FRONTERA GEOTECHNICAL

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Sea to Sky Community Services
c/o CPA Development Consultants Inc.
100-283 East 11th Avenue
Vancouver, BC V5T 2C4

November 29, 2021
File: 1706

Attention: Mr Casey Clerkson

RE: Preliminary Geotechnical Report, Proposed Mixed-Use Development, Lot 2 Harrow Road, Pemberton, BC

1.0 INTRODUCTION

It is proposed to construct an affordable housing project at Lot 2 Harrow Road in Pemberton, BC which has the legal lot description LOT 2 DISTRICT LOT 203 LILLOOET DISTRICT PLAN KAP56640.

We have reviewed the conceptual drawings prepared by Station One Architects dated August 30, 2021, and the site survey prepared by Bunbury and Associates dated October 6, 2021, in preparing this report. We understand that a four or five level building is being considered. Both building options are proposed to be at grade with a full or partial level of commercial space and/or parkade structure on the first floor and with residential development above.

A geotechnical investigation of the building site was completed by Frontera on October 22, 2021. This report presents the results of our geotechnical investigation which includes soil and groundwater conditions at the site and provides preliminary geotechnical recommendations for the design and construction of the building.

The site is located within the Lillooet River floodplain therefore a flood hazard exists. A flood hazard report has been prepared for the site by Frontera under separate cover which should be referenced alongside this report.

This report has been prepared exclusively for our client and for the use of others within their design and construction team, however it remains the property of Frontera Geotechnical Inc.

2.0 SITE DESCRIPTION

The property is located on the east side of the main village of Pemberton and is the lot directly adjacent to the intersection of Pemberton Portage Road and Harrow Road. The site is bound by acreages to the east and residential development and by Highway 99 to the south.

The site is an irregular triangular shape and is generally flat with grades ranging from approximately 206.0 m at the east and west ends of the site and up to 207.1 m geodetic elevation near the centre of the property based on the survey.

3.0 FIELD INVESTIGATION

Frontera conducted a geotechnical investigation on October 22, 2021. The investigation included eight solid-stem auger test holes. Four of the eight auger holes were supplemented with dynamic cone penetration test (DCPT) soundings. Two of the auger holes were supplemented with a cone penetration test (CPT) sounding.

The test holes were advanced to various depths ranging from 3.1 m to 9.1 m below the local grades at the time of the investigation. The soils were logged in the field and samples were collected for laboratory moisture content analysis. The test hole logs are included in Appendix A.

DCPT soundings are completed by driving steel rods with a blunt tip into the ground using a standardized mechanical drop hammer. The number of blows from the drop hammer required to advance the rods are recorded in 300 mm intervals. The number of blows required to drive the rods 300 mm can be used for inference of the in-situ density of granular soils and fills.

The CPT soundings were advanced to depths of 30 m below site grades, where the desired investigation depth was achieved. As the cone penetrometer is advanced into the ground, it records the tip resistance, sleeve friction, pore water pressure and inclination at 2 cm intervals. Analysis of the CPT sounding data allows for an estimation of geotechnical design parameters and inference of the sub-surface stratigraphy from soil-type behaviour characteristics. The CPT sounding logs and CPT based liquefaction analysis are presented in Appendix B and C, respectively.

The approximate locations of the test holes are shown on the attached site plan, Drawing No. 1706-01.

4.0 SUBSURFACE CONDITIONS

4.1 Soil Conditions

In general, the soil profile noted from the surface downwards at our test hole locations consists of sand to silty sand, over silt, which overlies interbedded peat and clayey silt deposits, underlain by a silt and sand layer. A general description of the soils encountered is as follows:

SAND

From the ground surface, a layer of sand was encountered in all test holes. This sand varied in thickness from 2.7 m to 3.3 m. The sand was fine to coarse grained and became coarser with depth. The sand was generally clean sand, with a trace of gravel in TH21-07. The sand was loose and dry to moist, becoming wet at approximately 2.0 m in all test hole locations. Based on laboratory moisture content analysis the moisture content within this stratum was found to range between 6% and 48%.

SILT

The sand is underlain by soft to firm, low plastic, moist, grey silt with some fibrous organics. This stratum was found at depths between 3.1 m and 3.8 m at TH21-02 to TH21-04, TH21-05 and TH21-06. Within TH21-06, the silt was found to contain traces of intact organic fibers. Moisture contents within this stratum were found to range from 33% to 45%.

Clayey SILT to Clayey PEAT

Deposits of clayey silt to clayey peat were encountered in TH21-02 through TH21-05 underlying the sand and silt where present. At similar depths, in TH21-01 a deposit of peat with trace silt and in TH21-06 an organic silt with organic fibers were noted. The unit was generally observed to contain soft, low plasticity clay and organic fibers and was encountered at depths between 3.3 m and 5.0 m.

Based on laboratory moisture content analysis the moisture content within this stratum was found to range between 80% and 118%.

PEAT

Peat was encountered below the materials above. The peat was amorphous and contained a significant long fibres and wood-like strands and noted to be soft. The peat was found to be up to 1.1 m thick and extended to depths of up to 6.1 m below ground surface. The moisture content was found to range between 104% and 297%.

SILT

The interbedded peat and clayey silt deposits are underlain by low plastic, soft silt at TH21-01, TH21-03, TH21-04 and TH21-05. The deposits encountered in TH21-05 contain traces of rotten wood. This stratum is found at depths between 4.6 m to 6.1 m. The moisture content was found to range between 42% and 53%.

SILTY SAND to SAND

At test holes TH21-05 and TH21-06 fine grained, uniformly graded, loose sand was encountered. This stratum was found at depths between 4.4 m and 9.1 m. The encountered thickness of this stratum was between 1.7 m and 2.0 m, however the stratum continued beyond the extent of our test holes. The moisture content of samples taken from this layer was found to range between 33% and 40%. Based on our review of the CPT interpretations, the silty sand/sand layer was encountered at between 9 to 9.5 m in test hole CPT21-01 and CPT21-02, and was found to extend to depths greater than 30 m.

For a more detailed description of the subsurface conditions refer to the test hole logs in Appendix A.

4.2 Groundwater Conditions

The groundwater table was estimated to be between 1.9 m and 2.4 m below the site grades at test hole locations based on CPT dissipations. The groundwater table is expected to be higher following periods of persistent precipitation and snow melt and may be influence by the water level within the Lillooet River.

5.0 DISCUSSION

5.1 General Comments

In general, the soil conditions consist of sand and silt underlain by clayey silt which in some areas is interbedded with peat. These deposits are underlain by peat, silt and loose sand to silty sand to depth beyond our investigation.

The near surface clayey silt and peat are considered susceptible to consolidation settlement when exposed to an increase in stress such as that imposed by foundation loads or site grading fill. Additional long-term

settlement is expected due to secondary compression and degradation of the peat over time. The compressible layers vary in thickness and depth across the site and therefore differential settlement would be expected unless mitigated against.

The underlying granular soils were found to be generally loose and are considered susceptible to earthquake induced liquefaction in consideration of the 2018 British Columbia Building Code (2018 BCBC) probabilistic seismic hazard.

The site is located within an identified flood hazard area. Available mapping indicates that the flood hazard at the site is significant. The flood hazard report prepared by Frontera should be referred to for flood construction considerations.

The site may be located within a geohazard area. A geohazard report should be completed, and if a hazard exits appropriate recommendations should be made for the project.

Provided the geotechnical consideration above are addressed as described below, we are of the opinion that the project is feasible from a geotechnical foundation design standpoint.

