1171 MAPLE AVE – GEOTECHNICAL REPORT

Project No.: CP-18-0217

Prepared for:

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McINTOSH PERRY

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GEOTECHNICAL INVESTIGATION and
FOUNDATION DESIGN RECOMMENDATION REPORT
1171 Maple Ave, 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 addition onto the existing post office building in Ottawa, Ontario. The field work was carried out on May 23, 2018 and comprised of five boreholes advanced to a maximum depth of 8.2 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 CSV Architects on behalf of Canada Post.

2.0 SITE DESCRIPTION

The property under considerations for proposed development is located at 1171 Maple Ave, south of intersection with Ann Street in Manotick, Ottawa. The property is located in the middle of a residential and commercial development. The existing property contains a single-story building with a portable behind the existing building accessible through a wooden ramp. There are paved parking areas on either side of the building. The topography of the site was observed to vary; Maple Ave is sloped down to the north east, the north west part of the site is observed to slope up approximately 2.2 m.

It is understood the proposed structure will be a single-story addition, without a basement.

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 and assess access for drill rig access. 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 placed based on the location of underground utilities and location of portable. Boreholes were advanced to a maximum depth of 8.2 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. 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.

4.0 LABORATORY TEST PROCEDURES

Laboratory testing on representative SPT samples was performed by McIntosh Perry Laboratories and included moisture content, Atterberg Limit, and hydrometer grainsize analysis. 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.

Paracel Laboratories Ltd., in Ottawa carried out chemical tests on one representative soil sample to determine the soil corrosivity characteristics. Laboratory tests are included in Appendix C.

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.

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 North Gower Drumlin Field. Surficial geology maps of southern Ontario identify the property to be between fine-textured glaciomarine and till deposits.

The North Gower Field region crosses Manotick, Greely, Metcalfe, and Russell, it contains scattered drumlins, in between which is clay and silt deposited by the Champlain Sea.

5.2 Subsurface Conditions

The site stratigraphy was observed to vary between boreholes. Types of soil encountered through the course of the investigation included; topsoil, fill, clay, alluvial deposits, and sandy silt. Boreholes BH18-1, 18-4, and 18-5 were terminated at auger refusal on probable boulders. The soils encountered at this site can be divided into four different zones.

a) Topsoil/Fill
b) Clay
c) Alluvial Deposits
d) Sandy Silt

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 Topsoil/Fill

Where boreholes were advance on grass areas, 0.1 to 0.3 m of topsoil were encountered. Where boreholes were advanced in the parking areas, 75 to 100 mm of asphalt were encountered, followed by 75 to 250 mm of gravelly silty sand fill.

5.2.2 Clay

In boreholes BH18-2, 18-3, and 18-5, a layer of brown, moist, weathered clay encountered. Clay was observed to be stiff, SPT 'N' values were observed between 7 and 9 blows/300 mm. Moisture content of the clay was observed to be an average of 33%. Bottom of the clay layer was observed in BH18-4 to be at 2.6 m (El. 89.3 m). One sample underwent Atterberg limit testing and was observed to have a liquid limit of 45%, and a plastic limit of 22%.

Test results are shown on Figure 3, included in Appendix B.

5.2.3 Alluvial Deposit

Alluvial deposits were observed in boreholes BH18-1, BH18-4 and BH18-5, there were observed from the surface of BH18-1 and 18-4, and below the clay layer in BH18-5. The deposits were observed to be mainly comprised of sand and silt, with trace clay and varying level of gravel. Frequent cobbles and boulders were encountered throughout the layer. SPT 'N' values ranged from 6 to 29 blows/300 mm, with an average blow count of 14, indicating a loose to dense state of compactness. Moisture content within the layer ranged from 7% to 15%, with an average of 9%. Three representative samples of the deposit from varying depths underwent hydrometer grain size analysis, distribution was found to range from 13% to 34% gravel, 24% to 40% sand, 33% to 43% silt, and 4% to 9% clay.

The bottom of the layer was observed to be very dense, with auger refusal encountered in boreholes BH18-1 and 18-5. Borehole BH18-4 was attempted in 4 separate locations, all terminated at boulder refusal.

Test results are shown on Figure 4, included in Appendix B.

5.2.4 Sandy Silt

In borehole BH18-5, below the gravelly silty sand to sandy silt, was a layer of grey, wet, soft, sandy silt. Layer was observed to have a moisture content of 20%.

5.3 Groundwater

Groundwater was observed in open boreholes BH18-05 at a depth of 3.6m (El. 88.3 m). Groundwater level may be expected to fluctuate due to seasonal changes.

5.4 Chemical Analysis

The chemical test results conducted by Paracel Laboratories in Ottawa, Ontario, to determine the resistivity, pH, sulphate and chloride content of representative soil sample are shown in Table 5-1 below:

Table 5-1: Soil Chemical Analysis Results

Borehole	Sample	Depth	pH	Sulphate (%)	Chloride (%)	Resistivity (Ohm-cm)
BH18-01	SS-03	1.5 – 1.7	7.99	0.0009	0.0010	1,070

6.0 DISCUSSIONS AND RECOMMENDATIONS

6.1 General

This section of the report provides recommendations for the design of the proposed addition to existing single-story Post Office Building located on Maple Street in Manotick, 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 types 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 topography of the property and surrounding streets and properties varied. Typically, the ground sloped down to the north east. The area surrounding the existing building was comprised of grass areas, paved parking, and a wooden ramp up to a temporary working portable in the footprint of the proposed building expansion. The surrounding area consisted of residential homes and commercial retail properties. 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 single-story and will likely be a conventional slab on grade with shallow footing foundation.

The existing building which have a half basement, have an expected footing depth around 1.8 m based on frost requirements. It is understood the proposed addition will not have a basement.

6.3 Frost Protection

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

6.4 Site Classification for Seismic Site Response

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 6-1, shown below and in Appendix E;

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

Sa(0.2)	Sa(0.5)	Sa(2.0)	PGA	PGV
0.157	0.086	0.020	0.098	0.066

The above notes spectral responses are for reference only and it may not indicate the critical spectrum for the proposed structure. The structural engineer shall consider deriving design specific spectral responses. The PGA for 2% probability of exceedance in 50 years is 0.279 g.

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 Slabs-on-Grade

Free-floating 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. If the slab-on-grade is designed to support internal columns, the fill used for the grade raise shall be compacted to minimum 100% SPMDD.

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

6.6 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.

