Municipal Class Environmental Assessment for
Road Improvements near Derry Road East and Alstep Drive:

Environmental Study Report

Appendix I: Geotechnical Investigation and Pavement Analysis

Bombardier Aerospace Project (BAP)
Mississauga, Ontario

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1. Introduction

This report presents the results of a geotechnical investigation and pavement condition evaluation carried out for the proposed road widening in the City of Mississauga, Ontario. The work was authorized by Bombardier Inc.

Based on the provided information, it is our understanding that the proposed widening includes the following road sections, as shown on Drawing No. 1:

- Derry Road East – approximate 250 m west of Telfor Way / Menkes Drive to 300 m east of Bramalea Road, approximate length 1,200 m;
- Telford Way – from Tranmere Drive to Derry Road East, approximate length 170 m;
- Mankes Drive – from Derry Road East to Alstep Drive, approximate length 160 m;
- Bramalea Road – approximate from 100 m south of Boylen Road / Logistics Drive to 200 m south of Derry Road East, approximate length 500 m; and
- East extension of Alstep Drive to Bramalea Road, approximate length 200 m.

The exact structural details for the roads were not available at the time of preparation of this report. However, it is understood that except the aforementioned road widening, sewers may be installed at a depth up to 3.5 m at the east extension of Alstep Drive.

The purpose of the current investigation and evaluation was to determine the pavement conditions by visual examination and the subsurface conditions at the subject site by drilling a limited number of sampled boreholes and based on the factual borehole data, to provide geotechnical engineering guidelines for the design and construction of the proposed development. Specifically, recommendations and / or comments regarding road widening and site services construction were to be provided.

The comments and recommendations given in this report are based on the terms of reference presented above and on the assumption that design will be in accordance with applicable codes and standards. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or the requirement of additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description and Regional Geology

The subject site is located within a residential and commercial urban area on the northeast part of the City of Mississauga (City). Derry Road East is a regional road, and the rest of the road sections are municipal roads. The terrains are generally flat along the road alignments.

Geologically, the site is located in the Peel Plain physiographic regions of Southern Ontario. Based on our physiographic study, it is understood that at the site location, the surficial overburden consists of modern alluvial deposits of clay and silt, or fine-textured glaciolacustrine silt and clay deposits. The overburden soils are further underlain by bedrock consisting typically of grey shale with minor fossiliferous calcareous siltstone, bioclastic limestone and storm-deposited sandstone interbeds of the Georgian Bay Formation, which belong to the Upper Ordovician Period. Ontario Geotechnical Borehole database and Ontario Water Well records indicate that the depth to bedrock in the area of this site may be less than 4 m. The direct distances from the west and east limits of the site to southward directed tributary streams of Etobicoke Creek are about 350 m.

3. Geotechncial Investigation Procedures

For the current investigation, a total of twenty (20) probeholes and boreholes (designated as Boreholes 1 through 20) were drilled to depths ranging from 2.0 to 4.7 m below the existing ground. The approximate borehole locations are shown on the attached Drawing No. 1 - Borehole Location Plan.

The borehole locations were established prior to the drilling works by EXP personnel using hand-held Global Positioning System (GPS) units – Garmin eTrex Legend H. The exploratory boreholes were also located in the field by EXP from adjacent surface features. The top elevations of the boreholes were established by Sokkia GCX3 GPS System. The vertical positioning accuracy of the instrument is ± 5 mm.

Prior to the commencement of drilling operations, underground services were cleared to minimize the risk of encountering any such services during the drilling operations.

Drilling and sampling operations, carried out in April 2020, were completed by a combination of solid / hollow stem continuous flight auger using truck / track mounted drill rigs owned and operated by specialist contractors. Either bulk or split-spoon samples were recovered from the probeholes / boreholes.

A representative of EXP was present throughout the drilling operations to monitor and direct the drill operations, and to record subsoil and groundwater information. Representative samples of the subsurface soils were recovered from Boreholes 11, 13, 14, 15, 17 and 20 at regular intervals using nominal 50 mm O.D. split spoon sampling equipment driven by automatic hammers mounted on the drill rigs, in accordance with the procedures of Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils (ASTM D1586). All split spoon samples were returned to EXP's Brampton laboratory for further geotechnical testing. The following tests were performed on selected soil samples:

- Moisture content
- Unit weight
- Grain size distribution

Where the drilling method allowed, groundwater levels were observed in the open probeholes and boreholes during the course of the fieldwork. Monitoring wells were installed in Boreholes 17 and 20 to permit subsequent monitoring of the groundwater level at the well locations. The monitoring wells consist of nominal 50 mm diameter PVC pipe with a slotted screen sealed at depths within the borehole / monitoring well. Above the monitoring well screens, the annulus surrounding the pipes were grouted to the surface with cement / bentonite grout.

4. Subsurface Conditions

The detailed soil profiles encountered in each probeholes and borehole and the results of geotechnical laboratory testing are indicated on the attached borehole logs (Drawing Nos. 2 through 21). It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change.

Notes on Sample Description and Soil Types (Drawing No. 1A) preceding the borehole logs form an integral part of and should be read in conjunction with this report.

The following is a brief description of the subsurface conditions encountered at the road segments during the current investigation.

4.1 Soil Conditions

Surficial Covers

Topsoil was encountered from ground surface in Boreholes 1, 8, 11, 13, 14, 15, 18, 19 and 20. The thicknesses of topsoil found at the borehole locations were summarized in the following table.

Table 01: Topsoil Thickness

Borehole No.	1	8	11	13	14	15	18	19	20
Topsoil (mm)	100	100	50	200	150	50	150	100	50

The remaining boreholes were advanced in the existing roadway areas. The existing pavement structure, i.e. the configurations of asphalt, granular base and subbase that were encountered from ground surface are summarized in the following table.

Table 02: Asphalt Pavement Structure

Borehole No.	2	3	4	5	6	7	9	10	12	16	17
Asphalt (mm)	190	130	155	150	135	150	160	190	250	170	150
Base & Subbase - Sand and Gravel (mm)	760	1070	1045	950	965	700	790	460	700	780	850

The granular base and subbase consisted of sand and gravel. This layer extended to the depths between 0.7 and 1.2 m below existing grade or to elevations ranging from 174.6 to 171.4 m.

The granular was in a compact to dense state of compactness, with a SPT N-value of 30 blows/0.3 m. The measured moisture contents of the granular samples ranged from about 4 to 8 percent of dry weight, indicating generally a moist condition.

It should be noted that the asphalt and topsoil thickness only represent those encountered at the borehole locations and should be used as a guide. If required, more coreholes or shallow test pits should be carried out to determine the pavement and topsoil thickness for tendering purposes.

Fill Materials

Fill materials were encountered below the topsoil. The fill typically consisted of clayey silt with trace contents of sand and gravel. Trace organic matters (rootlets and organics) were observed in this fill. This layer extended to depths varying from 0.5 to 1.6 m below the existing ground surface or to elevations ranging from 173.5 to 171.6 m.

The black to brown fill materials were in a loose to compact state of compaction as suggested by SPT N-values between 7 and 11 blows/0.3 m. The moisture contents within the fill were found to range from 13 to 24 percent of dry weight, indicating generally a moist condition. The unit weight of the fill ranged from 19.2 to 22.4 kN/m^3, with an average of 20.6 kN/m^3.

Clayey Silt Till

Below the asphalt pavement structure or fills in all boreholes, the soil explored consisted of a layer of clayey silt till, extending to borehole termination depths between 2.0 and 4.7 m below the ground surface or to elevations ranging from approximately 173.6 to 167.7 m. It was found that this glacial till deposit contains some sand to sandy, and trace gravel.

Grain size distribution analyses were carried out in the geotechnical laboratory on the selected clayey silt till samples. The test results are summarized in the tables below, and are included in Figure 1, Appendix B of this report.

Table 03: Grain Size Distribution Analysis – Clayey Silt Till

Sample No.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 3 / AS 2	1	3	36	60
BH 6 / AS 2	4	32	38	26

Sample No.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 11 / AS 2	4	21	48	27
BH 15 / AS 2	5	21	44	30
BH 17 / SS 5	3	28	48	21
BH 20 / SS 4	8	25	45	22

This brown to grey glacial till has a very stiff to hard consistency as suggested by the SPT N-values obtained in this stratum which varied from 19 to in excess of 50 blows/0.3 m. This deposit was moist, with natural moisture contents ranging from about 7 to 20 percent of dry weight. The unit weight of this till ranged from 21.0 to 22.8 kN/m^3, with an average of 22.1 kN/m^3.

The presence of cobbles and boulders should always be anticipated in the ice contact drift, owing to their mode of deposition.

4.2 Groundwater Conditions

Groundwater conditions were assessed by taking readings in open holes during the course of the fieldwork and in two (2) monitoring wells installed in the selected boreholes (designated as Boreholes 17 and 20) within the project limits. Short-term observations in the monitoring wells are recorded on the attached borehole logs and summarized in Table 04 below.

Table 04: Observed Groundwater Levels

Borehole No.	Depth/Elevation of Monitoring Well Tip (m)	Screened Strata	Date of Water Level Measurement (mm/dd/yyyy)	Measured Water Level Depth/Elevation (m)
17	4.5 / 167.9	Clayey silt till	04/08/2020 05/12/2020	1.3 / 171.1 1.5 / 170.9
20	3.1 / 170.2	Clayey silt till	04/08/2020 05/12/2020	Dry 2.0 / 171.3

Based on the configurations of the monitoring wells and the observation of groundwater, the observed depth of groundwater level varied from Elevation 171.3 to 170.9 m at the time of the investigation.

For design purposes, it is our opinion that the groundwater level is considered to be at about 1.5 m below the ground surface.

In the long term, it should be noted that the groundwater levels can vary seasonally and are subject to fluctuations in response to major weather events. A perched water table may occur due to the accumulation of surface water in the fill materials overlying the clayey silt till.

5. Pavement Condition Evaluation

A visual examination of pavement condition was carried out by EXP as part of the ground investigation fieldwork. The pavement areas were assessed in terms of the quantity and severity of pavement distress.

The findings of the visual examination are summarized in the following sections, photographs and evaluation forms are presented in Appendix A.

Intersection of Telford Way / Menkes Drive and Derry Road East

In general, the existing pavement surface on Telford Way between Tranmere Drive and Derry Road is presently in fair to good condition, with a comfortable ride. Predominant distresses included:

- Few slight to moderate transverse cracking;
- Localized slight severity longitudinal cracking, which is turning to alligator cracking;
- Localized moderate severity alligator cracking on the east bound right wheel path; and
- Slight ravelling throughout.