5.2 Consolidation Settlement

The underlying silt and clayey silt are considered susceptible to consolidation settlement when exposed to an increase in stress, such as that imposed by the expected foundation loads. The peat is considered susceptible to primary consolidation, secondary compression, and long-term degradation which would contribute to long term total and differential settlement. Therefore, unacceptable levels of total and differential settlement are expected if not mitigated against.

In consideration of the ground stress increase expected due to the weight of the building and site grading fill settlements are expected. To mitigate the potential for large and differential settlements, we recommend to prepare the site with a preload. The preload will pre-expose the underlying compressible soils to stress levels greater than those expected following construction.

Regardless, some long-term settlement beneath the building should be expected due to secondary compression and the long-term degradation of the underlying peat. To help reduce long term differential settlements, we propose to surcharge the preload to further compress the peat. Ultimately, review of the preload performance would allow us to estimate long term settlements.

5.3 Seismic Consideration

It is generally accepted that loose to compact and saturated non-plastic silts and sands are prone to liquefaction or strain softening during cyclic loading caused by large earthquakes. Once liquefaction is triggered, significant, permanent, vertical and horizontal movements may be experienced. The strength reduction caused by soil liquefaction can cause conventional spread foundations to fail by punching into the liquefied soils.

The 2018 BCBC states that the objective of earthquake-resistant design is to prevent major failure and/or collapse of structures. Structures designed in conformance with the National Building Code of Canada (NBCC) provisions should be able to resist moderate earthquakes without significant damage and major earthquakes without collapse. Collapse is defined as a state where occupants can no longer exit the building because of structural failure. For our analysis, we have relied upon the 2015 NBCC interpolated seismic hazard values from Natural Resources Canada, which are consistent with the 2018 BCBC.

For design purposes, the 2018 BCBC defines a “major” earthquake as one which results in accelerations and velocities with a 2% chance of being exceeded in 50 years which equates to a 1 in 2,475-year

probabilistic seismic hazard. The firm ground peak ground acceleration (PGA) at this location is 0.17g, where g is acceleration due to gravity.

For the purpose of this report, moderate ground shaking has been represented by the mean ground motion with a probability of exceedance of 10% in 50 years. This equates to a 1 in 475-year probabilistic seismic hazard with an associated firm ground PGA of 0.07g.

5.4 Liquefaction Assessment

5.4.1 Liquefaction Triggering

The near surface silts and peat are not considered susceptible to liquefaction although some strain softening may occur. The underlying loose to compact sand is considered susceptible to liquefaction.

We have carried out a liquefaction analysis using the methods of Boulanger and Idriss (2014). Liquefaction triggering was defined using a factor of safety against liquefaction of less than or equal to 1. We considered the method described by Zhang et al. (2002) for estimating liquefaction-induced free field settlements from CPT sounding data. We have limited our analysis of liquefaction potential to 20 m below grade based on common practice and the methods described by Zhang et al. (2002) which states that based on case studies from past earthquakes, little or no surface manifestation has been observed when the liquefied layer is below 20 m depth.

Review of our analysis indicates that the loose sand below 1.5 m to 2 m depth is susceptible to liquefaction triggering. Our liquefaction analysis was based on two CPT soundings at CPT21-01 and CPT21-02. The CPT soundings were advanced to 30 m depth.

Liquefaction triggering is expected when the 1 in 2,475-year seismic hazard is considered. Based on the methods proposed by Ishihara et. al (1985), ground damage is not considered likely.

Liquefaction triggering is considered to be negligible for the 1 in 475-year seismic hazard.

5.4.2 Vertical Settlements

1 in 2,475-year Seismic Hazard Analysis

Post-liquefaction free field settlements for the 1 in 2,475-year seismic hazard ranging from 32 to 40 cm have been calculated when summed from 20 m depth. We recommend that settlements up to 40 cm be considered for structural design due to inherent uncertainty. The soil profile is relatively uniform, and the total thickness and depth of liquefiable soils are similar at our test locations, however, some differential settlements should be expected. We therefore recommend that the structural designers consider differential settlements of up to 20 cm across the width of building.

1 in 475-year Seismic Hazard Analysis

Post-liquefaction free field settlements from the 1 in 475-year event are calculated to be negligible when summed from 20 m depth.

*It must be appreciated that the settlements estimated above are free field settlements and therefore are expected to be similar to the settlement of the surrounding area. The differential settlement estimates do not account for any stiffness associated with the foundation system.

5.4.3 Liquefaction Induced Lateral Displacements

Horizontal displacements are most problematic where sites are located on sloping ground, or near-to a free face such as a shoreline or large drainage channel. These conditions introduce a static bias within the soils and encourage post-liquefaction reconsolidation strains to accumulate in one direction.

The topography surrounding the site is relatively level and therefore, post-liquefaction lateral displacements are considered negligible for this site.

5.4.4 Liquefaction Induced Foundation Shear Failure

Soil liquefaction can cause a loss of vertical load carrying capacity of foundation soils. Foundations supported on non-liquefiable surficial soils can punch through into the underlying liquefied soils.

Based on the anticipated site grades we do not expect that there is sufficient thickness of non-liquefiable soils above the liquefiable stratum to prevent shear induced punching failure. Therefore, it is recommended to support the building on a raft foundation.

5.5 Liquefaction Mitigation Considerations

Provided that structural design can tolerate the post-liquefaction settlements described above, ground improvement to reduce the potential for liquefaction is not considered necessary. If the settlements as described above cannot be accommodated in the structural design of the building, then ground improvement would need to be considered.

5.6 Foundation Support Considerations

Following the recommended site preparation and preloading, we recommend that the building be supported on a raft foundation.

6.0 DESIGN RECOMMENDATIONS

6.1 Site Preparation

6.1.1 Stripping

Site stripping beneath buildings and on-site roads includes removing all trees and vegetation, organic debris, topsoil, structures, foundations, variable fill materials, and any other material considered to compromise the design recommendations herein. In all cases related to the construction these unsuitable materials should be excavated to expose a subgrade consisting of native sand or silty sand.

6.1.2 Compaction

Following stripping, the exposed granular soils should be compacted in place with a large ride-on vibratory compactor.

6.1.3 Site Grading – Engineered Fill

Following compaction, it may be necessary to place fill materials to achieve the desired building grades. Any fill materials placed beneath foundations, grade supported slabs, or roads should be carried out with “engineered fill”.

In the context of this report “engineered fill” is defined as clean sand and gravel fill, compacted in 300 mm loose lifts to a minimum standard of 95% of its Modified Proctor Maximum Dry Density (ASTM D1557) while at a moisture content that is within 2% of its optimum for compaction.

6.1.4 Preloading

Following site stripping and filling we recommend that the building area be preloaded to reduce the total and differential settlements associated with the consolidation of the underlying silt, clayey silt, and peat and to help reduce long-term settlements associated with the underlying peat deposits.

The preload would expose the underlying near-surface compressible soils to a level of stress greater than that anticipated following construction. We do not expect any significant stress attenuation between the applied stress at foundation level and the compressible stratum. Therefore, the foundations are required to be designed as not to exceed the pre-consolidation stress which will be applied during the preload period.

We recommend that for preliminary design purposes you allow for a 3.5 to 4.5 m high preload sand or sand and gravel above the finished slab level. The preload should extend outside of the edge of the foundations, at full height, a distance at least 1.5 m and then sloped at 1.5H to 1V to existing site grades. Any fill proposed for any nearby parking areas, roadways, and any raised landscaped or hardscaped areas should be placed at the time of preload placement.