Due to the presence of the existing temporary structure, we were not able to view the complete proposed building footprint, if fill is encountered within the building footprint it should be removed prior to placing material for footings or slab on grade. If adequate frost cover is not provided, the deficit of earth cover should be compensated by application of synthetic insulation material adequately projecting beyond foundation walls. All granular material 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).

6.6.1 Bearing Capacity

Assuming the strip footings are constructed through excavating any existing 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): 150 kPa

Serviceability Limit State (SLS): 75 kPa

It is expected the strip footing will be between 0.6 m and 2.0 m, if strip footings outside these dimensions are required, the authors of this report should be informed to verify the compatibility of the design.

Based on the results of the investigation, it is possible footings may be resting on different material. Footings resting on the clay may experience larger settlements than footing placed on the alluvial deposits. Differential settlement not more than 25 mm should be accounted for in the structural design. Overall footings placed on both clay subgrade or the high-silt content till are prone to tilting and shifting. Structural design should consider reducing eccentric loads as much as possible.

6.7 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

It is expected the footings for the new structure will be adjacent to the foundation wall of the existing structure. An average vertical stress distribution factor of 0.9 can be used for the soil elements beneath the footing and a at rest earth pressure coefficient of 0.5 can be used for estimation of lateral loading on the existing foundation wall induced by the footing load. Care should be taken to not undermine the existing footings during excavation.

7.0 SLOPE STABIILITY

A computer analysis using SoilVision's limit equilibrium software SVSLOPE was completed based on the soil model and site topography to approximate the ground safety factor of the sloped ground. Ground slopes at the north and northwest of the building. Based on site observations and the site topography, the slope angle varies from one corner of the property to the other, a 4H:1V slope was considered for the analysis as the steepest section.

Soil model was constructed based on our understanding of the site investigation data. The site is mostly vegetated which is expected to strengthen slope surface and reduce erosion potential, resulting in a reduced chance of surface failure. Several calculation methods where tried, however with the current site situation a safety factor of greater than 2 was obtained for both force and moment.

It should be noted that at the current state of the slope there were no building loads identified immediately at the crest of the slope and the water table was recorded lower than the existing toe. The analysis results will not remain valid if the stresses applied on the slope or the elevation of water table change in future.

The proposed excavation for footing construction will reduce the safety factor once the toe of the slope is cut and may cause localized failure. The proposed cut shall be sloped 3H:1V. Construction scheduling shall consider excavation, construction of foundation wall and backfilling in a short period of time. Given the high silt content of the till, if the vegetation is removed and the slope is subject to precipitation, there is a potential for failure. Once the excavation is completed, the toe of the slope which will be stripped of vegetation shall be immediately covered with poly sheets installed horizontally from toe up and sealed by clay barrier at the top to reduce the risk of toe erosion in case of precipitation. The toe cut shall be immediately reinstated once the foundation wall is constructed.

Given the expected downslope flow of the absorbed surface water, there is potential for cross migration of fine particles through the granular backfill over time. It is recommended to cover the surface of the cut slope with a layer of filter geotextile before placement of the backfill.

Given the potential pressure induce by the slope, the foundation wall shall be either backfilled evenly on both sides or to be designed as a retailing wall if planned to be backfilled on one side only, either temporarily or permanently.

8.0 CONSTRUCTION CONSIDERATIONS

Any organic material and existing fill material of any kind, should be removed from the footprint of the footings and all structurally load bearing elements. If grade raise is required suitable fill material to conform to specifications of OPSS Granular criteria shall be used. 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. Any water infiltrating into the open excavation can be removed through conventional sump and pump methods.

The excavations are expected to be advanced through either the clay or alluvial deposits. The overburden excavation should be completed in accordance with Ontario Regulation (O.Reg.) 213/91 under the Occupational Health and Safety Act (OHSA) with specific reference to acceptable side slopes and stabilization requirements. The general stratigraphy outlined herein can be considered an OHSA Type 3 Soil. For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number designation.

No information on the neighbouring properties type or depth of foundation has been provided. Existing properties should be reviewed prior to construction by a structural engineer to assess per-construction condition and establish a baseline. This is of more importance for those building at the top of the slope. Building exterior and interior conditions can be video recorded to document all existing cracks and other deficiencies. Survey benchmarks can be also installed on the buildings atop the slope to document pre and post construction elevations for future references. Groundwater was not encountered during the investigation. Given the encountered stratigraphy, expected water level and proximity of adjacent buildings, no significant impact is expected for any adjacent structures only due to potential groundwater lowering.

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 till is not a suitable material for backfilling. Sub-drains with positive of drainage to the City sewer should be provided at foundation level.

9.0 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 contains fine grain, 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. The engineer designing utilities shall ensure the proposed utility pipes can tolerate compaction loads.

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

10.0 CEMENT TYPE AND CORROSION POTENTIAL

A soil sample was submitted to Parcel laboratories for testing of chemical properties relevant to exposure of concrete elements to sulphate attacks as well as potential soil corrosivity effects on buried metallic structural element. Test results are presented in Tables 5-1.

The potential for sulphate attack on concrete structures is moderate. Type GU Portland cement is expected to be adequate to protect buried concrete elements in the subsurface conditions encountered.

The corrosion potential for buried steel elements was determined as ‘non-aggressive’.

11.0 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.

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Senior Geotechnical Engineer

12.0 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.

RIDEAU VALLEY INVESTIGATION

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.

