ADDENDUM NO. 1

August 21, 2018

MAISON DE LA FRANCOPHONIE D'OTTAWA
2720 Richmond Road, Ottawa, Ontario

The following is provided to bidders as additional information and/or clarification and/or in response to questions.

This Addendum forms part of the Contract Documents and amends the original Specifications and Drawings. Ensure that all affected parties are aware of the items noted and include any and all cost impacts in the Tender submission.

GENERAL

A1.1 Tree permit do be added as part of the documents.
Bidders are responsible to maintain the trees as per the City of Ottawa by-laws.

QUESTIONS / ANSWERS

A1.2 **Q:** Please confirm the width & depth dimensions of the elevator shaft. The specifications indicate that the elevator shaft is partially built but doesn't provide inside to inside measurements (width & depth) and neither does the drawings.

A: Refer to drawing S15.

A1.3 **Q:** We also noticed that the overhead (last floor served to underside of hoist beam) appears to be low on the plans, again no dimensions provided. Please provide dimensions.

A: Refer to drawing S15.

A1.4 **Q:** Drawing M-100 is missing/not included. It is noted on the cover page, but not within the combined drawing document (175 pages).

A: Drawings M-100 is missing from the package, please find attached drawing to be added to contract.

A1.5 **Q:** Two drawings are labelled M-201, they are similar, but slightly different. Please confirm if one required a different label, or if one supersede the other.

A: Please remove (2) drawings labelled as M-201 and replace with attached M-201.

A1.6 **Q:** It appears the Geotechnical Report, as noted on page 2 within the Instructions to Bidders, (DST file No. : GS-OT-015122 dated August 2012, 86 pages), by DST is missing. Please provide separately.

A: Please find attached Geotechnical Report by DST (DST file No. : GS-OT-015122 dated August 2012, 86 pages)

A1.7 **Q:** It appears the Designated Substance Report by Golder Associates, as noted on page 2 within the Instructions to Bidders titled "Pre-Demolition Designated Substances Review – Maison de la Francophonie d' Ottawa (Former Grant School), 2720 Richmond Road, Ottawa, Ontario (Project No.: 1791616 dated April 18, 2018 172 pages), is missing. This report is referenced multiple times within Division 2 of the specifications. Please provide a copy.

A: Please find attached Designated Substance Report by Golder Associates "Pre-Demolition Designated Substances Review – Maison de la Francophonie d' Ottawa (Former Grant School), 2720 Richmond Road, Ottawa, Ontario (Project No.: 1791616 dated April 18, 2018 172 pages).

File Number D06-01-18-0023

August 2 2018

Conseil des écoles publiques de l'Est de l'Ontario
2445, boulevard St-Laurent
Ottawa, ON K1G 6C3

Attention: Marc-André Hogue

Dear Mr. Hogue:

Re: Tree Permit for 2720 Richmond Road, Ottawa issued in accordance with Urban Tree Conservation By-law No. 2009-200

This letter confirms the receipt of the Landscape Plan developed by Gino A. Aiello, Landscape Architect and the Current Vegetation Plan developed by McIntosh Perry.

Subject to the following conditions, permission is hereby granted to remove the trees identified for removal in the above mentioned reports.

1. The harm or destruction of Butternut trees on site, or on adjacent sites, will be in accordance with the Endangered Species Act. Habitat requirements for retained Butternut trees must be in accordance with OMNRF guidelines.

2. The following protection measures must be implemented for retained trees, both on site and on adjacent sites as per the TCR and/or the grading plan, landscaping plan and site servicing plan, and prior to any site works or tree removal:

John Smit, BES MCIP RPP
Director, Economic Development & Long Range Planning
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue
City of Ottawa
613.580.2424 ext.13866
John.Smit@Ottawa.ca

John Smit, BES MCIP RPP
Directeur de Développment économique et planification à long terme
Direction général de la planification, de l'infrastructure et du développment économique
110, avenue Laurier Ouest
Ville d' Ottawa
613.580.2424 poste 13866
John.Smit@Ottawa.ca

- Under the guidance of an arborist, erect a fence at the critical root zone (CRZ) of trees where the CRZ is established as being 10 centimetres from the trunk of a tree for every centimetre of trunk diameter at breast height. The CRZ is calculated as DBH X 10 cm.;
- Do not place any material or equipment within the CRZ of the tree;
- Do not attach any signs, notices or posters to any tree;
- Do not raise or lower the existing grade within the CRZ without approval;
- Tunnel or bore when digging within the CRZ of a tree;
- Do not damage the root system, trunk, or branches or any tree;
- Ensure that exhaust fumes from all equipment are not directed towards any tree canopy.

3. Tree protection measures must be maintained for the duration of construction on site.

4. Mark Richardson, Planning Forester with the City of Ottawa's Planning, Infrastructure and Economic Development Department will be notified at least two business days prior to the commencement of tree removal operations. Contact information: mark.richardson@ottawa.ca 613-580-2424, ext. 23839

5. A tree with any part of its trunk/stem that crosses, or is located on, a property line is considered to be co-owned by both property owners. Permission for the removal of co-owned trees must be obtained from the adjoining property owner prior to tree removal.

6. No clearing of vegetation shall occur between April 15 and August 15, unless a qualified biologist has determined that no bird nesting is occurring within 5 days prior to the clearing. A pre-clearing survey for active stick nests and cavity nests shall also be conducted between April 1 and April 15, in order to identify and protect early-nesting owls and raptors.

7. The permit holder will comply with any federal regulations or orders relating to the movement of wood or wood products including ministerial orders issued by the Canadian Food Inspection Agency.

8. Impacts on wildlife will be minimized in accordance to Ottawa's Wildlife Protocol.

Unless otherwise specified, this permit does not authorize the harm or removal of trees located on either City-owned land or adjacent properties. In addition, this permit does not relieve the owner, applicant and/or permit holder from any responsibility to comply with all applicable provincial or federal legislation.

Please note that any personal information required for this permit is collected under the authority of Section 135 of the Municipal Act, 2001, S.O. 2001, c. 25, as amended and will be used for the administration and enforcement of the City's Urban Tree Conservation By-law No. 2009-200, as amended.

If you have any questions regarding this permission, please contact Mark Richardson R.P.F, in the Planning, Infrastructure and Economic Development Department at 613-580-2424, ext. 23839.

