540 DEALERSHIP DRIVE – GEOTECHNICAL REPORT

Project No.: CP-17-0442

Prepared for:

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September 2017

McINTOSH PERRY

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540 Dealership Drive, Ottawa, Ontario

1.0 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation performed at the above mentioned site, for the proposed construction of car dealership building in Barrhaven, Ontario. The field work was carried out on August 31, 2017 and comprised of seven boreholes advanced to a maximum depth of 10.2 m below existing ground surface.

The purpose of the investigation was to explore the subsurface conditions at this site and to provide anticipated geotechnical conditions influencing the design and construction of the proposed building.

McIntosh Perry Consulting Engineers Ltd (McIntosh Perry) carried out the investigation at the request of The Myers Group.

2.0 SITE DESCRIPTION

The property under considerations for proposed development is located at 540 Dealership Drive, off of Strandherd Drive in the south west neighbourhood of Ottawa. The road has recently been constructed, the area is relatively flat with limited development. The property to the east has been developed as a Honda dealership, the property to the west is a gravel parking lot, with a recently dug ditch separating it from the property. To the south of the property is a treeline and wet land, separating farmlands. A large part of the property has been cleared of all vegetation and graded to be relatively flat, the east side of the property was slightly higher with possible stockpiling. The southeast section of the property had not been cleared and was covered with grass and weeds.

It is understood the proposed structure will be a 2-story building, approximately 2,145 m^2, with no basement. The proposed building will be surrounded with an asphalt parking lot.

Location of the property is shown on Figure 1, included in Appendix B.

3.0 FIELD PROCEDURES

Staff of McIntosh Perry Consulting Engineers (McIntosh Perry) visited the site before the drilling investigation to mark out the proposed borehole locations. Utility clearance was carried out by USL-1 on behalf of McIntosh Perry. Public and private utility authorities were informed and all utility clearance documents were obtained before the commencement of drilling work.

The equipment used for drilling was owned and operated by CCC Geotechnical & Environmental Drilling Ltd. of Ottawa, Ontario. Boreholes were advanced using hollow and solid stem augers aided by track-mounted CME 850 drilling rig. Boreholes were advanced to a maximum depth of 10.2 m below the ground level. Soil samples were obtained at 0.75 m intervals of depth in boreholes using a 50 mm outside diameter split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure. MTO 'N' vane tests were taken to measure in-situ shear strength of cohesive material. Undisturbed soil samples were taken using a thin-wall sampler. In boreholes BH17-3, BH17-4, and BH17-5 the investigation was advanced from the surface or beyond the sampled depth with Dynamic Cone Penetration Tests (DCPT) to the termination depth. Boreholes were backfilled with auger cuttings. All boreholes were restored to match the original surface. Borehole locations are shown on Figure 2, included in Appendix B.

A traffic control plan was prepared and implemented according to Ontario Traffic Manual Book 7.

4.0 LABORATORY TEST PROCEDURES

Laboratory testing on representative SPT samples was performed at McIntosh Perry geotechnical lab and included moisture content, and Atterberg Limit Testing. Atterberg Limit test and one-dimensional consolidation testing was done on retrieved thin-walled Shelby tube samples, was tested by Stantec Ltd.. The laboratory tests to determine index properties were performed in accordance with Ministry of Transportation Ontario (MTO) test procedures, which follow American Society for Testing Materials (ASTM) test procedures. One-dimensional consolidation test was performed in accordance with ASTM D 2435.

The rest of the soil samples recovered will be stored in McIntosh Perry storage facility for a period of one month after submission of the final report. Samples will be disposed after this period of time unless otherwise requested in writing by the Client.

Laboratory tests are included in Appendix C.

5.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

Based on published physiography maps of the area (Ontario Geological Survey) the site is located within the Ottawa Valley Clay Plains. Surficial geology maps of southern Ontario identify the property as on fine-textured glaciomarine deposits.

The Ottawa Valley between Pembroke and Hawkesbury, Ontario consists of clay plains interrupted by ridges of rock or sand. It is naturally divided into two parts, above and below Ottawa, Ontario. Within the valley, the bedrock is further faulted so that some of the uplifted blocks appear above the clay beds. The sediments themselves in the valley are deep silty clay. Although the clay deposits are grey in color like the lime stones

that underlies them in part, they are only mildly calcareous and likely derived from the more acidic rock of the Canadian Shield.

5.2 Subsurface Conditions

In general, the site stratigraphy consists of a fill material topping some of the boreholes, followed by a silty clay, where borehole was advanced to the termination of the clay layer, it was observed to be underlain by a sand till. The soils encountered at this site can be divided into three different zones.

a) Fill
b) Clay
c) Till

The soils encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets included in Appendix C. Description of the strata encountered are given below.

5.2.1 Fill

A layer of fill was observed in boreholes BH17-1 and BH17-2. The fill was observed to be loose to compact sand and silt, brown and moist. SPT 'N' values were observed to be between 3 to 11 blows/300mm. moisture content was observed to be an average of 23%. The thickness of the fill, where observed was 1.1 m.

5.2.2 Clay

The clay was observed to be stiff to firm, moist to wet and grey. Moisture content within the weathered crust was an average of 50%. Within the clay crust SPT 'N' values ranged from 1 to 7 blows/300 mm, below the crust SPT 'N' values ranged from 0 to 2 blows/300 mm, with an average moisture content of 60%. Boreholes BH17-4 and BH17-5, were advanced with DCPT, values were observed to be between 2 and 22 blows/300mm. MTO N-sized vane tests were conducted which estimated the in-situ shear strength of the layer ranged from 38 kPa to 49 kPa, and sensitivity ranging between 4 and 9, indicating moderate to highly sensitive clay. Three Atterberg Limit test were conducted on representative samples and found to be clay of high-plasticity (CH) in accordance with Ministry of Transportation Ontario (MTO) classification for clay plasticity. Results showed the liquid limit values range from 63% to 72% and the plastic limit range from 22% to 25%. Test results are shown on Figure 3, included in Appendix B. Moisture content of sample tested below the weathered crust for Atterberg Limits, indicate the natural moisture content of the sample is beyond the liquid limit of the sample, indicating the layer is in a sensitive state. The thickness of the clay layer was observed to be 5.2 to 7.9 m, terminating at a depth between 6.4 to 7.9 m from the existing ground surface (El. 88.0 to 86.44 m).

One-dimensional consolidation test was carried out in accordance with ASTM D 2435 on a relatively undisturbed sample (TW-5) retrieved from BH17-2. The bulk density determined from the undisturbed

sample was observed to be 15.8 KN/m^3 with initial void ratio of 1.98. The results of the consolidation test, carried out to determine the compressibility characteristics of the clay deposit, are provided on Figure 4 in Appendix B. Results indicate that this strata is normally consolidated with a pre-consolidation pressure of approximately 110 kPa, and an over consolidation ratio (OCR) of approximately 1 to 1.5. The compression index, C_c, on the virgin curve was estimated to be 0.87 based on increments 8 and 9 with axial stresses of 120 kPa and 160 kPa and void ratios of 1.773 and 1.664 respectively. This compression index is only valid for stresses up to 160 kPa. The reloading slope, C_r, was obtained based increments 4 and 5 and estimated to be 0.10. The coefficient of consolidation, C_v, for the range of expected superimposed stresses was selected 0.0035 cm^2/s from the provided lab test results.