Menkes Drive between Derry Road and Alstep Drive was observed in fair to good condition, with a comfortable ride. Predominant distresses included:

- Few slight to moderate transverse cracking;
- Localized slight severity pavement edge breaking;
- Few localized moderate severity random cracking which is turning to alligator cracking; and
- Slight ravelling throughout.

The Derry Road East within the intersection was observed in good to excellent condition, with a comfortable ride. No noticeable distressed were observed other than slight severity raveling.

Intersection of Bramalea Road and Derry Road East

In general, the existing pavement surface on Bramalea Road between Logistic Drive and FedEx Ship Centre Entrance is presently in poor to fair condition, with a relatively uncomfortable ride and slight to moderate bumps. Predominant distresses included:

- Intermittent slight to moderate longitudinal wheel track single or multiple cracking;
- Frequent sight to moderate longitudinal midlane cracking
- Frequent moderate to severe transverse cracking;
- Localized moderate severity potholes;
- Localized areas of slight to moderate severity alligator cracking;
- Slight to moderate ravelling throughout;
- Localized deteriorated patch due to utility cut; and
- Some crack sealing has been carried out in the past with limited effectiveness.

The Derry Road East within the intersection was observed in good to excellent condition, with a comfortable ride. No noticeable distressed were observed other than slight severity raveling and a few localized sight severity transverse cracking.

6. Geotechnical Recommendations

The project involves the design and construction of road widening and road extension within the project limits. Based on the provided information, it was understood that sewers may be installed along the road alignment of the east extension of Alstep Drive. The anticipated installation depths of the sewers will be up to 3.5 m. It is envisaged that trenching method may be involved in the sewer installation. Based on these assumptions, the following subsections provide engineering guidelines for the design and construction of the proposed development.

6.1 Recommendations for Road Widening and Extension

6.1.1 Pavement Structure

The pavement structures of the municipal roads should be designed in accordance with Development Requirements Manual, Transportation and Works Department, City of Mississauga (effective January 2020) and the pavement structure of the regional road should be referred to Design, Standards Specification and Procedures, Region of Peel (Region). The recommended minimum pavement structures are presented in Table 5.

Table 05: Minimum Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Municipal Road derived from Manual
Asphaltic Concrete (OPSS 310 / 1150)	92 to 96.5% MRD[1]	40 mm HL1[4] 100 mm HDBC (50 mm, 2 lift)
Granular A Crusher Run Limestone (OPSS 1010)	100% SPMDD[2]	200 mm
Granular B Type II Crusher Run Limestone (OPSS 1010)	100% SPMDD[2]	325 mm (minimum), match or exceed adjacent subbase

Pavement Layer	Compaction Requirements	Regional Road derived from Manual
Asphaltic Concrete (OPSS 310 / 1150)	92 to 96.5% MRD[1]	50 mm HL1[4] 100 mm HDBC/HL8 (HS) (50 mm, 2 lift)
Granular A Crusher Run Limestone (OPSS 1010)[3]	100% SPMDD[2]	150 mm
Granular B Type II Crusher Run Limestone (OPSS 1010)[3]	100% SPMDD[2]	450 mm (minimum), match or exceed adjacent subbase

Notes: 1. MRD – Maximum relative density
2. SPMDD - Denotes standard Proctor maximum dry density, MTO LS-706 (Procedure 3)
3. According to City Standard 2220.010, 19 mm crusher run (CR) limestone may be substituted for the Granular A and 50 mm crusher run limestone may be substituted for the Granular B. However, mixing of material types within the same road structure will not be permitted.
4. HL1 may be substituted for DFC.

All intersections constructed within the Region's ROW shall follow Region's specifications. Performance Graded Asphalt Cements (PGAC) for all mixes shall be 70-28.

Within the subject pavement sections evaluated in this project, the subgrade type is predominately reworked or native clayey silt till. The City of Mississauga and the Region of Peel pavement design for the local road usage should satisfy the required traffic loading. The materials being used in this project should comply with the City / Region's material specifications or OPSS. Detailed pavement design based on the AASHTO method could be carried out if additional traffic information such as projected AADT and percent truck value is provided.

Abrupt differential settlements may be caused between the widening and the existing roads, and result in major cracking affecting the performance of a flexible pavement. Therefore, it is recommended that the pavement structures of the road widening should be close to those of the existing road sections, if at all feasible.

The upper 300 mm of the subgrade of the proposed pavement widening and extension should be compacted to 98% SPMDD and 95% below. As part of the subgrade preparation, the reconstruction areas should be stripped of obviously unsuitable materials. Fill required to raise the grades to design elevations should be organic-free and at a moisture content which will permit compaction to the densities indicated. The subgrade should be properly shaped, crowned, then proof-rolled in the full-time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD.

The foregoing design in Table 05 assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of granular material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped (preferably at a minimum gradient of 2 - 3%) to provide effective surface drainage toward catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. As per City Standard 2220.040, subdrains are to be required along the entire length of the roadways. Subdrains are utilized to intercept excess subsurface moisture and to prevent subgrade softening.

6.1.2 Other Design Considerations

Frost Penetration Depth

The frost penetration depth for the pavement design purposes of this project is considered as 1.2 m, according to Ontario Provincial Standard Drawing OPSD 3090.101 – Foundation, Frost Penetration Depths for Southern Ontario.

Pavement Crown and Crossfall

The existing centre line of the streets should remain the same after the road widening.

The finished pavement surface should be adequately sloped (normally 2%) towards the sides to provide positive drainage. Continuity of drainage through the granular road base and subbase layers should be maintained between the existing and new pavement structures, especially in the intersection areas. In this regard, the granular thickness for any new pavement structure may have to be increased from the above recommended minimum thicknesses in some areas to match any thicker granular fill encountered under the existing pavement.

Tack Coat

Tack coat should be used between each lift of asphalt and on milled surface for both the vertical and horizontal faces at butt joint or tie-ins. The tack coat to be employed for this project should conform to OPSS.PROV 308 (April 2012). Slow setting emulsions (e.g. SS-1) are most commonly utilized by contractors for tack coat. If the construction is to be carried out in relatively cold weather or at night, SS-1H or rapid setting emulsions (e.g. RS-1) or equivalent may be considered to use as a tack coat.

Culvert Bedding, Cover and Backfill

Bedding, cover and backfill for flexible and rigid pipe culverts should be in accordance with the OPSD 802 series, if applicable. Granular A material is recommended for bedding and cover to minor culverts.

Borrow Materials

This project may involve some minor cut and fill operations located through the sections. The fill material involved in this project will likely consist of granular materials and other existing fills.

The borrow materials are not accepted within the new roadway zones, but can be used under multi-use pathway (MUP) and sidewalk where the gradation and other properties meet the specifications.

Aggregate Materials

Granular materials required for the project are Granular A, Granular B Mod and aggregate for asphalt mixes. The required aggregates to be used in hot mix asphalt production should comply with the MTO Designated Sources of Materials List – DSM No. 3.05.25.

Granular A crusher run limestone and Granular B Type II crusher run limestone will be used as base and subbase materials, respectively. In general, the existing granular materials of the streets do not meet requirements for Granular A crusher run limestone or Granular B Type II crusher run limestone. However this material can be used as Granular B Mod, subject to appropriate blending and / or scalping to meet specifications. For design purposes, the following conversion factors can be considered:

Granular A	2.2 tonnes/m^3
Granular B Mod	2.1 tonnes/m^3
Granular B, Type I	2.0 tonnes/m^3
Granular B, Type II	2.1 tonnes/m^3

6.1.3 Construction Considerations

Based on the findings from the geotechnical investigation, the existing pavement structure is considered to be in general accordance with the minimum requirement of a Local Industrial Road specified in the Development Requirements Manual, Transportation and Works Department, City of Mississauga (effective January 2020) or a regional road of Design, Standards Specification and

Procedures, Region of Peel. As such, the pavement could be widened or extended to match with the existing asphalt structures.

Excavation and Groundwater Control

Excavation will be made through surficial covers, fill materials (clayey silt) and native clayey silt till. Excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the soils at this site may be classified as:

- Granular base and subbase — Type 3 soil above water level
- Fills — Type 3 soil above water level
- Clayey silt till — Type 2 soil above / below water level

Where workers must enter excavations extending deeper than 1.2 m, the trench walls must be suitably sloped and / or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

The excavation for road widening and extension is most likely to be carried out above water table. However, some seepage into the excavation should be expected, but the seepage rate should be slow, due to the presence of the fine-grained till, and it should be feasible to control the flow by gravity drainage and pumping from filtered sumps.

Additional Comments

The location and extent of subdrainage required within the paved areas should be comply with the relevant engineering design criteria of the City and the Region.

To prevent water ponding at the lower pavement areas, it is recommended that catchbasins should be provided to drain the surface run-offs.

To minimize the problems of differential movement between the pavement and catchbasins / manholes due to frost action, the backfill around the structures should consist of free-draining granular. In addition, the catchbasin should be perforated just above the drain and the holes screened with filter cloth.

The most severe loading conditions on the pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.

6.2 Recommendations for Site Services Construction

We understand that the project may include sewer installation along the east extension of Alstep Drive. The excavations are expected to extend to a maximum depth of about 3.5 m below road surface.

6.2.1 Trench Excavation

As indicated in the borehole logs, below the surficial covers and fills, the trenches will likely be excavating through very stiff to hard clayey silt till. It should be noted that the till deposit may contain cobbles and possibly boulders.

All excavations must be carried out in accordance with the Occupation Health and Safety Act (OHSA) O. Reg. 213/91. In accordance with OHSA, the soils can be classified as follows:

- Fills — Type 3 soil above water level
- Clayey silt till — Type 2 soil above / below water level

At this road section, the groundwater level was considered below an approximate minimum depth of 1.5 m. Therefore, the trenching is likely to be carried out below the interpreted long term groundwater table. However, the anticipated soil generally consists of a low permeability clayey silt till and in short term conditions, significant groundwater seepages into the trench is not anticipated. Any groundwater or precipitations is expected to be able to be controlled by pumping from local sumps excavated in the low areas.

The temporary unsupported cut slopes should be excavated in accordance with the OHSA regulations and should be visually monitored for any movement especially if workers are present within the excavation. These slopes should only be utilized for a short duration.

Services bearing soils are susceptible to disturbance from construction activity. Care should be taken during excavation and construction to minimize disturbance of the bearing soil. Stabilization of wet subgrades may be required where wet sandy seams or zones are encountered. Disturbance of the underlying soils during construction of the proposed pipe installation could influence future settlements of the proposed structures.

Excavation safety and stability of temporary construction slopes and lateral support systems are the Contractor's responsibility.

Stockpiles should be placed away from the edge of the excavation and their height should be controlled so they do not surcharge the sides of the excavation. Surface drainage should be controlled to prevent flow of surface water into the excavations.