In signing this letter, you agree to the following:

(a) to comply with the above noted conditions;
(b) to indemnify and save harmless the City from any claims, demands and causes of action arising out of or incurred by reason of the issuance of permit or the tree removal, and;
(c) that the removal of the above-noted trees in this permit is done at the owner's risk and the City of Ottawa assumes no responsibility for the removal or any residual effects of the removal.

Please return a signed copy of this letter to Mark Richardson, Planning Forester at the following address City Of Ottawa, Planning, Infrastructure and Economic Development Department, 110 Laurier Avenue, Ottawa, ON, K1P 1J1.

Regards,

John Smit, BES MCIP RPP
Director, Economic Development & Long Range Planning
Planning, Infrastructure and Economic Development Department

Attachment 1

Property Address where tree removal will occur: **2720 Richmond Road, Ottawa**

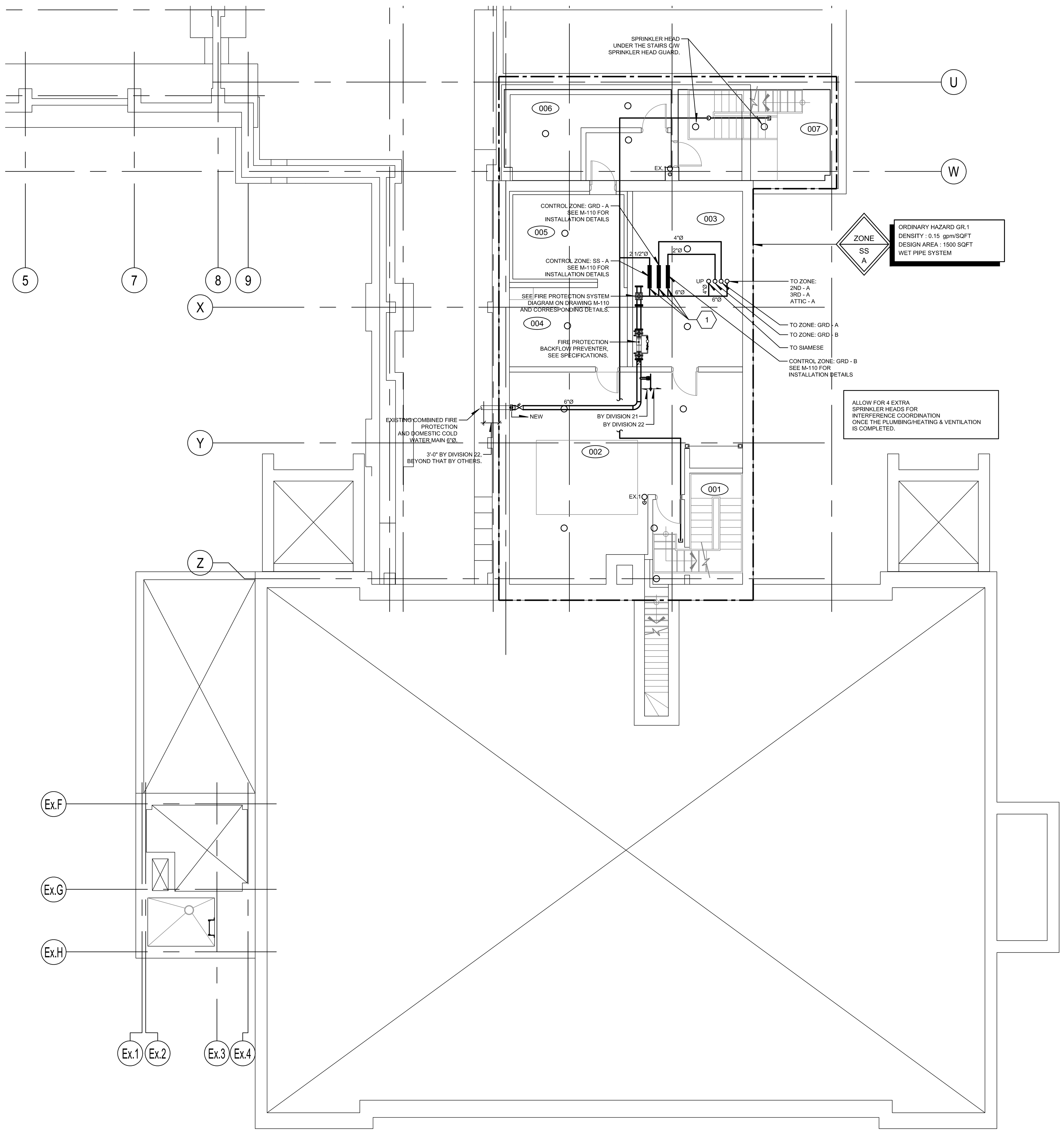
Name of Owner/Property Manager: **Marc-André Hogue**

Date: August 14/2018

Print: MARC-ANDRÉ HOGUE

Signature: [signature] **Witness:** [signature]

NOTE: THIS PERMIT AND THE APPROVED TREE CONSERVATION REPORT AND/OR LANDSCAPE PLAN MUST BE AVAILABLE ON-SITE DURING TREE REMOVAL, GRADING, CONSTRUCTION, AND ANY OTHER SITE ALTERATION ACTIVITIES



GENERAL NOTE(S):

1- PERFOMANCE BASED SPECIFICATIONS.
THIS DRAWING IS PRESENTED AS ADDITIONNAL DESIGN CRITERIA.

2- UNLESS INDICATED OTHERWISE ALL THE SPRINKLERS SHALL BE STANDARD K FACTOR OF 5.6. REFER TO ELECTROMECHANICAL SPECIFICATIONS SECTION 21 10 00 FOR SPRINKLER HEAD REQUIREMENTS.

3- IN AREAS IMMEDIATELY ABOVE EQUIPMENT THAT PRODUCES LARGE AMOUNTS OF HEAT AND HIGH TEMPERATURES, OR WHERE MAXIMUM CEILING TEMPERATURES EXCEED 100°F (38°C), SPRINKLERS WITH TEMPERATURE RATINGS IN ACCORDANCE WITH THE MAXIMUM CEILING TEMPERATURES OF TABLE 6.2.5.1 OF NFPA 13 SHALL BE USED.

