VETERANS HOUSE – WATERIDGE VILLAGE – GEOTECHNICAL REPORT

Project No.: CP-16-0462

Prepared for:

CSV Architects
1066 Somerset St. W. Suite 402
Ottawa, ON, K1Y 4T3

Prepared by:

McIntosh Perry
115 Walgreen Rd, R.R. 3
Carp, ON K0A 1L0

REVISED

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GEOTECHNICAL INVESTIGATION and
FOUNDATION DESIGN RECOMMENDATION REPORT
745 Mikinak Road, 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 a three floor multi-use building in Ottawa, Ontario. The field work was carried out on June 6, 2018 and comprised of five boreholes advanced to a maximum depth of 7.2 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.

2.0 SITE DESCRIPTION

The property under consideration for proposed development is located on Mikinak Road, east of Codd's Road, at civic address 745. The property is located south of the Ottawa River in the Viscount Alexander Park neighbourhood in Ottawa, Ontario. The property in its current state is a rectangular vacant lot surrounded on all four sides by asphalt roadway. The lot is at a lower elevation than the roadway and ponding water was visible at the time of drilling. The property contains a small grouping of trees in the northwest corner.

It is understood the proposed structure will be a three-storey residential structure. At this stage no basement is being considered.

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 advanced using hollow stem augers aided by a track-mounted CME-55 drilling rig. Boreholes were advanced to a maximum depth of 7.2 m below the ground surface. Soil samples were aimed at 0.75 m intervals of depth 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 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 limestones 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 fill material underlain by a layer of clay which transitions to a layer of silty sand under which is limestone bedrock. The soils encountered at this site can be divided into four different zones;

a) Fill
b) Silt and clay, trace sand
c) Silty sand, some clay, trace gravel
d) Limestone

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

In all boreholes was a layer of fill material that varied in depth across the site. The composition of the fill varied but in general ranged from clay to silty clay and contained trace amounts of sand and gravel. SPT 'N' values within this layer ranged from 5-17 blows /300 mm. Moisture content within this layer was observed to ranged drastically from 28% to 111%. The thickness of the fill was observed to range from 1.3 m to 3.0 m below surface.

5.2.2 Silt and Clay, Trace Sand

Below the fill was a layer of silt and clay with trace sand. It was described as being grey to brown, moist, very soft to soft. SPT 'N' values within this layer ranged from 1 – 4. Moisture content within this layer ranged from 40% to 108%. The layer extended form a maximum elevation of 86.3 m to a minimum elevation of 85.3 m. Three Atterberg limit tests were conducted on representative samples. Results indicate the clay in BH18-03 was of high plasticity with a liquid limit of 54% and plastic limit of 19%. The clay in BH18-04 ranged from an intermediate to high plasticity clay with liquid limit values ranging from 42% to 58% and plastic limit value ranging from 16% to 24%. Test results are shown in Figure 3 in Appendix B. Moisture content tests indicate natural moisture content of the samples are close to and exceeding the liquid limit. MTO N-sized vane tests were conducted, which estimated the in-situ shear strength of the layer. Values in BH18-04 ranged from 45 KPa to 66 KPa (firm to stiff) and from 32 KPa to 37 KPa in boreholes BH18-03. Sensitivity values of all tests conducted ranged from 1 to 2 indicating the layer has a low to medium sensitivity. A representative sample of the 'silt and clay' underwent 'hydrometer' grain size analysis, and was found to contain 0% gravel, 5% sand, 55% silt and 42% clay. Test results are shown on Figure 4 included in Appendix B.

5.2.1 Silty Sand Some Clay, Trace Gravel

Below the layer of silt and clay, trace sand and directly above the limestone bedrock, in boreholes BH18-03 and Bh18-05 was a smaller layer of silty sand with some clay and trace gravel. This material was observed to be grey, moist to wet and soft to firm. SPT 'N' values within this layer ranged from 2–8 blows /300 mm. Moisture content within this layer ranged from 39% to 122%. Two representative samples of the silty sand underwent 'hydrometer' grain size analysis and were found to contain 5%-10% gravel, 43%-50% sand, 30%-33% silt and 12%-17% clay. This layer, due to its relatively thin thickness, could have been formed as an interface between clay and the weathered rock surface.

