THURBER ENGINEERING LTD.

PRELIMINARY
GEOTECHNICAL/PAVEMENT INVESTIGATION REPORT
CLARK AVENUE EXTENSION
RUTHERFORD ROAD TO KENNEDY ROAD
CITY OF BRAMPTON

Report

to

HDR

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the results of a preliminary geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) in support of the Municipal Class Environmental Assessment (EA) Study for Clark Boulevard Extension and Eastern Avenue improvements. The limits of the project site are from Rutherford Road to Kennedy Road for a total length of approximately 900 m (the Site).

The purpose of this investigation was to explore the subsurface conditions within the project limits and based on the data obtained, to provide borehole logs, borehole location plans, and written descriptions of the subsurface conditions. Preliminary geotechnical recommendations for the road extension, road widening, pavement design, pipe bedding, excavations and backfill, management of excess soils, and foundation design for the proposed bridge are also provided.

A preliminary hydrogeological investigation was completed concurrently with the preliminary geotechnical investigation, the results of which are reported under separate cover and should be read in conjunction with this report.

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. SITE DESCRIPTION

The existing alignment of Eastern Avenue from Kennedy Road to Hansen Avenue is an east-west arterial road under the jurisdiction of the City of Brampton (the City) and consists of a 2-lane rural cross-section with a posted speed limit of 50 km/hr. Eastern Avenue is currently classified as a minor arterial road with an ultimate right-of-way of 26 to 30 meters. Representative pictures of the site typical conditions are included in Appendix F.

The existing Clark Boulevard, east of Rutherford Road is an east-west arterial road under the jurisdiction of the City and consists of a 4-lane urban cross-section with a posted speed limit of 50 km/hr. The proposed extension of Clark Boulevard is located at the westerly limit of Clark Boulevard and would extend to Hansen Road. This extension of Clark Boulevard would be classified as a minor arterial road with an ultimate right-of-way of 26 to 30 meters.

The Clark Boulevard extension would require a crossing of a minor tributary of Etobicoke Creek. The tributary is proposed to be re-aligned in order to allow for a more perpendicular crossing of the road and the tributary. The crossing would be located approximate 125 m west of Rutherford

Road South where the creek flows in an easterly direction and would intercept the proposed alignment at an acute angle.

The area of the proposed extension of Clark Boulevard east of the creek is currently occupied by a vacant parcel of industrial property owned by the City of Brampton at 25 Rutherford Road South. West of the creek the area of the extension is occupied by 35 Rutherford Road South, which currently contains a manufacturing plant for pre-fabricated concrete products.

The area surrounding the project corridor mainly contains industrial properties along both sides of Eastern Avenue and the proposed Clark Boulevard extension.

The study area is located within the Peel Plain physiographic region. The geology generally comprises of fine textured glaciolacustrine deposits of silt and clay overlying clay to silt textured till derived from glaciolacustrine deposits or shale. The overburden soils are underlain by shale and limestone bedrock of the Georgian Bay formation.

3. INVESTIGATION PROCEDURES

The borehole investigation field program was carried out between August 16 and September 23, 2021 and consisted of drilling and sampling a total of twenty five (25) boreholes. A summary of the drilled boreholes details and locations is provided in the table below.

Table 3.1 – Borehole Details

Structure	Approximate Location	Borehole No.	Approx. Ground Elevation (m)	Borehole Termination Depth (m)	Approx. Borehole Termination Elevation (m)
Clark Boulevard Extension Creek Crossing	West Side of Creek – 35 Rutherford Road	BR-01	215.7	8.8 (refusal to augering)	206.9
		BR-02	215.4	8.4 (refusal to augering)	207.0
	East Side of Creek – 25 Rutherford Road	BR-03	215.2	8.7 (refusal to augering)	206.5
		BR-04	215.7	9.4 (refusal to augering)	206.2
Clark Boulevard Extension	35 Rutherford Road	CE-01	217.8	3.7	214.1
		CE-02	217.1	3.7	213.4
		CE-03	216.0	3.2	212.8

Structure	Approximate Location	Borehole No.	Approx. Ground Elevation (m)	Borehole Termination Depth (m)	Approx. Borehole Termination Elevation (m)
	25 Rutherford Road	CE-04	215.9	3.7	212.3
	Rutherford Road	RR-01	215.7	2.1	213.6
		RR-02	215.3	2.1	213.2
Eastern Avenue	Eastern Avenue	EA-02	223.1	2.1	221.0
		EA-03	222.9	2.9	220.0
		EA-04	222.8	2.9	219.9
		EA-05	222.4	6.7	215.7
		EA-06	222.1	2.1	220.0
		EA-07	221.5	2.9	218.6
		EA-08	220.0	1.8	218.2
		EA-09	220.7	2.1	218.5
		EA-10	220.4	2.1	218.2
		EA-11	219.6	2.9	216.7
		EA-12	218.3	1.8	216.5
		EA-13	218.9	2.1	216.8
		EA-014	218.1	4.1	214.0
		EA-15	217.7	2.1	215.5
	Hansen Road	EA-16	217.6	2.1	215.5

The approximate locations of the completed boreholes are shown on the Borehole Location Drawings 30427-1 and 30427-2 in Appendix C.

The borehole locations were established in the field by Thurber relative to existing site features and using a handheld GPS receiver. The ground surface elevations at the borehole locations for were interpreted using topographic survey data provided by HDR

All borehole locations were cleared of utilities prior to commencement of drilling. The boreholes were repositioned as necessary in consideration of surface features, underground utilities, and restricted site access.

Boreholes BR-01 to BR-04, CE-01 to CE-04, RR-01, RR-02, EA-15 and EA16 were advanced using solid and hollow stem augers powered by a truck-mounted Mobile B60 drill rig. The remaining boreholes were drilled with a TMG STR 174 Drill Rig. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

The field investigation was supervised on a full-time basis by a member of Thurber's technical staff who directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions were observed in the open boreholes throughout the drilling operations. Monitoring wells were installed in selected boreholes to permit monitoring of the groundwater levels at the site. The monitoring wells consisted of 50 mm diameter PVC pipe with a slotted screen sealed at a selected depth within the borehole. The installation details are summarized in Table 3.2 below.

Table 3.2 – Monitoring Well Details

Borehole No.	Monitoring Well Tip		Slotted Screen Length (m)
	Depth (m)	Elevation (m)	
BR-03	8.5	206.3	1.5 m
BR-04	9.0	206.7	1.5 m
EA-05	6.1	216.3	1.5 m
EA-14	3.8	214.3	1.5 m

The boreholes in which no monitoring wells were installed were backfilled in general accordance with Ontario Regulation 903.

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture

content determination. Selected samples were also subjected to grain size distribution analyses (hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

To determine the proper disposal methods of the soil cuttings produced during the drilling operations and to provide a preliminary review of requirements for management and/or disposal of soil excavated during construction, soil samples recovered from the boreholes were submitted to SGS Laboratories for analyses of selected parameters outlined in Ontario Regulation 153/04 (O.Reg. 153/04). It should be noted that assessment of site conditions with respect to the requirements of O.Reg. 406/19, as amended, the "Excess Soils" regulation, was not with the scope of this project. The sample locations and material types are summarized in Table 4.1.

Table 4.1 – Samples Selected for Environmental Testing

Borehole	Sample No.	Depth (m)	Soil Type	Analysis
BR-01	SS2	0.8 – 1.4	Silty Clay	Metals & Inorganics
BR-01	SS4	2.3 – 2.9	Silt	Soil Corrosivity
BR-03	SS3	1.5 – 2.1	Silt Sand	Metals & Inorganics
BR-04	SS3	1.5 – 2.1	Clayey Silt	Metals & Inorganics (TCLP)
BR-04	SS5	3.1 – 3.7	Silty Sand	Soil Corrosivity

The results of the analyses are provided on the Certificates of Analysis in Appendix D.

5. SURFACE CONDITIONS (EASTERN AVENUE)

Eastern Avenue is currently a two-lane rural cross section. The existing travel lanes comprise a flexible pavement, with unpaved gravel shoulders.

5.1 Surface Drainage

Drainage of surface water along the existing corridor is managed through open ditches on both sides of the roadway. The ditches direct drainage towards the east and Hansen Road where it is directed into the Etobicoke Creek tributary located approximately 85 m north of Eastern Avenue. The tributaries of Etobicoke Creek represent the major drainage features in the area and flow southerly into Lake Ontario.

5.2 Eastern Avenue Existing Pavement Condition

The current condition of the pavement surface on Eastern Avenue is considered **Good**, with predominant pavement distresses consisting of few, low severity longitudinal wheel path cracking; few, low severity longitudinal joint cracking; and few, low severity transverse cracking.

6. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A and on the Borehole Location drawings in Appendix C. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions will vary between and beyond borehole locations.

6.1 Creek Crossing Area (Boreholes BR-01 to BR-04)

Boreholes BR-01 to BR-04 were drilled in the proposed general location for the Clark Boulevard creek crossing. Borehole BR-01 and BR-02 were drilled on the west side of the creek and Boreholes BR-03 and BR-04 were drilled on the east side of the creek.

The subsurface stratigraphy encountered in these boreholes generally consisted of mixed fill which was generally underlain by native sands and silts soils and sand and silt tills, over shale bedrock in two of the boreholes. Further descriptions of the individual strata are presented below.

6.1.1 Topsoil

Topsoil was encountered at the surface in borehole BR-03 and was approximately 75 mm thick.

6.1.2 Fill Materials

Silty sand with some gravel, to sand and gravel fill, was encountered at the surface in Boreholes BR-01 to BR-04. The cohesionless fill extended to depths of between 0.7 m and 1.5 m (Elevations 215.0 m to 213.7 m).

Silty clay fill, containing trace to some sand and trace to some gravel was encountered in Boreholes BR-01 and BR-02 beneath the cohesionless fill. The silty clay fill was approximately 1.5 m to 1.6 m thick and extended to depths of 2.2 m and 2.3 m (Elevations 213.5 m and 213.1 m) in Boreholes BR-01 and BR-02, respectively.

SPT ‘N’ values within the silty sand to sandy gravel fill ranged from 19 to 35 blows per 0.3 m of penetration, indicating a compact to dense condition. Moisture contents between 6 and 17 percent were measured in the cohesionless fill.

SPT ‘N’ values within the silty clay fill ranged from 6 to 10 blows per 0.3 m penetration, indicating a firm to stiff consistency. Moisture contents between 12 and 19 percent were measured in the silty clay fill.

The results of a grain size distribution analysis carried out on a selected sample of the silty sand fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	15
Sand	56
Silt	23
Clay	6

The results of a grain size distribution analysis carried out on a selected sample of the silty clay fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	20
Silt	49
Clay	31

6.1.3 Clayey Silt

Clayey silt, with sand and some organics was encountered in Boreholes BR-04 beneath the silt sand fill at a depth of 0.8 m (Elevation 214.9 m). The clayey silt was approximately 1.4 m thick and extended to a depth of 2.2 m (Elevation 213.5 m).

SPT ‘N’ values in the clayey silt ranged from 6 to 9 blows per 0.3 m penetration, indicating a firm to stiff consistency. Moisture contents between 18 and 21 percent were measured in the clayey silt.

The results of a grain size distribution analysis carried out on a selected sample of the clayey silt is presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	4
Sand	28
Silt	48
Clay	20

6.1.4 Silt

Silt, containing some sand, trace clay and trace gravel was encountered in Borehole BR-01 at a depth of 2.2 m (Elevation 213.5 m). The silt layer was approximately 1.9 m thick and extended to a depth of 4.1 m (Elevation 211.6 m).

SPT 'N' values in the silt ranged from 20 to 28 blows per 0.3 m penetration, indicating a compact condition. Moisture contents between 14 and 19 percent were measured in the silt.

The results of a grain size distribution analysis carried out on a selected sample of the silt is presented on the Record of Borehole sheets included in Appendix A and on Figure B6 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	1
Sand	19
Silt	72
Clay	8

6.1.5 Sand and Gravel to Silty Sand

Sand and gravel to silty sand with some gravel, and containing occasional cobbles, was encountered in Boreholes BR-02 to BR-04 at depths of between 1.5 m to 2.3 m (Elevations 213.7 m to 213.1 m). The sand and gravel to silty sand layers were approximately 0.7 m to 4.0 m thick and extended to depths of between 3.0 m and 5.4 m (Elevations 212.4 m and 209.7 m).

SPT 'N' values in the sand and gravel to silty sand ranged from 15 blows per 0.3 m penetration to 50 blows per 0.1 m penetration, indicating a compact to very dense condition. Moisture contents between 8 and 13 percent were measured in the sand and gravel to silty sand.

The results of grain size distribution analyses carried out on selected samples of the silty sand are presented on the Record of Borehole sheets included in Appendix A and on Figure B7 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	16 to 19
Sand	44 to 50
Silt	33
Clay	1 to 4

6.1.6 Low Plasticity Till

Sandy silt to sand and silt till, containing trace to some clay, trace to some gravel, and occasional shale fragments was encountered in boreholes BR-01 to BR-04 at depths of between 3.0 m to 5.5 m (Elevation 212.4 m to 209.7 m). The till layers were approximately 2.7 m to 5.0 m thick and extended to depths of between 8.2 m to 8.4 m (Elevations 207.5 m to 207.0 m).

SPT 'N' values of the till ranged from 30 blows per 0.3 m penetration to 100 blows per 0.175 m, indicating a dense to very dense condition. Moisture contents between 5 and 19 percent were measured in the till.

The results of grain size distribution analyses and Atterberg Limits testing carried out on selected samples of the till are presented on the Record of Borehole sheets included in Appendix A and on Figures B8 and B10 of Appendix B. The results of the grain distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	6 to 14
Sand	20 to 46
Silt	37 to 53
Clay	4 to 13

The results of the Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	18
Liquid Limit	31
Plasticity Index	13

The results of the Atterberg Limits indicate the layer to be of low plasticity with group symbol CL.

6.1.7 Sand and Gravel (Lower)

A lower layer of sand and gravel, containing some cobbles, was encountered below the silt till at a depth of 8.2 m (Elevation 207.5 m) in Borehole BR-01. The sand and gravel layer was approximately 0.6 m thick and extended the shale bedrock below at a depth of 8.8 m (Elevation 206.9 m).

An SPT 'N' value of 100 blows per 0.1 m penetration was recorded in the sand and gravel layer indicating a very dense condition. A moisture content of 5 percent was measured in the sand and gravel layer.

6.1.8 Shale Bedrock

Grey shale bedrock, of the Georgian Bay formation, was encountered at depths of between 8.2 m and 8.8 m (Elevations 207.5 m and 206.9 m) in Boreholes BR-01 to BR-04. The boreholes were terminated in the bedrock upon auger refusal at depths of between 8.4 m and 9.4 m (Elevations 207.0 m and 206.2 m).

Shale of the Georgian Bay formation in this region is typically highly weathered in the upper 1 m to 4 m.

6.1.9 Groundwater Conditions

Groundwater conditions were observed in the open boreholes throughout the drilling operations. Monitoring wells were installed in Boreholes BR-03 and BR-04 to permit monitoring of the groundwater levels at the site. A summary of the groundwater observations is provided in the table below.

Table 6.1 – Measured Groundwater Levels – Clark Boulevard Extension

Borehole	Date	Measured Water Level		Notes
		Depth (mbgs)	Elevation (masl)	
BR-01	August 19, 2021	Dry	-	Open Borehole
BR-02	August 19, 2021	8.38	206.98	Open Borehole
BR-03	October 27, 2021	1.91	213.27	Monitoring Well
	November 4, 2021	2.49	212.70	
	November 23, 2021	1.52	213.66	
BR-04	October 27, 2021	2.24	213.43	Monitoring Well
	November 4, 2021	2.93	212.74	
	November 23, 2021	2.13	213.54	

Notes: mgbs – meters below ground surface
masl – meters above sea level

Measured ground water levels in stabilized monitoring wells within the area of the proposed creek crossing during this investigation ranged between 212.7 m and 213.7 m. The groundwater level in this area should be assumed to reflect the creek water level.

Groundwater levels are short-term observations and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be higher elevation during spring and after periods of significant prolonged precipitation.

6.2 Clark Boulevard Extension Alignment (Boreholes CE-01 to CE-04)

Boreholes CE-01 to CE-04 were drilled along the proposed Clark Boulevard extension alignment within the properties at 25 Rutherford Road and 35 Rutherford Road.

The subsurface stratigraphy encountered in these boreholes generally consisted of mixed fill overlying native silty clay to clayey silt, which was further underlain by silt and sand tills. Further descriptions of the individual strata are presented below.

6.2.1 Topsoil

Topsoil was encountered at the surface in borehole CE-04 and was approximately 100 mm thick.

6.2.2 Fill Materials

Sandy gravel to silty sand with some gravel was encountered at the surface in Boreholes CE-01 to CE-04. The cohesionless fill extended to depths of between 0.7 m and 1.0 m (Elevations 217.1 m to 215.0 m).

Silty clay fill, containing some sand and trace gravel was encountered in Borehole CE-01 beneath the cohesionless fill at a depth of 0.7 m (Elevation 217.1 m). The silty clay fill was approximately 0.8 m thick and extended to a depth of 1.5 m (Elevations 216.2 m).

