Houle Chevrier Engineering

Submitted to:

Town of Carleton Place
175 Bridge Street
Carleton Place, Ontario
K7C 2V8

Geotechnical Investigation
Proposed Arena Addition
75 Neelin Street
Carleton Place, ON

May 17, 2017
Project: 61722.06

Houle Chevrier Engineering
a GEMTEC company

Houle Chevrier Engineering Ltd.
32 Steacie Drive
Ottawa, Ontario
K2K 2A9
tel: 613.836.1422
fax: 613.836.9731
ottawa@hceng.ca
www.hceng.ca

Town of Carleton Place
175 Bridge Street
Carleton Place, Ontario
K7C 2V8

May 17, 2017
Project: 61722.06

Attention: Walter Renwick, Project Manager

Re: Geotechnical Investigation
Proposed Arena Addition
75 Neelin Street
Carleton Place, ON

INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed addition to the Carleton Place Arena. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of test pits and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations, which could influence design decisions.

PROJECT AND SITE DESCRIPTION

Plans are being prepared to construct a 514 square metre (5,533 square feet) addition to the existing arena located at 75 Neelin Street, Carleton Place, Ontario. It is understood that the proposed addition is to be of slab on grade construction. The site of the proposed addition consists of a relatively flat, asphaltic concrete surfaced parking area.

Published geology maps of the area indicate that the site is expected to consist of a thin layer of overburden material (less than 1 metre) overlying dolostone bedrock with sandstone interbeds of the March formation. Fill material associated with previous development at the site should be anticipated.

SUBSURFACE INVESTIGATION

The field work for this investigation was carried out May 4, 2017. At that time, three (3) test pits, numbered 17-1 to 17-3, were advanced in the area of the addition prior to our arrival on site.

The test pits were advanced to between 1.3 and 1.6 metres below ground surface using a rubber tire backhoe supplied by the client.

The subsurface conditions in the test pits were identified by visual and tactile examination of the materials exposed on the sides and bottom of the test pits. The groundwater conditions in the open test pits were observed on completion of excavating. The test pits were logged by a member of our engineering staff.

Following the fieldwork, soil samples were returned to our laboratory for examination by a geotechnical engineer. A sample of the native overburden material was sent to Paracel Laboratories Ltd. for chemical analysis relating to corrosion of buried concrete and steel.

Descriptions of the subsurface conditions logged in the test pits are provided on the Record of Test Pit sheets in Attachment A. The approximate locations of the test pits are shown on the Test Pit Location Plan, Figure 1. The results of the chemical analysis relating to corrosion of buried concrete and steel are provided in Attachment B.

SUBSURFACE CONDITIONS

Existing Pavement Structure

All of the test pits were advanced through the asphaltic concrete in the parking area and encountered a pavement structure composed of 60 to 130 millimetres of asphaltic concrete. The asphaltic concrete is generally underlain by grey, crushed sand and gravel with trace to some silt (base/subbase material) ranging in thickness from about 130 to 320 millimetres.

At the location of test pit 17-2, a former pavement structure was noted below the existing structure at about 0.4 metres below ground surface. The former pavement structures consist of about 130 millimetres of asphaltic concrete over about 50 millimetres of grey, crushed sand and gravel (base/subbase material). The former pavement structure extends to about 0.6 metres below ground surface.

Fill/Possible Fill Material

The pavement structure encountered in the test pits is underlain by fill material of various composition. At the location of test pit 17-1, the fill material is about 1.1 metres thick, extends to about 1.3 metres below ground surface, and is composed of grey brown silty clay/clayey silt with trace sand, gravel, cobbles, boulders and refuse.

At the location of test pit 17-2, the fill material is about 0.2 metres thick, extends to about 0.7 metres below ground surface, and is composed of dark brown silty sand with some organic material.

At the location of test pit 17-3, the fill material is about 0.5 metres thick, extends to about 0.8 metres below ground surface, and is composed of dark brown silty sand with some gravel and organic material, and grey brown clayey silt with trace fine sand. A hydrocarbon odour was noted in the fill material in test pit 17-3.

Silty Clay/Clayey Silt

A native deposit of silty clay/clayey silt (herein referred to as silty clay) was encountered below the fill materials in test pits 17-1 and 17-2 at about 1.3 and 0.7 metres below ground surface, respectively.

The silty clay consists of stiff to very stiff, grey brown weathered crust with traces of fine sand. Test pits 17-1 and 17-2 were terminated within the silty clay at depths of 1.6 and 1.3 metres below ground surface, respectively.

