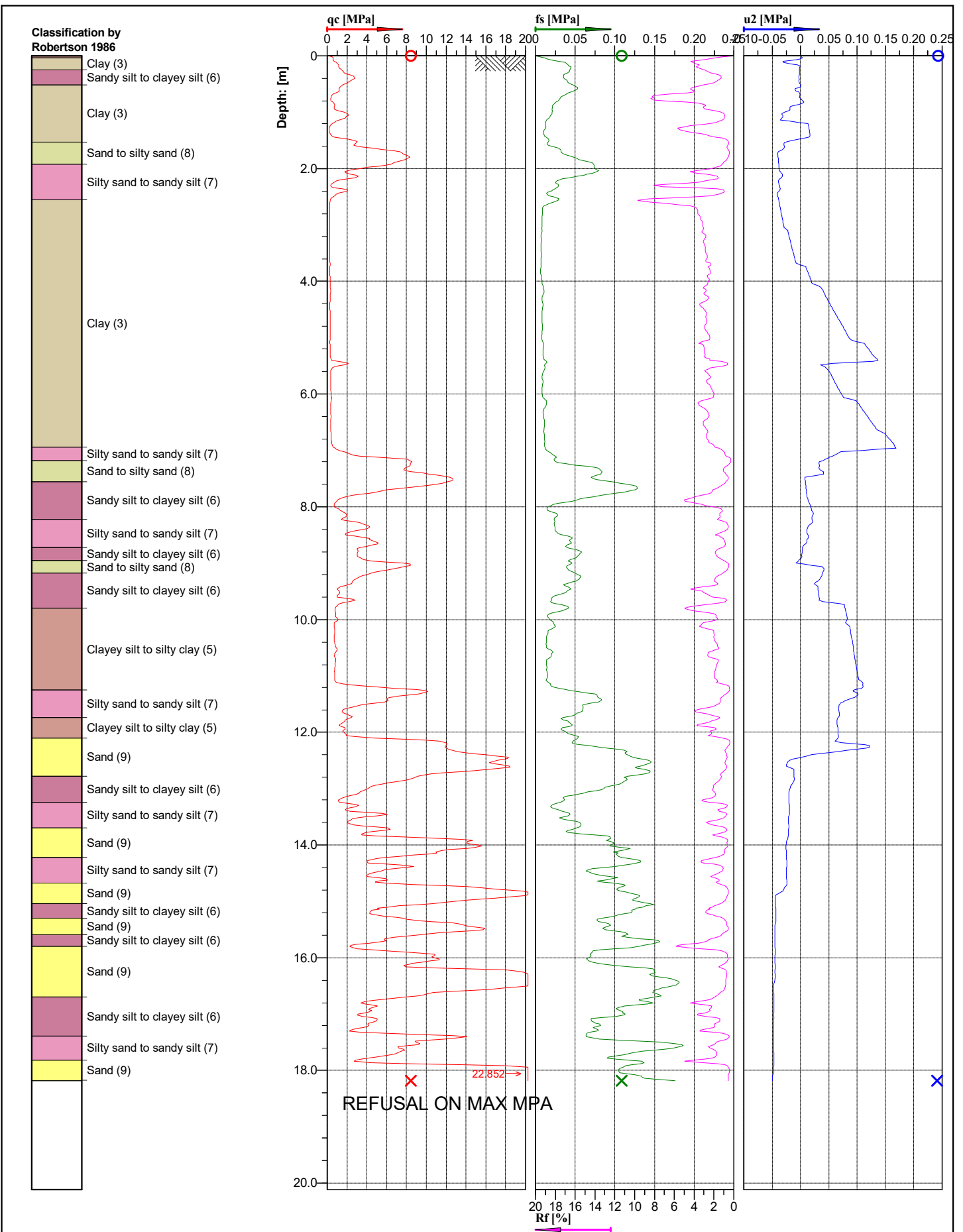
- Clay (3)
- Sandy silt to clayey silt (6)
- Silty clay to clay (4)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sensitive fine grained (1)
- Sand to silty sand (8)
- Silty clay to clay (4)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand (9)
- Clay (3)
- Sand to silty sand (8)
- Sand (9)
- Silty clay to clay (4)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Silty sand to sandy silt (7)
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- Sand to silty sand (8)
- Sandy silt to clayey silt (6)



**GEOTECH
DRILLING**

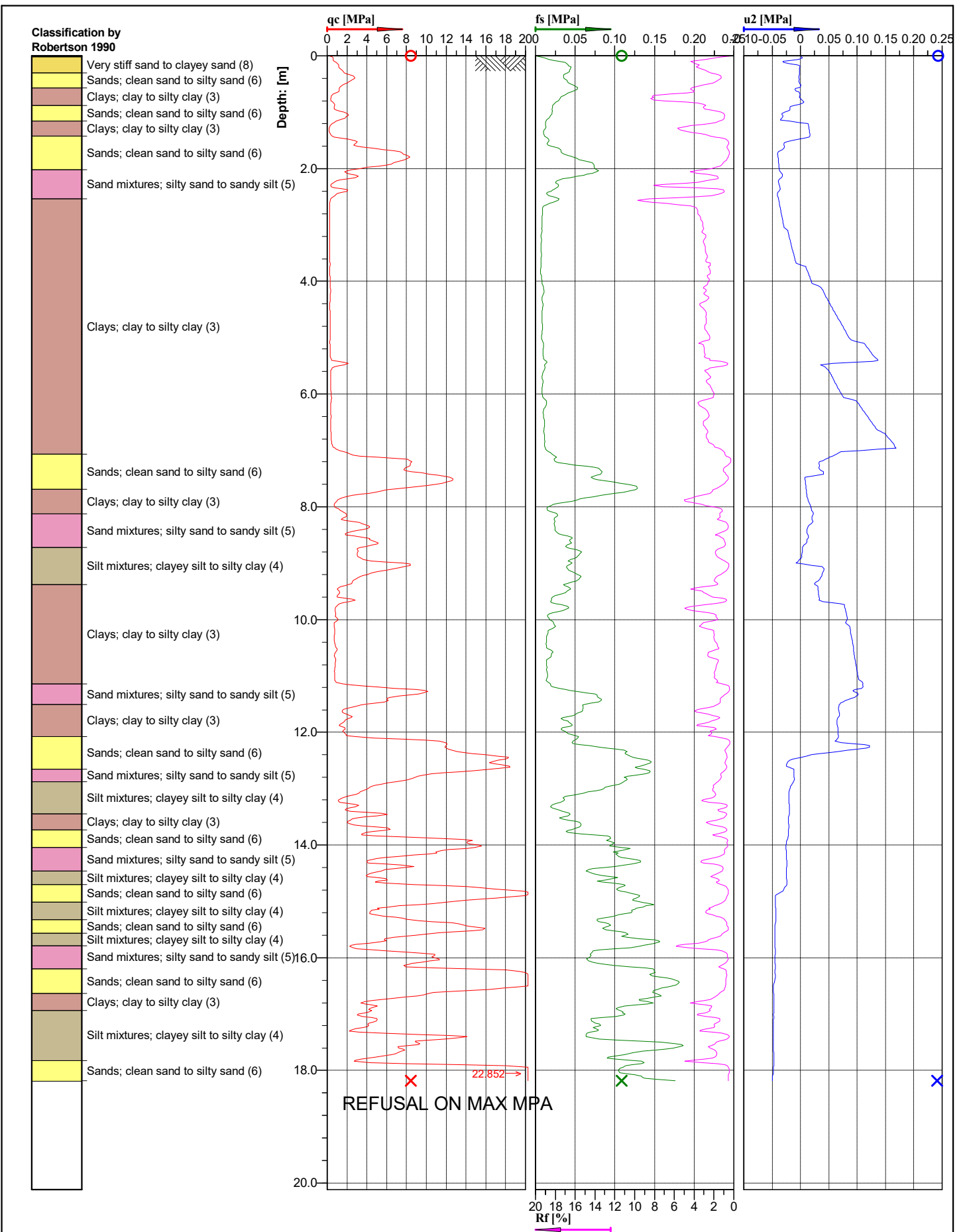
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT07
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50674 E 176.88780			File:	CPT07.cpt		



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT08
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50691 E 176.88699			File: CPT08.cpt

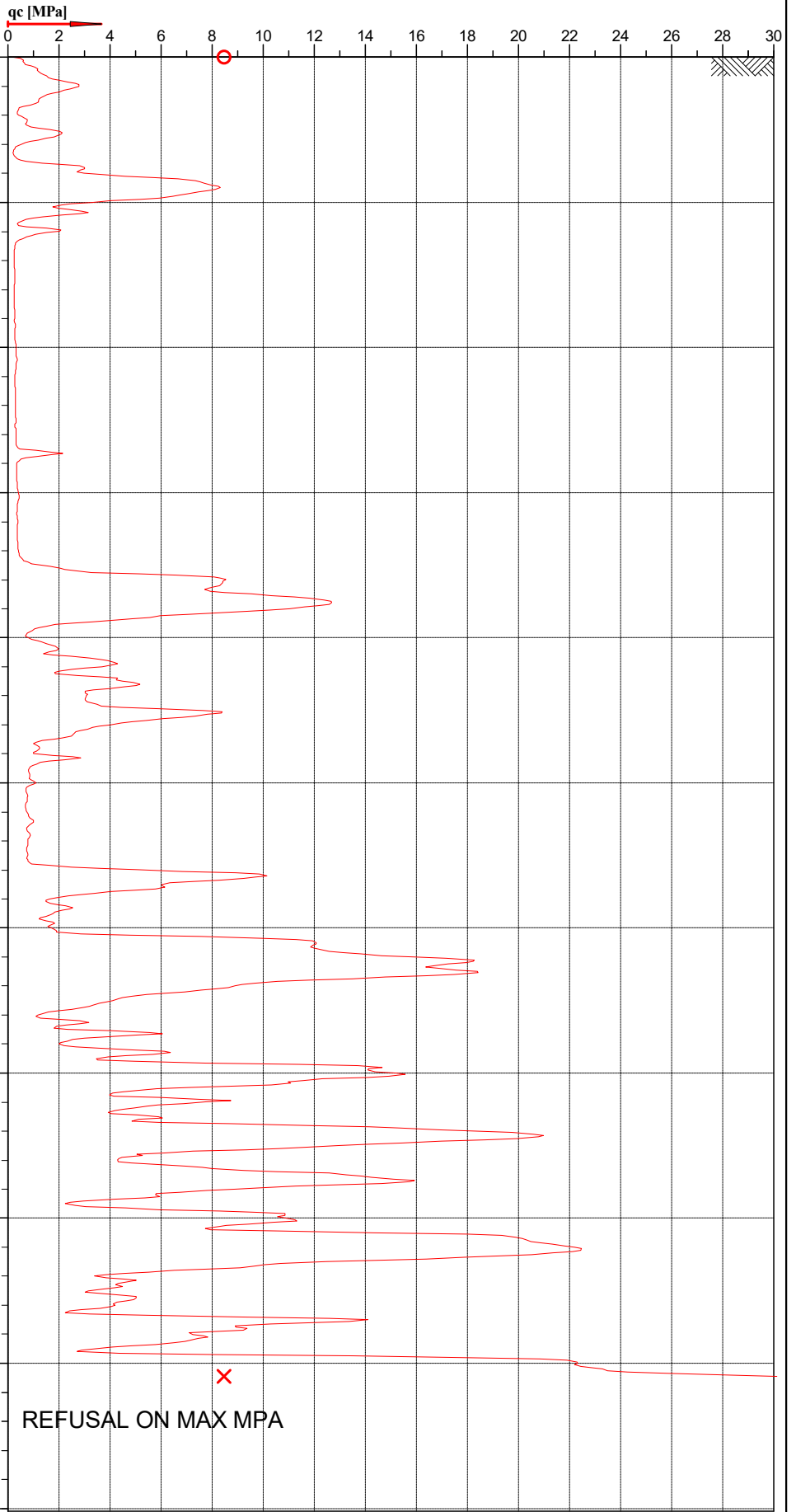
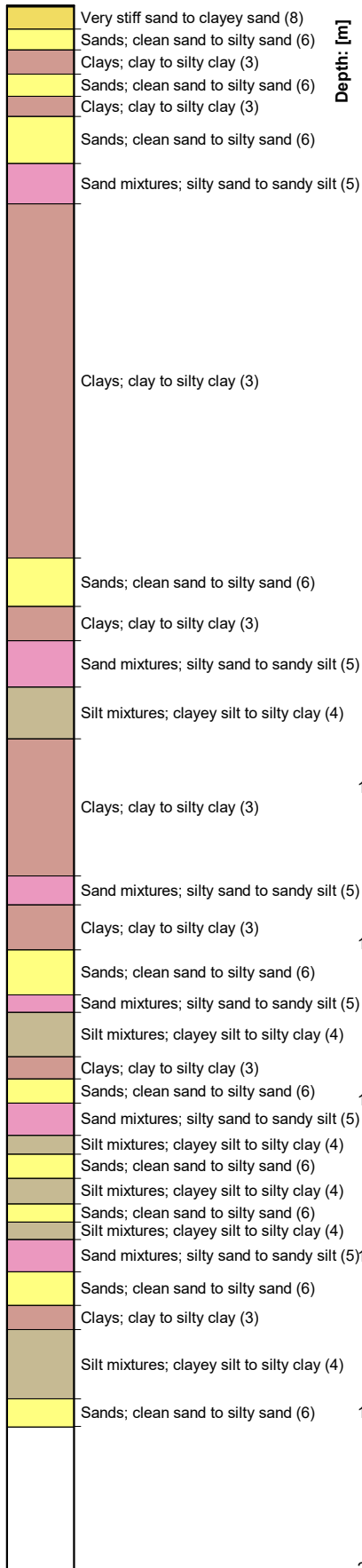


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT08
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50691 E 176.88699			File:	CPT08.cpt		

**Classification by
Robertson 1990**

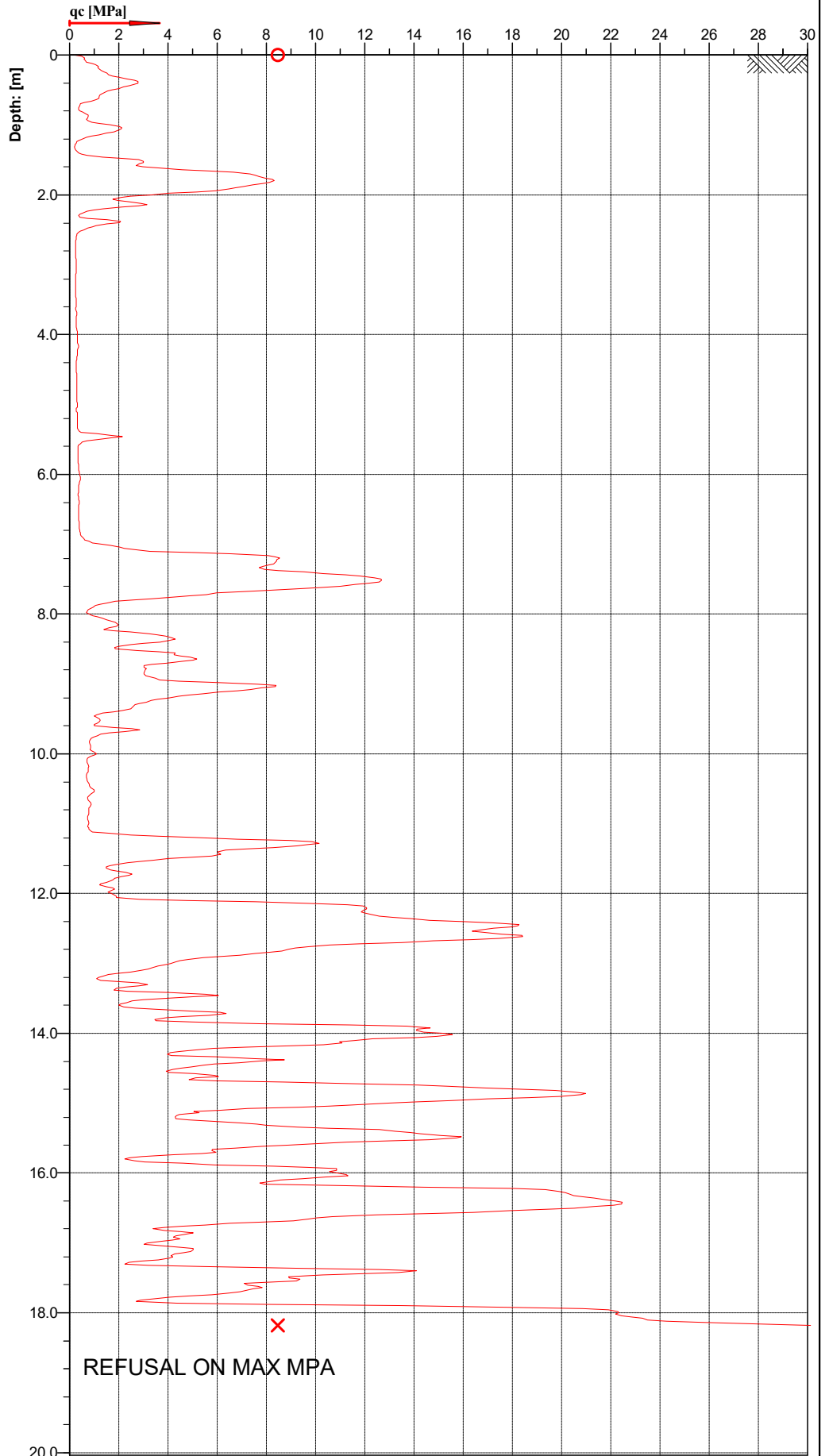
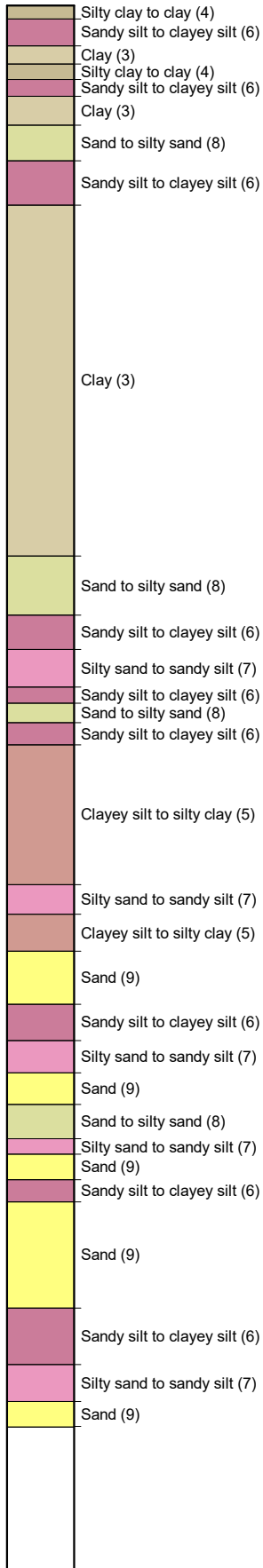


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT08
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	S 39.50691 E 176.88699		Page: 1/1
			File: CPT08.cpt

**Classification by
Robertson 1986**

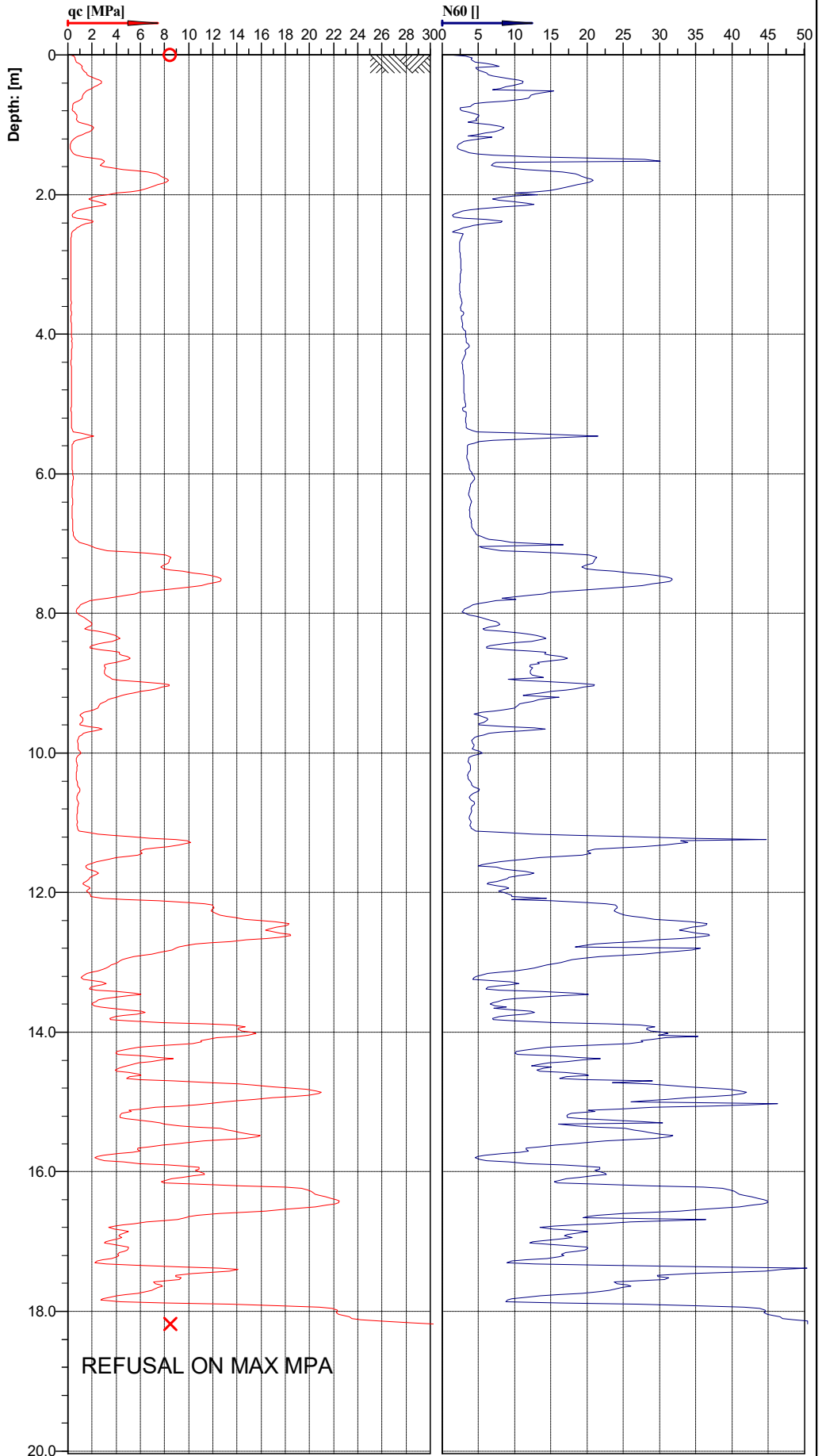
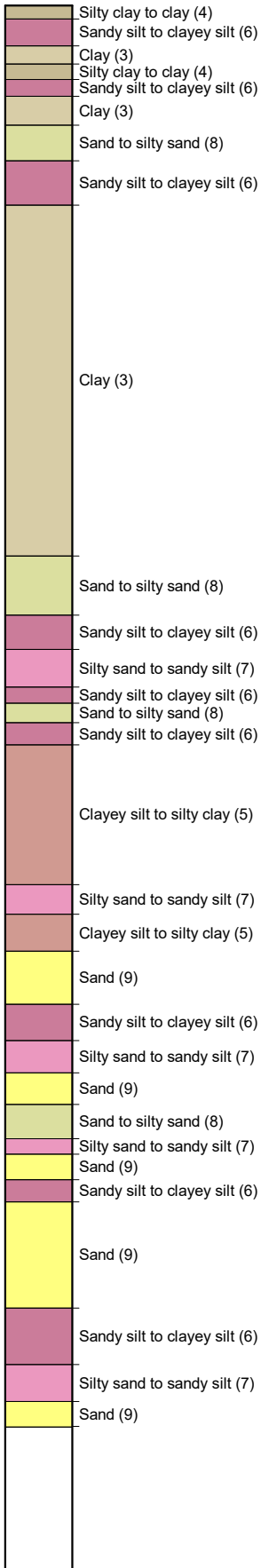


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT08
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50691 E 176.88699		File: CPT08.cpt	

**Classification by
Robertson 1986**



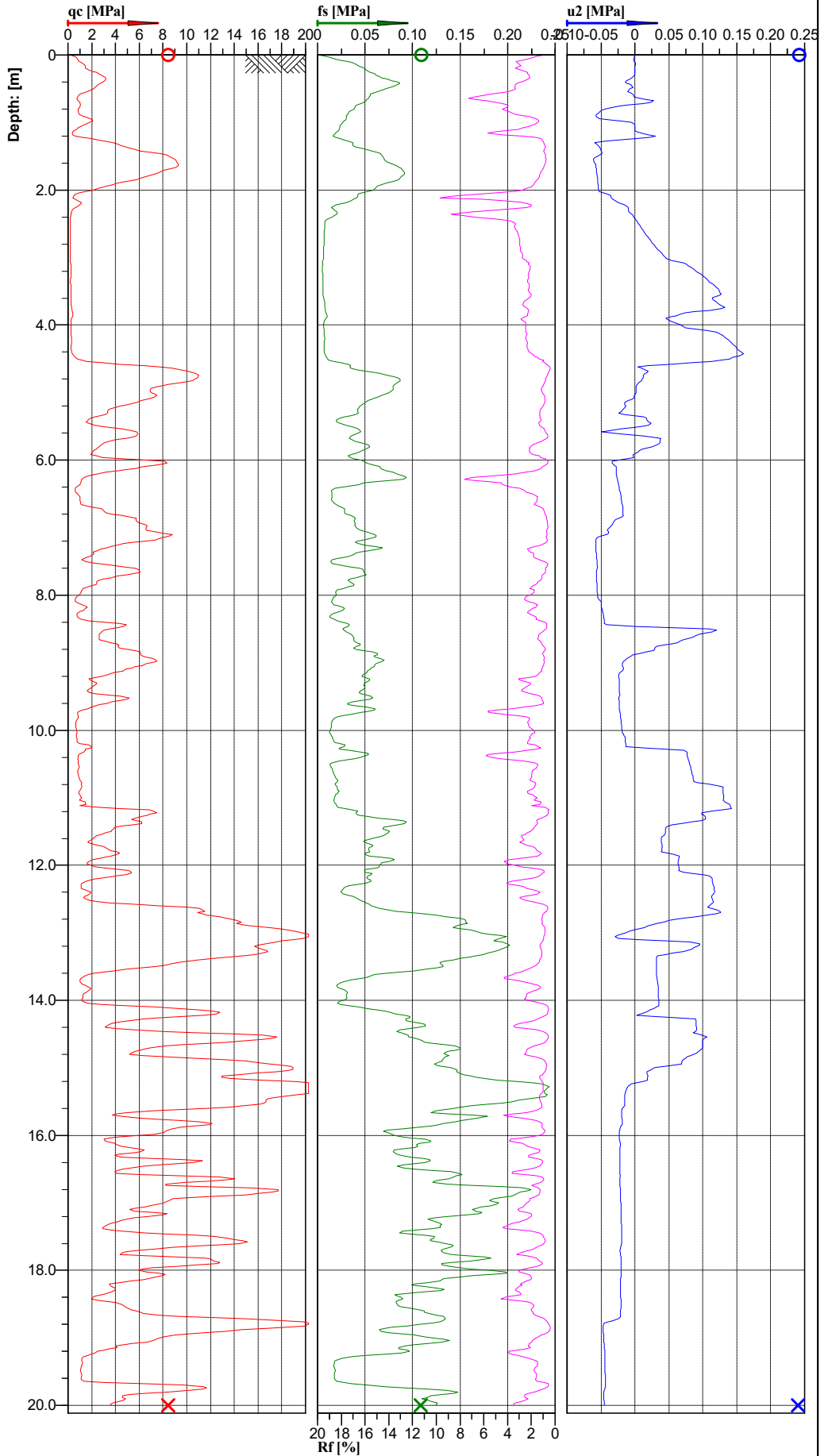
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT08
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50691 E 176.88699				File:	CPT08.cpt		

**Classification by
Robertson 1986**

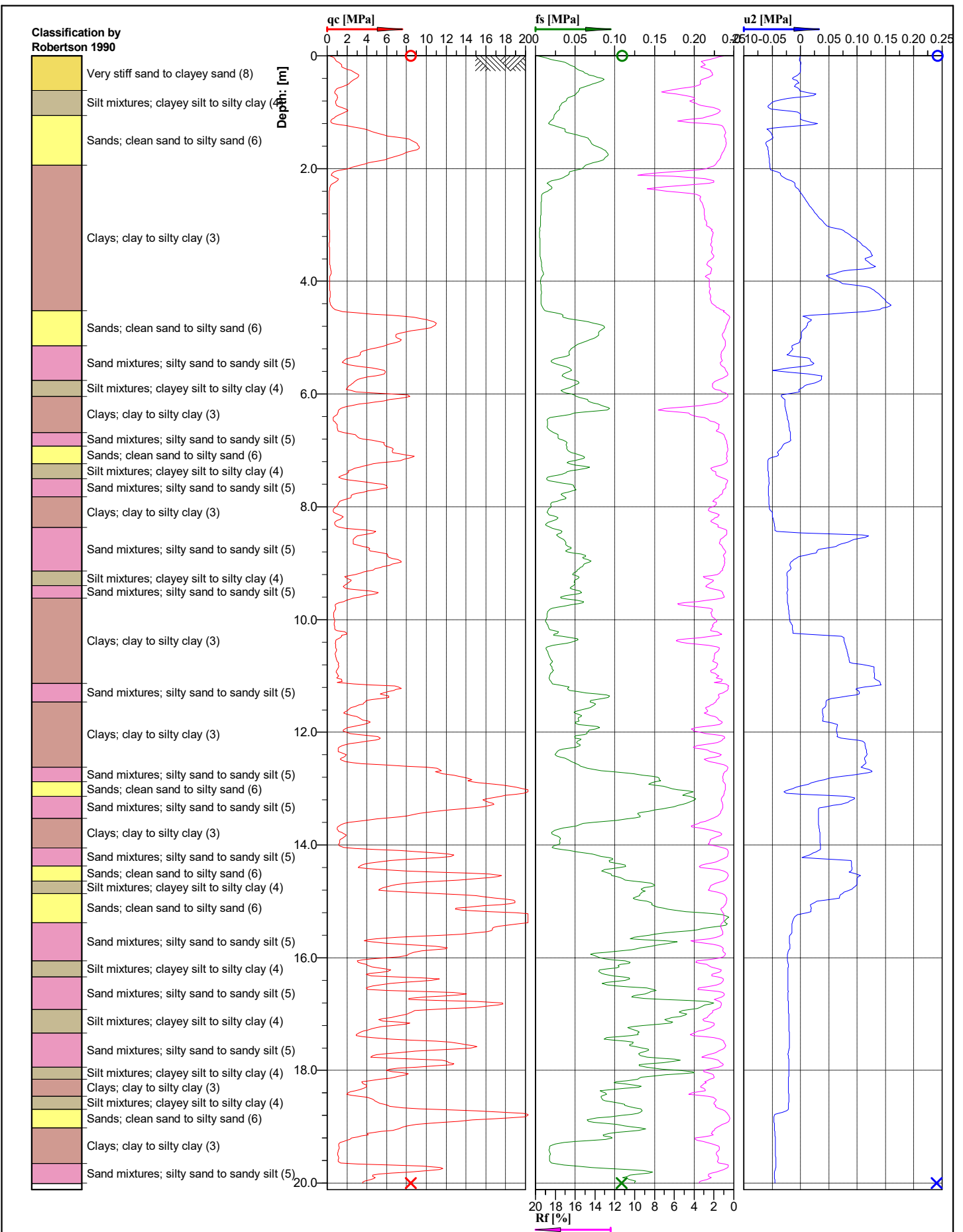
- Silty clay to clay (4)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT09
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50704 E 176.88780			File:	CPT09.cpt		

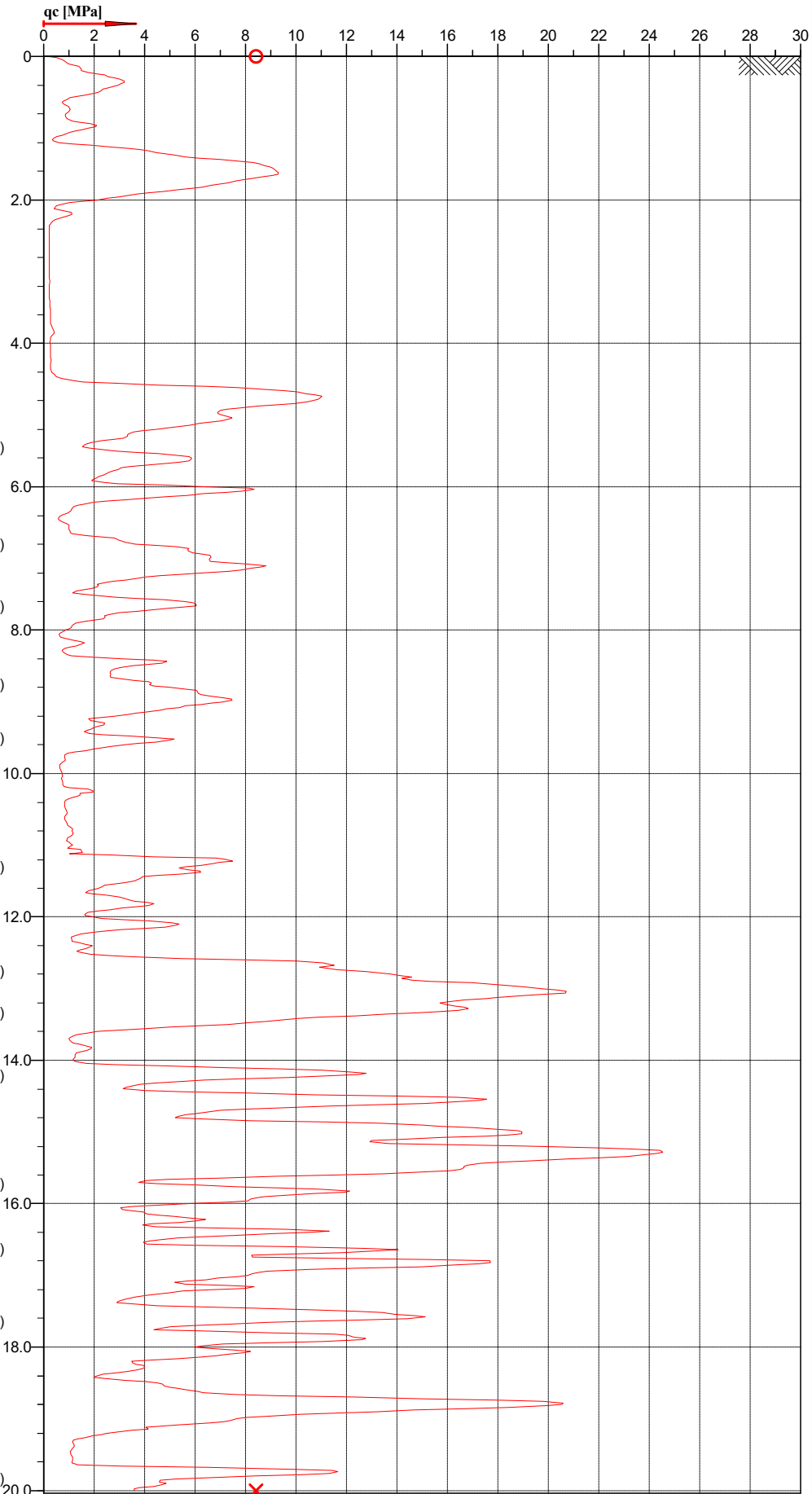
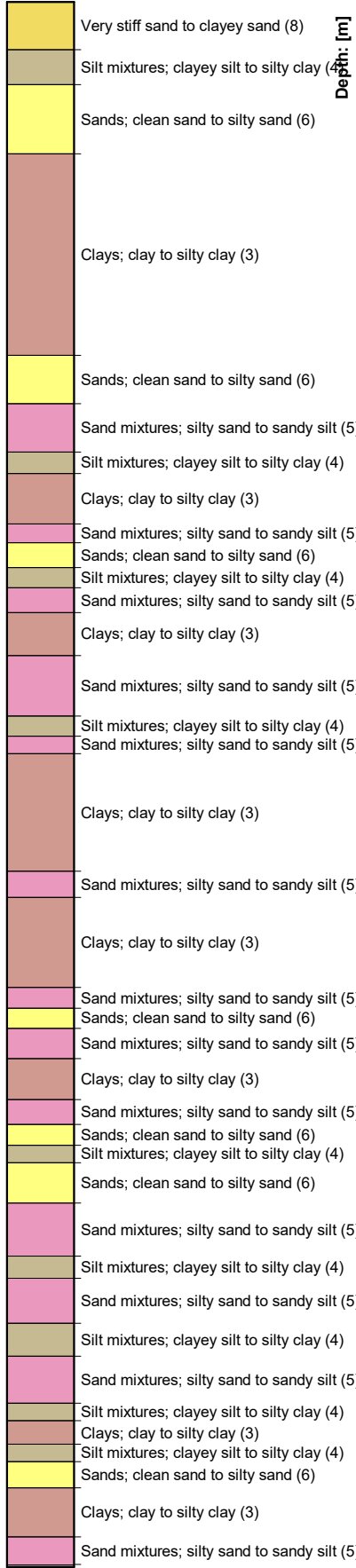


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT09
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50704 E 176.88780				File:	CPT09.cpt		

Classification by Robertson 1990



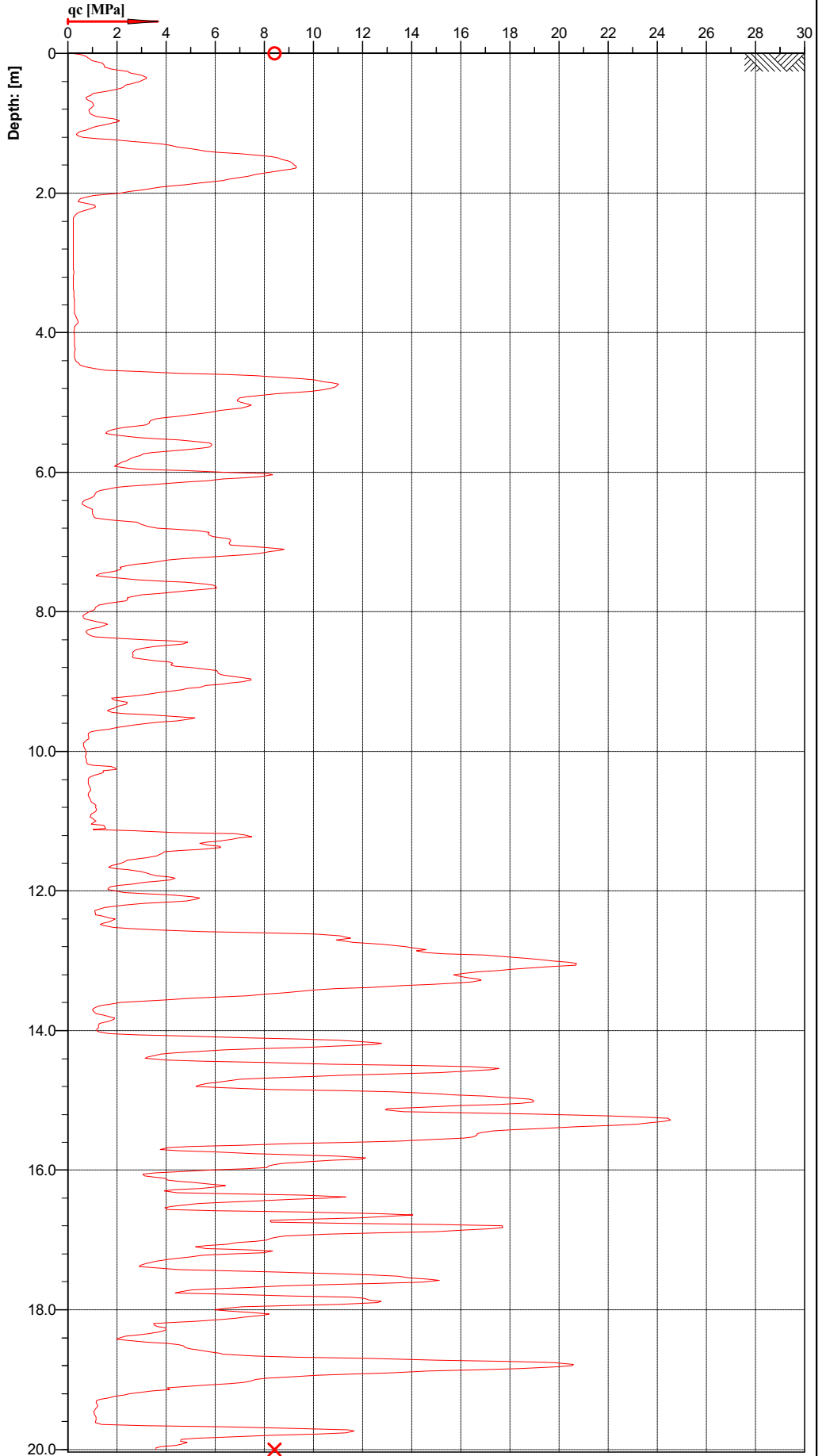
Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT09
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50704 E 176.88780				File:	CPT09.cpt		

**Classification by
Robertson 1986**

- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand (9)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)

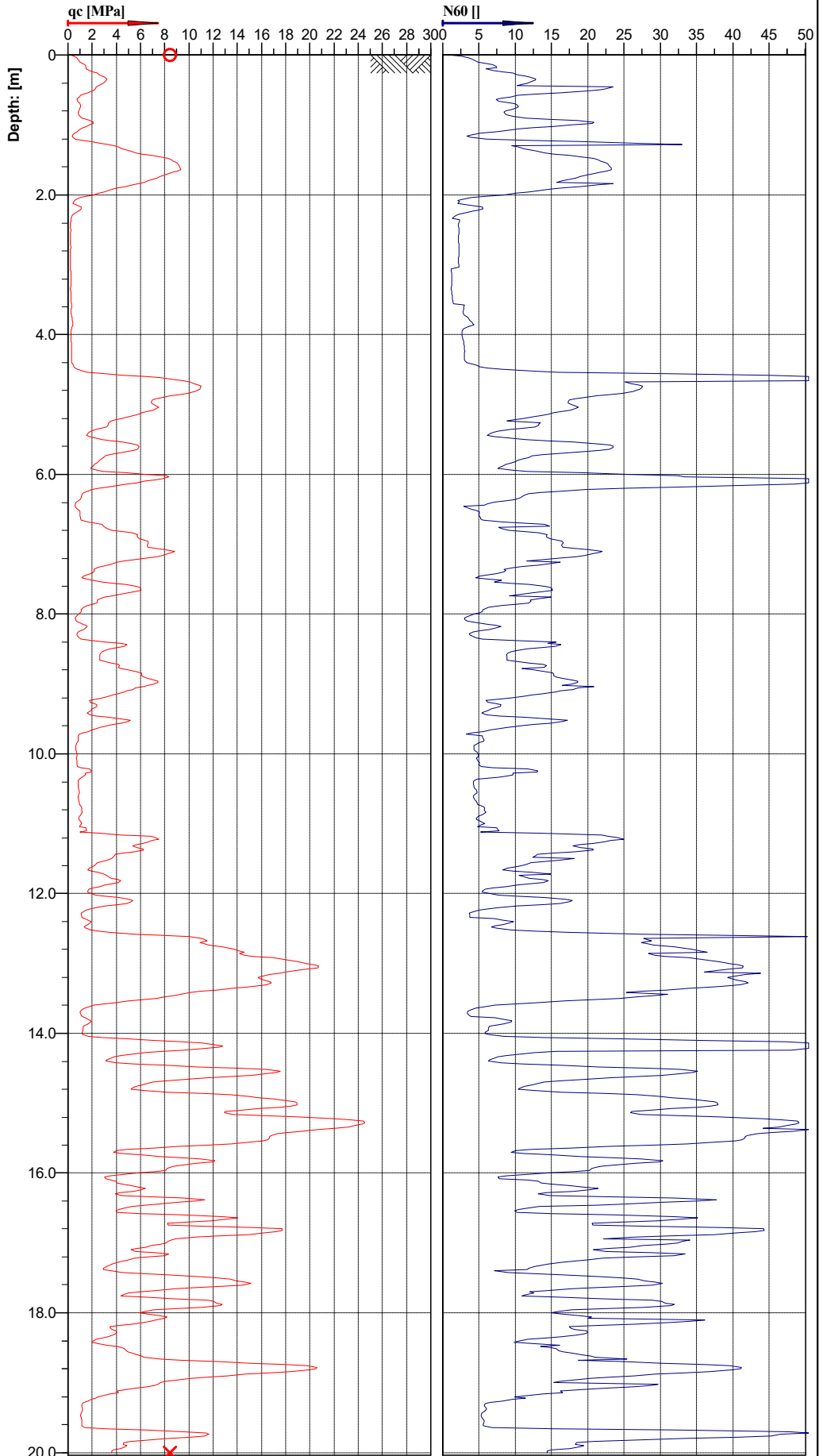


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT09
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50704 E 176.88780			File:	CPT09.cpt		

Classification by Robertson 1986

- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand (9)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)



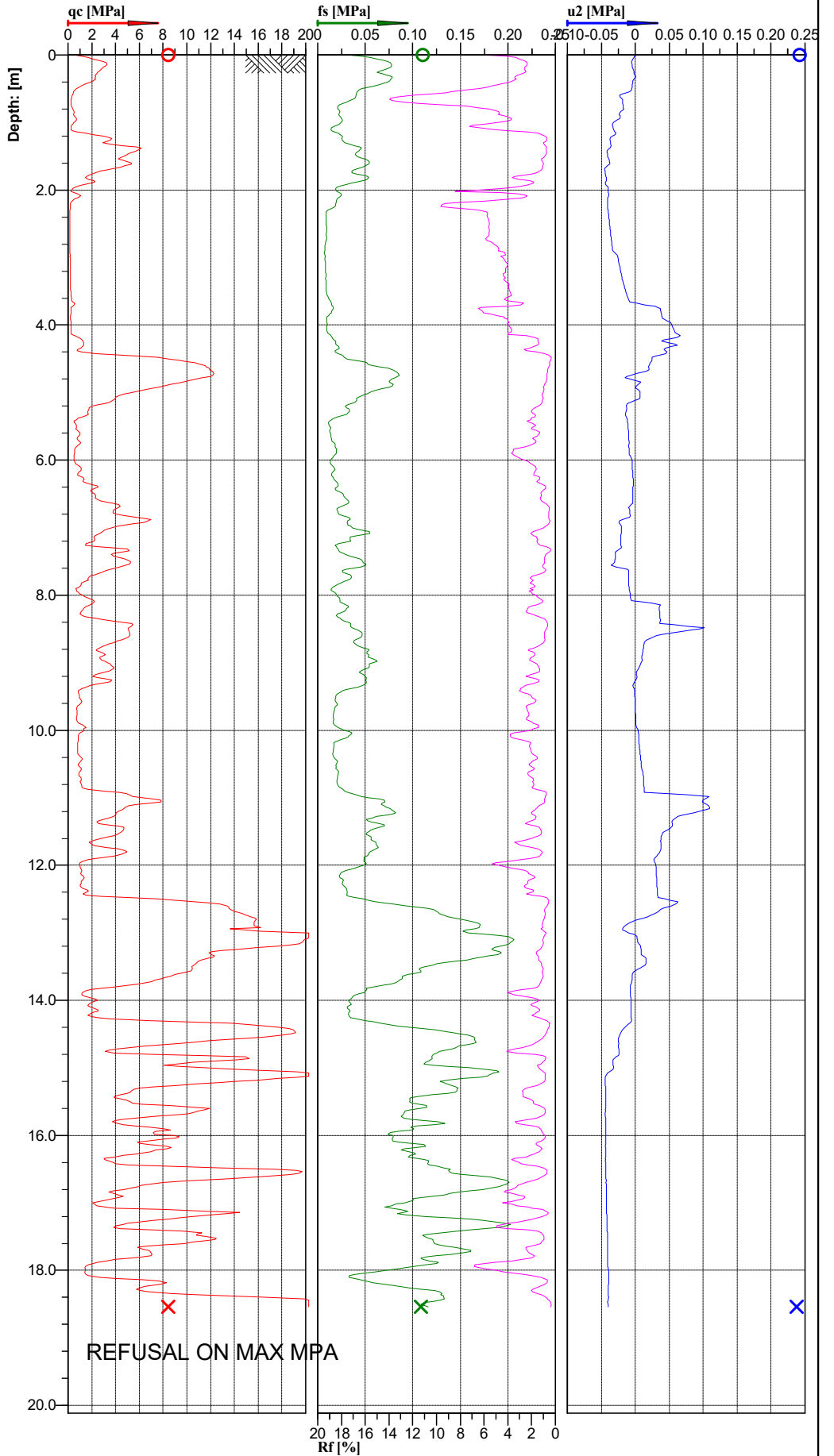
Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT09
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50704 E 176.88780			File:	CPT09.cpt		

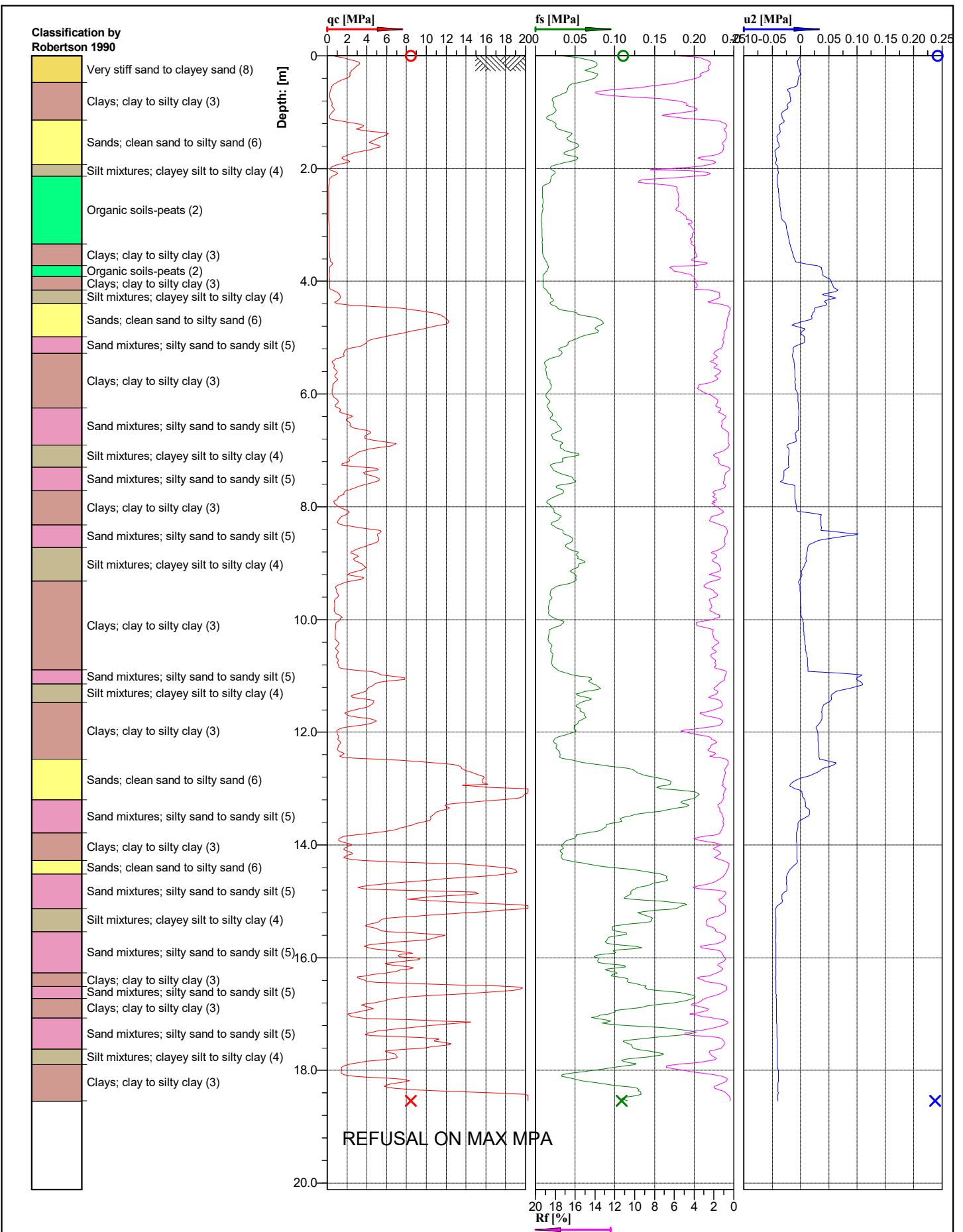
Classification by Robertson 1986

- Silty clay to clay (4)
- Organic material (2)
- Clay (3)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Organic material (2)
- Clay (3)
- Silty clay to clay (4)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand (9)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Clay (3)
- Silty sand to sandy silt (7)



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

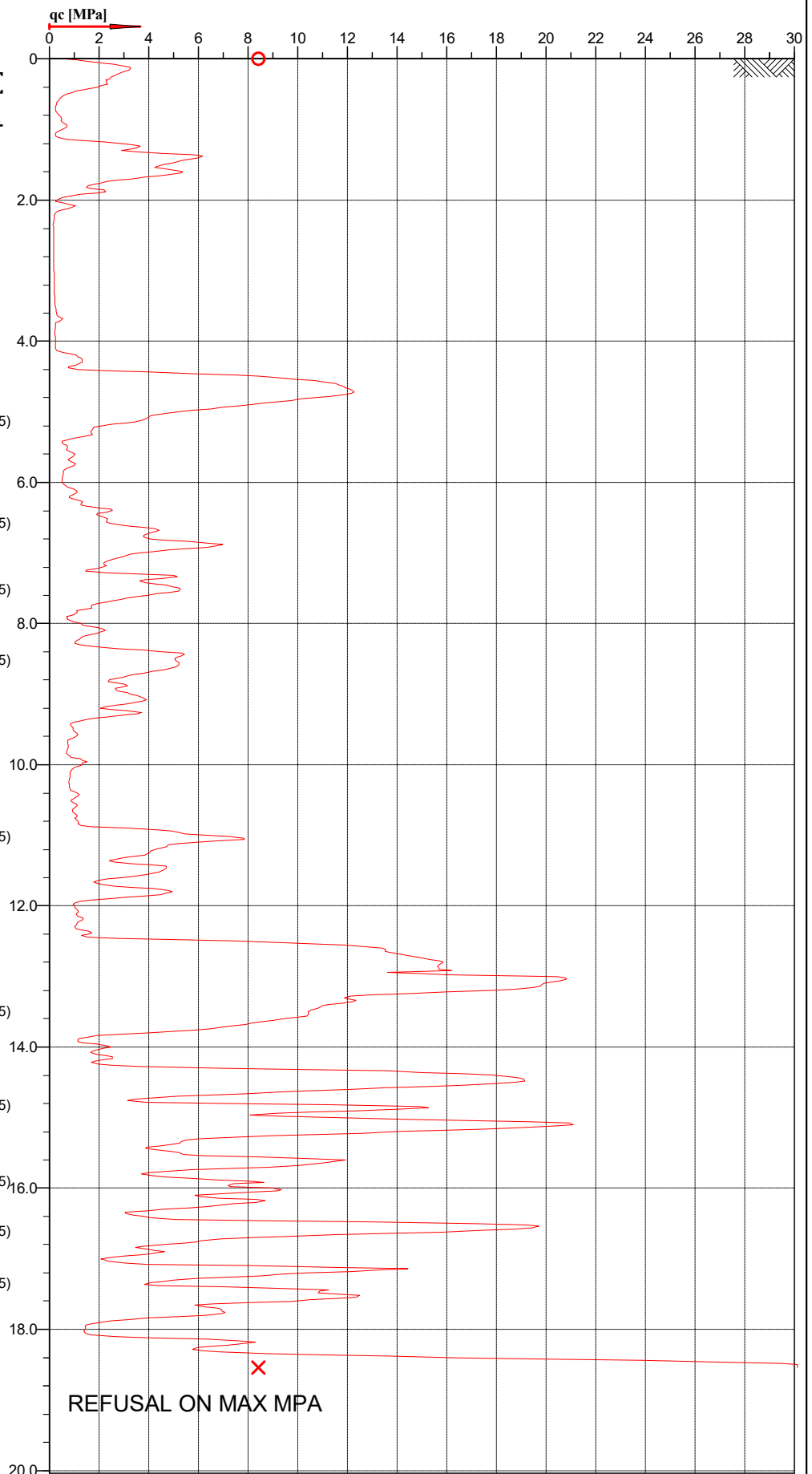
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Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50685 E 176.88809		File: CPT10.cpt	



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT10
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE	S 39.50685 E 176.88809	Page: 1/1	Fig.:
		File: CPT10.cpt	

Classification by Robertson 1990

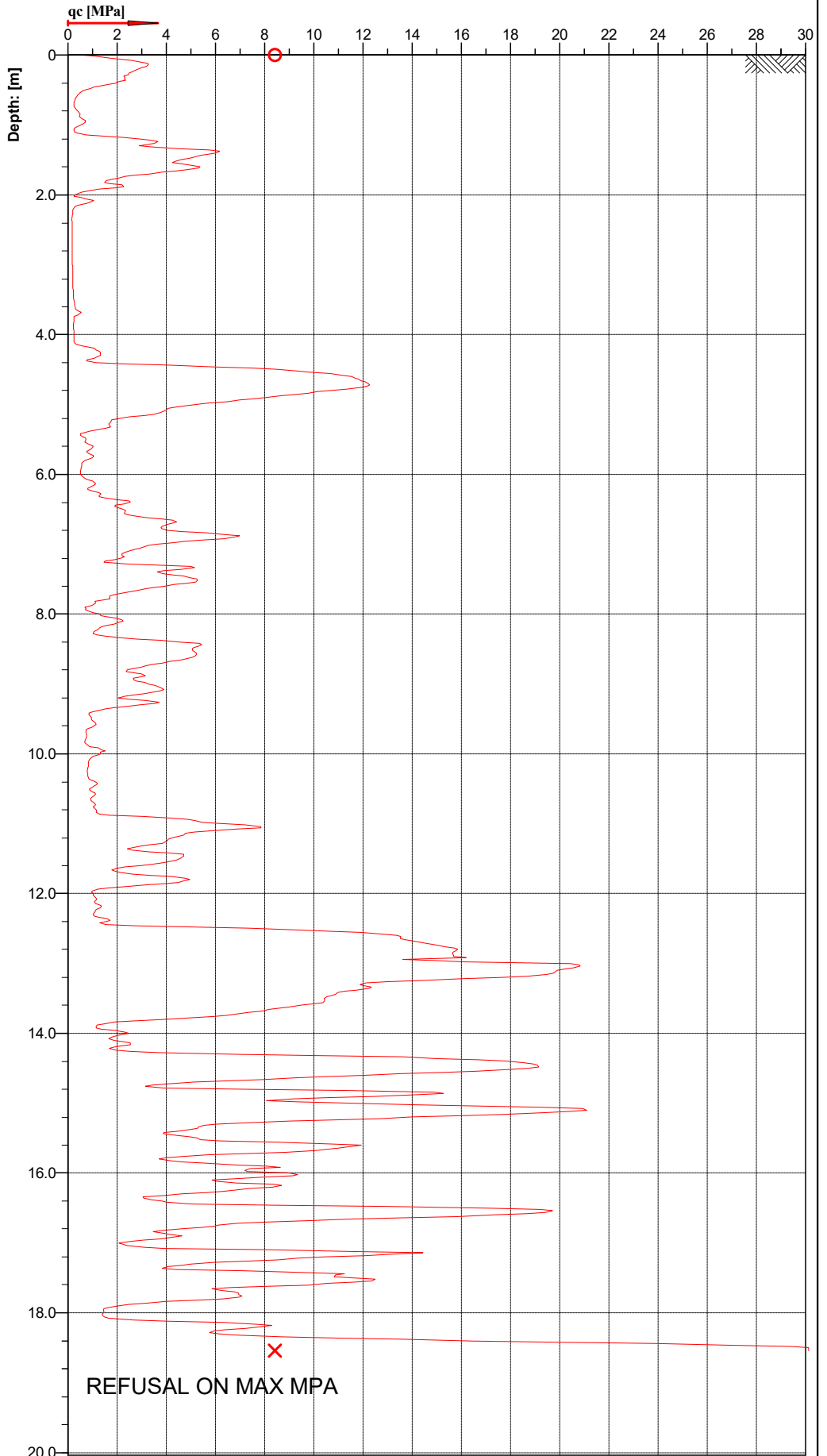


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT10
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50685 E 176.88809				File:	CPT10.cpt		

**Classification by
Robertson 1986**

- Sandy silt to clayey silt (6)
- Organic material (2)
- Clay (3)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Organic material (2)
- Clay (3)
- Sandy silt to clayey silt (6)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand (9)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clay (3)
- Silty sand to sandy silt (7)



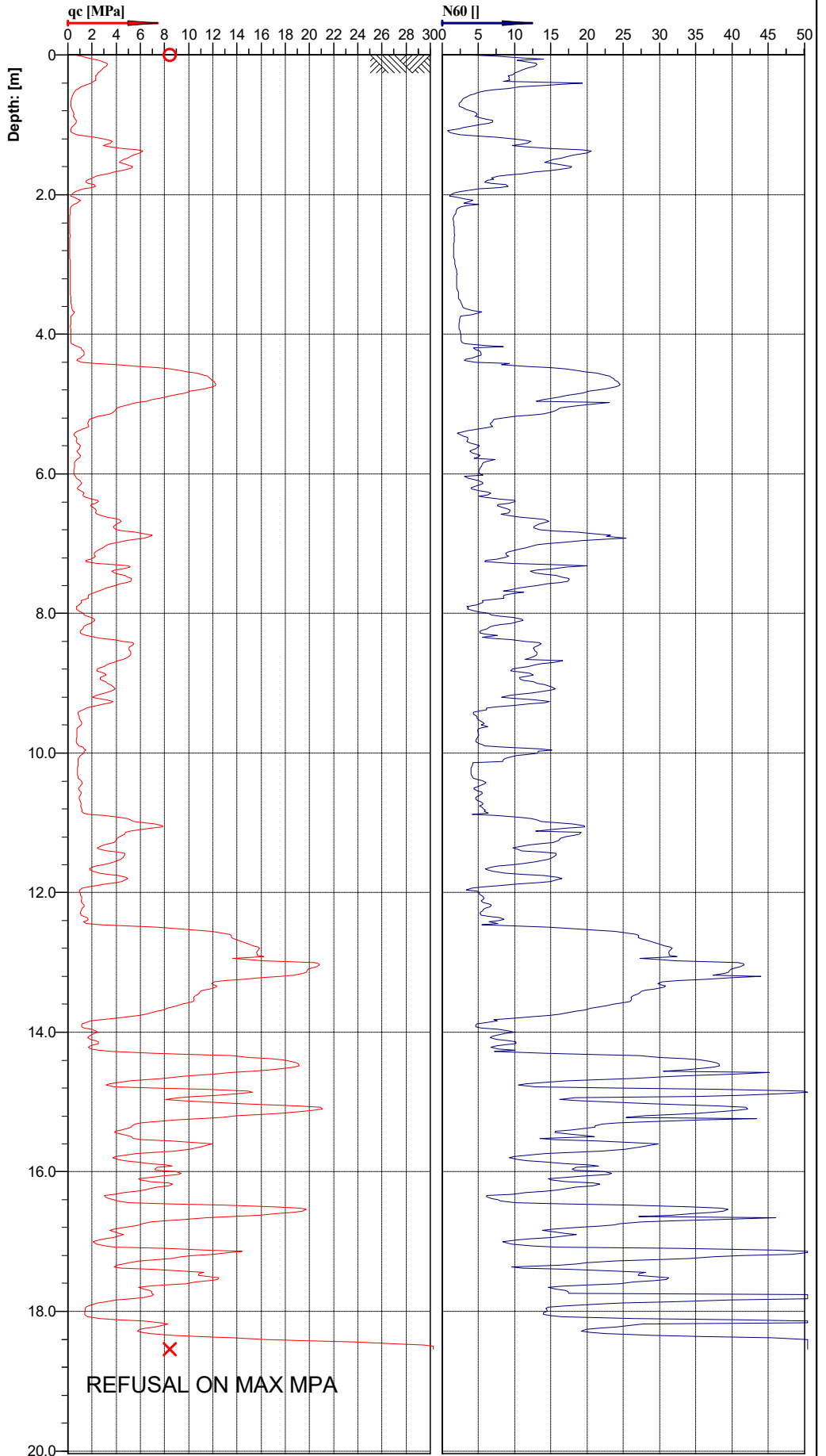
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT10
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50685 E 176.88809		File: CPT10.cpt	

Classification by Robertson 1986

- Sandy silt to clayey silt (6)
- Organic material (2)
- Clay (3)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Organic material (2)
- Clay (3)
- Sandy silt to clayey silt (6)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand (9)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clay (3)
- Silty sand to sandy silt (7)



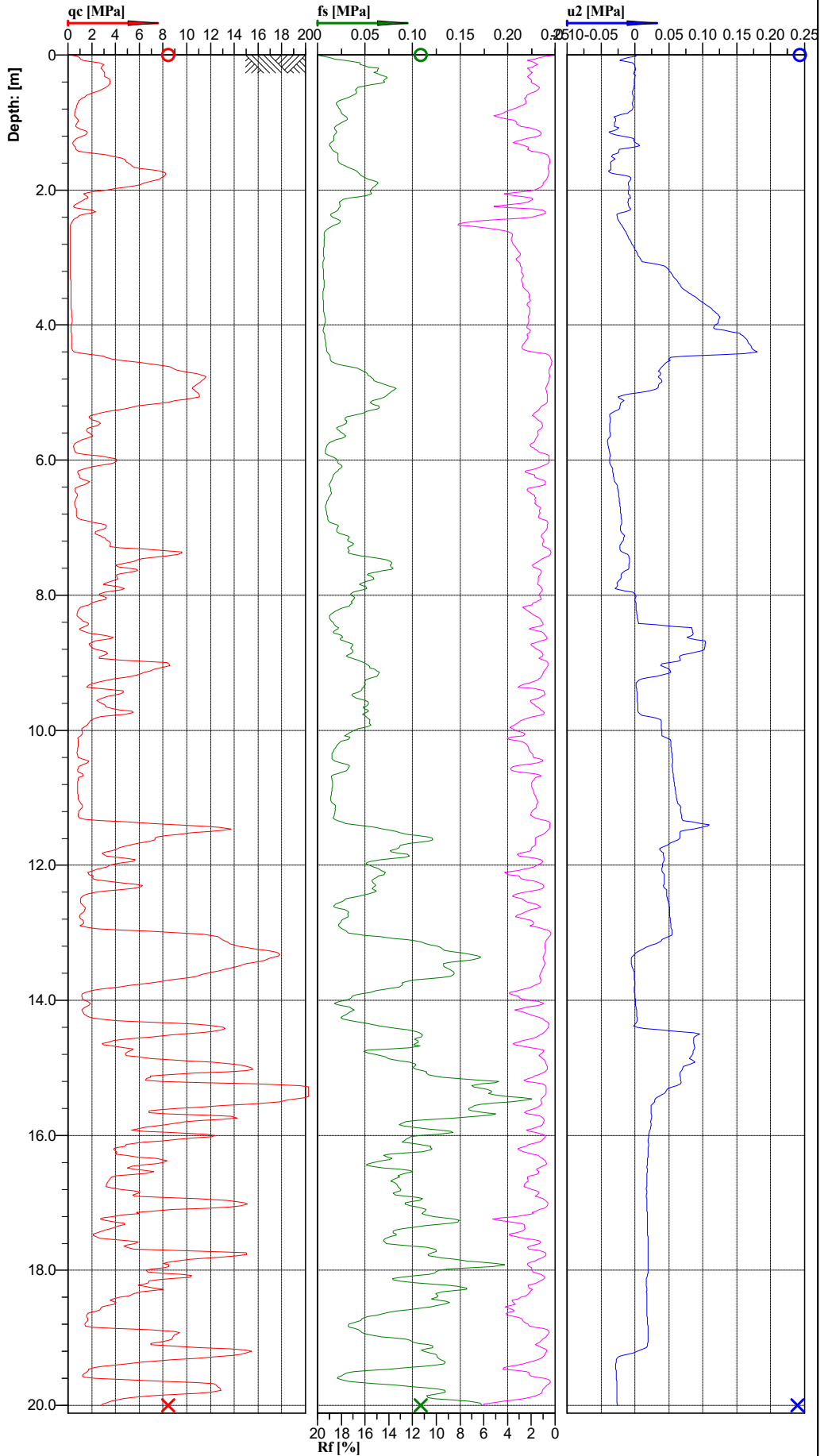
Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT10
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50685 E 176.88809			File:	CPT10.cpt		

**Classification by
Robertson 1986**

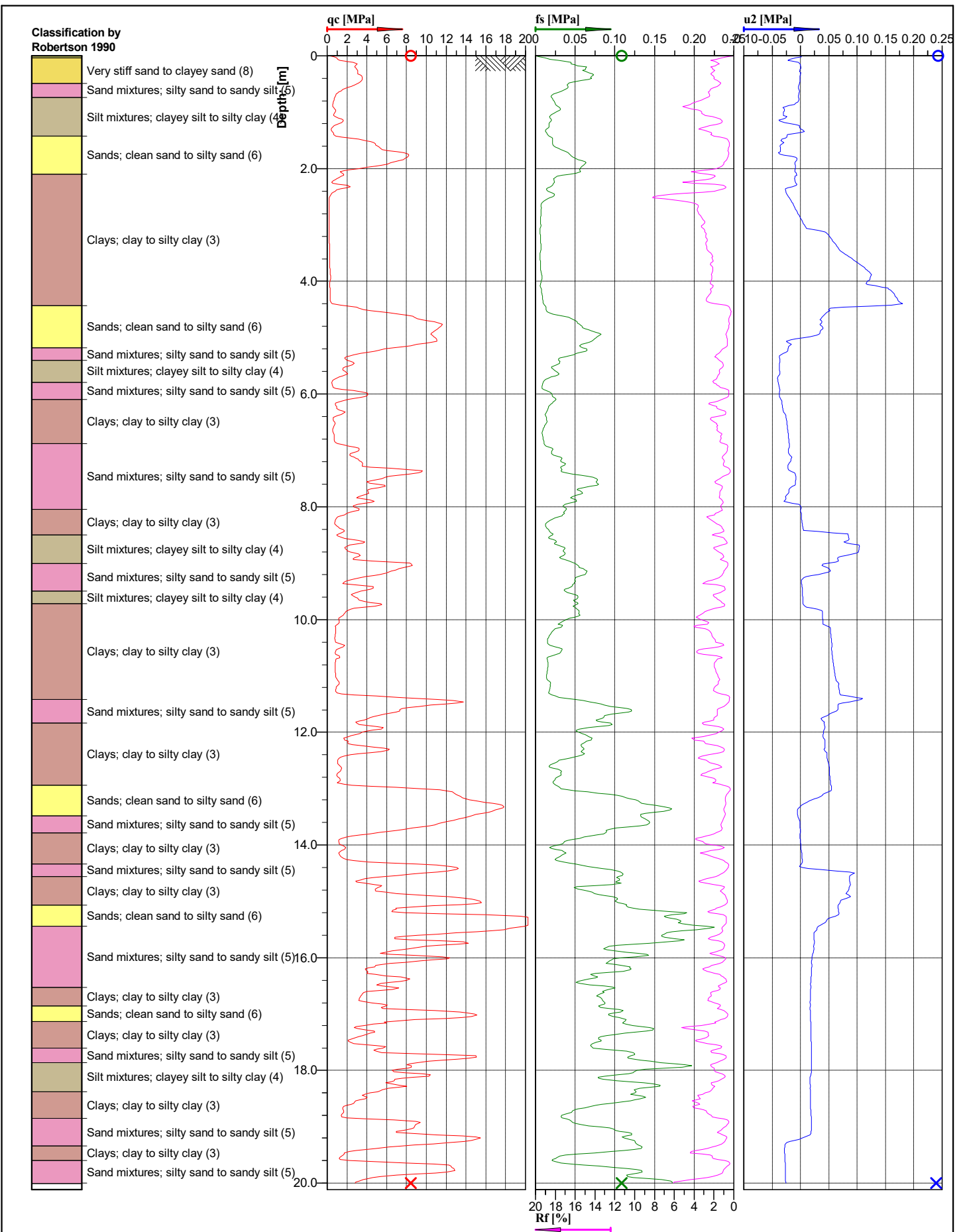
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Clay (3)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Clay (3)
- Sand to silty sand (8)
- Sand (9)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Sand (9)
- Sandy silt to clayey silt (6)
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- Sand to silty sand (8)
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- Sand (9)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)




Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



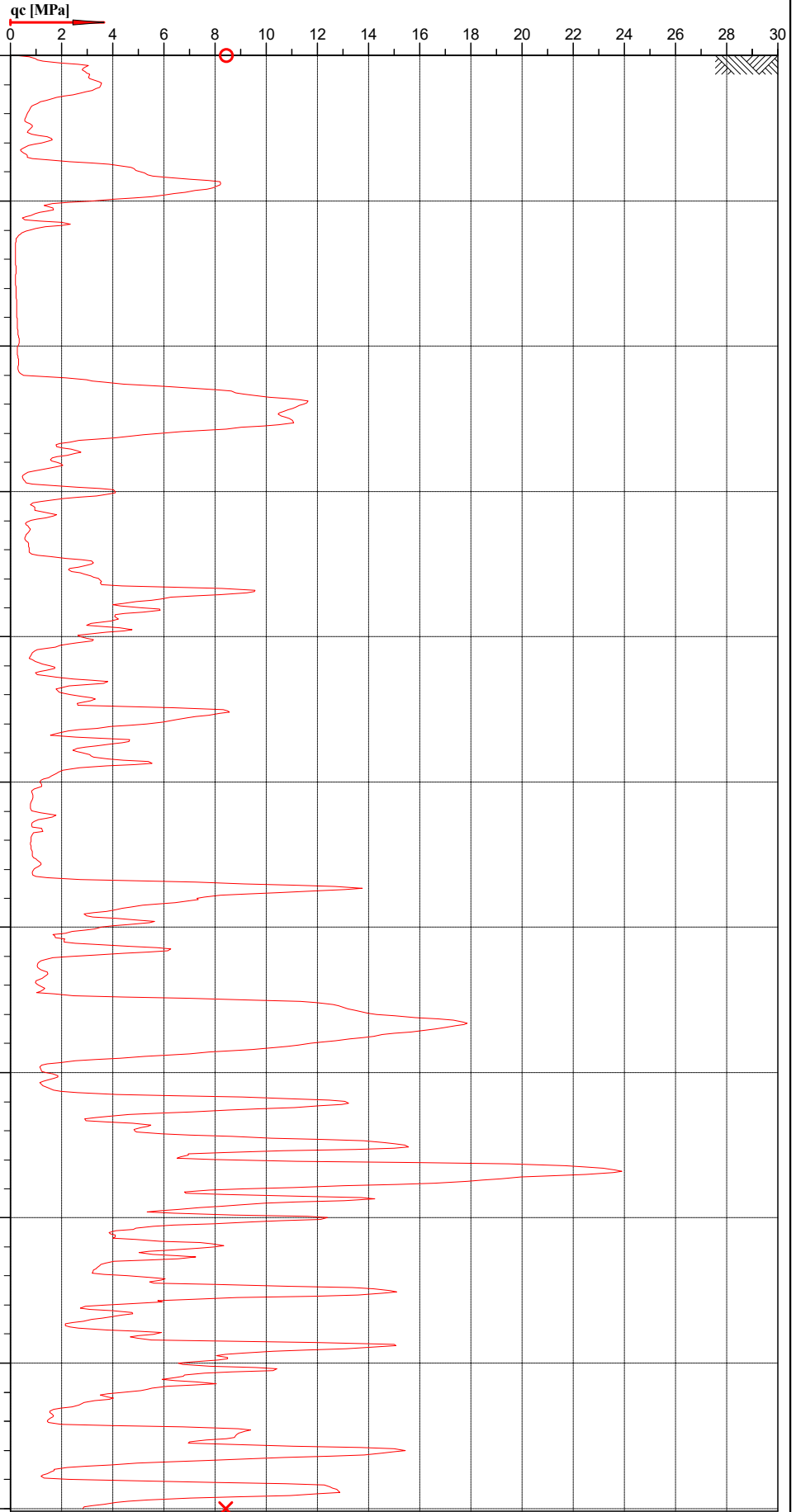
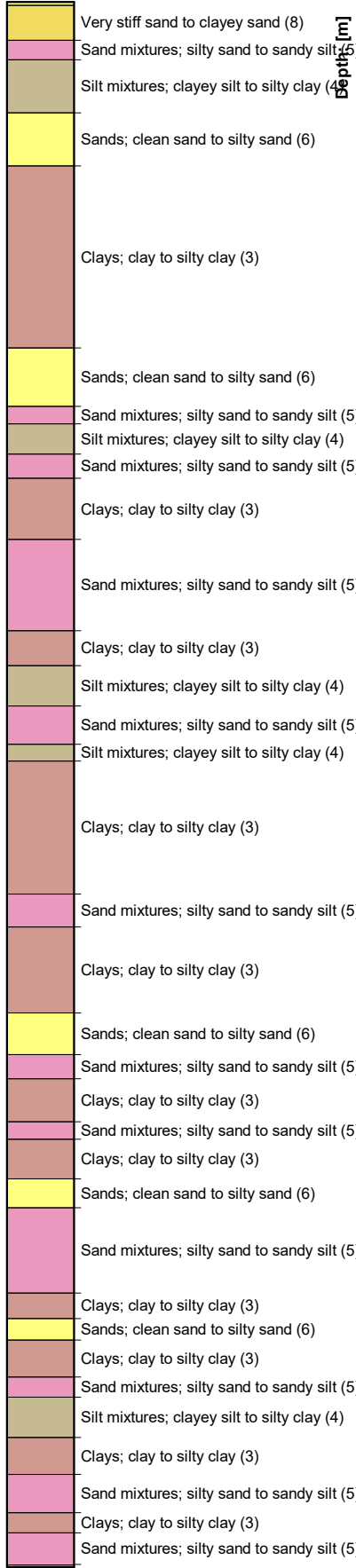
Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT11
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.80748 E 176.88815			File:	CPT11.cpt		




 Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT11
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.80748 E 176.88815				File:	CPT11.cpt		

**Classification by
Robertson 1990**



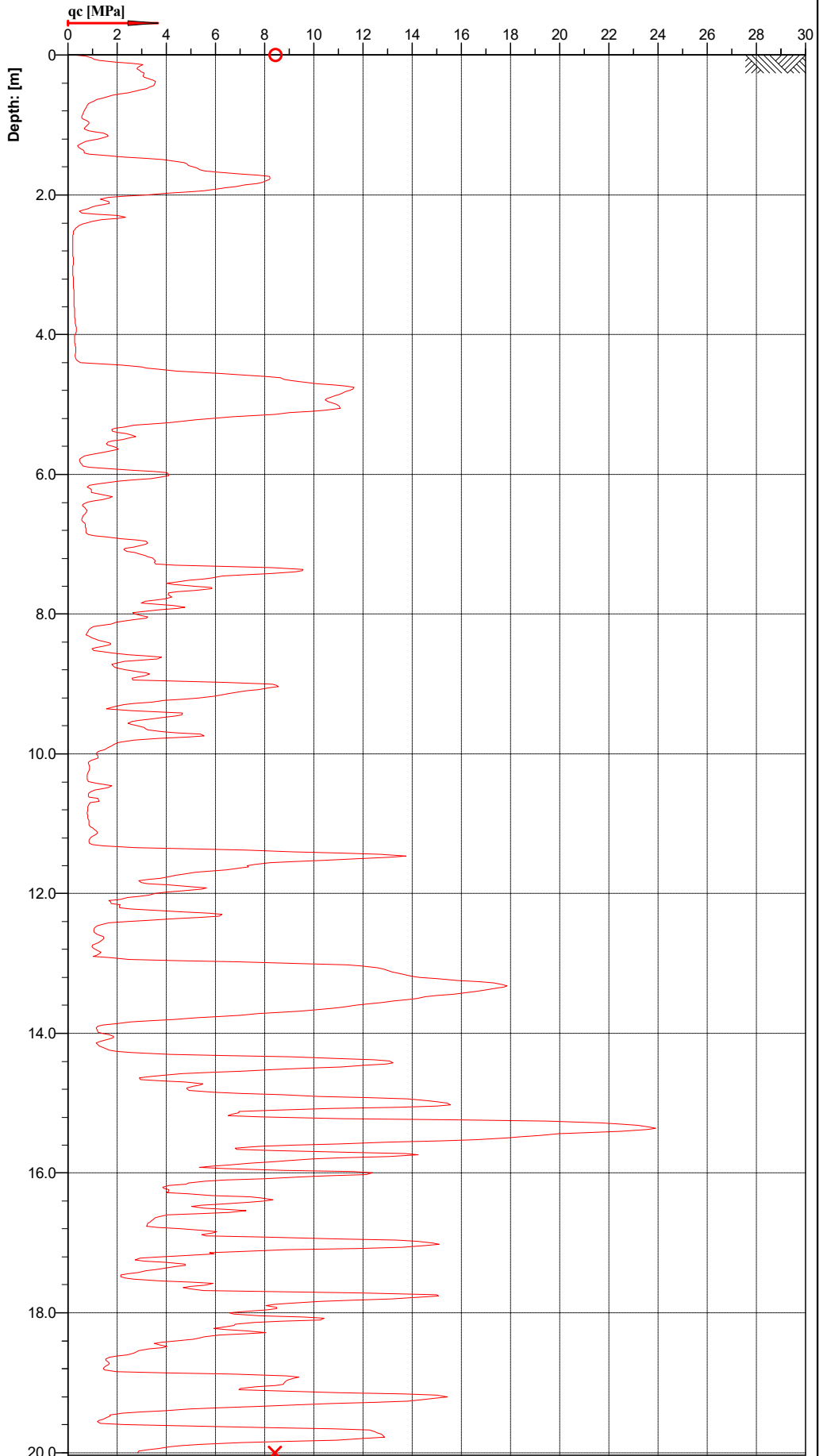
Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT11
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
				S 39.80748 E 176.88815		File:	CPT11.cpt

**Classification by
Robertson 1986**

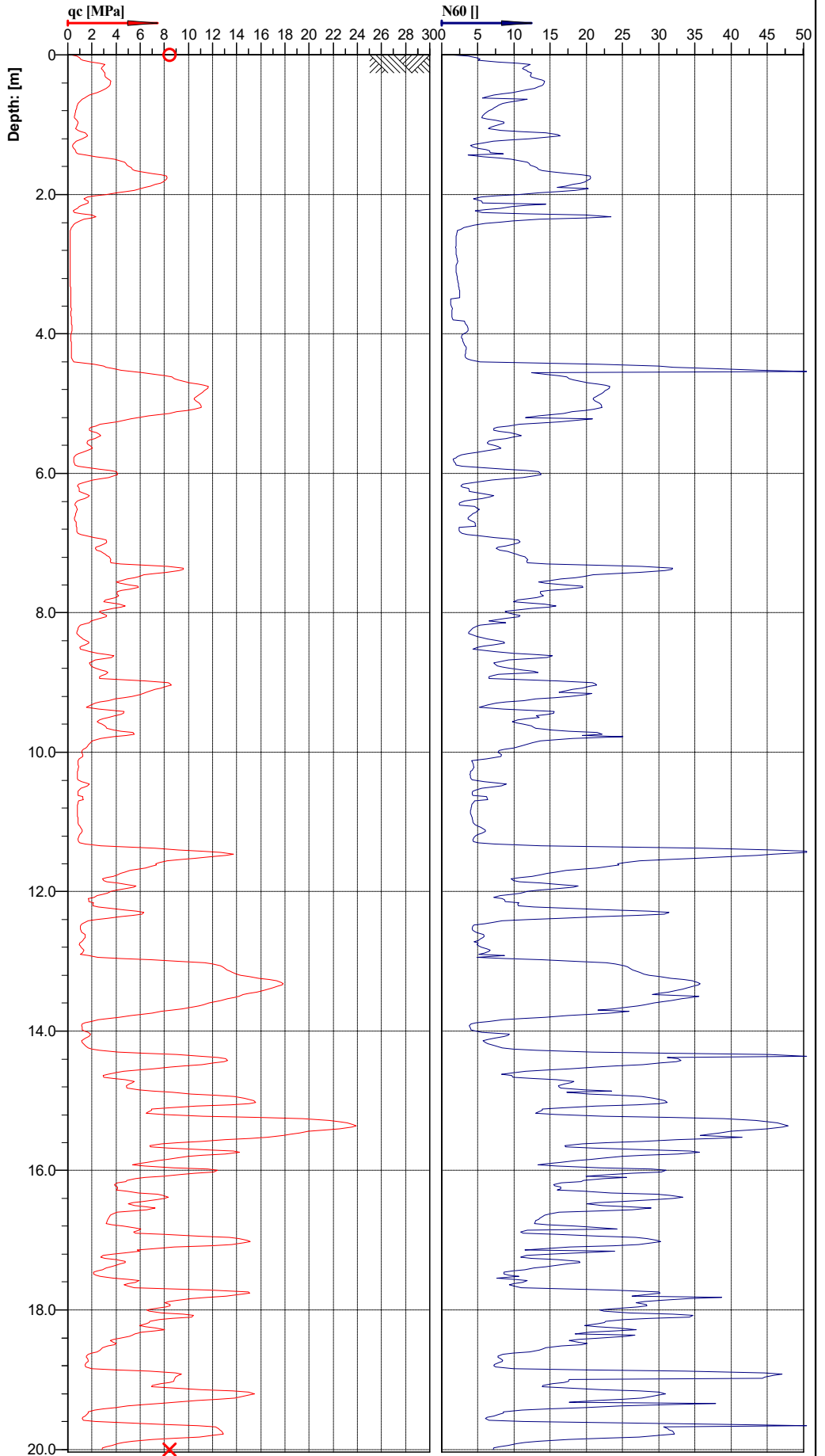
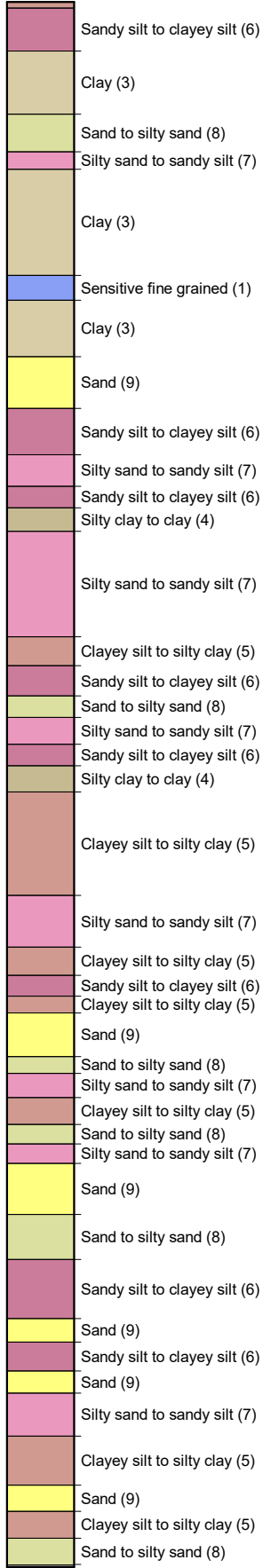
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clay (3)
- Sensitive fine grained (1)
- Clay (3)
- Sand (9)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty clay to clay (4)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand (9)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand (9)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m
Project ID:		Date:	26/11/2020
Client:	TONKIN & TAYLOR LTD	Scale:	1 : 86
Project:	AQUATIC CENTRE	Page:	1/1
	S 39.80748 E 176.88815	File:	CPT11.cpt

**Classification by
Robertson 1986**

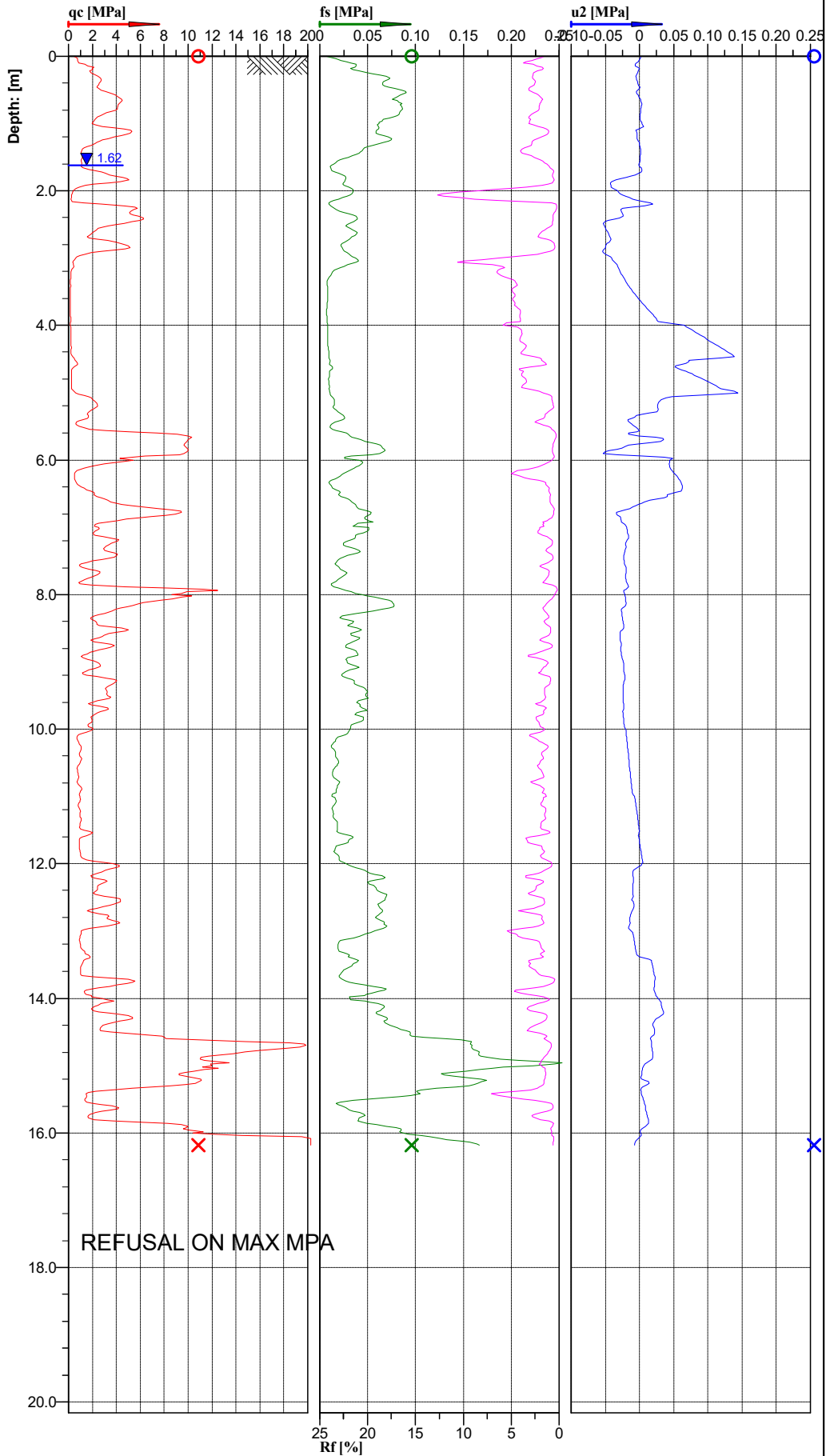
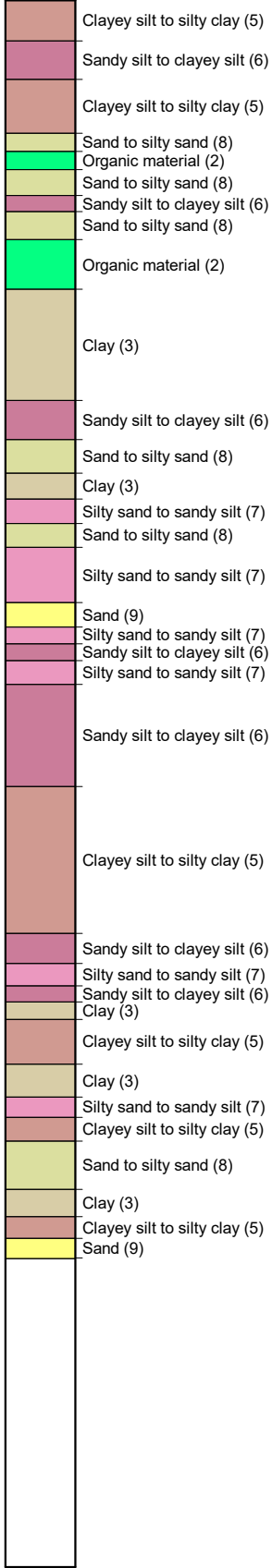


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT11
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
				File:	CPT11.cpt		
				S 39.80748 E 176.88815			

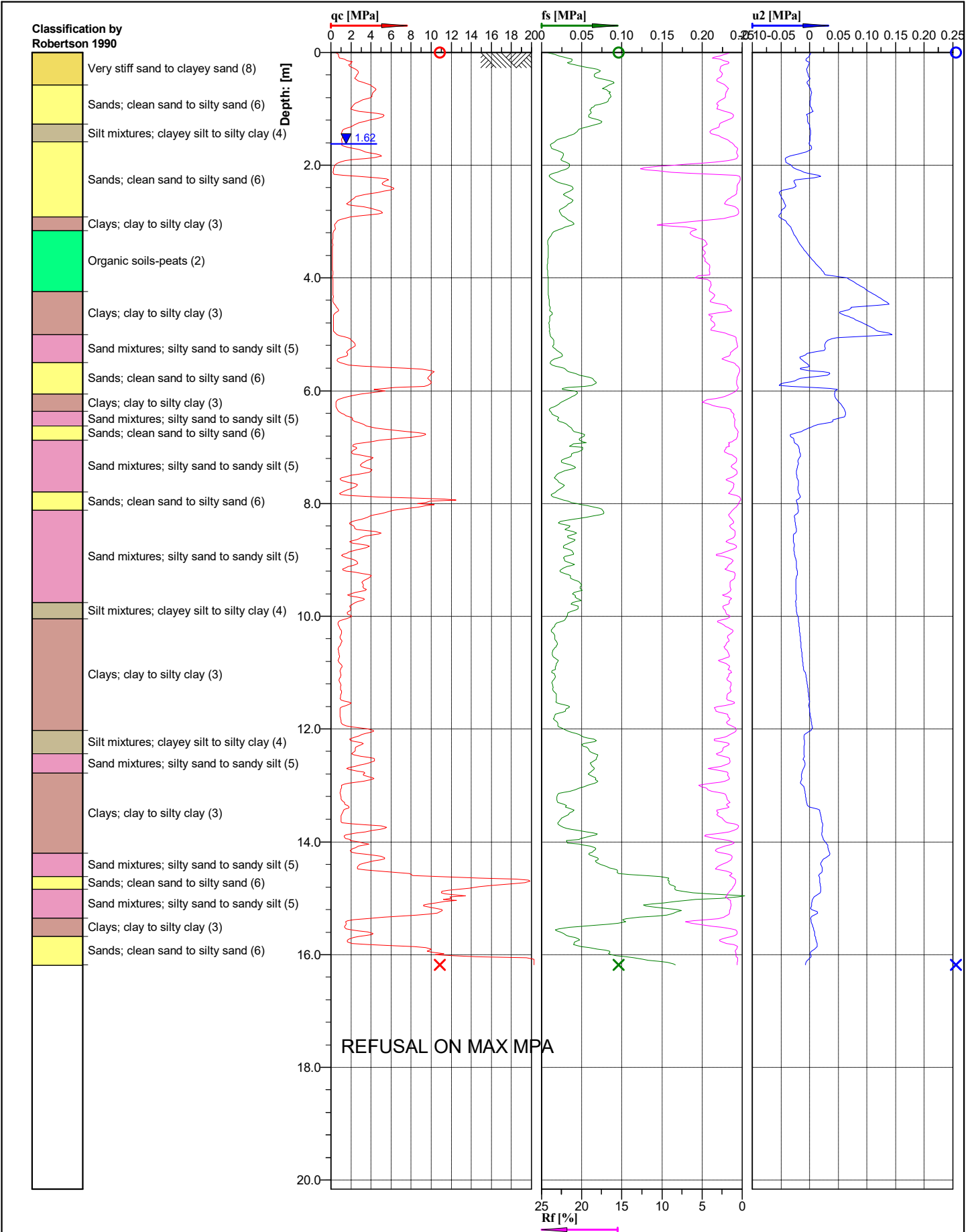
**Classification by
Robertson 1986**



Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



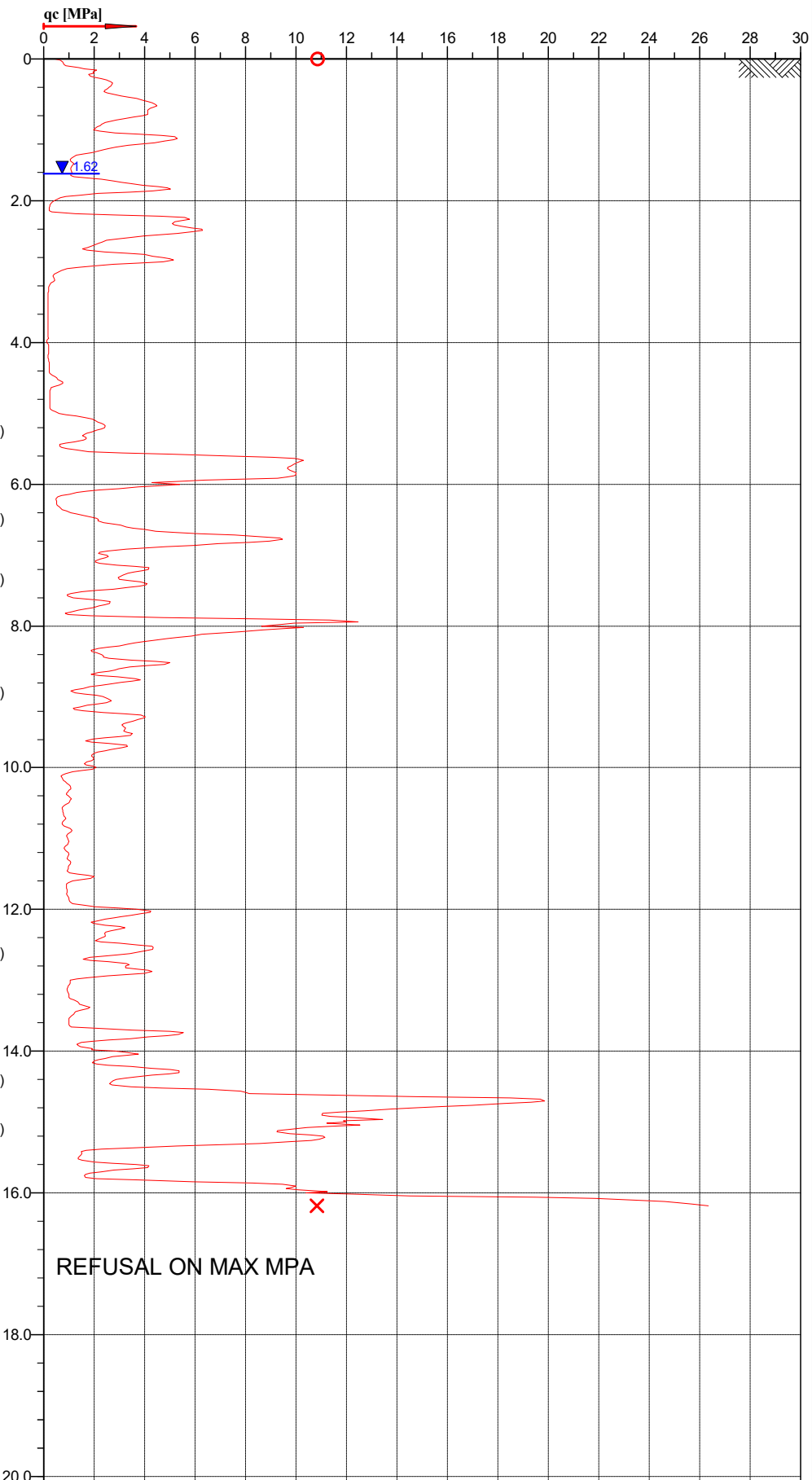
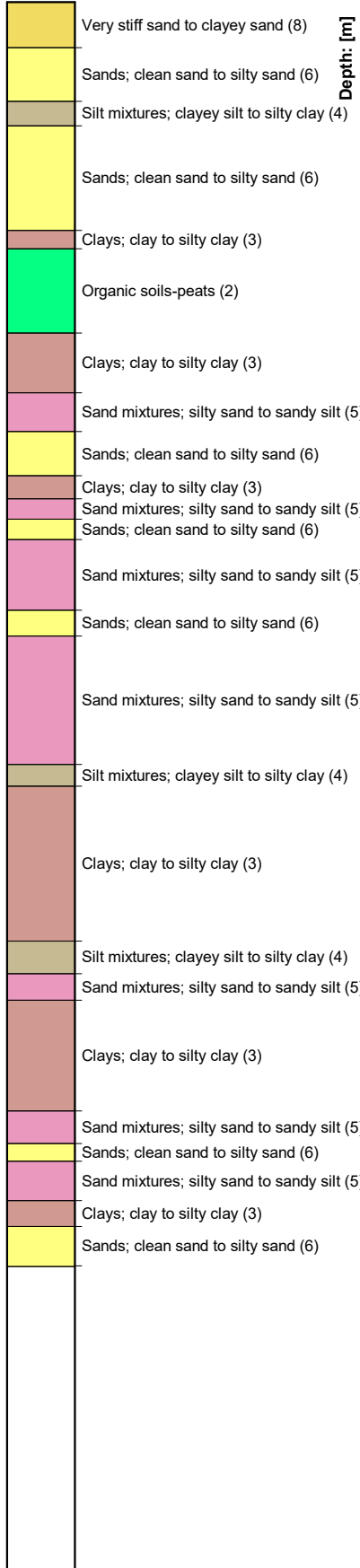
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Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 90
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50639, E 176.88823			File:	CPT13.cpt		



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT13
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 90
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50639, E 176.88823			File:	CPT13.cpt		

Classification by Robertson 1990



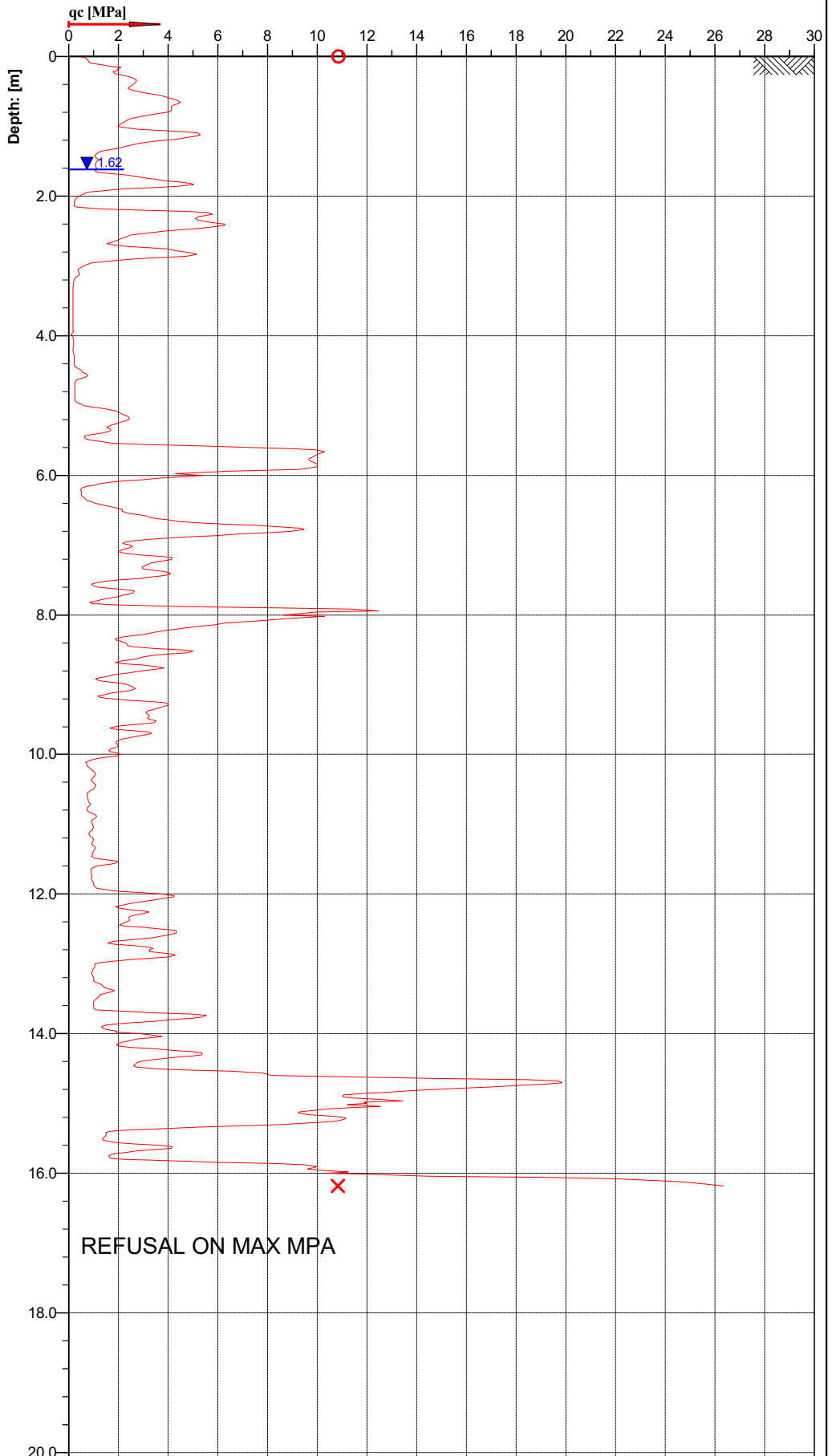
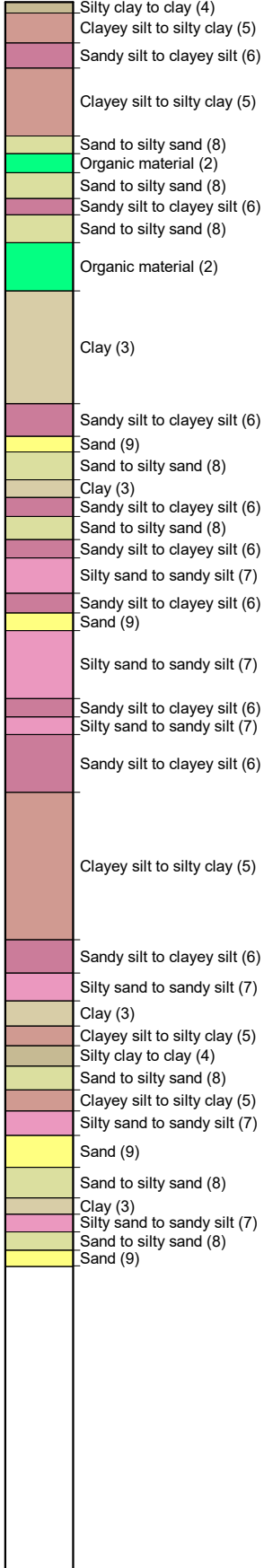
REFUSAL ON MAX MPA



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT13
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE	S 39.50639, E 176.88823	Page: 1/1	Fig.:
File: CPT13.cpt			

**Classification by
Robertson 1986**



REFUSAL ON MAX MPA

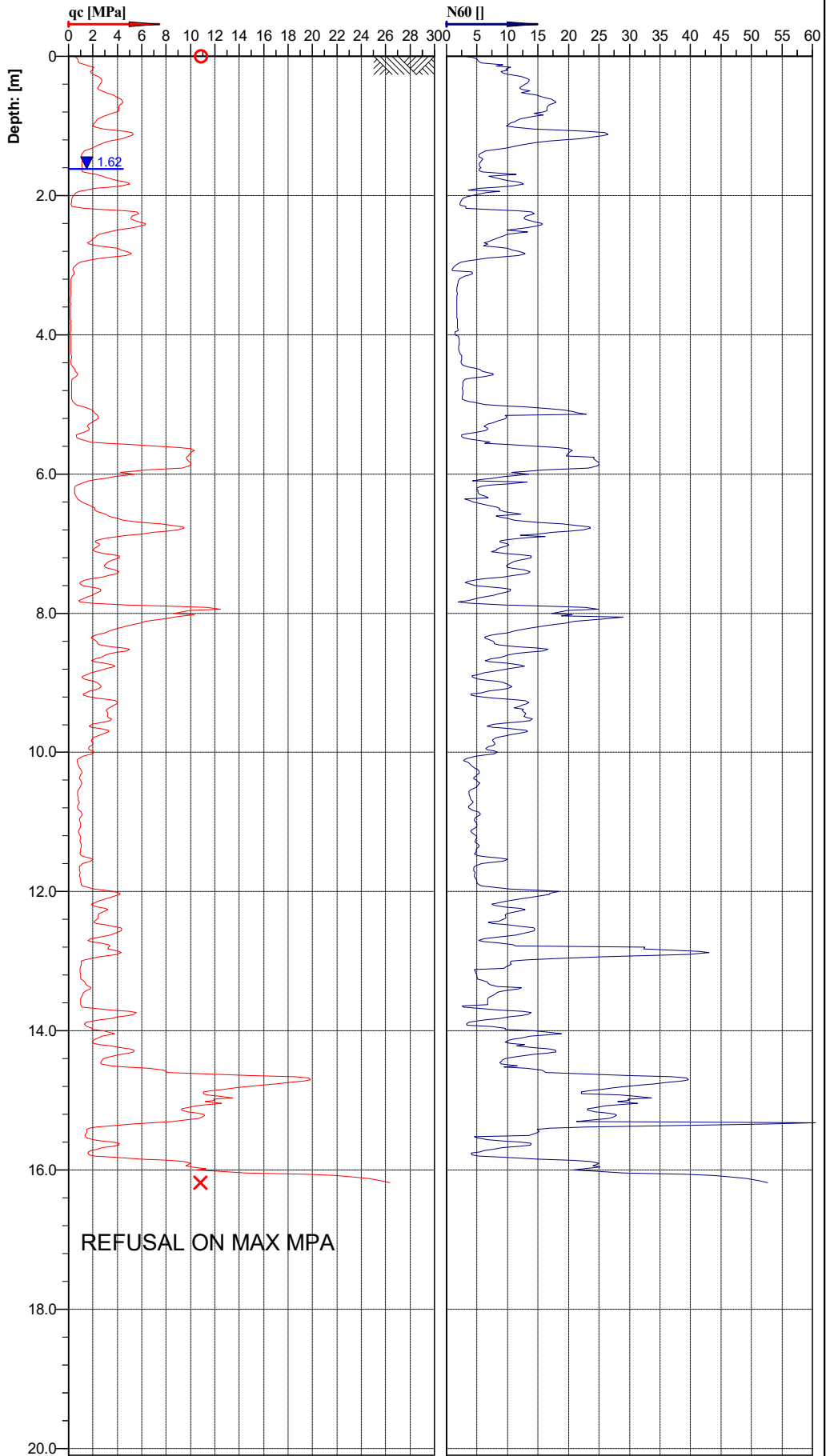
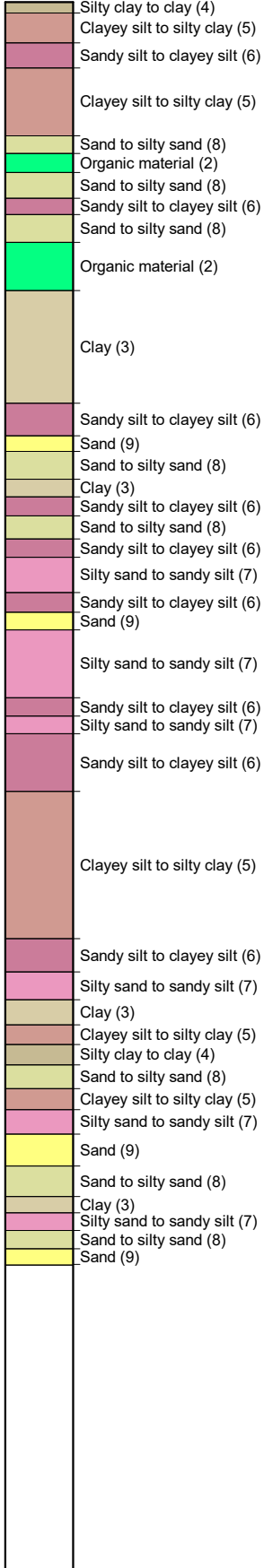


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT13
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50639, E 176.88823			File:	CPT13.cpt		

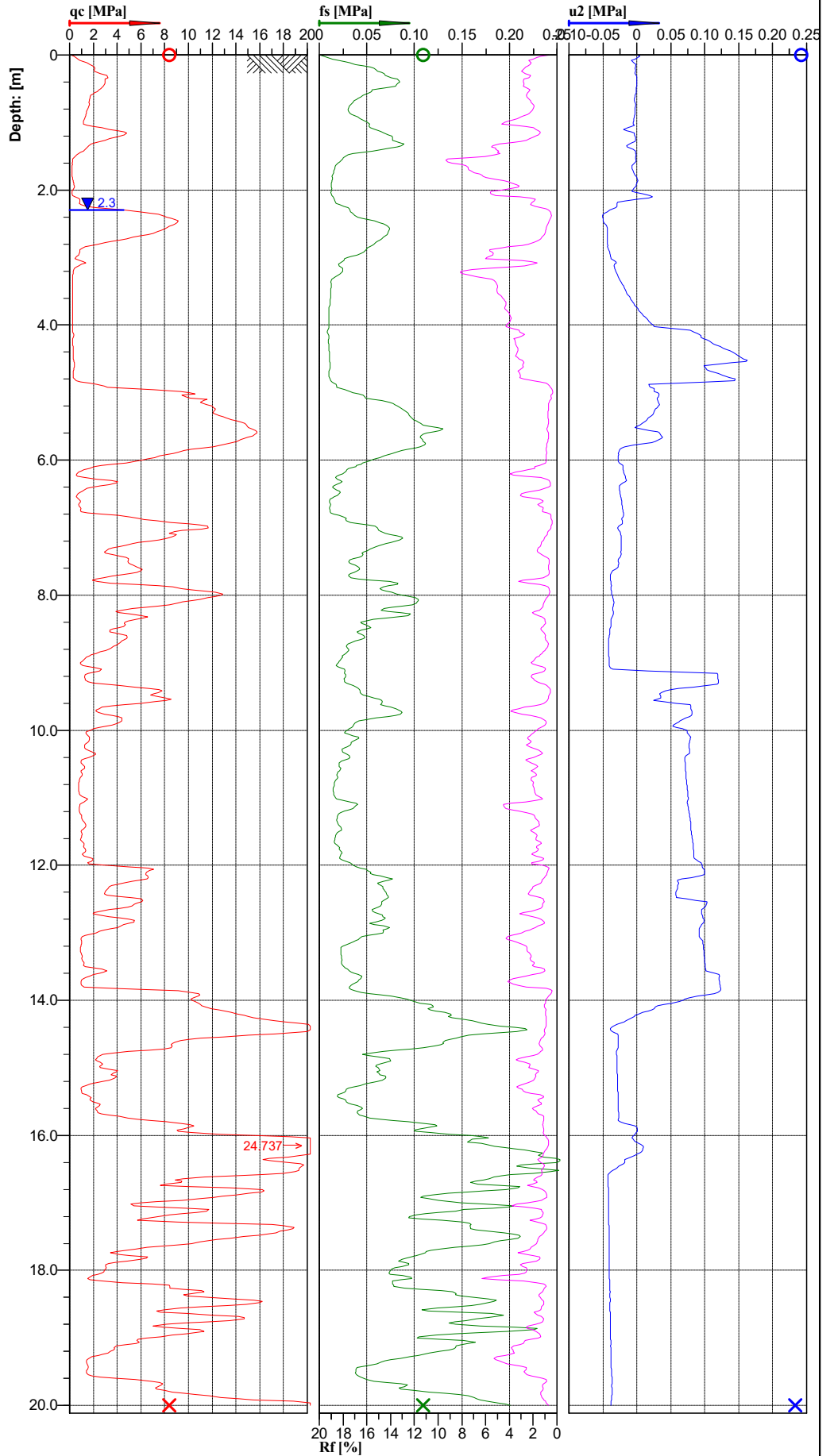
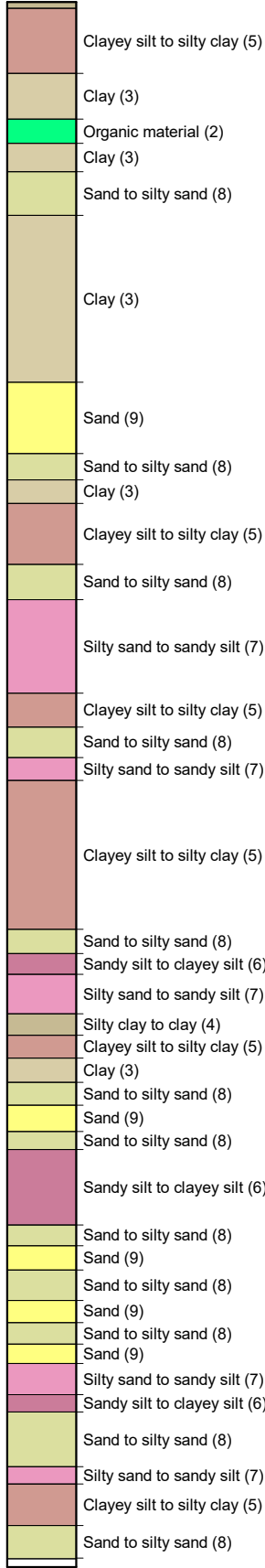
**Classification by
Robertson 1986**



Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT13
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50639, E 176.88823		File: CPT13.cpt	

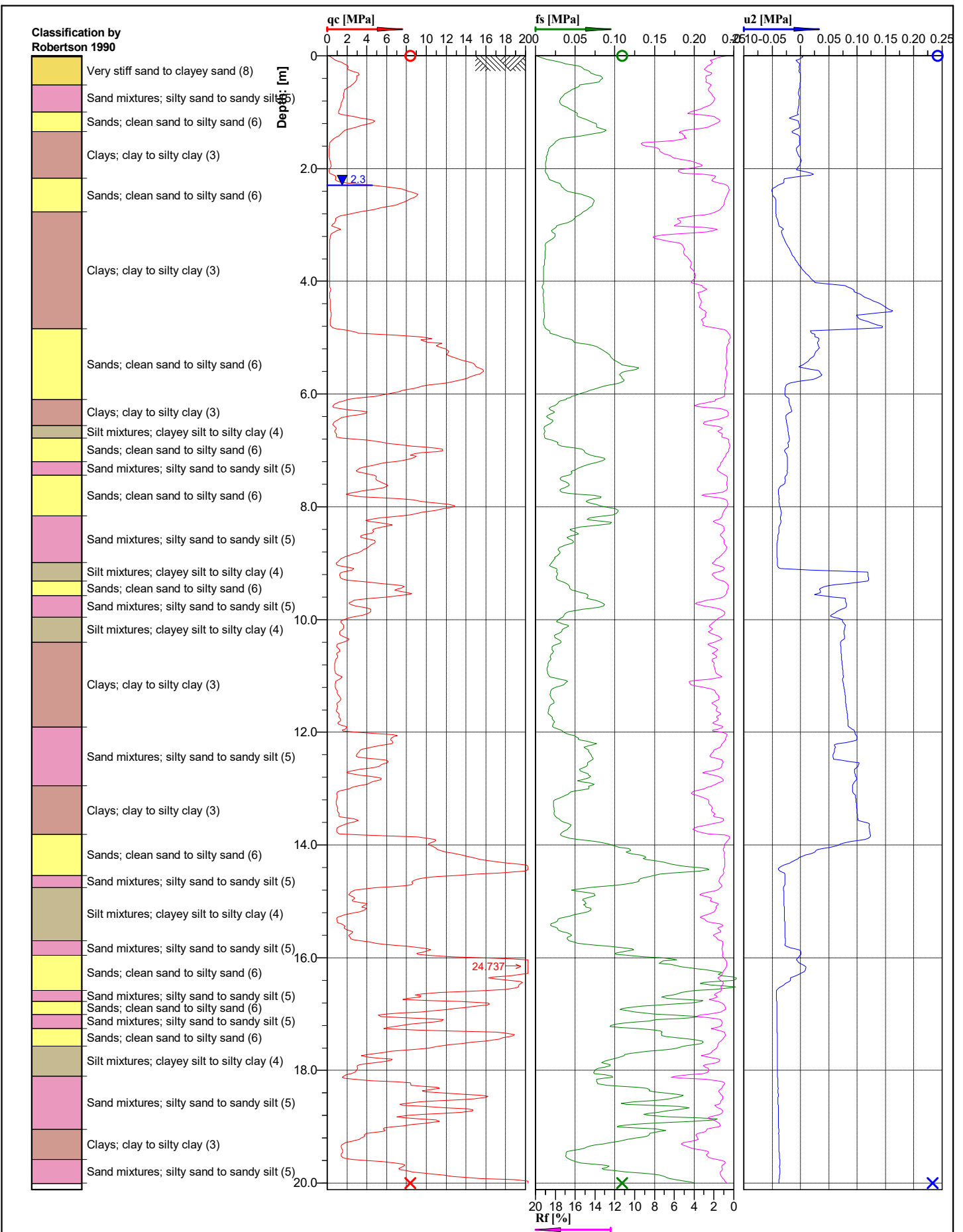
Classification by Robertson 1986



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT12
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50732 E 176.88855			File:	CPT12.cpt		

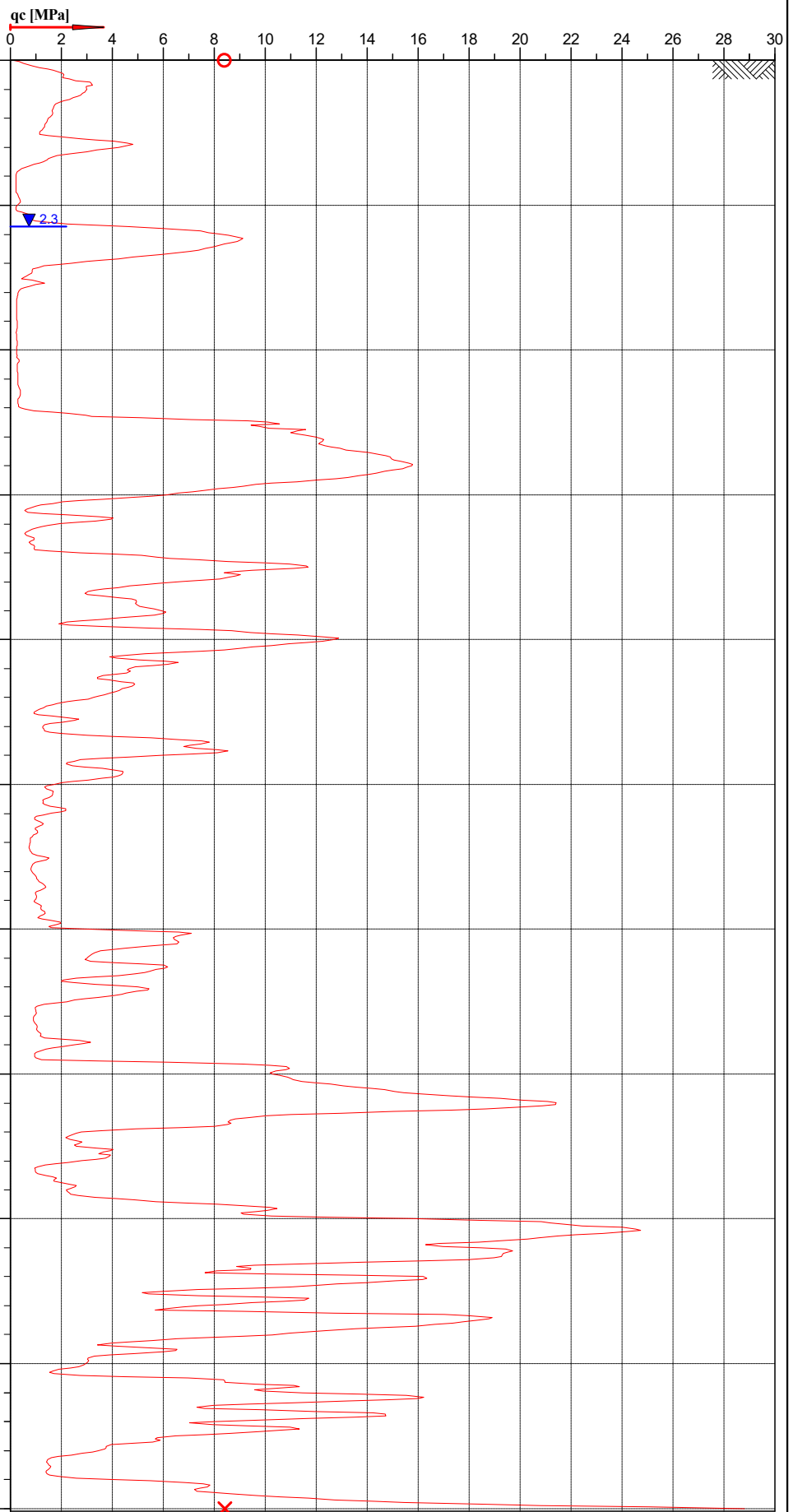
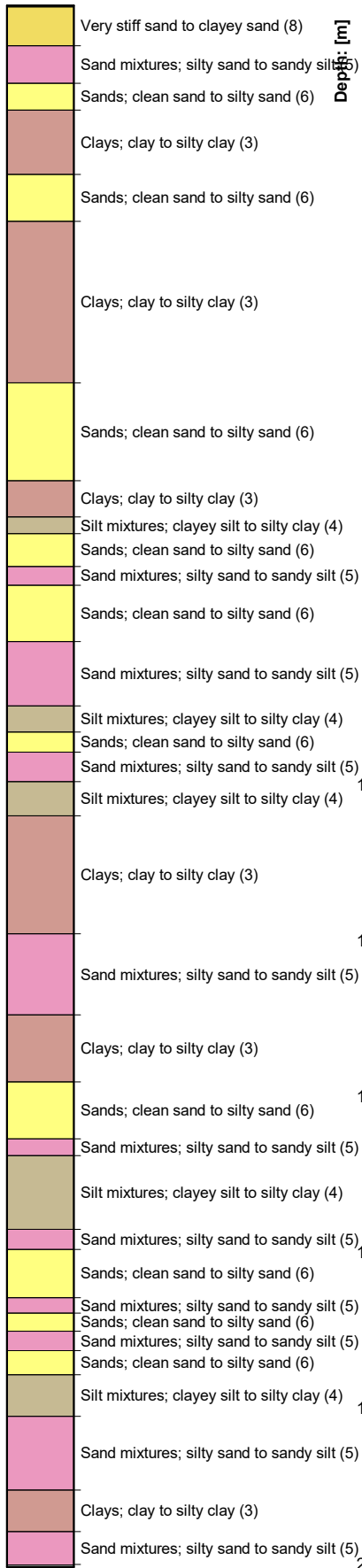


Cone No: 5550
 Tip area [cm2]: 10
 Sleeve area [cm2]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT12
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50732 E 176.88855				File:	CPT12.cpt		

**Classification by
Robertson 1990**

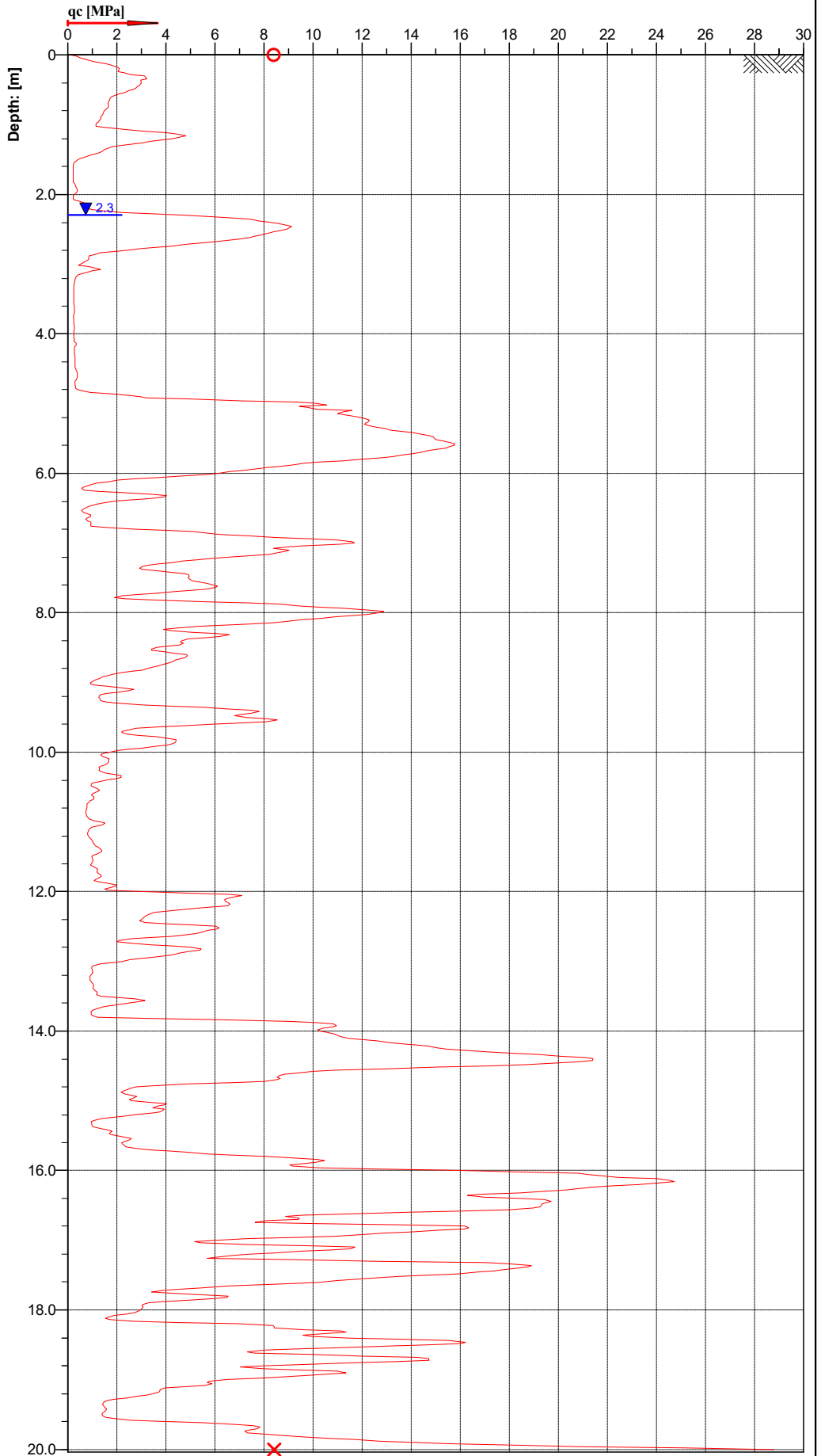
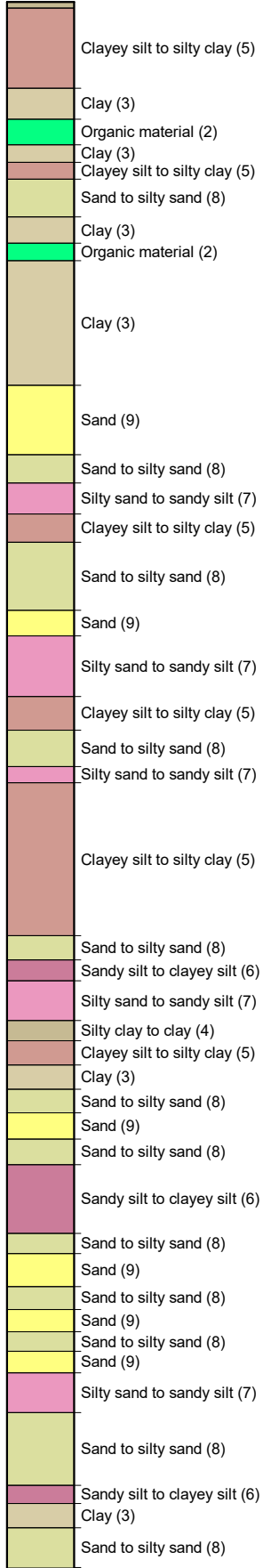


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT12
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50732 E 176.88855			File:	CPT12.cpt		

**Classification by
Robertson 1986**

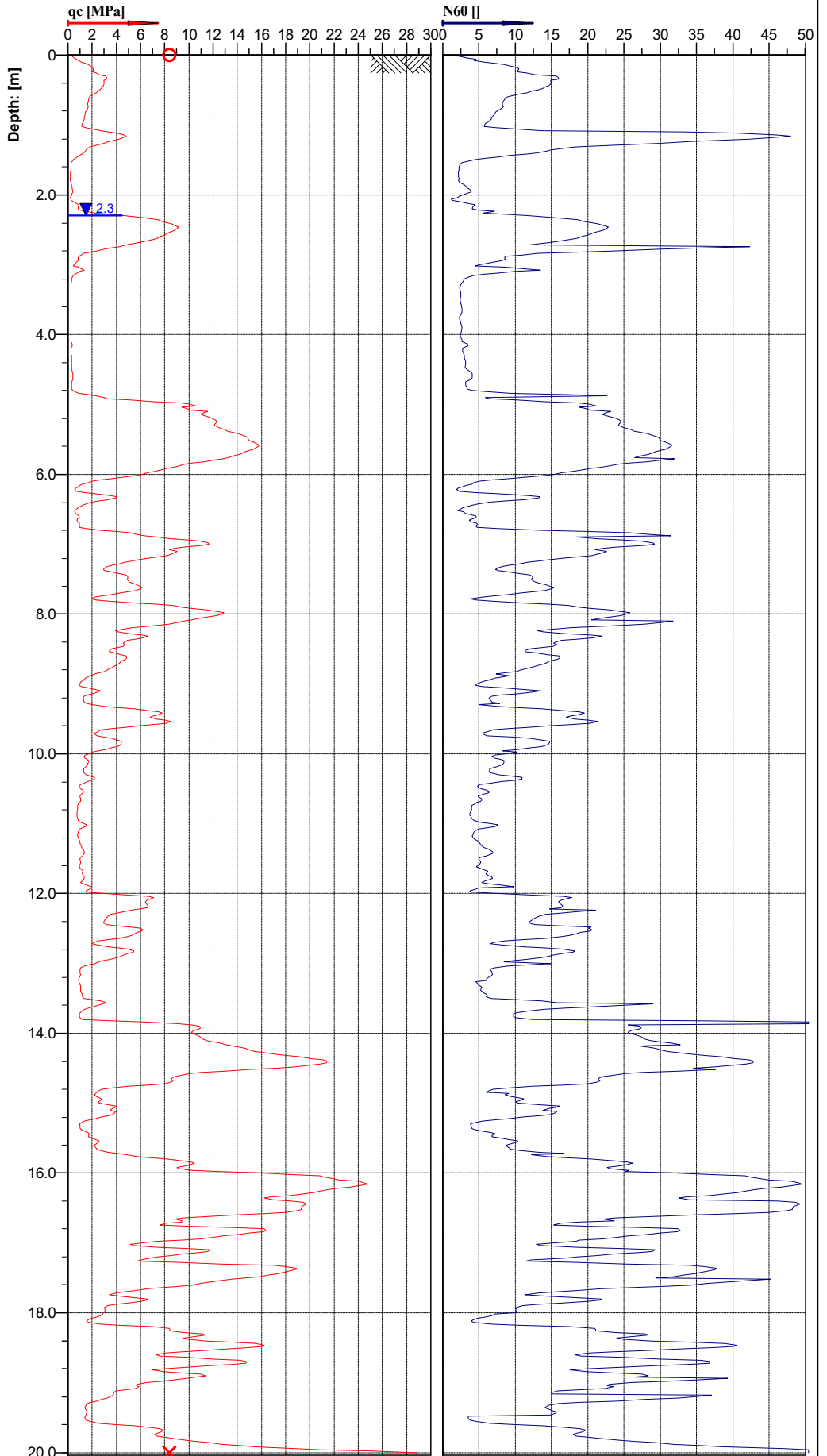
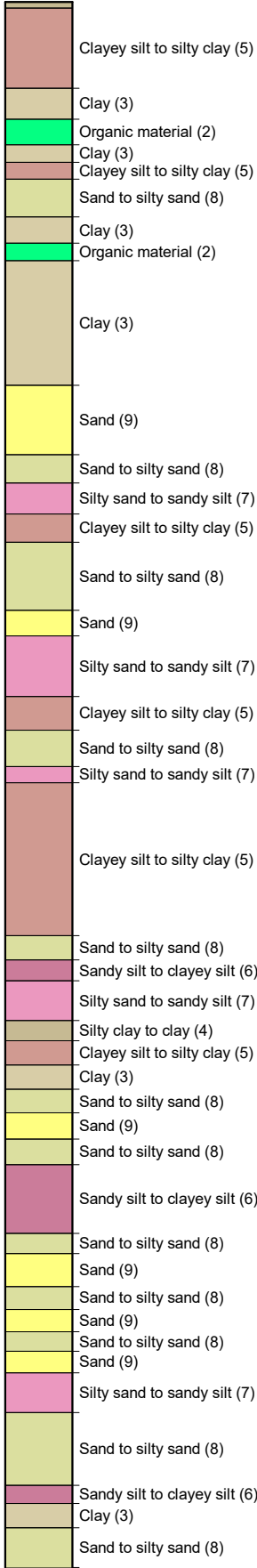


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT12
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50732 E 176.88855				File:	CPT12.cpt		

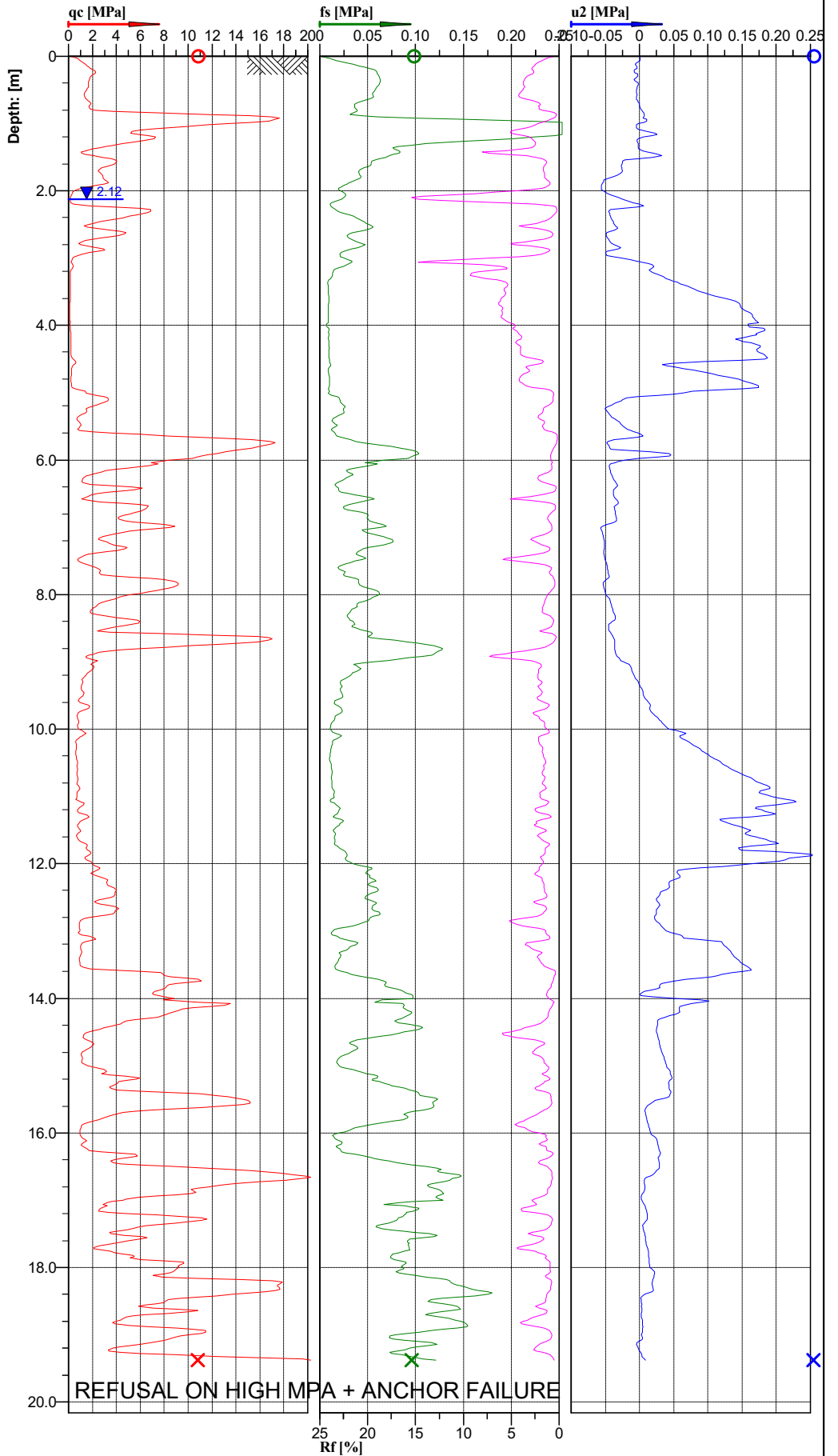
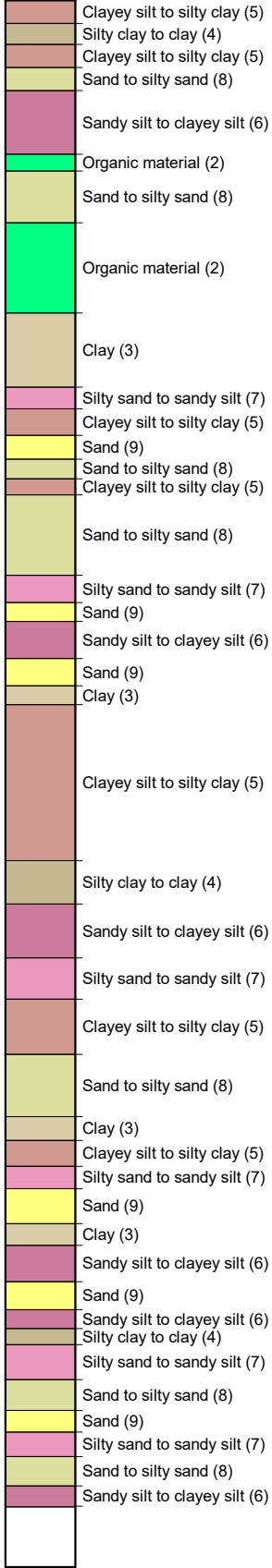
**Classification by
Robertson 1986**



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150

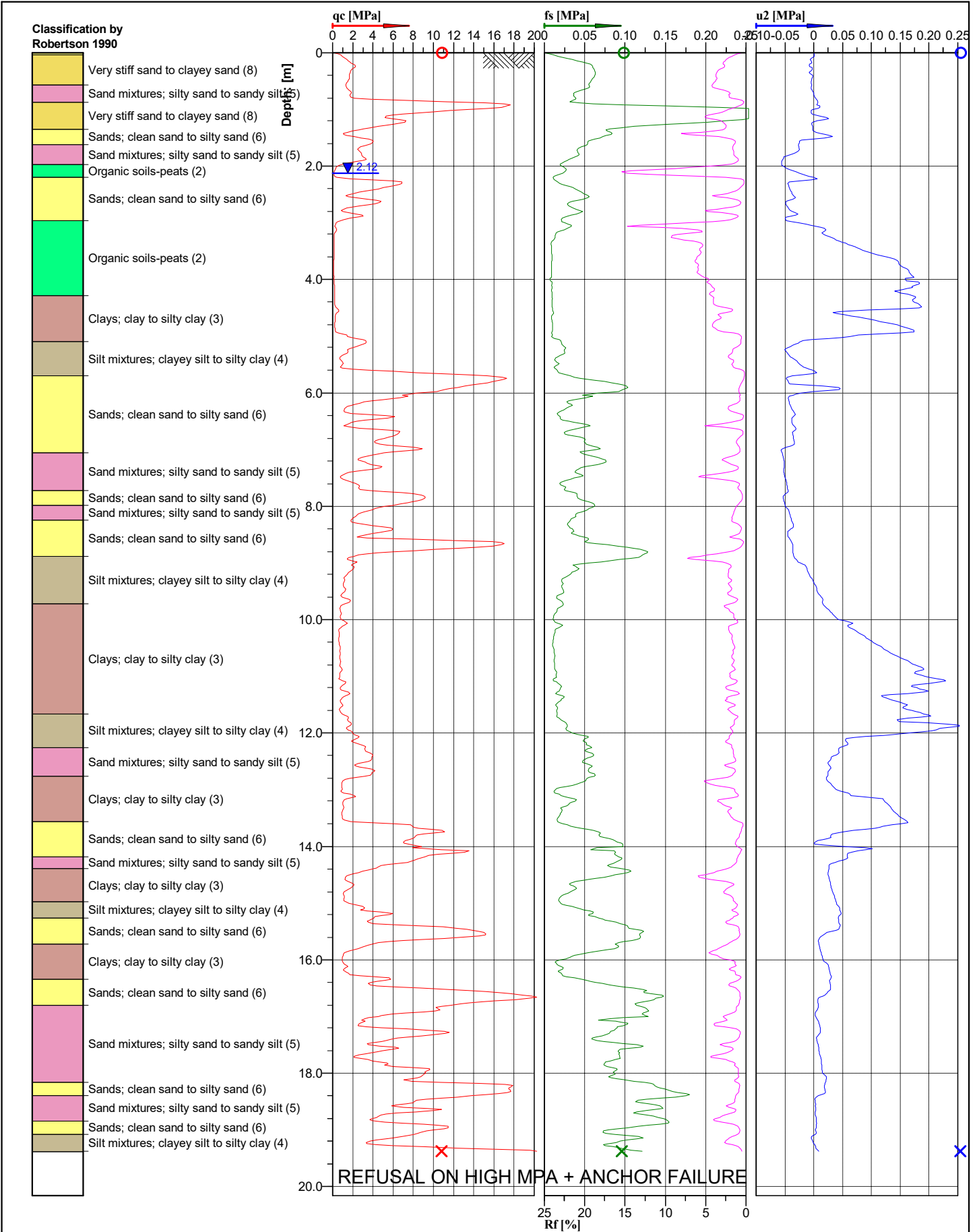
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Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50732 E 176.88855			File:	CPT12.cpt		

Classification by Robertson 1986



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

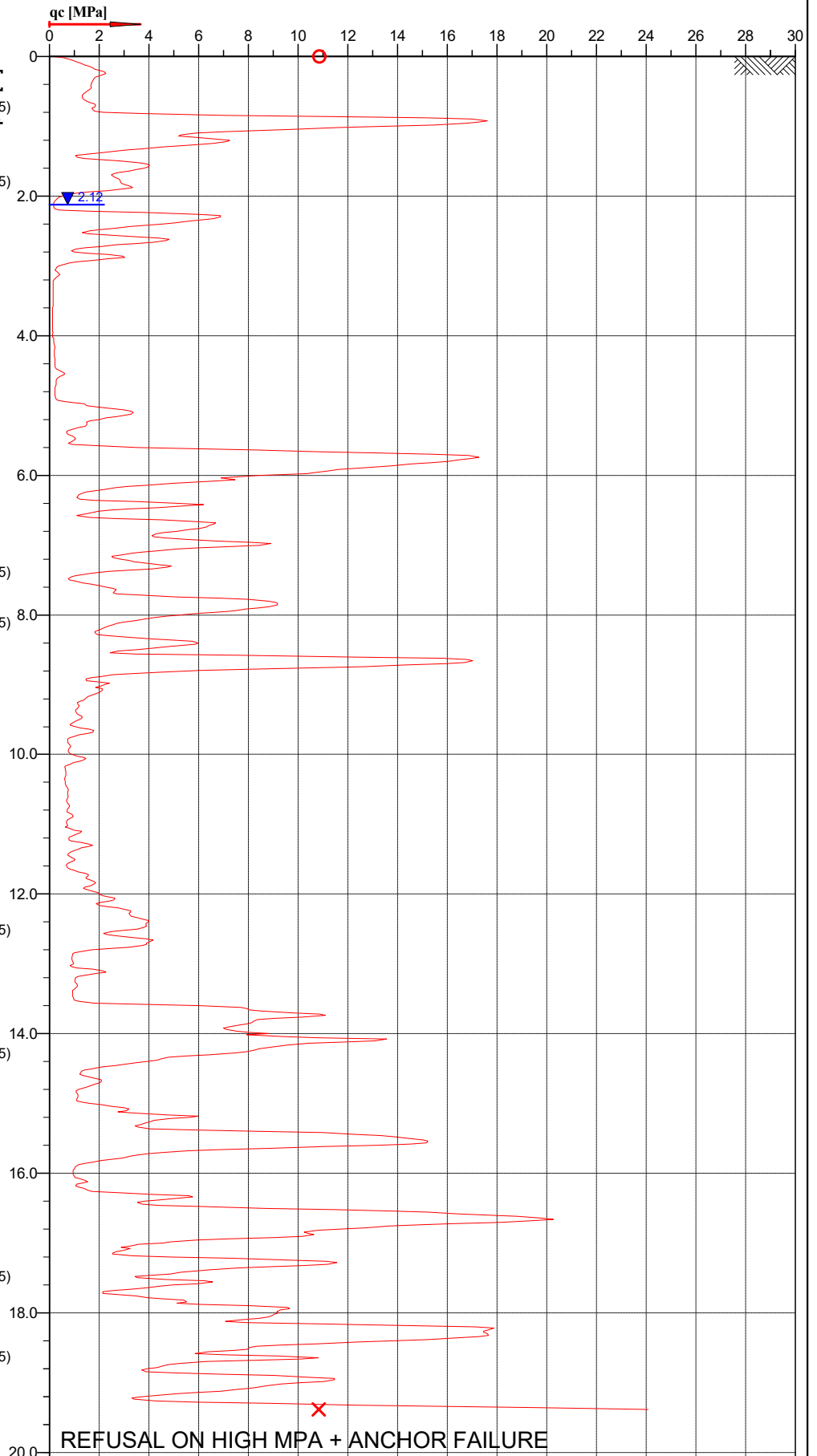
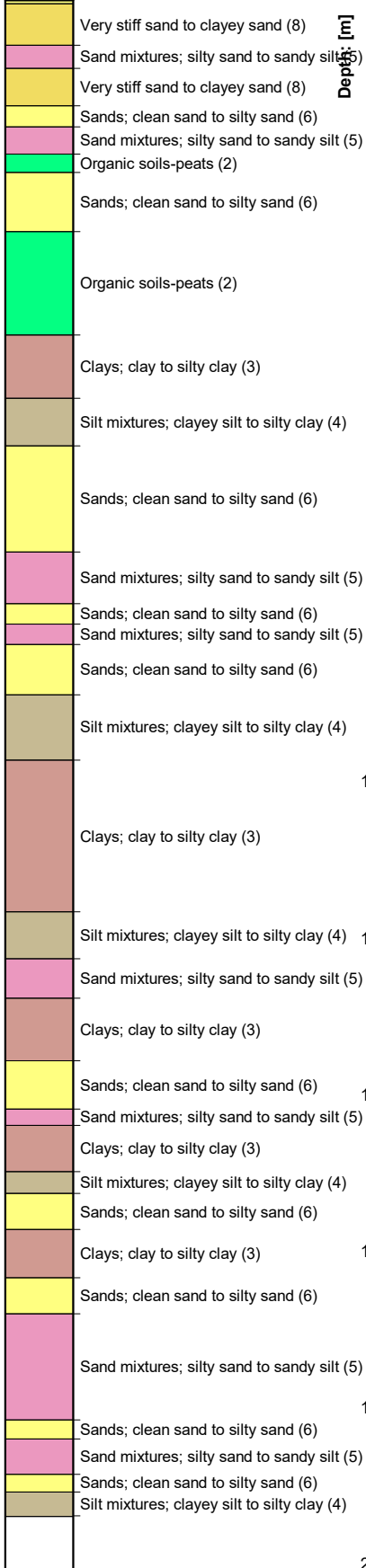
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT15
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50584, E 176.88846		File: CPT15.cpt	



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT15
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50584, E 176.88846			File: CPT15.cpt

Classification by Robertson 1990



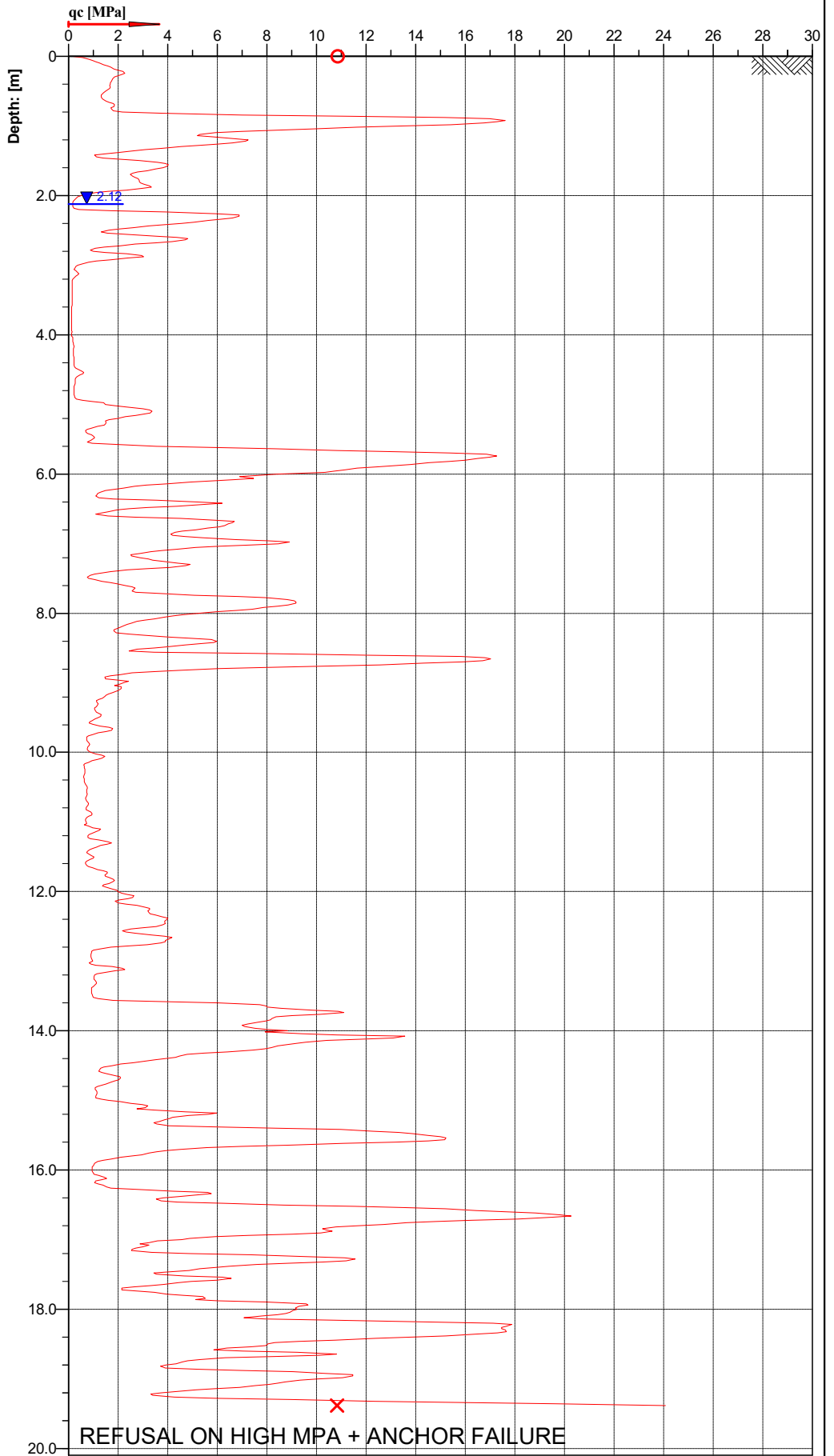
Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT15
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50584, E 176.88846			File:	CPT15.cpt		

Classification by Robertson 1986

- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Organic material (2)
- Silty sand to sandy silt (7)
- Organic material (2)
- Clay (3)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Sand (9)
- Sand to silty sand (8)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clay (3)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Sand (9)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clay (3)
- Clayey silt to silty clay (5)
- Sand to silty sand (8)
- Clay (3)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand (9)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Sand (9)
- Silty clay to clay (4)
- Silty sand to sandy silt (7)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sand (9)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)



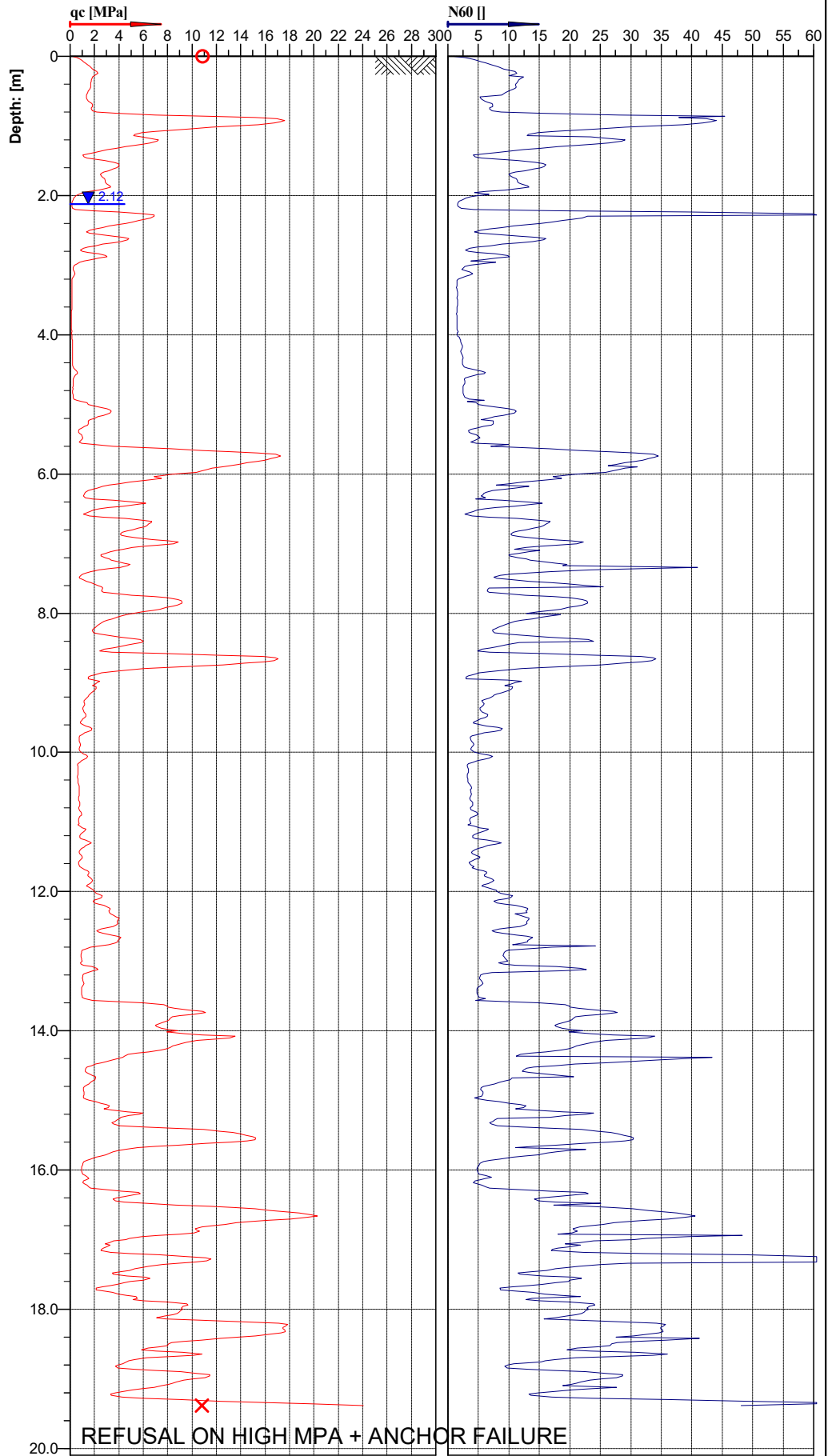
Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT15
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50584, E 176.88846			File:	CPT15.cpt		



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

**Classification by
Robertson 1986**

Clayey silt to silty clay (5)
Silty clay to clay (4)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Organic material (2)
Silty sand to sandy silt (7)
Organic material (2)
Clay (3)
Silty sand to sandy silt (7)
Clayey silt to silty clay (5)
Sand (9)
Sand to silty sand (8)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Clay (3)
Sand to silty sand (8)
Sandy silt to clayey silt (6)
Sand (9)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Clay (3)
Clayey silt to silty clay (5)
Sand to silty sand (8)
Clay (3)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Sand (9)
Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Sand (9)
Silty clay to clay (4)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Sand to silty sand (8)
Sand (9)
Silty sand to sandy silt (7)
Sand to silty sand (8)
Sandy silt to clayey silt (6)



REFUSAL ON HIGH MPA + ANCHOR FAILURE

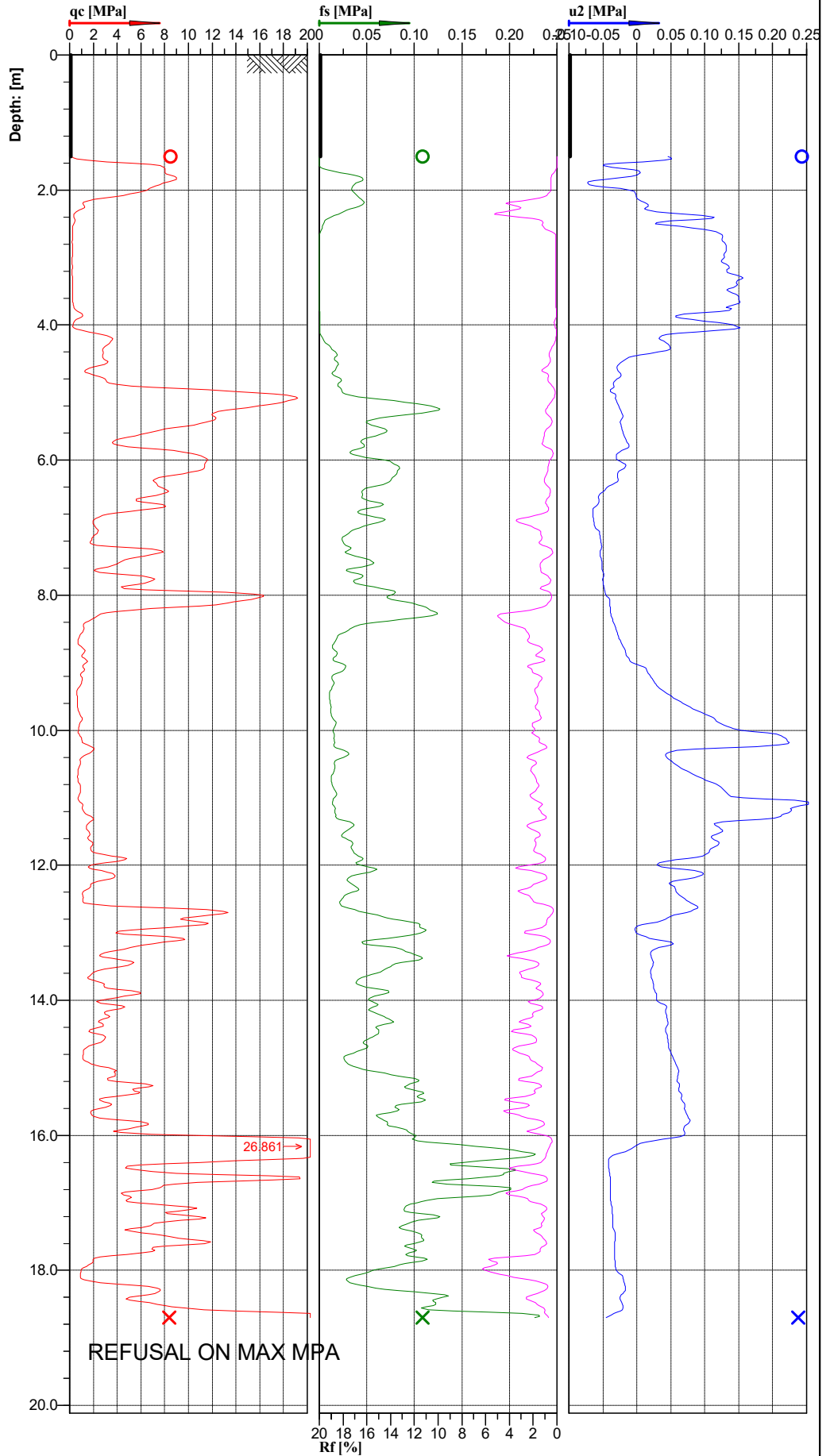
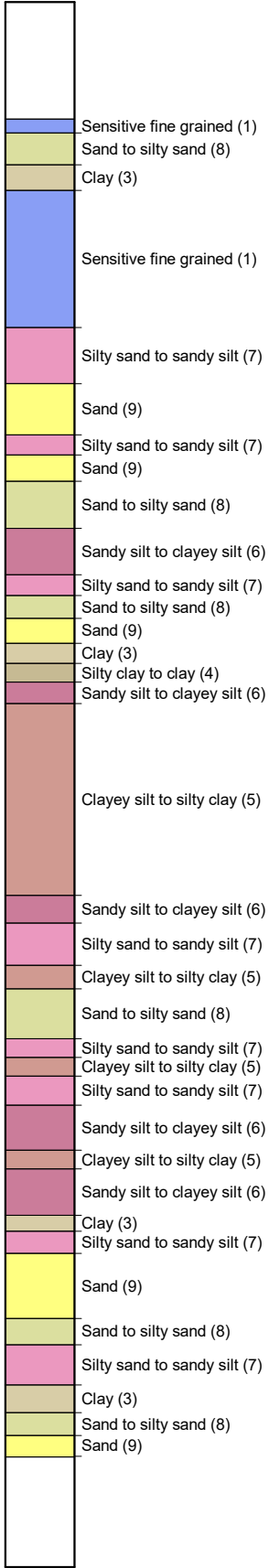


Cone No: 5447
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT15
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 87
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50584, E 176.88846		File: CPT15.cpt	

**Classification by
Robertson 1986**

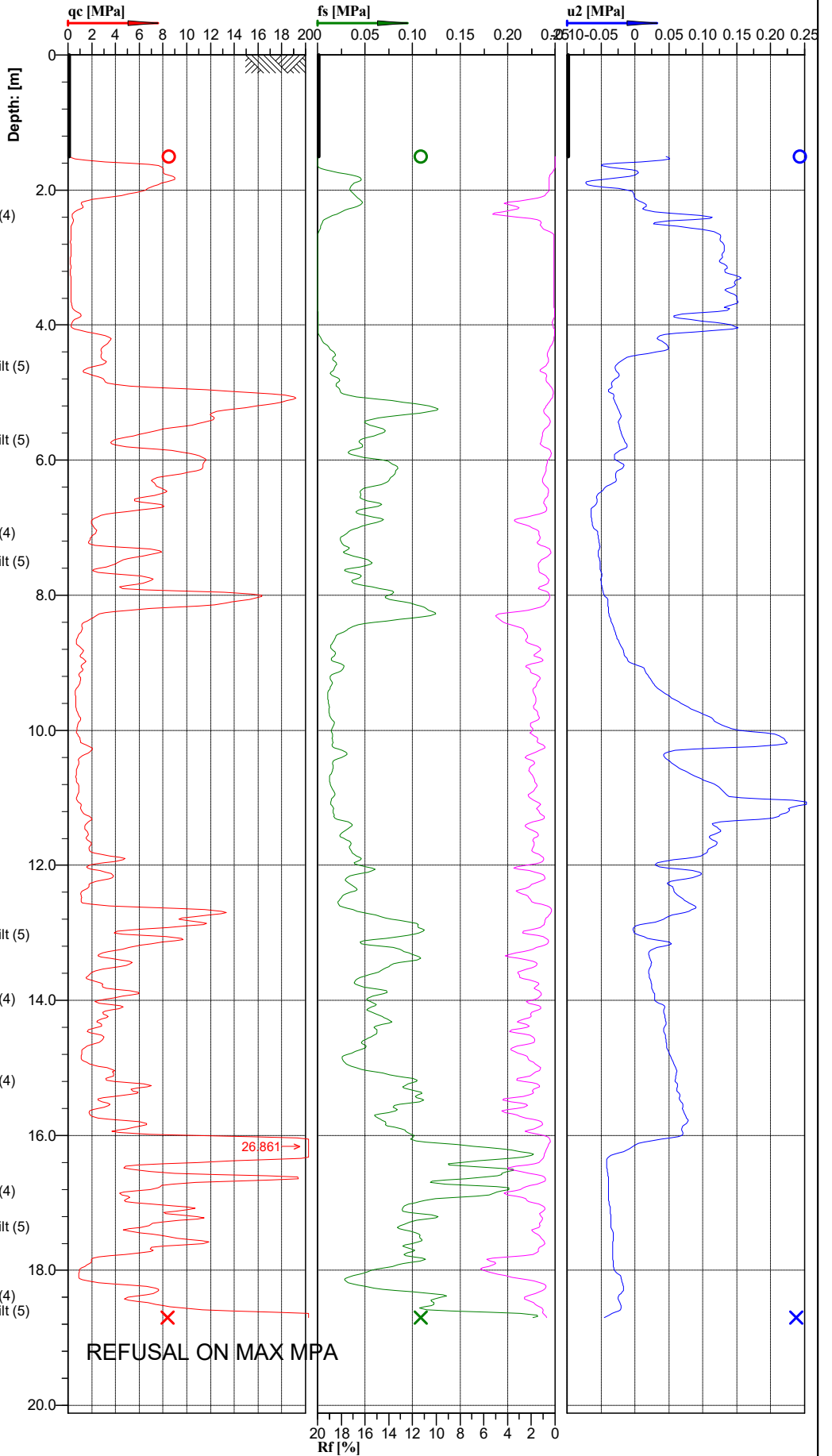
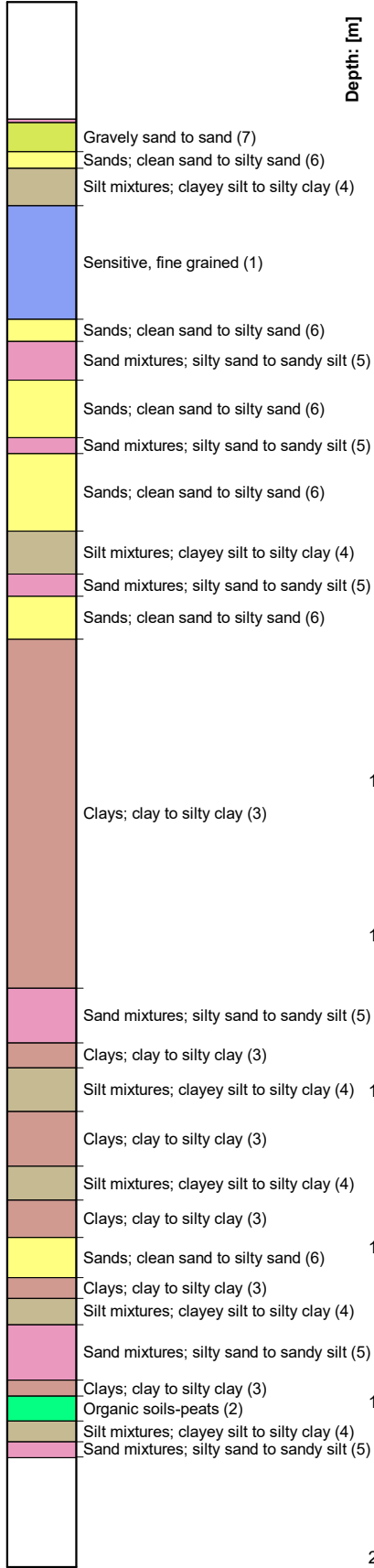


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT16
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50569 E 176.88879				File:	CPT16.cpt		

Classification by
Robertson 1990

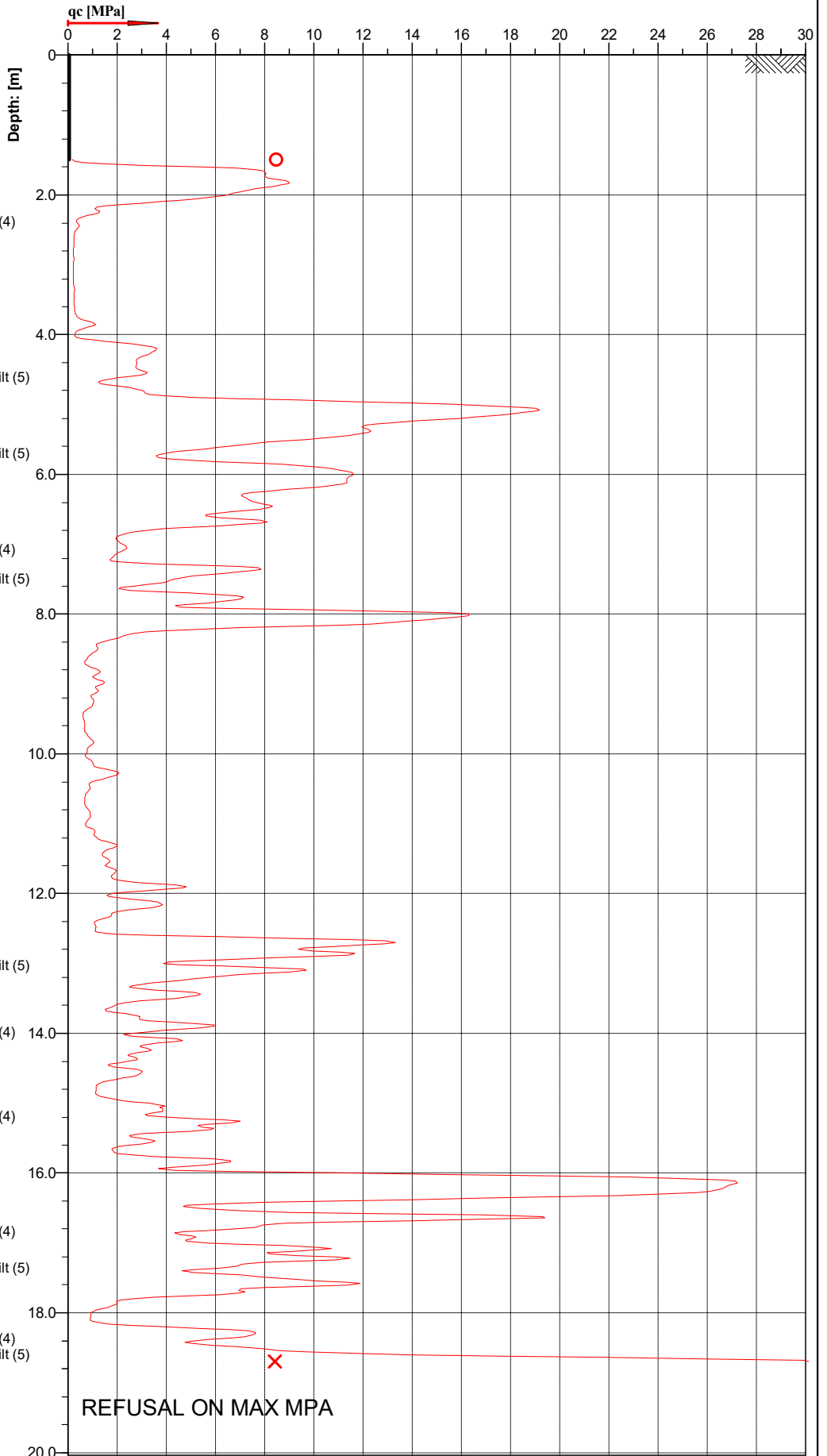
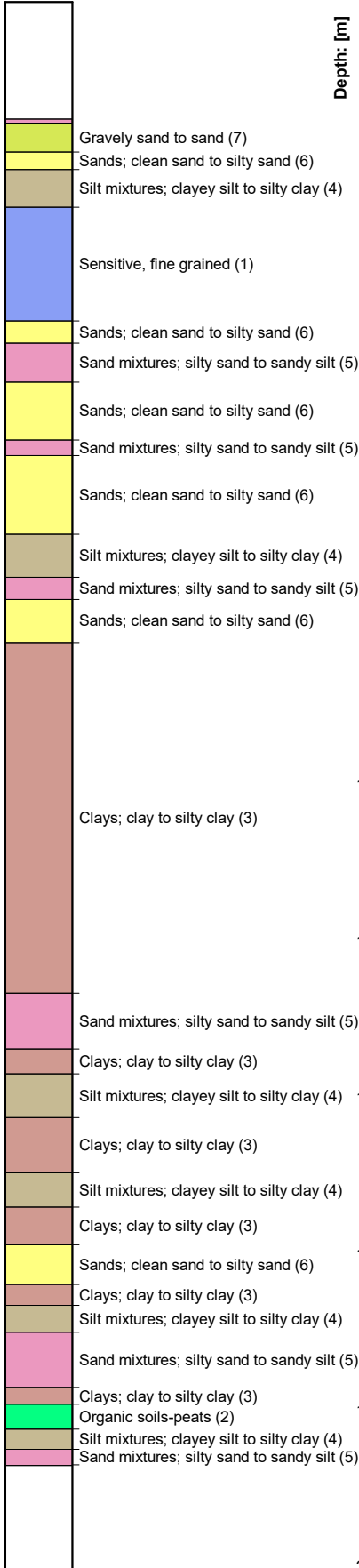


