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Retaining Walls (100% Submission)

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1. INTRODUCTION

This report presents the results of a foundation investigation and provides foundation recommendations for the design and construction of the proposed retaining structures along Highway 427. The project is part of the proposed 6.6 km long extension of Highway 427 from Highway 7 to Major Mackenzie Drive in the City of Vaughan, Ontario.

Recommendations on the foundation aspects of the retaining structures presented in this report were based on the interpretation of the subsurface information obtained during the current investigation by Thurber Engineering (Thurber) and from previous investigations by others.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. PROJECT DESCRIPTION AND GEOLOGY BACKGROUND

There are 12 retaining walls proposed for the Highway 427 widening/extension and are listed below:

Package/ Segment	Retaining Wall No.	Structure No.	Wall Type	Alignment	Location	Approx. Chainage		Length (m)	Maximum Height (m)
						From	To		
Package 9 Segment L-2	RW1	-	Gabion	Hwy427 SBL	West ROW	12+860	12+965	105	1.6
	RW2	-	Gabion	Hwy427 SBL	West ROW	13+044	13+187	143	2.0
	RW3	-	Gabion	Hwy427 SBL	West ROW	13+450 10+000	13+570 9+770	350	3.5
	RW4	W01	RSS	Hwy427 SBL	W-S Ramp Interface	13+822	13+954	132	3.2
Package 1 Segment L-3	RW5	B10 (RW-6)	RSS	Zenway EBL	South	9+743	9+901	158	7.5
	RW6	B10 (RW-5)	RSS	Zenway WBL	North	9+737	9+903	166	7.5
	RW7	B10 (RW-4)	RSS	Zenway EBL	South	10+037	10+178	141	9.1
	RW8	B10 (RW-3)	RSS	Zenway WBL	North	10+038	10+209	171	8.8
	RW9	W02	RSS	Langstaff Road near Carpool Lot	North ROW	9+649	9+755	106	3.3
	RW10	-	Toe Wall	Langstaff Road / Hwy427 E-N Ramp	East ROW	9+720	9+760	40	2.25
	RW11	W03	RSS	Hwy427 SBL	N-EW Ramp Interface	12+518	12+570	52	3.9
Package 3 Segment L-5	RW12	W04	RSS	MMD S-E Ramp	East ROW Limit	10+166	10+209	43	1.6

The sites are situated within the Peel Plain physiographic region in which the subsurface conditions generally comprise clayey silt to silty clay of Halton till with interlayers of sand and silt. Localized recent deposits of sands, silts and soft clays formed in small glacial meltwater ponds throughout the region may be encountered near the river and creek valleys. The site is underlain by shale bedrock of the Georgian Bay Formation with siltstone and limestone interlayers.

3. GEOTECHNICAL INVESTIGATION

A field investigation was conducted for the twelve (12) retaining wall sites. Forty (40) boreholes were drilled between May 19 and July 28, 2017. Two (2) boreholes from previous geotechnical investigations completed by Golder Associates and Peto MacCallum Ltd. were also used for this report. The details of the field investigation

are listed below.

Borehole coordinates and ground surface elevations at the borehole locations were derived from topographic drawings provided by WSP/MMM. The Record of Borehole sheets (which includes the approximate locations in MTM NAD 83, Zone 10 coordinates) and Borehole Locations and Soil Strata Drawings are included in the appendices.

Track mounted CME 55 drill rigs supplied by Walker Drilling Ltd. Of Utopia, Ontario were used to advance the boreholes. Soil samples were obtained at selected intervals using a 50 mm nominal inner diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT) procedures as per ASTM D1586.

Groundwater conditions were observed in the open boreholes throughout the drilling operations and measured upon completion of drilling. Standpipe piezometers were installed in Boreholes TS-17-15, RW7-17-01, RW7-17-02, STM 17-07, UC-17-08, UC-17-11, UC-17-13, UC-17-14, UC-17-16, UC-17-17, UC-17-18, ZB-17-05, RWLR-17-02, and FLR-17-06.

4. SUBSURFACE CONDITIONS

A general description of the stratigraphy is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description which was prepared for interpretation of the site conditions. Subsurface soil conditions may vary between and beyond borehole locations.

4.1 RW1

At RW1 two (2) boreholes were drilled, HM-17-07 and HM-17-08. In general, the stratigraphy of the site consists of clayey silt overlaying clayey silt to silty clay till which is in turn underlain by silty sand to sand till.

4.1.1 Clayey Silt

A 0.8 m thick deposit of clayey silt was encountered in Boreholes HM-17-07 and HM-17-08 and extended to Elevations ranging from 177.2 to 176.9. The SPT-N values within the deposit ranged from 10 to 12 blows per 0.3 m of penetration indicating a stiff consistency. The moisture contents of the clayey silt ranged from 19 percent to 23 percent.

4.1.2 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the clayey silt at both borehole locations and extended to a depth ranging from 5.6 m to 7.6 m (Elev. 172.3 m and 170.1 m). SPT-N values within the cohesive till ranged from 24 to 117 blows per 0.3 m of penetration indicating a very stiff to hard (predominantly hard) consistency. The moisture content of the clayey silt to silty clay till ranged from 9 percent to 22 percent.

4.1.3 Silty Sand to Sand Till

Silty sand to sand till was encountered underlying the clayey silt to silty clay till at both borehole locations and extended to the borehole termination depth of 9.1 m (Elev. 168.8 m and 168.5 m). SPT-N values within the sand till ranged from 48 to more than 50 blows per 0.3 m of penetration indicating a dense to very dense relative density. The moisture content of the silty sand to sand till ranged from 13 percent to 19 percent.

4.2 RW2

At RW2 two (2) boreholes were drilled, TS-17-15 and TS-17-16. In general, the stratigraphy of the site consists of clayey silt overlaying clayey silt to silty clay till.

4.2.1 Clayey Silt

A 0.8 m thick deposit of clayey silt was encountered in Boreholes TS-17-15 and TS-17-16 and extended to

Elevations ranging from 177.2 to 176.9. The SPT-N values within the deposit ranged from 12 to 29 blows per 0.3 m of penetration indicating a stiff to very stiff consistency. The moisture content of the clayey silt ranged from 11 percent to 14 percent.

4.2.2 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the clayey silt at both borehole locations and extended to the borehole termination depth, which ranged from 6.7 m to 7.6 m (Elev. 169.9 m and 169.6 m). SPT-N values within the cohesive till ranged from 28 to 144 blows per 0.3 m of penetration indicating a very stiff to hard consistency. The moisture content of the clayey silt to silty clay till ranged from 6 percent to 21 percent.

4.3 RW3

At RW3 five (5) boreholes were drilled, HM-17-11, HM-17-12, HM-17-13, RW7-17-02, and STM-17-06. In general, the stratigraphy of the site consists of clayey silt and fill overlaying clayey silt to silty clay till which is in turn underlain by sandy silt till.

4.3.1 Asphalt

Asphalt with a thickness ranging of 100 mm was encountered at the ground surface in Borehole HM-17-13

4.3.1 Topsoil

Topsoil with a thickness of 200 mm was encountered at the ground surface in Borehole STM-17-06.

4.3.2 Clayey Silt Fill

A 0.8 m thick deposit of fill was encountered at the ground surface in Boreholes HM-17-11, and below the asphalt in Borehole HM-17-13 and extended to a depth ranging from 0.8 m to 0.9 m (Elev. 176.9). The SPT-N values ranged from 12 to 14 blows per 0.3 m of penetration indicating a stiff consistency. The moisture content of the clayey silt fill ranged from 15 percent to 23 percent.

4.3.1 Sand and Gravel Fill

A 0.8 m thick deposit of fill was encountered at the ground surface in Borehole HM-17-12 and extended to Elevation 176.9. The SPT-N value was 8 blows per 0.3 m of penetration indicating a loose relative density. The moisture content of the sand and gravel fill was 7 percent.

4.3.2 Clayey Silt

A 0.6 m to 1.3 m thick deposit of clayey silt was encountered at the ground surface in Borehole RW7-17-02 and below the topsoil in Borehole STM-17-06 and extended to depths ranging from 0.6 m to 1.5 m (Elev. 179.0 to 178.5). The SPT-N values within the deposit ranged from 10 to 13 blows per 0.3 m of penetration indicating a stiff consistency. The moisture contents of the clayey silt ranged from 15 percent to 21 percent.

4.3.3 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the clayey silt and fill at all five borehole locations and extended to a depth of 7.6 m (Elev. 170.2) in Borehole HM-17-13. The other four Boreholes were terminated in the clayey silt to silty clay till at depths ranging from 8.2 m to 12.6 m (Elev. 171.4 to 167.4). SPT-N values within the cohesive till ranged from 36 to over 100 blows per 0.3 m of penetration indicating a hard consistency. The moisture content of the clayey silt to silty clay till ranged from 5 percent to 22 percent.

4.3.4 Sandy Silt Till

Silty sand to sand till was encountered underlying the clayey silt to silty clay till at in Borehole HM17-13 at a depth

of 7.6 m (Elev. 170.2). This layer extended to the borehole termination depth of 8.2 m (Elev. 169.6). The SPT-N value within the sandy silt till was 38 blows per 0.3 m of penetration indicating a dense relative density. The moisture content of the sandy silt till was 13 percent.

4.4 RW4

At RW3 three (3) boreholes were drilled, RW7-17-01, RW7-17-02 and STM-17-07. In general, the stratigraphy of the site consists of clayey silt to silty clay overlaying clayey silt to silty clay till.

4.4.1 Topsoil

Topsoil with a thickness of 150 mm was encountered at the ground surface in Borehole RW7-17-01.

4.4.2 Clayey Silt to Silty Clay

A 0.6 m thick deposit of clayey silt to silty clay was encountered at Boreholes RW7-17-01 and RW7-17-02 and extended to Elevations ranging from 179.5 m to 179.6 m. A 4.6 m thick layer of clay silt to silty clay was encountered within the clayey silt till in Borehole STM-17-07 at a depth of 4.1 m (Elevation 174.7 m) and extended to a depth of 8.7 m (Elevation 170.1). The SPT-N values within the deposit ranged from 11 to over 100 blows per 0.3 m of penetration indicating a stiff to hard consistency. The moisture content of the clayey silt to silty clay ranged from 12 percent to 19 percent.

4.4.3 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the silty clay at Boreholes RW7-17-01, RW7-17-02 and STM-17-07 and extended to a depth ranging from 8.2 m to 12.3 m (Elev. 171.4 m to 166.5 m). A 1.6 m thick layer of clayey silt till was encountered within the clayey silt to silty clay layer and extended to a depth of 2.2 m (Elev. 177.4) in Borehole RW7-17-02. SPT-N values within the cohesive till ranged from 29 to over 100 blows per 0.3 m of penetration indicating a very stiff to hard (predominantly hard) consistency. The moisture content of the clayey silt to silty clay till ranged from 7 percent to 20 percent.

4.5 Zenway Retaining Walls (RW5, RW6, RW7, RW8)

Twenty (20) boreholes, RWZB-17-02 to RWZB-17-05, UC-17-07 to UC-17-18, and ZB-17-01 to ZB-17-05 were drilled for the retaining walls along Zenway Boulevard. In general, the stratigraphy of the site consists of topsoil or asphalt overlaying fill, which is underlain by clayey silt to silty clay till which is intern underlain by sandy silt till and silt and shale bedrock.

4.5.1 Topsoil

Topsoil with a thickness ranging from 25 mm to 125 mm was encountered at the ground surface at Boreholes RWZB-17-02, UC-17-07 to UC-17-09, UC-17-11, UC-17-12, UC-17-14, UC-17-15 to UC-17-18, ZB-17-01, and ZB-17-05.

4.5.2 Asphalt

Asphalt with a thickness ranging from 100 mm to 150 mm was encountered at the ground surface at Boreholes RWZB-17-03 to RWZB-17-05, UC-17-13, and ZB-17-02, to ZB-17-04.

4.5.3 Sand to Gravelly Sand Fill

A 0.5 m to 0.7 m thick deposit of sand to gravelly sand was encountered below the asphalt at Boreholes RWZB-17-03 to RWZB-17-05, UC-17-13, and ZB-17-02 to ZB-17-04 and extended to a depth of 0.8 m (Elev. 184.1 to 180.1). The SPT-N values ranged from 20 of 58 blows per 0.3 m of penetration indicating a compact to very dense relative density. The moisture content of the sand fill ranged from 3 percent to 6 percent.

4.5.4 Silty Clay to Clayey Silt Fill

A 0.6 m to 0.9 m thick layer of silty clay to clayey silt fill was encountered below the topsoil and sand at Boreholes RWZB-17-02 to RWZB-17-04, UC-17-09, UC-17-11, UC-17-12, UC-17-16 to UC-17-18, and ZB-17-01 to ZB-17-04 and extended to depths ranging from 0.7 m to 1.7 m (Elev. 186.6 to 180.5). SPT-N values within the cohesive fill ranged from 6 to 21 blows per 0.3 m of penetration indicating a firm to very stiff consistency. The moisture content of the silty clay to clayey silt fill ranged from 9 percent to 19 percent.

4.5.5 Silty Clay to Clayey Silt

A 0.7 m to 0.8 m thick layer of silty clay to clayey silt was encountered below the silty clay fill in Borehole RWZB-17-03 and below the topsoil in Boreholes UB-17-07, UC-17-08, UC-17-14, UB-17-15, and ZB-17-05. This layer extended to depths ranging from 0.8 m to 2.2 m (Elev. 187.6 m to 181.9 m). SPT-N values within the silty clay to clayey silt ranged from 5 to 26 blows per 0.3 m of penetration indicating a stiff to very stiff consistency. The moisture content of the silty clay to clayey silt ranged from 14 percent to 22 percent.

4.5.6 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the silty clay to clayey silt fill and clayey silt at all borehole locations and extended to depths ranging from 7.2 m to 9.8 m (Elev. 180.8 m to 172.0 m). A layer of clayey silt to silty clay till was also encountered below the silt layer at a depth of 13.4 m (Elevation 174.6 m) in Borehole UC-17-14 and extended to a depth of 15.7 m (Elevation 172.3). SPT-N values within the cohesive till ranged from 4 to over 100 blows per 0.3 m of penetration indicating a firm to hard consistency. The moisture content of the clayey silt to silty clay till ranged from 9 percent to 23 percent.

4.5.7 Sandy Silt Till

Sandy silt till was encountered underlying the silty clay to clayey silt till at Borehole UC-17-14, UC-17-15, and ZB-17-02 to ZB-17-05 and extended to a depth ranging from 8.5 m to 18.0 m (Elev. 179.5 m to 164.8 m). SPT-N values within the sandy silt till ranged from 68 to over 100 blows per 0.3 m of penetration indicating a very dense relative density. The moisture content of the sandy silt till ranged from 7 percent to 17 percent.

4.5.8 Silt

Silt was encountered underlying the silty clay to clayey silt till and sandy silt till at Borehole RWZB-17-03 and UC-17-14 and extended to a depth ranging from 9.2 m to 13.4 m (Elev. 174.7 m to 174.6 m). A 0.8 m to 4.9 m thick layer of silt was encountered within the sandy silt till and clayey silt to silty clay till in Boreholes UC-17-15 and UC-17-17 and extended to depths ranging from 6.2 to 14.6 (Elev. 176.4 to 173.2). SPT-N values within the silt ranged from 43 to over 100 blows per 0.3 m of penetration indicating a dense to very dense relative density. The moisture content of the silt ranged from 12 percent to 22 percent.

4.5.9 Bedrock

Shale bedrock with limestone interbeds was encountered below the clayey silt to silty clay till in Borehole ZB-17-02 and ZB-17-03 at a depth ranging from 16.5 m to 18.0 m (Elevation 165.1 m to 164.8 m). The rock quality index for the shale ranged from 35 percent to 72 percent, and the unconfined compressive strength ranged from 7.3 MPa to 11.7 MPa. The unconfined compressive strength of the limestone ranged from 34.7 MPa to 56.3 MPa.

4.6 RW9

Two (2) boreholes, UC-17-21 and UC-17-22, were drilled near RW8. In general, the stratigraphy of the site consists of topsoil overlaying clayey silt to silty clay till.

4.6.1 Topsoil

Topsoil was encountered in both boreholes with thickness varying between 75 and 150 mm.

4.6.2 Silty Clay

A 0.6 m thick surficial layer of silty clay was encountered in Borehole UC-17-21. An SPT-N value obtained within the silty clay was 10 blows per 0.3 m of penetration, indicating a stiff consistency. The moisture content of the silty clay was 20 percent.

4.6.3 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the silty clay in Borehole UC-17-21 and below the topsoil in Borehole UC-17-22. Both boreholes were terminated within the till at a depth of 6.7 m. SPT-N values obtained within the cohesive till ranged typically from 7 to 24 blows per 0.3 m of penetration, indicating a firm to very stiff consistency. One SPT-N value of 100 blows for 0.2 m of penetration was measured in Borehole UC-17-22, likely indicating presence of cobbles. The moisture contents of the clayey silt to silty clay till ranged from 12 percent to 23 percent.

4.7 RW10

At RW9 two (2) boreholes were drilled, RWLR-17-09 and FLR-17-05. In general, the stratigraphy of the site consists of fill overlaying clayey silt to silty clay till.

4.7.1 Asphalt

Asphalt with a thickness of 50 mm was encountered at the ground surface in Borehole FLR-17-05.

4.7.2 Fill

A 0.4 m to 1.4 m thick deposit of gravelly sand fill was encountered in Boreholes RWLR-17-09, and FLR-17-05. SPT-N values within the fill ranged from 7 to more than 50 blows per 0.3 m of penetration indicating a loose to very dense relative density. The moisture content of the fill ranged from 5 percent to 19 percent.