SPT ‘N’ values within the sandy gravel to silty sand fill ranged from 20 blows per 0.3 m of penetration to 87 blows per 0.275 m of penetration, indicating a compact to very dense condition. Moisture contents between 3 and 11 percent were measured in the cohesionless fill.

An SPT ‘N’ value recorded within the silty clay fill was 11 blows per 0.3 m penetration, indicating a stiff consistency. A moisture content of 16 percent was measured in the silty clay fill.

The results of a grain size distribution analysis carried out on a selected sample of the silty clay fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	16
Silt	50
Clay	34

6.2.3 Silty Clay to Clayey Silt

Silty clay to clayey silt with sand to some sand and trace gravel was encountered in Boreholes CE-01 to CE-04 beneath the fill at depths of between 0.7 m and 1.5 m (Elevations 216.4 m and 215.0 m). Where fully penetrated, the silty clay to clayey silt was approximately 1.5 m thick and

extended to depths of between 2.2 m to 3.0 m (Elevations 214.8 m and 213.0 m). Boreholes CE-02 was terminated within the clayey silt at a depth of 3.7 m (Elevation 213.4 m).

SPT 'N' values in the silty clay to clayey silt ranged from 5 to 43 blows per 0.3 m penetration, indicating a firm to hard consistency. Moisture contents between 10 and 34 percent were measured in the clayey silt to silty clay, with typical values between 10 and 19 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay to clayey silt are presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 5
Sand	17 to 31
Silt	42 to 53
Clay	22 to 30

6.2.4 Sandy Silt Till

Sandy silt till, containing some gravel, trace clay and occasional cobbles and boulders was encountered in Boreholes CE-01 and CE-03 at depths of between 2.2 m and 3.0 m (Elevations 214.8 m and 213.8 m). Boreholes CE-01 and CE-03 were terminated within the till layer at depths of 3.7 m and 3.2 m (Elevations 214.1 m and 212.8 m), respectively.

SPT 'N' values within the sandy silt till ranged from 34 blows per 0.3 m penetration to 50 blows per 0.15 m penetration, indicating a dense to very dense condition. Moisture contents between 5 and 10 percent were measured in the till.

The results of a grain size distribution analysis carried out on a selected sample of the sandy silt till is presented on the Record of Borehole sheets included in Appendix A and on Figure B8 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	19
Sand	39
Silt	34
Clay	8

6.2.5 Gravelly Sand

Gravelly sand was encountered in Borehole CE-04 at a depth of 3.0 m (Elevation 213.0 m). Boreholes CE-04 was terminated within the gravelly sand at a depth of 3.7 m (Elevation 212.3 m).

An SPT 'N' value measured in the gravelly sand was 3 blows per 0.3 m penetration, indicating a very loose condition. A moisture content of 22 percent was measured in the gravelly sand.

6.3 Rutherford Road and Clark Boulevard Intersection (Boreholes RR-01 and RR-02)

Boreholes RR-01 and RR-02 were drilled at the east end of the Clark Boulevard extension within the paved travelled lanes of Rutherford Road at the intersection with the existing Clark Boulevard.

The subsurface stratigraphy encountered in these boreholes consisted of a pavement structure underlain by silty clay fill and native clayey silt. Further descriptions of the individual strata are presented below.

6.3.1 Pavement Structure

The existing pavement structure encountered within the Boreholes RR-01 and RR-02 consisted of 250 mm to 300 mm of asphalt over 390 mm to 510 mm of granular base. The granular base consisted of gravelly sand to sandy gravel with some recycled asphalt fragments.

6.3.2 Silty Clay Fill

Silty clay fill, containing some sand and some gravel was encountered beneath the pavement structure in Borehole RR-02 at a depth of 0.7 m (Elevation 214.7 m). The silty clay fill was approximately 0.8 m thick and extended to a depth of 1.5 m (Elevation 213.8 m).

An SPT 'N' value measured in the silty clay fill was 9 blows per 0.3 m penetration, indicating a stiff consistency. A moisture content of 11 percent was measured in the silty clay fill.

6.3.3 Clayey Silt

Clayey silt, with sand to some sand and trace gravel was encountered beneath the pavement structure or fill at depths of 0.8 m and 1.5 m (Elevations 214.9 m and 213.8 m). Boreholes RR-01 and RR-02 were terminated within the clayey silt layer at depths of 2.1 m (Elevations 213.6 m and 213.2 m, respectively).

SPT 'N' values in the clayey silt ranged from 12 to 15 blows per 0.3 m penetration indicating a

stiff consistency. Moisture contents of 13 to 14 percent were measured in the clayey silt.

The results of grain size distribution analyses carried out on selected samples of the clayey silt are presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	1 to 2
Sand	23 to 27
Silt	44 to 49
Clay	26 to 28

6.4 Eastern Avenue (Boreholes EA-02 to EA-16)

Boreholes EA-02 through EA-16 were drilled along Eastern Avenue between Kennedy Road and Hansen Road. The boreholes were located within the paved travelled lanes of Eastern Avenue as well as the gravel shoulders and ditches.

The subsurface stratigraphy encountered in these boreholes generally consisted of a pavement structure or topsoil overlying silty clay to clayey silt fill or native clayey silt which was further underlain by silty sand till. Further descriptions of the individual strata are presented below.

6.4.1 Pavement Structure

The existing pavement structure encountered in the boreholes on Eastern Avenue generally consisted of 160 mm to 300 mm of asphalt overlying 440 mm to 790 mm of granular base. The granular road base generally consisted of gravelly sand to sand and gravel, with trace to some silt.

In the Boreholes drilled through the unpaved shoulders of Eastern Avenue, the granular road base was encountered at the surface and was approximately 0.7 m thick.

The results of grain size distribution analyses carried out on selected samples of the sand and gravel to gravelly sand road base are presented on the Record of Borehole sheets included in Appendix A and on Figure B8 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	28 to 35
Sand	50 to 62
Silt & Clay	3 to 22

6.4.2 Topsoil

Topsoil was encountered in Boreholes EA-08 and EA-12 which were advanced through the ditches of Eastern Avenue. The topsoil was approximately 50 mm and 25 mm thick in Boreholes EA-08 and EA-12, respectively.

6.4.3 Sand to Silty Sand Fill

Sand to silty sand fill, containing trace to some gravel, some silt, and trace to some clay was encountered below the topsoil in Boreholes EA-08 and EA-12. Where fully penetrated in Borehole EA-12 sand fill was approximately 0.5 m thick and extended to a depth of 0.6 m (Elevation 217.7 m). Boreholes EA-08 was terminated within the silty sand fill at a depth of 1.8 m (Elevation 218.2 m).

Clayey silt fill, containing trace to some sand and trace gravel, was encountered in Boreholes EA-03, EA-04, and EA-11 beneath the granular road base. The clayey silt fill was approximately 0.8 m thick and extended to depths of approximately 1.5 m (Elevations 221.4 m to 218.9 m).

SPT ‘N’ values recorded in the sand to silty sand fill ranged between 1 and 6 blows for 0.3 m penetration, indicating a very loose to loose condition. Moisture contents of 7 to 13 were recorded in the fill.

SPT ‘N’ values in the clayey silt till ranged from 5 to 18 blows per 0.3 m penetration, indicating a firm to very stiff consistency. Moisture contents of 12 to 16 percent were measured in the clayey silt fill.

The results of grain size distribution analyses carried out on selected samples of the sand to silty sand fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	5 to 16
Sand	48 to 66
Silt	16 to 30
Clay	2 to 17

The results of a grain size distribution analysis carried out on a selected sample of the clayey silt fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	19
Silt	53
Clay	28

6.4.4 Silty Clay to Clayey Silt

Silty clay to clayey silt, containing sand to trace sand and trace gravel, was encountered in all boreholes, except for Borehole EA-08, beneath the pavement structure or fill. Where fully penetrated the silty clay to clayey silt ranged in thickness of between 0.6 m to 1.2 m and extended to depths of between 1.2 m and 1.5 m (Elevations 219.2 m and 215.9 m). Boreholes EA-02 to EA-07, EA-10, EA-13, EA-15 and EA 16 were terminated within the clayey silt to silty clay at depths between 2.1 m to 6.7 m.

SPT ‘N’ values in the silty clay to clayey silt ranged from 7 to 53 blows per 0.3 m penetration, indicating a firm to hard consistency. Moisture contents of 7 to 21 percent were recorded in the silty clay to clayey silt.

The results of grain size distribution analyses and Atterberg Limits testing carried out on selected samples of the silty clay to clayey silt are presented on the Record of Borehole sheets included in Appendix A and on Figures B3, B4, B5 and B11 of Appendix B. The results of the grain distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 6
Sand	8 to 31
Silt	45 to 51
Clay	20 to 41

The results of the Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	13
Liquid Limit	28
Plasticity Index	15

The results of the Atterberg Limits indicate the layer to be of low plasticity with group symbol CL.

6.4.5 Silty Sand to Sandy Silt Till

Silty Sand to sandy silt till, containing some gravel to gravelly, and trace to some clay, was encountered in Boreholes EA-09, EA-11, EA-12, and EA-14 at depths of between 1.2 m and 2.2 m (Elevations 219.2 m and 215.9 m). The boreholes were terminated within the silty sand to sandy silt till at depths of between 1.8 m and 4.1 m (Elevations 218.5 m and 214.0 m).

SPT ‘N’ values in the till ranged from 17 to 75 blows per 0.3 m penetration, indicating a compact to very dense condition. Moisture contents of 10 to 14 percent were measured in the till.

The results of grain size distribution analyses carried out on selected samples of the silty sand t sandy silt till are presented on the Record of Borehole sheets included in Appendix A and on Figure B8 of Appendix B. The results of the grain size distribution analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	19 to 23
Sand	39 to 43
Silt	24 to 29
Clay	10 to 13

6.4.6 Groundwater Conditions

Groundwater conditions were observed in the open boreholes throughout the drilling operations. All the boreholes along Eastern Avenue remained open and dry upon completion of drilling with the exception of Borehole EA-07 where a water level at a depth of 0.8 m was recorded upon completion. The water level in EA-07 upon completion reflected the water level that was observed in the adjacent ditch to EA-07 at the time of drilling. Monitoring wells were installed in Boreholes EA-05 and EA-14 to permit monitoring of the groundwater levels along Eastern Avenue. A summary of the groundwater observations as recorded in the monitoring wells is provided below.

Table 6.2 – Measured Groundwater Levels – Eastern Avenue

Borehole	Date	Measured Water Level		Notes
		Depth (mbgs)	Elevation (masl)	
EA-05	November 4, 2021	1.09	221.33	Monitoring Well
	November 23, 2021	1.21	221.21	Monitoring Well
EA-14	November 23, 2021	0.54	217.54	Monitoring Well

Notes: mgbs – meters below ground surface
masl – meters above sea level

Measured ground water levels in stabilized monitoring wells along Eastern Avenue during this investigation ranged between 221.3 m to 217.5 m.

Groundwater levels are short-term observations and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be higher elevation during spring and after periods of significant prolonged precipitation.

7. Limited Chemical Analysis

In general, visual and olfactory examination of the soil samples recovered from the field investigation program revealed no unusual staining or odours indicative of hydrocarbon impact or other contamination.

The analytical results were compared to Full Depth Generic Site Condition Standards in a for residential/parkland/institutional/industrial/commercial/community use property, as presented in the Ontario Ministry of Environment Conservation and Parks (MECP) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (MECP Table 1 Standards). The concentrations of all parameters measured in the samples were reported to be below MECP Table 1 Standards, with the exception of Electrical Conductivity and Sodium Absorption Ratio (SAR) in two samples. A summary of samples where exceedances were detected is provided below.

Table 7.1 – Summary of Test Exceedances

Sample	Soil Type	Guideline	Analysis	Parameter	Guide Value	Result
BR-01 SS 2	Silty Clay Fill	Table 1	O. Reg. 153 Metals & Inorganics	Conductivity	0.57	0.961
BR-01 SS 2	Silty Clay Fill	Table 1	O. Reg. 153 Metals & Inorganics	SAR	2.4	4.50
BR-03 SS 3	Silty Sand	Table 1	O. Reg. 153 Metals & Inorganics	Conductivity	0.57	0.769
BR-03 SS 3	Silty Sand	Table 1	O. Reg. 153 Metals & Inorganics	SAR	2.4	4.50

Note: Results compared to MECP Table 1 Standards ("Full Depth Generic Site Condition Standards Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use)

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

8. GENERAL

This section of the report provides interpretation of the geotechnical and pavement data and presents comments and preliminary recommendations for design and construction of the proposed road widening of Eastern Avenue, road construction of the Clark Boulevard extension, and the creek crossing to be installed as part of the Clark Boulevard Extension.

The recommendations are based on the subsurface soil and groundwater conditions encountered during the investigation. The soil conditions may vary between and beyond the borehole locations, and accordingly geotechnical inspection during construction is important to assess any variation of subsurface conditions and to provide additional recommendations if necessitated by such variations.

The interpretation and recommendations are intended for the use of the design consultant and the City of Brampton and shall not be relied upon by any other parties including the construction contractor, or used for any purposes other than development of the project design. Comments on construction methodology and equipment, where presented, are provided only to highlight those aspects that could affect the design of the project. Contractors must make their own assessment of the factual information presented in previous sections of the report, and the implications on equipment selection, construction methodology, and scheduling.

9. PAVEMENT DESIGN ANALYSIS

9.1 Traffic Analysis

Traffic information for this project was provided by HDR and included the existing Annual Average Daily Traffic (AADT) volumes for Eastern Avenue between Kennedy Road and Hansen Road and the 2041 projected AADT volumes for Eastern Avenue and the Clark Boulevard Extension from Rutherford Road to Hansen Avenue. It is assumed that the provided AADT includes two-way traffic volumes. A summary of the provided traffic information is provided in Table 9.1.

Table 9.1 – Traffic Volumes

Road Segment	YEAR	AADT	Percent Trucks	Medium Truck Split	Heavy Truck Split
Eastern Avenue – Kennedy Road to Hansen Road	Existing	1,000	9.1%	89%	11%
	2041	14,000	1.3%	69%	31%
Clark Boulevard – Hansen Road to Rutherford Road	2041	11,000	2.8%	69%	31%

Using the provided traffic information, with the assumptions identified below, the 20-year Design ESALs were estimated to be 1.1 million and 3.3 million for Clark Boulevard and Eastern Avenue, respectively.

To calculate the ESALs, a traffic volume growth rate of 2 percent per year was assumed to back calculate the AADT values for the initial year of road use after construction of the Clark Boulevard Extension. A design lane distribution factor of 90 percent was also assumed.

9.2 Pavement Structural Requirements

A pavement designs analysis was carried out for the road widening of Eastern Avenue and new road construction of Clark Boulevard using the methodology outlined in the 1993 AASHTO “Guide for the Design of Pavement Structures: as modified by the MTO’s “Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions”, and the MTO “Pavement Design and Rehabilitation Manual” and is provided in Appendix E The analysis was completed to determine the structural requirements for the pavement for this project.

In consideration of the typically stiff to very stiff clayey silt to clayey silt subgrade, a Soil Resilient Modulus of 20 MPa was assumed for design purposes. The table below presents the general input parameters used in the analysis.

AASHTO Input Parameters

Road Segment	Eastern Avenue	Clark Boulevard
Design ESAL	642,167	1,115,406
Reliability (%)	90	90
Standard Deviation	0.44	0.44
Design Serviceability Loss	4.2-2.0 = 2.2	4.2-2.0 = 2.2
Soil Resilient Modulus	30 MPa	30 MPa

Results of the analysis indicated that a Design Structural Number (SNDes) of 97 mm and 105 mm is required to support the estimated future traffic volumes of Eastern Avenue and Clark Boulevard, respectively.

As presented in Appendix E, the minimum pavement design for Eastern Avenue should consist of 105 mm of new hot mix asphalt, and 400 mm of granular Base/Subbase. The minimum pavement design for Clark Boulevard should consist of 120 mm of new hot mix asphalt, and 450 mm of Base/Subbase. Both designs were based on the use of Granular 'B' Type II Subbase material.

9.3 City of Brampton Design Requirements

The results of the AASHTO pavement design analysis were compared to the City of Brampton Road Design Standards for Arterial Roads (Drawing No. 205 - Arterial Road 15.0 m Pavement on 36.0 m R.O.W.) which is provided in the Table below. The City of Brampton design standard exceeds the new pavement design developed for pavement widening areas and thus should be used for new pavement areas.

City of Brampton Arterial Road – 15 m Pavement of 36 m R.O.W.

Material	Thickness
HL3 HS Asphalt	40 mm
HL8 Asphalt	85 mm
Granular 'A'	150 mm
Granular 'B' Type II	450 mm

9.4 Recommended Pavement Design

Based on the design input parameters and the calculated design ESALs, the City of Brampton minimum thickness design is considered appropriate for the Eastern Avenue road widening and Clark Boulevard Extension, with a minimum Granular Sub-Base thickness of 525 mm.