5.2.3 Till

Underlying the clay, was observed to be a layer of sand till, some gravel, some silt. The layer was observed to be dense and wet, with SPT 'N' values between 14 and 33 blows/300 mm, DCPT values within the probably till layer were observed to be between 27 and 75 blows/300 mm, with an average moisture content 12%. DCPT refusal was met in borehole BH17-4, was a value of 100 blows/230 mm.

5.3 Groundwater

Groundwater was observed in the clay layer while drilling, to be between El. 92.24 and 92.84 m. Groundwater level may be expected to fluctuate due to seasonal changes.

6.0 DISCUSSIONS AND RECOMMENDATIONS

6.1 General

This section of the report provides recommendations for the design of the proposed building at Dealership Drive in Ottawa, Ontario. The recommendations are based on interpretation of the factual information obtained from the boreholes advanced during the subsurface investigation. The discussions and recommendations presented are intended to provide sufficient information to the designer of the proposed building to select the suitable type of foundation to support the structure.

The comments made on the construction are intended to highlight aspects which could have impact or affect the detailed design of the building, for which special provisions may be required in the Contract Documents. Those who requiring information on construction aspects should make their own interpretation of the factual data presented in the report. Interpretation of the data presented may affect equipment selection, proposed construction methods, and scheduling of construction activities.

6.2 Project Design

6.2.1 Existing Site Condition

Detailed site condition is provided in Section 2. The site is predominately leveled and cleared. The surrounding area consisted of a mix between farm land and recent developments including a car dealership with paved parking lot to the east and a gravel parking lot to the west. The location of the site is shown on Figure 1 included in Appendix B.

6.2.2 Proposed Development

It is understood that the proposed development will be a two-storey with no basement, proposed area footprint of approximately 2,145 m^2, and will likely be a conventional slab on grade with shallow footing foundation.

The finished floor elevation of El. 95.80 m, is approximately 1.6 m higher than the existing grade. The expected grade raise is approximately 1.4 m.

6.3 Frost Protection

Based on applicable building codes, a minimum earth cover of 1.8 m, or the thermal equivalent of insulation, should be provided for all exterior footings to reduce the effects of frost action.

6.4 Site Classification for Seismic Site Response

Table 4.2 of CHBDC shall be consulted for the purpose of seismic design. Selected spectral responses in the general vicinity of the site for 10% chance of exceedance in 50 years (475 years return period) are as indicated in Table 6-3, shown below;

Table 6-1: Selected Seismic Spectral Responses (10% in 50 Yrs)

Sa(0.2)	Sa(0.5)	Sa(2.0)	PGA	PGV
0.150	0.084	0.020	0.094	0.064

The site can be classified as a Site Class “D” based on the clay consistency for the purposes of site-specific seismic response to earthquakes based on Table 4.1.8.4.A OBC 2012.

6.5 Engineered Fill

For calculation purposes, an engineered fill with an average thickness of 1.4 m over the flat areas was considered. Clay parameters as explained in section 5.2.3 were used for calculating consolidation settlement. A uniformly placed engineered fill with an average thickness of 1.4 m and unit weight of 21 kN/m^3 will impose a load of approximately 30 kPa uniformly through the depth (7.9 m clay thickness). With pre-consolidation

pressure of 110 kPa and coefficient of compressibility equal to 0.87 for normally consolidated clay, a total consolidation settlement of approximately 50 mm can be expected.

Any topsoil or soft and spongy material should be removed before placing the engineered fill. The fill should be placed in horizontal lifts of uniform thickness of no more than 300 mm before compaction. It should be placed at appropriate moisture content and compacted to a 100% standard Proctor density. The requirements for fill material and compaction may be addressed with a note on the structural drawing for foundation or grading drawing and/or with a Non Standard Special Provision (NSSP). In any location where the fill is to support any structural element, including pavement structure, minimum 100% Standard Proctor Maximum Dry Density (SPMDD) should be achieved. In other cases, minimum 96% SPMDD is adequate.

6.6 Slabs-on-Grade

Slabs-on-grade should be supported on minimum 200 mm of Granular A compacted to 100% SPMDD. In case the subgrade needs to be raised Granular B type II or granular A needs to be compacted to minimum 96% SPMDD.

All subgrades should be proof-rolled under the supervision of a geotechnical representative prior to placement of the Granular “A” and slab-on-grade.

6.7 Shallow Foundations

Considering the order of structural loads expected at the foundation level, provision of conventional strip footings will be adequate. Footings are expected to be buried to resist overturning and sliding and also to provide protection against frost action.

The excavation should extended to the top of the native clay, care must be taken not to disturb the clay. Excavation into the clay layer should be limited. If adequate frost cover is not provided, the deficit of earth cover should be compensated by application of synthetic insulation material.

Further consolidation settlement in addition to those imposed by the fill are expected underneath the strip footings. 1.4 m of grade raise fill is expected. For the purpose of serviceability analysis, a conventional 1 m wide strip footing was considered with a service load of 75 kPa. This would increase the expected settlement underneath the footings to approximately 55 mm.

In the absence of engineered fill, the expected settlements induced by 1 m strip footing and 75 kPa permanent service load will be approximately between 20 mm to 25 mm. It is evident that conventional construction methods will not satisfy serviceability requirements and alternative options should be explored.

6.7.1 Light-weight Fill

As indicated in the consolidation analysis the settlements caused by the building itself are expected to be within conventionally accepted range of building settlements. However the excessive settlement will be caused by the grading fill. In situations where the construction schedule is tight light-weight fill can be used for grading purposes. Geofoam or as commonly known Styrofoam blocks are known as a conventional solution to consolidation problems. Inclusion of a layer of 30 inches geofoam in the grade raise fill can reduce the expected settlements to 35 mm which in our opinion can be tolerable for this project.

6.7.2 Pre-loading

Preloading is the most common solution to control excessive consolidation settlements. Since the clay layer is relatively thin and the drainage path is approximately 3 m, consolidation settlements are expected to achieve fairly rapidly. It is expected to achieve 90% of the settlements in about 8 months. It is recommended to place the fill as the first step of the construction. Later foundation footprints can be excavated out to construct the footings. A lag of 8 months between fill placement till construction of footings can reduce the buildings settlements to approximately 25 mm. Any less waiting period, although as not efficient, can reduce the undesired settlements.

Accelerated consolidation methods are not included in this report due their relatively high cost.

6.7.3 Increased Structural Tolerance

As formerly mentioned, inclusion of 1.4 m of grade raise in combination with a conventional footing stress of 75 kPa is expected to induce approximately 50 to 55 mm of settlements. Aside from geotechnical solutions to reduce the settlement, depending on the structural design, if the structural engineer can increase the building tolerance to the predicted settlement, the construction can be executed without any site treatment. Even in this case it is recommended to first place the fill and then construct the footing later.

6.7.4 Bearing Capacity

Assuming the strip footings are constructed through excavating the fill and exposing the native subgrade, the following bearing capacity values can be used for structural design;

Factored beading pressure at Ultimate Limit State (ULS): 130 kPa

Serviceability Limit State (SLS): 75 kPa (post loading, 1 m wide strip footings)

If strip footings wider than 1 m are required, then authors of this report should be informed to verify the compatibility of the design with settlement criteria. Footings narrower than 0.6 m are not recommended due to the risk of punching failure.