6.2.2 Trench Box

Where roadway allowance or construction sequence restricts the above mentioned side slope configurations, or surface loading applies (e.g. traffic), the excavation side slope should be appropriately shored to support the excavation sidewalls during construction.

Where permissible under the OHSA, the preferred temporary trench support is generally in the form of trench boxes. Consideration should be given to the time taken between completing the excavation section and installing the trench boxes. Trench boxes are to be installed quickly and efficiently. When a trench box is to be moved, the void space between the trench box's outer walls and the trench is to be backfilled and compacted, which may require the trench box to be raised sequentially prior to sliding it laterally into its new position.

It is also important to ensure that the trench is not over-excavated so that there is a suitably tight fit between the trench box and the excavated trench walls. Post-construction ground settlements will occur along the line of the trench walls, or adjacent the excavated trench area, if the excavation is not adequately supported throughout the entire watermain installation procedure.

The earth pressure acting on trench box bracing may be evaluated using the earth pressure diagram given on Drawing No. 22.

6.2.3 Pipe Bedding

The undisturbed very stiff to hard clayey silt till is expected to be able to provide adequate support for the pipe installation and allow the use of normal Class B type bedding (OPSD 802.03 series). Class B sewer trench bedding is to be used as per City Standard 2112.080. Sewer bedding and cover material shall conform with City Standard 2112.090 and 2112.100, respectively. If water is present in the trench excavation, then 19 mm clear stone or 6 mm washed crushed gravel is to be used for bedding in accordance with City Standards 2112.110 and 2112.140, respectively.

Where wet or soft trench subgrade conditions are encountered, further on-site geotechnical assessment may be required to determine or re-examine the appropriate bedding in order to stabilize the subgrade for sewer construction (i.e. increase in bedding thickness, stone immersion techniques, leak proofing or wrapping of sewer pipe joints, Class A bedding, etc.).

Where fill materials are encountered at pipe invert level, the fill materials should be visually inspected. Fill materials containing organics, vegetation, debris, or are soft or wet and are unsuitable for pipe support should be excavated and replaced with clean fills or pipe bedding materials. The depth of sub-excavation should be determined during construction. The fill

subgrade should be proof-rolled and any soft spots encountered should be sub-excavated and backfilled with similar materials or bedding materials.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm and should comply with OPSD 802.01 and 802.03 series. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered. This is also applicable in area where fill materials in existing trenches are encountered at the subgrade level. The bedding material should consist of well graded granular material such as Granular A or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the crown of the pipe and 500 mm on each side of the pipe, or as set out by the local authority, should be placed.

If high performance bedding is used, a suitable, approved filter fabric (geotextile) is required to avoid contamination of the bedding through the loss of soil fines from the subgrade. The geotextile should extend along the sides of the trench and should be wrapped all around the bedding material.

6.2.4 Backfilling

The excavated soils free from organics and construction debris can be considered for reuse as general construction backfill. On-site verification of the excavated materials for re-use as backfill by suitably qualified personnel, during construction, would be required. If the soil becomes saturated due to precipitation, it will require partial drying or remove and dispose off-site. The use of granular backfill may therefore be required in this case.

The on-site excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as Granular B (OPSS 1010) should be used.

Trench backfilling shall comply with the City's Engineering Policy Statement as provided in the Development Requirements Manual (Section 4.02.06 - Trench backfilling on Roads). Where the excavated inorganic native subsoil is used for trench backfilling, the backfill should be placed in maximum 200 mm thick layers, and compacted to a minimum of 95% SPMDD within 2% of optimum moisture content. The top 1 m of the subgrade is to be compacted to a minimum of 98% of SPMDD at 2 - 3% drier than optimum moisture content. Unsuitable materials such as organic soils, obstructions, frozen soils, etc. should not be used for backfilling.

Suitable granular backfill is required adjacent to manholes, catchbasins and service connections.

The on-site excavated soils should not be used in confined areas (e.g. narrow trenches) where heavy compaction equipment cannot be operated. The use of imported granular fill would be preferable in confined areas and around structures, as per the local authority requirements.

6.2.5 Thrust Block and Restrained Joints

Thrust blocks may be used in native soils to resist the unbalanced internal pressure in the pipe. The thrust blocks should be cast directly against undisturbed native inorganic soils. For thrust blocks constructed in soil, the ultimate lateral resistance can be taken as passive pressure of the soil, plus the friction at the base of the thrust blocks. The passive pressure can be calculated use following equation:

$$p = K_p \gamma' h$$

where p = lateral earth pressure in kPa acting at depth h

K_p = passive earth pressure coefficient, recommend 3.4 and 2.8 for sandy soils and clayey soils, respectively

γ' = effective unit weight of soil, recommend 21 kN/m^3 above groundwater table and 11 kN/m^3 below groundwater table

h = depth below finished grade in m

The friction at the base depends on the soil type and strength, such that:

- For undrained conditions – clayey soils

$$\tau_b = S_u$$

where S_u = undrained shear strength, recommend 200 kPa

- For drained conditions – uncemented sands and gravels

$$\tau_b = \gamma' h \tan \emptyset$$

where $\emptyset$ = friction angle, recommend 33 degree

Considerations can also be given to use restrained joints instead of thrust blocks.

7. Soil Chemistry

Selected soil samples were submitted to an analytical laboratory, accredited by the Canadian Association for Laboratory Accreditation (CALA), for chemical testing in order to check conformance with Ministry of the Environment, Conservation and Parks (MECP) document "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" – April 15, 2011 (MECP Standards) in accordance with Ontario Regulation (O.Reg.) 153/04, as amended. As per our authorized scope, the soil samples were analyzed for selected Metals and Inorganic Parameters.

The chemical testing was carried out to assist in the selection of disposal options for excess material to be generated during proposed road widening construction activities. Based on the soil stratigraphy as revealed in the boreholes, the soil encountered is visually assessed as medium textured and therefore the criteria for medium and fine textured soils from the MECP Standards were applied to the site.

Sample location data is shown below and Certificates of Analyses for the selected inorganic parameters are attached in Appendix C for your reference.

Table 06: Sample and Test Performed

Borehole / Sample No.	Depth (m)	Material / Soil Type	Test Performed
BH 3 / AS 1	0.1 – 1.1	Fill	Soil - Selected metals and inorganic parameters
BH 6 / AS 2	1.1 – 2.0	Clayey silt till	Soil - Selected metals and inorganic parameters
BH 8 / AS 1	0.0 – 1.0	Fill	Soil - Selected metals and inorganic parameters
BH 11 / SS 1	0.0 – 0.6	Fill	Soil - Selected metals and inorganic parameters
BH 15 / SS 1	0.0 – 0.6	Fill	Soil - Selected metals and inorganic parameters
BH 17 / SS 3	1.5 – 2.0	Clayey silt till	Soil - Selected metals and inorganic parameters

Comparison with the criteria in Table 3 (non-potable groundwater) from the previously mentioned MECP document was selected as being most appropriate for the purpose of this study. The selection of Table 3 was based on the following site conditions:

- The property has not been identified as a sensitive site.
- The groundwater is not in use for potable purposes.

- Full restoration of contamination (if encountered) is assumed.

Based on the property use of the site (public roadways), Industrial / Commercial / Community (ICC) property use criteria under the Standards were considered to be applicable.

With the exception of elevated levels of Electrical Conductivity (EC) and Sodium Adsorption Ration (SAR) in the tested samples from Borehole 3 (sample depth 0.1 - 1.1 m below grade) and Borehole 6 (sample depth 1.1- 2.0 m), the results of analytical testing indicated conformance of the tested soil samples with the Table 3 ICC property use criteria adopted for the Site.

It should be noted that EC and SAR are ecological effect parameters and not health related parameters and therefore, in isolation, not considered cause for significant concern. The elevated level of EC and SAR is generally related to application of de-icing salt in winter months.

EC and SAR parameters are not hazardous to human health but may interfere with the growth of certain vegetation species. Soils with elevated levels of EC and SAR in isolation are not considered a significant environmental concern in general. In accordance with "Rules for Soil Management and Excess Soil Quality Standards" in O. Reg. 406/19 (On-Site and Excess Soil Management), the subject soil can be reused in the following situations:

- where it is reasonable to expect that the soil will be affected by the same chemicals (EC ad SAR) as a result of continued application of a substance for the safety of vehicular or pedestrian traffic under conditions of snow or ice; or

- within an industrial or commercial property to which non-potable standards would be applicable; or

- buried at least 1.5 metres below the surface of the soil.

The excess soil with elevated EC and SAR is not to be finally placed:

- within 30 metres of a waterbody;

- within 100 metres of a potable water well or area with an intended property use that may require a potable water well;

- within 2 metres above the watertable; or

- on property that will be used for growing crops or pasturing livestock unless the excess soil is placed 1.5 metres or greater below surface.

8. General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the geotechnical conditions of the subject property. The conclusions presented in this report reflect site conditions existing at the time of the investigation.

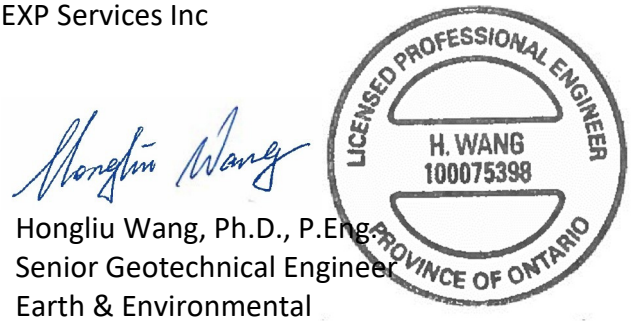
EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information, with respect to the conditions between samples, or the lateral and vertical extent of materials, may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, EXP Services Inc. should be contacted to assess the situation and additional testing and reporting may be required. EXP Services Inc. has qualified personnel to provide assistance in regards to future geotechnical and environmental issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

EXP Services Inc



Stephen S. M. Cheng
Digitally signed by Stephen S. M. Cheng
Date: 2022.06.23 11:10:03 -04'00'

Hongliu Wang, Ph.D., P.Eng.
Senior Geotechnical Engineer
Earth & Environmental

Stephen S. M. Cheng, P.Eng.
Discipline Manager
Geotechnical Division

DRAWINGS

LEGEND:

Approximate Borehole Location

EXP Services Inc.