All Hot Mix Asphalt (HMA) materials should meet the requirements of OPSS 310, OPSS 1150 and City of Brampton Specifications, and be compacted to at least 92 percent for HL1 material,

and 91 percent for HDBC, of the MRD. An asphalt cement binder grade of PG 64-28 is required for all asphalt mixes. A tack coat shall be utilized between all asphalt lifts, all vertical faces, and at all tie-ins to existing locations. Recycled Asphalt Pavement (RAP) material should not be used in either asphalt mix. Aggregates for the asphalt mixes should be in accordance with OPSS.MUNI 1003.

Should the City opt for Superpave asphalt mixes on this project, the 20-year design ESALs for Eastern Avenue and Clark Boulevard was estimated to be 642,167 and 1,115,406, respectively, thus a Traffic Category B designation should be used in preparing all Superpave asphalt mix designs.

All new granular subbase material should consist of OPSS Granular B Type II, while the granular base material should consist of OPSS Granular A. All new granular material should meet the requirements of OPSS.MUNI 1010,and be compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of Optimum Moisture Content (OMC). All granular material should be compacted in accordance with the requirements of OPSS.MUNI 501.

Smooth transitions are required in all areas where the new pavement meets the existing asphalt surface at the limits of the project. All longitudinal and transverse joints should meet the requirements of OPSS 310. All longitudinal joints should be staggered between the asphalt lifts, accomplished by offsetting the paving edge and the upper asphalt course by a minimum of 150 mm. At all transverse tie-ins to existing pavements, the top lift of asphalt should extend a minimum of 5 m in length beyond the transverse joint in the upper binder lift. Tie-ins between new and existing granular material should be carried out over a distance of at least 10 m to minimize the potential for differential frost action along the road.

9.5 Subgrade Preparation

In any pavement widening areas, any surficial topsoil should be stripped to expose the underlying soils. The underlying subgrade soils should be removed and graded as required to accommodate the new pavement platform. The exposed top of subgrade should be graded to a 3 percent crossfall toward the subdrains installed at the outer pavement edge.

The subgrade shall be compacted to a minimum of 95 percent of Standard Proctor Maximum Dry Density (SPMDD), within 2 percent of optimum moisture content (OMC). The exposed subgrade should be compacted and proof-rolled with a heavy roller and examined to identify areas of unstable subgrade. Any soft/wet areas identified should be sub-excavated and replaced with approved material.

Standard side slopes of 2H:1V or flatter should be suitable for embankment construction. For erosion control and maintenance activities, provision of a 2 m wide mid-height bench is recommended for fill slopes greater than 8 m in height. Exposed embankment surfaces should be provided with a vegetation cover or otherwise protected against erosion in accordance with OPSS 804.

9.6 Pavement Drainage

Proper drainage of the pavement structure must be provided by way of curb and gutter and use of subdrains to ensure optimal pavement performance. Pavement design thicknesses in widening areas are based on the pavement structure thicknesses recorded in the boreholes. It is cautioned that actual existing pavement thicknesses may fluctuate between borehole locations. The actual thickness of the new granular subbase layer may need to be increased during construction to ensure that the total thickness of the pavement in the widening area match, or exceed, the thickness of the existing pavement.

10. CREEK CROSSING STRUCTURE

It is understood that the construction of the Clark Boulevard extension will require a new structure, either a bridge or culvert, to allow for Clark Boulevard to pass over a tributary of Etobicoke Creek. Specific details about the proposed structure are yet to be determined however general foundation and construction recommendations have been provided below.

10.1 Bridge/Culvert Spread Footing Foundations

The depth/elevation of any proposed spread footings for support of bridge abutments or culvert structure are unknown as of the writing of this report, however, are expected to be at approximately the depth of frost penetration (1.3 m) below the downstream stream invert. Topographical survey data provided to Thurber by HDR, indicates the creek channel bottom is at approximately 212.8 m within the area of the proposed Clark Boulevard extension. Based on borehole logs and anticipated footing depths of shallow foundation options would be expected to be founded on native dense to very dense silty sand to sandy silt till.

It is anticipated that shallow spread footing foundations will be the preferred foundation option for the proposed structure due to the relatively dense till soils encountered at expected footing levels. Should higher bearing capacities be required to support the proposed structure, deep foundation options, including piles driven to bedrock, could be considered. However due to the presence of cobbles and boulders within the till soils, advancement of piles or caissons could prove difficult and have thus not been explored further in this report.

The values of factored geotechnical resistance at the Ultimate Limit State (ULS) and factored geotechnical resistance at Serviceability Limit State (SLS) for bridge abutment or culvert spread footings placed on dense to very dense silty sand to sandy silt till or very dense silt at the design founding levels for footing widths between 0.8 m and 1.5 m and are summarized in Table 10.2. below.

Table 10.2 – Recommended Geotechnical Resistances

Structure	Anticipated Founding Elevation	Soils	Factored ULS	Factored SLS
Etobicoke Creek Tributary Crossing	Below 211.4 m	Dense to Very Dense Silty Sand to Sandy Silt Till	450 kPa	300 kPa

The factored geotechnical resistance at SLS is provided for the settlement not exceeding 25 mm.

The factored Geotechnical Resistance at ULS was assessed assuming a Consequence Factor of 1.0 (Typical), and a Resistance Factor of 0.5 (Typical degree of understanding), as per CHBDC 2019. The factored Geotechnical Resistance at SLS was assessed assuming a factor of 0.8 for typical degree of understanding of the subsurface conditions.

The geotechnical resistance quoted above is for concentric, vertical loads only. In the case of eccentric or inclined loading, the geotechnical resistance should be calculated as indicated in the CHBDC (2019) Clause 6.10.3 and Clause 6.10.4.

All footing excavations must be inspected by qualified geotechnical personnel prior to placing concrete to confirm that the soil conditions exposed at the founding level are consistent with the design assumptions and that the base has been adequately cleaned of disturbed material. The footing bases should be kept free of water and a 75 mm skim slab provided over the founding surface if structural concrete cannot be placed within 24 hours of excavation.

The ULS resistance and settlement are dependent on the footing/culvert size, configuration and applied loads. Accordingly, the geotechnical resistances should be reviewed by Thurber as the design advances.

The footings should be sized to resist the structural loads as well as external loadings, including lateral earth pressure, weight of embankment fill, traffic loadings and surcharge due to construction equipment and activities.

10.2 Sliding Resistance

Resistance to lateral forces/sliding between cast-in-place concrete footings and the underlying sandy silt to silty sand till should be evaluated assuming an unfactored ultimate coefficient of friction of 0.40.

10.3 Frost Protection

For frost protection purposes, a minimum earth cover of 1.3 m or its thermal equivalent should be provided for all foundations.

10.4 Backfilling

Backfill to any proposed structures should consist of free-draining, non-frost susceptible granular materials such as Granular A or B Type II conforming to the requirements of OPSS.MUNI 1010 and as per OPSD 803.010 or 3101.150, as applicable.

Structural backfill should be placed in maximum 200 mm loose lifts and compacted to 98% of the material's Standard Proctor Maximum Dry Density (SPMDD). In order to achieve the desired density, the backfill material should have a moisture content within 2% of the Optimum Moisture Content (OMC).

All fills should be placed and compacted in accordance with OPSS.MUNI 501. The backfill should be maintained equal on both sides of the culvert walls, with one side not exceeding the other by more than 500 mm. Heavy compaction equipment should not be used adjacent to the walls and roof of the culvert. Compaction equipment to be used adjacent to retaining structures/culvert walls should be restricted in accordance with OPSS.MUNI 501.

10.5 Lateral Earth Pressure

Lateral earth pressures acting on the sub-surface walls may be assumed to impose a triangularly distributed load. For a fully drained backfill, the pressures should be computed in accordance with the CHBDC, but are generally given by the expression:

$$p = K(\gamma H + q)$$

where p = lateral earth pressure acting at depth H, kPa

K = earth pressure coefficient

γ = unit weight of retained soil or backfill, kN/m^3

H = depth below top of wall where pressure is computed, m

q = surcharge pressure including traffic loads, kPa

Table 10.3 lists the unfactored parameters recommended for design, assuming an essentially level ground surface behind and in front of the walls:

Table 10.3 – Earth Pressure Parameters

Parameter	Retained Material	
	OPSS Granular A or Granular B Type II	OPSS Granular B Type I
Unit Weight, kN/m^3	22.8	21.2
Friction Angle, degrees	35	32
Active Pressure Coefficient, K_a	0.27	0.31
At-Rest Pressure Coefficient, K_0	0.43	0.47
Passive Pressure Coefficient, K_p	3.7	3.3

If lateral movement is not permissible and/or the wall is restrained from lateral yielding, the at-rest earth pressure coefficient, K_o, should be used. If the wall design allows lateral yielding (non-rigid structure), the active earth pressure coefficient, K_a, may be used.

If the design includes a sloping ground surface behind or in front of the wall, the earth pressure parameters will require modification. Thurber should be contacted to provide appropriate earth pressure coefficients for a sloping ground situation.

The earth pressure coefficients in the table above do not include potential compaction effects that must be included in the design. Compaction effects should be considered as per the CHBDC.

Design of the structures must incorporate measures such as weepholes to permit drainage of the backfill and avoid potential build-up of hydrostatic pressures behind the walls.

10.6 Seismic Considerations

Based on the encountered subsurface conditions at the creek crossing site, Site Class C can be assumed to evaluate the seismic site response, as per Table 4.1, Clause 4.4.3.2 of the CHBDC 2019.

Based on the National Building Code of Canada (NBCC 2015), the peak horizontal ground acceleration (PGA), corresponding to a design earthquake having a 2 percent probability of being exceeded in 50 years (i.e. 2,475 year return period) is 0.106 g at the site.

Given the low seismic ground motions and the presence of typically dense to very dense cohesionless soil, the potential for liquefaction is considered negligible at the crossing site.

10.7 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 and above the water table at these sites may be classed as Type 3 soils for the firm to very stiff cohesive fill, compact to dense sand and gravel fill, compact silt, and native firm to stiff clayey silt. The dense to very dense sandy silt to silty sand till, may be classified as Type 2 soils.

The excavation and backfilling for culverts should be carried out in accordance with OPSS 902.

Slopes of temporarily unsupported cuts should conform with the requirements of OHSA. Flatter slopes may be required at locations where water seepage or sloughing occurs during excavation. Where space restrictions preclude excavation of inclined slopes, temporary shoring should be employed.

Temporary shoring, if required, should be designed by a licensed Professional Engineer experienced in design of shoring systems. The design of all members in the shoring system should include the effects of surcharge loads such as those imposed by adjacent utilities and construction equipment. Soil should not be stockpiled adjacent to the excavation.

Use of a hydraulic excavator should be suitable for foundation excavation in the overburden soils. The selection of the method of excavation is the responsibility of the contractor and must be based on their equipment, experience and interpretation of the site conditions. Provision must be made for the handling of pavement materials, potential obstructions in the fill, and possible cobbles, boulders and rock slabs in the till.

Groundwater level measurements in the monitoring wells at the creek crossing ranged between 212.7 m and 213.7 m. Installation of the foundations should be carried out in the dry. If the excavations for spread footings are expected to extend below the groundwater level or creek water level, then seepage should also be anticipated from the native sandy tills and overlying fill soils. In this case, the water level must be depressed below the base of the excavation to permit construction in the dry and to facilitate compaction of the bedding and backfill materials. Temporary stream diversion measures such as impervious dykes should be provided to divert surface water runoff and stream flow away from the excavations at all times during construction.

The culvert or footing installation should be carried out in the dry. Effective dewatering operations rely on the Contractor's experience, construction techniques, sequencing, and work force efficiency.

A preliminary hydrogeological investigation to provide recommendations for groundwater control during construction and determine the need for EASR registration or PTTW application was completed concurrently with the geotechnical investigation. A report documenting these findings will be issued under separate cover.

10.8 Erosion and Scour Protection

The bridge abutment or culvert footings must be protected from scour by stream flow considering high water levels and potential changes in stream alignment. Design of the erosion protection measures should consider hydrologic and hydraulic factors and should be carried out by specialists experienced in this field.

Typically, rock protection should be provided over all slope surfaces where creek water is likely to be in contact. A vegetation cover should be established on all other exposed earth surfaces to protect against surficial erosion in general accordance with OPSS.MUNI 804.

11. MUNICIPAL SERVICE INSTALLATION

11.1 Trench Excavation

Trench excavation for municipal service installation is expected to extend through existing fill, and into native silty sand sandy silt till and silty clay/clayey silt deposits. All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario and local regulations. For the purposes of the OHSA, the soils within the likely depth of excavation and above the water table at these sites may be classed as Type 3 soils for the firm to very stiff cohesive fill, compact to dense sand and gravel fill, compact silt, and native firm to

stiff clayey silt. The dense to very dense sandy silt to silty sand till, may be classified as Type 2 soils.

Slopes of temporarily unsupported cuts should conform with the requirements of OHSA. Flatter slopes may be required at locations where water seepage or sloughing occurs during excavation. Where space restrictions preclude excavation of inclined slopes, service installation may be carried out using a braced excavation. If the trench depth exceeds 6 m, the support system must be designed specifically for this project.

The design of all members in the shoring system should include the effects of surcharge loads such as those imposed by adjacent utilities, construction equipment and traffic. Soil should not be stockpiled within a horizontal distance from the trench wall equal to the depth of the trench. If this cannot be avoided, the soil surcharge must be incorporated into the shoring design.

Use of a hydraulic excavator should be suitable for trench excavation in the overburden soils. Provision should be made for handling of potential obstacles in the existing embankment fill as well as cobbles and boulders in the till soils during excavation.

Groundwater was measured in the monitoring wells between Elevations 221.3 m to 217.5 m. For shallow trench excavations within the silty clay to clayey silt soils, dewatering using sumps and pumps may be feasible, however, deeper trench excavations and excavations into the sandy till or sand soils may require a dewatering plan utilizing pumping from wells and well points.

A preliminary hydrogeological investigation to provide recommendations for groundwater control during construction and determine the need for EASR registration or PTTW application was completed concurrently with the geotechnical investigation. A report documenting these findings will be issued under separate cover.

11.2 Pipe Bedding and Backfill

Prior to placement of the pipe bedding, the base of the sewer trenches should be maintained in a dry condition, free of loose, disturbed material. The pipe must be placed on a uniformly competent subgrade. Pipe bedding materials, compaction and cover should follow OPSD 802.030 to 803.034, and/or City of Brampton specifications.

In areas where a less competent subgrade is encountered, it may be necessary to increase the bedding thickness. Any excessively soft, loose or compressible materials at the pipe subgrade should be subexcavated and replaced with OPS Granular A material compacted to at least 95% of Standard Proctor maximum dry density (SPMDD).

Trench backfill materials should be placed in loose lift thicknesses not exceeding 200 mm. Where trenches are located beneath the roadway, OPSS Granular A or B material compacted to 100% SPMDD, 19 mm or 50 mm crusher run limestone, or unshrinkable fill should be used as backfill. For trenches located outside of the roadway, the portion of the trench above the pipe cover can be backfilled with unfrozen excavated native soil provided it is free of organics, debris and other deleterious materials. The native silty clay to clayey silt and silty sand to sandy silt till material encountered across the site should be suitable for reuse as trench backfill on a selective basis, provided handling of the material results in a moisture content suitable for placement.

Approved soil backfill should be compacted to at least 98% of its SPMMD at a placement moisture content within about 2% of the optimum moisture content for efficient compaction. The till must be adequately broken down and compacted in the trench.

12. MANAGEMENT OF EXCESS EXCAVATED SOILS

The current sampling and testing program was completed primarily to allow for proper disposal of the soil cuttings generated during the drilling investigation and to obtain a limited insight of the environmental quality of project-related excavated materials in relation to regulatory requirements that were applicable at the time of the investigation. The spatial and vertical extent of impacted materials that may be encountered during construction was not fully delineated, and therefore, the current results should not be used as a basis to estimate quantities for tendering purposes.

EC and/or SAR values exceeding MECP Table 1 Standards were measured in two soil samples recovered from the boreholes. The EC and SAR values likely result from de-icing salt applied to the roadway for safety purposes. Currently, salt-related impacts are exempt where salt has been applied on a “highway” by a government or municipal authority, and the applicable site conditions standard is deemed not to be exceeded under Section 49 (1) of O. Reg. 153/04, as amended. Therefore the excavated materials may be managed by reuse in engineering applications on site (i.e. site grading fill or backfill), subject to the geotechnical considerations presented in Section 10.4 and 11.2 and The material should not be used within 1.5 m of the soil surface in landscaped areas with sensitive vegetation and plant species and may be subject to the restrictions outlined in MECP’s Rules for Excess Soil Management under O. Reg. 406/19 (e.g. more than 30 m from a water body, more than 100 m from a potable or supply well, etc).

Considering that the salt-associated parameter exceedances are non-health related, the soils may also be suitable for reuse at other sites require fill for a beneficial use, contingent on meeting all requirements of O.Reg. 406/19, as amended.

No statement made herein should be construed as relieving the Contractor's responsibility to comply with all applicable federal and provincial regulations, municipal by-laws and guidelines related to the handling or disposal/discharge of excavated materials and/ or extracted groundwater. It should be noted that the current regulatory requirements that were considered in this report are subject to change over time.

