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REPORT ON

GEOTECHNICAL INVESTIGATION
HIGHLAND PARK CEMETERY VISITATION CENTRE
2037 McGEE SIDE ROAD
OTTAWA, ONTARIO

Submitted to:

Novatech Engineering Consultants Ltd.
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March 25, 2010

Our ref: 10-025

Novatech Engineering Consultants Ltd.
200-204 Michael Cowpland Drive
Ottawa, Ontario
K2M 1P6

Attention: Mrs. Susan Gordon, P.Eng.

RE: GEOTECHNICAL INVESTIGATION
HIGHLAND PARK CEMETERY VISITATION CENTRE
2037 McGEE SIDE ROAD
OTTAWA, ONTARIO

Dear Mrs. Gordon:

Please find enclosed nine (9) copies of the geotechnical report for the proposed visitation centre at the Highland Park Cemetery located at 2037 McGee Side Road, Ottawa, Ontario.

We trust that this report provides sufficient information for your current purposes. If you have any questions concerning the report, please call.

Yours truly,

HOULE CHEVRIER ENGINEERING LTD.

Andrew Chevrier, M.Eng.,P.Eng.
Principal

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out at the site of a proposed visitation centre at 2037 McGee Side Road, Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of boreholes and test pits and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the proposed building and site services, including construction considerations that could influence design decisions. The results of a Phase I Environmental Site Assessment and a Hydrogeological Assessment are provided in separate reports.

This investigation was carried out in accordance with our proposal dated January 26, 2010.

2.0 PROJECT AND SITE DESCRIPTION

2.1 Project Description

Plans are being prepared to construct a 1,400 square metre building at the Highland Park Cemetery located at 2037 McGee Side Road, Ottawa, Ontario (see Key Plan, Figure 1). It is understood that the proposed building is to be of steel frame construction with a full depth basement over a portion of the building footprint. The remaining area of the building footprint will consist of slab on grade construction. The proposed building will house a visitation centre complete with visitation rooms and a chapel. The site work will include access roadways and parking areas. The site of the proposed building consists of a relatively flat, grass surfaced area.

2.2 Review of Geology Maps

Published geology maps of the area indicate that the subsurface conditions are expected to consist of overburden deposits of glacial till or marine deposits of silt and clay. The bedrock is mapped as interbedded limestone and shale of the Verulum formation or limestone of the Bobcaygeon formation at depths of between 2 and 5 metres.

3.0 SUBSURFACE INVESTIGATION

The field work for this investigation was carried out between February 8 and 9, 2010. During that time, six (6) boreholes, numbered 101 to 106, inclusive, were advanced in the area of the proposed building to depths ranging from 3.8 to 4.5 metres depth using a track mounted drill rig supplied and operated by George Downing Estate Drilling Ltd. of Hawkesbury, Ontario. All of the boreholes were advanced to practical auger refusal on inferred bedrock. In addition, two (2) test pits, numbered 101 and 102, were advanced in the area of the septic leaching bed; and, seven (7) test pits, numbered 103 to 109, were excavated in the area of the proposed parking lot and access roadways for pavement design purposes. The test pits were excavated using a rubber tire backhoe to depths ranging from 1.9 to 2.0 metres below ground surface.

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. Well screens were sealed in boreholes 102, 105, and 106 to measure the groundwater levels and facilitate groundwater sampling. Samples of the groundwater recovered from boreholes 102 and 105 were sent for basic chemical testing relating to corrosion of buried concrete and steel.

The subsurface conditions encountered in the test pits were logged by visual and tactile examination of the materials exposed on the sides and bottom of the test pits.

The field work was supervised throughout by members of our engineering staff, who located the boreholes and test pits, 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. Selected samples of the soil were tested for grain size distribution and water content.

The approximate locations of the boreholes and test pits are shown on the Site Plan, Figure 2. Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole sheets in Appendix A. The results of the soil classification testing from samples recovered from the boreholes are provided on the Record of Borehole sheets and on Figures A1 to A2 in Appendix A. Descriptions of the subsurface conditions logged in the test pits are provided on the Record of Test Pit sheets in Appendix B. The results of the soil classification testing from samples recovered from the test pits are provided on the Record of test pit sheets and on Figures B1 and B2 in Appendix B. The results of the chemical analysis of the groundwater samples relating to corrosion are provided in Appendix C.

The borehole and test pit locations were determined relative to existing site features by Houle Chevrier Engineering Ltd. personnel. The borehole and test pit elevations were provided by Novatech Engineering Consultants Ltd.

4.0 SUBSURFACE CONDITIONS

4.1 General

As previously indicated, the soil and groundwater conditions identified in the boreholes are given on the Record of Borehole sheets in Appendix A and on the Record of Test Pit sheets in Appendix B following the text of this report. The borehole and test pit 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 and test pits. 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 and test pits advanced during this investigation.

4.2 Site of Proposed Building (Boreholes 101 to 106)

4.2.1 Topsoil

A surficial layer of topsoil, ranging in thickness from about 0.1 metres to 0.3 metres, was encountered in all of the boreholes.

4.2.2 Silty Clay

All of the boreholes encountered deposits of weathered, grey brown silty clay below the surficial layer of topsoil. In general, the weathered silty clay has a thickness of between about 1.1 to 3.6 metres and extends to depths of about 1.2 to 3.7 metres below ground surface (elevation 107.1 and 110.3 metres, geodetic datum). The weathered silty clay contains variable amounts of sand and occasional silty sand seams. Standard penetration tests carried out in the weathered silty clay gave N values of 1 to 17 blows per 0.3 metres of penetration, which reflect a stiff to very stiff consistency.

A 0.6 metre thick layer of grey silty clay was encountered below the weathered silty clay, at about 3.7 metres below the ground surface (elevation 107.1 metres, geodetic datum), in borehole 105. A standard penetration test carried out in the grey silty clay gave an N value of "weight of hammer (WH)" per 0.3 metres of penetration, which reflects a firm consistency.

Grain size distribution curves for samples of the weathered silty clay recovered from boreholes 102 and 104 are provided on Figure A1 in Appendix A. The water content of the grey brown silty clay ranged from 24 to 40 percent.

4.2.3 Sandy Silt

A layer of grey brown sandy silt was encountered in borehole 101 at 1.3 metres below ground surface (elevation 109.7 metres, geodetic datum) within the grey brown silty clay deposit. The sandy silt has a thickness of approximately 0.8 metres. A standard penetration test carried out in the sandy silt gave an N value of 14 per 0.3 metres of penetration, which reflects a compact consistency.

At borehole 103, the weathered silty clay is underlain at approximately 1.2 metres below ground surface (elevation 110.3 metres, geodetic datum) by a 0.8 metre thick deposit of grey brown sandy silt. A standard penetration test carried out in the grey brown sandy silt gave an N value of 50 blows for 0.1 metres of penetration, which likely reflects the presence of cobbles and/or boulders in the sandy silt.

A grain size distribution curve for a sample of the sandy silt recovered from borehole 101 is provided on Figure A2 in Appendix A. The water content of a sample of sandy silt recovered from borehole 101 was 21 percent.

4.2.4 Glacial Till

A deposit of glacial till was encountered below the weathered silty clay deposit in boreholes 101, 102, 104, and 106, and below the sandy silt deposit in borehole 103, at depths of about 2.0 to 3.8 metres below ground surface (elevation 107.5 to 109.5 metres, geodetic datum). The glacial till can be generally described as a silty sand and sandy silt with variable amounts of clay and gravel. Cobbles and boulders should also be expected in the glacial deposit. Standard penetration tests carried out in the glacial till gave variable N values of 2 to 39 blows per 0.3 metres of penetration, which reflect a very loose to dense relative density. The water content of a sample of glacial till recovered from borehole 106 was 12 percent.

4.2.5 Inferred Bedrock

Practical refusal to further advancement of the hollow stem auger on the inferred surface of the bedrock occurred in boreholes 101 to 106, inclusive, at depths ranging from 3.8 to 4.9 metres below ground surface (elevation 106.4 to 107.6 metres, geodetic datum). It should be noted that practical auger refusal can sometimes occur within cobbles and boulders and may not necessarily be representative of the upper surface of the bedrock.

4.3 Site of Proposed Septic Leaching Bed (Test Pits 101 and 102)

4.3.1 Topsoil

A surficial layer of topsoil, ranging in thickness from 0.3 metres to 0.4 metres, was encountered in test pits 101 and 102.

