

Geotechnical Investigation

Proposed Residential Development

Conservancy Lands West Ottawa, Ontario

Prepared for Caivan Communities

Report PG5036-2 Revision 3, dated March 14, 2024



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1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Communities to prepare a geotechnical report for the proposed residential development to be located at the Conservancy Lands West, along Borrisokane Road in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2). The objective of the geotechnical investigation was to:

- Review available subsurface soil and groundwater information prepared by others.
- □ Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains the geotechnical findings and includes recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

It is understood that the proposed residential development will consist of singlefamily dwellings and townhouses with associated driveways, local roadways, landscaping areas, and park lands.

It is further anticipated that the proposed development will be serviced by future municipal water, sanitary and storm services.



3.0 Method of Investigation

3.1 Field Investigation

A geotechnical investigation was previously completed by others at the subject site during the periods of January 31 through March 31, 2017, and November 5 through 9, 2018. The geotechnical investigation consisted of 47 boreholes advanced to a maximum depth of 9.1 m below the existing ground surface. The locations of the boreholes are shown on Drawing PG5036-4 - Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. The drilling procedure consisted of augering to the required depths and sampling the overburden soils.

Reference should be made to the Soil Profile and Test Data sheets, prepared by others, which are presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Groundwater monitoring wells and standpipes were installed in 37 boreholes by others to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. All groundwater observations by others are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

3.2 Field Survey

The ground surface elevations at the borehole locations were surveyed by others and are understood to be referenced to a geodetic datum. The locations of the boreholes and the ground surface elevation for each borehole location are presented on Drawing PG5036-4 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

A total of 14 Shelby tube samples collected from the boreholes during the geotechnical investigation were submitted for unidimensional consolidation testing by others. The results of the consolidation testing are summarized in Section 5.3.

A total of 47 representative soil samples were submitted for Atterberg limit testing by others from the geotechnical investigation. The results of the Atterberg testing are presented in Section 4.2 and are discussed in Section 6.7.



4.0 Observations

4.1 Surface Conditions

Generally, the subject site consists of agricultural fields and is bordered by Highway 416 to the west, a railroad to the northwest, a stormwater retention pond to the northeast, vacant City Lands to the southeast, and the Jock River to the southwest. Foster Drain runs in a north-south direction across the east portion of the site. The existing ground surface across the site is relatively level at approximate geodetic elevation 91 to 92 m.

4.2 Subsurface Profile

Overburden

The subsurface profile encountered at the borehole locations generally consisted of an approximate 50 to 360 mm thick layer of topsoil underlain by a silty clay deposit.

The silty clay deposit was generally observed to have a very stiff to stiff, brown silty clay crust, becoming a firm to stiff, grey silty clay at approximate depths of 2.5 to 3 m below the existing ground surface. The silty clay deposit generally extended beyond the bottom of the boreholes at depths of up to 9 m.

However, near the western boundary of the site, a glacial till deposit was encountered underlying the silty clay at depths varying from 1.5 to 7.5 m below the existing ground surface. The glacial till was generally observed to consist of a loose to compact, grey silty clay to silty sand with some gravel, cobbles and boulders.

Laboratory Testing

Atterberg limit testing, as well as associated moisture content testing, was completed by others on recovered silty clay samples at selected locations throughout the subject site.

The results of the Atterberg limit tests are presented in Table 1 on the following page.



Table 1 - Atterberg Limits Results						
Borehole Number	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)	
BH 17-01	1.5	42	15	28	32	
BH 17-02	0.8	53	16	37	35	
BH 17-03	0.8	67	22	44	43	
BH 17-04	0.8	68	23	45	33	
BH 17-05	0.8	42	19	22	31	
BH 17-06	0.8	62	22	41	40	
BH 17-07	0.8	50	16	34	30	
BH 17-08	0.8	45	19	26	35	
BH 17-10	1.5	27	17	10	27	
BH 17-09	1.5	43	19	24	35	
BH 17-16	0.8	66	22	44	42	
BH 17-17	1.5	42	17	25	34	
BH 17-18	1.5	38	15	23	37	
BH 17-19	0.8	67	21	46	41	
BH 17-20	0.6	52	17	35	32	
BH 17-21	0.8	40	20	20	33	
BH 17-22	0.8	35	20	15	32	
BH 17-23	1.5	44	16	28	37	
BH 17-24	0.8	56	17	39	46	
BH 17-25	1.4	30	17	13	33	
BH 17-26	0.8	60	18	42	37	
BH 17-27	0.8	61	21	40	44	
BH 17-28	0.8	54	21	33	38	
BH 17-29	0.8	37	19	18	31	
BH 17-30	0.6	43	16	27	32	
BH 17-31	0.8	53	16	46	40	
BH 17-32	0.8	43	16	27	32	
BH 17-33	0.8	58	17	41	36	
BH 17-34	0.8	59	17	42	39	
BH 17-35	0.6	47	20	27	36	
BH 17-36	0.8	53	17	36	35	



Borehole Number	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)
BH 17-37	0.8	36	19	17	33
BH 17-38	0.5	46	16	30	32
BH 18-01	0.8	51	21	30	59
BH 18-02	1.5	36	16	20	45
BH 18-03	0.7	66	26	40	50
BH 18-04	1.5	35	17	18	37
BH 18-05	0.8	56	23	33	39
BH 18-06	0.8	64	26	28	46
BH 18-07	0.8	42	21	21	30
BH 18-08	1.5	54	21	33	45
BH 18-09	0.8	55	22	33	40
BH 18-10	1.5	35	16	19	33
BH 18-11	0.8	30	19	11	29
BH 18-12	1.5	47	20	27	37
BH 18-13	0.8	31	18	13	30
BH 18-14	1.5	38	18	20	33

The results of the shrinkage limit test indicate a shrinkage limit of 17.7% and a shrinkage ratio of 1.85.

Bedrock

Based on available geological mapping, bedrock in the area consists of interbedded limestone and dolomite of the Gull River formation with overburden drift thicknesses ranging between 5 and 15 m.

4.3 Groundwater

Groundwater levels (GWL) were measured by others in 37 boreholes following completion of the geotechnical investigation. The measured GWL readings are presented in Table 2 on the following page. It should be noted that surface water can become trapped within a backfilled borehole, which can lead to higher than normal groundwater level readings. It should be noted that long-term groundwater levels within a silty clay deposit can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples.



Based on these observations, the long-term groundwater level is expected between a 2 to 3 m depth.

However, it should be noted that the groundwater levels can fluctuate periodically throughout the year and higher levels could be encountered at the time of construction.

Table 2 – Summary of Groundwater Level Readings						
Borehole Number	Ground Elevation	(m)		Recording Date		
	(m)	Depth	Elevation			
BH 17-01	91.76	0.69	91.07	February 21, 2017		
BH 17-05	91.12	1.22	89.90	February 21, 2017		
BH 17-09	90.87	0.81	90.06	February 21, 2017		
BH 17-16	91.27	0.93	90.34	April 13, 2017		
BH 17-17A	91.82	0.61	91.21	March 31, 2017		
BH 17-18A	91.40	0.45	90.95	March 31, 2017		
BH 17-19	91.24	1.35	89.89	April 13, 2017		
BH 17-20A	91.03	0.66	90.37	March 31, 2017		
BH 17-22	91.36	0.37	90.99	April 13, 2017		
BH 17-23	91.41	0.06	91.36	April 13, 2017		
BH 17-24	90.90	0.31	90.59	April 13, 2017		
BH 17-25A	91.09	0.01	91.08	March 31, 2017		
BH 17-26	91.54	0.26	91.28	March 31, 2017		
BH 17-28A	91.10	0.32	90.78	March 31, 2017		
BH 17-30	90.92	0.46	90.46	April 13, 2017		
BH 17-32A	91.05	0.42	90.63	March 31, 2017		
BH 17-33	91.53	0.45	91.08	April 13, 2017		
BH 17-35	91.04	0.54	90.50	April 13, 2017		
BH 17-36A	91.35	0.62	90.73	March 31, 2017		
BH 17-38A	91.24	0.61	90.63	March 31, 2017		
BH 18-01	92.12	-0.19	92.31	April 30, 2019		
BH 18-02	91.65	0.46	91.19	April 30, 2019		
BH 18-03	91.32	0.22	91.09	April 30, 2019		
BH 18-04A	91.28	0.06	91.22	April 30, 2019		



Table 2 – Summary of Groundwater Level Readings						
Borehole Number	Ground Elevation	Measured Groundwater Level (m)		Ground (m)	Recording Date	
	(m)	Depth	Elevation	U		
BH 18-04B	91.28	0.22	91.06	April 30, 2019		
BH 18-05	91.29	0.19	91.10	April 30, 2019		
BH 18-06	91.25	0.18	91.07	April 30, 2019		
BH 18-07A	91.43	0.51	90.92	April 30, 2019		
BH 18-07B	91.43	0.25	91.18	April 30, 2019		
BH 18-8	91.48	0.32	91.16	April 30, 2019		
BH 18-9	91.12	0.07	91.05	April 30, 2019		
BH 18-10	91.24	0.18	91.06	April 30, 2019		
BH 18-11	91.26	0.05	91.21	April 30, 2019		
BH 18-12A	91.14	0.08	91.06	April 30, 2019		
BH 18-12B	91.14	0.04	91.10	April 30, 2019		
BH 18-13	91.07	0.49	90.57	April 30, 2019		
BH 18-14	91.38	0.37	91.01	April 30, 2019		
Notes: Borehole eleva	itions are refere	enced to a geodetic	c datum.	·		



5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed residential development. It is expected that the proposed residential buildings will be founded on conventional shallow footings placed on an undisturbed, stiff to firm silty clay bearing surface or an engineered fill pad over an approved subgrade soil.

Due to the presence of a silty clay deposit, permissible grade raise restrictions are recommended for this site.

A construction setback defined as the Limit of Hazard Lands has been defined for the slope face along the adjacent segment of the Jock River, as presented on Drawing PG5036-4 - Test Hole Location Plan. This is discussed further in Section 6.8.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Grading and Preparation

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

It is anticipated that the existing fill, free of deleterious materials and topsoil can be left in place below the proposed park blocks. However, it is recommended that the existing fill layer be thoroughly proof-rolled under dry conditions and in above freezing temperatures, using several passes of a vibratory drum roller and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with approved fill material, such as OPSS Granular B, Type II.

Fill Placement

Fill used for grading beneath the building areas, including the park blocks, should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Consideration could be given to using an alternative granular fill provided that the geotechnical engineer provides fill placement recommendations for the selected material. Granular material should be tested and approved prior to delivery to the site.



The fill should be placed in loose lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**. Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, firm silty clay bearing surface can be designed using a bearing resistance value at SLS of **60 kPa** and a factored bearing resistance value at ULS of **90 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

Footings placed over an engineered pad, consisting of a Granular A or Granular B Type II or approved granular fill alternative placed in maximum 300 mm loose lifts and compacted to 98% of its SPMDD, can be designed using a bearing resistance value at SLS of 100 kPa and a factored bearing resistance value at ULS of 200 kPa.

Bearing resistance values for footing design should be determined on a per lot basis at the time of construction. The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.



Park Block Structures

Thickened edge concrete slabs or footings supported on the proof-rolled and approved existing fill can be designed using a bearing resistance value at serviceability limit states (SLS) for **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **180 kPa**, provided that the bearing surface is inspected and approved by the geotechnical consultant at the time of construction. The total and differential settlements for the proposed structures are 25 and 20 mm, respectively.

Where the existing fill material is encountered at the foundation subgrade, the existing fill shall be proof-rolled under dry conditions and above freezing temperatures, using a vibratory drum roller making several passes and approved by the geotechnical consultant at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with approved fill material, such as OPSS Granular B, Type II.

The bearing medium under thickened edge concrete slab supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to silty clay and engineered fill above the groundwater table when a plane extending horizontally and vertically from the underside of the foundation at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Consideration can be given to slab-on-grade construction within the park blocks. With the removal of fill, containing significant amounts of deleterious or organic materials, the existing fill or native soil subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for slab-on-grade construction. Where the subgrade consists of existing fill, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill such as OPSS Granular B Type II.

It is recommended the upper 400 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill material required to raise grade within the footprint of settlement sensitive structures should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.



Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Twelve (12) site specific consolidation tests were conducted by others as part of the geotechnical investigation at the subject site. The results of the consolidation testing are presented in Table 3 below.

Table 3 - Summary of Consolidation Test Results						
Borehole Number	Sample	Depth (m)	p' _c (kPa)	p'₀ (kPa)	C _{cr}	Cc
BH 17-01	3	3.60	110.0	35.0	0.055	0.760
BH 17-05	5	5.00	85.0	50.0	0.055	0.800
BH 17-07A	1	6.50	115.0	55.0	0.005	1.540
BH 17-08	5	6.50	90.0	55.0	0.009	0.970
BH 17-16	7	8.10	115.0	65.0	0.006	1.470
BH 17-17	4	4.90	105.0	45.0	0.011	1.070
BH 17-19	4	5.00	90.0	50.0	0.004	1.100
BH 17-21	5	6.50	110.0	60.0	0.007	1.330
BH 17-33	6	8.00	85.0	60.0	0.007	2.280
BH 17-35	5	6.40	110.0	50.0	0.004	1.160



Table 3 - Summary of Consolidation Test Results						
Borehole NumberSampleDepth (m)p'c (kPa)p'o (kPa)CcrCc						
BH 18-03	5	3.40	58.0	35.0	0.011	0.540
BH 18-07	5	5.00	115.0	42.0	0.004	1.110

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c , as compared to the C_{cr} , illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

The values of p'_c , p'_o , C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests carried out for the present investigation are based on the long term groundwater level observed at each borehole location. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 1 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when buildings are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away



from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking.

The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

Based on the consolidation testing results and undrained shear strength values at the borehole locations and our experience with local Ottawa clays, we have determined our permissible grade raise recommendations for the current phase of the proposed development. Our permissible grade raise recommendations are presented in Drawing PG5036-5 - Permissible Grade Raise Plan in Appendix 2.

Based on the above discussion, several options could be considered to accommodate proposed grade raises with respect to our permissible grade raise recommendations, such as the use of lightweight fill, which allow for raising the grade without adding a significant load to the underlying soils. Alternatively, it is possible to preload or surcharge the subject site in localized areas provided sufficient time is available to achieve the desired settlements.

5.4 Test Fill Pile Settlement Monitoring Program

Between January 30, 2020 and February 11, 2020, a test fill pile settlement monitoring program consisting of two (2) test fill piles (Piles D and DD) was initiated. The test fill piles were strategically placed across the subject site to provide additional information regarding our permissible grade raise recommendations for the area. The test fill piles consisted of a 30 m x 30 m pile, ranging in height from 2.5 to 3.1 m at the time of construction. Two (2) settlement plates were installed in each of the two (2) test fill piles. An initial baseline survey was conducted on each settlement plate at the time of installation to accurately monitor settlement contributed by the test fill piles.

The results of the monitoring program indicate that up to 37 mm of settlement at Test Fill Pile D and DD have occurred since the initial baseline survey. The monitoring results to date are considered to have confirmed that our original permissible grade raise recommendations for the site.

The test fill piles are outlined in Drawing PG5036-4 - Test Hole Location Plan in Appendix 2. The periodic readings, including most recent results, from our test fill pile settlement monitoring program are presented in Figure 6 - Test Fill Pile Settlement Monitoring Program in Appendix 2.



5.5 Design for Earthquakes

The results of seismic shear wave velocity testing performed by others indicated an average shear wave velocity, Vs_{30} , at this site of 211 m/s and 176 m/s. A **Site Class D** is therefore applicable for design across the majority of the site. However, a **Site Class E** is applicable for an area within the northeast portion of the site, as shown on Drawing PG5036-4 in Appendix 2. The soils underlying the subject site are not susceptible to liquefaction.

Reference should be made to the latest revision of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

5.6 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill from within the footprint of the proposed buildings, the native soil surface or approved fill subgrade will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

For structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

5.7 Pavement Design

For design purposes, the pavement structure presented in the following tables is recommended for the design of park block pathways, access pathways, car only parking areas, local roadways and arterial roadways with bus traffic.



Table 4 - Recommended Pavement Structure – Park Block Pathways						
Thickness (mm) Material Description						
50	Wear Course - HL 3 or Superpave 12.5 Asphaltic Concrete					
300 SUBBASE - OPSS Granular B Type II						
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill						

Table 5 - Recommended Pavement Structure – Driveways / Car Only Parking Areas / Park Block Parking Areas and Access Pathways							
Thickness (mm)	Material Description						
50	Wear Course - HL 3 or Superpave 12.5 Asphaltic Concrete						
150	BASE - OPSS Granular A Crushed Stone						
300	SUBBASE - OPSS Granular B Type II						
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill							

Table 6 - Recommended Pavement Structure - Local Roads						
Thickness (mm)	Material Description					
40	Wear Course - Superpave 12.5 Asphaltic Concrete					
50	Binder Course - Superpave 19.0 Asphaltic Concrete					
150	BASE - OPSS Granular A Crushed Stone					
450 SUBBASE - OPSS Granular B Type II						
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill						

Table 7 - Recommended Pavement Structure - Roadways with Bus Traffic						
Thickness (mm)	Material Description					
40	Wear Course - Superpave 12.5 Asphaltic Concrete					
50	Upper Binder Course - Superpave 19.0 Asphaltic Concrete					
50	Lower Binder Course - Superpave 19.0 Asphaltic Concrete					
150	BASE - OPSS Granular A Crushed Stone					
600 SUBBASE - OPSS Granular B Type II						
SUBGRADE - Either soil or fill	SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill					



If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and PG 64-34 asphalt cement should be used for roadways with bus traffic. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on maintaining the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing load carrying capacity.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD using suitable vibratory equipment.



6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended for each proposed structure. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone which is placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of freedraining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings, such as structures within the park blocks.

It is recommended that Paterson review the proposed frost protection for each structure at the time of detailed design.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavations to be undertaken by open-cut methods (i.e. unsupported excavations).



The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level.

The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

The pipe bedding for sewer and water pipes placed on a relatively dry, undisturbed subgrade surface should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay material will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.



Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater at this site, clay seals should be provided within the service trenches excavated through the silty clay deposit. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches excavated through the silty clay deposit.

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation, and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.



6.6 Winter Construction

The subsurface conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping Considerations

Tree Planting Restrictions - Area 1 - Low to Medium Sensitivity Area

A low to medium sensitivity clay soil was encountered between the anticipated design underside of footing elevations and 3.5 m below finished grade as per City Guidelines in the areas outlined in Drawing PG5036-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg limits test results, the modified plasticity index does not exceed 40% in these areas. The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to **4.5 m** for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the conditions noted below are met.

□ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan.



- □ A small tree must be provided with a minimum of 25 m³ of available soils volume while a medium tree must be provided with a minimum of 30 m³ of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.
- □ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.
- □ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Tree Planting Restrictions - Area 2 - High Sensitivity Area

High sensitivity clay soils were encountered between the anticipated design underside of footing elevations and 3.5 m below finished grade as per City Guidelines at the areas outlined in PG5036-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg limits test results, the modified plasticity index generally exceeds 40% in these areas. The following tree planting setbacks are recommended for these high sensitivity areas. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits are 7.5 m for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the following conditions are met:

- □ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan.
- □ A small tree must be provided with a minimum of 25 m³ of available soils volume while a medium tree must be provided with a minimum of 30 m³ of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.
- □ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.



- □ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Aboveground Swimming Pools

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer's recommendations.

Aboveground Hot Tubs

Additional grading around hot tubs should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications.

Decks and Building Additions

Additional grading around proposed decks or additions should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

6.8 Slope Stability Assessment

A slope stability analysis was carried out to determine the required construction setback from the top of the bank. Two (2) slope cross-sections were studied as the worst case scenarios.

Erosional and access allowances were also considered in the determination of limits of hazard lands and are discussed in the following sections. The cross-section locations and the proposed limit of hazard lands are shown on Drawing PG5036-4 - Test Hole Location Plan attached to the current report.



Slope Stability Assessment

The analyses of the stability of the slopes were carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favouring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain that the risks of failure are acceptable.

A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

The cross-sections were analyzed based on our review of the available topographic mapping. The slope stability analysis was completed at each slope cross-section under worst-case-scenario by assigning cohesive soils under fully saturated conditions. Subsoil conditions at the cross-sections were inferred based on nearby boreholes and general knowledge of the area's geology.

The effective strength soil parameters used for static analysis were chosen based on the subsoil information recovered during the geotechnical investigation. The effective strength soil parameters used for static analysis are presented in Table 8 below.

Table 8 - Effective Soil and Material Parameters (Static Analysis)							
Soil Layer	Unit Weight (kN/m ³) Friction Angle (degrees) Undrained Shear Strength (kPa)						
Brown Silty Clay Crust	17	33	5				
Grey Silty Clay	16	33	10				
Glacial Till	20	33	0				

The total strength parameters for seismic analysis were chosen based on the in situ, undrained shear strengths recovered within the open boreholes completed at the time of the geotechnical investigation and based on our general knowledge of the geology in the area. The strength parameters used for seismic analysis at the slope cross-sections are presented in Table 9 on the following page.



Table 9 - Total Stres	s Soil and Material Parar	neters (Seismic Analysis	s)
Soil Layer	Unit Weight (kN/m³)	Friction Angle (degrees)	Undrained Shear Strength (kPa)
Brown Silty Clay Crust	17	-	150
Grey Silty Clay	16	-	25 to 40
Glacial Till	20	33	0

Static Loading Analysis

The results for the slope stability analyses under static conditions at Sections A and B are shown on Figures 2 and 4, attached to the present report. The factor of safety was found to be greater than 1.5 at Sections A and B. Based on these results, the slopes are considered to be stable under static loading.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for all slopes. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The results of the slope stability analyses under seismic conditions are shown on Figures 3 and 5 in Appendix 2. The results indicate that the factors of safety are greater than 1.1 under seismic conditions. Based on these results, the slopes are considered to be stable under seismic loading. Therefore, when considering seismic loading, no geotechnical setback from the top of the slope is required to achieve a factor of safety of 1.1 for the limit of the hazard lands.

Geotechnical Setback - Limit of Hazard Lands

Based on site reconnaissance completed by others, signs of active erosion were noted along portions of the slope. A 5 m toe erosion allowance is deemed appropriate for this slope based on the cohesive nature of the soils, the observed erosion areas and the current watercourse depth and width. It is considered that a toe erosion allowance of 5 m and an erosion access allowance of 6 m is required from the top of stable slope (ie.- slope with factor of safety greater than 1.5).

The limit of hazard lands, which include these allowances, is indicated on Drawing PG5036-4 - Test Hole Location Plan attached to the present report.

It is recommended that any existing vegetation on the slope faces not be removed as it contributes to the stability of the slope and reduces erosion.



6.9 Corrosion Potential and Sulphate

Four (4) soil sample was submitted for analytical testing. The analytical test results of the soil sample indicate that the sulphate content is less than 0.01%. These results along with the chloride and pH value are indicative that Type 10 Portland cement would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a moderate to aggressive corrosive environment.



7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined:

- **Q** Review detailed grading plan(s) from a geotechnical perspective.
- Observation of all bearing surfaces prior to the placement of concrete.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- □ Observation of all subgrades and subdrains prior to placing backfilling materials.
- Observation of proof-rolling operations for subgrade within park blocks.
- □ Field density tests to ensure that the specified level of compaction has been achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.





8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should also be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole logs are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Caivan Communities or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Kevin A. Pickard, EIT

Report Distribution:

- Caivan Communities (email copy)
- Paterson Group (1 copy)



David J. Gilbert, P.Eng.



APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS BY OTHERS SYMBOLS AND TERMS BY OTHERS SEISMIC SITE CLASS TESTING RESULTS BY OTHERS SHRINKAGE LIMIT RESULTS BY OTHERS

LOCATION: N 5013143.8 ;E 361309.9

RECORD OF BOREHOLE: 17-01

SHEET 1 OF 1 DATUM: CGVD28

BORING DATE: February 2, 2017

SAMPLER HAMMER, 64kg; DROP, 760mm PENETRATION TEST HAMMER, 64kg; DROP, 760mm DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m HYDRAULIC CONDUCTIVITY, k, cm/s SOIL PROFILE SAMPLES BORING METHOD ADDITIONAL LAB. TESTING DEPTH SCALE METRES PIEZOMETER 30m STRATA PLOT 40 60 80 10⁻⁶ 10⁻⁵ 10-4 10⁻³ OR 20 NUMBER STANDPIPE INSTALLATION ELEV. TYPE SHEAR STRENGTH nat V. + Q - ● Cu, kPa rem V. ⊕ U - ○ WATER CONTENT PERCENT BLOWS/0. DESCRIPTION DEPTH -OW - WI WpH (m) 20 40 60 80 40 60 80 GROUND SURFACE 91.76 0 TOPSOIL - (SM) SILTY SAND; dark 0.00 brown; moist 0.16 (CL/C/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, Bentonite Seal ∇ w>PL, very stiff to stiff 1 SS 3 0 1 Bentonite and Cuttings Mix 2 SS 1 н ÷Он 2 \oplus + Bentonite Seal 89.02 \oplus (CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, +Silica Sand 3 firm Stem) TP 10 PH С 3 Standpipe Power Auger n Diam. (Hollow nm Diam. +f 4 Silica Sand + 50 4 SS WН 5 +Ð ⊕ + Native Backfill 6 SS WH 0 5 7 \oplus + ⊕ +X 84.14 7.62 \oplus + End of Borehole W.L. in Standpipe at Elev. 91.07 m on February 21, 2017 8 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM 9 10 MIS-BHS 001 DEPTH SCALE LOGGED: DG ê Golder 1:50 CHECKED: SD ssociates

RECORD OF BOREHOLE: 17-02

BORING DATE: February 1, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013269.0 ;E 361573.3 SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	ДОН	SOIL PROFILE	SA	MPLES						YDRAULIC CONDUCTIVITY, k, cm/s					PIEZOMETER			
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	TYPE BLOWS/0 30m	SHEA Cu, kł	20 4 I. R STREN Pa			Q - • U - O	w	ATER C	0 ⁻⁵ 10 L ONTENT W	PERCEN) ⁻³ NT WI	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
	ă		STI	(m)		ā	1	20 4	0	60 8	0			0 6		0	_	
0		GROUND SURFACE	.	91.75														
		brown; moist (CL/C/I/CH) SILTY CLAY to CLAY, some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.07	1	SS 8												
1					2	SS 4						F						
2					3	SS 2												
		(CI/CH) SILTY CLAY to CLAY; grey with		<u>89.01</u> 2.74			•			+	+							
3	w Stem)	black organic mottling; cohesive, w>PL, stiff to firm			4	ss w	н											
4	Power Auger 200 mm Diam. (Hollow Stem)						⊕ ⊕	+		+								
5					5	ss w	н											
							⊕	+++										
6					6	ss w	н											
7							⊕ ⊕	+ +										
8		End of Borehole		84.13 7.62			⊕	+										
9																		
10																		
DEI	PTH S	CALE		1		<u> </u>	Â	G	olde	r <u>ates</u>	L	1	I				LC	GGED: DG

RECORD OF BOREHOLE: 17-03

BORING DATE: February 1, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012851.9 ;E 361409.3 SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	DOH-	SOIL PROFILE	1.1		SA	MPLE		DYNAMIC PE RESISTANCE	NETRA , BLOW		Ì,	HYDRAU				NG	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ER	ш	BLOWS/0.30m		40		80	10			0 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
Ψ	RING	DESCRIPTION	ATA	DEPTH	NUMBER	TYPE)/S/(SHEAR STRE Cu, kPa	NGTH	nat V. ⊣ rem V. ∉	- Q - ● 9 U - O			PERCE		ADDI AB. T	INSTALLATION
	BO		STR	(m)	z		BLC	20	40	60	80	20			30	Ľ^	
0		GROUND SURFACE		91.20													
-		TOPSOIL - (SM) sandy SILT; dark brown; moist		0.00													
		(CL/Cl/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff															
		cohesive, w>PL, very stiff to stiff															
1					1	SS	3						 э——				
					2	SS \	WH										
2					-												
						1											
								0	+								
				88.46				•	+								
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm		2.74				~									
3		soft to firm															
	Stem)				3	ss \	wн										
	ger sllow 5																
	Power Auger Diam. (Hollo																
4	200 mm Diam. (Hollow Stem)						Ð	₽ +									
	200 m						e	€ +									
5					4	SS \	vvH										
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6					-												
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						1											
7								⊕ +									
							e	Ð +									
				83.58			e	€ +									
		End of Borehole		7.62													
8																	
9																	
Ĩ																	
10																	
DEI	PTH S	SCALE							ماط	N #						LC	DGGED: DG
1:{	50							F AG		er ates						СН	ECKED: SD

RECORD OF BOREHOLE: 17-04 LOCATION: N 5013010.7 ;E 361684.6

BORING DATE: February 1, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	DOH.	SOIL PROFILE		S	AMPLE		IAMIC PENETRA	NS/0.3m	Ì,	HYDRAULIC CONDU k, cm/s	UTIVITY,	RGF	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	(m)	_ =	ТҮРЕ	MOS.O/SHE Cu,	20 40 AR STRENGTH kPa	60 80 nat V. + rem V. ⊕		10 ⁻⁶ 10 ⁻⁵		ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
	ă	GROUND SURFACE	91.2	_			20 40	60 8	0	20 40	60 80	+	
0		TOPSOIL - (SM) SILTY SAND; dark brown; moist (CL/CI/CH) SILTY CLAY to CLAY, some sand; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm	0.1										
1				1	ss	5				F-0			
2				2	ss v	vн							
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL,	<u>88.4</u> 2.7	<u>7</u> 4		⊕ ⊕	+ +						
	uger Hollow Stem)	firm		3	ss v	νн							
4	Power Auger 200 mm Diam. (Hollow Stem)					⊕ ⊕	+++						
5				4	ss v	vн							
6						⊕ ⊕	+++						
				5	TP F	РΗ							
7						•	+++						
		End of Borehole	83.5			Ð	+						
8													
9													
10													
DEI	PTH S	CALE					Gold	0.1					GGED: DG

1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

MIS-BHS 001

LOCATION: N 5012743.9 ;E 361739.5

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-05

SHEET 1 OF 1 DATUM: CGVD28

Bentonite Seal

Bentonite and Cuttings Mix

Bentonite Seal

Silica Sand

Standpipe

Silica Sand

Native Backfill

W.L. in Standpipe at Elev. 89.90 m on February 21, 2017

PIEZOMETER

OR

STANDPIPE INSTALLATION

 $\overline{\nabla}$

BORING DATE: February 1, 2017

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m SAMPLES HYDRAULIC CONDUCTIVITY, k, cm/s SOIL PROFILE BORING METHOD ADDITIONAL LAB. TESTING DEPTH SCALE METRES STRATA PLOT 30m 40 60 80 10⁻⁶ 10⁻⁵ 10-4 10⁻³ 20 NUMBER ELEV. TYPE SHEAR STRENGTH nat V. + Q - ● Cu, kPa rem V. ⊕ U - ○ WATER CONTENT PERCENT BLOWS/0. DESCRIPTION DEPTH -OW - WI WpH (m) 20 40 60 80 40 60 80 GROUND SURFACE 91.12 0 TOPSOIL - (SM) SILTY SAND; dark 0.00 brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff 1 SS 3 1 $O \parallel$ 2 SS 2 0 2 88.53 2.59 3 SS 1 (CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, ¢ soft to firm 3 Stem) SS WH 4 0 Power Auger n Diam. (Hollow mm Diam. Ð +4 ⊕ + 50 5 TP PH 0 С Ŀ 5 h ⊕ + 6 SS wн 6 ¢ 7 \oplus + ⊕ + 83.50 7.62 XX + \oplus End of Borehole 8 9 10 DEPTH SCALE LOGGED: DG Ê Golder 1:50 ssociates

CHECKED: SD

RECORD OF BOREHOLE: 17-06

BORING DATE: January 31, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013111.2 ;E 361966.0 SAMPLER HAMMER, 64kg; DROP, 760mm

	DOH.	SOIL PROFILE	1.		SA	MPLE		DYNAMIC F	ENETRA E, BLOV	VS/0.3m	Ì,	HYDRAU k	LIC CON , cm/s			RGE	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ER	_	BLOWS/0.30m	20	40	60	80	10-6			10 ⁻³	ADDITIONAL LAB. TESTING	OR
Ξ	RING	DESCRIPTION	ATA	DEPTH	NUMBER	TYPE)/S/(SHEAR STI Cu, kPa	RENGTH	nat V. rem V.	+ Q-● ⊕ U-○	WAT Wp H				ADDI ⁻ AB. T	INSTALLATION
1	BO		STR	(m)	z		BLC	20	40	60	80	20			80		
0		GROUND SURFACE		91.22							_						
Ŭ		TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00													
		(CL/CI/CH) SILTY CLAY to CLAY; grey															
		brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm															
1					1	SS	4					⊢		I			
					2	SS	1										
2					-												
								⊕		+							
				88.48				⊕	+								
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL,		2.74													
J		soft to firm				1											
	Stem)				3	SS	wн										
	Iollow																
	200 mm Diam. (Hollow Stem)							₽ +									
4	nn Di							т									
	200 r						e	₽ +									
					4	TP	PH										
5																	
							¢	+									
								⊕ +									
6																	
						1											
					5	SS	wн										
7																	
(
								⊕ +									
		End of Borehole		83.60 7.62				⊕ -	-								
8																	
9																	
10																	
D																	
υE	- I H S	SCALE						EAV	Gold	er iates						LO	GGED: DG

RECORD OF BOREHOLE: 17-07

BORING DATE: January 31, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013270.1 ;E 362250.9 SAMPLER HAMMER, 64kg; DROP, 760mm

N F	THOD	SOIL PROFILE	⊢	1	SA	AMPL		DYNAMIC PENE RESISTANCE, E				cm/s				ING ING	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.30m	20 40 SHEAR STRENO Cu, kPa		80 + Q - •	10 ⁻⁶ WATI	10 ⁻¹ ER CO	NTENT	PERCE	10 ⁻³ I ENT	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
≤. د	BORIN		STRAT	DEPTH (m)	NUN	`	3LOW:				Wp ⊢ 20	40	-0 ^W		WI	AD LAB	ING MELATION
0		GROUND SURFACE		91.56				20 40	60	80	20	40		50	80		
0		TOPSOIL - (SM) SILTY SAND; dark \brown; moist		0.00 0.10													
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers															
		WEATHERED CRUST); cohesive, w>PL, very stiff to firm															
1					1	SS	4				+	-0					
					2	SS	1					c)				
2					\vdash												
								Ð	+								
		(CI/CH) SILTY CLAY to CLAY: grev with		88.82				•	-								
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm				-											
	tem)				3	SS	wн					0					
	Iollow S																
4	200 mm Diam. (Hollow Stem)							⊕ +									
4	0 mm [• +									
	20																
					4	SS	wн						С				
5					Ľ								0				
								⊕ + ⊕ +									
6																	
						1											
					5	SS	wн						0				
7								€ +									
								€ +									
		End of Borehole		83.94 7.62													
8																	
9																	
10																	
DE	PTH S	CALE							1.1							LO	GGED: DG
1:								G	lder ociate	c							CKED: SD

LOCATION: 2 m North of 17-07

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-07A

BORING DATE: January 31, 2017

SHEET 1 OF 1

DATUM: CGVD28

ш		DO	SOIL PROFILE			SA	MPL	ES	DYNAMIC PE RESISTANC	NETRATI	ON 5/0.3m	<u> </u>	HYDR/	AULIC C k, cm/s	ONDUCT	IVITY,		, (7)	
DEPTH SCALE METRES		BORING METHOD		LOT		Ľ		30m	20	40	60 8	0	1) ⁻⁴ 1	0-3	ADDITIONAL LAB. TESTING	PIEZOMETER
METH		SING N	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	ТҮРЕ	BLOWS/0.30m	SHEAR STR Cu, kPa	ENGTH	nat V. + rem V. ⊕	Q - ● U - ○	w					B. TE	STANDPIPE INSTALLATION
DE		BOF		STR/	(m)	ž		BLO	20			80	VV P				WI 30	A	
_ (0		GROUND SURFACE		91.56 0.00														
E			For stratigraphy refer to RECORD OF BOREHOLE 17-07		0.00														
F																			
Ē																			
È.	1																		-
E																			-
Ē																			
E																			
- :	2																		
F																			
E																			
E		em)																	
	3	llow St																	-
Ē		Power Auger Diam. (Hollov																	
E	ſ	200 mm Diam. (Hollow Stem)																	
F		200																	-
Ē	4																		
E																			
F																			
Ē,	5																		-
Ē																			
F																			
Ē																			
	6				85.46														-
F			(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL,		6.10		тр	PH								0		с	
-			soft to firm		84.90		IF								1				
Ē			End of Borehole		6.66														
	7																		-
F																			
Ē																			
F.																			
₩- Щ-	8																		
2/17																			
09/1																			:
GDT	9																		-
I GA																			
7.GP.																			
MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM	0																		-
10																			
D 3HS 0	DEF	TH S	CALE							oldo	**							LC	DGGED: DG
1-SIM	: 5	0								SOCI2	ates								ECKED: SD

RECORD OF BOREHOLE: 17-08

17

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012981.2 ;E 362191.5 SAMPLER HAMMER, 64kg; DROP, 760mm BORING DATE: February 3, 2017

ш 	DOH.	SOIL PROFILE	1. 1		SA	MPL	_	DYNAMIC P RESISTANC		ION S/0.3m	Ì,	HYDRA	k, cm/s		FIVITY,		AL	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	ב ב פ	STRATA PLOT	ELEV.	3ER	Щ	BLOWS/0.30m	20	1	1	30 0 - •	10 W/				0 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
- 4 - 4	DRING	DESCRIPTION	RATA	DEPTH (m)	NUMBER	түре	OWS/	SHEAR STR Cu, kPa	ENGIH	rem V. ⊕	U - O				PERCE		ADD LAB.	INSTALLATION
-	<u> </u>		STI		_		BL	20	40	<u>60 8</u>	30	20				30		
0		GROUND SURFACE TOPSOIL - (SM) SILTY SAND; dark		91.15 0.00 0.10														
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.10														
		brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff																
		w>PL, very stiff to stiff																
1					1	SS	3							L				
					2	SS	1						0					
2													-					
]												
								Ð	-	•								
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL,		88.4 <u>1</u> 2.74				Ð	+									
3		black organic mottling; cohesive, w>PL, soft to firm																
	.	(ma			3	SS	wн							0				
	j.																	
	Power Auger	200 mm Diam. (Hollow Stem)				1												
4	Pow	m Diar						⊕	+									
		200 1						⊕ +										
					4	SS	wн							0				
5																		
								⊕ +										
								⊕ +										
6																		
					5	TP	РН					₊		0			с	
7																		
								⊕ +										
		End of Porobolo		83.53 7.62				⊕ +										
		End of Borehole		1.02														
8																		
9																		
10																		
DE	PTH	H SCALE					(Folde Soci	r								DGGED: DG
1:	50							VIA	soci	<u>ates</u>							CH	ECKED: SD

RECORD OF BOREHOLE: 17-09

BORING DATE: February 3, 2017

LOCATION: N 5012670.0 ;E 362072.9 SAMPLER HAMMER, 64kg; DROP, 760mm DATUM: CGVD28

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	ПОН	SOIL PROFILE	1	1	SA	AMPL		DYNAMIC PENETR RESISTANCE, BLC	WS/0.3m		HYDRAULIC C k, cm/s		NGA	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ĒR	ш	BLOWS/0.30m	20 40	60 80) ⁻⁵ 10 ⁻⁴ 10	└──── \ <u>ॅ</u> \ ĭi	OR STANDPIPE
Ψ	RING	DESCRIPTION	ATA	DEPTH	NUMBER	TYPE)/S//(SHEAR STRENGTI Cu, kPa	nat V. + C rem V. ⊕ L	2- € J- 0			ADDI: ABDI: AB.T	INSTALLATIO
	BO		STR	(m)			BLC	20 40	60 80				0	
0	_	GROUND SURFACE TOPSOIL - (SM) SILTY SAND; dark	ESS	90.87										
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.13										
		brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff												Bentonite Seal
		conesive, w/rL, very suit to suit												
1					1	SS	1							8
					'	000	'							
						1								
					2	SS	2					4		
2							-							Destantia and
														Bentonite and Cuttings Mix
								Ð	-					
		(CI/CH) SILTY CLAY to CLAY; grey with		88.13 2.74				Ð	+					
3		black organic mottling; cohesive, w>PL, soft to firm												
	(m				3	66	wн							
	Power Auger 200 mm Diam. (Hollow Stem)					33								
	Power Auger Diam. (Hollo					1								Bentonite Seal
4	Powe m Diar							⊕ +						Silica Sand
	200 m							⊕ +						Silica Sand
					4	TP	РН							Standpipe
5														
														Silica Sand
								⊕ +						
								€ +						
6														
					5	22	wн							
						000								Native Backfill
7								⊕ +						
								⊕ +						
		End of Borehole		83.25				⊕ +						8
				1.02										W.L. in Standpipe at Elev. 90.06 m on February 21, 2017
8														February 21, 2017
9														
10														
10														
1				1						I	<u> </u>	I		
DEF	PTH S	SCALE					(Gol	ler				L	OGGED: DG

SHEET 1 OF 1

LOCATION: N 5012858.2 ;E 362391.4

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-10

BORING DATE: February 15, 2017

SHEET 1 OF 1

DATUM: CGVD28

	DOH.	SOIL PROFILE			SA	AMPL		DYNAMIC PENETI RESISTANCE, BLO	RATION DWS/0.3m	Ì,	1		CONDUCT s			NG	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ER	u	BLOWS/0.30m	20 40	60	80					0 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
U.	RING	DESCRIPTION	RATA	DEPTH	NUMBER	TYPE)/S//(SHEAR STRENGT Cu, kPa	H nat V. rem V.	+ Q-● ⊕ U-○						ADDI AB. T	INSTALLATION
1	BO		STR	(m)	z		BLC	20 40	60	80					30	L`-'	
0	-	GROUND SURFACE	227	91.21													
		TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00	1												
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silt layers				GRAB	-										
		brown, contains silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm															
1																	
					2	SS	3										
						$\left \right $											
						1											
					3	SS	1					Ha					
2					<u> </u>	$\left \right $											
						1											
					4	SS	wн										
				88.31		$\left \right $											
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft fo firm]		1											
	04000	(Line of the second sec			5	SS	wн										
	uger																
	Power Auger							⊕ +									
4	۲ ۲																
	000	57						⊕ +									
					\vdash												
_					6	SS	wн										
5																	
								⊕ +									
								⊕ +									
6					-	$\left \right $											
					7	SS	wн										
7								⊕ +									
								⊕ +									
		End of Borehole		83.59 7.62				⊕ +									
8																	
_																	
9																	
10																	
			1	I	I						L			1	1		<u> </u>
		SCALE					(Gol	der								DGGED: DG
1:	50							Asso	ciates	5						CH	ECKED: SD

1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

MIS-BHS 001

LOCATION: N 5012987.6 ;E 361366.8

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-16

SHEET 1 OF 1 DATUM: CGVD28

PIEZOMETER

OR

STANDPIPE INSTALLATION

지기

BORING DATE: March 31, 2017

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m HYDRAULIC CONDUCTIVITY, k, cm/s SOIL PROFILE SAMPLES BORING METHOD ADDITIONAL LAB. TESTING DEPTH SCALE METRES STRATA PLOT 30m 40 60 80 10⁻⁶ 10-5 10-4 10⁻³ 20 NUMBER ELEV. TYPE SHEAR STRENGTH nat V. + Q - ● Cu, kPa rem V. ⊕ U - ○ WATER CONTENT PERCENT BLOWS/0. DESCRIPTION DEPTH -OW Wp - WI (m) 40 60 80 20 40 60 80 GROUND SURFACE 91.27 0 TOPSOIL - (SM) SILTY SAND; brown, 0.00 CL/CI/CH SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, 0.15 GRAB 1 Bentonite Seal w>PL, very stiff to stiff 1 SS 4 2 -1 3 SS 1 h 2 88.83 \oplus + (CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, 2.44 \oplus soft to firm 3 Cuttings SS WH 0 4 + Æ 4 Stem) +⊕ (Hollow Power Auger mm Diam 5 SS WH 0 5 00 h Æ 6 Bentonite Seal SS 6 wн Silica Sand 7 + Œ Standpipe Æ + W.L. in Standpipe at Elev. 90.34 m on April 13, 2017 7 TΡ PH Н 4 0 С 8 +9 XX 82.13 + Æ End of Borehole 9.14 10 DEPTH SCALE LOGGED: SN Golder 1:50 CHECKED: SD ssociates

1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

MIS-BHS 001

LOCATION: N 5013210.1 ;E 361450.6

RECORD OF BOREHOLE: 17-17

SHEET 1 OF 1 DATUM: CGVD28

BORING DATE: March 23 & 24, 2017

ATION TEST HANALED CALM DOOD 700mm

SAMPLER HAMMER, 64kg; DROP, 760mm PENETRATION TEST HAMMER, 64kg; DROP, 760mm HYDRAULIC CONDUCTIVITY, k, cm/s DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m SOIL PROFILE SAMPLES DEPTH SCALE METRES BORING METHOD ADDITIONAL LAB. TESTING PIEZOMETER STRATA PLOT 30m 20 40 60 80 10⁻⁶ 10⁻⁵ 10-4 10⁻³ OR NUMBER STANDPIPE INSTALLATION ELEV. TYPE BLOWS/0. SHEAR STRENGTH nat V. + Q - ● Cu, kPa rem V. ⊕ U - ○ WATER CONTENT PERCENT DESCRIPTION DEPTH -OW - WI WpH (m) 20 40 60 80 40 60 80 GROUND SURFACE 91.82 0 TOPSOIL - (ML) sandy SILT; dark 0.00 brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff 1 SS 4 1 2 SS 3 н -02 \oplus + 89.08 (CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm + 3 SS 0 3 1 ⊕ + 4 Stem) ⊕ + Hollow Power Auger mm Diam 4 TΡ PH Н h С 5 200 ⊕ + + 6 SS WH 0 5 7 ⊕ +6 SS WH 0 8 ⊕ + ⊕ +9 X 82.68 9.14 \oplus +End of Borehole 10 DEPTH SCALE LOGGED: KM Golder 1:50 CHECKED: SD ssociates

RECORD OF BOREHOLE: 17-17A

BORING DATE: March 24, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-17

									510				1						
	BORING METHOD		SOIL PROFILE			SA	AMPL		DYNAMIC RESISTA	NCE, BLC	KATION DWS/0.3r		HYDR	AULIC C k, cm/s	CONDUC	i ivity,		29	PIEZOMETER
METRES	1ET+			STRATA PLOT		~		BLOWS/0.30m	20	40	60	80					10 ⁻³	ADDITIONAL LAB. TESTING	OR
	≥ 0		DESCRIPTION	APL	ELEV.	IBE	TYPE	8/0.3				. + Q-● /.⊕ U-○	W		ONTEN			ΞĔË.	STANDPIPE INSTALLATION
2	ORIN			RAT	DEPTH	NUMBER	≿	No.	Cu, kPa		rem \	/.⊕ U-O	w		W		WI	ADI	INSTALLATION
	B	í		STF	(m)			BLO	20	40	60	80					80		
			GROUND SURFACE		91.82														
0		1	Refer to Borehole 17-17 for Stratigraphy		0.00														<u>.</u>
																			_
																			Bentonite Seal
1		Ê																	
		200 mm Diam. (Hollow Stem)																	Silica Sand
	Power Auger	1 ollo																	100
	/er A	Ē																	
	Po	Dia																	
2		E O																	
-		8																	51 mm Diam. PVC #10 Slot Screen
																			51 mm Diam. PVC #10 Slot Screen
																			l t
3		+	End of Borehole		88.77 3.05														Silica Sand
																			WL in Screen at
																			WL in Screen at Elev. 91.21 m on March 31, 2017
1																			
5																			
5																			
7																			
3																			
													1		1				
													1		1				
9													1		1				
													1		1				
													1		1				
													1		1				
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0																			
_									Ø										
		H SC	CALE					(Gol	der								OGGED: KM
	50									CEO	ninto	C						CH	ECKED: SD