6.8 Protection of Subgrade

Due to the sensitive nature of the subgrade clay, and in order to limit the degradation of the founding soil, it is recommended that a concrete working slab (lean concrete) be placed on the subgrade within four hours of preparation. Inspection and approval of the footing subgrade are required. This requirement may be addressed with a note on the structural drawing for foundation and/or with a Non Standard Special Provision (NSSP). If the constructor can ensure there won't be any traffics on the subgrade, protection can be done through temporary covering.

6.9 Lateral Earth Pressure

Free draining material should be used as backfill material for foundation walls. If the proper drainage is provided "at rest" condition may be assumed for calculation of earth pressure on foundation walls. The following parameters are recommended for the granular backfill.

Table 6-1: Backfill Material Properties

Borehole	Granular "A"	Granular "B"
Effective Internal Friction Angle, ϕ'	35°	30°
Unit Weight, γ (kN/m^3)	22.8	22.8

7.0 CONSTRUCTION CONSIDERATIONS

Any organic material, existing fill material of any kind, and loose sand, should be removed from the footprint of the footing. If grade raise above the native clay subgrade is required suitable fill material to conform to specifications of OPSS Granular A should be placed over a layer of geotextile. The Structural Fill, if directly supporting the load of the structure, should be free from any recycled or deleterious material, it should not be placed in lifts thicker than 300 mm and should be compacted to 100% Standard Proctor Maximum Dry Density (SPMDD).

The founding level is expected above the groundwater level encountered at this site and no dewatering problems are anticipated. However, the excavated subgrade must be kept dry at all time to minimize the disturbance of the subgrade. Groundwater elevation is expected to fluctuate seasonally.

A geotechnical engineer or technician should attend the site to confirm the type of the material and level of compaction.

Foundation walls should be backfilled with free-draining material such as OPSS Granular types A or B. The native clay is not a suitable material for backfilling. Sub-drains with positive drainage to the City sewer should be provided at foundation level.

8.0 SITE SERVICES

At the subject site, the burial depth of water-bearing utility lines is typically 2.4 m below ground surface. If this depth is not achievable due to design restrictions, equivalent thermal insulation should be provided. The contractor should retain a professional engineer to provide detailed drawings for excavation and temporary support of the excavation walls during construction.

Utilities should be supported on minimum of 150 mm bedding of Granular A compacted to minimum 96% of SPMDD. Since the native subgrade is fine grained, it is recommended to separate the subgrade from the bedding material by a layer of geotextile to prevent cross migration of materials. Utility cover can be Granular A or Granular B type II compacted to 96% SPMDD. All covers are to be compacted to 100% SPMDD if intersecting structural elements.

Cut-off walls should be provided for utility trenches running below the groundwater level to mitigate the settlement risk due to groundwater lowering.

9.0 PAVEMENT STRUCTURE

No details are provided on the traffic loads, but it is understood that the paved area surrounding the proposed buildings will be used frequently by light passenger vehicles and regularly by heavy weight delivery vehicles. Pavement structure likely to be placed on engineered fill, overlaying clay. Recommendations for fill placement are covered in previous sections. If the pavement is to be constructed on native ground, the topsoil is to be excavated to the required depth to accommodate the pavement structure. The subgrade should be exposed and proof rolled under the supervision of a geotechnical engineer or technician. Should grade raise be required, compacted Granular B Type II or Granular A should be placed as needed and compacted to 95% SPMDD prior to construction of pavement structure.

As no traffic information has been provided, McIntosh Perry recommends the use of the proposed pavement structure included in Table 10-1. The structure detailed will be adequate for use in the warehouse area, sections used by transport trucks, heavy duty vehicles, and the access road is included in Table 9-2.

Table 9-1: Proposed Pavement Structure

Material		Thickness (mm)
Surface	Superpave 12.5, Design Category C, PG 58-34	40
Binder	Superpave 19.0, Design Category C, PG 58-34	50
Base	OPSS Granular A	150
Sub-base	OPSS Granular B or SSM	450

If sections of the asphalt construction are identified as light use, at the digression of the client, the pavement structure may be reduced to structure specified in Table 10-2. It should be understood that a reduction in the thickness of the asphalt structure will result in a reduced performance and lifespan.

Table 9-2: Proposed Pavement Structure for Light Vehicle Parking Lots

Material		Thickness (mm)
Surface	Superpave 12.5, Design Category C, PG 58-34	50
Base	OPSS Granular A	150
Sub-base	OPSS Granular B or SSM	350

The base and sub base materials, i.e., Granular A for base and Granular Type B or SSM for subbase, shall be in accordance with OPSS 1010. Both base and sub-base should be compacted to 100% SPMDD. Asphalt layers should be compacted to comply with OPSS 310. Where the pavement structure is to be placed on engineered fill, the upper 600 mm of the fill should be compacted to 100% SPMDD to act as subbase.

Above recommended Superpave 12.5 and 19.0 can be replaced with HL-3 and HL-8 if required. If the required quantity of SP-19/HL-8 is small, and to avoid providing multiple asphalt mix designs, SP-19 can be replaced with SP-12.5 as long as they are placed in two separate layers. McIntosh Perry will not be responsible for cost implications of such decision.

10.0 CLOSURE

We trust this geotechnical investigation and foundation design report meets requirements of your project. The “Limitations of Report” presented in Appendix A are an integral part of this report. Please do not hesitate to contact the undersigned should you have any questions or concerns.

McIntosh Perry Consulting Engineers Ltd.

Mary-Ellen Gleeson, M.Eng., EIT.
Geotechnical Engineering Intern

N’eem Tavakkoli, M.Eng., P.Eng.
Senior Geotechnical Engineer

11.0 REFERENCES

Canadian Geotechnical Society, "Canadian Foundation Engineering Manual", 4th Edition, 2006.

Ontario Ministry of Natural Resources (OMNR), Ontario Geological Survey, Special Volume 2, "The Physiography of Southern Ontario", 3rd Edition, 1984.

Google Earth, Google, 2015.

MTO – Pavement Design and Rehabilitation Manual

540 DEALERSHIP DRIVE

APPENDIX A
LIMITATIONS OF REPORT

McINTOSH PERRY

LIMITATIONS OF REPORT

McIntosh Perry Consulting Engineers Ltd. (McIntosh Perry) carried out the field work and prepared the report. This document is an integral part of the Foundation Investigation and Design report presented.

The conclusions and recommendations provided in this report are based on the information obtained at the borehole locations where the tests were conducted. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the specific locations where tests were conducted and conditions may become apparent during construction, which were not detected and could not be anticipated at the time of the site investigation. The benchmark level used and borehole elevations presented in this report are primarily to establish relative differenced in elevations between the borehole locations and should not be used for other purposes such as to establish elevations for grading, depth of excavations or for planning construction.

The recommendations presented in this report for design are applicable only to the intended structure and the project described in the scope of the work, and if constructed in accordance with the details outlined in the report. Unless otherwise noted, the information contained in this report does not reflect on any environmental aspects of either the site or the subsurface conditions.