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT16
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 89
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50569 E 176.88879				File:	CPT16.cpt		

**Classification by
Robertson 1990**

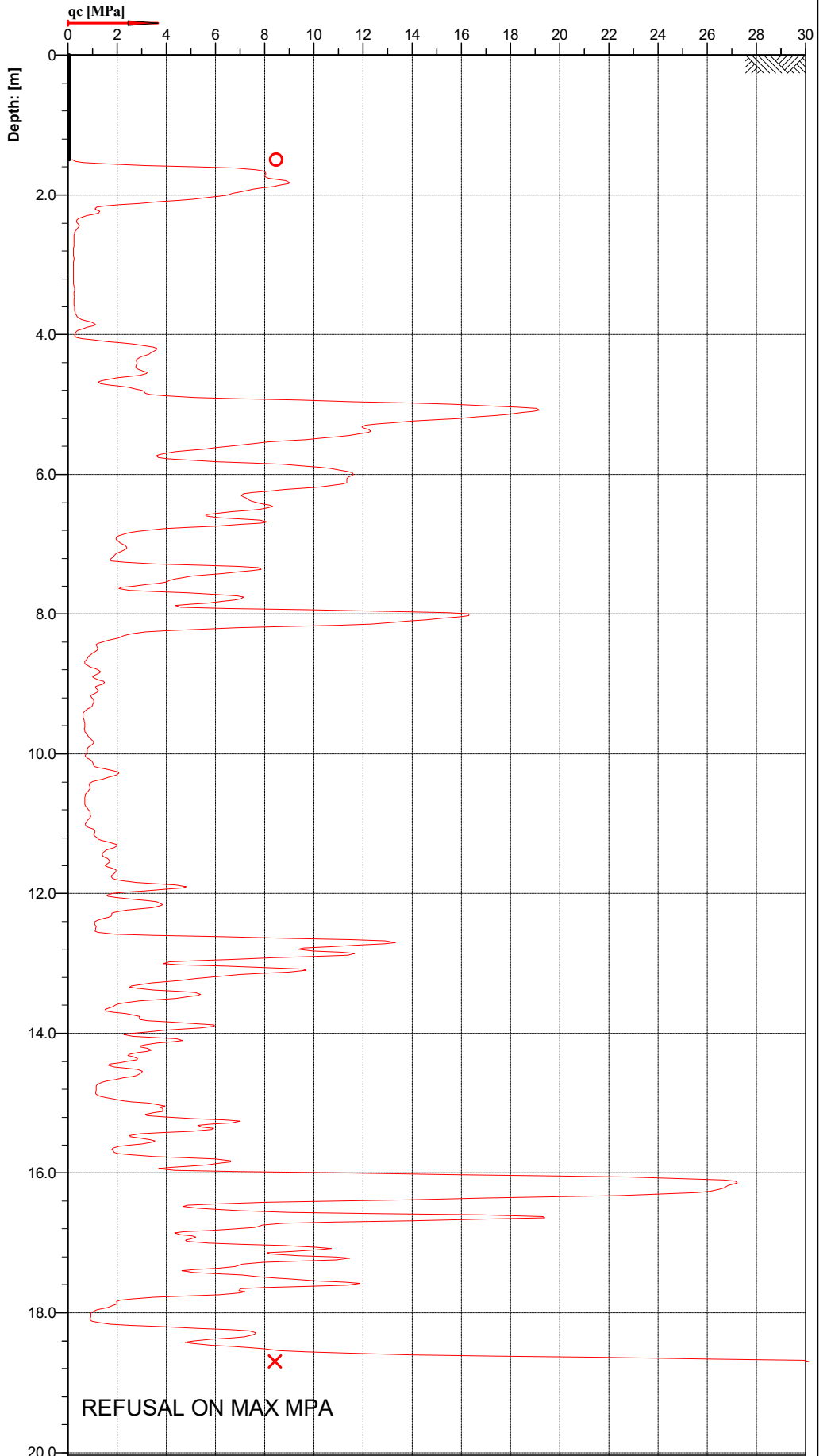
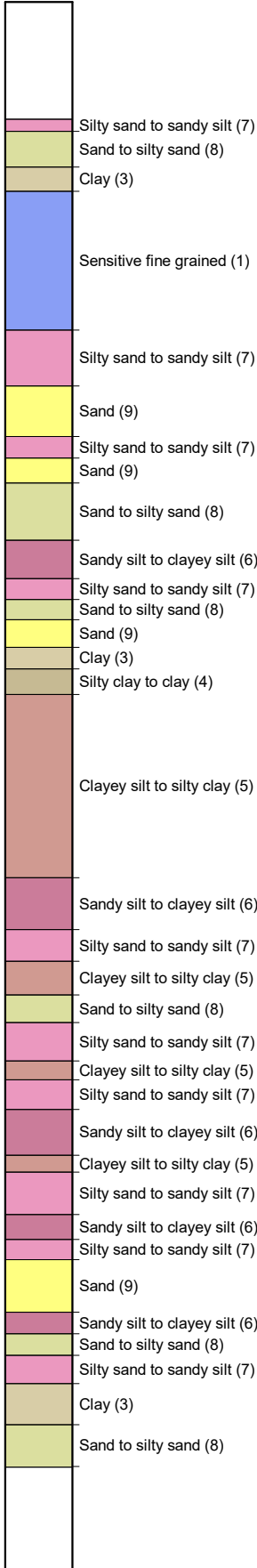


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT16
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50569 E 176.88879				File:	CPT16.cpt		

**Classification by
Robertson 1986**

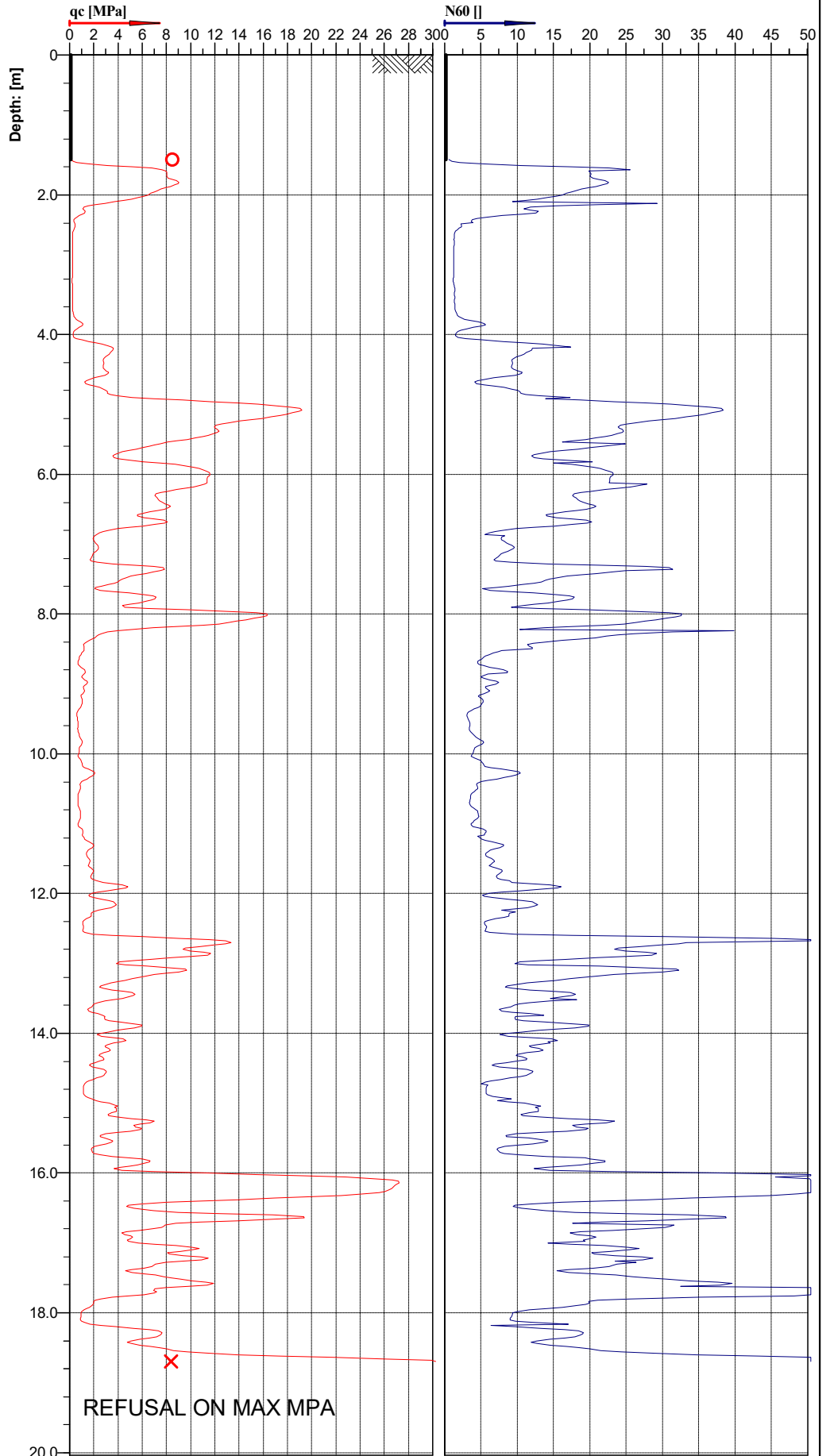
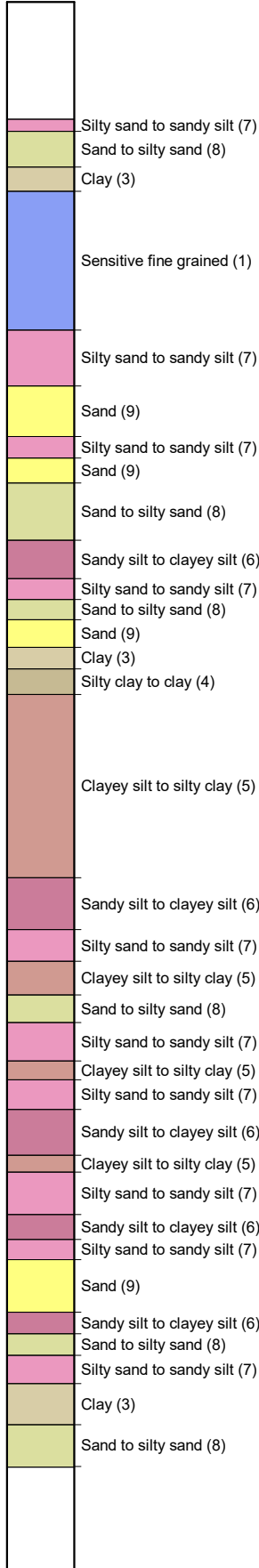


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT16
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50569 E 176.88879				File:	CPT16.cpt		

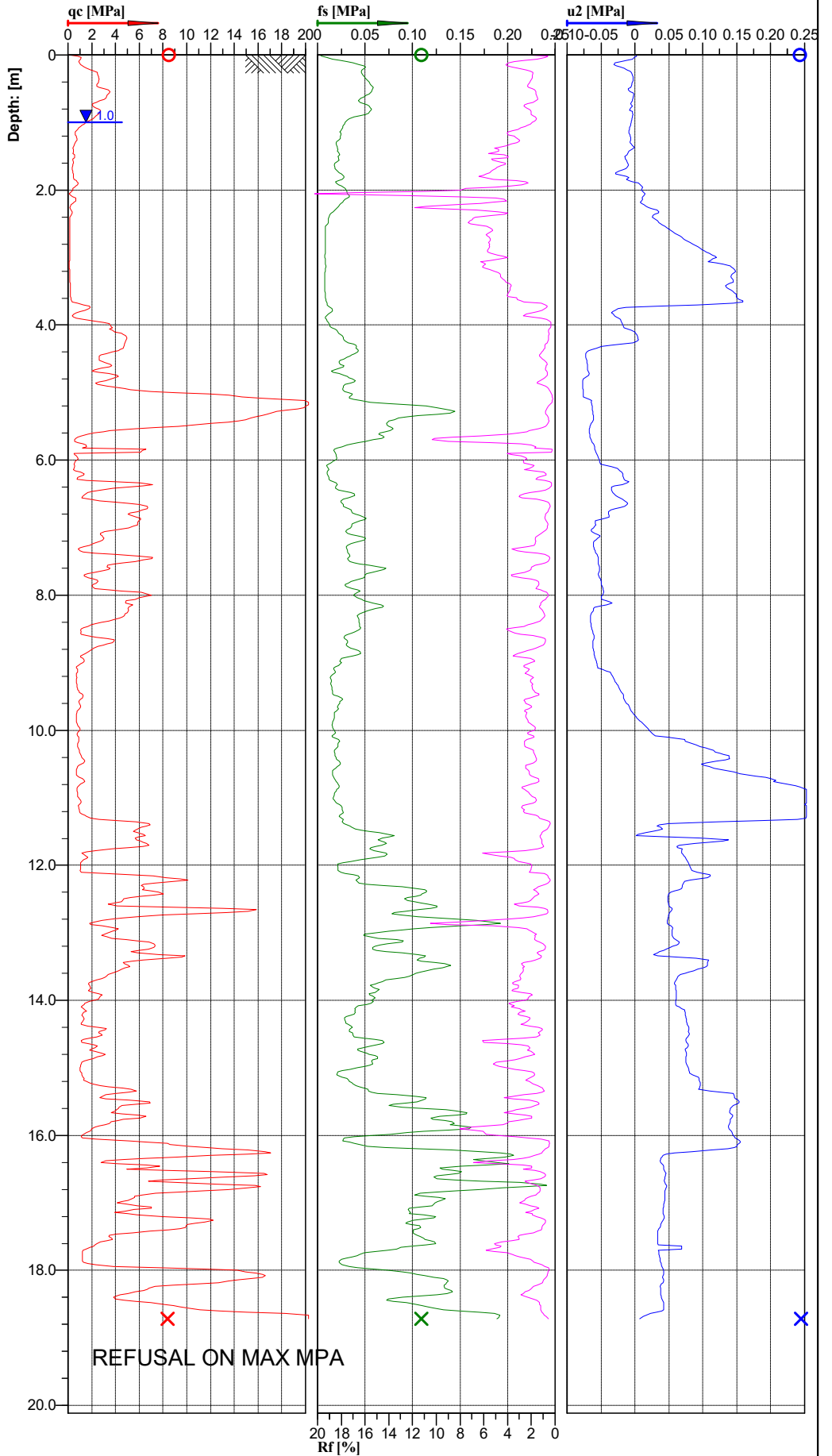
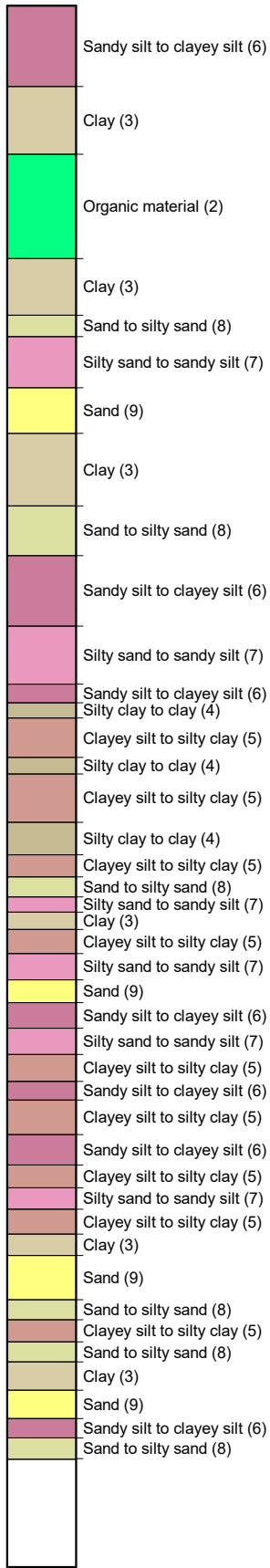
**Classification by
Robertson 1986**



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT16
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50569 E 176.88879				File:	CPT16.cpt		

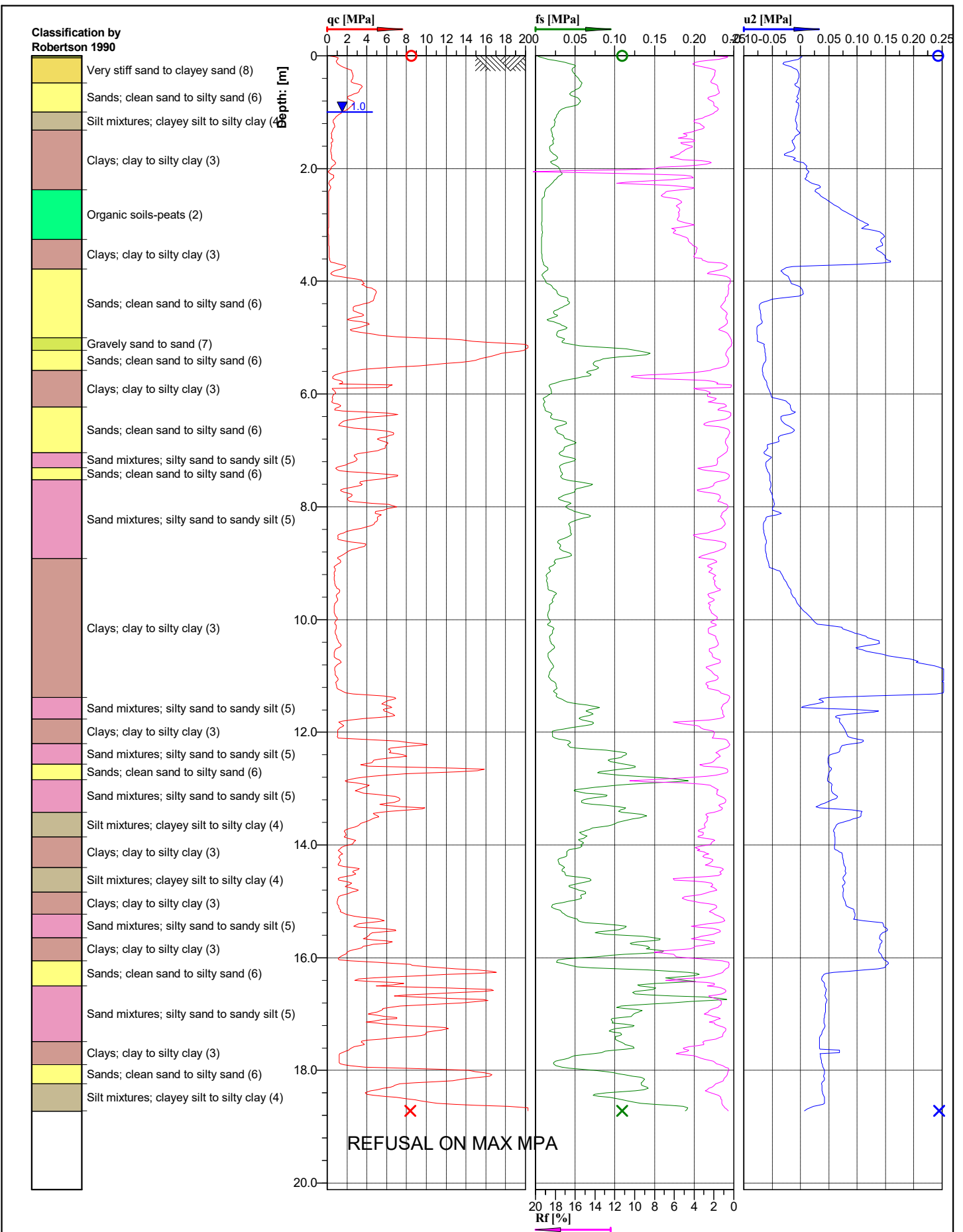
Classification by Robertson 1986



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



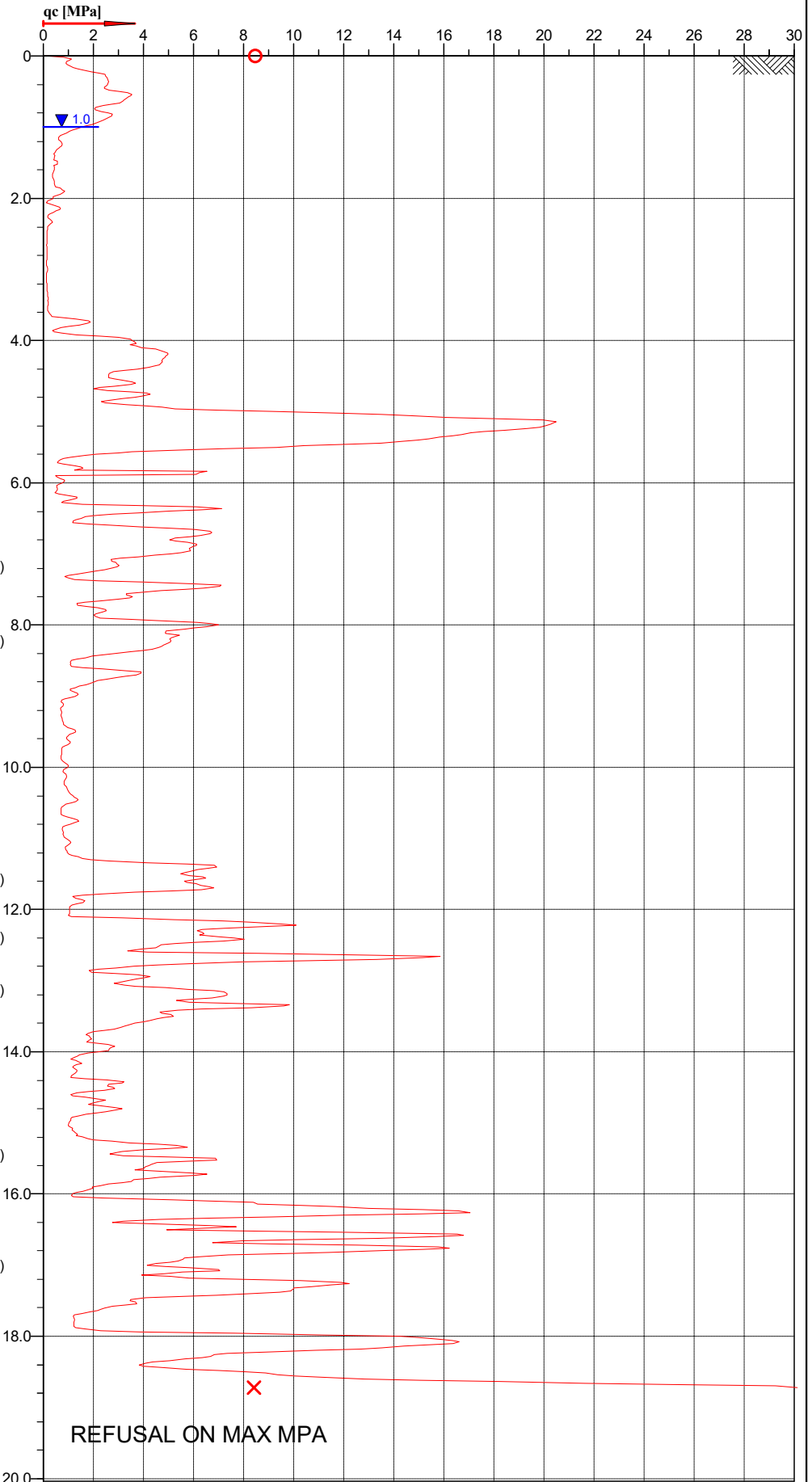
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT17
Project ID:	Client: TONKN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50558 E 176.88905		File: CPT17.cpt	



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT17
Project ID:	Client: TONKN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50558 E 176.88905		File: CPT17.cpt	

**Classification by
Robertson 1990**



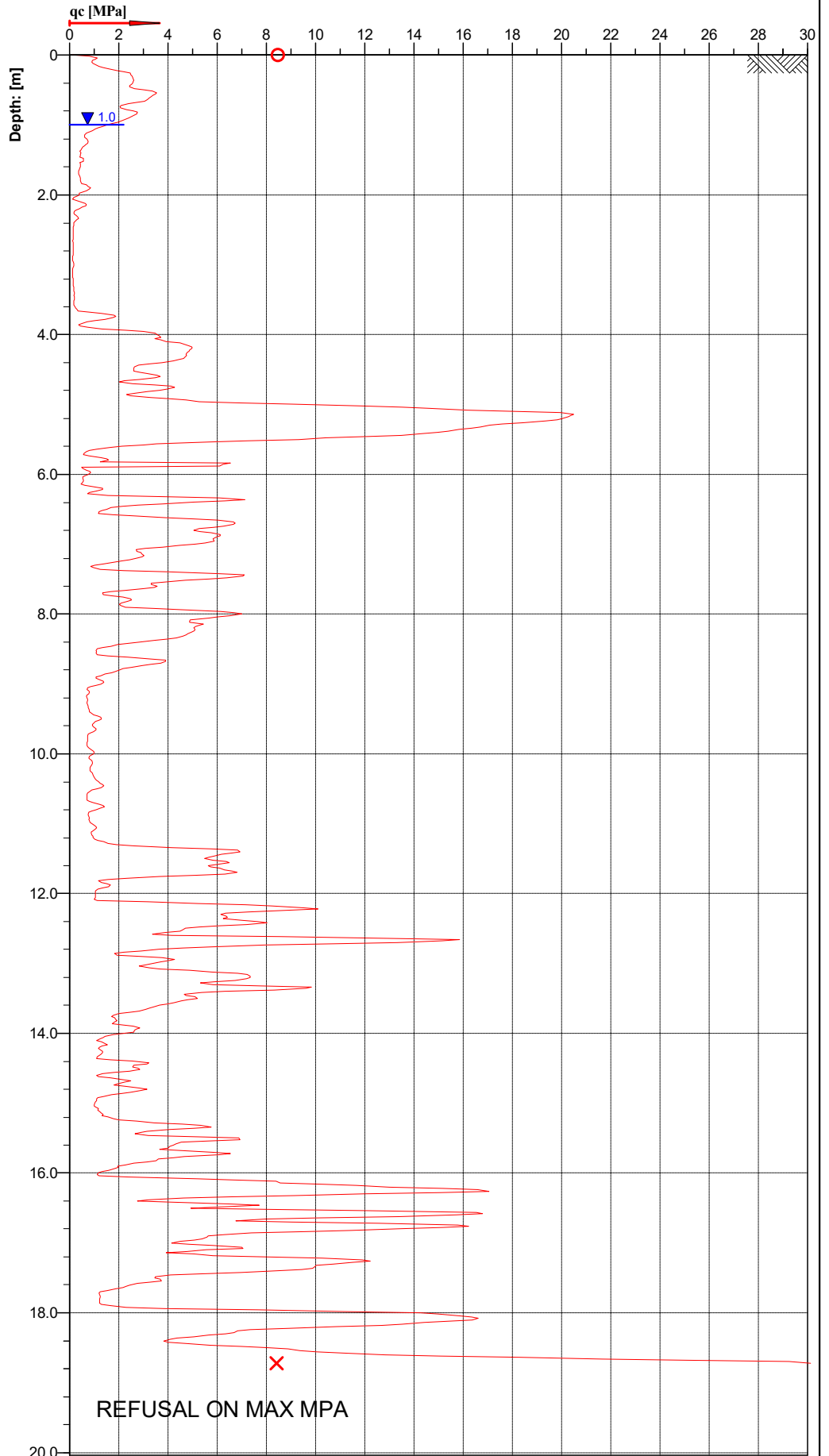
Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT17
Project ID:	Client: TONKN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	S 39.50558 E 176.88905	Page: 1/1	Fig.:
File: CPT17.cpt			

Classification by Robertson 1986

- Sandy silt to clayey silt (6)
- Clay (3)
- Organic material (2)
- Clay (3)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Sand (9)
- Clay (3)
- Silty clay to clay (4)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Silty clay to clay (4)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Silty sand to sandy silt (7)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Sandy silt to clayey silt (6)
- Clayey silt to silty clay (5)
- Silty sand to sandy silt (7)
- Clay (3)
- Sand (9)
- Sand to silty sand (8)
- Silty sand to sandy silt (7)
- Sand to silty sand (8)
- Clay (3)
- Sand (9)
- Sandy silt to clayey silt (6)
- Sand to silty sand (8)

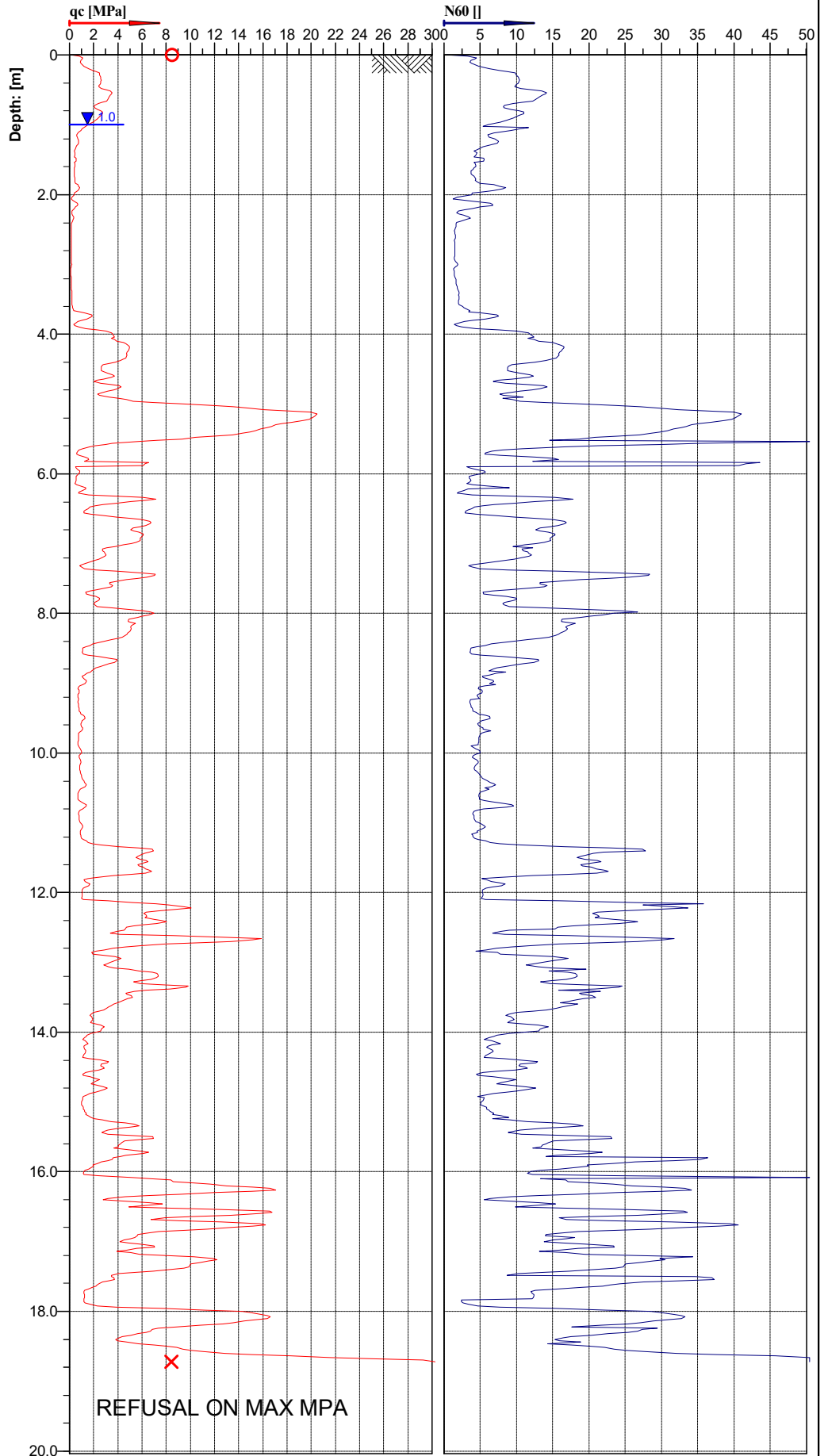
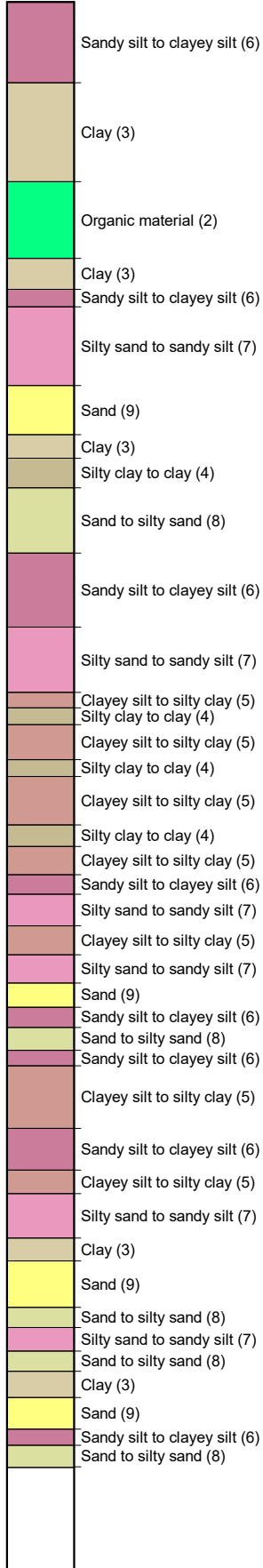


Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT17
Project ID:		Client:	TONKN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50558 E 176.88905				File:	CPT17.cpt		

**Classification by
Robertson 1986**

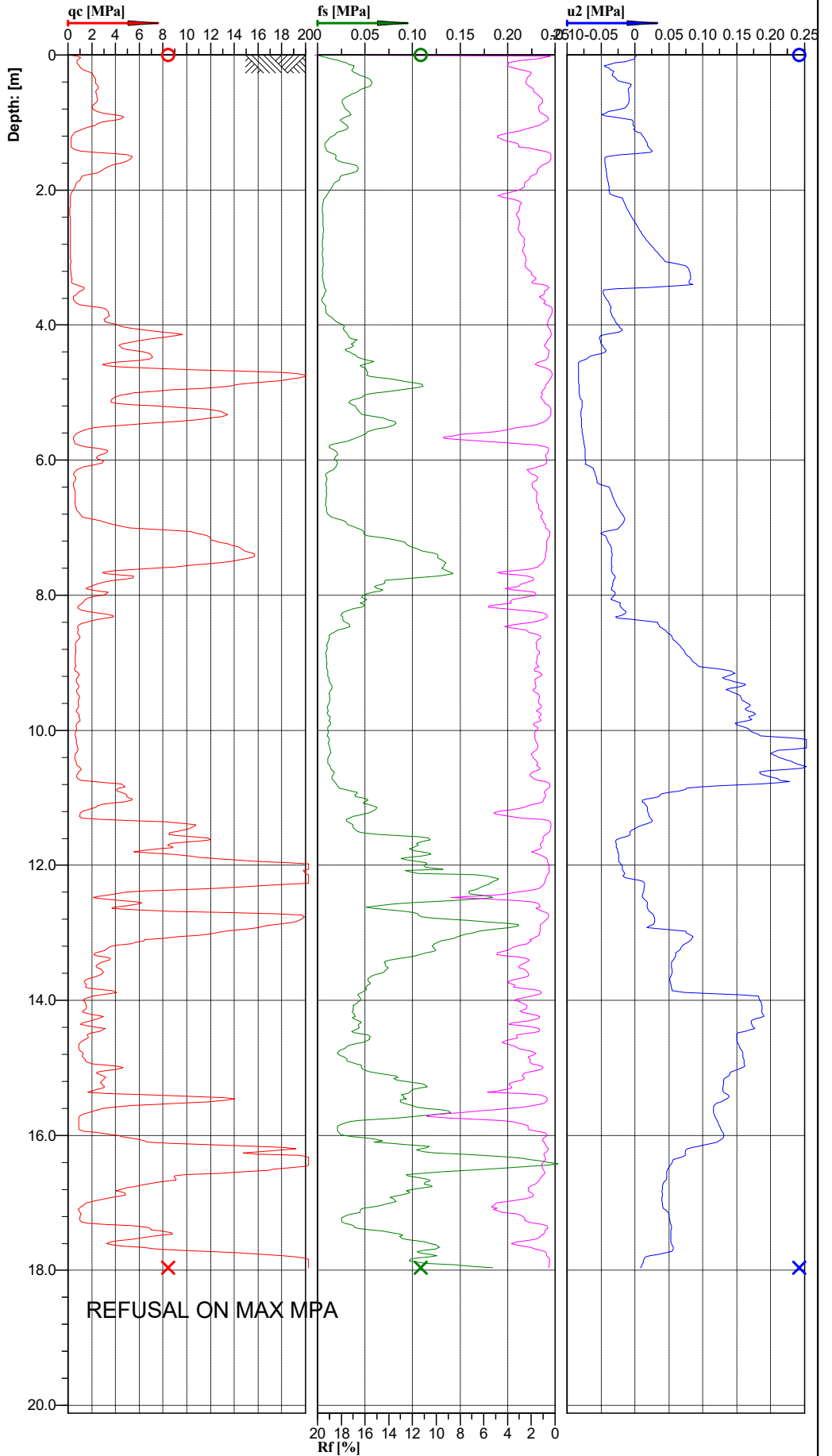
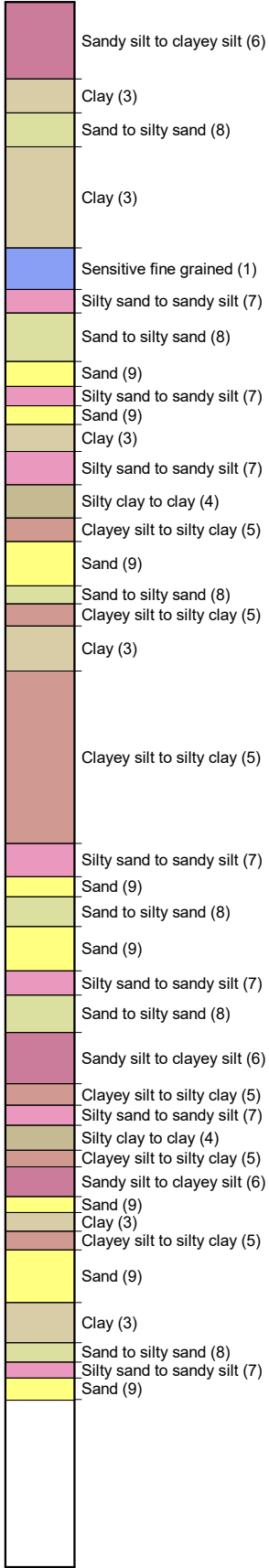


Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT17
Project ID:		Client:	TONKN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50558 E 176.88905			File:	CPT17.cpt		

**Classification by
Robertson 1986**



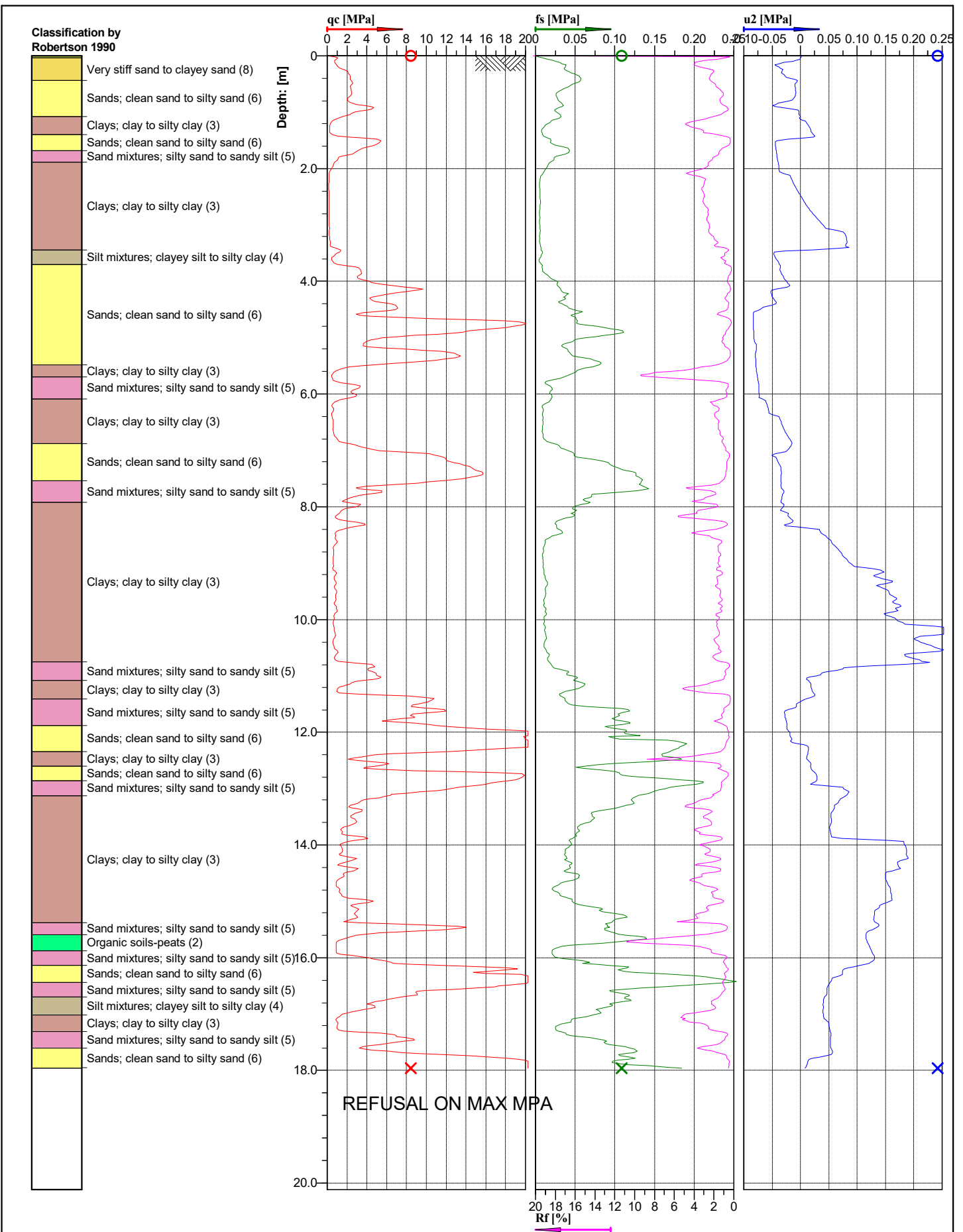
REFUSAL ON MAX MPA



Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



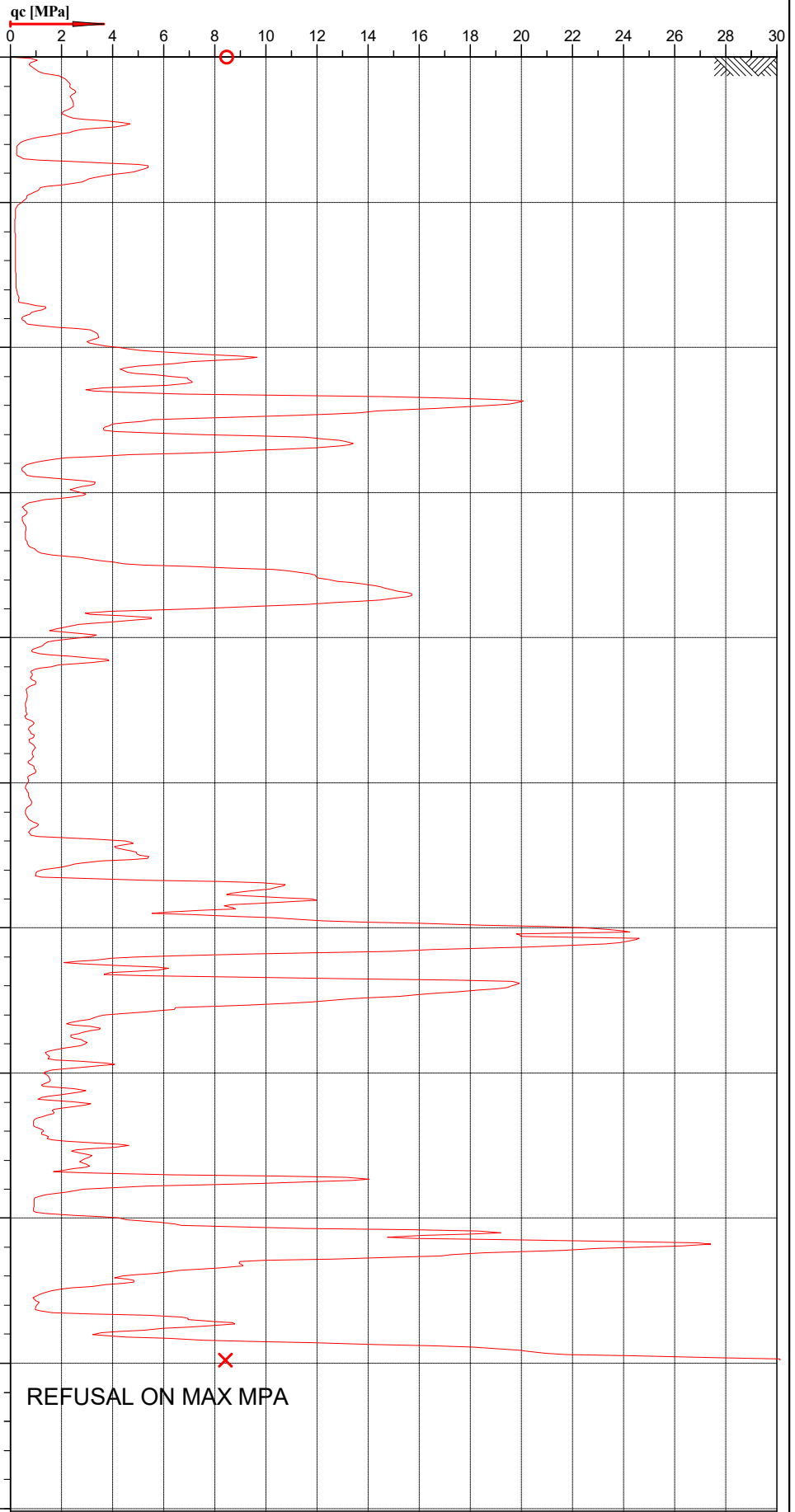
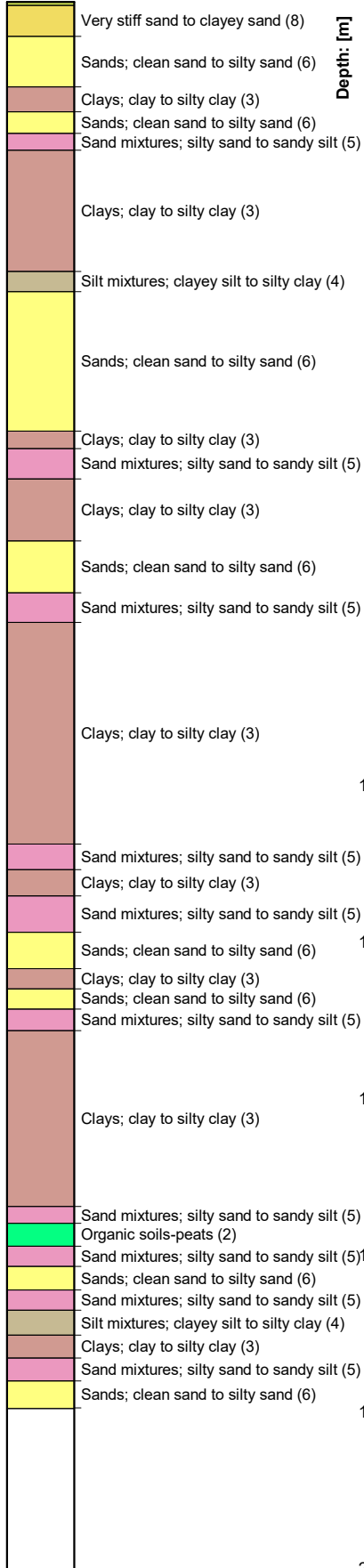
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT18
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50473 E 176.88885		File: CPT18.cpt	



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT18
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50473 E 176.88885			File: CPT18.cpt

**Classification by
Robertson 1990**

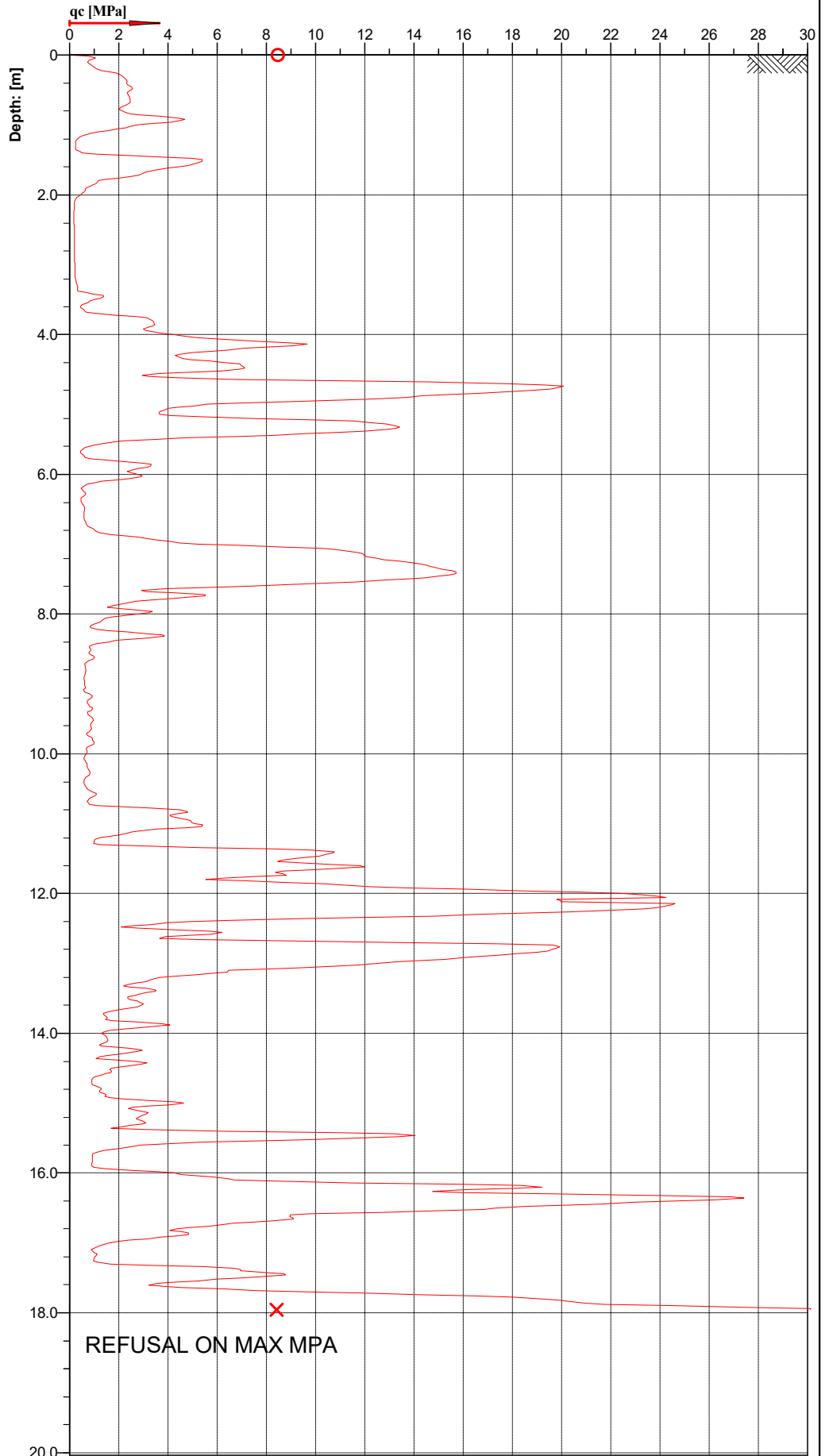
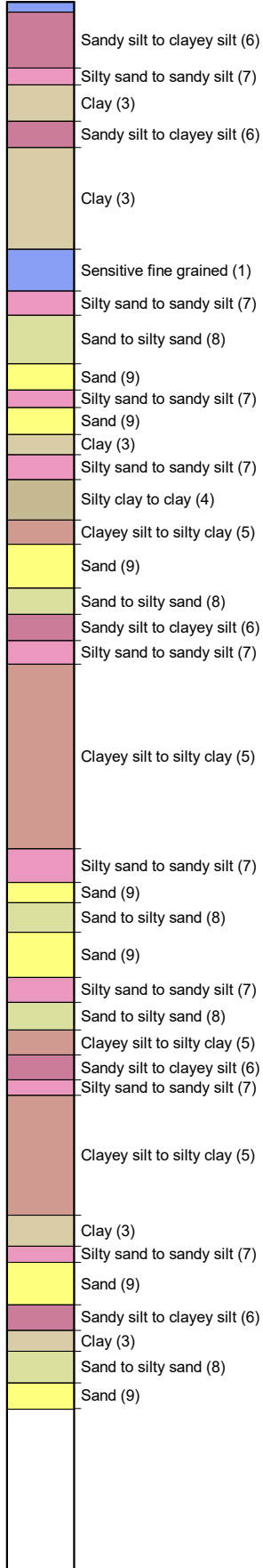


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT18
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50473 E 176.88885		File: CPT18.cpt	

**Classification by
Robertson 1986**

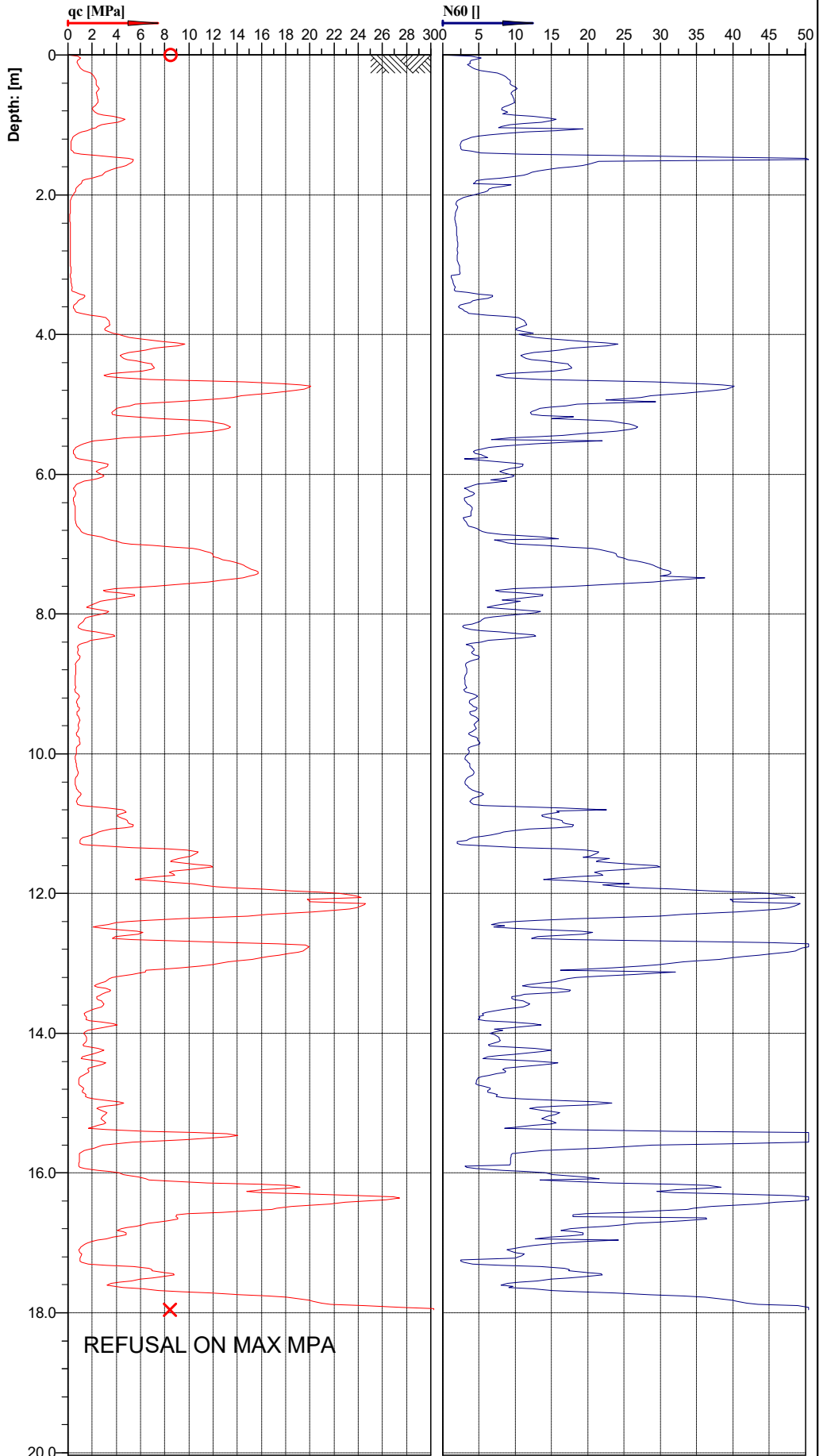
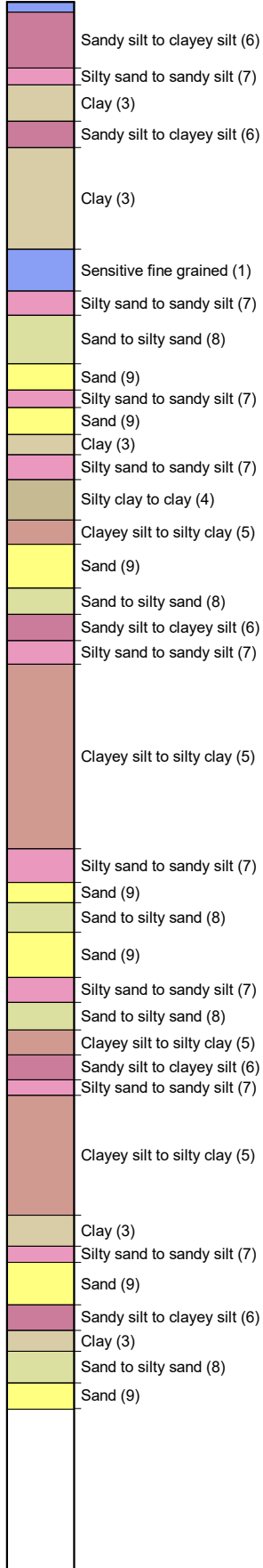


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT18
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50473 E 176.88885		File: CPT18.cpt	

**Classification by
Robertson 1986**

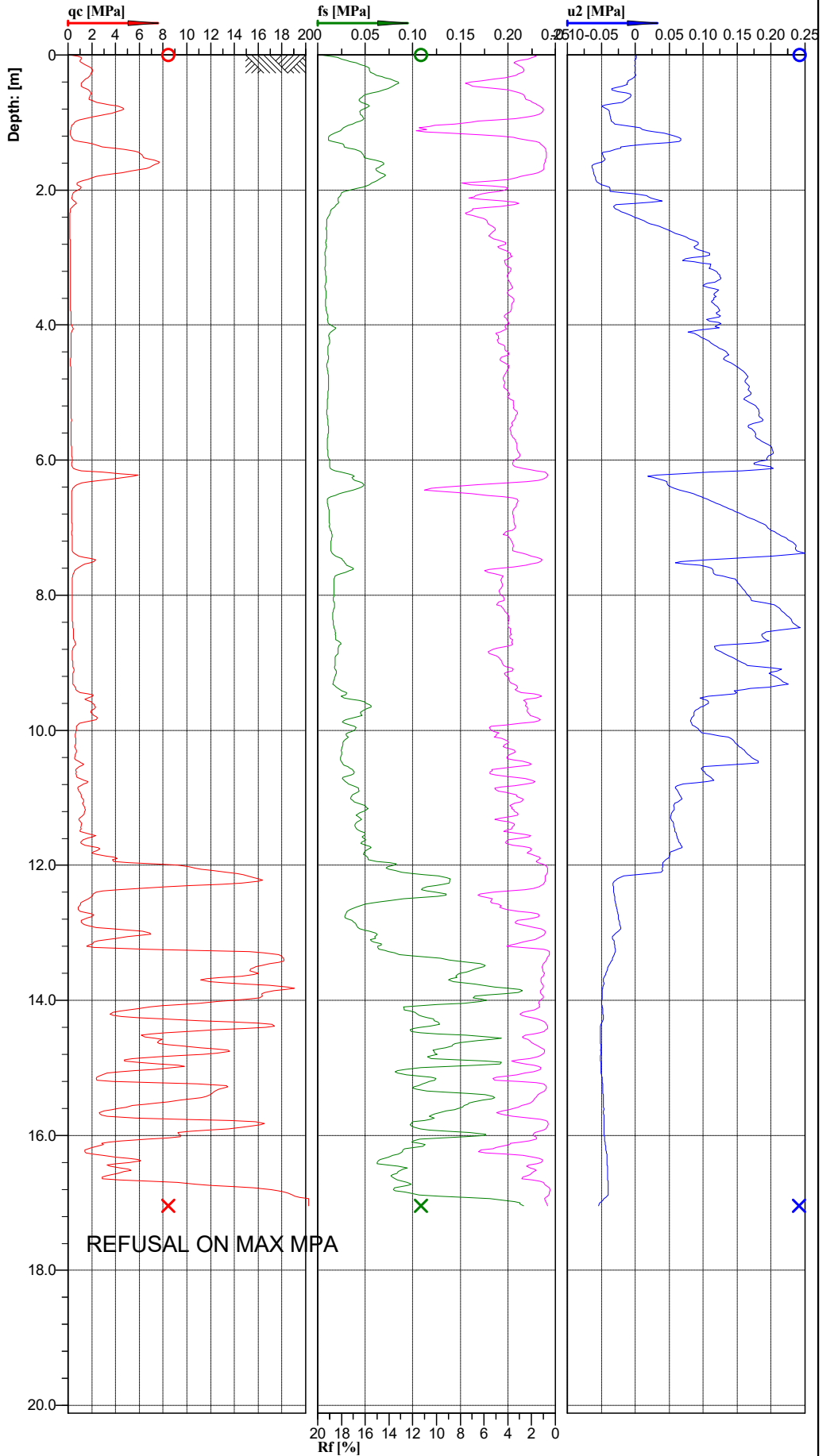
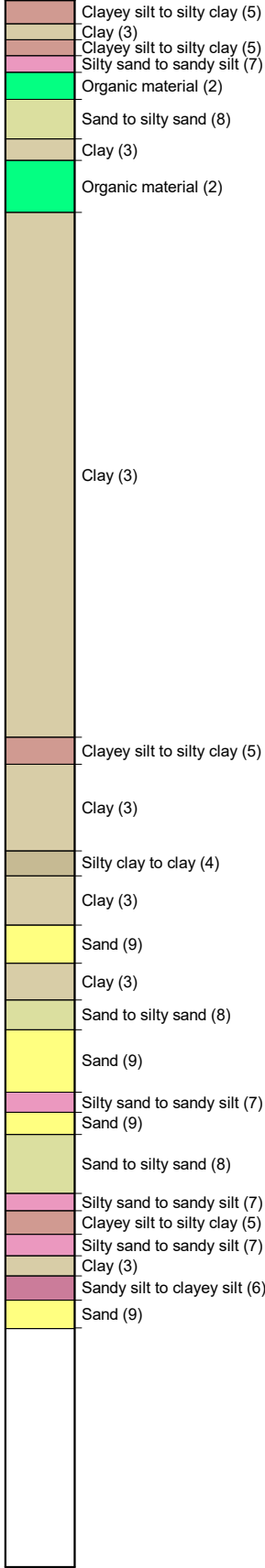


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT18
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50473 E 176.88885			File: CPT18.cpt

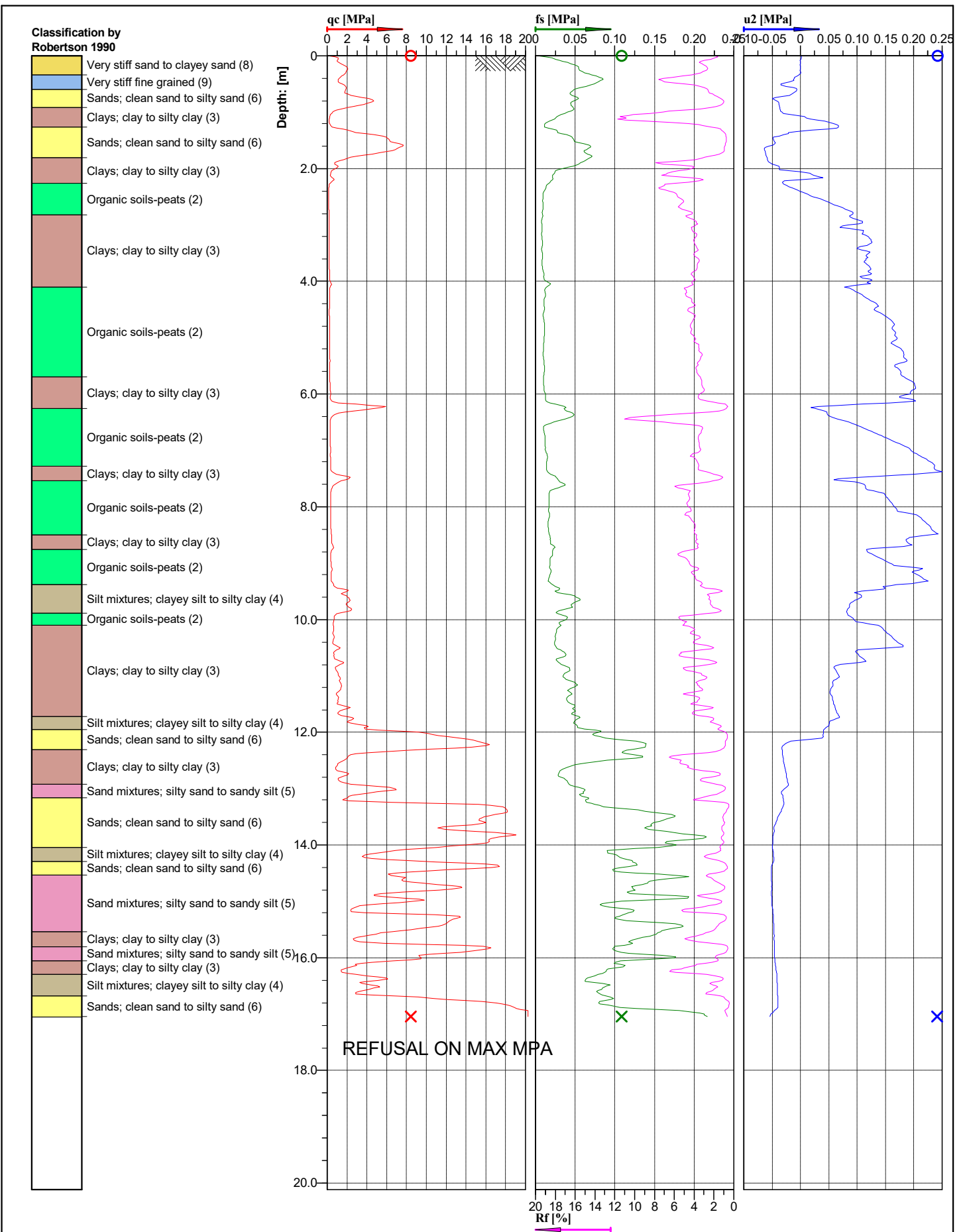
Classification by Robertson 1986



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



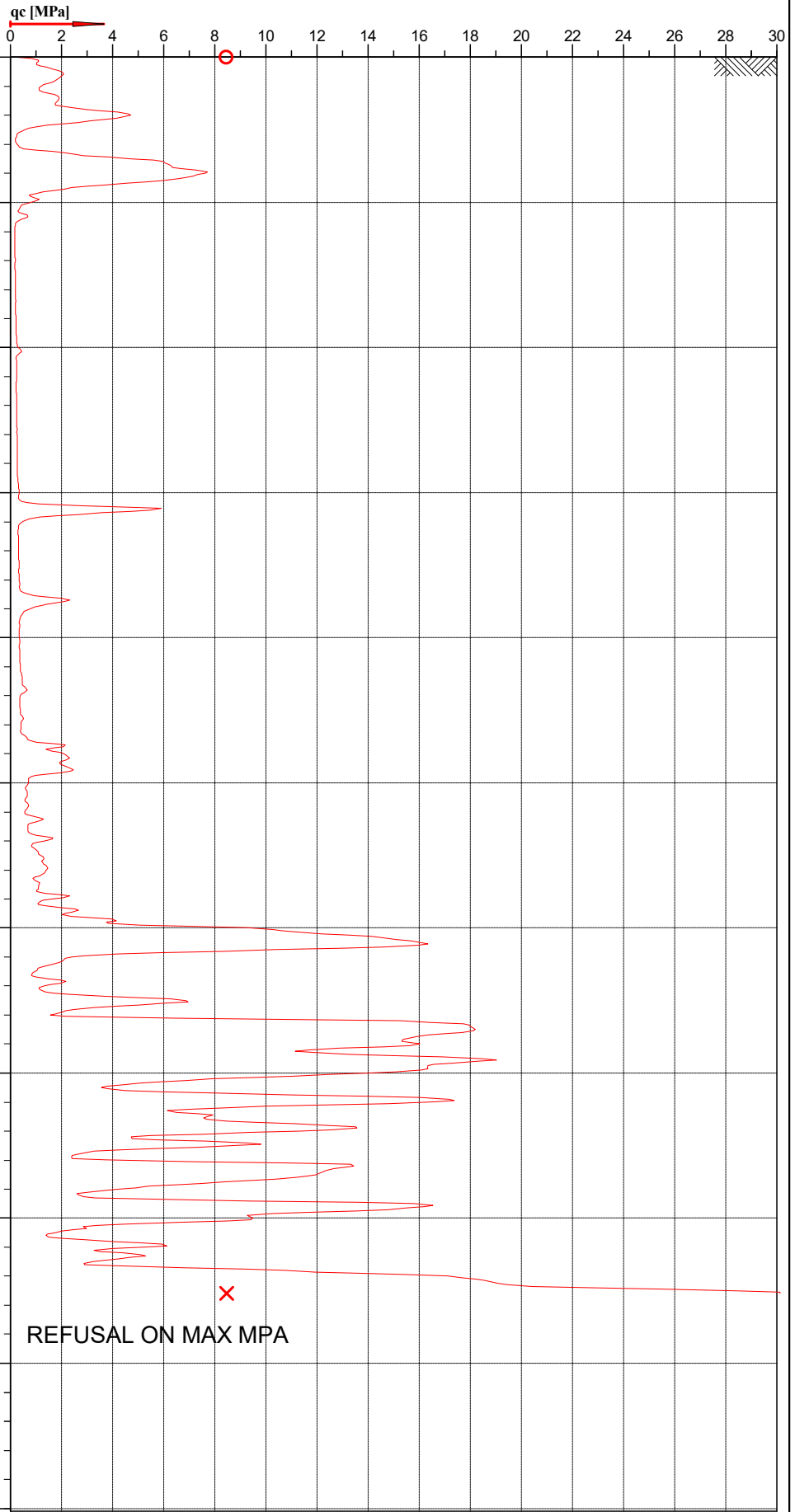
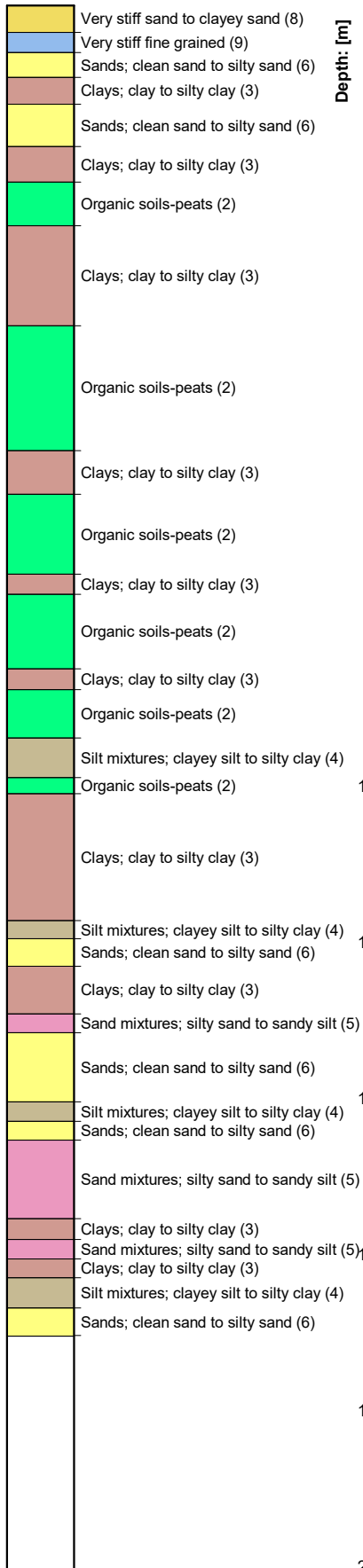
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Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.505877 E 176.88675			File: CPT19.cpt



Cone No: 5550
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT19
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 89
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.505877 E 176.88675			File: CPT19.cpt

**Classification by
Robertson 1990**

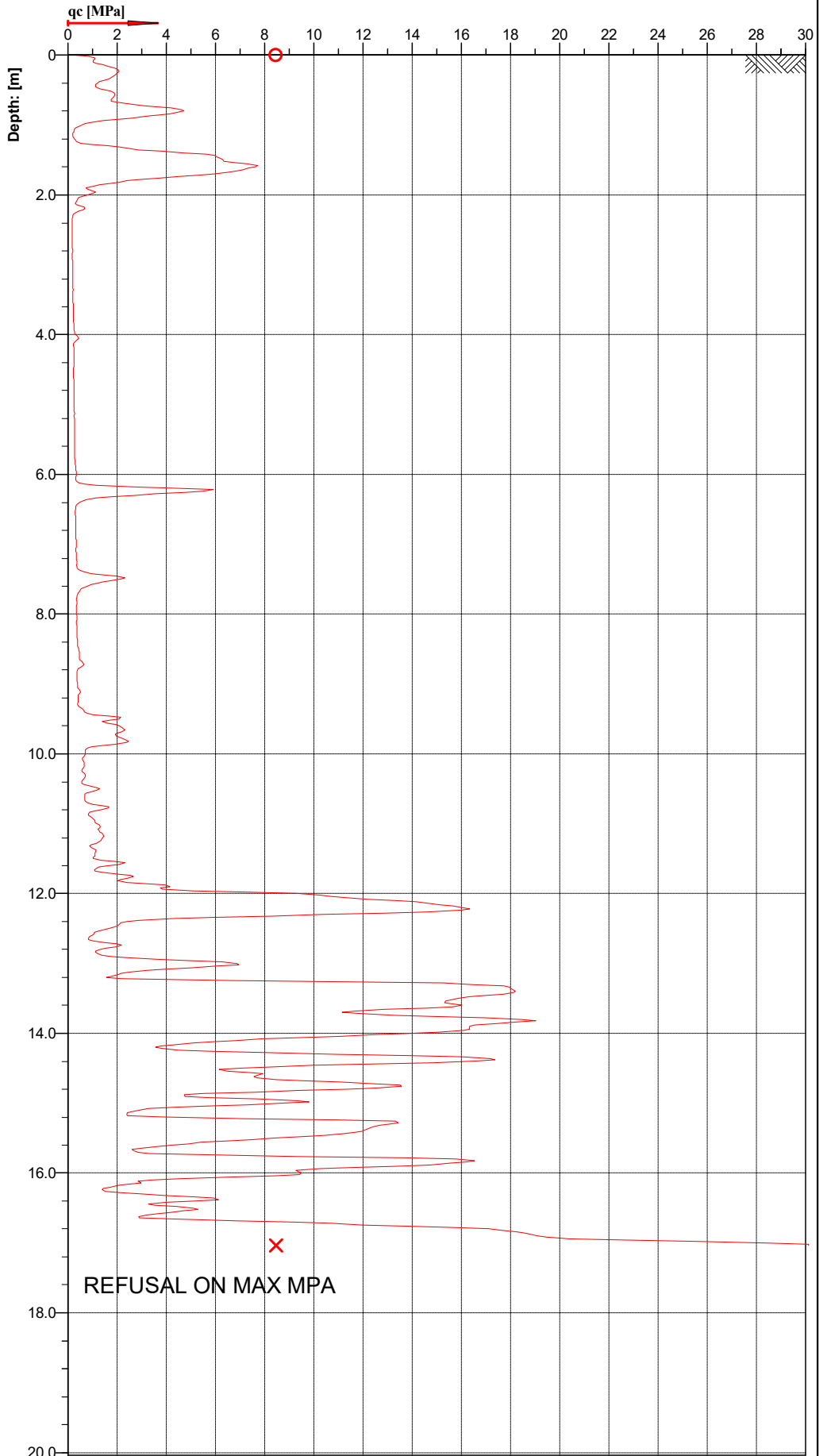
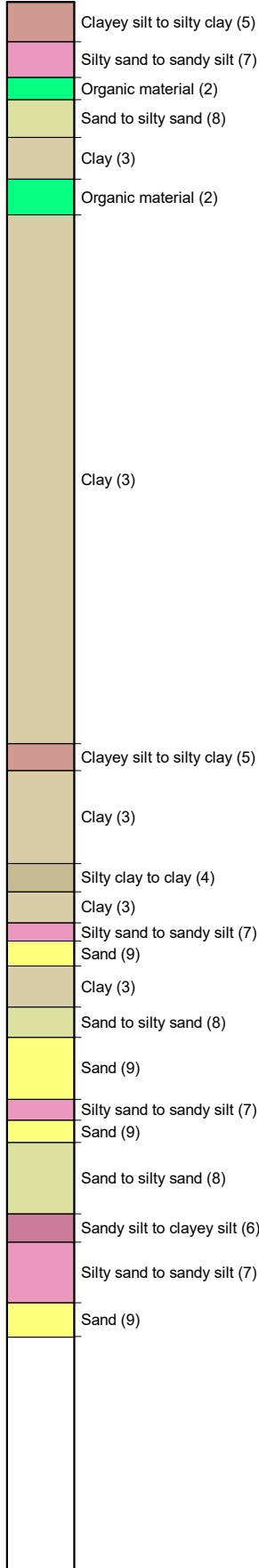


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT19
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	Page: 1/1		Fig.:
S 39.505877 E 176.88675			File: CPT19.cpt

**Classification by
Robertson 1986**

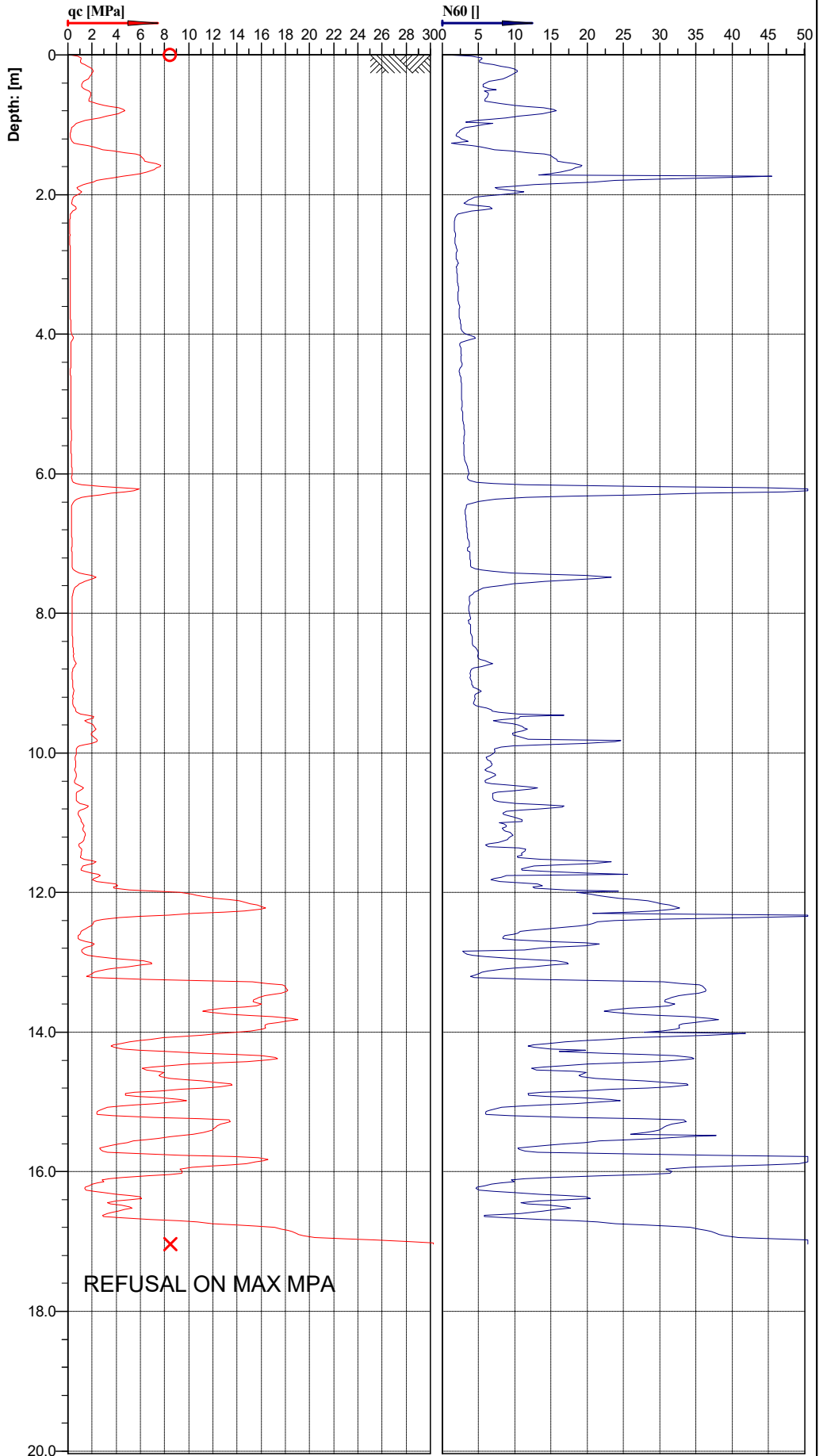
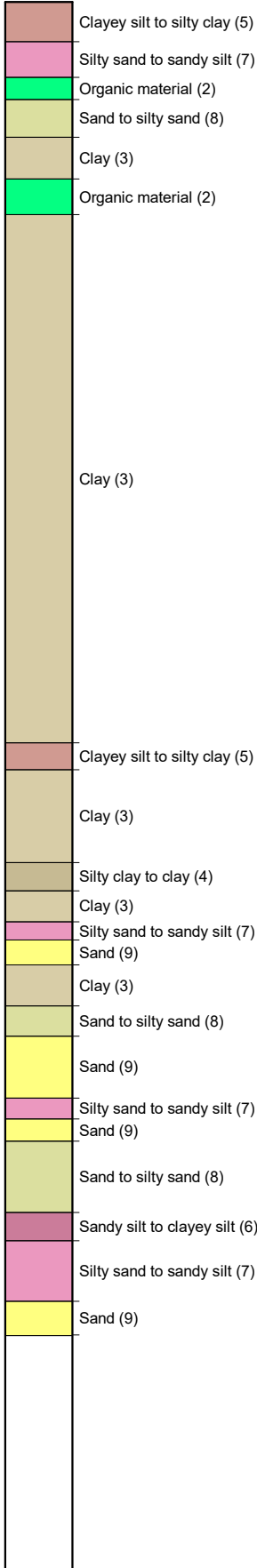


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT19
Project ID:	Client: TONKIN & TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 86
Project: AQUATIC CENTRE	S 39.505877 E 176.88675		Page: 1/1
			File: CPT19.cpt

**Classification by
Robertson 1986**

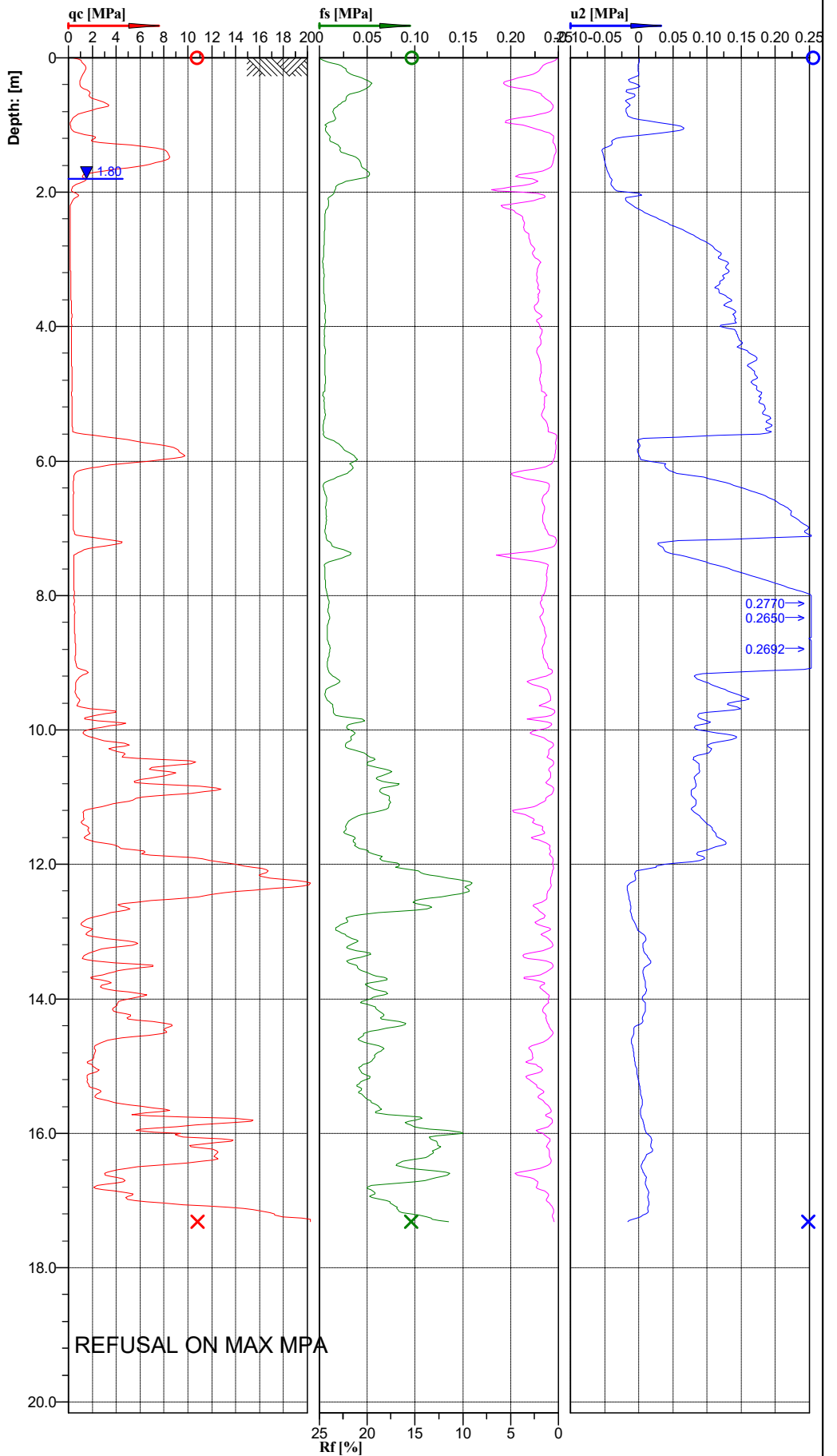
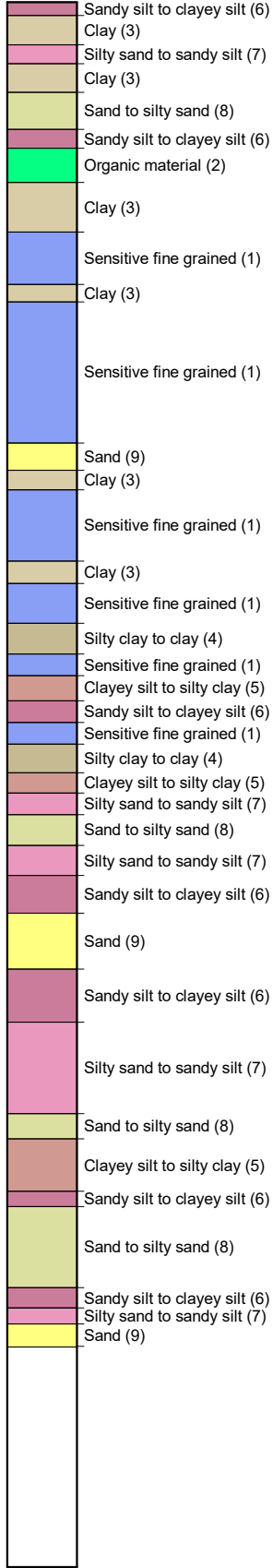


Cone No: 5550
Tip area [cm²]: 10
Sleeve area [cm²]: 150



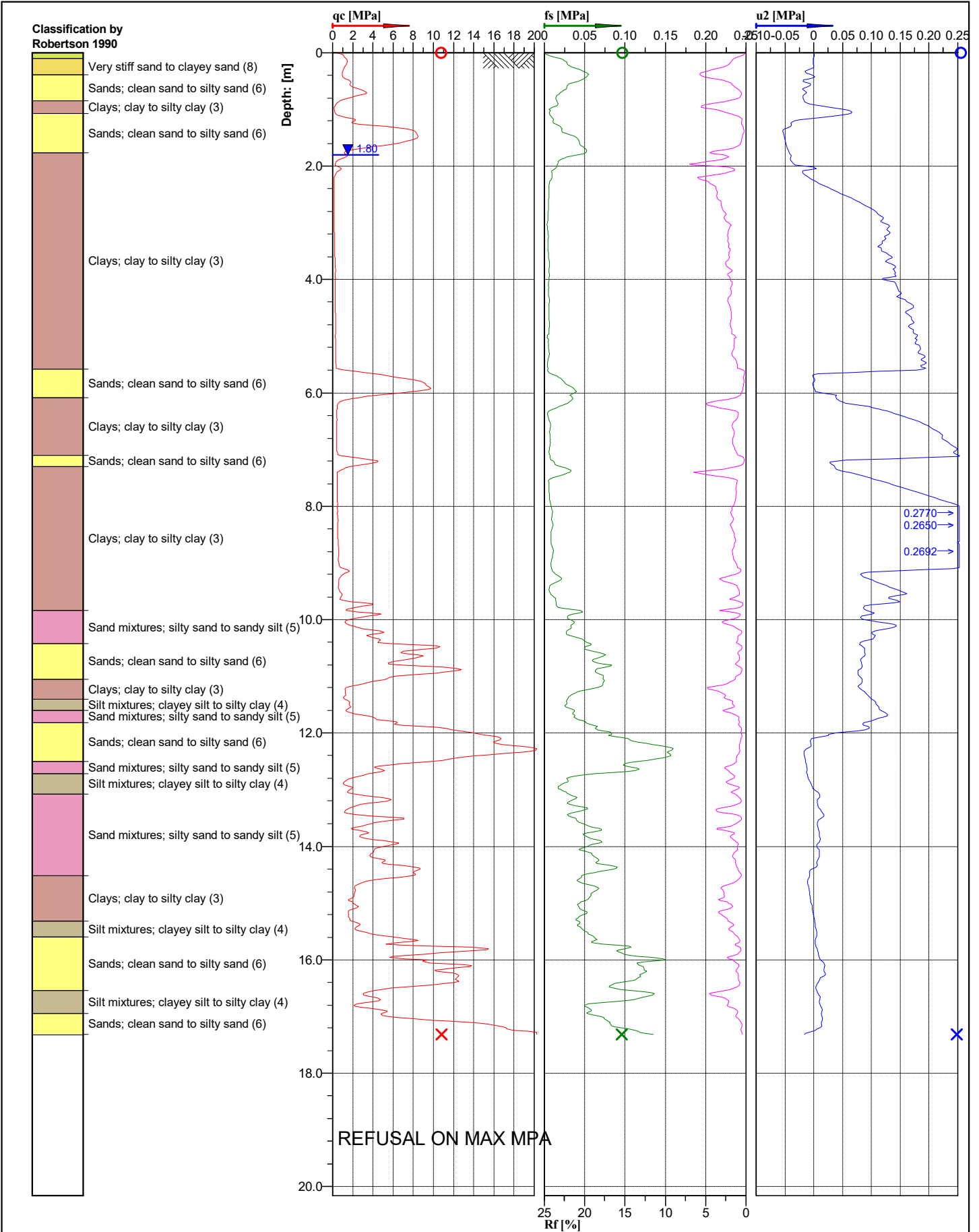
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Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 86
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.505877 E 176.88675				File:	CPT19.cpt		

Classification by Robertson 1986



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

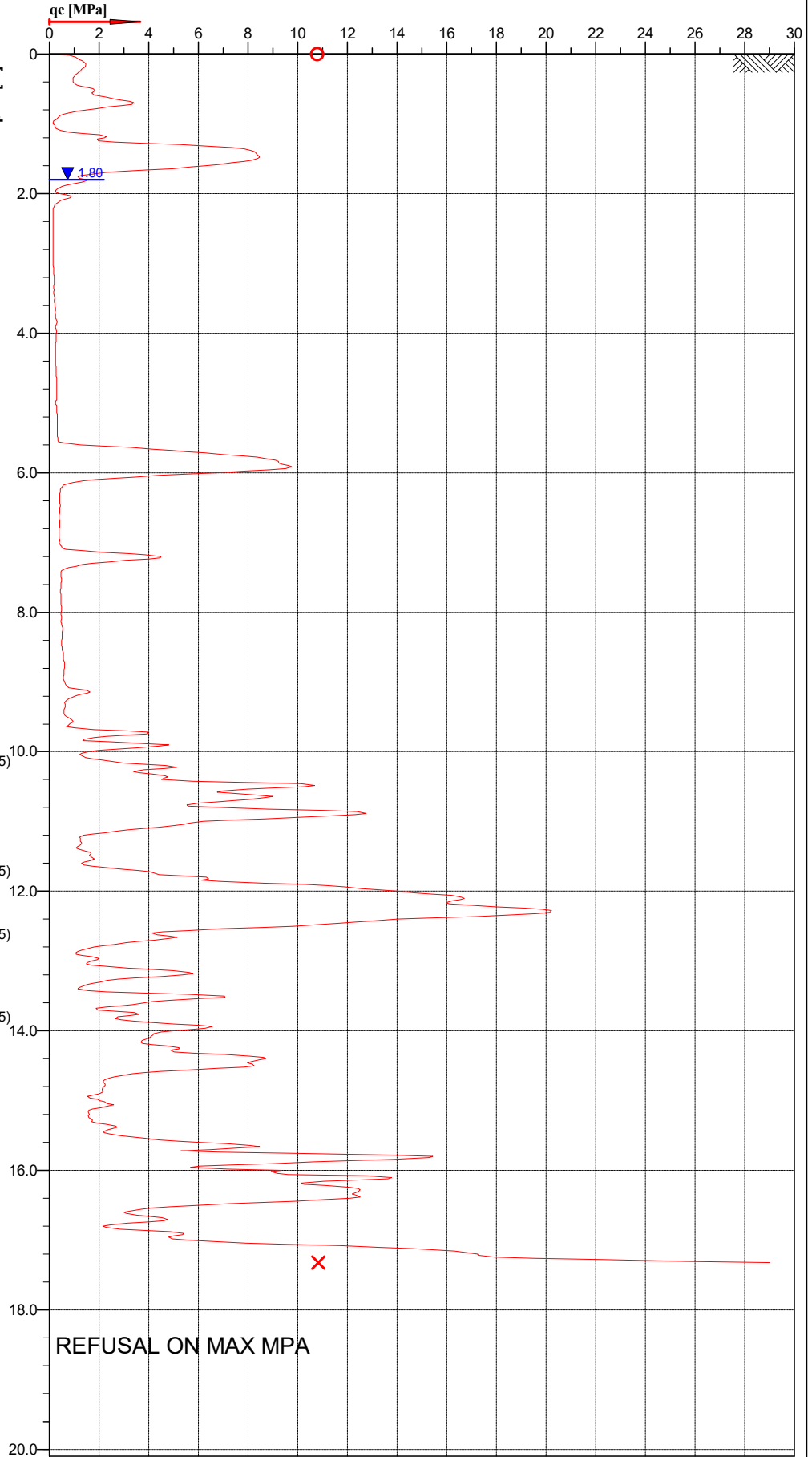
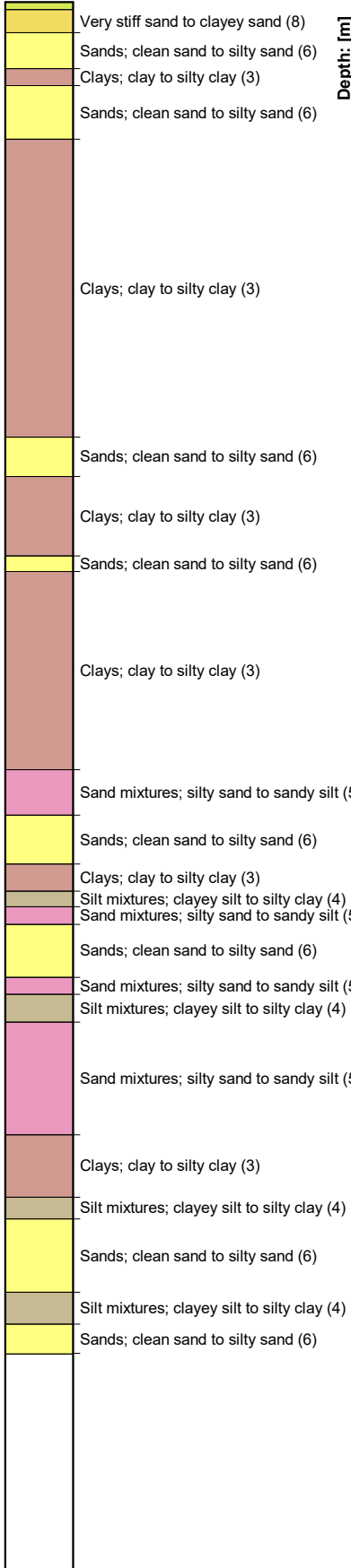
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT20
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50595, E 176.88660		File: CPT20.cpt	



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT20
Project ID:	Client: TONKIN + TAYLOR LTD	Date: 26/11/2020	Scale: 1 : 90
Project: AQUATIC CENTRE		Page: 1/1	Fig.:
S 39.50595, E 176.88660		File: CPT20.cpt	

Classification by Robertson 1990



REFUSAL ON MAX MPA

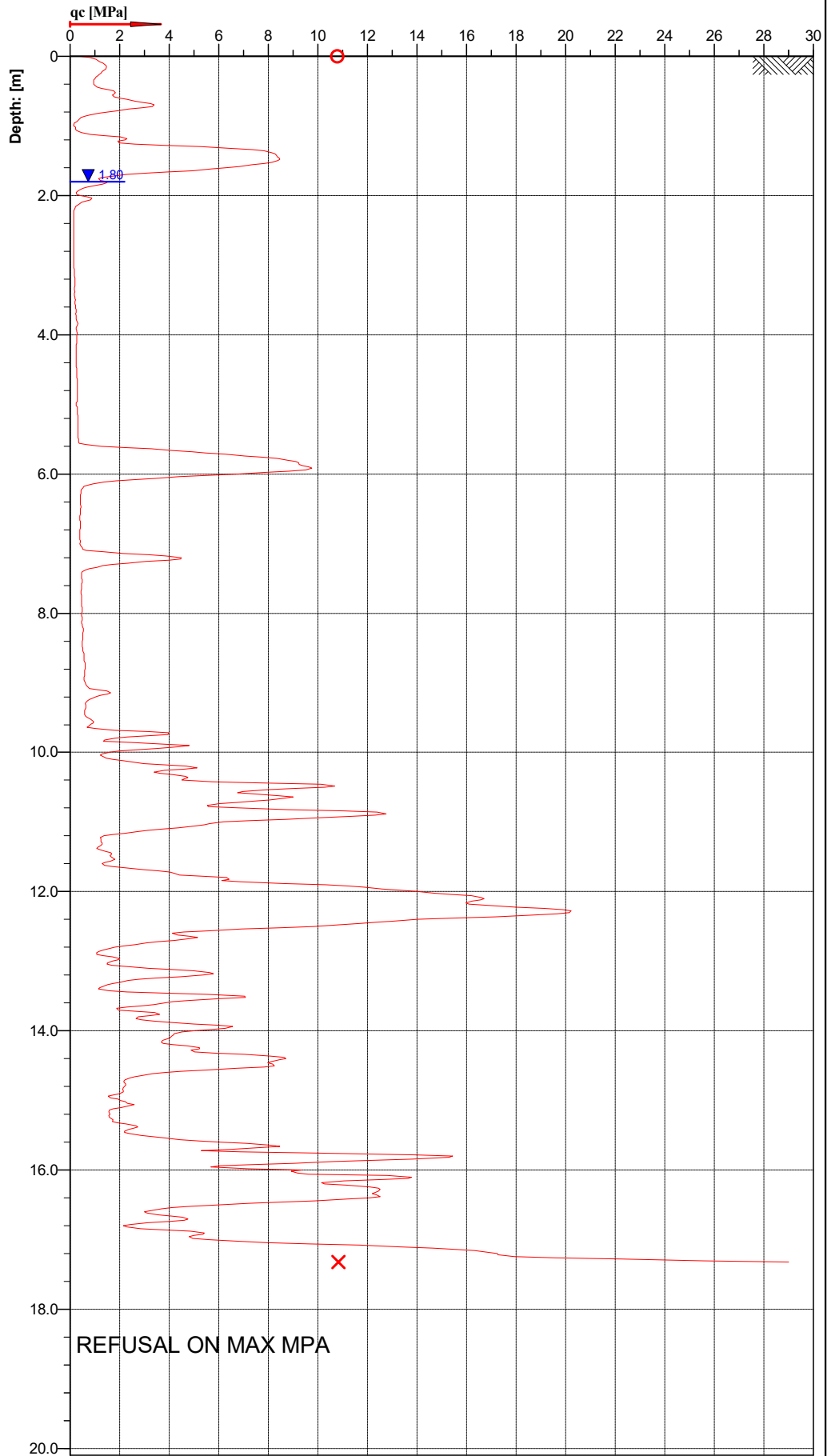
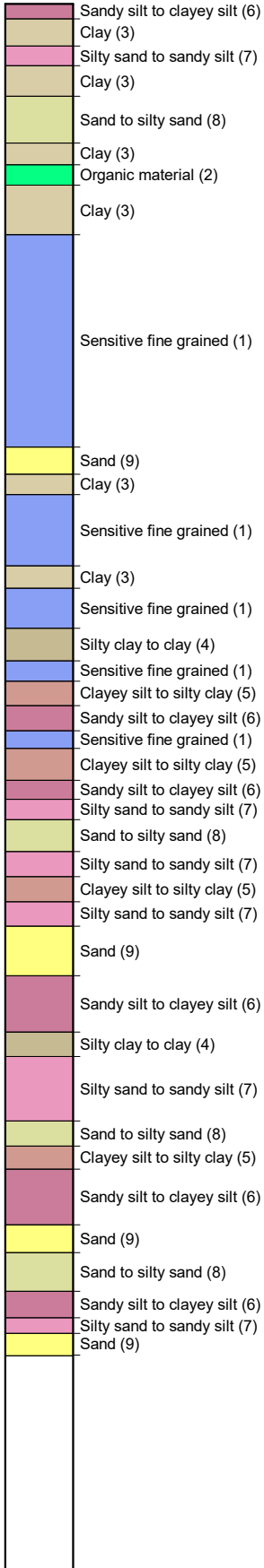


Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT20
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50595, E 176.88660			File:	CPT20.cpt		

Classification by Robertson 1986

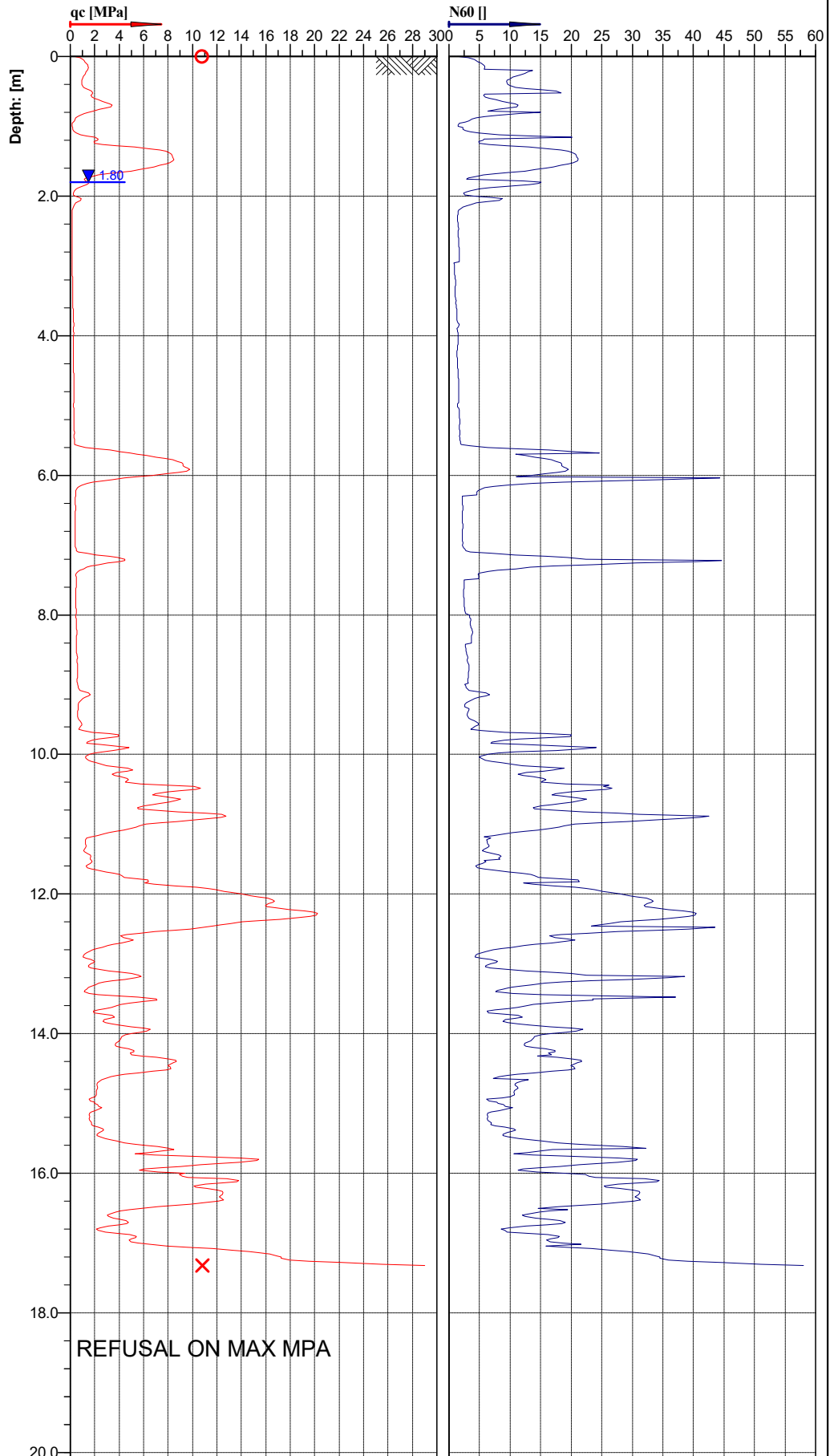
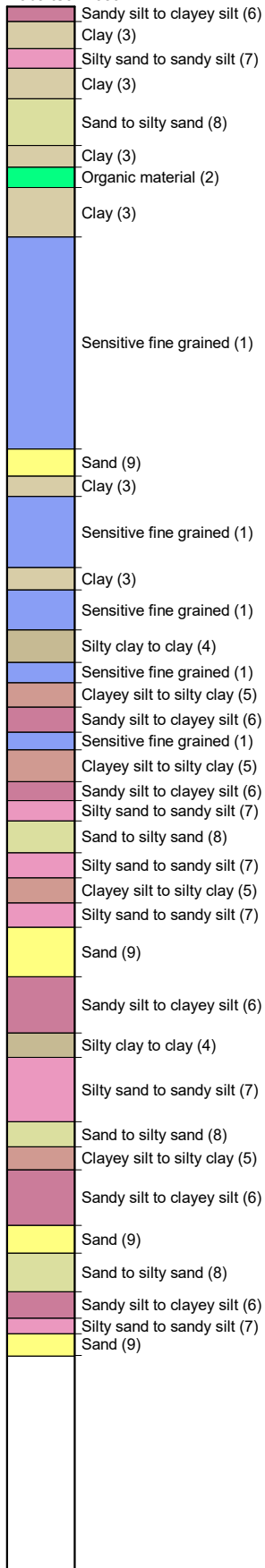


Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT20
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
S 39.50595, E 176.88660				File:	CPT20.cpt		

Classification by Robertson 1986



Cone No: 5447
 Tip area [cm²]: 10
 Sleeve area [cm²]: 150



Location:	NAPIER	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT20
Project ID:		Client:	TONKIN + TAYLOR LTD	Date:	26/11/2020	Scale:	1 : 87
Project:	AQUATIC CENTRE			Page:	1/1	Fig.:	
	S 39.50595, E 176.88660			File:	CPT20.cpt		

EXCAVATION LOG

Excavation Id.: **TP01**

SHEET: 1 OF 1





PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.889614 (WGS84) -39.506536 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			● 71/23 kPa		0.2		SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to coarse. Contains minor shell fragments.	D		F		0.2m: A+M	Top
					0.5		Silty fine SAND, trace gravel; greyish brown. Loosely packed, moist, uniformly graded. Includes fragments of ceramics, brick and shell.	M		L		0.5m: A+M	Fill
				1.1	1.0		Sandy SILT, trace gravel; greyish brown. Firm, moist. Sand; fine. Contains trace brick, ceramics and shell fragments.			F		1.5m: A+M	
				1.8	1.8		1.8m: becomes dark grey. Soft to Firm.					1.9m: A+M	
			● 26/19 kPa ● 23/16 kPa		2.0		1.9m: Target depth						

SKETCH / PHOTO:



COMMENTS:

Hole Depth
1.9m

EXCAVATION LOG

Excavation Id.: **TP02**

SHEET: 1 OF 1


PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.889411 (WGS84) -39.506494 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			<ul style="list-style-type: none"> 89/23 kPa 78/29 kPa 				<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to coarse. Sand; fine. Contains ceramics, glass fragments and shell fragments.</p> <p>Mix of sandy SILT and SAND, some silt; greyish brown, flecked and mottled orange brown. Firm silt, Sand-loosely packed, moist. Sand; fine. Contains shell fragments and trace ceramics.</p> <p>Silty fine SAND; greyish brown, flecked and stained orange brown. Loosely packed, moist uniformly graded. Sand; fine. Contains shell fragments.</p> <p>1.7m: becomes bluish grey.</p>	D	F		0.2m: A+M	Top	
		26/11/2020	<ul style="list-style-type: none"> 26/13 kPa 23/15 kPa 	11	1.0		1.7m: Collapse due to groundwater ingress.	M	L		0.6m: A+M	Fill	
				10	2.0								
				9	3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 1.7m

Scale 1:33

EXCAVATION LOG

Excavation Id.: **TP03**

SHEET: 1 OF 1


PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.889864 (WGS84) -39.506371 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL						
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			<ul style="list-style-type: none"> 31/21 kPa 34/26 kPa 					<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to coarse. Sand; fine.</p> <p>SILT, some sand, trace clay and gravel; greyish brown. Stiff, moist, low plasticity. Sand; fine. Contains trace white flecks and charcoal.</p> <p>SILT, some sand, trace clay; greyish brown. Firm, moist, low plasticity. Sand; fine. Layering/bedding visible.</p> <p>Fine SAND; greyish brown. Loosely packed, moist, uniformly graded.</p> <p>Fine SAND, some silt; bluish grey. Loosely packed, saturated, uniformly graded.</p>	D M L S	F	<p>0.3m: A+M</p> <p>0.6m: A+M</p> <p>2.0m: A+M</p>	Top Soil Fill Holocene Estuarine	
		26/11/2020						2.2m: Collapse					

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2.2m

EXCAVATION LOG

Excavation Id.: **TP04**

SHEET: 1 OF 1

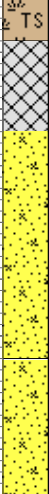
PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88962 (WGS84) -39.50619 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			● 55/16 kPa ● 88/19 kPa				<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to coarse. Sand; fine.</p> <p>SILT, some sand; greyish brown, streaked orange brown. Firm, moist, low plasticity. Contains shell fragments and trace ash/charcoal.</p> <p>Silty fine SAND, trace silt; greyish brown. Loosely packed, wet to saturated, uniformly graded.</p> <p>Silty fine sand, bluish grey, Loosely packed, wet, uniformly graded.</p>	D M W-S		10 25 50 100 200	0.2m: A+M 0.5m: A+M	Top Soil Fill Holocene Estuarine	
		26/11/2020					2.2m: Collapse						

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.2m

EXCAVATION LOG

Excavation Id.: **TP05**

SHEET: 1 OF 1

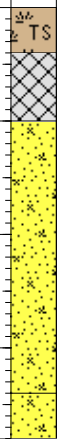
PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88979 (WGS84) -39.50589 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			● 119/23 kPa ● 112/41 kPa				<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to coarse. Sand; fine.</p> <p>SILT, some sand; greyish brown, streaked orange brown. Firm, moist. Contains shell fragments and trace ash/charcoal.</p> <p>Interbedded sandy SILT and SAND, some silt; greyish brown, flecked and mottled orange brown. Loosely packed, moist. Sand; fine. Contains shell fragments.</p> <p>Silty fine sand, bluish grey, Loosely packed, wet, uniformly graded.</p>	D M L	F	10 25 50 100 200	<p>0.2m: Glass jar and asbestos sample</p> <p>0.5m: Glass jar and asbestos sample</p>	Top Soil Fill Holocene Estuarine	
		26/11/2020 Groundwater seepage	● 26/19 kPa ● 19/16 kPa		1.9m		1.9m: END OF BOREHOLE						

SKETCH / PHOTO:



COMMENTS:

Hole Depth
1.9m

EXCAVATION LOG

Excavation Id.: **TP06**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88966 (WGS84) -39.50565 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3			● 65/19 kPa ● 49/16 kPa				Sandy SILT; brown. Firm, dry, non-plastic. Sand; fine. Contains ceramics and brick fragments.	D		F	10 25 50 100 200		Top Soil
					0.5		Mix of sandy SILT and SAND, some silt; brown, flecked and stained orange brown. Loosely packed, moist. Sand; fine. Contains ceramics and brick pieces.	M		L		0.2m: Glass jar and asbestos sample	Fill
					1.0		Silty SAND; bluish grey. Loosely packed, moist, uniformly graded. Sand; fine.					0.5m: Glass jar and asbestos sample	Holocene Estuarine
					1.5		Fine SAND; bluish grey. Loosely packed, wet, uniformly graded.	W				0.9m: Glass jar and asbestos sample	
					2.0		Clayey SILT, light brown. Soft, moist, low to medium plasticity.						
					2.5		Fine SAND; bluish grey. Loosely packed, wet, uniformly graded.						
					2.6		2.6m: Target depth						
					3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2.6m

EXCAVATION LOG

Excavation Id.: **TP07**

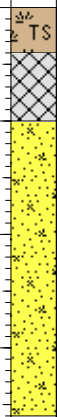
SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88999 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020
 (WGS84) -39.50604 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			● 127/32 kPa ● 32/16 kPa				SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to medium. Sand; fine.	M	F			0.2m: Glass jar and asbestos sample	Top Soil
					0.5		Sandy SILT, trace gravel; brown. Firm, moist. Sand; fine. Gravel, fine to medium.	D				0.4m: Glass jar and asbestos sample	Fill
					1.0		Silty SAND, some silt; grey, mottled brown. Loosely packed, moist, uniformly graded. Sand; fine. Contains shell fragments.	M	L			0.8m: Glass jar and asbestos sample	Holocene Estuarine
				10	2.0		SILT; grey. Very soft to soft, moist, low plasticity. 1.9m: Collapse						
					2.5								
				9	3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS: Groundwater not encountered in this hole.

Hole Depth
1.9m

EXCAVATION LOG

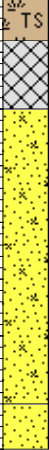
Excavation Id.: **TP08**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.89030 (WGS84) -39.50622 EXPOSURE METHOD: TP EXCAV. STARTED: 26/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 26/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL						
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
			● 119/39 kPa ● 114/32 kPa					<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to medium. Sand; fine.</p> <p>Sandy SILT; grey, mottled brown. Firm, dry. Sand; fine. Contains ash and ceramics.</p> <p>Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded. Sand; fine. Contains shell fragments.</p> <p>Fine SAND; bluish grey. Loosely packed, wet, uniformly graded.</p>	D M L W	F	<p>10</p> <p>25</p> <p>50</p> <p>100</p> <p>200</p>	<p>0.2m: Glass jar and asbestos sample</p> <p>0.4m: Glass jar and asbestos sample</p> <p>0.8m: Glass jar and asbestos sample</p>	Top Fill Estuarine
		26/11/2020			10	2.0		2m: Target depth					

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2m

EXCAVATION LOG

Excavation Id.: **TP09**

SHEET: 1 OF 1


PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88802 (WGS84) -39.50448 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
		27/11/2020	<ul style="list-style-type: none"> 130/32 kPa 114/49 kPa 		0.5		<p>SILT, some sand, trace gravel and rootlets; dark brown. Firm, dry. Gravel, fine to medium. Sand; fine. Contains brick and ash inclusions.</p> <p>SILT, some sand, trace gravel and rootlets; dark brown. Very stiff, dry, low plasticity. Gravel, fine to medium. Sand; fine. Contains brick and ash inclusions.</p> <p>Silty fine SAND; brown. Loosely packed, moist, uniformly graded. Contains brick inclusions.</p>	D	F			0.3m: Glass jar and asbestos sample	Top
					1.0		1.0m: Collapse due to groundwater ingress.	M	VSt			0.6m: Glass jar and asbestos sample	Fill
					1.5								
					2.0								
					2.5								
					3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 1m

Scale 1:33

EXCAVATION LOG

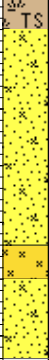
Excavation Id.: **TP10**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88673 (WGS84) -39.50574 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

R.L.: 11.50m OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL						
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
			● 32/16 kPa			11.0		SILT, some rootlets; dark brown. Firm, dry. Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.	D		L	10 25 50 100 200	0.1m: Glass jar and asbestos sample 0.35m: Glass jar and asbestos sample 0.8m: Glass jar and asbestos sample	Top Estuarine
						10.5		SILT; light brown. Soft, moist, low plasticity.			S			
						10.0		Silty fine SAND; grey. Loosely packed, moist, uniformly graded.			L			
						1.60		1.60m: Collapse due to groundwater ingress.						

SKETCH / PHOTO:



COMMENTS:

Hole Depth
1.6m

EXCAVATION LOG

Excavation Id.: **TP11**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88696 (WGS84) -39.50577 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

R.L.: 11.50m OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL							
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
								SILT, some rootlets; dark brown. Firm, dry.	D		F		0.15m: Glass jar and asbestos sample	Top Soil
						11	0.5	Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.	M		L		0.4m: Glass jar and asbestos sample	Holocene Estuarine
						10	1.5	SILT; light brown. Soft, moist, non plastic.			S		0.9m: Glass jar and asbestos sample	
								Silty fine SAND; grey. Loosely packed, moist, poorly graded. 1.7m: END OF INVESTIGATION			L			

SKETCH / PHOTO:



COMMENTS:

Hole Depth
1.7m

EXCAVATION LOG

Excavation Id.: **TP12**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88647 (WGS84) -39.50605 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020

R.L.: 11.50m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
							SILT, some rootlets; dark brown. Firm, dry.	D		F			
					11	0.5	Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.	M		L		0.3m: Glass jar and asbestos sample	Estuarine
					1.0		SILT; light brown, mottled orange. Soft, moist, non plastic.			S		0.6m: Glass jar and asbestos sample	
					1.5		Fine to medium SAND; grey. Loosely packed, moist, uniformly graded.			L		0.9m: Glass jar and asbestos sample	
					10	1.5	1.5m: END OF INVESTIGATION						

SKETCH / PHOTO:



COMMENTS:

Hole Depth 1.5m

EXCAVATION LOG

Excavation Id.: **TP13**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88659 (WGS84) -39.50613 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

R.L.: 11.50m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3							SILT, some rootlets; dark brown. Firm, dry.	D		F	10-20	0.15m: Glass jar and asbestos sample	Top Soil
					11		Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded. Contains fragments of brick and ceramics.	M		L	25-60	0.6m: Glass jar and asbestos sample	Fill
			● 19/13 kPa ● 18/13 kPa		1.0		SILT; light brown, mottled orange. Soft, moist, non plastic.			S	60-200	0.9m: Glass jar and asbestos sample	Holocene Estuarine
					10		Fine to medium SAND; grey. Loosely packed, wet, uniformly graded.	W		L			
					2.0		1.60m: Collapse due to groundwater ingress.						
					2.5								
					3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 1.6m

Scale 1:33

EXCAVATION LOG

Excavation Id.: **TP14**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.886709989225 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020
 (WGS84) -39.5059400273149 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

R.L.: 11.50m OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL							
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3												10 25 50 100 200		
		27/11/2020				11	0.5	SILT, some rootlets; dark brown. Firm, dry.	D		F		0.1m: Glass jar and asbestos sample	TSoil
								Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.	M		L		0.4m: Glass jar and asbestos sample	Estuarine
						10	1.0	SILT; light brown, mottled orange. Soft to firm, moist, non plastic.			S-F		0.9m: Glass jar and asbestos sample	
						10	1.5	Fine to medium SAND; grey. Loosely packed, moist, uniformly graded.			L			
								1.60m: Collapse due to groundwater ingress.						
						9	2.5							
						8	3.5							

SKETCH / PHOTO:







COMMENTS:

Hole Depth
1.6m

Scale 1:33

PROJECT: Napier Aquatic Centre	LOCATION: Maadi Road, Onekawa	JOB No.: 1009171.0000
CO-ORDINATES: 176.88755 (WGS84) -39.50698	EXPOSURE METHOD: TP EQUIPMENT: 12T Excavator	EXCAV. STARTED: 27/11/2020 EXCAV. FINISHED: 27/11/2020
R.L.: 12.50m	OPERATOR: Burkett Earthmovers	LOGGED BY: ZAFR
DATUM: NAPIHT1962	DIMENSIONS: 3m by 2m	CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL								
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT	
															10
						0.5		SILT, trace rootlets; dark brown. Firm, dry. Silty fine SAND; brown. Tightly packed, dry, uniformly graded. Contains broken ceramics, gravel and pieces of rubble.	D		F		0.15m: Glass jar and asbestos sample 0.5m: Glass jar and asbestos sample 1.0m: Glass jar and asbestos sample	Top Soil Fill	
						1.5		Buried TOPSOIL layer; brown. Firm to stiff, moist, non-plastic.	M		L			Top Soil	
						2.0		Silty fine SAND; grey, mottled brown. Loosely packed, moist, uniformly graded.							
						3.0		Fine SAND; grey. Loosely packed, wet, uniformly graded.							
						3.5		3.3m: END OF INVESTIGATION							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 3.3m

Scale 1:33

EXCAVATION LOG




Excavation Id.: **TP16**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88748 (WGS84) -39.50680 EXPOSURE METHOD: TP EXCAV. STARTED: 27/11/2020
 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 27/11/2020

R.L.: 12.50m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR
 DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL						
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
			<ul style="list-style-type: none"> ● 187/49 kPa ● 162/52 kPa 		12	0.5		SILT, trace rootlets; dark brown. Firm, dry.	D	F			0.1m: Glass jar and asbestos sample	Top
		27/11/2020 	<ul style="list-style-type: none"> ● 130/45 kPa ● 166/45 kPa 		11	1.0		Sandy SILT; brown, mottled grey. Very stiff, moist, non plastic. Sand; fine. Contains charcoal fragments, brick, glass, ceramics, metal and ash. 1.4m: Becomes entirely rusted metal fragments, ash and rubble.	M	Vst			0.3m: Glass jar and asbestos sample 0.6m: Glass jar and asbestos sample 0.8m: Glass jar and asbestos sample	Fill
					11	1.5		1.5m: Test pit terminated due to significant groundwater ingress.					1.5m: Glass jar and asbestos sample	

SKETCH / PHOTO:



COMMENTS: Groundwater rapidly ran into the hole at 1.3 m. Lots of gas bubbles coming through the groundwater. Backfilled test pit and covered with a truck load of top soil. Significant portions of fill in this test pit.

Hole Depth
1.5m

EXCAVATION LOG

Excavation Id.: **TP17**

SHEET: 1 OF 1

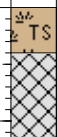

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88821 (WGS84) -39.50714 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020

R.L.: 12.00m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS			ENGINEERING DESCRIPTION				GEOLOGICAL							
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3												10 25 50 100 200		
			<ul style="list-style-type: none"> 62/24 kPa 65/19 kPa 			0.5		<p>SILT, trace sand and rootlets; dark brown. Firm, dry. Sand; fine.</p> <p>Sandy SILT; brown. Stiff, dry, non plastic. Sand; fine. Contains metal fragments, ceramics, ash, and brick.</p>	D		St		0.1m: Glass jar and asbestos sample	Fill
		30/11/2020 	<ul style="list-style-type: none"> 138/49 kPa 122/32 kPa >227 kPa 		11	1.0		<p>0.8m: Becomes hard.</p> <p>1.1m: Becomes very stiff.</p>		H	VSt	0.4m: Glass jar and asbestos sample		
						1.5		<p>1.4m: Contains glass bottles, ash, bitumen, rubble.</p> <p>1.4m: Test pit terminated due to significant groundwater ingress.</p>				0.9m: Glass jar and asbestos sample		
						2.0								
						2.5								
					9	3.0								
						3.5								

SKETCH / PHOTO:



COMMENTS: Groundwater rapidly ran into the hole at 1.2 m. Some gas bubbles coming through the groundwater. Smells like chlorine - suspected chlorine leak from the pools nearby. Significant portions of fill in this test pit.

Hole Depth 1.4m

EXCAVATION LOG

Excavation Id.: **TP18**




SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88775 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020
 (WGS84) -39.50733 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			<ul style="list-style-type: none"> ● 110/24 kPa ● 114/32 kPa 		0.5		SILT, trace rootlets; dark brown. Firm, dry.	D		F		0.2m: Glass jar and asbestos sample	Top Soil
			<ul style="list-style-type: none"> ● 49/16 kPa ● 45/19 kPa 		1.0		Sandy SILT; grey, mottled brown. Firm, moist, non plastic. Sand; fine.	M				0.6m: Glass jar and asbestos sample	Holocene Estuarine
			<ul style="list-style-type: none"> ● 65/24 kPa 		1.5		Fine SAND; grey. Loosely packed, moist, uniformly graded.			L			
		30/11/2020			2.0		Collapse due to groundwater ingress.					2.0m: Glass jar and asbestos sample	
					2.5								
				9	3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2m

Scale 1:33

EXCAVATION LOG

Excavation Id.: **TP19**

SHEET: 1 OF 1

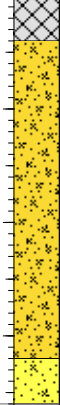

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88836 (WGS84) -39.50742 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020

R.L.: 11.75m EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

DATUM: NAPIHT1962 OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			<ul style="list-style-type: none"> ● 143/49 kPa ● 140/45 kPa ● 162/49 kPa ● 154/41 kPa 				SILT, trace rootlets; dark brown. Firm, dry. Contains ceramics.	D	F			0.1m: Glass jar and asbestos sample	Fill
			<ul style="list-style-type: none"> ● 68/41 kPa ● 73/23 kPa ● 65/19 kPa 		0.5 1.1 1.5		Sandy SILT; grey, mottled brown. Very stiff, moist. Sand; fine.	M				0.7m: Glass jar and asbestos sample	Estuarine
		30/11/2020			1.0 1.5 1.8		Silty fine SAND; bluish grey. Loosely packed, moist, uniformly graded.			L		1.6m: Glass jar and asbestos sample	
					2.0 2.5 3.0 3.5		1.8m: END OF INVESTIGATION						

SKETCH / PHOTO:



COMMENTS:

Hole Depth 1.8m

Scale 1:33

EXCAVATION LOG

Excavation Id.: **TP20**

SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.8878 (WGS84) -39.50681 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020
EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR
DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
			<ul style="list-style-type: none"> ● 65/49 kPa ● 65/16 kPa 				SILT, some gravel, trace rootlets; dark brown. Firm, dry. Gravel; fine to medium.	D	F		10-20	0.15m: Glass jar and asbestos sample	Fill
			<ul style="list-style-type: none"> ● 73/24 kPa ● 49/16 kPa 		0.5		Sandy SILT; brownish yellow. Stiff, moist, non plastic. Sand; fine.	M	St		25-60	0.55m: Glass jar and asbestos sample	
		30/11/2020			1.0		Sandy SILT; brownish grey. Stiff, moist. Sand; fine.					0.85m: Glass jar and asbestos sample	Holocene Estuarine
					2.0		Fine to medium SAND; light grey. Loosely packed, wet, uniformly graded.	W	L		60-200	2.0m: Glass jar and asbestos sample	
					3.0		2.6m: Collapse due to groundwater ingress.						

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2.6m

EXCAVATION LOG

Excavation Id.: **TP21**



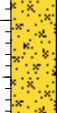
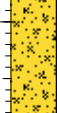
SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88798 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020
 (WGS84) -39.50672 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZA FR

DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL					
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
			<ul style="list-style-type: none"> ● 185/39 kPa ● 117/23 kPa ● >227 kPa ● >227 kPa 		0.5		SILT, trace rootlets; dark brown. Firm, dry. Contains broken ceramics and glass.	D		F		0.1m: Glass jar and asbestos sample	Top Soil
					1.0		Sandy SILT; grey, mottled brown. Hard, moist, low plasticity. Sand, fine. Contains brick, ash and ceramics.	M		H			0.7m: Glass jar and asbestos sample
			<ul style="list-style-type: none"> ● 203/49 kPa ● 114/32 kPa 		1.5		Sandy SILT; brownish grey. Very stiff to hard, moist, low plasticity. Sand; fine. Contains shell fragments.			VSH		1.3m: Glass jar and asbestos sample	
			<ul style="list-style-type: none"> ● 73/24 kPa ● 49/16 kPa 		2.0		Fine to medium SAND; light grey. Loosely packed, moist, uniformly graded.			L			
					2.5		2.2m: Collapse due to groundwater ingress.						
					3.0								
					3.5								

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2.2m

EXCAVATION LOG

Excavation Id.: **TP22**

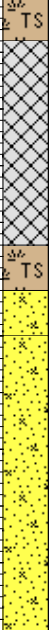
SHEET: 1 OF 1

PROJECT: Napier Aquatic Centre LOCATION: Maadi Road, Onekawa JOB No.: 1009171.0000

CO-ORDINATES: 176.88766 EXPOSURE METHOD: TP EXCAV. STARTED: 30/11/2020
 (WGS84) -39.50691 EQUIPMENT: 12T Excavator EXCAV. FINISHED: 30/11/2020

R.L.: 12.00m OPERATOR: Burkett Earthmovers LOGGED BY: ZAFR

DATUM: NAPIHT1962 DIMENSIONS: 3m by 2m CHECKED BY: JWY

EXCAVATION TESTS				ENGINEERING DESCRIPTION				GEOLOGICAL						
PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
									D	F			0.2m: Glass jar and asbestos sample	Top Soil
					11	1.0			M				0.9m: Glass jar and asbestos sample	Fill
													1.8m: Glass jar and asbestos sample	Top Soil
					10	2.0					L			Holocene Estuarine
					9	3.0		2.8m: Collapse due to groundwater ingress.						

SKETCH / PHOTO:



COMMENTS:

Hole Depth
2.8m

Appendix C: Laboratory Test Results

- Laboratory Testing Results



Our Ref: 1100700.0000/Rep 1
Customer Ref: 1009171
28 January 2021

Tonkin + Taylor
PO Box 5271
Victoria Street West
Auckland 1142

Attention: Zach Frame

Dear Zach

Onekawa Pools/Maadi Road - Napier Aquatic Centre
Laboratory Test Report

Samples from the above mentioned site have been tested as received according to your instructions and the results are included in this report. Results apply only to the samples tested.

Descriptions are enclosed for your information, but are not covered under the IANZ endorsement of this report.

This report has been prepared for the benefit of Tonkin + Taylor, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

This report may be reproduced only in full.

Samples not destroyed during testing will be retained for one month from the date of this report before being discarded. If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report prepared by:

Authorised for Geotechnics by:

.....
Sim Tirunahari
Soils Laboratory Manager
Approved Signatory

.....
Steven Anderson
Project Director



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Report checked by:

.....
James Kimiangatau
Laboratory Technician

28-Jan-21

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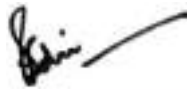
Auckland
 1 Hill Street
 Onehunga
 Auckland 1061
 New Zealand

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Report No: ASM:W21AK-0007
Issue No: 1

Material Test Report

Customer: Tonkin & Taylor Limited
Address: Level 2, 105 Carlton Gore Rd
 Newmarket Auckland 1023
Project: Onekawa Pools/Maadi Road - Napier Aquatic Centre
Project No.: 1100700.0000
Customer Reference No.: 1009171
Report Authorised By : Sim Tirunahari


 Approved By:
 Sim Tirunahari
 (Soils Laboratory Manager)
 Date of Issue: 28/01/2021
Please reproduce this report in full when transmitting to others or including in internal reports.

Material Details

Product:
Sampled From:
Specification:

Sample Details

Sampled By:
 'Sampling Endorsed:'
 Sample ID: S21AK000028 S21AK000029 S21AK000030 S21AK000031 S21AK000032 S21AK000033
 Client Sample ID: BH01_3.0m BH03_3.35m-3.50m BH03_9.0m BH05_9.0m BH06_3.0m BH07_9.0m
 Field Sample ID:
 Date Sampled:
 Date Tested: 19/01/2021 19/01/2021 19/01/2021 19/01/2021 19/01/2021 19/01/2021
 Tested By: James Kimiangatau James Kimiangatau James Kimiangatau James Kimiangatau James Kimiangatau James Kimiangatau

Other Test Results

Description	Method	Results					
Moisture Content (%)	NZS 4402:1986 Test 2.1	40.0	61.3	28.5	29.1	46.1	27.1

Comments

N/A

If samples have been taken, and were not destroyed during testing, they will be retained for one month from the date of this report before being discarded.



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000028		
	Reference	BH01	Top Depth	3.0m
	Sampled By		Bottom Depth	
	Description	SILT mixed with trace to minor clay and some sand, trace of shell fragments, soft, light greenish grey, medium plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	44
Plastic Limit	24
Plasticity Index	20

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000029		
	Reference	BH03	Top Depth	3.35m
	Sampled By		Bottom Depth	3.50m
	Description	SILT mixed with minor clay and trace of sand, soft to firm, light greenish grey, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	61
Plastic Limit	28
Plasticity Index	33

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. •Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000030		
	Reference	BH03	Top Depth	9.0m
	Sampled By	Bottom Depth		
	Description	SAND mixed with minor silt and trace of clay, trace of shell fragments, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	Not Obtainable
Plastic Limit	Not Obtainable
Plasticity Index	Not Obtainable

TEST REMARKS

• The material was unsuitable for testing both the Liquid Limit and the Plastic Limit. • Both the final and Plastic Limit results were unobtainable during the course of testing. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000031		
	Reference	BH05	Top Depth	9.0m
	Sampled By		Bottom Depth	
	Description	SAND mixed with minor silt and trace of clay, trace of shell fragments, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	Not Obtainable
Plastic Limit	Not Obtainable
Plasticity Index	Not Obtainable

TEST REMARKS

• The material was unsuitable for testing both the Liquid Limit and the Plastic Limit. • Both the final and Plastic Limit results were unobtainable during the course of testing. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000032		
	Reference	BH06	Top Depth	3.0m
	Sampled By		Bottom Depth	
	Description	SILT mixed with minor clay, trace of sand, soft, light greenish grey, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	55
Plastic Limit	24
Plasticity Index	31

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. •Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000033		
	Reference	BH07	Top Depth	9.0m
	Sampled By	Bottom Depth		
	Description	silty SAND mixed with trace of clay, trace of shell fragments, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	31
Plastic Limit	Not Obtainable
Plasticity Index	Non-Plastic

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The final Plastic Limit result was unobtainable during the course of testing. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • Date tested 19/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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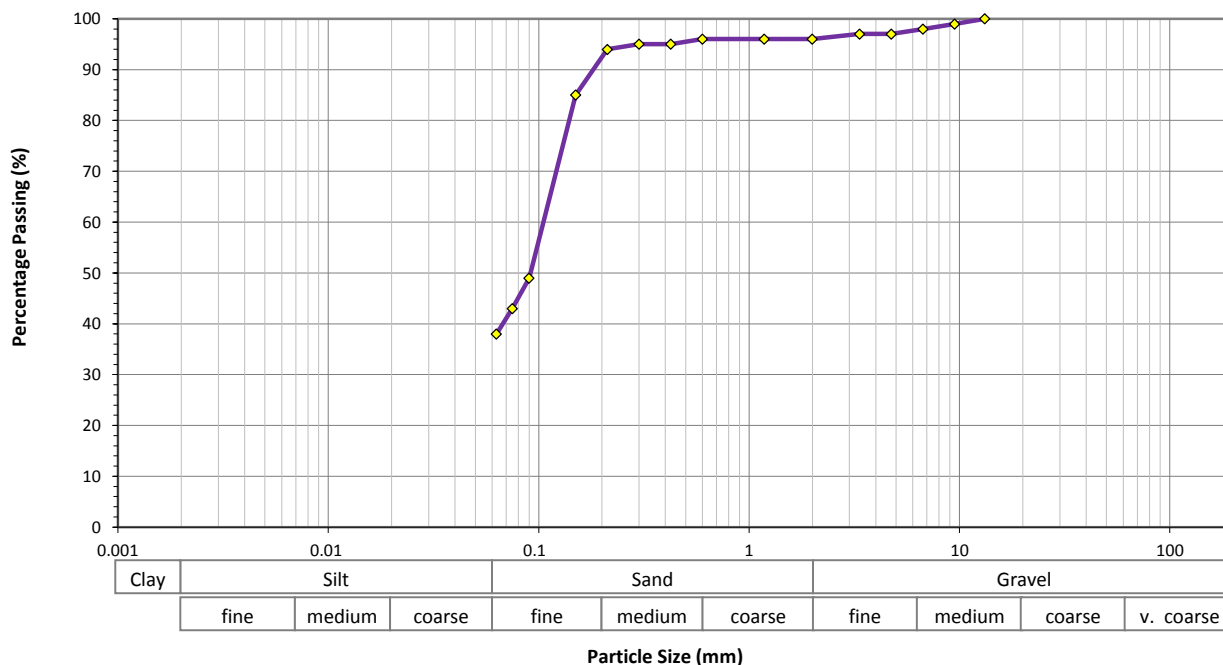
Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000023		
	Reference	BH02	Top Depth	1.5m
	Sampled By		Bottom Depth	
	Description	silty SAND mixed with trace of clay and trace of shell fragments, soft, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	97	0.300	95
100	-	19.0	-	3.35	97	0.212	94
75.0	-	16.0	-	2.00	96	0.150	85
63.0	-	13.2	100	1.18	96	0.090	49
53.0	-	9.50	99	0.600	96	0.075	43
37.5	-	6.70	98	0.425	95	0.063	38

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 13/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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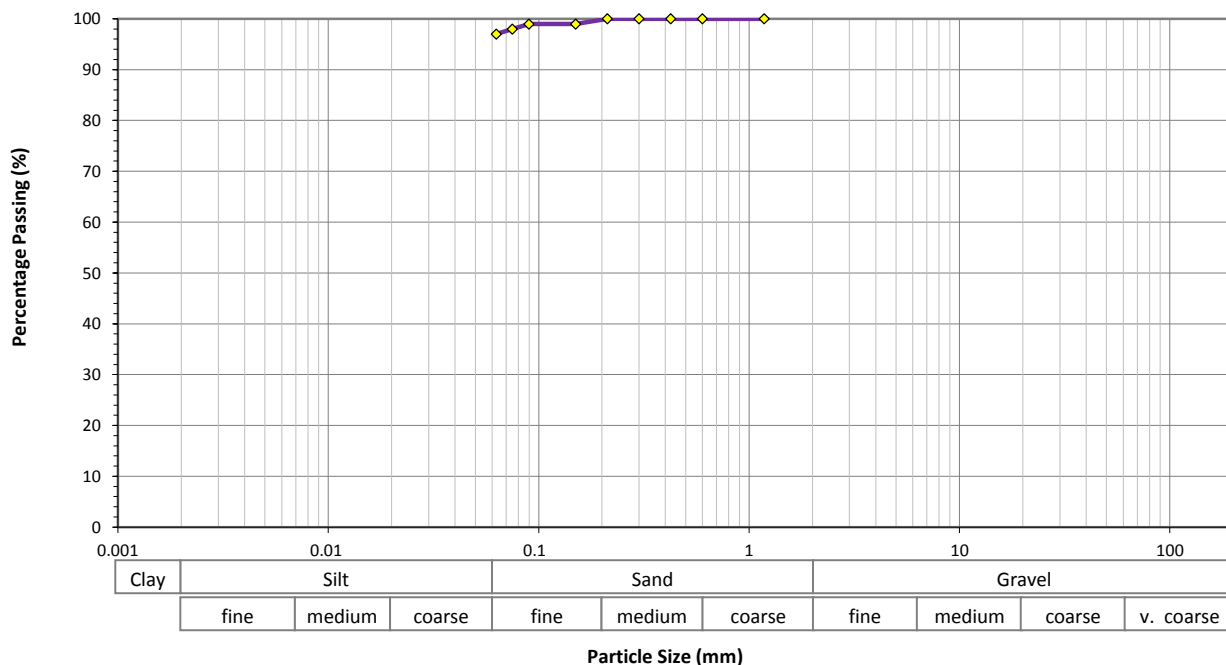
Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000024		
	Reference	BH02	Top Depth	9.0m
	Sampled By		Bottom Depth	
	Description	SILT mixed with minor to some clay and trace of sand, soft, light greenish grey, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	100
75.0	-	16.0	-	2.00	-	0.150	99
63.0	-	13.2	-	1.18	100	0.090	99
53.0	-	9.50	-	0.600	100	0.075	98
37.5	-	6.70	-	0.425	100	0.063	97

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 13/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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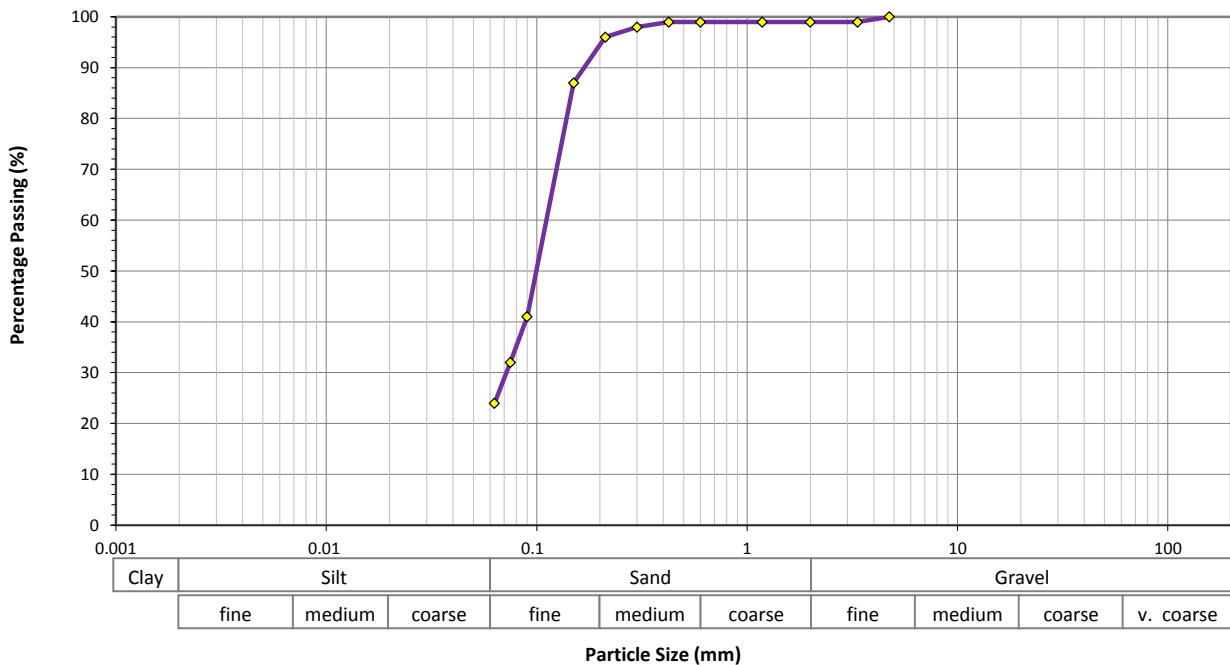
Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000025		
	Reference	BH03	Top Depth	6.0m
	Sampled By		Bottom Depth	
	Description	silty SAND mixed with trace of clay and trace of shell fragments, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	100	0.300	98
100	-	19.0	-	3.35	99	0.212	96
75.0	-	16.0	-	2.00	99	0.150	87
63.0	-	13.2	-	1.18	99	0.090	41
53.0	-	9.50	-	0.600	99	0.075	32
37.5	-	6.70	-	0.425	99	0.063	24

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 13/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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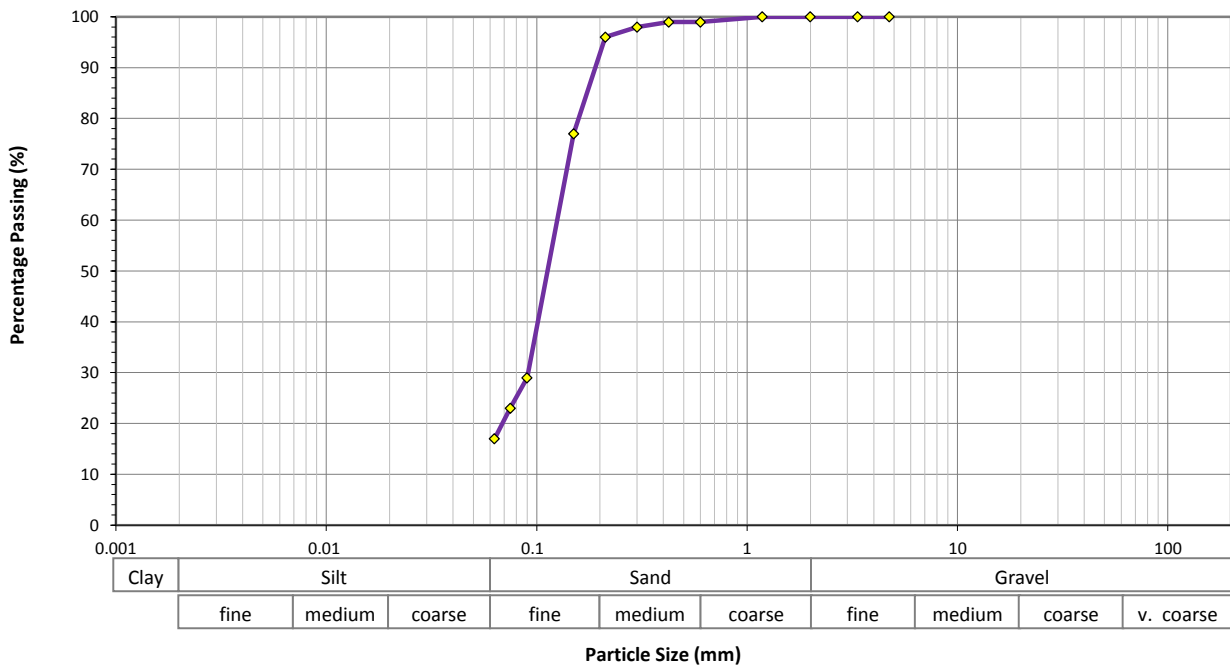
Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000026		
	Reference	BH06	Top Depth	1.5m
	Sampled By	Bottom Depth		
	Description	SAND mixed with some silt and trace of clay and trace of shell fragments, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	100	0.300	98
100	-	19.0	-	3.35	100	0.212	96
75.0	-	16.0	-	2.00	100	0.150	77
63.0	-	13.2	-	1.18	100	0.090	29
53.0	-	9.50	-	0.600	99	0.075	23
37.5	-	6.70	-	0.425	99	0.063	17

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 13/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



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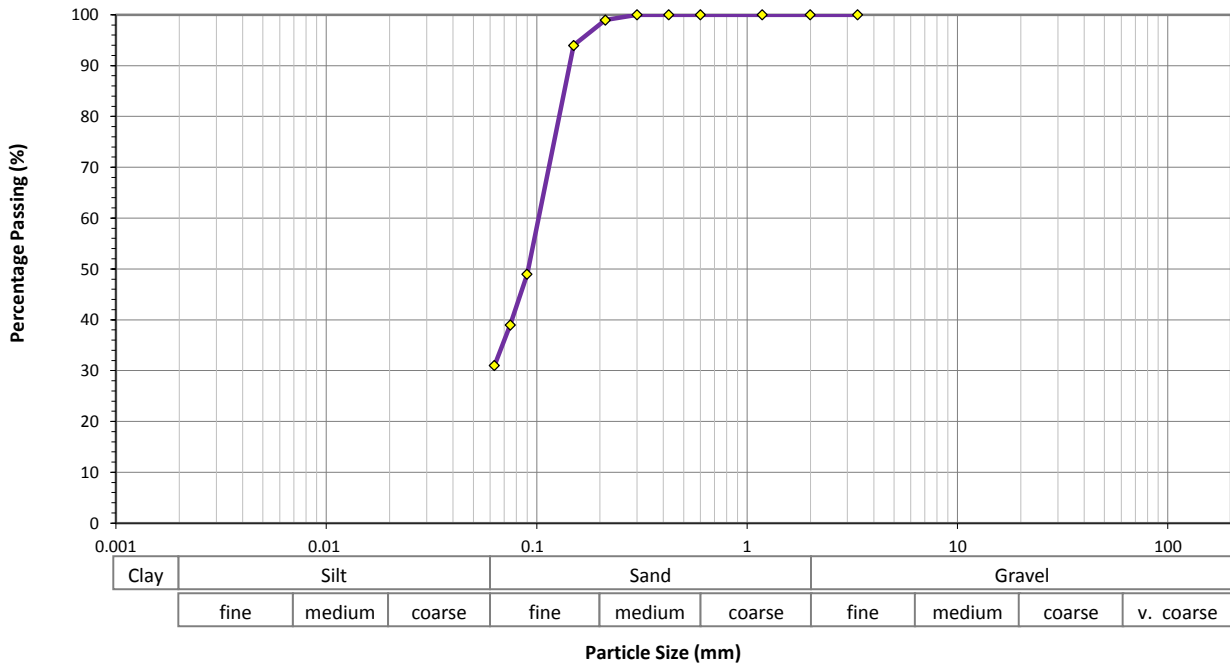
Geotechnics Project Number 1100700.0000
QESTLab Work Order ID W21AK-0007
Customer Project ID 1009171

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Onekawa Pools/Maadi Road - Napier Aquatic Centre		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000027		
	Reference	BH06	Top Depth	6.0m
	Sampled By		Bottom Depth	
	Description	silty SAND mixed with trace of clay and trace of shell fragments, soft, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	100	0.212	99
75.0	-	16.0	-	2.00	100	0.150	94
63.0	-	13.2	-	1.18	100	0.090	49
53.0	-	9.50	-	0.600	100	0.075	39
37.5	-	6.70	-	0.425	100	0.063	31

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 13/01/2021

Approved Signatory Sim Tirunahari
Date 28/01/2021



1 Hill Street, Onehunga, Auckland 1061

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GEOTECHNICS www.geotechnics.co.nz



Site: **Onekawa Pools/Maadi Road - Napier Aquatic Centre**

Your Job No.: **1009171**

BH No.: **1**

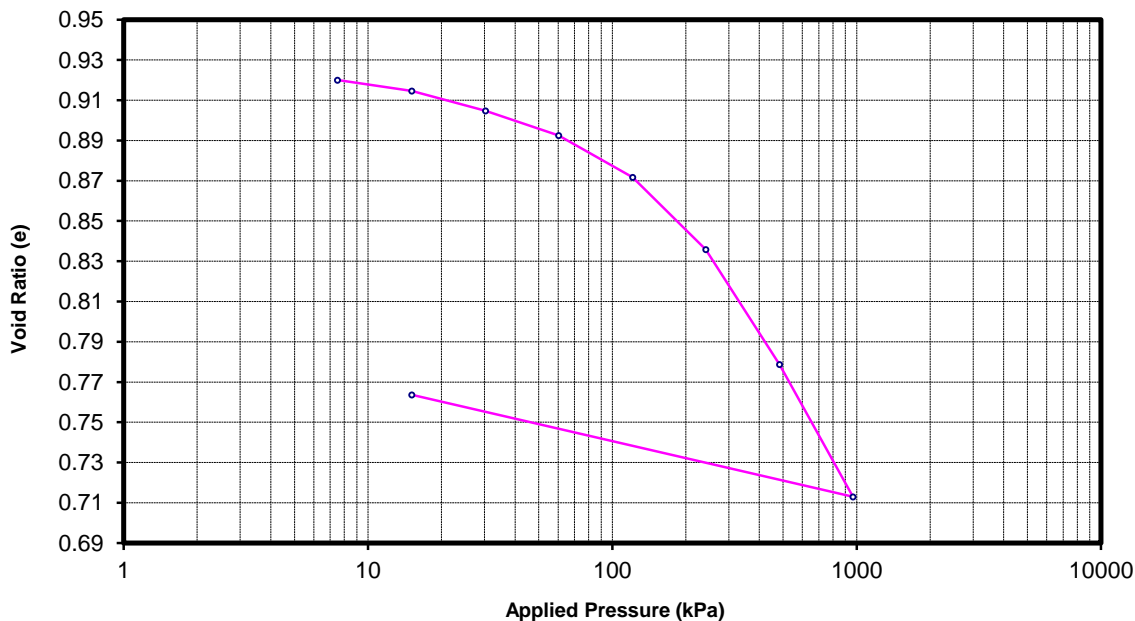
Sample ID.: **---**

Our Job No.: **1100700.0000**

Depth: **10.80-10.85 (m)**

Test Method Used: **NZS 4402:1986 Test 7.1 One-Dimensional Consolidation**

ONE-DIMENSIONAL CONSOLIDATION TEST



Pressure (kPa)	Void Ratio (e)	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m ² /yr)	Coefficient of Volume Compressibility Mv (m ² /MN)
As received	0			
Preload	7.5	0 to 7.5	NA	0.42
	15.1	7.5 to 15.1	34	0.37
	30.2	15.1 to 30.2	31	0.34
	60.3	30.2 to 60.3	26	0.22
	121	60.3 to 121	23	0.18
	241	121 to 241	20	0.16
	483	241 to 483	17	0.13
	966	483 to 966	16	0.077
Unload	15.1	966 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: sandy SILT with trace of clay, soft, light bluish-greenish grey.

Initial Dry Density (t/m³): 1.38 Initial Water Content: 33.8%

Solid Density (t/m³): 2.65 (Assumed) Initial Saturation: 97%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m³. The calculations of void ratio are affected by the solid density value.

The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by: **ST**

Date: 28.01.21

Checked by: **JJK**

Date: 28.01.21



1 Hill Street, Onehunga, Auckland 1061

p 64 9 356 3510

GEOTECHNICS www.geotechnics.co.nz



Site: **Onekawa Pools/Maadi Road - Napier Aquatic Centre**

Your Job No.: **1009171**

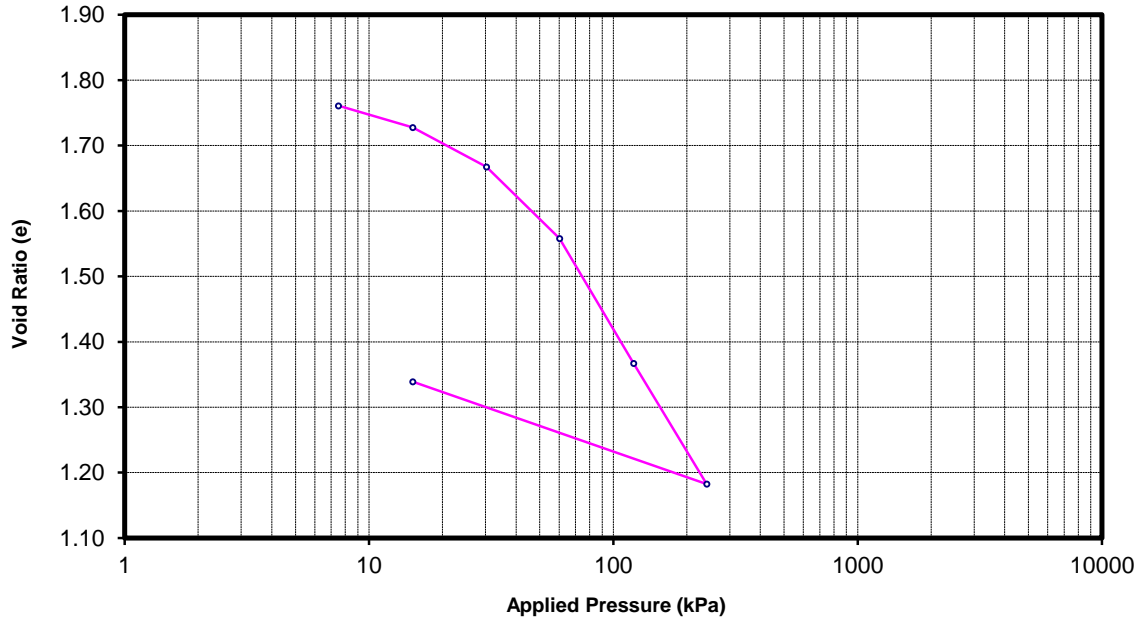
BH No.: **4** Sample ID.: **---**

Our Job No.: **1100700.0000**

Depth: **3.40-3.45 (m)**

Test Method Used: **NZS 4402:1986 Test 7.1 One-Dimensional Consolidation**

ONE-DIMENSIONAL CONSOLIDATION TEST



Pressure (kPa)	Void Ratio (e)	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m ² /yr)	Coefficient of Volume Compressibility Mv (m ² /MN)
As received	0			
Preload	7.5	0 to 7.5	NA	1.7
	15.1	7.5 to 15.1	3.5	1.6
	30.2	15.1 to 30.2	3.3	1.5
	60.3	30.2 to 60.3	2.8	1.4
	121	60.3 to 121	2.3	1.2
	241	121 to 241	3.8	0.65
Unload	15.1	241 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor clay and trace of sand, trace of shell fragments, soft, light greenish grey.

Initial Dry Density (t/m³): 0.95 Initial Water Content: 64.7%

Solid Density (t/m³): 2.65 (Assumed) Initial Saturation: 95%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m³. The calculations of void ratio are affected by the solid density value.

The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by: **ST**

Date: 28.01.21

Checked by: **JK**

Date: 28.01.21

1100700.0000/Rep 1



1 Hill Street, Onehunga, Auckland 1061

p 64 9 356 3510

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Site: **Onekawa Pools/Maadi Road - Napier Aquatic Centre**

Your Job No.: **1009171**

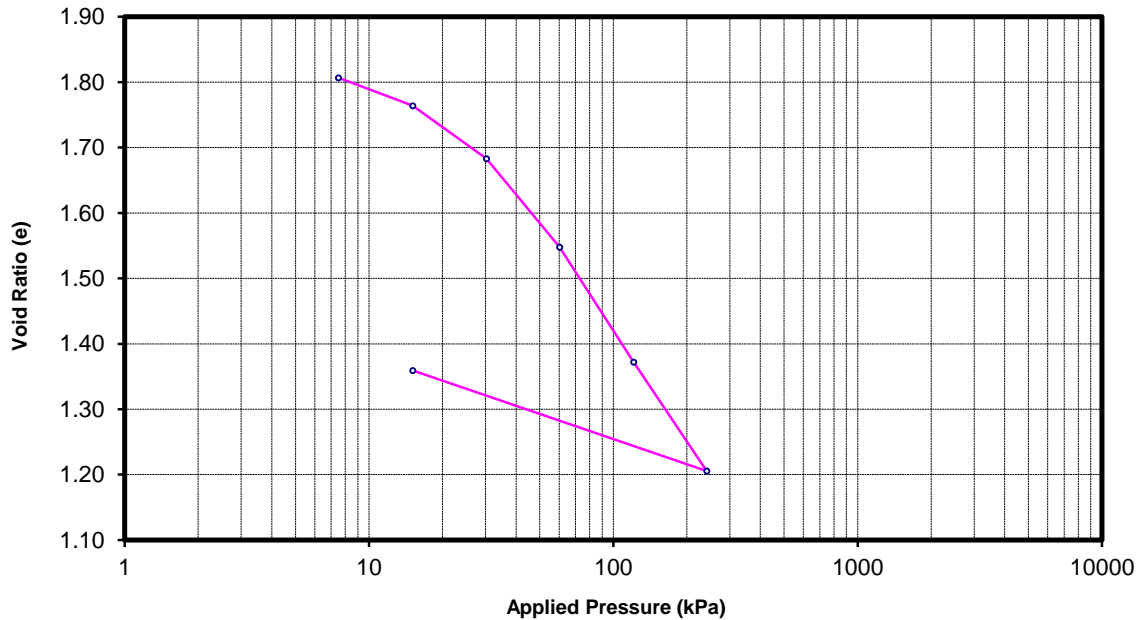
BH No.: **5** Sample ID.: **---**

Our Job No.: **1100700.0000**

Depth: **4.85-4.90 (m)**

Test Method Used: **NZS 4402:1986 Test 7.1 One-Dimensional Consolidation**

ONE-DIMENSIONAL CONSOLIDATION TEST



Pressure (kPa)	Void Ratio (e)	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m ² /yr)	Coefficient of Volume Compressibility Mv (m ² /MN)
As received	0			
Preload	7.5	0 to 7.5	NA	2.1
	15.1	7.5 to 15.1	2.1	2.0
	30.2	15.1 to 30.2	1.9	1.9
	60.3	30.2 to 60.3	1.4	1.7
	121	60.3 to 121	3.1	1.1
	241	121 to 241	2.9	0.59
Unload	15.1	241 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor clay and trace of sand, trace of shell fragments, soft, light bluish-greenish grey.

Initial Dry Density (t/m³): 0.93 Initial Water Content: 67.2%

Solid Density (t/m³): 2.65 (Assumed) Initial Saturation: 96%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m³. The calculations of void ratio are affected by the solid density value.