4.7.3 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the fill at both borehole locations and extended to a depth of 8.2 m (Elev. 179.8 m). SPT-N values within the cohesive till ranged from 6 to 26 blows per 0.3 m of penetration indicating a firm to very stiff consistency. The moisture content of the clayey silt to silty clay till ranged from 12 percent to 21 percent.

4.8 RW11

At RW10 two (2) boreholes were drilled, FLR-17-06 by Thurber and 205-12 by Peto MacCallum Ltd. In general, the stratigraphy of the site consists of silty clay or fill overlaying clayey silt to silty clay till.

4.8.1 Topsoil

Topsoil with a thickness of 200 mm was encountered at the ground surface at Borehole FLR-17-06.

4.8.2 Fill

A 0.9 m thick layer of clayey silt till was encountered in Borehole 205-12 and extended to an elevation of 187.6 m. The SPT-N value measured within the fill was 7 blows per 0.3 m of penetration indicating a firm consistency. The moisture content of the fill was 21 percent.

4.8.3 Silty Clay

A 2.8 m thick layer of silty clay was encountered at Borehole FLR-17-06, and extended to a depth of 3.0 m (Elev. 185.6). SPT-N values within the silty clay ranged from 4 to 9 blows per 0.3 m of penetration indicating a firm to stiff consistency. The moisture content of the silty clay ranged from 20 percent to 30 percent.

4.8.4 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the silty clay and the fill and extended to a depth ranging from of 8.2 m to 9.8 m (Elev. 180.4 m to 178.7). SPT-N values within the cohesive till ranged from 10 to 40 per 0.3 m of penetration indicating a stiff to hard consistency. To moisture content of the clayey silt to silty clay till ranged from 12 percent to 16 percent.

4.9 RW12

At RW11 two (2) boreholes were drilled, FCPR-17-02 by Thurber and E25 by Golder Associates. In general, the stratigraphy of the site consists of fill and clayey silt overlaying clayey silt to silty clay till which was intern underlain by sand and silt till.

4.9.1 Topsoil

Topsoil with a thickness of 200 mm was encountered at the ground surface at Boreholes FCPR-17-02 and E25.

4.9.2 Fill

A 0.5 m thick layer of silty clay fill was encountered in Borehole E25, and extended to an Elevation of 203.1 m. The SPT-N value measured within the silty clay fill was 8 blows per 0.3 m of penetration indicating a firm consistency.

4.9.3 Clayey Silt

A 0.5 m thick layer of clayey silt was encountered in Borehole FCPR-17-02, and extended to an Elevation of 202.5 m. The SPT-N value measured within the clayey silt was 7 blows per 0.3 m of penetration indicating a firm consistency. The moisture content of the clayey silt was 22 percent.

4.9.4 Clayey Silt to Silty Clay Till

Clayey silt to silty clay till was encountered underlying the fill and clayey silt and extended to a depth ranging from 12.5 to 12.8 m (Elev. 191.0 to 190.7 m). The SPT-N values obtained within the cohesive till ranged from 8 to 33 blows per 0.3 m of penetration indicating a stiff to hard consistency. The moisture content of the clayey silt to silty clay till ranged from 11 percent to 25 percent.

4.9.5 Sand and Silt Till

Sand and silt till was encountered underlying the clayey silt to silty clay till in Borehole FCPR-17-02 and extended to a depth of 12.7 m (Elev. 190.5 m). The SPT-N value measured within this deposit was 83 blows per 0.3 m of penetration indicating very dense relative density. The moisture content of the sand and silt till was 9 percent.

4.10 Groundwater Levels

Water levels observed in open boreholes and measured in piezometers are summarized in Table 4.1.

Table 4.1 – Groundwater Level Measurements

Retaining Wall No.	Borehole	Measurement Date	Water Level (m)		Comment
			Depth	Elevation	
RW1	HM-17-07	July 18, 2017	7.0	171.0	Open Borehole
	HM-17-08	July 15, 2017	4.3	173.4	Open Borehole
RW2	TS-17-15	October 25, 2017	1.1	175.2	In Piezometer
RW3	RW7 17-02	August 9, 2017	1.4	178.2	In Piezometer
		October 25, 2017	3.2	176.4	
RW4	RW7-17-01	August 9, 2017	0.5	179.8	In Piezometer
		October 25, 2017	0.9	179.4	
	RW7-17-02	August 9, 2017	1.4	178.2	In Piezometer

Retaining Wall No.	Borehole	Measurement Date	Water Level (m)		Comment
			Depth	Elevation	
		October 25, 2017	3.2	176.4	
	STM-17-07	August 9, 2017	0.4	178.4	In Piezometer
		October 25, 2017	-0.6*	179.4	
Zenway (RW5, RW6, RW7, RW8)	RWZB-17-03	July 7, 2017	3.0	181.1	Open Borehole
	UC-17-08	October 24, 2017	4.5	184.1	In Piezometer
	UC-17-11	October 24, 2017	2.3	180.8	In Piezometer
	UC-17-13	August 9, 2017	4.5	176.4	In Piezometer
		October 25, 2017	3.6	177.3	
	UC-17-15	June 20, 2017	11.4	176.4	Open Borehole
	UC-17-16	July 7, 2017	3.6	178.2	In Piezometer
		October 24, 2017	2.2	179.6	
	UC-17-17	July 7, 2017	9.1	173.5	In Piezometer
		October 24, 2017	4.9	177.7	
UC-17-18	October 24, 2017	3.5	177.9	In Piezometer	
	July 7, 2017	8.6	174.4		
	August 9, 2017	2.2	180.8		
ZB-17-05	October 24, 2017	2.4	180.6	In Piezometer	
	July 7, 2017	8.6	174.4		
	August 9, 2017	2.2	180.8		
RW9	UC-17-21	May 30, 2017	Dry	-	Open Borehole
	UC-17-22	May 30, 2017	Dry	-	Open Borehole
RW10	RWLR-17-09	June 19, 2017	1.5	186.5	In Piezometer
RW11	FLR17-06	June 19, 2017	4.5	184.1	In Piezometer
		October 30, 2017	1.1	187.5	
RW12	E25	March 18, 2009	12.5	191.3	Open Borehole

* Negative value (-) indicates water level above ground surface.

The above groundwater levels are relatively short-term readings, and seasonal fluctuations of the groundwater level are to be expected. The groundwater level may be at higher elevations after spring snowmelt or periods of heavy rainfall. Perched water may be present at higher levels in lenses or zones of more permeable sands and silts within the till.

5. ENGINEERING DISCUSSION AND RECOMMENDATIONS

The following recommendations are provided on our interpretation of the available geotechnical information and our understanding of the project requirements. The proposed wall type for each retaining wall is provided in the table in Section 2.

For submerged RSS walls the designer must carefully address the following aspects which include but are not limited to:

- Erosion and scour protection of the RSS walls during and after flood events
- Type of backfill material and control of migration of fines
- Reinforcement strength, facing connection strength and pullout resistance of reinforcement under submerged conditions
- Lateral stability of the RSS walls, including sliding and overturning
- Durability of the reinforcing strips against potential corrosion under submerged conditions

5.1 Backfill to Retaining Walls

Backfill to the concrete retaining walls should be Granular A or Granular B Type II material meeting the

requirements of OPSS.PROV 1010. The backfill should be in accordance with OPSS 902 and placed to the extent shown in OPSD 3101.150. The frost taper does not apply to the retaining walls along the embankment side slopes. Compaction equipment to be used adjacent to retaining structures should be restricted in accordance with OPSS 501. The design of the wall should incorporate wall drain and subdrain as shown in OPSD 3101.150.

5.2 Lateral Earth Pressure

Lateral earth pressures acting on the retaining wall may be assumed to be triangular and to be governed by the characteristics of the backfill. For a fully drained condition, the pressures should be computed in accordance with the CHBDC but are generally given by the expression:

$$P_h = K * (\gamma h + q)$$

Where:

- P_h = horizontal pressure on the wall at depth h (kPa)
- K = lateral earth pressure coefficient
- γ = unit weight of retained soil (kN/m³)
- h = depth below the top of fill where the pressure is computed (m)
- q = value of any surcharge (kPa)

In accordance with Clause 6.12.3 of the CHBDC (2014), a compaction surcharge should be added.

Earth pressure coefficients for backfill to the retaining wall are dependent on properties of the backfill. Typical values are shown in the table below.

Loading Condition	OPSS Granular A or Granular B Type II $\phi = 35^\circ, \gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I or Type III $\phi = 32^\circ, \gamma = 21.2 \text{ kN/m}^3$		Compacted Earth Fill/Native Cohesive Till $\phi = 30^\circ, \gamma = 20 \text{ kN/m}^3$	
	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)
Active (K_a) (Unrestrained Wall)	0.27	0.38	0.31	0.46	0.33	0.54
Passive (K_p)	3.7	-	3.3	-	3.0	-
At-rest (K_0) (Restrained Wall)	0.43	0.62	0.47	0.68	0.50	0.72

The coefficient of earth pressure at-rest (K_0) should be used for design unless the wall is free to move (translate or rotate) 0.002 times the wall height away from the retained soil in order to fully mobilize the active condition (K_a).

The passive resistance of the soil within the frost depth should be neglected when checking lateral stability (sliding and overturning) of the retaining walls.

It is recommended that the walls be designed to be free-draining and include a subdrain.

For walls retaining sloping backfill, the active earth pressure coefficients for sloping backfill should be used.

5.3 Seismic Considerations

Based on the encountered subsurface conditions from the previous investigation, Site Class C should be assumed to evaluate the seismic site response, as per Table 4.1, Clause 4.4.3.2 of the CHBDC 2014.

The peak ground acceleration, PGA, for a 2% in 50-year probability of exceedance at this site is 0.110 g as per

the National Building Code of Canada 2015 (NBCC 2015).

In accordance with Clause 4.6.5 of the CHBDC 2014, retaining structures should be designed using active (K_{AE}) and passive (K_{PE}) earth pressure coefficients that incorporate the effects of earthquake loading. The coefficients of horizontal earth pressure for seismic loading presented in the following table may be used:

Loading Condition	OPSS Granular A or Granular B Type II $\phi = 35^\circ, \gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I or Type III $\phi = 32^\circ, \gamma = 21.2 \text{ kN/m}^3$		Compacted Earth Fill/Native Cohesive Till $\phi = 30^\circ, \gamma = 20 \text{ kN/m}^3$	
	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)
Active (K_{AE})*	0.31	0.51	0.35	0.65	0.38	0.70
Passive (K_{PE})	3.5	-	3.1	-	2.9	-
At-rest (K_{OE})**	0.57	0.76	0.62	0.83	0.65	0.87

* After Mononobe and Okabe

** After Woods

Given the low seismic ground motions and the presence of firm to hard clayey silt to silty clay (till), the potential for liquefaction is considered low at these sites.

5.4 Frost Depth

The design depth of frost penetration at these sites is 1.2 m. The base of the concrete retaining wall should be provided with a minimum of 1.2 m of earth cover. The requirements for RSS wall embedment are discussed in a later section of the report.

5.5 Design Groundwater Level

The groundwater levels shown in Table 5.1 below should be used for the structural analysis and design of the retaining walls.

Table 5.1 – Design Groundwater Levels

Retaining Wall No.	Water Level (m)	
	Depth	Elevation
RW1	3.3	174.7
RW2	0.0	177.5
RW3	0.0	180.3
RW4	0.0	180.3
RW5, RW6, RW7, RW8	Varies	181.0
RW9	1.1	185.0
RW10	0.5	186.5
RW11	0.0	188.6
RW12	5.5	197.7

5.6 Geotechnical Resistances

For a minimum 1 to 2 m wide wall base founded on very stiff clayey silt to silty clay till, at the founding depths found in Table 5.2 below, factored geotechnical resistances of 300 kPa at ULS and 200 kPa at SLS (for up to 25 mm settlement) are recommended. The actual width of the wall base for each retaining wall must be determined by the wall designer taking into account the load demand. The geotechnical bearing resistances for RW5 to RW8 proposed at the Zenway Boulevard are provided in Section 5.12.

Table 5.2 – Highest Founding Levels of Retaining Walls

Retaining Wall No.	Highest Founding Depth (m)	Founding Elevation (m)
RW1	0.8	176.9
RW2	0.8	175.5
RW3	0.9	176.9
RW4	0.7	178.1
RW9	0.8	185.3
RW10	2.5	185.5
RW11	3.0	185.6
RW12	0.8	202.4

The actual founding depth of each retaining wall needs to be determined by the wall designer to satisfy the lateral stability of the wall.

The geotechnical resistances provided above are for concentric, vertical loads only. In the case of eccentric or inclined loading, the geotechnical resistances should be modified as indicated in the CHBDC (2014) Clause 6.10.3 and Clause 6.10.4.

5.7 Excavation and Dewatering

All excavations should be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the soils within the likely depth of excavation at these sites may be classed as Type 3 soils for surficial clayey silt, and Type 2 for native stiff to hard silty clay/clayey silt till. The excavation and backfilling for retaining walls should be carried out in accordance with OPSS 902.

Earth excavations required at these sites will penetrate through the firm to very stiff native silty clay/clayey silt. The native till may contain cobbles and/or boulders. Temporary shallow excavation through most soils at these sites may be formed unsupported with side slopes not steeper than 1H: 1V. Flatter slopes may be required at locations where the soils are less competent or where water seepage affects surficial stability.

Surface runoff and perched groundwater may seep into the excavations during wall construction. The bases of temporary excavations for wall construction will likely be below the prevailing groundwater level at the location of retaining walls RW2, RW3, RW4, RW10 and RW11. Given the consistency and relatively low permeability of the silty clay/clayey silt soils, groundwater control measures such as pumping from filtered sumps may be sufficient to remove any accumulation of water from the excavation and lower the groundwater table to below the base of excavation.

The wall construction shall be carried out in the dry. Silty clay to clayey silt till subgrade should be covered as soon as practical upon exposure and be protected from any disturbances that may weaken the material.

5.8 Subgrade Preparation

After the foundation excavation reaches the design subgrade level, the exposed surface should be inspected to confirm that the subgrade is suitable and uniformly competent. Any topsoil/organics, disturbed soils, loose/soft deposits and deleterious materials within the wall footprint must be removed and replaced with suitable earth material compacted as per OPSS.PROV 501.

Once the subgrade is prepared, the construction traffic and equipment must not travel on the subgrade. It is recommended that a 100 mm thick layer of mass concrete be placed as soon as practicable to protect the subgrade. The subgrade preparation should be carried out in the dry.

The RSS walls, excluding the RSS walls at Zenway, should be founded on a minimum 500 mm thick layer of bedding material conforming to OPSS Granular A requirements to form a uniform subgrade. Engineered fill placed under the RSS mass to achieve the design founding level should be compacted to 100% of its SPMDD at a moisture content within 2% of optimum. The engineered fill layer should extend at least 500 mm beyond the limits of the RSS mass. Where sub-excavation is required to reach competent bearing stratum, the sub-excavation will be backfilled with engineered Granular 'A' fill compacted to 100% of its SPMDD. All RSS walls addressed in this report will be constructed with the wall base at or above the ground surface and will not be submerged.

Construction inspection should be carried out during construction by qualified geotechnical personnel.

5.9 Sliding Resistance

The lateral resistance of the Concrete/Gabion wall base against sliding may be computed using an unfactored friction coefficient of 0.45 for cast-in-place concrete founded on very stiff clayey silt to silty clay till. This value of friction coefficient is an ultimate value and requires some degree of sliding movement to mobilize fully.

Sliding resistance along the RSS wall base on engineered granular fill may be estimated using an unfactored ultimate friction coefficient of 0.55.

5.10 Global Stability

The global stability analyses were carried out for three retaining wall locations, RW4, RW10 and RW12. The results of the analyses can be found in Appendix D. The wall geometries of RW4, RW10 and RW12 were assumed based on the highway design plan, profile and the proposed wall heights. The results of the analyses indicate that the global stability of the gravity walls analyzed is satisfactory under both short-term and long-term conditions.

Lateral stability of the retaining walls, including sliding and overturning, must be checked by the wall designer.

5.11 RSS Walls at Zenway Boulevard

5.11.1 General

At the east approach embankment, the approach fill between approximately Sta. 10+037 and 10+209 will be contained by RSS walls along the north and south shoulders of the Zenway Boulevard from the front face of the abutment to approximately 170.9 and 167.3 m east of the abutment face, respectively. The RSS wall will be up to approximately 7.5 m high above the existing ground surface.

At the west approach embankment, the approach fill between approximately Sta. 9+903 and 9+737 will be contained by RSS walls on both north and south sides and the fill in other sections of the approach embankment will slope down to the existing ground surface at a 2H:1V side slope. The two RSS walls will be up to 9.1 m in height above the existing ground surface.

The recommendations for the RSS walls are summarized as follows:

- For RSS walls (RW-5, RW-6, RW-7, RW-8) along the roadway shoulders, due to the varying wall heights, the following pad thicknesses are recommended:
 - A minimum 1.65 m thick engineered granular pad for RSS wall height ≥ 4 m;
 - A minimum 1 m thick engineered granular pad for RSS wall height < 4 m;
 - A 10H:1V stepped transition should be provided where pad thickness changes.

The base of all RSS walls should be at or below the existing ground surface.

The RSS walls will be designed to "High Performance" and "High Appearance" at this site. To provide acceptable performance, the entire RSS mass should be founded on competent soils or on engineered granular fill. Uniform and competent subgrade conditions within the entire footprint of the RSS mass and engineered fill pad will be critical for long-term performance of the RSS walls.

The approach embankments/RSS walls up to 7.5 to 9.1 m in height qualify as high fill. To meet MTO's Embankment Settlement Criteria for Design (March 2, 2010) as per PA Schedule 15-2, a waiting period of a minimum of three months should be allowed after backfilling the structure for embankment settlement to take place prior to approach slab construction and final paving.