4- SPRINKLERS OF INTERMEDIATE - AND HIGH-TEMPERATURE RATINGS SHALL BE INSTALLED IN SPECIFIED LOCATIONS AS REQUIRED BY THE NFPA 13 - 8.3.2. THE TEMPERATURE ZONE SHALL BE DETERMINED ON SITE WHEN THE FINAL LOCATION OF THE UNIT HEATER IS CONFIRMED.

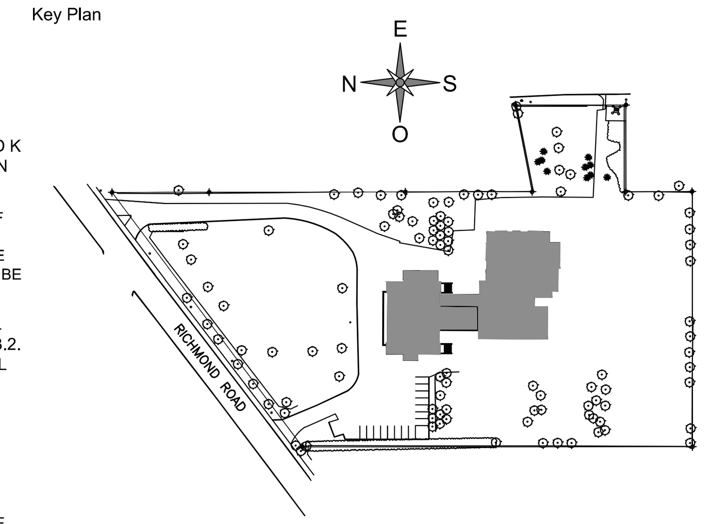
5- THE SPRINKLERS INSTALLED IN HORIZONTAL COMBUSTIBLE CONCEALED SPACES WHERE THE DEPTH OF THE SPACE IS LESS THAN 36 in. (900 mm) FROM DECK TO CEILING, SHALL BE LISTED FOR SUCH USE.

6- DO NOT TAKE SCALE MEASUREMENT ON DRAWINGS. THE CONTRACTOR IS RESPONSIBLE FOR PERFORMING DIMENSIONAL AUDITS APPEARING ON THE DRAWING AND THE SITE CONDITIONS IN ORDER TO VERIFY THEIR ACCURACY.

IDENTIFICATION(S):

1 FLOOR FLOW CONTROL & TEST STATION. SEE DETAIL FOR ACCESSORIES TO BE INSTALLED.

Key Plan



REVIEW

Nº	Date	Description
0	2018-07-25	FOR TENDER

PAGEAU MOREL
www.pageaumorel.com
Gatineau

Architect

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

Structure

Seal

F. DIONNE
PROVINCE OF ONTARIO

2018-07-25

Project

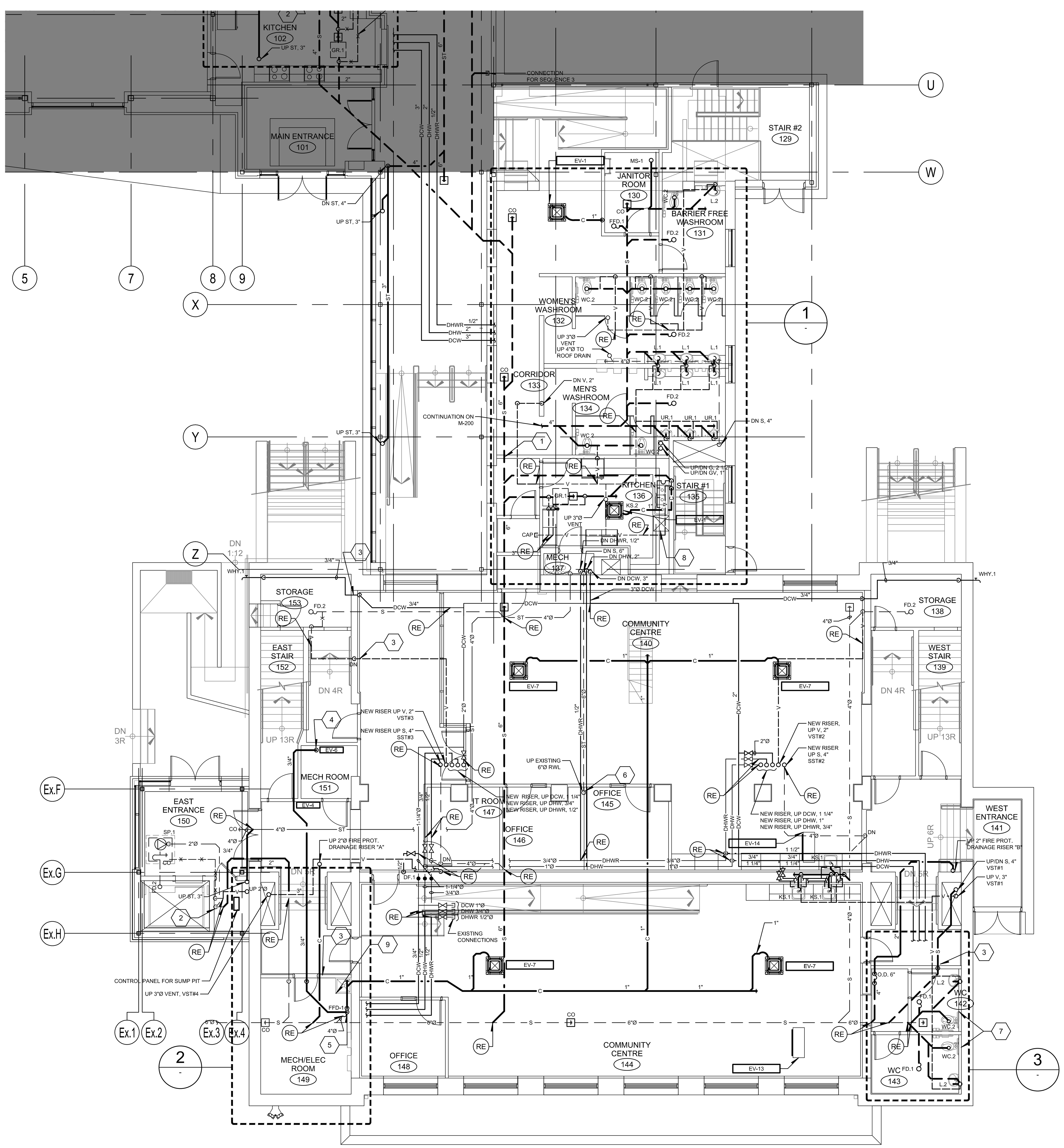
MAISON DE
DE LA FRANCOPHONIE D`OTTAWA
2720 RICHMOND ROAD, OTTAWA

Title

MECHANICAL
FIRE PROTECTION
BASEMENT NEW LAYOUT

Drawn by :	B. TREMBLAY	Project nº:	7342-001-000
Design by :	B. TREMBLAY	Date :	2018-07-06
Verified by :	F. DIONNE	Scale :	1/8" = 1'-0"