Settlement gauges should be installed within the preload to measure the rate of settlement. Based on our experience in the area, we estimate that it will take 6 to 9 months for primary consolidation settlement to be complete; at which point the preload could be removed, however, ultimately the preload performance would govern when it can be removed.

Once the building design has been finalized and structural loads are available a preload design drawing can be prepared upon request.

6.2 Foundation Recommendations

6.2.1 Raft Foundation

We expect that following the preloading treatment that building loads could be supported on a raft foundation at serviceability limit state (SLS) bearing pressures of up to 60 kPa and a factored ultimate limit state (ULS) bearing pressure of up to 120 kPa. The bearing capacity for final design should be confirmed once the preload design is complete.

6.2.2 Subgrade Modulus

We recommend that the structural engineer consider a subgrade reaction modulus of 20 MPa/m for preliminary design however, we actual modulus should be confirmed, through testing, at the time of initial site preparation prior to preload placement.

6.2.3 Settlement of Foundations

Post-construction foundation settlements should be expected due to the underlying peat deposits which will continue to settle long-term as they degrade. Frontera can provide updated anticipated settlements once the site has been preloaded and the associated settlements have been reviewed.

6.2.4 Seismic Design of Foundations

The proposed development site qualifies as Site Class F as defined in Table 4.1.8.4.A of the BCBC 2018 due to the presence of liquefiable soils beneath the site. However, in accordance with 4.1.8.4(8), we have assumed that the structure will have a fundamental period of vibration of less than 0.5 seconds and therefore we recommend that the site be classified as “Site Class E” for structural design purposes.

In accordance with BCBC 2018, Section 4.1.8.16., Sentence 8 b), the requirement that “spread footings founded on soil defined as Site Class E or F shall be interconnected by continuous ties in not less than two directions” should be adhered to.

6.2.5 Frost Protection

All foundations should be located a minimum of 0.6 m below site grades for frost protection.

6.4 Concrete Slabs

All grade supported concrete slabs should be underlain by a minimum of 150 mm of 19 mm clear crushed gravel, to help prevent moisture from accumulating below the slab, placed over compacted “engineered fill” as described in this report. The gravel should be lightly tamped in place. We recommend that a poly moisture barrier be placed overlying the gravel beneath the grade supported slabs to help reduce moisture within the concrete.

6.5 Backfill

Backfill adjacent to the foundations should be completed with free draining material such as clean sand and gravel or crushed rock fill containing less than 5% fines. The backfill should be compacted in lifts. In areas where the backfill will support hard landscaping or pavement areas the material should be compacted to a minimum of 95% of its Modified Proctor Maximum Dry Density while at a moisture content that is within 2% of its optimum for compaction.

6.6 Methane Generation Potential

Methane will be produced as a by-product of the natural decay of the underlying peat. Therefore, a gas barrier and gas ventilation system should be incorporated into the project in accordance with building code requirements.

6.7 On-Site Pavement Structures

The peat deposits present beneath the pavement structure will continue to settle with time as the organics decompose and therefore some maintenance due to settlement should be planned for. Following the recommended site preparation outlined in this report, the following pavement structure is considered sufficient to carry the vehicular loading for on-site parking areas.

Table 1: Recommended minimum pavement structure for parking areas

Material	*Thickness (mm)*
Asphaltic Concrete	75
19 mm minus crush gravel base	150
100 mm minus, well graded, clean, sand and gravel subbase course	300

All base and sub-base materials should be compacted to a minimum of 95% of their Modified Proctor Maximum Dry Density (ASTM D698) at a moisture content that is within 2% of optimum for compaction.

The use of geosynthetics in the asphalt subgrade or within the pavement section could be considered to help reduce the effects of settlement on the pavement and improve long-term pavement performance.

7.0 FIELD REVIEWS

As is normally required for Municipal Letters of Assurance, Frontera Geotechnical Inc. should be asked to carry out sufficient field reviews during construction to ensure that the Geotechnical Design recommendations contained within this report have been adequately communicated to the design team and to the contractors implementing the design. These field reviews are not carried out for the benefit of the contractors and therefore do not in any way effect the contractor's obligations to perform under the terms of their contract.

It is the contractors' responsibility to advise Frontera Geotechnical Inc. (a minimum of 24 hours in advance) that a field review is required. Geotechnical field reviews are normally required at the time of the following:

1.	Stripping	Review of stripped subgrade prior to any fill placement
2.	Engineered Fill	Review of materials, placement, and compaction
3.	Preload	Review of preload location and settlement readings
4.	Subgrade	Review of prepared foundation subgrade
5.	Slab-on-grade	Review of slab-on-grade preparation
6.	Backfill/Frost Depth	Review of final building backfill

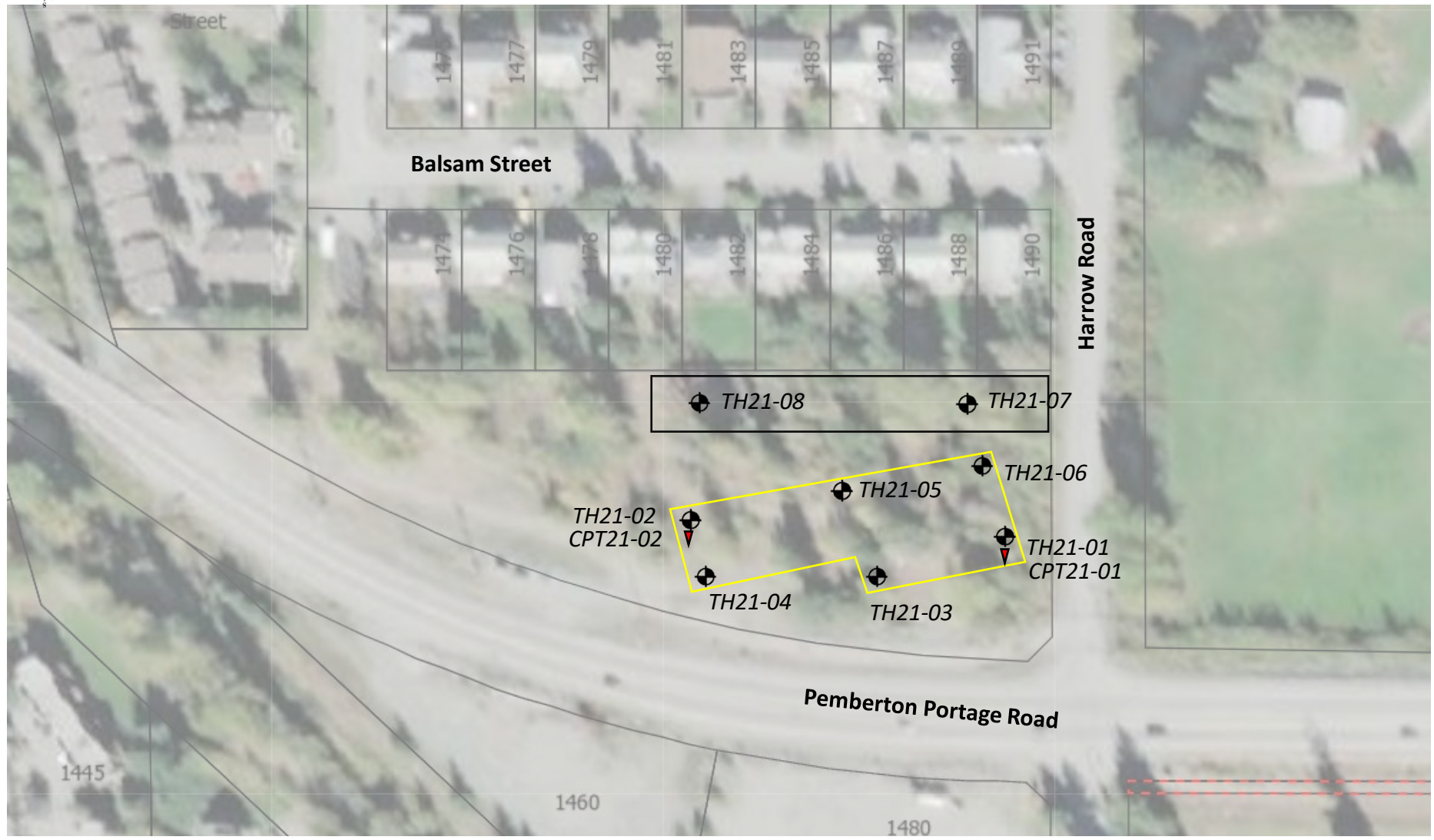
It is critical that these reviews are carried out to ensure that our intentions have been adequately communicated. It is also critical that contractors working on the site view this document in advance of any work being carried out so that they become familiarized with the sensitive aspects of the works proposed. It is the responsibility of the developer to notify Frontera Geotechnical Inc. when conditions or situations not outlined within this document are encountered.