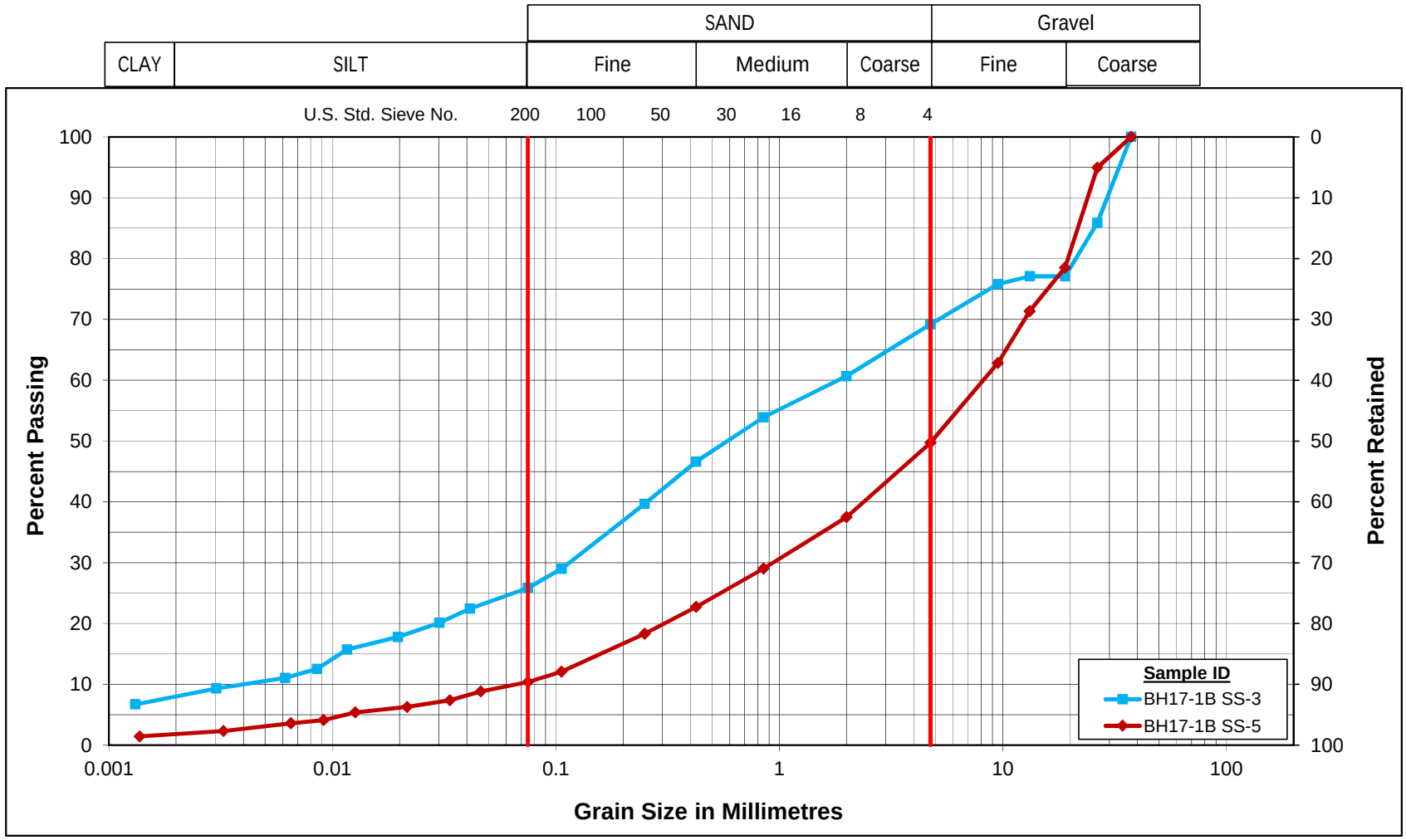
McIntosh Perry prepared this report for the exclusive use of the Client. Any use which a third party makes of this report, or any reliance on or decision to be made based on it, are the responsibility of such third parties. McIntosh Perry accepts no responsibility and will not be liable for damages,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

RIDEAU VALLEY INVESTIGATION PHASE 2

APPENDIX B
FIGURES

McINTOSH PERRY

Unified Soil Classification System



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GRAIN SIZE DISTRIBUTION

Figure No. 3

Project No. CP-16-0074-01 Ph.07

RIDEAU VALLEY INVESTIGATION PHASE 2

APPENDIX C
BOREHOLE LOGS

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EXPLANATION OF TERMS USED IN REPORT

N-VALUE: THE STANDARD PENETRATION TEST (SPT) N-VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N-VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N-VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

C_u (kPa)	0 – 12	12 – 25	25 – 50	50 – 100	100 – 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 – 5	5 – 10	10 – 30	30 – 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSION AND STRUCUTRAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINT AND BEDDING:

SPACING	50mm	50 – 300mm	0.3m – 1m	1m – 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ε	%	LINEAR STRAIN
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICALL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
c_c	1	COMPRESSION INDEX
c_s	1	SWELLING INDEX
c_a	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
Φ'	$^{-o}$	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
Φ_u	$^{-o}$	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1,%	VOID RATIO	e_{min}	1,%	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1,%	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1,%	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	s_r	%	DEGREE OF SATURATION	D_n	mm	N PERCENT – DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_P	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_P	%	PLASTICITY INDEX = $(W_L - W_L)$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $(W - W_P)/ I_P$	i	1	HYDAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $(W_L - W) / 1_P$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERED SOIL	$e_{,max}$	1,%	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

CORE CONDITION

Total Core Recovery (TCR)
The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)
The percentage of solid drill core, regardless of length, recovery at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)
The percentage of solid drill core, greater than 100 mm length, as measured along the centreline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index (25 cm intervals)
A count of the number of naturally occurring discontinuities (physical separations) in the rock core. Mechanically induced breaks caused by drilling are not included.

Angle with respect to (W.R.T.) Core Axis
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} angle is horizontal.

Description and Notes
An abbreviated description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

ABBREVIATIONS

General

II	Parallel to
OR	Orthogonal to
TCA	to Core Axis

Feature Type

AXJ	Axial Joint
BD	Bedding
BR	Broken Rock
CO	Contact
FLT	Fault
FO	Foliation/Schistosity
FR	Fracture
JN	Joint
MB	Mechanical Break
SH	Shear Plane/Zone
VN	Vain

Joint Shape

CU	Curved
IR	Irregular
PL	Planar
ST	Stepped
UN	Undulated

Joint Roughness

K	Slickensided
PO	Polished
RO	Rough
SM	Smooth
VR	Very Rough

Infill

Bc	Breccia
Ca	Calcite
Cl	Clay
Fe	Iron
Go	Gouge
Gv	Gravel
Py	Pyrite
Qz	Quartz
Sa	Sand
Si	Silt
Su	Sulphides

Relative Drilling Resistance (RDR) Criteria

RDR	Term	Criteria	Typical Ground Conditions
1	Very Easy	No chatter, very little resistance, very fast and steady drill advance rate	Very soft to soft silts and clays; very loose to loose silts and sands no gravel, cobbles, boulders or rubble
2	Easy	No chatter, some resistance with moderate advance rate	Firm to stiff silts and clays; loose to medium dense silts and sands; little to no gravel, no to very few cobles, boulders or pieces of rubble
3	Moderate	Some chatter firm drill resistance with moderate advance rate	Stiff to very stiff silts and clays; dense silts and sands; medium dense sands and gravel; occasional cobbles or rubble pieces (2-3 occurrences per 10 ft)
4	Hard	Frequent chatter and variable drill resistance, slow advance rate	Very stiff to hard silts and clays with some gravel and cobbles; very dense to extremely dense silts and sands with some gravel; dense to very dense sands and gravel; very weathered, soft bedrock; frequent cobbles and boulders or rubble pieces (3-4 per 10 ft)
5	Very Hard	Constant chatter, variable and very slow drill advance, nearly refusal	Hard to very hard silts and clays with some gravel; very dense to extremely dense gravelly sand or sandy gravel; very frequent cobbles and boulders (at least 5 per 10 ft); weathered, very jointed bedrock.