Drawing nº: M-100
Revision: 0



GROUND FLOOR - NORTH

GENERAL NOTE(S):

1- ALL EXISTING PIPING, THIS INCLUDES DCW, DHW, VENTS, STORM AND SANITARY DRAINAGE AT CEILING LEVEL TO REMAIN. SOME SECTION WILL REQUIRE SOME REPLACEMENT, SEE NEW LAYOUT.

2- SOME REMOVAL WILL BE REQUIRED AS INDICATED ON DRAWING. SOME SECTIONS OF PIPING ARE DAMAGED OR HAVE BEEN PULLED DOWN. THESE SECTIONS ARE TO BE REMOVED.

3- ALL EXISTING PIPE SUPPORTS WILL HAVE TO BE VERIFIED AND REPLACED IF NECESSARY, SOME MAY HAVE BEEN RIPPED OUT. PROVIDE FOR 20% REPLACEMENT ON PIPING THAT REMAINS. ALL OTHER PIPE SUPPORTS NOT USED OR DAMAGED ARE TO BE REMOVED COMPLETELY.

4- FOR INFORMATION ONLY. PIPING MATERIAL FOR CONDENSATE DRAINAGE SHOWN ON DRAWING IS AS FOLLOWS. MAIN PIPING IS IN XFR PLASTIC PIPING AND SIDE BRANCHES ARE COPPER LINES.

5- FOR INFORMATION ONLY. PIPING MATERIAL FOR STORM AND SANITARY DRAINAGE SHOWN ON DRAWING IS AS FOLLOWS. ALL PIPING IS IN XFR PLASTIC PIPE. THIS INCLUDES SIDE BRANCHES UP TO CONNECTION. NO CONNECTIONS OR FLANGE FOR CONNECTION TO A FIXTURE HAVE BEEN INSTALLED. IF ANY REMOVE AND REPLACE.

6- SEE DETAILS AND DIAGRAMS FOR ALL ACCESSORIES AND VALVES TO BE PROVIDED AND INSTALLED. DRAWINGS M-210 AND ABOVE.

7- NO DOMESTIC WATER LINES, DRAIN LINE OR VENTS ARE TO PASS IN THE OUTSIDE WALL, PIPING TO BE SURFACE MOUNTED. THIS INCLUDES MOST OF THE EXISTING WALLS IN THE EXISTING BUILDING.

8- CORES HAVE ALREADY BEEN MADE IN THE FLOOR AND WALLS FOR PAST FIT-UP, REUSE IF POSSIBLE OTHERWISE TO BE CAPPED OFF BY GENERAL CONTRACTOR AND NEW CORES TO BE MADE TO FIT WITH NEW SETUP.

9- FOR SANITARY PIPING (BRANCHES AND MAIN INCLUDING ALL VENTING) SEE DIAGRAM ON M-210 FOR SIZING.

10- COORDINATE THE LENGTH OF LOW VOLTAGE WIRE BETWEEN CONVERTER AND EQUIPMENT.

IDENTIFICATION(S):

1 SEE MODIFICATIONS TO SANITARY UNDER SLAB ON DRAWING M-200.

2 PRESENTLY VENT, SANITARY OUTLET AND CONDUIT FOR ELEVATOR SUMP PIT FLOATS SYSTEM ARE COMING OUT OF THE SLAB AT THIS LOCATION AND ARE CAPPED AT 3' FROM THE GROUND. SEE CONTINUATION ON NEW LAYOUT.

3 EXISTING CONCRETE WALL. PROVIDE CORING THROUGH WALL FOR PASSAGE OF PIPING.

4 PUMP CONDENSATE FROM WALL MOUNTED A/C UNIT.

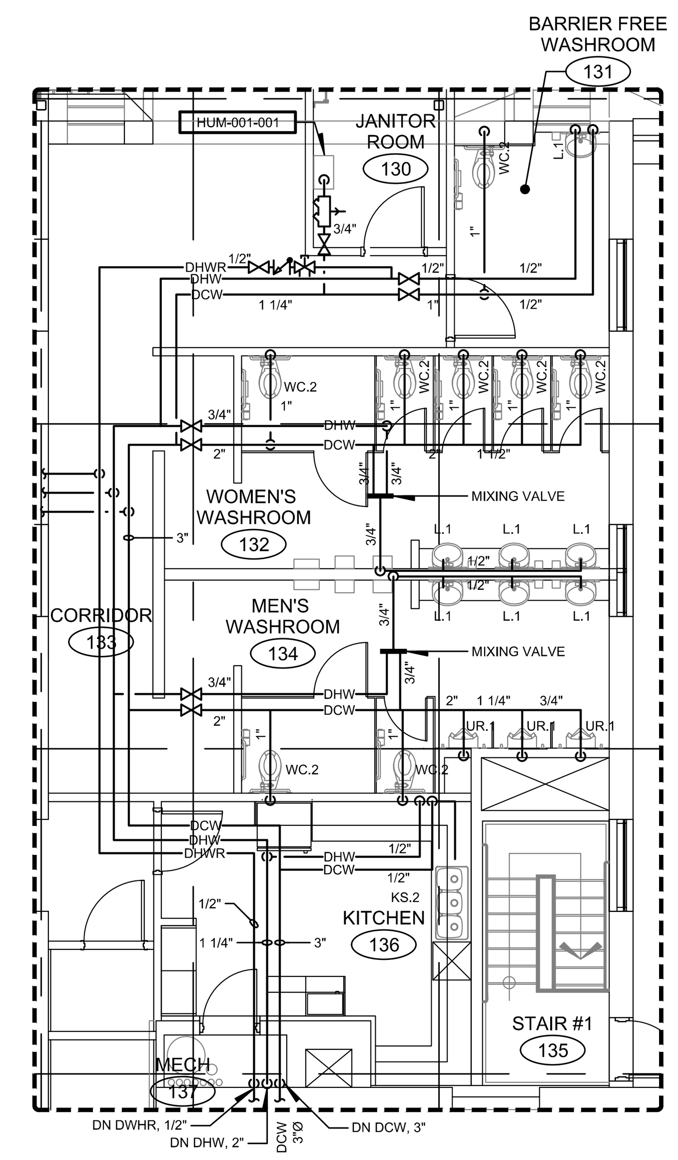
5 DRAIN CONDENSATE VIA OPEN DRAIN.