8.0 CLOSURE

This report is prepared solely for use by our client and their design team for this project as described to the general standards of similar work for similar projects in this area and no other warranty of any kind is expressed or implied. Frontera Geotechnical Inc. accepts no responsibility for any other use of this report.

We are pleased to assist you with this project, and we trust this information is helpful and sufficient for your purposes at this time. Please do not hesitate to call the undersigned if you require clarification or additional details.

Frontera Geotechnical Inc.



Geotechnical Investigation Plan

Proposed Mixed-Use Development

Lot 2 Harrow Road, Pemberton, BC

FILE NO. 1706

DWG NO. 1706 - 01

LEGEND

- Auger Borehole
- CPT Location

Date: 2021-10-05

Drawn By:	Approved By:	Reviewed By:
JB		

Scale: NTS, Locations Approximate

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APPENDIX A
TEST HOLE LOGS

Test Hole Log: TH21-01

Project No.: 1706
Project: Proposed Mixed-Use Development
Client: Sea to Sky Community Services Society
Location: Lot 2 Harrow Road, Pemberton, BC

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Depth (m)	Soil Profile: Strata	Soil Profile: Description	Soil Profile: Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.0				
0 – 2		**SAND** Medium grained, well graded, loose, moist, brown.	204.0		20		
2 – 3		**SAND** Coarse grained, well graded, loose, wet, grey.	203.2		20	▼	
3 – 4		**PEAT** Fibrous peat, woody, trace silt, soft, wet, brown.	201.4		196		
4 – 6		**SILT** Trace organics (wood), low plastic, soft, brown.	199.9		32		
6		End of Borehole					

Dynamic Cone Penetration Resistance: 0 20 40 60 80 (blows/0.3m)

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-02

Project No.: 1706
Project: Proposed Mixed-Use Development
Client: Sea to Sky Community Services Society
Location: Lot 2 Harrow Road, Pemberton, BC

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Depth (m)	Soil Profile: Strata	Description	Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.7				
0		**SAND** Fine to medium grained, poorly graded, loose, dry to moist. 1.5 m - grades to medium-coarse. 2.1 m - becomes wet and grey.			25		
3			203.3				
3		**SILT** Low plastic, soft, moist, grey.	202.8				
4		**Clayey Peaty SILT** Low plastic, soft, moist to wet, brown/grey.	201.6		80		
5					297		
6		**PEAT** Amorphous with some fibres, soft, wet, brown	200.6				
		End of Borehole					

Dynamic Cone Penetration Resistance: 0 20 40 60 80

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-03

Project No.: 1706
Project: Proposed Mixed-Use Development
Client: Sea to Sky Community Services Society
Location: Lot 2 Harrow Road, Pemberton, BC

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Depth (m)	Soil Profile: Strata	Soil Profile: Description	Soil Profile: Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.5				
0		**SAND** Medium grained, well graded, loose, dry to moist, brown.		3, 7, 4, 5, 3			
2				2, 4, 4, 3, 4	28	▼	
3			203.1	5, 1, 0, 1, 1			
4		**Clayey SILT Interbedded with PEAT** Low plastic clayey silt, fibrous peat, soft, moist, grey/brown	202.2		118		
5		**PEAT** Fibrous,trace silt, soft, moist, dark brown.	201.3	3, 3, 2, 4, 7	139		
6		**SILT** Low plastic, soft, moist, grey.	200.4		53		
7		End of Borehole					
8							
9							
10							

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
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Test Hole Log: TH21-04

Project No.: 1706
Project: Proposed Mixed-Use Development
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Depth (m)	Soil Profile: Strata	Soil Profile: Description	Soil Profile: Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.3				
0		**SAND** Fine grained, uniformly graded, loose, dry, brown.	205.6				
1		**SAND** Coarse grained, well graded, loose, moist, brown.	203.3				
3		**SILT** Low plastic, soft, moist, grey.	202.7				
4		**Clayey SILT** Intact organic fiber, low plastic, soft, moist, grey/brown.	201.8				
5		**PEAT** Fiberous, trace silt, soft, moist, dark brown.	200.9				
6		**SILT** Low plastic, soft, wet, grey.	200.3				
7		End of Borehole					
8							
9							
10							

Dynamic Cone Penetration Resistance (blows/0.3m): 0 20 40 60 80

Dynamic Cone Penetration Resistance values: 3, 7, 7, 7, 5, 5, 5, 3, 5, 5, 3, 4, 2, 1, 3, 2, 5, 4, 4, 7, 10

Water Content (%): 25, 33, 101, 42

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-05

Project No.: 1706
Project: Proposed Mixed-Use Development
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Location: Lot 2 Harrow Road, Pemberton, BC

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Depth (m)	Strata	Description	Elevation (m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.4			
		SAND Medium grained, well graded, loose, dry to moist, brown.	204.4			
2		**SAND** Coarse grained, well graded, loose, wet, grey.	203.4	30		
3		**SILT** Low plastic, soft, moist, grey.	202.9	45		
4		**Clayey PEAT** Low plastic, soft, moist, grey/brown.	202.3	104		
5		**PEAT** Fibrous, soft, moist, dark brown.	201.2			
6		**SILT** Trace organics (rotten wood), low plastic, soft, wet, grey.		45		
7		**Silty SAND** Fine grained, uniformly graded, loose, moist, grey.	199.2			
8				33		
9		End of Borehole	197.3			
10						

Dynamic Cone Penetration Resistance (blows/0.3m): 0, 20, 40, 60, 80

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-06

Project No.: 1706
Project: Proposed Mixed-Use Development
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Depth (m)	Soil Profile: Strata	Soil Profile: Description	Soil Profile: Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m)	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.3				
0 – 1.5		**SAND** Medium grained, well graded, loose, dry to moist, brown.	204.8	1, 3, 5, 5, 7	6		
1.5 – 2.7		**SAND** Coarse grained, well graded, loose, wet, grey.	203.6	5, 3, 3, 2, 2	19	▼	
2.7 – 3.4		**SILT** Trace organics (intact fibers), low plastic, soft, moist, grey.	203.0	1, 1, 1, 2, 2	190		
3.4 – 4.4		**PEAT** Fibrous, soft, moist, dark brown.	201.9	4, 4, 7, 8, 5	40		
4.4 – 6.0		**Silty SAND** Fine grained, uniformly graded, loose, moist, grey.	200.3				
6		End of Borehole					
7 – 10							