5.11.2 Subgrade Preparation

To provide an acceptable foundation performance, the RSS mass must be founded on competent soils or engineered fill. The foundation of the entire RSS mass must be considered, i.e. from the face of the wall to the furthest extent of the reinforcement strip.

The existing soils at the abutments and approach embankments consist of either pavement structure overlying firm to stiff silty clay fill or topsoil overlying a layer of firm to very stiff clayey silt extending to depths of as much as 2.2 m. The soils described above are underlain by firm to hard cohesive till.

Topsoil, pavement structure, very soft to firm surficial clayey silt/silty clay, disturbed soils and deleterious materials within the embankment footprint (and about 500 mm beyond that) should be removed and replaced with suitable granular material compacted as per OPSS.PROV 501. The exposed subgrade surface should be inspected and field-tested to confirm that the subgrade is suitable and uniformly competent. The work should be carried out in accordance with OPSS.PROV 902 and construction should be carried out in the dry. Once the subgrade is prepared the construction traffic and equipment should not travel on the subgrade.

The engineered granular fill pad will be constructed over the prepared subgrade for the support of RSS walls. The granular fill should be placed in 150 mm lifts compacted to 100% of its SPMDD at a moisture content within 2% of optimum. The granular fill should be OPSS Granular A or Granular B Type II.

5.11.3 Geotechnical Resistances

As per MTO RSS Design Guidelines, the minimum soil cover to the underside of the levelling pad shall be at least 800 mm or 40% of the frost depth in the area, whichever is greater. The minimum soil cover to the top of the levelling pad shall be at least 500 mm.

The RSS walls founded on engineered granular fill pad should be designed for a Factored Bearing Resistance at ULS of 375 kPa and a Factored Bearing Resistance at SLS of 250 kPa. The resistance values assume that the RSS wall reinforcement will extend a distance behind the wall face of a minimum 70% of the wall height.

The recommended geotechnical resistances are for vertical concentric loading. The effects of load inclination and eccentricity need to be considered in accordance with CHBDC (2014).

The RSS mass must be designed against various modes of failure including sliding and overturning. Sliding resistance along the RSS wall base on engineered granular fill may be estimated using an unfactored ultimate friction coefficient of 0.55.

The internal stability or structural integrity of the RSS walls should be analyzed by the supplier/designer of the proprietary product selected for this site.

5.11.4 Global Stability

Global stability analysis was carried out for a critical retaining wall section. The results of the analysis can be found in Appendix D. The wall geometries were assumed based on the latest GA and RSS layout drawings. The results of the analyses indicate that the global stability of the RSS walls is satisfactory under both short-term and long-term conditions.

Lateral stability of the RSS walls, including sliding and overturning, must be checked by the wall designer.

5.11.5 Predicted Settlement

The foundation settlements resulting from the approach fill/RSS wall loadings were estimated to be in the range of 30 to 40 mm. Approximately 75 to 85% of which would occur during embankment/RSS wall construction and within the first two to three months following completion of the embankment/RSS wall construction. A waiting period of minimum 3 months should be allowed for embankment settlement to take place prior to final paving and approach slab construction. Settlement rods should be installed at selected approach embankment sections before construction and monitored during construction to determine the actual timing for pile driving and final paving.

Embankment settlement due to fill compression is estimated at 0.5% of the fill height for granular fill or earth fill compacted to 100% of their SPMDD at a moisture content within 2% of optimum. Approximately 50% of the total fill compression (0.25% of the fill height) will occur during construction and the remaining 50% (~20 to 25mm) will occur after construction.

Differential settlement of the RSS wall panels (assuming a panel length of 1 m) is not expected to exceed 1/300 (0.33%). The differential settlement tolerance of the RSS walls should be confirmed with the designer/supplier of the proprietary product selected for this site.





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Appendix A

Record of Borehole Sheets – Current Investigation

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 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	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 C_{pen} Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils.	
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>			
Fresh (FR)	No visible signs of weathering.				
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.				CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.				SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.				SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.				COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.				Bedrock (general)
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No HM 17-07 2 OF 2 METRIC

W.P. _____ LOCATION N 4 846 561.8 E 294 130.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.18 - 2017.07.18 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L					
	Continued From Previous Page CUTTINGS TO SURFACE.																	

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-08 1 OF 2 METRIC

W.P. _____ LOCATION N 4 846 739.3 E 294 104.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.07.15 - 2017.07.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60									
177.7	GROUND SURFACE														
0.0	TOPSOIL: (150mm)														
0.2	Clayey SILT , trace sand, trace gravel, trace organics (rootlets) Stiff Brown Moist		1	SS	12										
176.9															
0.8	Clayey SILT to Silty CLAY , trace sand, trace gravel, occasional cobbles Hard Brown to Grey Moist (TILL)		2	SS	33										
			3	SS	37										
			4	SS	40										
			5	SS	60										
			6	SS	61										
			7	SS	41										
170.1	Silty SAND , some clay, trace to some gravel Dense Grey Moist to Wet (TILL)														
7.6															
			8	SS	48										
168.5	END OF BOREHOLE AT 9.1m. BOREHOLE CAVED TO 6.4m AND WATER LEVEL AT 4.3m BELOW GROUND SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND														
9.1															

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-08 2 OF 2 METRIC

W.P. _____ LOCATION N 4 846 739.3 E 294 104.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.07.15 - 2017.07.15 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					W _p	W	W _L					
	Continued From Previous Page CUTTINGS TO SURFACE.																	

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS 17-15 1 OF 1 METRIC

W.P. _____ LOCATION N 4 846 871.8 E 294 062.8 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.19 - 2017.07.19 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100										
							○ UNCONFINED	+	FIELD VANE							
							● QUICK TRIAXIAL	×	LAB VANE							
							WATER CONTENT (%)									
							20 40 60									
176.3	GROUND SURFACE															
0.0	Clayey SILT , trace gravel, organics Stiff Brown Moist		1	SS	12											
175.5																
0.8	Clayey SILT to Silty CLAY , trace to some sand, trace gravel, occasional cobbles Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	28											
			3	SS	53									5	27 39 29	
			4	SS	50/ 0.075											
			5	SS	61											
			6	SS	144											
			7	SS	50											
169.6	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.															
6.7	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.10.25 1.1 175.2															

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+³, ×³: Numbers refer to Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS 17-16 1 OF 1 METRIC

W.P. _____ LOCATION N 4 846 954.0 E 294 083.3 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.14 - 2017.07.14 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
						20	40	60	80	100						
177.5	GROUND SURFACE															
0.0	Clayey SILT , trace gravel Very Stiff Brown Moist		1	SS	29						○					
176.7																
0.8	Clayey SILT , trace to some sand, trace gravel, occasional cobbles Hard Brown to Grey Moist (TILL)		2	SS	48						○					
			3	SS	101						○					
			4	SS	50/ 0.075						○					
			5	SS	50/ 0.050						○					
			6	SS	76/ 0.175						○					
			7	SS	134						⊕					
169.9																
7.6	END OF BOREHOLE AT 7.6m. BOREHOLE CAVED TO 4.9m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW7 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 752.3 E 293 926.6 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.11 - 2017.07.11 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
					20	40	60	80	100	20	40	60				
180.3	GROUND SURFACE															
0.0	TOPSOIL: (150mm)															
0.2	Clayey SILT to Silty CLAY , trace sand, trace gravel, organics Stiff Brown Moist Clayey SILT to Silty CLAY , trace sand, trace gravel Very Stiff to Hard Brown Moist (TILL)	1	SS	13												
179.5		2	SS	29												
0.8		3	SS	45												
		4	SS	104												
		5	SS	79												
		6	SS	52												
		7	SS	45												0 0 61 39
		8	SS	70												
172.1	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.															
8.2	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.08.09 0.5 179.8 2017.10.25 0.9 179.4															

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW7 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 639.7 E 293 977.0 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.28 - 2017.07.28 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60											
179.6	GROUND SURFACE																
0.0	Clayey SILT , trace sand, trace gravel Stiff Brown Moist		1	SS	13												
179.0			2	SS	29												
0.6	Clayey SILT , trace sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	67												
177.4			4	SS	100/ 0.125												
2.2	Clayey SILT to Silty CLAY Hard Brown to Grey Moist (TILL)		5	SS	100/ 0.275												
			6	SS	43												
			7	SS	60												
			8	SS	70												
171.4	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
8.2	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.08.09 1.4 178.2 2017.10.25 3.2 176.4																

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+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STM 17-06 1 OF 2 METRIC

W.P. _____ LOCATION N 4 847 714.8 E 293 948.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.11 - 2017.07.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
180.0	GROUND SURFACE														
0.0	TOPSOIL: (200mm)														
0.2	Clayey SILT to Silty CLAY, trace sand, trace gravel, trace organics (rootlets) Stiff Brown Moist		1	SS	10										
			2	SS	12		179								
178.5	Clayey SILT to Silty CLAY, trace to some sand, trace gravel, occasional cobble Hard Brown to Grey Moist (TILL)		3	SS	44										
1.5			4	SS	100/ 0.150		178								
			5	SS	114		177								
			6	SS	103		176								
			7	SS	87		175								
			8	SS	48		174								
			9	SS	57		173								
							172								
							171								

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STM 17-06 2 OF 2 METRIC

W.P. _____ LOCATION N 4 847 714.8 E 293 948.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.11 - 2017.07.11 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
	Continued From Previous Page															
	Clayey SILT to Silty CLAY , trace to some sand, trace gravel, occasional cobble Hard Brown Moist (TILL)		10	SS	87											
167.4	Some weathered shale fragments		11	SS	100/ 0.150											
12.6	END OF BOREHOLE AT 12.6m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.															

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

RECORD OF BOREHOLE No STM 17-07 2 OF 2 METRIC

W.P. _____ LOCATION N 4 847 740.7 E 293 977.3 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.28 - 2017.07.28 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100										
							○ UNCONFINED	+	FIELD VANE							
							● QUICK TRIAXIAL	×	LAB VANE							
							20 40 60 80 100									
	Continued From Previous Page															
			10	SS	100/0.100											
						168										
						167										
166.5			11	SS	100/0.075											
12.3	END OF BOREHOLE AT 12.3m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.08.09 0.4 178.4 2017.10.25 -0.6 179.4 "-" Above ground surface															

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+³, ×³: Numbers refer to Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-12 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 352.9 E 294 059.2 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.13 - 2017.07.13 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
177.7	GROUND SURFACE					20	40	60	80	100	20	40	60				
0.0	SAND and GRAVEL , some silt, trace clay, trace organics (rootlets) Loose Brown Moist (FILL) Clayey SILT to Silty CLAY , some sand, trace gravel, occasional cobbles Hard Brown Moist (TILL) Cobbles		1	SS	8												
176.9			177														
0.8			176	2	SS	62											
			175	3	SS	125											
				4	SS	50/ 0.075											
				5	SS	146											
				6	SS	80											
				7	SS	58											
		8	SS	104/ 0.225													
169.1	8.5																
	END OF BOREHOLE AT 8.5m. BOREHOLE CAVED TO 5.8m AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

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+³, ×³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-11 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 199.6 E 294 049.8 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.13 - 2017.07.13 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
177.6	GROUND SURFACE					20 40 60 80 100	20 40 60										
0.0	Clayey SILT , trace sand, trace gravel, trace organics (rootlets) Stiff Brown Moist (FILL) Clayey SILT to Silty CLAY , trace to some sand, trace gravel Hard Brown Moist (TILL)		1	SS	12												
176.9			2	SS	65												
0.8			3	SS	98												
			4	SS	64												
			5	SS	41												0 0 72 28
			6	SS	79												
			7	SS	52												
			8	SS	45												
168.5	END OF BOREHOLE AT 9.1m. BOREHOLE CAVED TO 6.2m AND DRY. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

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+³, ×³: Numbers refer to Sensitivity
 20
 15 10 5
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-13 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 504.2 E 294 029.6 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.04 - 2017.07.04 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
177.8	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	Clayey SILT , some sand, trace gravel Stiff Brown Moist (FILL)		1	SS	14								
176.9													
0.9	Clayey SILT to Silty CLAY , some sand, trace gravel Hard Brown to Grey Moist (TILL)		2	SS	36								
			3	SS	87								
			4	SS	70								
			5	SS	79								
			6	SS	100								
			7	SS	62								
170.2													
7.6	Sandy SILT , some clay, trace gravel Dense Dark Brown Moist (TILL)		8	SS	38								0 25 46 29
169.6													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.1m, BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

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+³, ×³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STM 17-11 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 547.8 E 294 099.3 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.18 - 2017.07.18 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			PLASTIC LIMIT W _p
177.5	GROUND SURFACE														
0.0	Gravelly SAND Compact Grey Moist (FILL)		1	SS	14										
176.7															
0.8	Clayey SILT , some sand, some gravel Stiff Brown Moist		2	SS	11										
176.0															
1.5	Clayey SILT to Silty CLAY , trace sand Very Stiff to Stiff Grey Moist (TILL)		3	SS	15										
			4	SS	23										
			5	SS	23										
			6	SS	16										
			7	SS	14										
170.8	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
6.7															

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+³, ×³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-02 1 OF 2 METRIC

W.P. _____ LOCATION N 4 848 468.4 E 293 834.0 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.17 - 2017.07.17 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	WATER CONTENT (%) 20 40 60			
184.9	GROUND SURFACE												
0.0	TOPSOIL: (50mm)												
184.1	Silty CLAY , trace sand, trace gravel, trace topsoil and grass Firm Brown Moist (FILL)		1	SS	9								
0.8	Clayey SILT to Silty CLAY , sandy, trace gravel Very Stiff to Firm Brown Moist (TILL)		2	SS	15								
			3	SS	22								0 18 37 45
			4	SS	26								
			5	SS	25								
			6	SS	7								
	Becoming grey		7	SS	18								
			8	SS	45								
	Hard												
175.7	END OF BOREHOLE AT 9.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND		0	SS	50/								
9.2					0.025								

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-02 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 468.4 E 293 834.0 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.17 - 2017.07.17 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L					
	Continued From Previous Page CUTTINGS TO SURFACE.							20	40	60	80	100						

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-03 1 OF 2 METRIC

W.P. _____ LOCATION N 4 848 445.1 E 293 856.9 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.17 - 2017.07.17 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
184.1	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	Gravelly SAND , some silt Compact Grey		1	SS	20					○				
183.4	Moist (FILL)													
0.7	Silty CLAY , some gravel, trace sand Firm Brown		2	SS	7					○				
182.7	Moist (FILL)													
1.4	Silty CLAY , trace sand, trace gravel Stiff Brown		3	SS	16					○				
181.9	Wet													
2.2	Clayey SILT to Silty CLAY , sandy, trace gravel Stiff to Hard Grey Moist (TILL)		4	SS	8					○				
			5	SS	8					○				
			6	SS	7					○				
			7	SS	18					○				
			8	SS	37					○				
175.4	SILT , some sand Very Dense Grey Wet									○				
8.7														
174.7			9	SS	50/					○				
9.4	END OF BOREHOLE AT 9.4m. WATER LEVEL AT 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND				0.125									

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-03 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 445.1 E 293 856.9 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.17 - 2017.07.17 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					W _p	W	W _L					
	Continued From Previous Page CUTTINGS TO SURFACE.							20	40	60	80	100						

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-04 1 OF 2 METRIC

W.P. _____ LOCATION N 4 848 475.0 E 294 005.4 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.03 - 2017.07.03 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
181.9	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND, some gravel Brown Moist (FILL)		1	GS											
181.2															
0.7	Silty CLAY, some sand, trace gravel Stiff Brown Moist (FILL)		2	SS	14										
180.5															
1.4	Clayey SILT to Silty CLAY, sandy, trace gravel Stiff to Hard Grey Moist (TILL)		3	SS	13									0 18 41 41	
	Occasional brown sand seams Grey		4	SS	10										
			5	SS	8										
			6	SS	11										
			7	SS	30										
			8	SS	19										
			9	SS	15										
172.1	END OF BOREHOLE AT 9.8m.														

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-04 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 475.0 E 294 005.4 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.03 - 2017.07.03 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
	Continued From Previous Page						20	40	60	80	100	W _p	W	W _L			
	BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.0m, THEN CEMENT TO SURFACE.																

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWZB 17-05 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 503.8 E 294 041.6 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.03 - 2017.07.03 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60								
182.4	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND, trace gravel Brown Moist (FILL)		1	GS										
181.7														
0.7	Silty CLAY, sandy, trace gravel Stiff to Firm Brown to Grey Moist (FILL)		1	SS	11									
181.0														
1.4	Clayey SILT to Silty CLAY, sandy, trace gravel Stiff to Very Stiff Grey Moist (TILL)		2	SS	4									
			3	SS	7									
			4	SS	10								3 23 44 30	
			5	SS	10									
			6	SS	14									
			7	SS	26									
174.2														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 1.0m, THEN CEMENT TO SURFACE.													