6 EXISTING STORM RISER IN CAST IRON TO REPLACE WITH THE SAME MATERIAL AS HORIZONTAL SECTION. XFR PLASTIC PIPE FROM THIS LEVEL UP TO ROOF

7 FLOOR SLAB TO BE OPEN (BY GENERAL CONTRACTOR), PREPARE GROUND FOR PLUMBING AND RE-BURY WHEN PLUMBING WORKS ARE COMPLETED. SLAB TO BE RE-DONE AS PER ARCHITECTURAL SPECIFICATIONS.

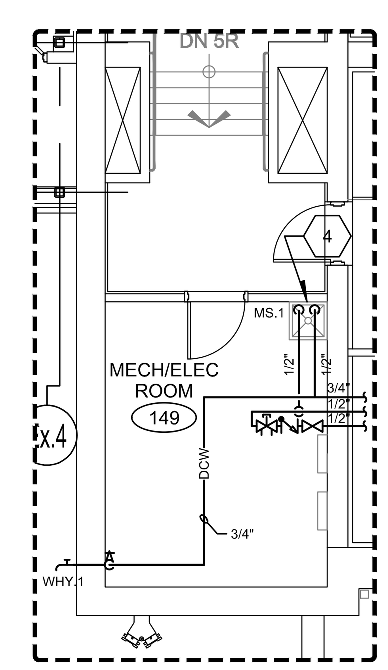
8 SEE DETAILS FOR DRAINAGE OF DISHWASHER. PROVIDE ALL NECESSARY EQUIPMENTS FOR HOT WATER CONNECTION TO DISHWASHER FROM KITCHEN SINK SERVICE, C/W ISOLATION VALVE.

9 MOP SINK FAUCETS AND SERVICES ARE SURFACE MOUNTED, PROVIDE AND INSTALL STEEL BRACKETS.



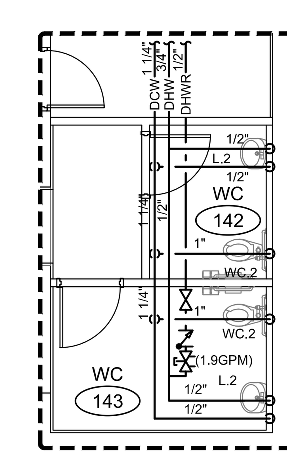
DCW / DHW / DHWR DISTRIBUTION

1 PARTIAL PLAN
SCALE : 1/8"=1'-0"



DCW / DHW / DHWR DISTRIBUTION

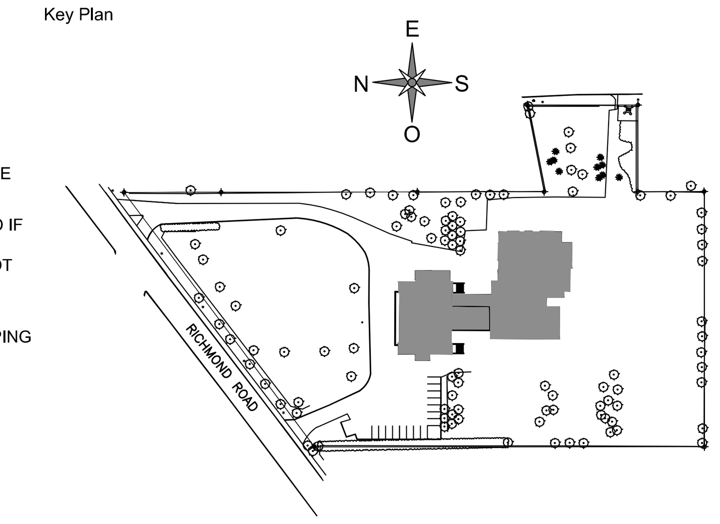
2 PARTIAL PLAN
SCALE : 1/8"=1'-0"



DCW / DHW / DHWR DISTRIBUTION

3 PARTIAL PLAN
SCALE : 1/8"=1'-0"

Key Plan



REVIEW

Nº	Date	Description
0	2018-07-25	FOR TENDER

PAGEAU MOREL
www.pageaumorel.com
Gatineau

Architect

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

Structure

Seal

F. DIONNE
100132015
PROVINCE OF ONTARIO

2018-07-25

Project

MAISON DE
DE LA FRANCOPHONIE D`OTTAWA
2720 RICHMOND ROAD, OTTAWA

Title

MECHANICAL
PLUMBING
GROUND FLOOR NEW LAYOUT

Drawn by :	B. TREMBLAY	Project nº:	7342-001-000
Design by :	B. TREMBLAY	Date :	2018-07-06
Verified by :	F. DIONNE	Scale :	1/8" = 1'-0"

Drawing nº
M-201

Revision
0

FINAL REPORT
GEOTECHNICAL INVESTIGATION REPORT
2720 RICHMOND ROAD
OTTAWA, ONTARIO

Bernard Benoit Project Management Inc

August 2012

DST File No.: GS-OT-015122

2150 Thurston Dr., Suite 203
Ottawa, ON KG 5T9
CANADA www.dstgroup.com

Phone: 613.748.1415
Fax: 613.748.1356

Table of Contents

List of Tables

Appendices

DST REFERENCE NO.: GS-OT-015122

1. INTRODUCTION

1.1 Purpose

DST Consulting Engineers Inc. (DST) has been retained by Bernard Benoit Project Management Inc. to conduct a geotechnical investigation for the proposed building expansion located at 2720 Richmond Road in Ottawa, Ontario.