Dynamic Cone Penetration Resistance: (blows/0.3m) 0 20 40 60 80

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-07

Project No.: 1706
Project: Proposed Mixed-Use Development
Client: Sea to Sky Community Services Society
Location: Lot 2 Harrow Road, Pemberton, BC

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604-898-1093
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Depth (m)	Strata	Description	Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m) 0 20 40 60 80	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.2				
0		**SAND** Trace gravel, medium to coarse grained, well graded, loose, dry to moist, brown.	204.7				
2		**SAND** Coarse grained, well graded, loose, wet, grey.	203.1		18	▼	
3		End of Borehole					

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

Test Hole Log: TH21-08

Project No.: 1706
Project: Proposed Mixed-Use Development
Client: Sea to Sky Community Services Society
Location: Lot 2 Harrow Road, Pemberton, BC

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604-898-1093
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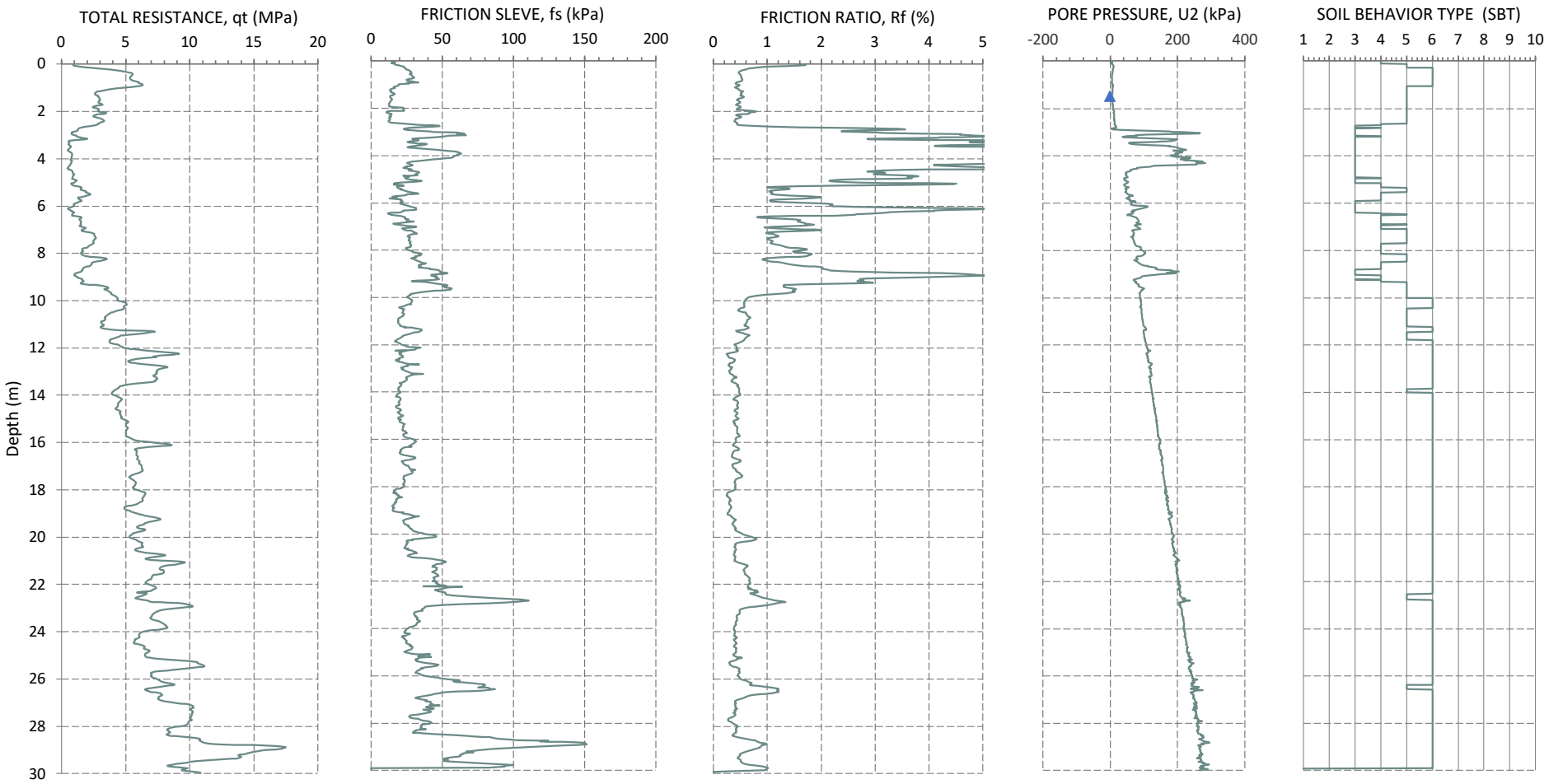
Depth (m)	Soil Profile: Strata	Soil Profile: Description	Soil Profile: Elevation (m)	Dynamic Cone Penetration Resistance (blows/0.3m) 0 20 40 60 80	Water Content (%)	Groundwater/Well	Remarks
0		Ground Surface	206.2				
0 – 1.4		**SAND** Medium grained, well graded, loose, dry to moist, brown. 1.4 m - grades to coarse.					
			204.4		28		
1.4 – 3		**SAND** Coarse grained, well graded, loose, wet, grey.				▼	
			203.1		48		
3		End of Borehole					

Date of Drilling: 10/22/2021
Rig Type: Solid Stem Auger
Logged By: SG

Datum: Bunbury Land Surveyin
Page: 1 of 1

APPENDIX B

CPT BASED SOIL INTERPERTATION



SBT Legend

1. Sensitive Fine Grained	4. Clayey Silt - Silty Clay	7. Gravely Sand - Sand
2. Organic Material	5. Silty Sand - Sandy Silt	8. Very Stiff Clay Sand
3. Clay - Silty Clay	6. Sand to Silty Sand	9. Very Stiff Fine Grained