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-07 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 440.0 E 293 657.4 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.19 - 2017.06.19 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L			
						20 40 60 80 100 WATER CONTENT (%)								
188.5	GROUND SURFACE													
0.0 0.1	TOPSOIL: (75mm)													
187.6	Clayey SILT , some sand, trace gravel, trace organics Stiff Brown Moist	1	SS	11										
187.6 0.9	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional oxide stains Firm to Hard Brown to Grey Moist (TILL)	2	SS	18										
		3	SS	19										
		4	SS	25										
		5	SS	22										
	Becoming grey													
		6	SS	7										
		7	SS	27										
180.4		8	SS	100/ 0.275										
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												9 22 46 23	

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+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-08 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 449.6 E 293 702.2 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.19 - 2017.06.19 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
					20	40	60	80	100	20	40	60	kn/m ³	GR SA SI CL	
188.6	GROUND SURFACE														
0.0	TOPSOIL: (125mm)														
0.1	Clayey SILT , some sand, trace gravel, roots and rootlets Stiff Dark Brown Moist	1	SS	10						○					
187.8															
0.8	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel, occasional oxide stains Stiff to Hard Brown Moist (TILL)	2	SS	17						○					
		3	SS	20						○	—			6 18 39 37	
	Occasional sand seam	4	SS	20						○					
		5	SS	27						○					
		6	SS	22						○					
		7	SS	11						○	—				
		8	SS	42						○					
180.4															
8.2	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
	WATER LEVEL READINGS														
	DATE DEPTH(m) ELEV.(m)														
	2017.07.07 Dry -														
	2017.10.24 4.5 184.1														

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-09 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 460.6 E 293 751.6 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.19 - 2017.06.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) W _p W W _L								
187.6	GROUND SURFACE													
0.0	TOPSOIL: (100mm)													
0.1	Clayey SILT , some sand, trace gravel, trace organics Very Stiff Brown Moist (FILL)		1	SS	19									
186.6														
1.0	Clayey SILT to Silty CLAY , sandy, trace gravel Stiff to Very Stiff Brown to Mottled Brown/Grey Moist (TILL)		2	SS	25									
			3	SS	25									
	Occasional oxidize stains		4	SS	29									
			5	SS	19									
			6	SS	11								6 26 37 31	
			7	SS	10									
			8	SS	29									
179.4														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.													

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-11 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 488.8 E 293 926.1 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
					20	40	60	80	100	20	40	60	KN/m ³	GR SA SI CL		
183.1	GROUND SURFACE															
0.0	TOPSOIL: (75mm)															
0.1	Clayey SILT , trace sand, trace gravel, trace roots	1	SS	10												
182.3	Stiff Brown Moist (FILL)															
0.8	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional cobbles	2	SS	19												
	Firm to Hard Brown to Grey Moist (TILL)															
		3	SS	13										3	27 39 31	
		4	SS	12												
	Becoming grey															
		5	SS	7												
		6	SS	12												
		7	SS	24												
		8	SS	30										2	25 49 24	
174.9	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.															
8.2	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 Dry - 2017.10.24 2.3 180.8															

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-12 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 522.4 E 294 098.8 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
182.9	GROUND SURFACE														
0.0	TOPSOIL: (75mm)														
0.1	Clayey SILT , trace gravel, trace roots Firm Light Brown Moist (FILL)		1	SS	8										
182.2			2	SS	19										
0.7	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional cobbles Stiff to Very Stiff Brown to Grey Moist (TILL)		3	SS	15									1	24 42 33
			4	SS	14										
			5	SS	13										
			6	SS	24										
	Becoming grey		7	SS	15										
			8	SS	24										
174.7	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.														

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-13 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 542.0 E 294 185.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.15 - 2017.06.15 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)			
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p W W _L PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT		20 40 60		GR SA SI CL	
180.9	GROUND SURFACE																
0.0	ASPHALT: (100mm)																
0.1	Gravelly SAND , trace silt, occasional cobbles	[Pattern]	1	SS	58						○						
180.1	Very Dense Light Brown Dry (FILL)	[Pattern]	2	SS	9						○						
0.8	Clayey SILT to Silty CLAY , sandy, trace gravel	[Pattern]	3	SS	11						○						
	Stiff to Very Stiff Brown Moist (TILL)	[Pattern]	4	SS	13						○						
		[Pattern]	5	SS	29						○		14 44 29 13				
		[Pattern]	6	SS	12						○						
		[Pattern]	7	SS	12						○						
		[Pattern]	8	SS	16						○						
172.7	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
8.2	WATER LEVEL READINGS																
	DATE DEPTH(m) ELEV.(m)																
	2017.08.09 4.5 176.4																
	2017.10.25 3.6 177.3																

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+³, ×³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-14 1 OF 2 METRIC

W.P. _____ LOCATION N 4 848 405.2 E 293 685.2 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%)											
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
188.0	GROUND SURFACE																
0.0	TOPSOIL: (100mm)																
0.1	Clayey SILT , some sand, trace gravel Stiff to Very Stiff Brown Moist		1	SS	10						○						
187.2																	
0.8	Clayey SILT to Silty CLAY , sandy, trace gravel Stiff to Hard Brown Moist (TILL)		2	SS	21						○						
	Occasional oxide staining		3	SS	23						○						
			4	SS	24						○						
			5	SS	23						○	—		2	27	35	36
			6	SS	14						○						
			7	SS	60						○						
180.8																	
7.2	Sandy SILT , trace gravel Very Dense Grey Moist (TILL)		8	SS	111/ 0.225						○						
179.5																	
8.5	SILT , some clay, trace sand Very Dense Grey Moist		9	SS	112/ 0.250						○			0	4	84	12

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+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-14 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 405.2 E 293 685.2 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
					20	40	60	80	100	20	40	60				
	Continued From Previous Page															
174.6		10	SS	69												
176		11	SS	43												
174.6	Clayey SILT to Silty CLAY, sandy, trace gravel Hard Grey Moist (TILL)	12	SS	46											0 49 31 20	
172.3		13	SS	106												
15.7	END OF BOREHOLE AT 15.7m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 Dry - 2017.10.24 Dry -															

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-15 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 415.4 E 293 738.8 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page						20	40	60	80	100						
175.9			10	SS	100/ 0.150												
11.9	SILT , some sand to sandy Very Dense Grey Wet to Saturated 100mm sand layer at 12.5m		11	SS	106/ 0.250												
173.2			12	SS	95												
14.6	Sandy SILT , trace clay, trace gravel Very Dense Grey Wet (TILL)		13	SS	115/ 0.225											5 33 53 9	
15.6	END OF BOREHOLE AT 15.6m. WATER LEVEL AT 11.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

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+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-16 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 460.9 E 293 967.0 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.21 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L					
	Continued From Previous Page BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 3.6 178.2 2017.10.24 2.2 179.6																	

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-17 1 OF 2 METRIC

W.P. _____ LOCATION N 4 848 480.4 E 294 069.5 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.21 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) W _p W W _L								
182.6	GROUND SURFACE													
0.0	ORGANICS: (25mm)													
181.6	Clayey SILT , some sand, trace gravel Very Stiff Brown Dry (FILL)		1	SS	21									
1.0	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional oxide stains Hard Brown to Grey Moist (TILL)		2	SS	30									
			3	SS	27									
			4	SS	19									
			5	SS	15									
			6	SS	11								0 29 44 27	
177.0	SILT , some to trace clay, trace sand Compact Grey Wet		7	SS	17								0 9 79 12	
176.4			8	SS	13									
172.8			9	SS	24									
9.8	END OF BOREHOLE AT 9.8m.													

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-17 2 OF 2 METRIC

W.P. _____ LOCATION N 4 848 480.4 E 294 069.5 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.21 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L					
	Continued From Previous Page							20	40	60	80	100						
	BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 9.1 173.5 2017.10.24 4.9 177.7																	

ONTMT4S_MTO-19484.GPJ_2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-18 1 OF 1 METRIC

W.P. _____ LOCATION N 4 848 501.1 E 294 150.7 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.21 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 W _p W W _L							
181.4	GROUND SURFACE																		
0.0 0.1	TOPSOIL: (75mm)	[diagonal lines]																	
	Clayey SILT , some sand, trace gravel, roots and rootlets Firm Dark Brown to Brown Moist	[diagonal lines]	1	SS	6							○							
180.5 0.9	(FILL)	[diagonal lines]																	
	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)	[diagonal lines]	2	SS	14							○							
	Occasional oxide stains	[diagonal lines]	3	SS	15											0 16 42 42			
	Becoming grey	[diagonal lines]	4	SS	11							○							
	25mm sand seam at 4.8m	[diagonal lines]	5	SS	10							○							
		[diagonal lines]	6	SS	15							○							
		[diagonal lines]	7	SS	15														
		[diagonal lines]	8	SS	17							○							
173.2 8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 Dry - 2017.10.24 3.5 177.9																		

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-01 1 OF 2 METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 499.2 E 293 978.5 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
182.5	GROUND SURFACE														
0.0 0.1	TOPSOIL: (75mm)														
181.9	Clayey SILT , some sand, trace gravel Very Stiff Brown Moist		1	SS	12										
0.6	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional cobbles and boulders Firm to Very Stiff Brown to Grey Moist (TILL)		2	SS	11										
			3	SS	14										
			4	SS	8										
			5	SS	9										
	Becoming grey		6	SS	17										
			7	SS	14										
			8	SS	24										
			9	SS	29										
172.7	END OF BOREHOLE AT 9.8m.													6 24 45 25	

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Continued Next Page

+³, ×³: Numbers refer to Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-01 2 OF 2 METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 499.2 E 293 978.5 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

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+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-02 2 OF 3 METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 469.5 E 293 930.8 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/HQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2017.07.10 - 2017.07.14 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
					20	40	60	80	100	20	40	60	GR	SA	SI	CL	
171.4	Continued From Previous Page																
10.2	SAND and SILT, trace gravel Very Dense Grey Moist (TILL)	10	SS	106/ 0.225						○							
		11	SS	103/ 0.250							○						
168.2	Clayey SILT to Silty CLAY, some sand to sandy, trace gravel, occasional shale fragments Hard Grey Moist (TILL)	12	SS	100/ 0.275						○	—						8 19 55 18
13.4		13	SS	50/ 0.125						○							
165.1		165									○						
165.1	SHALE highly weathered to fresh, thinly bedded, weak, grey, with limestone interbeds: (Georgian Bay Formation) Highly fractured zone (125mm) at 16.8m, 17.0m, (50mm) at 17.9m and (25mm) at 18.2m Clay seam (25mm) at 16.9m and 17.0m Thinly bedded, with limestone interbeds < 25mm	1	RUN														RUN #1 TCR=100% SCR=77% RQD=35% UCS=8.3MPa (Shale)
161.8		2	RUN														
19.8	END OF BOREHOLE AT 19.8m.																

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-02

3 OF 3

METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 469.5 E 293 930.8 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/HQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2017.07.10 - 2017.07.14 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100	W _p	W	W _L		
							○ UNCONFINED	+	FIELD VANE							
							● QUICK TRIAXIAL	×	LAB VANE							
							20	40	60	80	100		20	40	60	
	Continued From Previous Page BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, THEN ASPHALT TO SURFACE.															

ONT/MT/4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-03 2 OF 3 METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 470.9 E 293 893.2 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/HQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2017.07.12 - 2017.07.13 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
	Continued From Previous Page					20 40 60 80 100	20 40 60							
			10	SS	100/0.075									
			11	SS	100/0.100									
			12	SS	100/0.125									
			13	SS	100/0.125								2 41 47 10	
			14	SS	100/0.050									
164.8			15	SS	100/0.50							FI		
18.0	<p>SHALE highly weathered to fresh, thinly bedded, very weak to weak with medium strong to strong limestone interbeds, grey: (Georgian Bay Formation)</p> <p>Vertical fracture (25mm) at 18.0m</p> <p>Highly fractured zone (150mm) at 18.0m</p> <p>Clay seam (50mm) at 18.1m</p> <p>Limestone interbed (50mm) at 18.2m and 18.3m</p>		1	RUN								>10	RUN #1 TCR=88% SCR=64% RQD=36% UCS=7.3MPa (Shale)	
			2	RUN								0	RUN #2 TCR=100% SCR=92% RQD=72% UCS=11.2MPa (Shale) UCS=34.7MPa (Limestone)	

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-04 2 OF 2 METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 477.5 E 293 871.6 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.13 - 2017.07.13 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	Continued From Previous Page						20	40	60	80	100					
	COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.															

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-05

1 OF 2

METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 482.4 E 293 883.5 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.04 - 2017.07.04 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
						WATER CONTENT (%)							
						W _p	W	W _L					
183.0	GROUND SURFACE												
0.0	ORGANICS: (100mm)												
0.1	Clayey SILT , some sand, trace gravel, trace roots Firm to Very Stiff Brown Moist		1	SS	5								
			2	SS	26								
181.5	Clayey SILT to Silty CLAY , sandy, trace gravel, occasional sand seams Stiff to Hard Brown to Grey Moist (TILL)		3	SS	24								
1.5			4	SS	13								
			5	SS	12							3 25 42 30	
			6	SS	10								
			7	SS	26								
			8	SS	36								
174.2	SAND and SILT , trace to some clay, trace gravel Very Dense Grey Moist (TILL)		9	SS	100/ 0.275							10 33 42 15	
8.8													
173.4	END OF BOREHOLE AT 9.8m.												
9.6													

ONT/MT4S_MTCO-19484.GPJ_2017TEMPLATE(MTCO).GDT 1/11/18

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ZB 17-05

2 OF 2

METRIC

W.P. _____ LOCATION Zenway Blvd. Underpass N 4 848 482.4 E 293 883.5 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.04 - 2017.07.04 CHECKED BY ME

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L					
	Continued From Previous Page																	
	BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.07.07 8.6 174.4 2017.08.09 2.2 180.8 2017.10.24 2.4 180.6																	

ONTMT4S_MTO-19484.GPJ_2017TEMPLATE(MTO).GDT 1/11/18

RECORD OF BOREHOLE No UC 17-21 1 OF 1 METRIC

W.P. _____ LOCATION N 4 849 815.7 E 293 445.4 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.30 - 2017.05.30 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 WATER CONTENT (%)										
186.1	GROUND SURFACE															
0.0	TOPSOIL: (150mm)															
0.2	Silty CLAY , trace sand, trace gravel, some organics		1	SS	10											
185.3	Compact Brown Dry															
0.8	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel		2	SS	19											
	Very Stiff to Stiff															
	Brown Moist (TILL)		3	SS	19											
			4	SS	14											
			5	SS	19											
	Becoming grey	6	SS	14												
		7	SS	18												
179.4	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 4.9m AND DRY. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															
6.7																

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-22 1 OF 1 METRIC

W.P. _____ LOCATION N 4 849 847.7 E 293 518.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.30 - 2017.05.30 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
186.9	GROUND SURFACE															
0.0	TOPSOIL: (75mm)															
0.1	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel, occasional cobbles and boulders Firm to Hard Brown Moist (TILL)		1	SS	7											
			2	SS	14											
			3	SS	24											
			4	SS	22											
			5	SS	16											
			6	SS	100/ 0.200											
	Cobbles fragments		7	SS	15											
180.2	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															
6.7																

ONT/MT4S_MTC-19484.GPJ_2017TEMPLATE(MTC).GDT 1/15/18

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RWLR 17-09 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 092.7 E 293 768.0 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.19 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
188.0	GROUND SURFACE					20	40	60	80	100	20	40	60				
0.0	Gravelly SAND , some silt, trace to some clay Very Dense to Compact Brown Moist (FILL)		1	SS	50/ 0.125												
186.6			2	SS	10												21 48 18 13
1.4	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel, occasional cobbles Stiff to Very Stiff Brown Moist (TILL) Becoming grey		3	SS	11												
			4	SS	15												
			5	SS	21												
			6	SS	26												
			7	SS	23												
			8	SS	14												
			9	SS	15												
			10	SS	16												
179.8	8.2																
END OF BOREHOLE AT 8.2m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.19 1.5 186.5																	

ONTMT4S_MTC-19484.GPJ_2017TEMPLATE(MTC).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No FLR 17-05 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 139.3 E 293 741.8 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.23 - 2017.05.23 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
					20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
					WATER CONTENT (%)								
					20 40 60 W _p W W _L								
188.0	GROUND SURFACE												
0.0	ASPHALT: (50mm)												
187.6	Gravelly SAND, trace clay	1	SS	7									
0.4	Loose Brown Moist (FILL)												
	Clayey SILT to Silty CLAY, some sand to sandy, trace gravel	2	SS	6								2	34 35 29
	Firm to Very Stiff Brown to Grey Moist (TILL)												
		3	SS	7									
		4	SS	19									
		5	SS	17									
		6	SS	11									
	Becoming grey	7	SS	19									
		8	SS	12									
179.8	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.0m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No FLR 17-06 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 317.5 E 293 587.1 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.24 - 2017.05.24 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
					20	40	60	80	100							
188.6	GROUND SURFACE															
0.0	TOPSOIL: (150mm)															
0.2	Silty CLAY , trace sand, trace gravel, trace organics Firm to Stiff Brown Moist	1	SS	4												
		2	SS	6												
		3	SS	5												
		4	SS	9												
185.6	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel Stiff to Very Stiff Brown Moist (TILL)	5	SS	14												
	Becoming grey	6	SS	14												
		7	SS	18												
		8	SS	11												
180.4	END OF BOREHOLE AT 6.7m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.															
8.2	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.19 4.5 184.1 2017.10.30 1.1 187.5															

ONTMT4S_MTC-19484.GPJ_2017TEMPLATE(MTC).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No FCPR 17-02 1 OF 2 METRIC

W.P. _____ LOCATION N 4 853 644.8 E 292 143.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) 20 40 60						
203.2	GROUND SURFACE															
0.0	TOPSOIL: (150mm)															
0.2	Clayey SILT , trace sand, trace gravel Firm Brown Moist		1	SS	7											
202.5	Clayey SILT to Silty CLAY , trace sand, trace gravel, occasional cobbles Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	21											
0.7			3	SS	21											
			4	SS	20										0 12 46 42	
			5	SS	18											
			6	SS	20											
			7	SS	15											
			8	SS	10											
			9	SS	9											

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No FCPR 17-02 2 OF 2 METRIC

W.P. _____ LOCATION N 4 853 644.8 E 292 143.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY ME

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100			
	Continued From Previous Page															
	Clayey SILT to Silty CLAY , trace sand, trace gravel, occasional cobbles Stiff to Very Stiff Brown to Grey Moist (TILL)		10	SS	21										5 26 42 27	
190.7																
12.5 190.5	SAND and SILT , trace clay, trace gravel Very Dense Grey Moist (TILL)		11	SS	83											
12.7	END OF BOREHOLE AT 12.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 1/11/18