Glacial Till

A deposit of glacial till was encountered below the fill material in test pit 17-3 at a depth of about 0.8 metres below ground surface. The glacial till can be generally described as grey brown silty sand with some gravel, cobbles, boulders and trace clay.

Test pit 17-3 was terminated within the glacial till deposit at a depth of about 1.4 metres below ground surface.

Groundwater Levels

No groundwater was noted entering the open test pits during the relatively short period they were open prior to backfilling.

Soil Chemistry Relating to Corrosion

The chemical testing on a soil sample recovered from test pit 17-2 (SA2 – between 0.7 and 1.3 metres depth) gave the following results:

- Conductivity 1790 microSiemens/centimetre
- pH 7.28
- Sulphate Content 348 micrograms/gram dry
- Chloride Content 995 micrograms/gram dry

PROPOSED ARENA ADDITION

General

The information in the following sections is provided for the guidance of the design engineers and is intended for the design of this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous uses or activities of this site or adjacent properties, and/or resulting from the introduction onto the site from materials from off site sources are outside the terms of reference for this report.

Excavation

Excavation for the proposed addition may be carried out through pavement structure, fill material, and native deposits of silty clay and glacial till. The sides of the excavations should be sloped in accordance with the requirements in the Ontario Occupational Health and Safety Act. According to the act, the fill material and native deposits at this site can be classified as Type 3. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, slopes in the fill material and native deposits.

No unusual constraints are anticipated for the excavation of the proposed addition next to the existing structure. However, to prevent undermining of the existing building foundations, it is recommended that the bottom of the excavation for the proposed addition be located at the same elevation as the bottom of the existing footing. No excavation should be carried out within the zone extending down and out from the bottom edge of the existing building foundations at 1 horizontal to 1 vertical, or flatter.

Groundwater inflow from the overburden deposits should be controlled by pumping from within the excavations. It is not expected that short term pumping during excavation will have any significant effect on nearby structures and services.

Spread Footing Design

Based on the subsurface conditions which were encountered during the present investigation, it is considered that the proposed addition could be founded on spread footings bearing on or within the native silty clay or glacial till. The fill materials are considered to be compressible and are not considered suitable for the support of the proposed structure (i.e. foundations or rigid concrete slab on grade). Therefore, all fill material should be removed from the proposed addition area.

In areas where the underside of footing level is above the level of the native soil or where subexcavation of soil is required, the grade below the proposed building could be raised with granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type II. The granular material should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. To provide adequate spread of load below the footings, the granular material should extend at least 0.3 metres horizontally beyond the edge of the footings and down and out from this point at 1 horizontal to 1 vertical, or flatter.

Spread footings founded on or within native, undisturbed deposits of silty clay, glacial till, or on a pad of compacted granular fill above native, undisturbed soil should be sized using a geotechnical reaction at Serviceability Limit State (SLS) of 100 kilopascals and a factored geotechnical resistance at Ultimate Limit State (ULS) of 250 kilopascals.

The post construction total and differential settlement of footings at SLS should be less than 25 and 20 millimetres, respectively, provided that all loose or disturbed soil is removed from the bearing surfaces. Since any settlement of the addition will be differential with respect to the existing building, the foundations for the addition should be structurally separated from the existing structure by suitable control joints.

To reduce the potential for cracking in the footings, foundation walls, and concrete slabs on grade where the footings transition between different subgrade materials (e.g. between silty clay and glacial till), the foundation walls should be reinforced for a distance of 3 metres on both sides of the transition areas or as recommended by the structural engineer.

Frost Protection Requirements for Foundations (Heated Addition Only)

All exterior footings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated (unheated) footings that are located in areas that are to be cleared of snow should be provided with at least 1.8 metres of earth cover for frost protection purposes. Alternatively, the required frost protection could be provided by means of a combination of earth cover and extruded polystyrene insulation. An insulation detail could be provided upon request.

Seismic Design of Proposed Addition

The native overburden deposits in the area of the proposed addition are comprised of silty clay and glacial till. Based on bedrock geology maps, bedrock may be near surface.

Therefore, in our opinion the site classification for seismic site response may be taken as Site Class D as per the 2015 National Building Code of Canada.

In our opinion, there is no potential for seismic liquefaction of the native overburden soils at this site.

Foundation Wall Backfill and Drainage

Most of the fill and native deposits at this site are considered frost susceptible and should not be used as backfill against foundation walls. To avoid frost adhesion and possible heaving, the following options are provided for foundation backfilling:

- Backfill the foundations with imported, free-draining, non-frost susceptible granular material such as that meeting OPSS Granular A or Granular B Type I or II requirements, or

- Provide a suitable bond break to the surfaces of all the foundations and backfill using the fill or native soils. A suitable bond break could consist of at least 2 layers of 6 mil polyethylene sheeting. It is noted that the backfill material should be free of any cobbles or boulders. As such, some sorting of materials will be required if the existing soils are used as backfill.