DRAWN :	HW
CHECKED :	SC
P.M. :	SC
SCALE :	NFS
PAPER SIZE :	11 x 17

BOREHOLE LOCATION PLAN

Geotechnical Investigation & Pavement Analysis

Bombardier Aerospace Project (BAP)

Mississauga, Ontario

REFERENCE : STR-02018572-00

DRAWING NO. : 1

U:\Project\STR-02018572-00 BAP Geo Investigation & Pavement Analysis, Mississauga\Drawing_STR-02018572-00-BA.xlsx

Notes on Sample Descriptions and Soil Types — Drawing 1A

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** also follow the same system. Others may use different classification systems; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETERS

CLAY (PLASTIC) TO	FINE	MEDIUM	COARSE	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of

till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

4. Excerpt from “OHSA Regulations for Construction Projects,” Part III, Section 226:

- **Soil Types**

Type 1 Soil

a) is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b) has a low natural moisture content and a high degree of internal strength;
c) has no signs of water seepage; and
d) can be excavated only by mechanical equipment.

Type 2 Soil

a) is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b) has a low to medium natural moisture content and a medium degree of internal strength; and
c) has a damp appearance after it is excavated.

Type 3 Soil

a) is stiff to firm and compact to loose in consistency or is previously excavated soil;
b) exhibits signs of surface cracking;
c) exhibits signs of water seepage;
d) if it is dry, may run easily into a well-defined conical pile; and
e) has a low degree of internal strength.

Type 4 Soil

a) is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b) runs easily or flows, unless it is completely supported before excavating procedures;
c) has almost no internal strength;
d) is wet or muddy; and
e) exerts substantial fluid pressure on its supporting system.

O. Reg. 213/91, s. 226

Log of Borehole BH1

Project No. STR-02018572-00 Drawing No. 2

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
			174.41	0
		~ 100 mm TOPSOIL	~174.3	
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, brown, moist		
			~173.3	1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
			~172.4	2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.5

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH2

Project No. STR-02018572-00 | Drawing No. 3

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)
~ 190 mm ASPHALT	173.98	0
	~173.8	
FILL: sand and gravel, trace silt, brown, moist		
	~173.0	1
CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
	~172.0	2
END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH3

Project No. STR-02018572-00 Drawing No. 4

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
			175.18	0
		~ 130 mm ASPHALT	~175.1	
		FILL: sand and gravel, trace silt, brown, moist		
			~174.0	1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
			~173.2	2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH4

Project No. STR-02018572-00 Drawing No. 5

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)
~ 155 mm ASPHALT	175.57	0
	~175.4	
FILL: sand and gravel, trace silt, brown, moist		
	~174.4	1
CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
	~173.6	2
END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH5

Project No. STR-02018572-00 | Drawing No. 6

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 150 mm ASPHALT	173.33	0
		~173.2		
		FILL: sand and gravel, trace silt, brown, moist		
		~172.2		1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
		~171.3		2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH6

Project No. STR-02018572-00 Drawing No. 7

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 135 mm ASPHALT	173.55	0
		~173.4		
		FILL: sand and gravel, trace silt, brown, moist		
		~172.4		1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
		~171.5		2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH7

Project No. STR-02018572-00 Drawing No. 8

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test S_v

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 150 mm ASPHALT	174.39	0
		~174.2		
		FILL: sand and gravel, trace silt, brown, moist		
		~173.5		1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
		~172.4		2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH8

Project No. STR-02018572-00 Drawing No. 9

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
			174.52	0
		~ 100 mm TOPSOIL	~174.4	
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, brown, moist		
			~173.5	1
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
			~172.5	2
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.4

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH9

Project No. STR-02018572-00 Drawing No. 10

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit —○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 160 mm ASPHALT	174.35	0
		FILL: sand and gravel, trace silt, brown, moist	~174.2	
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist	~173.4	1
		END OF BOREHOLE	~172.3	2

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH10

Project No. STR-02018572-00 Drawing No. 11

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 29, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 190 mm ASPHALT	175.29	0
		FILL: sand and gravel, trace silt, frequent clayey silt inclusions, brown, moist	~175.1	
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist	~174.6	1
		END OF BOREHOLE	~173.3	2

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH11

Project No. STR-02018572-00 | Drawing No. 12

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength 100 200 kPa	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		~ 50 mm TOPSOIL	173.61	0				
		~173.6						
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, dark brown to brown, moist, loose			9	×		19.2
		~173.1						
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist, very stiff to hard		1	23	×		21.7
					40	×		22.2
		~171.5		2				
		END OF BOREHOLE						

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.5

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH12

Project No. STR-02018572-00 | Drawing No. 13

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 250 mm ASPHALT	173.27	0
		FILL: sand and gravel, trace silt, brown, moist	~173.0	
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist	~172.3	1
		END OF BOREHOLE	~171.3	2

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH13

Project No. STR-02018572-00 | Drawing No. 14

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~ 200 mm TOPSOIL	173.17	0				
			~173.0					
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, black to brown, moist, loose			7	×		
				1	8	×		
			~171.6					
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist, hard			19	×		21.9
			~171.0	2				
		END OF BOREHOLE						

SPT (N Value): 20 40 60 80
Shear Strength kPa: 100 200
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.5

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH14

Project No. STR-02018572-00 | Drawing No. 15

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~ 150 mm TOPSOIL	173.98	0				
			~173.8					
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, dark brown to brown, moist, compact			11			22.4
			~173.4					
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist, hard		1	38			22.4
					66 / 280mm			21.0
			~172.0					
		END OF BOREHOLE						

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.5

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

exp.

Log of Borehole BH15

Project No. STR-02018572-00 Drawing No. 16

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)	Natural Unit Weight kN/m³
	173.09		
~ 50 mm TOPSOIL	~173.0	0	
FILL: clayey silt, trace sand, trace gravel, trace rootlets, dark brown to brown, moist, loose			20.1
CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist, very stiff to hard	~172.2	1	21.7
	~171.0	2	22.4
END OF BOREHOLE			

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

7
22
30

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.4

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH16

Project No. STR-02018572-00 Drawing No. 17

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 170 mm ASPHALT	173.07	0
		FILL: sand and gravel, trace silt, brown, moist	~172.9	
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist	~172.1	1
		END OF BOREHOLE	~171.1	2

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Sample
Natural Unit Weight kN/m³

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open

Log of Borehole BH17

Project No. STR-02018572-00 | Drawing No. 18

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

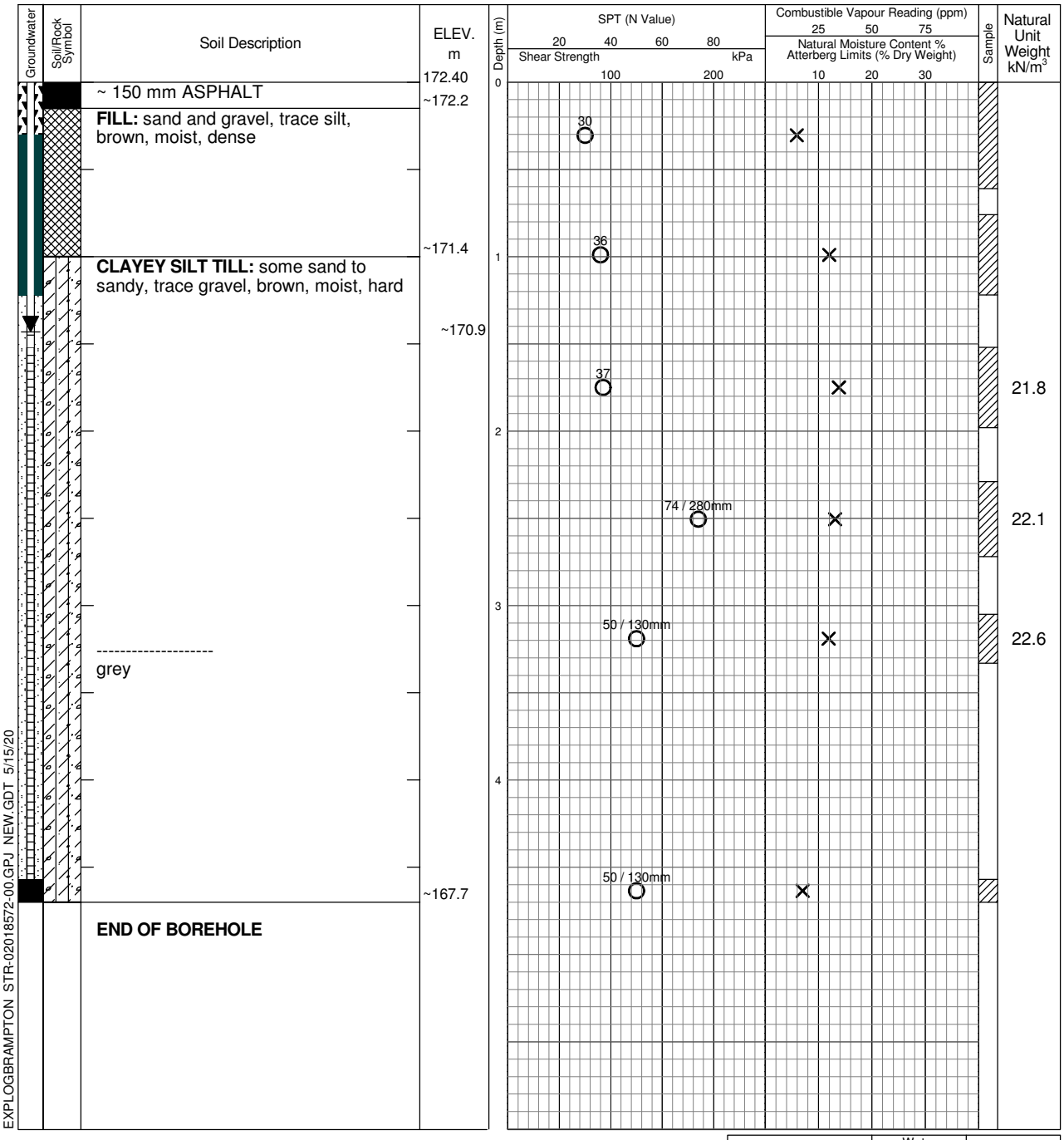
Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	4.6
Apr. 28, 2020	1.28	-
May 12, 2020	1.45	-

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/15/20

Log of Borehole BH18

Project No. STR-02018572-00 Drawing No. 19

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 150 mm TOPSOIL	173.37	0
		FILL: clayey silt, trace sand, trace gravel, trace rootlets, brown, moist	~173.2	
		CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist	~172.5	1
		END OF BOREHOLE	~171.2	2