McINTOSH PERRY

RECORD OF BOREHOLE No 17-1B

DATE:	01/06/2018 - 02/06/2018	**LOCATION:**	Rideau Valley (Nicholas and Laurier)	**ORIGINATED BY:**	PH
PROJECT:	16-0074-01-RIDEAUVAL	**COORDINATES:**	N: 5031803.38 , E: 368392.94	**COMPILED BY:**	MG
CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	AG
ELEVATION:	70.0 m	**REMARK:**		**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH (kPa) (20 40 60 80 100)	WATER CONTENT and LIMITS (%) (W_P W W_L) (25 50 75)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		70.0	Natural ground surface										
		0.0 / 69.8	160 mm Asphalt.										
		0.2 / 69.4	Fill. Sand and Gravel (fine)										
		0.5	Fill. Sand and Gravel (coarse)										
5	1	68.3											
		1.6	Fill.										
	2												
		67.5											
		2.5 / 67.4	Clay.										
		2.6	Not Sampled. RDR= 1-2										
10	3												
	4												
15													
	5												

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McINTOSH PERRY

RECORD OF BOREHOLE No 17-1B

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DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH (kPa) (20 40 60 80 100)	WATER CONTENT and LIMITS (%) (W_P W W_L) (25 50 75)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
25	7												
	8		RDR = 3-4										
30	9												
	10												
35			RDR = 4-5										
	11												

Vane test: ◇ Intact ◆ Remolded; Lab vane: □ Intact ■ Remolded

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RECORD OF BOREHOLE No 17-1B

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CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	AG
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DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH (kPa) Vane test ◇ Intact ◆ Remolded, Lab vane □ Intact ■ Remolded (20 40 60 80 100)	WATER CONTENT and LIMITS (%) W_P W W_L (25 50 75)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G	S	M	C
45	13	56.1 / 13.9	Silty and gravelly sand, traces of clay, grey, wet, compact to dense. Presence of cobbles and boulders. (TILL) RDR = 4-5		SS-1		10	119			○					
	14				RC-01											
50	15				SS-2		33	16			○					
					SS-3		42	15			○			31	43	19	7
55	16				SS-4		54	32			○ ○					
	17				SS-5		58	76			○			50	40	9	1
					SS-6		100	REF			○					

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McINTOSH PERRY

RECORD OF BOREHOLE No 17-1B

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CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	AG
ELEVATION:	70.0 m	**REMARK:**		**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		18.1	Lindsay Formation (Upper Member) Fine to coarse grained, medium to dark grey, LIMESTONE interbedded with black calcareaus fossiliferous shale. (shale ~20% to 40%) -calcite veining		RC-02		100	*27*				6 3 4 2 2	SCR 59 18.31-18.57 broken rock MB BD UN RO, ~50o shale SCR 57 18.88-19.11 broken rock BD PL SM, ~45o shale BD PL RO, 50o BD PL RP, 50o
65	19				RC-03		78	*18*				0 6	MB MB BD PL SM, 45o
	20		-slightly weathered, occasional calcite veining -beds dominate									4 4 4 4 4	MB 20.22-20.40 broken rock SCR 22 MB FR IR sealed ~50o MB MB JN UN RO, 90o
70	21				RC-04		33	*7*					20.63-21.83 rubble zone
	22		-slight weathering on shale partings -interbedded coarse grainted, fossiliferous (erinoids common)									2 3 1 2 2 2 2 2	SCR 95 MB JN UN RO, 60o JN UN RO, 40o JN PL RO, 70o 22.37-22.44 broken rock BD UN RO, ~55o JN UN RO, shale, 70o JN PL RO, 90o BD UN RO, 45-50o, shale JN IR RO, 90o JN UN RO, 90o JN IR RP, 90o JN IR RO, 90o
75	23				RC-05		98	*70*				2 3 2	SCR 90 BD PL RO, 50o BD UN RO, 50o JN IR RO, 90o BO UN Ro, 60o

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RECORD OF BOREHOLE No 17-1B

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PROJECT:	16-0074-01-RIDEAUVAL	**COORDINATES:**	N: 5031803.38 , E: 368392.94	**COMPILED BY:**	MG
CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	AG
ELEVATION:	70.0 m	**REMARK:**		**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: SYMBOL	SAMPLES: TYPE AND NUMBER	SAMPLES: STATE	SAMPLES: RECOVERY	SAMPLES: "N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
		45.6 / 24.4	Lindsay Formation (Middle Member) Fine to coarse grained, light to dark grey LIMESTONE, thin irregular undulating interlaminations and partings of black calcareous shale. (shale ~10% to 20%) -bioturbation		RC-06		100	*86*				2	BD PL RO, 50o JN PL RO, 80o MB
80												2	
												2	JU PL RO 45o, shale
												0	JN UN RO, 60o, shale
	25											0	SCR 100
												3	
					RC-07		100	*77*				4	BD PL RO, 60o, shale BD UN RO, 60o, shale
85												1	BD PL RO, 60o, shale
	26											1	BD UN RO, 60o, shale
												1	BD UN RO, 60o, shale calcite vug
												2	BD UN SM, 60o, shale 26.37-26.47 fracture, IR ~25o
												0	SCR 93 JN IR RO, 90o JN PL RO, 45o
	27											1	
					RC-08		94	*80*				5	JN IR RO, 90o disseminated pyrite
90												4	JN PL RO, 90o JN PL RO, 90o 27.38-27.50 broken rock
												1	BD PL RO, 55o BD PL RO, 55o MB
	28	41.9 / 28.1	-shale composition decreasing with depth									0	JN PL RO, 90o SCR 100 MB
			Light to dark grey, fine to coarse grained LIMESTONE with irregular, wispy, undulating, very thin black calcareous, shale laminations and partings. (shale < 10%) -bioturbation									2	JN ST RO, 50o
												0	JN UN RO, 45o, disseminated pyrite
					RC-09		100	*100*				1	
95	29											1	JN IR RO, 90o
												1	MB
												1	BD PL RO, 55o SCR 100
												0	MB
												1	