Where the backfill will ultimately support areas of hard surfacing (roadways or other similar surfaces), the backfill should be placed in maximum 200 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment. Where future landscaped areas will exist next to the proposed structures and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value.

Where areas of hard surfacing (pavement or pathways, etc.) abut the proposed addition, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible material to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below finished grade to the underside of the granular subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

Perimeter foundation drainage is not considered necessary for a slab on grade structure at this site, provided that the floor slab level is above the finished exterior ground surface level.

Slab on Grade Support (Heated Addition Only)

Based on the test pits advanced during this investigation, the area of the proposed addition is underlain by up to 1.3 metres of fill material. The fill material is not considered suitable for support of the slab on grade. To prevent long term settlement of the floor slab, all organic material and any fill should be removed from below the proposed slab.

The grade within the proposed building could then be raised, where necessary, with granular material meeting OPSS requirements for Granular B Type I or II. The use of Granular B Type II material is preferred under wet conditions. The granular base for the proposed slab on grade should consist of at least 150 millimetres of OPSS Granular A.

OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A. Since the source of recycled material cannot be determined, it is suggested that any granular materials used beneath the floor slab be composed of virgin material (100 percent crushed rock) only, for environmental reasons.

All imported granular materials placed below the proposed floor slab should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level.

If any areas of the building are to remain unheated during the winter period, thermal protection for the subgrade will be required. Further details on the insulation requirements could be provided, if necessary.

Corrosion of Buried Concrete and Steel

The measured sulphate concentration in one sample of the soil was is 348 micrograms per gram (dry). According to Canadian Standards Association (CSA) "Concrete Materials and Methods of Concrete Construction", the concentration of sulphate in the soil can be classified as low. For low exposure conditions, any concrete that will be in contact with the native soil or groundwater should be batched with General Use (formerly Type 10) cement. The effects of freeze thaw in the presence of de-icing chemical (sodium chloride) near the building should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

Based on the conductivity and pH of the groundwater, the groundwater can be classified as slightly aggressive toward unprotected steel. It is noted that the corrosivity of the groundwater could vary throughout the year due to the application sodium chloride for de-icing.

Effects of Construction Induced Vibration

Some of the construction operations (such as granular material compaction, excavation, etc.) will cause ground vibration on and off of the site. The vibrations will attenuate with distance from the source, but will likely be felt at nearby structure. We recommend that preconstruction surveys be carried out on the adjacent structures and that vibration monitoring be carried out during the construction so that any damage claims can be addressed in a fair manner.

Winter Construction

In the event that construction is required during freezing temperatures, the soil below the footings should be protected immediately from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means.