5.2.1 Limestone

Refusal was encountered in all BH's and bedrock was cored in BH18-03. Recovery ranged from 98% to 100% and RQD values for RC-01 and RC-02 were 100% and 79% respectively.

5.3 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 (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (Ohm-cm)
BH18-03	SS-04	2.29 – 2.90	7.72	0.0045	0.0011	8,710

5.4 Groundwater

Groundwater was observed in a well installed in BH18-03. Groundwater was measured in June 2018 at 2.43 m (El. 85.26 m) below existing ground surface. Groundwater level may be expected to fluctuate due to seasonal changes. Measurement was repeated in early November and indicated 1.95 m (El. 85.75 m) depth.

6.0 DISCUSSIONS AND RECOMMENDATIONS

6.1 General

This section of the report provides recommendations for the design of a mixed use three storey building with no basement. The structure will include residential units and office spaces. 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 property is currently sitting at a lower elevation than the roadway which surrounds the property and contains a small grouping of trees within the northwest corner. The surrounding area is currently under development and currently consists of residential homes and a park. 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 three-story mixed-use building with no basement, and will likely be a conventional slab on grade with shallow footing foundation.

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. Frost penetration depth is assumed reduced to 1.5 m for heated buildings if constructed properly, constantly heated, and the heat flux is not blocked.

6.4 Site Classification for Seismic Site Response

Selected spectral responses in the general vicinity of the site for 2% chance of exceedance in 50 years (2500 years return period) are as indicated in Table 6-1, shown below and in Appendix D;

Table 6-1: Selected Seismic Spectral Responses (2% in 50 Yrs, 2010 NBC)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.634	0.309	0.138	0.046	0.321

The site can be classified as a Site Class "D" for soft soil 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, due to elevation differences or over excavation, 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. The fill should be placed in horizontal lifts of uniform thickness of no more than 300 mm before compaction and it should be placed at appropriate moisture content. 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).

All slab-on-grade units shall float independently from all load-bearing structural elements.

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.

The excavation should extend at a minimum to the top of desiccated clay below the existing fill. Any existing fill and any material from the existing building must be removed from the footprint of the proposed building.

A geotechnical staff shall attend the site upon completion of excavation and approve the subgrade. Clay is prone to disturbance upon exposure. Foundation footprint shall be protected by placement of grout or lean concrete upon excavation or else the footings shall be placed as quickly as possible upon excavation before the subgrade is exposed to precipitation or frost. Excavation shall be avoided when temperature is below zero. Footings shall be placed and backfilled before the start of frost season. Subgrade protection shall cover at least the influence zone of the footings. The influence zone of the footing is defined by a line going outward and downward from the edge of the footing to the subgrade. The lean concrete shall provide compression strength equal or higher than the shale.

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.

6.6.1 Bearing Capacity

For footings bearing on clay, soil capacity values are normally dictated by serviceability limitation expected for the settlement of shallow footings. Consolidation parameters were calculated based on measured in-situ shear strength of the clay, plasticity index of clay, and historical data available for this site. Pre-consolidation pressure is expected in the vicinity of 140 kPa to 170 kPa for the clay surface. A coefficient of recompression equal to 0.05 was chosen for the calculations. Understanding the site will be raised by approximately 1.5 m, bearing capacities were calculated for pad footings and strip footings at the top of the clay. It was also assumed any of the footings will not exceed 2 m in the shorter dimension.

A factored bearing pressure at Ultimate Limit State (ULS) of 200 kPa can be used for the design on approved desiccated clay subgrade. A Serviceability Limit State (SLS) of 85 kPa can be used for shallow footings limit the total settlement to approximately 25 mm.