DYNAMIC CONE PEN. RESISTANCE PLOT: 20 40 60 80

SHEAR STRENGTH (kPa): Vane test ◇ Intact ◆ Remolded; Lab vane □ Intact ■ Remolded; 20 40 60 80 100

WATER CONTENT and LIMITS (%): W_P W W_L; 25 50 75

REMARKS & GRAIN SIZE DISTRIBUTION (%): G S M C

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RECORD OF BOREHOLE No 17-1B

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PROJECT:	16-0074-01-RIDEAUVAL	**COORDINATES:**	N: 5031803.38 , E: 368392.94	**COMPILED BY:**	MG
CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	AG
ELEVATION:	70.0 m	**REMARK:**		**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH (kPa) Vane test ◇ Intact ◆ Remolded, Lab vane □ Intact ■ Remolded (20 40 60 80 100)	WATER CONTENT and LIMITS (%) W_P W W_L (25 50 75)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
												1	JN IR RO, 45o
												1	JN PL RO, 45o
100					RC-10		100	*99*				1	JN UN RO, 55o
												1	MB
	31											1	MB
													SCR 100
												1	MB
													JN UN RO, 45o, shale
					RC-11		100	*100*				0	
												1	MB
105	32												JN PL RO, 60o, disseminated pyrite
		37.9										0	
		32.1	**END OF BOREHOLE**										
	33												
110													
	34												
115	35												

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RECORD OF BOREHOLE No NBH-01

DATE:	08/06/2018 - 10/06/2018	**LOCATION:**	Rideau Valley (Nicholas and Laurier)	**ORIGINATED BY:**	PH
PROJECT:	16-0074-01-RIDEAUVAL	**COORDINATES:**	N: 5031814.17 , E: 368406.602	**COMPILED BY:**	JU
CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	70.0 m	**REMARK:**	Dip 60, Aximuth 275	**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: SYMBOL	SAMPLES: TYPE AND NUMBER	SAMPLES: STATE	SAMPLES: RECOVERY	SAMPLES: "N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		70.0	Natural ground surface										
		0.0	150 mm Asphalt.										
		69.8 / 0.2	Fill. Sand and gravel (fine)										
		69.6 / 0.5	Fill. Sand and gravel (coarse)										
		69.2 / 0.9	Fill. Gravelly silty sand										
	1												
5													
	2												
		67.9 / 2.4	Clay.										
		67.9 / 2.4	Not sampled RDR = 2										
10	3												
	4												
15													
	5		RDR = 1-2										

DYNAMIC CONE PEN. RESISTANCE PLOT: 20 40 60 80

SHEAR STRENGTH (kPa): Vane test — ◇ Intact, ◆ Remolded; Lab vane — □ Intact, ■ Remolded; 20 40 60 80 100

WATER CONTENT and LIMITS (%): W_P W W_L; 25 50 75

REMARKS & GRAIN SIZE DISTRIBUTION (%): G S M C

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RECORD OF BOREHOLE No NBH-01

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ELEVATION:	70.0 m	**REMARK:**	Dip 60, Aximuth 275	**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: SYMBOL	SAMPLES: TYPE AND NUMBER	SAMPLES: STATE	SAMPLES: RECOVERY	SAMPLES: "N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT (20 40 60 80) / SHEAR STRENGTH (kPa) Vane test ◇ Intact ◆ Remolded, Lab vane □ Intact ■ Remolded (20 40 60 80 100)	WATER CONTENT and LIMITS (%) W_P W W_L (25 50 75)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
			RDR = 1										
	7												
25													
	8		RDR = 1-2										
	9												
30			RDR = 3-4										
	10												
35													
	11		RDR = 5										

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RECORD OF BOREHOLE No NBH-01

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DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: SYMBOL	SAMPLES: TYPE AND NUMBER	SAMPLES: STATE	SAMPLES: RECOVERY	SAMPLES: "N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
45	13												
	14												
50	15												
	16												
55	17	55.5 16.8	Silty and gravelly sand, grey, wet, very loose. Presence of cobbles and boulders.		SS-1 SS-2		50	109					

Vane test: ◇ Intact ◆ Remolded; Lab vane: □ Intact ■ Remolded

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RECORD OF BOREHOLE No NBH-01

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	19												
65	20												
	21												SCR 24
70					RC-01		100	*19*					
	22												SCR 67
					RC-02		92	*64*					
75	23												SCR 5

Vane test: ◇ Intact ◆ Remolded; Lab vane: □ Intact ■ Remolded

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RECORD OF BOREHOLE No NBH-01

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					RC-03		40	*0*					SCR 8
80													
	25												
					RC-04		46	*16*					
85													
	26	47.2											
		26.3	Lindsay Formation (Upper Member) Medium to dark grey, fine to coarse grained LIMESTONE, interbedded with black calcareous SHALE beds (commonly fossilferous) (shale 30%-45%) -crinods common		RC-05		100	*0*				4	SCR 34 26.29-26.70 broken rock, shale, some calcite veining
												4	
												4	SCR 29 26.70-27.46 Brecciated zone sealed with calcite and calcite veining
	27				RC-06		52	*26*				4	
90													SCR 96
					RC-07		100	*100*					27.65-30.00 irregular calcite veining JN, 55o
	28												JN PL SM, 55o
												2	SCR 88 MB JN PL SM, 45o, shale
												0	JN PL RO, 45o, shale
95												1	
	29				RC-08		100	*88*					JN PL RO, 50o
												1	MB
												1	
													JN UN RO 29.50-29.62
												1	Broken rock
												2	SCR 92 29.75-29.96 Broken rock, with

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RECORD OF BOREHOLE No NBH-01

