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REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED NEW BUS LAY BY AND FRONT ENTRANCE IMPROVEMENTS
ST. MARTIN DE PORRES CATHOLIC SCHOOL
20 MCKITRICK DRIVE
OTTAWA, ONTARIO

Submitted to:

Capital Engineering Group Limited
110 Dossetter Way
Ottawa, Ontario
K1G 4S5

April 2013

Our Ref: 13-027

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April 1, 2013 Our ref: 13-027

Capital Engineering Group Limited
110 Dossetter Way
Ottawa, Ontario
K1G 4S5

Attention: Mr. Andy Naoum, P.Eng.

RE: PROPOSED NEW BUS LAY BY AND
FRONT ENTRANCE IMPROVEMENTS
ST. MARTIN DE PORRES CATHOLIC SCHOOL
20 MCKITRICK DRIVE
OTTAWA, ONTARIO

Dear Sir:

This report presents the results of a geotechnical investigation carried out for the proposed improvements to the front entrance and bus access to St. Martin de Porres Catholic School located at 20 McKitrick Drive in Ottawa, Ontario (refer to Key Plan, Figure 1). The purpose of the investigation was to identify the general subsurface conditions near the entrance and proposed bus lay by area by means of a limited number of boreholes and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the proposed front entrance and proposed bus lay improvements, including construction considerations that could influence design decisions.

PROJECT DESCRIPTION

The plans for the proposed work have not been finalized; however, it is understood that the proposed improvements to the school include expansion of the parking area and a 7.0 metre wide bus lay by area which will enter and exit onto McKitrick Drive on the west side of the existing school. It is also understood that front entrance improvements are also being considered which will include two (2) new unit pavers (interlocking stone pedestrian walkways) on the west side of the school along with a new overhead archway at the main entrance to the school.

REVIEW OF GEOLOGY MAPS

Surficial geology maps indicate that the subsurface conditions at the site are composed of offshore marine sediments, likely consisting of silt and silty clay. Bedrock geology and drift thickness maps indicate that the bedrock consists of sandstone of the Nepean formation at depths of between 5 to 10 metres below ground surface. Fill material associated with the existing structure and past development should also be expected.

SUBSURFACE INVESTIGATION

The field work for this investigation was carried out on February 25, 2013. At that time, five (5) boreholes, numbered 13-1 to 13-5, inclusive, were advanced at the site using a track mounted, hollow stem auger drill rig supplied and operated by OGS Inc. of Almonte, Ontario. The boreholes were advanced to depths of about 1.5 and 5.8 metres below ground surface. Details for the boreholes are provided below:

- Boreholes 13-1 to 13-3, inclusive, were advanced to depths of about 1.5 metres below ground surface in the area of the proposed lay by area for pavement design purposes.
- Boreholes 13-4 was advanced to about 1.5 metres below ground surface in the area of the proposed unit pavers located on the north end of the school.
- Borehole 13-5 was advanced to about of 5.8 metres below ground surface near the proposed overhead archway at the main entrance to the school for foundation and unit paver design purposes.

Standard penetration tests were carried out in the boreholes and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler. One (1) sample of the soil recovered from borehole 13-5 was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

The field work was supervised throughout by a member of our engineering staff, who located the boreholes, logged the samples and observed the in-situ testing. Following the field work, the soil samples were returned to our laboratory for examination by a geotechnical engineer.

The borehole locations and elevations were measured using our Trimble R8 GPS survey instrument. The elevations are referenced to geodetic datum and are accurate to within the tolerance of the instrument.

Descriptions of the subsurface conditions logged in the boreholes are provided on the attached Record of Borehole sheets which are provided following the text of this report. The approximate borehole locations are shown on the Borehole Location Plan, Figure 2. The results of the chemical analysis of the soil sample relating to corrosion are provided in Attachment A at the end of this report.

SUBSURFACE CONDITIONS

General

As previously indicated, the subsurface conditions identified in the boreholes are given on the Record of Borehole sheets. The borehole logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the method of drilling, the frequency and recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at other than the test locations may vary from the conditions encountered in the boreholes. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties.

The groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. These conditions may vary seasonally or as a consequence of construction activities in the area.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and Houle Chevrier Engineering Ltd. does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The following presents an overview of the subsurface conditions encountered in the boreholes advanced during this investigation.