If the amount of grade raise above existing is going to exceed 1.5 m and/or the size of footings are going to exceed 2 m in shorter dimension, authors of this report shall be notified.

To avoid punching failure in clay, strip footings shall not be less than 0.75 m in width and isolated pad footings shall not be less than 1.0 m in shorter dimension.

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

7.0 CONSTRUCTION CONSIDERATIONS

Any organic material and existing fill material of any kind, shall be removed from the footprint of the footings and all structurally load bearing elements. The existing fill observed to contain organic material and construction debris. If grade raise above the native subgrade is required suitable fill material to conform to specifications of OPSS Granular criteria shall be used. The Structural Fill should be free from any recycled or deleterious material, it should not be placed in lifts thicker than 300 mm and should be compacted as specified.

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

Settlements are expected as a result of the grade raise across the site. For 1.5 m of grade raise settlement is expected to be less than 20 mm for this specific site. However, it should be noted some softer pockets of clay may experience slightly more settlement. Also, the global settlement across the site may affect utilities and roads. The best practice for grade raise, if the construction schedule permits, is to proceed with the grade raise in advance and later, at least six months, excavate and backfill for footings. Settlement may be expected to influence approximately 10 m projecting beyond the fill outline.

8.0 GROUNDWATER

The subdivision investigation was conducted in 2017 by others. The average groundwater table in the subdivision report indicated an approximate elevation at El. 87 m. McIntosh Perry installed a standpipe piezometer within the limits of the proposed development (borehole BH18-3) and groundwater elevation was measured approximately at 85.3 m in June 2018 and 85.7 m in November 2018. This rise in groundwater table is in line with observed increase of precipitation in Fall 2018 in compare to the summer season. As it appears seasonal changes affect the groundwater elevation

It is understood a so called ‘soakaway pit’ is proposed for the north side of the site for surface water storage and its gradual dissipation. It is understood the bottom elevation of the currently proposed soakaway pit will be at El. 86.95 which is about 1.25 m higher than our November reading and 1.45 m above the average reading recorded by McIntosh Perry. Therefore, based on currently collected information the proposed soakaway pit elevation looks feasible although may need to be adjusted if required by the designer.

A hydraulic conductivity test shall be conducted for the detailed design of the groundwater storage. This test can be only completed when ground is free from all frost.

Due to presence of clay and silt, the hydraulic conductivity is expected to be relatively low. Dewatering during excavation is expected to be manageable through conventional sump and pump methods. The groundwater

infiltration volume for the subject site is not expected to exceed 50,000 lit/day therefore a Permit to Take Water does not seem necessary. However, the exact amount of expected groundwater infiltration shall be confirmed through an on-site hydrogeology test.

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. 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

Samples from subgrade soil were submitted to Paracel Laboratories for testing of chemical properties relevant to exposure of concrete elements to sulfate attack, as well as potential soil corrosivity effects on the buried metallic structural elements. Test results are presented in Table 5-1.

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

The soil pH is relatively neutral, this combined with the high resistivity of the soil indicated the environment for buried steel element is within the non-aggressive range. In general, all steel components of the building buried in within a material with relatively high hydraulic conductivity, such as the native sand of this site, and being exposed to wetting drying cycles due to fluctuation of the groundwater table, are prone to corrosion.

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.

Juli Ushey, EIT.
Geotechnical Engineering Intern

N'eem Tavakkoli, M.Eng., P.Eng.
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.

Natural Resources Canada

VETERANS HOUSE – MIKINAK ROAD

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.

VETERANS HOUSE – MIKINAK ROAD

APPENDIX B
FIGURES

McINTOSH PERRY

450 225 0 450

Scale 1:15,000 Metres

LEGEND

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

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2018.