This report addresses the field investigation undertaken, laboratory test program performed, factual report on subsurface conditions encountered, site classifications and asphalt design recommendations.

Authorization to proceed with this work was received from Mr. Bernard Benoit of Bernard Benoit Project Management Inc., this report is prepared for the sole use of Bernard Benoit Project Management Inc and any use of the report, or any reliance on it by any other party, is the responsibility of such party.

A previous geotechnical investigation and report titled, *Preliminary Geotechnical Investigation, 2720 Richmond Road, Ottawa, Ontario* was completed at this site location by DST in February 2008 under DST File No.: OE-OT-008319 and can be found in Appendix F.

1.2 Scope of Services

The scope of work for the investigation is as follows

- One (1) borehole will be advanced up to auger refusal. Bedrock will be confirmed through coring up to 3 m into the bedrock.
- One (1) borehole will be advanced up to auger refusal,
- Advance three (3) geotechnical boreholes along the proposed fire route and parking lot up to a depth of 3 meter below existing grade to evaluate subsurface conditions and groundwater
- SPT sampling and in situ vane testing for cohesive soil;
- Collect undisturbed samples where cohesive soils are encountered.
- Installation of one groundwater standpipes to evaluate the static groundwater levels;
- Perform necessary laboratory tests for soil classification purposes including moisture content, grain size analysis, and if required hydrometer, and Atterberg limits on selected

samples

- Prepare borehole logs indicating the types and location of existing soils

Based on the soil and groundwater data obtained from this investigation and previous preliminary geotechnical soil investigation completed by DST Consulting Engineers, DST will provide a site classification and a geotechnical recommendation on the existing subsurface condition including footings design recommendations.

2. PROJECT DESCRIPTION

The site for the proposed development is located at 2720 Richmond Road Ottawa, Ontario.

It is understood that the scope of work for the proposed expansion will consist of the following:

- The existing building located on the southeast side of Richmond Road of approximately 702 m^2 will be demolished and replaced with a building of approximately 890 m^2. The proposed building will be extended outside of the existing building foundation.
- A proposed fire route will be constructed with approximately width ranging between 6 and 7 m along the northeast Richmond Road to south east the proposed building. In addition, a proposed parking lot will be added as shown in Appendix C.

Geotechnical information for the National Capital Region is available from the Natural Resources Canada website *http://gdr.ess.nrcan.gc.ca/website/_urbgeo_natcap/surficial_boreholes_e.htm*. This indicates that the local terrain is dominated by alluvial sediments, predominantly sand and silt deposits.

3. FIELD INVESTIGATION PROCEDURES AND LABORATORY TESTING

3.1 Field Investigation

Site work was carried out onsite on the 24th and the 25th of July, 2012. In order to evaluate the subsurface soil conditions, the geotechnical boreholes were located at different parts of the site to provide a representative coverage for the proposed building, the fire route and the parking lot. The geotechnical investigation included the advancement of a total of five (5) boreholes and including the installation of one (1) slotted PVC standpipe for groundwater sampling and static groundwater level measurement. The approximate borehole locations are shown on the Borehole Location Plan (Figure 2) provided in Appendix C.

To advance boreholes a truck mounted CME 75 drill rig equipped for geotechnical drilling and operated by George Downing Estates Drilling Limited was utilized. Boreholes were advanced with 108 mm inside diameter hollow stem augers. Representative soil samples were obtained from the auger flights and from the split spoon sampler used for the standard penetration test (SPT). The SPT involves driving a 51 mm diameter thick-walled sampler into the soil under the energy of a 63.5 kg weight falling through 760 mm. The number of blows required to drive the sampler 305 mm is known as the standard penetration blow count (N) which provides an indication of the condition or consistency of the soil. The standard penetration test was performed at intervals of 0.75 m from below the fill to 6.1 m and at intervals of 1.5 m at depths greater than 6.1 m in all boreholes. Results of the in-situ testing of soils are indicated on the borehole logs provided in Appendix D.

Ground surface elevations for all advanced boreholes locations were surveyed by Annis, O'Sullivan and Vollbekk Ltd. (AOV) and are referred to a geodetic benchmark in the area.

4. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the subsurface conditions for this project are given in the borehole logs and are discussed in detail below. All soil moistures and gradation analyses results are presented on the Borehole Logs and Grain size Analysis in Appendix D.

4.1 Topsoil

Topsoil with variable gradations and organic content was encountered from surface at borehole location BH2 with a thickness of approximately 0.60 m.

4.2 Asphalt

A total of four (4) boreholes were located on paved roadways. As such, a layer of asphaltic concrete was encountered at the surface of these borehole locations. The asphalt thickness encountered was 90, 100, 75 and 50 mm at borehole locations BH1, BH3, BH4 and BH5 respectively.

4.3 Fill

Sand and gravel fill material was encountered directly beneath the asphalt at borehole locations BH1, BH3, BH4 and BH5 with thicknesses of 150, 150, 90 and 150 mm respectively.

Sand fill with varying gradations of silt and gravel was encountered beneath the topsoil and sand and gravel fill at borehole locations BH1, BH2, BH3, BH4 and BH5 with thicknesses of 1.1, 1.1, 1.1, 1.2 and 0.5 m at depths of approximately 0.3 to 1.4 m, 0.6 to 1.7 m, 0.3 to 1.4 m, 0.2 to 1.4 m and 0.2 to 0.7 m respectively. SPT 'N' values obtained within the sand fill range from 4 to 14 blows per 0.3 m penetration indicating very loose to compact condition. Moisture contents of tested samples varied from 4% to 8%. The results of the laboratory tests are summarized in Table 4.1.

Table 4.1 Summary of sand fill grain size analyses

Laboratory Results – Grain Size Analyses	
Gravel %	2 to 7
Sand %	66 to 79
Fines %	14 to 32

Silty clay fill was encountered at borehole location BH1 with a thickness of 0.7 m at a depth of approximately 1.4 to 2.1 m. Silty clay fill was also encountered at borehole location BH2 with undetermined thickness below a depth of approximately 1.7 m. The thickness of this stratum is not defined in BH2 as borehole terminus was reached prior to the bottom of the stratum.