The comments or recommendation provided in this report on potential construction problems and possible construction methods are intended only to guide the designer. The number of boreholes advanced at this site may not be sufficient or adequate to reveal all the subsurface information or factors that may affect the method and cost of construction. The contractors who are undertaking the construction shall make their own interpretation of the factual data presented in this report and make their conclusions, as to how the subsurface conditions of the site may affect their construction work.

The boundaries between soil strata presented in the report are based on information obtained at the borehole locations. The boundaries of the soil strata between borehole locations are assumed from geological evidences. If differing site conditions are encountered, or if the Client becomes aware of any additional information that differs from or is relevant to the McIntosh Perry findings, the Client agrees to immediately advise McIntosh Perry so that the conclusions presented in this report may be re-evaluated.

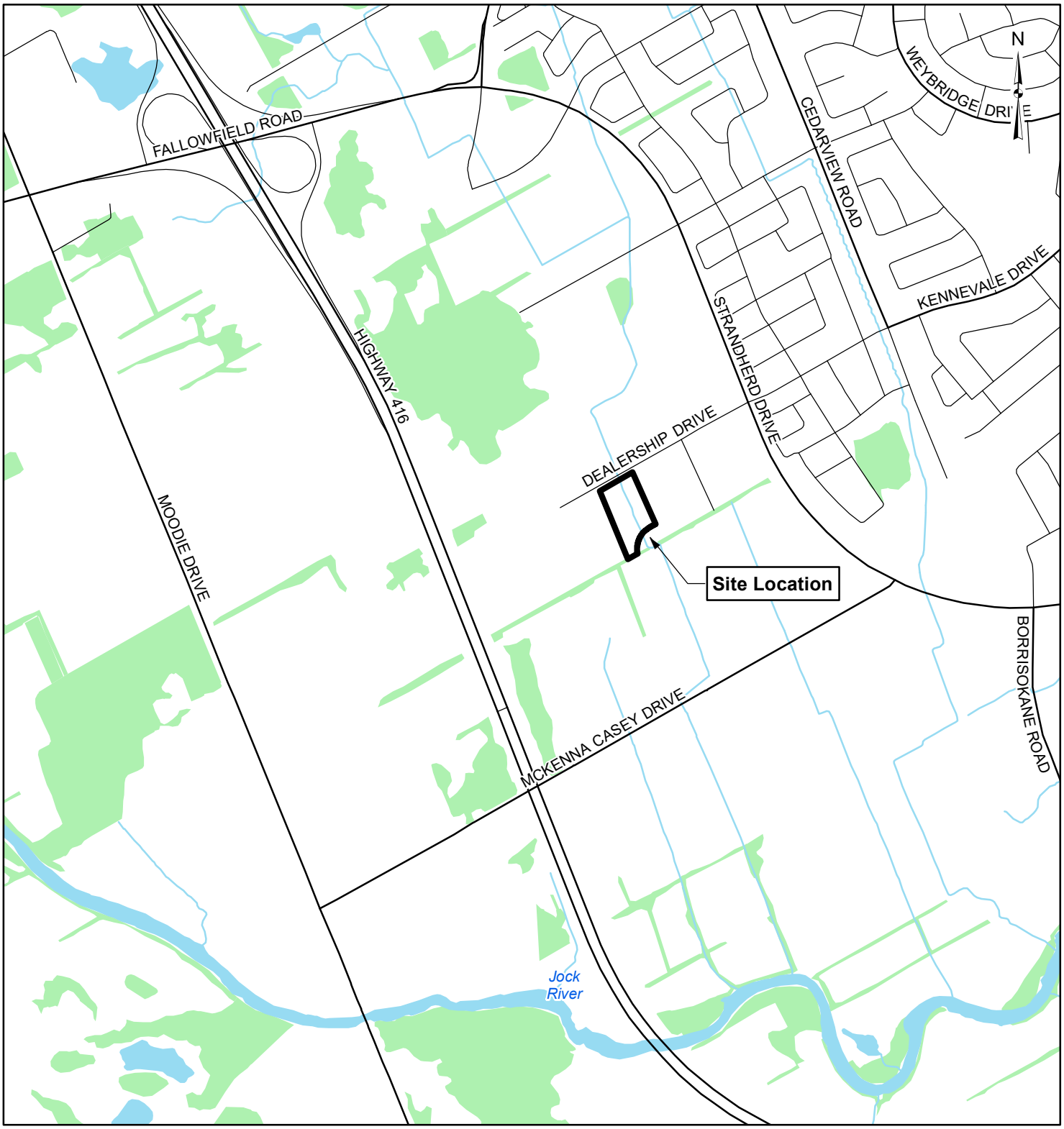
Under no circumstances shall the liability of McIntosh Perry for any claim in contract or in tort, related to the services provided and/or the content and recommendations in this report, exceed the extent that such liability is covered by such professional liability insurance from time to time in effect including the deductible therein, and which is available to indemnify McIntosh Perry. Such errors and omissions policies are available for inspection by the Client at all times upon request, and if the Client desires to obtain further insurance to protect it against any risks beyond the coverage provided by such policies, McIntosh Perry will co-operate with the Client to obtain such insurance.

McIntosh Perry prepared this report for the exclusive use of the Client. Any use which a third party makes of this report, or any reliance on or decision to be made based on it, are the responsibility of such third parties. McIntosh Perry accepts no responsibility and will not be liable for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

540 DEALERSHIP DRIVE

APPENDIX B
FIGURES

McINTOSH PERRY



450 225 0 450

Scale 1:15,000 Metres

LEGEND

- Local Road
- Major Road
- Watercourse
- Waterbody
- Wooded Area

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2017.

CLIENT: MYERS AUTOMOTIVE GROUP

PROJECT: GEOTECHNICAL INVESTIGATION
540 DELERSHIP DRIVE

TITLE: SITE LOCATION

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www.mcintoshperry.com

PROJECT NO:CP-17-0442	
Date	Sep., 08, 2017
GIS	JD
Checked By	MG

FIGURE: 1

H:\01 Project - Proposals\2017 Jobs\CP\0CP-17-0442 Myers_Barrhaven Volkswagen_540 Dealership Drive\GIS\mxd\0CP-17-0442_01_SiteLocationGeotechnical.mxd

30 15 0 30

Scale 1:1,000 Metres

LEGEND

Borehole Location

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2017.