13. CONSTRUCTION INSPECTION AND TESTING

The successful performance of the pavement, roadwork, and culvert/bridge installation will depend largely on good workmanship and quality control during construction. It is therefore recommended that materials testing and inspection by qualified personnel be provided during construction. The inspection and testing should include observation and inspection of asphalt paving and sampling, concrete testing, subgrade inspection as well as onsite recommendation and coordination.

Thurber should be retained to review the preliminary pavement recommendations during detailed design and have an opportunity to review the construction tender package for the proposed works to ensure that the recommendations in this report have been adequately interpreted.

14. CLOSURE

We trust that this report provides the information you require at this time. If you have any questions regarding this report, please contact the undersigned at your earliest convenience.

Yours truly,

Thurber Engineering Ltd.

Cory Zanatta, P.Eng.
Geotechnical Engineer

Renato Pasqualoni, P.Eng.
Principal, Review Engineer

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

THURBER

Appendix A

Record of Borehole Sheets

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

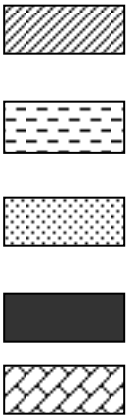
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
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.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

THURBER

RECORD OF BOREHOLE BR-01

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 19, 2021
COMPLETED : August 19, 2021
N 4 839 136.9 E 601 441.3

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 40 80 120 160) / WATER CONTENT, PERCENT (wp w wl 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		215.71							
	Hollow Stem Augers	**GRAVEL**, sandy, some silt, compact, brown, moist: (FILL)		0.00	1	SS	29				
				215.02							
1		**CLAY**, silty, some sand, trace gravel, firm, brown, moist: (FILL)		0.69	2	SS	6	Grain Size Analysis: Gr 0%/ Sa 20%/ Si 49%/ Cl 31%			
2					3	SS	8				
				213.50							
		SILT, some sand, trace clay, trace gravel, compact, brown, moist		2.21	4	SS	20				
3					5	SS	28	Grain Size Analysis: Gr 1%/ Sa 19%/ Si 72%/ Cl 8%			
4				211.59							
		SILT, some sand to sandy, trace clay, trace gravel, very dense, brown, moist: (TILL)		4.11	6	SS	85/ 0.250				
5											
6					7	SS	70/ 0.275				
7											
					8	SS	50/ 0.125				
8				207.49							
		SAND and **GRAVEL**, some cobbles, very dense, grey, moist		8.22							
				206.89	9	SS	100/ 0.100				
9		END OF BOREHOLE AT 8.81m UPON AUGER REFUSAL ON ASSUMED BEDROCK. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND GROUT TO SURFACE.		8.81							

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE BR-02

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 19, 2021
COMPLETED : August 19, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 839 147.3 E 601 491.1

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		215.36				
	Hollow Stem Augers	**SAND**, silty, some gravel, trace clay, dense, brown, moist: (FILL)		0.00	1	SS	35	Grain Size Analysis: Gr 15%/Sa 56%/Si 23%/ Cl 6%
				214.67				
1		**CLAY**, silty, trace to some sand, trace to some gravel, firm to stiff, dark grey to brown, moist: (FILL)		0.69	2	SS	8	
2					3	SS	10	
		SAND, gravelly, some cobbles, compact, brown, moist		213.07 2.29	4	SS	21	
3		**SAND** and **SILT**, trace clay, some gravel, some cobbles and boulders, very dense, brown, moist: (TILL)		212.39 2.97	5	SS	56	Grain Size Analysis: Gr 13%/Sa 46%/Si 37%/ Cl 4%
4								
					6	SS	50/0.150	
5								
6					7	SS	50/0.150	
7								
					8	SS	50/0.100	
8		**CLAY**, silty, some gravel, highly weathered shale, hard, grey, moist: (TILL)		207.38 7.97				
		END OF BOREHOLE AT 8.38m UPON AUGER REFUSAL ON BEDROCK. WATER LEVEL AT 7.62m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND GROUT TO SURFACE.		206.98 8.38	9	SS	50/0.150	
9								

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 7.62m

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
August 19, 2021

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE BR-03

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 16, 2021
COMPLETED : August 16, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 839 171.2 E 601 470.4

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		215.18				
		TOPSOIL: (75mm)		0.08				
		SAND and **GRAVEL**, compact to dense, brown, moist: (FILL)			1	SS	19	
					2	SS	32	
				213.71				
	Hollow Stem Augers	**SAND**, silty, some gravel, trace clay, compact to very dense, brown, moist		1.47	3	SS	15	Grain Size Analysis: Gr 16%/Sa 50%/Si 33%/ Cl 1%
					4	SS	54	
					5	SS	50/ 0.100	
				211.32				
		SAND and **GRAVEL**, some silt, very dense, grey, moist		3.86	6	SS	93/ 0.225	
				209.73				
	Tricone	**SILT**, sandy, some clay, trace gravel, very dense, grey, wet: (TILL)		5.45	7	SS	80/ 0.250	
		Highly weathered shale fragments			8	SS	90/ 0.300	Grain Size Analysis: Gr 6%/ Sa 33%/Si 50%/ Cl 11%
				206.95				
		SHALE, hard, grey, moist: (Georgian Bay Formation)		8.23				
				206.51	9	SS	50/ 0.125	
		END OF BOREHOLE AT 8.66m. UPON AUGER REFUSAL ON ASSUMED BEDROCK WATER LEVEL UNKNOWN UPON COMPLETION OF DRILLING. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		8.66				

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite
Filter Sand
Slotted Screen

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE BR-04

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 16, 2021
COMPLETED : August 18, 2021

Project No. 30427
SHEET 1 OF 2
DATUM Geodetic

N 4 839 183.1 E 601 523.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		215.67							
		SAND, silty, some gravel, some brick fragments, compact, brown, moist: (FILL)		0.00	1	SS	30				
				214.91							
1	Hollow Stem Augers	**SILT**, clayey, with sand, some organics, firm to stiff, brown, wet		0.76	2	SS	9	Grain Size Analysis: Gr 4%/ Sa 28%/ Si 48%/ Cl 20%			
					3	SS	6				
2				213.46							
		SAND, silty, some gravel, trace clay, dense, brown, moist		2.21	4	SS	48				
3											
					5	SS	42	Grain Size Analysis: Gr 19%/Sa 44%/ Si 33%/ Cl 4%			Bentonite
4				211.55							
		SILT, sandy, some clay, some gravel, some shale fragments, dense to very dense, grey, moist: (TILL)		4.11							
					6	SS	30				
5											
6	Tricone				7	SS	80/ 0.300	Grain Size Analysis: Gr 14%/Sa 20%/ Si 53%/ Cl 13%			
											Filter Sand
7											
					8	SS	100/ 0.175				
8											
		SHALE, hard, grey, moist: (Georgian Bay Formation)		207.51 8.15							Slotted Screen
9											
					9	SS	94/ 0.225				
		END OF BOREHOLE AT 9.37m. ON AUGER REFUSAL IN BEDROCK WATER LEVEL UNKNOWN UPON COMPLETION OF DRILLING.		206.29 9.37							

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE BR-04

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 16, 2021
COMPLETED : August 18, 2021
N 4 839 183.1 E 601 523.0

Project No. 30427
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.									
11											
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE CE-01

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 20, 2021
COMPLETED : August 20, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 838 981.8 E 601 303.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		217.77				
	Hollow Stem Augers	**GRAVEL,** sandy, very dense, grey, moist: (FILL)		0.00	1	SS	87/ 0.275	
		CLAY, silty, some sand, trace gravel, stiff, grey, moist: (FILL)		217.08 0.69	2	SS	11	Grain Size Analysis: Gr 0%/ Sa 16%/ Si 50%/ Cl 34%
1		**CLAY**, silty, trace sand, trace gravel, very stiff to hard, brown, moist		216.24 1.52	3	SS	17	
2					4	SS	43	
3		**SILT**, sandy, some gravel, trace clay, some boulders, dense, grey, moist: (TILL)		214.80 2.97	5	SS	50	
		END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		214.11 3.66				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE CE-02

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 20, 2021
COMPLETED : August 20, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 839 025.4 E 601 327.9

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		217.06				
	Hollow Stem Augers	**GRAVEL**, sandy, compact, brown, moist: (FILL)		0.00	1	SS	22	
				216.37				
1		**SILT**, clayey, with sand, trace gravel, hard, brown, moist		0.69	2	SS	23	Grain Size Analysis: Gr 5%/ Sa 31%/ Si 42%/ Cl 22%
2					3	SS	21	
					4	SS	13	
3					5	SS	35	
				213.40				
4		END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		3.66				
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✤ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE CE-03

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 20, 2021
COMPLETED : August 20, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 839 092.3 E 601 410.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		216.03				
	Hollow Stem Augers	**GRAVEL**, sandy, very dense, brown, moist: (FILL)		0.00	1	SS	60	
				215.34				
1		**SILT**, clayey, trace to some sand, trace to some gravel, stiff, brown, moist		0.69	2	SS	9	
2					3	SS	8	
				213.83				
		SILT, sandy, some gravel, trace clay, dense to very dense, brown, moist: (TILL)		2.20	4	SS	34	Grain Size Analysis: Gr 19%/Sa 39%/ Si 34%/ Cl 8%
		300mm dia. boulders at 2.74m						
3		Very dense		212.83	5	SS	50/ 0.150	
		END OF BOREHOLE AT 3.20m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		3.20				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE CE-04

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 16, 2021
COMPLETED : August 16, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 839 225.4 E 601 557.7

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		215.94				
		TOPSOIL: (100mm)		0.10				
		SAND, silty, some gravel, some topsoil, compact to loose, brown, moist: (FILL)			1	SS	20	
1	Hollow Stem Augers	**SILT**, clayey, some sand, trace gravel, firm, grey, wet		214.95 0.99	2	SS	5	
2					3	SS	5	Grain Size Analysis: Gr 0%/ Sa 17%/ Si 53%/ Cl 30%
					4	SS	6	
3		**SAND**, gravelly, very loose, brown, wet		212.97 2.97	5	SS	3	
		END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		212.28 3.66				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-02

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021
N 4 838 664.0 E 600 971.2

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		223.14				
		ASPHALT: (160mm)		0.00				
		SAND, gravelly, some silt, brown, moist: (GRANULAR BASE)		0.16	1	GS		
	Hollow Stem Augers	**SILT**, clayey, some sand, trace gravel, very stiff, brown, moist		222.45 0.69	2	SS	15	Grain Size Analysis: Gr 1%/ Sa 20%/ Si 51%/ Cl 28%
					3	SS	21	
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS, THEN ASPHALT TO SURFACE.		221.00 2.13				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-03

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 838 683.6 E 601 002.3

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		222.89				
	Hollow Stem Augers	**SAND**, gravelly, some silt, brown, moist: (FILL)		0.00	1	GS		
				222.20				
1		**SILT**, clayey, trace sand, trace gravel, very stiff, brown, moist: (FILL)		0.69	2	SS	18	
				221.44				
		SILT, clayey, some sand, trace gravel, very stiff to hard, brown, moist		1.45	3	SS	19	Grain Size Analysis: Gr 6%/ Sa 21%/ Si 47%/ Cl 26%
2					4	SS	53	
				219.99				
3		END OF BOREHOLE AT 2.90m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		2.90				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-04

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 838 703.8 E 601 005.6

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		222.82				
	Hollow Stem Augers	**SAND**, some silt and gravel, brown, moist: (FILL)		0.00	1	GS		
				222.13				
1		**SILT**, clayey, some sand, trace gravel, firm, brown, moist: (FILL)		0.69	2	SS	7	Grain Size Analysis: Gr 0%/ Sa 19%/ Si 53%/ Cl 28%
				221.37				
2		**SILT**, clayey, some sand, trace gravel, firm to very stiff, brown, moist		1.45	3	SS	8	
					4	SS	16	
				219.92				
3		END OF BOREHOLE AT 2.90m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		2.90				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-05

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 23, 2021
COMPLETED : September 23, 2021
N 4 838 728.6 E 601 043.1

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤ rem V - ● Q - ✖ Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp w wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		222.42							
		ASPHALT: (225mm)		0.00							
		SAND, gravelly, trace silt, brown to grey, moist: (GRANULAR BASE)		0.23	1	GS		Grain Size Analysis: Gr 35%/Sa 62%/ Si & Cl 3%			
				221.71	2	SS	27				
		SILT, clayey, some sand, trace gravel, hard to very stiff, brown, wet:		0.71	3	SS	41				
1											
					4	SS	26				
2											Bentonite
					5	SS	34				
3	Hollow Stem Augers										
					6	SS	15				
4											Filter Sand
		Firm			7	SS	7	Grain Size Analysis: Gr 2%/ Sa 22%/ Si 47%/ Cl 29%			
5											Slotted Screen
		Very stiff			8	SS	24				
6											
					9	SS	29				
				215.71							
7		END OF BOREHOLE AT 6.71m. BOREHOLE OPEN AND DRY UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		6.71							
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-06

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021
N 4 838 750.9 E 601 054.9

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		222.09							
		ASPHALT: (160mm)		0.00							
		SAND, gravelly, some silt, brown, moist: (GRANULAR BASE)		0.16	1	GS			○		
				221.33							
1		**CLAY**, silty, trace sand and gravel, very stiff to hard, brown, moist:		0.76	2	SS	17	Grain Size Analysis: Gr 0%/ Sa 8%/ Si 51%/ Cl 41%	○		
2					3	SS	34		○		
				219.95							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-07

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021
N 4 838 768.1 E 601 086.7

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		221.49				
	Hollow Stem Augers	**SAND**, gravelly, some silt, brown, moist: (FILL)		0.00	1	GS		
				220.80				
1		**CLAY**, silty, trace sand and gravel, firm to stiff, brown, moist: (FILL)		0.69	2	SS	6	
2					3	SS	10	
				219.28				
		CLAY, silty, trace sand and gravel, very stiff, brown, moist		2.21	4	SS	15	Grain Size Analysis: Gr 4%/ Sa 31%/ Si 45%/ Cl 20%
3				218.59				
		END OF BOREHOLE AT 2.90m. BOREHOLE OPEN AND WATER LEVEL AT 0.82m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		2.90				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
September 15, 2021

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-08

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 23, 2021
COMPLETED : September 23, 2021
N 4 838 792.4 E 601 090.0

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		220.02				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
0	Continuous Split Spoon	**TOPSOIL:** (50mm)		0.05							
		SAND, silty, some clay, trace gravel, very loose to loose, brown, moist: (FILL)			1	SS	2		○		
1					2	SS	6		○		
					3	SS	2	Grain Size Analysis: Gr 5%/ Sa 48%/ Si 30%/ Cl 17%	○		
				218.19					○		
2		END OF BOREHOLE AT 1.83m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		1.83							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-09

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021
N 4 838 814.3 E 601 129.3

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		220.67							
	Hollow Stem Augers	**ASPHALT:** (250mm)		0.00							
		SAND, gravelly, some silt, brown, moist: (GRANULAR BASE)		0.25	1	GS		Grain Size Analysis: Gr 28%/Sa 50%/ Si 17%/ Cl 5%	○		
				219.98							
1		**SILT**, clayey, some sand, trace gravel, stiff, brown, moist		0.69	2	SS	10		○		
				219.22							
		SAND, silty, compact, brown, moist		1.45	3	SS	17		○		
2				218.53							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-10

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 15, 2021
COMPLETED : September 15, 2021
N 4 838 834.2 E 601 142.4

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		220.35				
		ASPHALT: (175mm)		0.00				
		SAND, gravelly, some silt, brown, moist: (GRANULAR BASE)		0.18	1	GS		
	Hollow Stem Augers	**SILT**, clayey, some sand, trace gravel, stiff, brown, moist		219.66 0.69	2	SS	8	Grain Size Analysis: Gr 2%/ Sa 23%/ Si 47%/ Cl 28%
					3	SS	10	
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		218.21 2.13				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-11

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 16, 2021
COMPLETED : September 16, 2021

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

N 4 838 856.4 E 601 175.1

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		219.64							
	Solid Stem Augers	**SAND**, gravelly, some silt, brown, moist: (FILL)		0.00	1	GS			○		
				218.95							
1		**SILT**, clayey, some sand, trace gravel, firm, brown, moist: (FILL)		0.69	2	SS	5		○		
				218.19							
		SILT, clayey, trace sand and gravel, hard, brown, moist		1.45	3	SS	39		○		
2				217.43							
		SILT, sandy, some clay, some gravel, compact, brown, moist: (TILL)		2.21	4	SS	28	Grain Size Analysis: Gr 19%/Sa 39%/ Si 29%/ Cl 13%	○		
				216.74							
3		END OF BOREHOLE AT 2.90m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		2.90							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AF
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-12

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 23, 2021
COMPLETED : September 23, 2021
N 4 838 882.4 E 601 179.4