4.3.2 Glacial Till

A deposit of glacial till was encountered below the topsoil. The glacial till consists of silty sand and sandy silty with variable amounts of gravel, cobbles and boulders. At these locations, the glacial deposit was not fully penetrated; therefore, its thickness is not known.

Grain size distribution curves for samples of the glacial till recovered from test pits 101 and 102 are provided on Figure B2 in Appendix B.

4.4 Site of Proposed Parking Lot (Test Pits 103 to 109)

4.4.1 Topsoil

A surficial layer of topsoil, ranging in thickness from 0.2 metres to 0.3 metres, was encountered in test pits 103 to 109, inclusive.

4.4.2 Silty Clay and Sandy Silt

Deposits of weathered, grey brown silty clay were encountered in test pits 103 to 109, inclusive, below the surficial layer of topsoil. In test pits 103, 107, and 109, a 0.5 to 0.9 metre thick layer of grey brown sandy silt was encountered within the weathered silty clay deposits at about 0.8 to 1.0 metres below ground surface. Test pits 103, 107, and 109 were terminated within the grey brown silty clay deposits at 2.0 metres below the ground surface.

Deposits of grey brown sandy silt were encountered below the weathered silty clay in test pits 104, 105, 106, and 108 at depths of about 0.8 to 1.2 metres below ground surface. Where fully penetrated (test pit 104), the sandy silt has a thickness of 0.4 metres.

A grain size distribution curve for a sample of the silty clay recovered from test pit 104 is provided on Figure B1 in Appendix B. The water content of a sample of silty clay recovered from test pit 104 was 31 percent.

4.4.3 Glacial Till

A deposit of glacial till was encountered below the sandy silt deposit in test pit 104 at a depth of 1.3 metres below ground surface. The glacial till can be generally described as a sandy silt with gravel. Cobbles and boulders should also be expected in the glacial deposit. At this location, the glacial deposit was not fully penetrated; therefore, its thickness is not known.

4.5 Groundwater Levels

The groundwater levels in the well screens installed in boreholes 102, 105, and 106 ranged from 1.7 to 1.9 metres below ground surface on February 19, 2010 (elevation 108.9 to 109.7 metres, geodetic datum). No groundwater inflow was observed in the test pits during the short period that they were left open following excavation.

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

4.6 Groundwater Chemistry Relating to Corrosion

The chemical testing on groundwater samples recovered from boreholes 102 and 105 gave the following results:

Parameter	Borehole	
	BH102	BH105
Conductivity (micromhos/centimetre)	170	890
pH	7.62	7.72
Sulphate Content (mg/L)	61	59
Chloride Content (mg/L)	170	100

5.0 GEOTECHNICAL DESIGN GUIDELINES

5.1 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.

5.2 Proposed Visitation Centre

5.2.1 Excavation

The excavation for the proposed building will be carried out through topsoil, and native deposits of silty clay and sandy silt.

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, soils at this site can be classified as Type 3. That is, open cut excavations within overburden deposits should be carried out with side slopes of 1 horizontal to 1 vertical, or flatter.

It is our experience that the upper part of the weathered silty clay (i.e., within 0.3 to 0.5 metres from original ground surface) may be impacted by past frost action. During removal of the topsoil, the upper part of the silty clay could unavoidably peel upwards and become disturbed. Where this occurs in the proposed parking and access roadway areas, the upper part of the silty clay should be re-compacted in place using suitable compaction equipment. Within the existing building, it will likely be necessary to remove and replace the silty clay soil with imported granular material, such as OPSS Granular B Type II.

The groundwater inflow from the overburden deposits, if any, should be controlled by pumping from sumps within the excavation where required.

5.2.2 Depth of Basement

The underside of footing level for the basement of the proposed structure should be located at or above the groundwater level to reduce the risk of possible groundwater infiltration into the basement during periods of sump pump failure or a power outage. The groundwater levels measured to date range from 109.0 to 109.7 metres, geodetic datum. Therefore, for design purposes, the basement floor slab could be designed to be above about 110 metres, geodetic datum. It should be noted that the groundwater levels were measured on February 19, 2010 and may be higher during wet periods of the year such as the early spring or following periods of precipitation.

The following alternatives could also be considered:

1) Found the basement portion of the structure above or below the groundwater and reduce the risk of flooding during a power outage by installing a battery or generator backup system for the sump; OR

2) Found the basement above or below the groundwater level and provide a gravity outlet for the perimeter foundation drain (for example to a low area on the site).

5.2.3 Spread Footing Design

The proposed structure could be founded on spread footings bearing on or within the native soil (that is, the native silty clay and sandy silt) deposits. The topsoil is considered to be highly compressible and should be removed from below any foundations and concrete slabs.

In areas where the underside of footing level is above the level of the subgrade or where subexcavation of soil is required, the grade below the proposed building could be raised with imported granular material conforming to OPSS Granular B Type II compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. OPSS 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 building be composed of virgin material only for environmental reasons. To provide adequate spread of load below the footings, the material should extend at least 0.5 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 weathered silty clay and sandy silt deposits, or on a pad of compacted granular fill above native, undisturbed soil should be sized using a net geotechnical reaction at Serviceability Limit State (SLS) of 150 kilopascals and a factored net geotechnical resistance at Ultimate Limit State (ULS) of 250 kilopascals.

The post construction total and differential settlement at SLS of footings bearing on the weathered silty clay and sandy silt should be less than 25 and 20 millimetres, respectively, provided that all loose or disturbed soil is removed from the bearing surfaces.

5.2.4 Frost Protection Requirements for Foundations

All exterior footings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated (unheated) piers that are located in areas that are to be cleared of snow should also 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.

5.2.5 Seismic Design of Proposed Structure

The native overburden deposits in the area of the proposed structure are composed of deposits of weathered silty clay, sandy silt, and glacial till, over bedrock. The weathered silty clay has a very stiff consistency. The corrected standard penetration value obtained within the non-cohesive (sandy silt and glacial till) deposits range from 14 to 58 blows per 0.3 metres of penetration in boreholes 101, 102, 103, and 104. The top of bedrock, as inferred from the auger refusal depths, was encountered in boreholes 101 to 106, inclusive, at depths ranging from 3.8 to 4.9 metres below ground surface. In our opinion, the proposed building could be designed for Site Class D.

There is no potential for liquefaction of the overburden deposits at this site.

5.2.6 Foundation Wall Backfill and Drainage

5.2.6.1 Backfill Type

The upper native soils at this site are frost susceptible and should not be used as backfill against foundation walls. 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 Ontario Provincial Standard Specifications (OPSS) Granular B Type I or II requirements.

Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks 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. Light hand operated compaction equipment should be used next to the basement foundation walls to avoid excessive compaction induced stress on the foundation walls.

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 (concrete, sidewalk, pavement, etc.) abut the proposed building, 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 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.

5.2.6.2 Earth Pressures on Basement Foundation Walls

Basement foundation walls that are backfilled with sand or sand and gravel should be designed to resist "at rest" earth pressures calculated using the following formula:

$$P_o = K_o (\gamma H + q)$$

Where,

P_o = At rest earth pressure at the bottom of the foundation wall (kilopascals)
K_o = At rest earth pressure coefficient (0.50)
γ = Unit weight of backfill material (22 kilonewtons per cubic metre)
H = Height of foundation wall (metres)
q = Uniform surcharge at ground surface behind the wall to take into account traffic, equipment, or stockpiled soil (typically 10 kilopacals)

Where conditions dictate, allowance should be made in the structural design of the foundation walls for active loads due to ground supported vehicles/equipment. For example, the horizontal active load due to a uniform, vertical live load adjacent to the foundation wall could be determined using a horizontal earth pressure coefficient, K_o, of 0.50, times the vertical live load. The effects of other vertical loads (point loads, line loads, etc.) adjacent to or near the foundation walls could be provided, if required.

Heavy construction traffic should not be allowed to operated adjacent to the basement foundation walls for the proposed building (say within about 2 metres horizontal) during construction, without the approval of the designers.

Seismic shaking can increase the forces on the foundation walls during or following an earthquake. The increase in pressure may be estimated using the method suggested by Wood (1973) for foundation walls braced at both the top and bottom. For non-yielding smooth foundation walls, which are restrained against movement, dynamic thrust component at Ultimate Limit States (ULS) can be calculated using the following formula:

$$\Delta P_{eq} = \gamma H^2 (a_h/g) F_p$$

Where,

ΔP_{eq} = Dynamic thrust component (kilonewtons per metre)

γ = Unit weight of backfill material (22 kilonewtons per cubic metre)

H = Height of foundation wall (metres)

(a_h/g) = dimensionless horizontal pseudostatic coefficient (0.21 is typically used for the Ottawa area)

F_p = dimensionless dynamic thrust factor (typically 1.0 for foundation walls)

The dynamic thrust component typically acts at a height of 0.63H above the base of the foundation wall.