RECORD OF BOREHOLE: 17-18

BORING DATE: March 23, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013064.6 ;E 361497.9 SAMPLER HAMMER, 64kg; DROP, 760mm

3 ALE	LON L		SOIL PROFILE	⊢	1	S/	AMPL			MIC PEN TANCE,			1		k, cm	/s	JCTIVIT		ING	PIEZOMETER
METRES	BOPING METHOD		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.30m	SHEA		40 L NGTH	60 nat V.	80 + Q - ●			10 ⁻⁵	10 ⁻⁴	10 ⁻³ RCENT	ADDITIONAL LAB. TESTING	
.≥	NIGOS		DESCRIPTION	TRAT/	DEPTH (m)	NUM	≿	LOWS					+ Q-● ⊕ U-○	VV	р —	C	,w	- WI	ADC LAB.	INSTALLATION
		-	GROUND SURFACE	0.	91.40		-	8	2	0	40	60	80	2	20	40	60	80	_	
0			TOPSOIL - (ML) sandy SILT; dark \brown; moist		0.00 0.10															
			(CL/CI/CH) SILTY CLAY to CLAY; grev																	
			brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm																	
			w/r L, very sun to ninn																	
1						1	SS	6												
2						2	SS	WН						⊢		Ð				
2						<u> </u>	-													
									⊕			+								
					88.66 2.74				•		+									
3			(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams; cohesive, w>PL, soft to firm		2.74															
		ē																		
		ow Ster				3	SS	WH												
	Power Auger	200 mm Diam. (Hollow Stem)					1													
4	Powe	n Diam							⊕	+										
		200 mr							⊕	+										
						4	SS	wн												
5																				
									⊕ -											
									⊕	+										
6							-													
						5	SS	wн												
7																				
7									⊕	+										
									Ð	+										
			End of Borehole		83.78 7.62				⊕	+										
8																				
9																				
10																				
DE	PTI	H S	CALE					1		C	olde	r							L	DGGED: KM/SM
1:	50								V	Ass	olde soci	âtes							CH	ECKED: SD

RECORD OF BOREHOLE: 17-18A

BORING DATE: March 23, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-18

		1			-							1						
	BORING METHOD	SOIL PROFILE	_		SA	AMPL	ES	DYNAMIC PI RESISTANC	E, BLOW	ION S/0.3m	ì	HYDR	AULIC C k, cm/s	CONDUC	TIVITY,		_ <u>0</u>	PIEZOMETER
MEIKES	Ē		-oT		~		m	20	40	60 E	30	1	0-6	I0 ⁻⁵ 1	0-4	10 ⁻³	ADDITIONAL LAB. TESTING	OR
Ľ IJ	2 0	DESCRIPTION	APL	ELEV.	IBEF	TYPE	8/0.3	SHEAR STR Cu, kPa				W		ONTEN			-IĔË.	STANDPIPE INSTALLATION
≥	ORIN		STRATA PLOT	DEPTH	NUMBER	∣≿	BLOWS/0.30m	Cu, kPa		rem V. 🕀	U- O	w	р ——	W		WI	ADI	INSTALLATION
	B		STF	(m)	2		BL(20	40	60 8	30					80		
		GROUND SURFACE		91.40														
0		Refer to Borehole 17-18 for Stratigraphy		0.00														<u>ي</u> ة .
																		_
																		¥
																		Bentonite Seal
1	(m																	
	200 mm Diam (Hollow Stem)	± 0 ≥																Silica Sand
	Power Auger																	2.22
	ver /																	[X-
	۳ D																	<u> </u> X-
2																		[XF
-	2	N																51 mm Diam. PVC #10 Slot Screen
																		51 mm Diam. PVC #10 Slot Screen
3		End of Borehole	-	88.35 3.05		1								1				Silica Sand
																		WL in Screen at Elev. 90.95 m on March 31, 2017
																		March 31, 2017
4																		
5																		
6																		
Ĭ																		
7																		
в																		
9																		
10																		
		1		1	1	<u> </u>	L				1	1	1	1	1		1	1
EF	тΗ	SCALE							LINE								Ľ	OGGED: KM/SM
1:5										if atos								IECKED: SD
									SUCI	aucs								

MIS-BHS 001 1771847.GPJ GAL-MIS.GDT 09/12/17 JEM

LOCATION: N 5012932.6 ;E 361556.3

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-19

SHEET 1 OF 1 DATUM: CGVD28

BORING DATE: March 30, 2017

ц	ДŎ	SOIL PROFILE			SA	MPL	ES	DYNAMIC PEN RESISTANCE,	IETRAT BLOW	ION S/0.3m)	HYDRAUL k,	IC COI	NDUCT	IVITY,			PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 SHEAR STREM Cu, kPa	I NGTH	60 nat V. rem V.	80 + Q - ● ⊕ U - ○	10 ⁻⁶ WATE Wp H		NTENT	PERCI	10 ⁻³ ENT WI	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
_	ĕ		ST	(11)			BL	20 4	40	60	80	20	40			80	_	
• 0		GROUND SURFACE TOPSOIL - (SM) SILTY SAND; dark	EEE	91.24									_					
		CL/CI/CH) SILTY CLAY to CLAY; brown, moist (CL/CI/CH) SILTY CLAY to CLAY; brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm		0.15		-												
1					1	ss	2					F						7
2					2	SS	WH	Ð	+									
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL, soft to firm		88.50 2.74	3	ss	wн	⊕ +										Cuttings
· 4	Power Auger 200 mm Diam. (Hollow Stem)					-		⊕ + ₽ +										
5	Powe 200 mm Diam				4	TP		⊕ +				<u> </u>		0			с	
6					5	ss		⊕ +										Bentonite Seal
7						-		€ +										Silica Sand
8					6	SS		€ +										Standpipe
9						-		⊕ + ⊕ +										Cuttings
		End of Borehole		9.14 9.14				Φ +										W.L. in Standpipe at Elev. 89.89 m on April 13, 2017
10 DE		SCALE						A G	olde	er ates								DGGED: SM ECKED: SD

RECORD OF BOREHOLE: 17-20

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012801.4 ;E 361573.1 SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	MET			1							DN /0.3m	<u></u>		k, cm/s				1771	PIEZOMETER
WE			PLC	ELEV.	н		BLOWS/0.30m	20	40			30	10				10 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
·	BORING METHOD	DESCRIPTION	STRATA PLOT	DEPTH	NUMBER	TYPE	MS/C	SHEAR S Cu, kPa	TRENG	GTH r	nat V. + em V. ⊕	Q - • U - O			ONTENT			ABL T	INSTALLATION
	BO		STR	(m)	Ž		BLO	20	40	6	60 8	30	Wp 20				WI 80	~_	
0		GROUND SURFACE		91.03															
Ŭ		TOPSOIL - (ML) sandy SILT; dark \brown; moist		0.00															
		(CL/CL/CH) SILTY CLAY to CLAY arev																	
		brown, contains sandy silt layers (WEATHERED CRUST); cohesive,																	
		w>PL, very stiff to stiff											l .	~					
1					1	SS	4							0					
					2	SS	wн												
2																			
				88.74				Ð											
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains sandy silt seams; cohesive, w>PL, soft to firm		2.29				Ð		+									
		silt seams; cohesive, w>PL, soft to firm																	
3					3	SS	WН												
	Stem)					$\left \right $													
								⊕ +											
	Power Auger Diam. (Hollo																		
4	m Dia						€	+											
	200 mm Diam. (Hollow Stem)																		
					4	SS	wн												
5						1													
							6	⊕ +											
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6																			
Ĭ					5	SS	WН												
								⊕ -	+										
								U I	'										
7								⊕ -	+										
							e	⊕ +											
				83.41			F	Đ	+										
		End of Borehole		7.62															
8																			
9																			
10																			
			_	I								1	1			l			
DEP	TH S	CALE							Go	lde	r <u>stes</u>								GGED: KM ECKED: SD

RECORD OF BOREHOLE: 17-20A

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-20

			SOIL PROFILE		1	S	AMPI		DYNAMIC PE RESISTANCI	ENETRAT E, BLOW	'ION S/0.3m		HYDRA	ULIC C k, cm/s	ONDUCT			AL	PIEZOMETER
METRES	DODING METHOD	אפ ואובו	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	ТҮРЕ	BLOWS/0.30m	20 SHEAR STRI Cu, kPa		60 8 nat V. +		10 W/	ATER C		PERCE	0 ⁻³ NT	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
2				STRAT	DEPTH (m)	NUN		BLOW	Cu, kPa 20		rem V. ⊕ 60 8		Wp 20				WI 30	ADI	INGTALLATION
0			GROUND SURFACE Refer to Borehole 17-20 for Stratigraphy		91.03 0.00														
1	er.	ow Stem)																	Bentonite Seal ⊥ Silica Sand
2	Power Auger	200 mm Diam. (Hollow Stem)																	51 mm Diam. PVC 2 #10 Slot Screen
3			End of Borehole		87.98 3.05														Silica Sand
																			WL in Screen at Elev. 90.37 m on March 31, 2017
4																			
5																			
6																			
7																			
8																			
9																			
10																			
DE	PT	нs	CALE	1	1			1		Lolda		L			1	1	· I	L	I DGGED: KM
1:	50								V As	SOCI	ates							СН	ECKED: SD

RECORD OF BOREHOLE: 17-21

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012670.3 ;E 361616.6 SAMPLER HAMMER, 64kg; DROP, 760mm

	ТНОВ	SOIL PROFILE		S	AMPLI		DYNAMIC PENETI RESISTANCE, BL		Ì,		, cm/s		I RG ING	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT (m) (m)		TYPE	BLOWS/0.30m	20 40 I I SHEAR STRENGT Cu, kPa		80 - Q - ●		L FER CONT	10 ⁻⁴ 10 ENT PERCEN	IT E	OR STANDPIPE INSTALLATION
2	BOR		(m)	"] 2		BLOV	20 40		80	Wp 20	40	⊖ ^W v 60 80		
0	_	GROUND SURFACE	91.	24										
		TOPSOIL - (ML) sandy SILT; dark brown; moist (CL/C/I/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.	<u>20</u> 10										
1		w>PL, very stiff to stiff		1	ss	4					-0-1			
2				2	SS	WH					0			
							⊕ ⊕	+						
3	r ow Stem)	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, firm	88.		ss	wн					С			
4	200 mm Diam. (Hollow Stem)						⊕ + ⊕ +							
	20			4	SS						0			
5							⊕ +							
6						6	⊕ +							
				5	TP	PH				ŀ		ο	с	
7							⊕ + ⊖ +							
		End of Borehole	83.				€ +							
8														
9														
10														
DE	PTH S	CALE					Gol	der ciates					LO	GGED: KM

LOCATION: N 5012555.0 ;E 361697.8

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-22

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: CGVD28

ļ	DOH-	SOIL PROFILE		\$	SAMPI	-	RESISTA	PENETRA NCE, BLOV	VS/0.3m	Ì,	k, cm/s		AL	PIEZOMETER
METRES	MET).30m	20	40		80		0 ⁻⁵ 10 ⁻⁴ 10 ⁻³		OR STANDPIPE
ME	BORING METHOD	DESCRIPTION	LA DEP	тн 🛓	TYPE	BLOWS/0.30m	SHEAR S Cu, kPa	TRENGTH	nat V. + rem V. ∉	- Q - ● 9 U - O			ADDITIONAL LAB. TESTING	INSTALLATION
	BO		UN STR	1) Z		BLO	20	40	60	80		0 60 80	<u> </u>	
0		GROUND SURFACE	91	.36										
Ŭ		TOPSOIL - (ML) sandy SILT; dark brown; moist).00).09										
		(CL/CL/CH) SILTY CLAY to CLAY arev												
		WEATHERED CRUST); cohesive, w>PL, very stiff to stiff												
		w>PL, very stiff to stiff			_									
1														
				1	SS	2								
					_									
				2	SS	2								
2														
							⊕			+				
							⊕			+				
3			89	3.31										Cuttings
3		(CI/CH) SILTY CLAY to CLAY; grey with		3.05										
		black organic mottling, contains silt seams; cohesive, w>PL, firm		3	SS	wн								
4	í						⊕	+						
	w Sta						⊕	+						
	Auger													
	Power Auger													
5				4	SS	WН								
Ŭ	200													
							Ð	+						×
							⊕	+						
6														Bentonite Seal
				5	SS	WH								
				\vdash	_									Silica Sand
7							⊕							
'							Ψ	T						Standaire
							\oplus	+						Standpipe
					_									
				6	TP	PH								
8						"								🛛 🕅
					1					1				
							Ð	+		1				Cuttings
										1				🛛 🕅
9							Ð	†		1				🛛 🕅
3		End of Borehole		2.22			Ð	+		1				
														W.L. in Standpipe at Elev. 90.99 m on
														April 13, 2017
10														
	ртн	SCALE											1.	OGGED: KM
νE		UUNEL				(Gold Issoc	er					IECKED: SD

RECORD OF BOREHOLE: 17-23

BORING DATE: March 30, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013132.3 ;E 361640.7 SAMPLER HAMMER, 64kg; DROP, 760mm

L L L	DOH.	SOIL PROFILE	L		SA	MPL		DYNAM RESIST	ANCE, B	LOWS	JN /0.3m	Ì,	HYDRA	k, cm/s		IVHY,	A P	PIEZOMET	ER
DEPTH SCALE METRES	BORING METHOD		STRATA PLOT	ELEV.	ĒR	ω	BLOWS/0.30m	20				30 [`]	10				<u>2 ü</u>	OR STANDPIP	ΡĒ
	RING	DESCRIPTION	RATA	DEPTH	NUMBER	TYPE)/SMC	SHEAR Cu, kPa	STRENG	ifH r	nat V. + em V. ⊕	Q - ● U - ○	W/ Wn			PERCEN		INSTALLATI	ION
-	BC		STF	(m)			BLC	20	40	e	50 8	30	20		0 6			·	
0		GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark	222	91.41 91.23														<u> </u>	4.5
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.18															
		WEATHERED CRUST); cohesive,																	
		w>PL, very stiff to stiff																	
1					1	SS	9												
					2	SS	1								_				
2														Ũ					
								\oplus		+									
		(CI/CH) SILTY CLAY to CLAY; grey with		88.67 2.74				\oplus		+									
3		black organic mottling; cohesive, w>PL, firm				-												Cuttings	
					3	SS	wн												
4	(me)							Ð	+										
	Power Auger 200 mm Diam. (Hollow Stem)							⊕	+										
	Power Auger Diam. (Hollov																		
	Pov nm Dia				4	SS	wн												
5	200 г																		
								Ð	+										
								Ð	+										
6					<u> </u>	-												Bentonite Seal	
					5	SS	wн												
																		Silica Sand	
7																			1.32
'								Ð	+									Standpipe	10.2
							#	₽	+									Stanopipo	12.2
						-													×
8					6	SS	wн												
-					-	-													
								Ð	+									Cuttings	
9				00.07				Ð	+										
		End of Borehole		82.27 9.14				Ð	+										KX
																		W.L. in Standpipe at Elev. 91.36 m on April 13, 2017	
10																			
DE	PTH \$	SCALE								14-								LOGGED: SM	
1:								(Go Asso	Ale Ale	ľ tes							HECKED: SD	

RECORD OF BOREHOLE: 17-24

SHEET 1 OF 1

BORING DATE: March 29, 2017

DATUM: CGVD28

LOCATION: N 5012870.0 ;E 361739.6 SAMPLER HAMMER, 64kg; DROP, 760mm

	гнор	SOIL PROFILE	L F	-	SA	MPL		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	TYPE	BLOWS/0.30m	20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ●	k, cm/s Y 10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³ WATER CONTENT PERCENT U U U Wp	OR STANDPIPE STANDPIPE INSTALLATION
	BC		STF	(m)			BL(20 40 60 80	20 40 60 80	
0		GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark	ESS	90.90 0.00 0.11		$\left \right $	-			
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt seams (WEATHERED CRUST); cohesive, w>PL, stiff to firm		0.11		-				
1					1	ss	2			
2					2	ss	1			
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm		<u>88.16</u> 2.74		-		⊕ + ⊕ +		Cuttings
					3	SS	wн			
4	Power Auger 200 mm Diam. (Hollow Stem)						e	+ + +		
5	Powe 200 mm Diam				4	TP	PH (÷ +		
6					5	SS		⊕ +		Bentonite Seal
7						-		Ð +		Silica Sand
						-		⊕ +		Standpipe
8					6	SS		Ð +		Cuttings
9		End of Borehole		81.76 9.14				 ⊕ + ⊕ + 		W.L. in Standpipe
10										at Elev. 90.59 m on April 13, 2017
DEI	PTH S	CALE						Golder		LOGGED: KM

RECORD OF BOREHOLE: 17-25

BORING DATE: March 24, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012633.8 ;E 361839.8 SAMPLER HAMMER, 64kg; DROP, 760mm

Bit Mark Status Bit Mark Status Bit Mark Status S		탈	SOIL PROFILE			SA	AMPL		DYNAM RESIST	ANCE,	BLOW	ION S/0.3m	Ì,	1			IVITY,	NG	PIEZOMETER
Point Weight Str. dark Point Str. dark Poi	TRES			PLOT	FI FV	ËR		0.30m										TION.	
Point Weight Str. dark Point Str. dark Poi	WE	RING	DESCRIPTION	ATA	DEPTH	UMB	TΥΡΕ)/S/(SHEAR Cu, kPa	STREM	IGTH	nat V. + rem V. ⊕	Q - • U - O					ADDI ⁻ AB. T	INSTALLATION
0 0 0 0 1 <th1< th=""> <th1< th=""> <th1< th=""> <th1< th=""></th1<></th1<></th1<></th1<>		<u></u>		STR		Ž		BLO	20) 4	10	60 8	30	1					
2 0 + 1 1 55 2 1 55 2 2 0 1 0 + 2 0 + 2 0 + 2 0 + 3 0 + 4 0 + 4 0 + 2 0 + 3 0 + 4 0 + 4 0 + 0 + 0 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 1 0 + 2 0 + 2 0 + 3 5 0 4 0 + 2 0 + 3 0 + 4 0 4<					91.09														
CCUCHT SLTY CLAY G CLAY gev; 					0.00														
1 1 5 6 + 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 3 1 1 1 1 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <td></td> <td></td> <td>(CL/CL/CH) SILTY CLAY to CLAY: grey</td> <td></td>			(CL/CL/CH) SILTY CLAY to CLAY: grey																
1 1 5 6 + 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 3 1 1 1 1 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <td></td> <td></td> <td>(WEATHERED CRUST); cohesive,</td> <td></td>			(WEATHERED CRUST); cohesive,																
1 2 30 2 30 2 4 4 5 90 + 3 1 1 1 1 1 1 1 1 1 3 1 1 1 1 1 1 1 1 1 4 2 3 3 55 W1 - + + 0 - - - 0 + + + 0 - - 0 + - - 0 - - - 0 + - 0 - - - 0 + - 0 - - - 0 + - 0 - - - 0 + - 0 - - - 0 + - 0 - - - 0 + - 0 - - - - 0 + 0 - - - 0 + 0 - - 0 + - 1 0 0 + <td< td=""><td></td><td></td><td>w>PL, very stiff to stiff</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>			w>PL, very stiff to stiff																
2	1					1	SS	4											
2						<u> </u>	$\left \right $												
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0 Image: Control in SULTY CLAY to CLAY prov. 0 0 + + 1 Image: Control in SULTY CLAY to CLAY prov. 0 0 + + 2 0 0 + + + + 3 SS VN - + + + 4 SS VN - + + + 6 + + + + + + 7 - - - - + + 8 - - - - - - - 9 -						2	SS	2						1	-	\rightarrow			
0 Image: Control in SULTY CLAY to CLAY prov. 0 0 + + 1 Image: Control in SULTY CLAY to CLAY prov. 0 0 + + 2 0 0 + + + + 3 SS VN - + + + 4 SS VN - + + + 6 + + + + + + 7 - - - - + + 8 - - - - - - - 9 -																			
3	2																		
3 ICHCH19 SLITYCLAY to CLAY, gray,									Ð				+						
3 COCH, SLITY CLAY to CLAY to CLAY to PL, fmm 2									\oplus			+							
3 COCH, SLITY CLAY to CLAY to CLAY to PL, fmm 2					88.19														
$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 $	3		(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams: cohesive. w>PL		2.90														
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7 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 8 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Co	6					<u> </u>	$\left \right $												
7 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 8 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole Image: Constraint of Borehole 9 Image: Constraint of Borehole Image: Co						5	ss	wн											
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8 End of Borehole 83.47 7.62 •• + • 9 End of Borehole 1	7								\oplus	+									
8 End of Borehole 7.62									⊕	+									
8 End of Borehole 7.62									<u>а</u>										
9		Τ	End of Borehole						Ψ	+									
	8				1														
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					1														
	9				1														
					1														
10					1														
					1														
	10				1														
Golder	DEPTI 1:50		UALE							G	olde	r							

RECORD OF BOREHOLE: 17-25A

BORING DATE: March 24, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-25

щ		p p	SOIL PROFILE			S/	AMPL	LES	DYNAMIC PE RESISTANC	ENETRAT	ION S/0.3m	HYDRAU	JLIC CO k, cm/s	ONDUCT	TVITY,		_ U	PIEZOMETER
DEPTH SCALE METRES		BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	ТҮРЕ	BLOWS/0.30m	20 SHEAR STR Cu, kPa		60 80 nat V. + 0 rem V. ⊕		TER C	0 ⁻⁵ 10 L ONTENT	PERCE		ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
		8	GROUND SURFACE	STR	(m) 91.09			BLC	20	40	60 80	 20				80	لد ` 	
- 0			Refer to Borehole 17-25 for Stratigraphy		0.00													Bentonite Seal
- 1	Power Auger	200 mm Diam. (Hollow Stem)																Silica Sand
- 2		200 m																51 mm Diam. PVC
- 3			End of Borehole		88.04 3.05													Silica Sand
- 4 - 5 - 6																		WL in Screen at Elev. 91.08 m on March 31, 2017
- 8																		
- 9 - 10																		-
DE 1 :			CALE		<u> </u>						er ates) DGGED: SM/KM ECKED: SD

LOCATION: N 5013197.9 ;E 361757.1

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-26

BORING DATE: March 23, 2017

SHEET 1 OF 1

DATUM: CGVD28

	BORING METHOD	SOIL PROFILE	1.		SA	MPLE		DYNAMIC PENETR/ RESISTANCE, BLO	ATION WS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	J 2 PIEZ	OMETER
METRES	MET		STRATA PLOT		ER		BLOWS/0.30m	20 40	60 80	10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³		OR NDPIPE
ME	SING	DESCRIPTION	ATA F	ELEV. DEPTH	NUMBER	TYPE	WS/C	SHEAR STRENGTH Cu, kPa	nat V. + Q - ● rem V. ⊕ U - ○	WATER CONTENT PERCENT Wp I────────────────────────────────────		ALLATION
	BOI		STR.	(m)	Ž		BLO	20 40	60 80	20 40 60 80		
0		GROUND SURFACE		91.54								1.51
-		TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00								∇
		(CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt seams			1	SS	12					
		WEATHERED CRUST); cohesive, w>PL, very stiff to firm			-						Bentonite Se	al
						1						
1					2	SS	6				Silica Sand	2
					<u> </u>						Silica Sand	10.2
					3	SS	1					
2						1					51 mm Diam	. PVC
								⊕ +	-		#10 Slot Scre	en
				88.95 2.59				⊕ +				N.C.
	tam)	(CI/CH) SILTY CLAY to CLAY; grey, contains silt seams; cohesive, w>PL,		2.09								44.J.W
3	Power Auger	firm]					Silica Sand	14. M.
	Power Auger				4	SS	wн					×
	Pow											
	200 m							⊕ +				×
4								⊕ +				×
				07.40								
		(SM) gravelly SILTY SAND; grey,		87.12 4.42								×
		contains cobbles and boulders (GLACIAL TILL); non-cohesive, wet,			5	SS	7					×
5		loose to compact									Cuttings	×
					-							×
					6	SS	10					×
												×
6					-							×
					7	SS	6					×
				84.99								
		End of Borehole		6.55							WL in Screen	nat
7											Elev. 91.28 n March 31, 20	1 on
8												
U												
9												
10												
DE	PTH	SCALE					(Gold	er		LOGGED: K	M/SM
1:	50							Gold	tiates		CHECKED: S	D