In situ vane testing was attempted in BH2 but was not able to be advanced past the split spoon sampling depth due to dense material being encountered. SPT 'N' values obtained within the clay range from 5 to 10 blows per 0.3 m penetration which correlate to an estimated undrained shear strength of between 25 and 100 kPa. The moisture content of the tested samples ranged from 18 to 25%.

4.4 Sand to Silty Sand

Sand to silty sand was encountered borehole location BH4 with a thickness of 10.2 m at depths of approximately 0.8 to 11.0 m and at borehole locations BH1, BH3 and BH5 with undetermined thickness below depths of approximately 2.1 m, 0.8 m, and 0.7 m respectively. The thickness of this stratum is not defined at BH1, BH3 and BH5 as borehole terminus was reached prior to the bottom of the stratum. Within the sand, occasional silt lenses and cobbles were noted during the drilling process.

SPT 'N' values obtained within the sand range from 7 to 66 blows per 0.3 m penetration indicating loose to very dense condition. However, some SPT values may be artificially high due to the presence of cobbles within the stratum. Moisture contents of tested samples varied from 2 to 22%. The results of the laboratory tests are summarized in Table 4.2.

Table 4.2 Summary of sand grain size analyses

Laboratory Results – Grain Size Analyses	
Gravel %	0 to 5
Sand %	67 to 90
Fines %	9 to 31

4.5 Till

Till composed of gravel, sand, silt and clay was encountered at borehole location BH4 with a thickness of 0.7 m at depths of approximately 11.0 to 11.7 m. A full SPT was not completed exclusively within the till material, however, the SPT 'N' values obtained for the sample containing the till was 22 blows per 0.3 m penetration indicating a compact condition. Moisture content of the tested sample was 20%.

4.6 Bedrock

At borehole location BH4, auger refusal was encountered at a depth of 11.7 m. Shale (unweathered) bedrock was confirmed by coring 3.2 m into bedrock up to a depth of 14.9 m, using NQ size rotary drilling equipment. Total core recovery exceeded 98% with Rock Quality Designation (RQD) values of 94 to 98% which corresponds to a rating of excellent.

4.7 Grain Size Analyses

Grain size analyses were performed on selected samples collected at borehole locations as shown in Table 4.3 below.

Table 4.3 Summary of grain size analysis results

Laboratory Results – Grain Size Analyses				
Borehole	Depth of sample (m)	Gravel %	Sand %	Fines %
BH1	2.0	1	81	18
BH2	1.5	2	66	32
BH3	0.8	7	79	14
BH4	1.5	0	90	9
BH4	6.1	2	67	31
BH4	9.1	0	86	14
BH5	0.8	3	70	27
BH5	5.3	5	67	29

4.8 Groundwater

Upon completion of drilling, a piezometer was installed in BH5. The water depth above bedrock was observed to be 9.16 m below surface on July 26th, 2012. This indicates that at the time of investigation the groundwater table was located at an approximate elevation of 74.97 m.

Groundwater levels are shown on the Borehole Logs and may fluctuate seasonally and in response to climatic conditions. Groundwater level measurements are summarized in Table 4.4 below.

Table 4.4 Groundwater measurements

Borehole	July 26th, 2012	
	Depth Measured (m)	Elevation (m)
BH5	9.16	74.97

5. DISCUSSION

DST Consulting Engineers Inc. (DST) has been retained by Bernard Benoit Project Management Inc to conduct a geotechnical investigation for the proposed building expansion subject site located at 2720 Richmond Road in Ottawa, Ontario.

The generalized stratigraphy of the existing site, based on the conditions encountered at borehole locations BH1 through BH5, consists of a variable thickness of fill that overlies sand with varying percentages of silt and gravel. This is underlain by predominantly sand and silt till over bedrock with a RQD rating of excellent.

Unless noted otherwise, foundation design parameters are given for static, vertically and concentrically loaded foundations in compression. Dynamic, lateral, eccentric and uplift design parameters can be provided upon request, if applicable.

All foundation design recommendations presented in this report are based on the assumption that an adequate level of construction monitoring during foundation excavation and installation will be provided. An adequate level of construction monitoring is considered to be: a) for shallow foundations, examination of all excavation surfaces prior to fill placement to ensure the integrity of the subgrade; and b) for earthwork, full-time monitoring and compaction testing.

To accommodate the specified heated building of approximately 890 m^2 (9,580 ft^2) various options of shallow spread footings were considered.

5.1 Shallow Footings

A foundation system utilizing conventional spread footings founded on undisturbed inorganic sand or silty sand is suitable for the anticipated structural loadings. Due to the depth of frost penetration it is suggested that the footings be installed at suitable depth with sufficient soil cover or if less soil cover is provided then the equivalent synthetic insulation should be provide for frost protection where footings are located at the perimeter of the building. To provide geotechnical reactions that meet the maximum Serviceability Limits States (SLS) loading (within maximum settlements of 25 mm) and Ultimate Limit States (ULS) resistances, reactions have been provided in the following tables.

Due to the granular nature of the underlying material beneath the building footprint, most total and differential settlements are expected to occur during construction.

Total settlement is not expected to exceed 25 mm with differential settlement less than 20 mm. In situations where column loads dictate footings wider than those widths provided are required, the geotechnical engineer should be contacted with specific column loads, and options can possibly be developed.

All existing topsoil and/or other deleterious materials (including fill and construction debris) must be removed prior to the start of subgrade preparation. All excavations should be backfilled with approved engineered fill compacted to 100% of the SPMDD.

Bearing areas will require very careful preparation. Following excavation all bearing surfaces should be cleaned of all organic, loose, disturbed, or slough material prior to concreting or placing compacted fill material. Bearing surfaces should be protected at all times from rain, freezing temperatures and the ingress of groundwater before, during and after construction.

The engineered backfill should comprise Granular B Type I fill material meeting Ontario Provincial Standard Specifications SSP110S13. The fill should be placed and compacted in an unfrozen condition and the subgrade should be protected at all times from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to confirm the integrity of the bearing surface.

5.1.1 Square Footings

Square Footing elements for the building should be founded on the native inorganic undisturbed sand and silt soil. Spread footings may be designed using limit state static bearing pressures listed in the Table 5.1. For these bearing pressure to be realized soil covers of 0.5 m, 1.0 m and 1.5 m are required respectively above the footing as described below. Minimum and maximum footing widths of 1.0 m and 2.5 m are recommended respectively. A minimum distance of one footing width is also required between adjacent footings.