5.2.6.3 Foundation Drainage

The foundation walls for the basement should be damp proof and a perforated plastic foundation drain with a surround of clear crushed stone should be installed on the exterior of the foundation walls. The drain should outlet by gravity to a storm sewer, ditch, or a sump from which the water is pumped. To avoid loss of sand backfill into the voids in the clear stone (and possible post construction settlement of the ground around the building), a nonwoven geotextile should be placed between the clear stone and any sand backfill material.

Perimeter foundation drainage is not considered necessary for the slab on grade portion of the proposed structure, provided that the floor slab level is above the finished exterior ground surface level.

5.2.7 Basement Slab and Slab on Grade Support

To provide predictable settlement performance of the basement slab and slab on grade, all topsoil should be removed from below the slab areas.

If necessary, the grade beneath the basement floor slab could be raised with either 19 millimetre clear crushed stone or OPSS Granular B Type II. The base for the floor slab should consist of at least 150 millimetres of OPSS Granular A or 19 millimetre clear crushed stone. A nonwoven geotextile separator should be provided between the clear crushed stone and any native sandy silt. The geotextile should overlap at least 0.4 metres. The grade beneath the slab on grade could 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 B Type II material. 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.

The clear crushed stone should be nominally compacted in maximum 300 millimetre thick lifts with at least 2 passes of a diesel plate compactor. The Granular A and Granular B Type II should be compacted in maximum 150 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value using suitable vibratory equipment. Care must be taken during placement and compaction of any granular materials to avoid disturbance to the subgrade soils.

Underfloor drainage should be provided below the basement floor slab. If well graded material (such as OPSS Granular A or Granular B Type II) is used below the basement floor slab, we suggest that drainage be provided by means of plastic perforated pipes spaced at about 6 metres horizontally or as required to link any hydraulically isolated areas on the basement. If clear crushed stone is used below the floor slab, drains are not considered essential provided that all of the clear stone can outlet to the sump; in this case, two 1.5 metre long stub drains should be installed in the clear stone and should outlet to the sump pit.

For slab on grade portions of the building, underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level.

The floor slabs should be appropriately moist or wet cured to minimize shrinkage cracking and slab curling.

If any areas of the building are to remain unheated during the winter period, thermal protection of the materials beneath the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

5.2.8 Corrosion of Buried Concrete and Steel

The measured sulphate concentrations in the groundwater were 61 and 59 milligrams per litre at boreholes 102 and 105, respectively. According to Canadian Standards Association (CSA) "Concrete Materials and Methods of Concrete Construction", the concentration of sulphate in the groundwater 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 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 non-aggressive to 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.

5.3 Septic Leaching Bed Design

The glacial till encountered in test pits 101 and 102 consists of silty sand and sandy silt. Due to the relatively low permeability of the sandy silt glacial till, we recommend that the leaching bed consist of a fully raised bed with a sand mantle. If imported sand fill is used for the leaching bed construction, the length of distribution pipe could is determined using the T-time of the imported sand fill. In our experience, a T-Time of 6 minutes per centimetre (min/cm) is suitable for imported sand in Ottawa.

In accordance with Clause 8.7.4.1 of the OBC, a loading rate of 6 litres per square metre per day (L/m^2 per day) should be used to determine the minimum contact area for the raised leaching bed.

5.4 Access Roadways and Parking Areas for the Proposed Building

5.4.1 Subgrade Preparation

In preparation for the parking lot and access roadway construction, all surficial topsoil and any soft, wet or deleterious materials should be removed. Any subexcavated areas could be filled with compacted earth borrow that is frost compatible with the native silty clay soils.

The subgrade surfaces should be proof rolled with a large steel drum roller under dry conditions and shaped and crowned to promote drainage of the roadway granular materials to the perimeter swales.

5.4.2 Pavement Design

It is suggested that parking areas to be used by light vehicles (cars, etc.) be constructed using the following minimum pavement structure:

50 millimetres of HL3 or Superpave 12.5 asphaltic concrete, over
150 millimetres of OPSS Granular A base, over
300 millimetres of OPSS Granular B Type II subbase

For any access roadways which will be used by heavy trucks or fire trucks, the asphaltic concrete surfacing thickness should be increased to 90 millimetres and the thickness of the subbase layer increased to 450 millimetres.

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

The design life of the pavement should be 20 to 25 years. Allowance should be made for normal crack sealing, as required, and a possible asphaltic concrete overlay in about 12 to 15 years.

5.4.3 Asphaltic Concrete Types

The asphaltic concrete in the parking areas should consist of 50 millimetres of Superpave 12.5 or HL3. For any access roadways that will be used by truck traffic or fire trucks, the asphaltic concrete surfacing thickness should be increased to 90 millimetres (40 millimetres of Superpave 12.5 or HL3 over 50 millimetres of Superpave 19.0 or HL8). The superpave asphaltic concrete mixes should be designed for Traffic Level A or B.

Performance grade PG 58-34 asphaltic concrete should be specified for either Superpave or Marshall mixes.

5.4.4 Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. If surface drainage is used, swales or ditches are suggested around the paved areas. The granular base and subbase materials should extend horizontally to the ditches/swales. Where possible, the bottom of the swales/ditches should be at least about 0.3 metres below the bottom of the Granular B Type II. The need for additional subdrains within the granular material should be assessed by us as part of the design.

5.4.5 Effects of Soil Disturbance and Construction Traffic on the Pavement Design

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 subgrade material. The contractor should be responsible for construction access.

The above pavement structures assume that the subgrade level is at most about 0.5 metres below existing ground surface and that the roadway subgrade surface is prepared as described above. If the subgrade level is more than 0.5 metres below ground surface or if the roadway subgrade surface or becomes disturbed or wetted due to construction operations or precipitation, the Granular B Type II thickness given above may not be adequate and it may be necessary to:

- Increase the thickness of the Granular B Type II subbase,
- Incorporate a woven geotextile separator between the roadway subgrade surface and the granular subbase material, or

- A combination of the above.

The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

5.5 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 or services.

5.6 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.

5.7 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 building, parking areas, and access roadways 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.