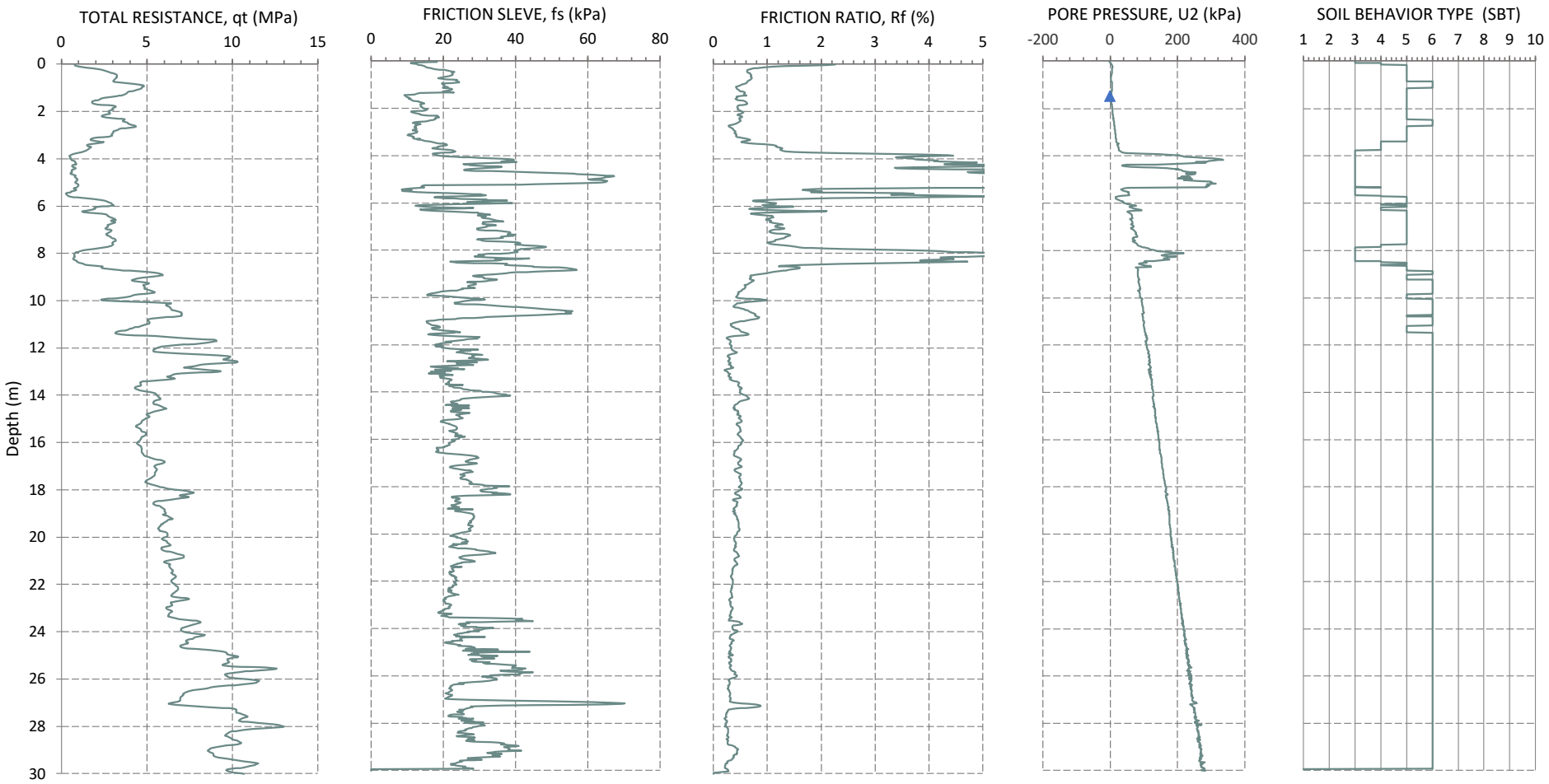
FRONTERA GEOTECHNICAL

Frontera Geotechnical Inc.
#1-38920 Queens Way
Squamish, BC V8B 0K8
604-898-1093

Client:	Sea to Sky Community Services Society
Job No.	1706
Location:	Lot 2 Harrow Road, Pemberton, BC
Date:	October 22, 2021
CPT Trace:	**CPT21-01**

Input Parameters and Analysis Data

SBT Method:	Robertson (1986)
Water Table (m, below grade):	1.5



SBT Legend

1. Sensitive Fine Grained	4. Clayey Silt - Silty Clay	7. Gravely Sand - Sand
2. Organic Material	5. Silty Sand - Sandy Silt	8. Very Stiff Clay Sand
3. Clay - Silty Clay	6. Sand to Silty Sand	9. Very Stiff Fine Grained

FRONTERA GEOTECHNICAL

Frontera Geotechnical Inc.
#1-38920 Queens Way
Squamish, BC V8B 0K8
604-898-1093

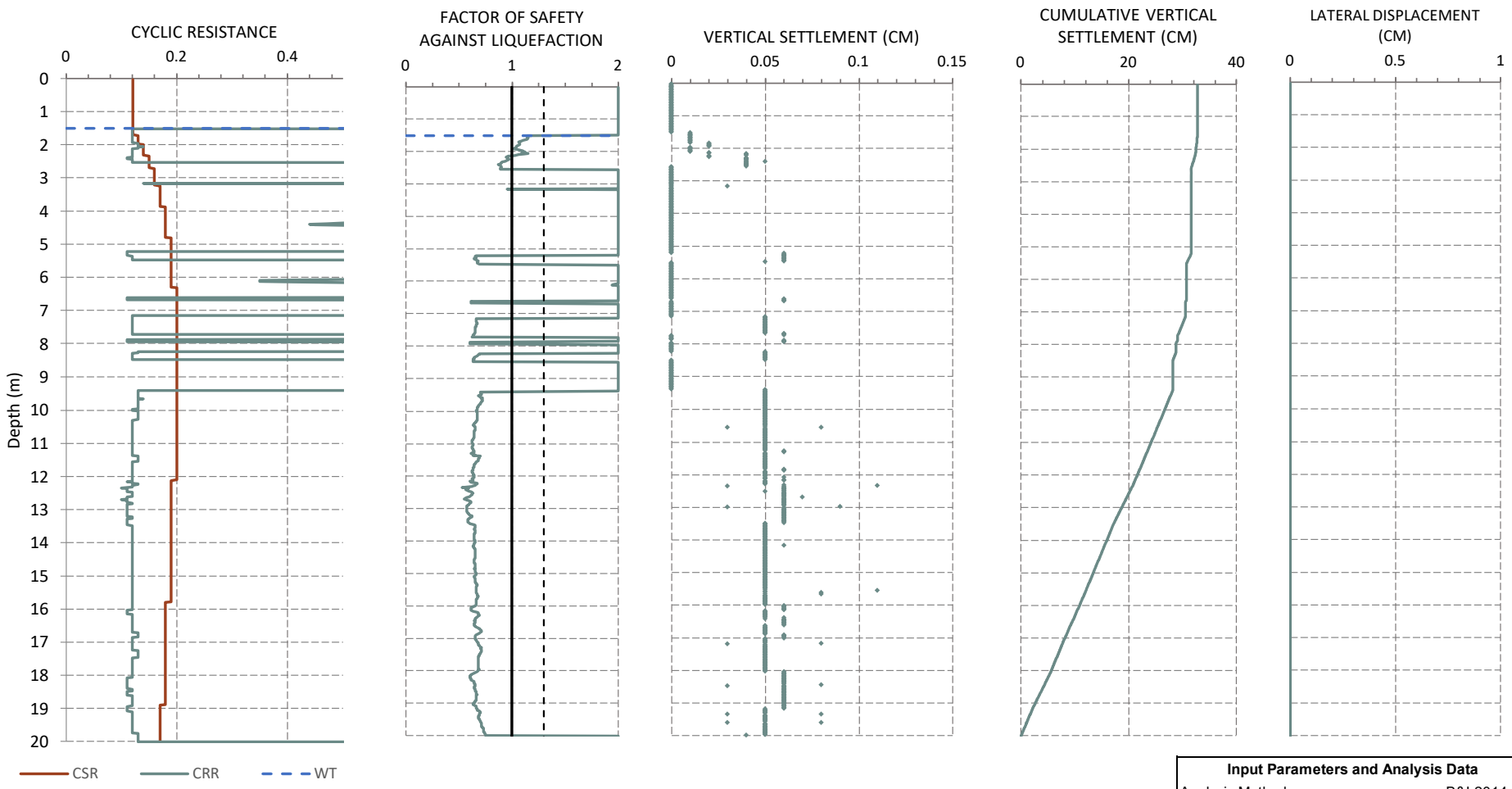
Client:	Sea to Sky Community Services Society
Job No.	1706
Location:	Lot 2 Harrow Road, Pemberton, BC
Date:	October 22, 2021
CPT Trace:	**CPT21-02**