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		218.34							
		TOPSOIL: (25mm)		0.08							
	Continuous Sampling	**SAND**, some gravel, some silt, very loose, brown, moist: (FILL)		217.73	1	SS	1	Grain Size Analysis: Gr 16%/Sa 66%/ Si 16%/ Cl 2%	○		
1		**SILT**, clayey, some sand, trace gravel, stiff, brown, moist		0.61 217.12	2	SS	11				
		SAND, silty, some gravel, trace clay, compact, brown, moist (Till)		1.22 216.51	3	SS	23				
2		END OF BOREHOLE AT 1.83m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		1.83							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-13

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 23, 2021
COMPLETED : September 23, 2021
N 4 838 902.1 E 601 217.7

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		218.90							
	Hollow Stem Augers	**ASPHALT:** (250mm)		0.00							
		SAND and **GRAVEL**, trace silt, brown, moist: (GRANULAR BASE)		0.25	1	GS		Grain Size Analysis: Gr 30%/Sa 52%/ Si & Cl 18%	○		
				218.14	2	SS	19				
1		**CLAY**, silty, some sand, trace gravel, very stiff to hard, brown, moist		0.76	3	SS	19		○		
2				216.76	4	SS	43				
		END OF BOREHOLE AT 2.13m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-14

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : September 23, 2021
COMPLETED : September 23, 2021
N 4 838 934.0 E 601 240.8

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		218.08				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
		ASPHALT: (200mm)		0.00							
		SAND and **GRAVEL**, trace silt, compact, brown, moist: (GRANULAR BASE)		0.20	1	GS					
					2	SS	14				Bentonite
1	Hollow Stem Augers	**CLAY**, silty, some sand, trace gravel, trace oxidation, very stiff, mottled brown/grey, moist		217.09 0.99	3	SS	16				
					4	SS	15				Filter Sand
2		**SAND**, silty, gravelly, trace clay, very dense, brown, wet: (TILL)		215.87 2.21	5	SS	69	Grain Size Analysis: Gr 23%/Sa 43%/ Si 24%/ Cl 10%			
3					6	SS	75				Slotted Screen
4				213.96	7	SS	57/ 0.150				
		END OF BOREHOLE AT 4.11m UPON AUGER REFUSAL ON PROBABLE BEDROCK. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		4.11							
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-15

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 18, 2021
COMPLETED : August 18, 2021
N 4 838 947.9 E 601 261.6

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		217.65							
	Hollow Stem Augers	**ASPHALT:** (250mm)		0.00							
		SAND, gravelly, loose, grey, moist: (GRANULAR BASE)		0.25	1	SS	9				
				216.96							
		SILT, clayey, some sand, trace gravel, stiff, brown, moist		0.69							
1					2	SS	14	Grain Size Analysis: Gr 5%/ Sa 26%/ Si 46%/ Cl 23%			
					3	SS	21				
2				215.51							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS THEN ASPHALT TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE EA-16

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 18, 2021
COMPLETED : August 18, 2021
N 4 838 980.7 E 601 271.4

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		217.64							
		ASPHALT: (275mm)		0.00							
		SAND, gravelly, compact, brown, moist: (GRANULAR BASE)		217.36 0.28	1	SS	20		○		
		SILT, clayey, with sand, trace gravel, stiff, brown, moist		216.95 0.69	2	SS	12	Grain Size Analysis: Gr 2%/ Sa 30%/ Si 45%/ Cl 23%	○		
1	Hollow Stem Augers										
					3	SS	9		○		
2				215.50							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS THEN ASPHALT TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE RR-01

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 18, 2021
COMPLETED : August 18, 2021
N 4 839 278.1 E 601 576.7

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		215.69				
	Hollow Stem Augers	**ASPHALT:** (250mm)		0.00				
		GRAVEL, sandy, some asphalt, very dense, brown, moist: (GRANULAR BASE)		0.25	1	SS	50	
				214.93				
1		**SILT**, clayey, some sand, trace gravel, stuff, brown, moist		0.76	2	SS	13	Grain Size Analysis: Gr 2%/ Sa 23%/ Si 49%/ Cl 26%
2					3	SS	15	
				213.55				
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.		2.13				
3								
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

RECORD OF BOREHOLE RR-02

PROJECT : Clark Boulevard Extension
LOCATION : Brampton, ON
STARTED : August 18, 2021
COMPLETED : August 18, 2021
N 4 839 239.6 E 601 618.2

Project No. 30427
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		215.34				
	Hollow Stem Augers	**ASPHALT:** (300mm)		0.00				
		SAND, gravelly, some asphalt fragments, dense, brown, moist: (GRANULAR BASE)		215.03 0.30	1	SS	47	
		CLAY, silty, some sand, some gravel, stiff, grey, moist: (FILL)		214.65 0.69	2	SS	9	
1		**SILT**, clayey, with sand, trace gravel, stiff, greyish brown, moist		213.81 1.52	3	SS	12	Grain Size Analysis: Gr 1%/ Sa 27%/ Si 44%/ Cl 28%
2		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS, THEN ASPHALT TO SURFACE.		213.20 2.13				
3								
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : OA
CHECKED : CZ

THURBER

THURBER2S TEL-30427.GPJ 11/8/21

THURBER

Appendix B

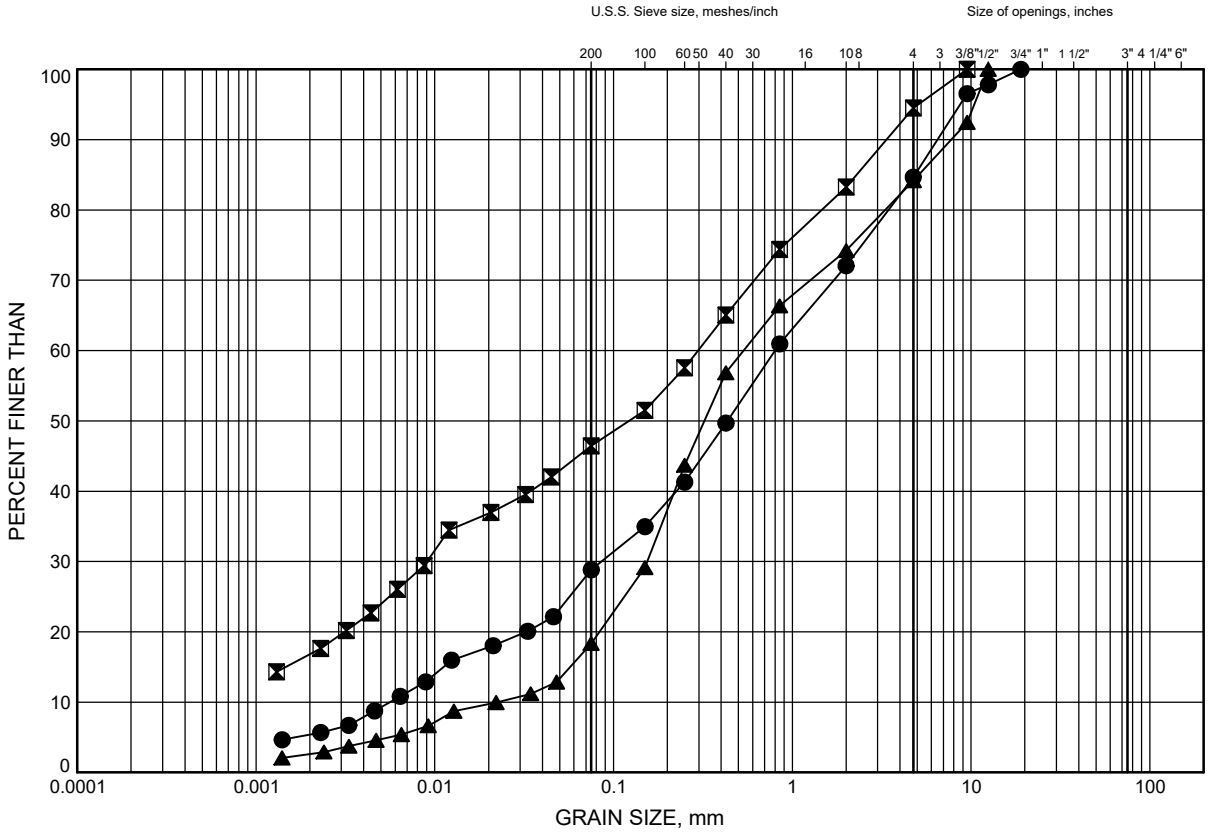
Geotechnical Laboratory Test Results

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B1

Silty SAND to SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-02	0.30	215.05
⊠	EA-08	1.52	218.49
▲	EA-12	0.61	217.73

Date November 2021

Project 30427

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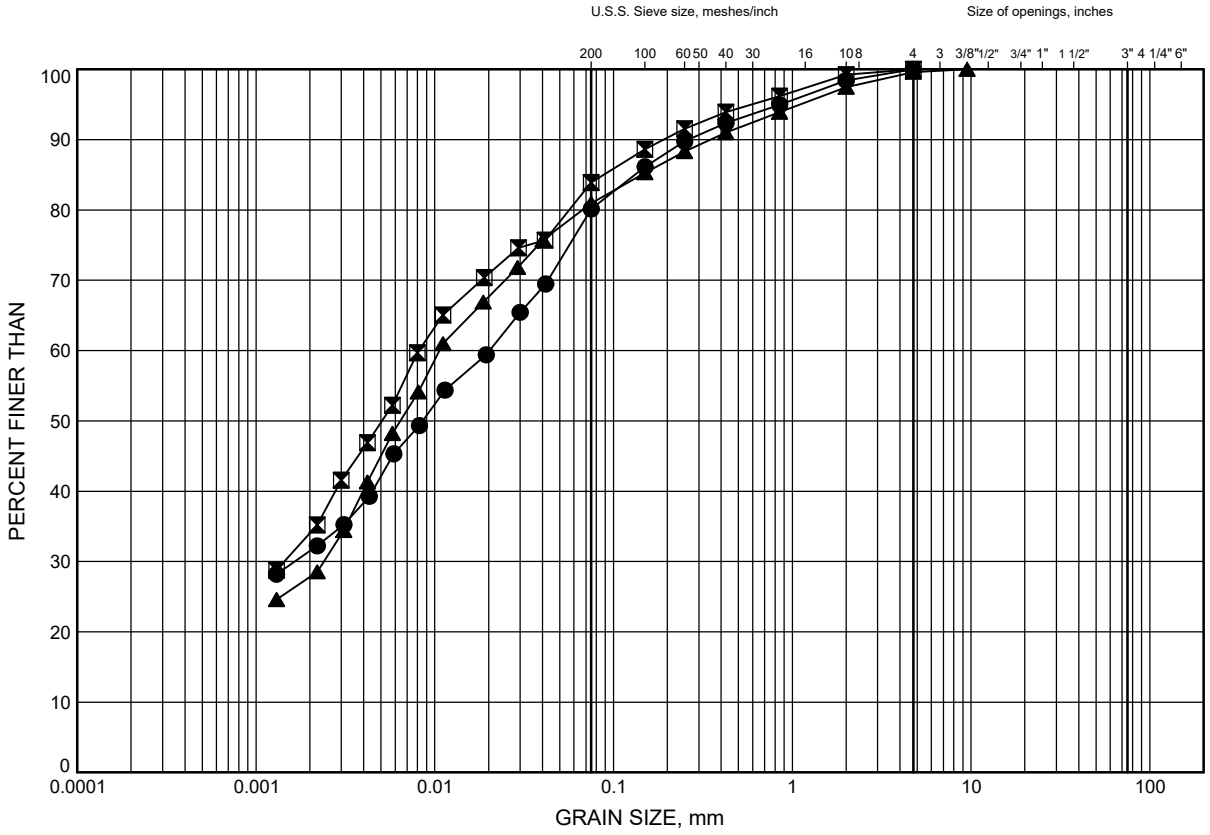
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty CLAY FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-01	1.07	214.64
⊠	CE-01	1.07	216.70
▲	EA-04	1.07	221.75

Date November 2021

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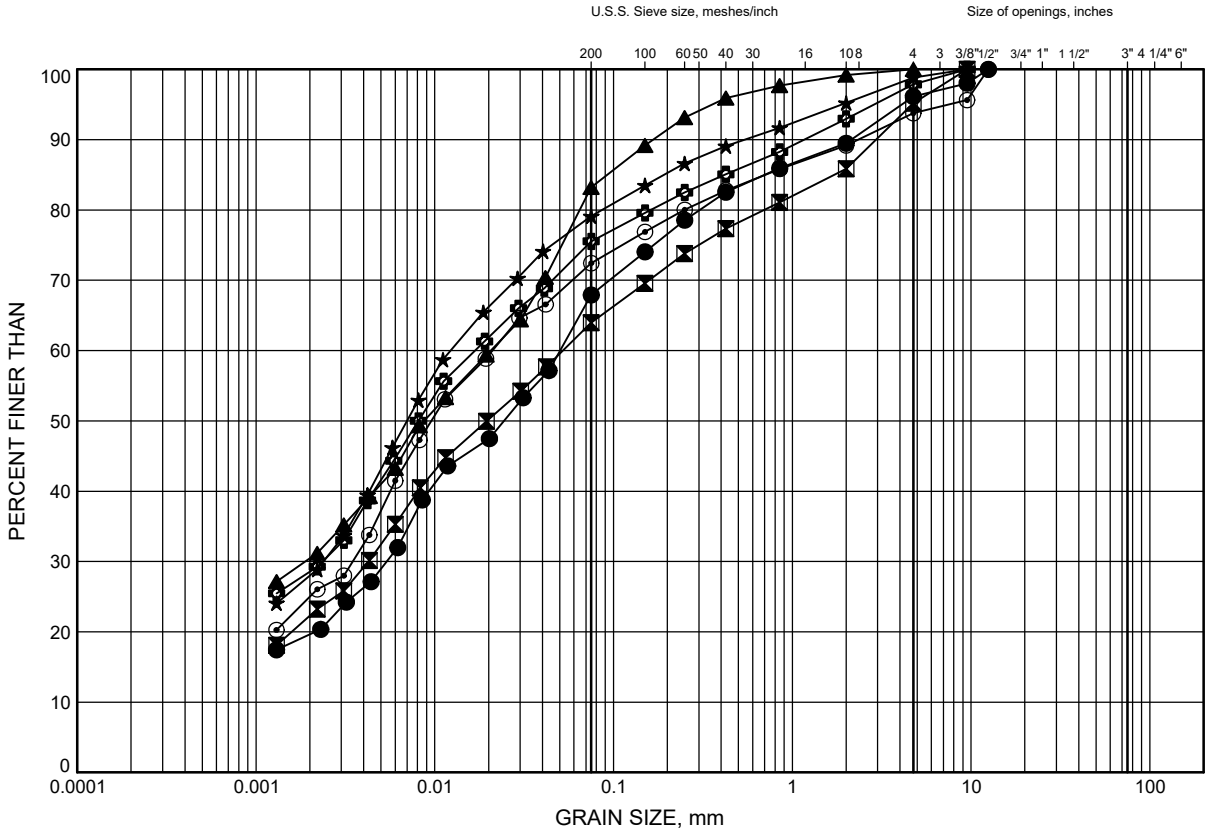
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B3

Clayey SILT to Silty CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-04	1.07	214.60
⊠	CE-02	1.07	215.99
▲	CE-04	1.83	214.11
★	EA-02	1.07	222.07
⊙	EA-03	1.83	221.06
✿	EA-05	4.88	217.54

Date November 2021

Project 30427

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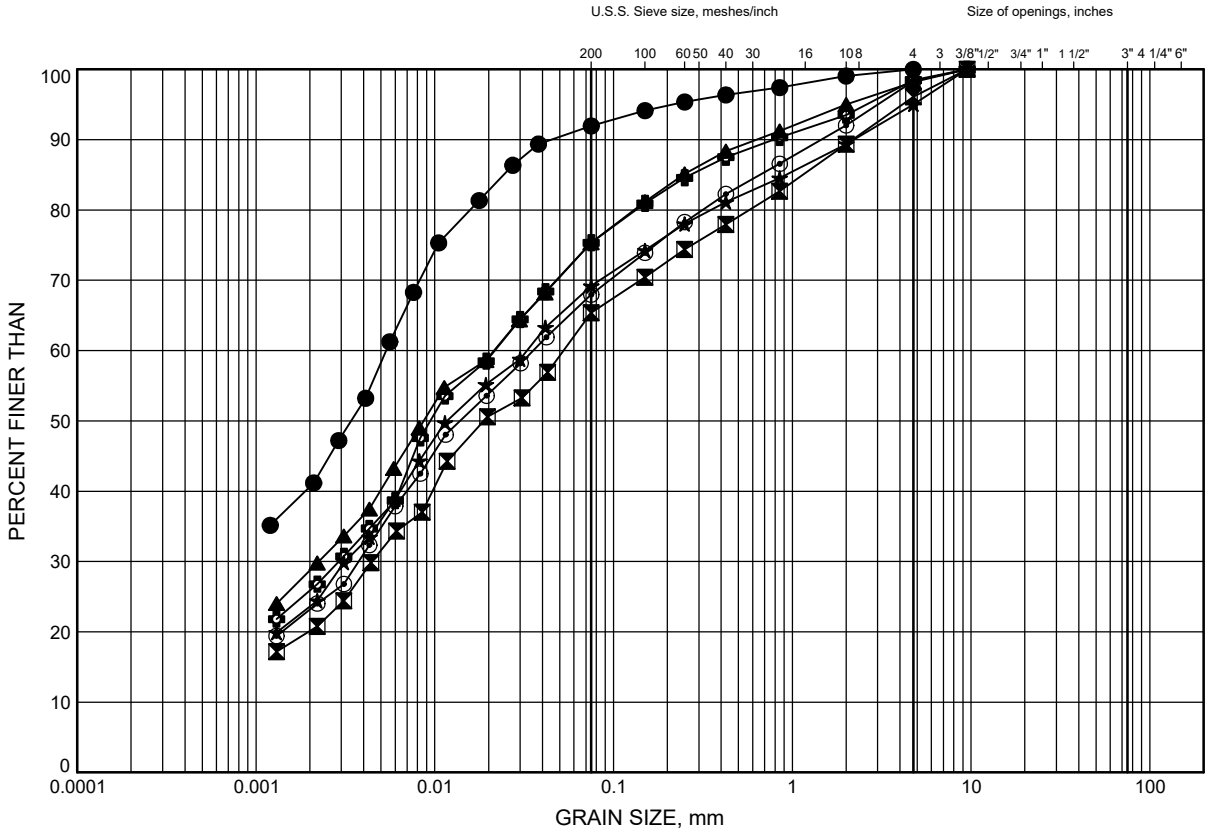
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B4