Johnathan A. Cholewa, Ph.D., EIT

Andrew Chevrier, M.Eng.P.Eng.
Principal

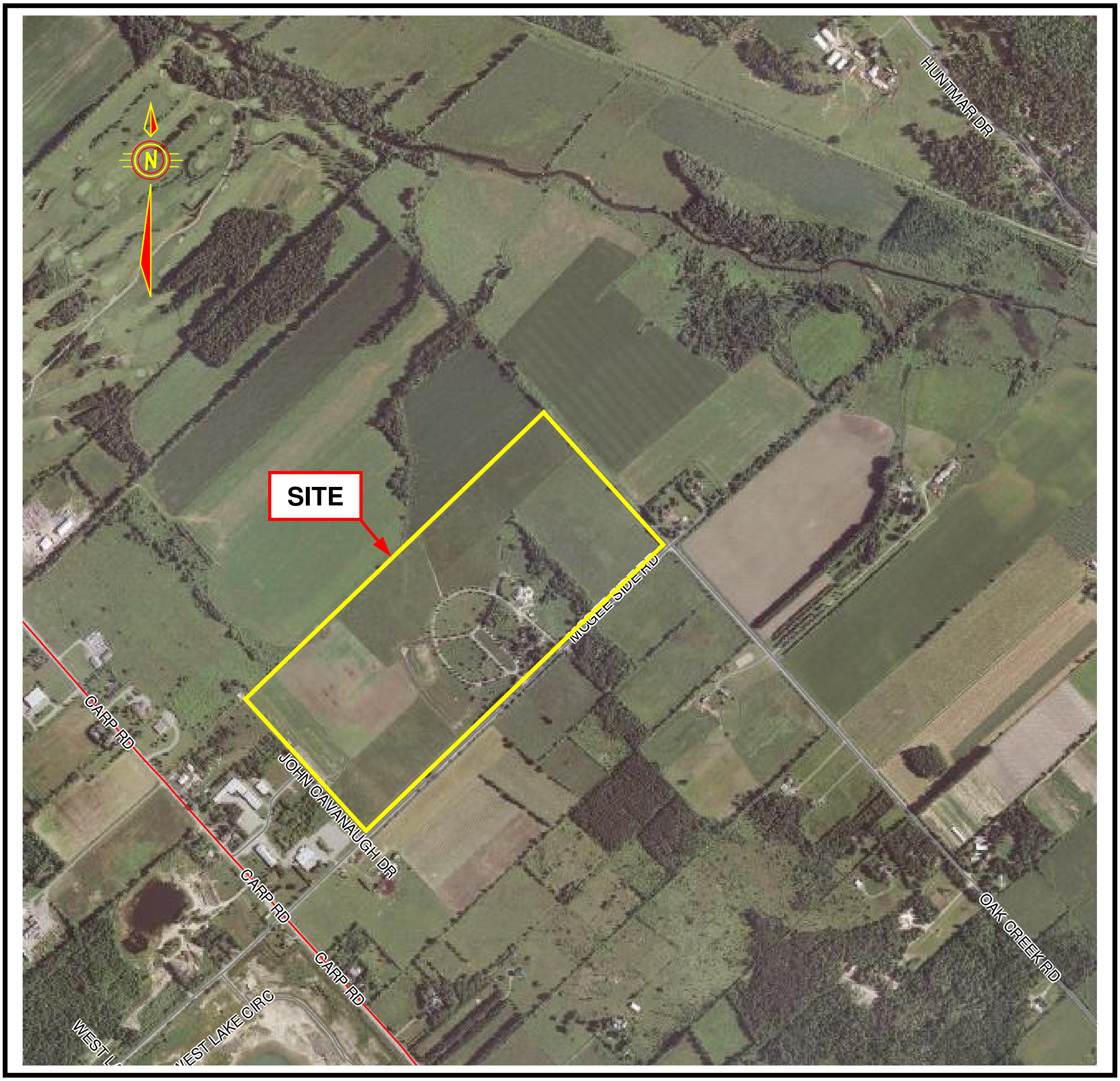
LICENSED PROFESSIONAL ENGINEER
A.F. CHEVRIER
7974504
PROVINCE OF ONTARIO

References

Wood, J. (1973). "Earthquake-induced soil pressure on structures," Report EERL 73-05, California Institute of Technology, Pasadena, California, 311 pp.

KEY PLAN

FIGURE 1



N.T.S

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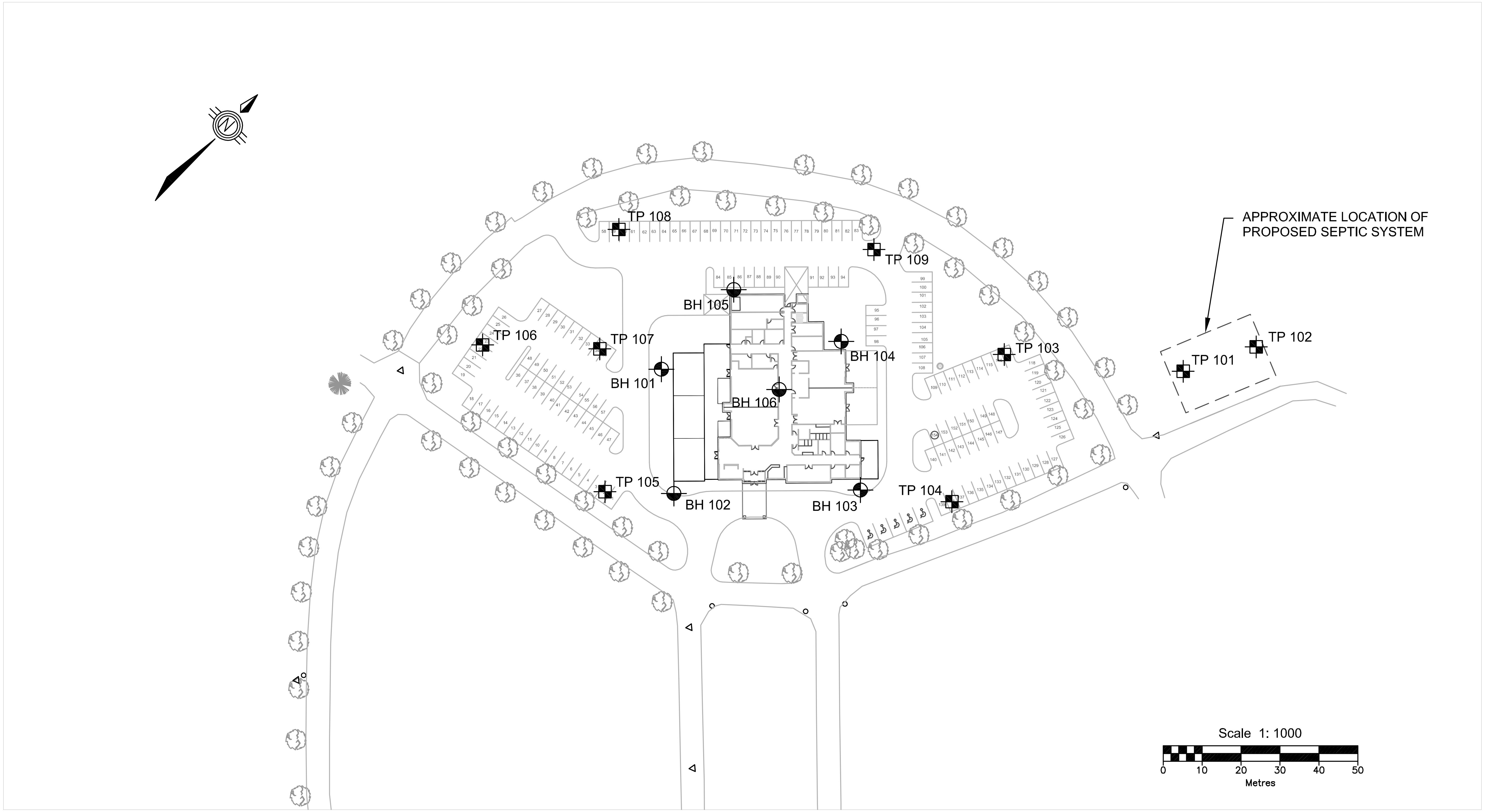
Date: March 2010

Project: 10-025



LEGEND

TP # APPROXIMATE TEST PIT LOCATION IN PLAN

BH # APPROXIMATE BOREHOLE LOCATION IN PLAN

BH # BOREHOLE WITH MONITORING WELL INSTALLATION

REFERENCE: PLAN PREPARED USING SITE PLAN PROVIDED BY NOVATECH ENGINEERING CONSULTANTS LTD.

Client PINECREST REMEMBRANCE SERVICES LTD.		Location HIGHLAND PARK CEMETERY 2037 McGEE SIDE ROAD OTTAWA, ON	Revision 0
Drawn by D.J.R	Approved by S.M.G.	Project No. 10-025	Scale 1:1000
Houle Chevrier Engineering		Title SITE PLAN	
		Date March 2010	FIGURE 2

APPENDIX A

RECORD OF BOREHOLE SHEETS AND FIGURES A1 to A2

PROJECT: 10-025

RECORD OF BOREHOLE 101

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 8, 2010

SPT HAMMER: 63.6 kg; drop 0.76m

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

BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT, PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
Power Auger 200 mm Diameter Hollow Stem	Ground Surface		111.06						
	TOPSOIL								
	Very stiff, grey brown SILTY CLAY, some sand		110.81 0.25	1	50 DO	10			
	Compact, grey brown SANDY SILT, some clay		109.74 1.32	2	50 DO	14	○	MH (See Fig. A2)	
	Very stiff to stiff, grey brown SILTY CLAY, with occasional silty sand seams		108.98 2.08	3	50 DO	5			
				4	50 DO	1			
	Very loose, grey silty sand, some gravel and clay (GLACIAL TILL)		107.45 3.61	5	50 DO	2			
	End of Borehole Auger Refusal		106.79 4.27						Groundwater conditions not observed

DEPTH SCALE 0 1 2 3 4 5 6 METRES

DEPTH SCALE
1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: J.M.