The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by: **ST**

Date: 28.01.21

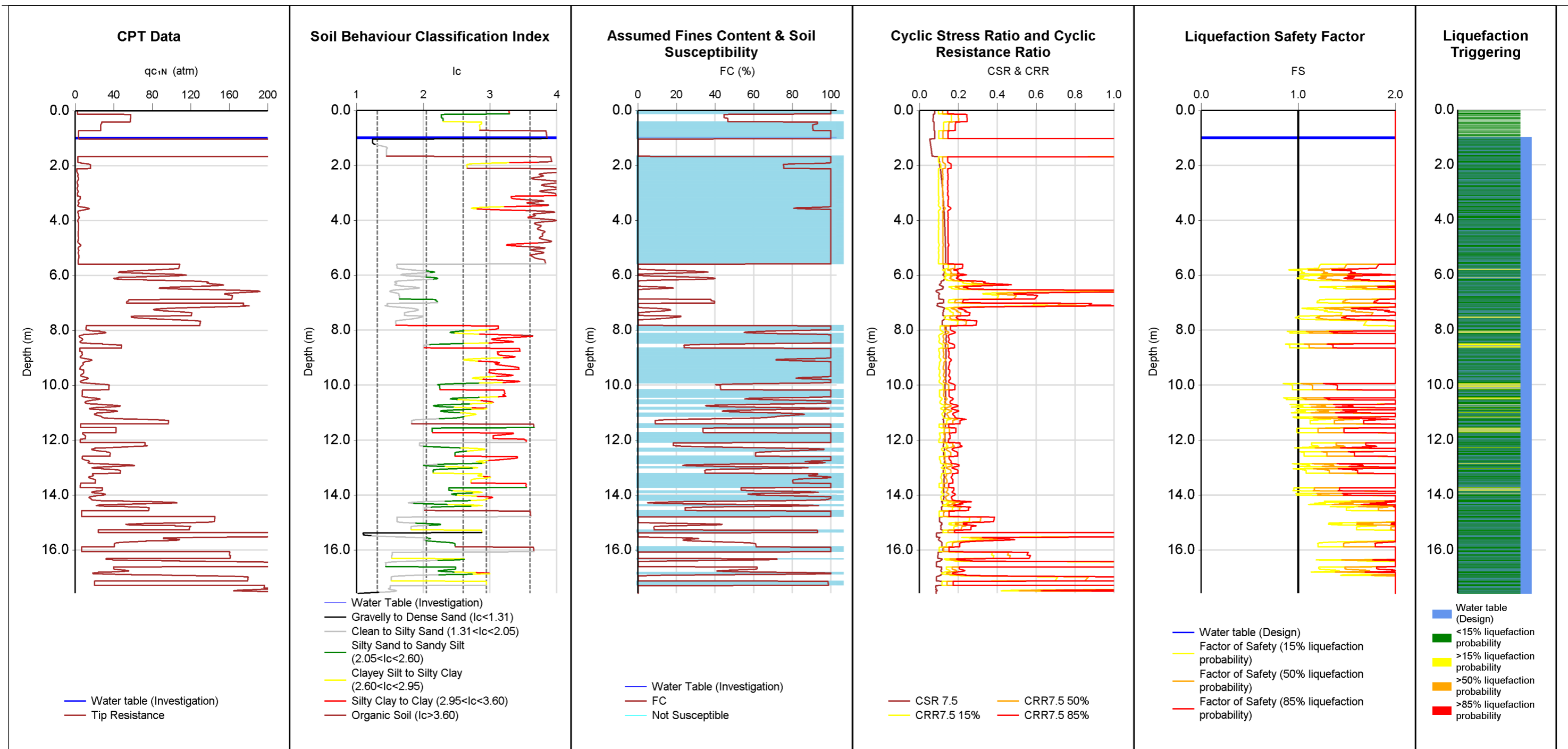
Checked by: **JK**

Date: 28.01.21

1100700.0000/Rep 1

Appendix D: Liquefaction Analysis

- Liquefaction Calculator Outputs



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	35	1.3	0	4	6.1	0					
50%	14	0	0	1	17.6	0					
85%	7	0	0	1	17.6	0					

Reviewed by:

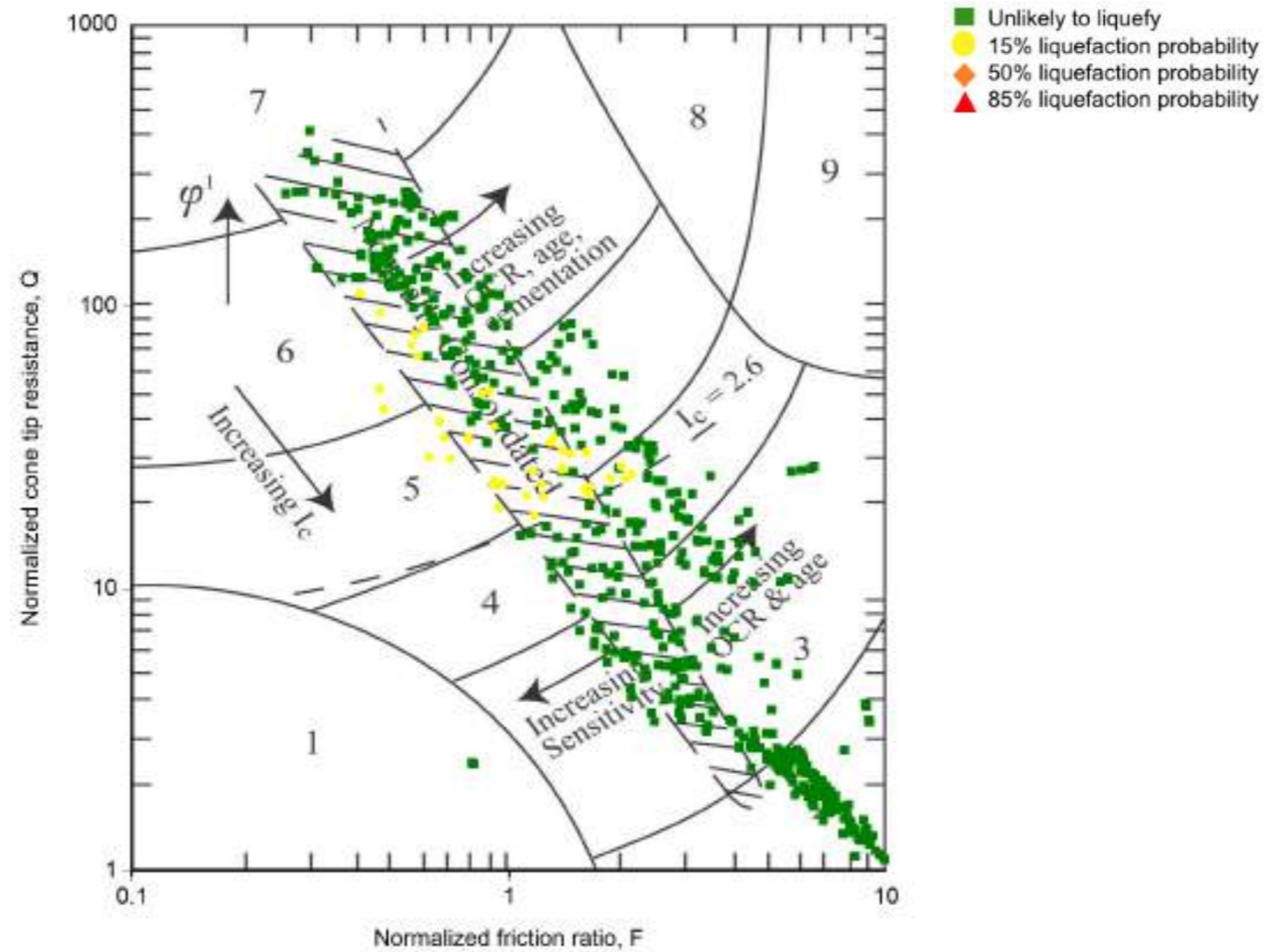
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

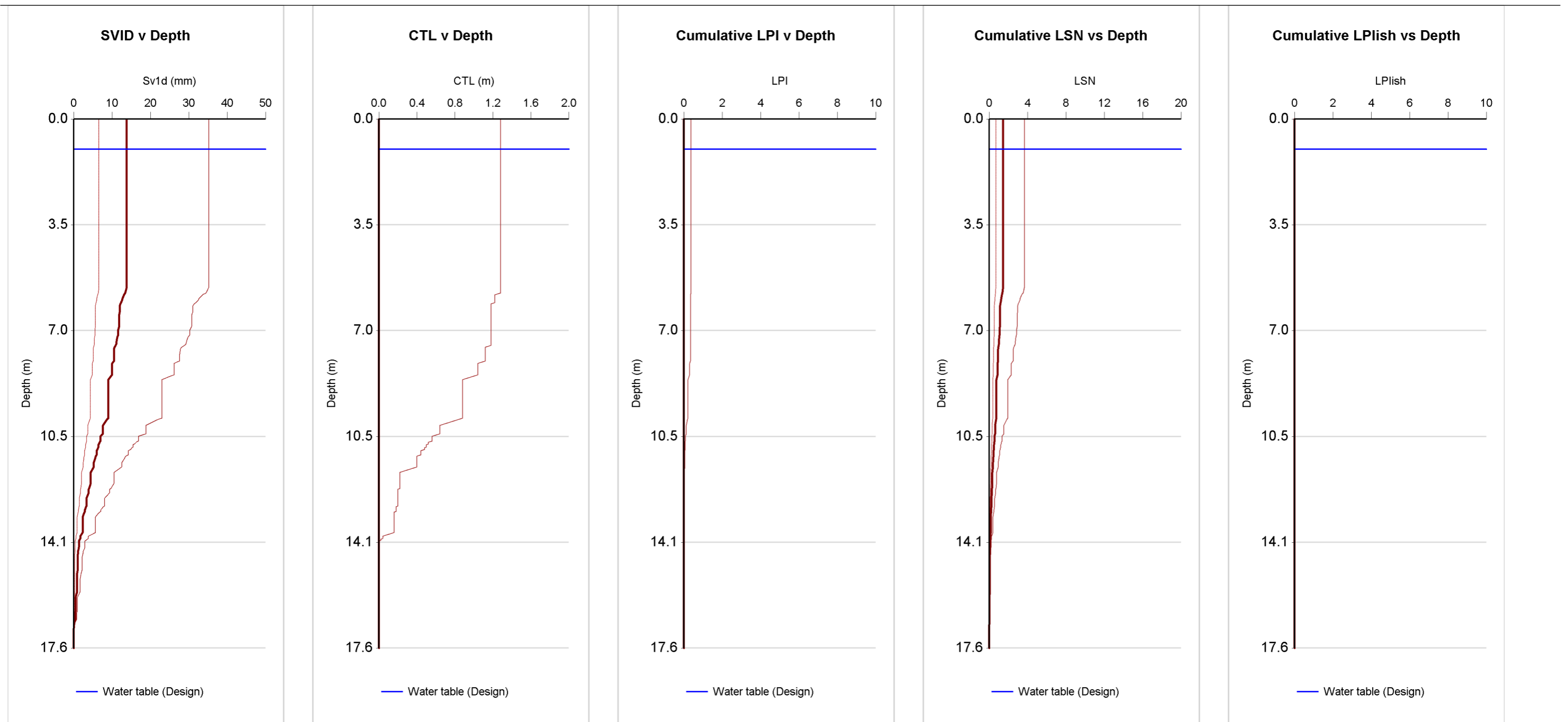


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

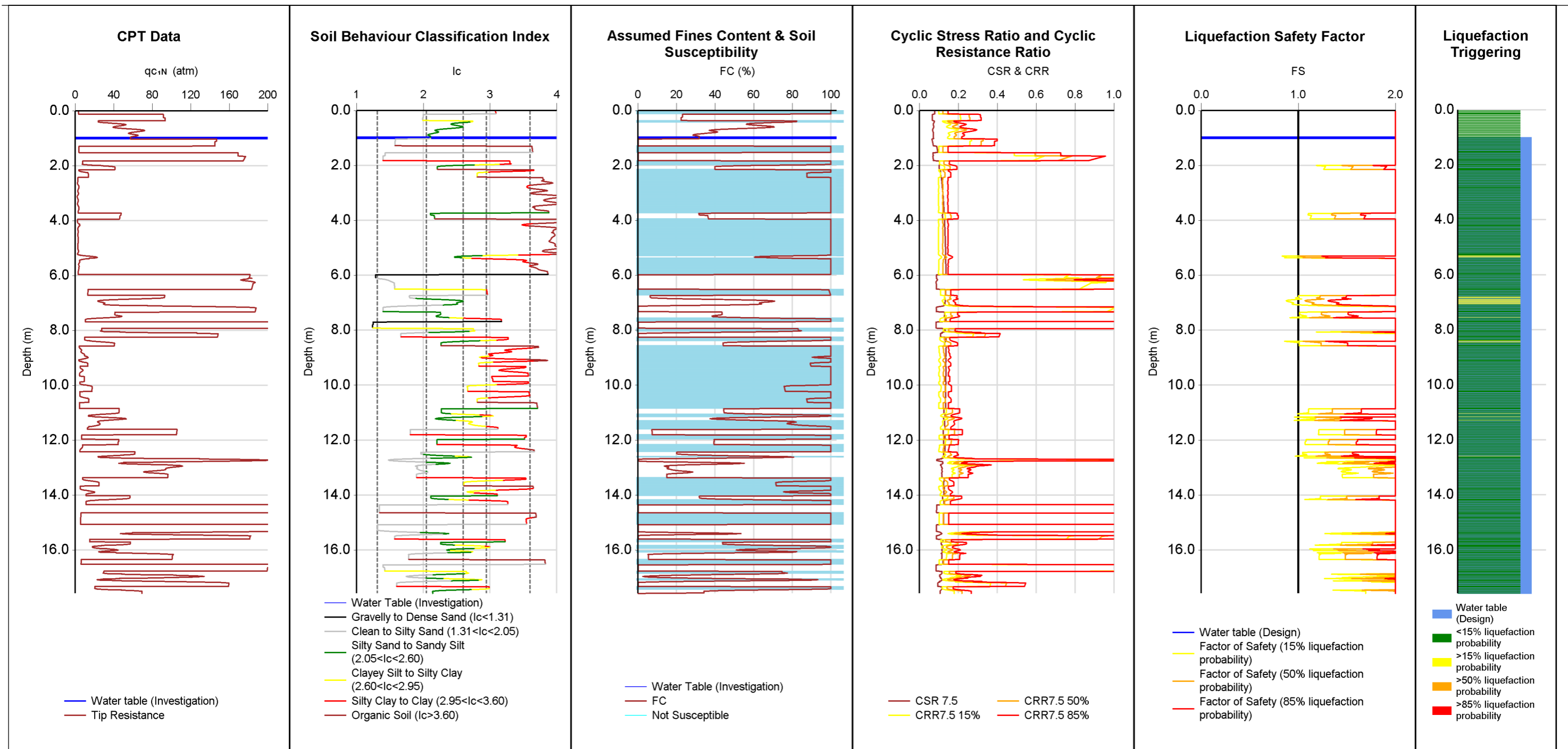
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	<p>CLIENT Napier City Council</p>	<p>LOCATION Napier</p>	<p>DATE 15/02/2021</p>
	<p>PROJECT Onekawa Aquatic Centre</p>	<p>ANALYSED zafr</p>	
	<p>TITLE SLS - Onekawa Aquatic Centre Liquefaction Analysis</p>	<p>JOB NUMBER 1009171</p>	
	<p>COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]</p>	<p>PAGE 3 of 9 pages</p>	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	23	0.5	0	3	6.8	0					
50%	10	0	0	1	17.6	0					
85%	4	0	0	1	17.6	0					

Reviewed by:

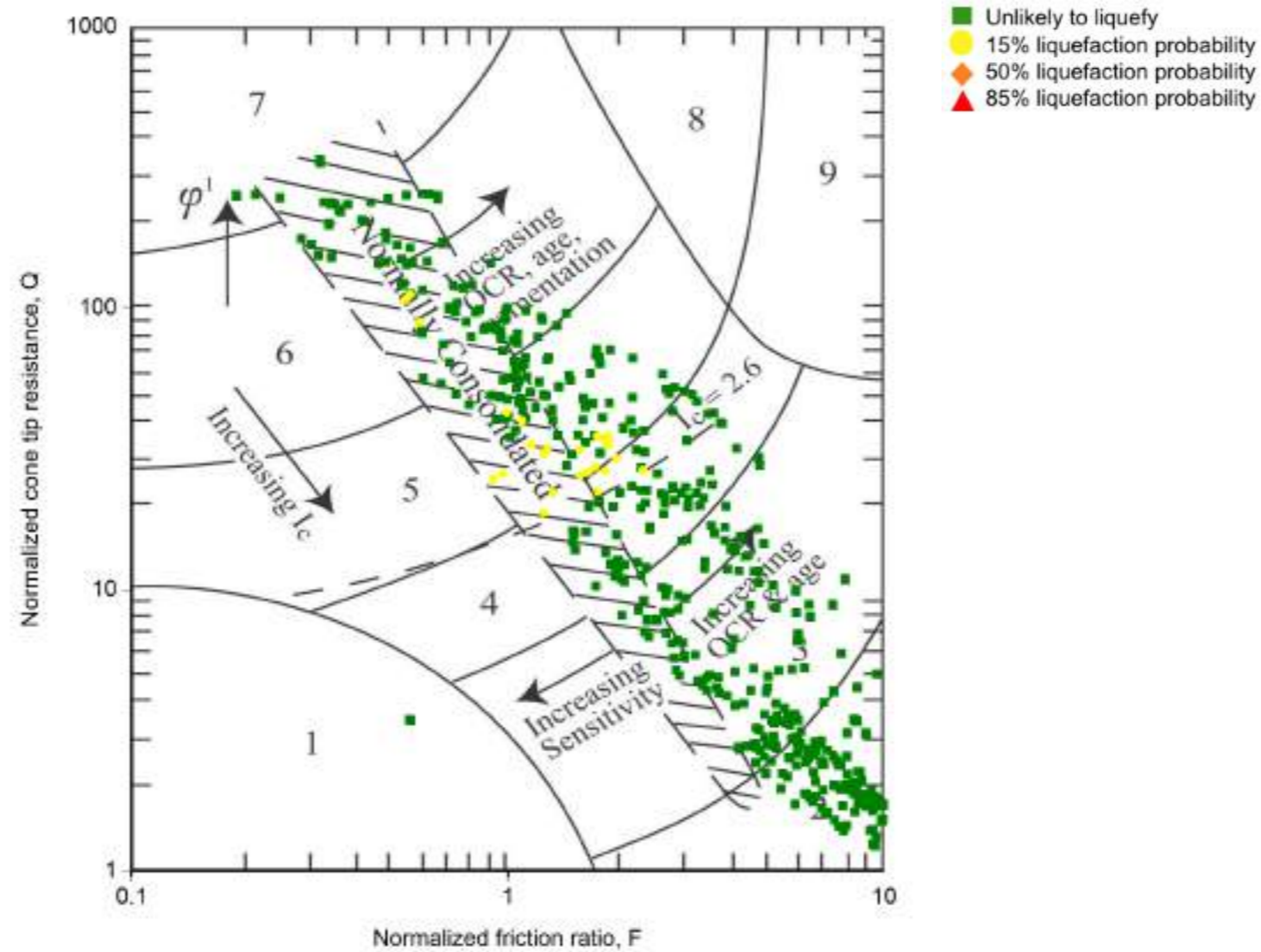
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

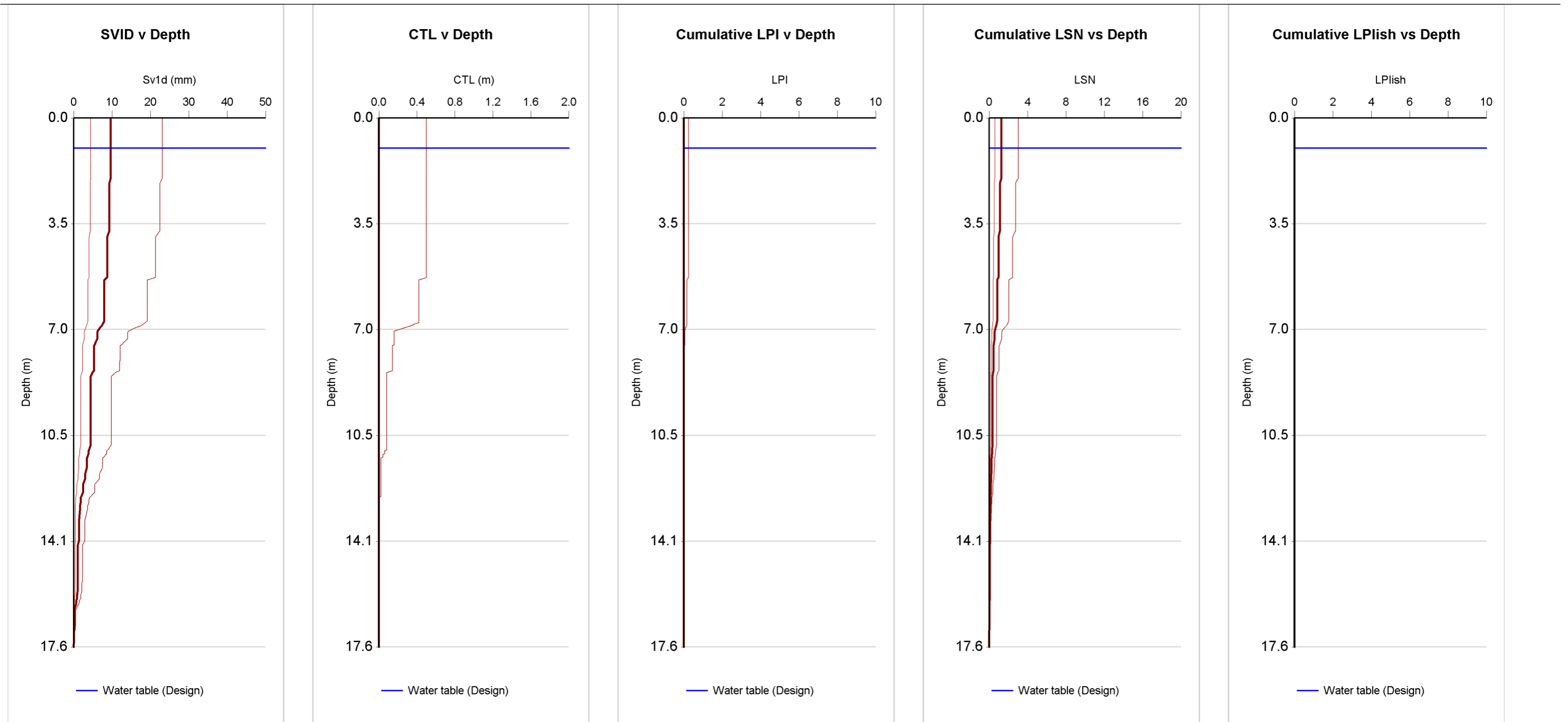


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

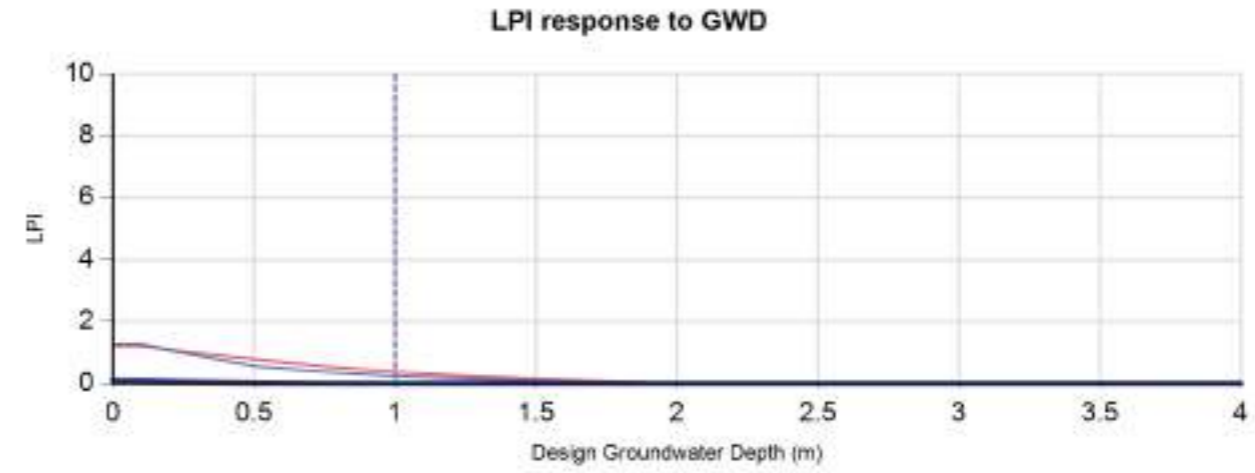
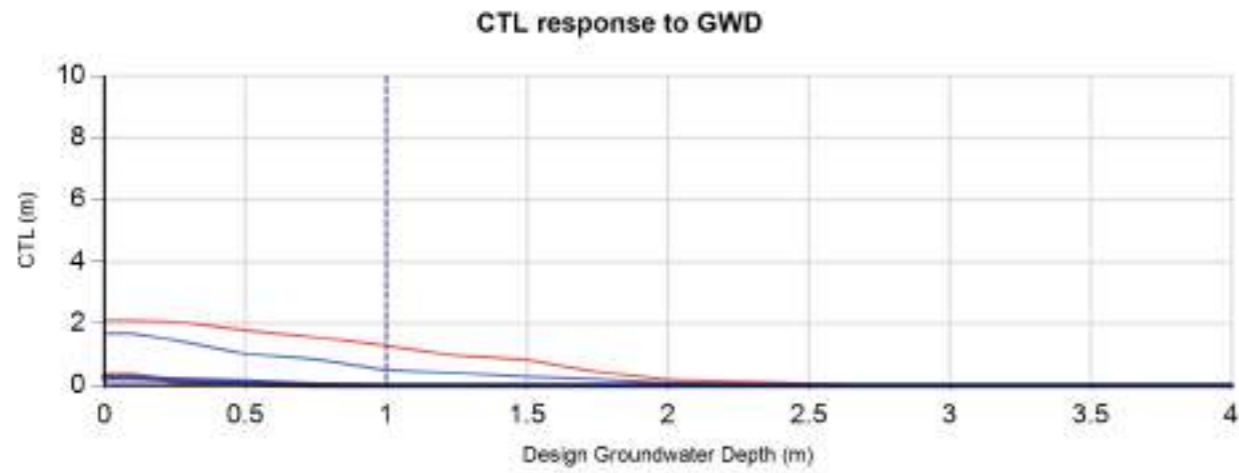
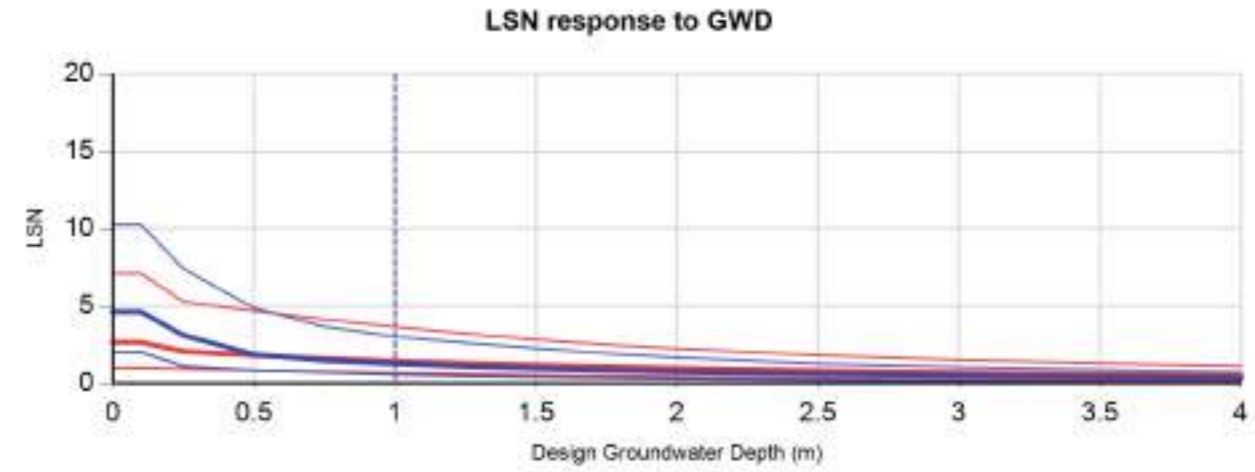
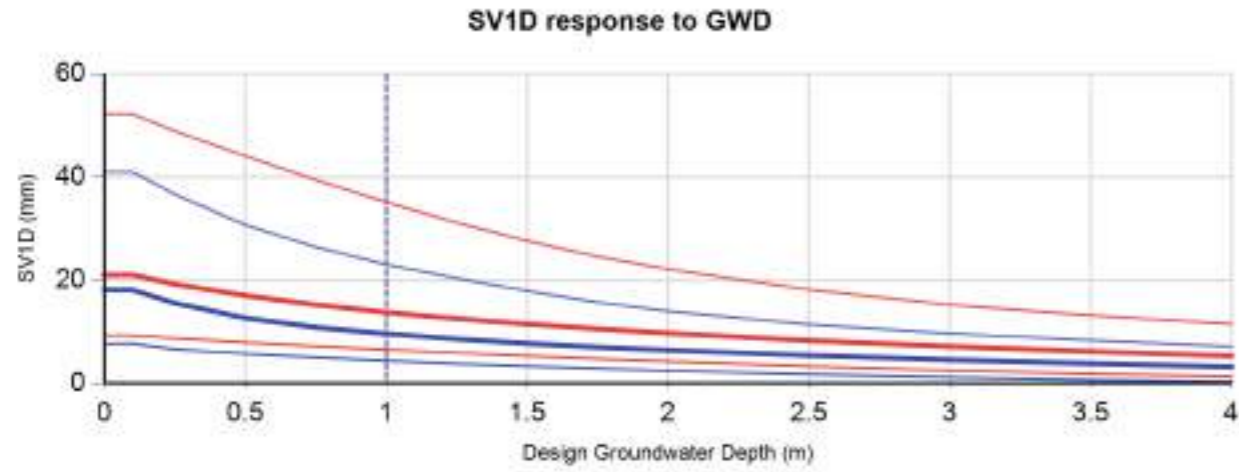
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER		
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]	1009171	PAGE	5 of 9 pages



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]				




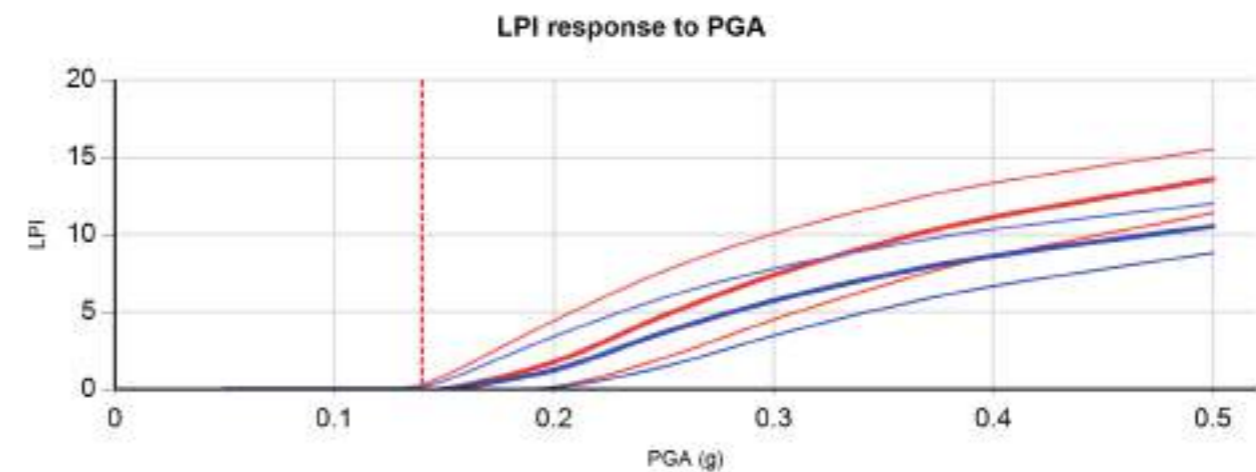
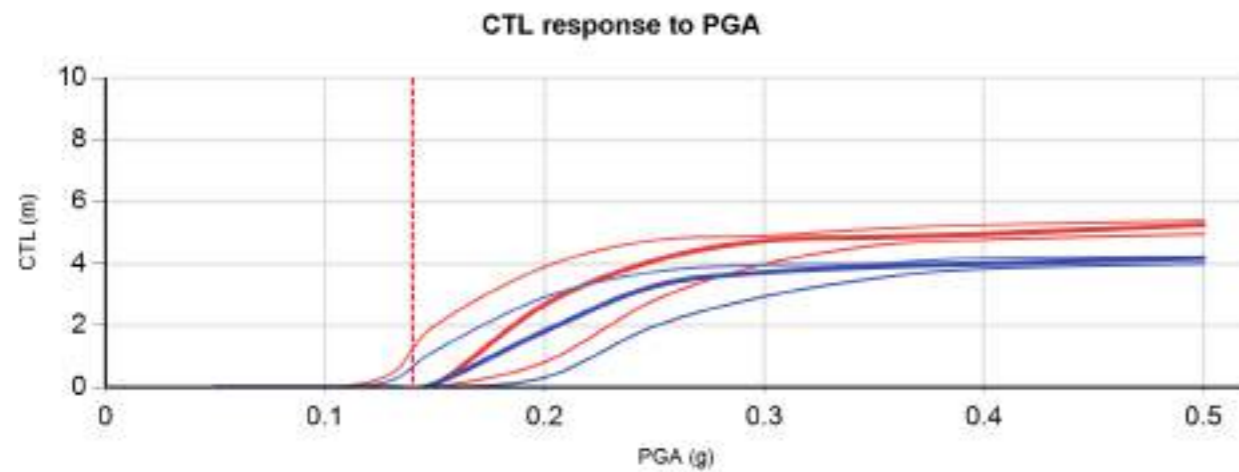
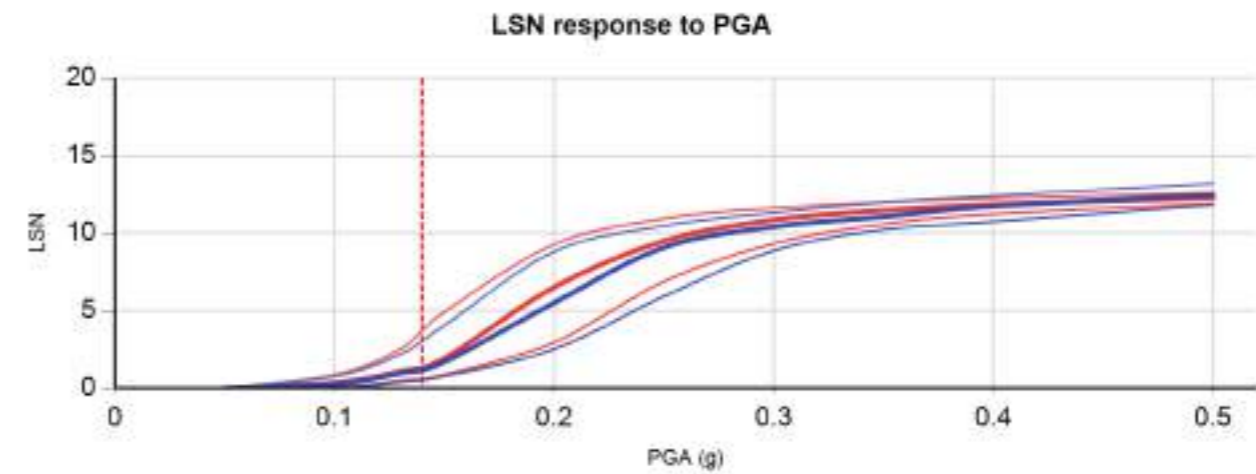
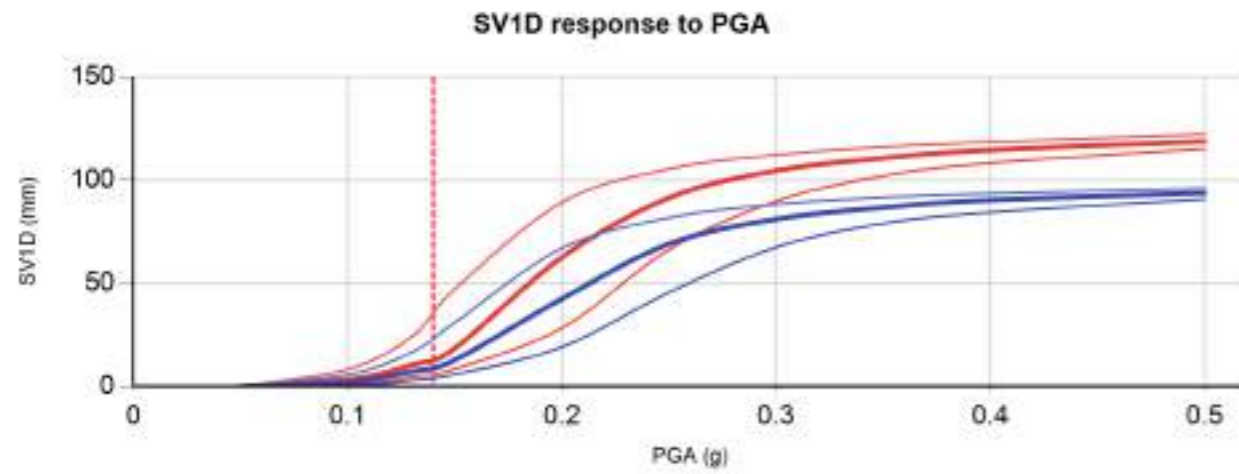
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 1 - 2]	PAGE	7 of 9 pages



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

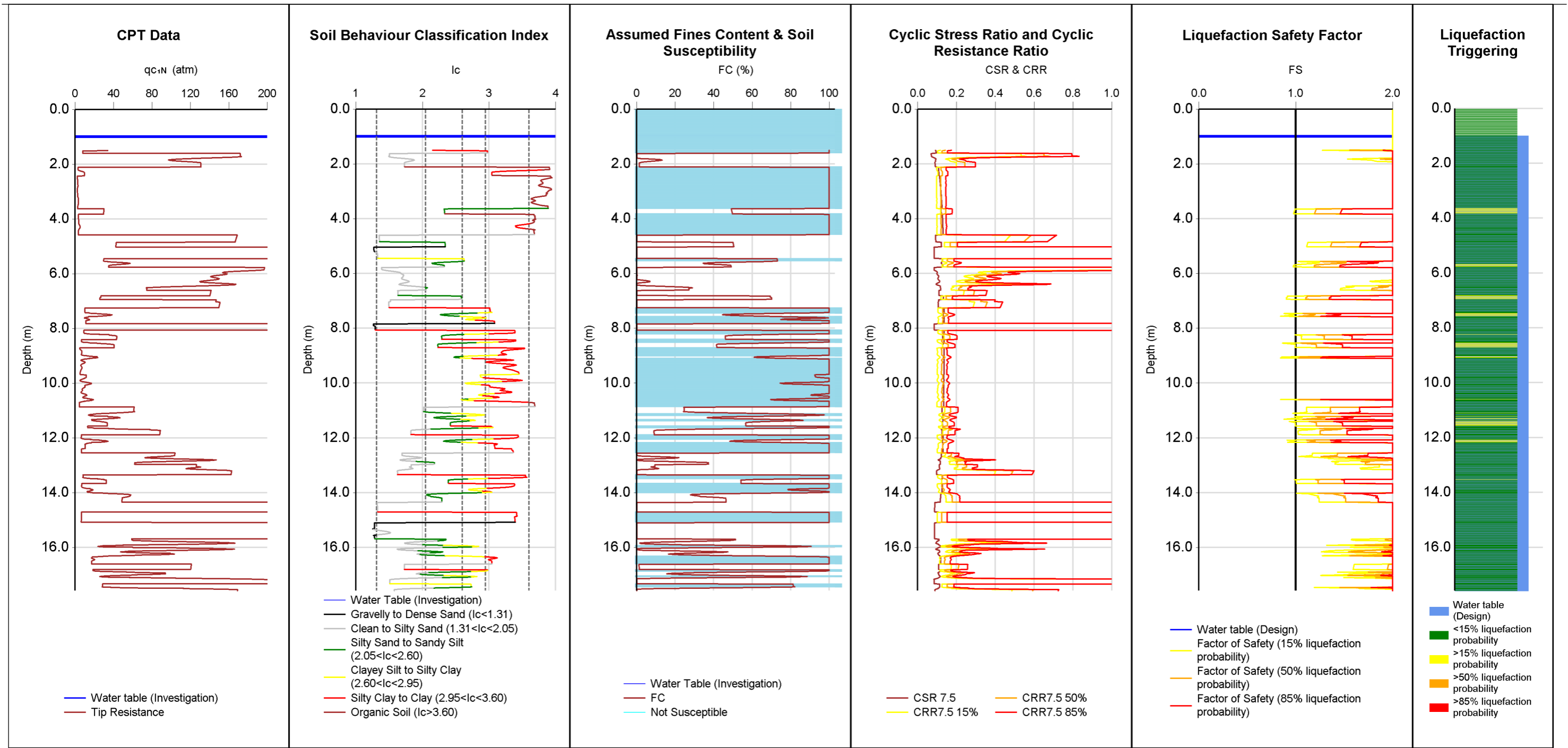
ID	NZGD 152807	NZGD 152808
CPT Name	CPT01	CPT02
Run description	CPT01	CPT02
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.58	17.9
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152807	CPT01	0	0	0
NZGD 152807	CPT01	0	17.58	2.6
NZGD 152808	CPT02	0	0	0
NZGD 152808	CPT02	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152807	CPT01	0	17.58	0 CFC
NZGD 152808	CPT02	0	17.58	0 CFC



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	30	1.2	0	4	3.7	0					
50%	12	0	0	1	17.6	0					
85%	6	0	0	1	17.6	0					

Reviewed by:

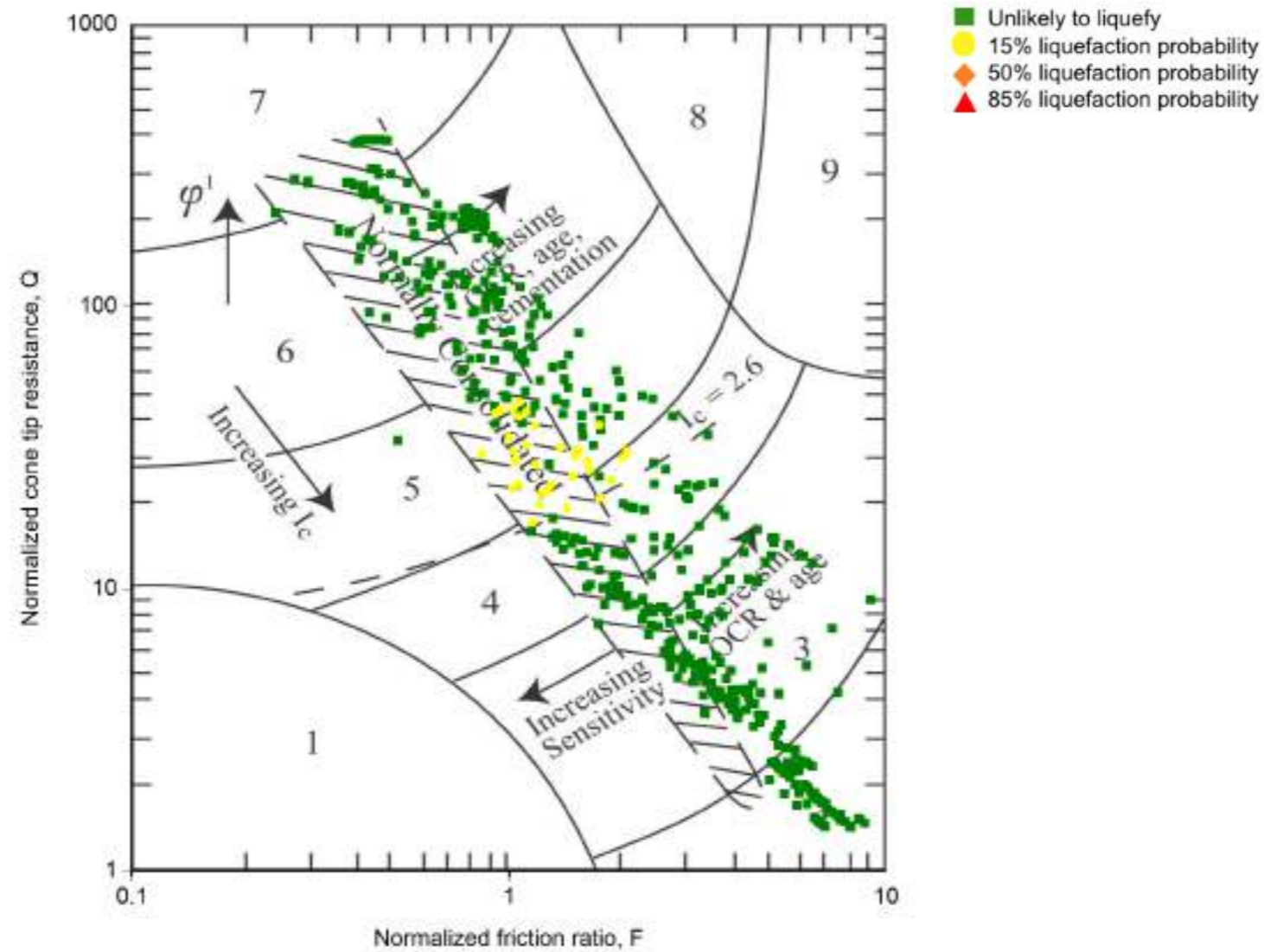
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]

LOCATION	Napier	DATE	15/02/2021
JOB NUMBER	1009171	ANALYSED	zafz
PAGE	1 of 12 pages		



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

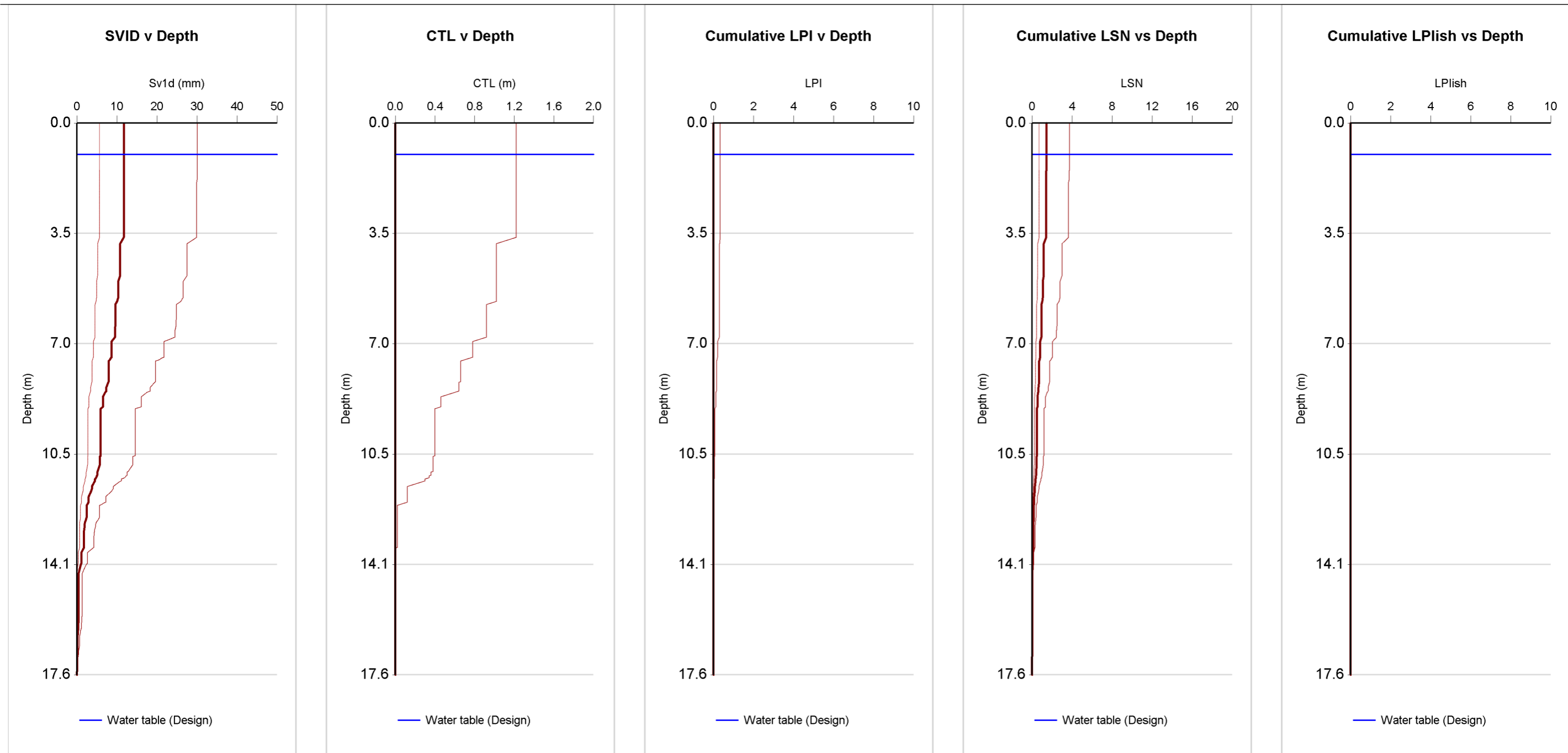
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

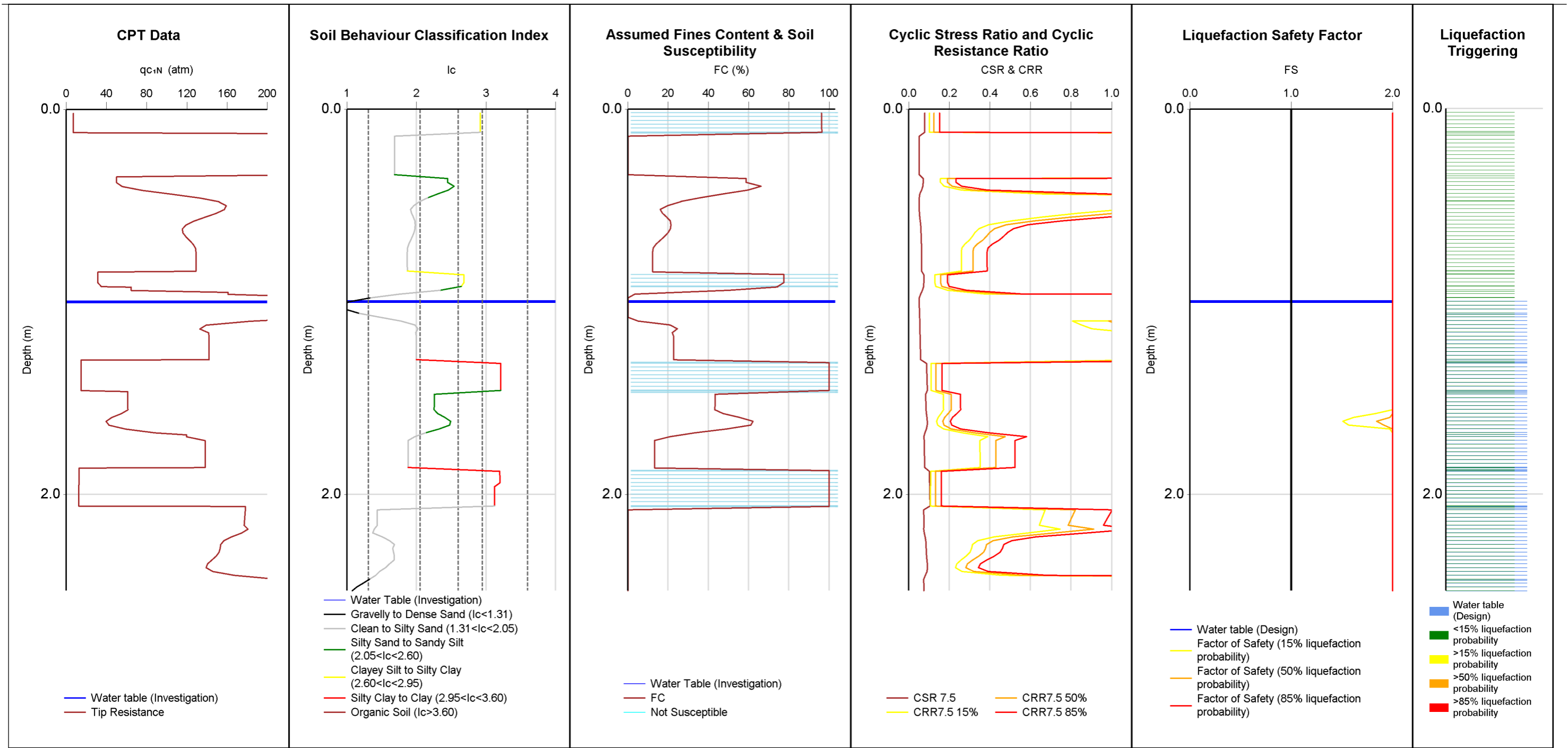


Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 12 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.2	0.14	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	0	0	0	0	2.5	0					
50%	0	0	0	0	2.5	0					
85%	0	0	0	0	2.5	0					

Reviewed by:

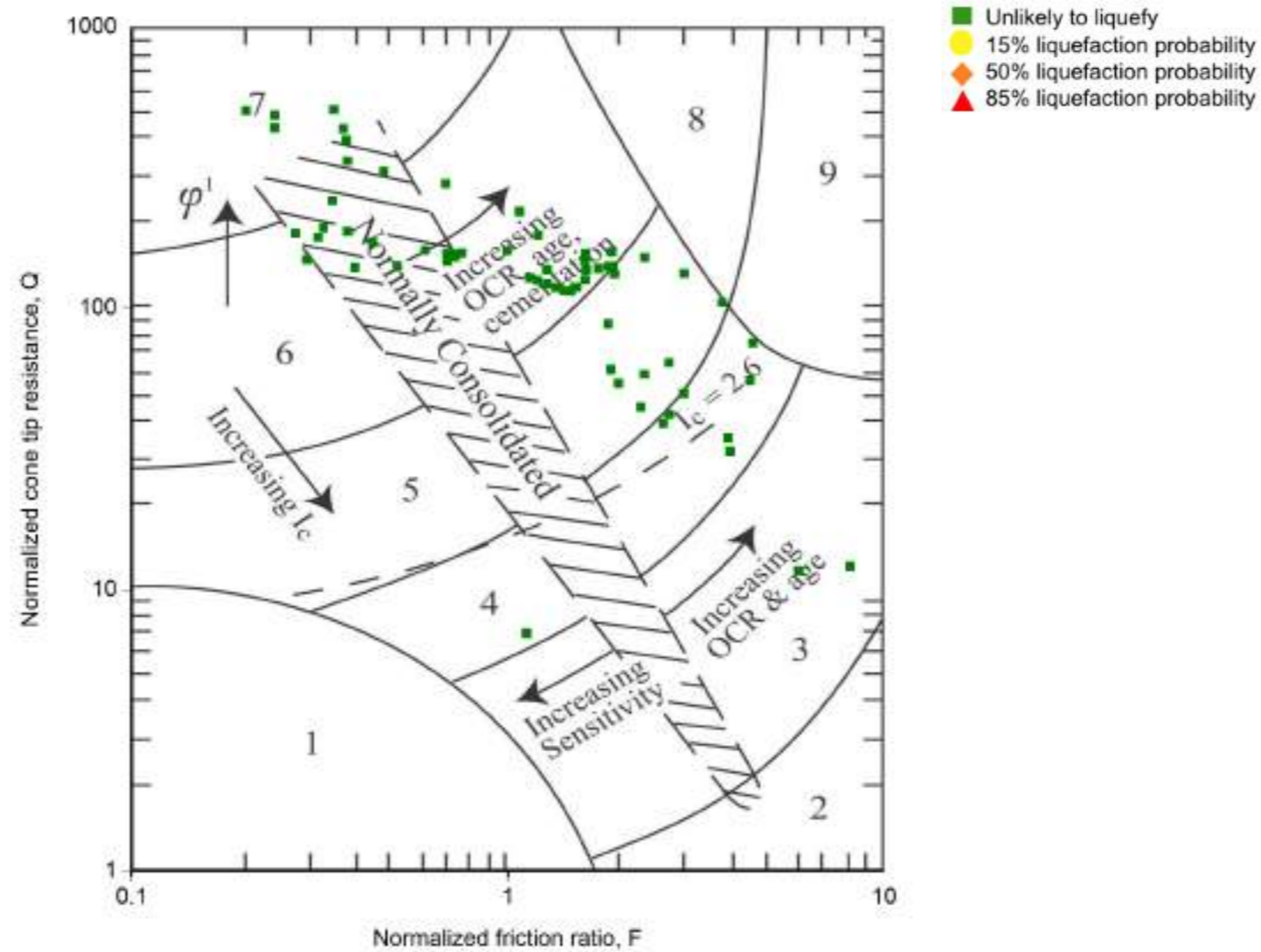
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]


LOCATION	Napier	DATE	15/02/2021
JOB NUMBER	1009171	ANALYSED	zafz
		PAGE	4 of 12 pages

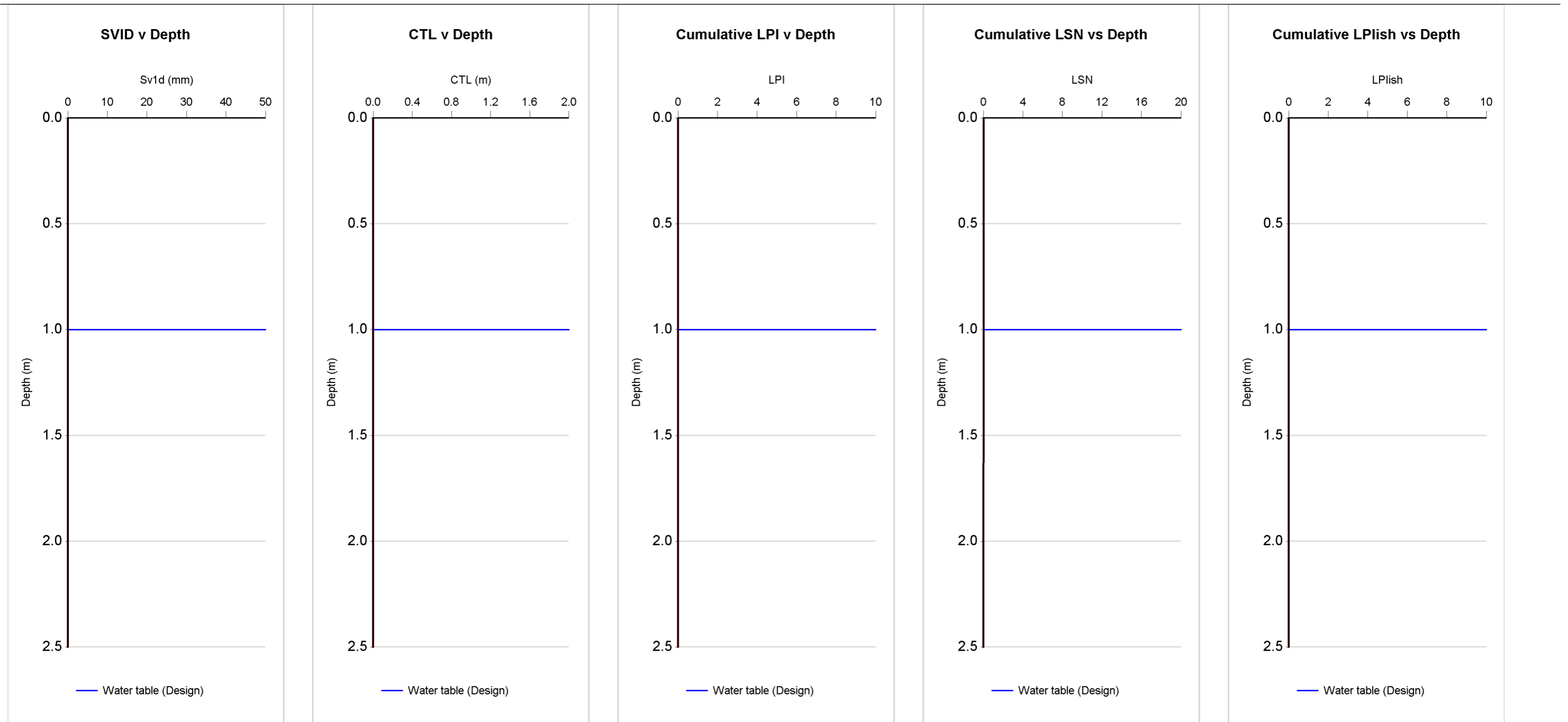


- 1. Sensitive, fine grained
- 2. Organic soils - peats
- 3. Clays - silty clay to clay
- 4. Silt mixtures - clayey silt to silty clay
- 5. Sand mixtures - silty sand to sandy silt
- 6. Sands - clean sand to silty sand
- 7. Gravelly sand to dense sand
- 8. Very stiff sand to clayey sand *
- 9. Very stiff, fine grained *

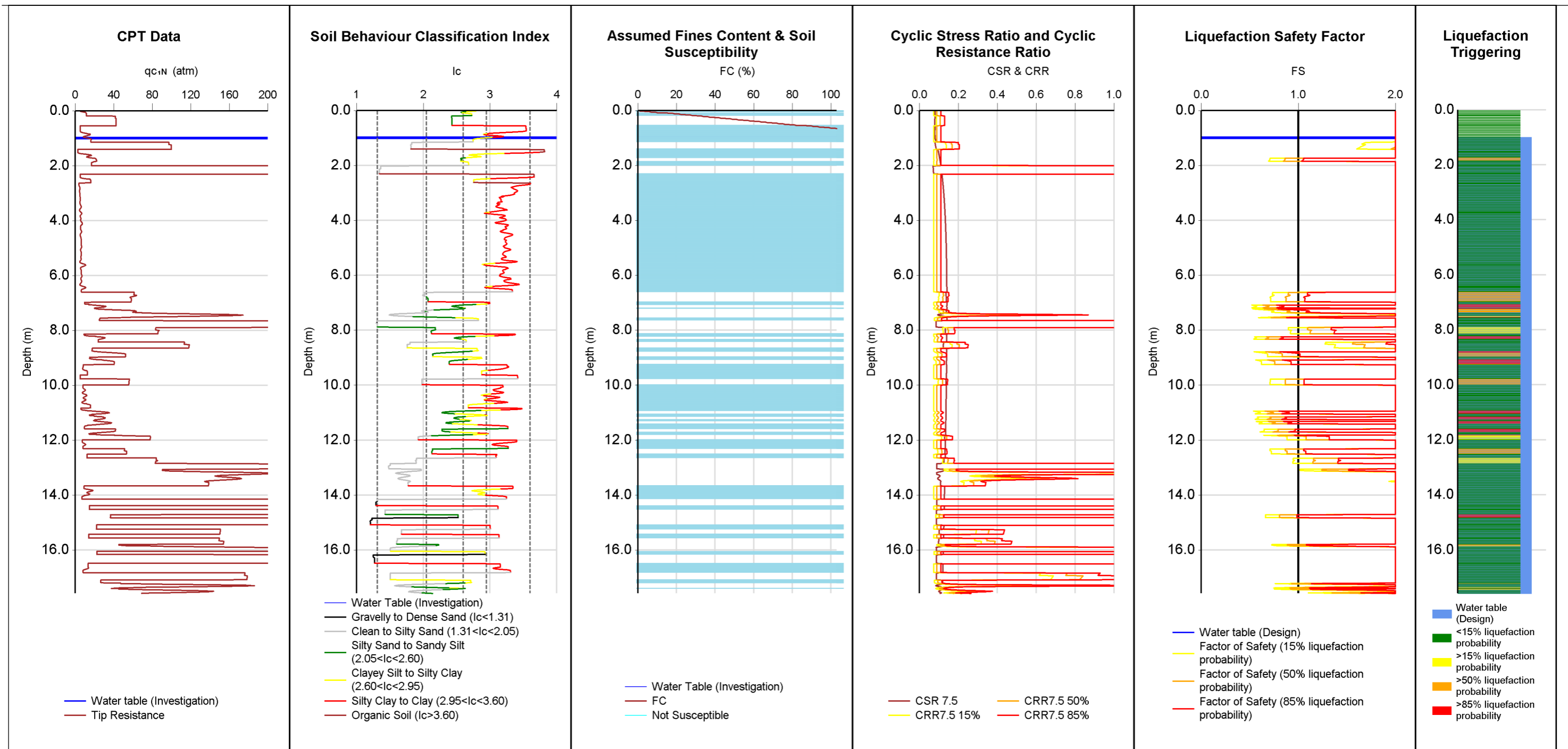
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 12 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	128	3.1	5	17	1.8	3					
50%	116	2.4	2	15	1.8	1					
85%	72	1.1	1	9	7.2	0					

Reviewed by:

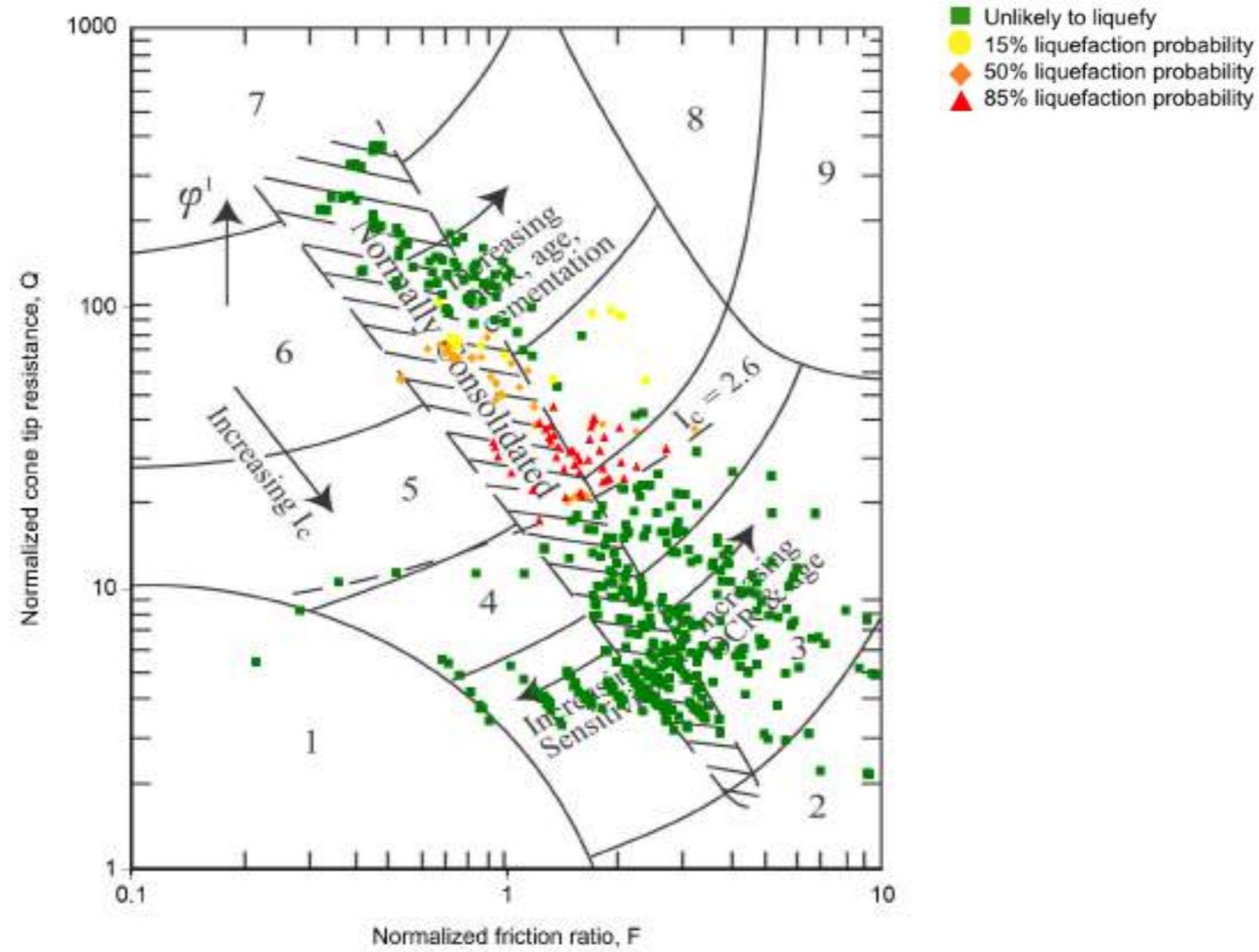
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **7 of 12 pages**

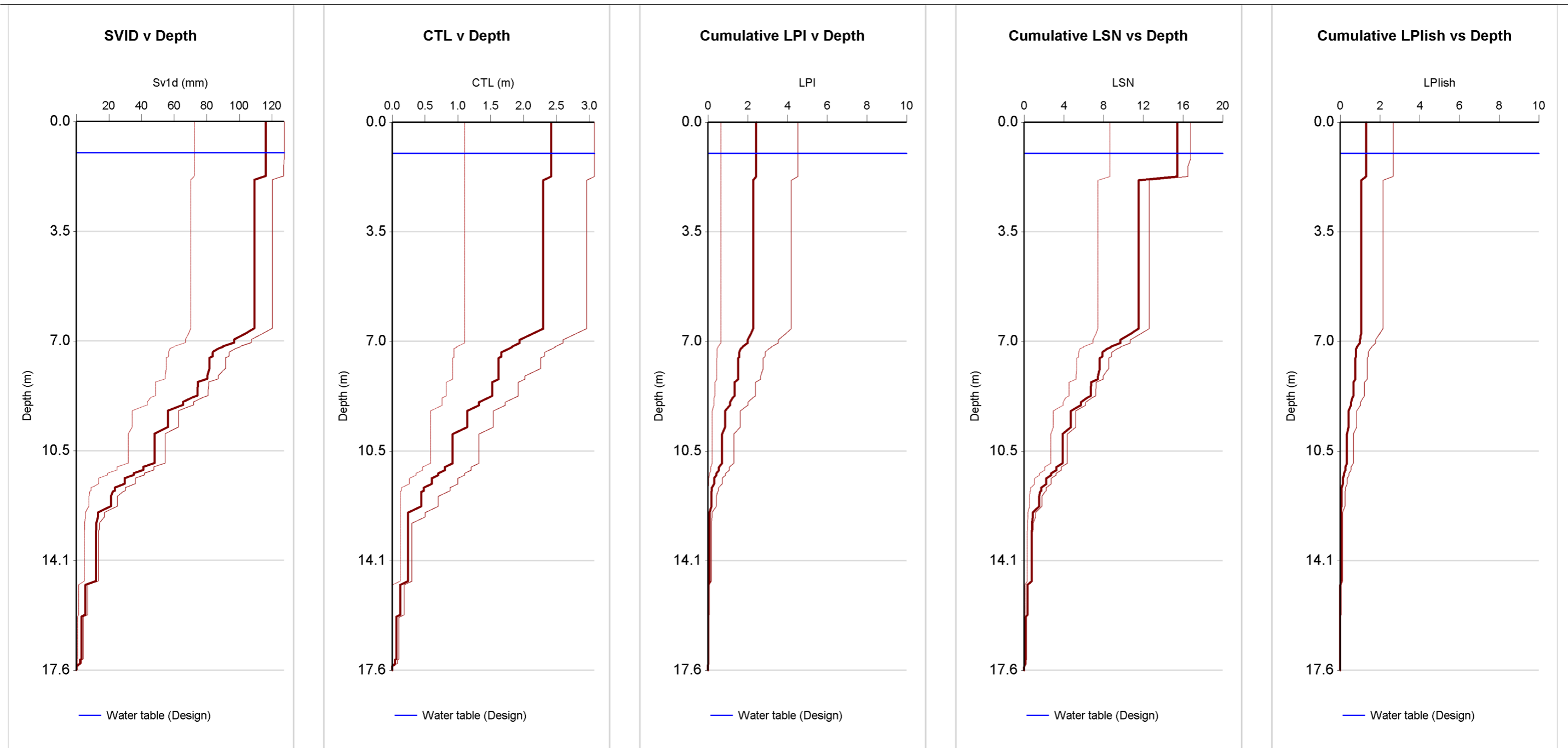


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

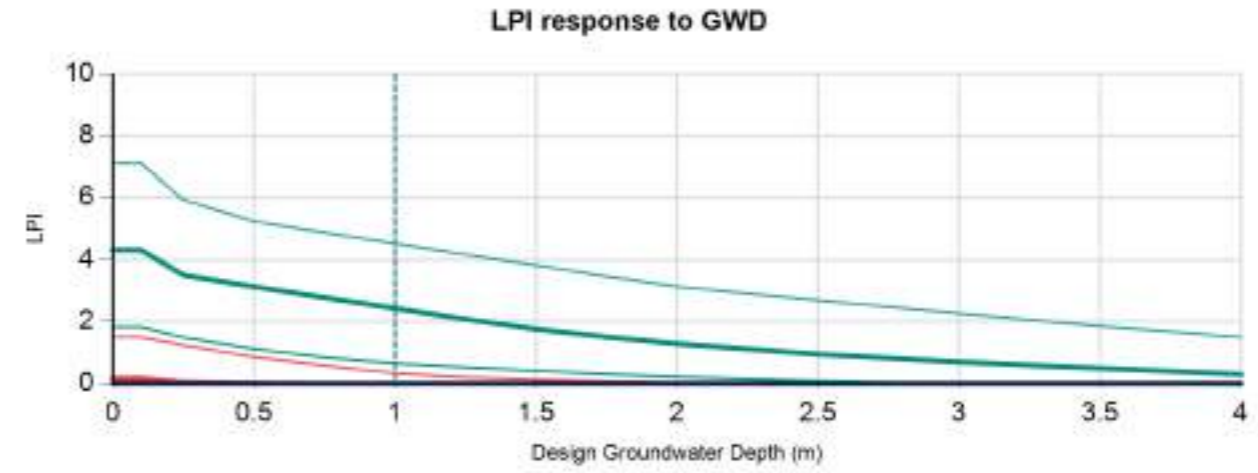
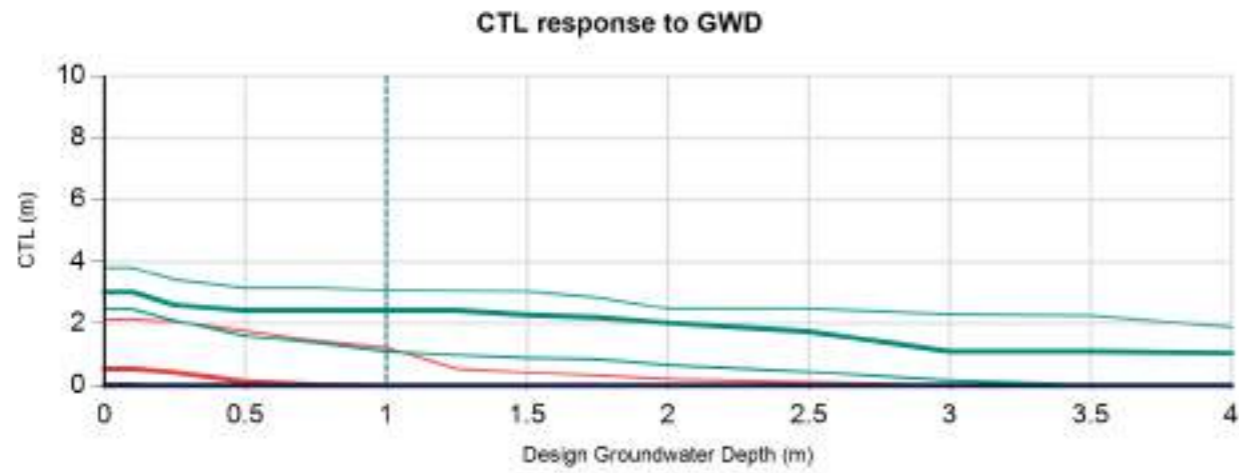
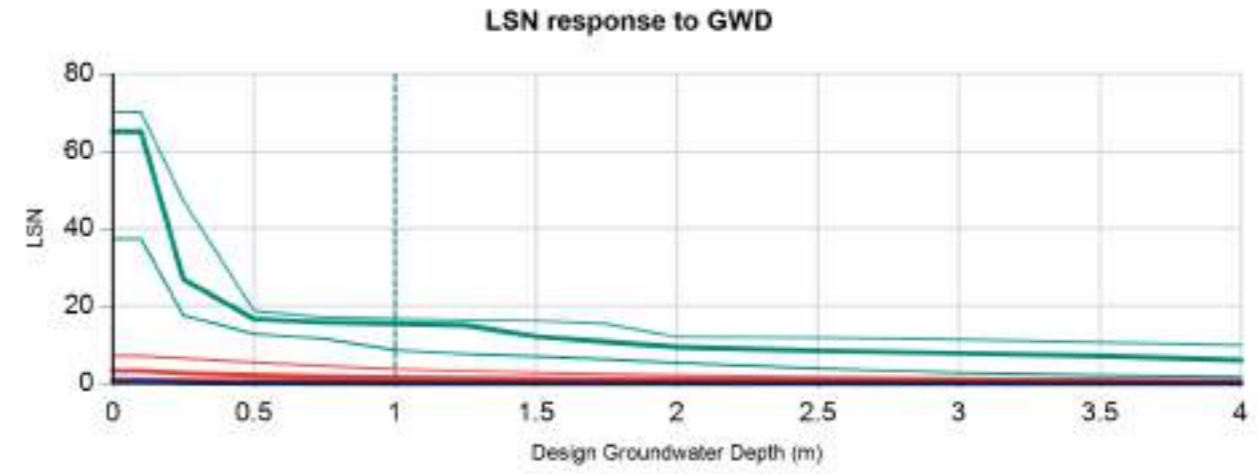
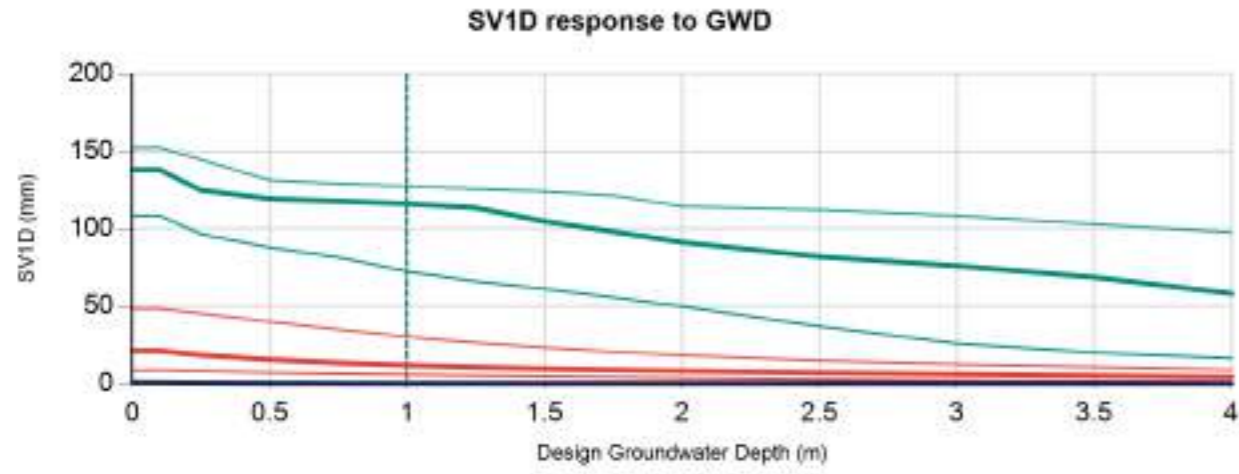
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 12 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	9 of 12 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]				




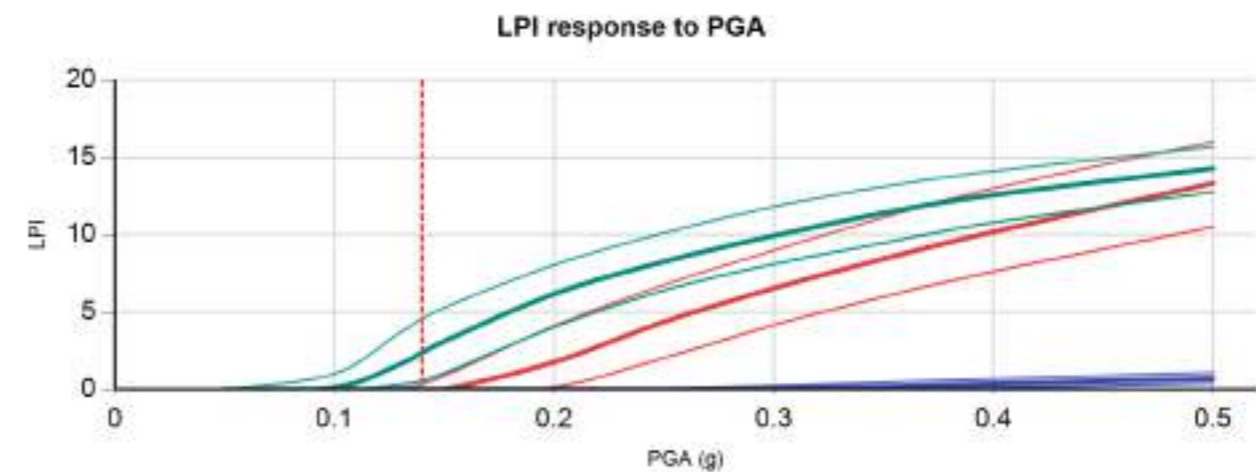
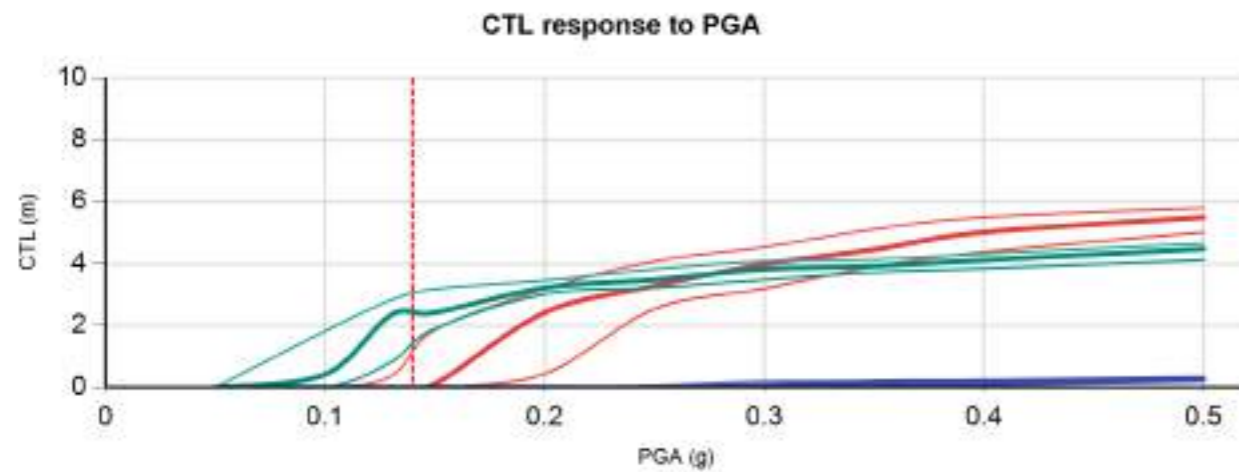
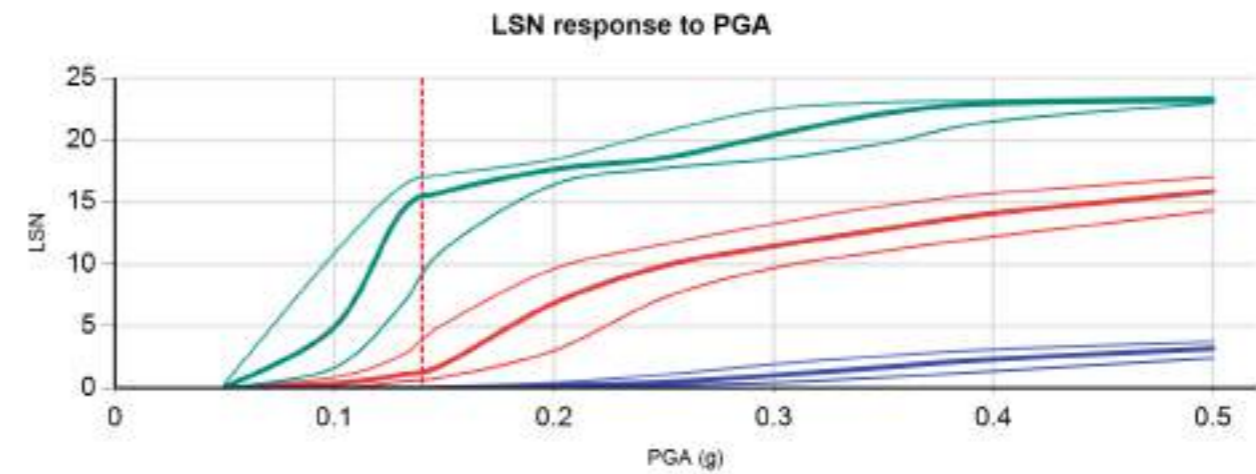
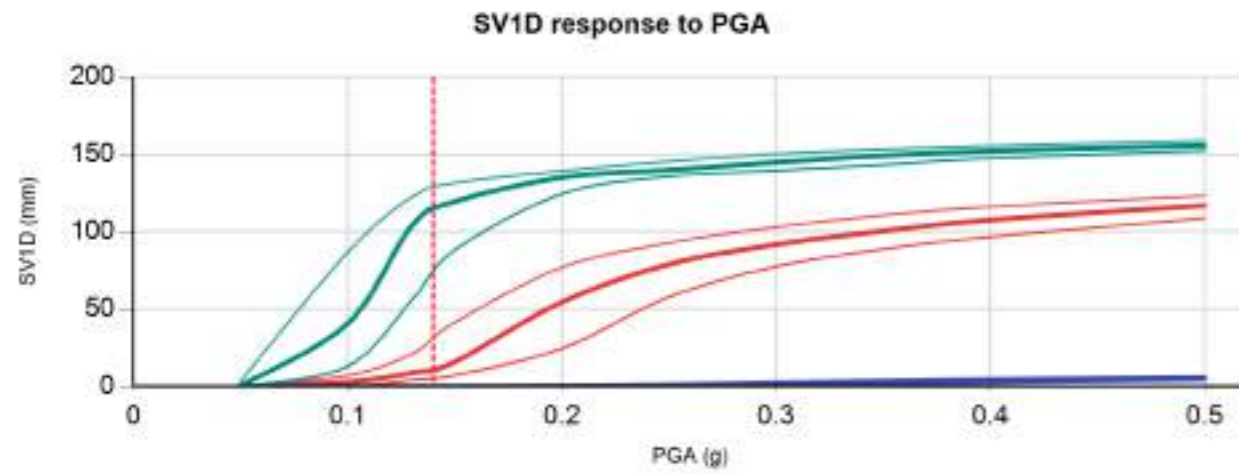
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	10 of 12 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 3 - 5]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

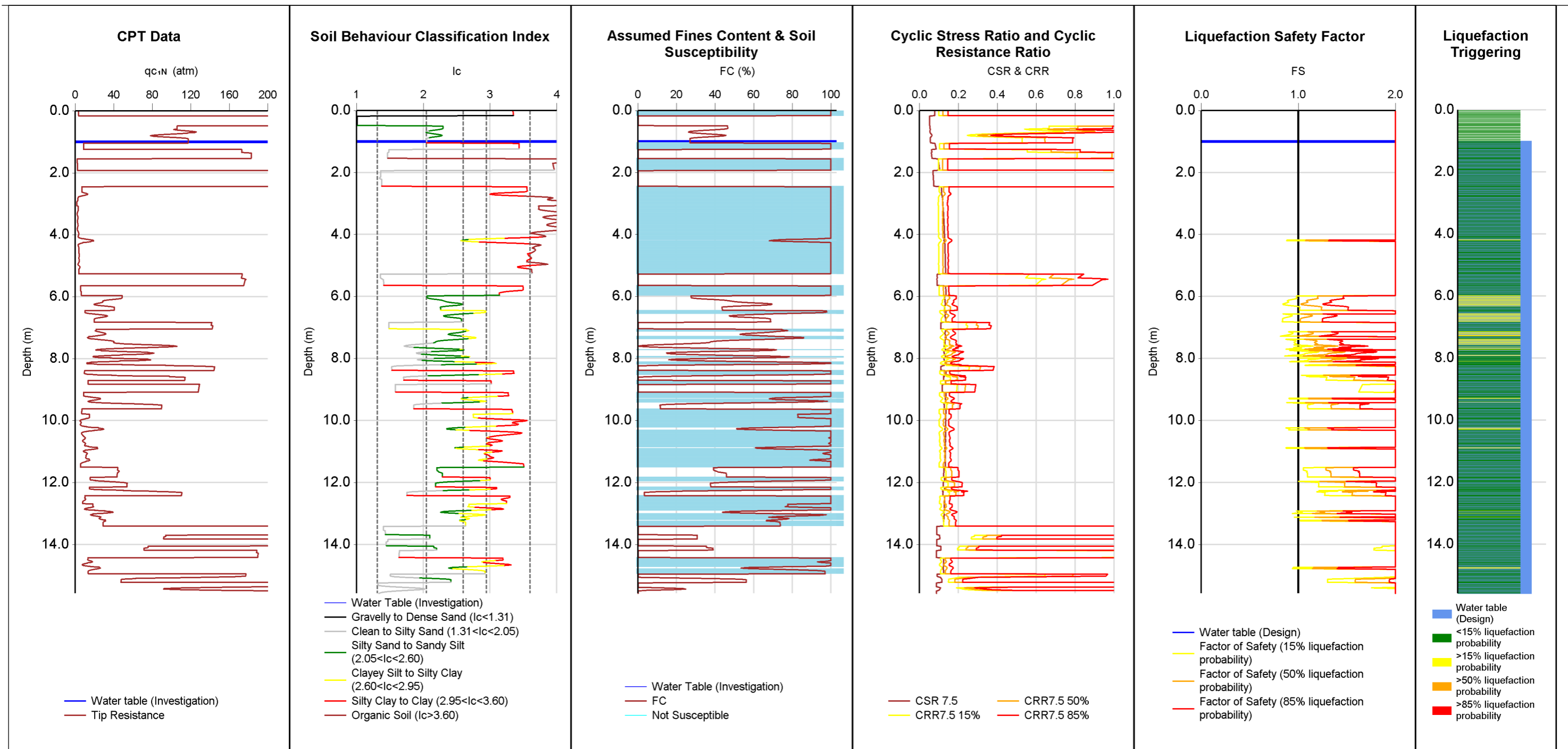
ID	NZGD 152809	NZGD 152810	NZGD 153039
CPT Name	CPT03	CPT04	CPT05
Run description	CPT03	CPT04	CPT05
PGA	0.14g	0.14g	0.14g
Magnitude	6.2	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1	1
Depth to groundwater for design (m)	1	1	1
Predrill depth (m)	1.5	0	0
Assumed predrill tip resistance and skin friction		qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.04	2.5	17.76
Minimum depth of analysis (m)	0	0	0
Maximum depth of analysis (m)	17.58	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152809	CPT03	0	1.5	0
NZGD 152809	CPT03	1.5	17.58	2.6
NZGD 152810	CPT04	0	0	0
NZGD 152810	CPT04	0	2.5	2.6
NZGD 153039	CPT05	0	0	0
NZGD 153039	CPT05	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152809	CPT03	1.5	17.58	0 CFC
NZGD 152810	CPT04	0	2.5	0 CFC
NZGD 153039	CPT05	0	17.58	0 %



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	39	1.5	1	5	6	0					
50%	14	0	0	2	15.6	0					
85%	7	0	0	1	15.6	0					

Reviewed by:

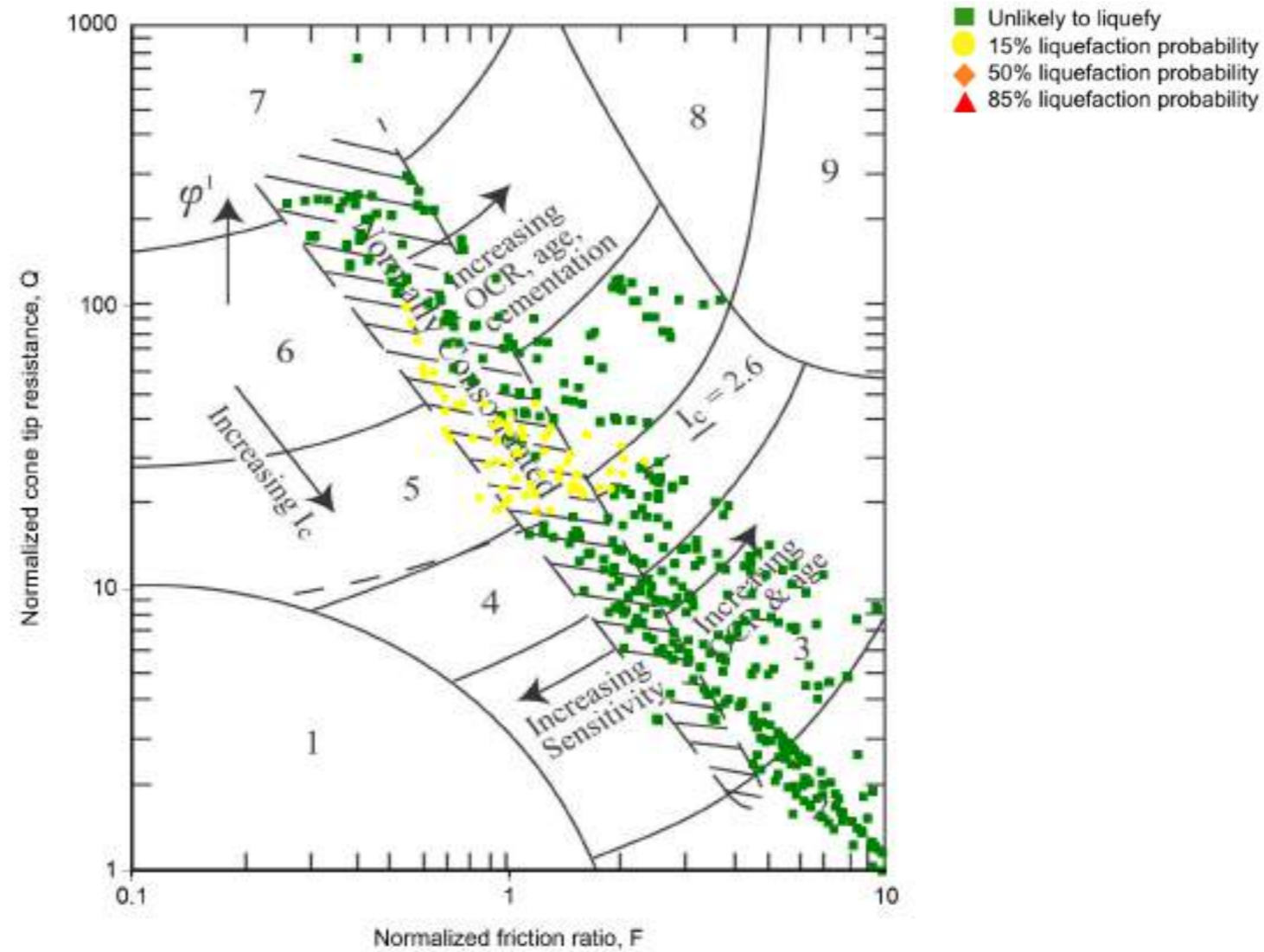
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

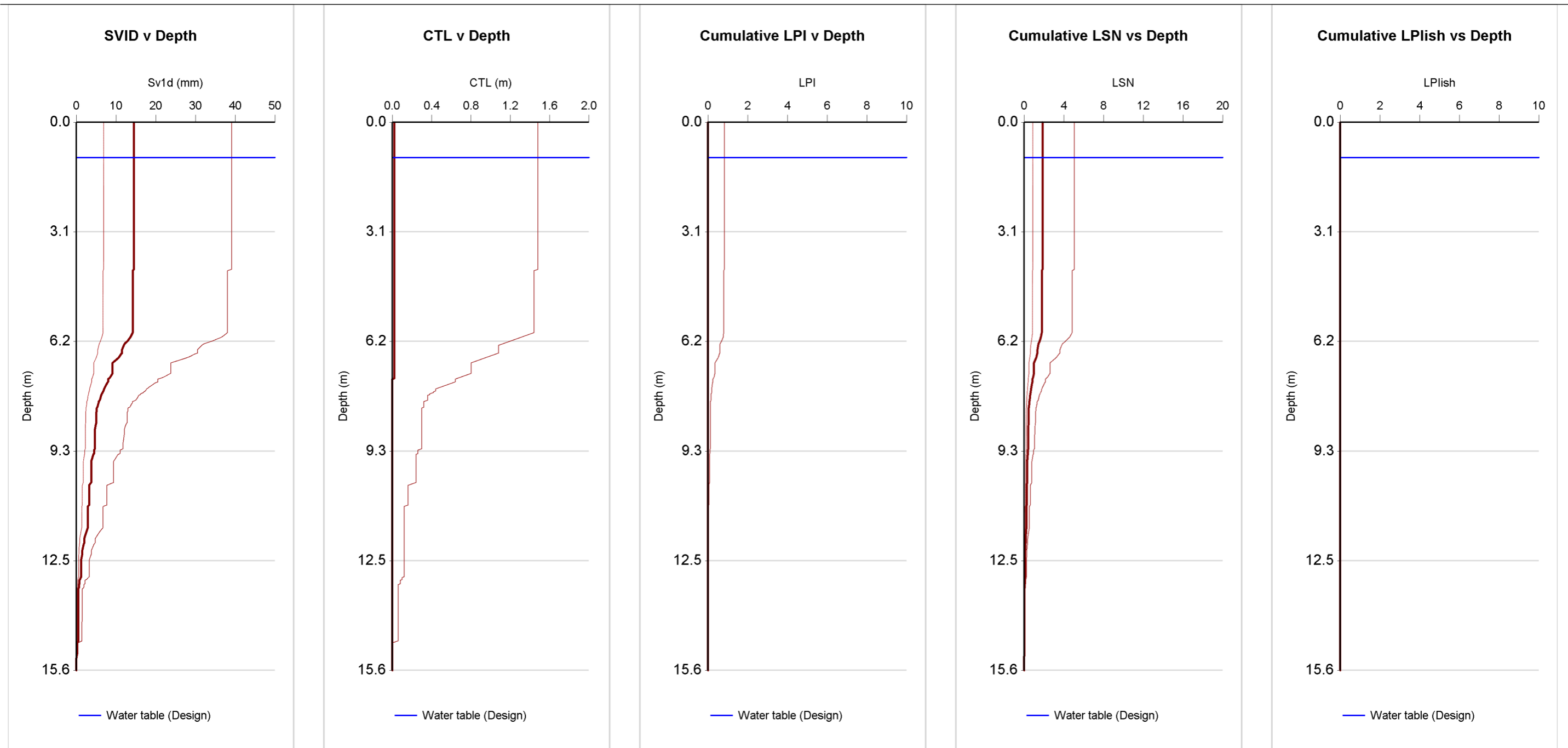


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

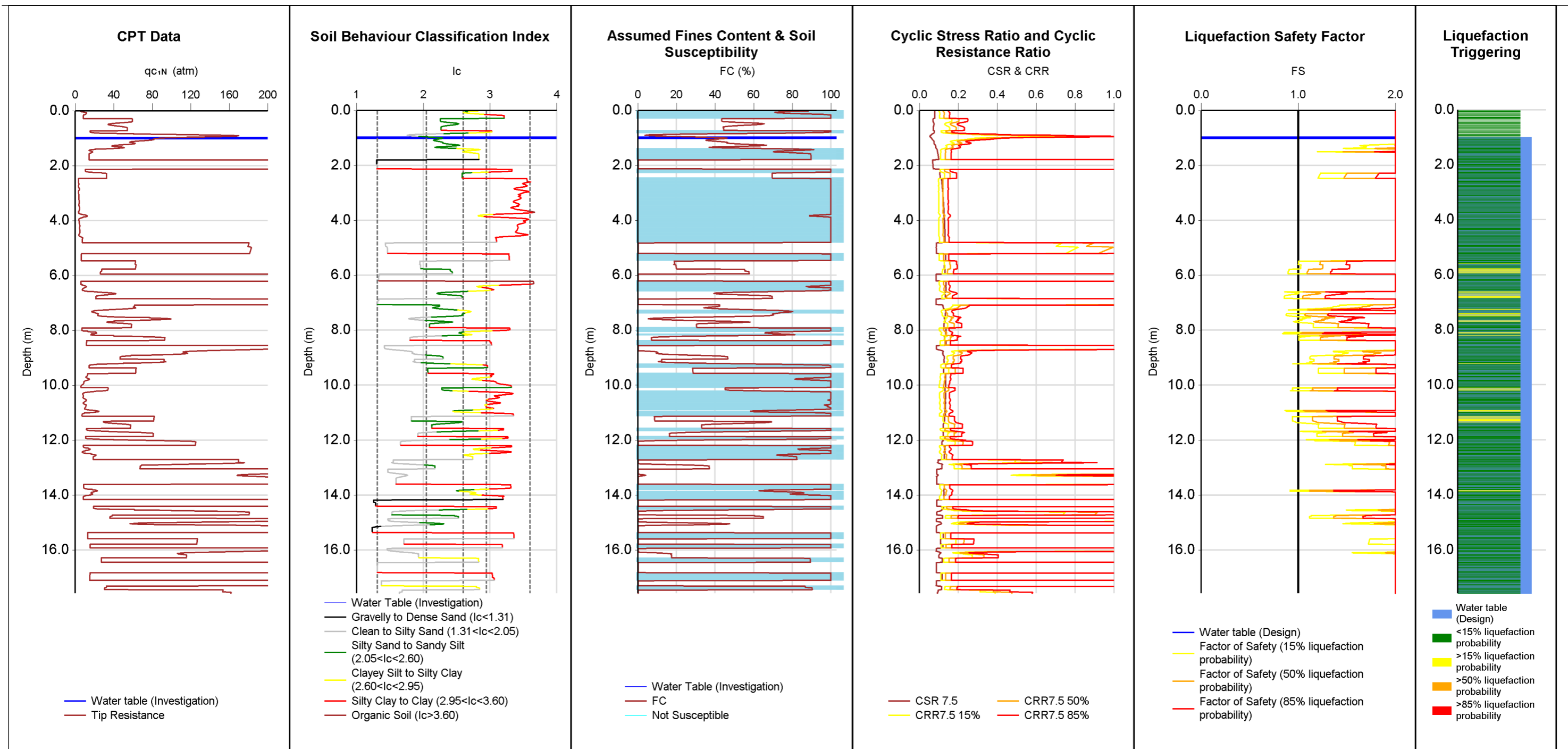
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	<p>CLIENT Napier City Council</p>	<p>LOCATION Napier</p>	<p>DATE 15/02/2021</p>
	<p>PROJECT Onekawa Aquatic Centre</p>	<p>JOB NUMBER 1009171</p>	<p>ANALYSED zafr</p>
	<p>TITLE SLS - Onekawa Aquatic Centre Liquefaction Analysis</p> <p>COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]</p>	<p>PAGE 3 of 9 pages</p>	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	37	1.2	1	5	5.8	0					
50%	14	0	0	2	17.6	0					
85%	7	0	0	1	17.6	0					

Reviewed by:

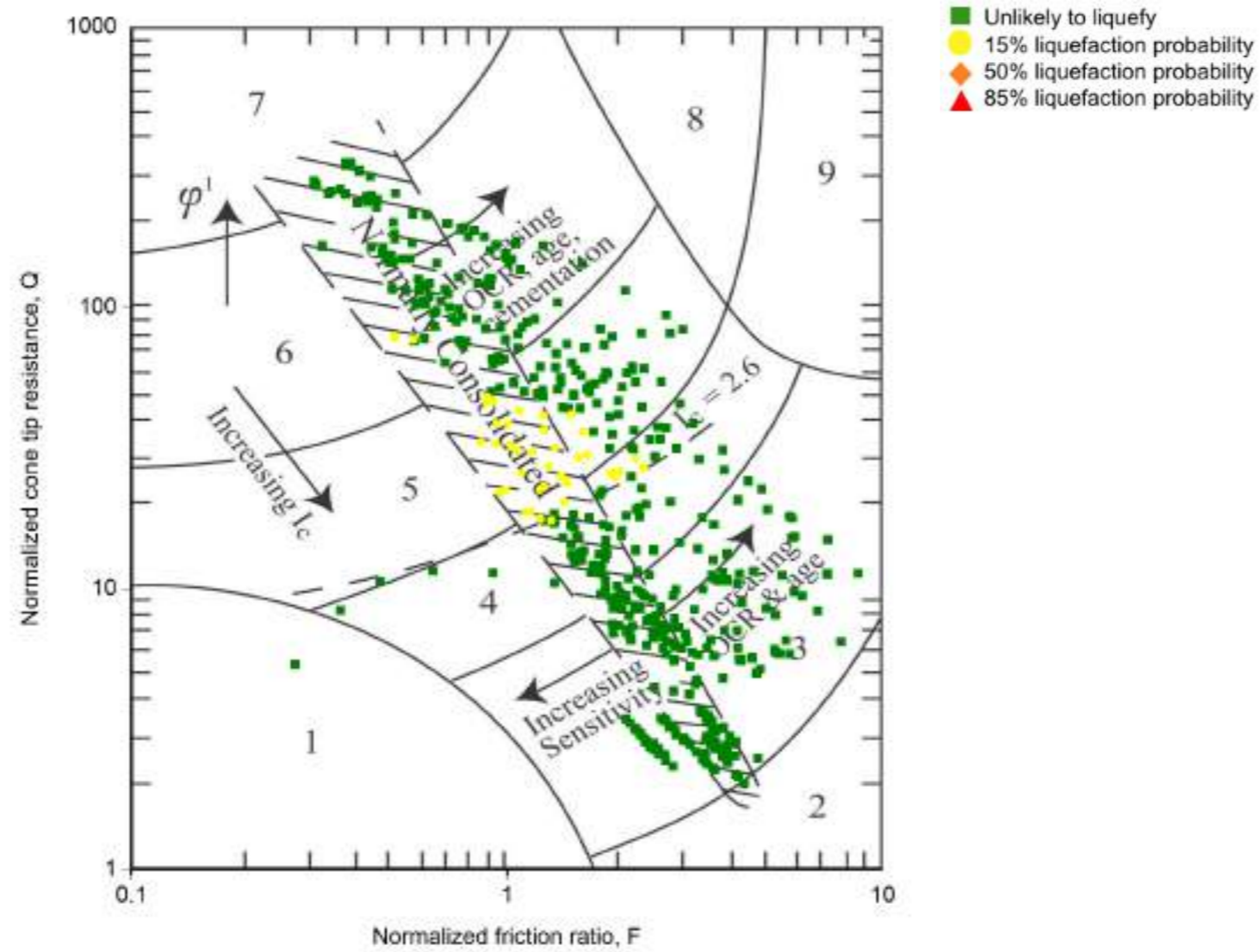
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

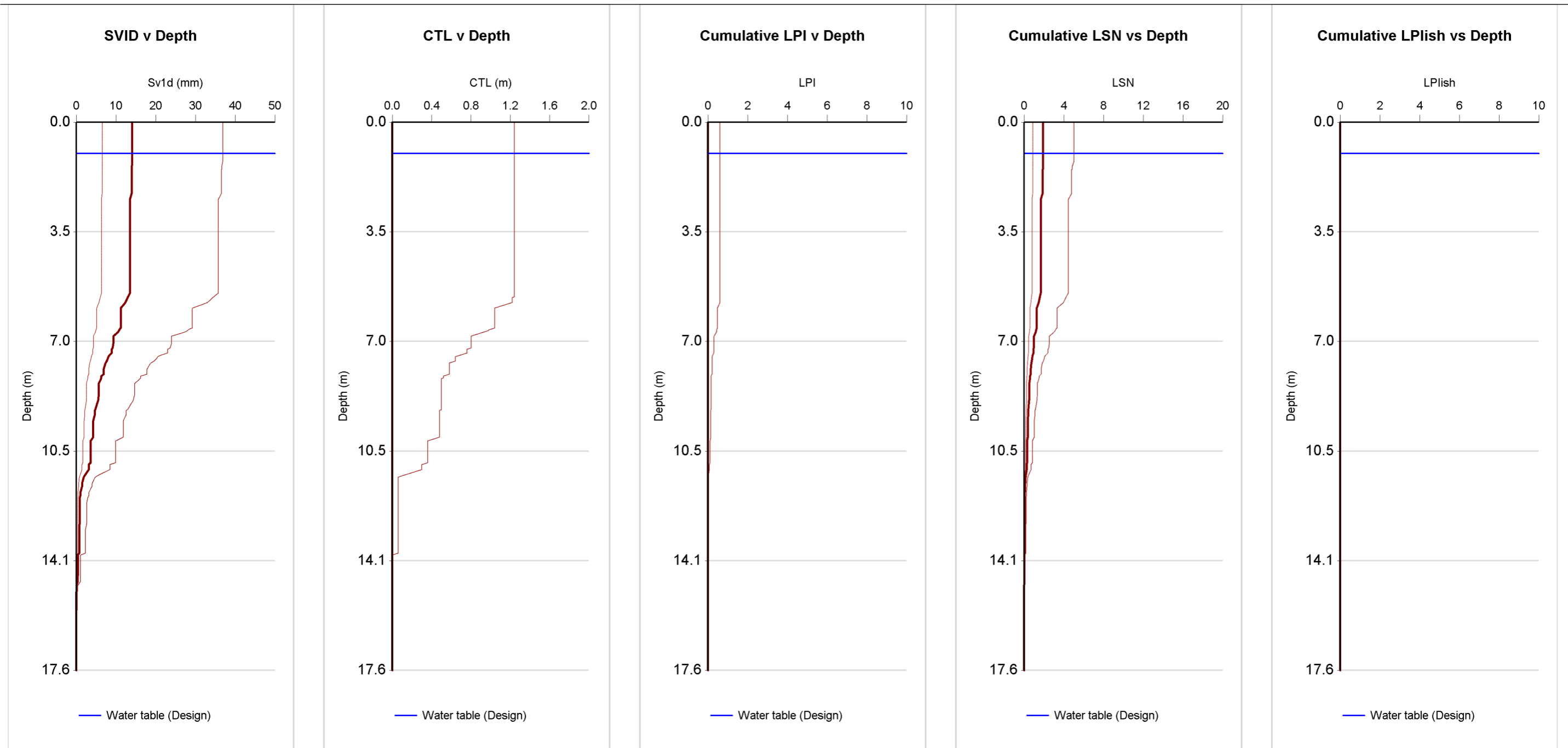


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

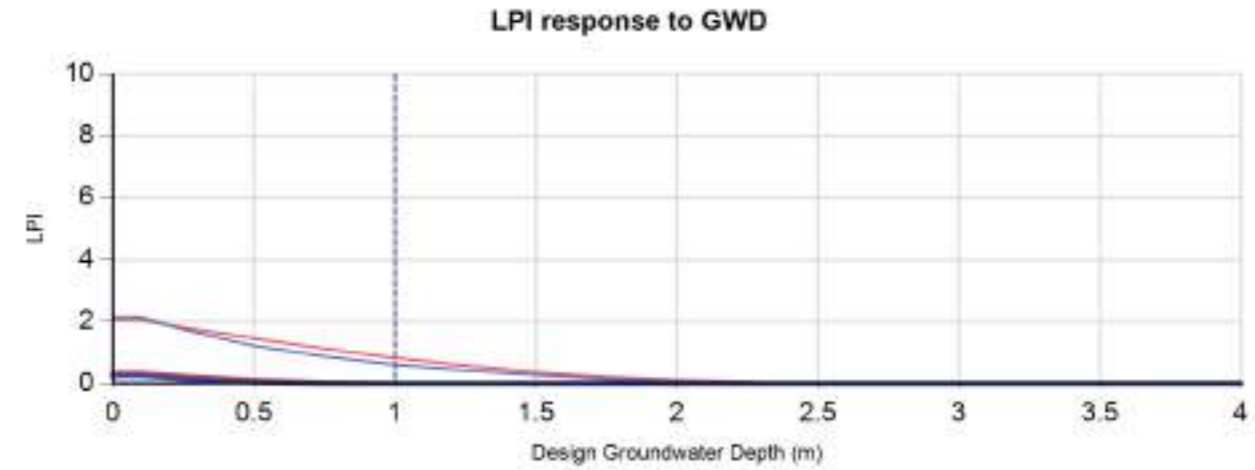
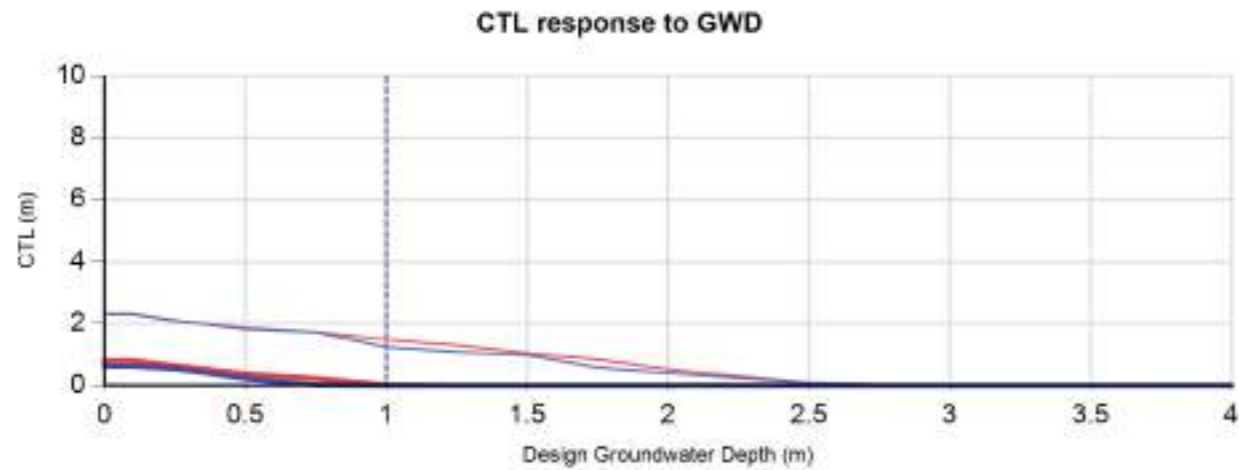
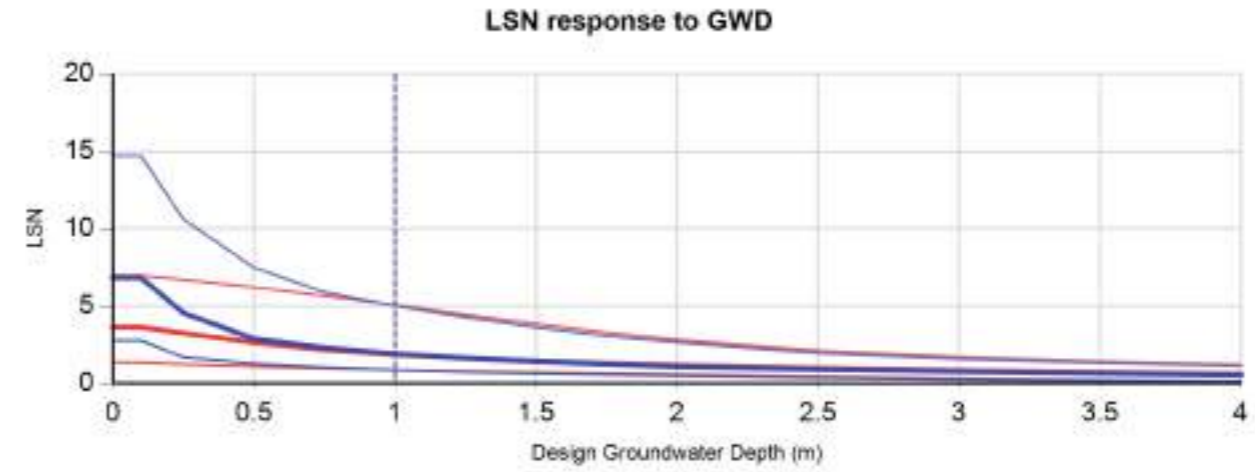
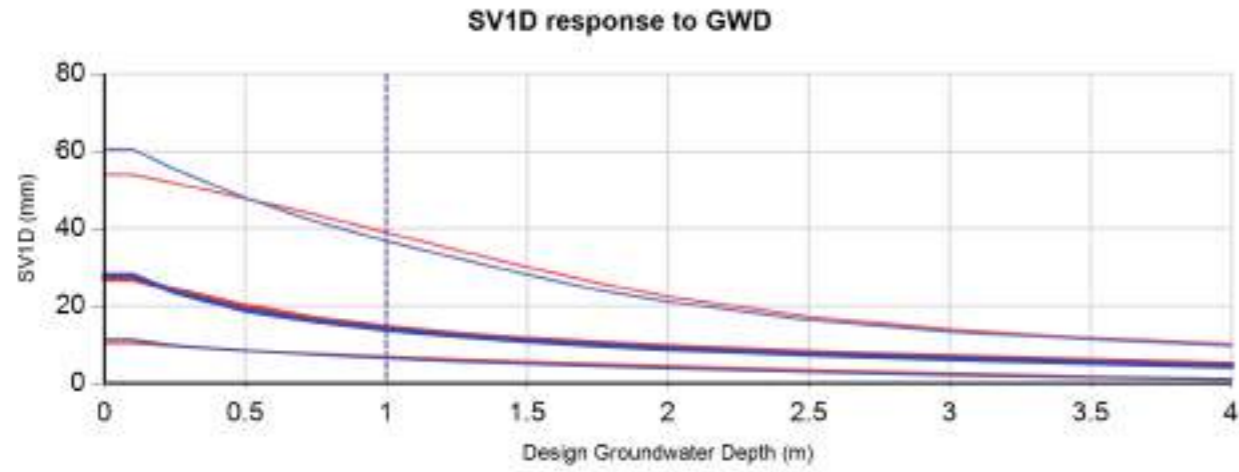
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]				




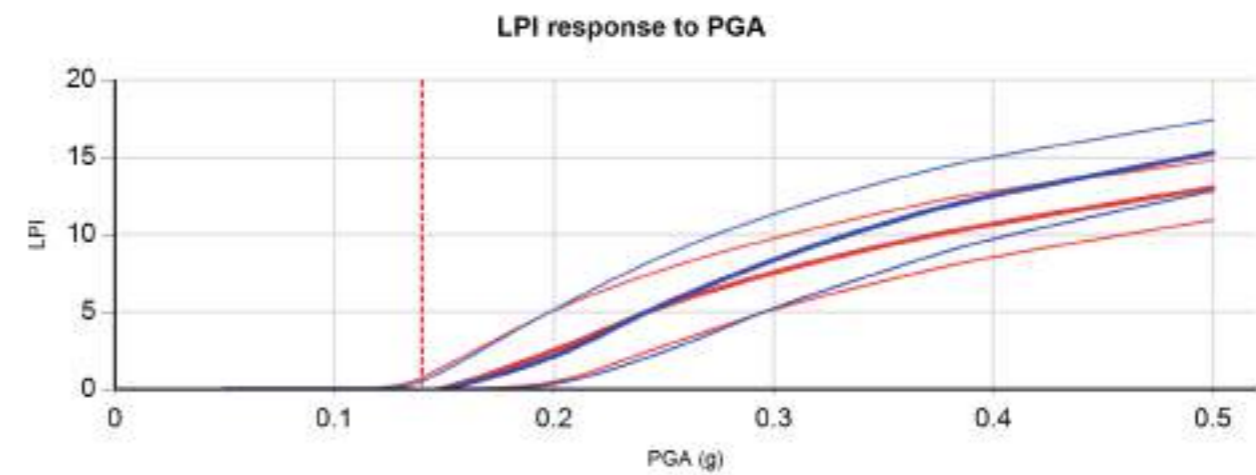
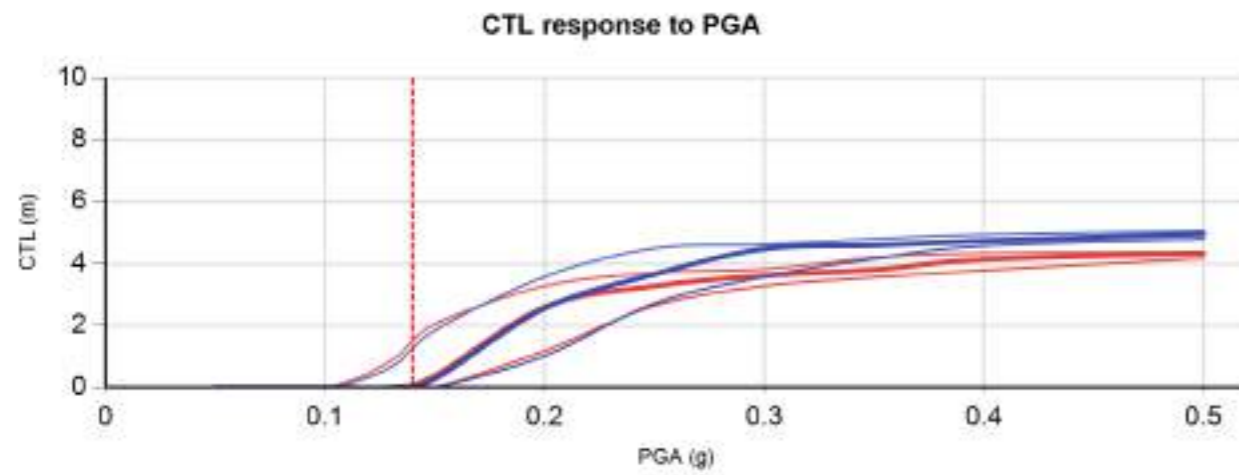
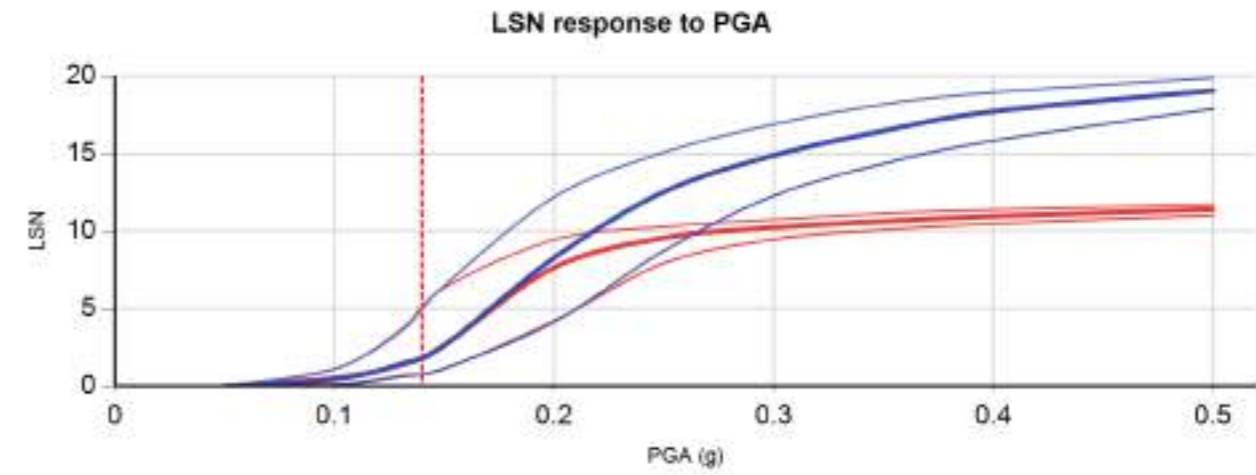
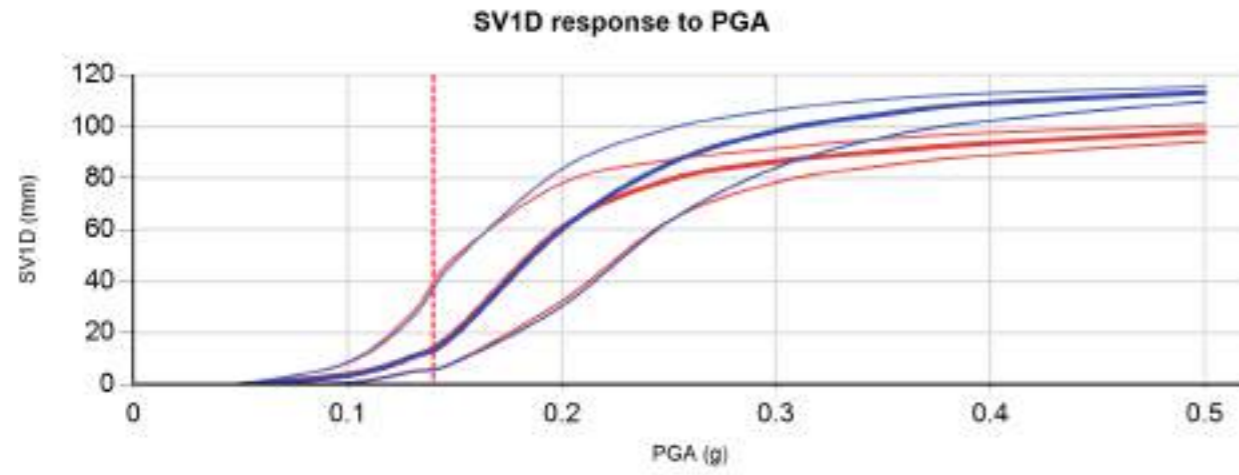
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]					




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 6 - 7]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

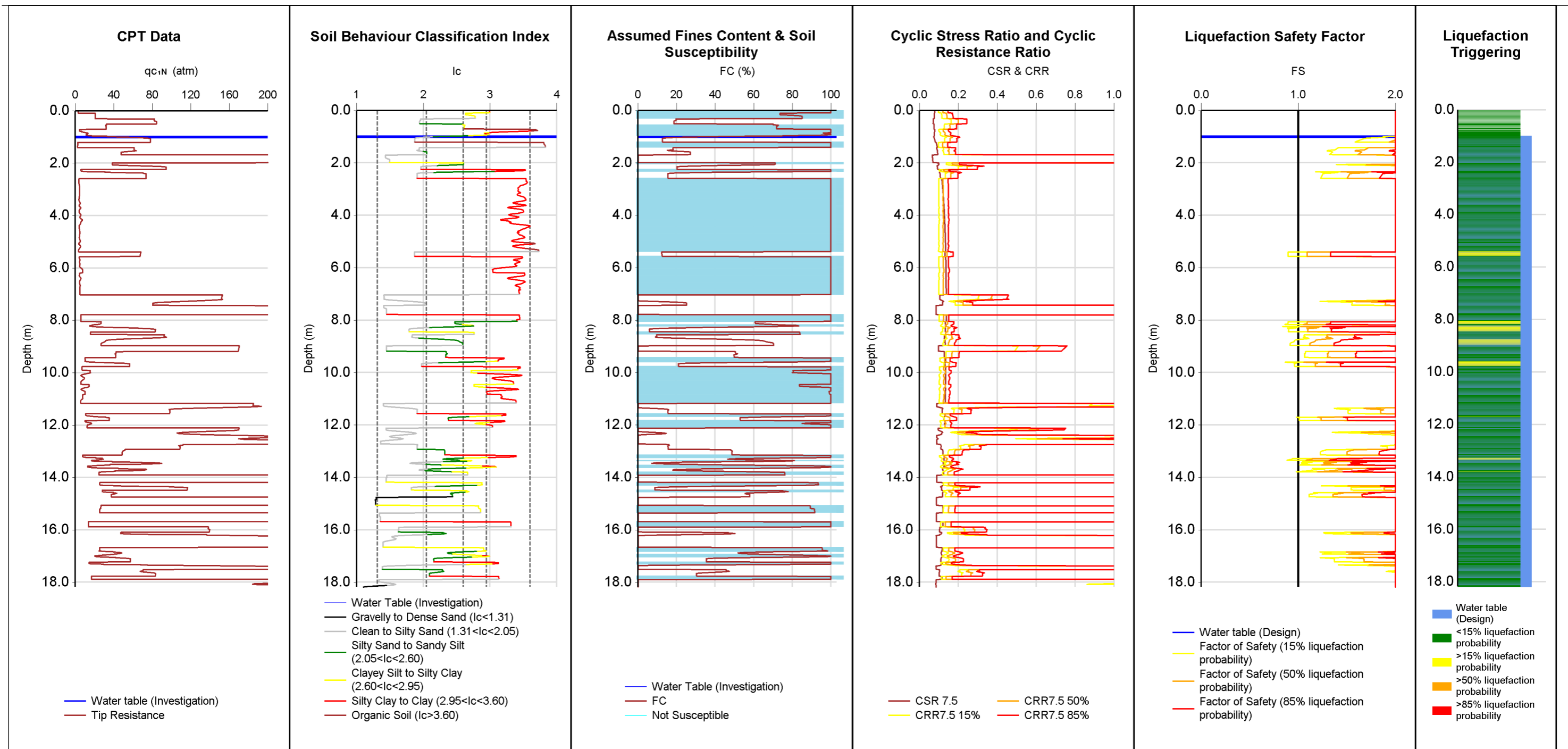
ID	NZGD 152811	NZGD 152812
CPT Name	CPT06	CPT07
Run description	CPT06	CPT07
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	15.58	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152811	CPT06	0	0	0
NZGD 152811	CPT06	0	15.58	2.6
NZGD 152812	CPT07	0	0	0
NZGD 152812	CPT07	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152811	CPT06	0	15.58	0 CFC
NZGD 152812	CPT07	0	17.58	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT08	152813	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	31	1.1	0	4	5.5	0					
50%	12	0	0	2	18.2	0					
85%	5	0	0	1	18.2	0					

Reviewed by:

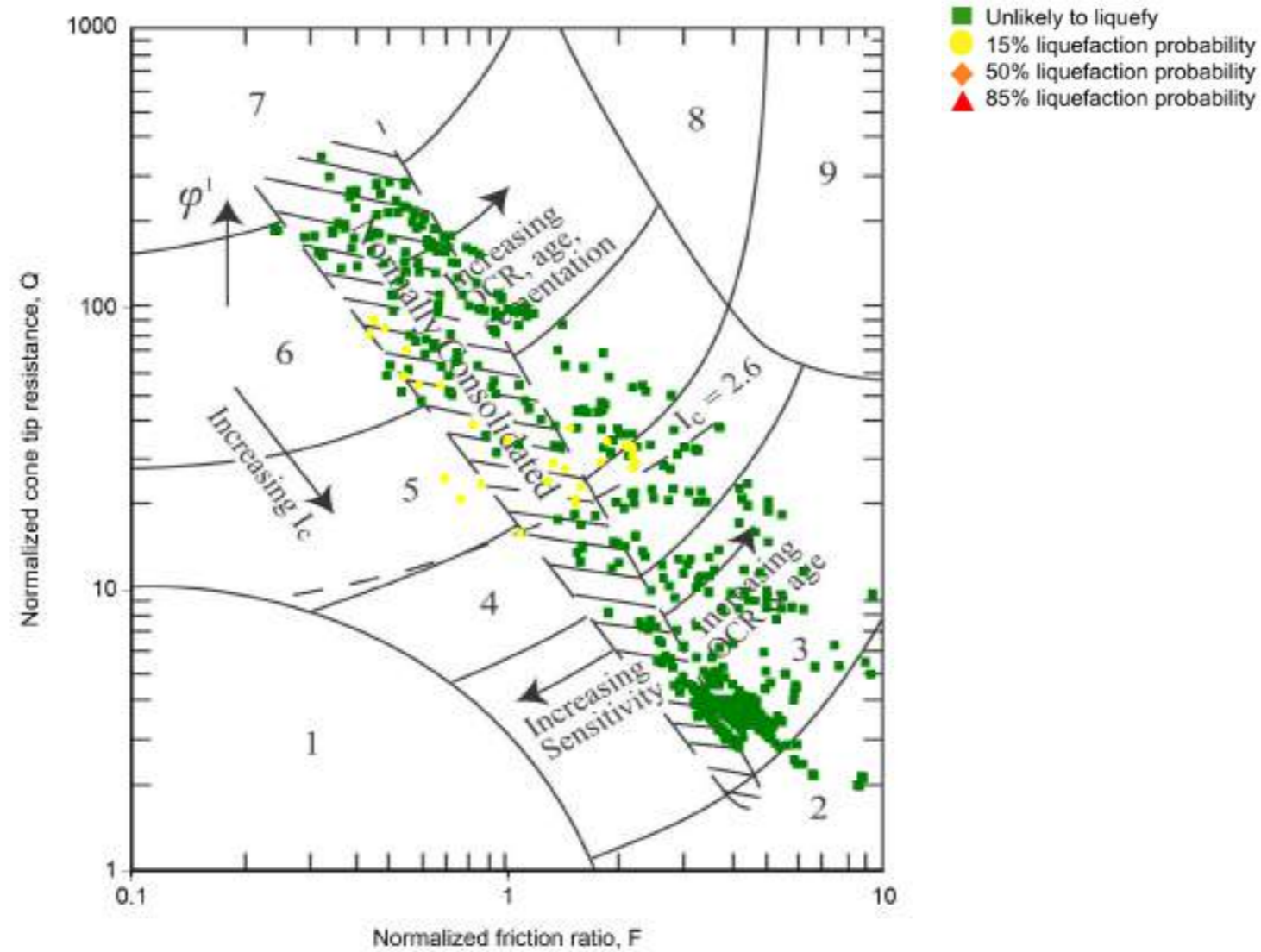
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

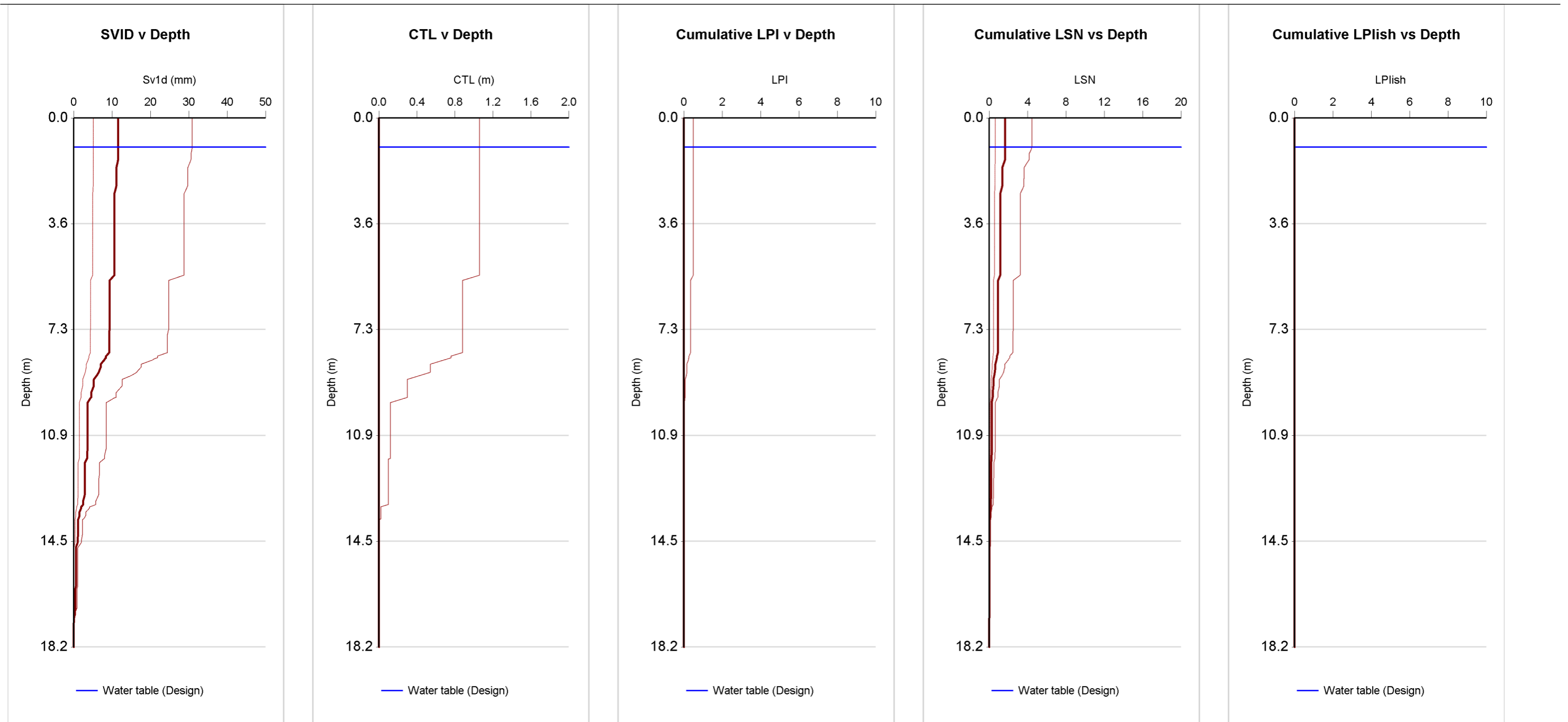


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

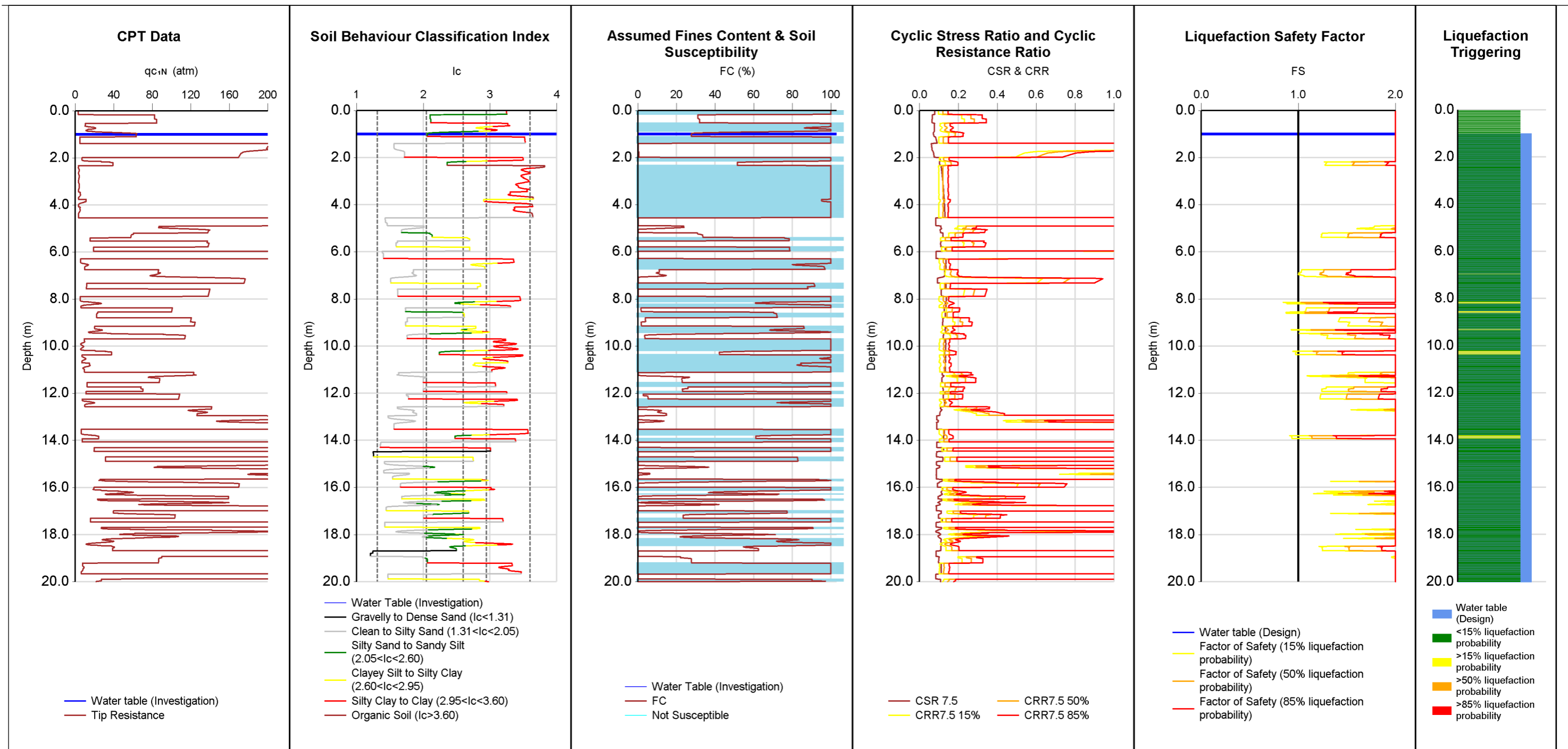
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT08	152813	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	19	0.5	0	2	8.2	0					
50%	8	0	0	1	20	0					
85%	3	0	0	0	20	0					

Reviewed by:

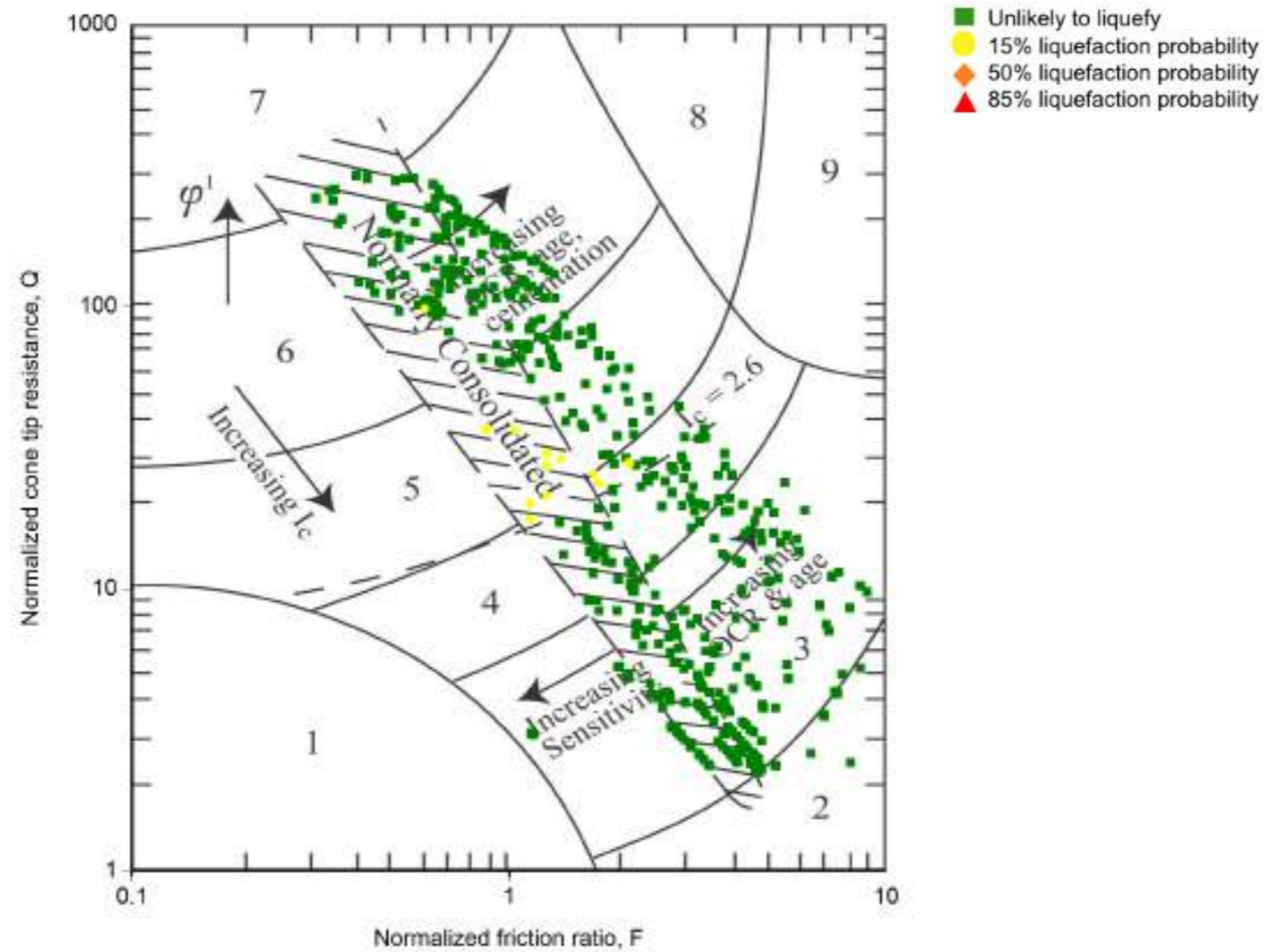
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

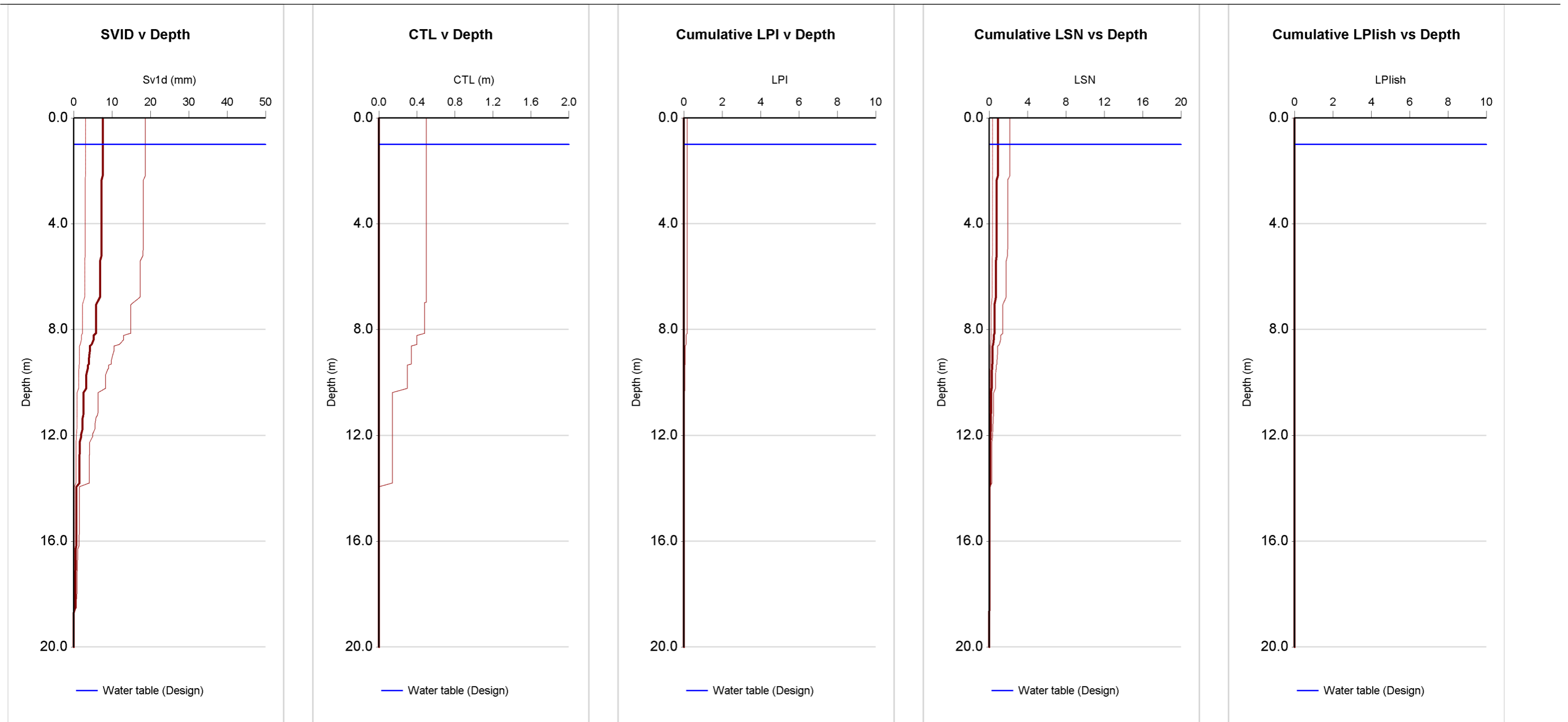


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
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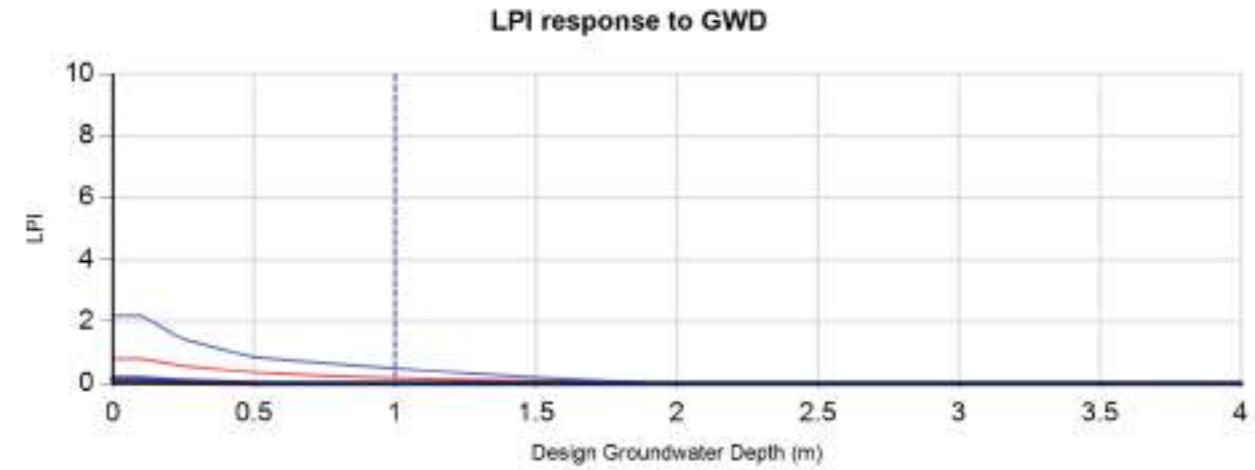
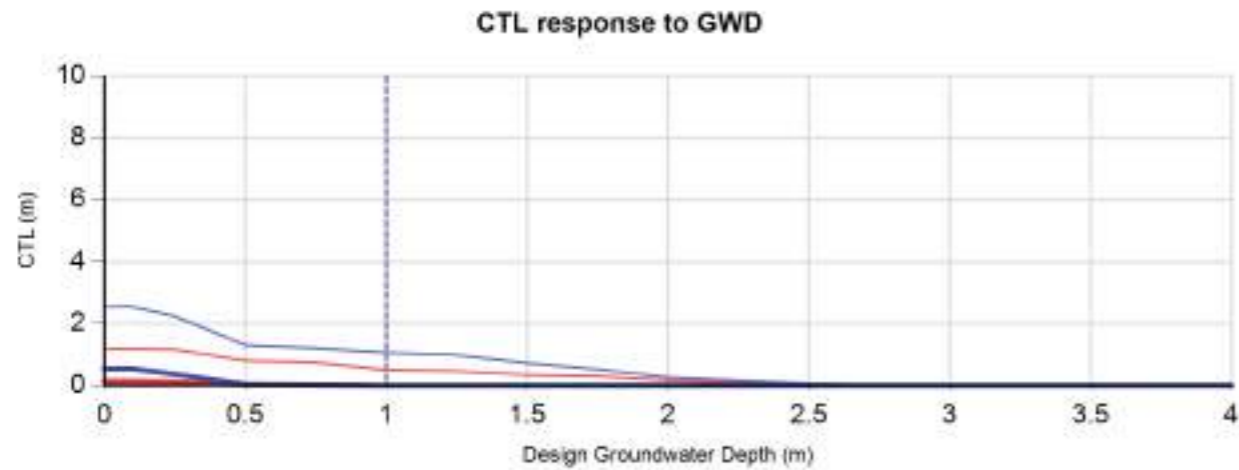
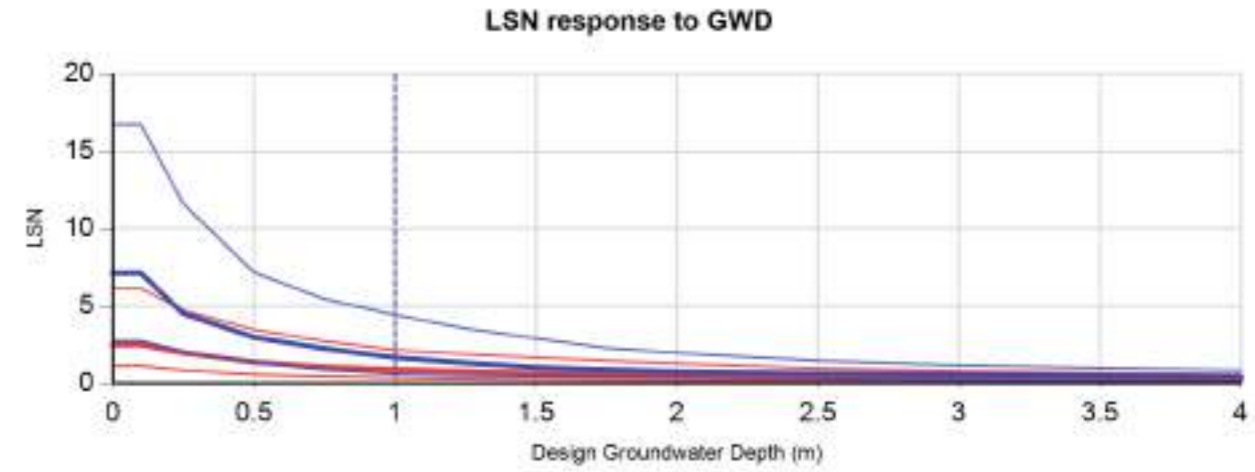
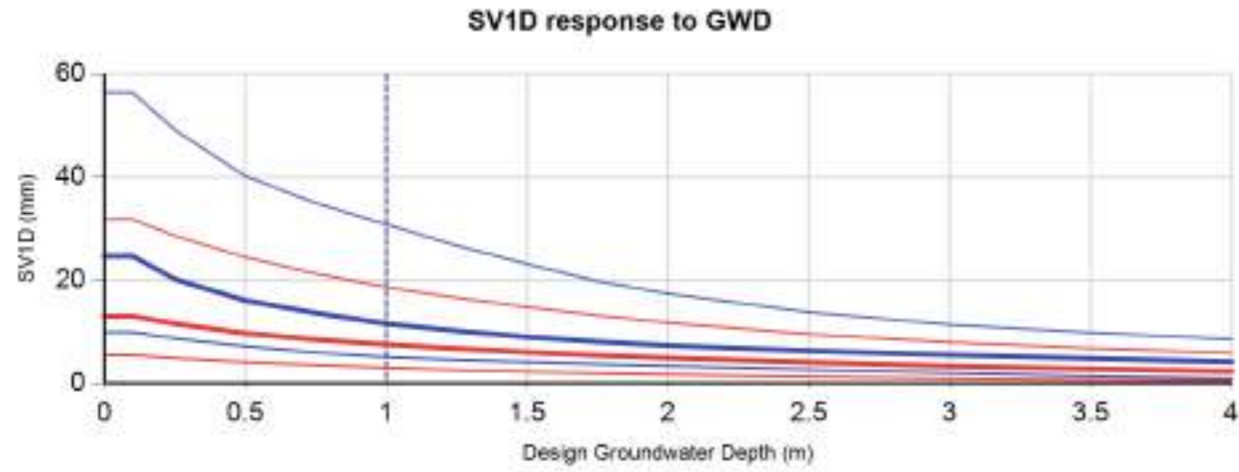
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	ANALYSED	zafr		
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]				




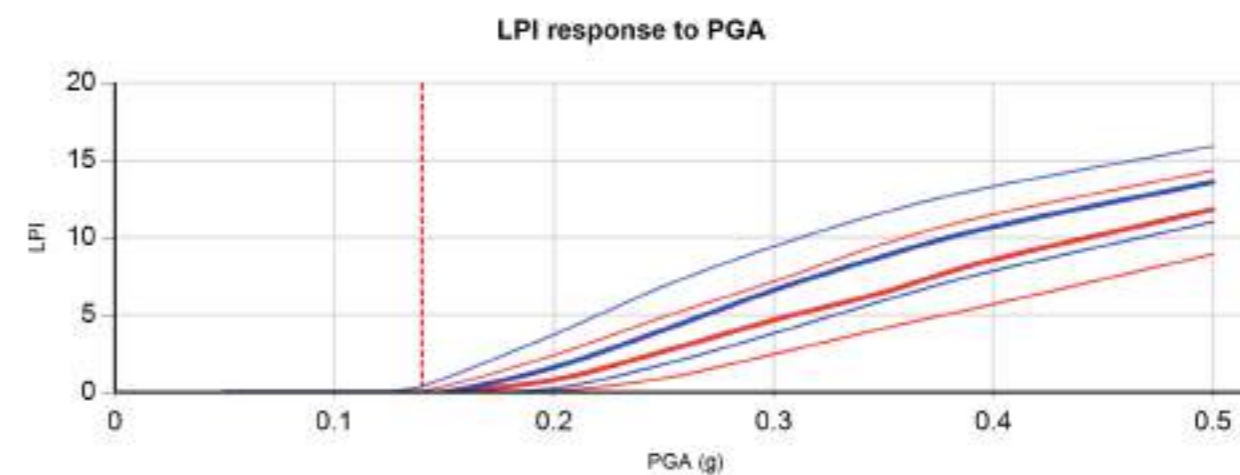
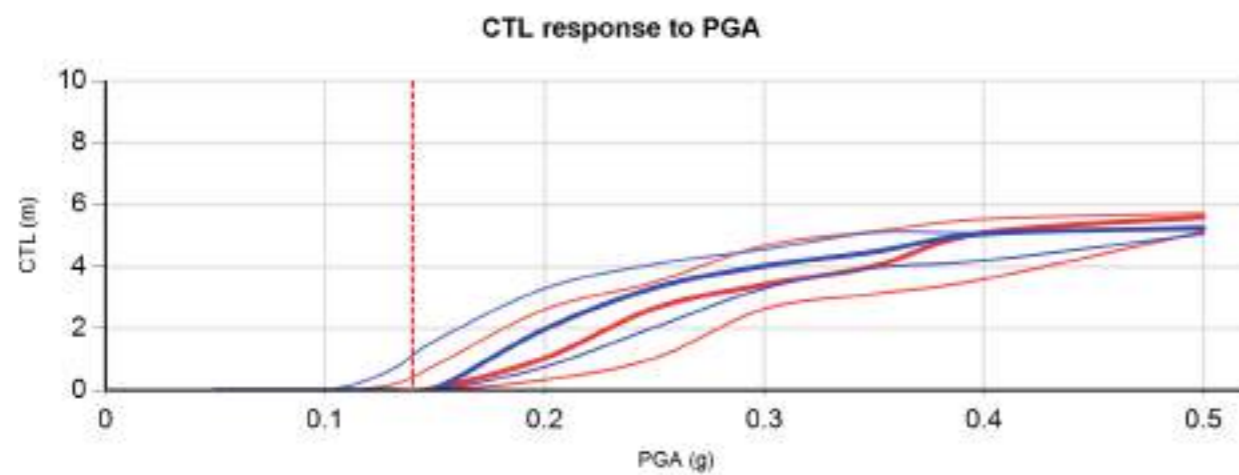
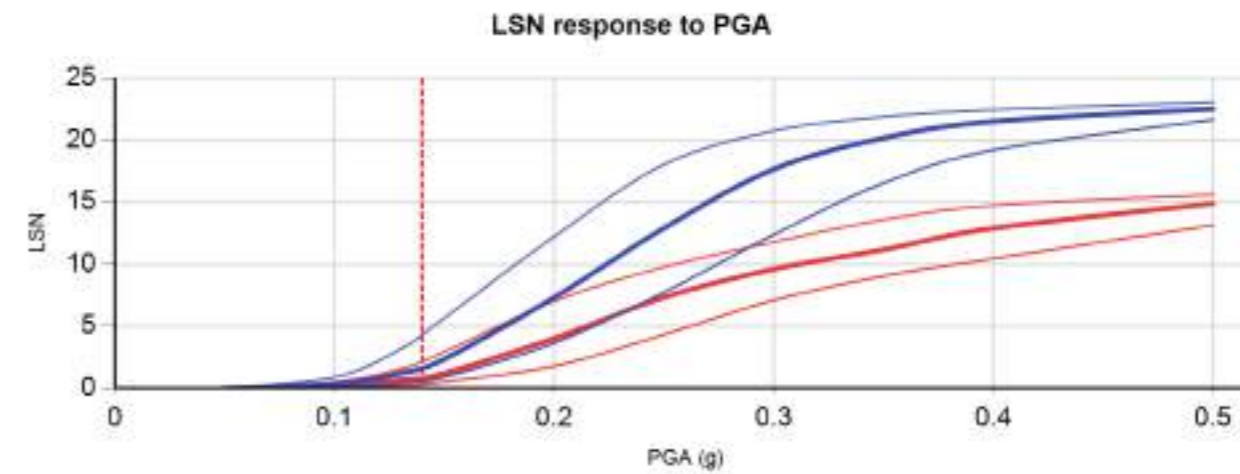
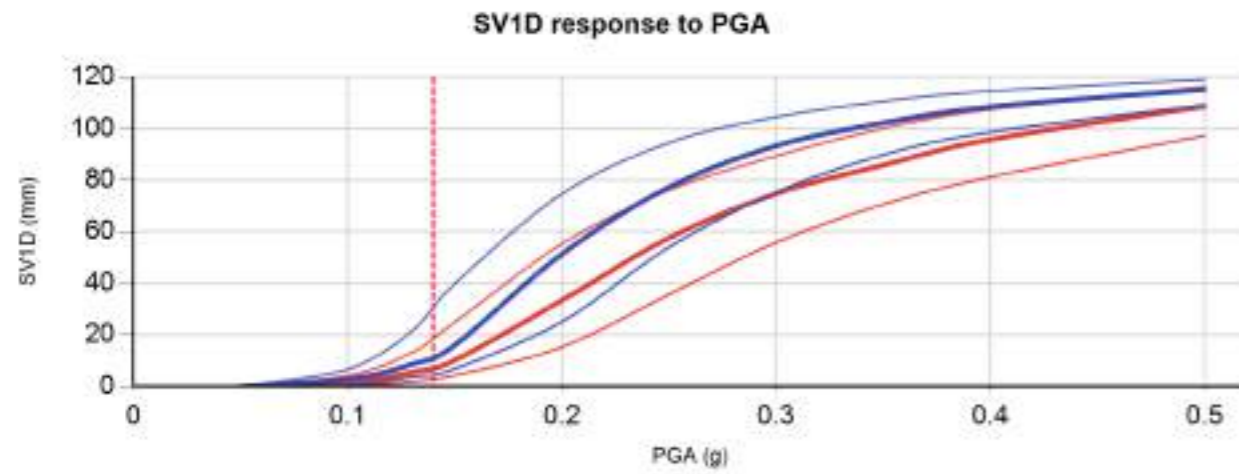
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 8 - 9]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

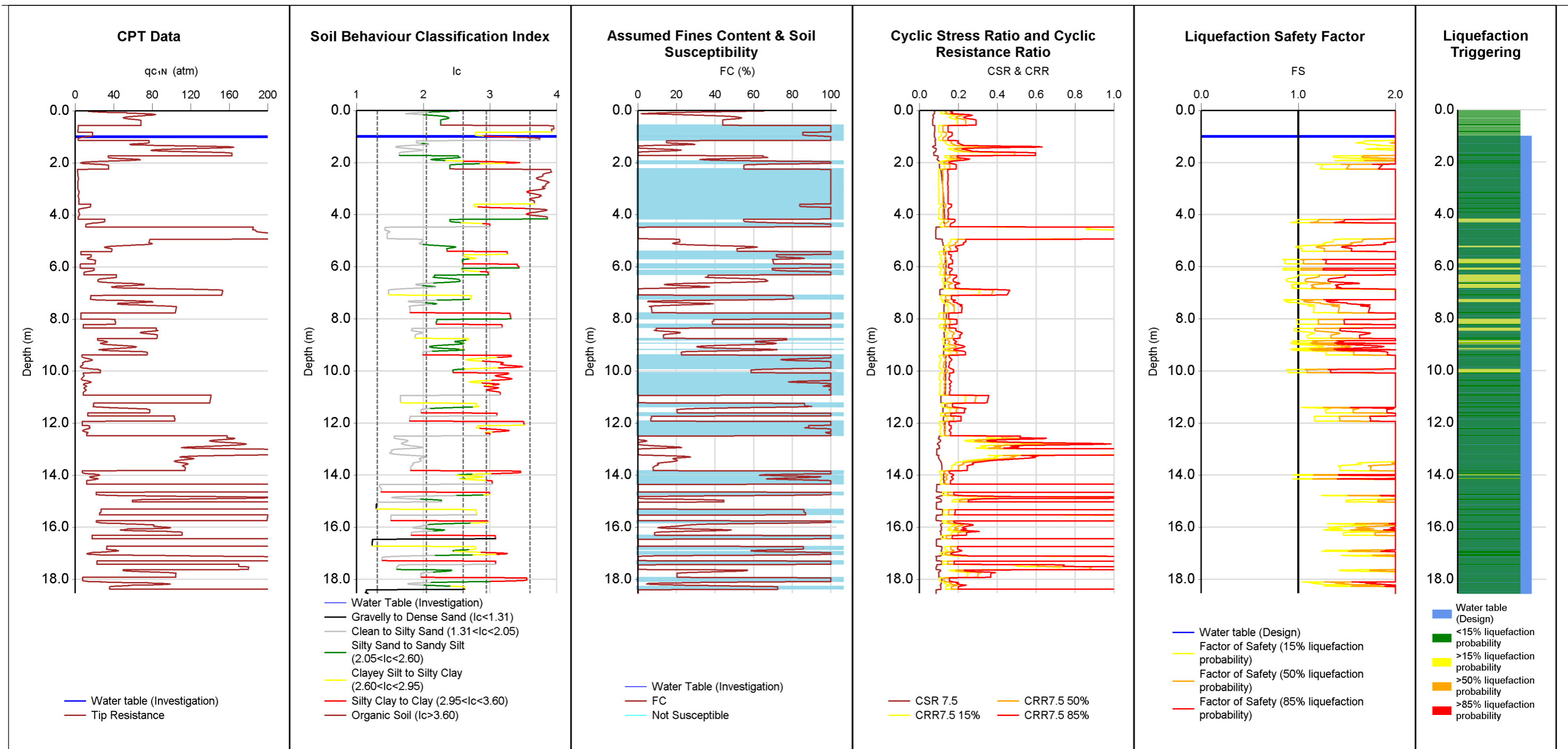
ID	NZGD 152814	NZGD 152813
CPT Name	CPT09	CPT08
Run description	CPT09	CPT08
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	18.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152814	CPT09	0	0	0
NZGD 152814	CPT09	0	20	2.6
NZGD 152813	CPT08	0	0	0
NZGD 152813	CPT08	0	18.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152814	CPT09	0	20	0 CFC
NZGD 152813	CPT08	0	18.18	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT10	152815	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	44	1.8	1	7	4.3	0					
50%	17	0	0	2	18.5	0					
85%	7	0	0	1	18.5	0					

Reviewed by:

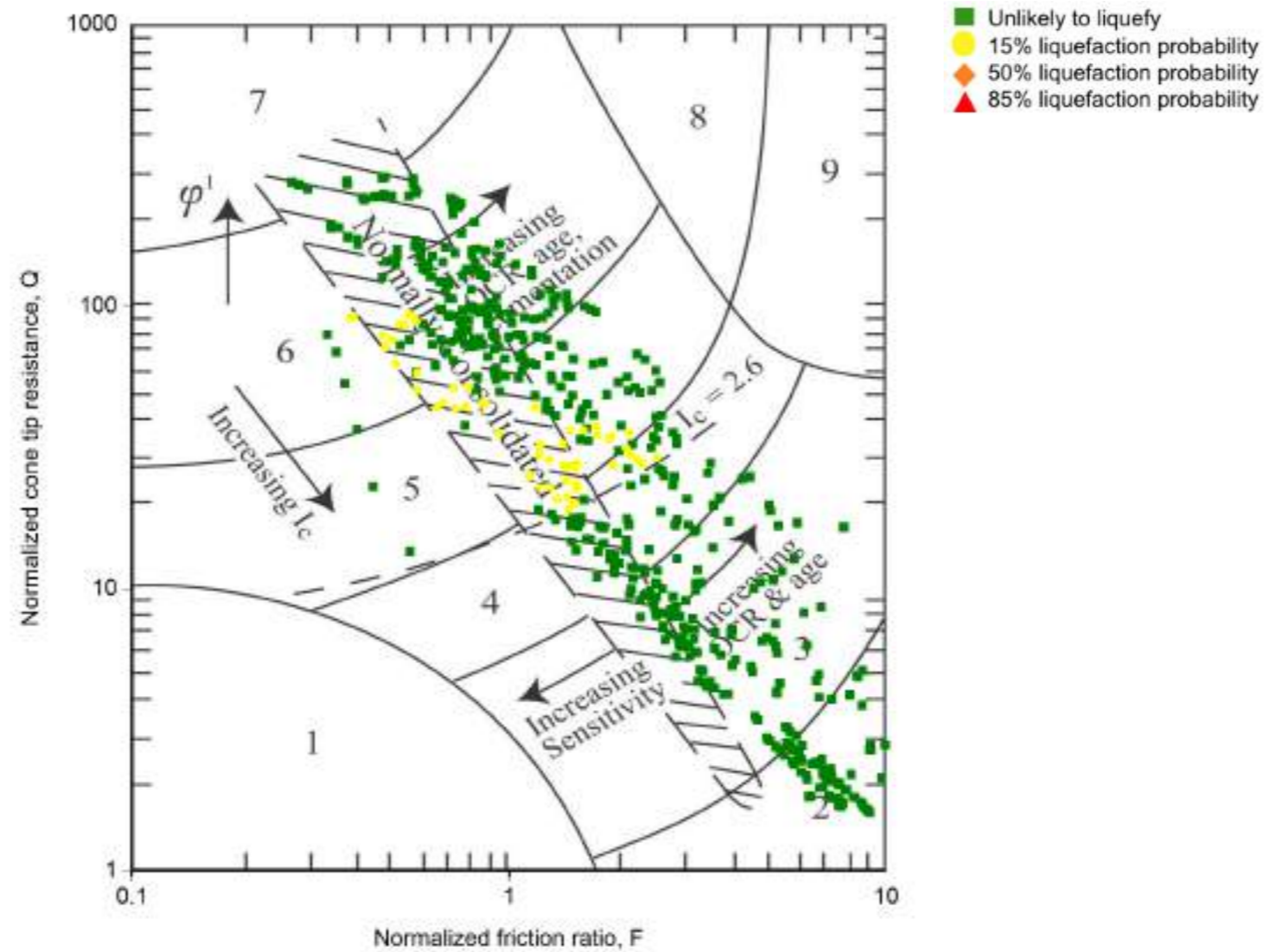
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]


LOCATION **Napier**
DATE **15/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**

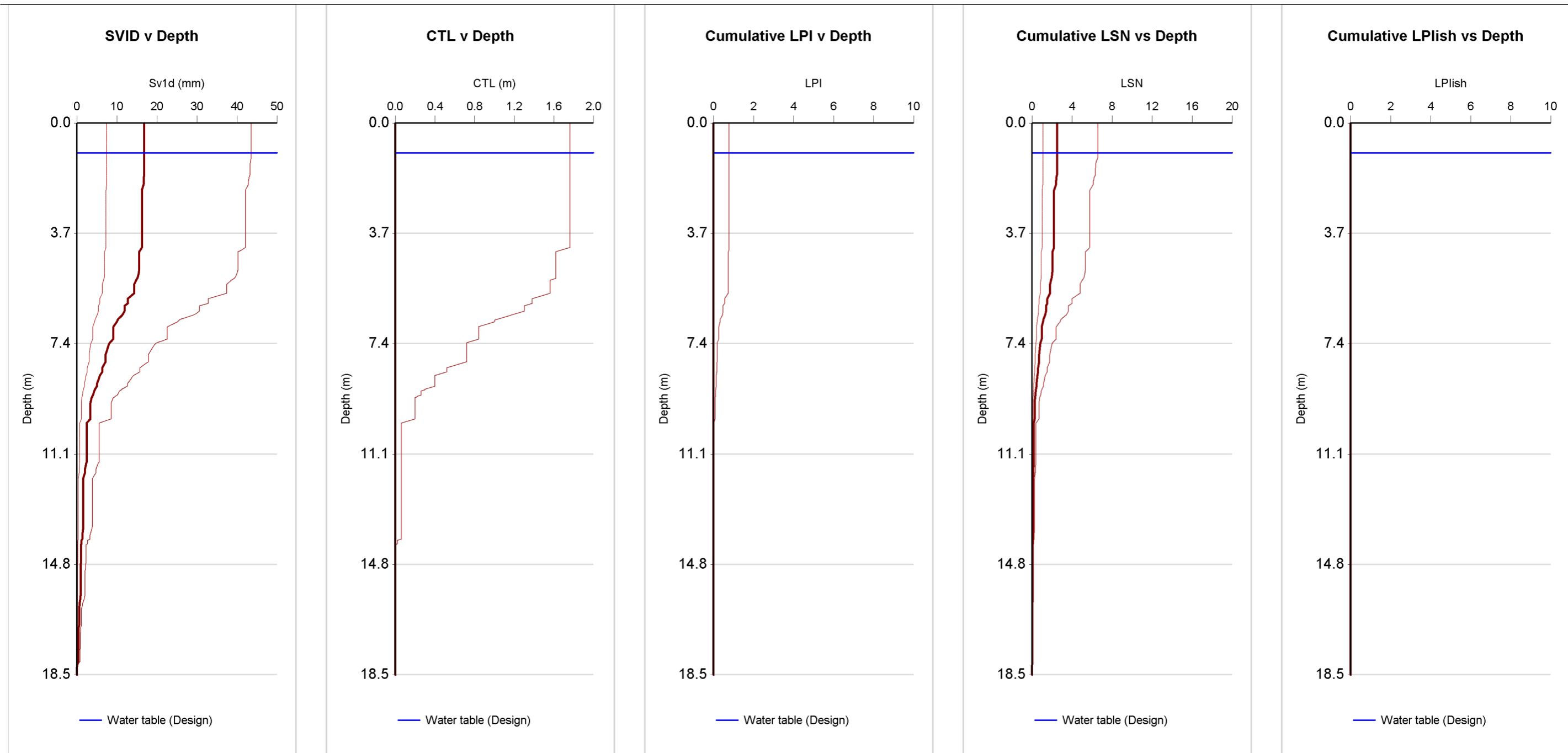


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|--|-------------------------------------|
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
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*Heavily overconsolidated or cemented

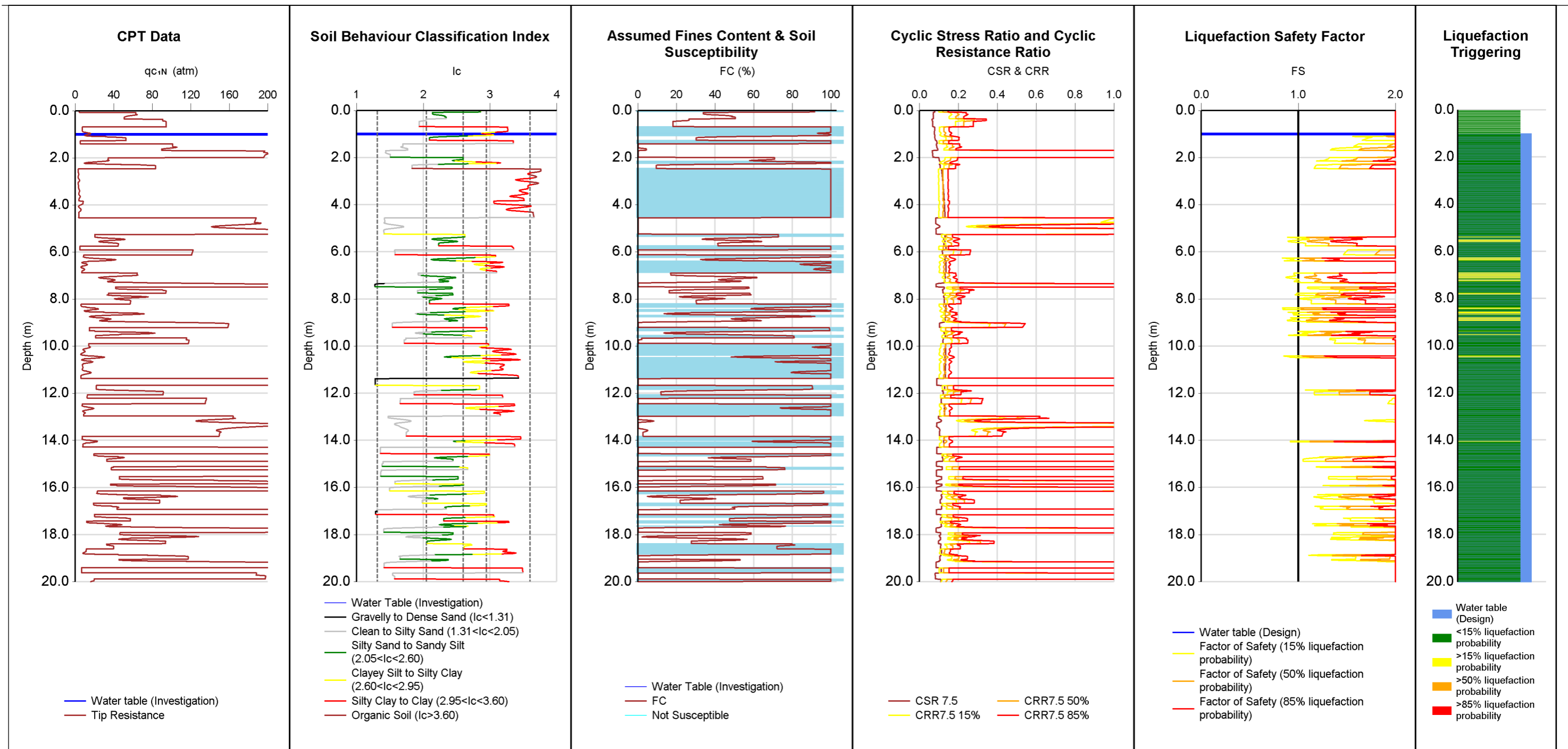
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT10	152815	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]					



Note: Inverse filtered Qc/Fs data (10 cm²) used.

INPUT		Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
		CPT11	152816	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
OUTPUT		PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
		15%	37	1.3	1	5	5.5	0					
		50%	14	0	0	2	20	0					
		85%	6	0	0	1	20	0					

Reviewed by:

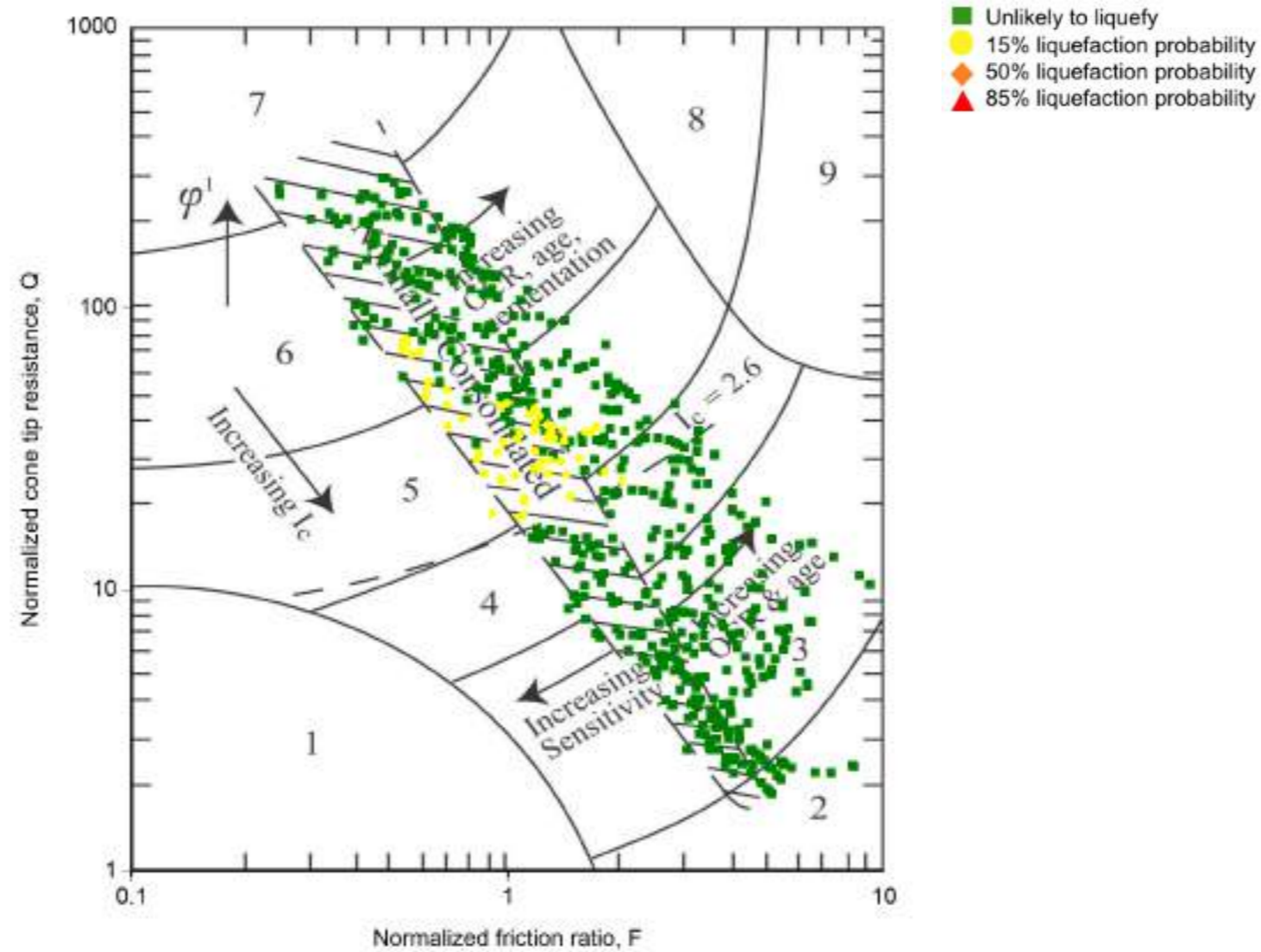
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

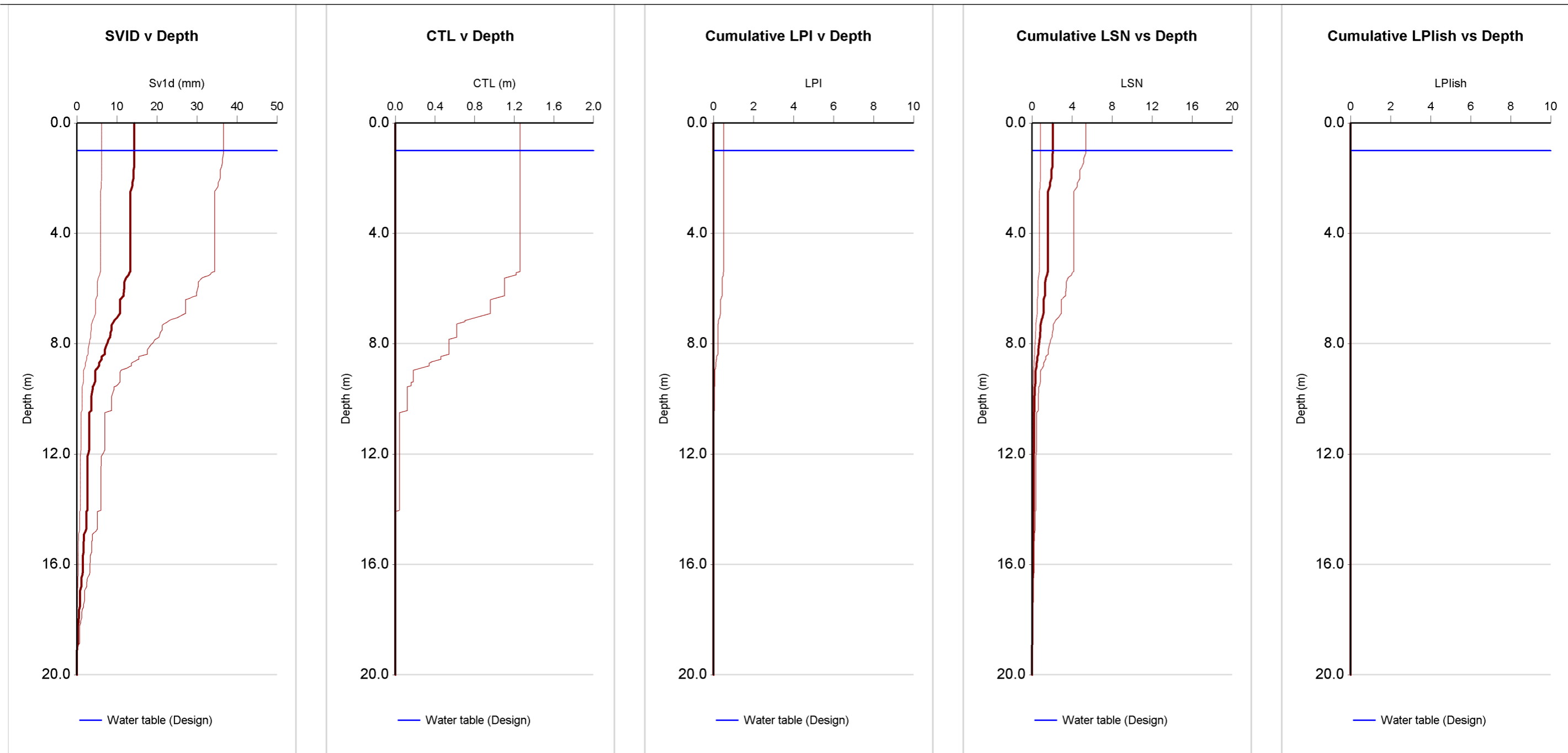


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|--|-------------------------------------|
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CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]				



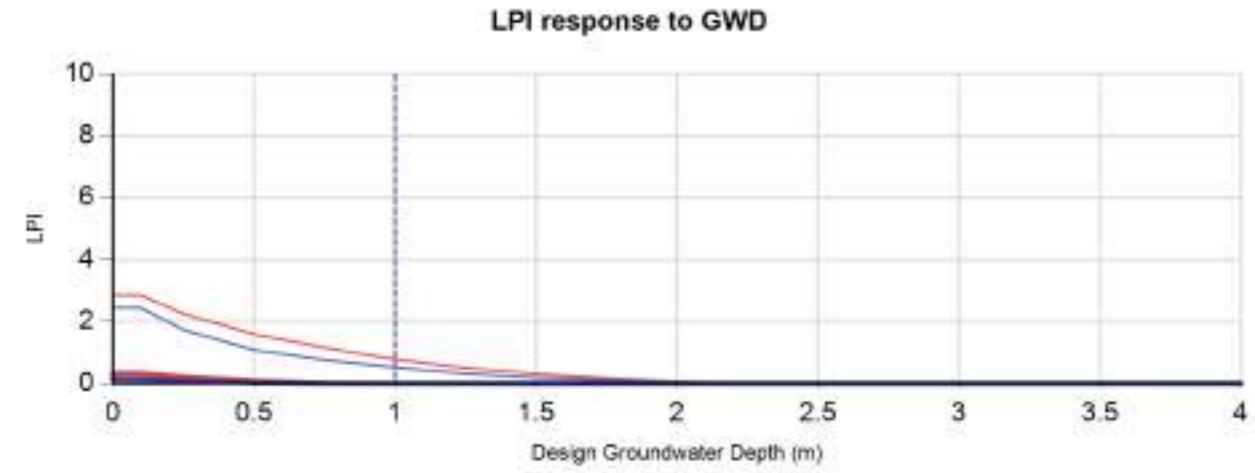
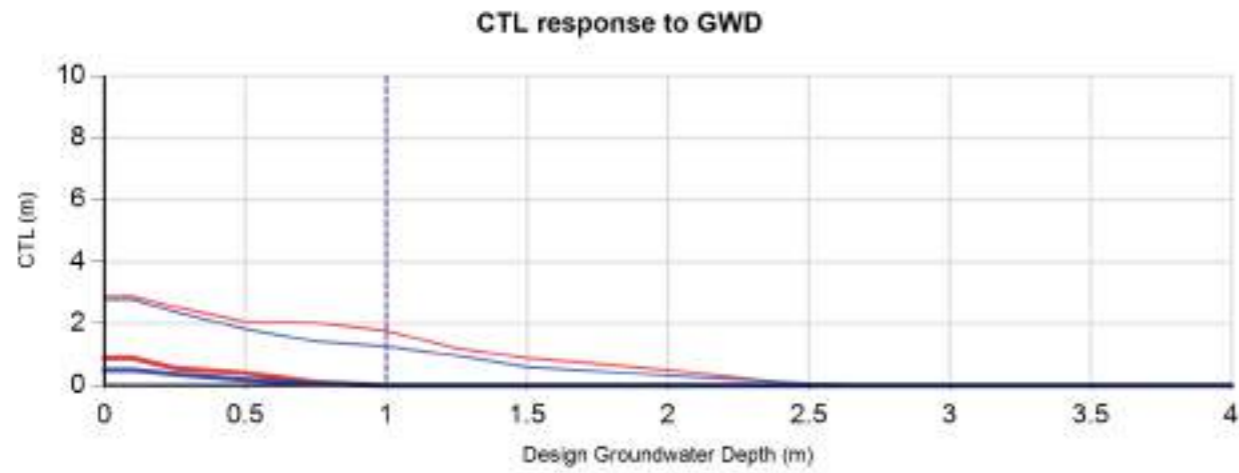
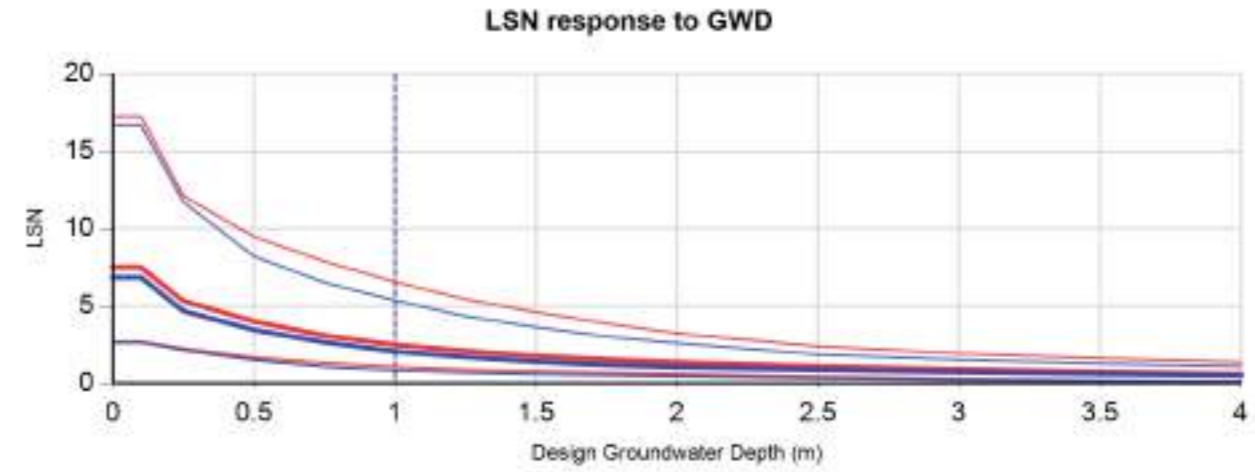
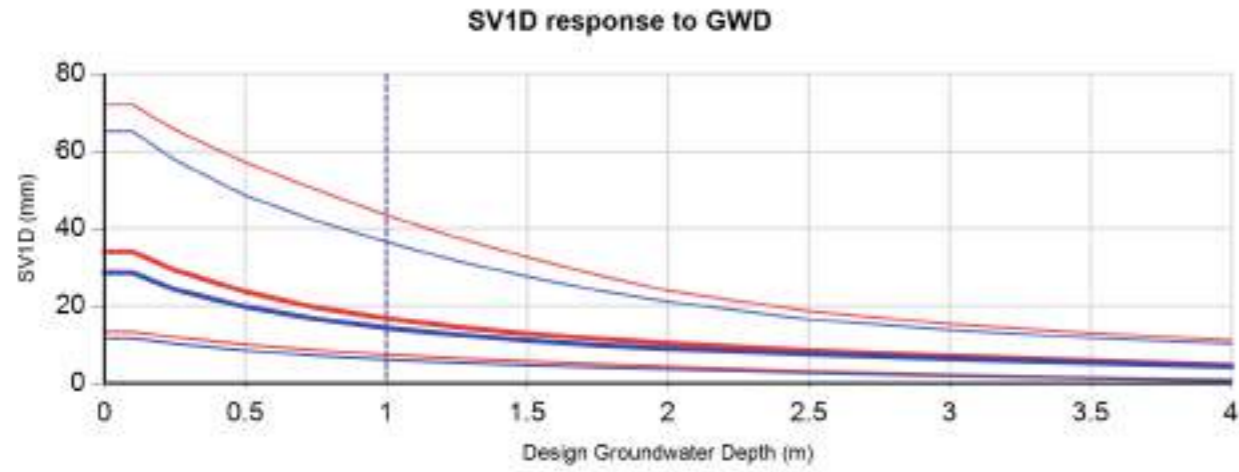
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT11	152816	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	



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 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]

LOCATION	Napier	DATE	15/02/2021
		ANALYSED	zafr
JOB NUMBER	1009171	PAGE	6 of 9 pages

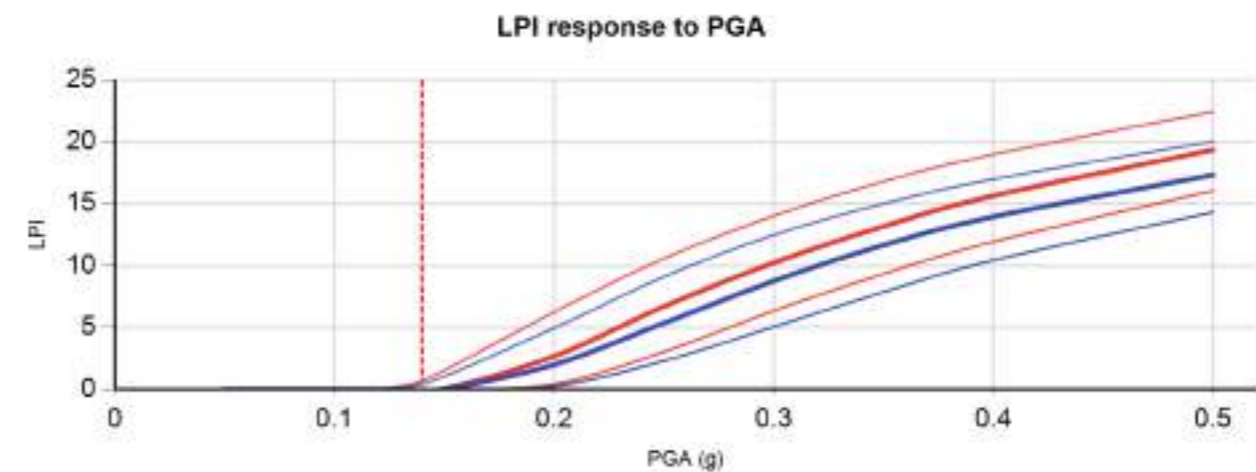
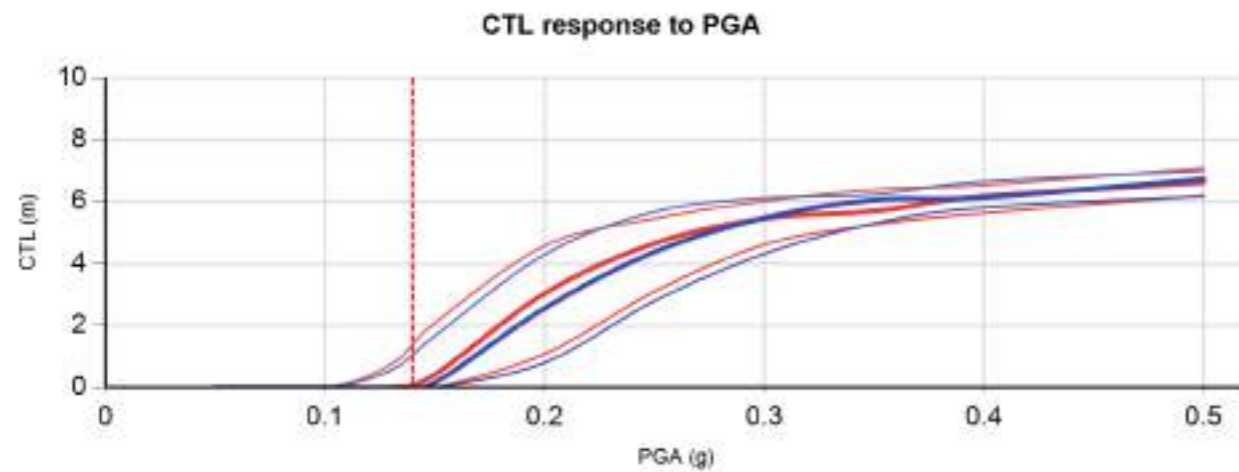
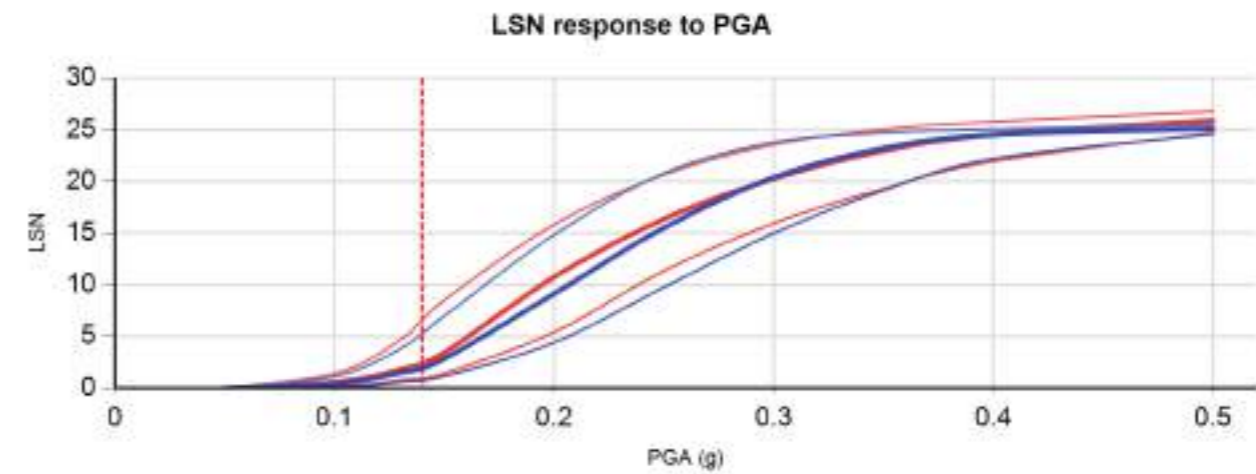
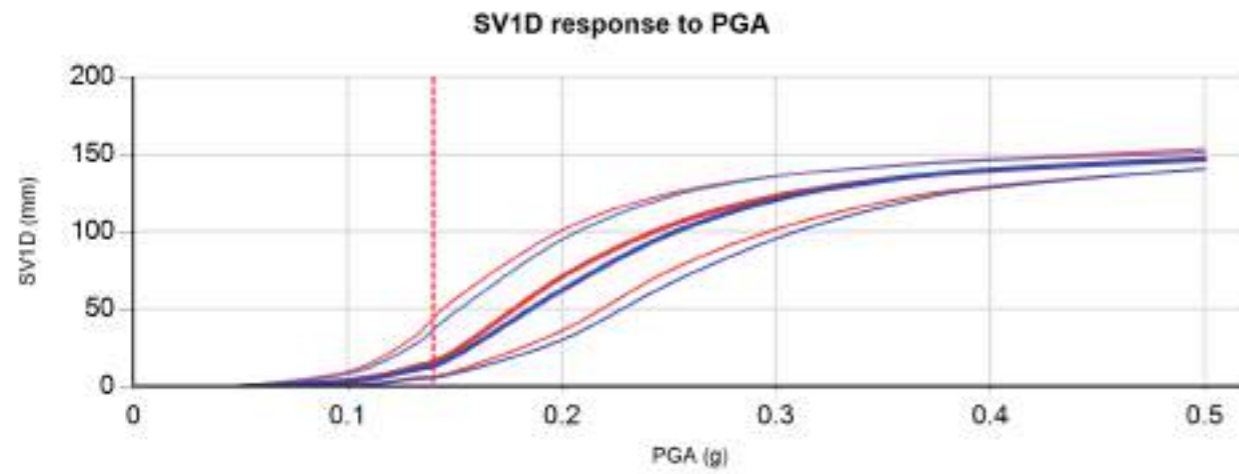


Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	8 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 10 - 11]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

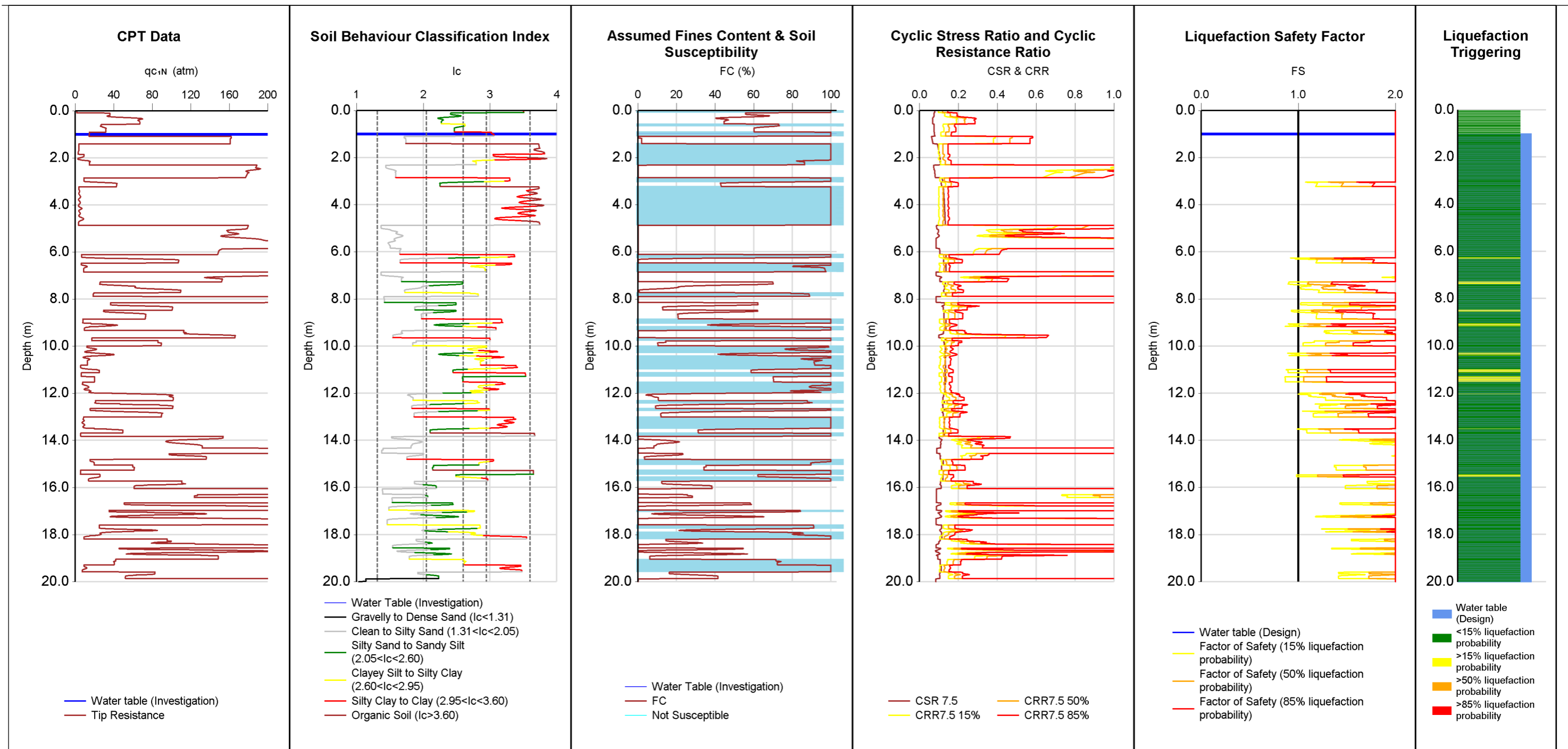
ID	NZGD 152815	NZGD 152816
CPT Name	CPT10	CPT11
Run description	CPT10	CPT11
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.54	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152815	CPT10	0	0	0
NZGD 152815	CPT10	0	18.54	2.6
NZGD 152816	CPT11	0	0	0
NZGD 152816	CPT11	0	20	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152815	CPT10	0	18.54	0 CFC
NZGD 152816	CPT11	0	20	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

INPUT		Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
		CPT12	152817	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
OUTPUT		PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
		15%	34	1	0	4	7.3	0					
		50%	14	0	0	1	20	0					
		85%	6	0	0	1	20	0					

Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

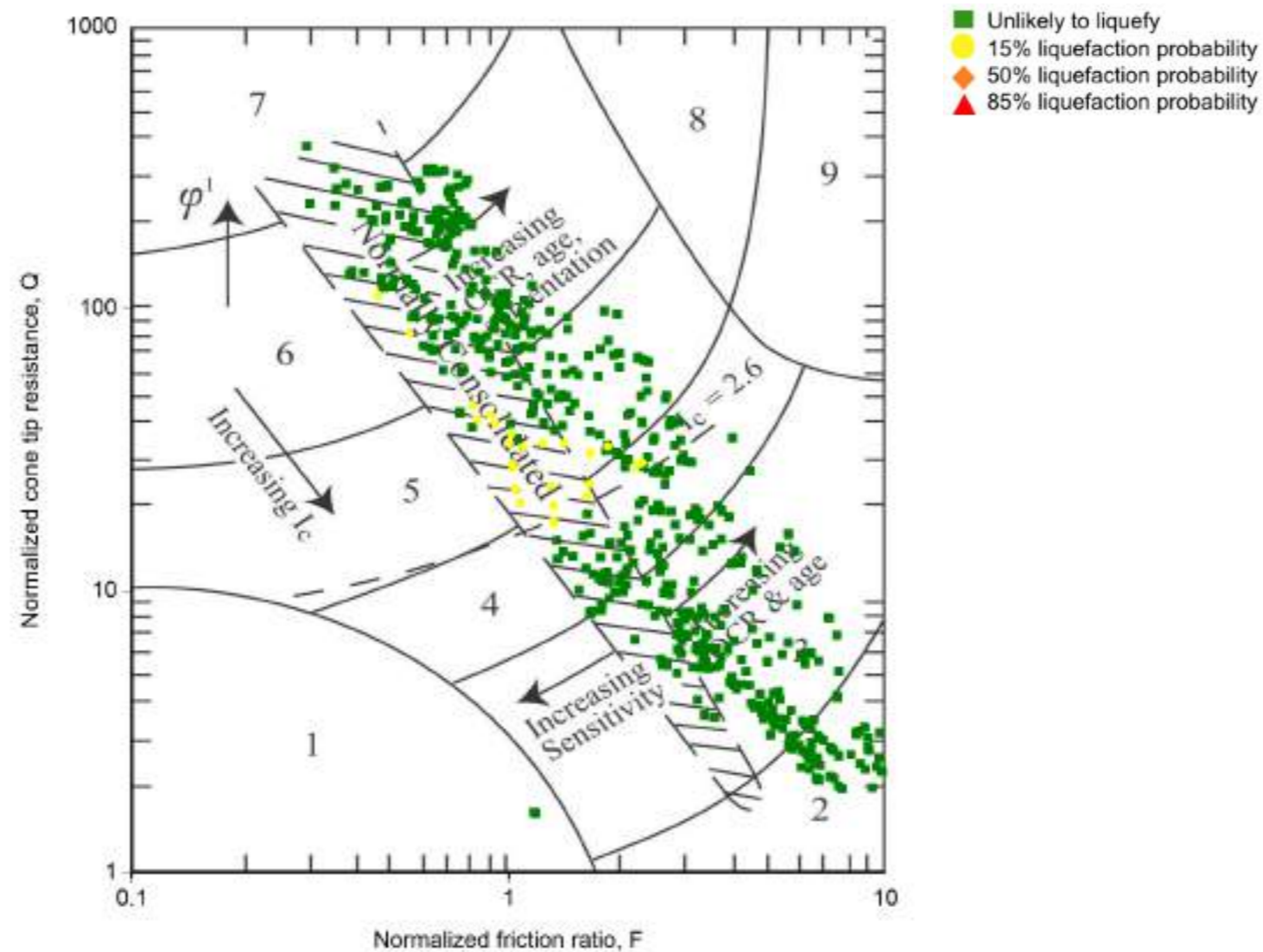


Tonkin + Taylor
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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]

LOCATION **Napier**
JOB NUMBER **1009171**

DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

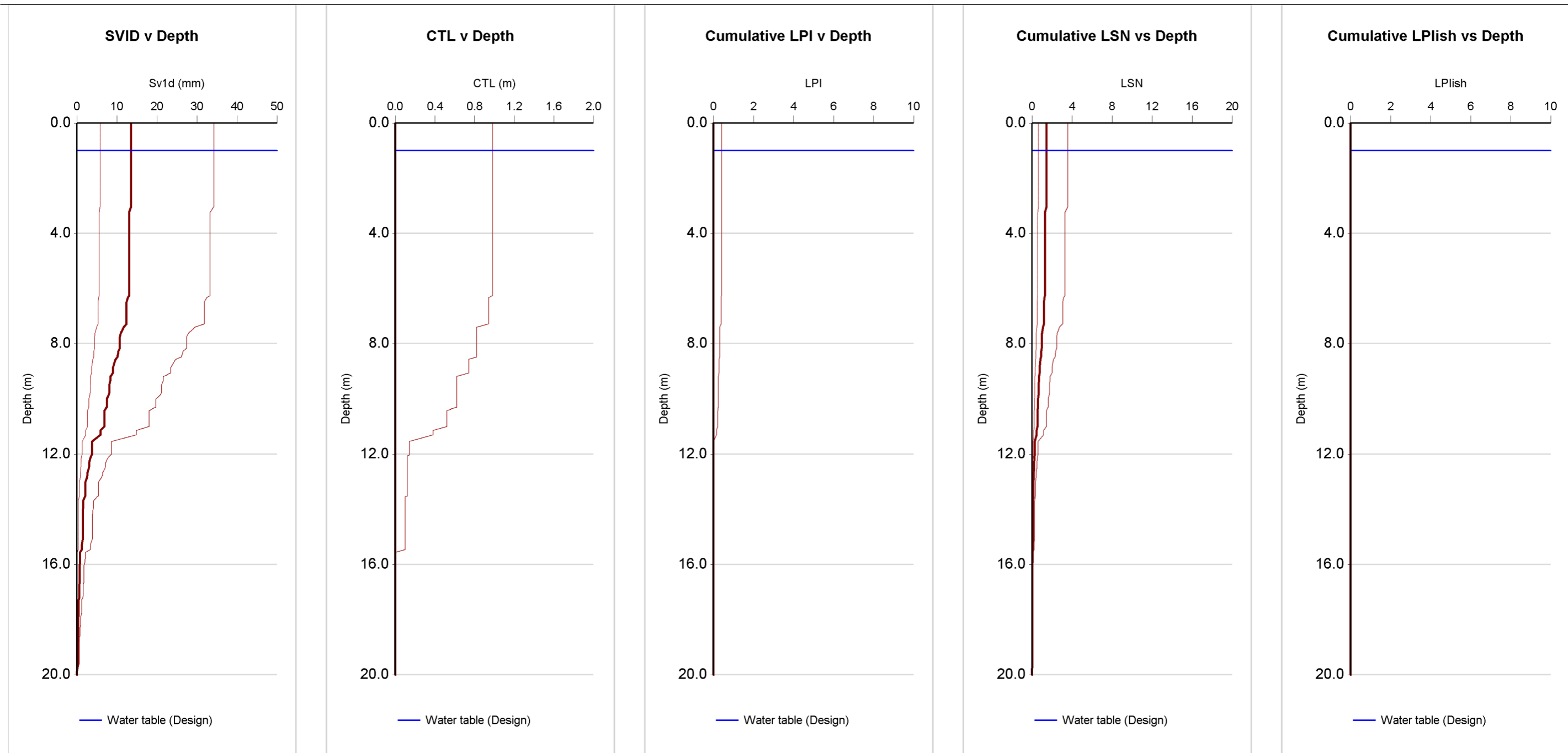
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




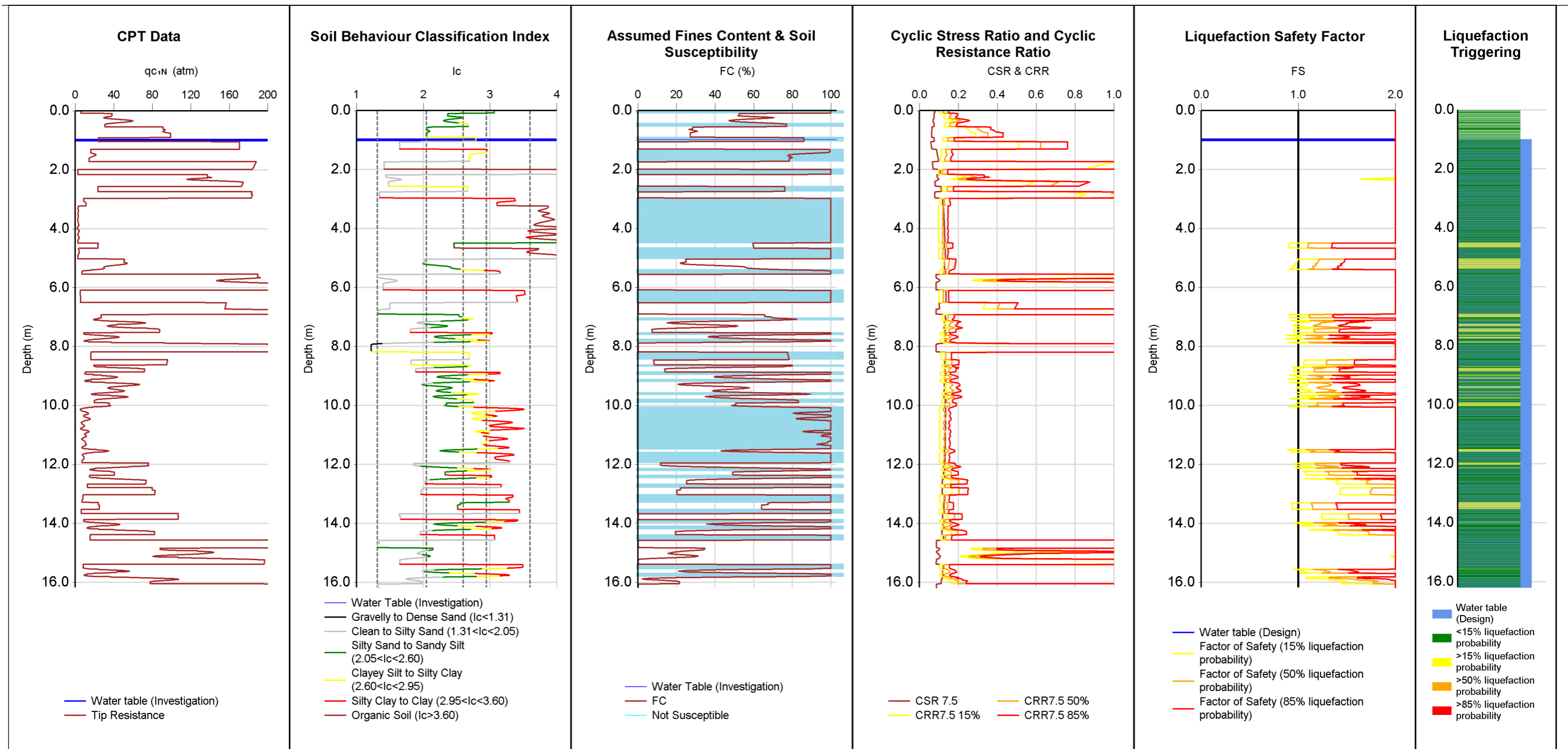
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT12	152817	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	44	2	1	5	4.6	0					
50%	16	0	0	2	16.2	0					
85%	8	0	0	1	16.2	0					

Reviewed by:

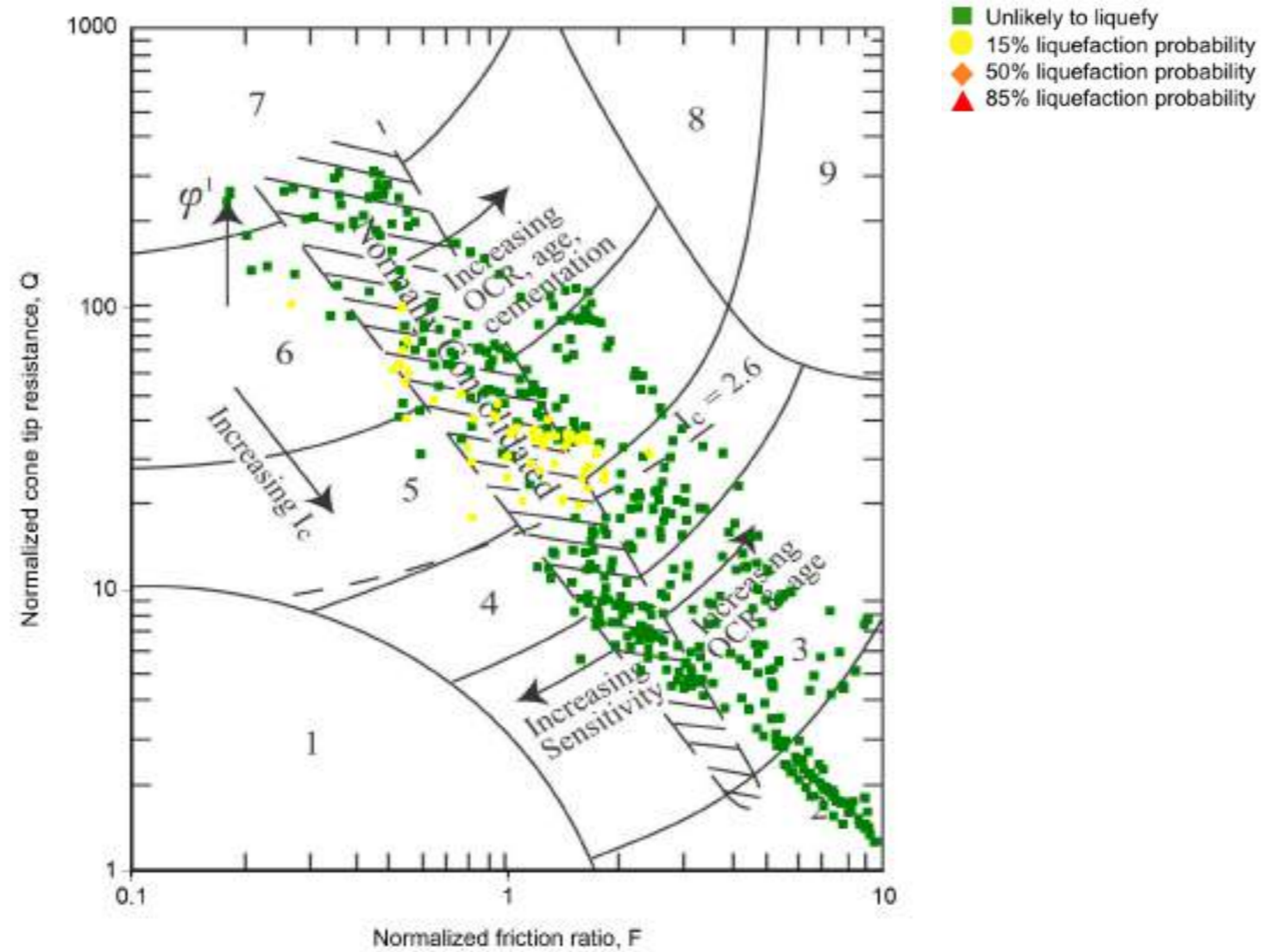
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

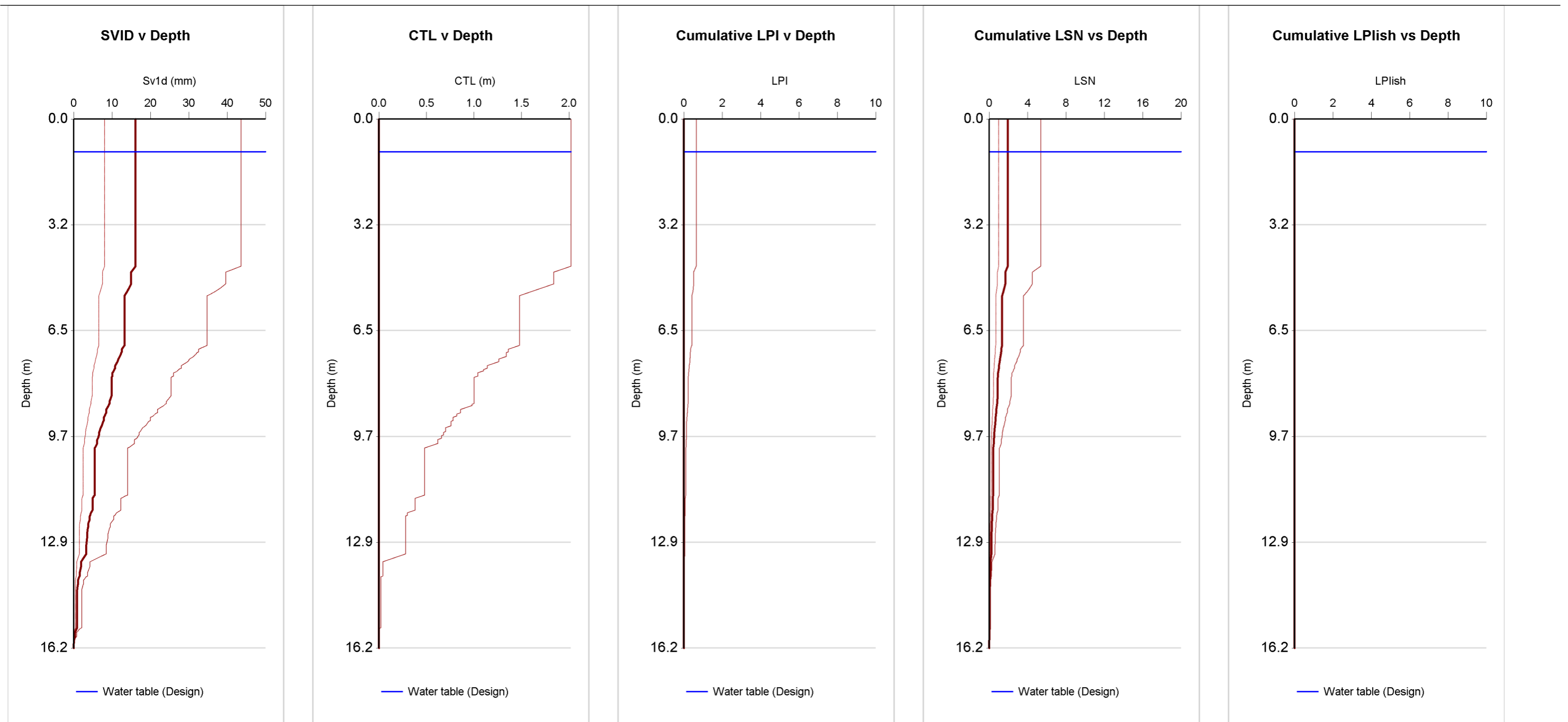


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

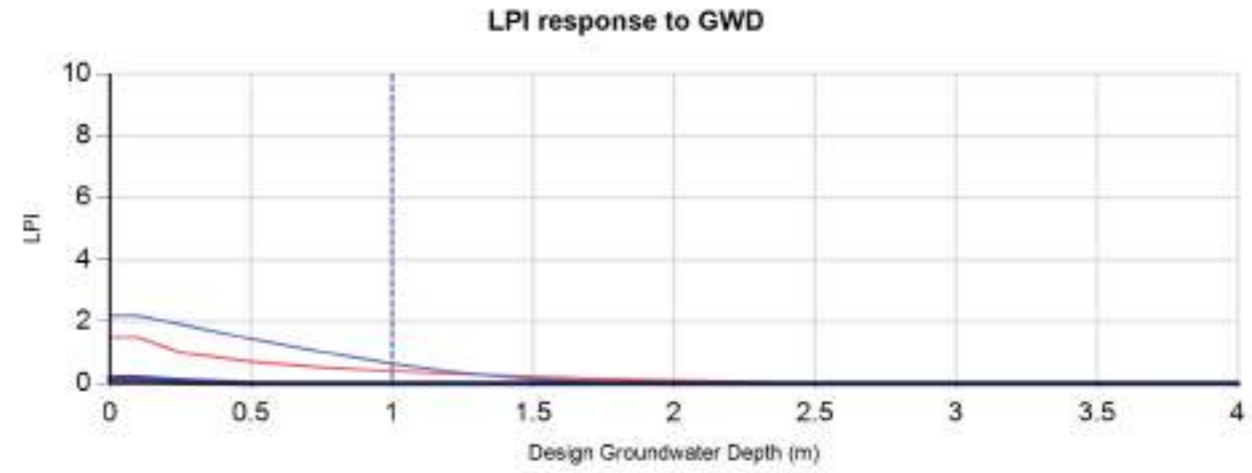
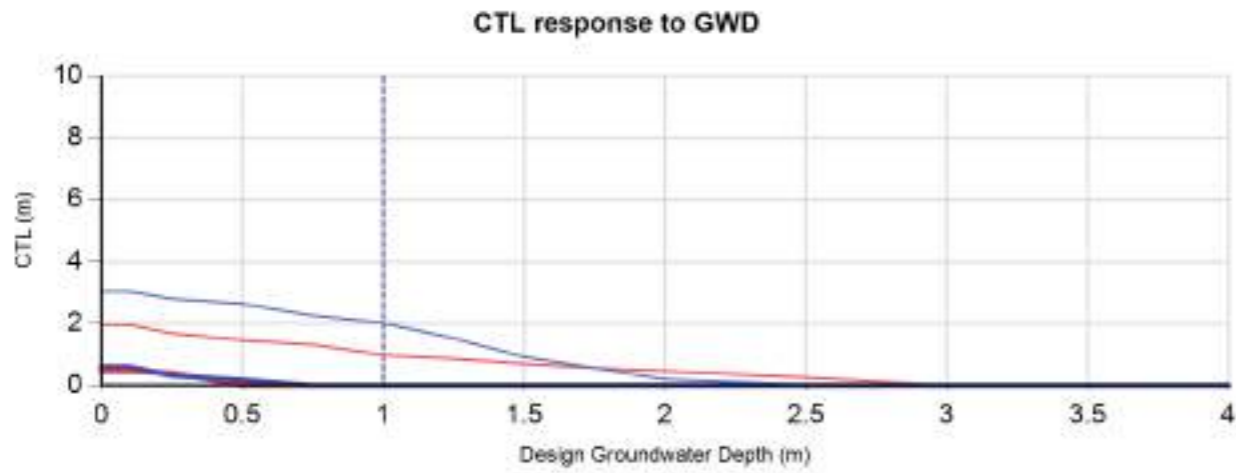
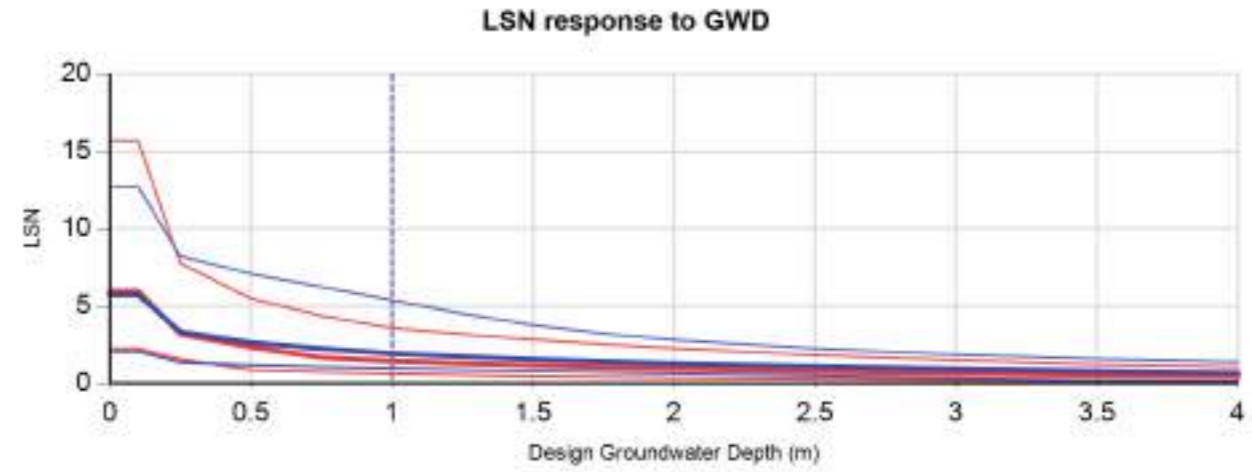
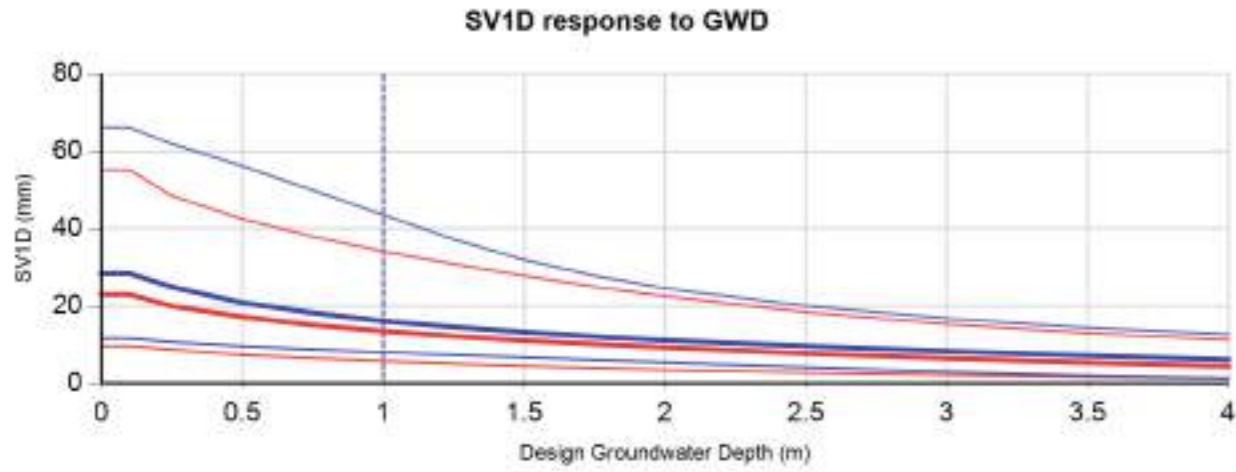
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER		
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]	1009171	PAGE	5 of 9 pages



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]				




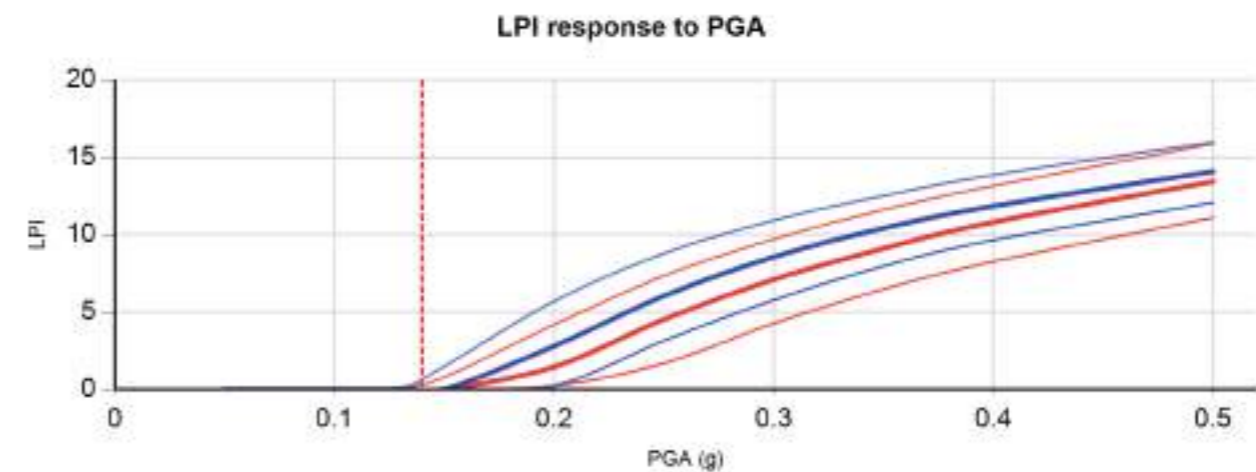
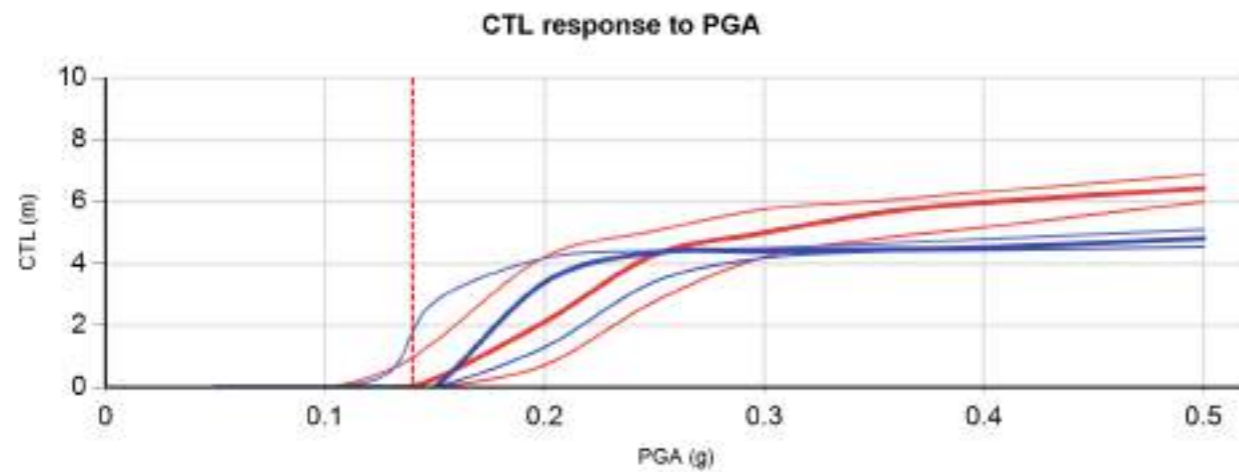
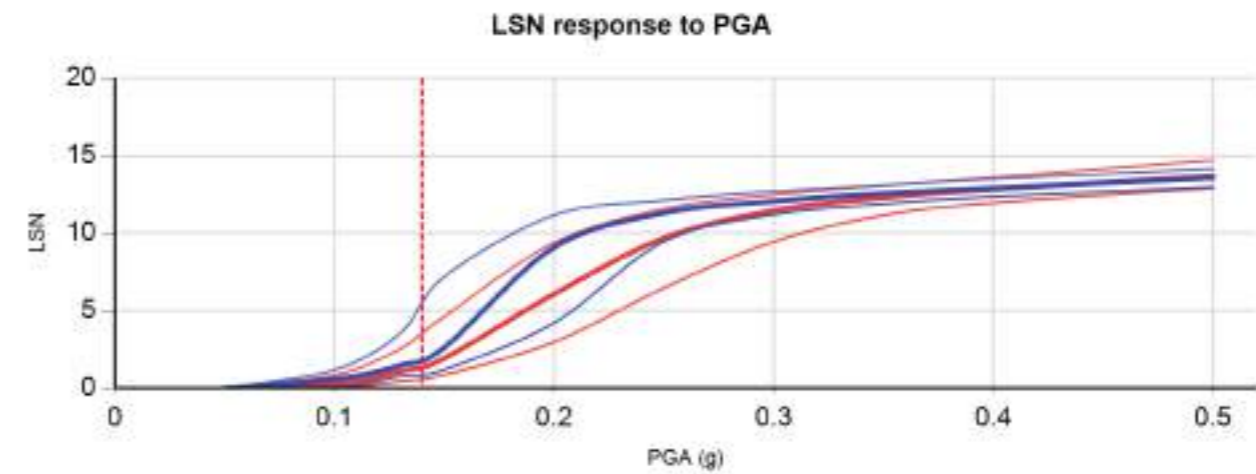
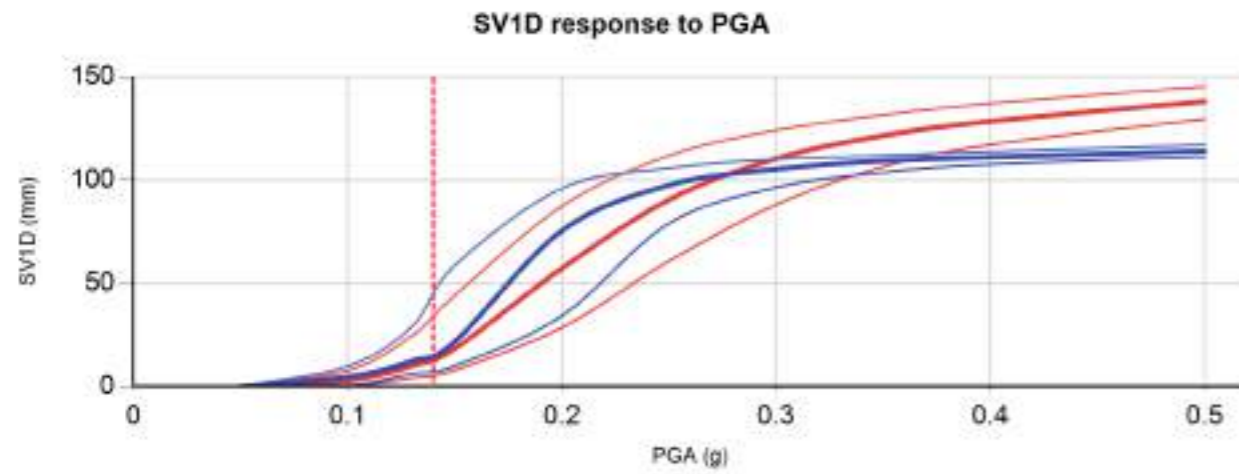
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedence case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedence cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 12 - 13]					



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

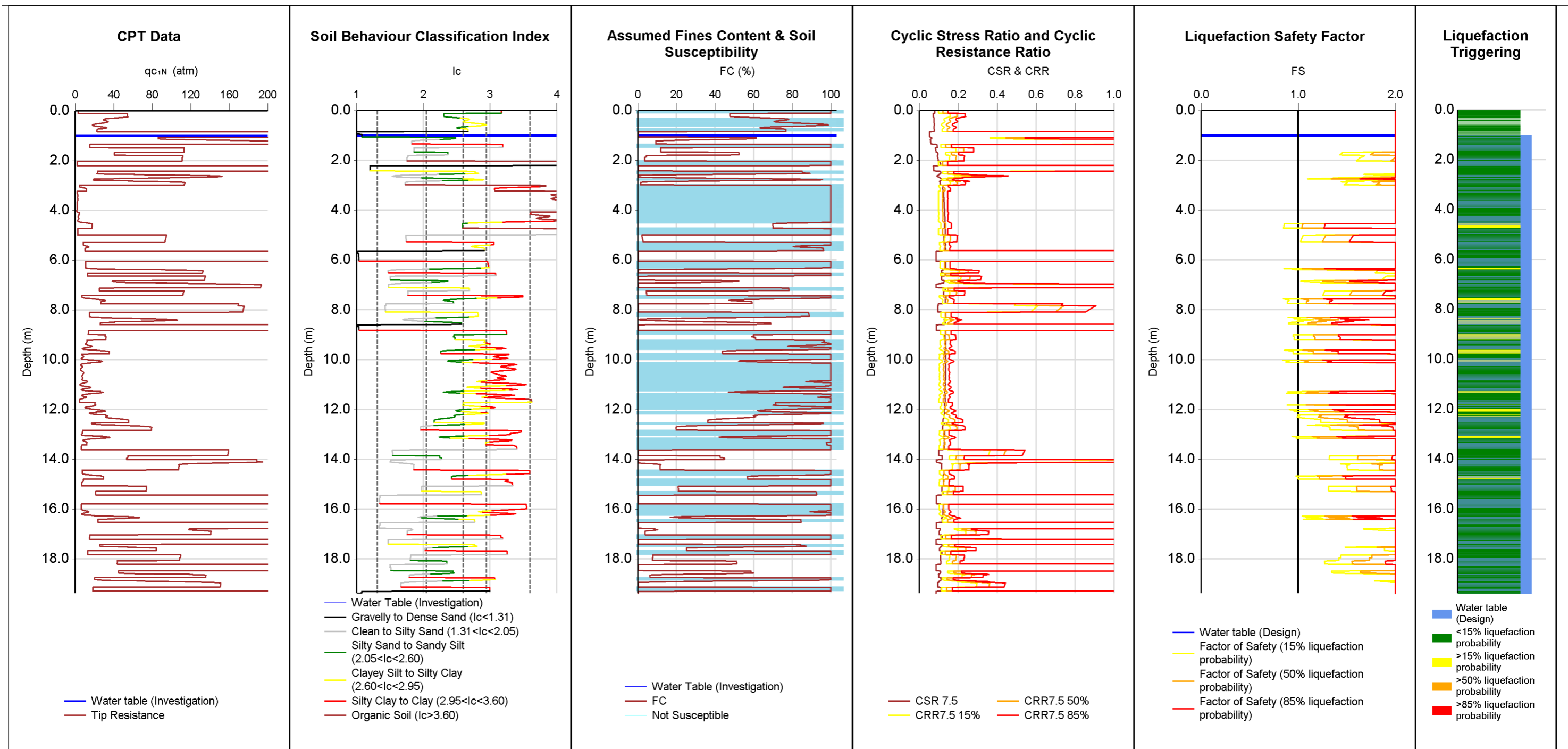
ID	NZGD 152817	NZGD 153237
CPT Name	CPT12	CPT13
Run description	CPT12	CPT13
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	16.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152817	CPT12	0	0	0
NZGD 152817	CPT12	0	20	2.6
NZGD 153237	CPT13	0	0	0
NZGD 153237	CPT13	0	16.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152817	CPT12	0	20	0 CFC
NZGD 153237	CPT13	0	16.18	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	41	1.6	1	5	4.6	0					
50%	15	0	0	2	19.4	0					
85%	7	0	0	1	19.4	0					

Reviewed by:

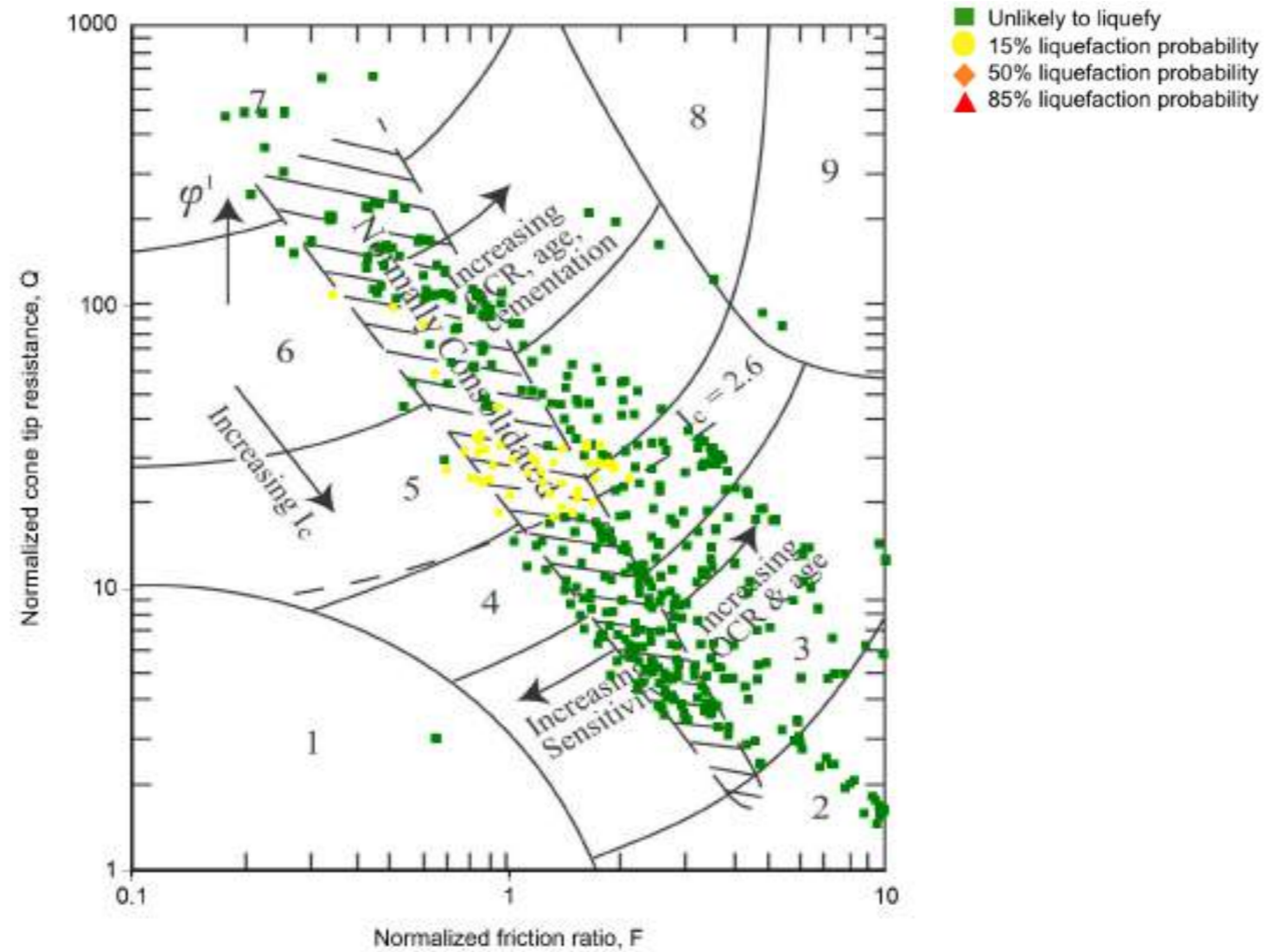
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 15 - 16]


LOCATION **Napier**
DATE **15/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**

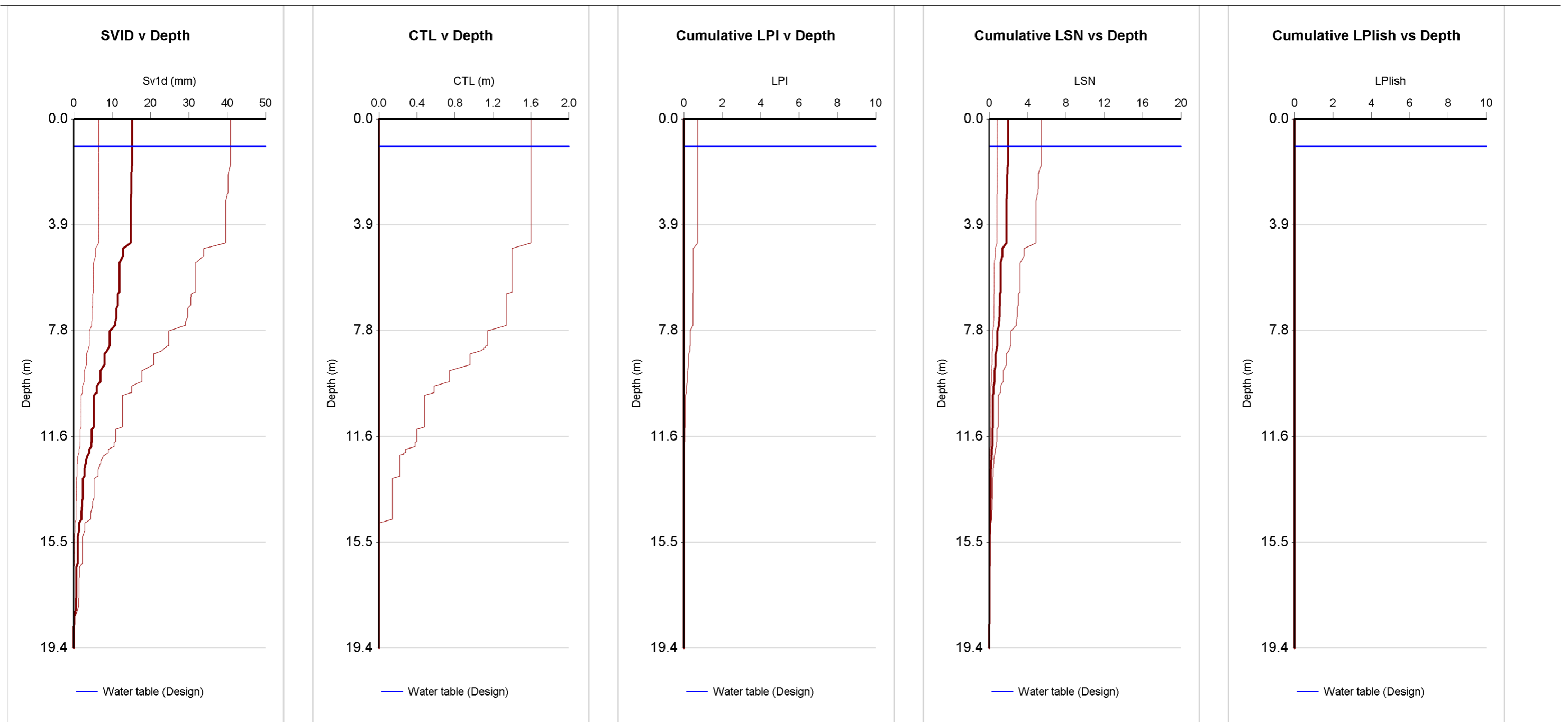


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

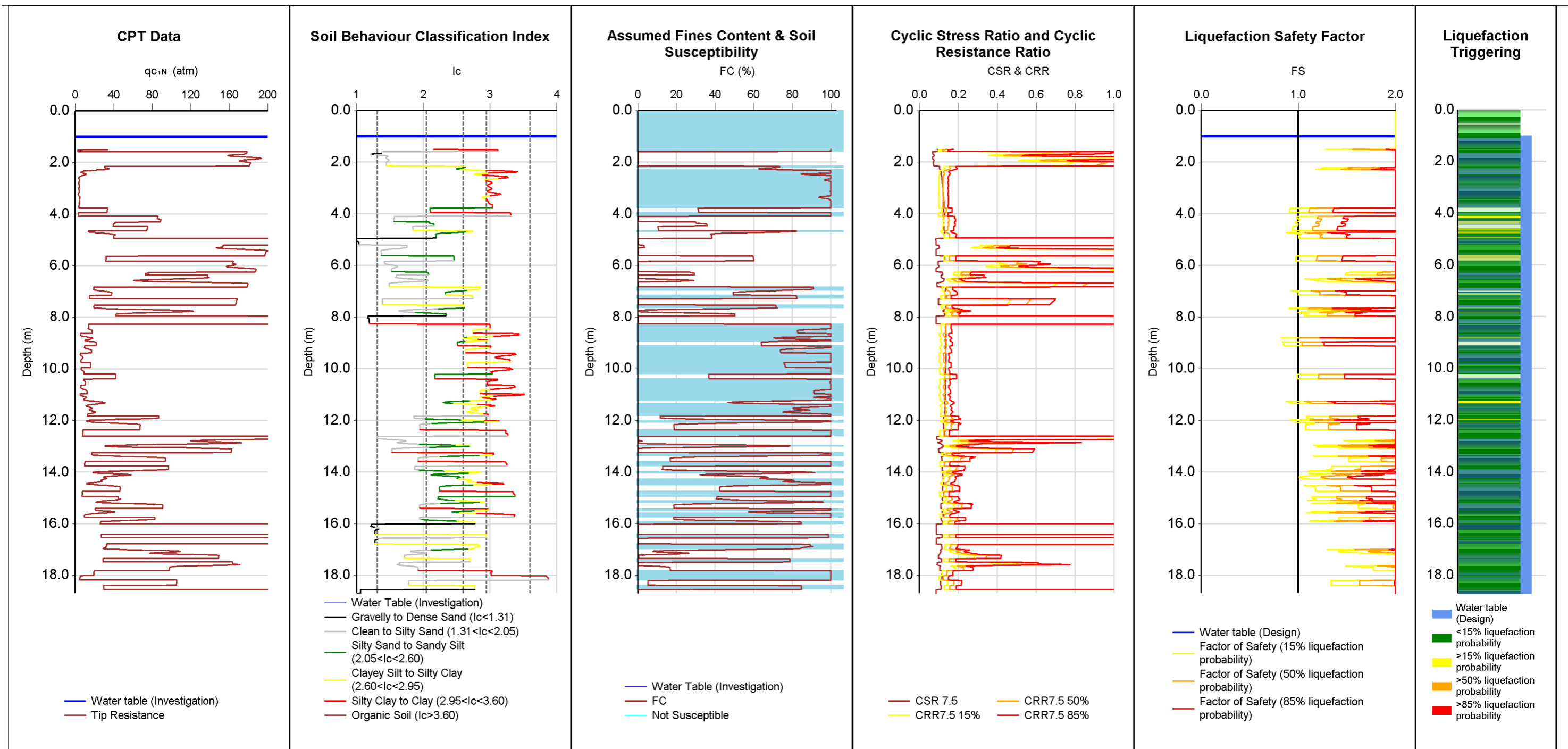
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	<p>CLIENT Napier City Council</p>	<p>LOCATION Napier</p>	<p>DATE 15/02/2021</p>
	<p>PROJECT Onekawa Aquatic Centre</p>	<p>JOB NUMBER 1009171</p>	<p>ANALYSED zafr</p>
	<p>TITLE SLS - Onekawa Aquatic Centre Liquefaction Analysis</p> <p>COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 15 - 16]</p>	<p>PAGE 3 of 9 pages</p>	

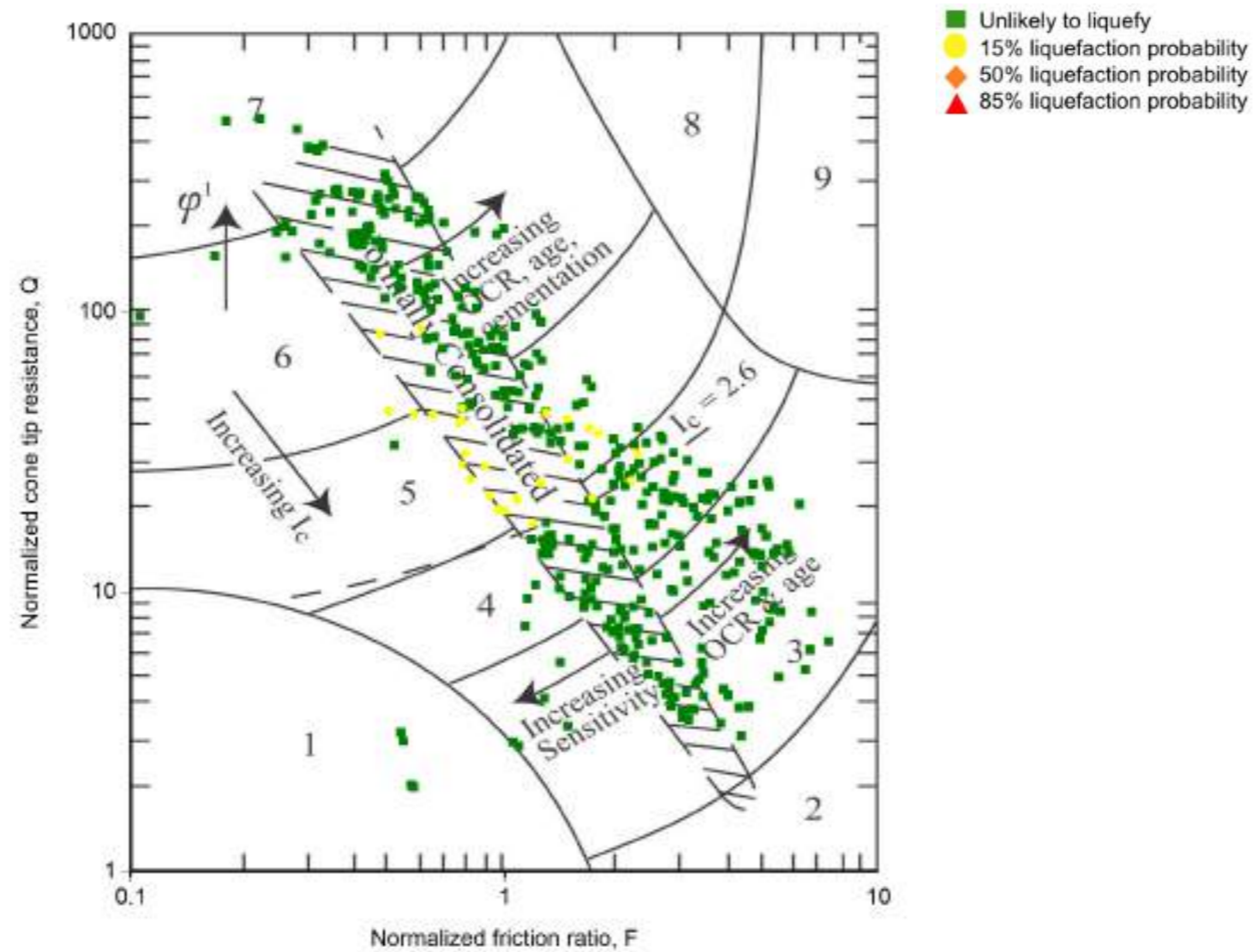


Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.2	0.14	BI-2014	ZRB-2002	18		0	

PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish
15%	40	1.6	1	6	3.9	0
50%	16	0	0	2	18.7	0
85%	7	0	0	1	18.7	0

Reviewed by:


CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

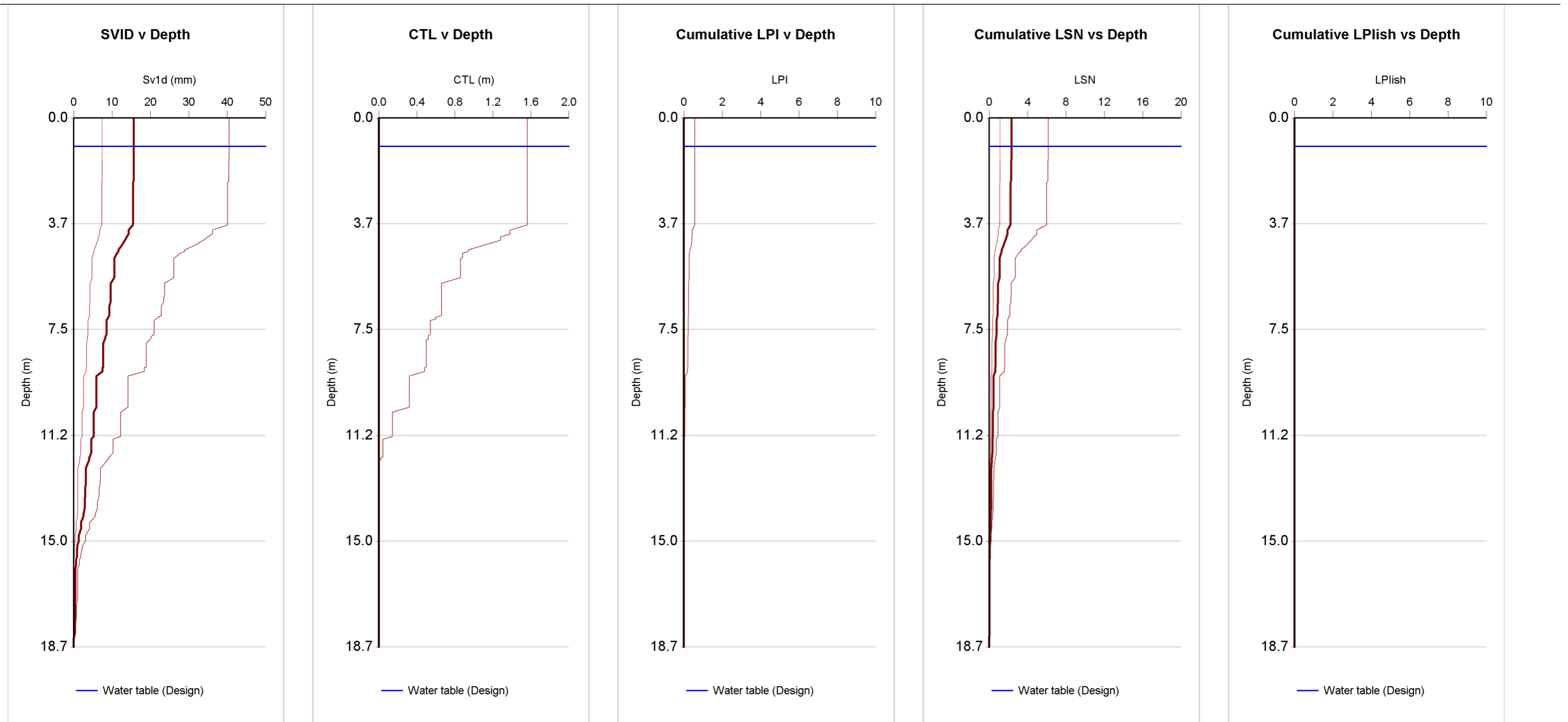


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|--|-------------------------------------|
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

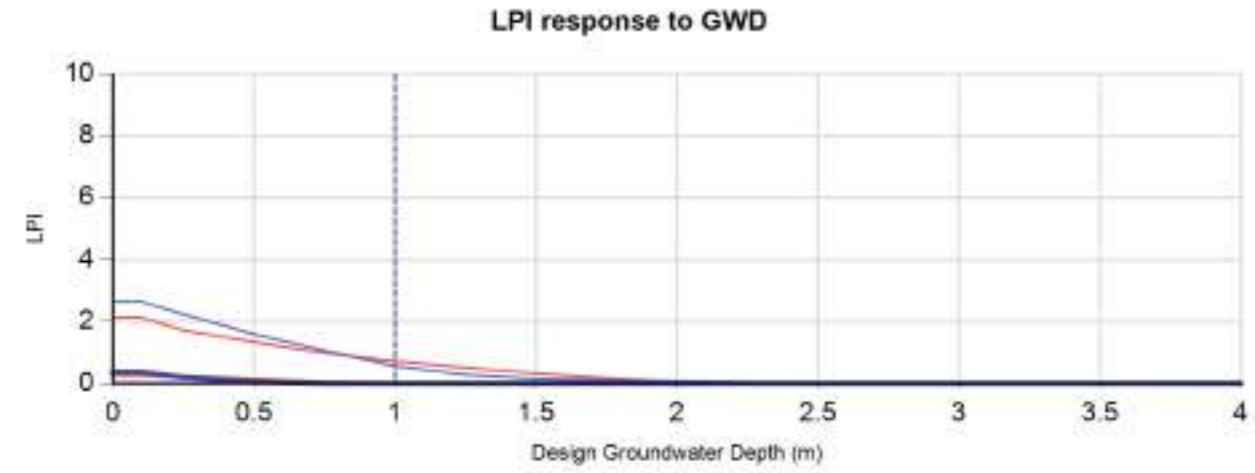
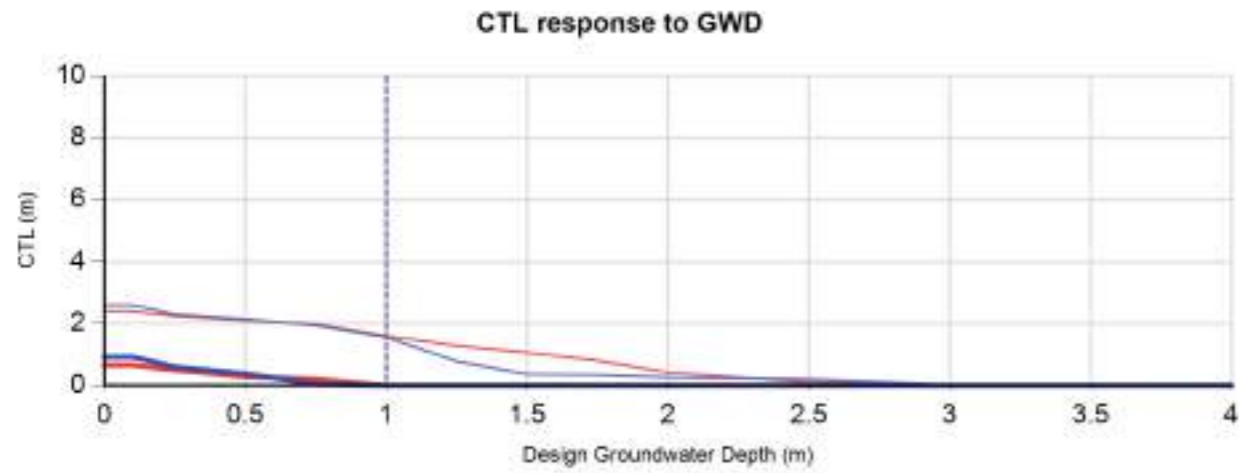
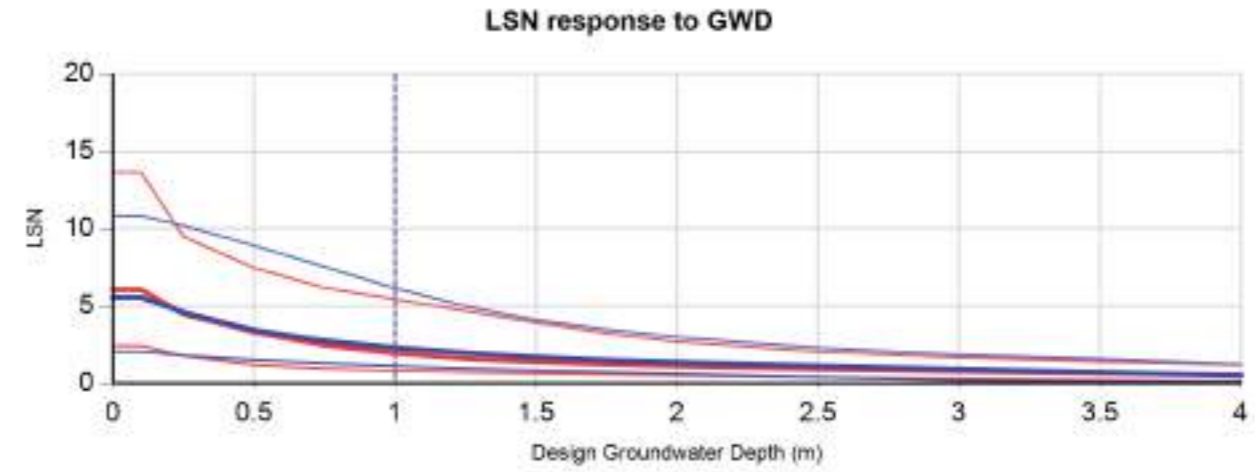
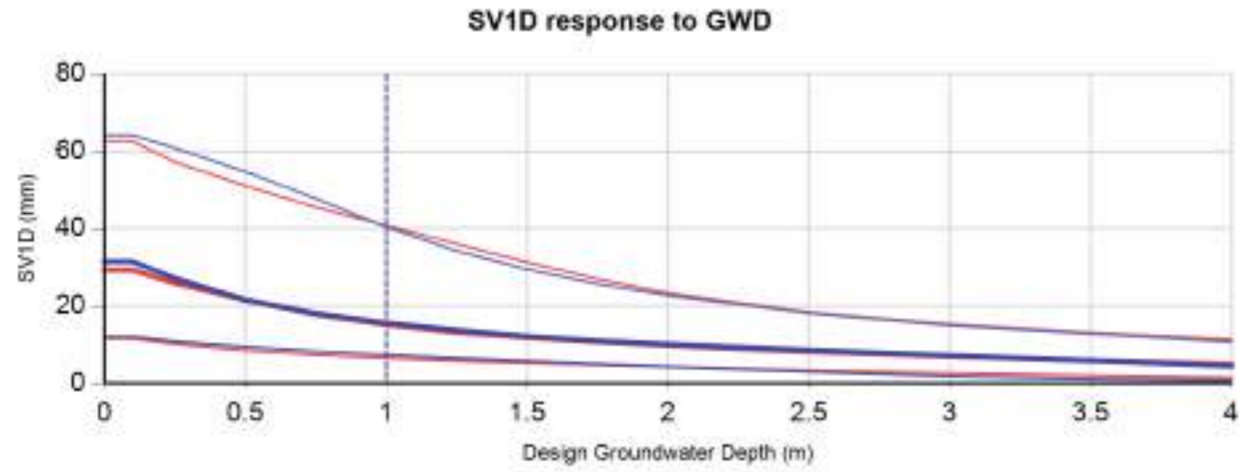
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.2	0.14	BI-2014	ZRB-2002	18		0	

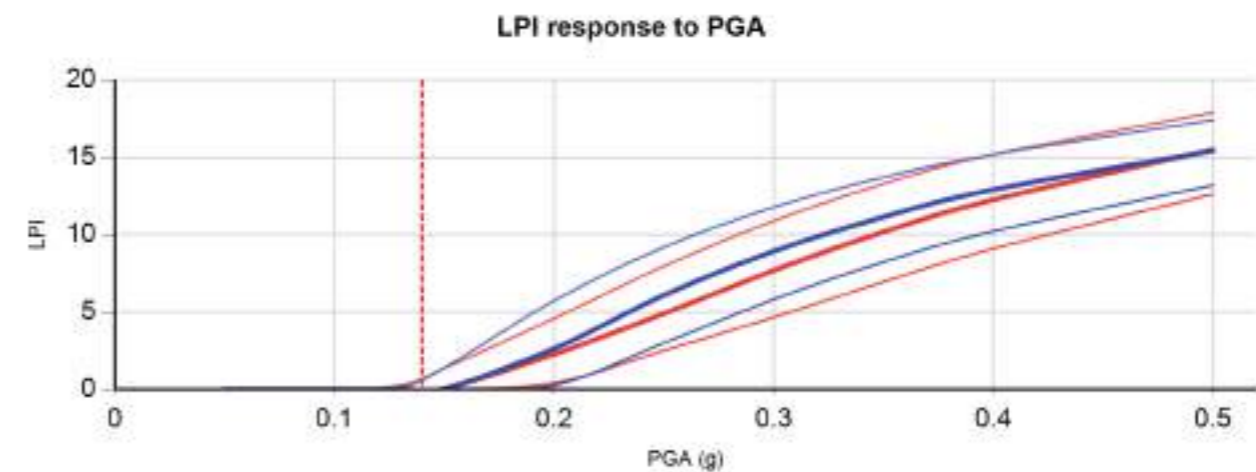
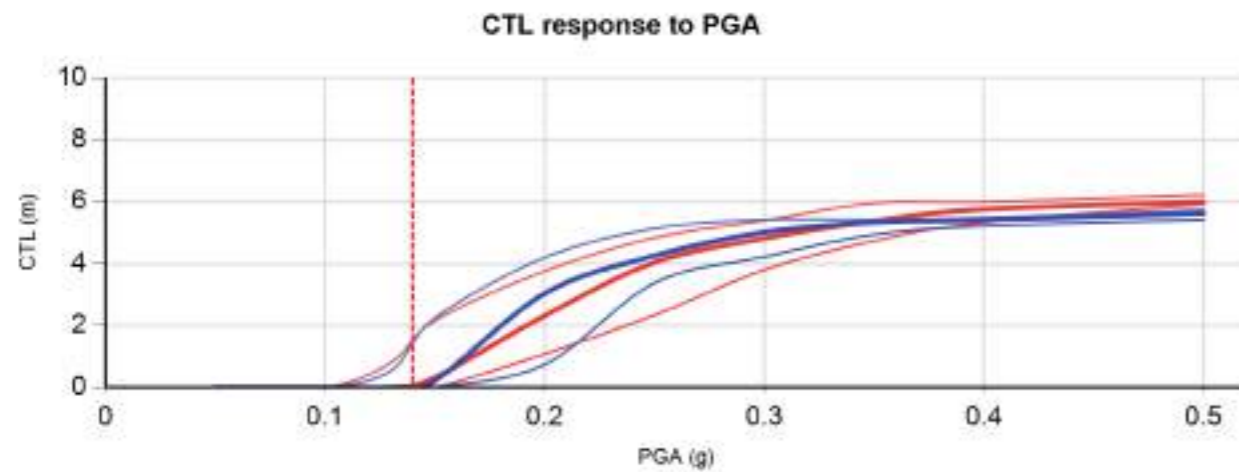
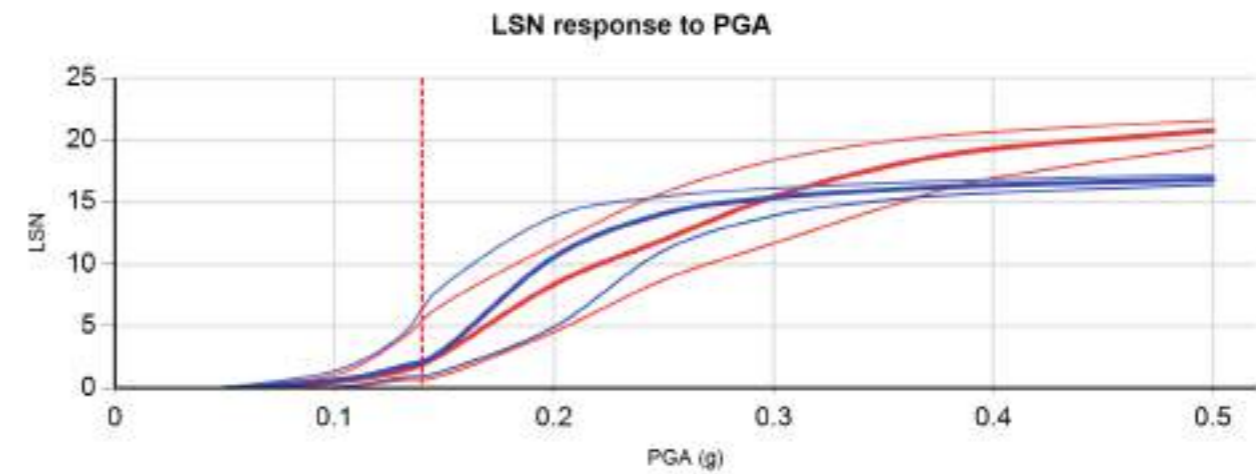
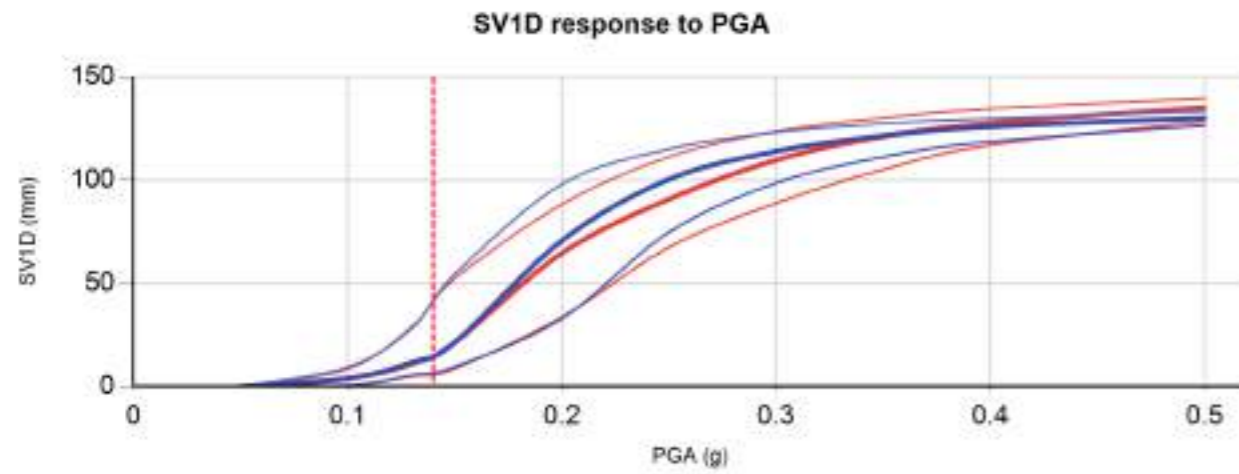


Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

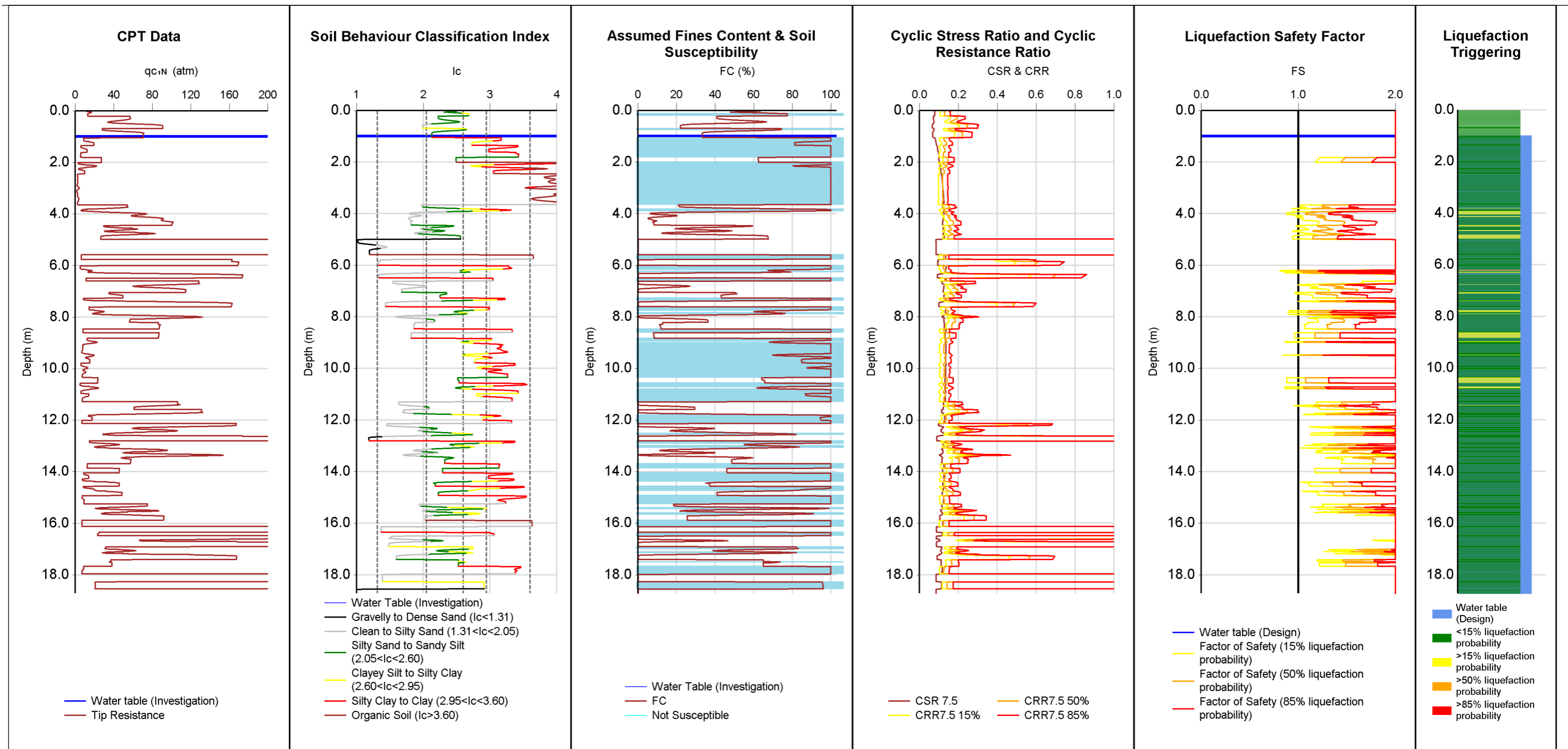
ID	NZGD 152818	NZGD 152819
CPT Name	CPT15	CPT16
Run description	CPT15	CPT16
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	1.5
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	19.38	18.7
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152818	CPT15	0	0	0
NZGD 152818	CPT15	0	19.38	2.6
NZGD 152819	CPT16	0	1.5	0
NZGD 152819	CPT16	1.5	18.7	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152818	CPT15	0	19.38	0 CFC
NZGD 152819	CPT16	0	18.7	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	45	1.3	1	7	4	0					
50%	18	0	0	3	18.7	0					
85%	8	0	0	1	18.7	0					

Reviewed by:

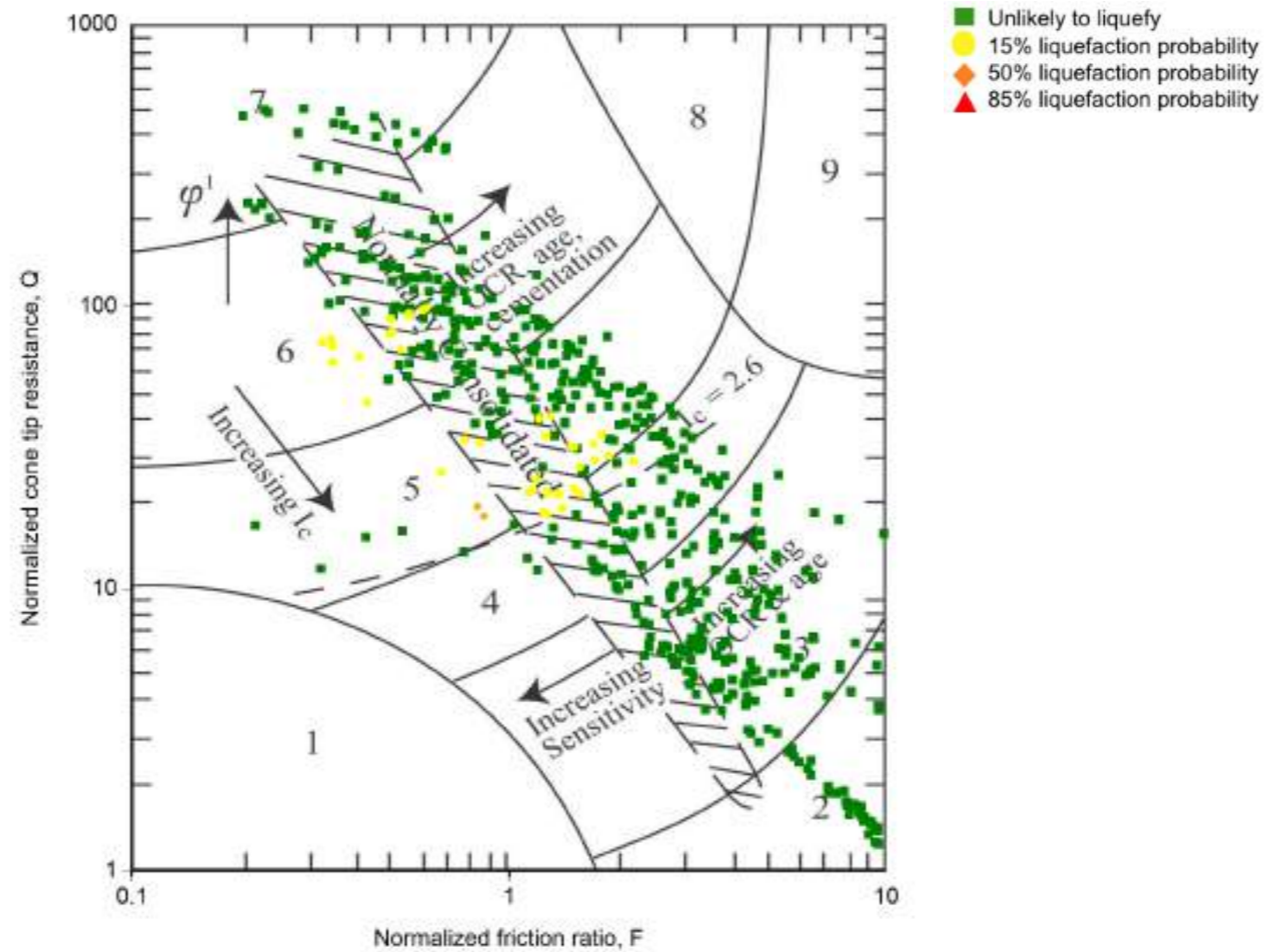
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]


LOCATION **Napier**
DATE **15/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**

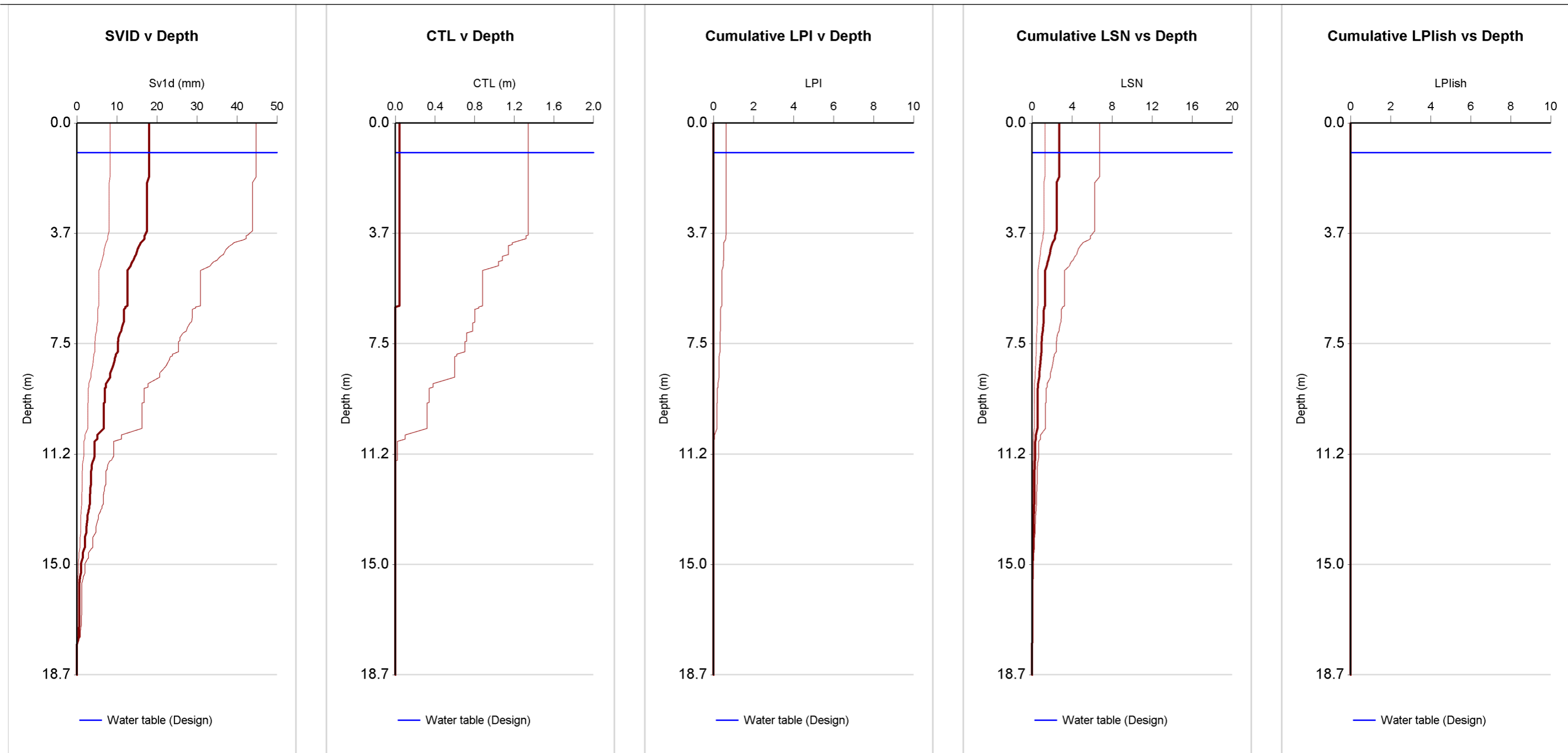


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

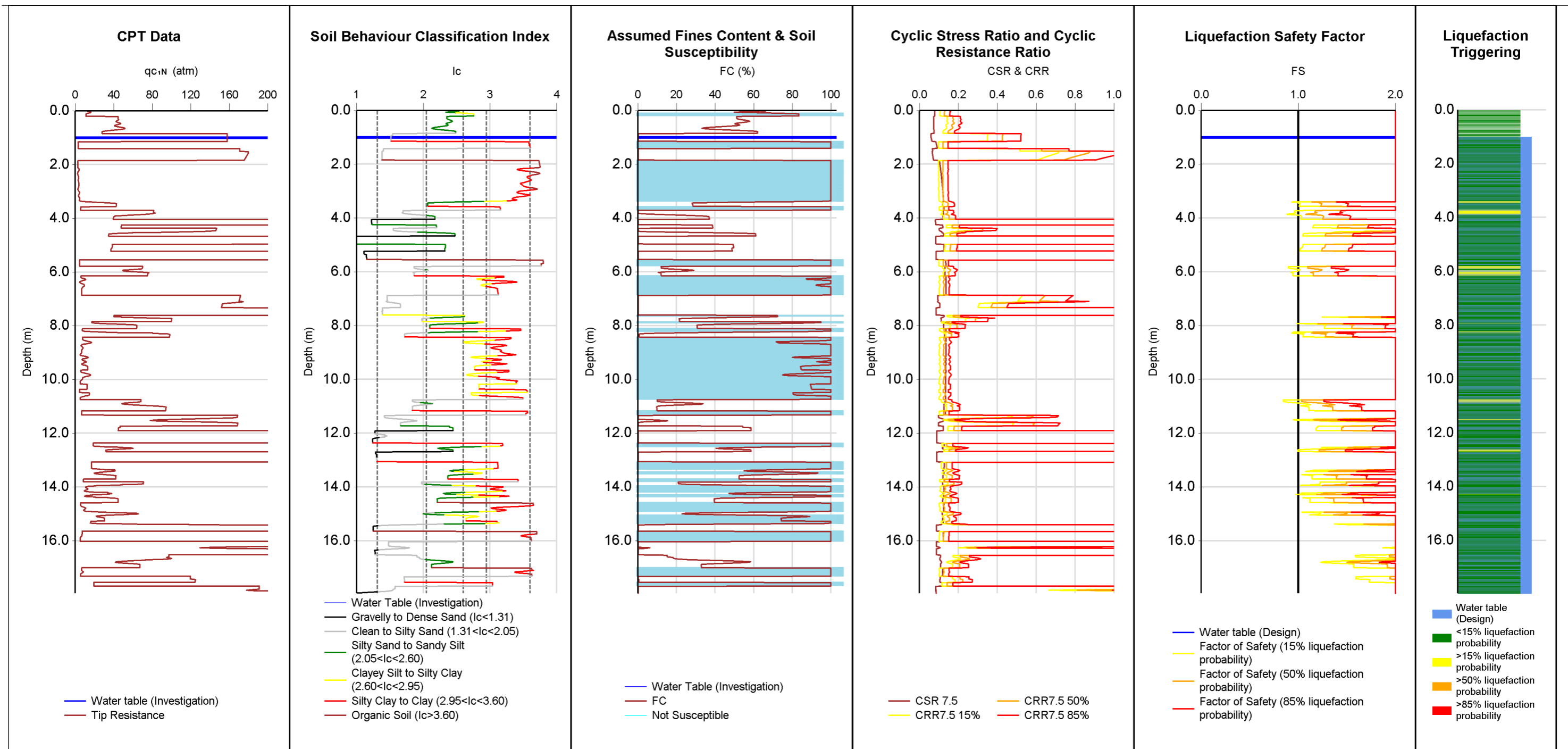
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	31	0.9	0	5	3.7	0					
50%	13	0	0	2	18	0					
85%	6	0	0	1	18	0					

Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

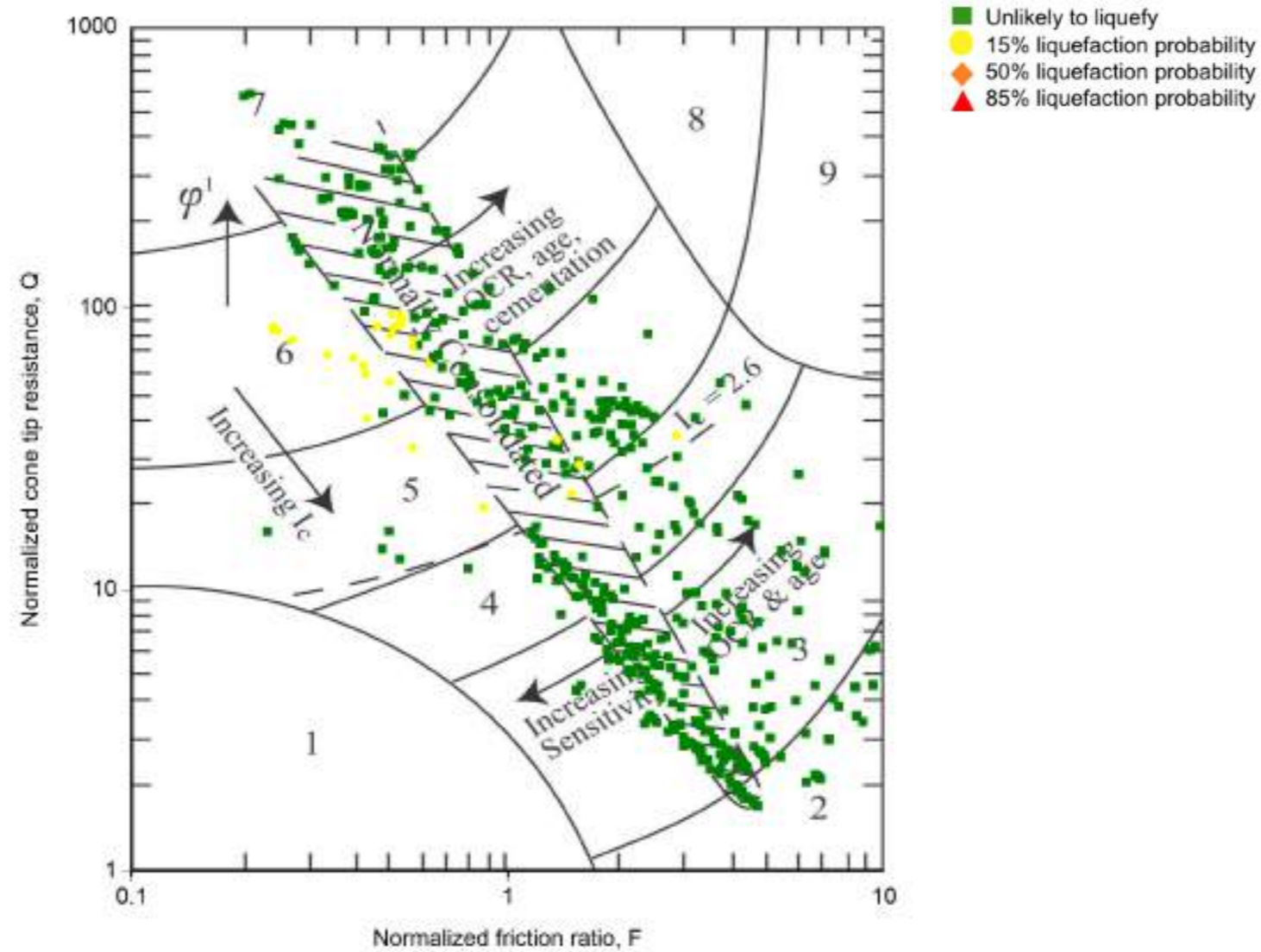


Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]

LOCATION **Napier**
JOB NUMBER **1009171**


DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

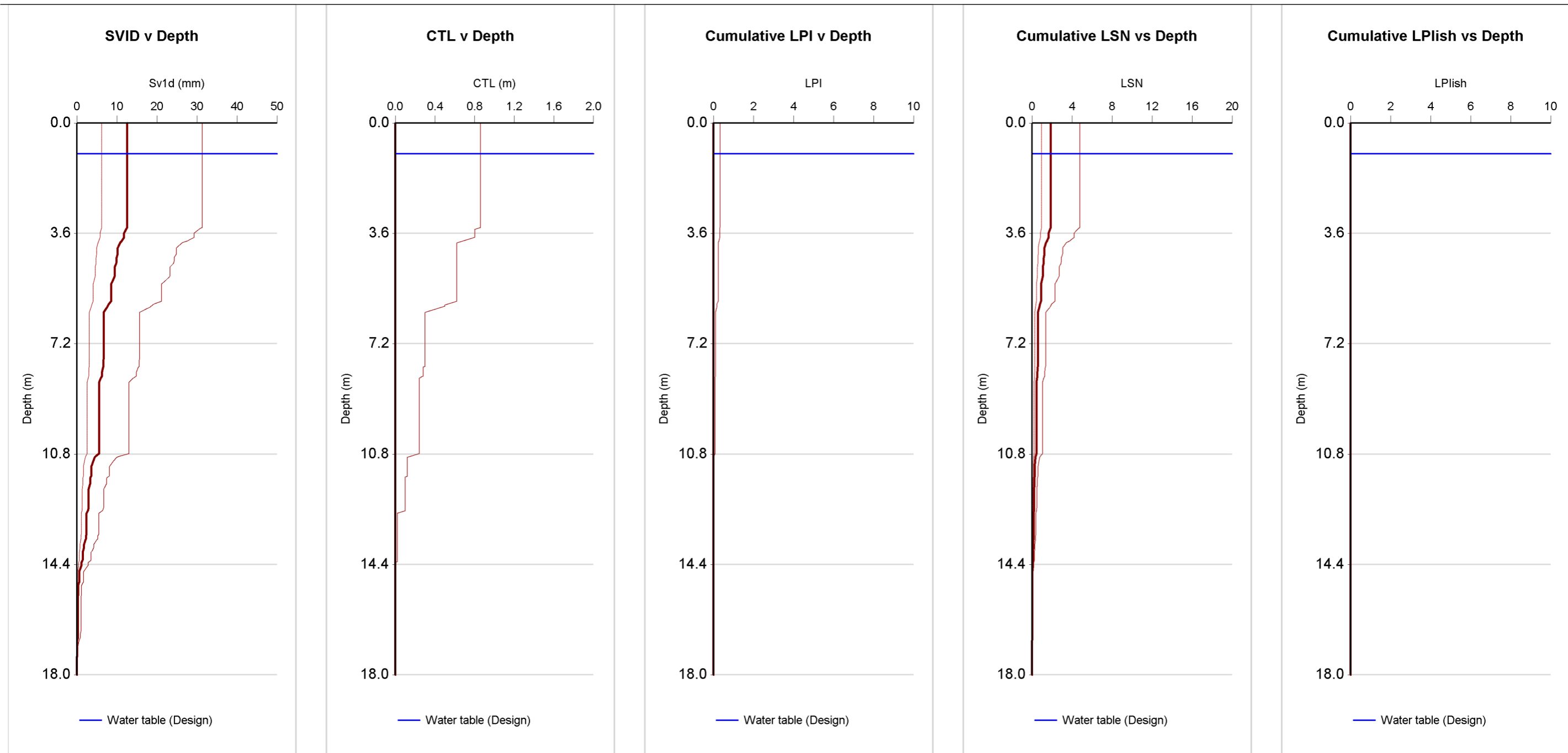


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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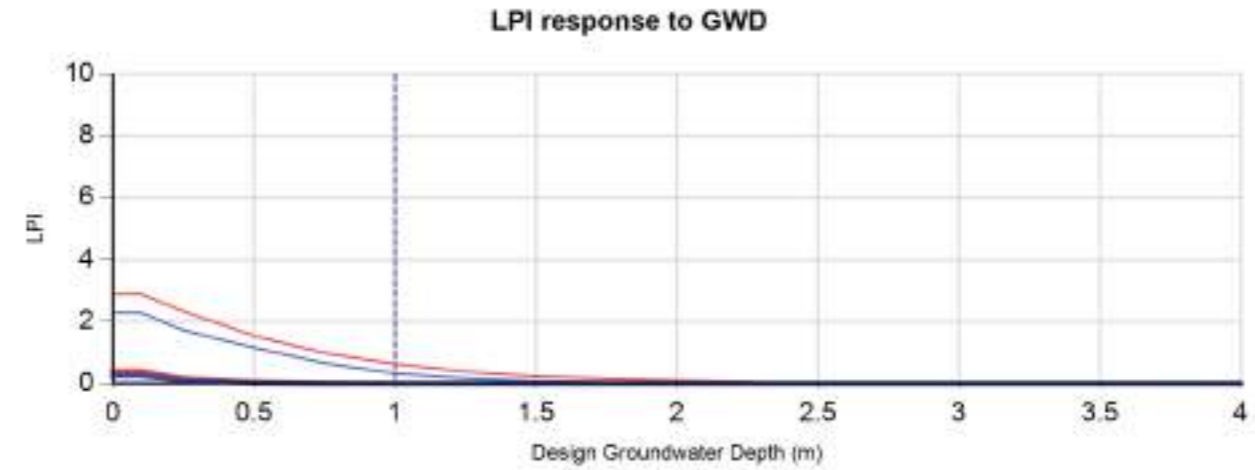
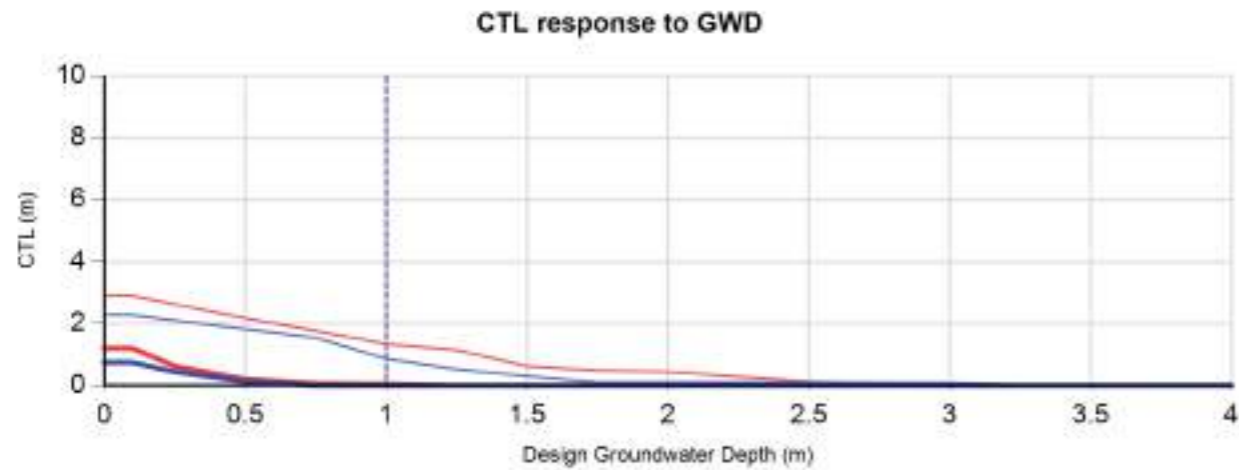
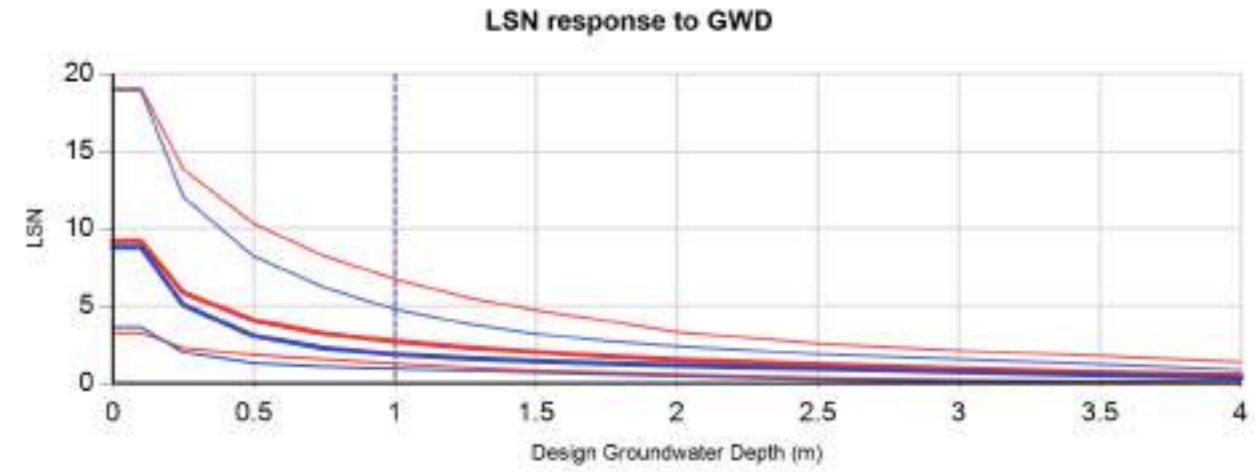
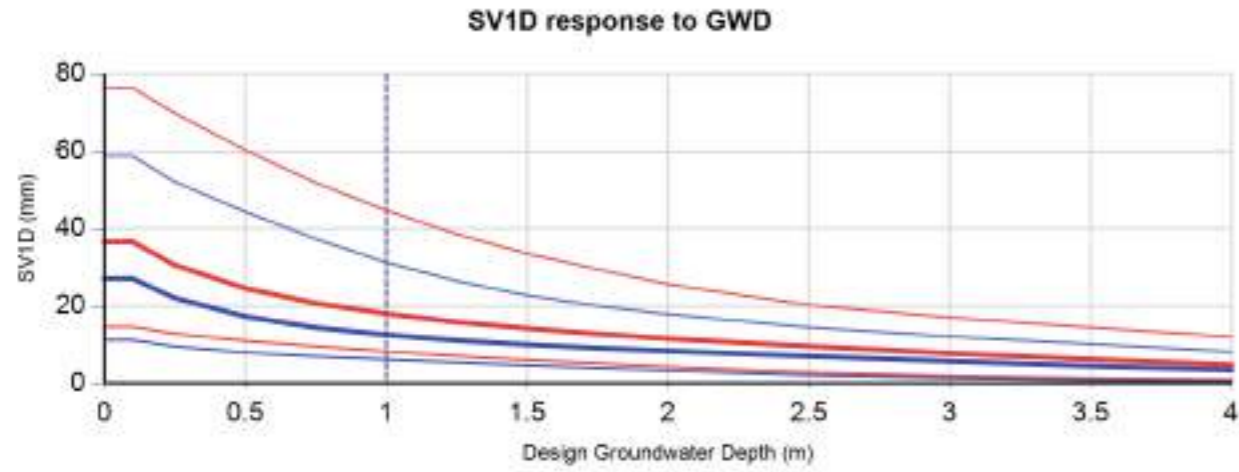
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	




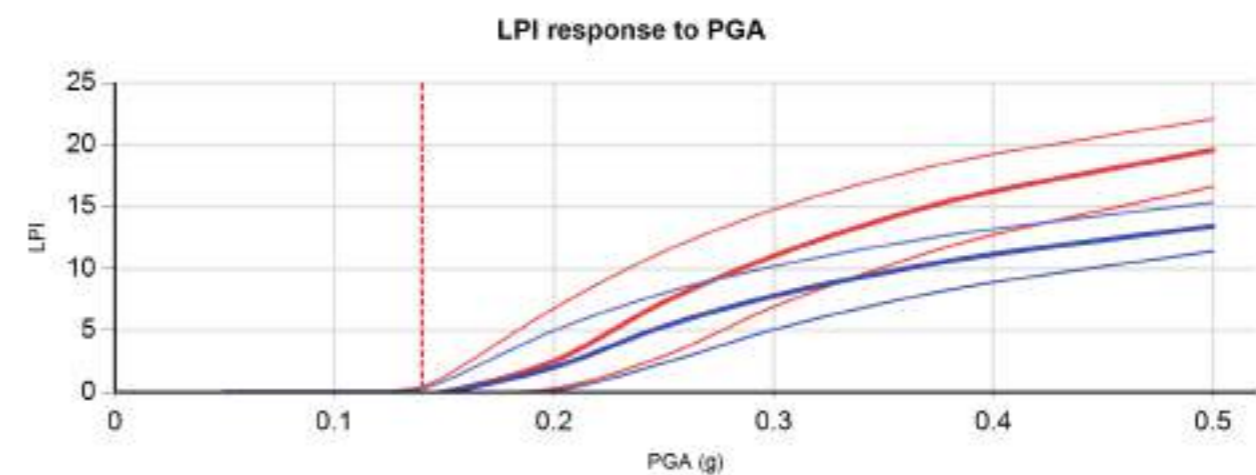
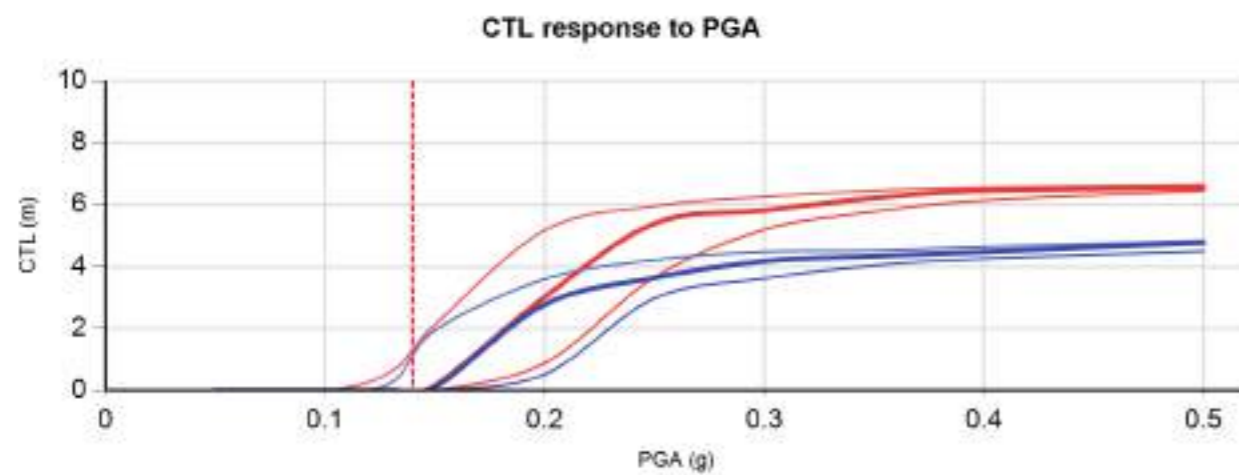
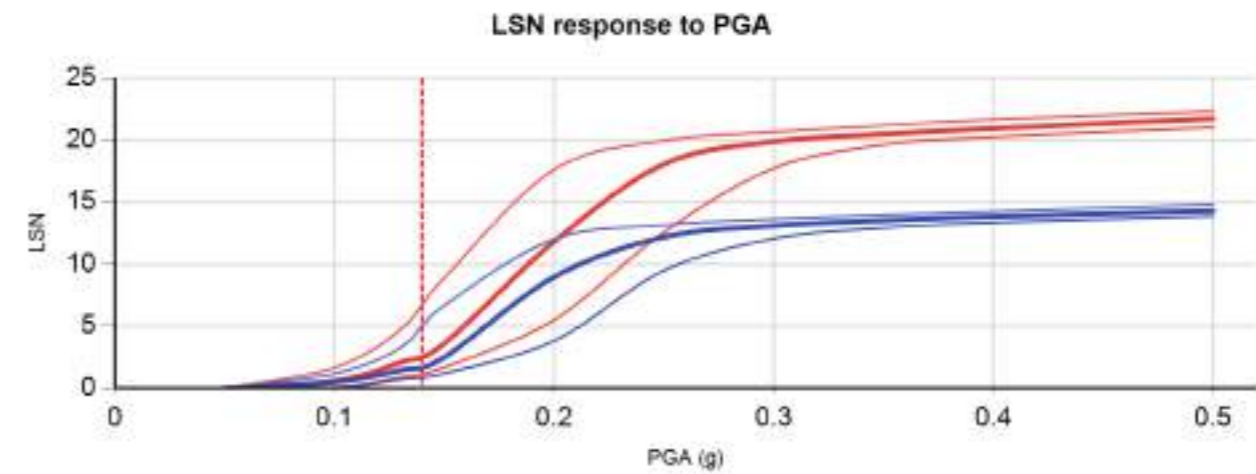
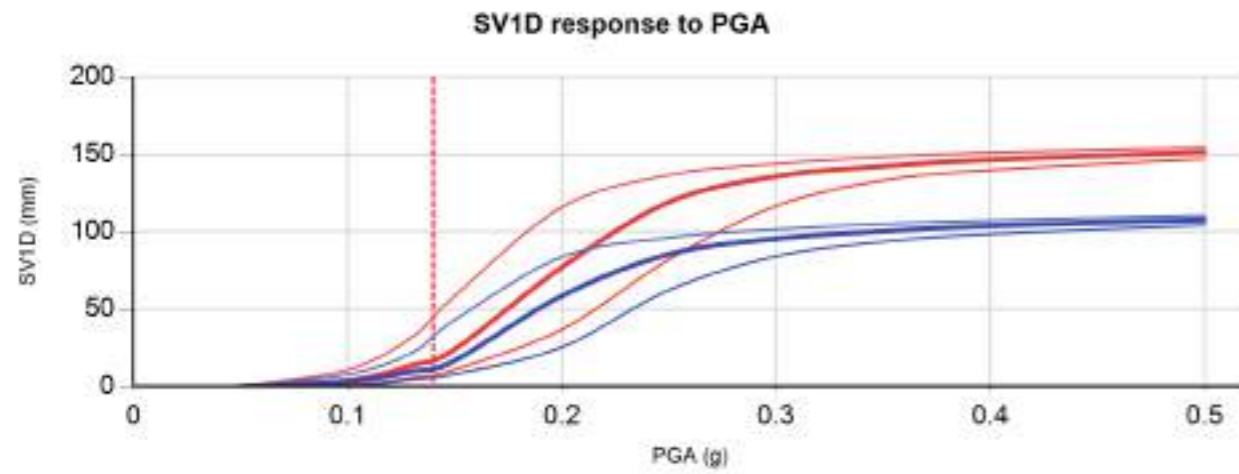
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 17 - 18]	PAGE	7 of 9 pages



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

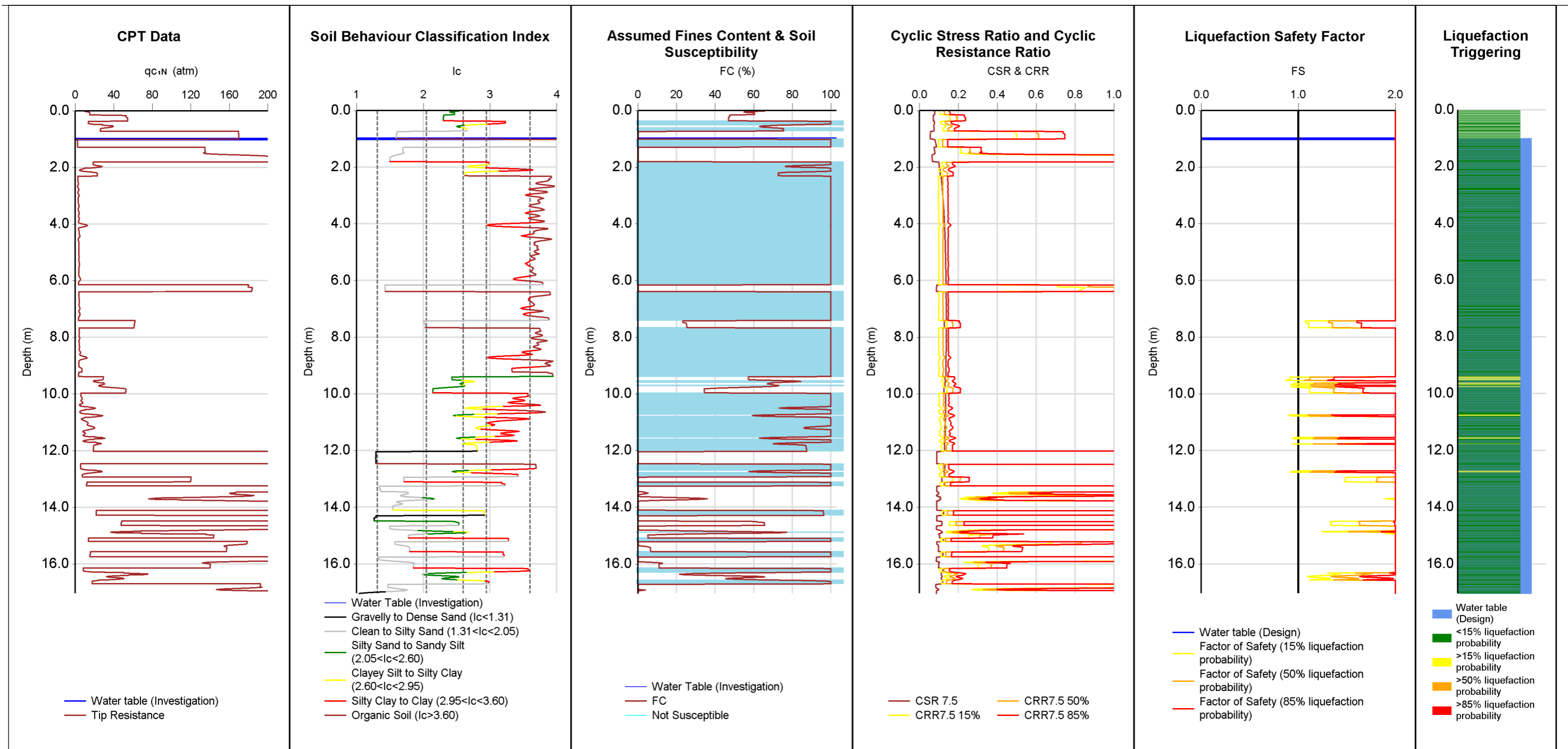
ID	NZGD 152820	NZGD 152821
CPT Name	CPT17	CPT18
Run description	CPT17	CPT18
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.72	17.96
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152820	CPT17	0	0	0
NZGD 152820	CPT17	0	18.72	2.6
NZGD 152821	CPT18	0	0	0
NZGD 152821	CPT18	0	17.96	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152820	CPT17	0	18.72	0 CFC
NZGD 152821	CPT18	0	17.96	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	12	0.5	0	1	9.5	0					
50%	5	0	0	0	17	0					
85%	2	0	0	0	17	0					

Reviewed by:

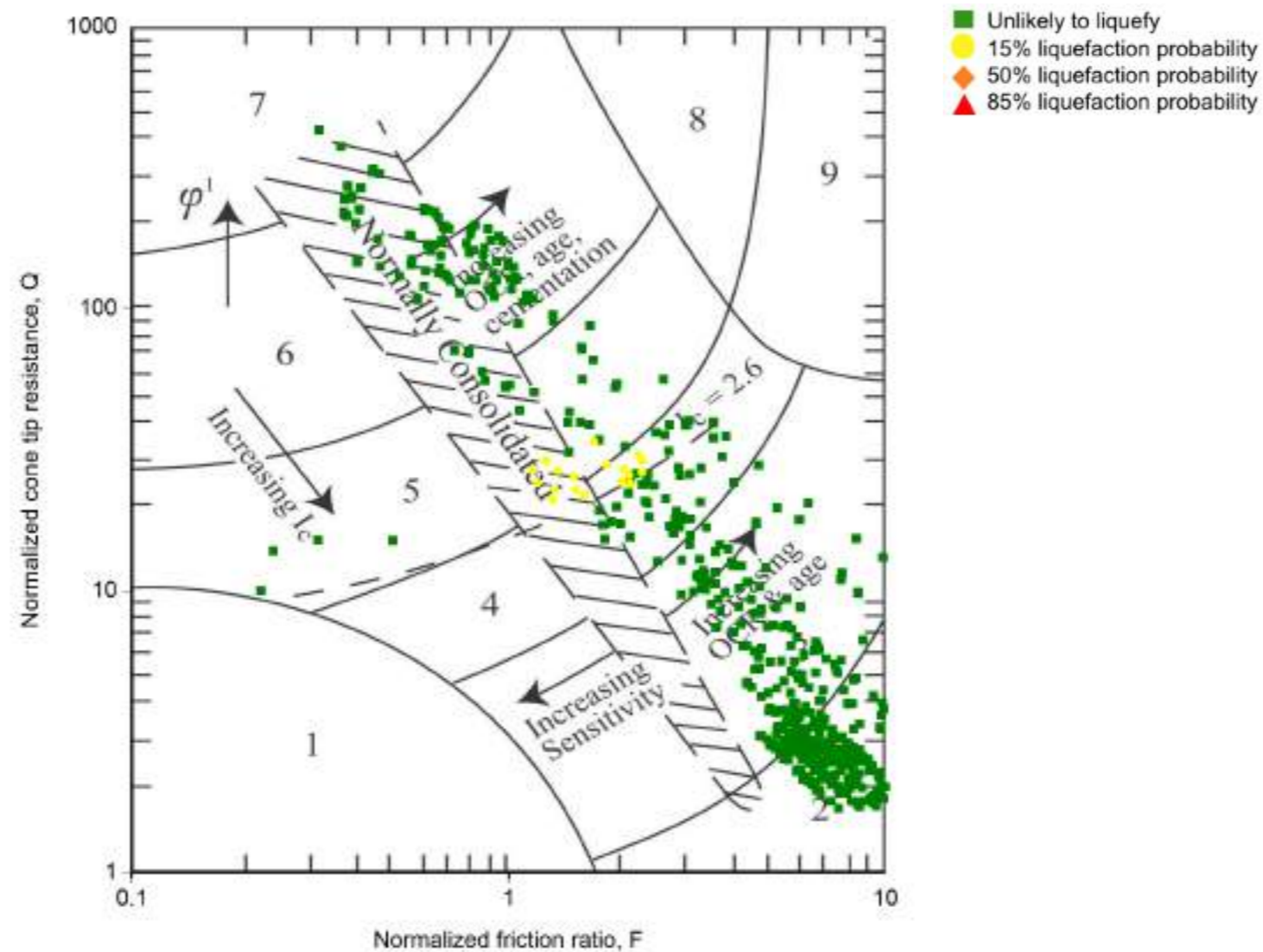
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]

LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**



- 1. Sensitive, fine grained
- 2. Organic soils - peats
- 3. Clays - silty clay to clay
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- 5. Sand mixtures - silty sand to sandy silt
- 6. Sands - clean sand to silty sand
- 7. Gravelly sand to dense sand
- 8. Very stiff sand to clayey sand *
- 9. Very stiff, fine grained *

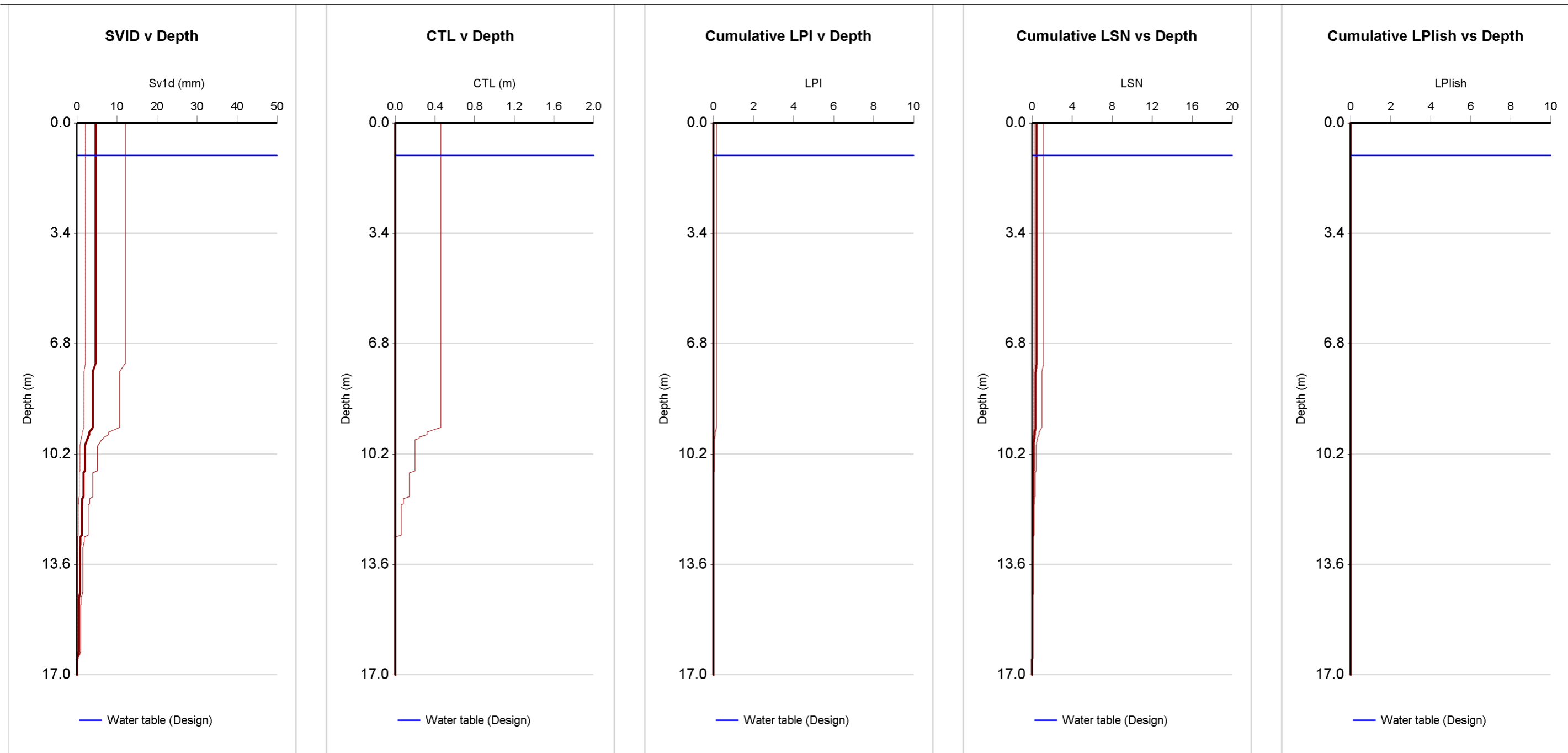
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




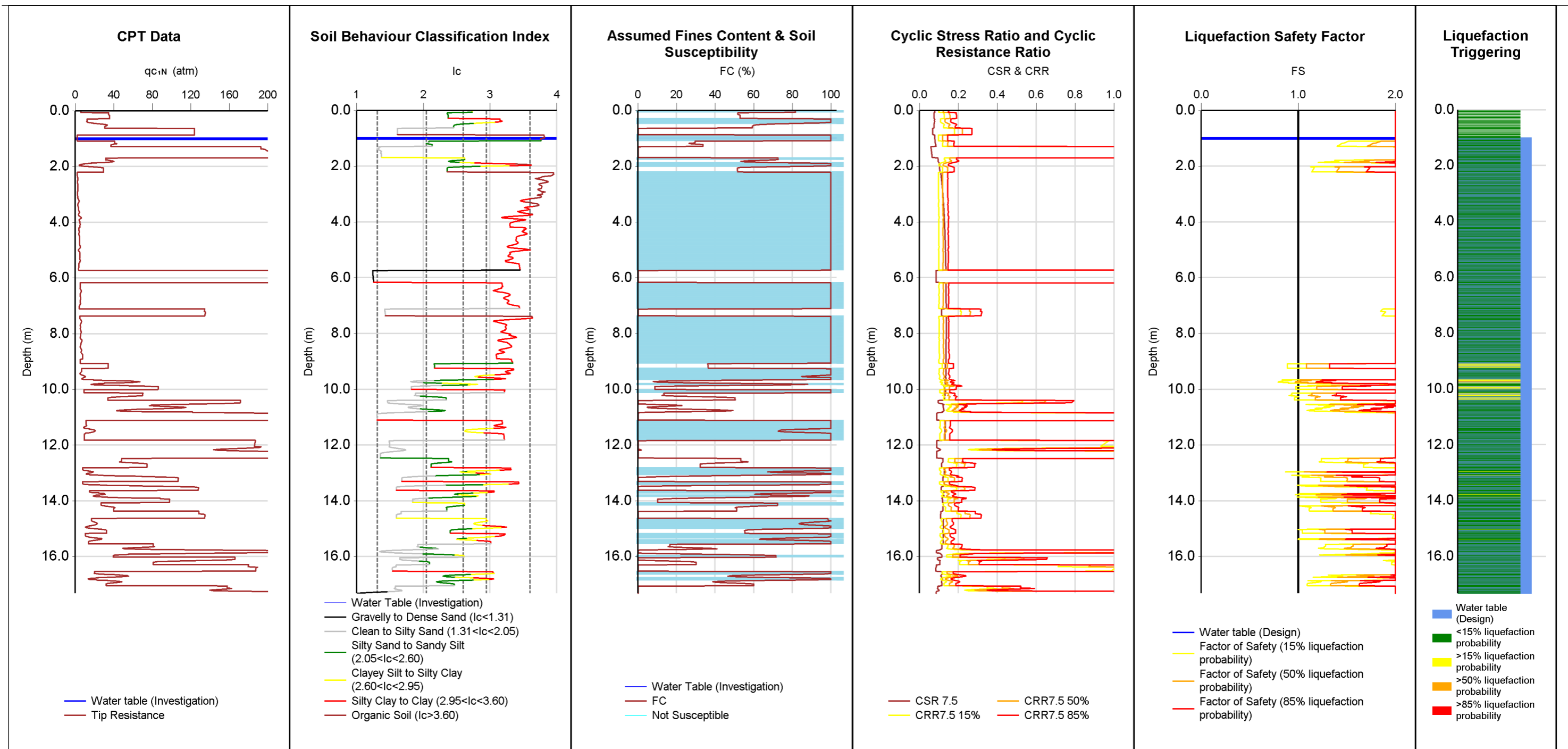
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]					



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	26	0.8	0	3	9.2	0					
50%	11	0	0	1	17.3	0					
85%	5	0	0	1	17.3	0					

Reviewed by:

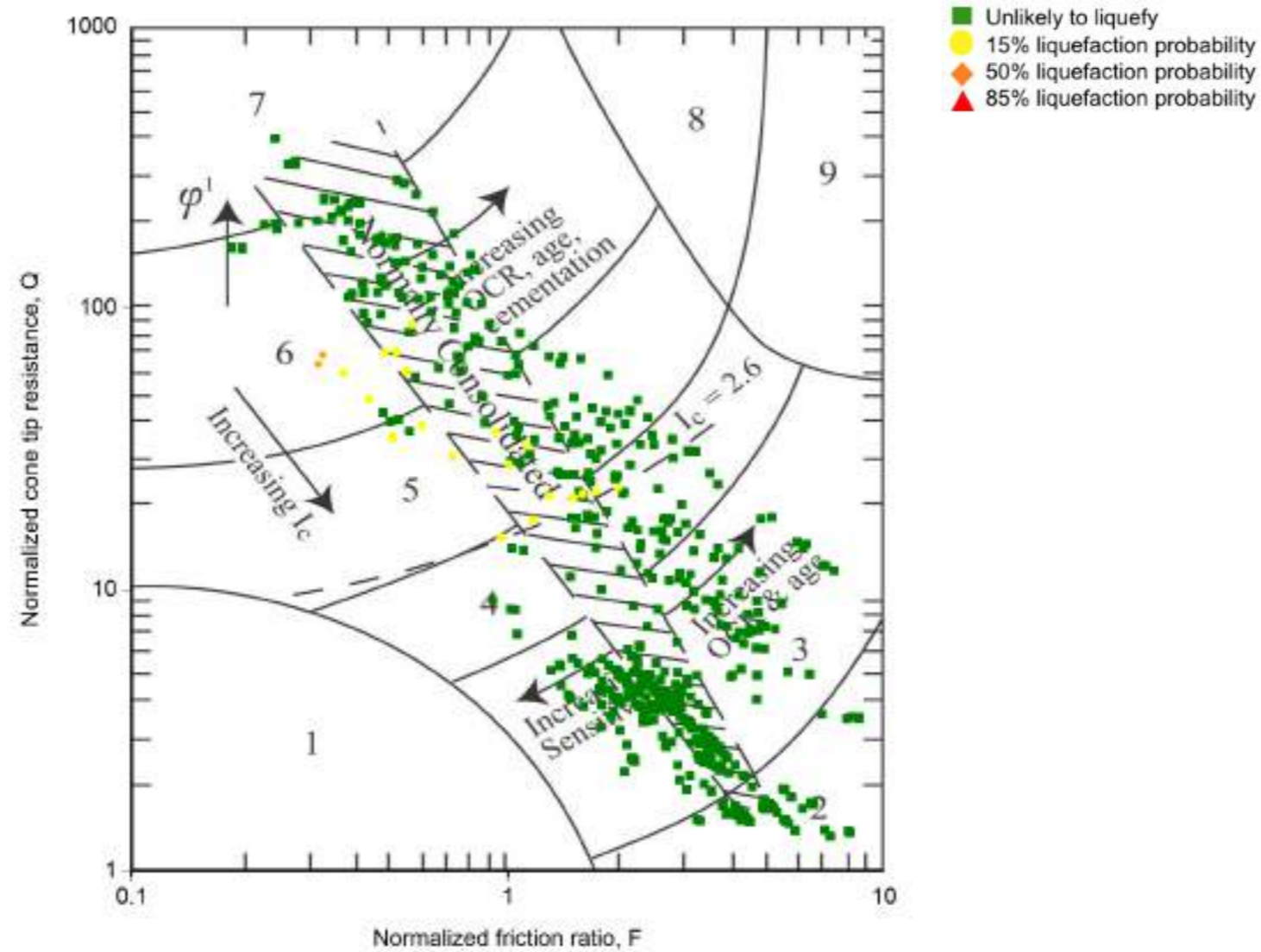
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

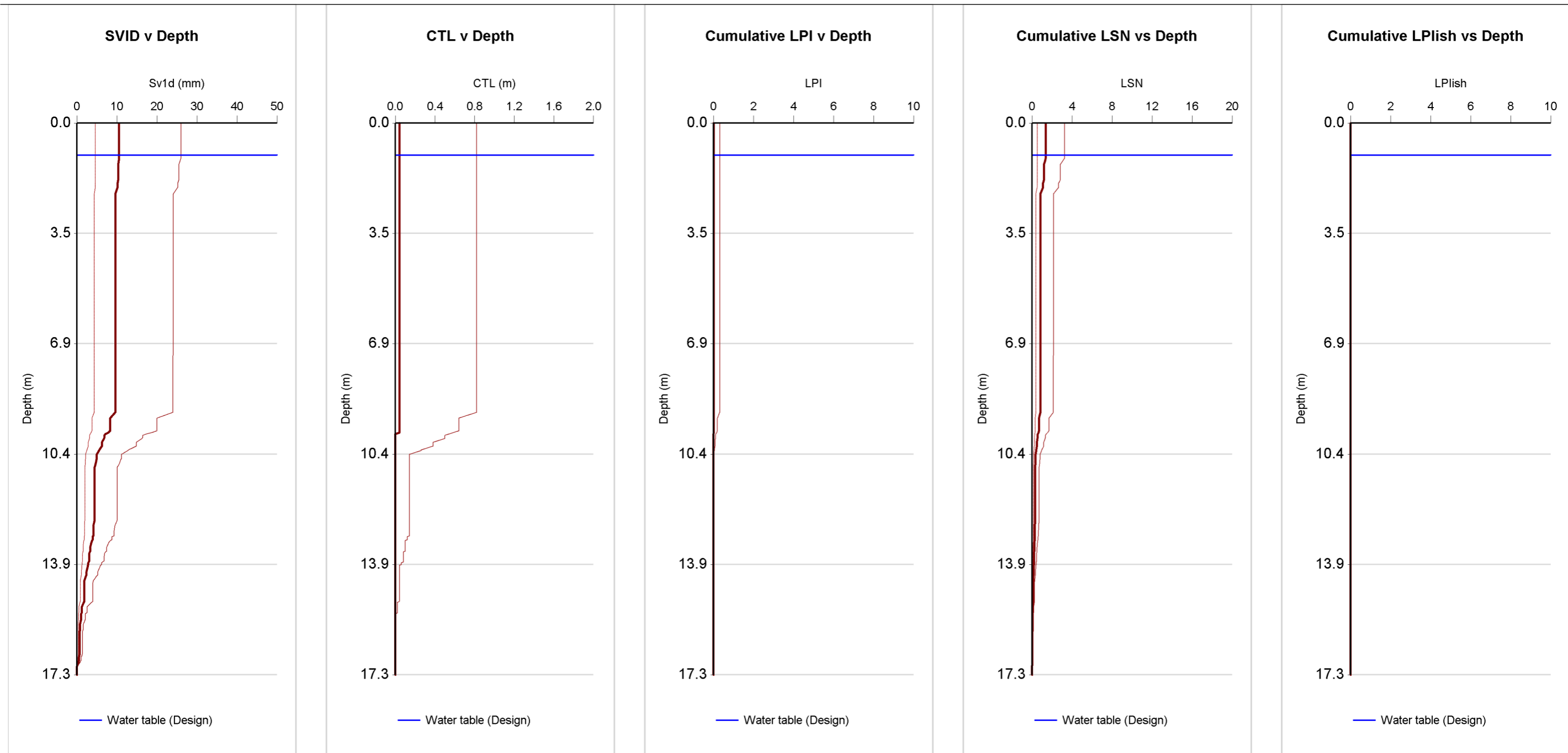


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

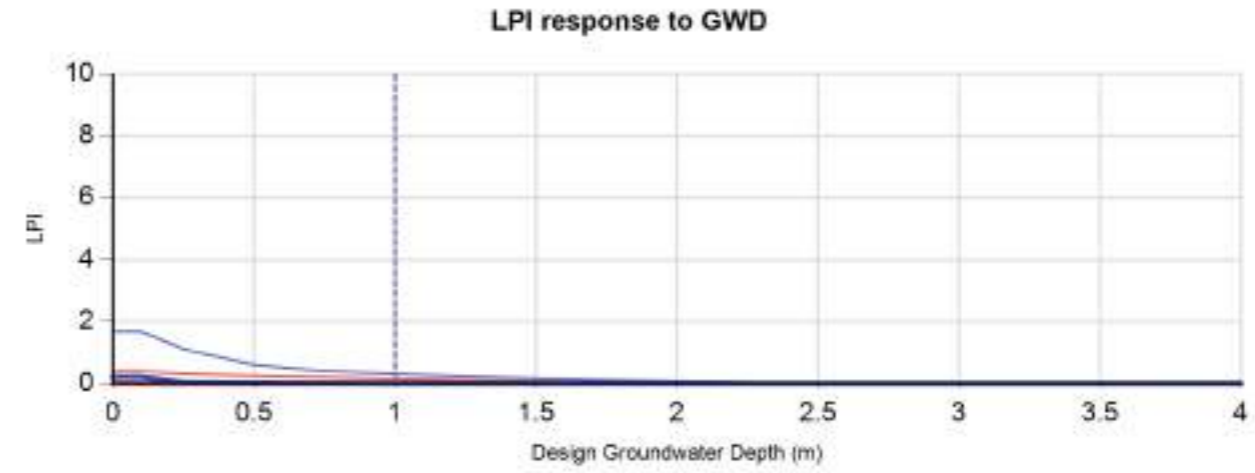
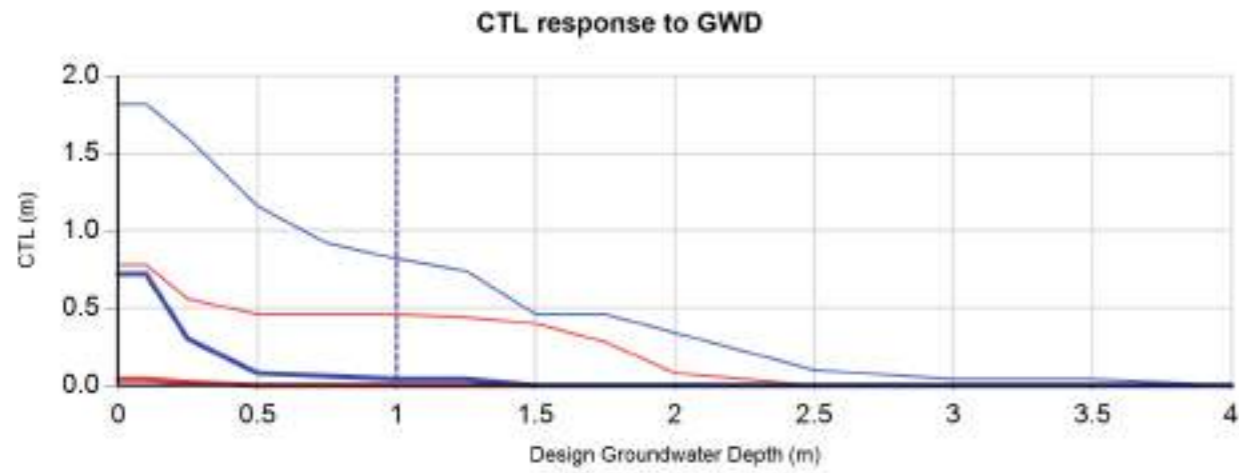
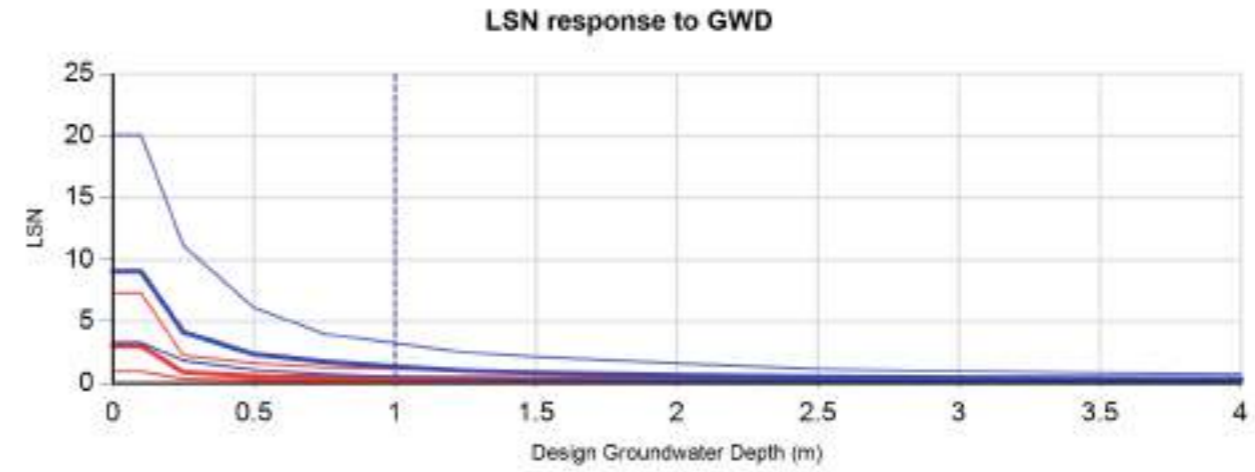
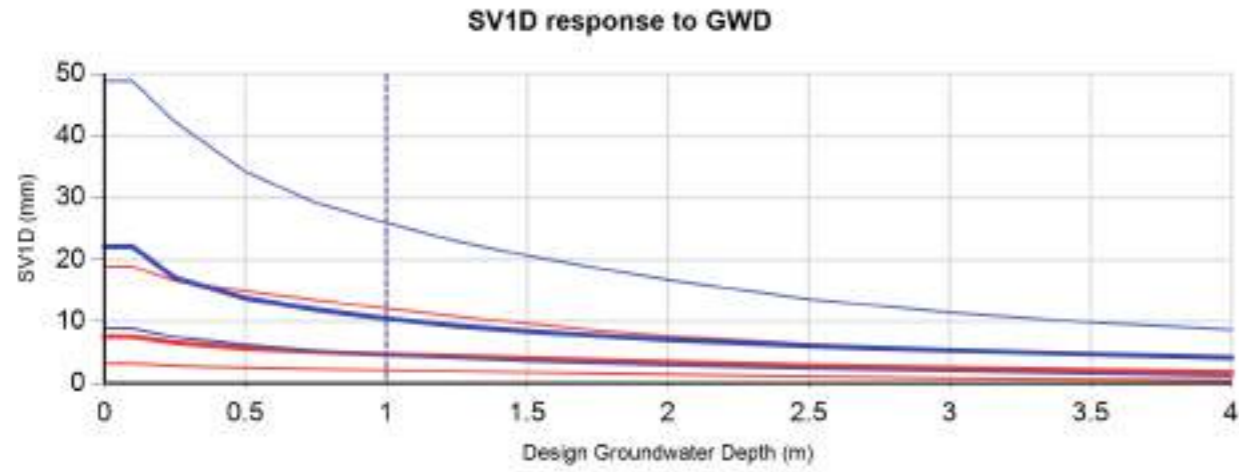
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.2	0.14	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]				




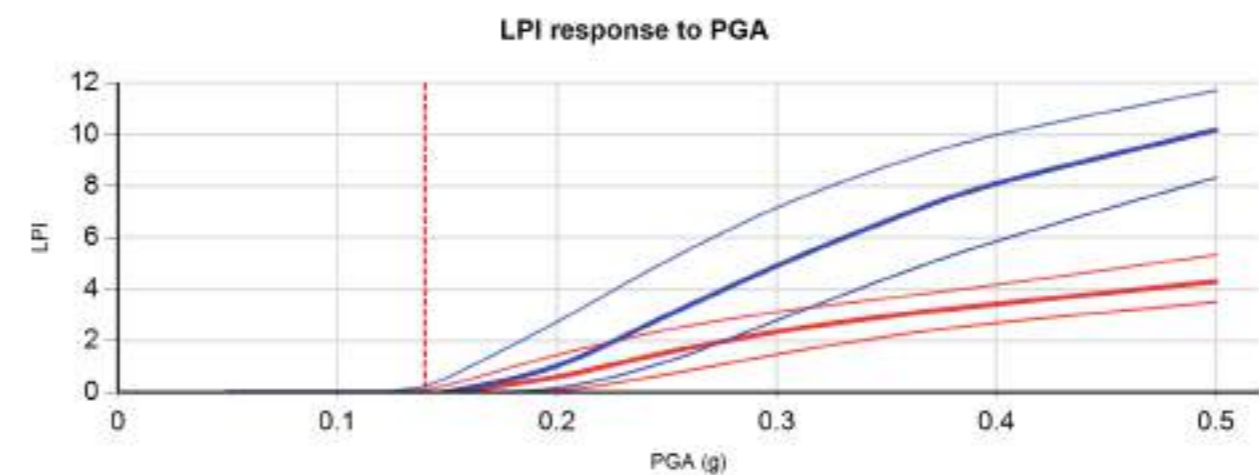
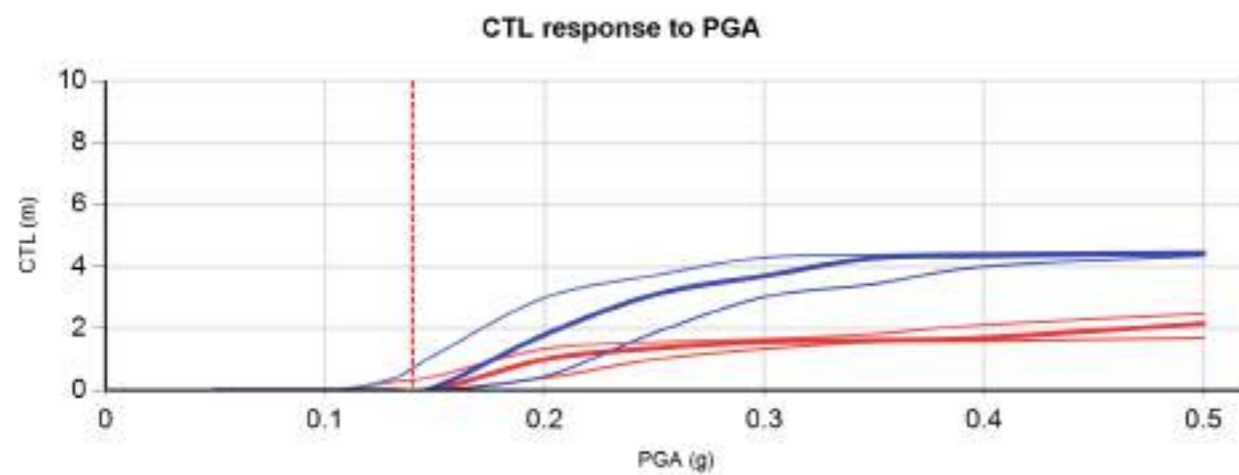
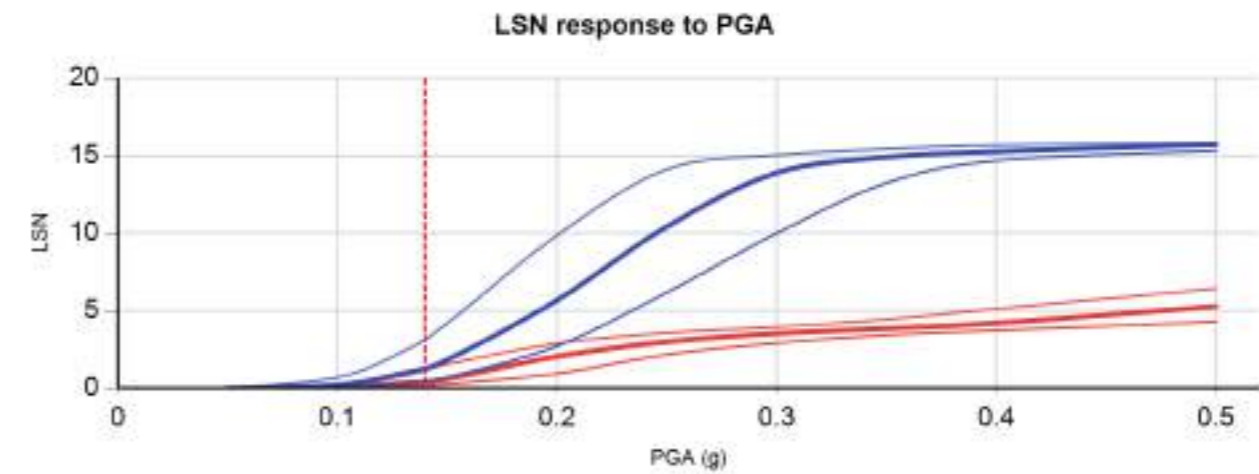
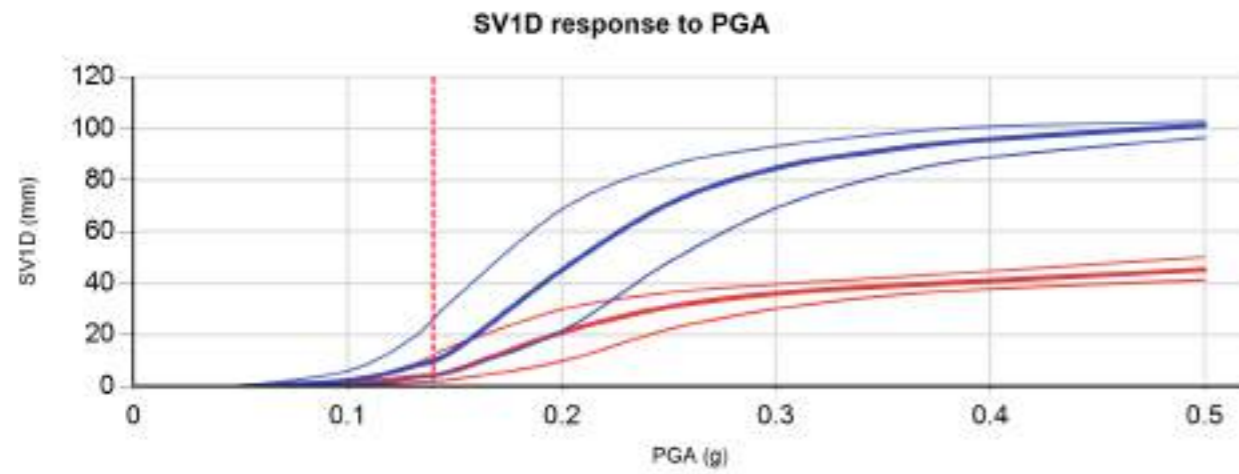
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.2	0.14	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	SLS Magnitude 6.2, PGA - 0.14g (1 in 25 years) [CPT 19 - 20]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

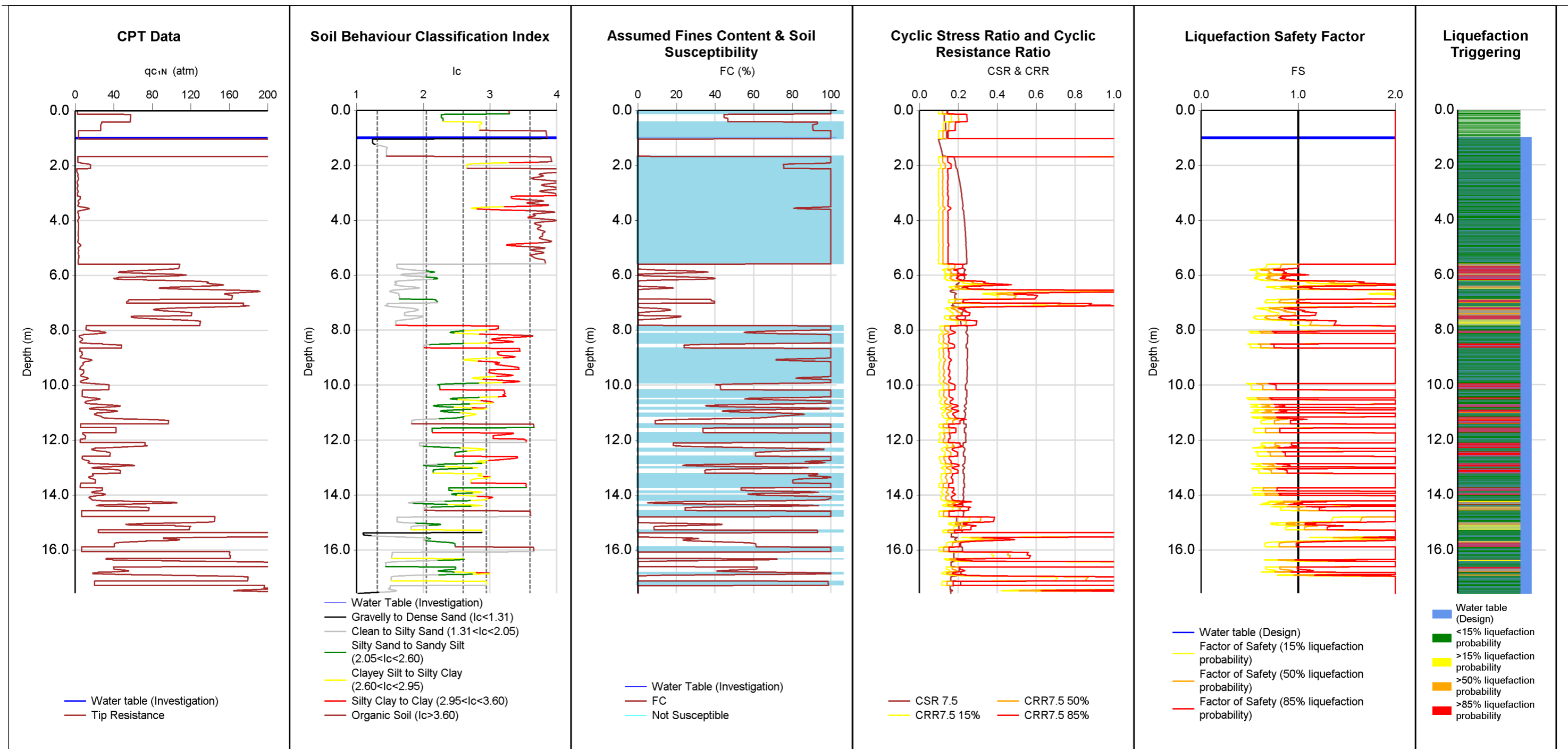
ID	NZGD 152822	NZGD 152823
CPT Name	CPT19	CPT20
Run description	CPT19	CPT20
PGA	0.14g	0.14g
Magnitude	6.2	6.2
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.04	17.32
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152822	CPT19	0	0	0
NZGD 152822	CPT19	0	17.04	2.6
NZGD 152823	CPT20	0	0	0
NZGD 152823	CPT20	0	17.32	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152822	CPT19	0	17.04	0 CFC
NZGD 152823	CPT20	0	17.32	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	107	4.8	8	11	5.7	0					
50%	93	4.2	5	10	5.7	0					
85%	69	3.2	2	7	5.8	0					

Reviewed by:

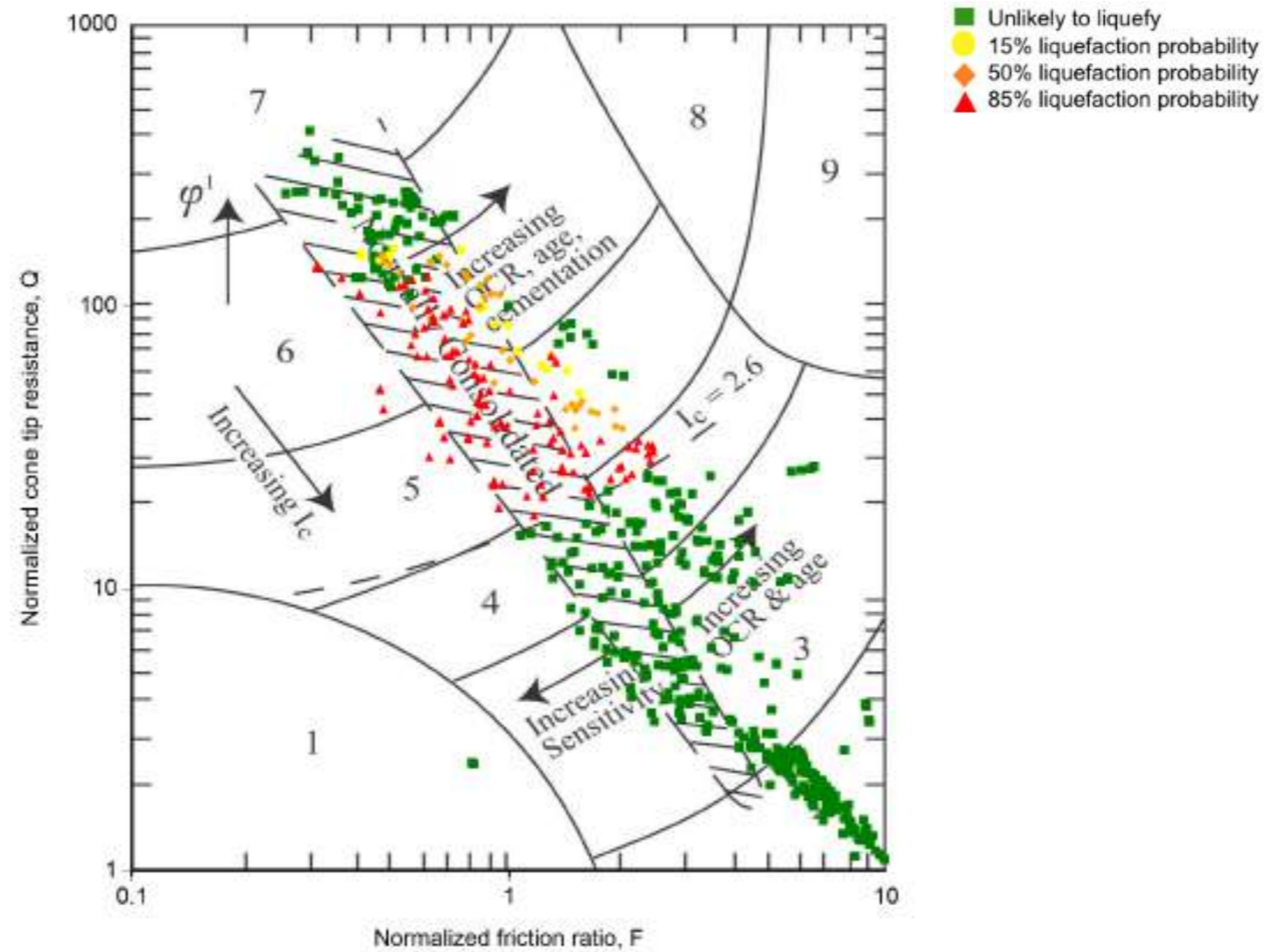
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

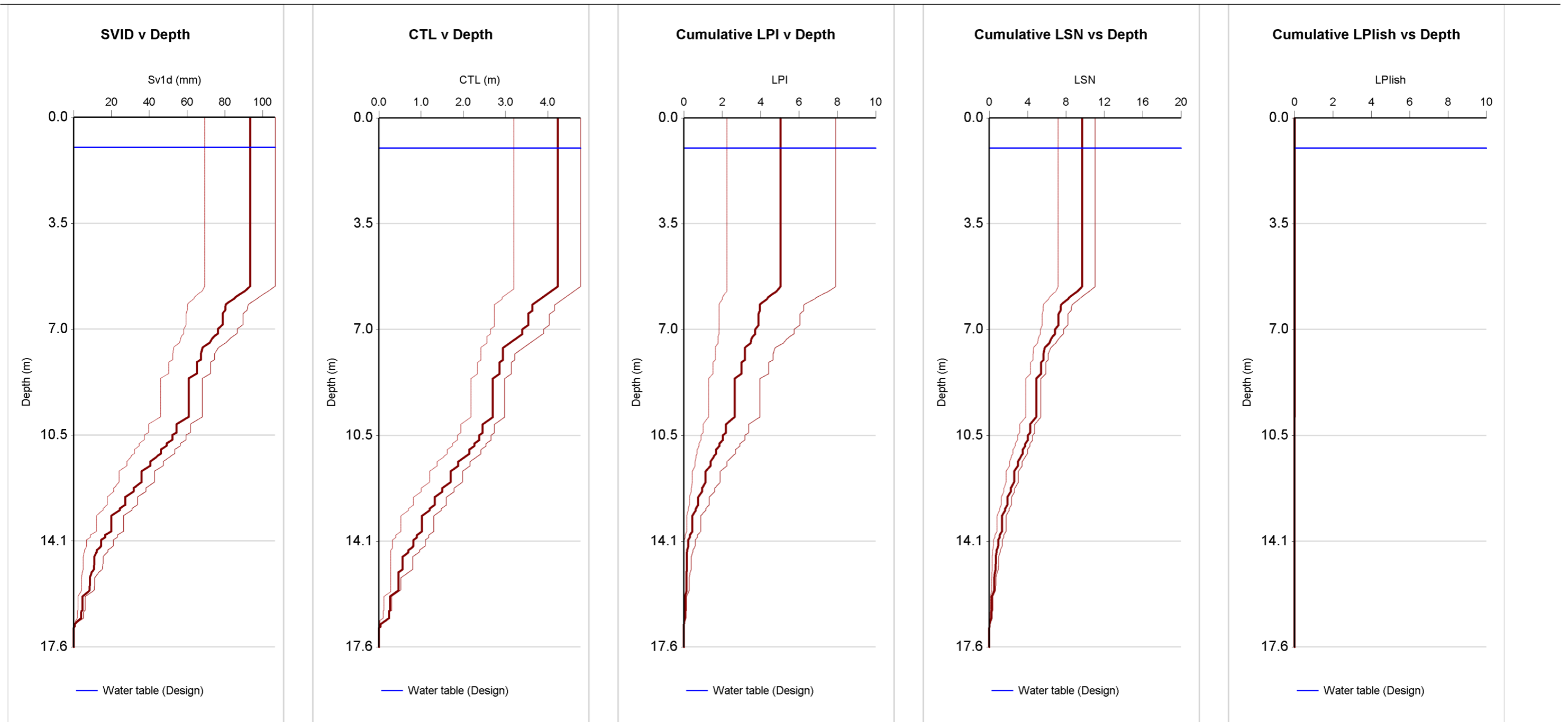


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

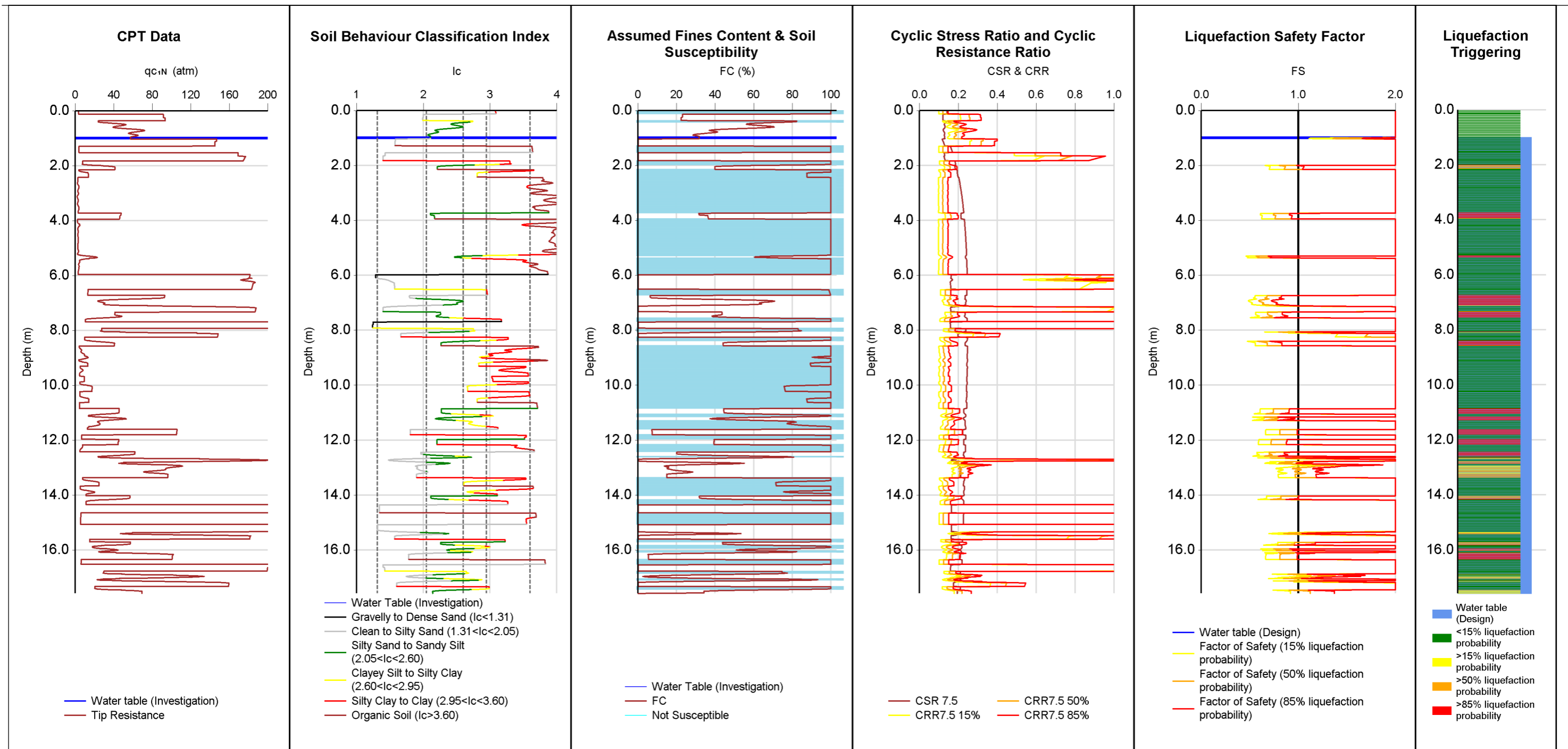
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	83	3.8	6	11	2.1	4					
50%	71	3.3	4	9	2.1	2					
85%	48	2.4	2	6	3.8	1					

Reviewed by:

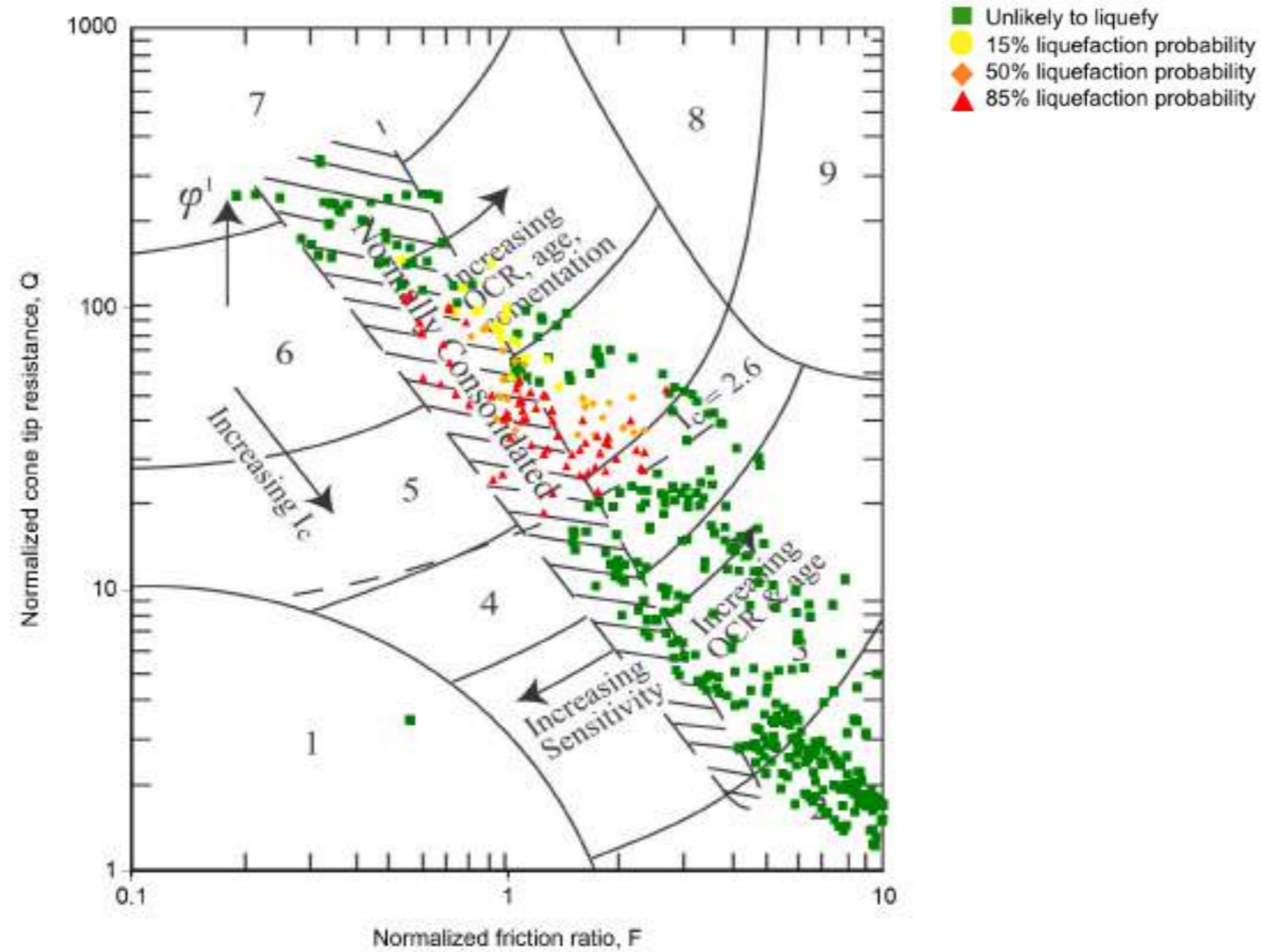
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

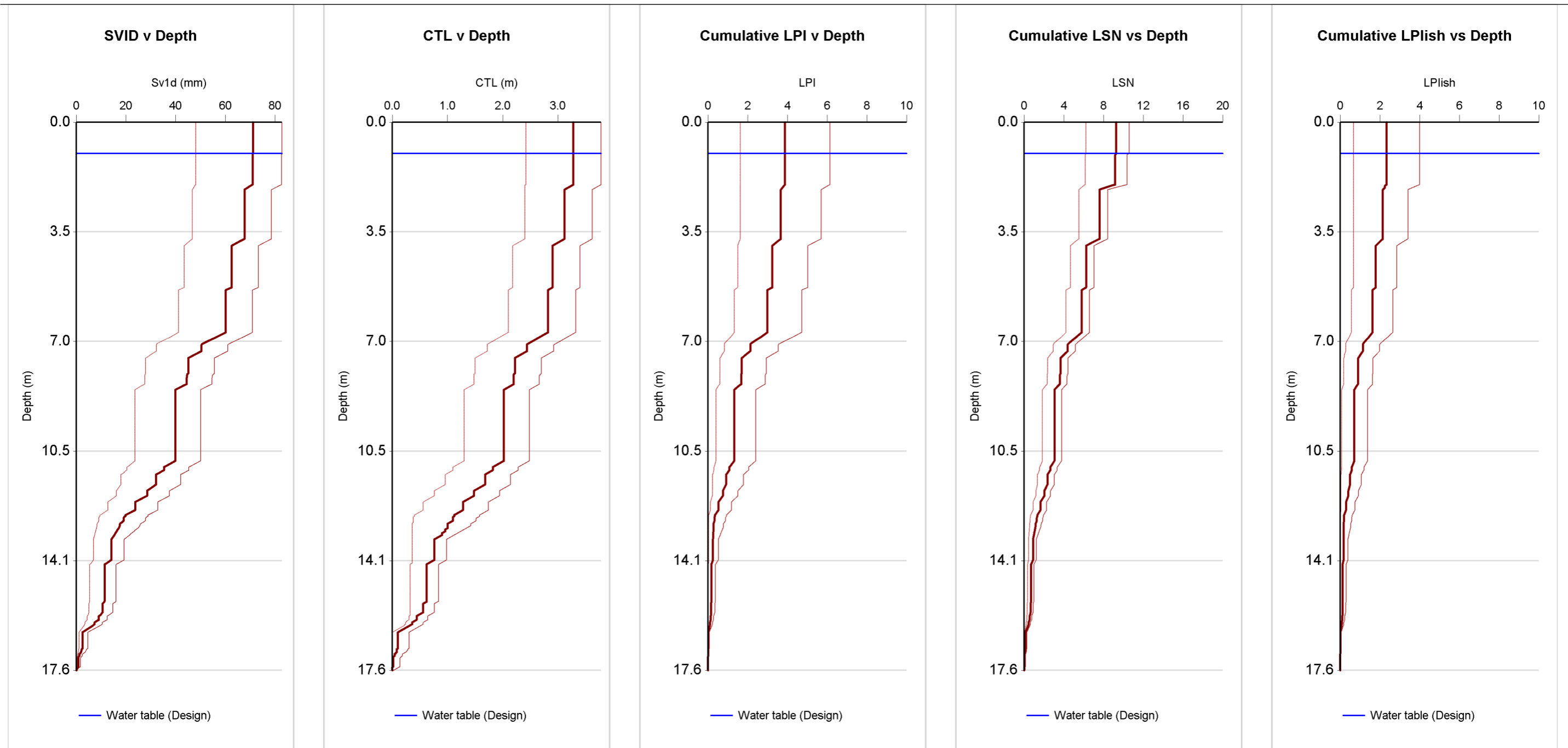


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

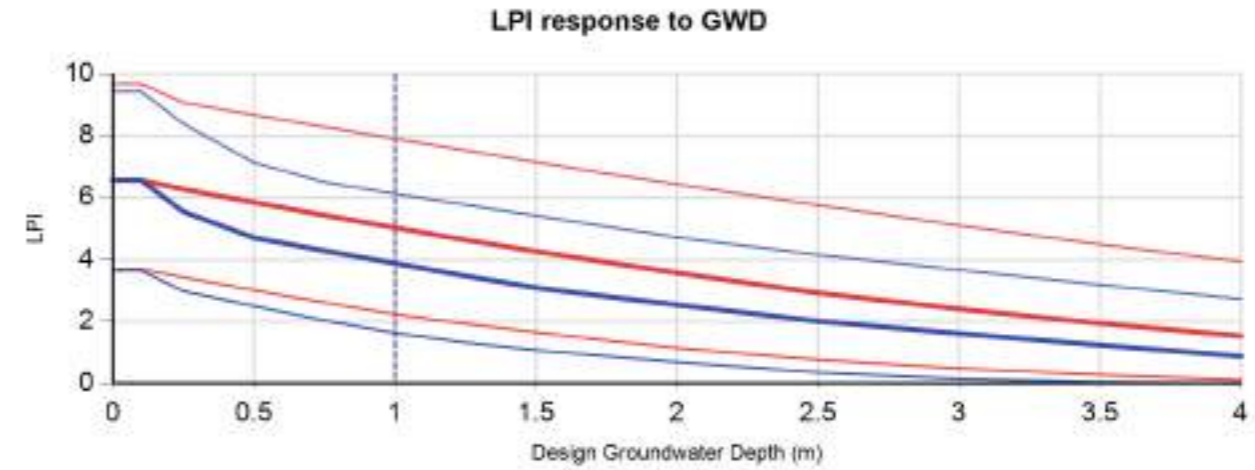
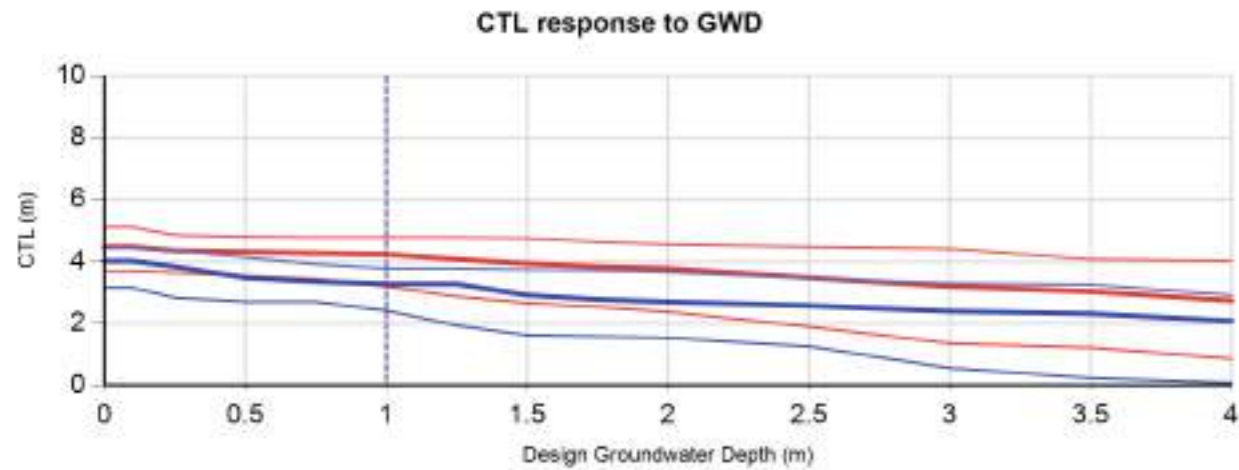
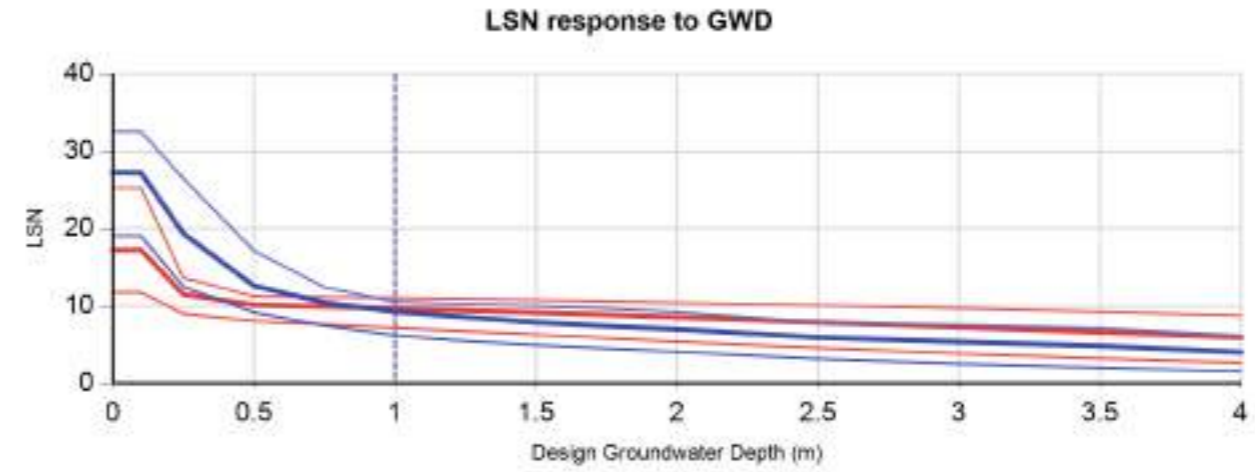
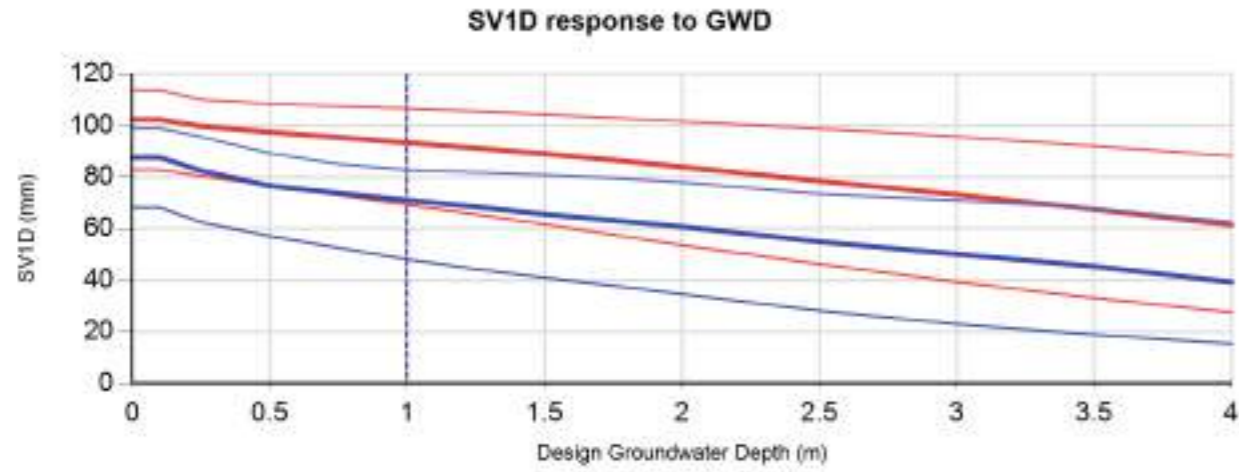
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]				




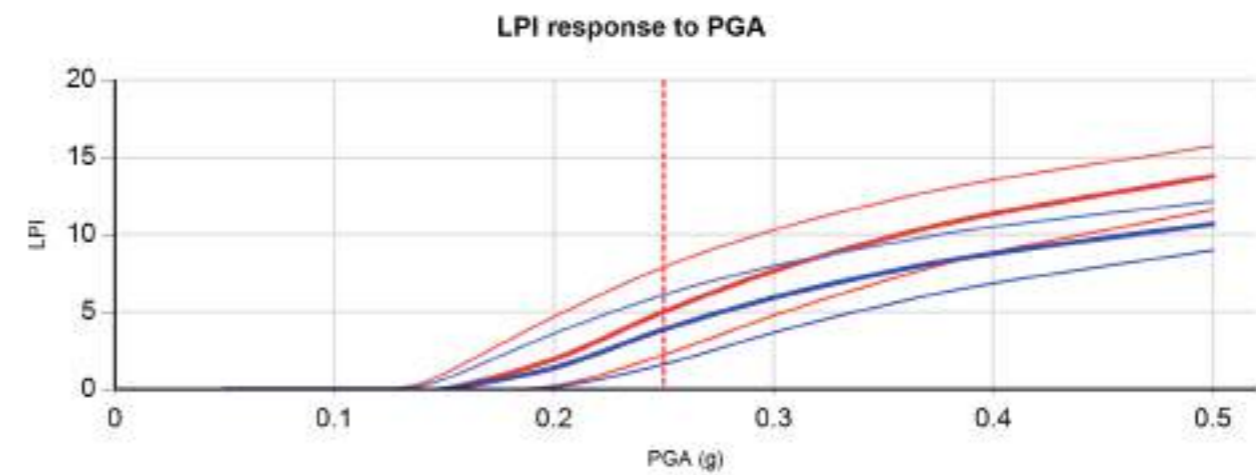
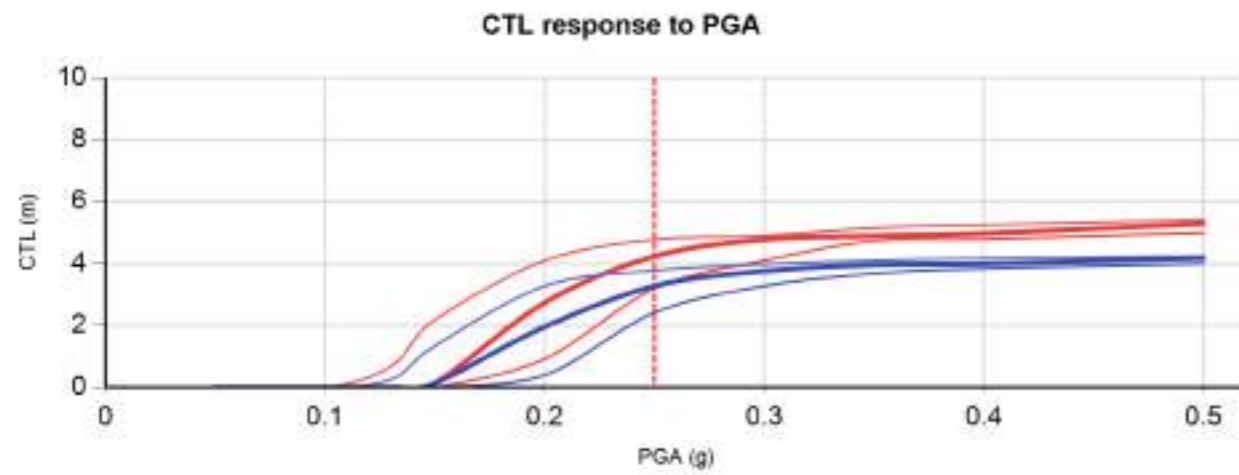
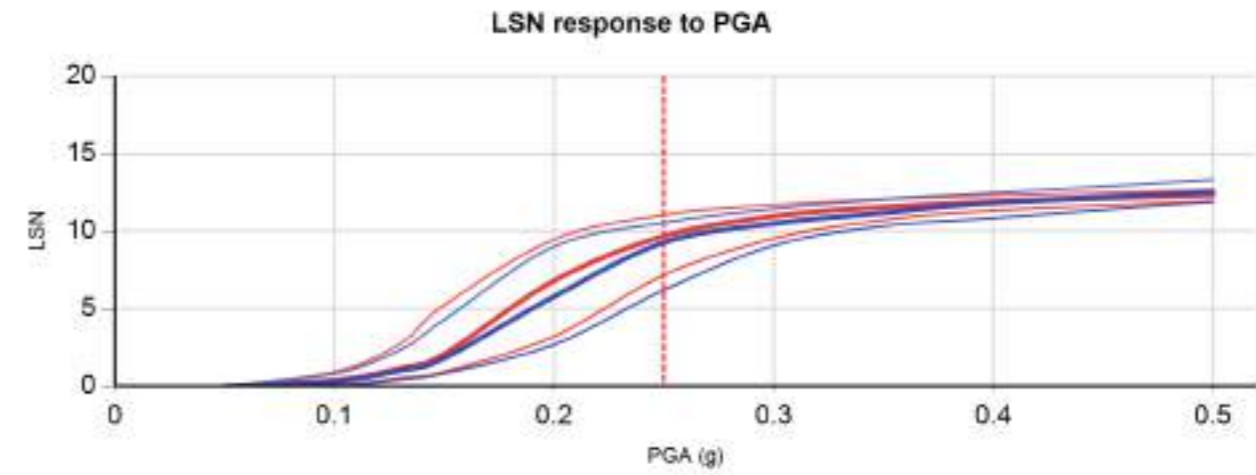
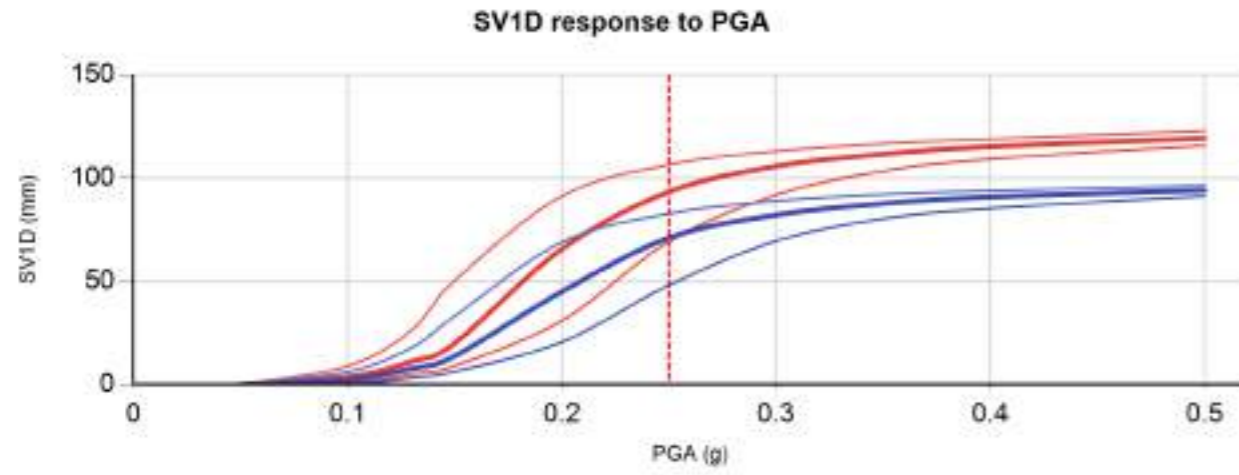
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 1 - 2]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

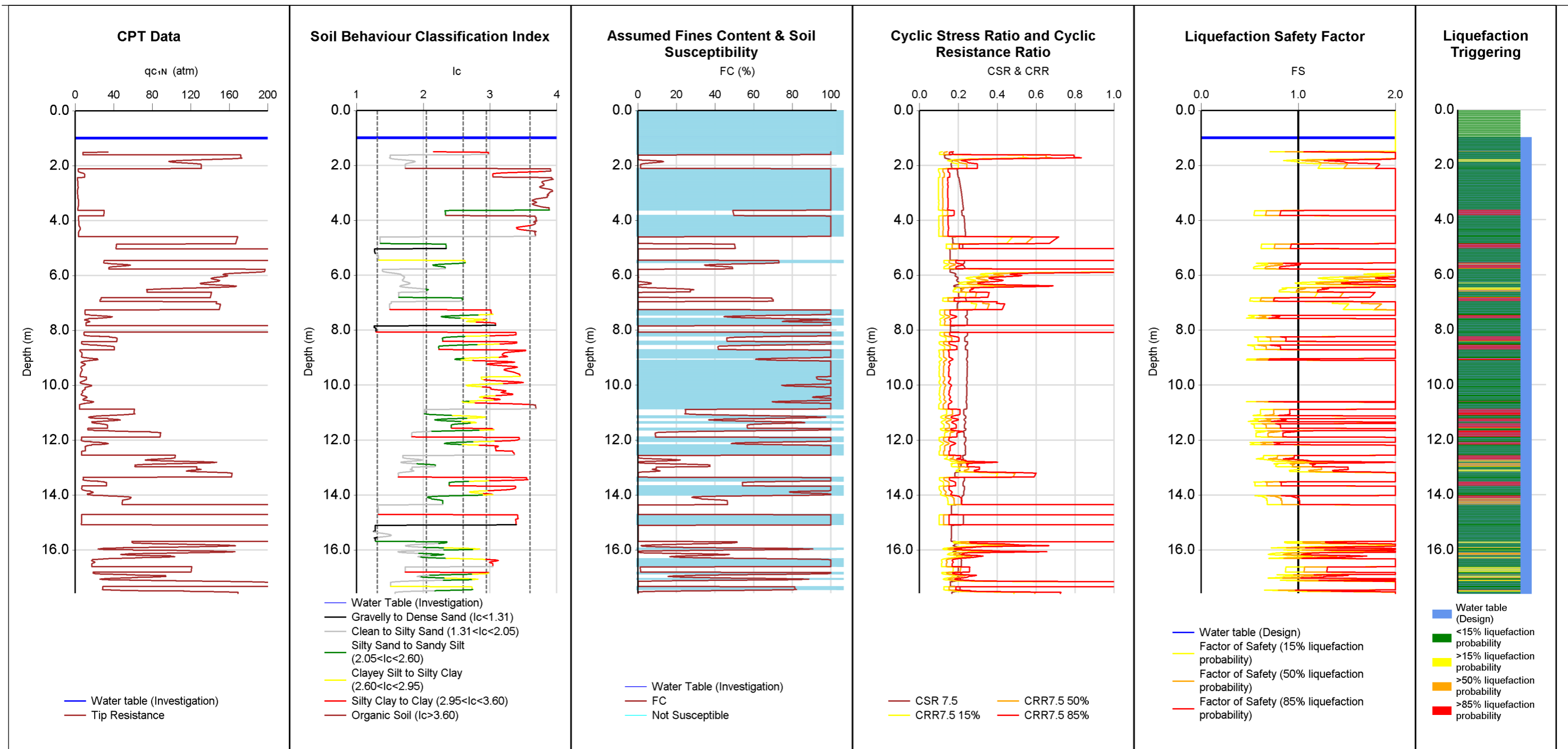
ID	NZGD 152807	NZGD 152808
CPT Name	CPT01	CPT02
Run description	CPT01	CPT02
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.58	17.9
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152807	CPT01	0	0	0
NZGD 152807	CPT01	0	17.58	2.6
NZGD 152808	CPT02	0	0	0
NZGD 152808	CPT02	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

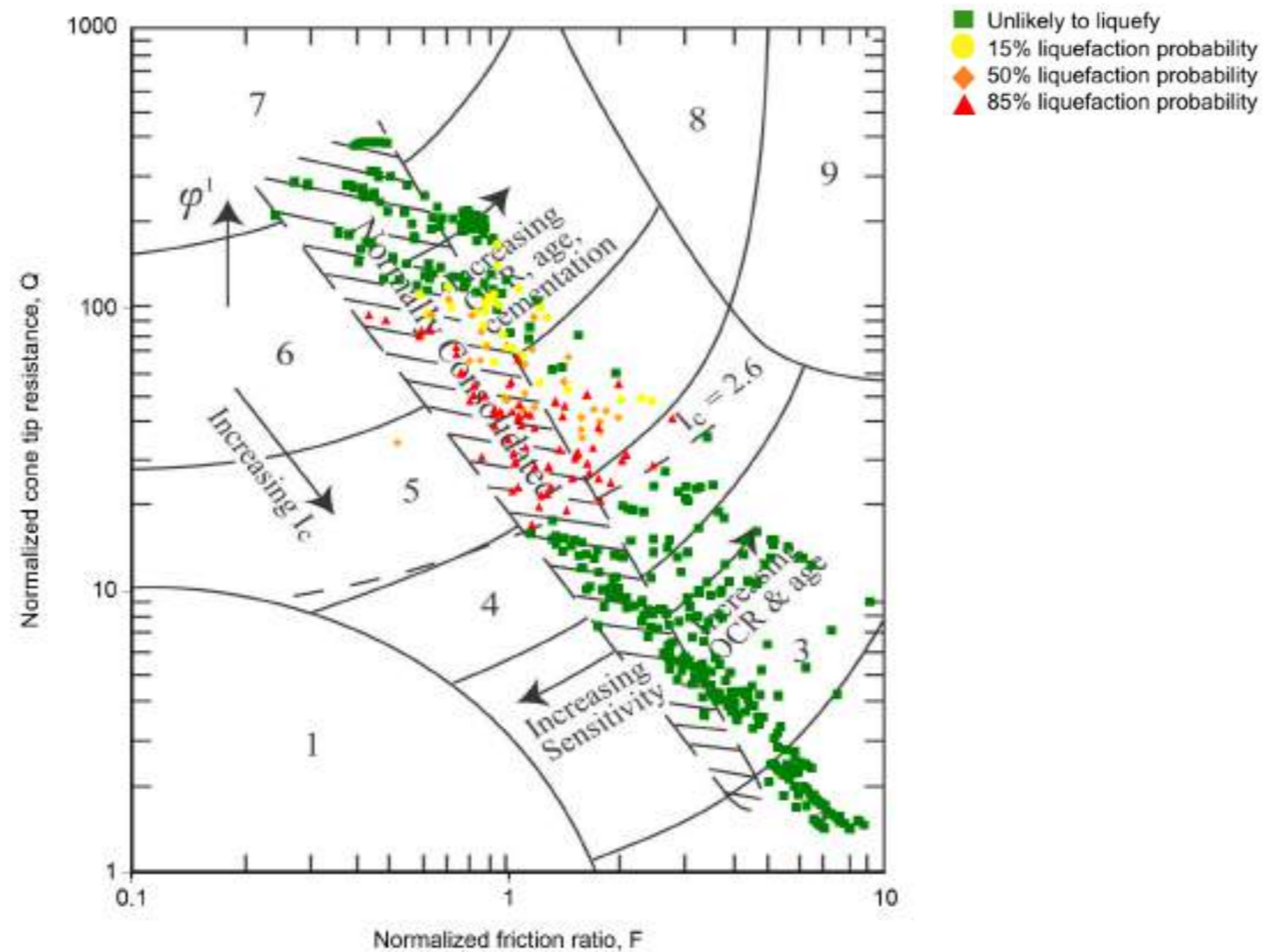
ID	Run description	From (m)	To (m)	Fc
NZGD 152807	CPT01	0	17.58	0 CFC
NZGD 152808	CPT02	0	17.58	0 CFC



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.3	0.25	BI-2014	ZRB-2002	18		0	

PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish
15%	94	4.2	7	12	1.9	4
50%	81	3.4	5	10	3.7	3
85%	60	2.6	2	8	3.7	0

Reviewed by:	
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

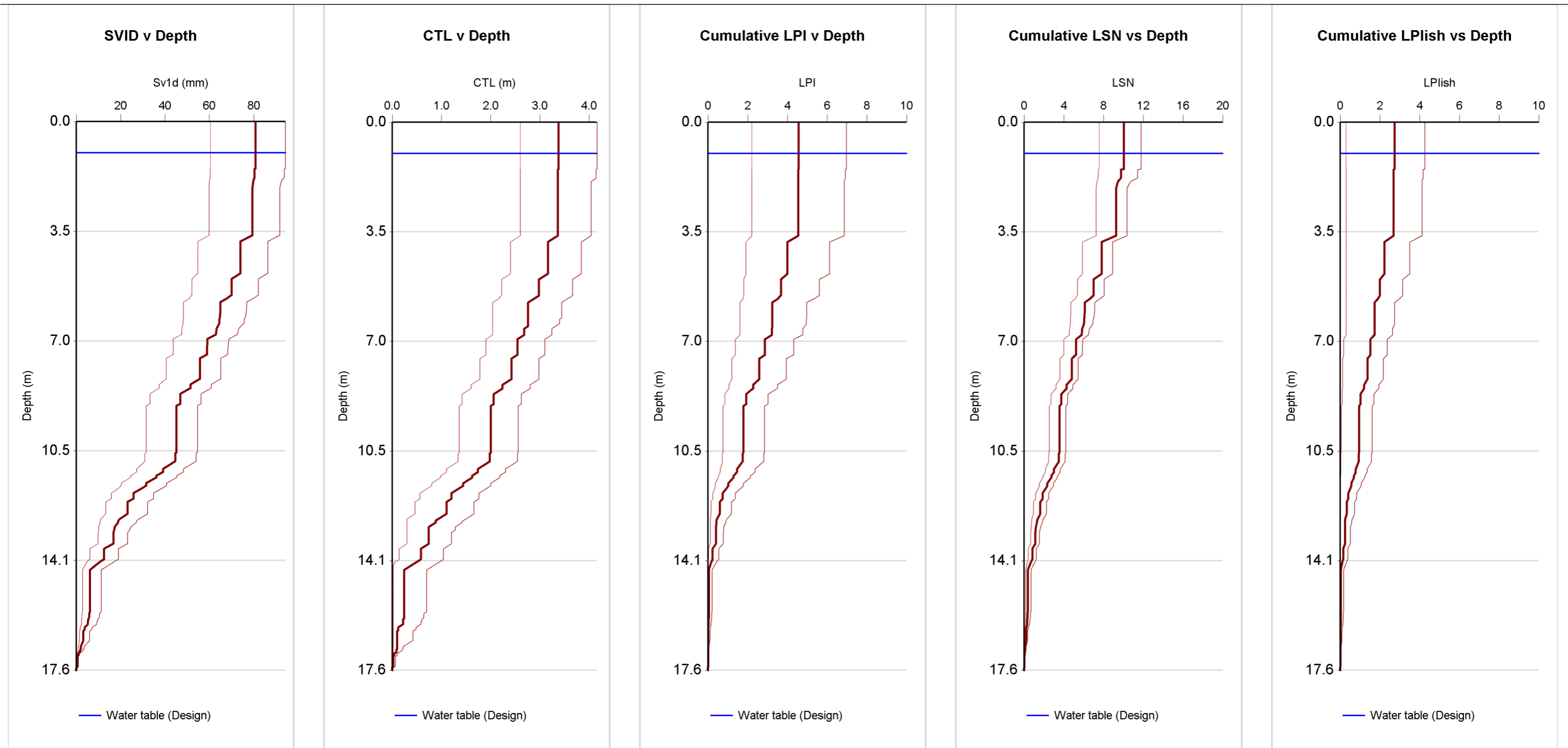
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




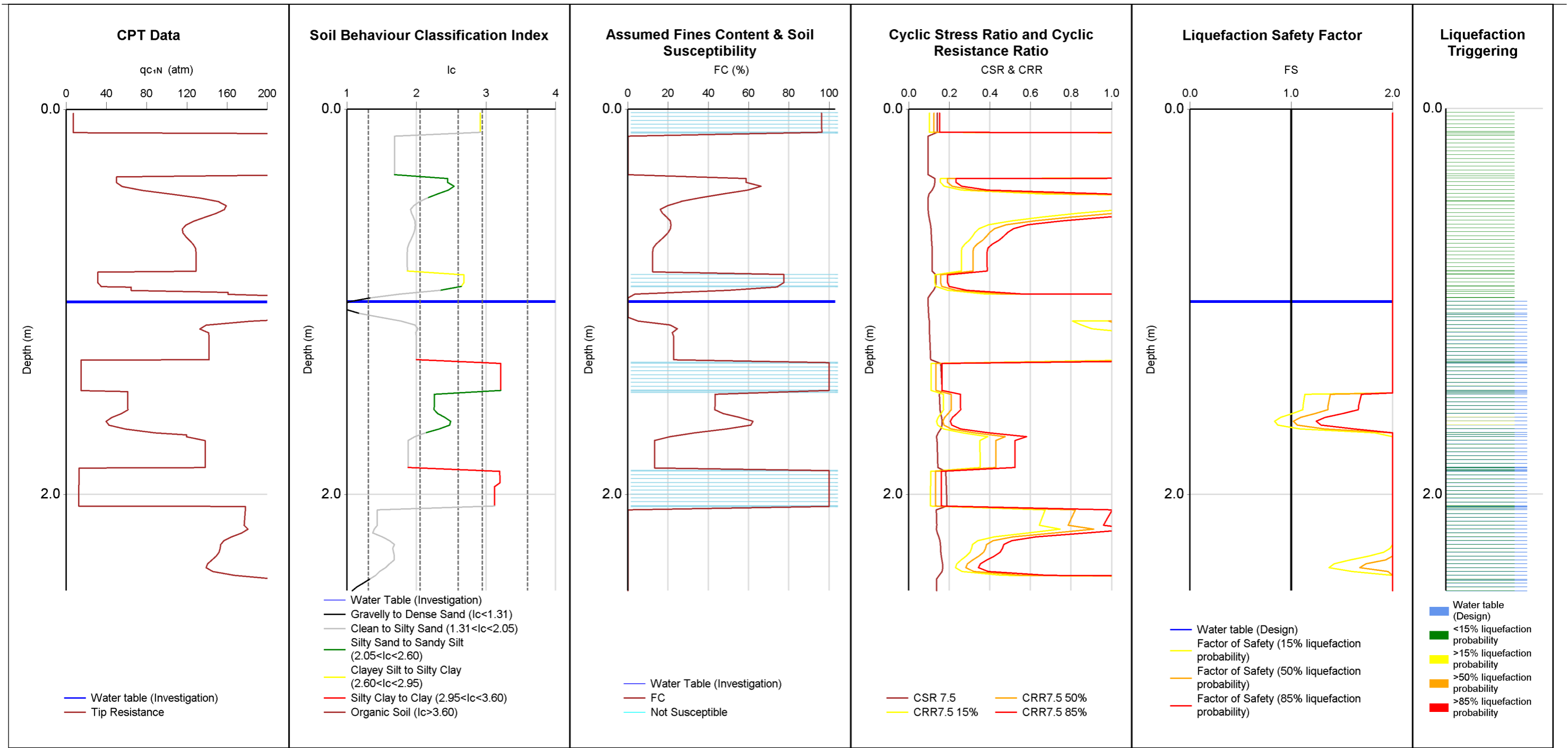
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 12 pages
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 12 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 3 - 5]				

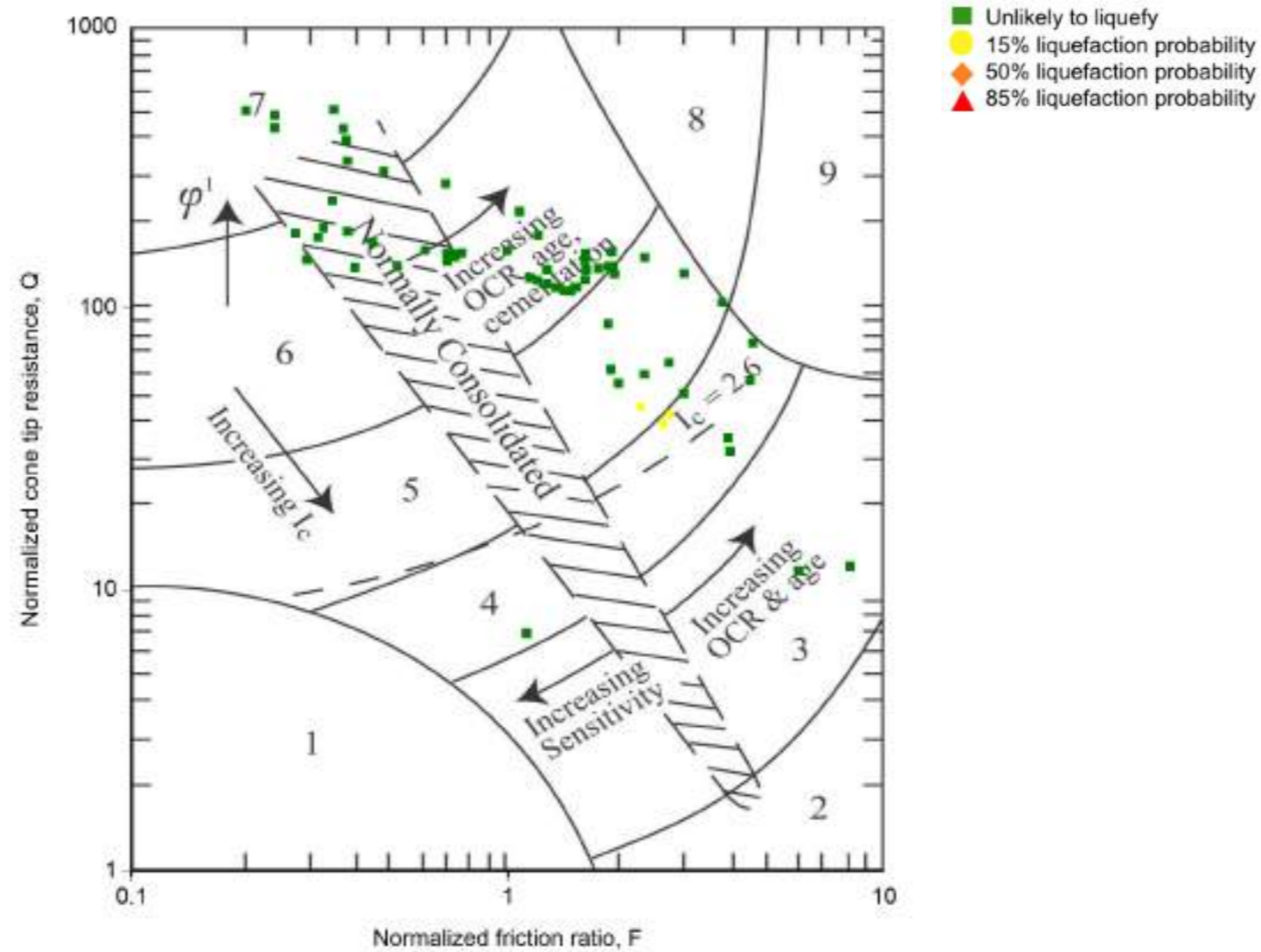


Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	2	0.1	0	1	2.5	0					
50%	1	0	0	0	2.5	0					
85%	0	0	0	0	2.5	0					

Reviewed by:

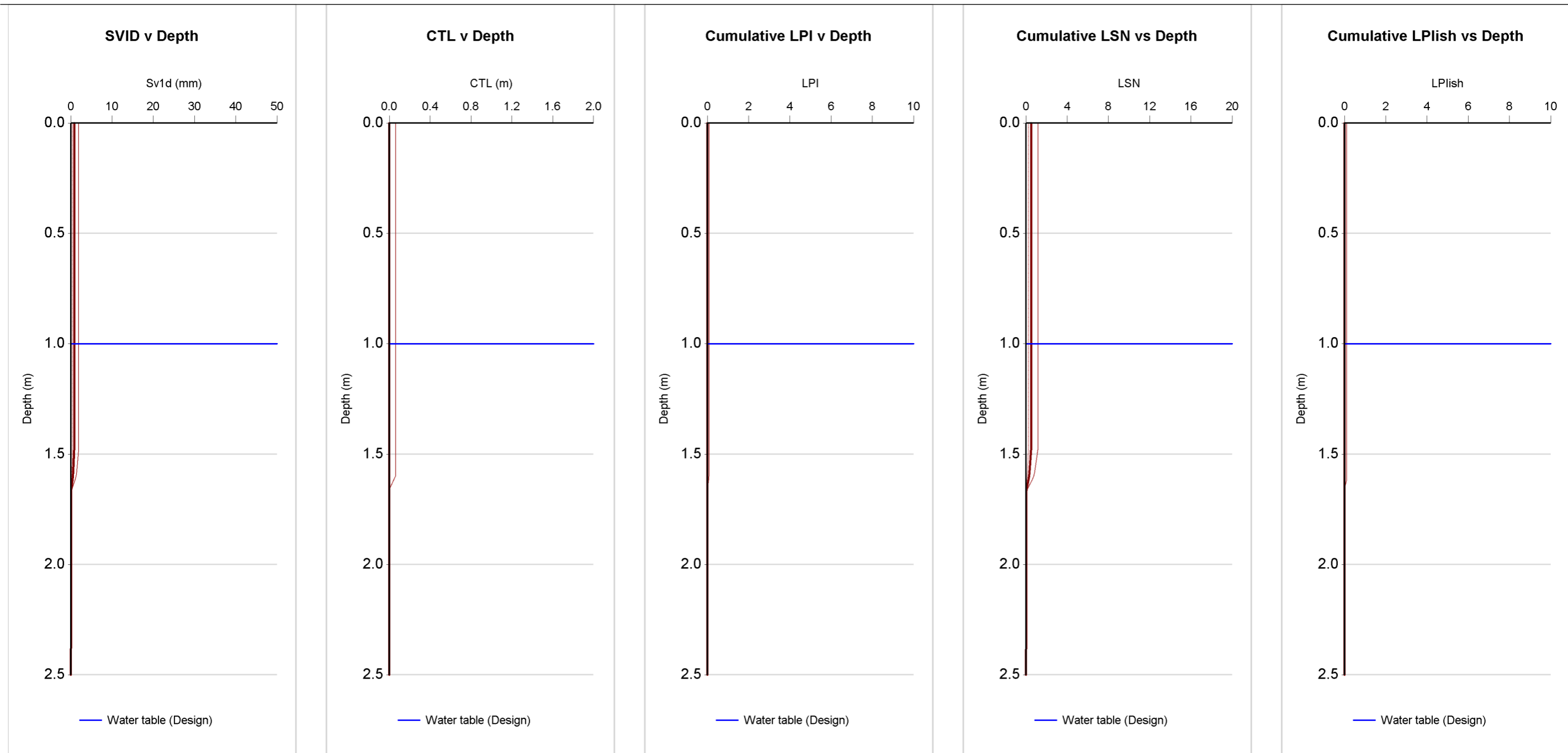
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



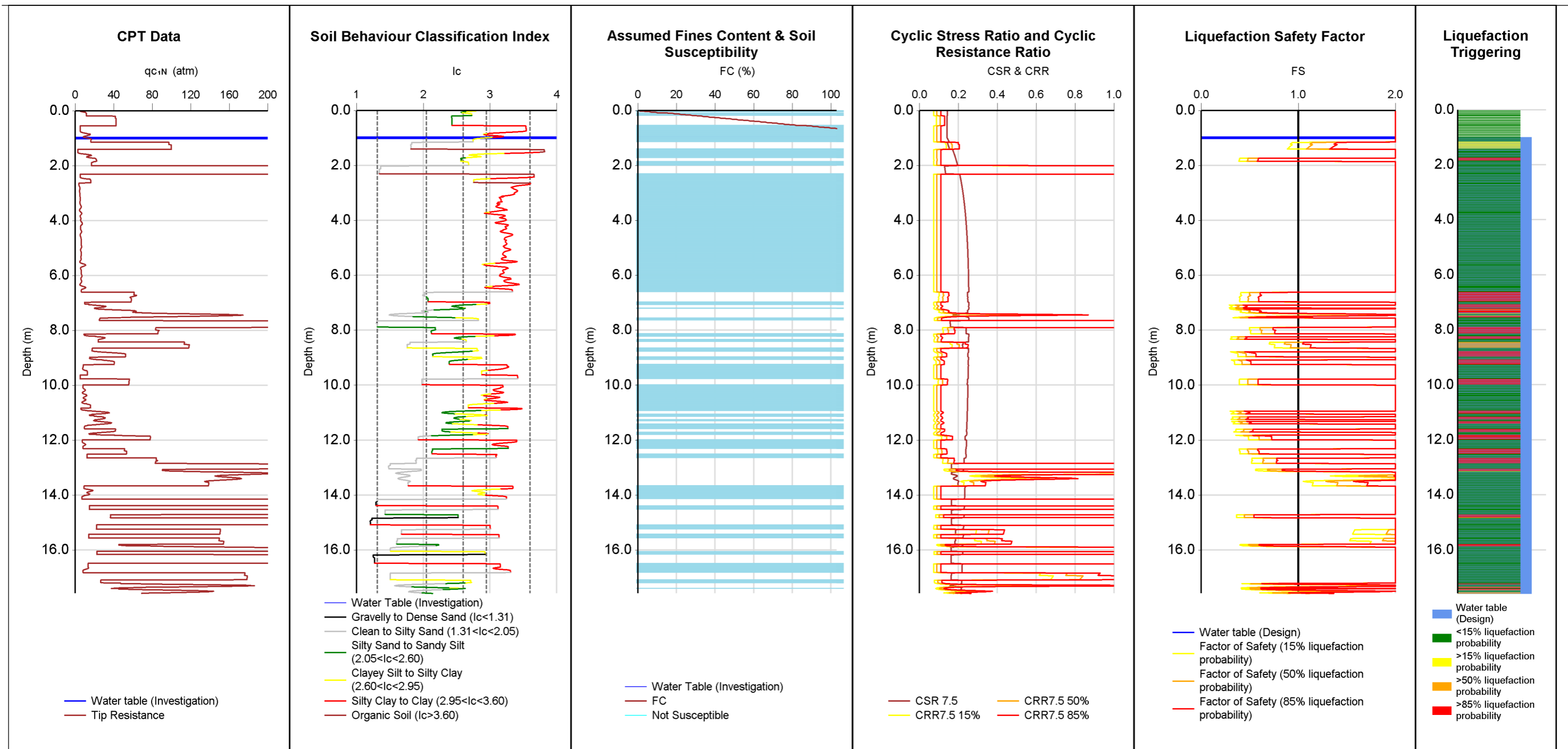
- | | |
|--|-------------------------------------|
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CPT-based soil behavior type classification chart by Robertson (1990)



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	146	3.8	10	21	1.2	6					
50%	140	3.5	8	19	1.8	5					
85%	136	3.2	7	18	1.8	4					

Reviewed by:

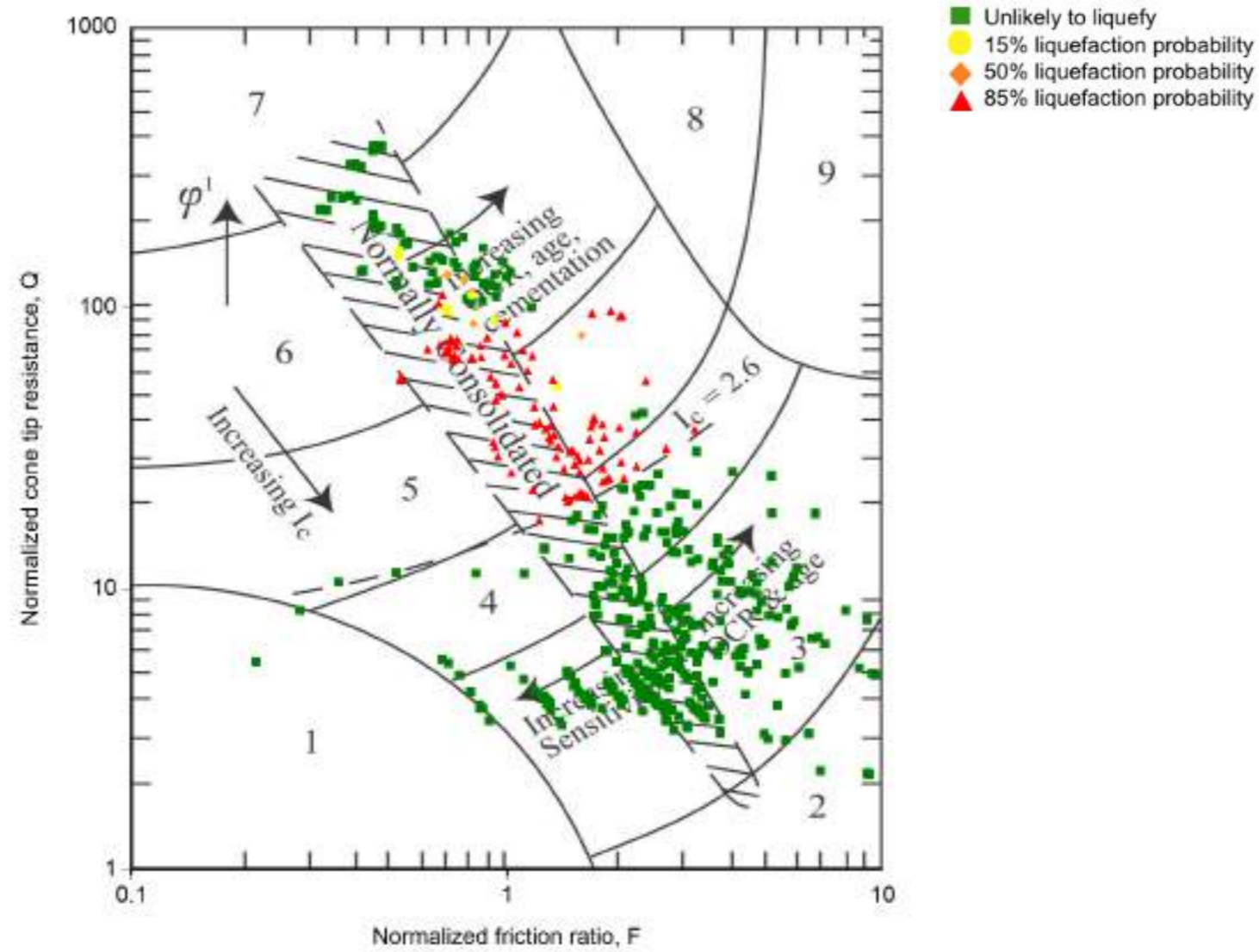
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 3 - 5]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **7 of 12 pages**

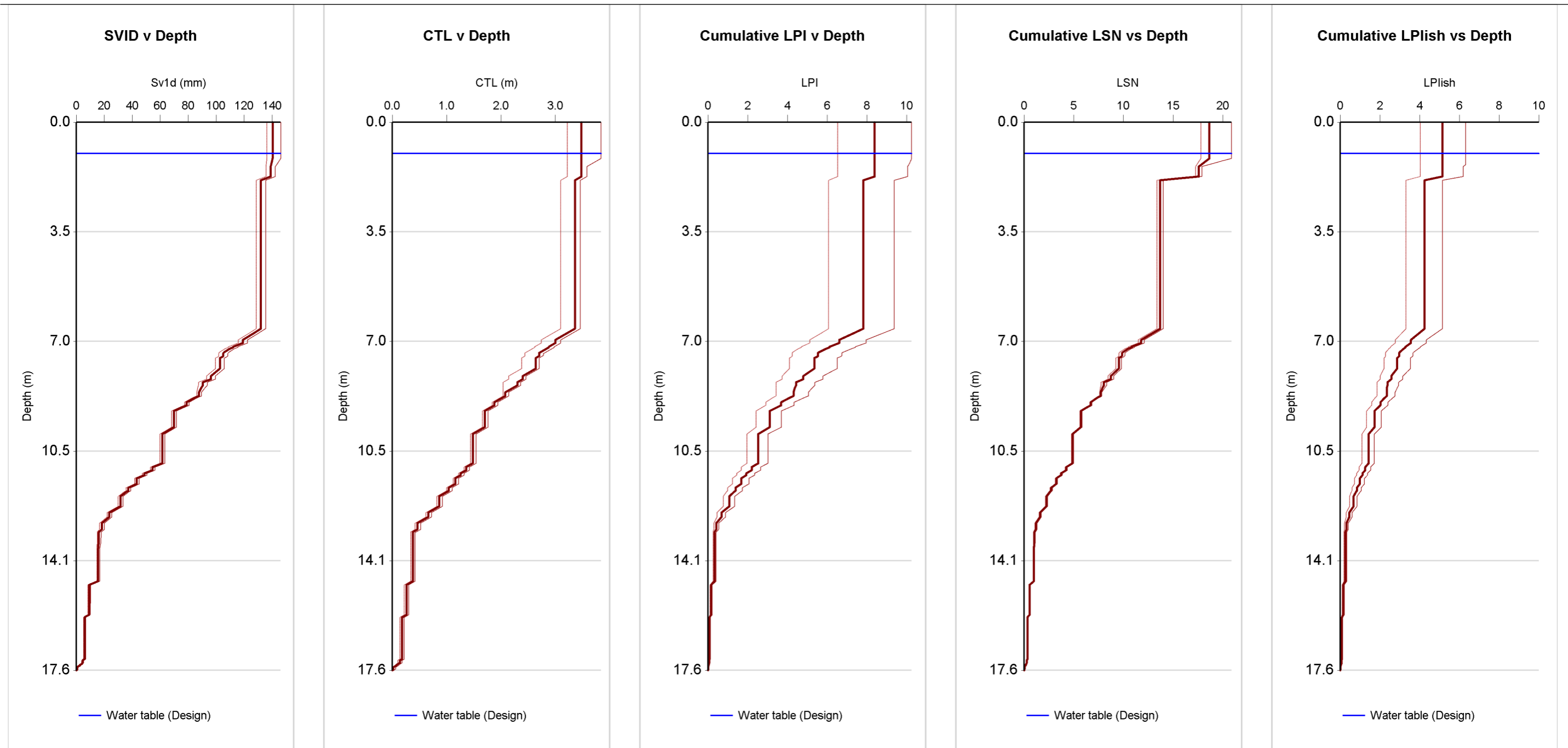


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|--|-------------------------------------|
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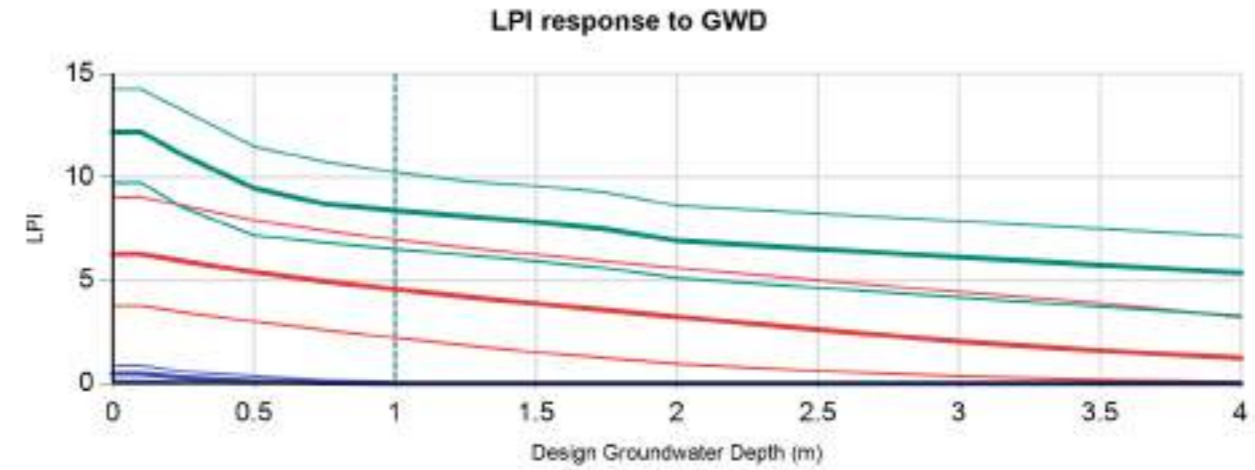
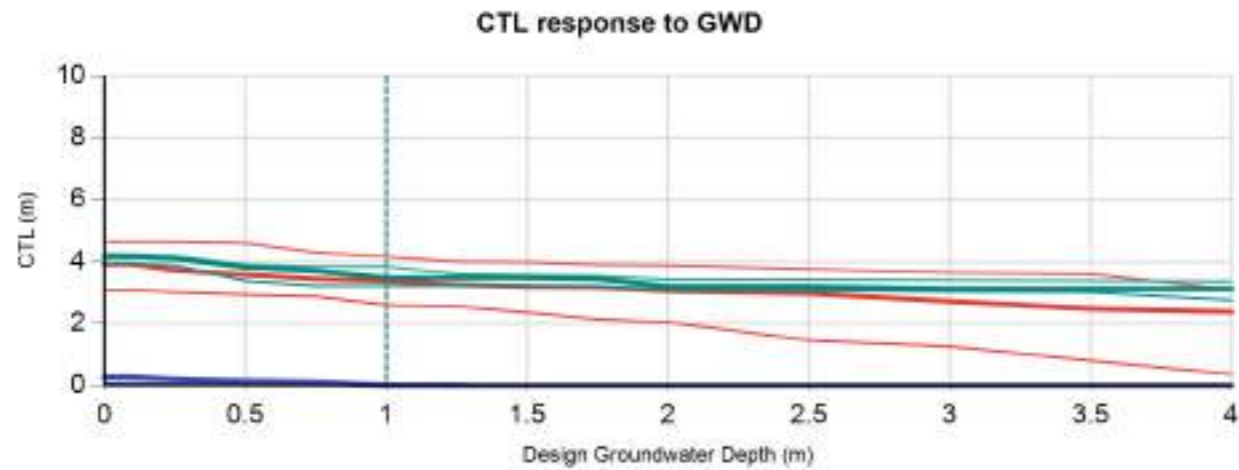
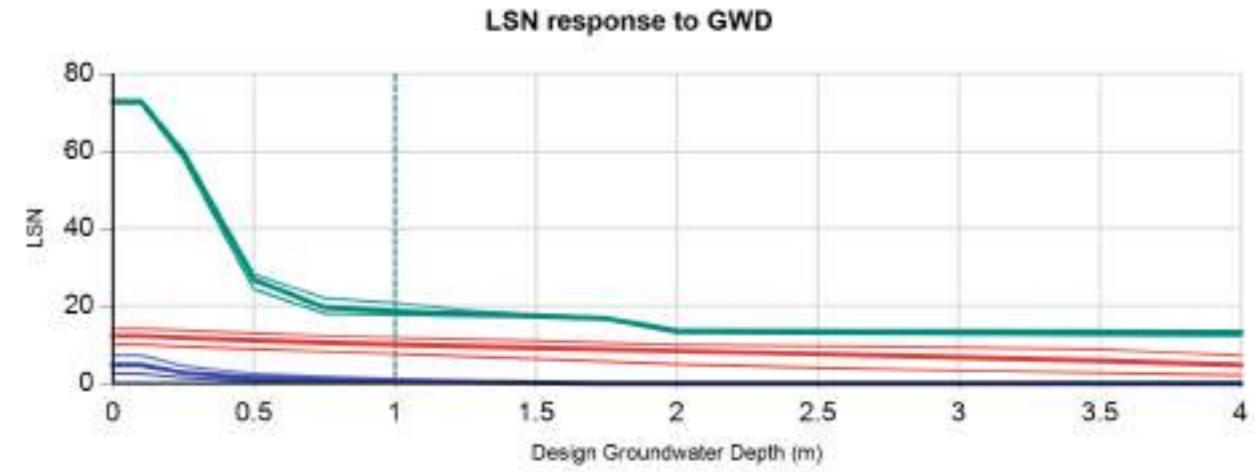
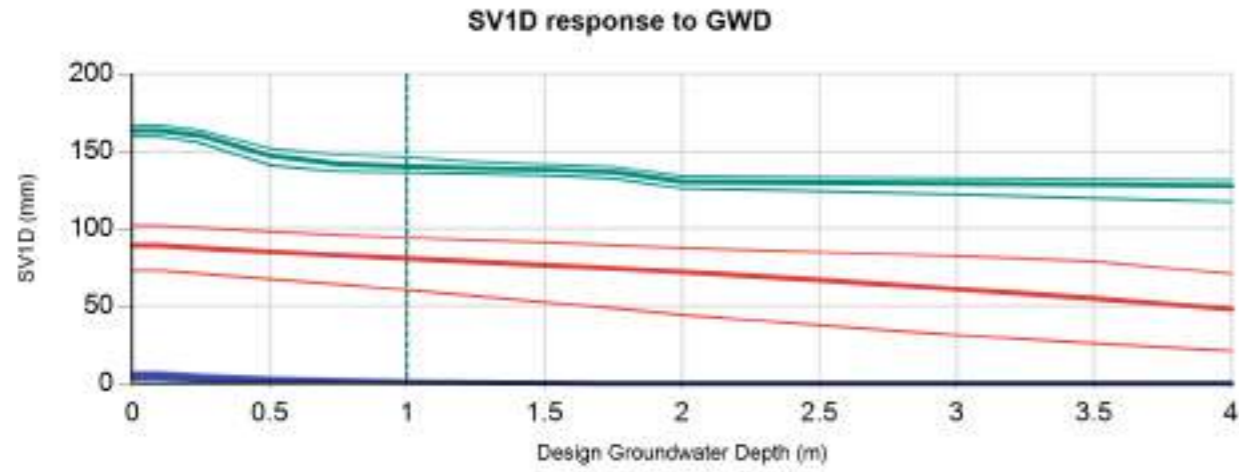
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 12 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	




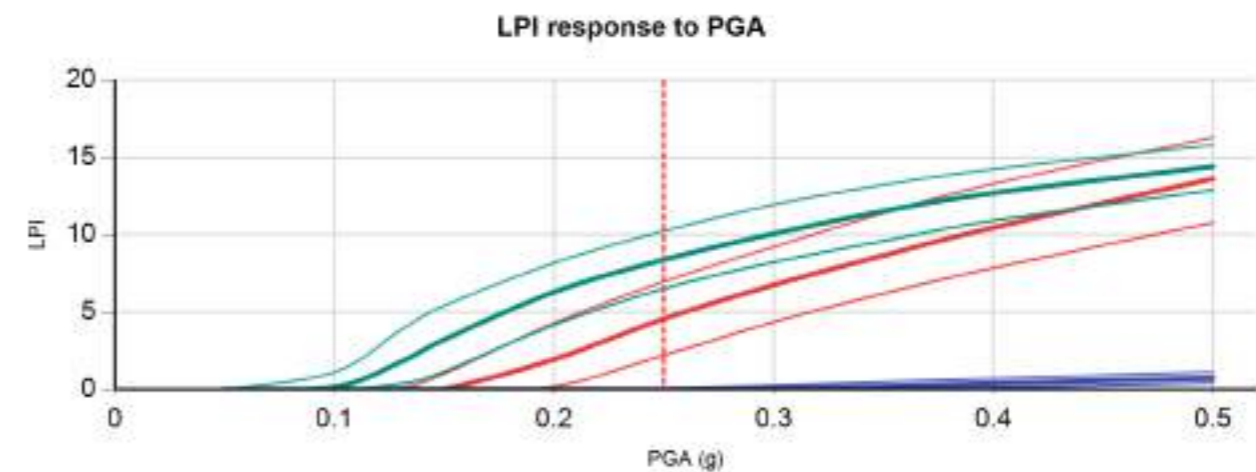
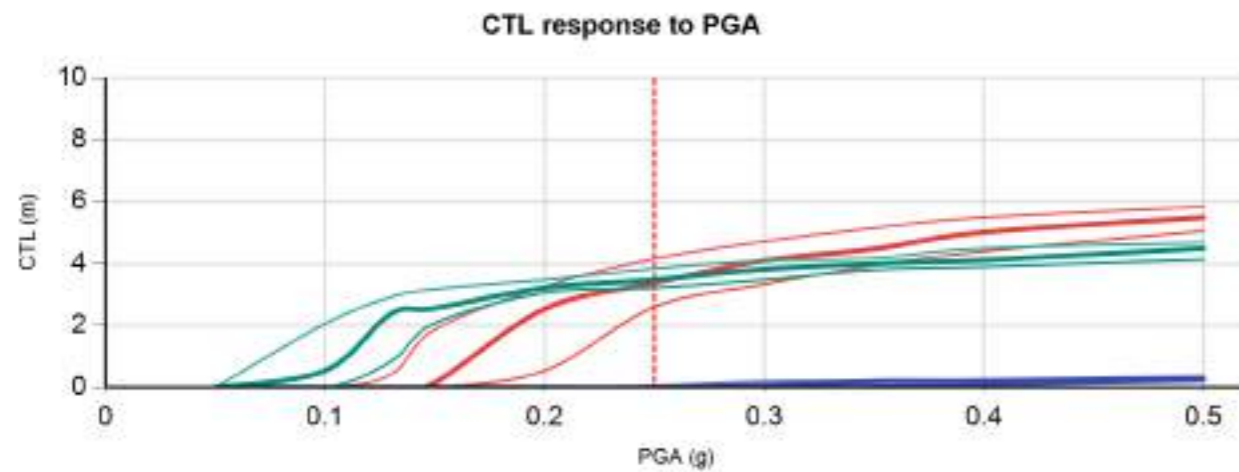
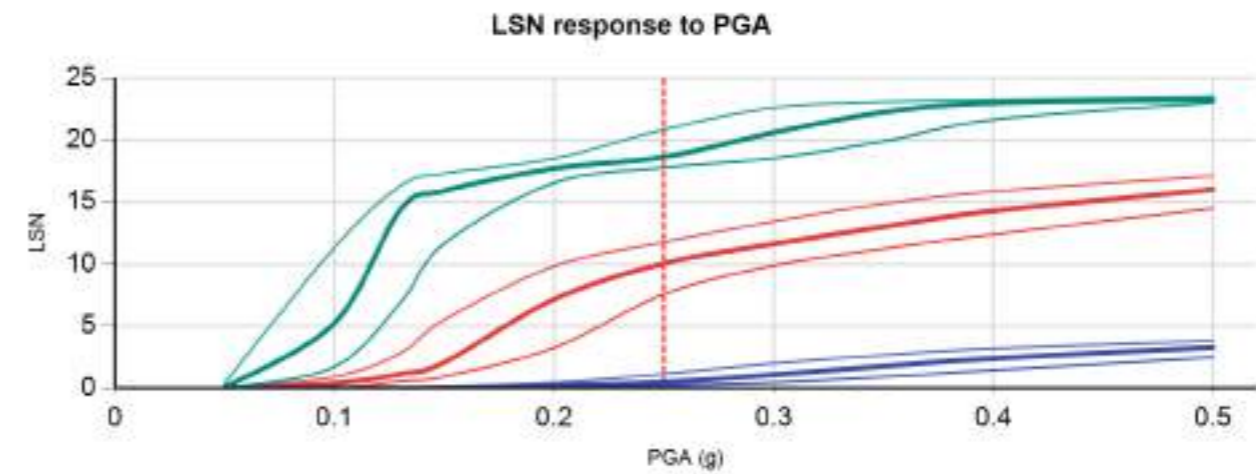
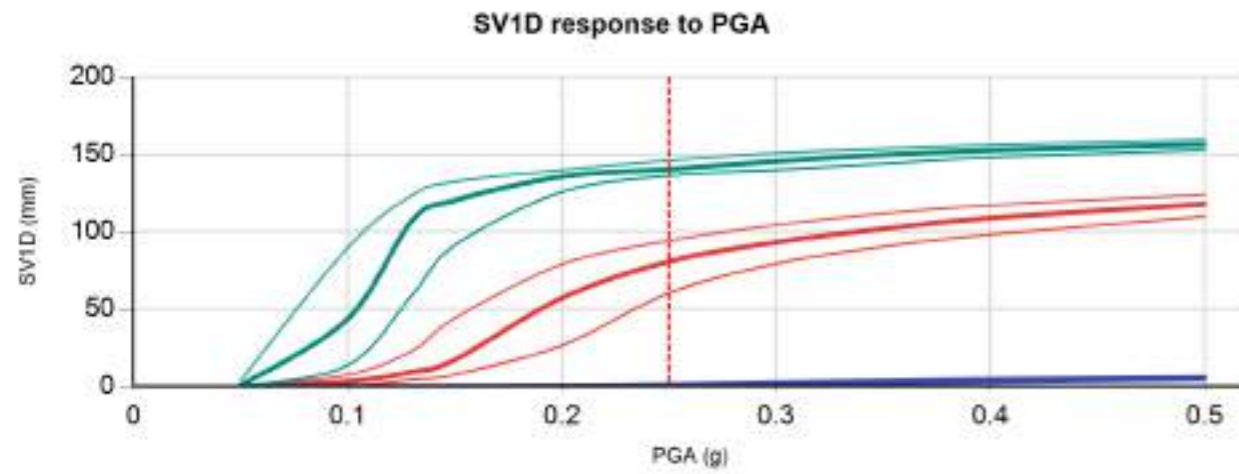
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	10 of 12 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 3 - 5]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

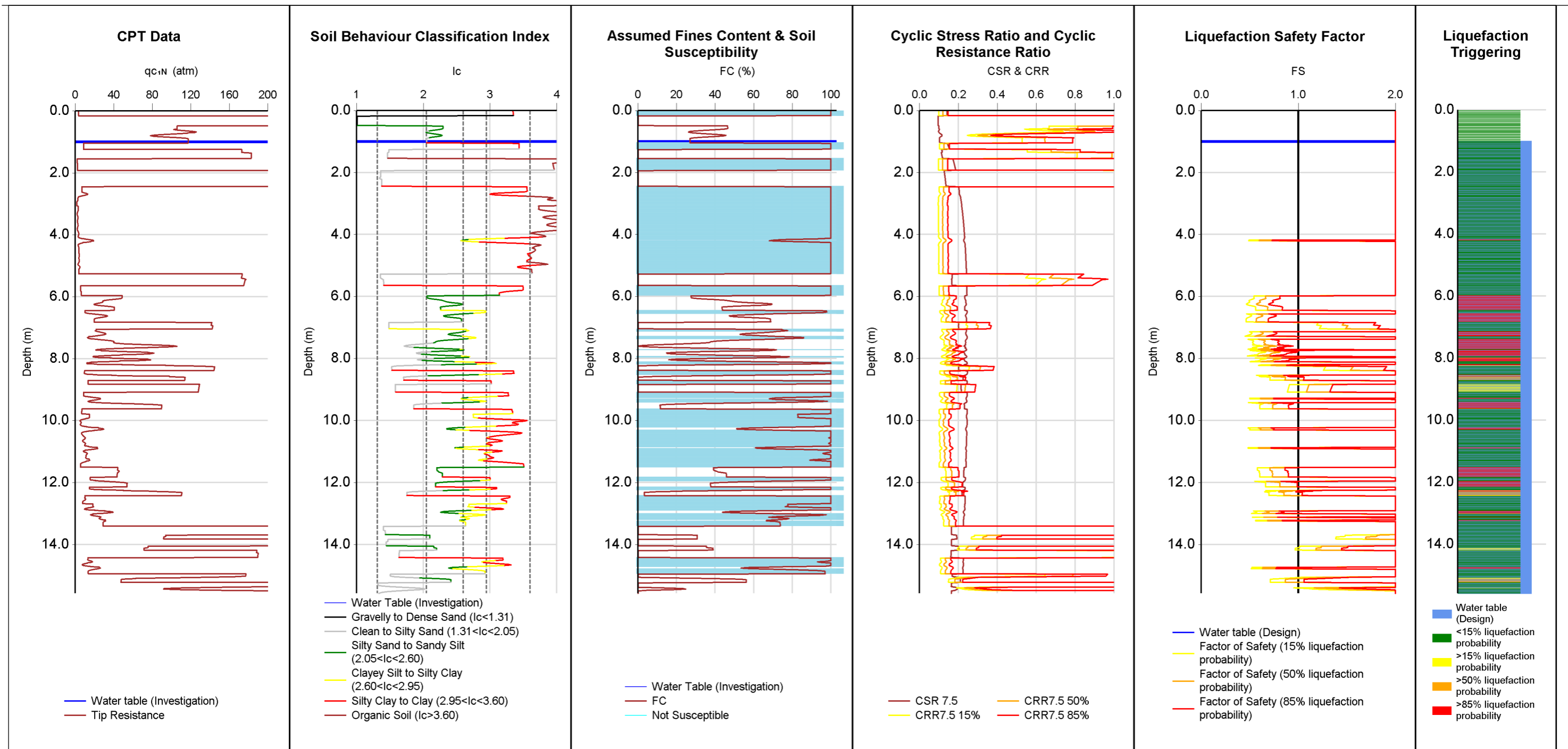
ID	NZGD 152809	NZGD 152810	NZGD 153039
CPT Name	CPT03	CPT04	CPT05
Run description	CPT03	CPT04	CPT05
PGA	0.25g	0.25g	0.25g
Magnitude	6.3	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1	1
Depth to groundwater for design (m)	1	1	1
Predrill depth (m)	1.5	0	0
Assumed predrill tip resistance and skin friction		qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.04	2.5	17.76
Minimum depth of analysis (m)	0	0	0
Maximum depth of analysis (m)	17.58	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152809	CPT03	0	1.5	0
NZGD 152809	CPT03	1.5	17.58	2.6
NZGD 152810	CPT04	0	0	0
NZGD 152810	CPT04	0	2.5	2.6
NZGD 153039	CPT05	0	0	0
NZGD 153039	CPT05	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152809	CPT03	1.5	17.58	0 CFC
NZGD 152810	CPT04	0	2.5	0 CFC
NZGD 153039	CPT05	0	17.58	0 %



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	88	3.7	8	10	6	4					
50%	80	3.3	6	10	6	2					
85%	65	2.9	3	8	6	0					

Reviewed by:

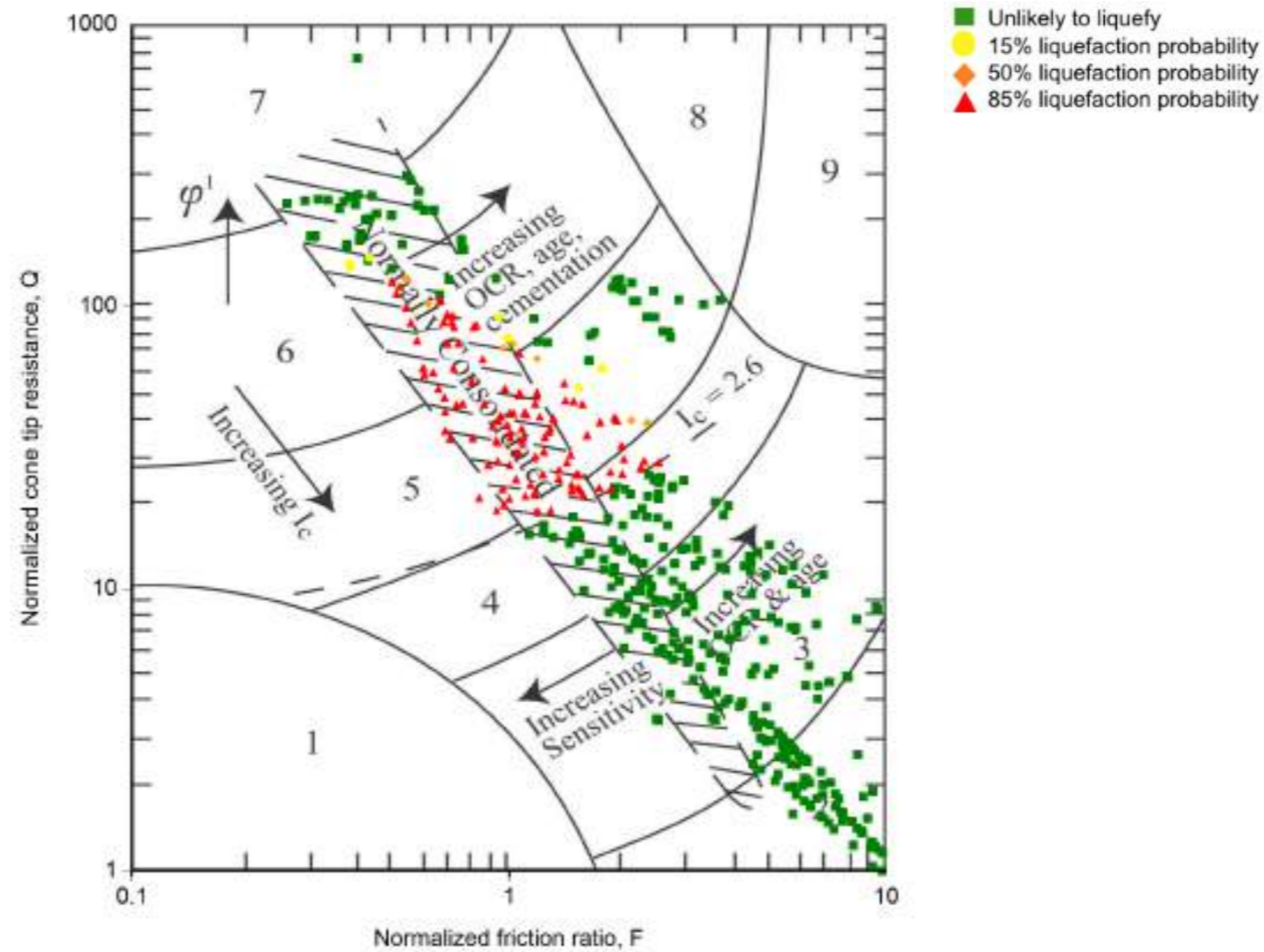
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

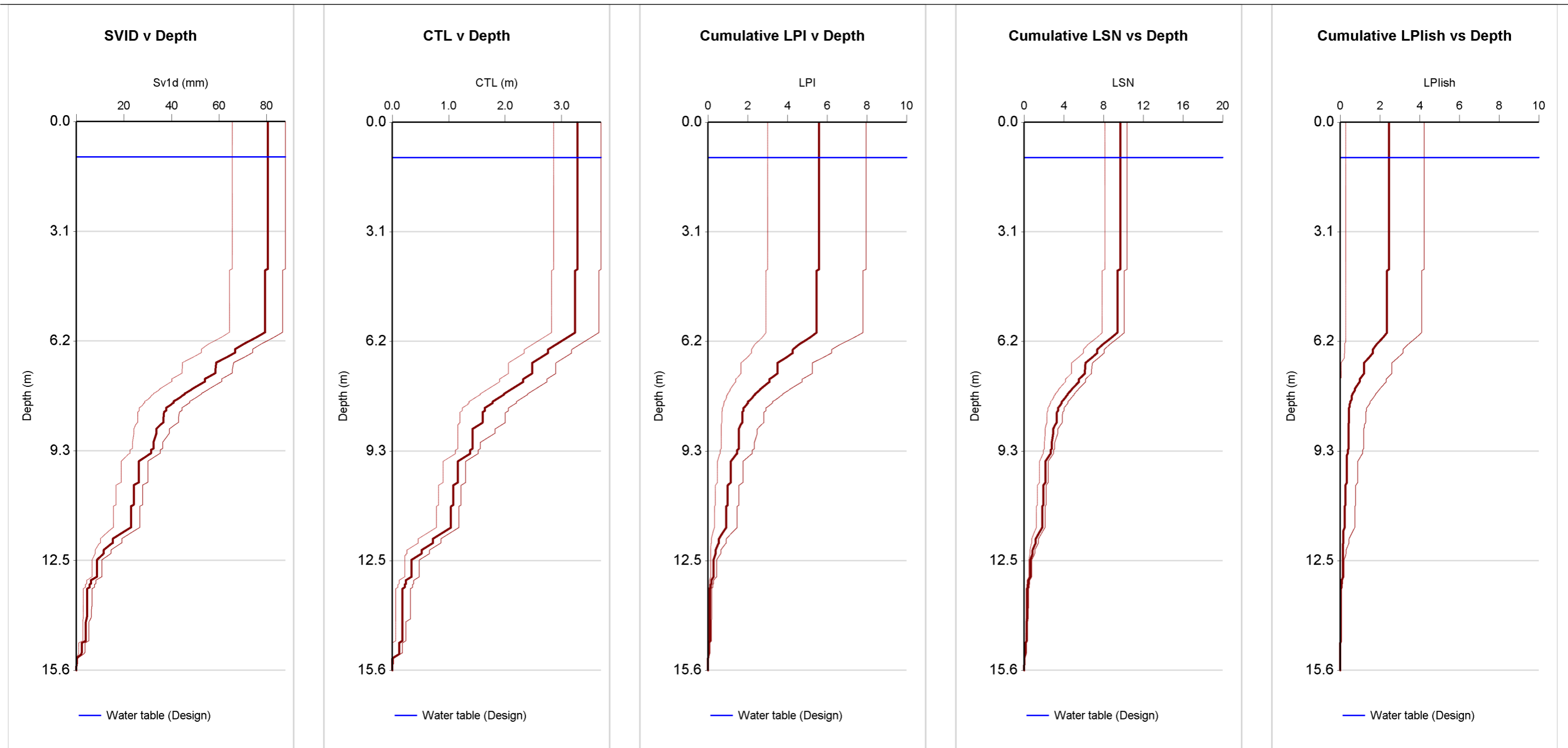


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]				



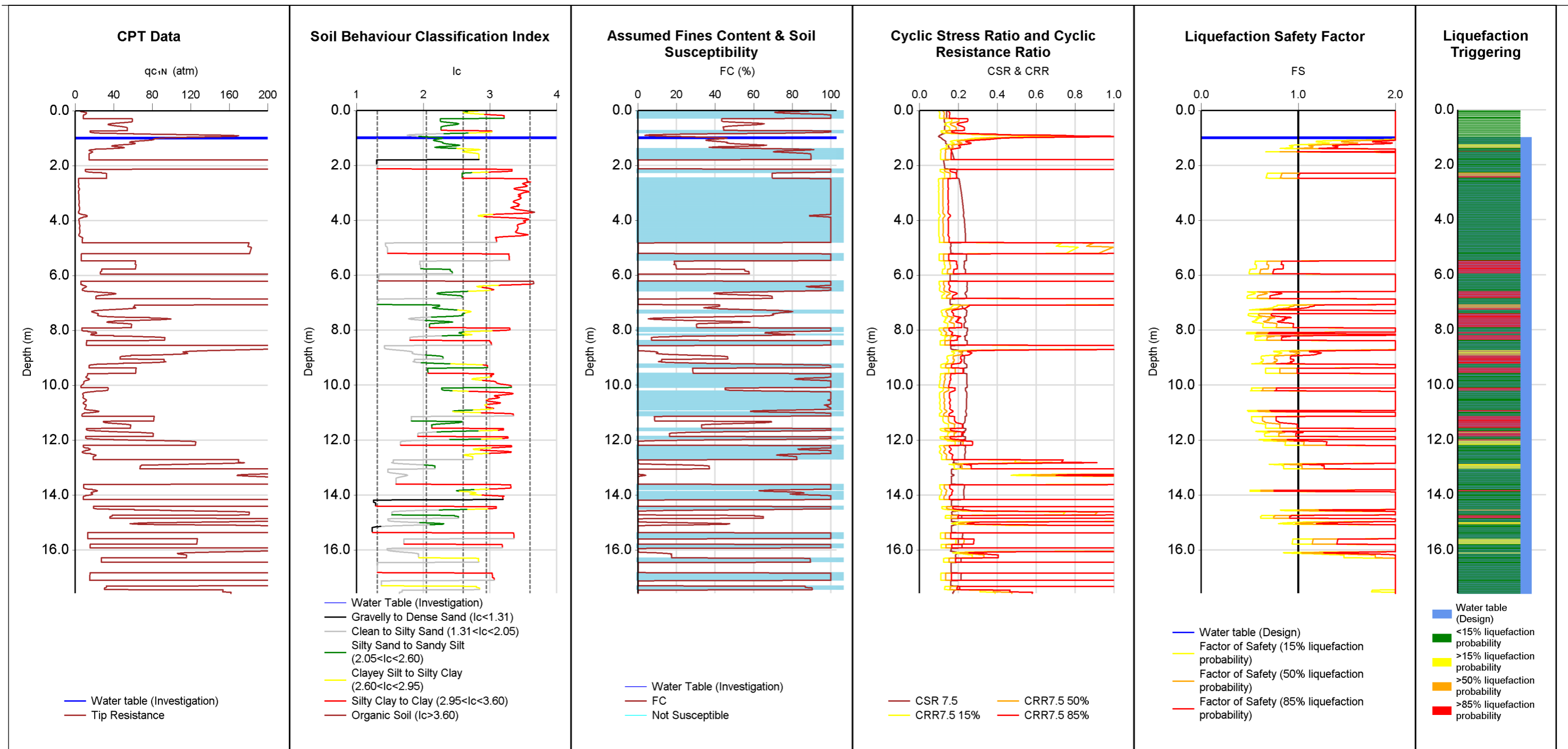
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	



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CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]

LOCATION	Napier	DATE	15/02/2021
JOB NUMBER	1009171	ANALYSED	zafr
		PAGE	3 of 9 pages



Note: Inverse filtered Q_c/F_s data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	100	4.5	9	15	1.3	5					
50%	87	3.7	6	13	2.3	3					
85%	66	3.1	3	9	5.5	1					

Reviewed by:

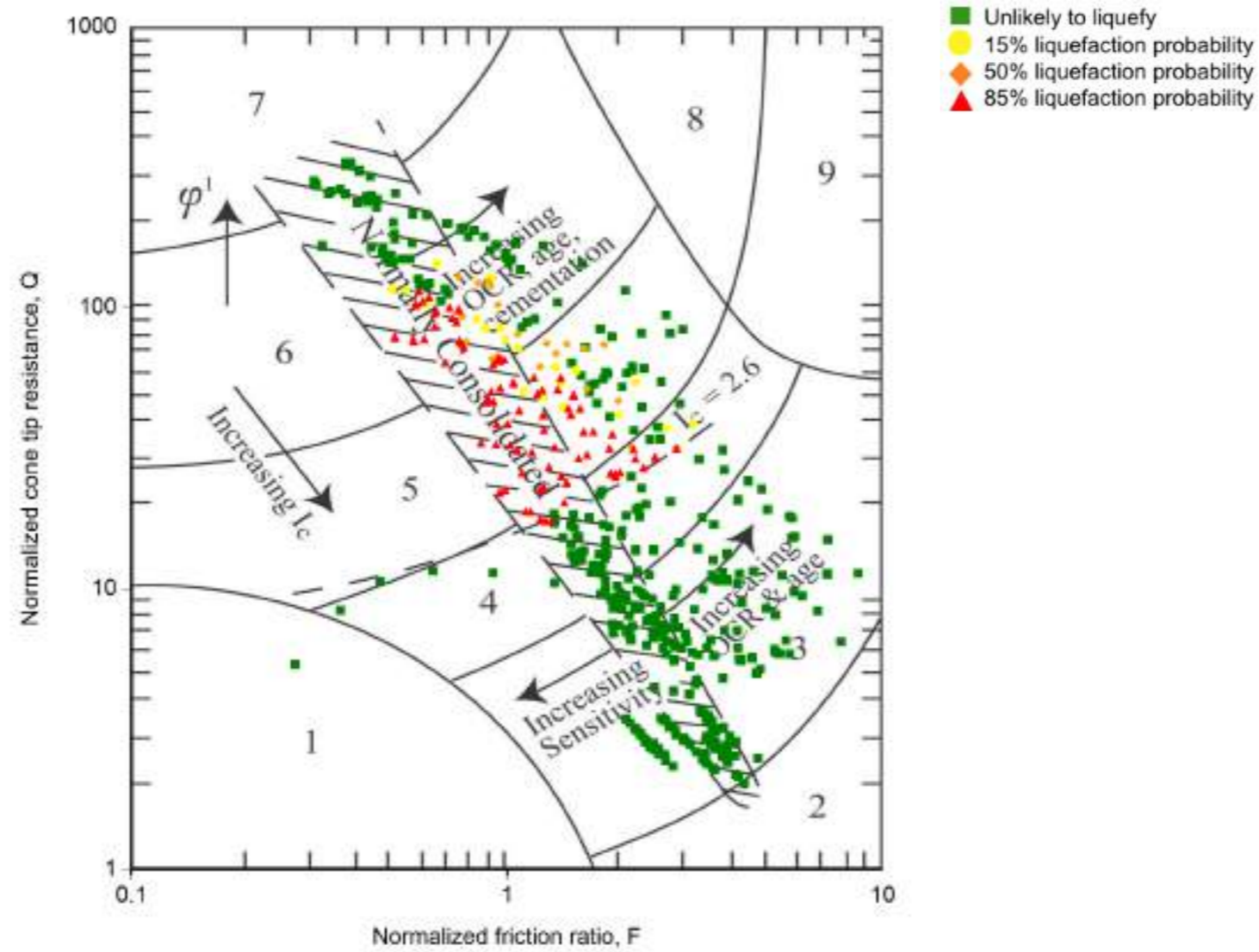
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

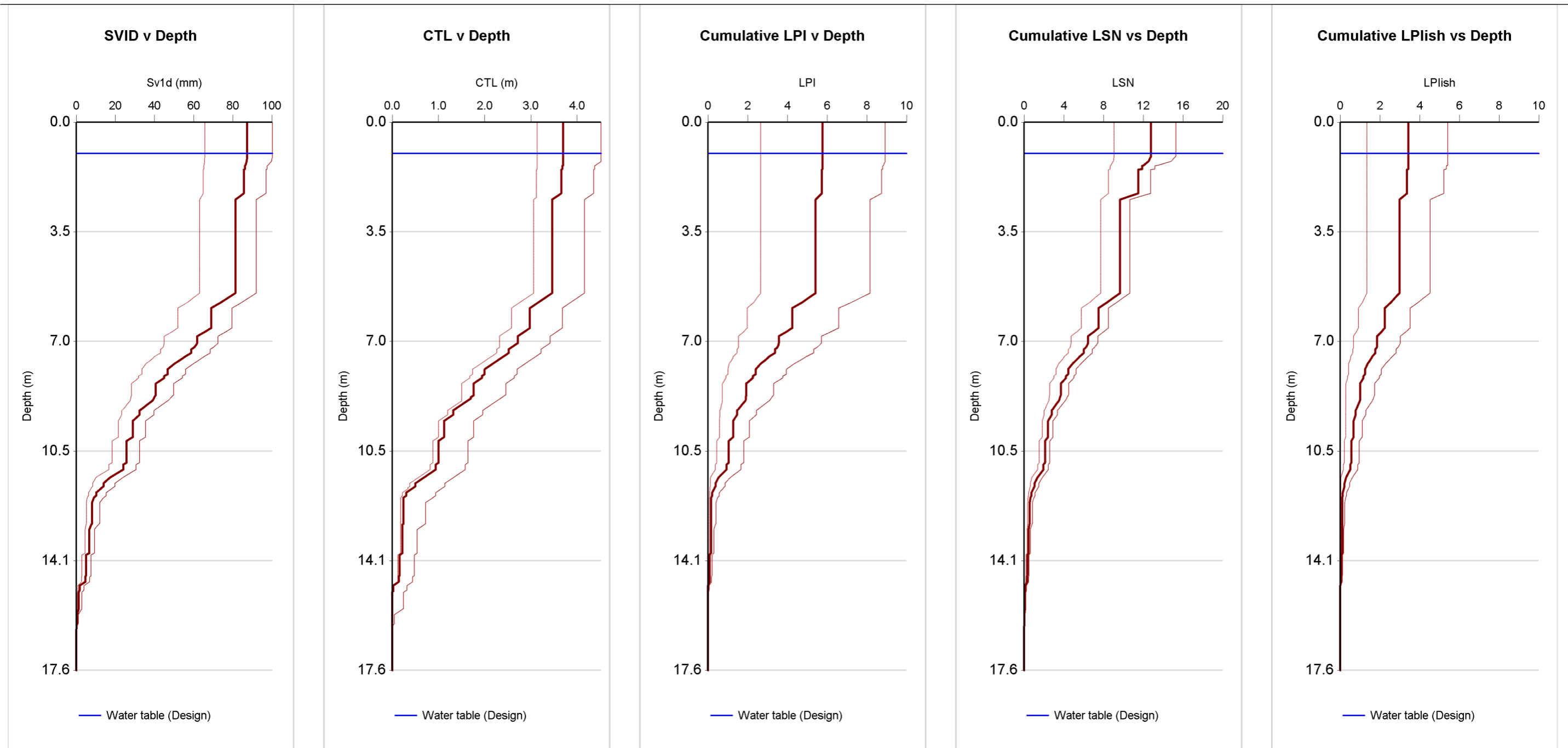


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


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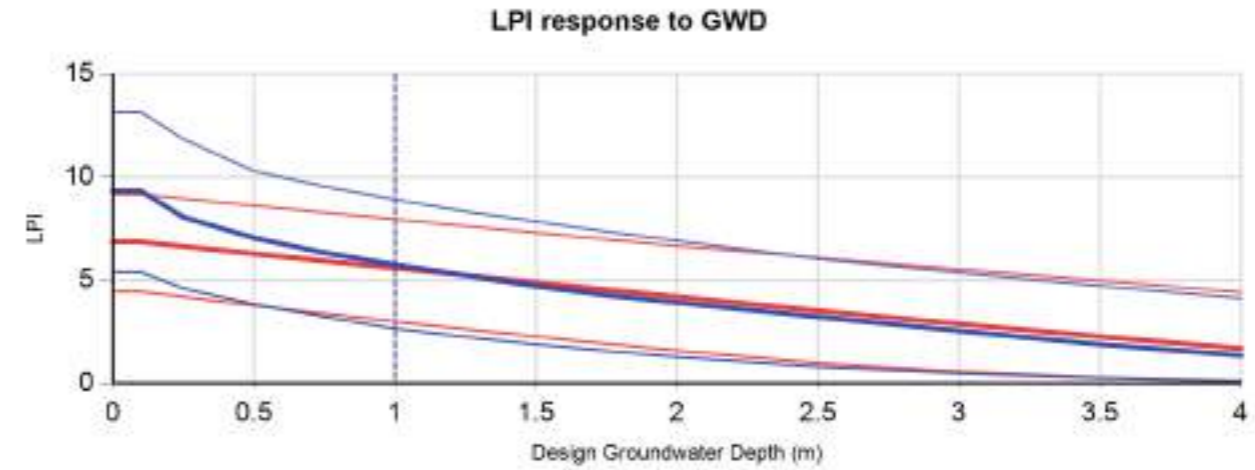
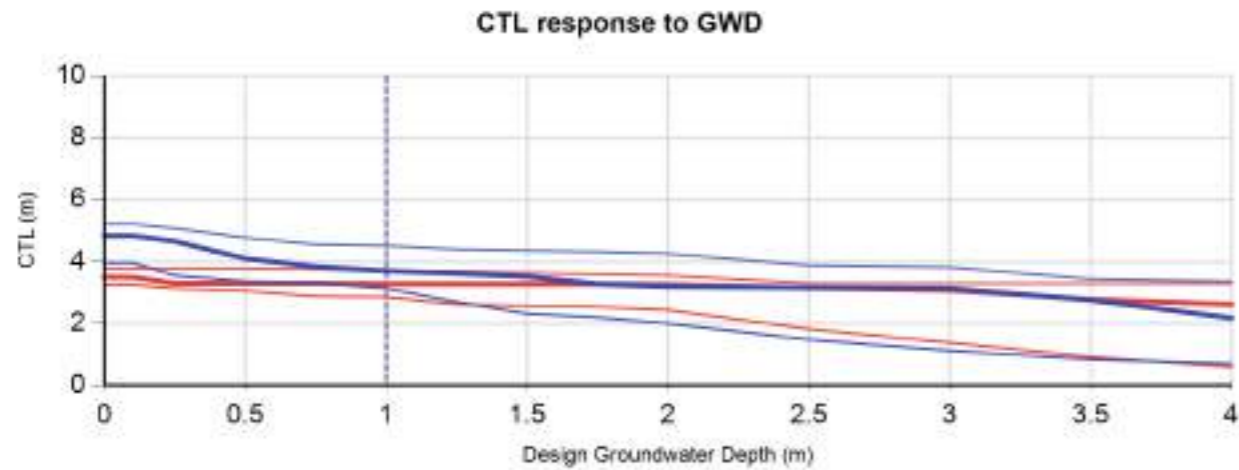
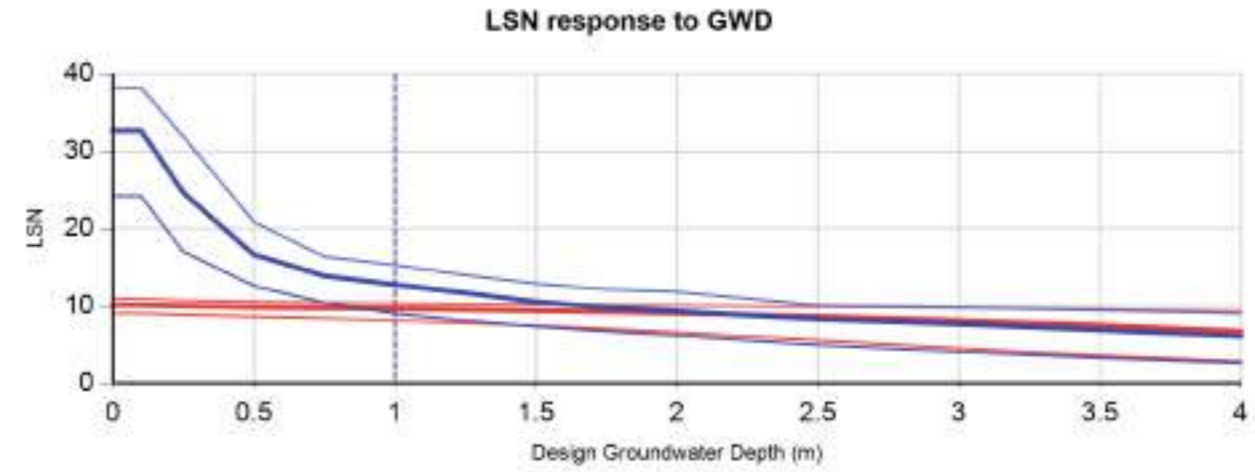
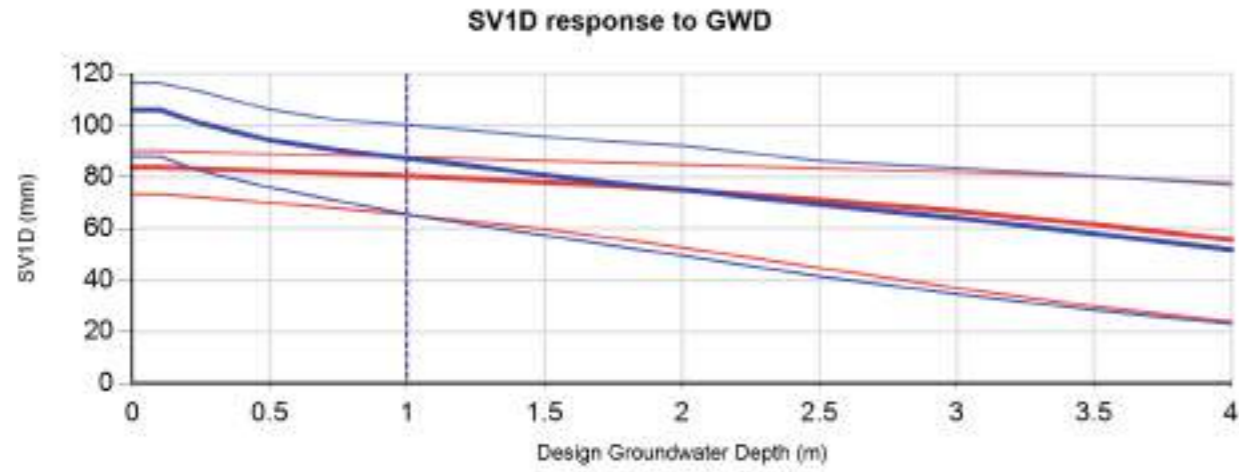
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]				




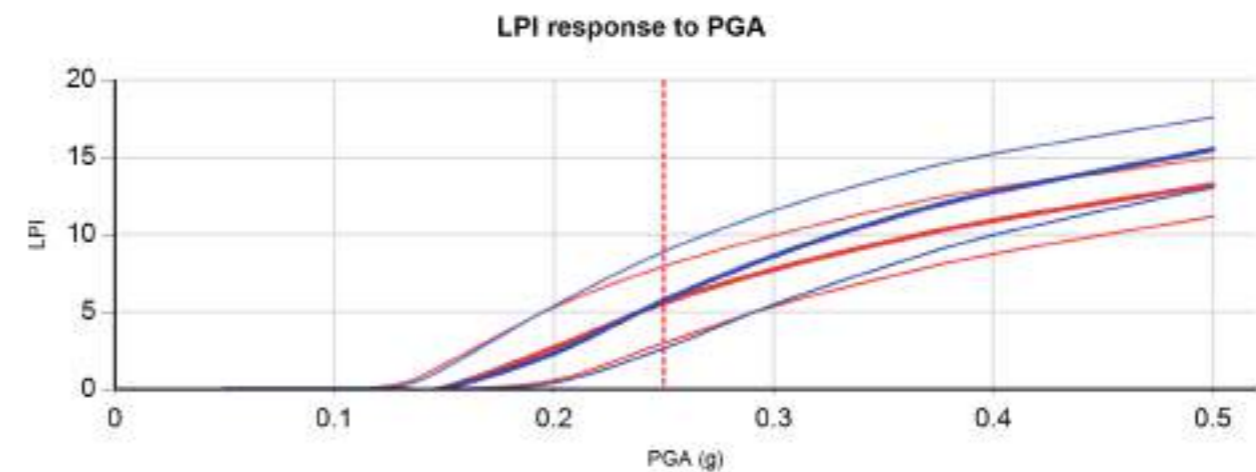
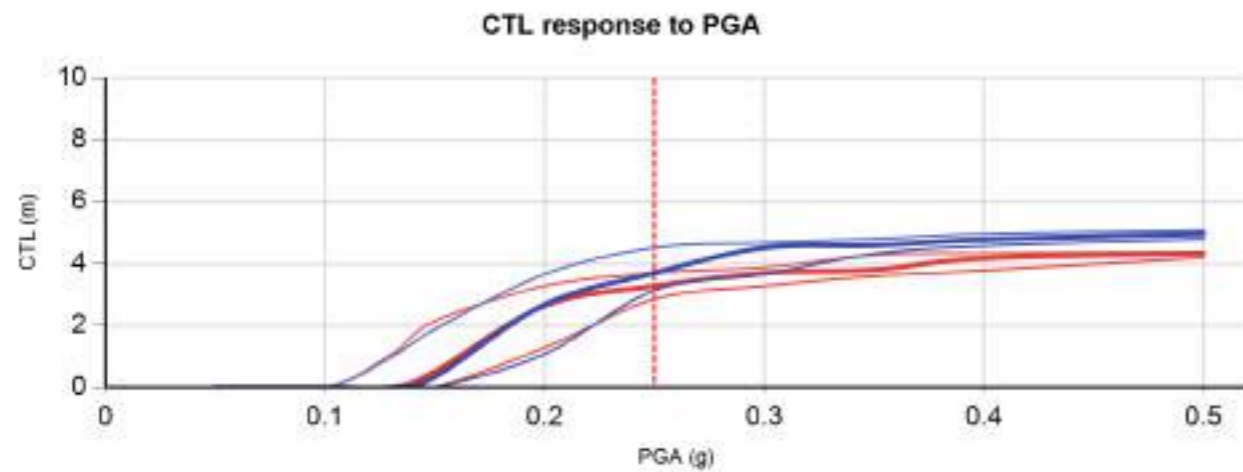
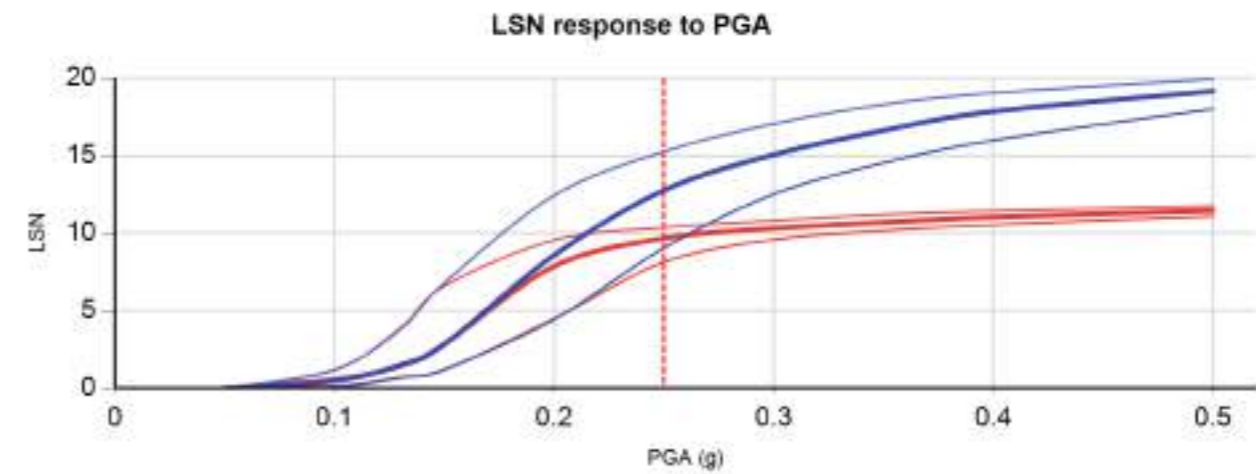
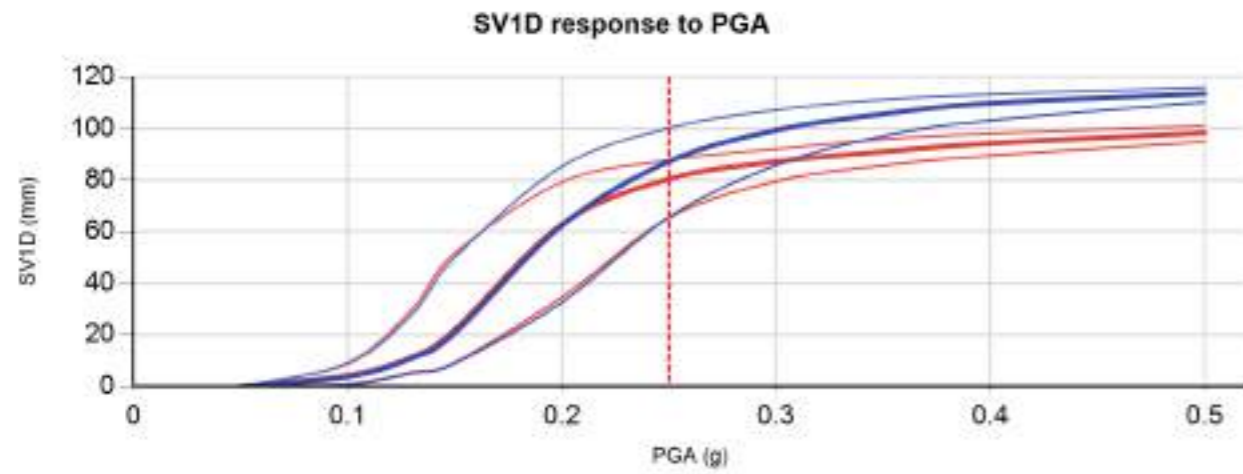
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 6 - 7]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

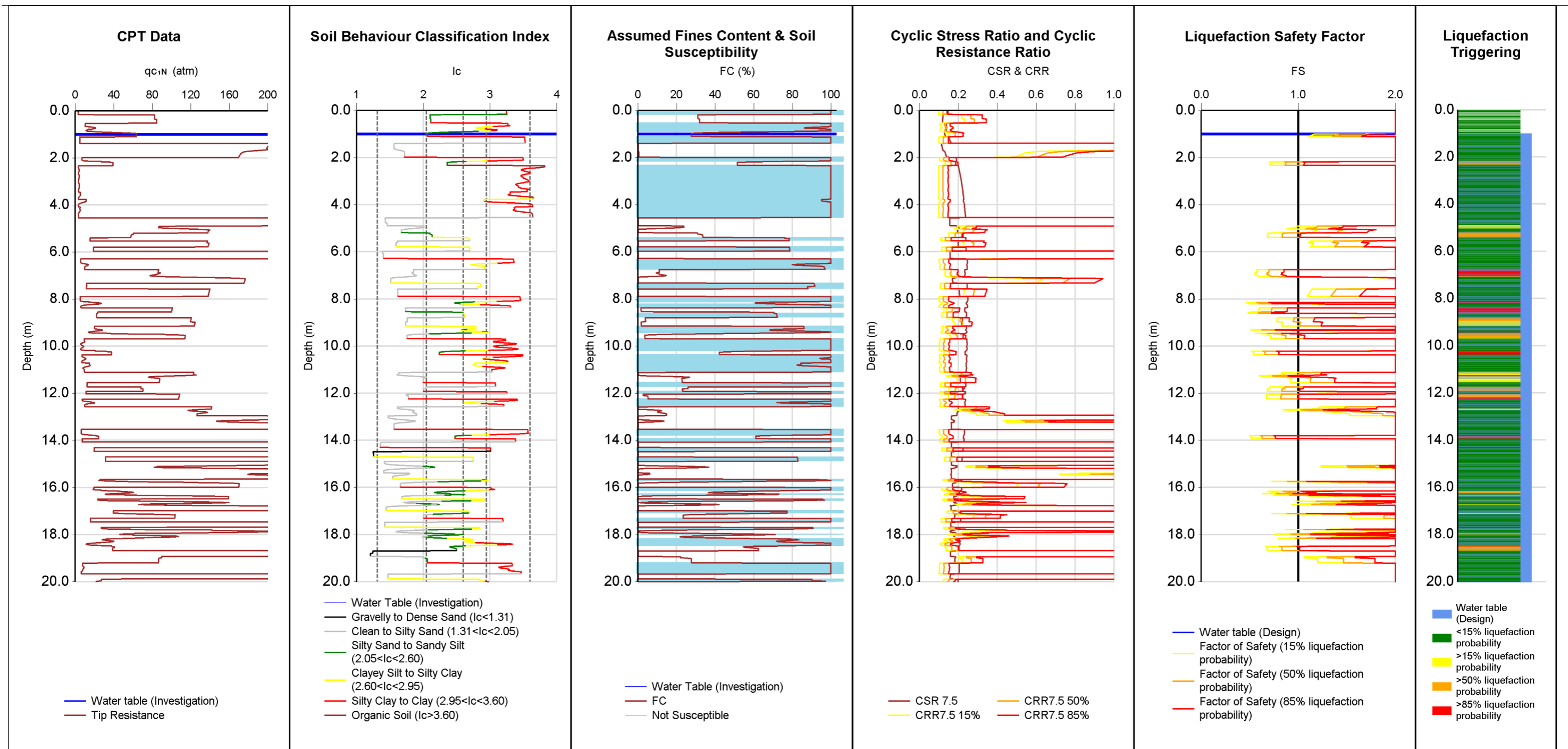
ID	NZGD 152811	NZGD 152812
CPT Name	CPT06	CPT07
Run description	CPT06	CPT07
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	15.58	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of I_c inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	I _c
NZGD 152811	CPT06	0	0	0
NZGD 152811	CPT06	0	15.58	2.6
NZGD 152812	CPT07	0	0	0
NZGD 152812	CPT07	0	17.58	2.6

Table 1.1-3 Summary of F_c inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	F _c
NZGD 152811	CPT06	0	15.58	0 CFC
NZGD 152812	CPT07	0	17.58	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	78	3.5	5	10	2.3	3					
50%	60	2.7	3	8	2.3	1					
85%	38	1.1	1	5	6.8	0					

Reviewed by:

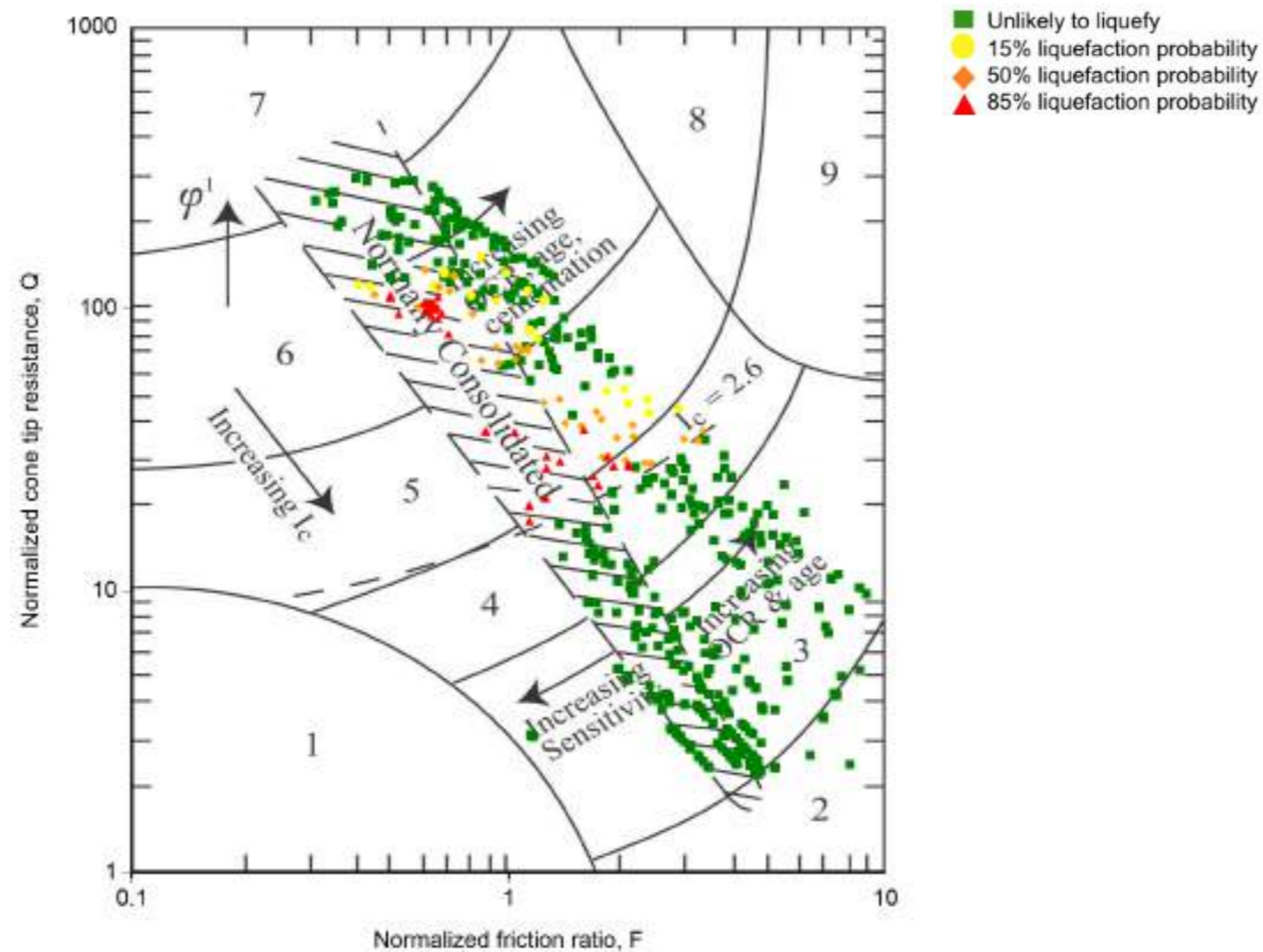
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

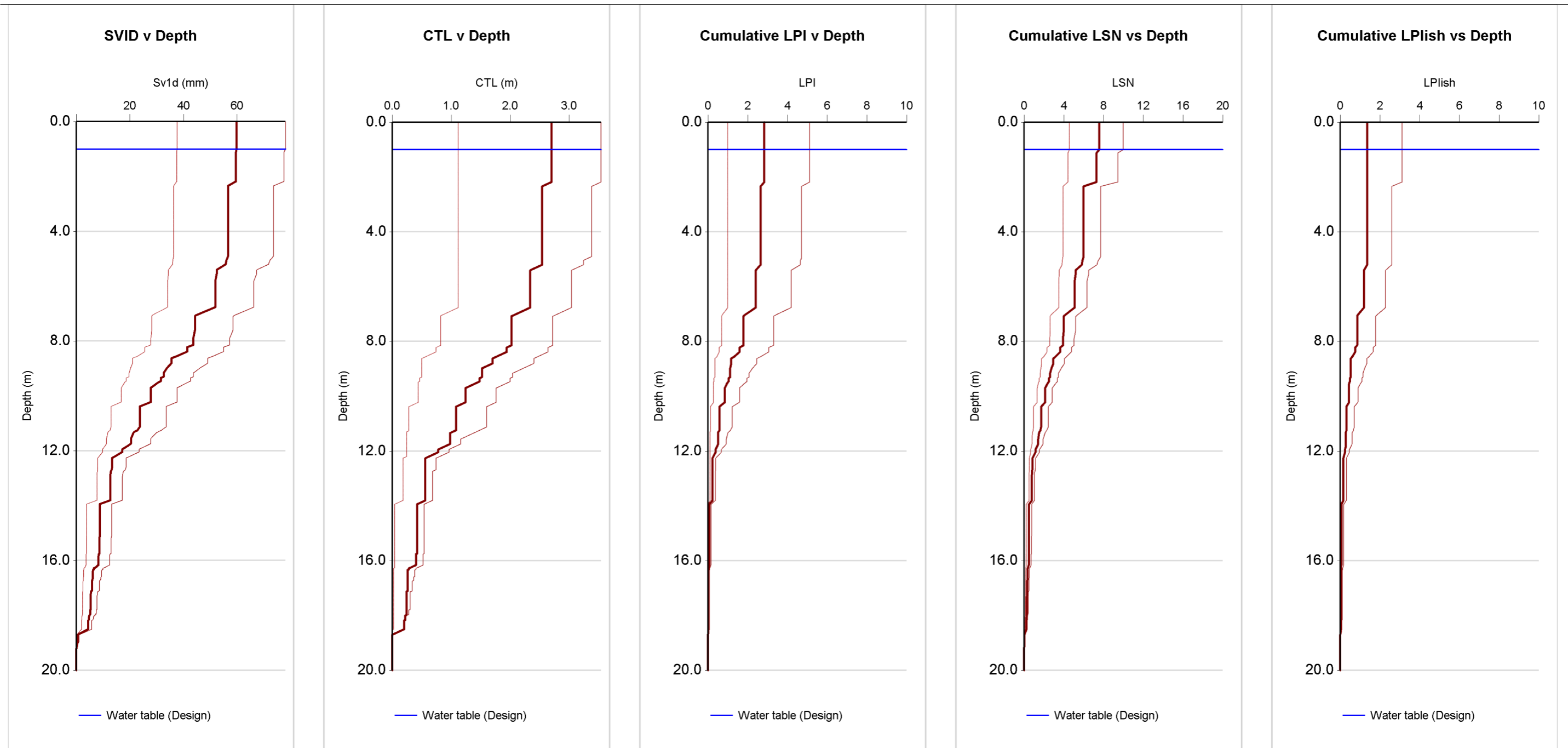


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]				



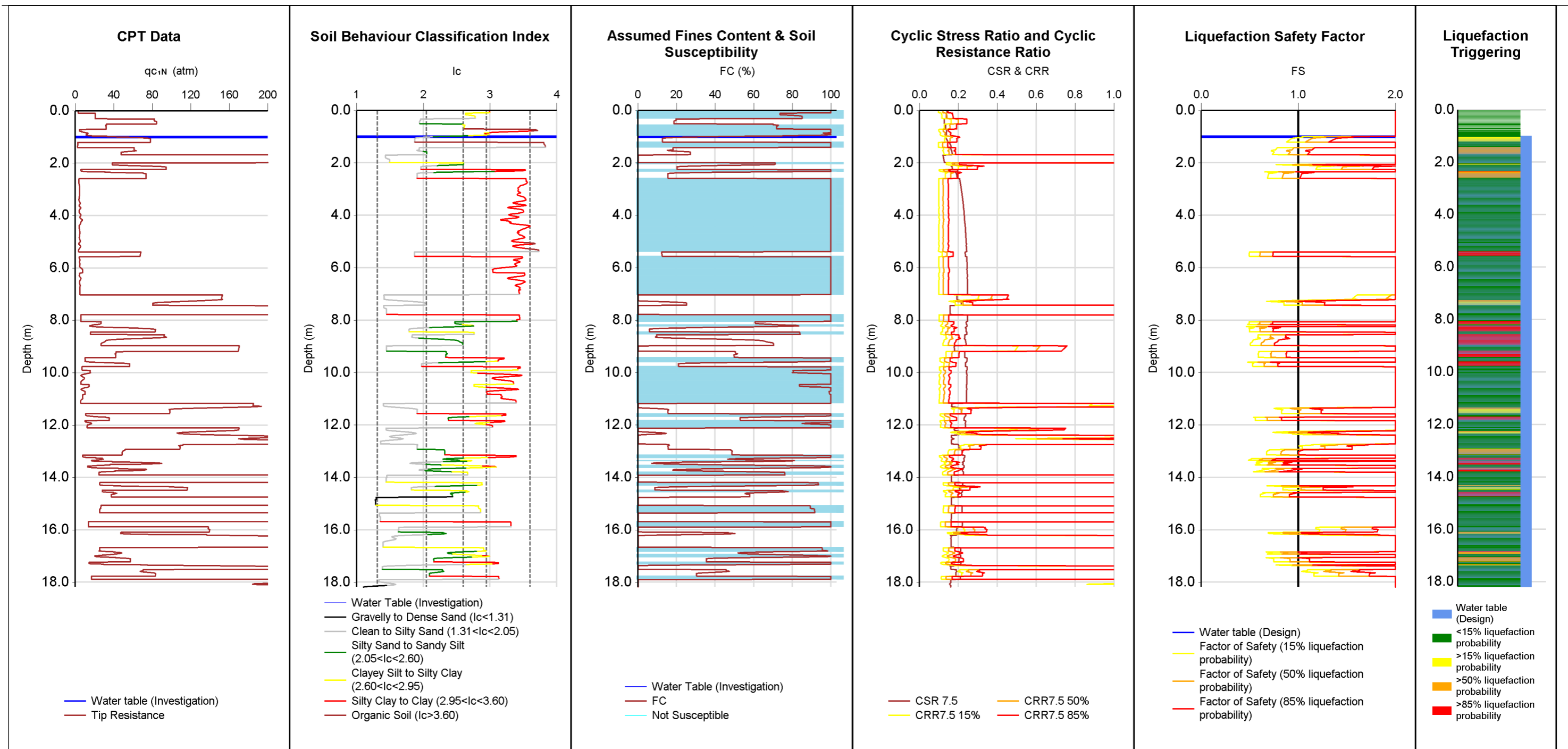
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	



Tonkin + Taylor
 Exceptional thinking together
 V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]

LOCATION	Napier	DATE	15/02/2021
JOB NUMBER	1009171	ANALYSED	zafr
PAGE		PAGE	3 of 9 pages



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT08	152813	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	96	4.1	7	18	1.1	5					
50%	79	3.4	4	13	1.5	2					
85%	56	2.1	2	8	5.5	1					

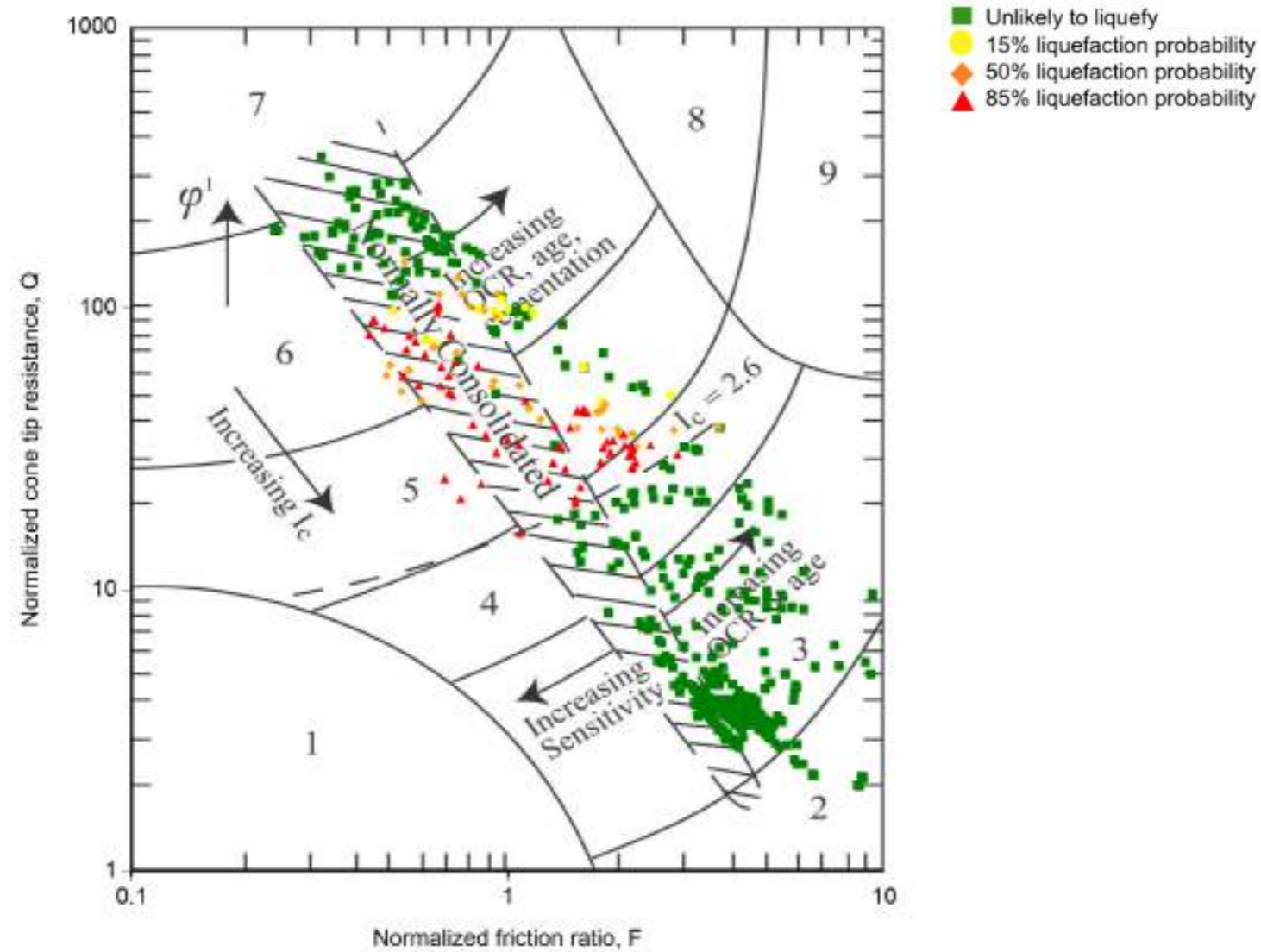
Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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Exceptional thinking together
V2.4.15


CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafz
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	4 of 9 pages
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]				

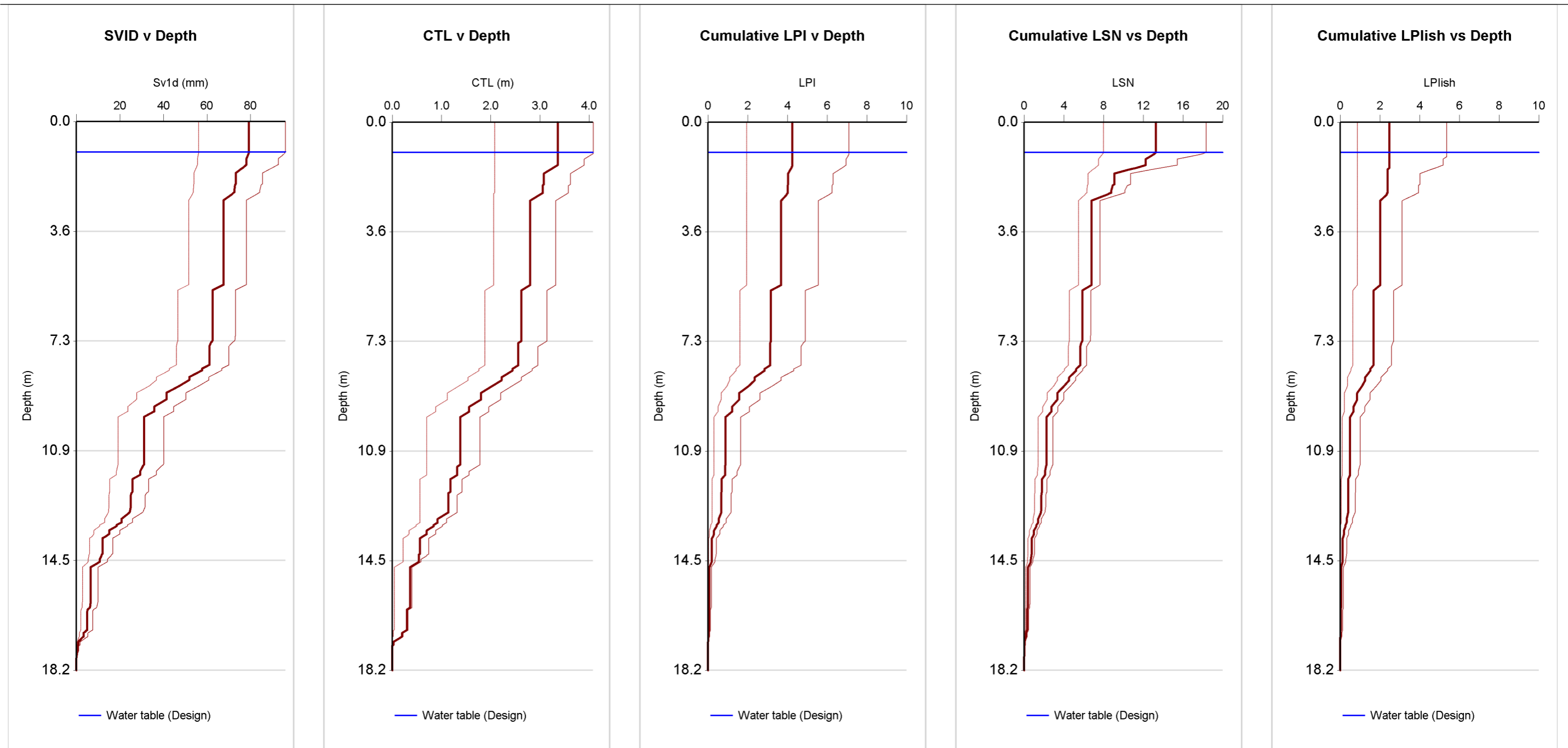


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|--|-------------------------------------|
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CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]				



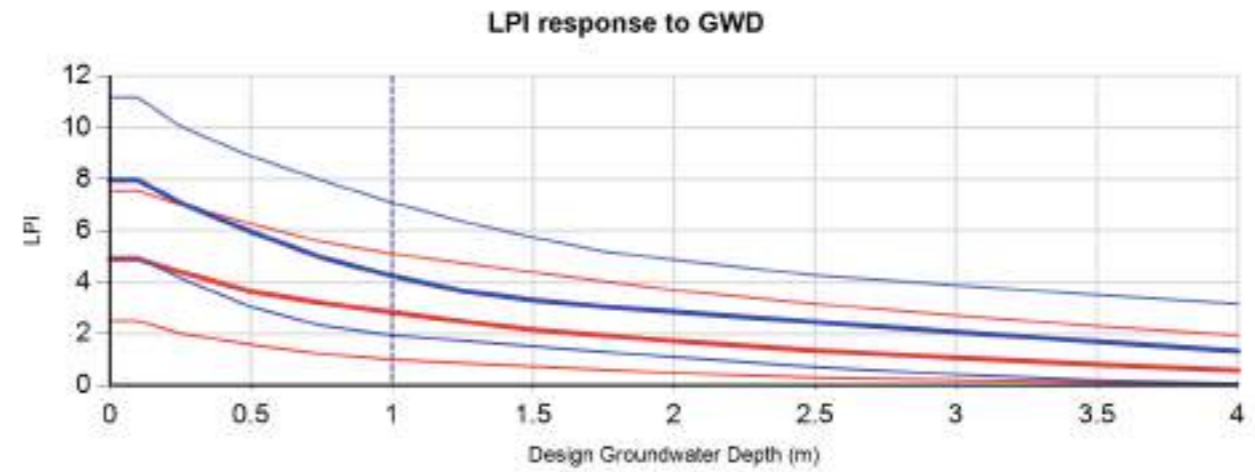
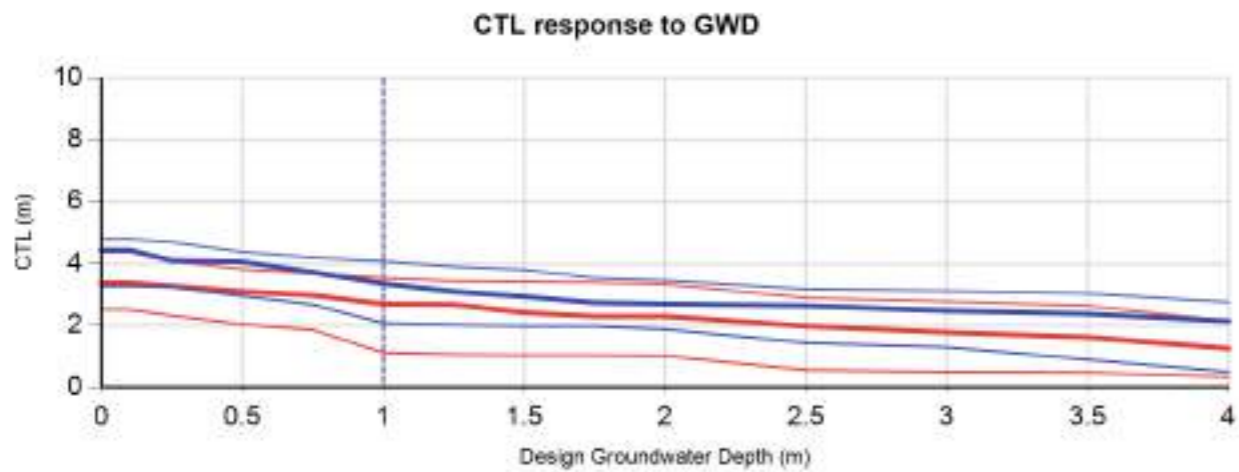
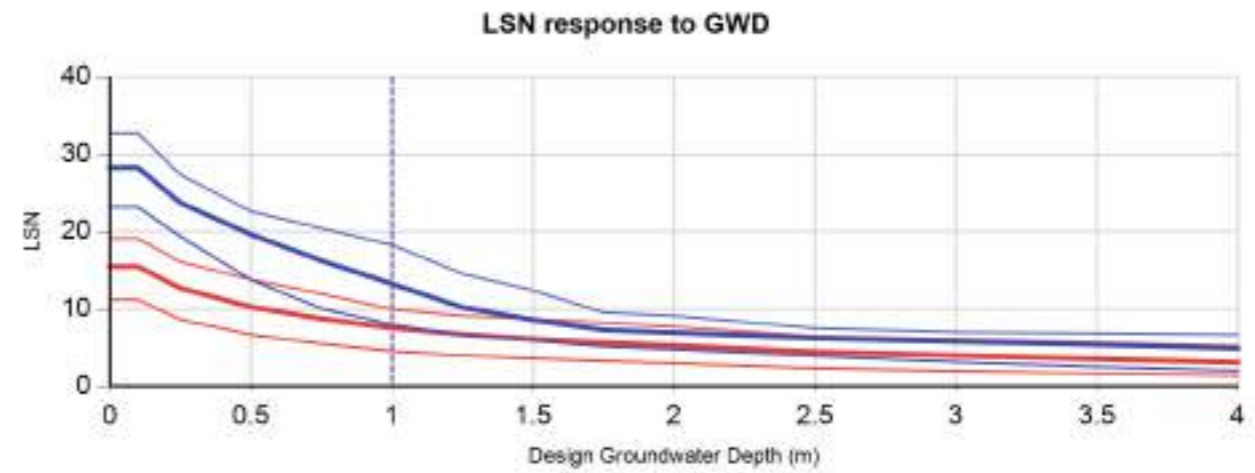
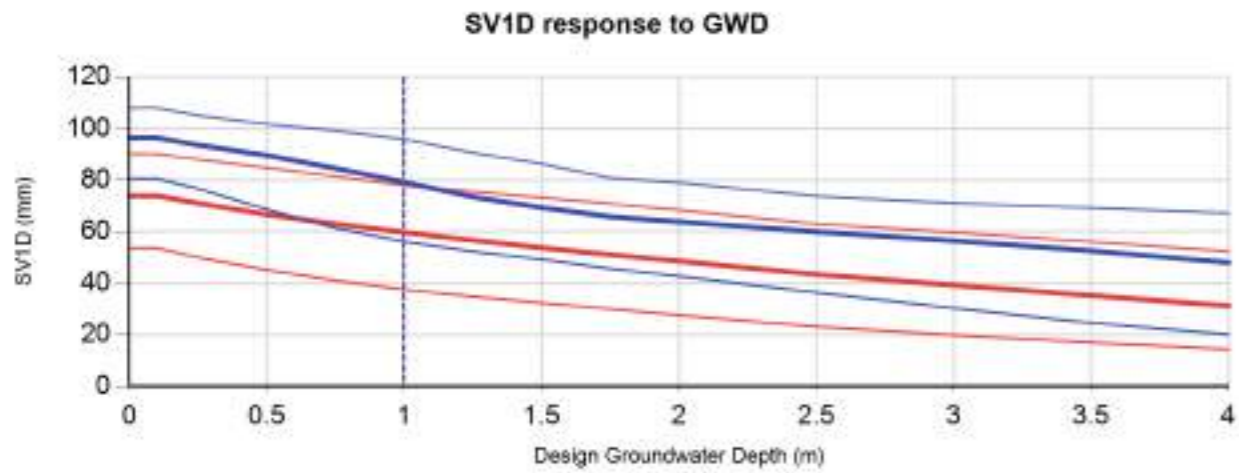
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT08	152813	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	



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CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]

LOCATION	Napier	DATE	15/02/2021
JOB NUMBER	1009171	ANALYSED	zafr
		PAGE	6 of 9 pages



Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

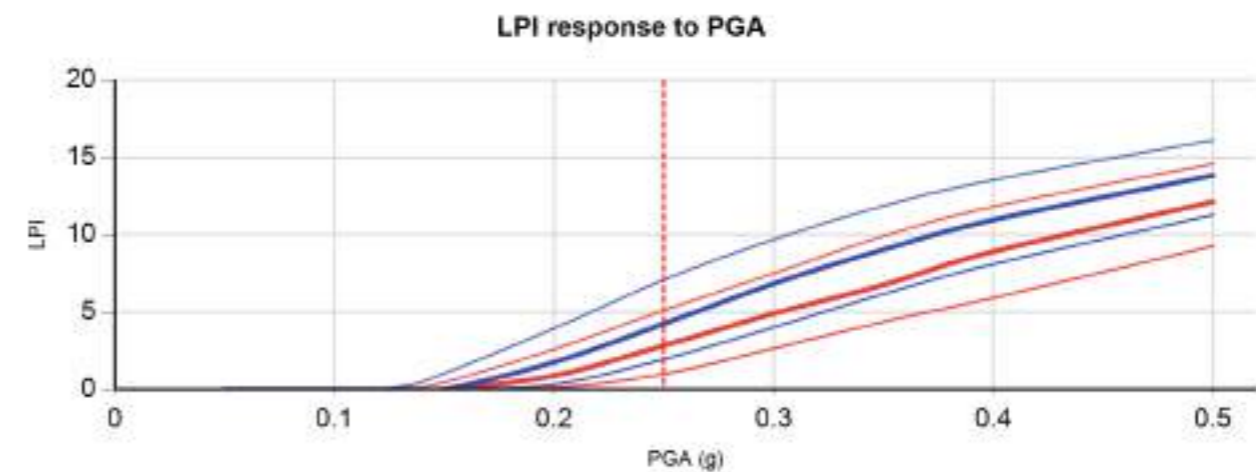
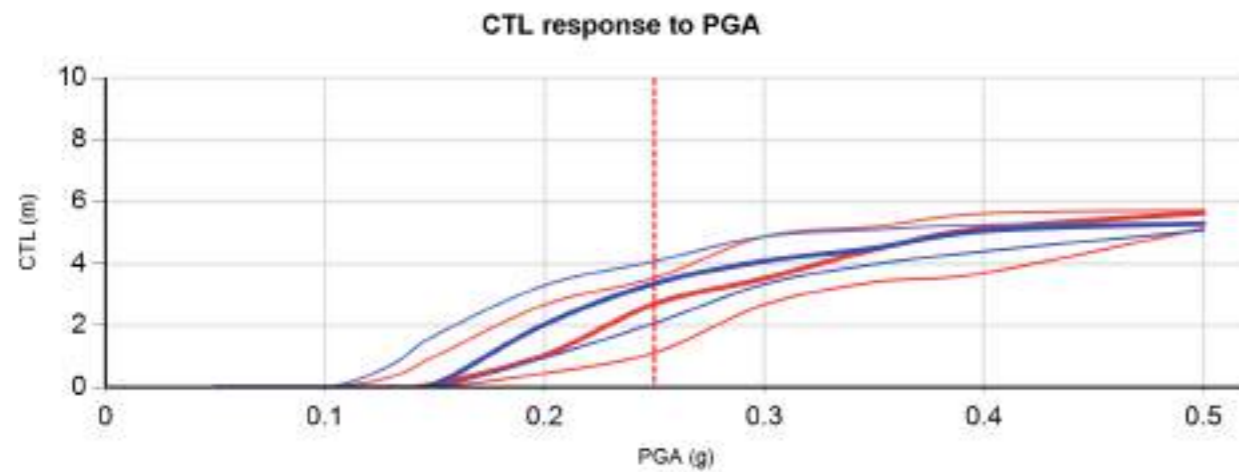
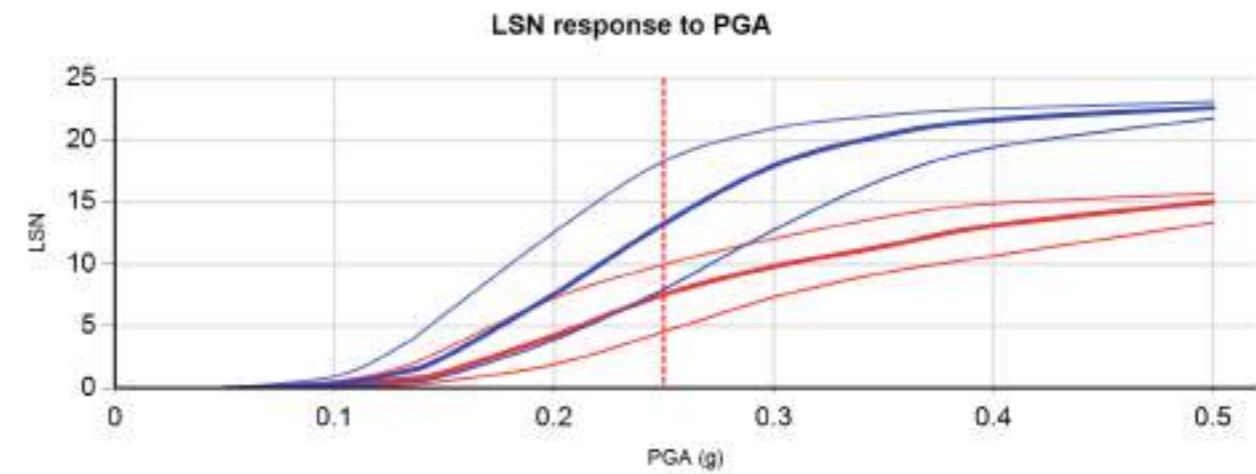
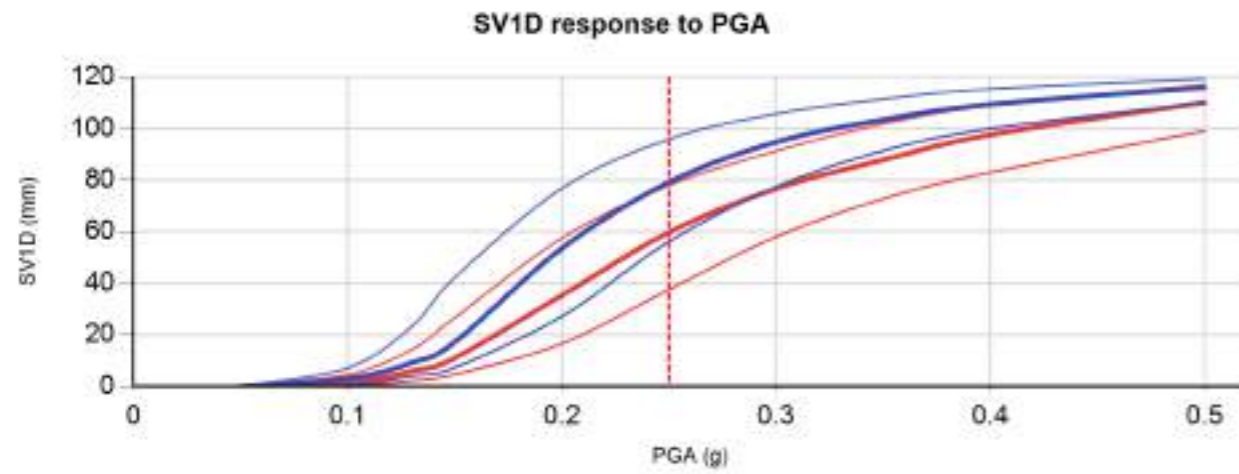


Tonkin + Taylor
 Exceptional thinking together
 V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 8 - 9]

LOCATION	Napier
JOB NUMBER	1009171

DATE	15/02/2021
ANALYSED	zafr
PAGE	7 of 9 pages



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

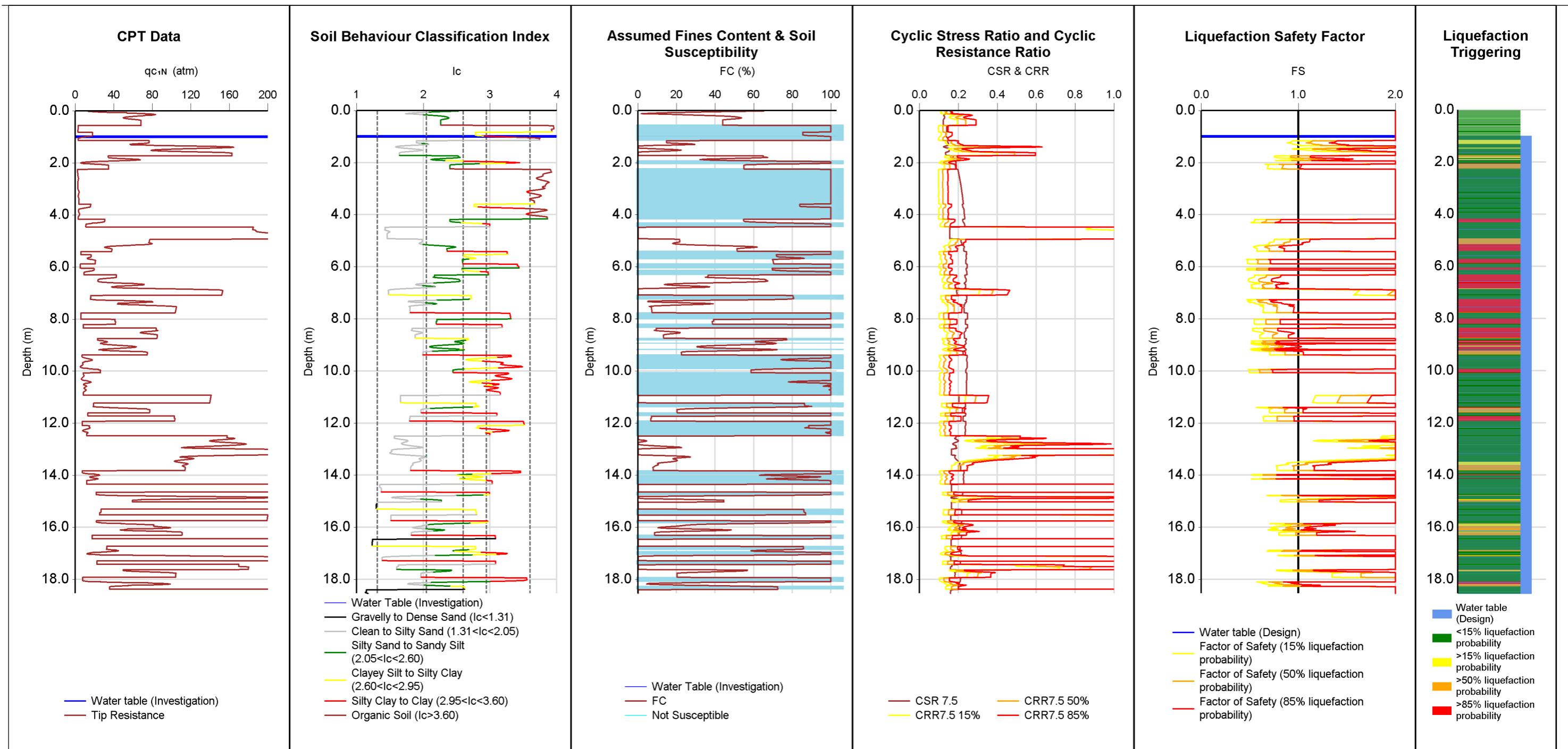
ID	NZGD 152814	NZGD 152813
CPT Name	CPT09	CPT08
Run description	CPT09	CPT08
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	18.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152814	CPT09	0	0	0
NZGD 152814	CPT09	0	20	2.6
NZGD 152813	CPT08	0	0	0
NZGD 152813	CPT08	0	18.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152814	CPT09	0	20	0 CFC
NZGD 152813	CPT08	0	18.18	0 CFC



Note: Inverse filtered Q_c/F_s data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT10	152815	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	126	5.5	11	21	1.2	7					
50%	107	4.9	7	17	1.9	4					
85%	78	3.2	3	12	4.2	2					

Reviewed by:

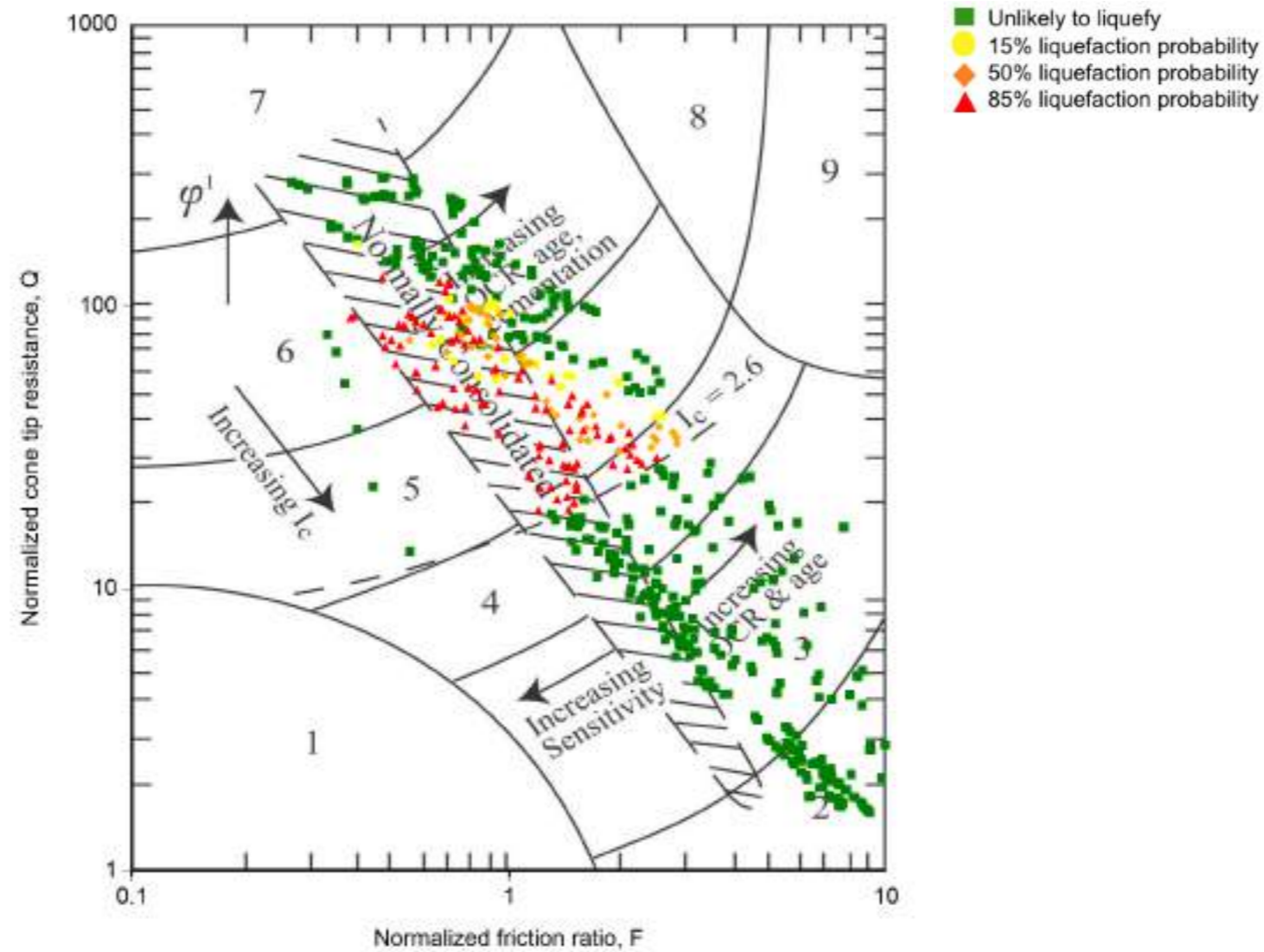
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]


LOCATION **Napier**
DATE **15/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**

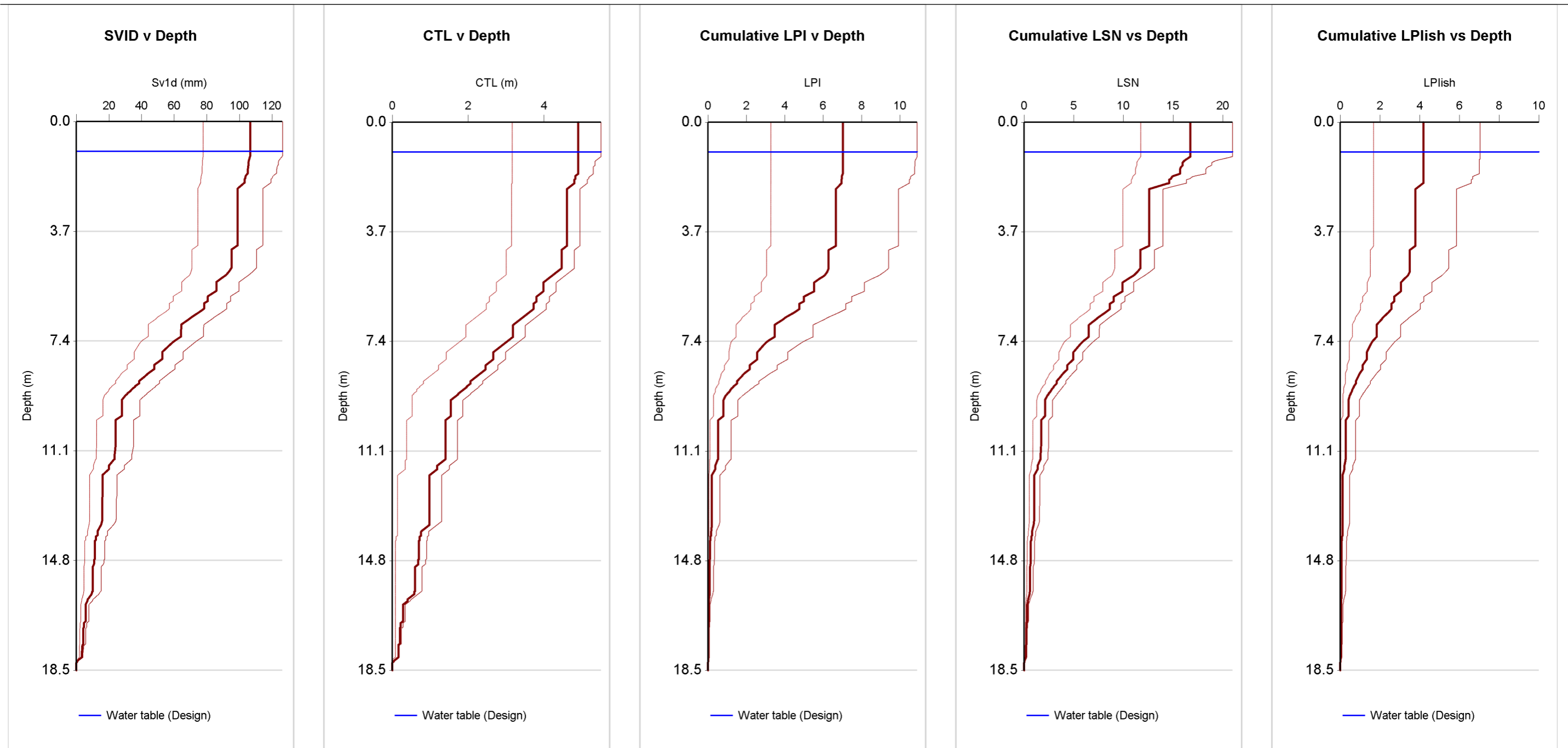


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

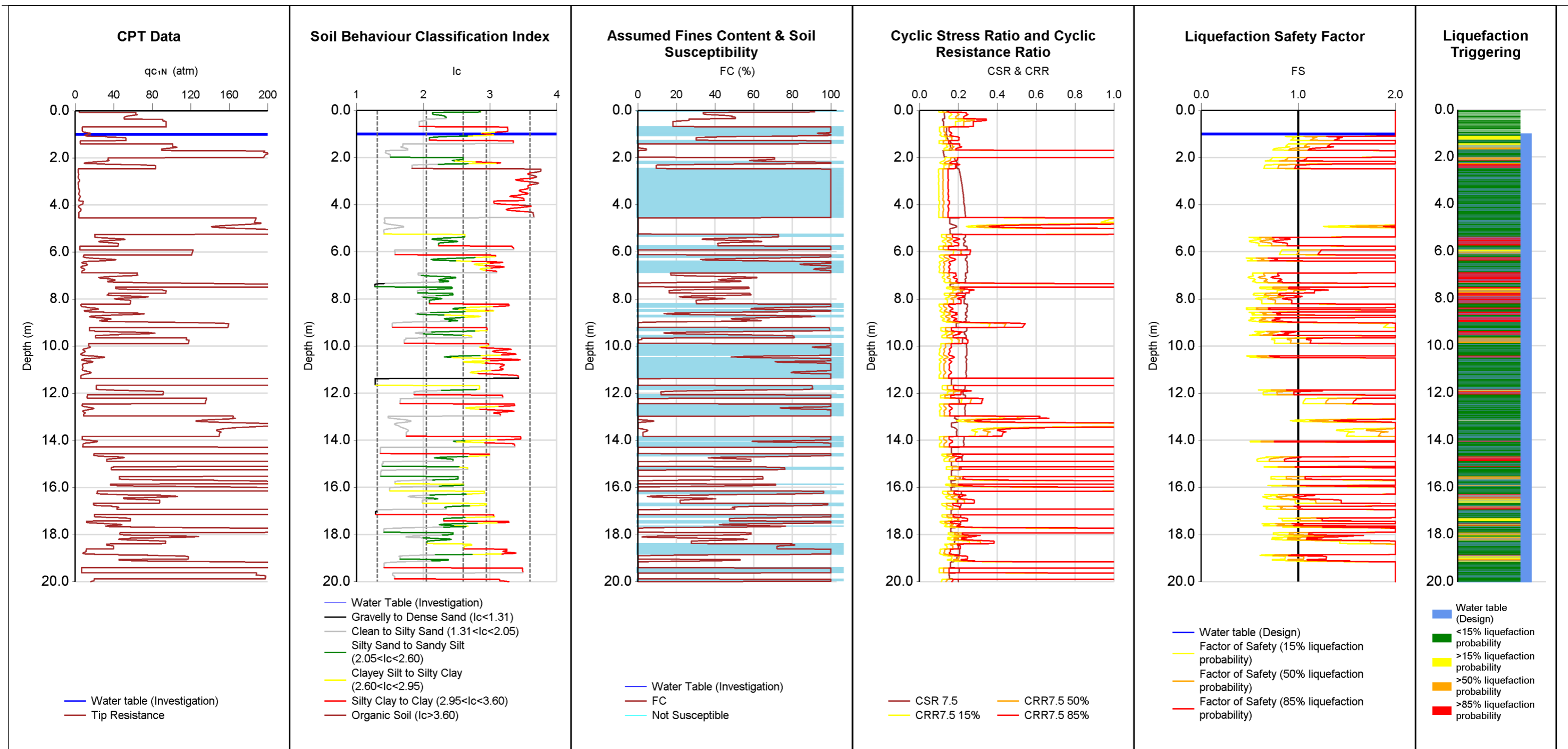
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT10	152815	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]				

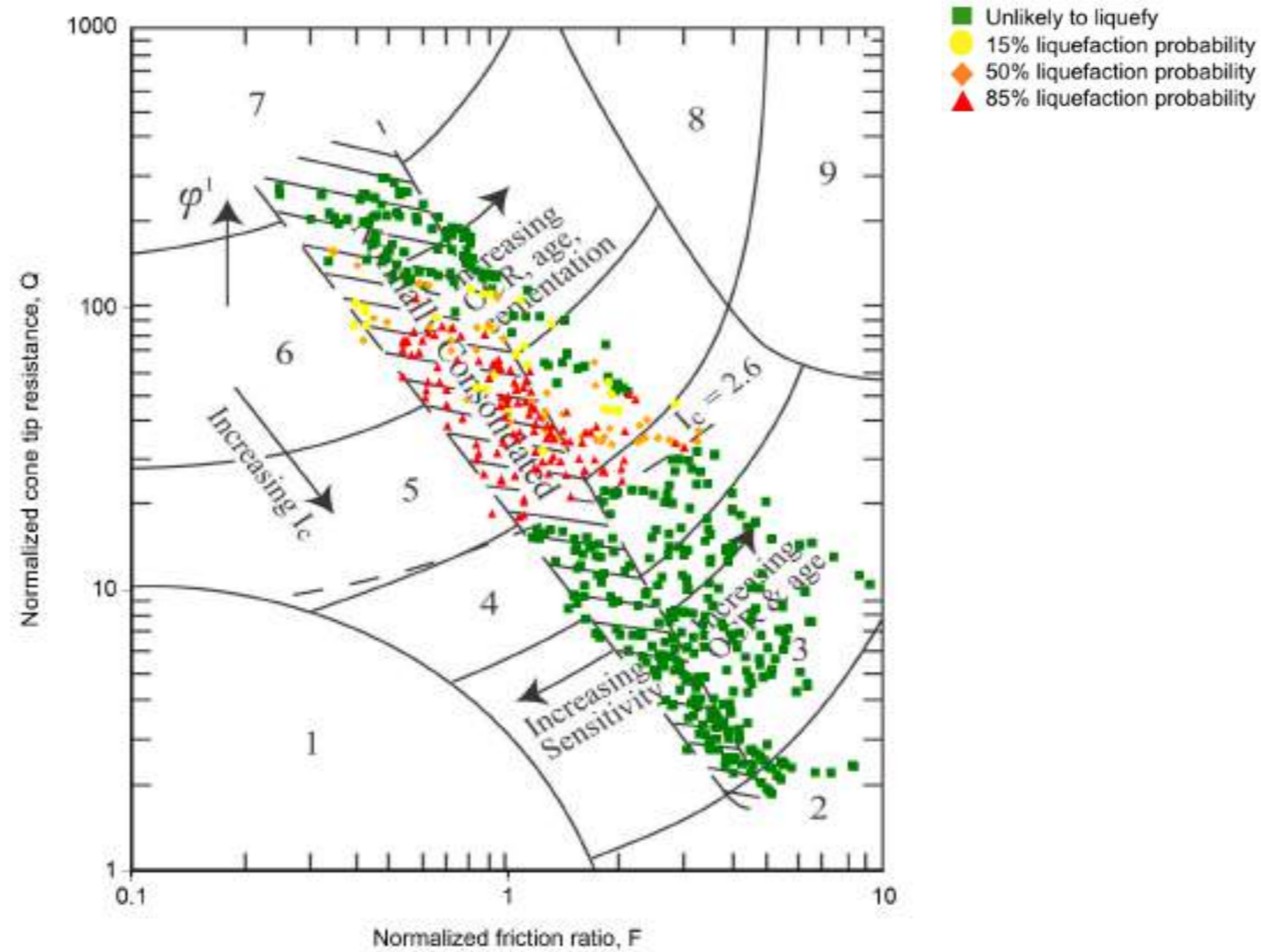


Note: Inverse filtered Q_c/F_s data (10 cm²) used.