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.4

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH19

Project No. STR-02018572-00 Drawing No. 20

Project: Geotechnical Investigation and Pavement Analysis Sheet No. 1 of 1

Location: Mississauga, Ontario

Date Drilled: Apr. 27, 2020

Drill Type: Auger Drill - Solid

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)
	173.15	0
~ 100 mm TOPSOIL	~173.1	
FILL: clayey silt, trace sand, trace gravel, trace rootlets, brown, moist		
	~172.0	1
CLAYEY SILT TILL: some sand to sandy, trace gravel, brown, moist		
	~171.0	2
END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m³

Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	1.5

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/7/20

Log of Borehole BH20

Project No. STR-02018572-00 | Drawing No. 21

Project: Geotechnical Investigation and Pavement Analysis | Sheet No. 1 of 1

Location: Mississauga, Ontario

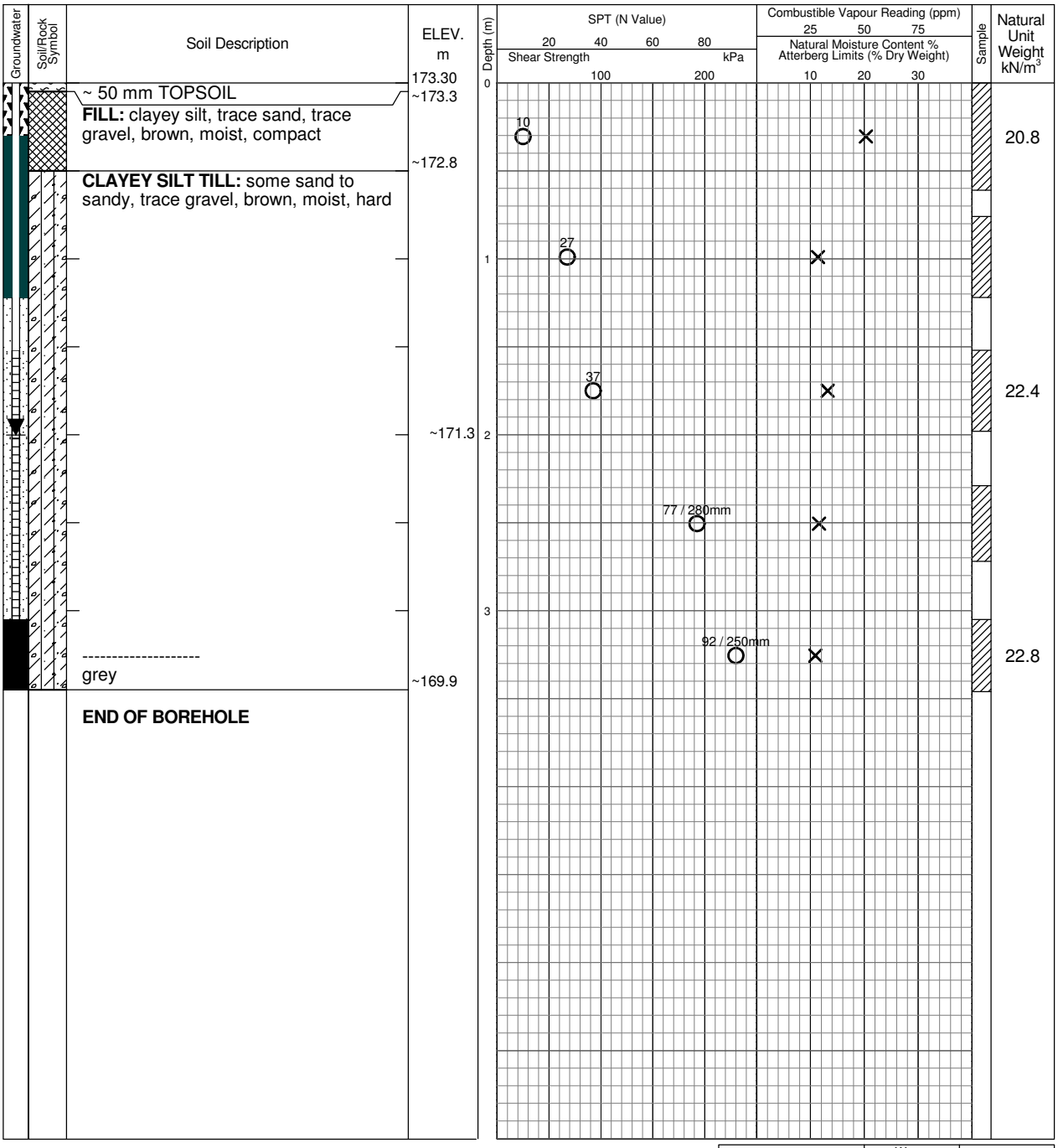
Date Drilled: Apr. 24, 2020

Drill Type: CME 75 - Truck Mount

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

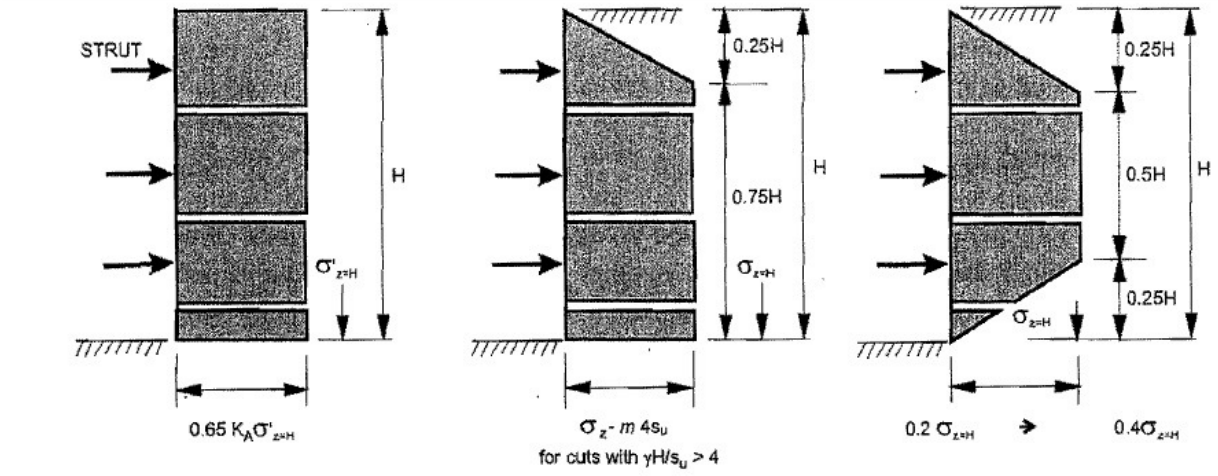
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



Elapsed Time	Water Level (m)	Hole Open to (m)
0n completion	dry	open
Apr. 28, 2020	dry	-
May 12, 2020	2.02	-

EXPLOGBRAMPTON STR-02018572-00.GPJ NEW.GDT 5/15/20

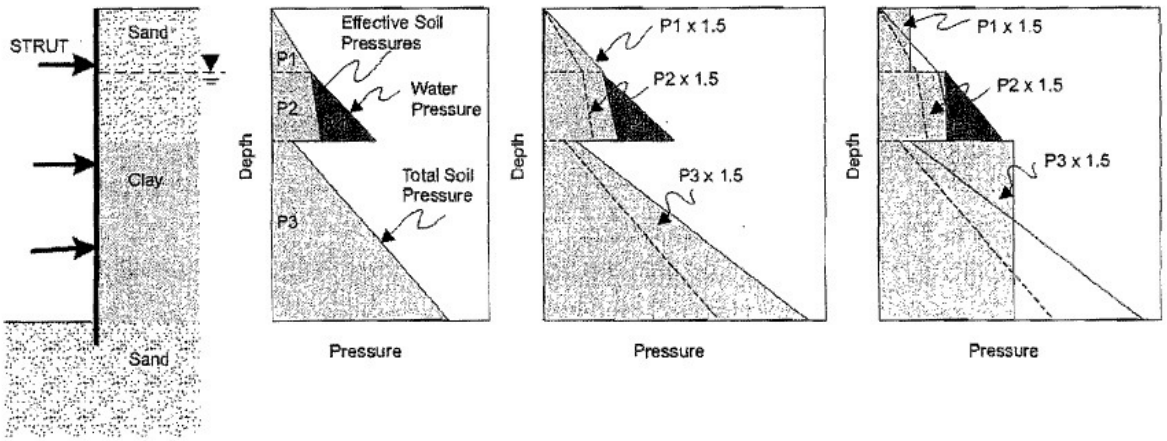
Project: STR-02018572-00 **Drawing No. 22**



a) granular soils

b) soft to firm cohesive soils (see text for *m*)

c) stiff to hard cohesive soils



d) method for estimating apparent earth pressures for layered soils

FIGURE 26.8 *Apparent earth pressure distributions*

APPARENT EARTH PRESSURE DISTRIBUTION

Source: Canadian Geotechnical Society (2006). "*Canadian Foundation Engineering Manual*", 4th Edition, Section 26.10.3 - Supported Excavations & Flexible Retaining Structures / Multi-Anchor, Multiple-Raker and Internally Braced (Strutted) Retaining Structures / Braced Retaining Structures Loading Conditions

APPENDICES

APPENDIX A

Pavement Photographs and Flexible Pavement Condition Evaluation Form

Derry Road E and Bramalea Rd Intersection

Photo 1: Longitudinal and Transverse Cracking (Slight to Moderate Severity)-Bramalea Road WB

Photo 2: Localized Patch and Alligator Cracking (Slight to Moderate Severity)- Bramalea Road WB

Photo 3: Catch Basin Settlement and Transverse Cracking turning to Alligator Cracking (Slight to Moderate Severity)-Bramalea Road WB

Photo 4: Localized Potholes and Cracking (Slight to Moderate Severity)-Bramalea Road WB

Photo 5: Localized Patch Repair Due to Utility Repair- Bramalea Road WB

Photo 6: Transverse Cracking (Moderate Severity)-Bramalea Road EB

Photo 7: Localized Utility Cut- Bramalea Road

Photo 8: Localized Alligator Cracking (Moderate Severity)-Bramalea Road EB

Photo 9: Transverse and Longitudinal Cracking (Slight to Moderate Severity)-Bramalea Road EB

Photo 10: Transverse and Longitudinal Cracking (Low to Moderate Severity)-Bramalea Road WB

Photo 11: Localized Transverse Cracking (Slight Severity)- Derry Road E NB

Photo 12: Ravelling (Slight Severity)- Derry Road E NB

Photo 13: Localized Transverse Cracking (Slight Severity)- Derry Road E NB

Derry Road E and Telford Way/Menkes Drive Intersection

Photo 14: Localized Transverse and Longitudinal Cracking (Slight Severity)- Telford Way EB

Photo 15: Edge Breaking and Transverse Cracking (Slight to Moderate Severity)- Telford Way