CHECKED: JC

PROJECT: 10-025

RECORD OF BOREHOLE 102

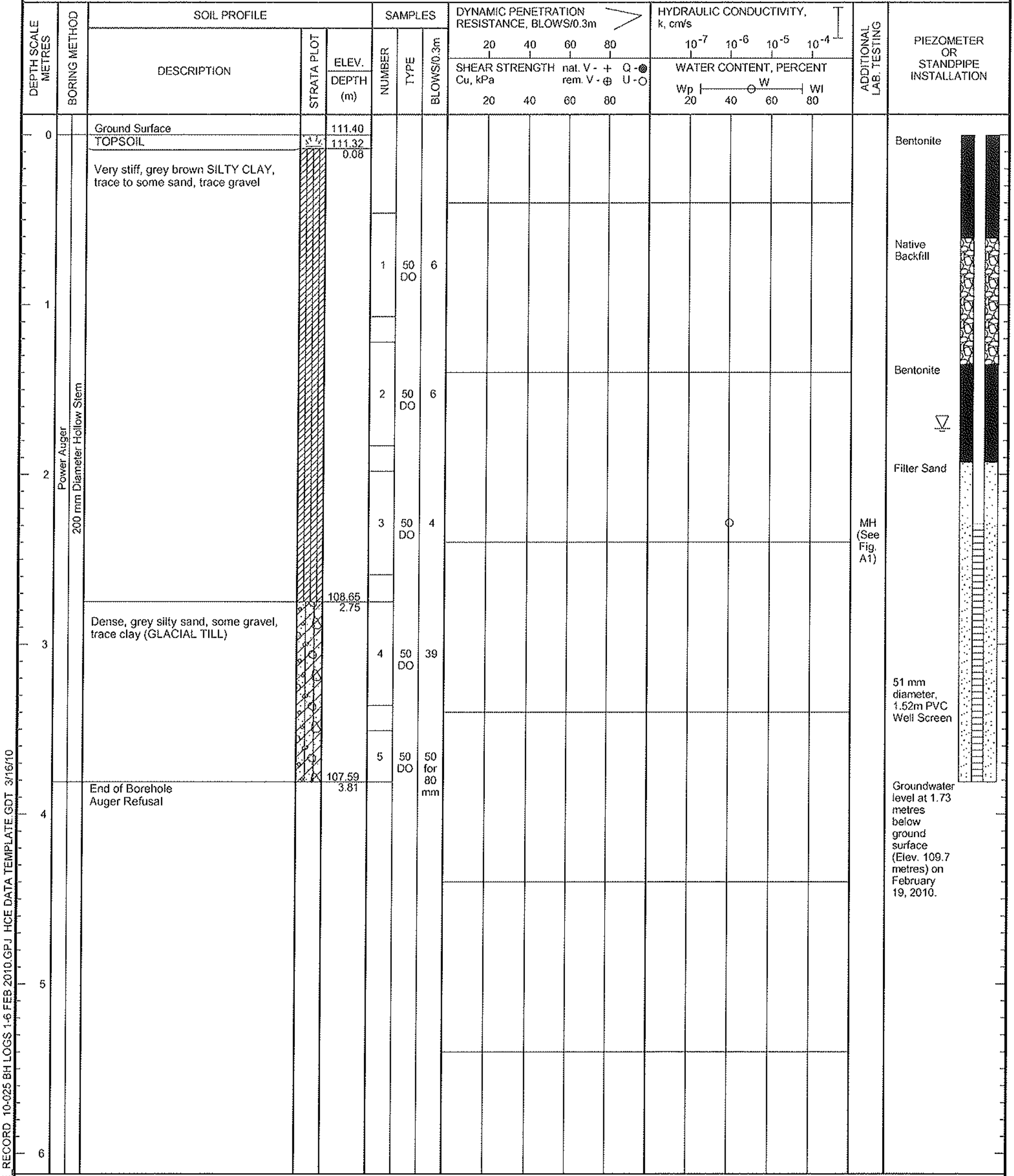
SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 8, 2010

SPT HAMMER: 63.6 kg; drop 0.76m



DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
Ground Surface	111.40				
TOPSOIL	111.32 0.08				
Very stiff, grey brown SILTY CLAY, trace to some sand, trace gravel		1	50 DO	6	
		2	50 DO	6	
		3	50 DO	4	MH (See Fig. A1)
Dense, grey silty sand, some gravel, trace clay (GLACIAL TILL)	108.65 2.75	4	50 DO	39	
		5	50 DO	50 for 80 mm	
End of Borehole Auger Refusal	107.59 3.81				

Groundwater level at 1.73 metres below ground surface (Elev. 109.7 metres) on February 19, 2010.

BOREHOLE_RECORD 10-025 BH LOGS 1-6 FEB 2010.GPJ HCE DATA TEMPLATE.GDT 3/16/10

DEPTH SCALE
1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: J.M.
CHECKED: JC

PROJECT: 10-025

RECORD OF BOREHOLE 103

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 8, 2010

SPT HAMMER: 63.6 kg; drop 0.76m

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	111.48				
		TOPSOIL	111.40 0.08				
		Very stiff, grey brown SILTY CLAY, some sand		1	50 DO	7	
1		Compact grey brown SANDY SILT, some clay, cobbles and possible boulders	110.26 1.22	2	50 DO	50 for 100 mm	
2		Compact, grey brown silty sand, some gravel and clay (GLACIAL TILL)	109.50 1.98	3	50 DO	12	
3				4	50 DO	58 for 230 mm	
4		Compact to dense, grey brown sandy silt, some gravel, trace clay (GLACIAL TILL)	107.97 3.51	5	50 DO	12	
				6	50 DO	36	
5		End of Borehole Auger Refusal	106.60 4.88				Groundwater conditions not observed
6							

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: J.M..

CHECKED: JC

PROJECT: 10-025

RECORD OF BOREHOLE 104

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 8, 2010

SPT HAMMER: 63.6 kg; drop 0.76m

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	WATER CONTENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	110.91						
		TOPSOIL	0.05						
		Very stiff to stiff, grey brown SILTY CLAY, trace sand							
1				1	50 DO	6			
				2	50 DO	17	○	MH (See Fig. A1)	
2									
				3	50 DO	2			
3		Dense to very loose, grey brown sandy silt, some gravel, trace clay (GLACIAL TILL)	107.96 2.95						
				4	50 DO	36			
4				5	50 DO	3			
		End of Borehole Auger Refusal	106.44 4.47						Groundwater conditions not observed
5									
6									

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: J.M..

CHECKED: JC

BOREHOLE_RECORD 10-025 BH LOGS 1-6 FEB 2010.GPJ HCE DATA TEMPLATE.GDT 3/16/10

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

BORING DATE: February 8, 2010

RECORD OF BOREHOLE 105

SHEET 1 OF 1

DATUM: Geodetic

SPT HAMMER: 63.6 kg; drop 0.76m

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

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

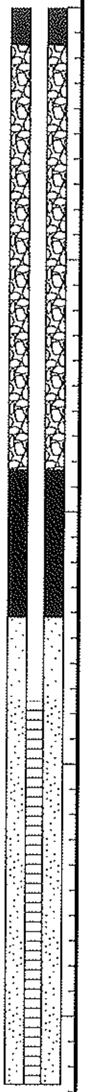
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-7} 10^{-6} 10^{-5} 10^{-4}

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

ADDITIONAL LAB. TESTING

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	110.80			
		TOPSOIL	0.05			
		Very stiff, grey brown SILTY CLAY, trace organic material, trace sand				
1				1	50 DO	9
		Very stiff, grey brown SILTY CLAY, trace sand	109.43 1.37	2	50 DO	12
2		Stiff, grey brown SILTY CLAY with occasional fine sand seams	108.67 2.13	3	50 DO	3
3				4	50 DO	2
4		Grey SILTY CLAY	107.14 3.66	5	50 DO	WH
		End of Borehole Auger Refusal	106.53 4.27			
5						
6						

PIEZOMETER OR STANDPIPE INSTALLATION



Groundwater level at 1.93 metres below ground surface (Elev. 108.9 metres) on February 19, 2010.

DEPTH SCALE

1 to 30

Houle Chevrier Engineering Ltd.

LOGGED: J.M.