LOCATION: N 5013051.5 ;E 361831.3

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-27

BORING DATE: March 28, 2017

SHEET 1 OF 1

DATUM: CGVD28

ц Д	ПОН	SOIL PROFILE		s	SAMPI	-	DYNAMIC PEN RESISTANCE,	BLOW		Ì,		k, cm/s		NG	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT (m) (m)	۳	ш	BLOWS/0.30m				BO `	10-6			ADDITIONAL LAB. TESTING	OR STANDPIPE
ME	DRING	DESCRIPTION	TA DEPT	FH S	TYPE)/SMC	SHEAR STREM Cu, kPa	NGTH	nat V. + rem V. ∉	. Q - ● 9 U - ○	WA Wn		NTENT P	ADDI AB. T	INSTALLATION
'	BC		MIN (m)			BLC	20 4	0	60	80	20				
0		GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark	91. 222 0. 0.	21										 _	
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey	0.	09											
		(WEATHERED CRUST); cohesive,													
		w>PL, stiff to firm			_										
1				1	SS	2							<u> </u>		
				2	SS	wн									
2															
							0	+							
		(CI/CH) SILTY CLAY to CLAY; grey with	88.	47 74			⊕	+							
3		black organic mottling, contains silt seams; cohesive, w>PL, soft to firm			_										
				3	SS	wн									
4	em)						⊕ +								
	low St						⊕ +								
	Power Auger Diam. (Hollov				_										
	Power Auger 200 mm Diam. (Hollow Stem)			4	SS	1									
5	200 m														
							⊕ +								
							⊕ +								
6					_										
				5	TP	PH									
					_										
7							⊕ +								
							⊕ +								
				\vdash	_										
				6	SS	wн									
8															
							⊕ +								
							⊕ +								
9		End of Borehole	82.				⊕ +								
10															
								1		1	I			 	
		CALE				(G	olde	r						OGGED: KM
1:5	50						V Ass	OCI	er ates					CHI	ECKED: SD

RECORD OF BOREHOLE: 17-28

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012922.4 ;E 361888.7 SAMPLER HAMMER, 64kg; DROP, 760mm

	DOH.	SOIL PROFILE	1 - 1 -	s	AMPL		DYNAMIC PENETRA RESISTANCE, BLOW	TION /S/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ୁ ଅ PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT (m) (m)	FH S	TYPE	BLOWS/0.30m	20 40 I I SHEAR STRENGTH Cu, kPa	60 80 nat V. + Q - ● rem V. ⊕ U - ○	10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³ WATER CONTENT PERCENT Wp ├──── ^W I Wi	PIEZOMETEF OR ULLIOR STANDPIPE INSTALLATIO
-	ă	GROUND SURFACE			-	B	20 40	60 80	20 40 60 80	
0 -		TOPSOIL - (ML) sandy SILT; dark brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive,	91. 555 0. 0.	<u>00</u> 10	SS	13				
1		w>PL, very stiff to stiff		2	SS	5				
2				3	SS	wн				
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt	<u>88.</u> 2.	<u>36</u> 74			⊕ ⊕ +	+		
3	uger łollow Stem)	black organic mottling, contains silt seams; cohesive, w>PL, soft to firm		4	SS	wн				
4	Power Auger 200 mm Diam. (Hollow Stem)						⊕ + ⊕ +			
5				5	SS	wн				
6										
				6	SS	wн				
7		End of Borehole	<u>83.</u> 7.				 ⊕ + ⊕ + ⊕ + 			
8										
9										
10										
DEI	PTH S	CALE					Gold	 er		LOGGED: KM

RECORD OF BOREHOLE: 17-28A

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-28

0	гнор		SOIL PROFILE	⊢		SA	AMPL		DYNAMIC PI RESISTANC			~	HYDRAULIO k, c	m/s		AL	PIEZOMETER
MEIKES	BORING METHOD		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	түре	BLOWS/0.30m	20 SHEAR STR Cu, kPa	ENGTH	nat V. + rem V. ⊕		vvp —		W	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
+		+	GROUND SURFACE	0)	91.10				20	40	<u>60 8</u>	30	20	40 6	80 80		
0 -			Refer to Borehole 17-28 for Stratigraphy		0.00												.전 모 Bentonite Seal
1	Power Auger	200 mm Diam. (Hollow Stem)															Silica Sand
2		200 m															51 mm Diam. PVC
3			End of Borehole		88.05 3.05												Silica Sand
																	WL in Screen at Elev. 90.78 m on March 31, 2017
4																	
5																	
5																	
6																	
7																	
8																	
9																	
10																	
	PTF	150	CALE	1		I	1	<u> </u>				<u> </u>	I				DGGED: KM
1:5										SOCI	ates						ECKED: SD

RECORD OF BOREHOLE: 17-29

BORING DATE: March 28, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012811.0 ;E 361925.0 SAMPLER HAMMER, 64kg; DROP, 760mm

ц Д	DOH.	SOIL PROFILE	1.	1	SA	AMPL	_	DYNAMIC RESISTAN	PENETRA CE, BLOV	110N /S/0.3m	Ľ.		k, cm/s				NG	PIEZOMETER
DEP IN SUALE METRES	BORING METHOD		STRATA PLOT	ELEV.	ЖЕR	щ	BLOWS/0.30m	20		60	80	10				0 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
	JRING	DESCRIPTION	RATA	DEPTH	NUMBER	TYPE	/SMC	SHEAR ST Cu, kPa	KENGIH	nat V. rem V.	+ Q-● ⊕ U-○	W/ Wp		NTENT	PERCE		ADDI -AB. 1	INSTALLATION
	BC		STF	(m)		_	BLC	20	40	60	80	20		0 6		30		
0		GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark	222	92.08 0.00 0.08						_								
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.08														
		brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff																
		w>PL, very stiff to stiff																
1					1	SS	3						— 0 –1					
							Ŭ						01					
					2	SS	2											
2						00	2											
								Ð		+								
		(CI/CH) SILTY CLAY to CLAY; grey with		89.34 2.74				Ð		+								
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm				4												
	(iii				3	90	wн											
	er ow Ste					00	••••											
	Power Auger					1												
4	Power Auger 200 mm Diam. (Hollow Stem)							⊕ +										
	200 mr							⊕ +										
					4	22	wн											
5					-	00												
								⊕ +										
								⊕ +										
6																		
					5	22	wн											
						00												
7								⊕ +										
								⊕ +										
		Find of Deschola		84.46				⊕ +										
		End of Borehole		7.62														
8																		
9																		
10																		
						<u> </u>												
DE	PTH	SCALE					(Gold	er								OGGED: KM
1:	50								Gold <u>ssoc</u>	iates	5						CH	ECKED: SD

RECORD OF BOREHOLE: 17-30

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012708.4 ;E 361971.8 SAMPLER HAMMER, 64kg; DROP, 760mm

ц Д	DOH.		SOIL PROFILE			SA	MPL		RESIS	VIC PEN TANCE,	BLOW	ION S/0.3m				cm/s		AL	PIEZOMETER
METRES	BORING METHOD			STRATA PLOT	ELEV.	ĒR	ш	BLOWS/0.30m				60	80	<u>`</u>	10 ⁻⁶	10-		ADDITIONAL LAB. TESTING	OR STANDPIPE
WE	RING		DESCRIPTION	RATA	DEPTH	NUMBER	ТҮРЕ)/SMC	Cu, kP	R STREM a	NGTH	nat V. rem V.	+ Q- ⊕ U-	0				ADDI AB. T	INSTALLATION
,	B	+		STF	(m)	2		BLO	2	20 4	10	60	80		20	40	80		
0			GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark		90.92 0.00 0.09												 		
		$-\Lambda$	brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.09														
			brown, contains sandy silt layers (WEATHERED CRUST); cohesive,																
			w>PL, very stiff to stiff																
1						1	SS	4							F	\rightarrow			
						2	SS	3											
2							-												
									•				+						
									•			+							
					88.02														Cuttings
3			(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt		2.90														
			seams; cohesive, w>PL, soft to firm			3	SS	WH											
									⊕	+									
4		tem)							⊕	+									
	ger	ollow Si																	
	Power Auger	200 mm Diam. (Hollow Stem)																	
	Pov	nm Dia				4	SS	WH											
5		200 r																	
									⊕	+									
									⊕	+									
6						_													Bentonite Seal
						5	SS	WH											
							1												Silica Sand
_									⊕	+									
7									⊕	+									Standpipe
																			Stanupipe
8						6	55	WH											
5							1												
																			Cuttings
									⊕	+									
9									⊕	+									
		+	End of Borehole		81.78 9.14				⊕	+									×
																			W.L. in Standpipe at Elev. 90.46 m on April 13, 2017
10																			
DE	PTH	1 SC	CALE						Â									L	OGGED: KM
	50									GG	olde	er ates							ECKED: SD

RECORD OF BOREHOLE: 17-31

BORING DATE: March 27, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012999.3 ;E 362038.6 SAMPLER HAMMER, 64kg; DROP, 760mm

SES	AETHOD	SOIL PROFILE	-OT			MPL	_			ETRATI BLOWS		30	HYDRAUL k, 10 ⁻⁶	IC CON cm/s 10 ⁻⁵		TY, 10 ⁻³	ONAL STING	PIEZOMETER OR
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	түре	BLOWS/0.30m	SHEAI Cu, kP	R STREM a	IGTH	⊥ nat V. + rem V. ⊕	Q - ● U - O	Wp H	ER CON			ADDITIONAL LAB. TESTING	STANDPIPE INSTALLATION
		GROUND SURFACE	55	91.20					0 4	10	<u>50 8</u>	30	20	40	60	80		
0		TOPSOIL - (ML) sandy SILT; dark brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand layers (WEATHERED CRUST); cohesive, w>PL, very stiff to firm		0.00														
1					1	SS	7											
2					2	SS	3											
				88.46				Ð		+								
3		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt layers; cohesive, w>PL, soft to firm		2.74				Ð		+								
	Hollow Stem)				3	TP	PH											
4	Power Auger 200 mm Diam. (Hollow Stem)							⊕ ⊕	+ +									
5					4	SS	wн											
6								⊕ ⊕	+									
					5	SS	wн											
7								⊕ ⊕	+ +									
8		End of Borehole		83.58				Ð	+									
9																		
10																		
DE	PTH S	SCALE						Â	C	olde OCia	r						LO	GGED: KM

LOCATION: N 5012872.7 ;E 362097.3

RECORD OF BOREHOLE: 17-32

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: March 17, 2017

	ДОН.	SOIL PROFILE			SA	MPLES		AMIC PE	INETRA E, BLOV	TION VS/0.3m	Ì.		k, cm/s		uvity,		NG	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT		Я	TYPE BLOWS/0 30m		20	40		30	10			1	10 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
WE	RING	DESCRIPTION	ATA	ELEV.	NUMBER	TYPE	SHE Cu, I	AR STR (Pa	INGTH	nat V. + rem V. ⊕	Q - ● U - ○	W/					AB. TI	INSTALLATION
ĩ	BOF		STR/	(m)	ž			20	40		30	20				WI 80		
\neg		GROUND SURFACE		91.05		+							- 4					
0	\top	TOPSOIL - (ML) sandy SILT; brown;		0.00			1											
		\moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.12														
		brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff																
		w>PL, very stiff to stiff																
1																		
'					1	SS 5	;					H	-0-	-				
				Ļ														
				ŀ														
					2	SS 1												
2					2	55												
							⊕			+								
				88.31														
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling; cohesive, w>PL,		2.74			•			+								
3		black organic mottling; cohesive, w>PL, firm to soft		ļ														
	Ê																	
	v Ster				3	ss w	н											
	Hollov			╞														
	Power Auger 200 mm Diam. (Hollow Stem)						⊕		+									
4	nm Di						ľ		'									
	200 n						⊕		F									
5					4	ss w	н											
Ĩ				F														
							-											
							₽	-	F									
							⊕	+										
6																		
				Ē														
					5	ss w	н											
7							₽	+										
							⊕	+										
				83.43														
ŀ		End of Borehole		7.62			Ð	+										
8																		
0																		
9																		
10																		
ררי	ס עדנ																	
		CALE						<u>A</u> (old	er iates								OGGED: KM
1:5	50						V	ZAS	SOC	<u>iates</u>							CHE	ECKED: SD

RECORD OF BOREHOLE: 17-32A

BORING DATE: March 17, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-32

	_																		
ш			SOIL PROFILE			SA	AMPL	ES	DYNAMIC F RESISTAN	PENETRA	TION /S/0.3m	ì	HYDR/	AULIC C k, cm/s	ONDUC	FIVITY,		.0	
ES				ОТ				Б	20	40		80	1			0-4 1	10 ⁻³	NAL	PIEZOMETER OR
ETR		ן ≊ טי	DESCRIPTION	A PL	ELEV.	BER	TYPE	\$/0.3							ONTENT	1		- ĔĔ	STANDPIPE
DEPTH SCALE METRES		BORING MEI HOD	DESCRIPTION	STRATA PLOT	DEPTH	NUMBER	≿	BLOWS/0.30m	SHEAR ST Cu, kPa		rem V. 🤅	ĐŪ-Õ	W				WI	ADDITIONAL LAB. TESTING	INSTALLATION
		2 2		STF	(m)			BLG	20	40	60	80					80		
			GROUND SURFACE		91.05														
- 0			Refer to Borehole 17-32 for Stratigraphy		0.00														<u> </u>
-																			\Box
-																			-
-																			Bentonite Seal
_																			
- 1		200 mm Diam. (Hollow Stem)																	- R: R:
-	F	low S																	Silica Sand
	Power Auger	Hol																	
	ower	Diam																	
_	1	L m																	
- 2		200																	51 mm Diam. PVC
																			51 mm Diam. PVC #10 Slot Screen
- 3					88.00														Silica Sand
			End of Borehole		3.05														WL in Screen at
																			WL in Screen at Elev. 90.63 m on March 31, 2017
- 4																			-
- 5																			-
- 6																			_
0																			
-																			
7																			-
8																			-
- 9																			-
- 10																			-
	грт	Чς	CALE						Ø	_								1.4	OGGED: KM
								(Gold	er								
9 9 9 10 110	50								V A	SSOC	lates							CH	ECKED: SD

RECORD OF BOREHOLE: 17-33

BORING DATE: March 28, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013212.1 ;E 362096.4 SAMPLER HAMMER, 64kg; DROP, 760mm

4	오	SOIL PROFILE	1.	1	SP	MPLI		RESIS	TANCE,	BLOW	TION S/0.3m	Ì.		k, c	m/s	DUCT			ĘΨ	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT		L.		BLOWS/0.30m	2		0		80		10-6	10-5	10) ⁻⁴	10 ⁻³	ADDITIONAL LAB. TESTING	OR
WET	ЫNG	DESCRIPTION	TAF	ELEV. DEPTH	NUMBER	TYPE	VS/0.	SHEAF Cu, kPa	R STREN	IGTH	nat V	+ Q- ● 9 U- O			R CON	ITENT	PERC		B. TE	INSTALLATIO
5	BOR		3TRA	(m)	ΙĨ	-	SLOV			0			l w	/p		−⊖W		WI		
		GROUND SURFACE	0,	91.53			-	2	0 4	10	60	80		20	40	6	U	80	+	
0		TOPSOIL - (ML) sandy SILT; dark		0.00										+						t K
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		0.12																
		brown, contains sandy silt layers																		<u>∑</u> 8
		brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff																		
1					1	SS	3						+	-	0					
					2	SS	wн								0					l 8
2																				
								Ð			+									
								\oplus			+									
3				88.48																Cuttings
J		(CI/CH) SILTY CLAY to CLAY; grey with		3.05		1														
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm			3	SS	wн								þ					
]														
4	- -							\oplus	+											
	/ Ster							Ð	+											
	lollow							Ψ												
	200 mm Diam. (Hollow Stem)																			
	m Dis				4	SS	ωн								0					
5	00														Ŭ					
								Ð	+											
							Ē	₽	+											
6					<u> </u>															
																	_			Bentonite Seal
					5	SS	wн										0			
																				Silica Sand
7								Φ	+											
								₽	+											Standpipe
8					6	TP	PH							-			0	·	С	
					<u> </u>															
																				Cuttings
								⊕	+											
								⊕	+											
9				82.39																
ŀ		End of Borehole		9.14	1			⊕	+											₿
																				W.L. in Standpipe at Elev. 91.08 m on
																				April 13, 2017
10																				
חרי	סדני י																			
	-145	SCALE					- (C	alde	er ates								L	OGGED: KM

RECORD OF BOREHOLE: 17-34

BORING DATE: March 27, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013095.4 ;E 362152.5 SAMPLER HAMMER, 64kg; DROP, 760mm

4	DOH.	5	SOIL PROFILE			SA	MPL		RESIS	MIC PEN TANCE,	BLOWS	5/0.3m	Ì,		k, cm/s				NG	PIEZOMETER
METRES	BORING METHOD			STRATA PLOT	ELEV.	ĔR	ш	BLOWS/0.30m			1		BO `	10				0 ⁻³	ADDITIONAL LAB. TESTING	OR STANDPIPE
E E	RING	DESCR	IPTION	٤ATA	DEPTH	NUMBER	TYPE)/S//(SHEAF Cu, kP	a	NGIH	nat V. + rem V. ⊕	Q - • U - O	W/ Wp		DNTENT	PERCE		ADDI AB. T	INSTALLATION
1	BO			STF	(m)			BLC	2	0 4	10	60 8	80	20				30		
0		GROUND SURFACE		622	91.25 0.00															
		TOPSOIL - (ML) san brown; moist	- /	Ĩ	0.00															
		(CL/CI/CH) SILTY CL brown, contains sand	AY to CLAY; grey																	
		brown, contains sand (WEATHERED CRU w>PL, very stiff to sti	ŚT); coĥesive, ff																	
							SS	5												
1						1	55	5												
						2	SS	2												
2																				
									⊕			+								
									\oplus			H								
3					88.20 3.05															
	Í	(CI/CH) SILTY CLAY black organic mottling seams; cohesive, w>	g, contains silt		5.05	3	22	wн												
	Power Auger	seams, conesive, W ²				3	33													
	Power Auger					-	1													
4	Power	2							⊕	+										
									Ð	+										
		í																		
5						4	SS	wн												
									\oplus	+										
									⊕ +	-										
6																				
						5	SS	wн												
7									⊕	+										
									⊕	+										
					83.63				⊕ ·	+										
		End of Borehole			7.62															
8																				
9																				
10																				
														•						
DEI	-TH	SCALE								G	olde	r Ates							LC	OGGED: KM

RECORD OF BOREHOLE: 17-35

BORING DATE: March 28, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012859.6 ;E 362245.8 SAMPLER HAMMER, 64kg; DROP, 760mm

SES	ИЕТНОВ	SOIL PROFILE	LOT					DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60	80	HYDRAULIC CONDUCTIVITY, k, cm/s 10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³	ONAL STING	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH nat V. + Cu, kPa rem V. = 20 40 60	- Q - ● Ə U - ○ 80	WATER CONTENT PERCENT Wp 0 20 40 60 80	ADDITIONAL LAB. TESTING	STANDPIPE INSTALLATION
		GROUND SURFACE		91.04								
0		TOPSOIL - (ML) sandy SILT; dark brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, stiff to firm		0.00	1	SS	2			⊢− ⊖−1		Ţ
2					2	ss	wн			0		
		(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm		88.45 2.59				⊕ + ⊕ +				Cuttings
3					3	ss				0		
4	Power Auger 200 mm Diam. (Hollow Stem)					-		⊕ + ⊕ +				
5	Power 200 mm Diam.				4	SS		Ð +		0		
6					5	TP	PH	€ +		⊢–−i c	С	Bentonite Seal
7								⊕ + ⊕ +				Silica Sand
					6	ss	wн			с		Standpipe
8								⊕ + ⊕ +				Cuttings
9		End of Borehole		81.90 9.14				⊕ + ● +				W.L. in Standpipe at Elev. 90.50 m on April 13, 2017
10												
	PTH S 50	CALE						Golder				OGGED: KM IECKED: SD

RECORD OF BOREHOLE: 17-36

BORING DATE: March 17, 2017

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013155.1 ;E 362292.3 SAMPLER HAMMER, 64kg; DROP, 760mm

METRES	BORING METHOD	SOIL PROFILE		1	SA	MPL		DYNAMIC PENE RESISTANCE, E				k, cm/s			ING	PIEZOMETER
TREE	3 MEI		STRATA PLOT	ELEV.	ĔR	اس	BLOWS/0.30m				10-6				ADDITIONAL LAB. TESTING	OR STANDPIPE
ME	RING	DESCRIPTION	ATA	DEPTH	NUMBER	TYPE	WS/(SHEAR STRENO Cu, kPa	iH nat rer	tV. + Q-● nV.⊕ U-O		TER CO			ADDI AB. T	INSTALLATION
1	BOI		STR.	(m)	Ž		BLO	20 40	60	80	20				 ~``	
		GROUND SURFACE		91.35										0		
0		TOPSOIL - (ML) sandy SILT; dark	EEE AXXX	0.00												
		\brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey		1												
		WEATHERED CRUST); cohesive, w>PL, very stiff to stiff														
		w>PL, very stiff to stiff			<u> </u>											
1				1												
					1	SS	5					-0	-			
					2	SS	wн									
2																
								\oplus		+						
								Ð		+						
3		(CI/CH) SILTY CLAY to CLAY: arev with		88.30 3.05												
	Ę	(CI/CH) SILTY CLAY to CLAY; grey with black organic mottling, contains silt seams; cohesive, w>PL, soft to firm			3	SS	ωн									
	r W. Stem				ľ											
	Auge.			1												
4	200 mm Diam Hollow							÷ +								
4																
	000							⊕ +								
					4	SS	\A/L									
5					4	35	vvrl									
								⊕ +								
								⊕ +								
6					<u> </u>											
					_											
					5	SS	WH									
					<u> </u>											
7								⊕ +								
'								✓ [⊤]								
								⊕ +								
		End of Dorohol-		83.73				⊕ +								
		End of Borehole		7.62												
8																
9																
10																
10																
		I		I	I										 	
DE	PTH	SCALE							lder ociat						LC	GGED: KM
1:	50							A ss	nciat	29					CHE	ECKED: SD

RECORD OF BOREHOLE: 17-36A

BORING DATE: March 17, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-36

Ш	ДОН	SOIL PROFILE	1.		SA	MPL		DYNAMIC PI RESISTANC	ENETRAT	'ION S/0.3m	<u> </u>	HYDRA	ULIC C k, cm/s	ONDUC	TIVITY,		NG	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 SHEAR STR Cu, kPa	40 ENGTH		Q - • U - O	vvp	ATER C		PERCE	WI	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
0 		GROUND SURFACE Refer to Borehole 17-36 for Stratigraphy	S	91.35 0.00			8	20	40	<u>60 8</u>	30	20) 2	40 é	50 E	80		
																		Bentonite Seal
- 1 - - - - -	Power Auger	200 mm Diam. (Hollow Stem)																Silica Sand
- - 2 - - - - -		200 mm																51 mm Diam. PVC 2014 #10 Slot Screen
- - - 3 -		End of Borehole		88.30 3.05														Silica Sand
-																		WL in Screen at Elev. 90.73 m on March 31, 2017
- - - 4																		
-																		
- - - 5 -																		
- - - 6 -																		
- - - 7 -																		
-																		
- - ≥ 8																		
r / I / I																		
- - - - - - - - - - - - - - - - - - -																		
9.7401771 10																		
MIN-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		I SCALE	<u> </u>	1	<u> </u>	<u> </u>	I(Golde	r	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>		DGGED: KM ECKED: SD