Parking Area Structure

A pavement structure associated with the existing parking area was encountered at borehole 13-1. The pavement structure at borehole 13-1 consists of 90 millimetres of asphaltic concrete overlying 190 millimetres of grey, crushed sand and gravel with trace silt.

Topsoil Fill

Topsoil fill was encountered in boreholes 13-2 to 13-5, inclusive. At the locations of boreholes 13-2 and 13-5, the topsoil fill consists of dark brown silty clay with some organic material and variable amounts of sand and gravel; however, at boreholes 13-3 and 13-4, the topsoil fill consists of dark brown silty sand with some organic material. The thickness of the topsoil material was about 0.3 to 0.6 metres thick at the borehole locations.

Standard penetration tests carried out in the topsoil fill material encountered in the boreholes gave N values ranging from about of 8 to 23 blows per 0.3 metres of penetration, which reflects a loose to compact relative density. The higher N values represent frozen soil conditions.

Fill Material

Fill material was encountered below the pavement structure at borehole 13-1 and below the topsoil fill at boreholes 13-2 to 13-5. The fill material is variable across the site and is summarized in the table below.

Borehole	Thickness (m)	Description
13-1	0.9	- Dark grey silty clay, trace gravel and sand
13-3	0.2	- Brown clayey sand, trace to some silt
13-4	1.2	- Brown, fine to medium grained sand, trace silt, some gravel (0.3 metres thick), over - Dark grey silty clay
13-5	0.9	- Grey brown silty clay (0.1 metres thick), over - Brown, fine to medium grained sand, trace silt, some gravel (0.2 metres thick), over - Grey silty clay, some gravel and sand, some roots

Standard penetration tests carried out in the fill materials encountered in the boreholes gave N values ranging from about of 12 to 19 blows per 0.3 metres of penetration, which reflects a very stiff consistency for the cohesive soils and a compact relative density for the non-cohesive soils. Borehole 13-4 was terminated within the fill material at a depth of 1.5 metres below ground surface (elevation 100.16 metres, geodetic datum).

Silty Clay

A deposit of grey brown silty clay was encountered below the topsoil fill at borehole 13-2 and below the fill materials at boreholes 13-1, 13-3 and 13-5 at depths of about 0.5 to 1.5 metres below ground surface (elevations 99.8 to 100.6 metres, geodetic datum).

The silty clay consists of a very stiff to stiff, grey brown, weathered crust and, where fully penetrated at borehole 13-5, extends to a depth of about 3.1 metres below ground surface. Standard penetration tests carried out in the weathered silty clay crust gave N values ranging from 3 to 13 blows per 0.3 metres of penetration, and generally showed a decreasing trend with depth.

Below the weathered zone in borehole 13-5, the silty clay is grey in colour. Standard penetration tests carried out in the grey silty clay gave N values of ‘WH’ (static weight of hammer) to 3 blows per 0.3 metres of penetration. In-situ vane shear strength tests gave shear strengths ranging between 43 and 86 kilopascals, which indicates a firm to stiff consistency. The remoulded shear strengths ranged between 10 and 19 kilopascals within the grey silty clay layer. The sensitivity of the silty clay (defined herein as the undrained shear strength divided by the remoulded shear strength) ranged between 4 to 5; therefore, the silty clay can be classified as having “low sensitivity”.

Boreholes 13-1, 13-2 and 13-3 were terminated within the weathered silty clay deposit at a depth of about 1.5 metres below ground surface (elevations 99.4 to 99.8 metres, geodetic datum). Borehole 13-5 was terminated within the grey silty clay at 5.8 metres below ground surface (elevation 95.5 metres, geodetic datum).

Groundwater Levels

Wells screens were not installed in the boreholes upon completion of the drilling. The soil samples were noted to be wet in borehole 13-5 from about 3.5 metres below ground surface (elevation 97.8 metres, geodetic datum).

The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

Groundwater Chemistry Relating to Corrosion

The results of chemical testing on a soil sample recovered from borehole 13-5 are provided in Attachment A and are summarized below:

Conductivity	121 microsiemens/centimetre
pH	7.19
Sulphate Content	24 µg/g dry
Chloride Content	14 µg/g dry

PROPOSED OVERHEAD ARCHWAY AND BUS LAY BY AREA

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 offsite sources are outside the terms of reference for this report.