CHECKED: JC

PROJECT: 10-025

RECORD OF BOREHOLE 106

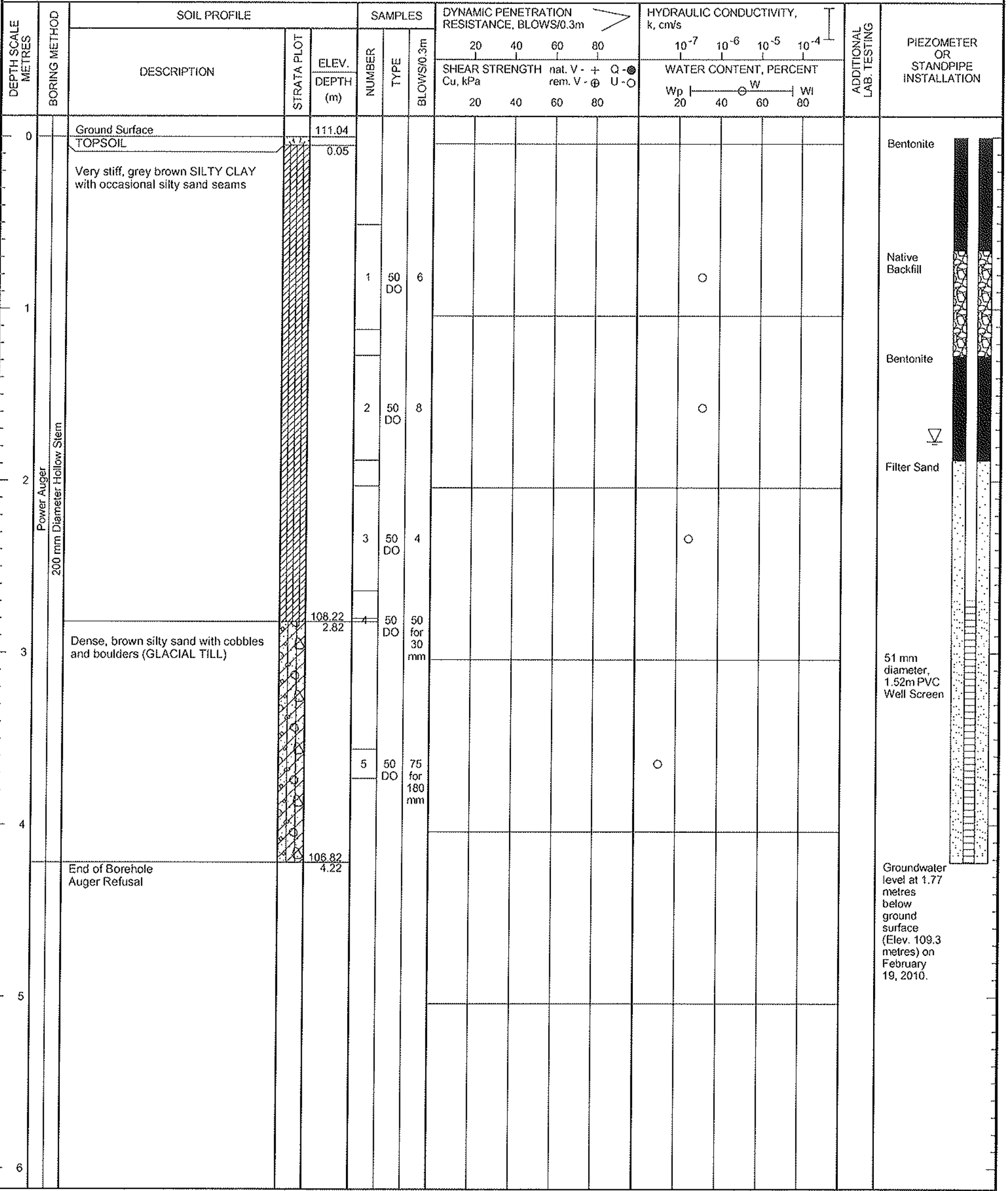
SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Geodetic

BORING DATE: February 9, 2010

SPT HAMMER: 63.6 kg; drop 0.76m



DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
Ground Surface	111.04			
TOPSOIL	0.05			
Very stiff, grey brown SILTY CLAY with occasional silty sand seams		1	50 DO	6
		2	50 DO	8
		3	50 DO	4
Dense, brown silty sand with cobbles and boulders (GLACIAL TILL)	108.22 2.82	4	50 DO	50 for 30 mm
		5	50 DO	75 for 180 mm
End of Borehole Auger Refusal	106.82 4.22			

Groundwater level at 1.77 metres below ground surface (Elev. 109.3 metres) on February 19, 2010.

DEPTH SCALE

1 to 30

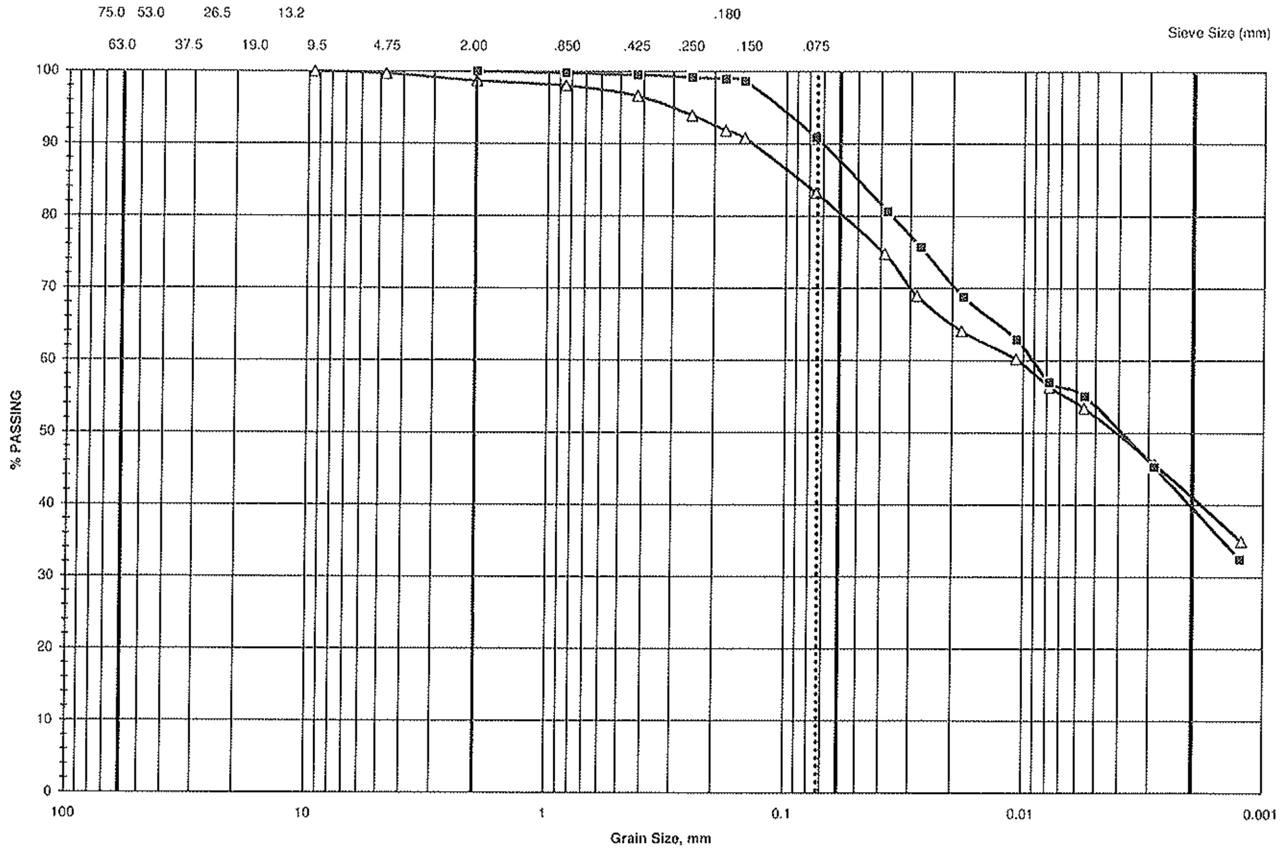
Houle Chevrier Engineering Ltd.

LOGGED: J.A.C.