CLIENT: MYERS AUTOMOTIVE GROUP

PROJECT: GEOTECHNICAL INVESTIGATION
540 DELERSHIP DRIVE

TITLE: BOREHOLE LOCATIONS

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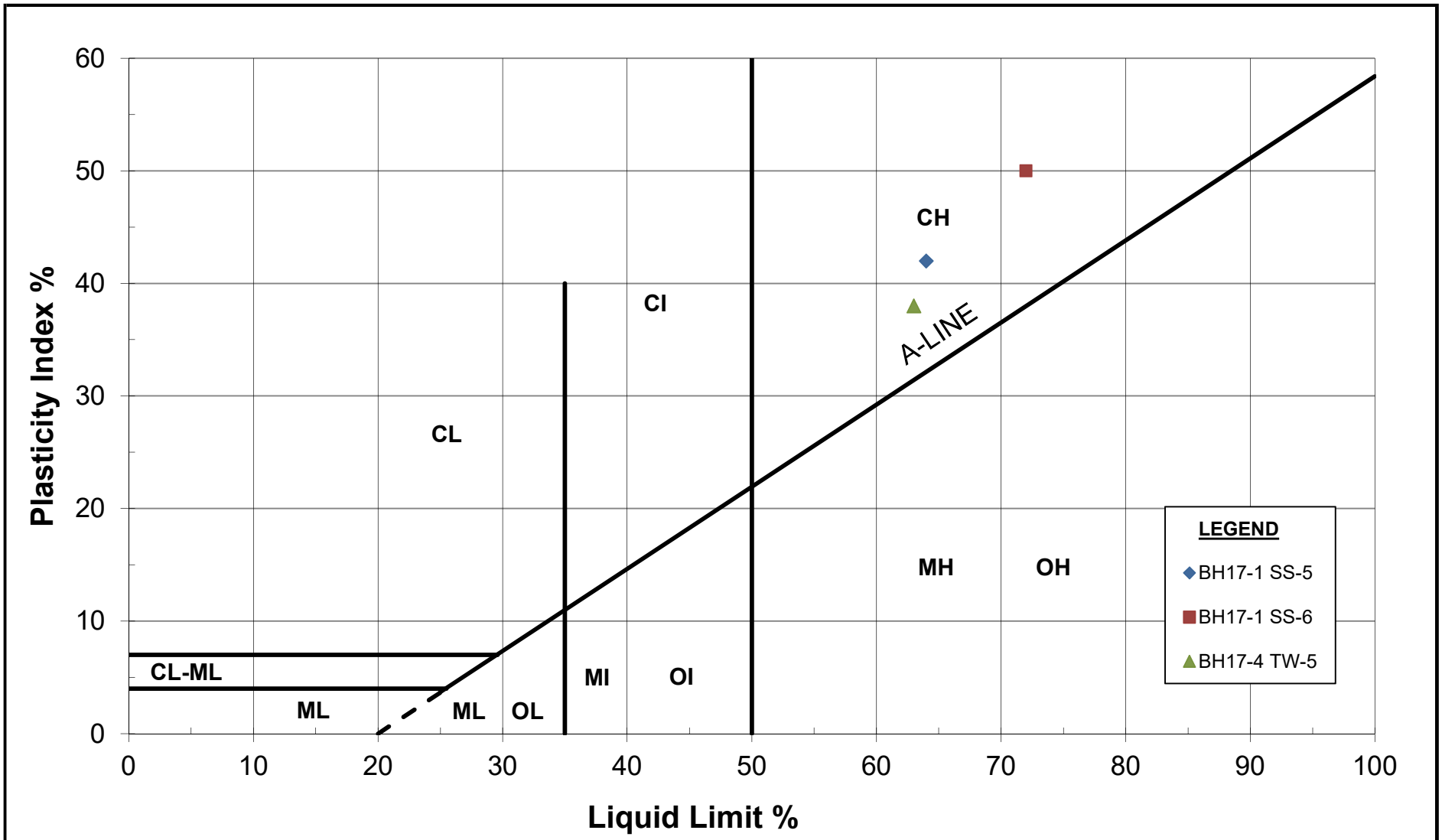
PROJECT NO:CP-17-0442	
Date	Sep., 08, 2017
GIS	JD
Checked By	MG

FIGURE: 2

H:\01 Project - Proposals\2017 Jobs\CP\0CP-17-0442 Myers - Barrhaven Volkswagen - 540 Dealership Drive\GIS\mxd\0CP-17-0442_02_BoreholeLocationsGeotechnical.mxd