Photo 16: Localized Random Cracking (Moderate Severity)- Menkes Dr

Photo 17: Localized Random Cracking (Slight to Moderate Severity)- Menkes Dr

Photo 18: Ravelling (Slight Severity)- Menkes Dr

Photo 19: Ravelling (Slight Severity)- Derry Road E NB

Photo 20: Ravelling (Low Severity)- Derry Road E SB

Bramalea Road

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: Logistic Drive **To:** FedEx Entrance

LHRS ____ km (BEGINS / OFFSET) **Section** 0.5 km (LENGTH)

Survey Date 2019 12 (YEAR / MONTH)

PCR 60 **RCR** 6.0

Contract No. ____

WP No. ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LA NES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class C — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h) — X

- 10 **EXCELLENT** Smooth and pleasant
- 8 **GOOD** Comfortable
- 6 **FAIR** Uncomfortable
- 4 **POOR** Very rough and bumpy
- 2 **VERY POOR** Dangerous at 80 km/h
- 0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few <10	Intermittent 10-20	Frequent 20-50	Extensive 50-80	Throughout 80-100	
			(wi)	0.5	1	2	3	4	0.5	1	2	3	4	
Surface Defects	Ravelling & C. Agg. Loss	1	3.0			x							x	18.00
	Flushing	2	1.5											0.00
Surface Deformations	Rippling and Shoving	3	1.0											0.00
	Wheel Track Rutting	4	3.0											0.00
	Distortion	5	3.0											0.00
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5		x					x				3.00
	Alligator	7	3.0			x				x				9.00
Cracking — Centre Line	Single and Multiple	8	0.5			x					x			2.00
	Alligator	9	2.0			x				x				6.00
Cracking — Pavement Edge	Single and Multiple	10	0.5											0.00
	Alligator	11	1.5											0.00
Cracking — Transverse	Half, Full and Multiple	12	1.0			x					x			4.00
	Alligator	13	3.0			x					x			12.00
Cracking — Long Meander and Midlane		14	1.0		x						x			3.00
Cracking — Random		15	0.5											0.00
IRI from Ride Comfort Rating (RCR):			2.2											57.00
Back-calculated PCI Value:			63									**DMI**	7.26	

Shoulders		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Dominant Type										
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, %: <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above) ____

Other Comments (e.g. subsections, additional contracts) ____

Evaluated by R. Islam

Derry Road East at Bramalea Rd

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: 150 m South of Bramalea Road **To:** 250 m North of Bramalea Road

LHRS ____ km (BEGINS / OFFSET) **Section** 0.4 km (LENGTH)

Survey Date 2019 (YEAR) 12 (MONTH)

PCR 90 **RCR** 9.0

Contract No. ____ **WP No.** ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LA NES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class A — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h) — X

- 10 **EXCELLENT** Smooth and pleasant
- 8 **GOOD** Comfortable
- 6 **FAIR** Uncomfortable
- 4 **POOR** Very rough and bumpy
- 2 **VERY POOR** Dangerous at 80 km/h
- 0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few <10	Intermittent 10-20	Frequent 20-50	Extensive 50-80	Throughout 80-100	
			(wi)	0.5	1	2	3	4	0.5	1	2	3	4	
Surface Defects	Ravelling & C. Agg. Loss	1	3.0	x							x			7.50
	Flushing	2	1.5											0.00
Surface Deformations	Rippling and Shoving	3	1.0											0.00
	Wheel Track Rutting	4	3.0											0.00
	Distortion	5	3.0											0.00
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5											0.00
	Alligator	7	3.0											0.00
Cracking — Centre Line	Single and Multiple	8	0.5											0.00
	Alligator	9	2.0											0.00
Cracking — Pavement Edge	Single and Multiple	10	0.5											0.00
	Alligator	11	1.5											0.00
Cracking — Transverse	Half, Full and Multiple	12	1.0	x					x					1.00
	Alligator	13	3.0											0.00
Long Meander and Midlane		14	1.0											0.00
Random		15	0.5											0.00
IRI from Ride Comfort Rating (RCR):			0.9											8.50
Back-calculated PCI Value:			94										DMI 9.59	

Shoulders: Dominant Type		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above) ____

Other Comments (e.g. subsections, additional contracts) ____

Evaluated by R. Islam

Telford Way

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: Derry Road **To:** Tranmere Dr

LHRS ____ km (BEGINS / OFFSET) **Section** 0.15 km (LENGTH)

Survey Date 2019 12 (YEAR / MONTH)

PCR 80 **RCR** 8.0

Contract No. ____

WP No. ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LA NES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class C — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h)

10 **EXCELLENT** Smooth and pleasant
8 **GOOD** Comfortable (X)
6 **FAIR** Uncomfortable
4 **POOR** Very rough and bumpy
2 **VERY POOR** Dangerous at 80 km/h
0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few <10	Intermittent 10-20	Frequent 20-50	Extensive 50-80	Throughout 80-100	
			(wi)	0.5	1	2	3	4	0.5	1	2	3	4	
Surface Defects	Ravelling & C. Agg. Loss	1	3.0		x								x	15.00
	Flushing	2	1.5											0.00
Surface Deformations	Rippling and Shoving	3	1.0											0.00
	Wheel Track Rutting	4	3.0											0.00
	Distortion	5	3.0											0.00
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5		x				x					2.25
	Alligator	7	3.0		x				x					4.50
Cracking — Centre Line	Single and Multiple	8	0.5											0.00
	Alligator	9	2.0											0.00
Cracking — Pavement Edge	Single and Multiple	10	0.5											0.00
	Alligator	11	1.5		x				x					2.25
Cracking — Transverse	Half, Full and Multiple	12	1.0		x				x					1.50
	Alligator	13	3.0											0.00
Cracking — Long Meander and Midlane		14	1.0		x				x					1.50
Cracking — Random		15	0.5											0.00
IRI from Ride Comfort Rating (RCR):			1.2											27.00
Back-calculated PCI Value:			83											

DMI 8.70

Shoulders: Dominant Type		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above)

Other Comments (e.g. subsections, additional contracts)

Evaluated by R. Islam

Menkes Dr

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: Derry Road **To:** Alstep Dr

LHRS ____ km (BEGINS / OFFSET) **Section** 0.15 km (LENGTH)

Survey Date 2019 (YEAR) 12 (MONTH)

PCR 80 **RCR** 8.0

Contract No. ____ **WP No.** ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LA NES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class C — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h)

10 **EXCELLENT** Smooth and pleasant
X 8 **GOOD** Comfortable
6 **FAIR** Uncomfortable
4 **POOR** Very rough and bumpy
2 **VERY POOR** Dangerous at 80 km/h
0

Pavement		Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few <10	Intermittent 10-20	Frequent 20-50	Extensive 50-80	Throughout 80-100	
				(wi)	0.5	1	2	3	4	0.5	1	2	3	4	
Surface Defects		Ravelling & C. Agg. Loss	1	3.0		x							x	x	12.00
		Flushing	2	1.5											0.00
Surface Deformations		Rippling and Shoving	3	1.0											0.00
		Wheel Track Rutting	4	3.0											0.00
		Distortion	5	3.0											0.00
Cracking	Longitudinal Wheel Track	Single and Multiple	6	1.5											0.00
		Alligator	7	3.0											0.00
	Centre Line	Single and Multiple	8	0.5											0.00
		Alligator	9	2.0											0.00
	Pavement Edge	Single and Multiple	10	0.5											0.00
		Alligator	11	1.5		x				x					2.25
	Transverse	Half, Full and Multiple	12	1.0			x			x					2.50
		Alligator	13	3.0											0.00
	Long Meander and Midlane		14	1.0		x				x					1.50
	Random		15	0.5			x			x					1.25
IRI from Ride Comfort Rating (RCR):				1.2											19.50
Back-calculated PCI Value:				87											

DMI 9.06

Shoulders: Dominant Type		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above)

Other Comments (e.g. subsections, additional contracts)

Evaluated by R. Islam

Derry Road East at Telford Dr

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: 150 m North of Telford Way **To:** 150 m South of Telford Way

LHRS ____ km (BEGINS / OFFSET) **Section** 0.3 km (LENGTH)

Survey Date 2019 (YEAR) 12 (MONTH)

PCR 90 **RCR** 9.0

Contract No. ____

WP No. ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LA NES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class A — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h) — X

- 10 **EXCELLENT** Smooth and pleasant
- 8 **GOOD** Comfortable
- 6 **FAIR** Uncomfortable
- 4 **POOR** Very rough and bumpy
- 2 **VERY POOR** Dangerous at 80 km/h
- 0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few <10	Intermittent 10-20	Frequent 20-50	Extensive 50-80	Throughout 80-100	
			(wi)	0.5	1	2	3	4	0.5	1	2	3	4	
Surface Defects	Ravelling & C. Agg. Loss	1	3.0	x							x			7.50
	Flushing	2	1.5											0.00
Surface Deformations	Rippling and Shoving	3	1.0											0.00
	Wheel Track Rutting	4	3.0											0.00
	Distortion	5	3.0											0.00
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5											0.00
	Alligator	7	3.0											0.00
Cracking — Centre Line	Single and Multiple	8	0.5											0.00
	Alligator	9	2.0											0.00
Cracking — Pavement Edge	Single and Multiple	10	0.5											0.00
	Alligator	11	1.5											0.00
Cracking — Transverse	Half, Full and Multiple	12	1.0											0.00
	Alligator	13	3.0											0.00
Long Meander and Midlane		14	1.0											0.00
Random		15	0.5											0.00
IRI from Ride Comfort Rating (RCR):			0.9											7.50
Back-calculated PCI Value:			94											DMI 9.64

Shoulders: Dominant Type		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, % <10	10-20	20-50	50-80	>80
		1	2	3	4	5
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above) ____

Other Comments (e.g. subsections, additional contracts) ____

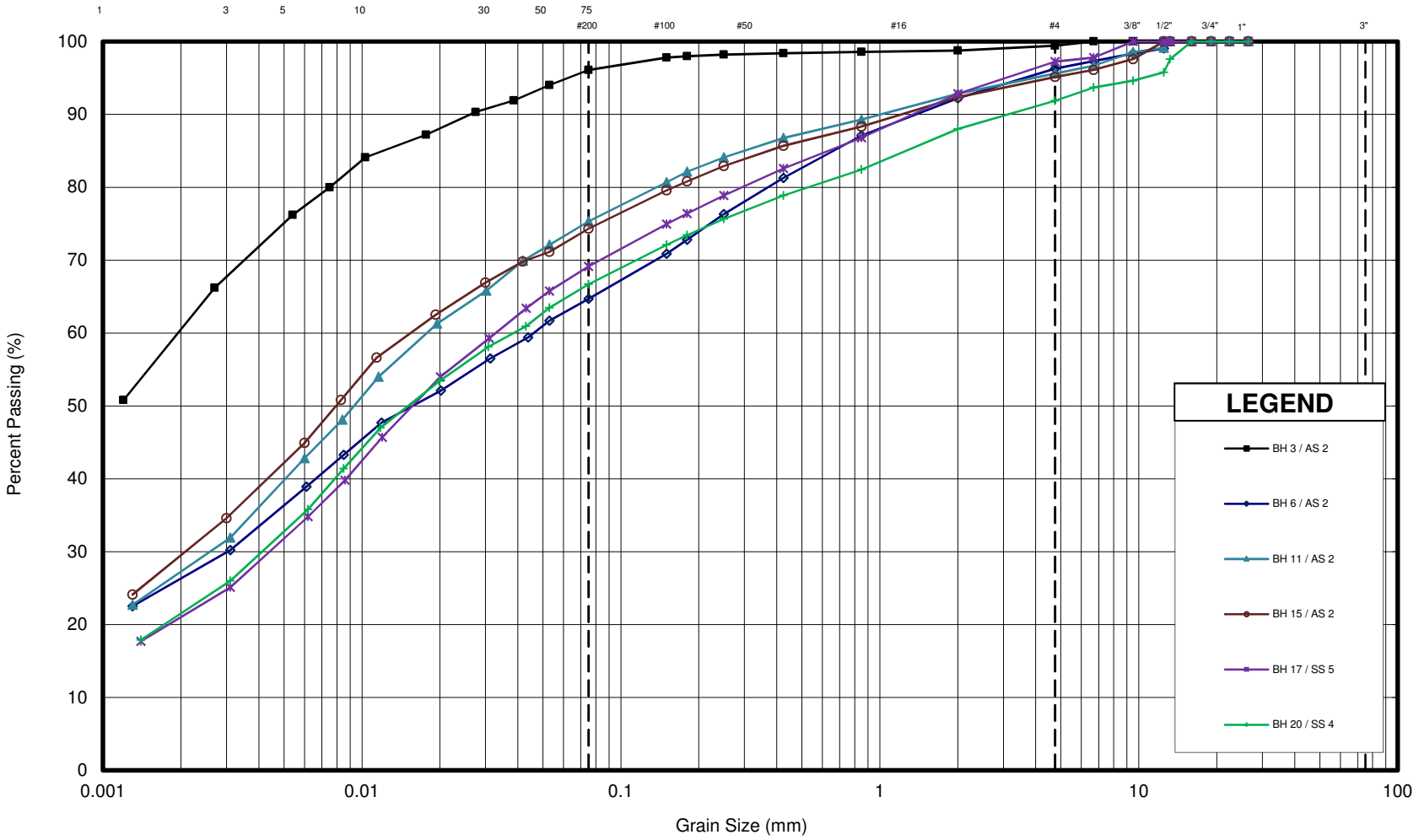
Evaluated by R. Islam

APPENDIX B

Geotechnical Laboratory Testing Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



GRAIN SIZE DISTRIBUTION

CLAYEY SILT TILL

some sand to sandy, trace gravel

FIGURE No.	1
REF. No.	STR-02018572-00
DATE	May 2020

U:\Project\STR-02018572-00 BAP Geo Investigation & Pavement Analysis, Mississauga\Lab\Grain Size Distribution_STR-02018572-00.xlsx

APPENDIX C

Soil Chemistry Results

Your Project #: STR-02018572-00
Site Location: MISSISSAUGA
Your C.O.C. #: 138689

Attention: Hongliu Wang

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2020/05/07
Report #: R6166659
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0A5134
Received: 2020/04/29, 13:04

Sample Matrix: Soil
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Hot Water Extractable Boron	6	2020/04/30	2020/05/04	CAM SOP-00408	R153 Ana. Prot. 2011
Free (WAD) Cyanide	6	2020/04/30	2020/05/04	CAM SOP-00457	OMOE E3015 m
Conductivity	6	2020/05/04	2020/05/04	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (1)	6	2020/04/30	2020/05/01	CAM SOP-00436	EPA 3060/7199 m
Strong Acid Leachable Metals by ICPMS	2	2020/04/30	2020/05/06	CAM SOP-00447	EPA 6020B m
Strong Acid Leachable Metals by ICPMS	4	2020/05/01	2020/05/05	CAM SOP-00447	EPA 6020B m
Moisture	6	N/A	2020/04/29	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT	6	2020/05/01	2020/05/01	CAM SOP-00413	EPA 9045 D m
Sodium Adsorption Ratio (SAR)	6	N/A	2020/05/05	CAM SOP-00102	EPA 6010C

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Soils are reported on a dry weight basis unless otherwise specified.

Your Project #: STR-02018572-00
Site Location: MISSISSAUGA
Your C.O.C. #: 138689

Attention: Hongliu Wang

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2020/05/07
Report #: R6166659
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0A5134
Received: 2020/04/29, 13:04

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BV Labs Job #: C0A5134
Report Date: 2020/05/07

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

O.REG 153 METALS & INORGANICS PKG (SOIL)

BV Labs ID		MNM789			MNM789			MNM790	MNM791		
Sampling Date		2020/04/27			2020/04/27			2020/04/27	2020/04/29		
COC Number		138689			138689			138689	138689		
	UNITS	**BH 3**	**RDL**	**QC Batch**	**BH 3 Lab-Dup**	**RDL**	**QC Batch**	**BH 6**	**BH 8**	**RDL**	**QC Batch**
Calculated Parameters											
Sodium Adsorption Ratio	N/A	56		6702238				31	8.3		6702238
Inorganics											
Conductivity	mS/cm	2.6	0.002	6708416	2.6	0.002	6708416	2.3	0.49	0.002	6708416
Moisture	%	4.9	1.0	6703152				12	14	1.0	6703152
Available (CaCl2) pH	pH	8.43		6706177				7.97	7.70		6706177
WAD Cyanide (Free)	ug/g	<0.01	0.01	6704818				<0.01	0.02	0.01	6704818
Chromium (VI)	ug/g	<0.18	0.18	6704677				0.19	<0.18	0.18	6704677
Metals											
Hot Water Ext. Boron (B)	ug/g	0.22	0.050	6704467				0.18	0.15	0.050	6704467
Acid Extractable Antimony (Sb)	ug/g	<0.20	0.20	6705976	<0.20	0.20	6705976	<0.20	<0.20	0.20	6705976
Acid Extractable Arsenic (As)	ug/g	1.7	1.0	6705976	1.7	1.0	6705976	4.1	3.9	1.0	6705976
Acid Extractable Barium (Ba)	ug/g	27	0.50	6705976	29	0.50	6705976	65	92	0.50	6705976
Acid Extractable Beryllium (Be)	ug/g	<0.20	0.20	6705976	<0.20	0.20	6705976	0.64	0.73	0.20	6705976
Acid Extractable Boron (B)	ug/g	<5.0	5.0	6705976	<5.0	5.0	6705976	10	11	5.0	6705976
Acid Extractable Cadmium (Cd)	ug/g	<0.10	0.10	6705976	<0.10	0.10	6705976	0.15	0.15	0.10	6705976
Acid Extractable Chromium (Cr)	ug/g	11	1.0	6705976	11	1.0	6705976	22	23	1.0	6705976
Acid Extractable Cobalt (Co)	ug/g	3.6	0.10	6705976	3.7	0.10	6705976	11	11	0.10	6705976
Acid Extractable Copper (Cu)	ug/g	13	0.50	6705976	13	0.50	6705976	26	26	0.50	6705976
Acid Extractable Lead (Pb)	ug/g	4.0	1.0	6705976	4.1	1.0	6705976	9.6	11	1.0	6705976
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.50	6705976	<0.50	0.50	6705976	0.60	<0.50	0.50	6705976
Acid Extractable Nickel (Ni)	ug/g	6.3	0.50	6705976	6.4	0.50	6705976	26	24	0.50	6705976
Acid Extractable Selenium (Se)	ug/g	<0.50	0.50	6705976	<0.50	0.50	6705976	<0.50	<0.50	0.50	6705976
Acid Extractable Silver (Ag)	ug/g	<0.20	0.20	6705976	<0.20	0.20	6705976	<0.20	<0.20	0.20	6705976
Acid Extractable Thallium (Tl)	ug/g	0.054	0.050	6705976	0.062	0.050	6705976	0.12	0.16	0.050	6705976
Acid Extractable Uranium (U)	ug/g	0.36	0.050	6705976	0.37	0.050	6705976	0.61	0.61	0.050	6705976
Acid Extractable Vanadium (V)	ug/g	21	5.0	6705976	20	5.0	6705976	26	31	5.0	6705976
Acid Extractable Zinc (Zn)	ug/g	19	5.0	6705976	19	5.0	6705976	59	63	5.0	6705976
Acid Extractable Mercury (Hg)	ug/g	<0.050	0.050	6705976	<0.050	0.050	6705976	<0.050	<0.050	0.050	6705976

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: C0A5134
Report Date: 2020/05/07

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

O.REG 153 METALS & INORGANICS PKG (SOIL)

BV Labs ID		MNM792		MNM793		MNM794		
Sampling Date		2020/04/29		2020/04/29		2020/04/29		
COC Number		138689		138689		138689		
	UNITS	**BH 11**	**QC Batch**	**BH 15**	**QC Batch**	**BH 17**	**RDL**	**QC Batch**
Calculated Parameters								
Sodium Adsorption Ratio	N/A	1.4	6702238	0.53	6702238	1.7		6702238
Inorganics								
Conductivity	mS/cm	0.32	6708416	0.18	6708416	0.74	0.002	6708416
Moisture	%	19	6703152	18	6703152	11	1.0	6703152
Available (CaCl2) pH	pH	7.47	6706177	7.56	6706177	7.86		6706177
WAD Cyanide (Free)	ug/g	0.02	6704818	0.03	6704818	0.01	0.01	6704818
Chromium (VI)	ug/g	<0.18	6704677	<0.18	6704677	<0.18	0.18	6704677
Metals								
Hot Water Ext. Boron (B)	ug/g	0.31	6704467	0.17	6704467	0.086	0.050	6704467
Acid Extractable Antimony (Sb)	ug/g	0.43	6704281	0.23	6705976	<0.20	0.20	6704281
Acid Extractable Arsenic (As)	ug/g	5.2	6704281	3.5	6705976	3.9	1.0	6704281
Acid Extractable Barium (Ba)	ug/g	87	6704281	73	6705976	74	0.50	6704281
Acid Extractable Beryllium (Be)	ug/g	1.0	6704281	0.64	6705976	0.62	0.20	6704281
Acid Extractable Boron (B)	ug/g	7.8	6704281	9.9	6705976	9.3	5.0	6704281
Acid Extractable Cadmium (Cd)	ug/g	0.47	6704281	0.28	6705976	0.11	0.10	6704281
Acid Extractable Chromium (Cr)	ug/g	35	6704281	21	6705976	18	1.0	6704281
Acid Extractable Cobalt (Co)	ug/g	13	6704281	8.9	6705976	11	0.10	6704281
Acid Extractable Copper (Cu)	ug/g	36	6704281	22	6705976	22	0.50	6704281
Acid Extractable Lead (Pb)	ug/g	25	6704281	13	6705976	10	1.0	6704281
Acid Extractable Molybdenum (Mo)	ug/g	0.56	6704281	<0.50	6705976	<0.50	0.50	6704281
Acid Extractable Nickel (Ni)	ug/g	32	6704281	21	6705976	24	0.50	6704281
Acid Extractable Selenium (Se)	ug/g	<0.50	6704281	<0.50	6705976	<0.50	0.50	6704281
Acid Extractable Silver (Ag)	ug/g	0.54	6704281	<0.20	6705976	<0.20	0.20	6704281
Acid Extractable Thallium (Tl)	ug/g	0.20	6704281	0.14	6705976	0.15	0.050	6704281
Acid Extractable Uranium (U)	ug/g	0.66	6704281	0.82	6705976	0.72	0.050	6704281
Acid Extractable Vanadium (V)	ug/g	37	6704281	26	6705976	25	5.0	6704281
Acid Extractable Zinc (Zn)	ug/g	100	6704281	65	6705976	57	5.0	6704281
Acid Extractable Mercury (Hg)	ug/g	0.062	6704281	<0.050	6705976	<0.050	0.050	6704281

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: C0A5134
Report Date: 2020/05/07

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

TEST SUMMARY

BV Labs ID: MNM789
Sample ID: BH 3
Matrix: Soil

Collected: 2020/04/27
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6705976	2020/05/01	2020/05/05	Viviana Canzonieri
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

BV Labs ID: MNM789 Dup
Sample ID: BH 3
Matrix: Soil

Collected: 2020/04/27
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Strong Acid Leachable Metals by ICPMS	ICP/MS	6705976	2020/05/01	2020/05/05	Viviana Canzonieri

BV Labs ID: MNM790
Sample ID: BH 6
Matrix: Soil

Collected: 2020/04/27
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6705976	2020/05/01	2020/05/05	Viviana Canzonieri
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

BV Labs ID: MNM791
Sample ID: BH 8
Matrix: Soil

Collected: 2020/04/29
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6705976	2020/05/01	2020/05/05	Viviana Canzonieri
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

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BV Labs Job #: C0A5134
Report Date: 2020/05/07

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

TEST SUMMARY

BV Labs ID: MNM792
Sample ID: BH 11
Matrix: Soil

Collected: 2020/04/29
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6704281	2020/04/30	2020/05/06	Kevin Comerford
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

BV Labs ID: MNM793
Sample ID: BH 15
Matrix: Soil

Collected: 2020/04/29
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6705976	2020/05/01	2020/05/05	Viviana Canzonieri
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

BV Labs ID: MNM794
Sample ID: BH 17
Matrix: Soil

Collected: 2020/04/29
Shipped:
Received: 2020/04/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	6704467	2020/04/30	2020/05/04	Archana Patel
Free (WAD) Cyanide	TECH	6704818	2020/04/30	2020/05/04	Louise Harding
Conductivity	AT	6708416	2020/05/04	2020/05/04	Gnana Thomas
Hexavalent Chromium in Soil by IC	IC/SPEC	6704677	2020/04/30	2020/05/01	Rupinder Sihota
Strong Acid Leachable Metals by ICPMS	ICP/MS	6704281	2020/04/30	2020/05/06	Kevin Comerford
Moisture	BAL	6703152	N/A	2020/04/29	Prgya Panchal
pH CaCl2 EXTRACT	AT	6706177	2020/05/01	2020/05/01	Gnana Thomas
Sodium Adsorption Ratio (SAR)	CALC/MET	6702238	N/A	2020/05/05	Automated Statchk

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BV Labs Job #: C0A5134
Report Date: 2020/05/07

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Results relate only to the items tested.

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BV Labs Job #: C0A5134
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QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: STR-02018572-00
Site Location: MISSISSAUGA
Sampler Initials: EZ

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6703152	Moisture	2020/04/29							3.0	20
6704281	Acid Extractable Antimony (Sb)	2020/05/06	85	75 - 125	103	80 - 120	<0.20	ug/g		
6704281	Acid Extractable Arsenic (As)	2020/05/06	91	75 - 125	102	80 - 120	<1.0	ug/g		
6704281	Acid Extractable Barium (Ba)	2020/05/06	NC	75 - 125	103	80 - 120	<0.50	ug/g		
6704281	Acid Extractable Beryllium (Be)	2020/05/06	99	75 - 125	102	80 - 120	<0.20	ug/g		
6704281	Acid Extractable Boron (B)	2020/05/06	92	75 - 125	100	80 - 120	<5.0	ug/g		
6704281	Acid Extractable Cadmium (Cd)	2020/05/06	96	75 - 125	101	80 - 120	<0.10	ug/g		
6704281	Acid Extractable Chromium (Cr)	2020/05/06	92	75 - 125	99	80 - 120	<1.0	ug/g		
6704281	Acid Extractable Cobalt (Co)	2020/05/06	91	75 - 125	101	80 - 120	<0.10	ug/g		
6704281	Acid Extractable Copper (Cu)	2020/05/06	87	75 - 125	101	80 - 120	<0.50	ug/g		
6704281	Acid Extractable Lead (Pb)	2020/05/06	97	75 - 125	103	80 - 120	<1.0	ug/g		
6704281	Acid Extractable Mercury (Hg)	2020/05/06	93	75 - 125	96	80 - 120	<0.050	ug/g		
6704281	Acid Extractable Molybdenum (Mo)	2020/05/06	94	75 - 125	102	80 - 120	<0.50	ug/g		
6704281	Acid Extractable Nickel (Ni)	2020/05/06	90	75 - 125	99	80 - 120	<0.50	ug/g		
6704281	Acid Extractable Selenium (Se)	2020/05/06	95	75 - 125	103	80 - 120	<0.50	ug/g		
6704281	Acid Extractable Silver (Ag)	2020/05/06	96	75 - 125	105	80 - 120	<0.20	ug/g		
6704281	Acid Extractable Thallium (Tl)	2020/05/06	98	75 - 125	104	80 - 120	<0.050	ug/g		
6704281	Acid Extractable Uranium (U)	2020/05/06	99	75 - 125	104	80 - 120	<0.050	ug/g		
6704281	Acid Extractable Vanadium (V)	2020/05/06	NC	75 - 125	100	80 - 120	<5.0	ug/g		
6704281	Acid Extractable Zinc (Zn)	2020/05/06	NC	75 - 125	102	80 - 120	<5.0	ug/g		
6704467	Hot Water Ext. Boron (B)	2020/05/04	109	75 - 125	99	75 - 125	<0.050	ug/g	0.90	40
6704677	Chromium (VI)	2020/05/01	50 (1)	70 - 130	84	80 - 120	<0.18	ug/g		
6704818	WAD Cyanide (Free)	2020/05/04	66 (2)	75 - 125	98	80 - 120	<0.01	ug/g	4.5	35
6705976	Acid Extractable Antimony (Sb)	2020/05/05	108	75 - 125	107	80 - 120	<0.20	ug/g	NC	30
6705976	Acid Extractable Arsenic (As)	2020/05/05	101	75 - 125	104	80 - 120	<1.0	ug/g	0.60	30
6705976	Acid Extractable Barium (Ba)	2020/05/05	NC	75 - 125	104	80 - 120	<0.50	ug/g	4.9	30
6705976	Acid Extractable Beryllium (Be)	2020/05/05	102	75 - 125	103	80 - 120	<0.20	ug/g	NC	30
6705976	Acid Extractable Boron (B)	2020/05/05	100	75 - 125	110	80 - 120	<5.0	ug/g	NC	30
6705976	Acid Extractable Cadmium (Cd)	2020/05/05	104	75 - 125	105	80 - 120	<0.10	ug/g	NC	30
6705976	Acid Extractable Chromium (Cr)	2020/05/05	100	75 - 125	104	80 - 120	<1.0	ug/g	4.8	30
6705976	Acid Extractable Cobalt (Co)	2020/05/05	98	75 - 125	105	80 - 120	<0.10	ug/g	4.0	30

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6705976	Acid Extractable Copper (Cu)	2020/05/05	100	75 - 125	106	80 - 120	<0.50	ug/g	0.71	30
6705976	Acid Extractable Lead (Pb)	2020/05/05	100	75 - 125	106	80 - 120	<1.0	ug/g	2.4	30
6705976	Acid Extractable Mercury (Hg)	2020/05/05	89	75 - 125	94	80 - 120	<0.050	ug/g	NC	30
6705976	Acid Extractable Molybdenum (Mo)	2020/05/05	104	75 - 125	105	80 - 120	<0.50	ug/g	NC	30
6705976	Acid Extractable Nickel (Ni)	2020/05/05	97	75 - 125	106	80 - 120	<0.50	ug/g	0.65	30
6705976	Acid Extractable Selenium (Se)	2020/05/05	101	75 - 125	107	80 - 120	<0.50	ug/g	NC	30
6705976	Acid Extractable Silver (Ag)	2020/05/05	103	75 - 125	106	80 - 120	<0.20	ug/g	NC	30
6705976	Acid Extractable Thallium (Tl)	2020/05/05	101	75 - 125	105	80 - 120	<0.050	ug/g	14	30
6705976	Acid Extractable Uranium (U)	2020/05/05	103	75 - 125	105	80 - 120	<0.050	ug/g	1.6	30
6705976	Acid Extractable Vanadium (V)	2020/05/05	99	75 - 125	106	80 - 120	<5.0	ug/g	5.1	30
6705976	Acid Extractable Zinc (Zn)	2020/05/05	94	75 - 125	107	80 - 120	<5.0	ug/g	2.5	30
6706177	Available (CaCl2) pH	2020/05/01			98	97 - 103			0.14	N/A
6708416	Conductivity	2020/05/04			100	90 - 110	<0.002	mS/cm	0.81	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) The matrix spike recovery was below the lower control limit. This may be due in part to the reducing environment of the sample. The matrix spike was reanalyzed to confirm result.

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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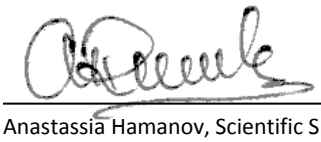
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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