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		43.8 / 30.3	Lindsay Formation (Middle Member) Light to dark grey (mottled) fine to coarse grained LIMESTONE with irregular interlaminateions and partings of black calcareous shale. (shale ~10-15%)									2	coarse calcite
												0	
100					RC-09		100	*94*				0	JN PL Ro, 45o, slight weathering
												1	JN PL RO, 45o
	31											1	
												0	SCR 100
												0	MB
												0	
105	32				RC-10		100	*100*				0	JN IR RO, shale
												0	MB
												0	MB 32.46-32.62 sealed vertical fracture
		41.6 / 32.8	Light to dark grey (mottled), fine to coarse grained LIMESTONE with thin irregular whispy lamination and partings of black calcareous SHALE. (shale ~5-10%) -scattered small fossils -bioturbation									2	
												0	SCR 86
	33											0	
												1	MB
110					RC-11		100	*87*				1	JN PL RO, 70o
												0	MB on calcite vein
	34											0	MB
												1	SCR 95
												0	JN UN RO, 90o
												0	MB
115	35				RC-12		100	*94*				0	MB
												0	
												1	JN UN RO, 45o
												0	MB SCR 90

McINTOSH PERRY

RECORD OF BOREHOLE No NBH-01

DATE:	08/06/2018 - 10/06/2018	**LOCATION:**	Rideau Valley (Nicholas and Laurier)	**ORIGINATED BY:**	PH
PROJECT:	16-0074-01-RIDEAUVAL	**COORDINATES:**	N: 5031814.17 , E: 368406.602	**COMPILED BY:**	JU
CLIENT:	DTJV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	70.0 m	**REMARK:**	Dip 60, Aximuth 275	**REPORT DATE:**	21/06/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	FRACTURE INDEX (25 cm intervals)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
										20 40 60 80		0	G S M C
120					RC-13		100	*97*				1	36.31-36.41 FR IR RO, 45o to 90o -disseminated pyrite on shale JN PL RO, 45o
	37											1	
												0	
		37.6										0	MB
		37.3	**END OF BOREHOLE**										
125	38												
	39												
130													
	40												
	41												
135													

Vane test: ◇ Intact ◆ Remolded; Lab vane: □ Intact ■ Remolded

SHEAR STRENGTH (kPa): 20 40 60 80 100

WATER CONTENT and LIMITS (%): W_P W W_L; 25 50 75

\\LICENSES7\Sobek\Geotec80\Style\Log_Borehole_v5 MTM_Fract.sty

CP-16-0074-01 Rideau Valley Investigation
BH17B
RC-2: 18.31 m to 18.87 m
RC-3: 18.87 m to 20.40 m
RC-4: 20.40 m to 21.95 m

DRAFT

CP-16-0074-01 Rideau Valley Investigation
BH17B
RC-5: 21.95 m to 23.50 m
RC-6: 23.50 m to 24.97 m

DRAFT

CP-16-0074-01 Rideau Valley Investigation
BH17B
RC-7: 24.97 m to 26.47 m
RC-8: 26.47 m to 28.09 m

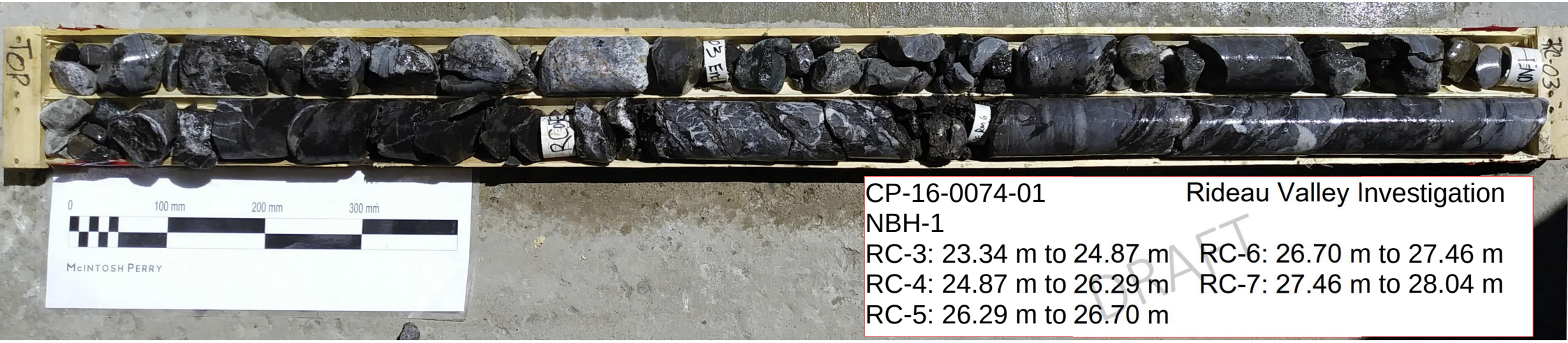
DRAFT

CP-16-0074-01 Rideau Valley Investigation
BH17B
RC-9: 28.09 m to 29.54 m
RC-10: 29.54 m to 31.14 m

DRAFT


0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
BH17B
RC11: 31.14 m to 32.11 m
DRAFT

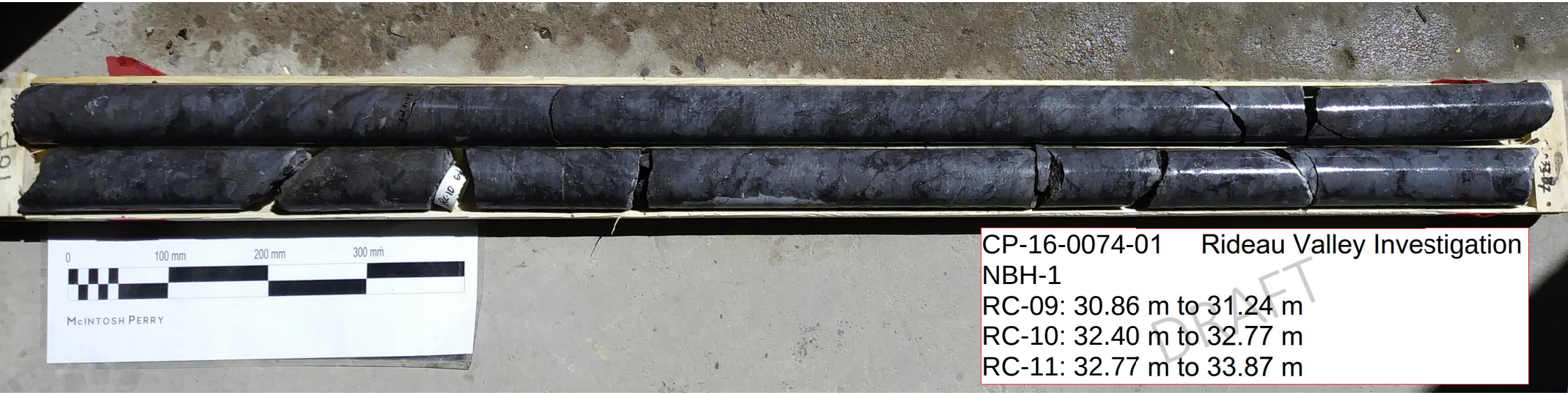

TOP
RC-01
0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
NBH-1
RC-1: 20.98 m to 21.82 m
RC-2: 21.82 m to 23.34 m
DRAFT



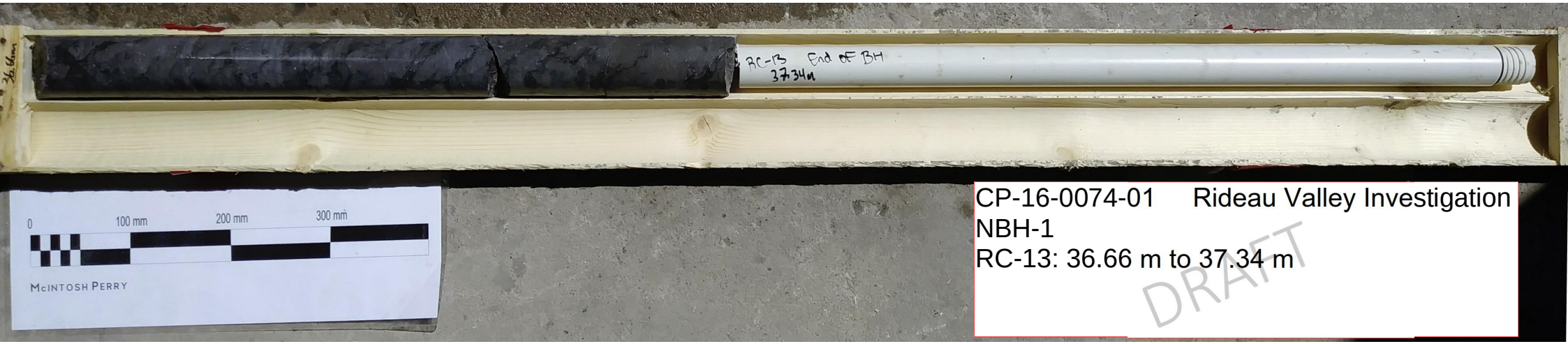
CP-16-0074-01 Rideau Valley Investigation
NBH-1

RC-3: 23.34 m to 24.87 m
RC-4: 24.87 m to 26.29 m
RC-5: 26.29 m to 26.70 m
RC-6: 26.70 m to 27.46 m
RC-7: 27.46 m to 28.04 m


0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
NBH-1
RC-7: 28.04 m to 28.25 m
RC-8: 28.25 m to 29.72 m
RC-9: 29.72 m to 30.86 m
DRAFT


0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
NBH-1
RC-09: 30.86 m to 31.24 m
RC-10: 32.40 m to 32.77 m
RC-11: 32.77 m to 33.87 m
DRAFT


0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
NBH-1
RC-11: 33.87 m to 34.32 m
RC-12: 34.32 m to 35.81 m
RC-13: 35.81 m to 36.66 m
DRAFT


RC-13 End of BH
37.34m
0
100 mm
200 mm
300 mm
McINTOSH PERRY
CP-16-0074-01 Rideau Valley Investigation
NBH-1
RC-13: 36.66 m to 37.34 m
DRAFT

RIDEAU VALLEY INVESTIGATION PHASE 2

APPENDIX D
LABORATORY TEST RESULTS

McINTOSH PERRY

McINTOSH PERRY

WATER CONTENT DETERMINATION

Test Method Utilized	☑ MTO LS-701	☐ ASTM D 2216	☐ AASHTO T-265				
Project No.: CP-16-0074-01 Ph.07					Date Received: 06/13/18		
Project Name/Location: Rideau Valley Investigation - Nicholas & Laurier					Date Tested: 06/14/18		
Material Type: Soils					Lab Sample No.: OL-18-0004		
Borehole No.	Depth Sample Taken (ft ')	Sample Container I.D.	Wet Sample + Tare (A)	Dry Sample + Tare (B)	Tare (C)	Mass of Sample (D) (B-C)	% Moisture (A-B)/Dx100
BH17-1B SS-1	45.5'-47'	TR.28	117.20	115.73	52.64	63.09	**2.3**
BH17-1B SS-2	49'-50.5'	TR.29	333.72	309.70	52.71	256.99	**9.3**
BH17-1B SS-3	50.5'-52.5'	TR.103	882.26	816.04	130.10	685.94	**9.7**
BH17-1B SS-4A	53'-54'	TR.30	235.58	218.95	52.85	166.10	**10.0**
BH17-1B SS-4B	54'-55'	TR.17	294.86	268.57	52.62	215.95	**12.2**
BH17-1B SS-5	55.5'-57.5'	TR.101	1427.53	1331.45	130.00	1201.45	**8.0**
BH17-1B SS-6	58'-59'	TR.16	302.28	269.93	52.60	217.33	**14.9**

Non-Comformance's from Test Procedure: N/A

Comments:

Tested by:	Signature:
Checked by: H.S.	Signature:

McINTOSH PERRY

Particle-Size Analysis of Soils

LS702

ASTM D422

PROJECT DETAILS			
Client:	**0**	Project No.:	**CP-16-0074-01 Ph.07**
Project:	**Rideau Valley Investigation - Nicholas & Laurier**	Test Method:	**LS702**
Material Type:	**Soil**	Sampled By:	**P.H.**
Source:	**BH17-1B**	Date Sampled:	**June 13, 2018**
Sample No.:	**SS-3**	Tested By:	**H.Smith**
Sample Depth:	**50.5'-52.5'**	Date Tested:	**June 19, 2018**

WASH TEST DATA	
Oven Dry Mass In Hydrometer Analysis (g)	102.23
Sample Weight after Hydrometer and Wash (g)	23.20
Percent Passing No. 200 Sieve (%)	**77.3**
Percent Passing Corrected (%)	**46.89**

PERCENT LOSS IN SIEVE	
Sample Weight Before Sieve (g)	**685.94**
Sample Weight After Sieve (g)	**685.94**
Percent Loss in Sieve (%)	**0.00**

SOIL INFORMATION		
Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification	CL_ML	
Specific Gravity (G_s)	2.730	
Sg. Correction Factor (α)	0.982	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS	
Oven Dried Mass (W_o), (g)	62.57
Air Dried Mass (W_a), (g)	63.00
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9932
Air Dried Mass in Analysis (M_a), (g)	102.93
Oven Dried Mass in Analysis (M_o), (g)	102.23
Percent Passing 2.0 mm Sieve (P_{10}), (%)	60.66
Sample Represented (W), (g)	168.53

SIEVE ANALYSIS		
Sieve Size mm	**Cum. Wt. Retained**	**Percent Passing**
75.0		100.0
63.0		100.0
53.0		100.0
37.5	0.0	100.0
26.5	97.1	85.8
19.0	157.2	77.1
13.2	157.2	77.1
9.5	165.9	75.8
4.75	211.3	69.2
2.00	269.9	60.7
Sample Wt.	685.94	
0.850	11.38	53.9
0.425	23.63	46.6
0.250	35.36	39.7
0.106	53.36	29.0
0.075	58.64	25.9
PAN	59.76	

HYDROMETER DETAILS	
Volume of Bulb (V_B), (cm^3)	58.0
Length of Bulb (L_2), (cm)	13.8
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.90
Scale Dimension (h_s), (cm/Div)	0.163
Cross-Sectional Area of Cylinder (A), (cm^2)	27.3
Meniscus Correction (H_m), (g/L)	1.0

START TIME 10:53 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
19-Jun-18	10:54 AM	1	42.5	4.0	20.0	38.5	22.4	9.6480	10.0910	0.0133	0.0413
19-Jun-18	10:55 AM	2	38.5	4.0	20.0	34.5	20.1	10.3000	10.0910	0.0133	0.0302
19-Jun-18	10:58 AM	5	34.5	4.0	20.0	30.5	17.8	10.9520	10.0910	0.0133	0.0197
19-Jun-18	11:08 AM	15	31.0	4.0	20.0	27.0	15.7	11.5225	10.0910	0.0133	0.0116
19-Jun-18	11:23 AM	30	25.5	4.0	20.0	21.5	12.5	12.4190	10.0910	0.0133	0.0085
19-Jun-18	11:53 AM	60	23.0	4.0	20.0	19.0	11.1	12.8265	10.0910	0.0133	0.0061
19-Jun-18	3:03 PM	250	20.0	4.0	21.0	16.0	9.3	13.3155	9.8484	0.0131	0.0030
20-Jun-18	10:53 AM	1440	15.5	4.0	20.0	11.5	6.7	14.0490	10.0910	0.0133	0.0013

Remarks:

Gravelly Sand some Silt trace Clay

%Gravel: 30.8 %Sand: 43.3 %Silt: 19.2 %Clay: 6.7

Reviewed By: H.Smith

Date: June 19,2018

McINTOSH PERRY

Particle-Size Analysis of Soils

LS702

ASTM D422

PROJECT DETAILS

Client:	**0**	Project No.:	**CP-16-0074-01 Ph.07**
Project:	**Rideau Valley Investigation - Nicholas & Laurier**	Test Method:	**LS702**
Material Type:	**Soil**	Sampled By:	**P.H.**
Source:	**BH17-1B**	Date Sampled:	**June 13, 2018**
Sample No.:	**SS-5**	Tested By:	**H.Smith**
Sample Depth	**55.5'-57.5'**	Date Tested:	**June 19, 2018**

WASH TEST DATA

Oven Dry Mass In Hydrometer Analysis (g)	102.86
Sample Weight after Hydrometer and Wash (g)	
Percent Passing No. 200 Sieve (%)	**100.0**
Percent Passing Corrected (%)	**37.48**

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	**1201.45**
Sample Weight After Sieve (g)	**1201.45**
Percent Loss in Sieve (%)	**0.00**

SOIL INFORMATION

Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification	SM-SC	
Specific Gravity (G_s)	2.703	
Sg. Correction Factor (α)	0.988	
Mass of Dispersing Agent/Litre	24	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	62.57
Air Dried Mass (W_a), (g)	63.00
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9932
Air Dried Mass in Analysis (M_a), (g)	103.57
Oven Dried Mass in Analysis (M_o), (g)	102.86
Percent Passing 2.0 mm Sieve (P_{10}), (%)	37.48
Sample Represented (W), (g)	274.44

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5	0.0	100.0
26.5	60.8	94.9
19.0	258.4	78.5
13.2	344.3	71.3
9.5	446.8	62.8
4.75	603.8	49.7
2.00	751.1	37.5
Sample Wt.	1201.45	
0.850	23.16	29.04
0.425	40.50	22.72
0.250	52.55	18.33
0.106	69.71	12.08
0.075	74.38	10.38
PAN	75.31	10.0

HYDROMETER DETAILS

Volume of Bulb (V_B), (cm^3)	58.0
Length of Bulb (L_2), (cm)	13.8
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.9
Scale Dimension (h_s), (cm/Div)	0.163
Cross-Sectional Area of Cylinder (A), (cm^2)	27.3
Meniscus Correction (H_m), (g/L)	1.0

START TIME 11:06 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
19-Jun-18	11:07 AM	1	27.5	3.0	20.0	24.5	8.82	12.09223	10.09098	0.013286	0.04620
19-Jun-18	11:08 AM	2	23.5	3.0	20.0	20.5	7.38	12.74423	10.09098	0.013286	0.03354
19-Jun-18	11:11 AM	5	20.5	3.0	20.0	17.5	6.30	13.23323	10.09098	0.013286	0.02162
19-Jun-18	11:21 AM	15	18.0	3.0	20.0	15.0	5.40	13.64073	10.09098	0.013286	0.01267
19-Jun-18	11:36 AM	30	14.5	3.0	20.0	11.5	4.14	14.21123	10.09098	0.013286	0.00914
19-Jun-18	12:06 PM	60	13.0	3.0	20.0	10.0	3.60	14.45573	10.09098	0.013286	0.00652
19-Jun-18	3:16 PM	250	9.5	3.0	20.0	6.5	2.34	15.02623	10.09098	0.013286	0.00326
20-Jun-18	11:06 AM	1440	7.0	3.0	20.0	4.0	1.44	15.43373	10.09098	0.013286	0.00138

Remarks:
Gravel and Sand trace Silt trace Clay
%Gravel: 50.3 %Sand: 39.4 %Silt: 8.9 %Clay:1.4

Reviewed By: H.Smith
Date: June 19,2018