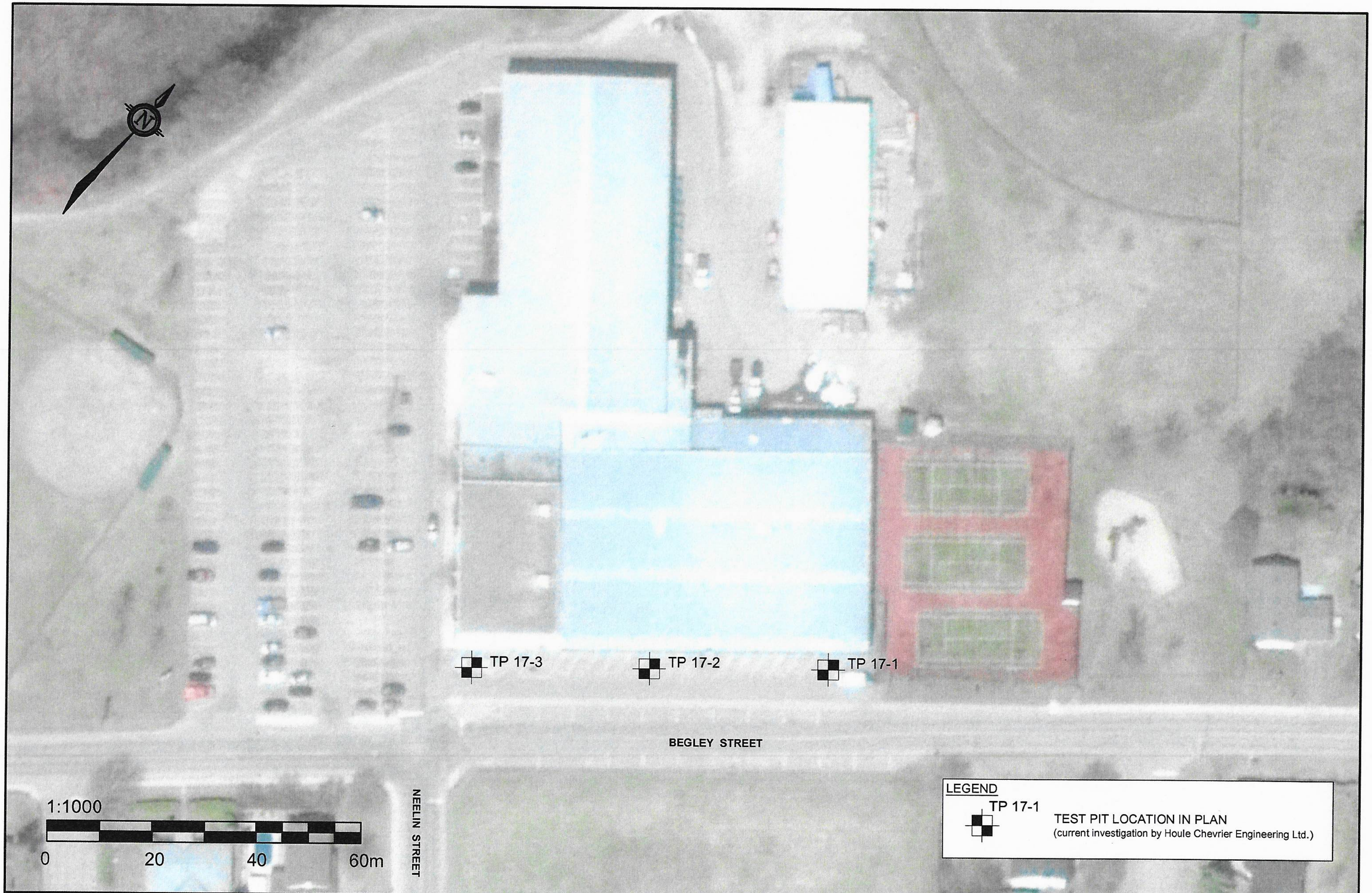
Design Review and Construction Observation

The details for the proposed construction were not available to us at the time of preparation of this report. It is recommended that the final design drawings be reviewed by the geotechnical engineer as the design progresses to ensure that the guidelines provided in this report have been interpreted as intended.

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed excavations do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design. The subgrade surfaces for the proposed addition should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Luc Bouchard, P.Eng., ing.
P:\0. Files\61700\61722.06\61722.06_RPT_V01_2017-05-17.docx



Houle Chevrier Engineering 32 Steacie Drive, Ottawa, ON K2K 2A9 T: (613) 836-1422 | www.hceng.ca | ottawa@hceng.ca	Project GEOTECHNICAL INVESTIGATION PROPOSED ARENA ADDITION 75 NEELIN STREET CARLETON PLACE, ON	Drwn By: P.C. Chkd By: L.B. Date: MAY 2017 File No.: 61722.06 Revision No.: 0 FIGURE 1	Drawing TEST PIT LOCATION PLAN

ATTACHMENT A

Abbreviations and Terminology
Record of Test Pit Logs

Houle Chevrier Engineering

Report to: Town of Carleton Place
Project: 61722.06 (May 17, 2017)

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS auger sample
CA casing sample
CS chunk sample
BS Borros piston sample
DO drive open
MS manual sample
RC rock core
ST slotted tube
TO thin-walled open Shelby tube
TP thin-walled piston Shelby tube
WS wash sample

PENETRATION RESISTANCE

Standard Penetration Resistance, N

The number of blows by a 63.5 kg hammer dropped 760 millimetre required to drive a 50 mm drive open sampler for a distance of 300 mm. For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

Dynamic Penetration Resistance

The number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter, 60° cone attached to 'A' size drill rods for a distance of 300 mm.

WH

Sampler advanced by static weight of hammer and drill rods.

WR

Sampler advanced by static weight of drill rods.

PH

Sampler advanced by hydraulic pressure from drill rig.

PM

Sampler advanced by manual pressure.

SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH sieve and hydrometer analysis
U unconfined compression test
Q undrained triaxial test
V field vane, undisturbed and remoulded shear strength

SOIL DESCRIPTIONS

Relative Density	'N' Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	over 100

LIST OF COMMON SYMBOLS

c_u undrained shear strength
e void ratio
C_c compression index
c_v coefficient of consolidation
k coefficient of permeability
I_p plasticity index
n porosity
u pore pressure
w moisture content
w_L liquid limit
w_P plastic limit
ϕ^1 effective angle of friction
γ unit weight of soil
γ^1 unit weight of submerged soil
σ normal stress

PROJECT: 61722.06

LOCATION: See Test Pit Location Plan, Figure 1

DATE OF EXCAVATION: May 4, 2017

RECORD OF TEST PIT 17-1

SHEET 1 OF 1

DATUM:

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp ⊢—o W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Asphaltic concrete							
	Grey, crushed sand and gravel, trace silt (BASE / SUBBASE MATERIAL)		0.10					
	Grey brown silty clay/clayey silt, trace sand, gravel, cobbles and general refuse (FILL MATERIAL)		0.23	1				
1								
	Stiff to very stiff, grey brown SILTY CLAY/CLAYEY SILT, trace fine sand (WEATHERED CRUST)		1.28	2				
	End of test pit No groundwater observed entering test pit		1.63					
2								
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

TESTPIT LOG 6172206 TEST PIT LOGS GNT V01 2017-05-08.GPJ HOULE CHEVRIER FEB 9 2011.GDT 17/5/17

PROJECT: 61722.06

LOCATION: See Test Pit Location Plan, Figure 1

DATE OF EXCAVATION: May 4, 2017

RECORD OF TEST PIT 17-2

SHEET 1 OF 1

DATUM:

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp ⊢ W ⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Asphaltic concrete							
	Grey, crushed, sand and gravel, trace silt (BASE / SUBBASE MATERIAL)		0.06	1				
	Asphaltic concrete		0.38					
	Grey, crushed, sand and gravel, trace silt (BASE / SUBBASE MATERIAL)		0.51					
	Dark brown silty sand, some organic material (FILL MATERIAL)		0.56					
1	Stiff to very stiff, grey brown SILTY CLAY/CLAYEY SILT, trace fine sand (WEATHERED CRUST)		0.71	2				
	End of test pit No groundwater observed entering test pit		1.27					
2								
3								

TESTPIT LOG 6172206 TEST PIT LOGS GNT V01 2017-05-08.GPJ HOULE CHEVRIER FEB 9 2011.GDT 17/5/17

DEPTH SCALE

1 to 15

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

RECORD OF TEST PIT 17-3

PROJECT: 61722.06

LOCATION: See Test Pit Location Plan, Figure 1

DATE OF EXCAVATION: May 4, 2017

SHEET 1 OF 1

DATUM:

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp ⊢—o W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Asphaltic concrete							
	Grey, crushed, sand and gravel, trace silt (BASE / SUBBASE MATERIAL) (possible hydrocarbon odor)		0.13	1				
	Dark brown silty sand, trace gravel and organic material (FILL MATERIAL) (possible hydrocarbon odor)		0.39	2				
	Grey brown clayey silt, trace sand (FILL/POSSIBLE MATERIAL)		0.48	3				
1	Grey brown silty sand, some gravel, cobbles and boulders, trace clay (GLACIAL TILL)		0.84	4				
	End of test pit No groundwater observed entering test pit		1.35					
2								
3								

TESTPIT LOG 6172206_TEST PIT LOGS_GNT_V01_2017-05-08.GPJ HOULE CHEVRIER FEB 9 2011.GDT 17/5/17

DEPTH SCALE

1 to 15

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

ATTACHMENT B

Soil Chemistry Relating to Corrosion
Paracel Order No.1719333

Houle Chevrier Engineering

Report to: Town of Carleton Place
Project: 61722.06 (May 17, 2017)

PARACEL LABORATORIES LTD.
TRUSTED. RESPONSIVE. RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Houle Chevrier
32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Luc Bouchard

Client PO:
Project: 61722.06
Custody:

Report Date: 16-May-2017
Order Date: 10-May-2017

Order #: 1719333

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

Paracel ID	Client ID
1719333-01	BH 17-2 SA2

Approved By:

Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

PARACEL
LABORATORIES LTD.

Order #: 1719333

Certificate of Analysis

Client: Houle Chevrier

Client PO:

Report Date: 16-May-2017

Order Date: 10-May-2017

Project Description: 61722.06

	Client ID:	BH 17-2 SA2	-	-	-
	Sample Date:	04-May-17	-	-	-
	Sample ID:	1719333-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	79.7	-	-	-
General Inorganics					
Conductivity	5 uS/cm	1790	-	-	-
pH	0.05 pH Units	7.28	-	-	-
Anions					
Chloride	5 ug/g dry	995	-	-	-
Sulphate	5 ug/g dry	348	-	-	-