CHECKED: JC

GRAIN SIZE ANALYSIS

FIGURE A1



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			

Modified M.I.T. Classification

Bore Hole	Sample	Depth (m)	Legend
102	3	2.29 - 2.90	△
104	2	1.52 - 2.13	▨

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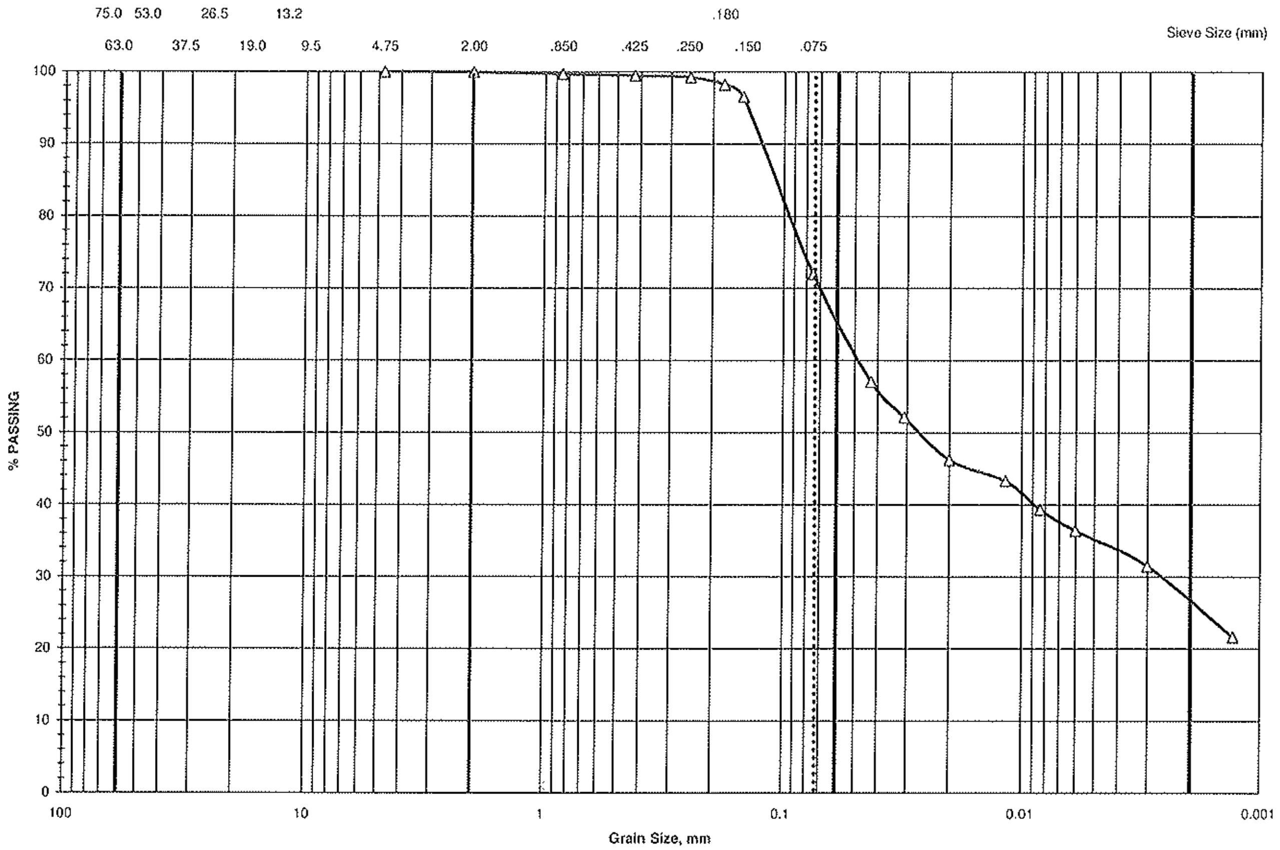
Date: March 2010
Project : 10-025

GRAIN SIZE ANALYSIS

FIGURE A2



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			
Modified M.I.T. Classification										

Bore Hole	Sample	Depth (m)	Legend
101	2	1.52 - 2.13	△

Houle Chevrier
Engineering

Date: March 2010
Project : 10-025

APPENDIX B

RECORD OF TEST PIT SHEETS AND FIGURES B1 to B2

PROJECT: 10-025

RECORD OF TEST PIT 101

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Not Applicable

DATE OF EXCAVATION: February 9, 2010

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE			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
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
	Ground Surface							
0	TOPSOIL							
	Brown sandy silt with gravel, cobbles and trace sand (GLACIAL TILL)		0.30					
1								
2	End of Test Pit		2.00					Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

PROJECT: 10-025

RECORD OF TEST PIT 102

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Not Applicable

DATE OF EXCAVATION: February 9, 2010

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE			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
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
	Ground Surface							
0	TOPSOIL							
	Brownish grey sandy silt with gravel, cobbles and trace clay (GLACIAL TILL)		0.35					
1								
	End of Test Pit		1.90					Groundwater conditions not observed
2								
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

TESTPIT_RECORD 10-025 TP LOGS 101-109 FEB 2010.GPJ HCE DATA TEMPLATE.GDT 3/16/10

PROJECT: 10-025

RECORD OF TEST PIT 103

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Not Applicable

DATE OF EXCAVATION: February 9, 2010

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE			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
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
0	Ground Surface		110.97					
	TOPSOIL							
	Grey brown SILTY CLAY with occasional silty sand seams		110.72 0.25					
1	Grey brown SANDY SILT with some clay		110.07 0.90					
	Grey brown SILTY CLAY with occasional silty sand seams		109.57 1.40					
2	End of Test Pit		108.97 2.00					Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

DATE OF EXCAVATION: February 9, 2010

RECORD OF TEST PIT 104

SHEET 1 OF 1

DATUM: Not Applicable

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		111.42					
	TOPSOIL		111.12 0.30					
	Grey brown SILTY CLAY with occasional silty sand seams		110.52 0.90			○	MH (See Fig. B1)	
1	Grey brown SANDY SILT, some clay		110.12 1.30					
	Grey brown sandy silt with gravel, cobbles and trace clay (GLACIAL TILL)		109.42 2.00					
2	End of Test Pit							Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

DATE OF EXCAVATION: February 9, 2010

RECORD OF TEST PIT 105

SHEET 1 OF 1

DATUM: Not Applicable

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		111.63					
	TOPSOIL		111.43 0.20					
	Grey brown SILTY CLAY with occasional silty sand seams		110.43 1.20					
1								
	Grey brown SANDY SILT, some clay		109.63 2.00					
2	End of Test Pit							Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JL

PROJECT: 10-025

RECORD OF TEST PIT 106

SHEET 1 OF 1

LOCATION: See Site Plan, Figure 2

DATUM: Not Applicable

DATE OF EXCAVATION: February 9, 2010

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		111.07					
	TOPSOIL		110.82 0.25					
	Grey brown SILTY CLAY with occasional silty sand seams		110.27 0.80					
1	Grey brown SANDY SILT, with some clay		109.07 2.00					
2	End of Test Pit							Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

DATE OF EXCAVATION: February 9, 2010

RECORD OF TEST PIT 107

SHEET 1 OF 1

DATUM: Not Applicable

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		111.09					
	TOPSOIL							
	Grey brown SILTY CLAY with occasional silty sand seams		110.84 0.25					
	Grey brown SANDY SILT, some clay		110.29 0.80					
1								
	Grey brown SILTY CLAY with occasional silty sand seams		109.59 1.50					
2	End of Test Pit		109.09 2.00					Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

TESTPIT_RECORD 10-025 TP LOGS 101-109 FEB 2010.GPJ HCE DATA TEMPLATE.GDT 3/16/10

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

DATE OF EXCAVATION: February 9, 2010

RECORD OF TEST PIT 108

SHEET 1 OF 1

DATUM: Not Applicable

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		110.73					
	TOPSOIL		110.48 0.25					
	Grey brown SILTY CLAY with occasional silty sand seams	▨	109.93 0.80					
1	Grey brown SANDY SILT, some clay	▨	108.73 2.00					
2	End of Test Pit							Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: JC

TESTPIT_RECORD 10-025 TP LOGS 101-109 FEB 2010.GPJ HCE DATA TEMPLATE.GDT 3/16/10

PROJECT: 10-025

LOCATION: See Site Plan, Figure 2

DATE OF EXCAVATION: February 9, 2010

RECORD OF TEST PIT 109

SHEET 1 OF 1

DATUM: Not Applicable

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		110.63					
	TOPSOIL							
	Grey brown SILTY CLAY with occasional silty sand seams		110.38 0.25					
1	Grey brown SANDY SILT, some clay		109.63 1.00					
	Grey brown SILTY CLAY with occasional silty sand seams		108.73 1.90					
2	End of Test Pit		108.63 2.00					Groundwater conditions not observed
3								