CLIENT: MULTIFAITH HOUSING INITIATIVE

PROJECT: GEOTECHNICAL INVESTIGATION
745 MIKINAK ROAD

TITLE: SITE LOCATION

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CP-16-0462
Date	Jun., 28, 2018
GIS	JD
Checked By	JU

FIGURE: 1

20 10 0 20

Scale 1:1,000 Metres

LEGEND

- Borehole Location
- Approximate Property Boundary

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2018.

CLIENT: MULTIFAITH HOUSING INITIATIVE

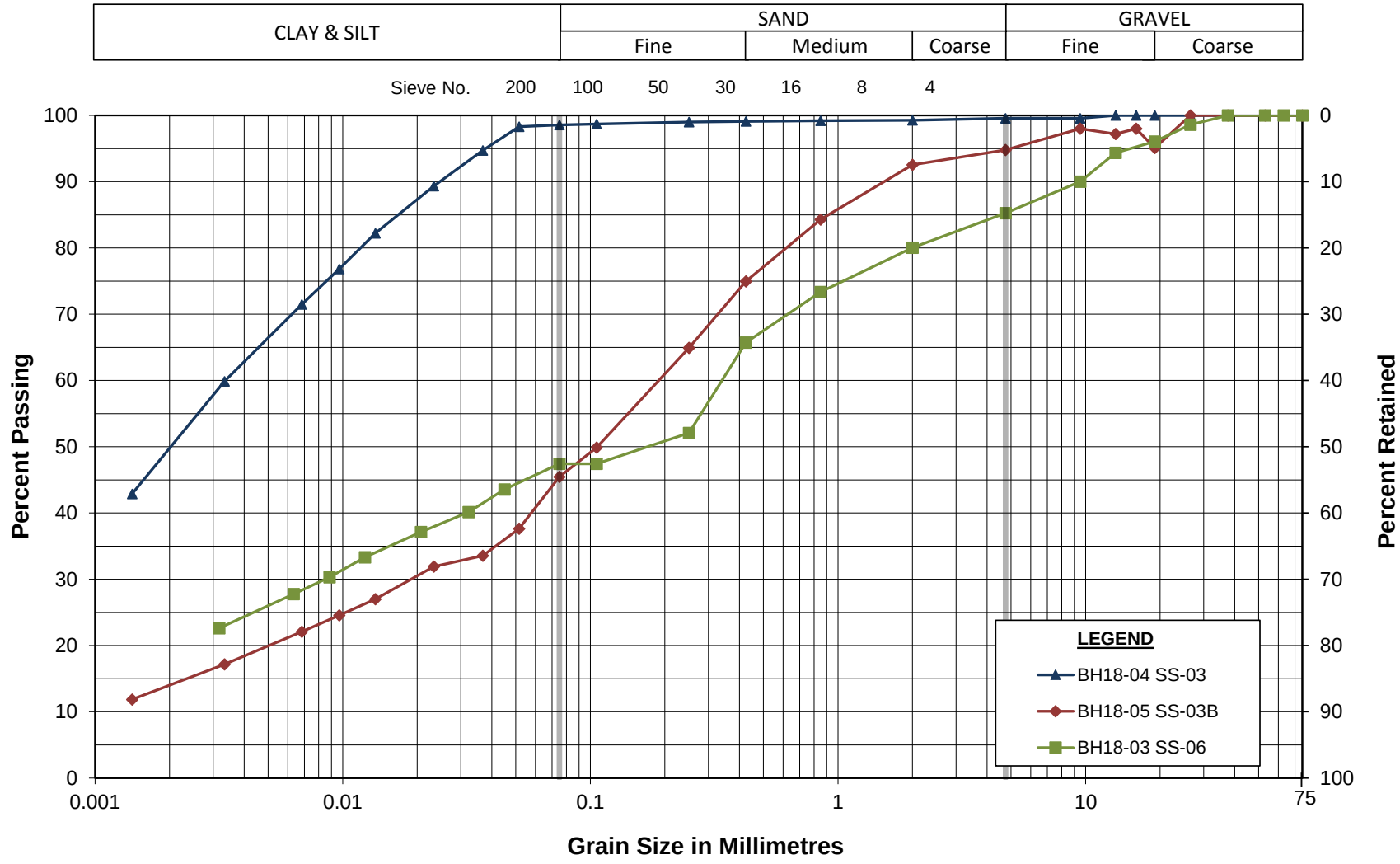
PROJECT: GEOTECHNICAL INVESTIGATION 745 MIKINAK ROAD

TITLE: BOREHOLE LOCATIONS

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:CP-16-0462		FIGURE:
Date	Jun., 28, 2018	2
GIS	JD	
Checked By	JU	