+³, ×³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

Appendix B

Record of Borehole Sheets - Previous Investigations

RECORD OF BOREHOLE No. 12

1 of 1

METRIC

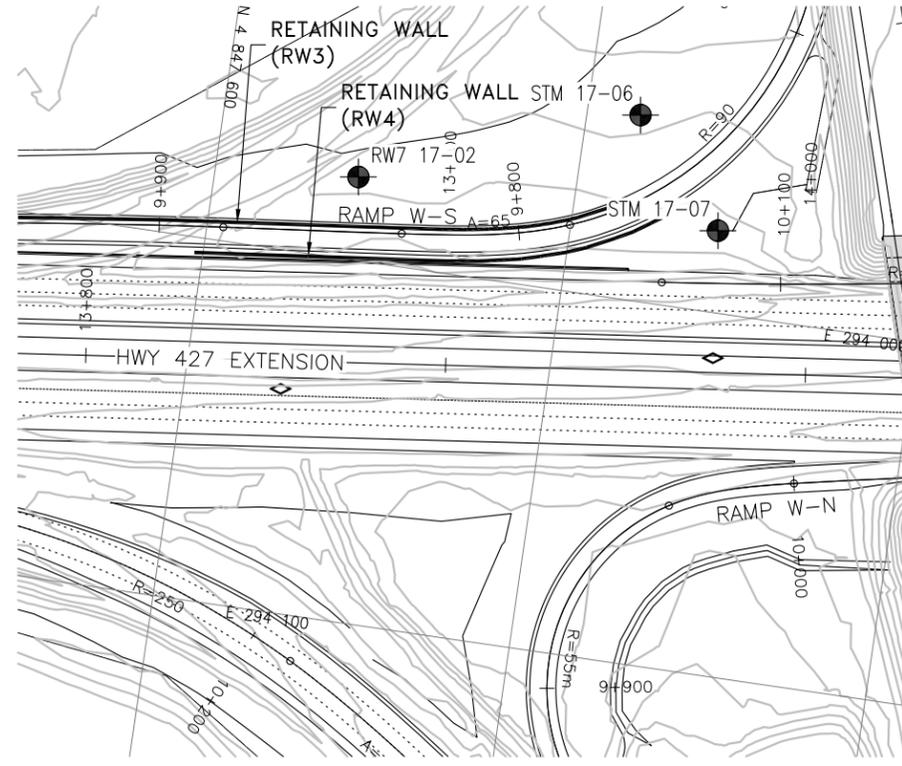
G.W.P. 2230-09-00 LOCATION Coords: 4 850 412.5 N; 293 614.9 E ORIGINATED BY S.A.
 DIST Central HWY 427 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.D.
 DATUM Geodetic DATE August 12, 2014 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100					
188.5	Ground Surface														
0.0	Clayey silt, trace sand organics, rootlets		1	SS	7										
187.6	Firm to stiff Dark brown/brown Moist brown/brown (FILL)		2	SS	10						138				
0.9	Clayey silt some to with sand trace gravel		3	SS	22						188				2 19 44 35
	Very stiff to hard Brown/grey Moist grey (TILL)		4	SS	40						225				
	sand seams cobbles and boulders		5	SS	31										
	Grey		6	SS	36										
			7	SS	27						138				3 22 47 28
			8	SS	35						225				
			9	SS	25						225				
			10	SS	38										
178.7	End of borehole														
9.8															

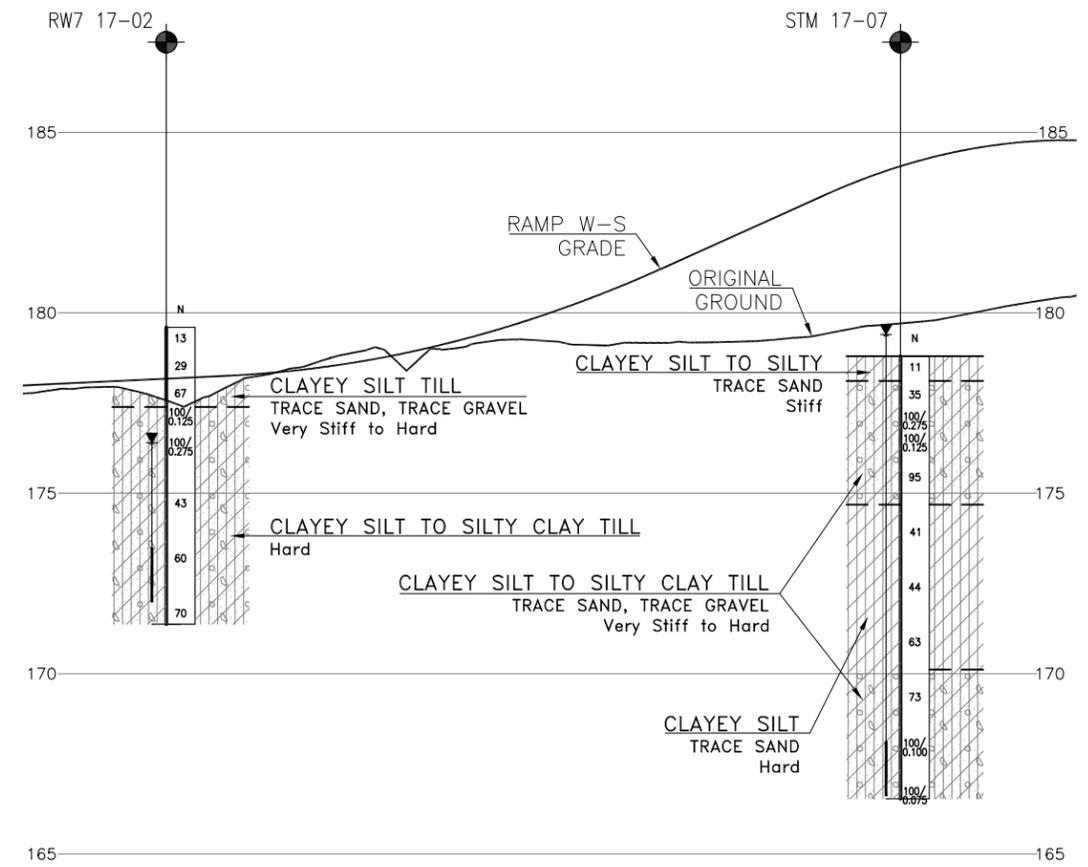
* Borehole dry
 ■ Pocket penetrometer

Appendix C

Borehole Locations and Soil Strata Drawings



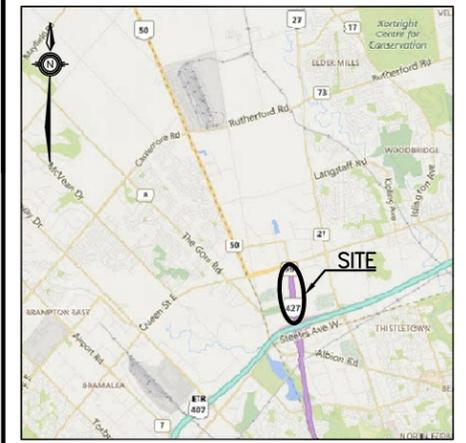
PLAN



PROFILE ALONG C RAMP W-S (HWY 7)

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole (By Thurber)
	Borehole (By Others)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW7 17-02	179.6	4 847 639.7	293 977.0
STM 17-07	178.8	4 847 740.7	293 977.3

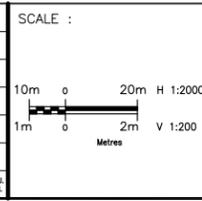
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRIS No.

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PLOTDATE: 2/22/2019 10:03 AM

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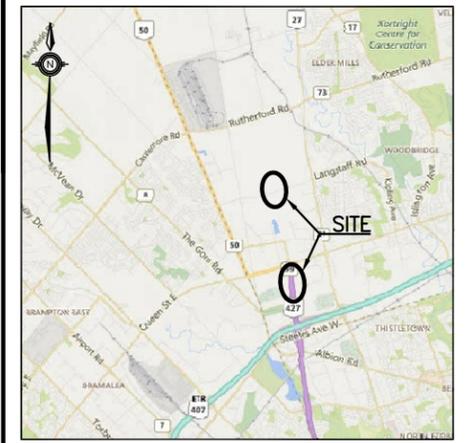
DESIGNED	N. BERG	NB	19/02/22
DRAWN	A. NOOR	AN	19/02/22
CHECKED	J. LEE	JL	19/02/22
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/22
APPROVED PROJ. MANAGER	P. BAMFORTH	PB	19/02/22



PROJECT ID.		STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D		H	9	FND		DWG	A	



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

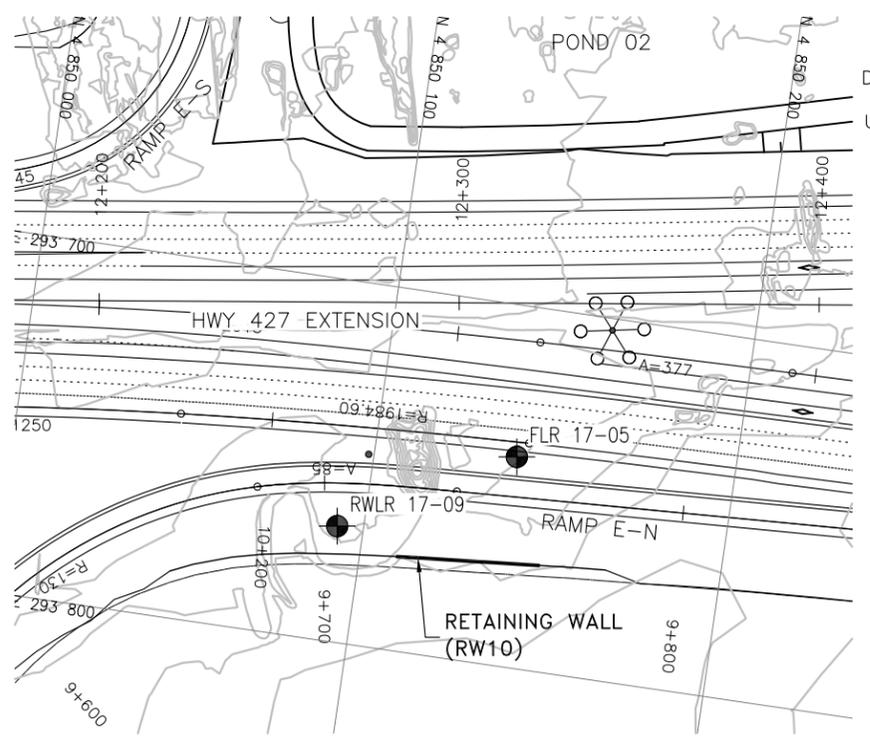
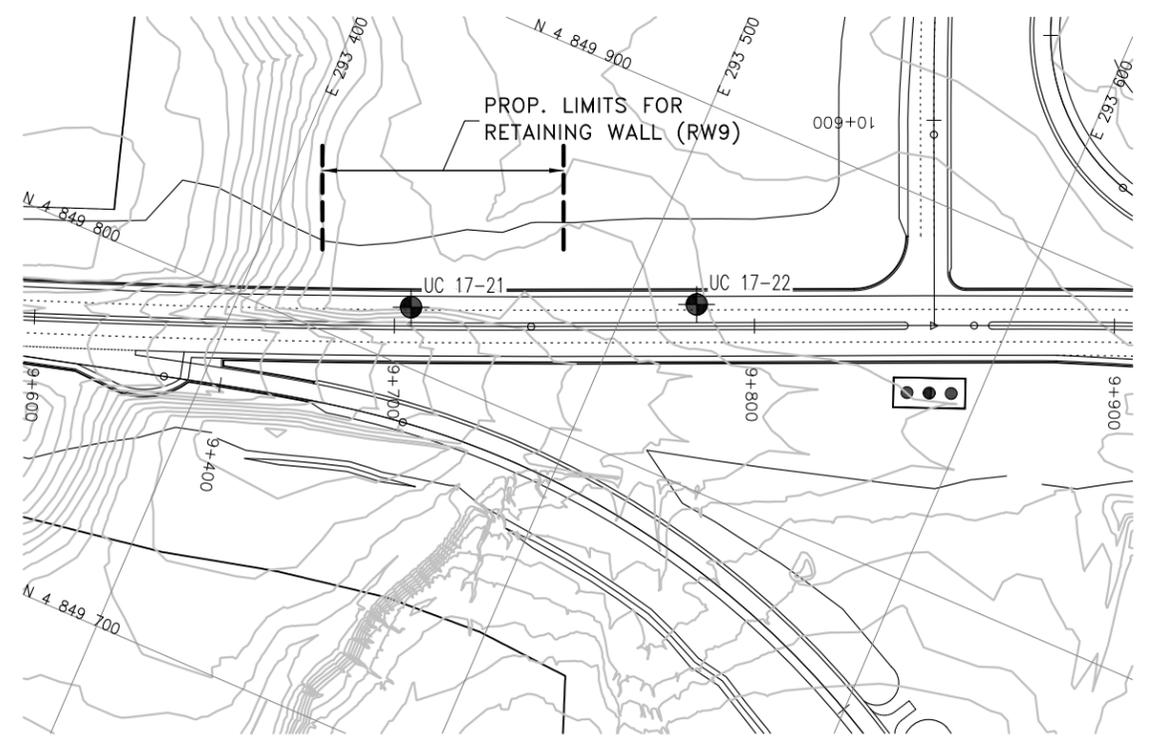
LEGEND

- Borehole (By Thurber)
- Borehole (By Others)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

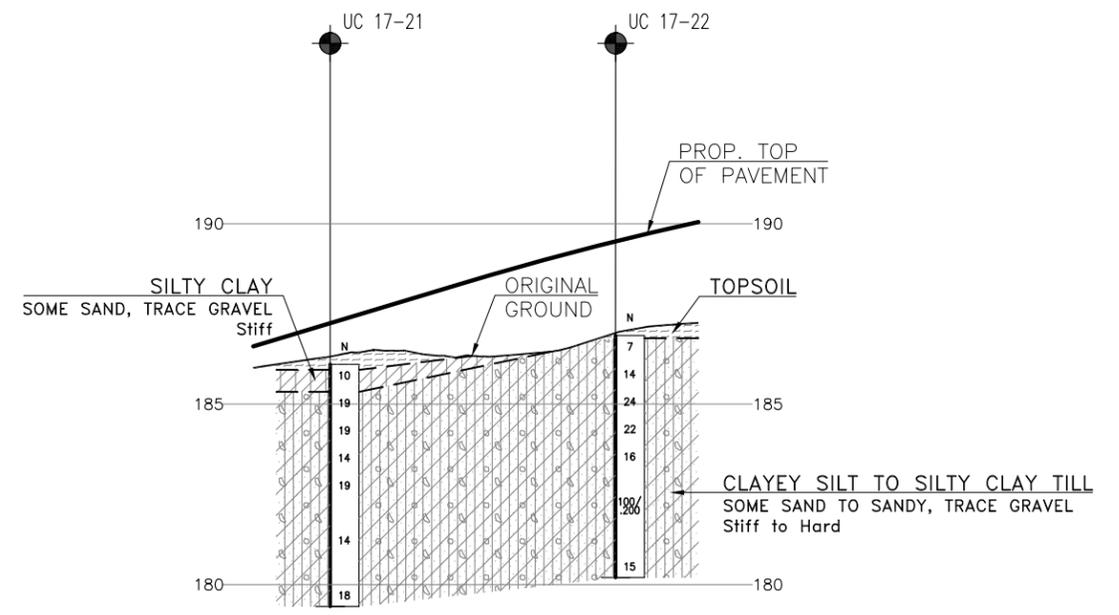
NO	ELEVATION	NORTHING	EASTING
FLR 17-05	188.0	4 850 139.3	293 741.8
RWLR 17-09	188.0	4 850 092.7	293 768.0
UC 17-21	186.1	4 849 815.7	293 445.4
UC 17-22	186.9	4 849 847.7	293 518.0

- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

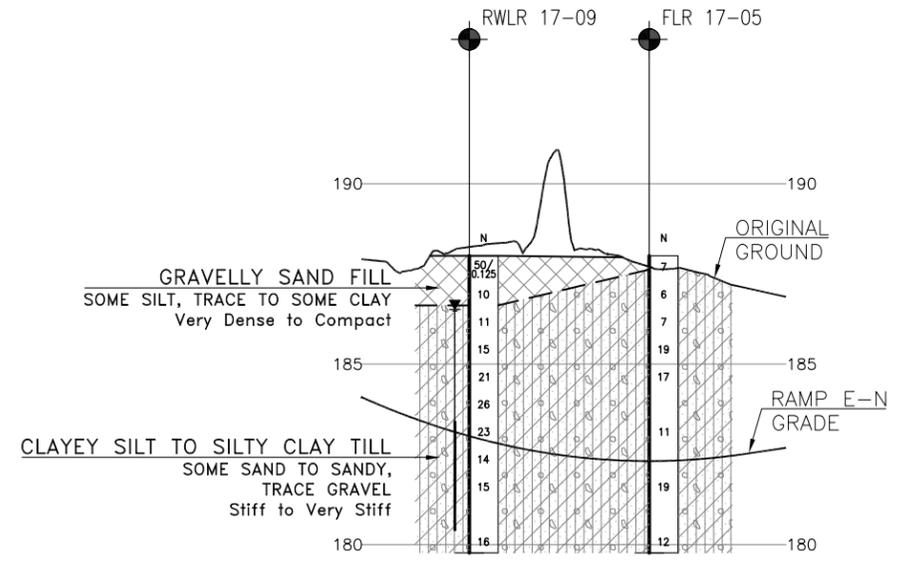
GEOGRES No.



PLAN



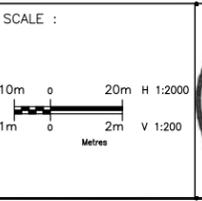
PROFILE ALONG Q LANGSTAFF RD



PROFILE ALONG Q RAMP E-N (LANGSTAFF RD.)