Clayey SILT to Silty CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EA-06	1.07	221.02
⊠	EA-07	2.59	218.90
▲	EA-10	1.07	219.28
★	EA-15	1.07	216.58
⊙	EA-16	1.07	216.57
✿	RR-01	1.07	214.62

Date November 2021

Project 30427

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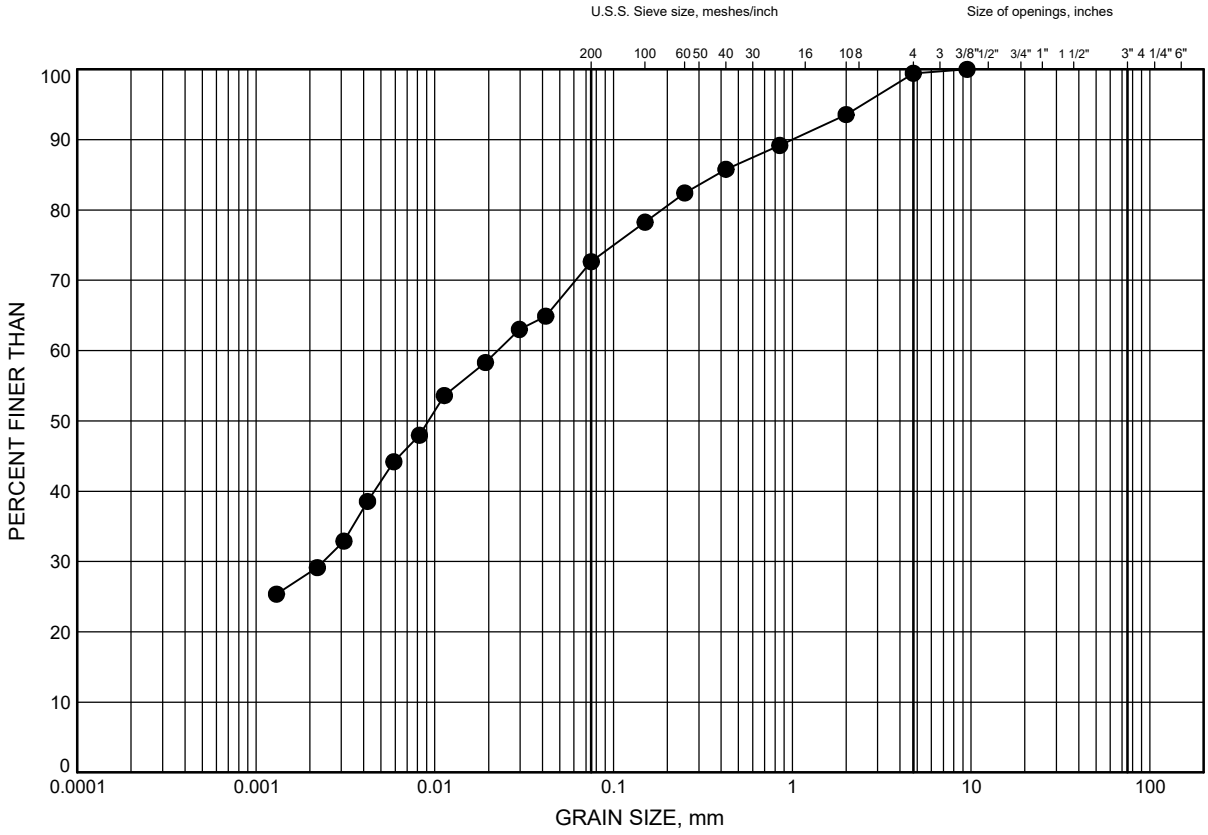
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B5

Clayey SILT to Silty CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	RR-02	1.83	213.51

Date November 2021

Project 30427

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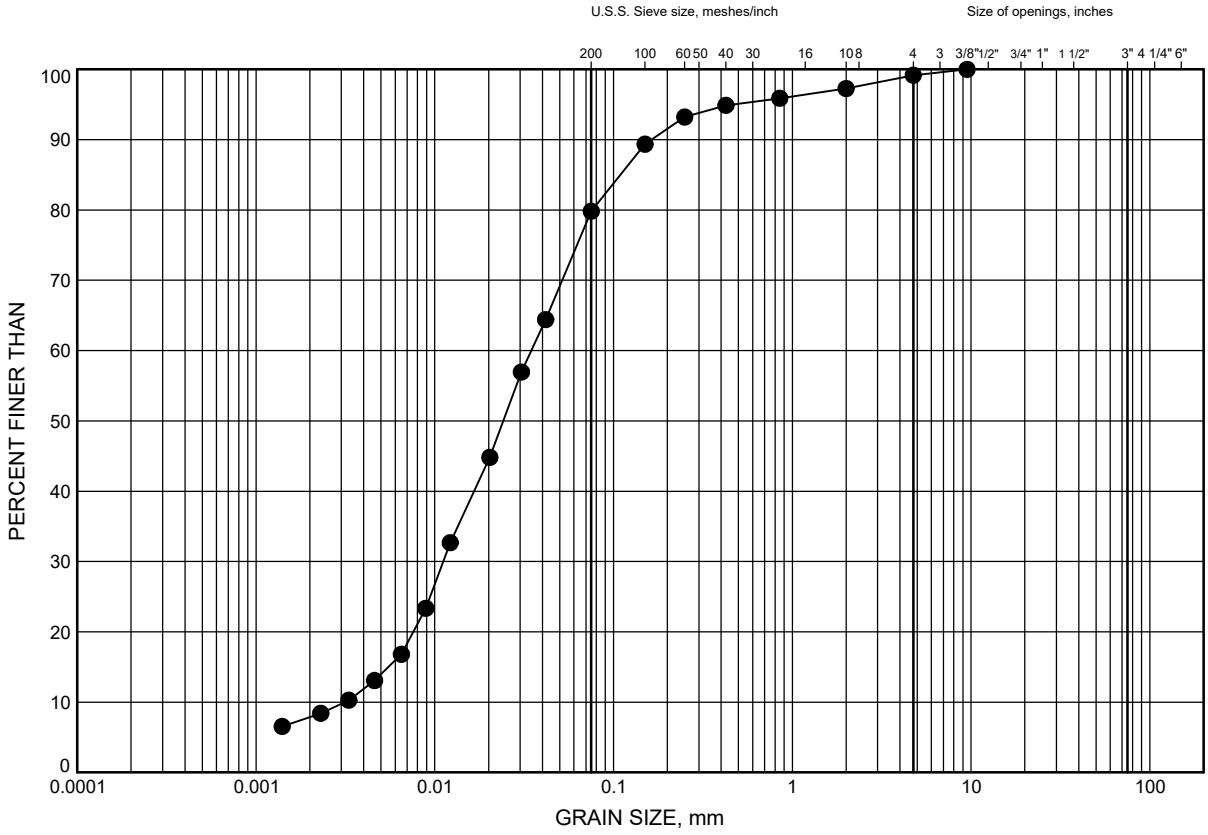
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B6

SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-01	3.35	212.35

Date November 2021

Project 30427

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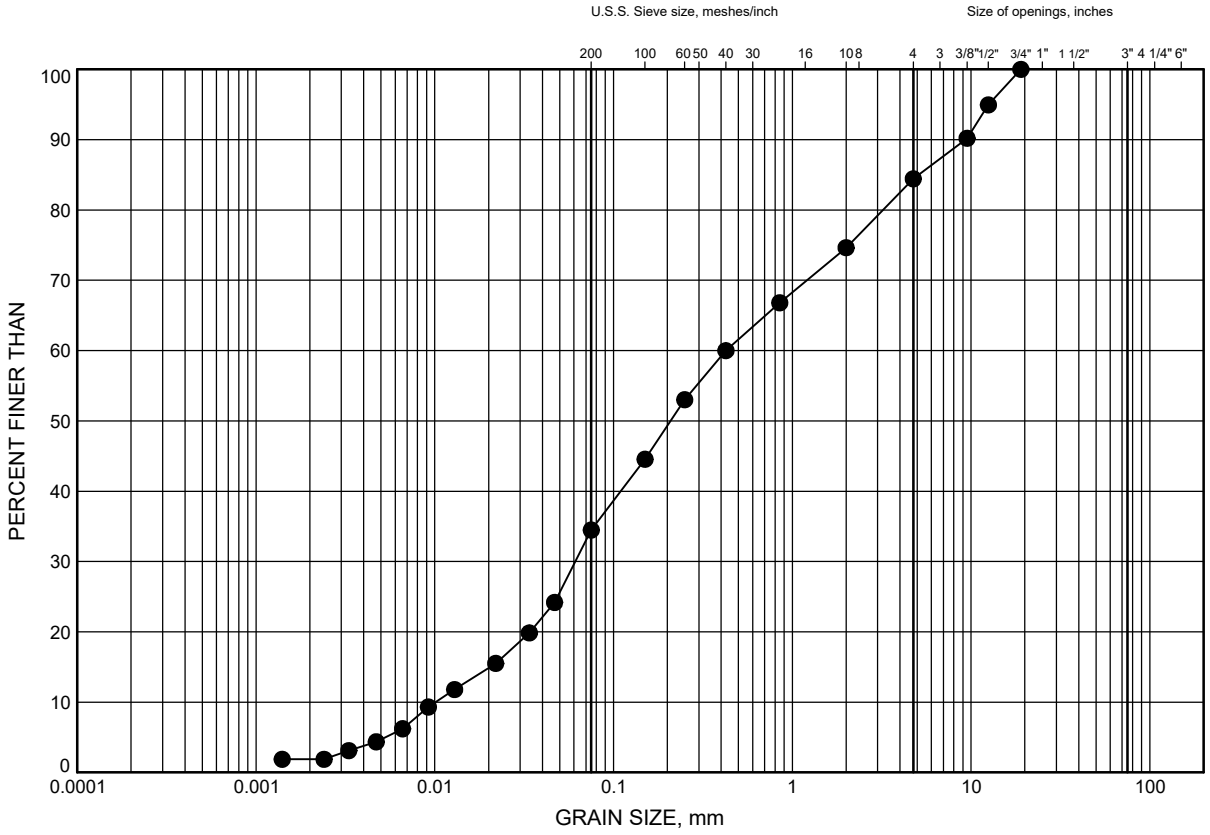
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B7

Silty SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-03	1.83	213.35

Date November 2021

Project 30427

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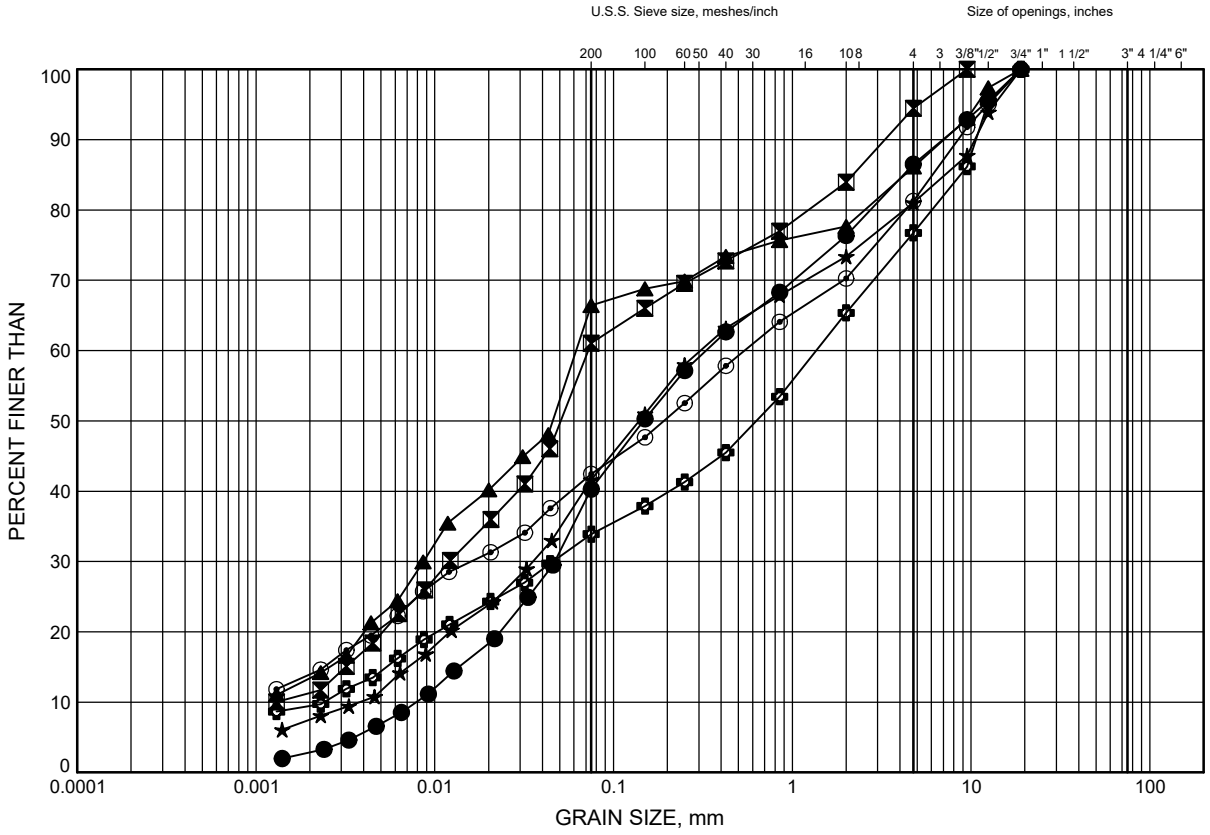
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B8

Sandy SILT to Silty SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-02	3.35	212.00
⊠	BR-03	7.77	207.40
▲	BR-04	6.32	209.34
★	CE-03	2.55	213.47
⊙	EA-11	2.59	217.05
✿	EA-14	2.59	215.49

Date November 2021

Project 30427

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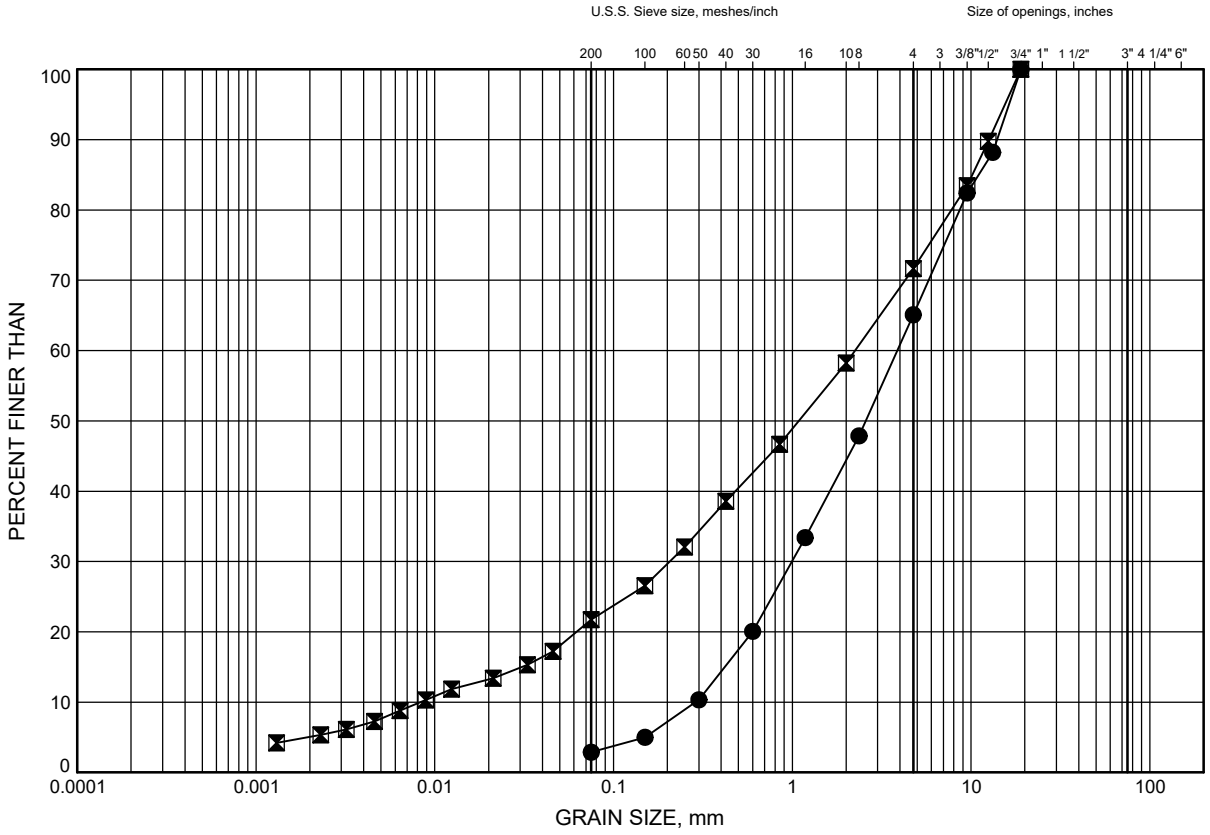
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