Unified Soil Classification System

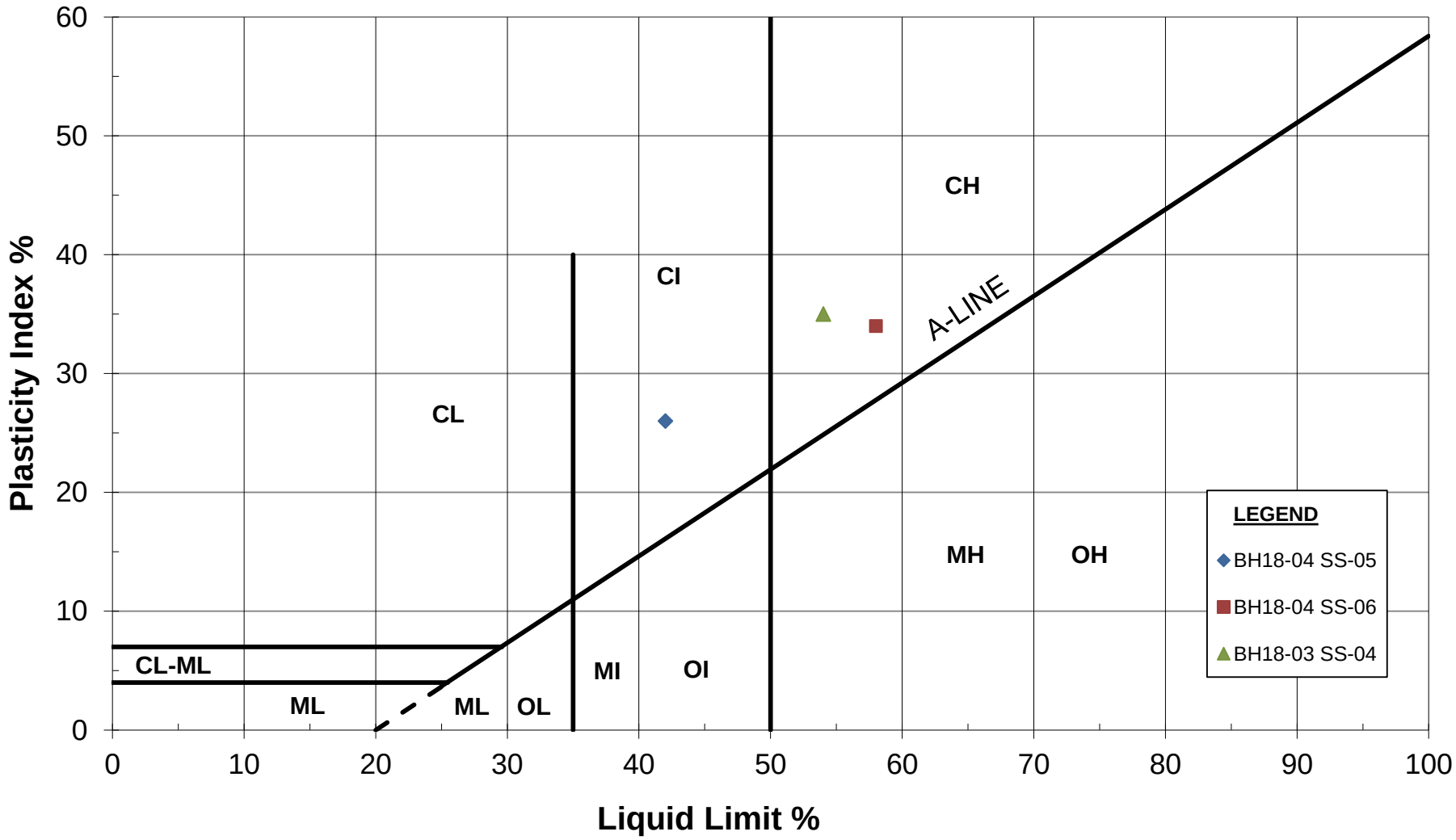


McINTOSH PERRY

Grain Size Distribution

Figure No. 3

CP-16-0462



McINTOSH PERRY

PLASTICITY CHART

CLAY

Figure No. 4

CP-16-0462

VETERANS HOUSE – MIKINAK ROAD

APPENDIX C
BOREHOLE LOGS

McINTOSH PERRY

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'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
Φ_u	-°	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						

McINTOSH PERRY

RECORD OF BOREHOLE No 18-01

DATE:	06/06/2018 - 06/06/2018	**LOCATION:**	Mikinak Road ()	**ORIGINATED BY:**	JU
PROJECT:	CP-16-0462-MIKINAK	**COORDINATES:**	Lat: 45.45277 , Lon: -75.62997	**COMPILED BY:**	JU
CLIENT:	CSV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	88.2 m	**REMARK:**		**REPORT DATE:**	30/01/2019

DEPTH - feet	DEPTH - meters	ELEVATION - m / DEPTH - m	SOIL PROFILE: 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 (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
		88.2	Natural ground surface									
		0.0	Fill : Clay, brown, moist, loose.									
	1				GS-01							
		86.6 / 1.5	**END OF PROBE HOLE.**									
5												
	2											
10	3											
	4											
15												
	5											
20	6											
	7											
25												
	8											
	9											
30												

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

McINTOSH PERRY

RECORD OF BOREHOLE No 18-02

DATE:	06/06/2018 - 06/06/2018	**LOCATION:**	Mikinak Road ()	**ORIGINATED BY:**	JU
PROJECT:	CP-16-0462-MIKINAK	**COORDINATES:**	Lat: 45.45267 , Lon: -75.63003	**COMPILED BY:**	JU
CLIENT:	CSV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	88.0 m	**REMARK:**		**REPORT DATE:**	30/01/2019