McINTOSH PERRY

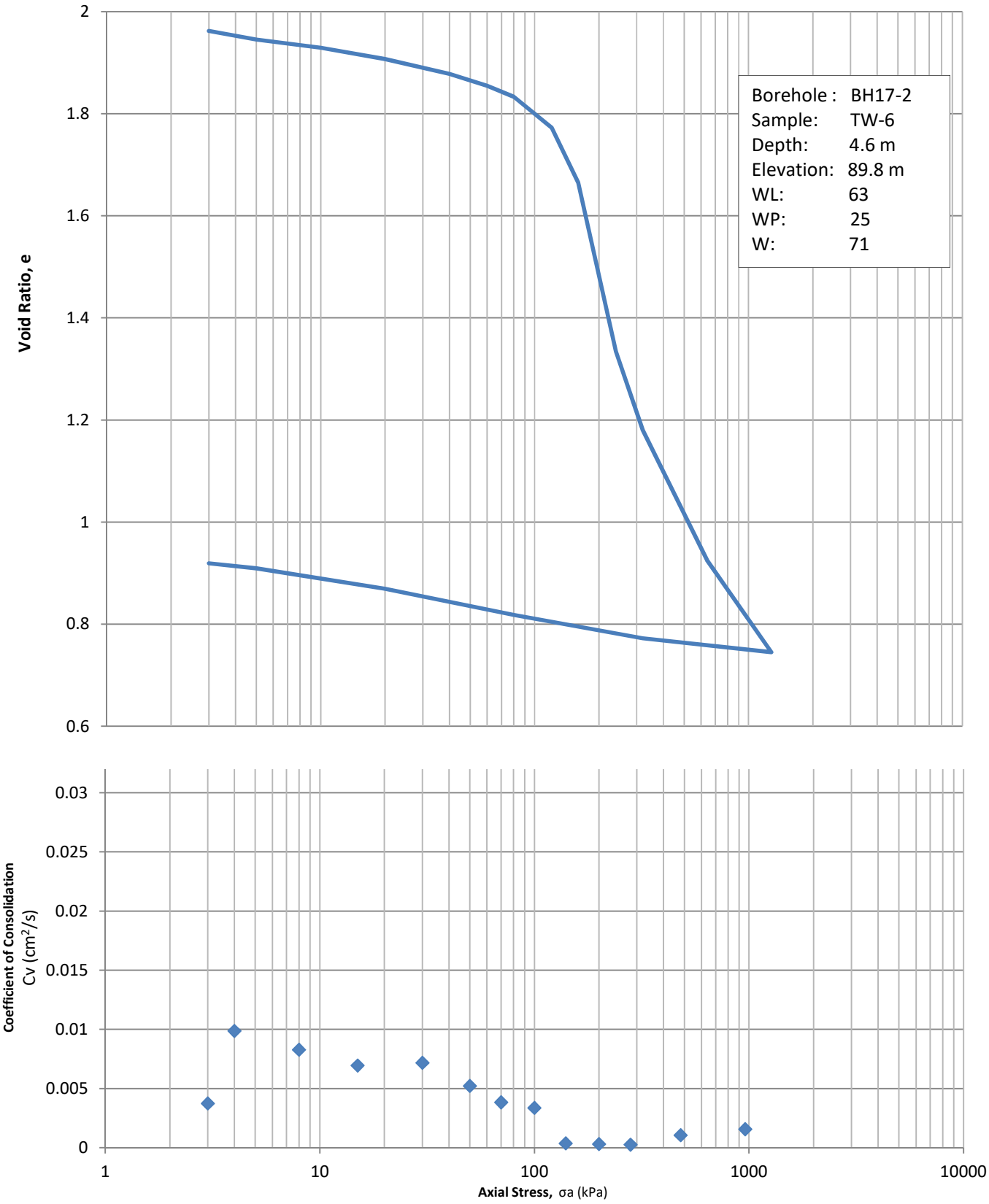
PLASTICITY CHART

CLAY

540 Dealership Drive

Figure No. 3

CP-17-0442



McINTOSH PERRY	One-Dimentional Consolidation CLAY, (CH)	Figure No. 4 CP-17-0442

540 DEALERSHIP DRIVE

APPENDIX C
BOREHOLE LOGS

McINTOSH PERRY

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-1

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 94.44
LOCATION 540 Dealership Drive
COORDINATE N: 5012395.3177 m, E: 438667.7974 m
DATUM Geodetic
ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES (REC)	* GROUND WATER CONDITIONS
94.4						
0.0	**SAND and SILT,** trace clay, compact, moist, brown (FILL)		1	SS	10	
93.4			2	SS	8	
1.1	**CLAY,** sitff, weathered, moist, grey		3	SS	5	▼
			4	SS	2	
			5	SS	1	
90.8						
3.7	**CLAY,** firm, wet, grey		6	SS	0	
88.0			7	SS	5	
6.4	**SAND,** some gravel, some silt, dense, wet (TILL)		8	SS	33	
87.1						
7.3	**END OF BOREHOLE**					

ELEVATION SCALE: 94, 93, 92, 91, 90, 89, 88

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
25 50 75

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

$+^3$, $\times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-2

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 94.37

LOCATION 540 Dealership Drive
COORDINATE N: 5012367.4834 m, E: 438661.9765 m
DATUM Geodetic

ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES (REC)	* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
94.4											
0.0	**SAND and SILT,** trace clay, loose to compact, moist, brown (FILL)		1	SS	3		94				
93.3			2	SS	11						
1.1	**CLAY,** sitff, weathered, moist, grey		3	SS	5	▼	93				
			4	SS	3		92				
91.3											
3.0	**CLAY,** firm, wet, grey		5	SS	1		91	6, 6			
			6	TW			90				110 kPa Pc' ~~= 90~~ Cc = 0.87 Cr = 0.10 eo = 1.98
							89	8, 9			
87.8			7	SS	1		88				
6.6	**SAND,** some gravel, some silt, dense, wet (TILL)		8	SS	14		87				
			9	SS	21						
86.1											
8.2	**END OF BOREHOLE**										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-3

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 94.34

LOCATION 540 Dealership Drive
COORDINATE N: 5012340.1784 m, E: 438656.1557 m
DATUM Geodetic

ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES (REC)	* GROUND WATER CONDITIONS
94.3 / 0.0	**CLAY,** sitff, weathered, moist, grey		1	SS	5	
			2	SS	7	
			3	SS	7	
			4	SS	2	
91.4 / 2.9	**CLAY,** firm, wet, grey		5	SS	0	
			6	SS	0	
			7	SS	2	
87.0 / 7.3	Probable **SILTY CLAY**					
86.4 / 7.9	Probable **TILL**					
84.1 / 10.2	**END OF BOREHOLE**					

ELEVATION SCALE: 94, 93, 92, 91, 90, 89, 88, 87, 86, 85

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
25 50 75

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

+^{3}, ×^{3}: Numbers refer to Sensitivity
○$^{3\%}$ STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

DATE 31/08/2017

RECORD OF BOREHOLE No BH17-4

1 OF 1

METRIC

ID CP-17-0442 LOCATION 540 Dealership Drive ORIGINATED BY GR

CLIENT Myers COORDINATE N: 5012381.8768 m, E: 438636.7881 m COMPILED BY MG

ELEVATION 94.42 DATUM Geodetic CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES (REC)	*		SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P w w_L WATER CONTENT (%)	γ kN/m³	GR SA SI CL
94.4								20 40 60 80 100	25 50 75		
0.0	Probable **CLAY**						94				
							93				
							92				
							91				
							90				
							89				
							88				
87.6							87				
6.9	Probable **TILL**						86				
85.1											
9.3	**END OF BOREHOLE**										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-5

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 93.97
LOCATION 540 Dealership Drive
COORDINATE N: 5012353.9367 m, E: 438686.5299 m
DATUM Geodetic
ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES (REC)	* GROUND WATER CONDITIONS
94.0 / 0.0	Probable **CLAY**					
85.3 / 8.7	Probable **TILL**					
84.1 / 9.9	**END OF BOREHOLE**					

ELEVATION SCALE: 93, 92, 91, 90, 89, 88, 87, 86, 85

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
25 50 75

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

$+^3, \times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-6

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 94.87
LOCATION 540 Dealership Drive
COORDINATE N: 5012310.1216 m, E: 438724.3125 m
DATUM Geodetic
ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES (REC)	* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
94.9											
0.0	**SILTY CLAY,** sitff to firm, moist to wet, grey						94				
							93				
							92				
91.1											
3.8	**END OF BOREHOLE**										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

McIntosh Perry Consulting Engineers Ltd
1-1329 Gardiners Rd
Kingston, Ontario K7P 0L8

RECORD OF BOREHOLE No BH17-7

1 OF 1

METRIC

DATE 31/08/2017
ID CP-17-0442
CLIENT Myers
ELEVATION 93.62
LOCATION 540 Dealership Drive
COORDINATE N: 5012277.1016 m, E: 438653.7215 m
DATUM Geodetic
ORIGINATED BY GR
COMPILED BY MG
CHECKED BY NT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES (REC)	* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.6								20 40 60 80 100	25 50 75		
0.0	**SILTY CLAY,** sitff to firm, moist to wet, grey						93				
							92				
91.3											
2.3	**END OF BOREHOLE**										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

540 DEALERSHIP DRIVE

APPENDIX D
LAB RESULTS

McINTOSH PERRY

Stantec Consulting Ltd.
400 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

September 11, 2017
File: 122410330

Attention: N'eem Tavakkoli
McIntosh Perry
115 Walgreen Road
Carp, Ontario, Canada, K0A 1L0
Tel: 613-836-2184
e-mail: n.tavakkoli@mcintoshperry.com

Dear Mr. Tavakkoli,

Reference: Consolidation Test Results for VW Dealership Project, McIntosh Perry, File# CP-17-0442
BH 17-2, ST-1, sampled on August 31, 2017

This letter presents the results of a one-dimensional consolidation test carried out on the above referenced sample in accordance with ASTM D2435/D2435M - 11. The test results are provided in the attached tables and figures.

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Regards,

STANTEC CONSULTING LTD.