DEPTH SCALE

1 to 15

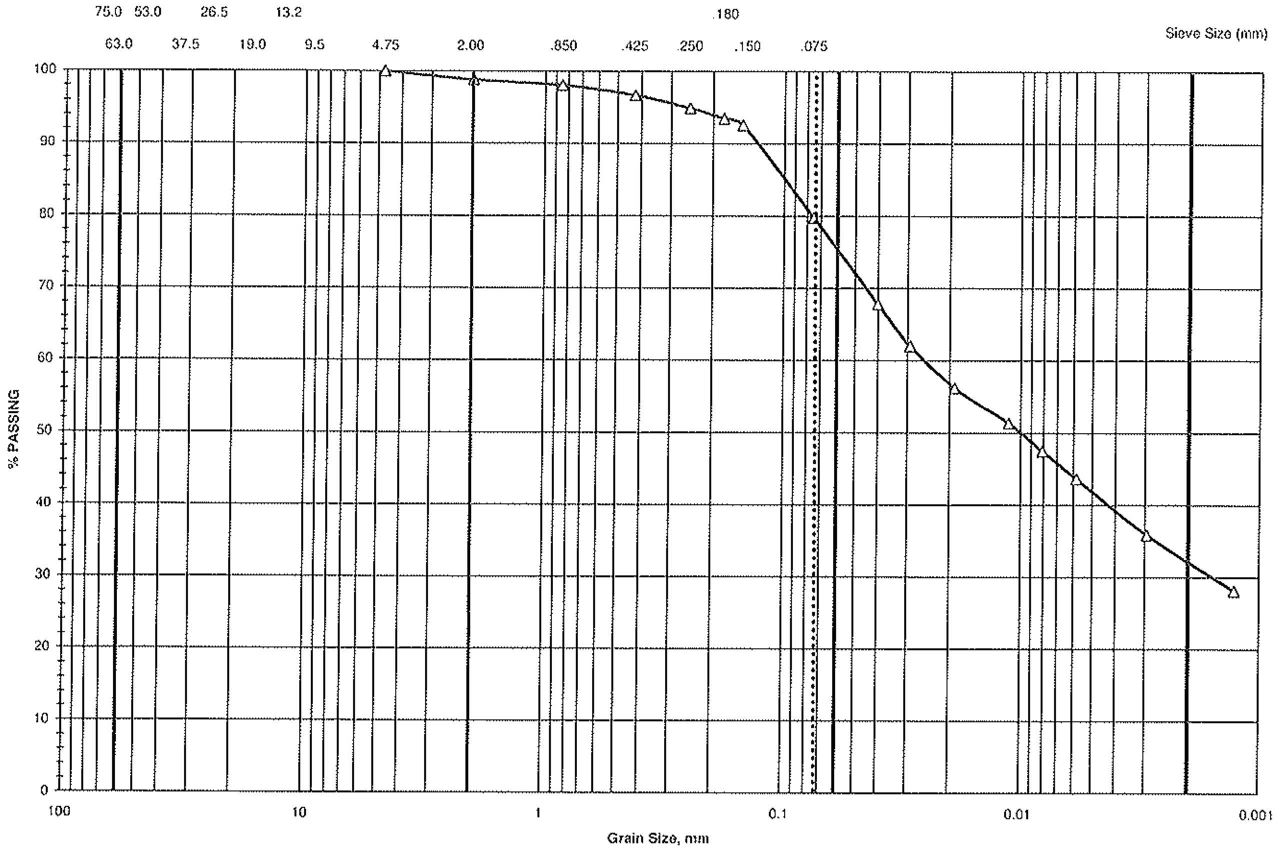
Houle Chevrier Engineering Ltd.

LOGGED: A.N.

CHECKED: AC

GRAIN SIZE ANALYSIS

FIGURE B1



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			
Modified M.I.T. Classification										

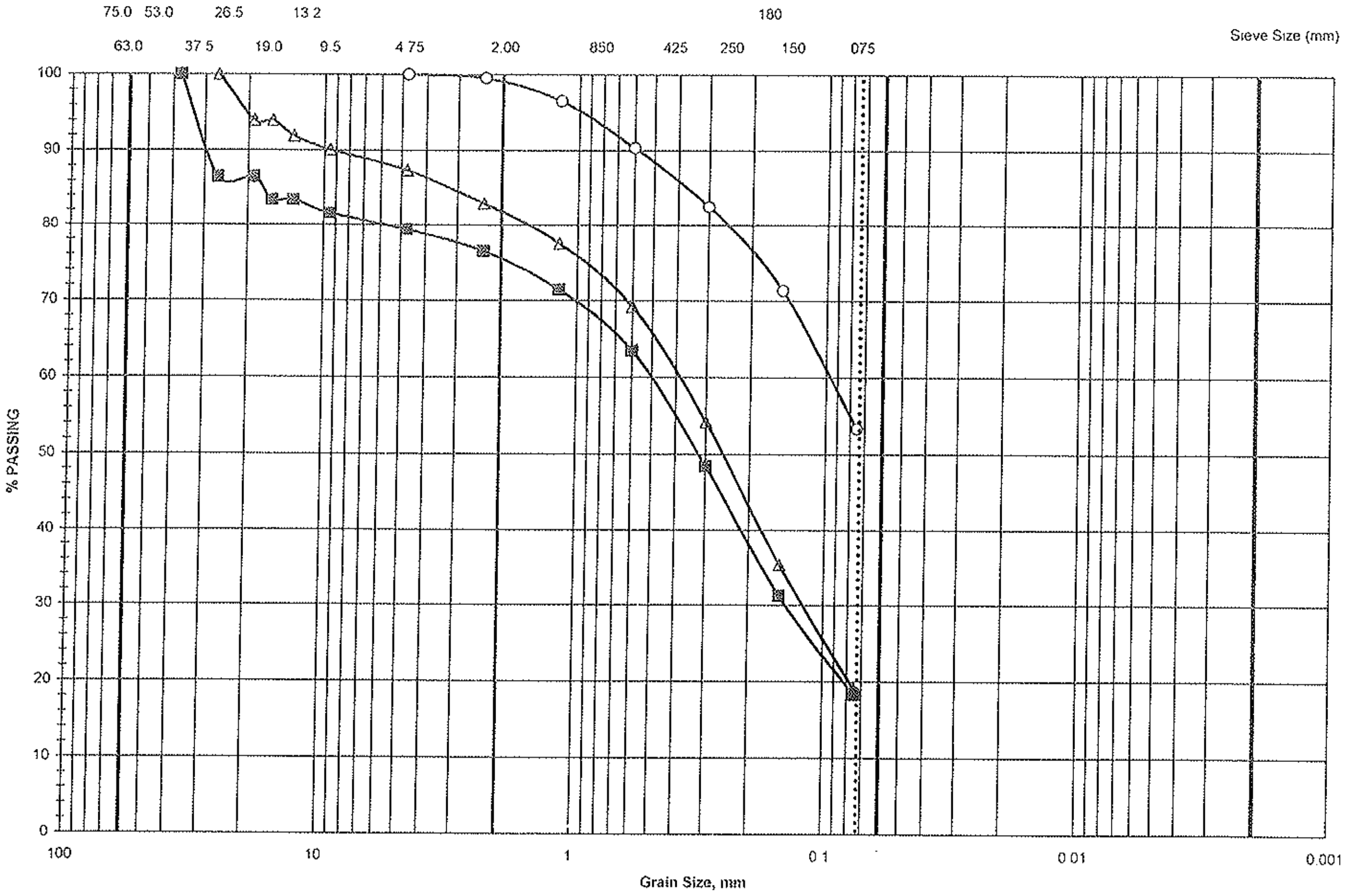
Test Pit	Sample	Depth (m)	Legend
104	1	0.5	△

Houle Chevrier Engineering

Date: March 2010
Project : 10-025

GRAIN SIZE ANALYSIS

FIGURE B2



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			
Modified M.I.T. Classification										

Test Pit	Sample	Depth (m)	Legend
101	1	0.50	△
101	2	1.00	▨
102	2	1.00	○

Houle Chevrier Engineering

Date: March 2010
Project : 10-025

APPENDIX C

CHEMICAL TEST RESULTS ON GROUNDWATER SAMPLE RELATING TO CORROSION

EXOVA ACCUTEST

REPORT OF ANALYSIS

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. Mike Grinnell

Report Number: 1003388
Date: 2010-03-10
Date Submitted: 2010-02-19

Project: 10-025

P.O. Number:
Matrix: Water

Chain of Custody Number: 105482

		LAB ID:	777946	777947				GUIDELINE		
		Sample Date:	2010-02-19	2010-02-19						
		Sample ID:	BH102	BH105						
PARAMETER	UNITS	MRL						TYPE	LIMIT	UNITS
Chloride	mg/L	1	170	100						
Conductivity	uS/cm	5	1140	890						
pH			7.62	7.72						
Resistivity	Mohm-cm		0.0009	0.0011						
Sulphate	mg/L	1	61	59						

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor