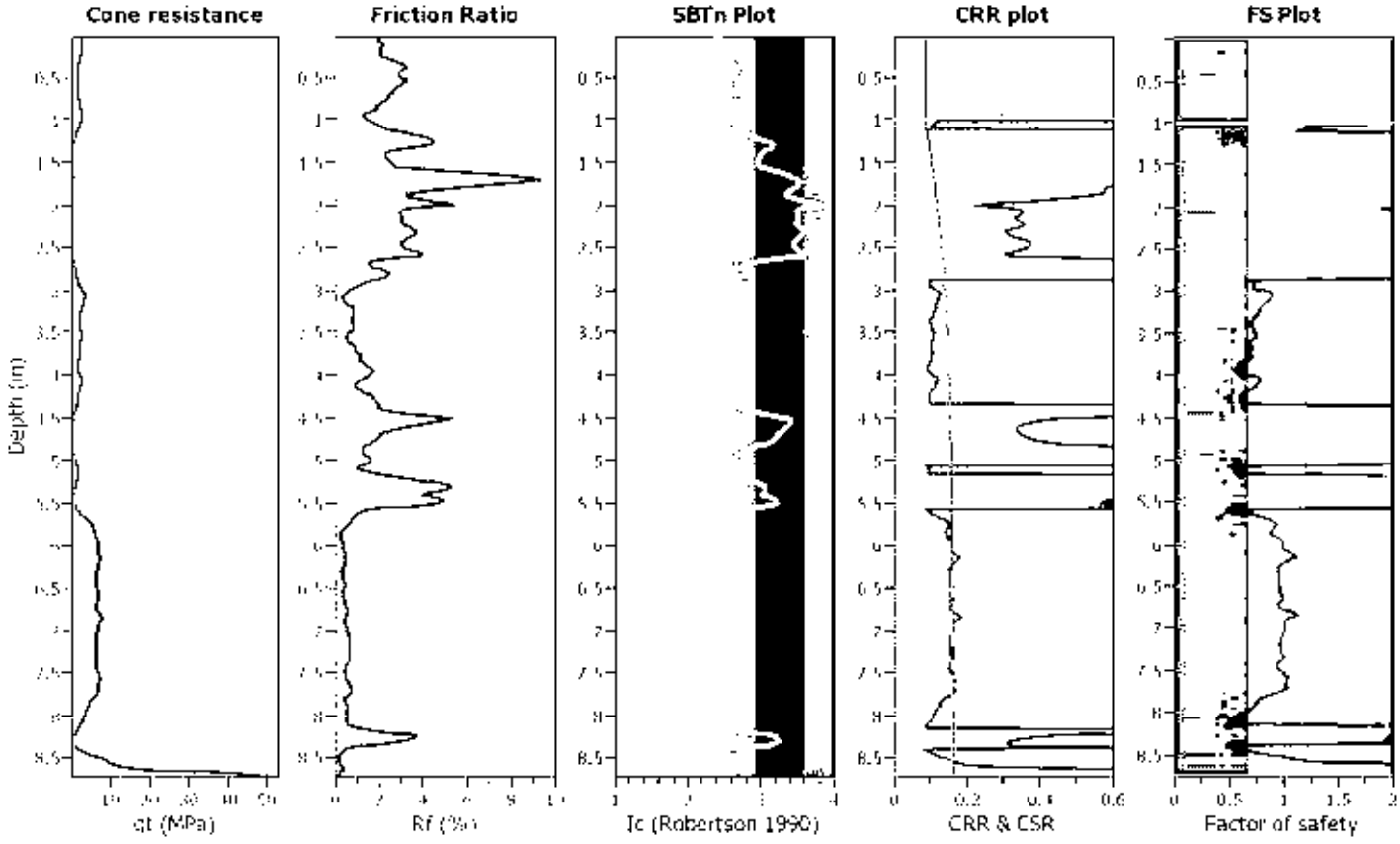
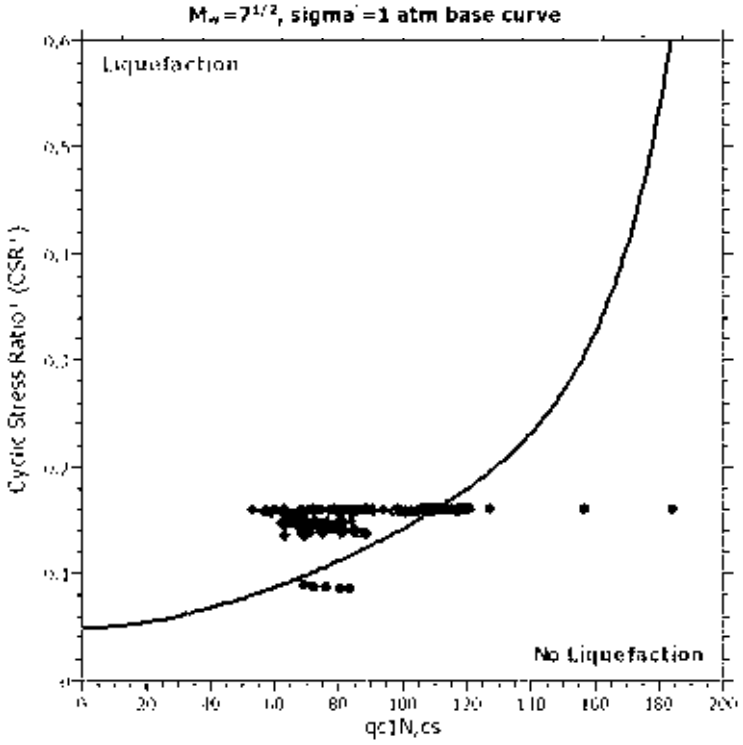
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

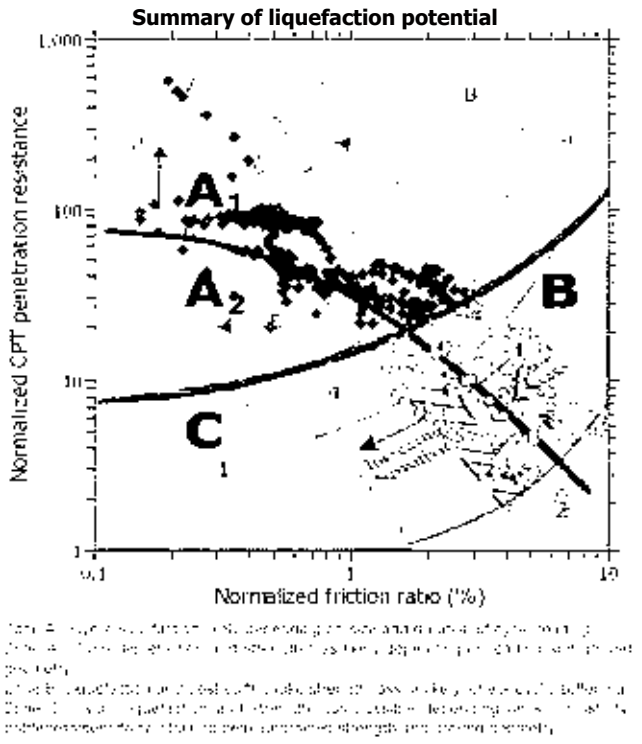
CPT file : CPT40_32SutherlandsRd

Input parameters and analysis data

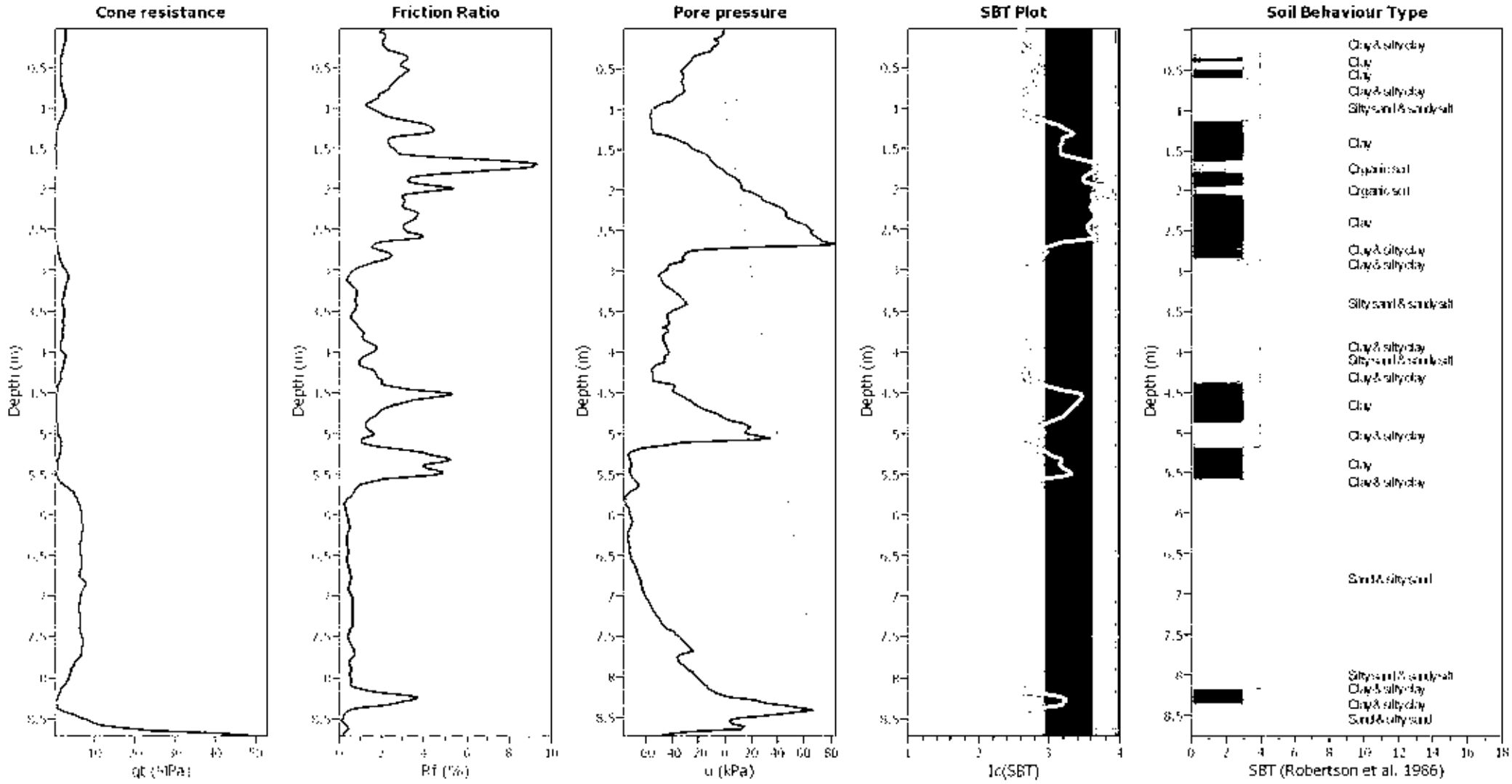
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



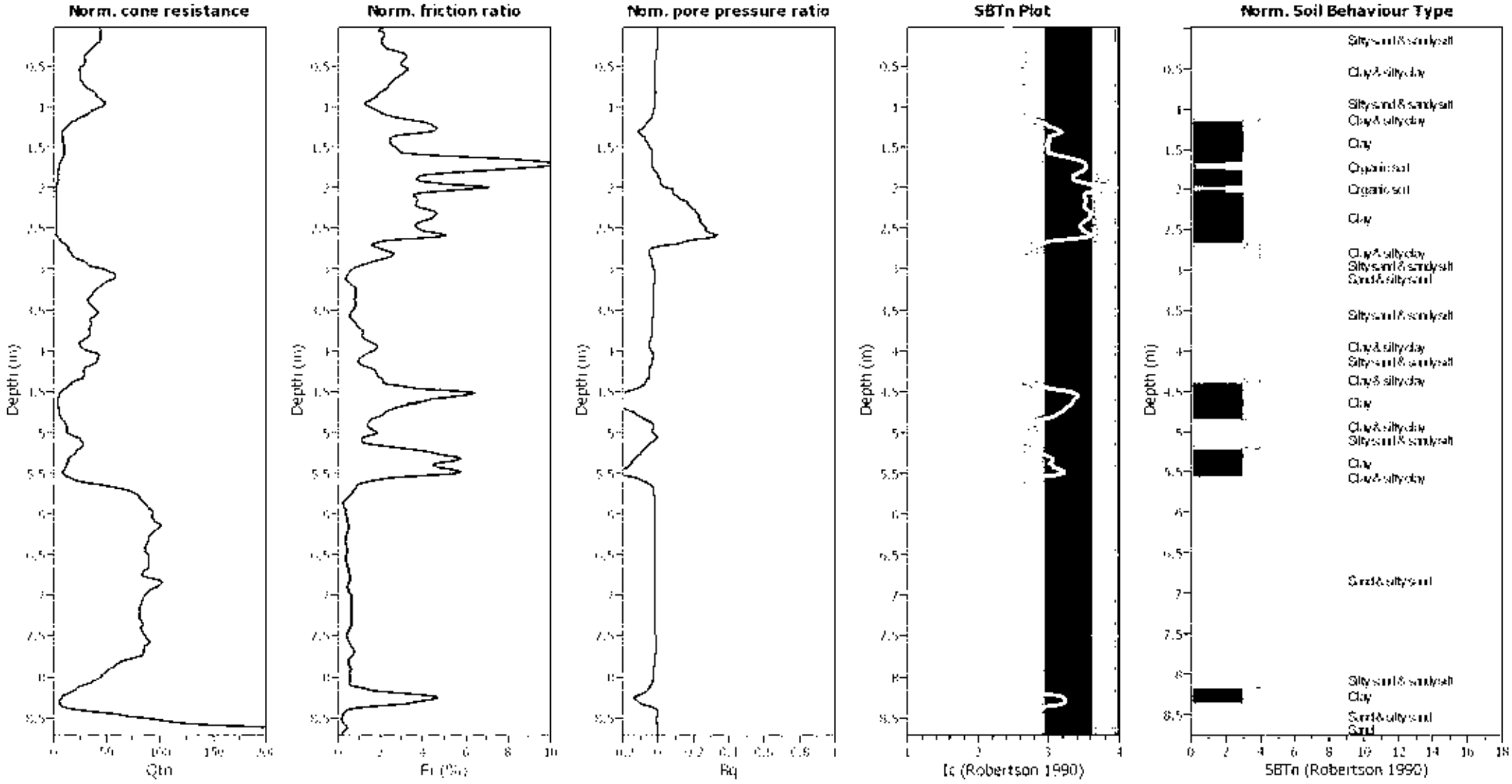
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



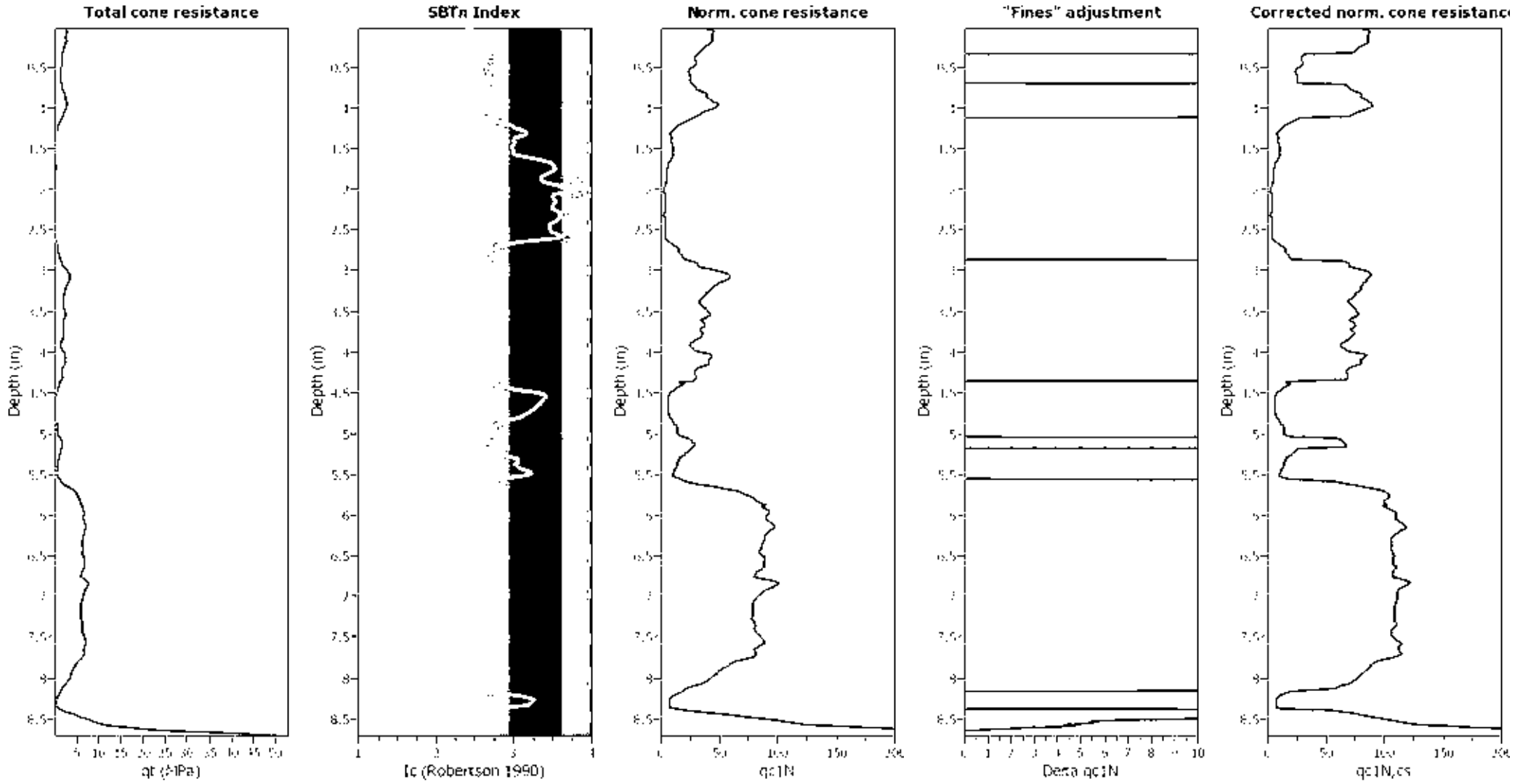
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

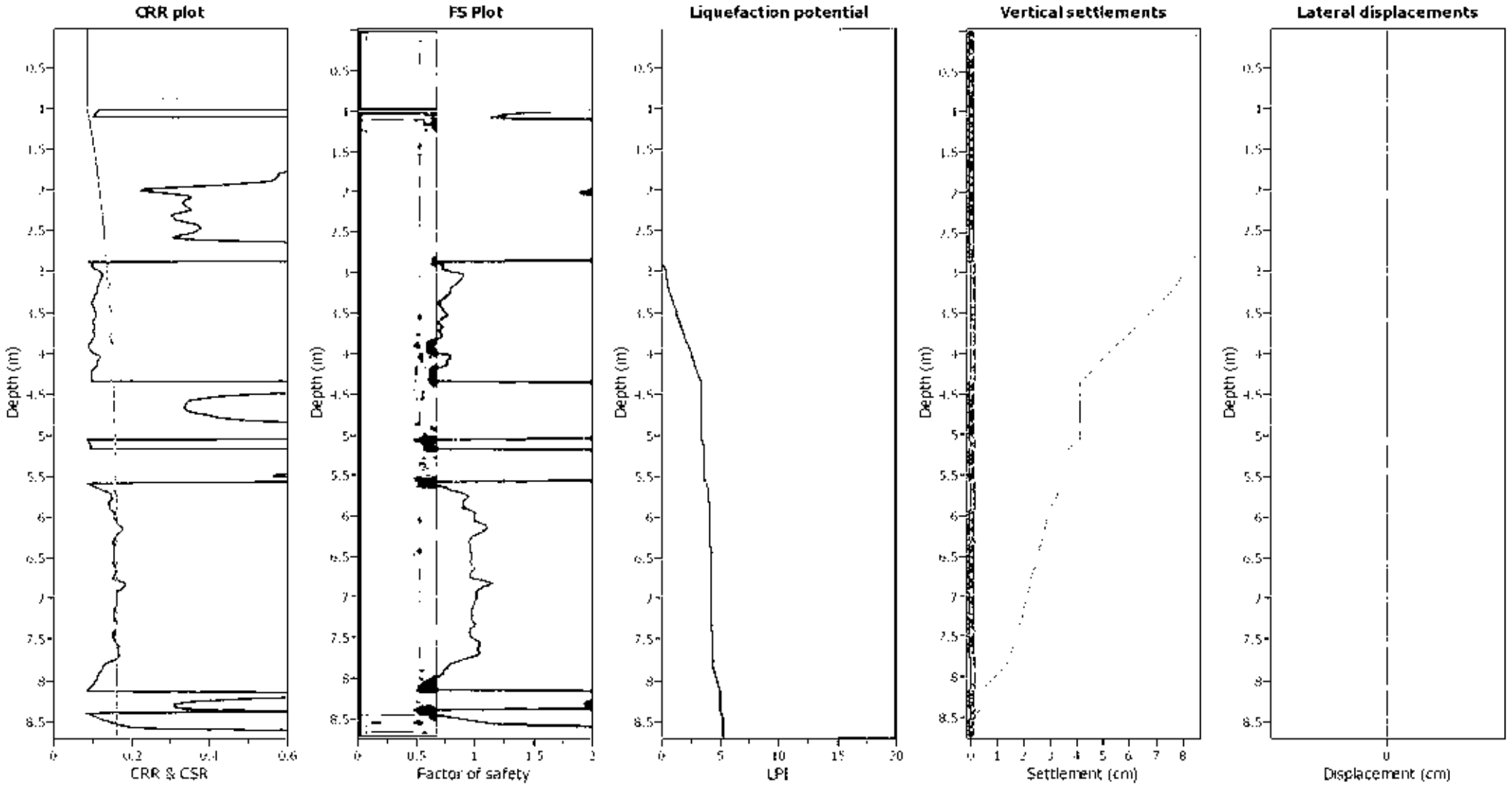
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

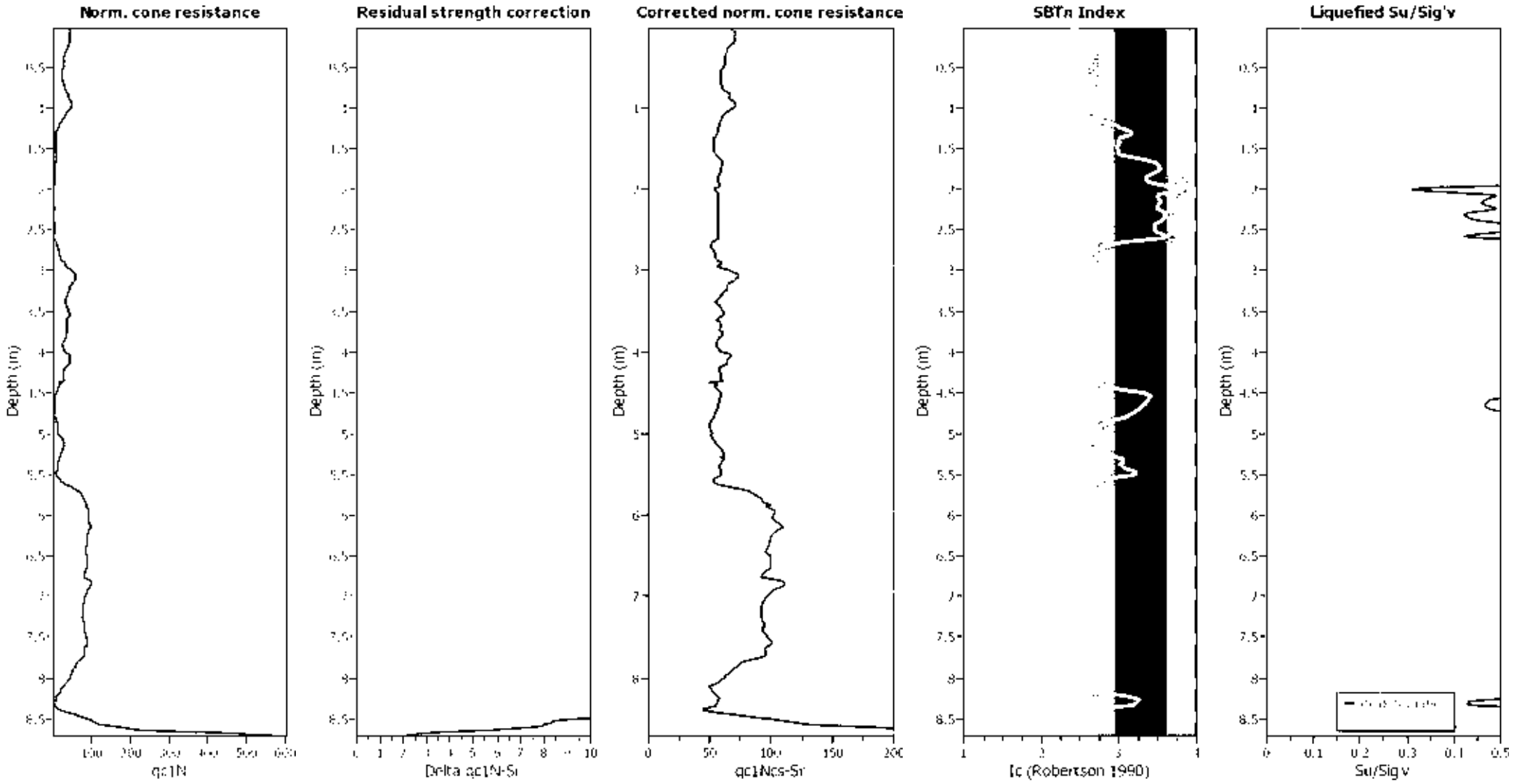
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

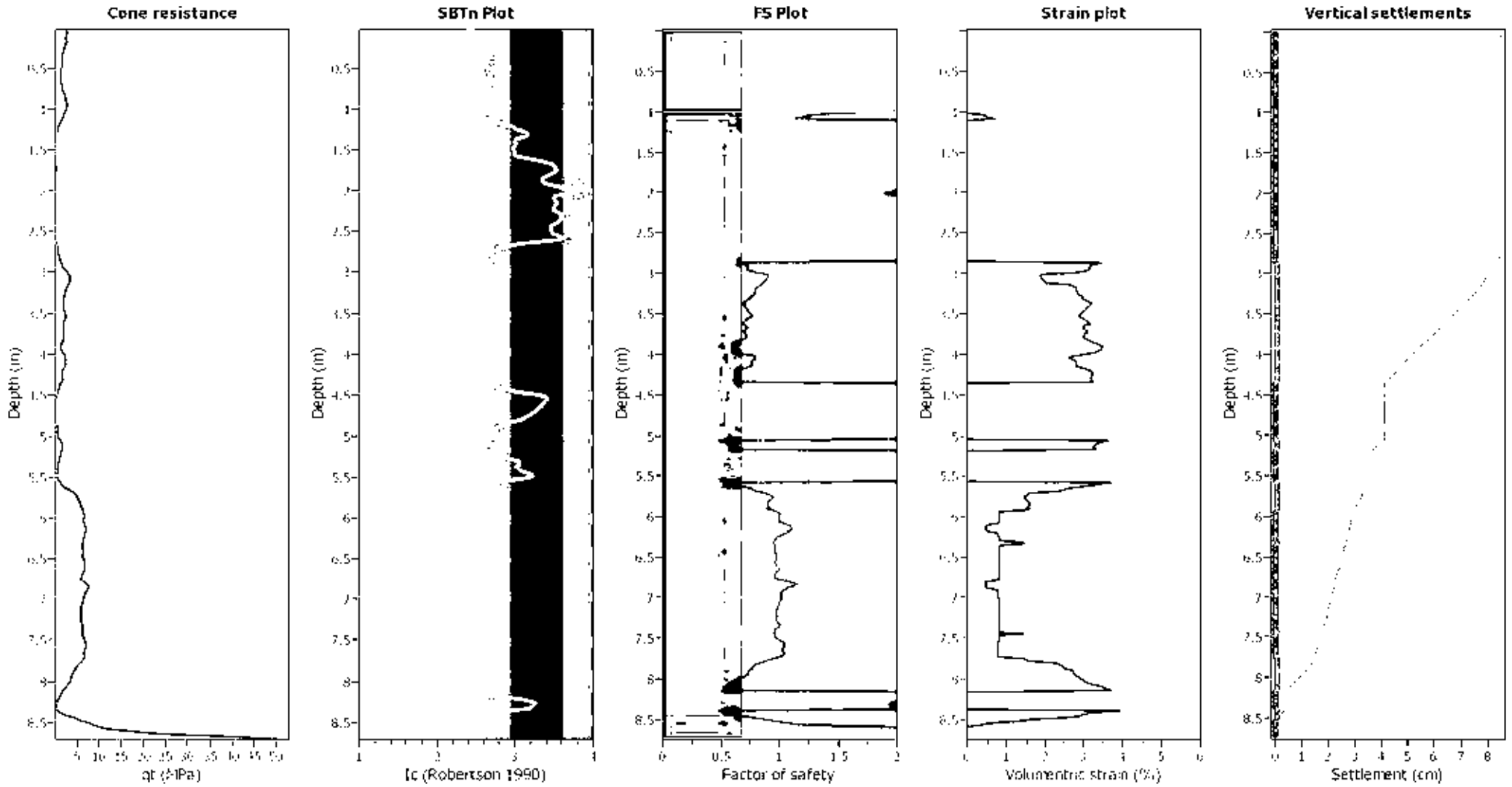
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

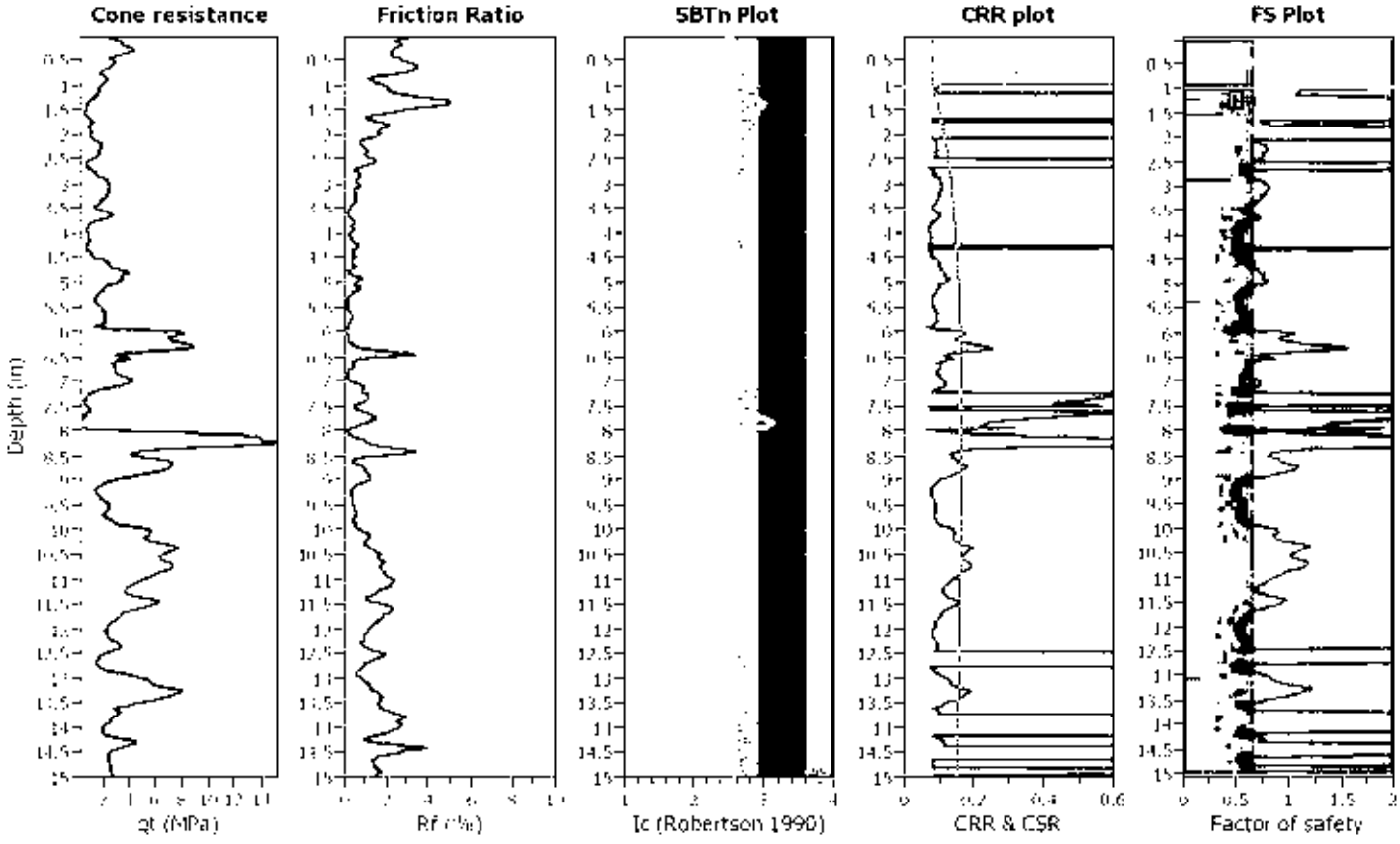
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

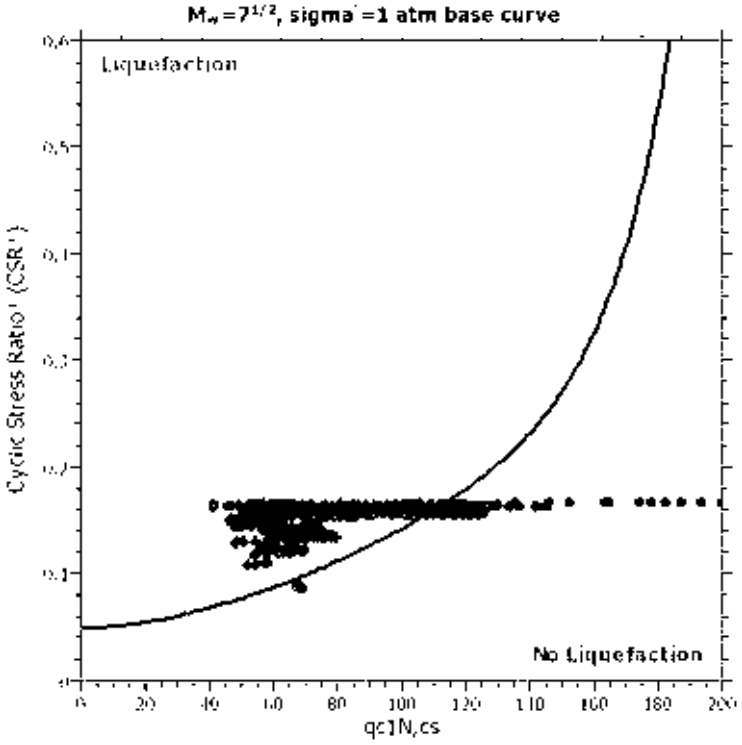
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

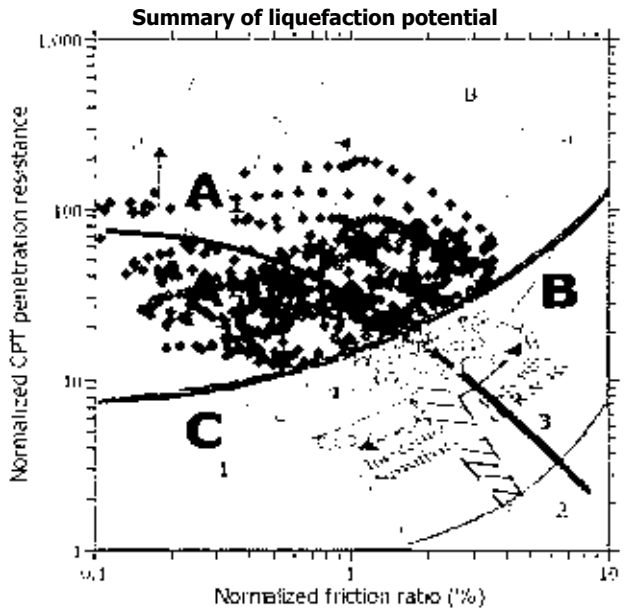
CPT file : CPT41_678CashmereRd

Input parameters and analysis data

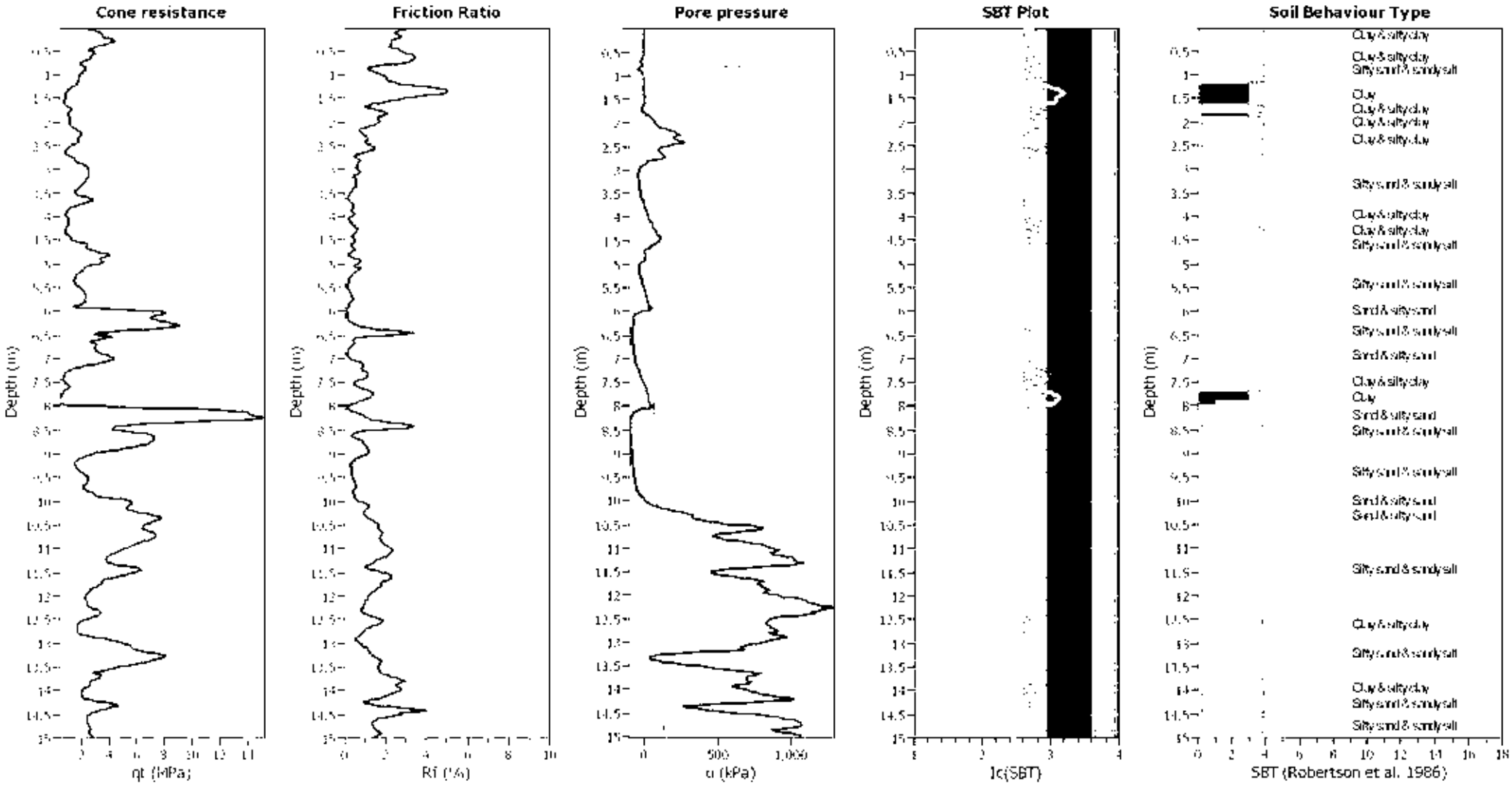
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



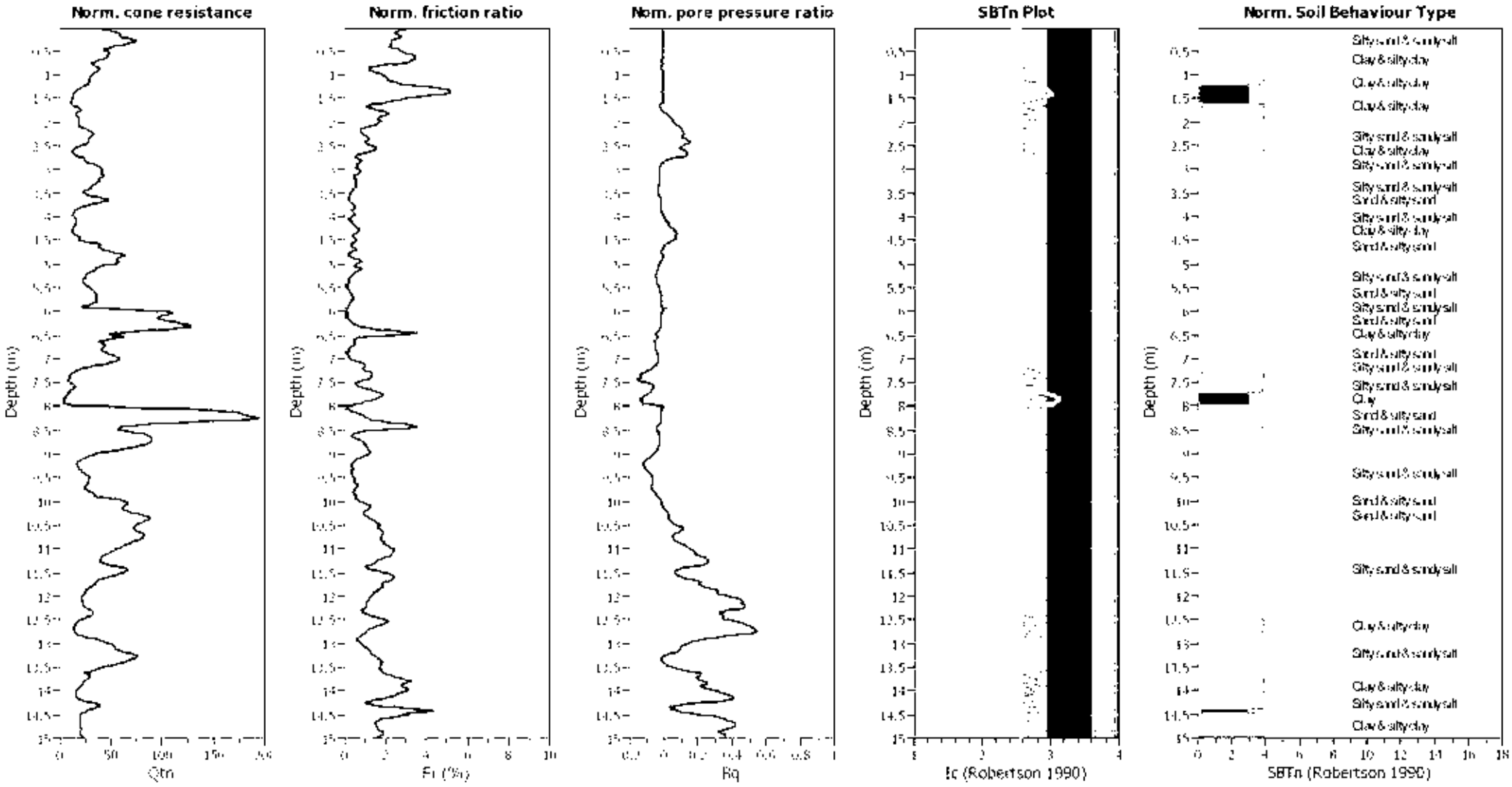
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



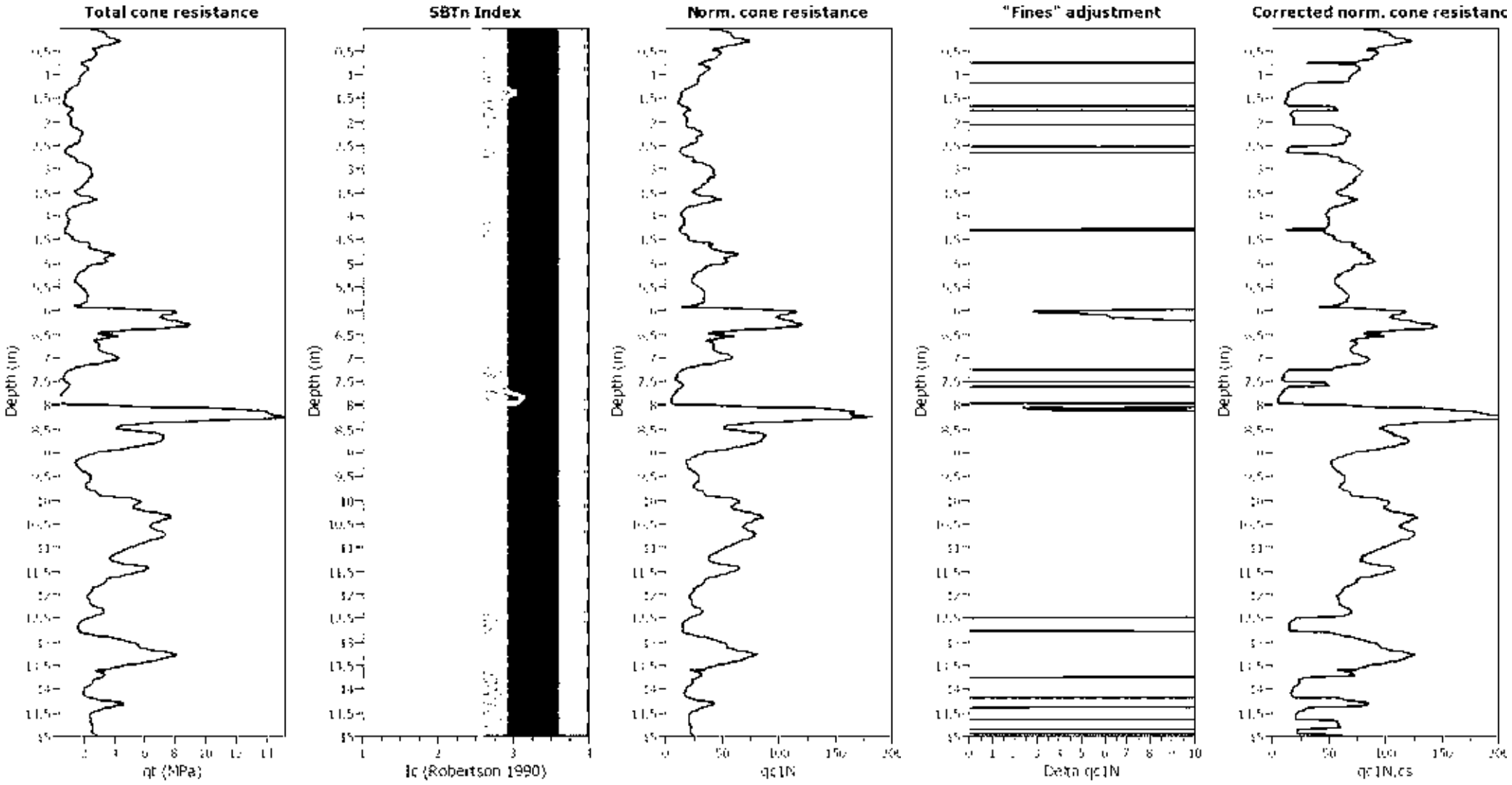
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

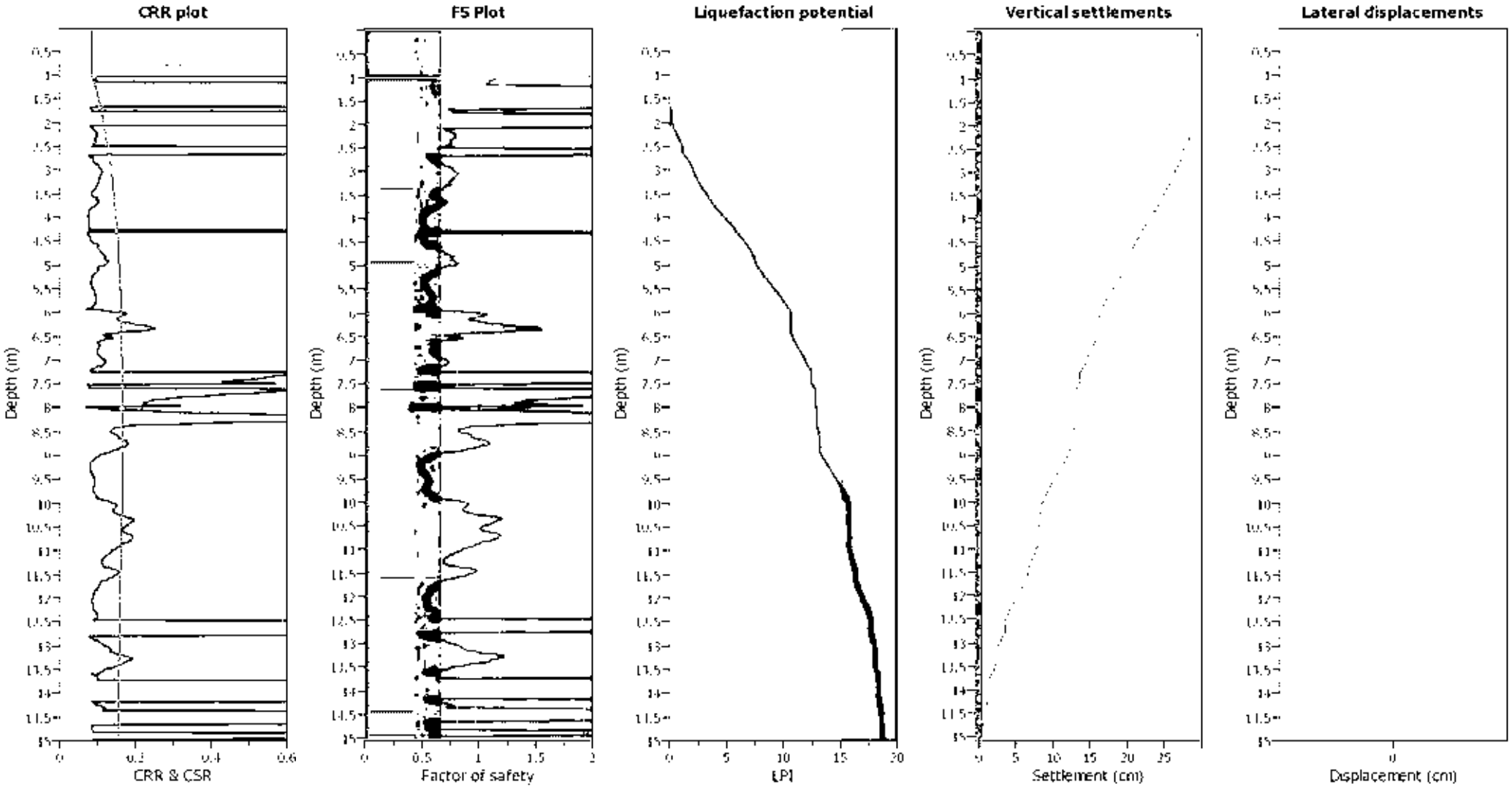
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

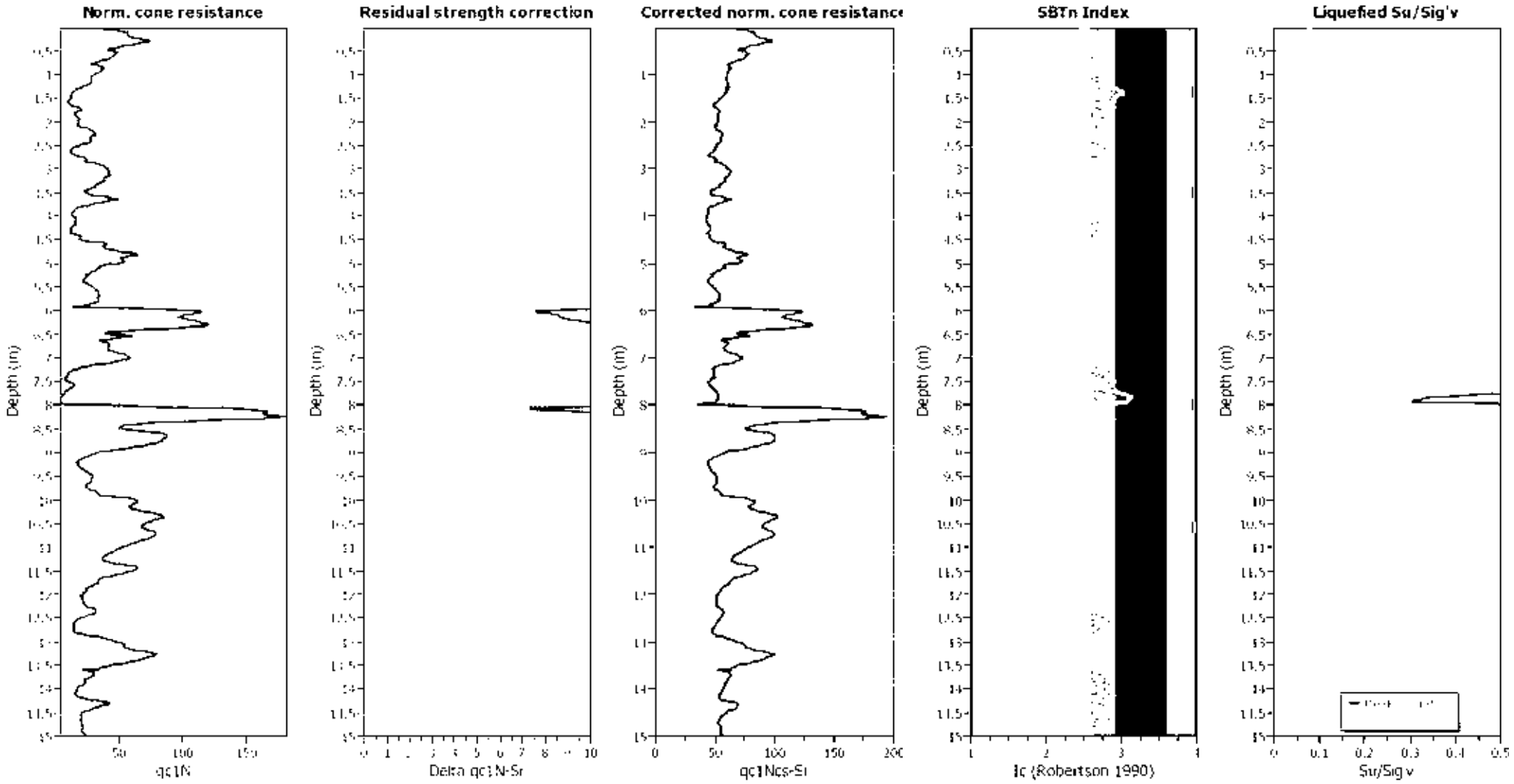
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

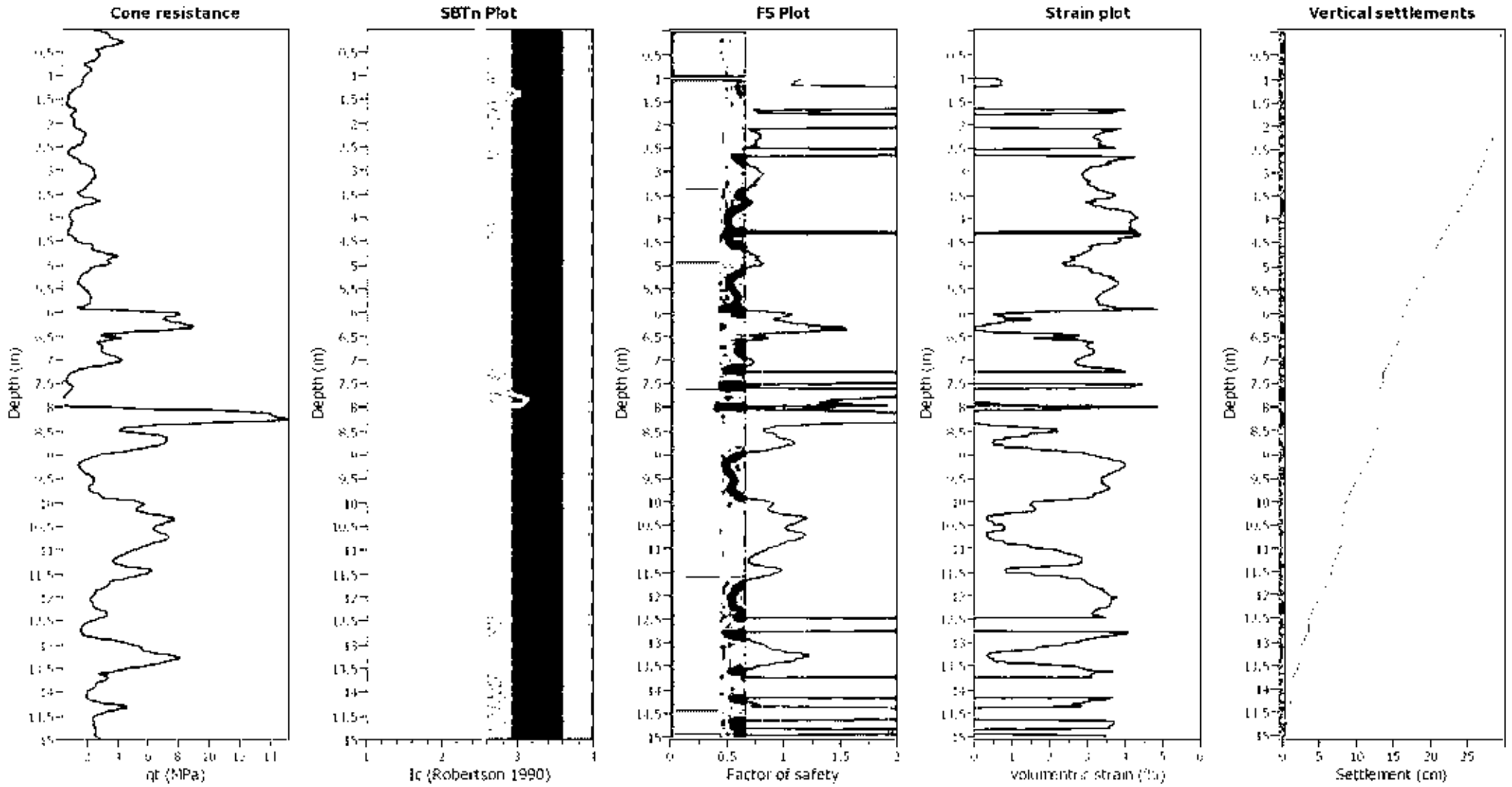
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

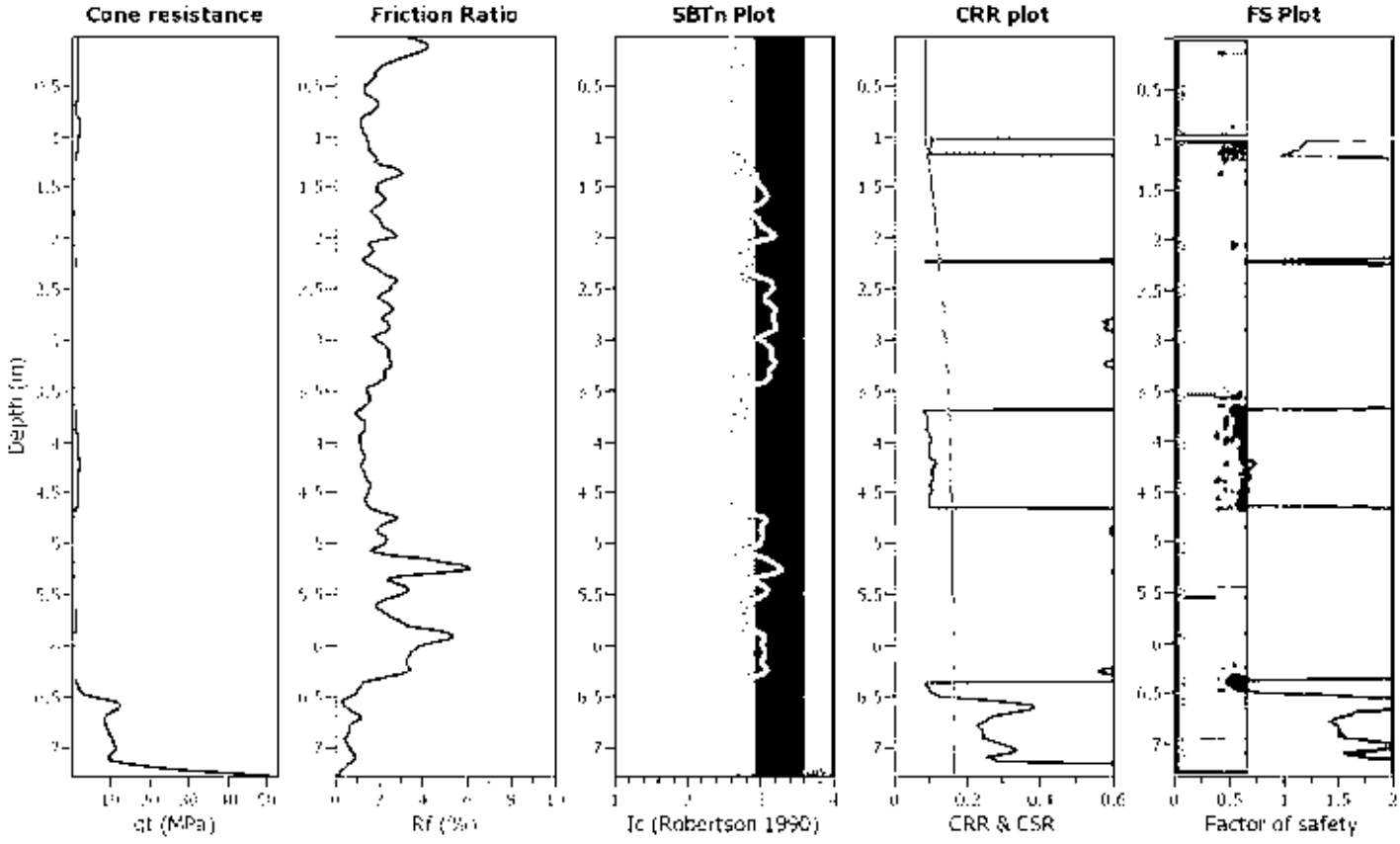
[illegible]	Total cone resistance (cone resistance q corrected for pore water effects)
[illegible]	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

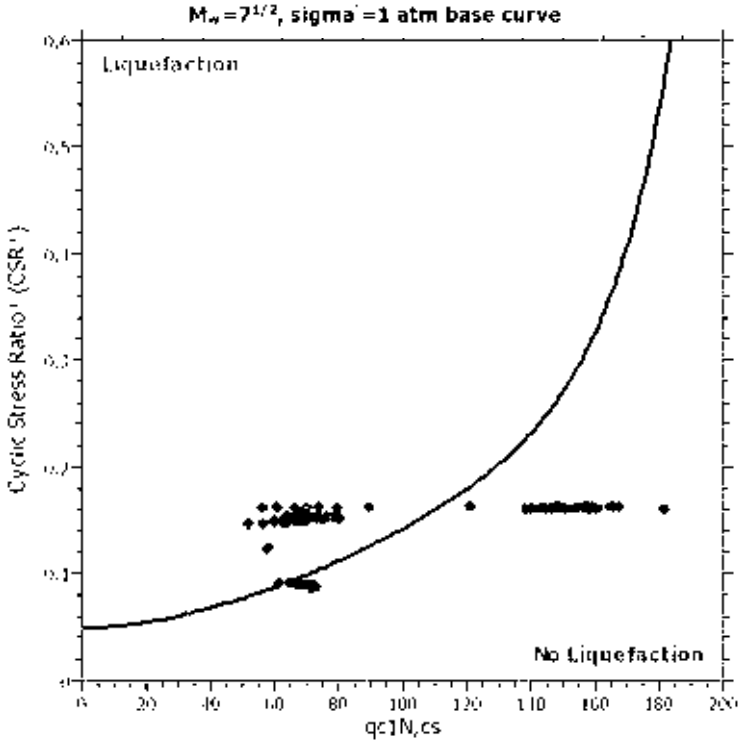
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

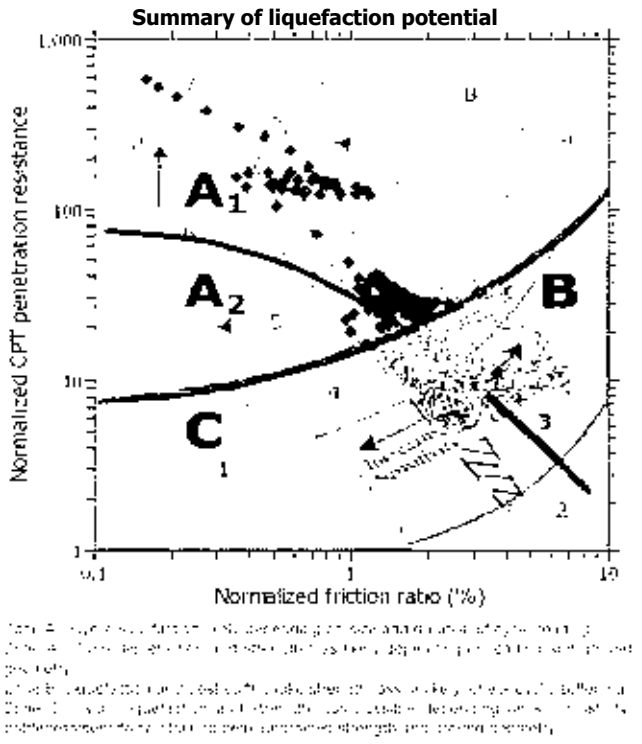
CPT file : CPT42_564CashmereRd

Input parameters and analysis data

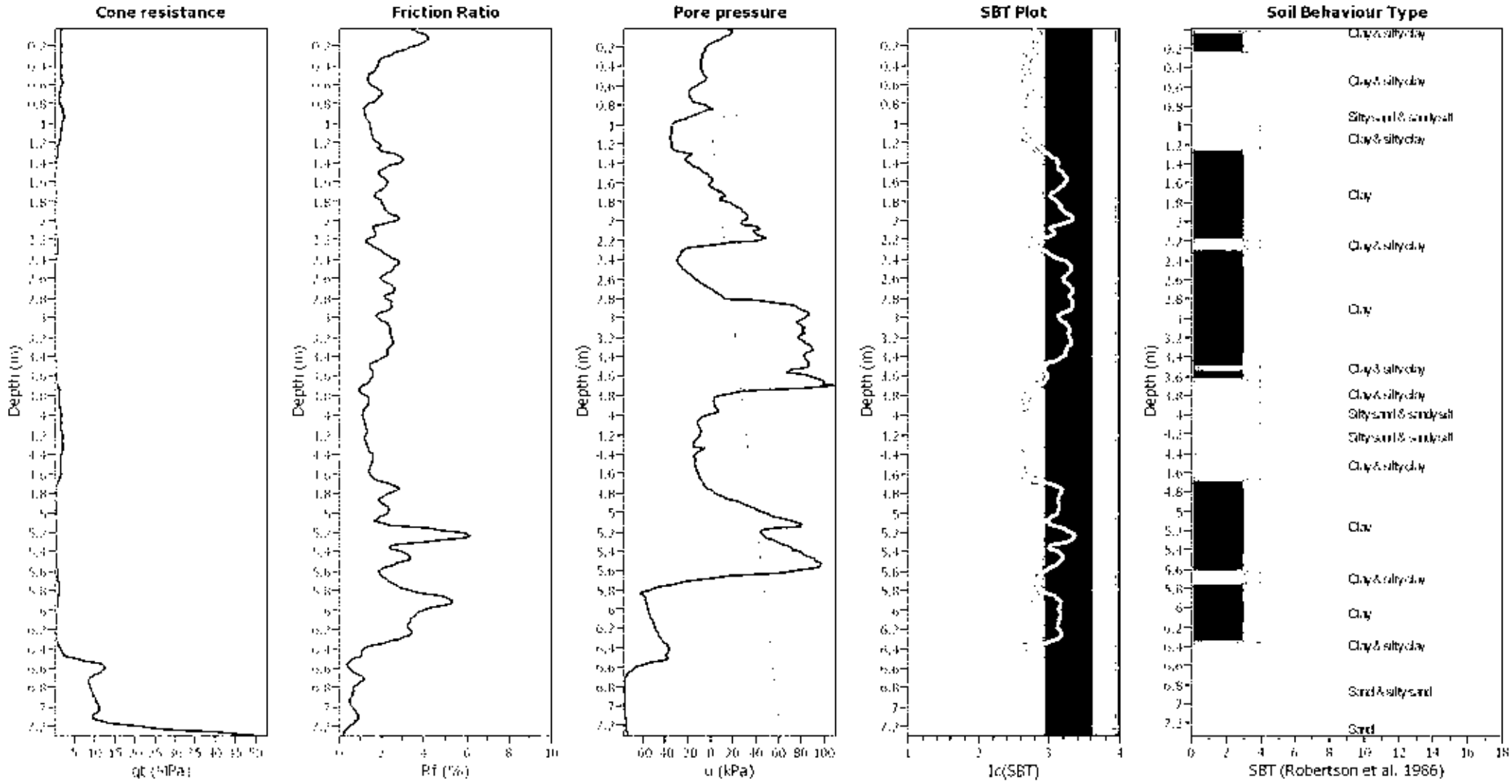
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



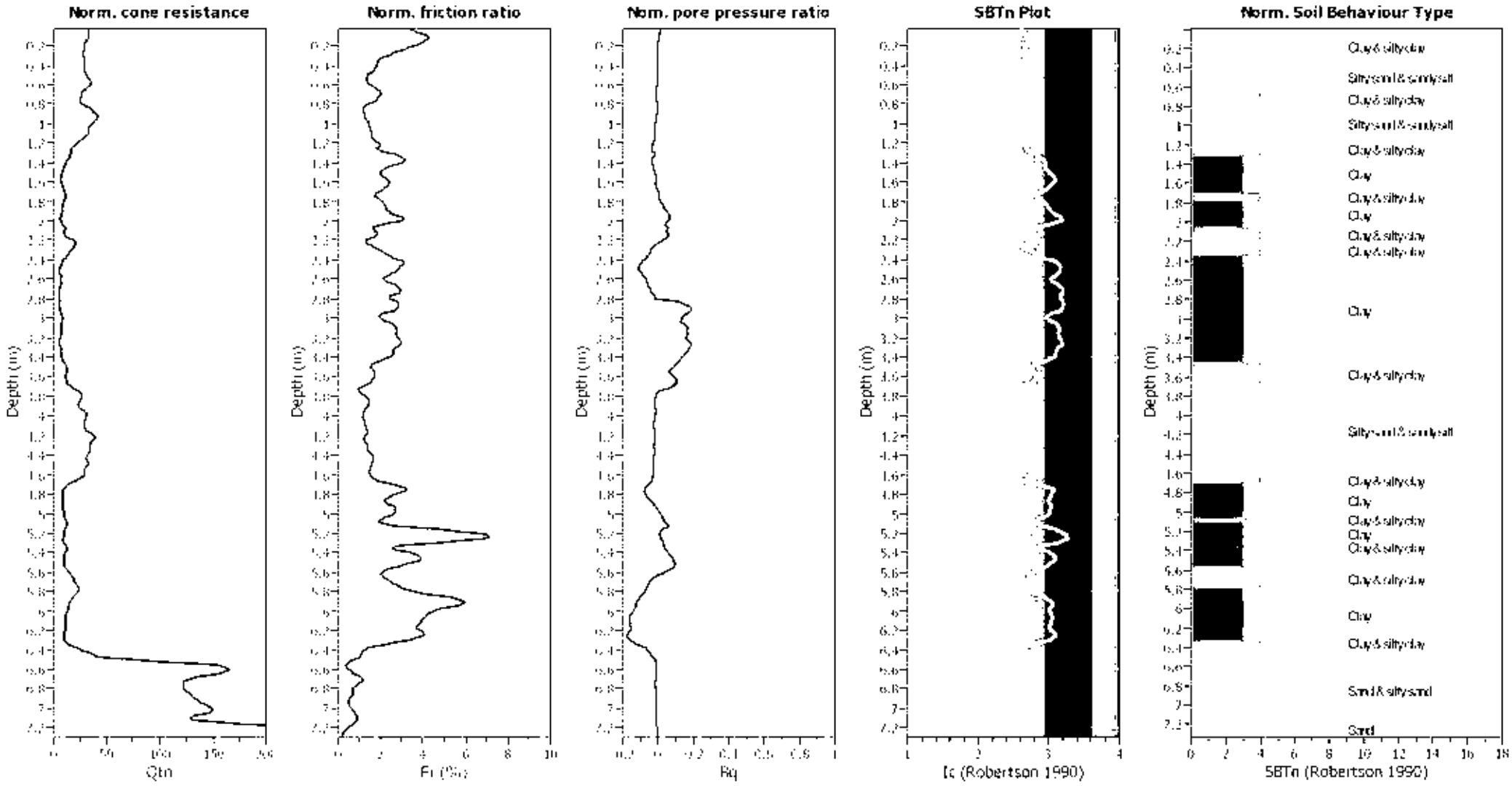
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



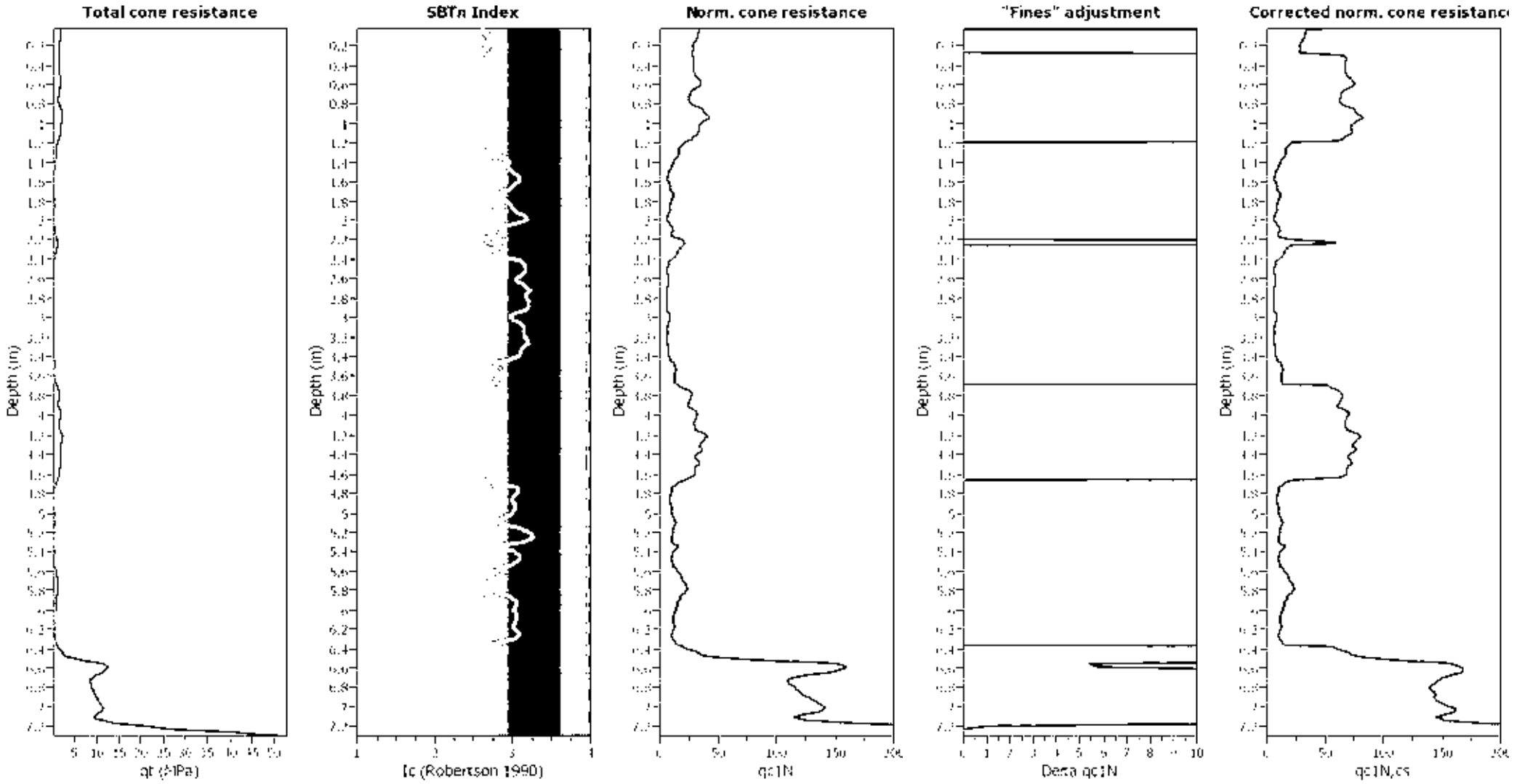
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

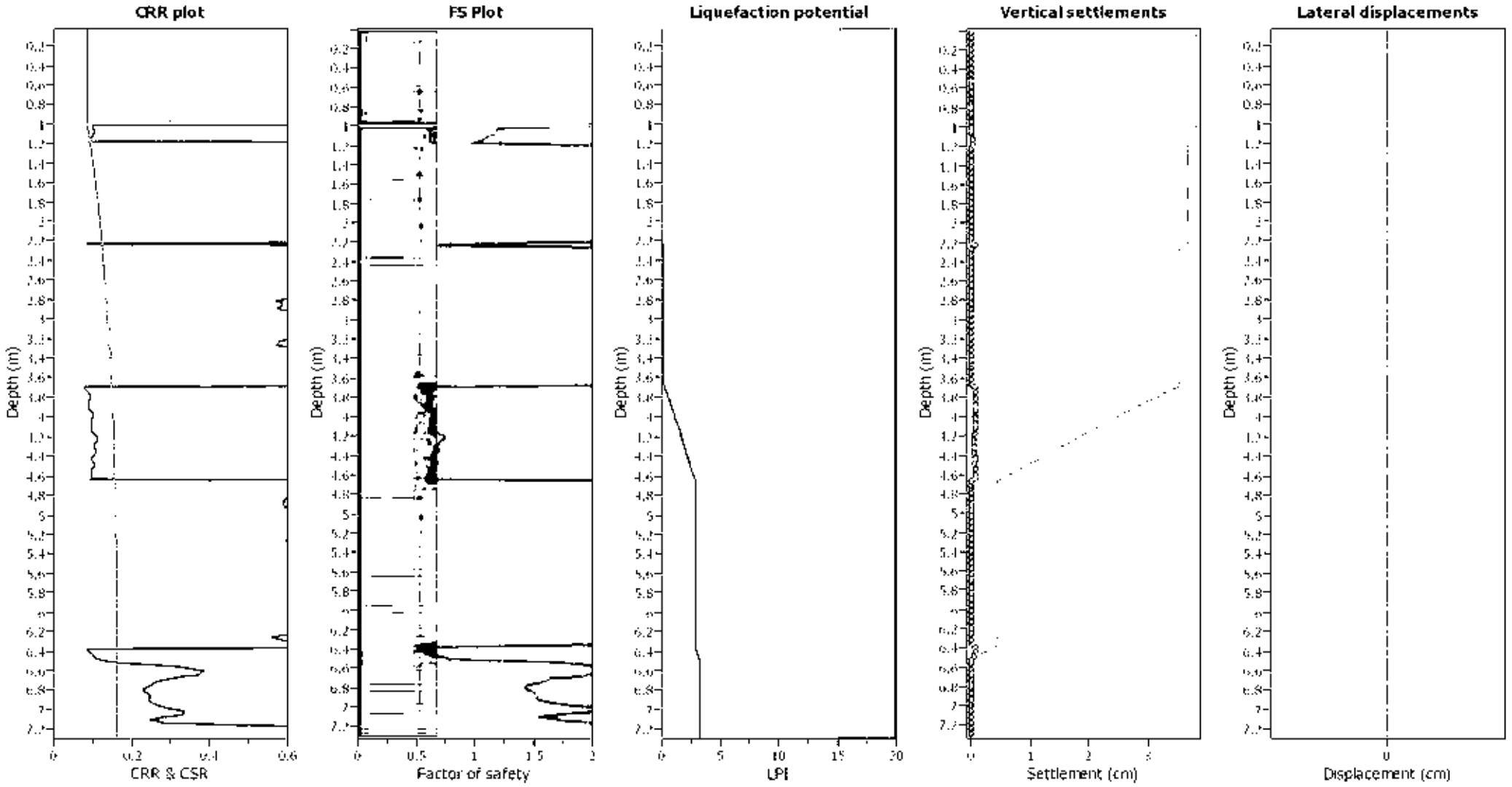
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

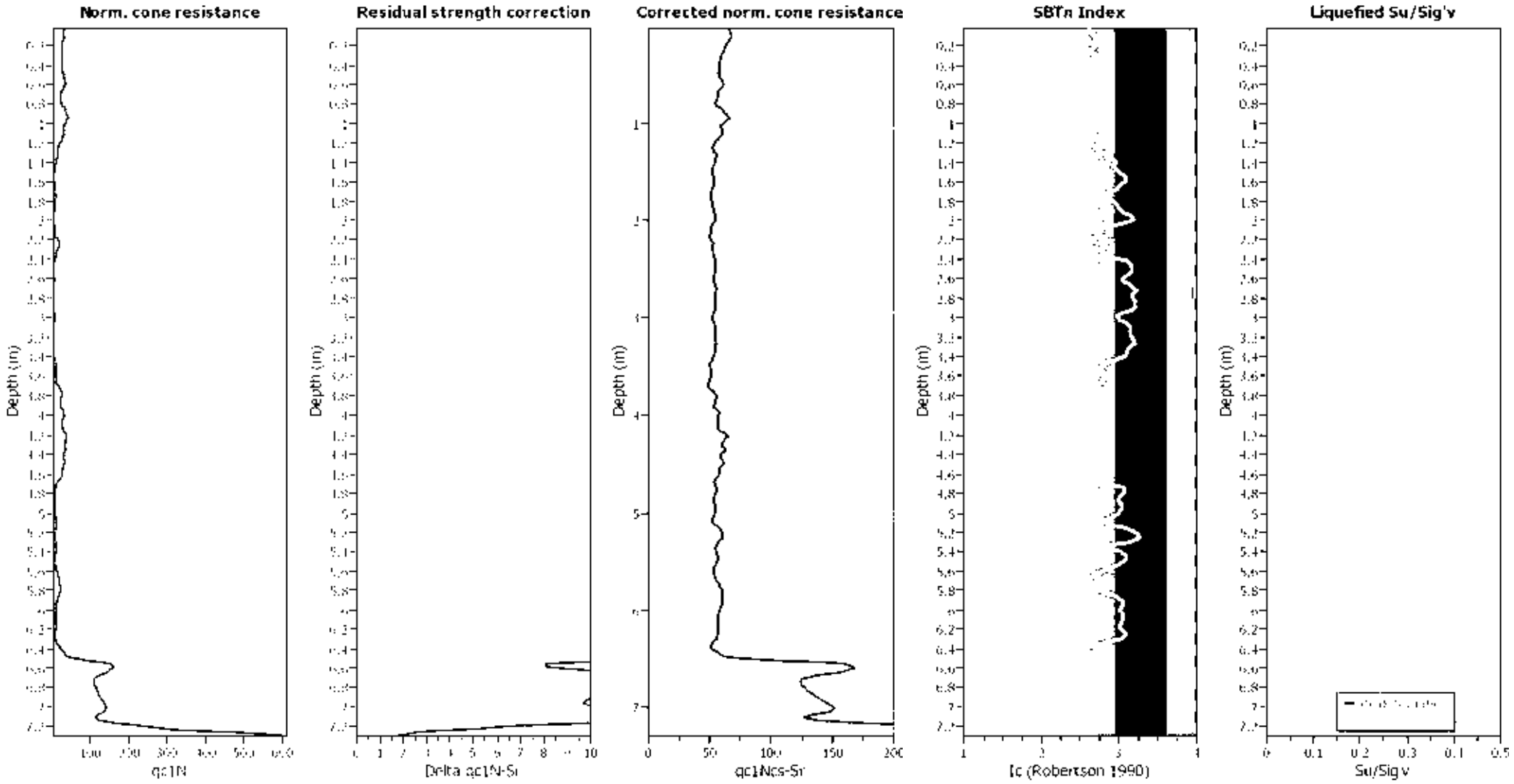
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

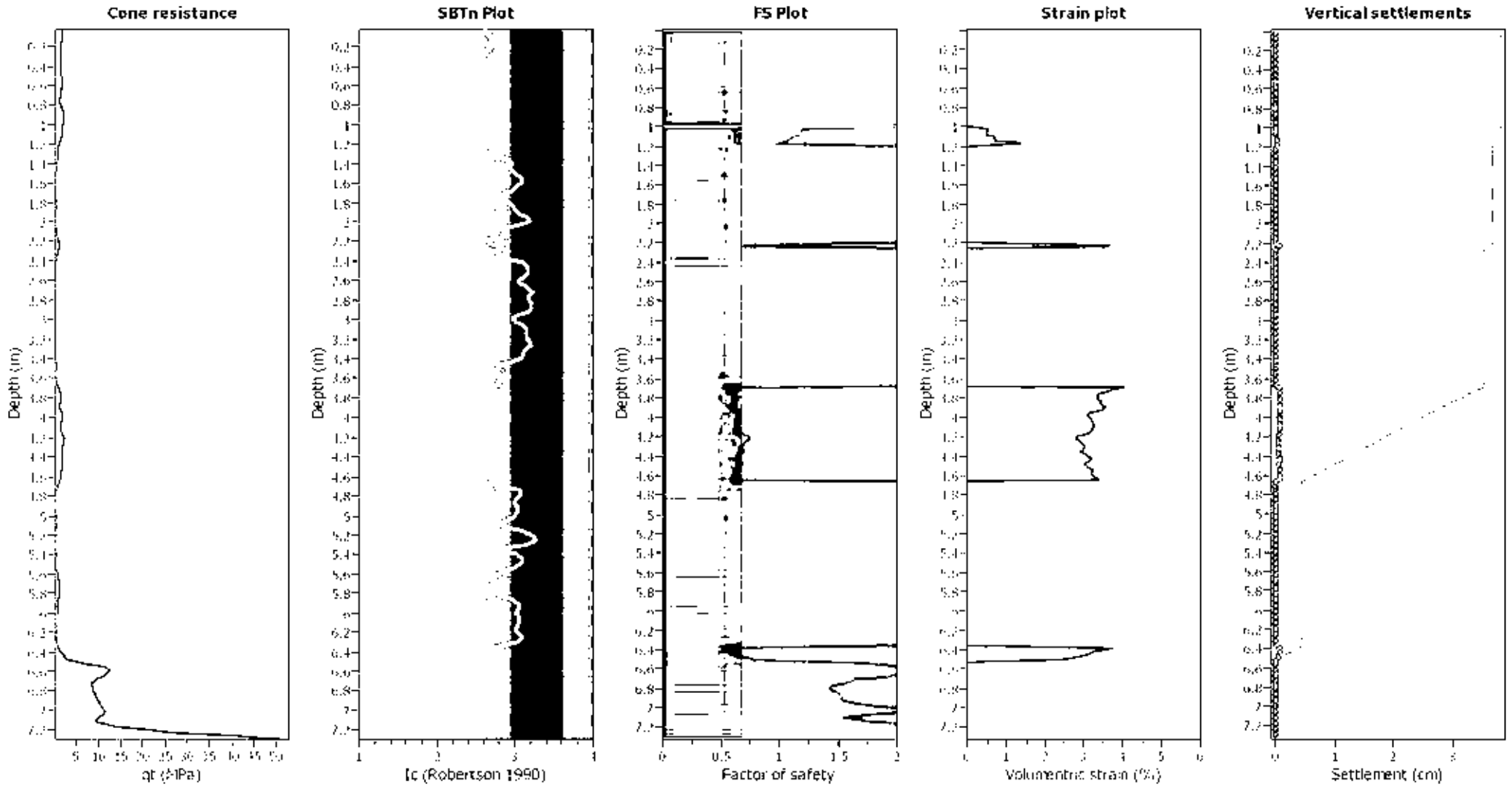
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

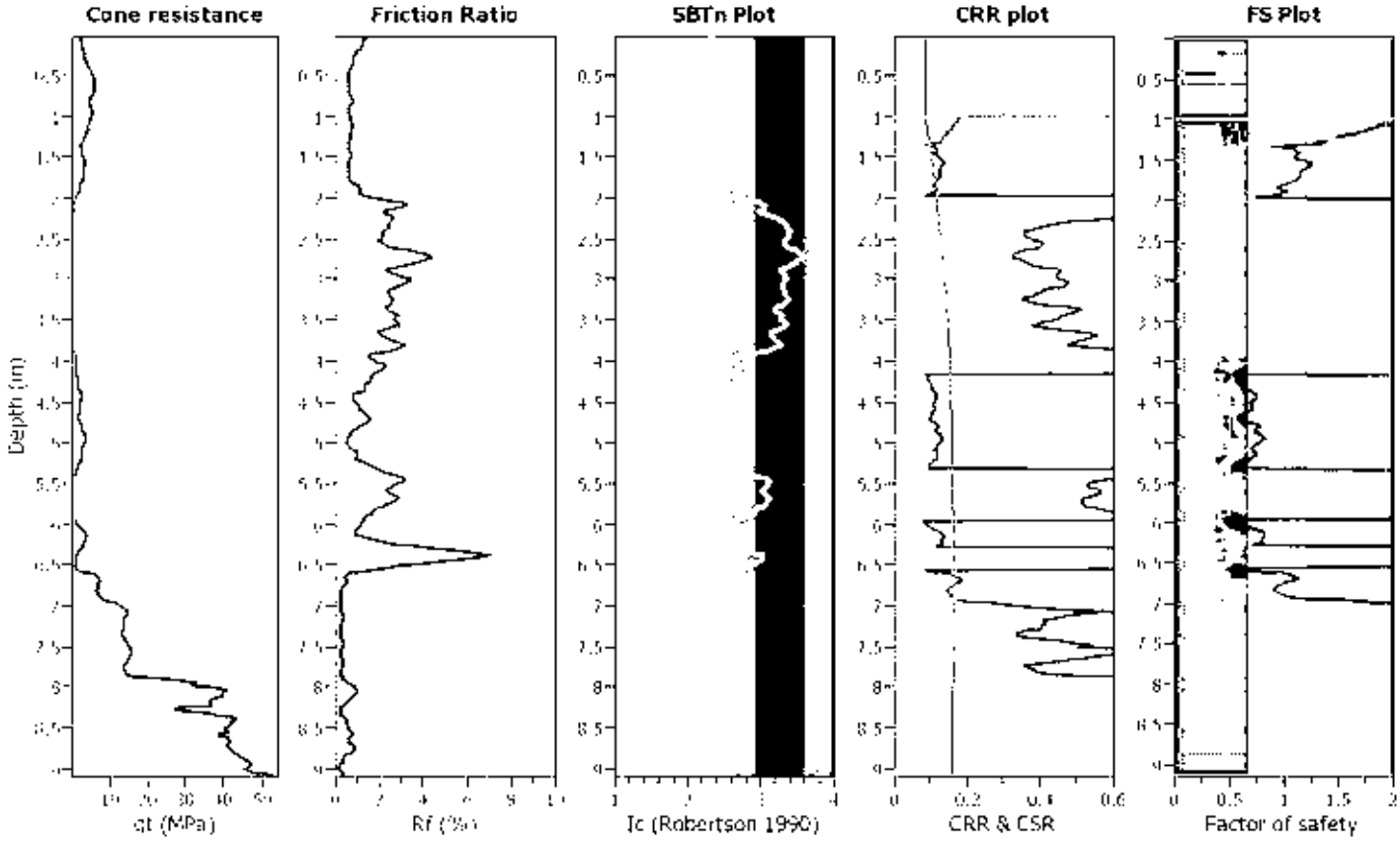
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

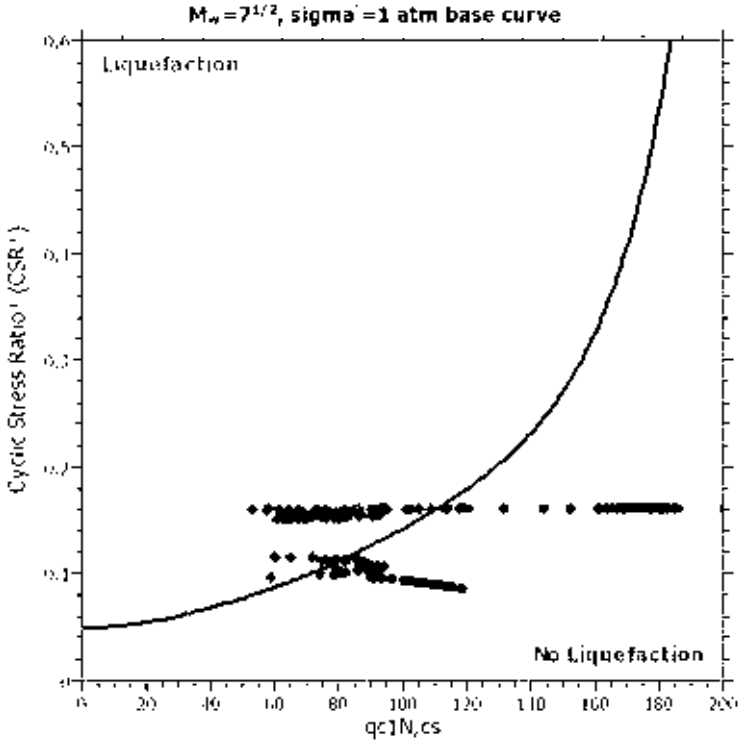
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

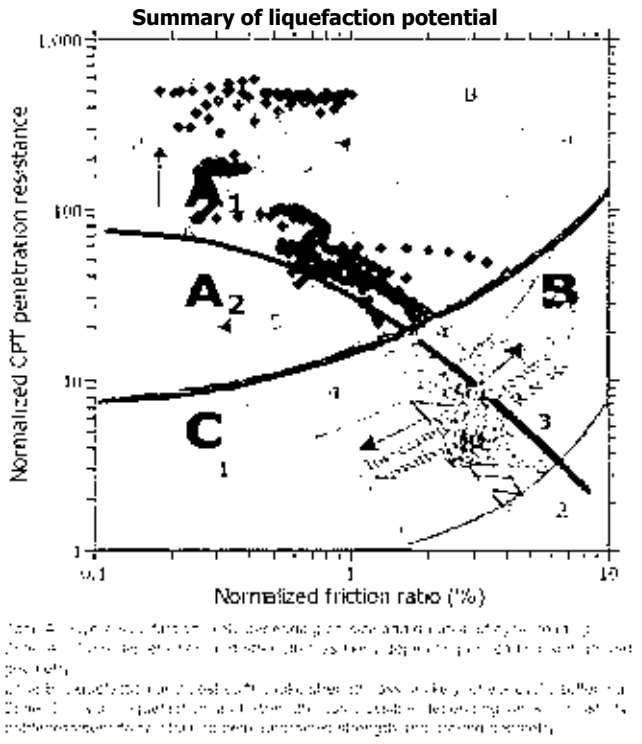
CPT file : CPT43_484CashmereRd

Input parameters and analysis data

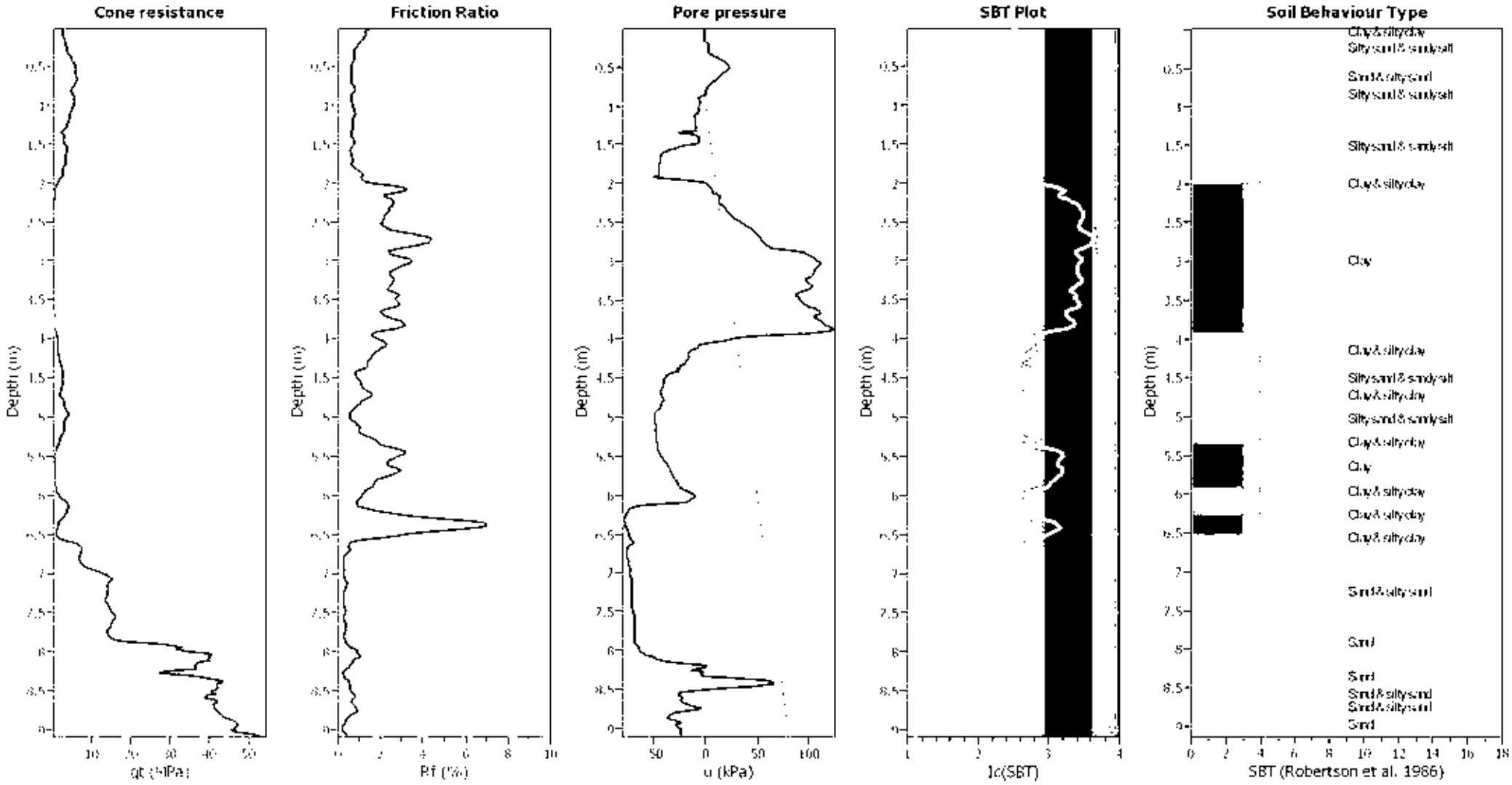
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



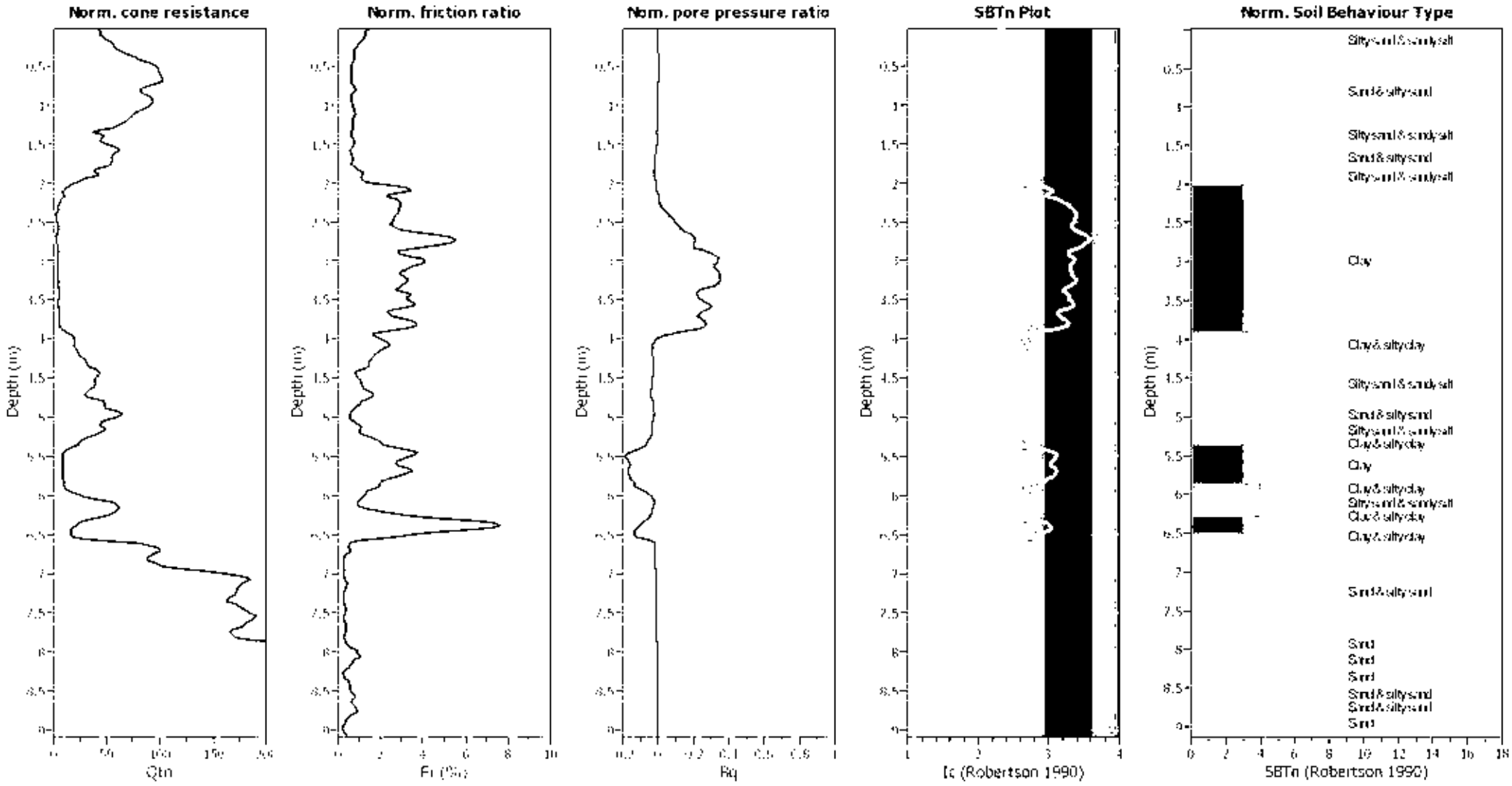
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



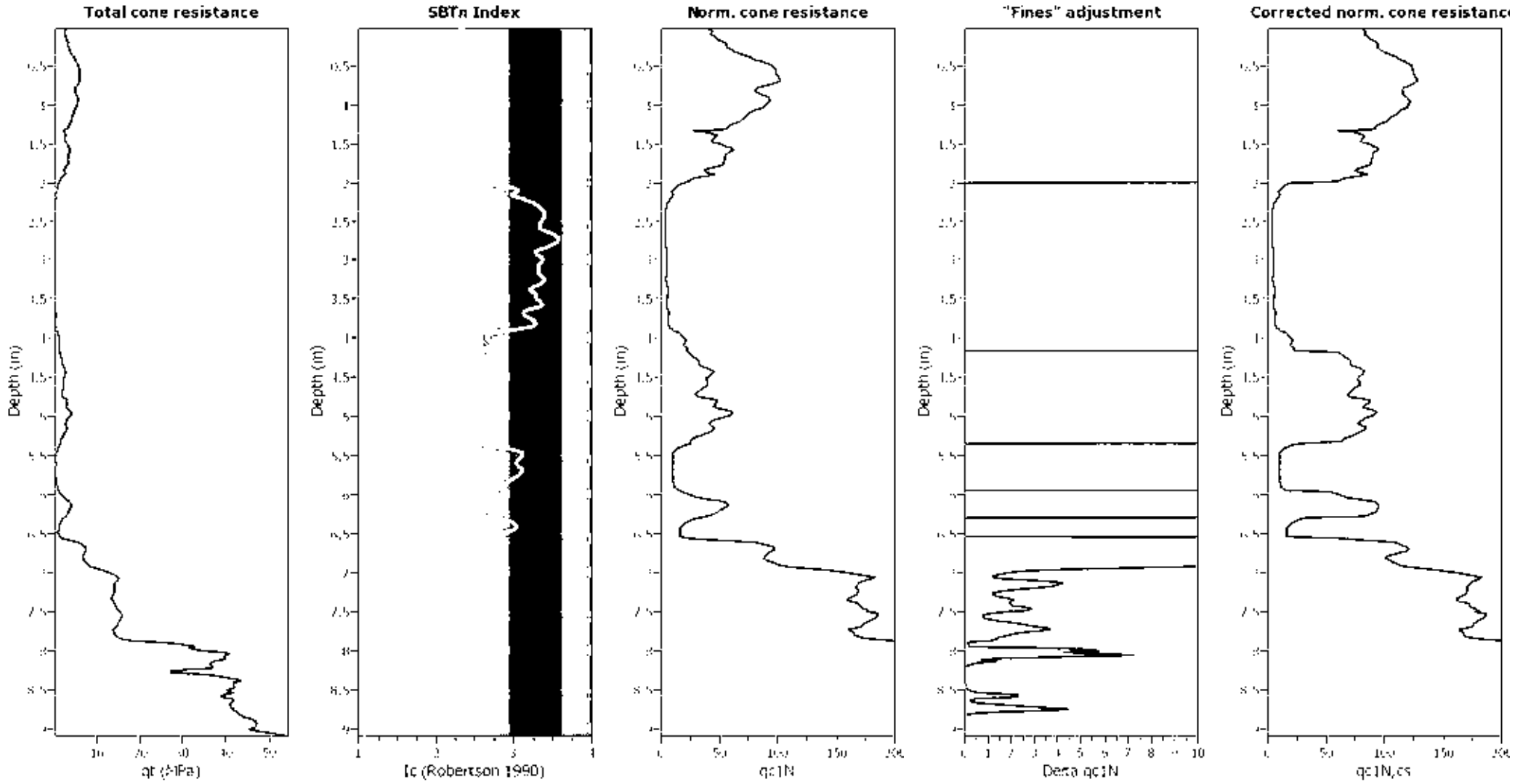
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

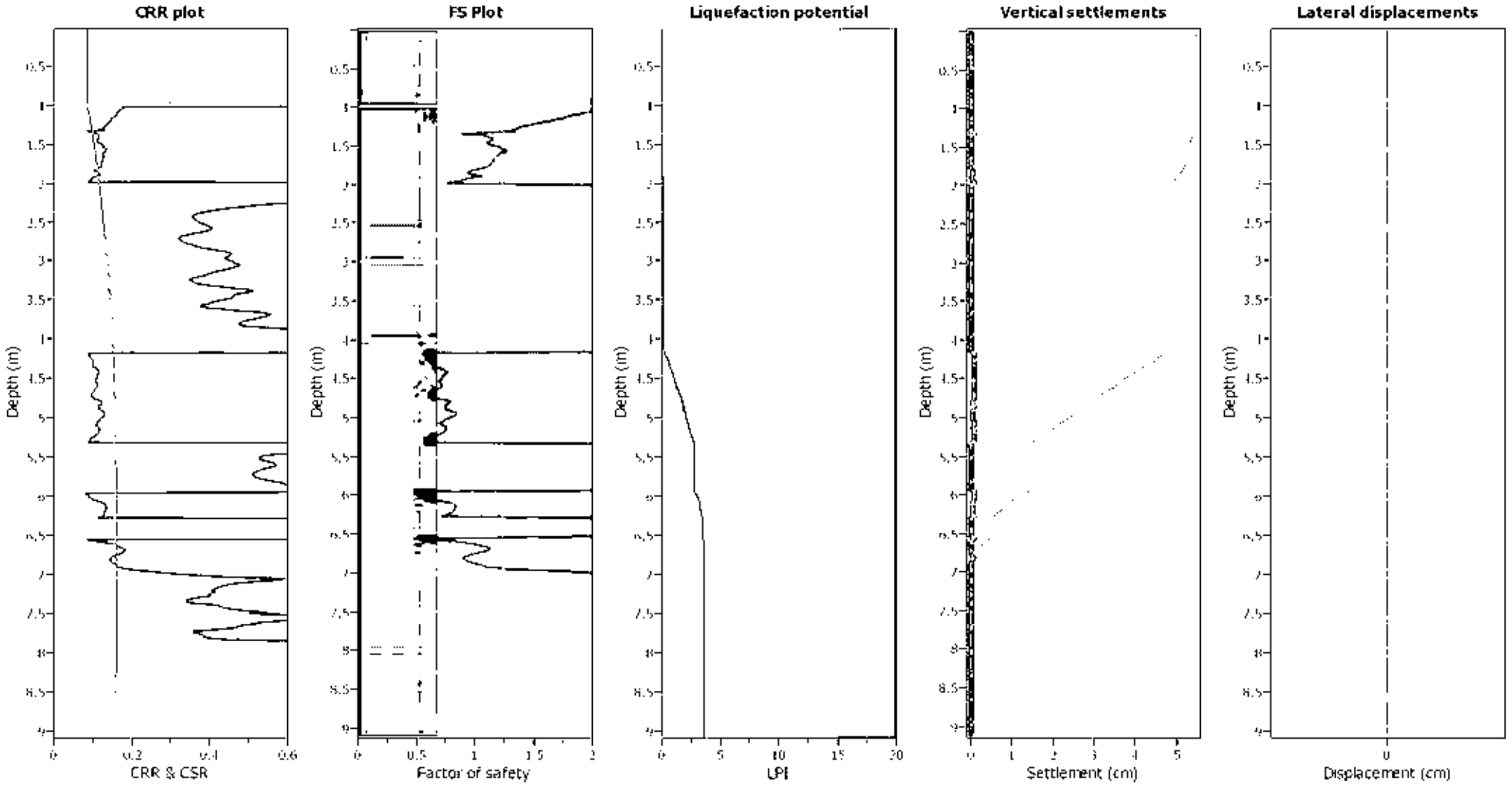
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

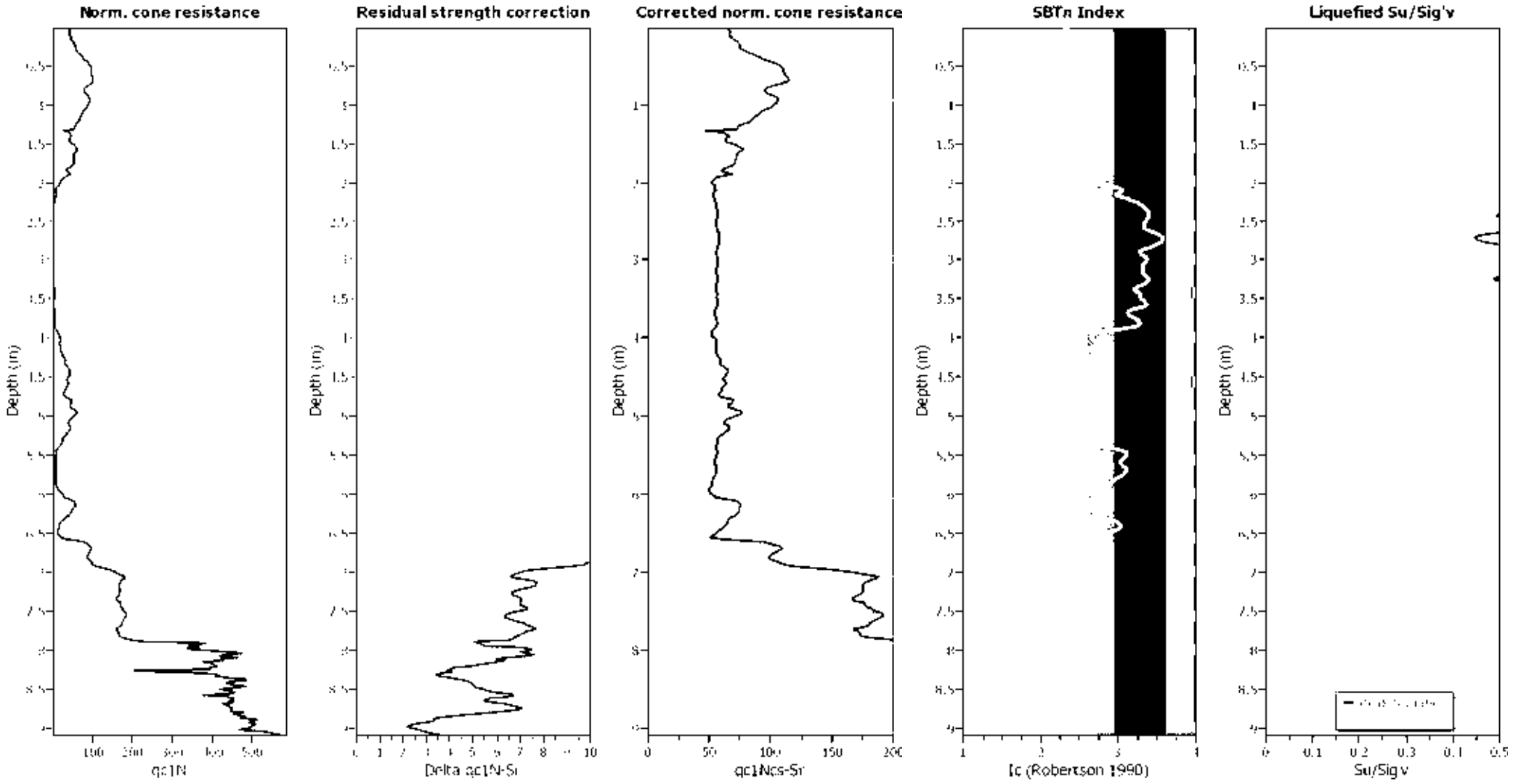
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