Input Parameters and Analysis Data

SBT Method:	Robertson (1986)
Water Table (m, below grade):	1.5

APPENDIX C.1

1 IN 2,475 YEAR SEISMIC HAZARD CPT BASED LIQUEFACTION ANALYSIS



Input Parameters and Analysis Data	
Analysis Method:	B&I 2014
Fines Correction Method:	B&I 2014
Earthquake Magnitude:	7
Peak Ground Acceleration:	0.18
Seismic Hazard:	**1 in 2,475**
I_c cut-off value	2.6
Transitional Layer Detection:	ON
Limit Depth:	20.00 m
Water Table (m, below grade):	1.5

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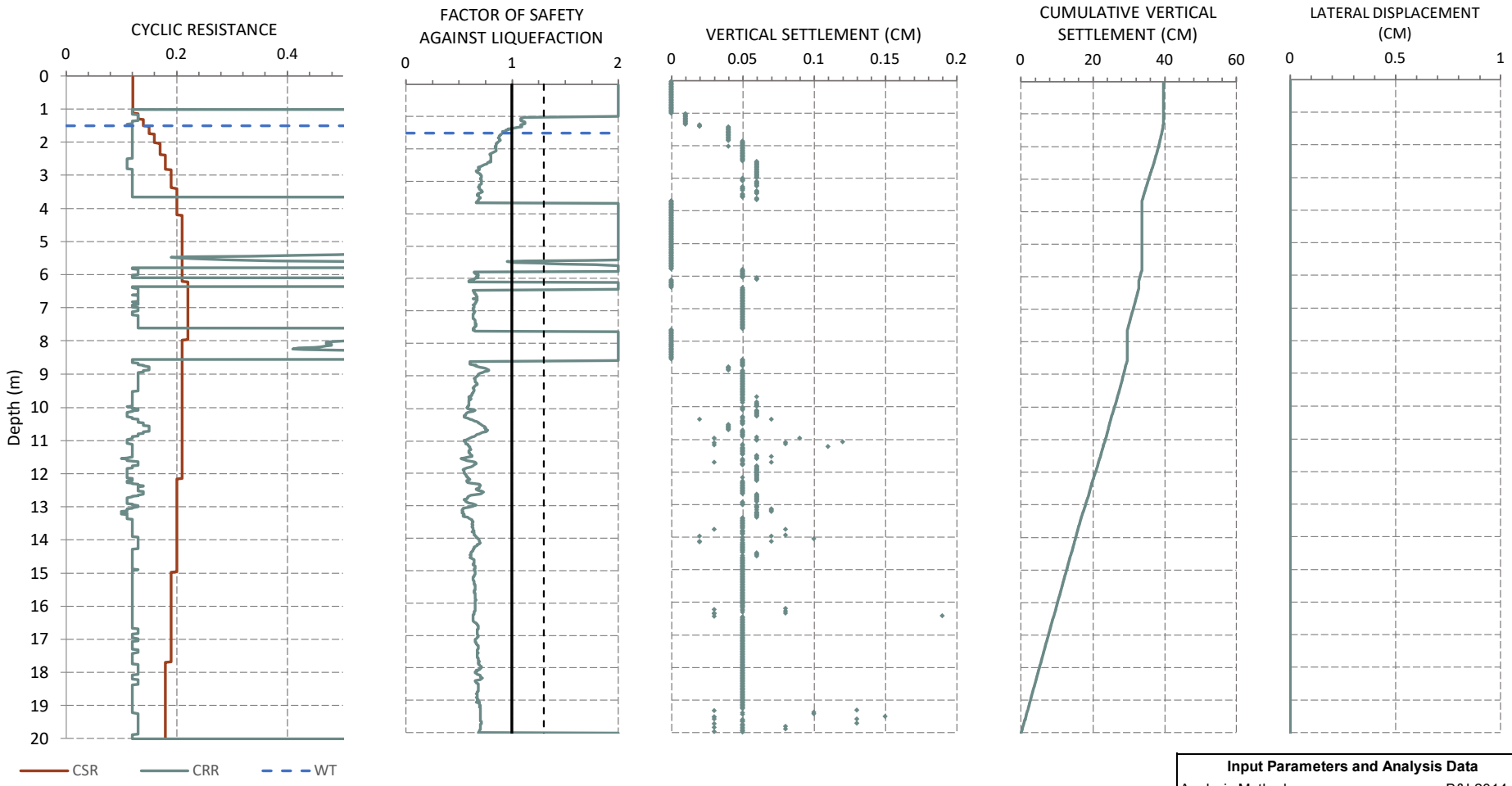
604-898-1093

Client: Sea to Sky Community Services Society
Job No. 1706
Location: Lot 2 Harrow Road, Pemberton, BC
Date: October 22, 2021
CPT Trace: **CPT21-01**



Input Parameters and Analysis Data	
Analysis Method:	B&I 2014
Fines Correction Method:	B&I 2014
Earthquake Magnitude:	7
Peak Ground Acceleration:	0.18
Seismic Hazard:	**1 in 2,475**
I_c cut-off value	2.6
Transitional Layer Detection:	ON
Limit Depth:	20.00 m
Water Table (m, below grade):	1.5