GRAIN SIZE DISTRIBUTION

FIGURE B9

SAND and GRAVEL to Gravelly SAND (Granular Road Base)



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EA-05	0.38	222.04
⊠	EA-09	0.46	220.21

Date November 2021

Project 30427

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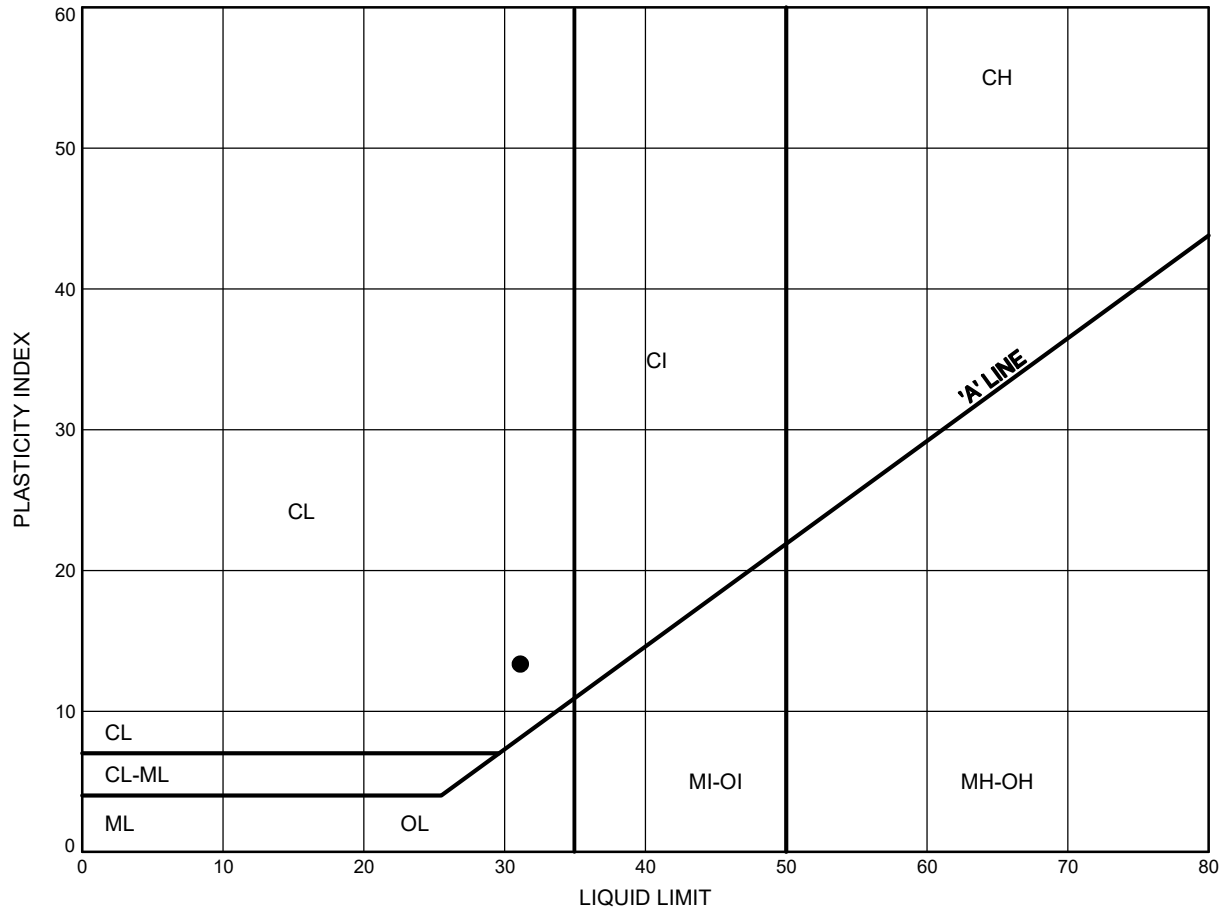
GRAIN SIZE DISTRIBUTION - THURBER TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

ATTERBERG LIMITS TEST RESULTS

FIGURE B10

Sandy SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BR-04	6.32	209.34

Date November 2021

Project 30427

THURBER

Prep'd AN

Chkd. CZ

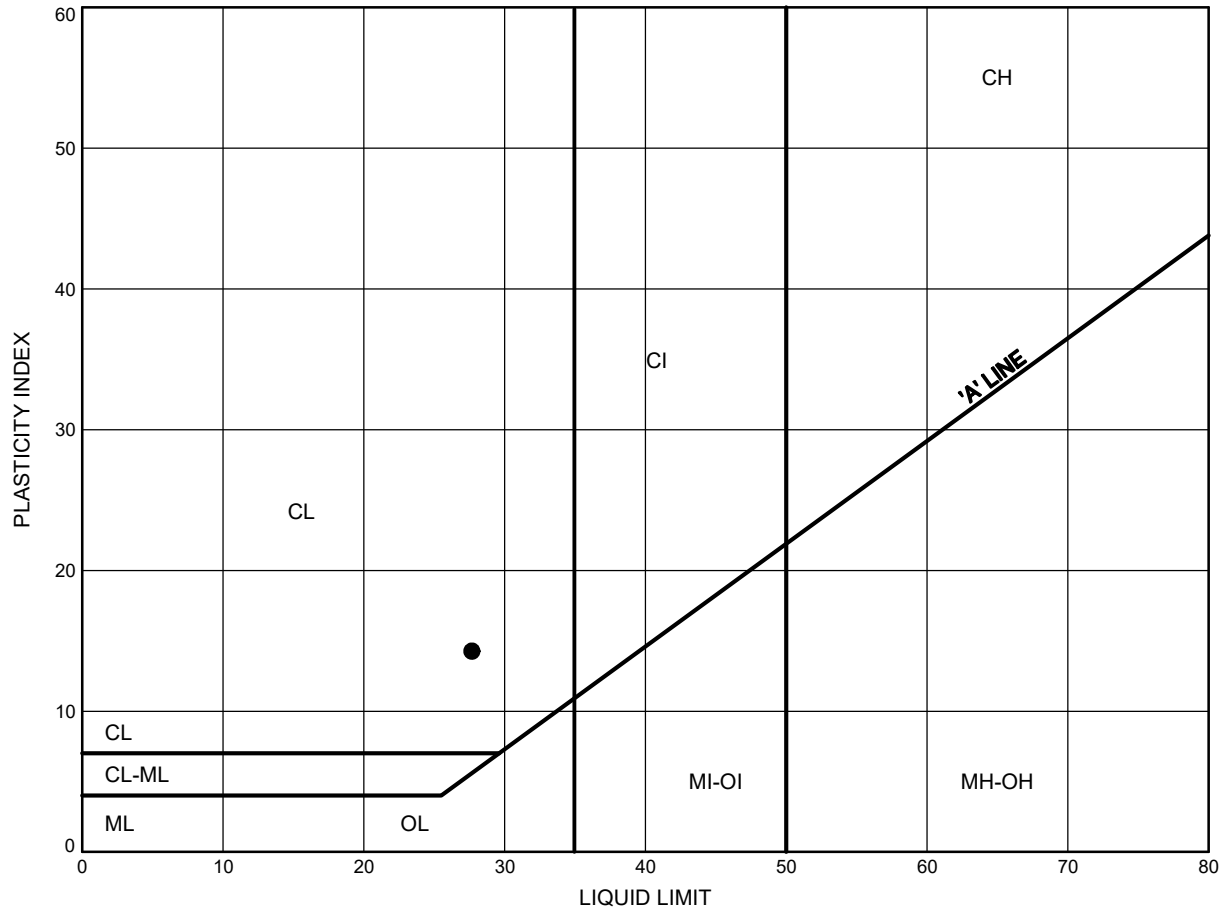
THURBALT TEL-30427.GPJ 11/22/21

Clark Boulevard Extension

ATTERBERG LIMITS TEST RESULTS

FIGURE B11

Silty CLAY to Clayey SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EA-05	4.88	217.54

Date November 2021

Project 30427

THURBER

Prep'd AN

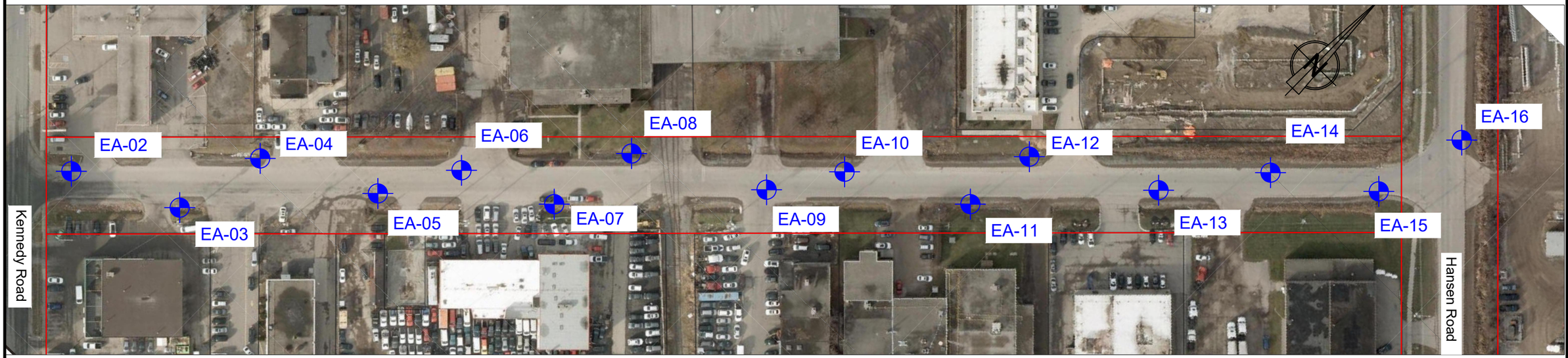
Chkd. CZ

THURBALT TEL-30427.GPJ 11/22/21

THURBER

Appendix C

Borehole Locations Drawings



Eastern Avenue

Borehole Location

GEOTECHNICAL INVESTIGATION

CLARK BOULEVARD EXTENSION
BRAMPTON, ON

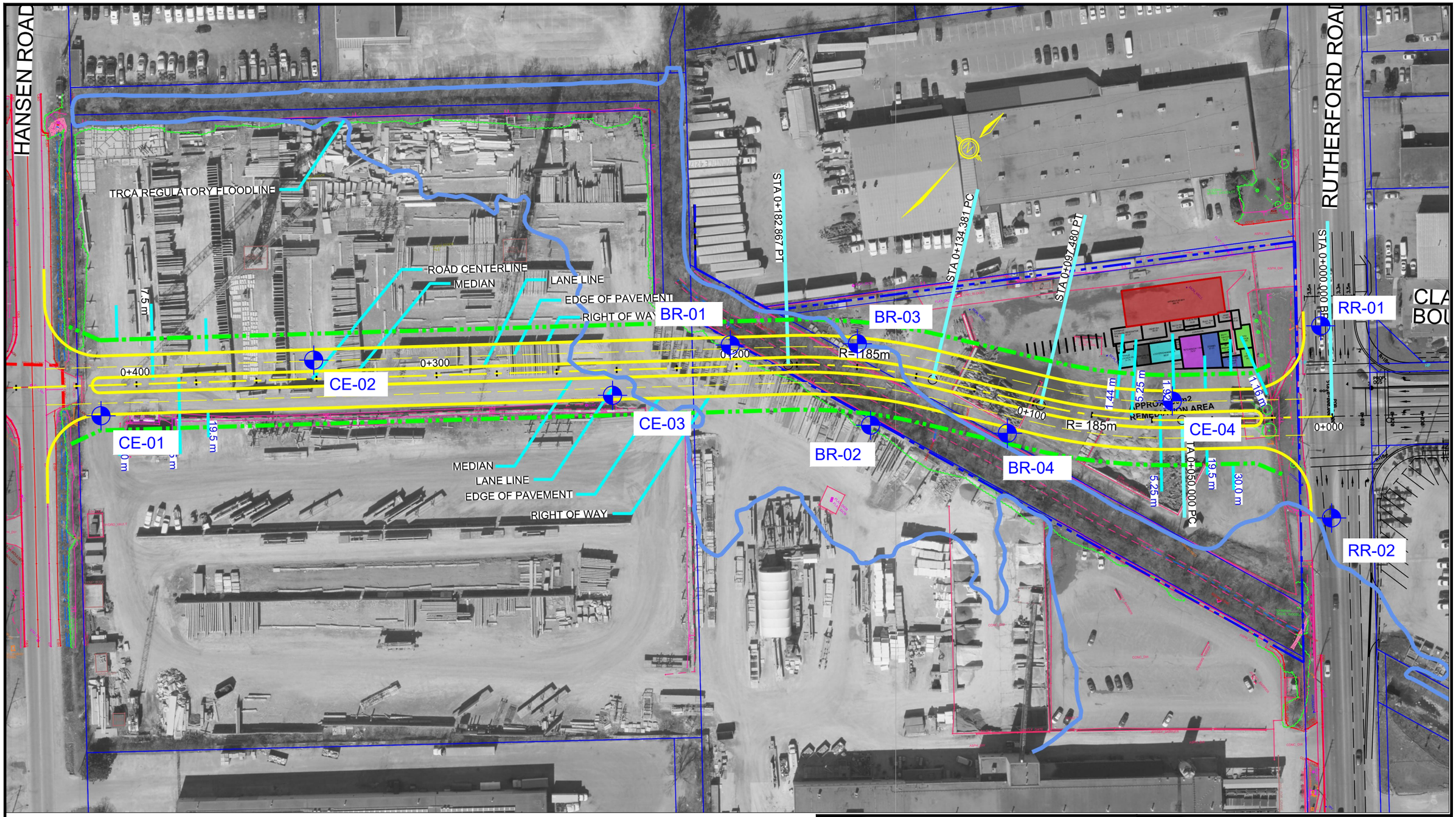
BOREHOLE LOCATION PLAN

JOB# 30427

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
CZ	CZ	RP
DATE :	SCALE :	DRAWING No.
NOVEMBER 2021	NTS	30427-2

FILENAME: C:\Users\czanatta\Documents\Thurber\Clark Blvd\Borehole Location Plan.dwg
PLOTDATE: Nov 22, 2021 - 3:08 PM



Borehole Location

GEOTECHNICAL INVESTIGATION

CLARK BOULEVARD EXTENSION
BRAMPTON, ON

BOREHOLE LOCATION PLAN

JOB# 30427

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
CZ	CZ	RP
DATE :	SCALE :	DRAWING No.
NOVEMBER 2021	NTS	30427-2

FILENAME: C:\Users\czanatta\Documents\Thurber\Clark Blvd\Borehole Location Plan.dwg
PLOTDATE: Nov 22, 2021 - 3:06 PM

THURBER

Appendix D

Laboratory Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666
ATTENTION TO: Cory Zanatta
PROJECT: 30427
AGAT WORK ORDER: 21T817646
SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Lab Manager
DATE REPORTED: Oct 26, 2021
PAGES (INCLUDING COVER): 11
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 21T817646

PROJECT: 30427

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

Corrosivity Package

DATE RECEIVED: 2021-10-19

DATE REPORTED: 2021-10-26

		SAMPLE DESCRIPTION:		BR-01 SS4	BR-04 SS5
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2021-10-07	2021-10-07
Parameter	Unit	G / S	RDL	3106683	3106684
Chloride (2:1)	µg/g	NA	2	118	136
Sulphate (2:1)	µg/g		2	42	26
pH (2:1)	pH Units		NA	7.94	8.12
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.321	0.314
Resistivity (2:1) (Calculated)	ohm.cm		1	3120	3180
Redox Potential 1	mV		NA	396	254
Redox Potential 2	mV		NA	378	248
Redox Potential 3	mV		NA	353	248

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3106683-3106684 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Amanjot Bhela

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AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21T817646