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PLOTDATE: 2/22/2019 10:04 AM

NO.	DATE	REVISIONS	BY	CHK	LEAD	PRJL	MAN
A	19/02/22	100% SUBMISSION TO CA	NB	JL	JL	PB	



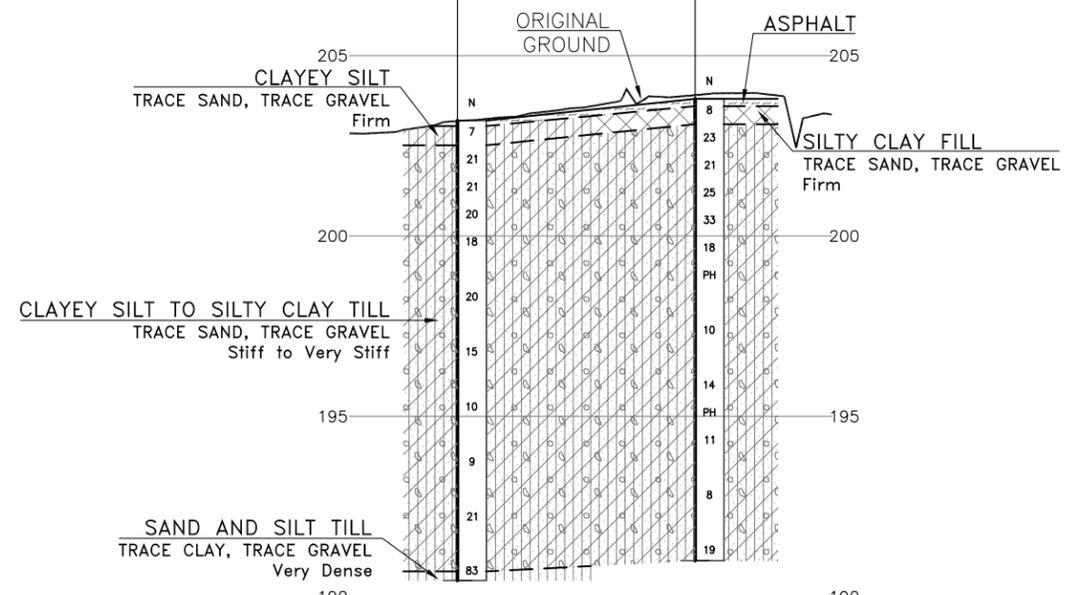
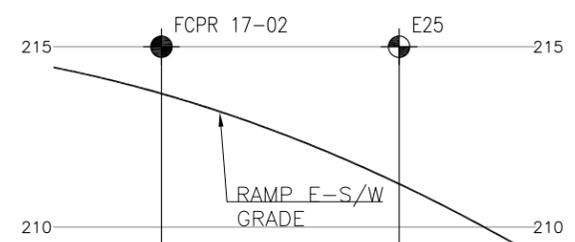
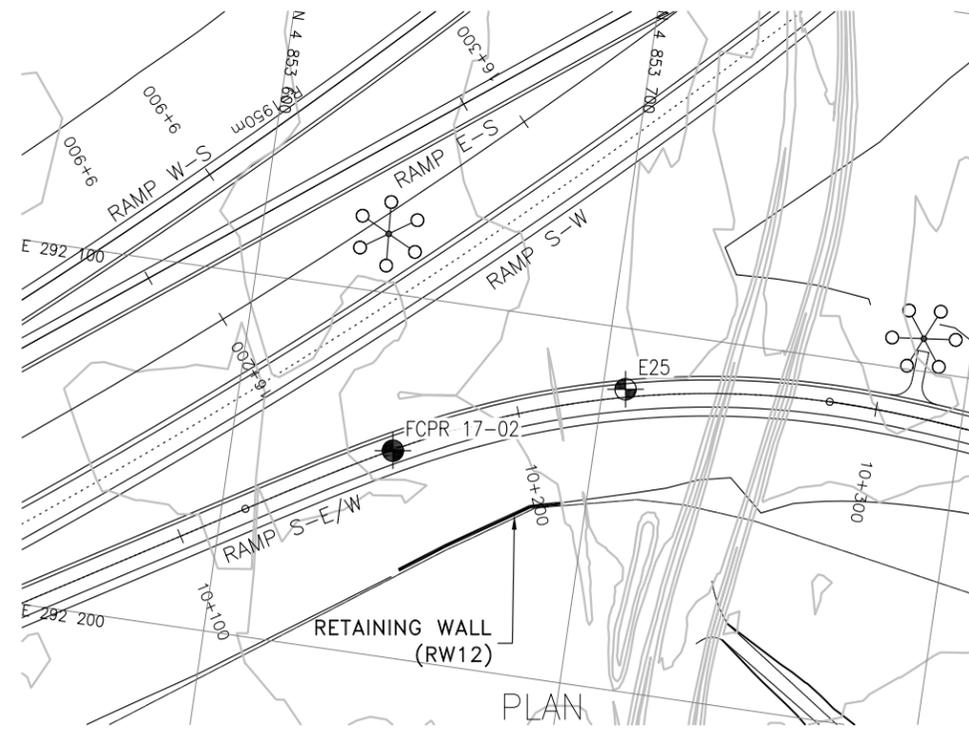
DESIGNED	N. BERG	NB	19/02/22
DRAWN	A. NOOR	AN	19/02/22
CHECKED	J. LEE	JL	19/02/22
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/22
APPROVED PROJ. MANAGER	P. BAMFORTH	PB	19/02/22
NAME (PRINT)		INIT.	DATE



PROJECT ID.		STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D		H	1	FND		DWG	A	

TITLE
**HWY 427 EXPANSION
RETAINING WALLS**

BOREHOLE LOCATIONS & SOIL STRATA



PROFILE ALONG C RAMP E-S/W (MAJOR MACKENZIE DRIVE)

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
E25	203.8	4 853 706.3	292 116.8
FCPR 17-02	203.2	4 853 644.8	292 143.0

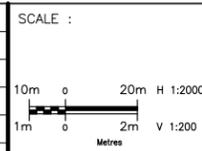
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRILES No.

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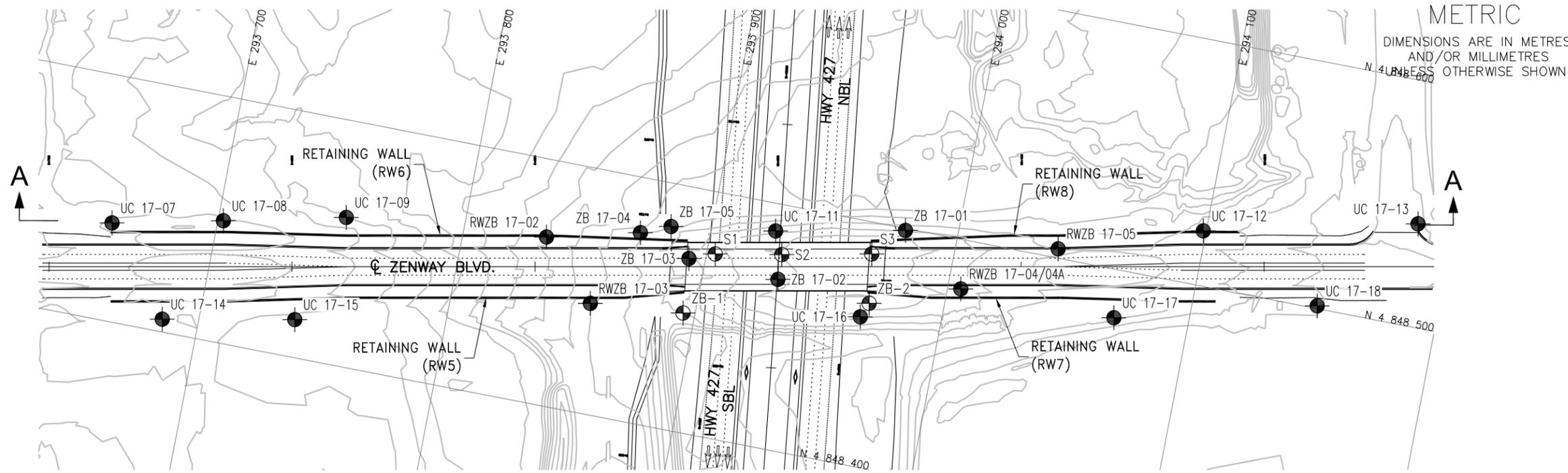
NO.	DATE	REVISIONS	BY	CHK	LEAD. DES.	PRJ. MGR.
A	19/02/22	100% SUBMISSION TO CA	NB	JL	JL	PB



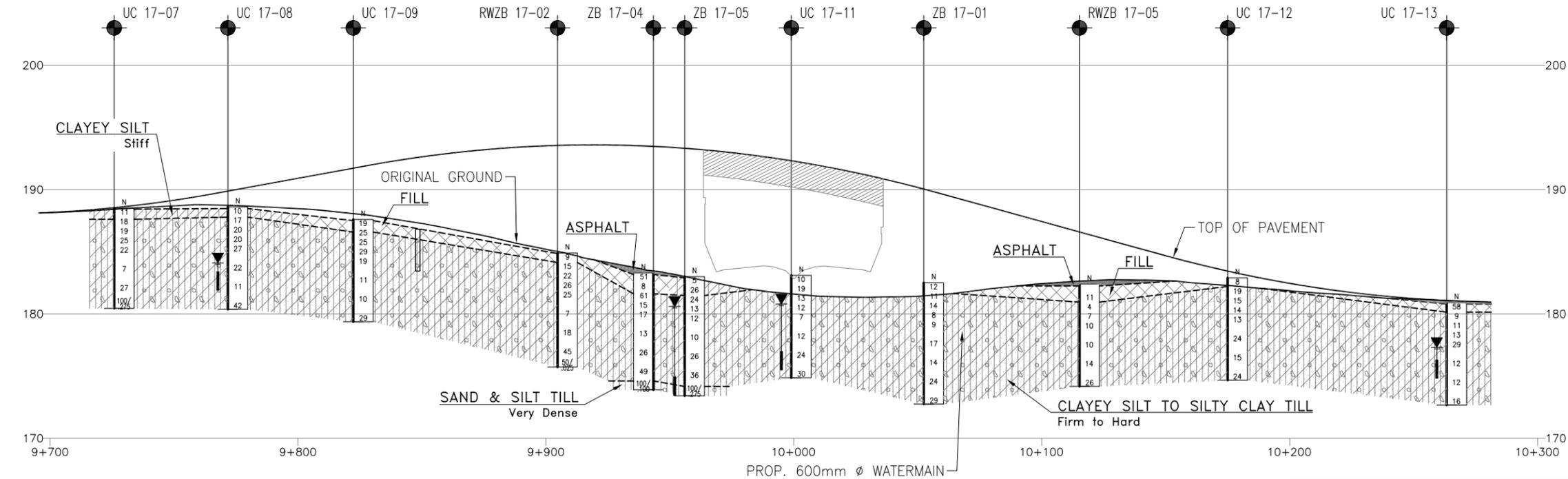
DESIGNED	N. BERG	NB	19/02/22
DRAWN	A. NOOR	AN	19/02/22
CHECKED	J. LEE	JL	19/02/22
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/22
APPROVED PROJ. MANAGER	P. BAWFORTH	PB	19/02/22
NAME (PRINT)	INIT.	DATE	



TITLE							
HWY 427 EXPANSION RETAINING WALLS							
BOREHOLE LOCATIONS & SOIL STRATA							
PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	H	3	FND		DWG	A	



PLAN



PROFILE A-A ALONG ZENWAY BLVD. WBL

CONT No
WP No

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RWZB 17-02	184.9	4 848 468.4	293 834.0
RWZB 17-03	184.1	4 848 445.1	293 856.9
RWZB 17-04/04A	181.9	4 848 480.0	294 005.4
RWZB 17-05	182.4	4 848 503.8	294 041.6
S1	182.2	4 848 474.8	293 903.5
S2	181.4	4 848 479.8	293 930.4
S3	181.1	4 848 487.1	293 966.7
UC 17-07	188.5	4 848 440.0	293 657.4
UC 17-08	188.6	4 848 449.6	293 702.2
UC 17-09	187.6	4 848 460.6	293 751.6
UC 17-11	183.1	4 848 488.8	293 926.1
UC 17-12	182.9	4 848 522.4	294 098.8
UC 17-13	180.9	4 848 542.0	294 185.0
UC 17-14	188.0	4 848 405.2	293 685.2
UC 17-15	187.8	4 848 415.4	293 738.8
UC 17-16	181.8	4 848 460.9	293 967.0
UC 17-17	182.6	4 848 480.4	294 069.5
UC 17-18	181.4	4 848 501.1	294 150.7
ZB 17-01	182.5	4 848 499.2	293 978.5
ZB 17-02	181.6	4 848 469.5	293 930.8
ZB 17-03	182.8	4 848 470.9	293 893.2

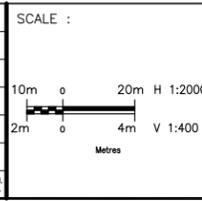
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCREs No.

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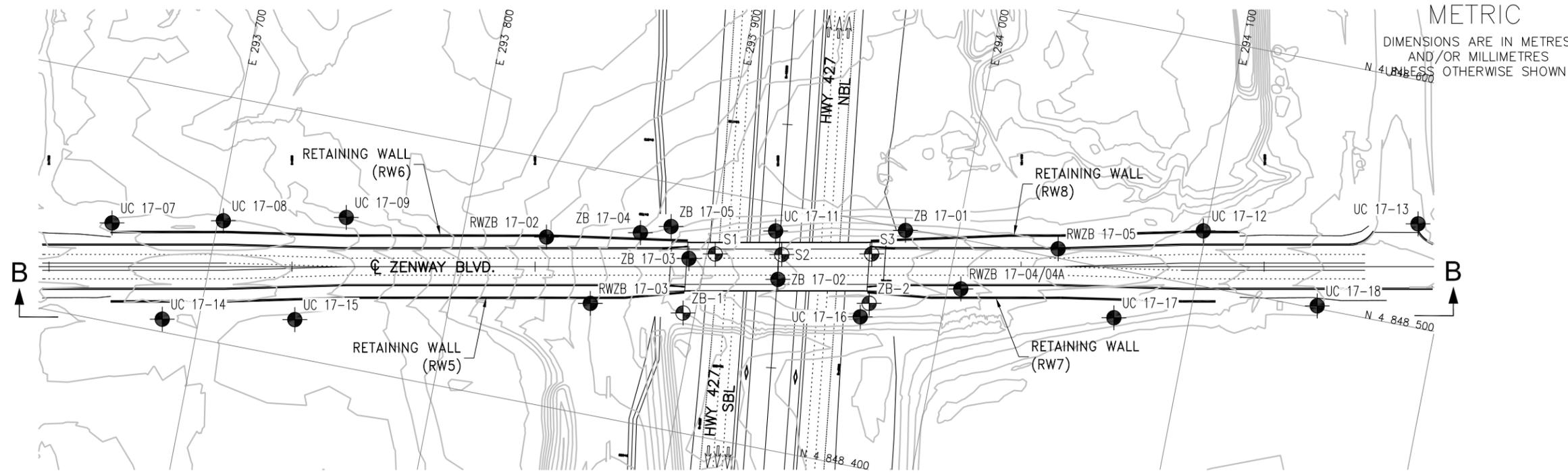
NO.	DATE	REVISIONS	BY	CHK	LEAD. ENG.	PROJ. MGR.
A	19/02/22	100% SUBMISSION TO CA	MB	JL	JL	PB



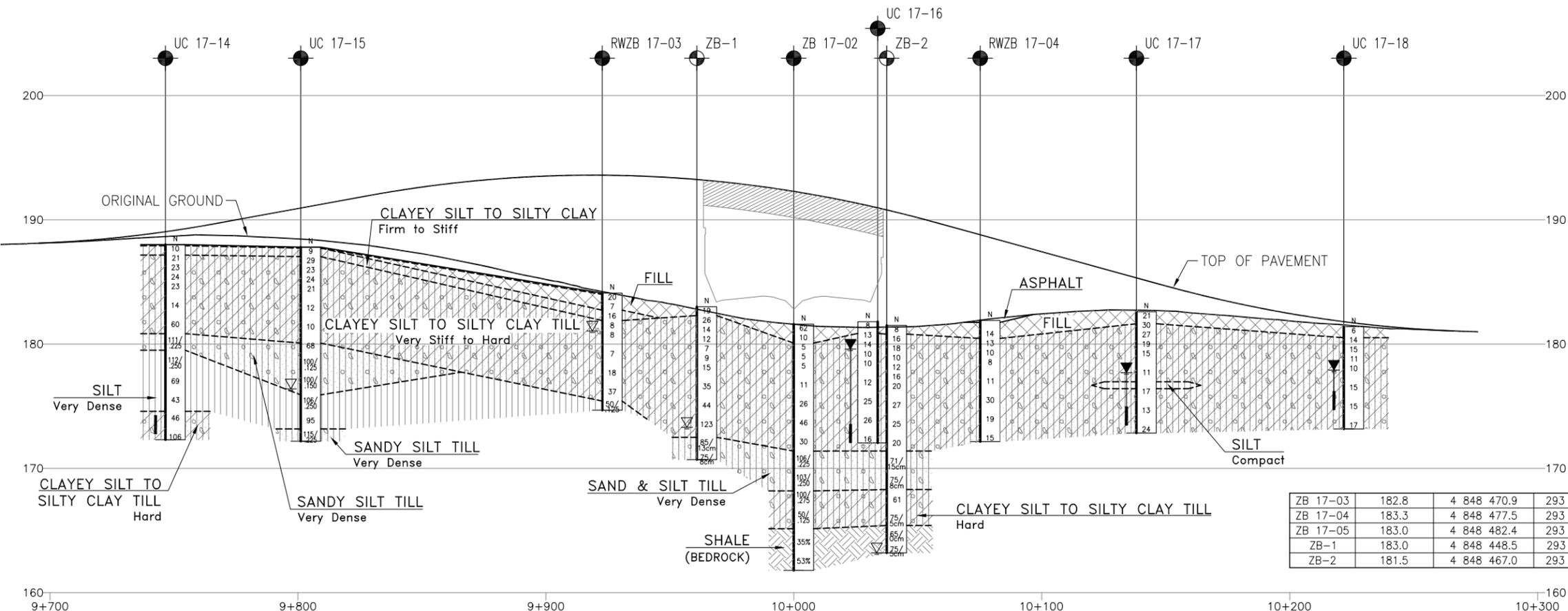
DESIGNED	M. BOUCHER	MB	19/02/22
DRAWN	A. NOOR	AN	19/02/22
CHECKED	J. LEE	JL	19/02/22
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/22
APPROVED PROJ. MANAGER	P. BAMFORTH	PB	19/02/22



PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	H	9	FND	000	DWG		A



PLAN



PROFILE B-B ALONG ZENWAY BLVD. EBL

CONT No
WP No



KEYPLAN

LEGEND

- Borehole (By Thurber)
- ⊕ Borehole (By Others)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ∇ Water Level
- ⊕ Head Artesian Water
- ⊕ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RWZB 17-02	184.9	4 848 468.4	293 834.0
RWZB 17-03	184.1	4 848 445.1	293 856.9
RWZB 17-04/04A	181.9	4 848 480.0	294 005.4
RWZB 17-05	182.4	4 848 503.8	294 041.6
S1	182.2	4 848 474.8	293 903.5
S2	181.4	4 848 479.8	293 930.4
S3	181.1	4 848 487.1	293 966.7
UC 17-07	188.5	4 848 440.0	293 657.4
UC 17-08	188.6	4 848 449.6	293 702.2
UC 17-09	187.6	4 848 460.6	293 751.6
UC 17-11	183.1	4 848 488.8	293 926.1
UC 17-12	182.9	4 848 522.4	294 098.8
UC 17-13	180.9	4 848 542.0	294 185.0
UC 17-14	188.0	4 848 405.2	293 685.2
UC 17-15	187.8	4 848 415.4	293 738.8
UC 17-16	181.8	4 848 460.9	293 967.0
UC 17-17	182.6	4 848 480.4	294 069.5
UC 17-18	181.4	4 848 501.1	294 150.7
ZB 17-01	182.5	4 848 499.2	293 978.5
ZB 17-02	181.6	4 848 469.5	293 930.8
ZB 17-03	182.8	4 848 470.9	293 893.2

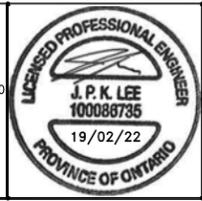
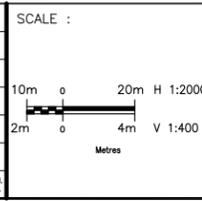
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCREs No.

FILENAME: H:\Drafting\19000\19484\19484-PLR-HWY-427 (RetainingWall) ZENWAY BLVD.dwg
PLOT DATE: 2/22/2019 10:38 AM

NO.	DATE	REVISIONS	BY	CHK	LEAD. ENG.	PROJ. MGR.
A	19/02/22	100% SUBMISSION TO CA	MB	JL	JL	PB



DESIGNED	M. BOUCHER	MB	19/02/22
DRAWN	A. NOOR	AN	19/02/22
CHECKED	J. LEE	JL	19/02/22
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/22
APPROVED PROJ. MANAGER	P. BAMFORTH	PB	19/02/22



PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	H	9	FND	000	DWG		A

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HWY 427 EXPANSION
ZENWAY BLVD EBL
RETAINING WALLS
STA. 9+700 TO 10+300
BOREHOLE LOCATIONS AND SOIL STRATA

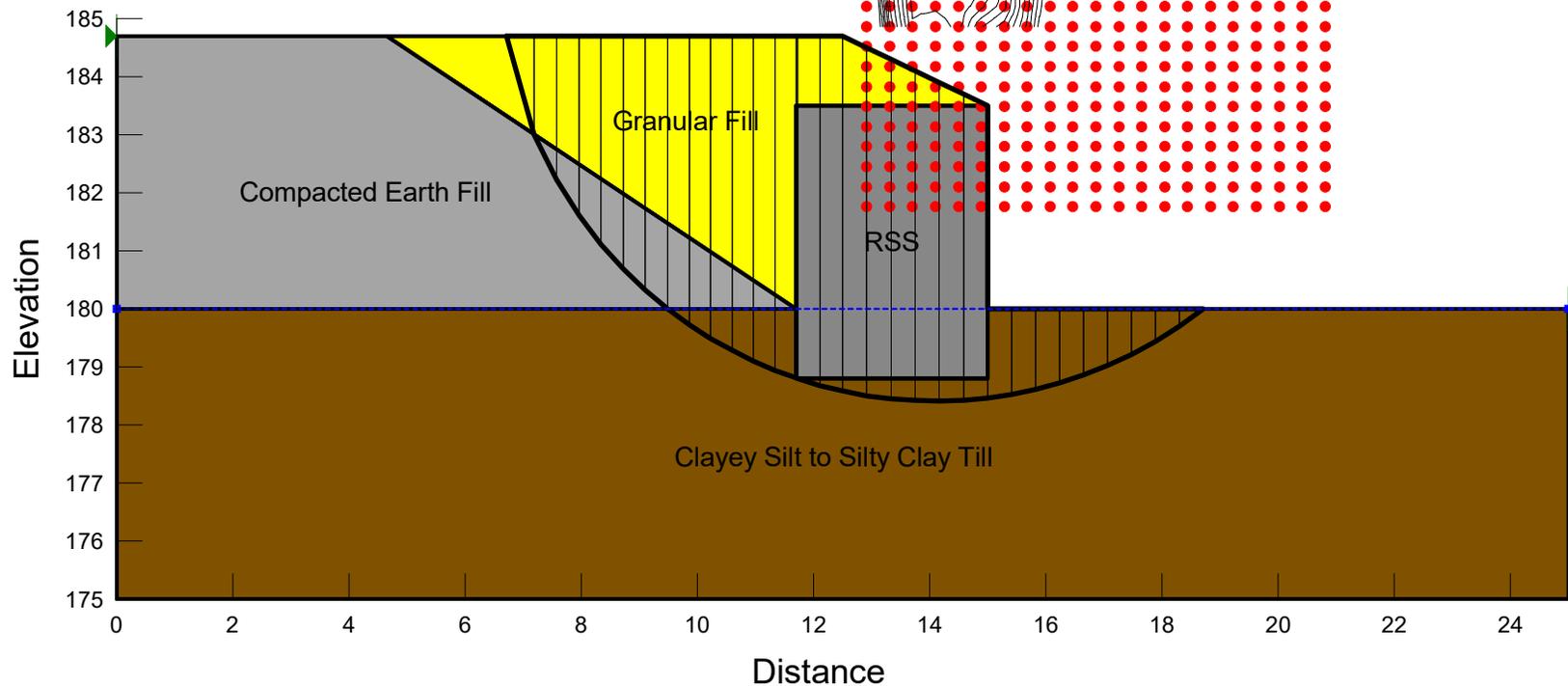
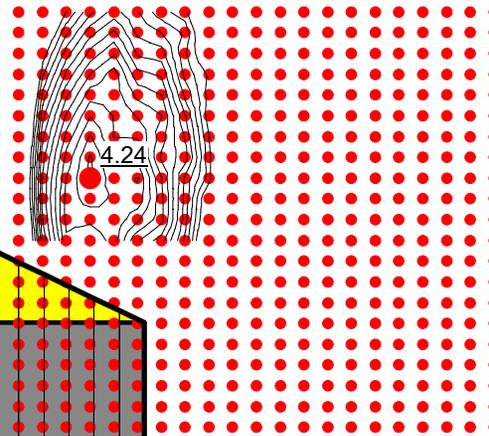
Appendix D

Global Stability Analysis Output for Retaining Walls / Embankments

**CRITICAL SECTION (STA. 9+720)
RW4 - HIGHWAY 7 W-S RAMP
SHORT-TERM CONDITION**

File Name: RW3 Sta 9+720 (Short-Term).gsz
 Last Edited By: Geoff Lay
 Date: 10/19/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

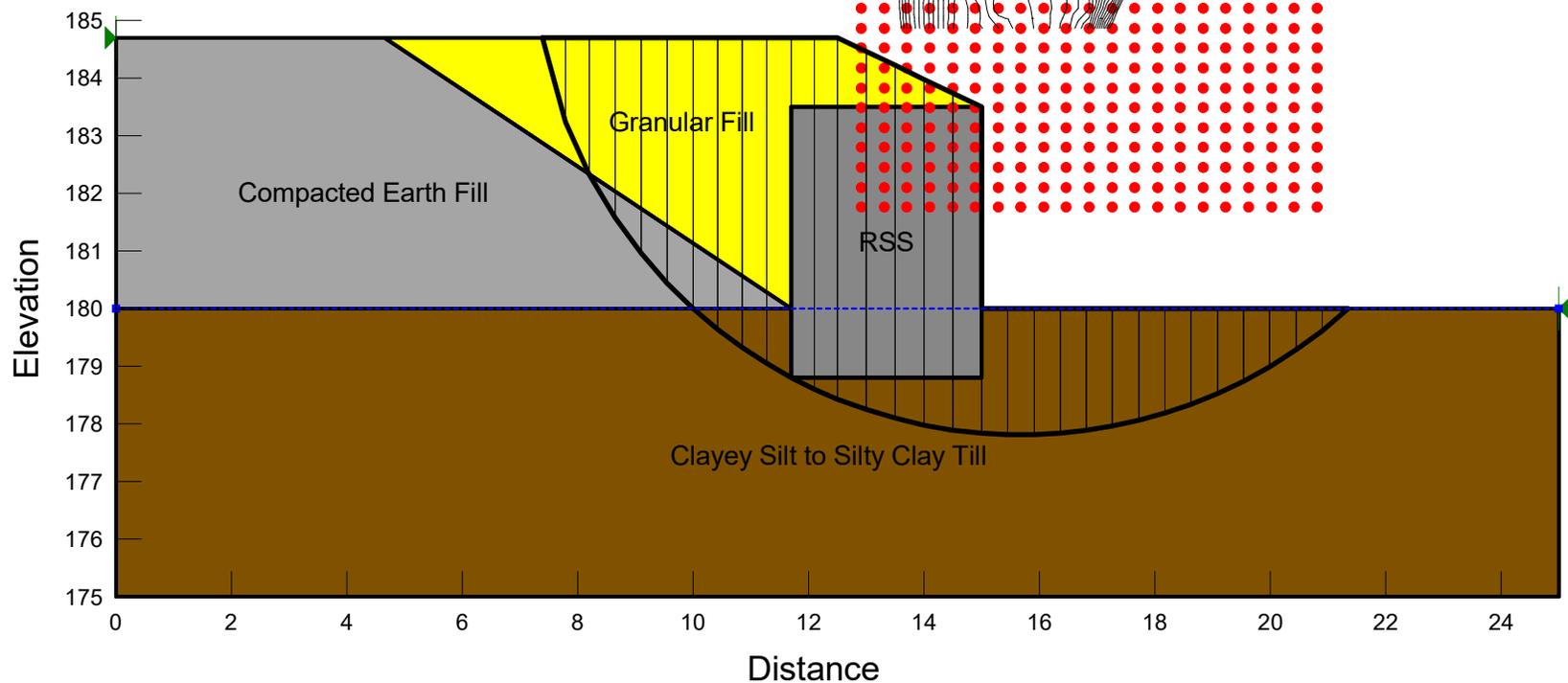
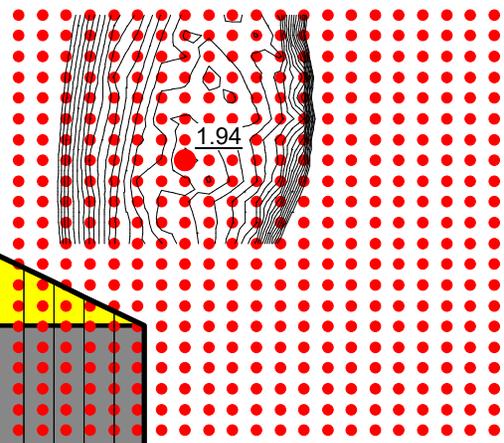
RSS	22 kN/m ³	200 kPa	34 °	
Granular Fill	21 kN/m ³	0 kPa	35 °	
Compacted Earth Fill	18 kN/m ³	0 kPa	30 °	
Clayey Silt to Silty Clay Till	21 kN/m ³	100 kPa	0 °	



**CRITICAL SECTION (STA. 9+720)
RW4 - HIGHWAY 7 W-S RAMP
LONG-TERM CONDITION**

File Name: RW3 Sta 9+720 (Long-Term).gsz
 Last Edited By: Geoff Lay
 Date: 10/19/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

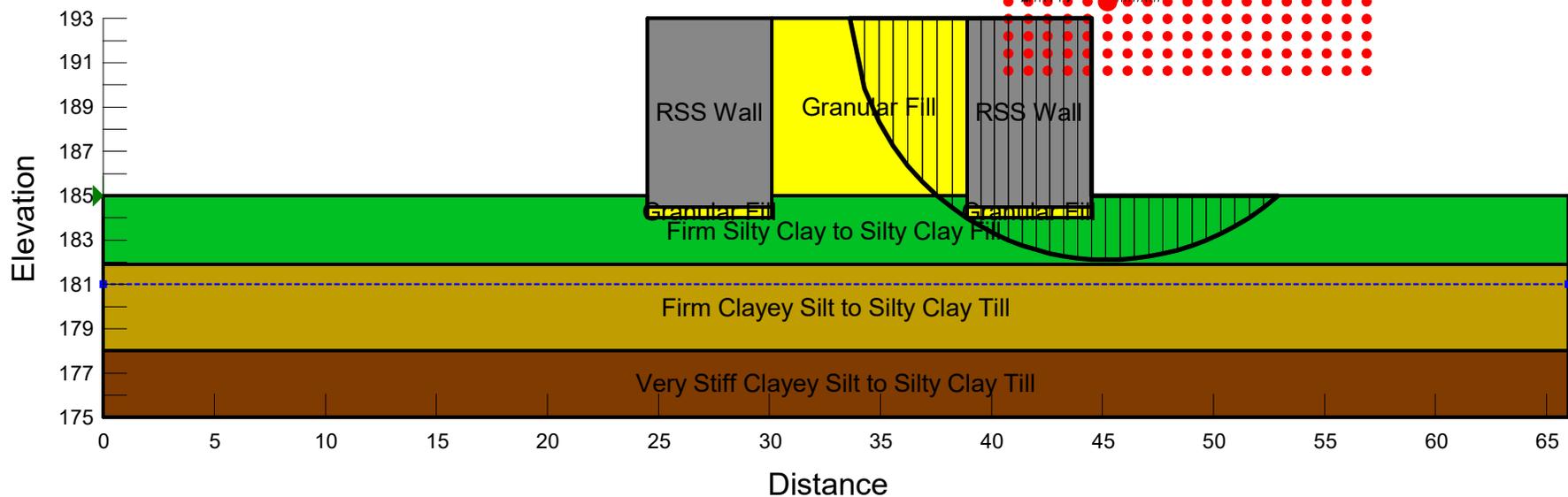
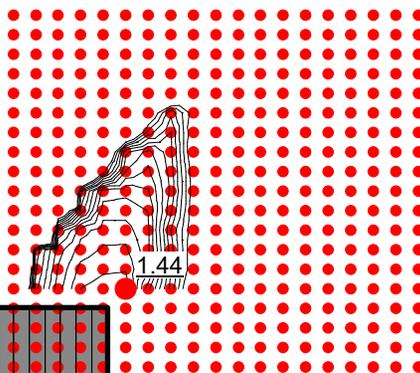
RSS	22 kN/m ³	200 kPa	34 °	
Granular Fill	21 kN/m ³	0 kPa	35 °	
Compacted Earth Fill	18 kN/m ³	0 kPa	30 °	
Clayey Silt to Silty Clay Till	21 kN/m ³	5 kPa	32 °	



**CRITICAL SECTION (STA. 9+900)
RW5&6 - ZENWAY BOULEVARD
SHORT-TERM CONDITION**

Firm Silty Clay to Silty Clay Fill	18 kN/m ³	50 kPa	0 °
RSS Wall	22 kN/m ³	200 kPa	34 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Very Stiff Clayey Silt to Silty Clay Till	21 kN/m ³	100 kPa	0 °
Firm Clayey Silt to Silty Clay Till	20 kN/m ³	65 kPa	0 °

Method: Morgenstern-Price, Half Sine
Minimum Slip Surface Depth: 1 m
Seismic: 0



**CRITICAL SECTION (STA. 9+900)
RW5&6 - ZENWAY BOULEVARD
LONG-TERM CONDITION**

Firm Silty Clay to Silty Clay Fill	18 kN/m ³	5 kPa	29 °
RSS Wall	22 kN/m ³	200 kPa	34 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Very Stiff Clayey Silt to Silty Clay Till	21 kN/m ³	5 kPa	32 °
Firm Clayey Silt to Silty Clay Till	20 kN/m ³	0 kPa	30 °

Method: Morgenstern-Price, Half Sine
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