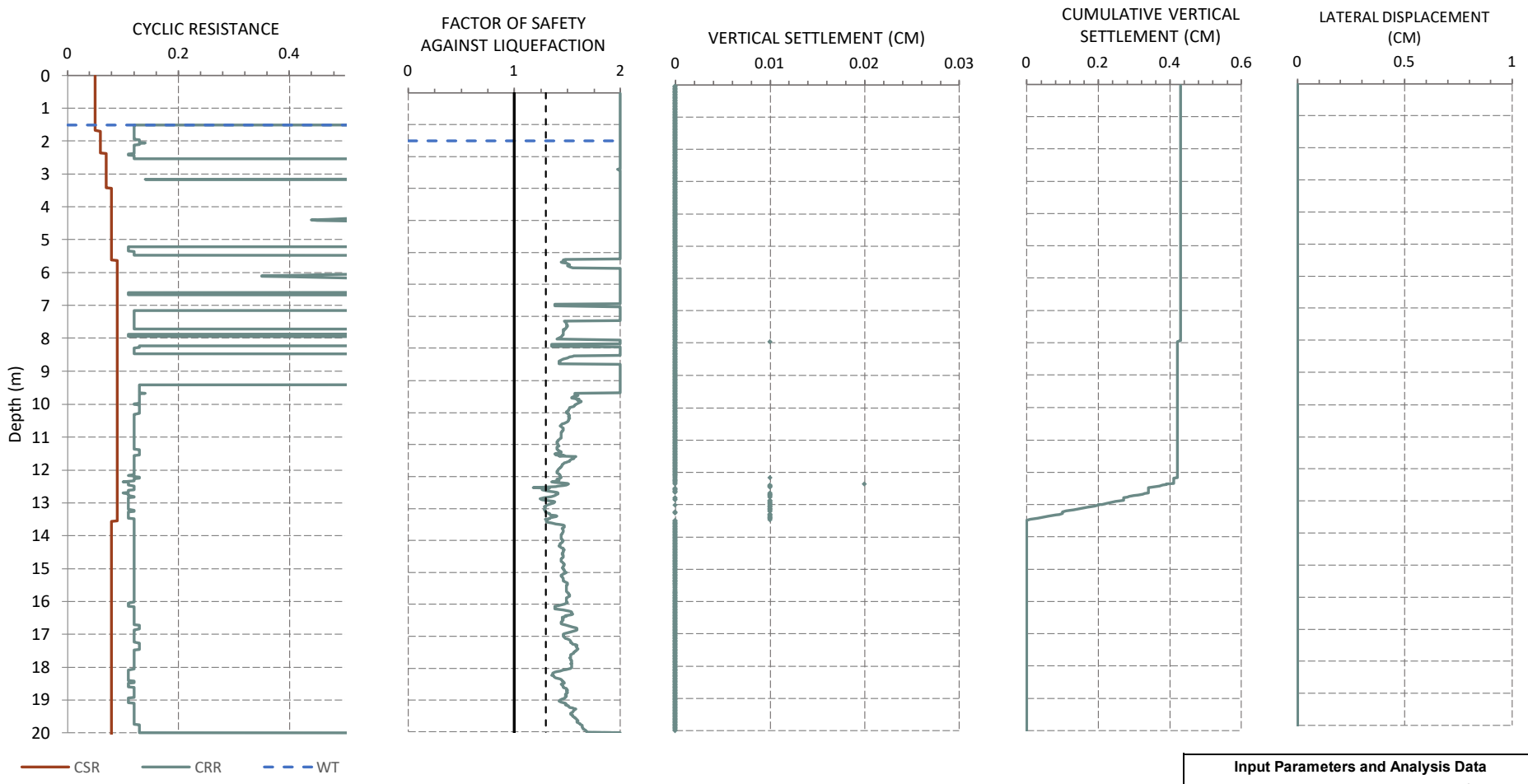
FRONTERA GEOTECHNICAL

Frontera Geotechnical Inc.
#1-38920 Queens Way
Squamish, BC V8B 0K8
604-898-1093

Client:	Sea to Sky Community Services Society
Job No.	1706
Location:	Lot 2 Harrow Road, Pemberton, BC
Date:	October 22, 2021
CPT Trace:	**CPT21-02**

APPENDIX C.2

1 IN 475 YEAR SEISMIC HAZARD CPT BASED LIQUEFACTION ANALYSIS



Input Parameters and Analysis Data	
Analysis Method:	B&I 2014
Fines Correction Method:	B&I 2014
Earthquake Magnitude:	7
Peak Ground Acceleration:	0.08
Seismic Hazard:	**1 in 475**
I_c cut-off value	2.6
Transitional Layer Detection:	ON
Limit Depth:	20.00 m
Water Table (m, below grade):	1.5

FRONTERA GEOTECHNICAL

Frontera Geotechnical Inc.
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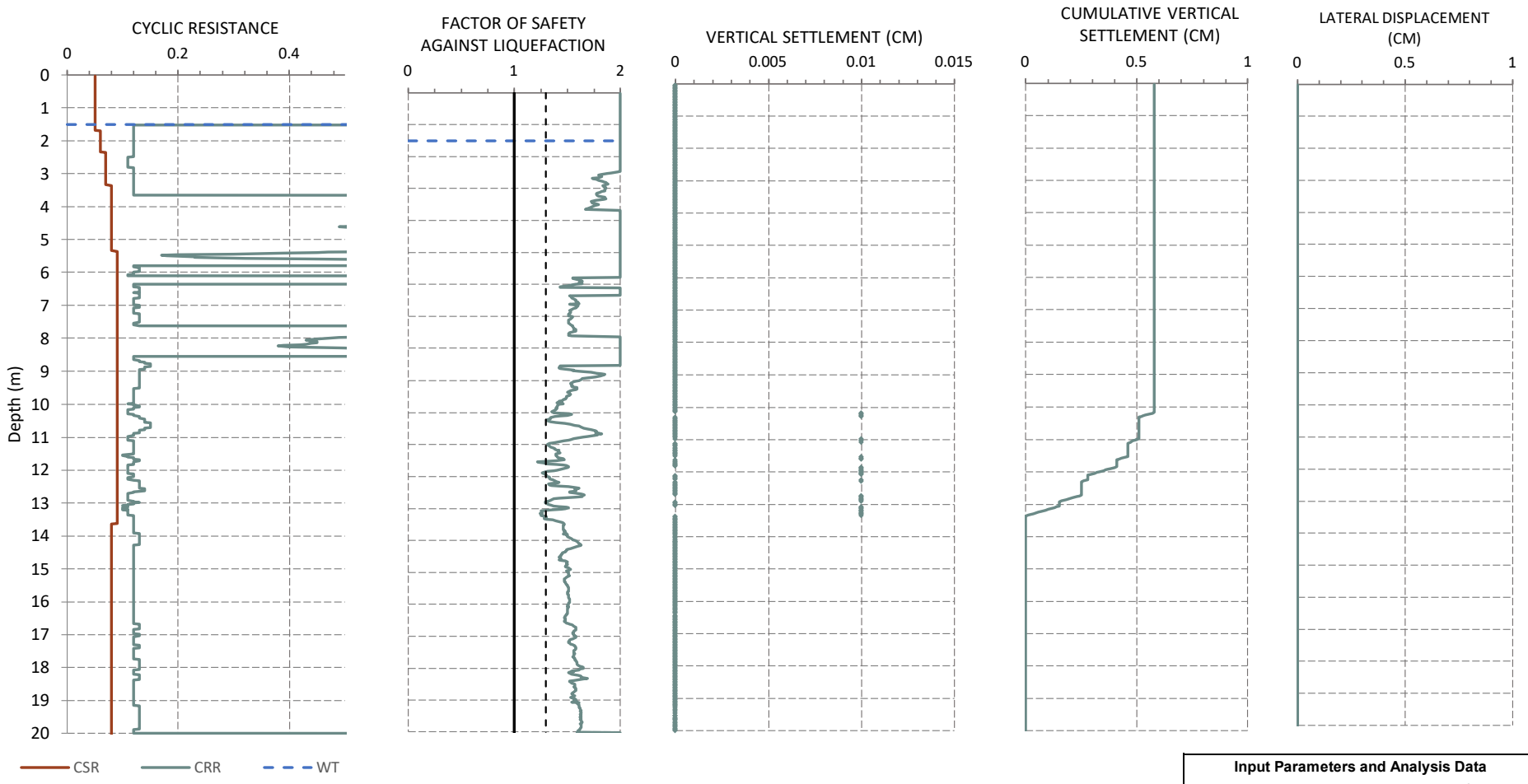
Client:	Sea to Sky Community Services Society
Job No.	1706
Location:	Lot 2 Harrow Road, Pemberton, BC
Date:	October 22, 2021
CPT Trace:	**CPT21-01**



Input Parameters and Analysis Data	
Analysis Method:	B&I 2014
Fines Correction Method:	B&I 2014
Earthquake Magnitude:	7
Peak Ground Acceleration:	0.08
Seismic Hazard:	**1 in 475**
I_c cut-off value	2.6
Transitional Layer Detection:	ON
Limit Depth:	20.00 m
Water Table (m, below grade):	1.5

FRONTERA GEOTECHNICAL

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Squamish, BC V8B 0K8
604-898-1093

Client:	Sea to Sky Community Services Society
Job No.	1706
Location:	Lot 2 Harrow Road, Pemberton, BC
Date:	October 22, 2021
CPT Trace:	**CPT21-02**