Overhead Archway

Overburden Excavation

The foundation excavation for the proposed overhead archway will be carried out through fill materials and possibly grey brown silty clay. The sides of the excavation should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the overburden at this site can be classified as Type 3 soil and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical, or flatter, extending from the bottom of the excavation.

Excavation Next to Existing Building Foundations

To prevent undermining of the existing building foundations, it is recommended that the bottom of the excavation for the proposed overhead archway be located beyond a line extending down and out from the bottom edge of the existing building foundations at 1 horizontal to 1 vertical, or flatter. If excavation is required within this zone, underpinning of the existing foundations may be required. Details for underpinning could be provided upon request.

The underside of footing level should match the existing underside of footing level where the overhead archway foundation butts up to the existing foundation walls.

Groundwater Pumping

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

Foundation Design

Based on the results of the subsurface investigation, the proposed overhead archway could be founded on spread or pad footings bearing on or within undisturbed native silty clay material. All topsoil, fill material, loose or water softened soils encountered should be removed from the footing areas.

In areas where the underside of footing level is above the level of the native silty clay, or where subexcavation is required, the grade below the proposed footing 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. City of Ottawa documents allow recycled asphaltic concrete and concrete to be used in Granular B Type II materials. Since the source of recycled material cannot be determined, it is suggested that any granular materials used beneath the proposed canopy be composed of virgin material only, for environmental reasons. 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.

The bearing pressures for the footings at this site are based on the necessity to limit the stress increase on the softer, compressible grey silty clay deposits to an acceptable level. There are many possible combinations of founding depths, footing sizes and thickness of fill which might be suitable for this site. The bearing pressures for footings founded on the weathered silty clay, or on a pad of compacted engineered fill material above the undisturbed native silty clay, at about elevation 99.4 metres, geodetic datum (i.e., 1.8 metres below ground surface) are presented in the table below:

Type of Footing	Assumed Elevation of Footing (metres, geodetic datum)	Maximum Size of Footing (metres)	Factored Net Geotechnical Reaction at Serviceability Limit State (kilopascals)	Factored Net Geotechnical Resistance at Ultimate Limit State (kilopascals)
Exterior Strip	99.4	0.8	100	250
Exterior Pad	99.4	1.2 square	100	250

The allowable bearing pressures given in the above table may have to be reduced if:

- The footing sizes are larger than those given above or the footings are founded at a different depth.

- The amount of grade raise fill is greater than 0.5 metres.

All other foundation alternatives must be checked by the geotechnical engineer to ensure that overstressing of the underlying softer grey silty clay soil does not occur, as this could result in excessive settlement and cracking/distress of the structure.

The post construction total and differential settlement at SLS of footings bearing on the native silty clay deposit or on a pad of engineered fill material above the native deposit should be less than 25 and 15 millimetres, respectively, provided that all loose or disturbed soil is removed from the bearing surfaces and any engineered fill material below foundations is prepared as described above. Since any settlement of the overhead archway will be differential with respect to the existing building, the foundations for the archway should be structurally separated from the existing structure by suitable control joints.

Frost Protection of the Foundations

The footing for the proposed canopy 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, if required.

Foundation Backfill

Most of the fill material at this site are frost susceptible and should not be used as backfill against the foundations for the proposed canopy. To avoid frost adhesion and possible heaving, the foundations should be backfilled with imported, free-draining, non-frost susceptible granular material such as that meeting OPSS Granular B Type I or II requirements.

Where the backfill will ultimately support areas of hard surfacing (pavement, unit pavers 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 structure 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 abut the proposed buildings, 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 fill and/or native materials 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 base/subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

Corrosion of buried concrete and steel

The measured sulphate concentration in a soil sample recovered from borehole 13-5 was 24 micrograms per gram. 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 known as Type 10 cement). The design of any concrete should take into consideration freeze thaw effects and the presence of chlorides used for de-icing.

