

APPENDIX B: LIQUEFACTION ASSESSMENT RESULTS



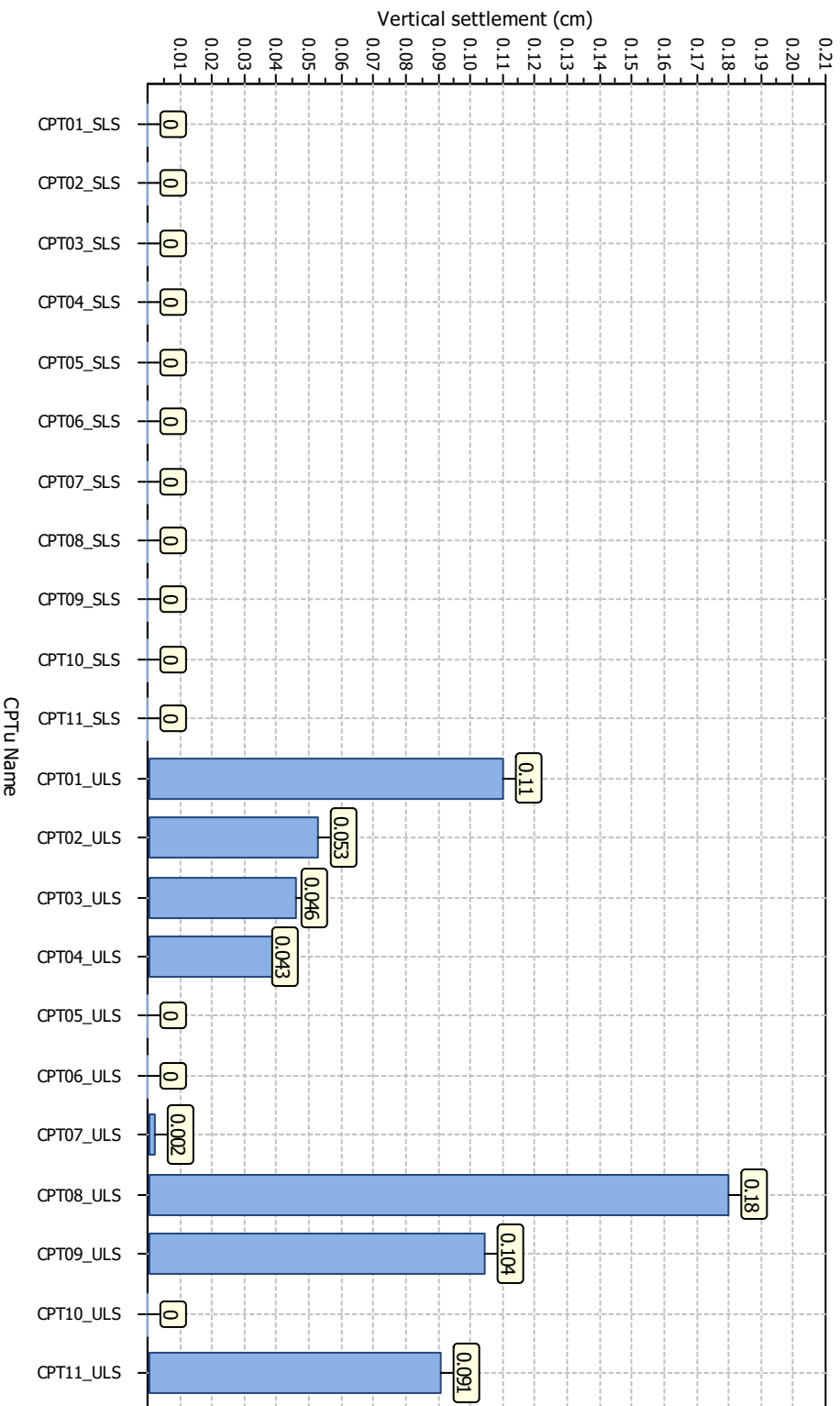
RDCL

RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall vertical settlements report





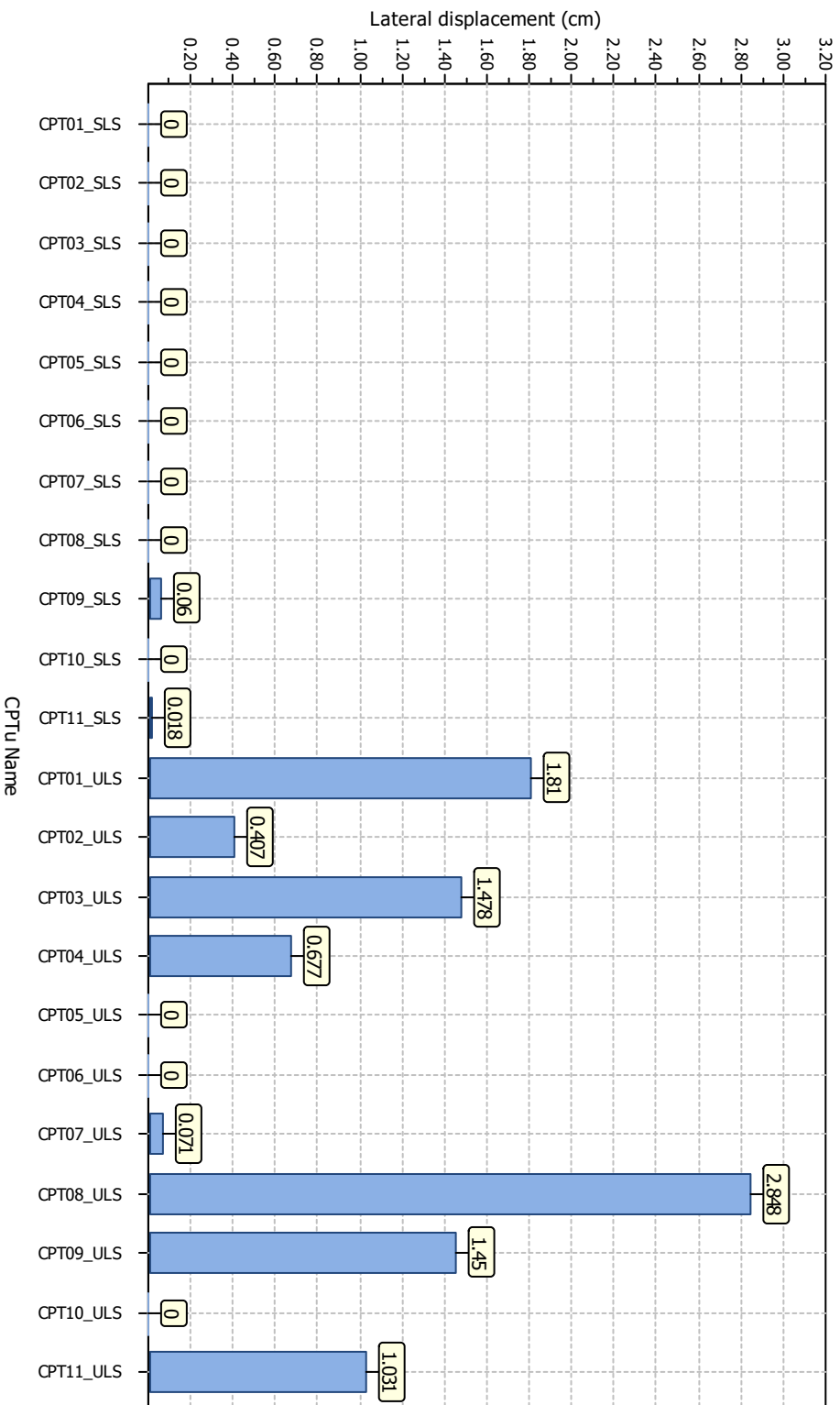
RDCL

RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall lateral displacements report





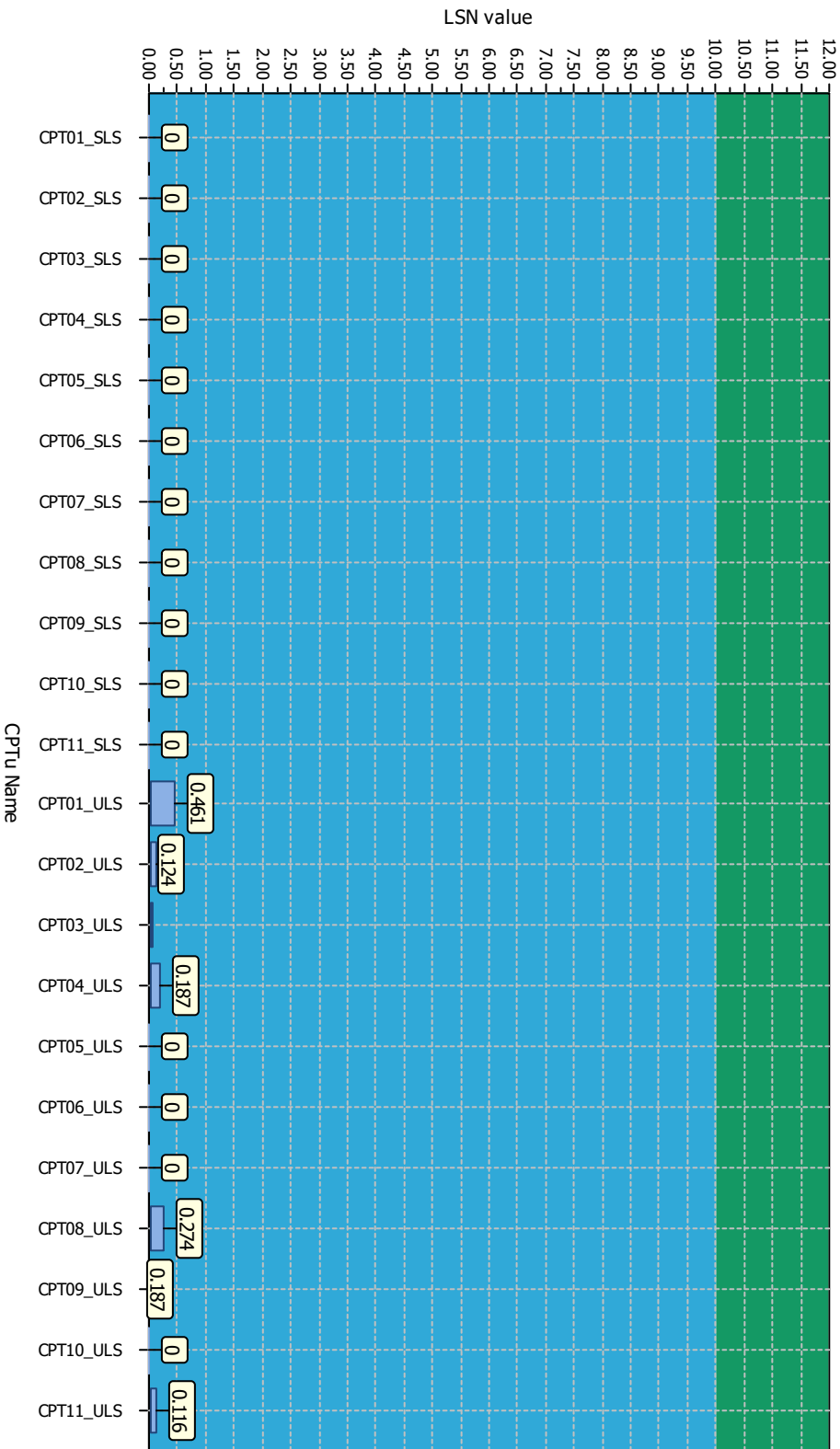
RDCL

RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall Liquefaction Severity Number report



LSNcolor scheme

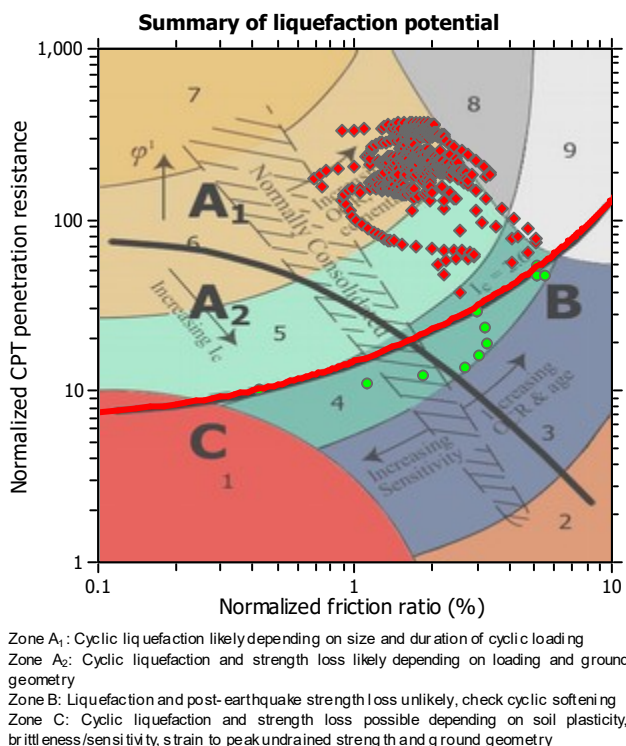
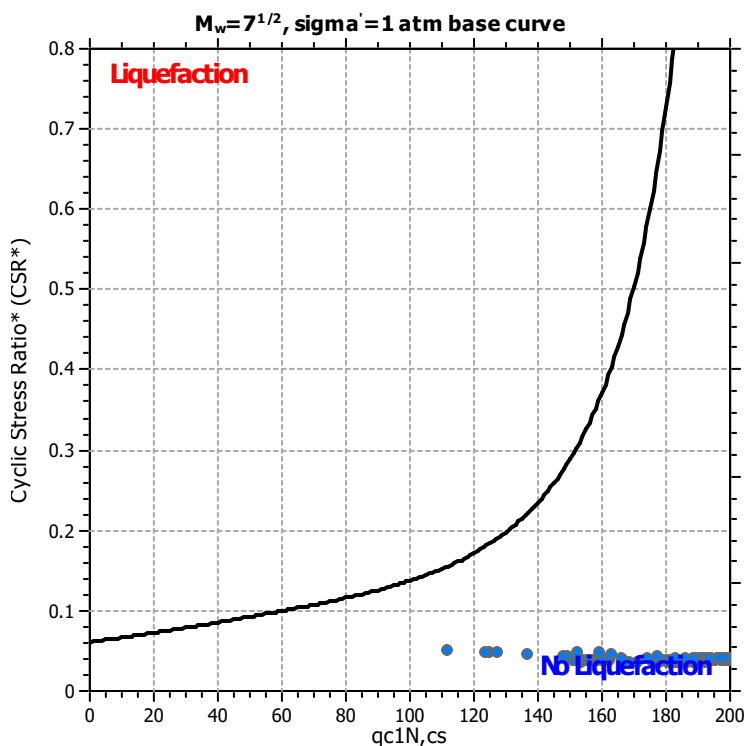
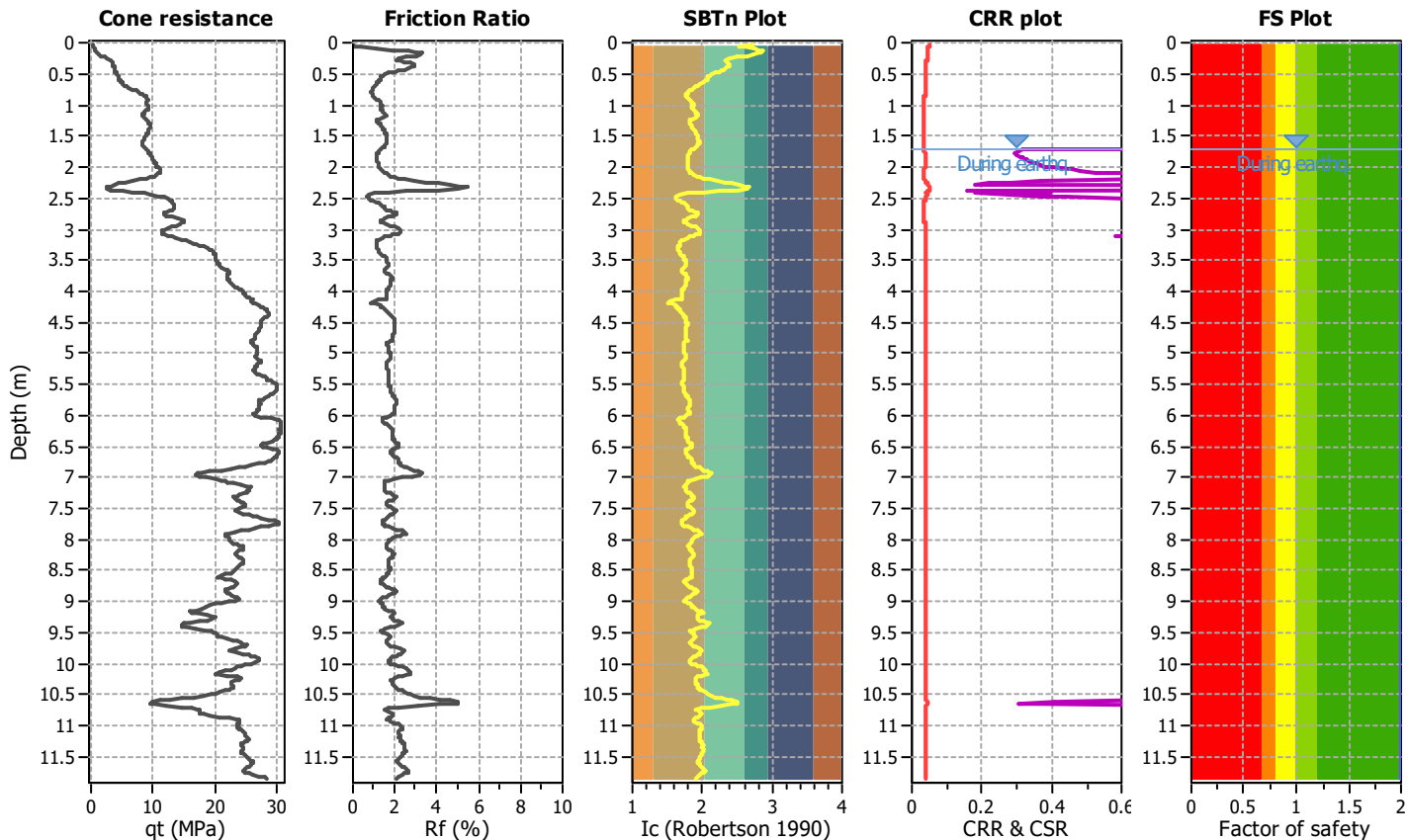
- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

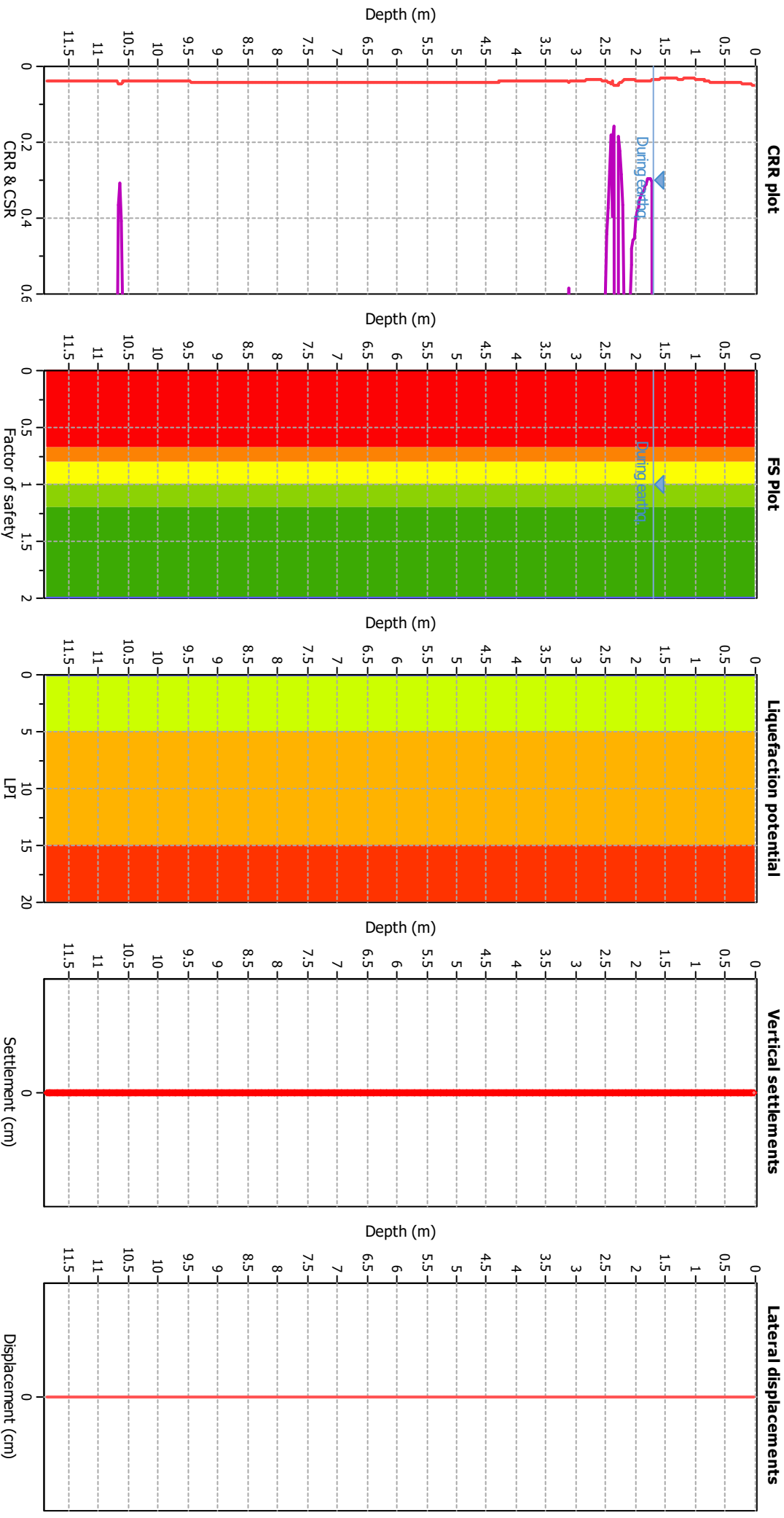
- Total CPT number: 22
- 100% little liquefaction
- 0% minor liquefaction
- 0% moderate liquefaction
- 0% moderate to major liquefaction
- 0% major liquefaction
- 0% severe liquefaction

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT01_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 1.70 m

Depth to GWT (earthq.): 1.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

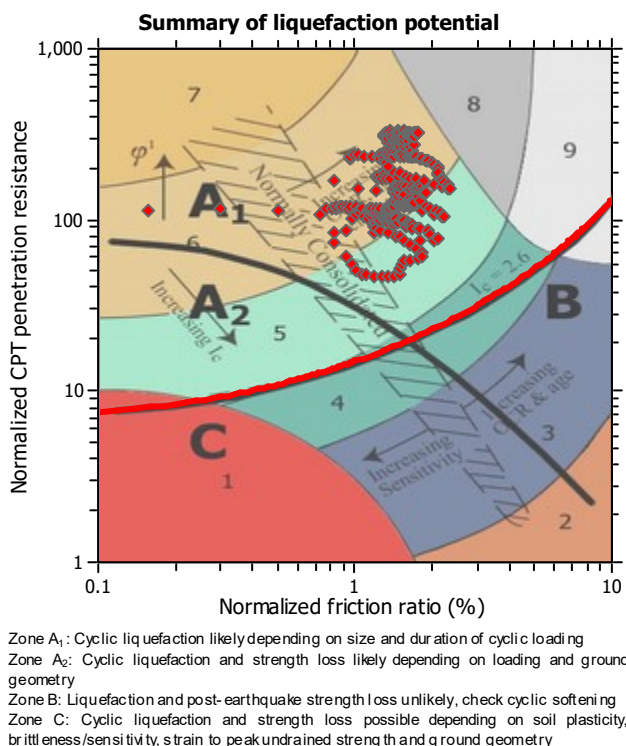
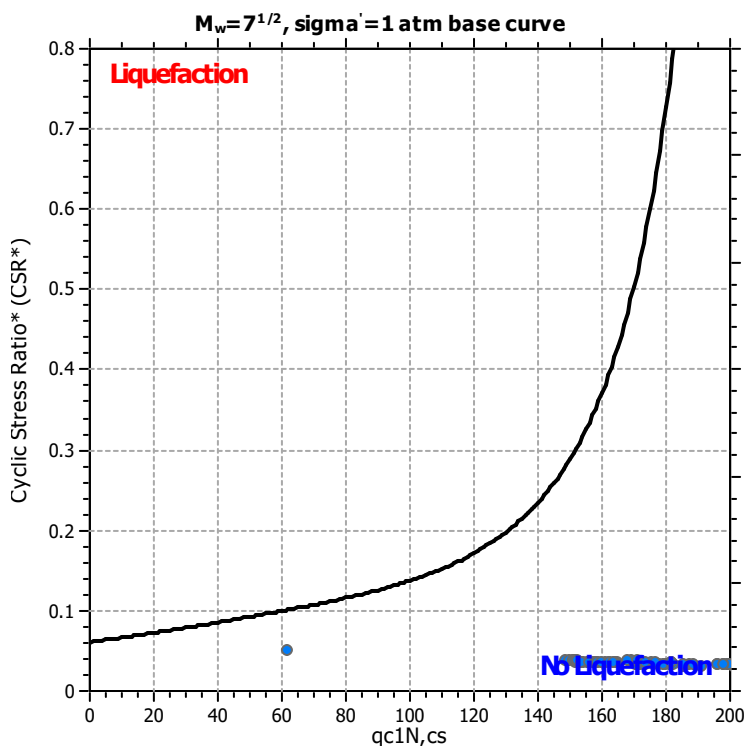
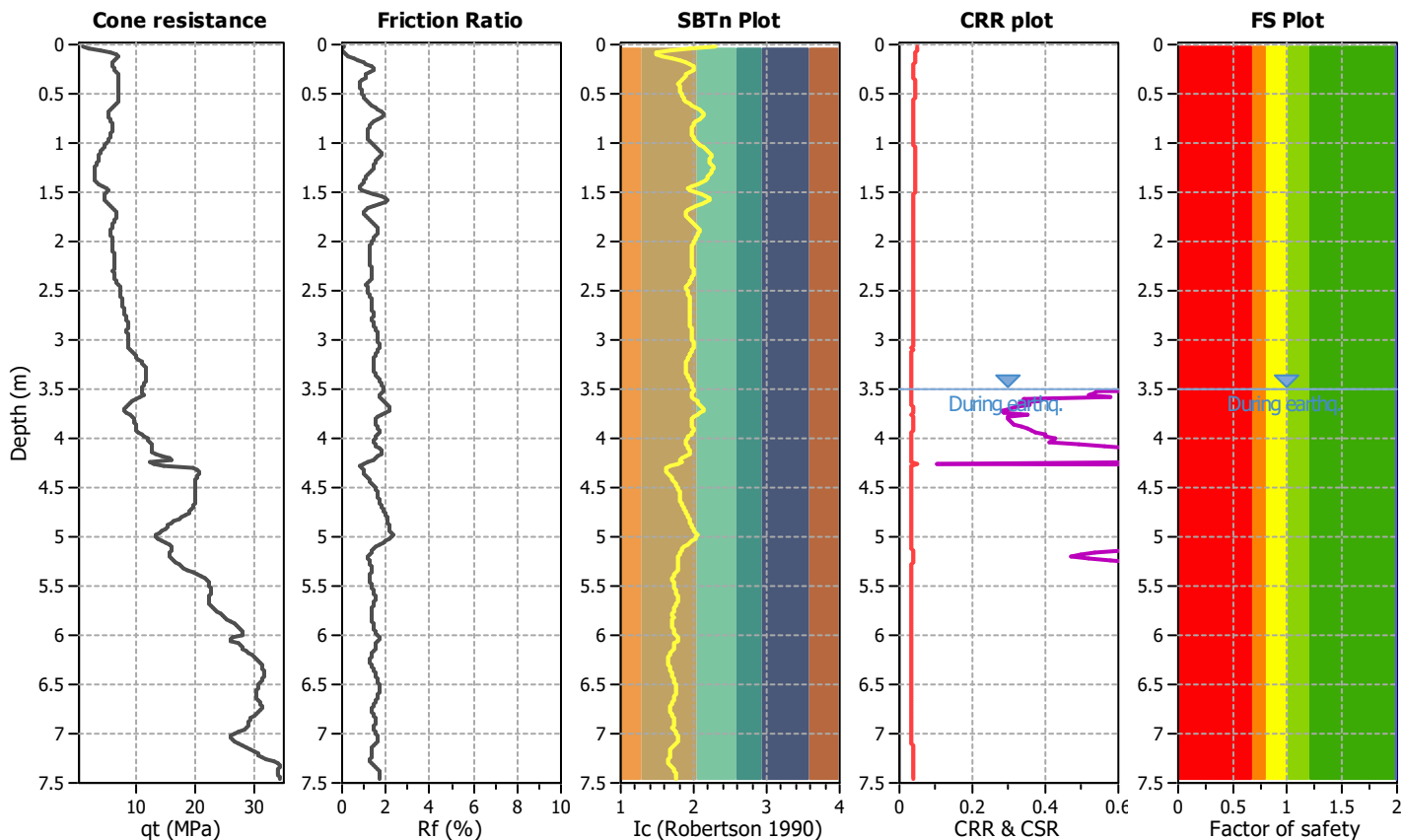
Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: 20.00 m

FS color scheme
■ Almost certain it will liquify
■ Very likely to liquify
■ Liquefaction and no liq. are equally likely
■ Unlike to liquify
■ Almost certain it will not liquify