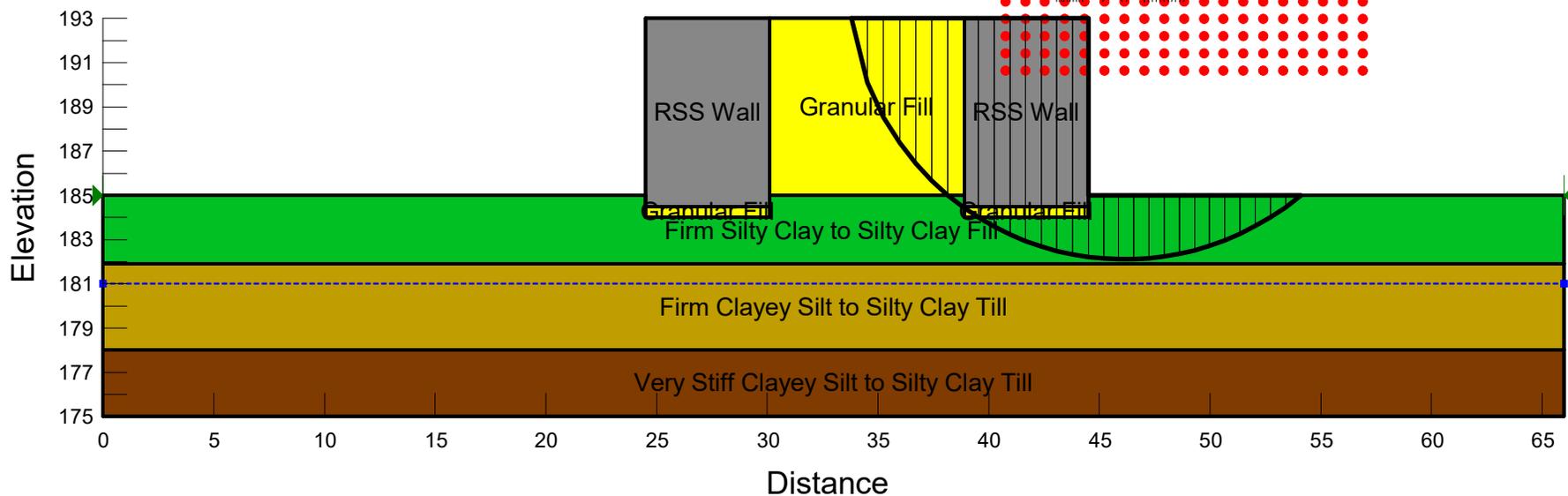
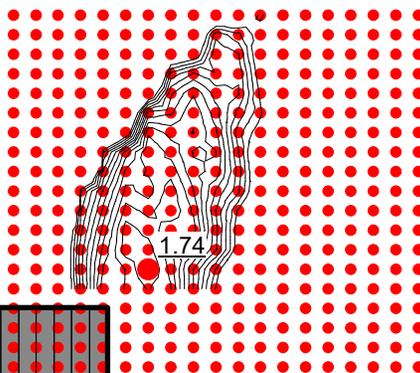


FIGURE 5

**CRITICAL SECTION (STA. 9+740)
RW10 - LANGSTAFF E-N RAMP
SHORT-TERM CONDITION**

File Name: RW8 Sta 9+740 (Short-Term).gsz
 Last Edited By: Geoff Lay
 Date: 1/11/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

Retaining Wall	24 kN/m ³	1,000 kPa	0 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Compact Gravelly Sand Fill	18 kN/m ³	0 kPa	30 °
Stiff Clayey Silt to Silty Clay Till	20 kN/m ³	75 kPa	0 °
V. Stiff Clayey Silt to Silty Clay Till (Upper)	21 kN/m ³	125 kPa	0 °
V. Stiff Clayey Silt to Silty Clay Till (Lower)	20.5 kN/m ³	100 kPa	0 °

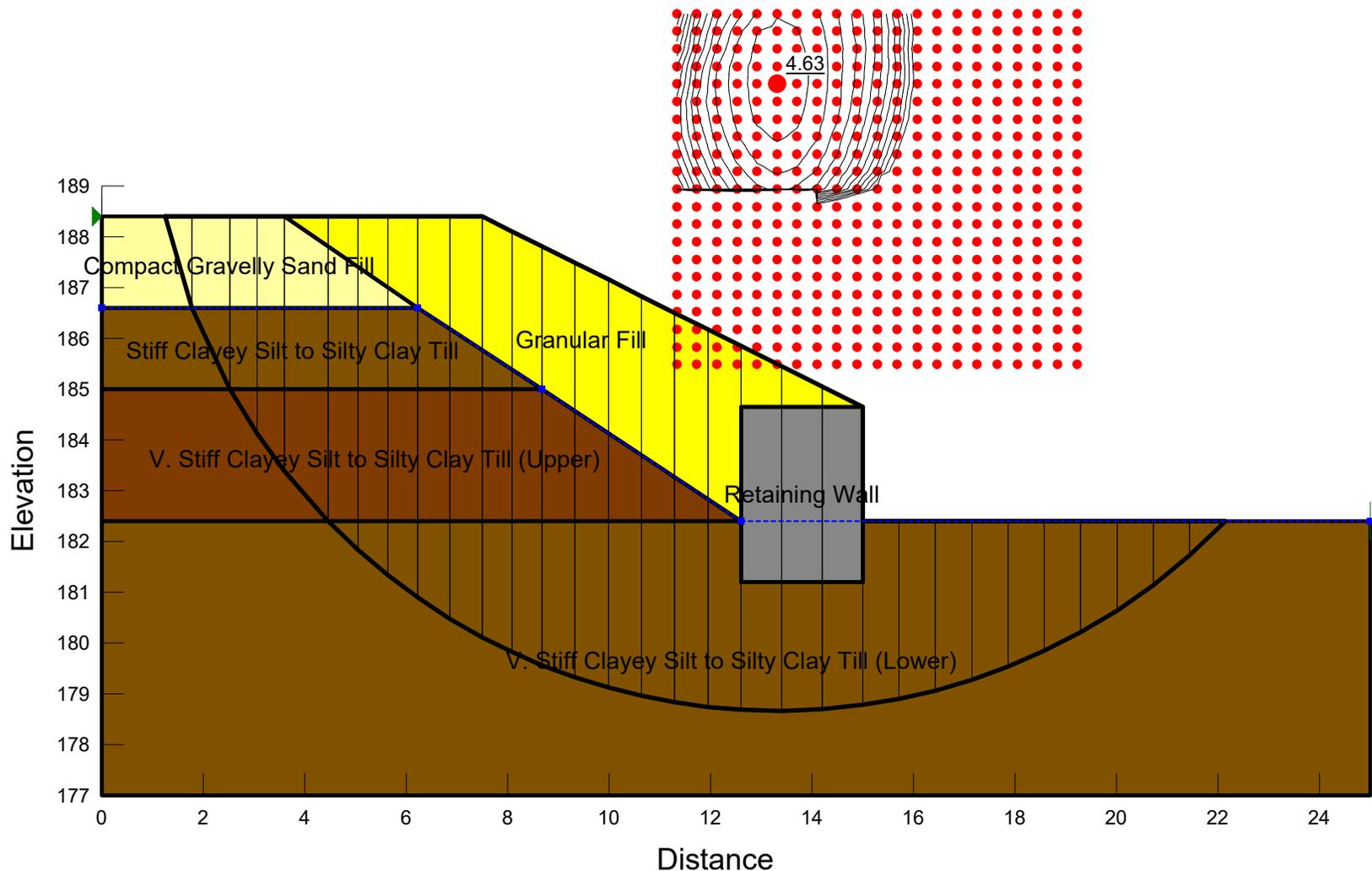
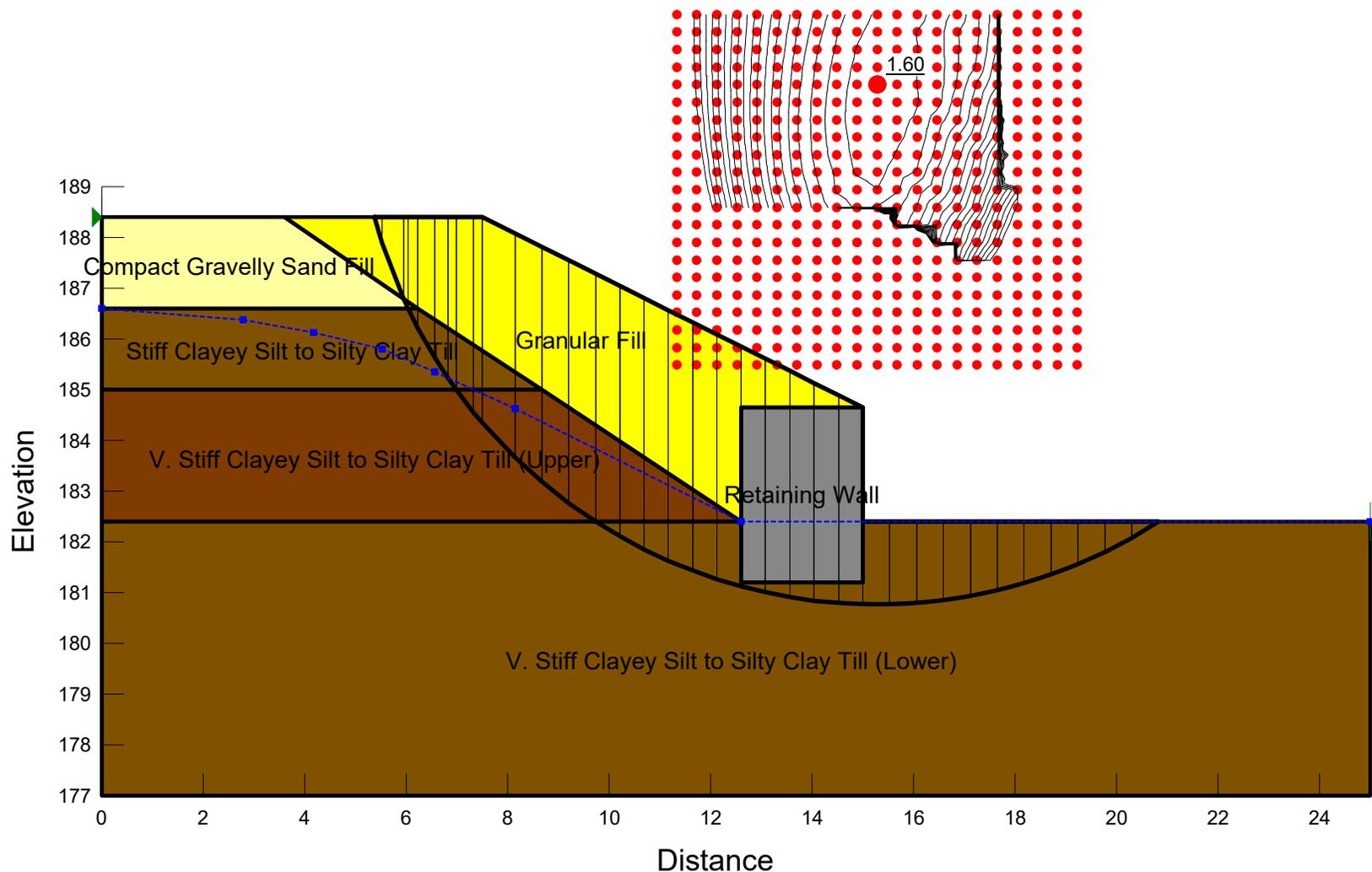


FIGURE 6

**CRITICAL SECTION (STA. 9+740)
RW10 - LANGSTAFF E-N RAMP
LONG-TERM CONDITION**

File Name: RW8 Sta 9+740 (Long-Term).gsz
 Last Edited By: Geoff Lay
 Date: 1/11/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

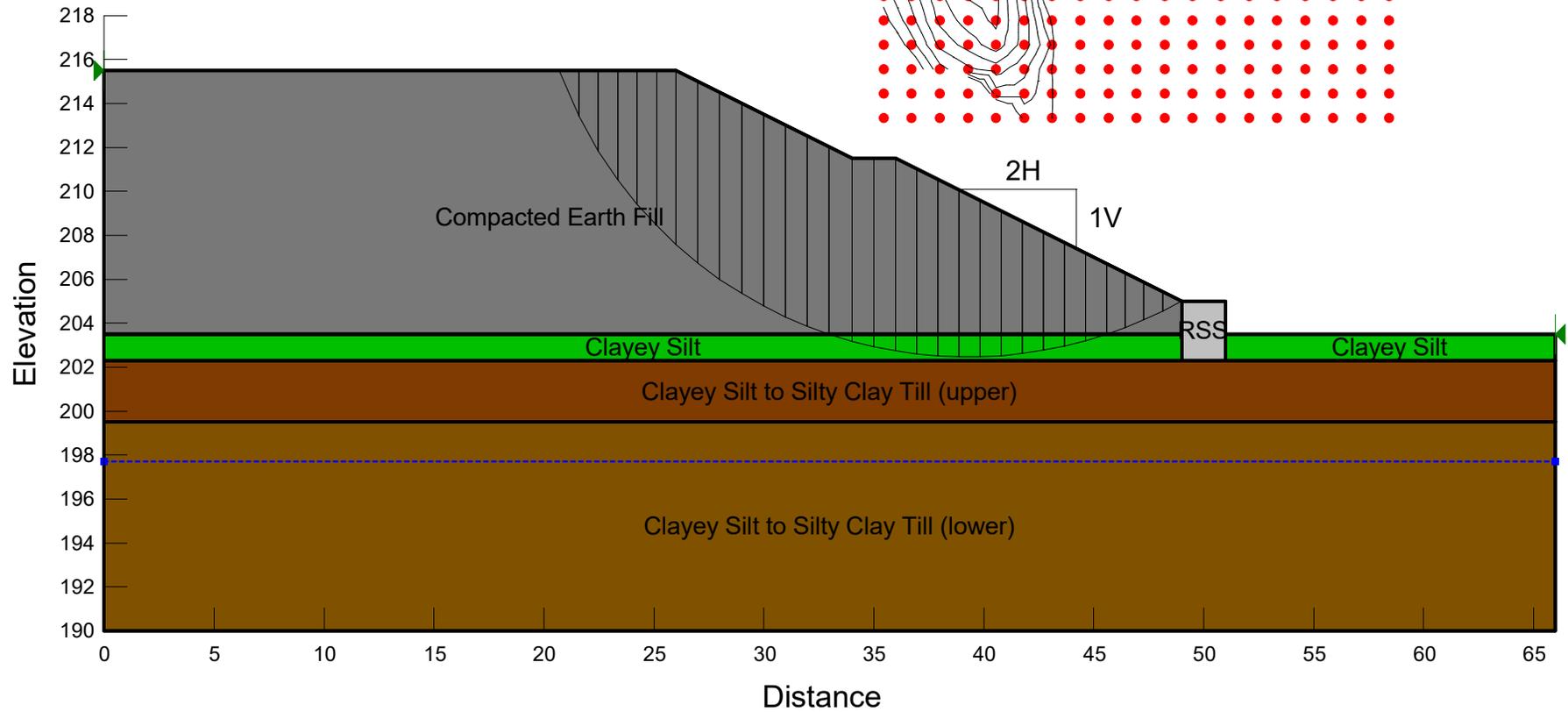
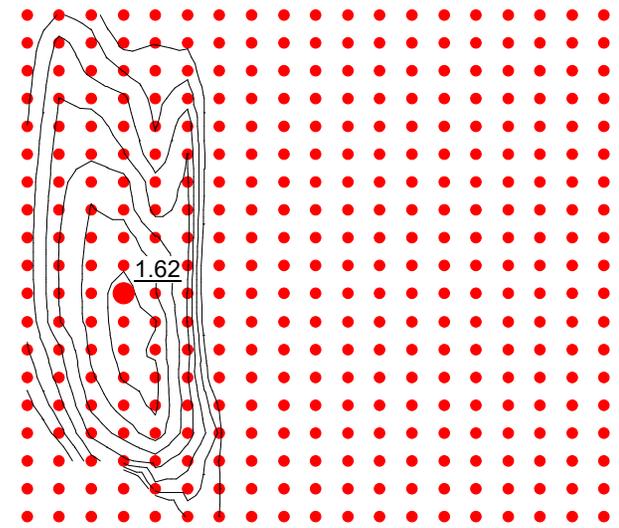
Retaining Wall	24 kN/m ³	1,000 kPa	0 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Compact Gravelly Sand Fill	18 kN/m ³	0 kPa	30 °
Stiff Clayey Silt to Silty Clay Till	20 kN/m ³	5 kPa	29 °
V. Stiff Clayey Silt to Silty Clay Till (Upper)	21 kN/m ³	5 kPa	32 °
V. Stiff Clayey Silt to Silty Clay Till (Lower)	20.5 kN/m ³	5 kPa	30 °



**CRITICAL SECTION (STA. 10+170)
RW12 - MAJOR MACKENZIE S-E RAMP
SHORT-TERM CONDITION**

File Name: RW12 Sta 10+170 (Short Term).gsz
 Last Edited By: Geoff Lay
 Date: 10/19/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

Compacted Earth Fill	20 kN/m ³	0 kPa	30 °
Clayey Silt	18 kN/m ³	50 kPa	0 °
Clayey Silt to Silty Clay Till (upper)	21 kN/m ³	100 kPa	0 °
Clayey Silt to Silty Clay Till (lower)	20 kN/m ³	75 kPa	0 °
RSS	22 kN/m ³	200 kPa	34 °



**CRITICAL SECTION (STA. 10+170)
RW12 - MAJOR MACKENZIE S-E RAMP
LONG-TERM CONDITION**

File Name: RW12 Sta 10+170 (Long Term).gsz
 Last Edited By: Geoff Lay
 Date: 10/19/2018
 Method: Morgenstern-Price
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

Compacted Earth Fill	20 kN/m ³	0 kPa	30 °
Clayey Silt	18 kN/m ³	5 kPa	30 °
Clayey Silt to Silty Clay Till (upper)	21 kN/m ³	0 kPa	32 °
Clayey Silt to Silty Clay Till (lower)	20 kN/m ³	0 kPa	31 °
RSS	22 kN/m ³	200 kPa	34 °