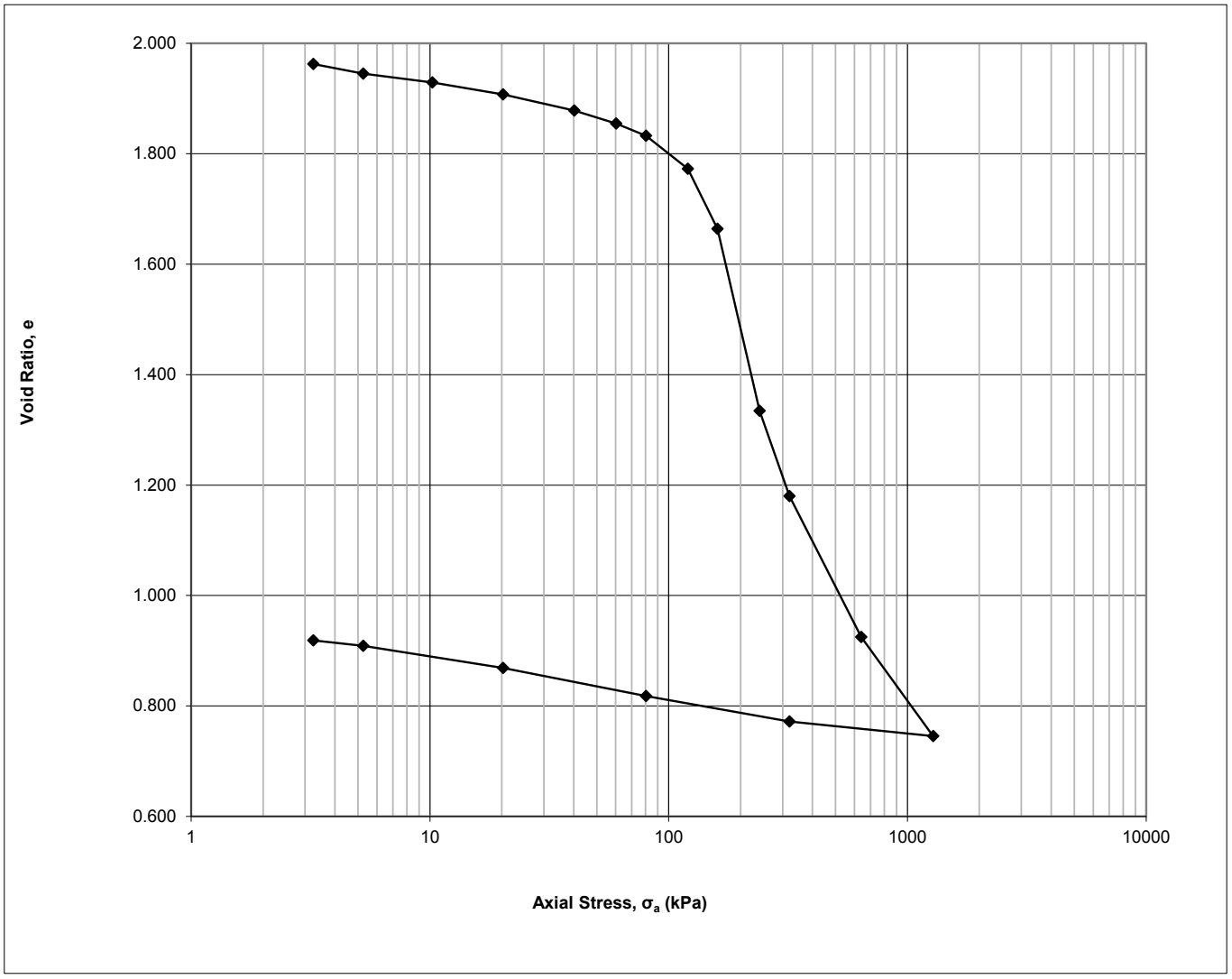
Ramy Saadeldin, Ph.D., P.Eng.
Geotechnical Engineer
Phone: (613) 738-6047
Fax: 613-722-2799
Ramy.Saadeldin@stantec.com

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11

Project	**McINTOSH PERRY, File# CP-17-0442**
Project No.	**122410330**
Borehole No.	**BH 17-2**
Sample No.	**ST-1**
Sample Depth	**15-17 ft.**



Stantec

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11

Filename: V:\0121\active\laboratory_standing_offers\2017 L
Checked by: D. Boateng Date: 9-Sep-17
Approved by: R. Hache Date: 9-Sep-17

Specimen Details

Project Name	McINTOSH PERRY, File# CP-17-0442
Project Location	VW Dealership
Borehole	BH 17-2
Sample No.	ST-1
Depth	15-17 ft.
Sample Date	August 31, 2017
Test Number	One
Technician Name	Daniel Boateng

Soil Description & Classification

Silty Clay, Grey, Fissured, Wet - CH		
Specific Gravity of Solids		2.758
Liquid Limit	%	63
Plastic Limit	%	25
Plasticity Index	%	38
Average water content of trimmings	%	71
Additional Notes (information source, occurence and size of large isolated particles etc.)		

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	62.22
Dry Mass	g	36.38
Density	Mg/m^3	1.584
Dry Density	Mg/m^3	0.926
Water Content	%	71.03
Degree of Saturation	%	99.1
Height of Solids	mm	6.72
Initial Void Ratio		1.977

Final Specimen Conditions

Water Content	%	36.31
Final Void Ratio		0.919

Stantec

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11

Filename: V:\01216\active\laboratory_standing_offers\2017 Laboratory Standing Offers\122

Checked by: D. Boateng Date: 9-Sep-17

Approved by: R. Hache Date: 9-Sep-17

Specimen Details

Project Name	McINTOSH PERRY, File# CP-17-0442
Project Location	VW Dealership
Borehole	BH 17-2
Sample No.	ST-1
Depth	15-17 ft.
Sample Date	August 31, 2017
Test Number	One
Technician Name	Daniel Boateng

Test Procedure

Date Started		September 7, 2017
Date Finished		September 8, 2017
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	3
Water Used		Distilled
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	3	0.0000	20.0000	0.00	1.977
1	13.3	3	0.0982	19.9018	0.49	1.962
2	15.0	5	0.2151	19.7849	1.08	1.945
3	15.0	10	0.3232	19.6768	1.62	1.929
4	20.0	20	0.4681	19.5319	2.34	1.907
5	25.0	40	0.6629	19.3371	3.31	1.878
6	38.3	60	0.8235	19.1765	4.12	1.855
7	31.8	80	0.9694	19.0306	4.85	1.833
8	83.5	120	1.3728	18.6272	6.86	1.773
9	197.3	160	2.1042	17.8958	10.52	1.664
10	339.3	240	4.3177	15.6823	21.59	1.334
11	187.3	320	5.3557	14.6443	26.78	1.180
12	110.3	640	7.0675	12.9325	35.34	0.925
13	86.5	1280	8.2743	11.7257	41.37	0.745
14	16.5	320	8.0958	11.9042	40.48	0.772
15	36.8	80	7.7865	12.2135	38.93	0.818
16	67.0	20	7.4443	12.5557	37.22	0.869
17	90.5	5	7.1770	12.8230	35.89	0.909
18	43.5	3	7.1101	12.8899	35.55	0.919

Stantec

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11

Filename: V:\01216\active\laboratory_standing_offers\2017 Laboratory Standing Offers\12