LOCATION: N 5013047.0 ;E 362327.9

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-37

BORING DATE: March 24, 2017

SHEET 1 OF 1

DATUM: CGVD28

METRES	IETHOD	SOIL PROFILE	To:		AMPL		DYNAMIC PENET RESISTANCE, BL 20 40	RATION OWS/0.3m 60	80	HYDRAULIC COND k, cm/s 10 ⁻⁶ 10 ⁻⁵	UCTIVITY, 10 ⁻⁴ 10 ⁻³	STING	PIEZOMETER OR
METR	BORING METHOD	DESCRIPTION	STRATA PLOT (m) (d) (a) (d) (d) (d) (d) (d) (d) (d) (d) (d) (d	TH S	TYPE	BLOWS/0.30m	SHEAR STRENG Cu, kPa	TH nat V.		WATER CONTI	ENT PERCENT	ADDITIONAL LAB. TESTING	STANDPIPE
	BC				_	BL	20 40	60	80	20 40	60 80		
0		GROUND SURFACE TOPSOIL - (ML) sandy SILT; dark	91.	08 00 10	-							+	
		brown; moist (CL/CI/CH) SILTY CLAY to CLAY; grey brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	0.	.10									
1				1	ss	5				н то н			
2				2	ss	3							
							Ð	+					
		(CI/CH) SILTY CLAY to CLAY; grey with	88.	<u>34</u> 74			Ð	+					
3		black organic mottling, contains silt seams; cohesive, w>PL, soft to firm		\vdash	_								
				3	SS	wн							
4	v Stem)						⊕ + ⊕ +						
	Power Auger I Diam. (Hollow						~ '						
	200 mm Diam. (Hollow Stem)			4	SS	wн							
5	200			\vdash	_								
							₽ +						
6							⊕ +						
				5	SS	wн							
7							⊕ +						
							€ +						
				\vdash	-								
8				6	SS	wн							
							⊕ +						
							⊕ + ⊕ +						
9		End of Borehole	81.	94 14			⊕ +						
10													
	этн я	SCALE											GGED: KM
1:							GO	lder ociates	1				CKED: SD

LOCATION: N 5012944.6 ;E 362382.6

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 17-38

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

	ДОН.	SOIL PROFILE			SA	MPLE		DYNAMIC PEN RESISTANCE,	BLOWS	5/0.3m	Ì,	1			NDUCT	IVIIĬ,		AL	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	_, _,	ER		BLOWS/0.30m	20 4			80		0-6	10			10 ⁻³	ADDITIONAL LAB. TESTING	OR
WE	RING	DESCRIPTION	ATA	ELEV. DEPTH	NUMBER	TYPE	WS/C	SHEAR STREN Cu, kPa	IGTH	nat V. ⊣ rem V. €	+ Q- ● 9 U- O					PERCE		ABLT	INSTALLATION
ā	BOF		STR/	(m)	ĭ		BLO				80		′p — 20	40			WI 80		
_		GROUND SURFACE		91.24															
0		TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00															
		(CL/CL/CH) SILTY CLAY to CLAY: grey		0.10															
		brown, contains sandy silt layers (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff																	
		w>PL, very stiff to stiff			1	SS	6					F	-	\rightarrow	-				
1																			
					2	SS	2												
2								Ð			+								
								\oplus	-	H									
		(CI/CH) SILTY CLAY to CLAY; grey with		88.50 2.74															
3		black mottling, contains sandy silt seams; cohesive, w>PL, soft to stiff		2.14	3	SS N													
ŕ					э		v V 171												
	Stem)																		
	Power Auger 200 mm Diam. (Hollow Stem)						€	+											
	Power Auger																		
4	Pow						€	+											
	200 m																		
					4	SS N													
					4		~~~												
5																			
							€	+											
							⊕	+											
							P	, +											
6					5	ss I	wн												
							•	Ð	+										
7								⊕ +											
							€	+											
		End of Borehole	FIELD	83.62 7.62			€	+											
8																			
9																			
10																			
DE	PTH	SCALE							14-	-								LC	OGGED: KM
	50							JAG	ndė	ľ tog									ECKED: SD

PROJECT: 1771847

RECORD OF BOREHOLE: 17-38A

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

LOCATION: Adjacent to BH 17-38

	-								DAVING		TION		10/25		0.000	ED (175 (
Ш			SOIL PROFILE	1.		SA	MPL		DYNAMIC F	CE, BLOV	VS/0.3m	Ì.	HYDR/	AULIC C k, cm/s	ONDUCT	IIVIIY,		Ę,	PIEZOMETER
DEPTH SCALE METRES		Į		STRATA PLOT		Ľ.		BLOWS/0.30m	20	40	60	80		0 ⁻⁶ 1	0 ⁻⁵ 1	0 ⁻⁴ 1	10 ⁻³	ADDITIONAL LAB. TESTING	OR
PTH		ב צ	DESCRIPTION	TAP	ELEV.	NUMBER	TYPE	/S/0.	SHEAR ST Cu, kPa	RENGTH	nat V.	+ Q- •	W		ONTENT		ENT	ED.	STANDPIPE INSTALLATION
DE		ן אַכ		TRA	DEPTH (m)	₽	-	LOW					VVp		W		WI	LAI	
		-	GROUND SURFACE	0				8	20	40	60	80	2	0 ·	40 E	50	80	┼──┦	
— O		\square		—		<u> </u>				_									
	Power Auger	200 mm Diam. (Hollow Stem)	Refer to Borehole 17-38 for Stratigraphy End of Borehole		91.24 0.00 88.19 3.05														Bentonite Seal Silica Sand 51 mm Diam. PVC #10 Slot Screen Silica Sand WL in Screen at Elev. 90.63 m on March 31, 2017
- - - - - - - - - - - - - - - - - - -																			
MIS-BHS 001 1771847.6PJ GAL-MIS.GDT 09/12/17 JEM																			
01 1771847.GPJ G																			
IO SHE DE SHE SIW 1 :	EPTI 50		CALE					(Ø	Gold ssoc	er iates								OGGED: KM IECKED: SD

RECORD OF BOREHOLE: 18-01

BORING DATE: November 5, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012964.6 ;E 361071.4 SAMPLER HAMMER, 64kg; DROP, 760mm

	DOH-	SOIL PROFILE	-]	SA			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	AL	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	ТҮРЕ	BLOWS/0.30m	20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - € rem V. ⊕ U - C	10 ⁻⁸ 10 ⁻⁶ 10 ⁻⁴ 10 ⁻² WATER CONTENT PERCENT Wp	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
-	B	GROUND SURFACE	ST	(m)	_		Ē	20 40 60 80	20 40 60 80	<u> </u>	<u> </u>
1		TOPSOIL - (CI/CH) SILTY CLAY, trace sand; dark brown (CI/CH) SILTY CLAY to CLAY, trace sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff (CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm		92.12 0.00 91.94 0.18 91.05 1.07 90.60	1	SS	8				Bentonite Seal Silica Sand
2	Power Auger mm Diam. (Hollow Stem)	(ML) gravelly sandy SILT; grey (GLACIAL TILL); non-cohesive, wet, compact to loose (SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, compact to loose		1.52 89.99 2.13	3	-	10				PVC #10 Slot
	200 mm Di	(SW) SAND, trace gravel; non-cohesive, wet, dense (SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, dense to very dense		89.07 3.05 88.77 3.35	5	ss	33				
5				86.56	6 7 8	ss	31 34 >50		, 0	МН	Cave
6		End of Borehole	<	5.56							WL in screen at Elev. 92.31 m on April 30, 2019
8											
9 10											
DEF	PTH	SCALE						GOLDER			DGGED: RI ECKED:

RECORD OF BOREHOLE: 18-02

BORING DATE: November 6, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5013068.6 ;E 361173.1 SAMPLER HAMMER, 64kg; DROP, 760mm

	ДОН	SOIL PROFILE	1. 1	s	AMPLE		DYNAMIC PENETRA RESISTANCE, BLOW	S/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	βŕ	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	D ATA	ELEV. EPTH (m)	ТҮРЕ	BLOWS/0.30m	20 40 I I SHEAR STRENGTH Cu, kPa 20 40	60 80 nat V. + Q - ● rem V. ⊕ U - ○ 60 80	10 ⁸ 10 ⁶ 10 ⁴ 10 ² WATER CONTENT PERCENT Wp	ADDITIONAL LAB. TESTING	STANDPIPE
0		GROUND SURFACE		91.65							
Ū		TOPSOIL - (CI/CH) SILTY CLAY (CI/CH) SILTY CLAY to CLAY to CLAY; brown (WEATHERED CRUST); cohesive, w>PL		0.00 0.15 1	ss	8					Native Backfill
1				2	SS	7					Bentonite Seal
											Silica Sand
2		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm		89.52 2.13	SS	2	⊕ +			МН	38 mm Diam. PVC #10 Slot
3							⊕ +				
	uger Hollow Stem)			4	ss	wн					
4	Power Auger 200 mm Diam. (Hollow Stem)						⊕ + <u></u>				
				5	ST	PM	⊕ + \				
5											Cave
6							⊕ +				
				6	53	WH))				
7							⊕ + ⊕ +				
		End of Borehole		84.03 7.62			⊕ +				8
8											WL in screen at Elev. 91.19 m on April 30, 2019
9											
10											
DEF	PTH S	CALE					GOL	DER		L	OGGED: RA

RECORD OF BOREHOLE: 18-03

BORING DATE: November 6, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012861.1 ;E 361112.0 SAMPLER HAMMER, 64kg; DROP, 760mm

	ДОН	SOIL PROFILE	1. 1		SA	MPLE		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	ТҮРЕ	BLOWS/0.30m	20 40 60 80 1 SHEAR STRENGTH Cu, kPa nat V. + Q. • rem V. ⊕ U - O 20 40 60 80	k, cm/s 10 ⁴ 10 ² 10 ⁴ 10 ³ 10 ⁶ 10 ⁴ 10 ² WATER CONTENT PERCENT 10 ⁴ 10 ⁴ 10 ⁴ Wp W W 10 ⁴ 10 ⁴ 20 40 60 80 10 ⁴	STANDPIPE INSTALLATION
0 -		GROUND SURFACE TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand (CI/CH) SILTY CLAY to CLAY, trace sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		91.32 0.00 91.07 0.25	1	SS	5			 Bentonite Seal
1				-	2	SS SS	2			H Silica Sand
3		(CI/C) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm to soft		89.03 2.29	4	SS	wн			38 mm Diam. PVC #10 Slot Screen
4	Power Auger 200 mm Diam. (Hollow Stem)			86.37	5	TP	РН 3	⊕ + + + + + + + + + + + + + + + + + + +		Silica Sand
5 6 7		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose to loose		4.95	7 / ∞	SS SS	6			Cave
8		End of Borehole		83.85 7.47	9	¥s	5			WL in screen at Elev. 91.09 m on April 30, 2019
9										
DEF	PTH S	CALE						GOLDER		LOGGED: RI

RECORD OF BOREHOLE: 18-04

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012942.7 ;E 361222.8 SAMPLER HAMMER, 64kg; DROP, 760mm

ES .	IETHOD	SOIL PROFILE	10			/IPLE		DYNAMIC PER RESISTANCE 20	NETRAT , BLOW 40		80	HYDRAULIC COND k, cm/s 10 ⁻⁸ 10 ⁻⁶	UCTIVIT	Y, 10 ⁻²	DNAL STING	PIEZOMETER	
METRES	BORING METHOD	DESCRIPTION	TA DE	EV. PTH m)	NUMBER	TYPE		SHEAR STRE Cu, kPa		nat V. + rem V. €		WATER CONT			ADDITIONAL LAB. TESTING	STANDPIPE	
0		GROUND SURFACE		91.28													_
0		TOPSOIL - (CL/CI) SILTY CLAY; brown (Cl/CH) SILTY CLAY to CLAY; grey (WEATHERED CRUST); cohesive, w>PL, stiff to very stiff		0.00	1	SS	7									¥ Native Backfill ∑ Bentonite Seal	
1				-	2	ss	2									Silica Sand	
2		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft to firm		2.13		SS	⊕	+								38 mm Diam. PVC 3 #10 Slot Screen 'B'	had a set of the set o
4	Power Auger 200 mm Diam. (Hollow Stem)					ss w	⊕									Native Backfill	
7					6	N EE	€ ⊕	+ +					- 0			Bentonite Seal Silica Sand	
8				-	7	ss v	€	•	+							38 mm Diam. PVC	NUL NUL NUL NUL NUL NUL NUL NUL
10		End of Borehole		<u>9.14</u> 9.14			€	₽ .	ł							Lin screen 'A' at Elev. 91.22 m on April 30, 2019 WL in screen 'B' at Elev. 91.06 m on April 30, 2019	
DEF 1:5		SCALE			1			GC	L	DE	R		1	I		DGGED: RA ECKED:	-

RECORD OF BOREHOLE: 18-05

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012741.6 ;E 361151.9 SAMPLER HAMMER, 64kg; DROP, 760mm

u J	дон	SOIL PROFILE	, , ,		SAM	IPLES	DYNAMIC F	PENETRATIO	DN /0.3m	2	HYDRA	ULIC CON k, cm/s	IDUCTIVITY,	و ب	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION		ELEV. DEPTH (m)	NUMBER	TYPE BLOWS/0.30m	20 SHEAR ST Cu, kPa 20	RENGTH r	60 80 hat V. + em V. ⊕	Q - ● U - ○				NT UOLLIQUE NT UOLLIQUE WI 80	
0		GROUND SURFACE TOPSOIL - (CI/CH) SILTY CLAY to	222	91.29 0.00	_	_									
		CLAY, trace sand; dark brown (SM/ML) SILTY SAND to sandy SILT; grey brown; non-cohesive, moist to wet, loose		91.04	1 5	SS 7									∑ Bentonite Seal
1		(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		90.38	2 5	SS 3								MI	l Silica Sand
2				89.16	3 5	ss wh						\mathbb{Z}			
		(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm		2.13			⊕	+++		\square					38 mm Diam. PVC # #10 Slot Screen
3	ger blow Stem)				4 5	SS PM					$\left \right\rangle$	C)		
4	Power Auger 200 mm Diam. (Hollow Stem)						⊕ + ⊕ +	16		\supset					
5					5 5	SS PM									
								>							Cave
6				F	6	55 PM							0		
7							⊕	+							
		End of Borehole		83.67 7.62			⊕	+							
8															WL in screen at Elev. 91.10 m on April 30, 2019
9															
10															
DEF	PTH S	CALE		I			G		DE	R		I	1	1	LOGGED: RA

RECORD OF BOREHOLE: 18-06

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012825.6 ;E 361270.4 SAMPLER HAMMER, 64kg; DROP, 760mm

November 7, 2018

ļ	ПОН	SOIL PROFILE			SA	MPL		DYNAMIC PENETRA RESISTANCE, BLOV		HYDRAULIC CONDUCTIVITY, k, cm/s	Ę,	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT		Ш		BLOWS/0.30m	20 40	60 80	10 ⁻⁸ 10 ⁻⁶ 10 ⁻⁴ 10 ⁻²	ADDITIONAL LAB. TESTING	OR
Hu	RING	DESCRIPTION	ATA F	ELEV. DEPTH	NUMBER	TYPE	WS/0	SHEAR STRENGTH Cu, kPa	nat V. + Q - ● rem V. ⊕ U - O	WATER CONTENT PERCENT	AB. TI	INSTALLATION
5	BOF		STR/	(m)	Ŋ		BLO	20 40	60 80	Wp		
0		GROUND SURFACE		91.25								
		TOPSOIL - (CL/CU) SILTY CLAY; brown (CI/CH) SILTY CLAY to CLAY; grey		0.00								Native Backfill
		brown (WEATHERED CRUST); cohesive, w>PL, stiff to firm		5.10	1	SS	3					×
		CONCORCE, WALL SUIT IO III III										Bentonito Soci
												Bentonite Seal
1					2	SS	6					
												Silica Sand
								⊕ +				200
						1						
2					3	SS	4					
				88.9 <u>6</u> 2.29								38 mm Diam. PVC #10 Slot Screen
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft		2.29								
					4	ST	РМ					
3												
	6								$ \langle \langle \vee \rangle$	1/		
	v Sterr				5	SS	WН					
	Auger (Hollov											
4	200 mm Diam. (Hollow Stem)							⊕ + /~	\downarrow			
-) mm [$+ \uparrow >$			
	200							●	$\forall / \uparrow $			
									$\langle \langle $			
					6	SS	wн		\searrow			
5								$\langle \frown \rangle$				
							ľ	$\langle + \rangle$	7			Cave
							\square					
								₽∕₽∕				
6						$\left \right $						
				//	7	20	WH					
				$ \langle \rangle $	1	SS.))					
				\searrow	$\overline{}$	\downarrow	ľ					
7							ľ	₽ +				
								€ +				
				83.63								
		End of Borehole		7.62				₽ +				
8												WL in screen at
												WL in screen at Elev. 91.07 m on April 30, 2019
9												
3												
10												
DEI	PTH S	SCALE						GOL			L	DGGED: RA
1:5	50					<					СН	ECKED:

RECORD OF BOREHOLE: 18-07

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012600.1 ;E 361205.1 SAMPLER HAMMER, 64kg; DROP, 760mm

ц Д	DH-	SOIL PROFILE	L		SA	AMPL		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m K, cm/s	NGAL	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH nat V. + Q - ● WATER CONTENT PERCE Cu, kPa rem V. ⊕ U - O Wp	00 S A Z C C C C C C C C C C C C C C C C C C	OR STANDPIPE INSTALLATION
0		GROUND SURFACE TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand		91.43 0.00 91.13	1	SS	5			Ţ
		(CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contain silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.30		-				Bentonite Seal 💆
1					2	SS	2			Silica Sand
2					3	ss	wн	Φ +		38 mm Diam. PVC #10 Slot Screen 'B'
3		(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm		88.38 3.05	4	ss	WH			
4	Stem)	-,						€ +		
5	Power Auger 200 mm Diam. (Hollow Stem)				5	тр	PM		с	Native Backfill
6							PM			Bentonite Seal Silica Sand
8		(SM) gravelly SILTY SAND: grey (GLACIAL TILL); non-cohesive, wet, compact to loose		83.81 7.62	7	ss		o		38 mm Diam. PVC #10 Slot Screen 'A'
9		End of Borehole		82.28 9.15	8	ss	5			WL in screen 'A' at Elev. 90.92 m on April 30, 2019 WL in screen 'B' at Elev. 91.18 m on April 30, 2019
DEI	PTH S	CALE						GOLDER		OGGED: RI IECKED:

RECORD OF BOREHOLE: 18-08

BORING DATE: November 8, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012701.2 ;E 361309.6 SAMPLER HAMMER, 64kg; DROP, 760mm

_ ۲.۴	ТНОР	SOIL PROFILE			SA	MPLES	DYNAMIC PENETR RESISTANCE, BLO		$\langle $	AULIC CONDUCTIVITY, k, cm/s	MG	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE BLOWS/0 30m	20 40 I SHEAR STRENGTH Cu, kPa		2-• W	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
\dashv	-	GROUND SURFACE	S	91.48			20 40	60 80	2	0 40 60 80		
0 -		TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown (CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.00 91.12 0.36	2	SS 3						모 Bentonite Seal
2	-	(CI/CH) SILTY CLAY to CLAY, trace		89.35 2.13	3	ss 2						Silica Sand
3		sand; grey, contains silty sand seams; cohesive, w>PL, firm		-		-	⊕ +	+				#10 Slot Screen
4	Power Auger 200 mm Diam. (Hollow Stem)			- 85.99	4	SS W	⊕ + ⊕ +		7			Cave
6		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose to loose		5.49 84.01 7.47	6	55 2			+ 0			
8		-										WL in screen at Elev. 91.16 m on April 30, 2019
9 10												
DEF	PTH S	CALE		<u> </u>			GOL		2			DGGED: RI

RECORD OF BOREHOLE: 18-09

BORING DATE: November 8, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012730.1 ;E 361453.5 SAMPLER HAMMER, 64kg; DROP, 760mm

ц 	ДОН	SOIL PROFILE	1.	,	SA			DYNAMIC PENETRA RESISTANCE, BLO	TION VS/0.3m	2	HYDRAULIC CONDUCTIVITY, k, cm/s	NG	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ER		BLOWS/0.30m	20 40		80	10 ⁻⁸ 10 ⁻⁶ 10 ⁻⁴ 10 ⁻²	ADDITIONAL LAB. TESTING	OR
۳	RING	DESCRIPTION	ATA	DEPTH	NUMBER	TYPE	WS/0	SHEAR STRENGTH Cu, kPa	nat V. rem V. €	- Q - ● 9 U - O	WATER CONTENT PERCENT	ABDI AB. T	INSTALLATION
L C	BO		STR	(m)	z		BLC	20 40	60	80	Wp		
0		GROUND SURFACE		91.12									
		TOPSOIL - (CL/CI) SILTY CLAY; brown		0.00 90.92 0.20									Native Backfill
		(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		0.20	1	SS	8						Native Backfill
		CONCORVO, WALL, VOLY SUIT IO SUIT											
1													Bentontie Seal
					2	SS	4						R
													Silica Sand
2					3	SS	1						
													38 mm Diam. PVC #10 Slot Screen
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, soft to firm		88.6 <u>9</u> 2.43				⊕	+				#10 Slot Screen
		cohesive, w>PL, soft to firm						⊕ +		$ \land \rangle$			
3										X /			
	(L									$\downarrow \searrow$			
	w Ster				4	SS	WH						
	Power Auger Diam. (Hollo					$\left \right $							
4	200 mm Diam. (Hollow Stem)							⊕ + <u>/</u>	+				
	00 mm							+ +	$\sqrt{2}$	\square			
	2								\Y/				
					_				$\langle \rangle$				
5					5	SS	WH	\frown					
							/]	/) [7				Cave
								»∕/±++∕					
							1	⊕ +					
6								\searrow					
				\vee									
				$ \langle $	6	ST	РМ)						🕷
				\square	$\left \right\rangle$	\mathbb{N}	Ϊ						
7					$\left \right\rangle$	\bigvee	/	⊕ +					
								Φ +					
		End of Doroho'-		83.50				⊕ +					
		End of Borehole		7.62									
8													WL in screen at Elev. 91.05 m on April 30, 2019
													April 30, 2019
9													
10													
DE	PTH S	SCALE						GOL	DF	P		L	OGGED: RA
1:	50					<	V.					CH	IECKED:

RECORD OF BOREHOLE: 18-10

BORING DATE: November 7, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012493.1 ;E 361243.6 SAMPLER HAMMER, 64kg; DROP, 760mm

	ПОН	SOIL PROFILE			SA	MPLES		MIC PENE TANCE, E	ETRATIC BLOWS/	N 0.3m	~		k, cm/s			AL	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION		ELEV. DEPTH (m)	NUMBER	TYPE BLOWS/0.30m	SHEA Cu, kF	20 41 R STREN Pa 20 41	GTH n	atV.+ emV.⊕	Q - • U - O	w w			PERCENT WI 0 80	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
0		GROUND SURFACE		91.24					0								
Ū		TOPSOIL - (CI/CH) SILTY CLAY to CLAY, trace to some sand; dark brown (CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff to firm		0.00 91.01 0.23	1	SS 4											∑ Bentonite Seal
1					2	SS 1											Silica Sand
2		(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive,		<u>89.11</u> 2.13	3	SS WH							A				38 mm Diam. PVC #10 Slot Screen
3		w>PL, firm					•		+	+		$\left \right\rangle$					전:전:전:전:전: 전:전:전:전:전: 전:전:전:전: 전: 전
	Power Auger 200 mm Diam. (Hollow Stem)				4	SS PM						$\left \right\rangle$					
4	Pov 200 mm Dia						⊕	+									
5					5	SS PN		+		\checkmark				0			Cave
6					6	S5 PN	•	+									
-		End of Borehole		83.62 7.62			⊕ ⊕	+ +									
8																	WL in screen at Elev. 91.06 m on April 30, 2019
9																	
10																	
DEF	PTH S	CALE	_11	I				GO	LC) E	R		1	1	<u> </u>	L	I DGGED: RI

RECORD OF BOREHOLE: 18-11

BORING DATE: November 8, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012581.7 ;E 361340.0 SAMPLER HAMMER, 64kg; DROP, 760mm

	БН	SOIL PROFILE	.		SA	AMPLE		DYNAMIC PENETRA RESISTANCE, BLO	VS/0.3m	Ì.	HYDRAULIC C k, cm/s	ONDUCTIVITY,	일	PIEZOMETER
METRES	BORING METHOD		STRATA PLOT	ELEV.	ER		BLOWS/0.30m	20 40		30		0 ⁻⁶ 10 ⁻⁴ 10 ⁻²	ADDITIONAL LAB. TESTING	OR
E I	SING	DESCRIPTION	ATA I	DEPTH	NUMBER	TYPE	WS/0	SHEAR STRENGTH Cu, kPa	nat V. + rem V. ⊕	Q - ● U - ○			AB. T	INSTALLATION
	BOI		STR/	(m)	Ĭ		BLO	20 40	60 8	30		0 60 80		
0		GROUND SURFACE		91.26										
Ű		TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown		0.00										<u> </u>
		(CI/CH) SILTY CLAY to CLAY trace to	Ī	90.96 0.30	1	SS	4							
		some sand; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff												Bentonite Seal
		cohesive, w>PL, very stiff to stiff			-	1								
1					2	SS	2				i-a		мн	
														Silica Sand
					<u> </u>	-								402
					3	SS	1							
2						55	'							
						1								38 mm Diam. PVC
								•	+					#10 Slot Screen
								Φ	Ļ	$ \wedge$				4
3				88.21					ĺ,	//	$ \wedge $			
3		(CI/CH) SILTY CLAY to CLAY, trace sand; grey, contains silty sand seams;		3.05		1				$ \langle \rangle$				Silica Sand
	Stem)	cohesive, w>PL, firm	ı	87.9 <u>1</u> 3.35	4	SS	12			\searrow	$ \langle $			
	≥	(CI/CH) SILTY CLAY to CLAY, some gravel; grey; cohesive, w>PL, firm		87.60 3.66							\searrow			
	Power Auger Diam. (Hollo	(CI/CH) SILTY CLAY to CLAY, trace sand; grey, contains silty sand seams; cohesive, w>PL, firm		3.00	-	$\left \right $			\square					
4	Power mm Diam.	cohesive, w>PL, firm			5	SS	wн			-	C			
	200 r								$\mathbb{V}/$	\vdash				
						$\left \right $								
					6	SS	ωн		\rangle					
5					ľ			\square						
						1 /	/	////-	7					Cave
							\backslash	€						
								€ 4						
6					L			\searrow						
					\vdash	$\left \right $	\setminus							
				\leq	7	SS	PM					0		
				\setminus	\vdash		/ /							
7					\land	M		€ +						
						$ \ge$								
							1	€ +						
ŀ		End of Borehole	_9222	83.64 7.62				€ +						
8														W/L in coroon of
0														WL in screen at Elev. 91.21 m on April 30, 2019
9														
10														
DEF	PTH S	CALE					C	GOL	DE	R			L	OGGED: RI

RECORD OF BOREHOLE: 18-12

BORING DATE: November 8, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012613.5 ;E 361486.7 SAMPLER HAMMER, 64kg; DROP, 760mm

METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAF Cu, kP	R STREI a	NGTH	nat V. + rem V. ⊕	Q - • U - O	ATER C	TNTENT OW	0 ⁻⁴ 10 PERCEN	ADDITIO	OR STANDPIPE INSTALLATIC
0	_	GROUND SURFACE TOPSOIL - (CL/CI) SILTY CLAY; brown	EZ	91.14													<u> </u>
1		(CI/CH) SILTY CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		98.98 0.18		ss ss											– Native Backfill Bentontie Seal
2					3	ss	3						\square	-1			Silica Sand
3		(CI/CH) SILTY CLAY; grey; cohesive, w>PL< firm		<u>88.09</u> 3.05		_		0			+ +						38 mm Diam. PVC #10 Slot Screen 'A'
Power Auger	200 mm Diam. (Hollow Stem)				4	SS	WH	⊕	+								
5 6	200 mm Dian				5	SS SB	WH		+ +					ю			Native Backfill
7								⊕ ⊕	+								Bentontie Seal
8					7	ss	wн										Silica Sand
9				82.00				⊕ ⊕	+++++++++++++++++++++++++++++++++++++++								38 mm Diam. PVC #10 Slot Screen 'B'
10		End of Borehole		9.14				Ð	+								WL in screen 'A' at Elev. 91.06 m on April 30, 2019 WL in screen 'B' at Elev. 91.10 m on April 30, 2019

RECORD OF BOREHOLE: 18-13

BORING DATE: November 8, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012467.9 ;E 361426.7 SAMPLER HAMMER, 64ka: DROP, 760mm

ДĢ	SOIL PROFILE		SA	MPLES		MIC PENET TANCE, BL	RATIO	N \).3m \		HYDRAULIC CO k, cm/s	NDUCTIVITY,	_ <u>0</u>	PIEZOMETER
BORING METHOD	DESCRIPTION	CTRATA PLOT (m) (m) (m)	NUMBER	TYPE BLOWS/0.30m	SHEAI Cu, kP	20 40 R STRENG a	60 TH na re 60	at V. + Q m V.⊕ U	` - 0	10 ⁻⁸ 10 WATER CC Wp		ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
	GROUND SURFACE TOPSOIL - (CI/CH) SILTY CLAY to CLAY, some sand; dark brown (CI/CH) SILTY CLAY to CLAY, trace to some sand; grey brown, contains silty sand seams (WEATHERED CRUST);	91.07 0.00 90.79 0.28	1	SS 3									Bentonite Seal
	sand seams (WEATHERED CRUST); cohesive, w>PL, stiff		2	SS 3						нa			Silica Sand
		88.78	3	ss w	H								28 mm Diam - D/C **
	(CI/CH) SILTY CLAY to CLAY; grey, contains silty sand seams; cohesive, w>PL, firm	2.29			⊕ ⊕		+ +		\bigcirc	$ \ge $			38 mm Diam. PVC #10 Slot Screen
Power Auger 200 mm Diam. (Hollow Stem)			4	TP PI	1				$\langle \rangle$				
Pow 200 mm Diar					⊕	+ +		7	\sum				
		-	5	SS PI		+	7				0		Cave
			6	SS PI	•								
					Ð	++							
	End of Borehole	83.45 7.62			₽	+							WL in screen at Elev. 90.57 m on April 30, 2019
	CALE					GO							DGGE

RECORD OF BOREHOLE: 18-14

BORING DATE: November 9, 2018

SHEET 1 OF 1

DATUM: CGVD28

LOCATION: N 5012533.4 ;E 361557.7 SAMPLER HAMMER, 64kg; DROP, 760mm

1	тнор	SOIL PROFILE	 _		SA	AMPLE		RESISTANCE, BLOWS/0.3m k,		PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 40 60 80 10 ⁻⁸	.cm/s .gv/s 10 ⁶ 10 ⁴ 10 ² ER CONTENT PERCENT .gv/s 0W .gv/s 40 60 80	OR STANDPIPE INSTALLATION
0 -		GROUND SURFACE TOPSOIL - (CL/CI) SILTY CLAY; dark brown (CI/CH) SILTY CLAY to CLAY; brown (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff		91.38 0.00 0.15	1	SS	6			Native Backfill
2		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm			3	SS	2	⊕ ⊕ + +	MH	Silica Sand 2 38 mm Diam. PVC #10 Slot Screen
4	Power Auger 200 mm Diam. (Hollow Stem)	Unicente, W/FL, IIIII			4	ss	WH			Cave
6		(ML) gravelly sandy SILT; grey (GLACIAL TILL); non-cohesive, wet, very loose to compact		85.28 6.10 83.91	6	5	wн 11		ОМН	
8		End of Borehole		7.47						WL in screen at Elev. 91.01 m on April 30, 2019
9 10										
DEF	PTH S	CALE						GOLDER		.OGGED: RA

Organic or Inorganic	Soil Group	Туре	of Soil	Gradation or Plasticity	Cu	$=\frac{D_{60}}{D_{10}}$		$Cc = \frac{(D)}{D_{10}}$	$(xD_{60})^2$	Organic Content	USCS Group Symbol	Group Name
		of s mm)	Gravels with	Poorly Graded		<4		≤1 or ≧	23		GP	GRAVEL
(se	(mm)	ELS mass action i	≤12% fines (by mass)	Well Graded		≥4		1 to 3	3		GW	GRAVEL
by mas	solls	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with	Below A Line			n/a				GM	SILTY GRAVEL
ANIC ≤30%	INED ((>5 co; larg€	>12% fines (by mass)	Above A Line			n/a				GC	CLAYEY GRAVEL
NORG	E-GRA s is larç	an) s	Sands with	Poorly Graded		<6		≤1 or 2	≥3	≤30%	SP	SAND
INORGANIC (Organic Content ≤30% by mass)	OARS by mas	DS mass c tction is 4.75 n	≤12% fines (by mass)	Well Graded		≥6		1 to 3	3		SW	SAND
(Org	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with	Below A Line			n/a				SM	SILTY SAND
	Ŭ	(≥5 co small	>12% fines (by mass)	Above A Line			n/a				SC	CLAYEY SAND
Organic	Soil			Laboratory		F	Field Indica	tors	Taughpaga	Organic	USCS Group	Primary
or Inorganic	Group	Туре	of Soil	Tests	Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread) N/A (can't	Content	Symbol	Name
	<u>_</u>	LL plot		Liquid Limit	Rapid	None	None	>6 mm	roll 3 mm thread)	<5%	ML	SILT
(ss)	75 mm) and L	Line city low)	<50	Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
by ma	OILS 1an 0.0	SILTS tic or PI	below A-Line on Plasticity Chart below)		Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or Pl and	g o D	Liquid Limit	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	МН	CLAYEY SILT
INORG	:-GRAI is is sm	NO N		≥50	None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	ОН	ORGANIC SILT
ganic -	FINE by mas	plot	e on hart	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to	CL	SILTY CLAY
Ō	≥50%	CLAYS and LL r	above A-Line on Plasticity Chart below)	Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium	30%	CI	SILTY CLAY
	U	(Pl a	Plasi	Liquid Limit ≥50	None	High	Shiny	<1 mm	High	(see Note 2)	СН	CLAY
≻ ^O 9	30% s)		mineral soil tures							30% to		SILTY PEAT, SANDY PEAT
HIGHLY ORGANIC SOILS (Organic	Content >30% by mass)	may con mineral so	antly peat, tain some il, fibrous or ous peat							75% 75% to 100%	PT	PEAT
4 0 0	tý clay-clay Silt ML (: 10		AY COP	sility clay Clay Clay Pure Layey silit ML EGANIC Silit OL 40 s quid limit (LL)	CLAY CH CLAYEY S ORGANIC S	70	80	a hyphen, For non-cc the soil h transitiona gravel. For cohes liquid limit of the plas Borderlin separated A borderlin has been transition b	for example, ohesive soils, as between il material be ive soils, the and plasticity ticity chart (s e Symbol — by a slash, for identified as between simil ay be used to	GP-GM, S the dual sy 5% and etween "c dual symb index val ee Plastici A borderl or example ould be us s having p ar materia	two symbols is SW-SC and Cl ymbols must b 12% fines (i.e lean" and "di bol must be us ues plot in the ty Chart at leff ine symbol is e, CL/Cl, GM/S sed to indicate properties that Is. In addition a range of simi	ML. e used when e. to identify rty" sand or ed when the CL-ML area t). two symbols SM, CL/ML. that the soil t are on the , a borderline

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

named SILT. Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (<i>i.e.</i> , SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_i), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); Nd: The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

- PH: Sampler advanced by hydraulic pressure
- PM: Sampler advanced by manual pressure
- WH: Sampler advanced by static weight of hammer
- WR: Sampler advanced by weight of sampler and rod

NON-COHESIVE (CO	OHESIONLESS) SOILS
Comp	actness ²
Term	SPT 'N' (blows/0.3m) ¹
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic 2. trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

SAMPLES	
AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
ТО	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

1.

SOIL LESTS	
w	water content
PL, w _p	plastic limit
LL, WL	liquid limit
С	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
Μ	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

	COHESIVE SOILS Consistency	
Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure 1.

SPT 'N' in accordance with ASTM D1300, unconceded to overballed processes effects; approximate only. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations. 2.

	Water Content
Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

Unless otherwise stated, the symbols employed in the report are as follows:

I.	GENERAL	(a) w	Index Properties (continued) water content
π	3.1416	wi or LL	liquid limit
ln x	natural logarithm of x	w _p or PL	plastic limit
log ₁₀	x or log x, logarithm of x to base 10	I _p or PI	plasticity index = (wլ – wբ)
g	acceleration due to gravity	NP	non-plastic
t	time	Ws	shrinkage limit
		l∟ Ic	liquidity index = $(w - w_p) / I_p$ consistency index = $(w_l - w) / I_p$
		emax	void ratio in loosest state
		emin	void ratio in densest state
		ID	density index = $(e_{max} - e) / (e_{max} - e_{min})$
II.	STRESS AND STRAIN		(formerly relative density)
γ	shear strain	(b)	Hydraulic Properties
Δ	change in, e.g. in stress: $\Delta \sigma$	h	hydraulic head or potential
3	linear strain	q	rate of flow
εv	volumetric strain coefficient of viscosity	v i	velocity of flow hydraulic gradient
η	Poisson's ratio	k	hydraulic conductivity
υ	total stress	ĸ	(coefficient of permeability)
σ σ'	effective stress ($\sigma' = \sigma - u$)	j	seepage force per unit volume
σ΄νο	initial effective overburden stress	,	
	principal stress (major, intermediate,		
., _, -	minor)	(c)	Consolidation (one-dimensional)
		Cc	compression index
σoct	mean stress or octahedral stress		(normally consolidated range)
	$= (\sigma_1 + \sigma_2 + \sigma_3)/3$	Cr	recompression index
τ	shear stress	0	(over-consolidated range)
u E	porewater pressure modulus of deformation	Cs Cα	swelling index secondary compression index
G	shear modulus of deformation	Cα m _v	coefficient of volume change
ĸ	bulk modulus of compressibility	Cv	coefficient of consolidation (vertical
			direction)
		Ch	coefficient of consolidation (horizontal direction)
		Tv	time factor (vertical direction)
III.	SOIL PROPERTIES	U	degree of consolidation
		σ'p	pre-consolidation stress
(a)	Index Properties	OCR	over-consolidation ratio = σ'_p / σ'_{vo}
ρ(γ)	bulk density (bulk unit weight)*	()	Choose Oferen ath
ρd(γd)	dry density (dry unit weight)	(d)	Shear Strength
ρw(γw) ρs(γs)	density (unit weight) of water density (unit weight) of solid particles	τρ, τr 4'	peak and residual shear strength effective angle of internal friction
ps(γs) γ'	unit weight of submerged soil	φ' δ	angle of interface friction
Y	$(\gamma' = \gamma - \gamma_w)$	μ	coefficient of friction = tan δ
DR	relative density (specific gravity) of solid	C'	effective cohesion
	particles (D _R = ρ_s / ρ_w) (formerly G _s)	Cu, Su	undrained shear strength (ϕ = 0 analysis)
е	void ratio	р	mean total stress $(\sigma_1 + \sigma_3)/2$
n	porosity	p'	mean effective stress ($\sigma'_1 + \sigma'_3$)/2
S	degree of saturation	q	(σ ₁ - σ ₃)/2 or (σ' ₁ - σ' ₃)/2
		qu	compressive strength ($\sigma_1 - \sigma_3$)
		St	sensitivity
* Densi	ty symbol is ρ . Unit weight symbol is γ	Notes: 1	$\tau = c' + \sigma' \tan \phi'$
	$\gamma = \rho g$ (i.e. mass density multiplied by	2	shear strength = (compressive strength)/2
	eration due to gravity)		



TECHNICAL MEMORANDUM

DATE July 16, 2018

Project No. 18100364/2000

TO Andrew Finnson, CAIVAN Communities

СС

FROM Stephane Sol, Christopher Phillips

EMAIL ssol@golder.com; cphillips@golder.com

NBCC SEISMIC SITE CLASS TESTING RESULTS BORRISOKANE RD, OTTAWA, ONTARIO

This technical memorandum presents the results of four Multichannel Analysis of Surface Waves (MASW) tests performed for the National Building Code of Canada (NBCC 2015). The seismic testing was carried out near Cedarview Rd/Borrisokane Rd in Ottawa, Ontario and location of each MASW line is shown on Figure 1. The geophysical testing was performed by Golder Associates Ltd. (Golder) personnel on May 16 and 17 and June 26, 2018.



Figure 1: MASW Location Site Map (MASW Lines in red)

Methodology

The MASW method measures variations in surface-wave velocity with increasing distance and wavelength and can be used to infer the rock/soil types, stratigraphy and soil conditions.

A typical MASW survey requires a seismic source, to generate surface waves, and a minimum of two geophone receivers, to measure the ground response at some distance from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium.

The depth of penetration of a surface wave into a medium is directly proportional to its wavelength. In a non-homogeneous medium, surface waves are dispersive, i.e., each wavelength has a characteristic velocity owing to the subsurface heterogeneities within the depth interval that particular wavelength of surface wave propagates through. The relationship between surface-wave velocity and wavelength is used to obtain the shear-wave velocity and attenuation profile of the medium with increasing depth.

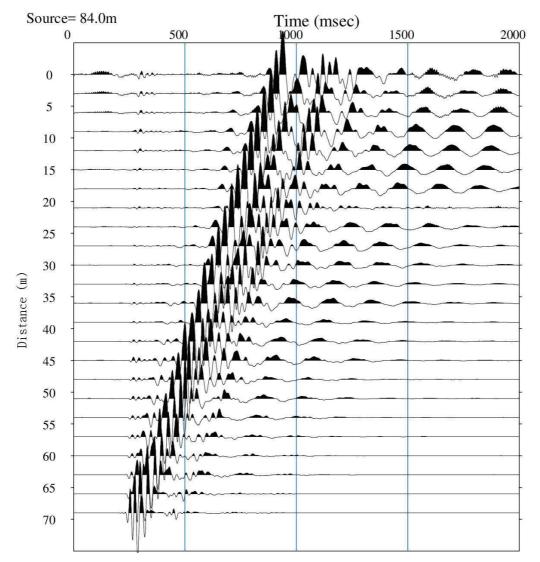
The seismic source used can be either active or passive, depending on the application and location of the survey. Examples of active sources include explosives, weight-drops, sledge hammer and vibrating pads. Examples of passive sources are road traffic, micro-tremors, and water-wave action (in near-shore environments).

The geophone receivers measure the wave-train associated with the surface wave travelling from a seismic source at different distances from the source.

The participation of surface waves with different wavelengths can be determined from the wave-train by transforming the wave-train results into the frequency domain. The surface-wave velocity profile with respect to wavelength (called the 'dispersion curve') is determined by the delay in wave propagation measured between the geophone receivers. The dispersion curve is then matched to a theoretical dispersion curve using an iterative forward-modelling procedure. The result is a shear-wave velocity profile of the tested medium with depth, which can be used to estimate the dynamic shear-modulus of the medium as a function of depth.

Field Work

The MASW field work was conducted on May 16 and 17 and June 26, 2018, by personnel from the Golder Mississauga and Ottawa office. For the three MASW lines, a series of 24 low frequency (4.5 Hz) geophones were laid out at 3 metre intervals. Both active and passive readings were recorded along the MASW line. For the active investigation, a seismic drop of 45 kg and a 9.9 kg sledge hammer were used as seismic sources. Active seismic records were collected with seismic sources located 5, 10, and 15 metres from and collinear to the geophone array. Examples of active seismic record collected along each MASW line are shown on Figures 2, 3, 4, and 5 below.





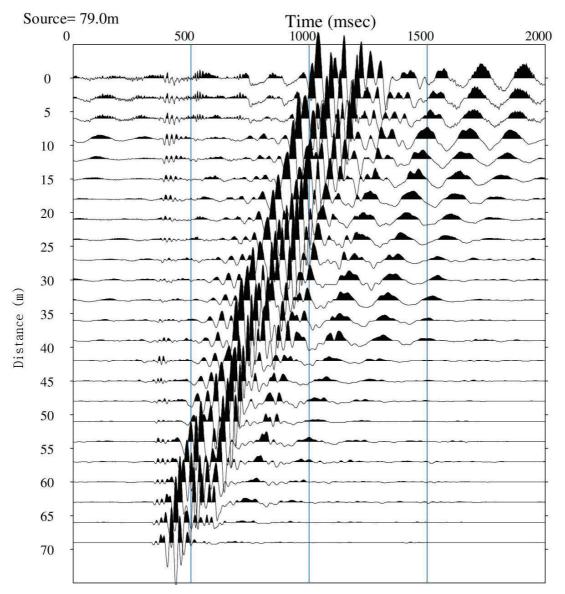


Figure 3: Typical seismic record collected at the site of the MASW Line 2.

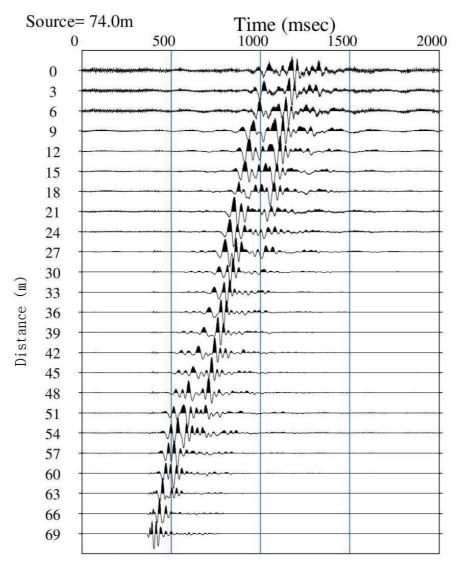
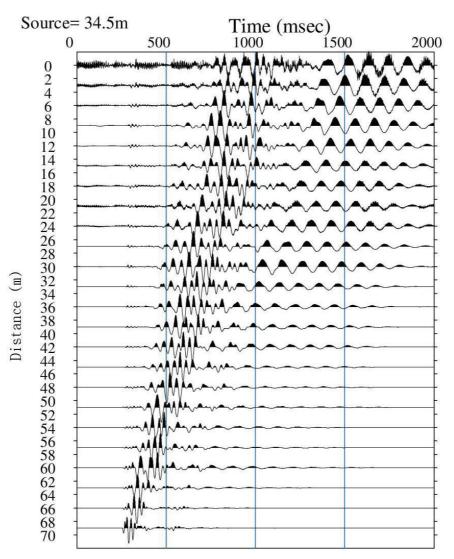


Figure 4: Typical seismic record collected at the site of the MASW Line 3.





Data Processing

Processing of the MASW test results consisted of the following main steps:

- 1) Transformation of the time domain data into the frequency domain using a Fast-Fourier Transform (FFT) for each source location;
- 2) Calculation of the phase for each frequency component;
- 3) Linear regression to calculate phase velocity for each frequency component;
- 4) Filtering of the calculated phase velocities based on the Pearson correlation coefficient (r2) between the data and the linear regression best fit line used to calculate phase velocity;
- 5) Generation of the dispersion curve by combining calculated phase velocities for each shot location of a single MASW test; and,

6) Generation of the stiffness profile, through forward iterative modelling and matching of model data to the field collected dispersion curve.

Processing of the MASW data was completed using the SeisImager/SW software package (Geometrics Inc.). The calculated phase velocities for a seismic shot point were combined and the dispersion curve generated by choosing the minimum phase velocity calculated for each frequency component as shown on Figures 6, 7, 8 and 9 for MASW Lines 1, 2, 3, and 4, respectively. Shear wave velocity profiles were generated through inverse modelling to best fit the calculated dispersion curves. The active survey of MASW Lines provided a dispersion curve with a suitable frequency range as summarized in Table 1, below.

MASW Line	Minimum Frequency (Hz)	Maximum Frequency (Hz)
MASW Line 1	3	38
MASW Line 2	4	26
MASW Line 3	3	35
MASW Line 4	4	22

Table 1: Summary of Dispersion Curves with Suitable Frequency Ranges

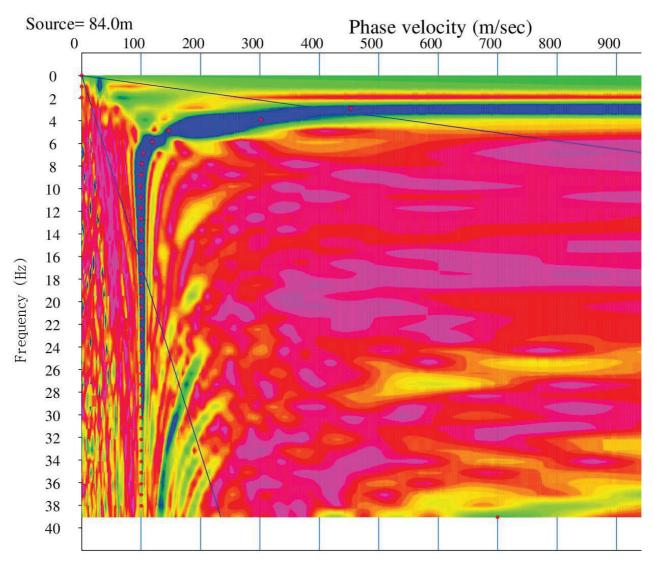


Figure 6: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 1

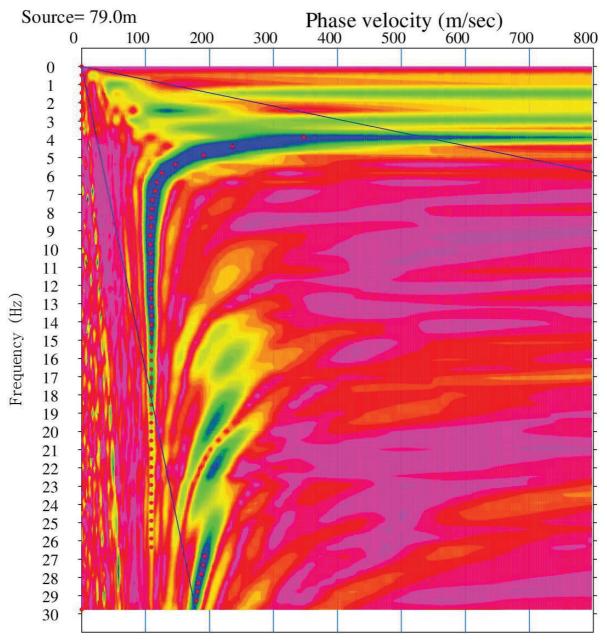
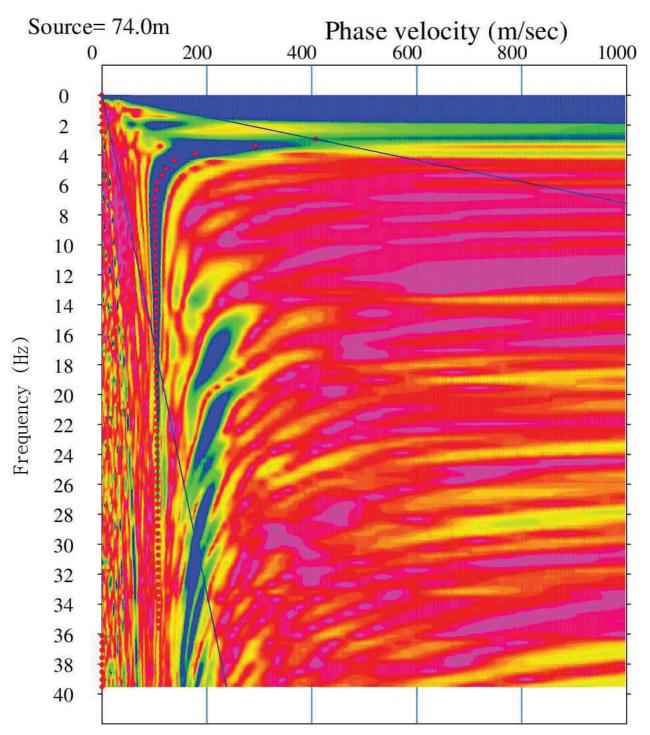


Figure 7: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 2





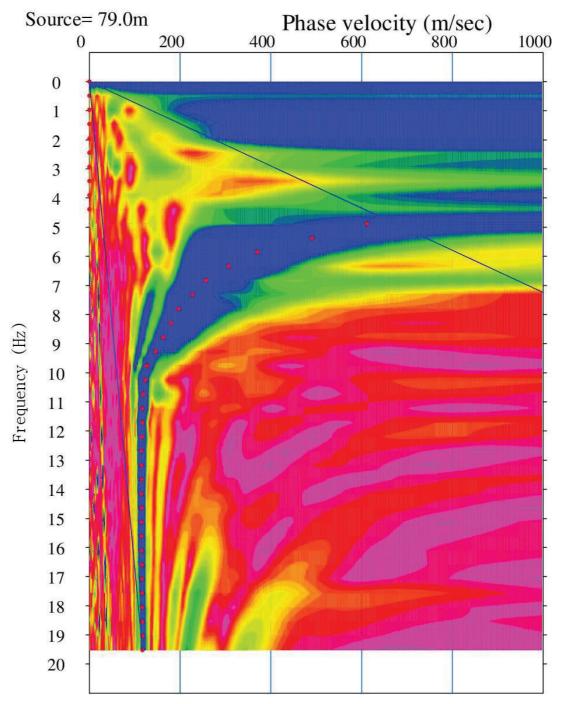
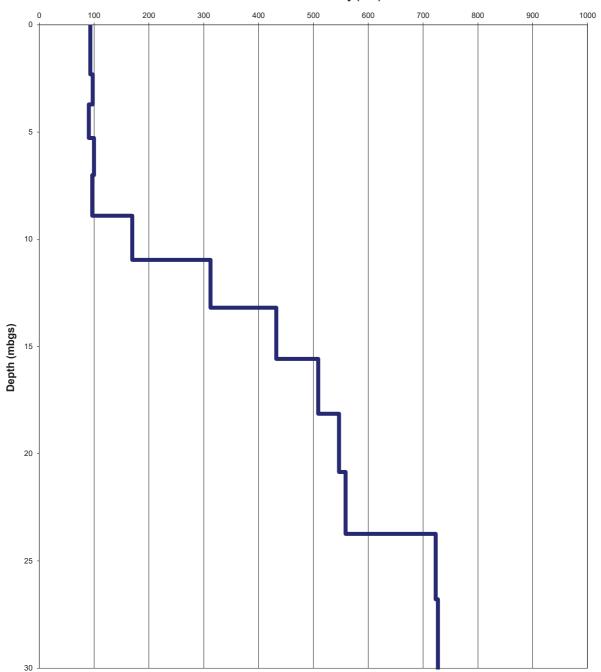


Figure 9: Active MASW Dispersion Curve Picks (red dots) along the MASW Line 4

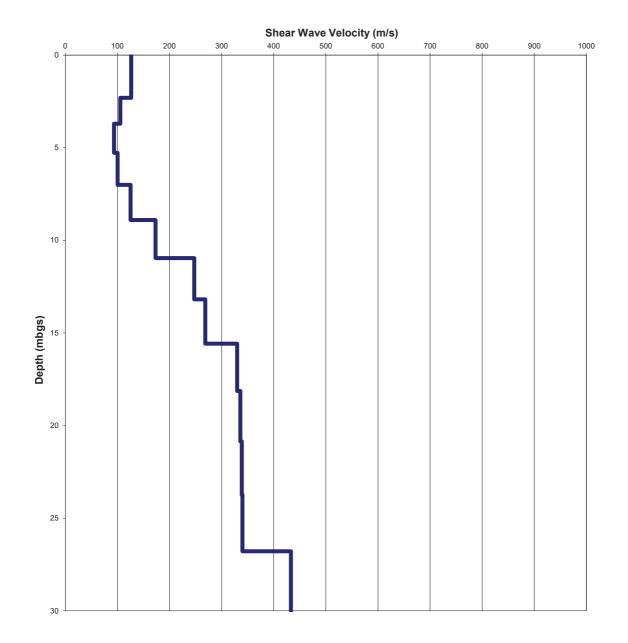
Results

The MASW test results are presented in Figures 10, 11, 12, and 13 for MASW Lines 1, 2, 3, and 4, respectively. These results present the calculated shear wave velocity profiles derived from the field testing along each MASW line. The field collected dispersion curves are compared with the model generated dispersion curves on Figures 14, 15, 16 and 17 for MASW Lines 1, 2, 3, and 4, respectively. There is a satisfactory correlation between the field collected and model calculated dispersion curves, with a root mean squared error of less than 3% along each MASW line.

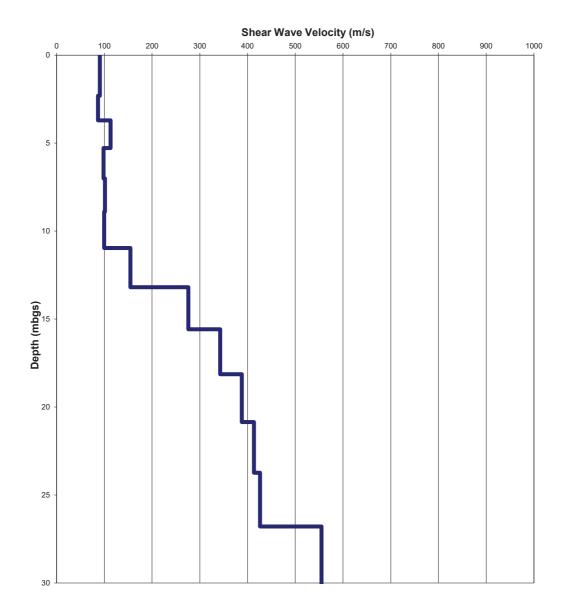


Shear Wave Velocity (m/s)

Figure 10: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 1









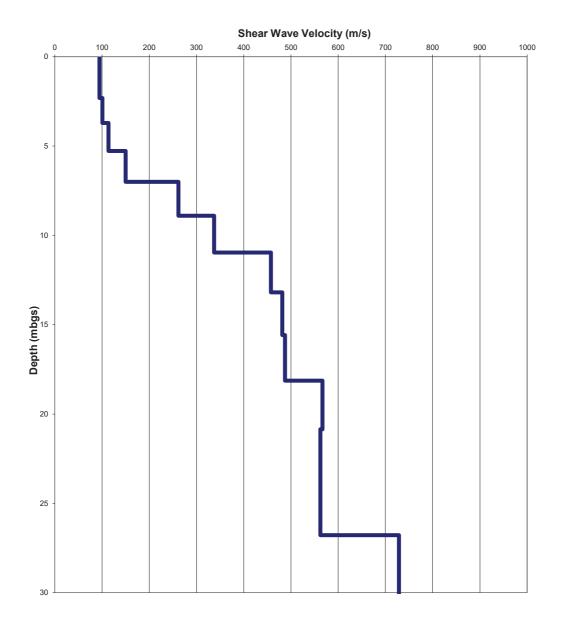


Figure 13: MASW Modelled Shear-Wave Velocity Depth profile along the MASW Line 4

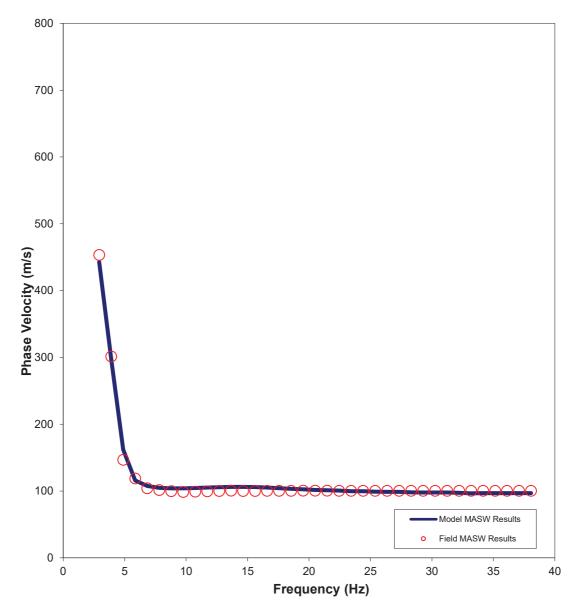


Figure 14: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 1

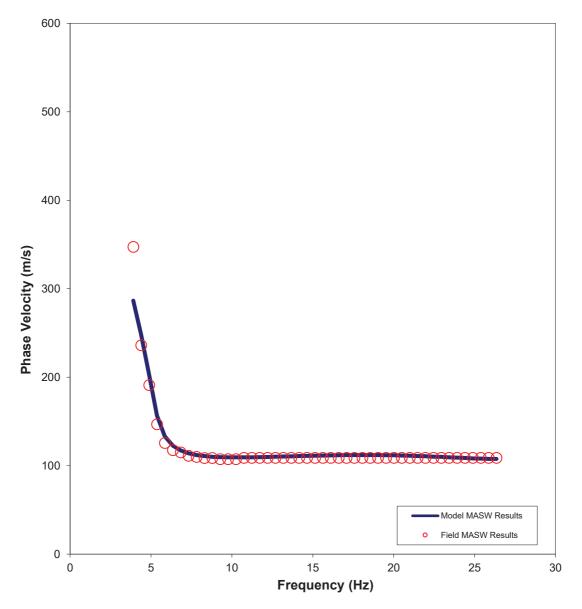


Figure 15: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 2

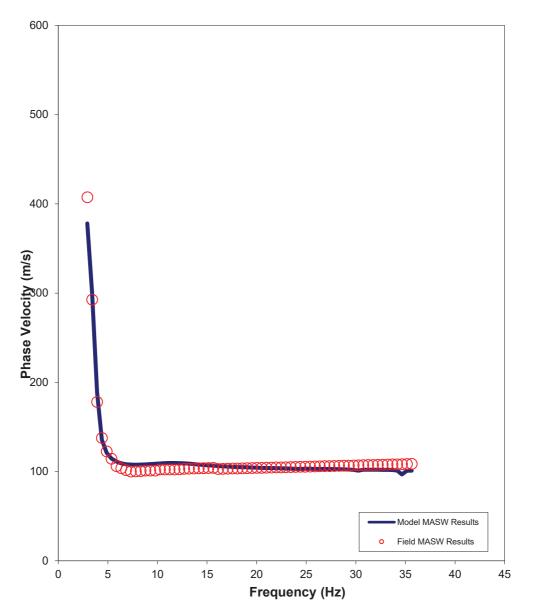


Figure 16: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 3

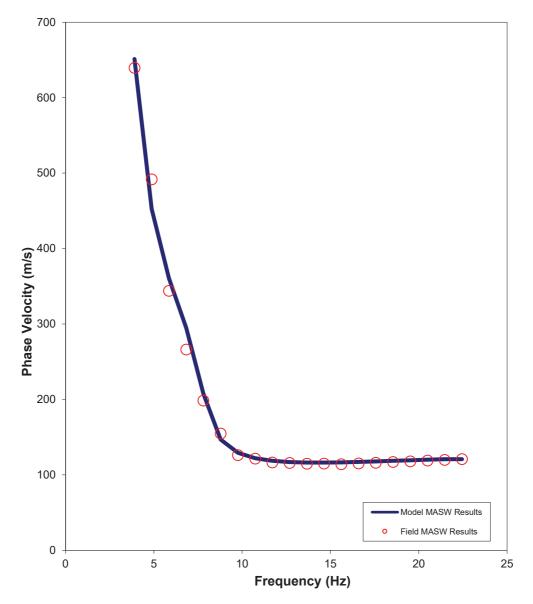


Figure 17: Comparison of Field (red dots) vs. Modelled Data (blue line) along the MASW Line 4

To calculate the average shear-wave velocity as required by the National Building Code of Canada (NBCC 2015), the results were modelled to 30 metres below ground surface. The average shear-wave velocity along MASW Line 1 was found to be 211 m/s (Table 2). The average shear-wave velocity along MASW Line 2 was found to be 198 m/s (Table 3). The average shear-wave velocity along MASW Line 3 was found to be 176 m/s (Table 4). The average shear-wave velocity along MASW Line 4 was found to be 268 m/s (Table 5).

The NBCC 2015 requires special site specific evaluation if certain soil types are encountered on the site, so the site classification stated here should be reviewed, and modified if necessary, according to borehole stratigraphy, standard penetration resistance results, and undrained shear strength measurements, if available for this site.

Model Layer (mbgs)		Layer Thickness		Shear Wave Travel Time Through	
Тор	Bottom	(m)	Shear Wave Velocity (m/s)	Layer (s)	
0.00	1.07	1.07	93	0.011498	
1.07	2.31	1.24	93	0.013267	
2.31	3.71	1.40	98	0.014353	
3.71	5.27	1.57	90	0.017329	
5.27	7.01	1.73	100	0.017316	
7.01	8.90	1.90	97	0.019599	
8.90	10.96	2.06	170	0.012140	
10.96	13.19	2.23 312 2.39 432	0.007123		
13.19	15.58		0.005528		
15.58	18.13	2.55	509	0.005023	
18.13	20.85	2.72	547	0.004975	
20.85	23.74	2.88	559	0.005163	
23.74	26.79	3.05	723	0.004217	
26.79	30.00	3.21	727	0.004420	
			Vs Average to 30 mbgs (m/s)	211	

Table 2: Shear-Wave Velocity Profile along the MASW line 1

Table 3: Shear-Wave Velocity Profile along the MASW line 2

Model Layer (mbgs)		Layer Thickness		Shear Wave Travel Time Through
Тор	Bottom	(m)	Shear Wave Velocity (m/s)	Layer (s)
0.00	1.07	1.07	126	0.008475
1.07	2.31	1.24	126	0.009779
2.31	3.71	1.40	106	0.013266
3.71	5.27	1.57	94	0.016742
5.27	7.01	1.73	100	0.017247
7.01	8.90	1.90	125	0.015147
8.90	10.96	2.06	173	0.011895
10.96	13.19	2.23	248	0.008989
13.19	15.58	2.39	269	0.008896
15.58	18.13	2.55	330	0.007747
18.13	20.85	2.72	336	0.008092
20.85	23.74	2.88	339	0.008512
23.74	26.79	3.05	340	0.008967
26.79	30.00	3.21	433	0.007423
			Vs Average to 30 mbgs (m/s)	198

Model Layer (mbgs)		Layer Thickness		Shear Wave Travel Time Through	
Тор	Bottom	(m)	Shear Wave Velocity (m/s)	Layer (s)	
0.00	1.07	1.07	91	0.011826	
1.07	2.31	1.24	91	0.013646	
2.31	3.71	1.40	87	0.016153	
3.71	5.27	1.57	113	0.013867	
5.27	7.01	1.73 98	0.017616		
7.01	8.90	1.90	101	0.018731	
8.90	10.96	2.06	100	0.020696	
10.96	13.19	2.23 155 2.39 276	0.014399		
13.19	15.58		2.39 276	0.008661	
15.58	18.13	2.55	343	0.007453	
18.13	20.85	2.72	388	0.007012	
20.85	23.74	2.88	414	0.006976	
23.74	26.79	3.05	426	0.007158	
26.79	30.00	3.21	555	0.005790	
			Vs Average to 30 mbgs (m/s)	176	

Table 4: Shear-Wave Velocity Profile along the MASW line 3

Table 5: Shear-Wave Velocity Profile along the MASW line 4

Model Layer (mbgs)		Layer Thickness		Shear Wave Travel Time Through		
Тор	Bottom	(m)	Shear Wave Velocity (m/s)	Layer (s)		
0.00	1.07	1.07	94	0.011341		
1.07	2.31	1.24	94	0.013085		
2.31	3.71	1.40	101	0.013903		
3.71	5.27	1.57	114	0.013779		
5.27	7.01	1.73	150	0.011561		
7.01	8.90	1.90	262	0.007243		
8.90	10.96	2.06	337	0.006109		
10.96	13.19	2.23	458	0.004864		
13.19	15.58	2.39	481	0.004964		
15.58	18.13	2.55	487	0.005242		
18.13	20.85	2.72	567	0.004800		
20.85	23.74	2.88	562	0.005131		
23.74	26.79	3.05	562	0.005424		
26.79	30.00	3.21	729	0.004411		
			Vs Average to 30 mbgs (m/s)	268		

Limitations

This technical memorandum is based on data and information collected by Golder Associates Ltd. and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this memo.

Golder Associates Ltd. has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the reports as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The services performed, as described in this memo, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this memo, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this memo.

The findings and conclusions of this memo are valid only as of the date of this memo. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this memo, and to provide amendments as required.

Closure

We trust that this technical memorandum meets your needs at the present time. If you have any questions or require clarification, please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.

Stephane Sol, Ph.D., P. Geo. Senior Geophysicist

SS/CRP/jl

Christopher Phillips, M.Sc., P. Geo. *Senior Geophysicist, Principal*

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TABLE 2 - SHRINKAGE LIMIT DETERMINATIONS

Borehole Number	1	8-08		
Sample Number	4			
Depth, m	3.0	5-3.66		
Shrinkage Dish Number	1	2		
Mass of the dry soil pat, g	17.68	17.48		
Mass of dry soil pat + shrinkage dish, g	40.84	39.71		
Mass of shrinkage dish, g	23.16	22.23		
Volume of shrinkage dish, cm ³	13.40	13.33		
Mass of wet soil + shrinkage dish, g	47.81	46.61		
Moisture content of the soil	39.42	39.47		
Mass of dry soil pat before waxing, g	17.68	17.48		
Volume of dry soil pat + wax, cm ³	14.46	15.79		
Mass of dry soil pat + wax in air, g	22.22	23.28		
Mass of dry soil pat + wax in water, g	7.76	7.49		
Mass of wax, g	4.54	5.80		
Volume of wax, cm ³	4.91	6.27		
Specific gravity of wax	0.925	0.925		
Volume of dry soil pat, cm ³	9.55	9.52		
SHRINKAGE LIMIT, SL	17.66	17.68		
SHRINKAGE RATIO, R	1.85	1.84		
Project Numb 18108333 (2000)	Date Tested	December 3, 2018		
Tested By X. Meng	Checked By	М		

Notes:

Shrinkage limits of samples determined according to ASTM D4943-18 standard. Test carried out using wax method.

Microsere Wax 5214.

Certificate of Analysis

Environment Testing

Client:	Golder Associates Ltd. (Ottawa)
	1931 Robertson Road
	Ottawa, ON
	K2H 5B7
Attention: PO#:	Mr. Alex Meacoe
Invoice to:	Golder Associates Ltd. (Ottawa)

eurofins

Report Number:	1821076
Date Submitted:	2018-11-20
Date Reported:	2018-11-27
Project:	18108333/1000
COC #:	838159

				Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1400203 Soil 2018-11-01 18-24 sa3/5-7'	1400204 Soil 2018-10-29 18-25 sa3/5-7'	1400205 Soil 2018-10-30 18-29 sa3/5-7'	1400206 Soil 2018-11-07 18-06 sa3A/5.5-6'8''
Group	Analyte	MRL	Units	Guideline				
Anions	Cl	0.002	%		<0.002	<0.002	<0.002	<0.002
	SO4	0.01	%		<0.01	<0.01	<0.01	0.05
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.30	0.18	0.19	0.24
	рН	2.00			7.43	7.96	8.00	7.15
	Resistivity	1	ohm-cm		3330	5880	5260	4170

Lab I.D.	1400207
Sample Matrix	Soil
Sample Type Sampling Date Sample I.D.	2018-11-08 18-09 sa3/5-7'

Group	Analyte	MRL	Units	Guideline	
Anions	CI	0.002	%		<0.002
	SO4	0.01	%		0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.18
	рН	2.00			7.97
	Resistivity	1	ohm-cm		5560

Guideline =

* = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted. Methods references and/or additional QA/QC information available on request. MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Environment Testing

Client:	Golder Associates Ltd. (Ottawa)	Report Number:	1702391	
	1931 Robertson Road	Date Submitted:	2017-02-17	
	Ottawa, ON	Date Reported:	2017-02-22	
	K2H 5B7	Project:	1771847	
Attention:	Ms. Kim MacDonald	COC #:	815762	
PO#:				
Invoice to:	Golder Associates Ltd. (Ottawa)			

				Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1281581 Soil 2017-02-02 BH 17-1 SA 1/2.5-4.5	1281582 Soil 2017-02-03 BH 17-10 SA2/2.5-4.5	1281583 Soil 2017-02-14 BH 17-14 SA1/2.5-4.5
Group	Analyte	MRL	Units	Guideline			
General Chemistry	Cl	0.002	%		0.003	0.003	0.004
	Electrical Conductivity	0.05	mS/cm		0.20	0.15	0.18
	рН	2.0			7.4	7.1	6.9
	Resistivity	1	ohm-cm		5000	6670	5560
	SO4	0.01	%		0.01	<0.01	<0.01

Guideline =

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* = Guideline Exceedence

All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario). Results relate only to the parameters tested on the samples submitted. Methods references and/or additional QA/QC information available on request. MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Environment Testing

	.			
Client:	Golder Associates Ltd. (Ottawa)	Report Number:	1705915	
	1931 Robertson Road	Date Submitted:	2017-04-21	
	Ottawa, ON	Date Reported:	2017-04-28	
	K2H 5B7	Project:	1771847	
Attention:	Mr. Steve Dunlop	COC #:	817524	
PO#:				
Invoice to:	Golder Associates Ltd. (Ottawa)			
PO#:	K2H 5B7 Mr. Steve Dunlop	Project:		1771847

				Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1289218 Soil 2017-03-30 BH17-19 sa2 5-7	1289219 Soil 2017-03-30 BH17-29 sa2 5-7	1289220 Soil 2017-03-30 BH17-37 sa2 5-7	1289221 Soil 2017-03-30 BH17-47 sa2 5-7
Group	Analyte	MRL	Units	Guideline				
Agri Soil	рН	2.0			8.0	8.0	8.0	8.1
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.22	0.19	0.20	0.19
	Resistivity	1	ohm-cm		4540	5260	5000	5260
	SO4	0.01	%		<0.01	<0.01	<0.01	<0.01
Subcontract	Cl	0.002	%		<0.002	0.003	0.002	<0.002

				Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1289222 Soil 2017-03-30 BH17-57 sa2 5-7
Group	Analyte	MRL	Units	Guideline	
Agri Soil	рН	2.0			8.0
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.16
	Resistivity	1	ohm-cm		6250
	SO4	0.01	%		<0.01
Subcontract	CI	0.002	%		<0.002

Guideline =

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* = Guideline Exceedence

All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario). Results relate only to the parameters tested on the samples submitted. Methods references and/or additional QA/QC information available on request.



APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 to 5 – SLOPE STABILITY ANALYSIS SECTIONS FIGURE 6 – TEST FILL PILE SETTLEMENT MONITORING PROGRAM DRAWING5036-4 - TEST HOLE LOCATION PLAN

DRAWING5036-5 - PERMISSIBLE GRADE RAISE PLAN

DRAWING5036-6 - TREE PLANTING SETBACK RECOMMENDATIONS

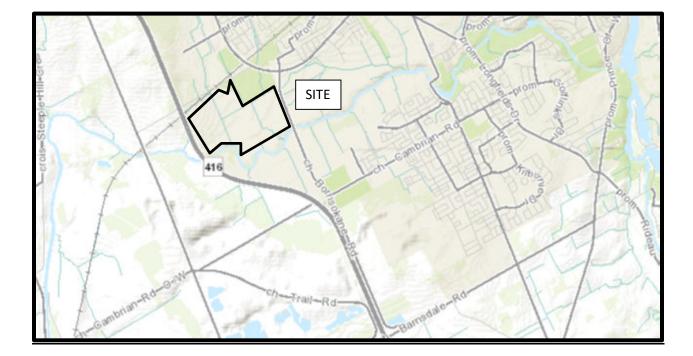
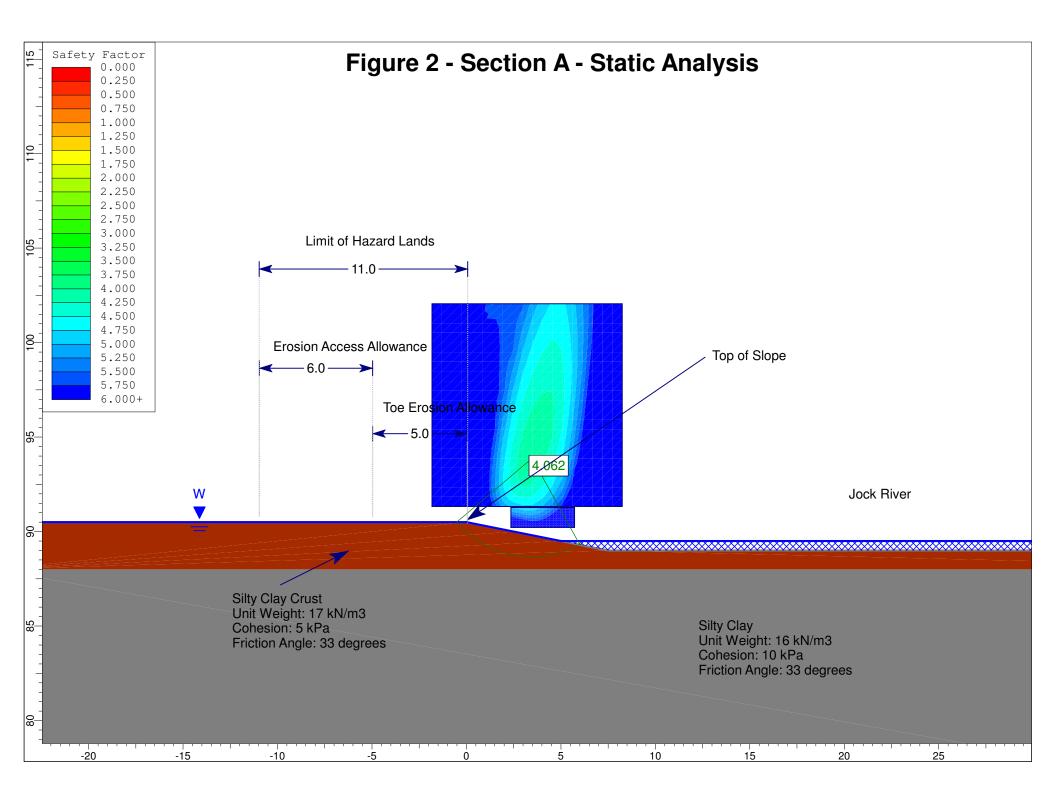
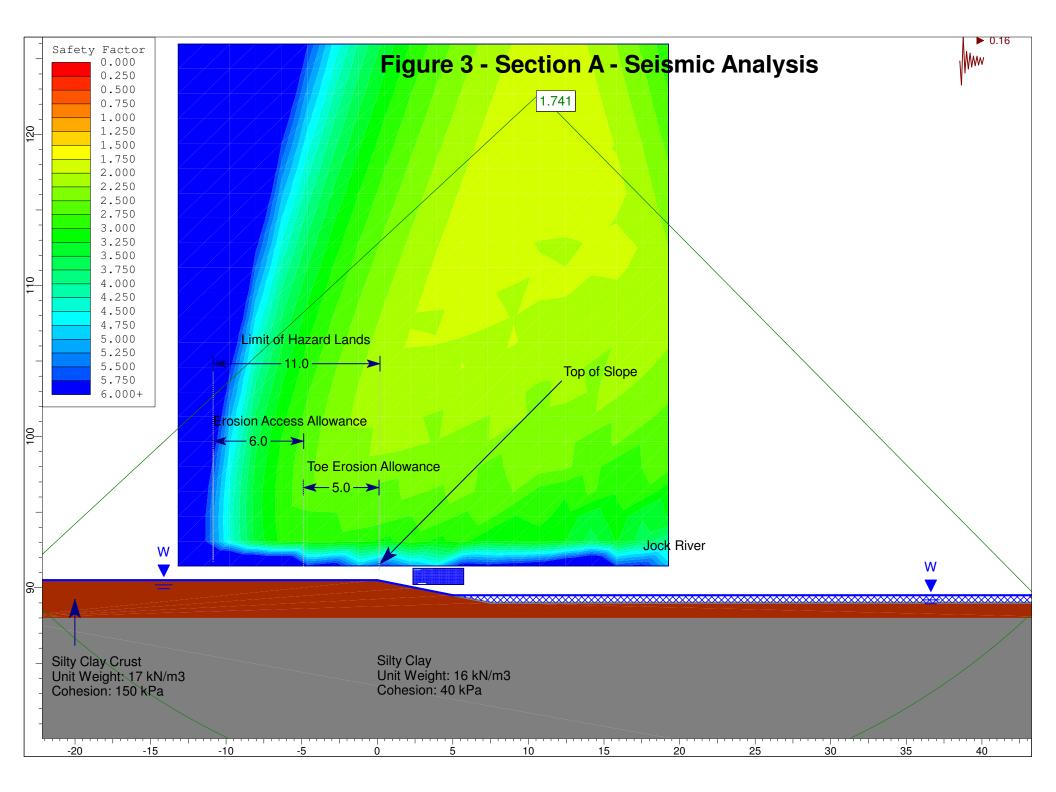


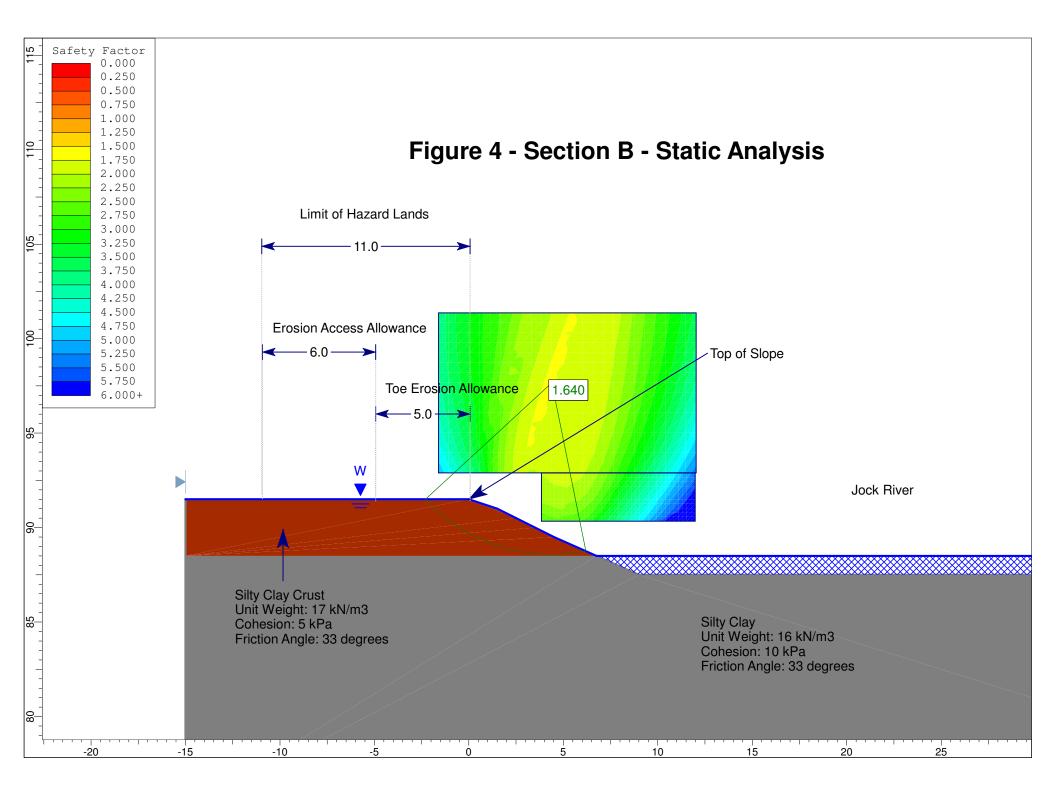
FIGURE 1

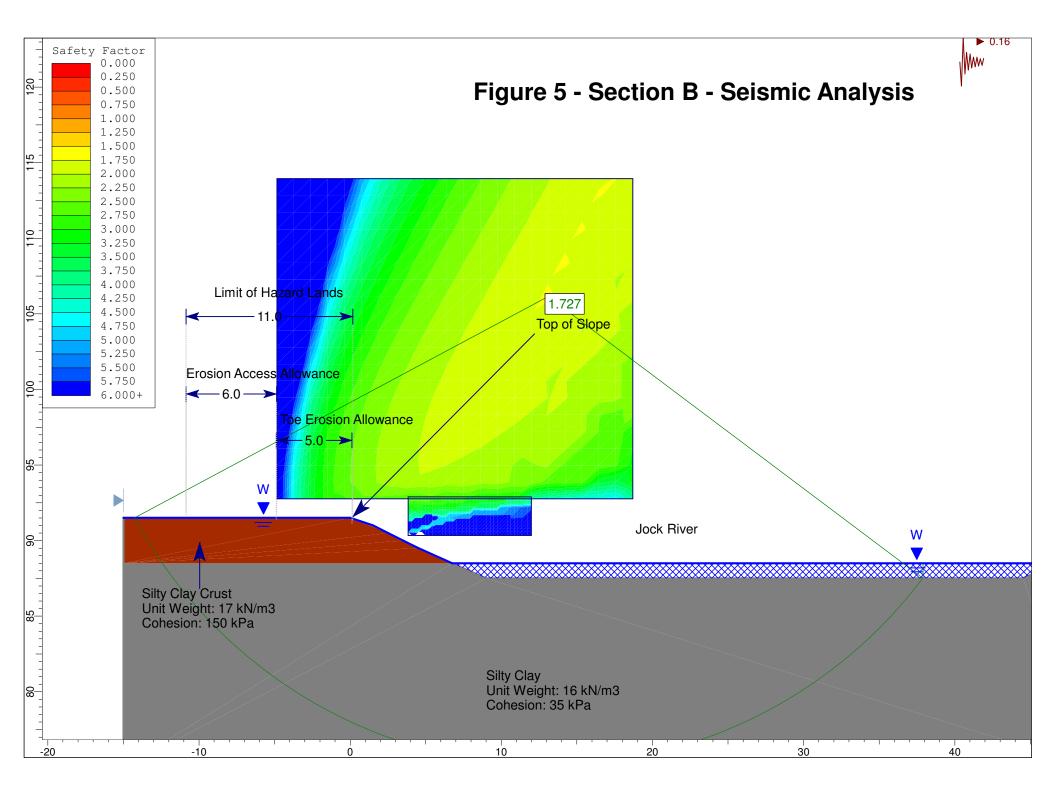
KEY PLAN

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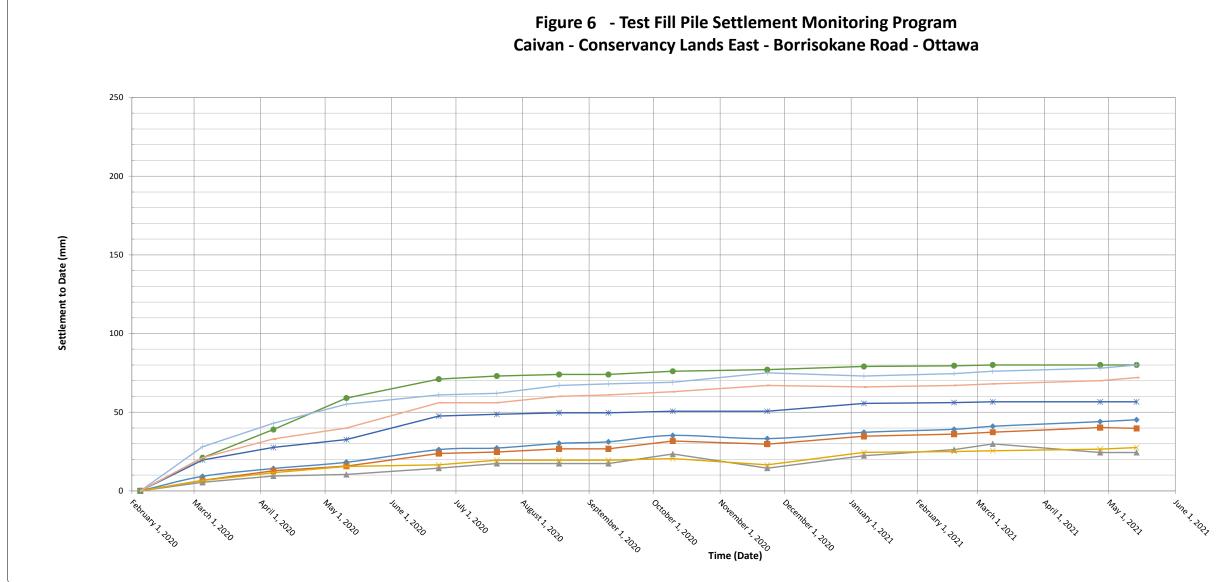






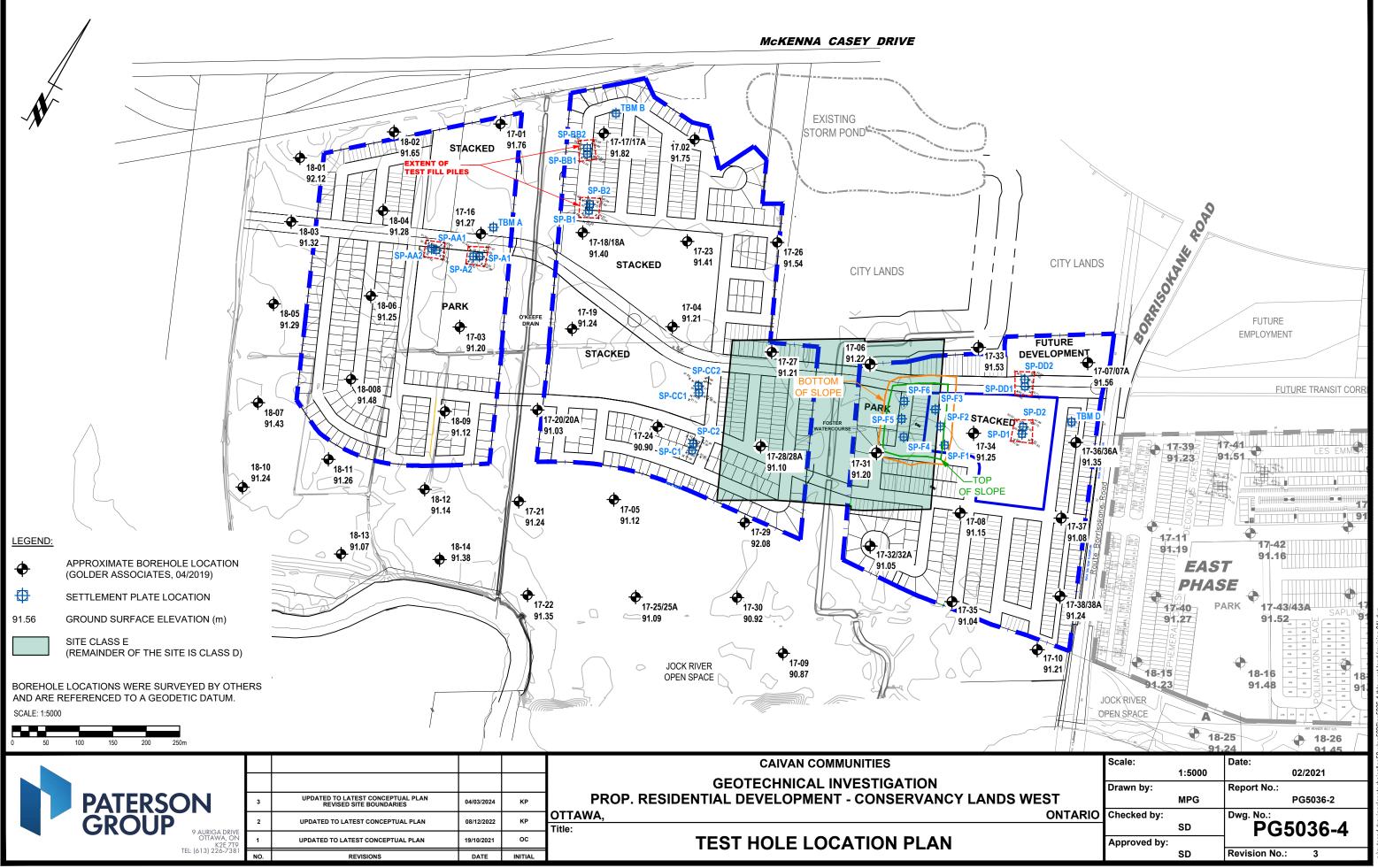




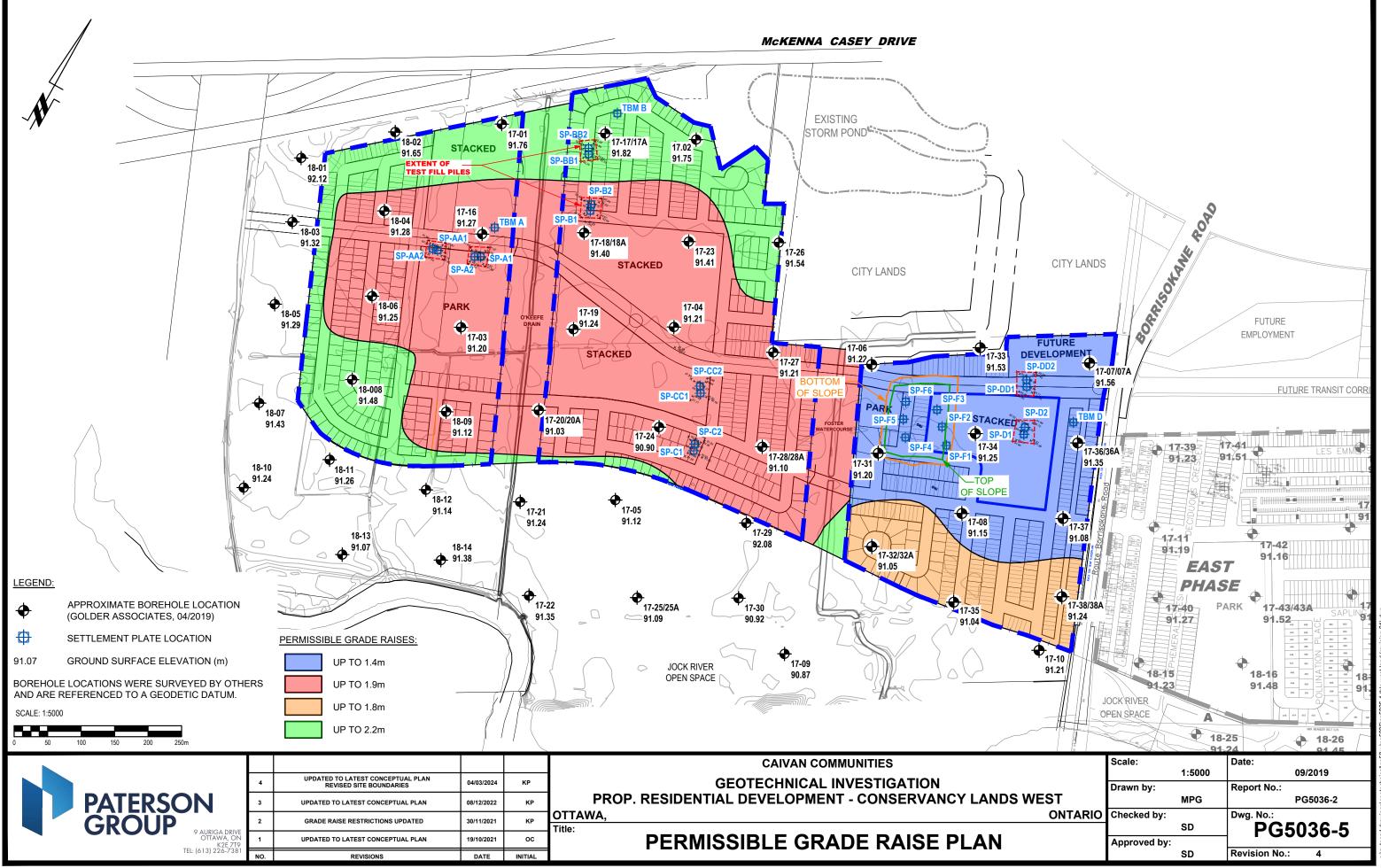


Current Fill Height at Settlement Plate

	2.3 m
	2.3 m
	2.4 m
	2.4 m
───── SP-E1	2.5 m
SP-E2	2.4 m
SP-EE1	2.9 m
	2.9 m



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