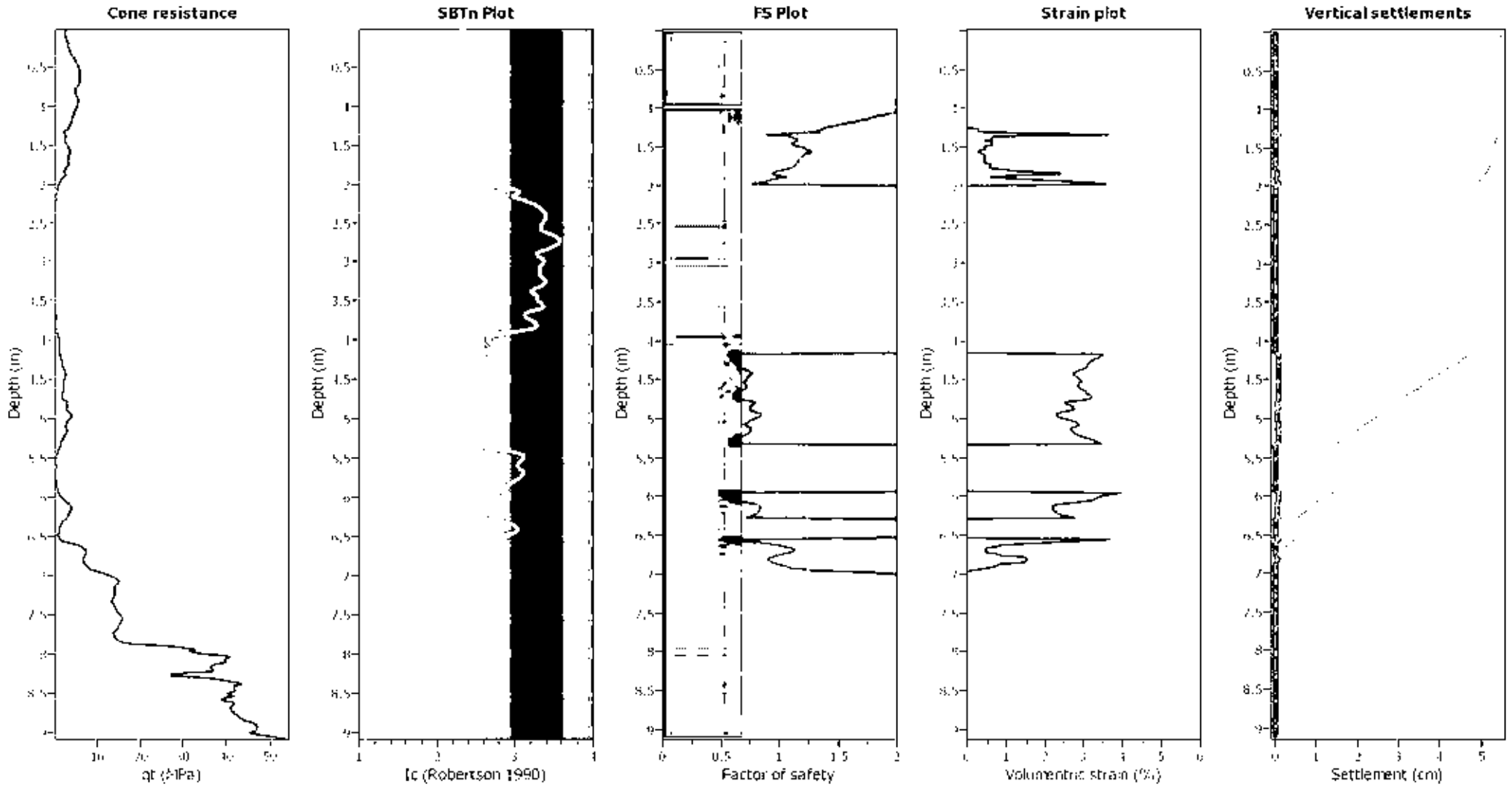
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

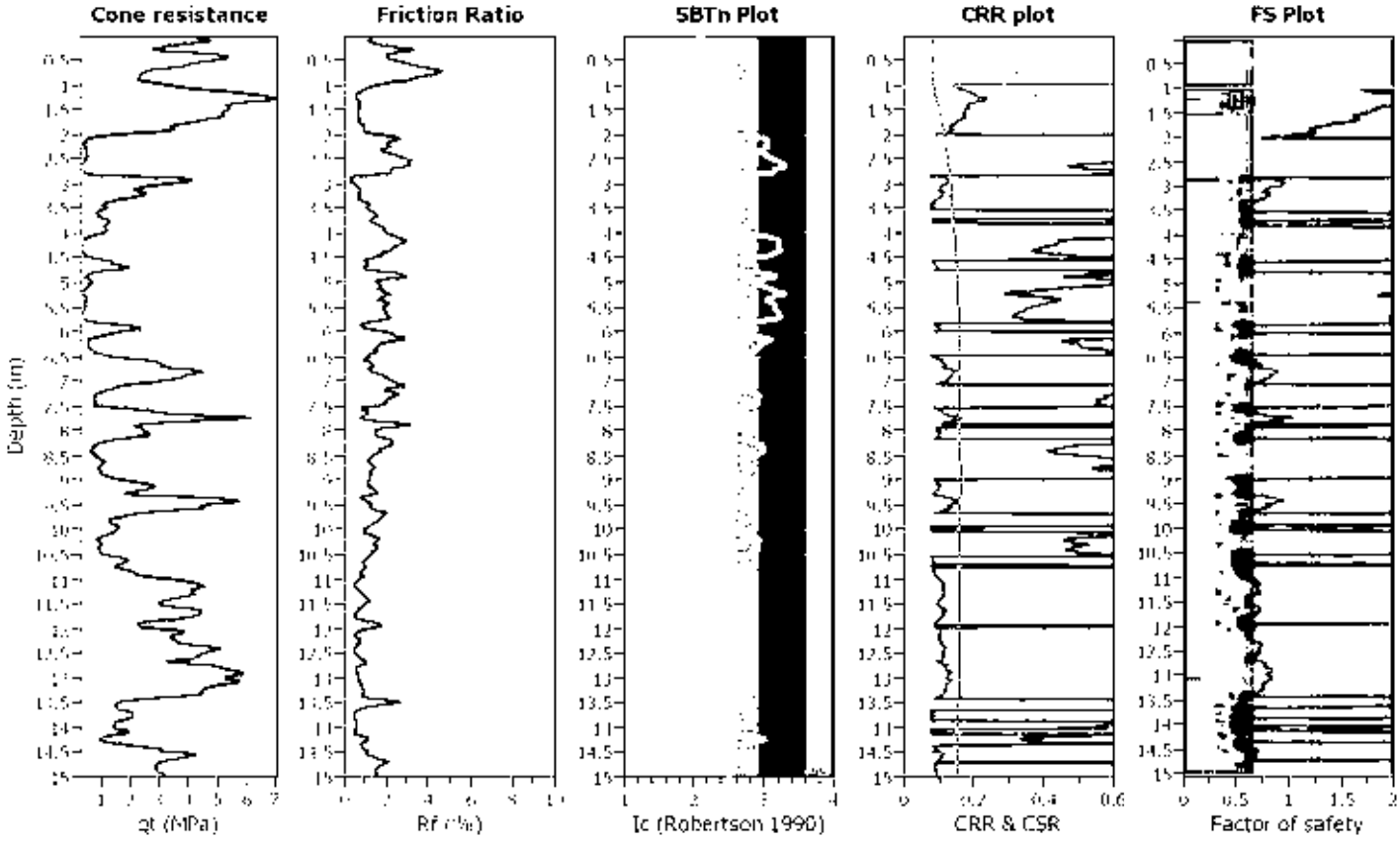
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

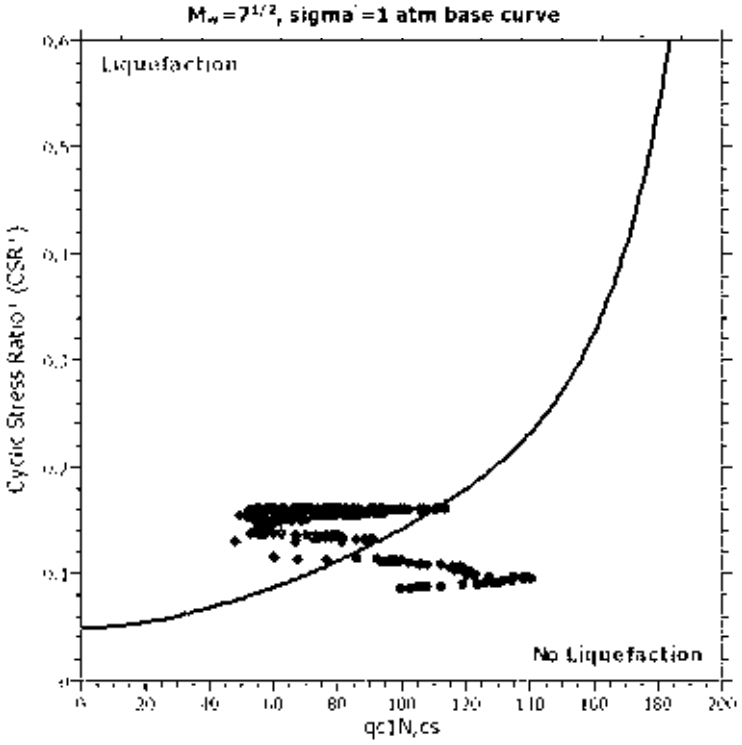
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

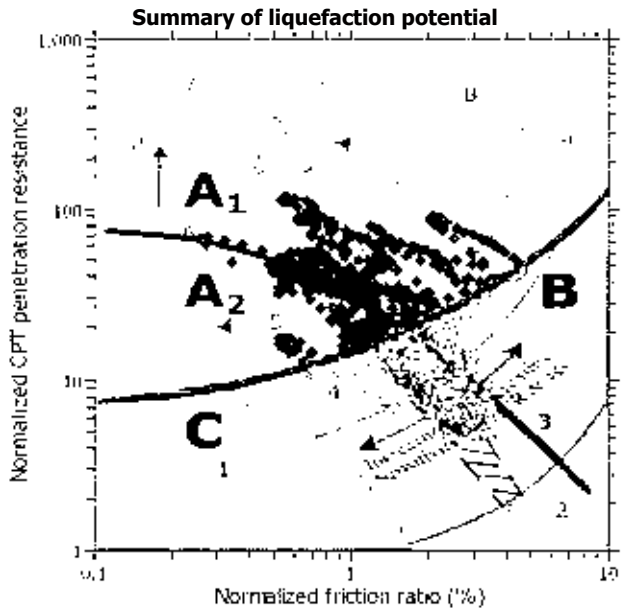
CPT file : CPT44_564CashmereRd

Input parameters and analysis data

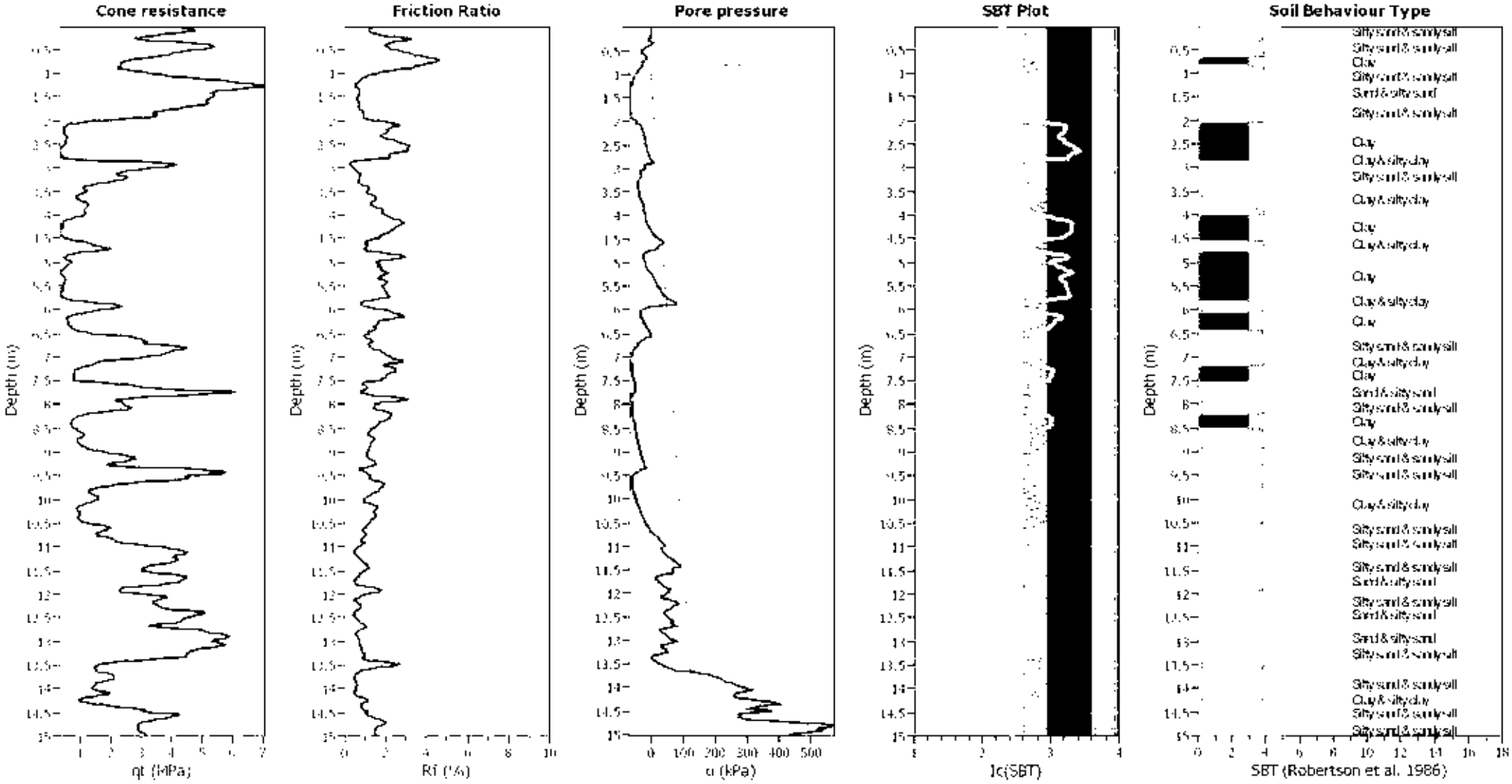
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



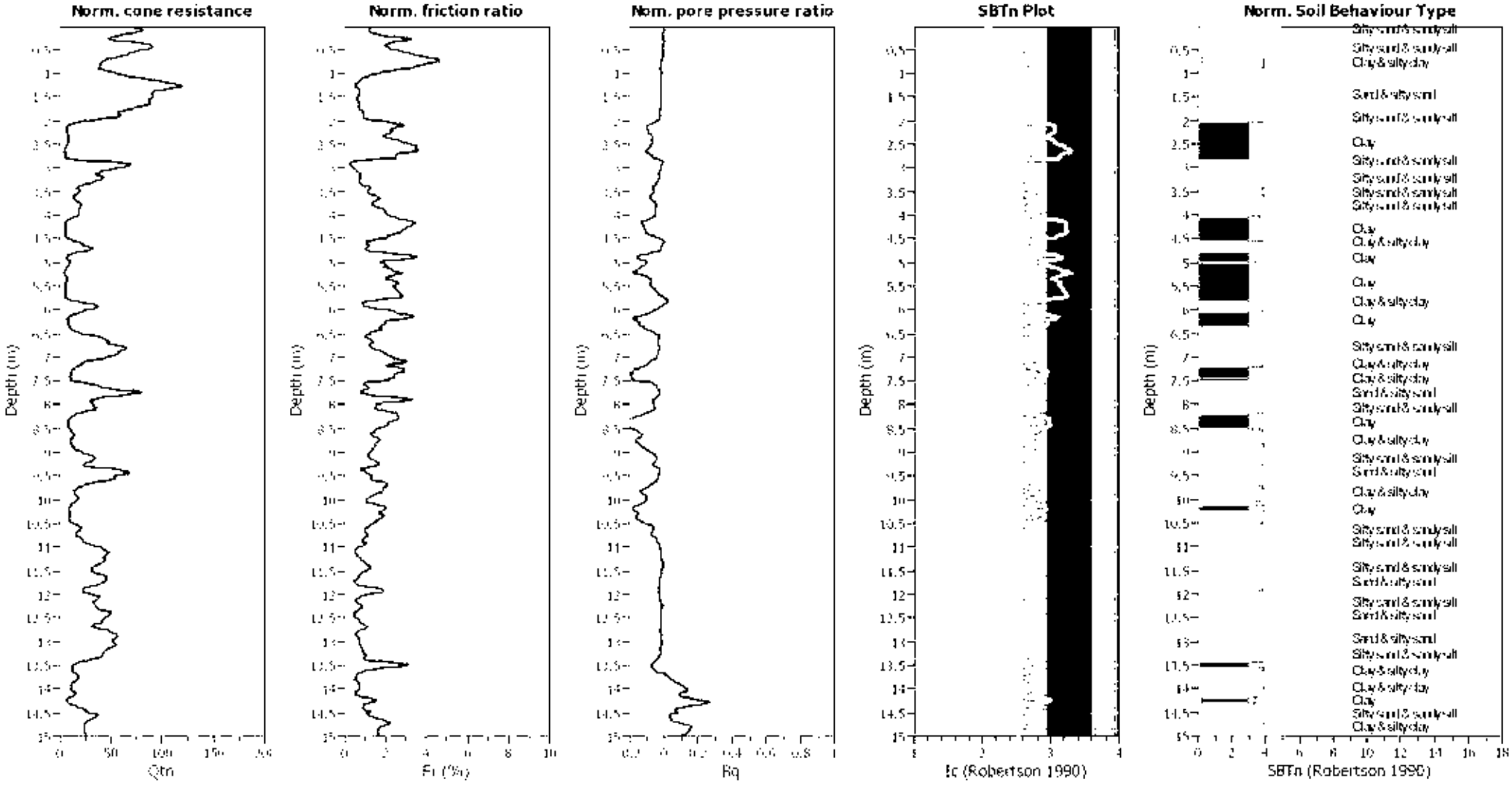
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



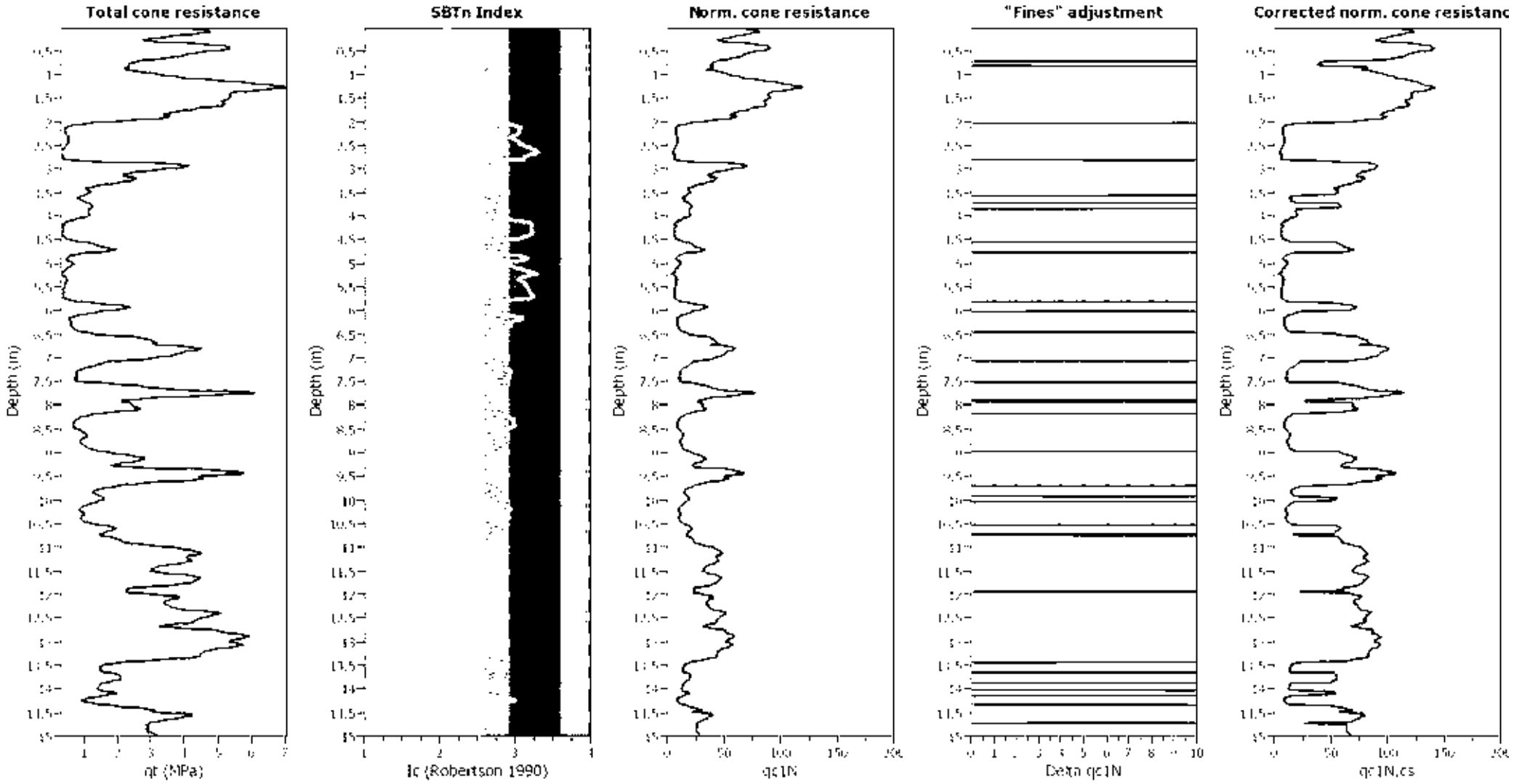
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

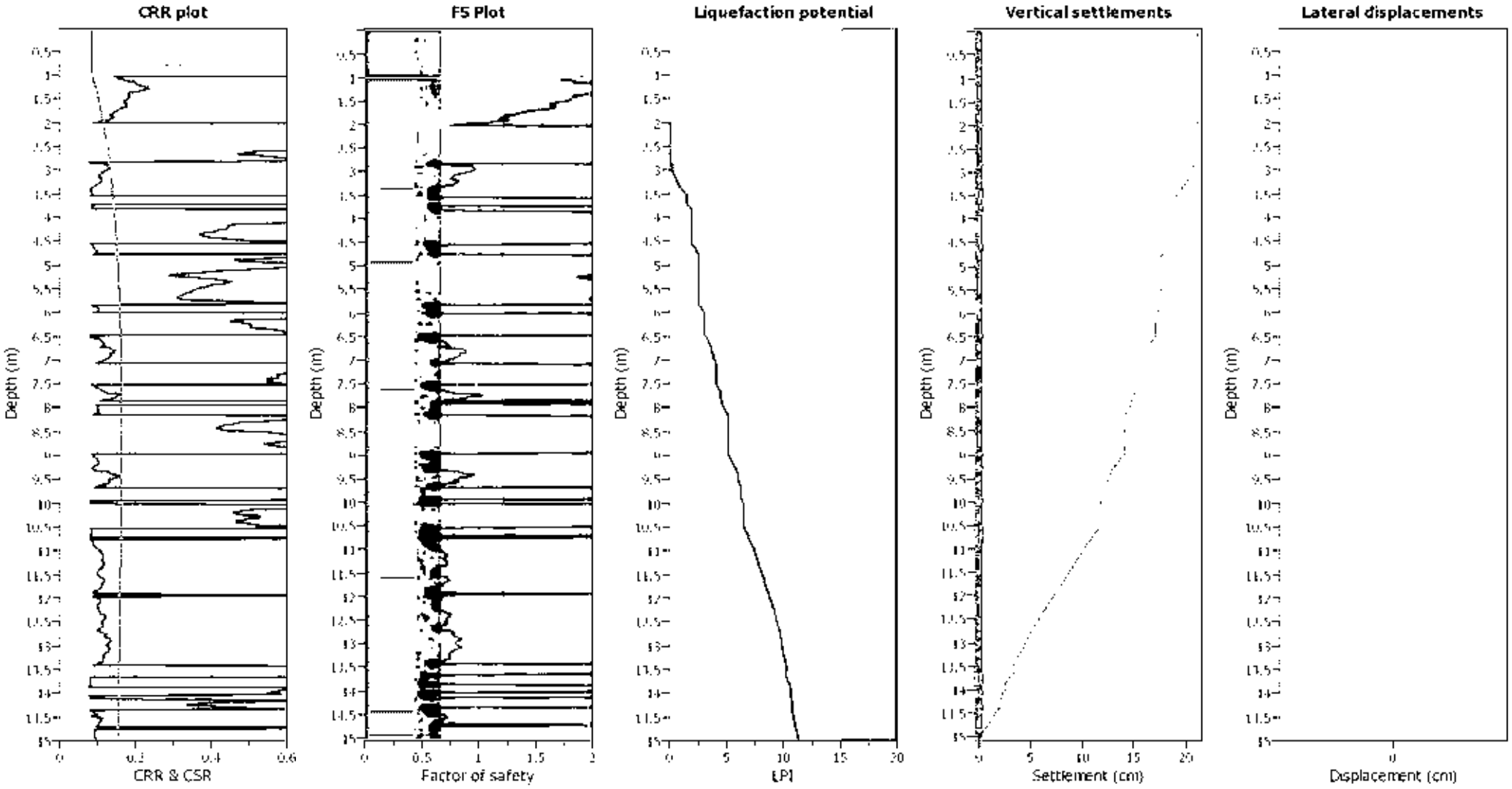
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

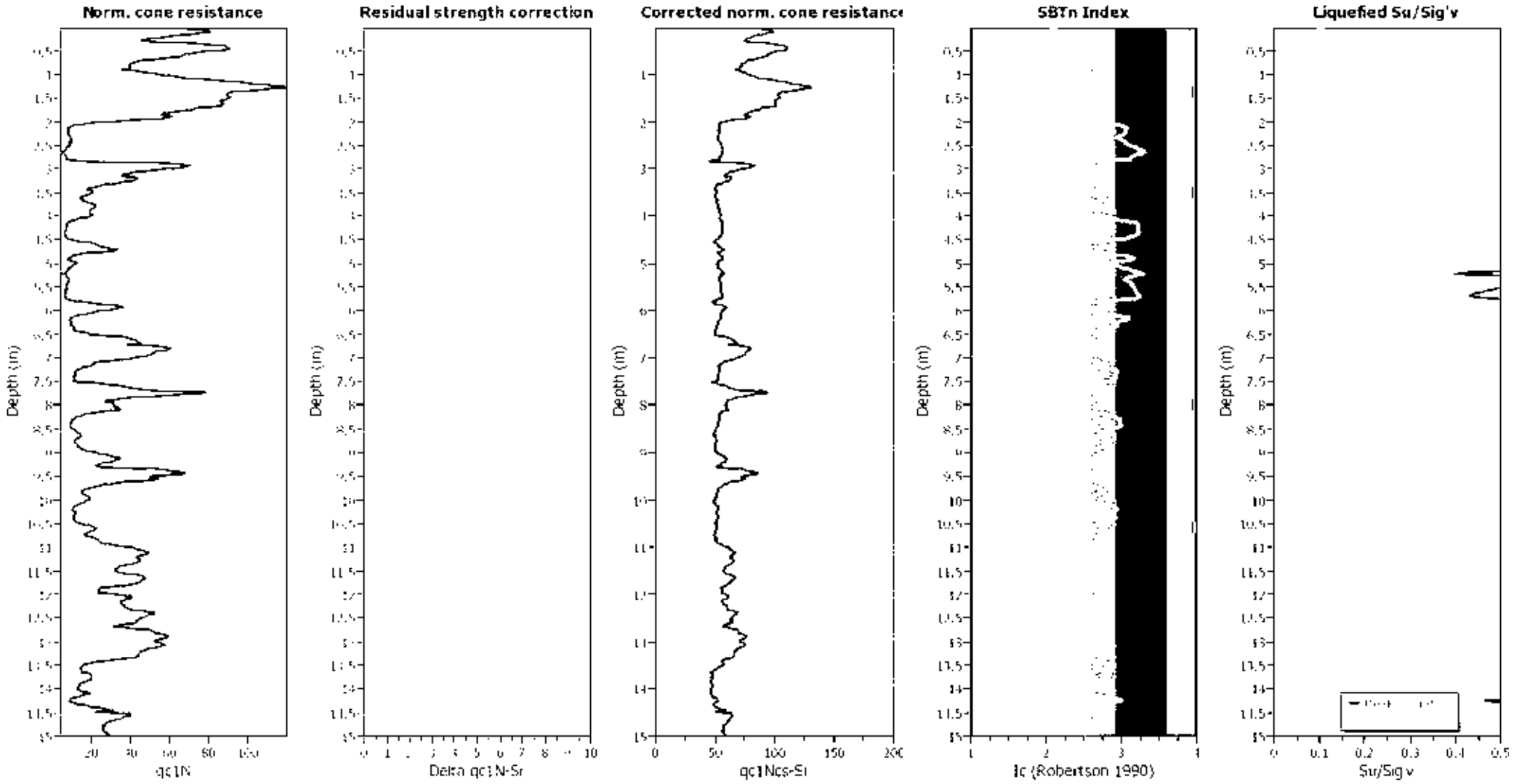
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

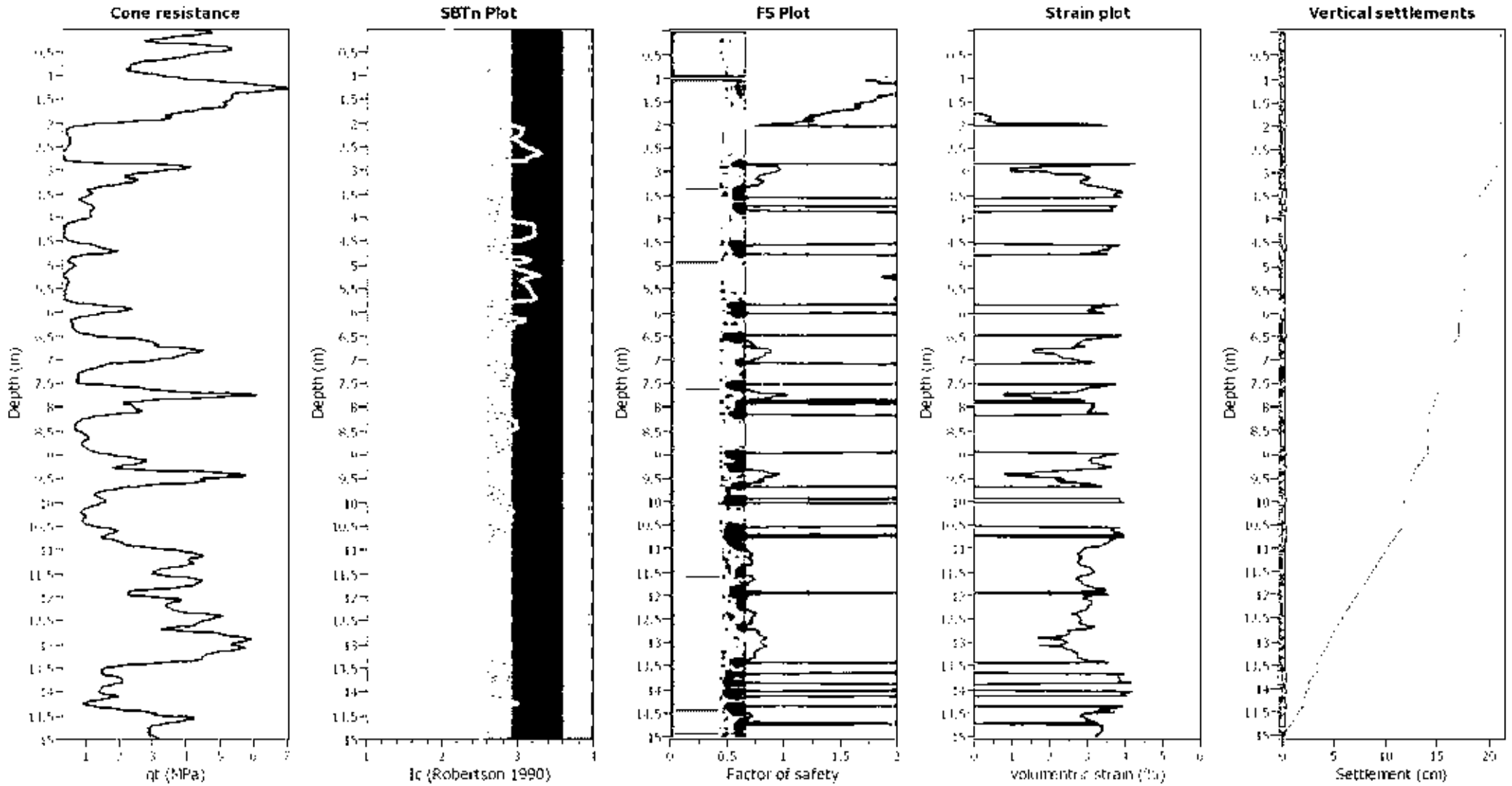
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

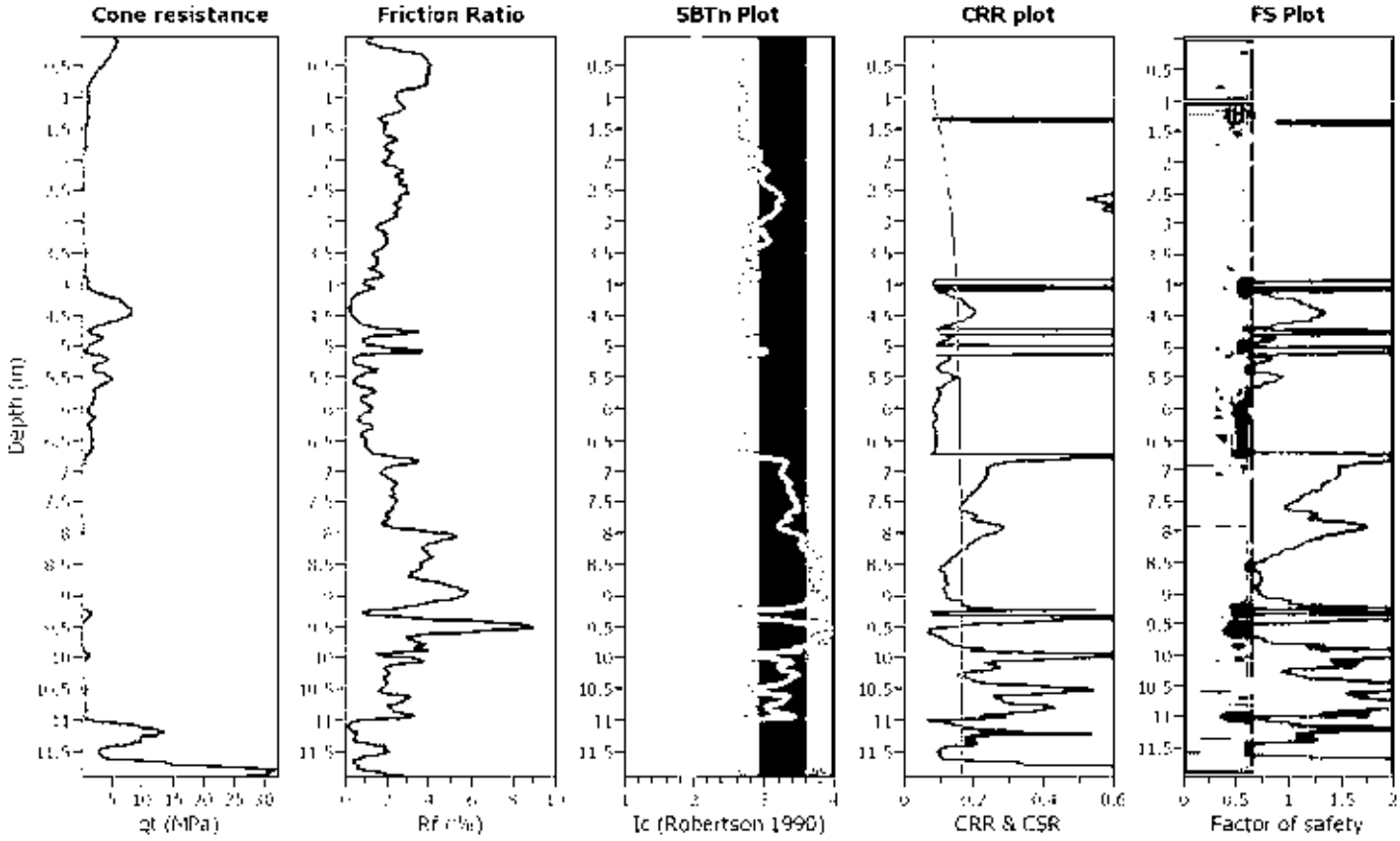
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

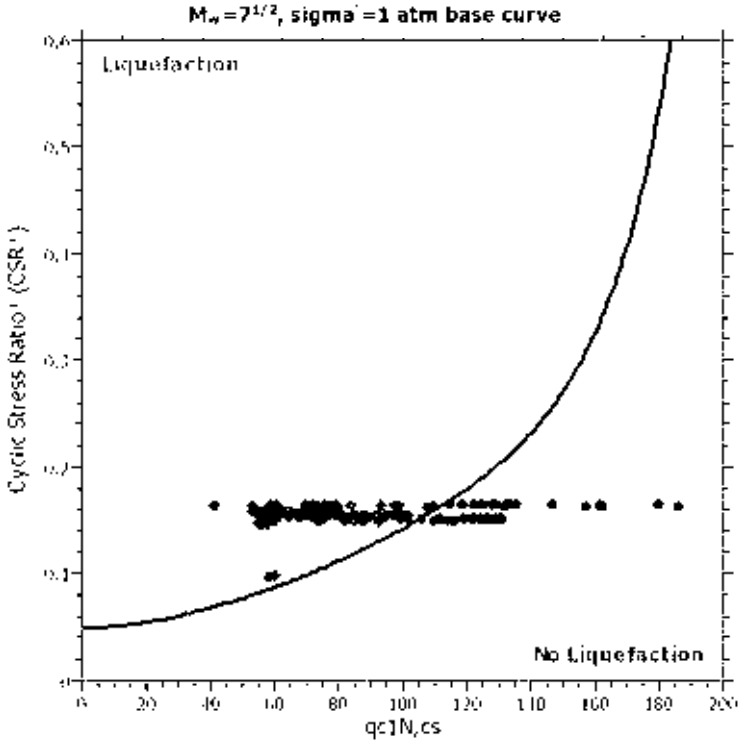
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

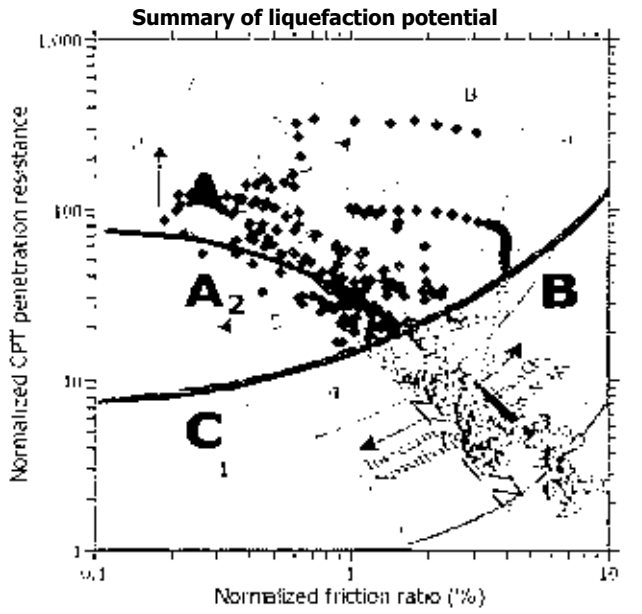
CPT file : CPT45_428cashmereRd

Input parameters and analysis data

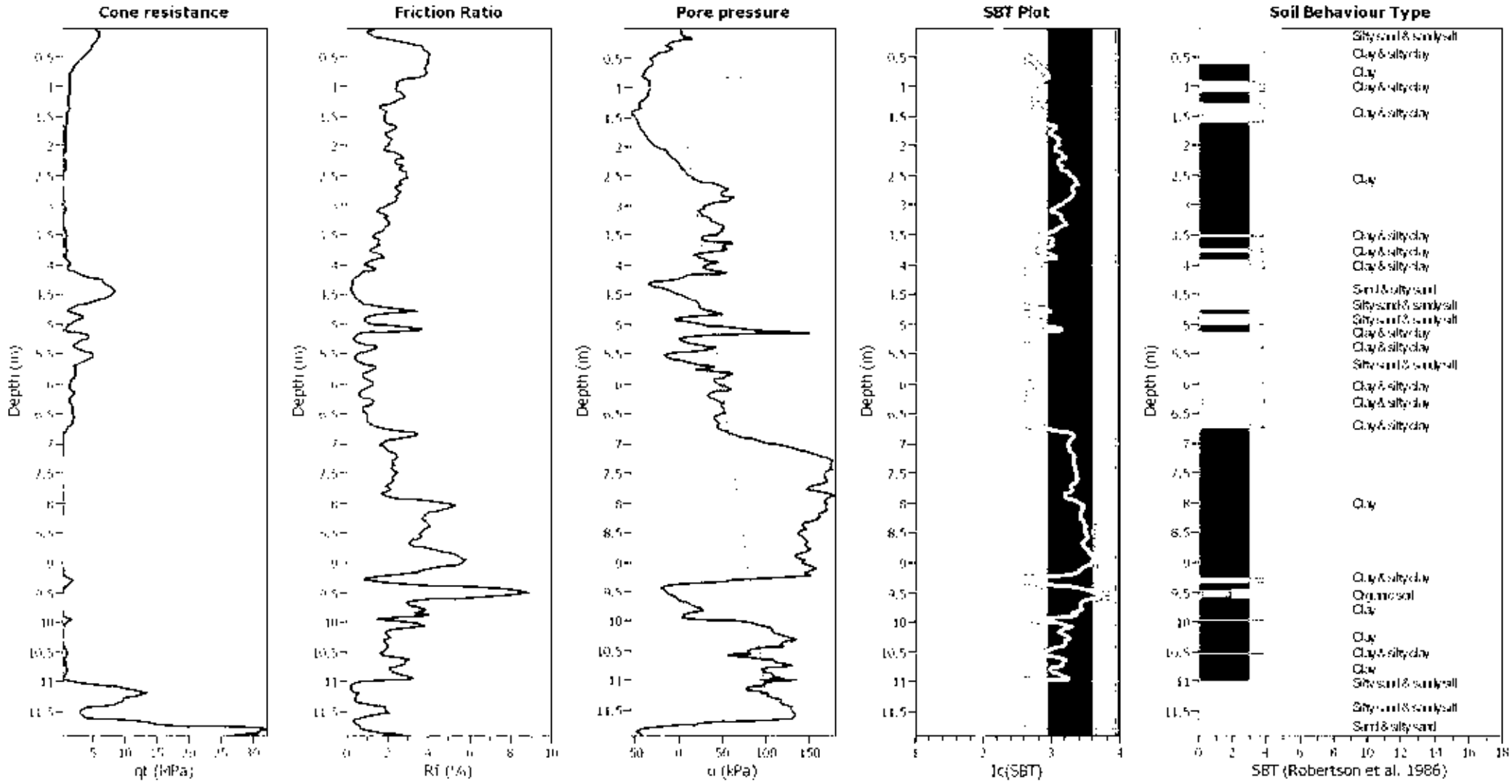
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K applied:	Yes		







CPT basic interpretation plots



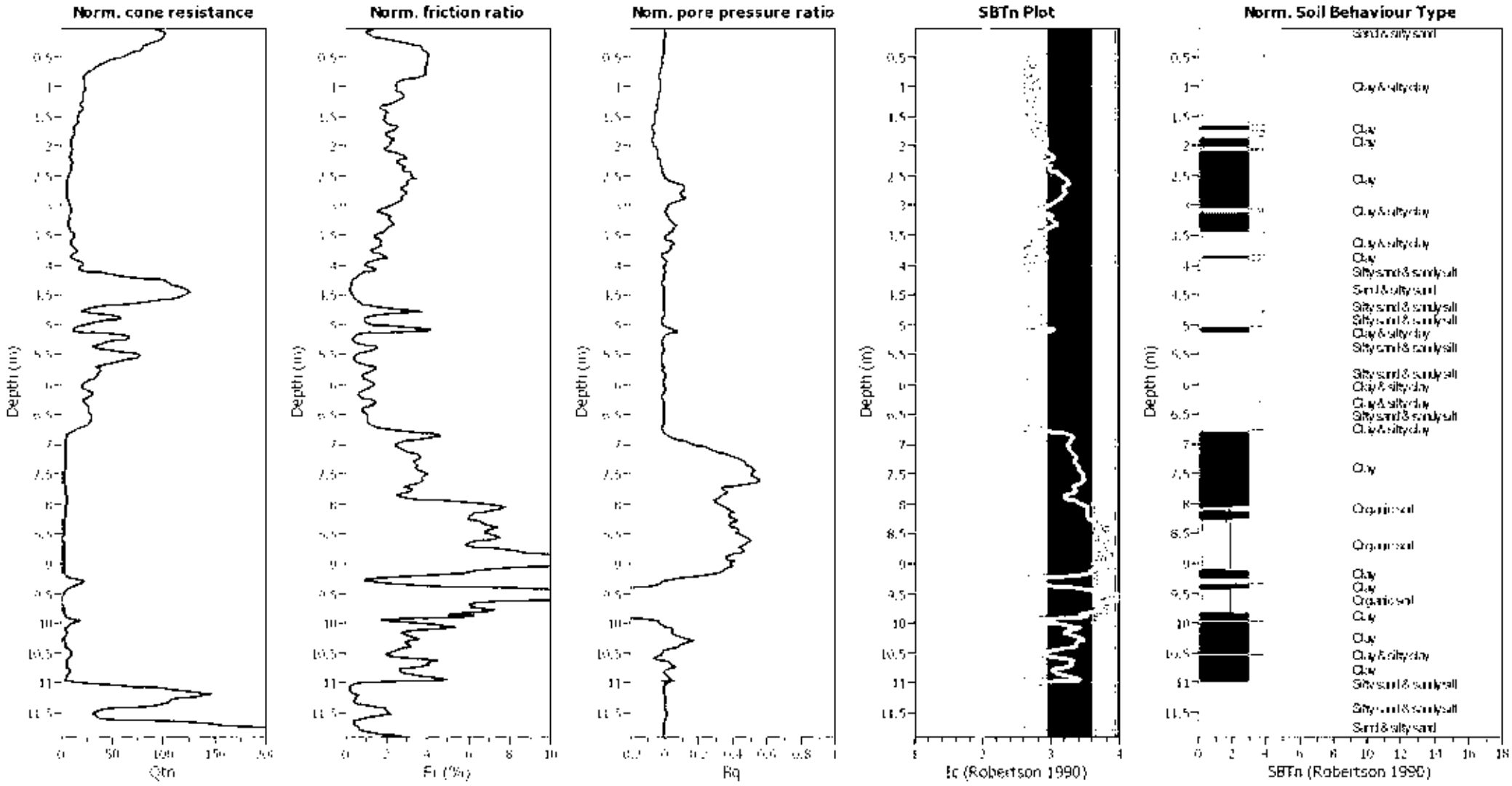
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



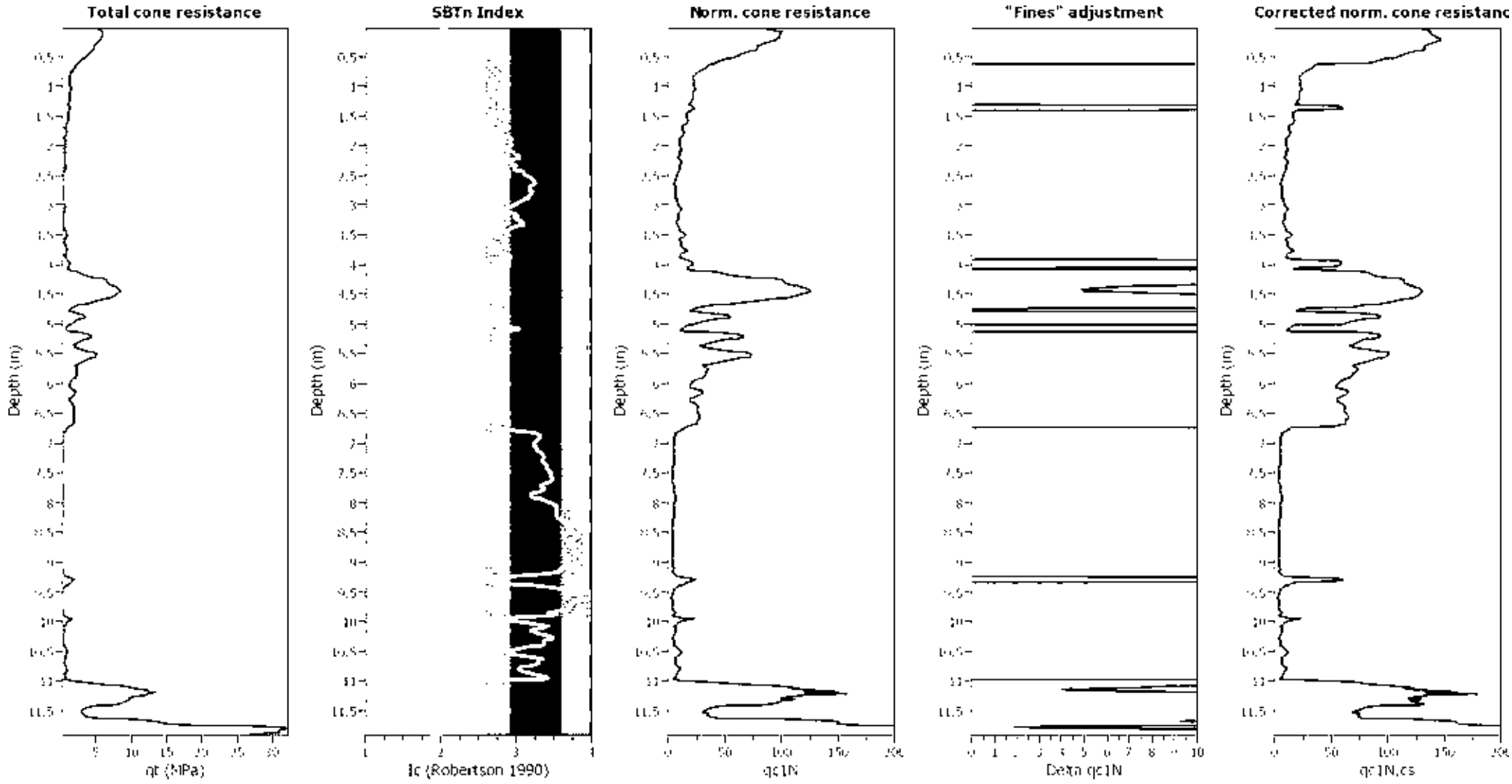
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

SBTn legend

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

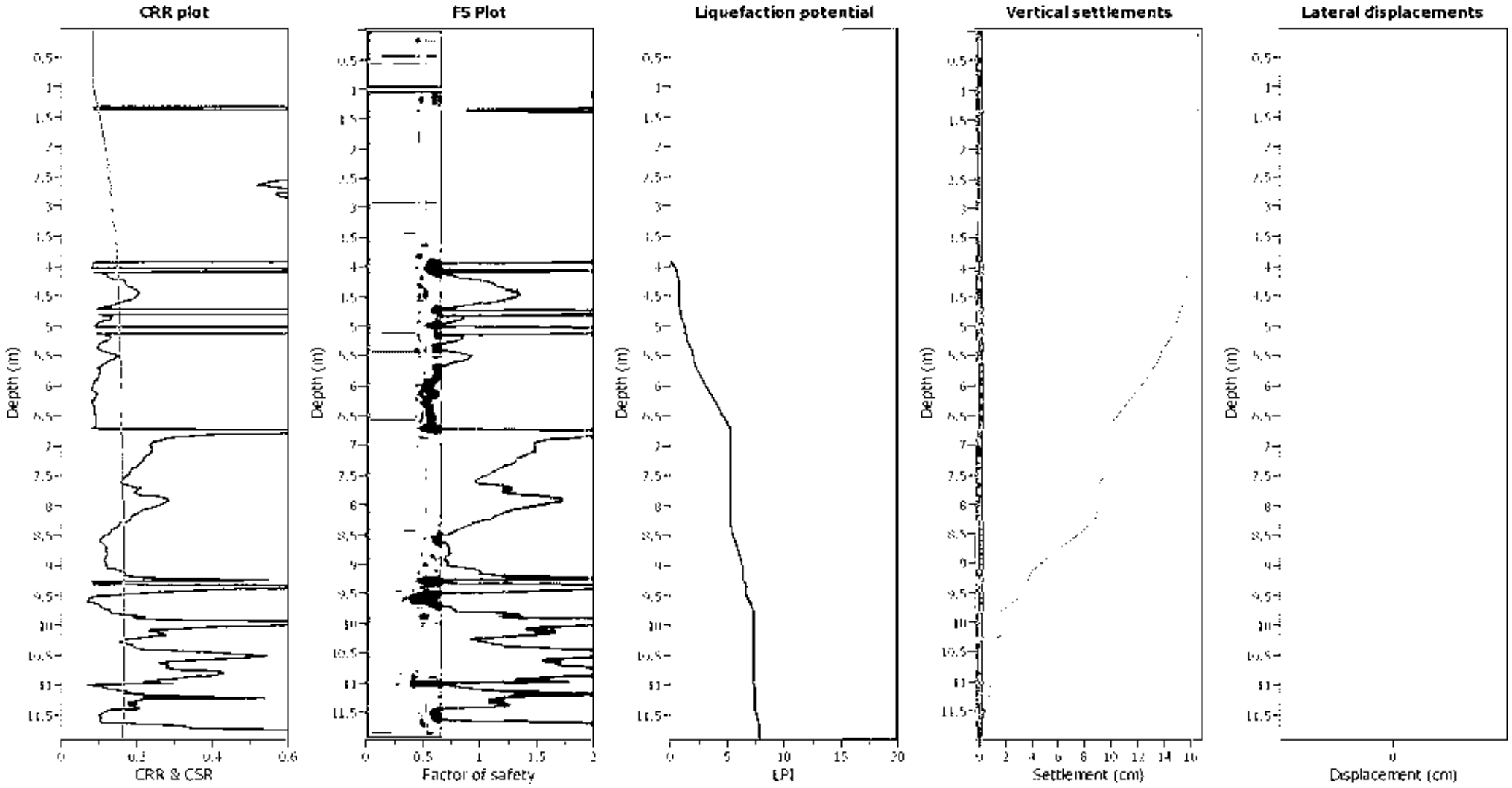
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

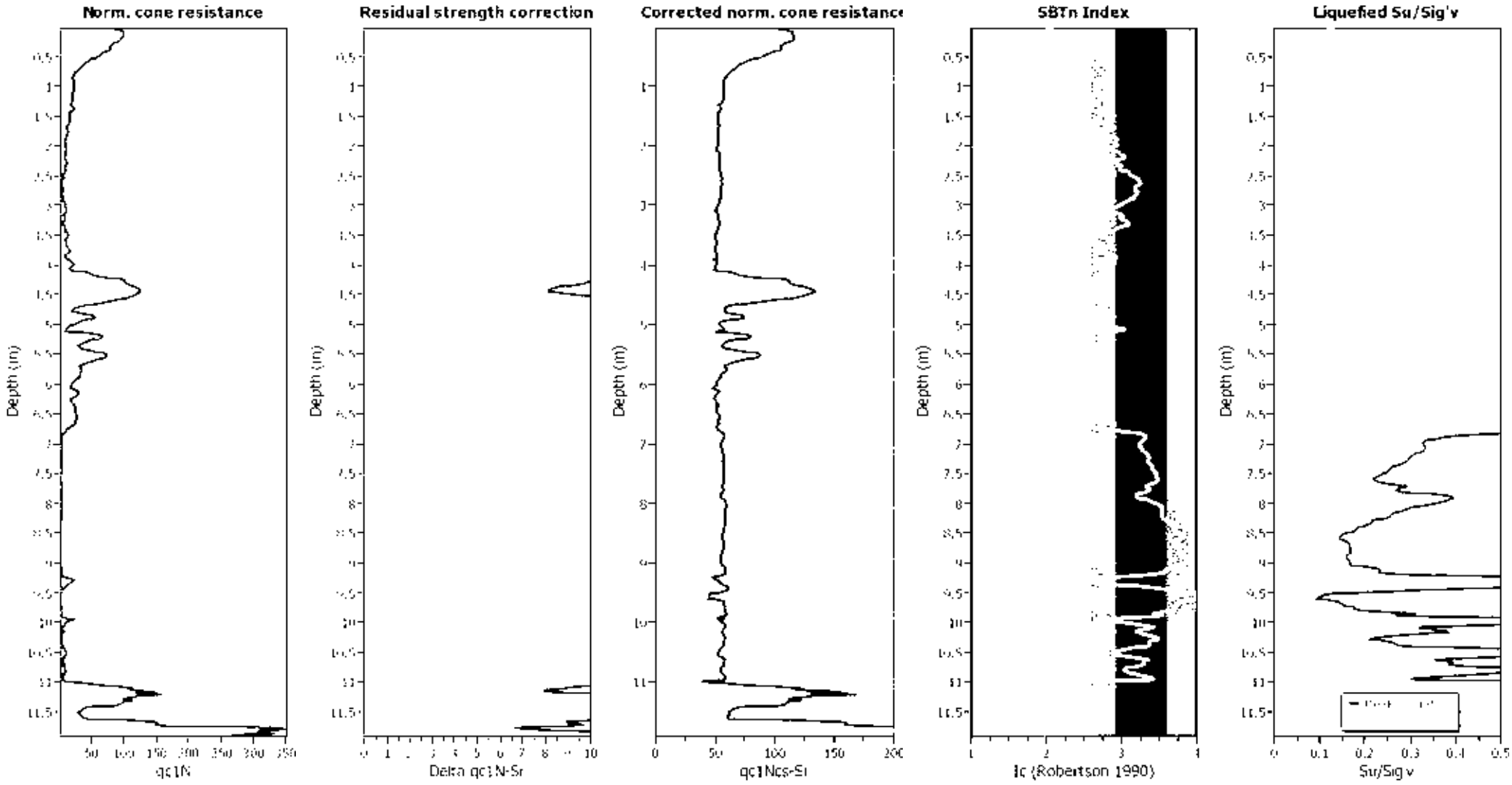
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

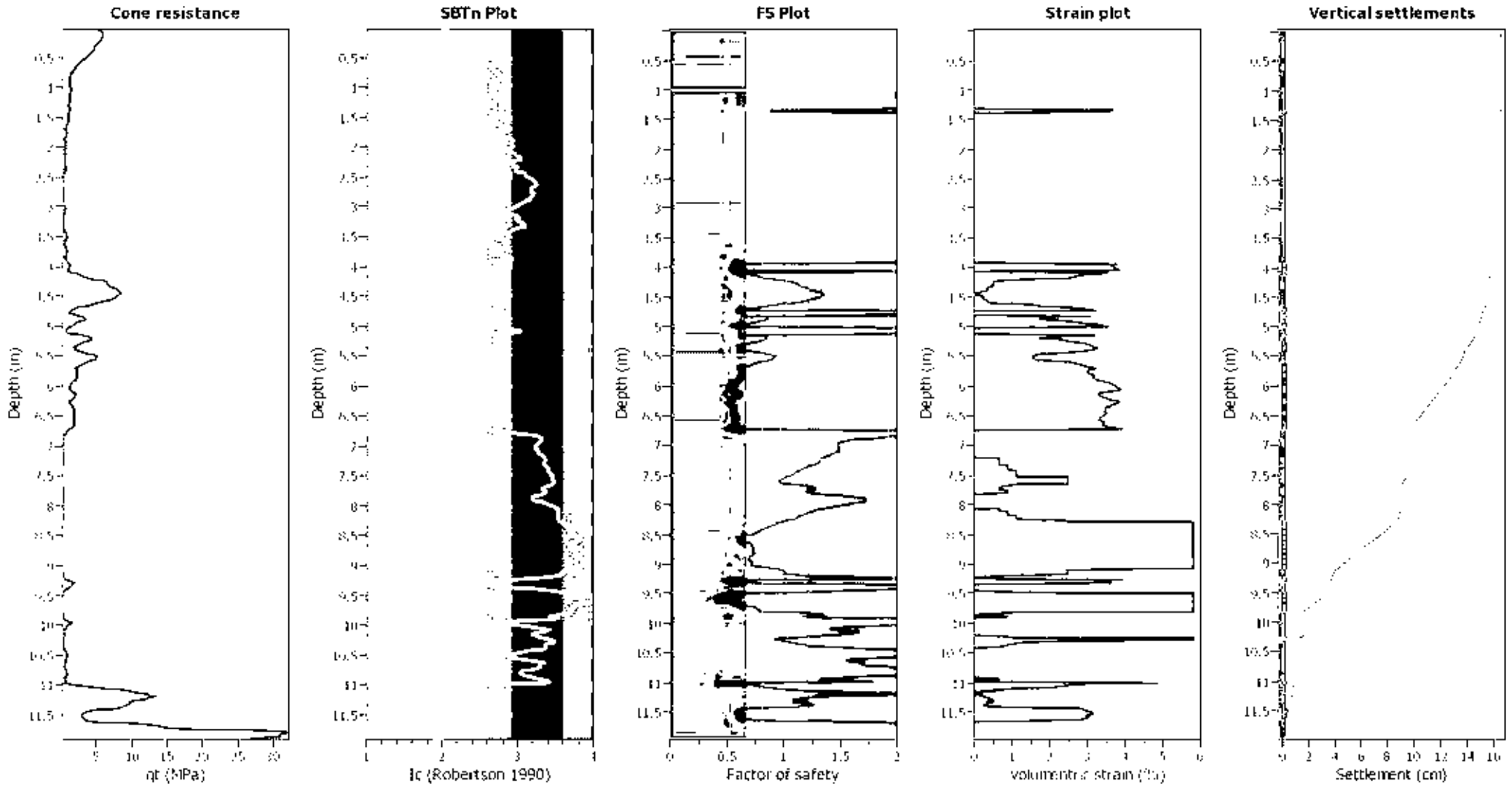
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

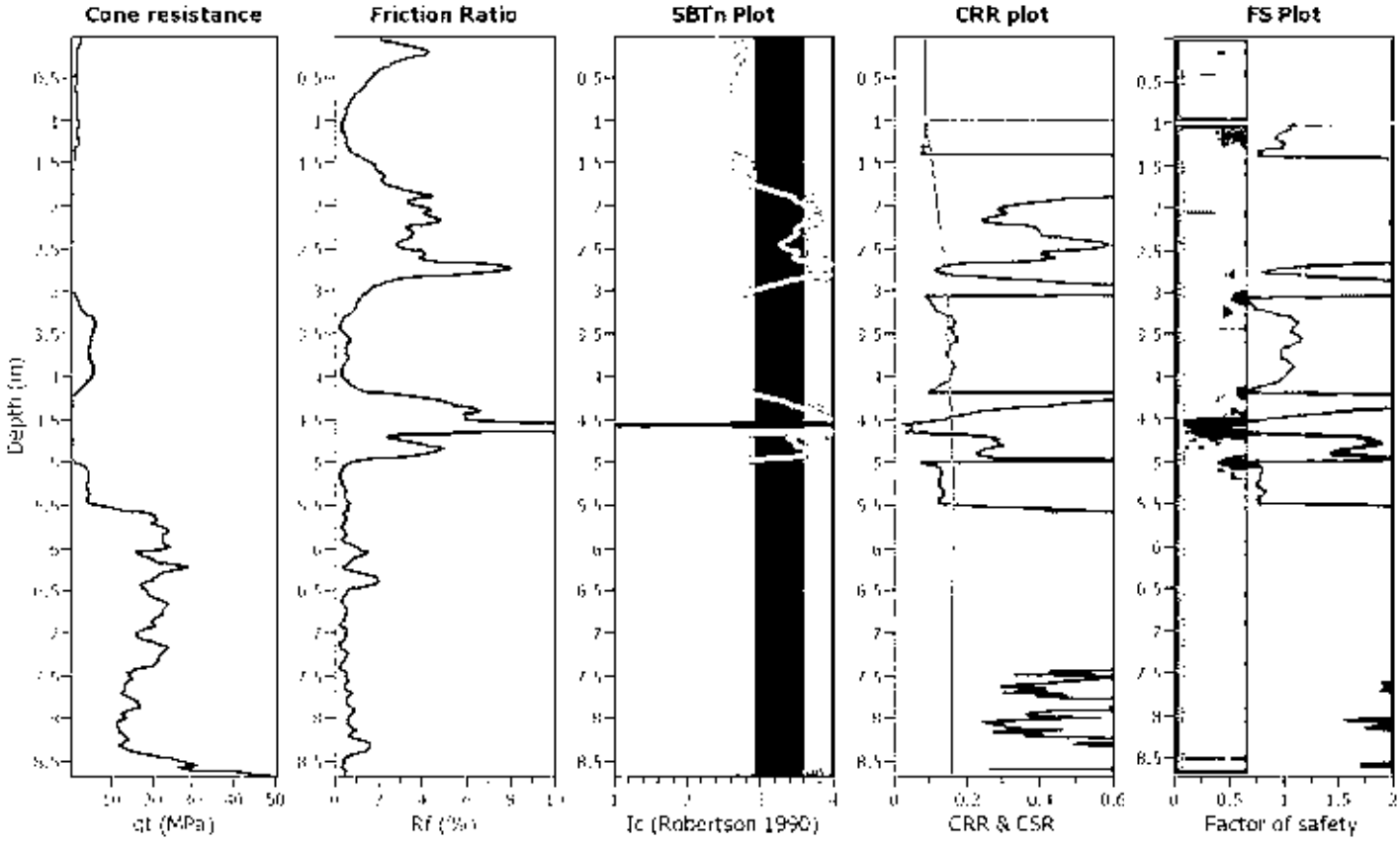
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

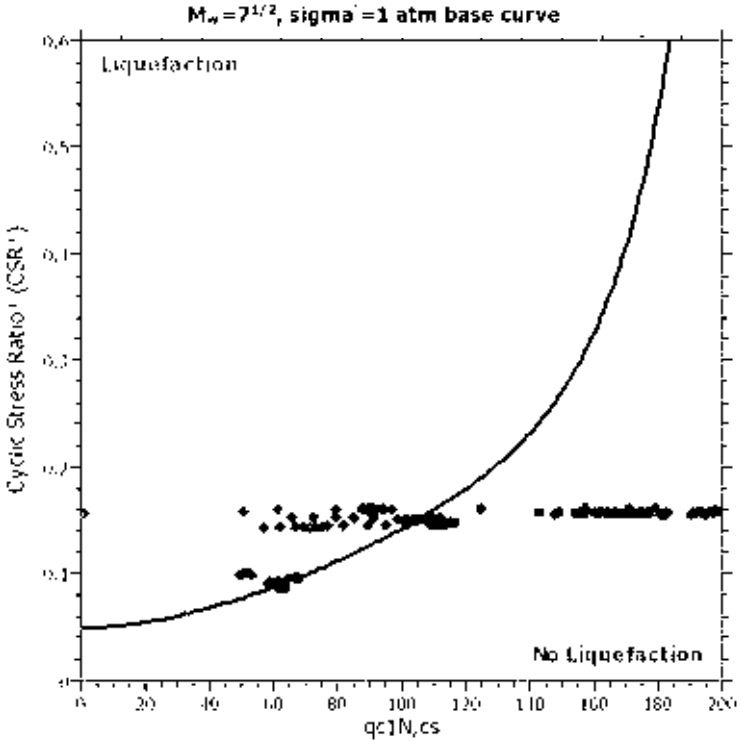
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

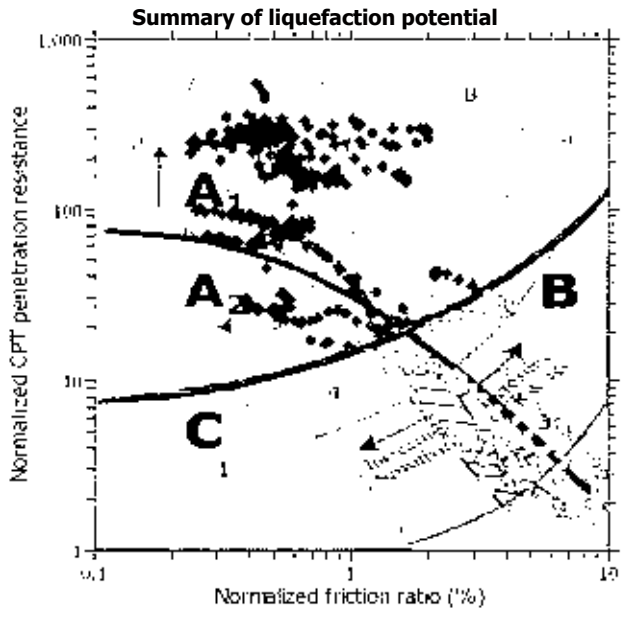
CPT file : CPT46_428cashmereRd

Input parameters and analysis data

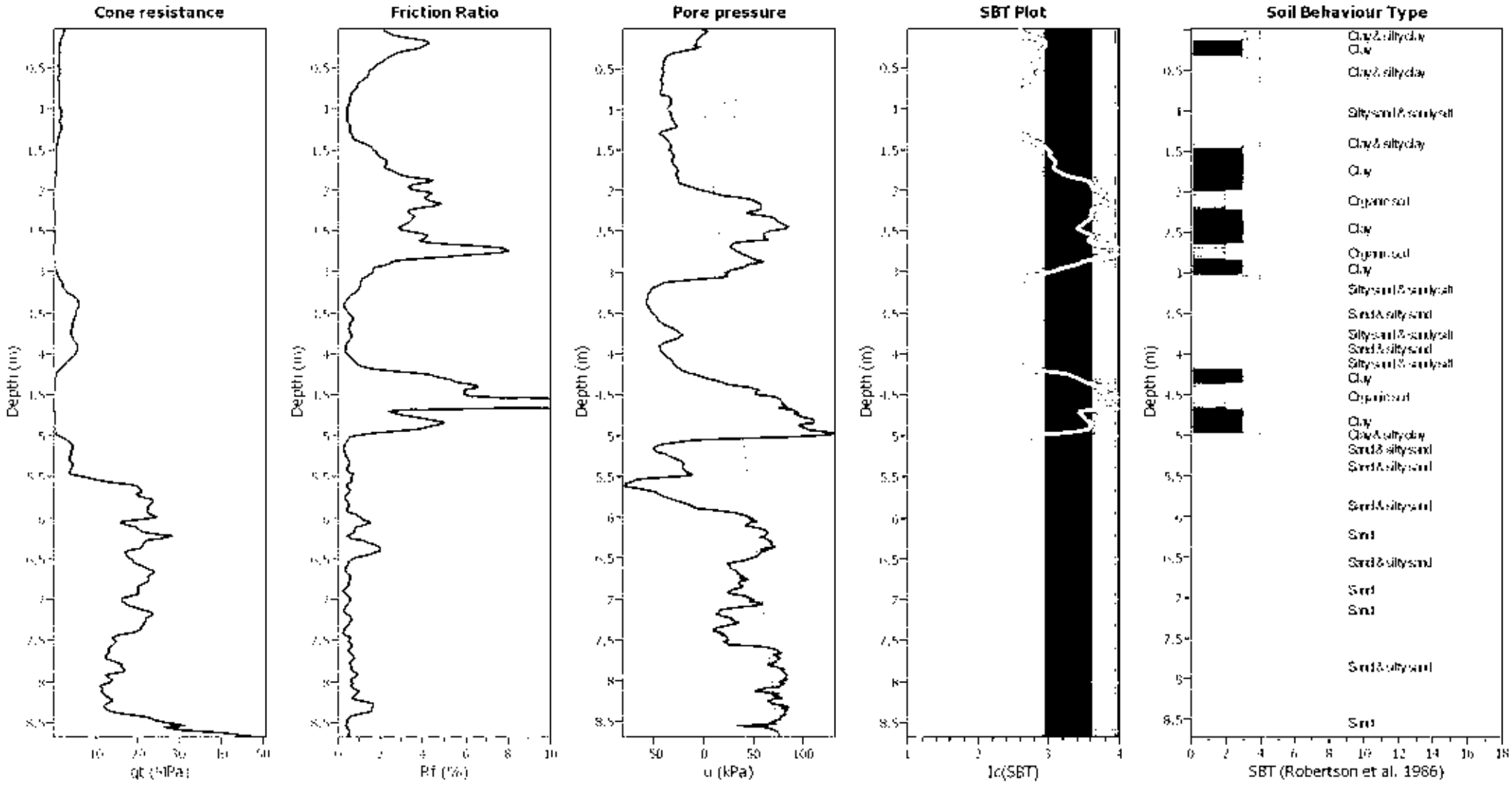
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



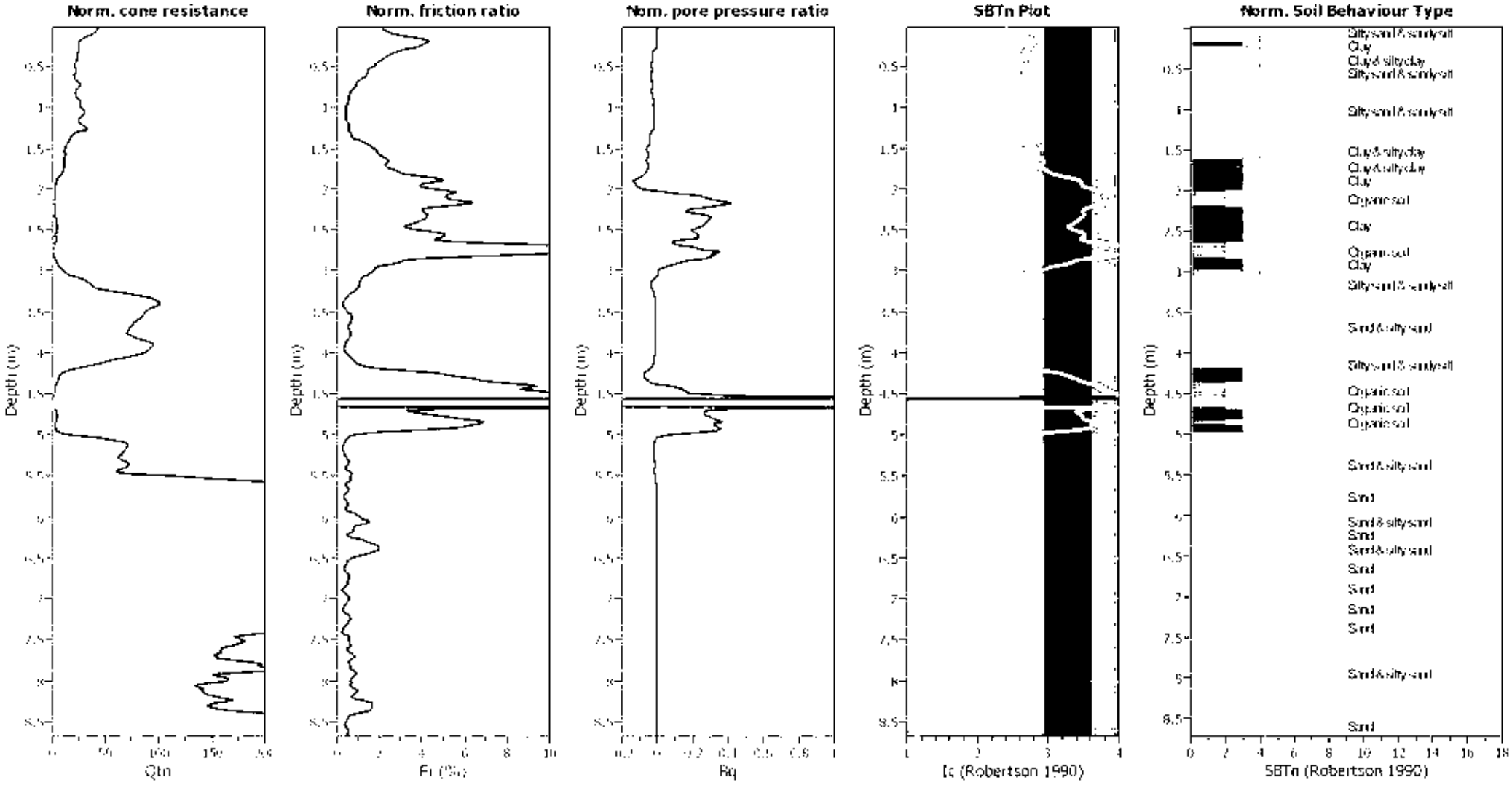
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



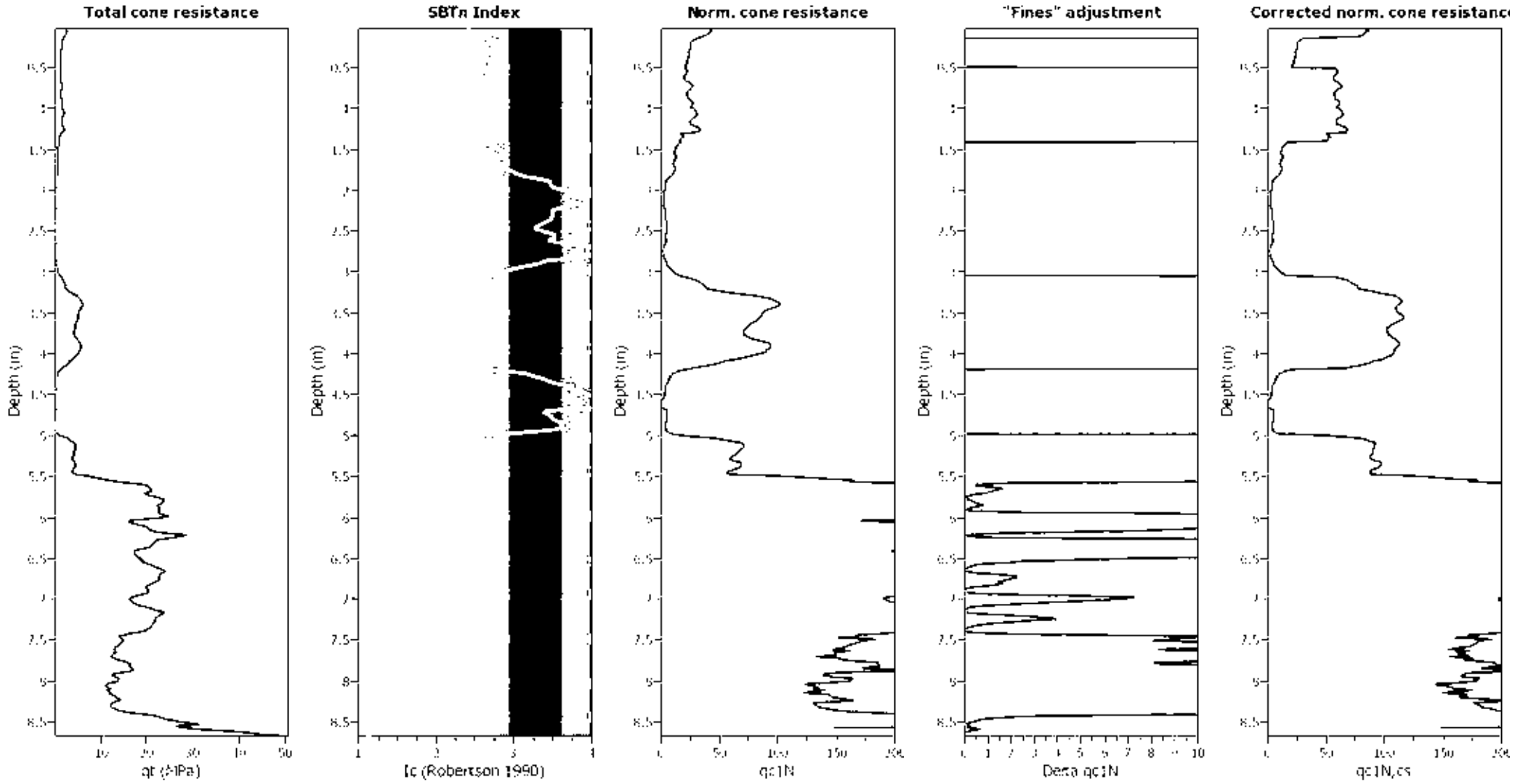
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

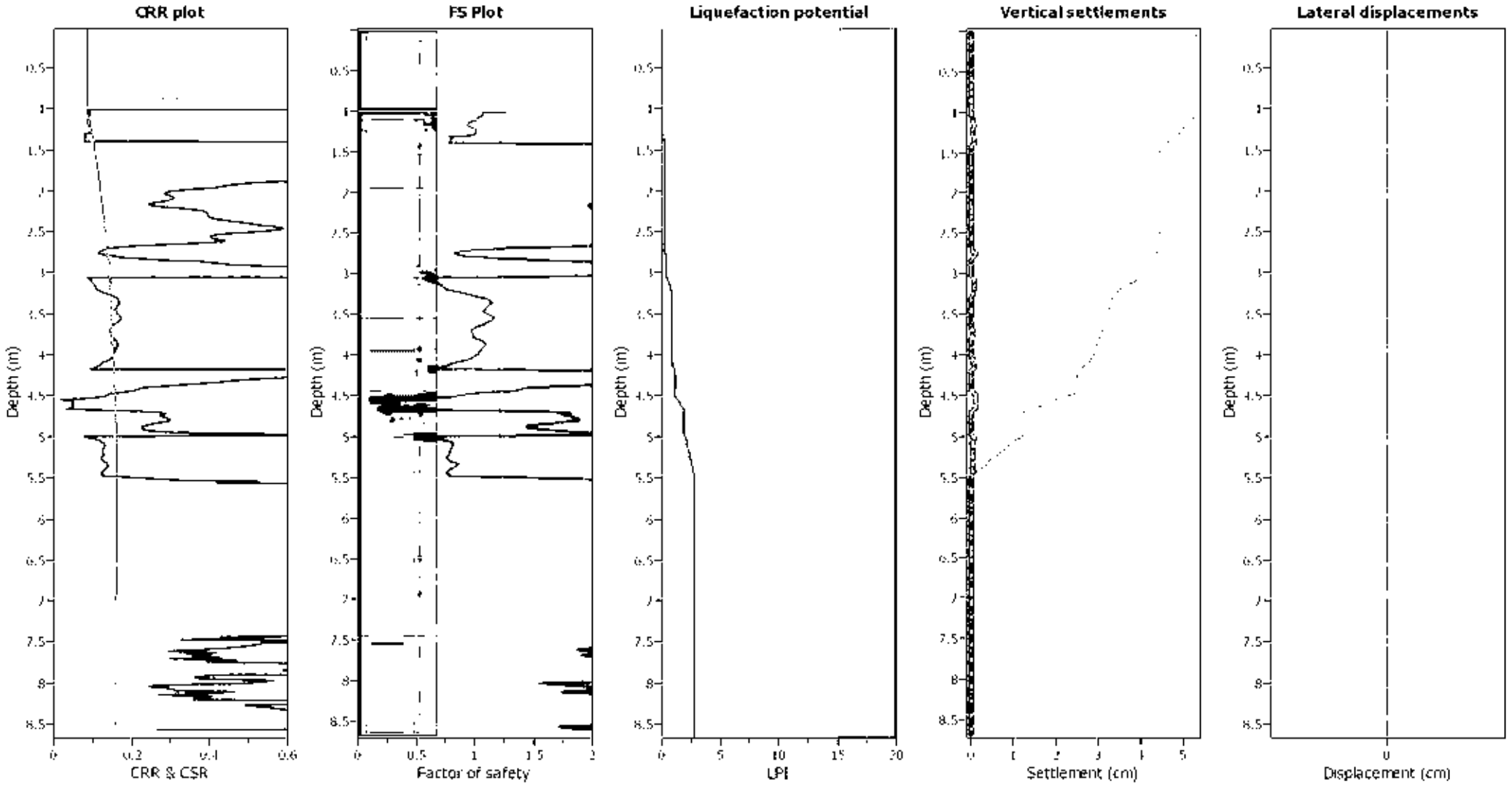
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

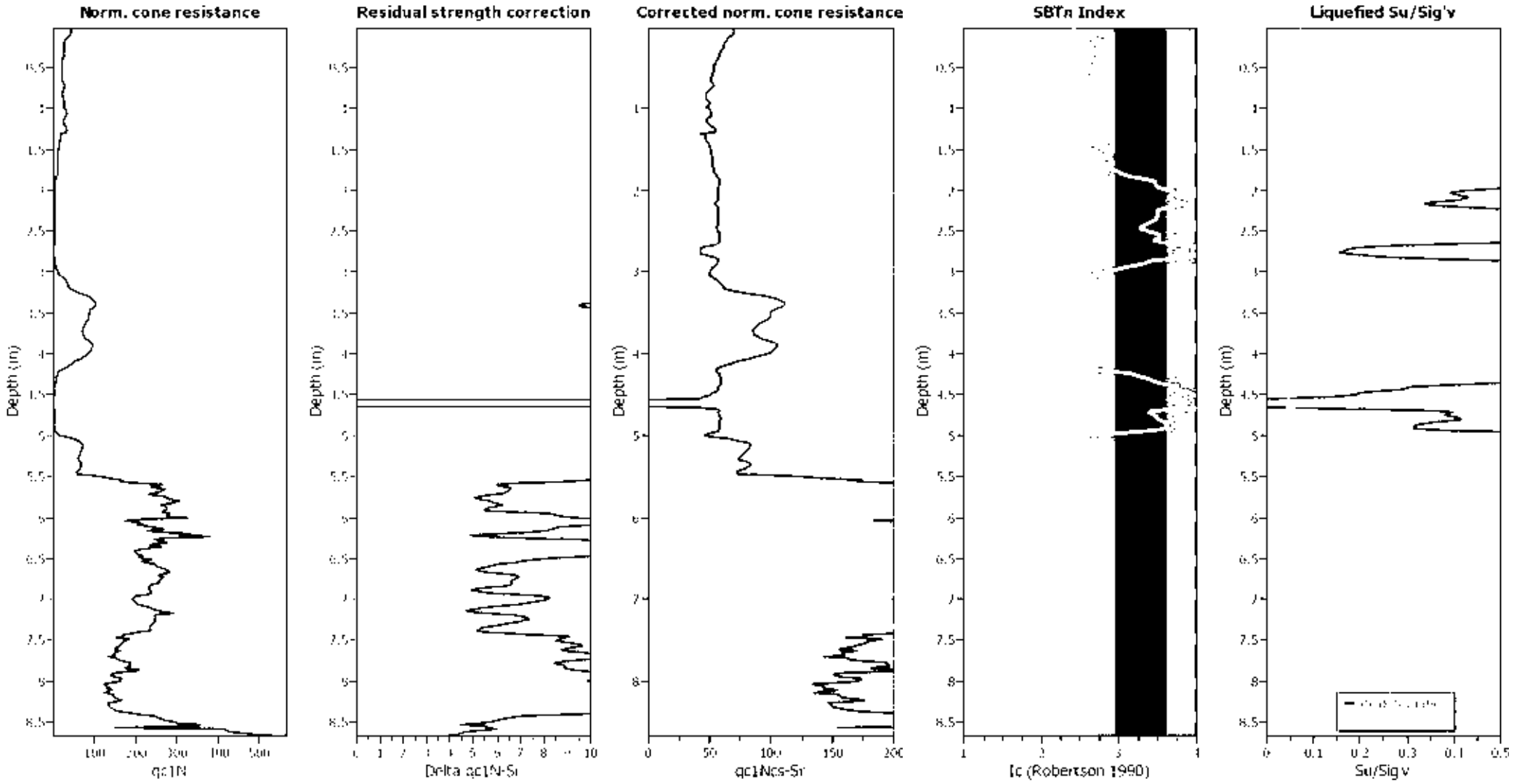
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

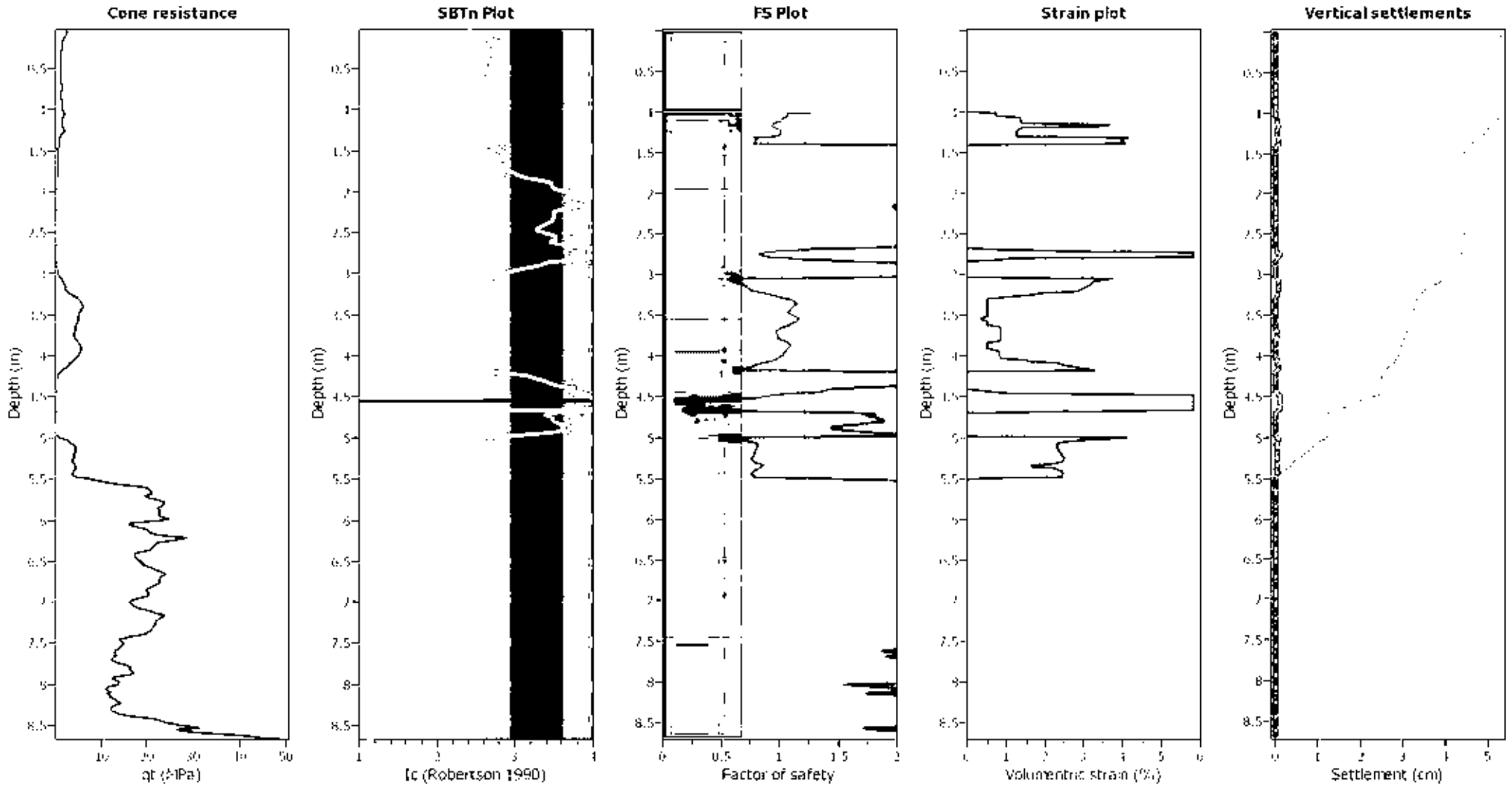
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

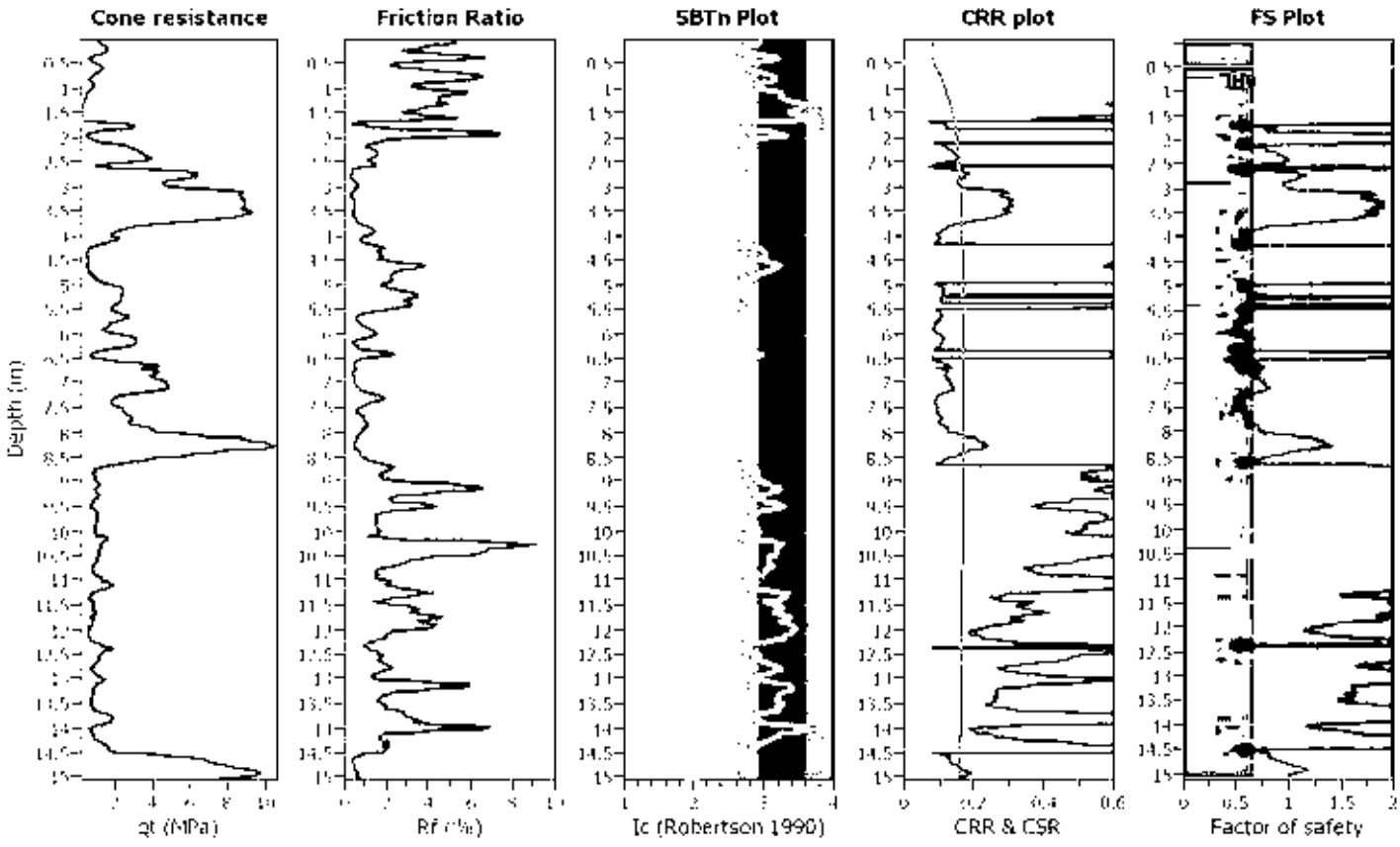
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

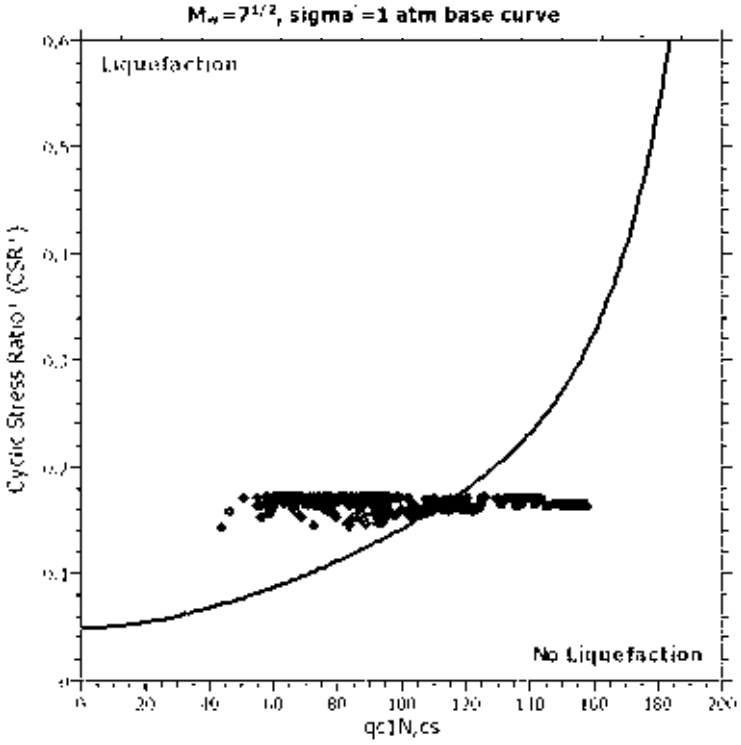
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

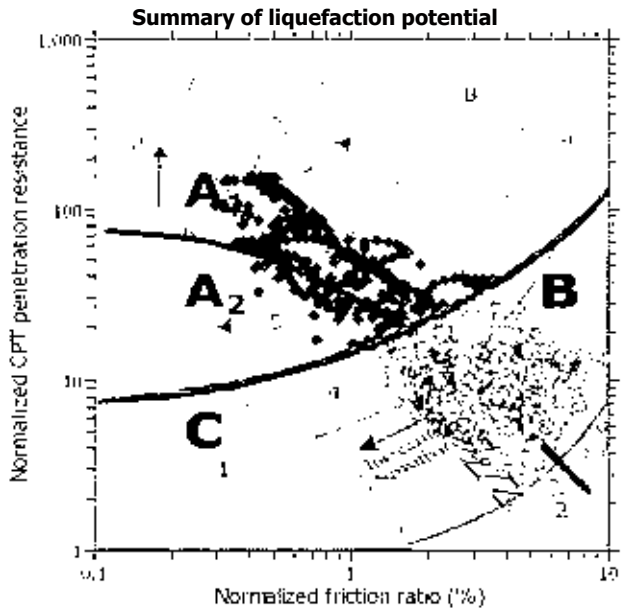
CPT file : CPT47_334SparksRd

Input parameters and analysis data

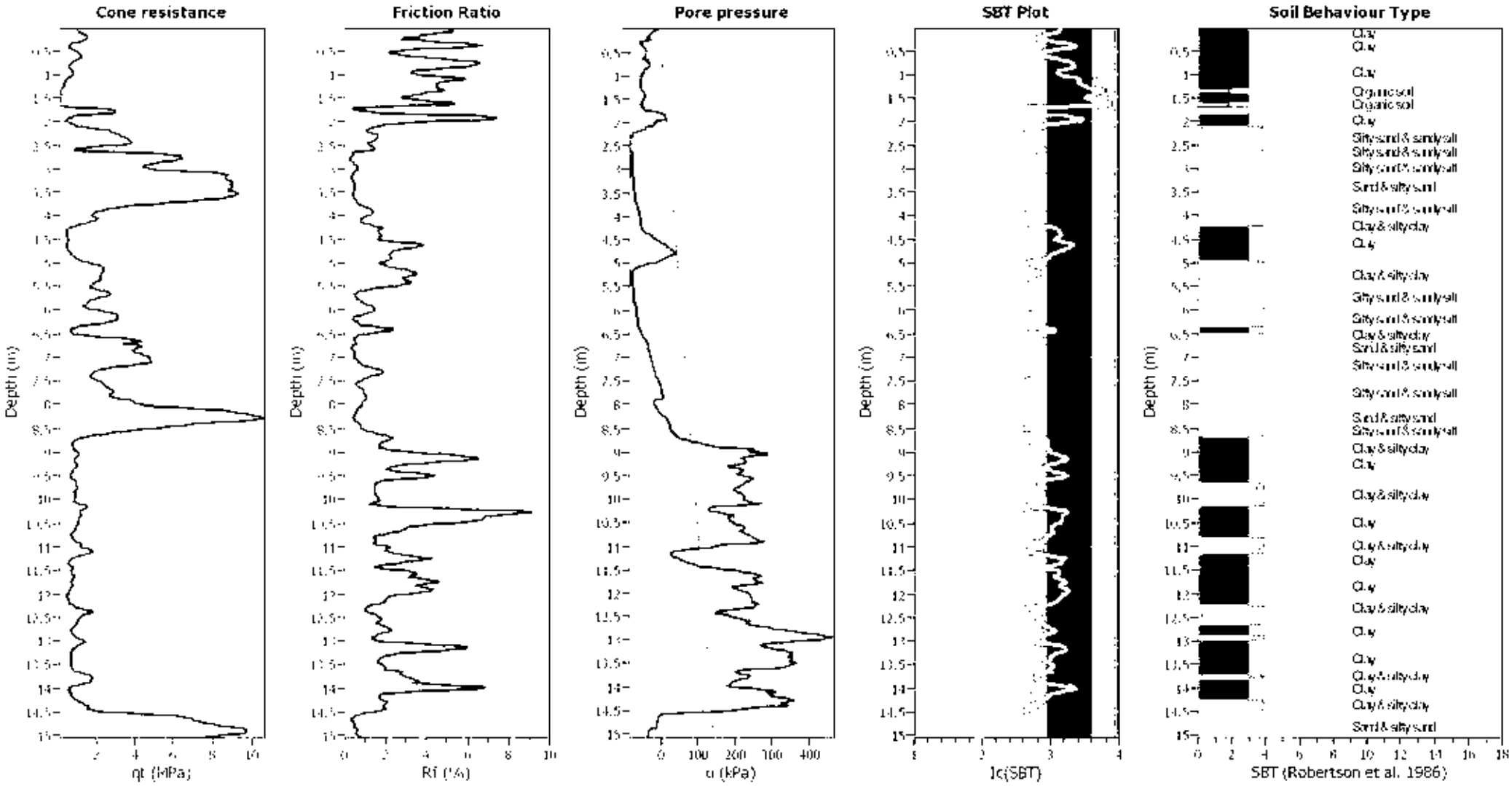
Analysis method:	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



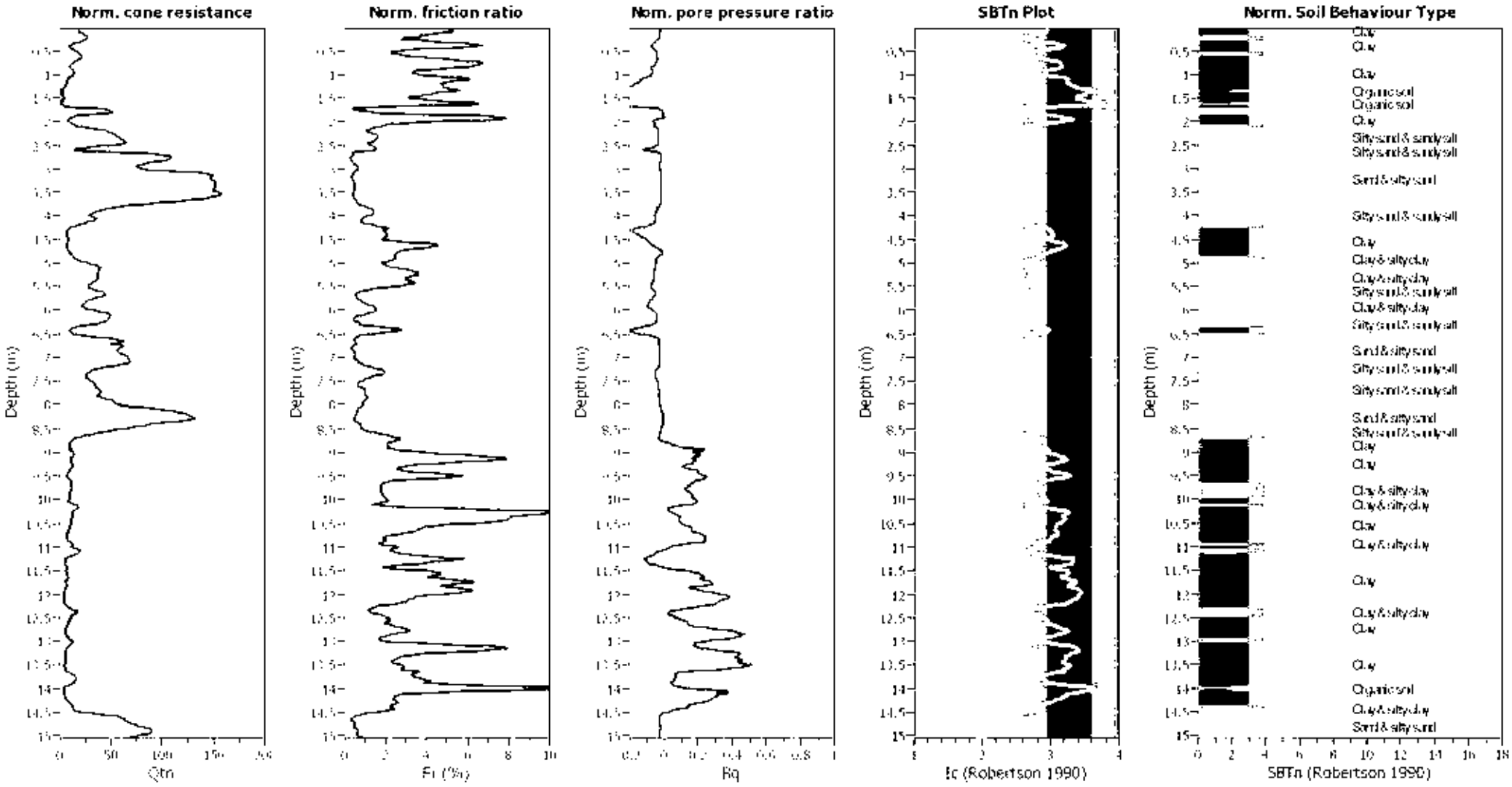
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



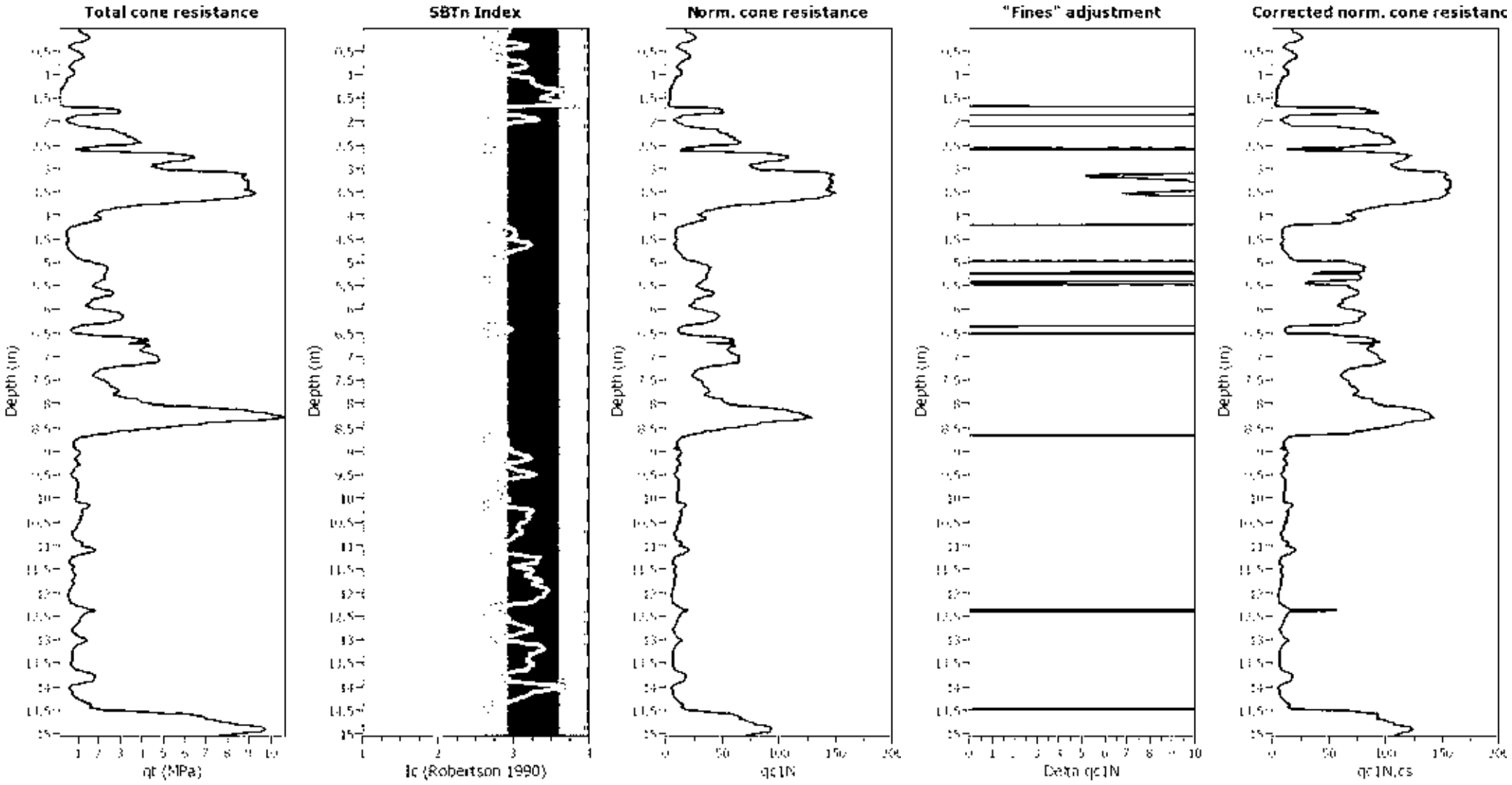
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

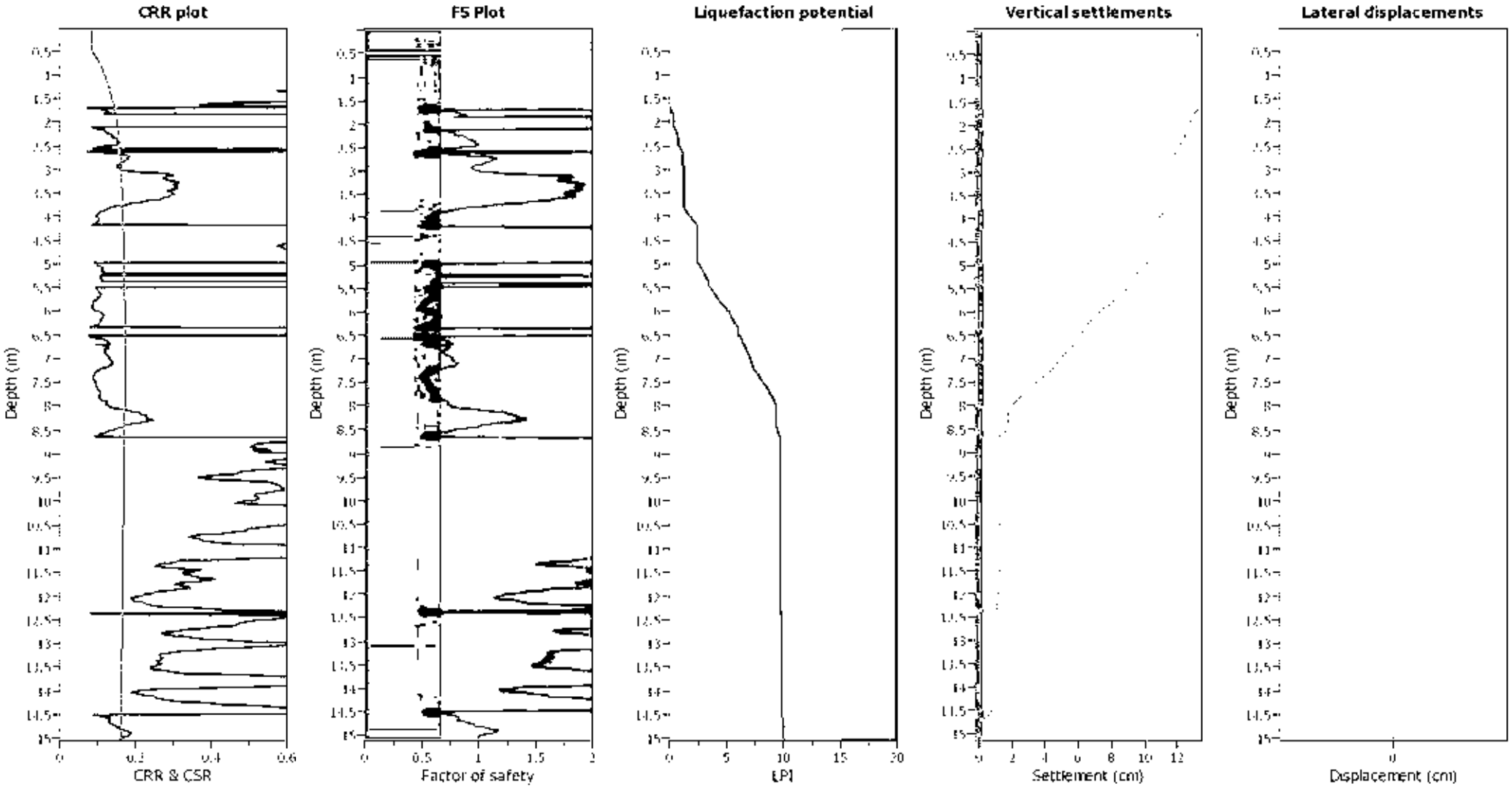
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

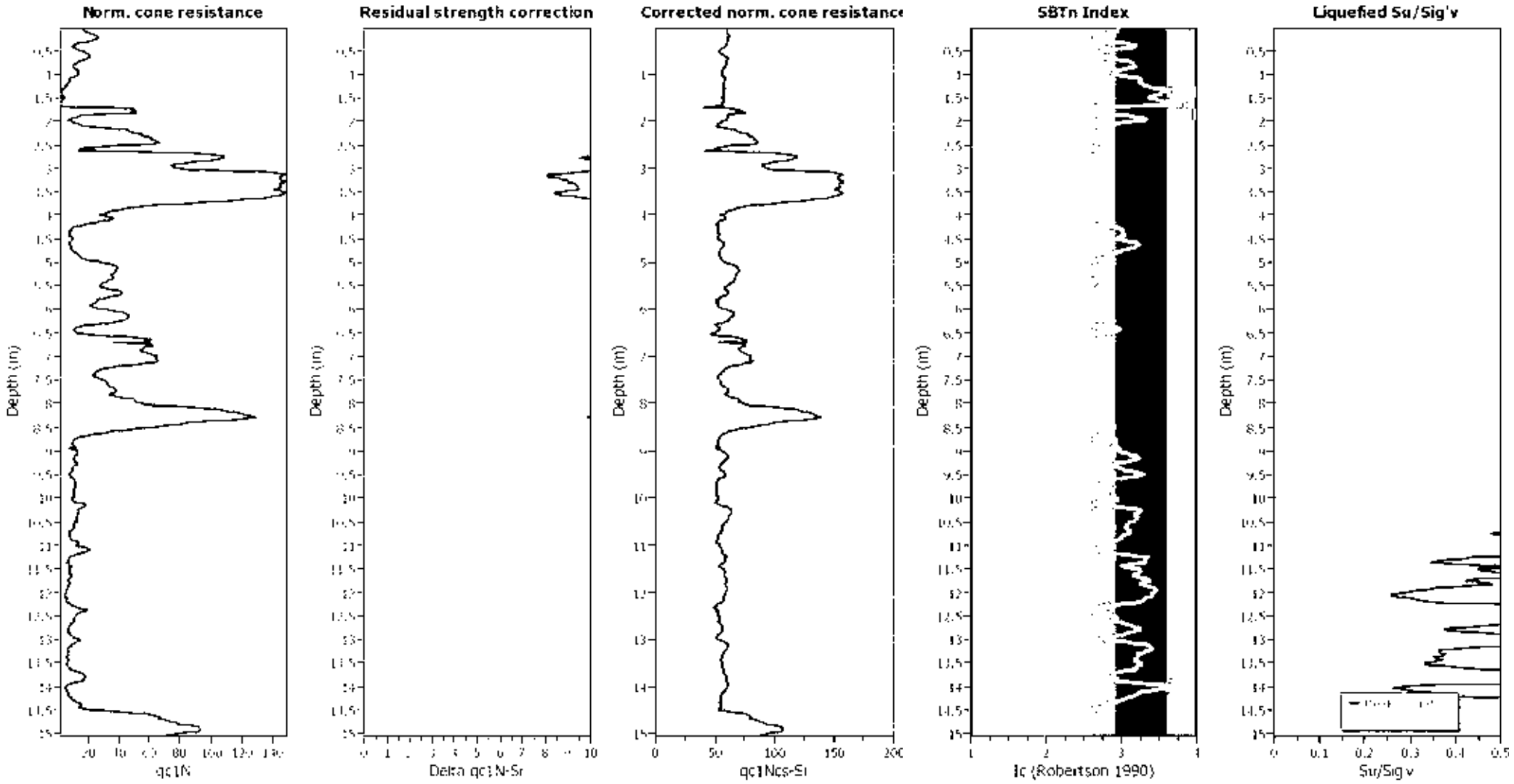
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

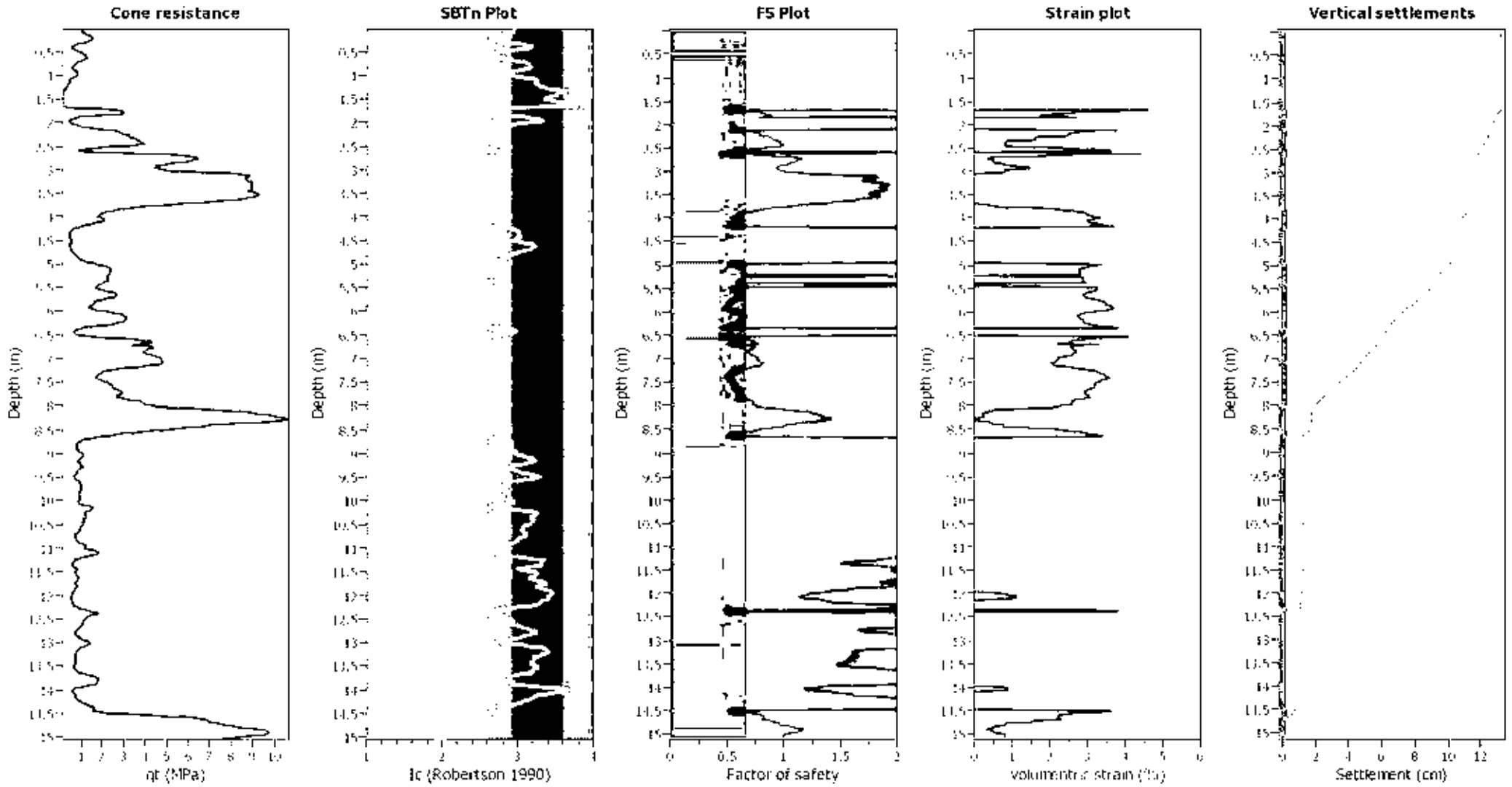
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

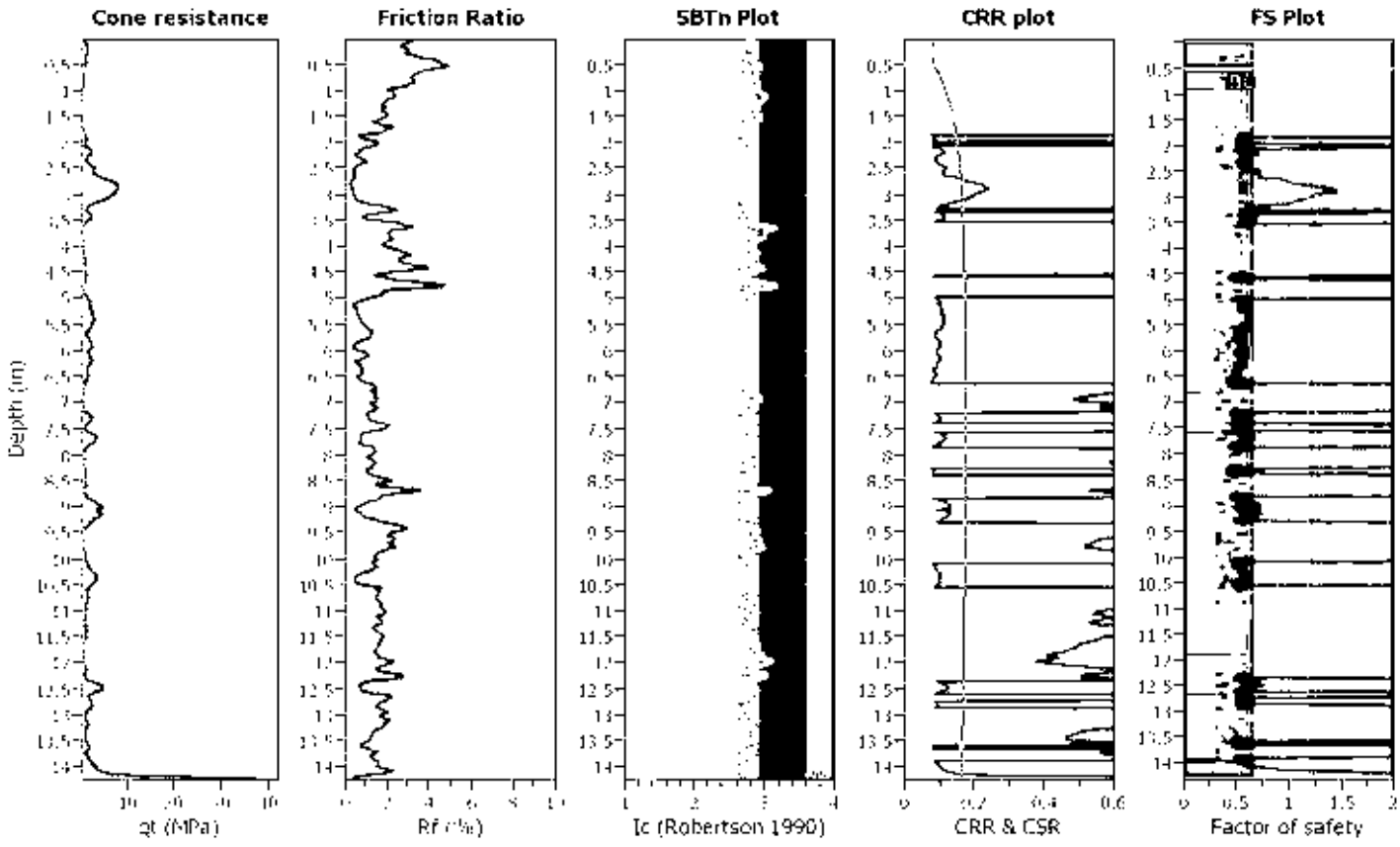
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

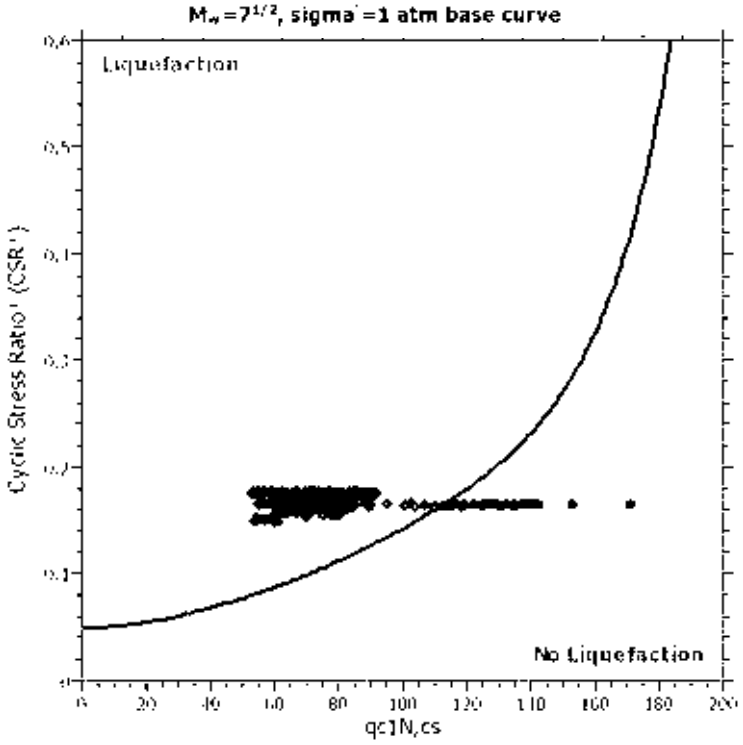
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

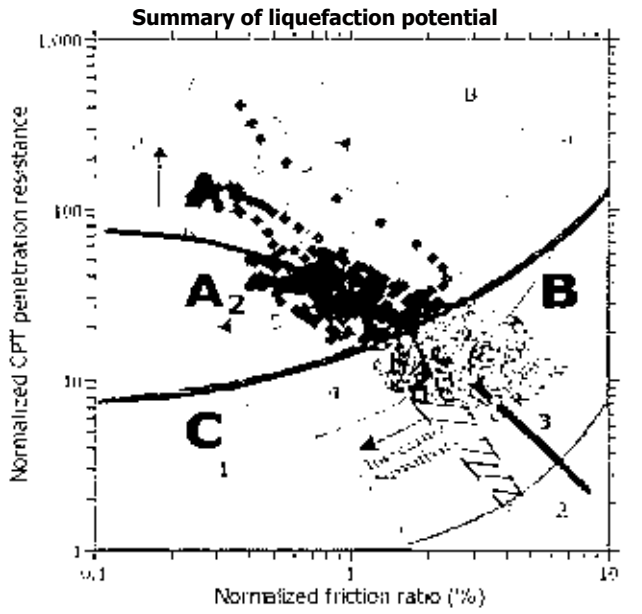
CPT file : CPT48_334SparksRd

Input parameters and analysis data

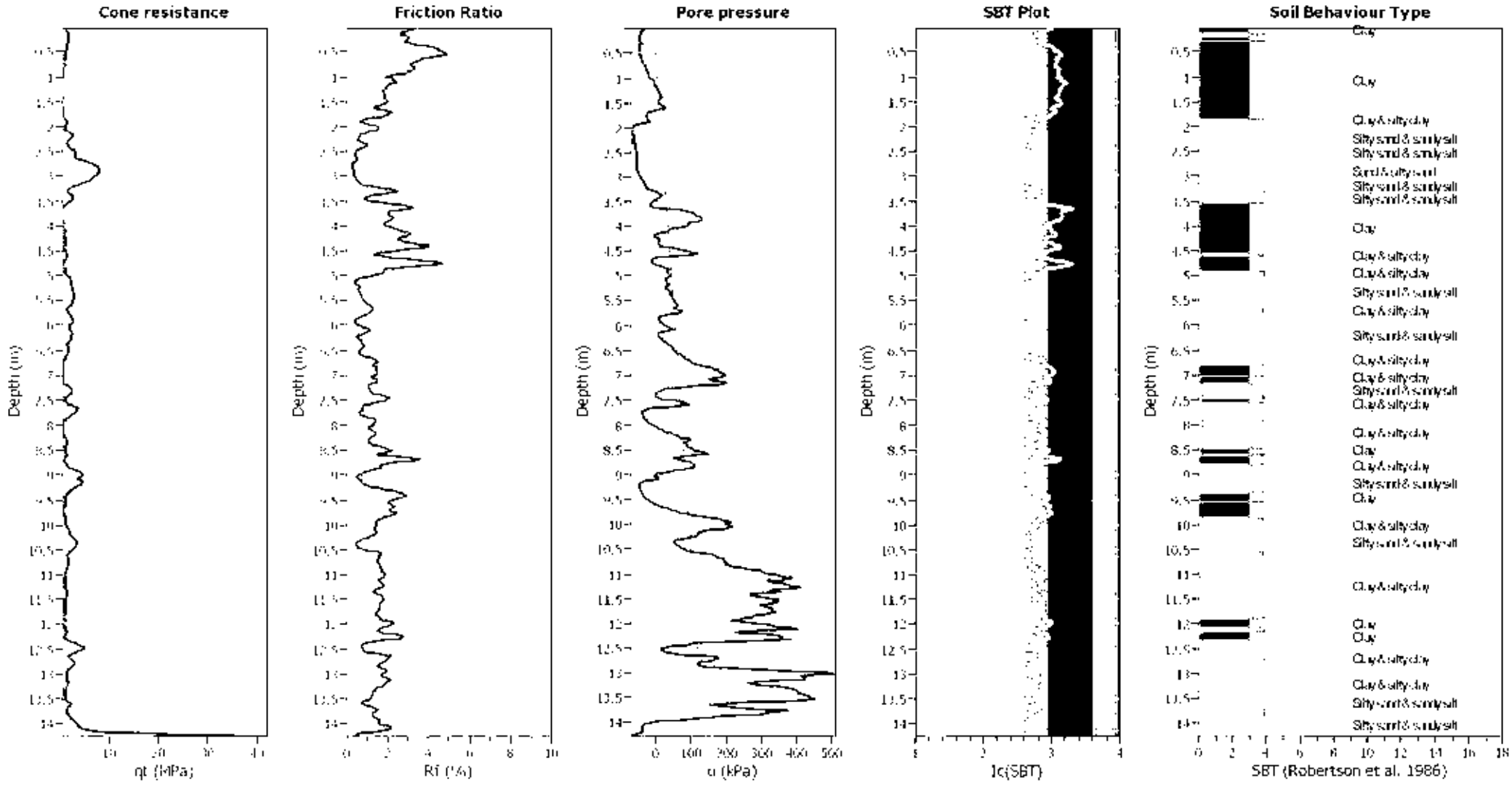
Analysis method	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



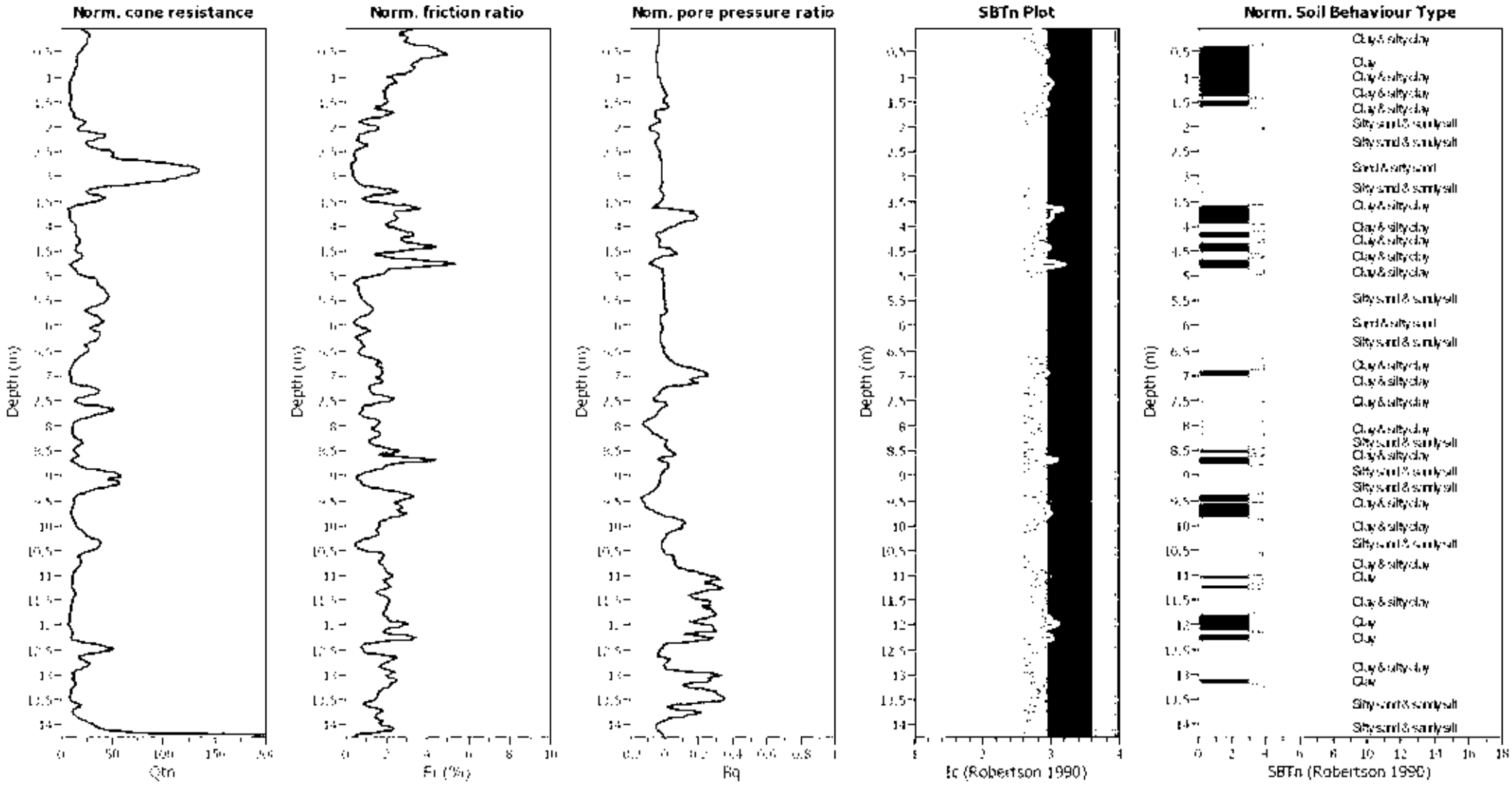
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



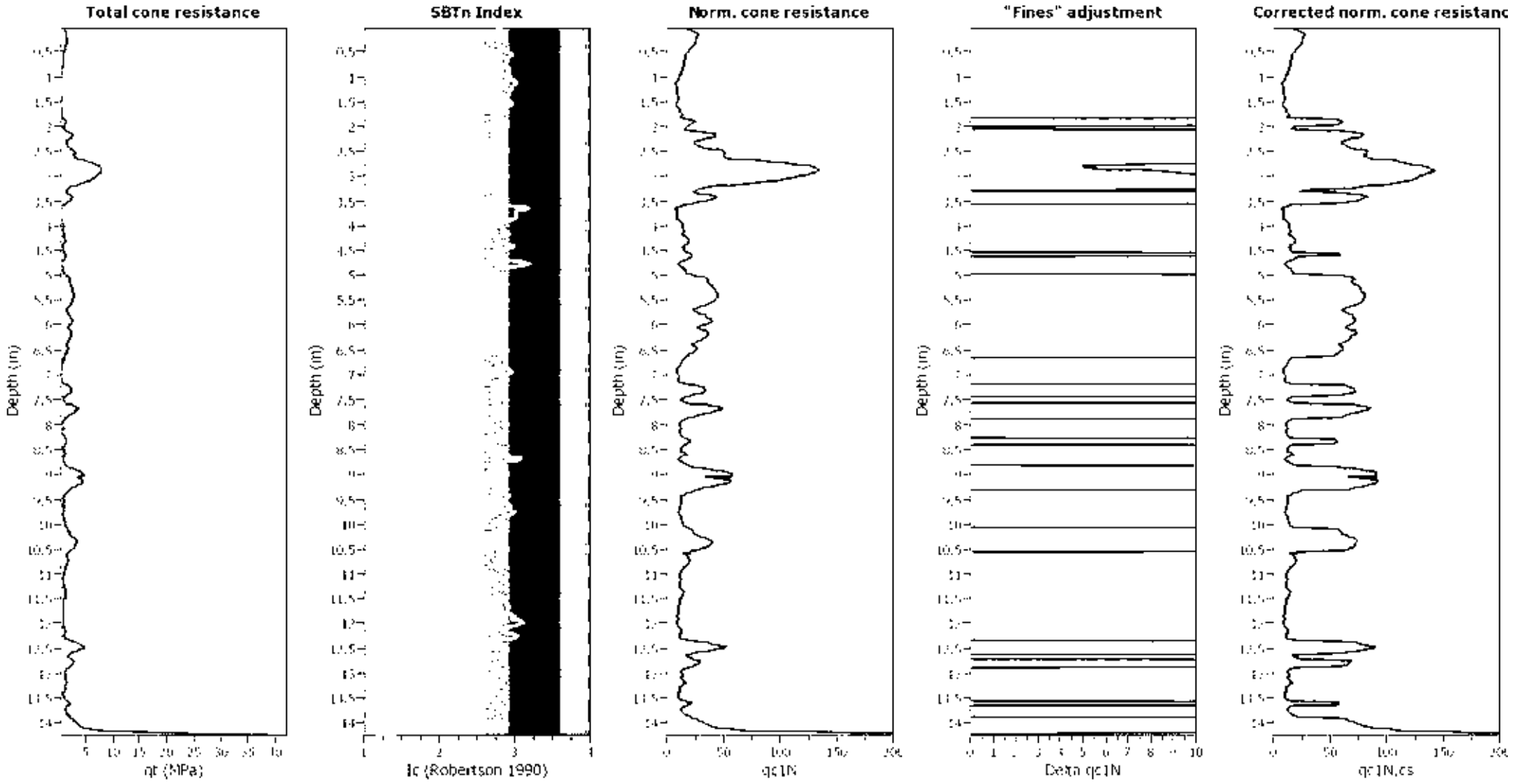
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

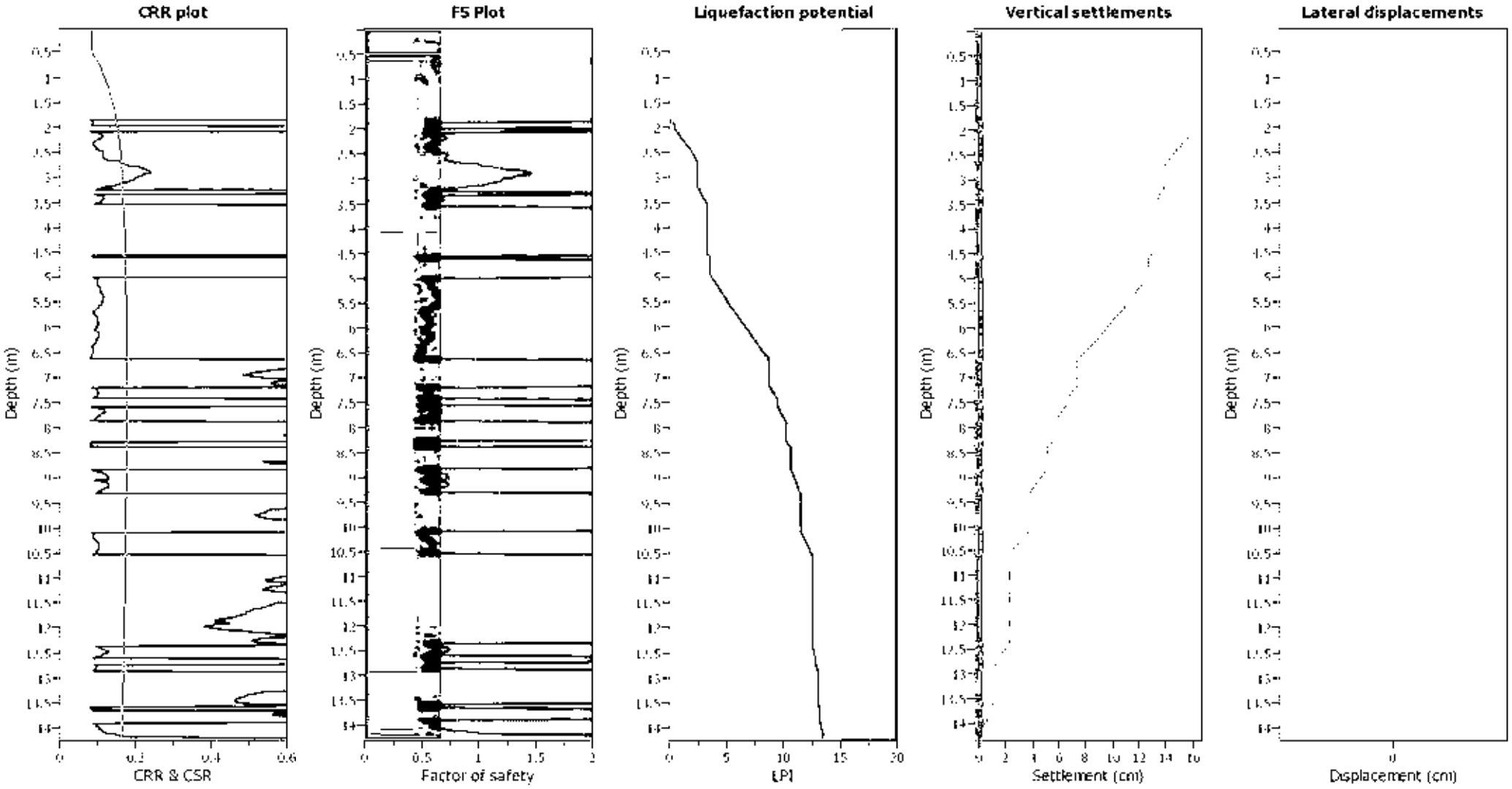
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
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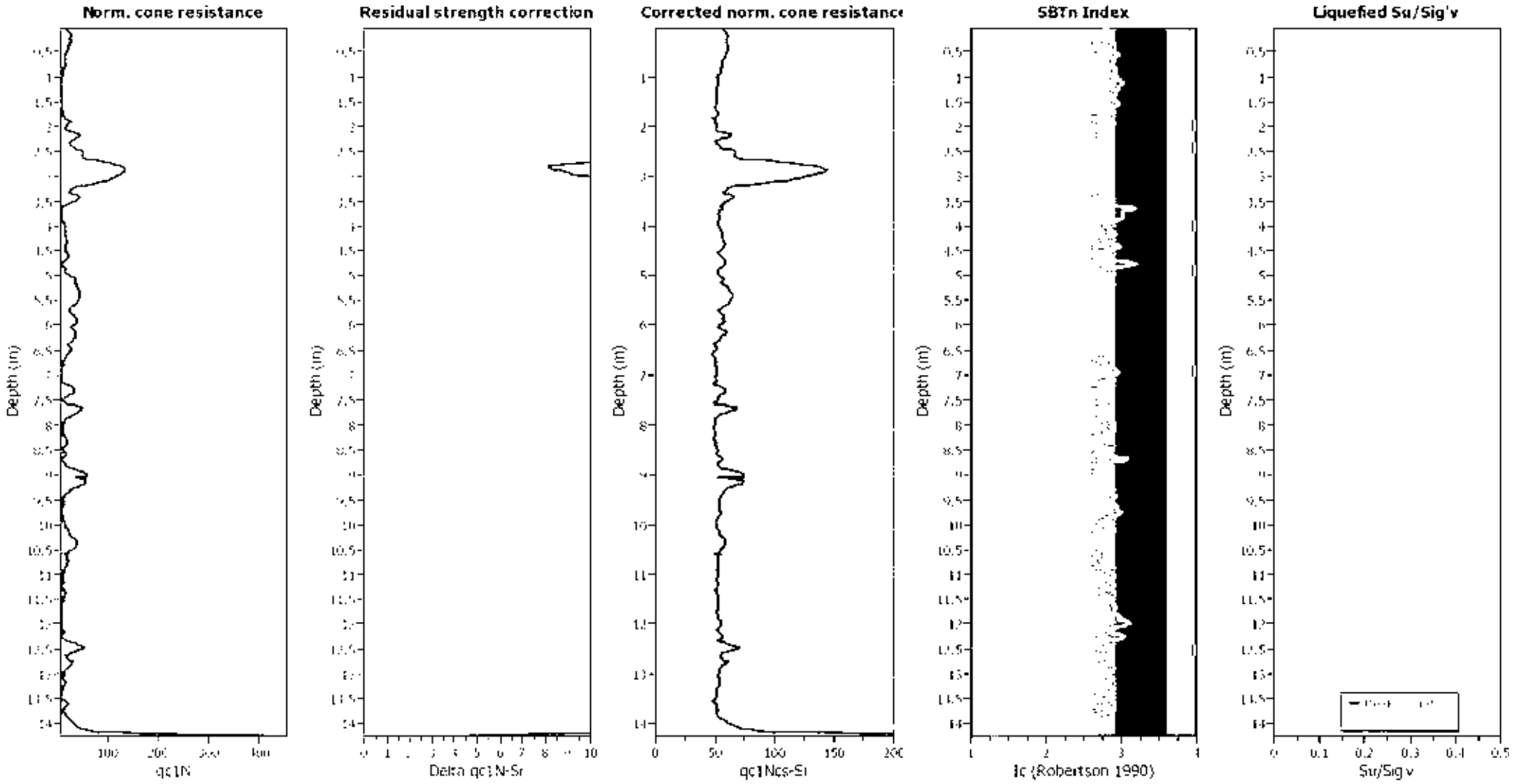
- ☐ Low risk

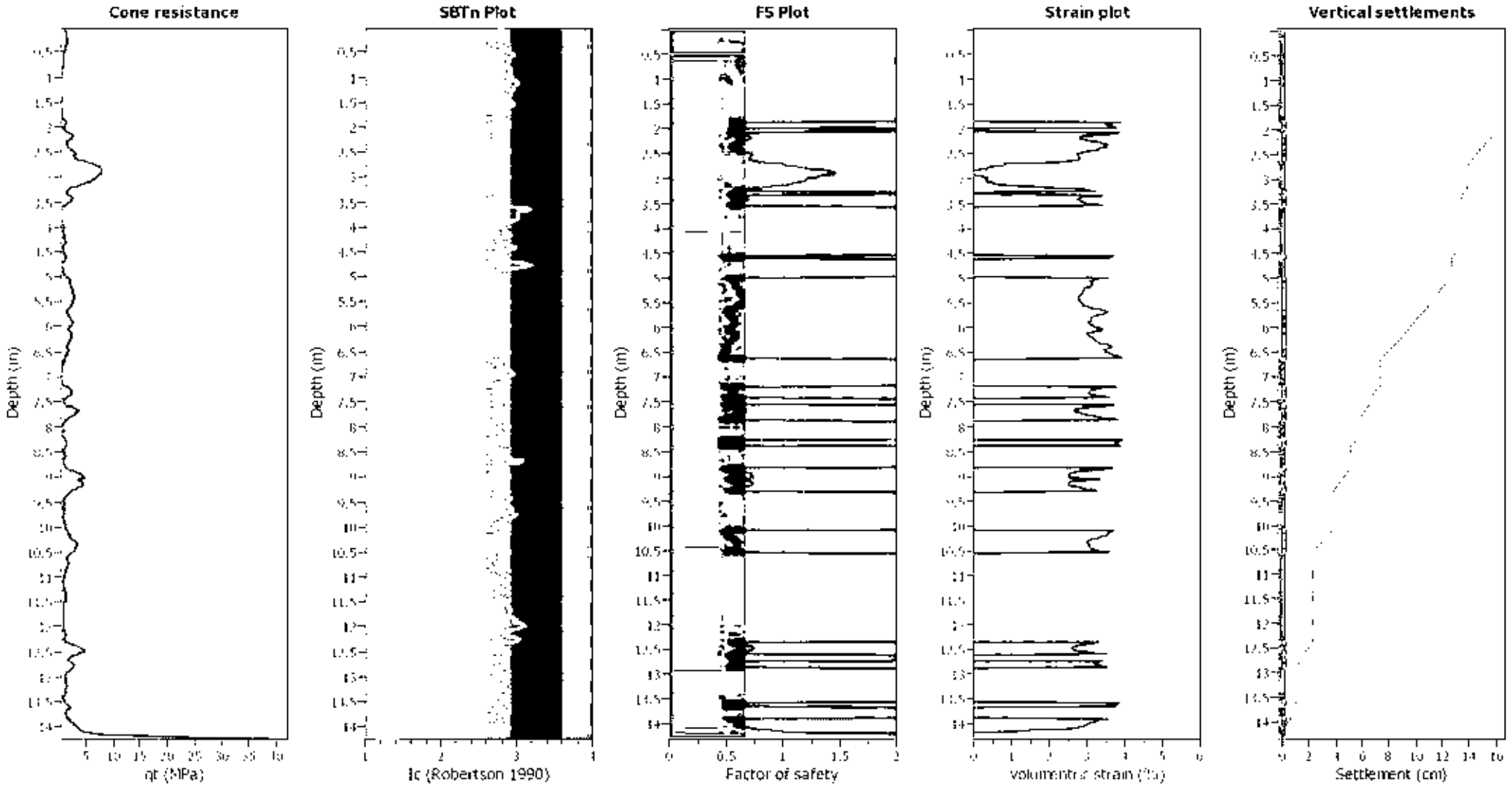
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

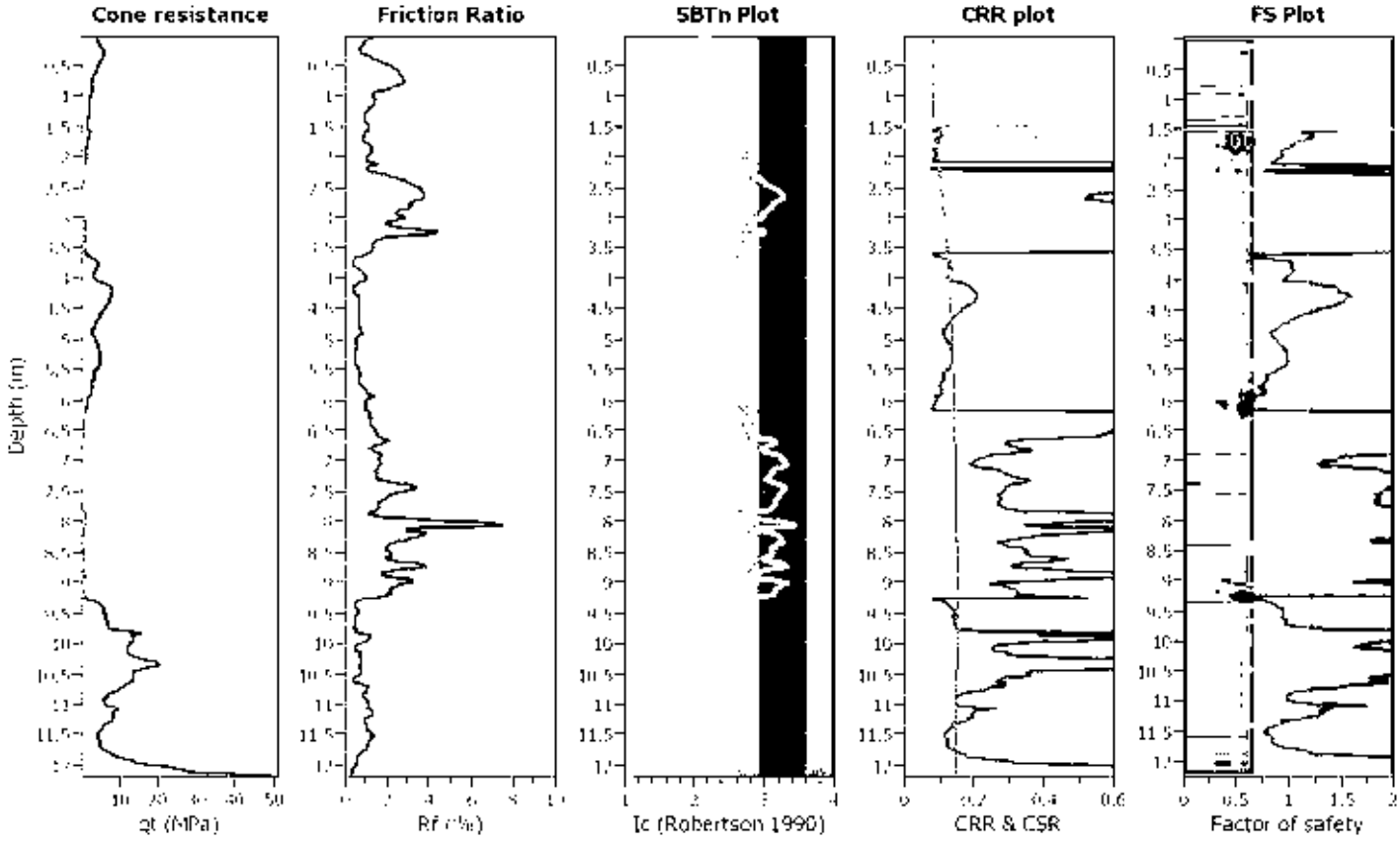
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

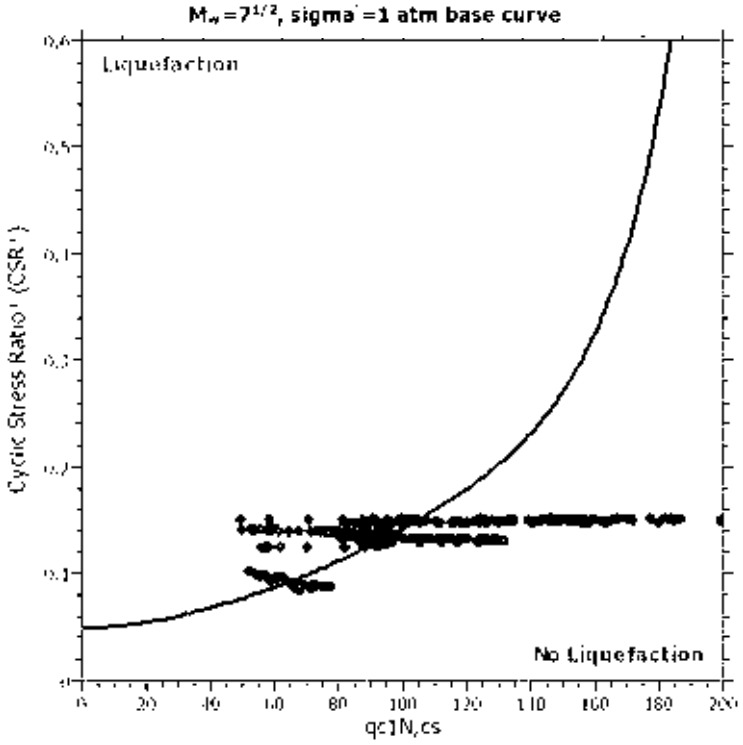
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

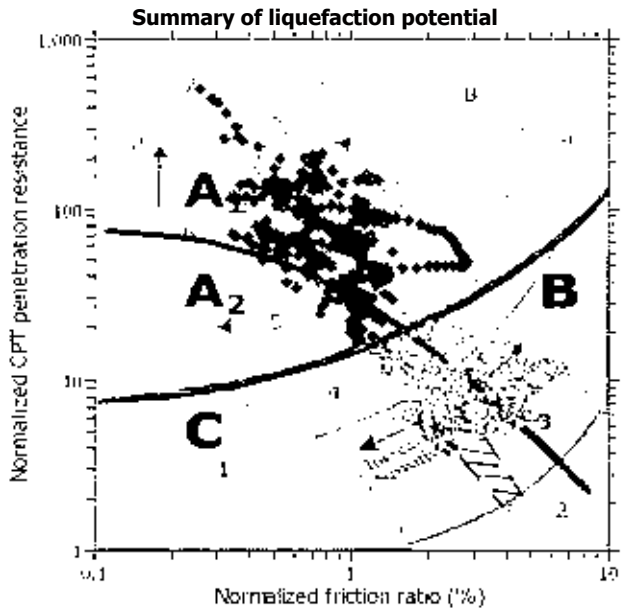
CPT file : CPT49_200CashmereRd

Input parameters and analysis data

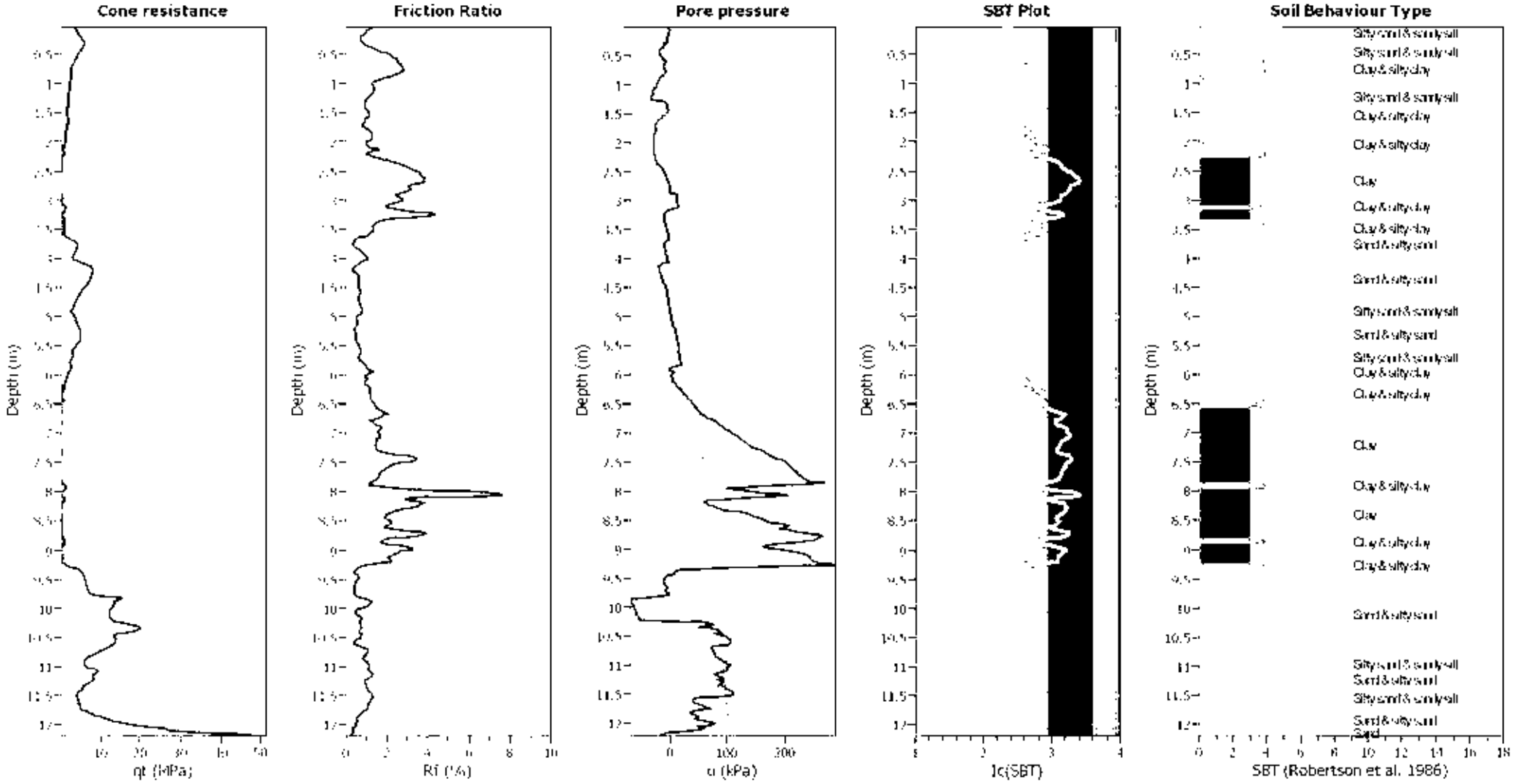
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



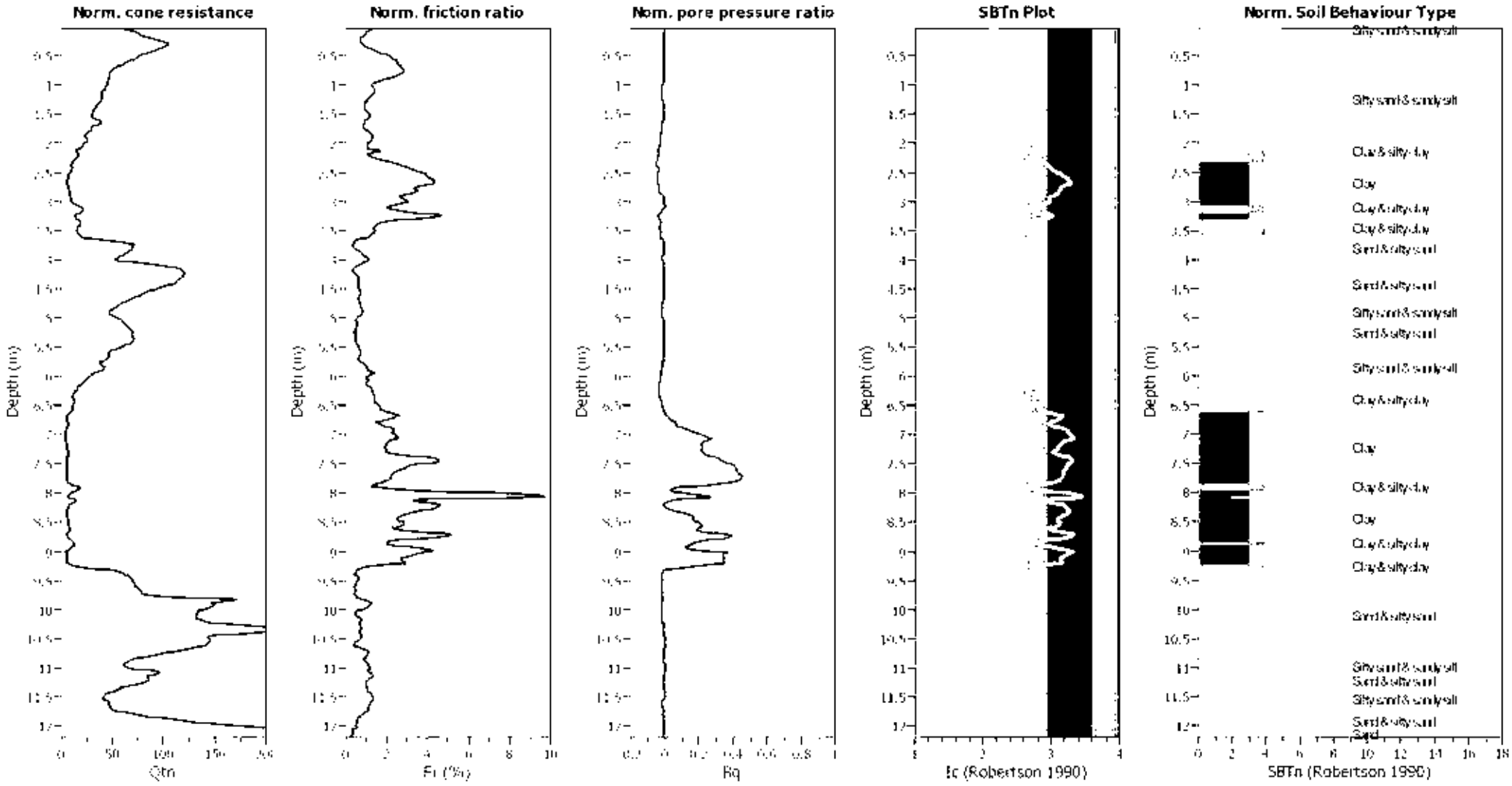
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



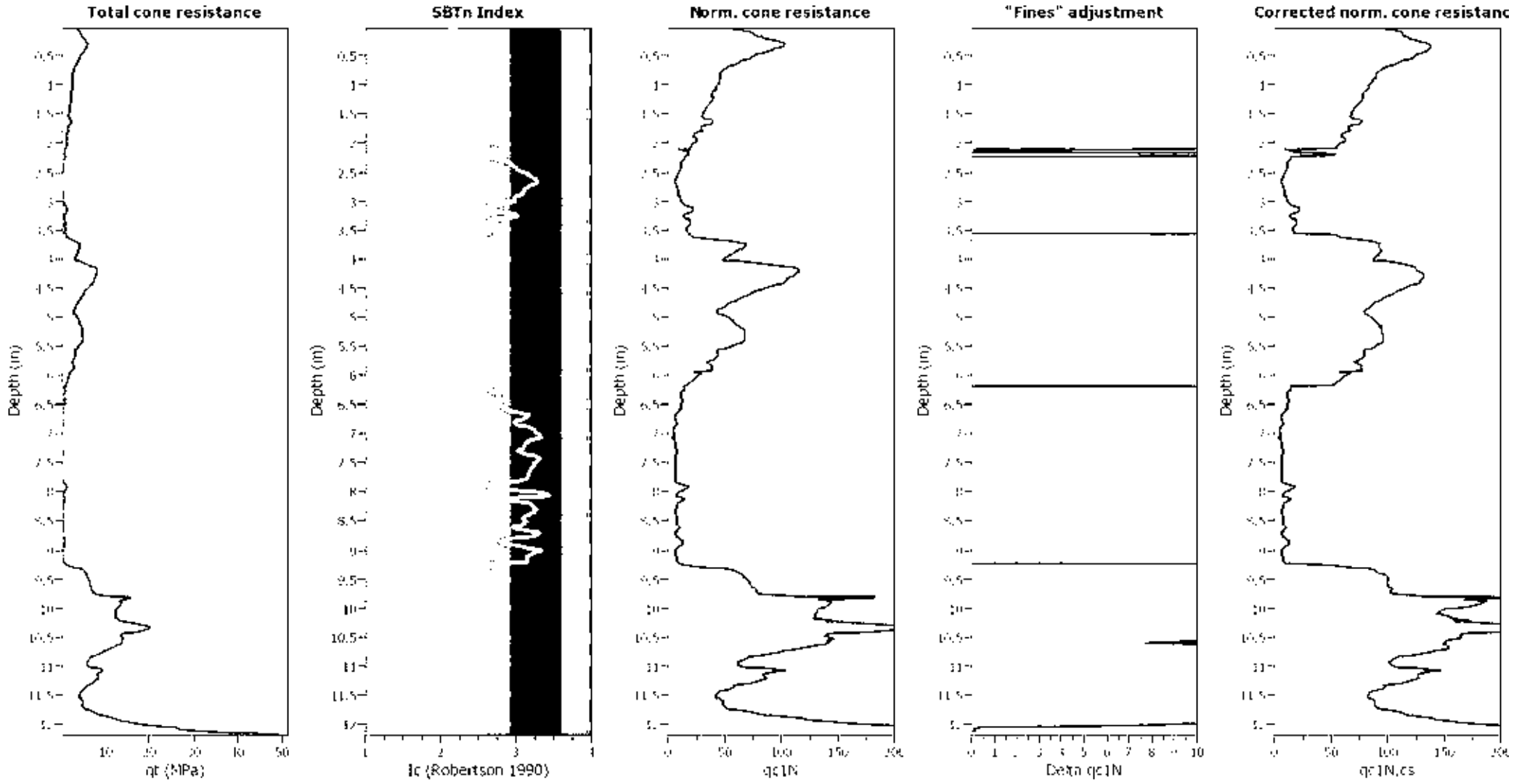
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

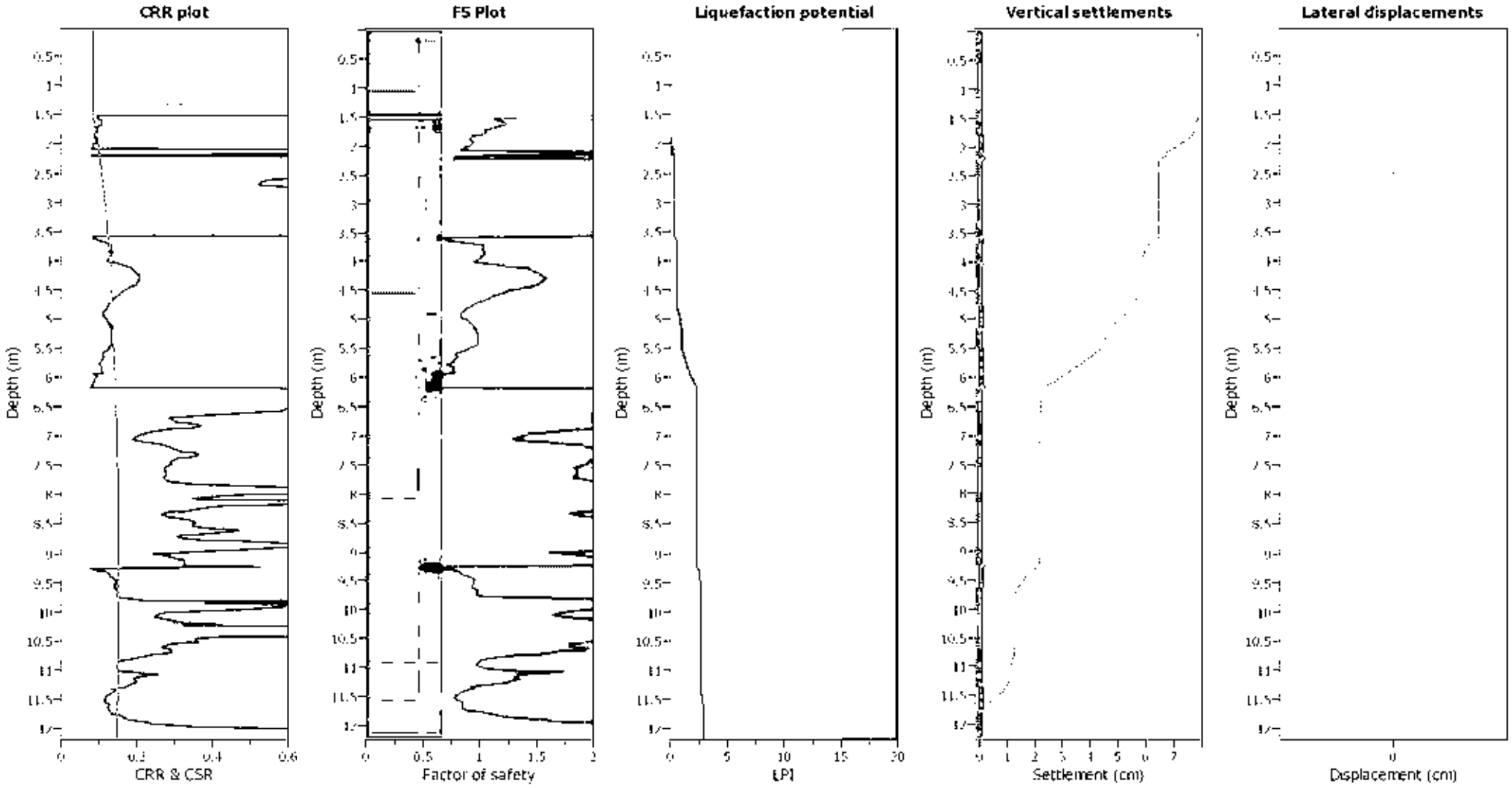
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.50 m	Fill height:	N/A	Limit depth:	N/A

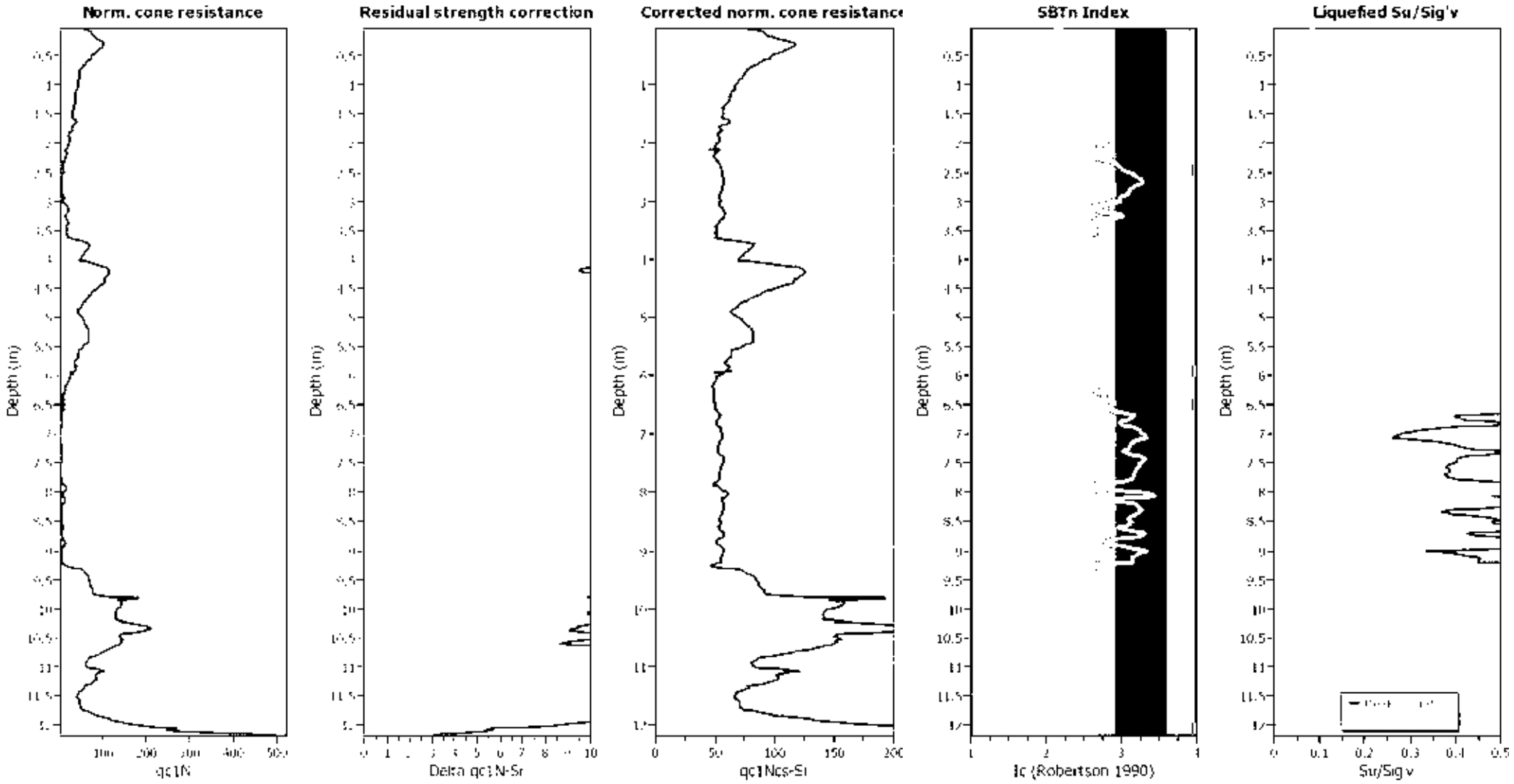
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

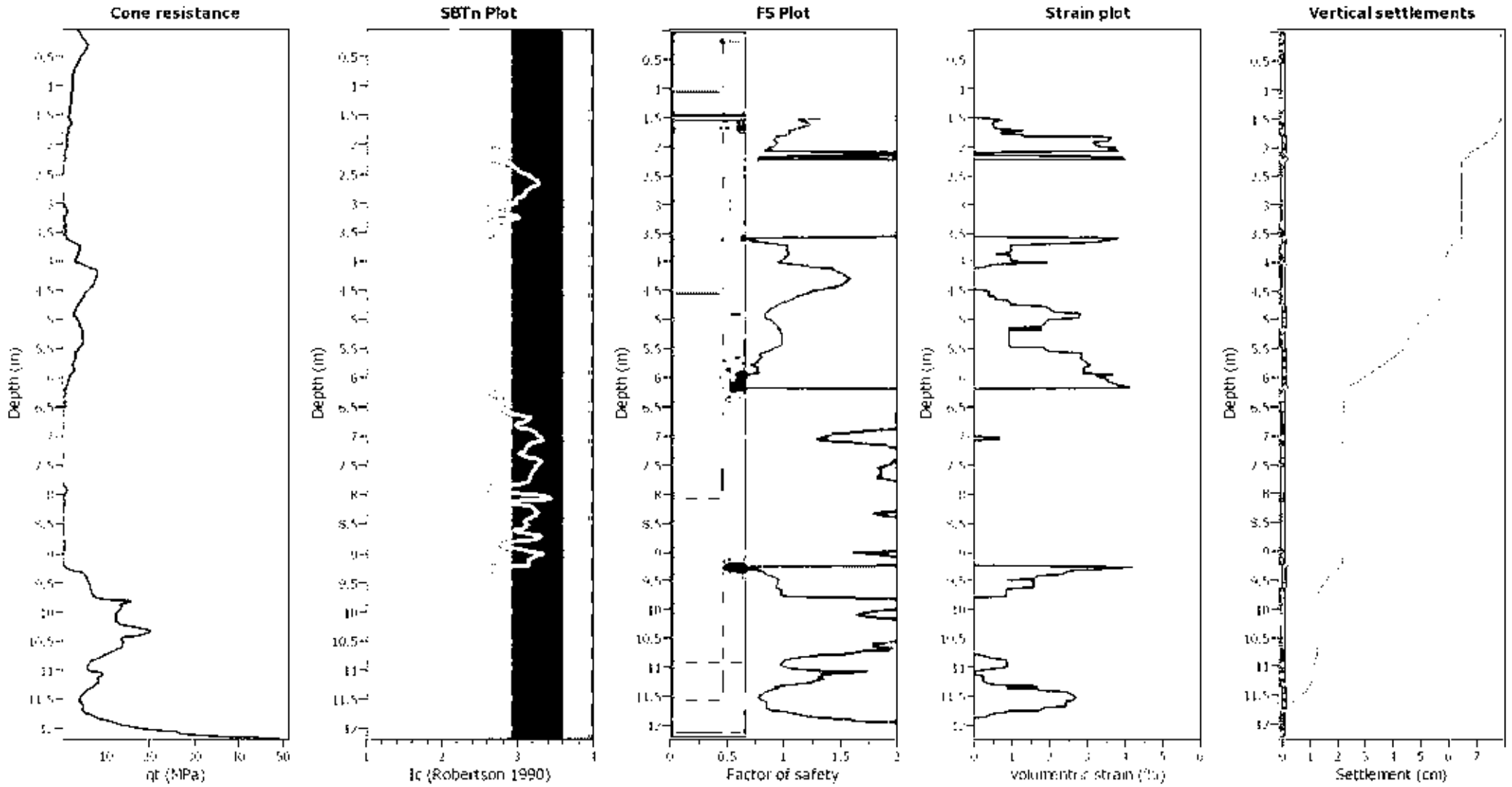
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Liquefaction correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

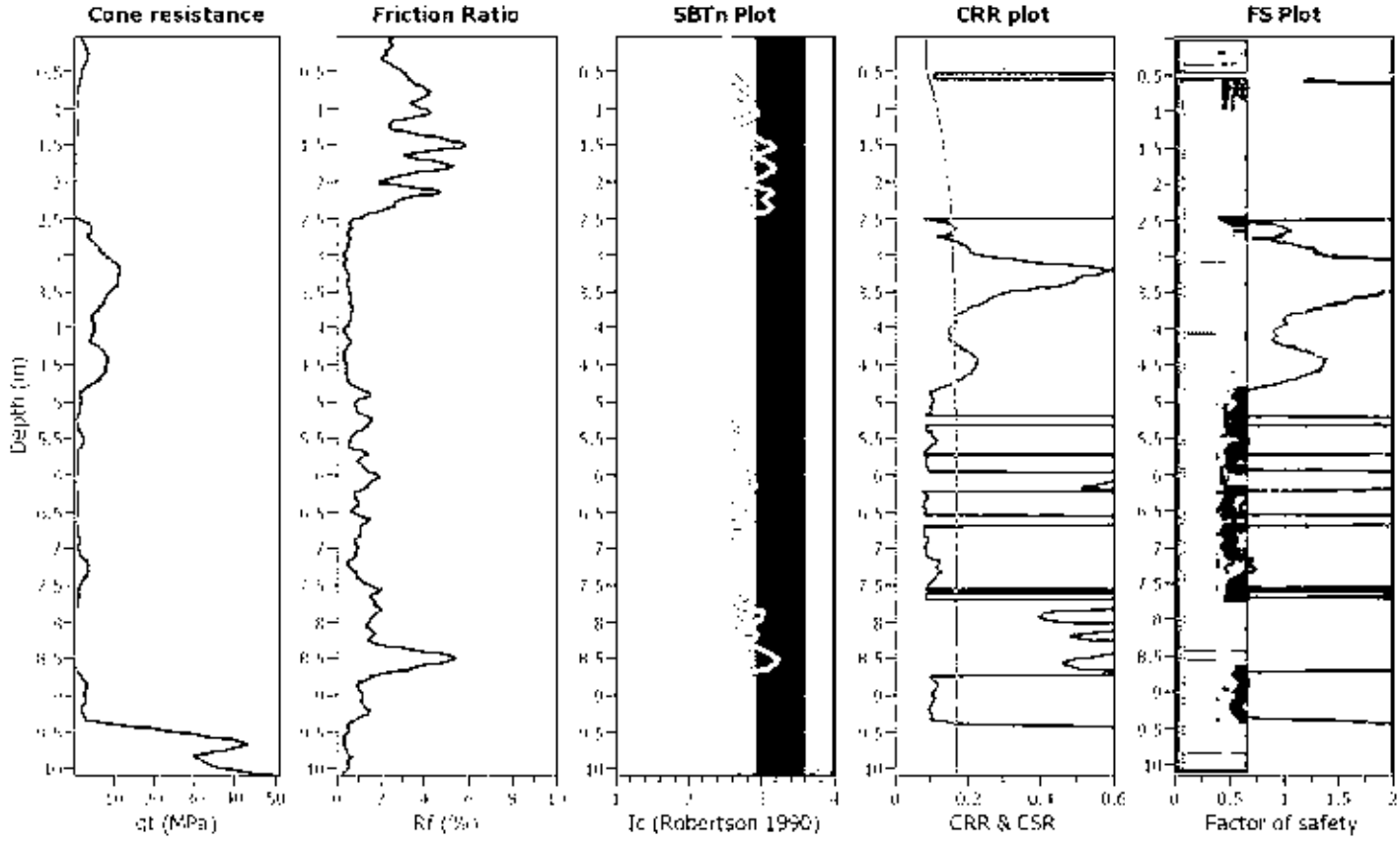
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

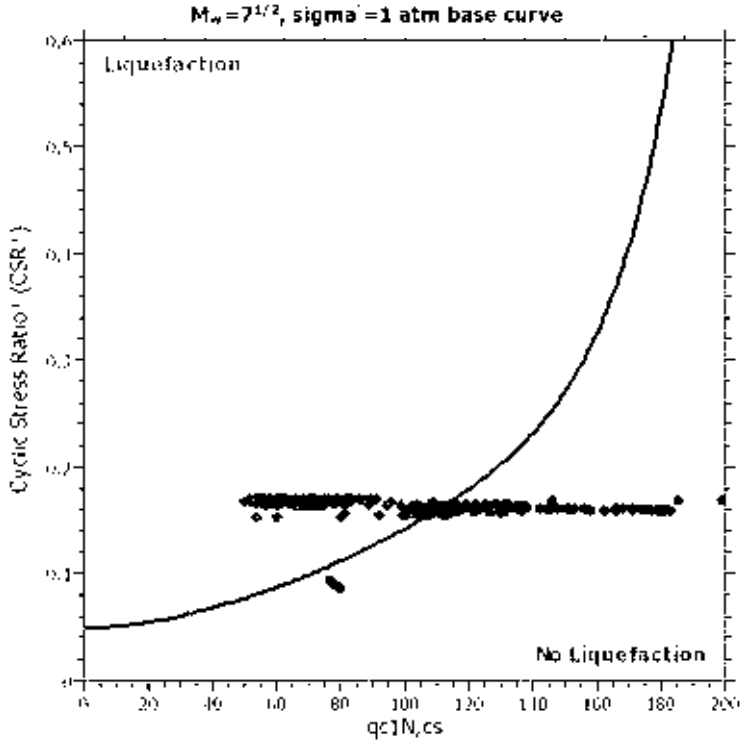
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

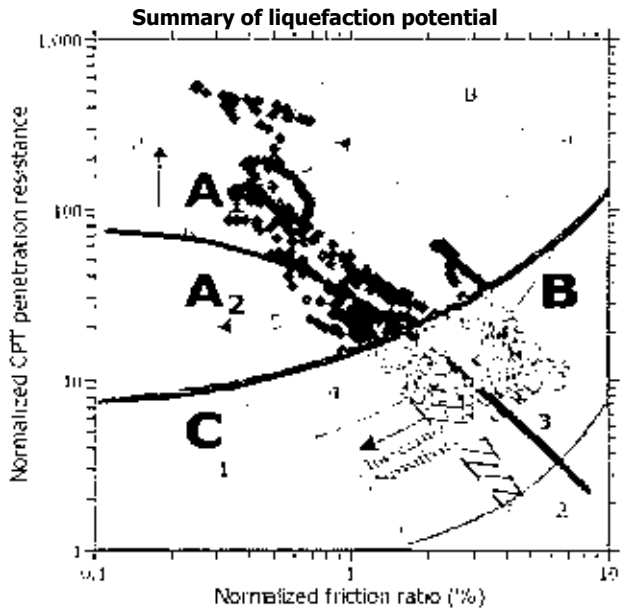
CPT file : CPT50_334SparksRd

Input parameters and analysis data

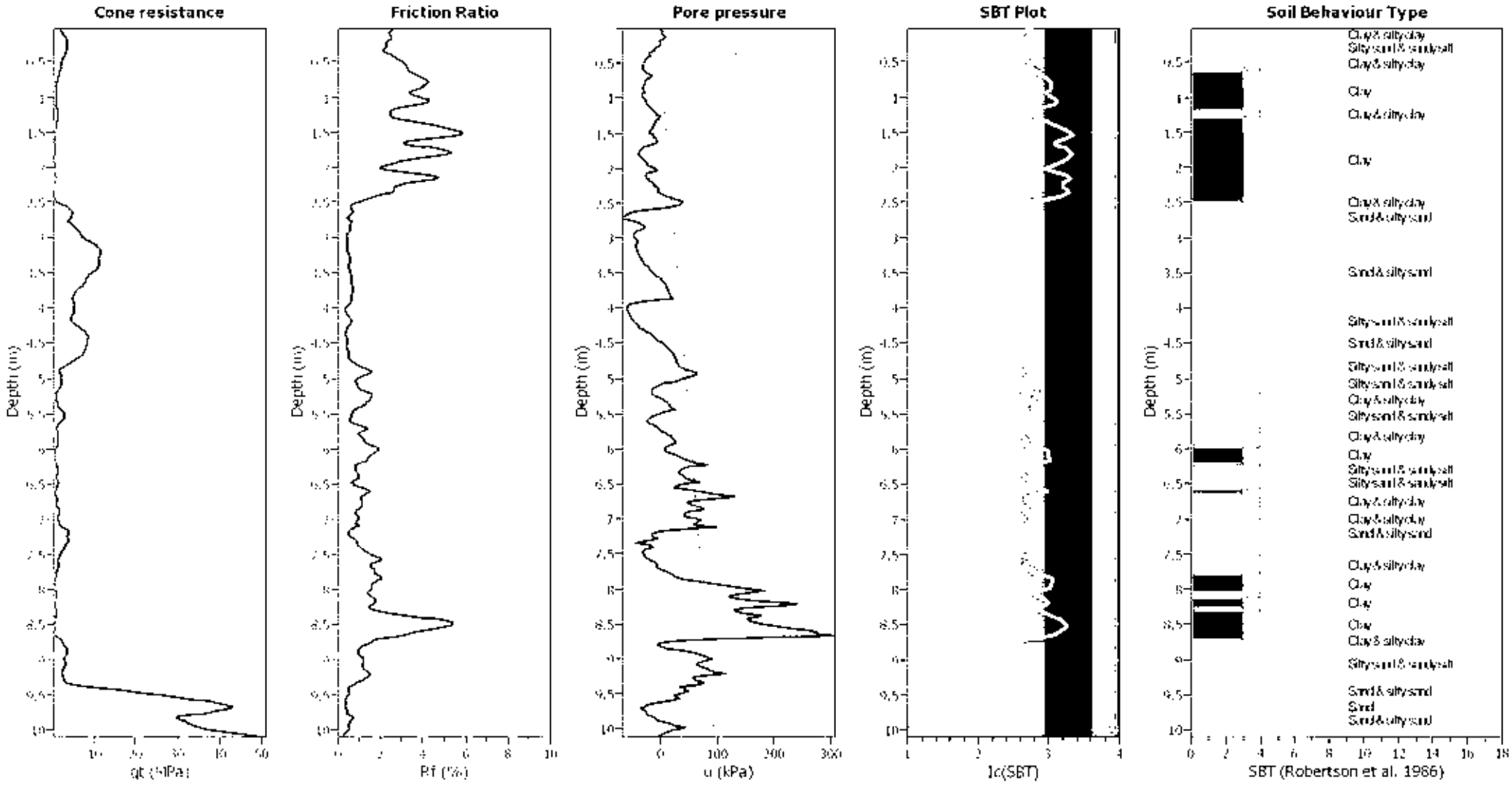
Analysis method	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.13	Unit weight calculation:	Based on SBT	K applied:	Yes		







CPT basic interpretation plots



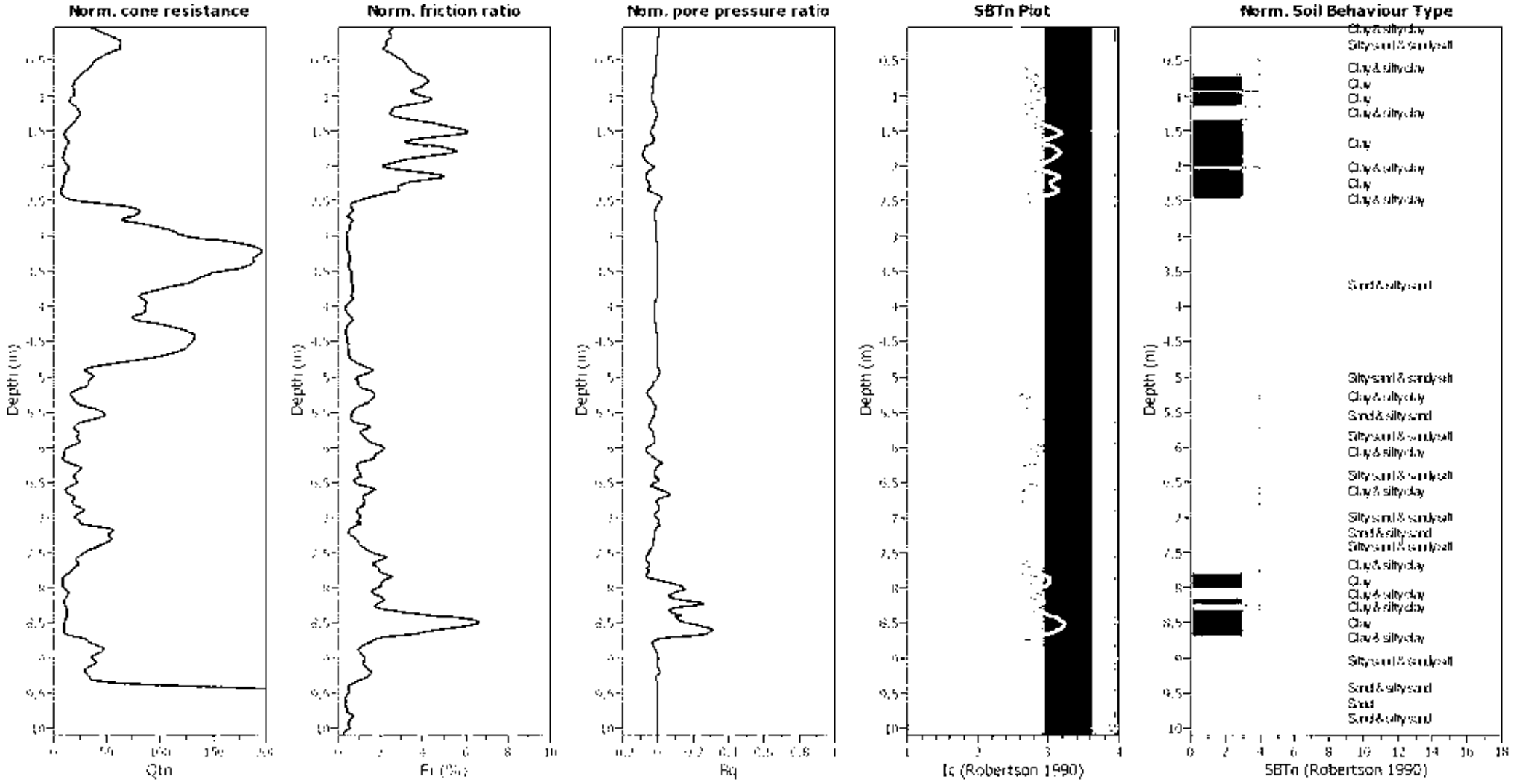
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



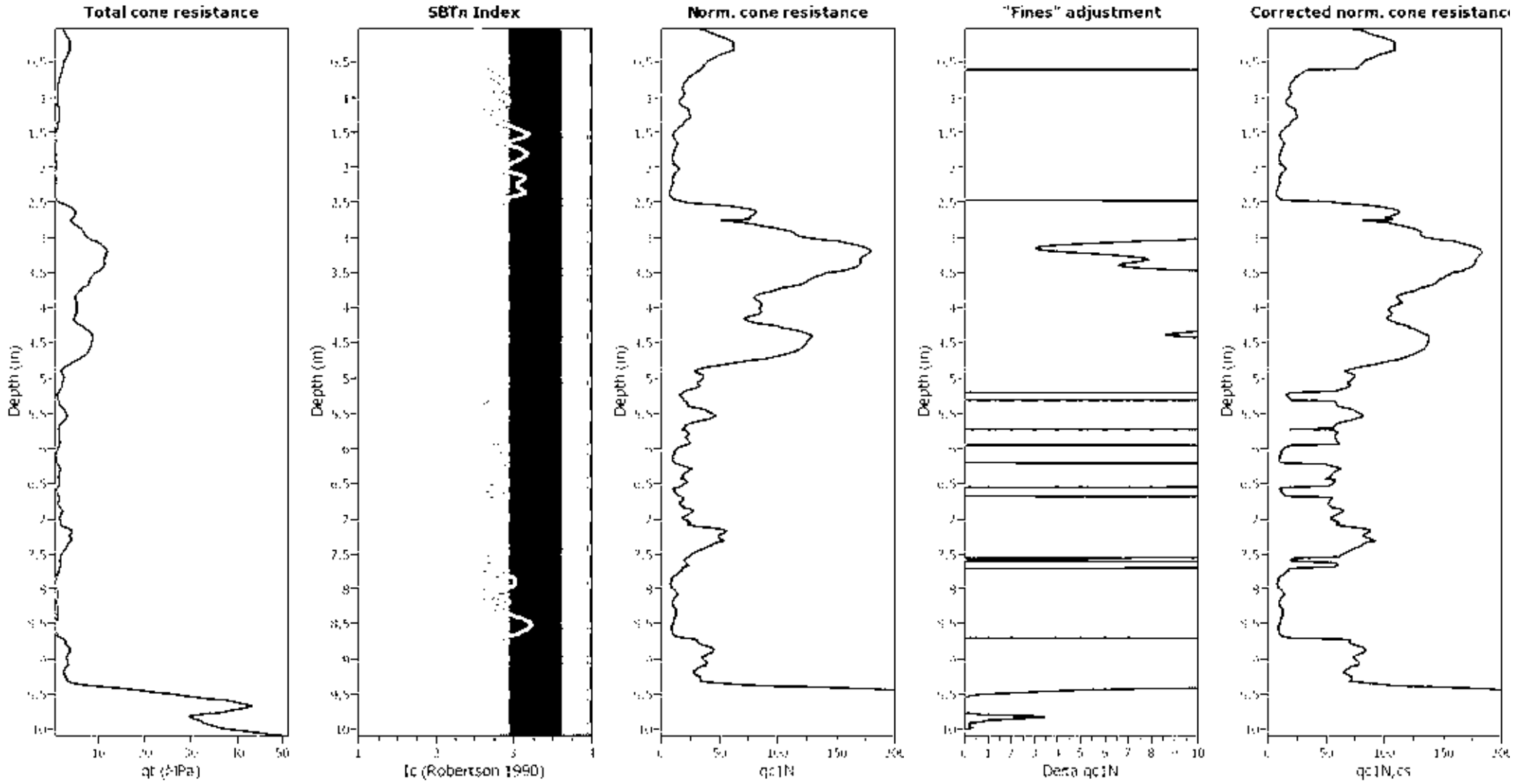
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

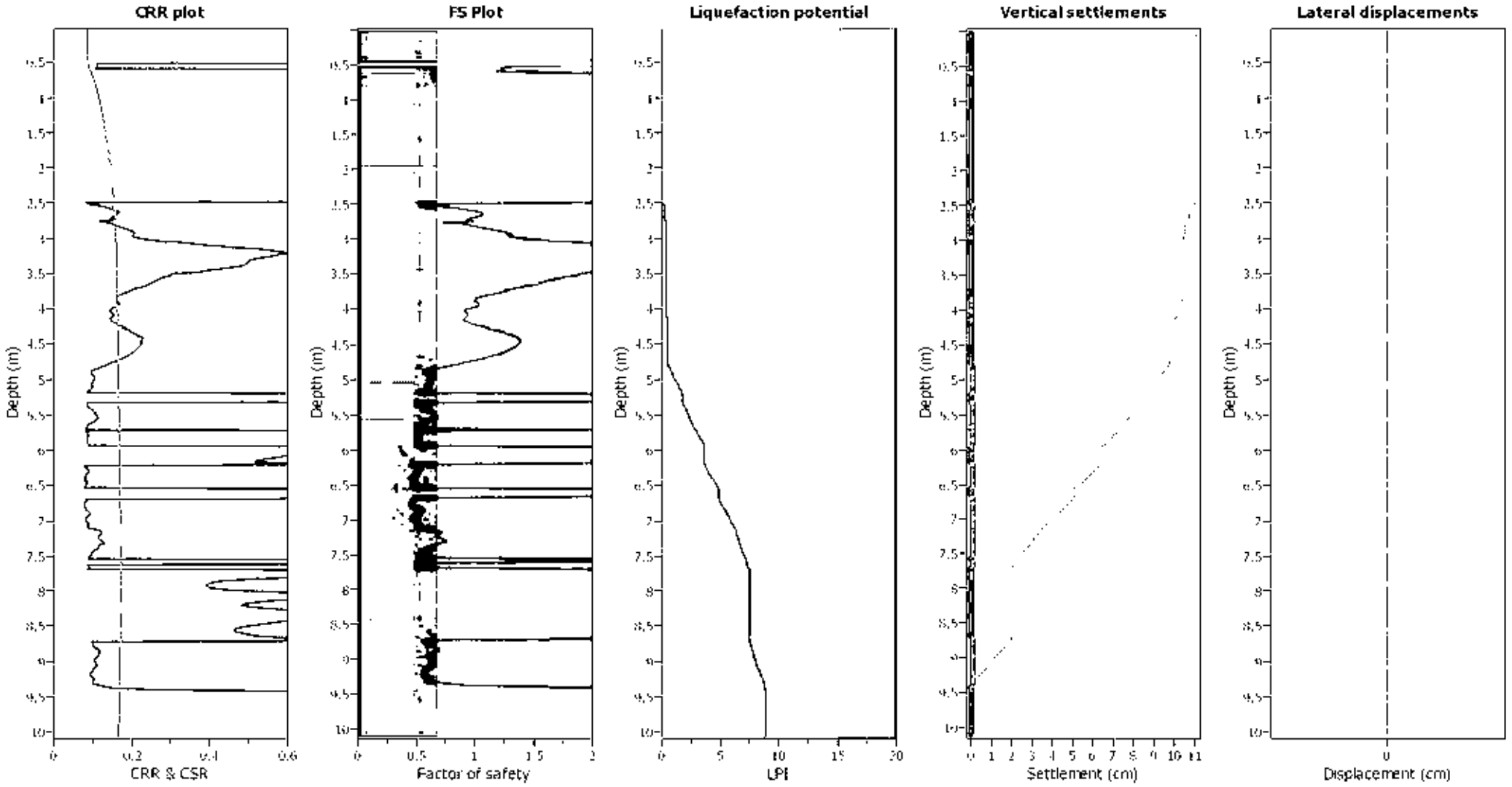
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (m/ft):	0.50 m	Fill height:	N/A	Limit depth:	N/A

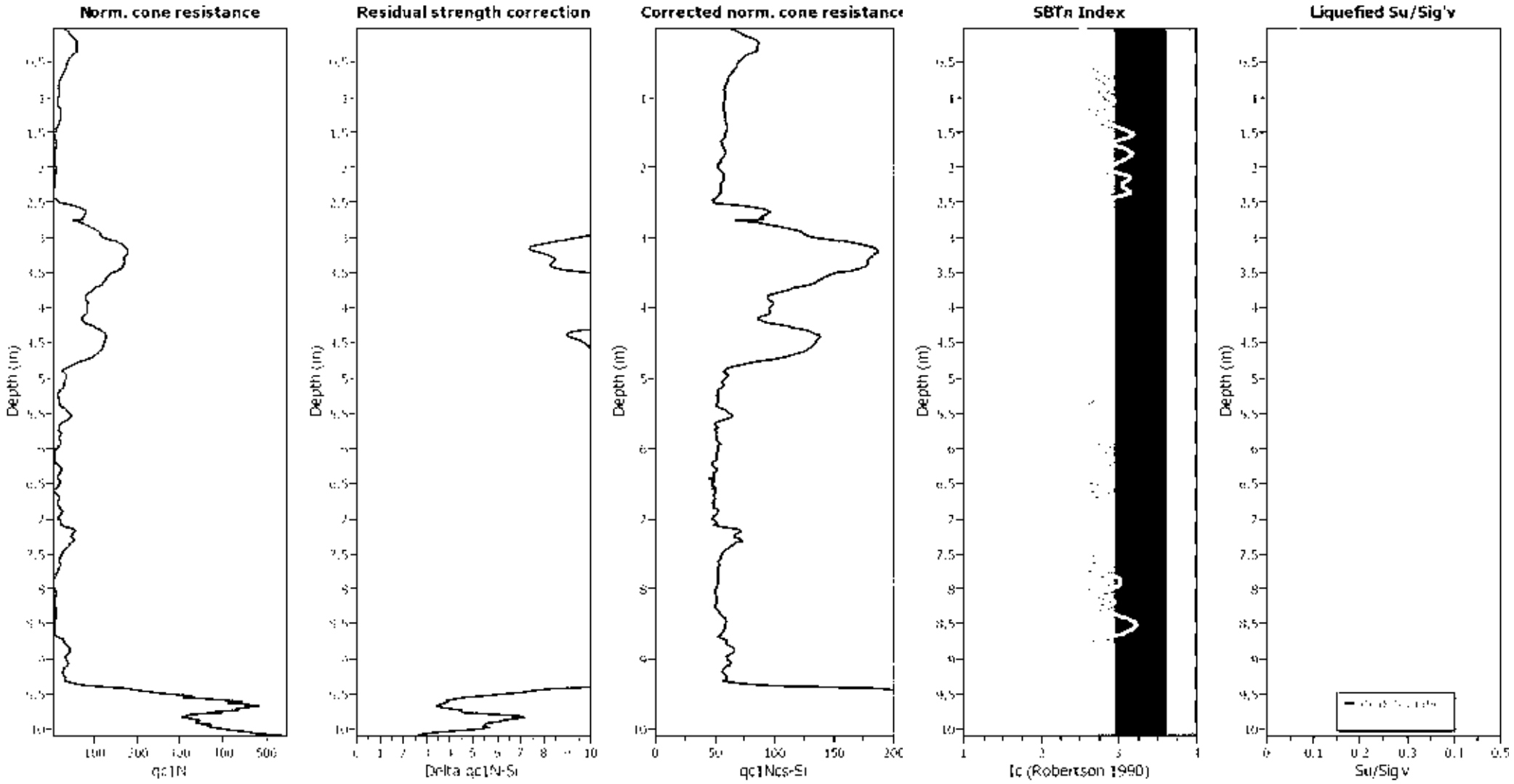
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

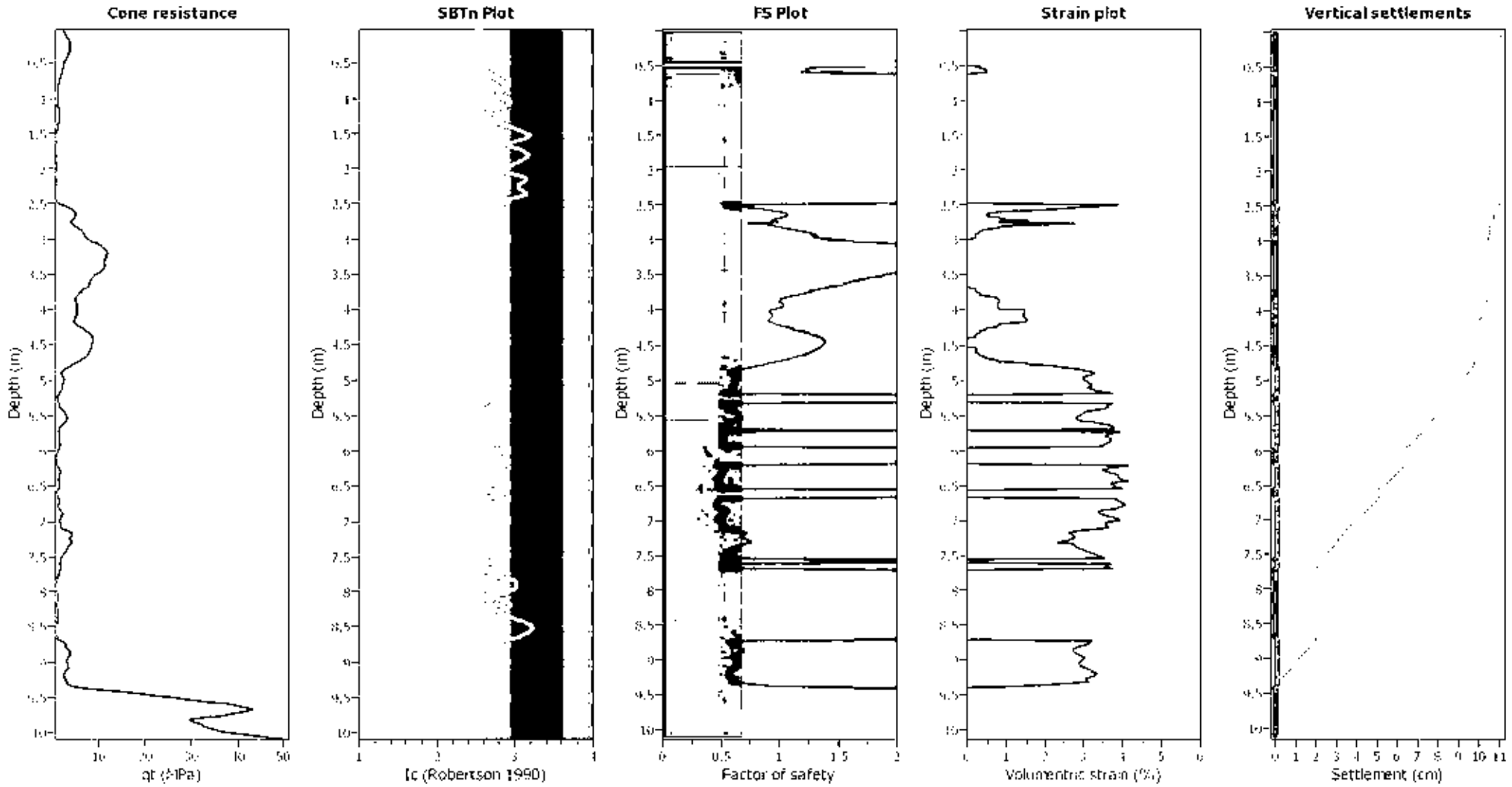
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

qc	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

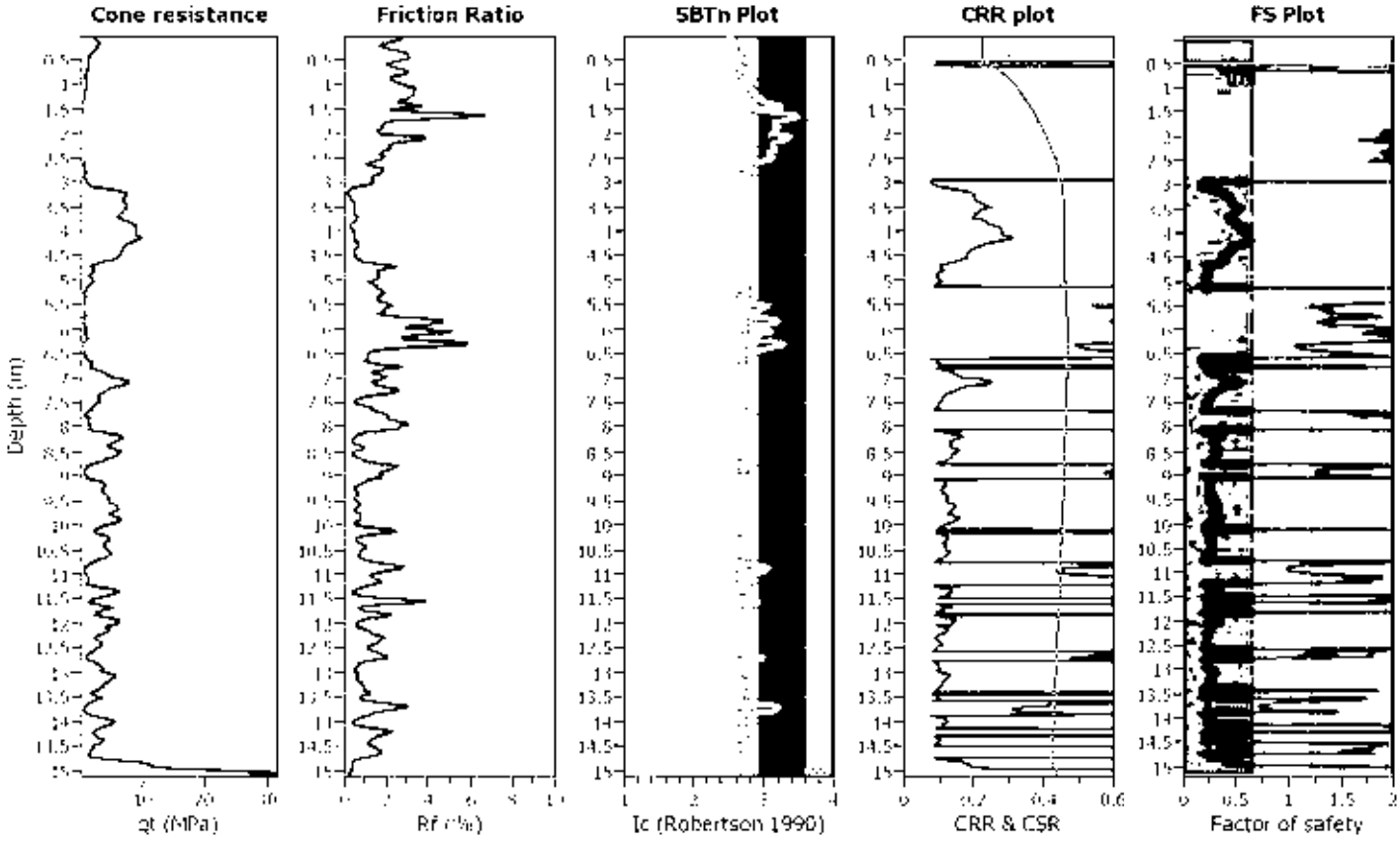
Beca Ltd
Geotechnical Engineers
www.beca.com

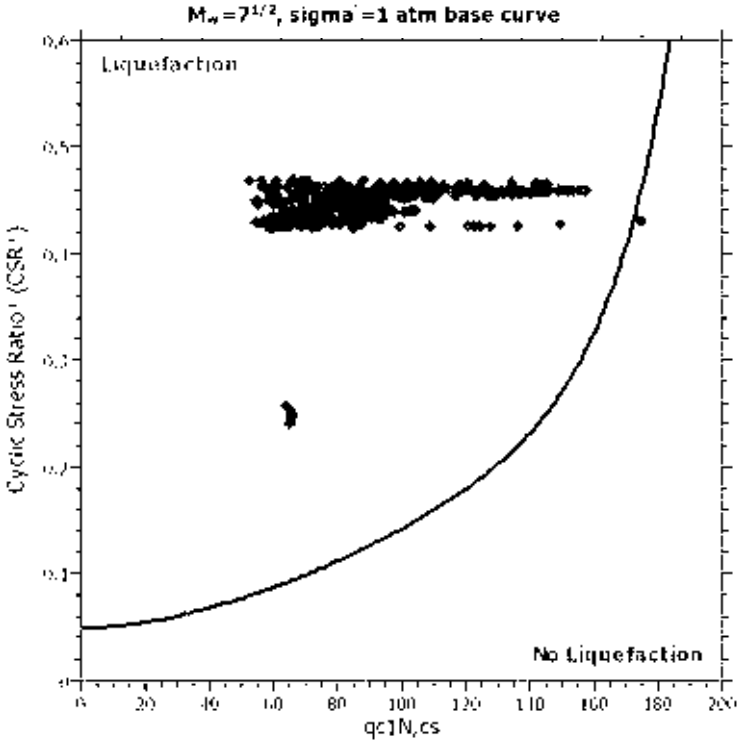
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

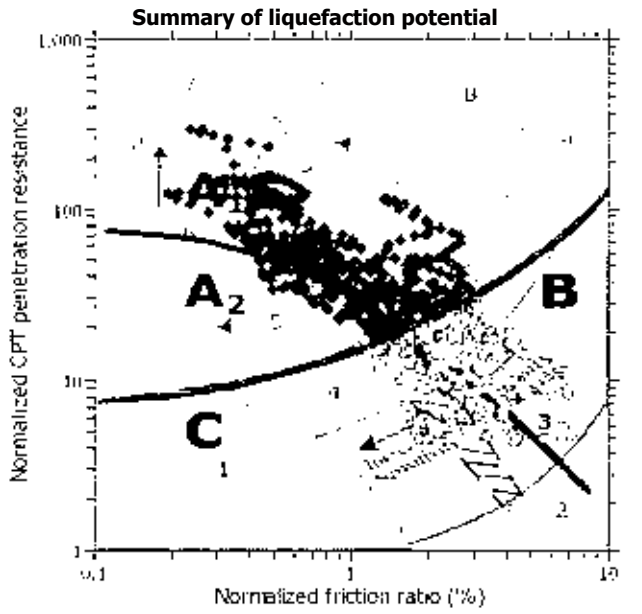
CPT file : CPT34_396SparksRd

Input parameters and analysis data

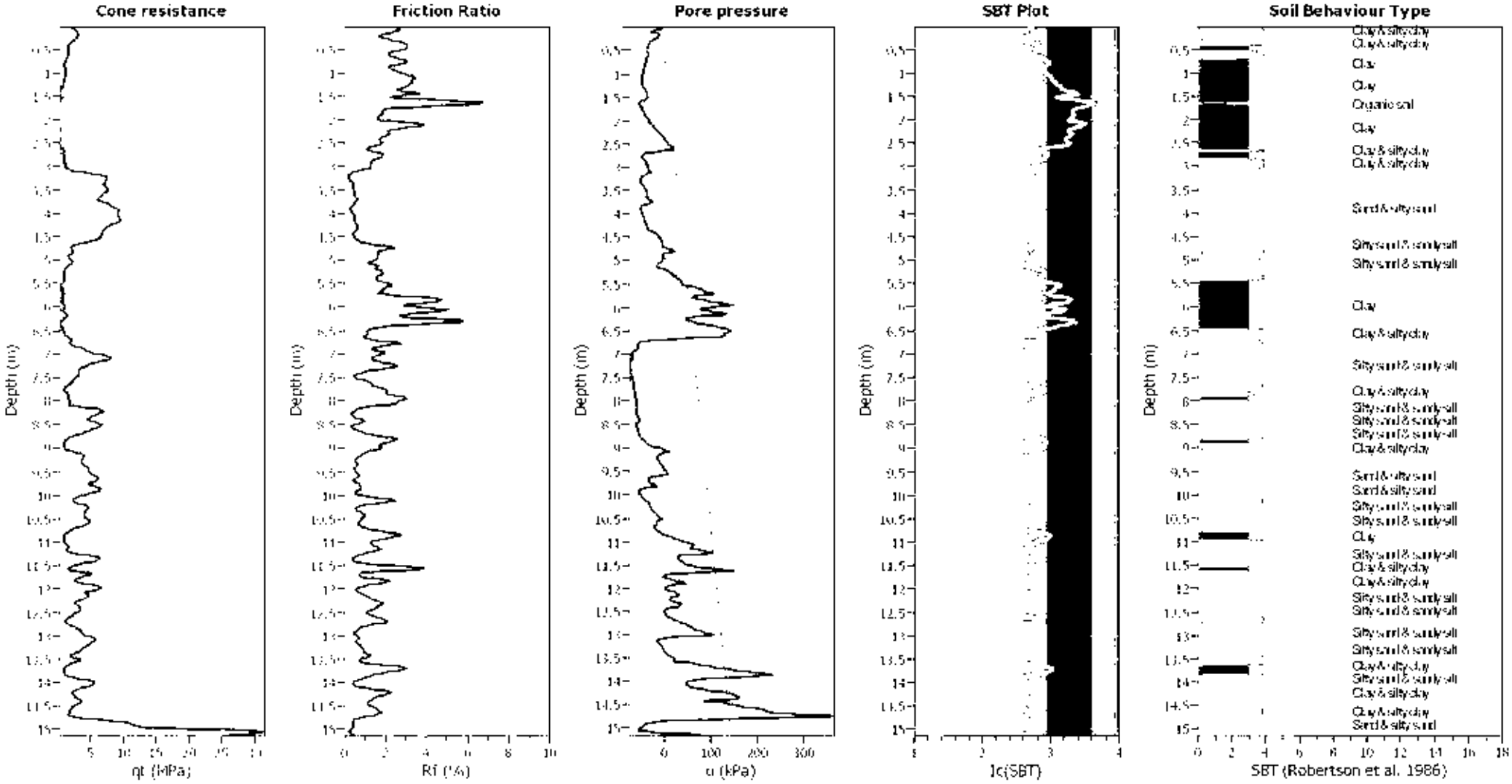
Analysis method	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



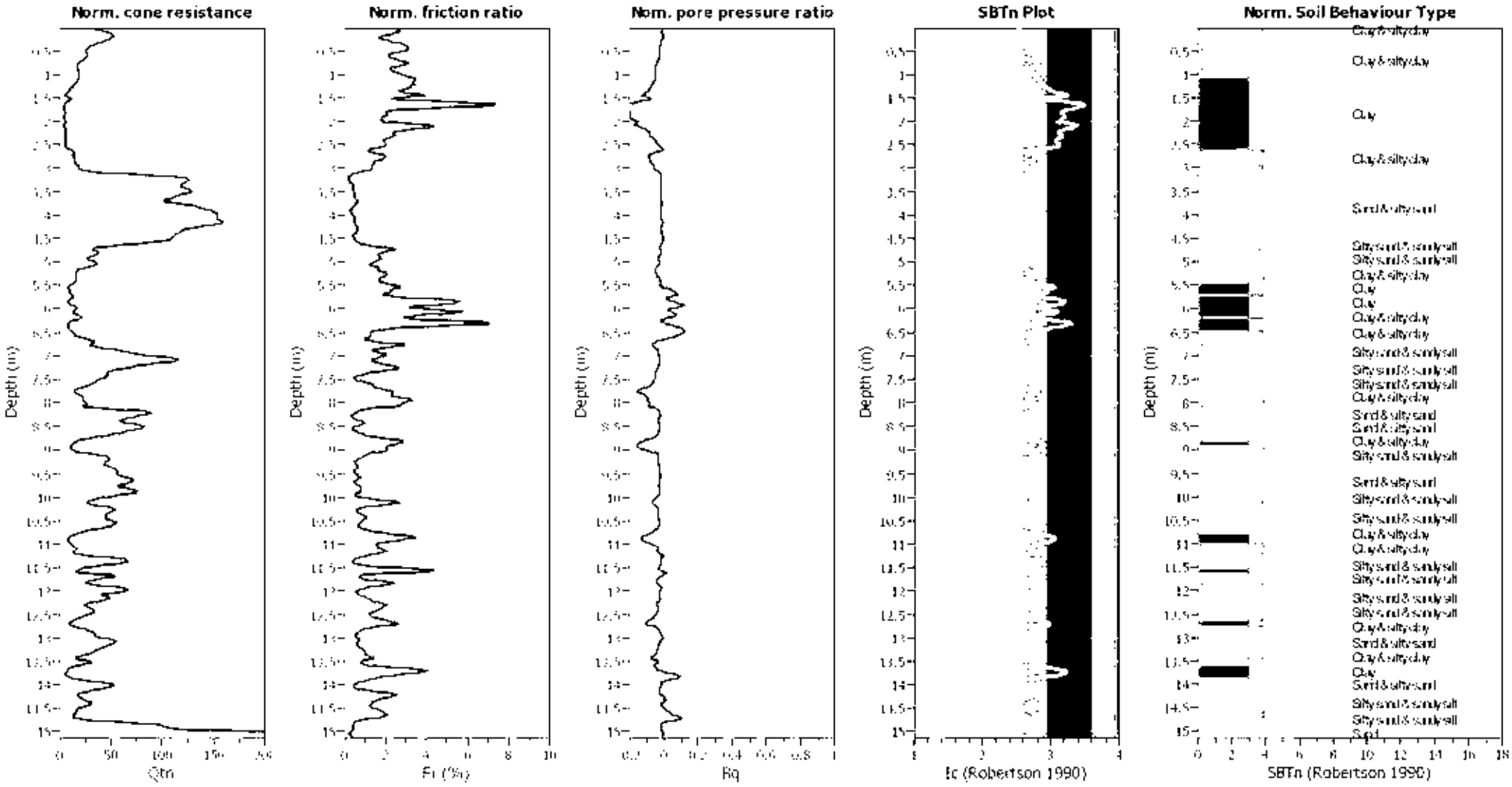
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



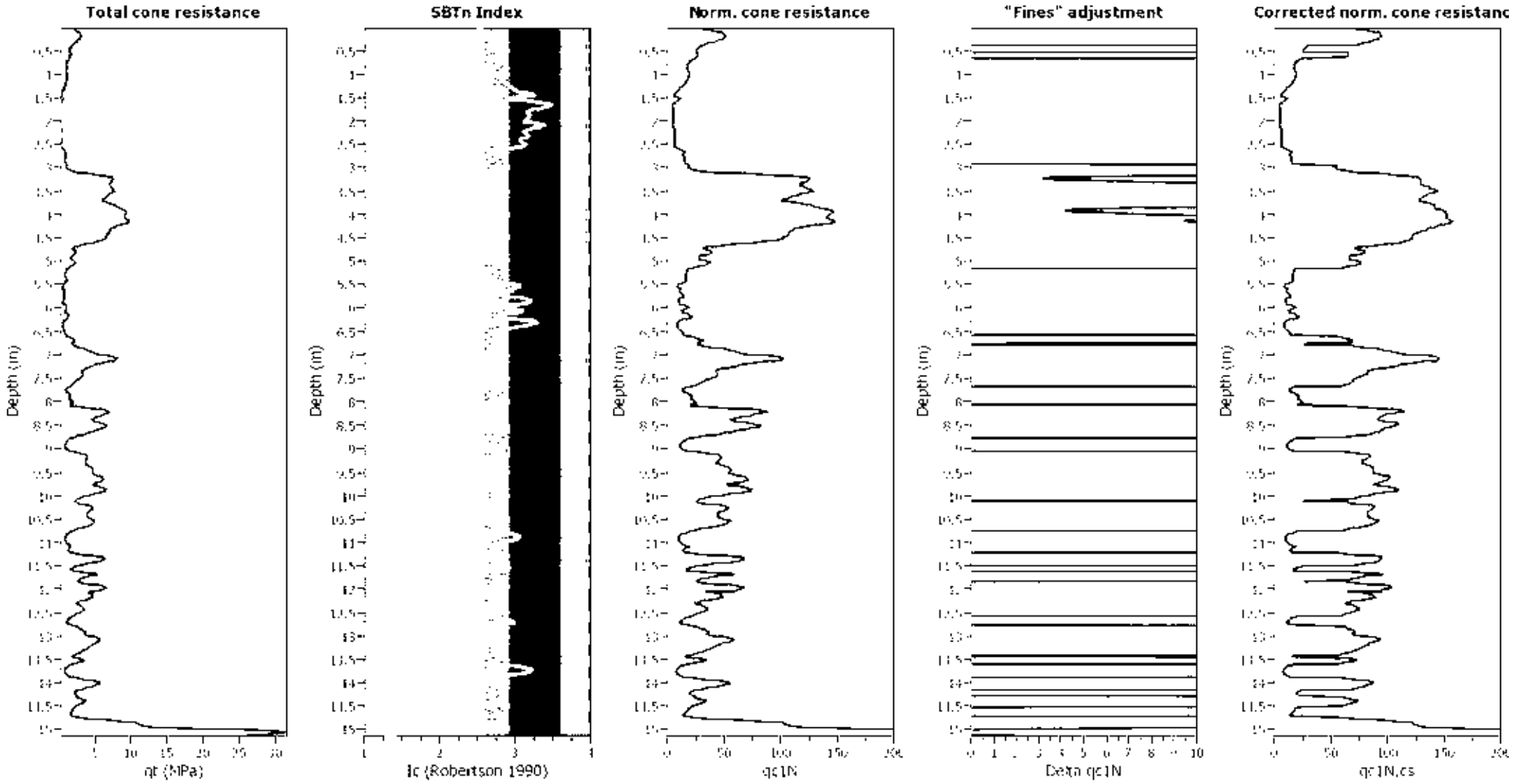
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

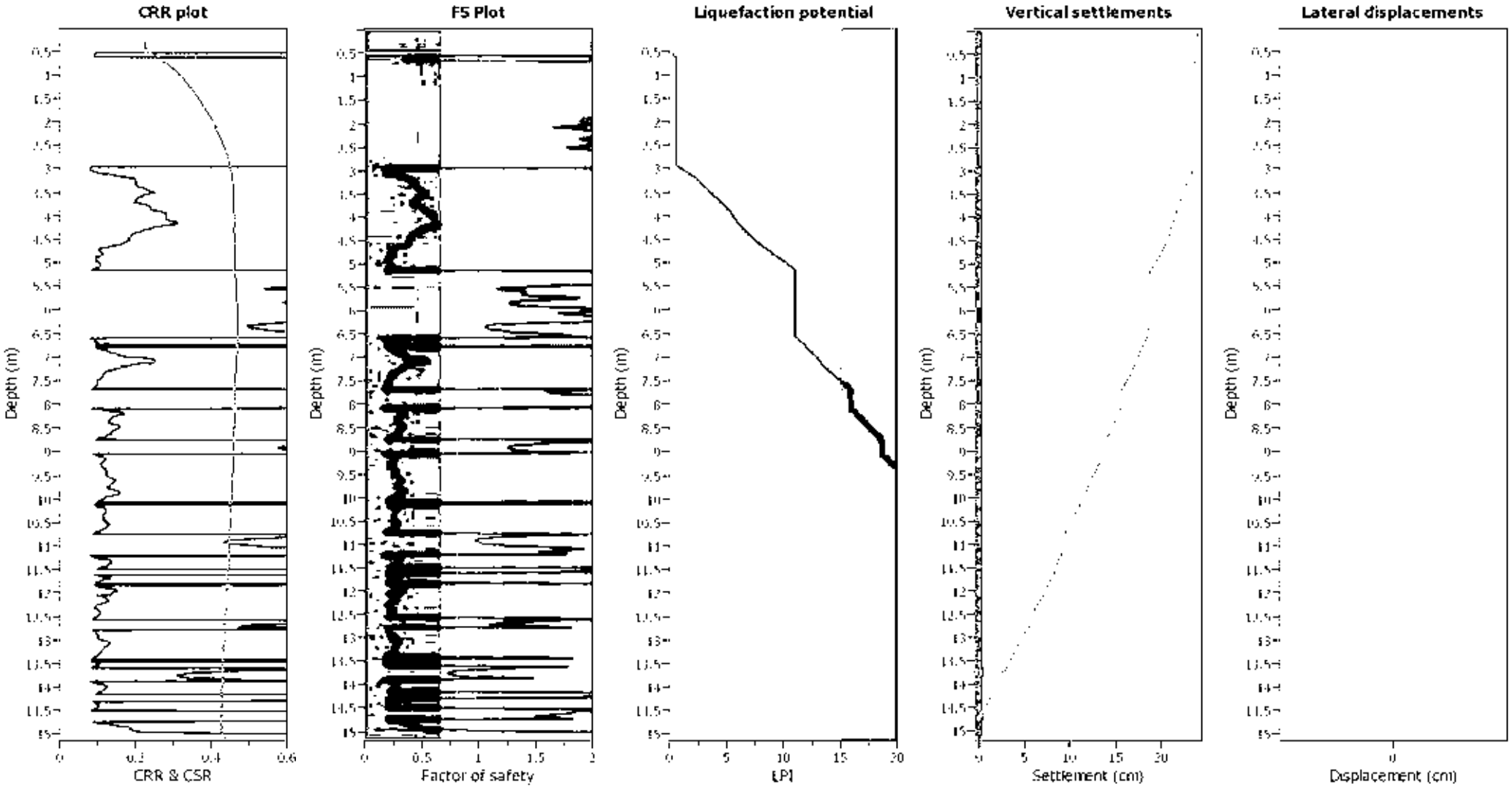
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

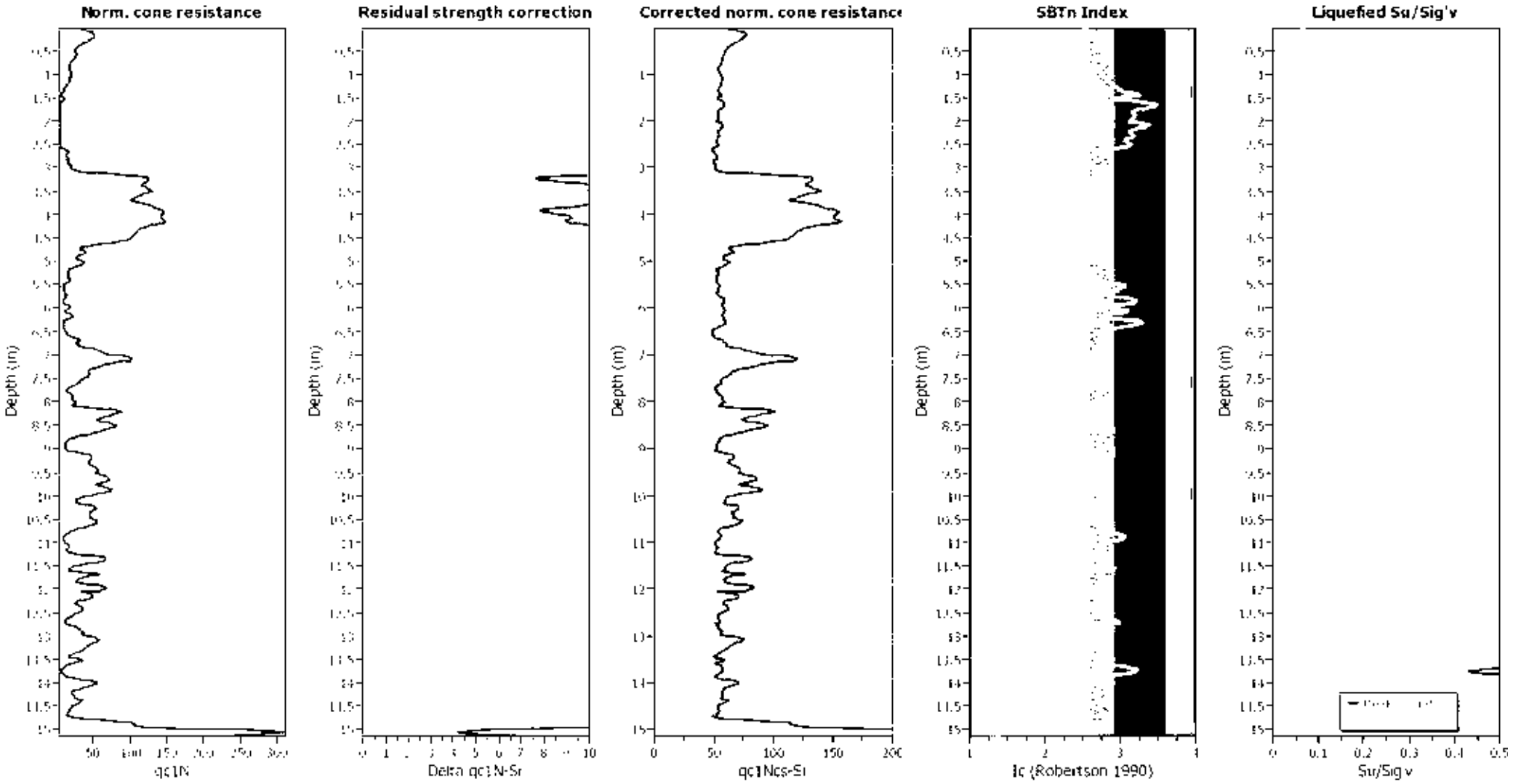
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

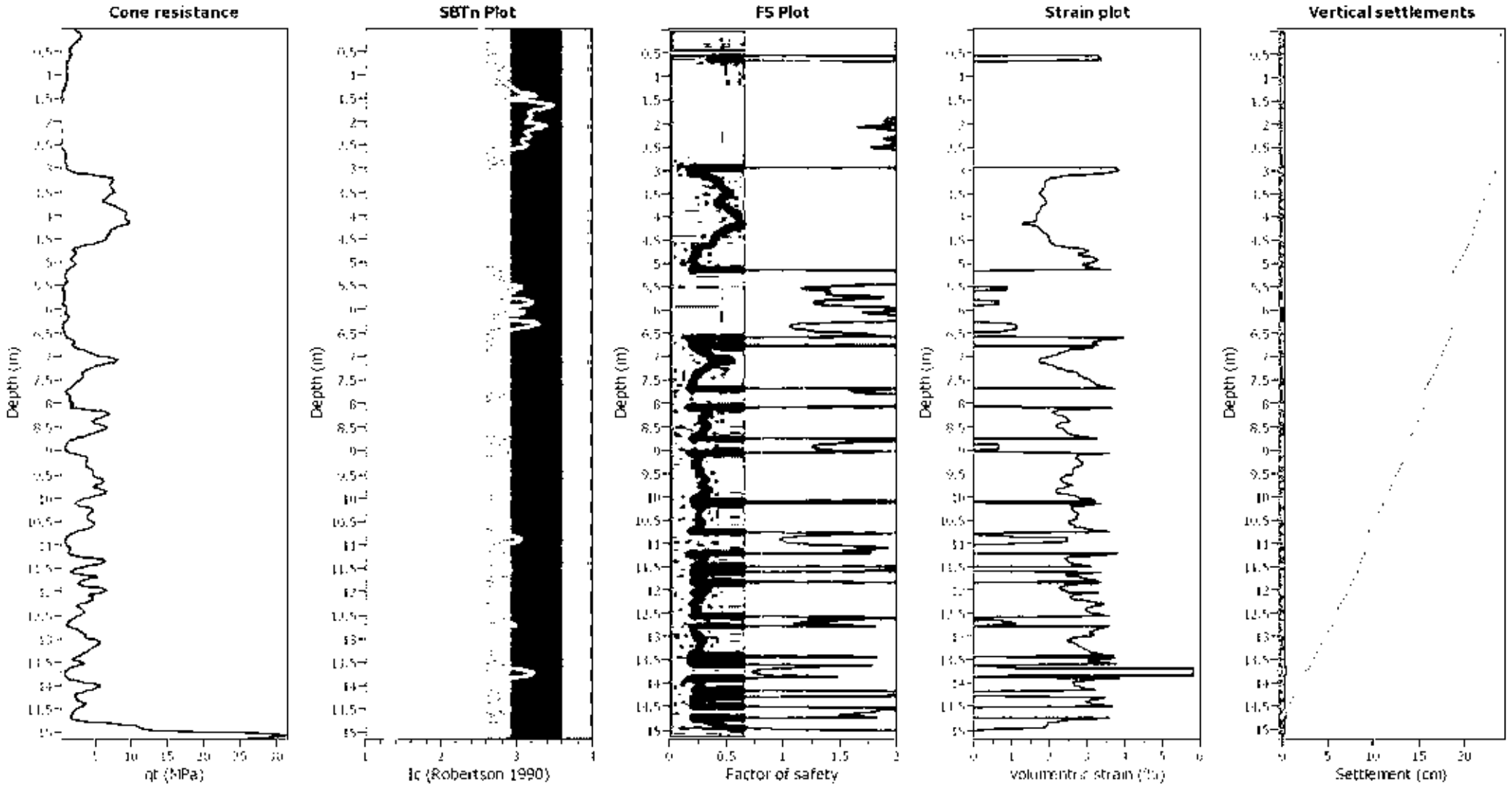
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

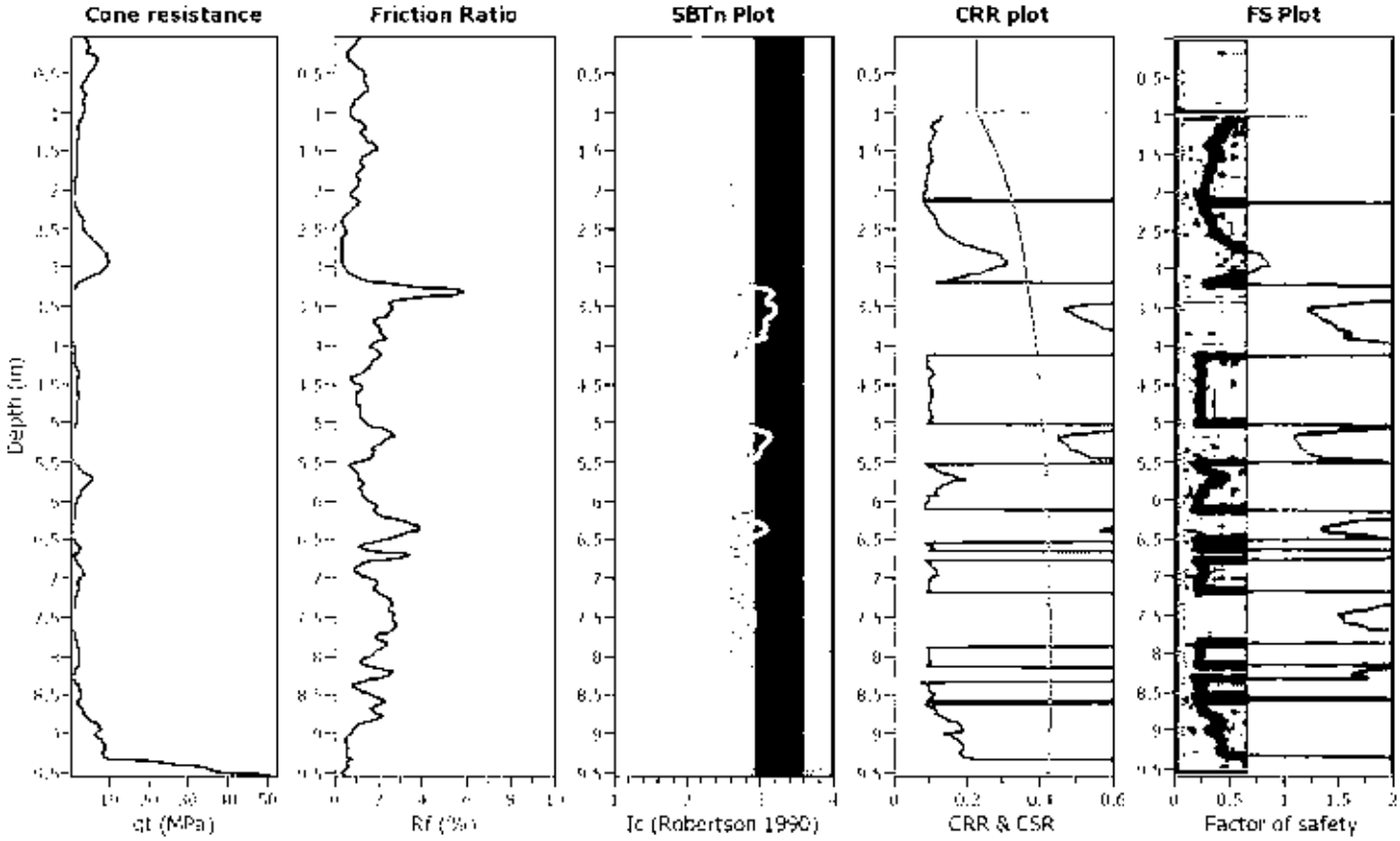
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

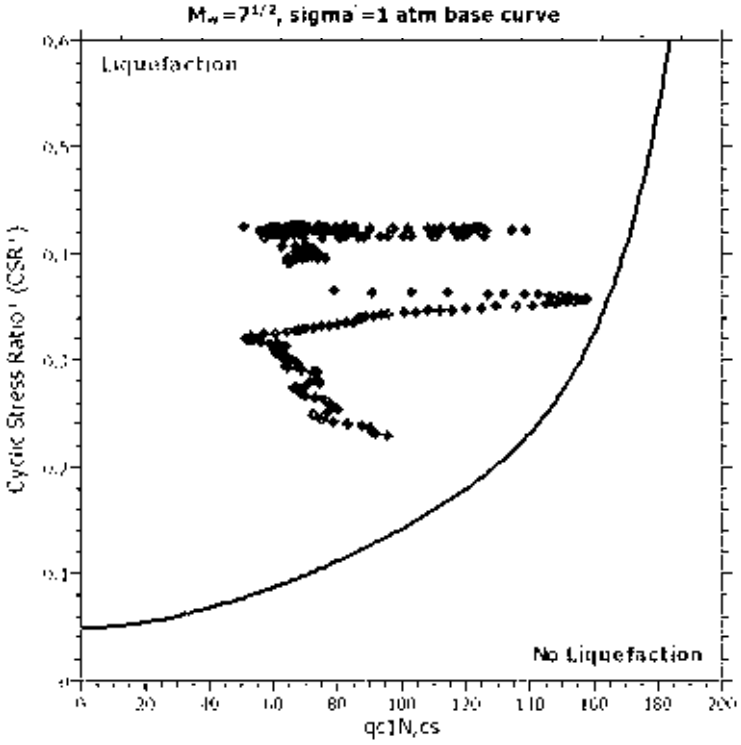
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

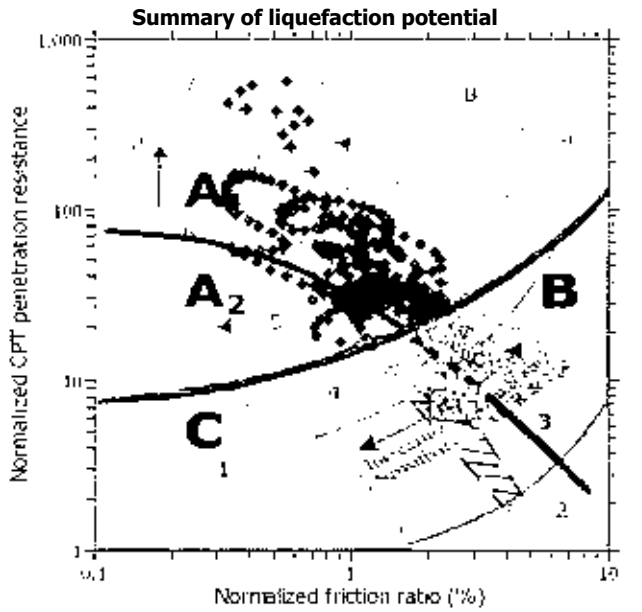
CPT file : CPT35_32SutherlandsRd

Input parameters and analysis data

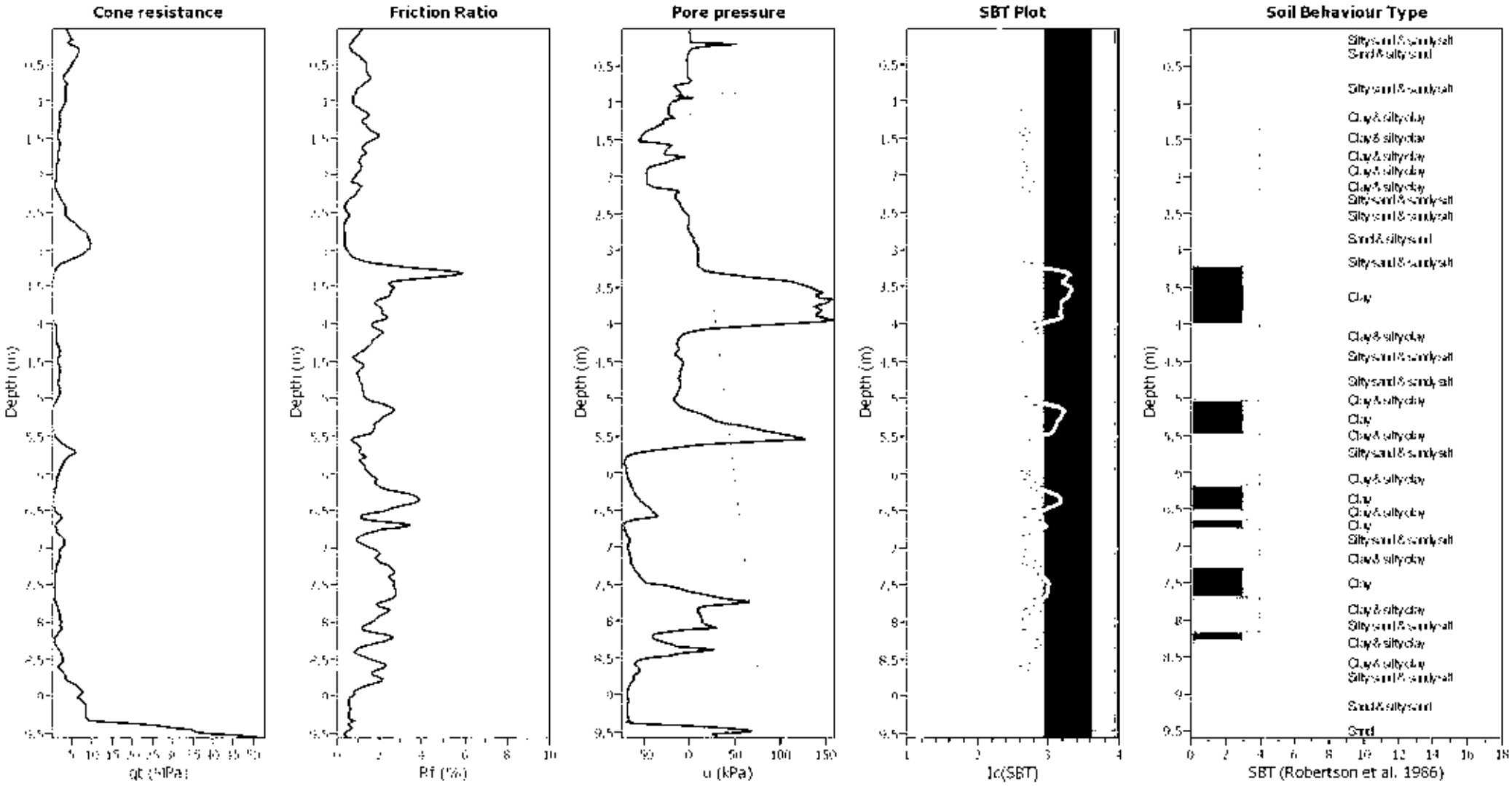
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



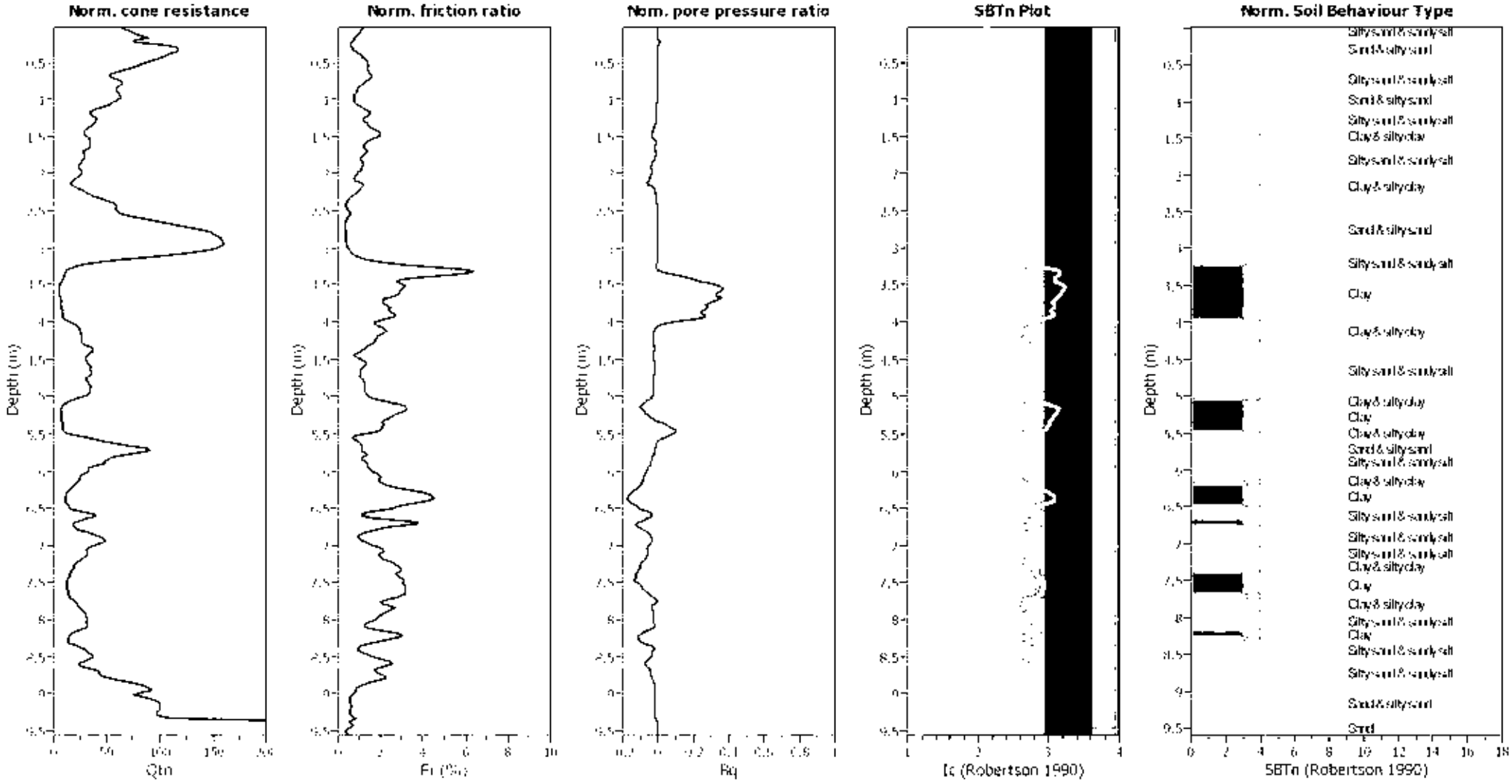
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



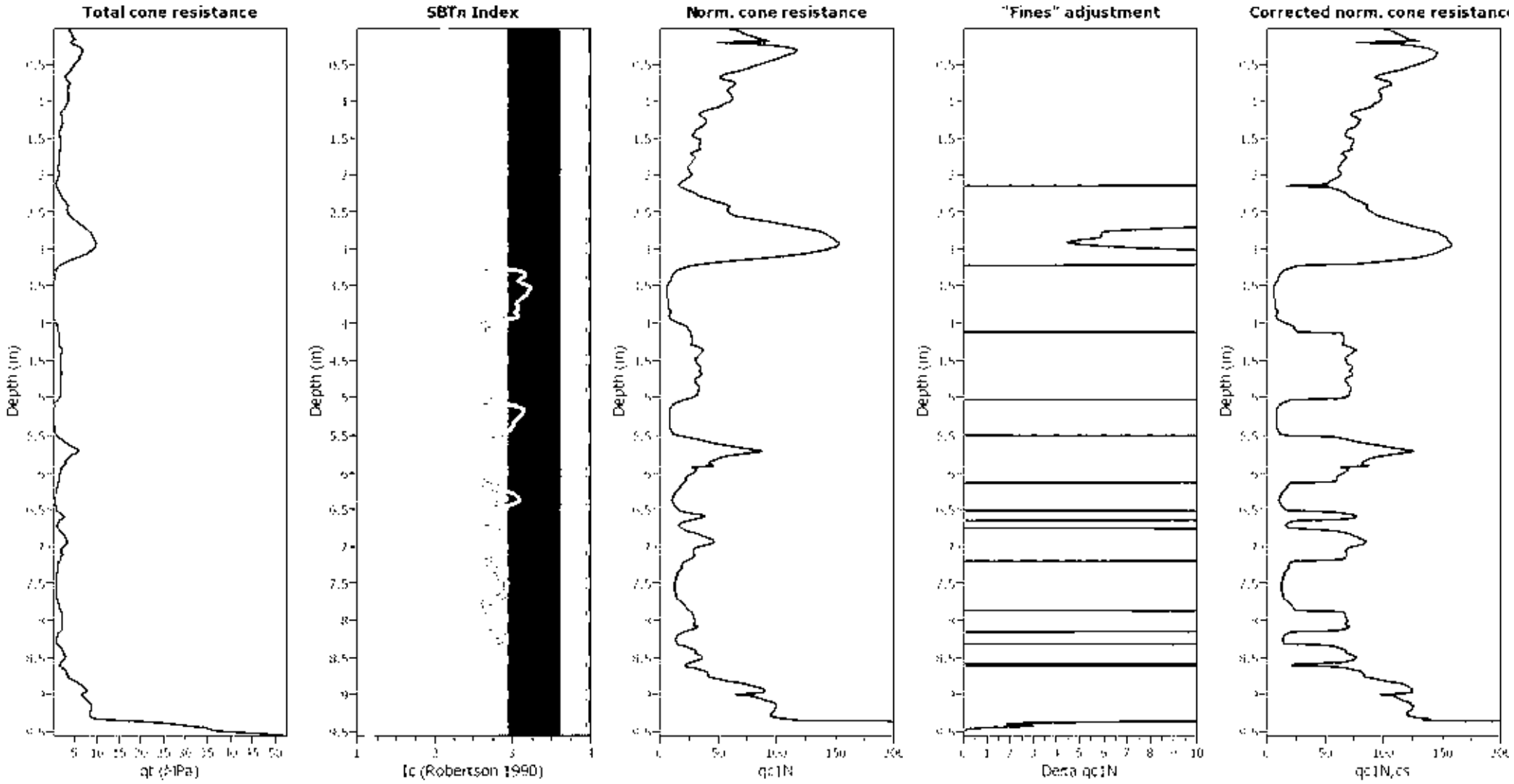
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

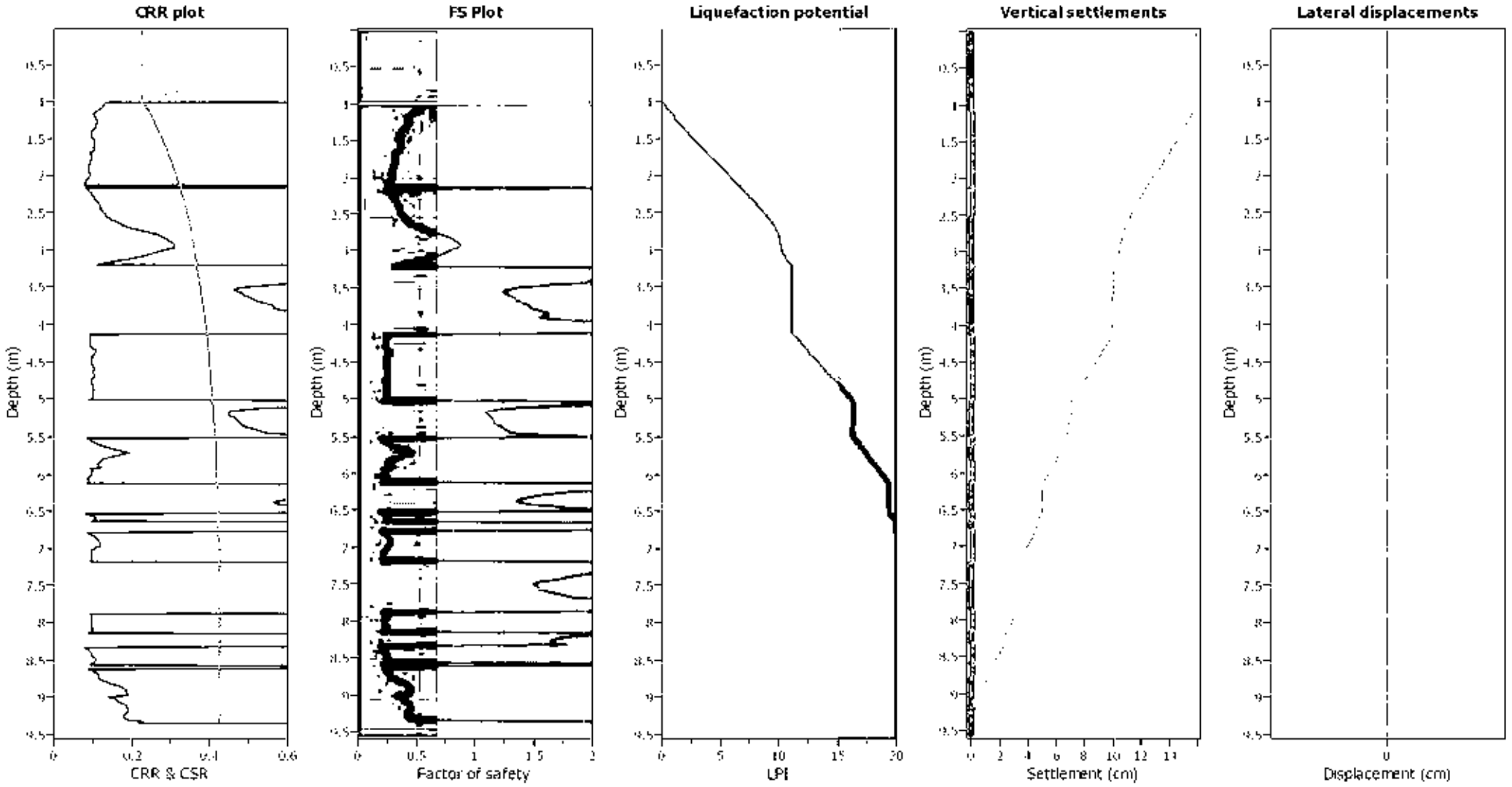
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

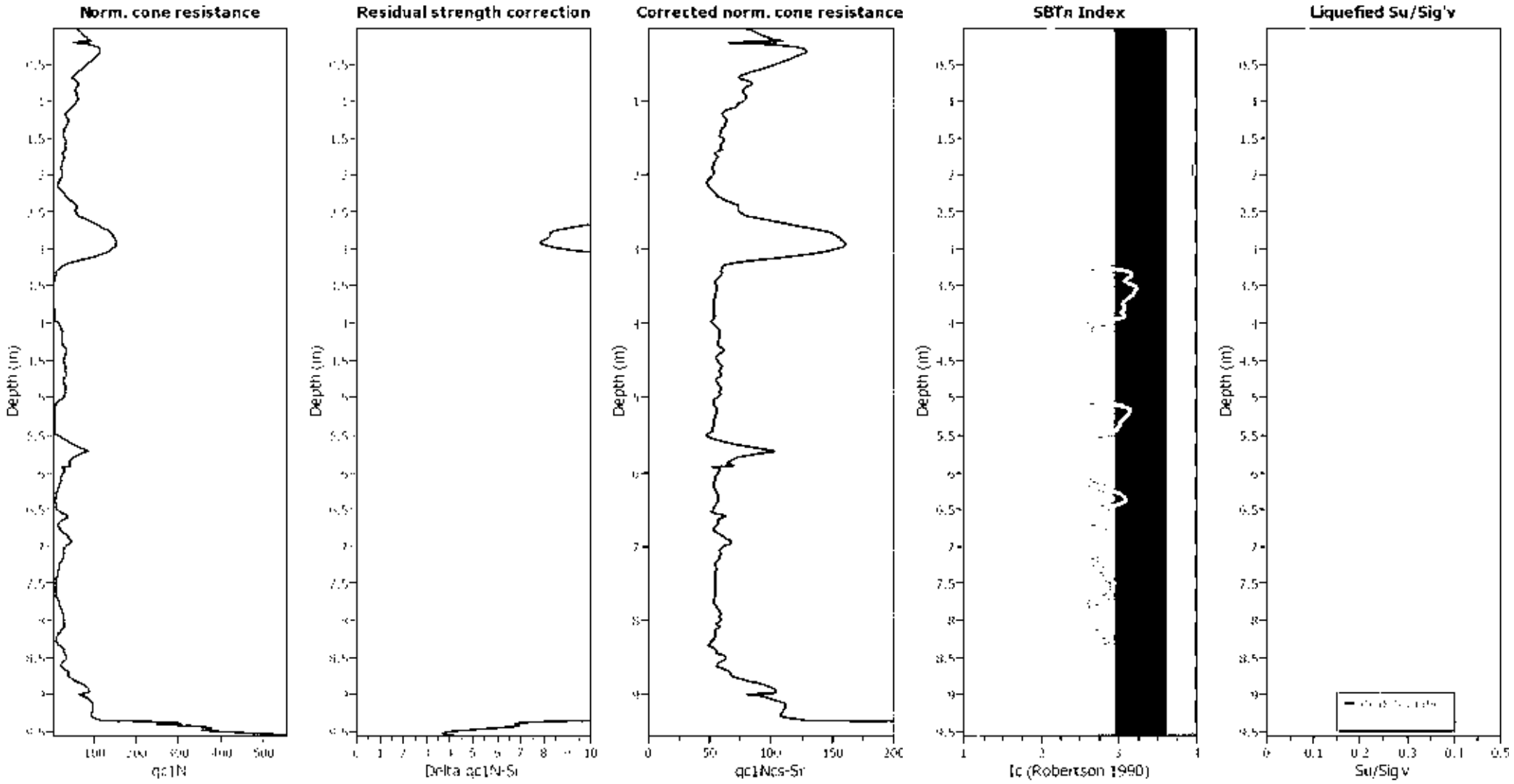
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

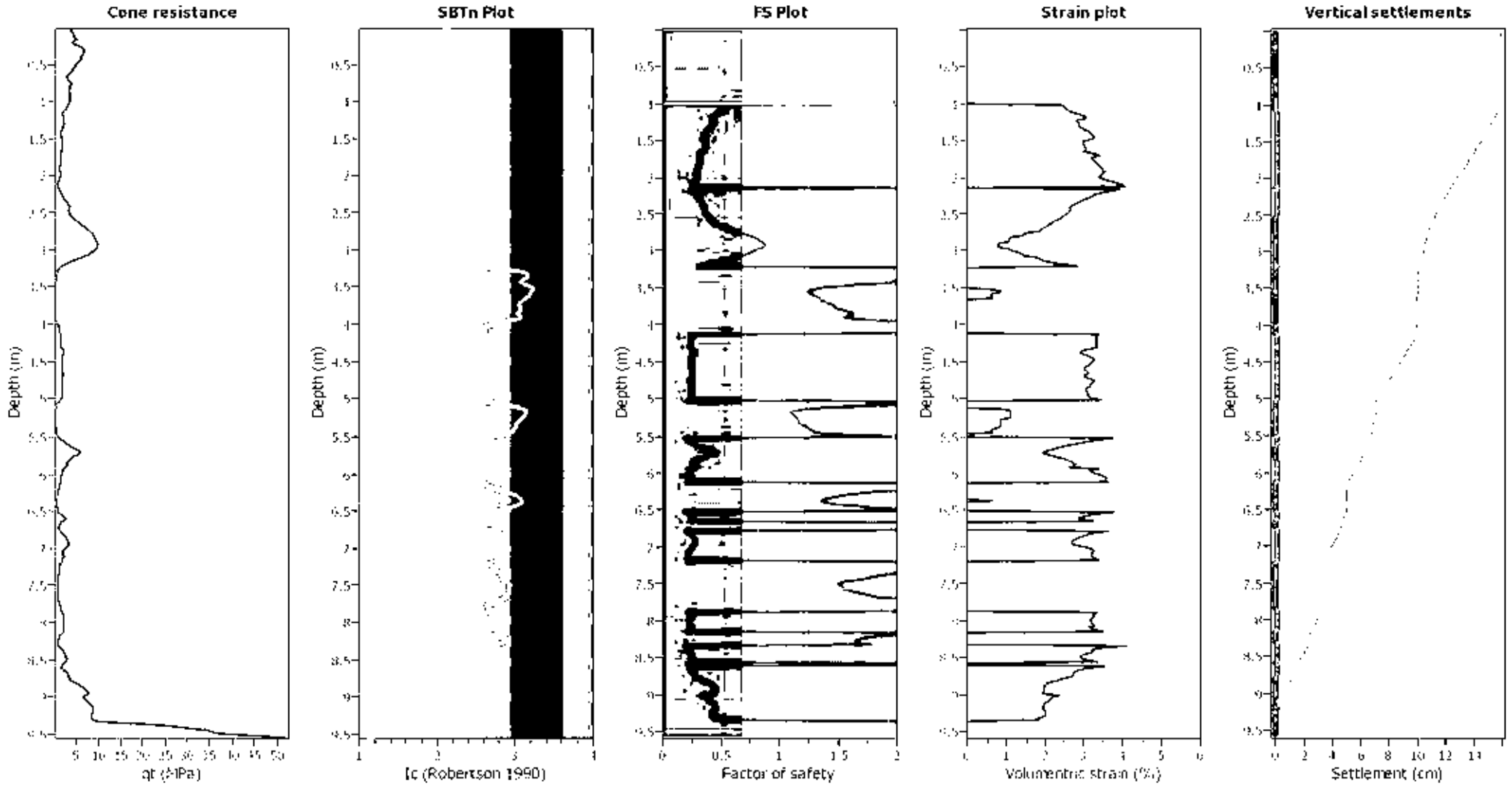
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

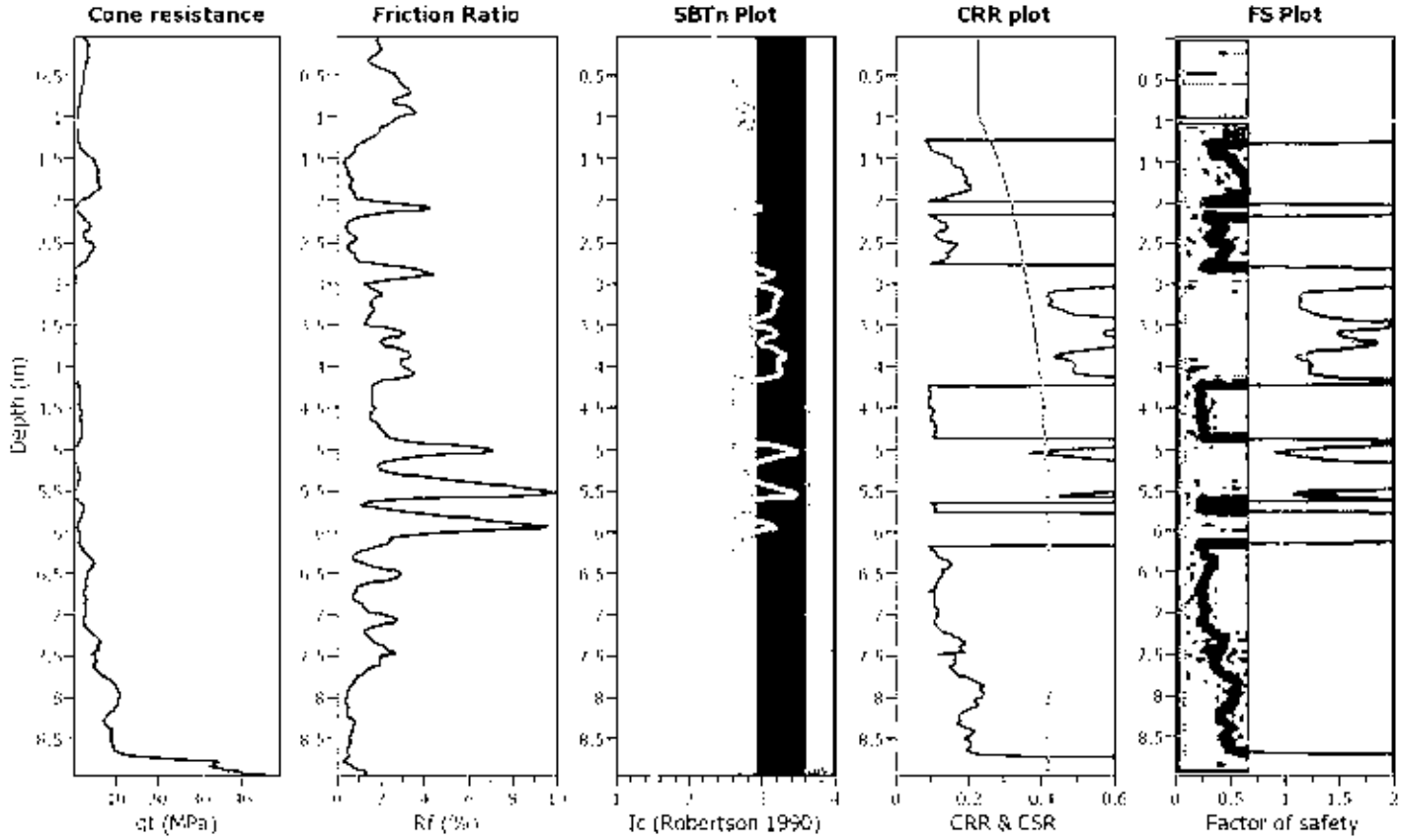
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

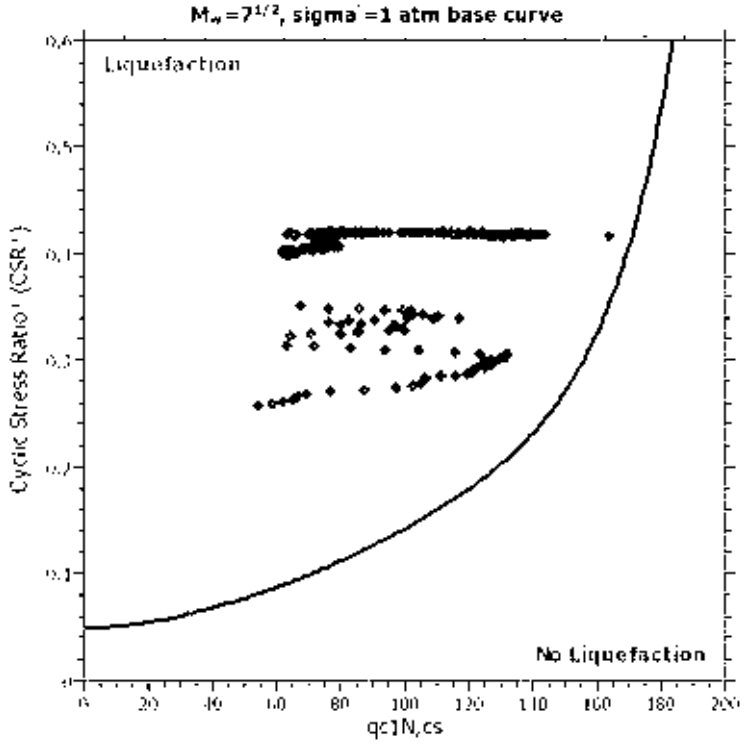
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

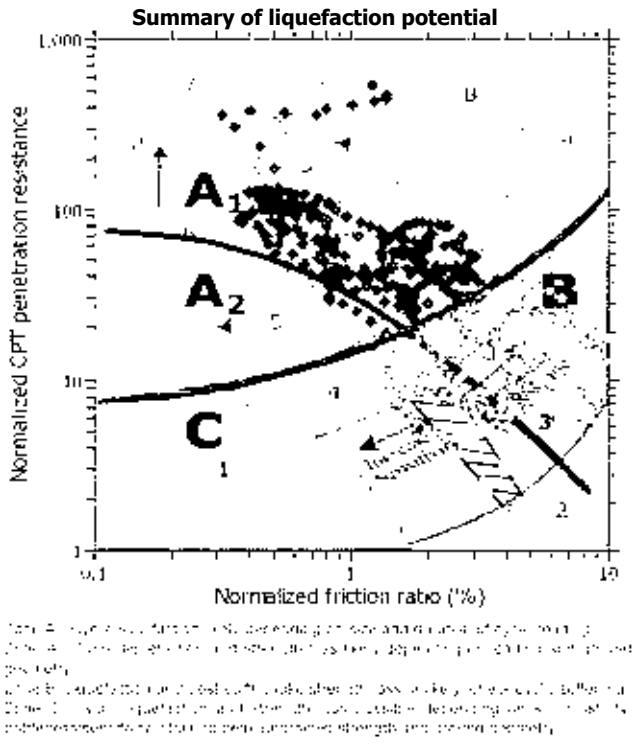
CPT file : CPT36_32SutherlandsRd

Input parameters and analysis data

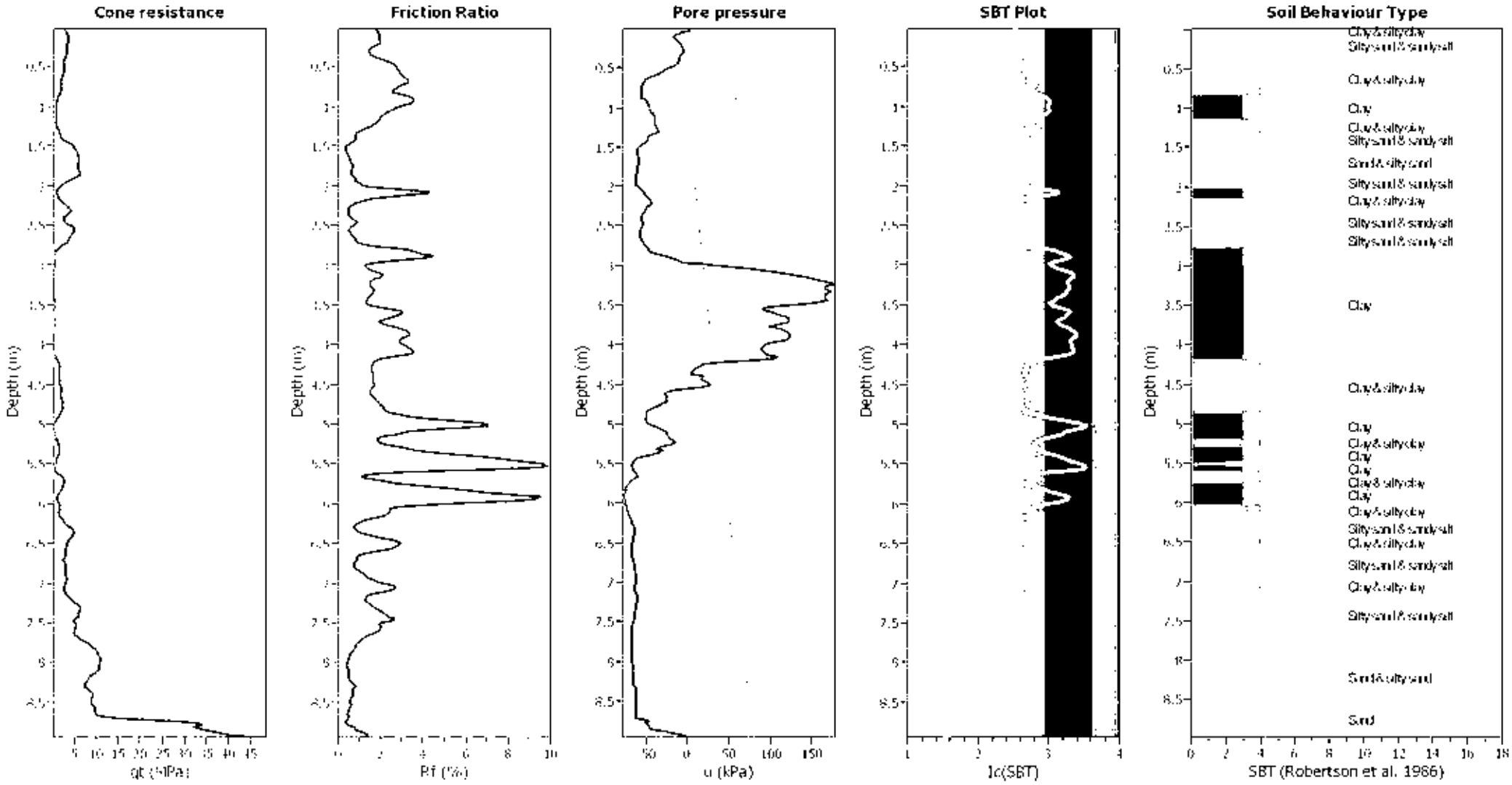
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



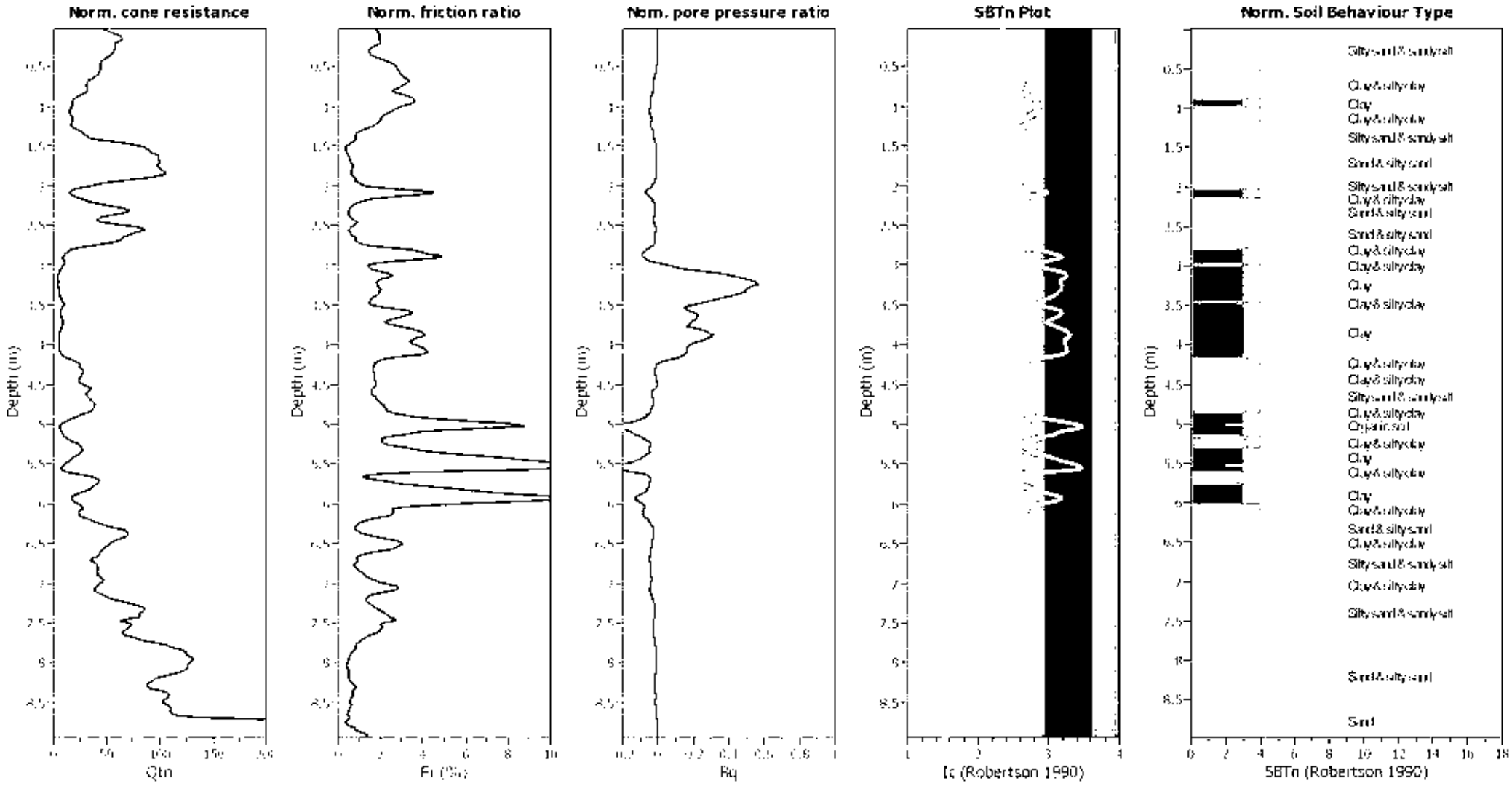
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



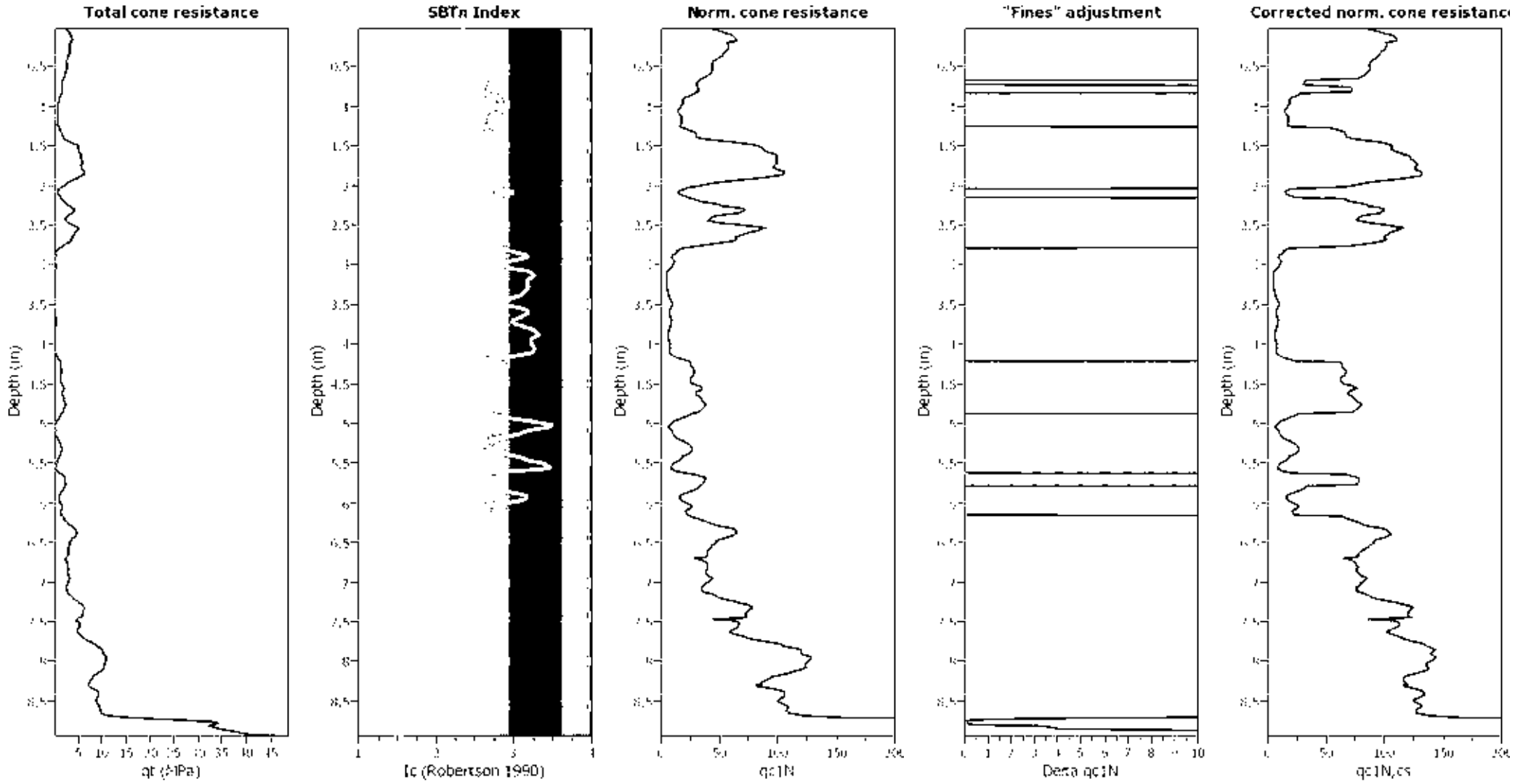
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

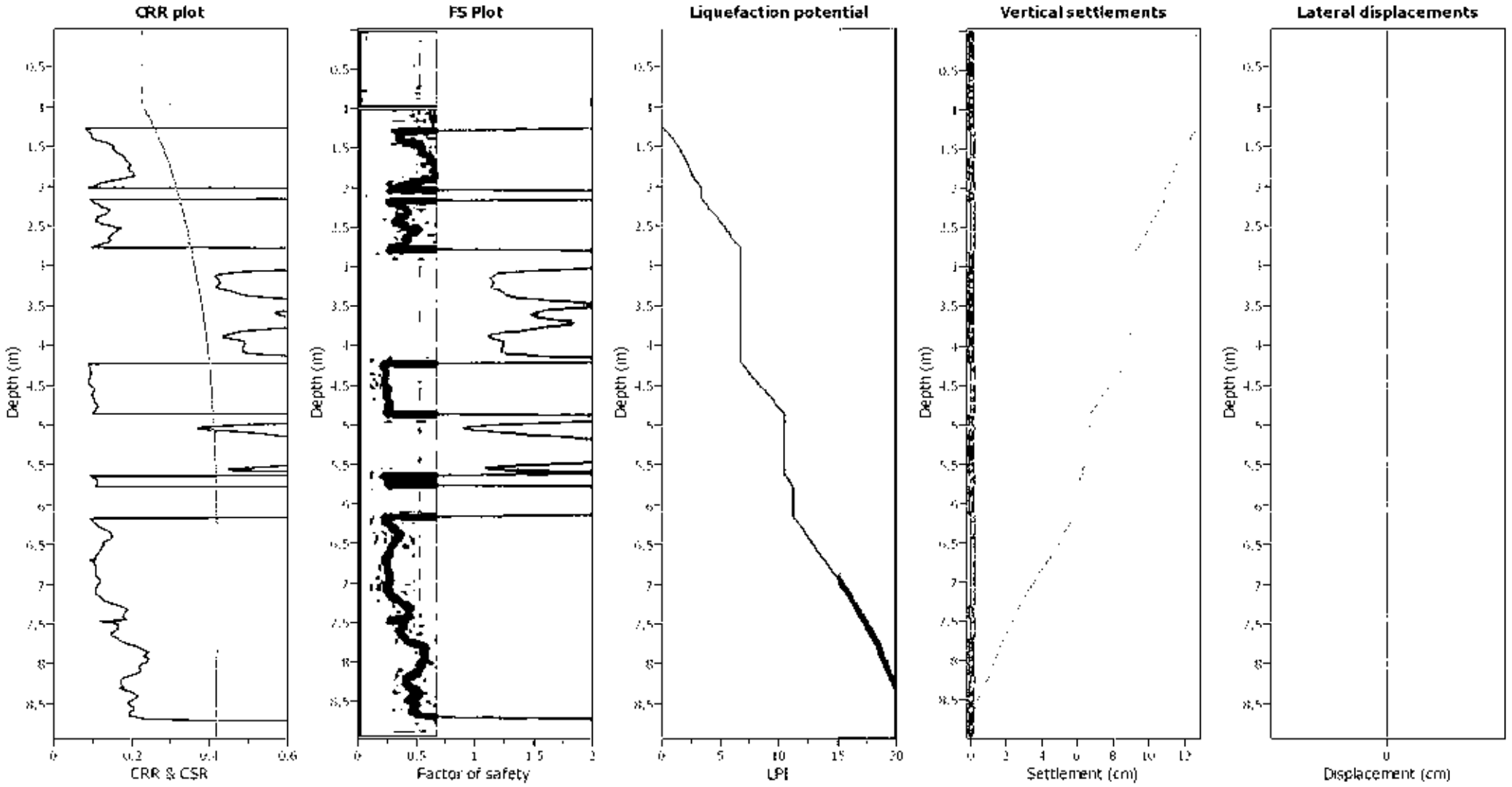
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

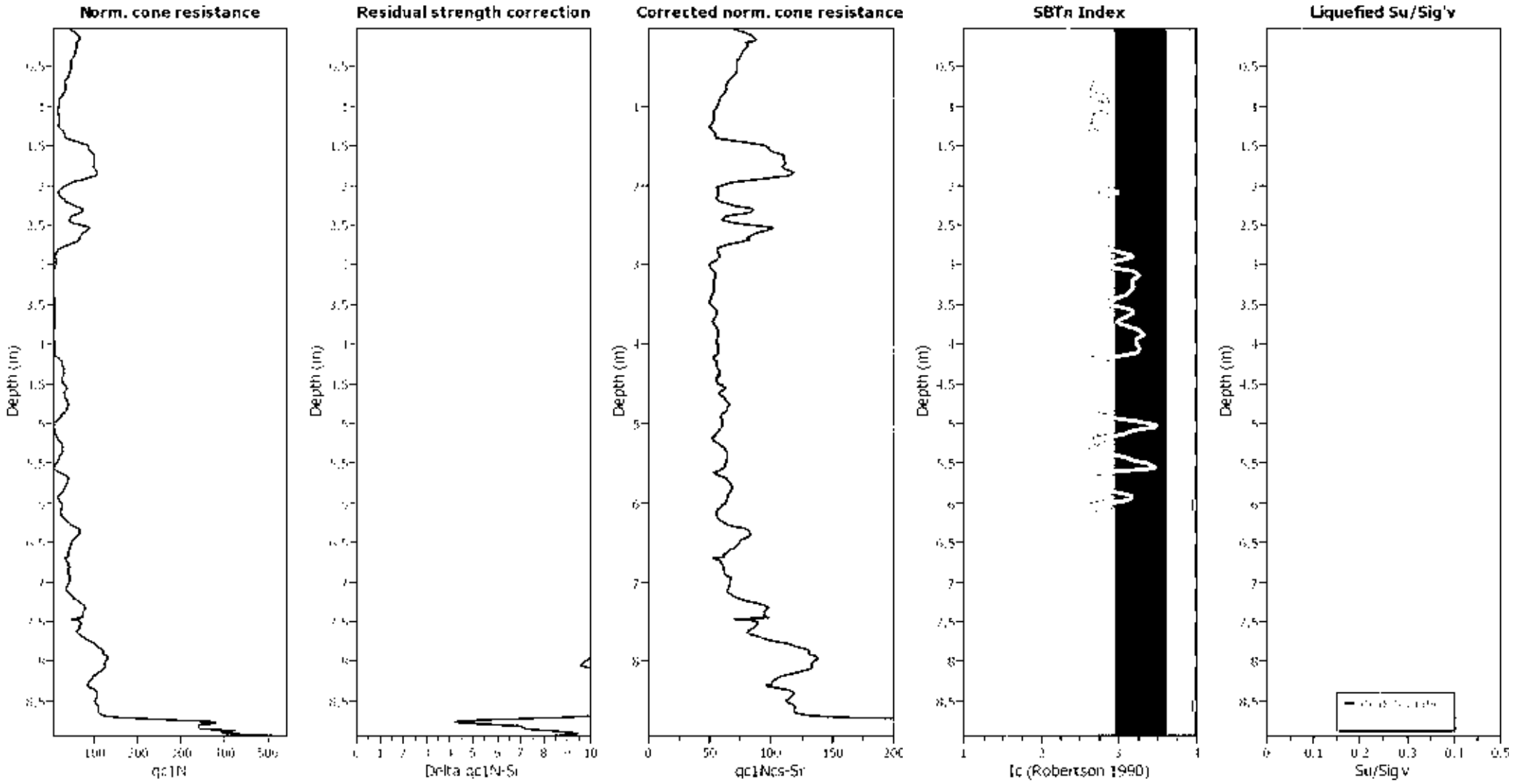
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

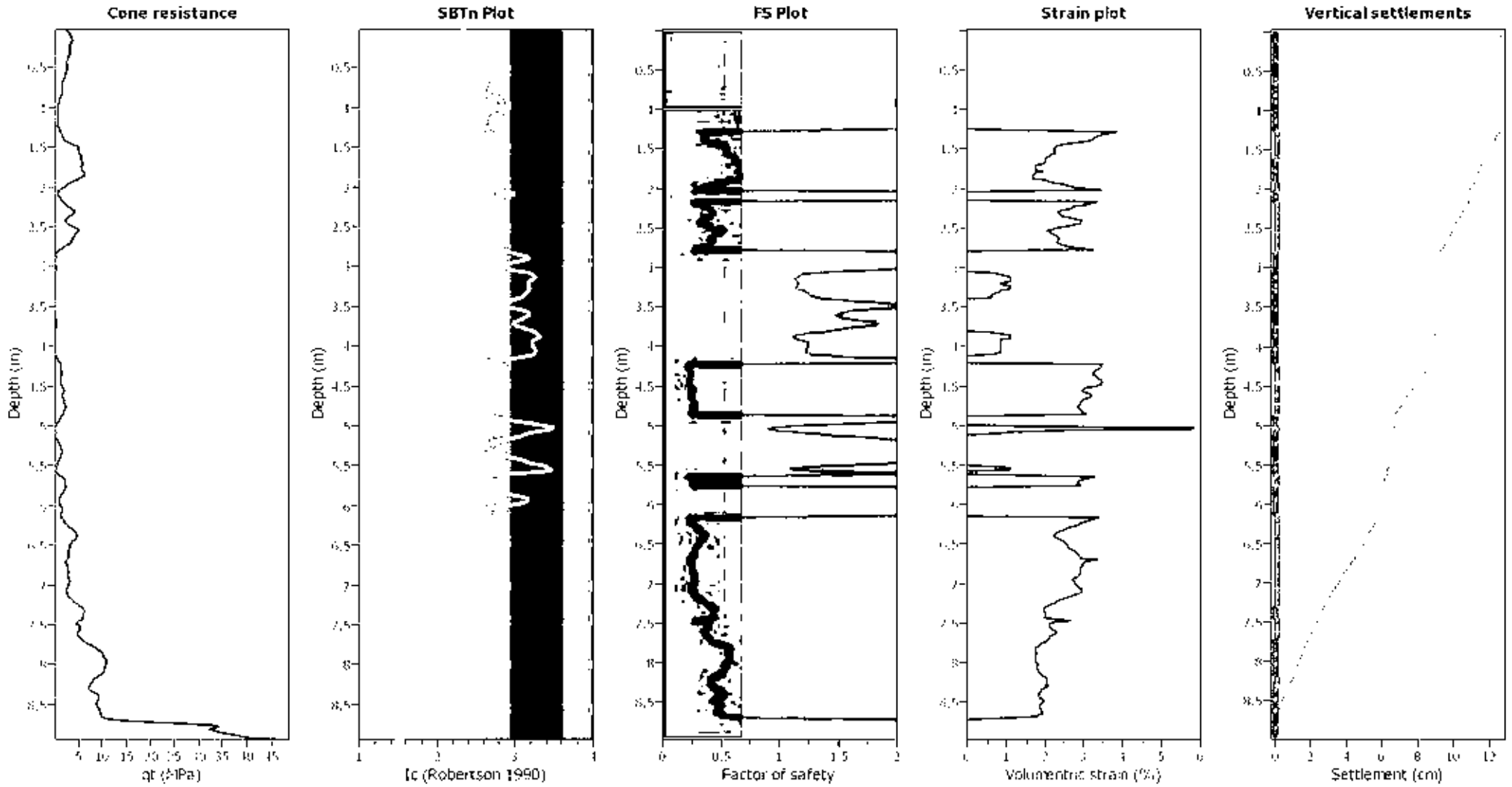
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

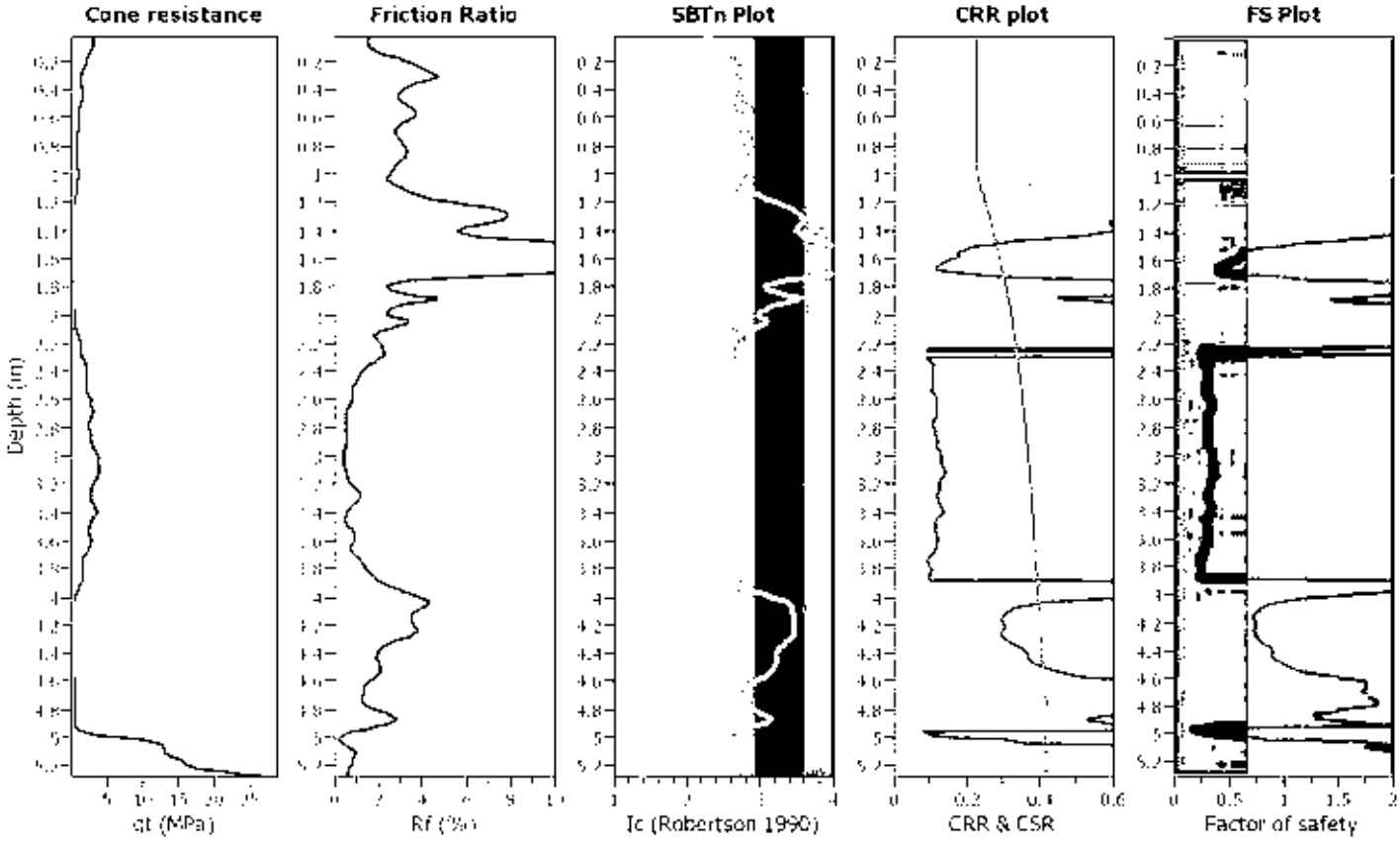
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

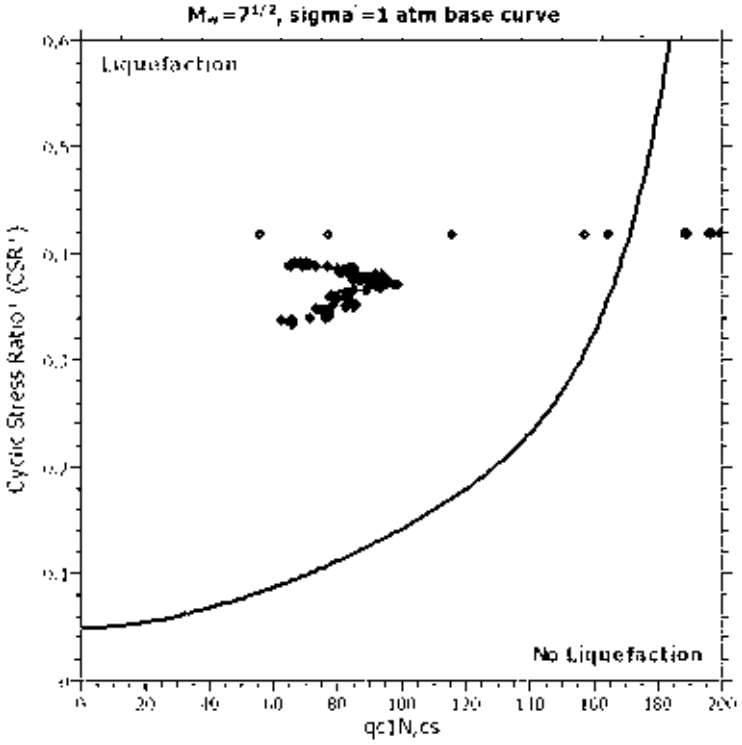
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

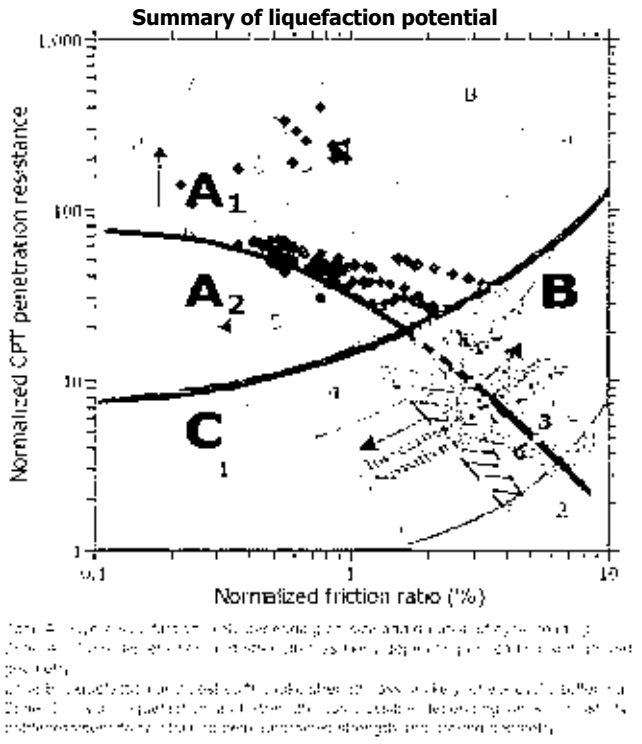
CPT file : CPT37_32SutherlandsRd

Input parameters and analysis data

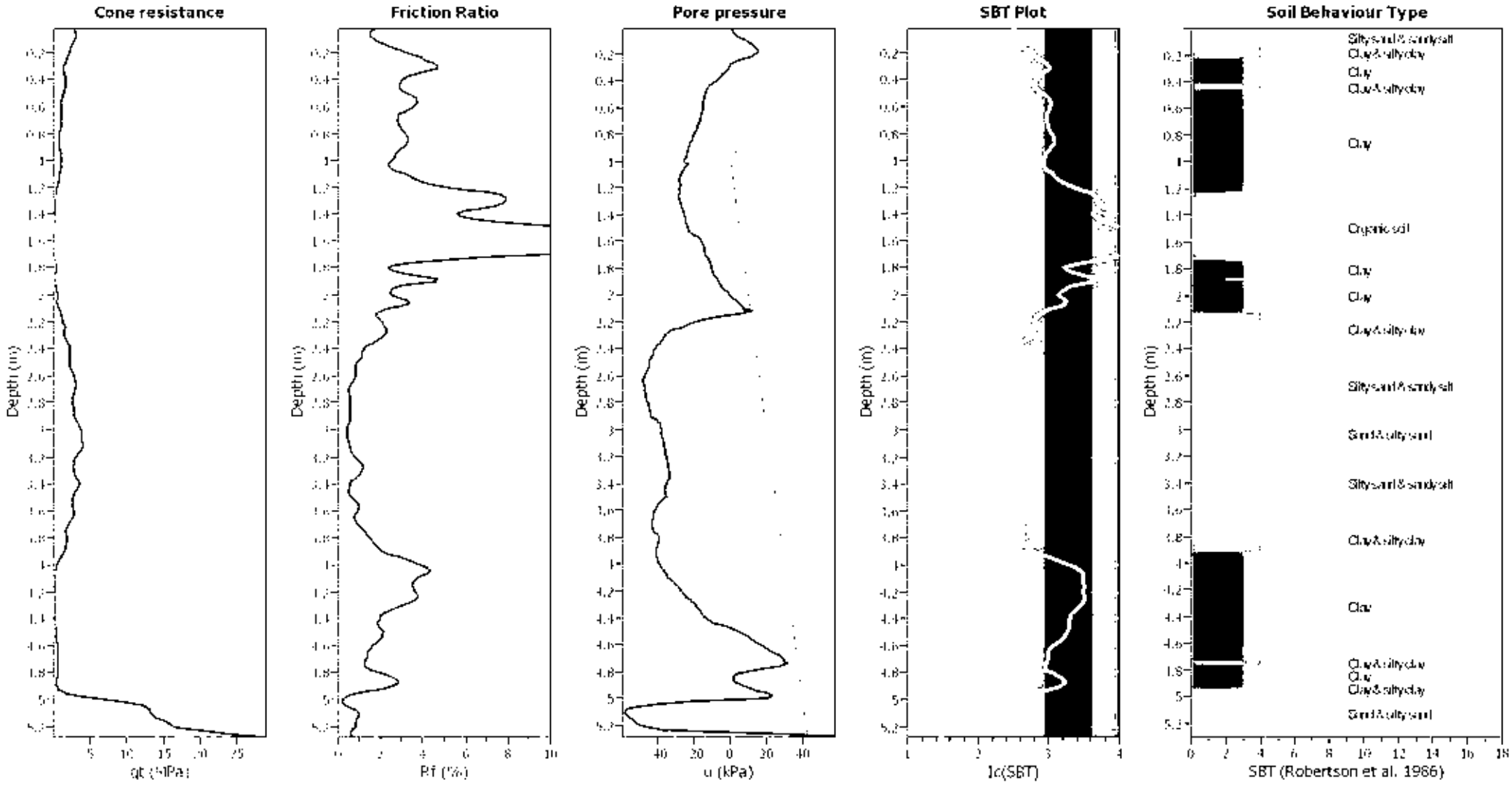
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



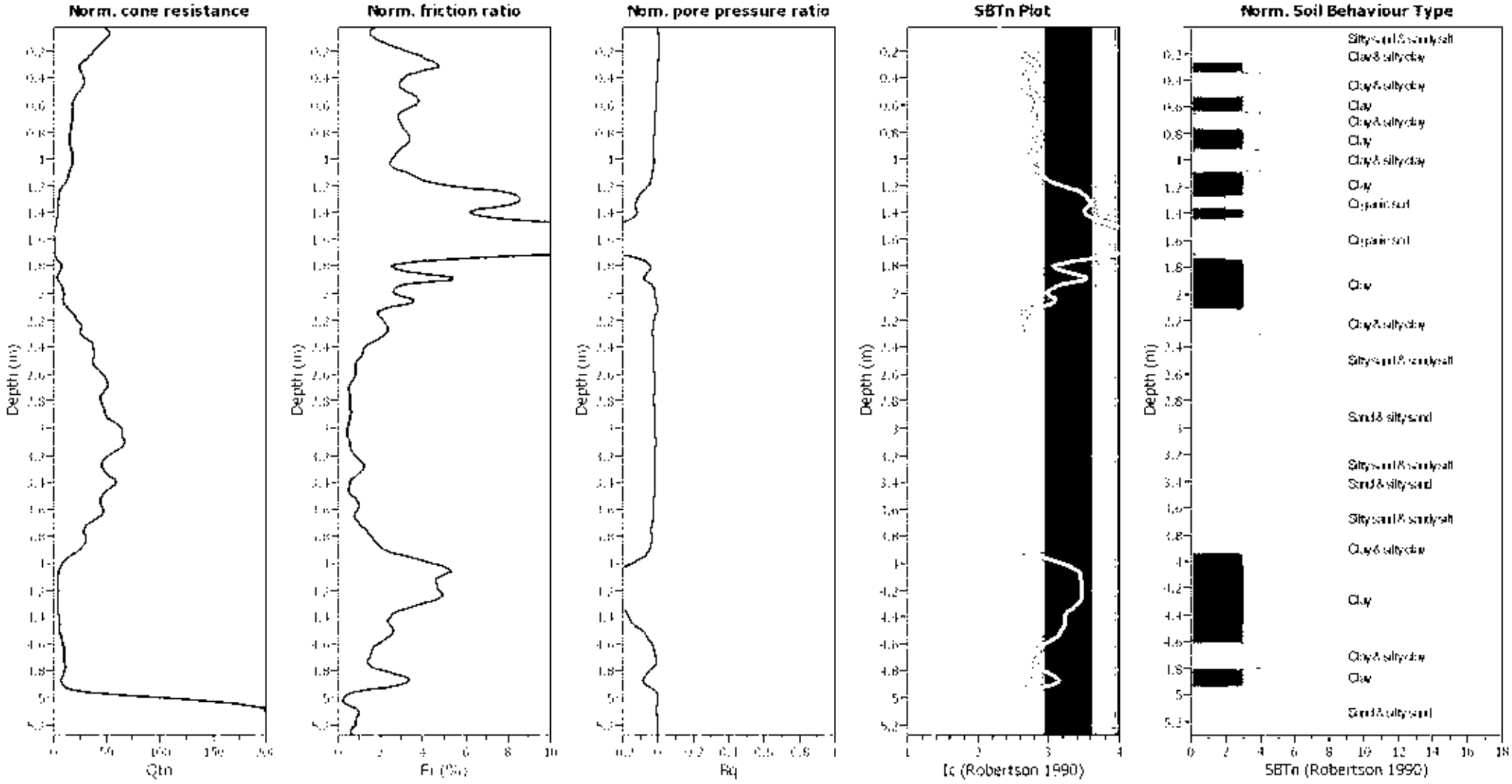
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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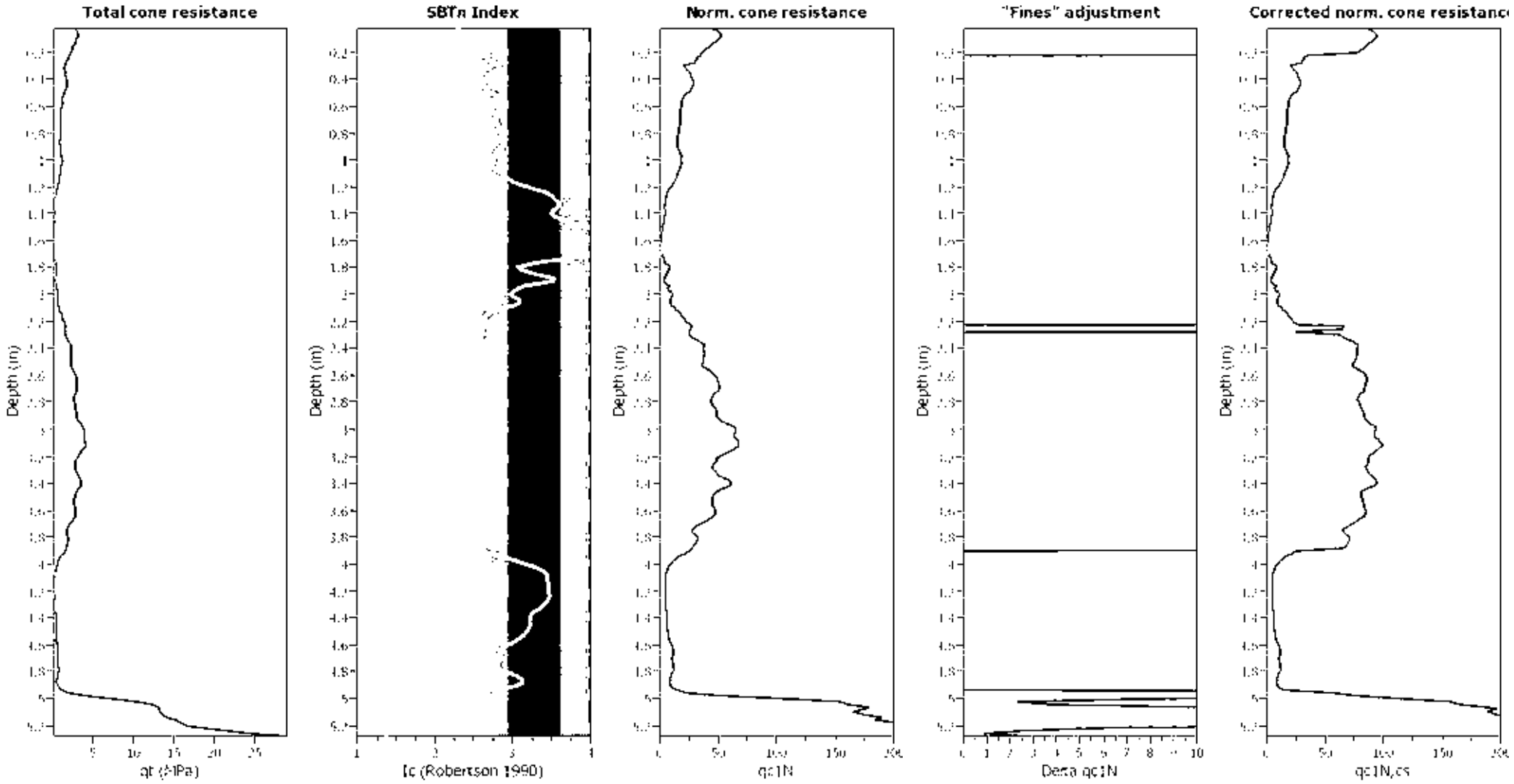
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

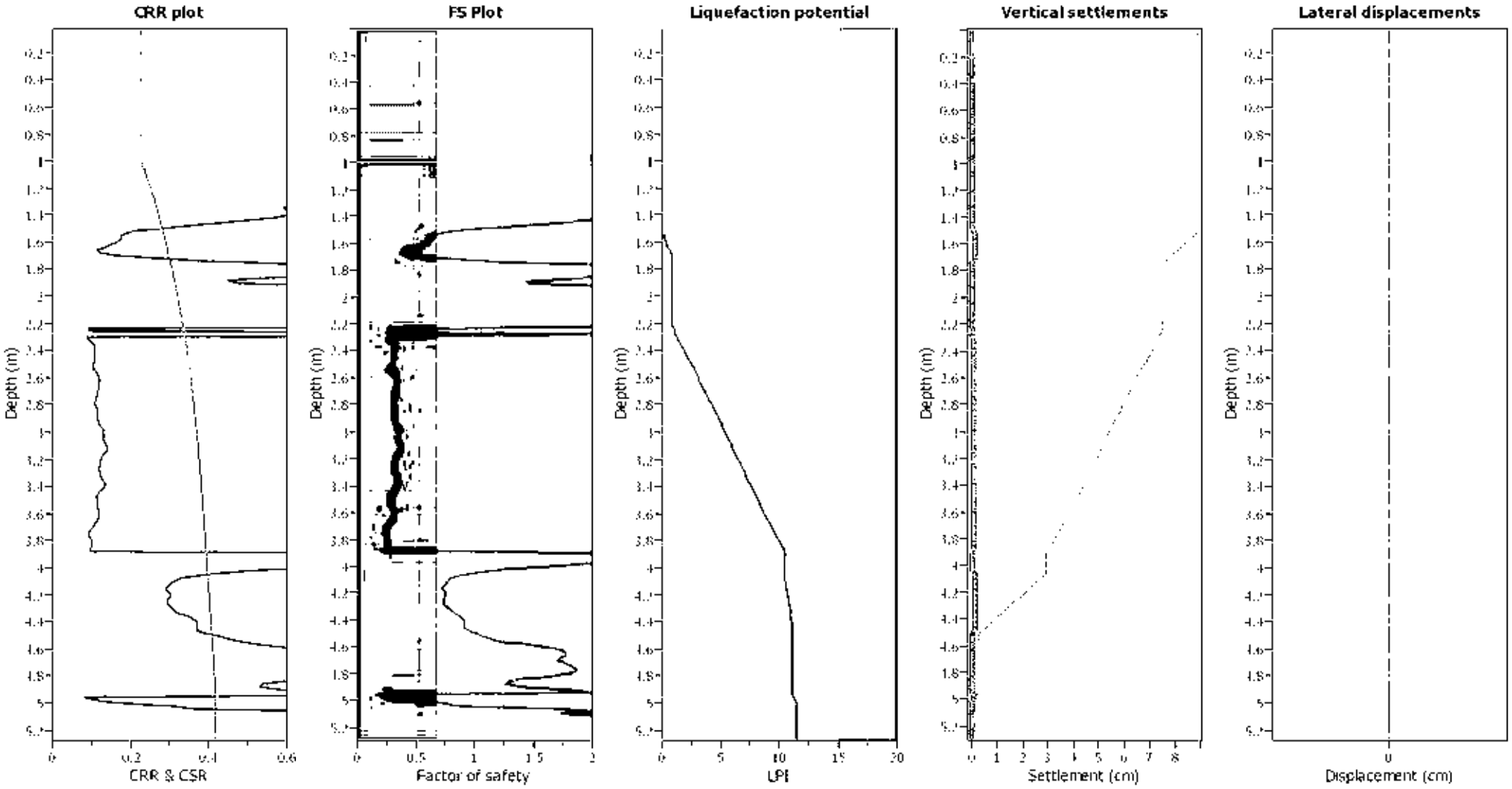
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

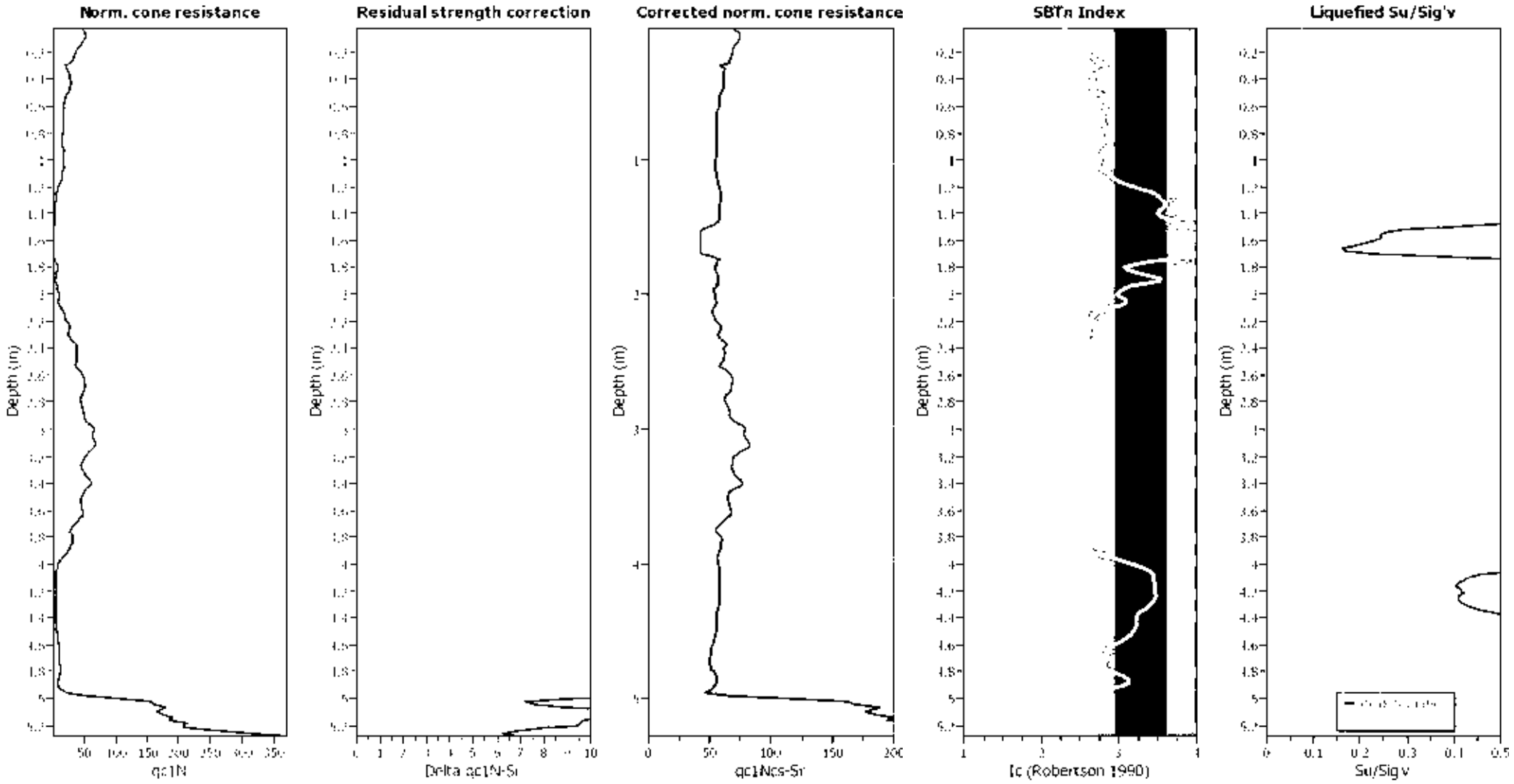
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

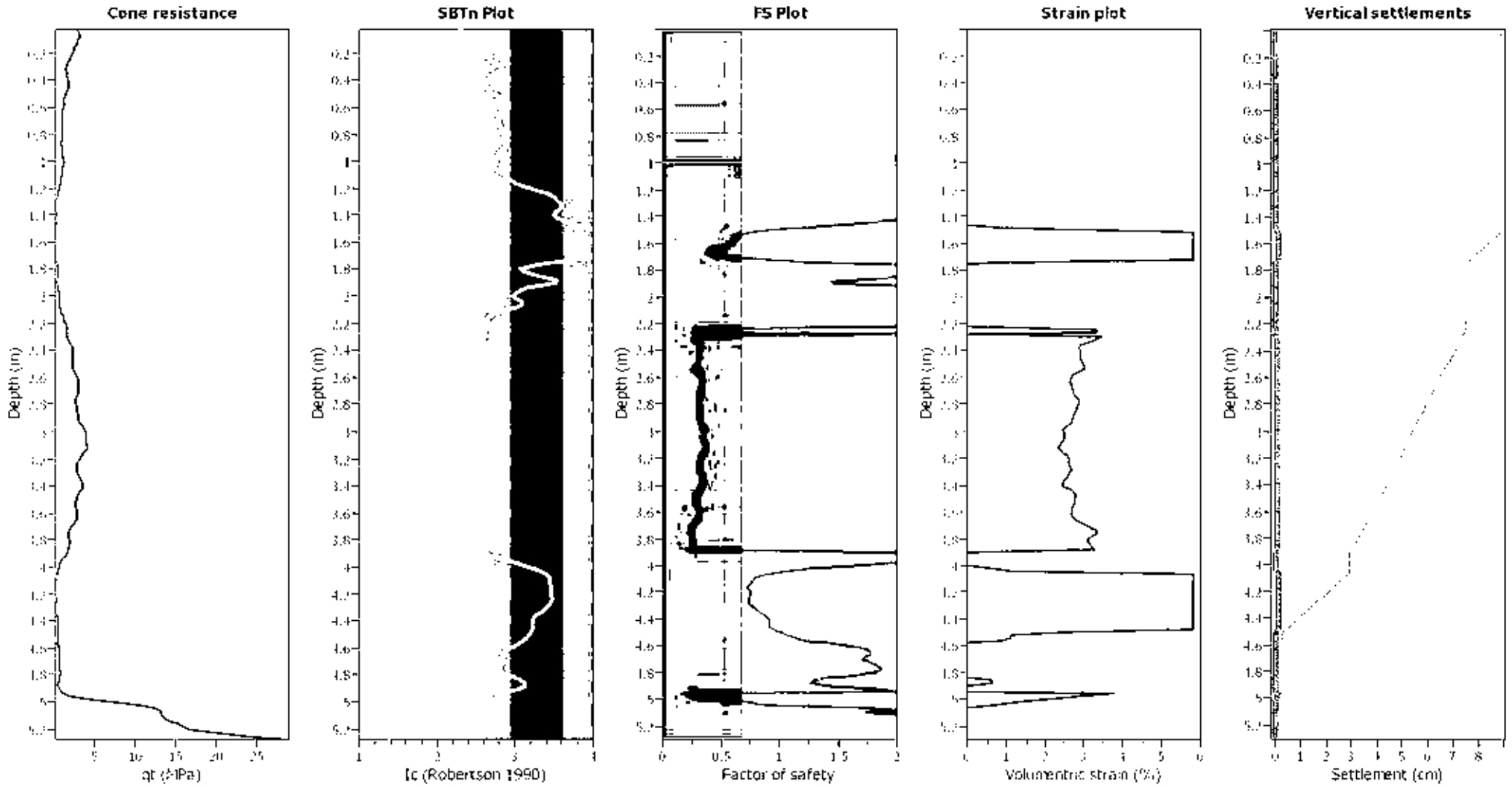
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

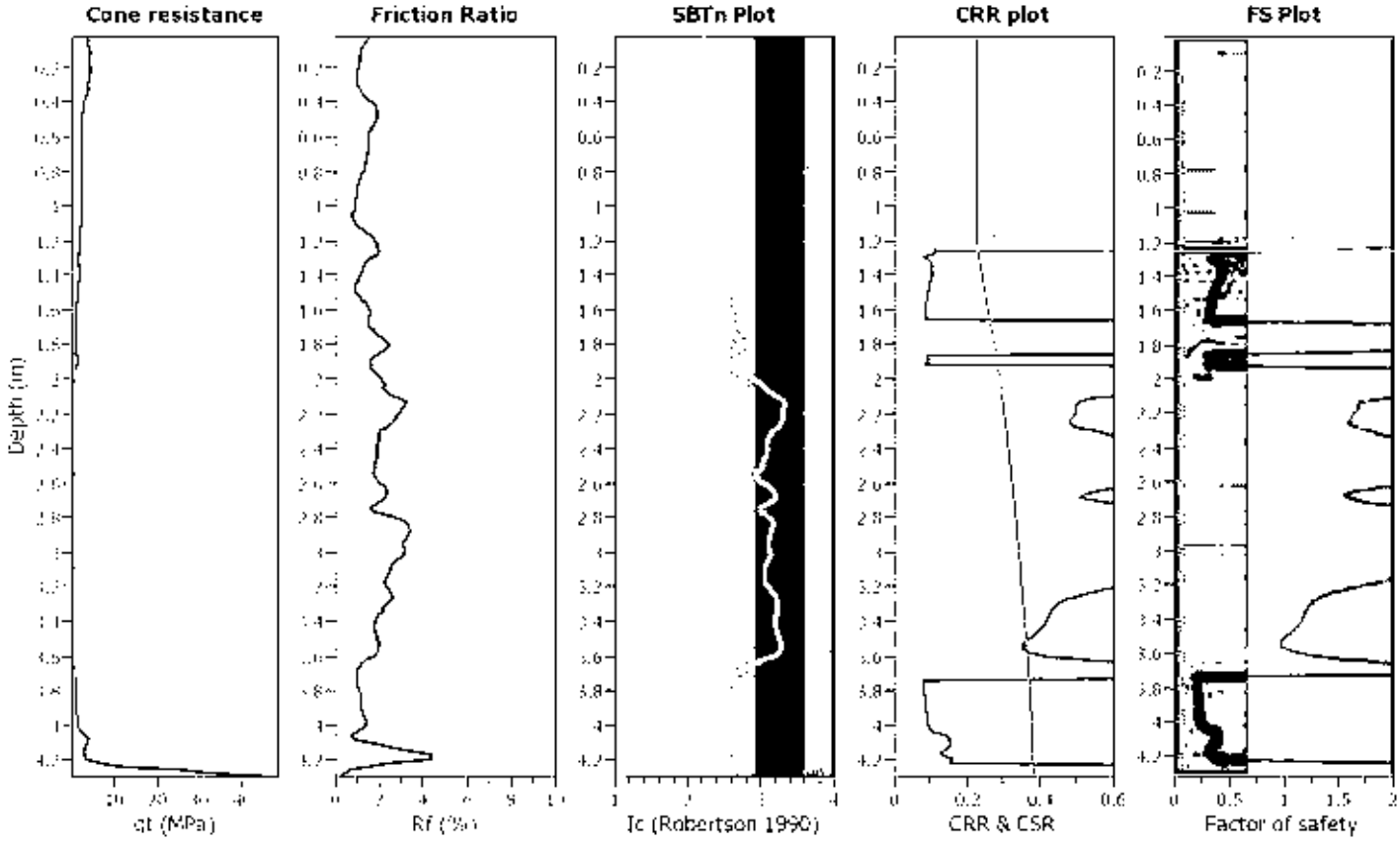
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

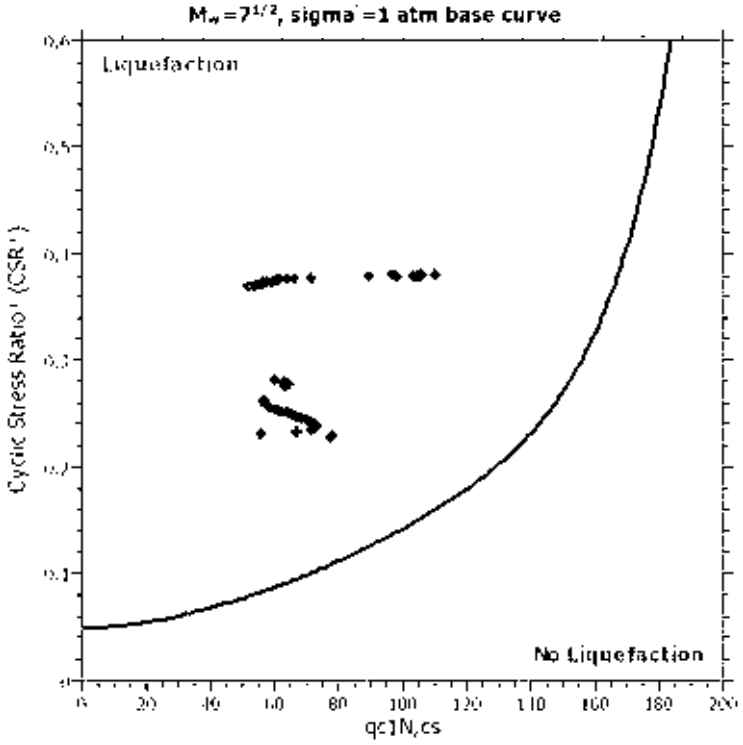
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

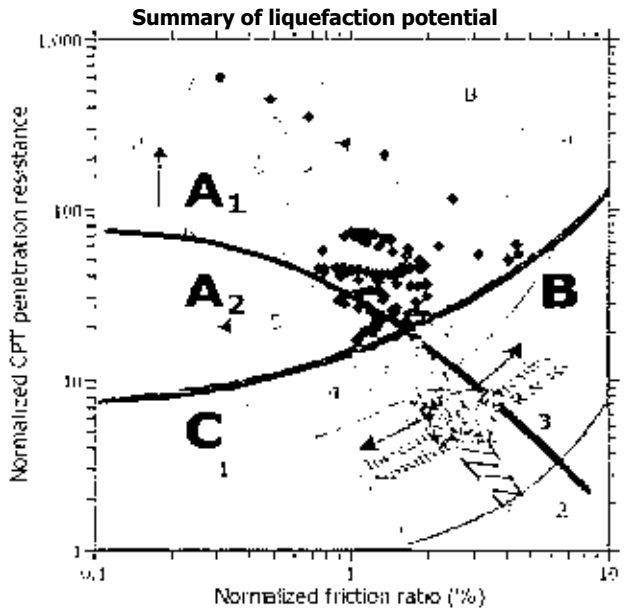
CPT file : CPT38_32SutherlandsRd

Input parameters and analysis data

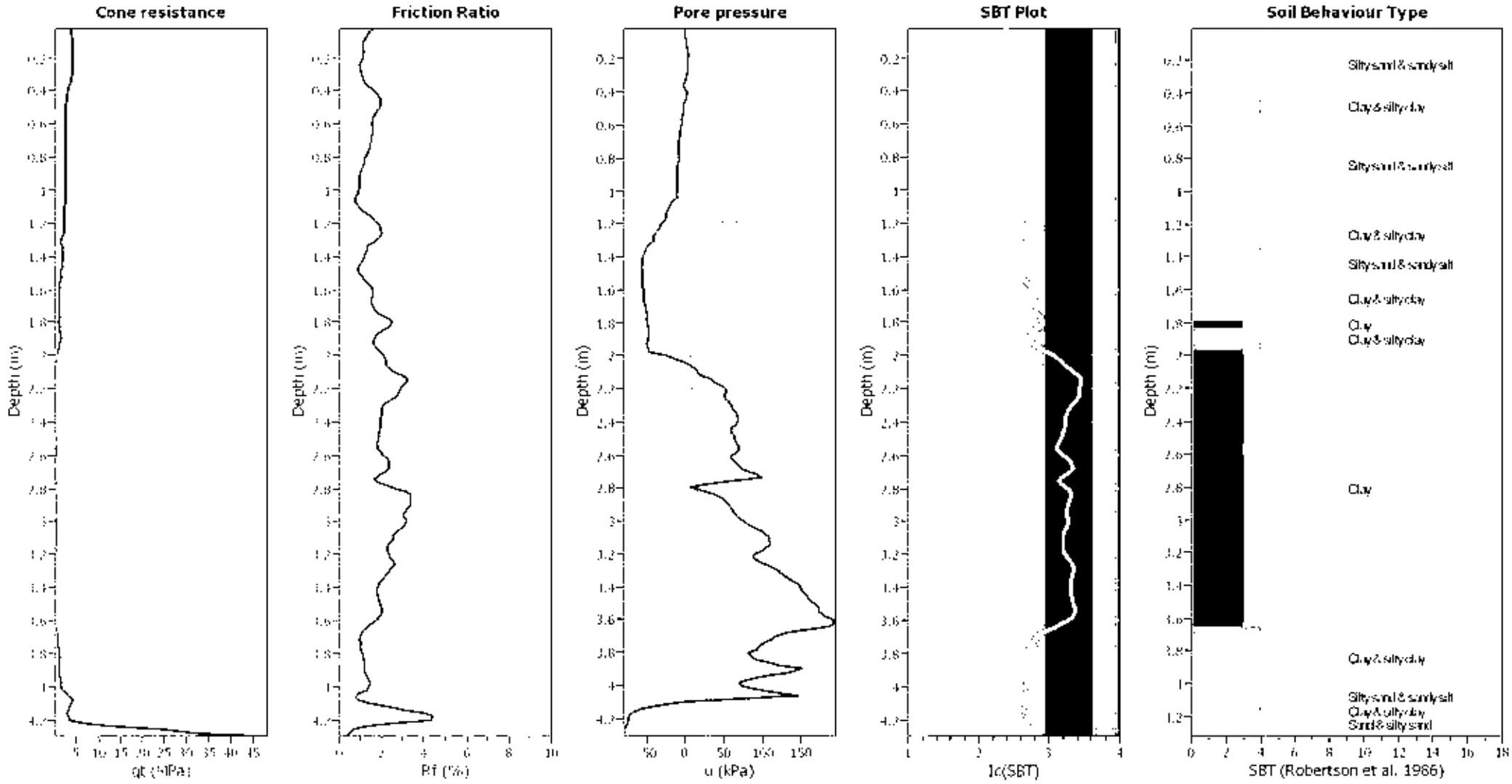
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.25 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.25 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



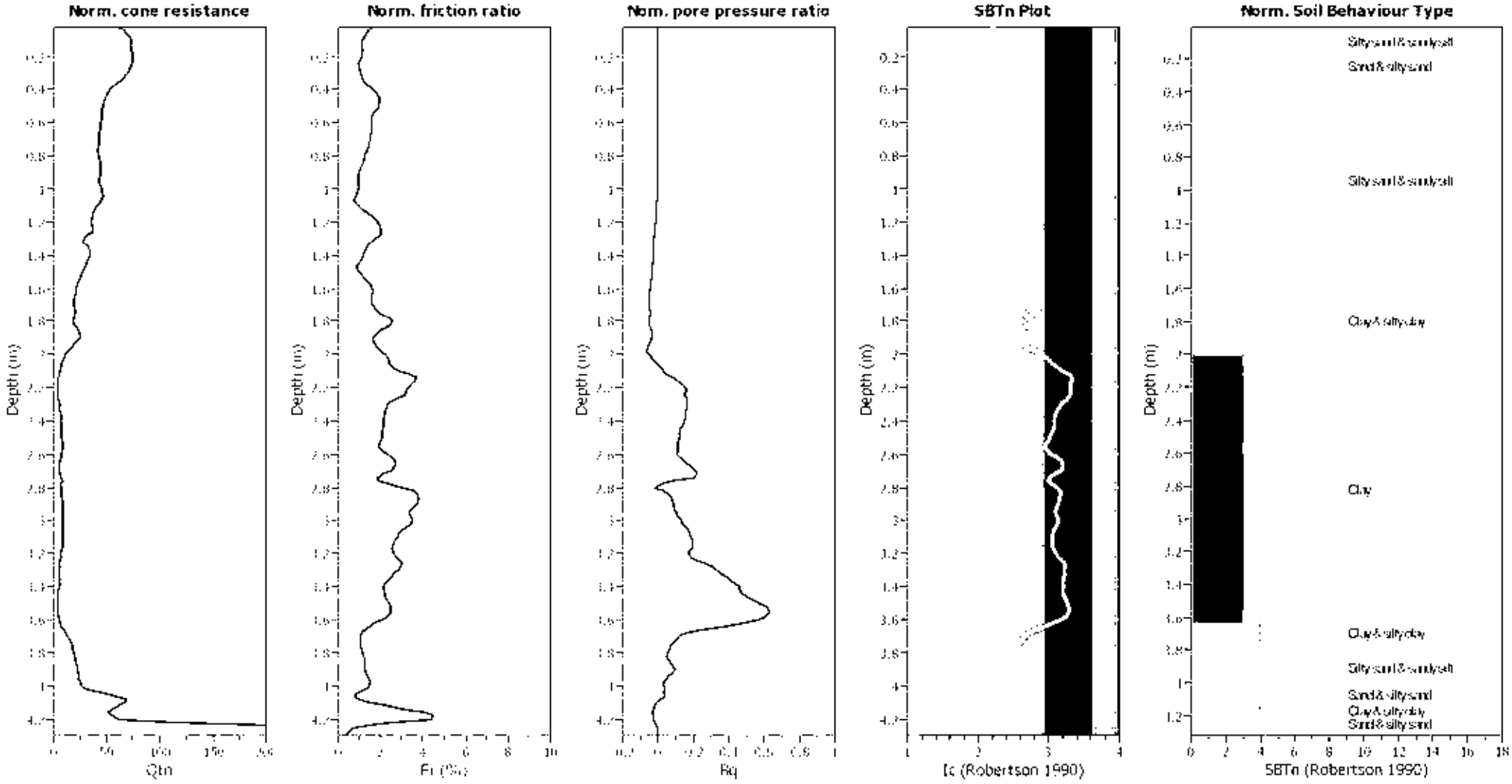
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Unit weight:	N/A
Liquefaction correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



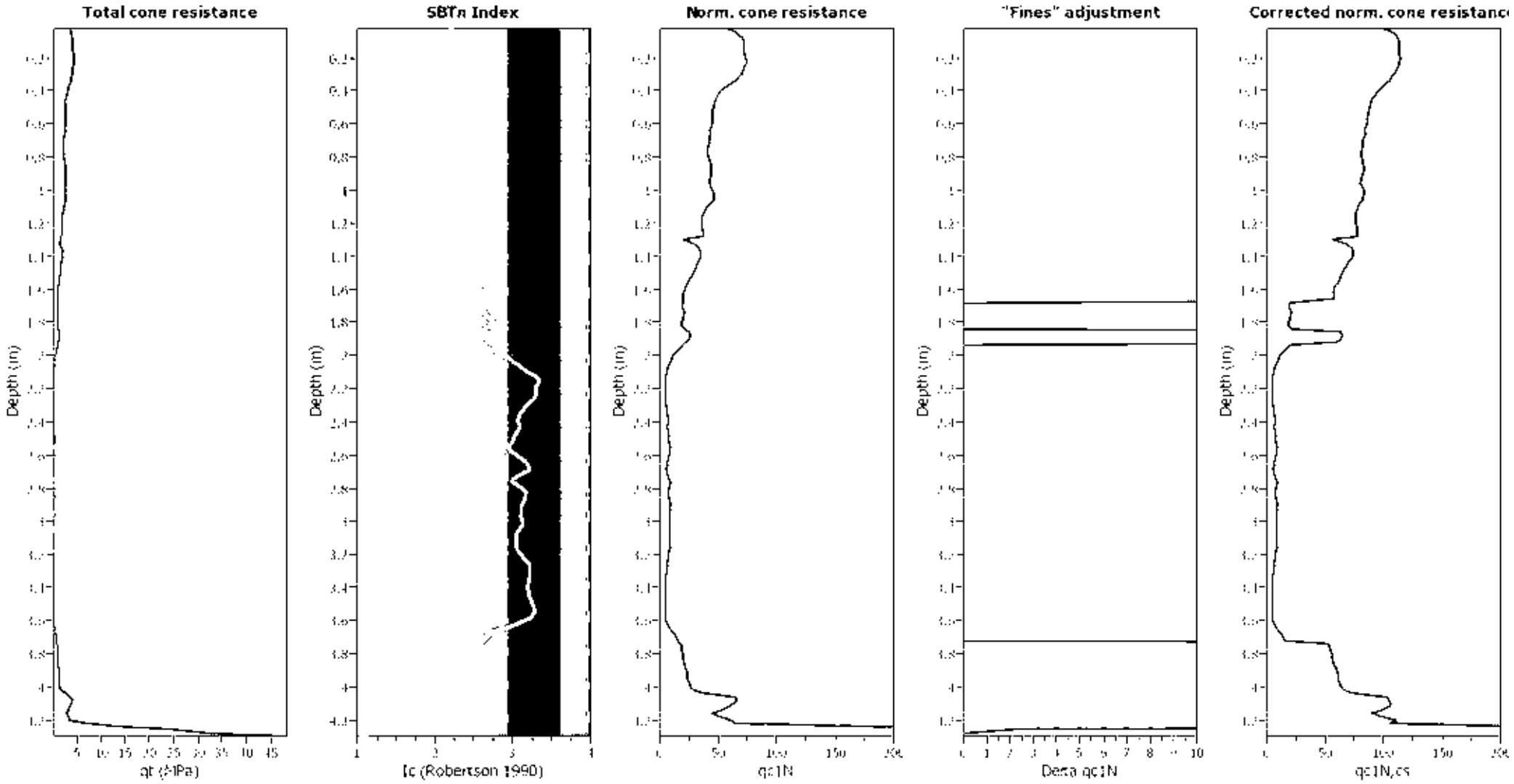
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

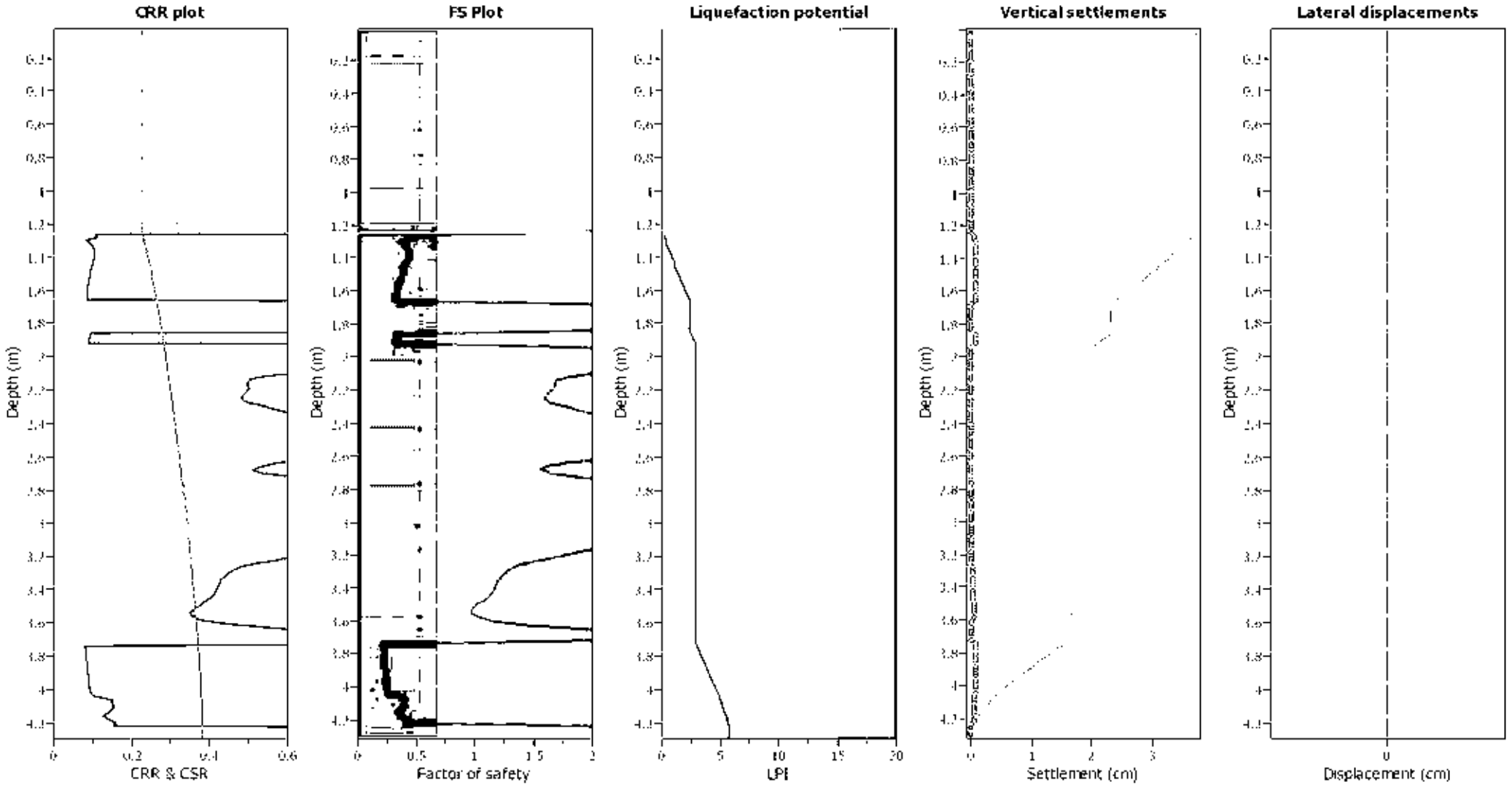
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Liquefaction correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.25 m	Fill height:	N/A	Limit depth:	N/A

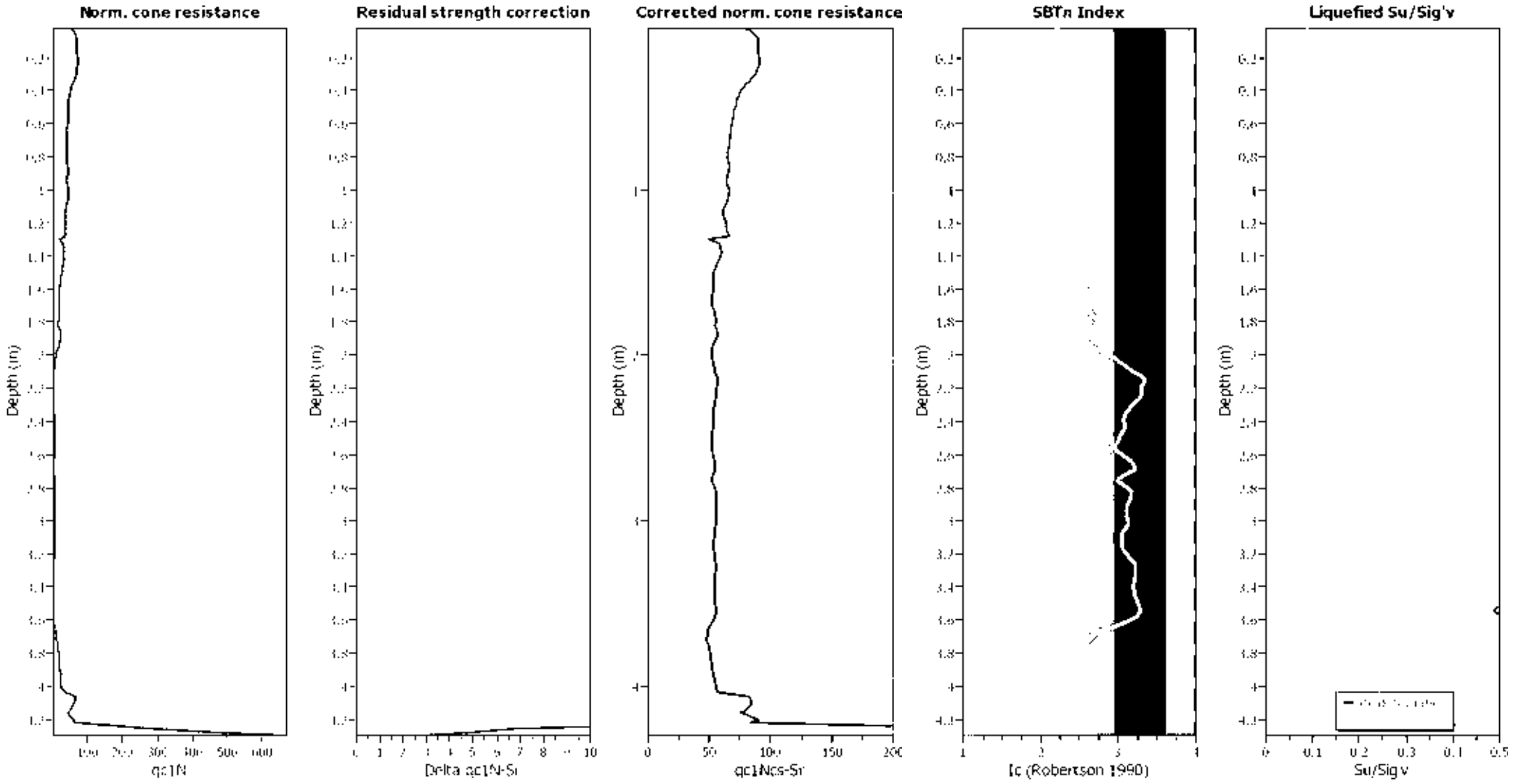
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

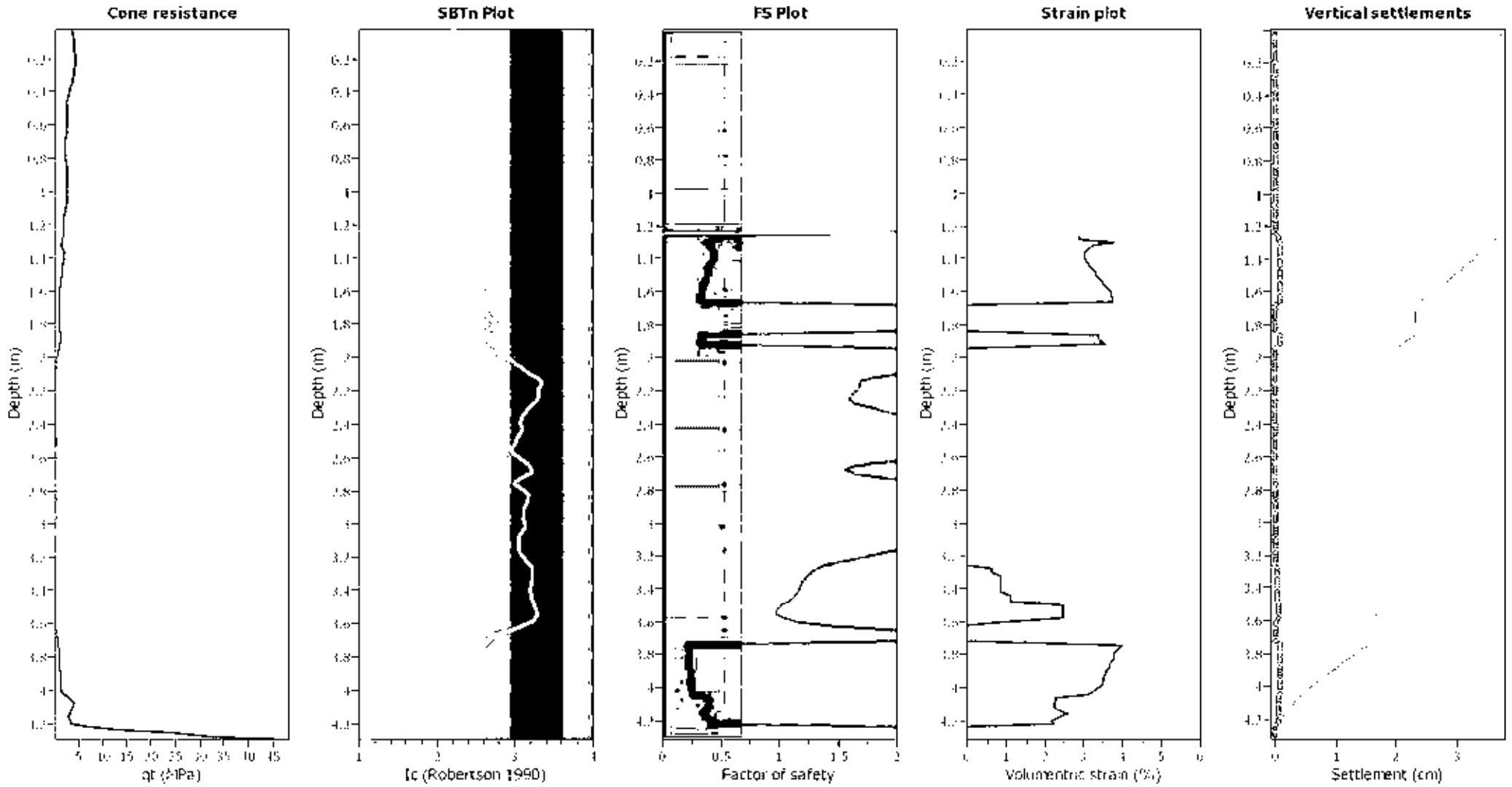
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.25 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

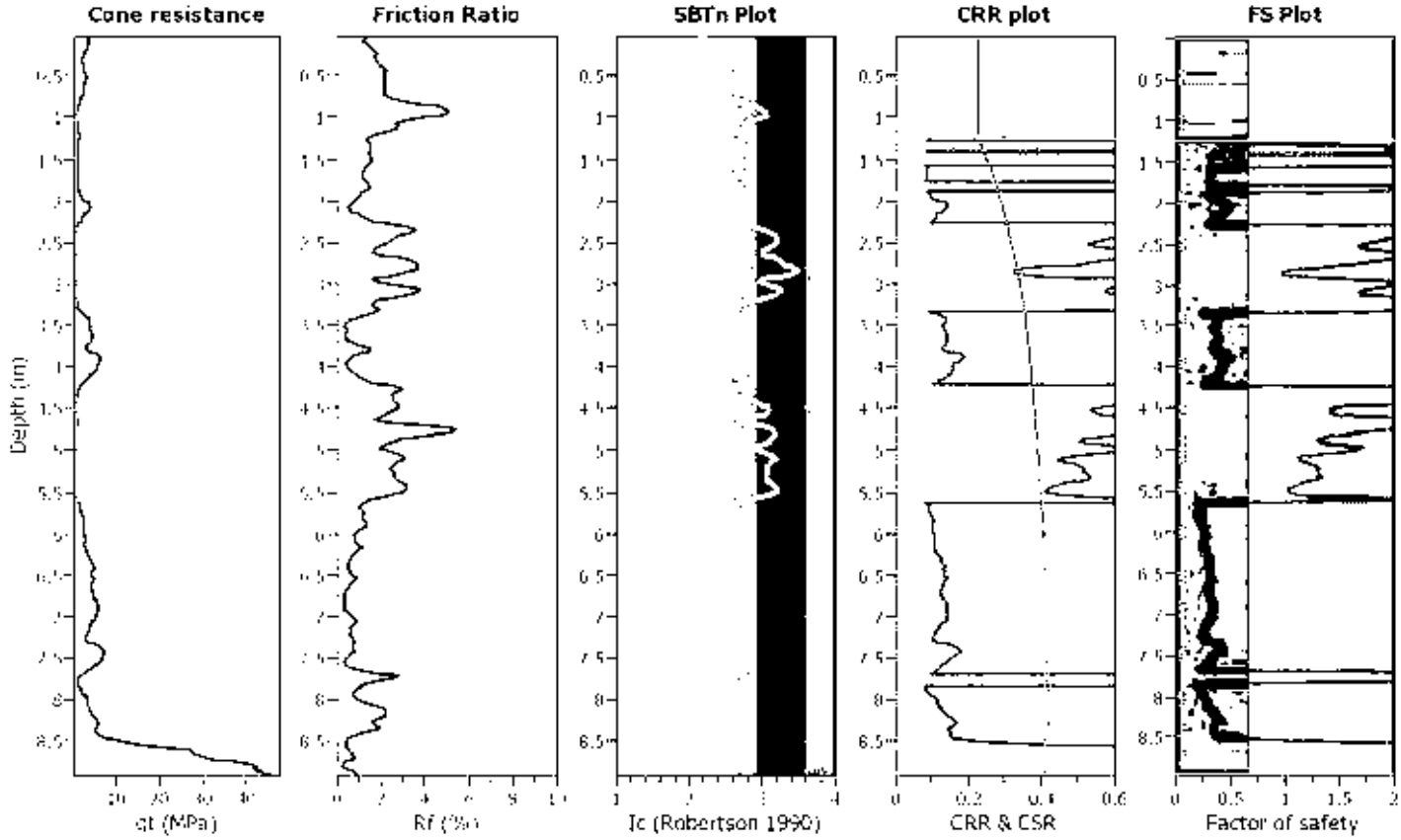
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

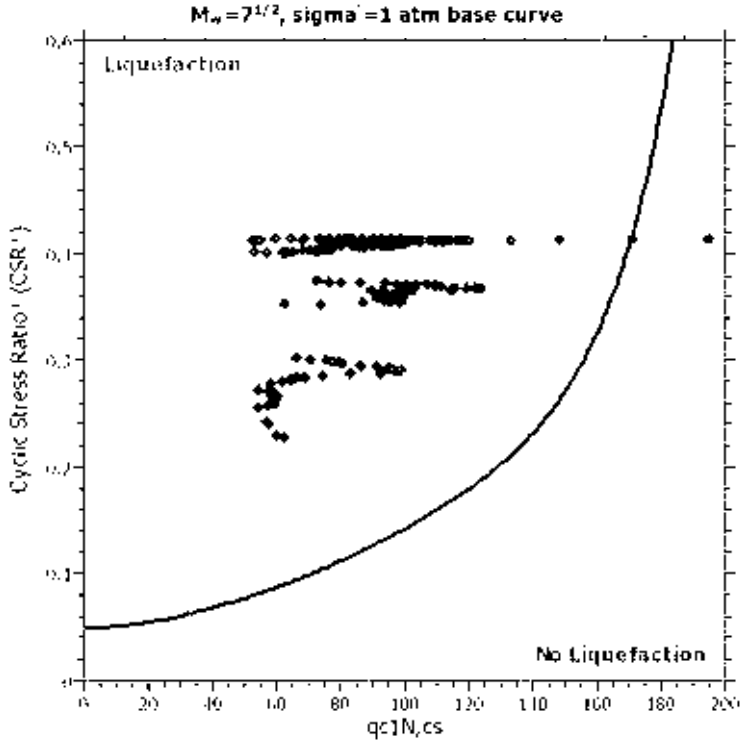
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

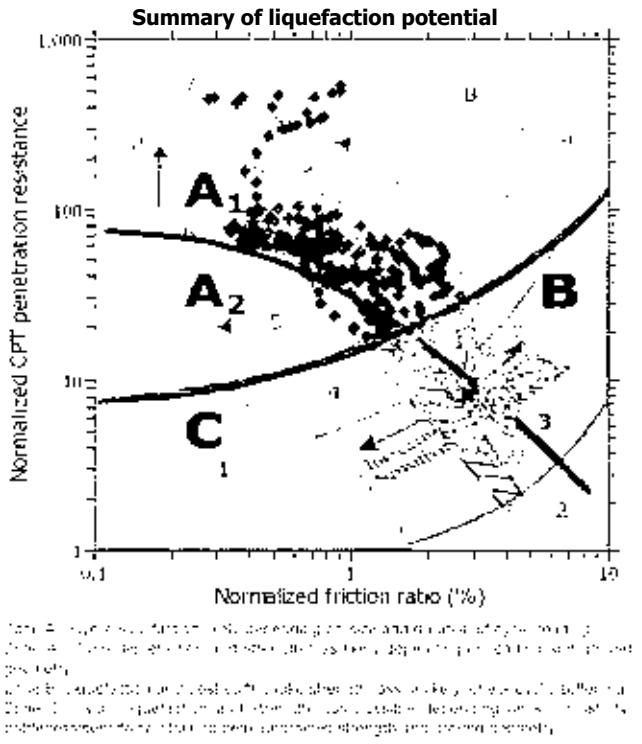
CPT file : CPT39_32SutherlandsRd

Input parameters and analysis data

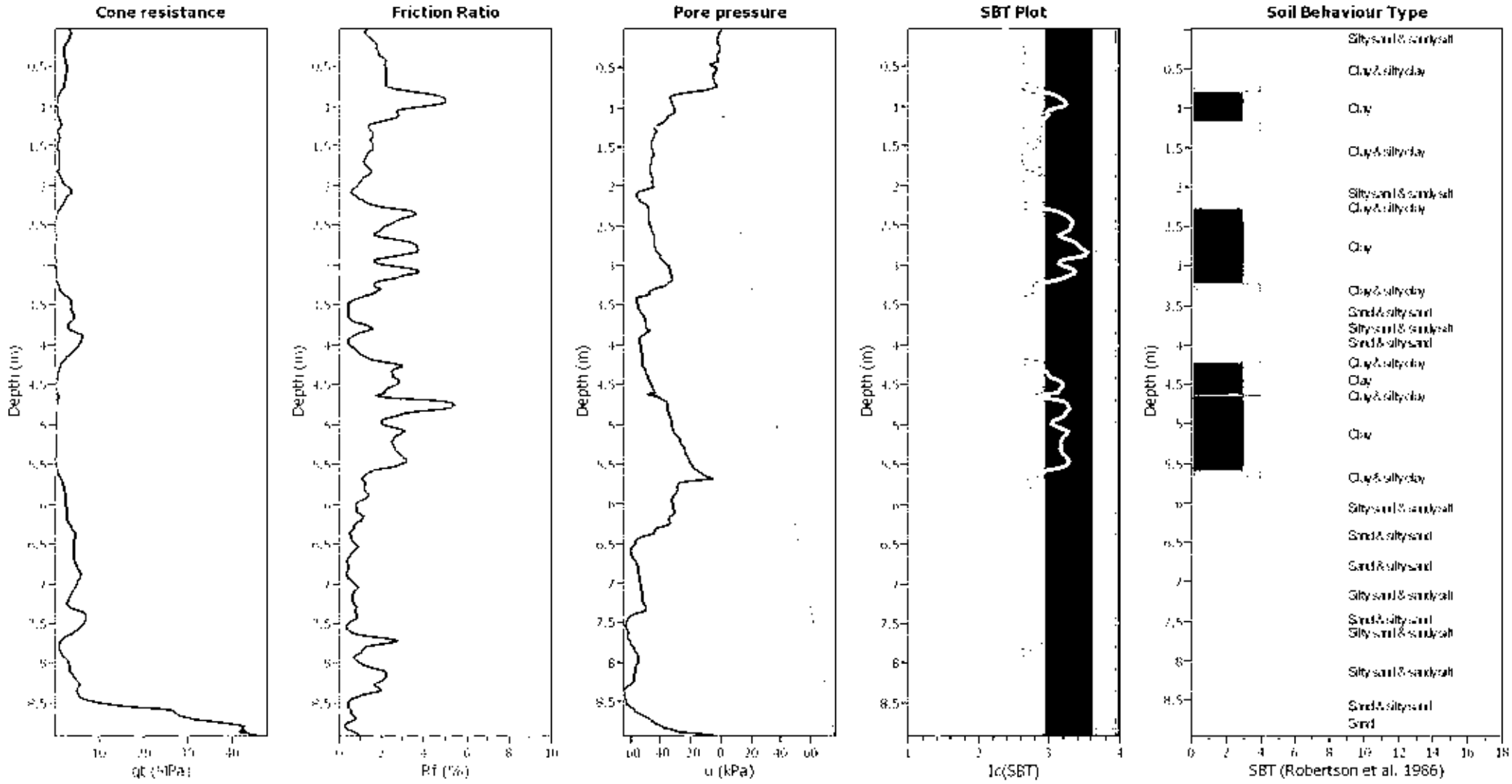
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.25 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.25 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



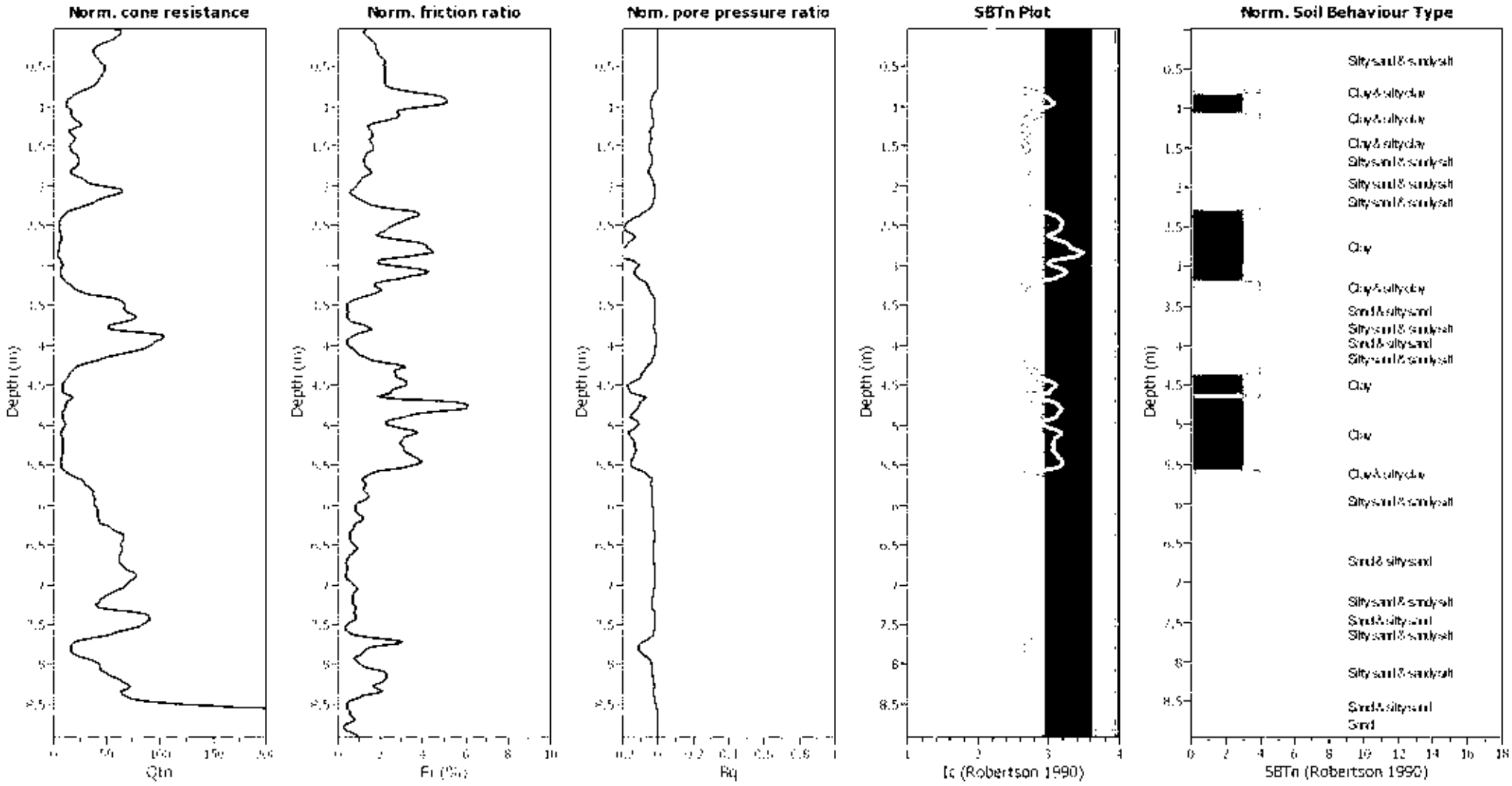
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



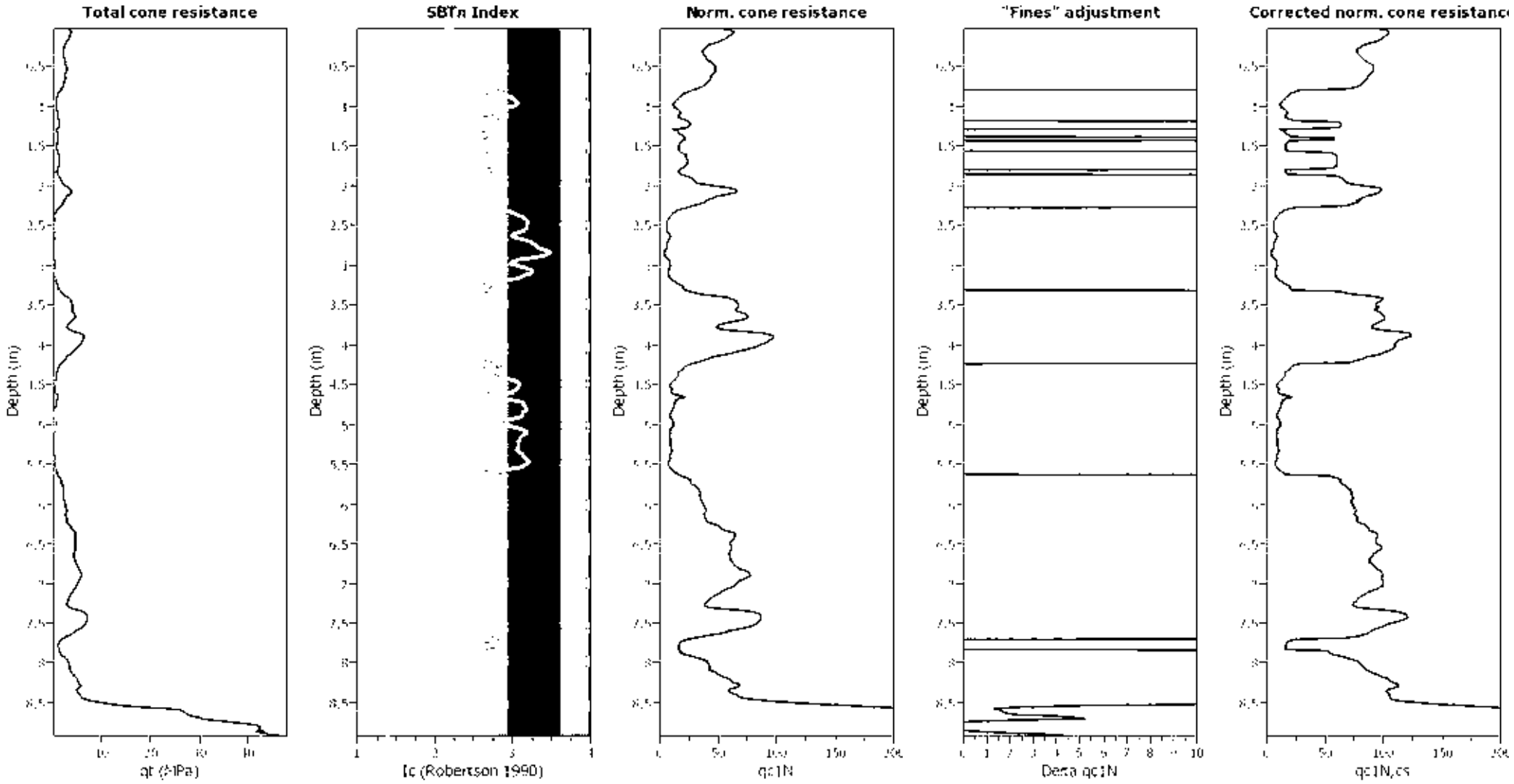
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

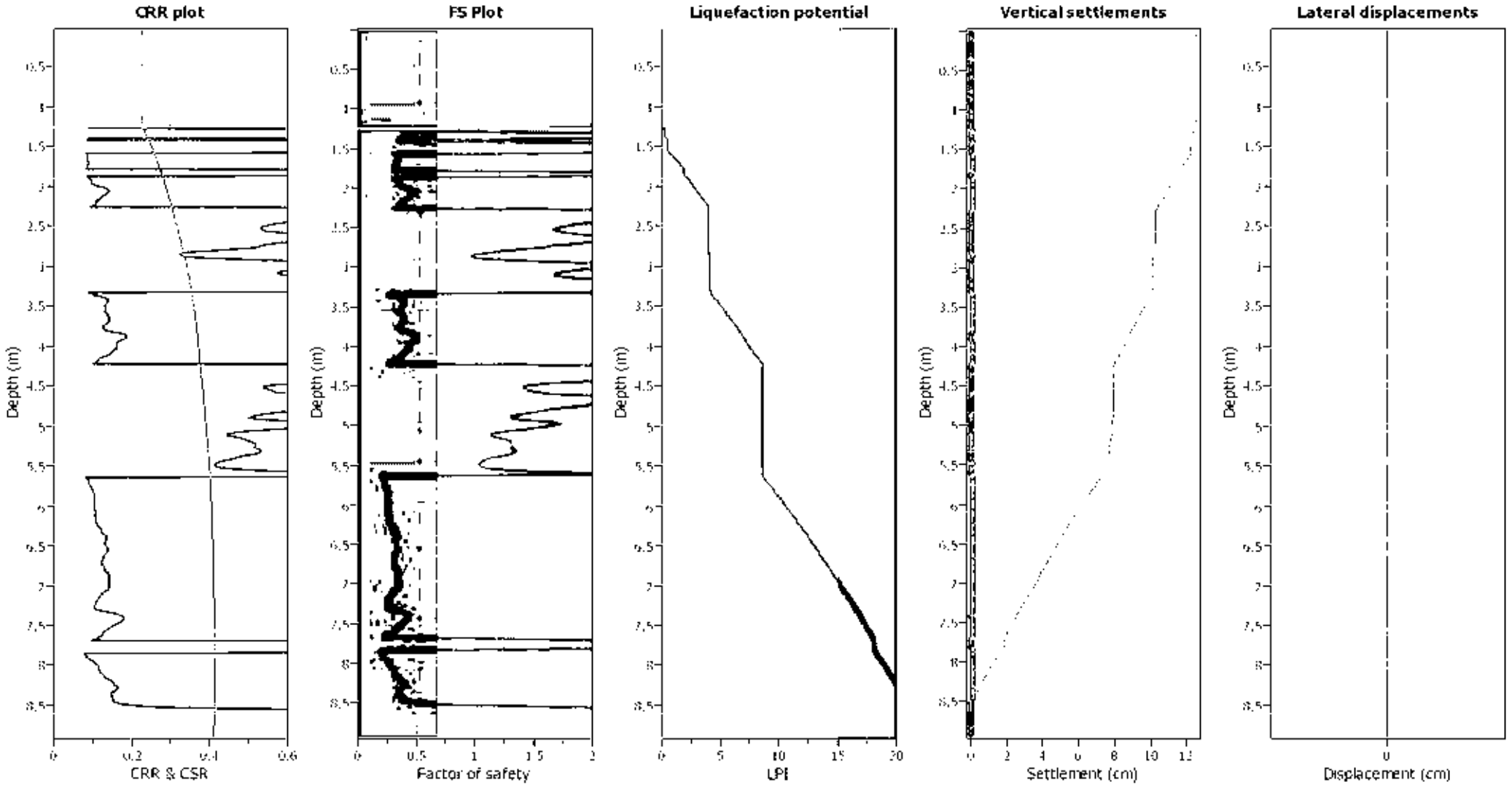
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.25 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.25 m	Fill height:	N/A	Limit depth:	N/A

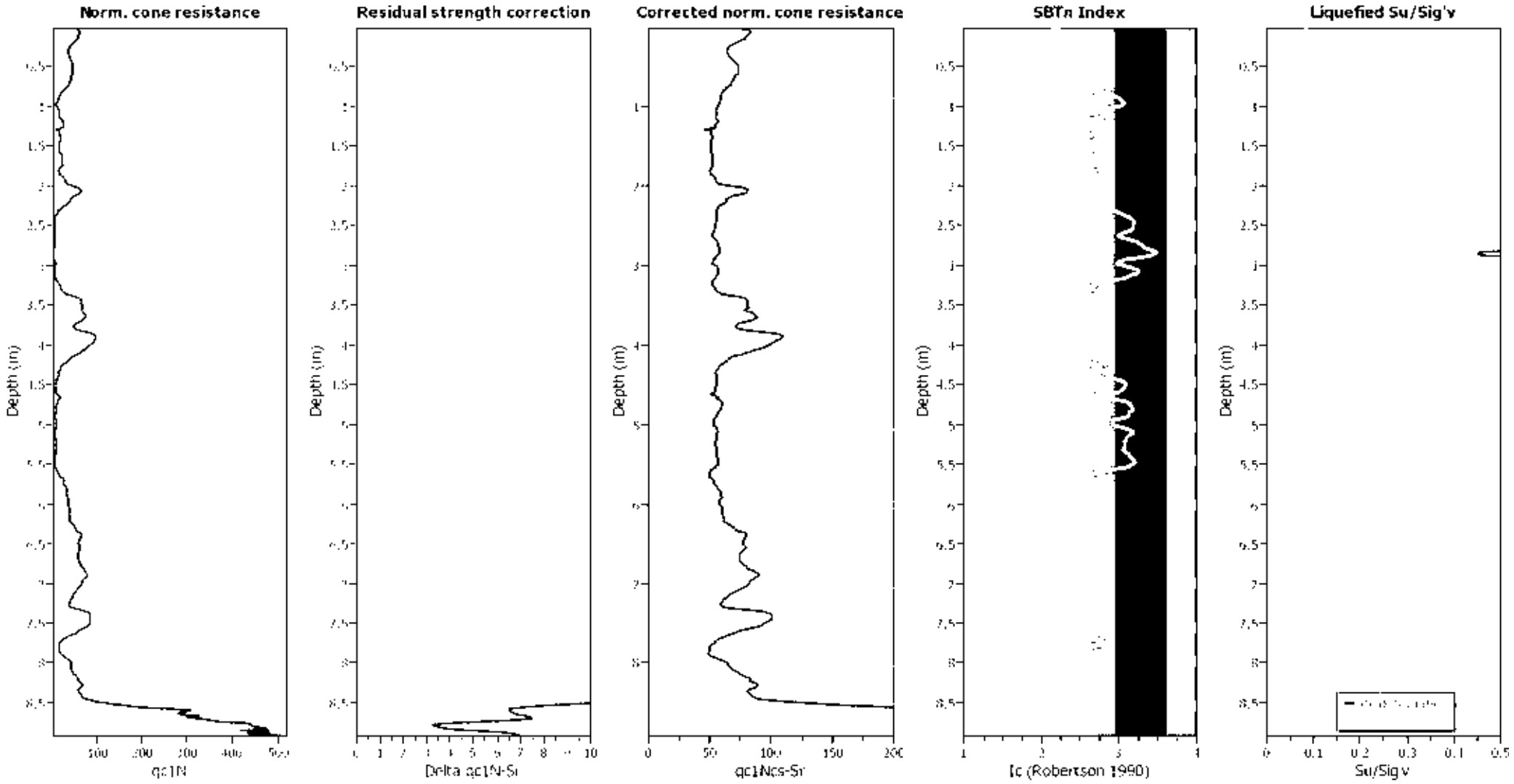
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

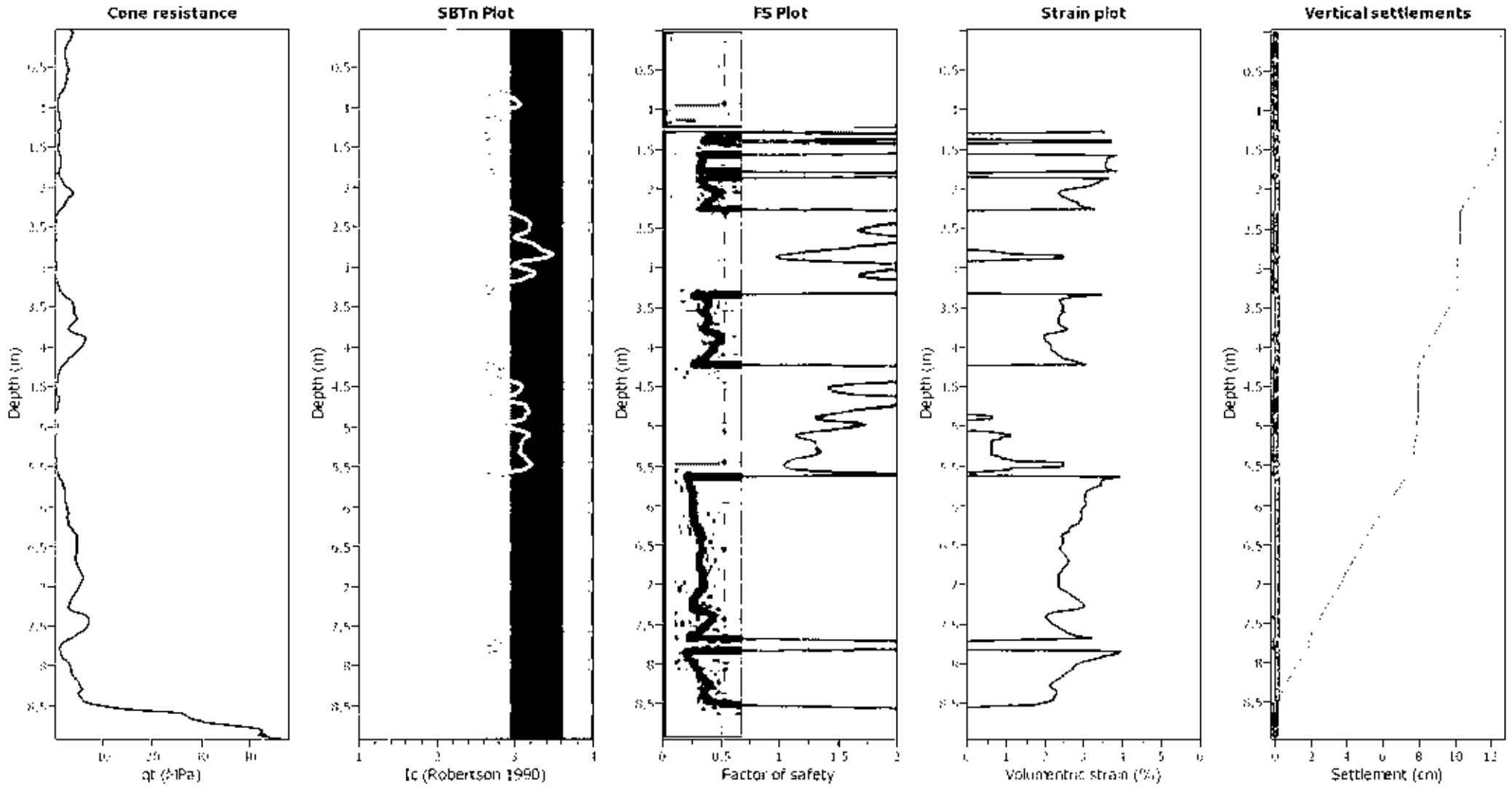
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.25 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.25 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

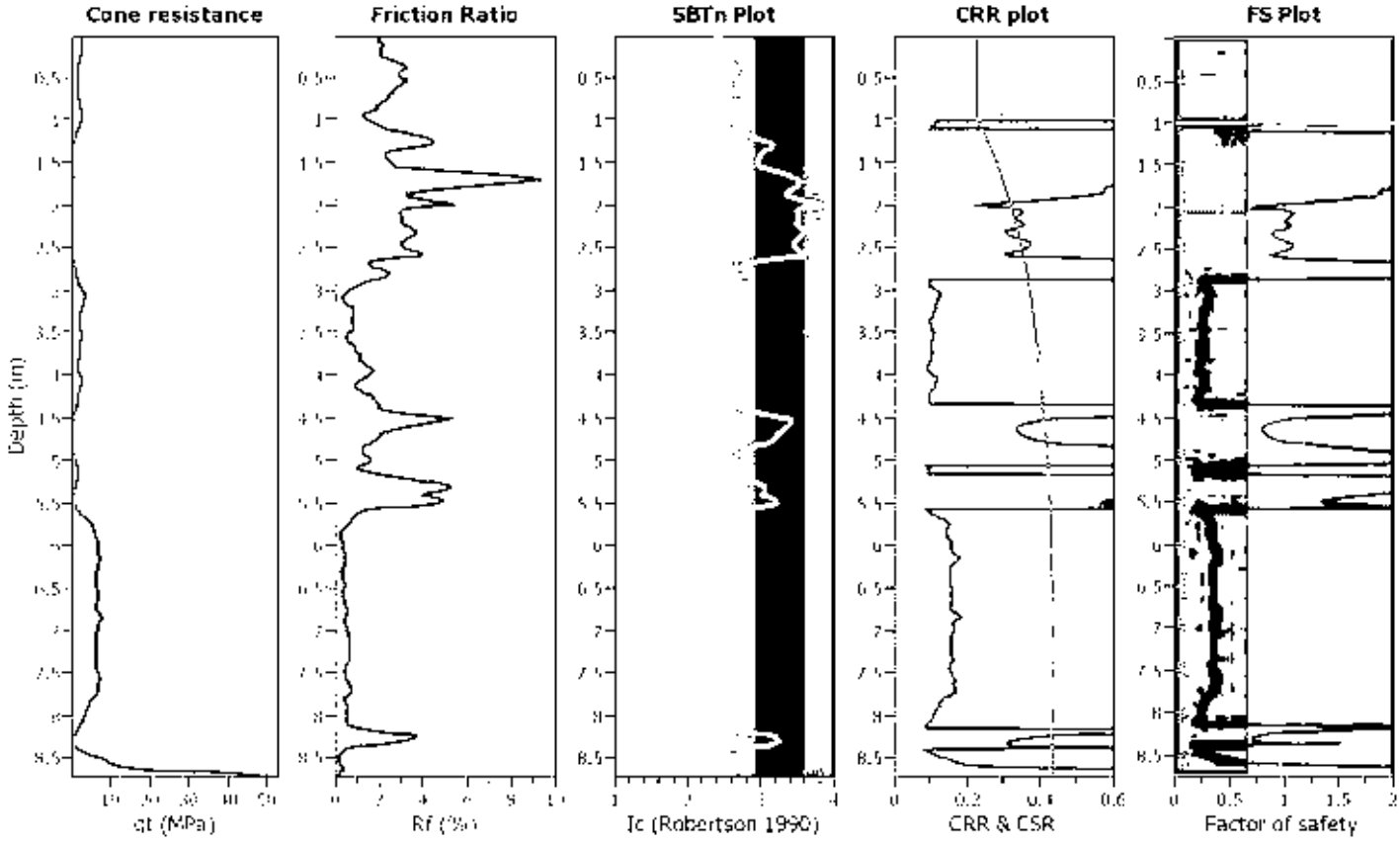
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

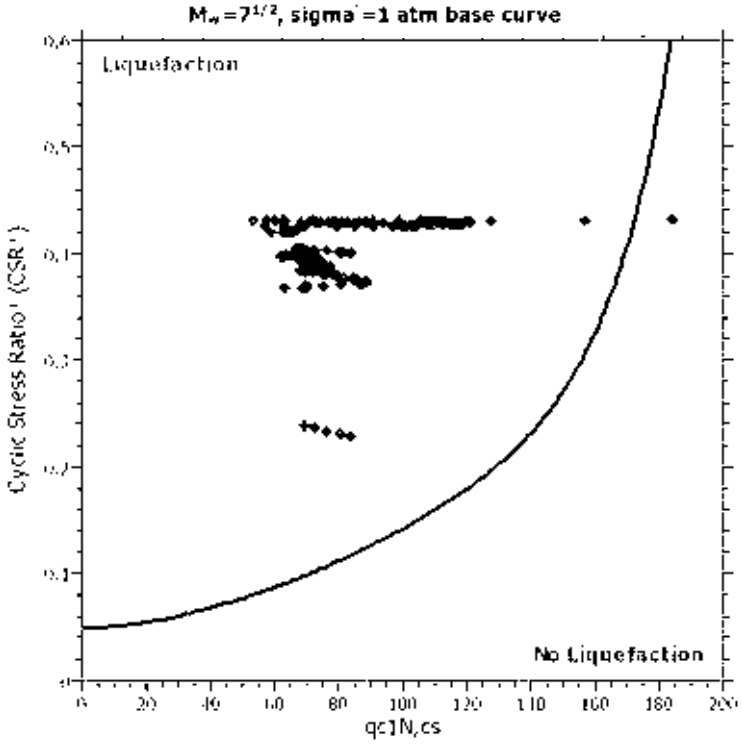
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

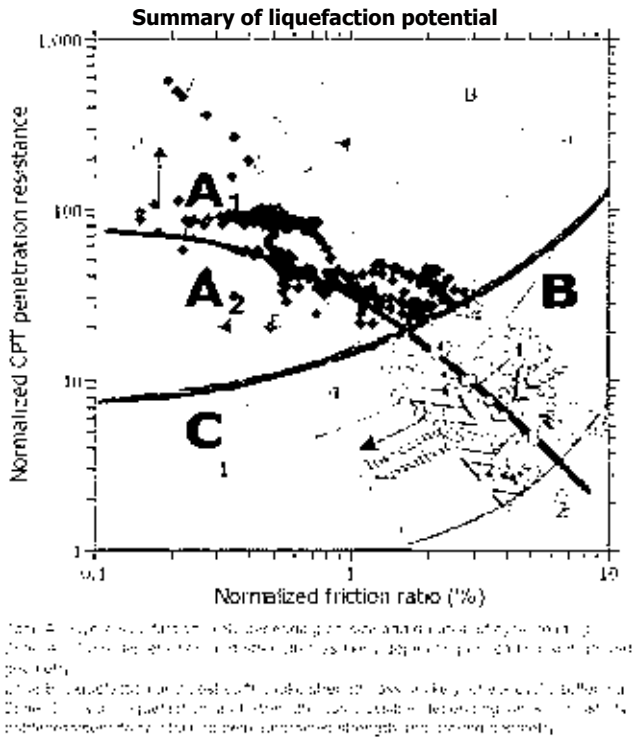
CPT file : CPT40_32SutherlandsRd

Input parameters and analysis data

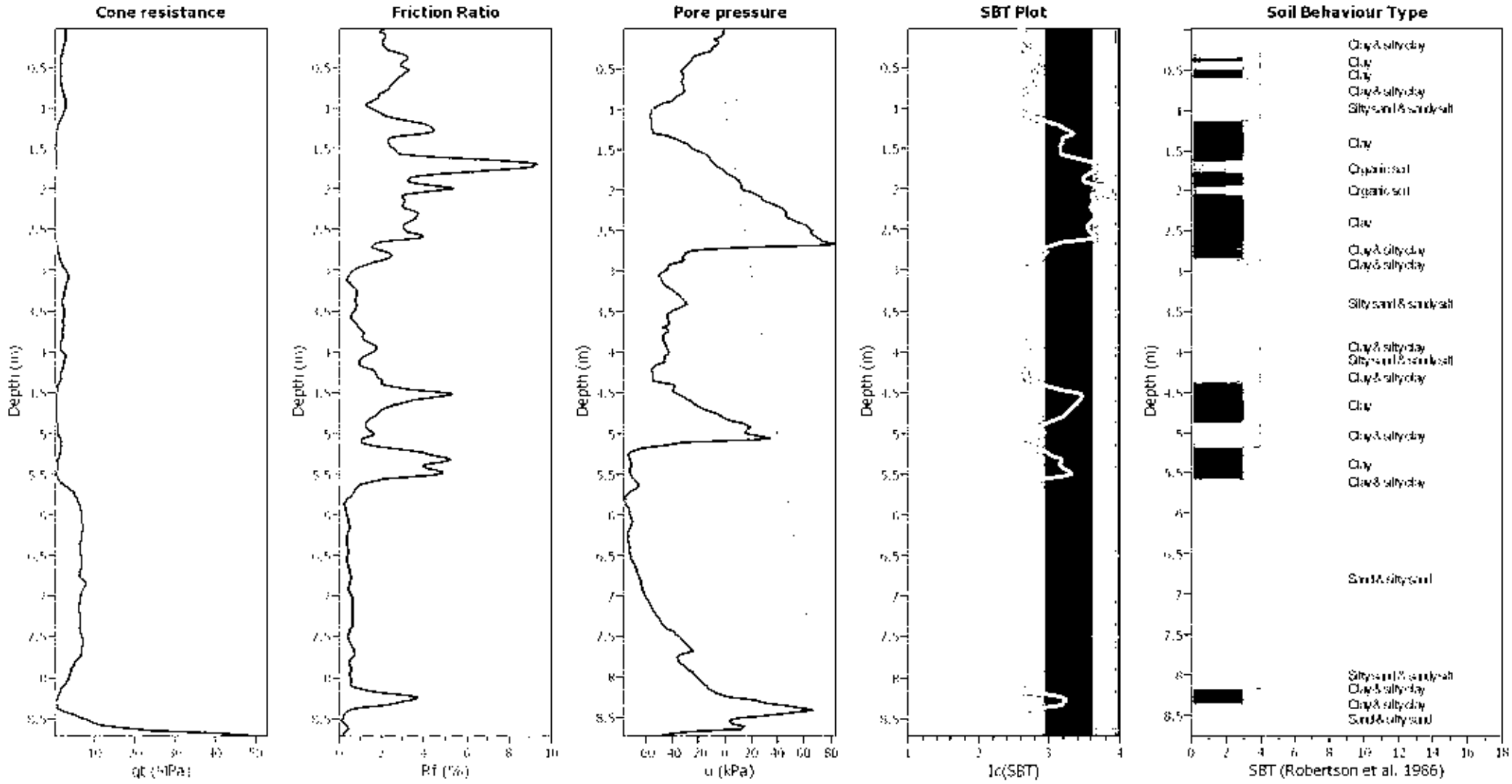
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



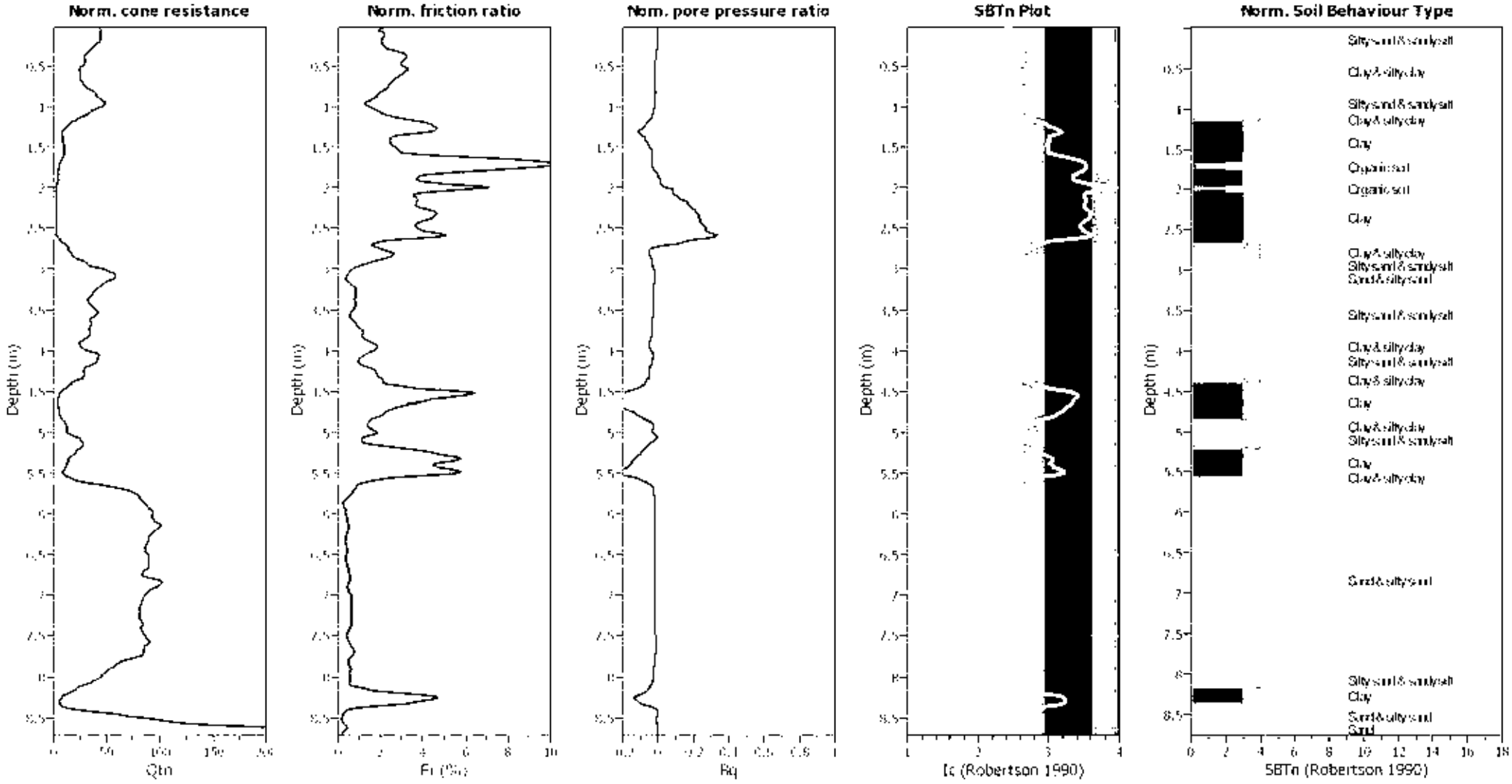
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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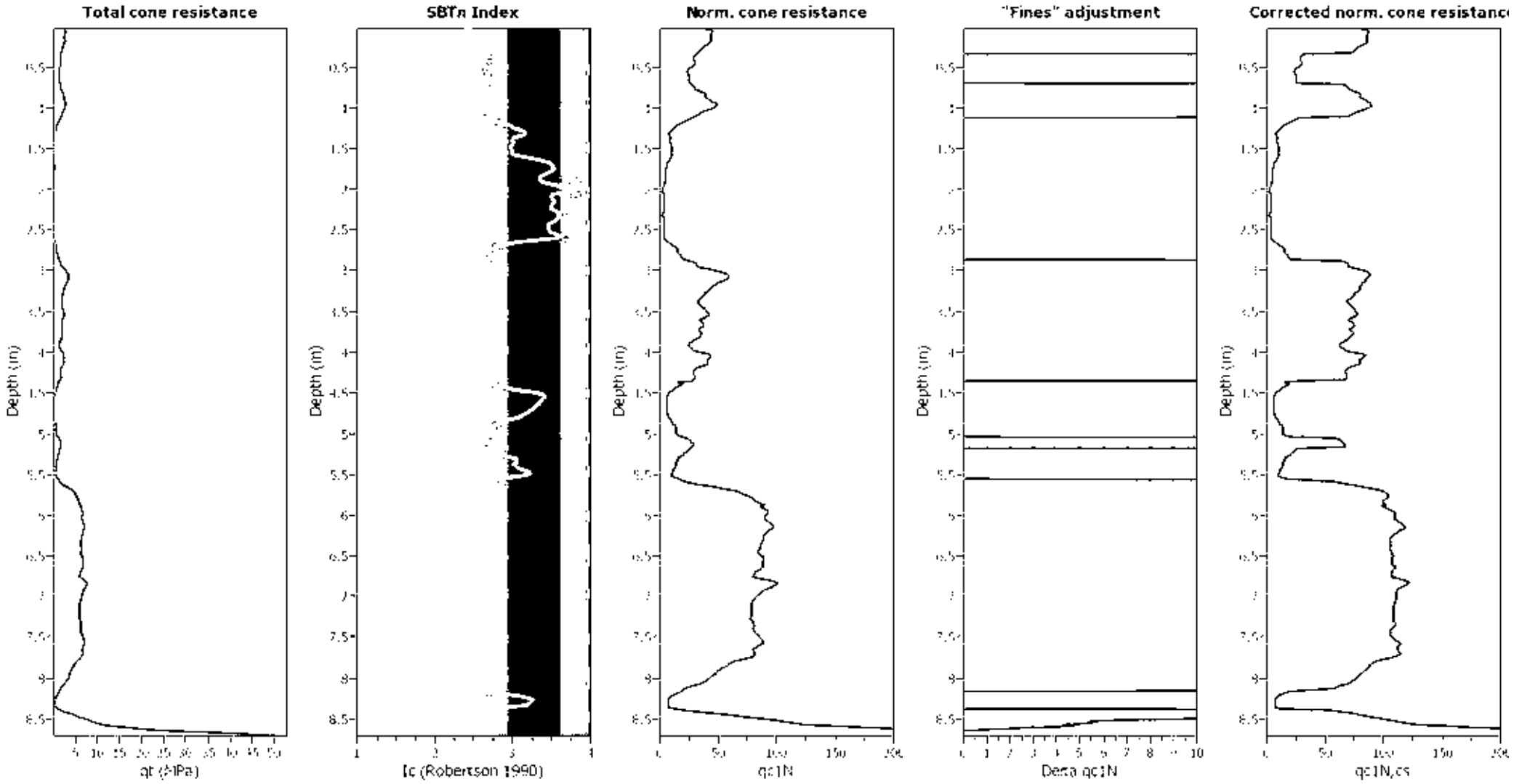
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

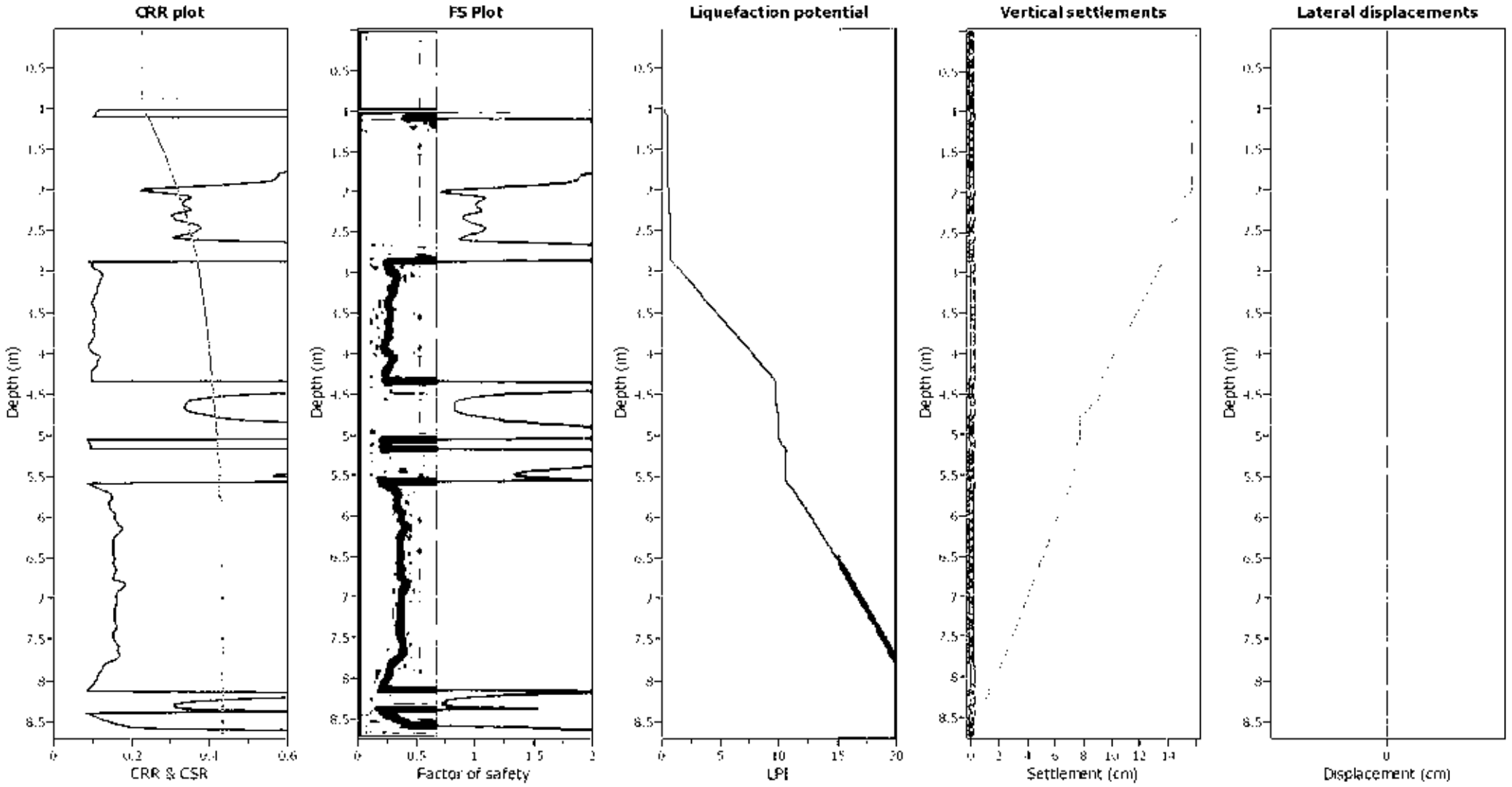
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

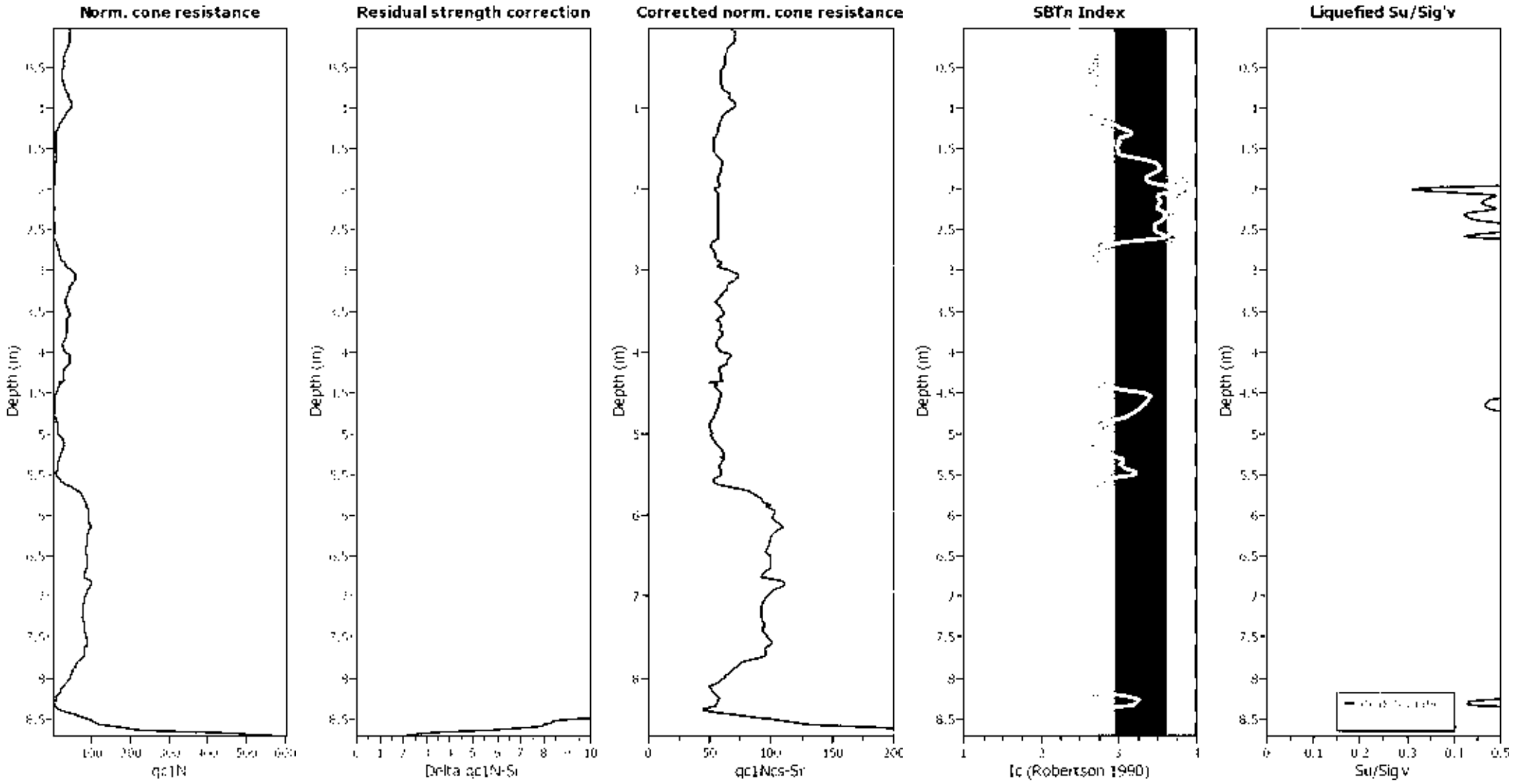
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

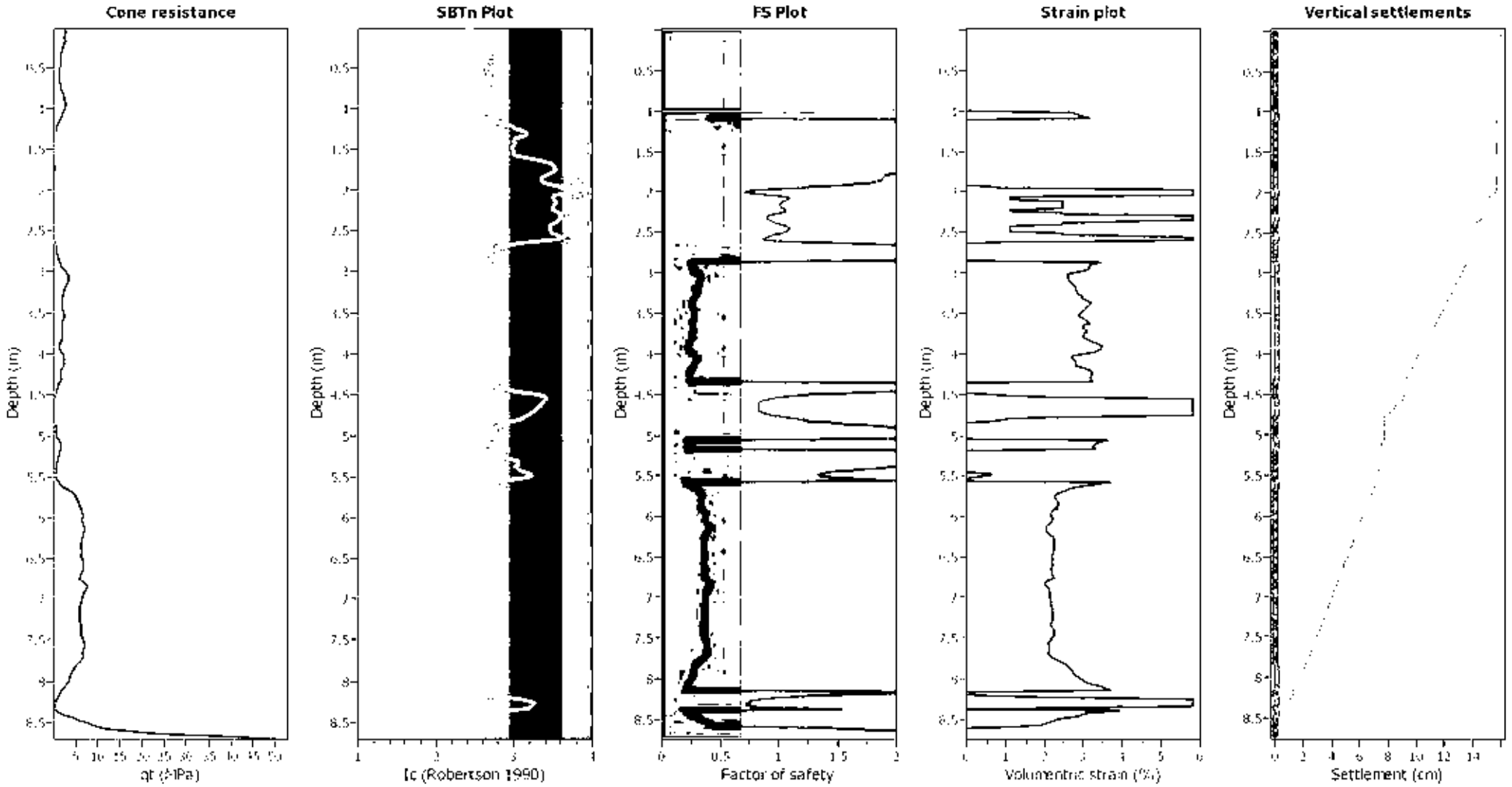
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

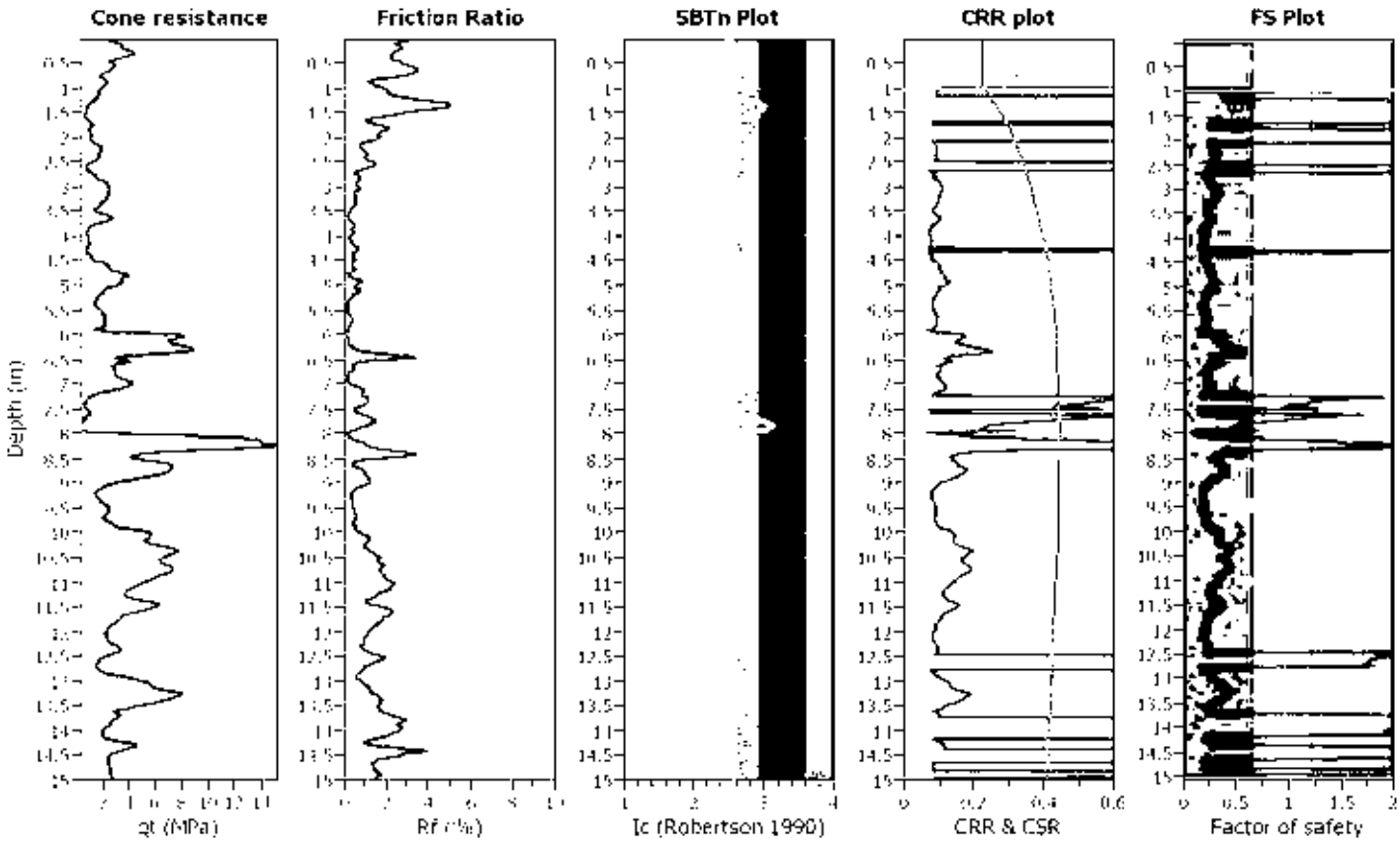
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

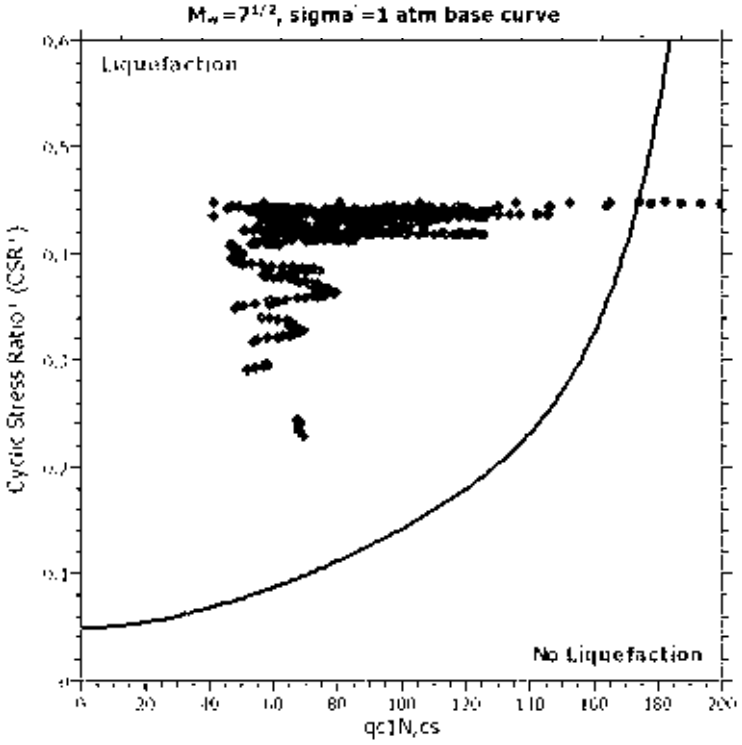
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

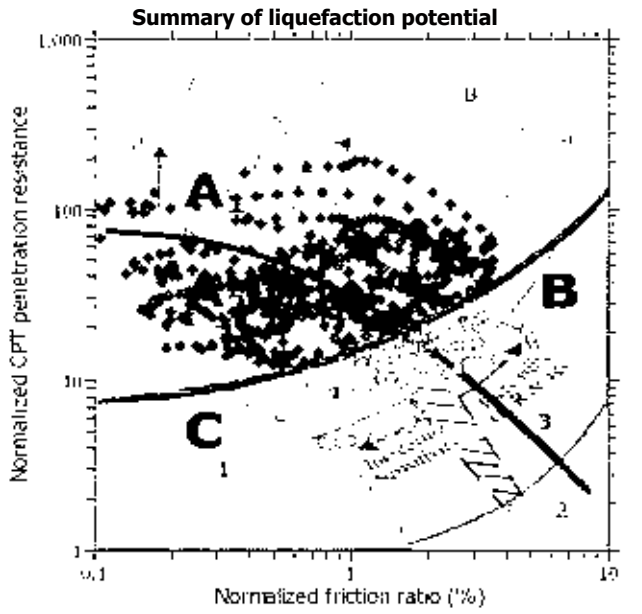
CPT file : CPT41_678CashmereRd

Input parameters and analysis data

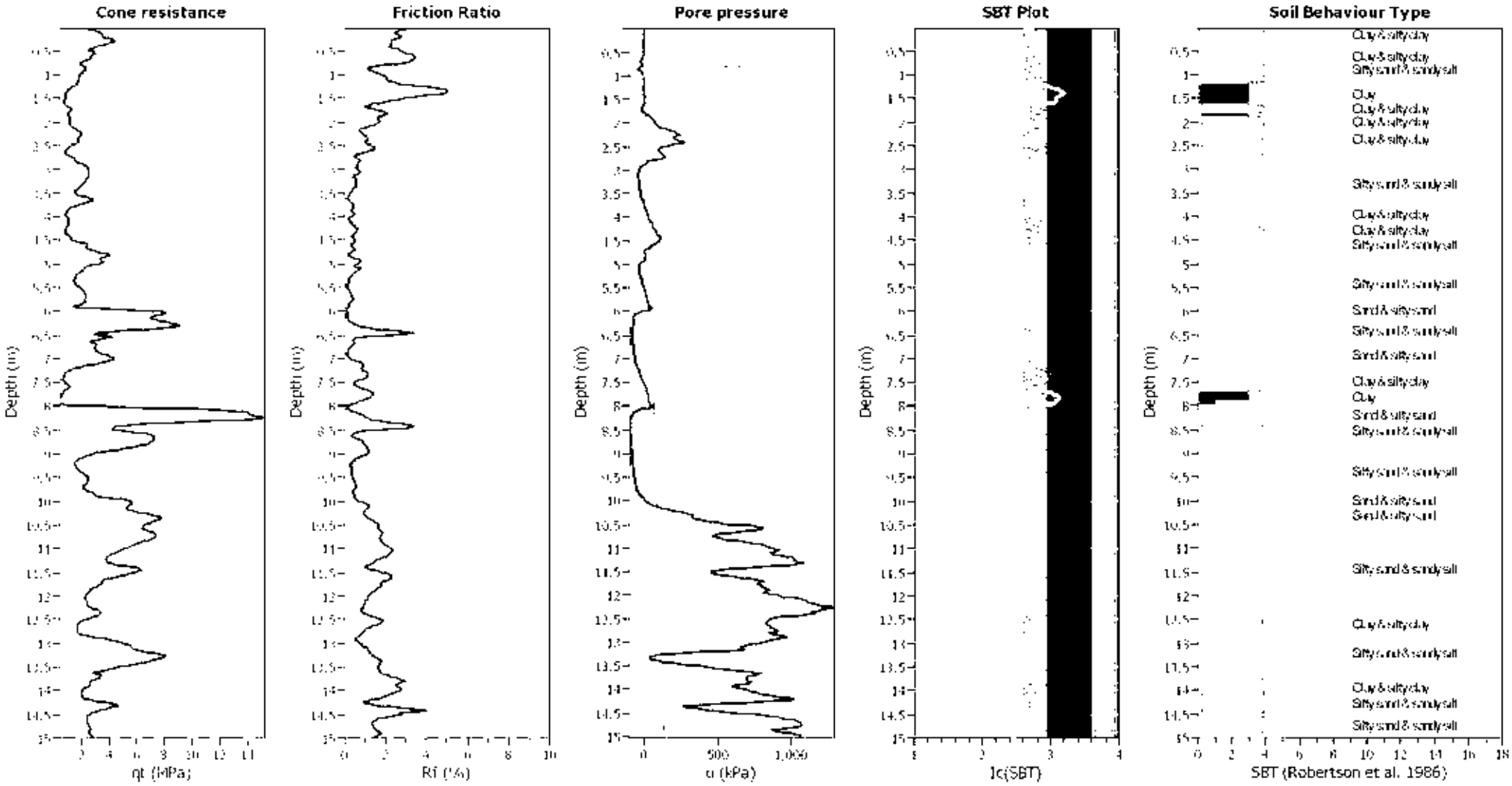
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



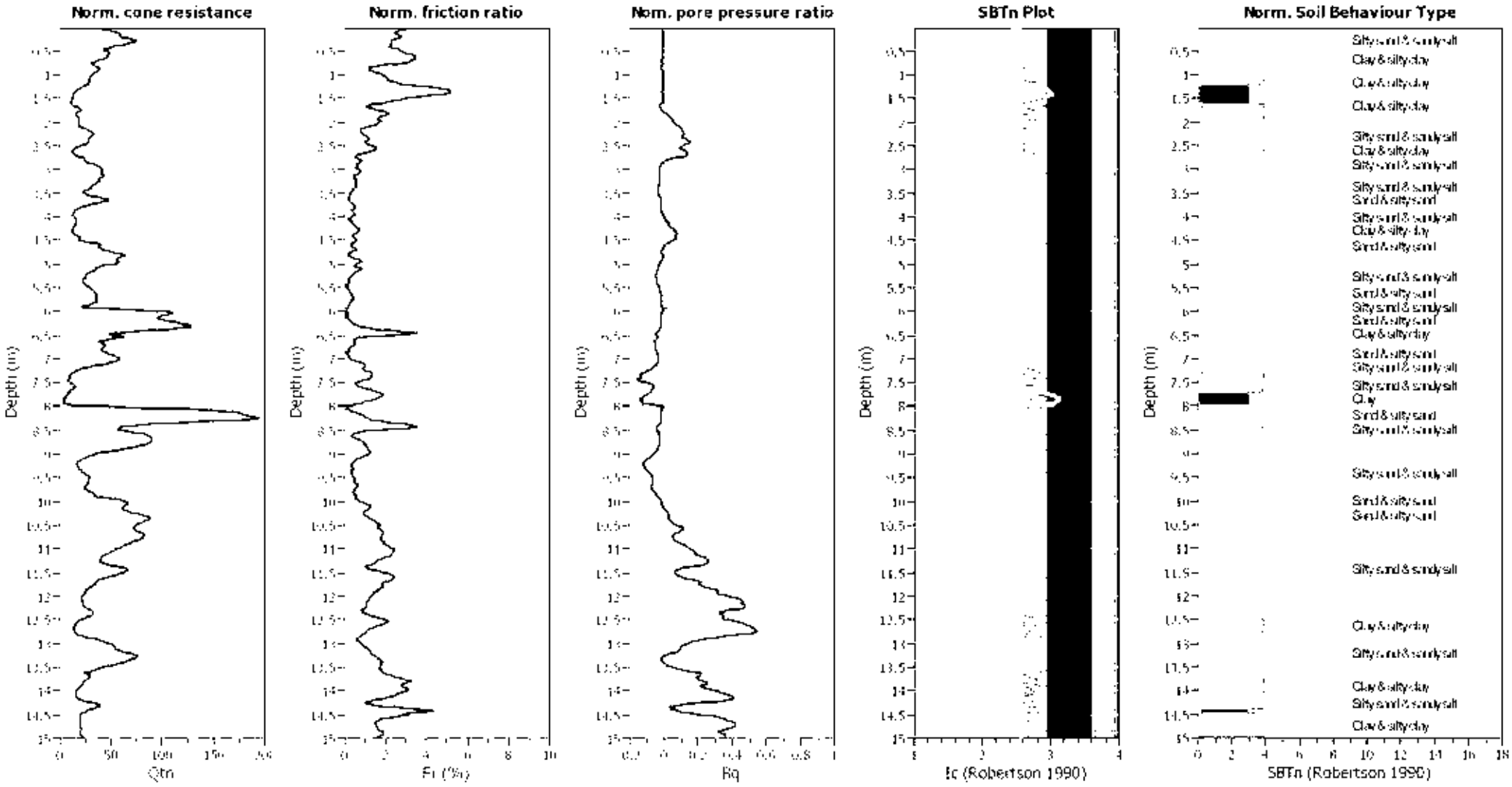
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



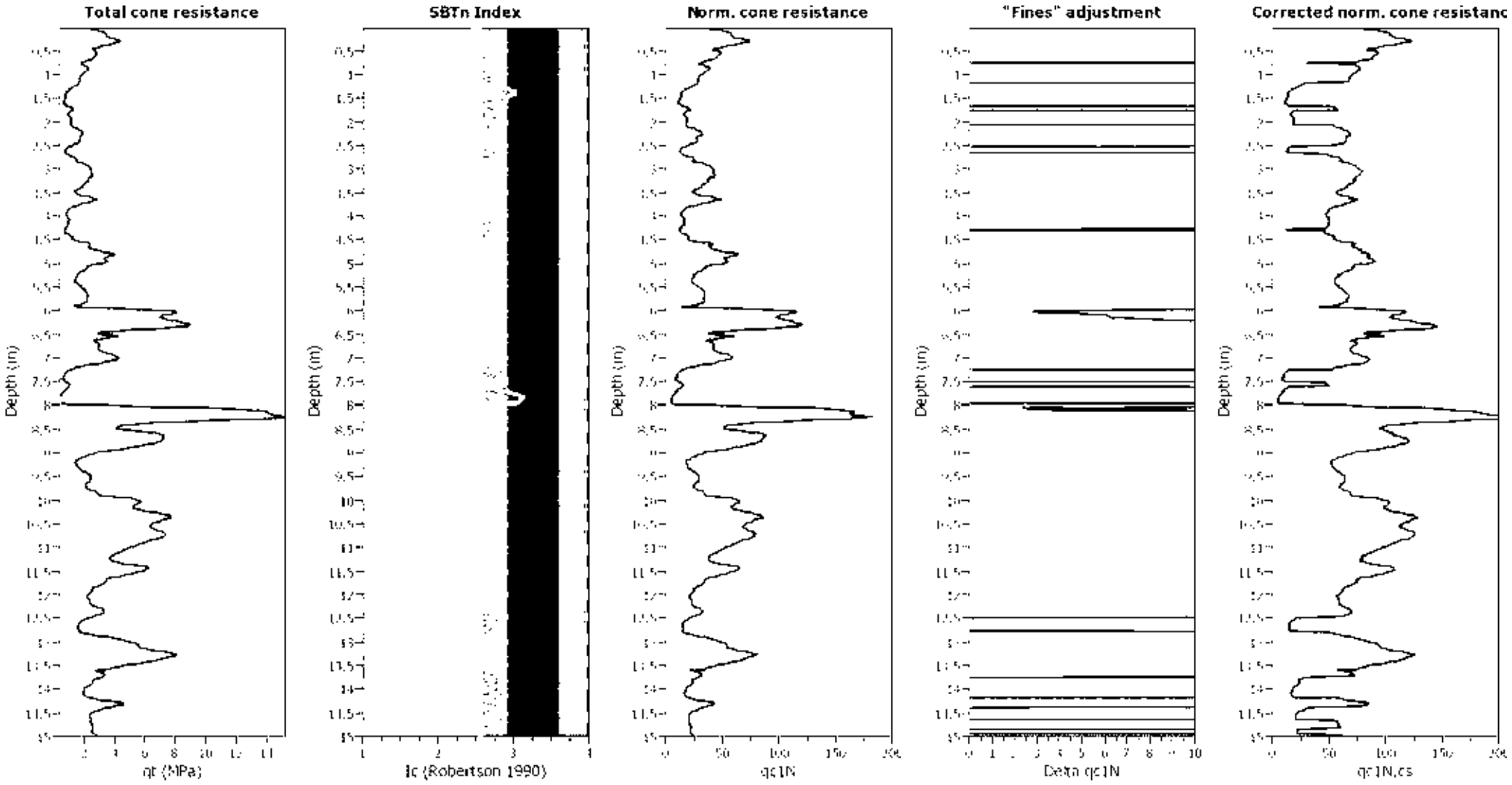
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

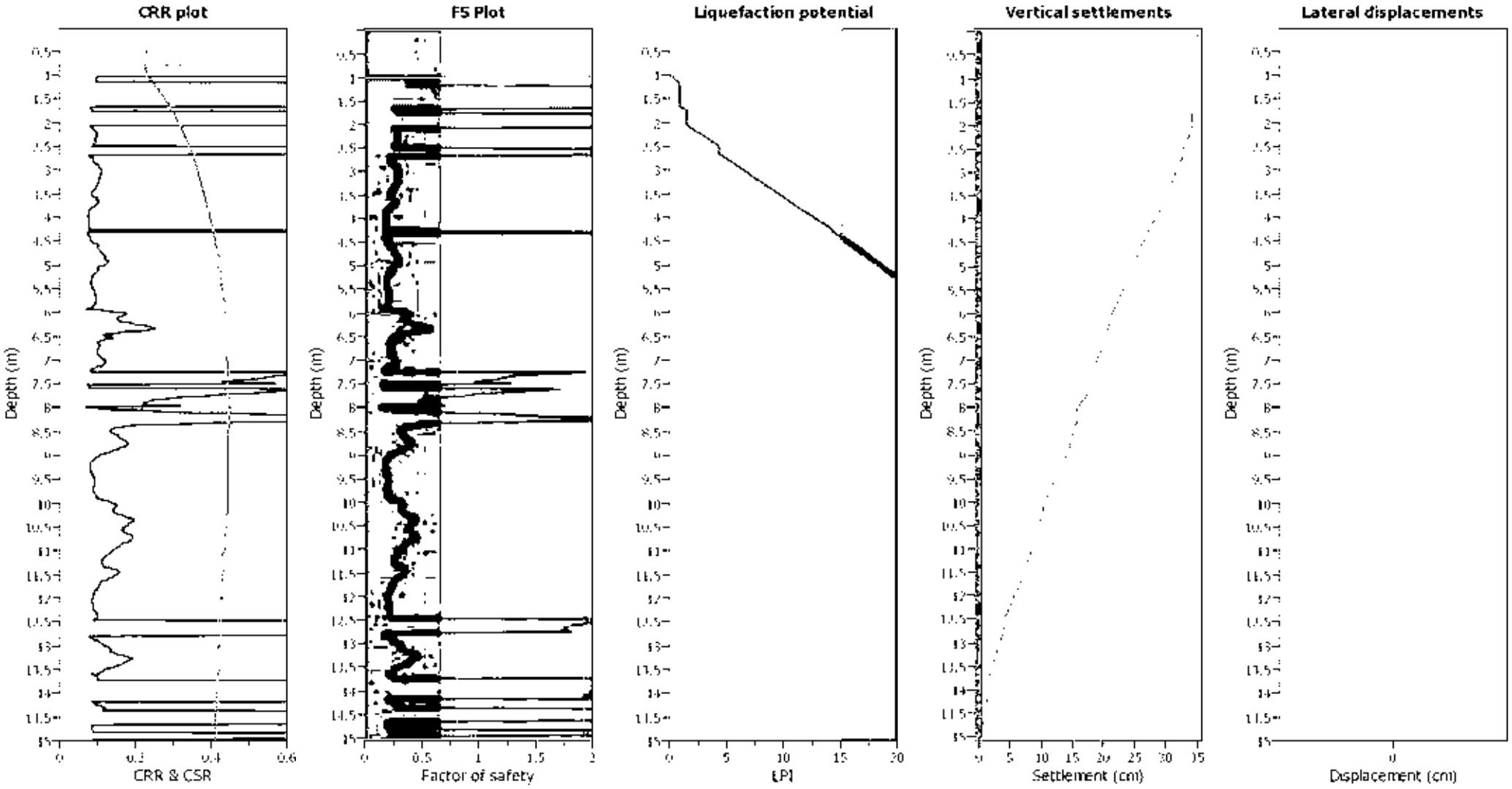
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

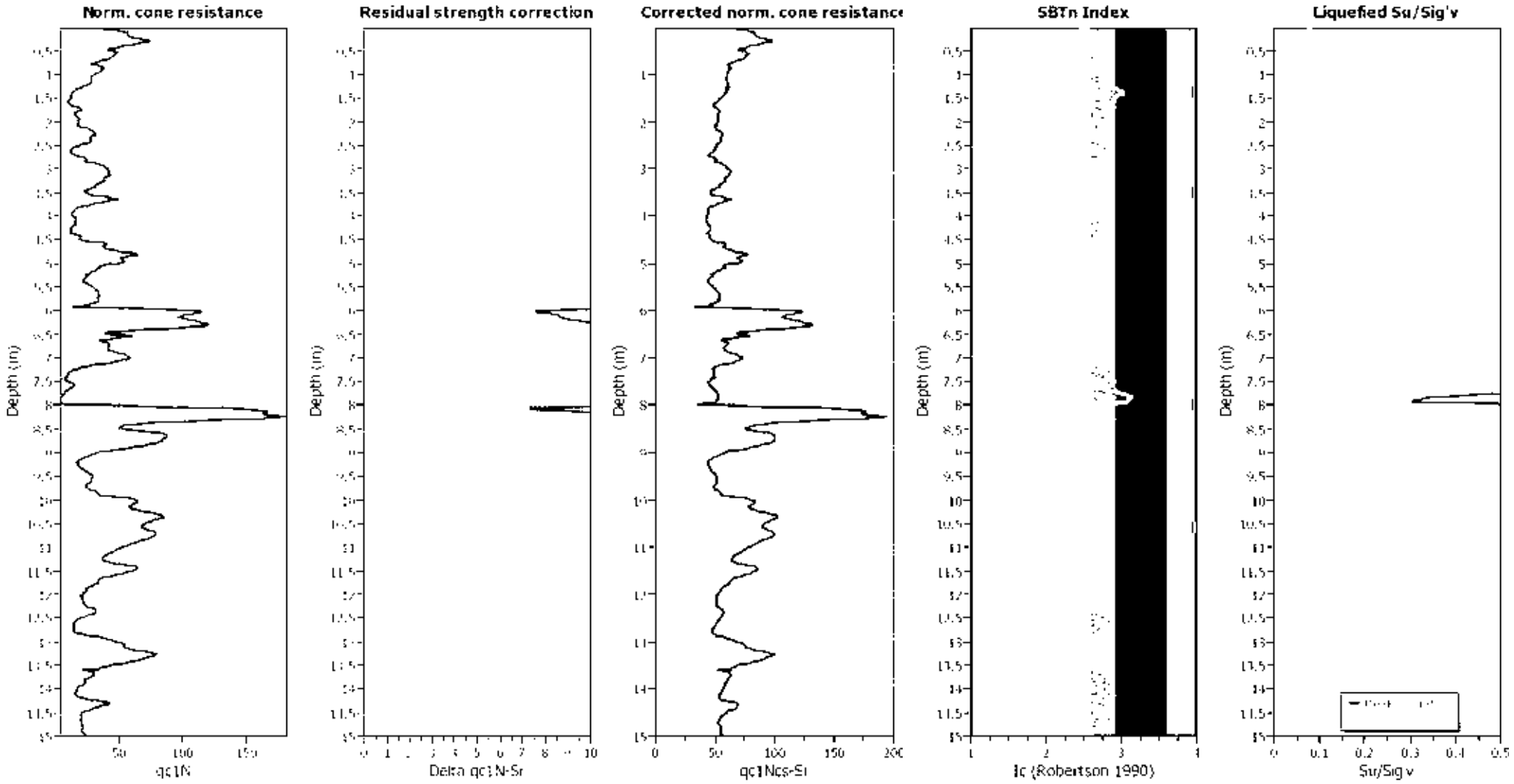
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

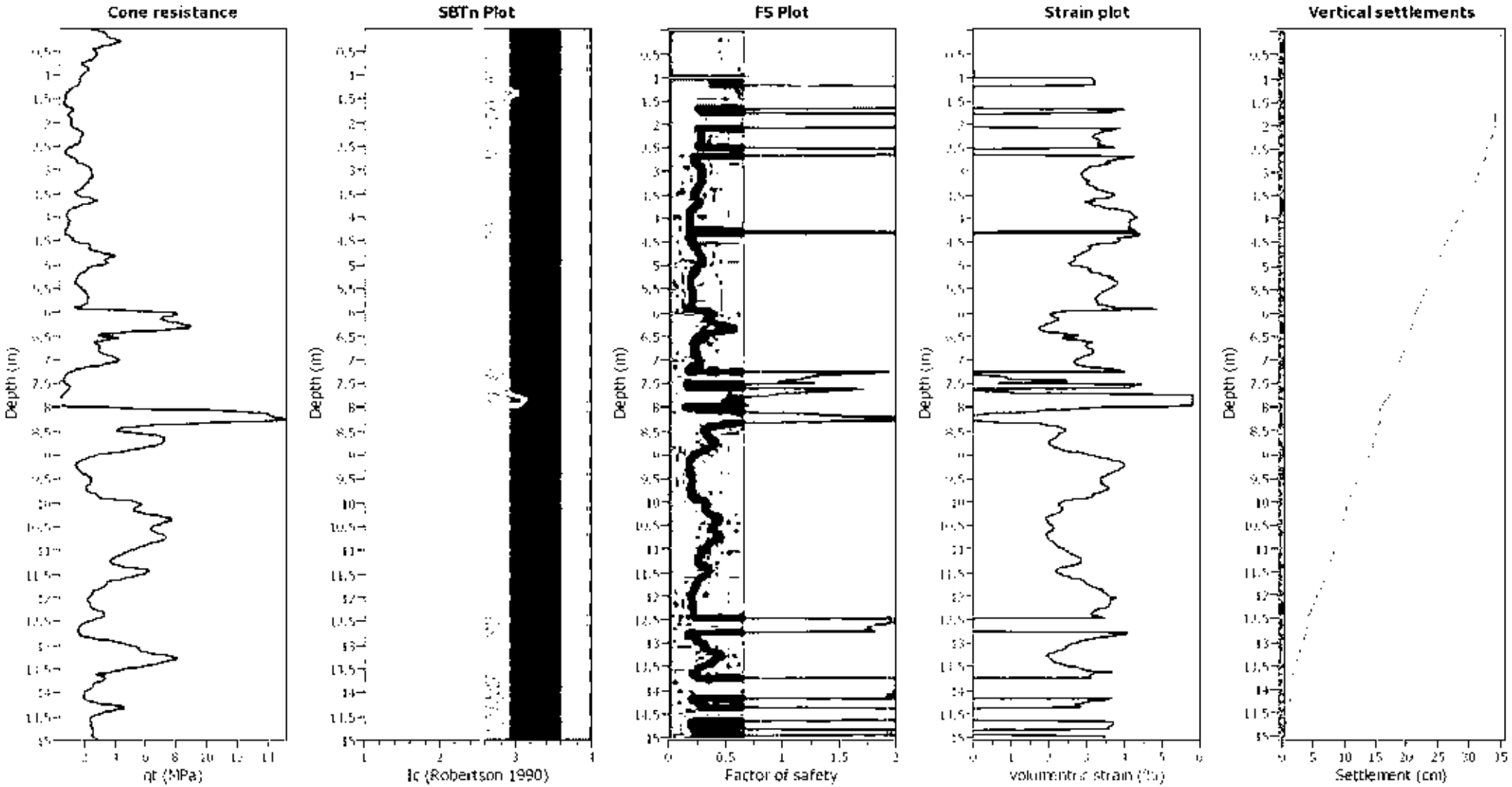
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

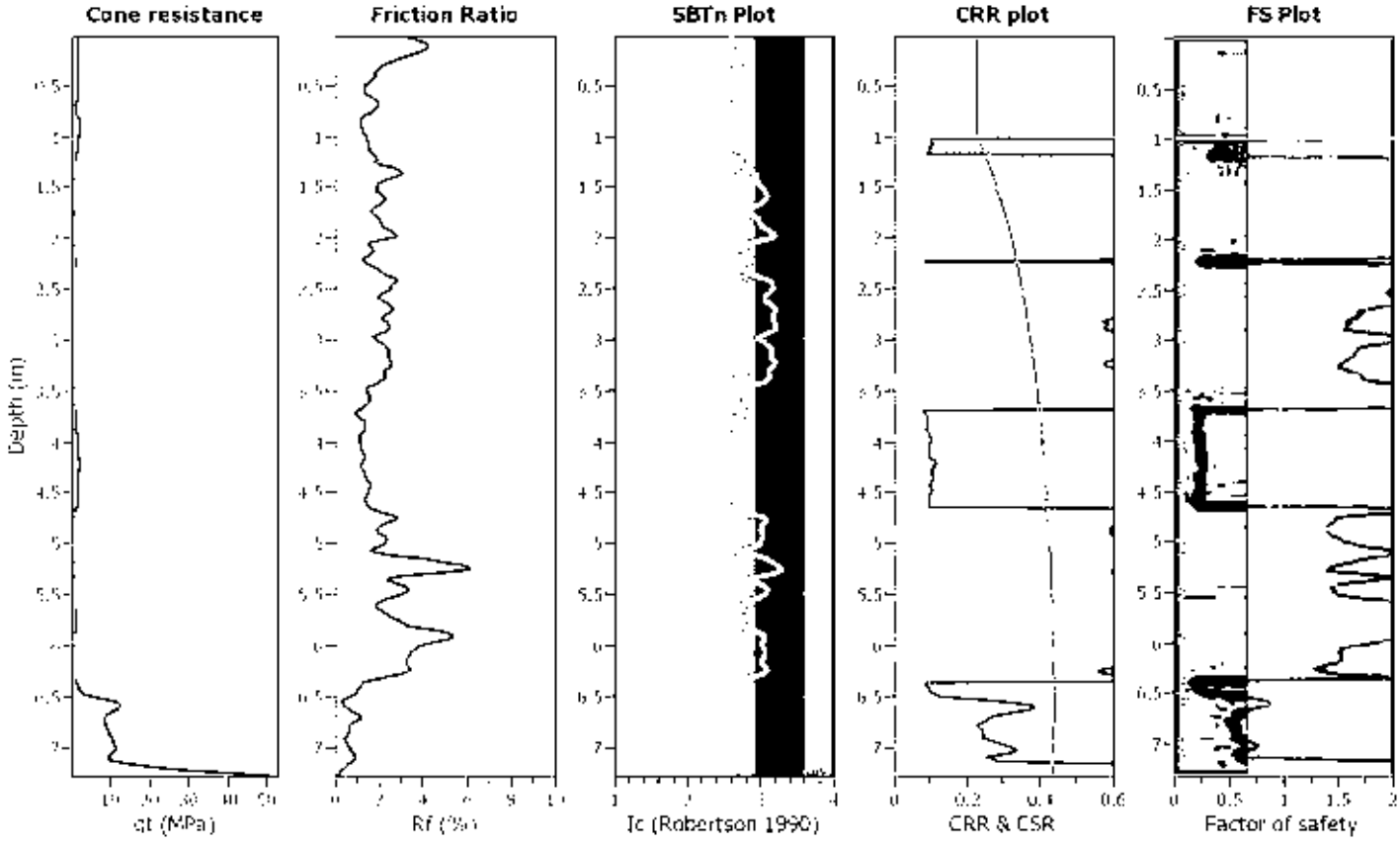
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

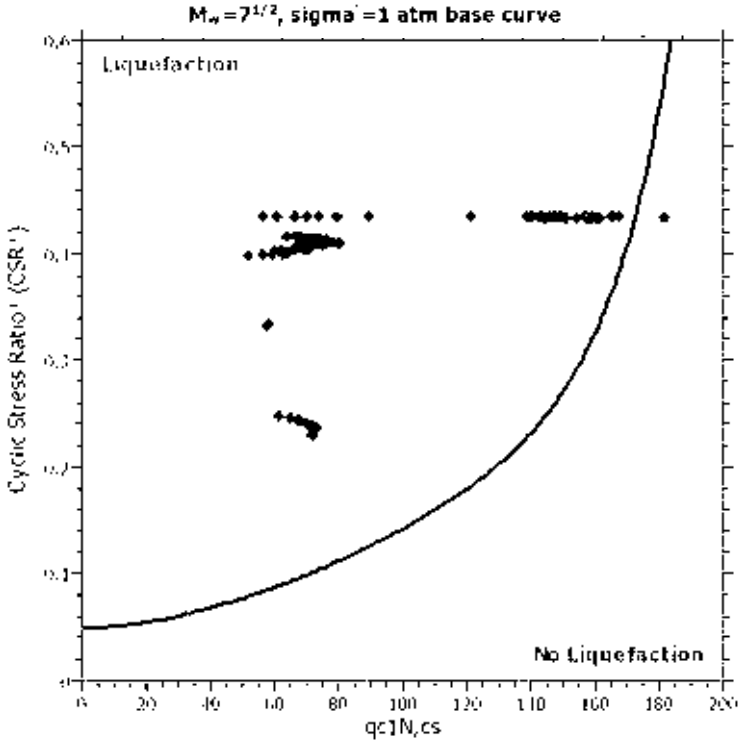
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

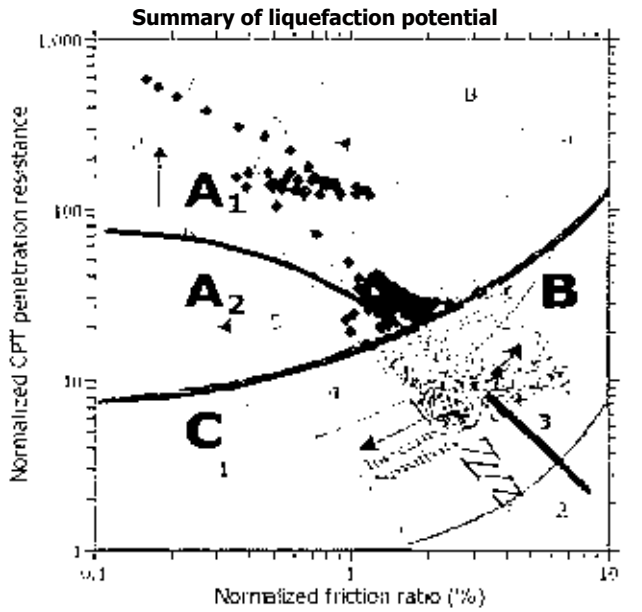
CPT file : CPT42_564CashmereRd

Input parameters and analysis data

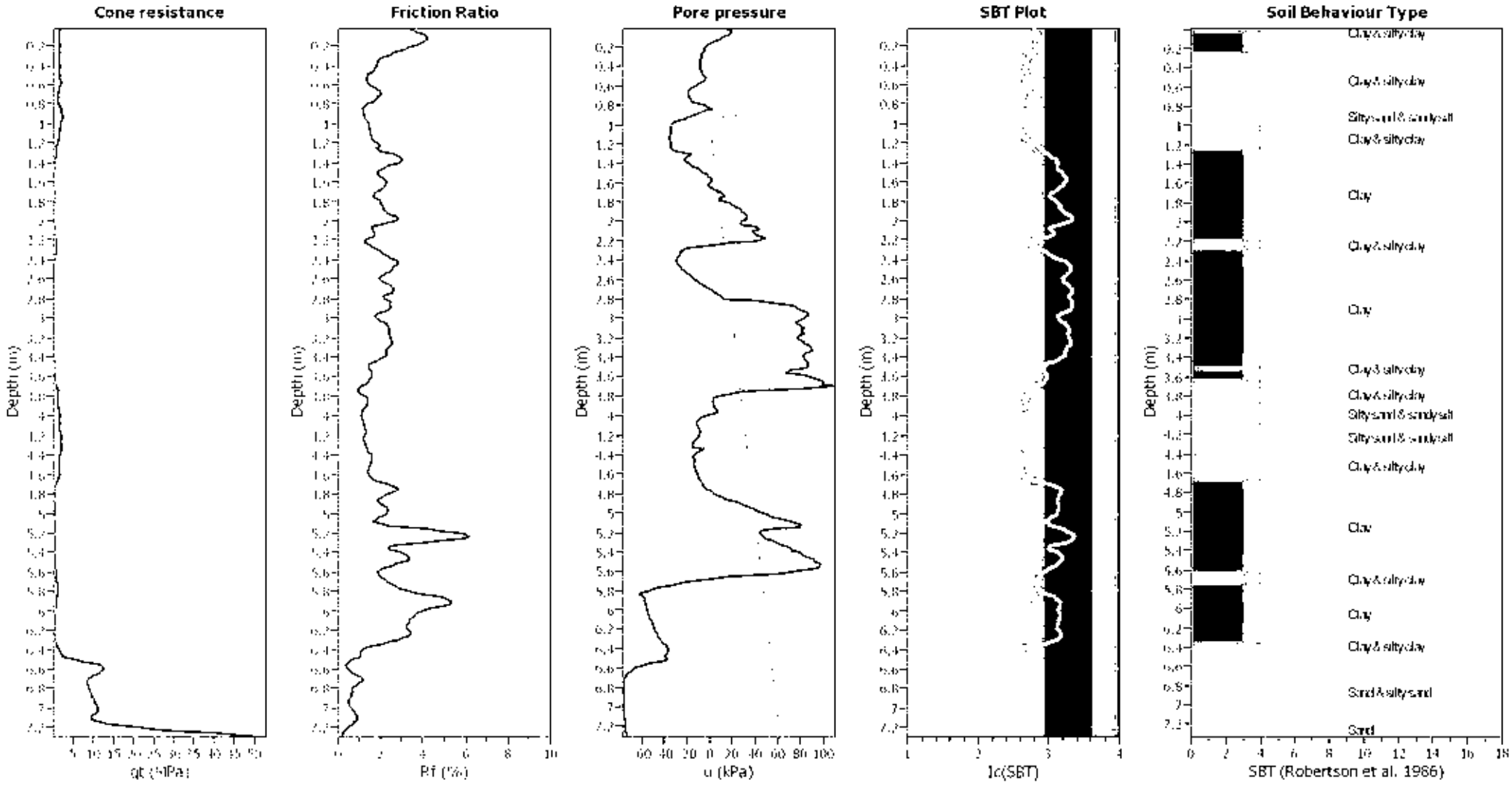
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



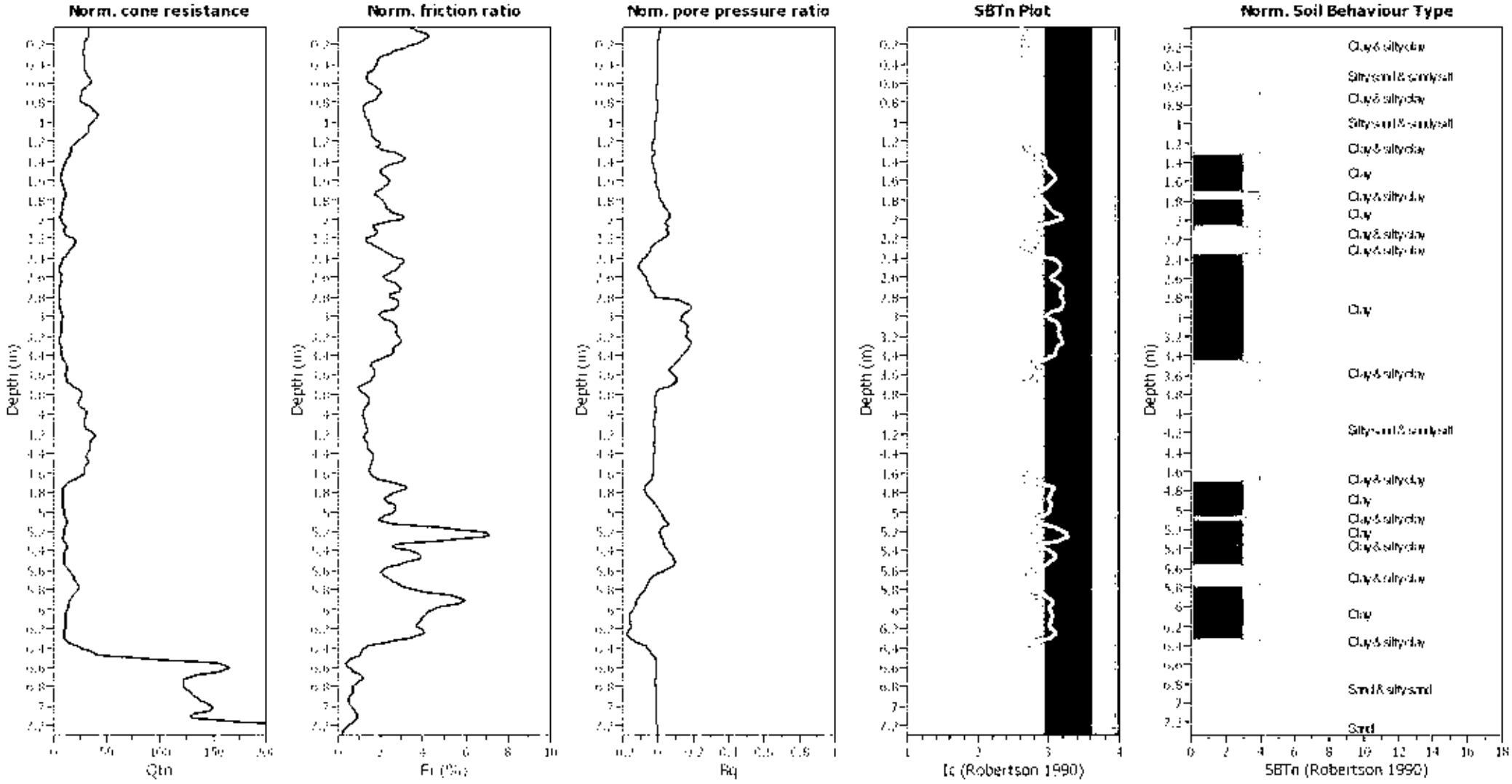
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



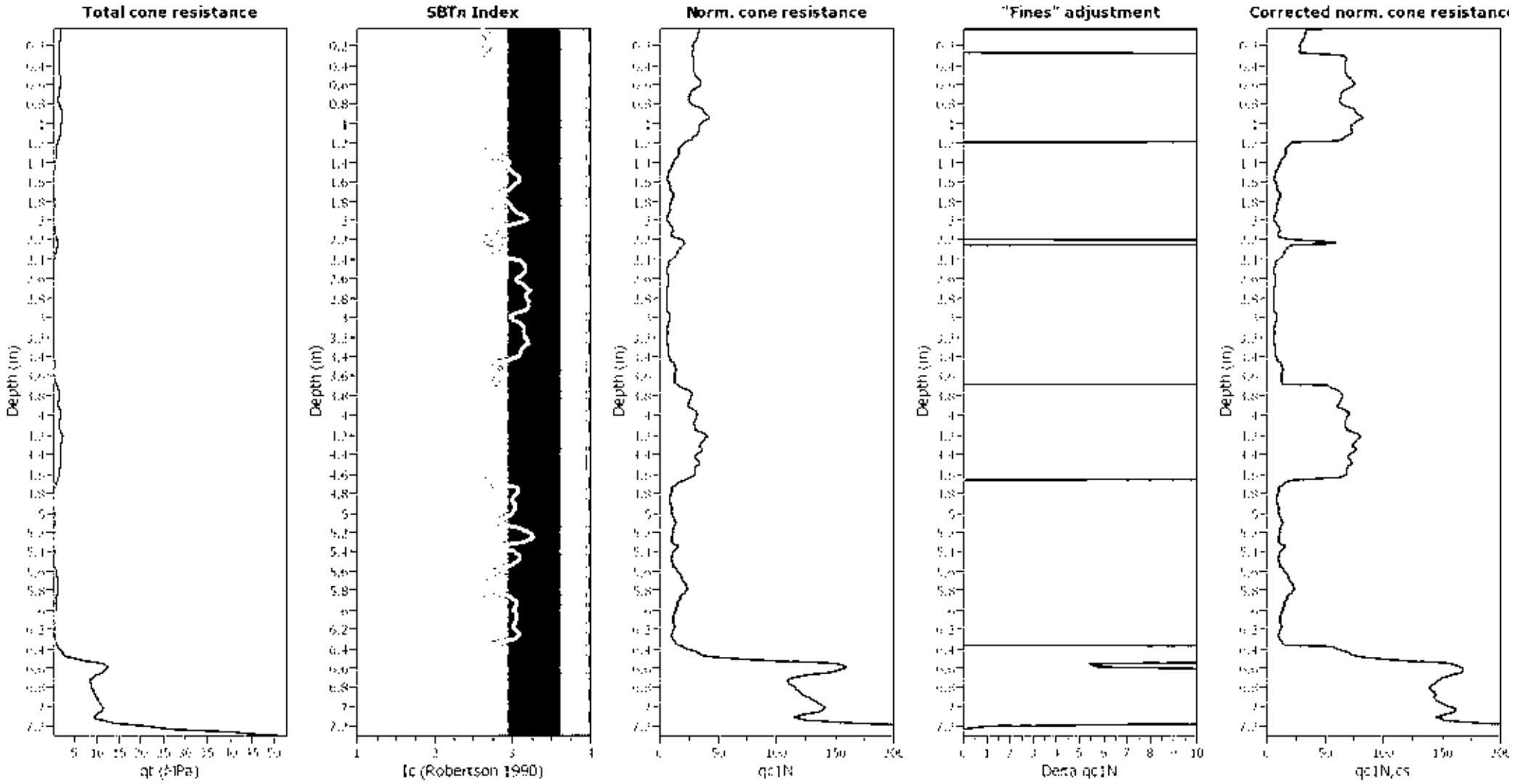
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

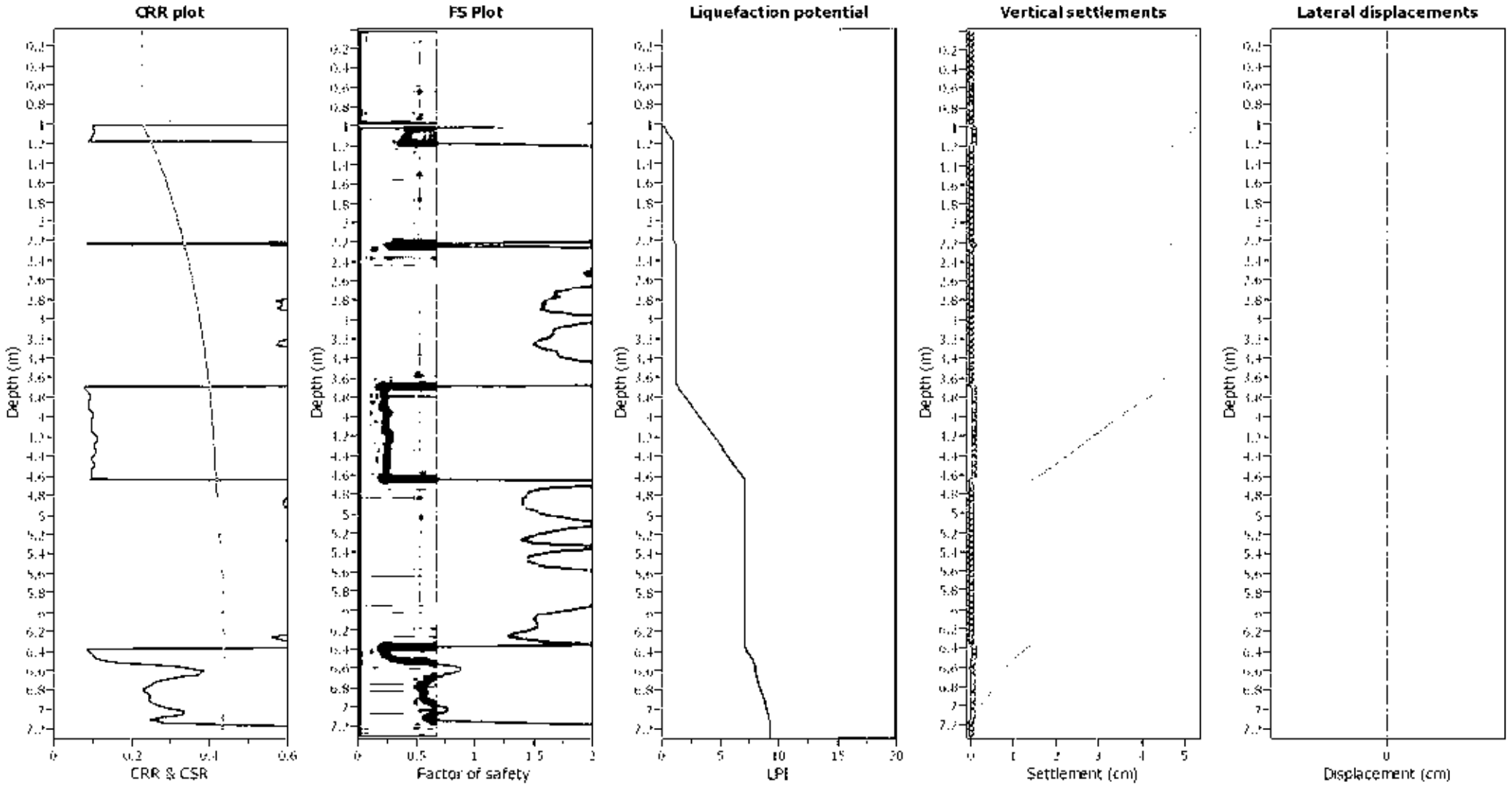
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

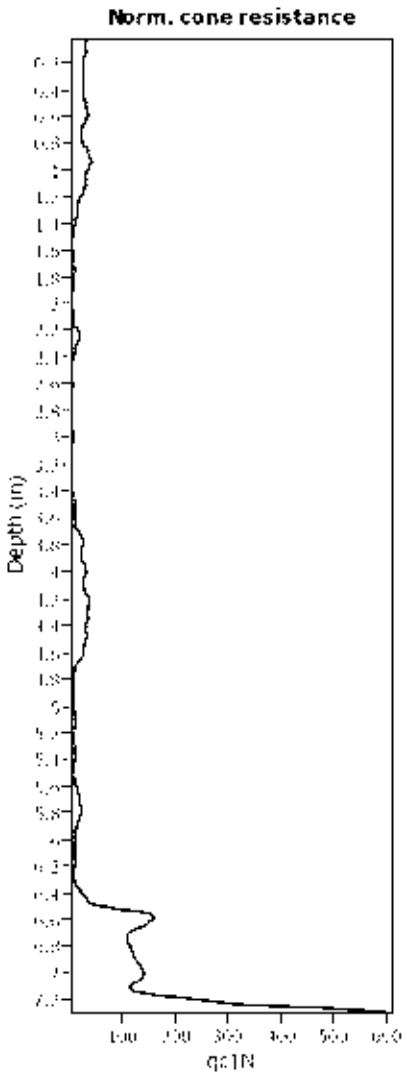
F.S. color scheme

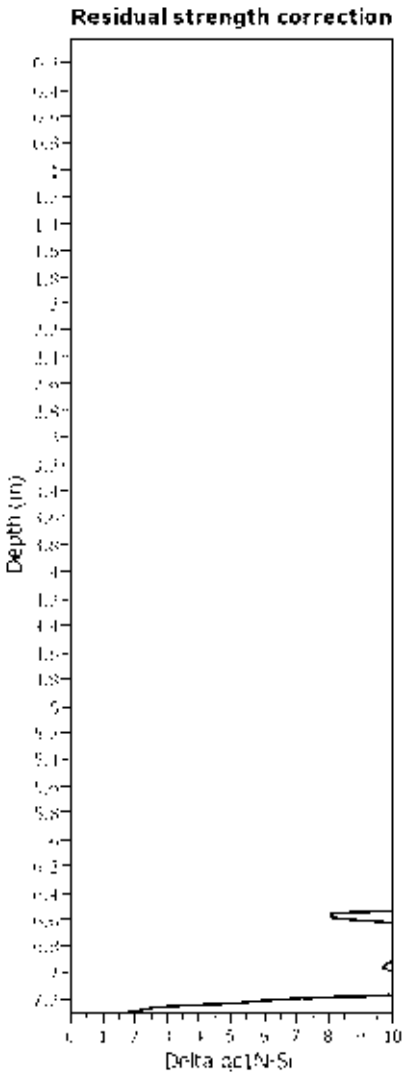
- ☐ Almost certain it will liquefy
- ☐ Very likely to liquefy
- ☐ Liquefaction and no liquefaction are equally likely
- ☐ Unlike to liquefy
- ☐ Almost certain it will not liquefy

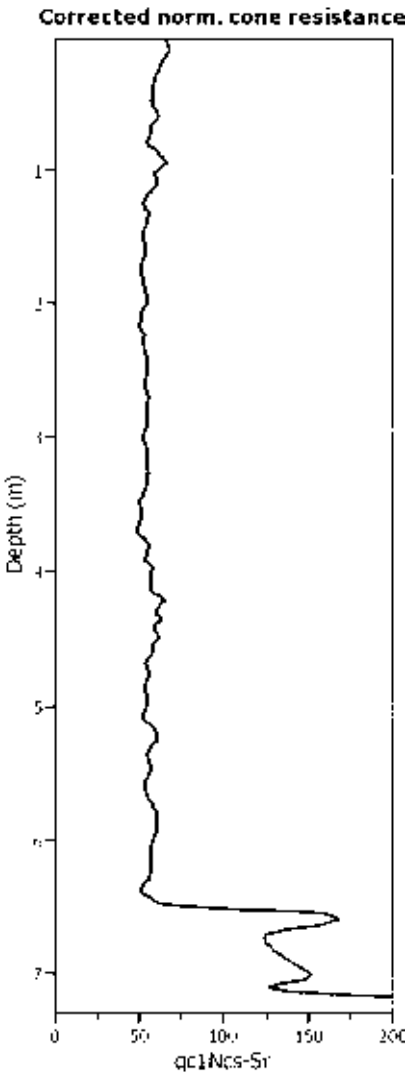
LPI color scheme

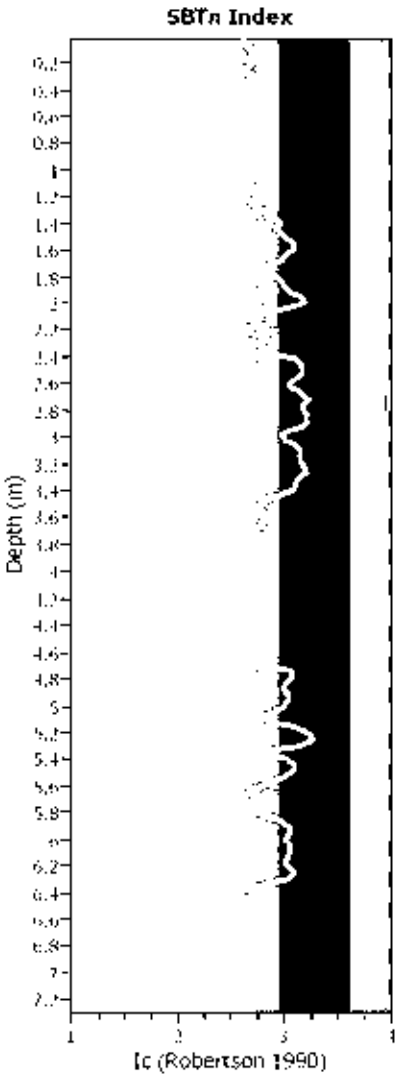
- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

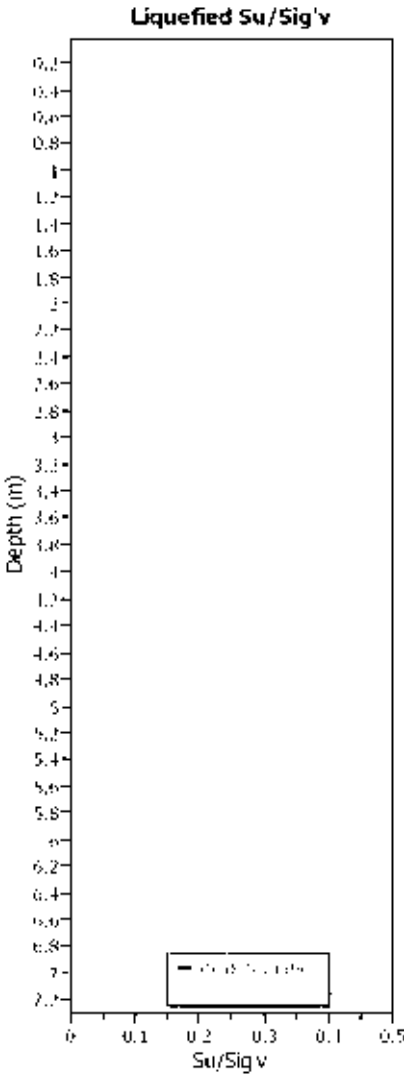
Check for strength loss plots (Idriss & Boulanger (2008))







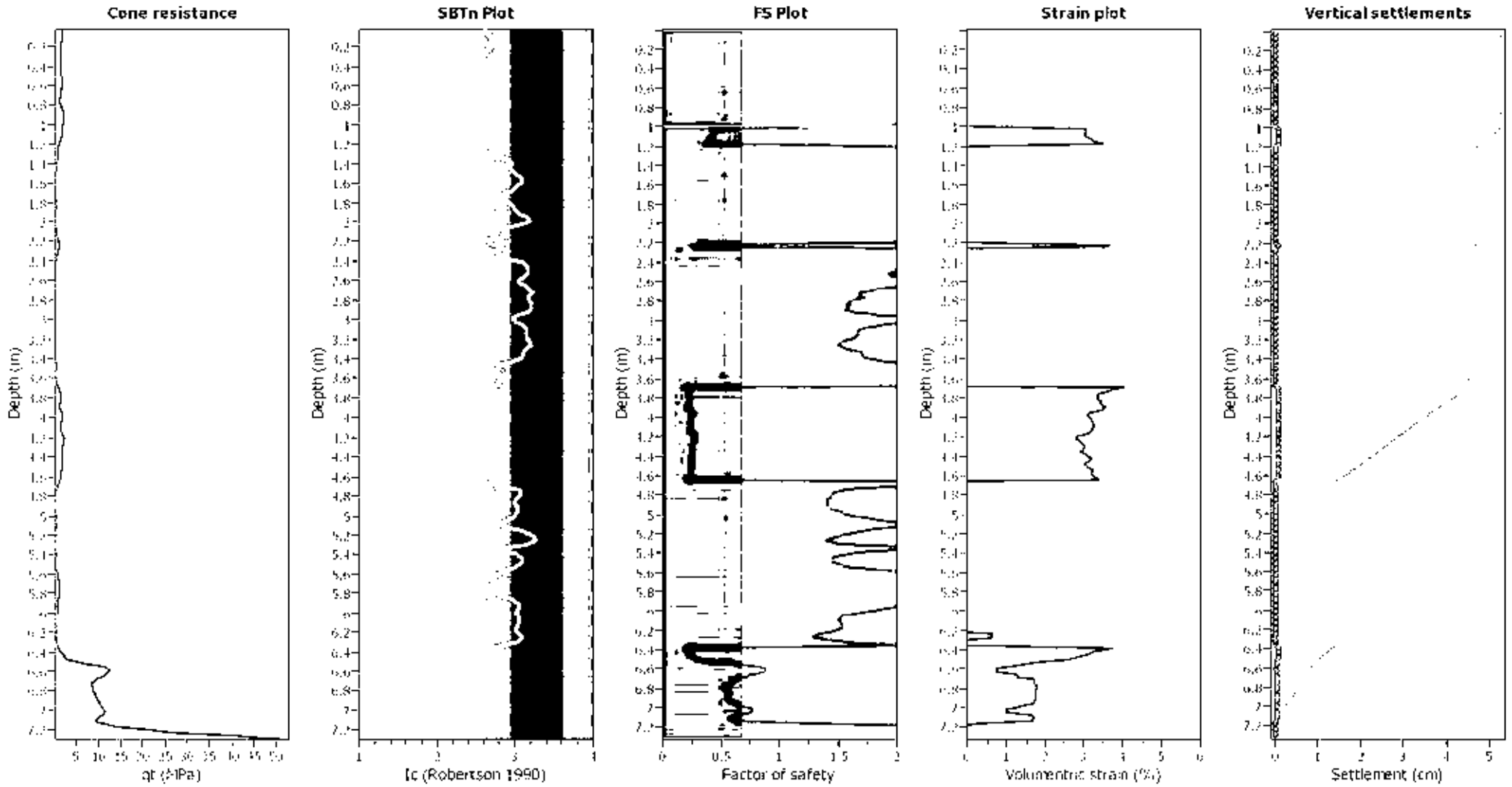




Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

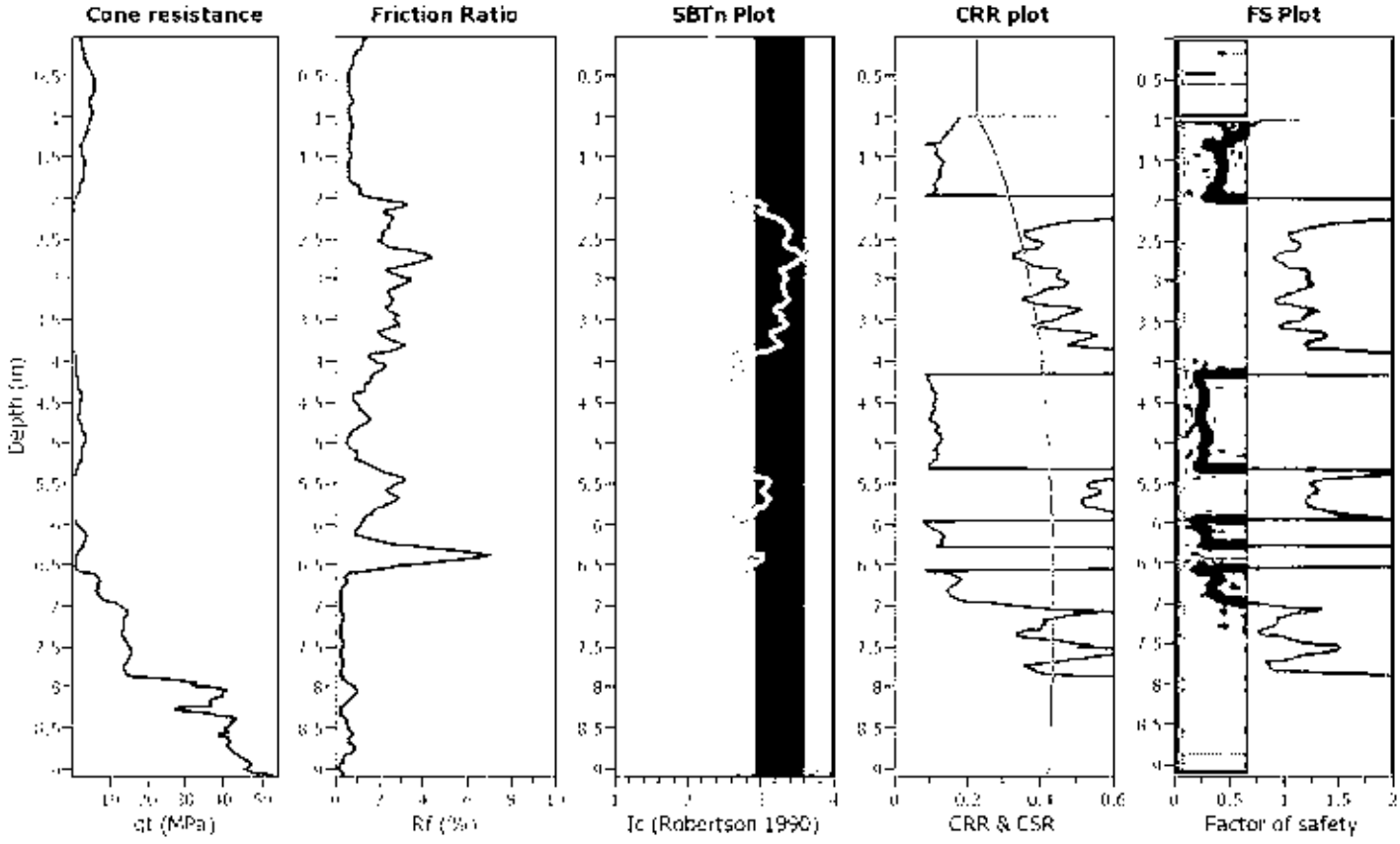
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

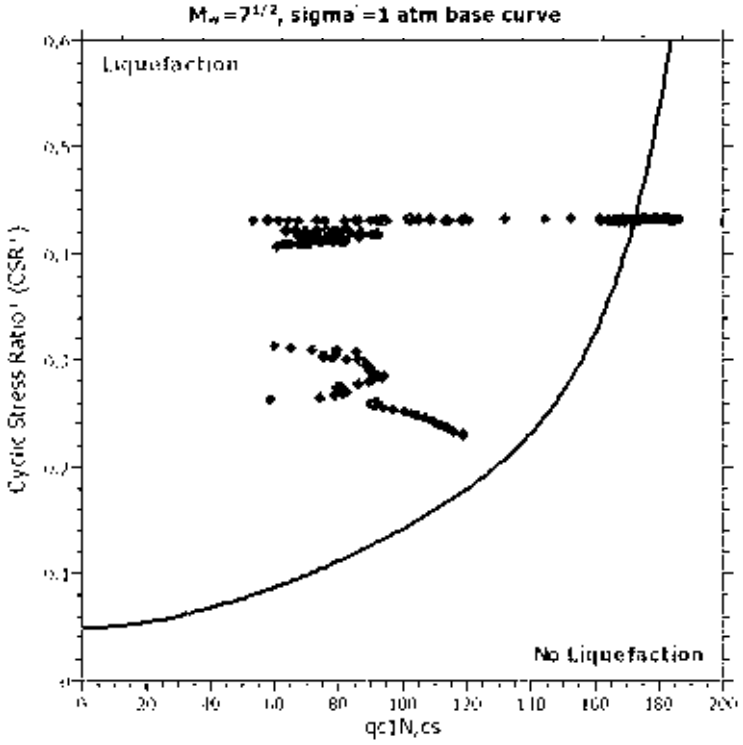
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

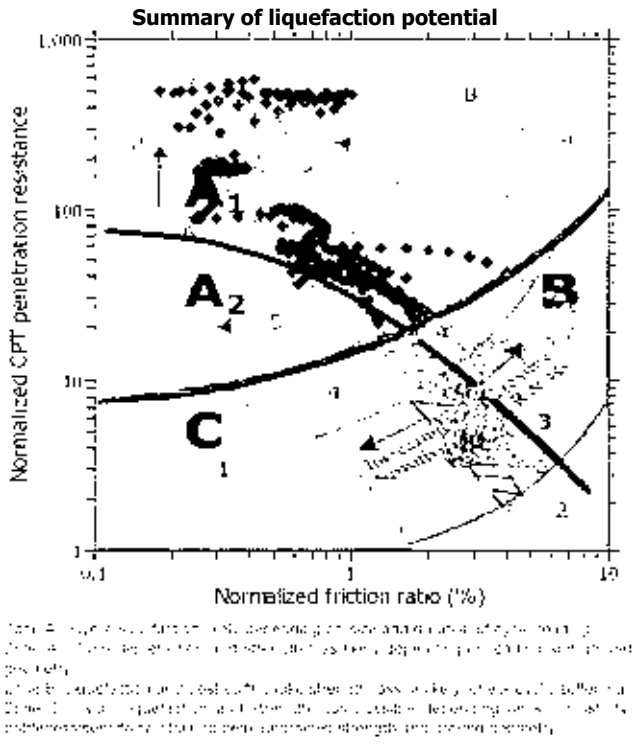
CPT file : CPT43_484CashmereRd

Input parameters and analysis data

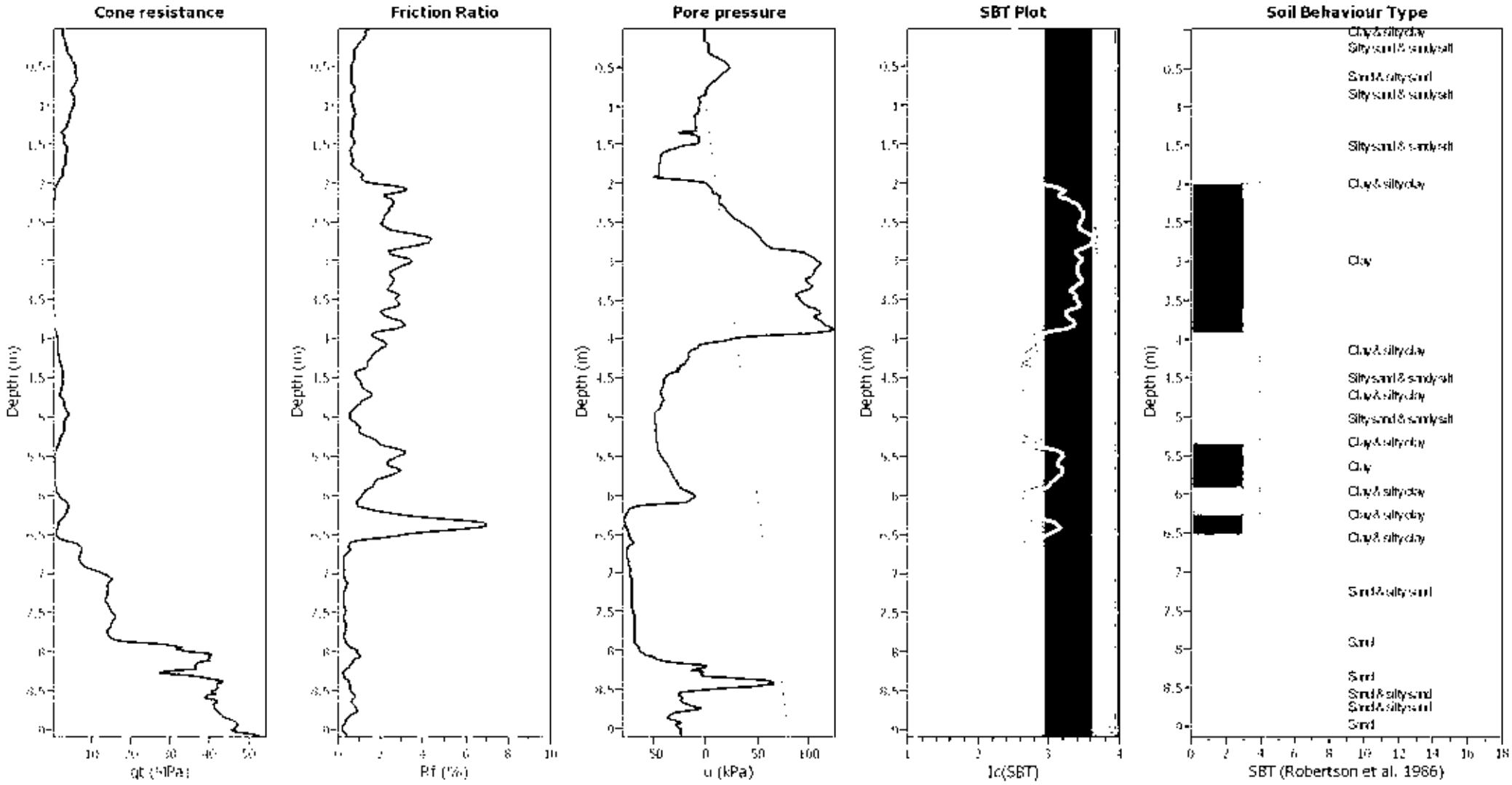
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



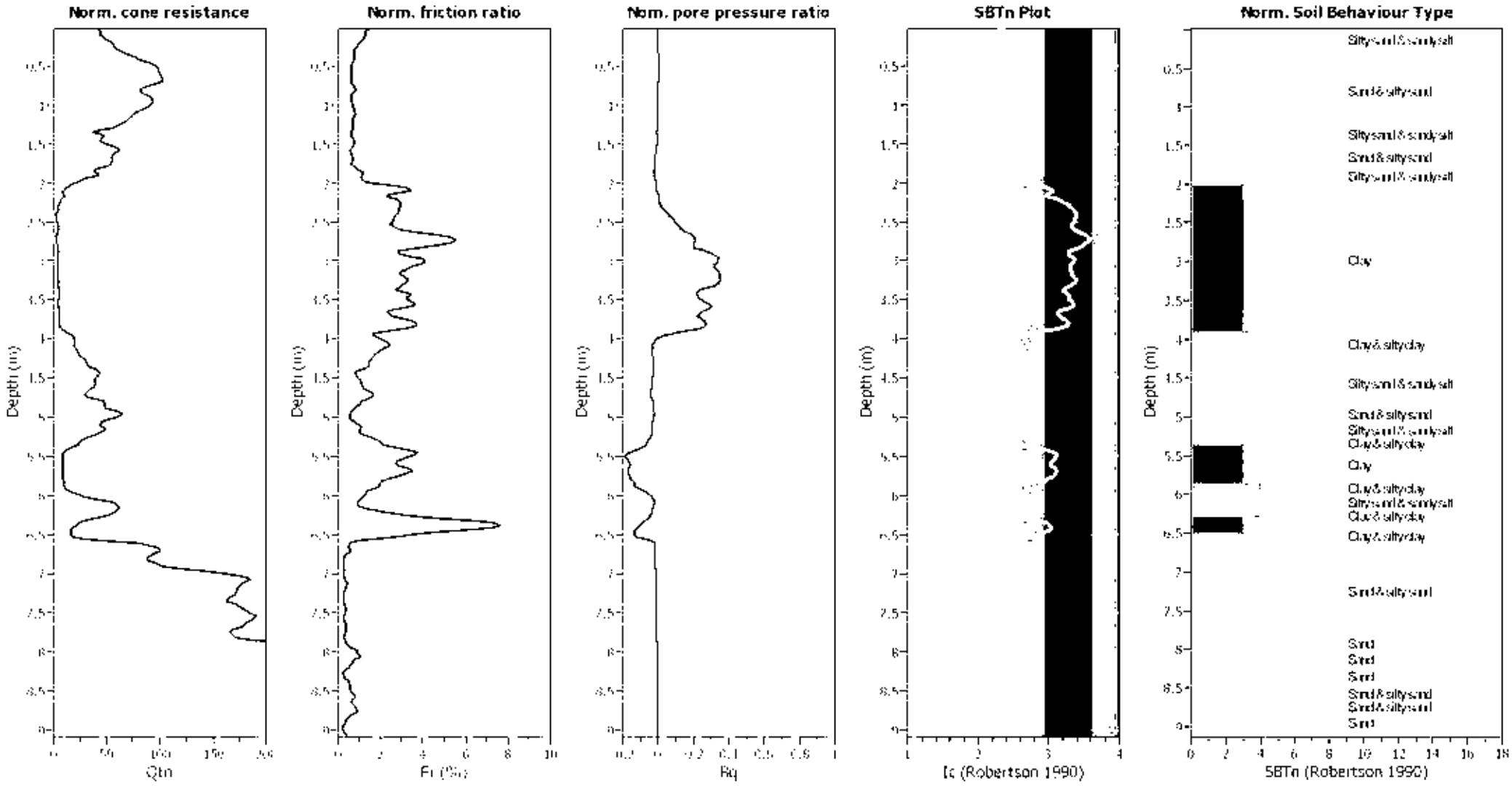
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



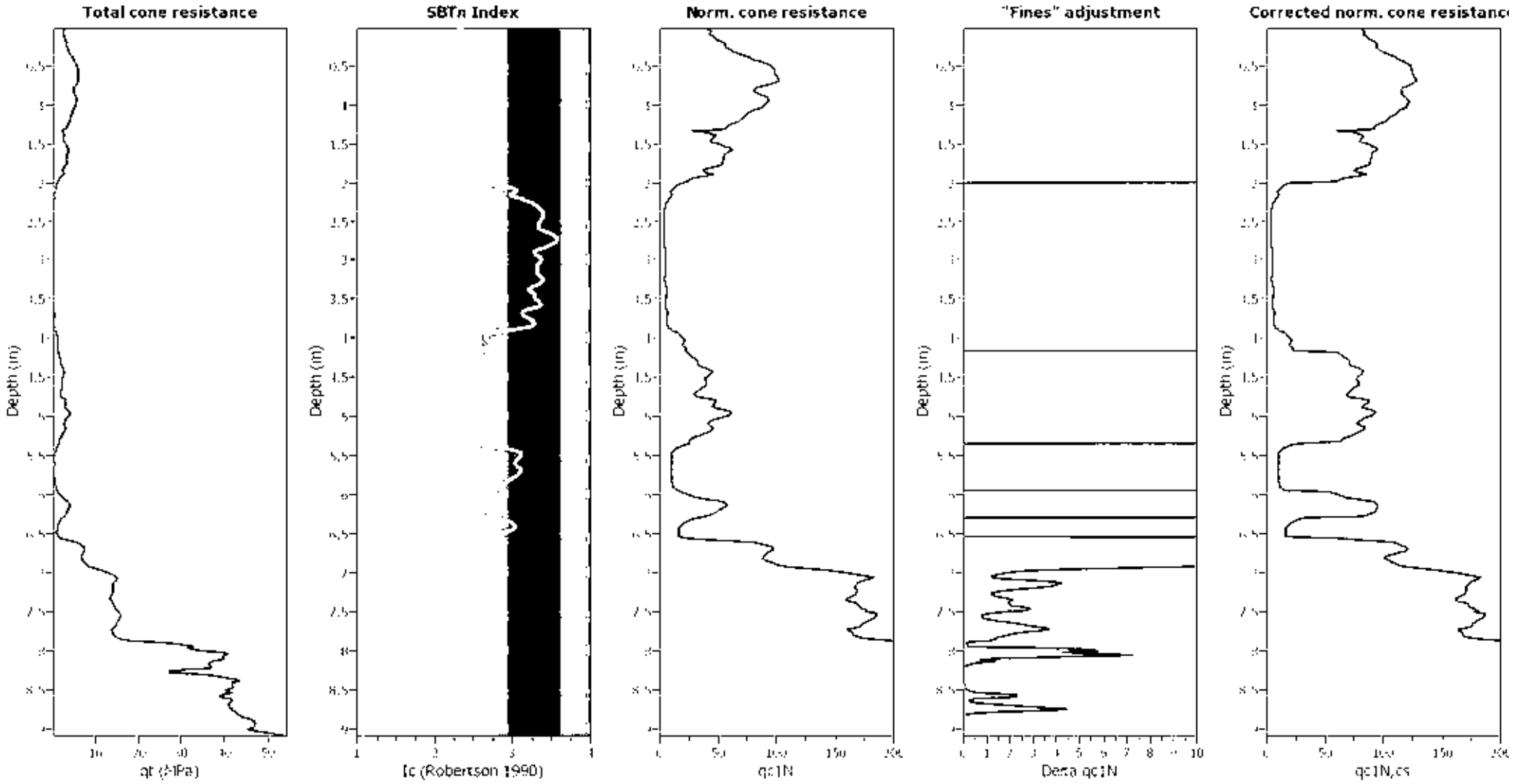
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

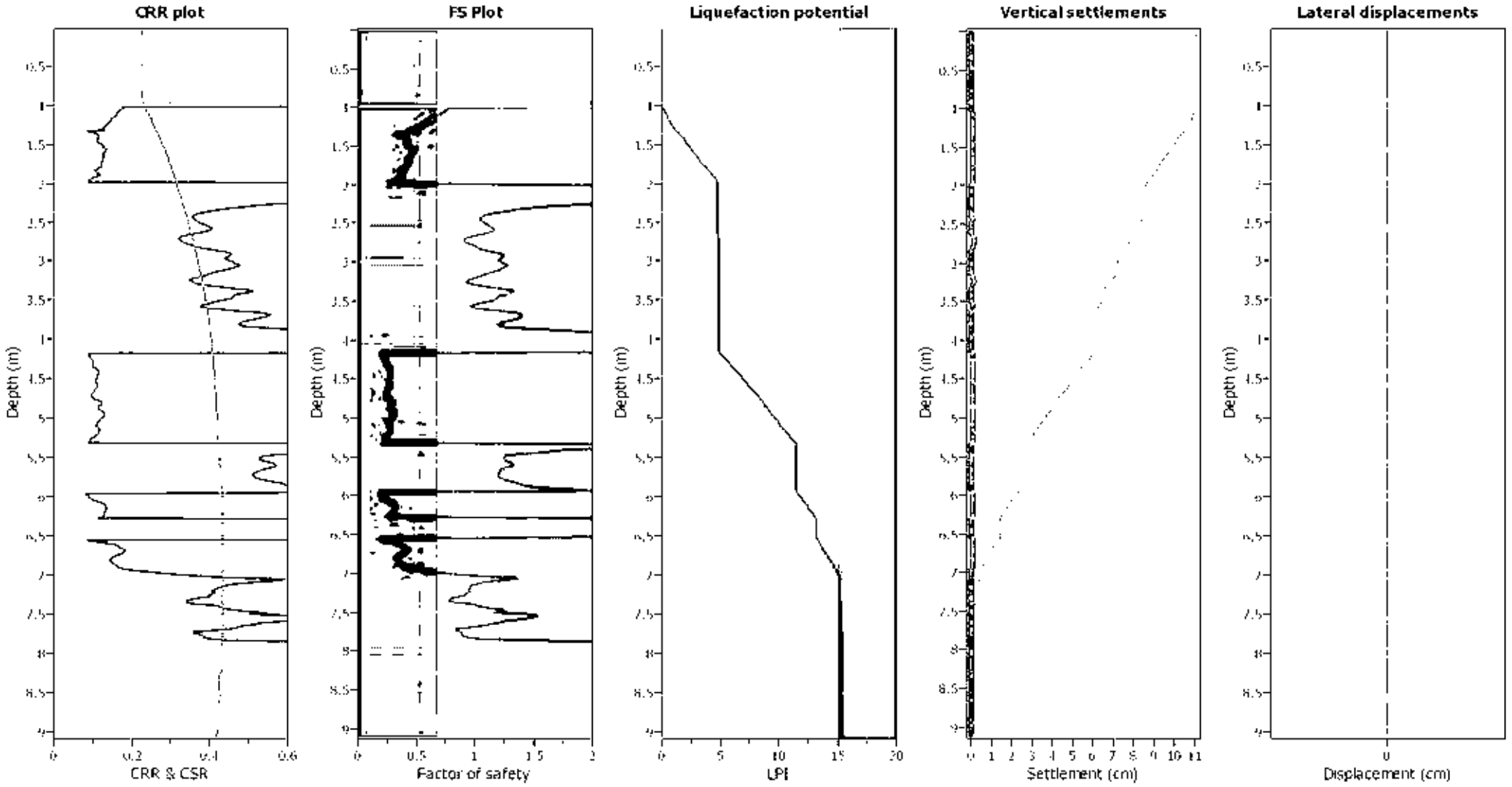
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

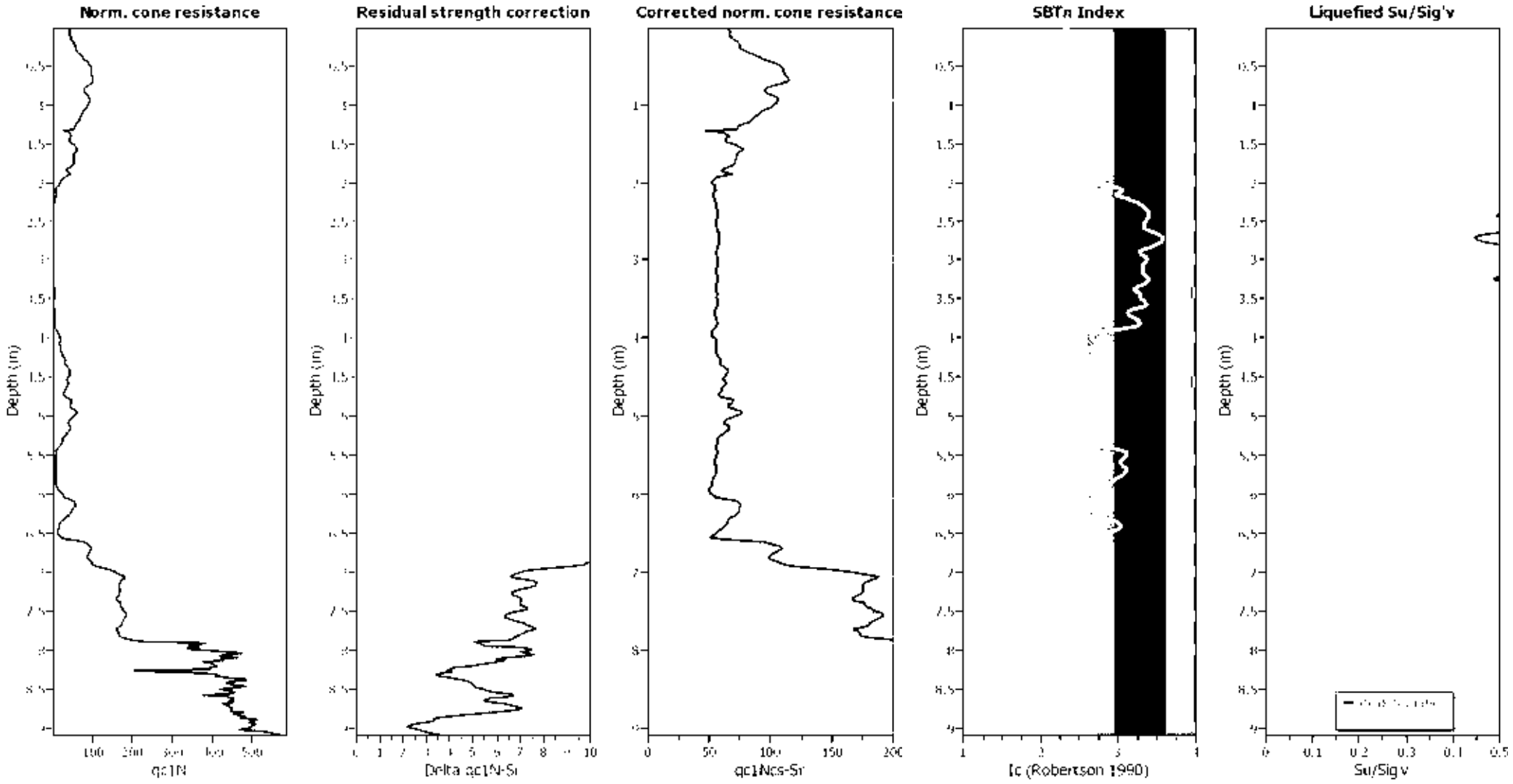
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

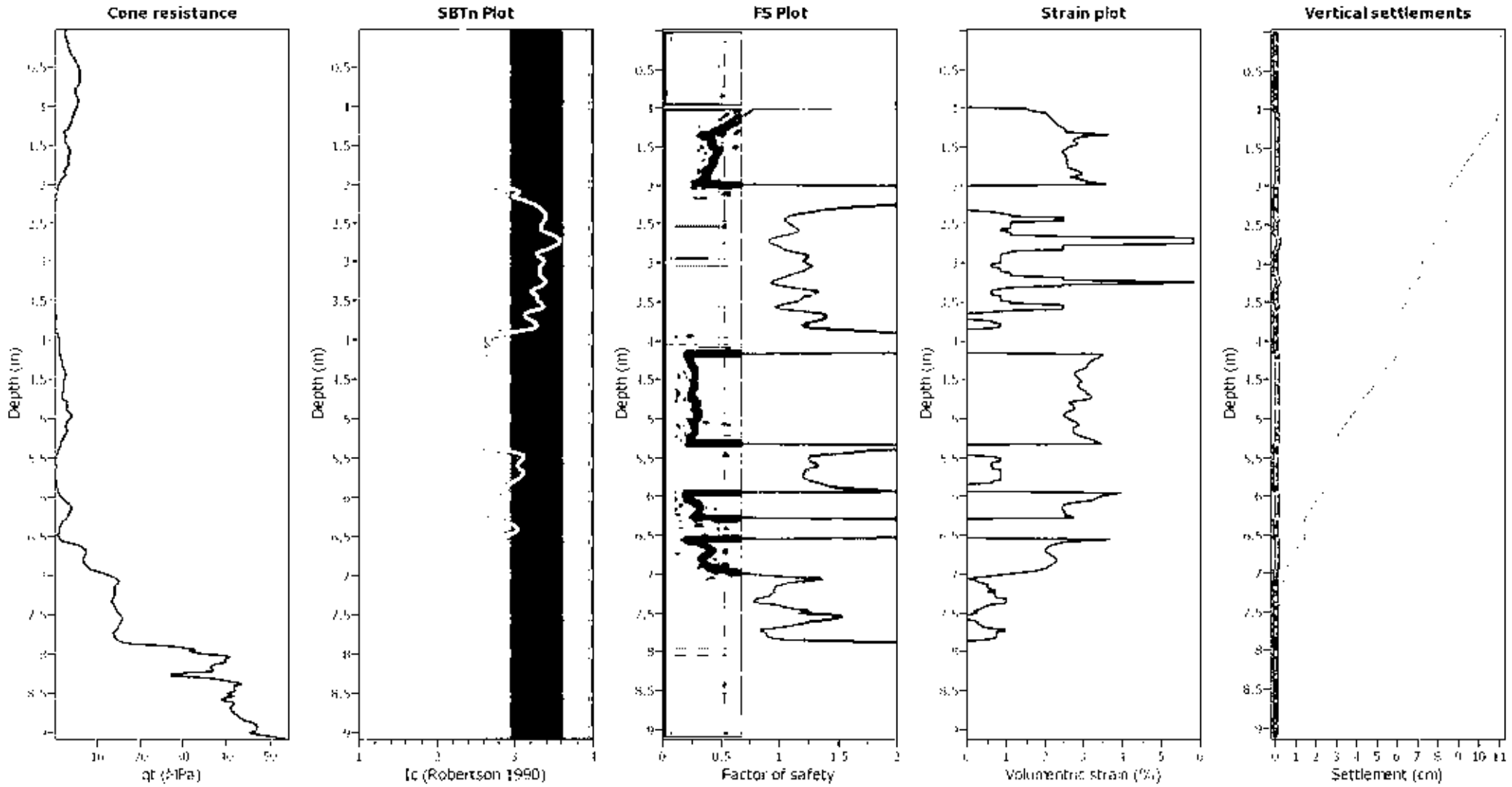
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

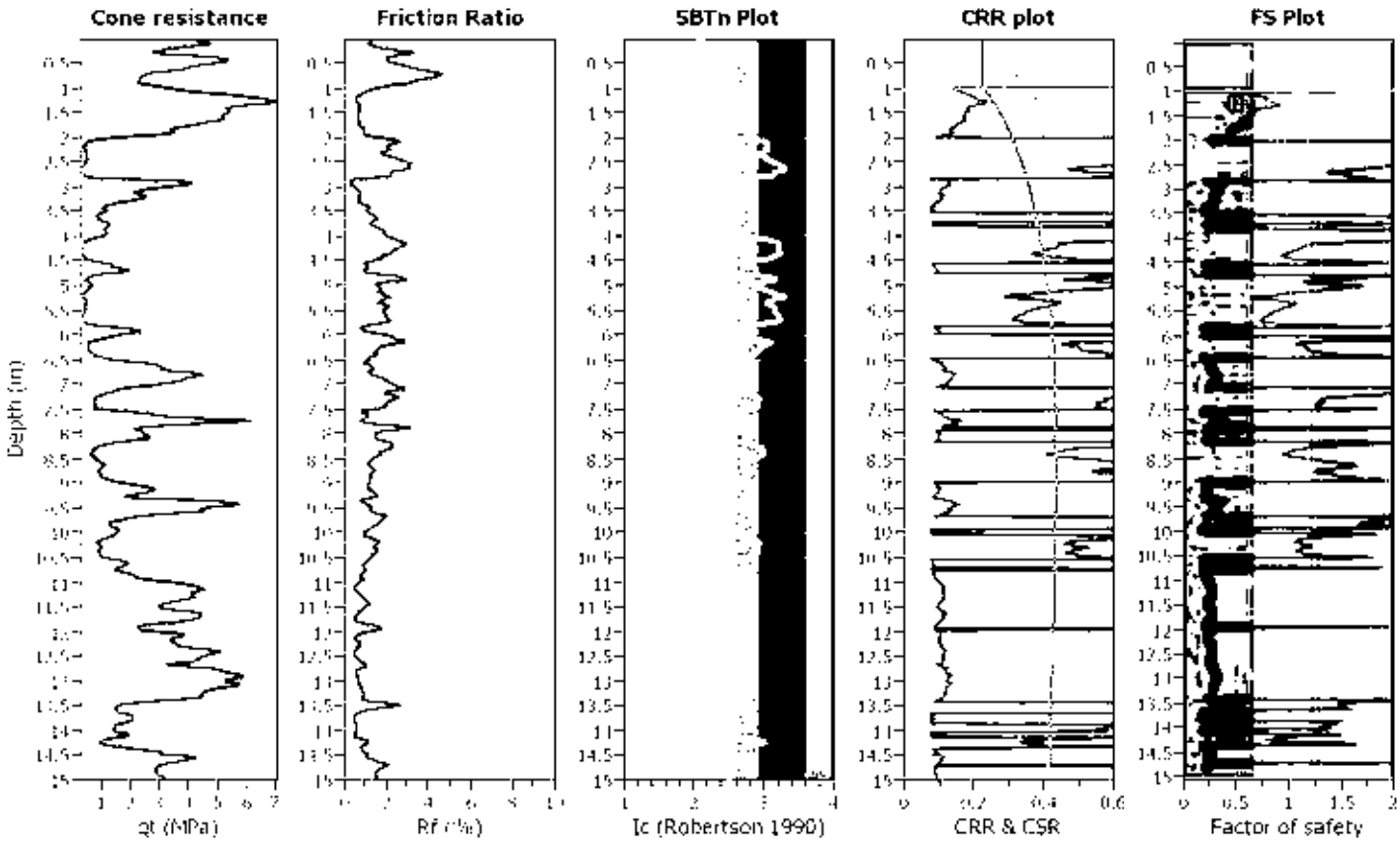
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

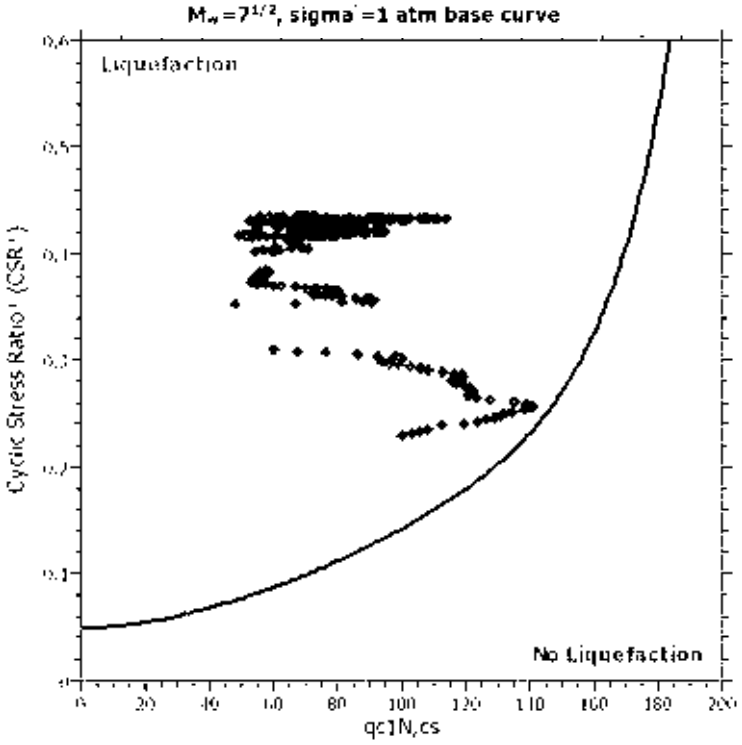
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

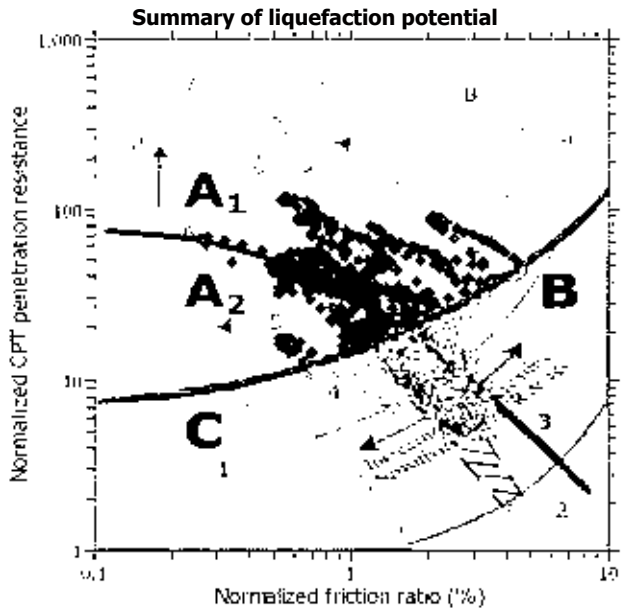
CPT file : CPT44_564CashmereRd

Input parameters and analysis data

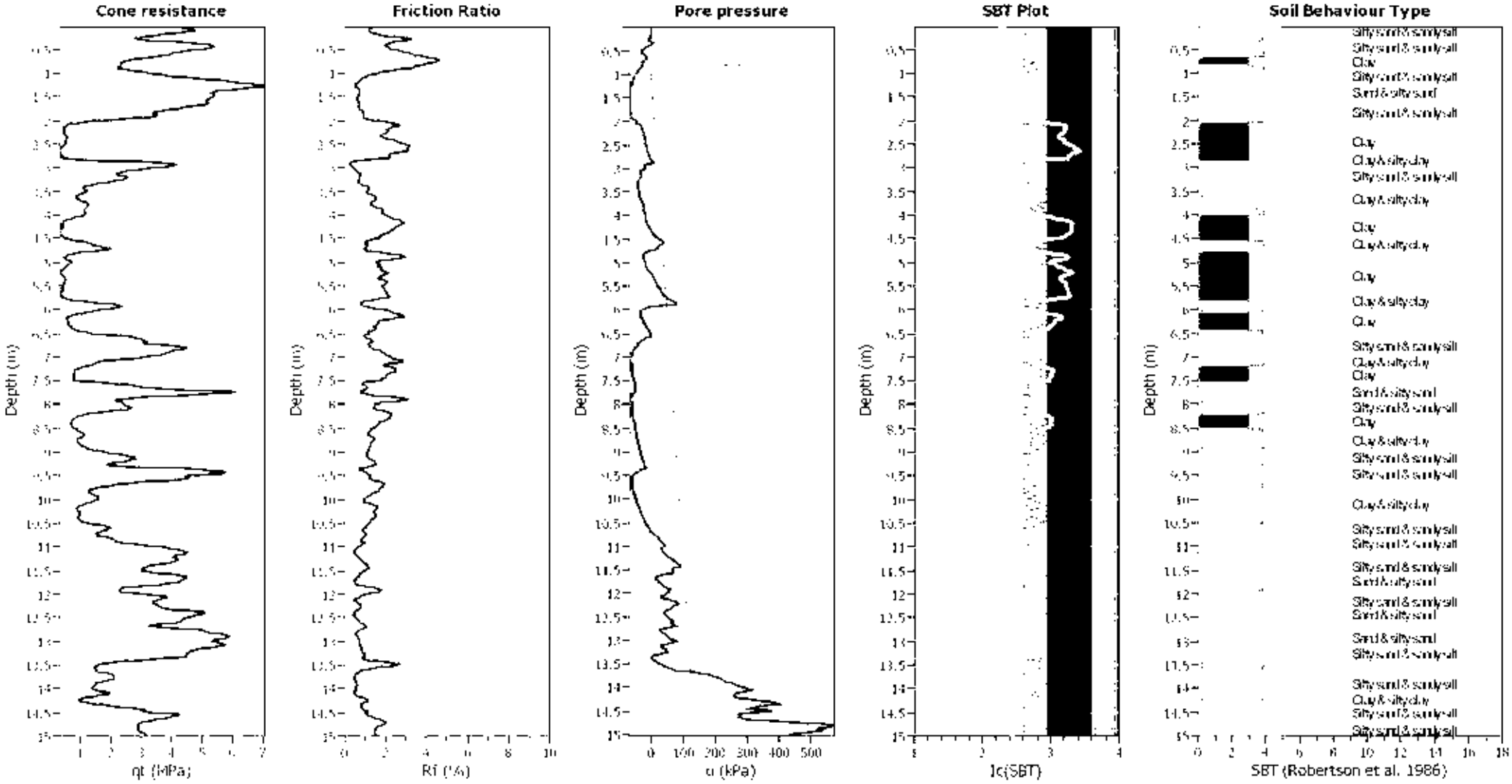
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



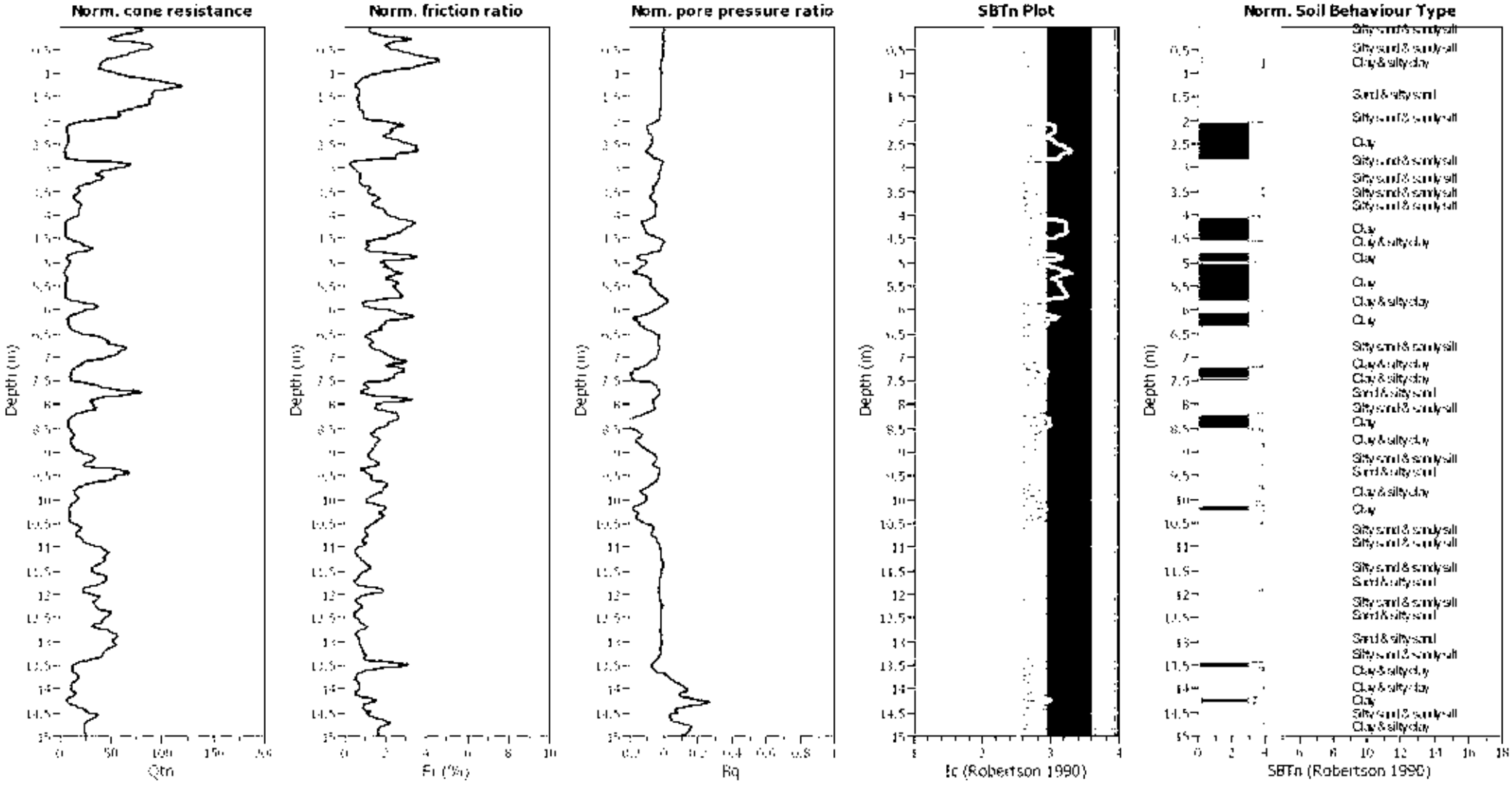
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



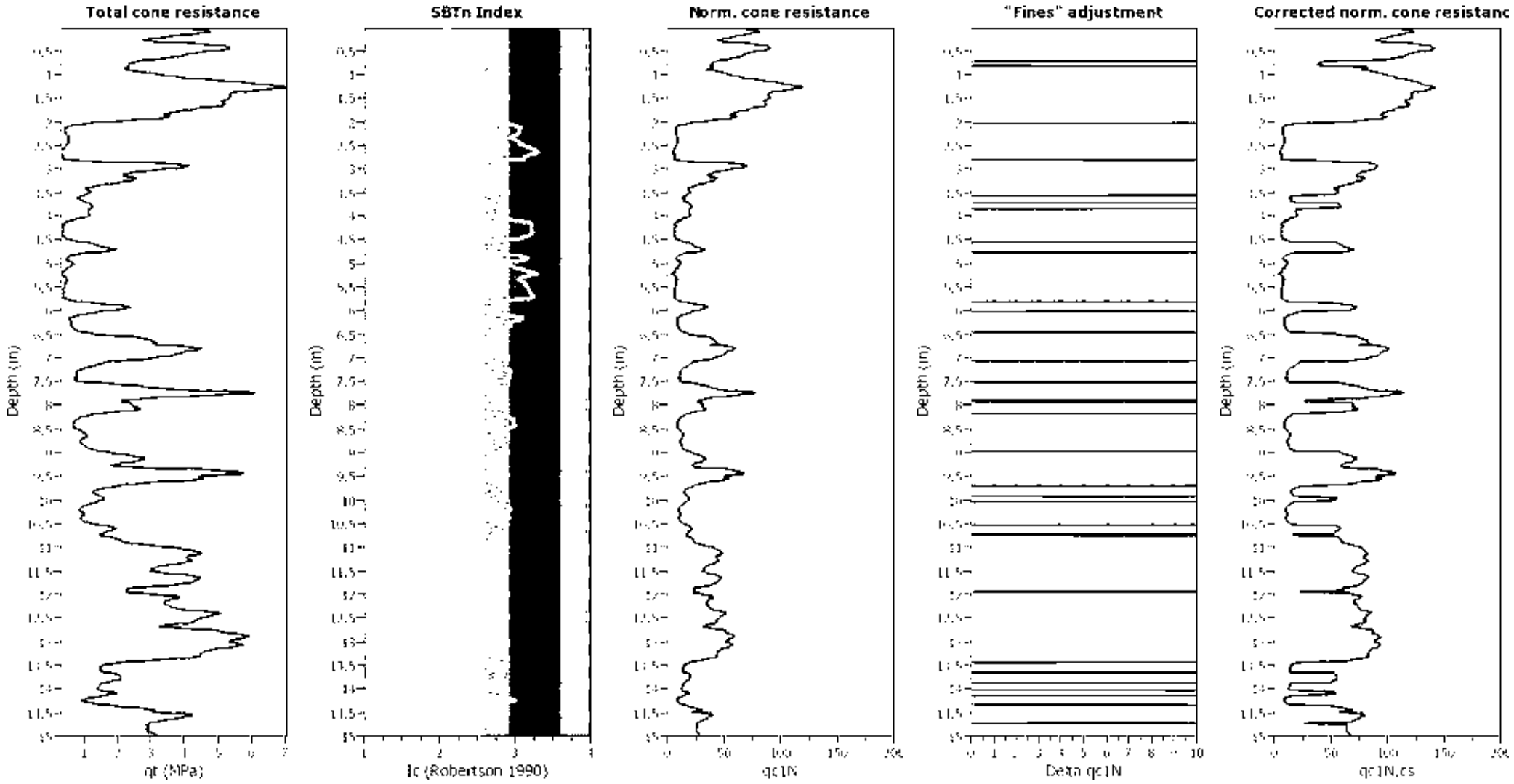
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

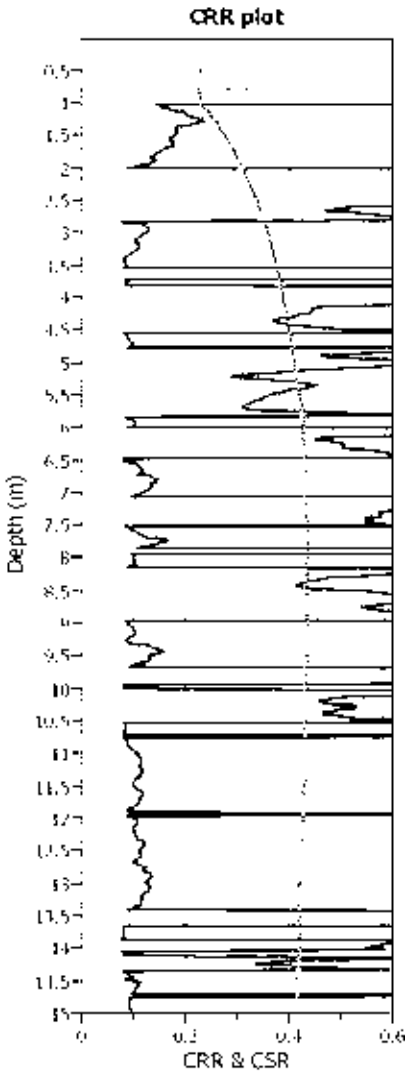
Liquefaction analysis overall plots (intermediate results)

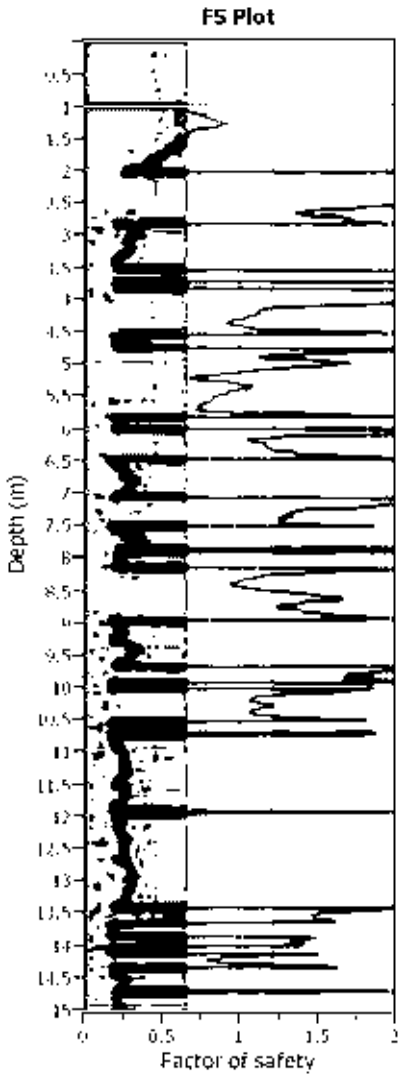


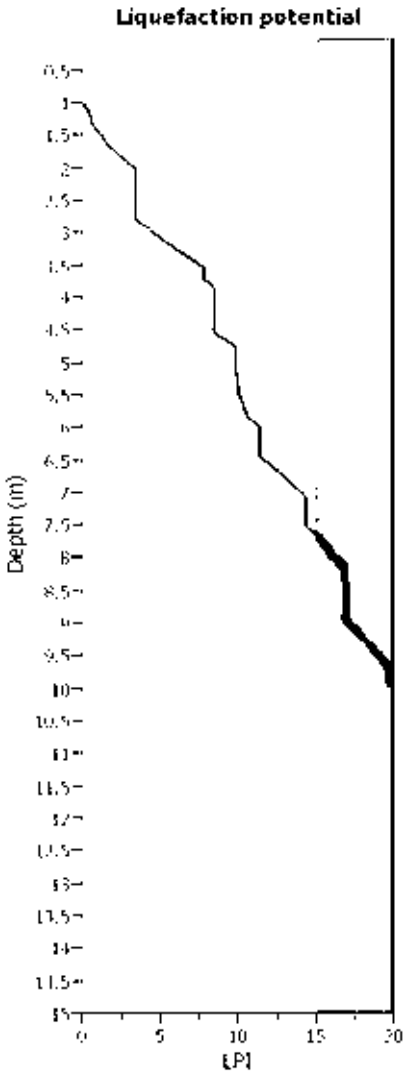
Input parameters and analysis data

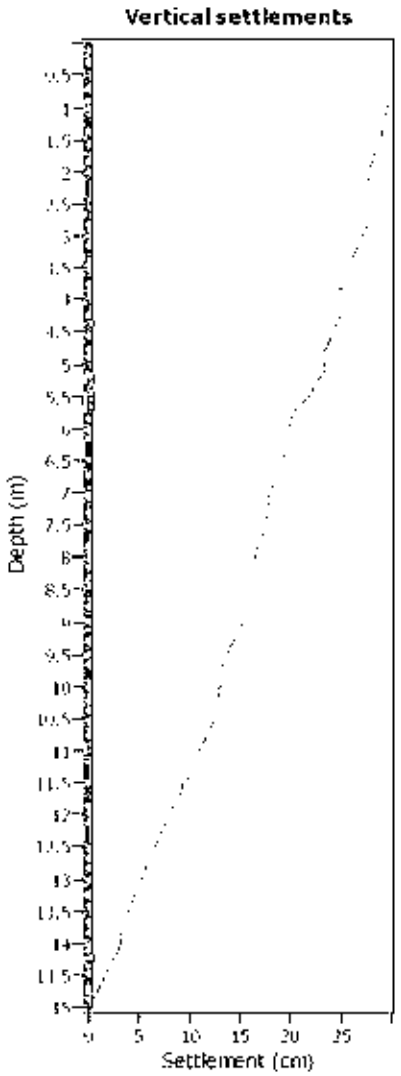
Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

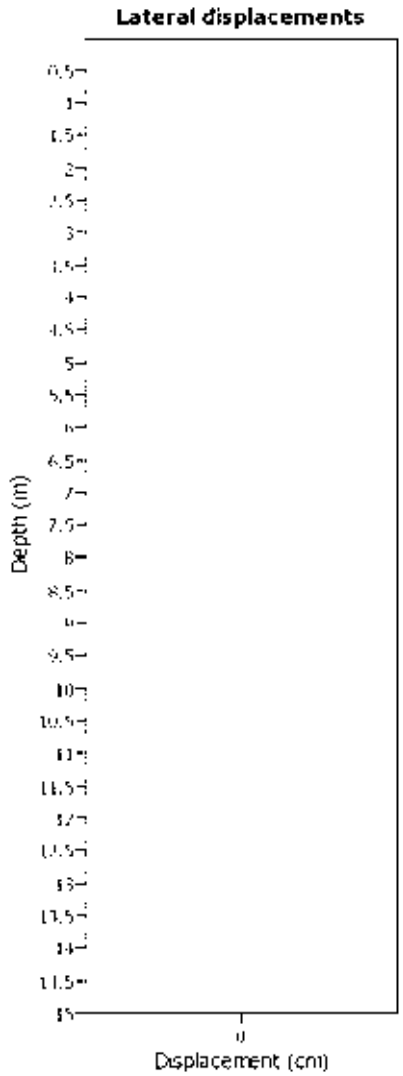
Liquefaction analysis overall plots











Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

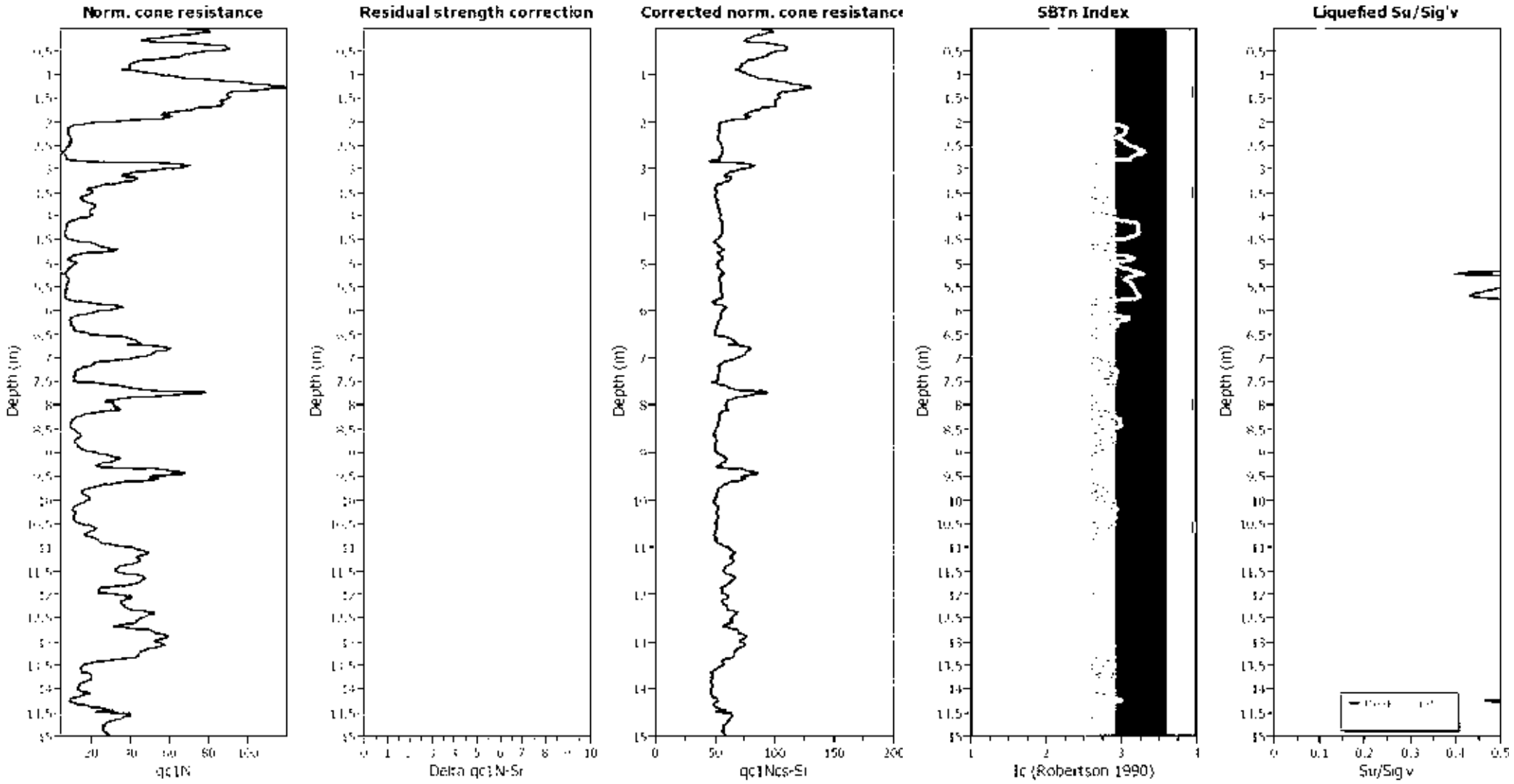
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

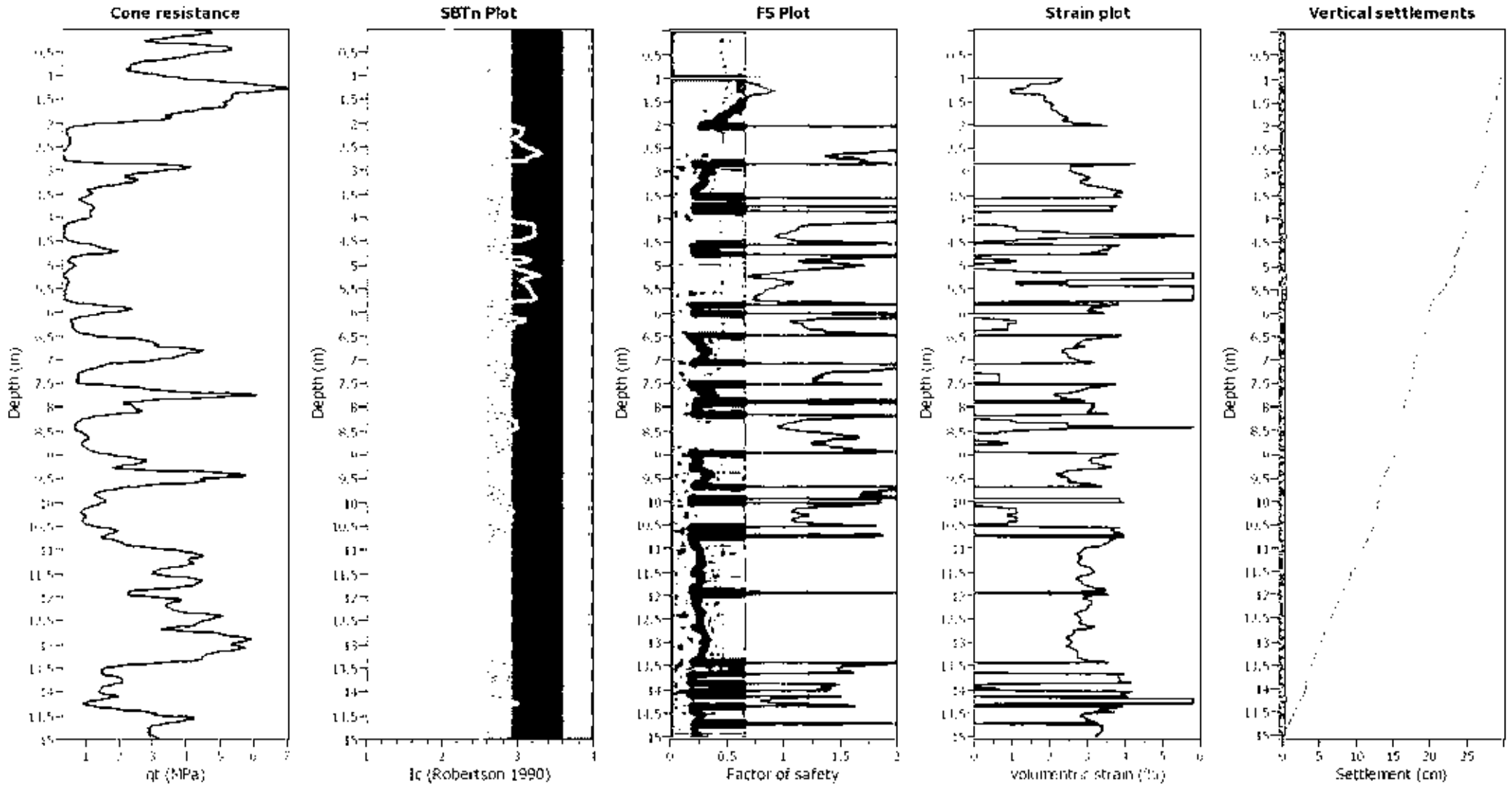
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

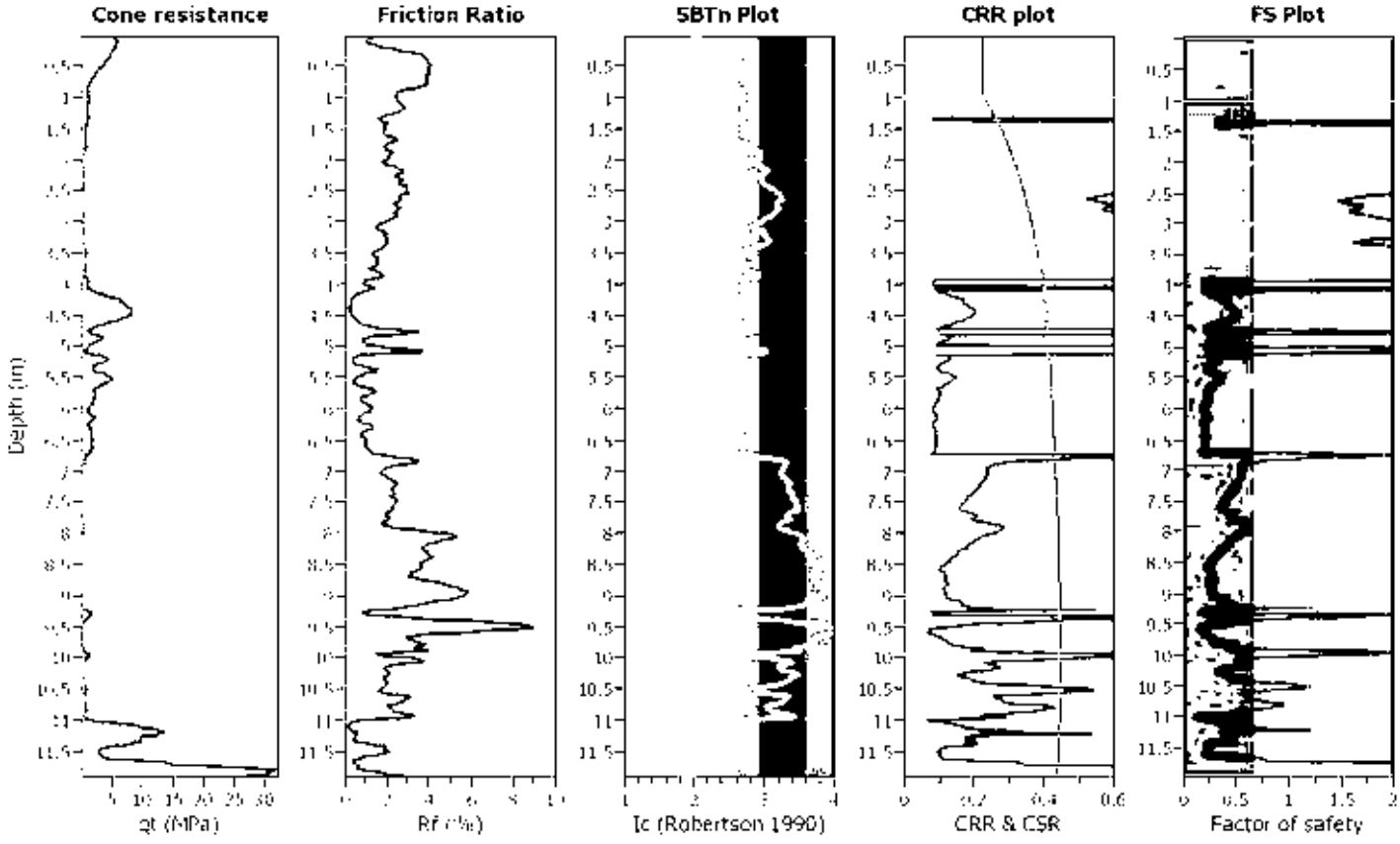
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

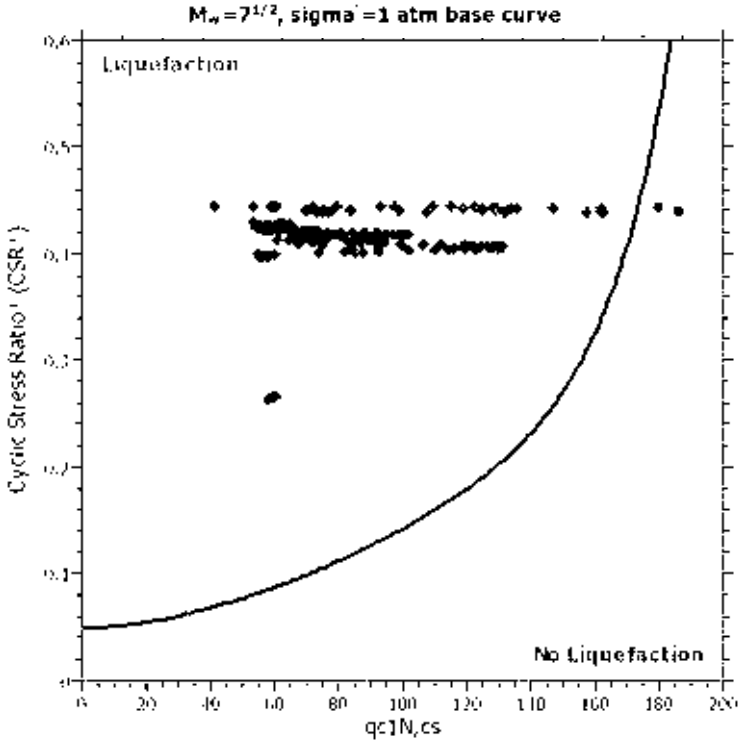
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

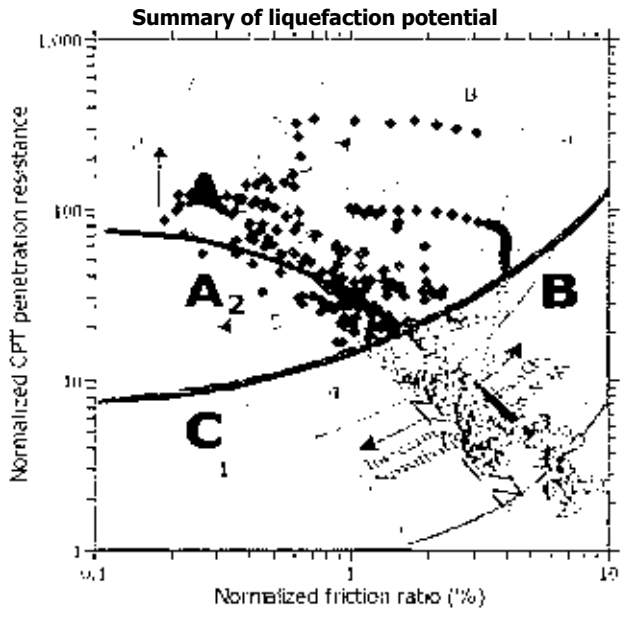
CPT file : CPT45_428cashmereRd

Input parameters and analysis data

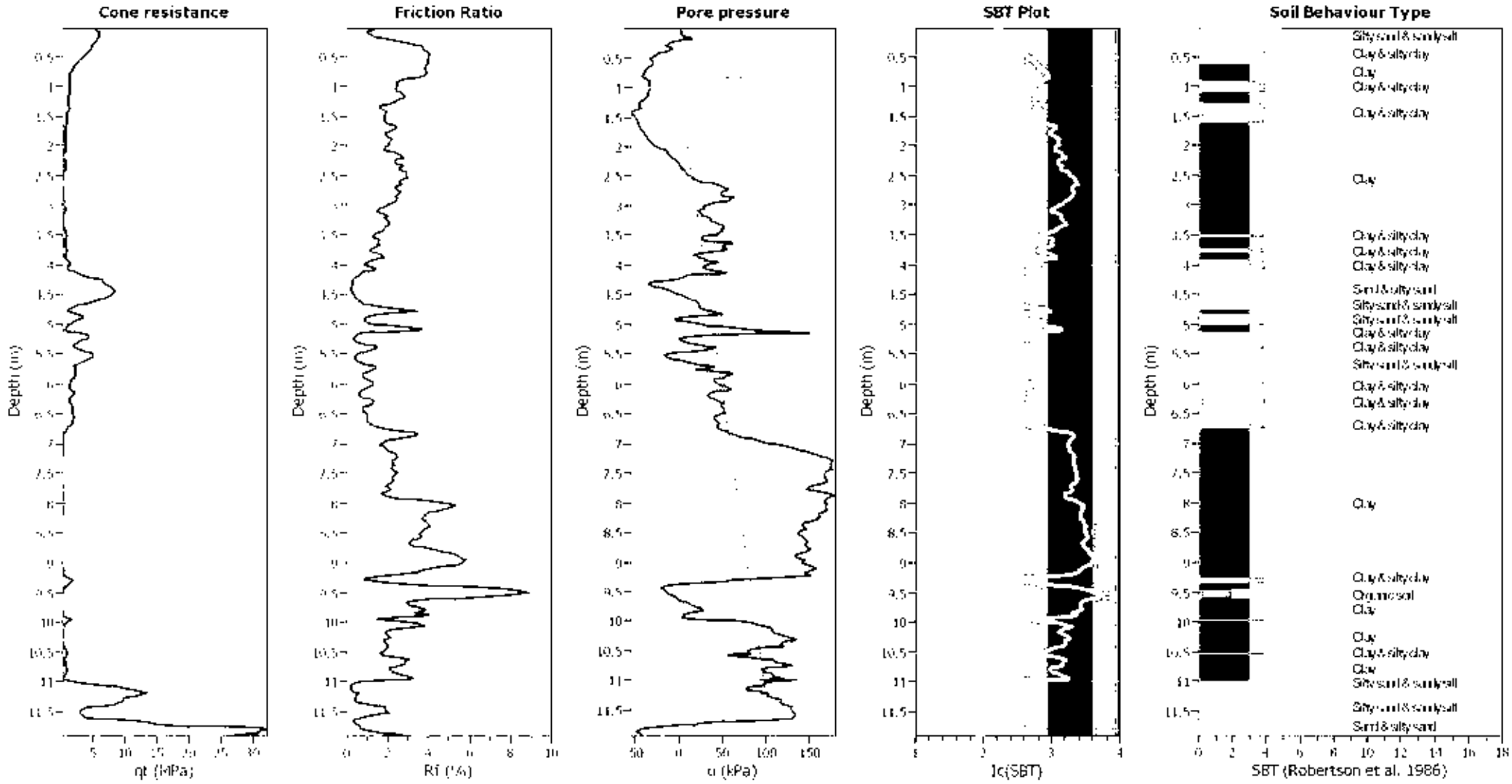
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



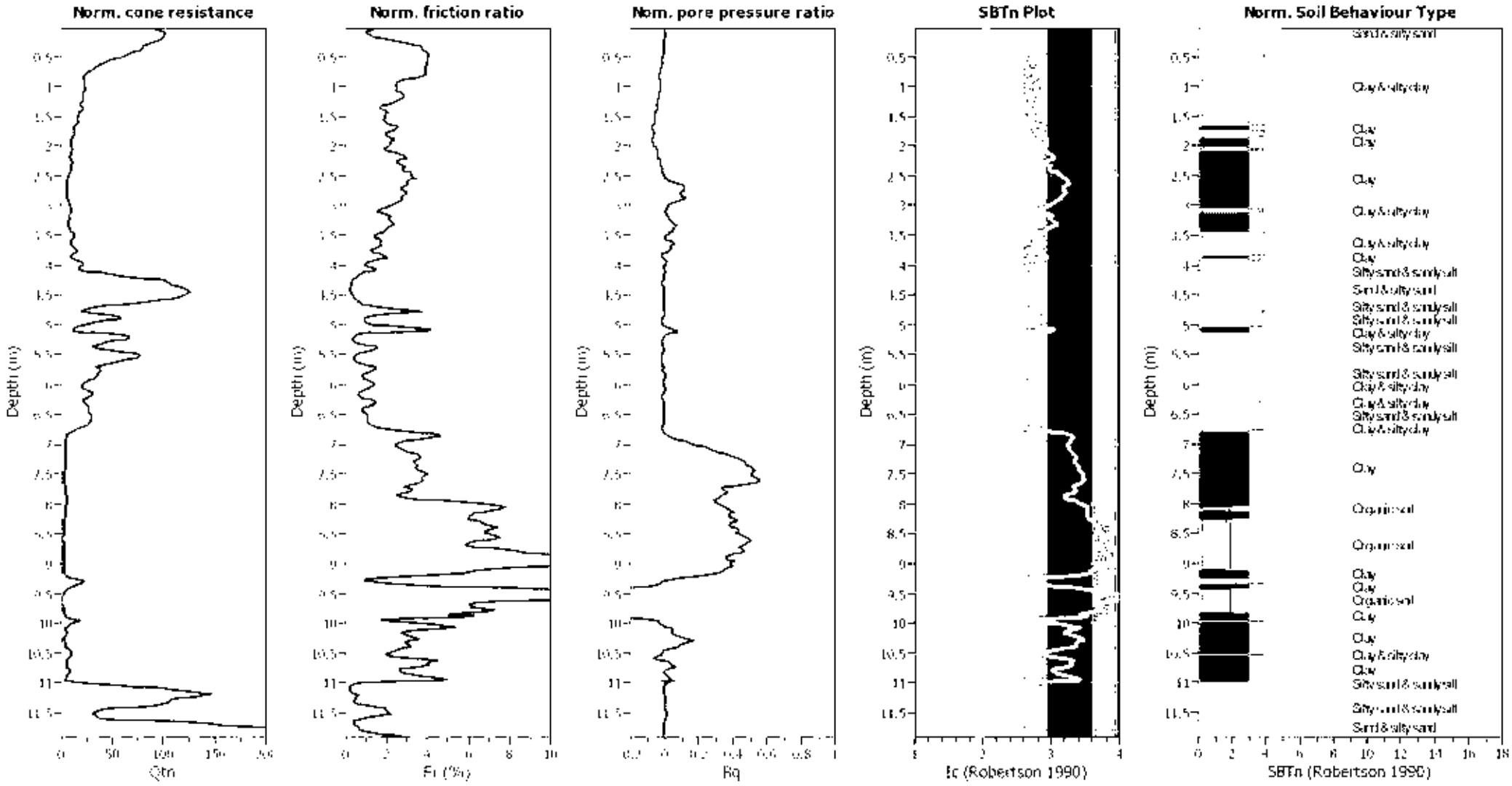
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



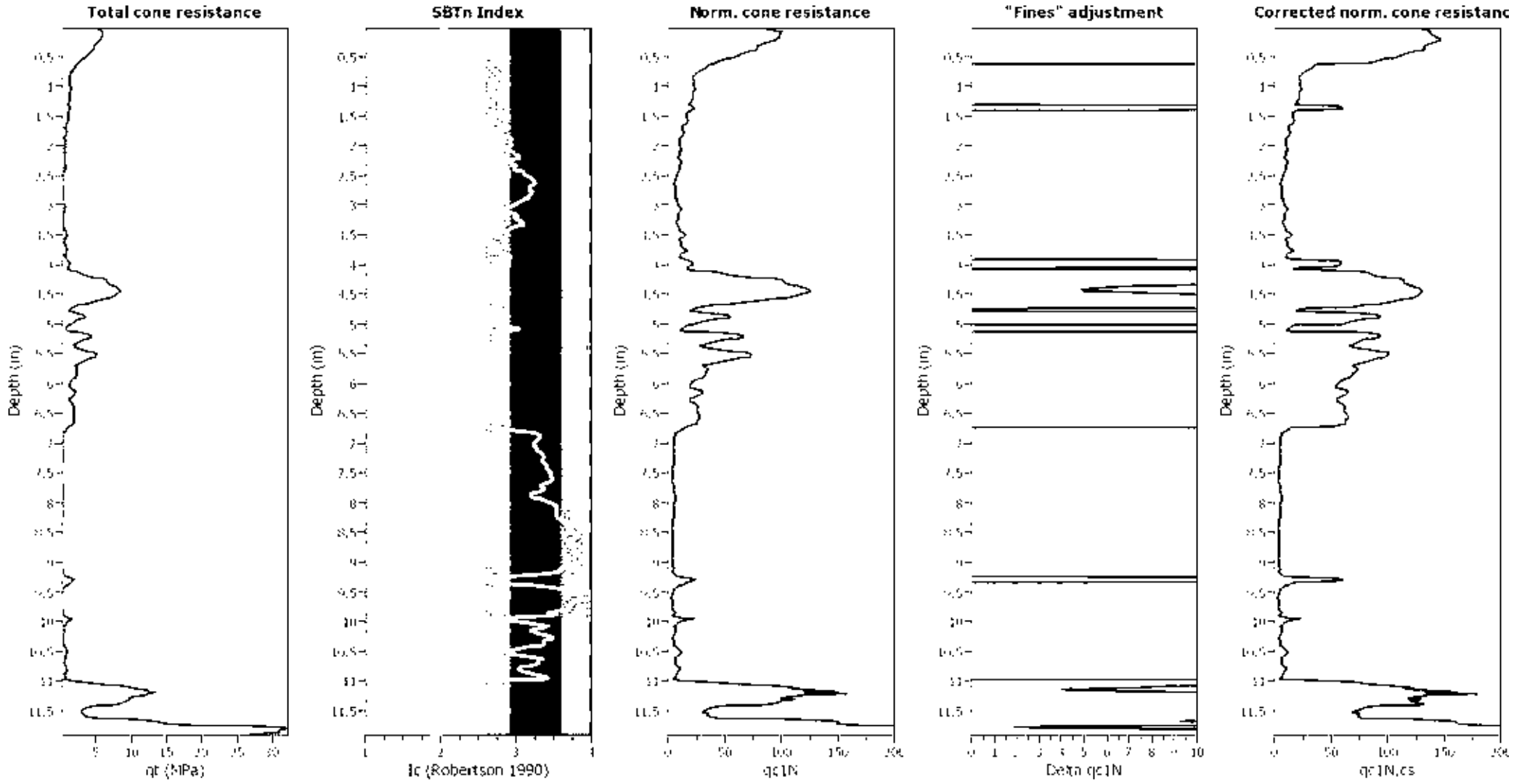
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

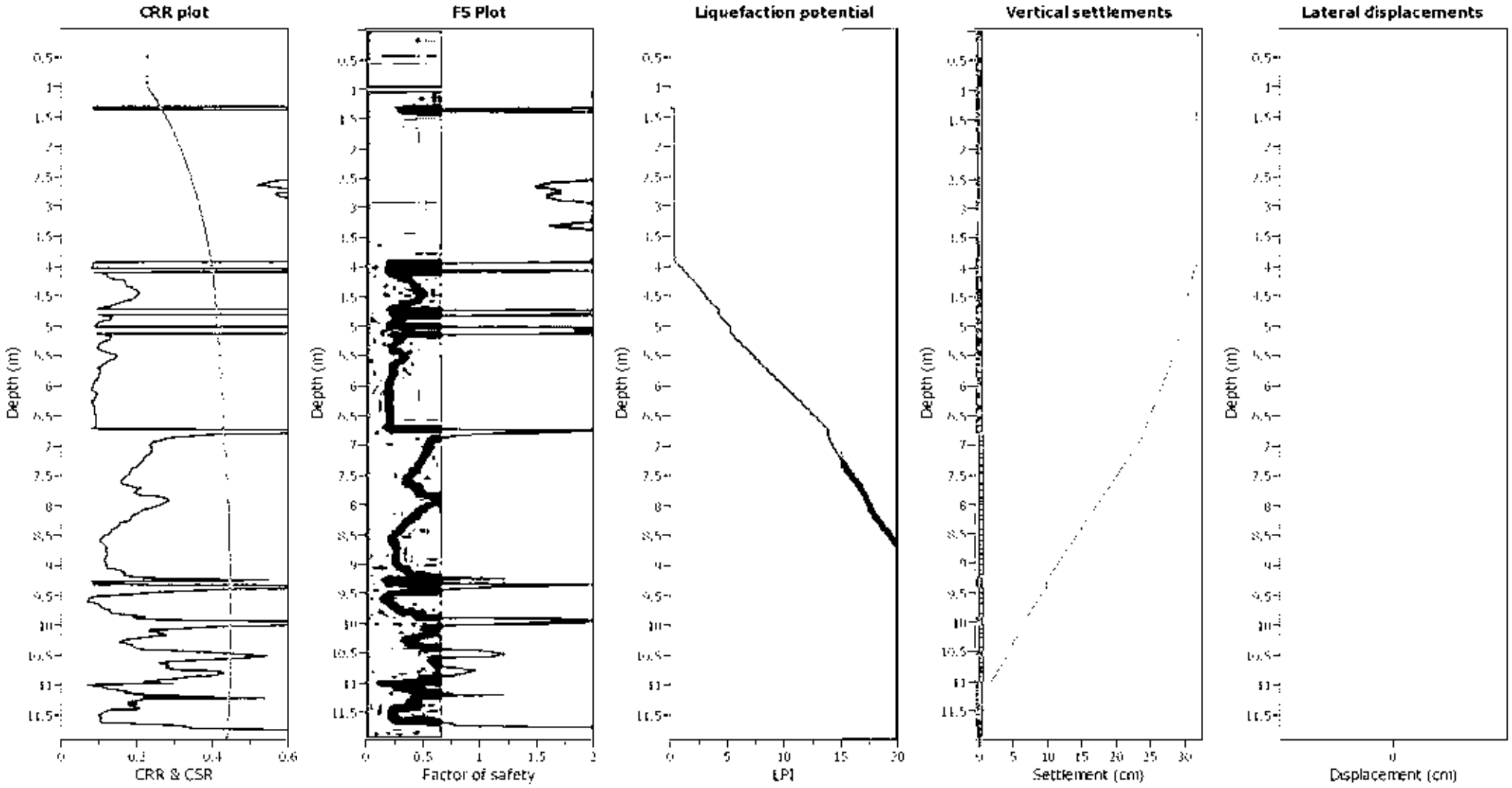
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

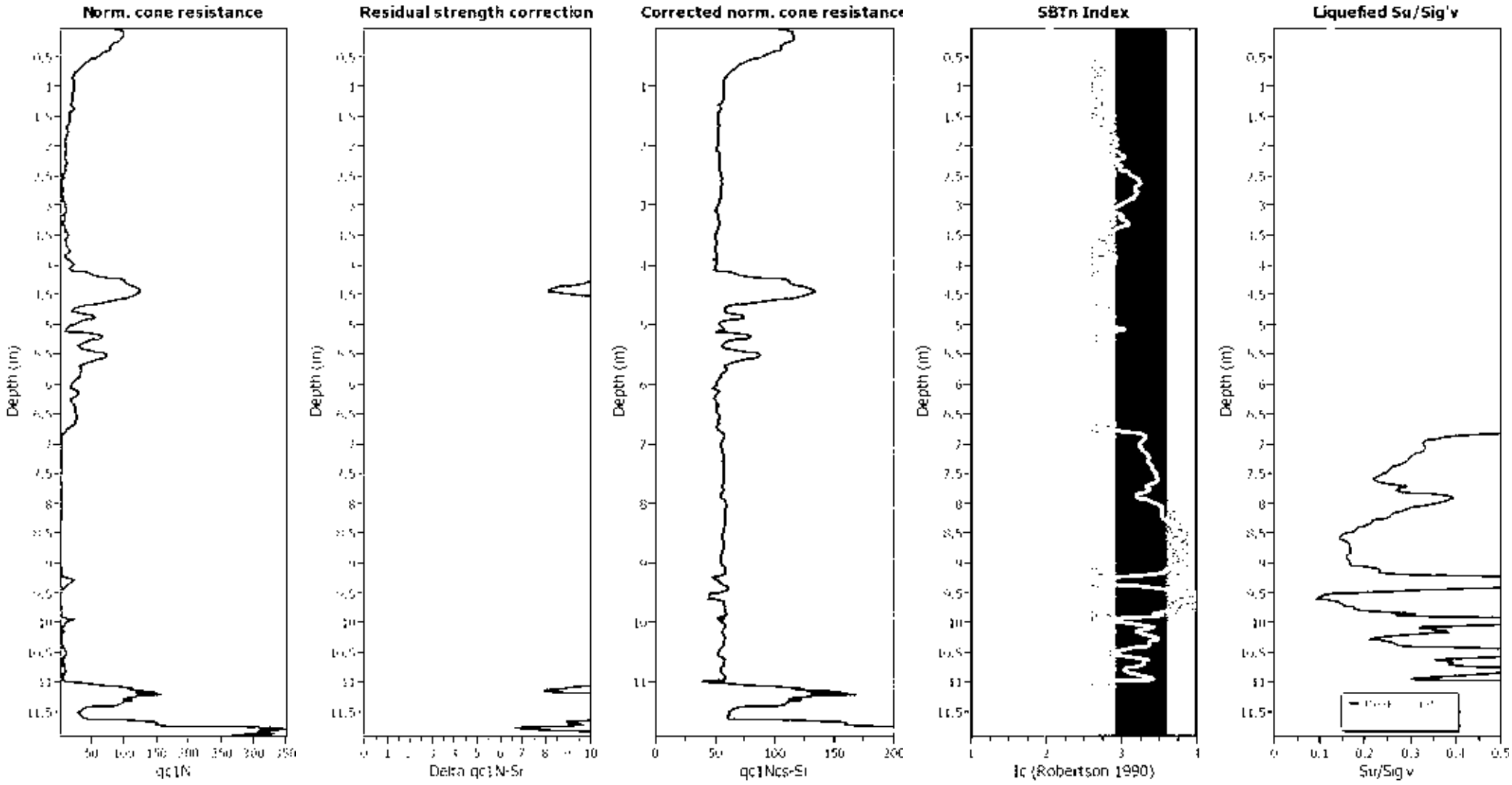
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

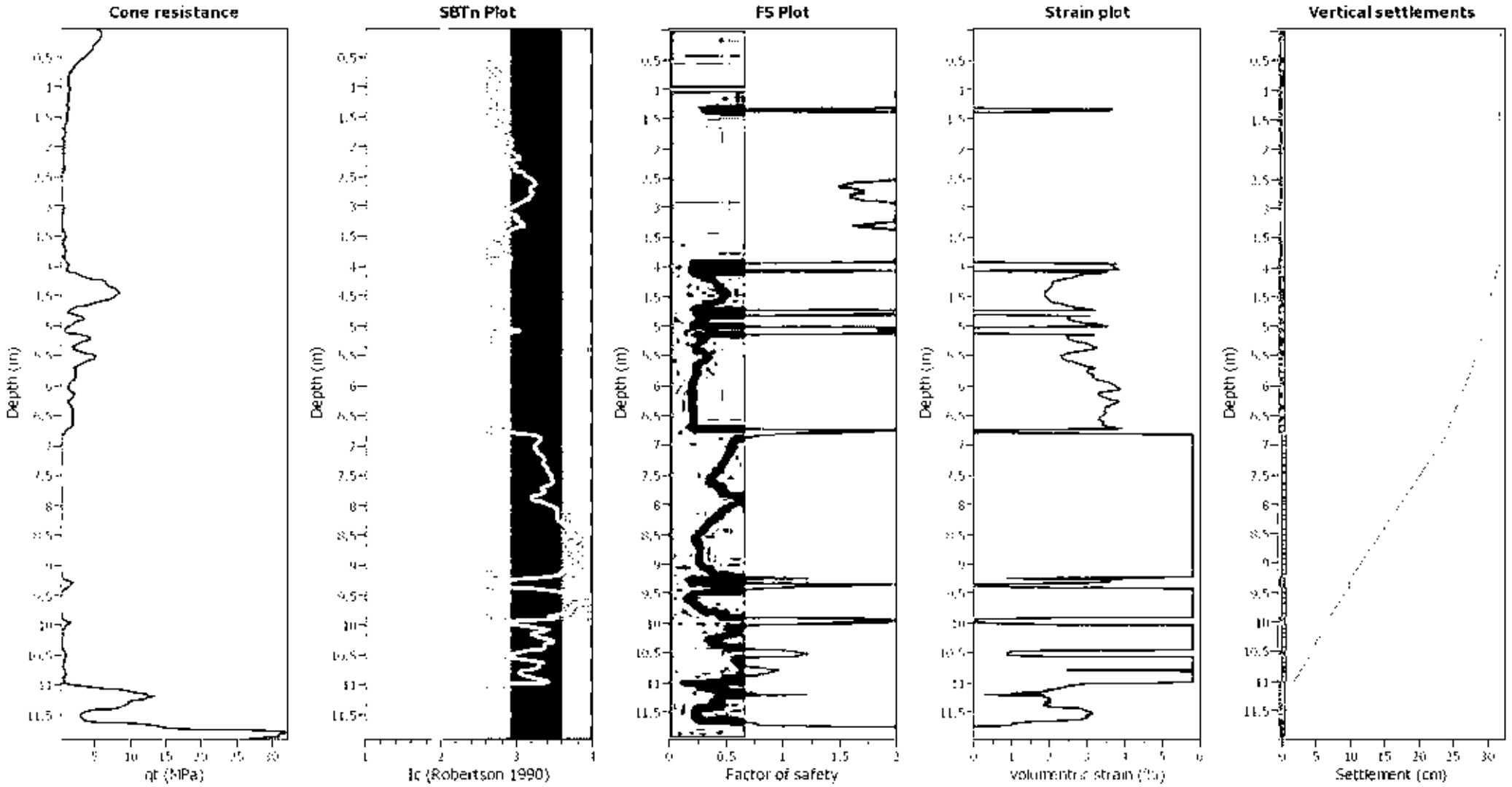
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

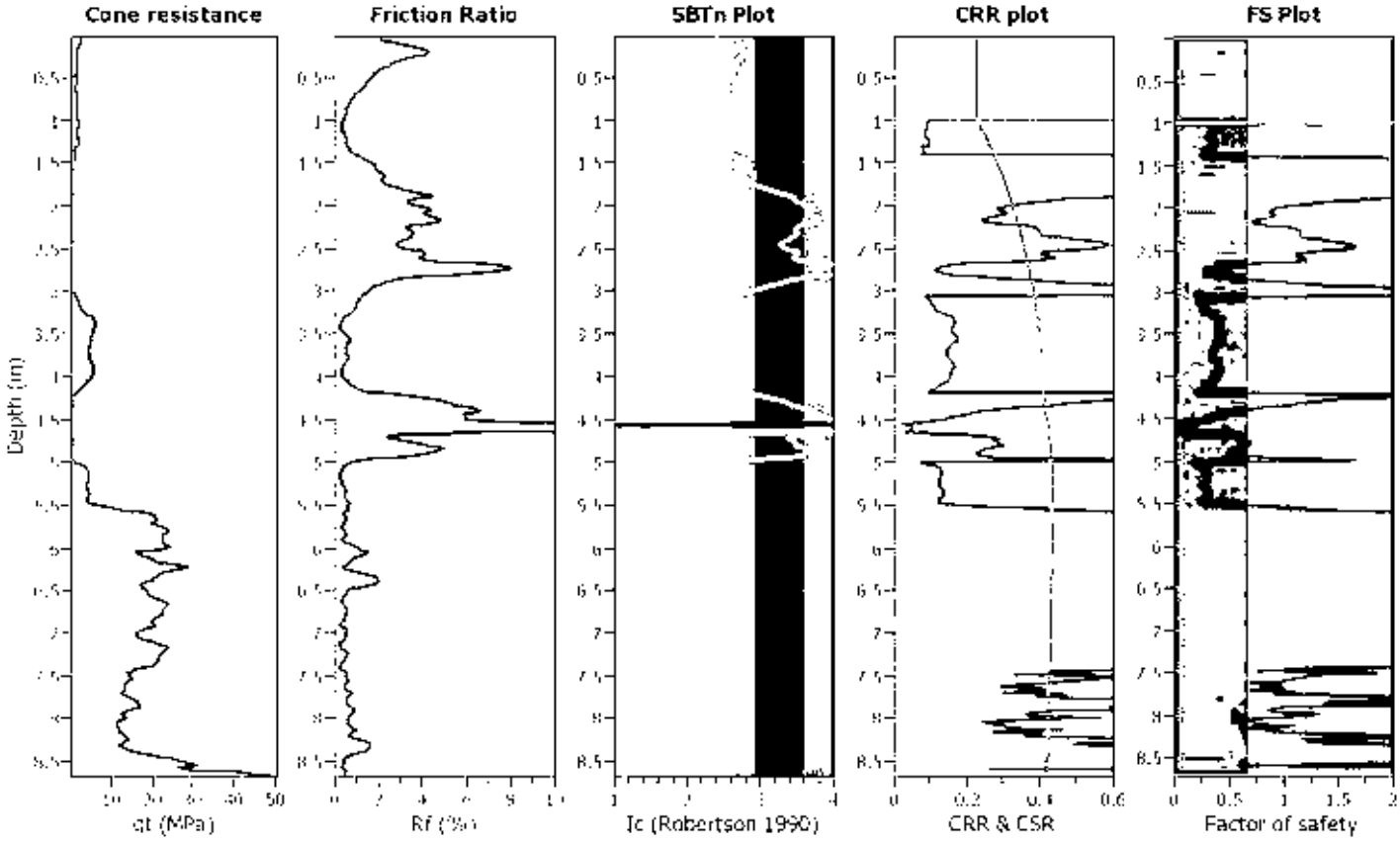
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

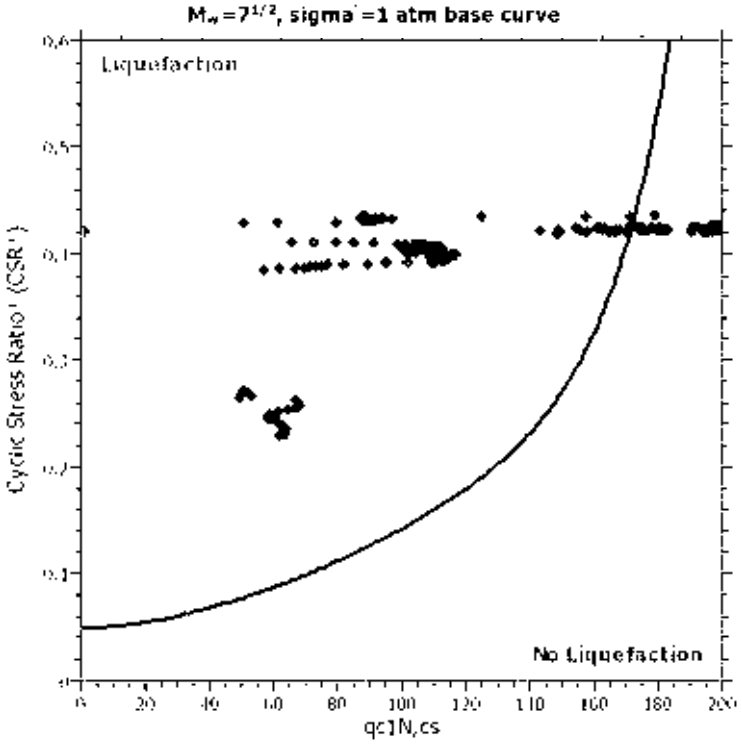
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

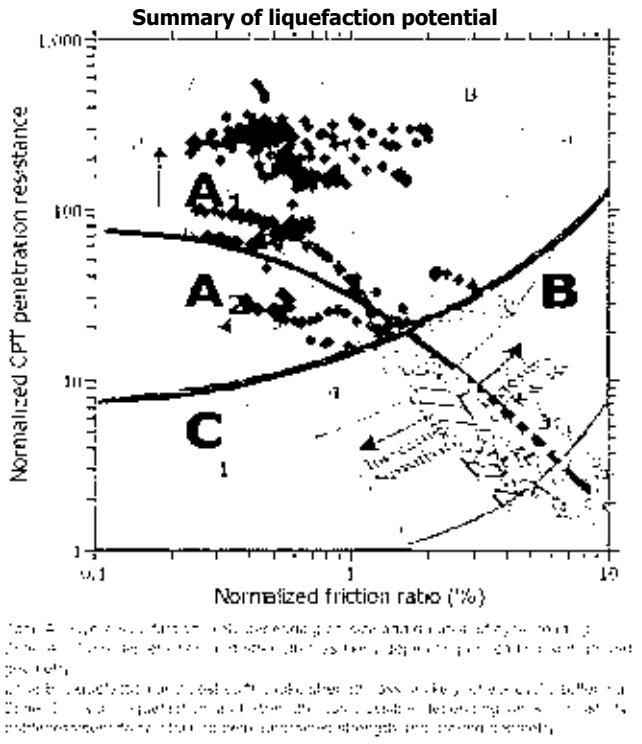
CPT file : CPT46_428cashmereRd

Input parameters and analysis data

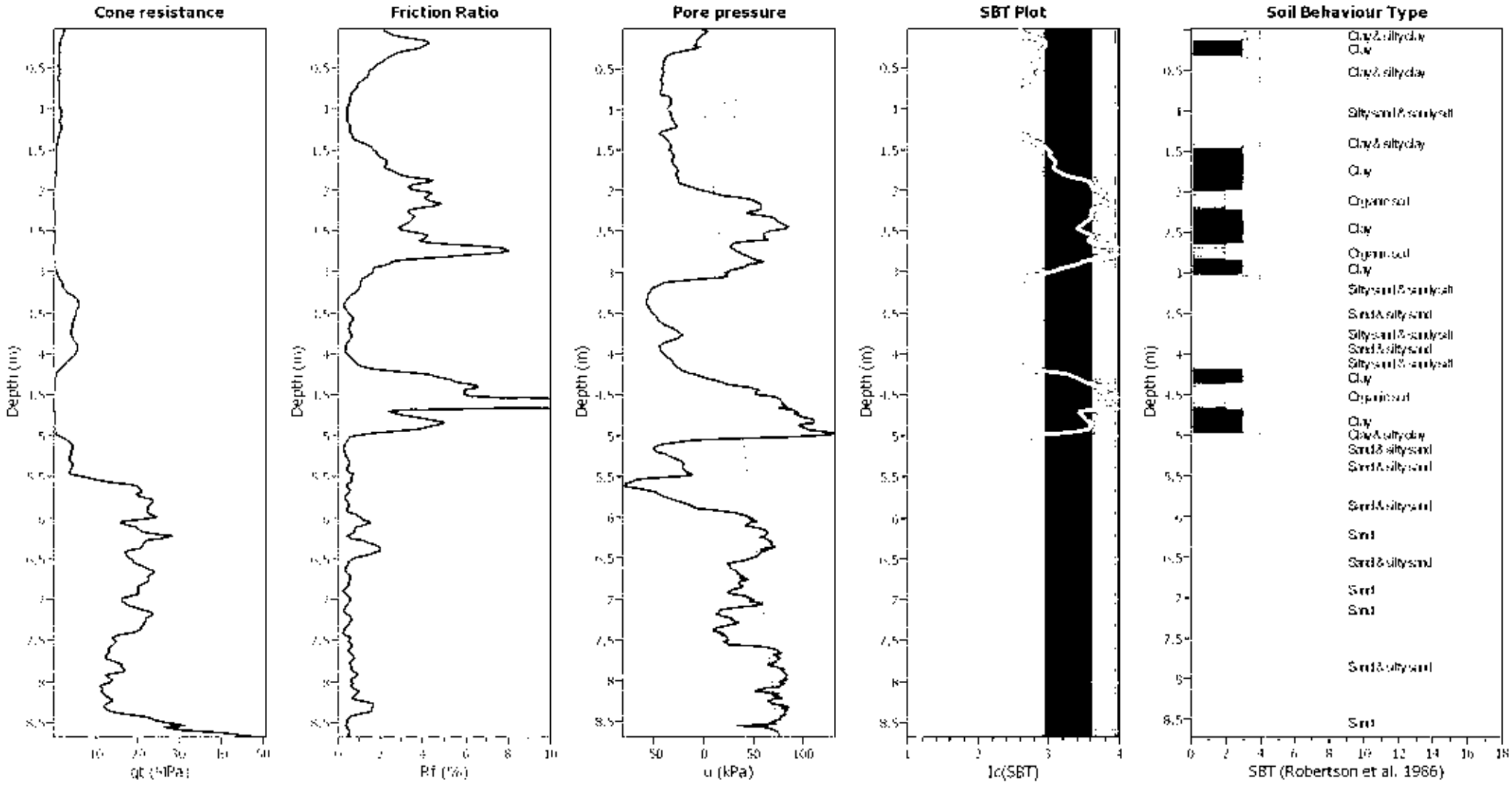
Analysis method:	I&B (2008)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



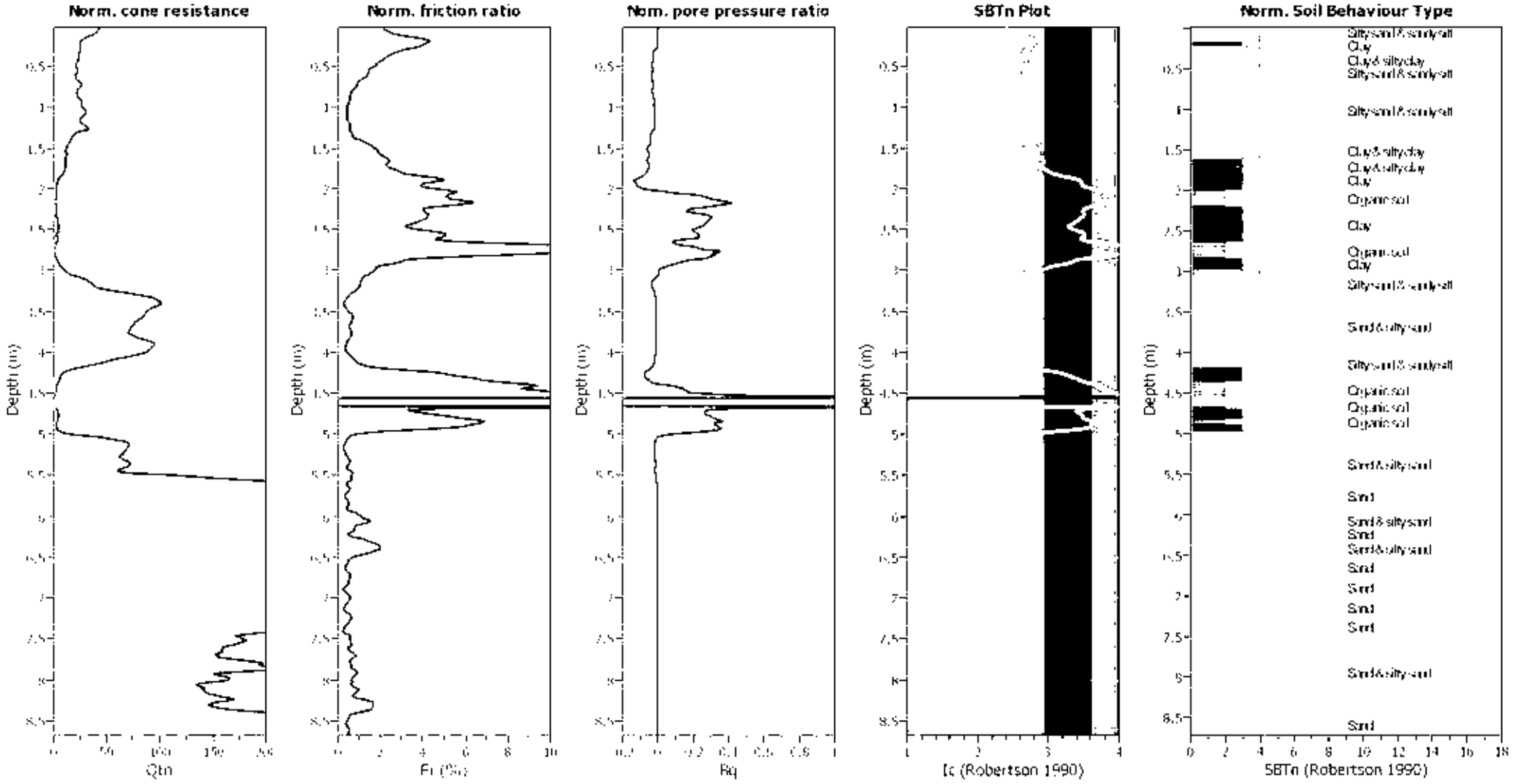
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



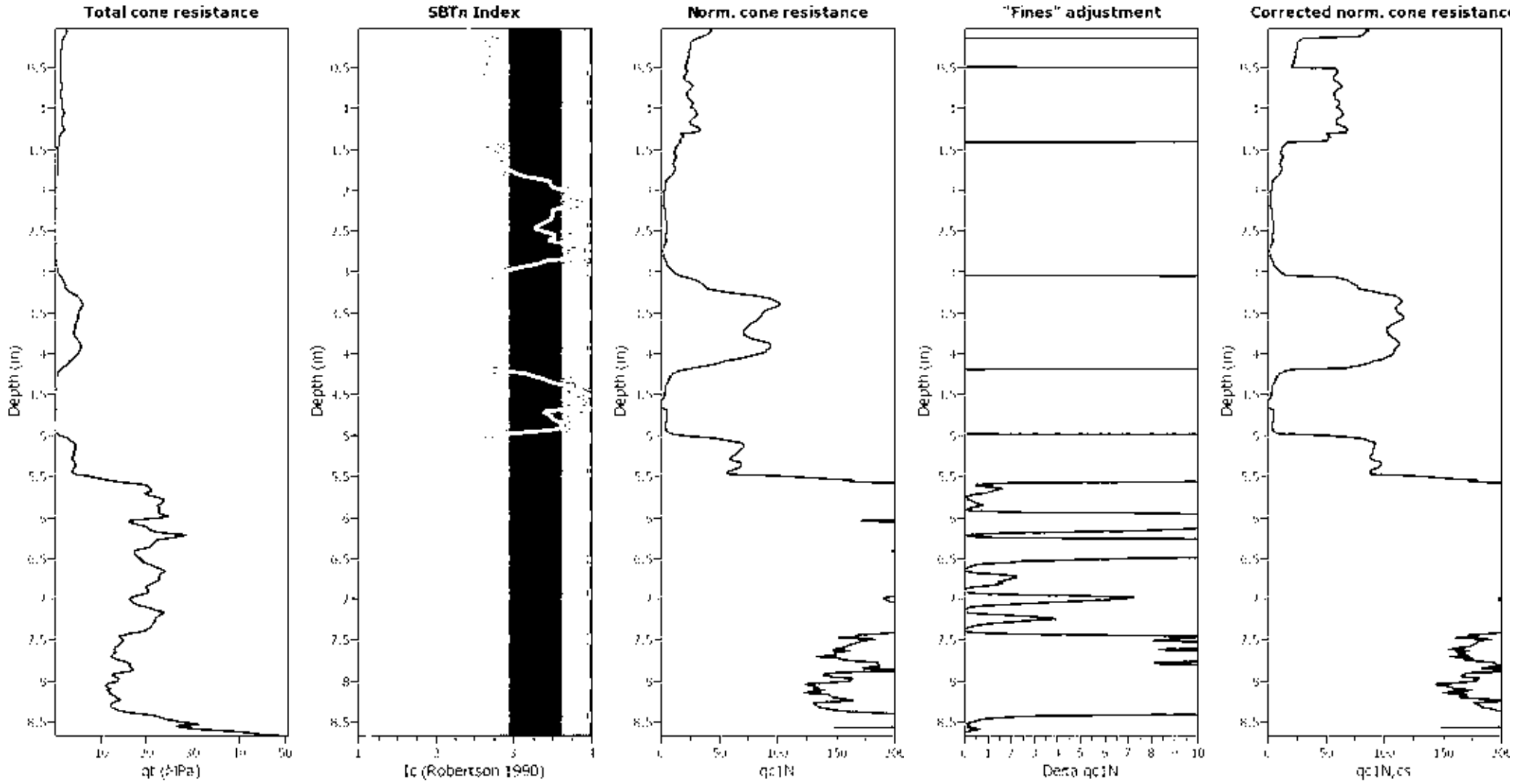
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

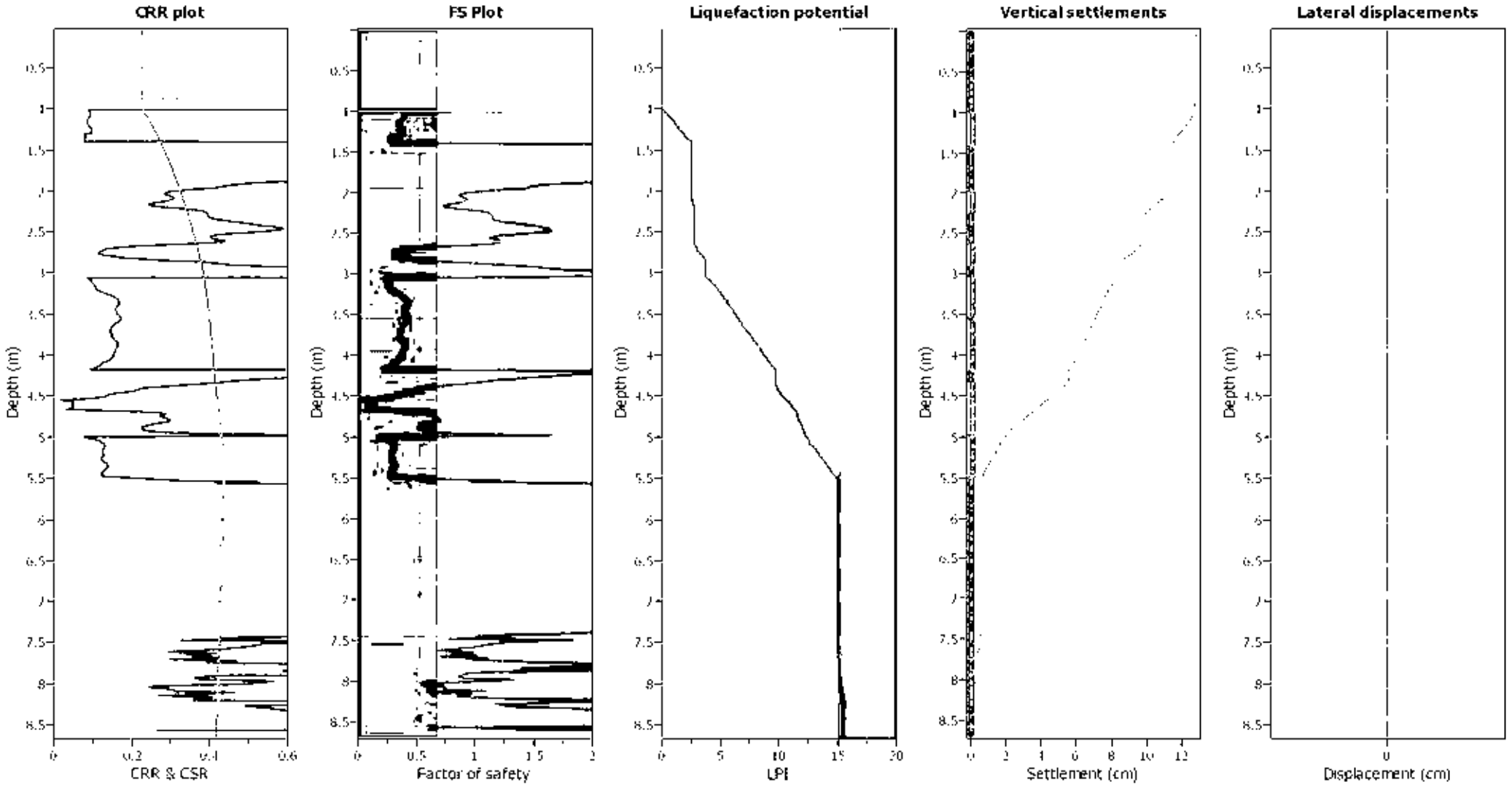
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	1.00 m	Fill height:	N/A	Limit depth:	N/A

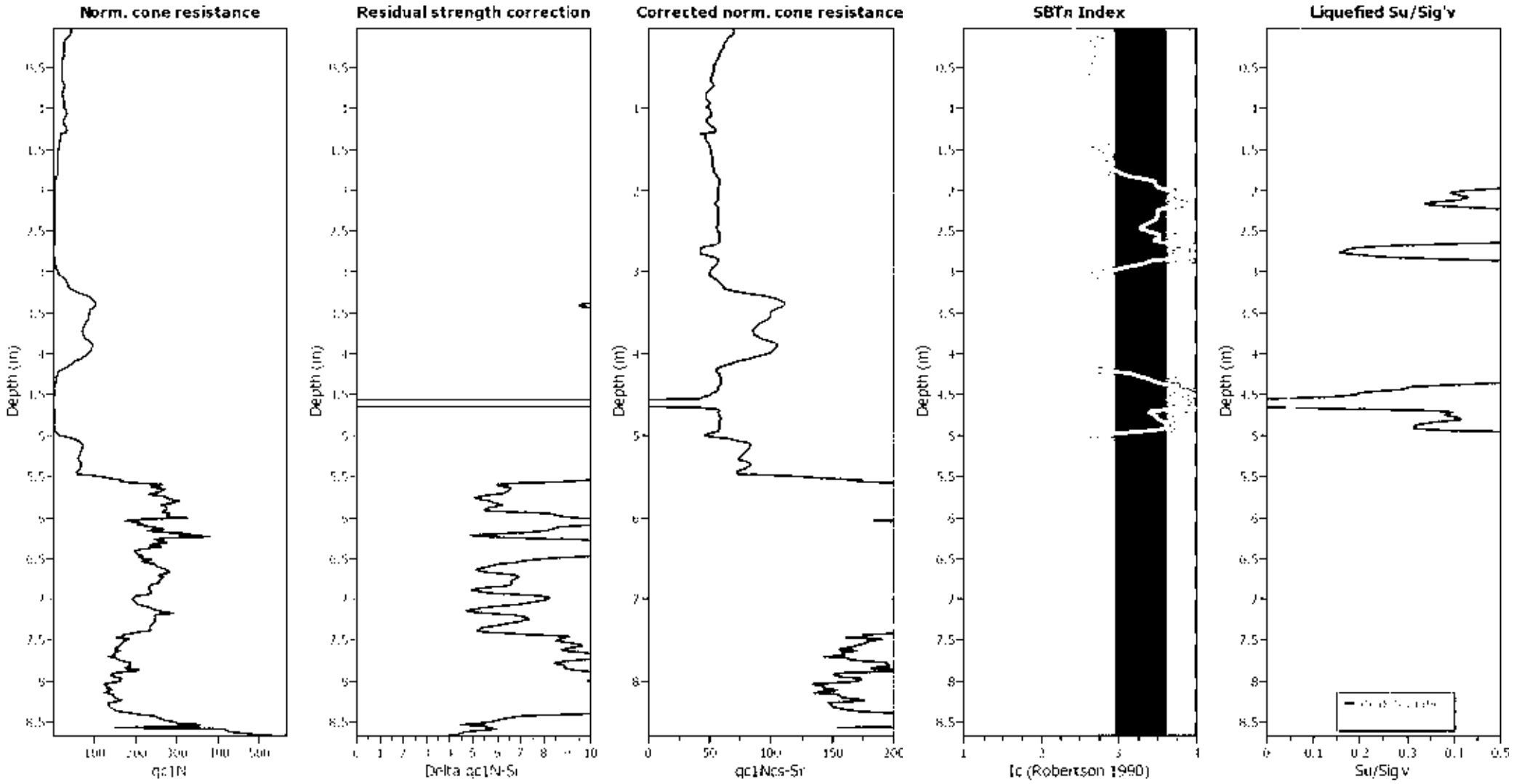
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

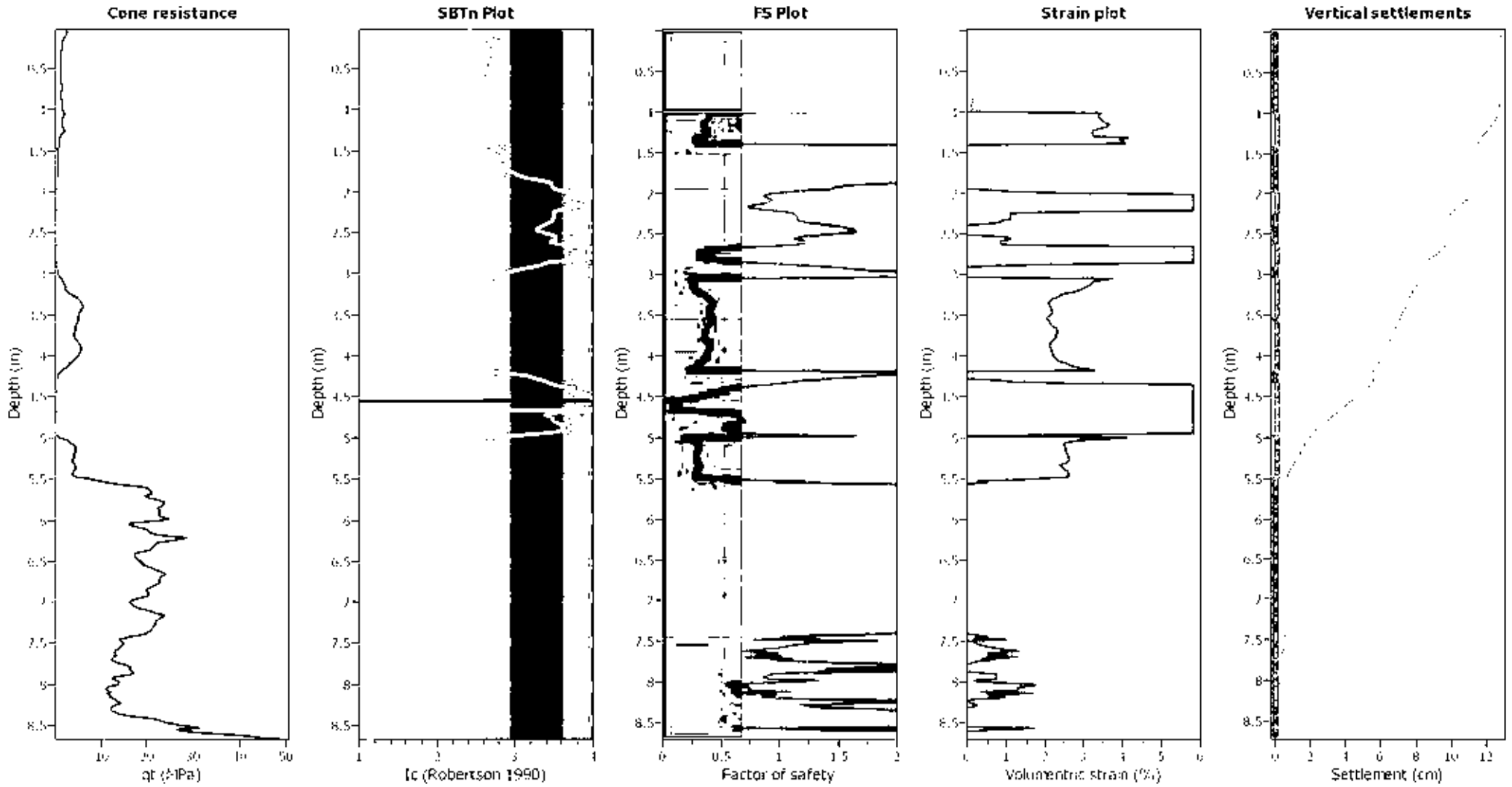
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

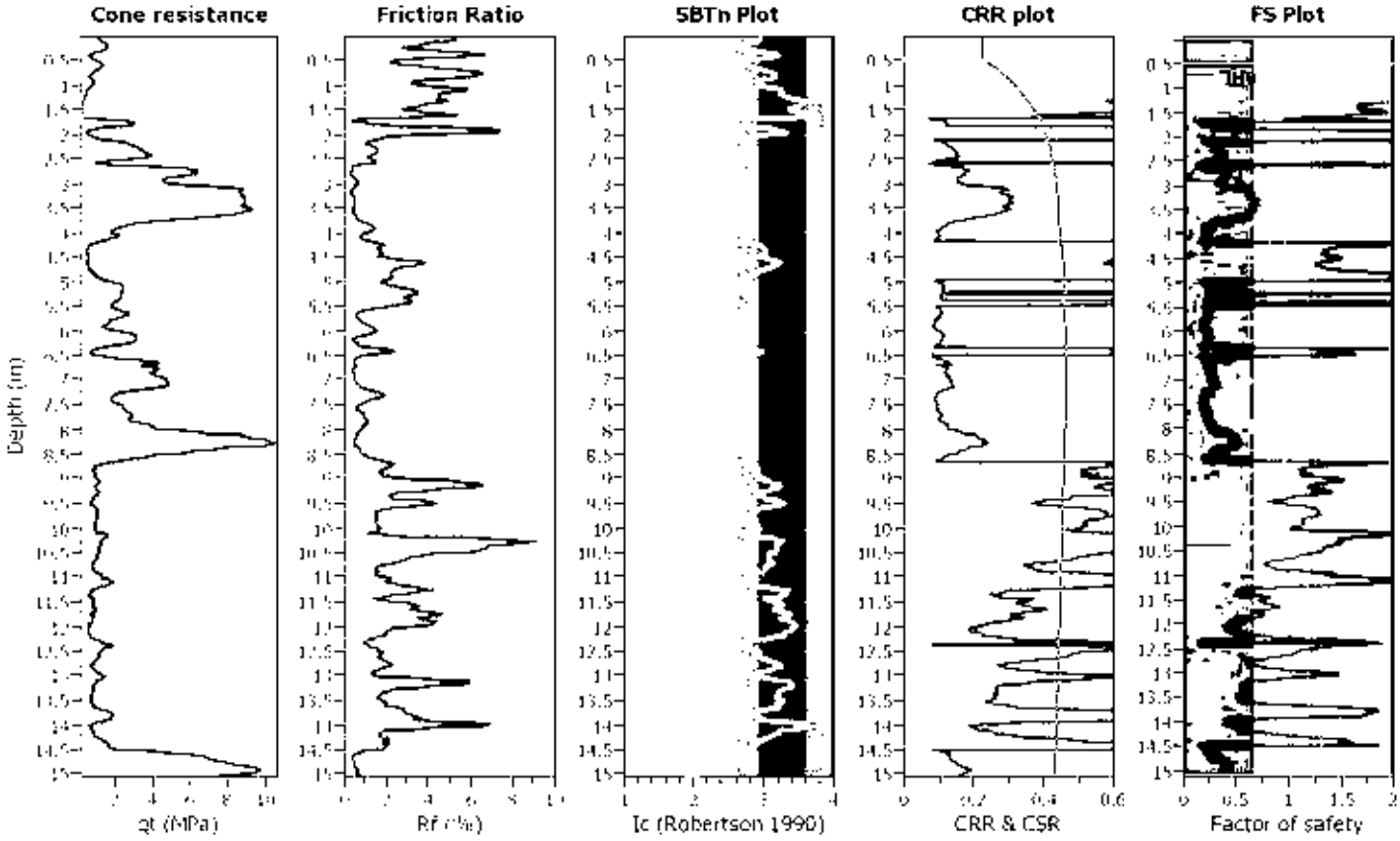
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain	Post liquefaction volumetric strain

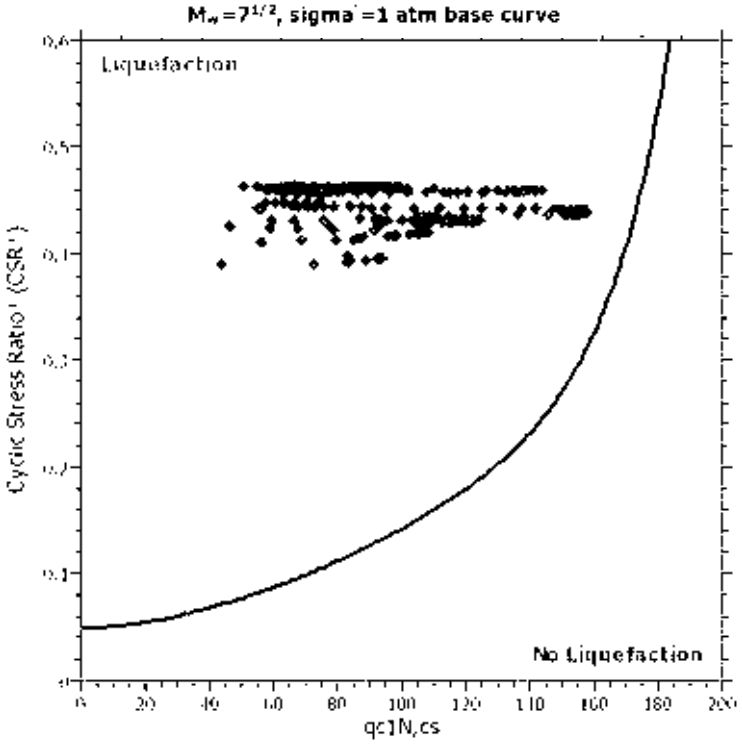
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

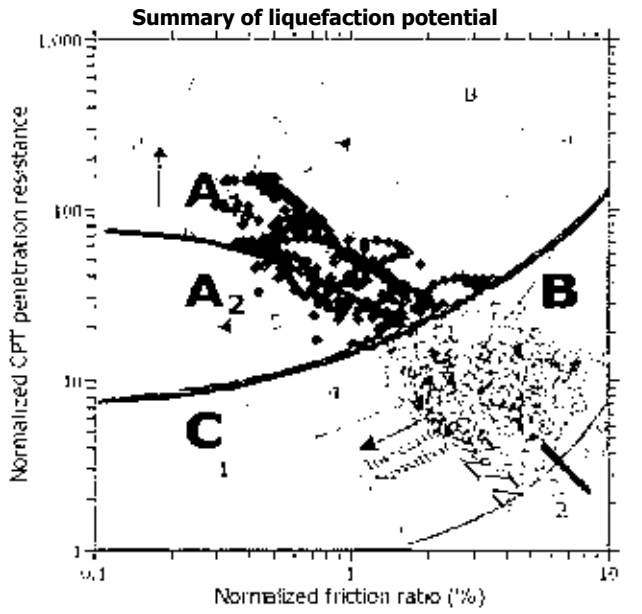
CPT file : CPT47_334SparksRd

Input parameters and analysis data

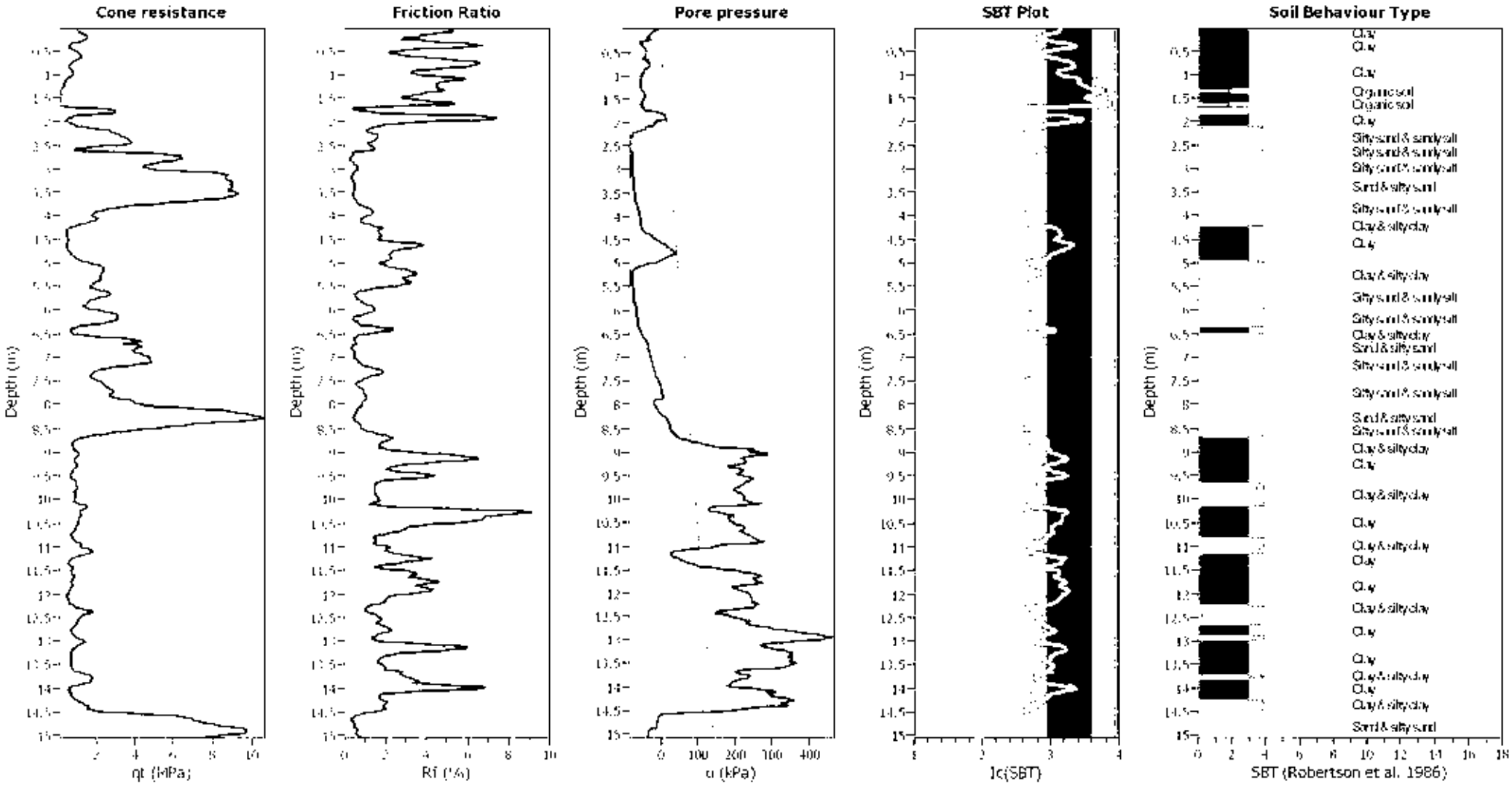
Analysis method	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



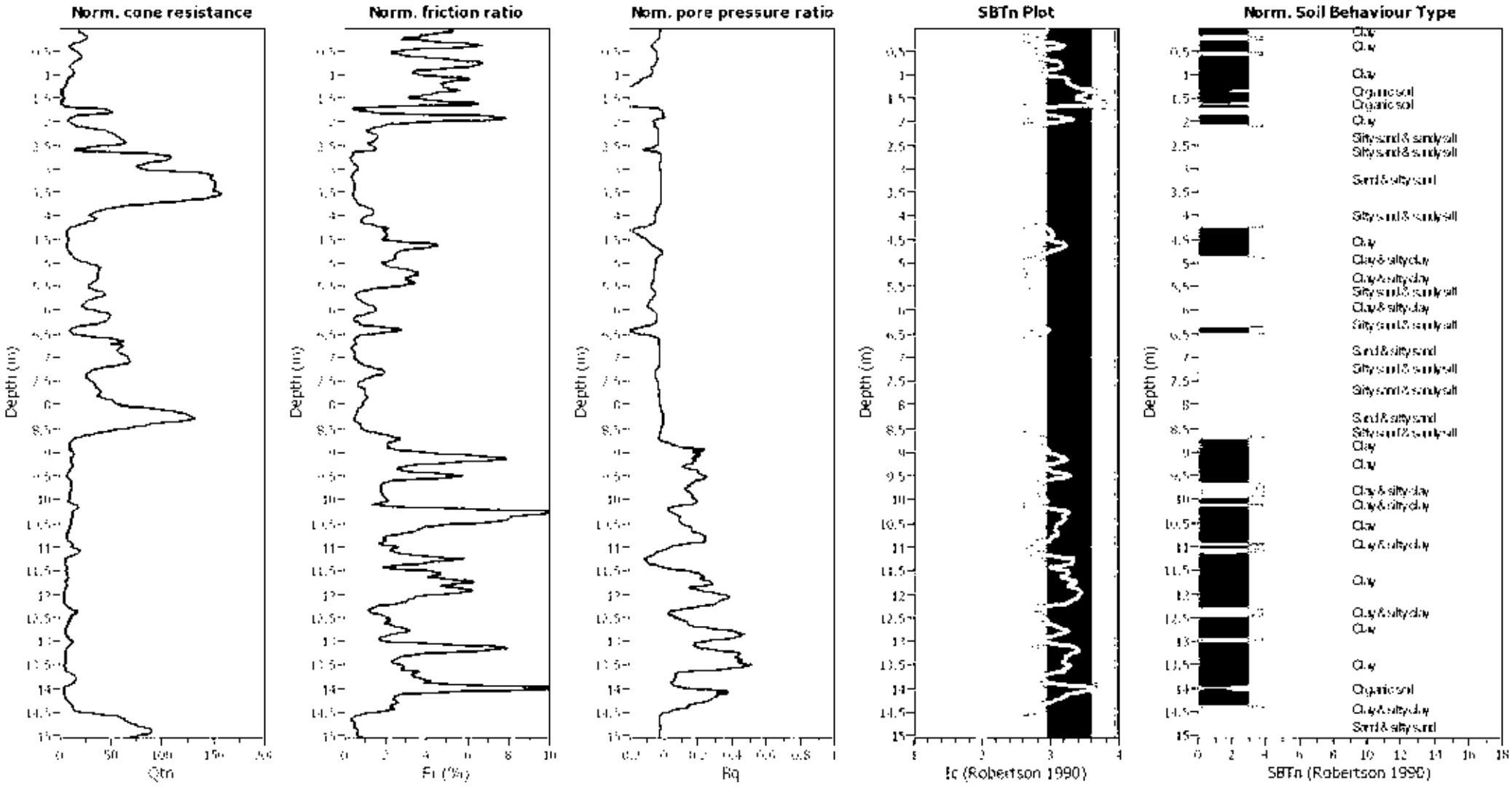
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



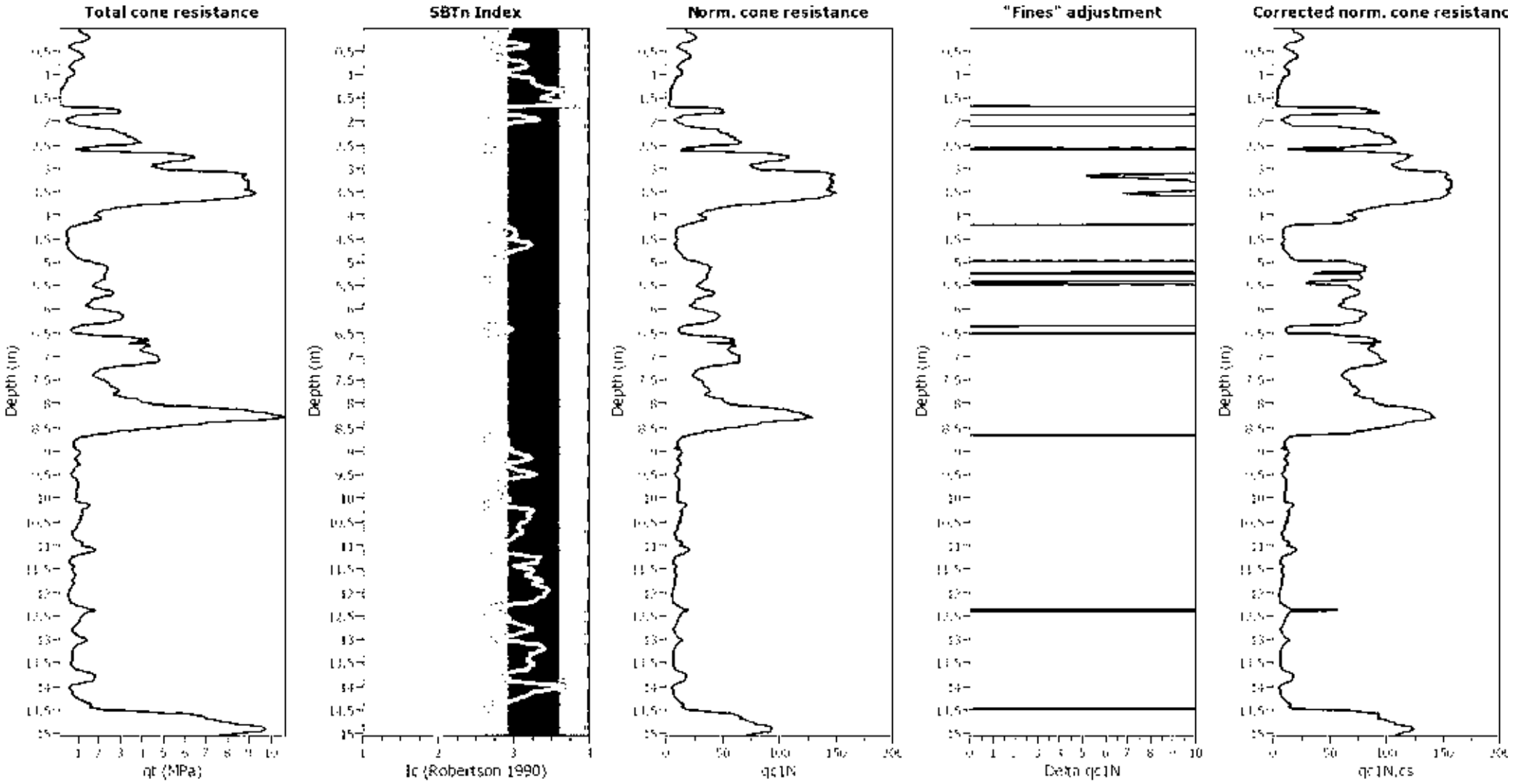
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

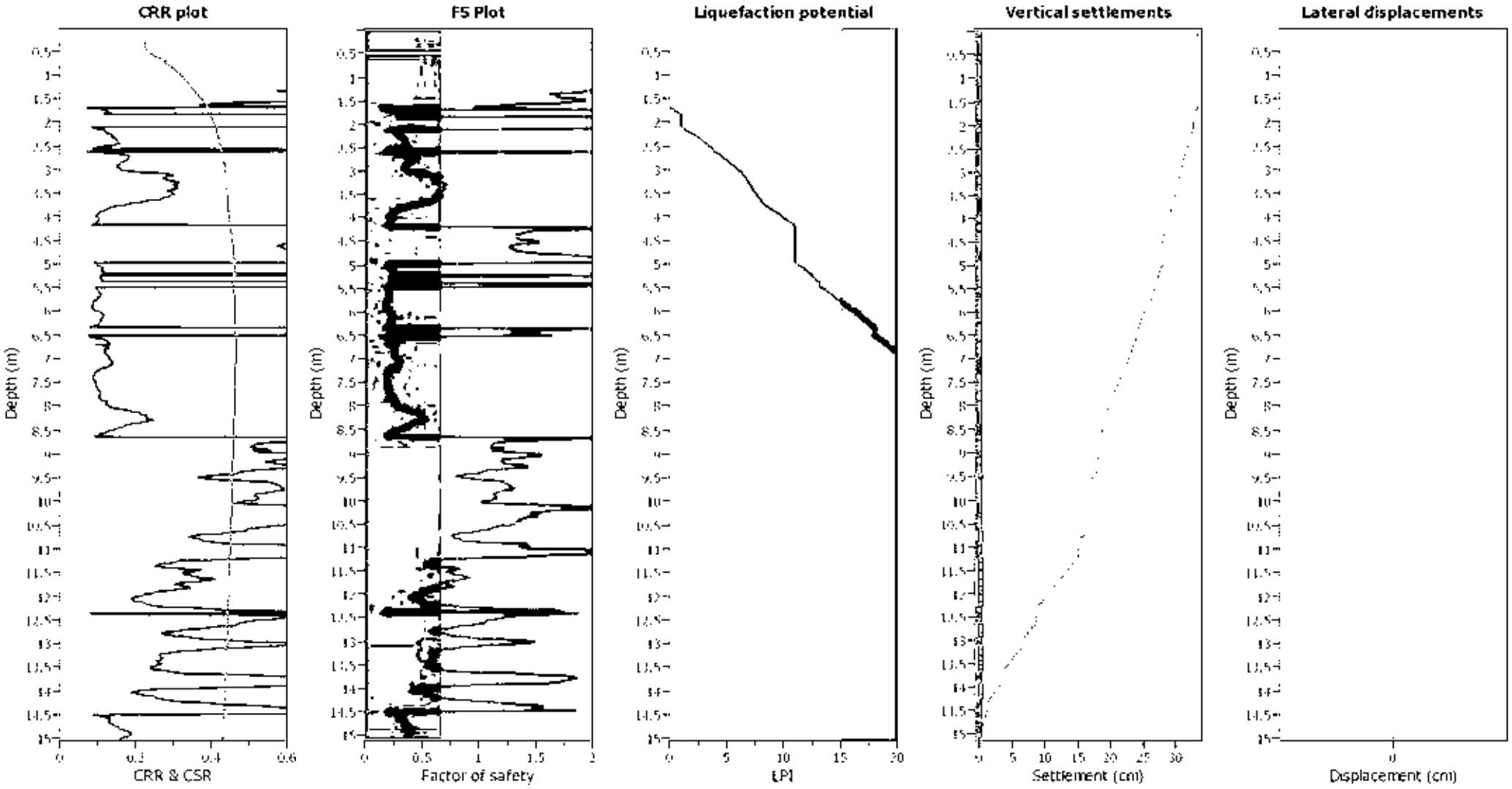
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

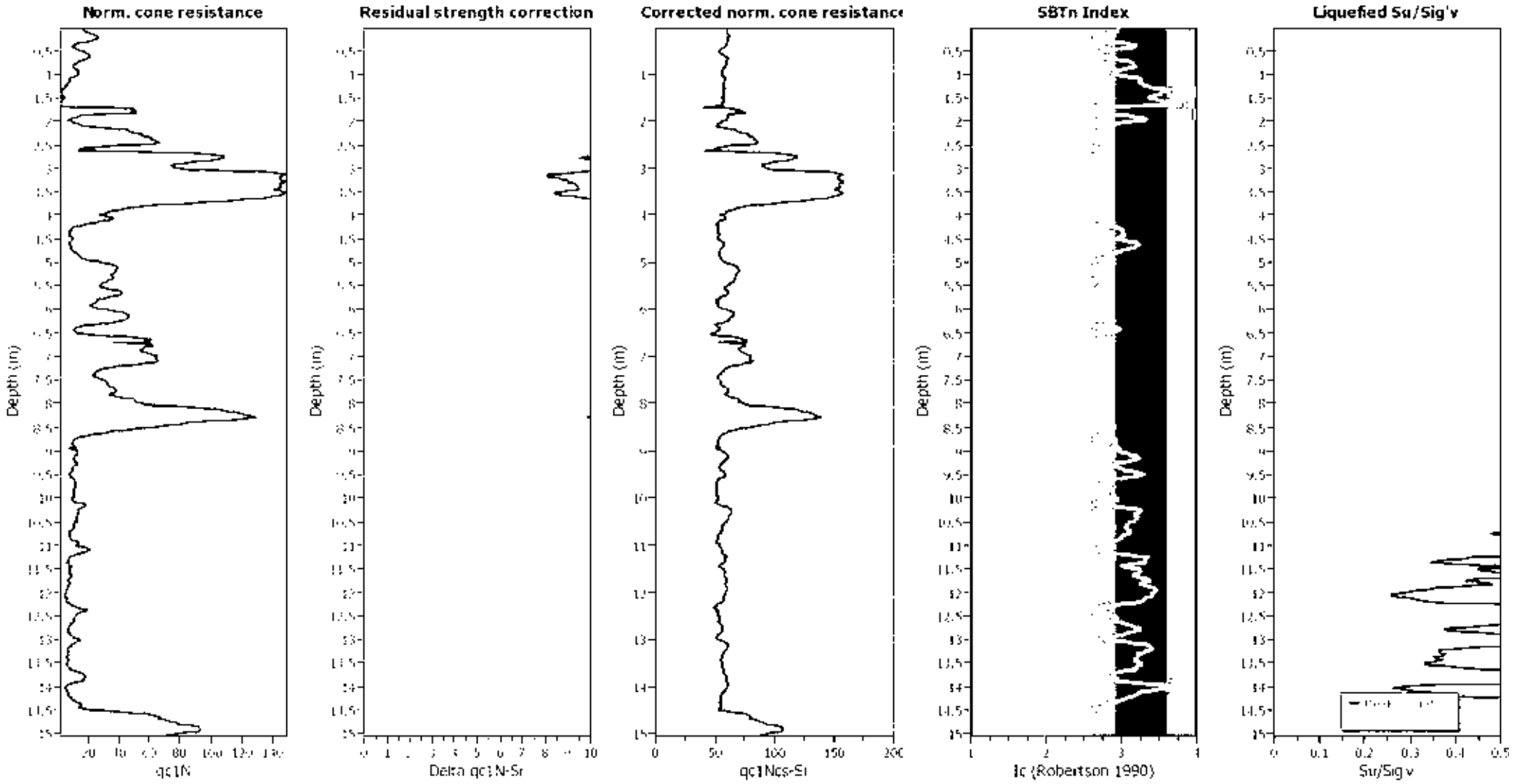
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

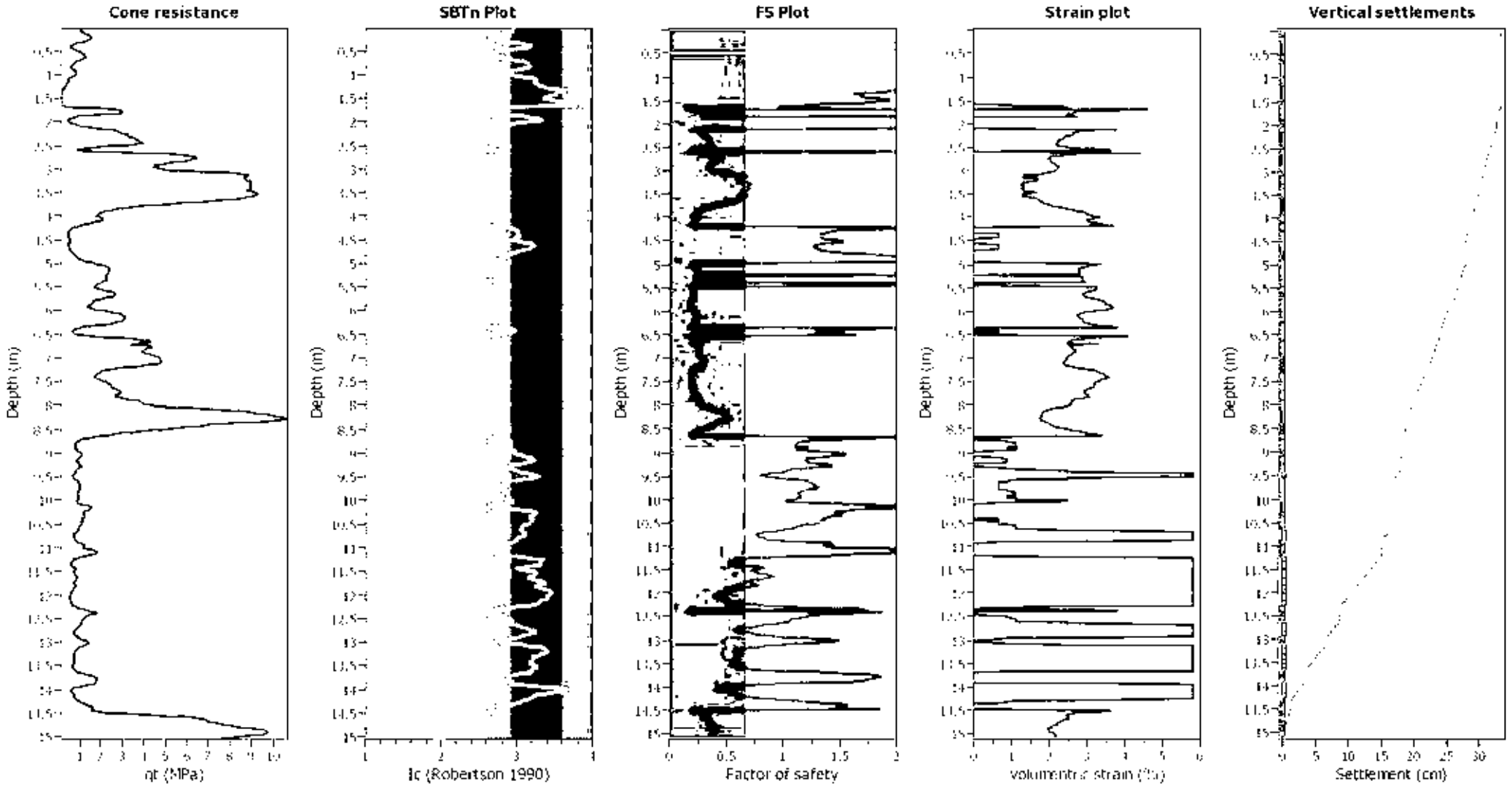
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

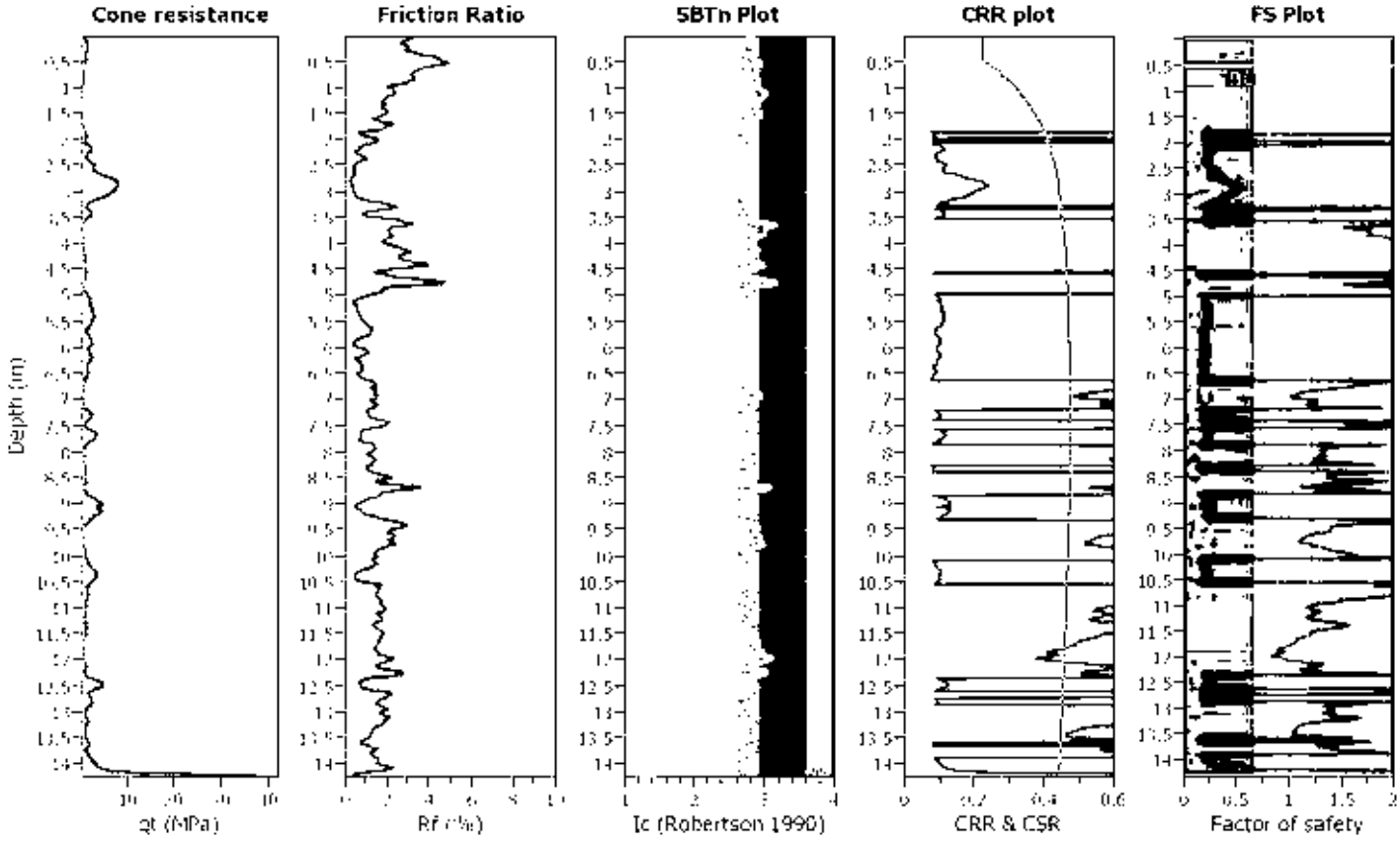
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

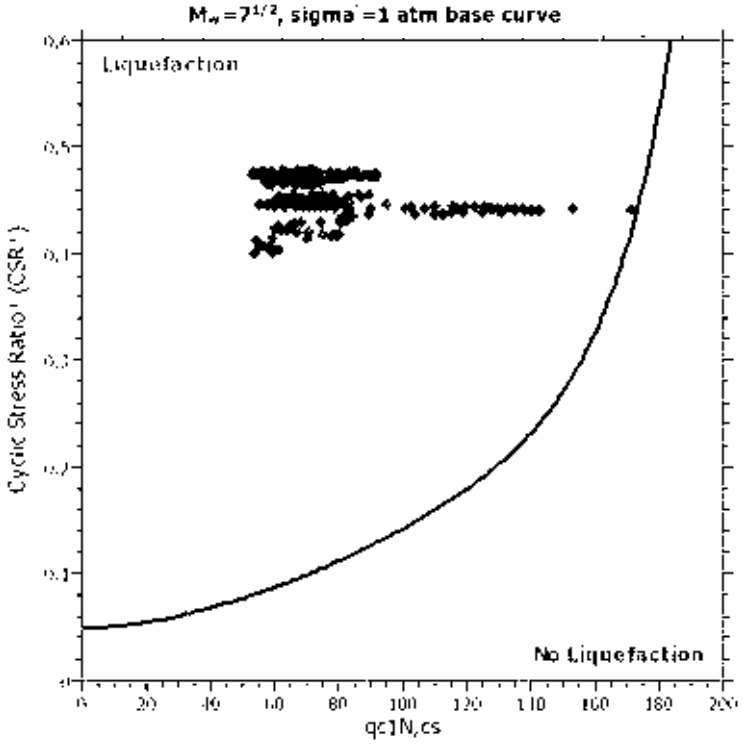
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

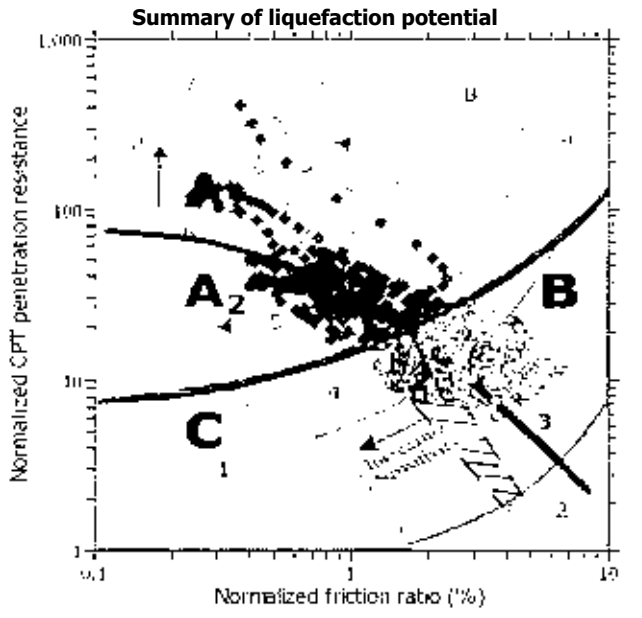
CPT file : CPT48_334SparksRd

Input parameters and analysis data

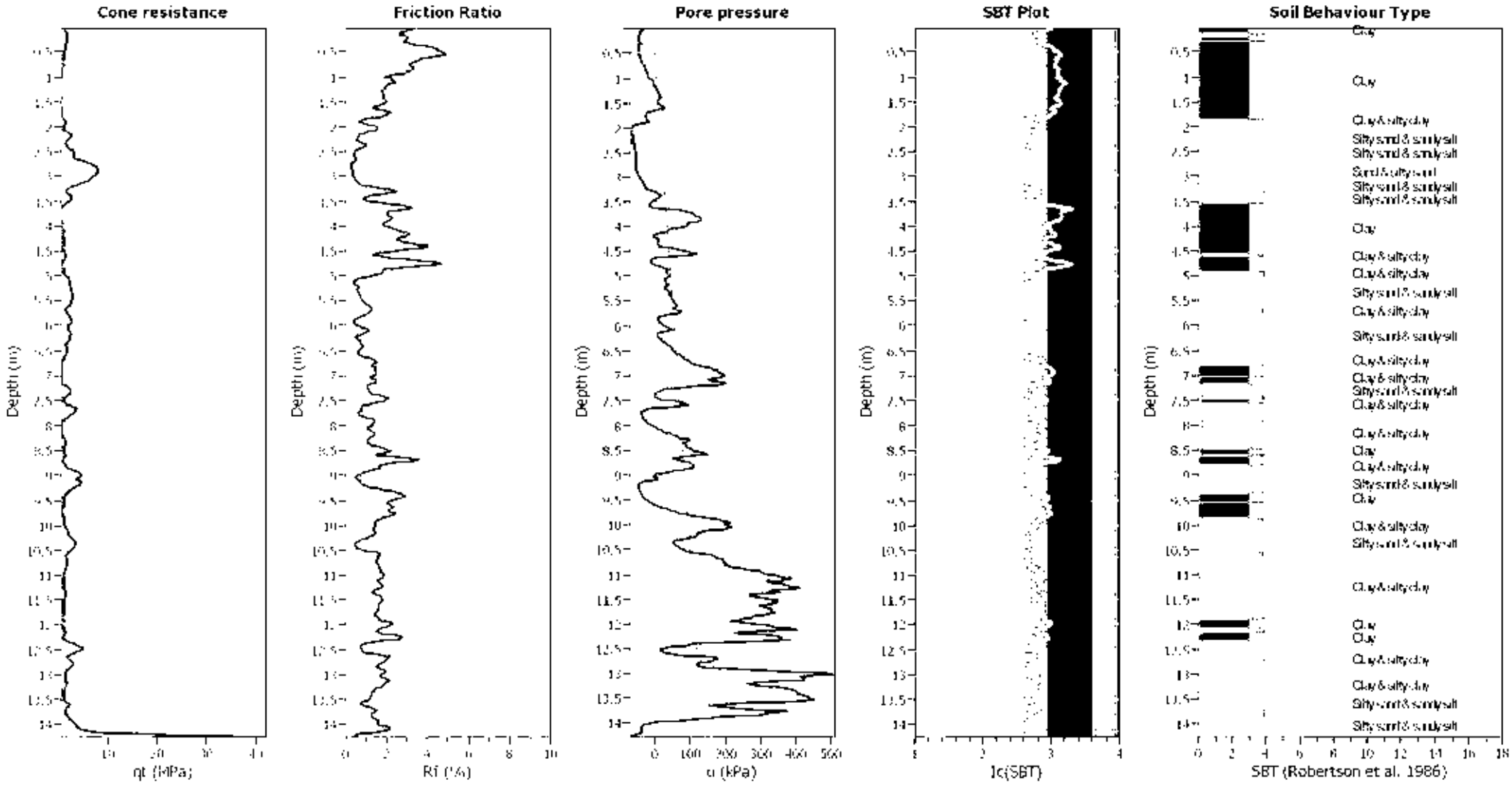
Analysis method	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



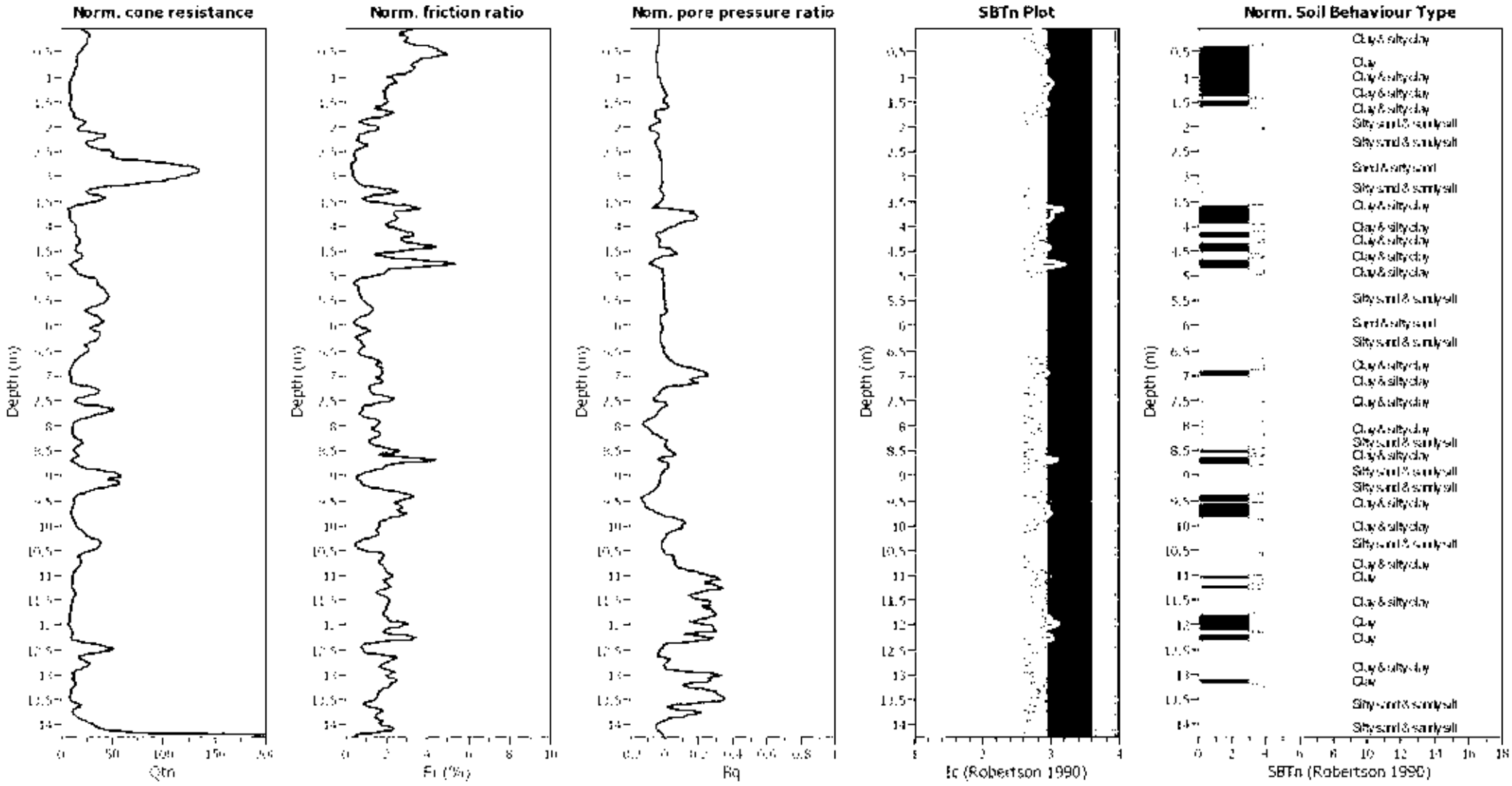
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

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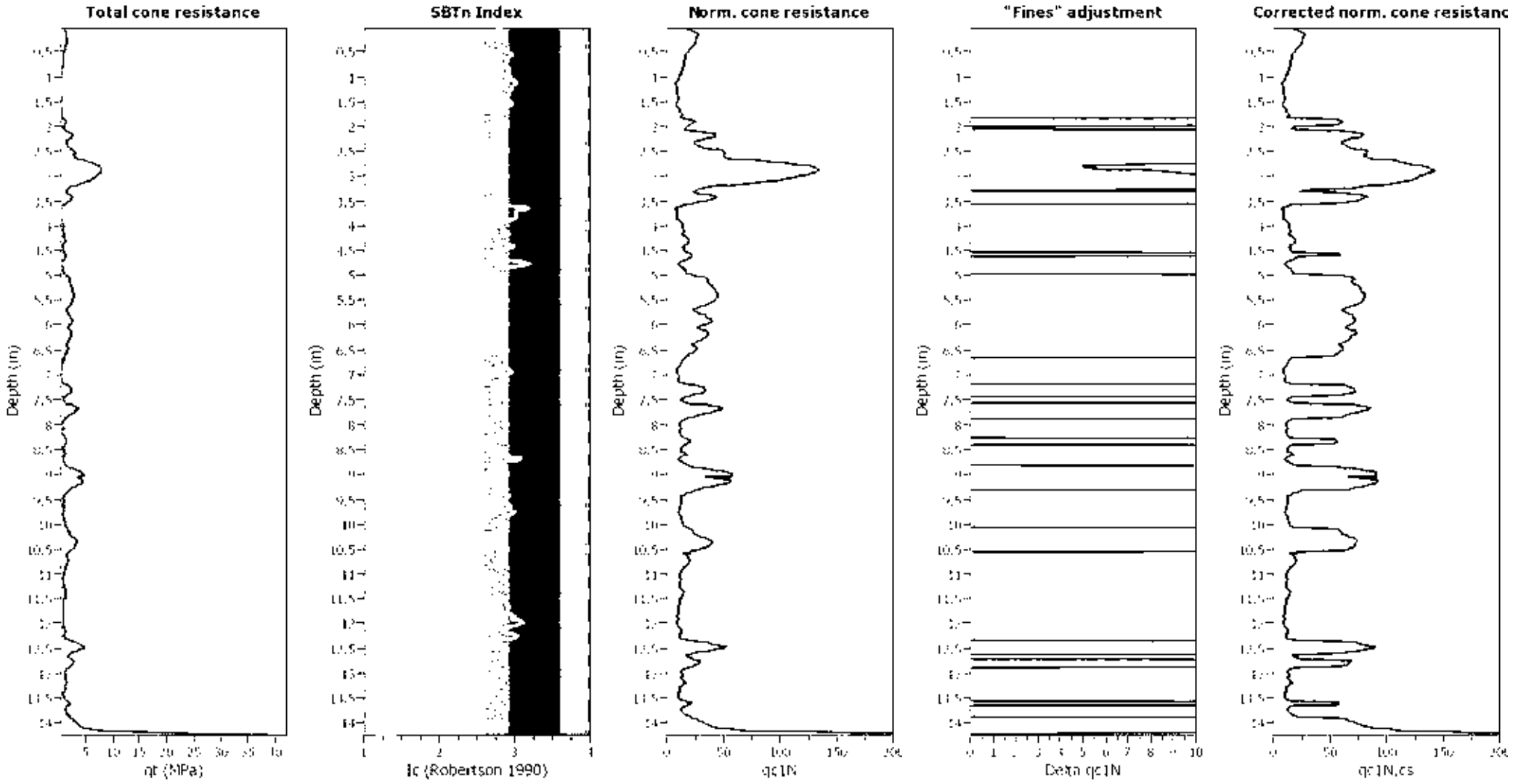
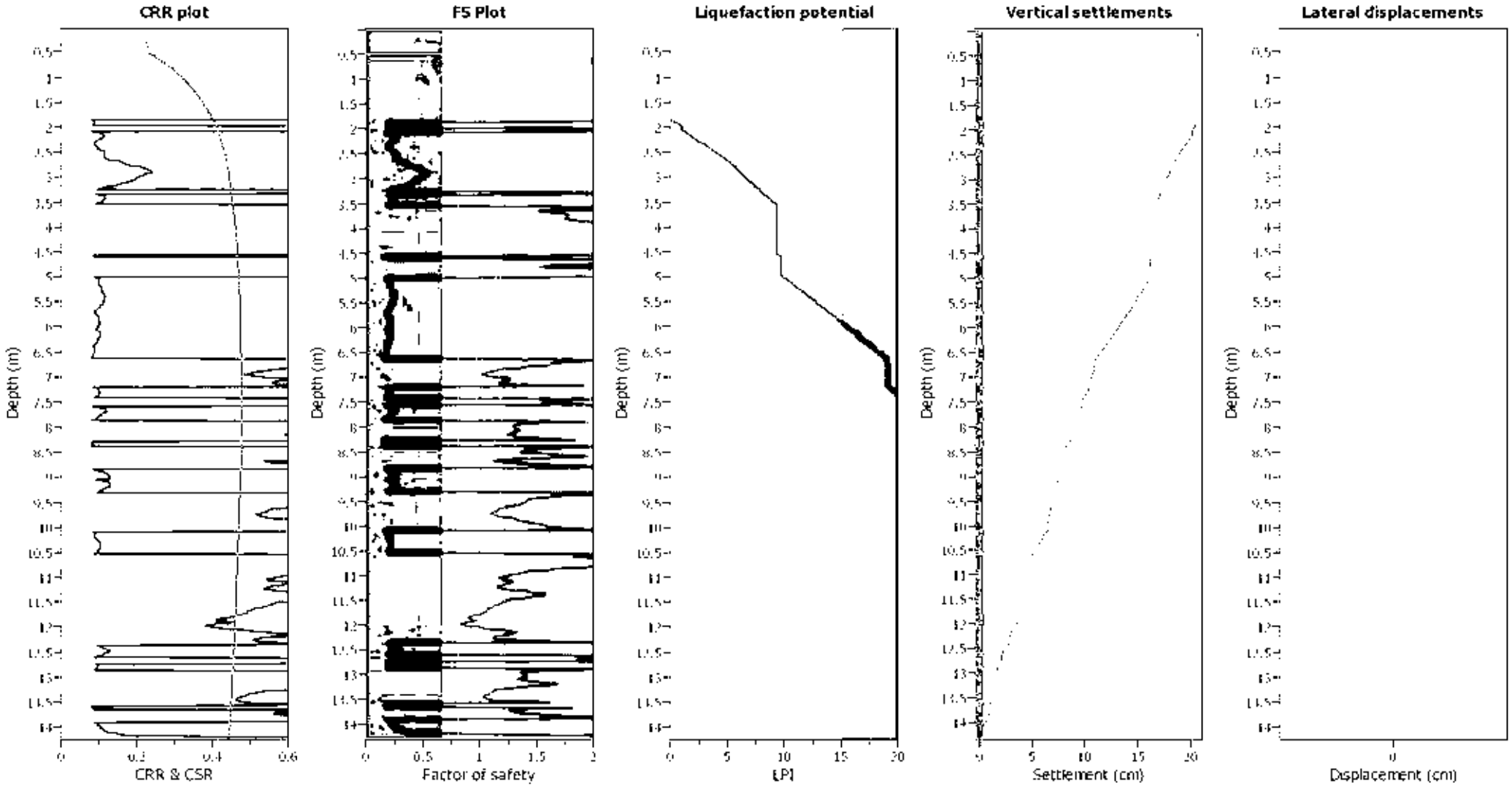
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

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LPI color scheme

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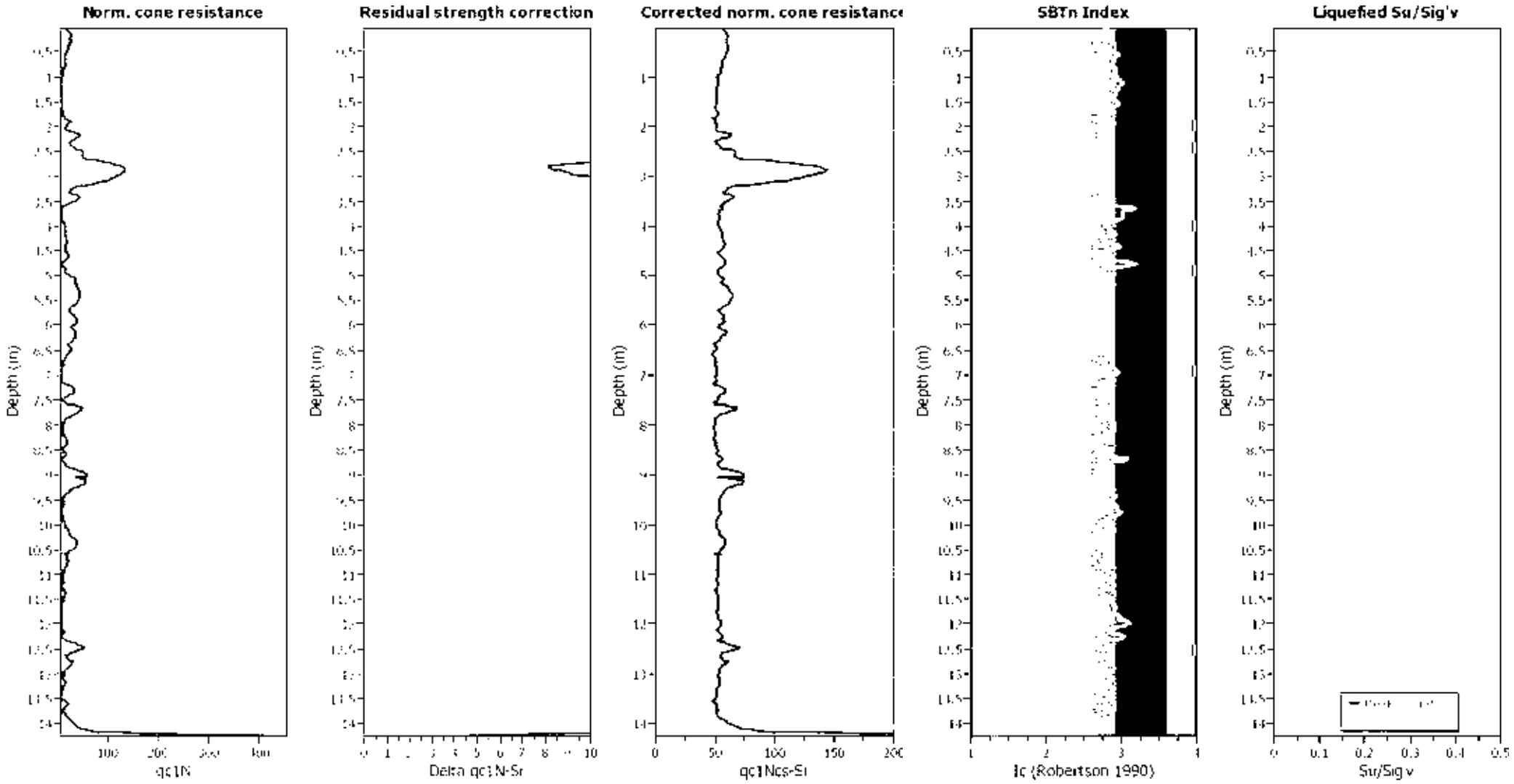
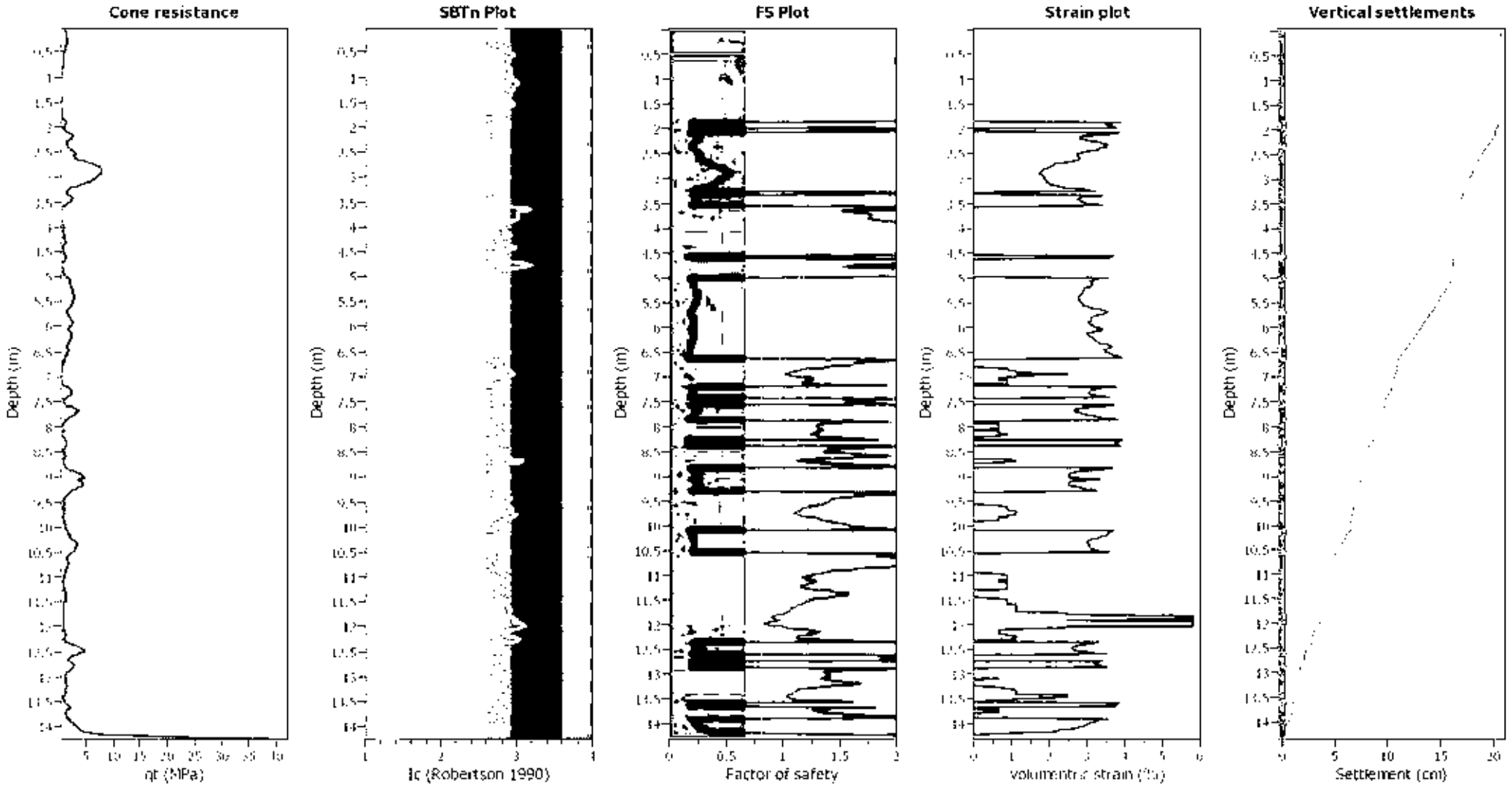
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

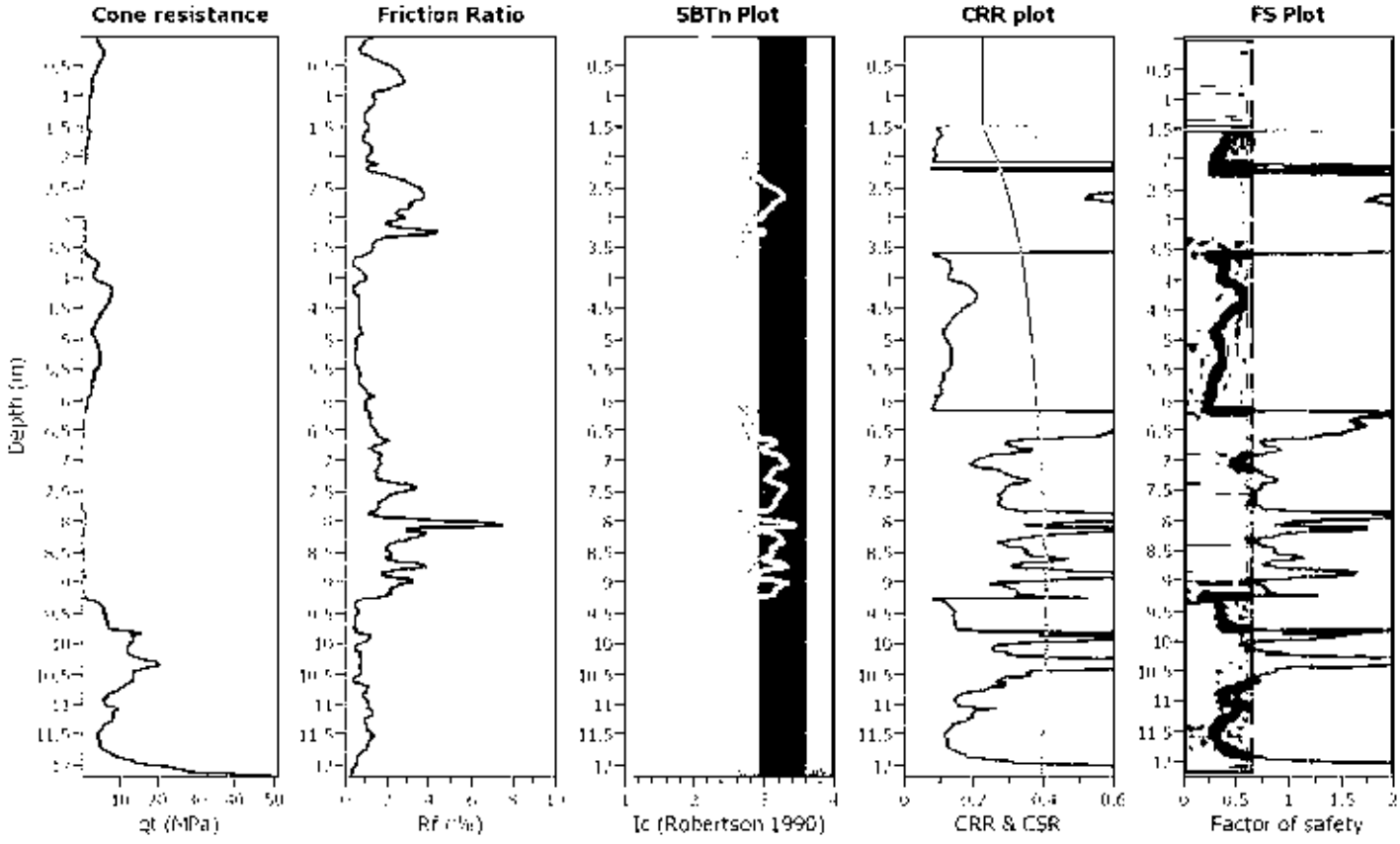
qt:	Total cone resistance (cone resistance q corrected for pore water effects)
Ic:	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

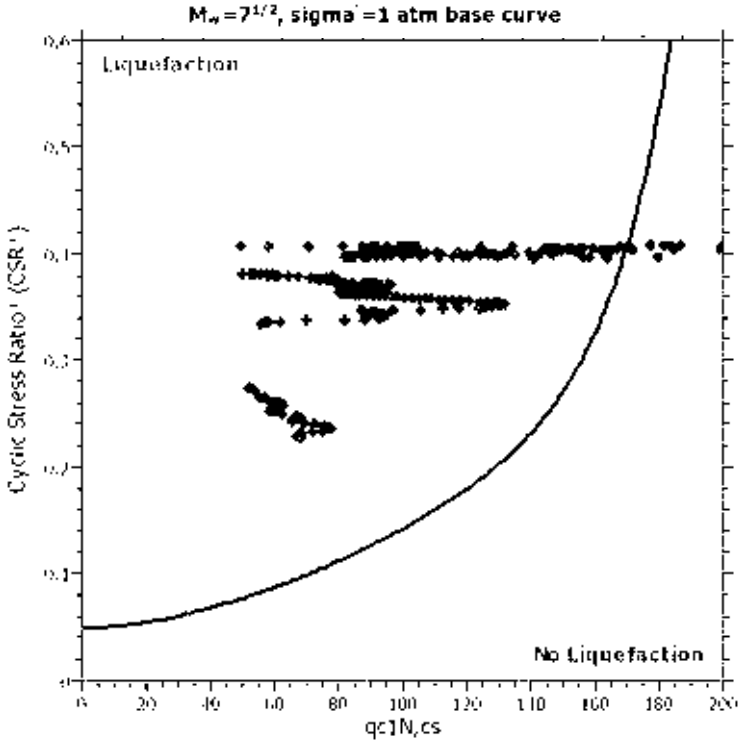
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

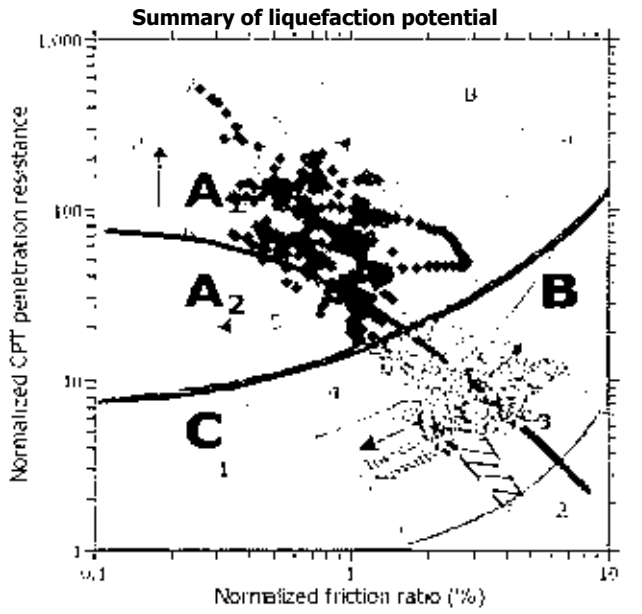
CPT file : CPT49_200CashmereRd

Input parameters and analysis data

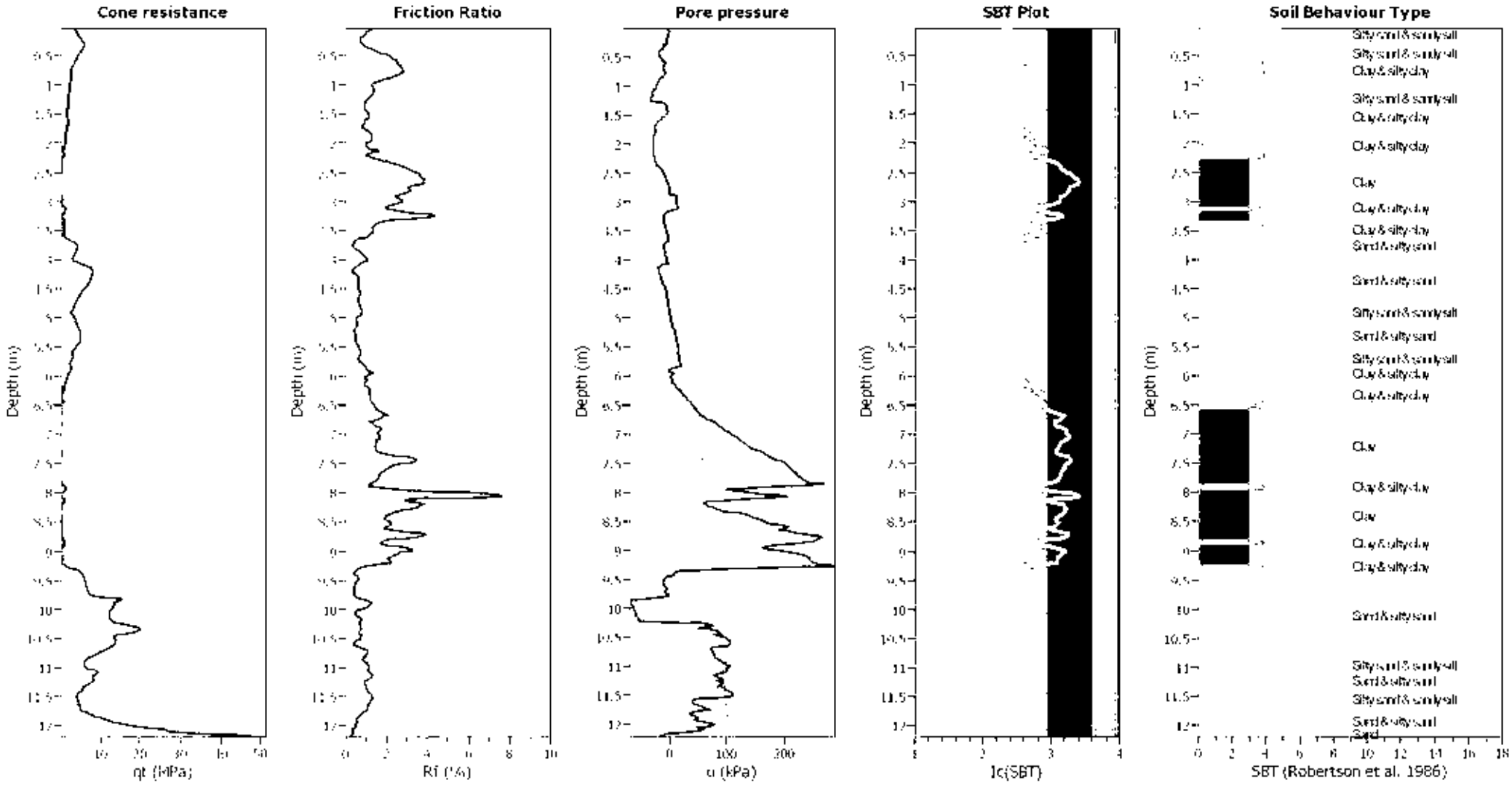
Analysis method	I&B (2008)	G.W.T. (in-situ):	1.50 m	Use fill	No	Clay like behavior applied:	Sand & Clay
Fines correction method	I&B (2008)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



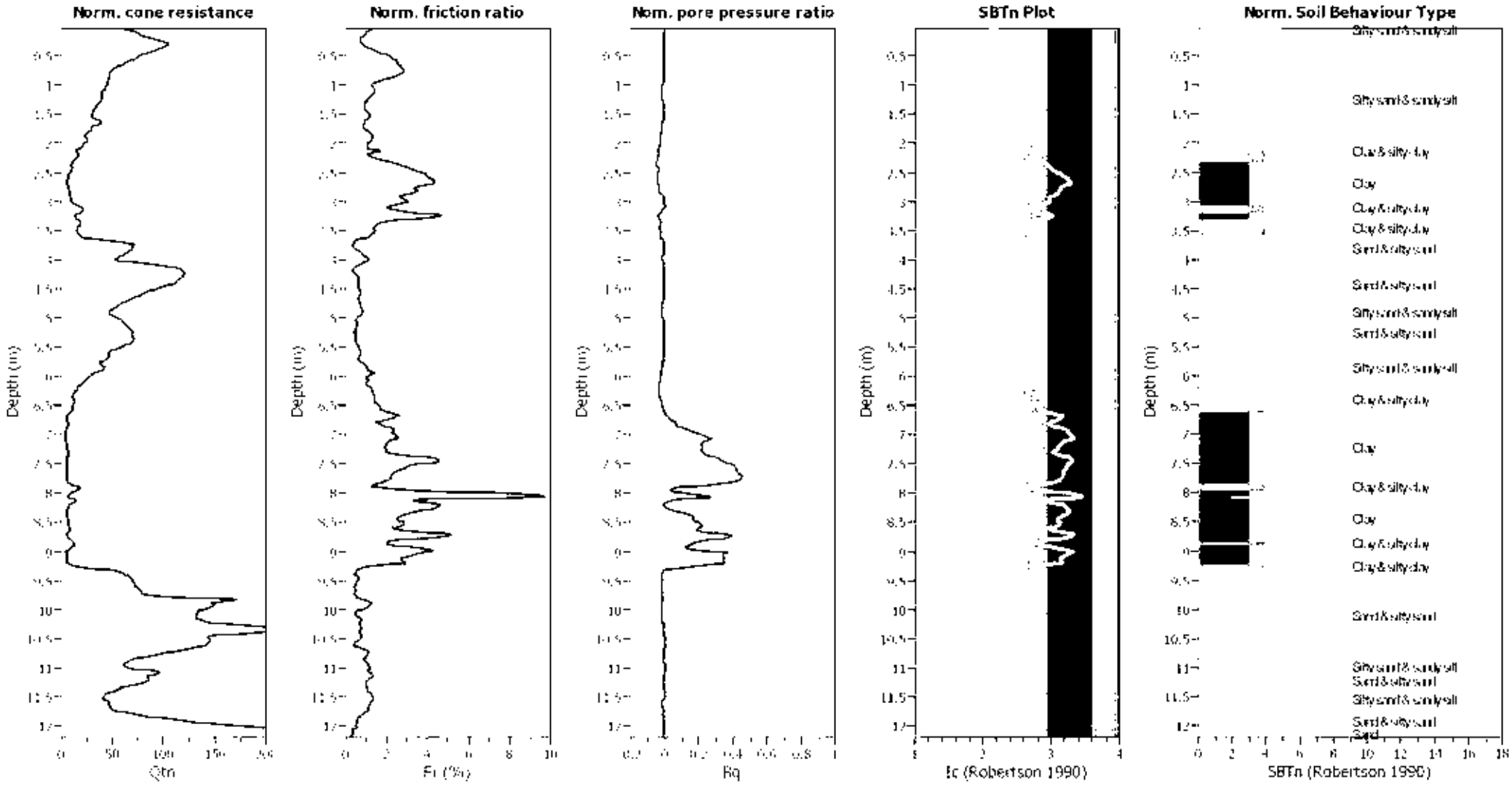
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



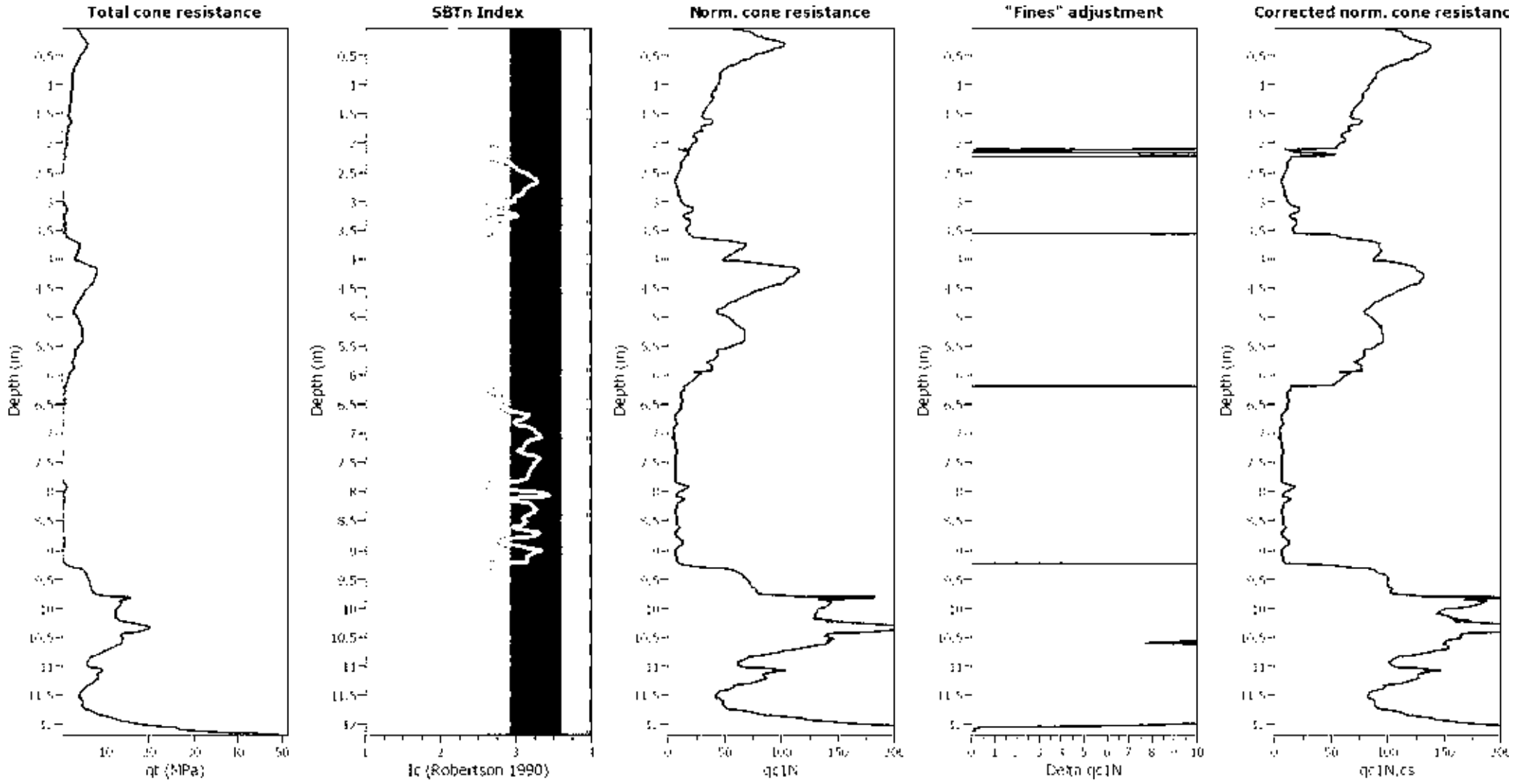
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

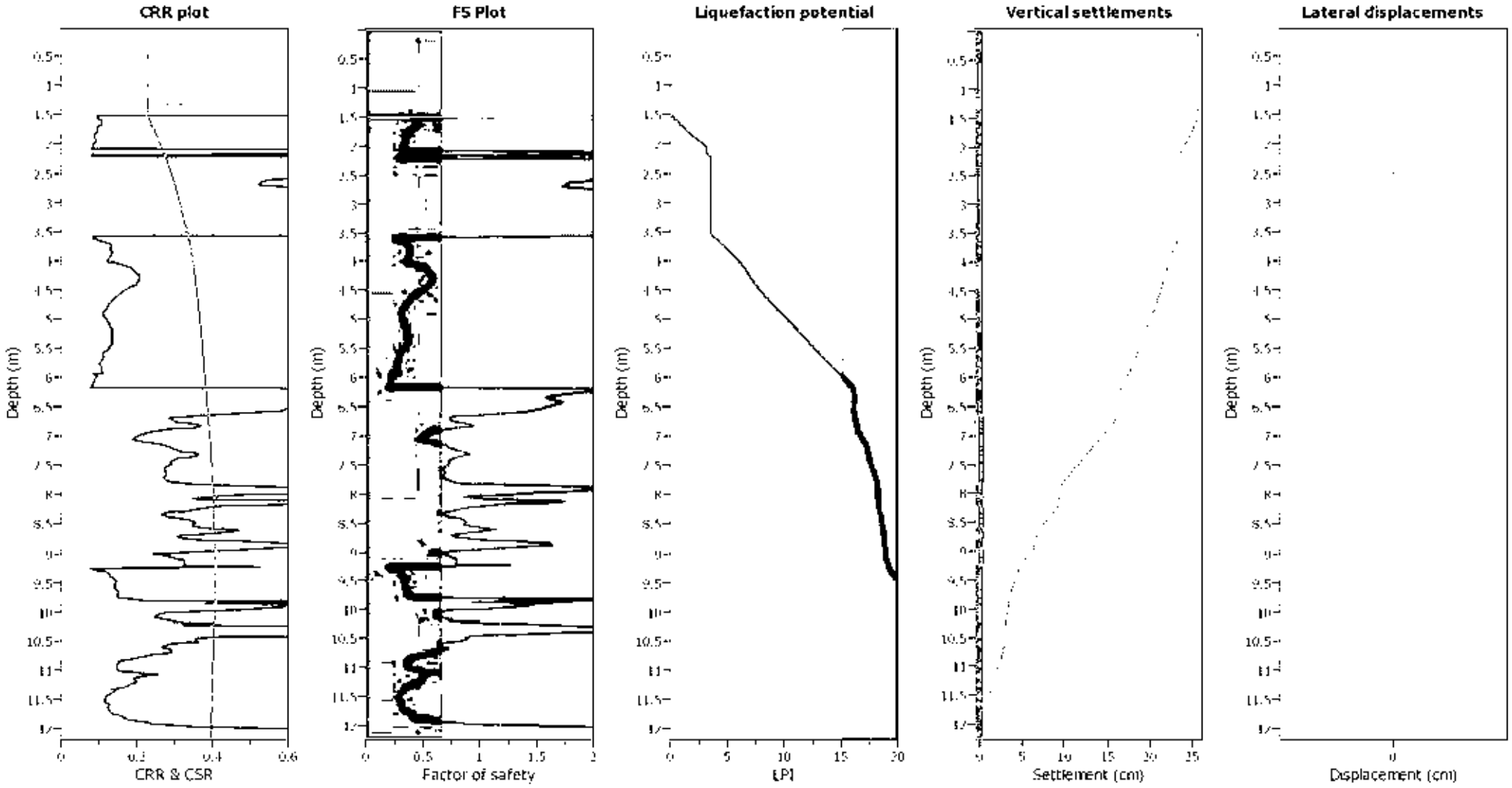
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K$_\sigma$ applied:	Yes
Earthquake magnitude M$_w$:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

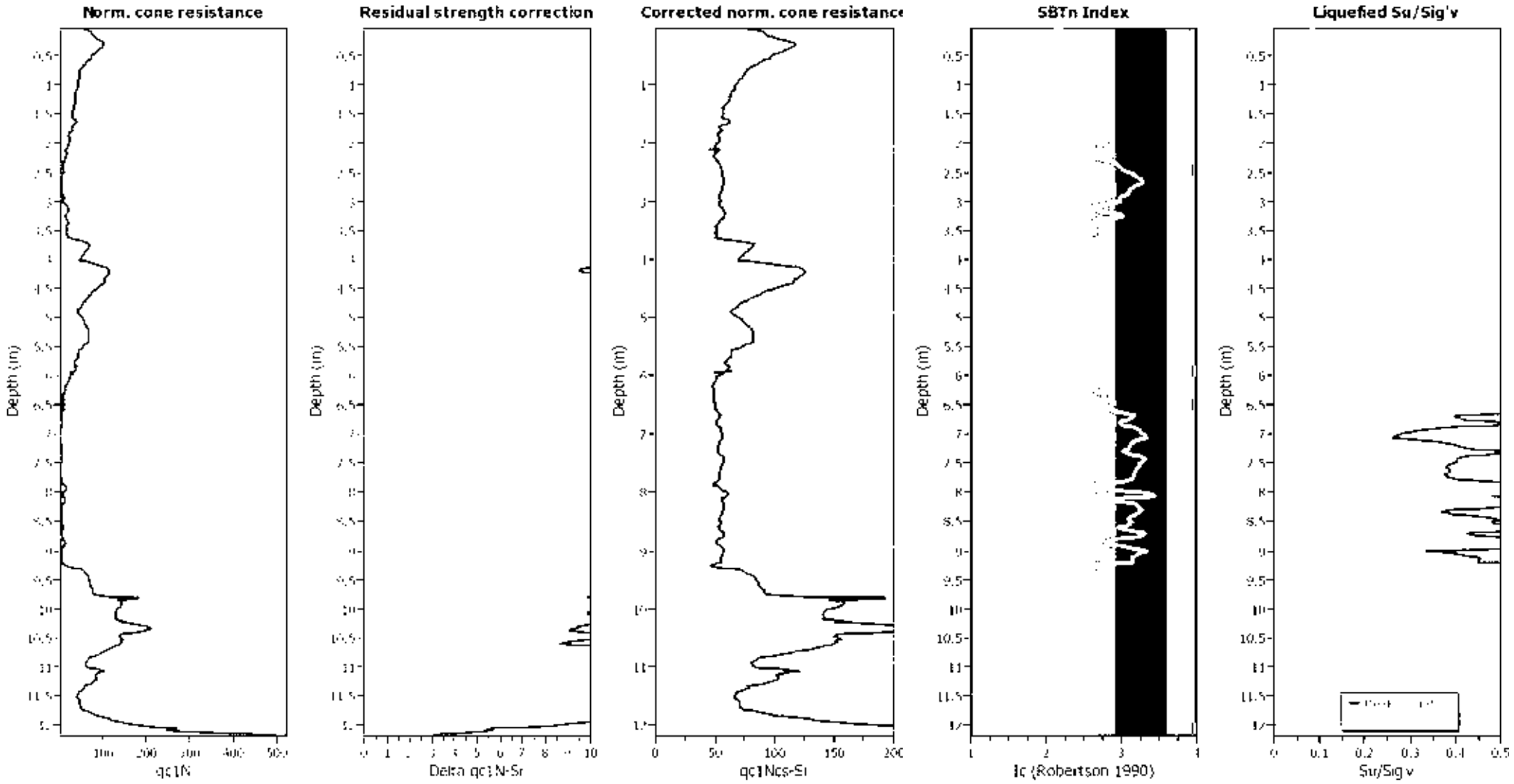
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

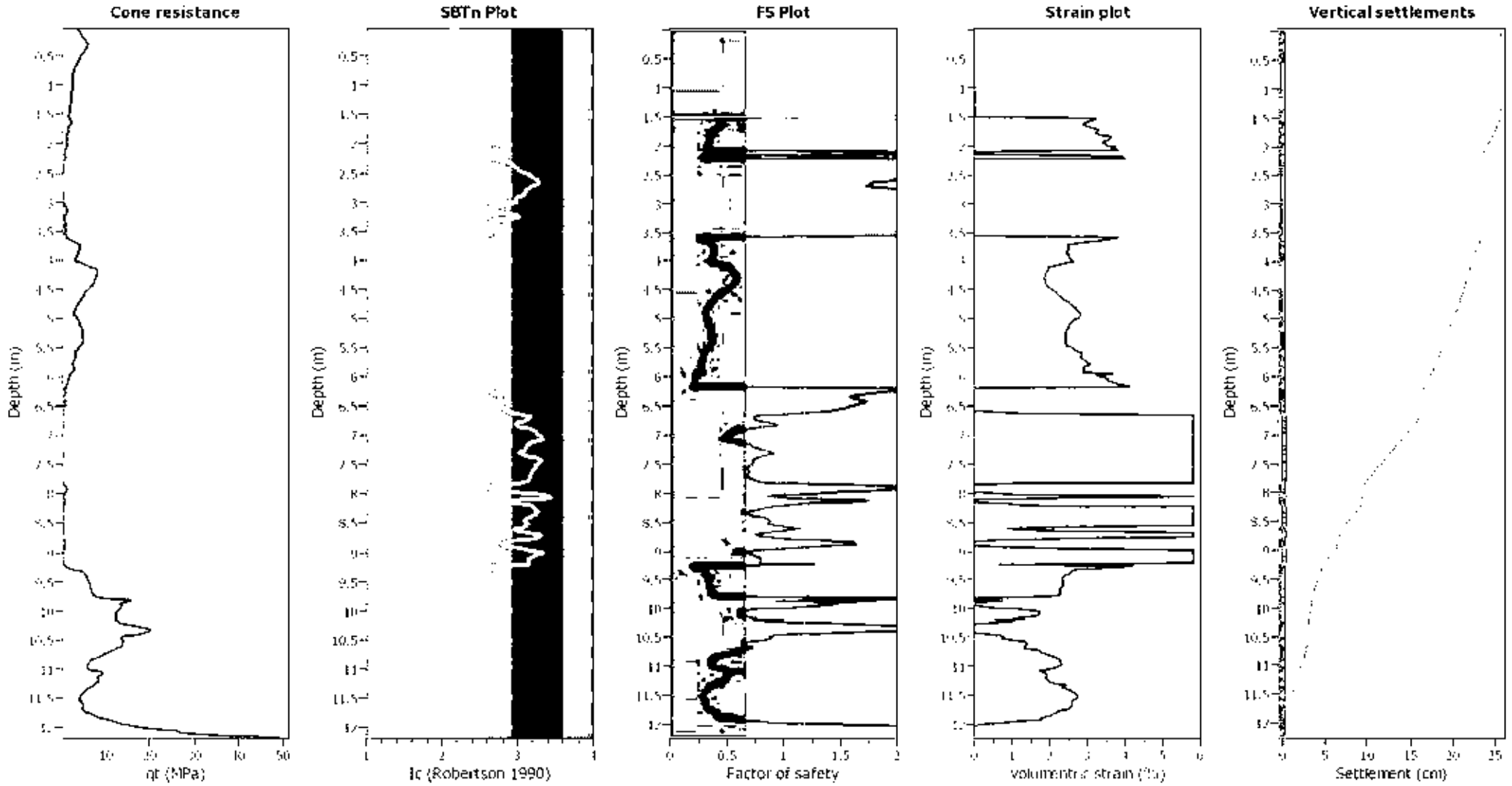
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Liquefaction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth	N/A

Estimation of post-earthquake settlements



Abbreviations

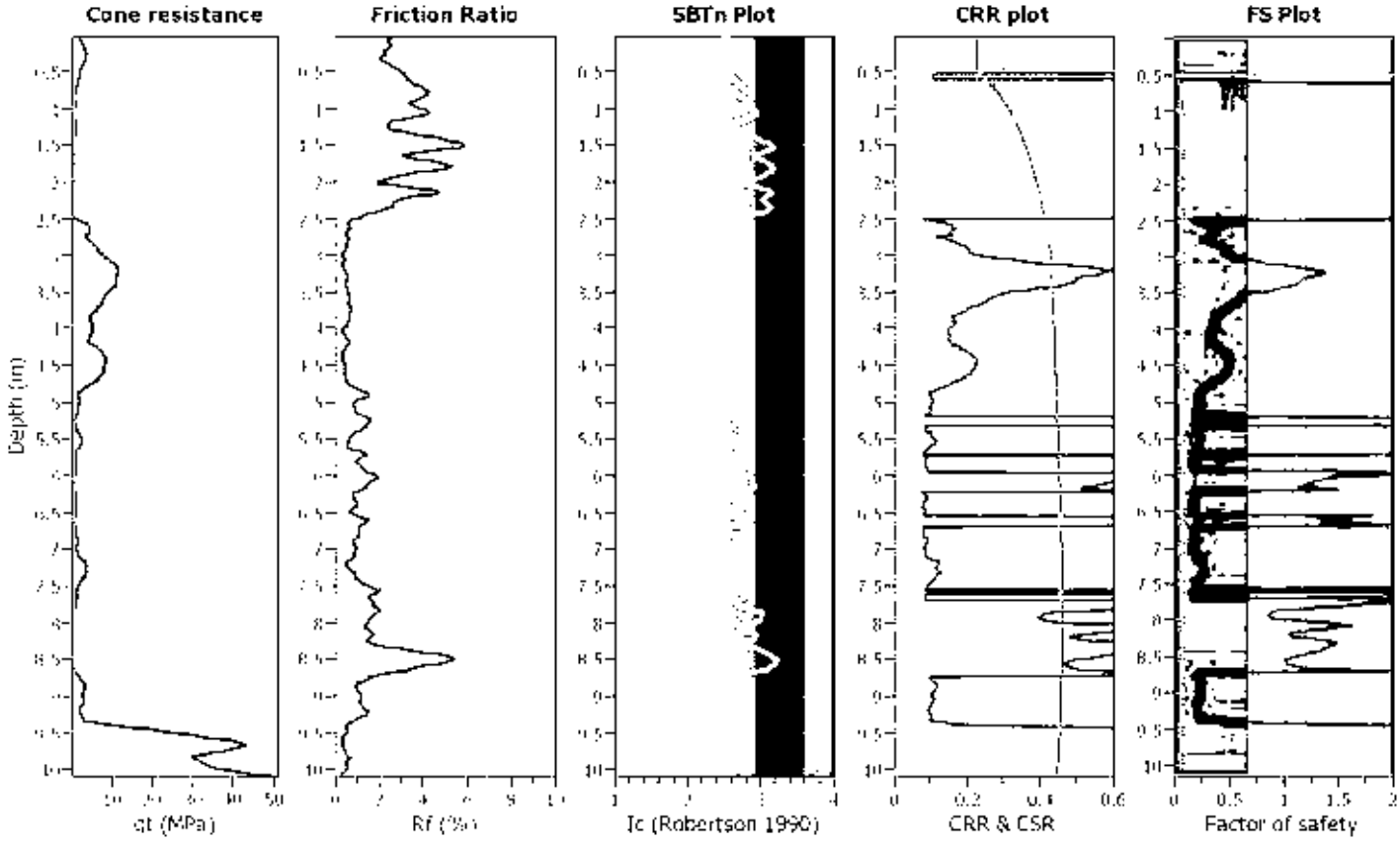
qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumetric strain:	Post liquefaction volumetric strain

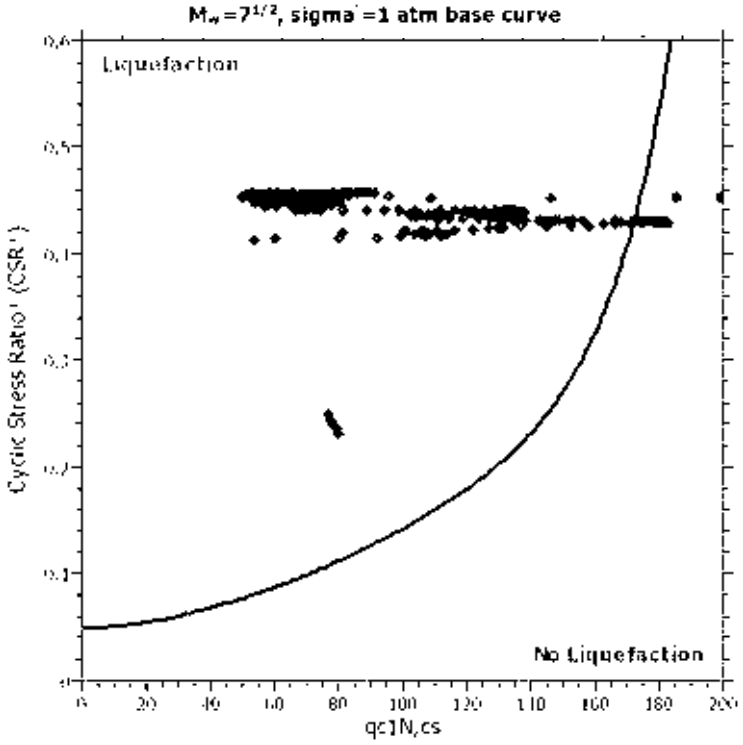
Project title : CCC Halswell ODP Geotechnical Investigation **Location : Halswell, Christchurch**

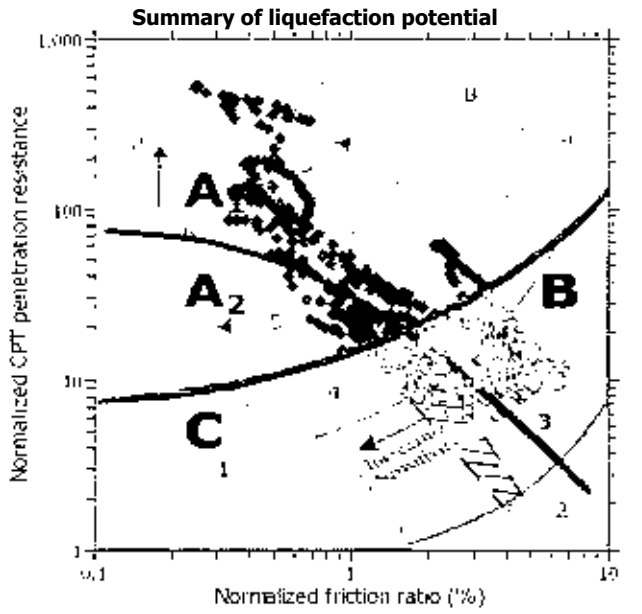
CPT file : CPT50_334SparksRd

Input parameters and analysis data

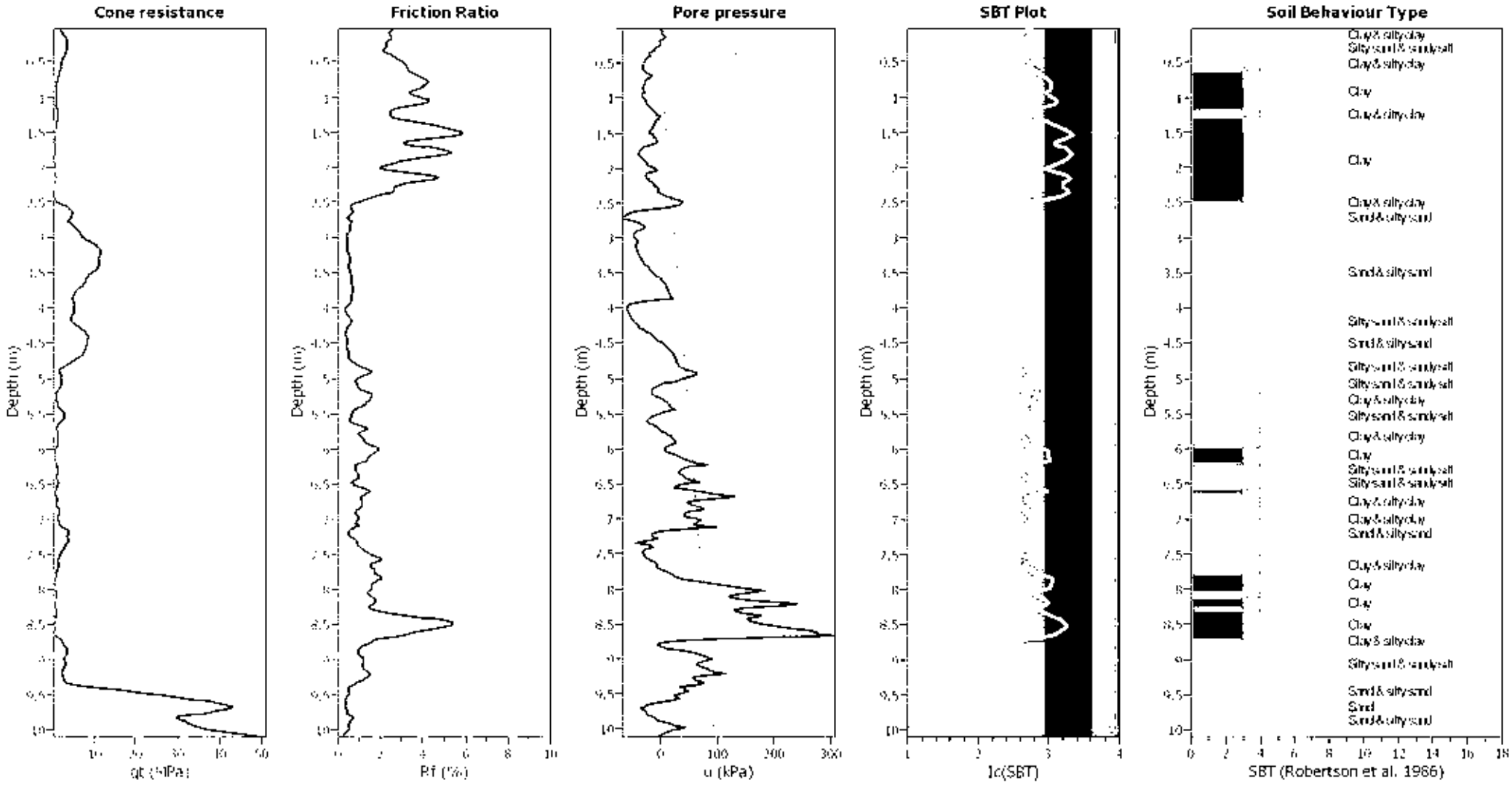
Analysis method:	I&B (2008)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	I&B (2008)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K$_\sigma$ applied:	Yes		







CPT basic interpretation plots



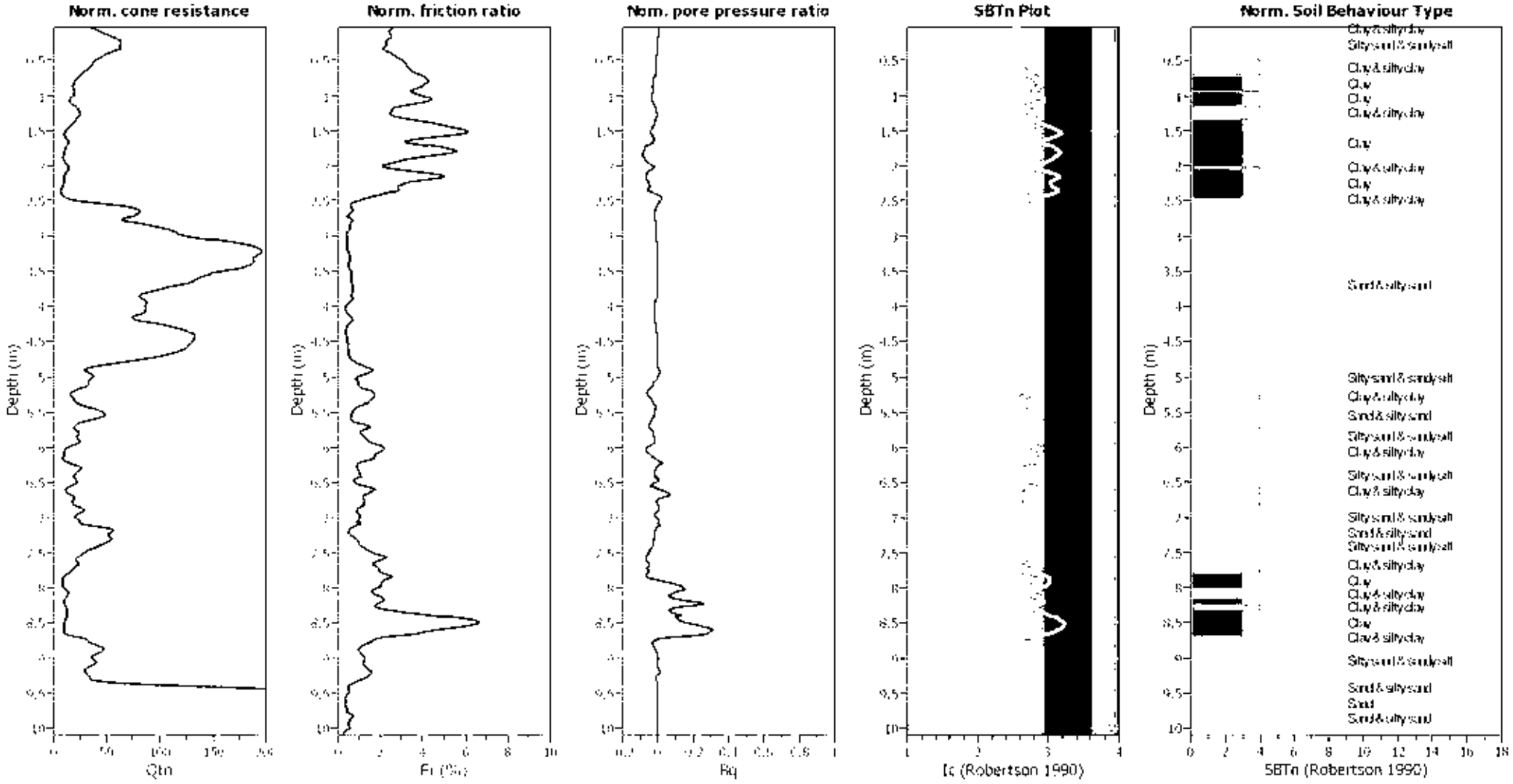
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



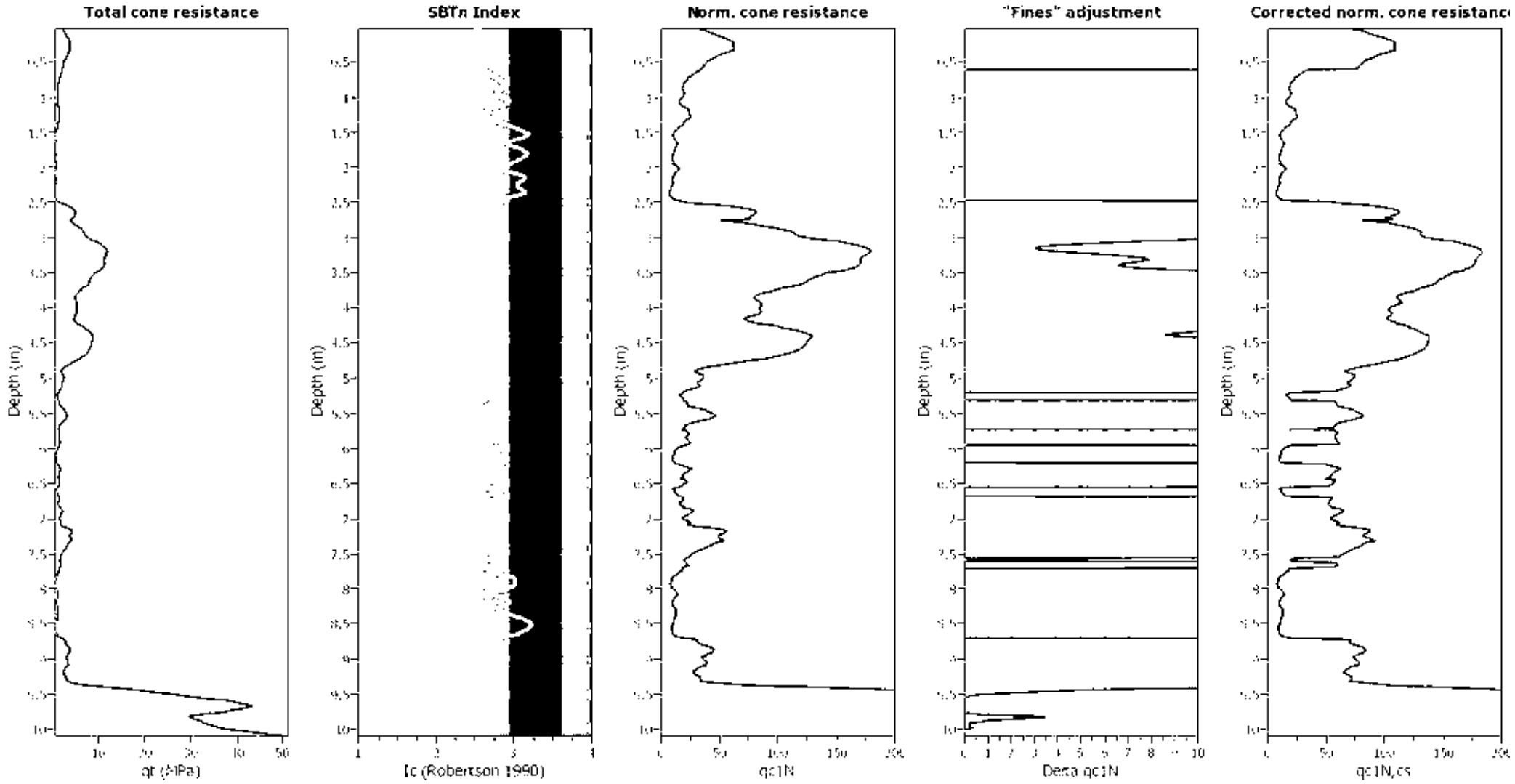
Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

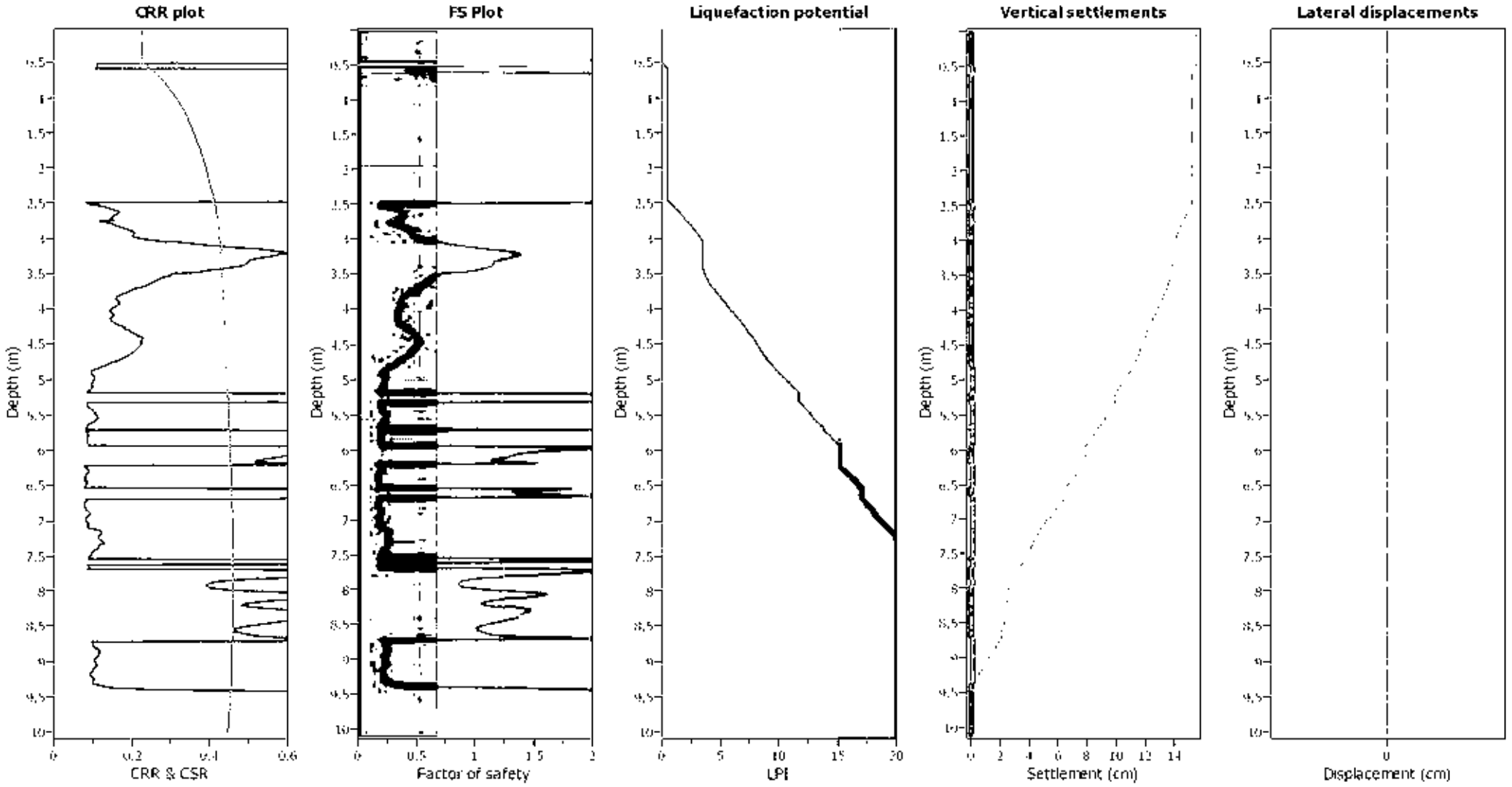
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Liner correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth:	N/A

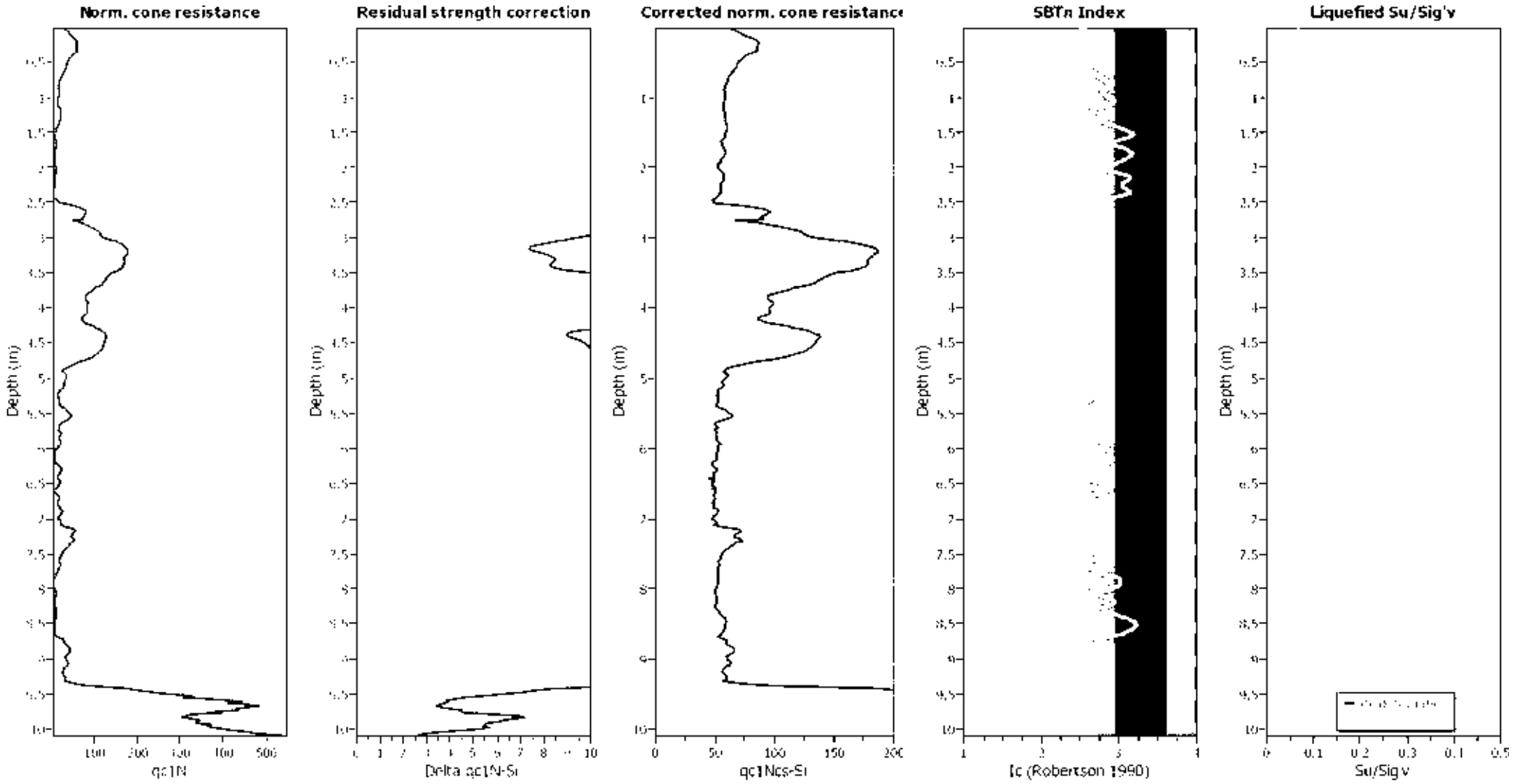
F.S. color scheme

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

LPI color scheme

- ☐ Very high risk
- ☐ High risk
- ☐ Low risk

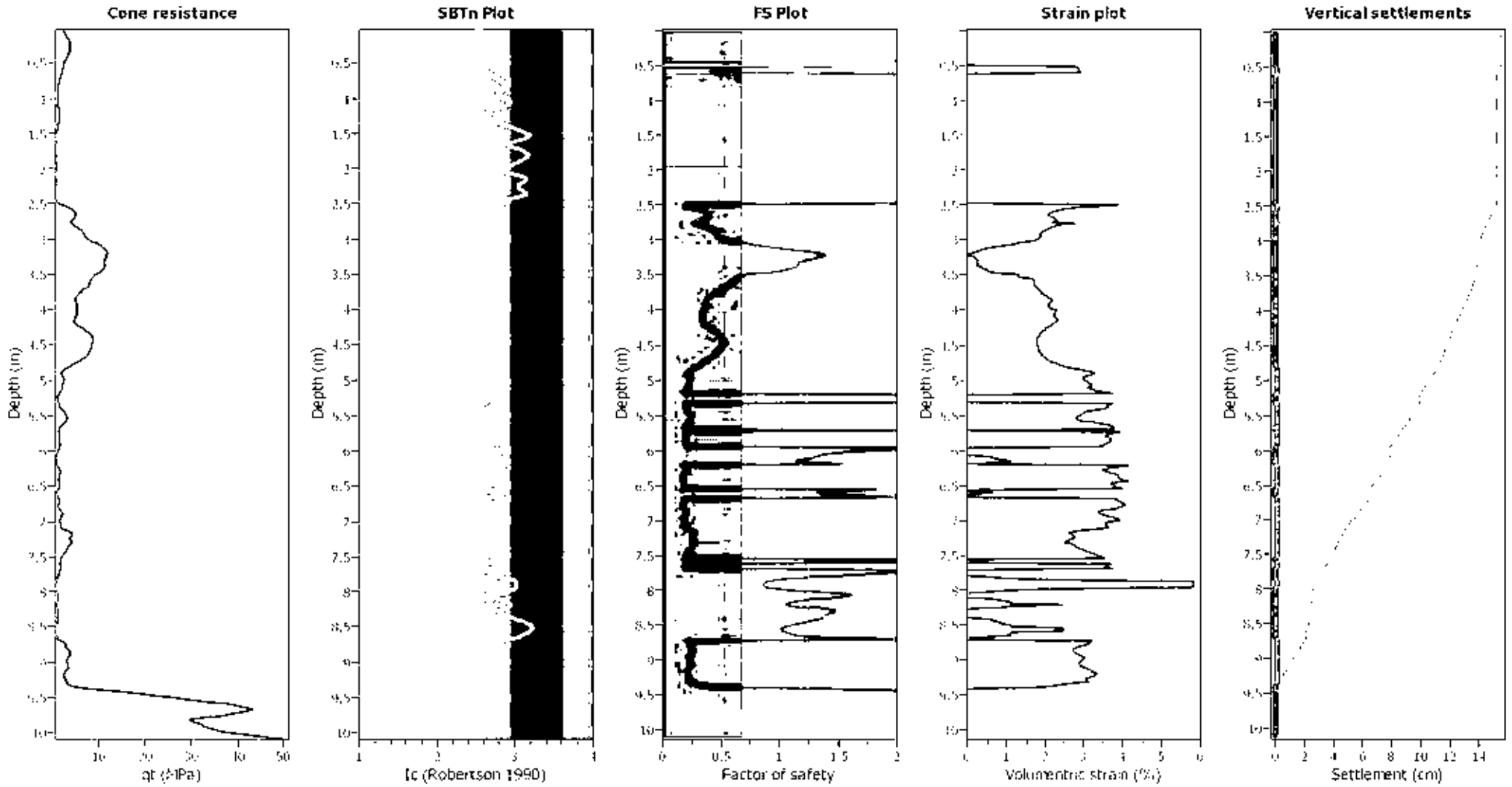
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	I&B (2008)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	I&B (2008)	Average results interval:	3	Transition detect. applied:	Sand & Clay
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behaviour applied:	.
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (erthq.):	0.50 m	Fill height:	N/A	Limit depth	N/A

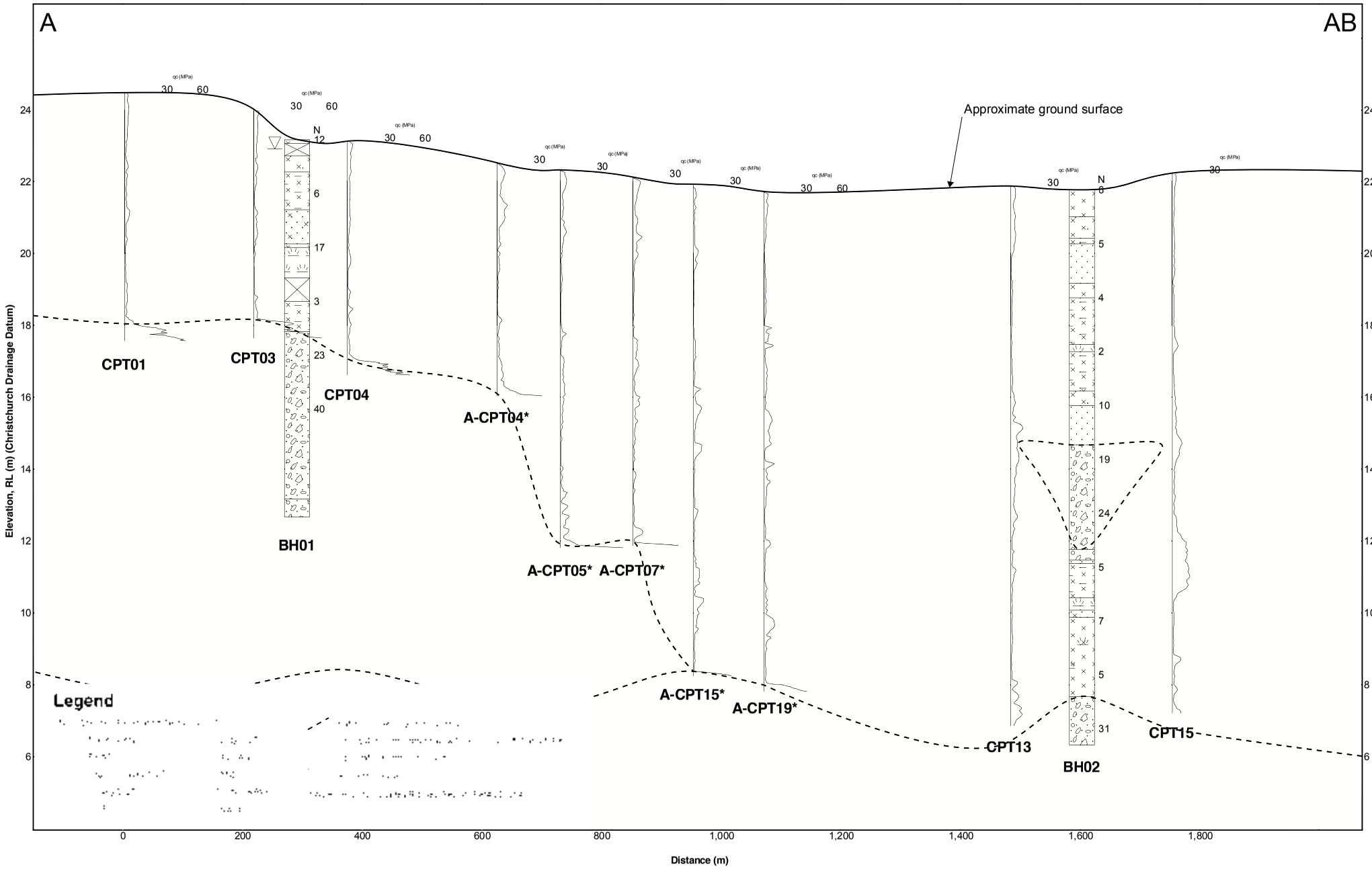
Estimation of post-earthquake settlements



Abbreviations

qt	Total cone resistance (cone resistance q corrected for pore water effects)
Ic	Soil Behaviour Type Index
FS	Calculated Factor of Safety against Liquefaction
Volumentric strain:	Post liquefaction volumentric strain

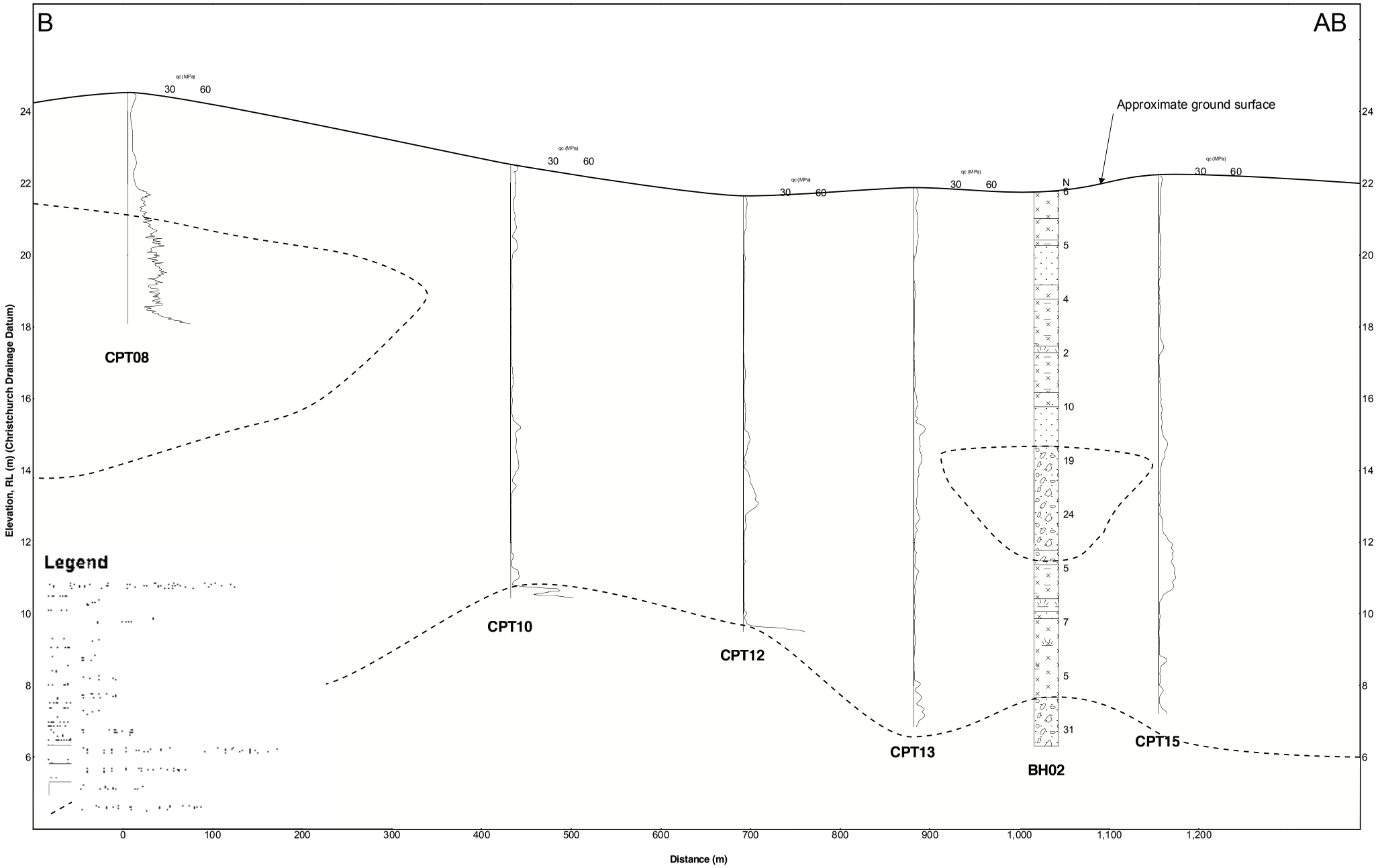
Geological Cross Sections



Horizontal Scale 1:6000
Vertical Scale 1:100

R15 NW-SE Geological Cross-Section

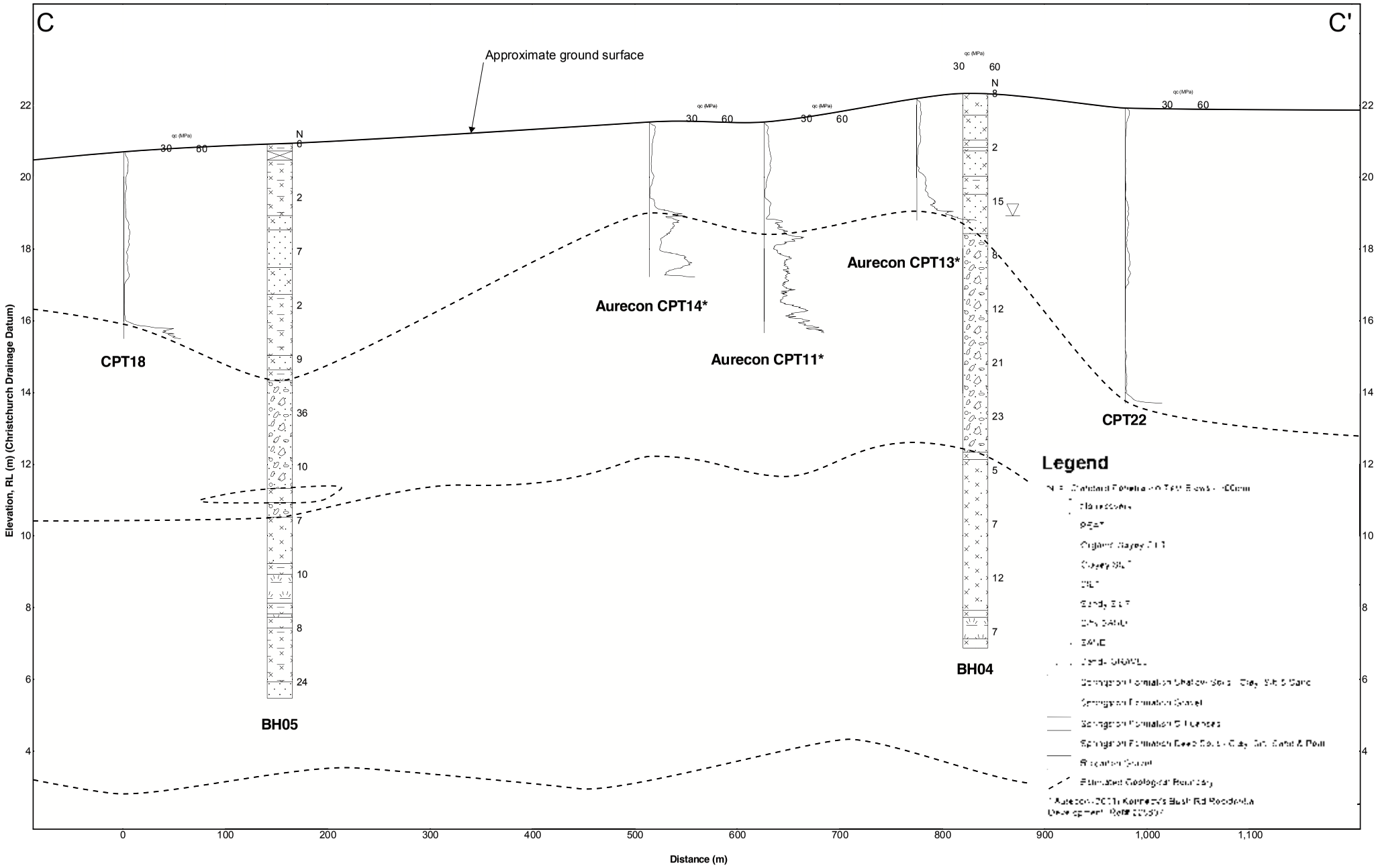
SECTION A-AB



Horizontal Scale 1:5000
Vertical Scale 1:100

R15 N-S Geological Cross-Section

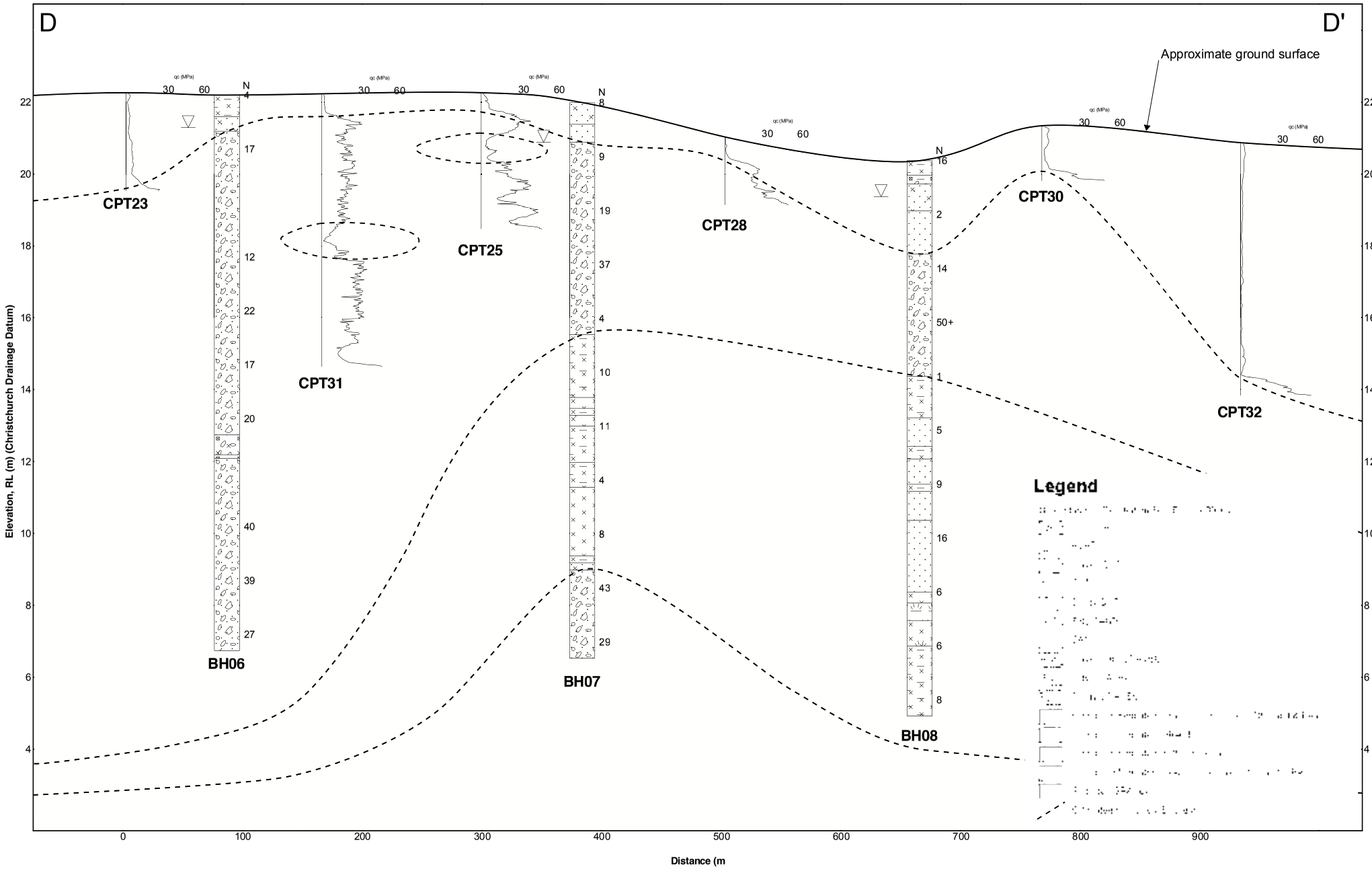
SECTION B-AB



Horizontal Scale 1:3500
Vertical Scale 1:100

R16 W-E Geological Cross-Section

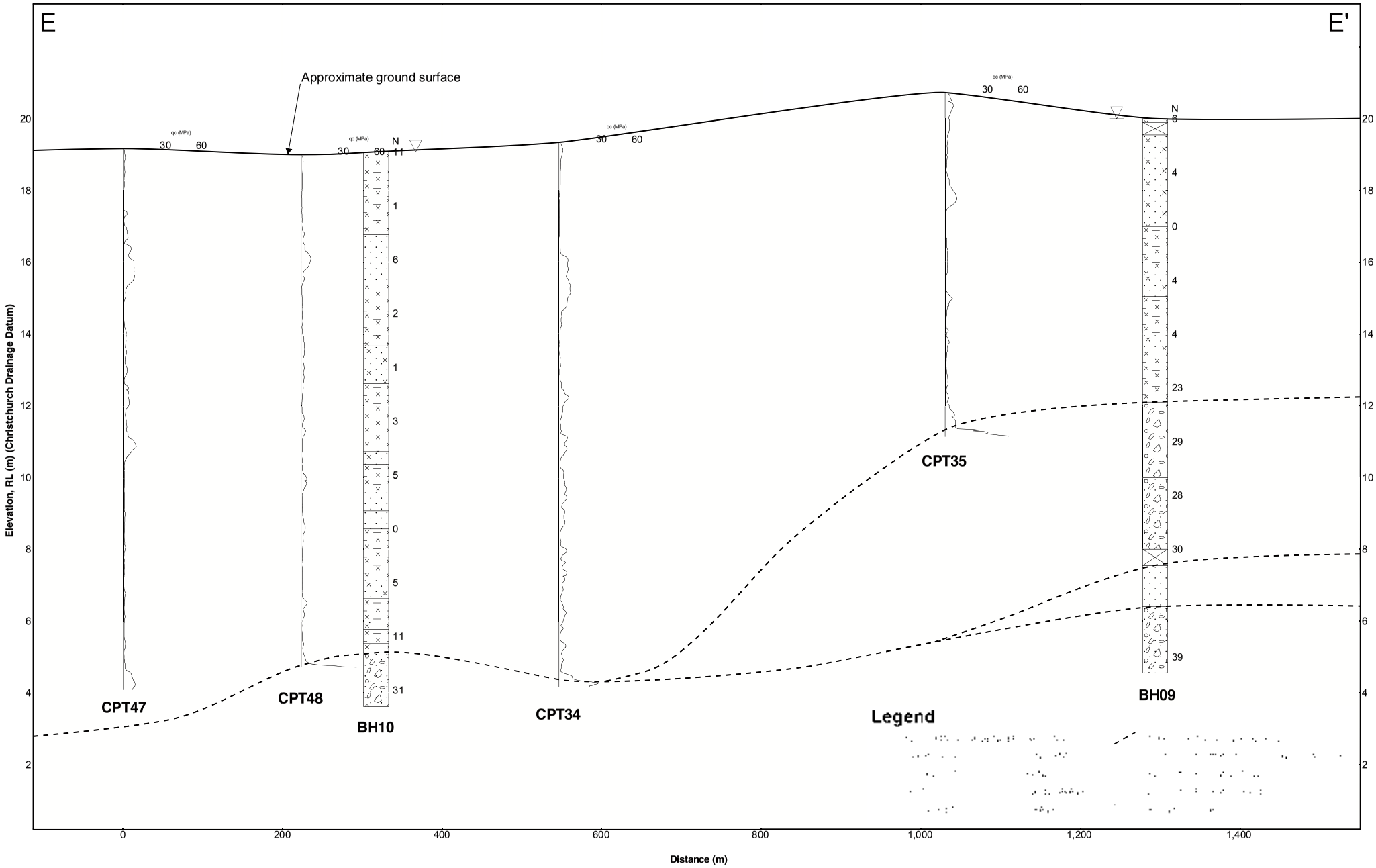
SECTION C-C'



Horizontal Scale 1:3000
Vertical Scale 1:100

R17 N-S Geological Cross-Section

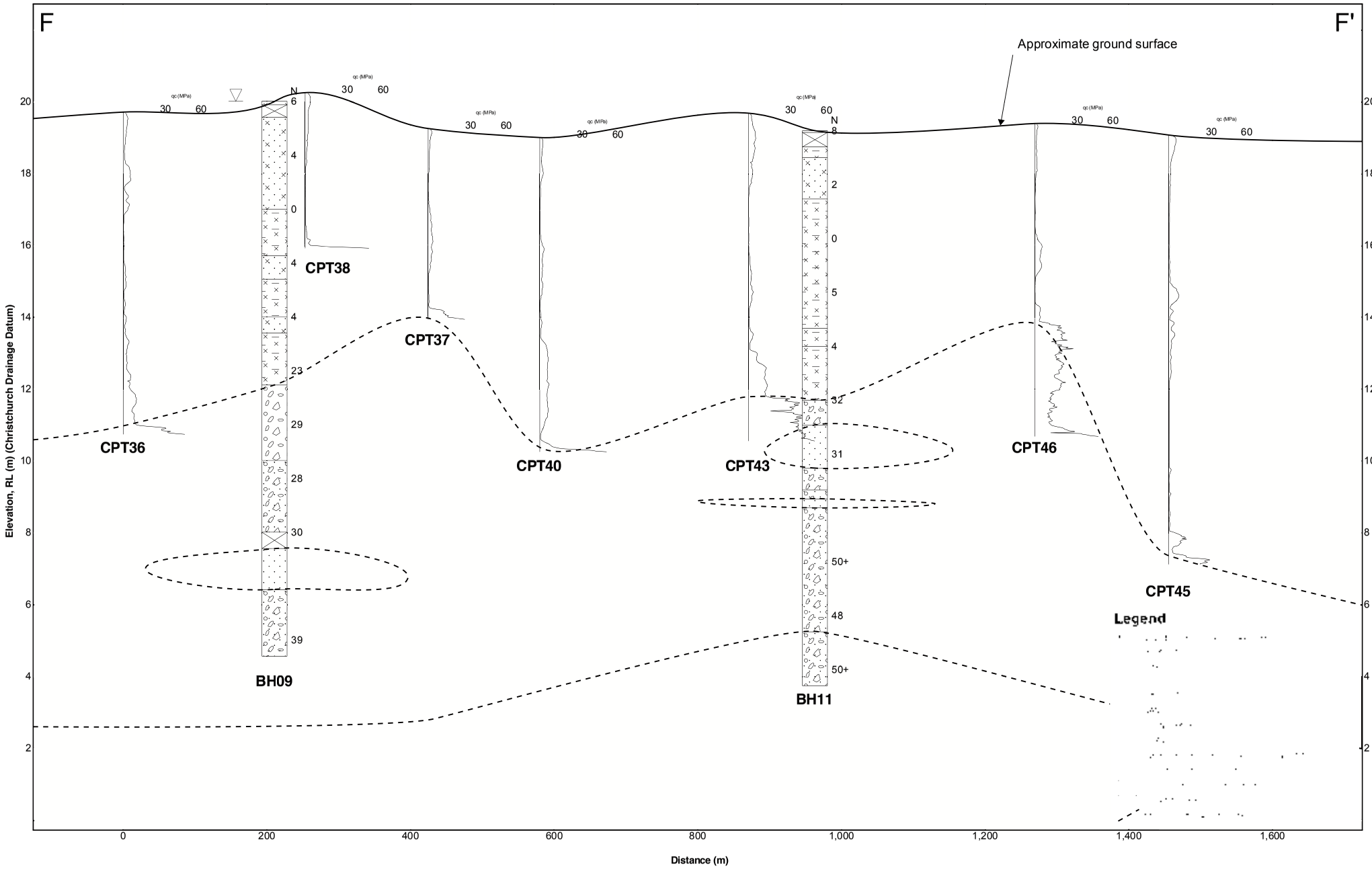
SECTION D-D'



Horizontal Scale 1:4500
Vertical Scale 1:100

R18 N-S Geological Cross-Section

SECTION E-E'



Horizontal Scale 1:5000
Vertical Scale 1:100

R18 SW-NE Geological Cross-Section

SECTION F-F'

Geotechnical Summary Sheets

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**A10 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH12	15.45
CPT49	12.2

Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	8.9 - 12	Very soft - stiff / very loose - loose
Sandy GRAVEL & GRAVEL	8.9 - 12	>3	Medium dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT49	2	50	260	80

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**B7 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
No ground investigations conducted	

Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	>15	Unknown

** The soil profile is derived from one CPT (CPT47) located outside of Grid B7.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
No ground investigations conducted				

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**B9 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
No ground investigations conducted	

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, organic clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	8.9 - 12	Very soft-stiff / loose
Sandy GRAVEL & GRAVEL	8.9 - 12	>3	Medium dense

** The soil profile is derived from one borehole (BH12) located outside of Grid B9 & CGD data.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
No ground investigations conducted				

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**C1 (R15)**

Technical Category	TC3 & TC2/3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH1	10.5
CPT01	6.88
CPT02	5.44

Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY clayey SILT & sandy SILT; silty SAND & SAND	0	5 - 6.5	Very soft-stiff / loose
Sandy GRAVEL	5 - 6.5	>4	Medium dense - dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT01	2	50	120	100
CPT02	2	50	80	50

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**C2 (R15)**

Technical Category (Description)	TC3 & TC2/3
Groundwater Depth (m) (Source)	1.0 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT03	6.34
CPT04	6.48

Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Cohesion/Density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	6 - 8	Very soft - firm / very loose - loose
Sandy GRAVEL & GRAVEL	6 - 8	>7	Medium dense - very dense

** The soil profile is derived from a combination of Beca investigations, Beca interpretations of Aurecon (2012) investigations & CGD data.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT03	2	50	90	60
CPT04	2	50	90	70

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**C6 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
BH10	15.45
CPT34	15.14
CPT47	15.06
CPT48	14.26

Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT; silty SAND & SAND with occassional lenses of PEAT	0	14 - 15+	Very soft - stiff / loose
Sandy GRAVEL	14 - 15+	>1	Dense

** The gravel layer first occurs between 14-15m across most of the grid. In the northeast of the grid (CPT47) there is no indication of the gravel layer before the CPT was terminated at 15m.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT34	2	50	240	180
CPT47	2	50	330	130
CPT48	2	50	210	160

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**C7 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT50	10.1

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	8.5 - 15+	Very soft - firm / loose
Sandy GRAVEL	8.5 - 15+	Unknown	Medium dense - dense

** Soil profile is derived from CPT46 & CPT47 located outside Grid C7 combined with CPT50. The gravel layer depth is shallowest (approximately 9.0 m bgl) at the eastern end of the grid and was not encountered in the northwest corner of the grid.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT50	2	50	160	110

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**C8 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.0 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT45	11.92
CPT46	8.68

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	8.5 - 12	Very soft - firm / loose
Sandy GRAVEL	8.5 - 12	Unknown	Medium dense - dense

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT45	2	50	320	170
CPT46	2	50	130	50

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D1 (R15)**

Technical Category (Description)	TC3 & TC2/3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT05	6.22
CPT06	4.98

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT, silty SAND & SAND	0	5 - 14	Unknown
Sandy GRAVEL	5 - 14	Unknown	Medium dense - very dense

** The soil profile is derived from Beca investigations & Beca interpretations of Soil & Rock (2013) investigations.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT05	2	50	100	40
CPT06	2	50	60	50

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D2 (R15)**

Technical Category (Description)	TC3 & TC2/3
Groundwater Depth (m) (Source)	0.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT07	11.18

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	6.5 - 14.5	Soft - firm / very loose - medium dense
Sandy GRAVEL & GRAVEL	6.5 - 14.5	>1	Medium dense - very dense

** The soil profile is derived from a combination of Beca investigations & Beca interpretations of Aurecon (2012) investigations. Gravel layer was observed at shallower depths in the north of the grid.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT07	2	50	180	110

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D3 (R15)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT08	6.42
CPT10	12.06

North Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT & silty SAND	0	2 - 4	Very soft - stiff / loose
Sandy GRAVEL	2 - 4	>2	Medium dense - dense

South & East Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occassional lenses of PEAT	0	11 - 13.5	Very soft - stiff / loose
Sandy GRAVEL	11 - 13.5	Unknown	Medium dense - very dense

** The soil profile is derived from a combination of Beca investigations, Beca interpretations of Aurecon (2012) investigations & CGD data.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT08	2	50	20	0
CPT10	2	50	210	80

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D5 (R17)**

Technical Category (Description)	TC2
Groundwater Depth (m) (Source)	1.5 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH6	15.45
CPT23	2.7
CPT24	4.34
CPT31	7.56

Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT, silty SAND & SAND	0	1 - 3	Soft - firm / loose
Sandy GRAVEL & silty GRAVEL with occasional lenses of SAND	1 - 3	>14*	Medium dense - dense

** Thickness of gravel determined from borehole. The maximum refusal of CPTs was 7.56m. Gravel should not be assumed to occur to 15m across the entire grid.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT23	2	50	20	0
CPT24	2	50	0	0
CPT31	2	50	10	5

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D6 (R17 & R18)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.0 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT26	3.38
CPT35	9.56

West Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT & silty SAND	0	1.5	Very soft - firm / loose
Sandy GRAVEL	1.5	>2	Medium dense - dense

East Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	9.5 - 15	Very soft - firm / loose
Sandy GRAVEL	9.5 - 15	Unknown	Medium dense - dense

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT26	2	50	0	0
CPT35	2	50	160	120

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D7 (R18)**

Technical Category (Description)	TC3 and TC2/3
Groundwater Depth (m) (Source)	1.0 (GNS Median Depth to Water Table)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH11	15.45
CPT37	5.28
CPT40	8.72
CPT43	9.1

Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded organic clayey SILT, clayey SILT, SILT, sandy SILT & silty SAND with occassional lenses of PEAT	0	5 - 8.5	Very soft - firm / loose
Sandy GRAVEL with occasional layers of SAND	5 - 8.5	>6	Dense - very dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT37	2	50	90	40
CPT40	2	50	160	90
CPT43	2	50	110	60

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**D8 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.0 (GNS Median Depth to Water Table)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT42	7.3
CPT44	15

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT & sandy SILT with occassional layers of silty SAND & SAND	0	7 - 15+	Very soft-firm / loose
Sandy GRAVEL with occasional layers of SAND	7 - 15+	Unknown	Medium dense - very dense

** The gravel layer is shallowest (approximately 7m bgl) in the east of the grid and was not encountered in the west of the grid.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT42	2	50	50	40
CPT44	2	50	300	210

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E2 (R15)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT11	14.74
CPT14	14.32

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT.	0	14.0 - 14.5	Unknown
GRAVEL	14.0 - 14.5	Unknown	Unknown

** The soil profile is derived from a combination of Beca investigations & Beca interpretations of Aurecon (2012) investigations.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT11	2	50	240	60
CPT14	2	50	350	90

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E3 (R15)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT12	12.12
CPT13	15

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT.	0	12 - 15+	Firm / very loose - medium dense
Sandy GRAVEL	12 - 15+	>3.5	Dense - very dense

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT12	2	50	220	90
CPT13	2	50	260	150

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E5 (R17)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
BH7	15.45
BH8	15.45
CPT25	3.76
CPT27	6
CPT28	1.86

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of peat.	0	1 - 5	Soft - stiff / very loose - loose
Sandy GRAVEL with occassional lenses of gravelly SAND*	1 - 5	1.5 - 5.5	Medium dense - very dense
Interbedded clayey SILT, SILT, sandy SILT, silty SAND, SAND & PEAT	6.5	6.5 - 8.5+	Very soft - stiff / loose - medium dense
Sandy GRAVEL	13 - 15+	>2.5	Medium dense - dense

** The shallow gravel layer is absent in a small area along the western boundary of the grid.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT25	2	50	5	0
CPT27	2	50	50	5
CPT28	2	50	0	0

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E6 (R17 & R18)**

Technical Category (Description)	TC3, TC2 & TC2/3
Groundwater Depth (m) (Source)	1.0 (Beca CPT)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH9	15.45
CPT29	4.16
CPT36	8.94

West Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT & silty SAND	0	0.5 - 2	Very soft - firm / loose
Sandy GRAVEL with occassional lenses of sand	1.5	3.5+	Medium dense - dense

East Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, SILT & silty SAND	0	8 - 8.5	Very soft - firm / loose
Sandy GRAVEL	8 - 8.5	4	Medium dense
SAND	12	1.5	Medium dense
Sandy GRAVEL	13.5	>2	Dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT29	2	50	0	0
CPT36	2	50	130	70

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E7 (R18)**

Technical Category (Description)	TC3 & TC2/3
Groundwater Depth (m) (Source)	1.25 (Beca CPT)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT38	4.3
CPT39	8.92

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT & silty SAND	0	4.5 - 8.5	Very soft - firm / loose
Sandy GRAVEL with occassional layers of SAND	4.5 - 8.5	Unknown	Medium dense - dense

** Shallow gravel layer encountered at the western side of the grid at a depth of 4m . The extent of the layer is unknown, although depth of gravel is observed as 8m (BH09) less than 100m west in Grid E6.*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT38	2	50	40	20
CPT39	2	50	130	90

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**E8 (R18)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.0 (Beca CPT)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT41	15

Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occassional lenses of PEAT	0	15+	Very soft - stiff / loose - medium dense

** The soil profile model is derived from a single CPT (CPT41).*

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT41	2	50	350	300

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F3 (R15)**

Technical Category (Description)	TC3
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
BH2	15.45
CPT15	15
CPT16	15

Northwest Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Cohesion/Density
Interbedded clayey SILT, SILT, sandy SILT; silty SAND, SAND and PEAT	0	7	Soft - firm / loose
Sandy GRAVEL	7	3.5	Medium dense
Interbedded layers of clayey SILT, organic clayey SILT; Silty SAND, SAND and PEAT.	10.5	3.5	Firm / loose
Sandy GRAVEL	14	1+	Dense

Central Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	10	Very soft - firm / loose
SAND	10	2	Loose - medium dense
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	12	4	Unknown
GRAVEL	16	Unknown	Dense

** The soil profile is derived from Beca investigations & CGD CPT data.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT15	2	50	270	180
CPT16	2	50	220	90

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F3 (R16)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT17	9.26

Central Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	10	Very soft - firm / loose
SAND	10	2	Loose - medium dense
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND	12	4	Unknown
GRAVEL	16	Unknown	Dense

** The soil profile is derived from Beca investigations combined with CGD CPT data.*

Southeast Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Cohesion/Density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND, SAND & occassional lenses of PEAT	0	7	Very soft - firm / loose
SAND (potential GRAVEL)	7	>2.5	Medium dense - dense

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT17	2	50	90	60

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F4 (R16)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
No ground investigations conducted	

West Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT silty SAND & SAND with occasional lenses of PEAT	0	15+	Soft - stiff / loose - medium dense
SAND & silty SAND	10	2	Loose - medium dense

** The soil profile is derived from Beca interpretations of Aurecon (2011) investigations.*

East Generalised Soil Profile			
Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	2 - 5	Soft - stiff / loose
Interbedded GRAVEL, sandy GRAVEL, silty sandy GRAVEL & gravelly SAND	2 - 5	>1.7	Medium dense - very dense

** The soil profile is derived from Beca interpretations of Aurecon (2011) investigations.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
No ground investigations conducted				

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F5 (R16)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations

Reference ID	Depth of Investigation (m)
BH4	15.45
CPT22	8.2

West Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	4	Soft - firm / very loose - medium dense
Sandy GRAVEL & GRAVEL	4	10	Loose - medium dense
Interbedded organic clayey SILT, SILT, sandy SILT & PEAT	10	5+	Firm - stiff / loose - medium dense

East Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND & PEAT	0	8	Very soft - firm / very loose - loose
GRAVEL	8	Unknown	Medium dense - dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT22	2	50	170	120

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F5 (R17)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations

Reference ID	Depth of Investigation (m)
CPT30	1.5
CPT33	10.24

North Generalised Soil Profile

Ground Materials*	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	1.2 - 2.6	Very soft - firm / very loose - loose
Sandy GRAVEL	1.2 - 2.6	3.4	Medium dense - very dense
Interbedded organic clayey SILT, clayey SILT, SILT, SAND & PEAT	6	9+	Very soft - stiff / loose - medium dense

** The soil profile is derived from Beca investigations & Beca interpretations of Aurecon (2010) investigations.*

Southeast Generalised Soil Profile

Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, SILT, sandy SILT, silty SAND, SAND & PEAT	0	10	Very soft - firm / very loose - loose
GRAVEL	10	Unknown	Dense

Summary of Estimated Liquefaction Induced Settlements

ID	Importance Level	Design Life (Years)	Settlement values 1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT30	2	50	0	0
CPT33	2	50	200	130

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**F6 (R17 & R18)**

Technical Category (Description)	TC3, TC2 & TC2/3
Groundwater Depth (m) (Source)	1.5 (closest grids)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
CPT32	7

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded SILT, sandy SILT & clayey SILT; silty SAND	0	7	Very soft - firm / loose
Sandy GRAVEL	7	>0.5	Medium dense - dense

** The soil profile is derived from a single CPT (CPT32) located inside grid F6.*

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT32	2	50	100	70

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**G3 (R16)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
BH5	15.45
CPT18	5.18
CPT19	4.62
CPT20	6.94

Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, SILT, sandy SILT, silty SAND & SAND with occasional lenses of PEAT	0	4 - 7	Soft - stiff / loose
Sandy GRAVEL	4 - 7	>1	Medium dense - dense
Interbedded organic SILT, clayey SILT, sandy SILT, silty SAND, SAND & PEAT	10	5+	Firm - stiff / loose - medium dense

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT18	2	50	70	20
CPT19	2	50	50	20
CPT20	2	50	70	20

Job Name	**CCC Halswell ODP Geotechnical Investigation**
Date	**7/03/2014**
Grid Reference (Area)	**G4 (R16)**

Technical Category (Description)	TC3 & TC2
Groundwater Depth (m) (Source)	1.5 (ECan Wells)

Summary of Investigations	
Reference ID	Depth of Investigation (m)
BH3	15.45
CPT21	1.1

West Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded CLAY, silty CLAY, clayey SILT, sandy SILT, SILT, silty SAND, SAND & gravelly SAND with occasional PEAT layers	0	1.1 - 6	Soft - stiff / loose
Sandy GRAVEL & silty sandy GRAVEL	1.1 - 6	>1.4	Loose - dense

East Generalised Soil Profile			
Ground Materials	Approximate Depth to Top of Unit (m)	Thickness (m)	Consistency/ Relative density
Interbedded clayey SILT, SILT, sandy SILT, silty SAND & SAND	0	7 - 10	Very soft - firm / loose
Sandy GRAVEL with occassional lenses of SAND	7 - 10	3 - 6	Dense
Clayey SILT, SILT, sandy SILT, silty SAND, SAND & Peat	14	1+	Very soft - soft / loose

Summary of Estimated Liquefaction Induced Settlements				
	Importance		Settlement values	
ID	Level	Design Life (Years)	1/500 (ULS, 0.35g)	1/25 (SLS, 0.13g)
CPT21	2	50	0	0

Technical Categories Maps

Legend

LURP Zones

DBH Equivalent Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
TC2/3	As above

DBH Residential Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
No Fill N/A	No information avaliable

This map contains data derived in part or wholly from sources other than Beca, and therefore, no representations or warranties are made by Beca as to the accuracy or completeness of this information.

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This map must be read in conjunction with Beca's full report

Map Scale @ A3: 1:6,000

0 40 80 160 240 320 400

Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	SCV	9/04/2014

Title: **LURP Zones with DBH Equivalent Technical Category CCC Halswell ODP R15 Zone Map**

Client: Christchurch City Council

Project: CCC Halswell ODP Geotechnical Investigations

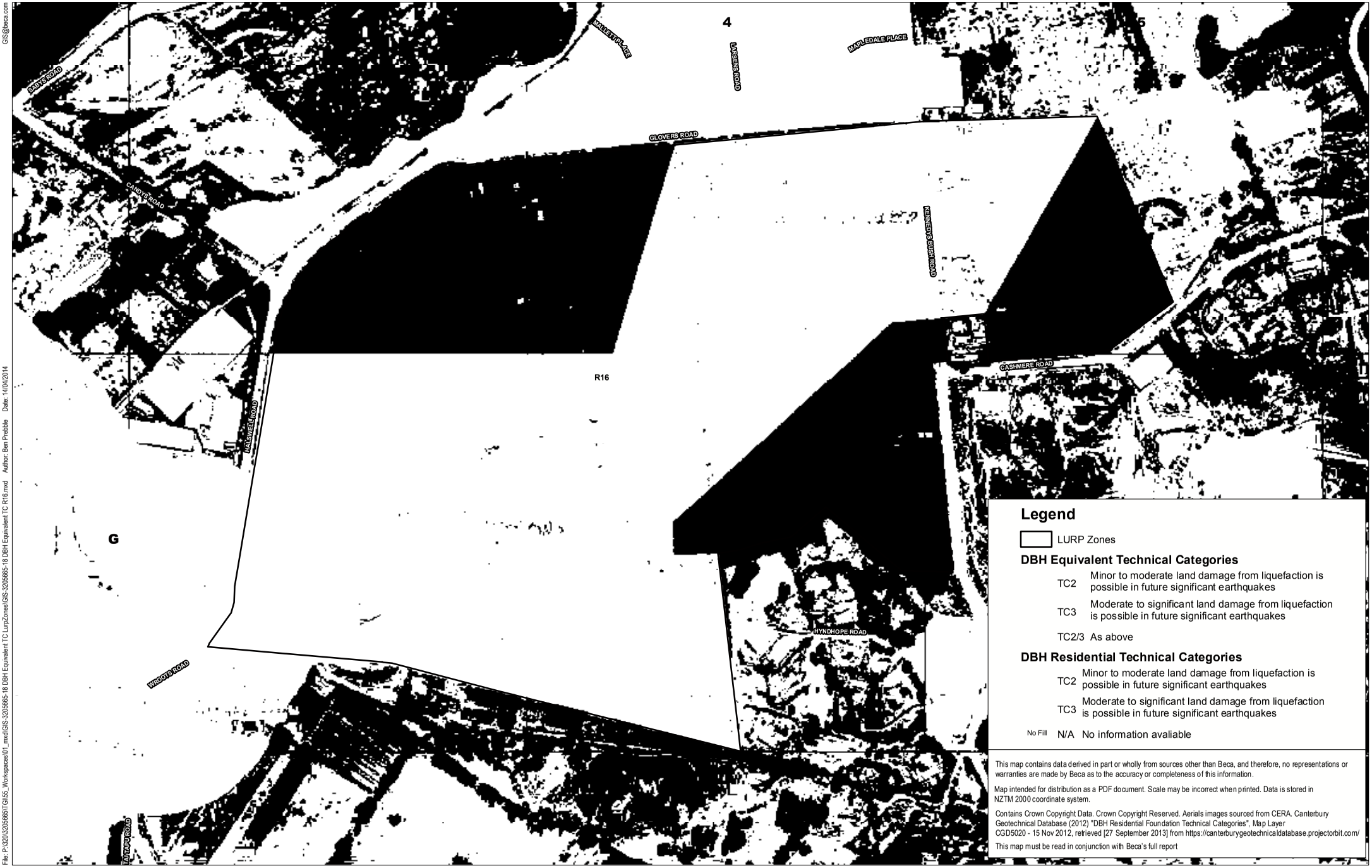
Beca

Discipline: GIS

Drawing No: GIS-3205665-18

GIS@beca.com

File: P:\320\3205665\GIS_Workspaces\01_mxd\GIS-3205665-18 DBH Equivalent TC LurpZones\GIS-3205665-18 DBH Equivalent TC R15.mxd Author: Ben Prebble Date: 14/04/2014



GIS@beca.com

File: P:\320\32056651\GIS5_Workspaces\01_mxd\GIS-3205665-18 DBH Equivalent TC LurpZones\GIS-3205665-18 DBH Equivalent TC R16.mxd Author: Ben Prebble Date: 14/04/2014

Map Scale @ A3: 1:3,000

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Metres

±

Revision	Author	Verified	Approved	Date
1	RJL	BAP	SCV	9/04/2014

Title: **LURP Zones with DBH Equivalent Technical Category CCC Halswell ODP R16 Zone Map**

Client: Christchurch City Council

Project: CCC Halswell ODP Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-18

Legend

LURP Zones

DBH Equivalent Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
TC2/3	As above
Port Hills Zones	DBH Technical Category does not apply

DBH Residential Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
No Fill N/A	No information avaliable

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This map must be read in conjunction with Beca's full report

Map Scale @ A3: 1:4,000

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Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	SCV	9/04/2014

Title: **LURP Zones with DBH Equivalent Technical Category CCC Halswell ODP R17 Zone Map**

Client: Christchurch City Council

Project: CCC Halswell ODP Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-18

GIS@beca.com

File: P:\320\32056651\GIS\5_Workspaces\01_mxd\GIS-3205665-18 DBH Equivalent TC LurpZones\GIS-3205665-18 DBH Equivalent TC R17.mxd Author: Ben Prebble Date: 14/04/2014

Legend

LURP Zones

DBH Equivalent Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
TC2/3	As above
Port Hills Zones	DBH Technical Category does not apply

DBH Residential Technical Categories

TC2	Minor to moderate land damage from liquefaction is possible in future significant earthquakes
TC3	Moderate to significant land damage from liquefaction is possible in future significant earthquakes
No Fill N/A	No information avaliable

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This map must be read in conjunction with Beca's full report

GIS@beca.com

File: P:\3201\3205665\TG\55_Workspaces\01_mxd\GIS-3205665-18 DBH Equivalent TC LurpZones\GIS-3205665-18 DBH Equivalent TC R18.mxd Author: Ben Priebbe Date: 14/04/2014

Map Scale @ A3: 1:8,000

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Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	SCV	9/04/2014

Title: **LURP Zones with DBH Equivalent Technical Category CCC Halswell ODP R18 Zone Map**

Client: Christchurch City Council

Project: CCC Halswell ODP Geotechnical Investigations

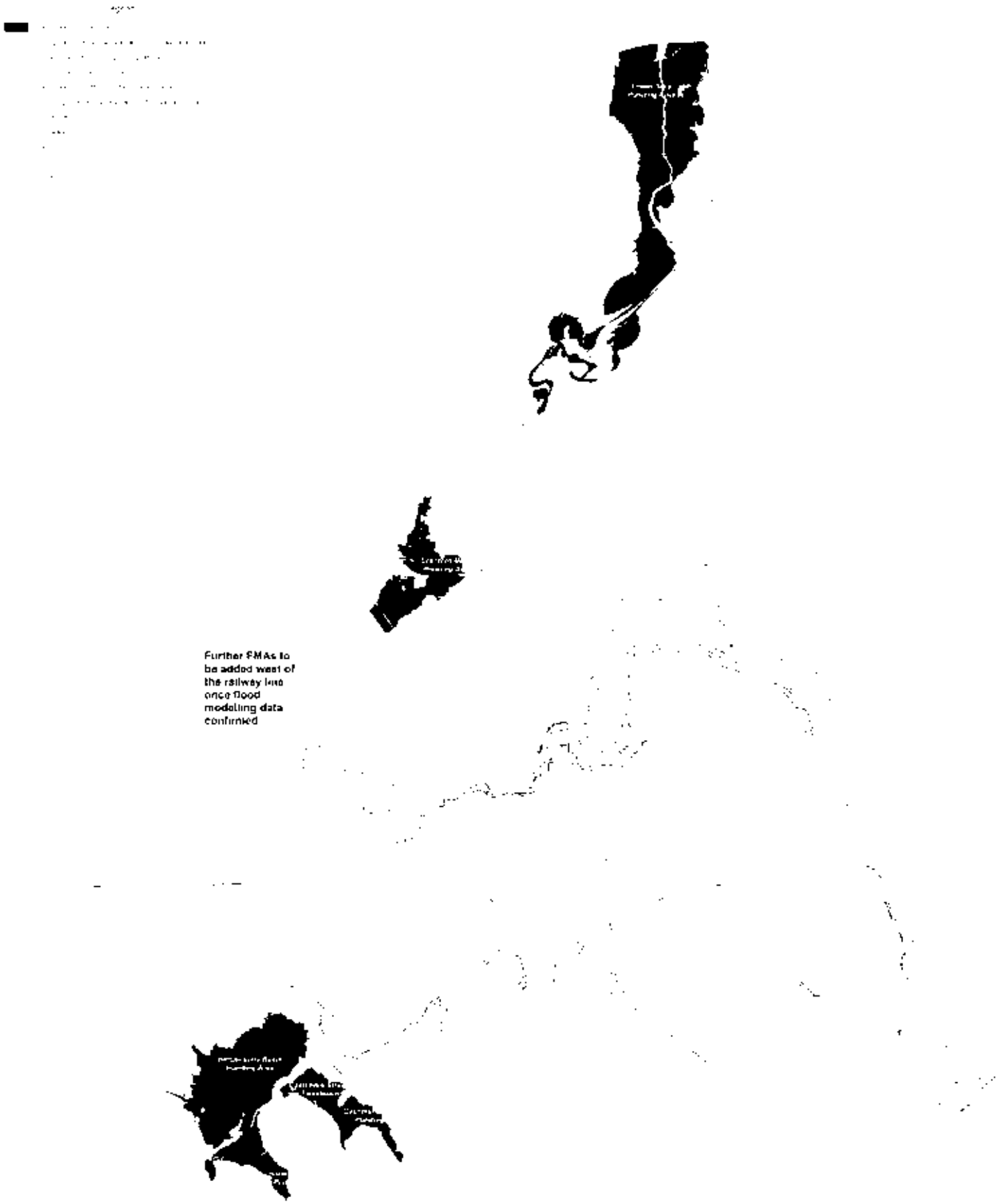
Beca

Discipline: GIS

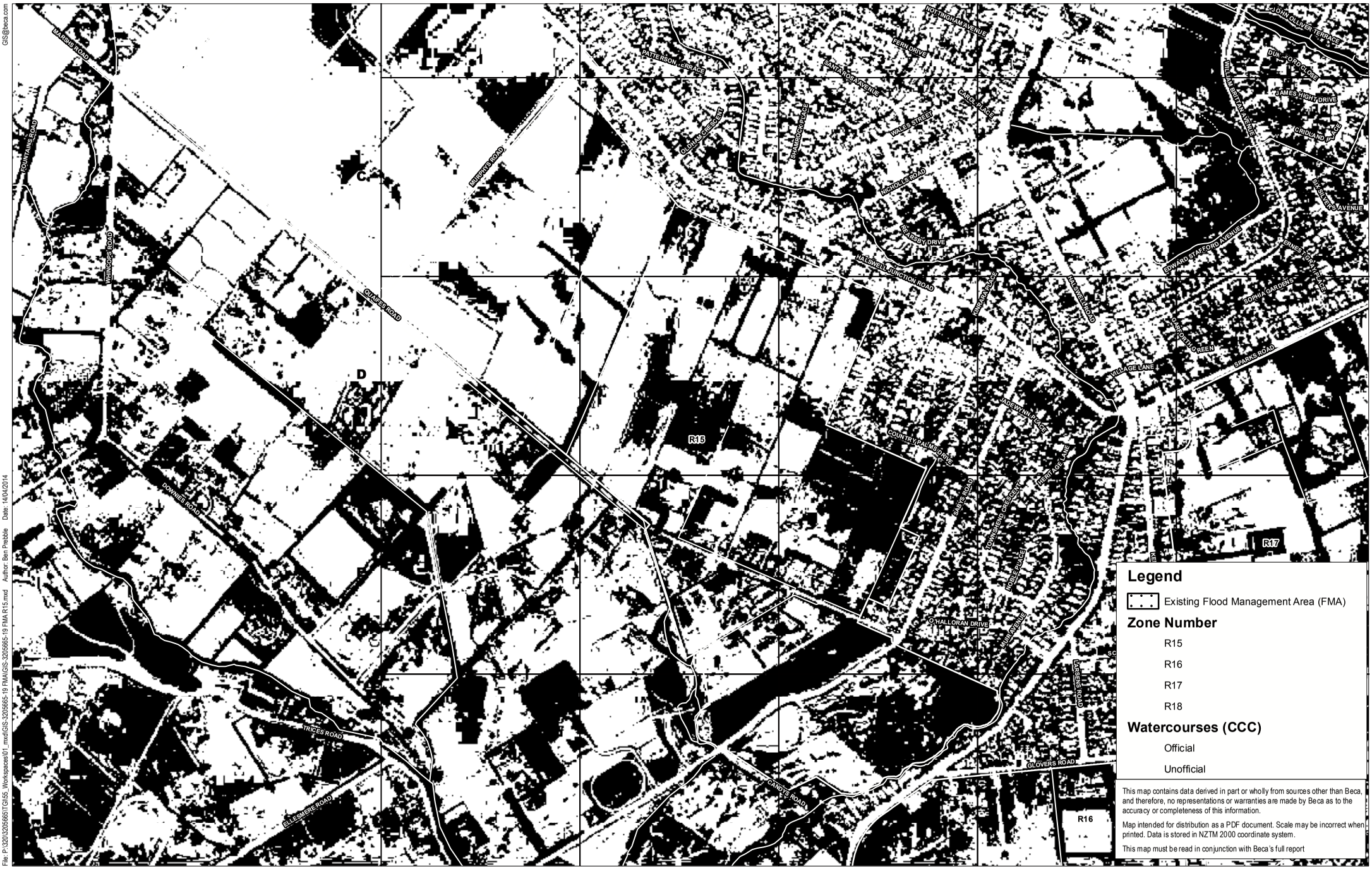
Drawing No: GIS-3205665-18

[redacted]

Flood Risk



Existing & Proposed Flood Management Area (FMA) 0.5m Sea-Level Rise



File: P:\320\3205665\TG\55_Workspaces\01_mxd\GIS-3205665-19 FMA\GIS-3205665-19 FMA R15.mxd Author: Ben Prebble Date: 14/04/2014

GIS@beca.com

Map Scale @ A3: 1:6,000

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Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	KMP	9/04/2014

Title: **Existing Flood Management Area**
CCC Halswell ODP
R15 Zone Map

Client: Christchurch City Council

Project: CCC Halswell ODP
Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-19

GIS@beca.com

File: P:\3203\3205665\TG\55_Workspaces\01_mxd\GIS-3205665-19 FMA\GIS-3205665-19 FMA R16.mxd Author: Ben Prebble Date: 14/04/2014

Map Scale @ A3: 1:3,000

0 20 40 80 120 160 200

Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	KMP	9/04/2014

Title: **Existing Flood Management Area**
CCC Halswell ODP
R16 Zone Map

Client: Christchurch City Council

Project: CCC Halswell ODP
Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-19

GIS@beca.com

File: P:\3201\3205665\TG\55_Workspaces\01_mxd\GIS-3205665-19 FMA\GIS-3205665-19 FMA R17.mxd Author: Ben Prebble Date: 14/04/2014

Map Scale @ A3: 1:4,000

0 25 50 100 150 200 250

Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	KMP	9/04/2014

Title: **Existing Flood Management Area**
CCC Halswell ODP
R17 Zone Map

Client: Christchurch City Council

Project: CCC Halswell ODP
Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-19

Legend

Existing Flood Management Area (FMA)

Zone Number

R15

R16

R17

R18

Watercourses (CCC)

Official

Unofficial

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GIS@beca.com

File: P:\3201\3205665\TG\55_Workspaces\01_mxd\GIS-3205665-19 FMA\GIS-3205665-19 FMA R18.mxd Author: Ben Prebble Date: 14/04/2014

Map Scale @ A3: 1:8,000

0 50 100 200 300 400 500

Metres

Revision	Author	Verified	Approved	Date
1	RJL	BAP	KMP	9/04/2014

Title: **Existing Flood Management Area**
CCC Halswell ODP
R18 Zone Map

Client: Christchurch City Council

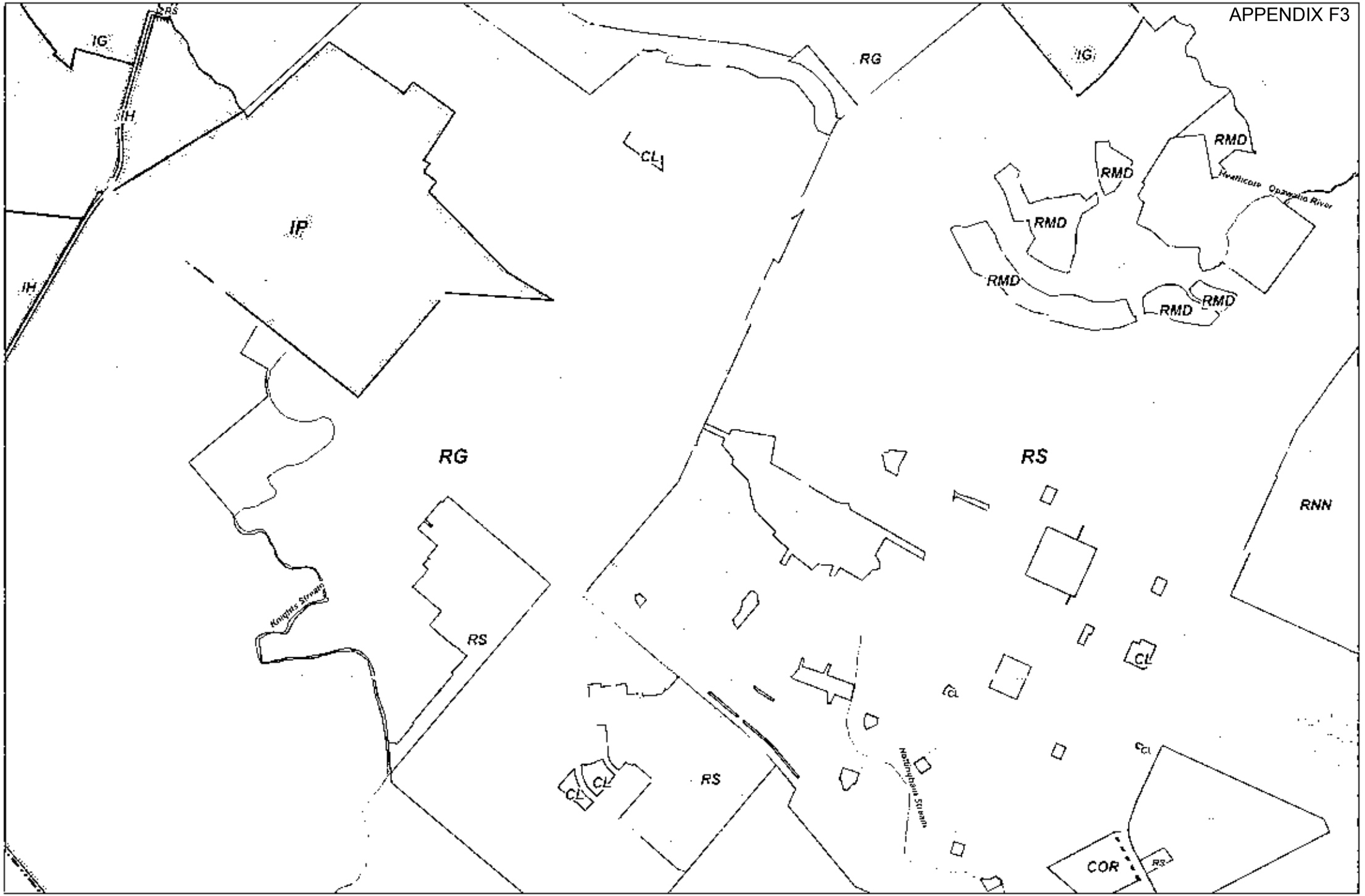
Project: CCC Halswell ODP
Geotechnical Investigations

Beca

Discipline: GIS

Drawing No: GIS-3205665-19

APPENDIX F3



Christchurch City Council | District Plan Review

Draft Map 44

Date: 15 03 2014 updated from 25 02 2014

PLANNING ZONES

- CBP — Commercial Banks Peninsula
- COR — Commercial Core
- CF — Commercial Fringe
- CL — Commercial Local
- CRP — Commercial Retail Park
- IG — Industrial General
- IH — Industrial Heavy
- IP — Industrial Park
- RBP — Residential Banks Peninsula
- RC — Residential Conservation
- RG — Residential Greenfield
- RGA — Residential Guest Accommodation
- RMD — Residential Medium Density
- RNN — Residential New Neighbourhood
- RS — Residential Suburban

OTHER NOTATIONS

- 1 — Existing Rural Hamlet
- 2 — Medium Density (Higher Height Limit and Site Density)
- 3 — Office Park Policy Overlay
- 4 — Port Ground Condition Constraint
- 5 — Prestons Road Overlay
- 6 — Residential Suburban Density Overlay
- 7 — Residential Suburban Redwood
- 8 — Stormwater Capacity Constraint
- Liquefaction Assessment Area 1
- Liquefaction Assessment Area 2
- Cliff Hazard Management Area
- Rockfall Hazard Management Area 1
- Rockfall Hazard Management Area 2
- Mass Movement Hazard Management Area (subject to ongoing investigation report due in May 2014 to amend boundaries)
- Mass Movement Hazard Management Area 2
- Mass Movement Hazard Management Area 3
- Remainder of Port Hills and Banks Peninsula Slope Instability Management Area
- Flood Management Area (FMA)
- Fixed Minimum Floor Level Overlay
- Flood Ponding
- Waimakariri River Floodplain High Hazard
- Waimakariri River Floodplain
- Waimakariri River Stopbank Setback
- Key Pedestrian Frontage
- Community Housing Redevelopment Mechanism
- Lyttelton Port Influences Overlay Area
- Air Noise Contour (50dBA Ldn) approved through the Land Use Recovery Plan

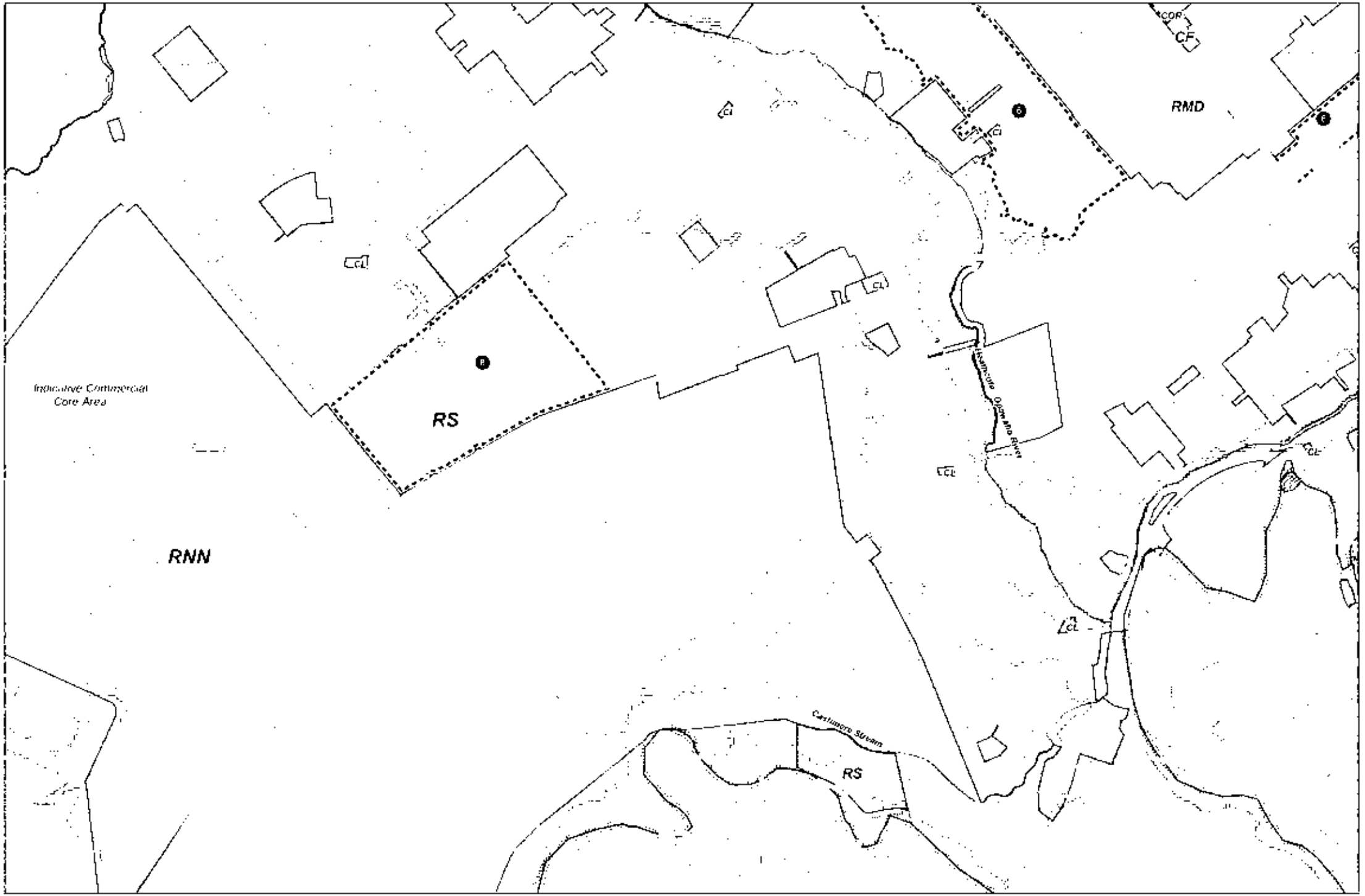
INFORMATION ONLY

- Christchurch District Boundary
- Area outside Christchurch District Boundary
- CERA Residential Red Zone (October 2011) - not being reviewed in this round of notification
- Phase Two Review Area
- Railway
- Hazard Line 1 (Coastal)
- Major Arterial Road
- Minor Arterial Road
- Proposed Major Arterial Road
- River

The cadastre and coastline shown on the planning maps is not part of the information in the District Plan. It has been provided on the planning maps as an additional function to enhance navigability and search capability. The cadastre was based on the most recent information held by the Council at the date the map was produced.

Establishing compliance or otherwise with the plan may require a formal survey.

CCC planning maps and data are designed to be viewed at a scale of 1:10000. The accuracy of any layer cannot be guaranteed at large scale.



Christchurch City Council | District Plan Review

Draft Map 45

Date: 15 03 2014 updated from 25 02 2014

PLANNING ZONES

- CBP — Commercial Banks Peninsula
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- CF — Commercial Fringe
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OTHER NOTATIONS

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- Lyttelton Port Influences Overlay Area
- Air Noise Contour (50dBA Ldn) approved through the Land Use Recovery Plan

INFORMATION ONLY

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- Hazard Line 1 (Coastal)
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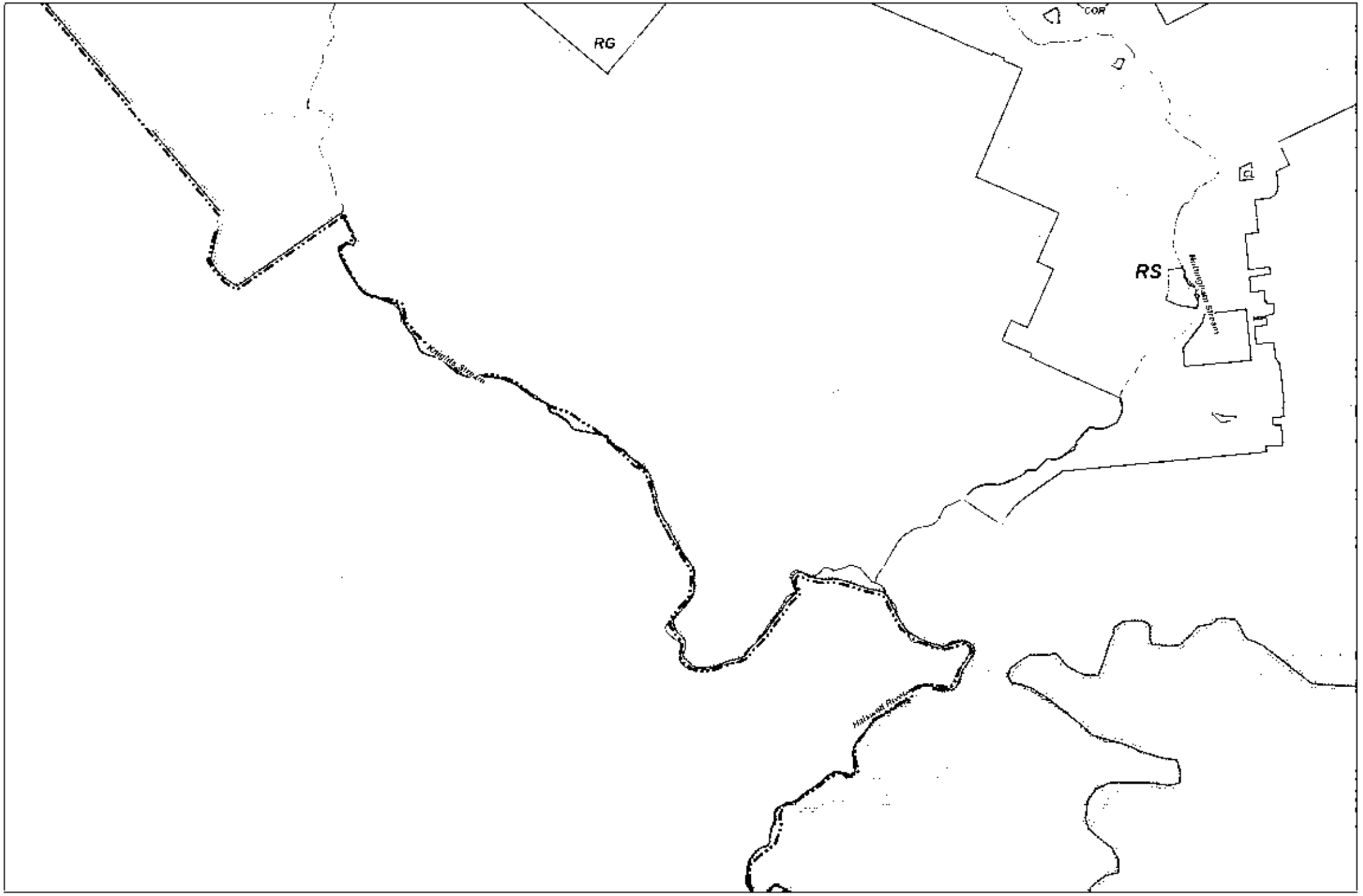

Christchurch City Council | District Plan Review

Draft Map 49

Date: 15 03 2014 updated from 25 02 2014

PLANNING ZONES

- CBP — Commercial Banks Peninsula
- COR — Commercial Core
- CF — Commercial Fringe
- CL — Commercial Local
- CRP — Commercial Retail Park
- IG — Industrial General
- IH — Industrial Heavy
- IP — Industrial Park
- RBP — Residential Banks Peninsula
- RC — Residential Conservation
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- RGA — Residential Guest Accommodation
- RMD — Residential Medium Density
- RNN — Residential New Neighbourhood
- RS — Residential Suburban

OTHER NOTATIONS

- 1 — Existing Rural Hamlet
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- Lyttelton Port Influences Overlay Area
- Air Noise Contour (50dBA Ldn) approved through the Land Use Recovery Plan

INFORMATION ONLY

- Christchurch District Boundary
- Area outside Christchurch District Boundary
- CERA Residential Red Zone (October 2011) - not being reviewed in this round of notification
- Phase Two Review Area
- Railway
- Hazard Line 1 (Coastal)
- Major Arterial Road
- Minor Arterial Road
- Proposed Major Arterial Road
- River

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Christchurch City Council | District Plan Review

Draft Map 50

Date: 15 03 2014 updated from 25 02 2014

PLANNING ZONES

- CBP — Commercial Banks Peninsula
- COR — Commercial Core
- CF — Commercial Fringe
- CL — Commercial Local
- CRP — Commercial Retail Park
- IG — Industrial General
- IH — Industrial Heavy
- IP — Industrial Park
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- RC — Residential Conservation
- RG — Residential Greenfield
- RGA — Residential Guest Accommodation
- RMD — Residential Medium Density
- RNN — Residential New Neighbourhood
- RS — Residential Suburban

OTHER NOTATIONS

- 1 — Existing Rural Hamlet
- 2 — Medium Density (Higher Height Limit and Site Density)
- 3 — Office Park Policy Overlay
- 4 — Port Ground Condition Constraint
- 5 — Prestons Road Overlay
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INFORMATION ONLY

- Christchurch District Boundary
- Area outside Christchurch District Boundary
- CERA Residential Red Zone (October 2011) - not being reviewed in this round of notification
- Phase Two Review Area
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- Hazard Line 1 (Coastal)
- Major Arterial Road
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- River

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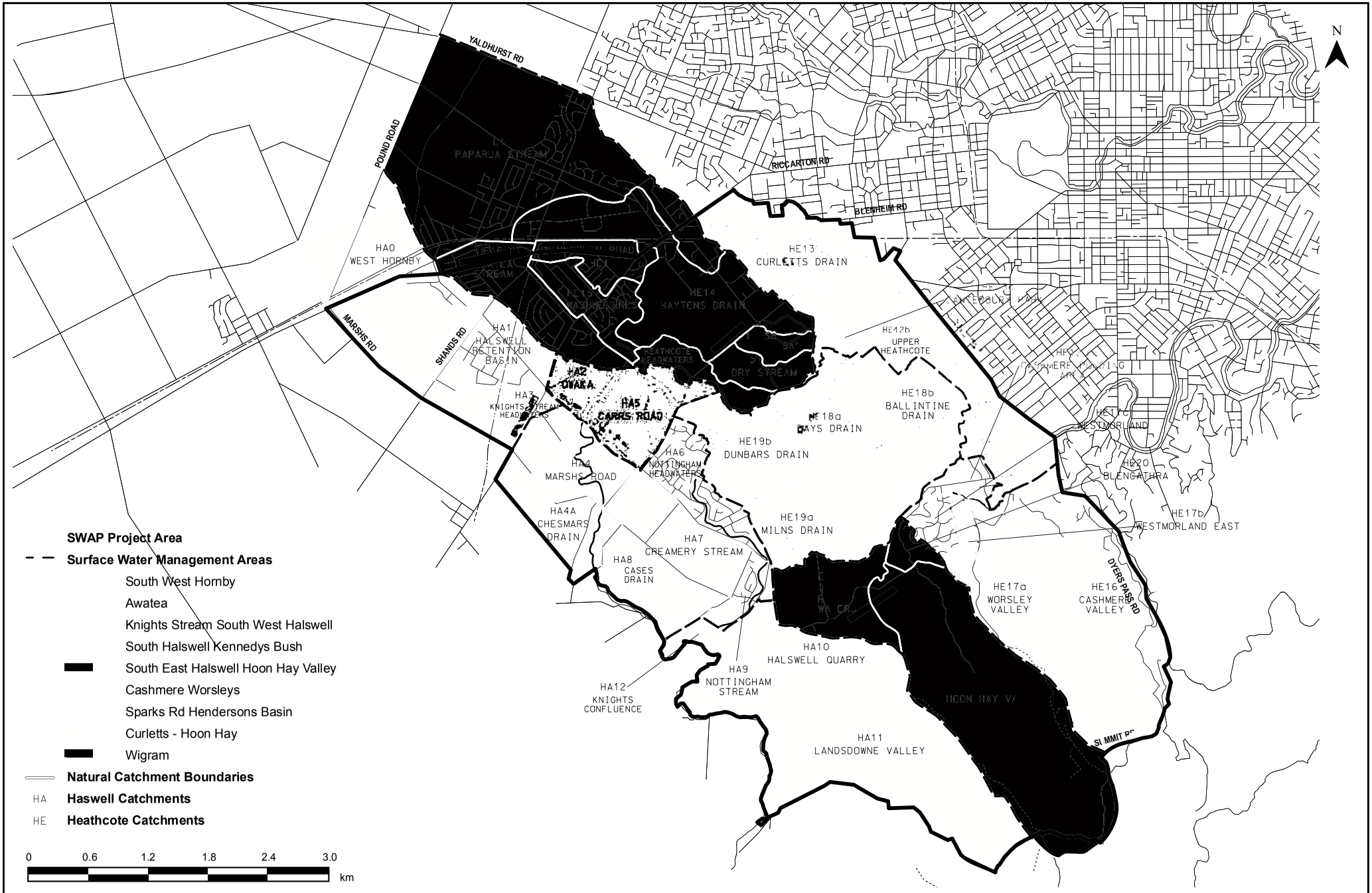

Golder Associates

SWMA'S AND THEIR RELATIONSHIP TO SUB-CATCHMENTS IN SOUTH-WEST CHRISTCHURCH

DECEMBER 2007
CHCCC-CHC-015

2.4

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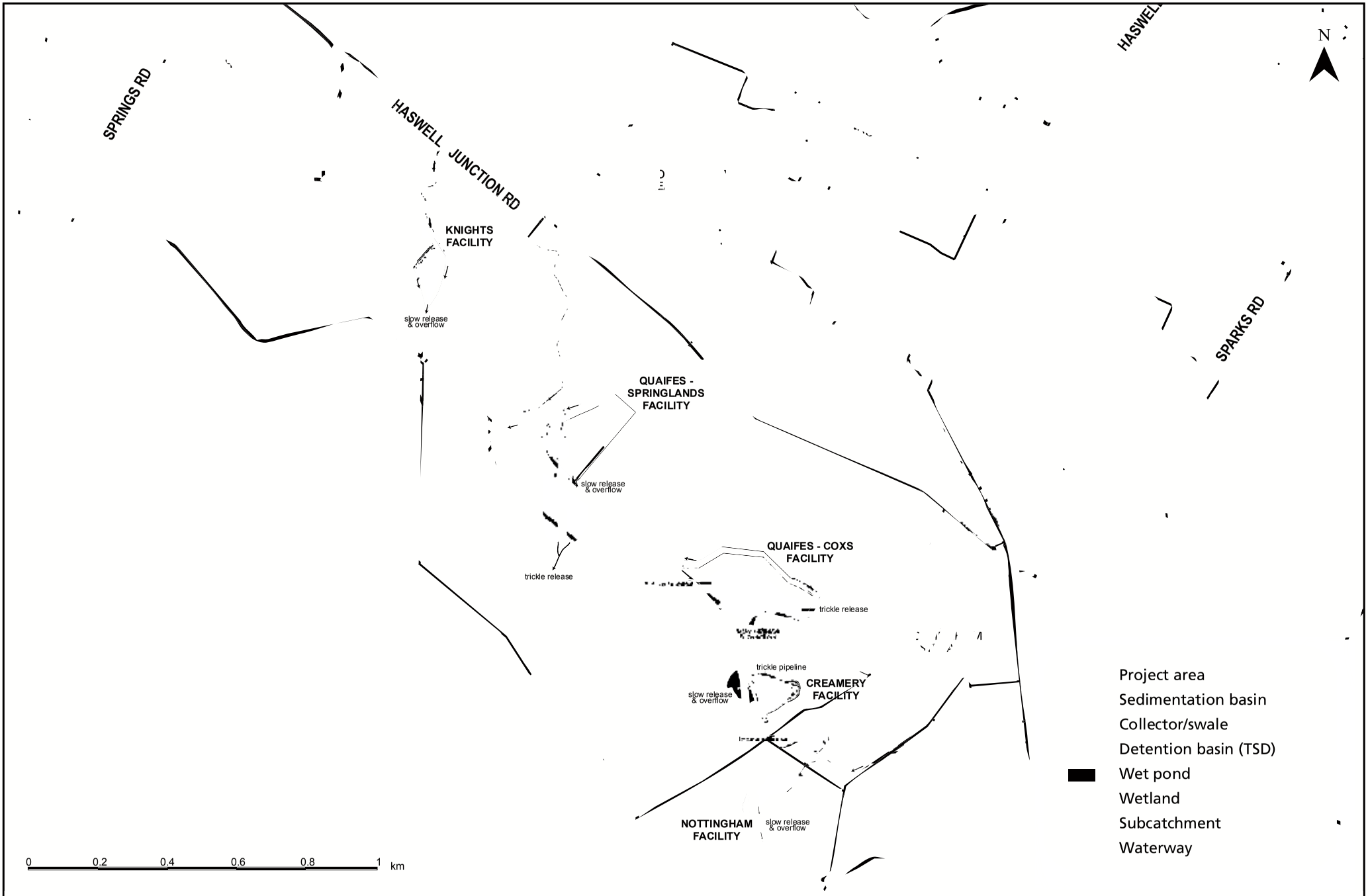
Christchurch City Council

CAPITAL PROGRAMME GROUP

APPROVED	FOR TENDER	FOR CONSTRUCTION	
PROJECT TITLE	SOUTH WEST AREA		
DRAWING TITLE	PROPOSED BASIN AND STORMWATER SYSTEM		
CAD DRAWING FILE REF.	DG101901	ORIGINAL SHEET SIZE	A1
SCALES	A1 1:10,000	A3 1:20,000	
CPG PROJECT FILE NUMBER	CP500000	SHEET	1 OF 1



Golder Associates

KNIGHTS STREAM-SOUTH WEST HALSWELL STORMWATER MANAGEMENT AREA

DECEMBER 2007
CHCCC-CHC-015

6.2

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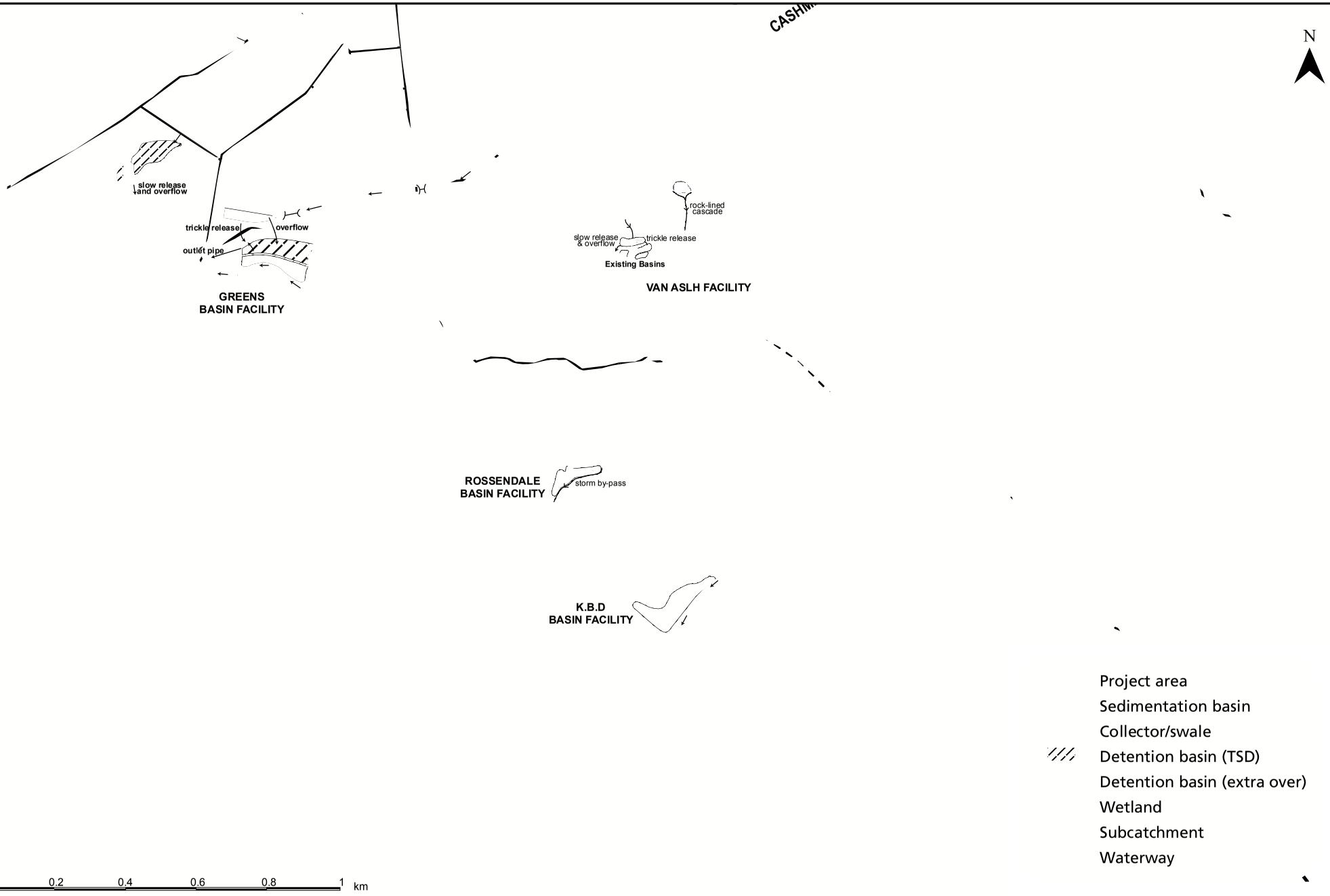

Golder Associates

SOUTH HALSWELL-KENNEDYS BUSH STORMWATER MANAGEMENT AREA

DECEMBER 2007
CHCCC-CHC-015

6.1

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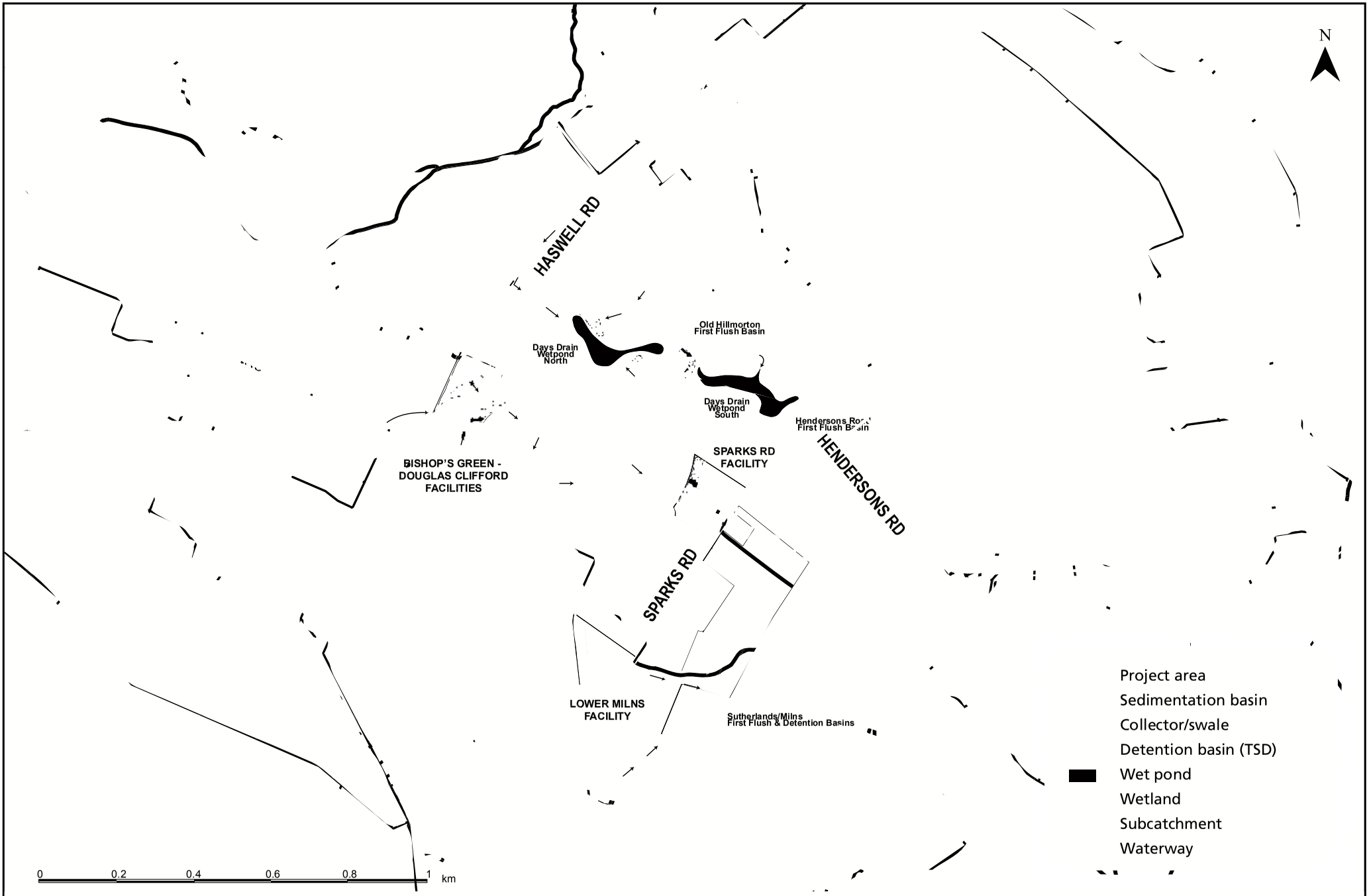

Golder Associates

SPARKS ROAD HENDERSON BASIN STORMWATER MANAGEMENT AREA

DECEMBER 2007
CHCCC-CHC-015

6.3

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