INPUT		Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
		CPT11	152816	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
OUTPUT		PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
		15%	125	5.7	9	21	1.2	7					
		50%	101	4.6	6	16	1.7	3					
		85%	69	3	3	10	2.4	1					

Reviewed by:


CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

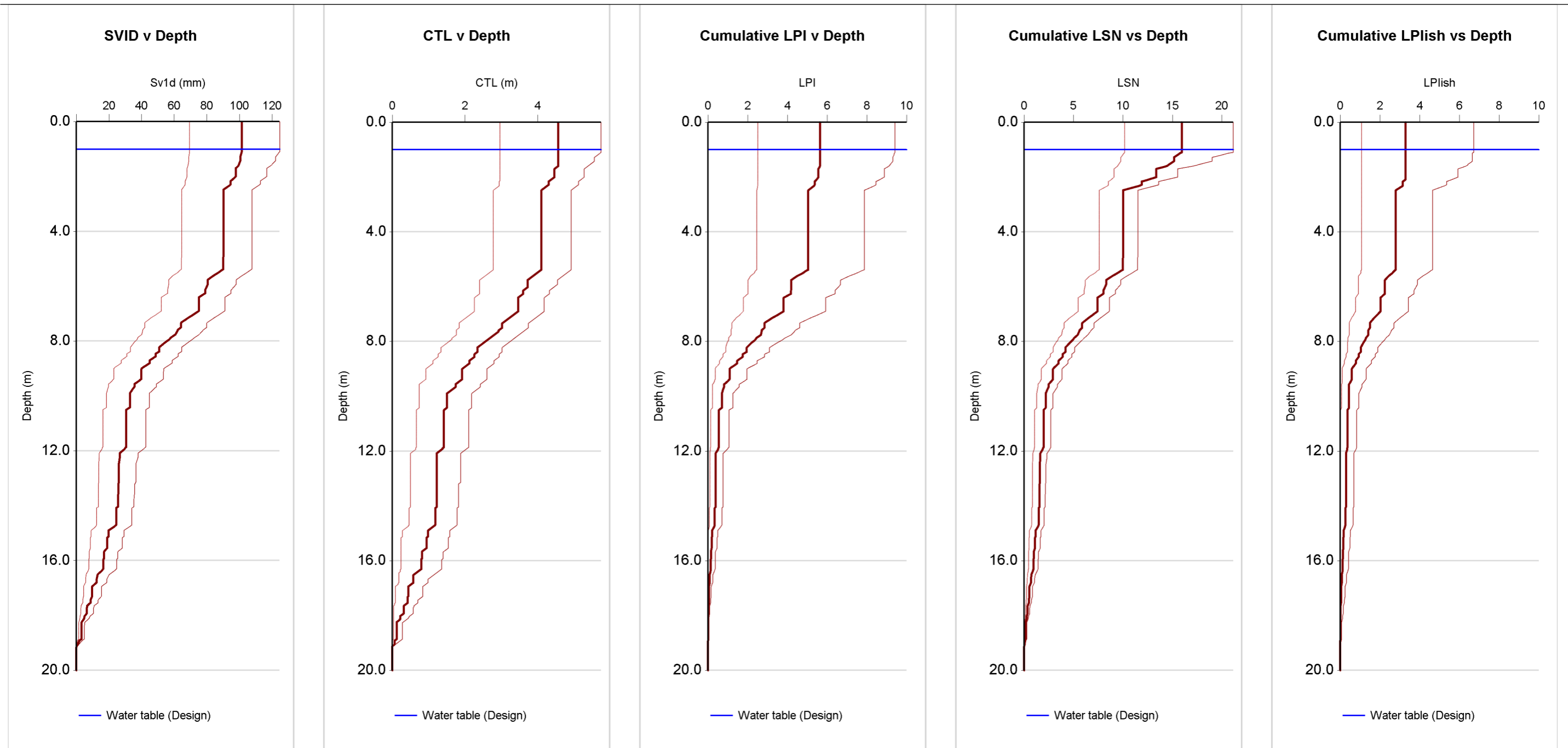


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

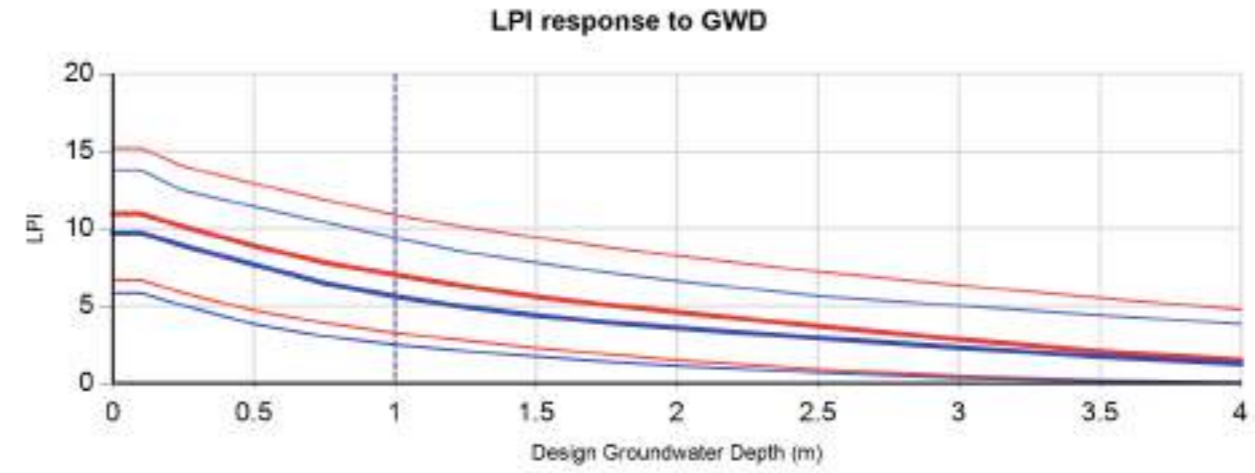
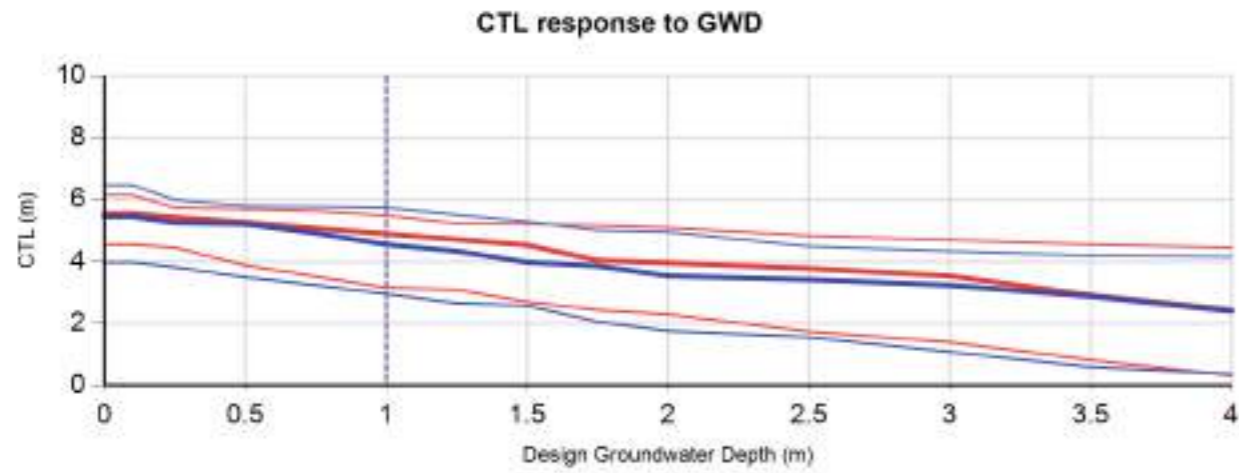
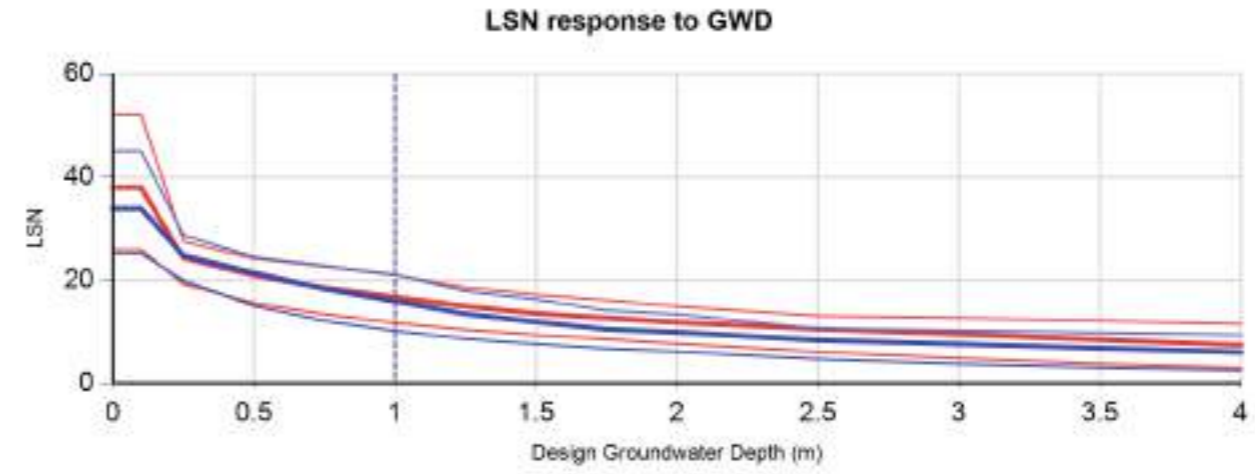
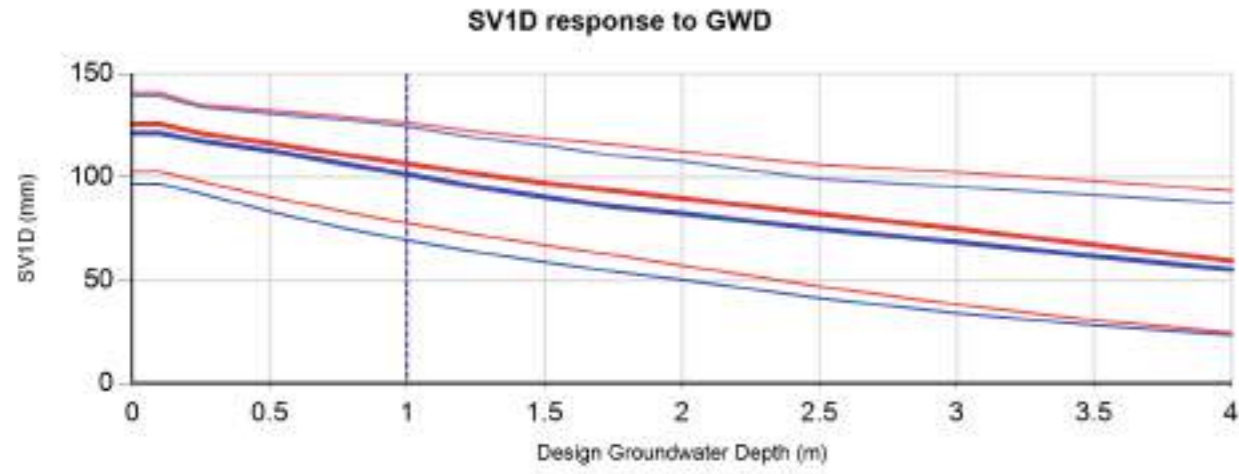
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT11	152816	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]				




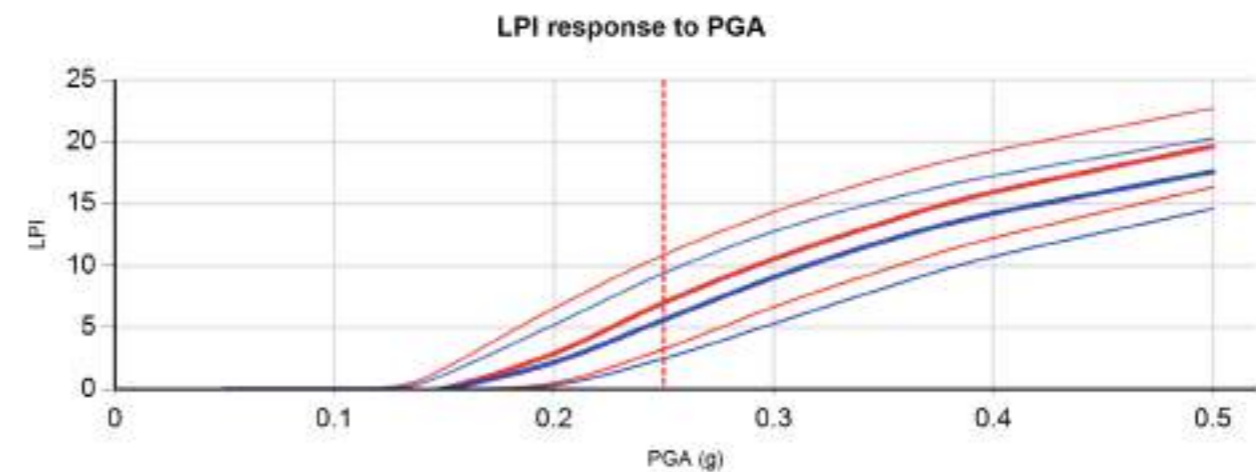
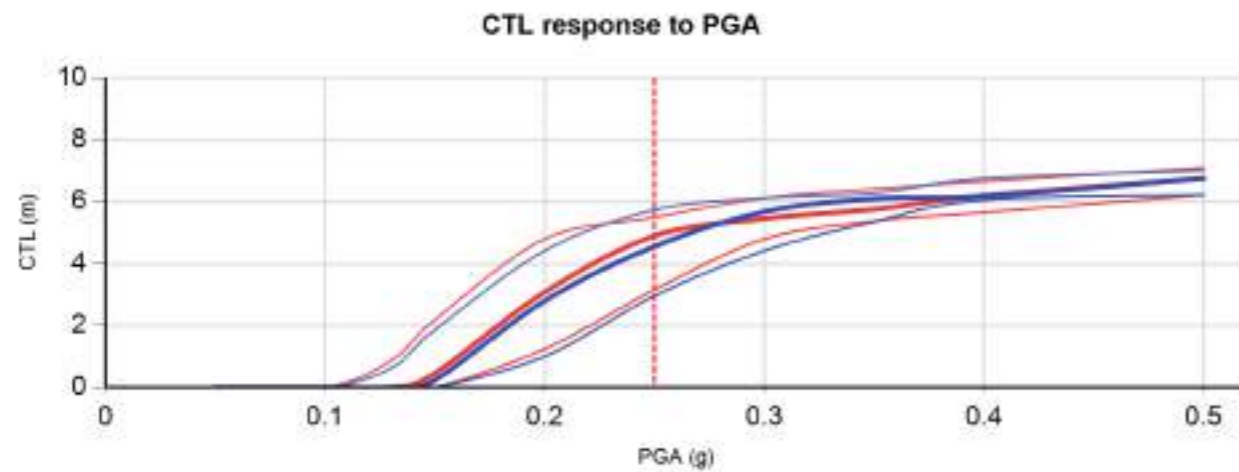
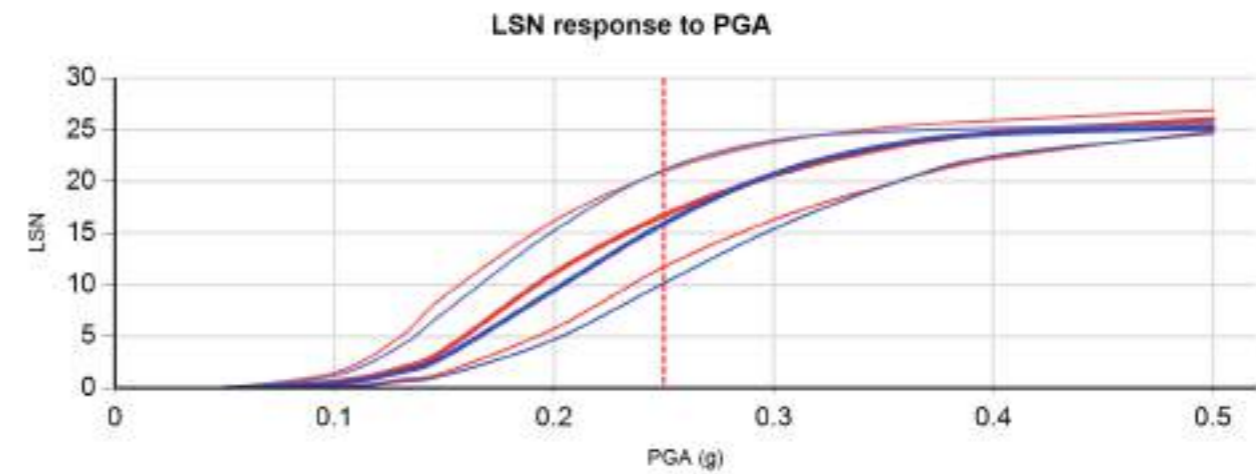
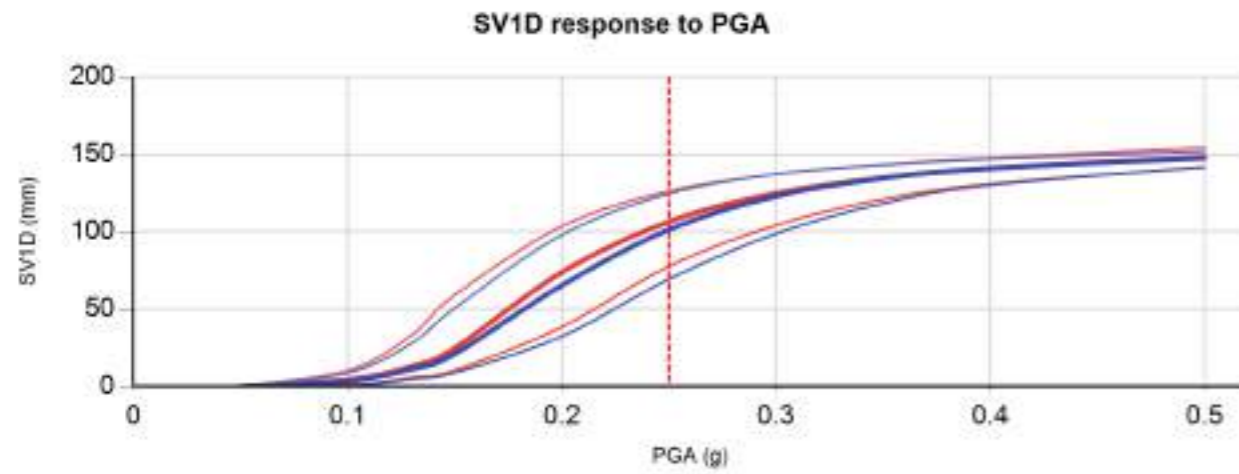
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 10 - 11]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

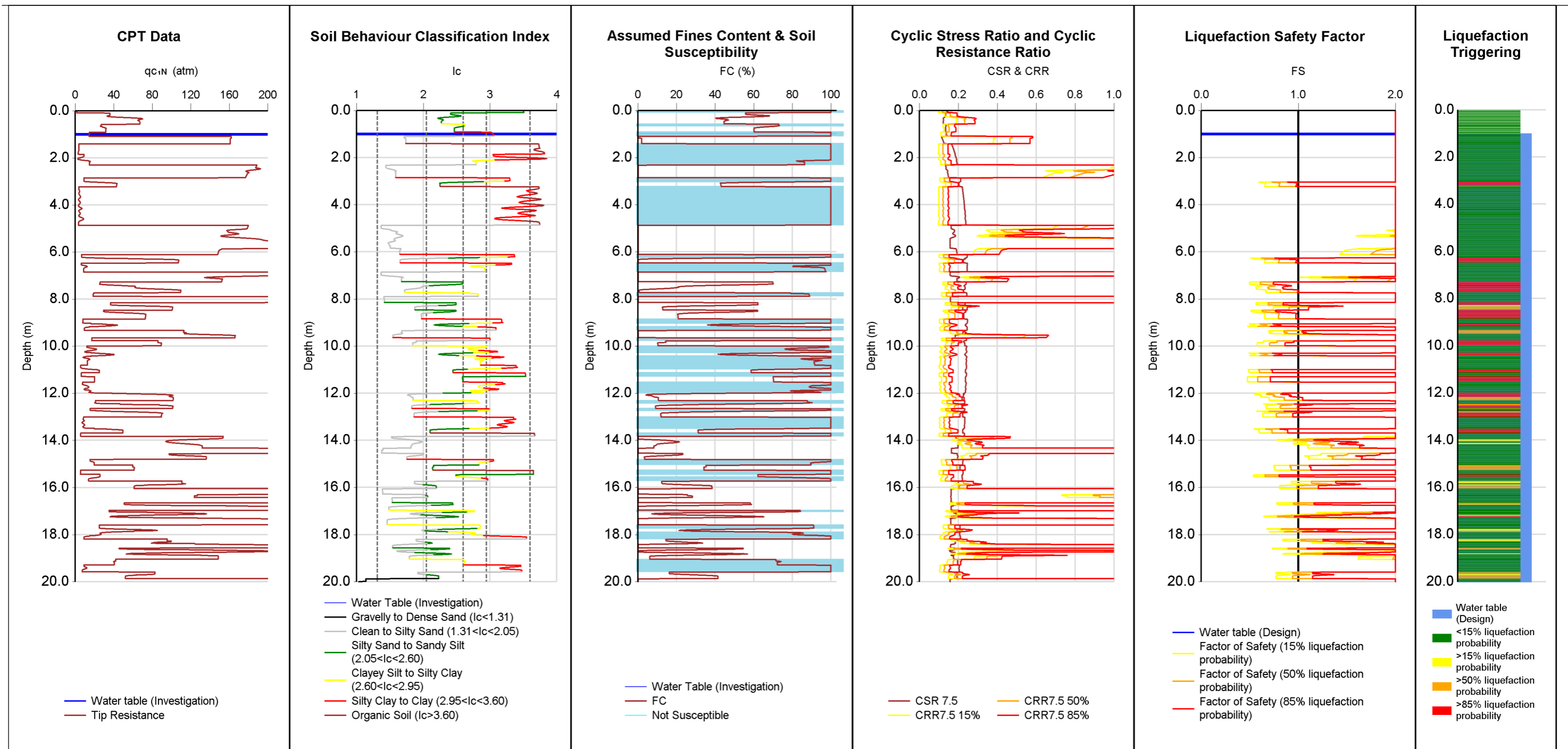
ID	NZGD 152815	NZGD 152816
CPT Name	CPT10	CPT11
Run description	CPT10	CPT11
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.54	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152815	CPT10	0	0	0
NZGD 152815	CPT10	0	18.54	2.6
NZGD 152816	CPT11	0	0	0
NZGD 152816	CPT11	0	20	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152815	CPT10	0	18.54	0 CFC
NZGD 152816	CPT11	0	20	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT12	152817	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	114	5.1	8	12	3.1	4					
50%	94	4.5	5	10	3.1	2					
85%	64	3.1	2	7	3.1	1					

Reviewed by:

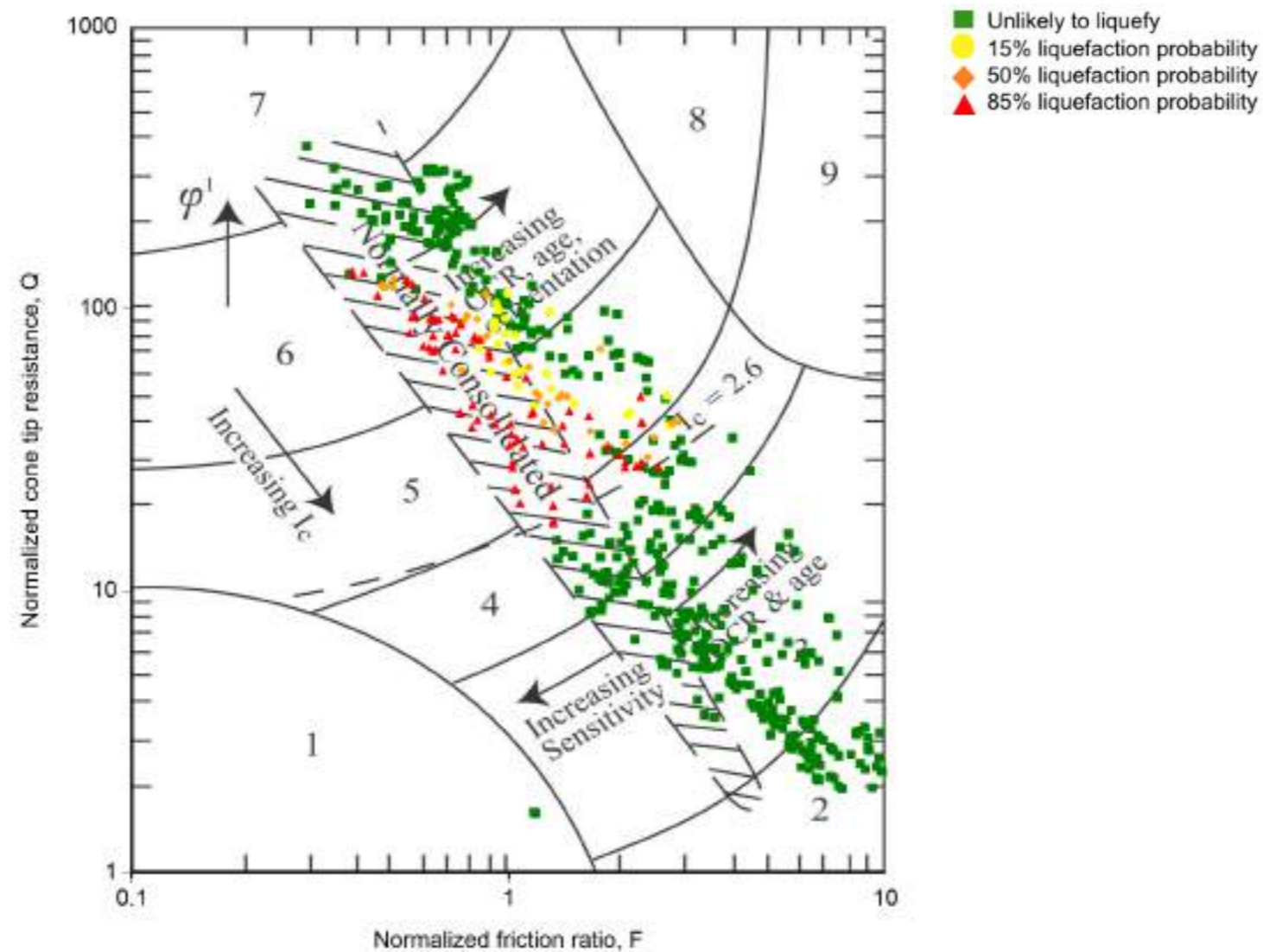
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]

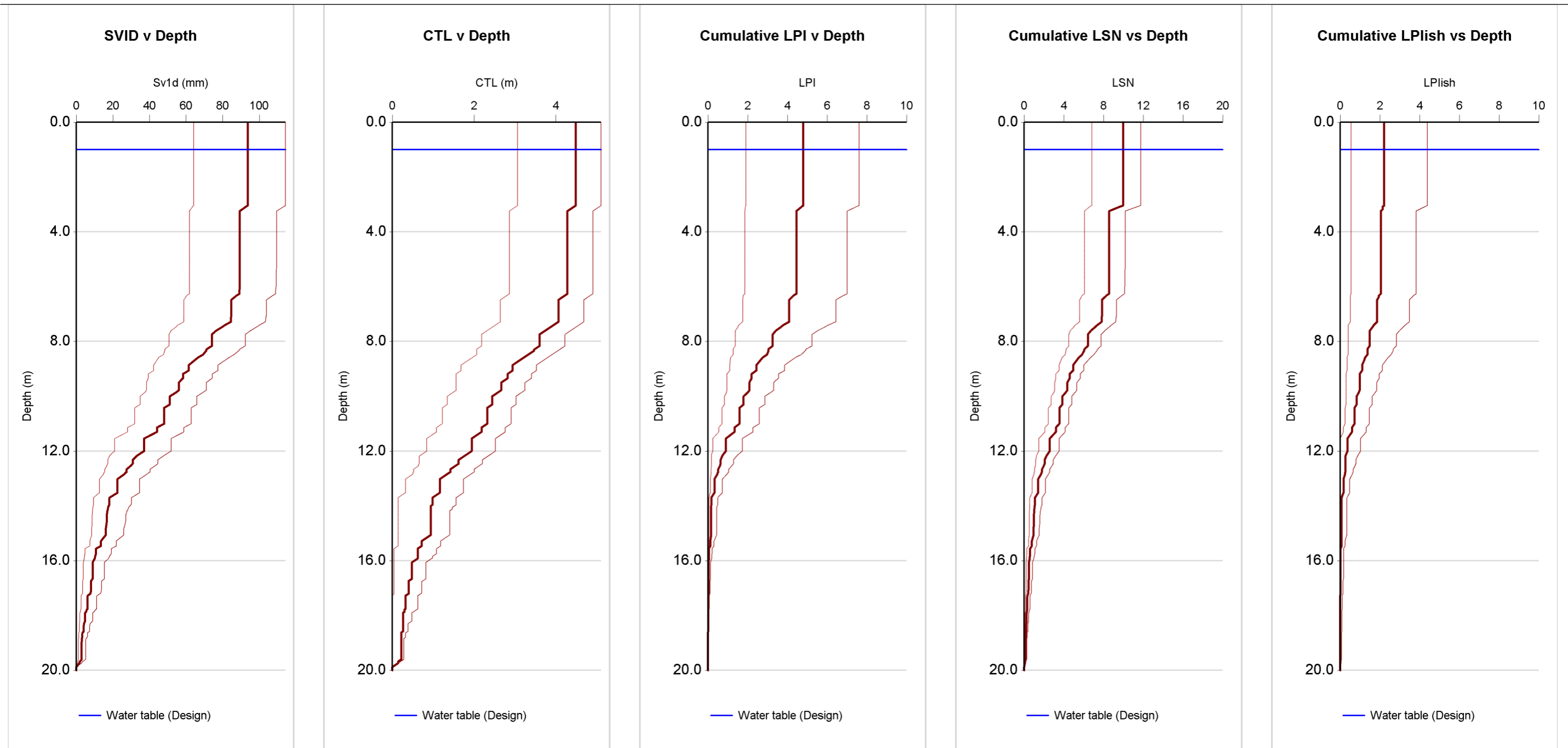
LOCATION **Napier**
DATE **15/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**




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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

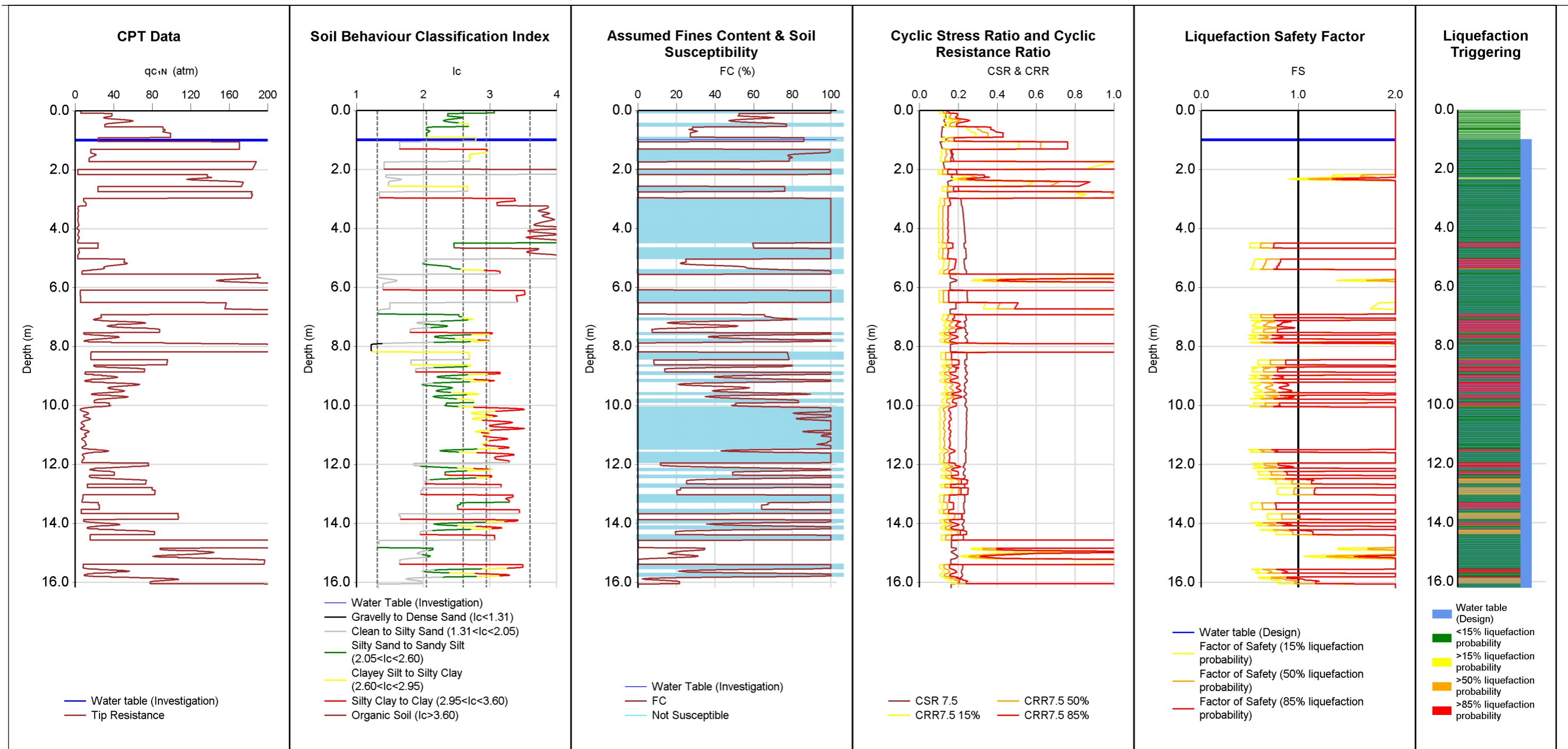
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT12	152817	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	107	4.4	9	12	4.5	5					
50%	99	4.4	6	11	4.6	2					
85%	82	3.4	3	10	4.6	0					

Reviewed by:

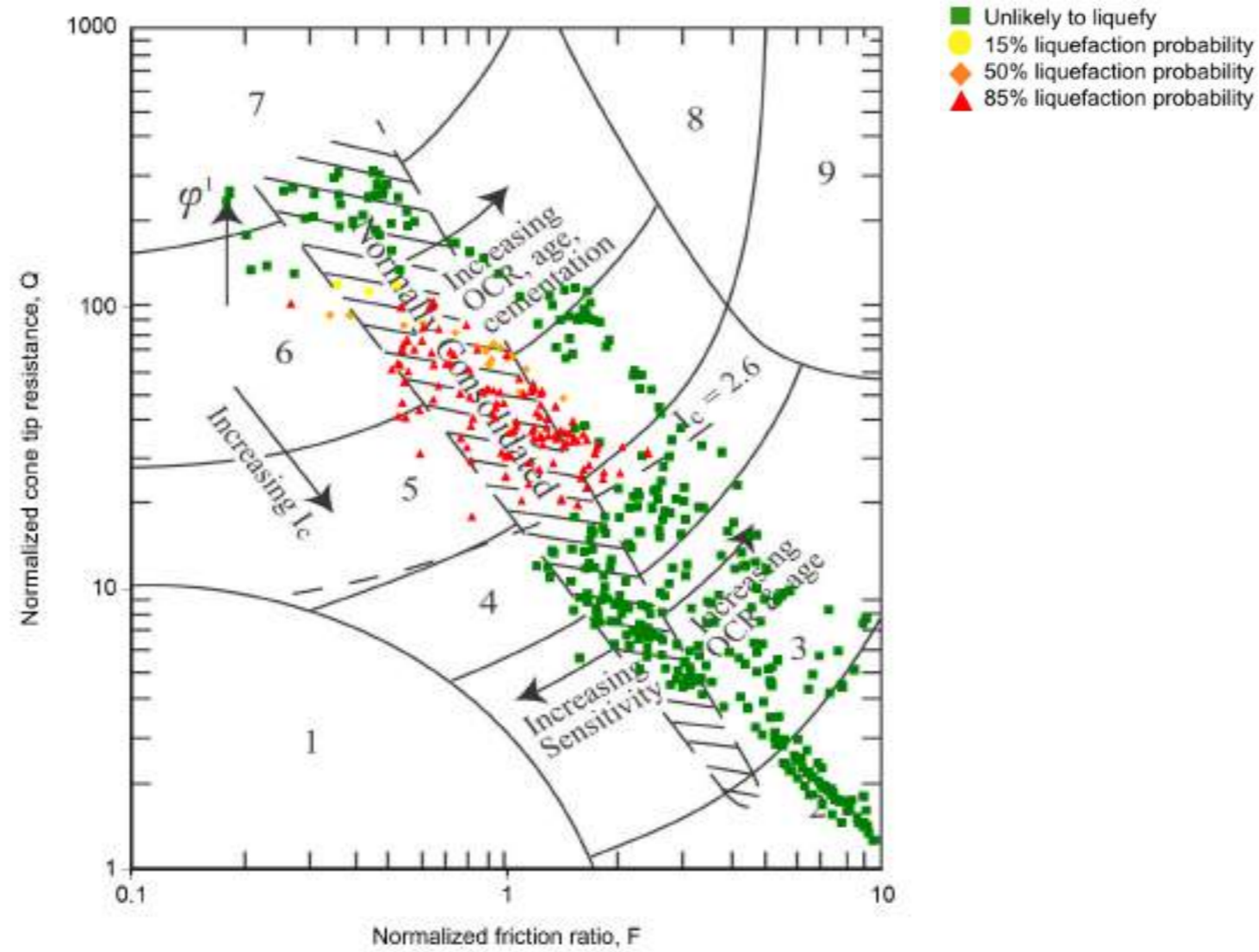
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

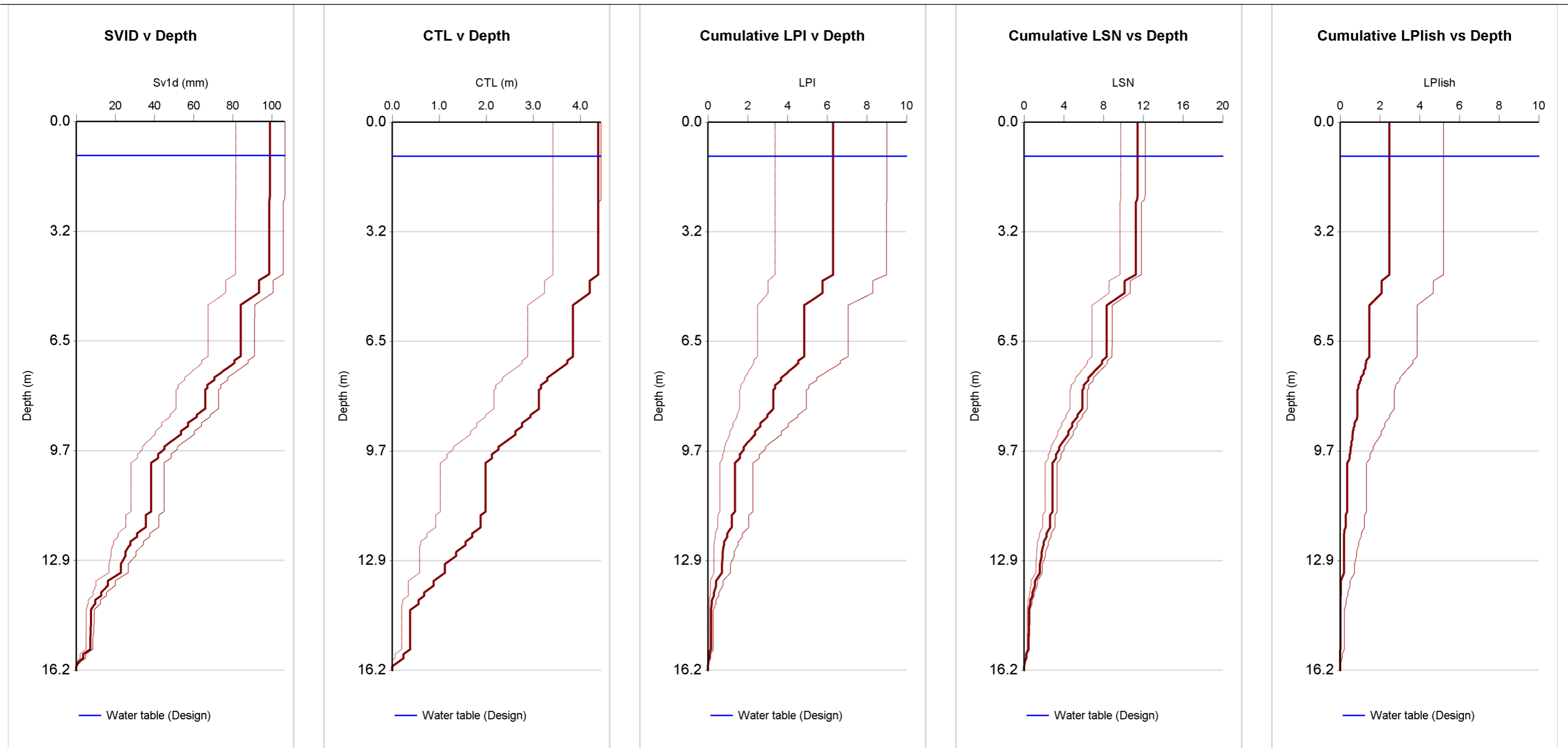


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

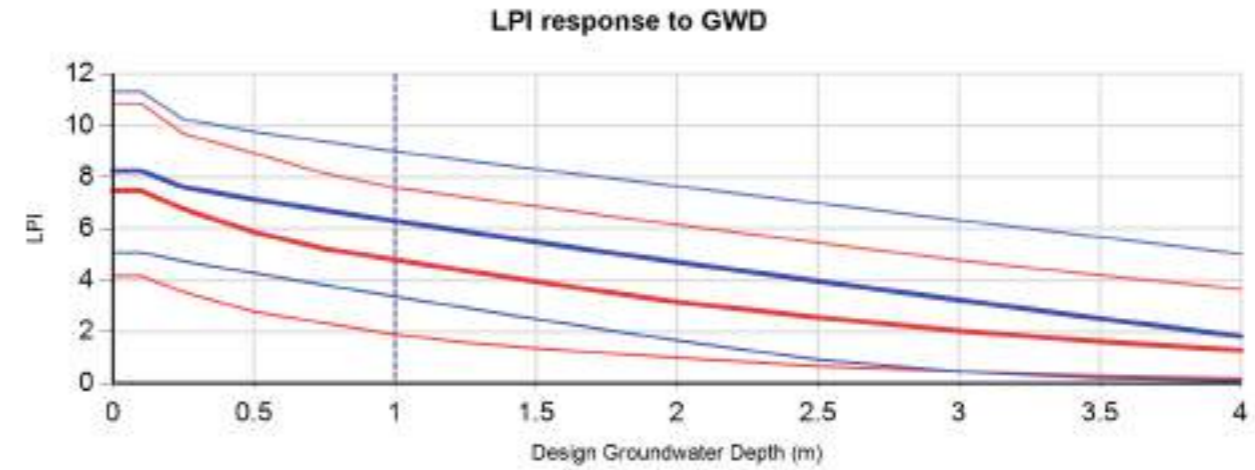
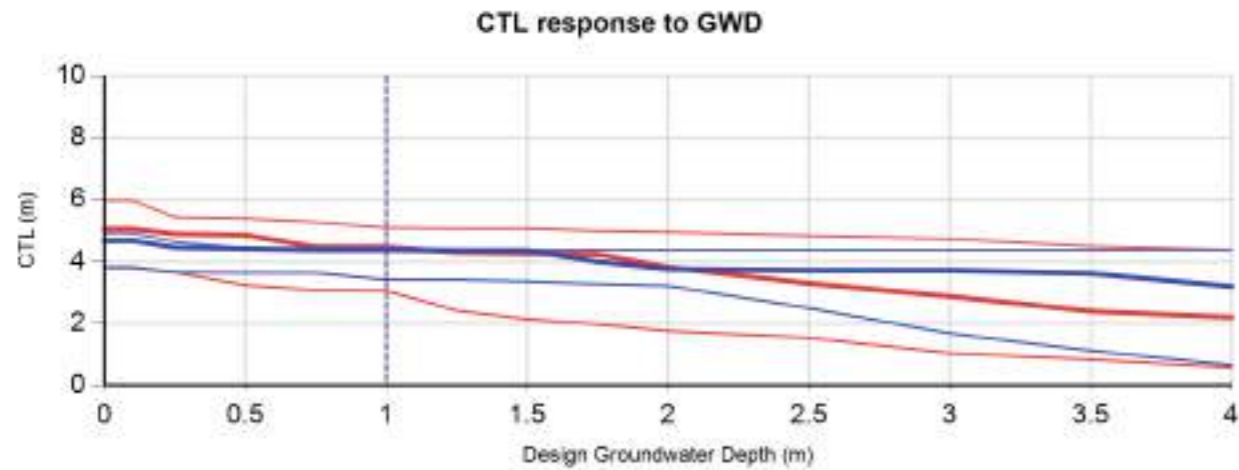
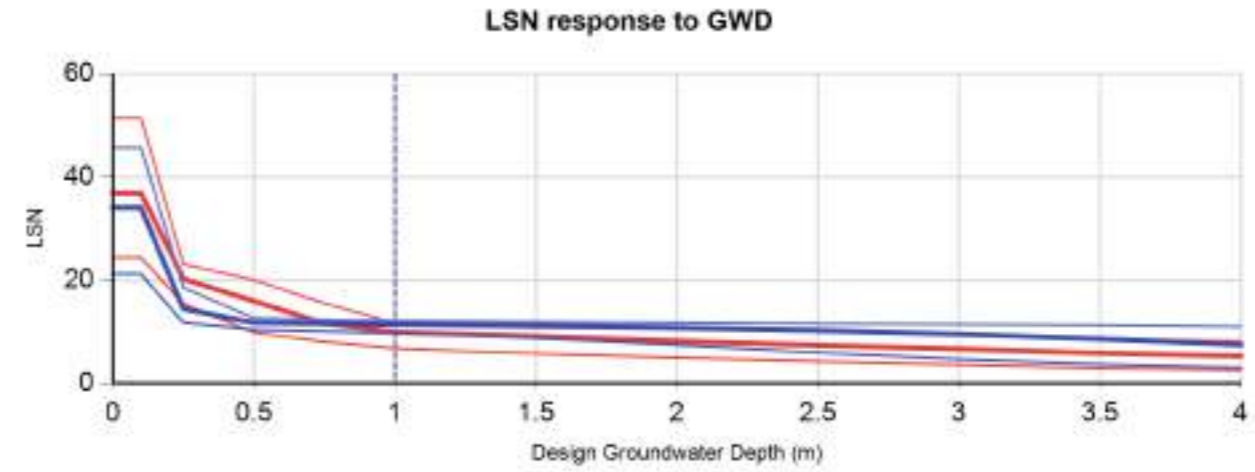
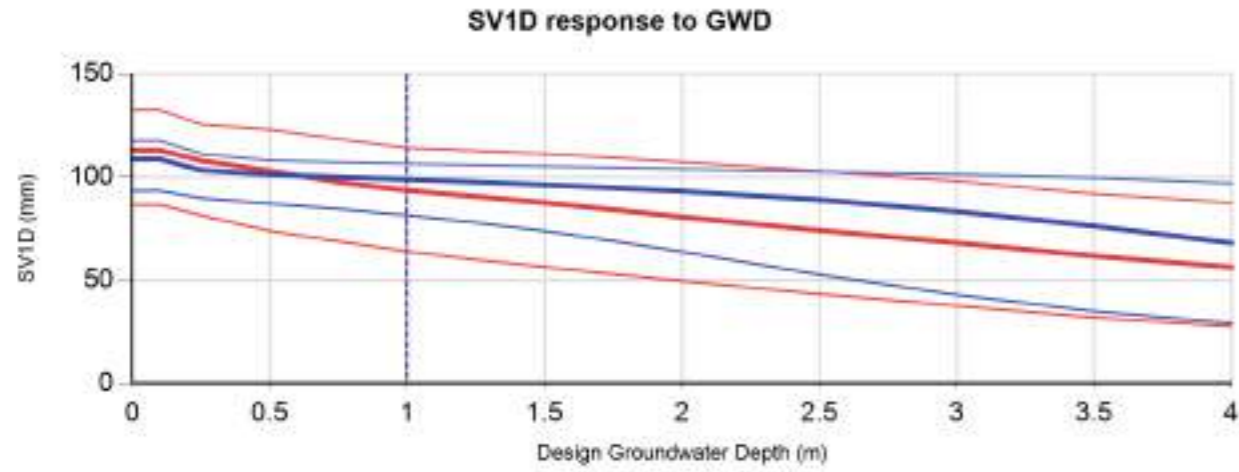
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]				




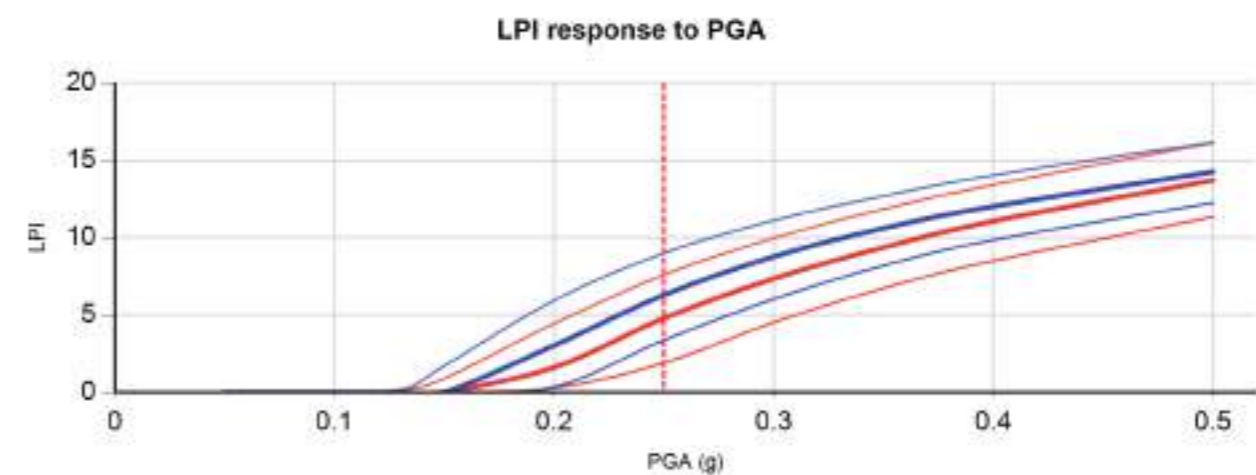
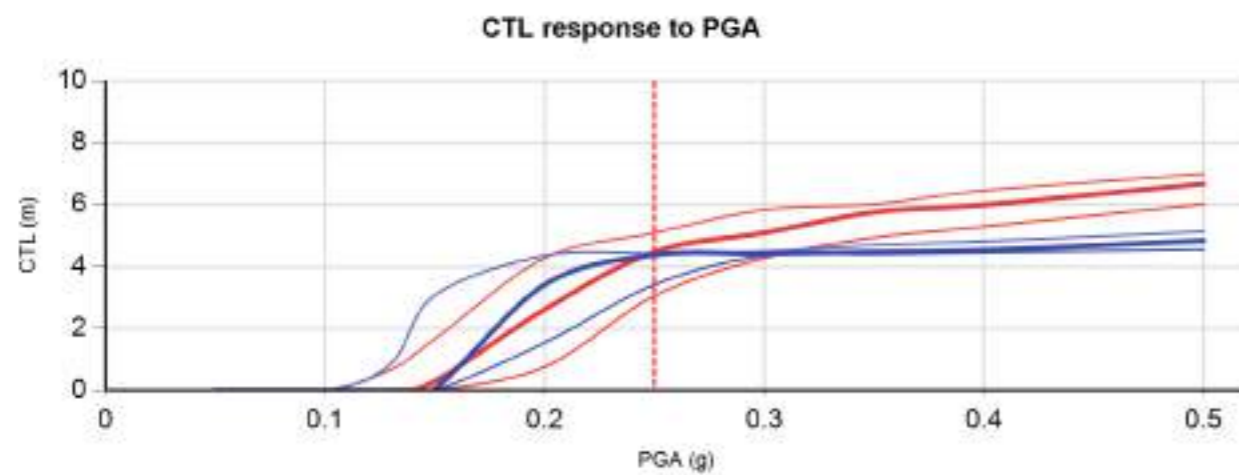
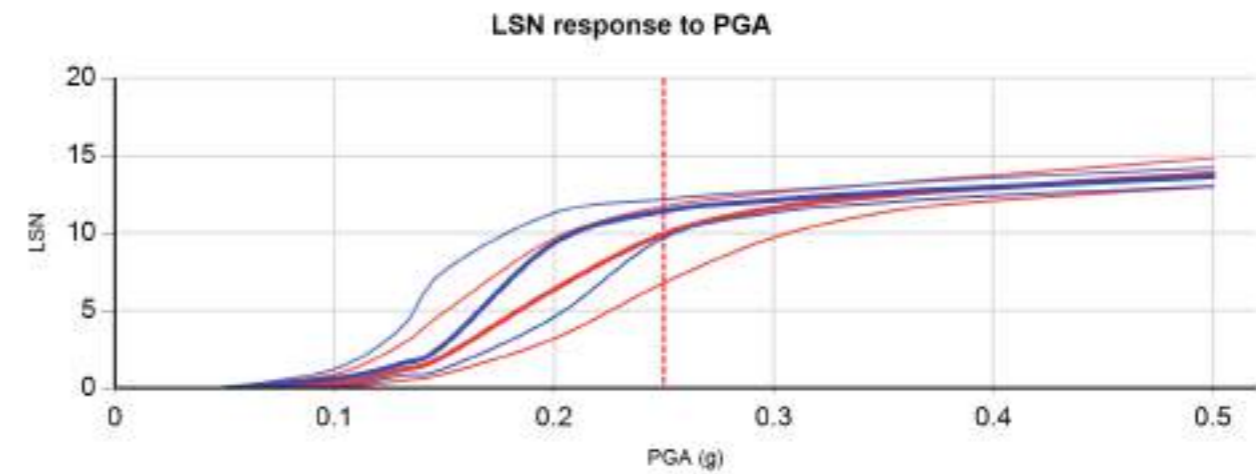
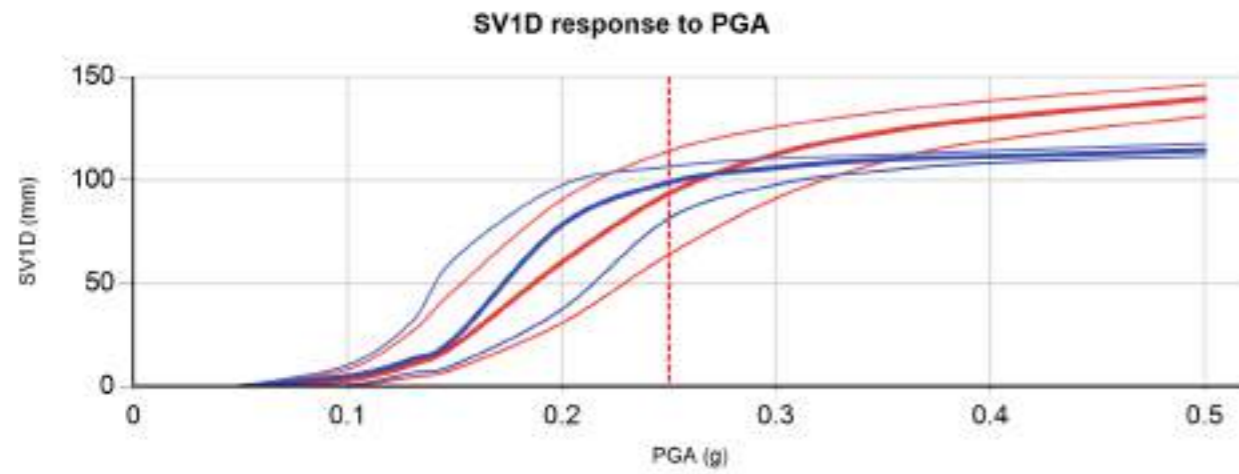
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 12 - 13]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

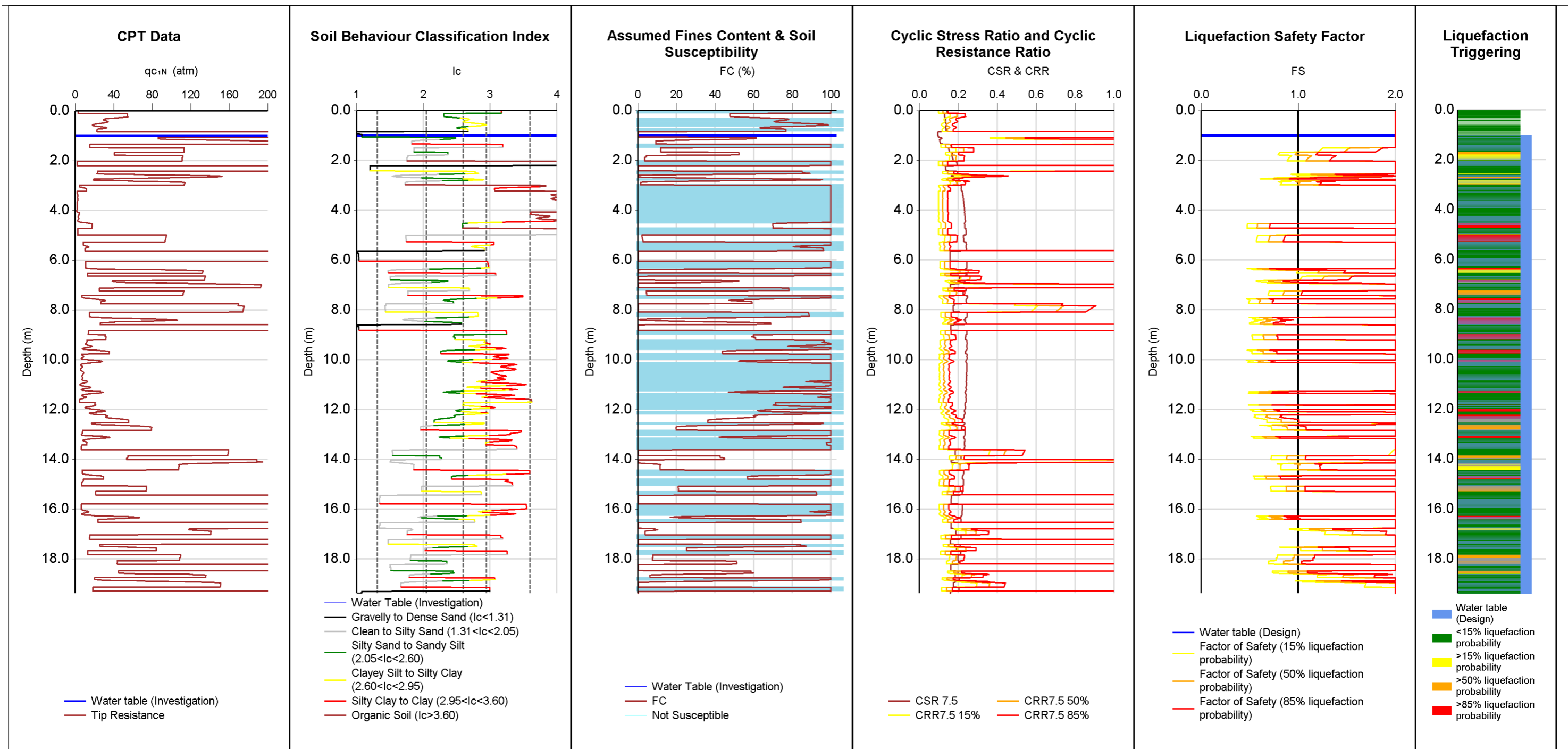
ID	NZGD 152817	NZGD 153237
CPT Name	CPT12	CPT13
Run description	CPT12	CPT13
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	16.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152817	CPT12	0	0	0
NZGD 152817	CPT12	0	20	2.6
NZGD 153237	CPT13	0	0	0
NZGD 153237	CPT13	0	16.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152817	CPT12	0	20	0 CFC
NZGD 153237	CPT13	0	16.18	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	113	5	8	16	1.8	5					
50%	93	4.2	5	12	1.8	3					
85%	70	2.4	3	9	4.6	1					

Reviewed by:

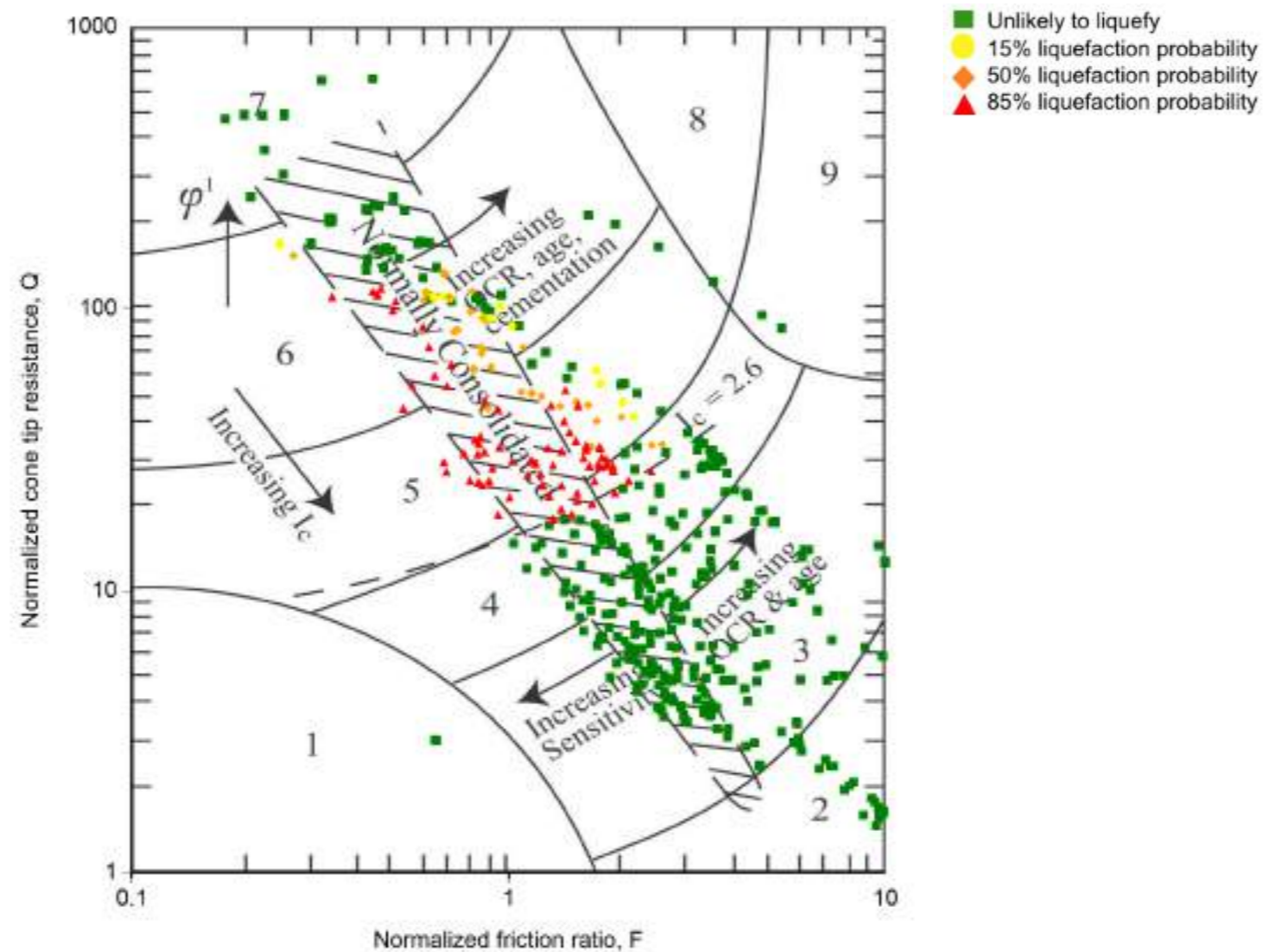
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

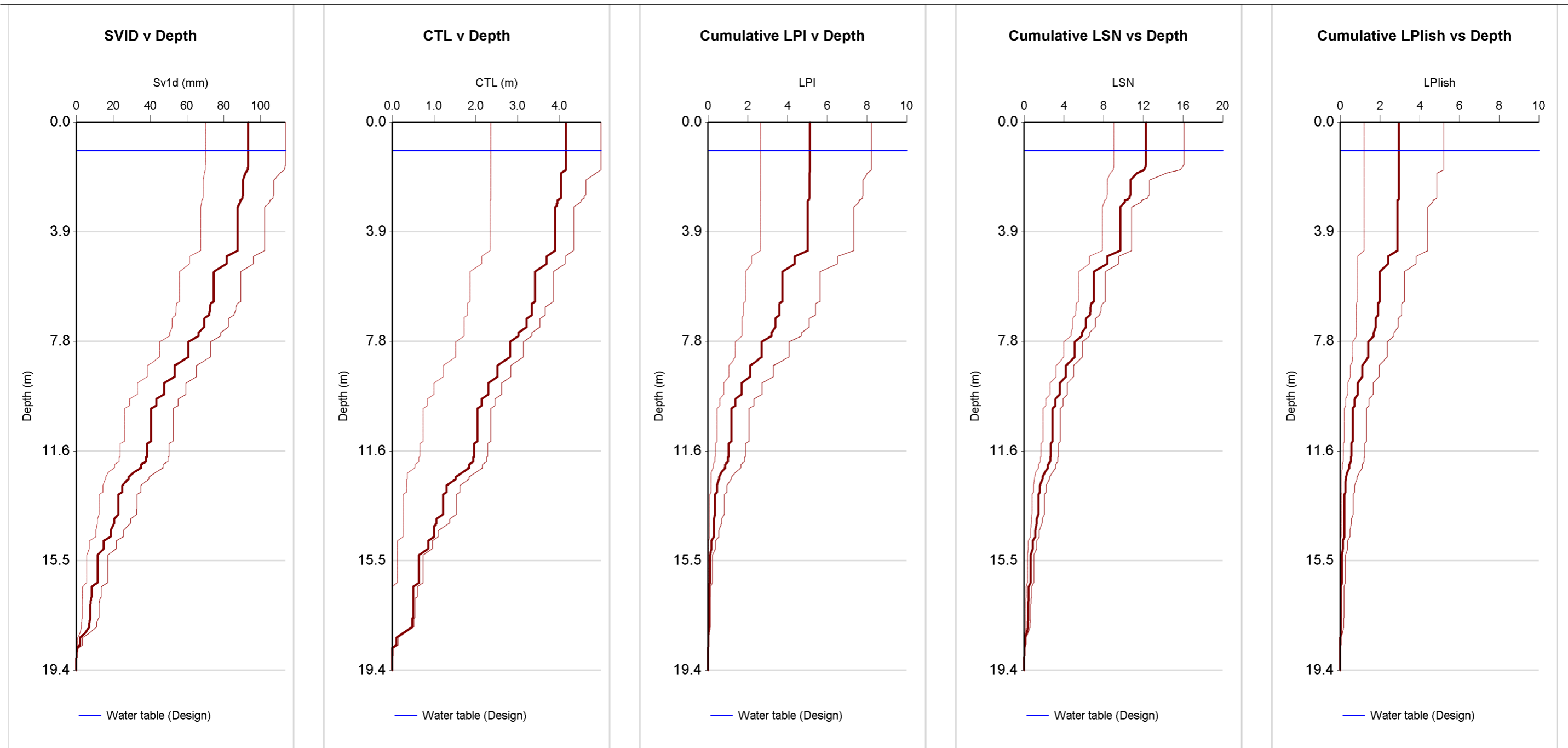


- 1. Sensitive, fine grained
- 2. Organic soils - peats
- 3. Clays - silty clay to clay
- 4. Silt mixtures - clayey silt to silty clay
- 5. Sand mixtures - silty sand to sandy silt
- 6. Sands - clean sand to silty sand
- 7. Gravelly sand to dense sand
- 8. Very stiff sand to clayey sand *
- 9. Very stiff, fine grained *


*Heavily overconsolidated or cemented

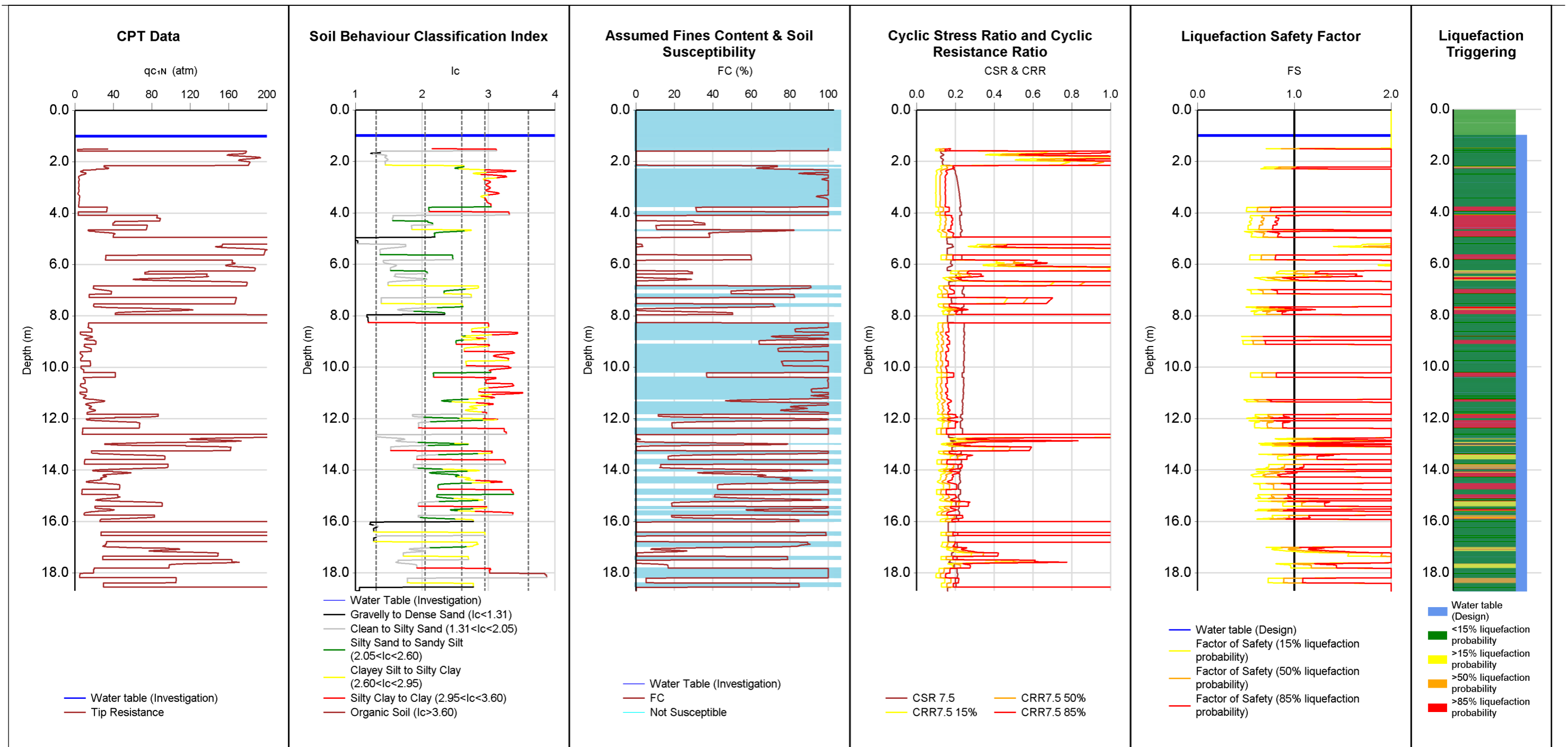
CPT-based soil behavior type classification chart by Robertson (1990)

 Tonkin + Taylor Exceptional thinking together V2.4.15	CLIENT	Napier City Council	LOCATION	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER		
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]	1009171	PAGE	2 of 9 pages



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.3	0.25	BI-2014	ZRB-2002	18		0	

PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish
15%	117	5.2	9	16	3.8	6
50%	103	4.4	6	14	3.8	4
85%	78	3.4	3	11	3.8	2

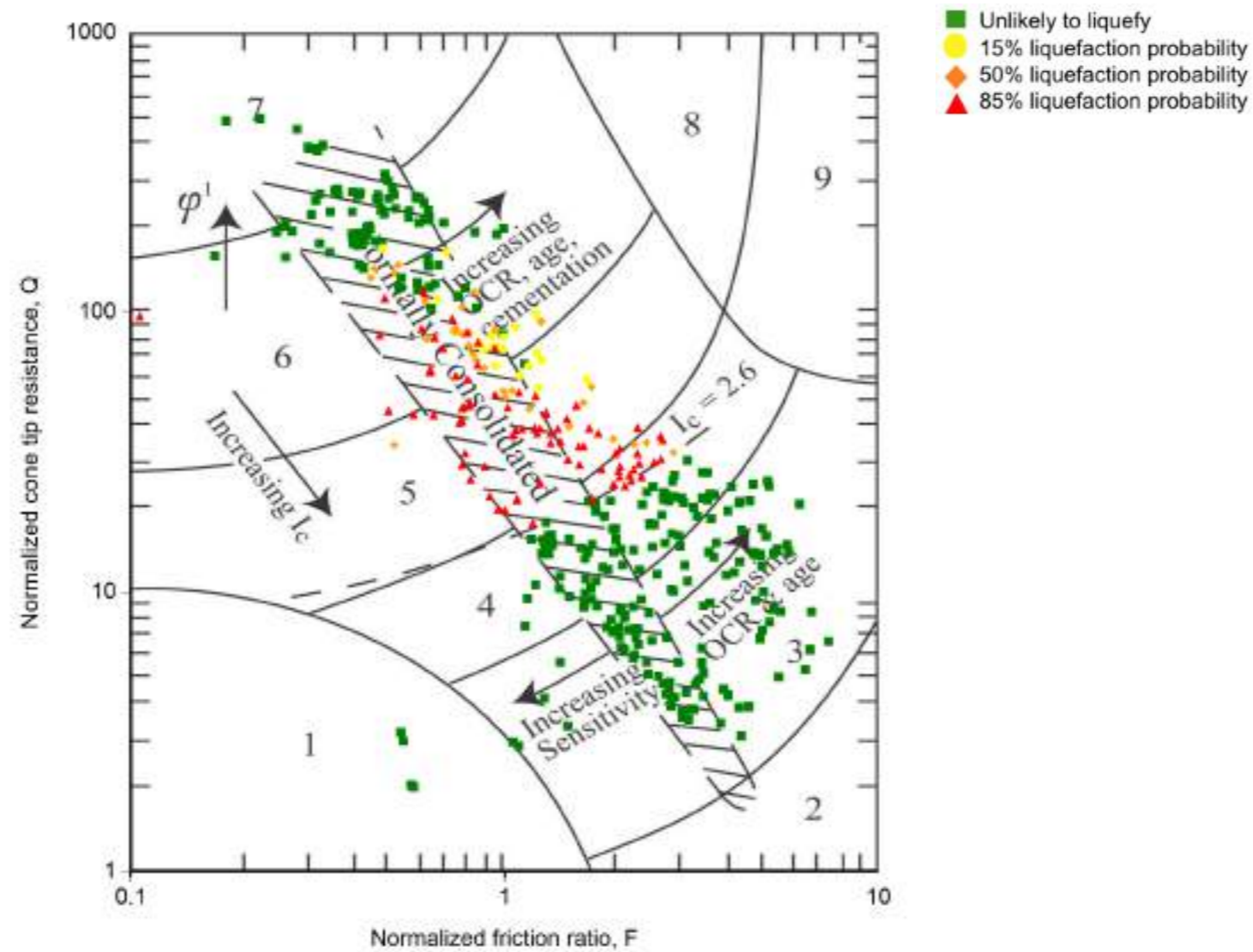
Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15


CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafz
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	4 of 9 pages
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				

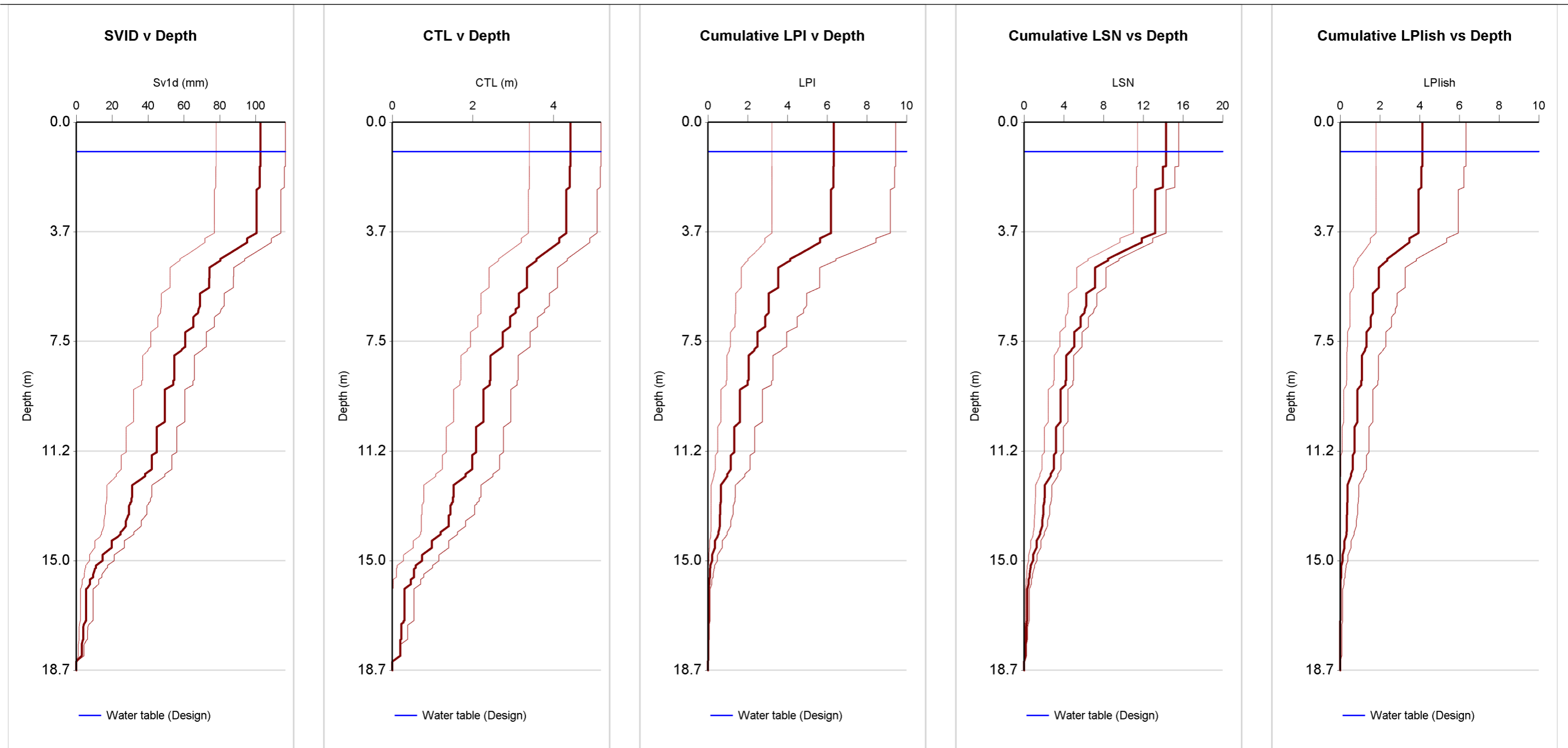


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

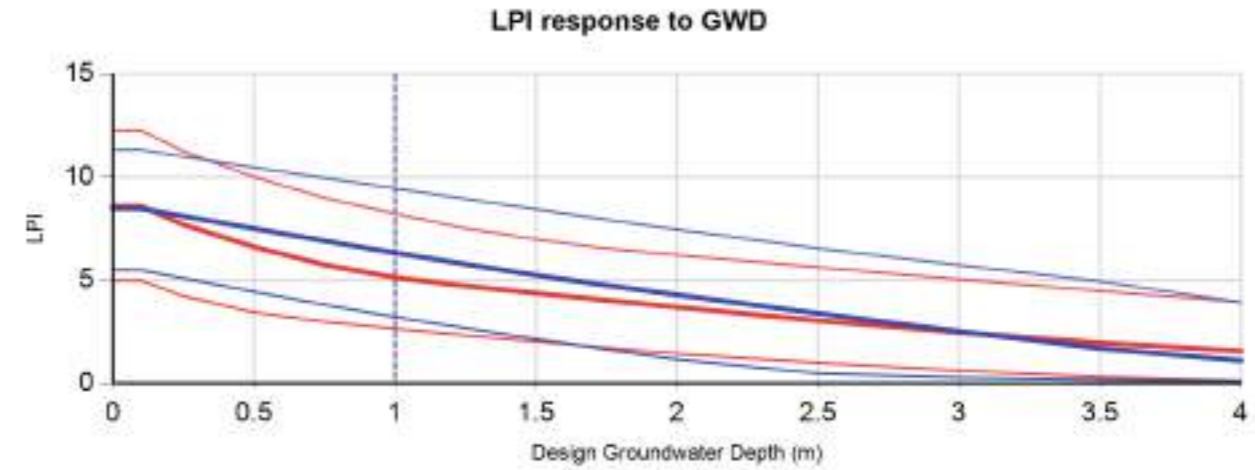
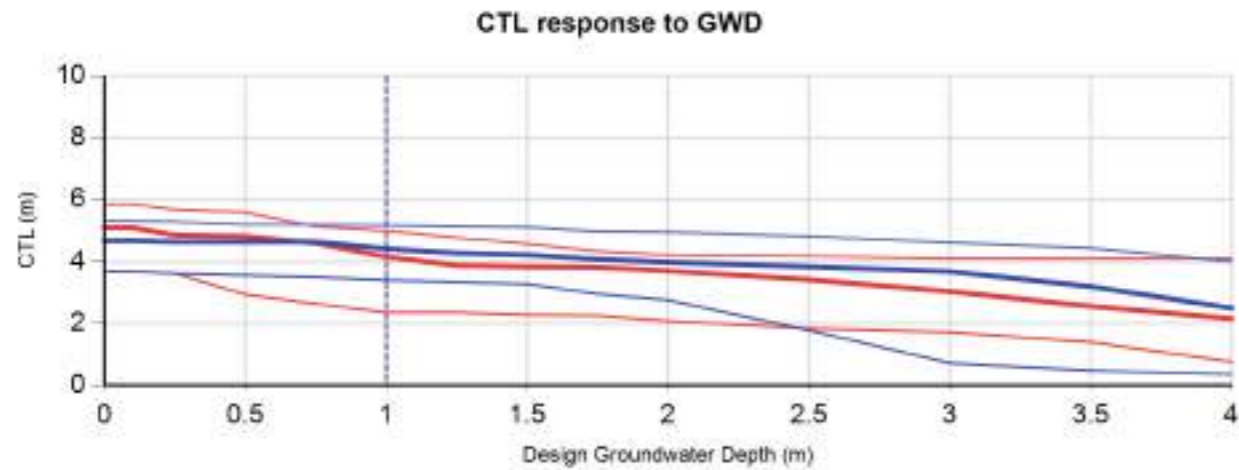
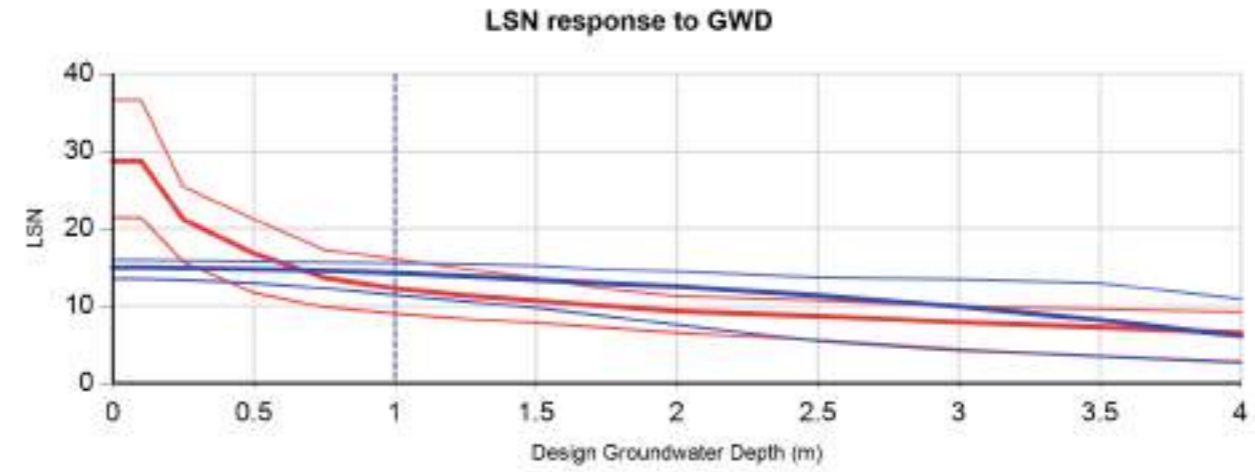
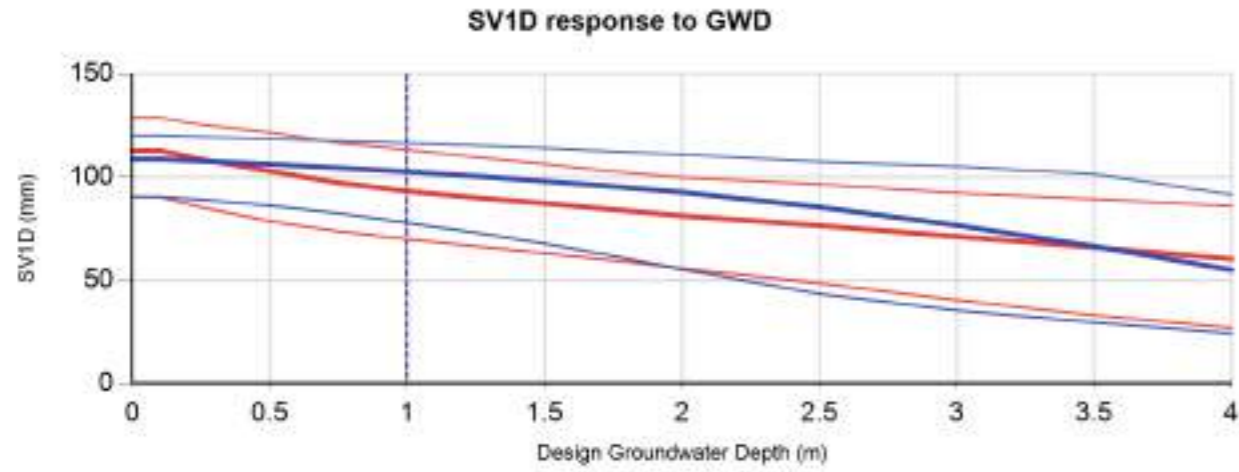
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				




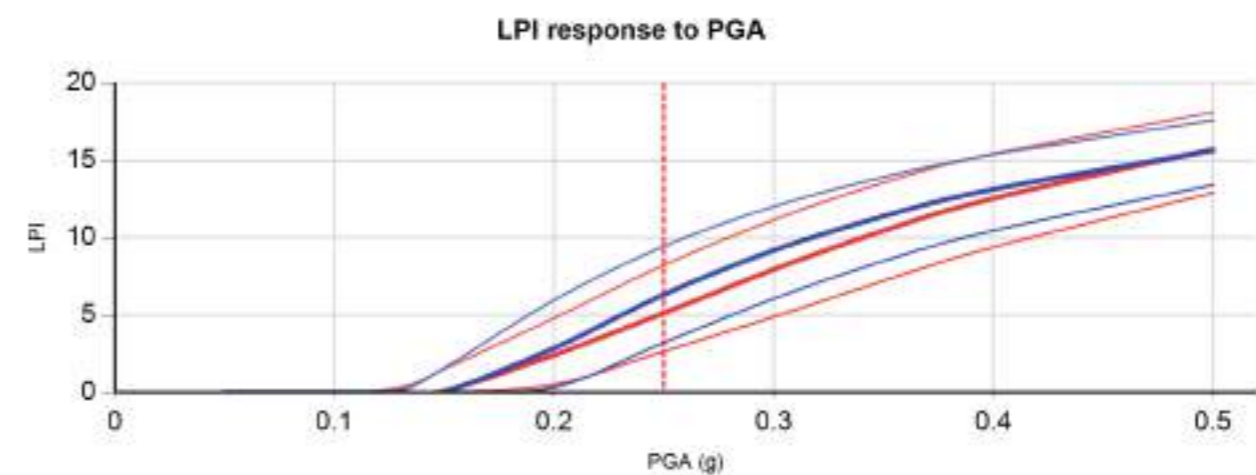
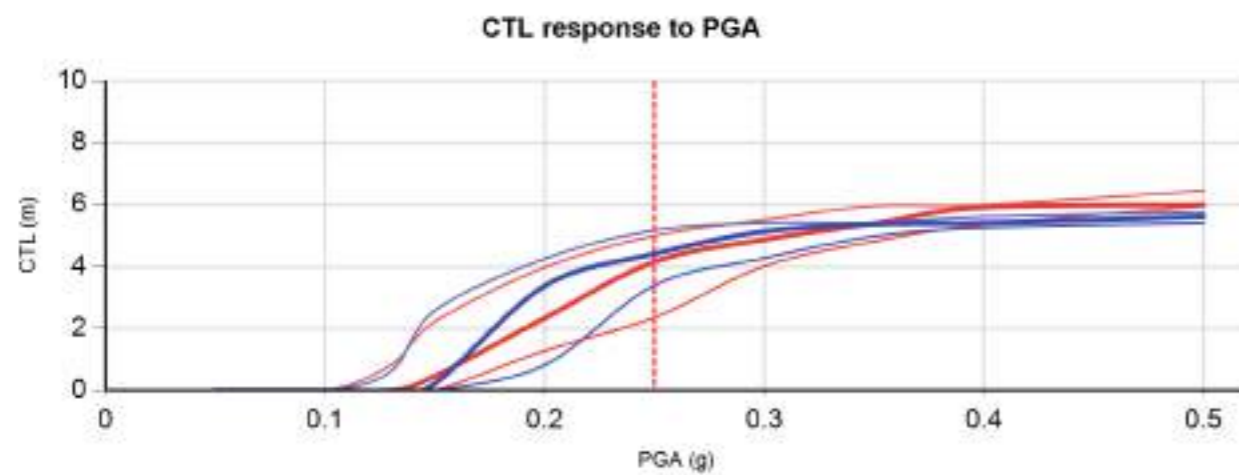
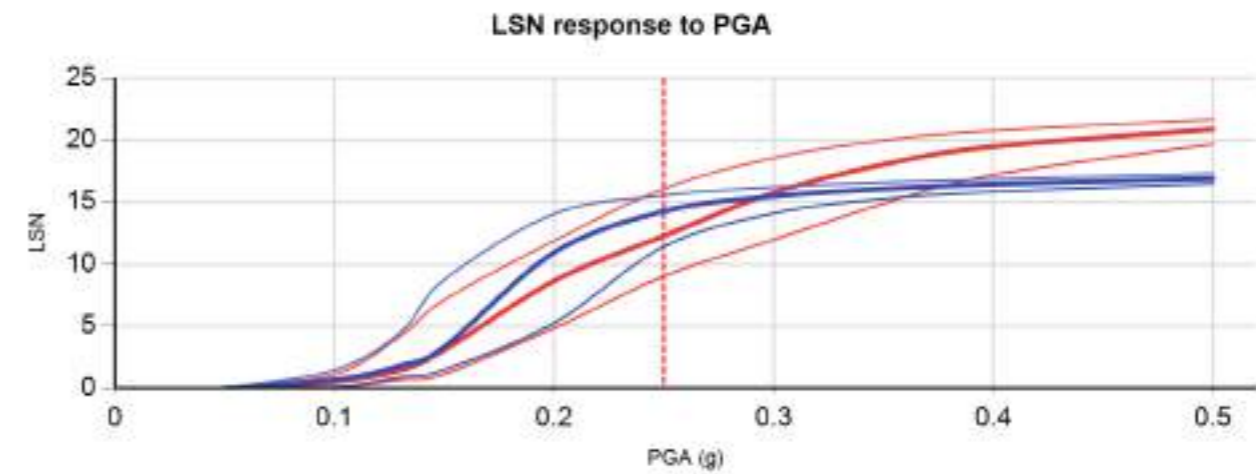
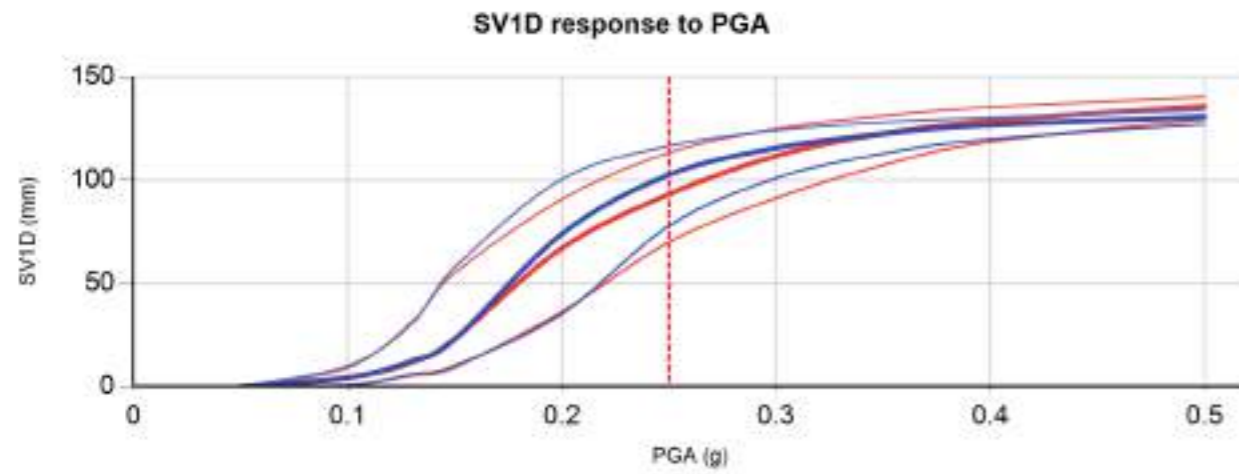
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 15 - 16]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

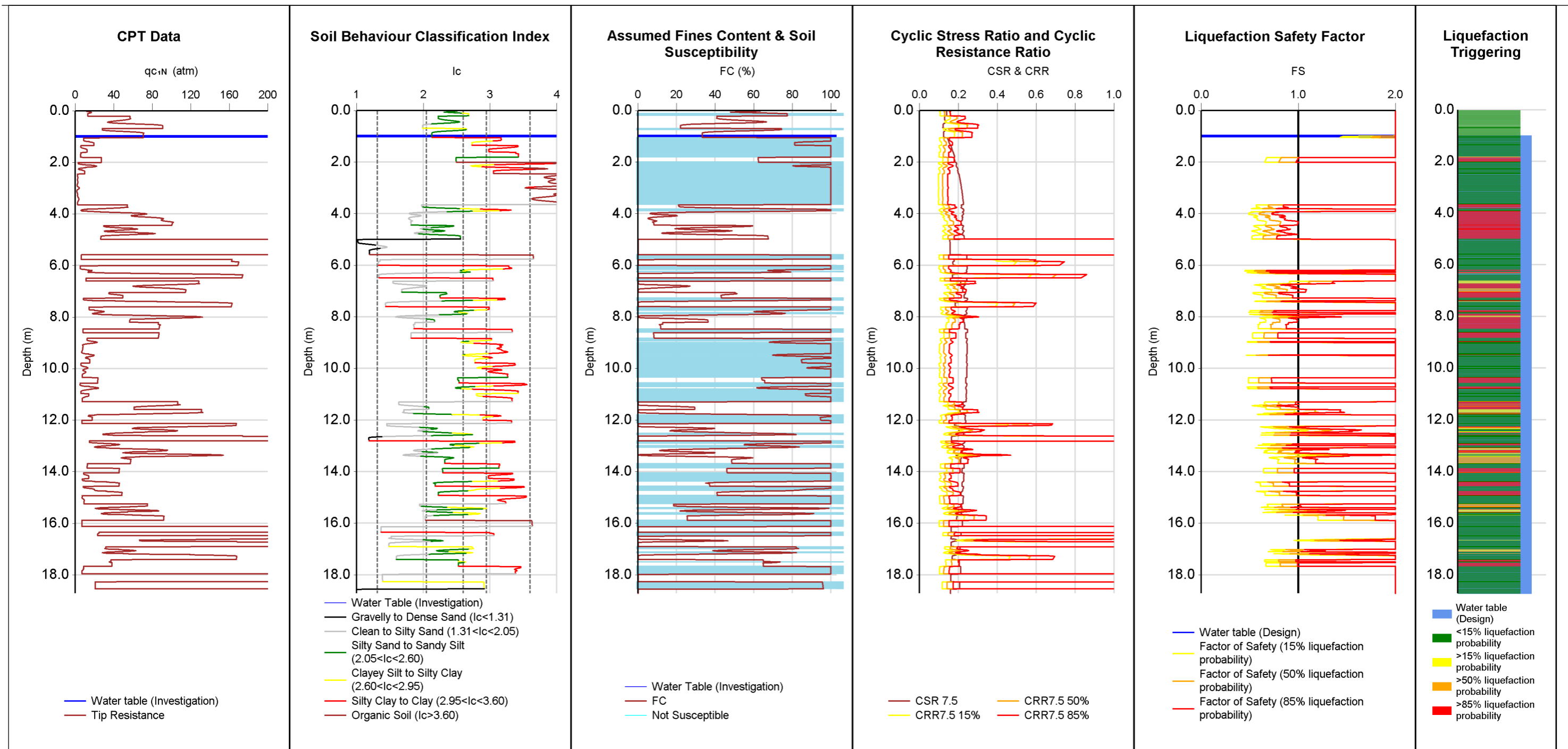
ID	NZGD 152818	NZGD 152819
CPT Name	CPT15	CPT16
Run description	CPT15	CPT16
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	1.5
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	19.38	18.7
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152818	CPT15	0	0	0
NZGD 152818	CPT15	0	19.38	2.6
NZGD 152819	CPT16	0	1.5	0
NZGD 152819	CPT16	1.5	18.7	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152818	CPT15	0	19.38	0 CFC
NZGD 152819	CPT16	0	18.7	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	138	6	12	20	1.9	8					
50%	122	5.4	8	18	1.9	5					
85%	86	4.5	3	13	1.9	2					

Reviewed by:

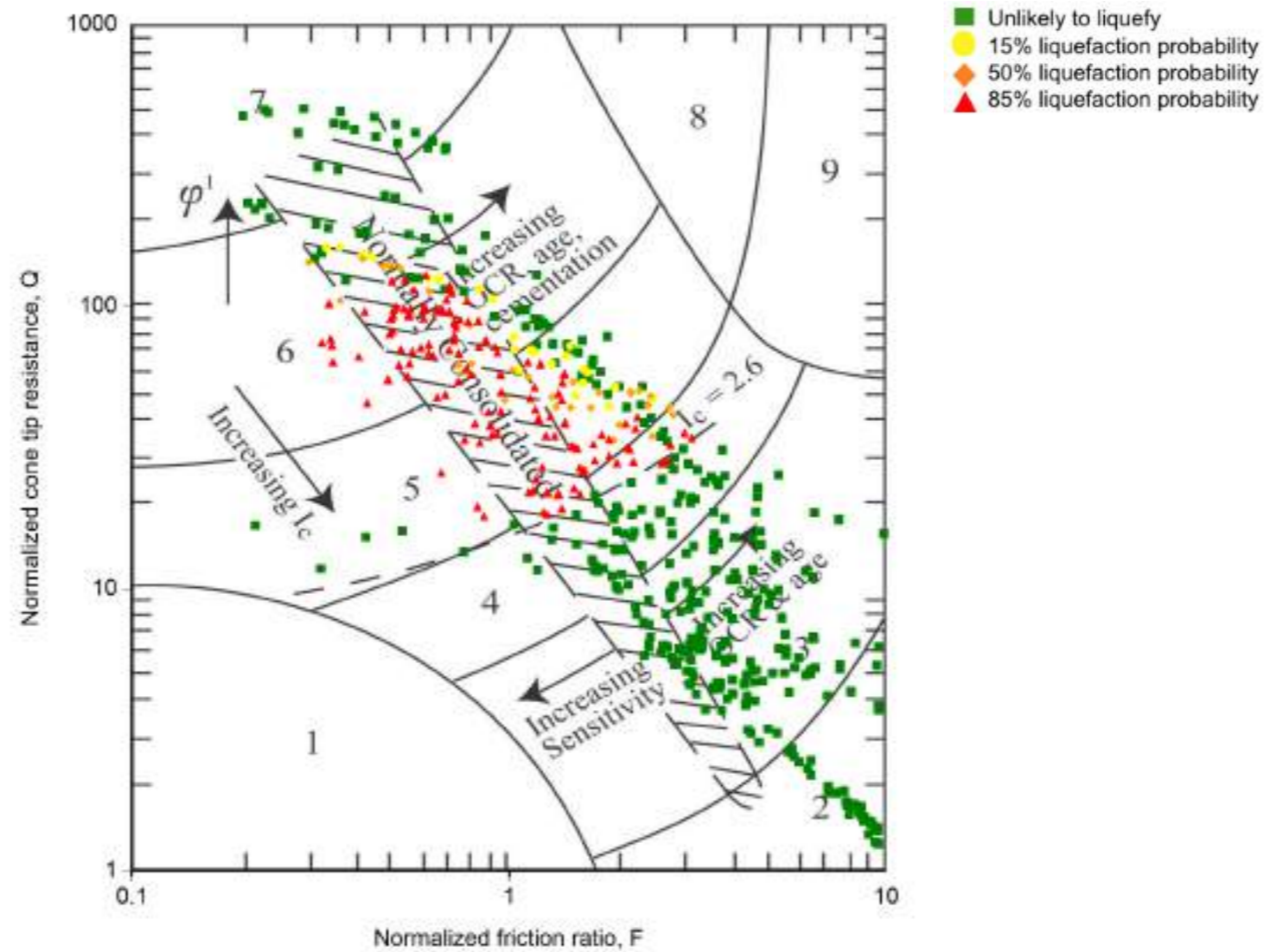
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]

LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

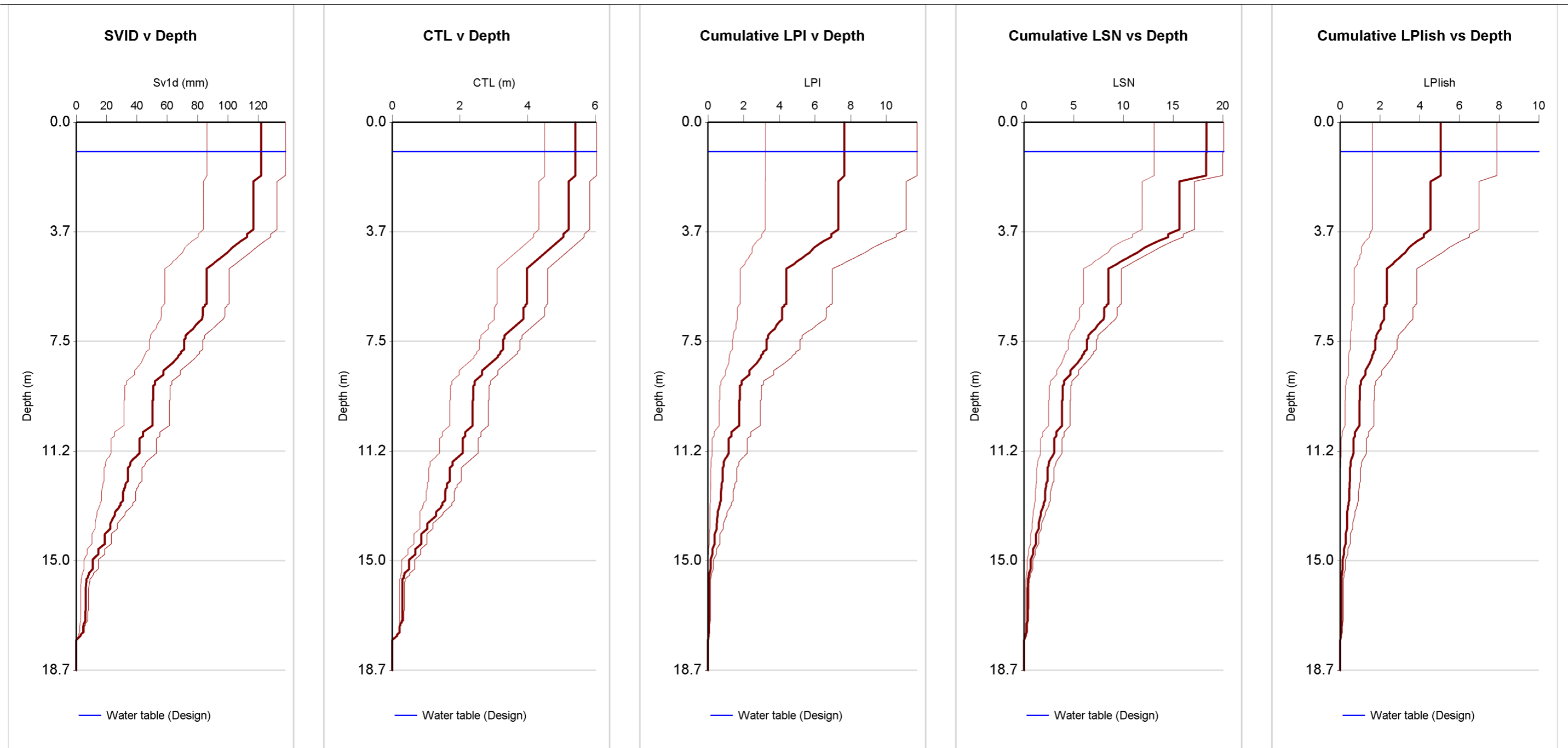
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




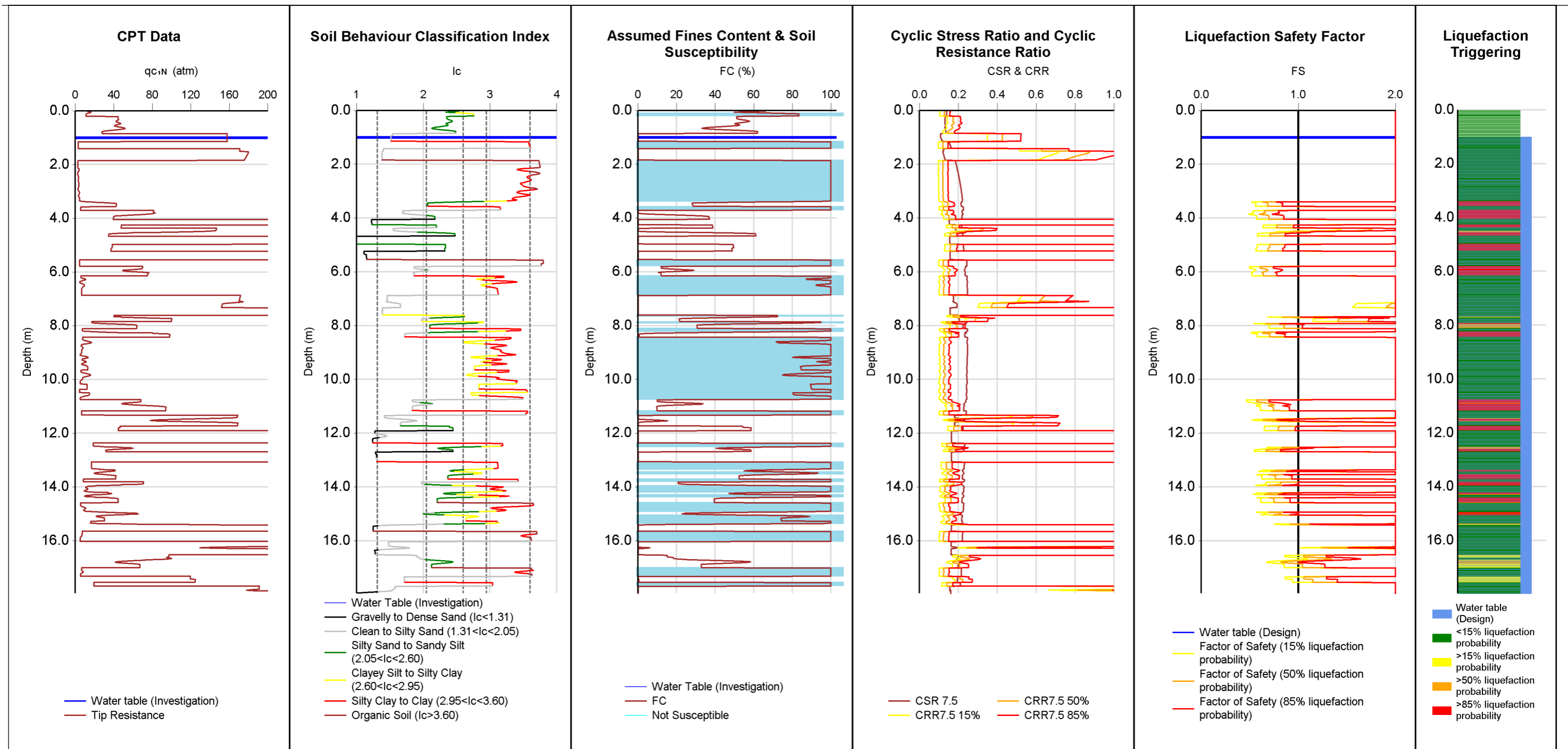
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	97	4.2	8	13	3.5	5					
50%	87	3.6	6	12	3.5	3					
85%	65	3.2	3	10	3.5	0					

Reviewed by:

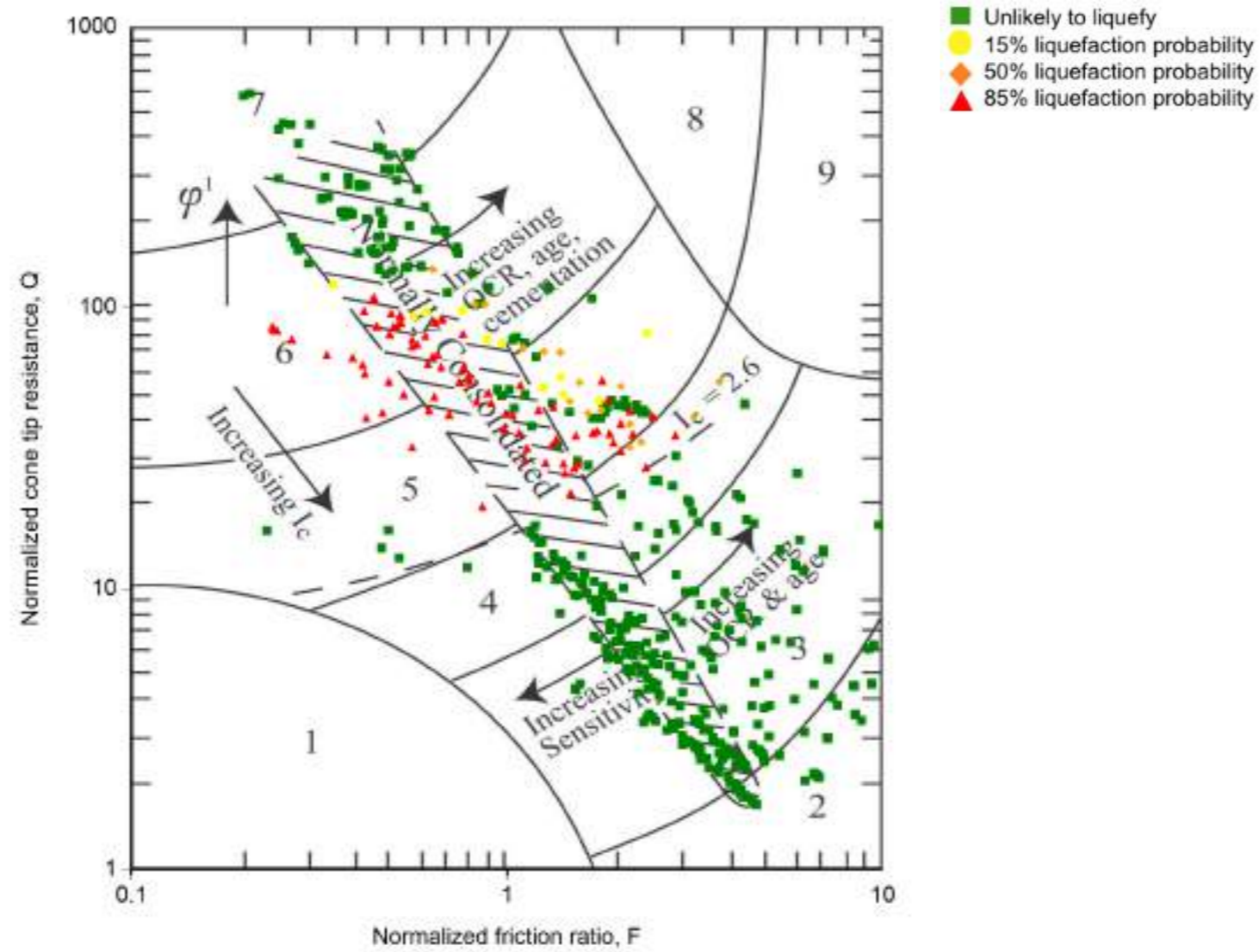
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

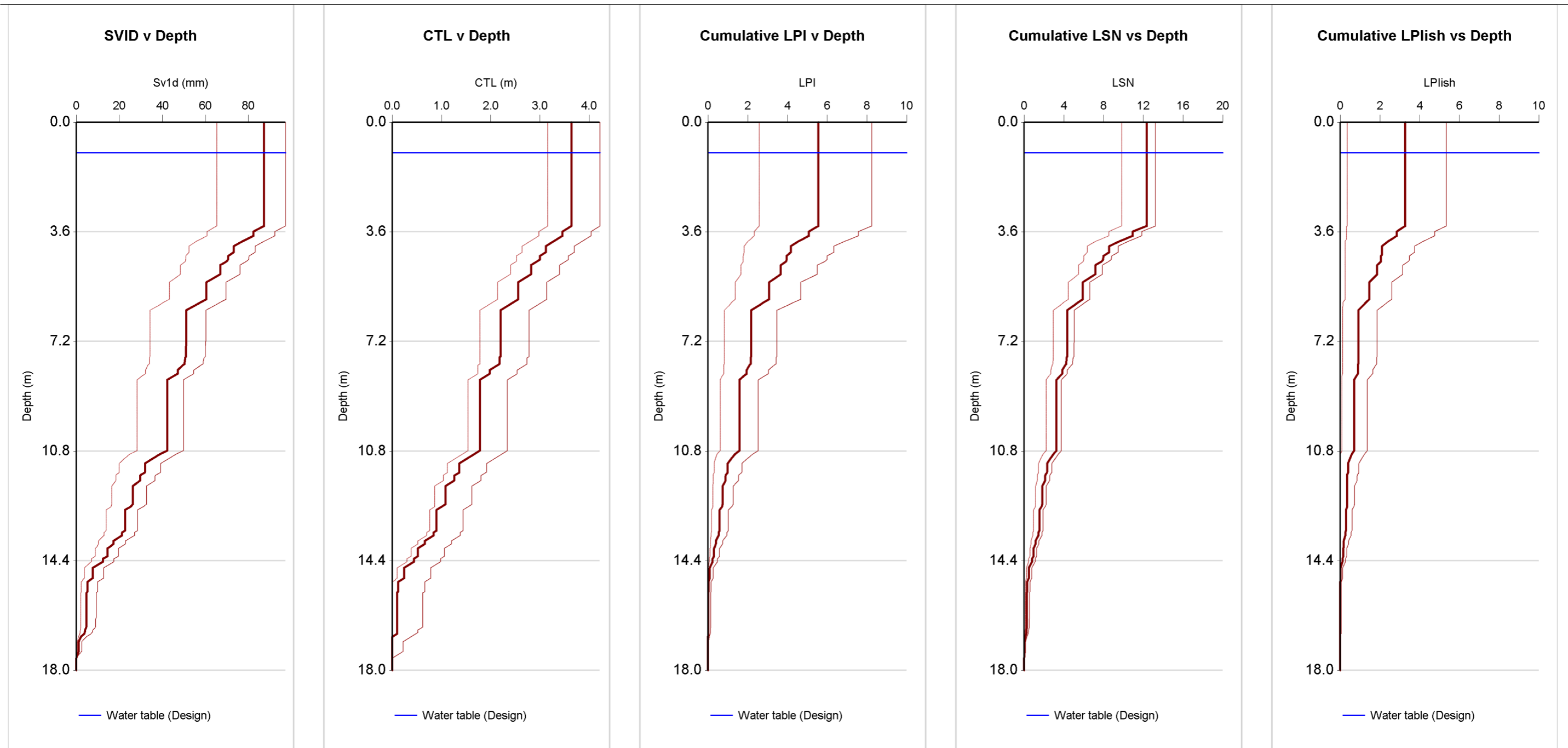


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

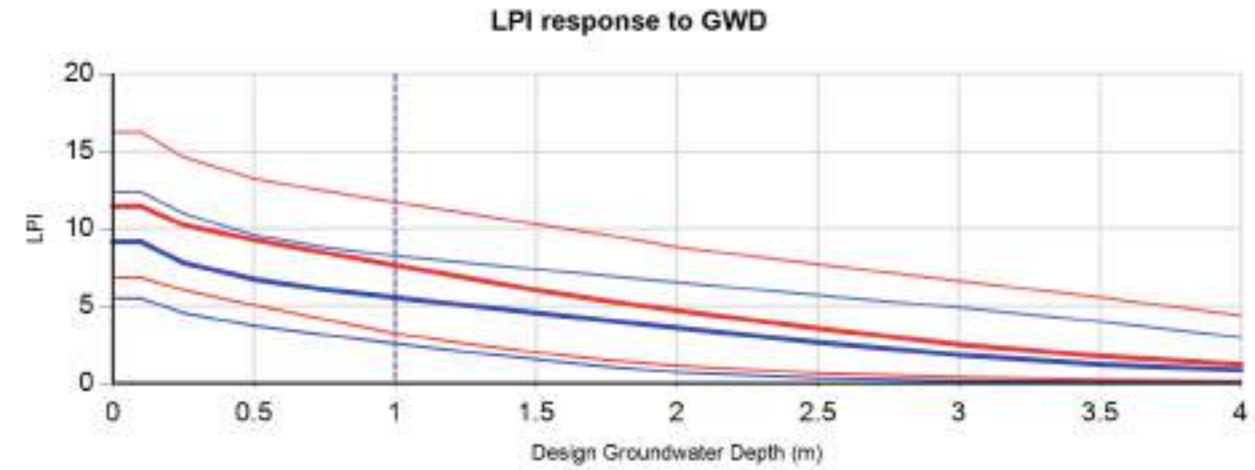
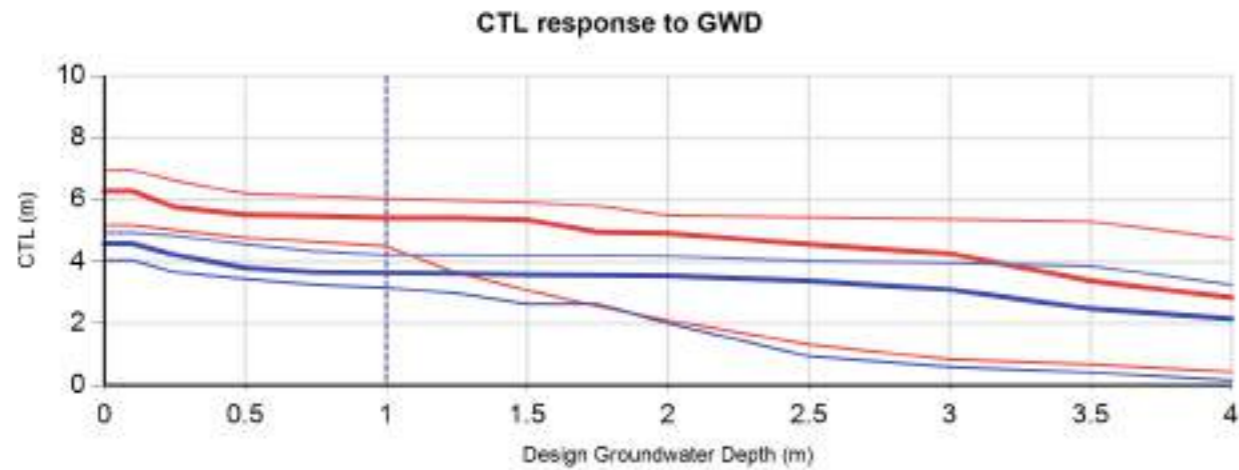
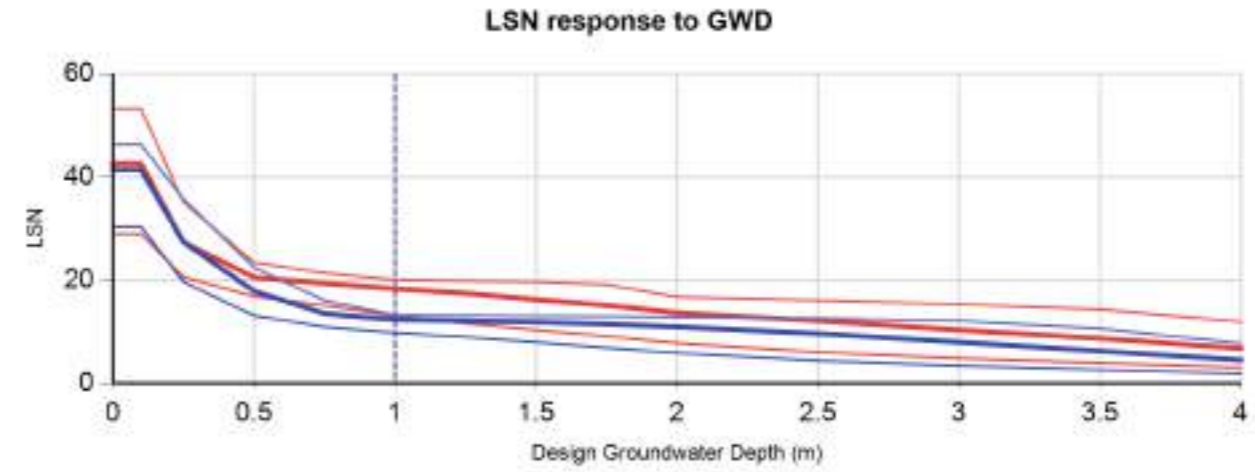
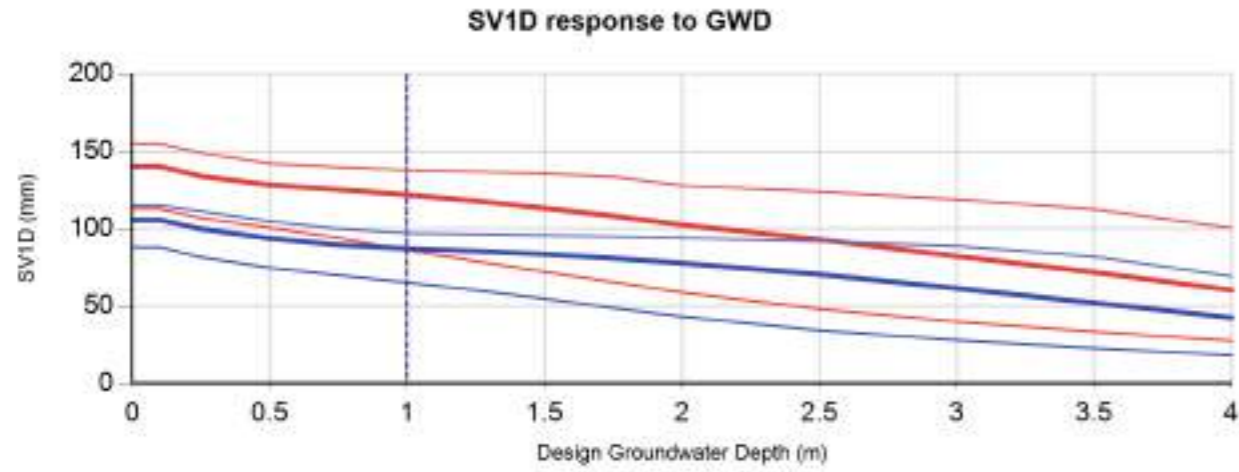
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]				




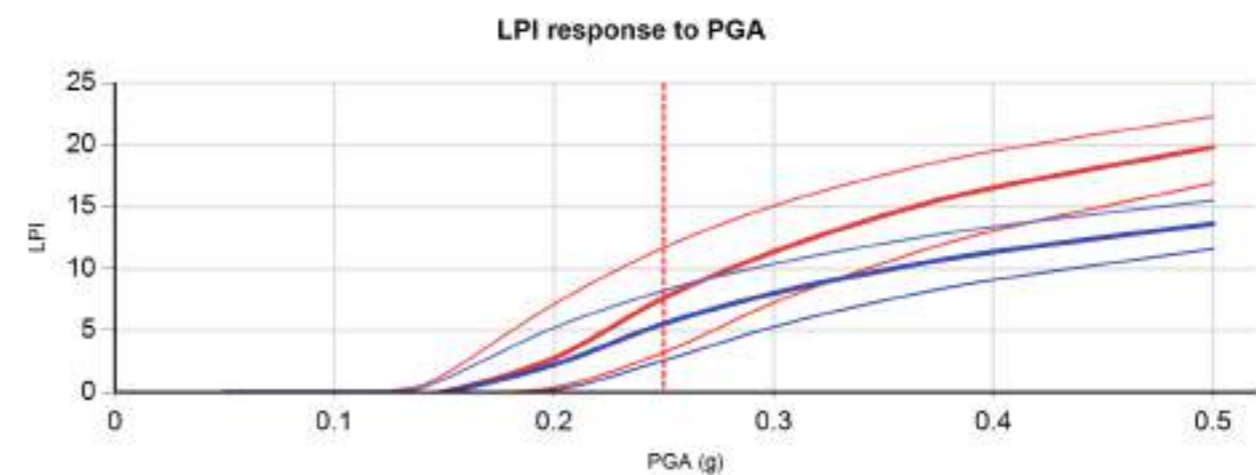
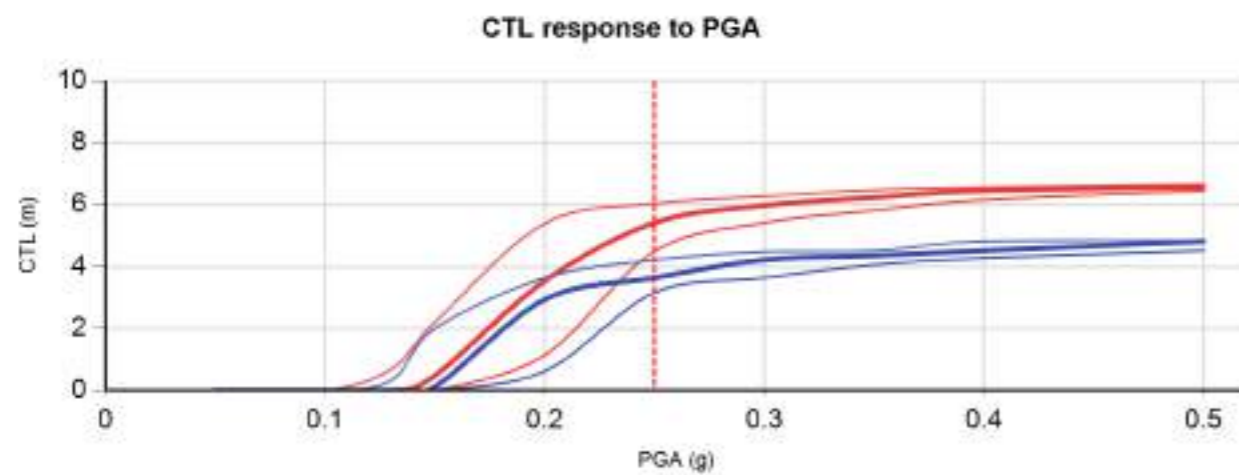
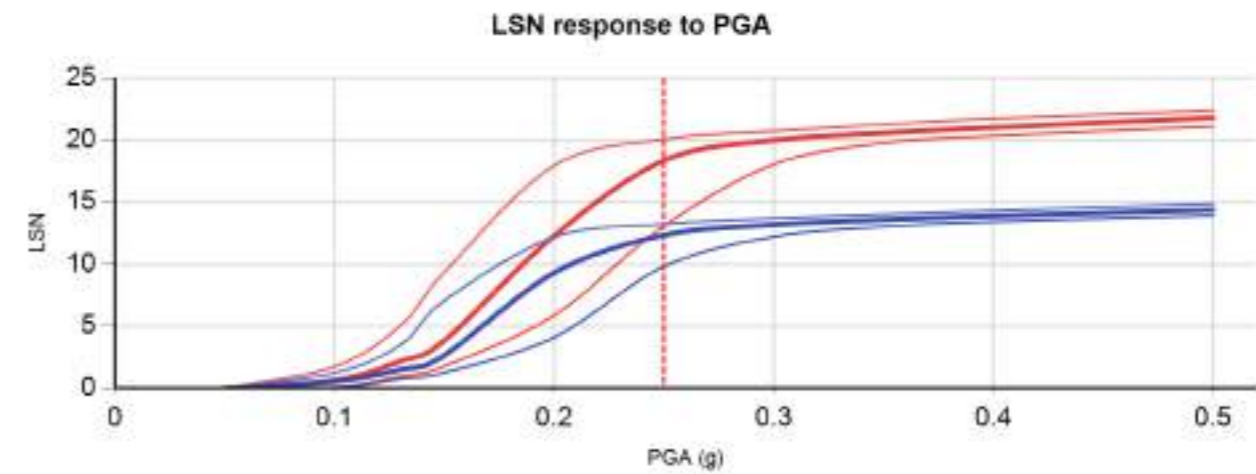
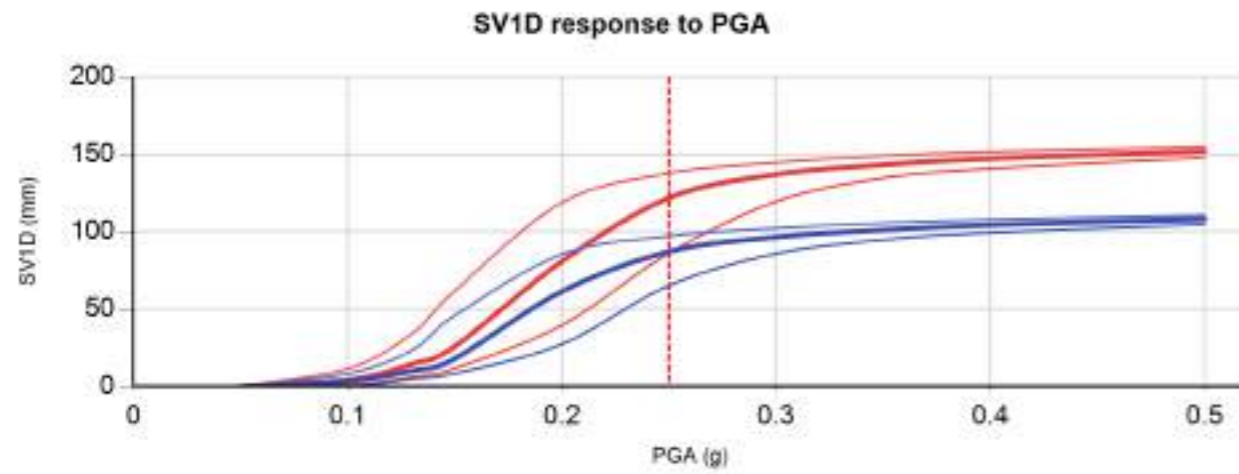
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 17 - 18]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

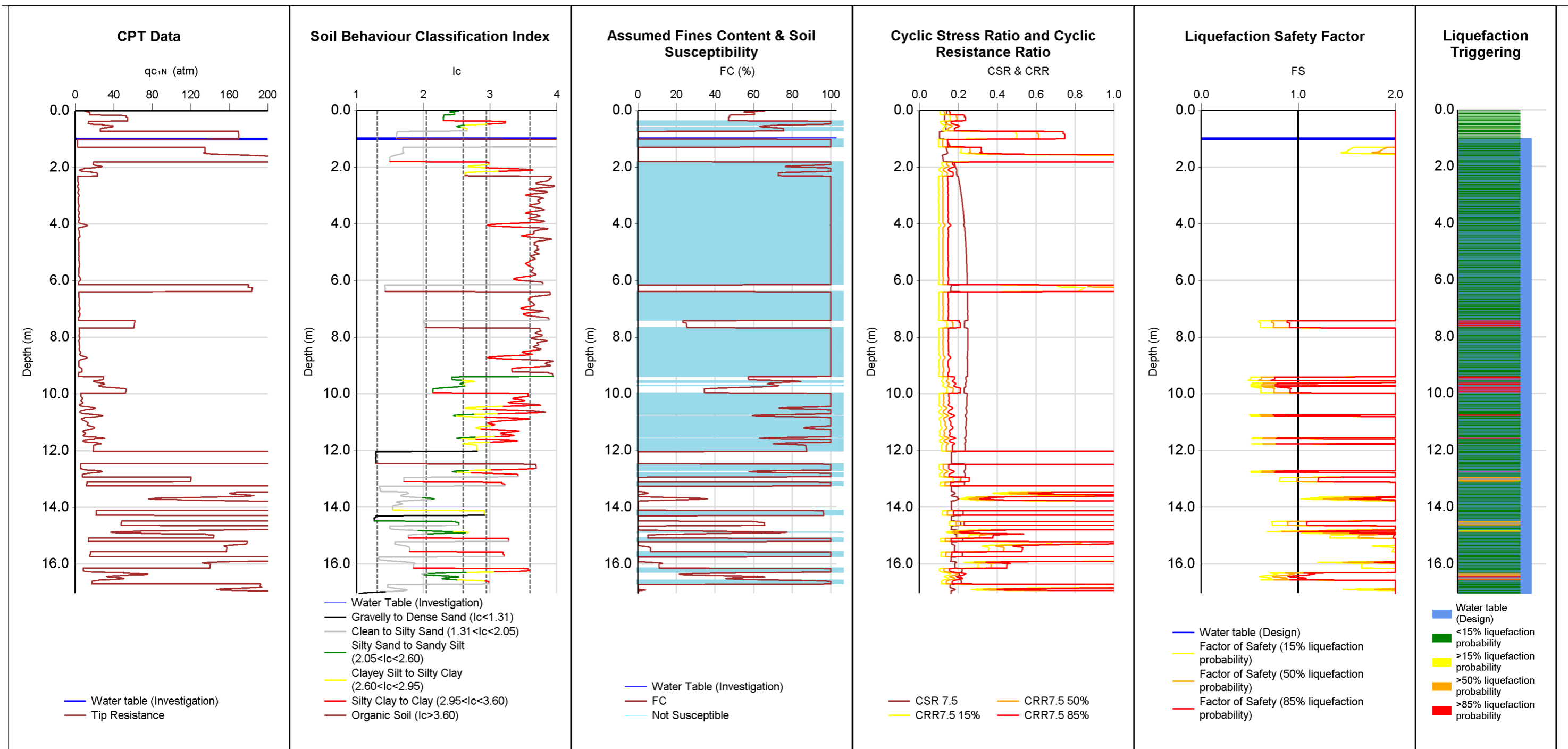
ID	NZGD 152820	NZGD 152821
CPT Name	CPT17	CPT18
Run description	CPT17	CPT18
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.72	17.96
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152820	CPT17	0	0	0
NZGD 152820	CPT17	0	18.72	2.6
NZGD 152821	CPT18	0	0	0
NZGD 152821	CPT18	0	17.96	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152820	CPT17	0	18.72	0 CFC
NZGD 152821	CPT18	0	17.96	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	37	1.6	3	4	7.5	0					
50%	32	1.5	2	3	7.5	0					
85%	23	1	1	2	7.5	0					

Reviewed by:

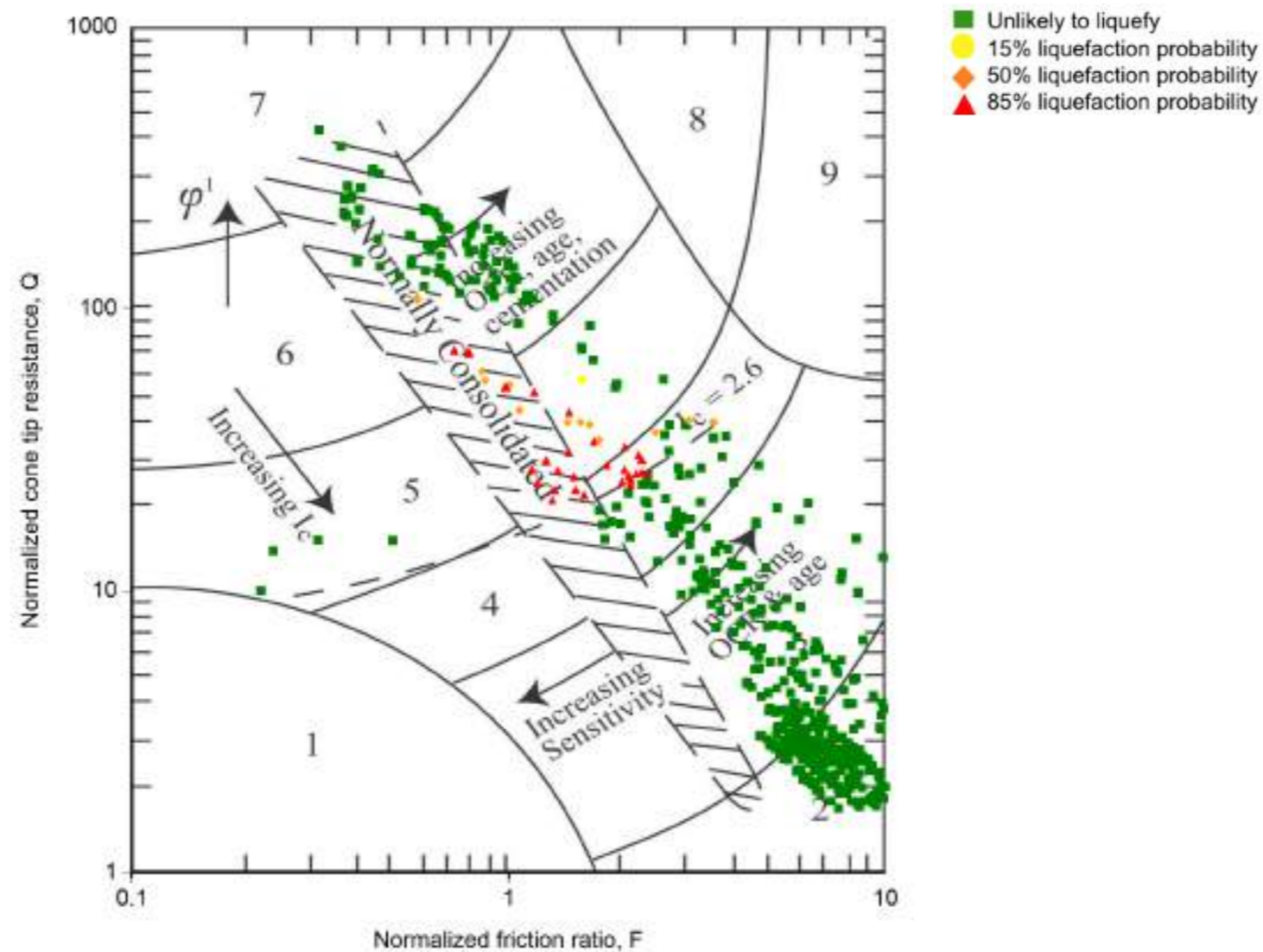
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]

LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

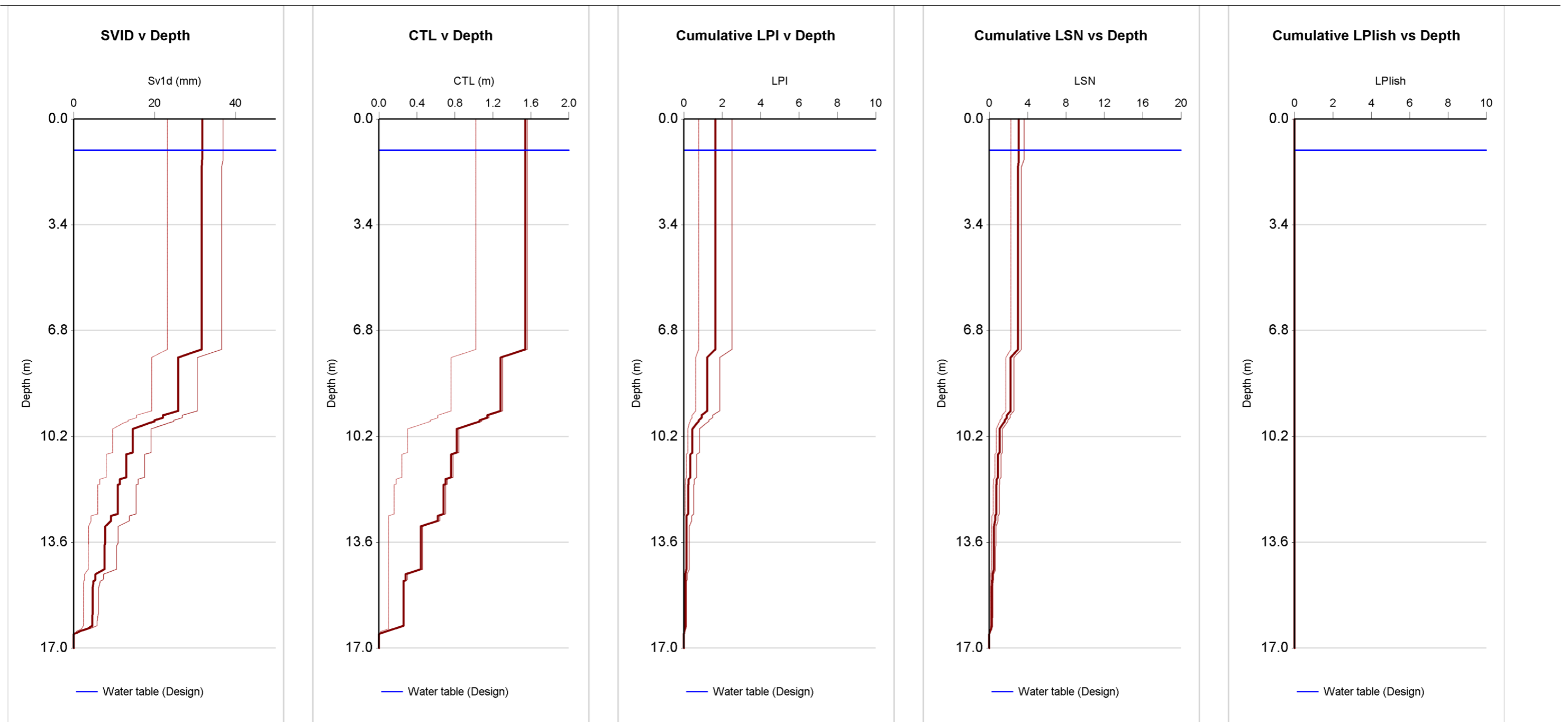
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




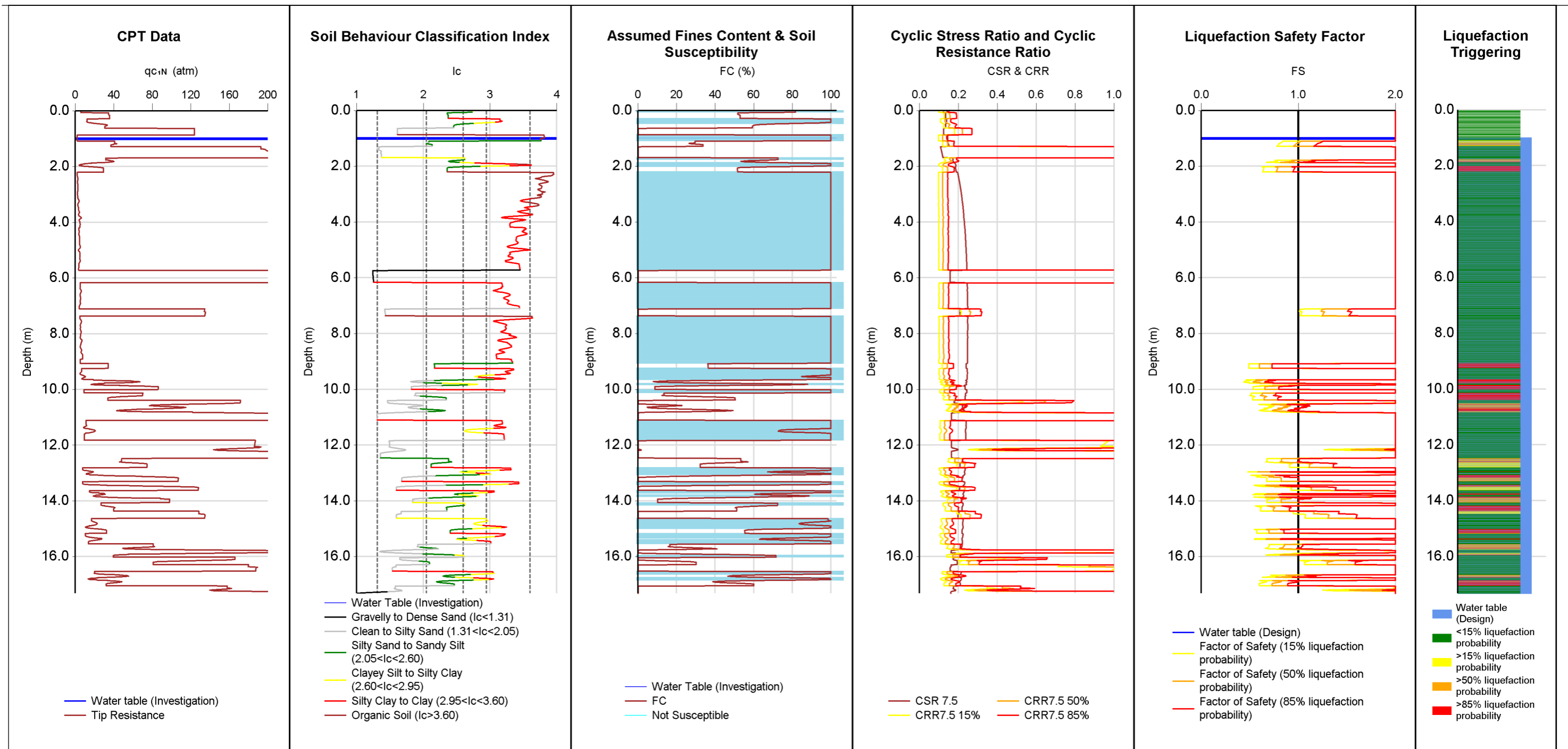
Tonkin + Taylor
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CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	87	3.7	5	14	1.2	4					
50%	73	3.1	3	11	1.3	2					
85%	51	2	1	6	2.1	1					

Reviewed by:

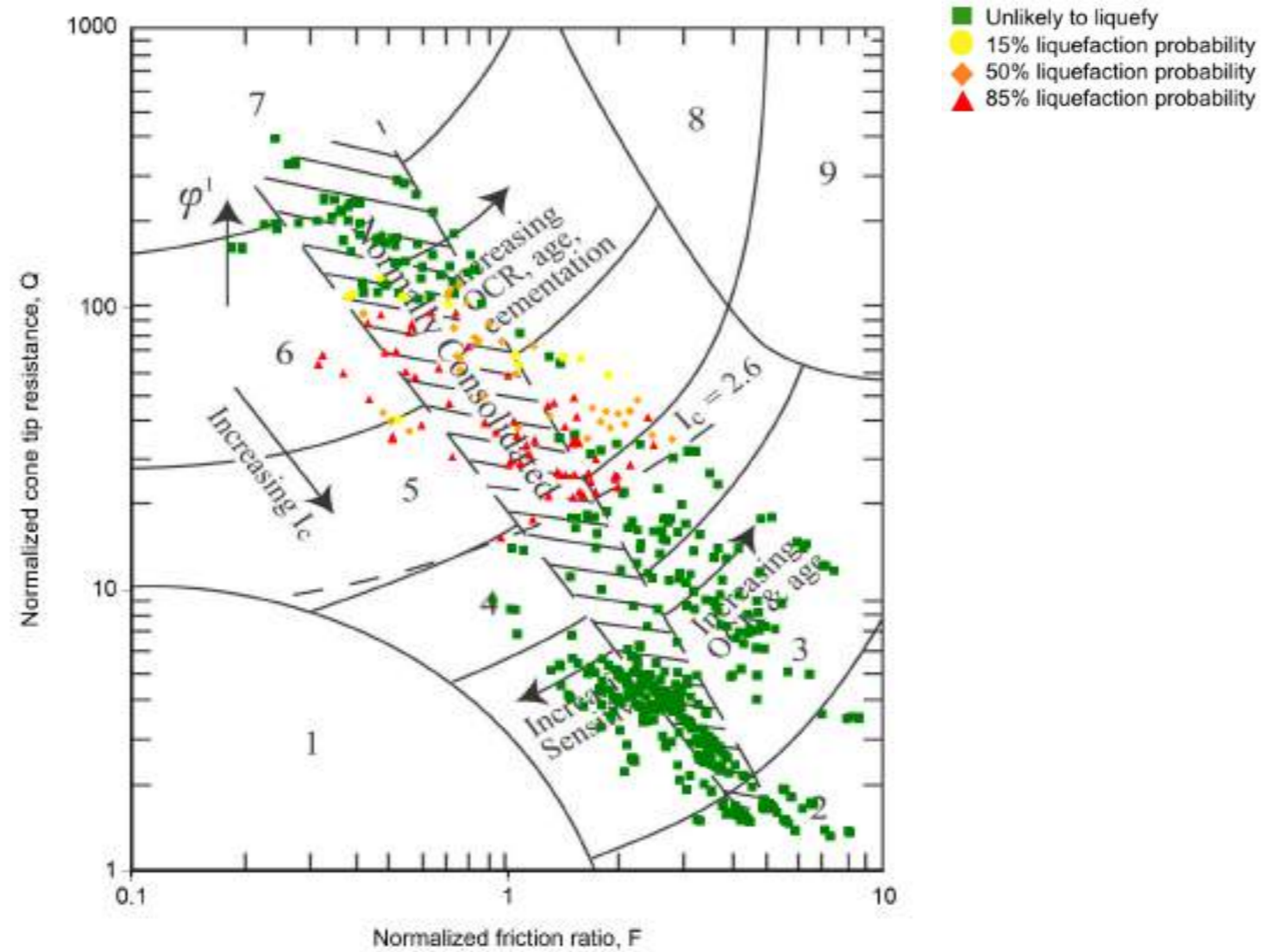
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **SLS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **15/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

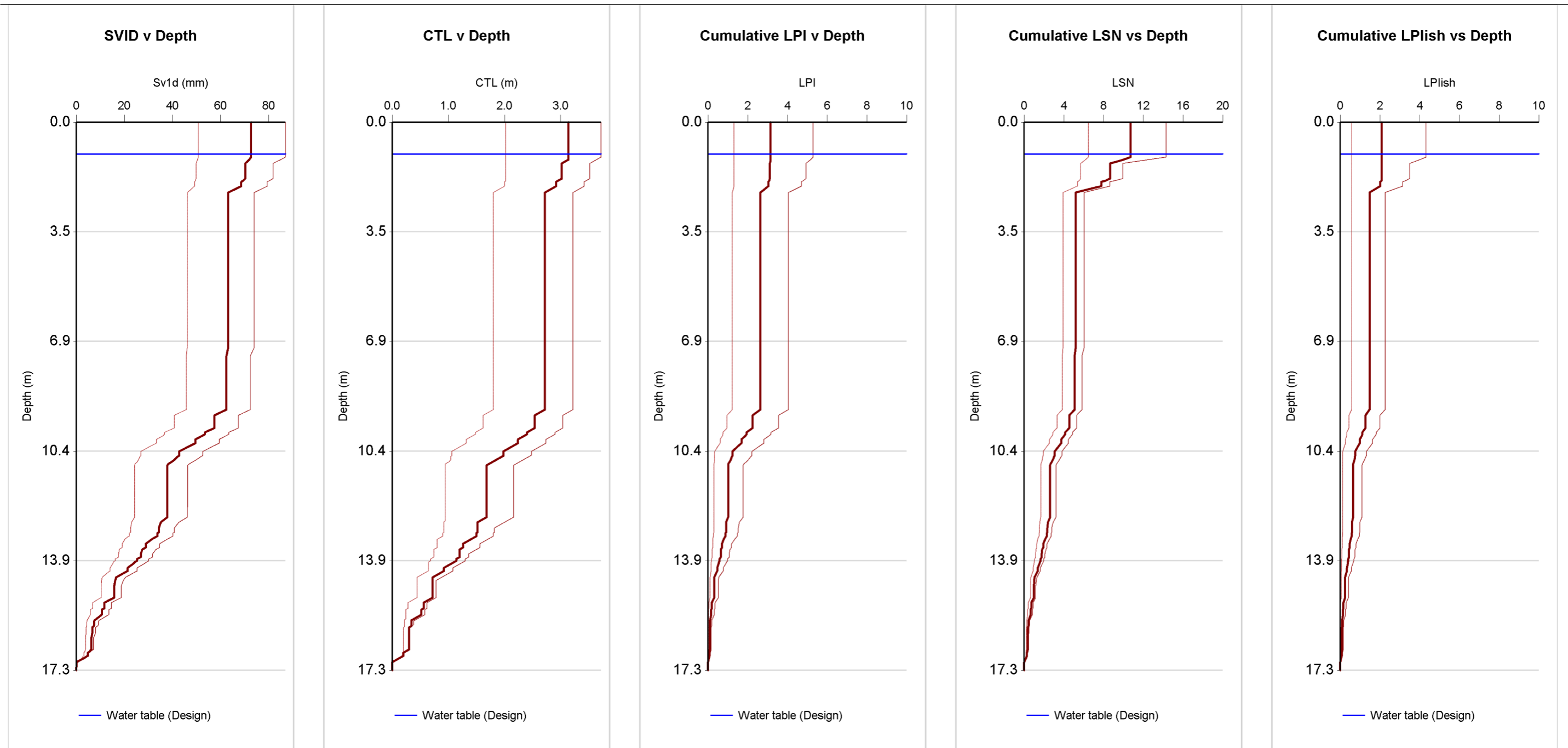


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

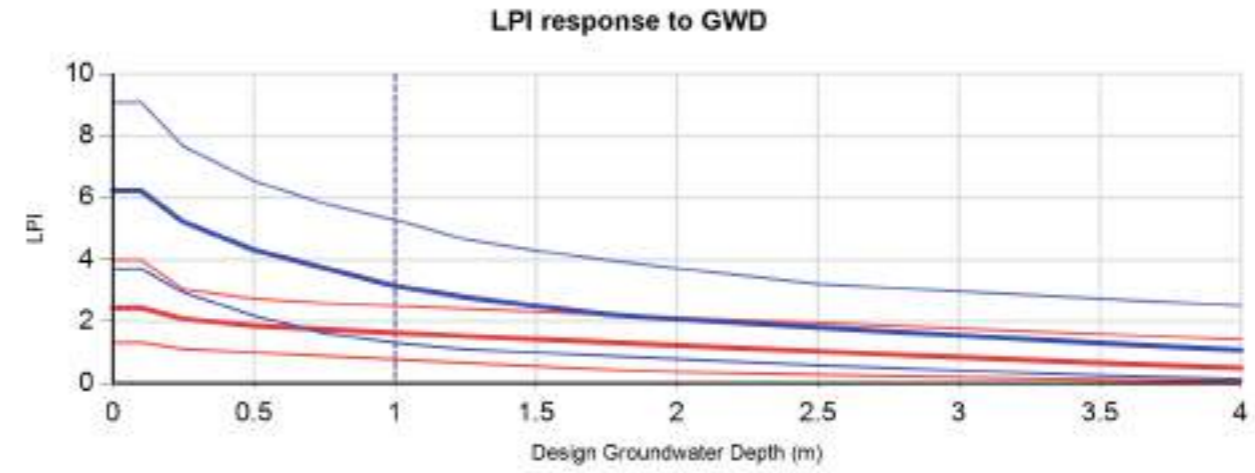
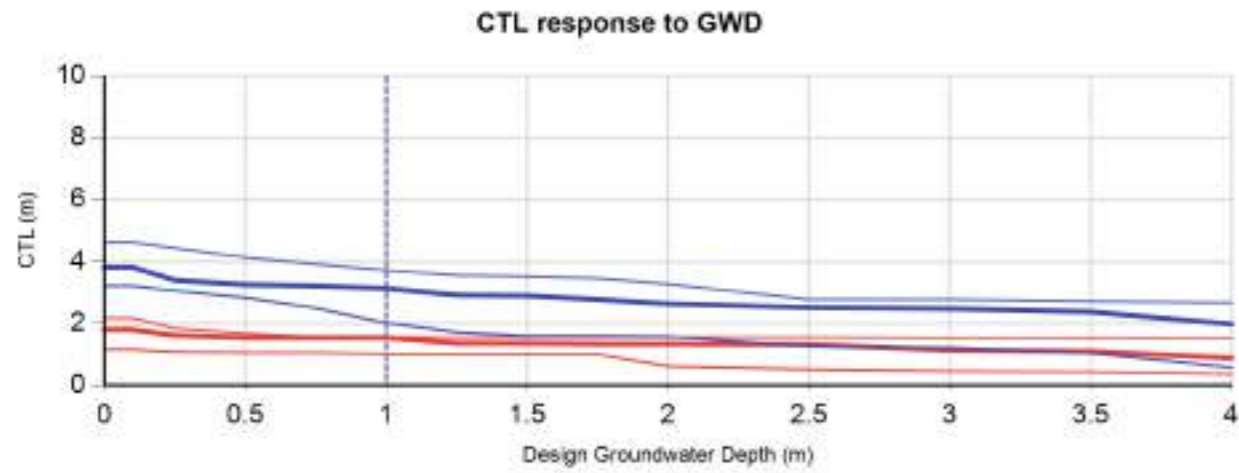
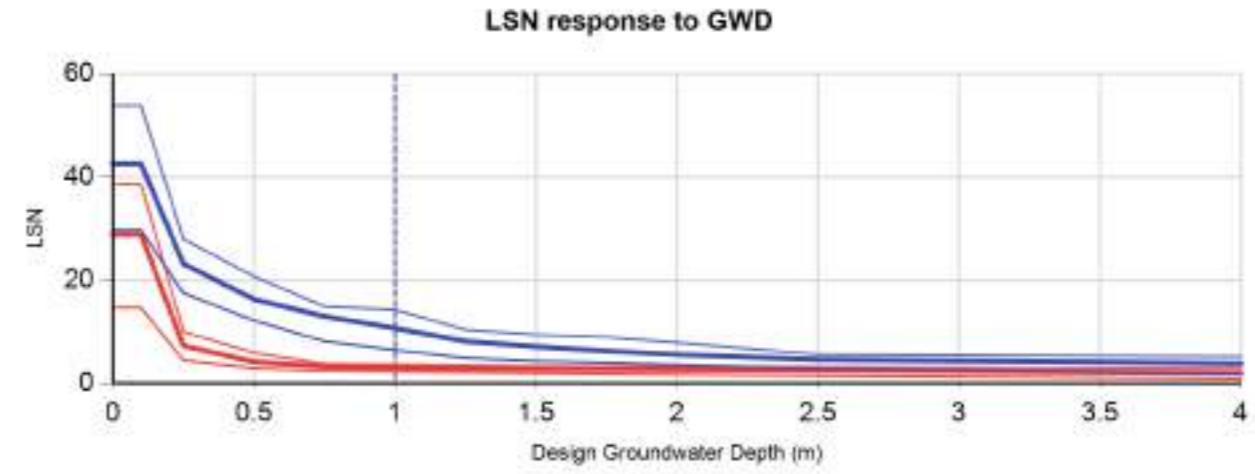
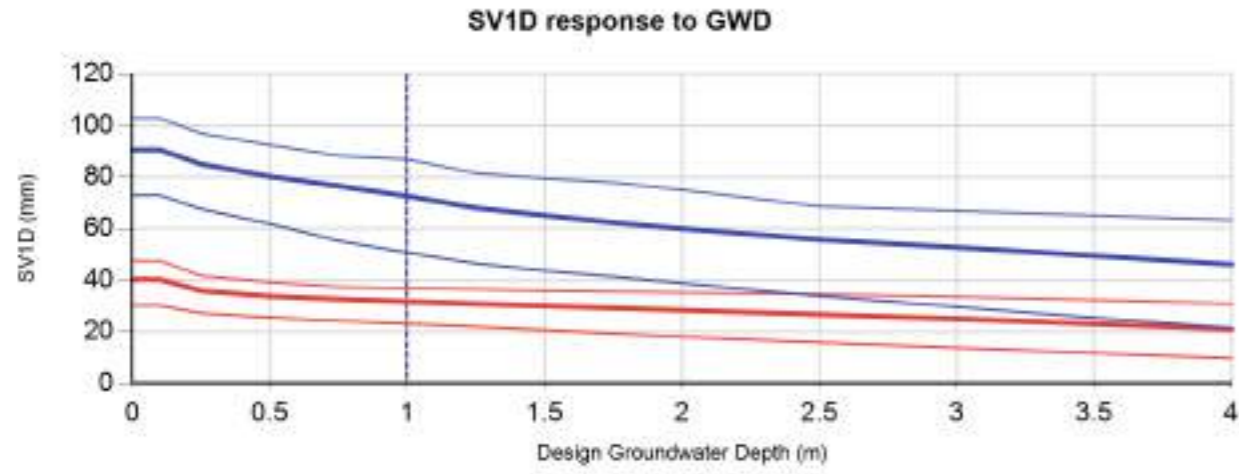
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.3	0.25	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	15/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	SLS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	SLS Magnitude 6.3, PGA - 0.25g (1 in 100 years) [CPT 19 - 20]				

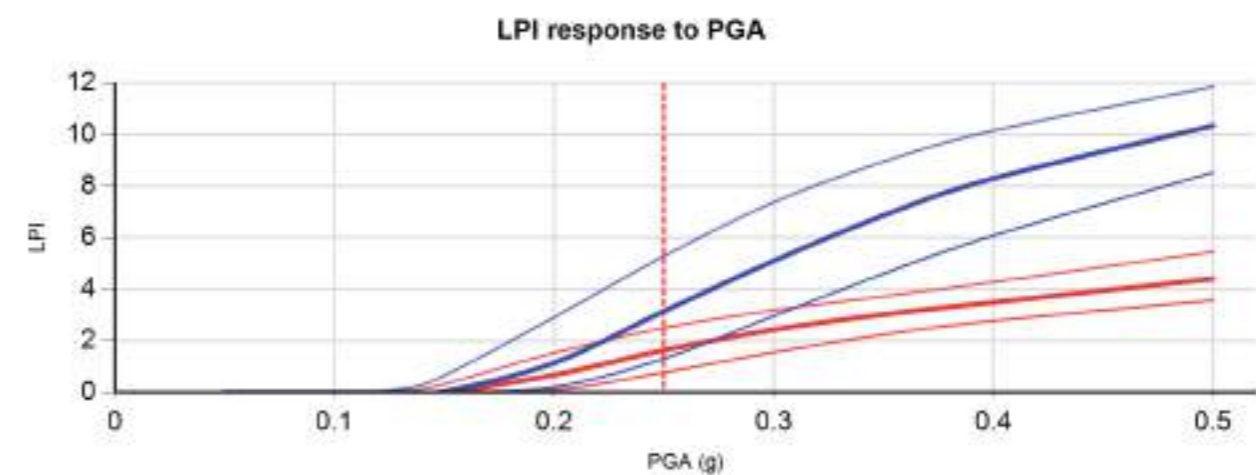
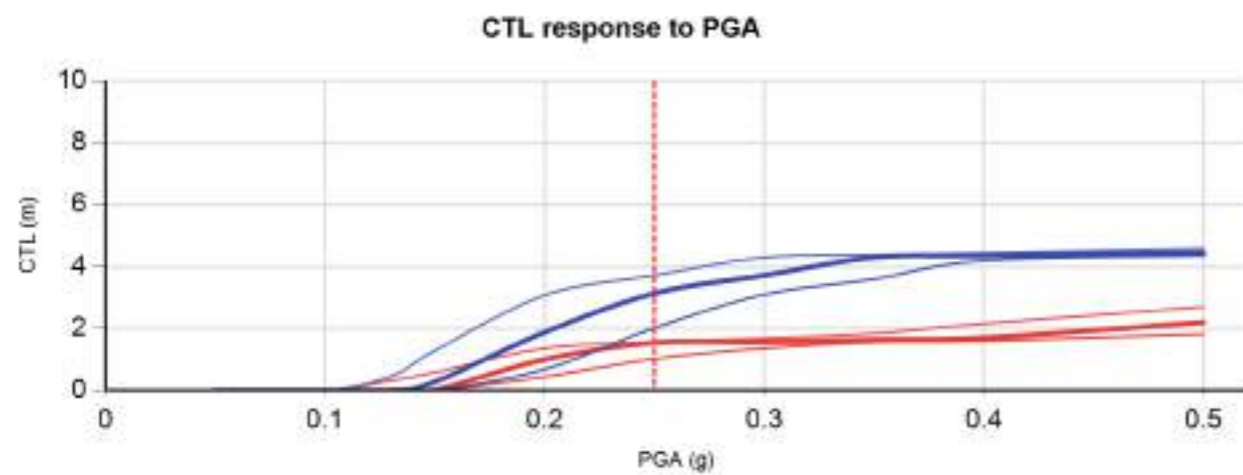
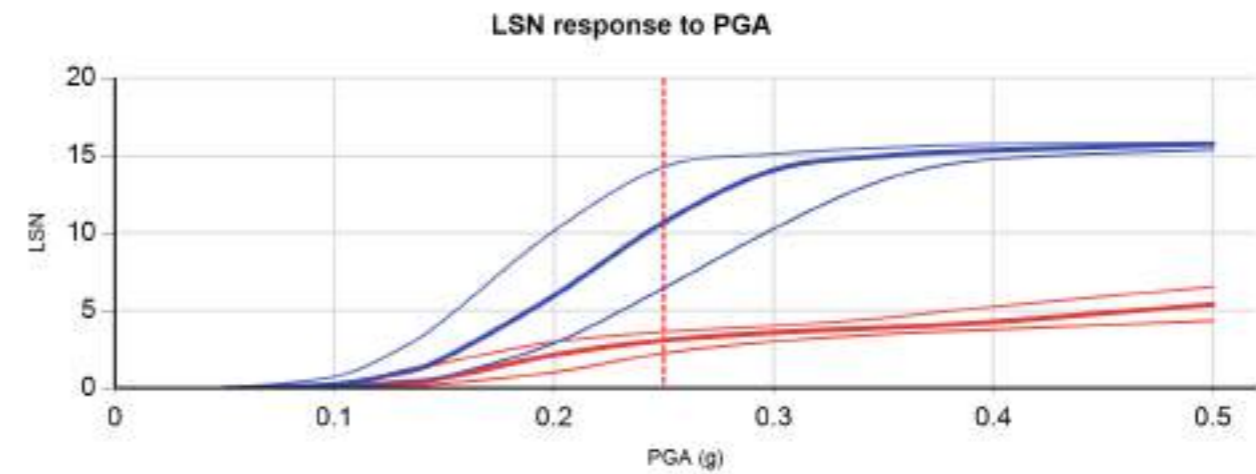
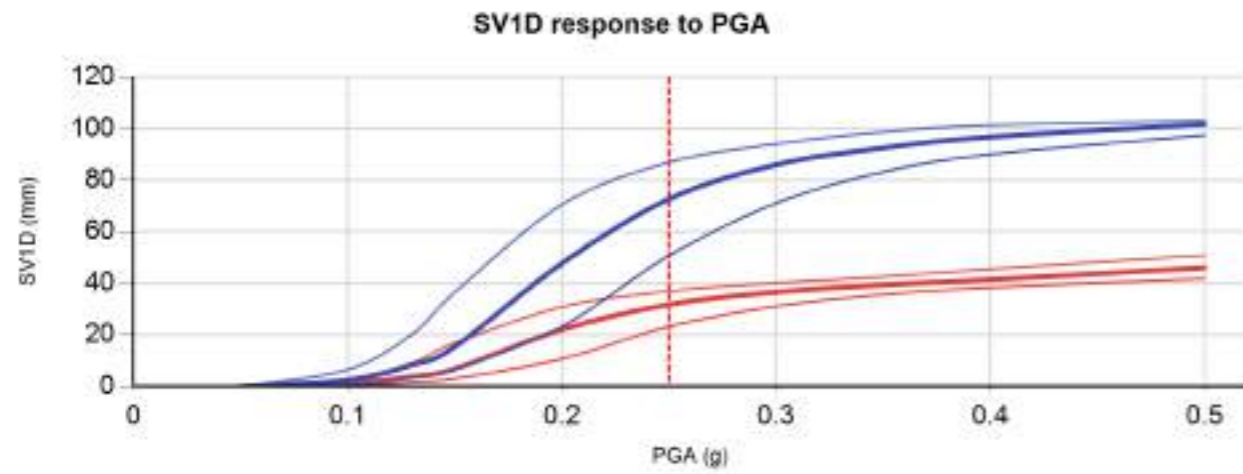


Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.3	0.25	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

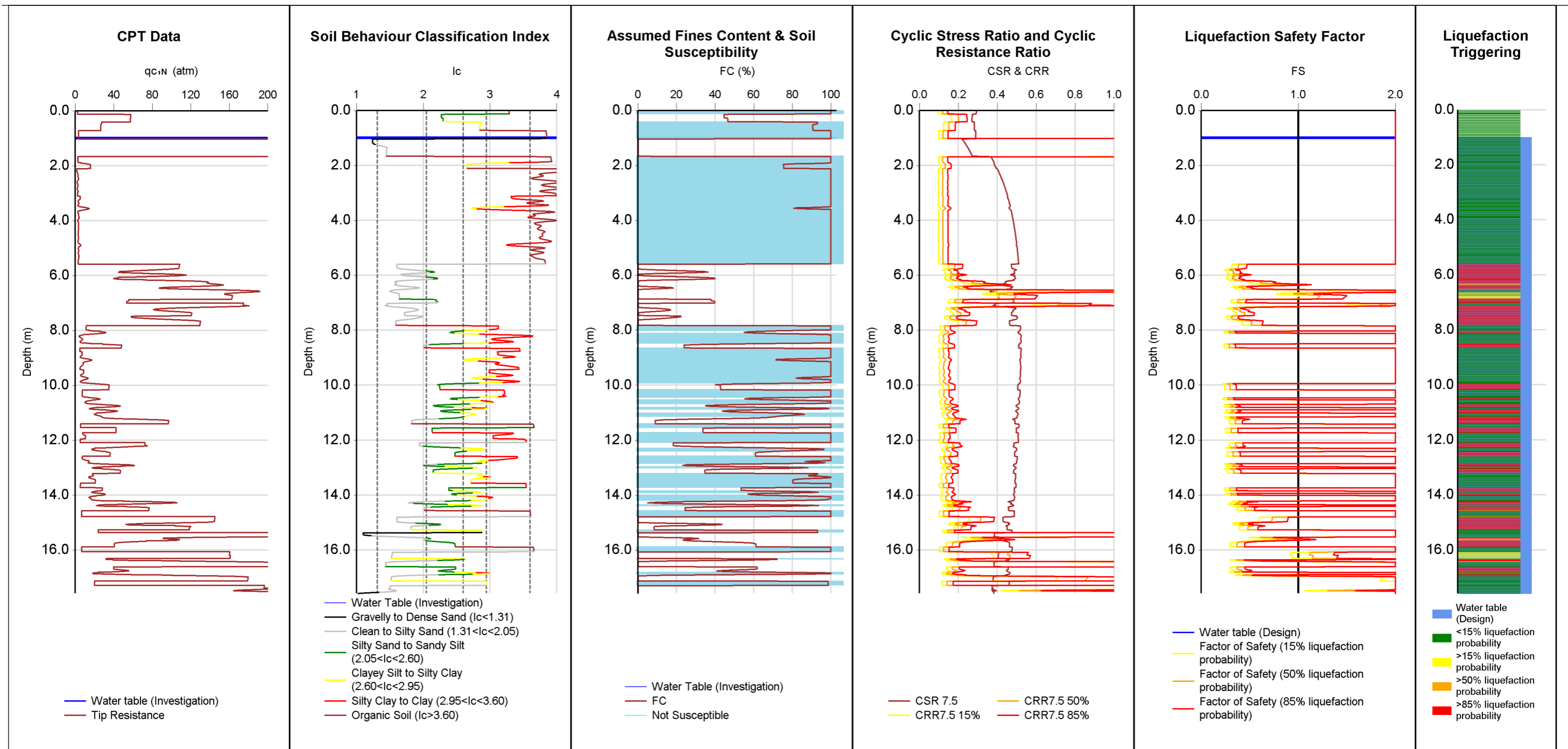
ID	NZGD 152822	NZGD 152823
CPT Name	CPT19	CPT20
Run description	CPT19	CPT20
PGA	0.25g	0.25g
Magnitude	6.3	6.3
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.04	17.32
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152822	CPT19	0	0	0
NZGD 152822	CPT19	0	17.04	2.6
NZGD 152823	CPT20	0	0	0
NZGD 152823	CPT20	0	17.32	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152822	CPT19	0	17.04	0 CFC
NZGD 152823	CPT20	0	17.32	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	125	5.8	16	13	5.7	9					
50%	122	5.4	15	13	5.7	8					
85%	118	5.2	13	12	5.7	6					

Reviewed by:

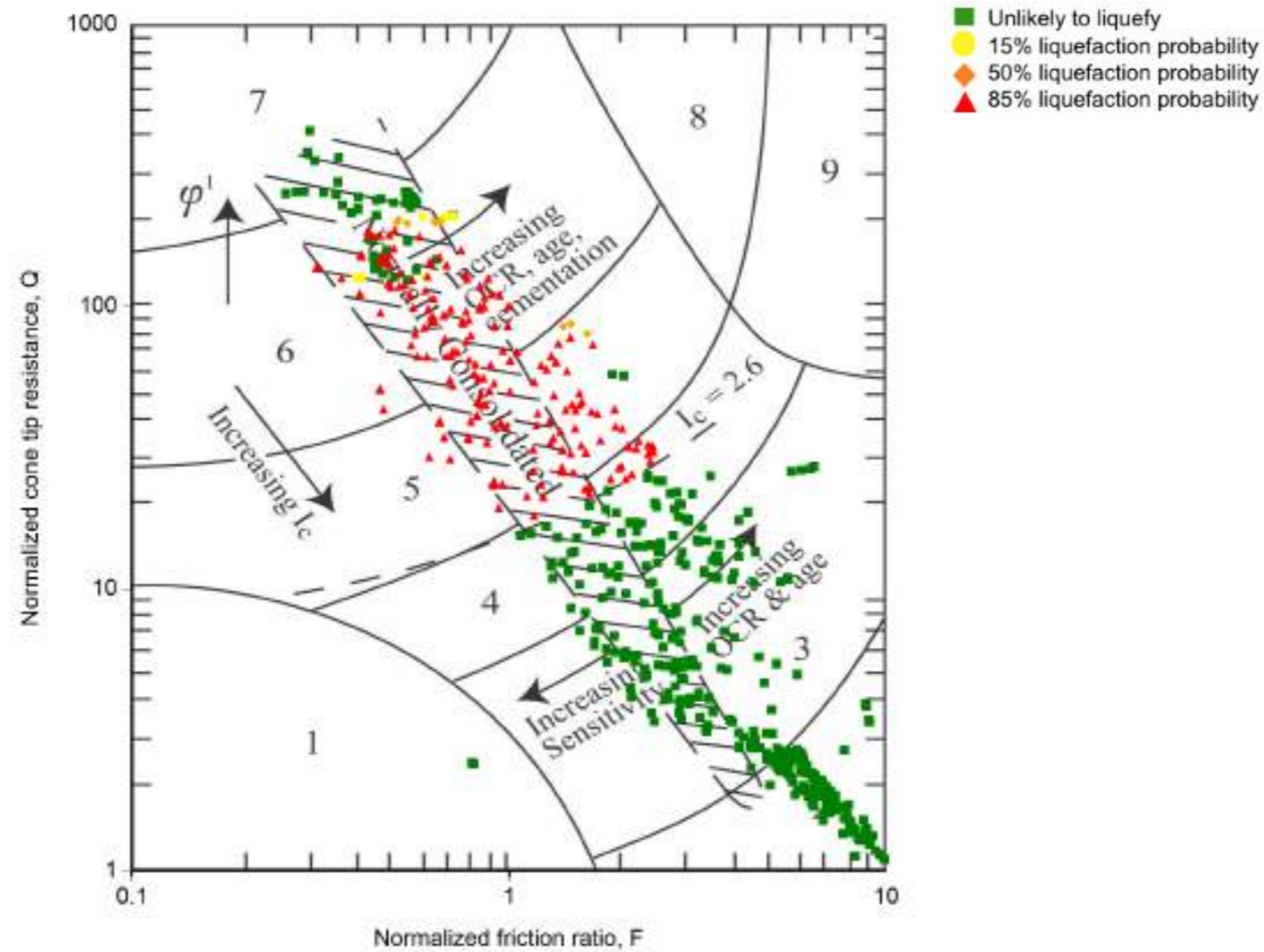
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

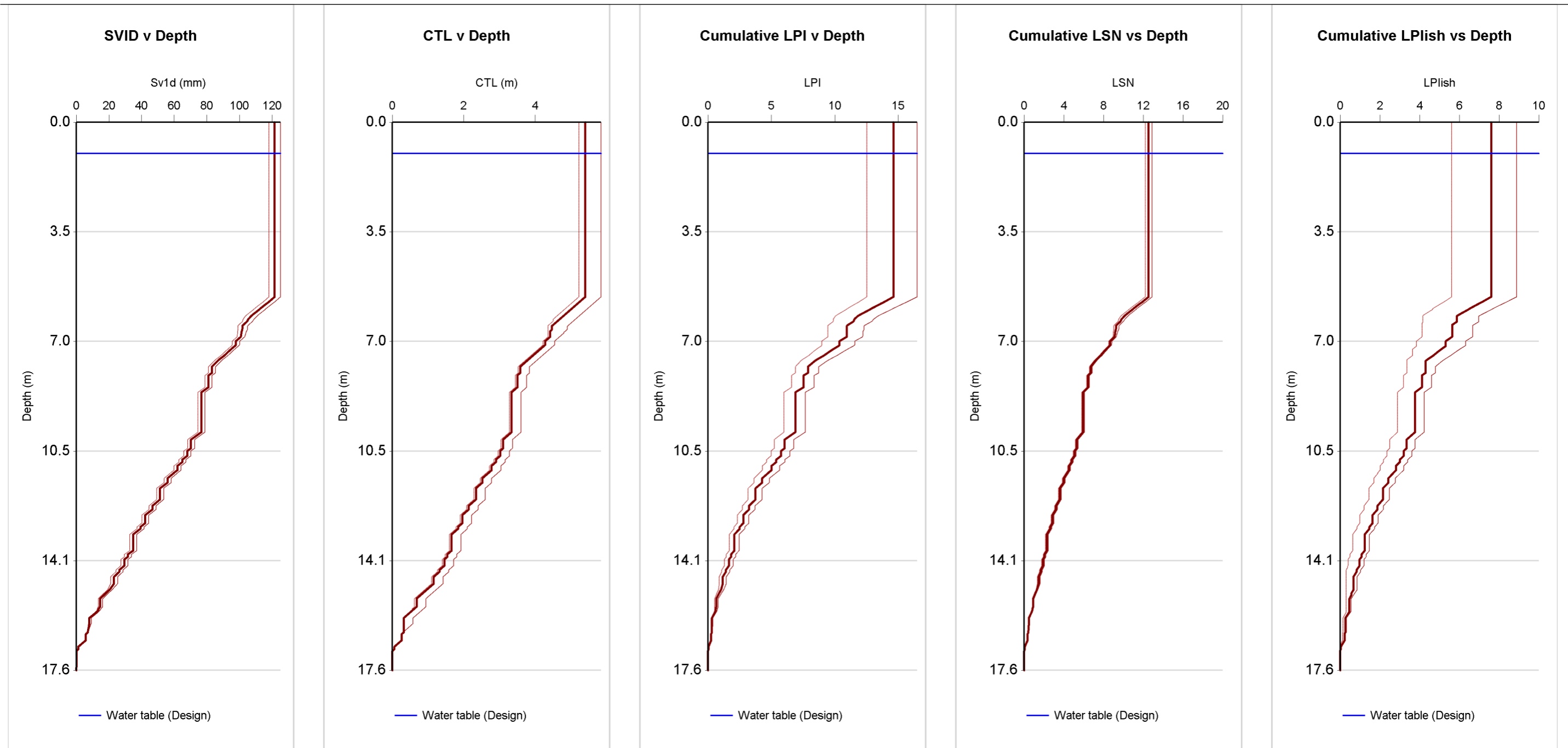


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|--|-------------------------------------|
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*Heavily overconsolidated or cemented

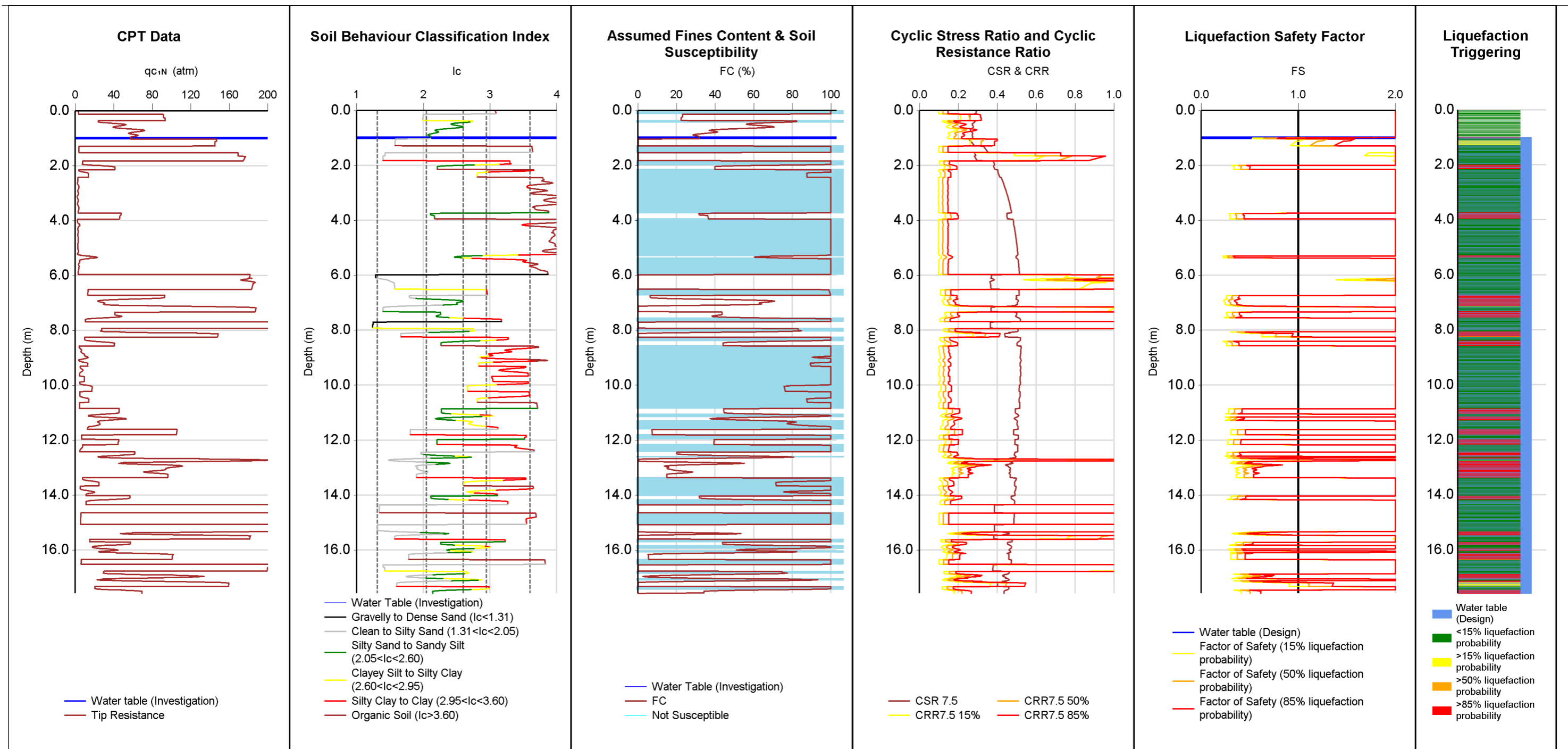
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT01	152807	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	98	4.6	13	14	1.2	9					
50%	95	4.2	11	13	2	8					
85%	93	4.2	10	12	2	7					

Reviewed by:

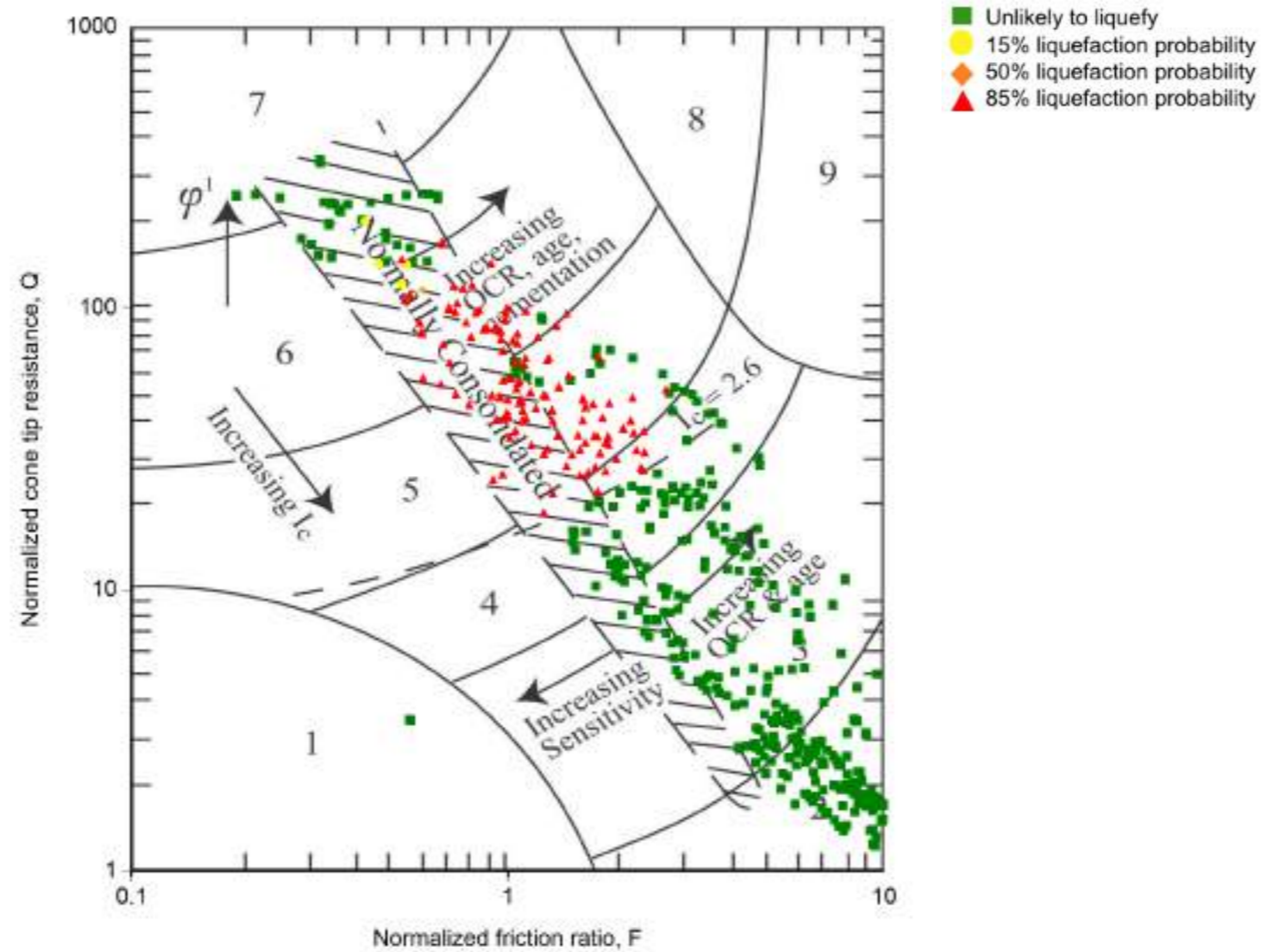
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

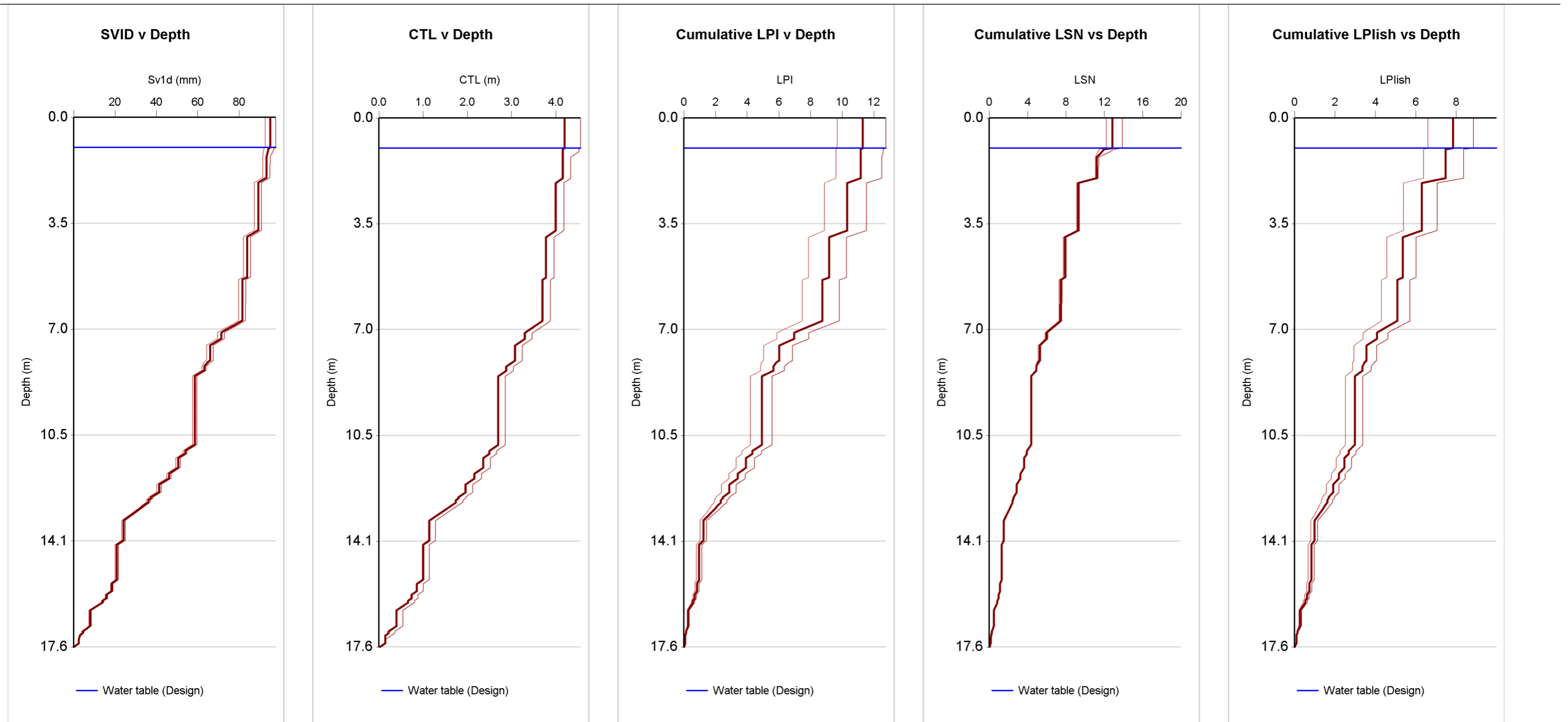


- | | |
|--|-------------------------------------|
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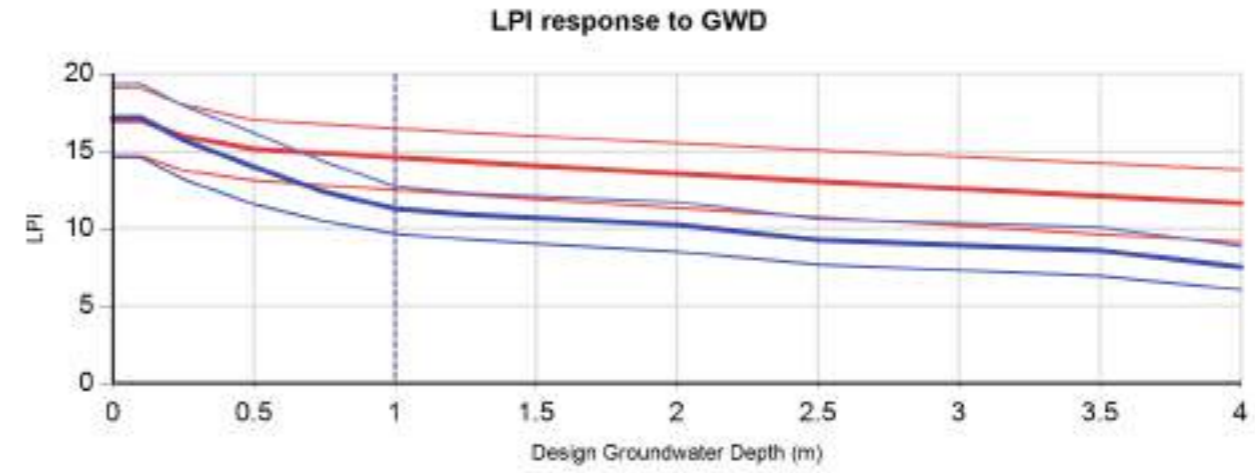
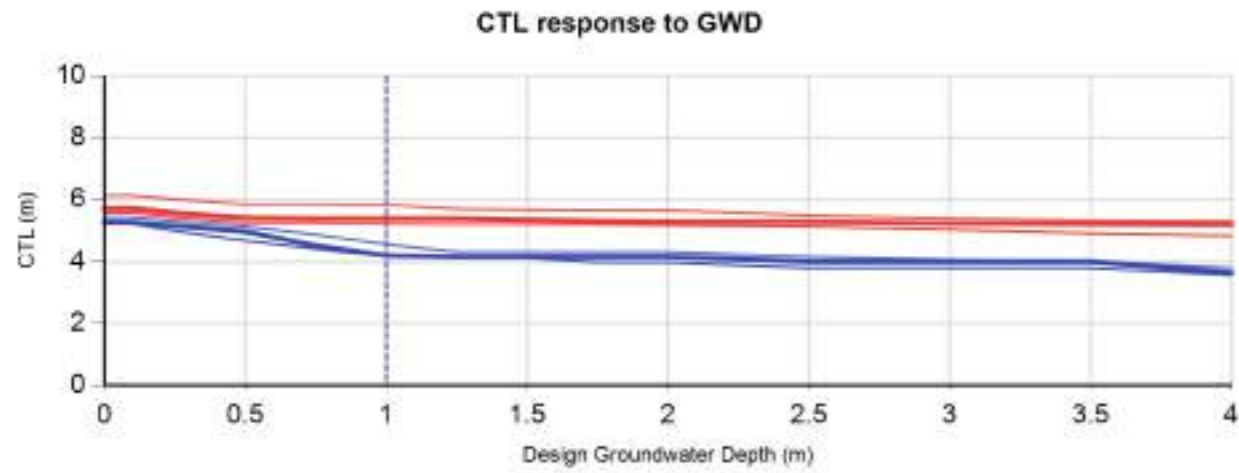
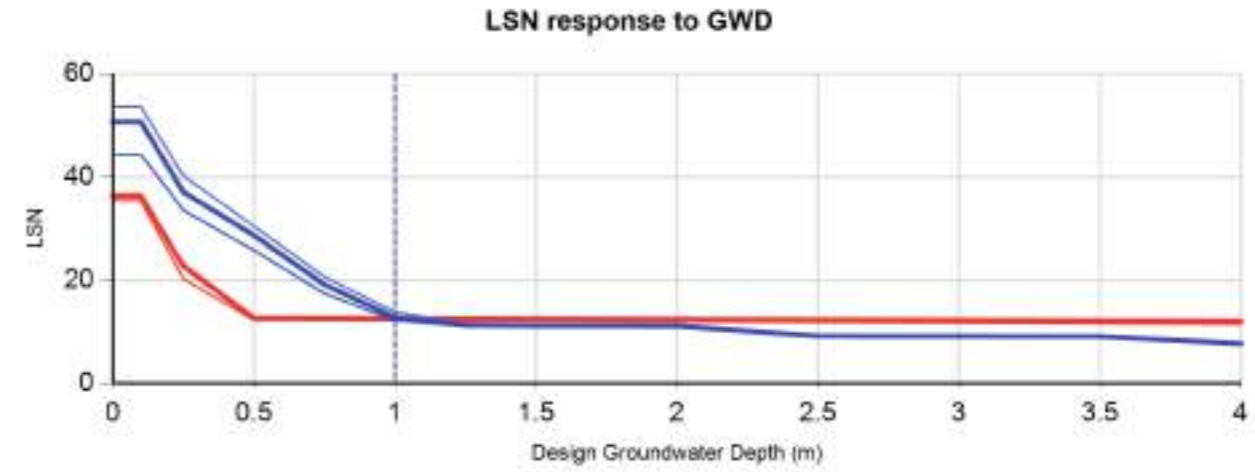
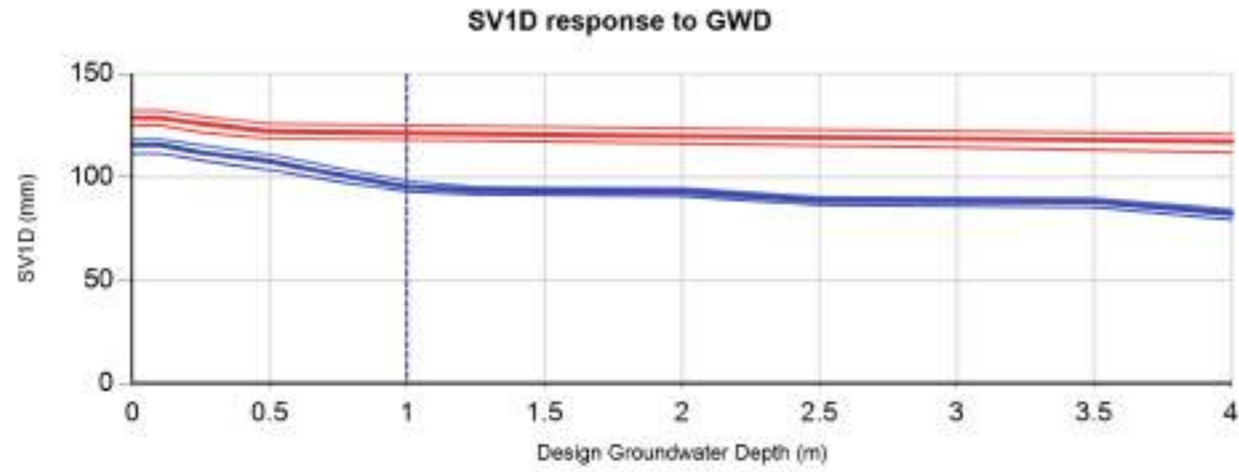
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 Tonkin+Taylor Exceptional thinking together V2.4.15	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT02	152808	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	




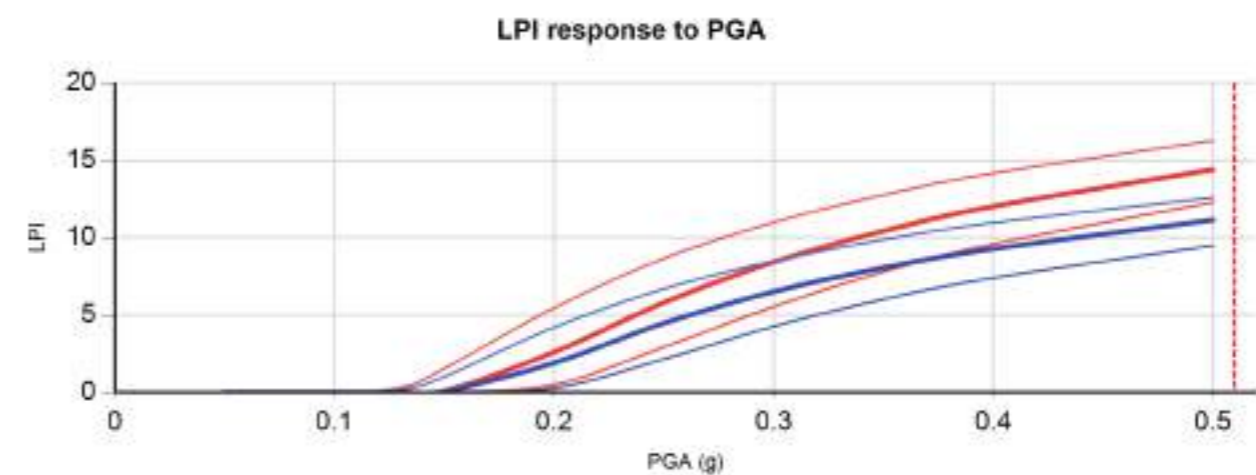
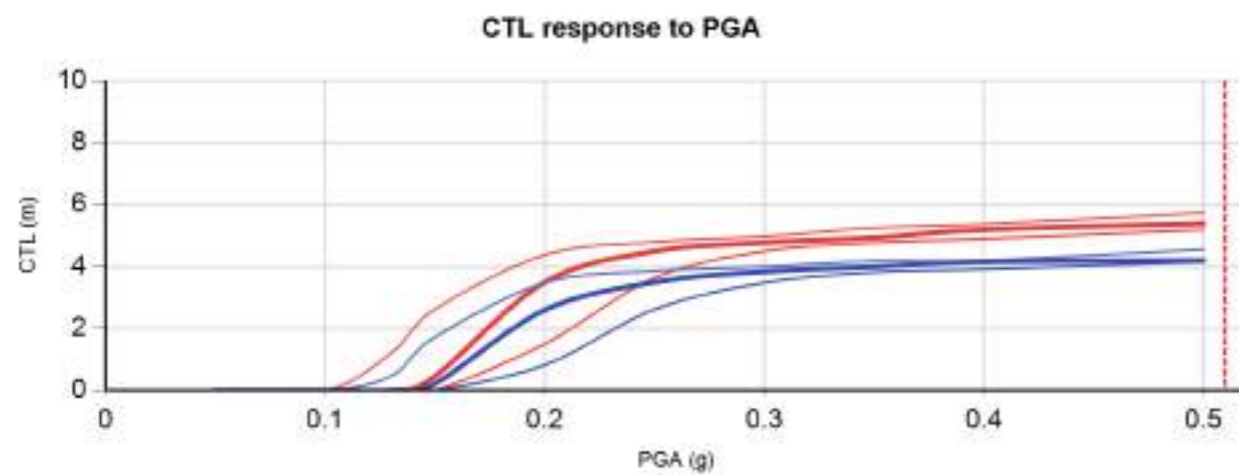
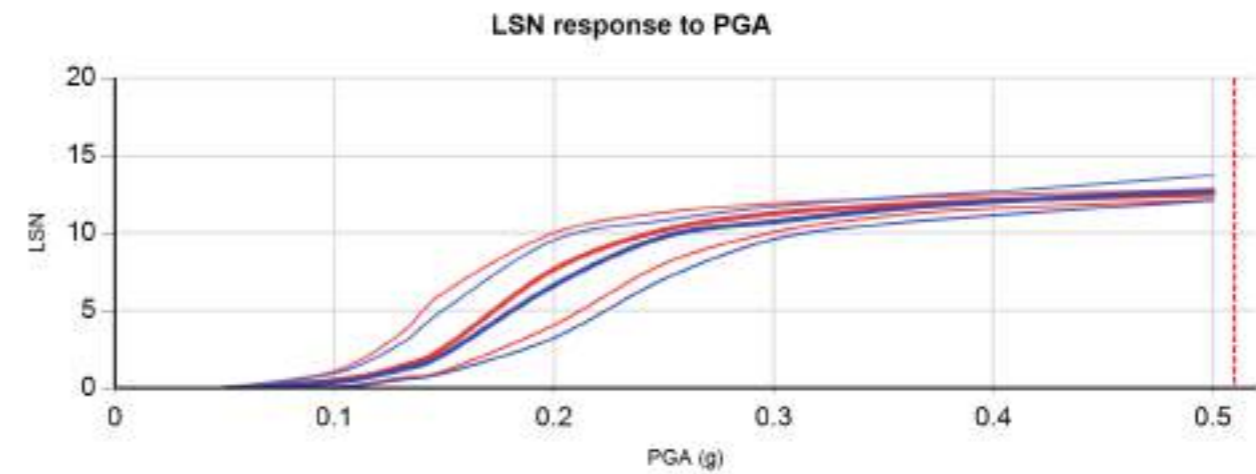
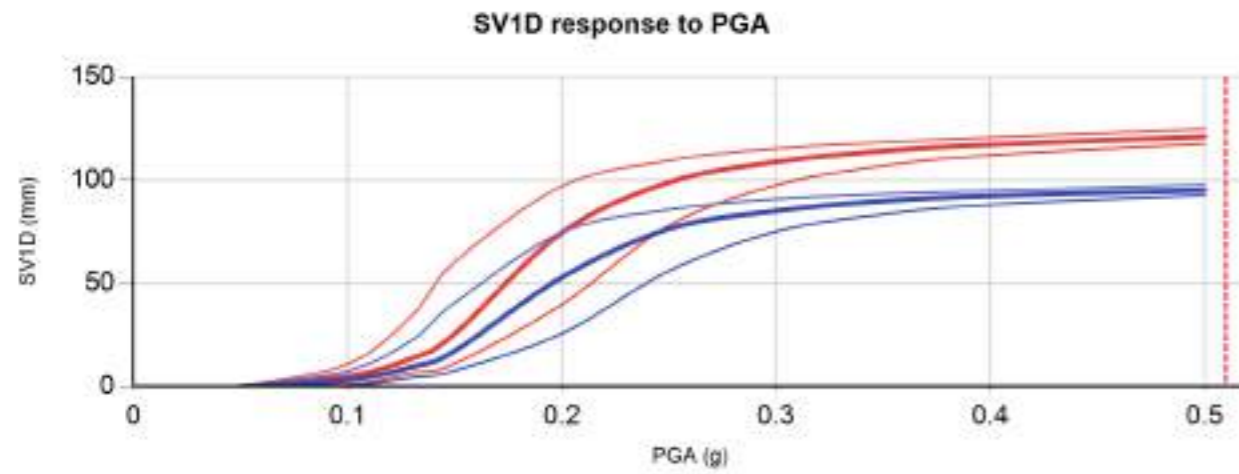
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT01	152807	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT02	152808	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 1 - 2]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

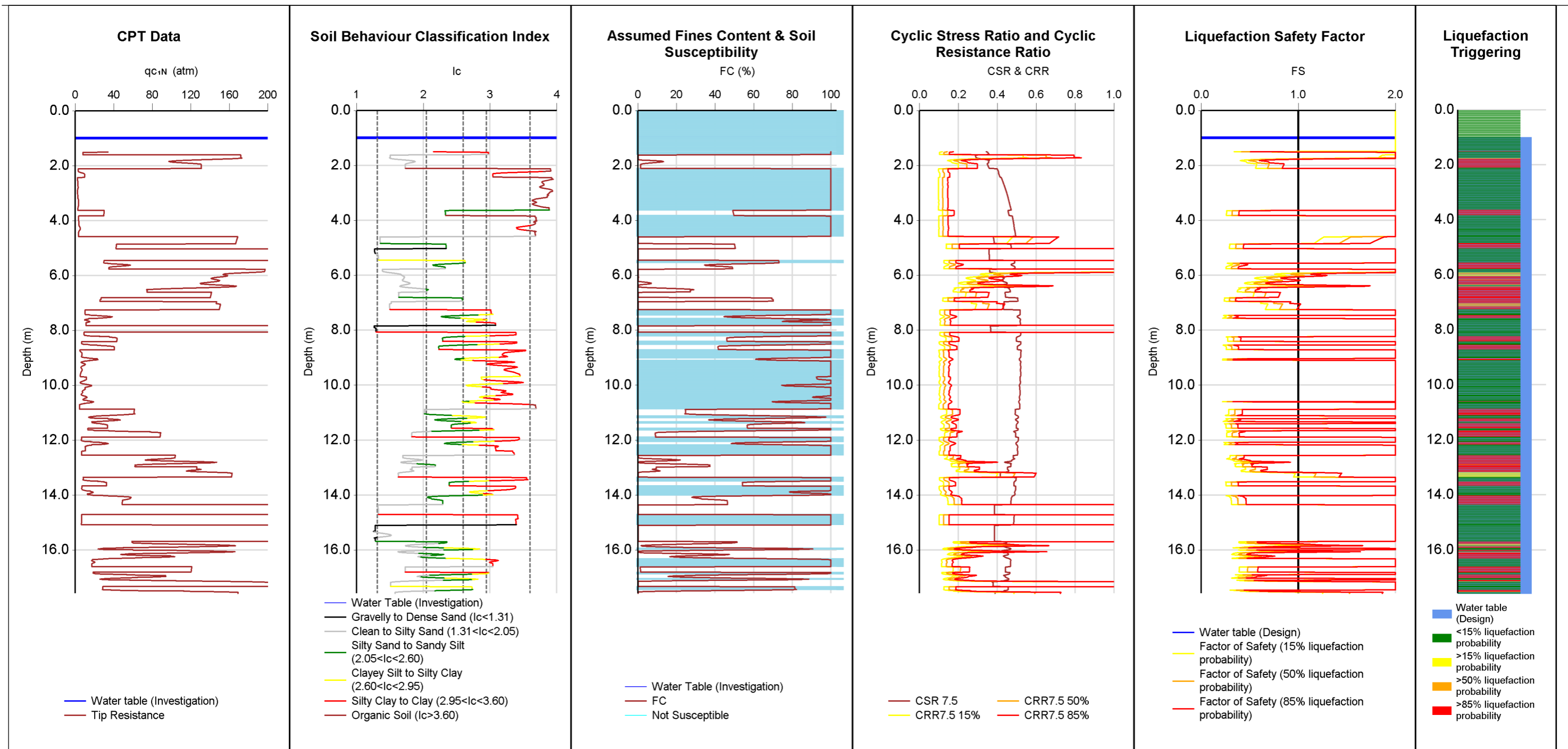
ID	NZGD 152807	NZGD 152808
CPT Name	CPT01	CPT02
Run description	CPT01	CPT02
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.58	17.9
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152807	CPT01	0	0	0
NZGD 152807	CPT01	0	17.58	2.6
NZGD 152808	CPT02	0	0	0
NZGD 152808	CPT02	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

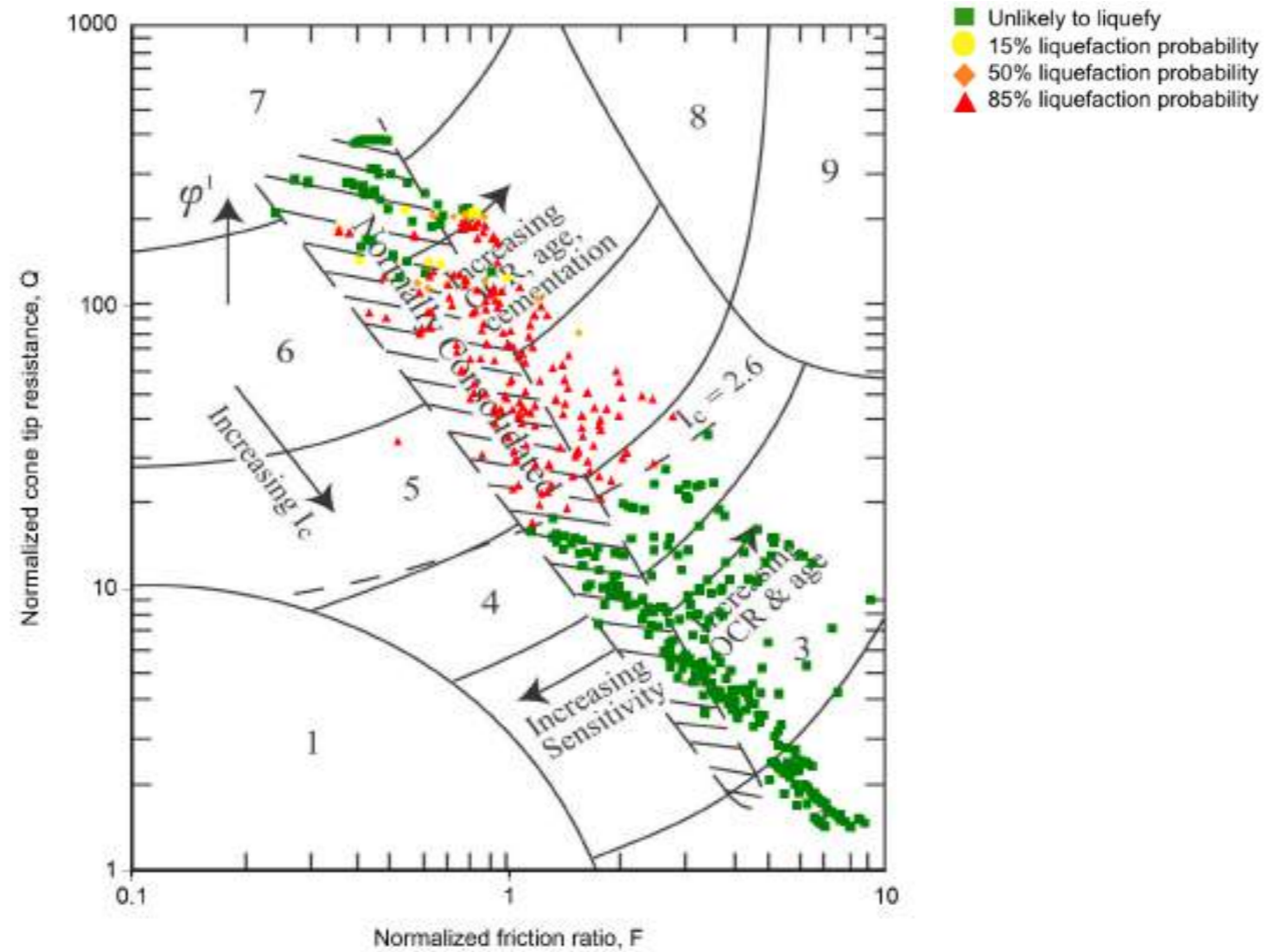
ID	Run description	From (m)	To (m)	Fc
NZGD 152807	CPT01	0	17.58	0 CFC
NZGD 152808	CPT02	0	17.58	0 CFC



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.6	0.51	BI-2014	ZRB-2002	18		0	
OUTPUT											
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
15%	127	6	17	17	17	1.8					
50%	121	5.7	15	17	17	1.9					
85%	114	5.4	12	15	15	1.9					

Reviewed by:


CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

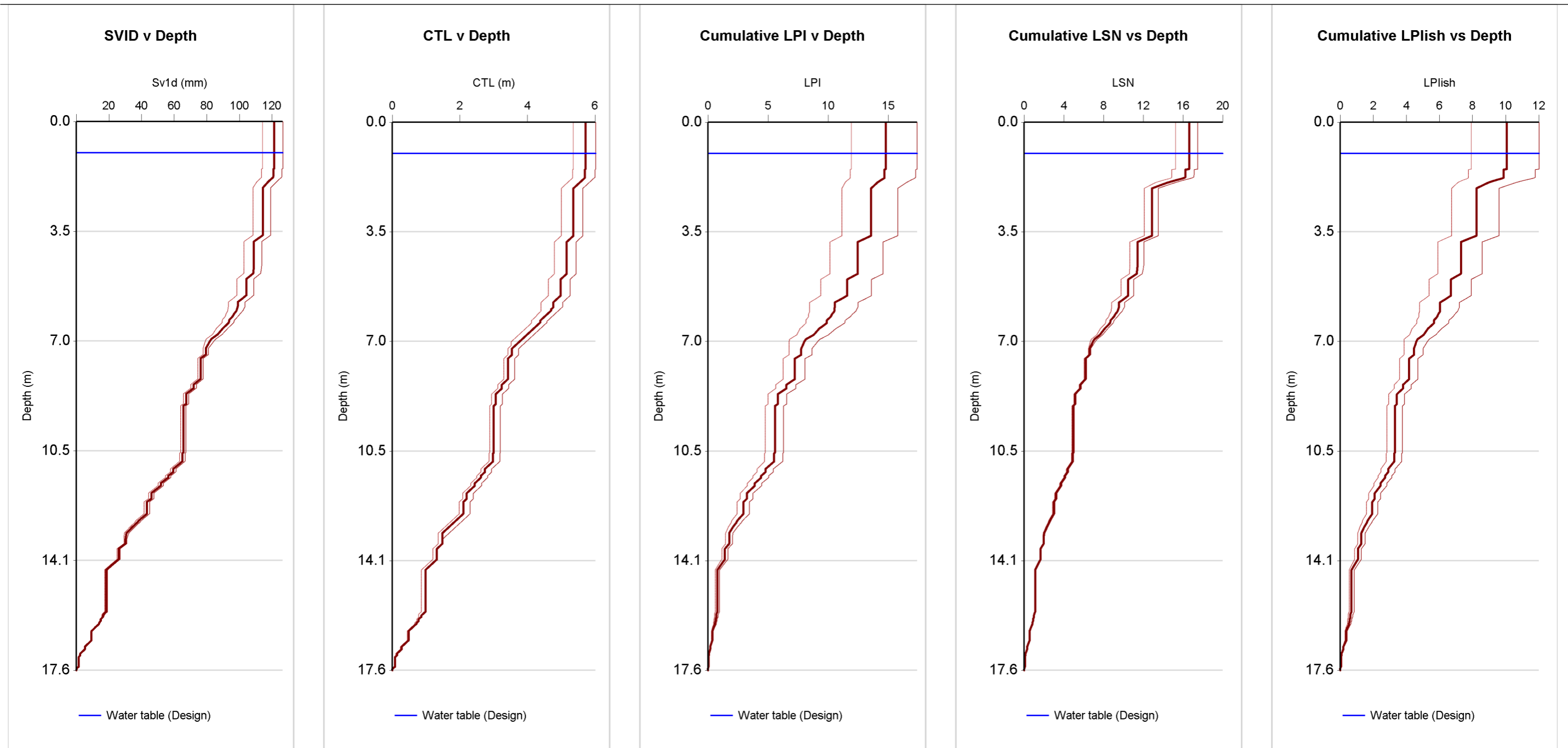


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

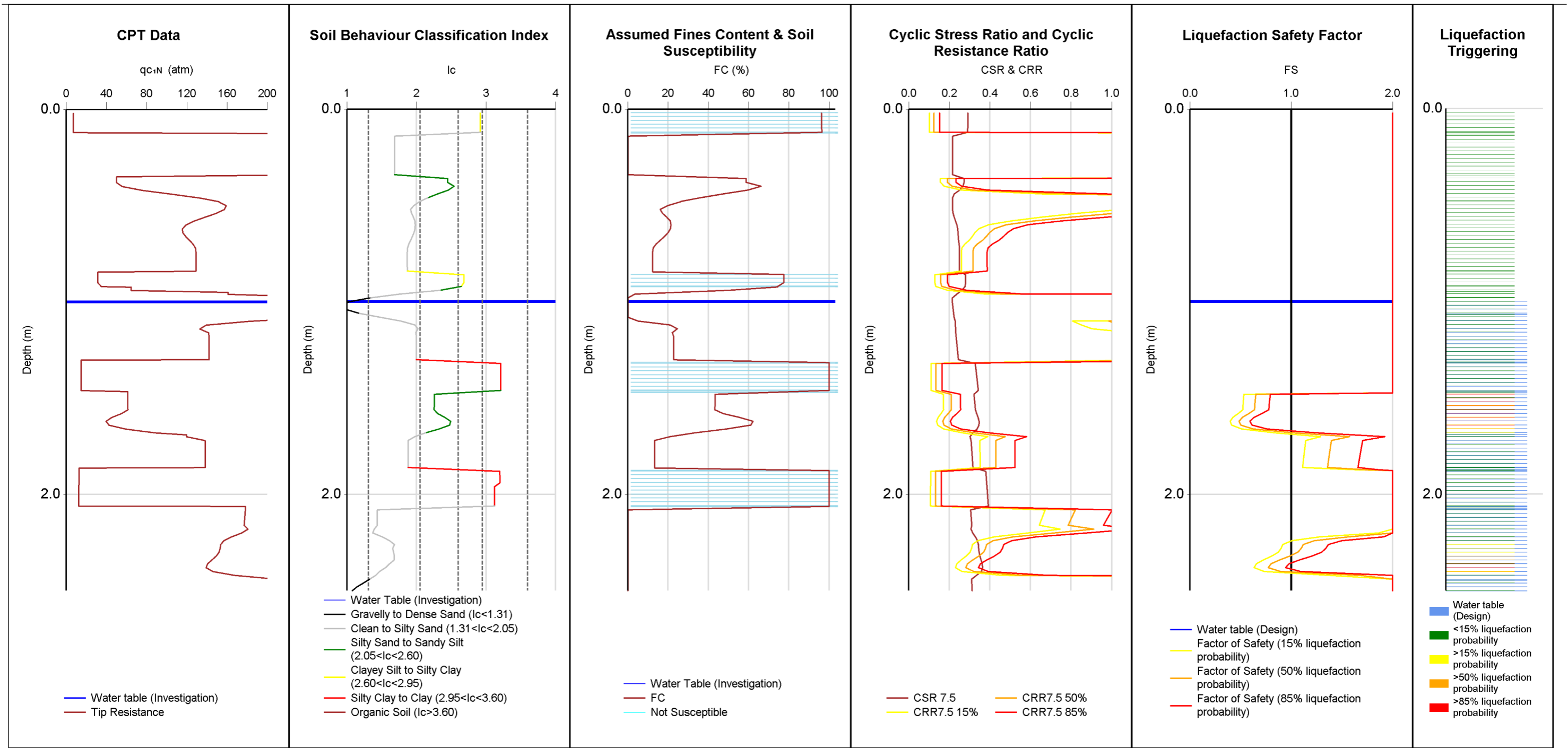
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 12 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT03	152809	26/11/2020	1.5	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 12 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]				



Note: Inverse filtered Q_c/F_s data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	7	0.4	1	4	1.6	2					
50%	6	0.3	1	4	1.6	1					
85%	5	0.2	1	3	1.6	1					

Reviewed by:

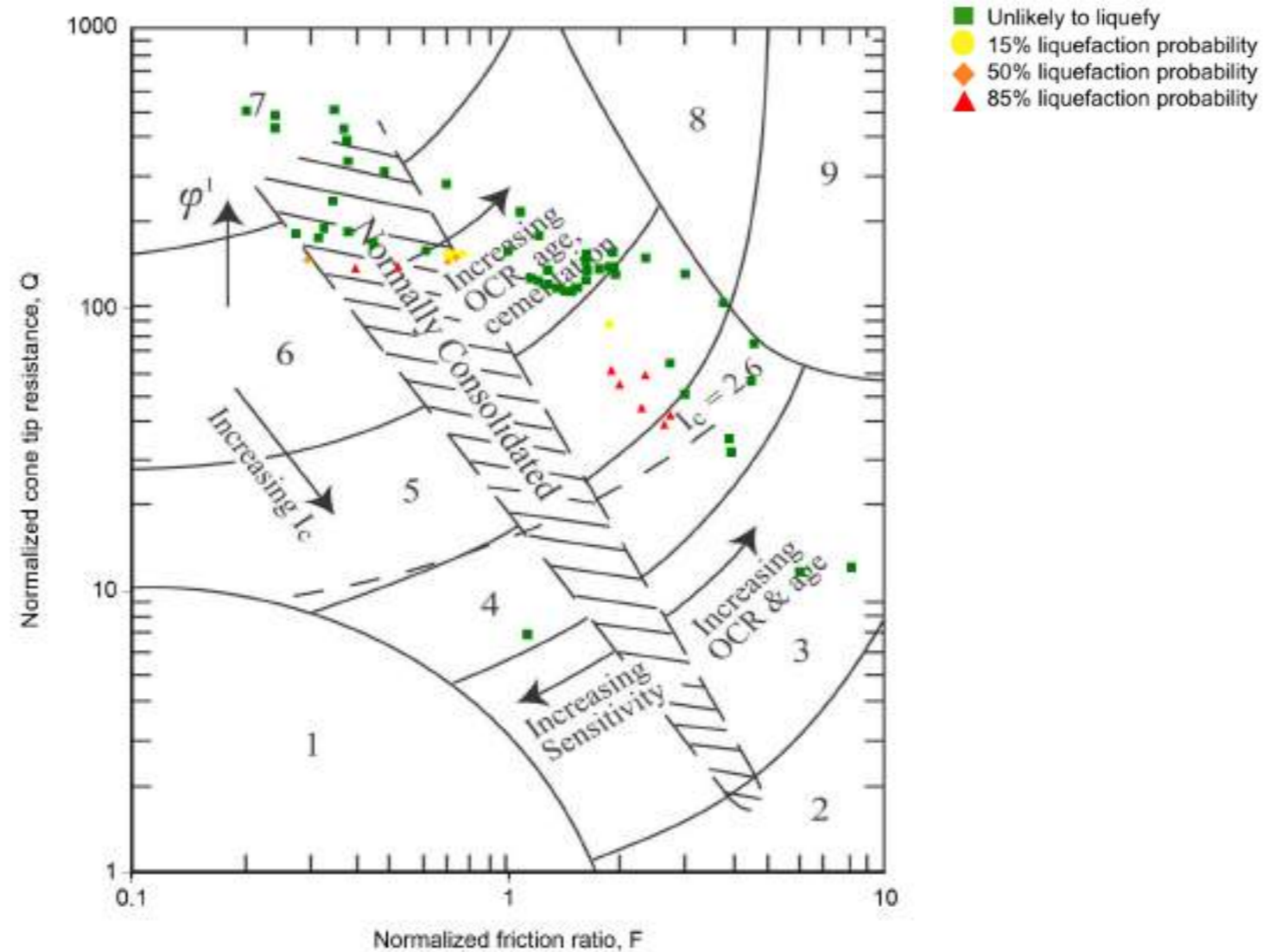
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]

LOCATION	Napier	DATE	10/02/2021
JOB NUMBER	1009171	ANALYSED	zafz
		PAGE	4 of 12 pages



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

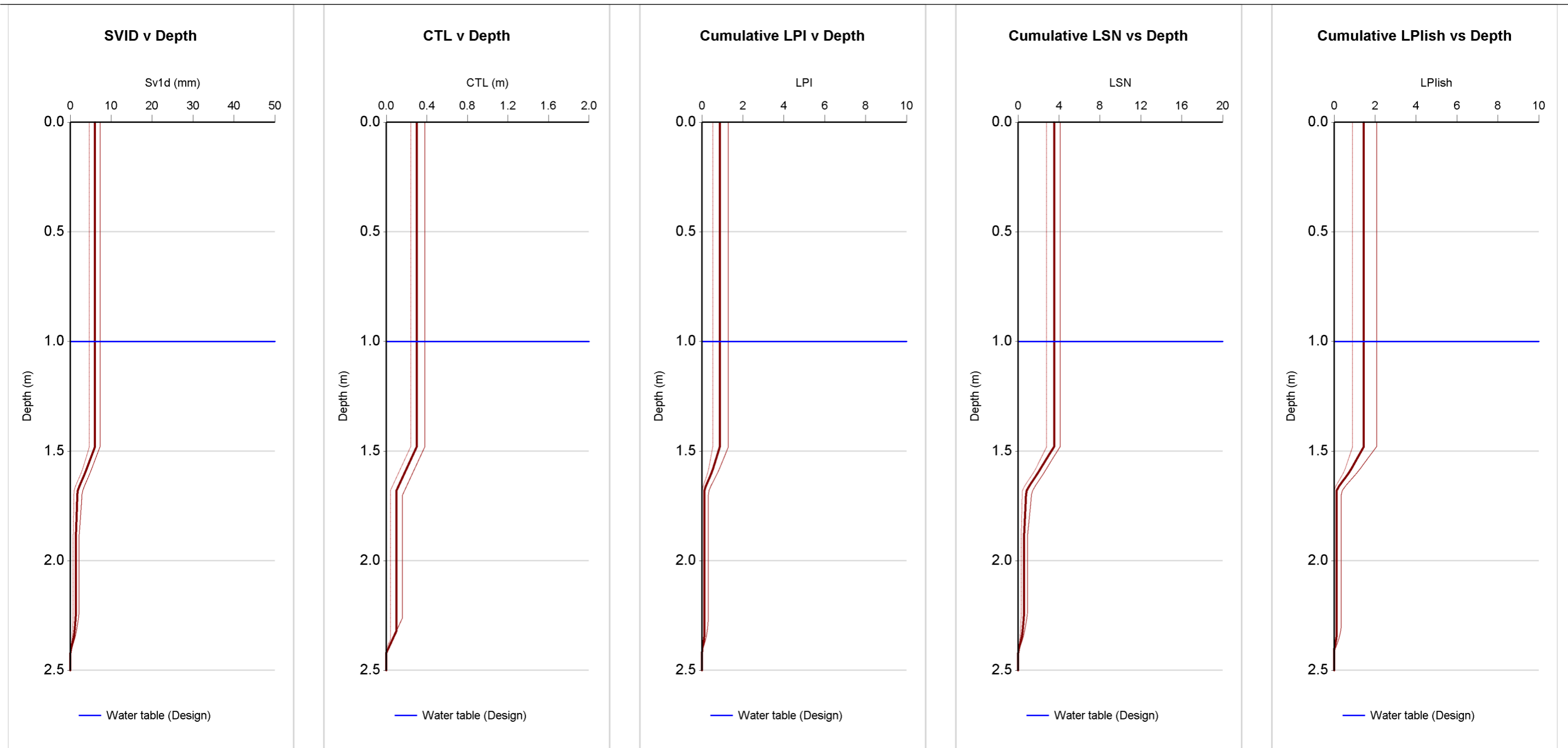
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




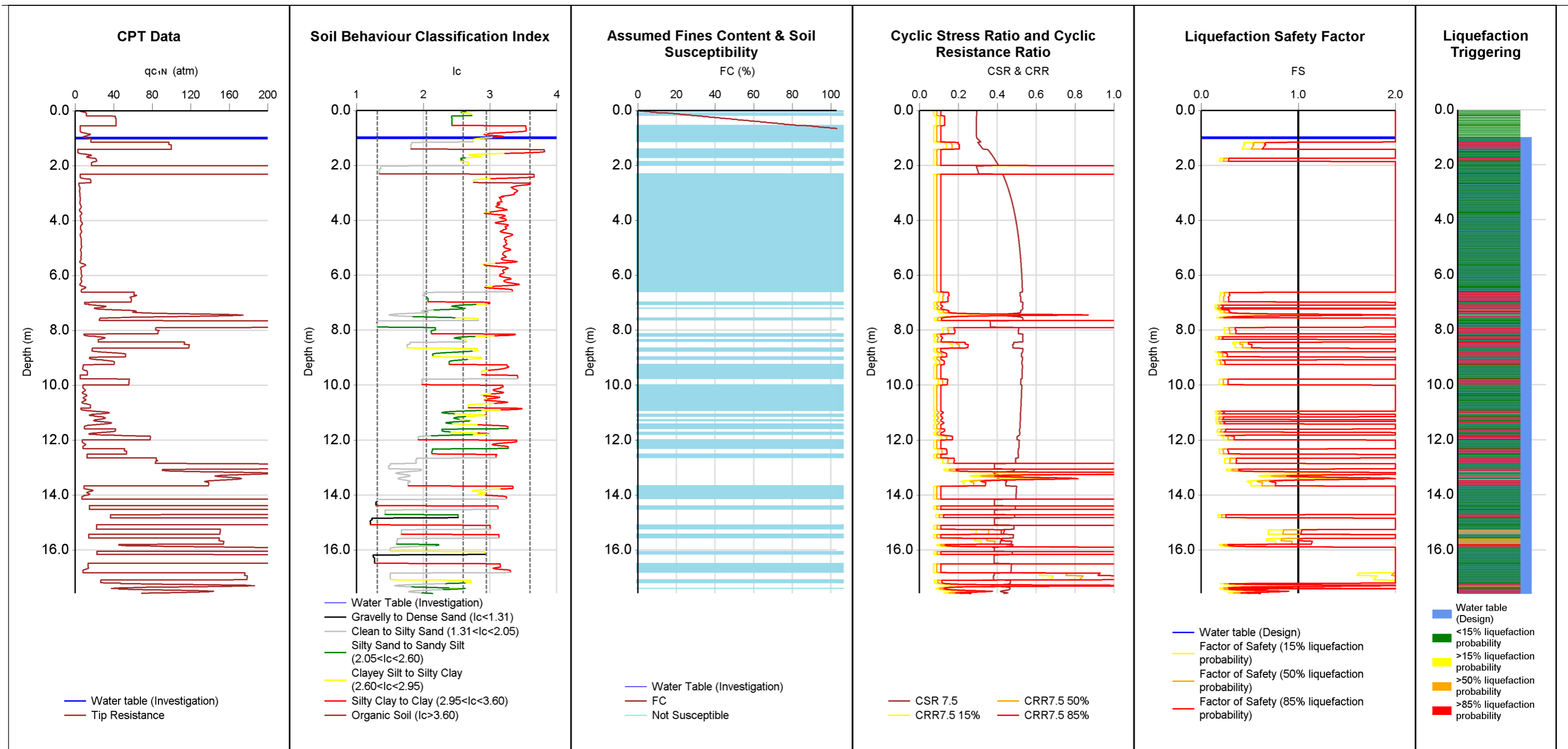
Tonkin + Taylor
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 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 12 pages
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT04	152810	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 12 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	162	4.7	16	24	1.2	12					
50%	159	4.6	15	23	1.2	11					
85%	155	4.2	13	23	1.2	10					

Reviewed by:

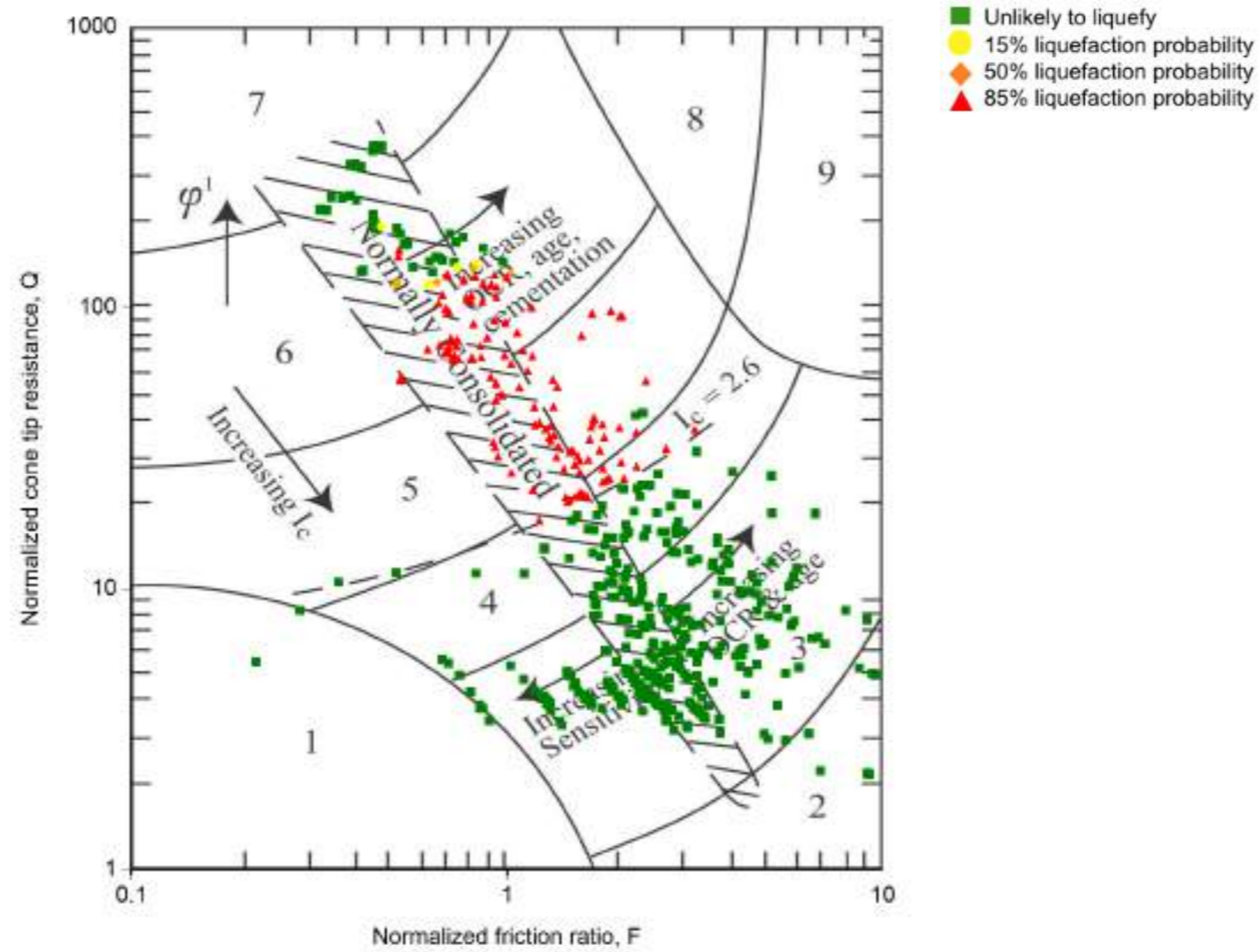
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **7 of 12 pages**

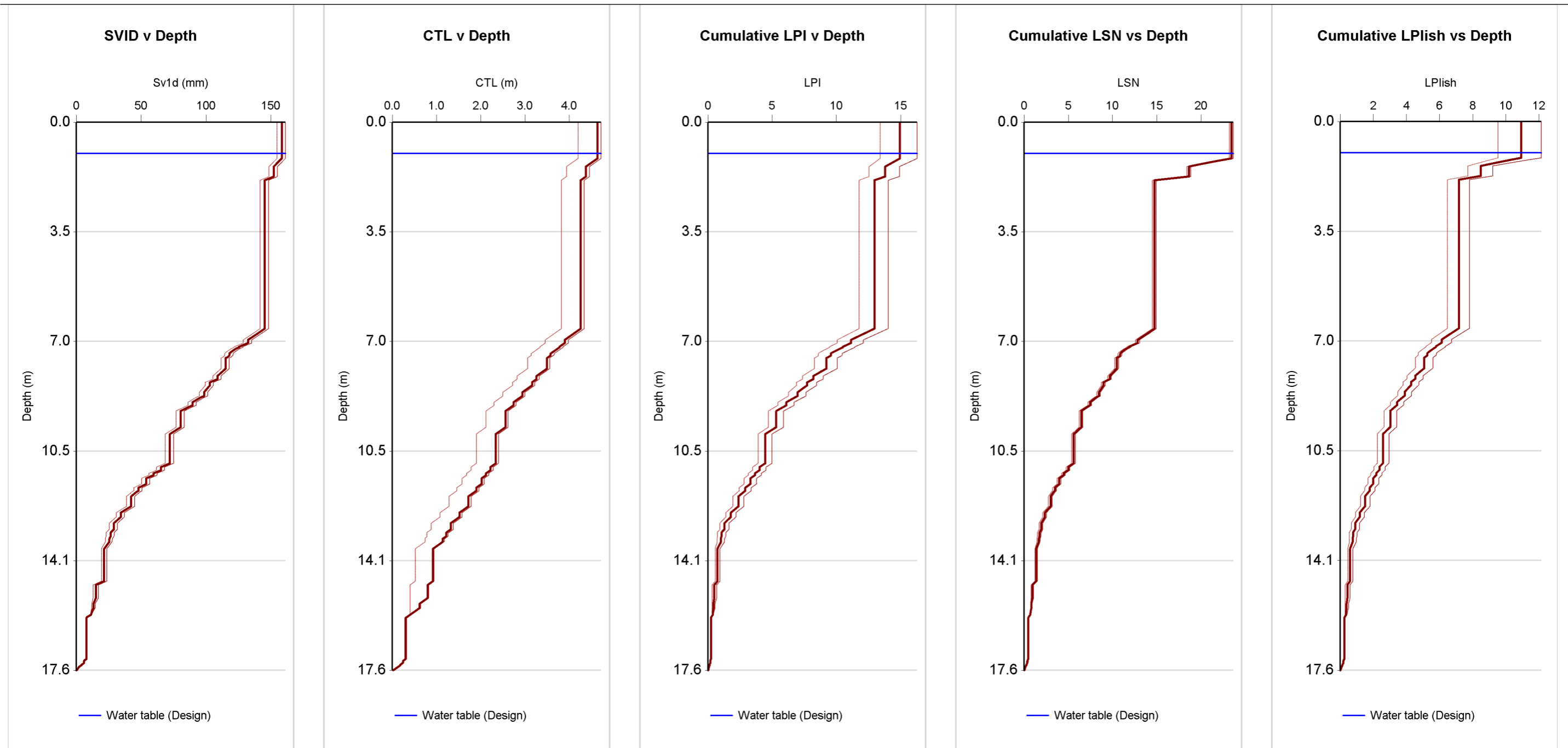


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 12 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]				



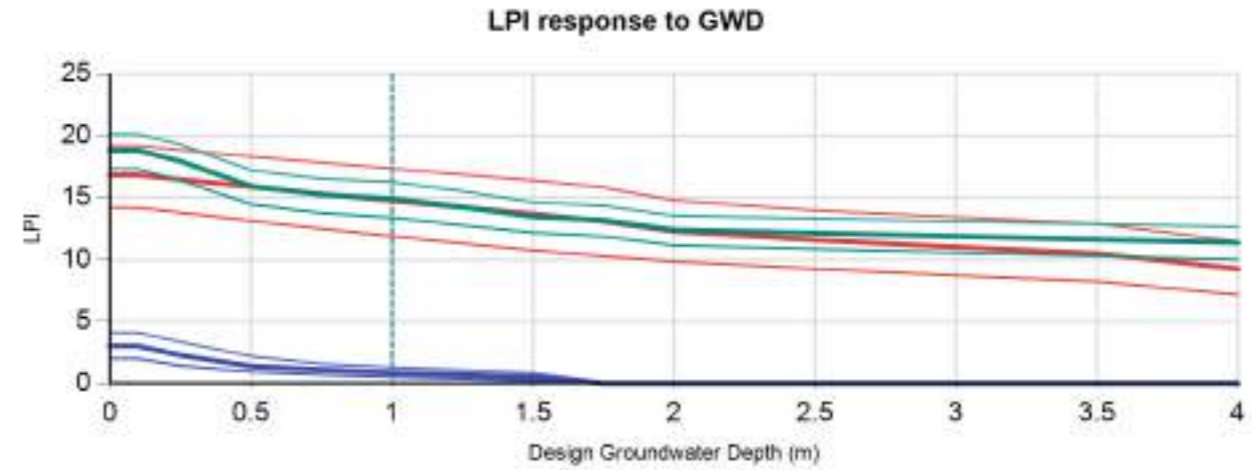
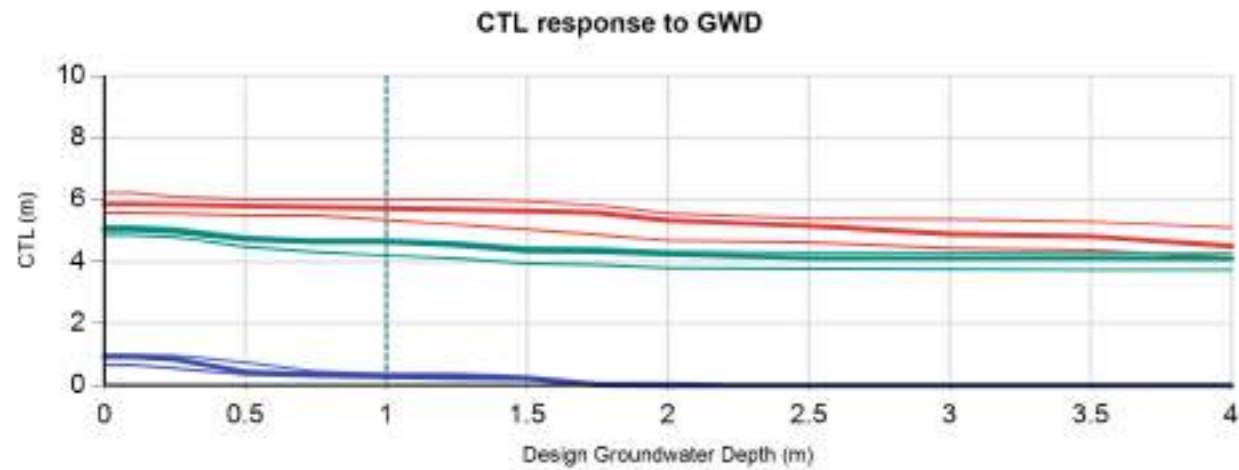
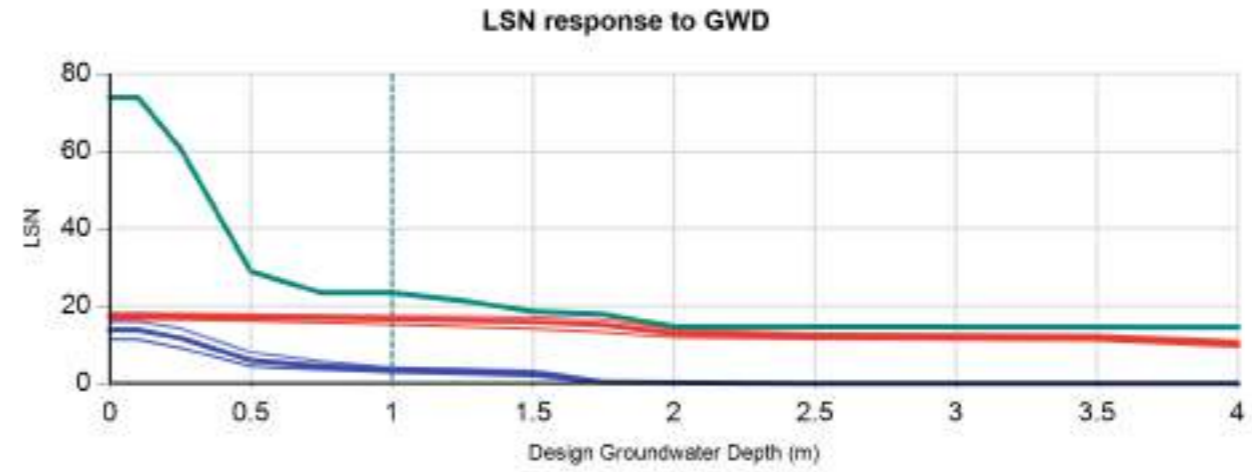
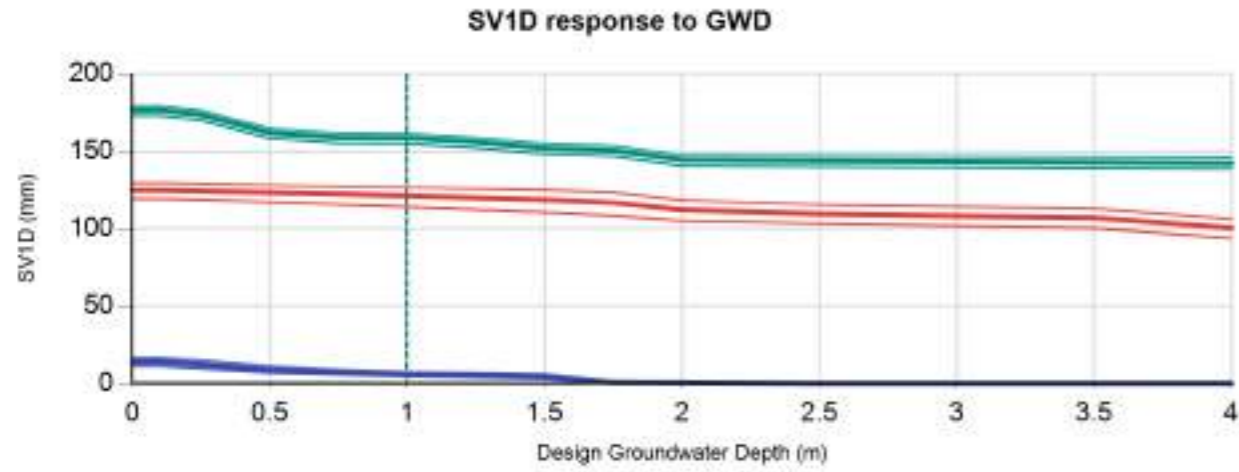
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT05	153039	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	



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 Exceptional thinking together
 V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]

LOCATION	Napier	DATE	10/02/2021
JOB NUMBER	1009171	ANALYSED	zafr
		PAGE	9 of 12 pages



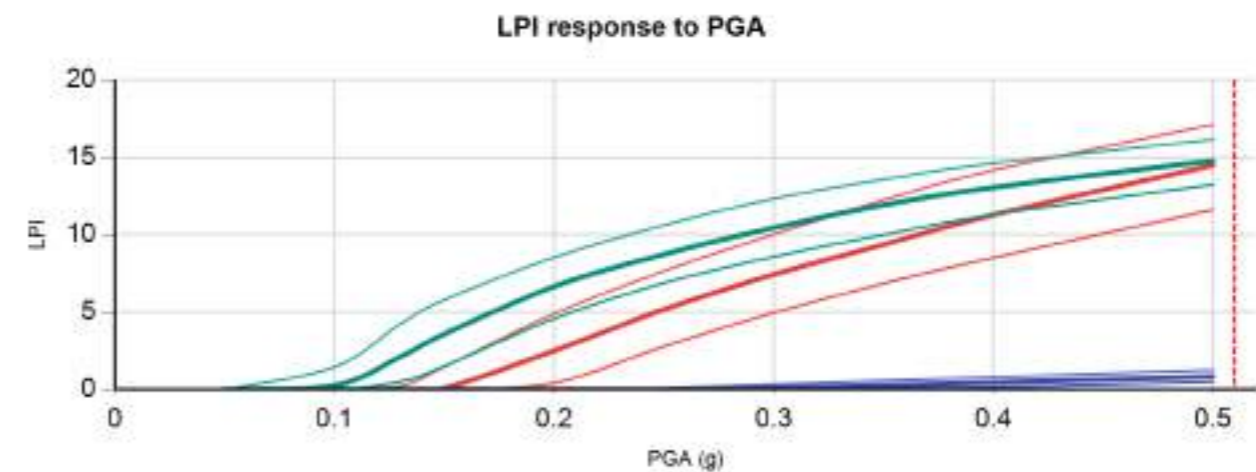
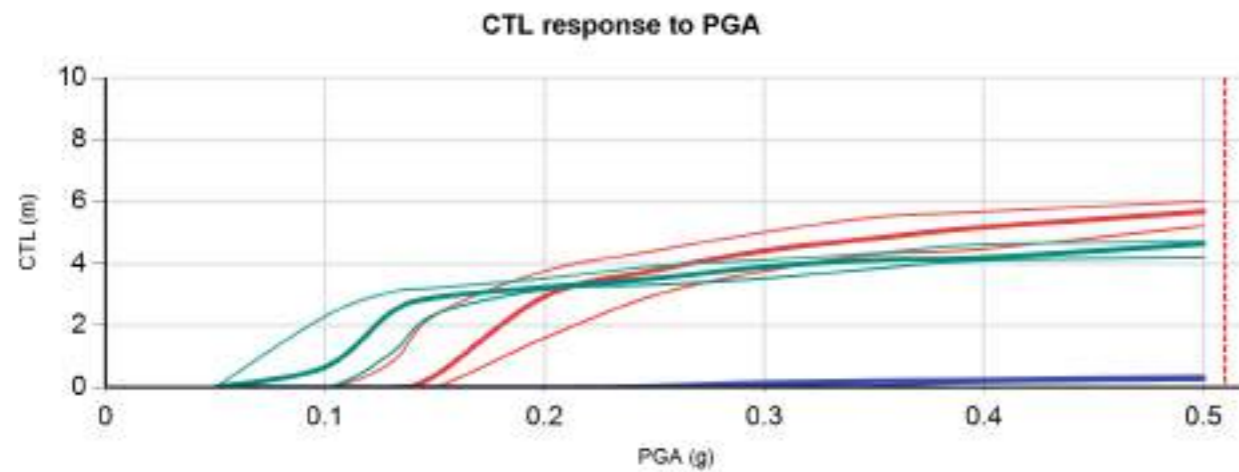
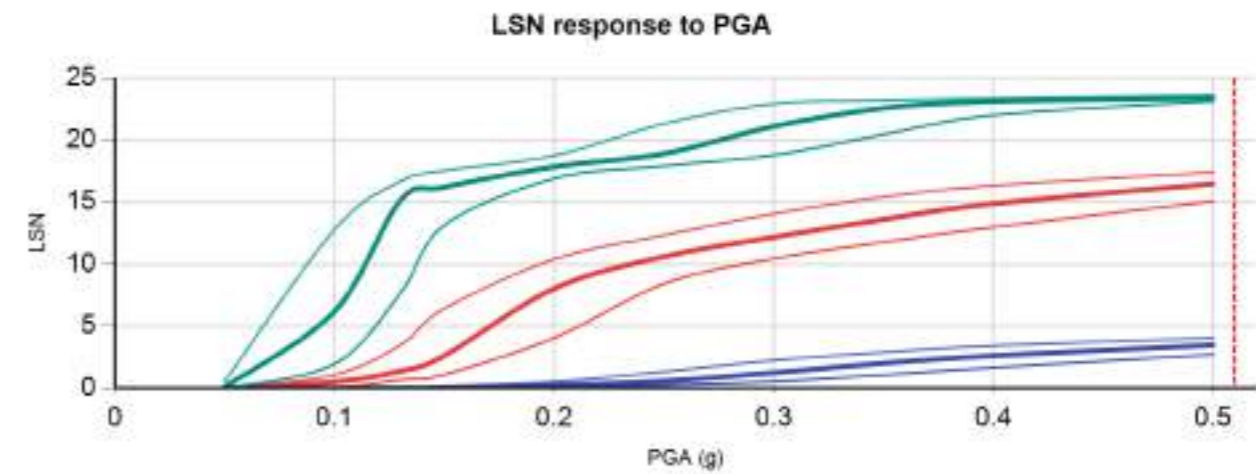
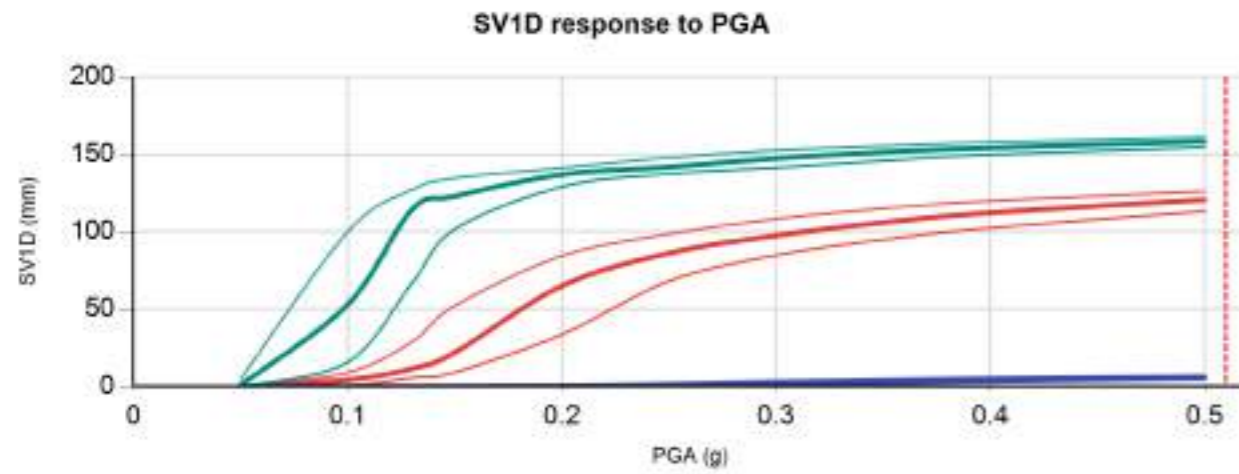
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

<p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	PAGE	10 of 12 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 3 - 5]	1009171		



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT03	152809	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT04	152810	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT05	153039	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

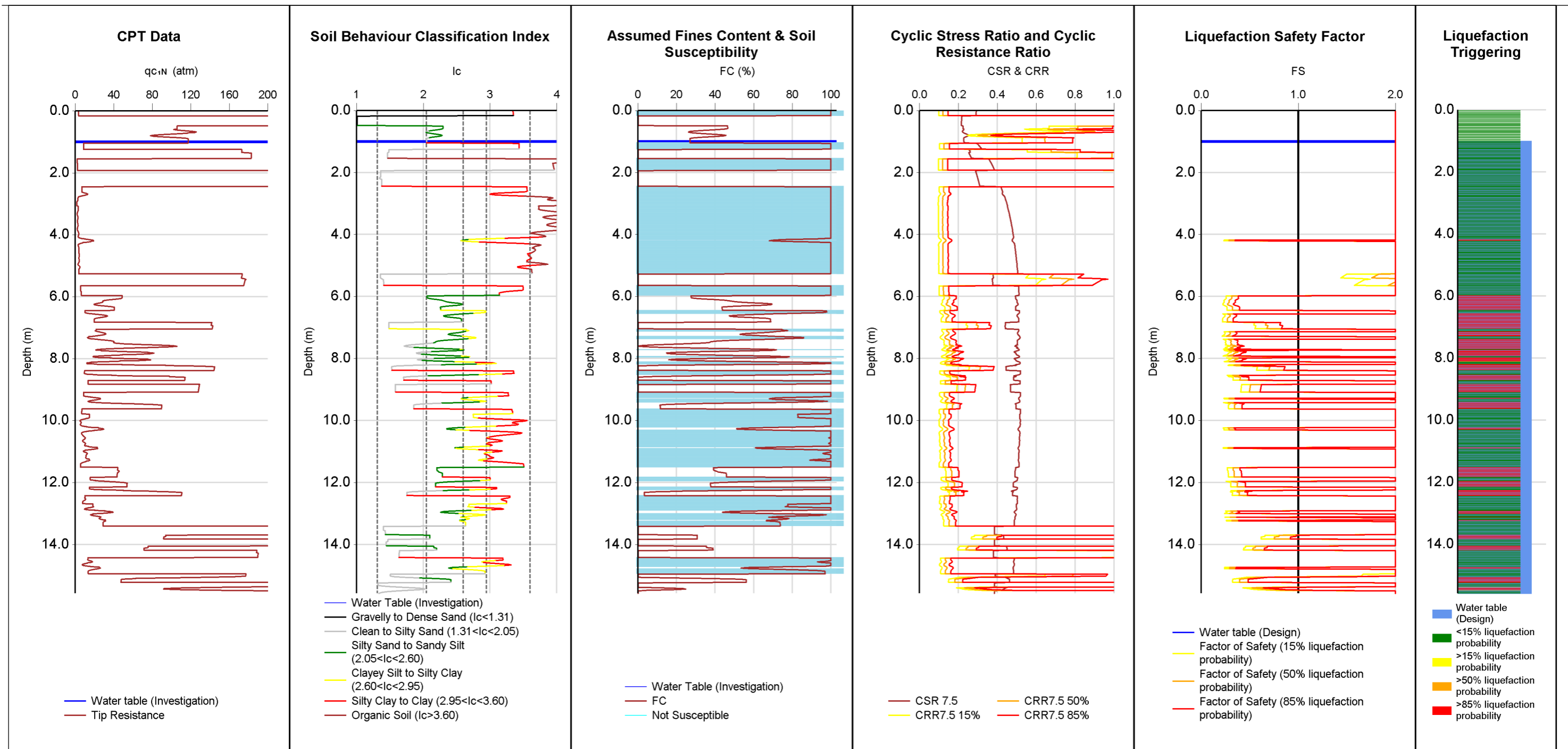
ID	NZGD 152809	NZGD 152810	NZGD 153039
CPT Name	CPT03	CPT04	CPT05
Run description	CPT03	CPT04	CPT05
PGA	0.51g	0.51g	0.51g
Magnitude	6.6	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1	1
Depth to groundwater for design (m)	1	1	1
Predrill depth (m)	1.5	0	0
Assumed predrill tip resistance and skin friction		qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.04	2.5	17.76
Minimum depth of analysis (m)	0	0	0
Maximum depth of analysis (m)	17.58	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152809	CPT03	0	1.5	0
NZGD 152809	CPT03	1.5	17.58	2.6
NZGD 152810	CPT04	0	0	0
NZGD 152810	CPT04	0	2.5	2.6
NZGD 153039	CPT05	0	0	0
NZGD 153039	CPT05	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152809	CPT03	1.5	17.58	0 CFC
NZGD 152810	CPT04	0	2.5	0 CFC
NZGD 153039	CPT05	0	17.58	0 %



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	102	4.4	16	12	6	9					
50%	100	4.4	14	12	6	8					
85%	97	4.3	12	11	6	6					

Reviewed by:

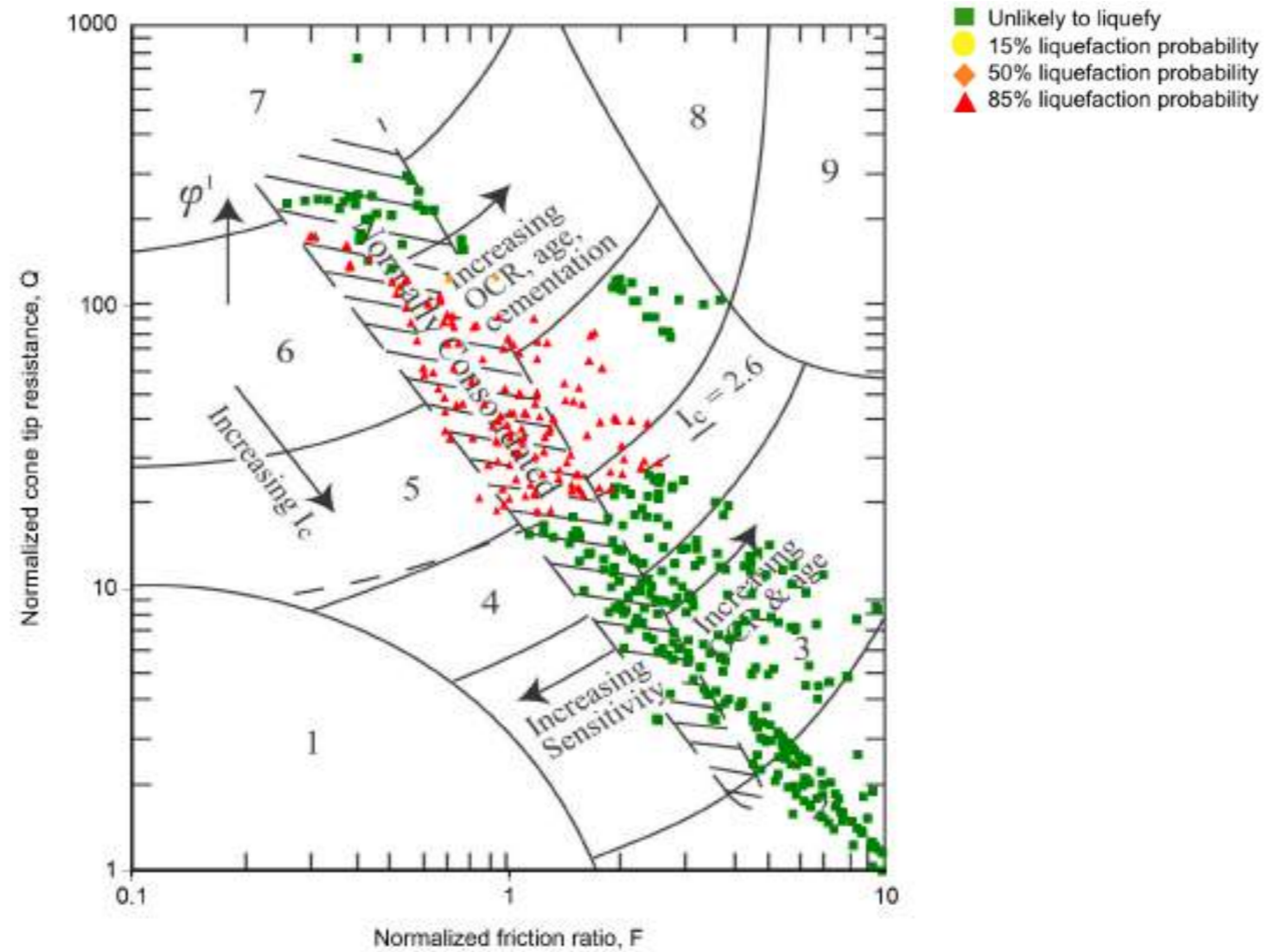
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

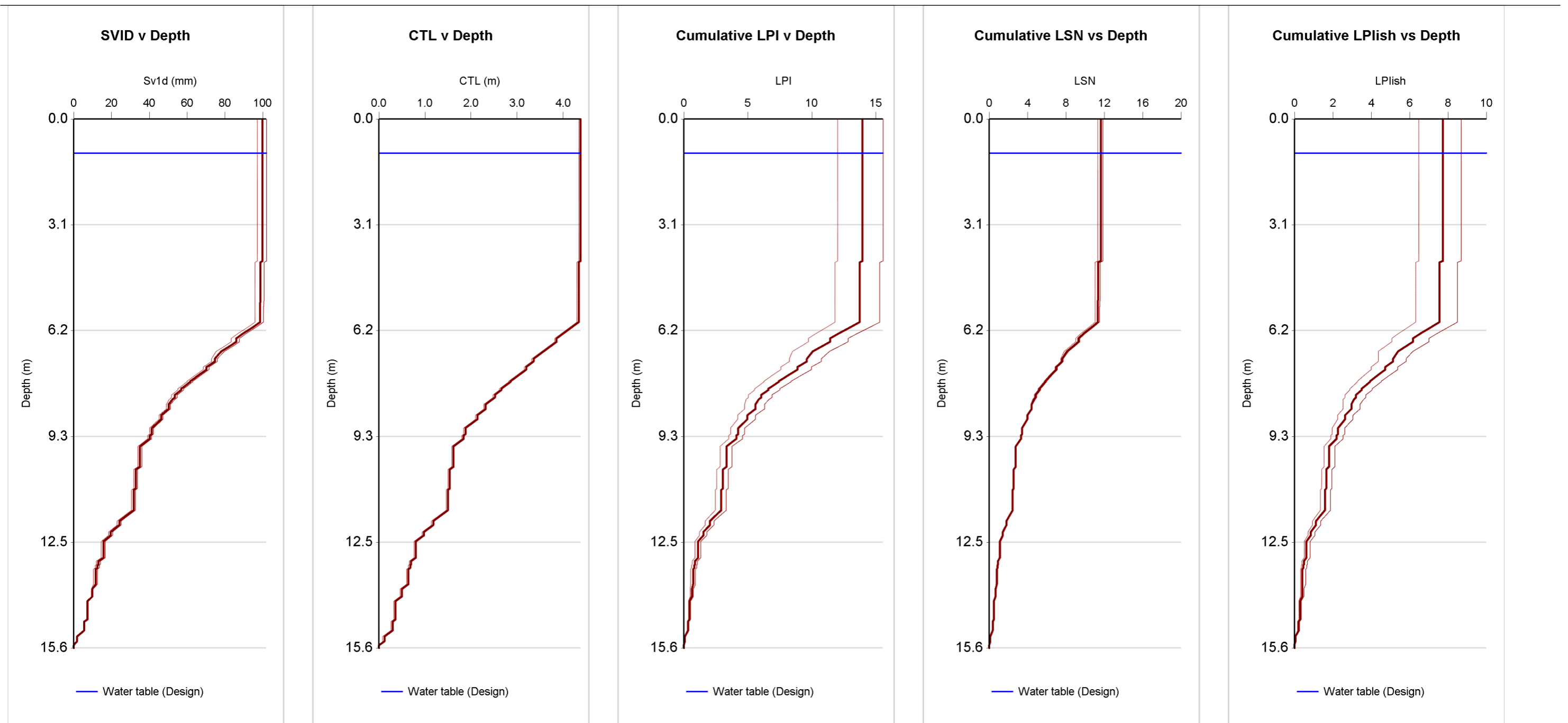


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

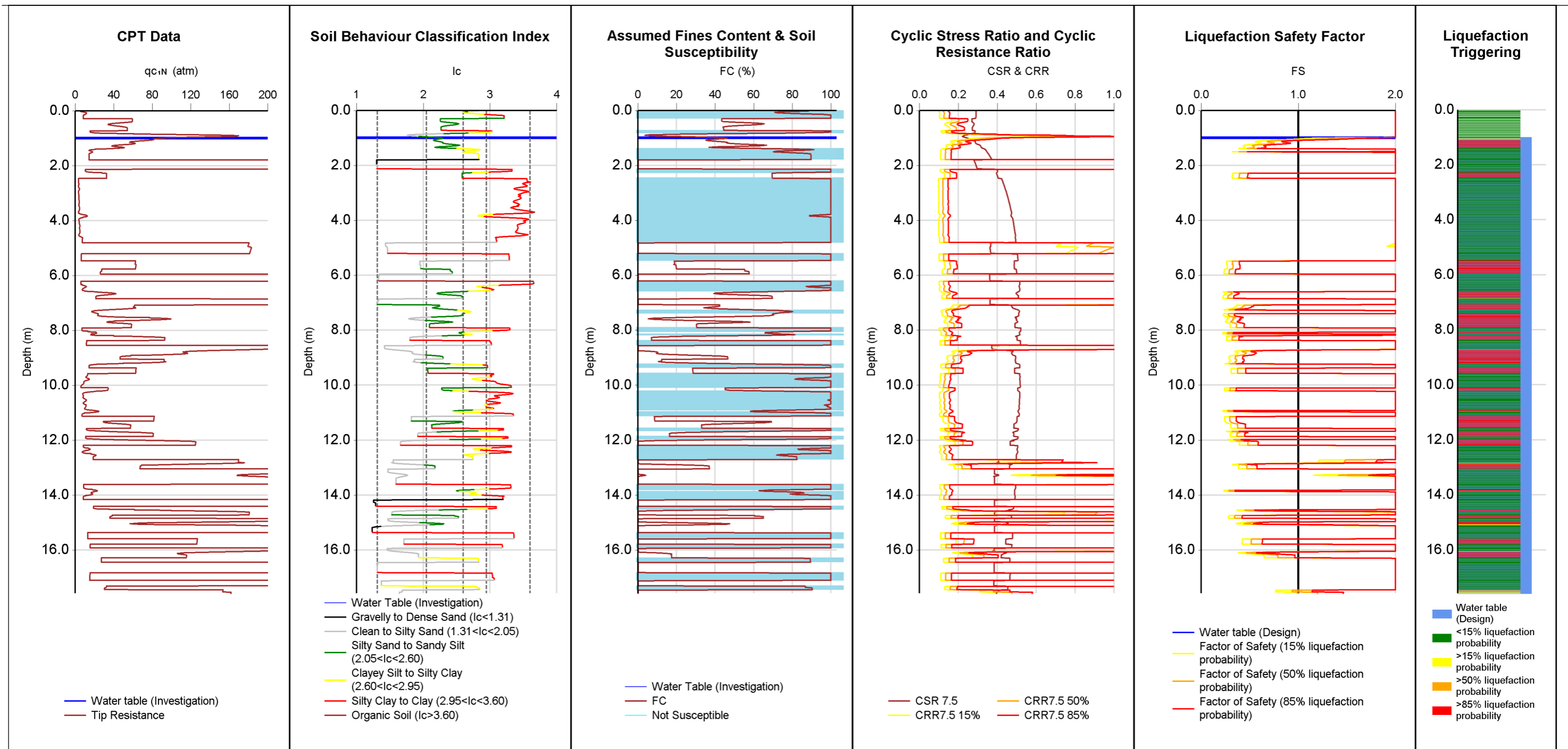
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT06	152811	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]				



Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	117	5.2	18	20	1.1	14					
50%	115	5	16	20	1.2	12					
85%	112	4.9	14	18	1.2	10					

Reviewed by:

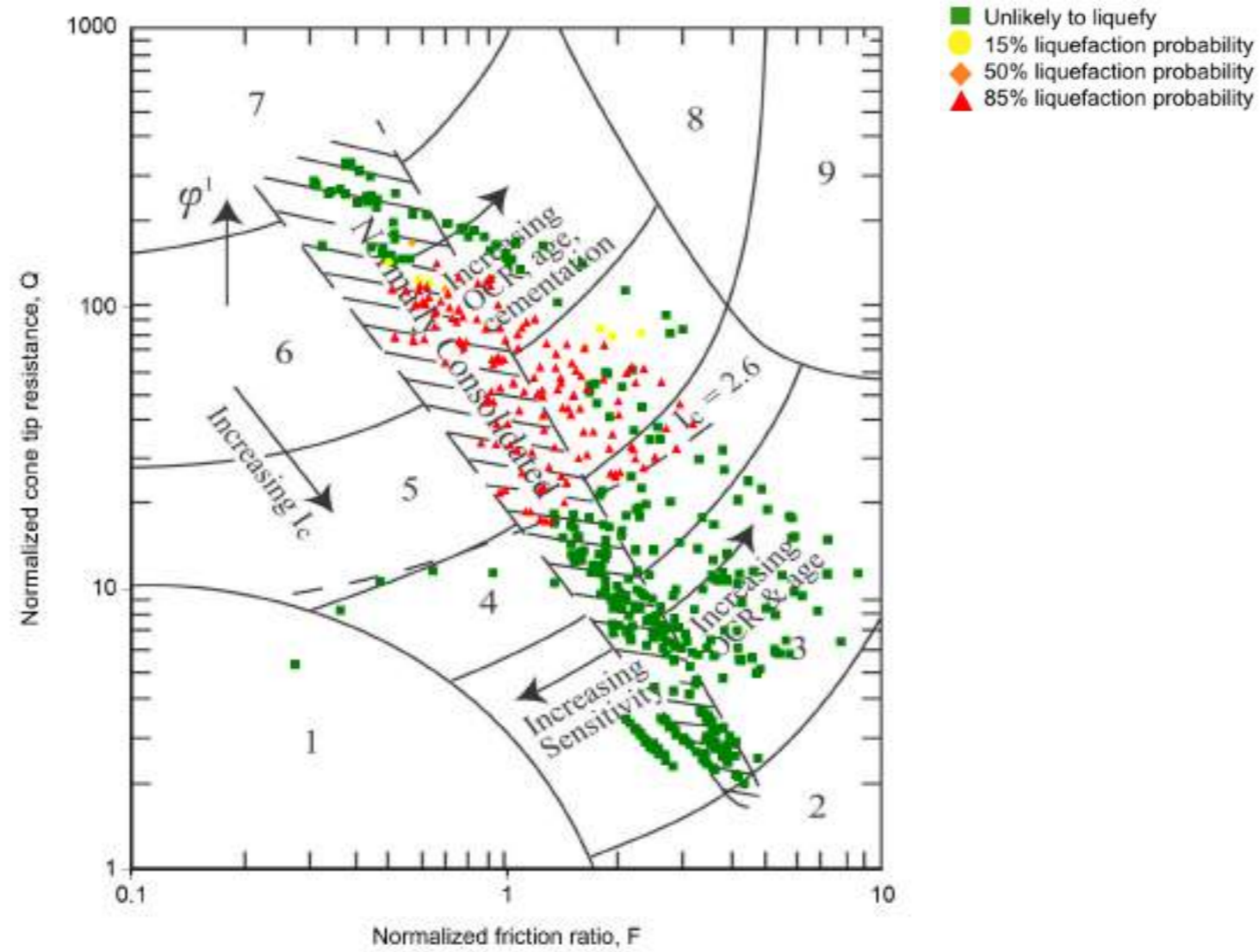
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

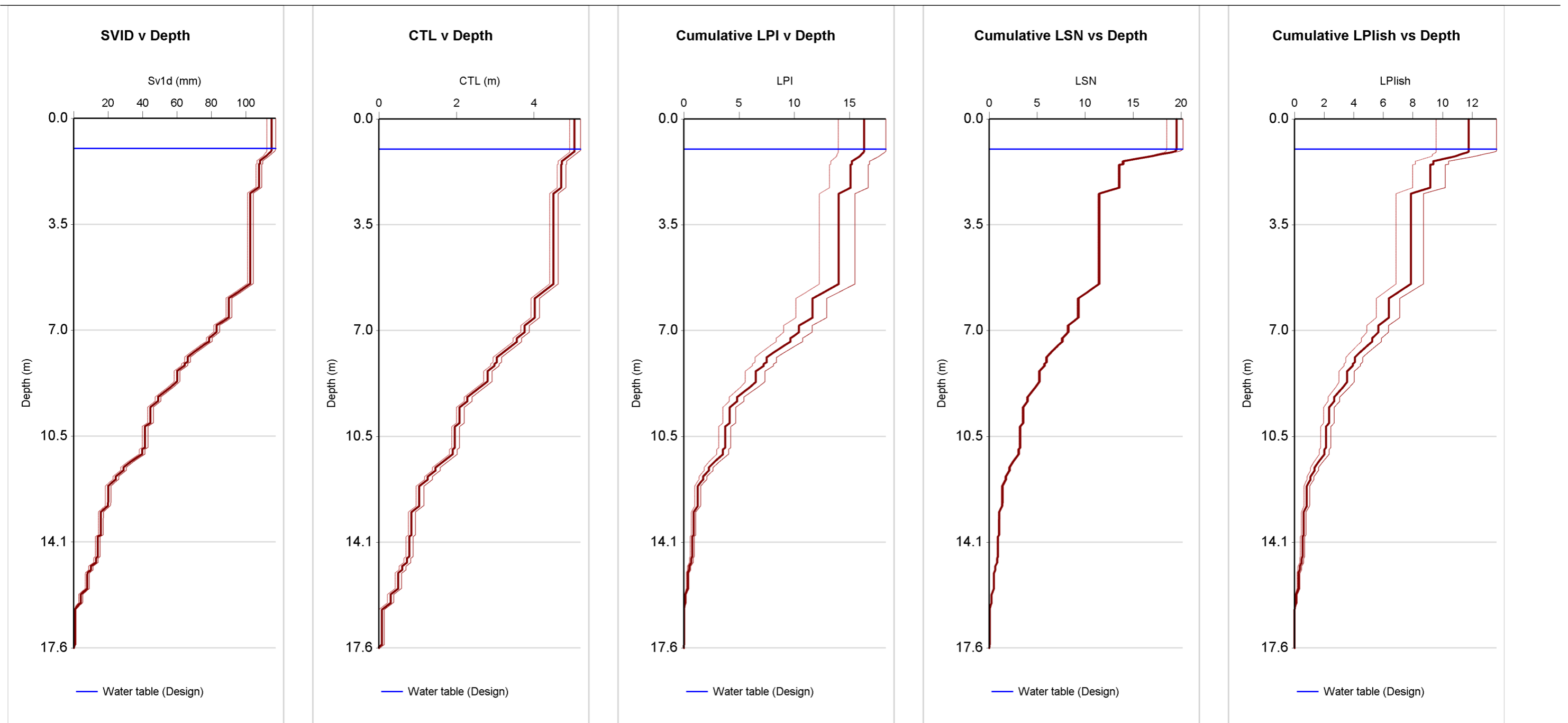


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

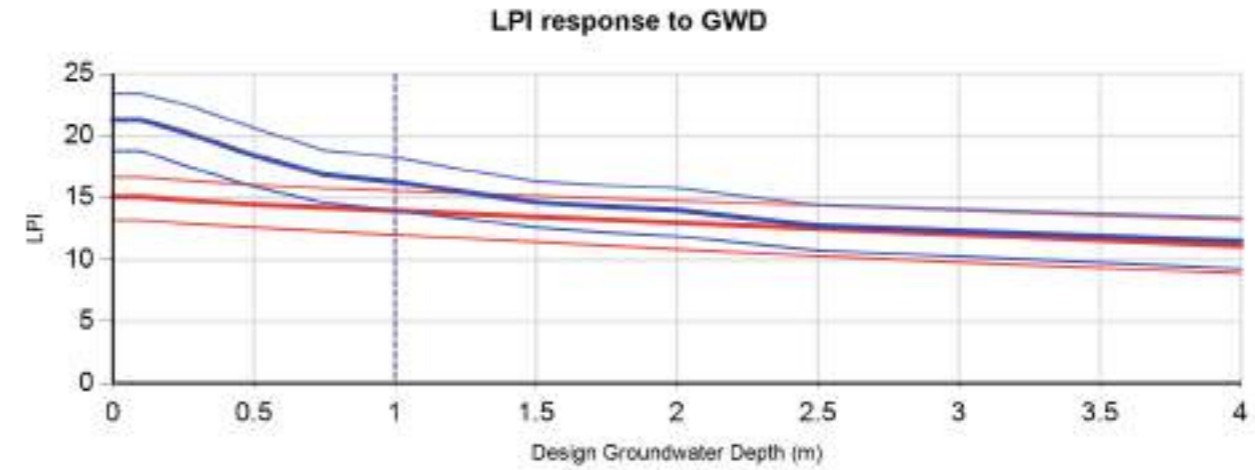
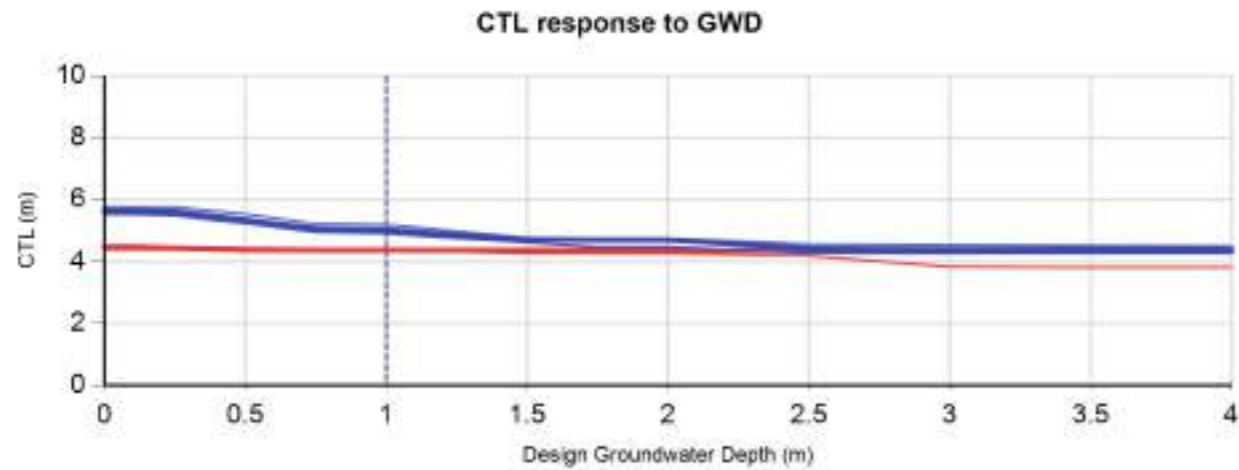
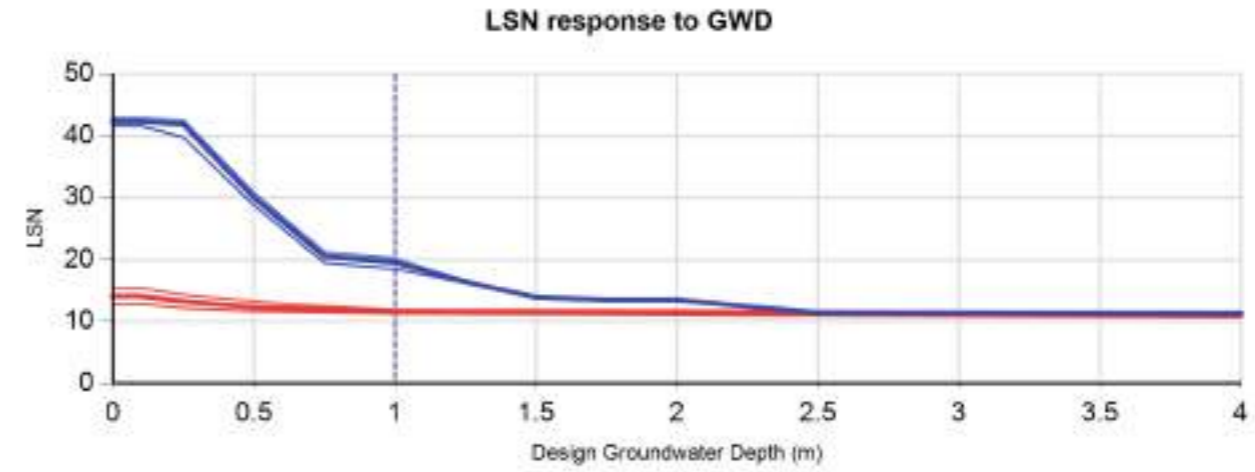
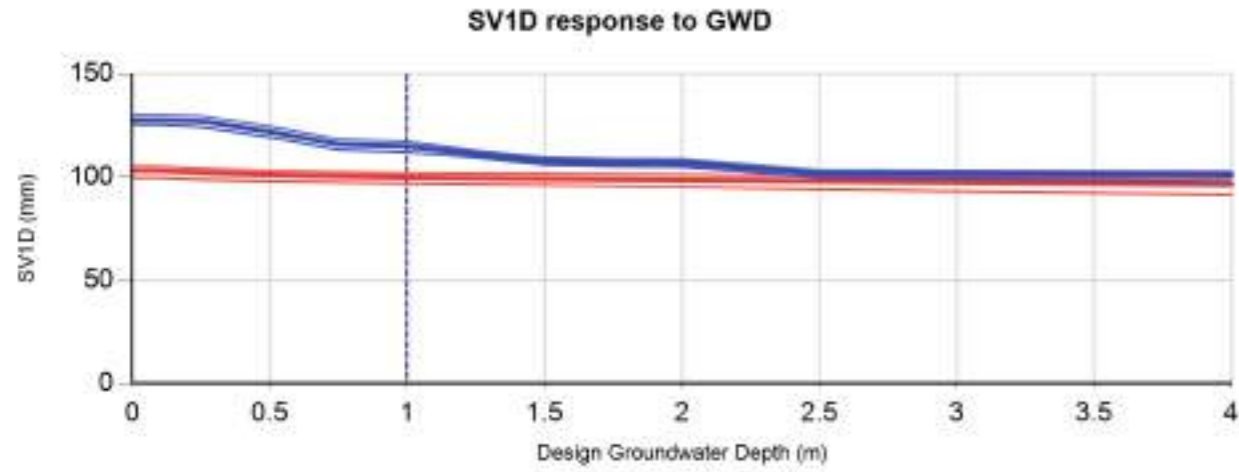
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT07	152812	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	




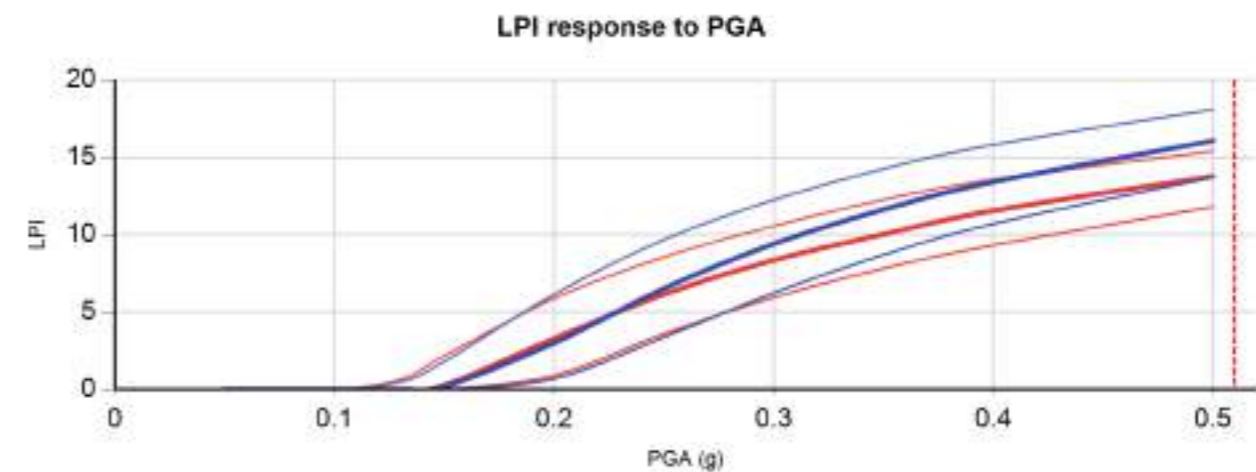
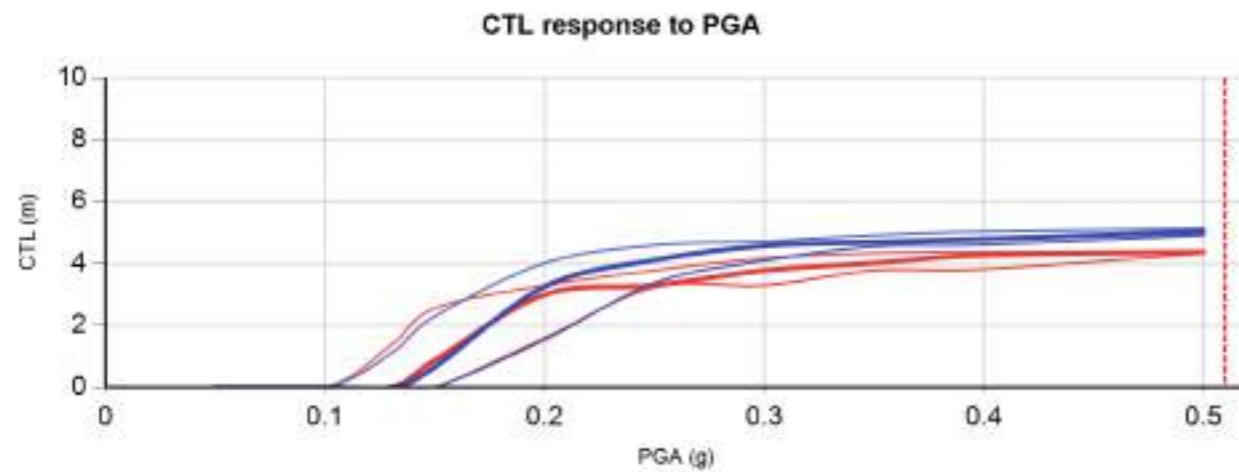
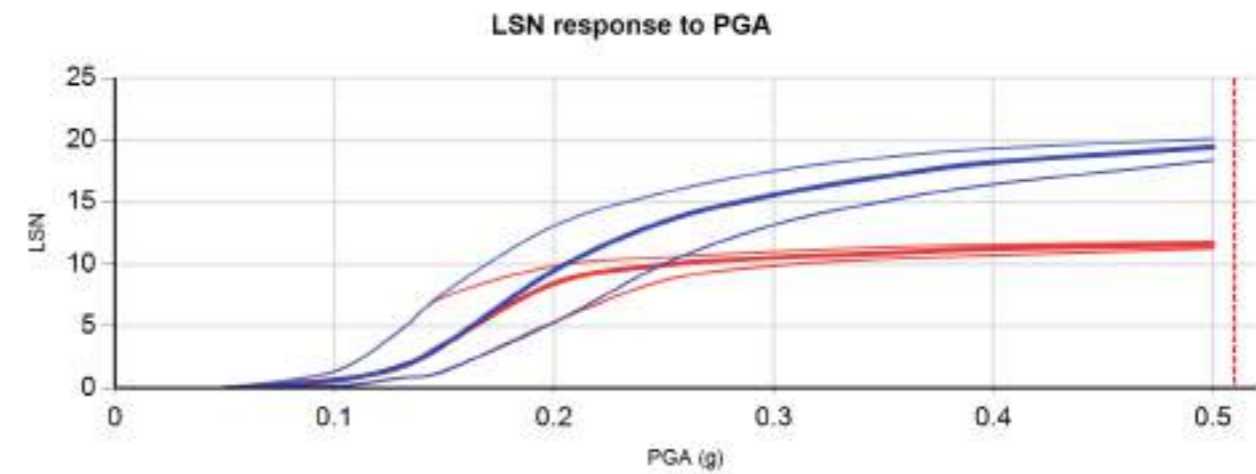
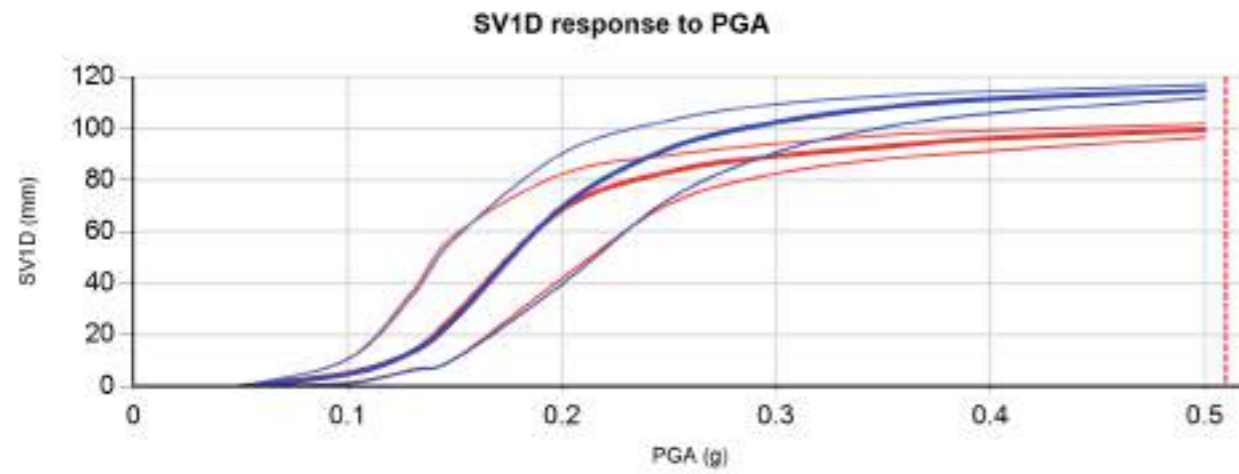
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT06	152811	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT07	152812	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 6 - 7]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

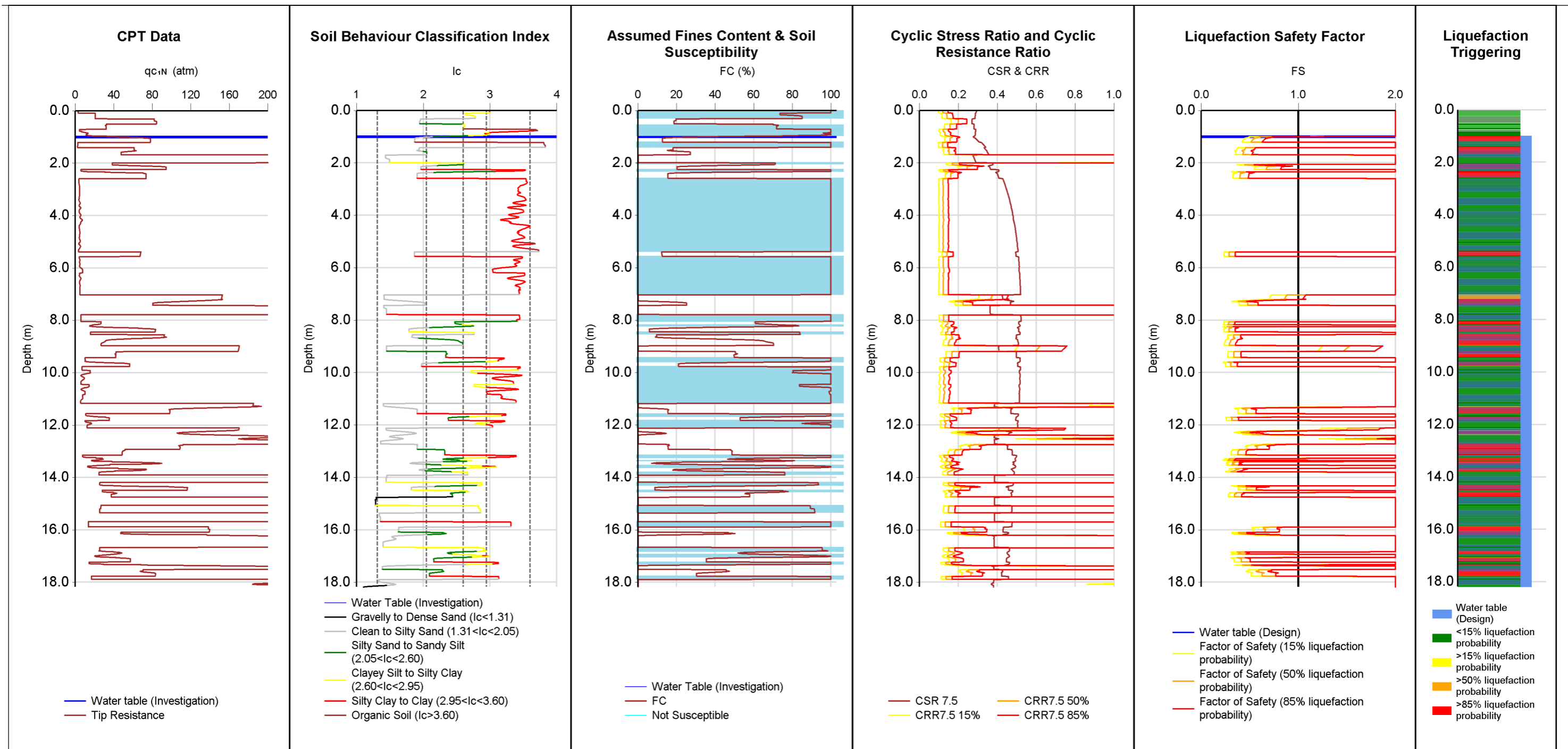
ID	NZGD 152811	NZGD 152812
CPT Name	CPT06	CPT07
Run description	CPT06	CPT07
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	15.58	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	17.58	17.58
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152811	CPT06	0	0	0
NZGD 152811	CPT06	0	15.58	2.6
NZGD 152812	CPT07	0	0	0
NZGD 152812	CPT07	0	17.58	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152811	CPT06	0	15.58	0 CFC
NZGD 152812	CPT07	0	17.58	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

INPUT		Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
		CPT08	152813	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
OUTPUT		PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
		15%	120	5.3	17	23	1.1	16					
		50%	118	5.3	15	23	1.1	13					
		85%	113	5.1	12	22	1.1	11					

Reviewed by:

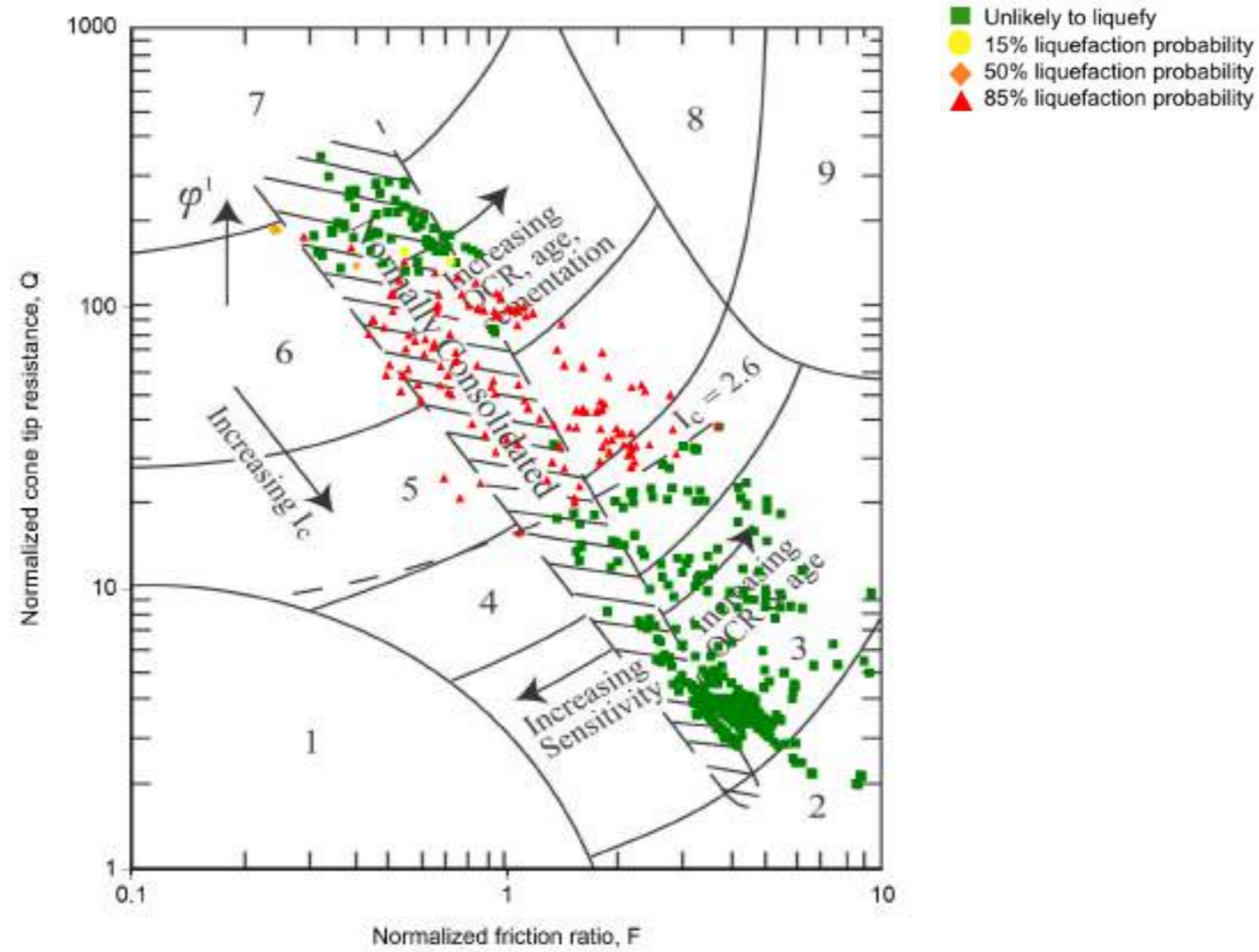
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

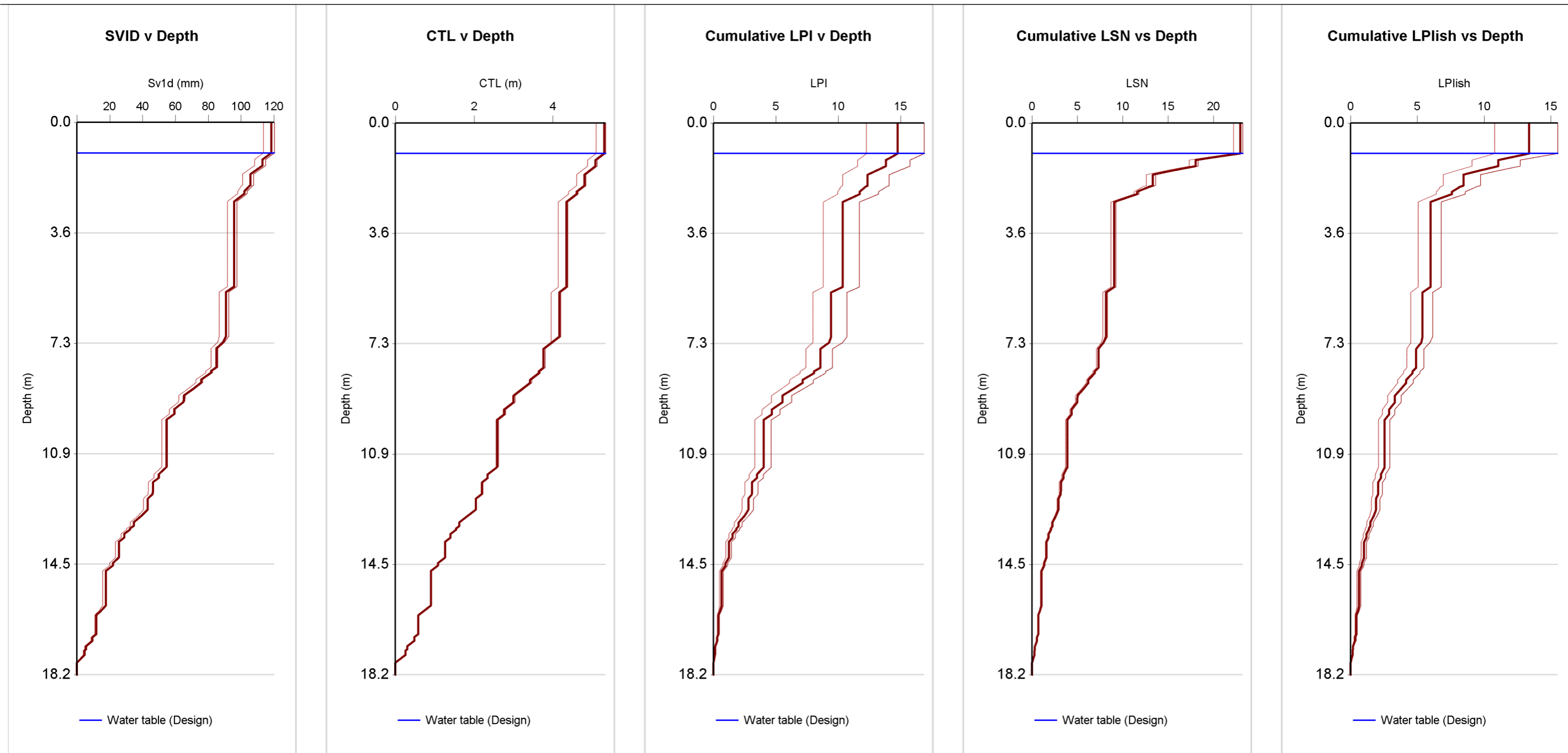


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

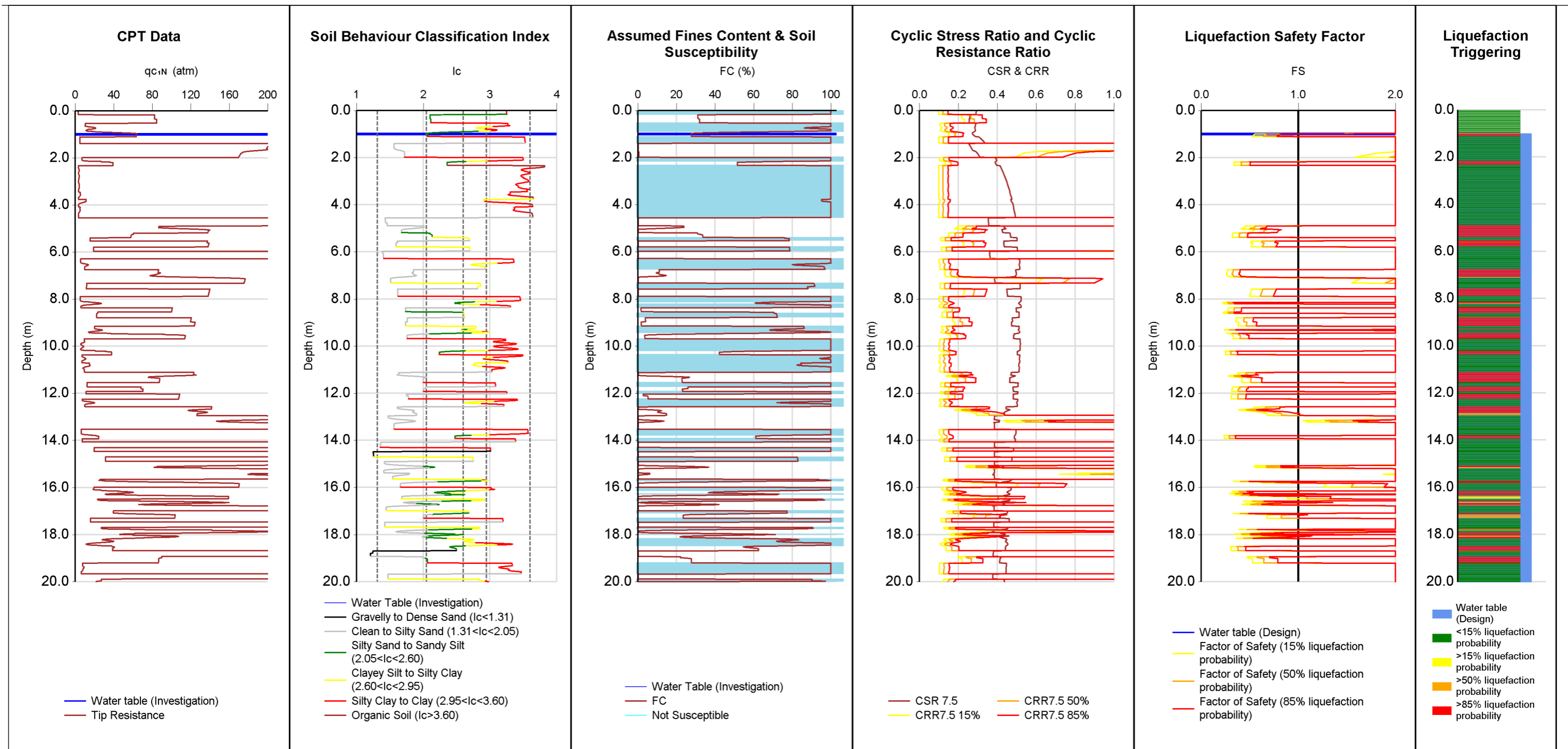
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT08	152813	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	120	5.9	16	16	1.1	11					
50%	115	5.7	13	16	1.1	9					
85%	105	5.3	10	14	1.1	7					

Reviewed by:

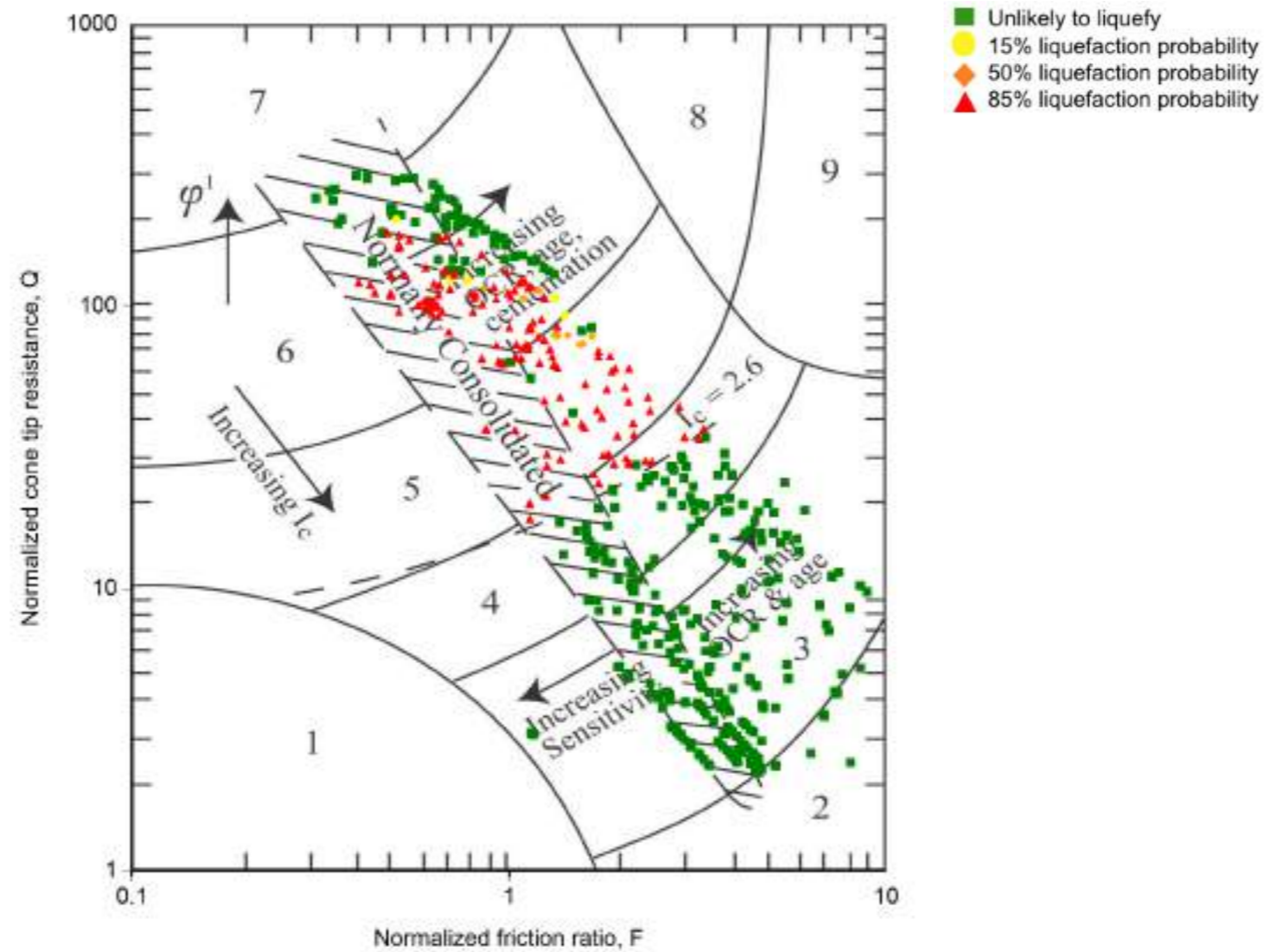
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

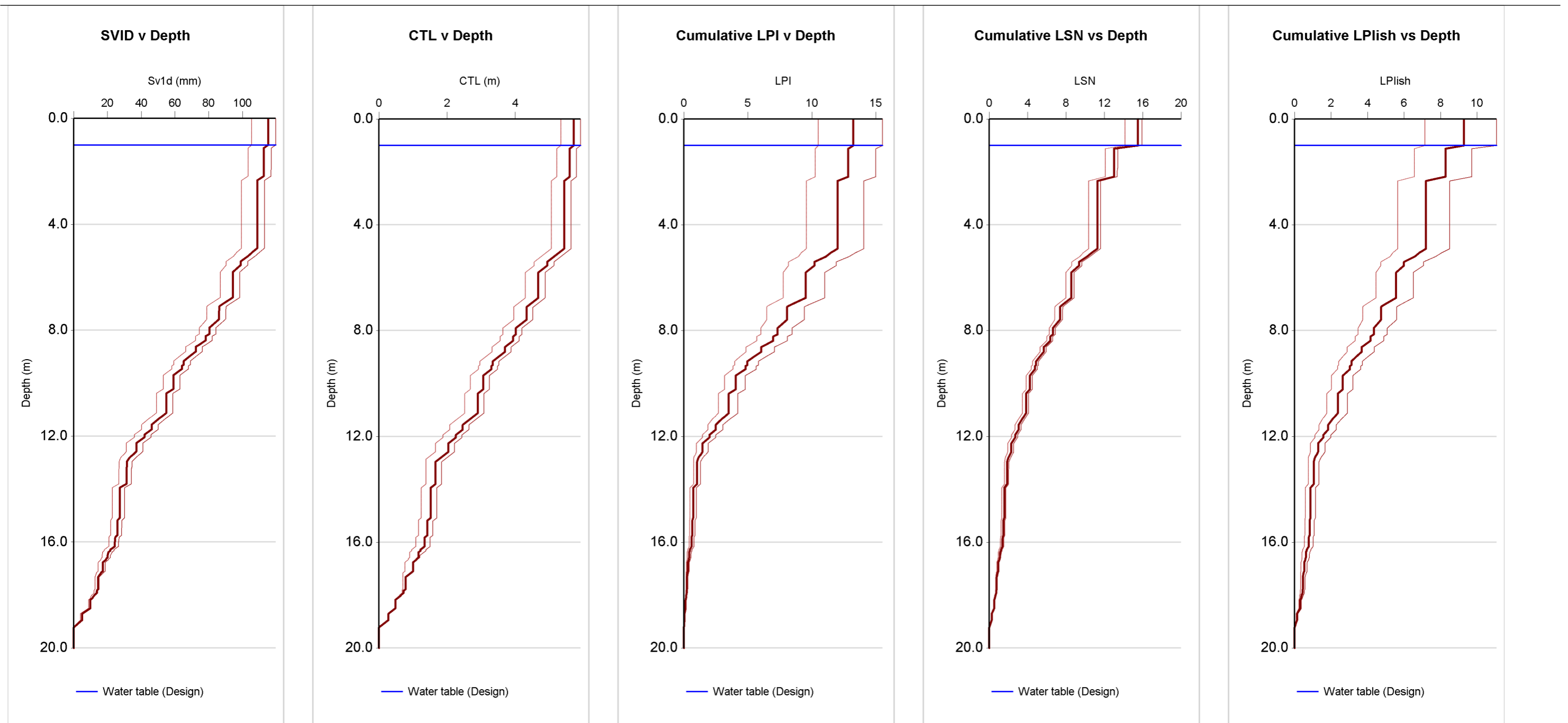


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

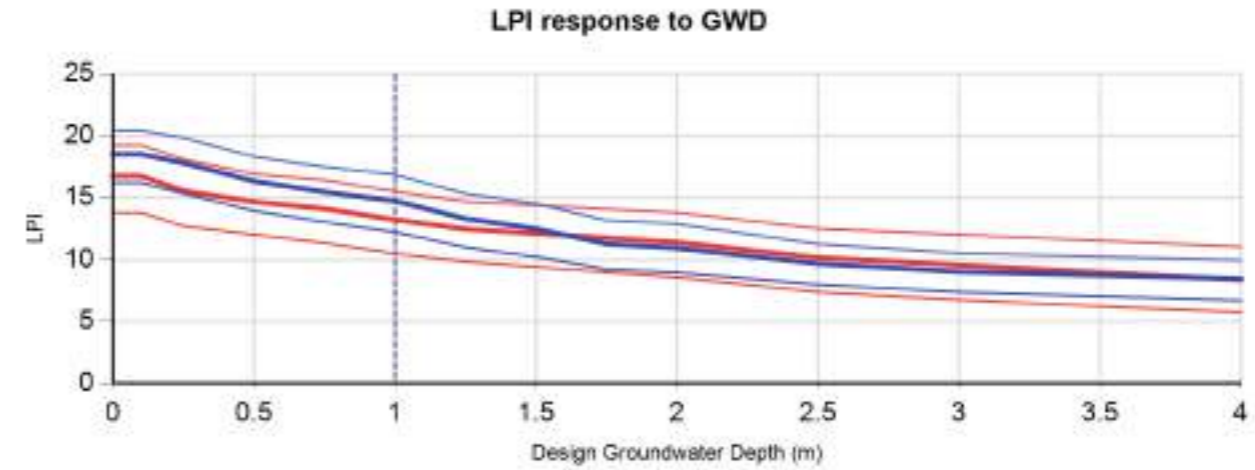
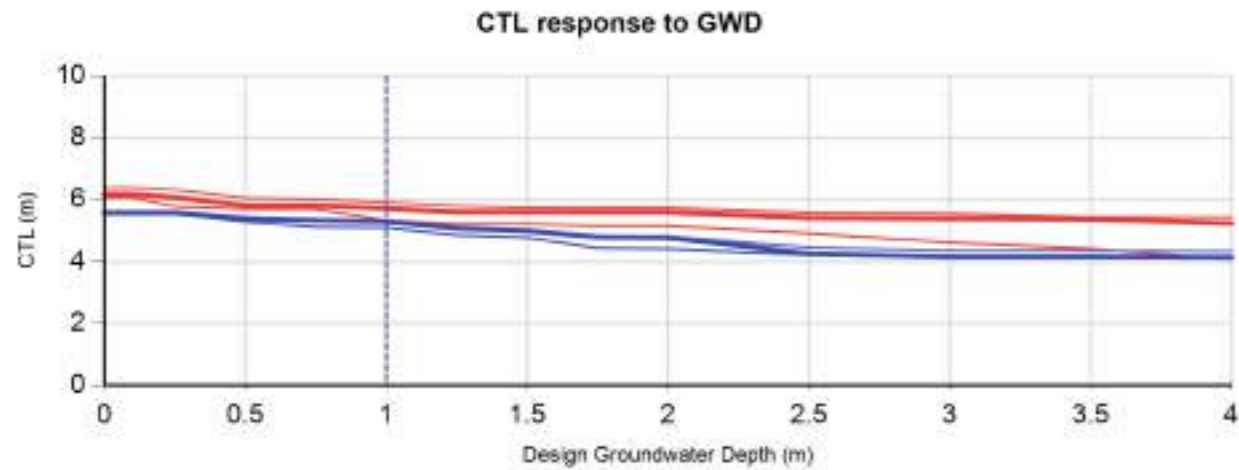
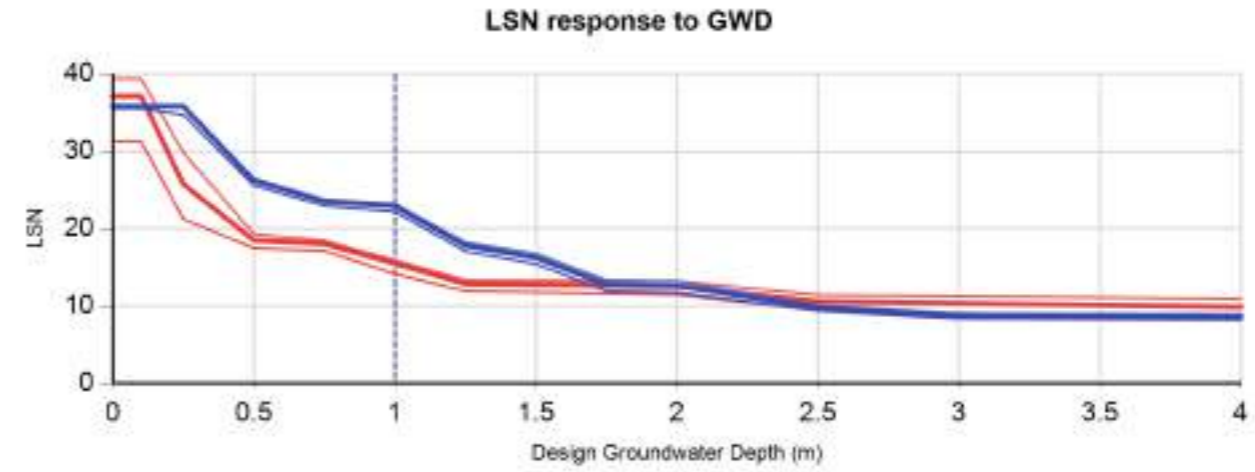
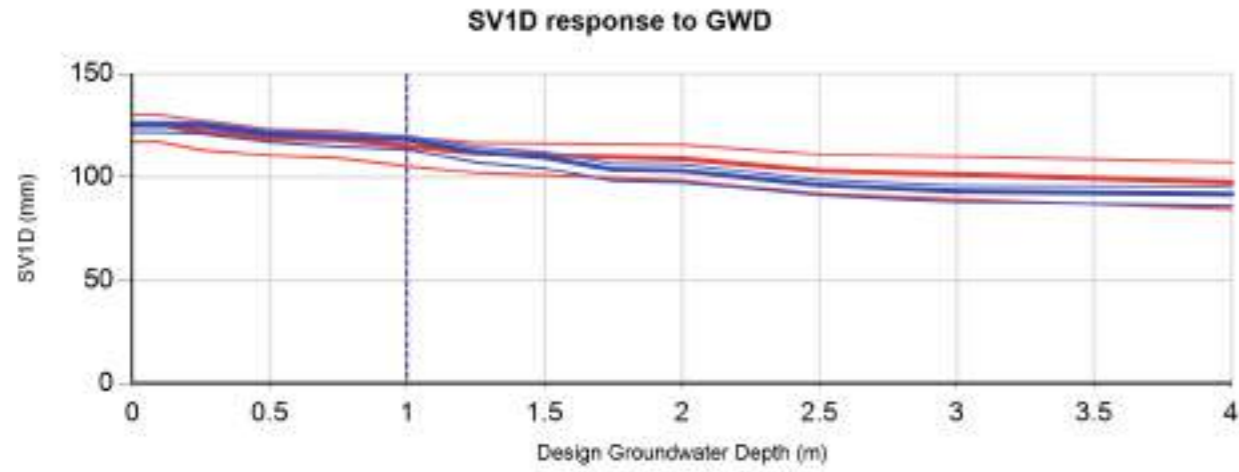
CPT-based soil behavior type classification chart by Robertson (1990)

 Tonkin + Taylor Exceptional thinking together V2.4.15	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT09	152814	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]				




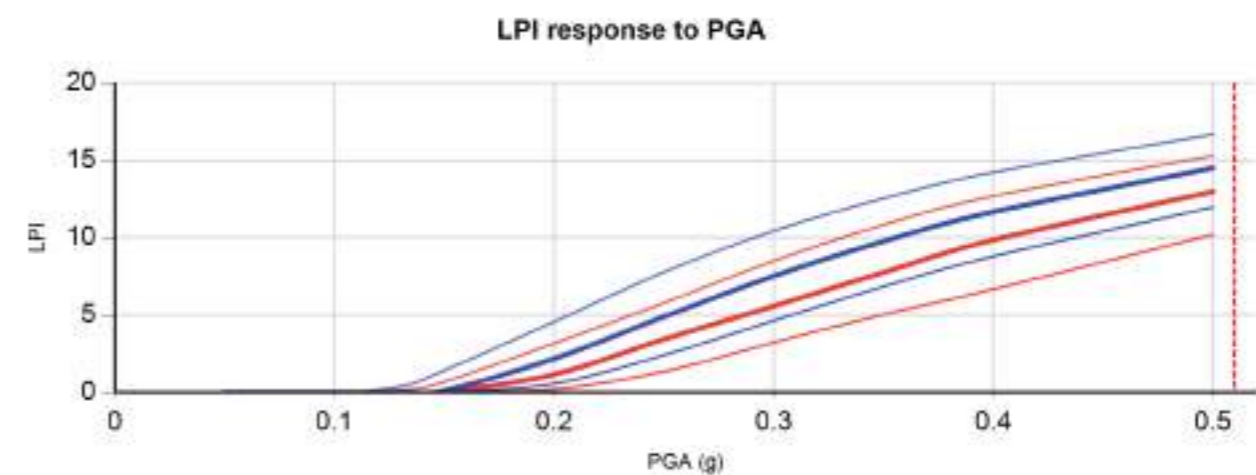
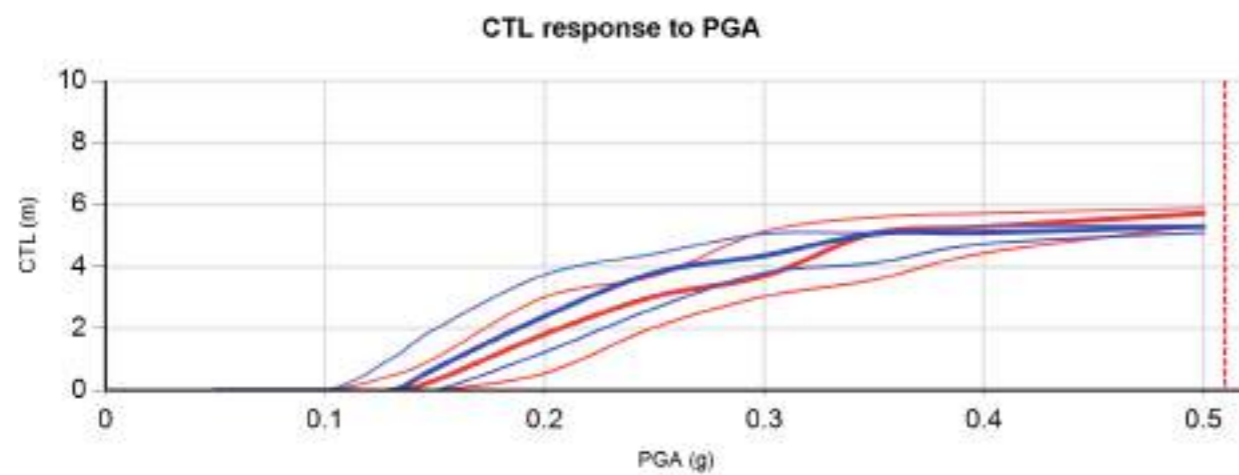
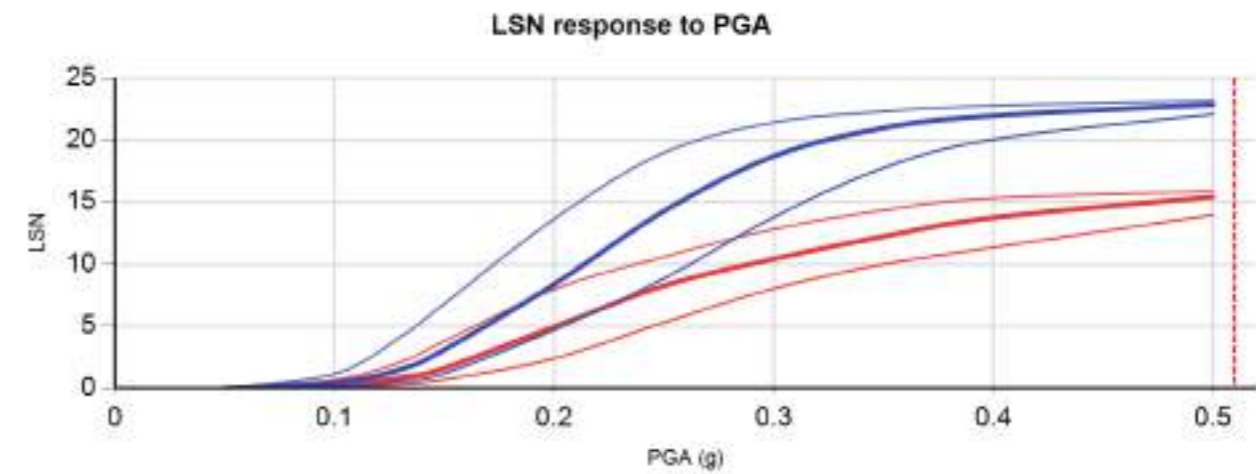
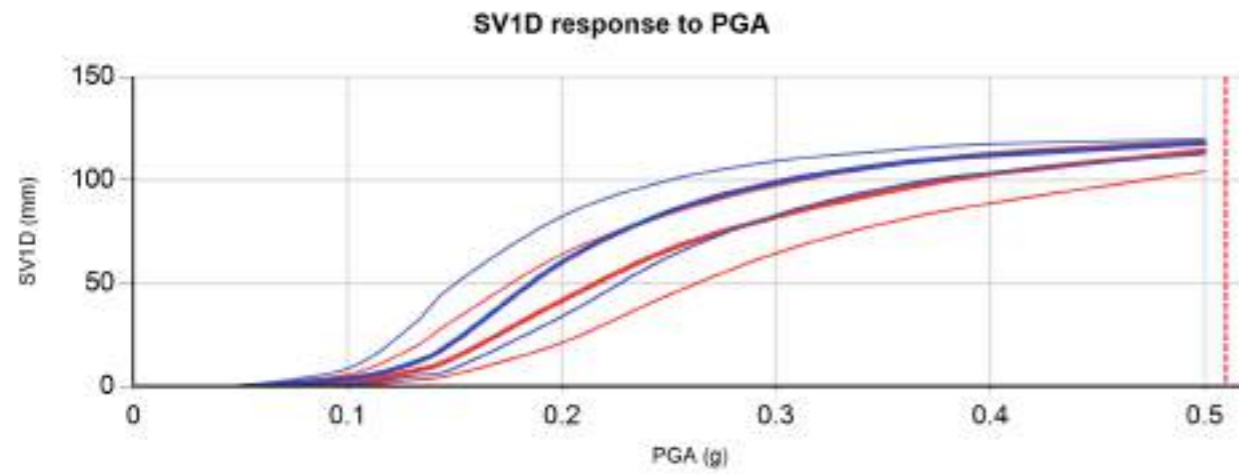
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 8 - 9]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT09	152814	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT08	152813	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

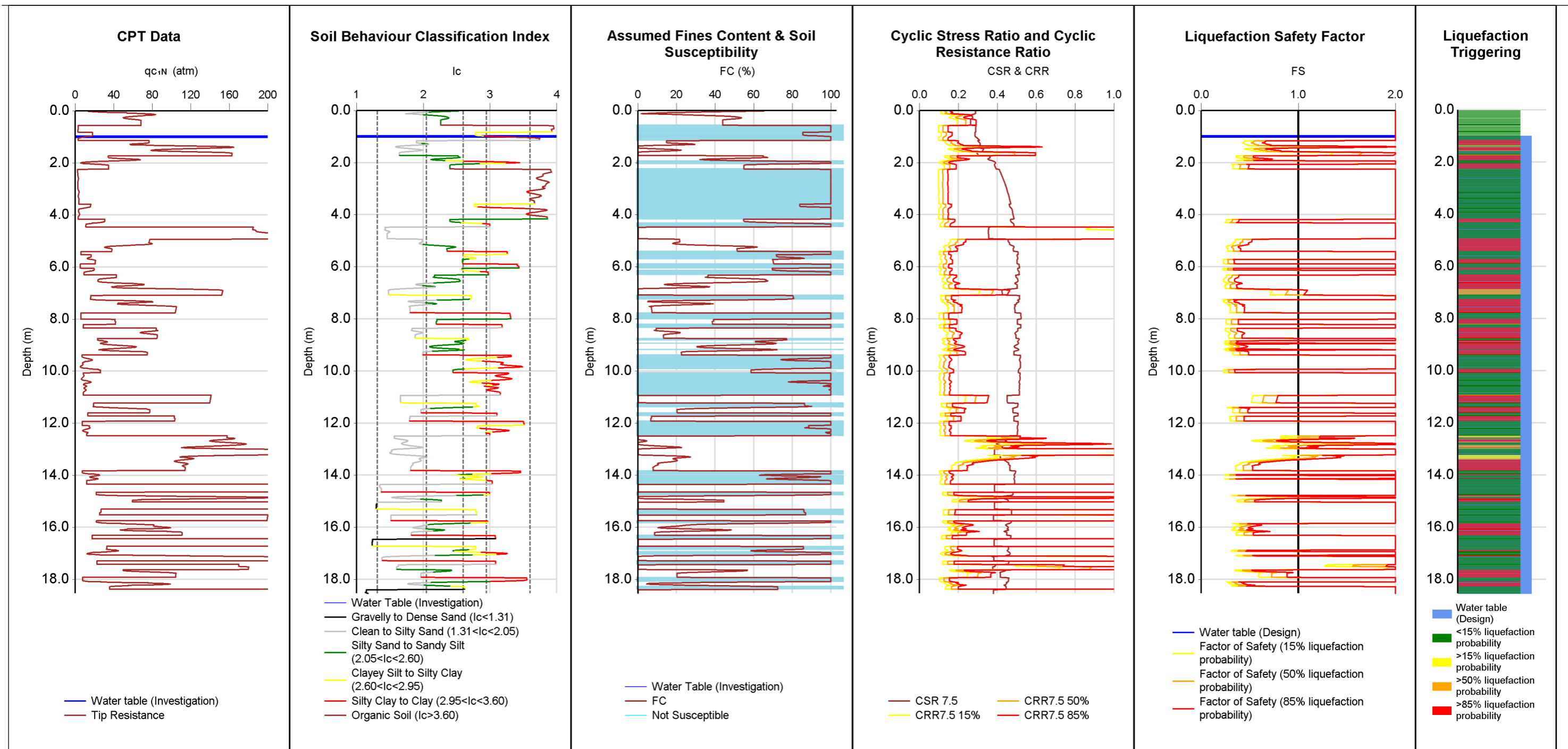
ID	NZGD 152814	NZGD 152813
CPT Name	CPT09	CPT08
Run description	CPT09	CPT08
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	18.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152814	CPT09	0	0	0
NZGD 152814	CPT09	0	20	2.6
NZGD 152813	CPT08	0	0	0
NZGD 152813	CPT08	0	18.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152814	CPT09	0	20	0 CFC
NZGD 152813	CPT08	0	18.18	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

INPUT		Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
		CPT10	152815	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
OUTPUT		PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
		15%	157	7.2	24	27	1.2	19					
		50%	152	7	21	27	1.2	16					
		85%	146	6.5	18	25	1.2	13					

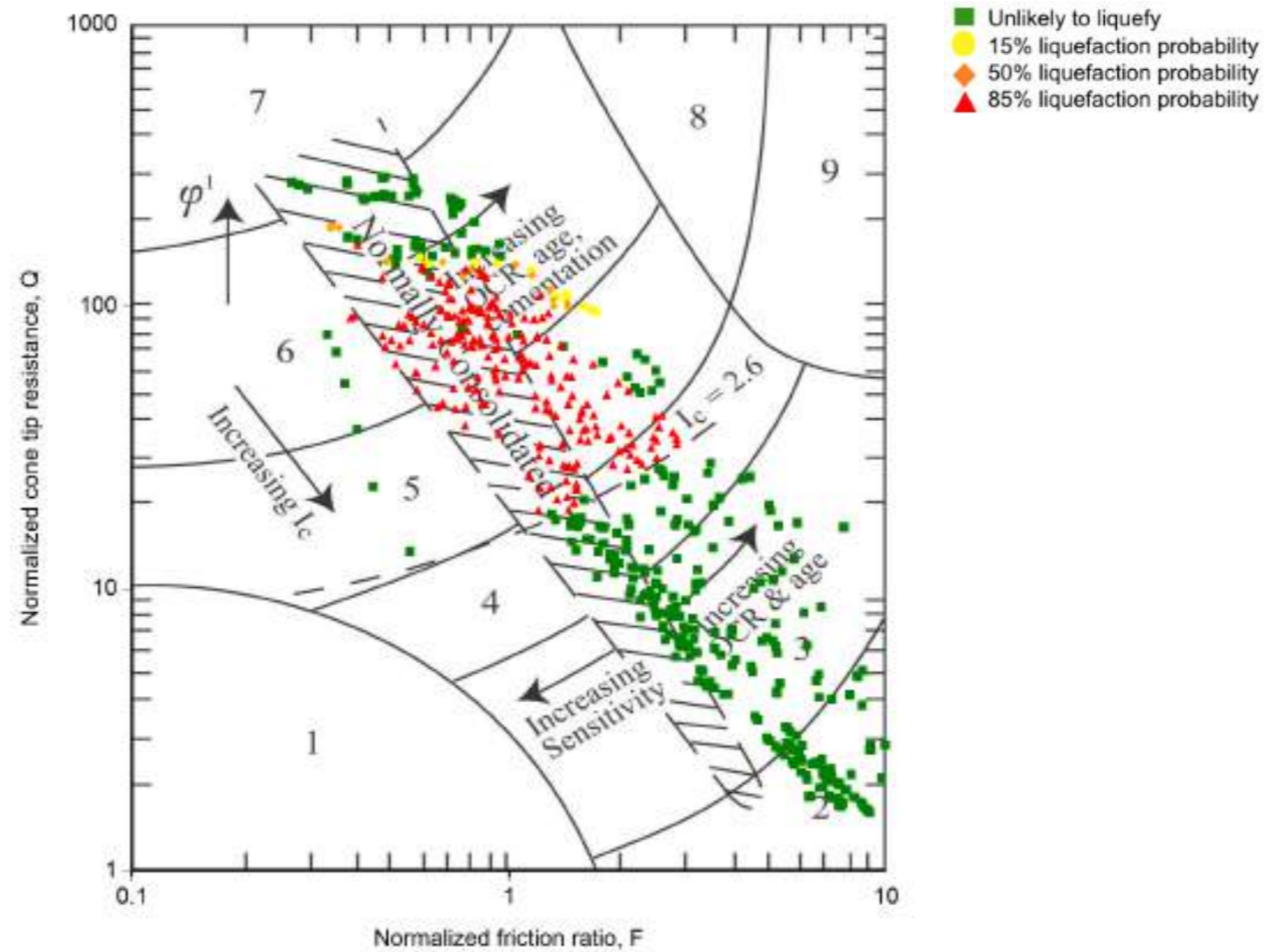
Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15


CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafz
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	1 of 9 pages
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 10 - 11]				

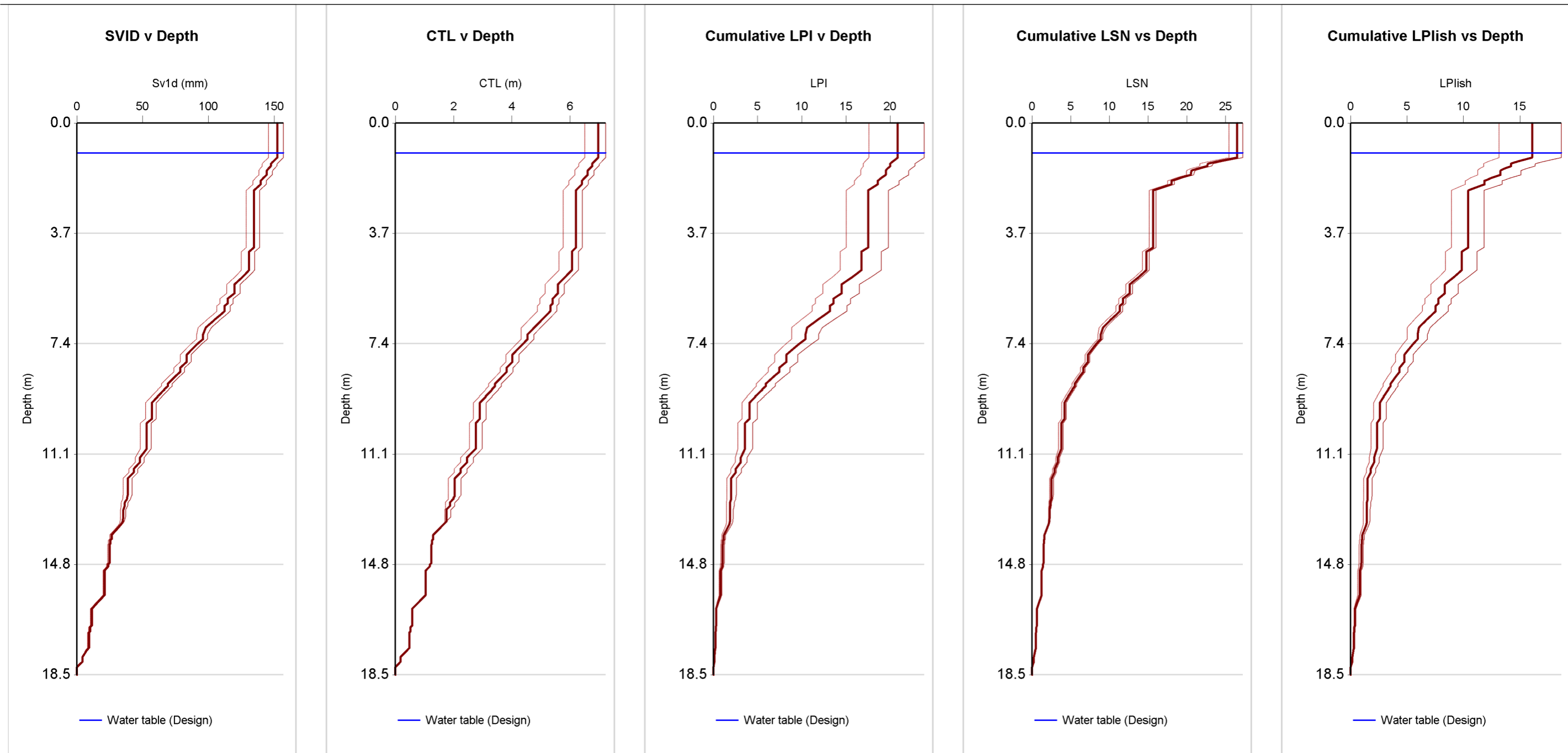


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

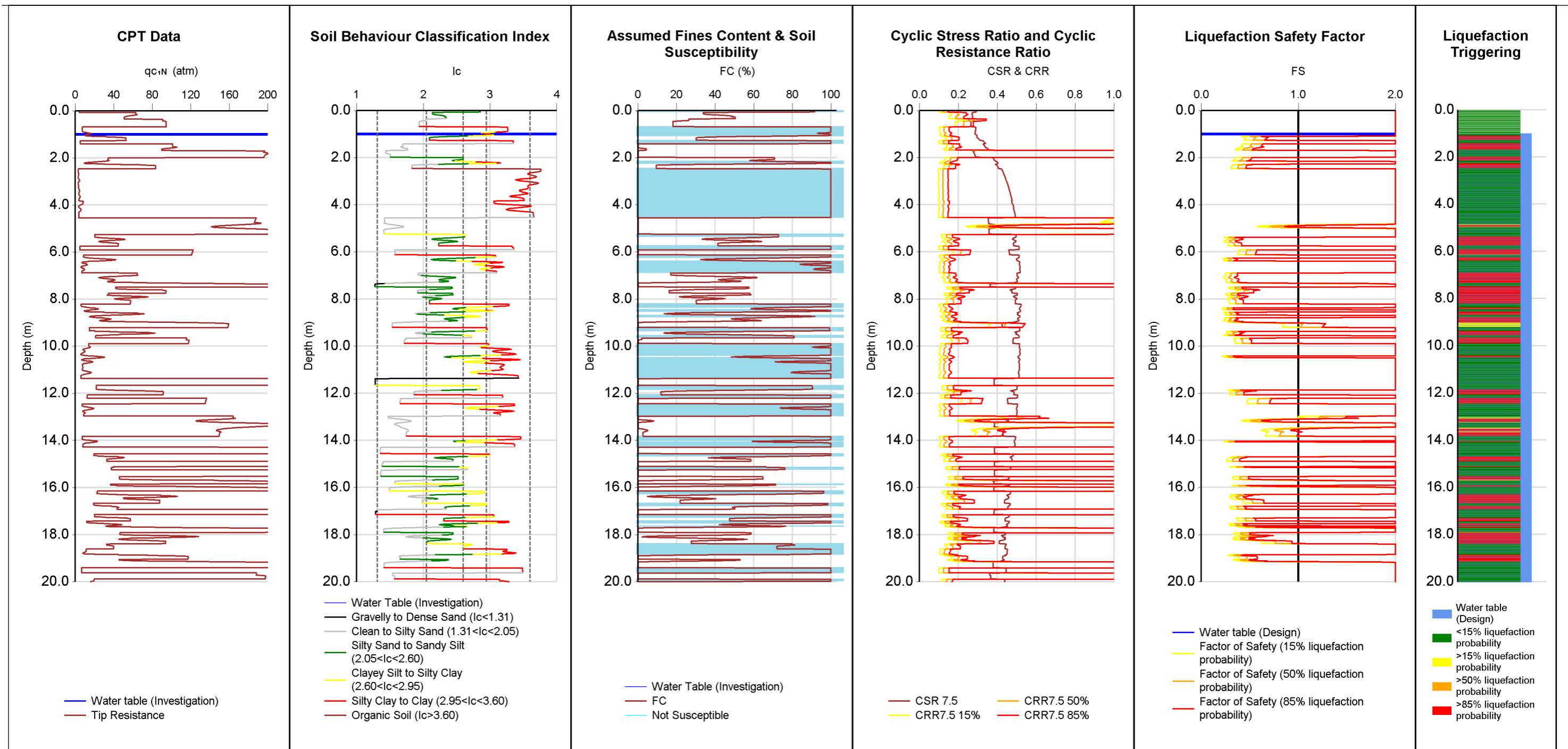
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER		
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 10 - 11]	1009171	PAGE	2 of 9 pages



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT10	152815	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT11	152816	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	155	7.1	21	26	1.2	18					
50%	150	6.8	19	25	1.2	16					
85%	145	6.6	16	25	1.2	13					

Reviewed by:

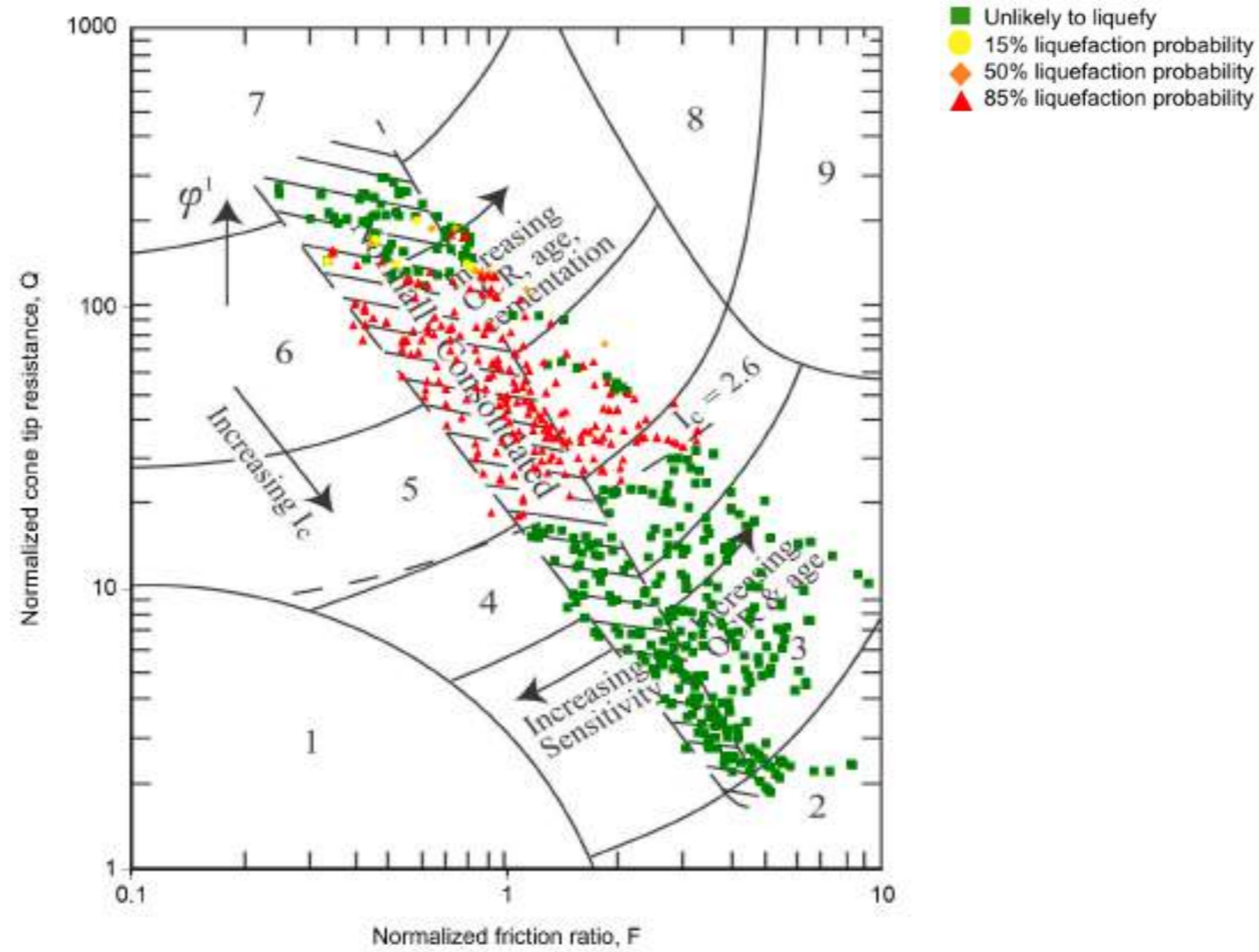
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 10 - 11]**


LOCATION **Napier**
DATE **10/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **4 of 9 pages**

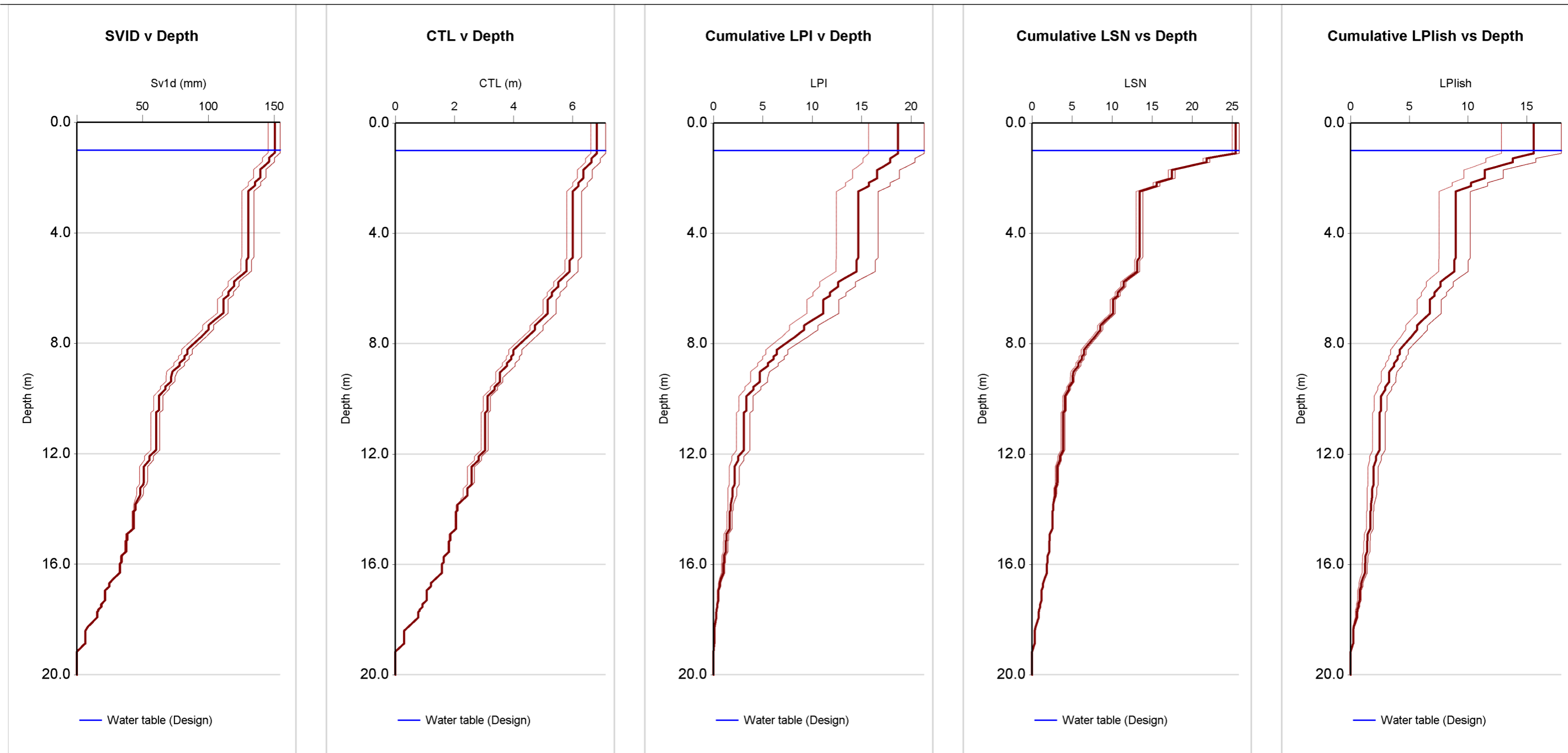


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

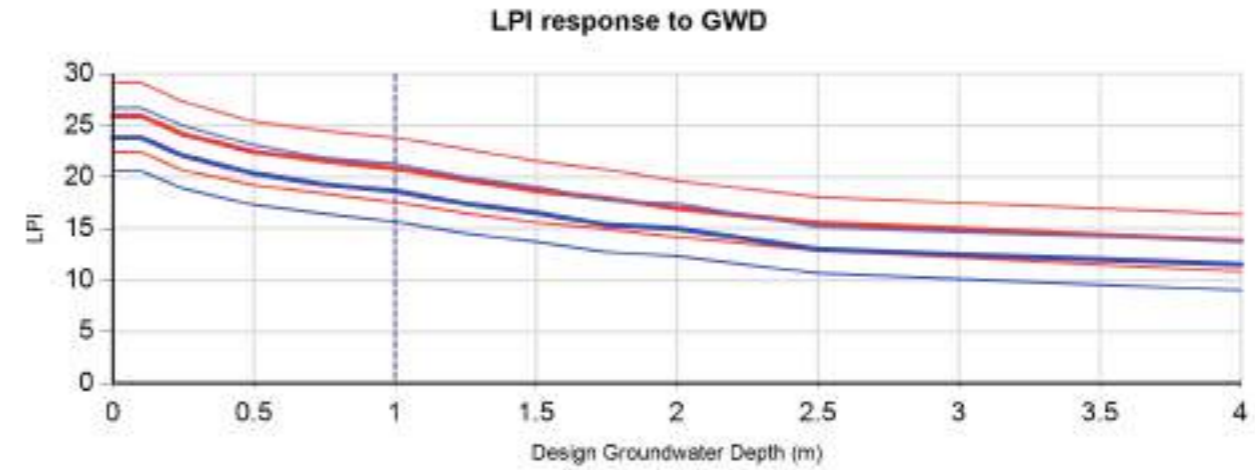
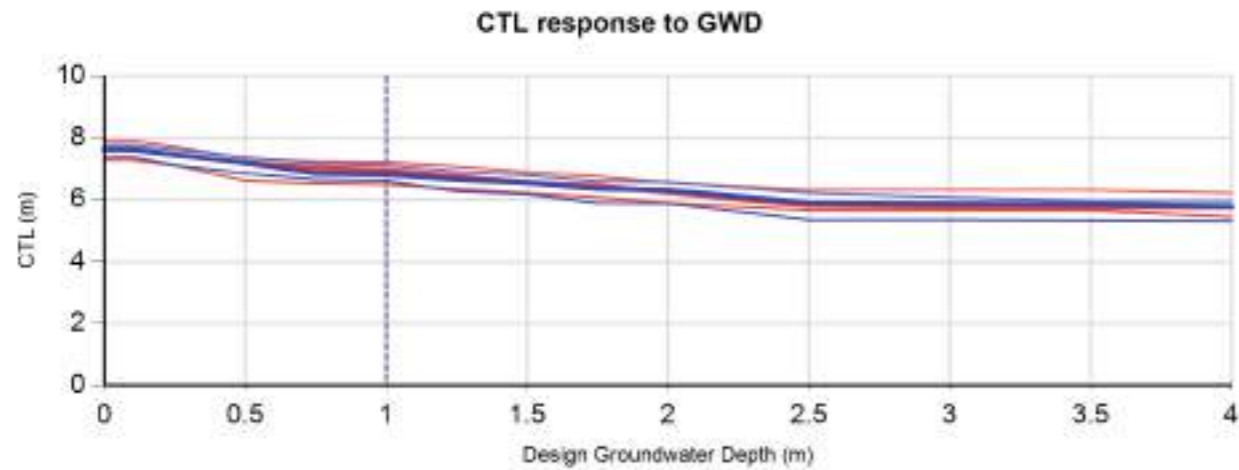
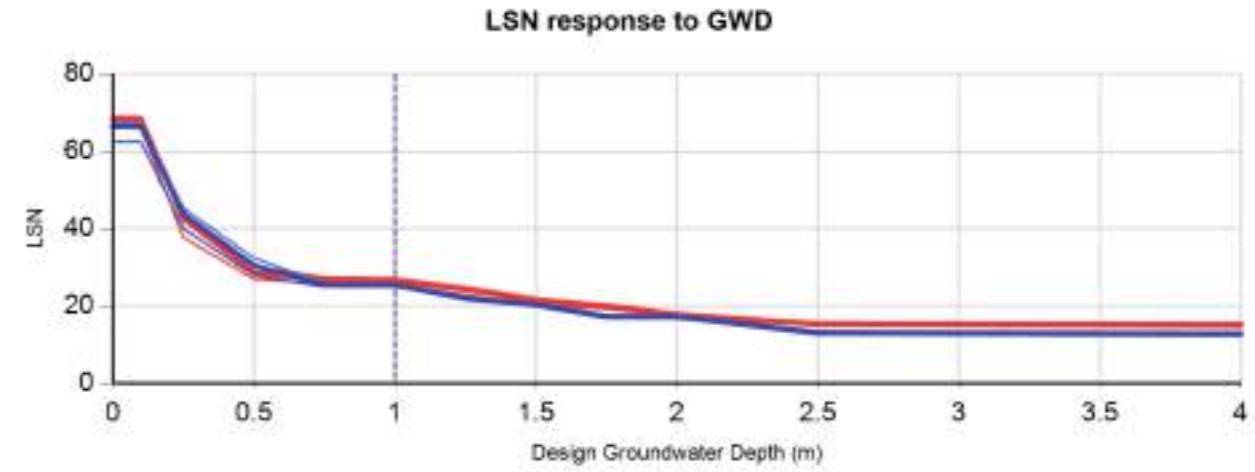
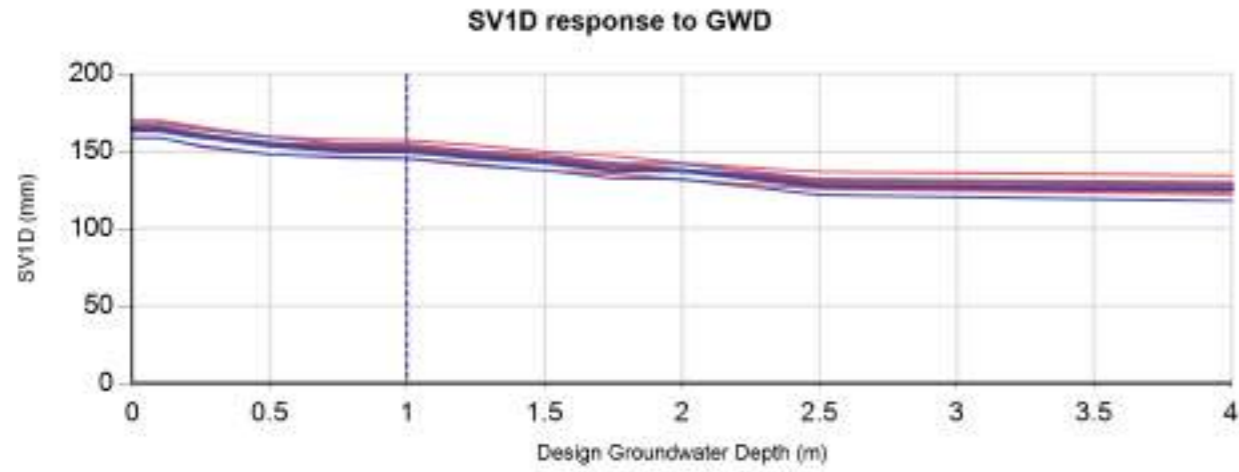
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 10 - 11]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT11	152816	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	




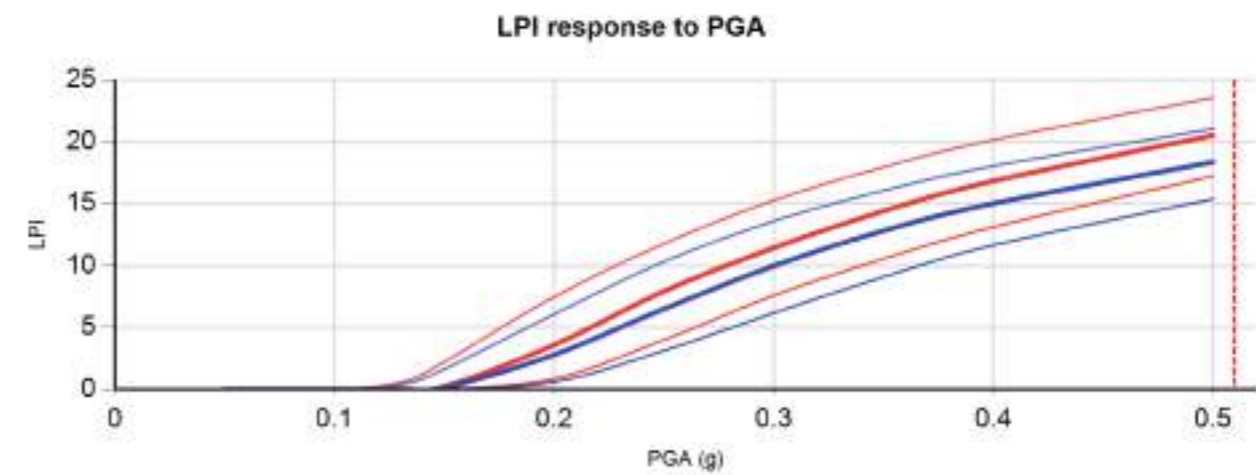
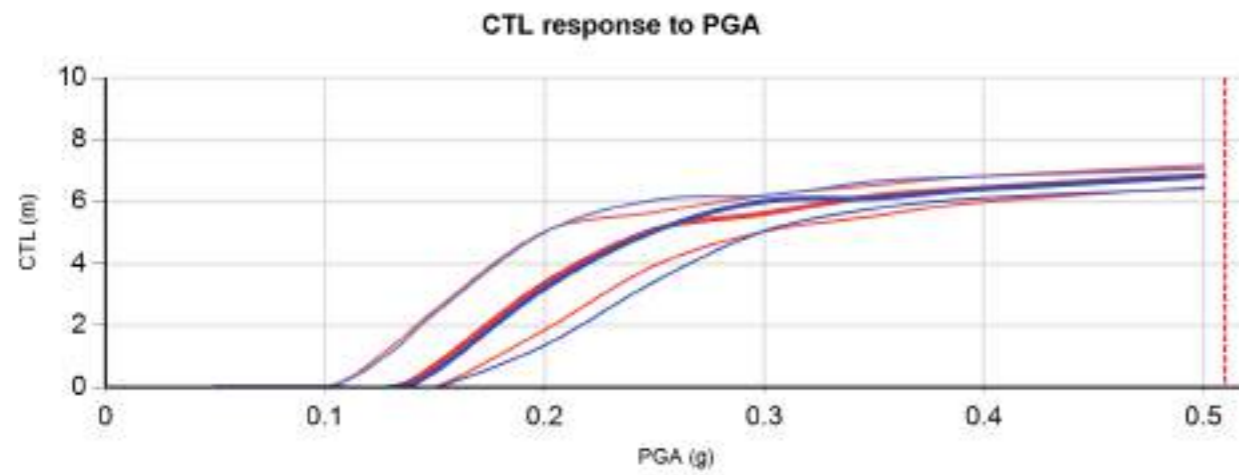
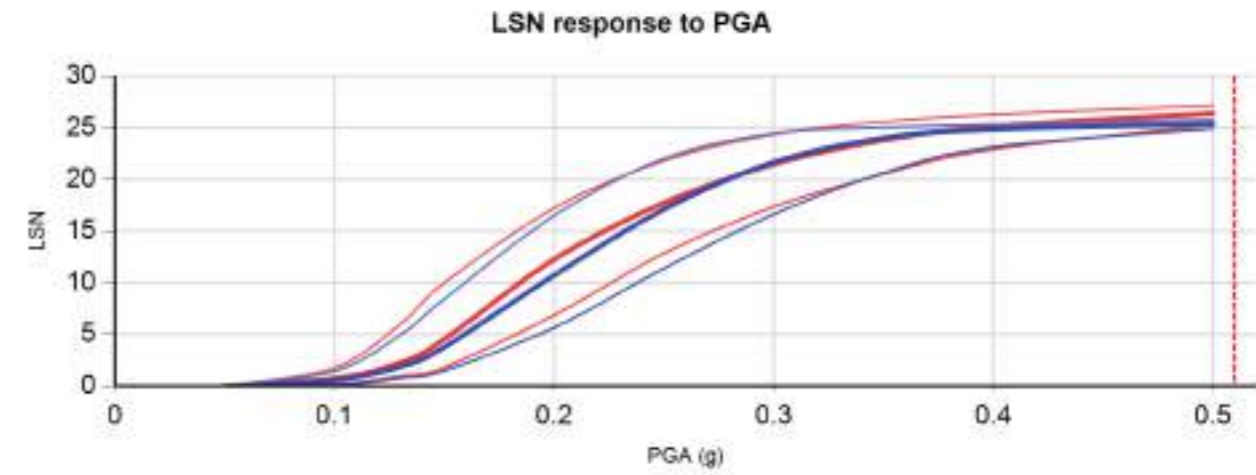
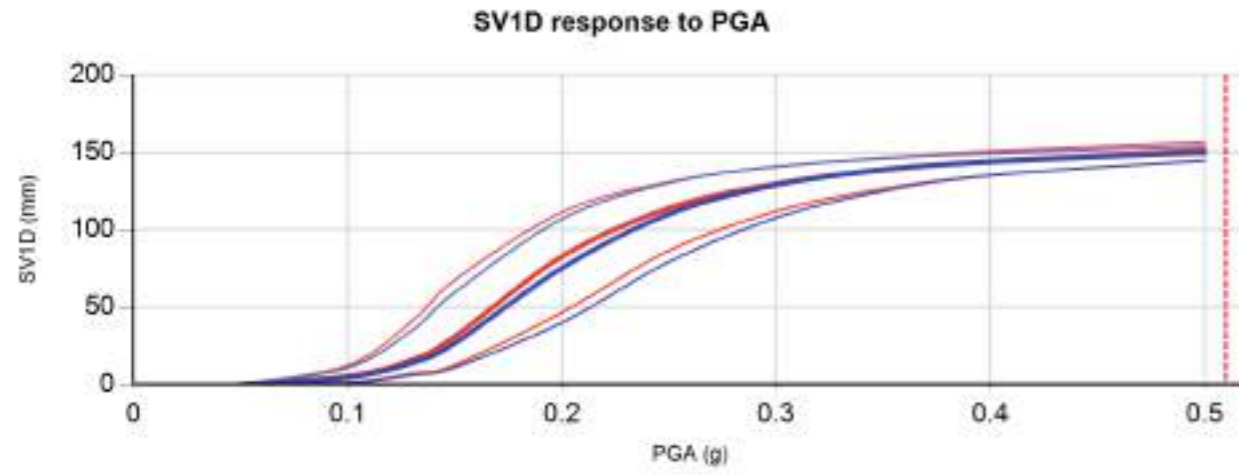
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

	Tonkin + Taylor Exceptional thinking together V2.4.15	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
		PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
		TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
		COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 10 - 11]				



Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT10	152815	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT11	152816	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

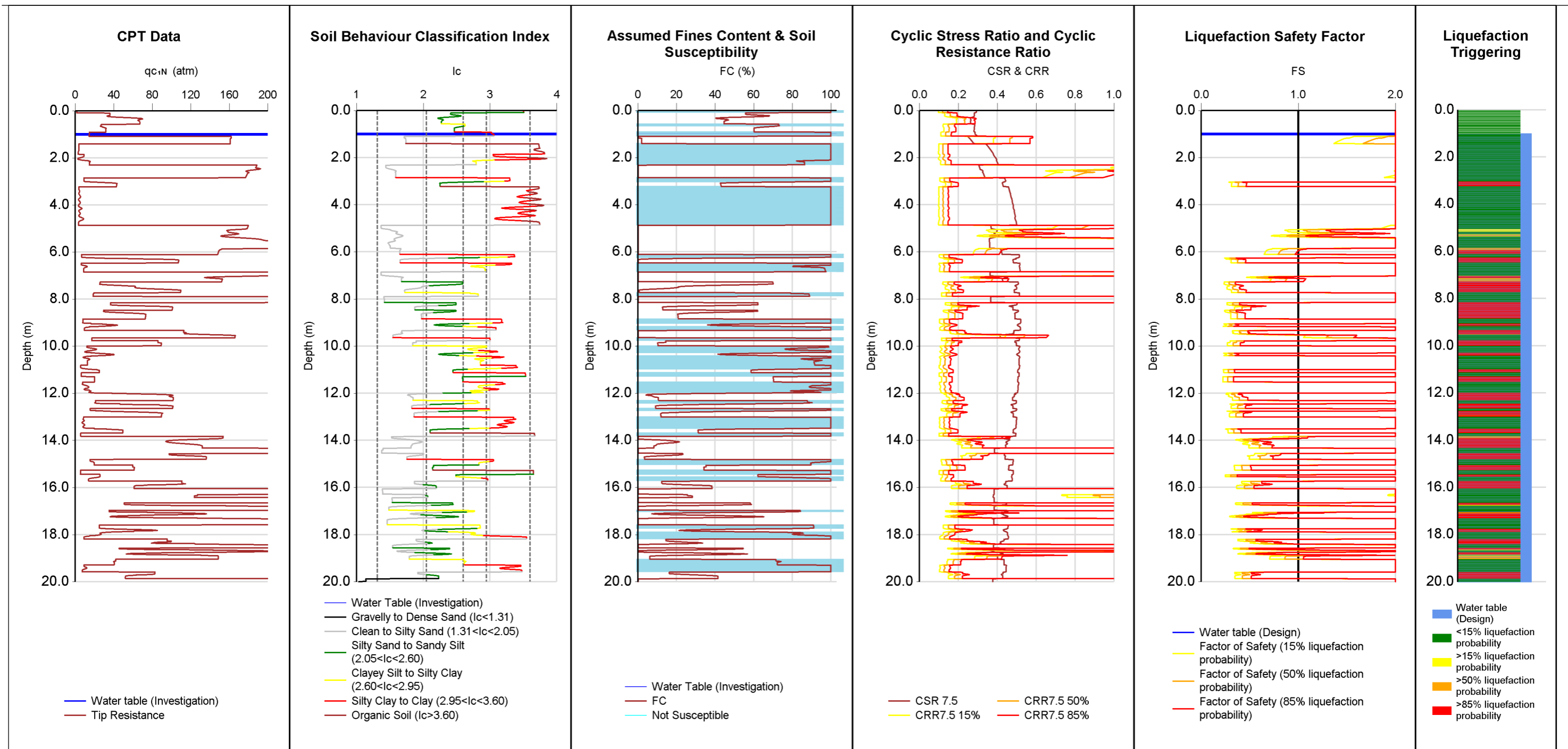
ID	NZGD 152815	NZGD 152816
CPT Name	CPT10	CPT11
Run description	CPT10	CPT11
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.54	20
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of I_c inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	I _c
NZGD 152815	CPT10	0	0	0
NZGD 152815	CPT10	0	18.54	2.6
NZGD 152816	CPT11	0	0	0
NZGD 152816	CPT11	0	20	2.6

Table 1.1-3 Summary of F_c inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	F _c
NZGD 152815	CPT10	0	18.54	0 CFC
NZGD 152816	CPT11	0	20	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT12	152817	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	150	7.1	17	15	3.1	11					
50%	144	6.8	15	14	3.1	9					
85%	136	6.3	12	13	3.1	8					

Reviewed by:

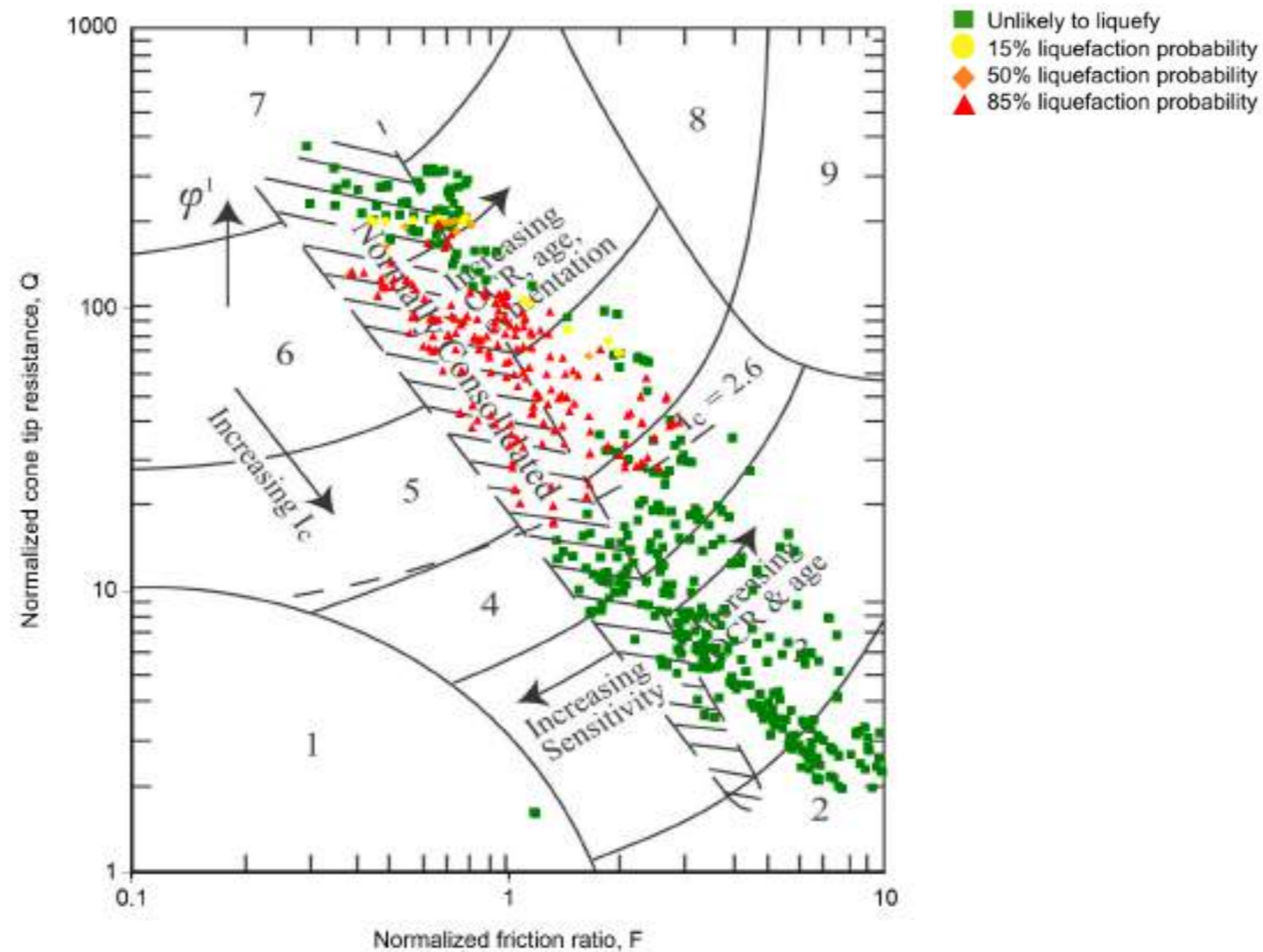
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]**

LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

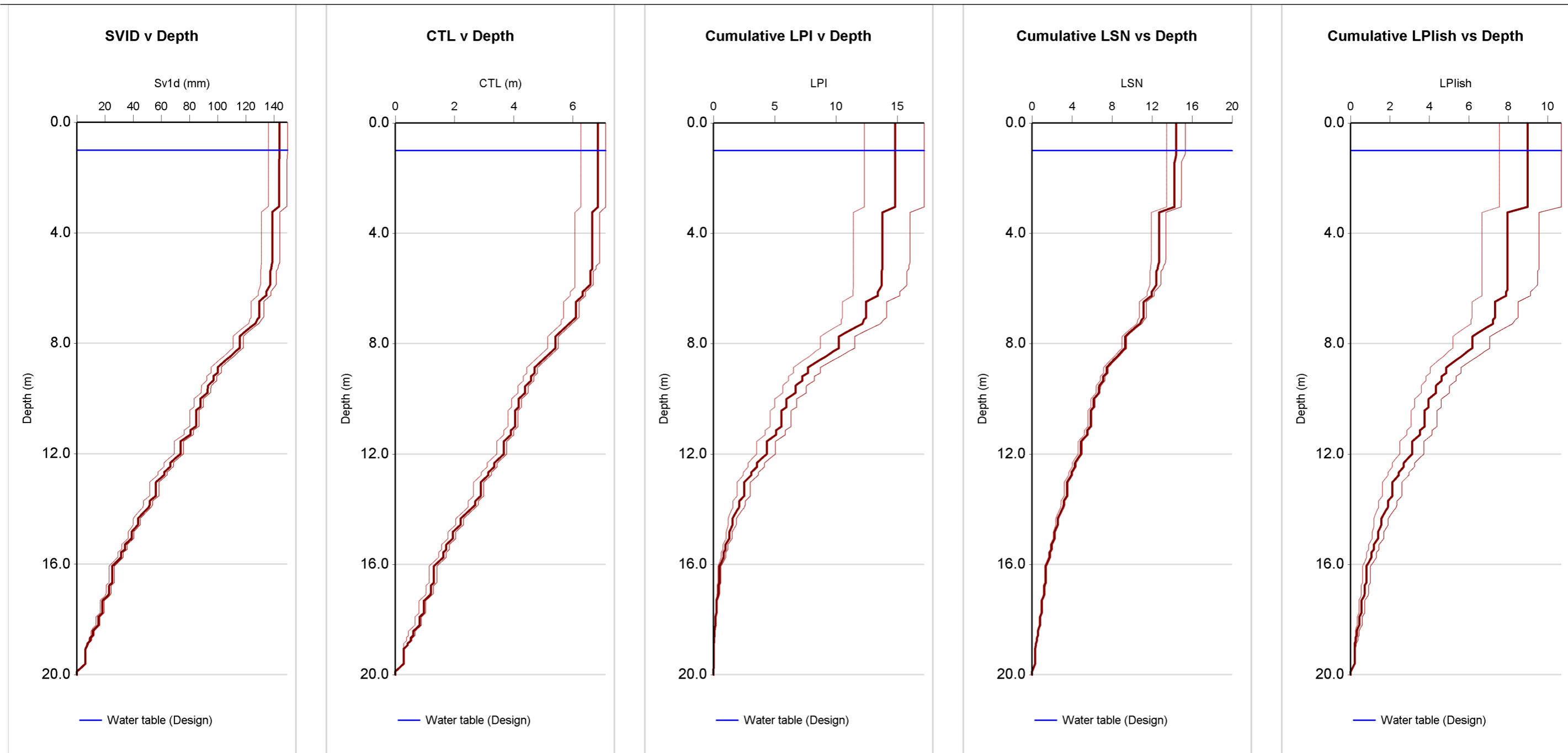


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

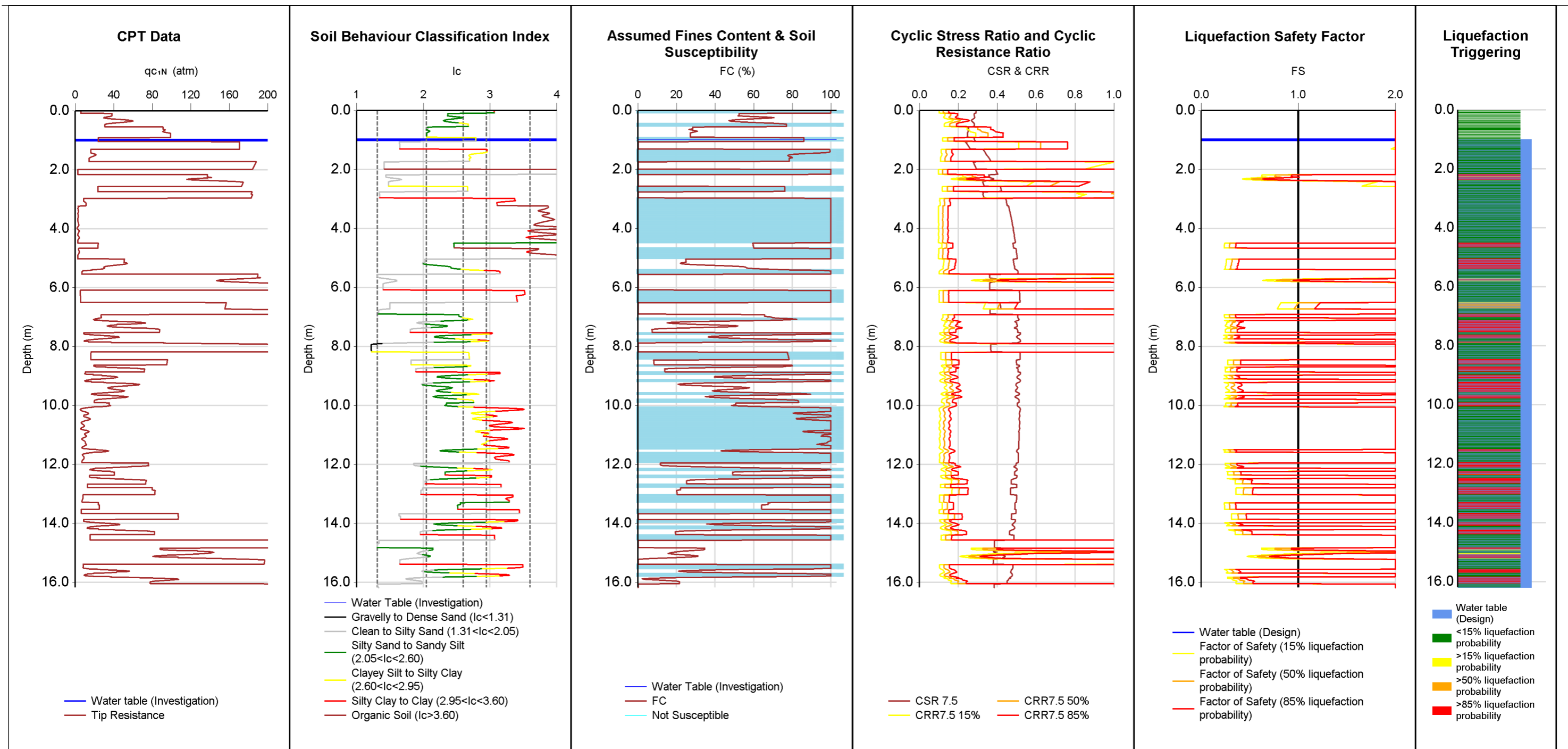
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT12	152817	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	119	5.2	17	15	2.3	10					
50%	116	5.1	15	14	2.3	9					
85%	113	4.8	13	13	2.3	8					

Reviewed by:

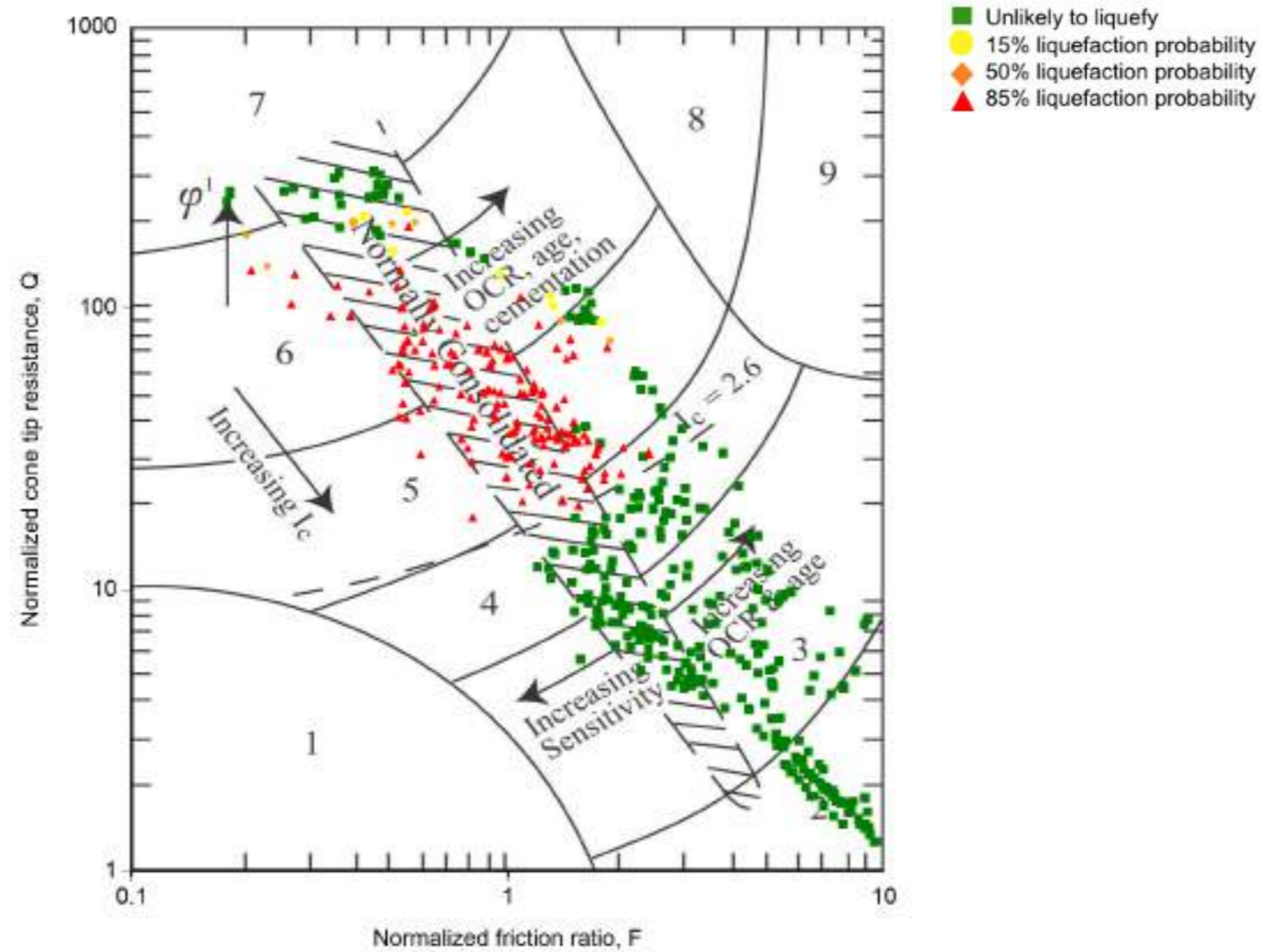
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]**

LOCATION **Napier**
DATE **10/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **4 of 9 pages**



- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

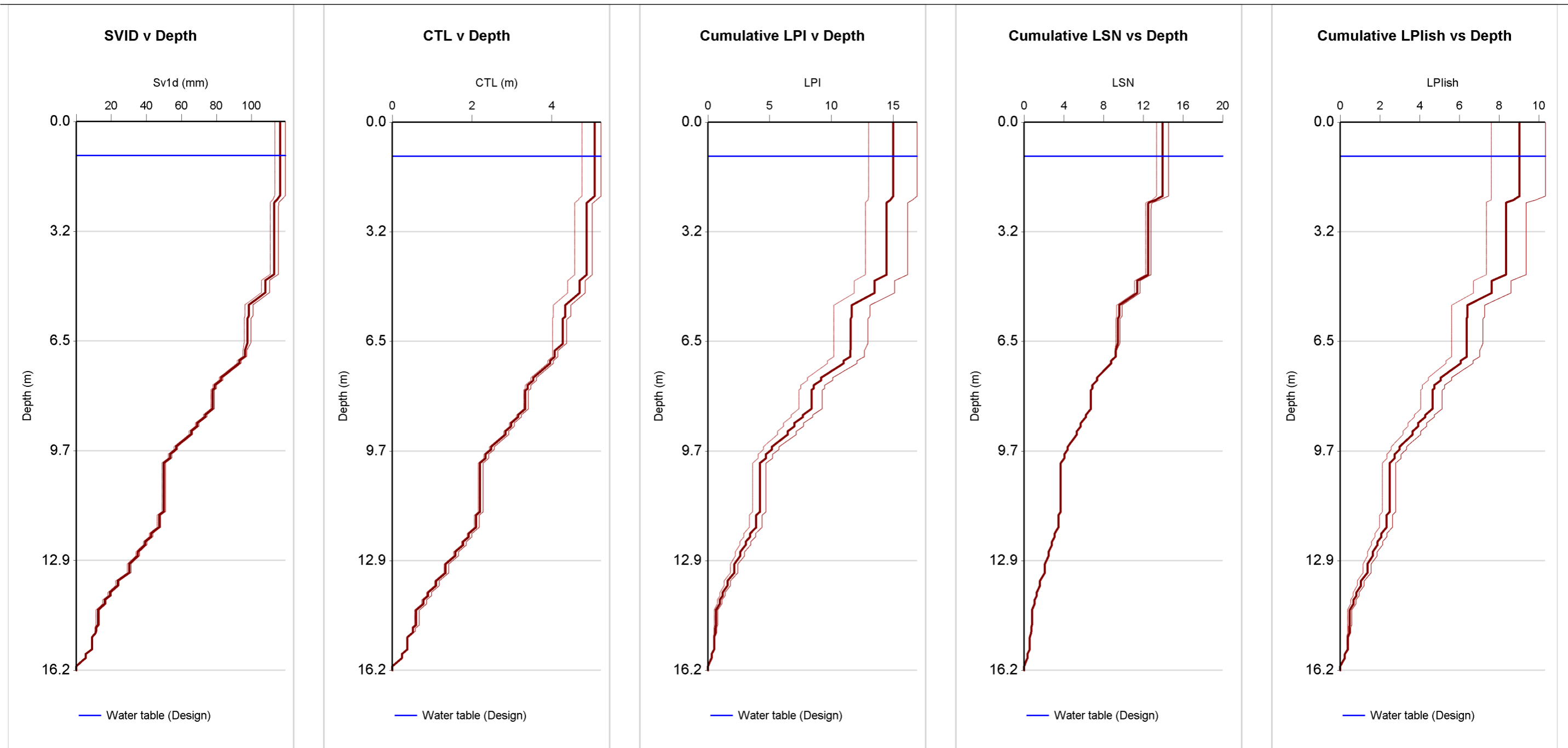
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




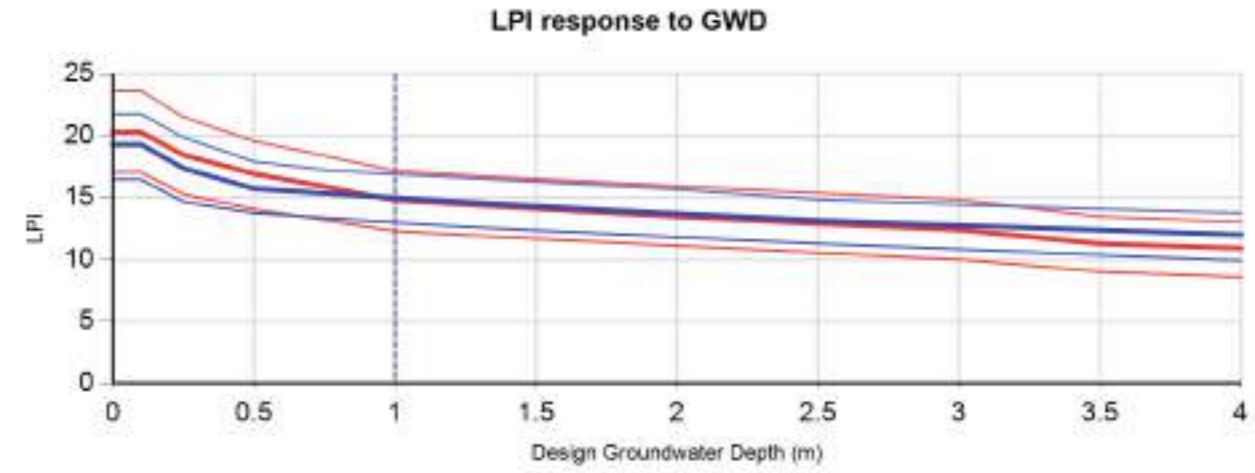
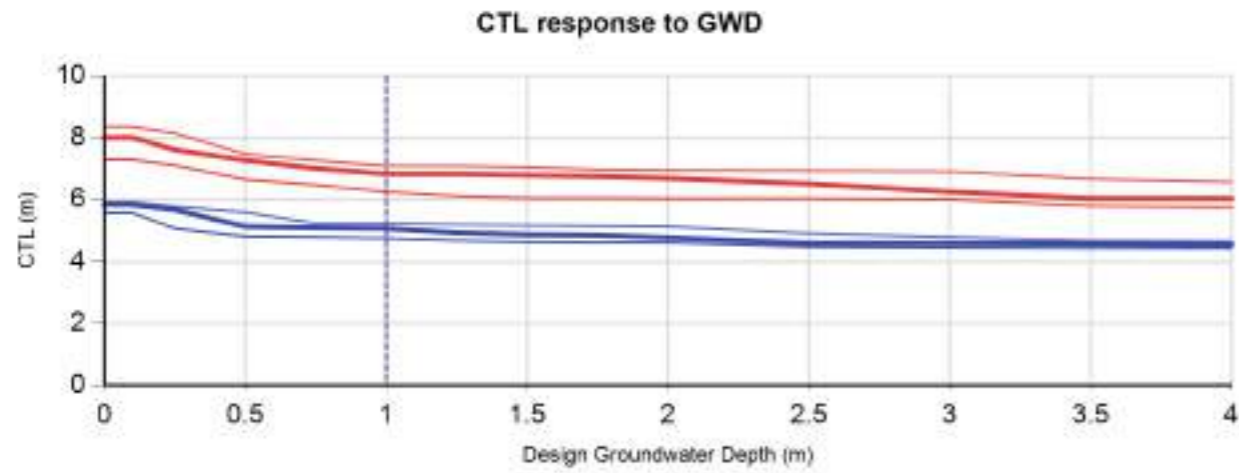
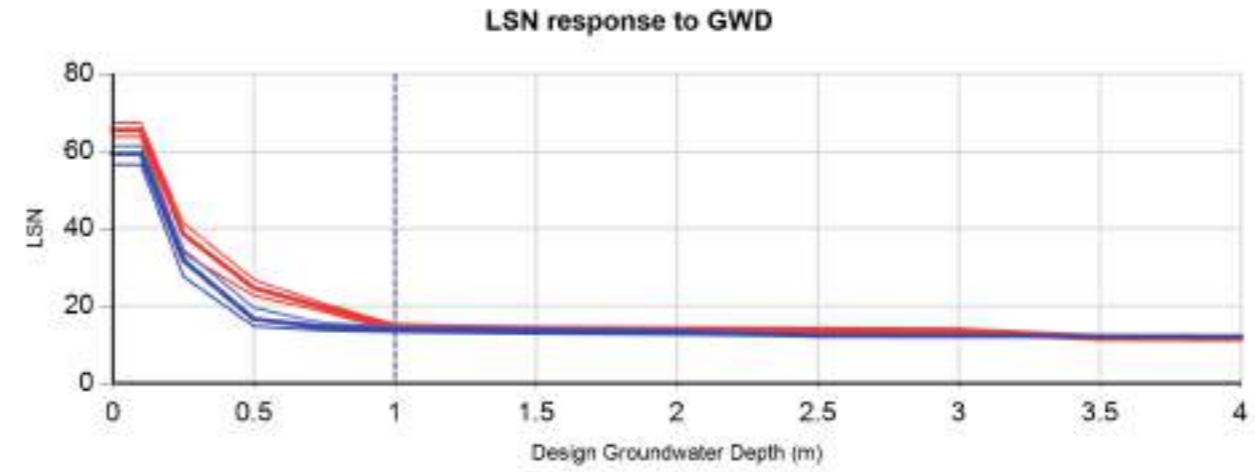
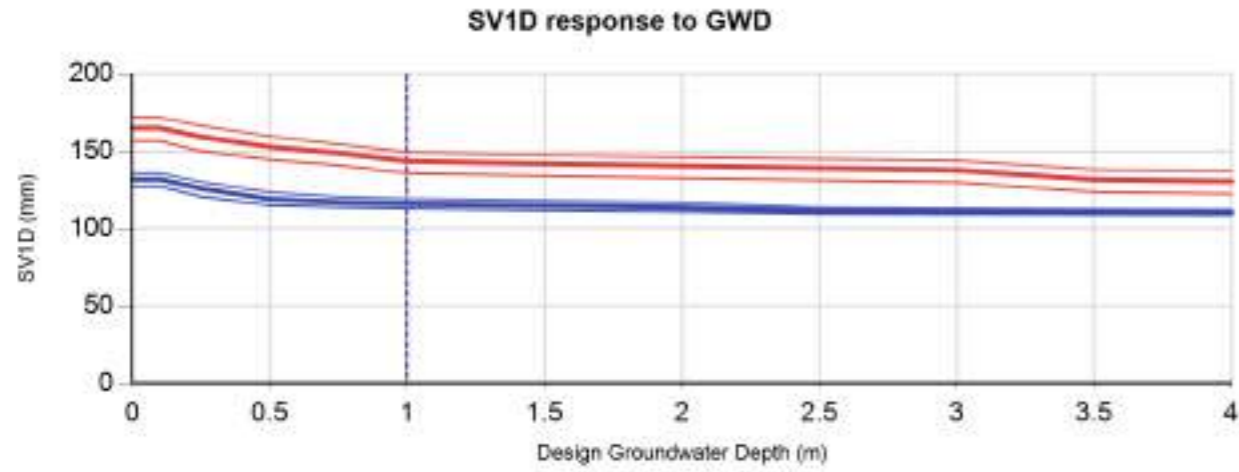
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT13	153237	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]				




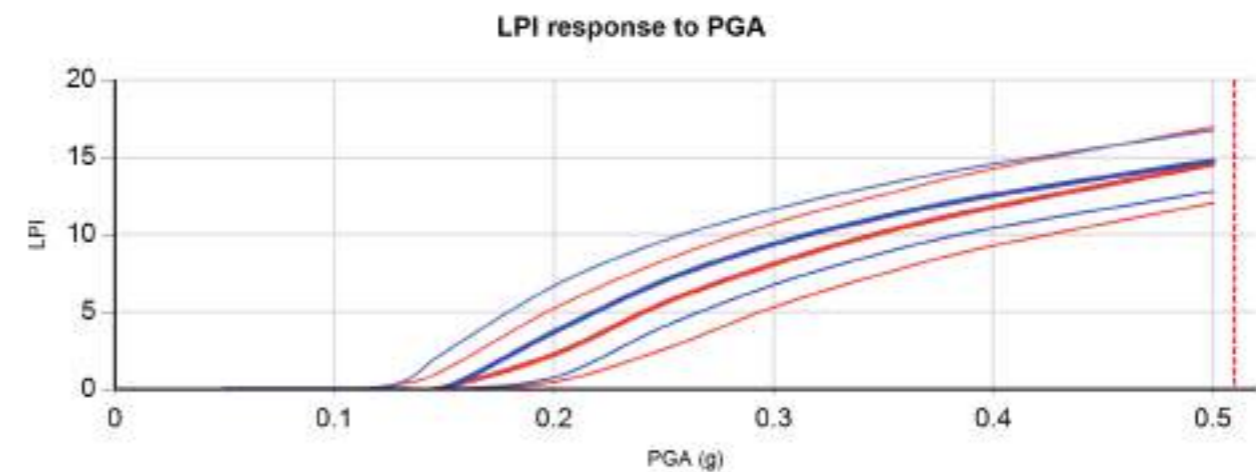
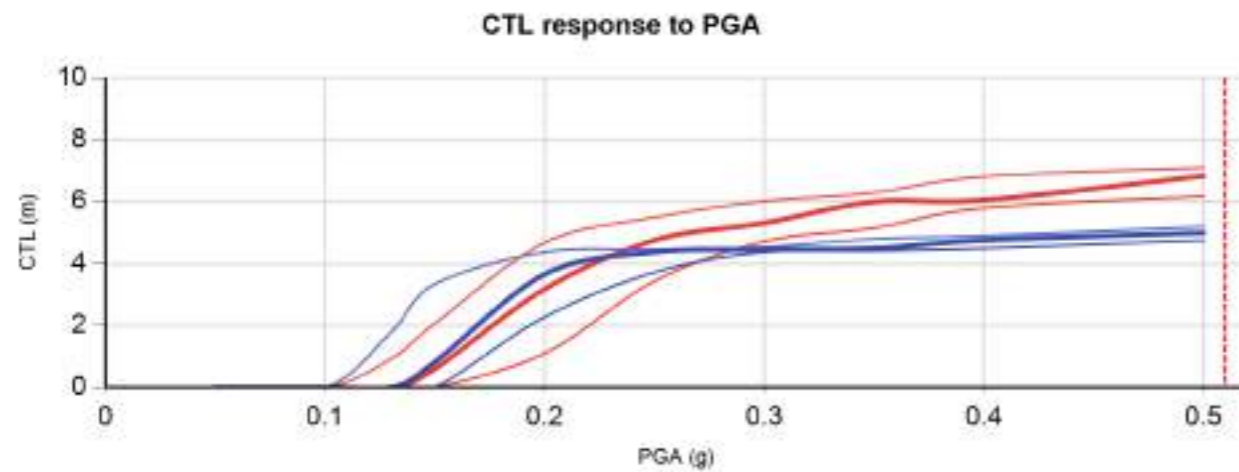
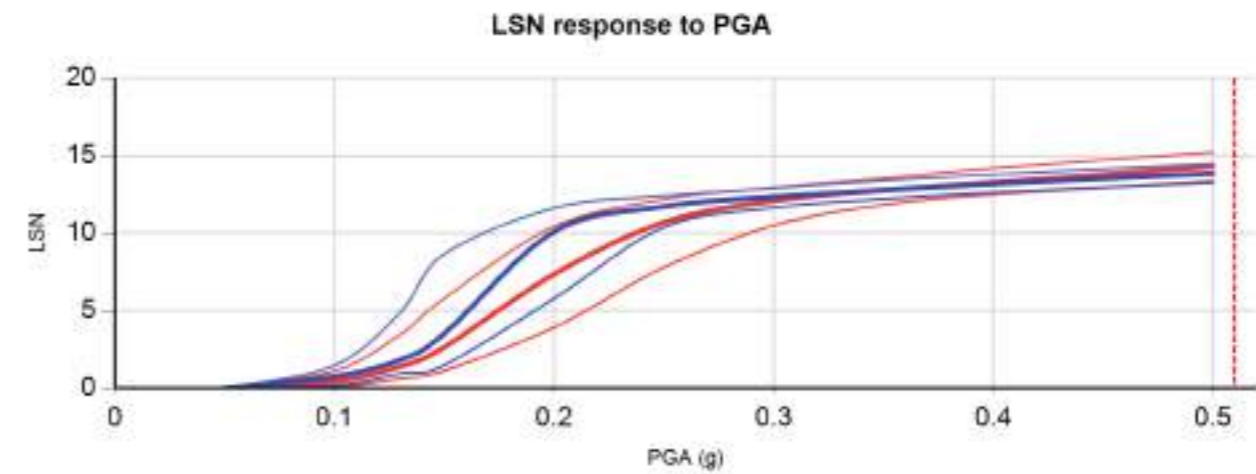
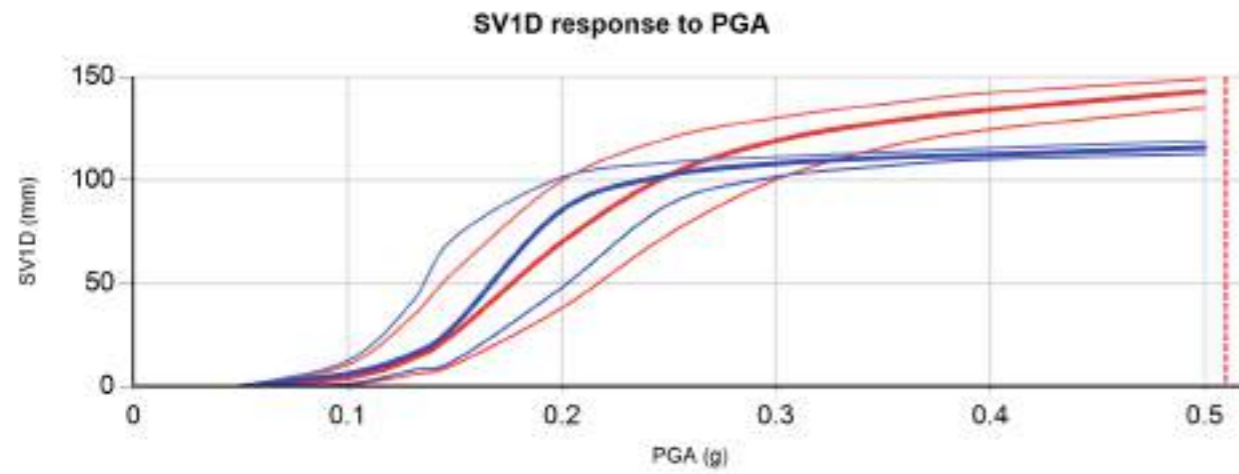
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

	Tonkin + Taylor Exceptional thinking together V2.4.15	CLIENT Napier City Council	LOCATION Napier	DATE 10/02/2021
		PROJECT Onekawa Aquatic Centre		ANALYSED zafr
		TITLE ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER 1009171	
		COMMENT ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]		PAGE 7 of 9 pages




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT12	152817	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT13	153237	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 12 - 13]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

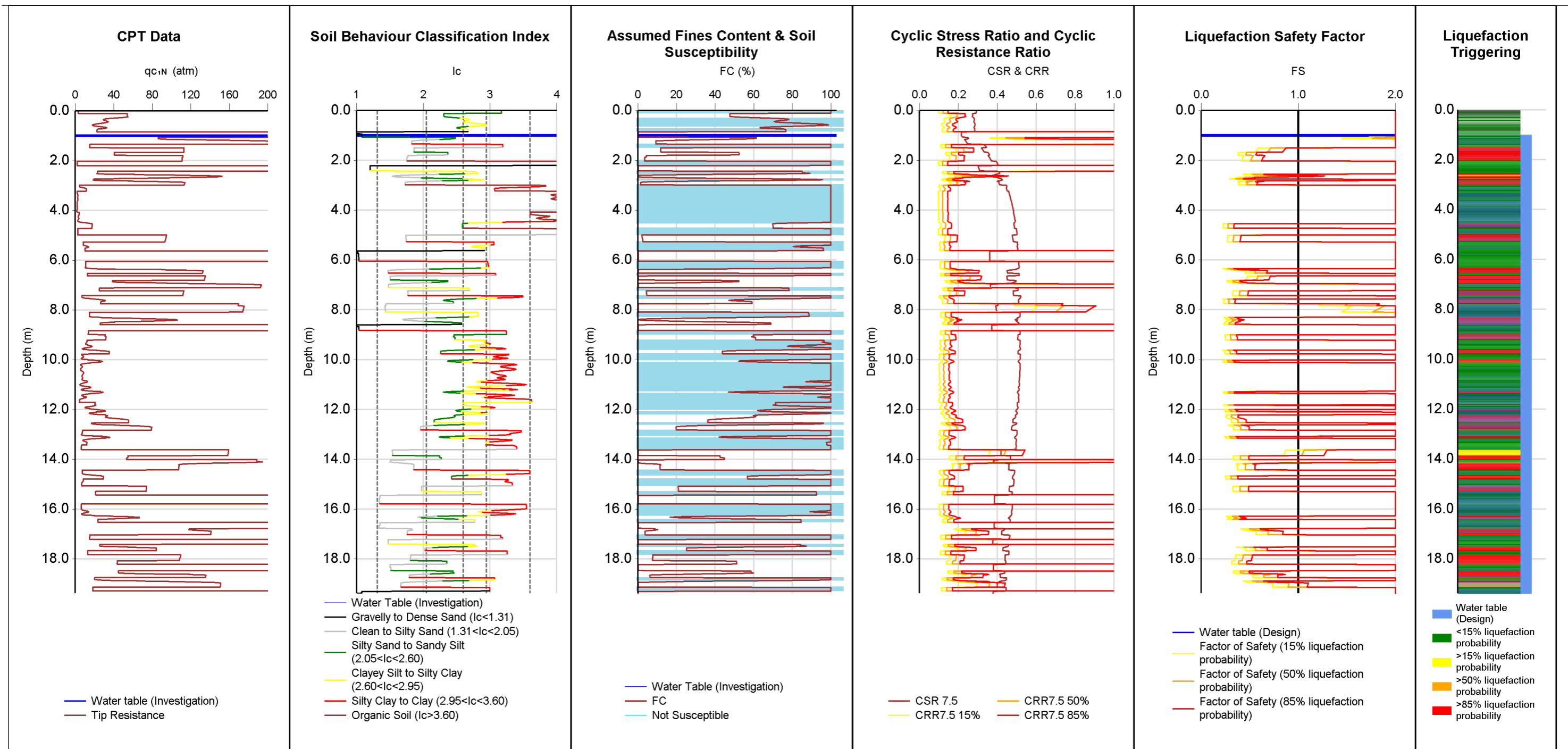
ID	NZGD 152817	NZGD 153237
CPT Name	CPT12	CPT13
Run description	CPT12	CPT13
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	20	16.18
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152817	CPT12	0	0	0
NZGD 152817	CPT12	0	20	2.6
NZGD 153237	CPT13	0	0	0
NZGD 153237	CPT13	0	16.18	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152817	CPT12	0	20	0 CFC
NZGD 153237	CPT13	0	16.18	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	142	6.5	19	22	1.6	15					
50%	139	6.2	17	21	1.6	13					
85%	133	6	14	20	1.6	11					

Reviewed by:

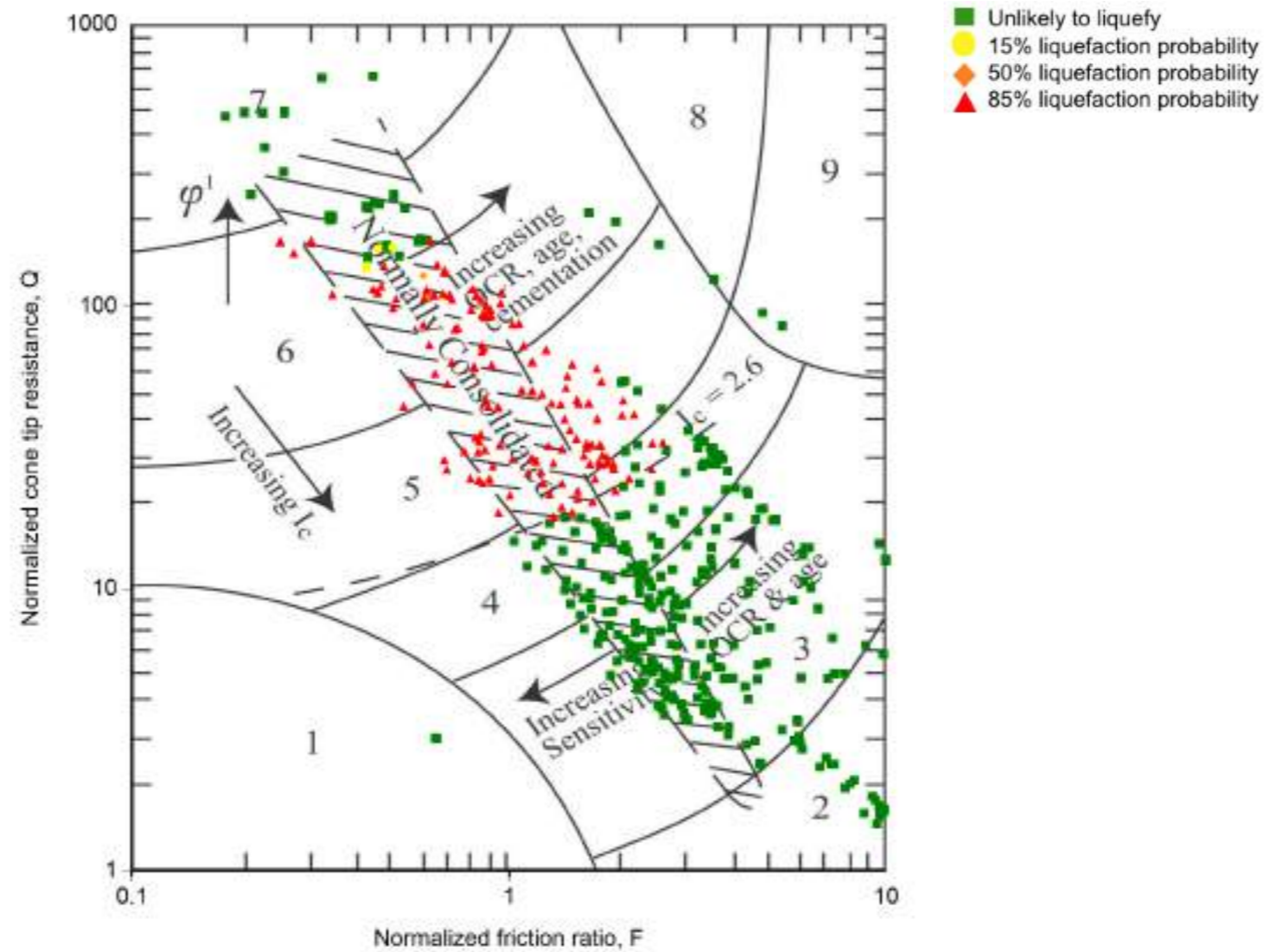
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**

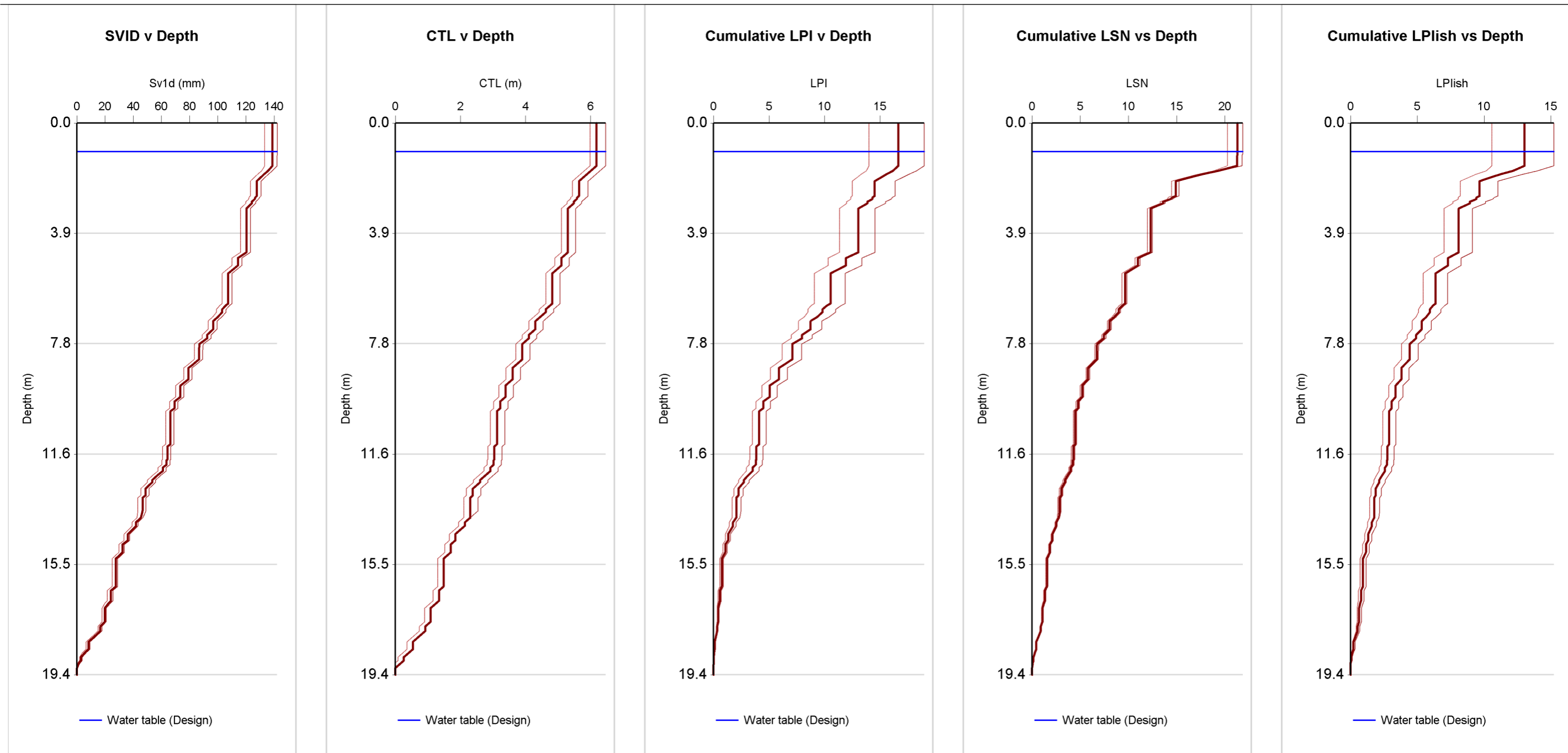


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

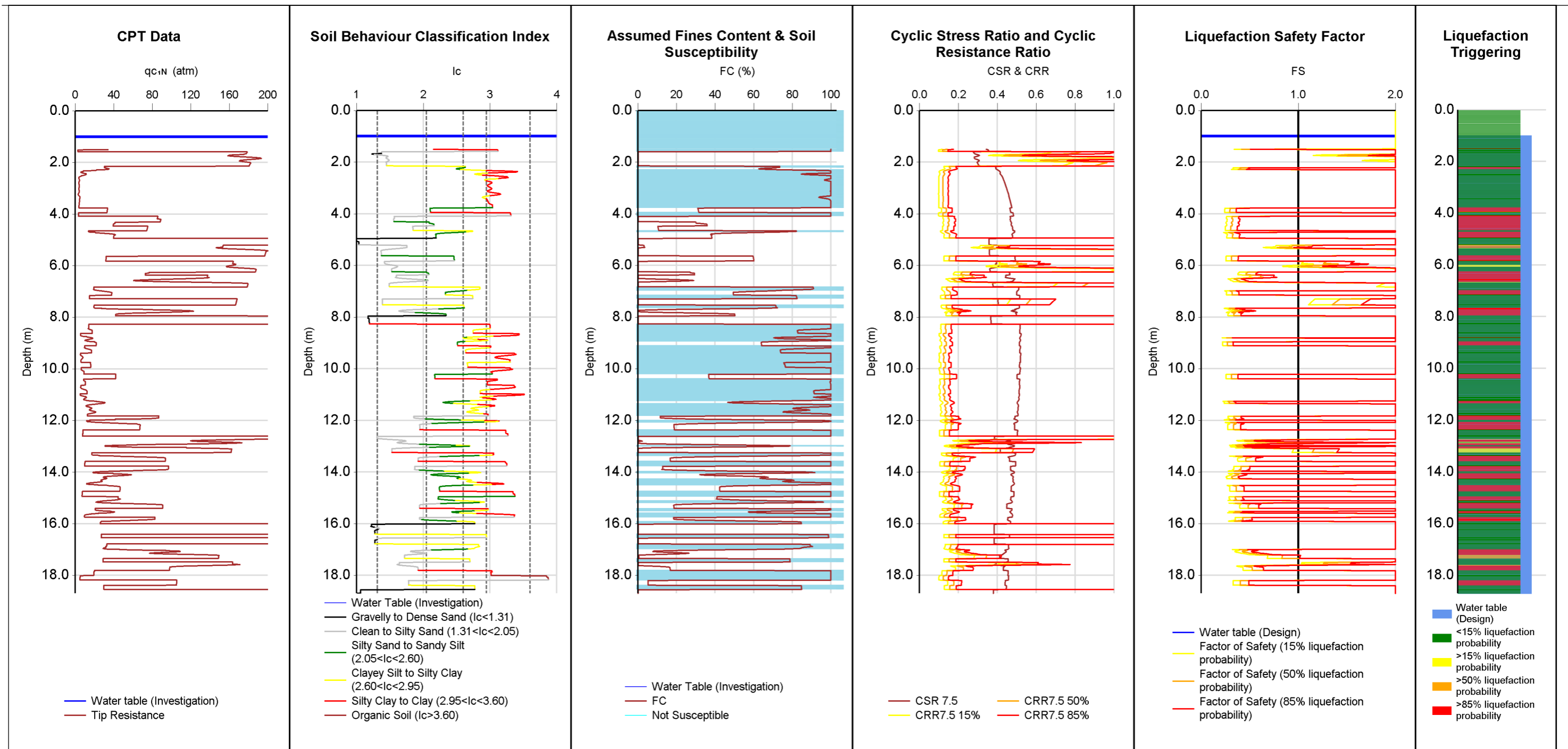
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT15	152818	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

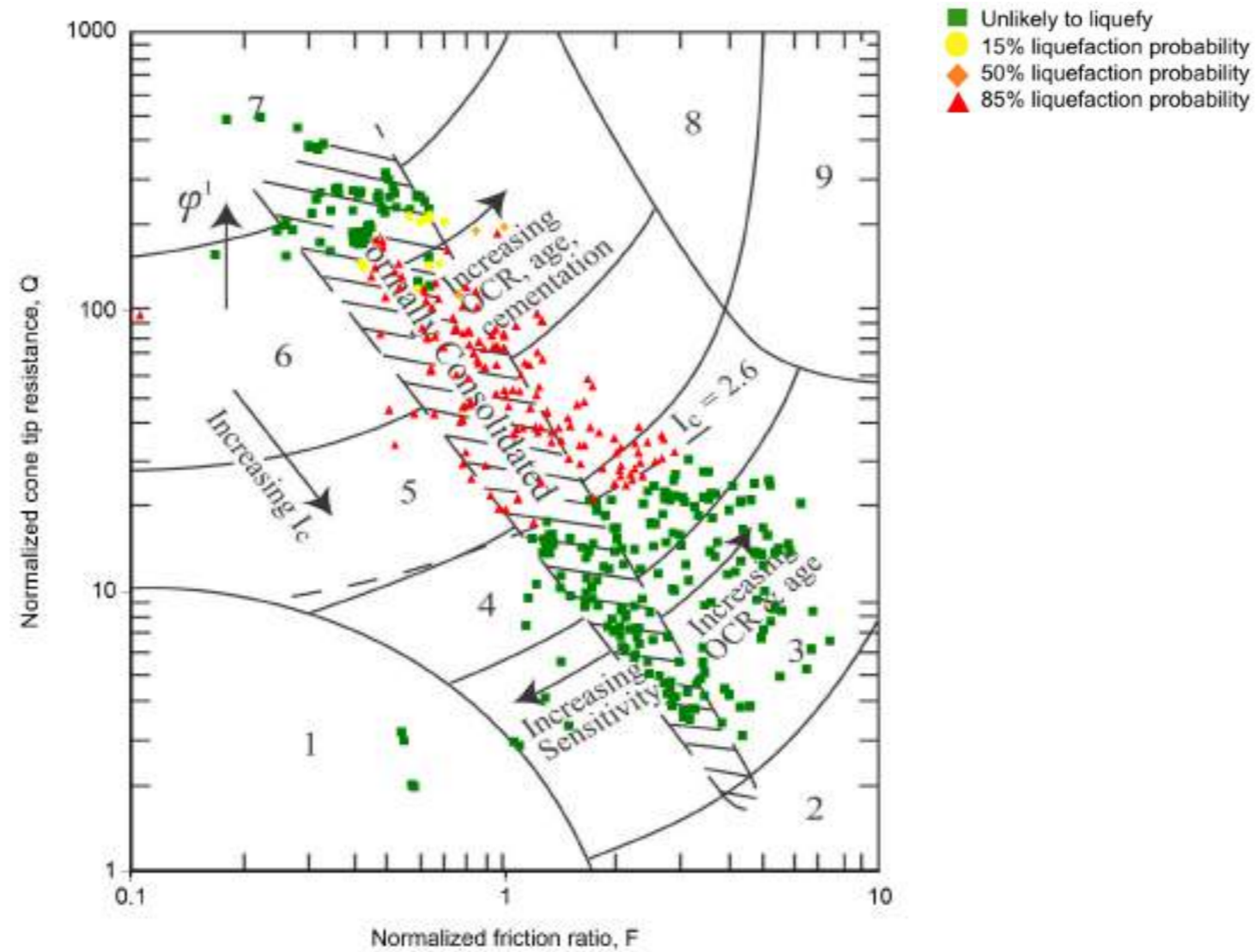
 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.6	0.51	BI-2014	ZRB-2002	18		0	
OUTPUT											
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
15%	136	6.1	18	18	3.8	12					
50%	133	5.7	16	17	3.8	11					
85%	129	5.5	14	17	3.8	10					

Reviewed by:


CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

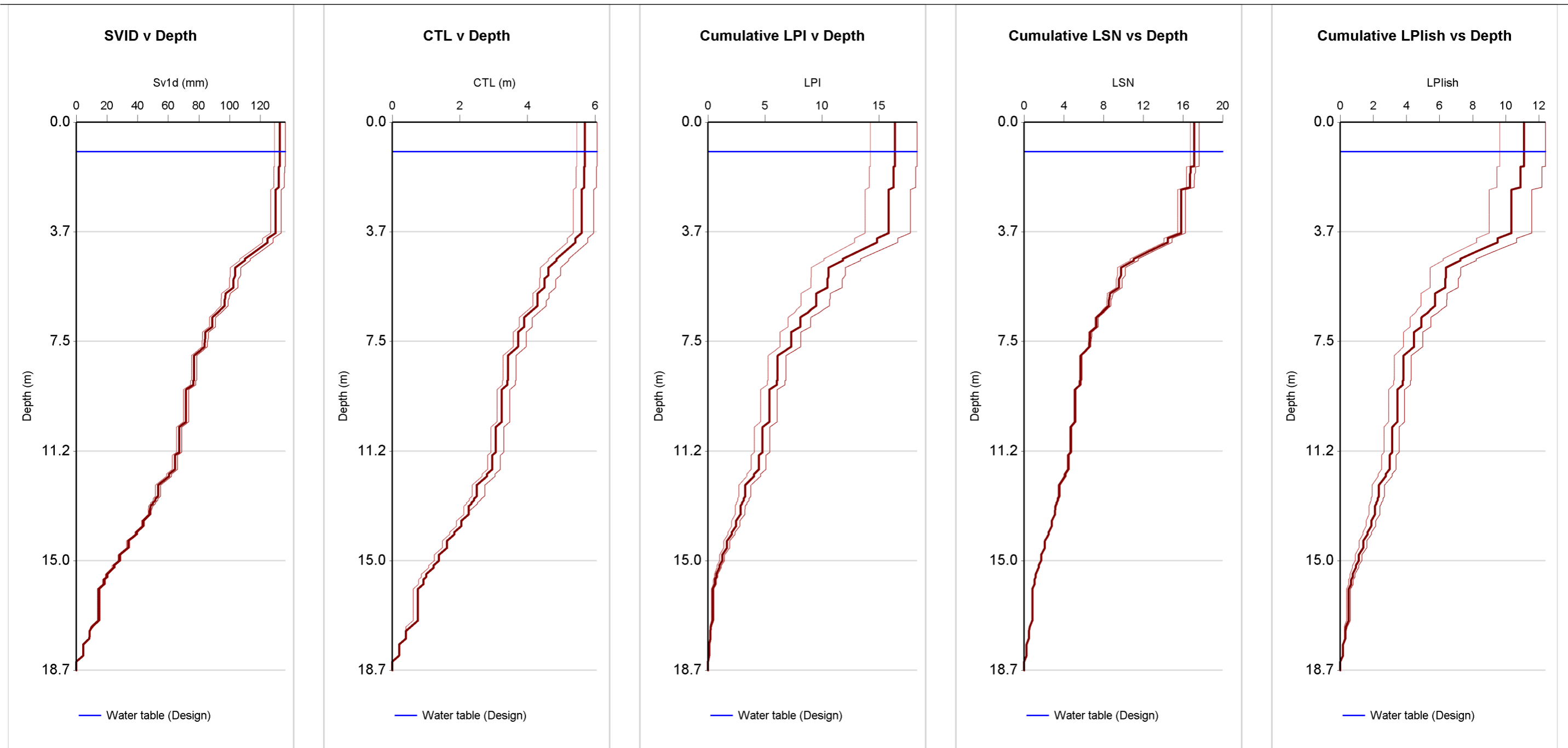


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

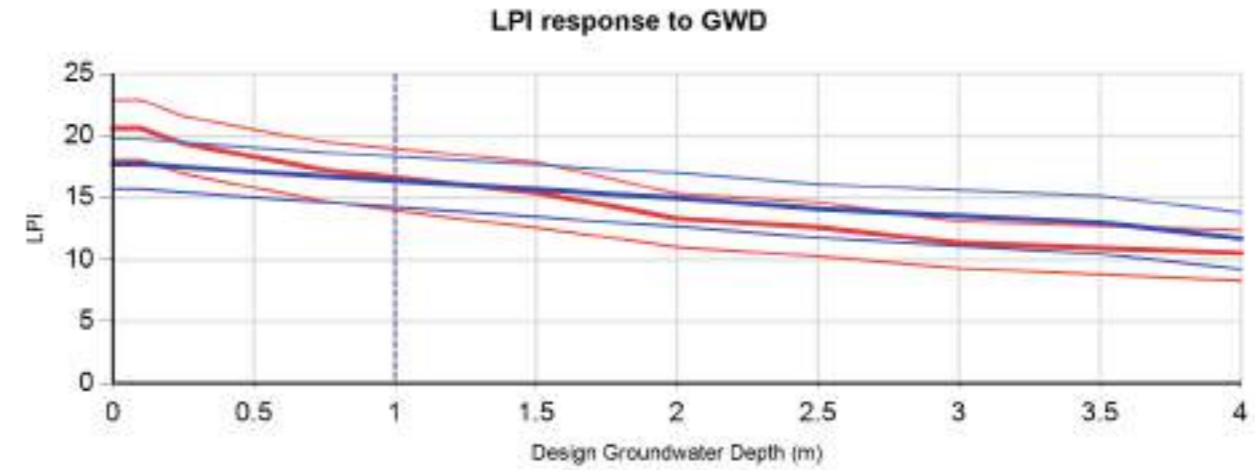
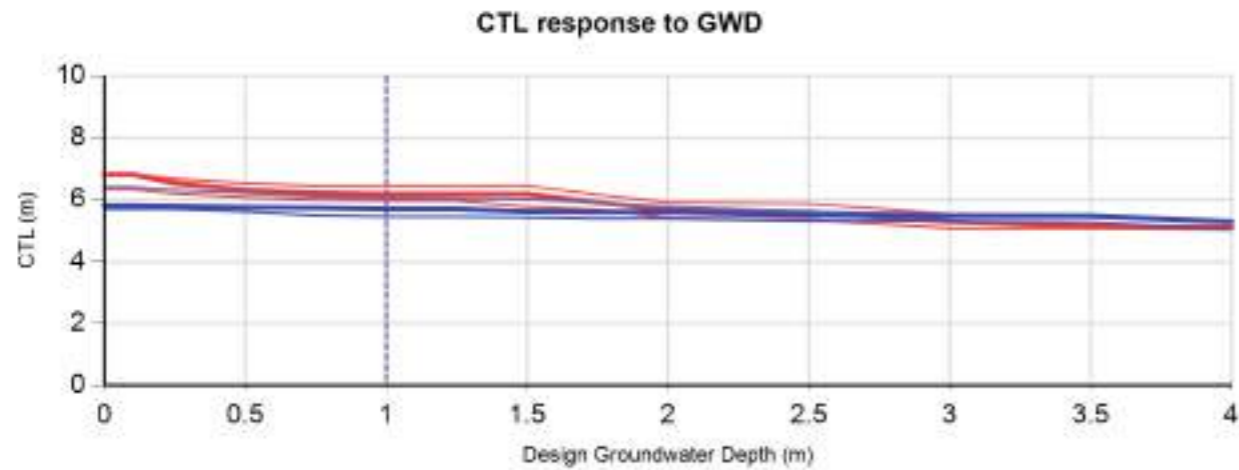
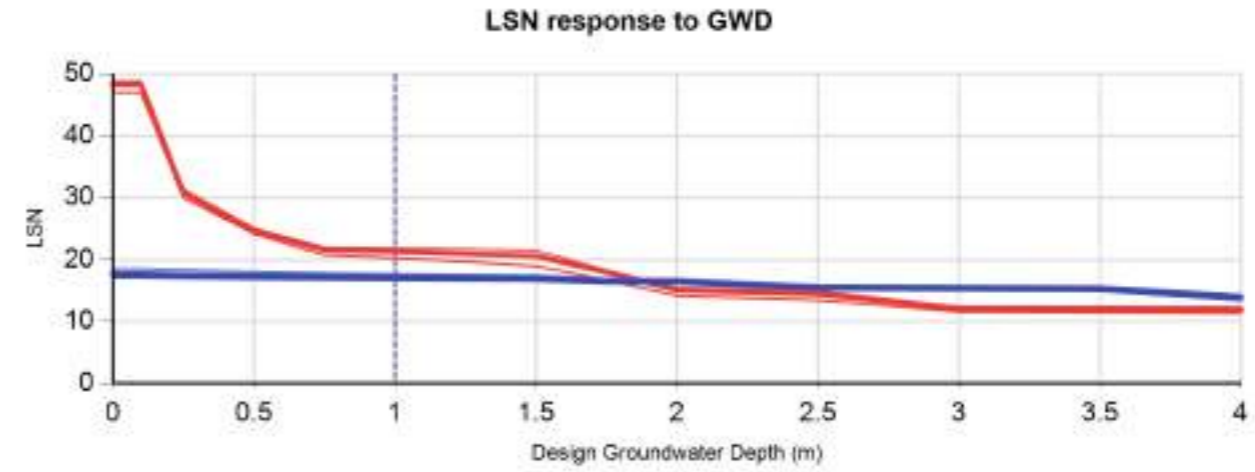
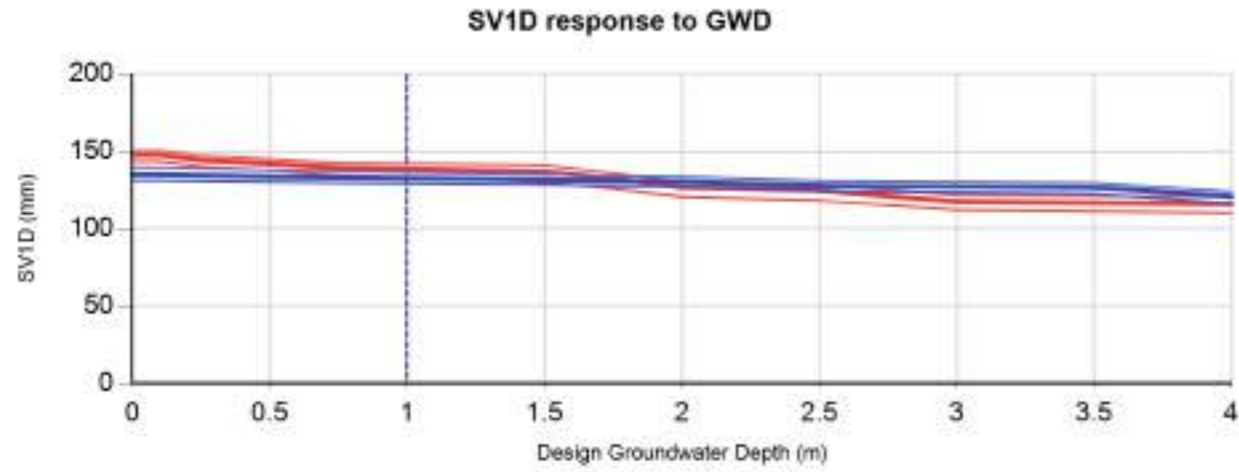
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT16	152819	26/11/2020	1.5	6.6	0.51	BI-2014	ZRB-2002	18		0	




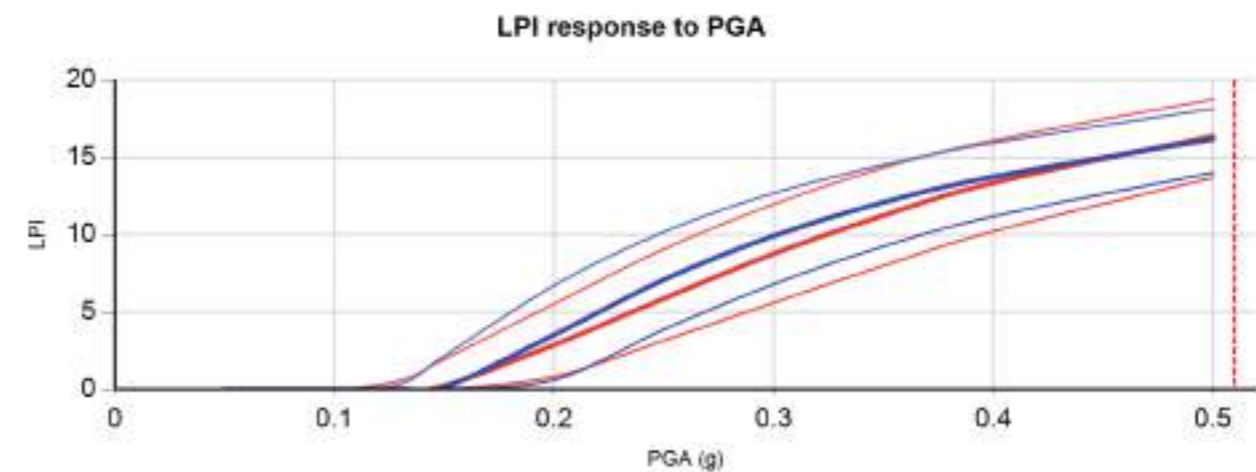
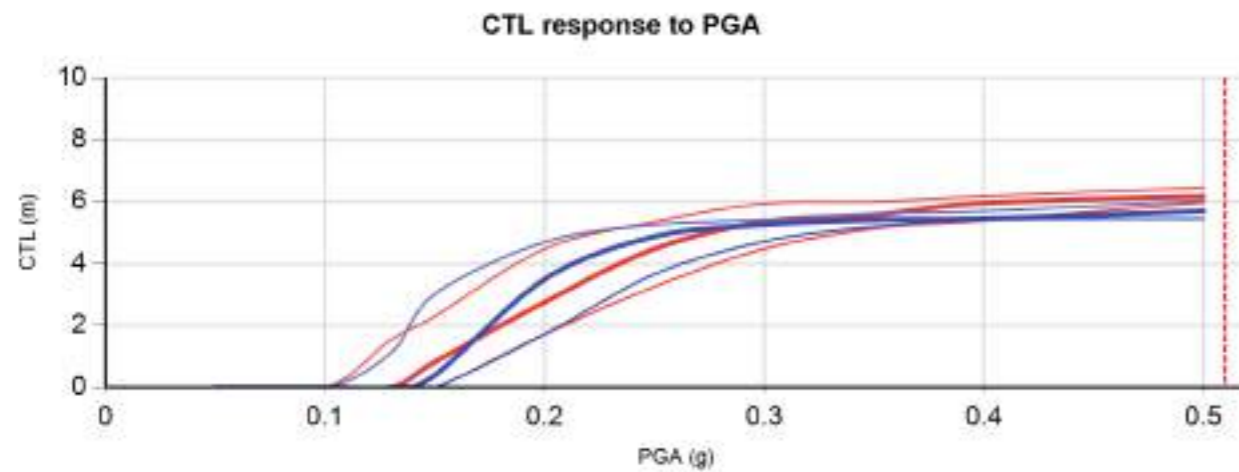
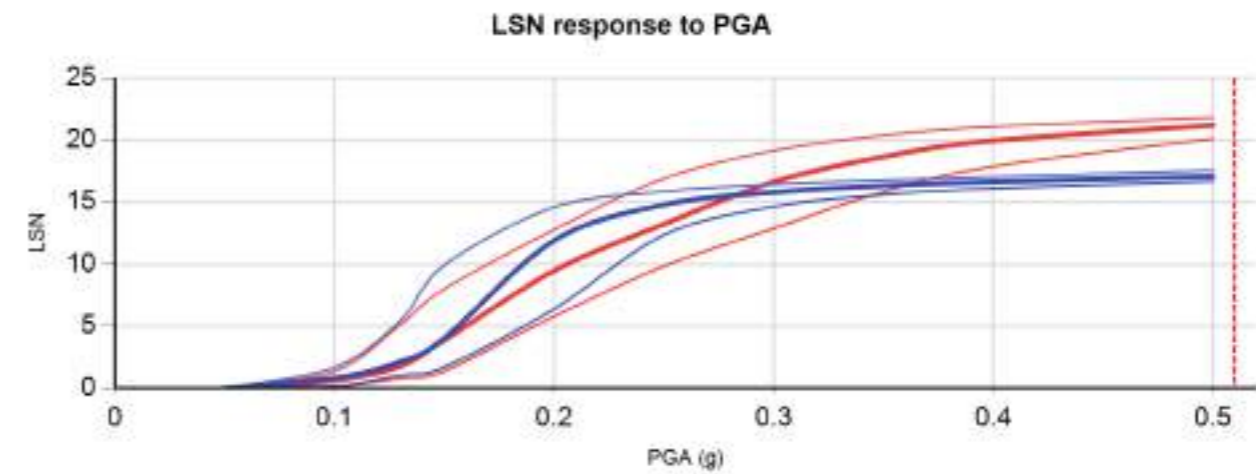
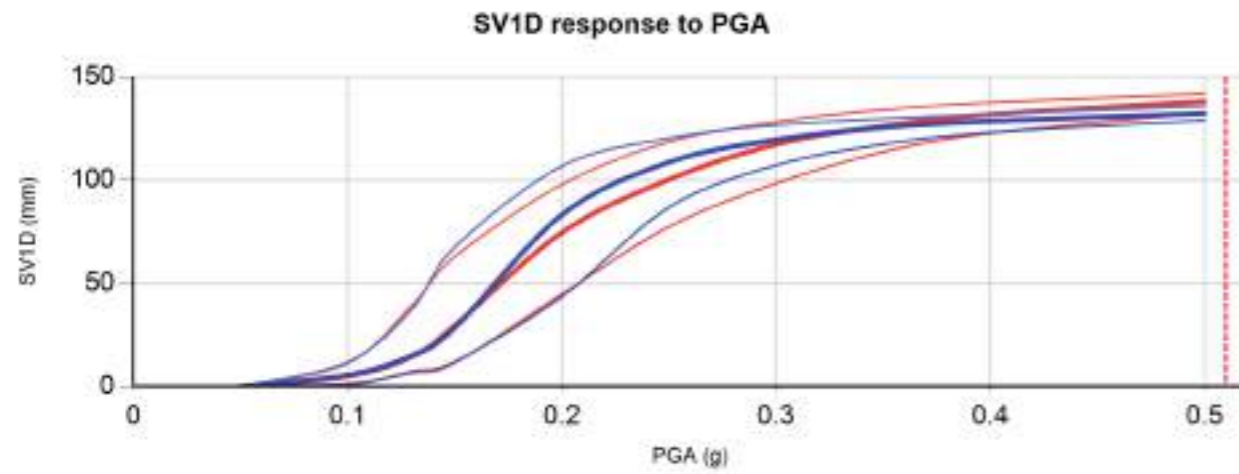
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT15	152818	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT16	152819	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 15 - 16]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

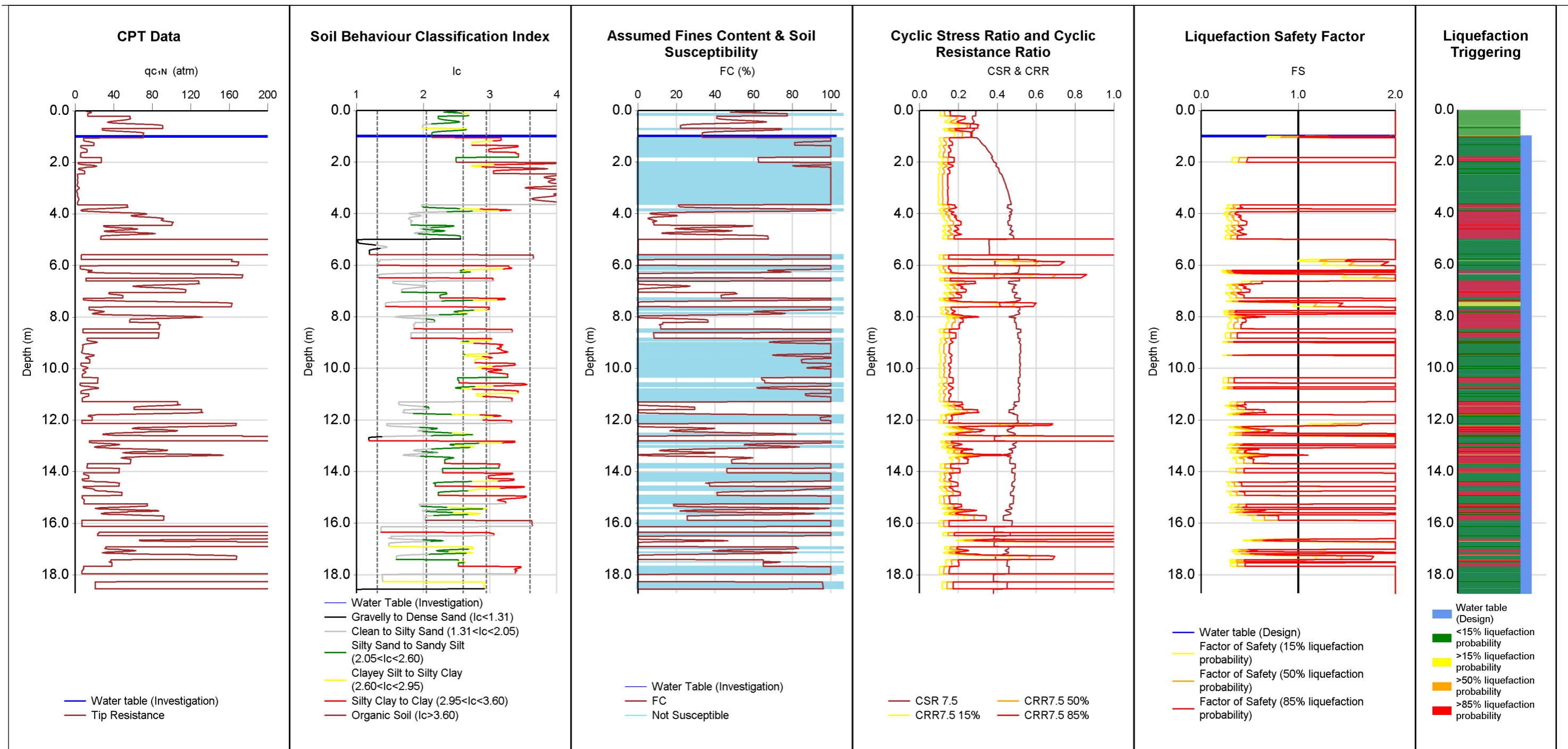
ID	NZGD 152818	NZGD 152819
CPT Name	CPT15	CPT16
Run description	CPT15	CPT16
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	1.5
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	19.38	18.7
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152818	CPT15	0	0	0
NZGD 152818	CPT15	0	19.38	2.6
NZGD 152819	CPT16	0	1.5	0
NZGD 152819	CPT16	1.5	18.7	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152818	CPT15	0	19.38	0 CFC
NZGD 152819	CPT16	0	18.7	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	156	6.9	23	23	1.8	16					
50%	154	6.6	21	22	1.8	14					
85%	151	6.5	18	21	1.9	12					

Reviewed by:

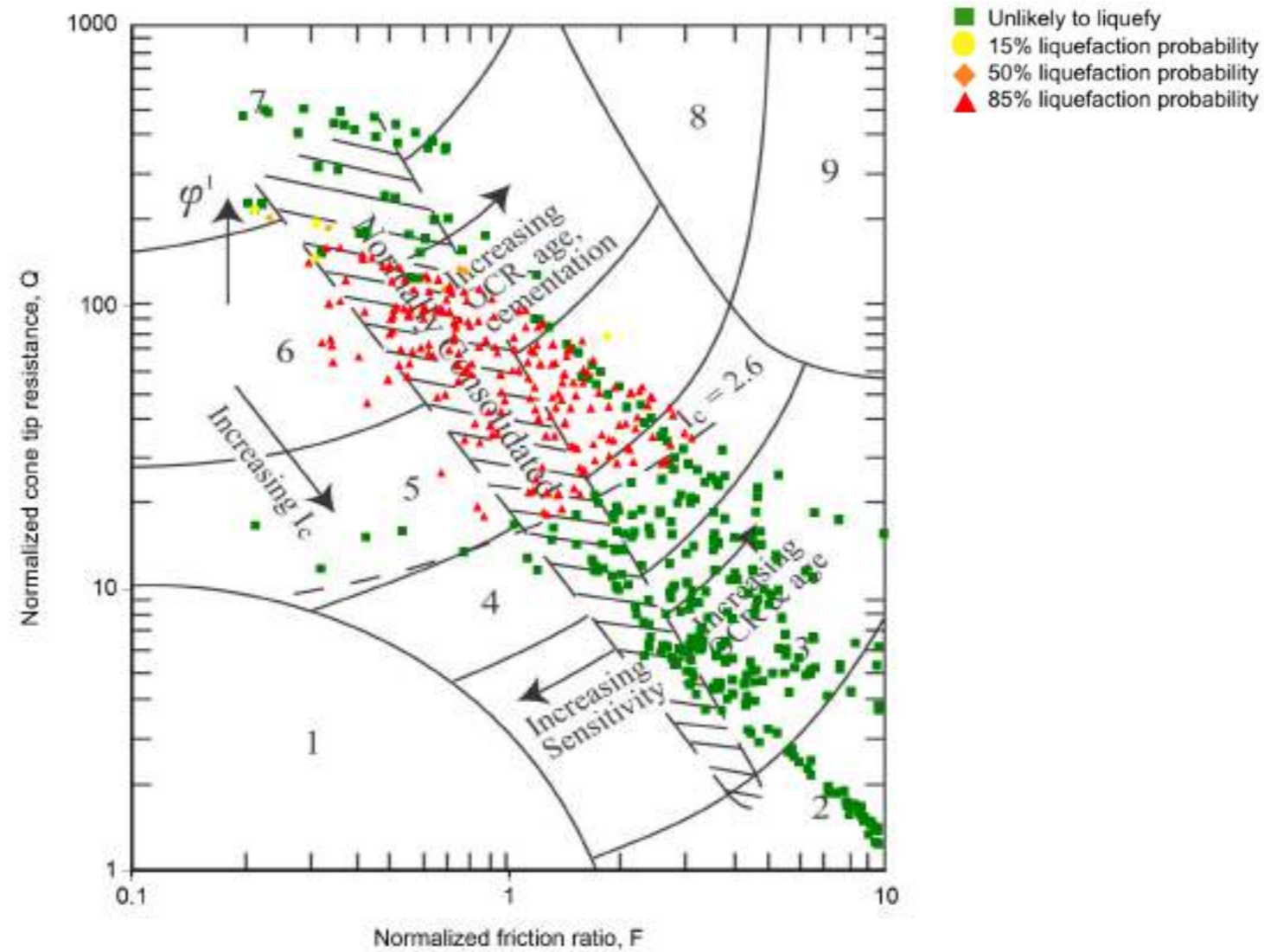
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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Exceptional thinking together
V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]**


LOCATION **Napier**
DATE **10/02/2021**
ANALYSED **zafz**
JOB NUMBER **1009171**
PAGE **1 of 9 pages**

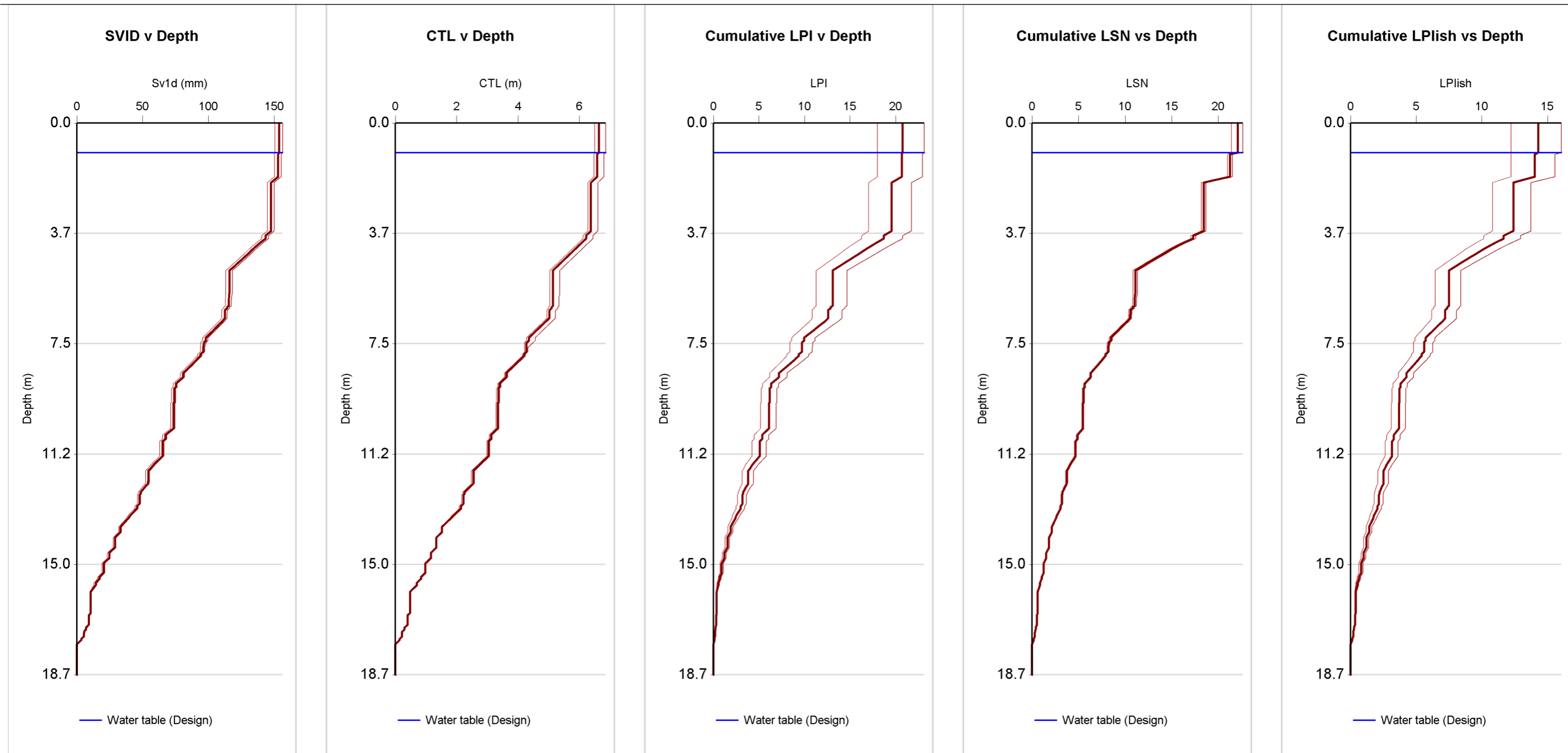


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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

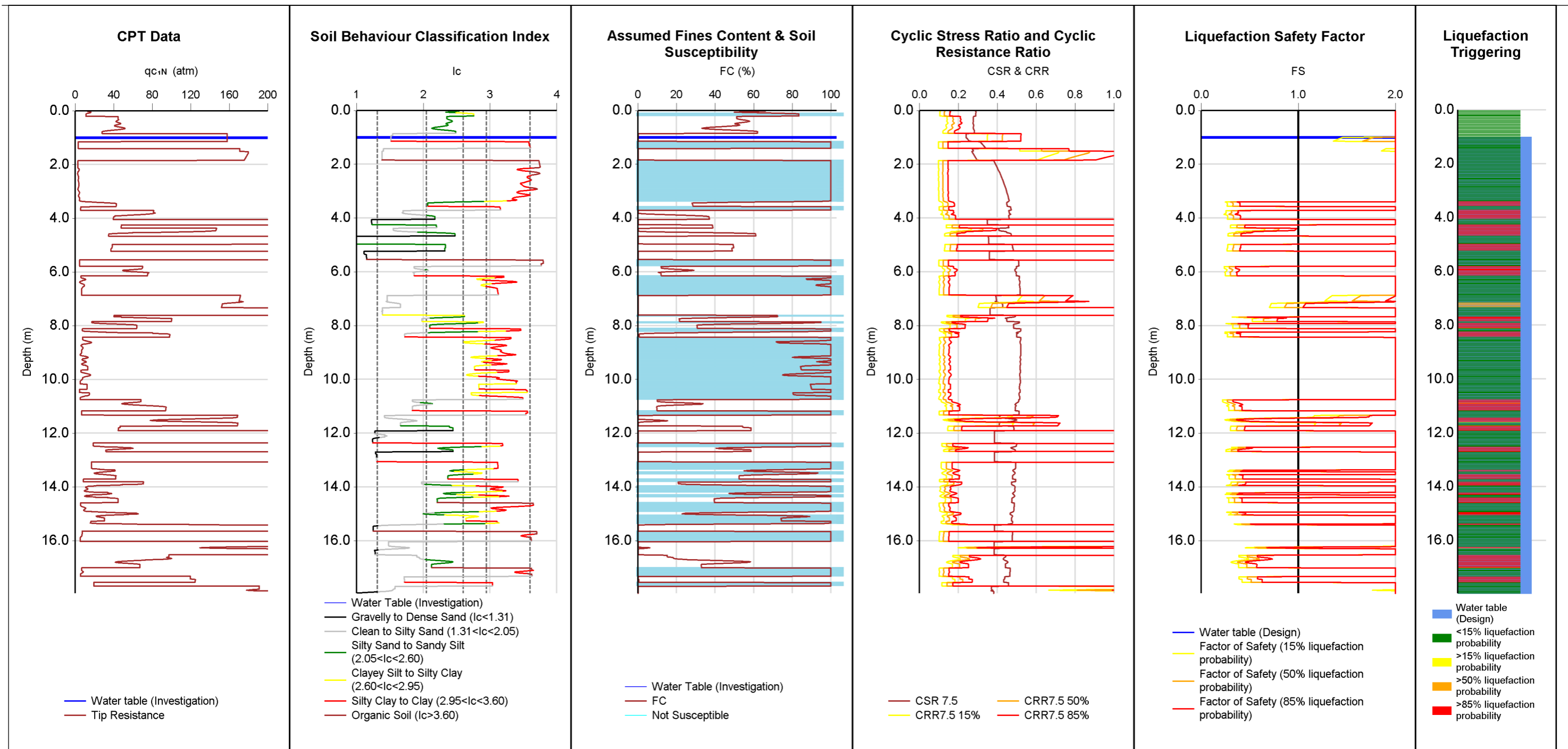
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	2 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT17	152820	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	112	4.9	16	15	3.5	11					
50%	110	4.8	14	15	3.5	9					
85%	107	4.6	12	14	3.5	8					

Reviewed by:

CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL

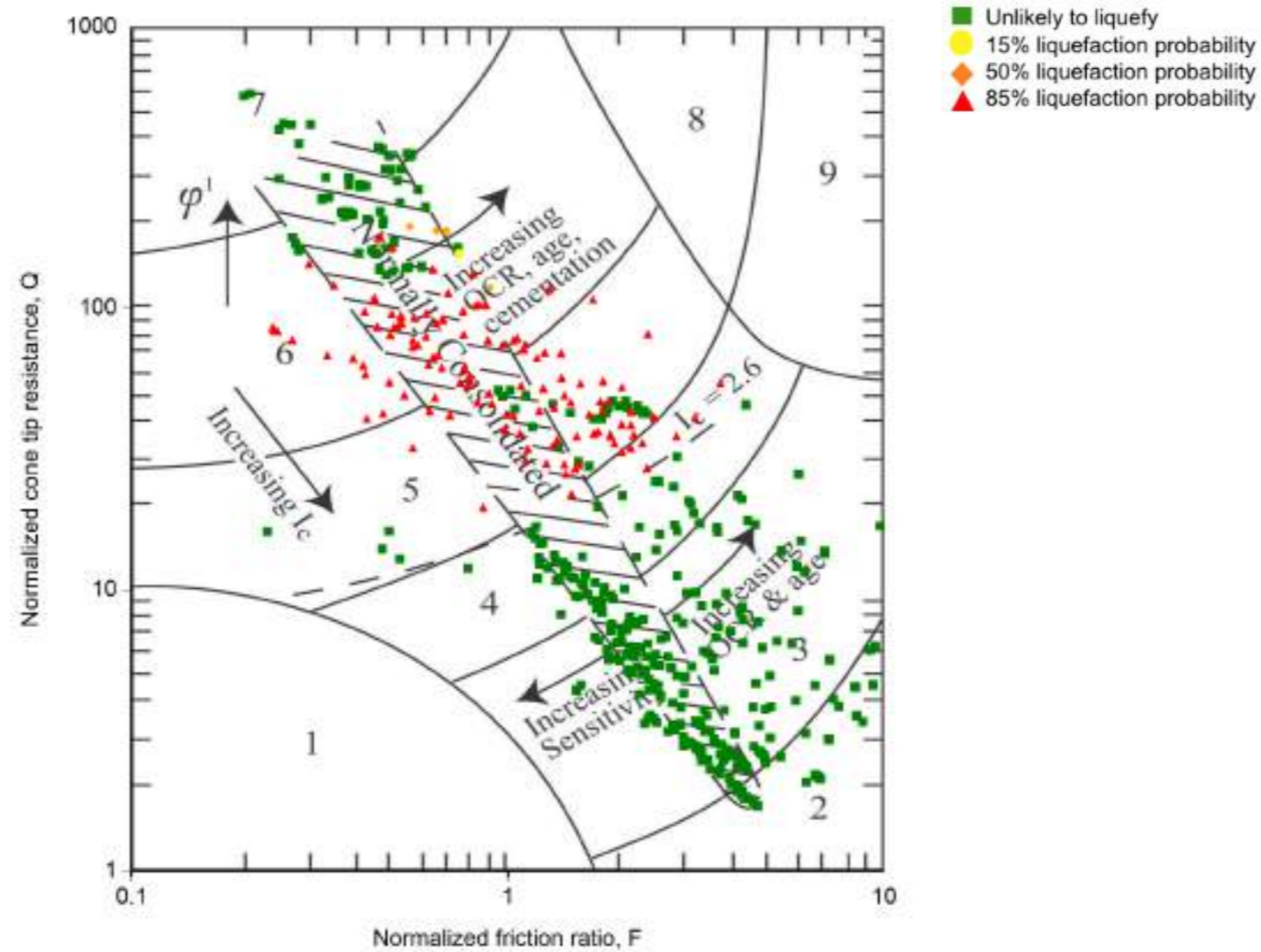


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CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]**

LOCATION **Napier**
JOB NUMBER **1009171**


DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

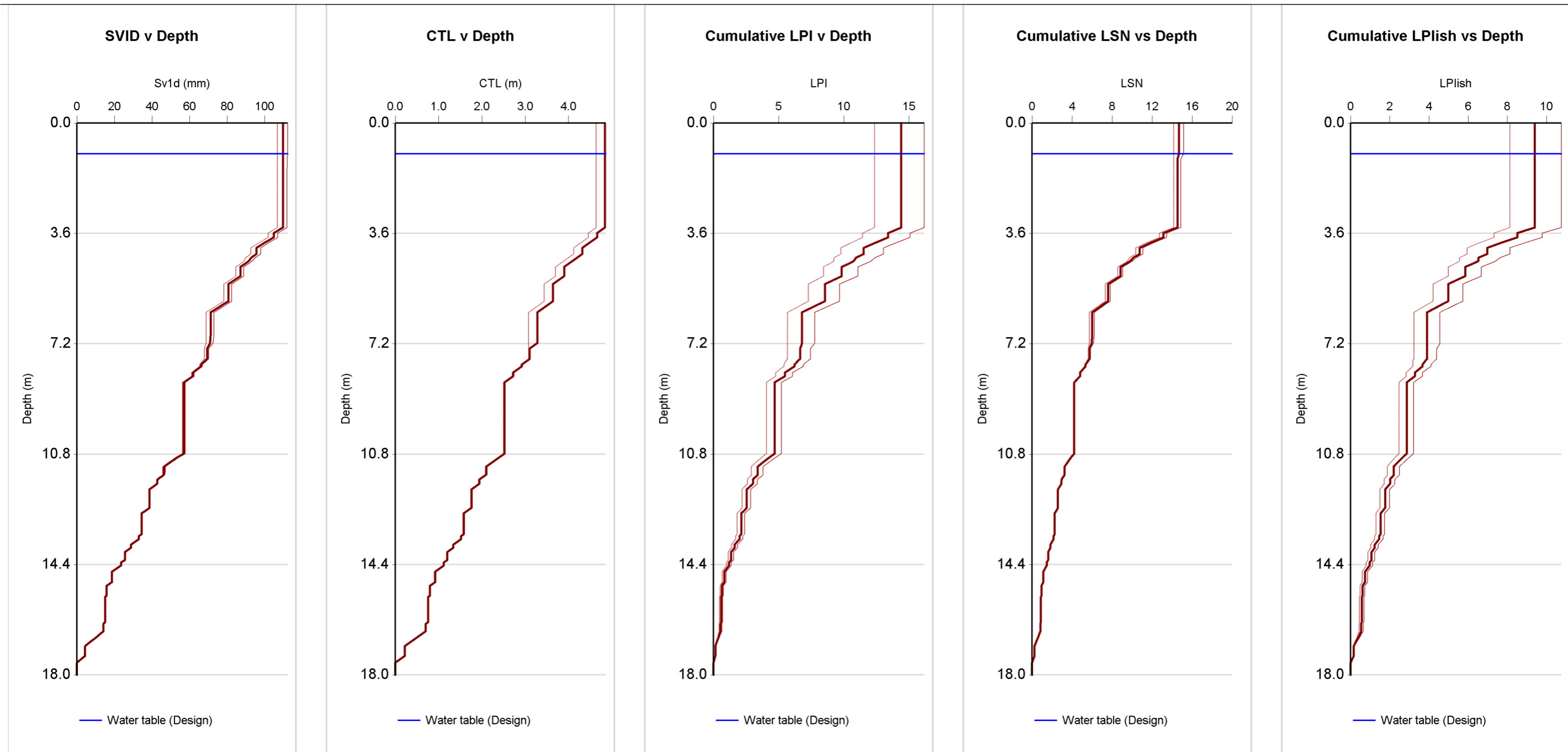


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	5 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]				



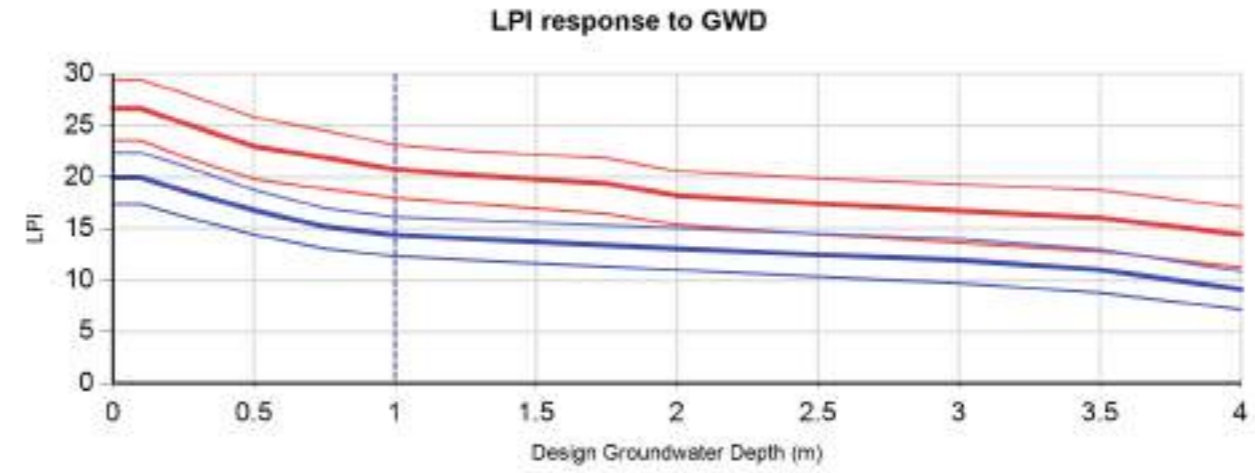
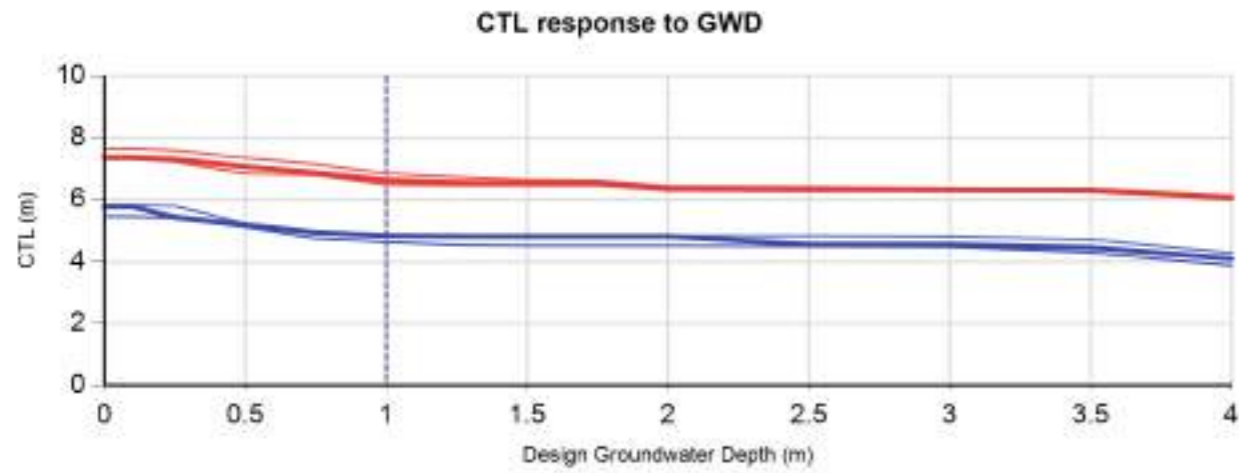
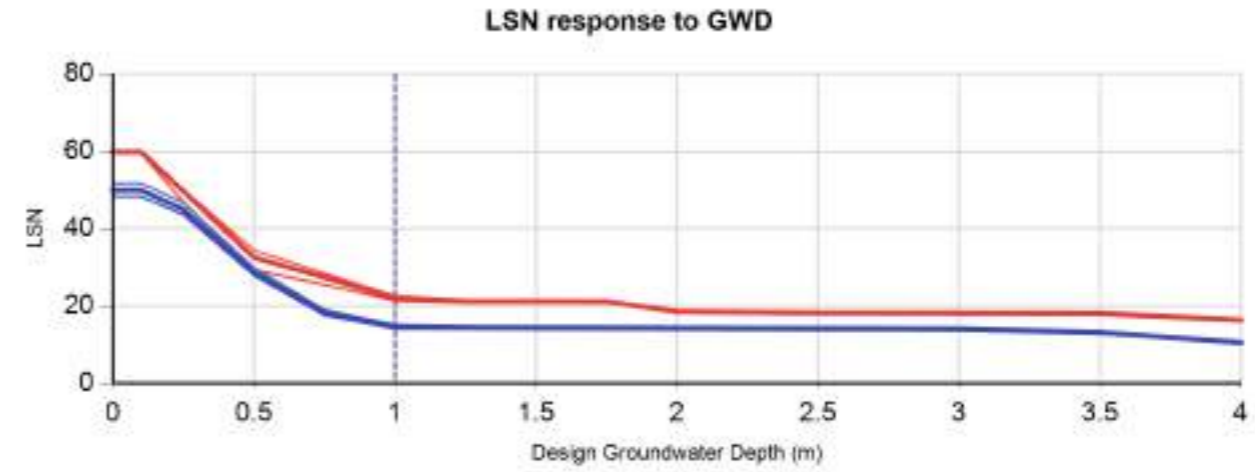
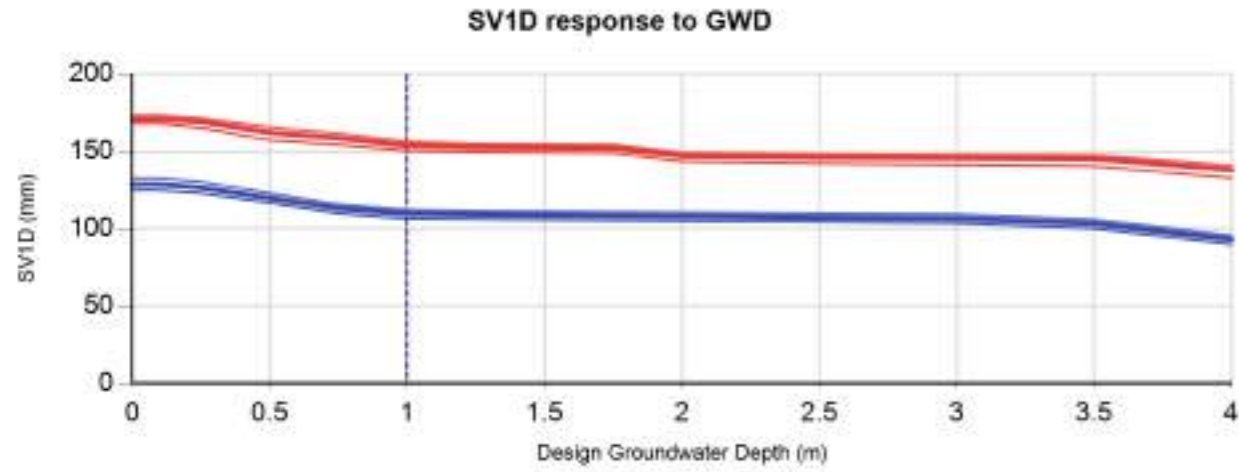
Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT18	152821	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	



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 together
 V2.4.15

CLIENT	Napier City Council
PROJECT	Onekawa Aquatic Centre
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]

LOCATION	Napier	DATE	10/02/2021
JOB NUMBER	1009171	ANALYSED	zafr
		PAGE	6 of 9 pages




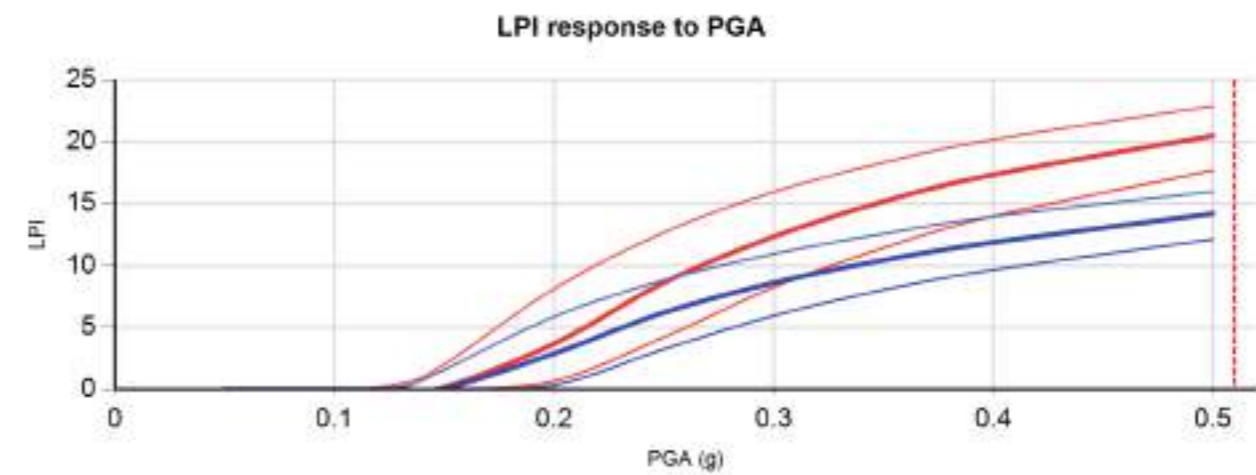
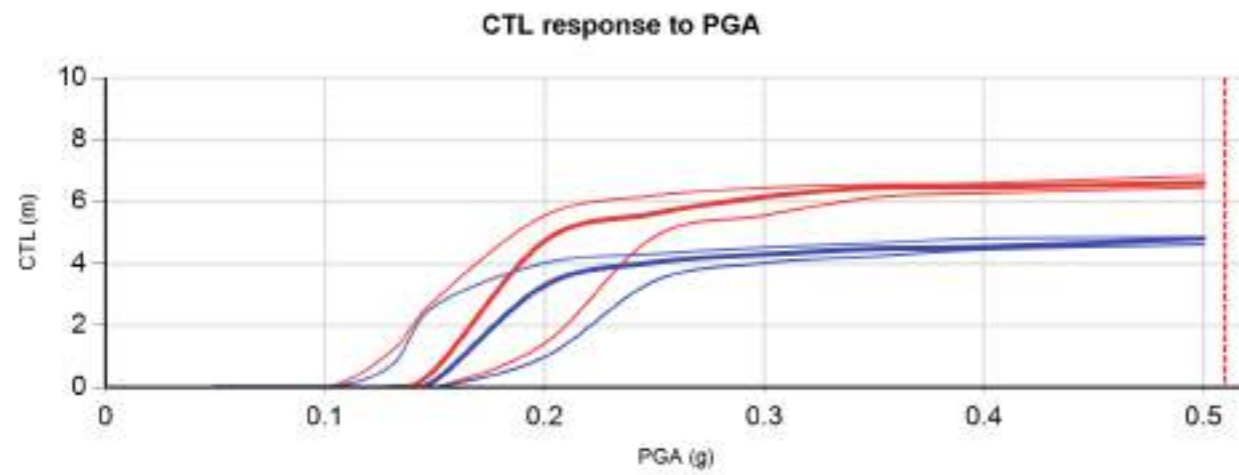
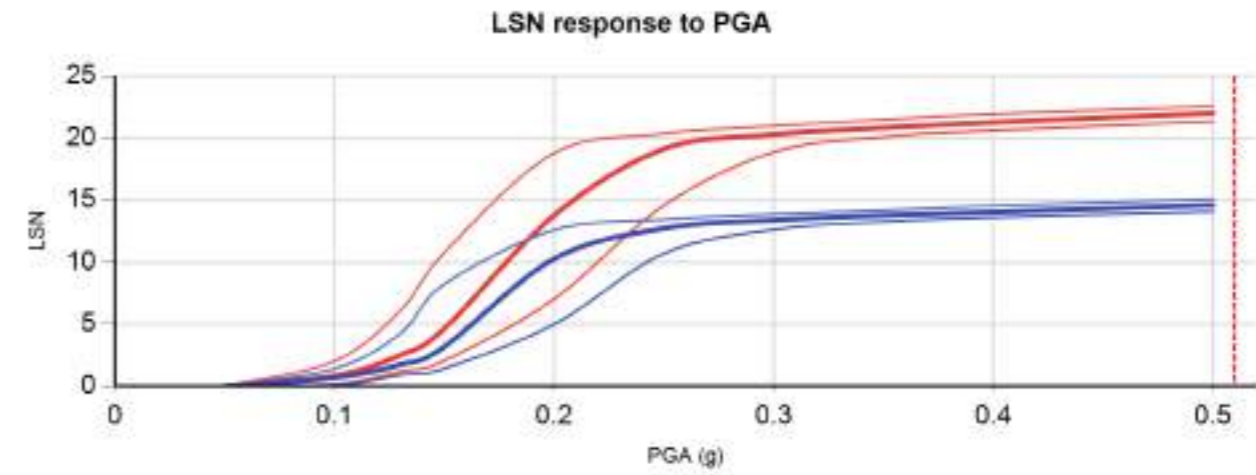
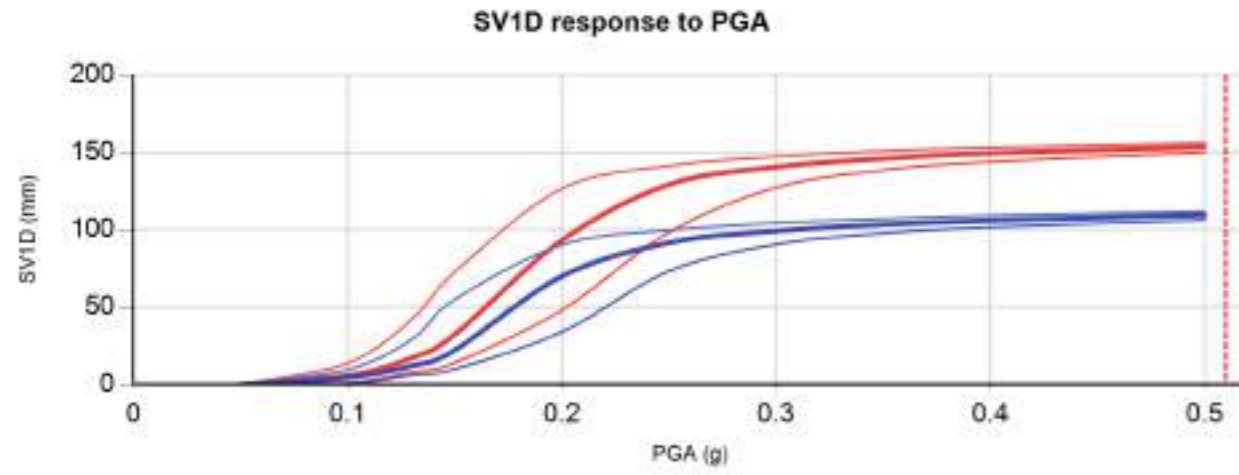
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m^3)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT17	152820	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT18	152821	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 17 - 18]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

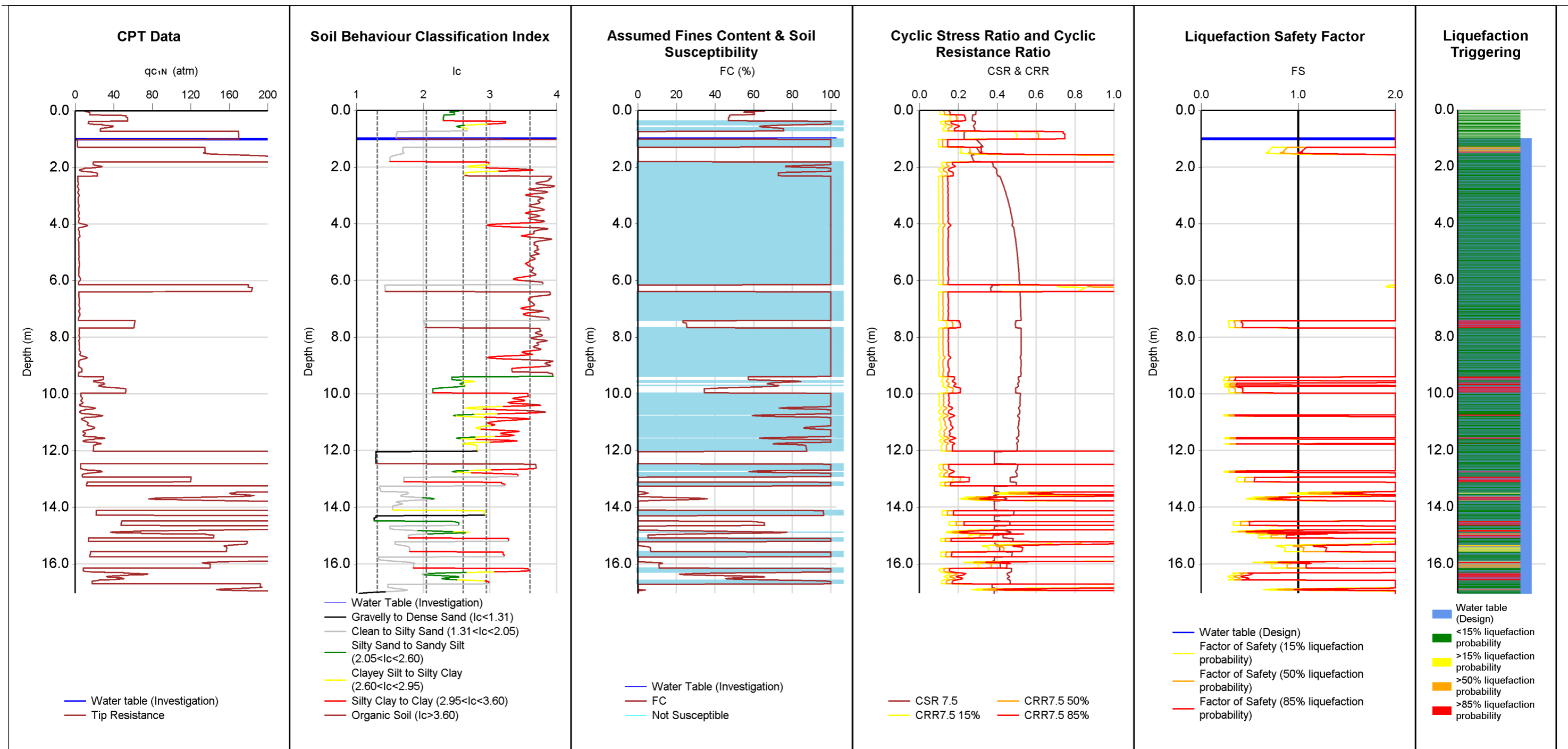
ID	NZGD 152820	NZGD 152821
CPT Name	CPT17	CPT18
Run description	CPT17	CPT18
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	18.72	17.96
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
NZGD 152820	CPT17	0	0	0
NZGD 152820	CPT17	0	18.72	2.6
NZGD 152821	CPT18	0	0	0
NZGD 152821	CPT18	0	17.96	2.6

Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
NZGD 152820	CPT17	0	18.72	0 CFC
NZGD 152821	CPT18	0	17.96	0 CFC



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	54	2.8	6	7	1.4	4					
50%	49	2.5	5	6	1.4	3					
85%	44	1.9	4	5	7.5	2					

Reviewed by:

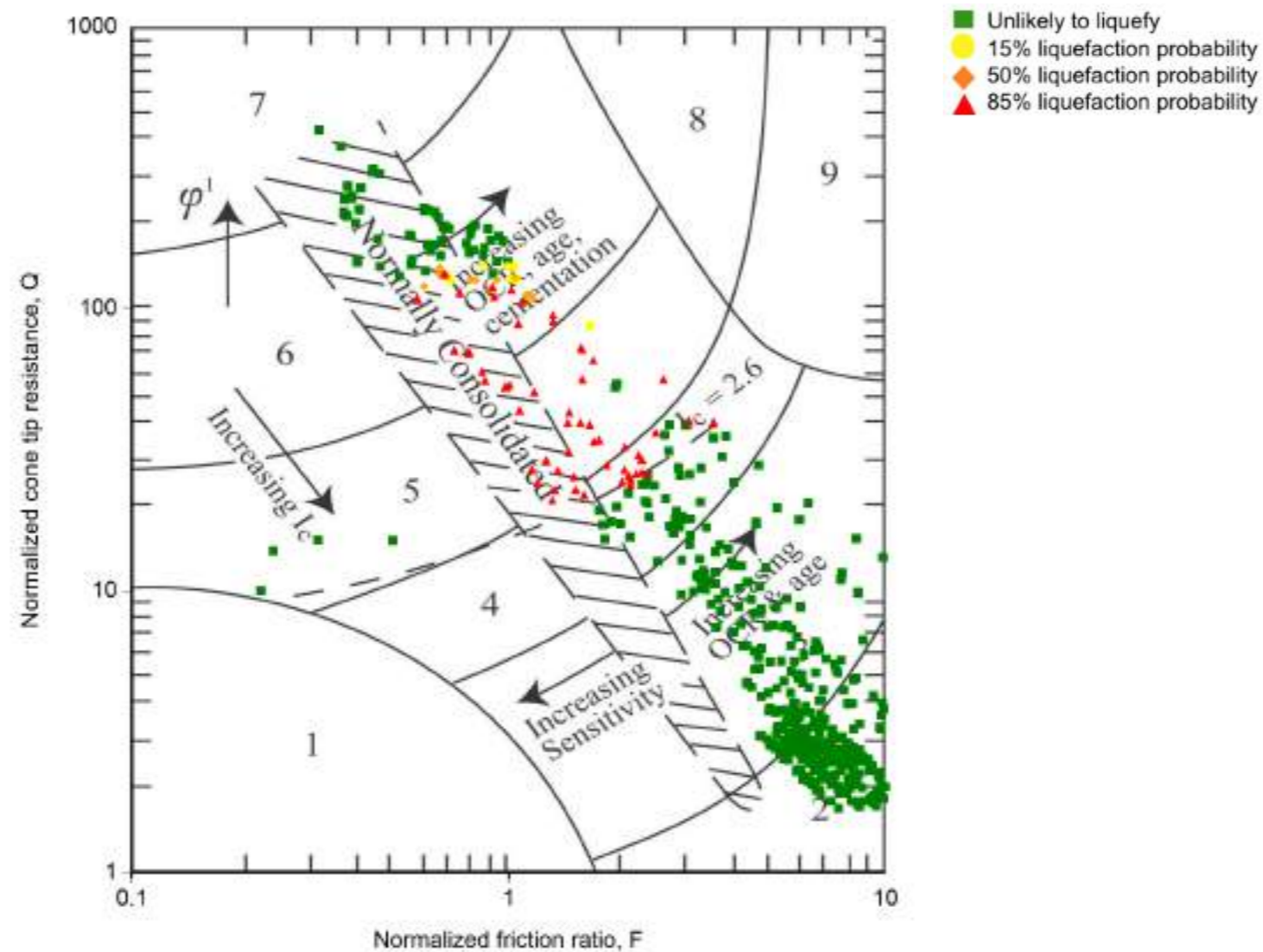
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]

LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **1 of 9 pages**



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|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
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| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |

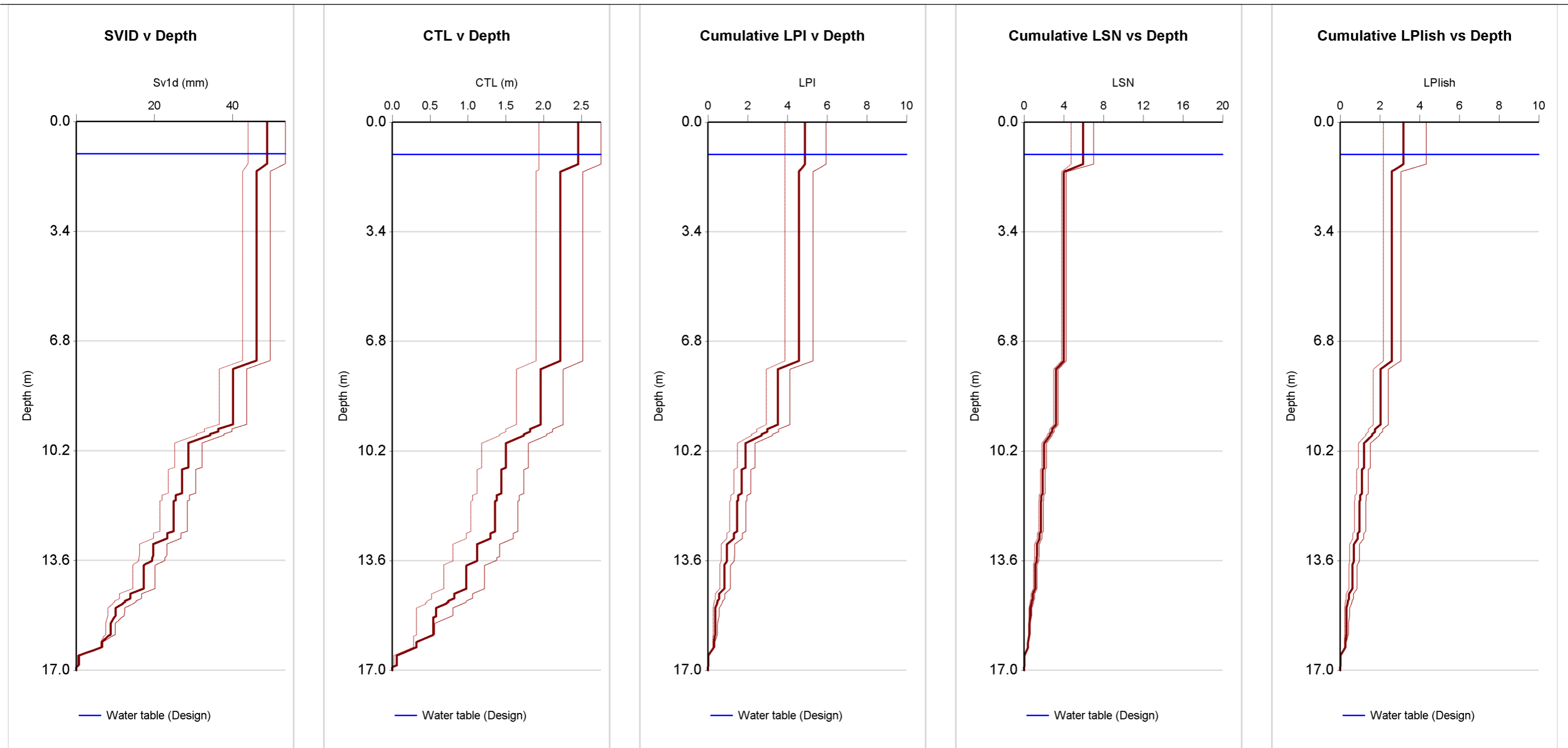
*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)




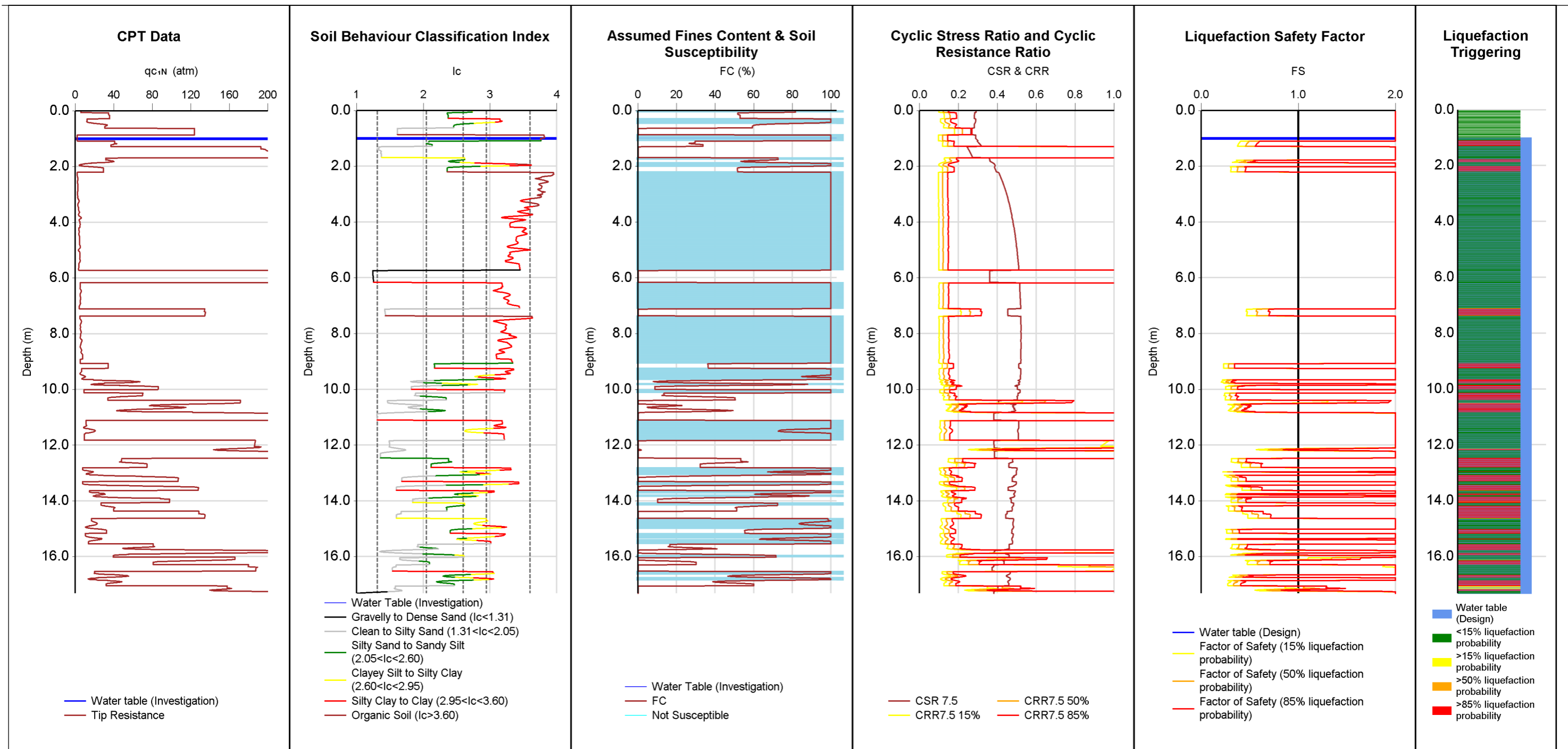
Tonkin + Taylor
 Exceptional thinking
 together
 V2.4.15

CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	2 of 9 pages
COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]				



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT19	152822	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	3 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]				



Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPlish					
OUTPUT 15%	104	4.6	12	16	1.2	11					
50%	103	4.5	11	16	1.2	9					
85%	100	4.4	9	16	1.2	8					

Reviewed by:

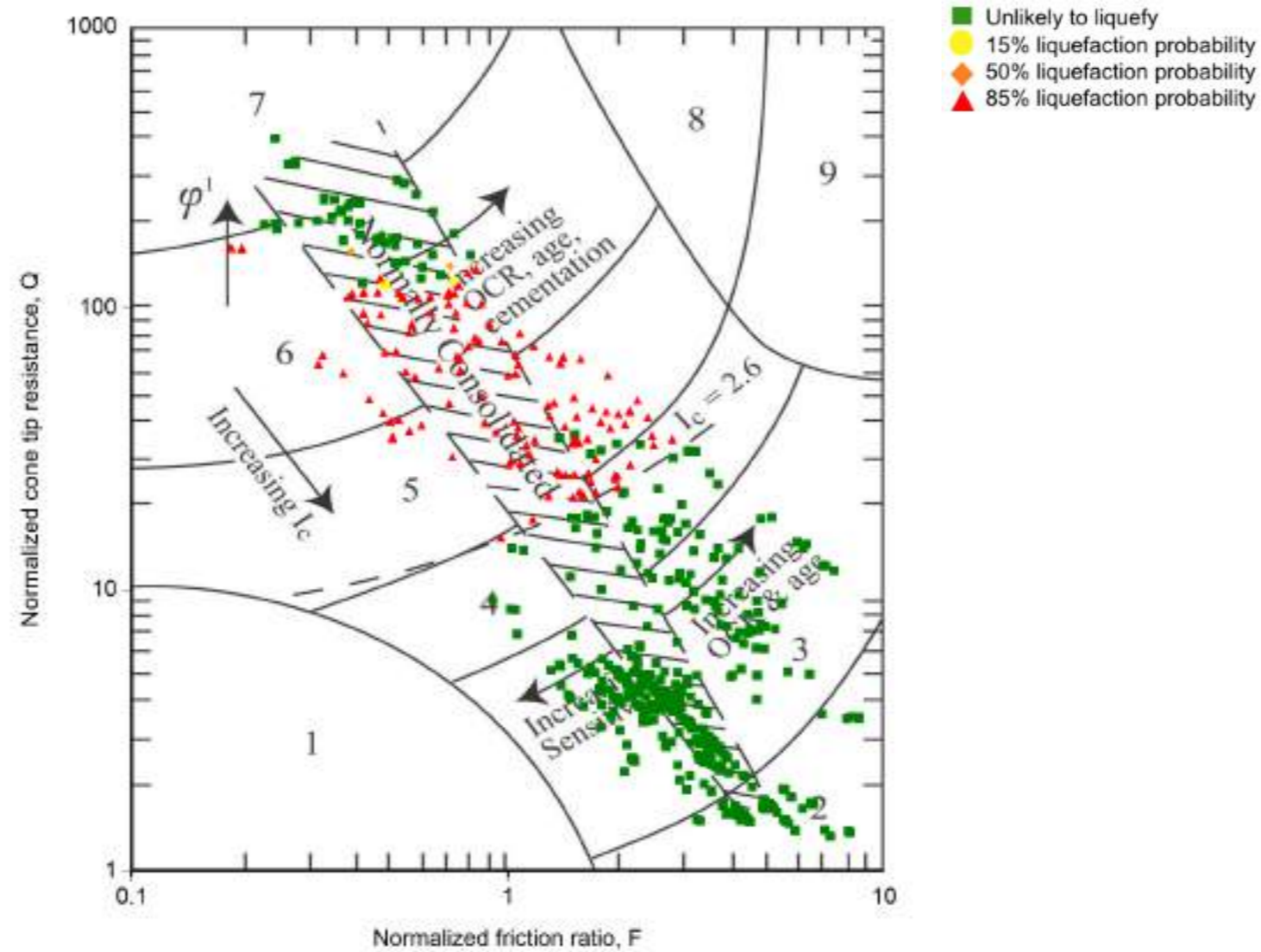
CPT Inversion	ABL
Groundwater	ABL
Susceptibility	ABL
Triggering	ABL
Consequence	ABL



Tonkin + Taylor
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V2.4.15

CLIENT **Napier City Council**
PROJECT **Onekawa Aquatic Centre**
TITLE **ULS - Onekawa Aquatic Centre Liquefaction Analysis**
COMMENT **ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]**


LOCATION **Napier**
JOB NUMBER **1009171**
DATE **10/02/2021**
ANALYSED **zafz**
PAGE **4 of 9 pages**

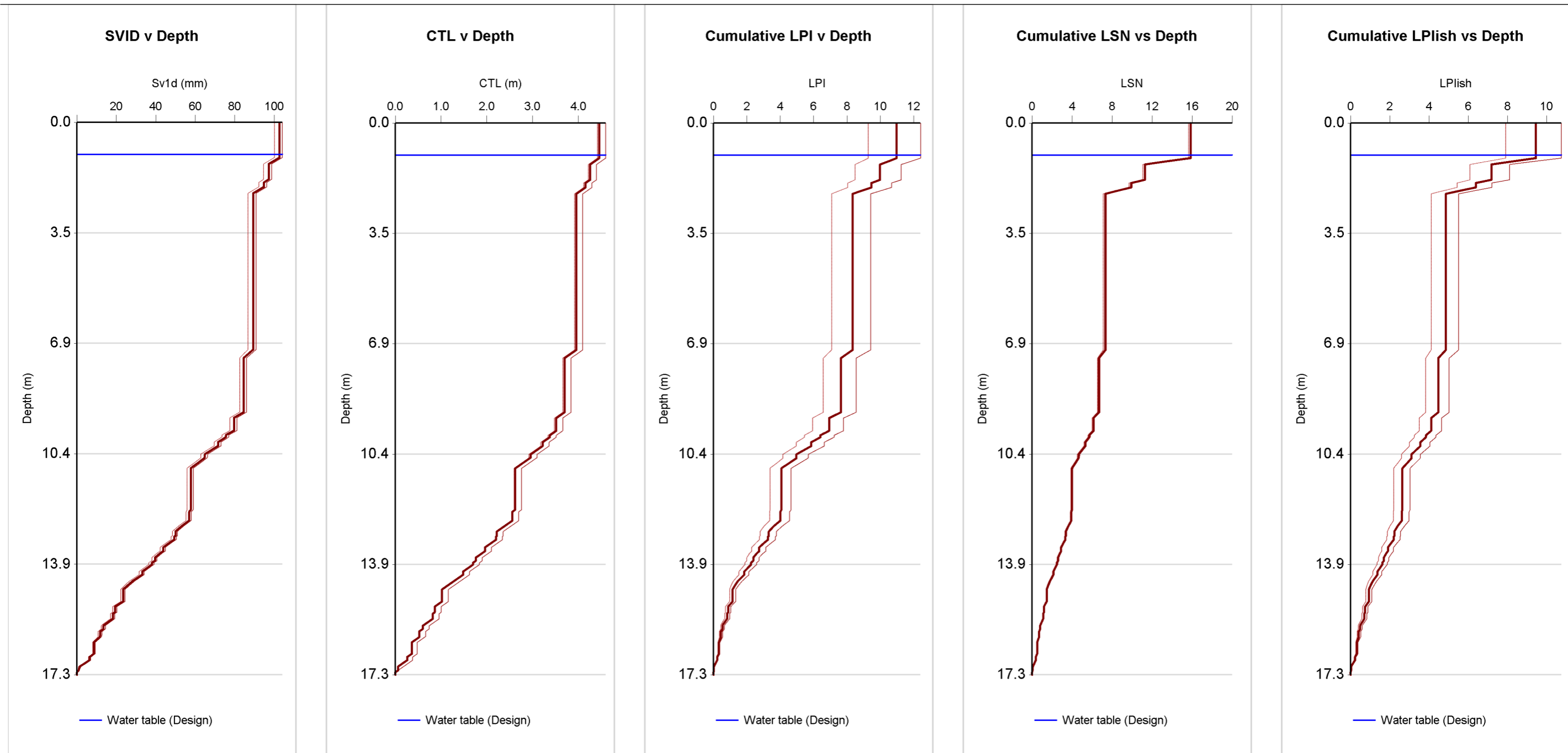


- | | |
|--|-------------------------------------|
| 1. Sensitive, fine grained | 6. Sands - clean sand to silty sand |
| 2. Organic soils - peats | 7. Gravelly sand to dense sand |
| 3. Clays - silty clay to clay | 8. Very stiff sand to clayey sand * |
| 4. Silt mixtures - clayey silt to silty clay | 9. Very stiff, fine grained * |
| 5. Sand mixtures - silty sand to sandy silt | |


*Heavily overconsolidated or cemented

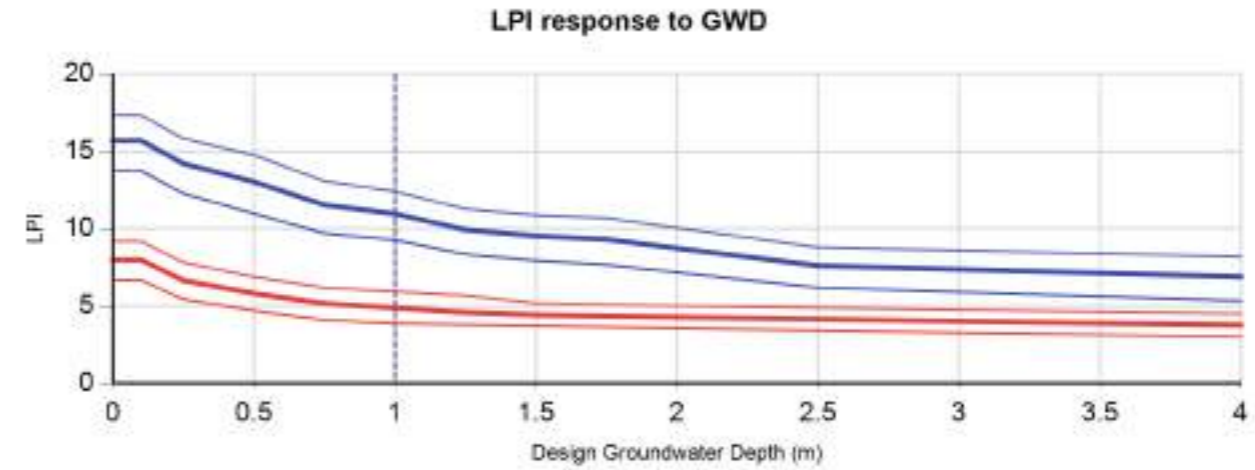
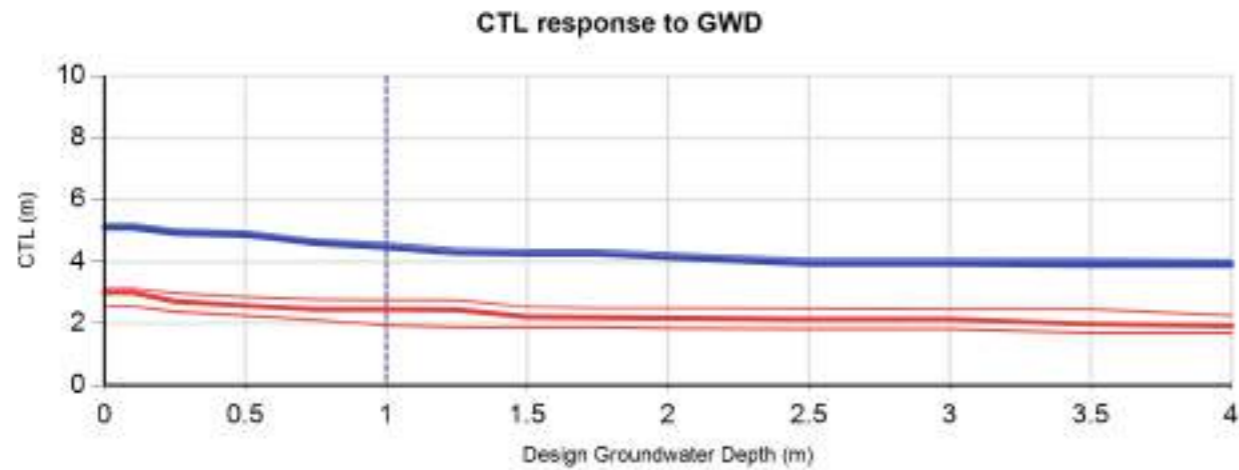
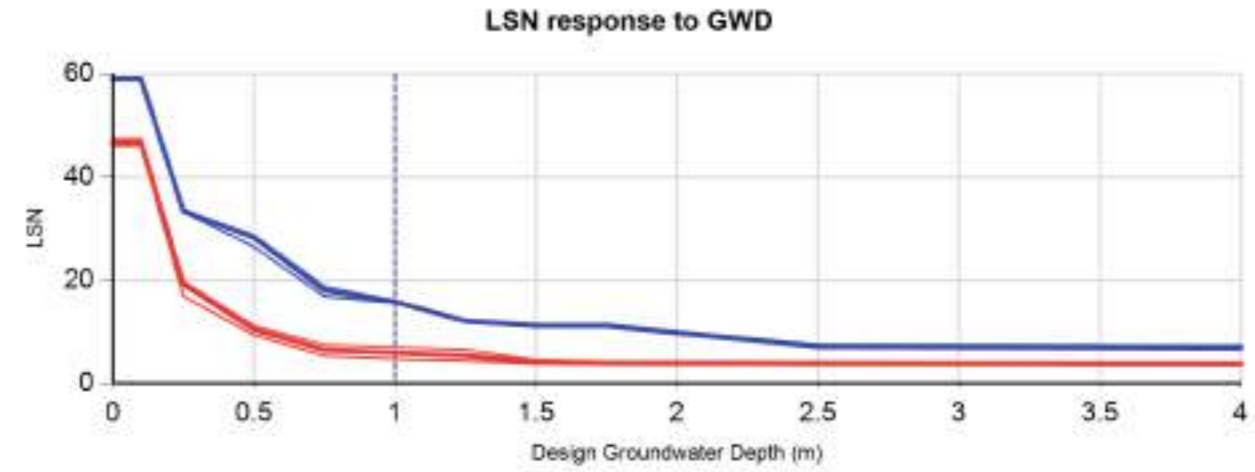
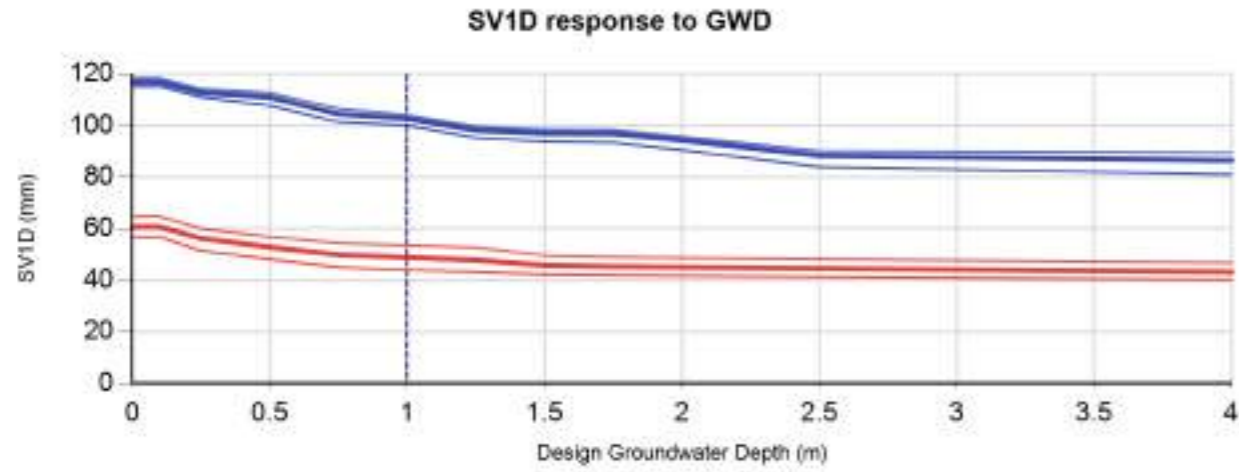
CPT-based soil behavior type classification chart by Robertson (1990)

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	Napier	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER		
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]	1009171	PAGE	5 of 9 pages



Run Description	NZGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT CPT20	152823	26/11/2020	0	6.6	0.51	BI-2014	ZRB-2002	18		0	

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	6 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]				




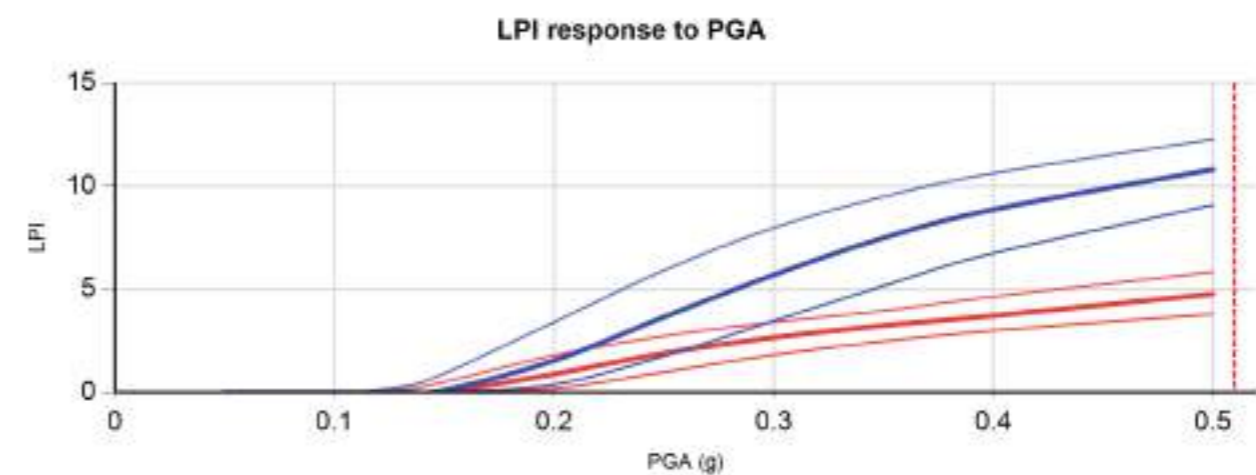
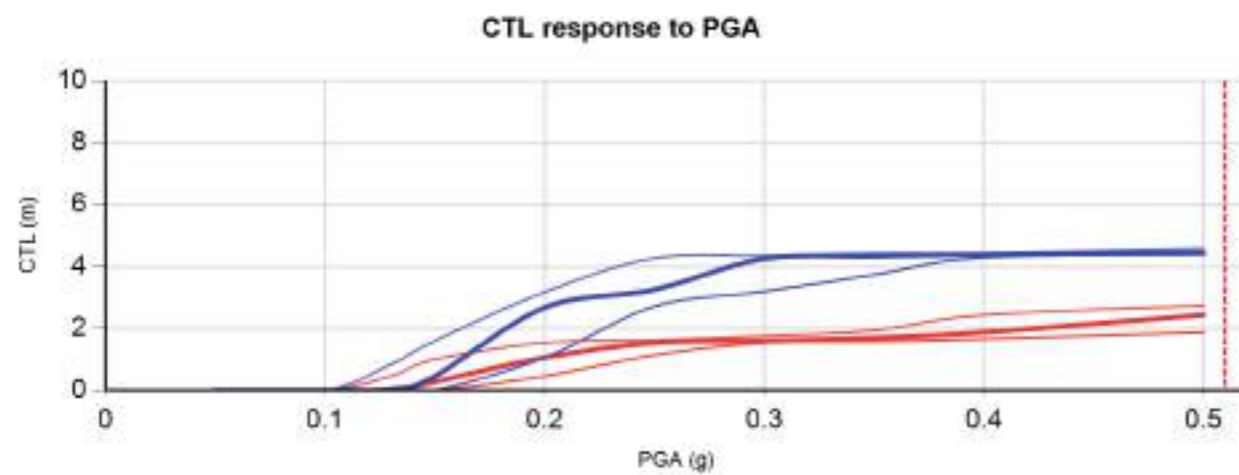
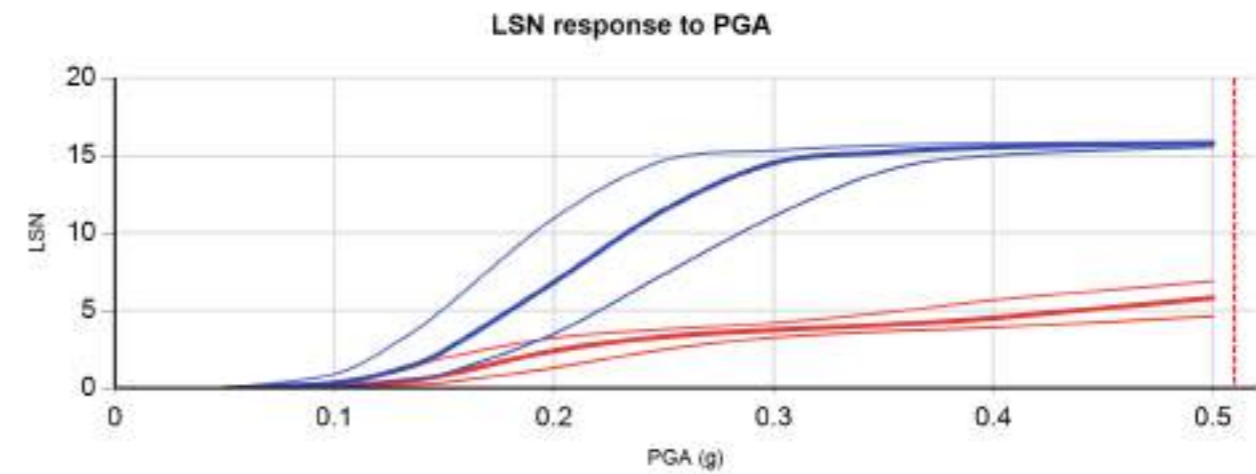
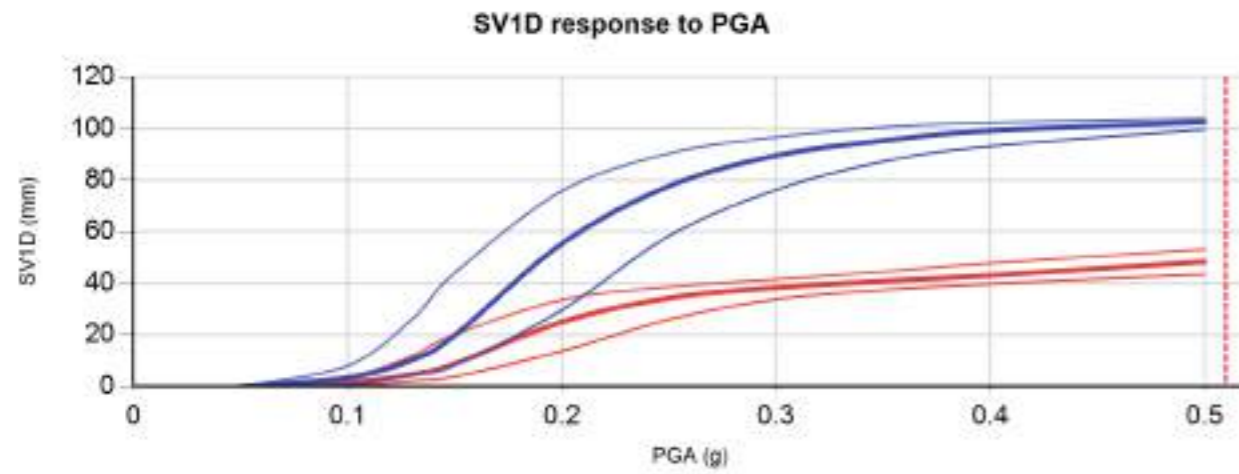
Vertical dotted line/s indicate design groundwater depth at the CPT locations.

Note: Inverse filtered Q_c/F_s data (10 cm^2) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre	JOB NUMBER	1009171	ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis			PAGE	7 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]				




Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	NZGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m ³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT19	152822	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	
CPT20	152823	26/11/2020	6.6	0.51	BI-2014	ZRB-2002		18		0	

Thicker lines represent the 50% probability of exceedance case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.

 <p>Tonkin + Taylor Exceptional thinking together V2.4.15</p>	CLIENT	Napier City Council	LOCATION	Napier	DATE	10/02/2021
	PROJECT	Onekawa Aquatic Centre			ANALYSED	zafr
	TITLE	ULS - Onekawa Aquatic Centre Liquefaction Analysis	JOB NUMBER	1009171	PAGE	8 of 9 pages
	COMMENT	ULS Magnitude 6.6, PGA - 0.51g (1 in 1000 years) [CPT 19 and 20]				

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

ID	NZGD 152822	NZGD 152823
CPT Name	CPT19	CPT20
Run description	CPT19	CPT20
PGA	0.51g	0.51g
Magnitude	6.6	6.6
Depth to groundwater at time of Investigation (m)	1	1
Depth to groundwater for design (m)	1	1
Predrill depth (m)	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	17.04	17.32
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse Filtering applied?	Yes (10 cm ²)	Yes (10 cm ²)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

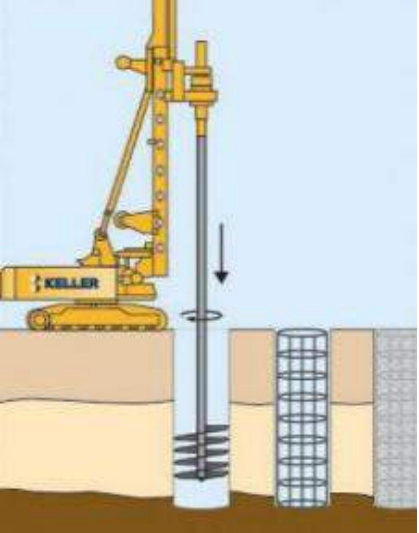
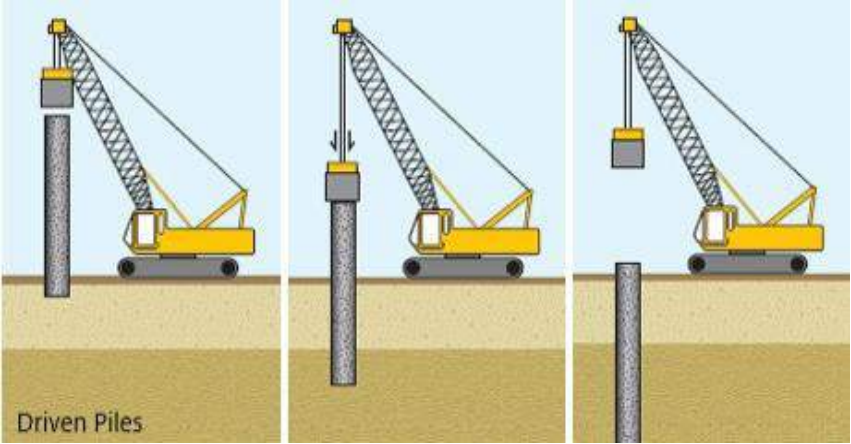
ID	Run description	From (m)	To (m)	Ic
NZGD 152822	CPT19	0	0	0
NZGD 152822	CPT19	0	17.04	2.6
NZGD 152823	CPT20	0	0	0
NZGD 152823	CPT20	0	17.32	2.6

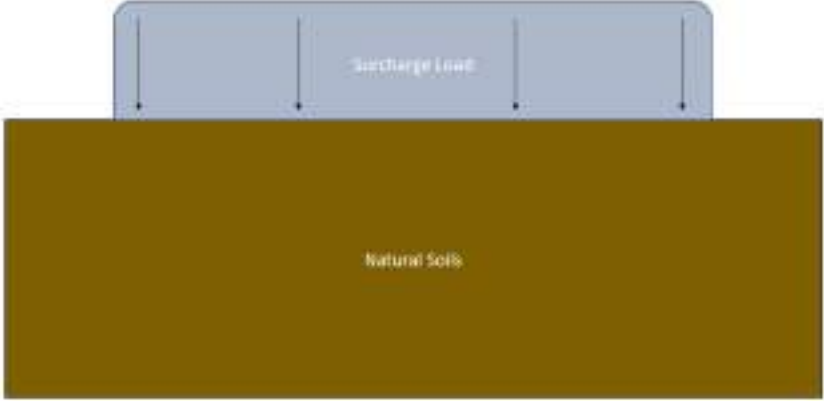
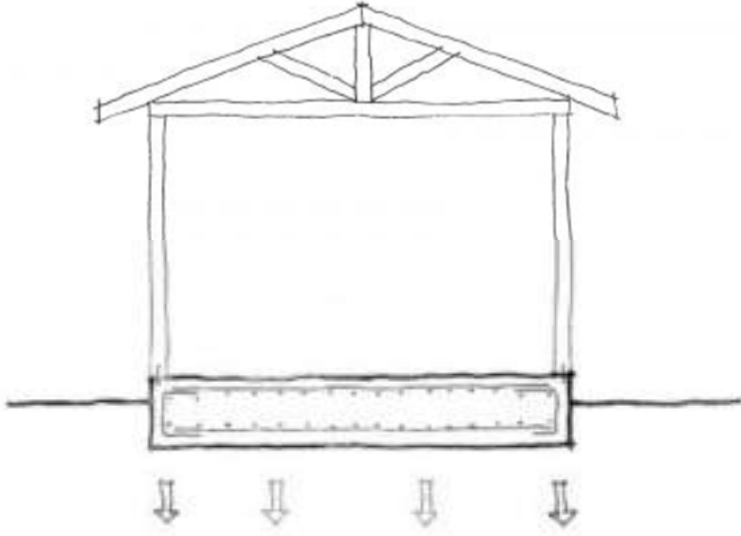
Table 1.1-3 Summary of Fc inputs for liquefaction analysis

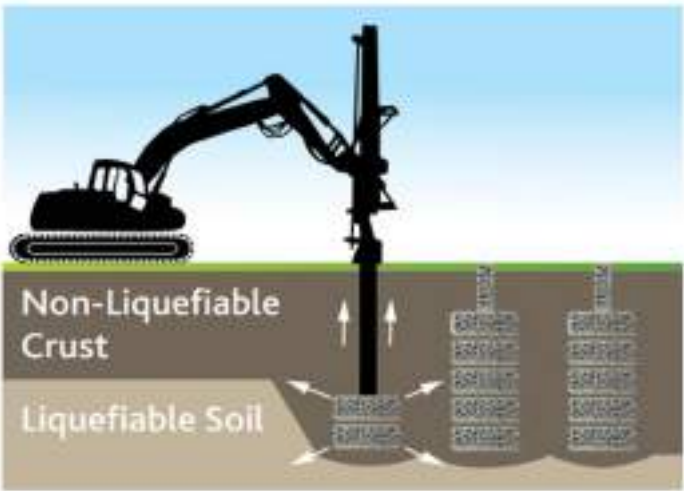
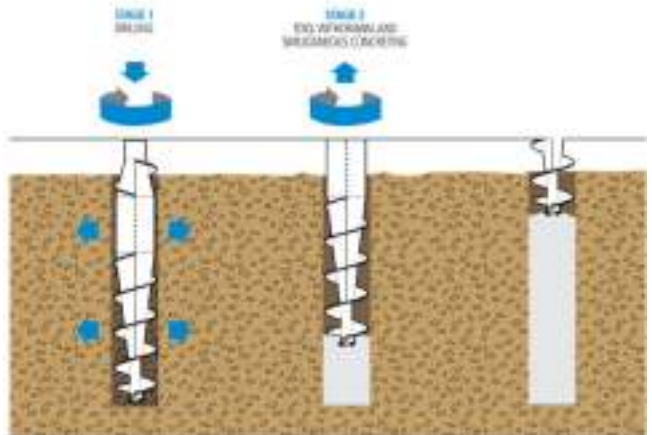
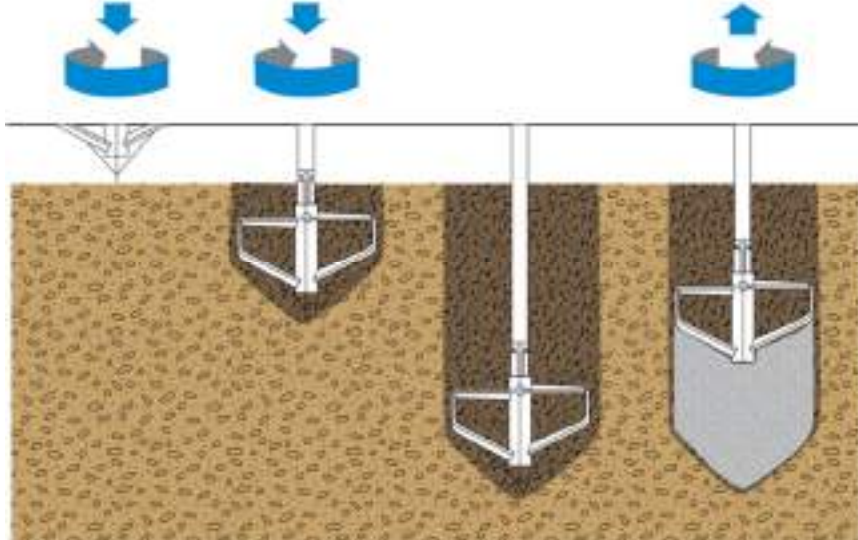
ID	Run description	From (m)	To (m)	Fc
NZGD 152822	CPT19	0	17.04	0 CFC
NZGD 152823	CPT20	0	17.32	0 CFC

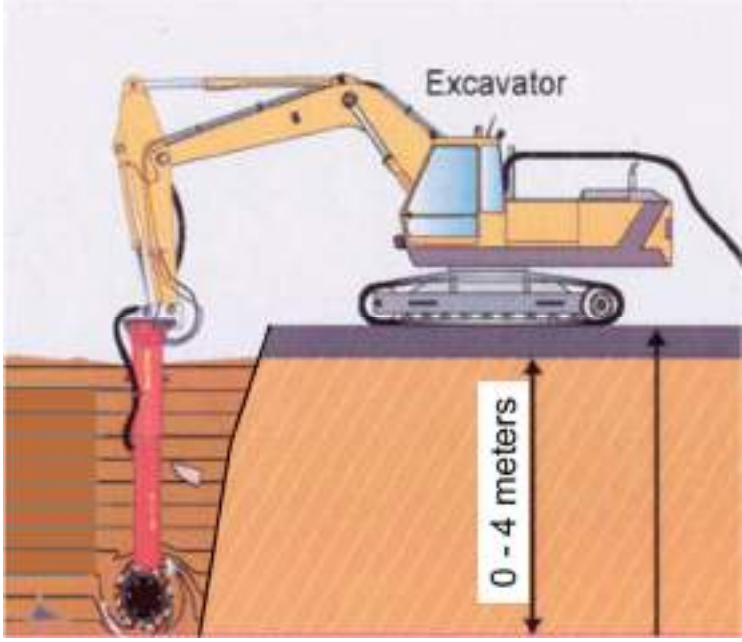
Appendix E: Foundation Optioneering Plan

Table E1. Foundation and Ground Improvement Optioneering for the Onekawa Pool Site.

Options	Potential Solutions	Installation Depth	Opportunities	Risks	Recommendation
1	<p>Bored Pile</p> 	~ 14-22m	<ul style="list-style-type: none"> - Low vibration effects. - Low noise. - Proven technique with local contractor capacity. 	<ul style="list-style-type: none"> - Piles would need temporary support or bentonite slurry to keep shafts open. - Potential for disposal of contaminated soils would need to be considered. - Large plant required. - Relatively high cost. - Relatively slow programme. - Lack of consistent founding layer. Piles would need to be designed as friction piles. - Liquefaction effects would need to be accounted for in design. - Continuous Flight Auger (CFA) pile variant could possibly be adopted. 	<p>Pool complex: <u>Not recommended</u></p> <p>Gym extension: <u>Not recommended</u></p>
2	<p>Driven Pile</p> 	~ 14-22m	<ul style="list-style-type: none"> - Relatively quick production rates. - Reduced programme. - No spoil. - Readily available plant and local contractors. - Specific QA requirement. 	<ul style="list-style-type: none"> - Creates lots of noise and vibrations. Noting, the development is in a residential neighbourhood and there are potential vibrations that could damage existing buildings/infrastructure. - Design would need to allow for liquefaction effects and potentially loss of support in sand lenses. - Relatively high cost. - Large plant required. - Lack of consistent founding layer. Piles would need to be designed as friction piles. 	<p>Pool complex: <u>Not recommended</u></p> <p>Gym extension: <u>Not recommended</u></p>

Options	Potential Solutions	Installation Depth	Opportunities	Risks	Recommendation
3	<p data-bbox="409 254 1071 281">Pre-Loading of the Soil and a shallow foundation solution</p>  <p data-bbox="655 743 825 770">Step 1: Pre-Load</p>  <p data-bbox="320 1444 1160 1503">Step 2: Construct a shallow foundation (i.e., rigid concrete mat or similar overlying shallow gravel raft) on completion of preloading.</p>	<p data-bbox="1196 254 1377 315">Surcharge ~ 2m above ground</p> <p data-bbox="1196 352 1368 548">Shallow foundations constructed following preloading and monitoring.</p>	<ul style="list-style-type: none"> - Proven technique locally with relatively cheap sources of aggregate/fill. - Relatively low cost. - Does not require a specialised contractor. - QA is relatively simple with local surveyor and monitoring. - Material could potentially be reused elsewhere on site following preloading (i.e. hardfill imported then used as carpark subbase). 	<ul style="list-style-type: none"> - Would still require removal of shallow uncontrolled fill. - Programme delays relating to preloading (approx. 1–2-year duration). This can possibly be accelerated with wick drains but would be an additional cost. - Surcharge over existing services may require the diversion of existing SW/SS/Water lines. - Potentially disruptive to site operations if preload in place for significant duration. - Preload takes longer than anticipated, leads to programme delays. 	<p data-bbox="2421 254 2772 415">Pool complex: <u>Unlikely</u> - due to large amount of underground services, large fill volume required and disruption to the site</p> <p data-bbox="2421 453 2772 653">Gym extension: <u>Yes</u> – Expected to be suitable for the gym complex. Shallow foundation system overlying an engineered gravel raft, following preloading.</p>

Options	Potential Solutions	Installation Depth	Opportunities	Risks	Recommendation
4	<p>Rammed Aggregate Piers (RAP)/Grouted Impact Pier (GIP)</p>  <p>Geopier Rammed Aggregate Pier™ System (RAP)</p>	~ 6-8m	<ul style="list-style-type: none"> - Relatively lower cost than piling options. - Relatively quick installation. - Option to densify liquefiable layers as well as reduce settlements through stiffening. - Generally low noise and vibrations. - No spoil (i.e. removal of contaminated soils). 	<ul style="list-style-type: none"> - Modest plant required. - Specialised contractor required. - Proprietary product (only one company have licence in NZ). - Specialist QA required. - Construction through soft silt will likely require grout additive to increase column stiffness. 	<p>Pool complex: <u>Yes</u> - appropriate for pool building.</p> <p>Gym extension: <u>Yes</u> - but would need to be installed to greater depths.</p>
5	<p>Full Displacement Piles as Ground Improvement (i.e. unreinforced)</p> 	~ 6-8m	<ul style="list-style-type: none"> - No spoil (i.e. removal of contaminated soils). - Lower cost than traditional piling with reinforcement. - Low noise and vibration. 	<ul style="list-style-type: none"> - QA more onerous. - Specialised contractor required. Limited capacity in NZ. - Relatively high cost. - Large plant required. - Slower production. 	<p>Pool complex: <u>Yes</u> - appropriate for pool building.</p> <p>Gym extension: <u>Yes</u> - but would need to be installed to greater depths.</p>
6	<p>Deep Soil Mixed (DSM) Columns</p> 	~ 6-8m	<ul style="list-style-type: none"> - Used extensively in NZ. - Minimal spoil (soil is reused and reinforced with a binder material). - Low noise and vibration. 	<ul style="list-style-type: none"> - QA high cost and extensive. - Specialised contractor required. Limited capacity in NZ. - Relatively high installation cost. - Relatively large plant. - Slow production. 	<p>Pool complex: <u>Yes</u> - appropriate for pool building.</p> <p>Gym extension: <u>Yes</u> - but would need to be installed to greater depths.</p>

Options	Potential Solutions	Installation Depth	Opportunities	Risks	Recommendation
7	<p data-bbox="492 254 991 281">In-Situ Concrete Mixing (Mass stabilisation)</p> 	<p data-bbox="1228 254 1359 348">~ <4m max treatment depth</p>	<ul data-bbox="1451 254 1774 653" style="list-style-type: none"> - Continuous soil stabilisation, so could treat the existing fill. - Limited plant size – i.e., can be staged over several phases. - Reduced impacts on the site. - Low noise and vibration. 	<ul data-bbox="1855 254 2356 520" style="list-style-type: none"> - Not able to treat ground to the required depth. Limited to about 4m depth. - Relatively high installation cost. - Slow production. - Limited contractor capacity in NZ. 	<p data-bbox="2487 254 2703 317">Pool complex: <u>Not recommended</u></p> <p data-bbox="2487 352 2712 415">Gym extension: <u>Not recommended</u></p>