Checked by: D. Boateng Date: 9-Sep-17

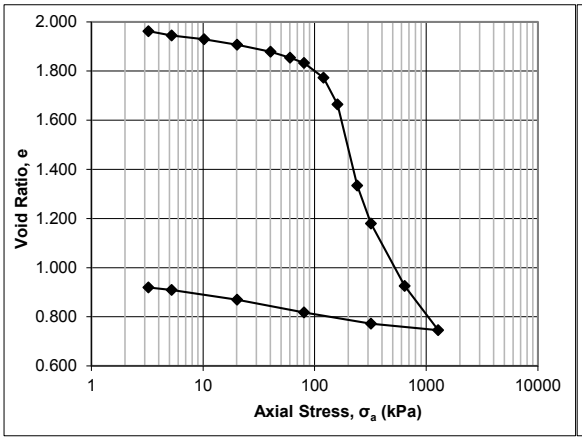
Approved by: R. Hache Date: 9-Sep-17

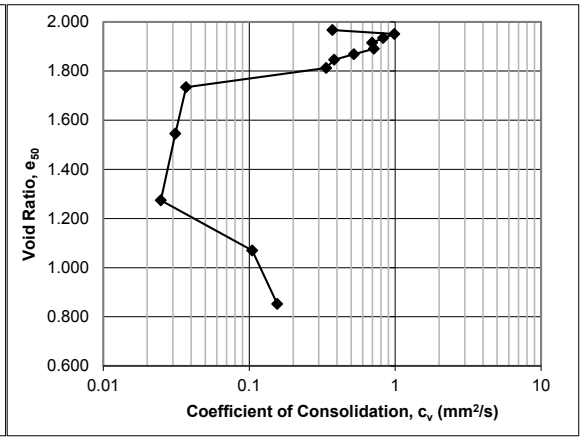
Specimen Details

Project Name	McINTOSH PERRY, File# CP-17-0442
Project Location	VW Dealership
Borehole	BH 17-2
Sample No.	ST-1
Depth	15-17 ft.
Sample Date	August 31, 2017
Test Number	One
Technician Name	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	2								
1	3	0.0679	19.9321	0.34	1.967			226	3.73E-01
2	4	0.1762	19.8238	0.88	1.951			84	9.87E-01
3	8	0.2840	19.7160	1.42	1.935			100	8.28E-01
4	15	0.4133	19.5867	2.07	1.916			117	6.95E-01
5	30	0.5795	19.4205	2.90	1.891			112	7.17E-01
6	50	0.7323	19.2677	3.66	1.868			151	5.22E-01
7	70	0.8787	19.1213	4.39	1.846			202	3.83E-01
8	100	1.1058	18.8942	5.53	1.812			224	3.37E-01
9	140	1.6303	18.3697	8.15	1.734			1938	3.69E-02
10	200	2.9017	17.0983	14.51	1.545			1991	3.11E-02
11	280	4.7212	15.2788	23.61	1.274			1996	2.48E-02
12	480	6.0963	13.9037	30.48	1.070			391	1.05E-01
13	960	7.5556	12.4444	37.78	0.852			211	1.56E-01
14	800	8.1318	11.8682	40.66	0.767				
15	200	7.8951	12.1049	39.48	0.802				
16	50	7.7559	12.2441	38.78	0.823				
17	13	7.4306	12.5694	37.15	0.871				
18	4	7.1585	12.8415	35.79	0.912				





Stantec	Project No.: 122410330	Photo Log
	Project Name: McINTOSH P. File# CP-17-0442	

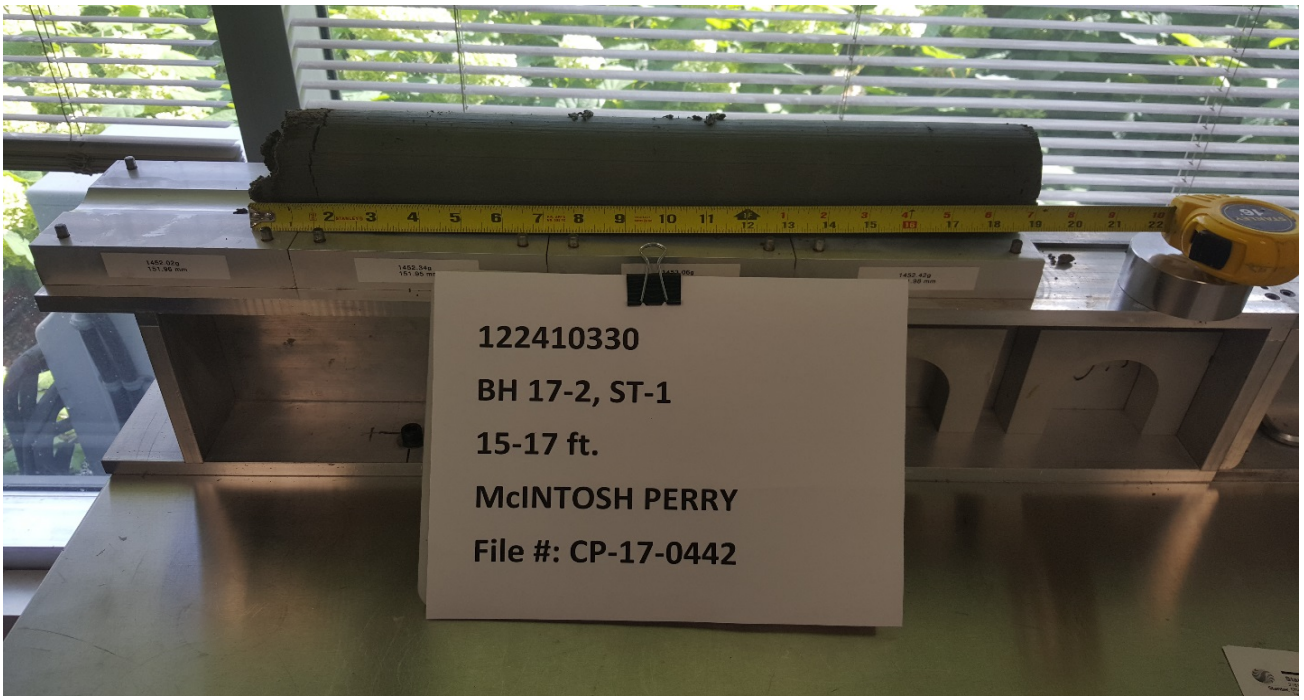


Photo No.: 1	Borehole: BH 17-02, ST-1	Depth: 15 – 17 ft.

Photo No.: 2 & 3	Borehole: BH 17-02, ST-1	Depth: 15 – 17 ft.

540 DEALERSHIP DRIVE

APPENDIX E
SEISMIC HAZARD CALCULATION

McINTOSH PERRY

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

September 20, 2017

Site: 45.2619 N, 75.7821 W User File Reference: 540 Dealership Drive

Requested by: M.Gleeson, McIntosh Perry

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.421	0.494	**0.415**	0.316	**0.224**	**0.112**	**0.054**	**0.014**	**0.0052**	**0.265**	**0.186**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.040	0.135	0.228
Sa(0.1)	0.056	0.172	0.279
Sa(0.2)	0.051	0.150	0.238
Sa(0.3)	0.041	0.117	0.183
Sa(0.5)	0.029	0.084	0.131
Sa(1.0)	0.015	0.043	0.067
Sa(2.0)	0.0059	0.020	0.031
Sa(5.0)	0.0012	0.0046	0.0078
Sa(10.0)	0.0006	0.0018	0.0031
PGA	0.030	0.094	0.152
PGV	0.020	0.064	0.105

References

National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français