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

Pavement and Unit Paver Structures

Subgrade Preparation

In preparation for the construction of the new asphaltic concrete lay by area and new unit pavers, all topsoil, organic material and any loose/soft or wet soil should be removed from the proposed subgrade surface and replaced with suitable compacted earth borrow or granular fill. It is not considered necessary to remove all of the fill material from within the lay by and unit paver areas provided that some future settlement of the surface can be tolerated. It is however suggested that any exposed fill material which contains an abundance of organic material or otherwise deleterious material be subexcavated and replaced with suitable earth borrow. Prior to placing the granular base/subbase material for the lay by area and unit pavers, the exposed subgrade should be heavily proof rolled with a large (10 tonne) vibratory steel drum roller under dry conditions. Any soft areas evident from the proof rolling should be subexcavated and replaced with suitable, compacted earth borrow.

Parking Lot and Bus Lay By Pavement Structures

For the proposed car (light vehicle) parking areas, the following minimum pavement structure is suggested:

50 millimetres of hot mix asphaltic concrete, over
150 millimetres of OPSS Granular A base, over
300 millimetres of OPSS Granular B Type II (50 or 100 millimetre minus crushed stone)

The asphaltic concrete should consist of Superpave 12.5 (Traffic Level A or B) or HL3. Performance grade PG58-34 asphaltic concrete should be specified.

For the proposed bus lay by area and for any access roadways, parking areas or other which will be used by heavy truck traffic (including fire trucks), the following minimum pavement structure is suggested:

90 millimetres of hot mix asphaltic concrete, over
150 millimetres of OPSS Granular A base, over
450 millimetres of OPSS Granular B Type II (50 or 100 millimetre minus crushed stone)

The asphaltic concrete should consist of 40 millimetres of OPSS HL3 (or Superpave 12.5, Traffic Level A or B) over 50 millimetres of OPSS HL8 (or Superpave 19.0, Traffic Level A or B). Performance grade PG58-34 asphaltic concrete should be specified.

The granular base and subbase materials for the proposed lay by area should be compacted in maximum 200 millimetre thick lifts to at least 98 percent of the standard Proctor maximum dry density value.

To avoid cracking of the asphaltic concrete due to an abrupt change in the thickness of the roadway granular materials where the new pavement structure joins with existing pavement structures, the granular depths should taper up or down at 5 horizontal to 1 vertical to match the existing pavement structure.

The granular thicknesses given above assume that the subgrade surfaces are prepared as described in this report. If the subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase and/or to incorporate a woven geotextile separator between the subgrade surface and the granular subbase material. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

If the granular pavement materials are to be used by construction traffic, it may be necessary to increase the thickness of the Granular B Type II, install a woven geotextile separator between the roadway subgrade surface and the granular subbase material, or a combination of both, to prevent pumping and disturbance to the subbase material. The contractor should be made responsible for their construction access.

Unit Pavers Structure

The construction of the unit pavers should be carried out in general accordance with City of Ottawa Drawing No. SC9 “Interlocking Paving Stones Installation Procedure”, dated May 2001.

As per the City of Ottawa drawing, the following minimum granular structure is suggested beneath the paving stones:

25 millimetres stone dust, over
150 millimetres of OPSS Granular A base

The above granular thickness is for pedestrian traffic only. If the pavers are to be used for vehicular traffic, the thickness of the granular base should be increased. Further details could be provided upon request.

The granular base material for the proposed unit pavers should be compacted in maximum 200 millimetre thick lifts to at least 98 percent of the standard Proctor maximum dry density value.

The granular thicknesses given above assume that the subgrade surfaces are prepared as described in this report. If the subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular A and/or to incorporate a woven geotextile separator between the subgrade surface and the granular subbase material.

Base for Sidewalks and Curbs

Prior to the construction of the sidewalks and curbs for the new lay by area, the subgrade surface should be proof rolled with a smooth drum roller under dry conditions. Any soft areas should be subexcavated and replaced with suitable, compacted earth borrow material.

The granular base for the sidewalks should be composed of at least 100 millimetres of OPSS Granular A at typical sidewalk sections. The Granular A should be compacted in maximum 200 millimetre thick lifts to at least 98 percent of the standard Proctor dry density value.

Drainage

The subgrade surface for the bus lay by area should be shaped and crowned to promote drainage of the granular base and subbase materials.

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. As such, it is suggested that, if storm sewers and catch basins are installed in the lay by area, the catch basins should be provided with perforated stub drains extending about 3 metres out from the catch basins in two directions. These drains should be installed on the roadway subgrade at the bottom of the subbase layer. If catch basins and storm sewers are not used, suitable ditching or swales should be constructed. The granular subbase and base layers should extend to these ditches or swales.

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 may be felt at nearby structures. The magnitude of the vibrations will be much less than that required to cause damage to the nearby structures that are in good condition.

Winter Construction

In the event that construction of the proposed canopy is required during freezing temperatures, the soil subgrade below the footings and slabs should be protected immediately from freezing using straw, propane heaters, polystyrene insulation, 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 canopy, bus lay by area and pavers 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.

Yours truly,

HOULE CHEVRIER ENGINEERING LTD.

Luc Bouchard, P.Eng.

A.C. Houle

Craig Houle, M.Eng.,P.Eng.

LICENSED PROFESSIONAL ENGINEER
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List of Abbreviations and Symbols
Record of Borehole Sheets
Figures 1 and 2
Attachment A

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS	auger sample
CA	casing sample
CS	chunk 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^o 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

RECORD OF BOREHOLE 13-1

PROJECT: 13-027
LOCATION: See Borehole Location Plan, Figure 2
BORING DATE: February 25, 2013

SHEET 1 OF 1
DATUM: Geodetic
SPT HAMMER: 63.5 kg; drop 0.76 m

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat. V - + Q - ● rem. V - ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-7} 10^{-6} 10^{-5} 10^{-4}
WATER CONTENT, PERCENT: Wp W Wl 20 40 60 80

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		101.34					
	Power Auger 200 mm Diameter Hollow Stem	Asphaltic Concrete	■						Asphaltic Concrete Cold Patch
		Grey, crushed sand and gravel, trace silt (BASE / SUBBASE MATERIAL)		101.25 0.09	1	CS			
		Very stiff, dark grey silty clay, trace gravel and sand (FILL MATERIAL)	▨	101.06 0.28					
1		Very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	▥	100.20 1.14	2	50 DO	12		Backfilled with Auger Flight Cuttings
		End of Borehole		99.82 1.52					
2									
3									
4									
5									
6									

DEPTH SCALE
1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: A.N.
CHECKED:

PROJECT: 13-027

RECORD OF BOREHOLE 13-2

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 25, 2013

SPT HAMMER: 63.5 kg; drop 0.76 m

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat. V - + Q - ● rem. V - ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-7} 10^{-6} 10^{-5} 10^{-4}

WATER CONTENT, PERCENT: Wp ⊢ W ○ ⊣ Wl 20 40 60 80

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	101.26					
		Dark brown silty clay, trace gravel, some roots (TOPSOIL / FILL)	100.62 0.64	1	50 DO	23		Backfilled with Auger Flight Cuttings
1		Very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	99.74 1.52	2	50 DO	13		
		End of Borehole						
2								
3								
4								
5								
6								

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED:

PROJECT: 13-027

RECORD OF BOREHOLE 13-3

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 25, 2013

SPT HAMMER: 63.5 kg; drop 0.76 m

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat. V - + Q - ● rem. V - ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-7} 10^{-6} 10^{-5} 10^{-4} WATER CONTENT, PERCENT Wp W Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface		100.93							
		Dark brown silty sand, some organic material (TOPSOIL / FILL)		100.62 0.31	1	50 DO	21				Backfilled with Auger Flight Cuttings
		Brown, clayey sand, trace to some silt (FILL MATERIAL)		100.40 0.53							
1		Very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		99.41 1.52	2	50 DO	10				
		End of Borehole									
2											
3											
4											
5											
6											

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED:

PROJECT: 13-027

RECORD OF BOREHOLE 13-4

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 25, 2013

SPT HAMMER: 63.5 kg; drop 0.76 m

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat. V - + Q - ● rem. V - ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}); WATER CONTENT, PERCENT Wp W Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		101.68							
0	Power Auger 200 mm Diameter Hollow Stem	Dark brown silty sand, some organic material (TOPSOIL / FILL)		101.37 0.31	1	50 DO	15				Backfilled with Auger Flight Cuttings
		Brown, fine to medium grained sand, trace silt, some gravel (FILL MATERIAL)	▨	100.84 0.84							
1		Very stiff, dark grey silty clay (FILL MATERIAL)	▨	100.16 1.52	2	50 DO	19				
		End of Borehole									
2											
3											
4											
5											
6											

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED:

PROJECT: 13-027

RECORD OF BOREHOLE 13-5

SHEET 1 OF 1

LOCATION: See Borehole Location Plan, Figure 2

DATUM: Geodetic

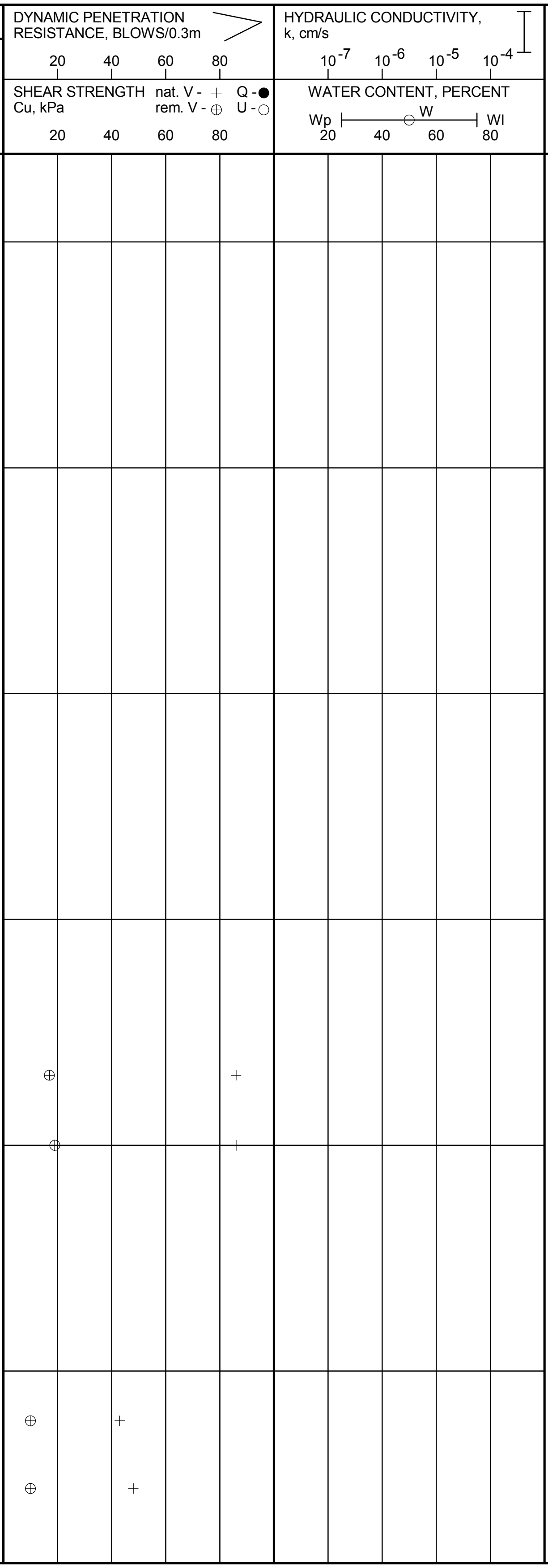
BORING DATE: February 25, 2013

SPT HAMMER: 63.5 kg; drop 0.76 m

BORING METHOD: Power Auger, 200 mm Diameter Hollow Stem

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
Ground Surface	101.27
Dark brown silty clay, some sand, some organic material (TOPSOIL / FILL)	100.66 0.61
Very stiff, grey brown silty clay (FILL MATERIAL)	100.56 0.71
Brown, fine to medium grained sand, trace silt, some gravel (FILL MATERIAL)	100.41 0.86
Very stiff, grey silty clay, some gravel and sand, some roots (FILL MATERIAL)	99.75 1.52
Very stiff to stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	98.22 3.05
Very stiff to stiff, grey SILTY CLAY, with occasional silty sand seems	95.48 5.79
End of Borehole	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	14
3	50 DO	8
4	50 DO	4
5	50 DO	3
6	50 DO	WH



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Backfilled with Auger Flight Cuttings

DEPTH SCALE METRES: 0 1 2 3 4 5 6

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED:

KEY PLAN

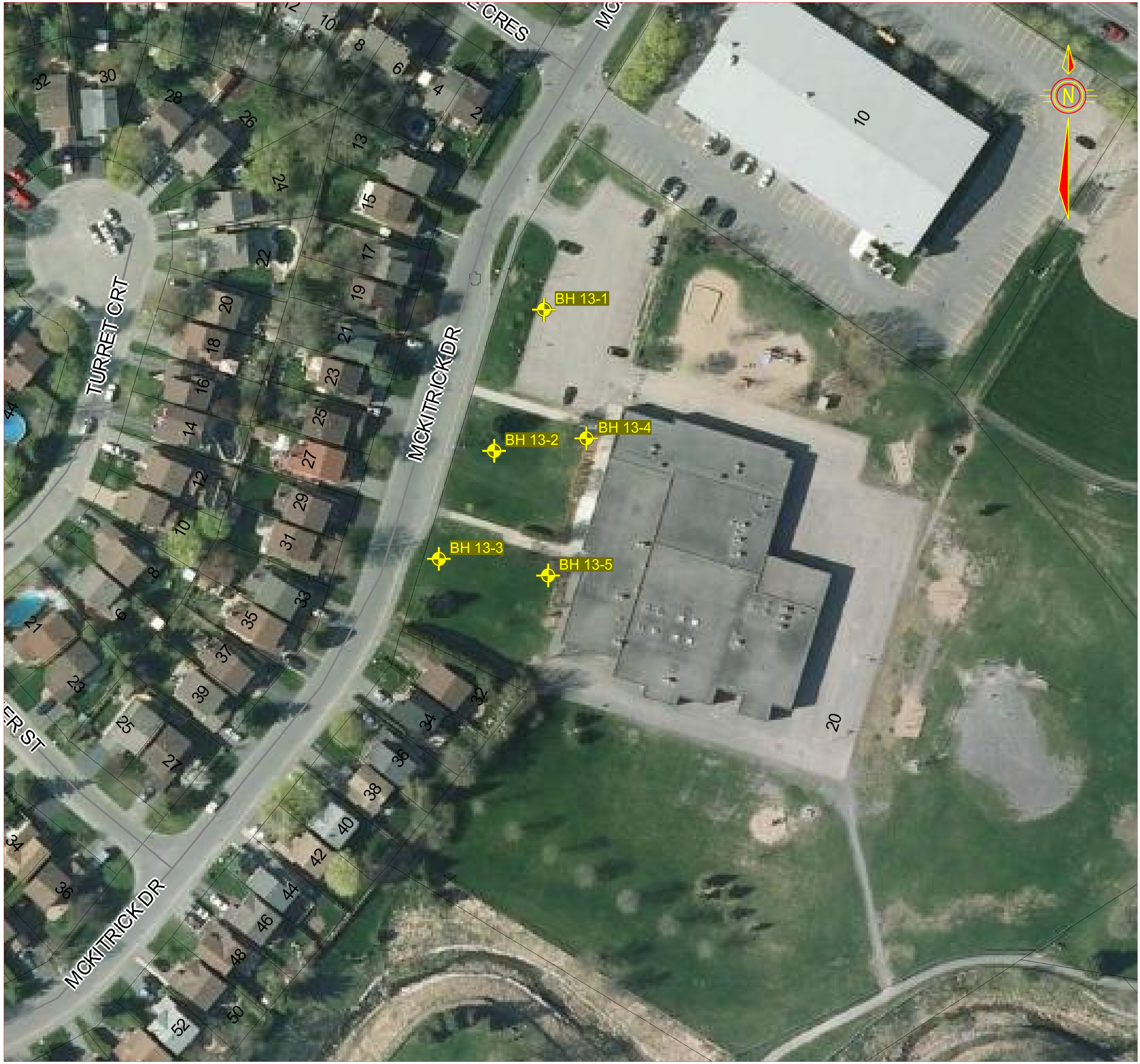
FIGURE 1

N.T.S

Houle Chevrier
Engineering

Date: April 2013

Project: 13-027



LEGEND

BH 13-1 APPROXIMATE BOREHOLE LOCATION IN PLAN, CURRENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD.

Client CAPITAL ENGINEERING GROUP LIMITED		Location 20 McKITRICK DRIVE OTTAWA, ONTARIO	Revision 0
Drawn by D.J.R.	Approved by L.B.	Project No. 13-027	Scale 1: 1000
Houle Chevrier Engineering		Title BOREHOLE LOCATION PLAN	
		Date April 2013	FIGURE 2

ATTACHMENT A

PARACEL LABORATORIES LTD.

REPORT NO. 1310059

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p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Certificate of Analysis

Houle Chevrier
180 Wescar Lane
Carp, ON K0A 1L0
Attn: Luc Bouchard

Phone: (613) 836-1422
Fax: (613) 836-9731

Client PO:
Project: 13-027
Custody: 97355

Report Date: 7-Mar-2013
Order Date: 4-Mar-2013
Order #: 1310059

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

Paracel ID	**Client ID**
1310059-01	BH 13-5 SA-3 5'-7'

Approved By: Mark Foto

Mark Foto, M.Sc. For Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 07-Mar-2013
Order Date:4-Mar-2013

Client: **Houle Chevrier**
Client PO:
Project Description: 13-027

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	6-Mar-13	6-Mar-13
Conductivity	MOE E3138 - probe @25 °C, water ext	6-Mar-13	6-Mar-13
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	5-Mar-13	6-Mar-13
Solids, %	Gravimetric, calculation	5-Mar-13	5-Mar-13

Certificate of Analysis

Report Date: 07-Mar-2013
Order Date:4-Mar-2013

Client: **Houle Chevrier**
Client PO:
Project Description: 13-027

Client ID:		BH 13-5 SA-3 5'-7'	-	-	-
Sample Date:		25-Feb-13	-	-	-
Sample ID:		1310059-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	75.9	-	-	-
General Inorganics					
Conductivity	5 uS/cm	121	-	-	-
pH	0.05 pH Units	7.19	-	-	-
Anions					
Chloride	5 ug/g dry	14	-	-	-
Sulphate	5 ug/g dry	24	-	-	-

Certificate of Analysis

Report Date: 07-Mar-2013
Order Date:4-Mar-2013

Client: **Houle Chevrier**
Client PO:
Project Description: 13-027

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Conductivity	ND	5	uS/cm						

Certificate of Analysis

Report Date: 07-Mar-2013
Order Date:4-Mar-2013

Client: **Houle Chevrier**
Client PO:
Project Description: 13-027

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	11.7	5	ug/g dry	12.4			5.6	20	
Sulphate	39.5	5	ug/g dry	40.1			1.5	20	
General Inorganics									
Conductivity	119	5	uS/cm	121			1.8	6.2	
pH	7.11	0.05	pH Units	7.19			1.1	10	
Physical Characteristics									
% Solids	84.2	0.1	% by Wt.	82.0			2.6	25	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	13.5		mg/L	1.2	97.8	78-113			
Sulphate	15.8		mg/L	4.01	94.3	78-111			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

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(Lab Use Only)
Nº 97355

Page 1 of 1

Client Name: Houle Chevrier Eng
Contact Name: Lucy Bouchard.
Address: 180 Wescar lane
Telephone: 613 836 1422 Ext. 228

Project Reference: 13-027
Quote #
PO #
Email Address: lbouchard@hceng.ca

TAT: [✓ Regular] [ ] 3 Day [ ] 2 Day [ ] 1 Day
Date Required: ________

Criteria: [ ] O. Reg. 153/04 Table __ [ ] O. Reg. 153/11 (Current) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [ ] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality:________ [ ] Other: ____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Paracel Order Number: 1310059

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	**Sample Taken** Date	**Sample Taken** Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP/MS	Hg	CrVI	B (HWS)	PH	Sulphate	Chloride	Conductivity			
1	BH 13-5 SA-3 5'-7'	S	8	1	Feb. 25 2013									✓	✓	✓	✓		250 ml	
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Walk-in

Relinquished By (Print & Sign): M. Wilson
Date/Time: March 4, 2013 / 4:18 pm.

Received by Driver/Depot:
Date/Time:
Temperature: ______ °C

Received at Lab: MJC
Date/Time: Mar 4/13 4:19
Temperature: 19.9 °C

Verified By: MJC
Date/Time: Mar 4/13 5:51
pH Verified [ ] By: N/A

Chain of Custody (Env) - Rev 0.2 December 2011