DEPTH - feet	DEPTH - meters	ELEVATION - m / DEPTH - m	SOIL PROFILE: 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 (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		88.0	Natural ground surface									
		0.0	Clay, traces of sand, brown, moist, firm.									
	1				GS-01							
		86.6										
5		1.4	**END OF PROBE HOLE.**									
	2											
10	3											
	4											
15												
	5											
20	6											
	7											
25												
	8											
	9											
30												

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

McINTOSH PERRY

RECORD OF BOREHOLE No 18-03

DATE:	06/06/2018 - 06/06/2018	**LOCATION:**	Mikinak Road ()	**ORIGINATED BY:**	JU
PROJECT:	CP-16-0462-MIKINAK	**COORDINATES:**	Lat: 45.45213 , Lon: -75.63	**COMPILED BY:**	JU
CLIENT:	CSV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	87.7 m	**REMARK:**		**REPORT DATE:**	30/01/2019

DEPTH - feet	DEPTH - meters	ELEVATION - m / DEPTH - m	SOIL PROFILE: 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 (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G	S	M	C
		87.7	Natural ground surface												
		0.0	Fill: Clay, traces of gravel, grey to brown, dry to moist, firm to stiff. Presence of organic matter.		SS-01		11	13							
	1				SS-02		42	17							
		86.4 / 1.3	Fill: Clay and sand, traces of gravel, grey, dry, compact. Presence of cobbles and boulders.												
5		86.3 / 1.4	Clay and silt, traces of sand, grey, moist, very soft.		SS-03		75	4	1.95 m						
	2				SS-04		100	1							
10	3														
	4				ST-05										
15		82.8 / 4.9	Silty sand, some clay, grey, moist to wet, soft.		SS-06		100	2				10	43	30	17
	5	82.4 / 5.3	Limestone Granite Bedrock.												
20	6				RC-07		100	*100*							
	7				RC-08		98	*79*							
		80.5 / 7.2	**END OF BOREHOLE**												
25	8														
30	9														

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

McINTOSH PERRY

RECORD OF BOREHOLE No 18-04

DATE:	06/06/2018 - 06/06/2018	**LOCATION:**	Mikinak Road ()	**ORIGINATED BY:**	JU
PROJECT:	CP-16-0462-MIKINAK	**COORDINATES:**	Lat: 45.45192 , Lon: -75.63036	**COMPILED BY:**	JU
CLIENT:	CSV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	87.9 m	**REMARK:**		**REPORT DATE:**	30/01/2019

DEPTH - feet	DEPTH - meters	ELEVATION - m / DEPTH - m	SOIL PROFILE: 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 (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		87.9	Natural ground surface									
		0.0	Fill: Silty and sandy clay, brown, moist, compact.		SS-01		37	11				
	1				SS-02		21	16				Auger grinding, pulled up piece of old rebar from fill material.
5		86.4 / 1.5	Fill: Silty and sandy clay, brown, moist, dense to very dense.		SS-03		100	50				Concrete pieces stuck in tip of spoon.
	2											Auger refusal at 1.7 m. Moved north 3.0 m to drill another borehole to verify refusal was not caused by concrete mixed in with the fill material.
		85.6 / 2.3	Clay and silt, traces of sand, brown, moist, stiff.		SS-04		8	4				
10	3				SS-05		100	1				
	4									23.0 45.0		
										45.0		
15	5				SS-06		100	0				0 5 55 40
										55.6 66.0		
										56.2 62.0		
20	6				SS-07		100	2				
		81.5 / 6.4	**END OF BOREHOLE. BOREHOLE TERMINATED ON DCPT REFUSAL.**									
	7											
25	8											
	9											
30												

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

W_P W W_L

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

McINTOSH PERRY

RECORD OF BOREHOLE No 18-05

DATE:	06/06/2018 - 06/06/2018	**LOCATION:**	Mikinak Road ()	**ORIGINATED BY:**	JU
PROJECT:	CP-16-0462-MIKINAK	**COORDINATES:**	Lat: 45.45233 , Lon: -75.62969	**COMPILED BY:**	JU
CLIENT:	CSV	**DATUM:**	Geodetic	**CHECKED BY:**	MG
ELEVATION:	87.7 m	**REMARK:**		**REPORT DATE:**	30/01/2019

DEPTH - feet	DEPTH - meters	ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	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)	REMARKS & GRAIN SIZE DISTRIBUTION (%) G	S	M	C
		87.7	Natural ground surface												
		0.0	Fill: Silty clay, brown, moist, firm to stiff.												
	1				SS-01		100	12							
		86.3													
5		1.4	Clay and silt, traces of sand, grey, moist, stiff.												
	2				SS-02		100	5							
10	3														
		84.4													
		3.4	Silty sand, some clay, traces of gravel, grey, moist to wet, compact.		SS-03		83	8				5	50	33	12
	4	83.6			SS-04		10	50							
		4.1	**BH TERMINATED ON AUGER REFUSAL.**												
15	5														
20	6														
25	7														
	8														
30	9														

VETERANS HOUSE – MIKINAK ROAD

APPENDIX D
LAB RESULTS

McINTOSH PERRY

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www.paracellabs.com

Certificate of Analysis

McIntosh Perry Consulting Eng. (Carp)

215 Menton Place
Nepean, ON K2H 9C1
Attn: Mary Ellen Gleeson

Client PO: CP-16-0462
Project: CP-16-0462-Mikinak
Custody: 42846

Report Date: 26-Jun-2018
Order Date: 20-Jun-2018

Order #: 1825475

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1825475-01	CP16-0462 BH18-03 SS-04

Approved By:

Dale Robertson, BSc
Laboratory Director

PARACEL LABORATORIES LTD.

Order #: 1825475

Certificate of Analysis

Client: McIntosh Perry Consulting Eng. (Carp)

Client PO: CP-16-0462

Report Date: 26-Jun-2018

Order Date: 20-Jun-2018

Project Description: CP-16-0462-Mikinak

	Client ID:	CP16-0462 BH18-03 SS-04	-	-	-
	Sample Date:	06/06/2018 00:00	-	-	-
	Sample ID:	1825475-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	68.6	-	-	-
General Inorganics					
pH	0.05 pH Units	7.72	-	-	-
Resistivity	0.10 Ohm.m	87.1	-	-	-
Anions					
Chloride	5 ug/g dry	11	-	-	-
Sulphate	5 ug/g dry	45	-	-	-

Certificate of Analysis
Client: McIntosh Perry Consulting Eng. (Carp)
Client PO: CP-16-0462

Report Date: 26-Jun-2018
Order Date: 20-Jun-2018
Project Description: CP-16-0462-Mikinak

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	19.7	5	ug/g dry	18.4			7.0	20	
Sulphate	15.8	5	ug/g dry	20.1			23.5	20	QR-01
General Inorganics									
pH	7.79	0.05	pH Units	7.77			0.3	10	
Resistivity	43.9	0.10	Ohm.m	44.1			0.4	20	
Physical Characteristics									
% Solids	92.2	0.1	% by Wt.	93.6			1.6	25	

Certificate of Analysis
Client: McIntosh Perry Consulting Eng. (Carp)
Client PO: CP-16-0462

Report Date: 26-Jun-2018
Order Date: 20-Jun-2018
Project Description: CP-16-0462-Mikinak

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	107	5	ug/g	18.4	89.0	78-113			
Sulphate	108	5	ug/g	20.1	88.4	78-111			

VETERANS HOUSE – MIKINAK ROAD

APPENDIX E
SEISMIC HAZARD CALCULATION

McINTOSH PERRY

2010 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

Requested by: , November 15, 2018

Site Coordinates: 45.4525 North 75.6301 West

User File Reference:

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

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.634	**0.309**	**0.138**	**0.046**	**0.321**

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. 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 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(0.2)	0.090	0.249	0.386
Sa(0.5)	0.043	0.123	0.187
Sa(1.0)	0.017	0.056	0.088
Sa(2.0)	0.0062	0.018	0.028
PGA	0.039	0.123	0.201

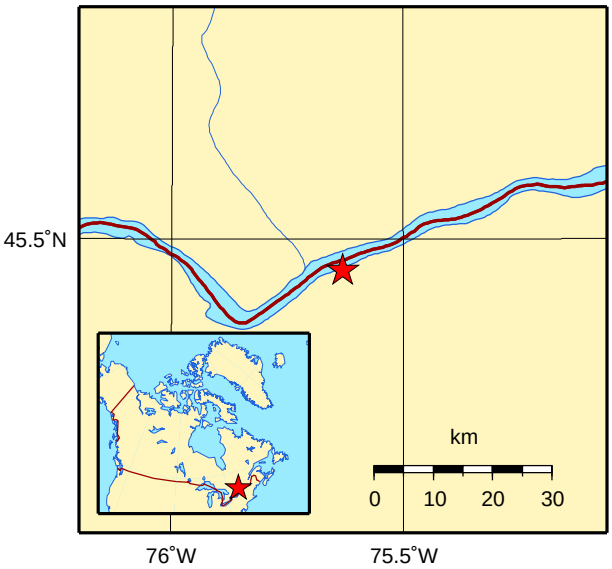
References

National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

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



Aussi disponible en français