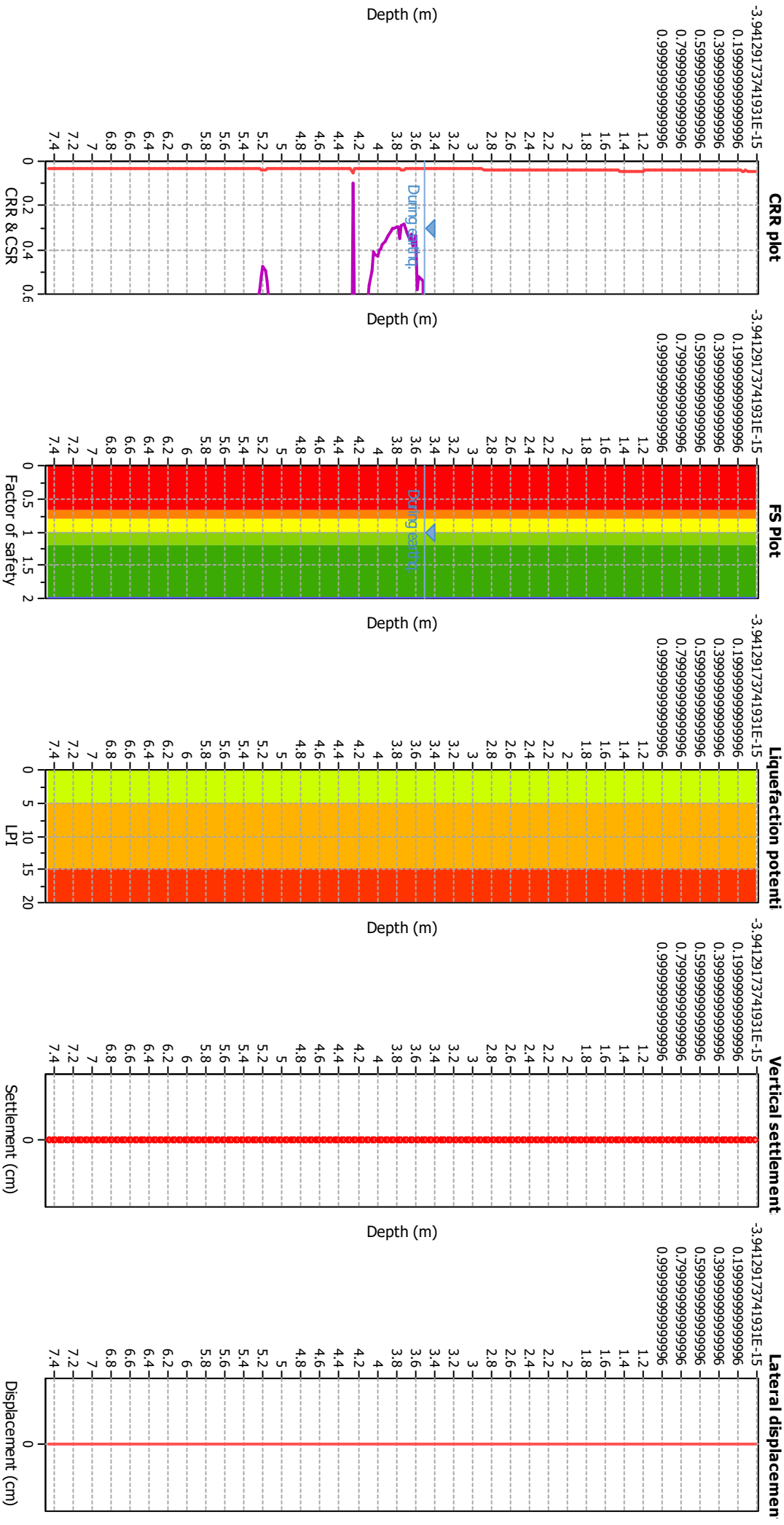
LPI color scheme
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT02_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	3.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

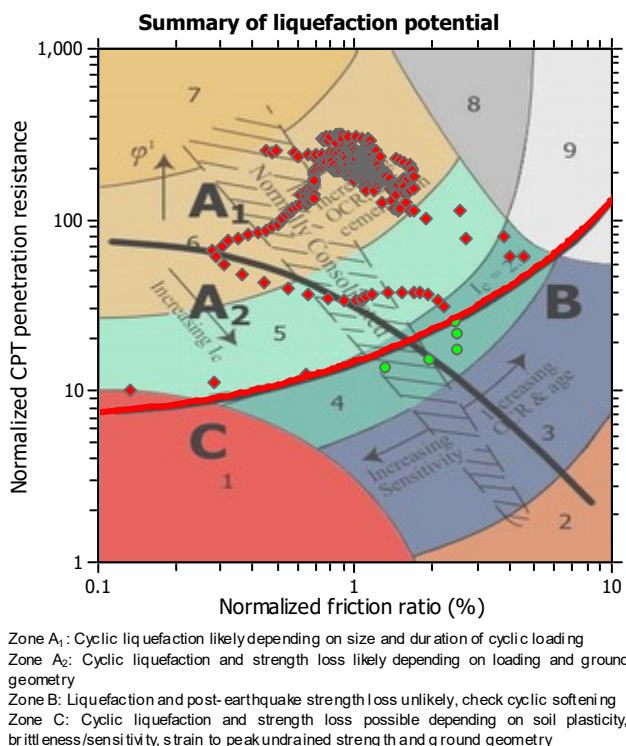
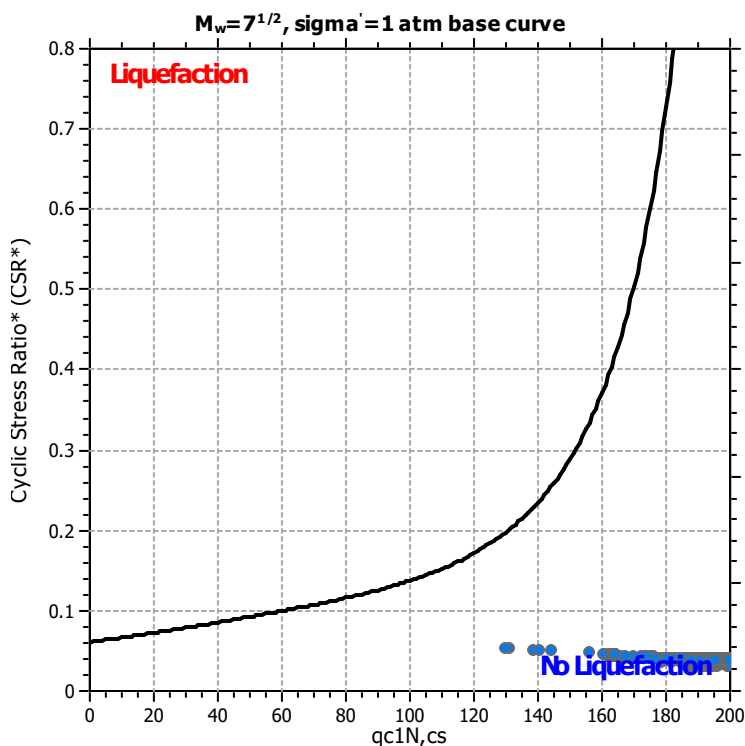
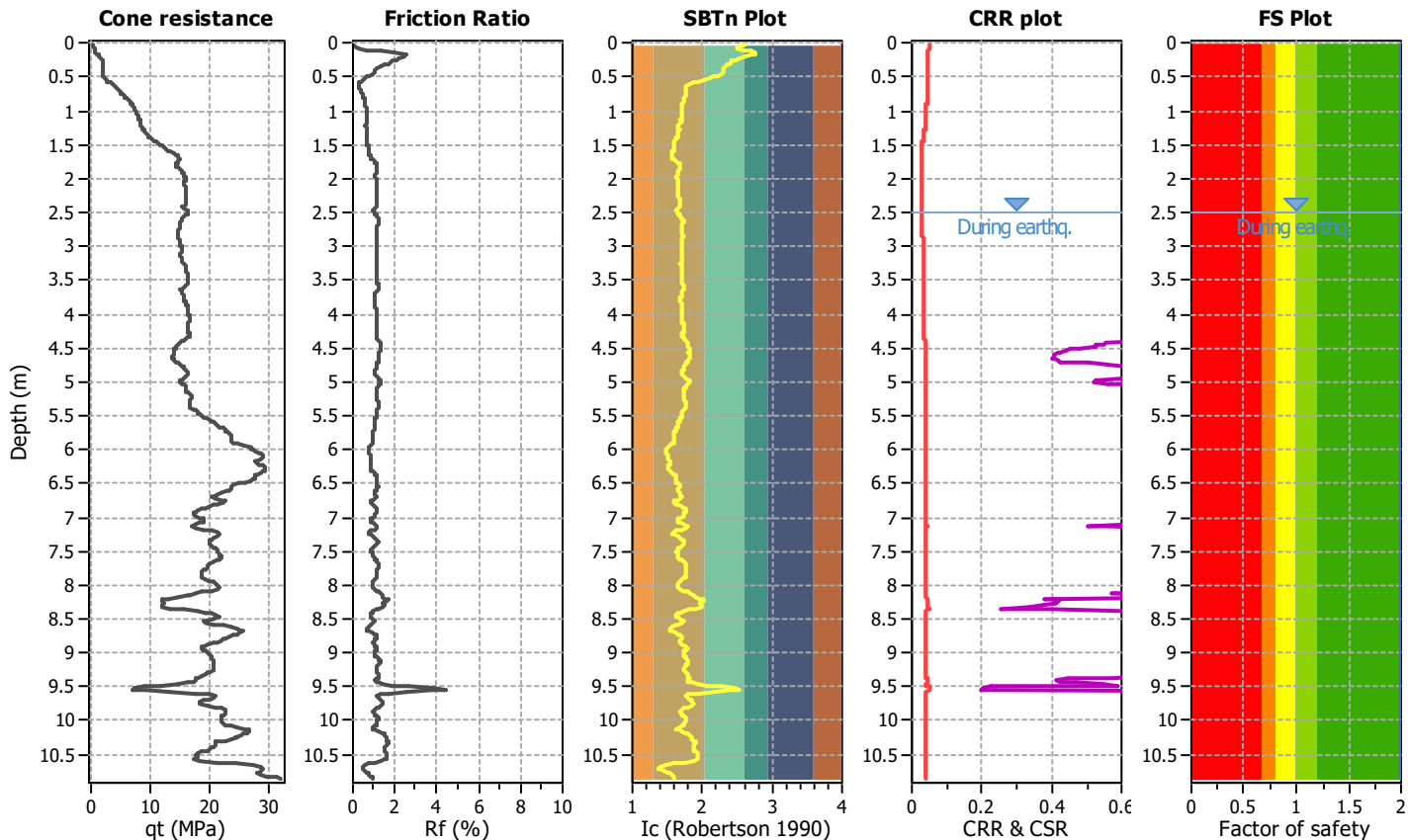
Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 3.50 m

Depth to GWT (earthq.): 3.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

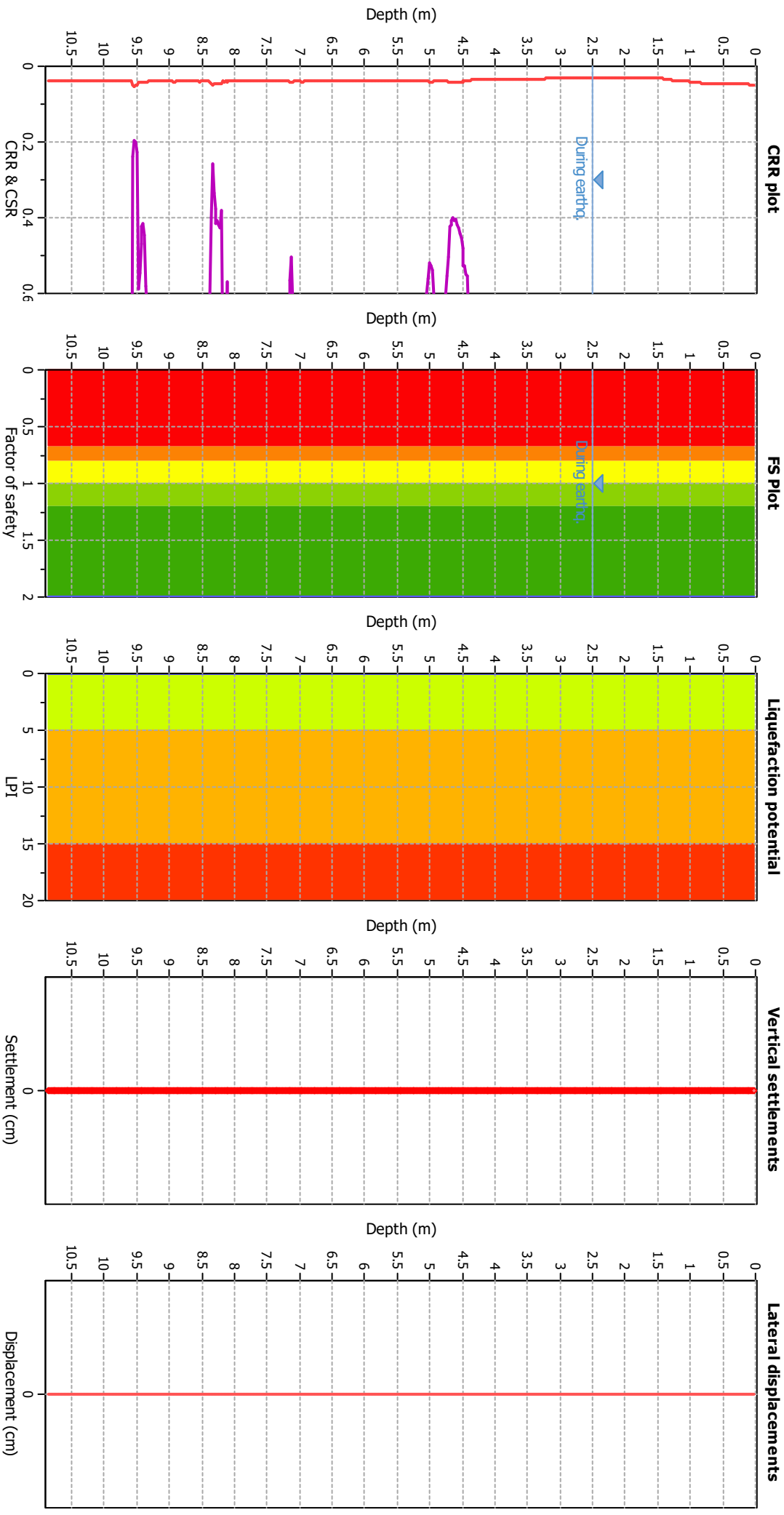
Fill weight: N/A
Transition detect. applied: No
 K_p applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT03_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 2.50 m

Depth to GWT (earthq.): 2.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

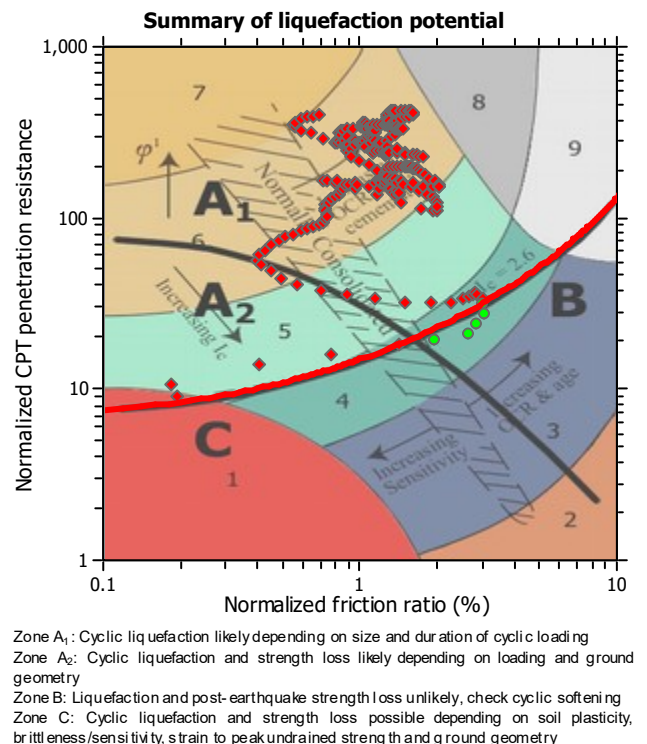
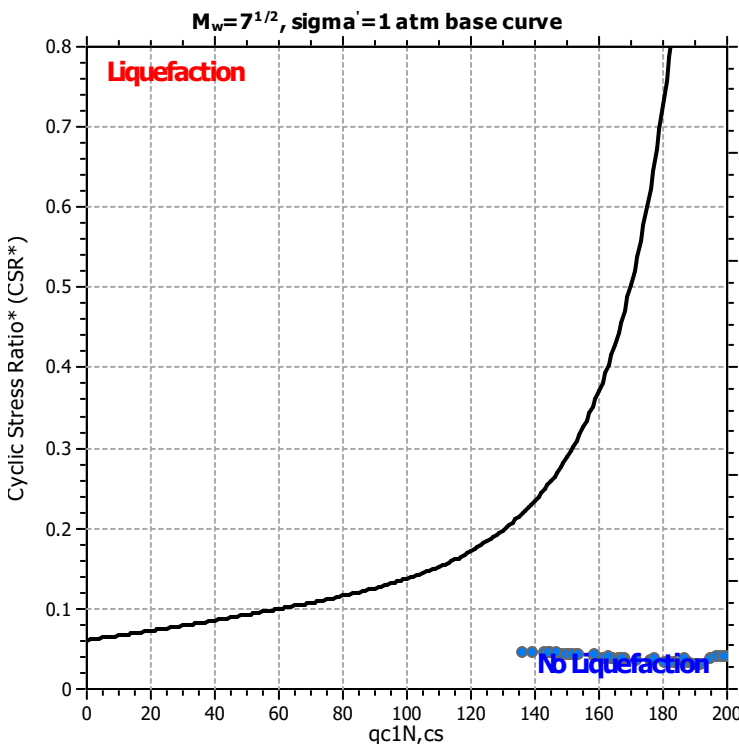
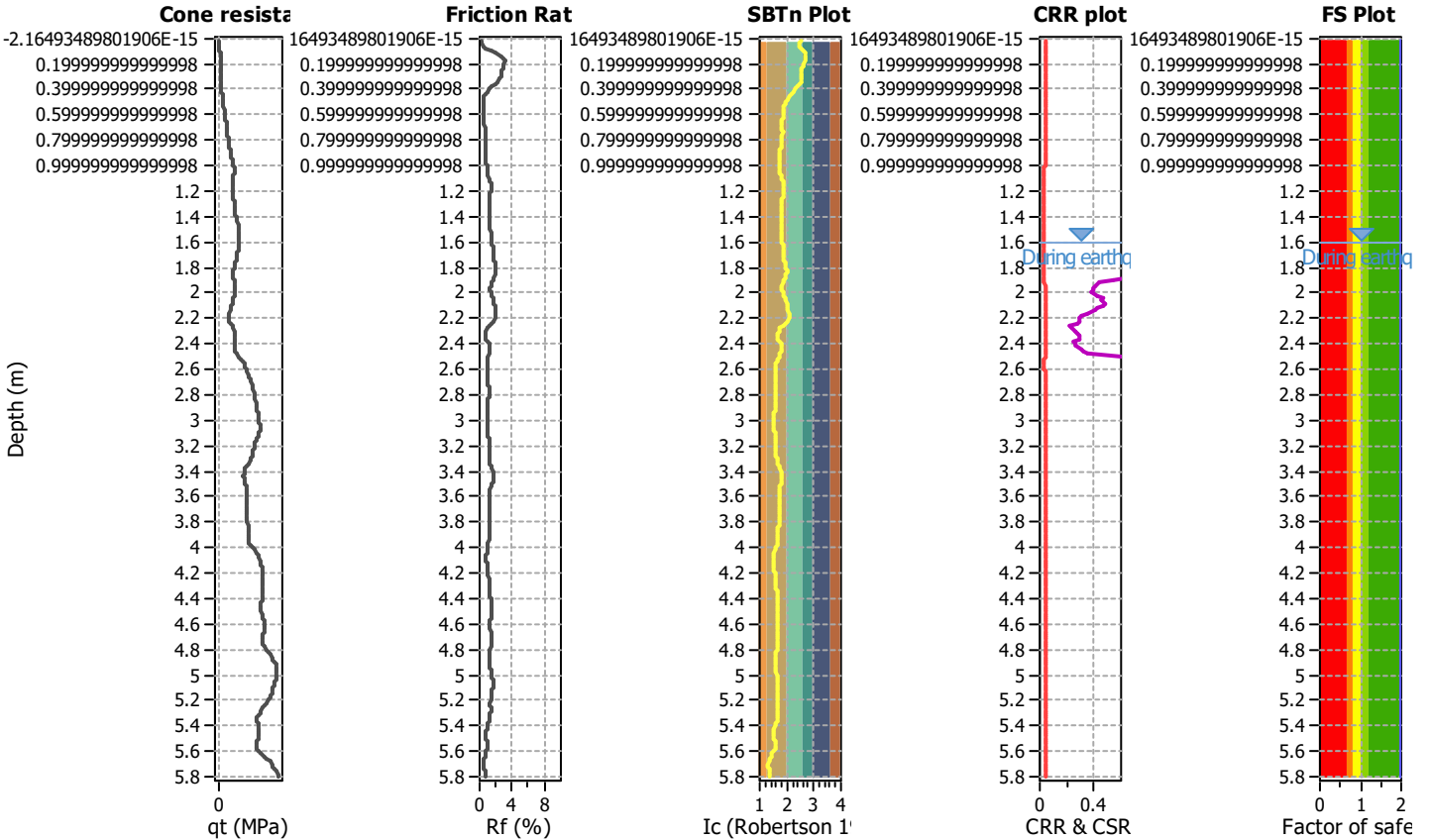
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

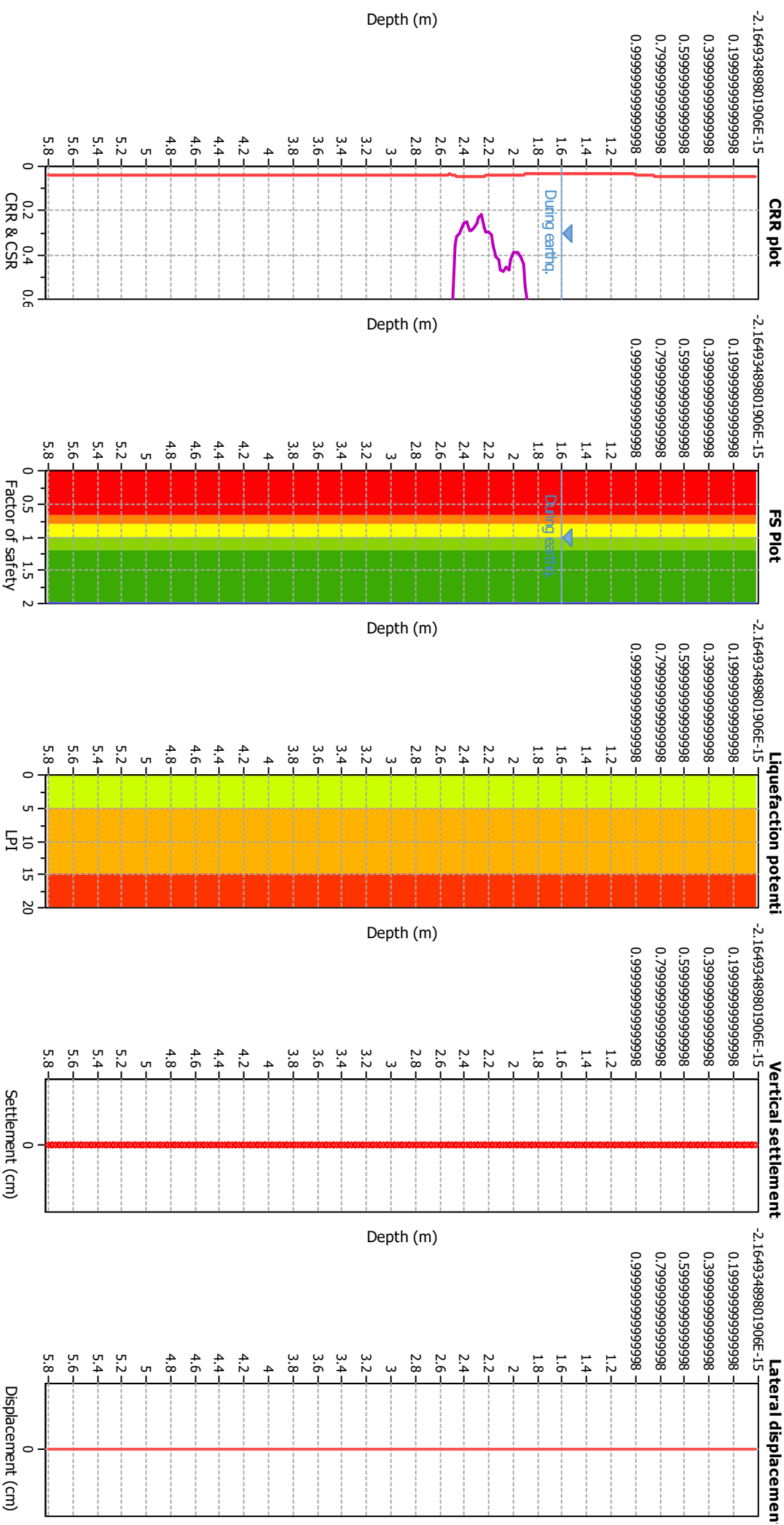
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihangā Rd, Paraparaumu
CPT file : CPT04_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.60 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on I_c value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 1.60 m

Depth to GWT (earthq.): 1.60 m
Average results interval: 3
 I_c cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme

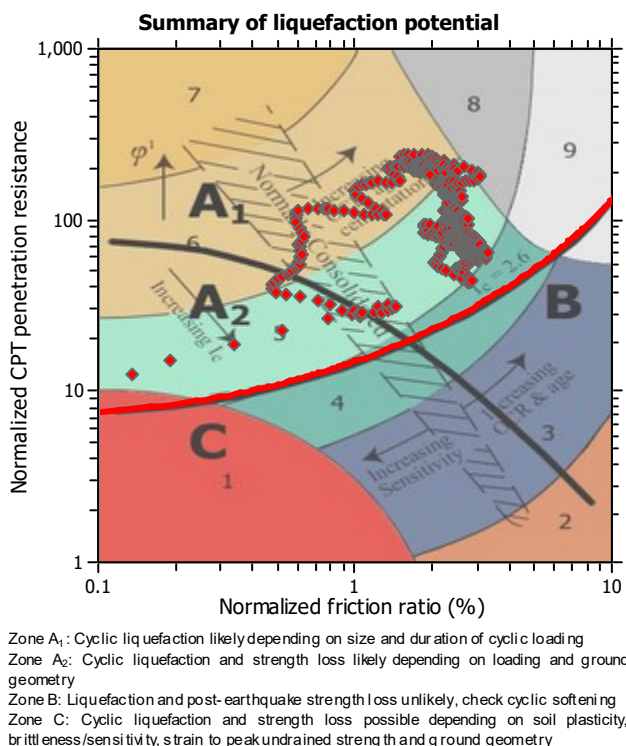
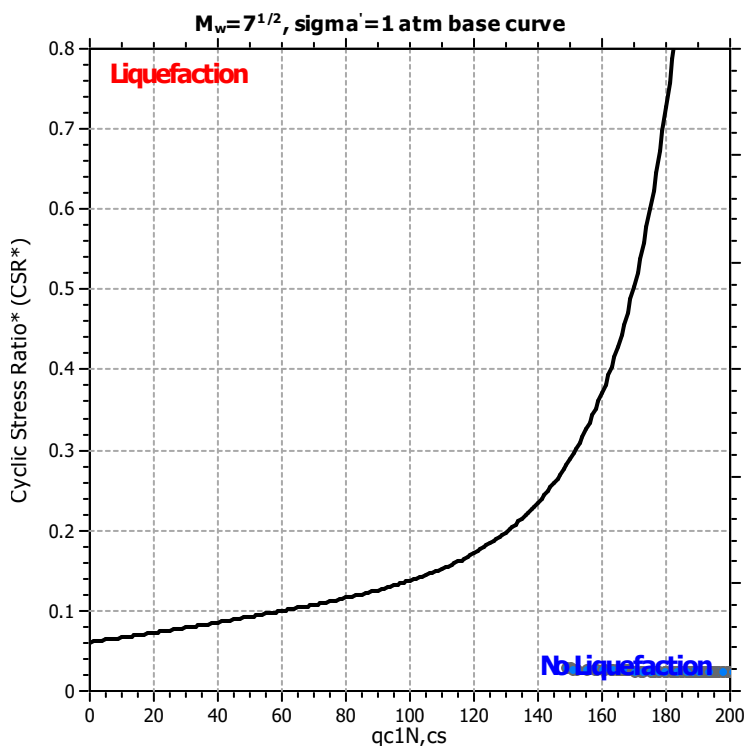
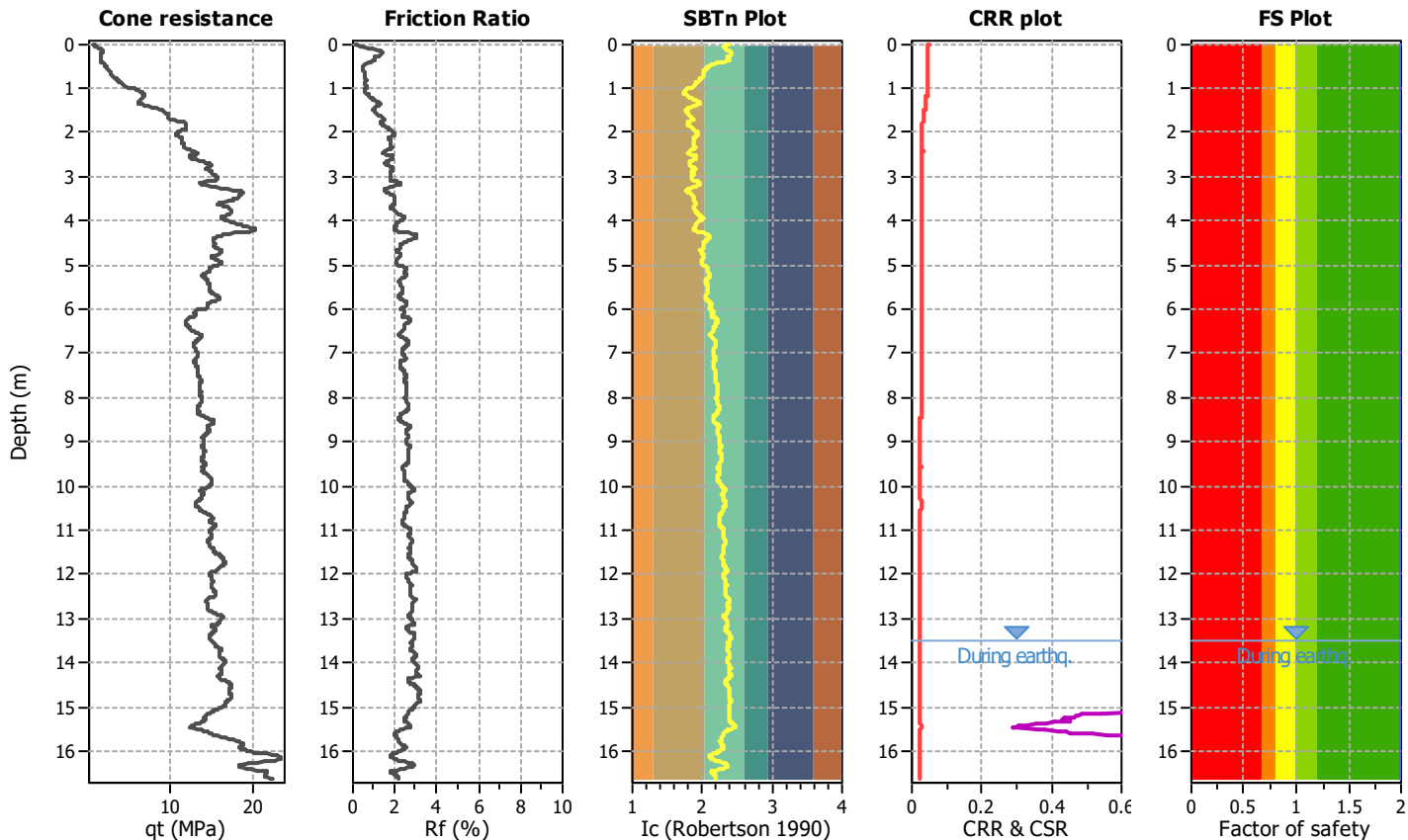
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

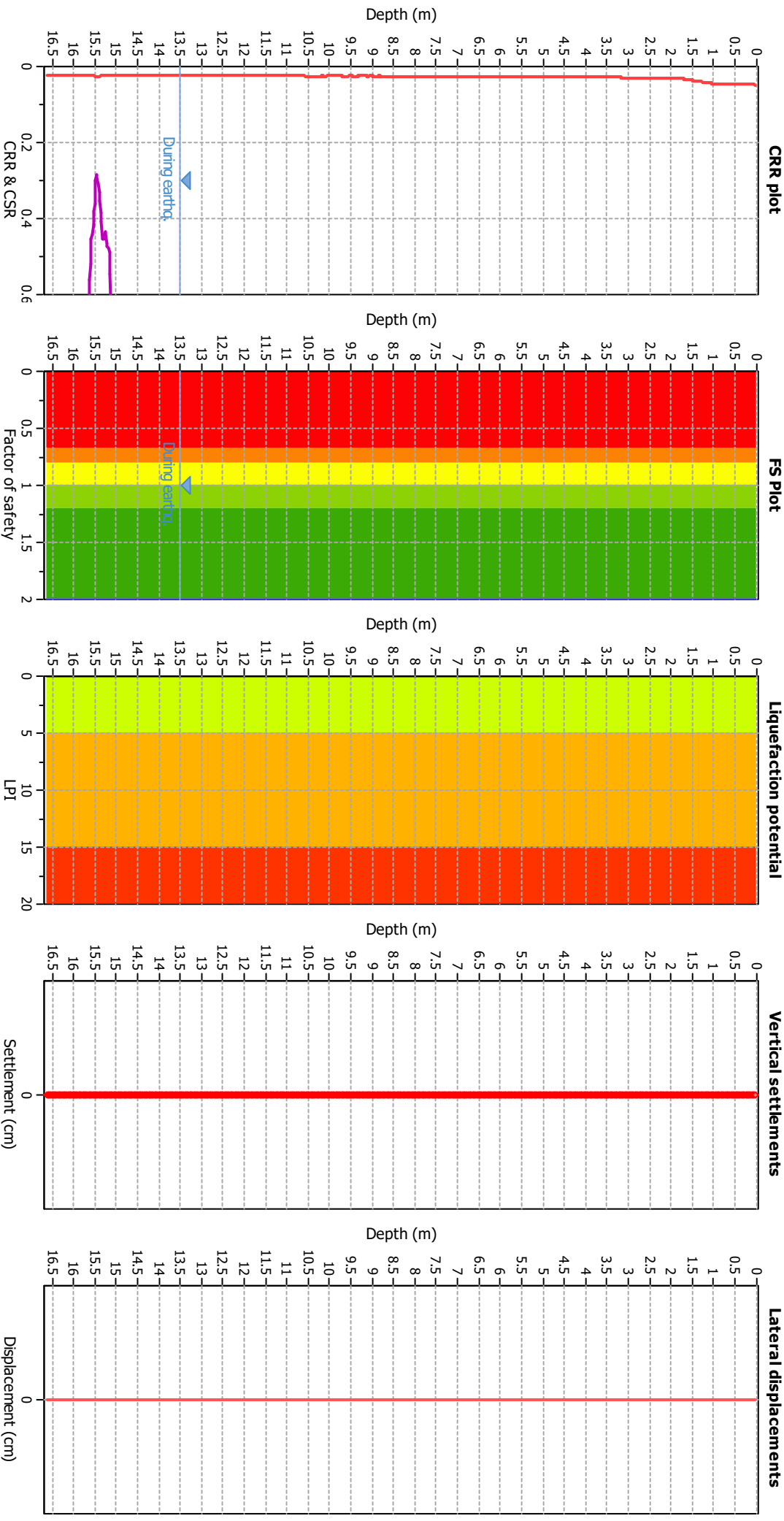
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT05_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on I_c value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 13.50 m

Depth to GWT (earthq.): 13.50 m
Average results interval: 3
 I_c cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT

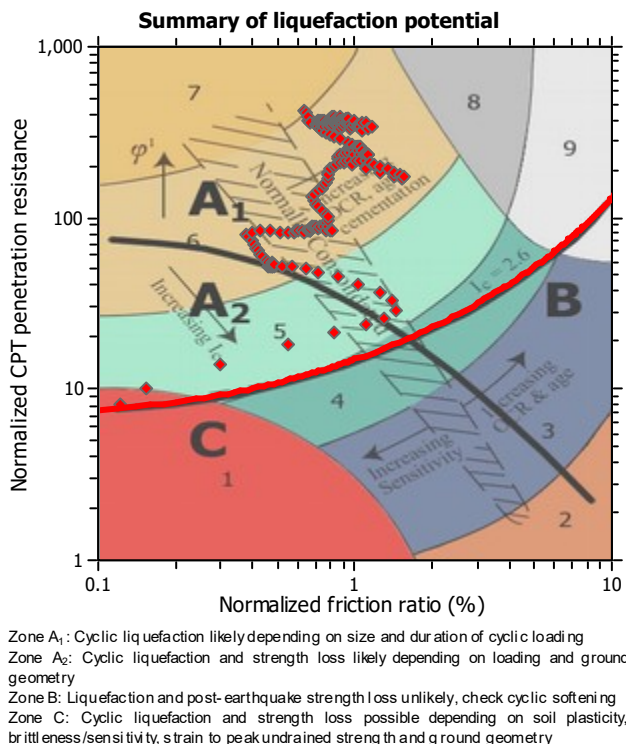
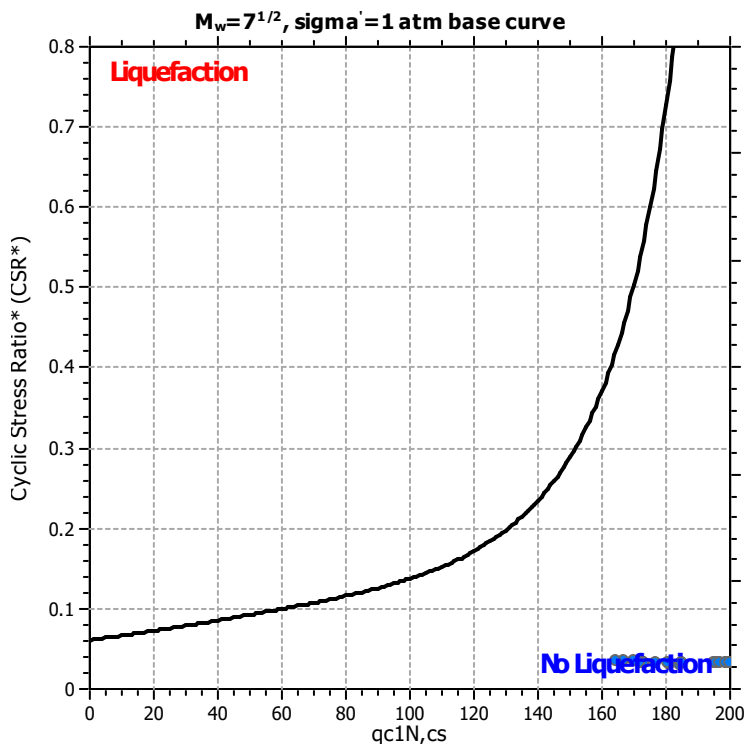
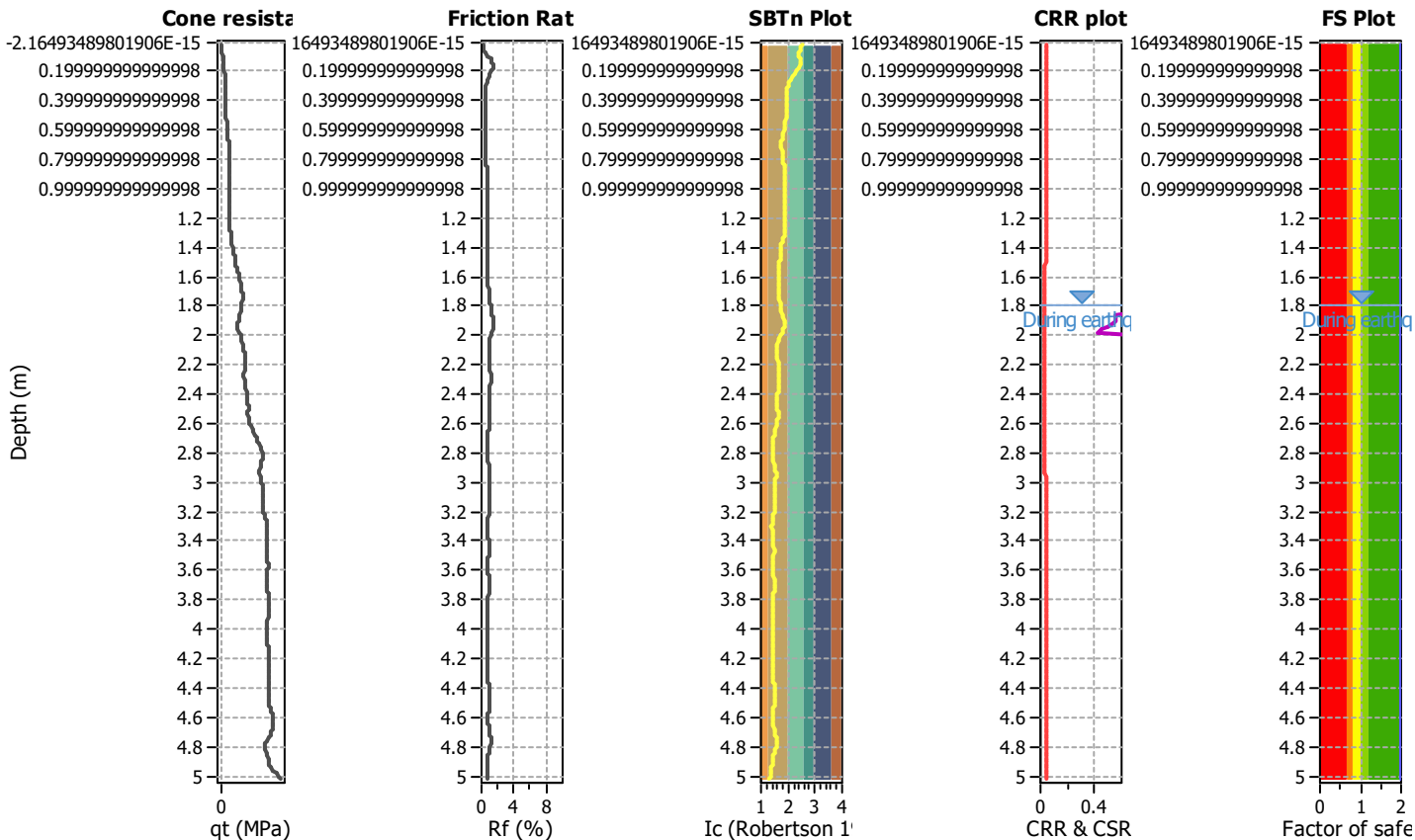
Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

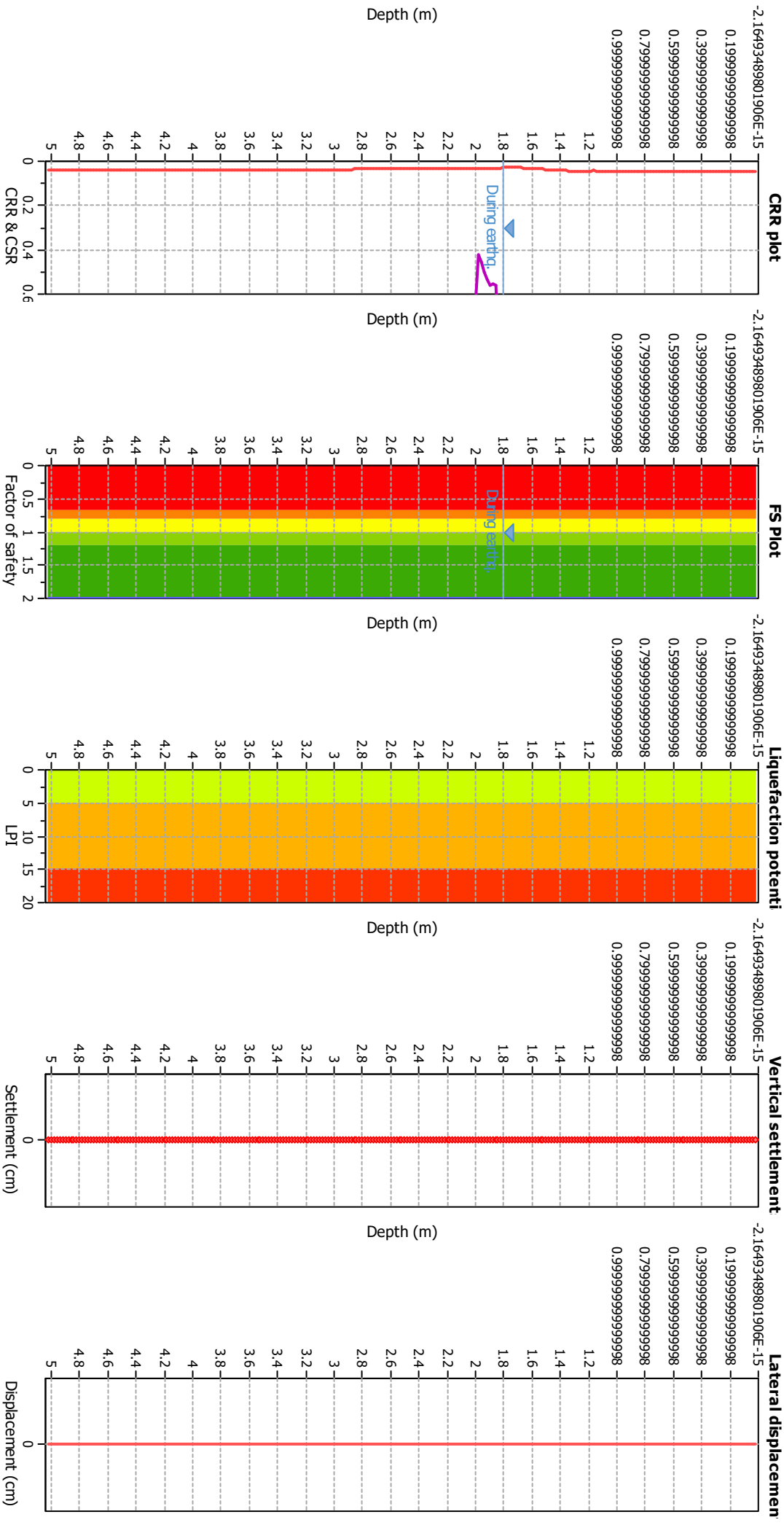
CPT file : CPT06_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.80 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 1.80 m
Depth to GWT (earthq.): 1.80 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A
Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme

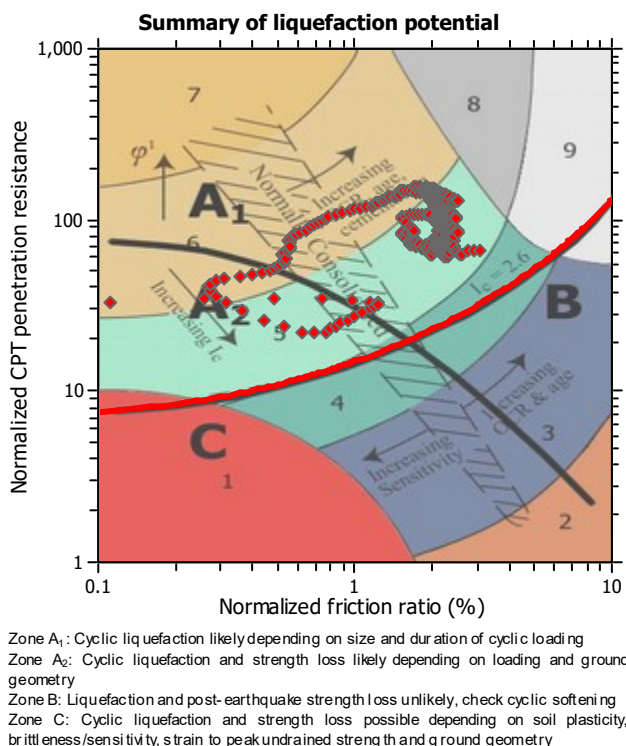
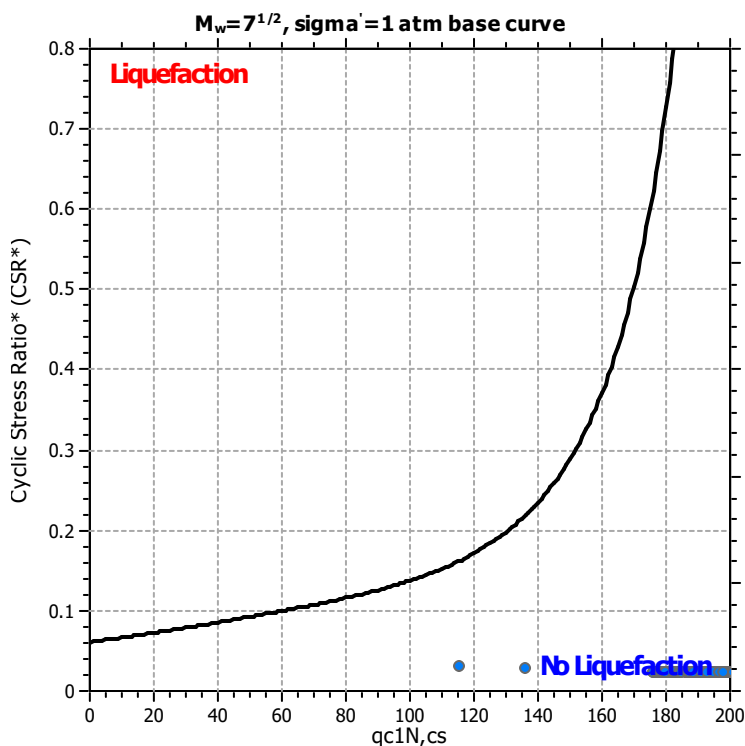
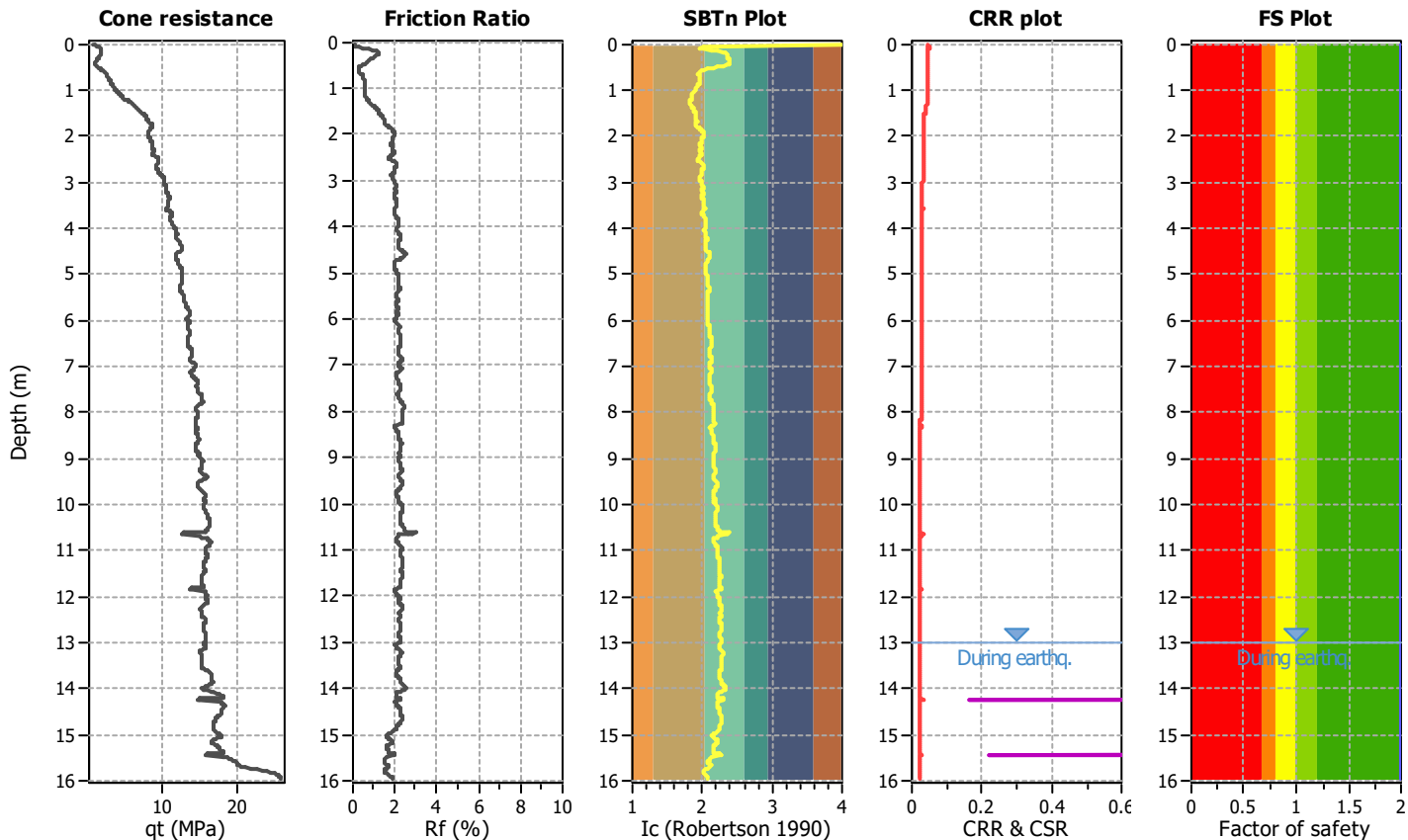
■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

LPI color scheme

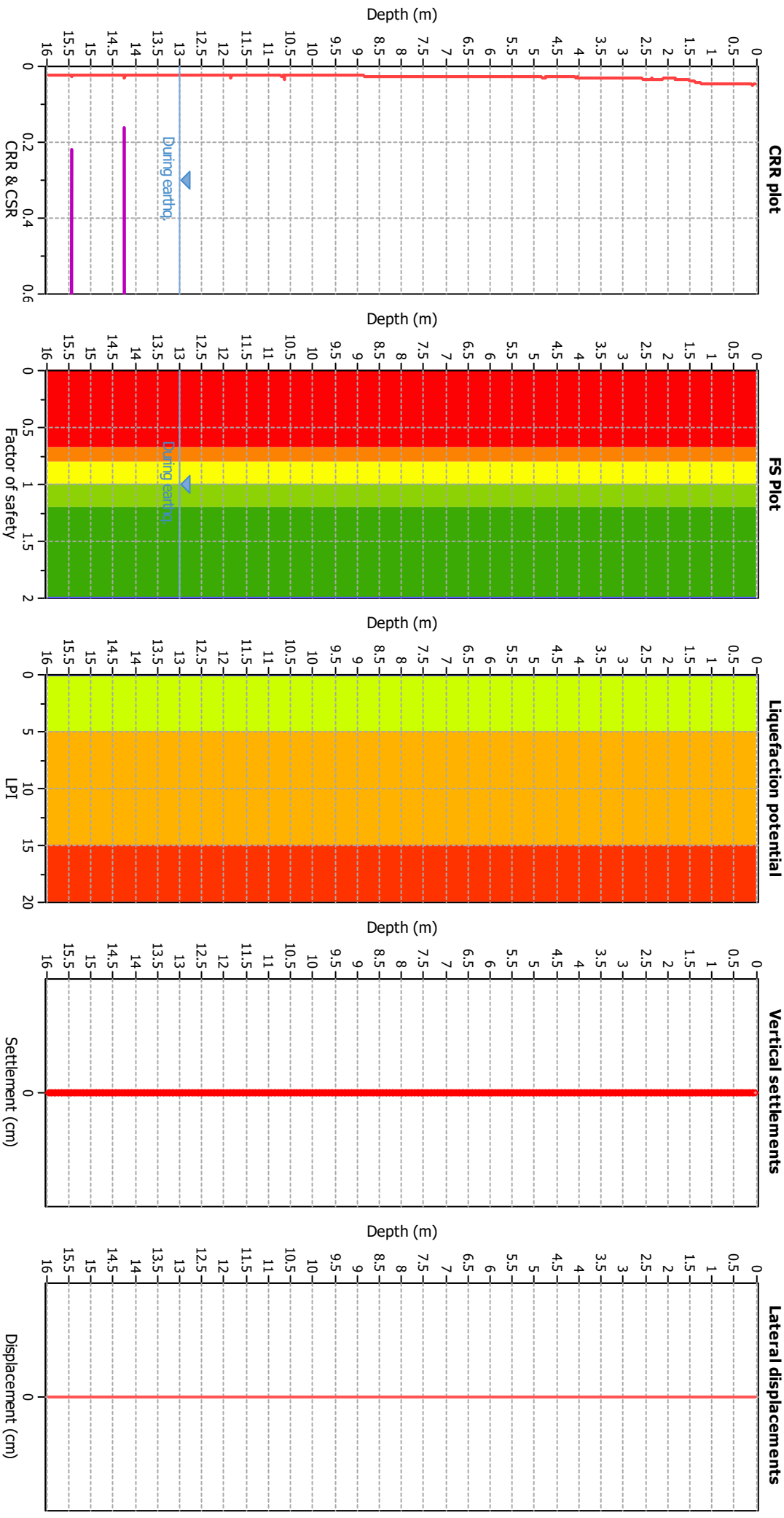
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT07_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 13.00 m

Depth to GWT (earthq.): 13.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_p applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

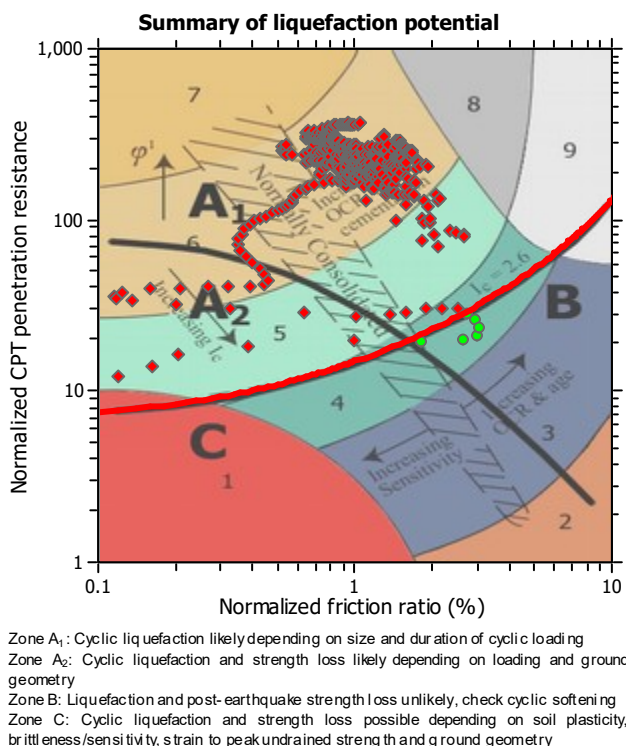
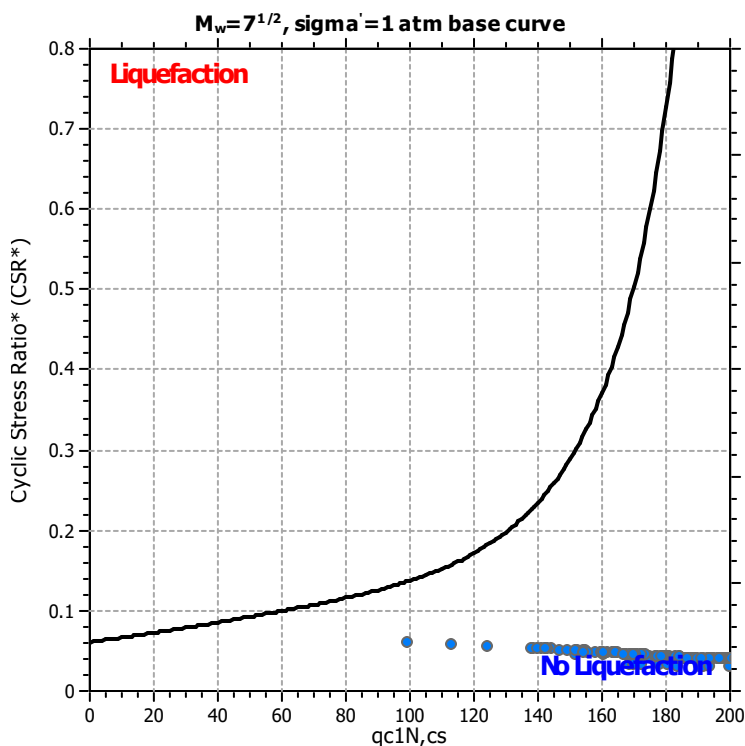
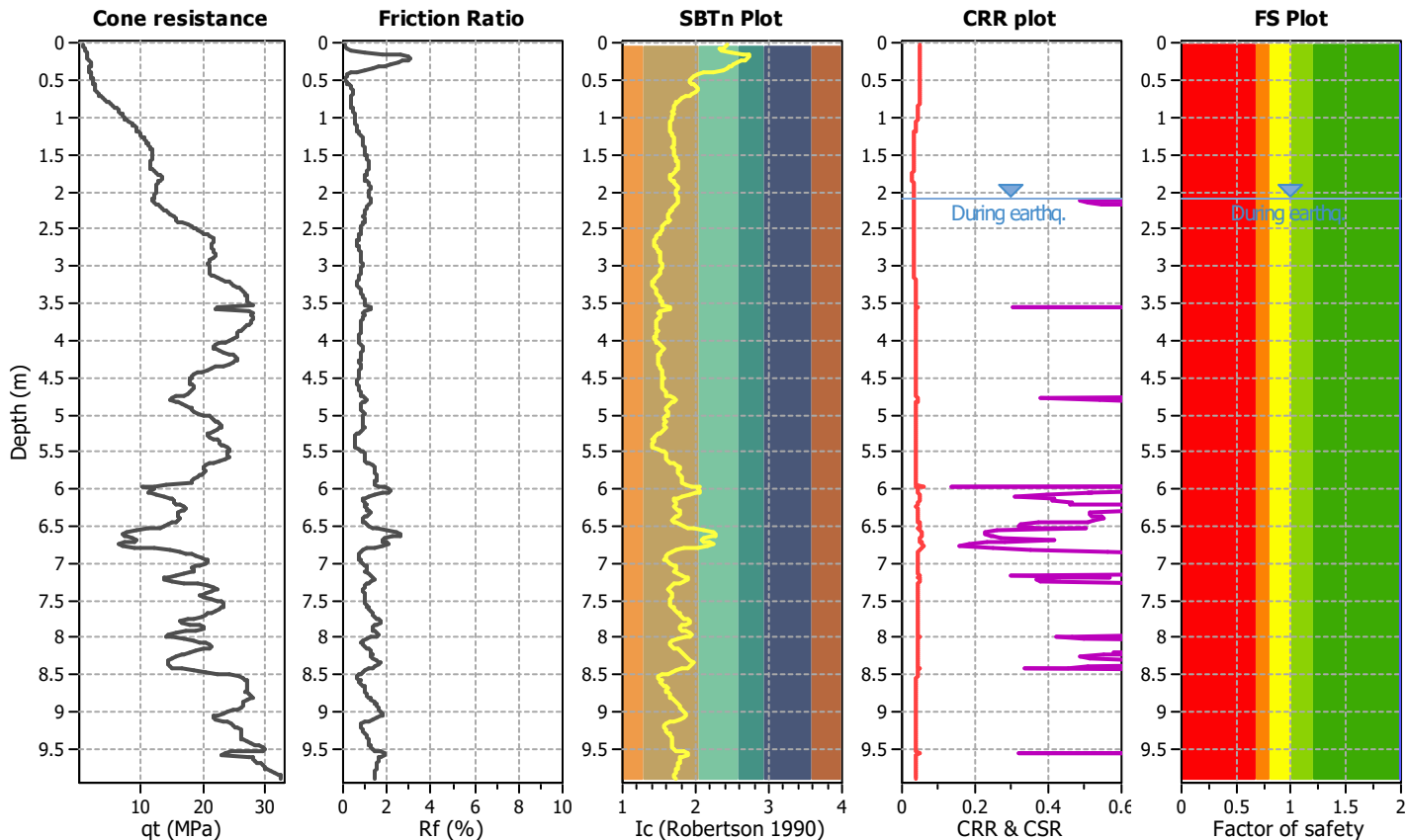
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

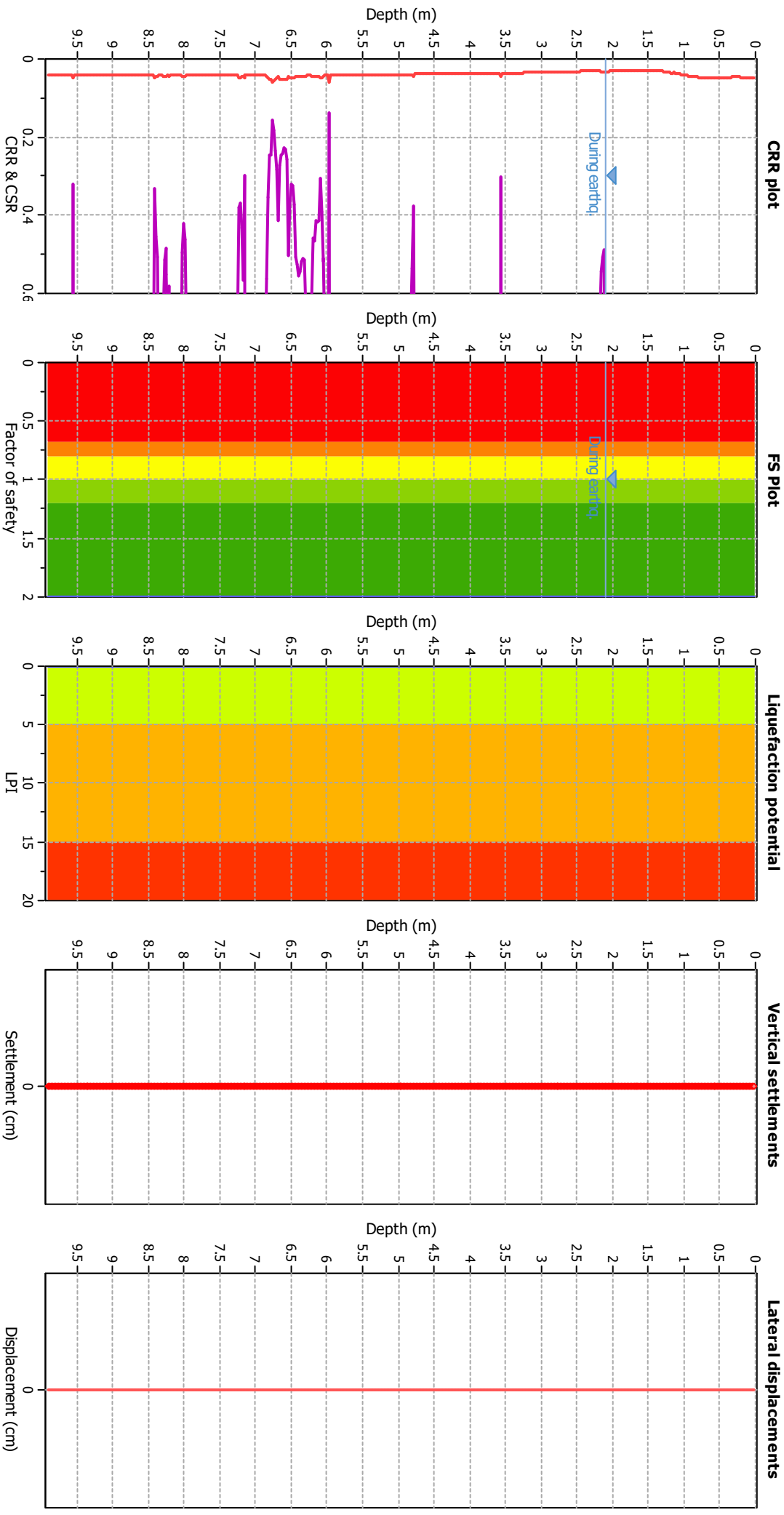
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT08_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.10 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.10 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 2.10 m

Depth to GWT (earthq.): 2.10 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

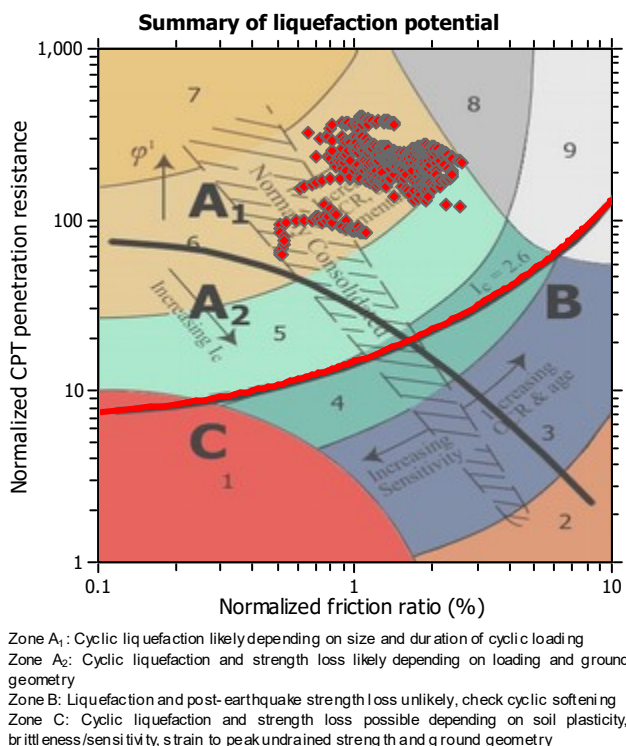
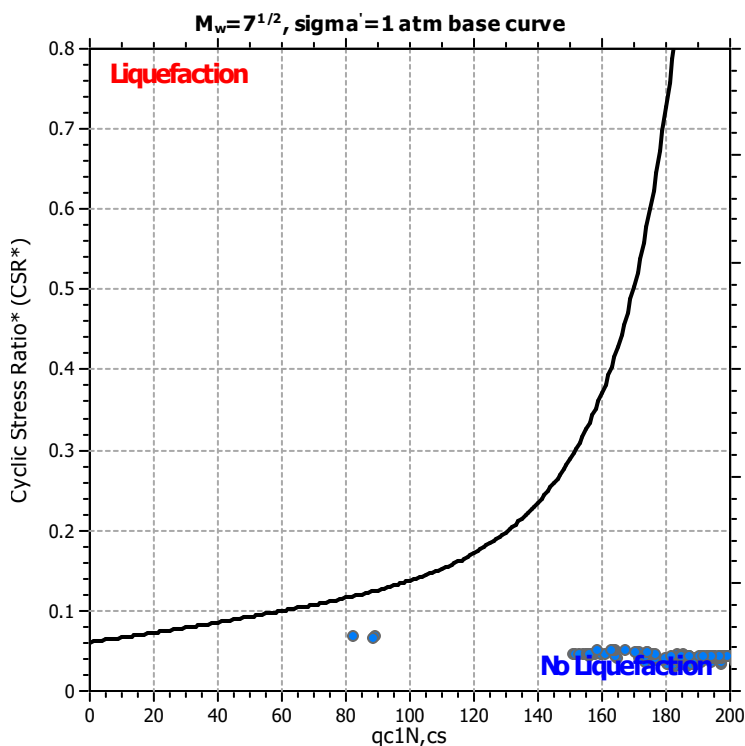
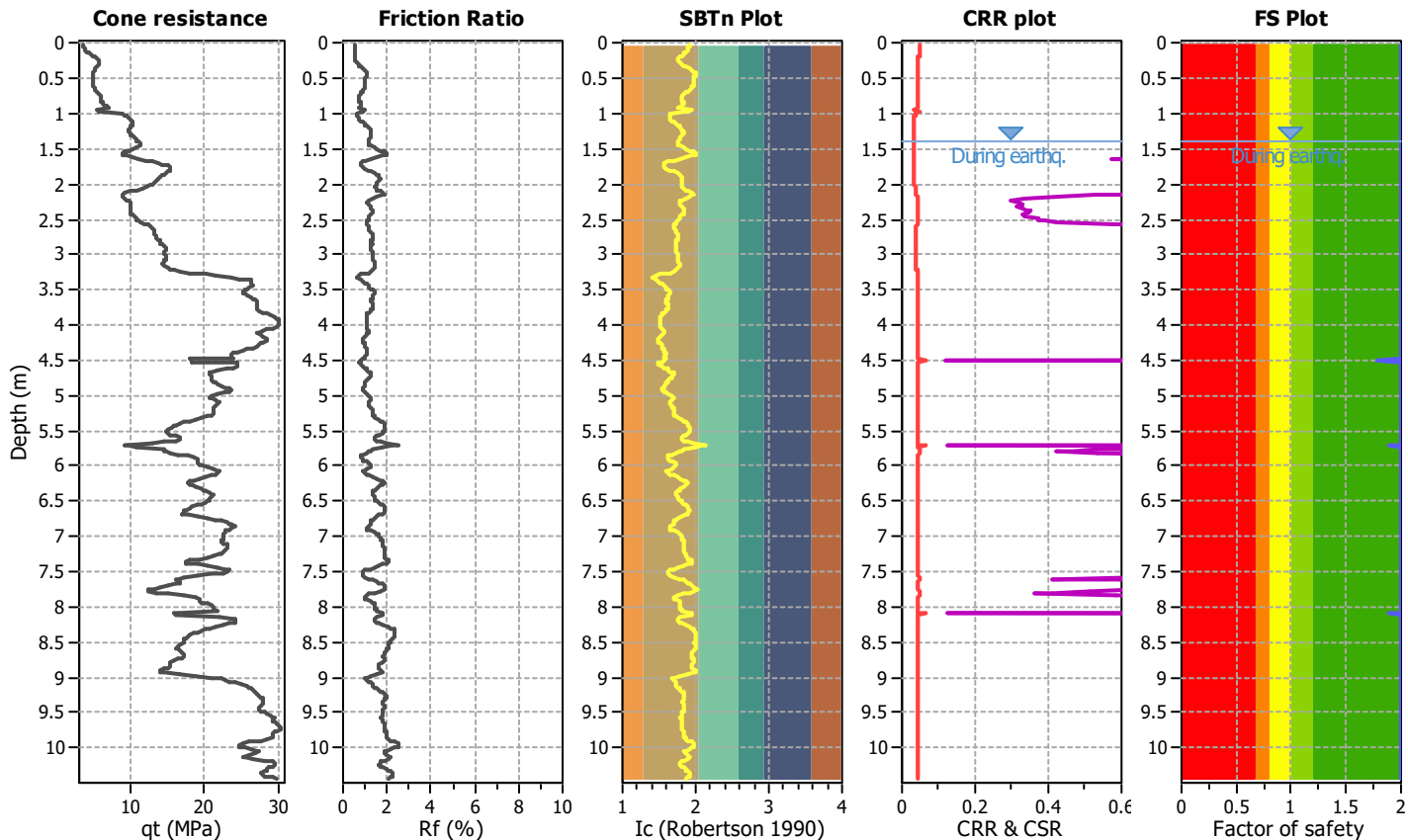
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

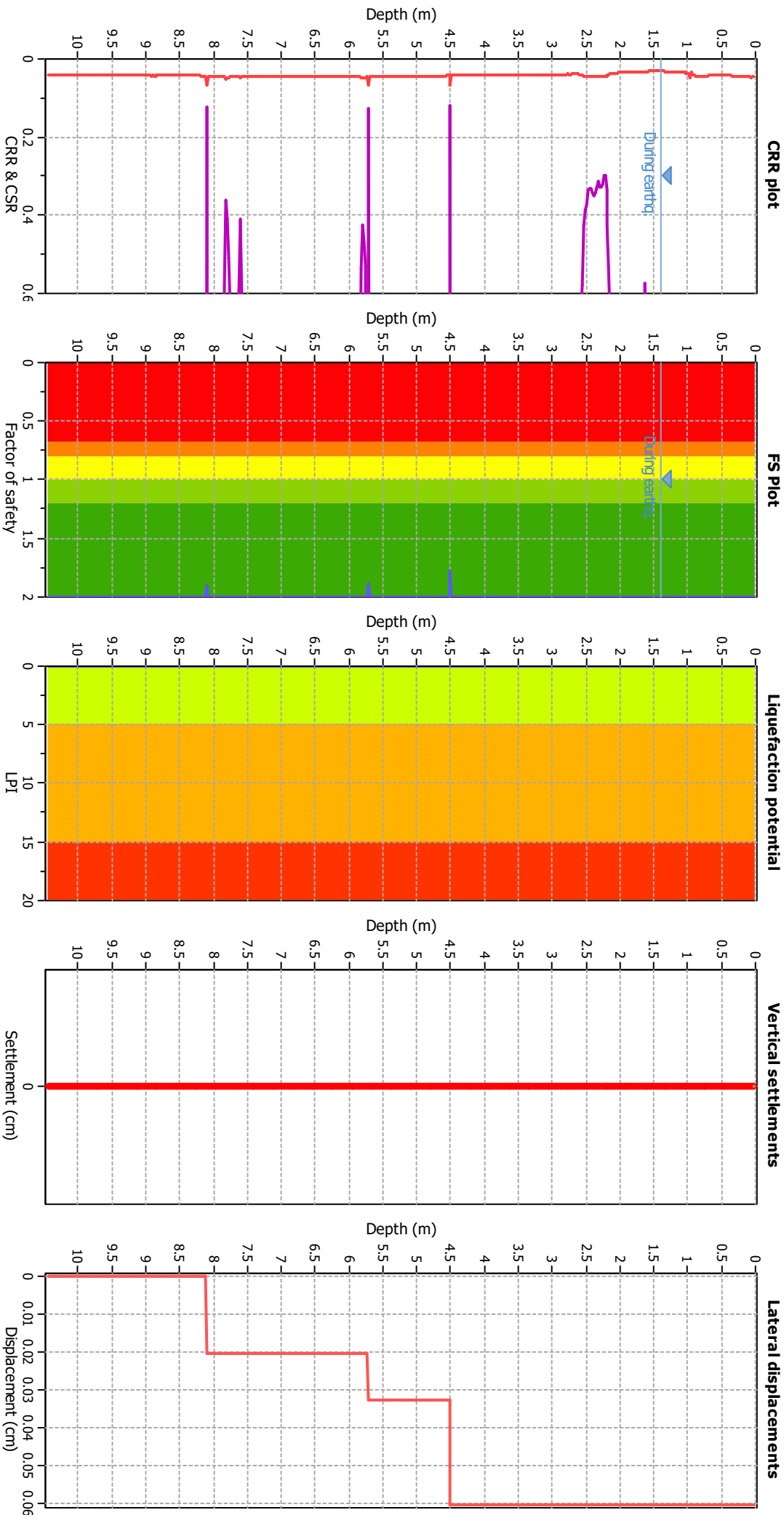
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT09_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.40 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

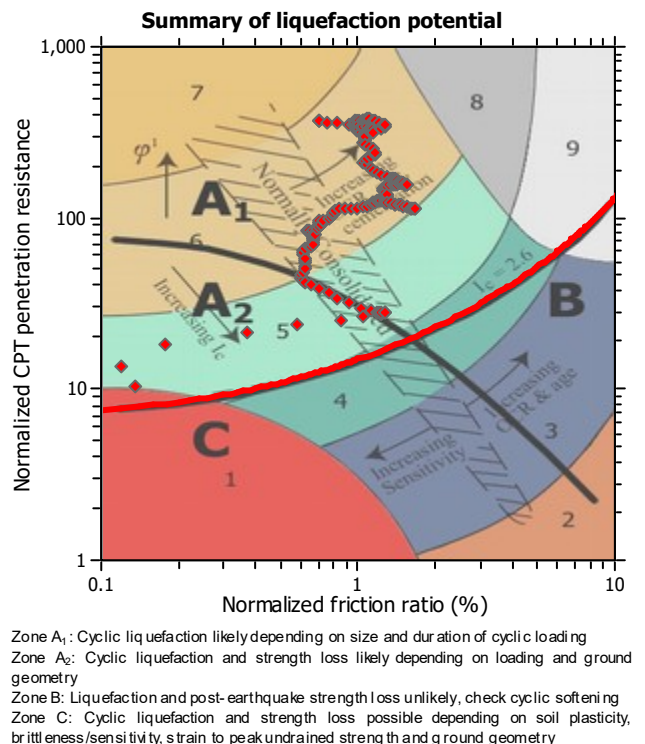
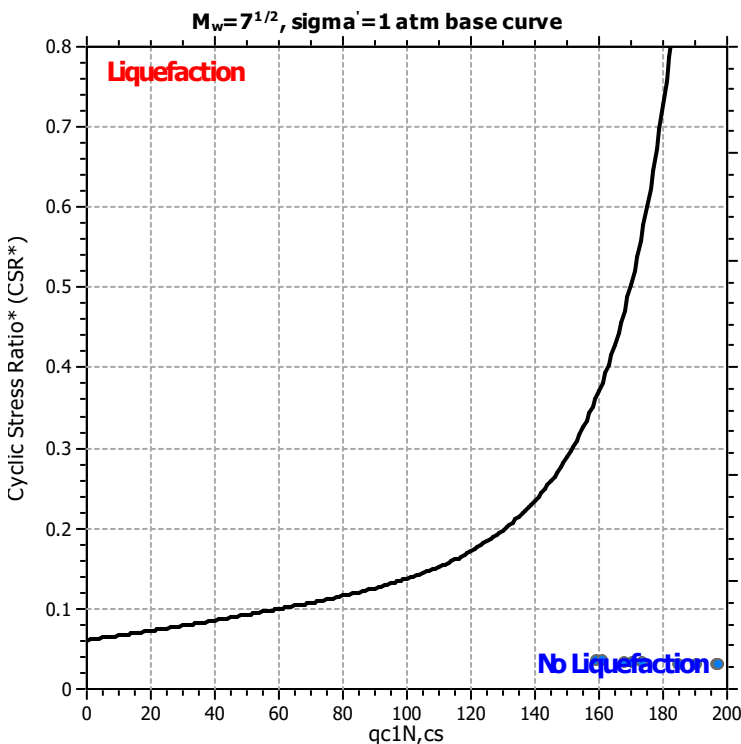
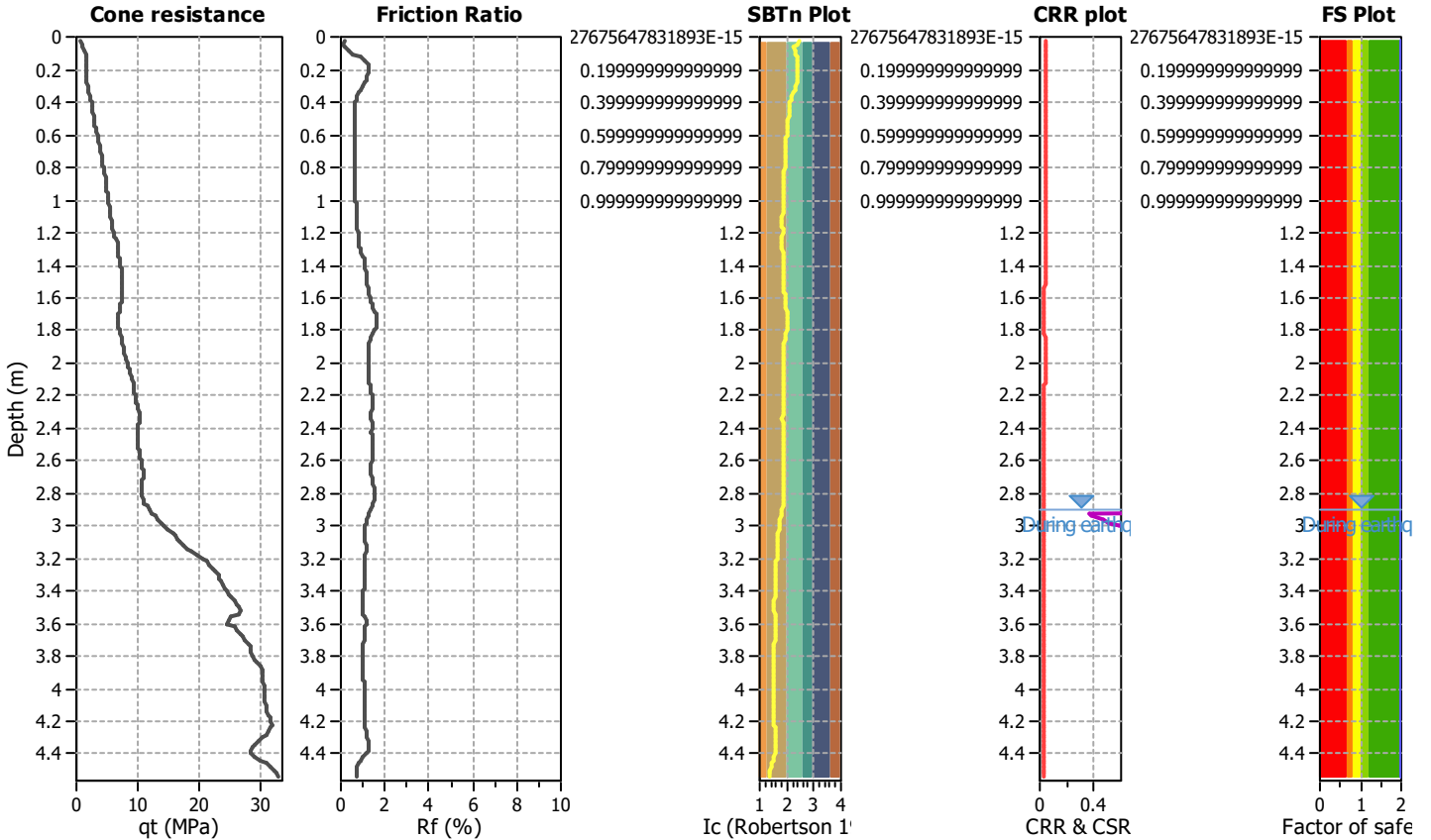
Analysis method: A nalysis method:
Finest correction method: B&I (2014)
Points to test: B&I (2014)
Earthquake magnitude M_w : Based on I_c value
Peak ground acceleration: 6.00
Depth to water table (insitu): 0.08
Fill weight: 1.40 m
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: No
Limit depth applied: 20.00 m
Limit depth: N/A

FS color scheme
■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

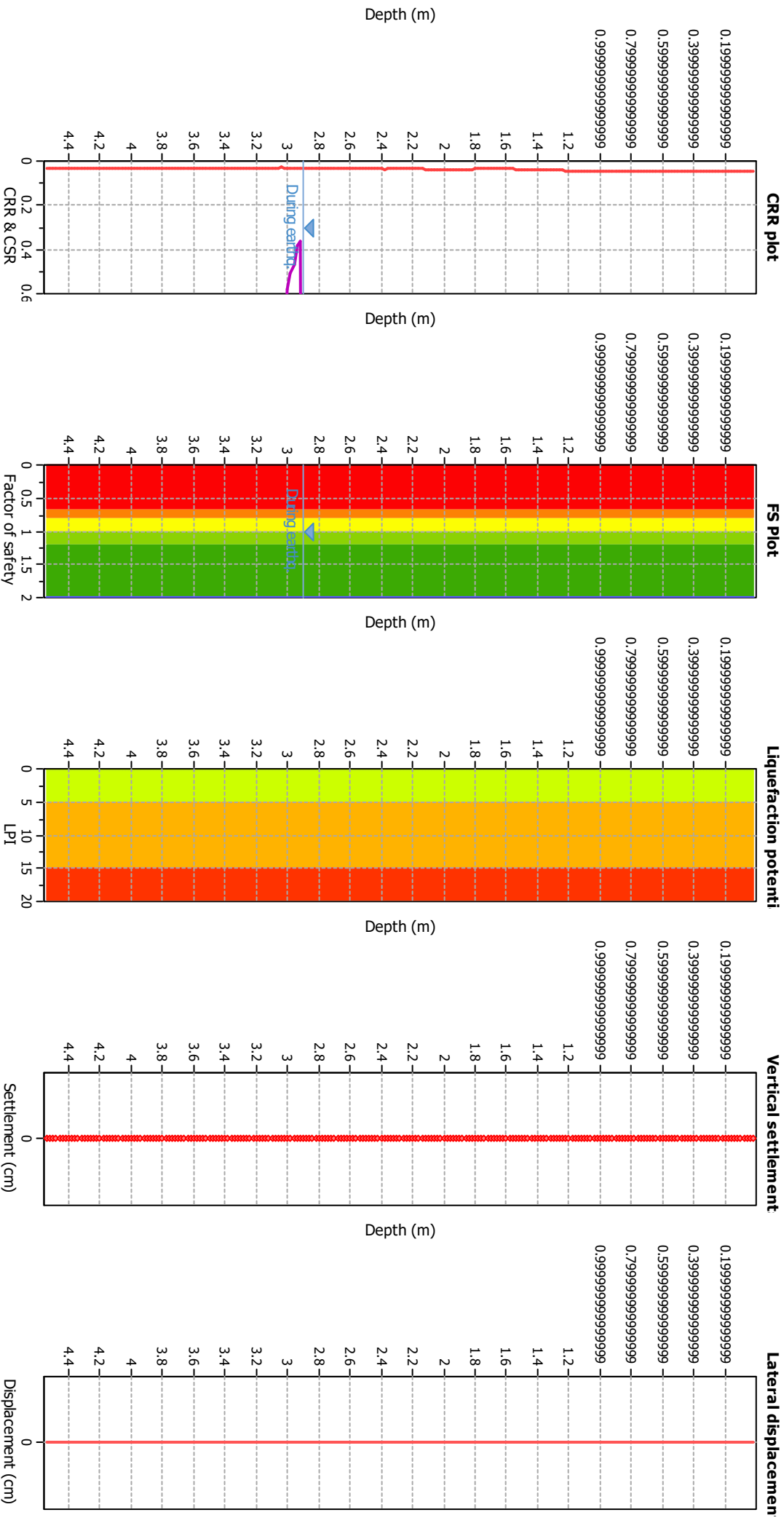
LPI color scheme
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT10_SLS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.90 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.90 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 2.90 m

Depth to GWT (earthq.): 2.90 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT

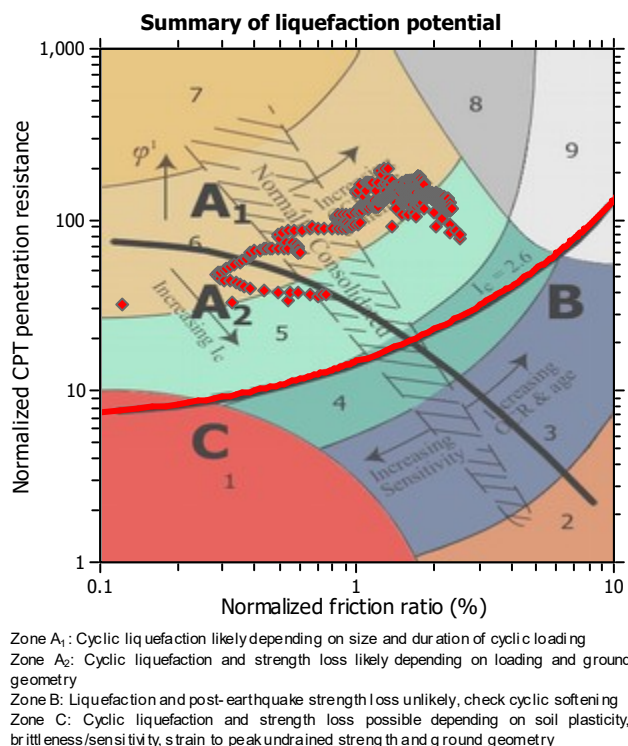
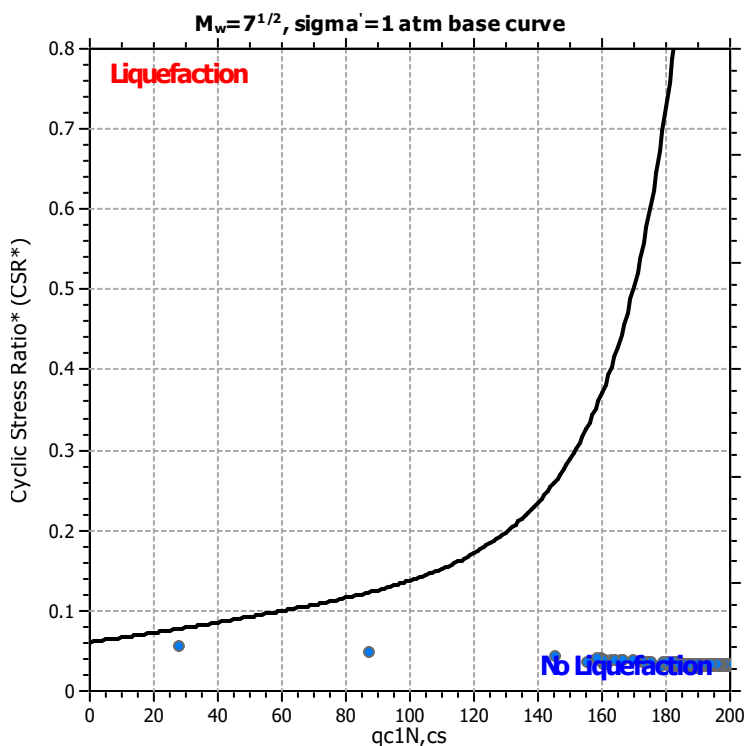
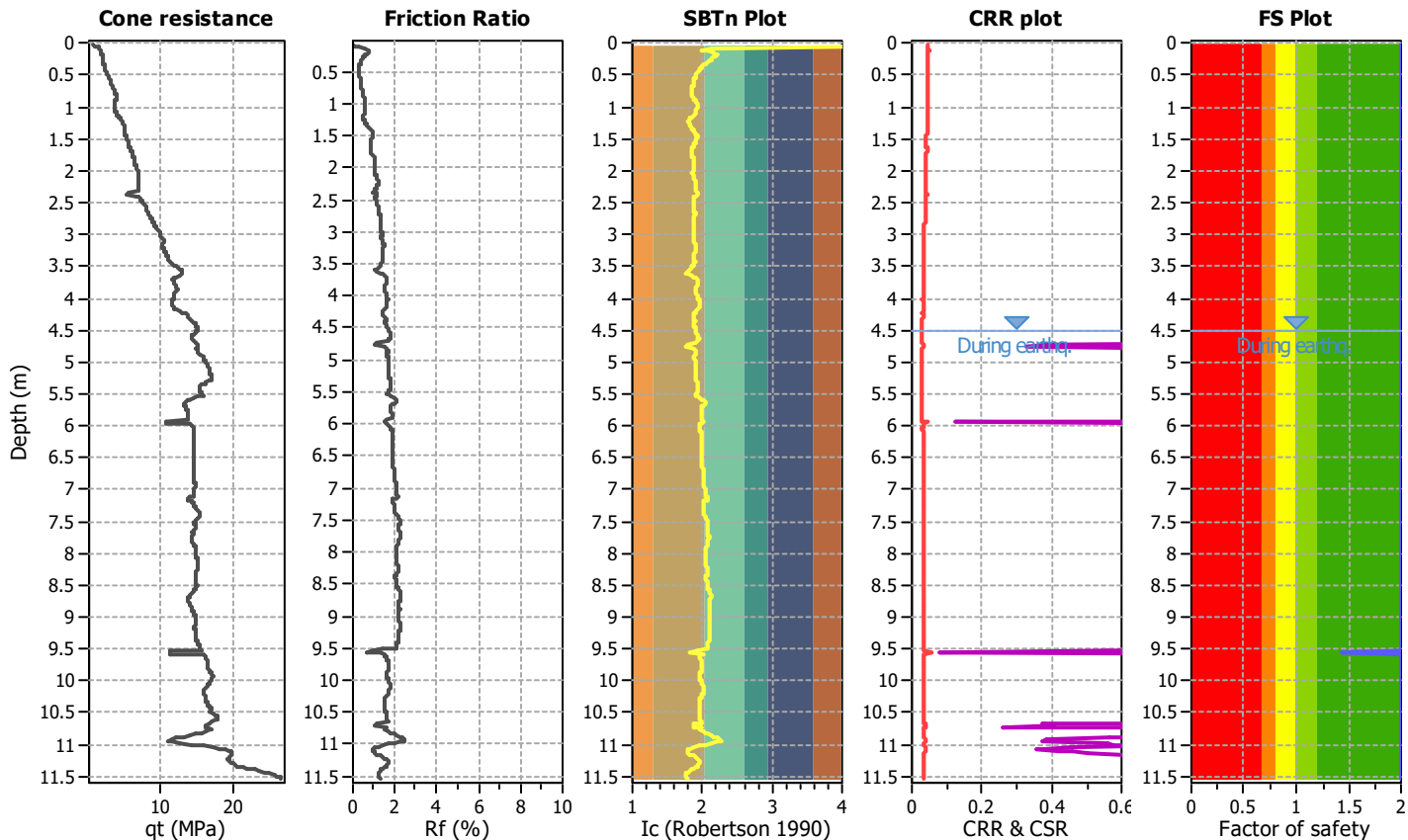
Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

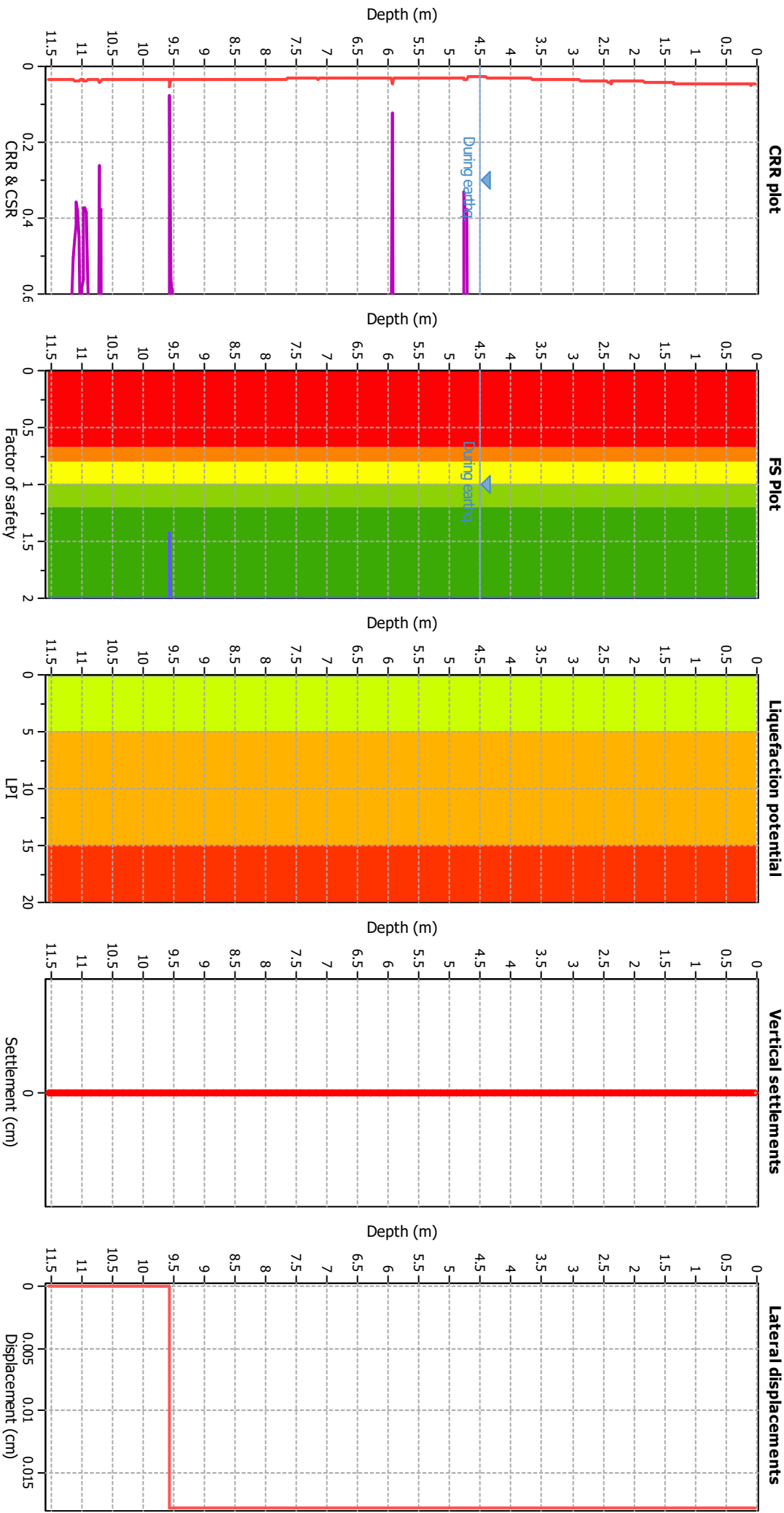
CPT file : CPT11_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.08	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.00
Peak ground acceleration: 0.08
Depth to water table (insitu): 4.50 m

Depth to GWT (earthq.): 4.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Yes
Limit depth applied: 20.00 m
Limit depth: 20.00 m

FS color scheme

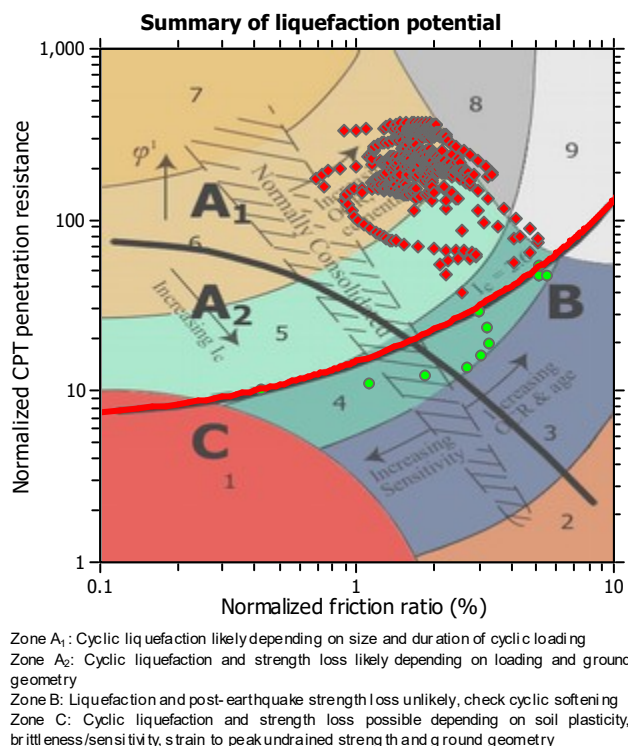
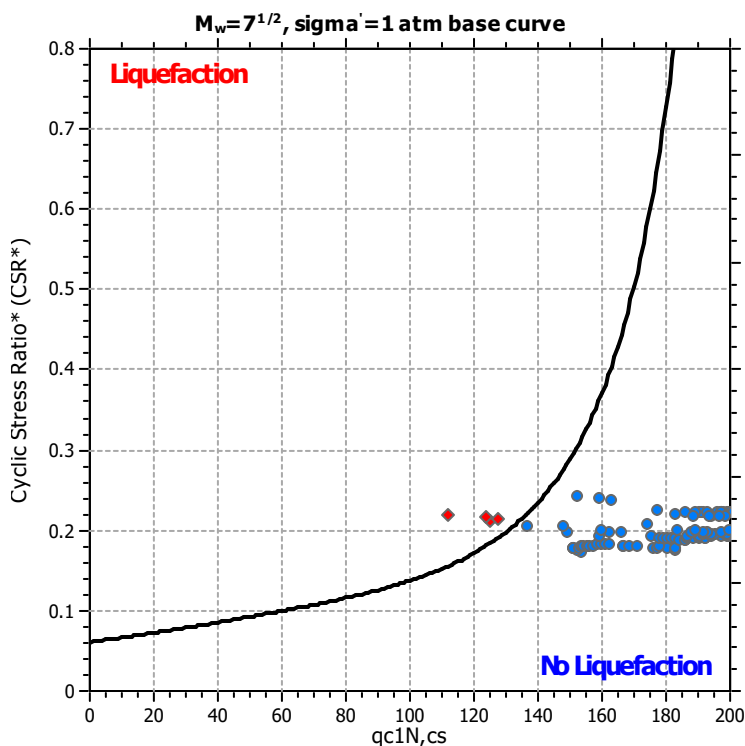
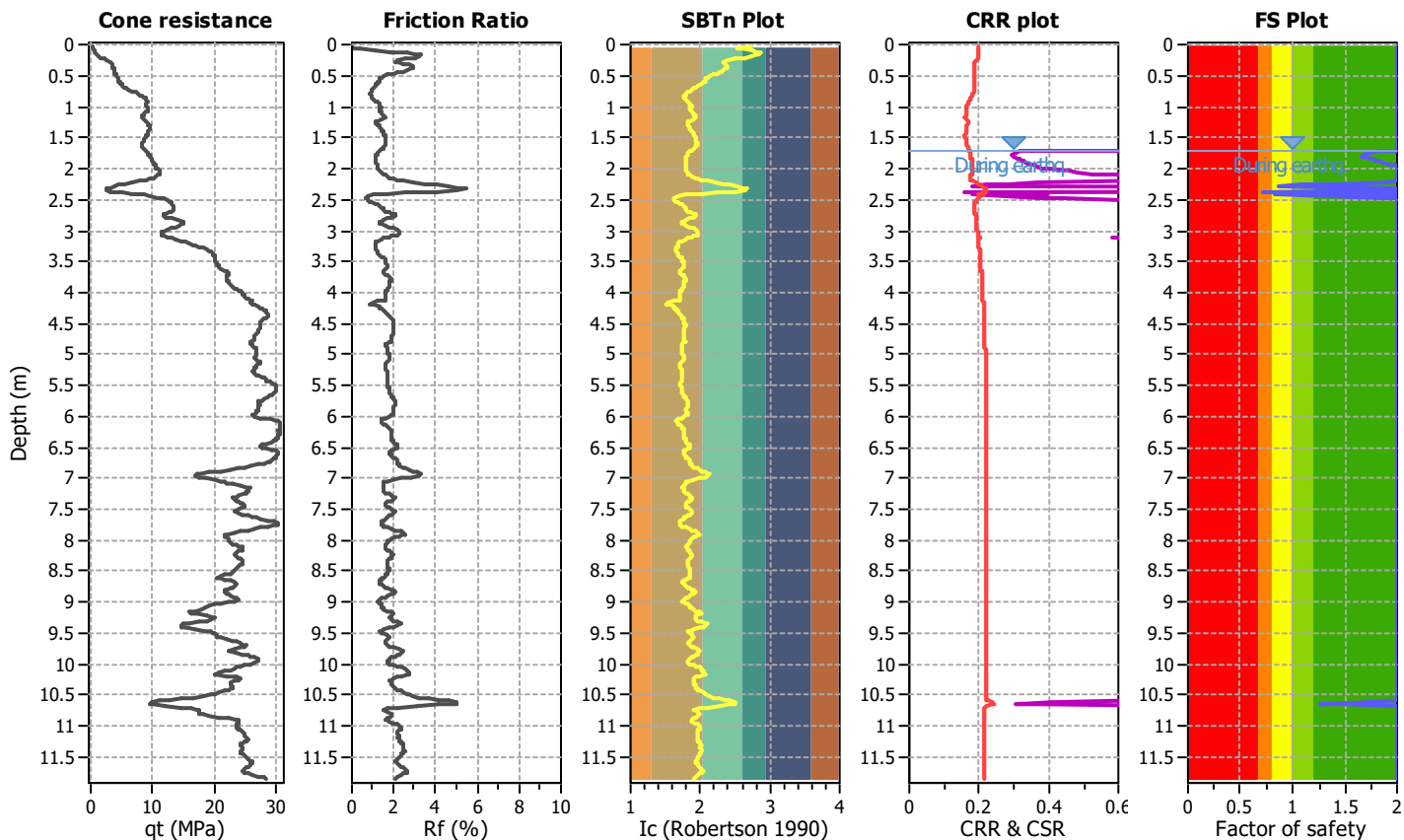
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

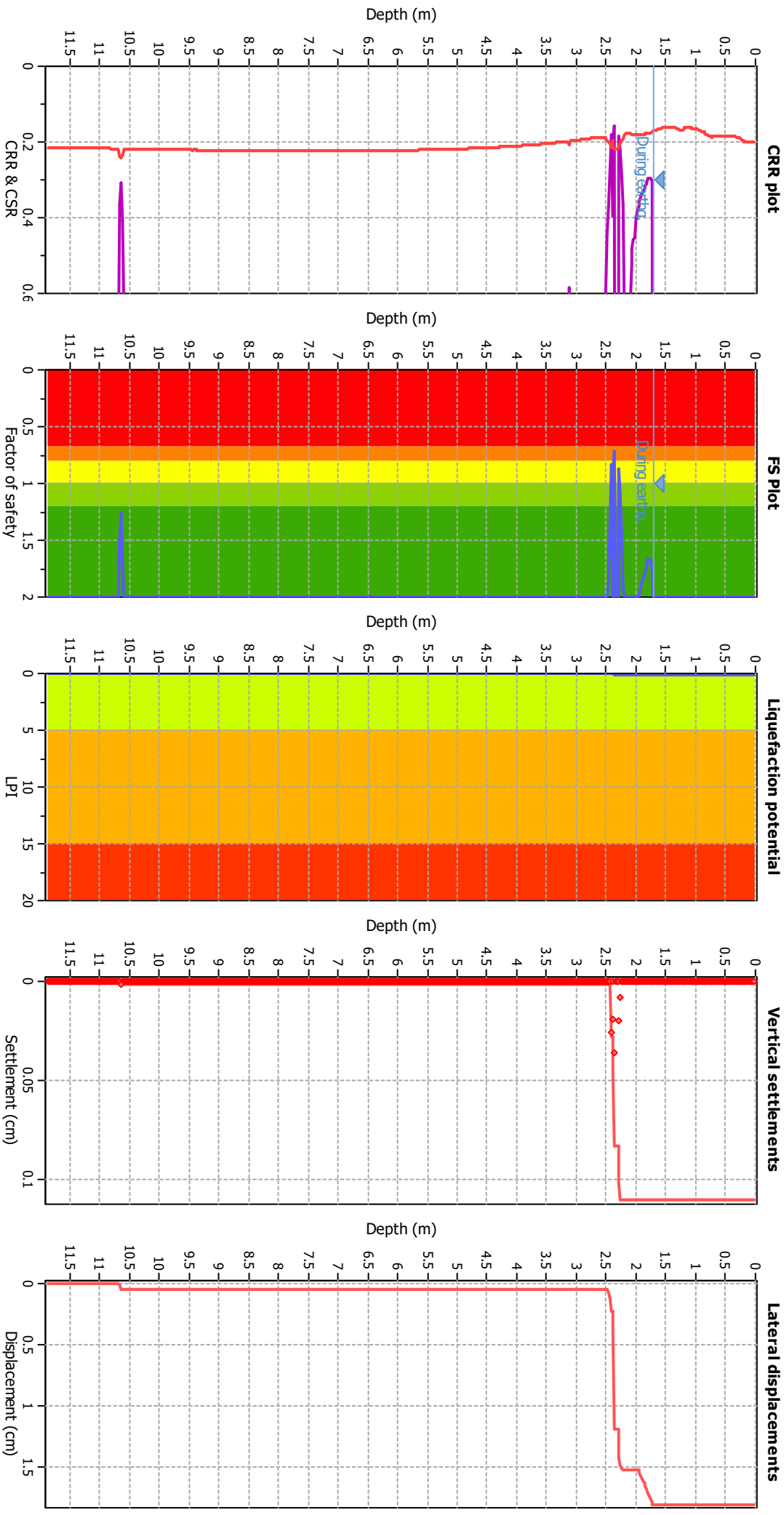
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT01_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 1.70 m

Depth to GWT (earthq.): 1.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

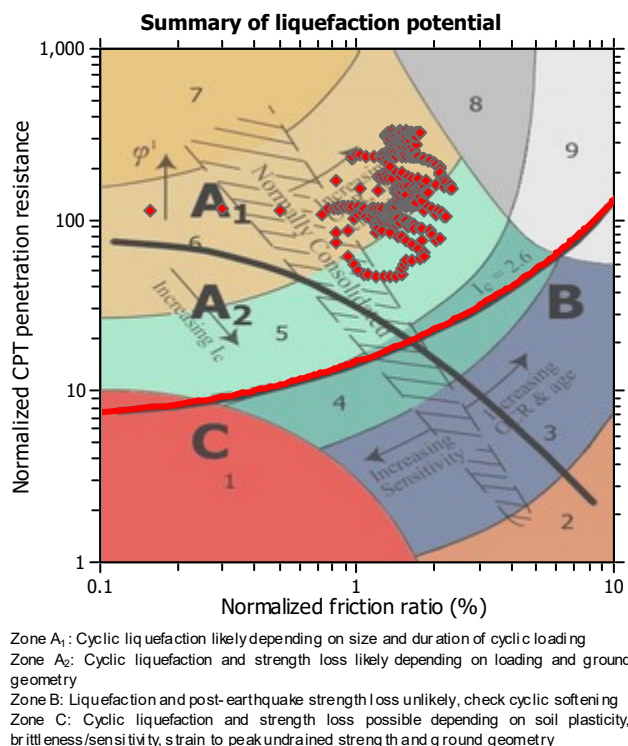
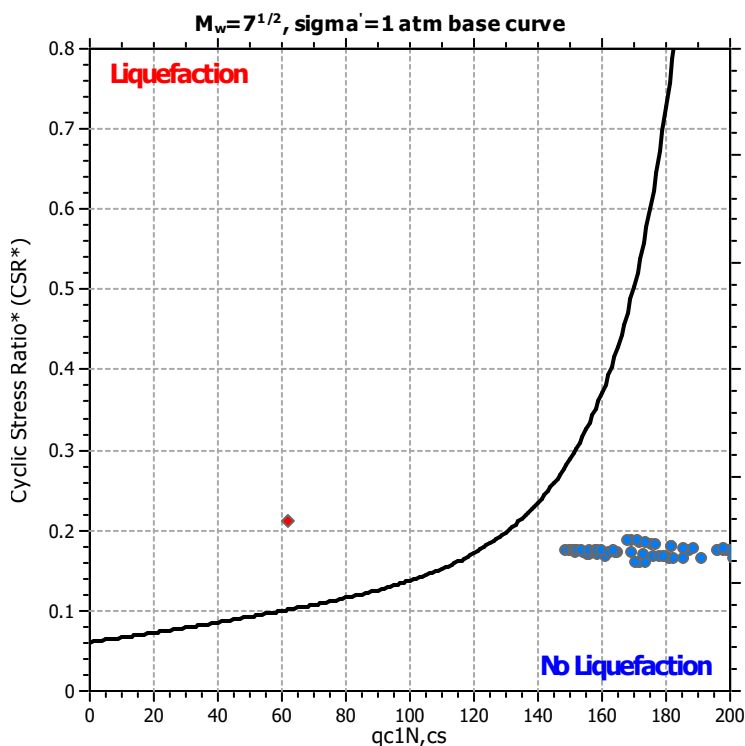
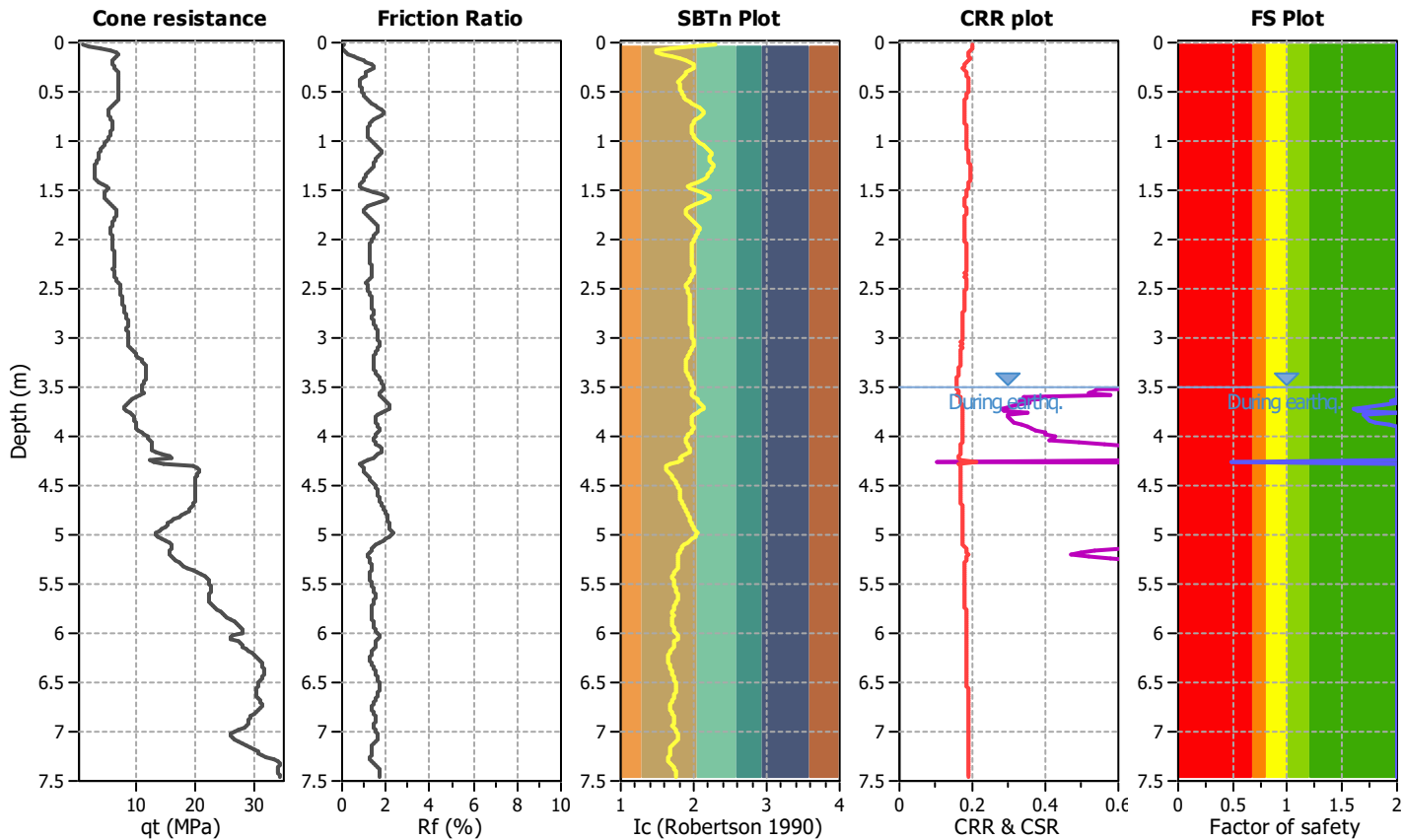
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

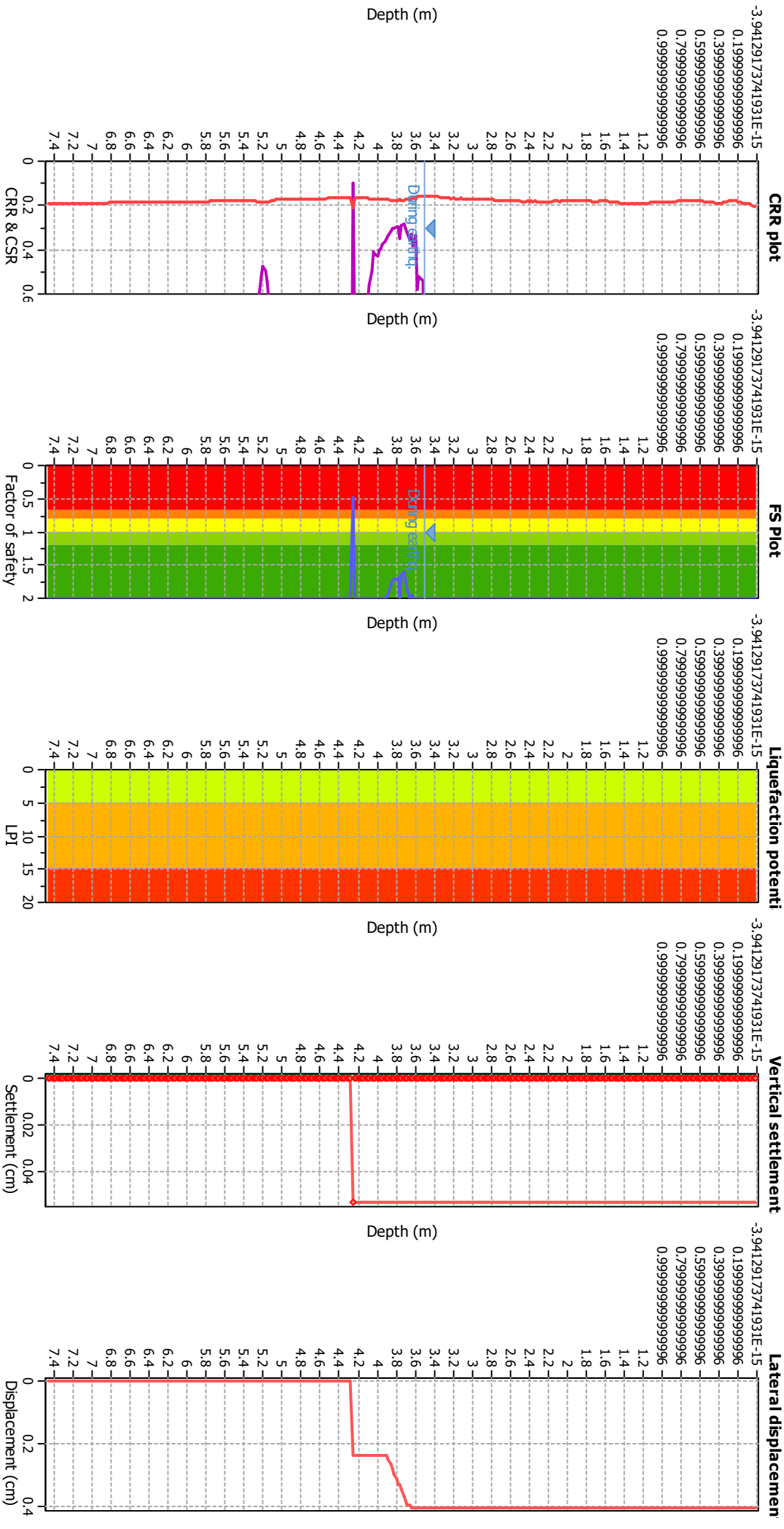
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT02_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	3.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

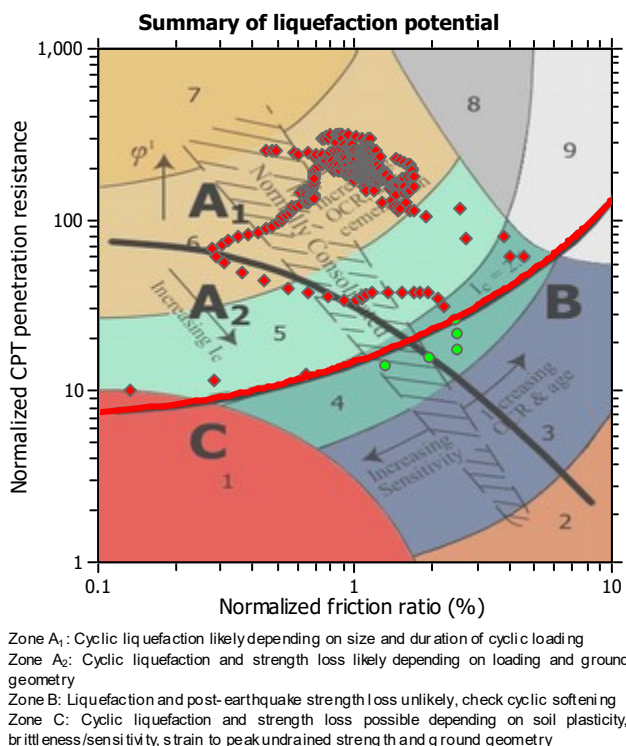
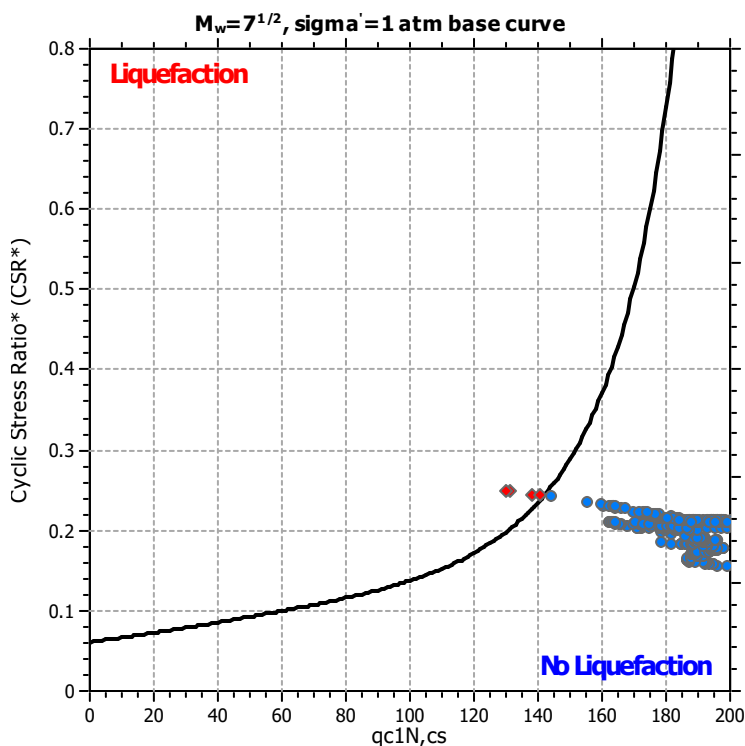
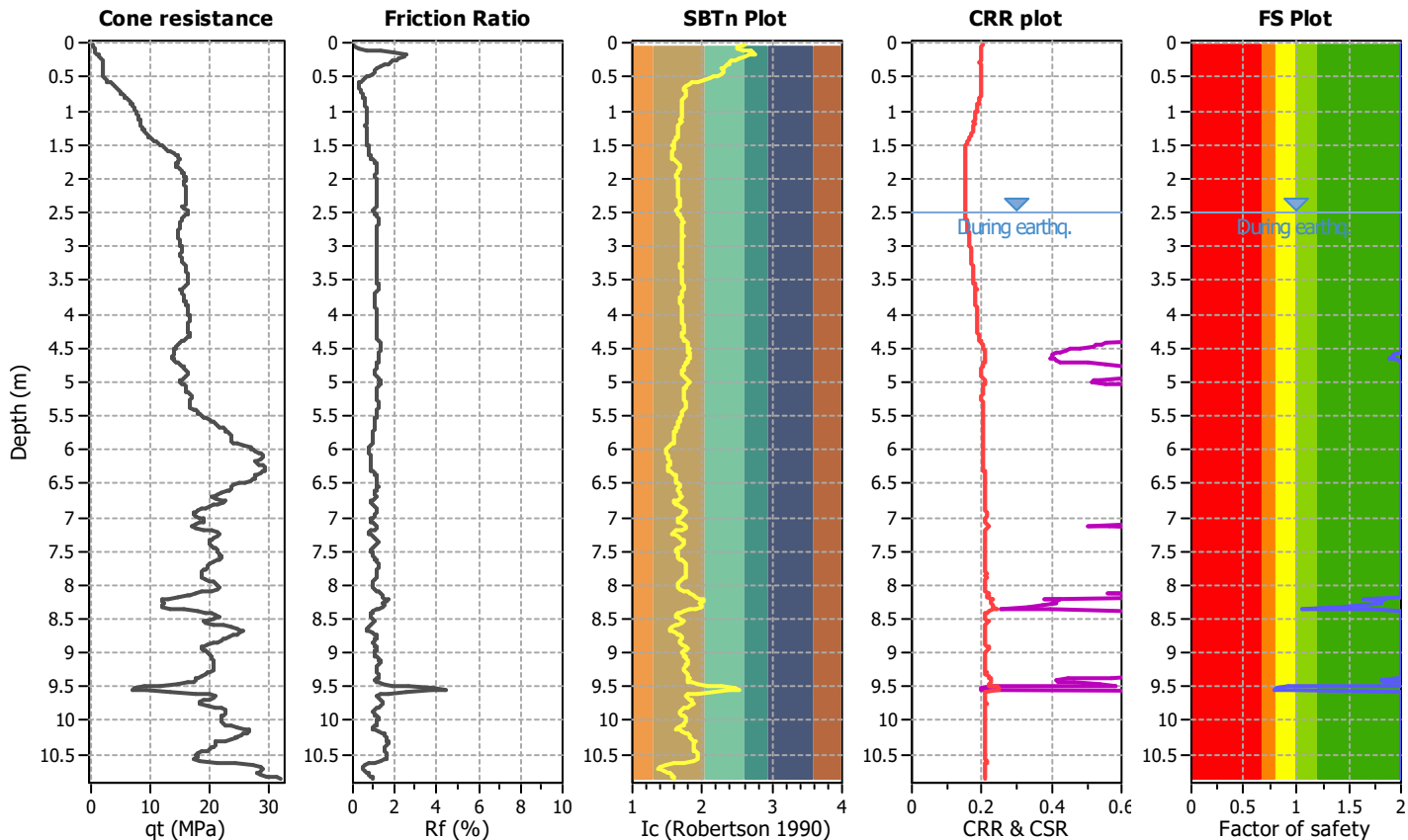
Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 3.50 m

Depth to GWT (earth): 3.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

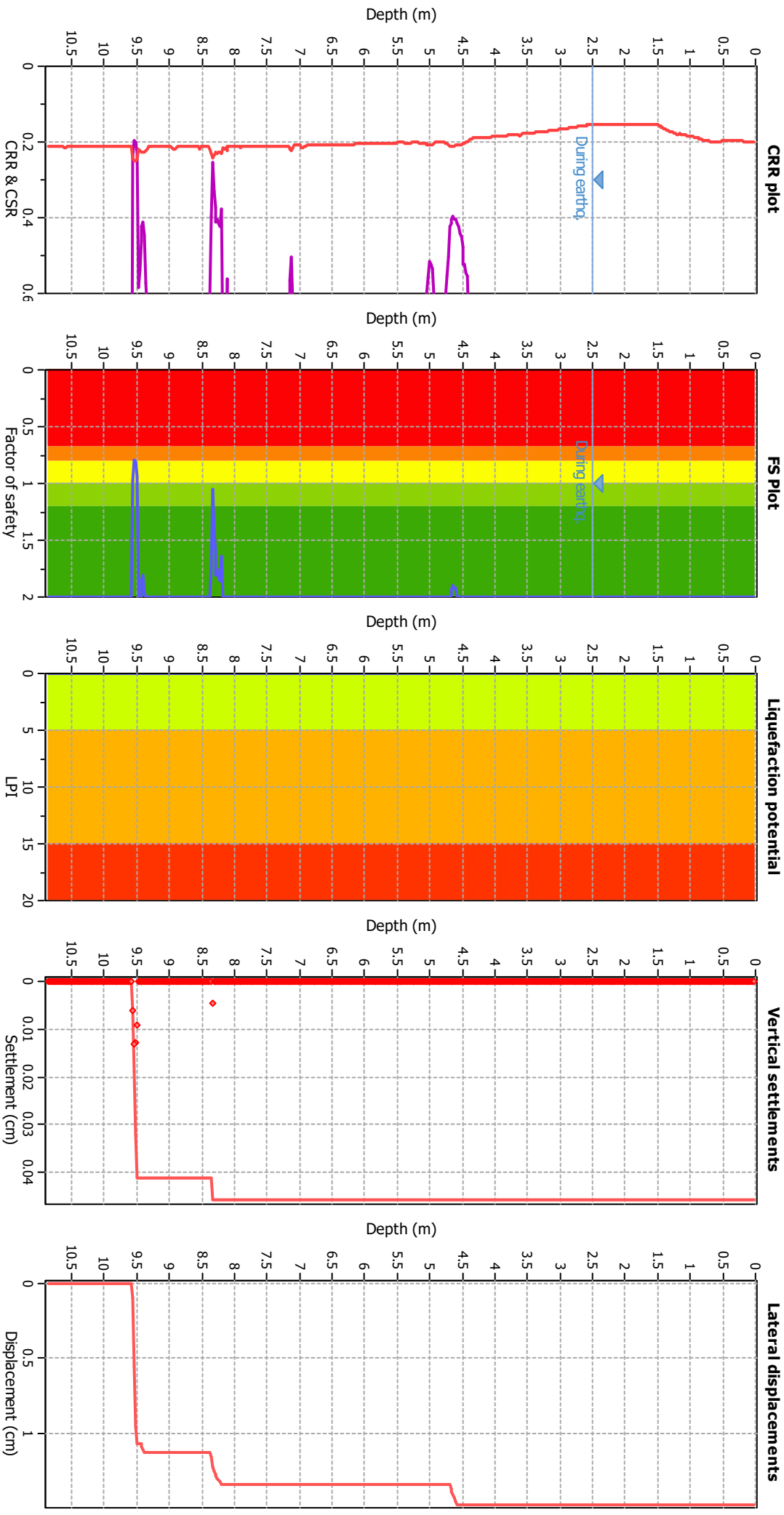
Fill weight: N/A
Transition detect. applied: No
 K_p applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT03_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 2.50 m

Depth to GWT (earthq.): 2.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

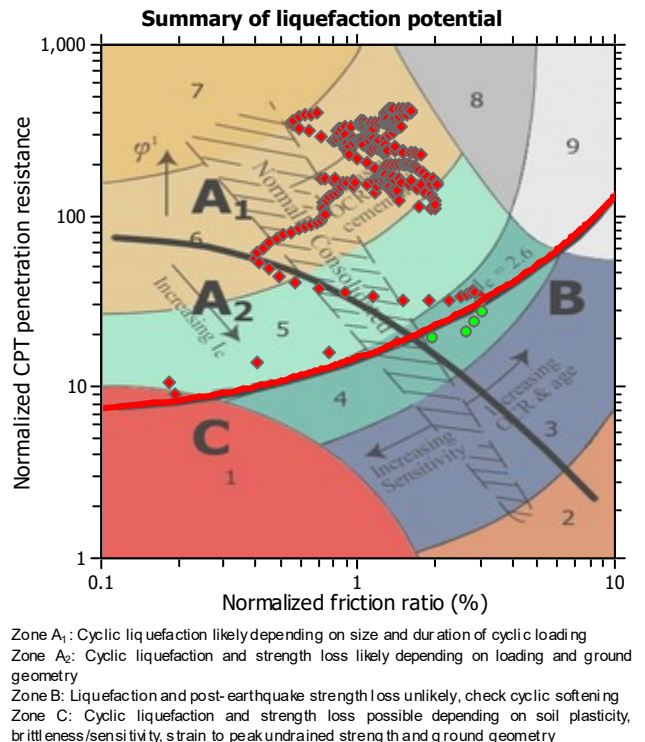
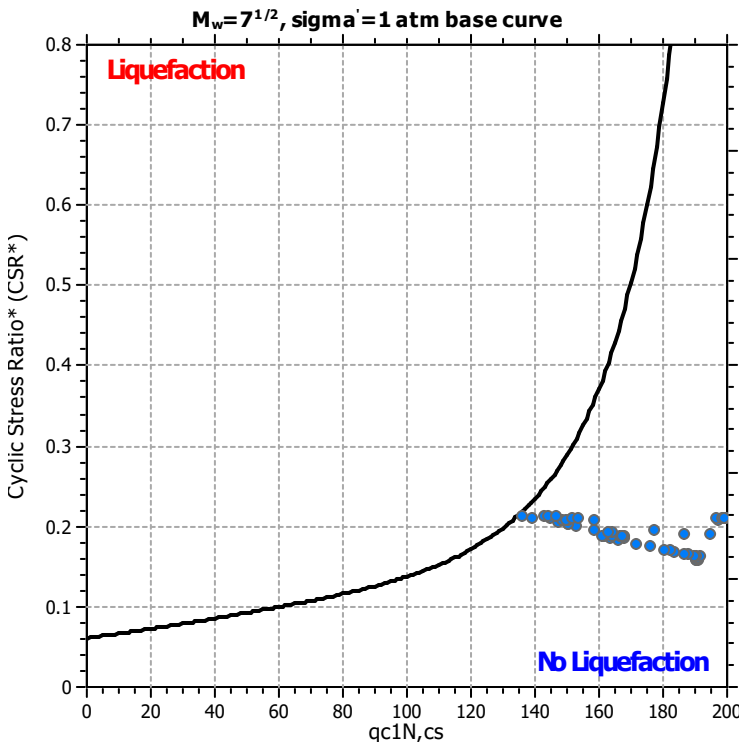
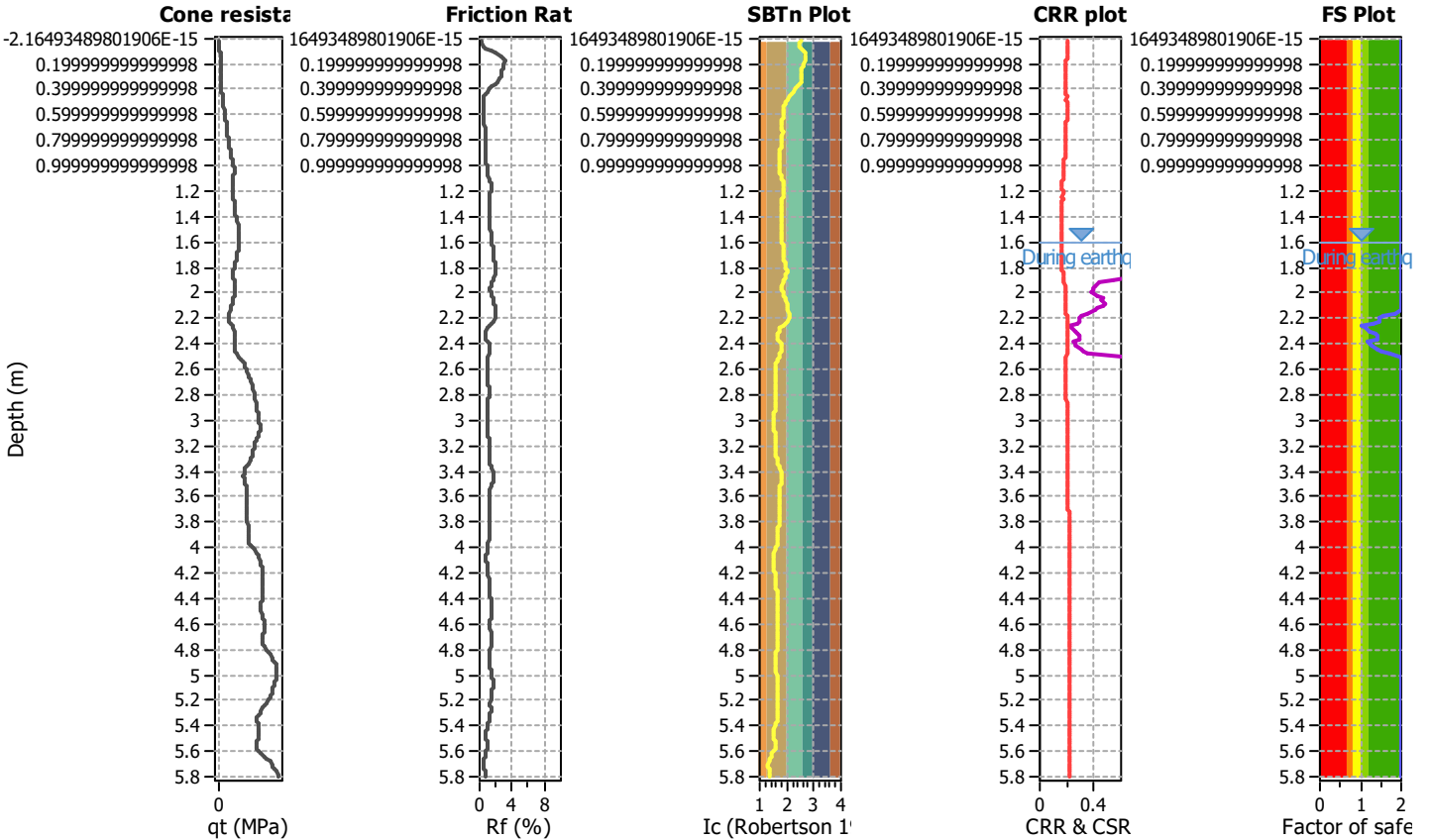
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

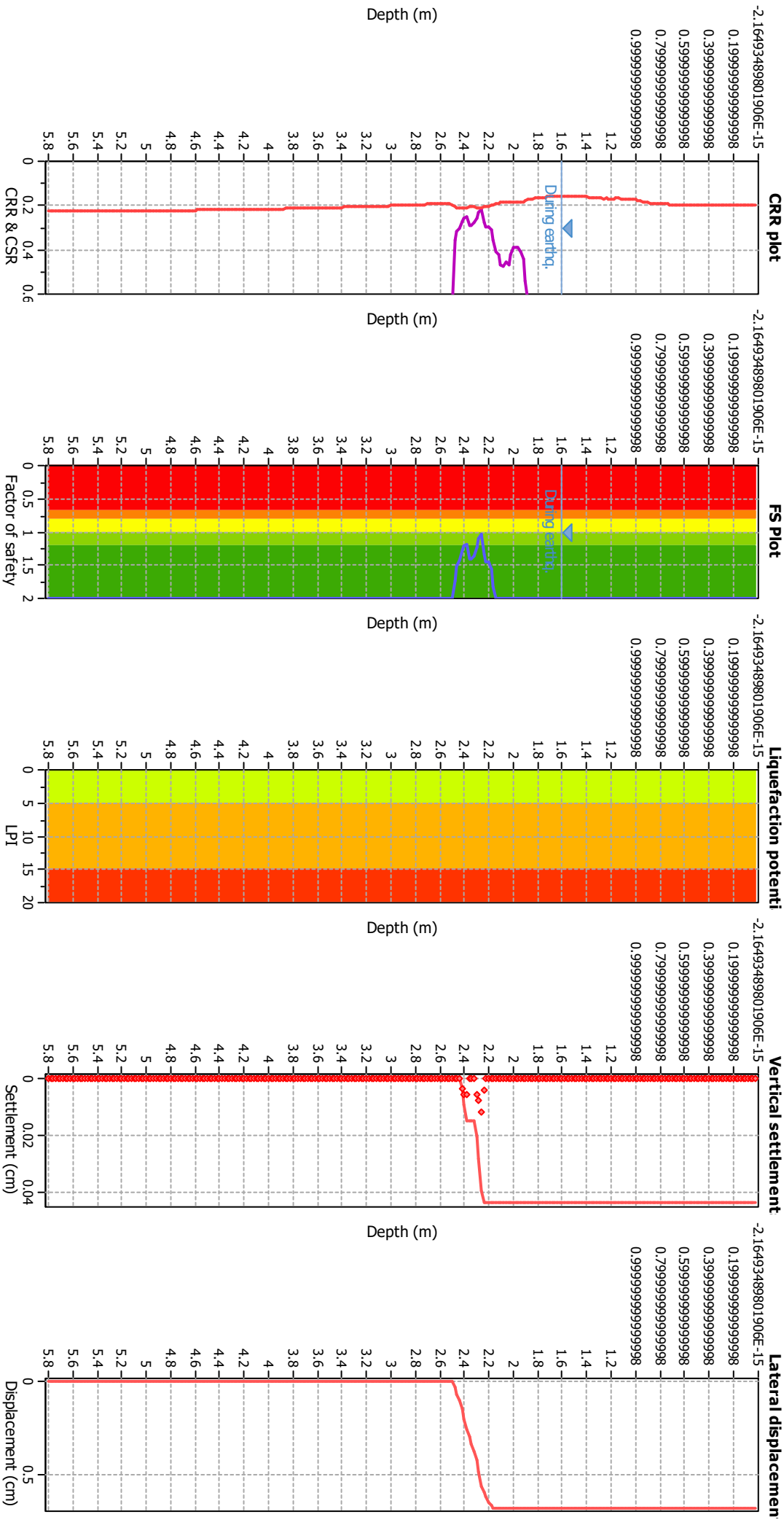
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihangā Rd, Paraparaumu
CPT file : CPT04_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.60 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 1.60 m

Depth to GWT (earthq.): 1.60 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

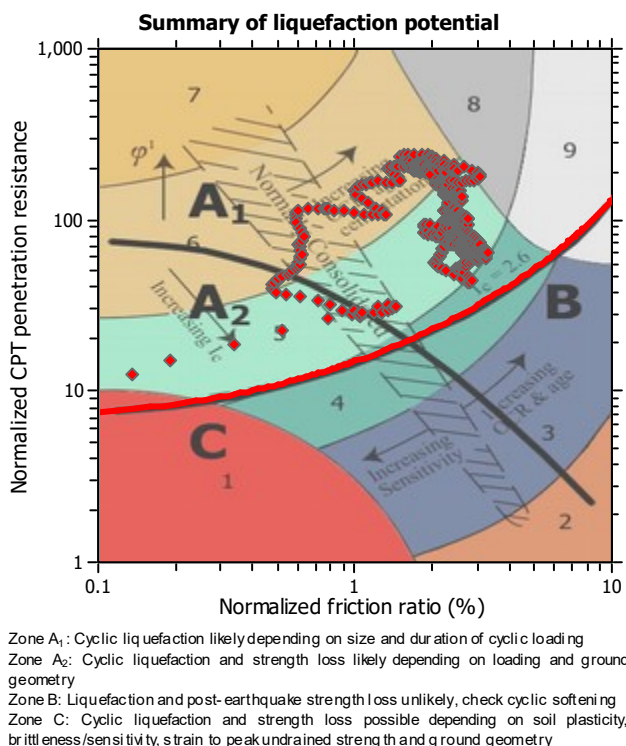
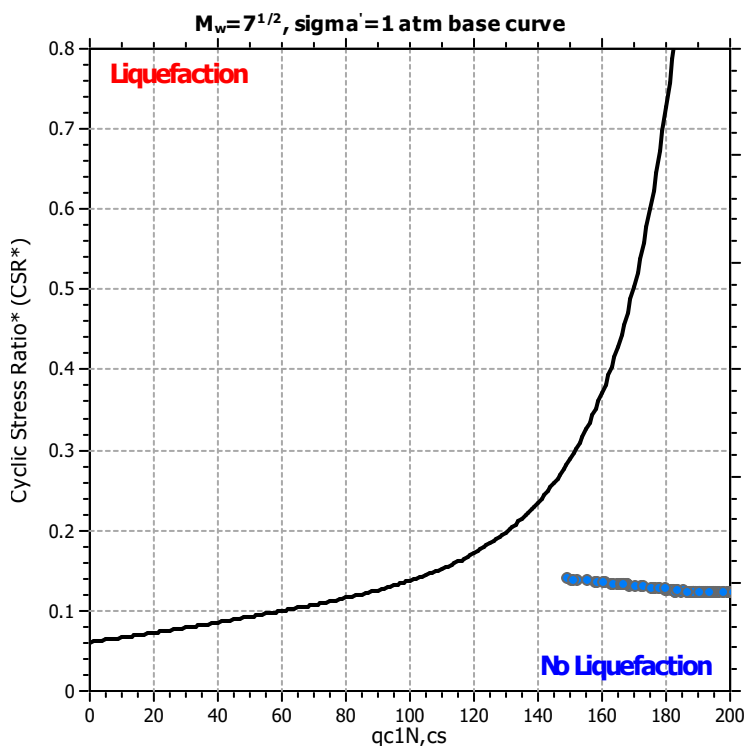
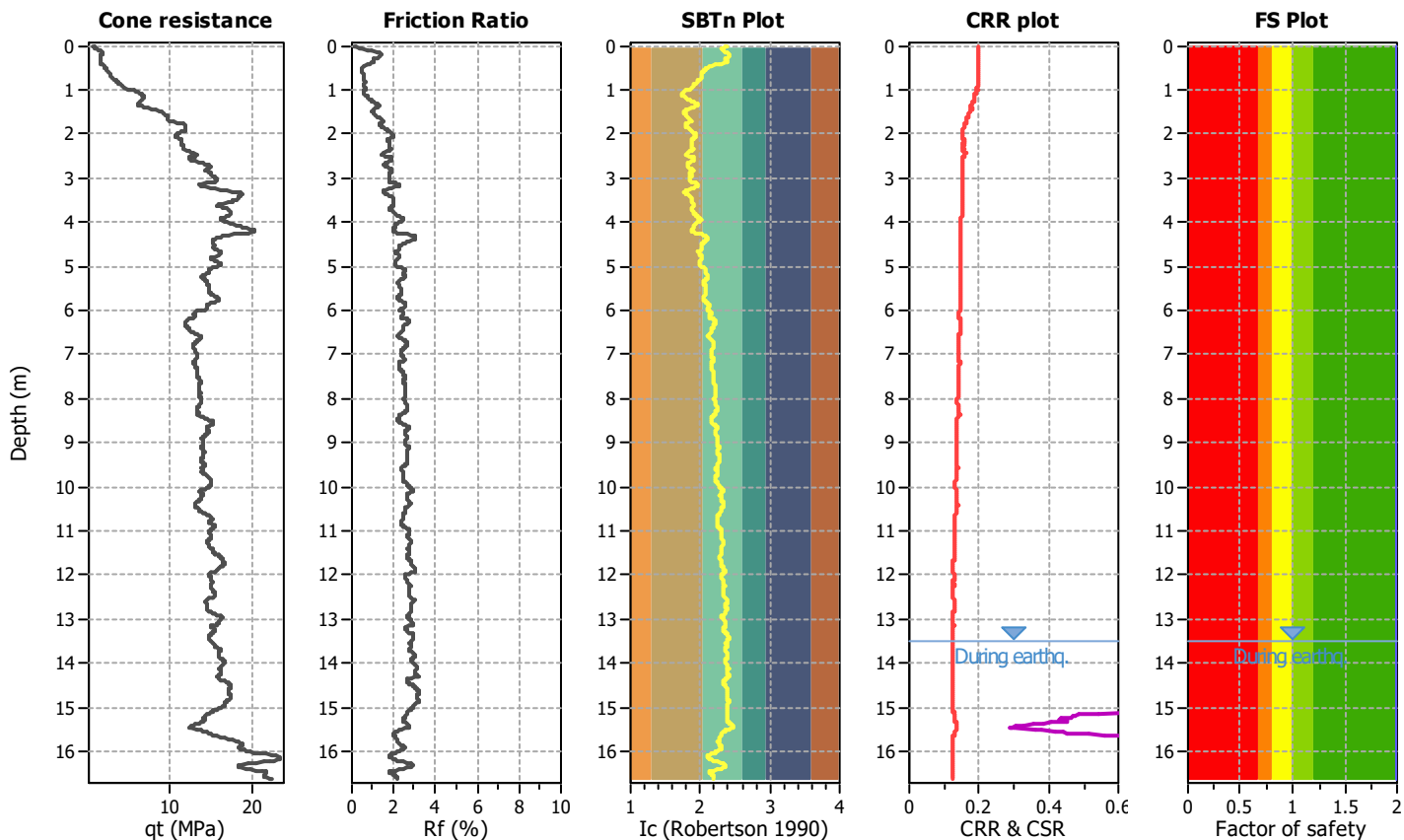
Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme
■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

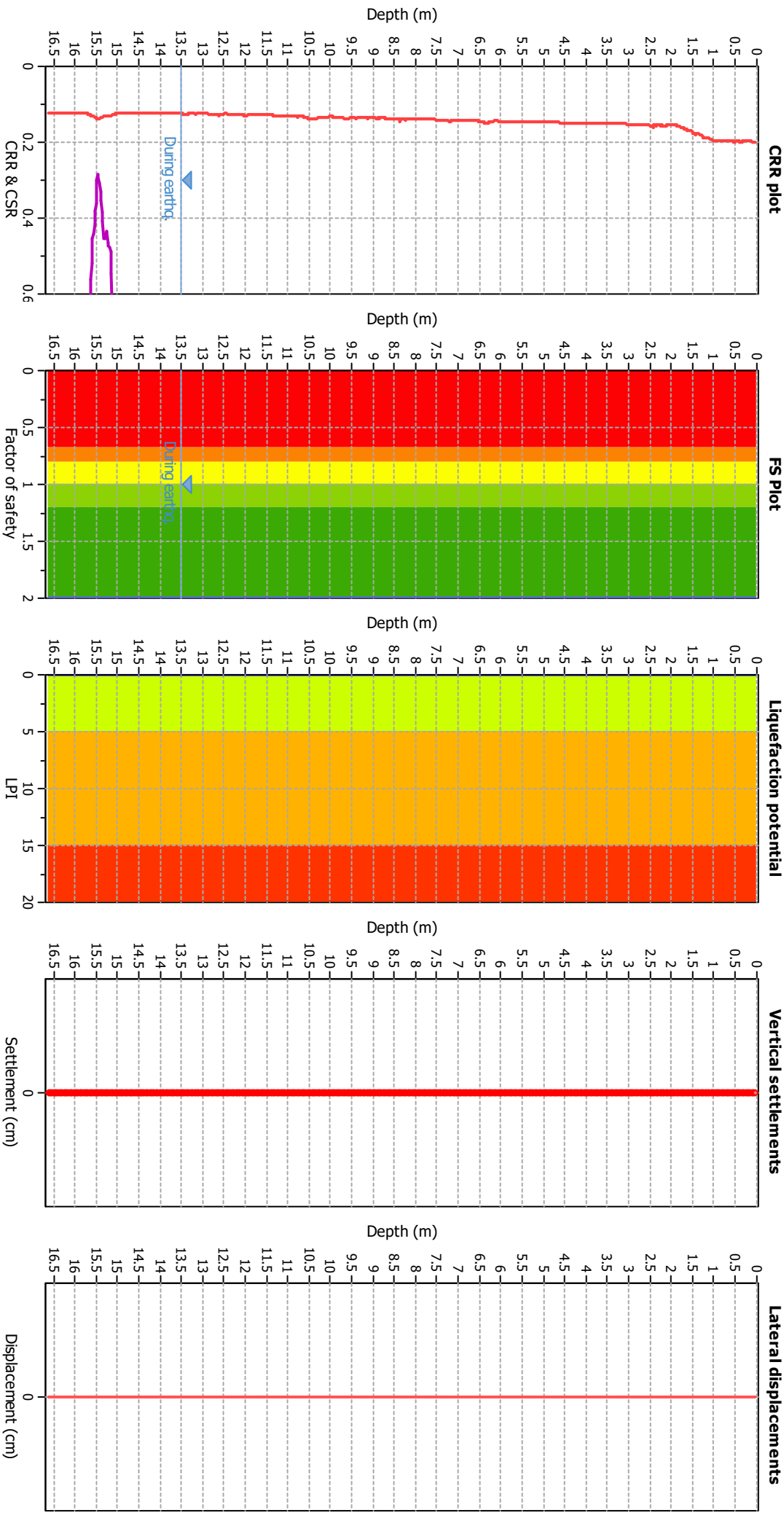
LPI color scheme
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT05_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 13.50 m

Depth to GWT (earthq.): 13.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

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

LPI color scheme

■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT

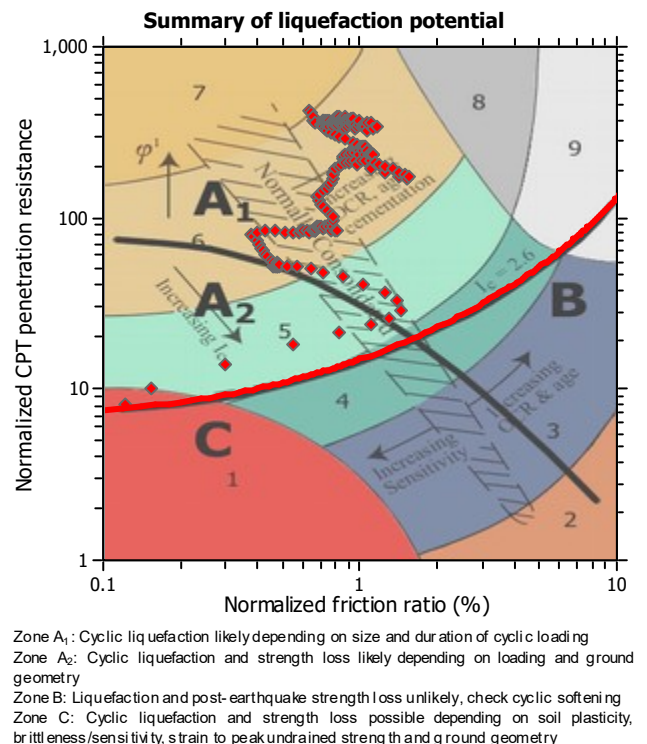
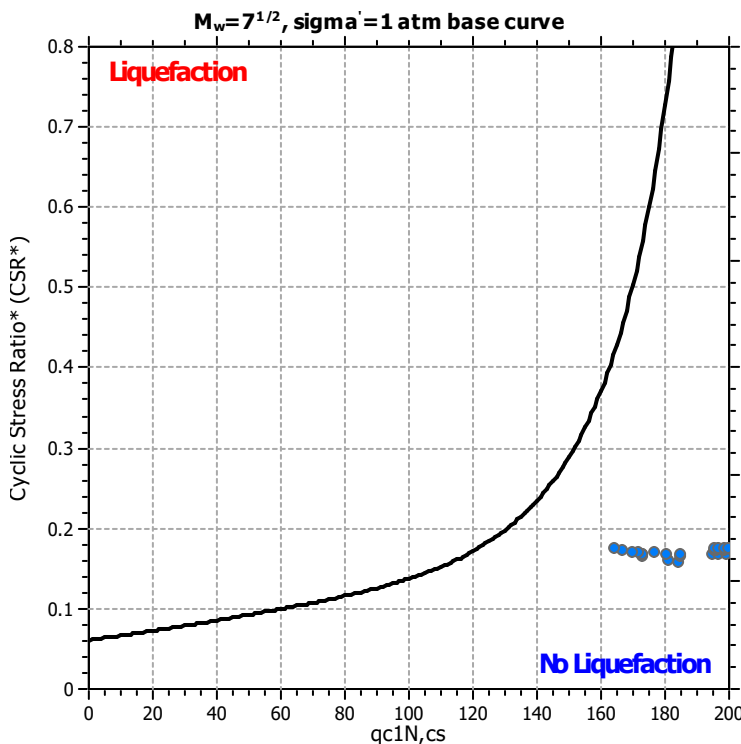
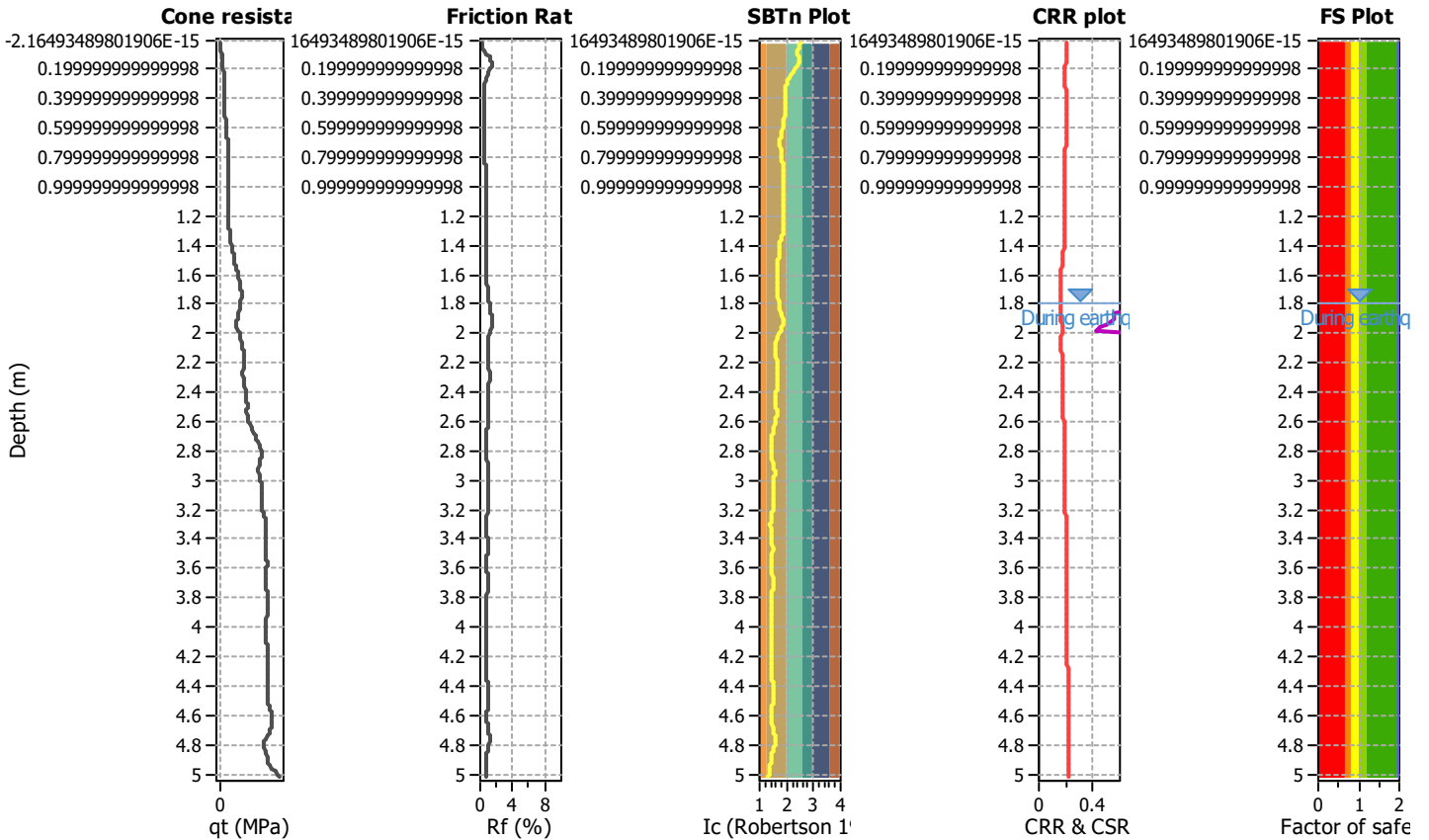
Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

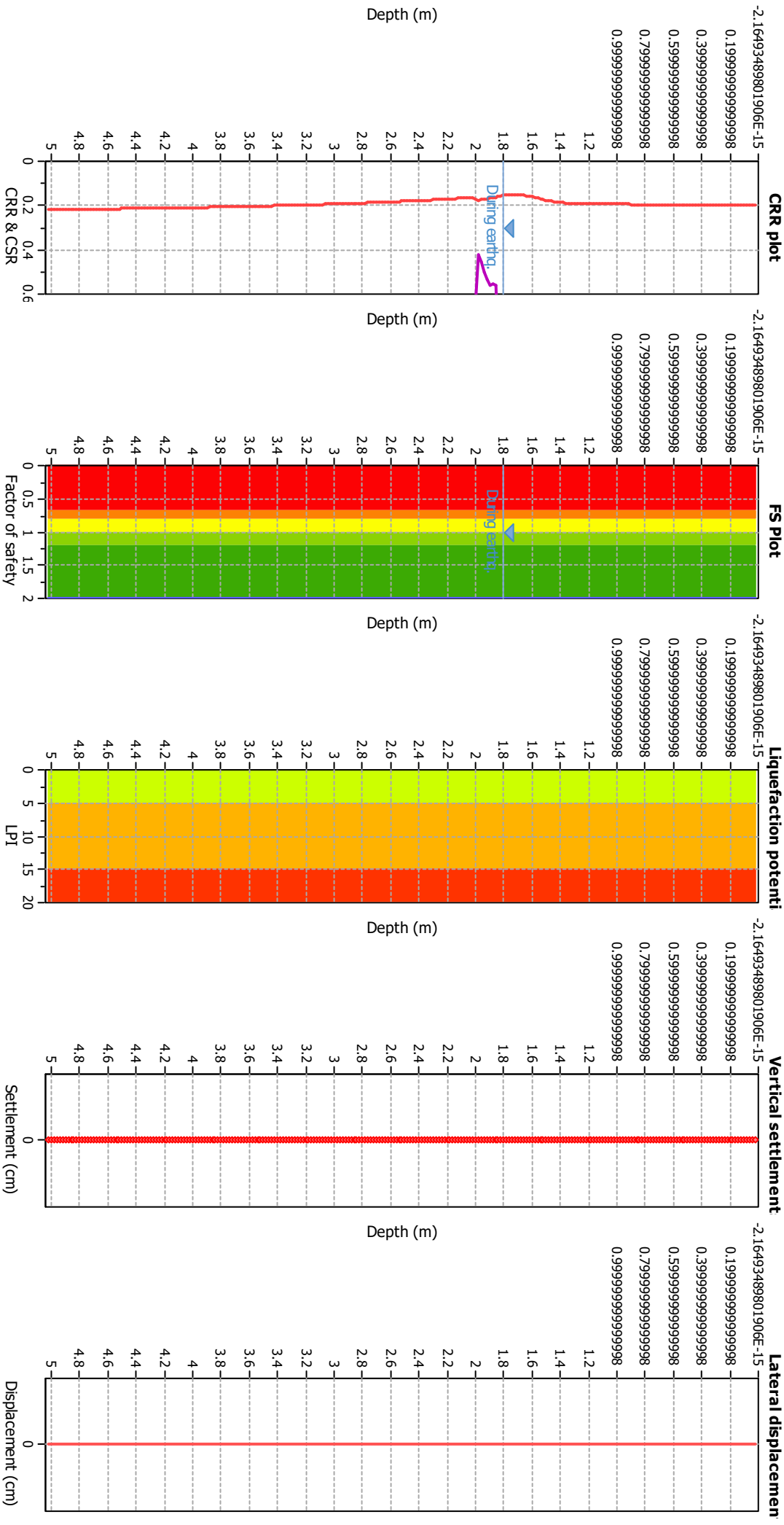
CPT file : CPT06_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.80 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 1.80 m

Depth to GWT (earth): 1.80 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme

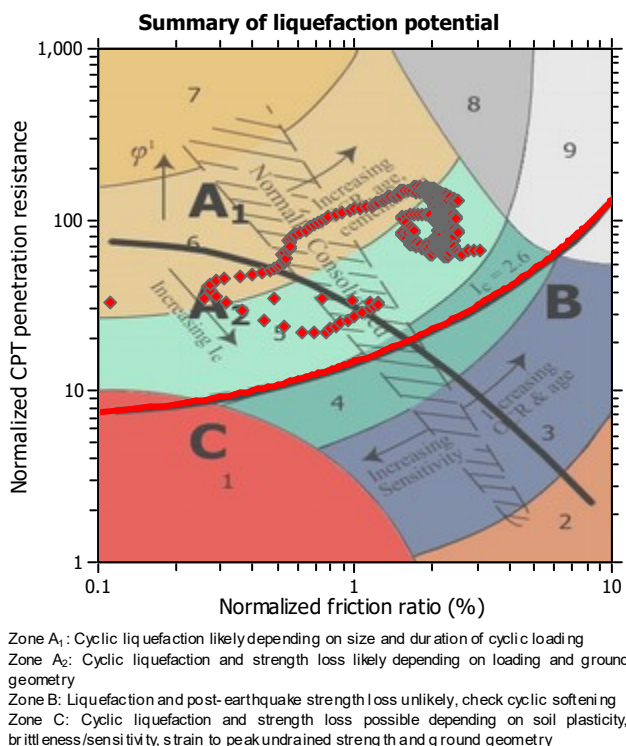
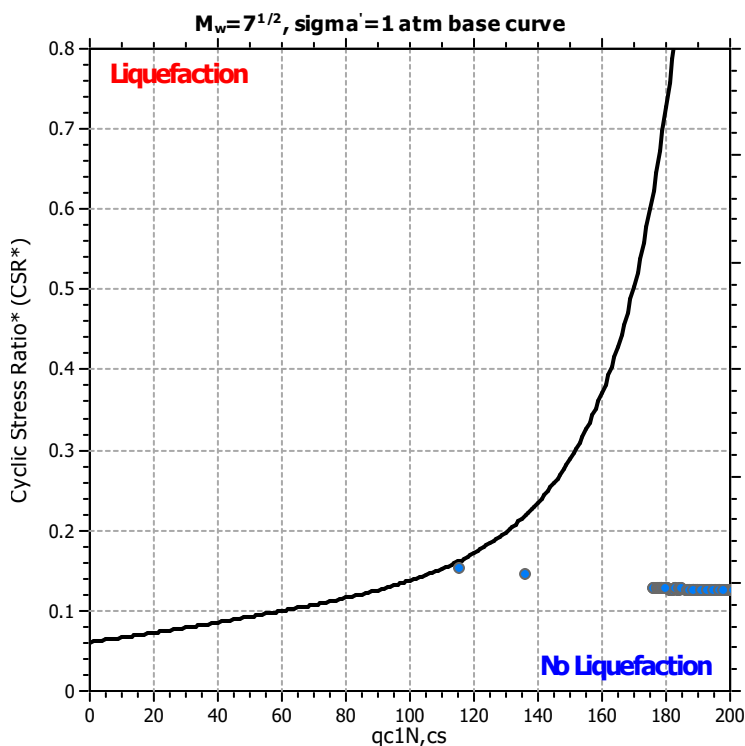
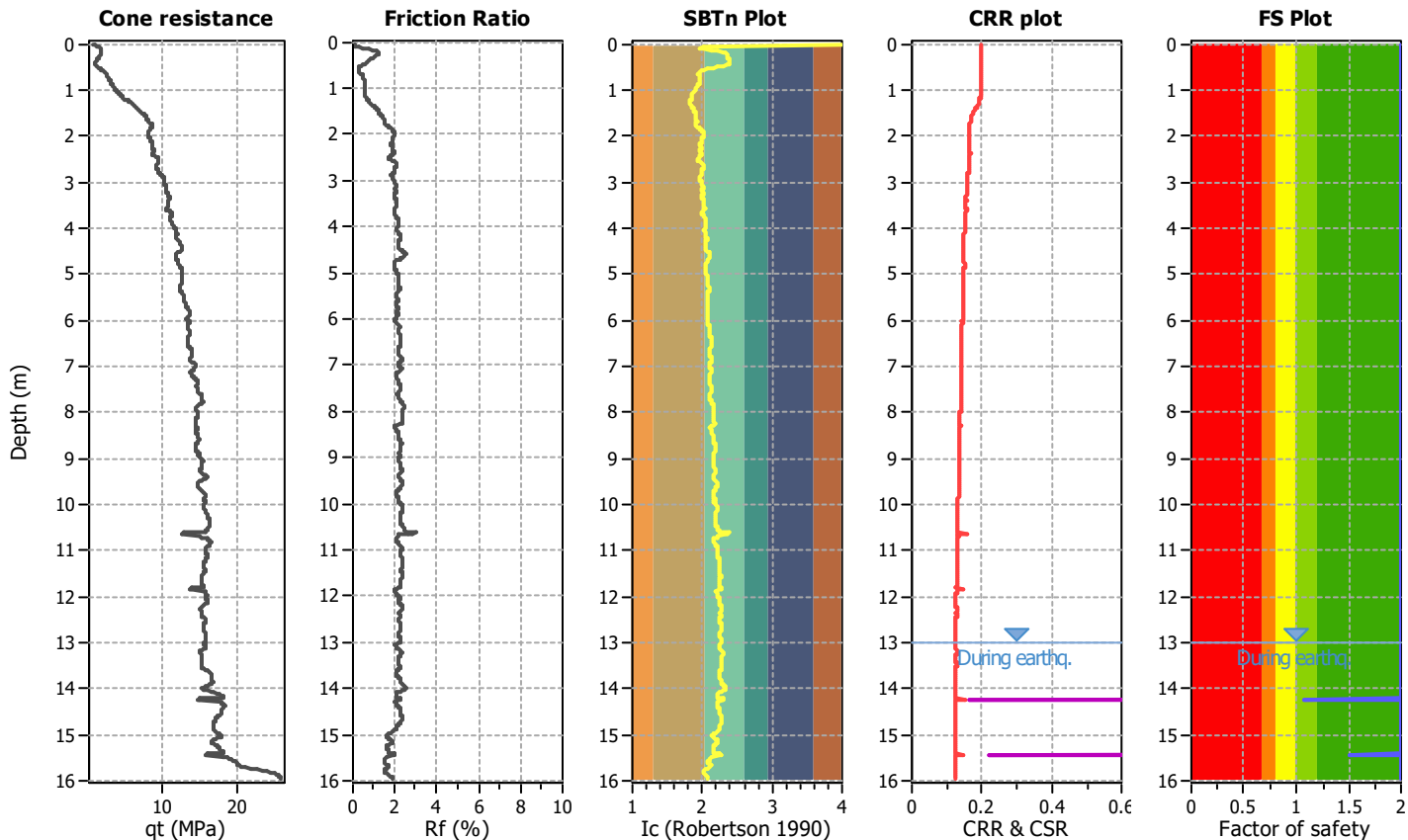
■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

LPI color scheme

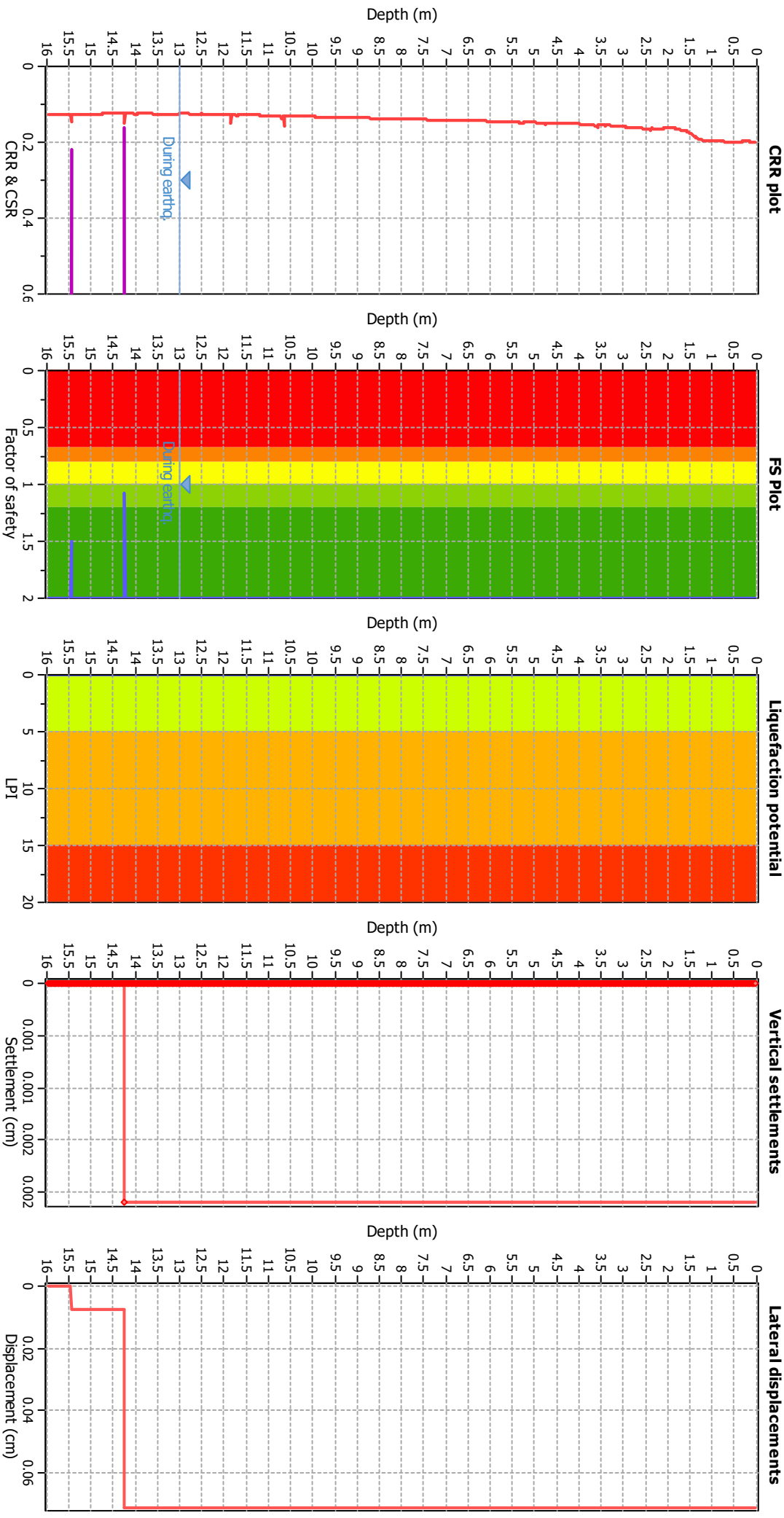
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT07_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 13.00 m

Depth to GWT (earthq.): 13.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

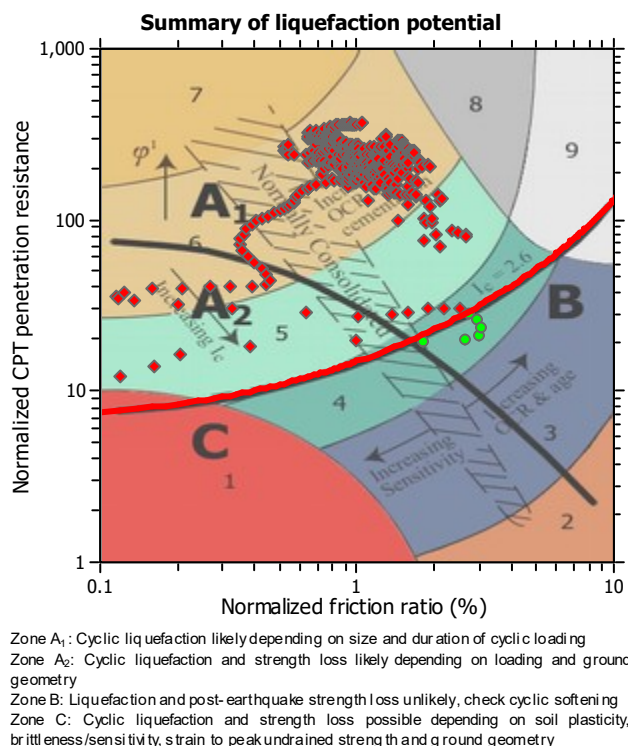
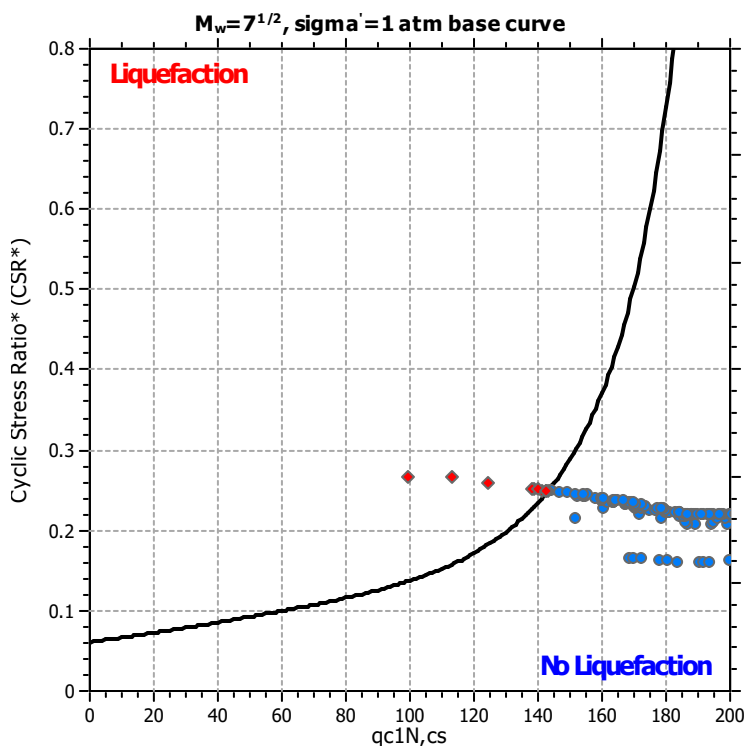
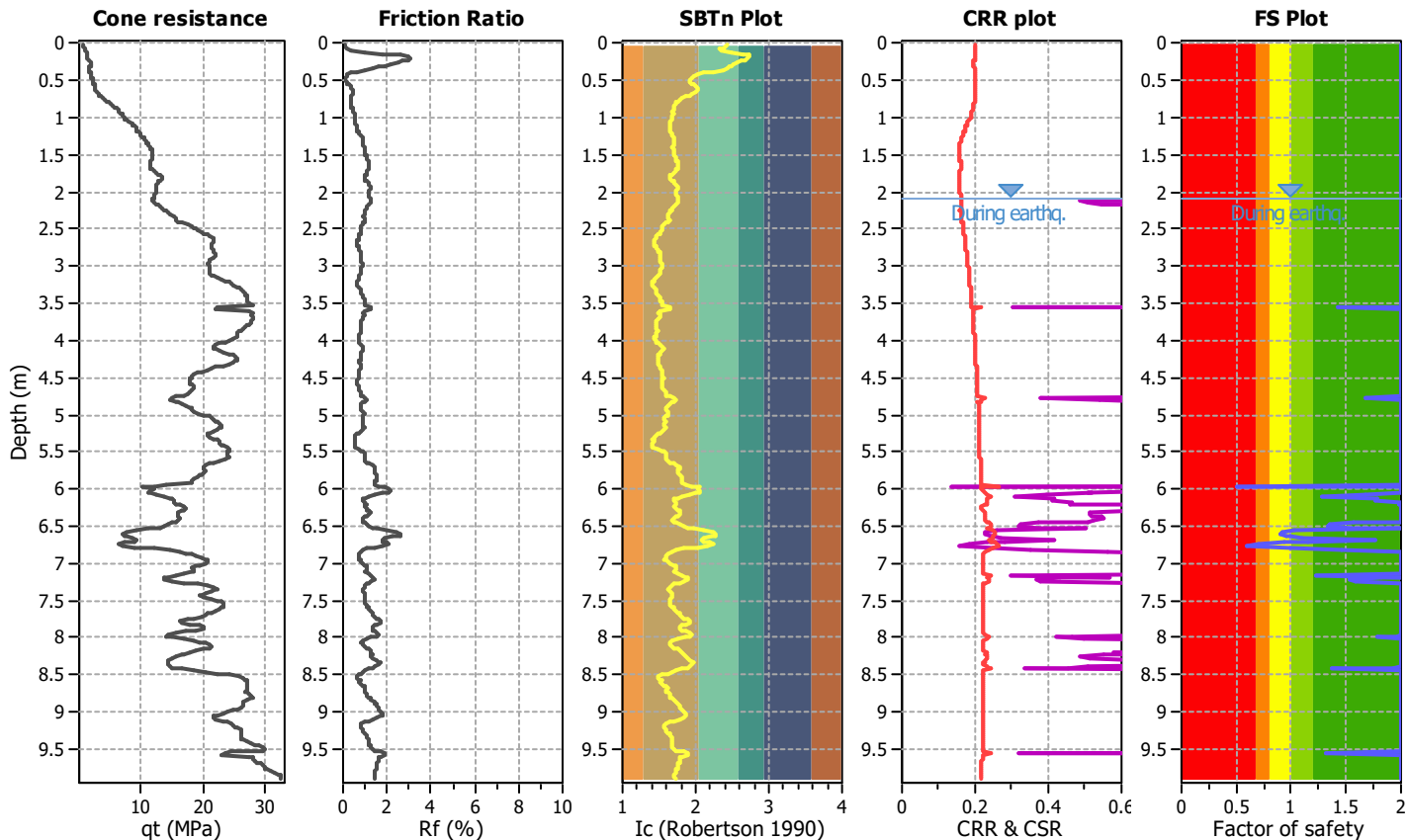
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

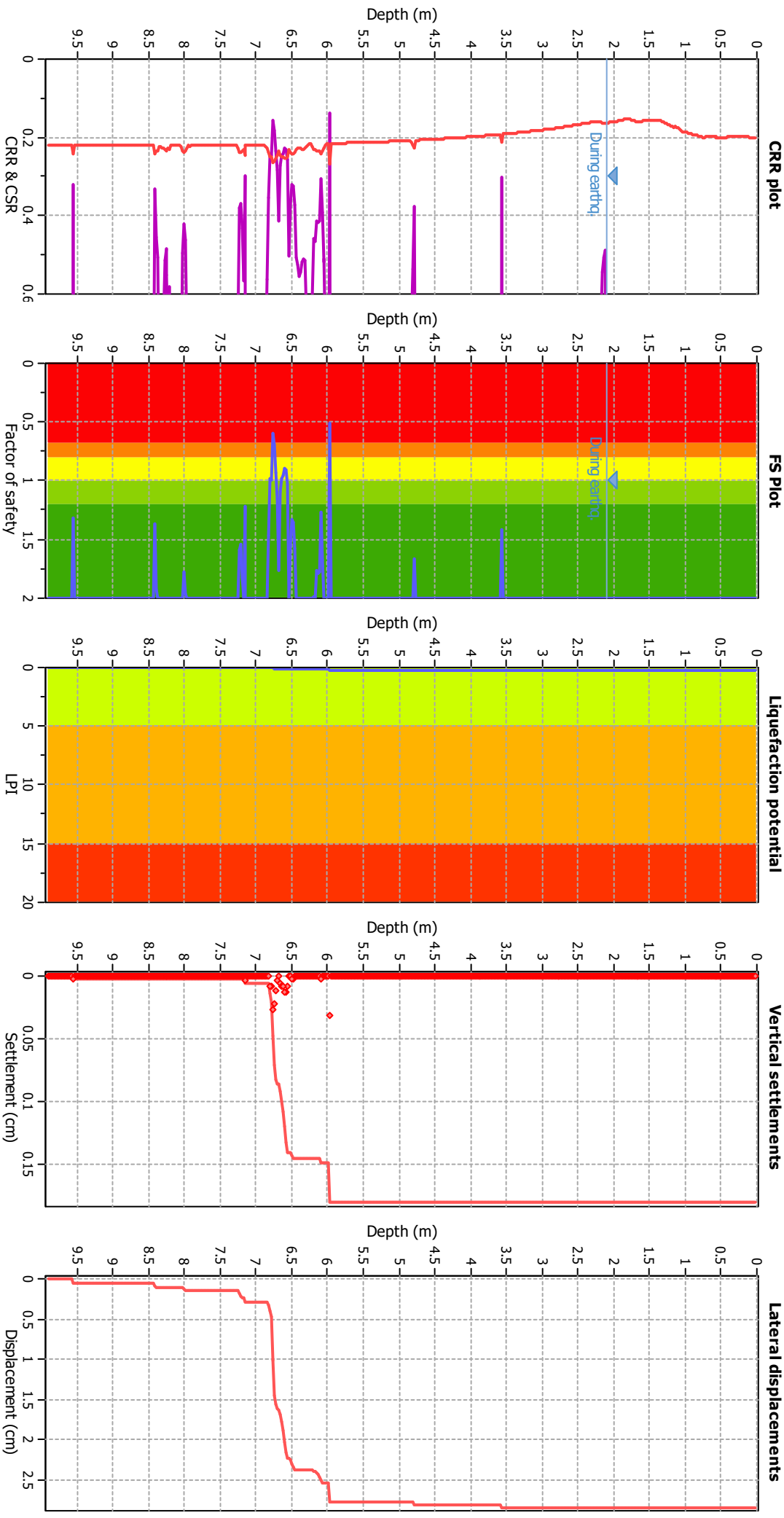
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT08_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.10 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.10 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 2.10 m

Depth to GWT (earthq.): 2.10 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

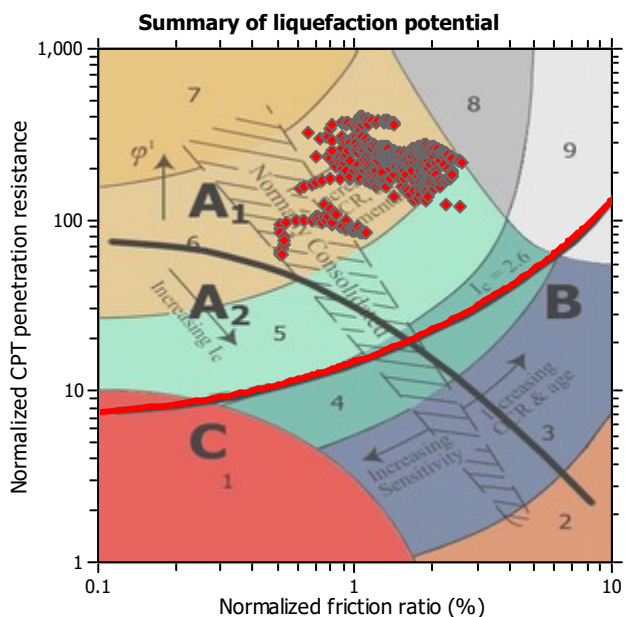
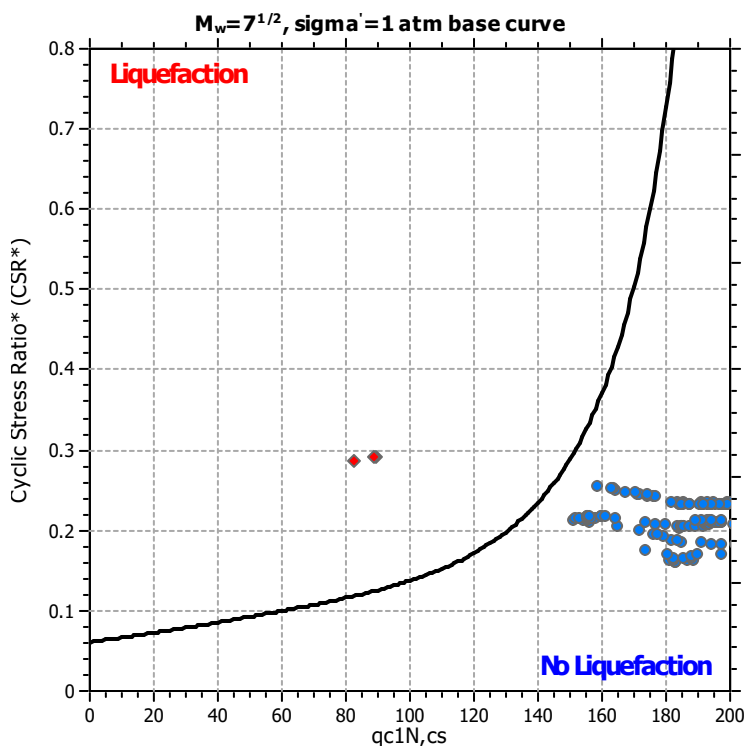
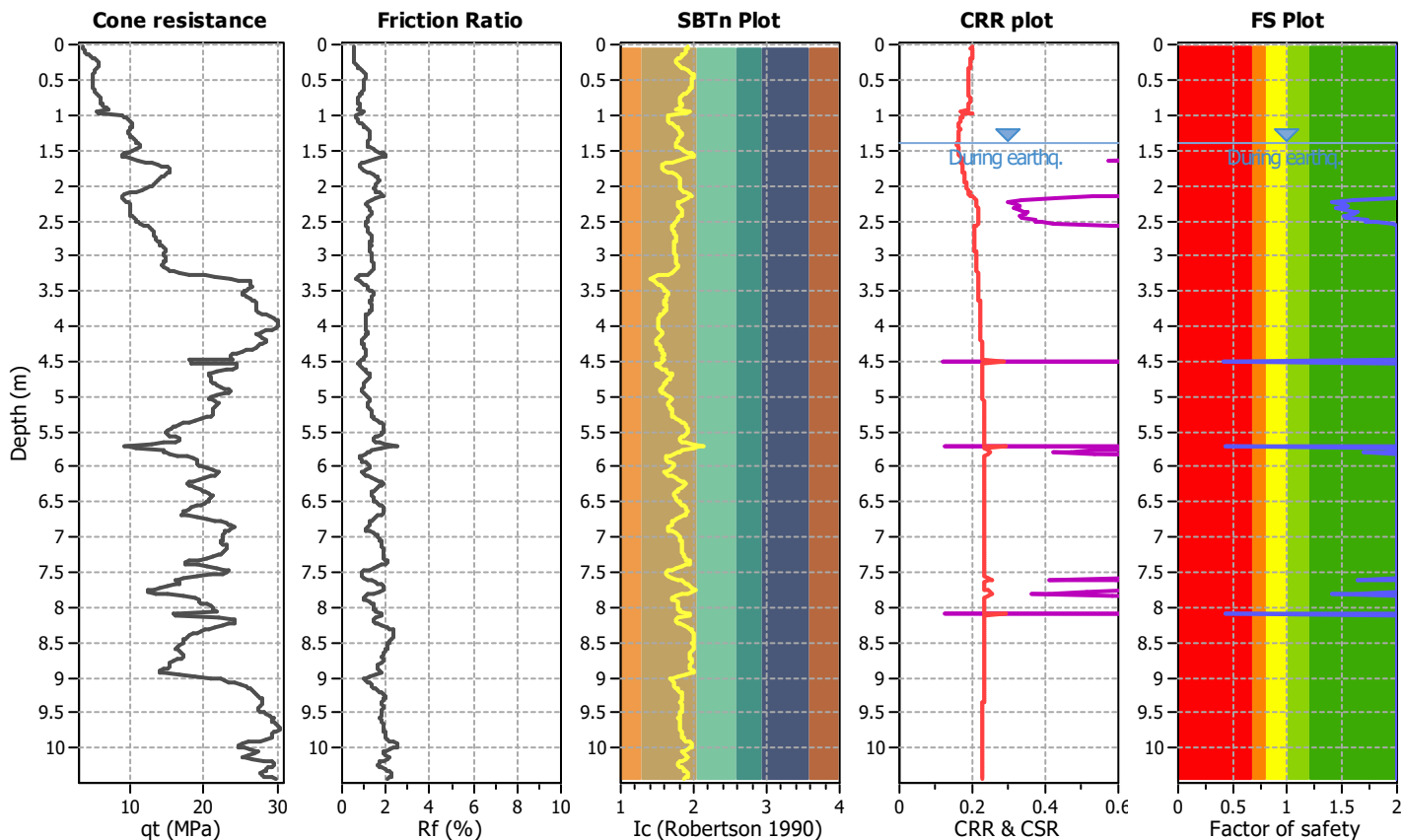
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

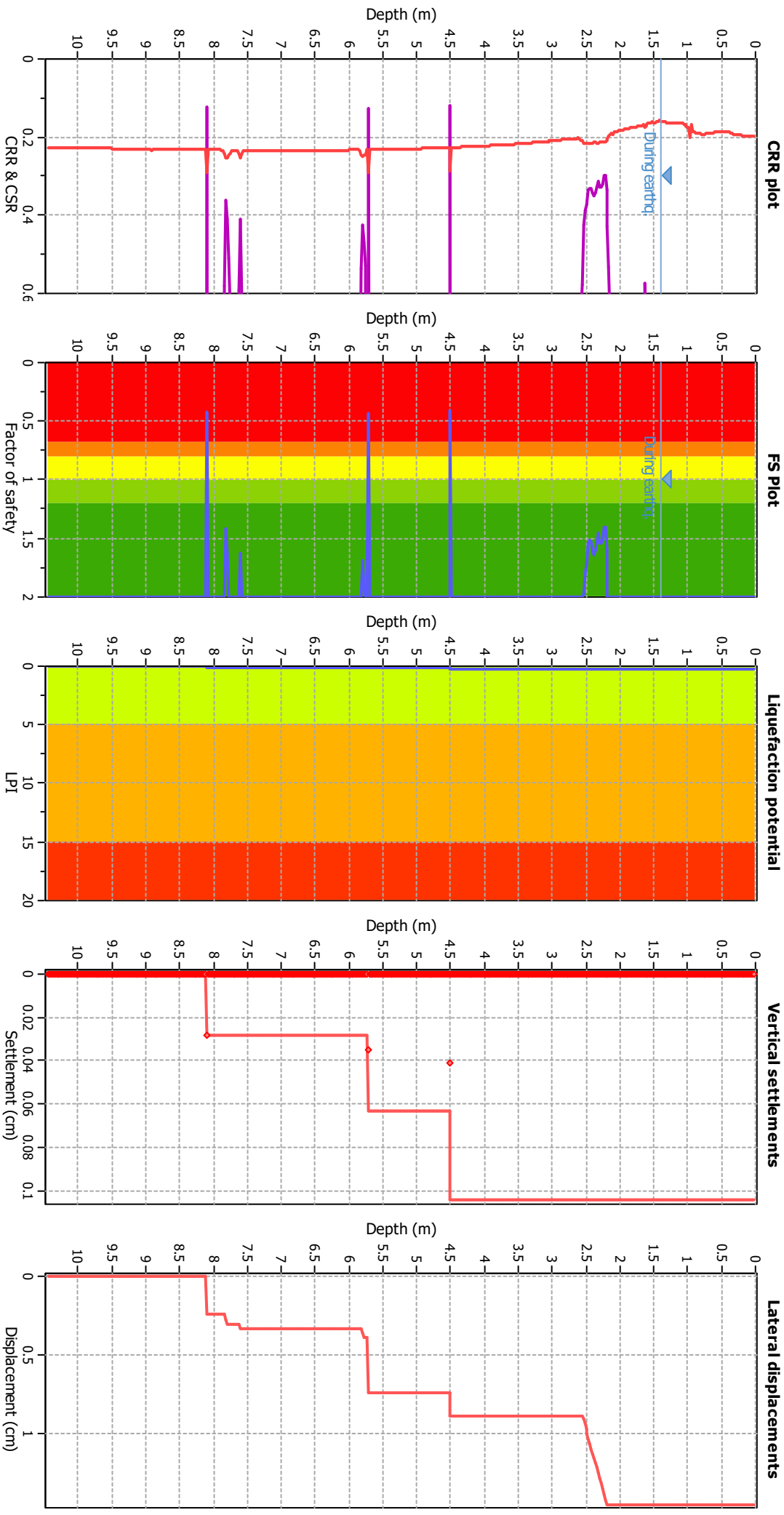
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT09_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.40 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 1.40 m

Depth to GWT (earthq.): 1.40 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_p applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

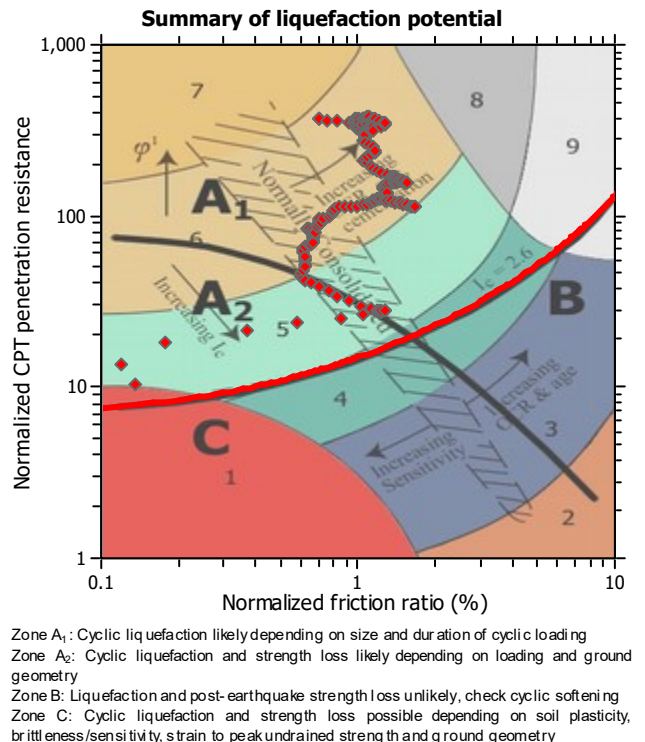
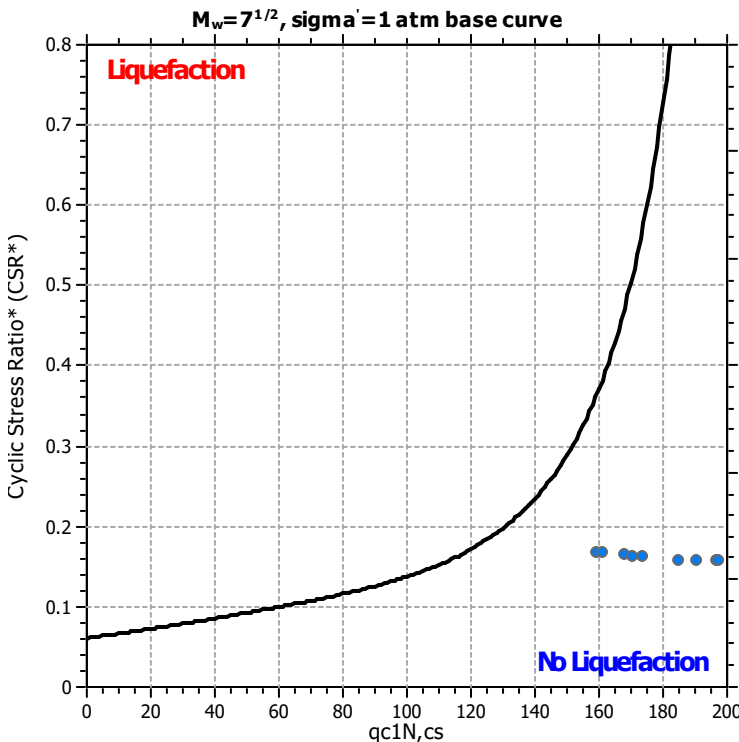
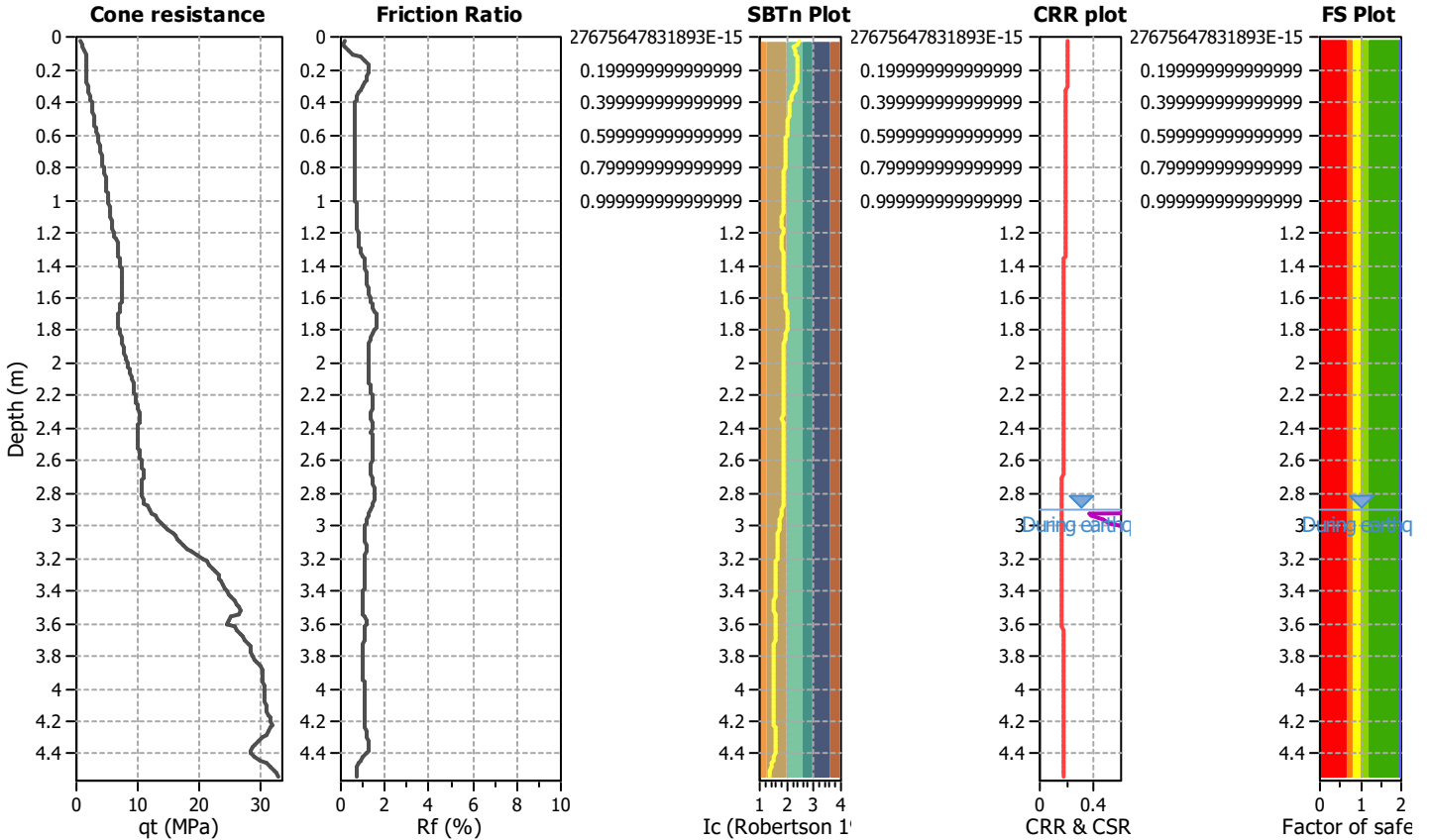
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

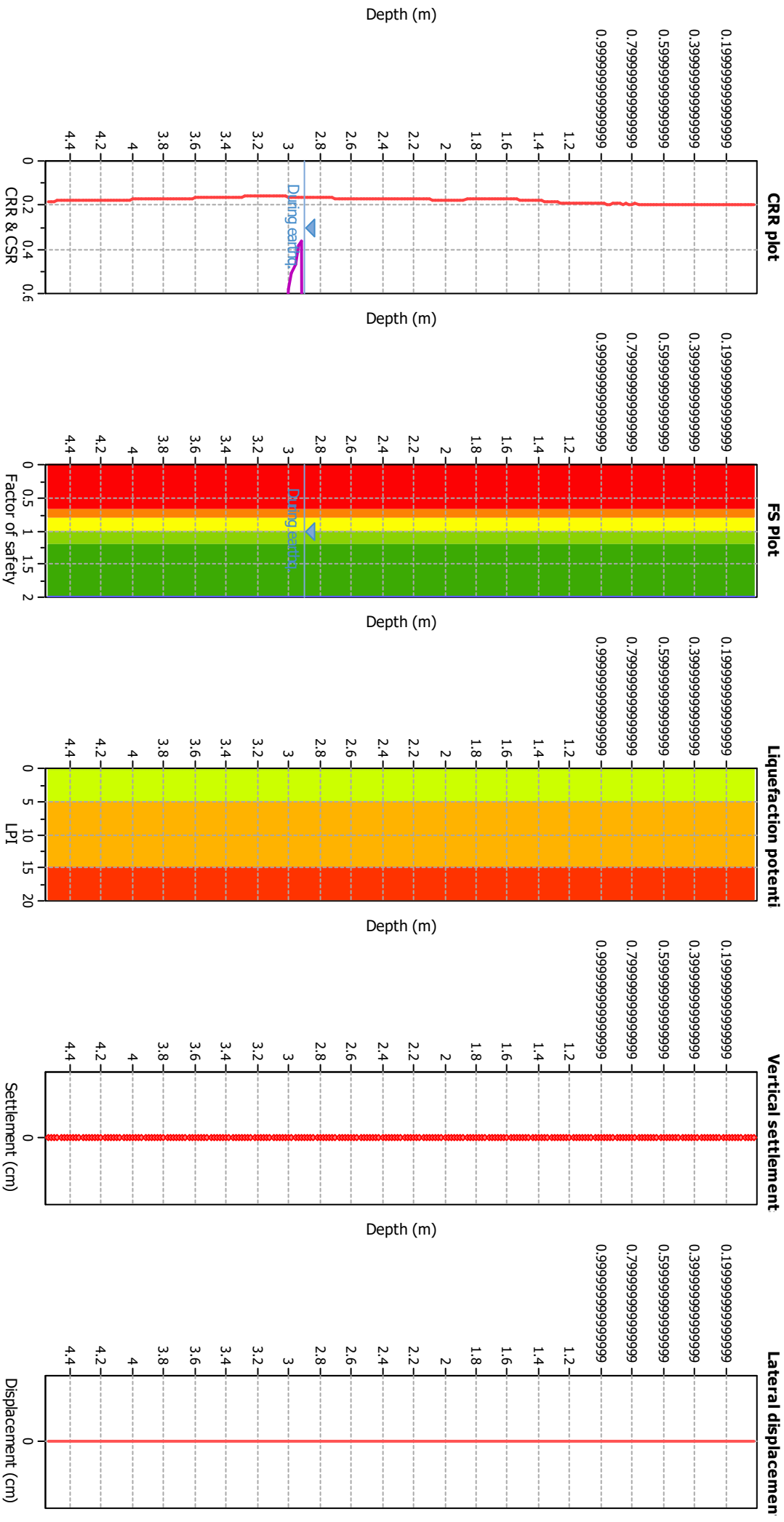
- Very high risk
- High risk
- Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT10_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.90 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.90 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No		



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 2.90 m
Depth to GWT (earthq.): 2.90 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A
Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: No
Limit depth applied: Yes
Limit depth: 20.00 m

F.S. color scheme

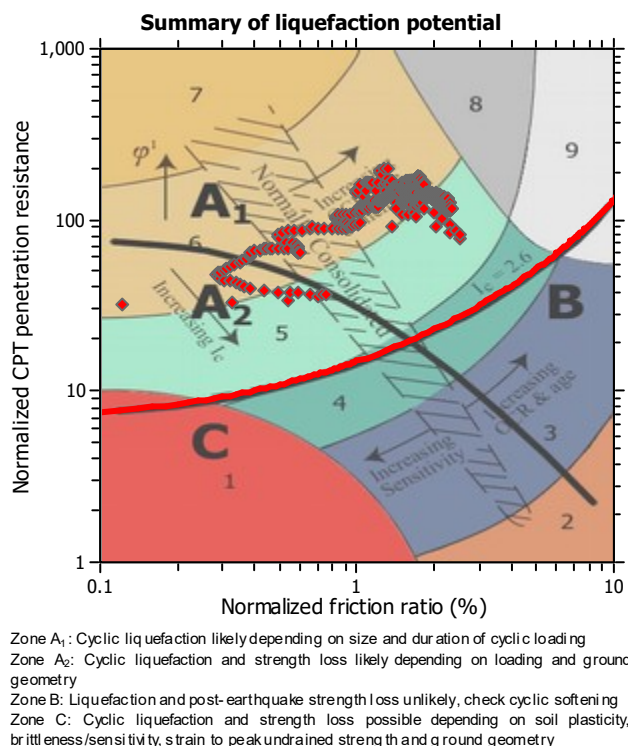
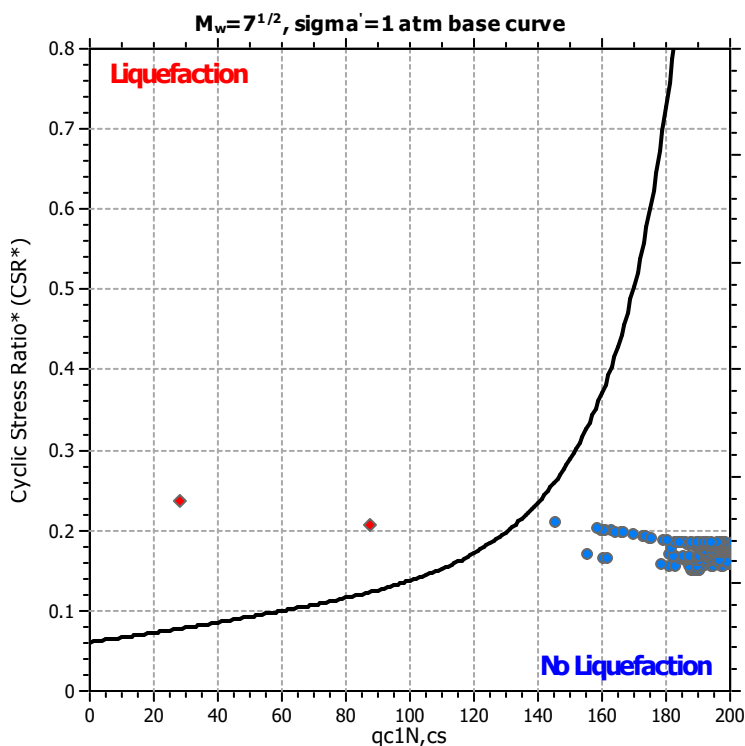
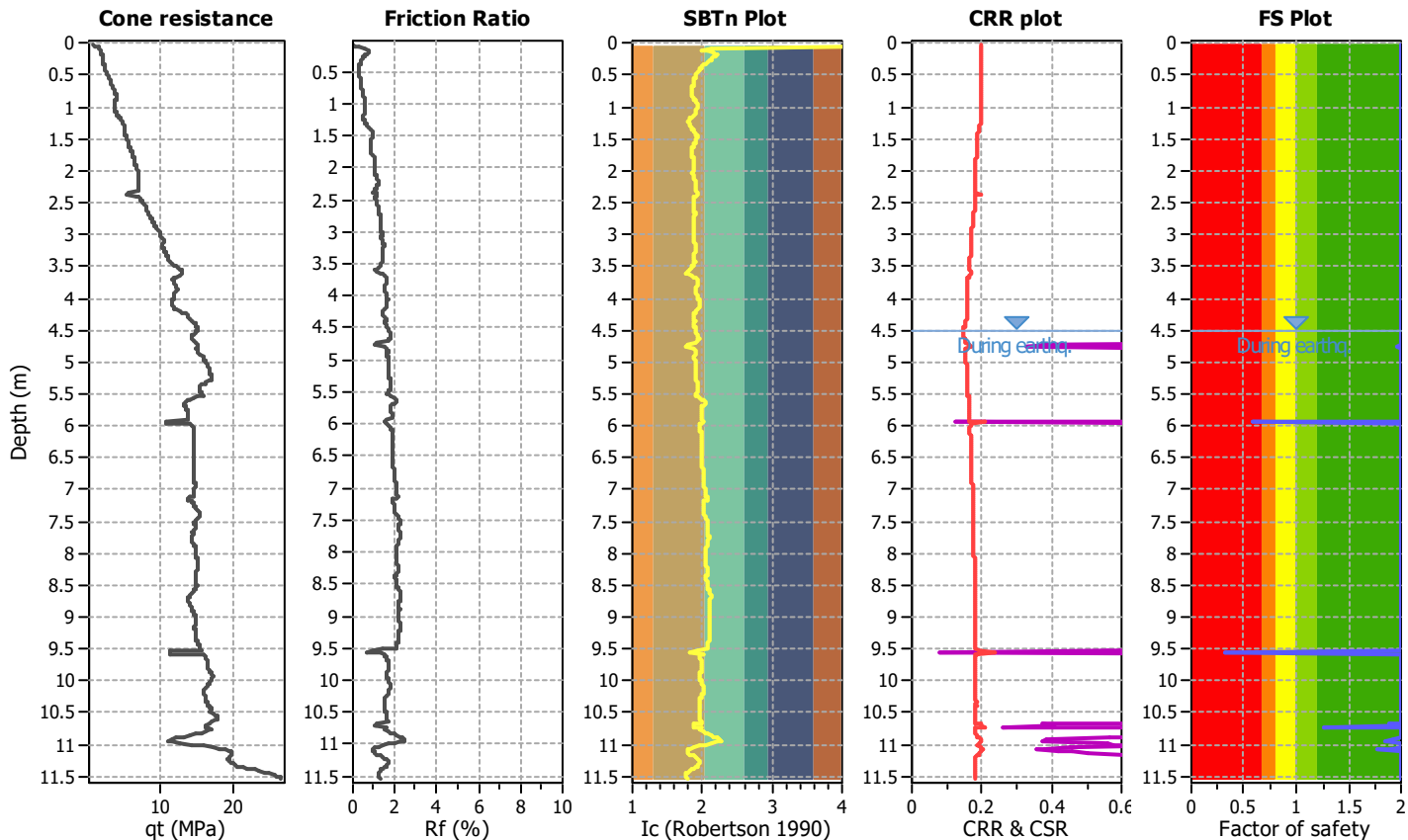
■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

LPI color scheme

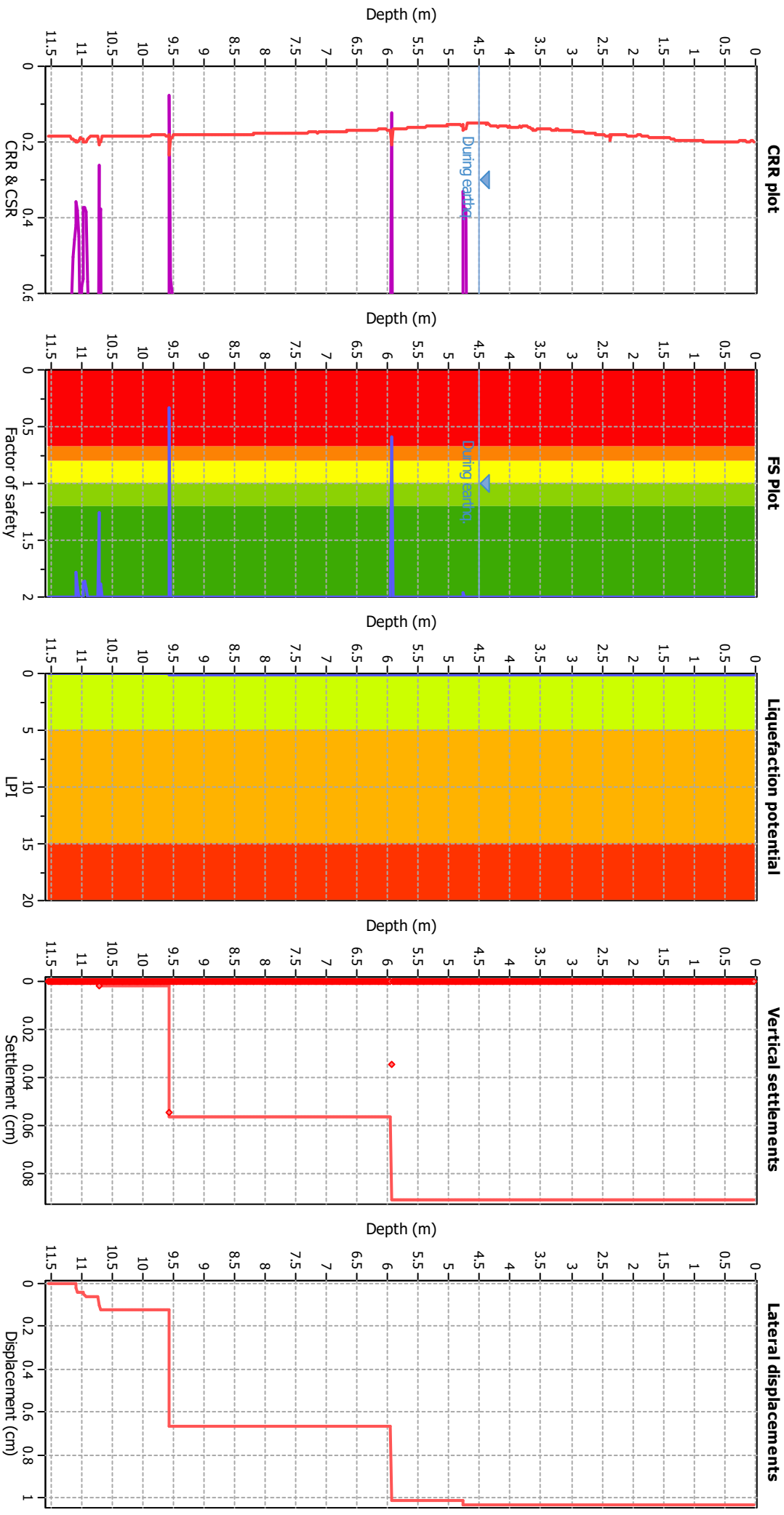
■ Very high risk
■ High risk
■ Low risk

LIQUEFACTION ANALYSIS REPORT
Project title : 195340402
Location : 131 Otaihanga Rd, Paraparaumu
CPT file : CPT11_ULS
Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w :	6.75	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	20.00 m
Peak ground acceleration:	0.32	Unit weight calculation:	Based on SBT	K_σ applied:	No	MSF method:	Method based



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Finest correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 6.75
Peak ground acceleration: 0.32
Depth to water table (insitu): 4.50 m

Depth to GWT (earthq.): 4.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
 K_u applied: No
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 20.00 m

FS color scheme

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

LPI color scheme

■ Very high risk
■ High risk
■ Low risk

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it.* A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.* Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*



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e-mail: info@geoprofessional.org www.geoprofessional.org