PROJECT: 30427

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-10-19

DATE REPORTED: 2021-10-26

		SAMPLE DESCRIPTION:		BR-01 SS2	BR-03 SS3
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2021-10-07	2021-10-07
Parameter	Unit	G / S	RDL	3106685	3106686
Antimony	µg/g	1.3	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	7	6
Barium	µg/g	220	2.0	172	49.4
Beryllium	µg/g	2.5	0.4	1.2	<0.4
Boron	µg/g	36	5	11	6
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.28	0.11
Cadmium	µg/g	1.2	0.5	<0.5	<0.5
Chromium	µg/g	70	5	39	12
Cobalt	µg/g	21	0.5	13.1	7.7
Copper	µg/g	92	1.0	28.6	32.2
Lead	µg/g	120	1	12	4
Molybdenum	µg/g	2	0.5	<0.5	<0.5
Nickel	µg/g	82	1	34	18
Selenium	µg/g	1.5	0.8	1.0	<0.8
Silver	µg/g	0.5	0.5	<0.5	<0.5
Thallium	µg/g	1	0.5	<0.5	<0.5
Uranium	µg/g	2.5	0.50	1.69	<0.50
Vanadium	µg/g	86	0.4	55.7	20.4
Zinc	µg/g	290	5	115	32
Chromium, Hexavalent	µg/g	0.66	0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	**0.961**	**0.769**
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	N/A	**4.50**	**4.89**
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.61	7.78

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21T817646

PROJECT: 30427

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-10-19 **DATE REPORTED: 2021-10-26**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3106685-3106686 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Amanjot Bhela

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
AMANJOT BHELA
CHEMIST

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Certificate of Analysis

AGAT WORK ORDER: 21T817646

PROJECT: 30427

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2021-10-19

DATE REPORTED: 2021-10-26

		SAMPLE DESCRIPTION:		BR-04 SS3
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2021-10-07
Parameter	Unit	G / S	RDL	3106687
Arsenic Leachate	mg/L	2.5	0.010	<0.010
Barium Leachate	mg/L	100	0.010	0.555
Boron Leachate	mg/L	500	0.050	0.075
Cadmium Leachate	mg/L	0.5	0.010	<0.010
Chromium Leachate	mg/L	5	0.050	<0.050
Lead Leachate	mg/L	5	0.010	0.015
Mercury Leachate	mg/L	0.1	0.01	<0.01
Selenium Leachate	mg/L	1	0.010	<0.010
Silver Leachate	mg/L	5	0.010	<0.010
Uranium Leachate	mg/L	10	0.050	<0.050
Fluoride Leachate	mg/L	150	0.10	<0.10
Cyanide Leachate	mg/L	20	0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

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Exceedance Summary

AGAT WORK ORDER: 21T817646

PROJECT: 30427

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3106685	BR-01 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.57	0.961
3106685	BR-01 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	4.50
3106686	BR-03 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.57	0.769
3106686	BR-03 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	4.89

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD
AGAT WORK ORDER: 21T817646
PROJECT: 30427
ATTENTION TO: Cory Zanatta
SAMPLING SITE:Clark Blvd
SAMPLED BY:RB

Soil Analysis

RPT Date: Oct 26, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	3106664		28	28	0.0%	< 2	98%	70%	130%	105%	80%	120%	105%	70%	130%
Sulphate (2:1)	3106664		40	40	0.0%	< 2	95%	70%	130%	103%	80%	120%	102%	70%	130%
pH (2:1)	3106664	3106664	8.12	8.14	0.2%	NA	99%	80%	120%						
Electrical Conductivity (2:1)	3106387		0.051	0.056	9.3%	< 0.005	102%	80%	120%	NA			NA		
Redox Potential 1	1						100%	90%	110%						
Comments: NA signifies Not Applicable. pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.															
Duplicate NA: results are under 5X the RDL and will not be calculated.															
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	3110291		<0.8	<0.8	NA	< 0.8	94%	70%	130%	106%	80%	120%	100%	70%	130%
Arsenic	3110291		3	4	NA	< 1	122%	70%	130%	108%	80%	120%	113%	70%	130%
Barium	3110291		61.1	52.3	15.6%	< 2.0	115%	70%	130%	105%	80%	120%	111%	70%	130%
Beryllium	3110291		<0.4	<0.4	NA	< 0.4	93%	70%	130%	112%	80%	120%	111%	70%	130%
Boron	3110291		<5	<5	NA	< 5	86%	70%	130%	103%	80%	120%	103%	70%	130%
Boron (Hot Water Soluble)	3106691		0.12	0.13	NA	< 0.10	92%	60%	140%	98%	70%	130%	97%	60%	140%
Cadmium	3110291		<0.5	<0.5	NA	< 0.5	117%	70%	130%	109%	80%	120%	106%	70%	130%
Chromium	3110291		23	23	NA	< 5	107%	70%	130%	104%	80%	120%	110%	70%	130%
Cobalt	3110291		7.1	7.2	1.4%	< 0.5	109%	70%	130%	109%	80%	120%	108%	70%	130%
Copper	3110291		10.9	11.1	2.0%	< 1.0	95%	70%	130%	107%	80%	120%	100%	70%	130%
Lead	3110291		11	11	0.8%	< 1	109%	70%	130%	91%	80%	120%	85%	70%	130%
Molybdenum	3110291		2.0	2.0	NA	< 0.5	113%	70%	130%	115%	80%	120%	115%	70%	130%
Nickel	3110291		16	16	5.6%	< 1	106%	70%	130%	109%	80%	120%	106%	70%	130%
Selenium	3110291		<0.8	<0.8	NA	< 0.8	125%	70%	130%	112%	80%	120%	116%	70%	130%
Silver	3110291		<0.5	<0.5	NA	< 0.5	103%	70%	130%	106%	80%	120%	99%	70%	130%
Thallium	3110291		<0.5	<0.5	NA	< 0.5	93%	70%	130%	104%	80%	120%	101%	70%	130%
Uranium	3110291		0.51	0.56	NA	< 0.50	97%	70%	130%	95%	80%	120%	90%	70%	130%
Vanadium	3110291		25.9	26.6	2.4%	< 0.4	116%	70%	130%	102%	80%	120%	110%	70%	130%
Zinc	3110291		34	35	2.9%	< 5	107%	70%	130%	111%	80%	120%	118%	70%	130%
Chromium, Hexavalent	3102764		<0.2	<0.2	NA	< 0.2	102%	70%	130%	91%	80%	120%	87%	70%	130%
Cyanide, Free	3096401		<0.040	<0.040	NA	< 0.040	107%	70%	130%	108%	80%	120%	93%	70%	130%
Mercury	3110291		<0.10	<0.10	NA	< 0.10	111%	70%	130%	100%	80%	120%	98%	70%	130%
Electrical Conductivity (2:1)	3106387		0.051	0.056	8.9%	< 0.005	102%	80%	120%	NA			NA		
Sodium Adsorption Ratio (2:1) (Calc.)	3103680		2.48	2.38	4.2%	N/A	NA			NA			4%		
pH, 2:1 CaCl2 Extraction	3106685	3106685	7.61	7.63	0.3%		99%	80%	120%	NA			NA		
Comments: NA signifies Not Applicable. pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document. Duplicate NA: results are under 5X the RDL and will not be calculated.															
O. Reg. 558 Metals and Inorganics															

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 21T817646

PROJECT: 30427

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

Soil Analysis (Continued)

RPT Date: Oct 26, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Arsenic Leachate	3095559		<0.010	<0.010	NA	< 0.010	96%	70%	130%	110%	80%	120%	116%	70%	130%
Barium Leachate	3095559		0.150	0.148	1.4%	< 0.010	102%	70%	130%	119%	80%	120%	111%	70%	130%
Boron Leachate	3095559		<0.050	0.051	NA	< 0.050	99%	70%	130%	81%	80%	120%	97%	70%	130%
Cadmium Leachate	3095559		<0.010	<0.010	NA	< 0.010	99%	70%	130%	100%	80%	120%	101%	70%	130%
Chromium Leachate	3095559		<0.050	<0.050	NA	< 0.050	97%	70%	130%	104%	80%	120%	109%	70%	130%
Lead Leachate	3095559		<0.010	<0.010	NA	< 0.010	91%	70%	130%	91%	80%	120%	86%	70%	130%
Mercury Leachate	3095559		<0.01	<0.01	NA	< 0.01	97%	70%	130%	96%	80%	120%	90%	70%	130%
Selenium Leachate	3095559		<0.010	<0.010	NA	< 0.010	98%	70%	130%	113%	80%	120%	113%	70%	130%
Silver Leachate	3095559		<0.010	<0.010	NA	< 0.010	99%	70%	130%	103%	80%	120%	93%	70%	130%
Uranium Leachate	3095559		<0.050	<0.050	NA	< 0.050	105%	70%	130%	95%	80%	120%	92%	70%	130%
Fluoride Leachate	3095559		0.15	0.15	NA	< 0.10	101%	90%	110%	98%	90%	110%	96%	70%	130%
Cyanide Leachate	3095559		<0.05	<0.05	NA	< 0.05	107%	70%	130%	108%	80%	120%	90%	70%	130%
(Nitrate + Nitrite) as N Leachate	3095559		<0.70	<0.70	NA	< 0.70	98%	80%	120%	97%	80%	120%	91%	70%	130%

Comments: NA Signifies Not Applicable

Certified By:

Amanjot Bhela

CHARTERED CHEMIST AMANJOT BHELA — ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO

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Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 21T817646

PROJECT: 30427

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS

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Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 21T817646

PROJECT: 30427

ATTENTION TO: Cory Zanatta

SAMPLING SITE:Clark Blvd

SAMPLED BY:RB

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Arsenic Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Barium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Boron Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Cadmium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Chromium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Lead Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Mercury Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Selenium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Silver Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Uranium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Fluoride Leachate	INOR-93-6018	EPA 1311 & modified from SM4500-F-C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA 1311 modified from MOE 3015 SM 4500 CN-I,G387	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & modified from SM 4500 - NO3- I	LACHAT FIA

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 21T817646

Cooler Quantity:

Arrival Temperatures: 24.6 | 25.9 | 25.8
22.7 | 21.0 | 22.1

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes: ICE PACK

Report Information:

Company: Thurber Engineering
Contact: Cory Zanatta
Address: 2010 Winston Park Drive. Suit 103 Oakville ONT.
Phone: 905-829-8666 Fax:
Reports to be sent to:
1. Email: czanatta@thurber.ca
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☑ Regulation 153/04
Table 1 2 3 *Indicate One*
☑ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☑ Fine

☐ Excess Soils R406
Table _____ *Indicate One*

☑ Regulation 558

☐ CCME

☐ Sewer Use ☐ Sanitary ☐ Storm
_____ *Region*

☐ Prov. Water Quality Objectives (PWQO)

☐ Other
_____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 30427
Site Location: Clark Blvd
Sampled By: RB
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐CrVI, ☐Hg, ☐HWSB	O. Reg 153: BTEX, F1-F4 PHCs	O. Reg 153: Analyze F4G if required ☐Yes ☐No	O. Reg 153: PAHs	O. Reg 153: PCBs	O. Reg 153: VOC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐M&I ☐VOCs ☐ABNs ☐B(a)P ☐PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐Metals ☐VOCs ☐SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Corrosivity Package	Potentially Hazardous or High Concentration (Y/N)
BR-01 SS 4	Oct 7, 2021	AM/PM	1	S														X	
BR-04 SS 5	↓	AM/PM	1	S														X	
BR-01 SS 1		AM/PM	1	S			X												
BR-03 SS 3		AM/PM	1	S			X												
BR-04 SS 3		AM/PM	1	S										X					
		AM/PM	8																
		AM/PM																	
		AM/PM																	
		AM/PM																	
		AM/PM																	
		AM/PM																	

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date 10/19/21	Time 10:45	Samples Received By (Print Name and Sign):	Date 10/19/21	Time 10:10
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1

N°: T 124355

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

AGAT Laboratories

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: Cory Zanatta

PROJECT: 21T817646

AGAT WORK ORDER: 21T820402

SOLID ANALYSIS REVIEWED BY: Sherin Moussa, Senior Technician

DATE REPORTED: Nov 08, 2021

PAGES (INCLUDING COVER): 5

Should you require any information regarding this analysis please contact your client services representative at (905) 501-9998

*Notes

Disclaimer:
- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 90 days following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Measurement Uncertainty is not taken into consideration when stating conformity with a specified requirement.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.

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Certificate of Analysis

AGAT WORK ORDER: 21T820402

PROJECT: 21T817646

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

(201-042) Sulfide

DATE SAMPLED: Oct 24, 2021 | DATE RECEIVED: Oct 25, 2021 | DATE REPORTED: Nov 08, 2021 | SAMPLE TYPE: Other

Analyte:	Sulfide
Unit:	%
Sample ID (AGAT ID) RDL:	0.05
3106683B BR-01 SS4 (3125692)	<0.05
3106683B.Dup BR-01 SS4 (3125693)	<0.05

Comments: RDL - Reported Detection Limit

Analysis performed at AGAT 5623 McAdam Rd., Mississauga, ON (unless marked by *)
Insufficient Sample : IS
Sample Not Received : SNR

Certified By: Sherin Moussa

Results relate only to the items tested. Results apply to samples as received.

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Quality Assurance - Replicate

AGAT WORK ORDER: 21T820402

PROJECT: 21T817646

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

(201-042) Sulfide

	REPLICATE #1				REPLICATE #2											
Parameter	Sample ID	Original	Replicate	RPD	Sample ID	Original	Replicate	RPD								
S	3125692	0.005	0.005	0.0%	3125693	< 0.005	<0.005	0.0%								
Sulfate	3125692	< 0.01	<0.01	0.0%	3125693	< 0.01	<0.01	0.0%								
Sulfide	3125692	< 0.05	<0.05	0.0%	3125693	< 0.05	<0.05	0.0%								

Results relate only to the items tested. Results apply to samples as received.

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Quality Assurance - Certified Reference materials

AGAT WORK ORDER: 21T820402

PROJECT: 21T817646

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Cory Zanatta

(201-042) Sulfide

	CRM #1				CRM #2											
Parameter	Expect	Actual	Recovery	Limits	Expect	Actual	Recovery	Limits								
S	0.80	0.80	100%	90% - 110%	0.80	0.80	100%	90% - 110%								
Sulfate	0.01	0.01	100%	90% - 110%	0.01	0.01	100%	90% - 110%								
Sulfide	0.80	0.79	98%	90% - 110%	0.80	0.79	98%	90% - 110%								

Results relate only to the items tested. Results apply to samples as received.

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Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 21T820402

PROJECT: 21T817646

ATTENTION TO: Cory Zanatta

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Solid Analysis			
Sulfide	MIN-200-12037		LECO

Results relate only to the items tested. Results apply to samples as received.

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Appendix E

Pavement Analysis

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Clark Boulevard - Hansen Road to Rutherford Road
New Pavement Structure
Flexible Pavement Design 20 - Year

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	1,115,406
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	105 mm

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	7,600
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 80-kN ESALs over Performance Period
1	97.2	2	0	0	0
2	1.9	2	0.75	0	432,504
3	0.9	2	2.5	0	682,902
Total	100	-	-	-	1,115,406

Growth	Compound
Total Calculated Cumulative ESALs	1,115,406

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New HMA	0.42	1	120	3.5	50
2	New Base	0.14	1	150	3.5	21

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
3	New Subbase	0.14	1	300	3.5	42
Total	-	-	-	570	-	113

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
1	New HMA	0.42	1	-	50	2,500,000	3.5	115	48
2	New Base	0.14	1	150	-	250,000	3.5	150	21
3	New Subbase	0.09	1	-	300	150,000	3.5	397	36
Total	-	-	-	-	-	-	-	662	105

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Eastern Avenue - Kennedy Road to Hansen Road
New Pavement Structure
Flexible Pavement Design 20 - Year

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	642,167
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	97 mm

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	9,600
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 80-kN ESALs over Performance Period
1	98.7	2	0	0	0
2	0.9	2	0.75	0	258,784
3	0.4	2	2.5	0	383,383
Total	100	-	-	-	642,167

Growth	Compound
Total Calculated Cumulative ESALs	642,167

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New HMA	0.42	1	105	3.5	44
2	New Base	0.14	1	150	3.5	21

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
3	New Subbase	0.14	1	250	3.5	35
Total	-	-	-	505	-	100

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
1	New HMA	0.42	1	-	50	2,500,000	3.5	105	44
2	New Base	0.14	1	150	-	250,000	3.5	150	21
3	New Subbase	0.09	1	-	300	150,000	3.5	357	32
Total	-	-	-	-	-	-	-	611	97

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Appendix F

Photographs of Typical Site Conditions

Photo 1: Eastern Avenue intersection with Kennedy Road, looking west.

Photo 2: Eastern Avenue south road shoulder and ditch, looking west.

Photo 3: Eastern Avenue north shoulder and ditch, looking west.

Photo 4: East end of Eastern Avenue, looking west.

Photo 5: Eastern Avenue intersection with Hansen Road, looking east.

Photo 6: Property at 25 Rutherford Road, proposed Clark Extension Alignment, looking west.

Photo 7: Tributary of Etobicoke Creek along Clark Boulevard Extension Alignment. Looking North.