Table 5.1 Geotechnical resistances and reactions for square footings on native undisturbed soil

Depth (m)	Width of Footing (B) (m)	Ultimate Bearing Capacity (kPa)	Resistance at ULS (kPa)	Reaction at SLS (kPa)
0.5	1.0	320	160	160
	1.5	340	170	170
	2.0	360	180	180
	2.5	390	195	180
1.0	1.0	590	295	295
	1.5	620	310	290
	2.0	640	320	200
	2.5	660	330	170
1.5	1.0	870	435	430
	1.5	890	445	280
	2.0	910	455	210
	2.5	930	465	160

5.1.2 Strip Footings

Strip footing elements for the building should be founded on the native inorganic undisturbed sand and/or sandy silt soils. Spread footings may be designed using limit state static bearing pressures listed in the Table 5.2. Minimum and maximum footing widths of 0.5 m and 1.5 m are recommended. A minimum distance of one footing width is also required between adjacent footings.

Table 5.2 Geotechnical resistances and reactions for strip footings on native undisturbed soil

Depth (m)	Width of Footing (B) (m)	Ultimate Bearing Capacity (kPa)	Resistance at ULS (kPa)	Reaction at SLS (kPa)
0.5	0.5	210	105	105
	1.0	250	125	125
	1.5	290	145	145
1.0	0.5	380	190	190
	1.0	420	210	200
	1.5	460	230	145
1.5	0.5	550	275	275
	1.0	590	295	190
	1.5	630	315	135

5.2 Floor Slab-On-Grade

Concrete floor slab-on-grade construction is considered feasible provided certain precautions are undertaken. To accommodate the presence of variable fill materials beneath the slab-on-grade flooring, 0.3 m thick Granular B Type I fill compacted to at least 98% of standard proctor maximum dry density (SPMDD) is required. Very coarse material (larger than 25 mm diameter) should be avoided directly beneath the slab-on-grade to limit potential stress concentrations within the slab. To confirm existing fill material suitability, natural water content, SPMDD testing and grain size analysis should be conducted on granular materials used during construction.

The slab should be structurally independent from walls and columns, which are supported by the foundations. This is to reduce any structural distress that may occur as a result of differential soil movement. If it is intended to place any internal non-load bearing partitions directly on the slab-on-grade, such walls should also be structurally independent from other elements of the building founded on the conventional foundation system so that some relative vertical movement of the walls can occur freely.

The subgrade beneath the slab-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of water. This applies during and after the construction period.

Some relative movement between the slab-on-grade floor and adjacent walls or foundations and differential movement within the slab should be anticipated. Generally, if the recommendations outlined in this report are followed, these movements are estimated to be less than 10 mm.

5.3 Lateral Earth Pressure

Structures may be designed to resist lateral earth pressures. When some degree of wall movement is allowed, then the design may be based on passive and active lateral earth pressures. The following expressions may be use in the above noted equations:

$K_0 = 1\text{-Sin } \phi$

$K_a = K_0 / (1+K_0)$

$K_p = 1 / K_a$

Where

ϕ = Angle of internal friction (30 degrees)

K_0 = Co-efficient of earth pressure at rest condition

K_a= Co-efficient of earth pressure at active condition

Kp= Co-efficient of earth pressure at passive condition

5.4 Seismic Site Classification and Liquefaction Potential

The design peak horizontal acceleration was calculated as 0.417 g based on 2005 National Building Code Seismic Hazard Map interpolation and it is shown in Appendix E. Assessment of liquefaction potential for loose granular soil were estimated using N_{60} values interpreted from in situ SPT data applying Seed and Idriss (1971, 1982). The assessment considered Maximum Considered Earthquake (MCE) of magnitude of 7.5. Liquefaction analysis from the standard penetration resistance is evaluated and liquefaction is not imminent at the site. Factor of safety is in excess of 1.25 at foundation levels and below (>1.0 m depth).

Based on the average standard penetration resistance ($15 < N_{60} < 50$) of the overburden thickness of sand and silt (up to 11.70 m in thickness) found in the area of the boreholes and the type of bedrock (shale) with an estimate shear wave velocity of 2000 m/s, the project site is classified as site “Class D”. F_a and F_v corresponding to Site “Class D” should be taken as 1.15 and 1.35 respectively (Table 4.1.8.4 B and C, OBC 2006).

5.5 Frost Protection

Based on the Ministry of Environment published data, which is based on 85% probability, the design freezing index for Ottawa, Ontario has been estimated to be 1,050 degree-days Celsius (1,922 degree-days Fahrenheit). Based on this data, the calculated depth of frost penetration for sand to silty sand for an area which has been assumed to be kept clear of snow cover will be in the order of 1.8 m.

To limit the effects of frost penetration, a minimum depth of soil cover of 1.5 m is required for perimeter footings of heated structures providing the structure is heated to at least 18 degrees Celsius and there is some heat loss through the foundation wall and floor. Isolated footings should have a minimum depth of soil cover of 1.8 m for frost protection. If less soil cover is provided then the equivalent synthetic insulation should be provide for frost protection.

Perimeter footings should be placed below frost depth. If less soil cover is provided then the equivalent synthetic insulation should be provided for frost protection. Insulation with 25 mm of Styrofoam SM insulation or equivalent extending horizontally 1.22 m from the face of the wall footing.

For the unheated isolated foundations the existing soil layer has frost susceptibility at the building location. Frost heave should be expected for these soils, due to soil moisture. To completely prevent frost heave of the underlying soils, the foundation should be placed with 1.8 m of soil cover or if less soil cover is provided foundations may be underlain with Styrofoam Highload insulation or equivalent of sufficient strength. Insulation with 63.5 mm of Styrofoam Highload insulation or equivalent must be placed beneath the footing and extending 2.44 m from the face of the wall footing should be provided.

The Styrofoam should be installed in accordance with the manufacturer's directions. Note that Styrofoam insulation could be significantly degraded by a fuel spill.

An alternate approach for any unheated concrete slab options is to sub-excavate all soil (1.8 m depth) and replace with compacted Granular B Type I fill compacted to 100% of standard proctor maximum dry density. Seasonal frost movements, if uninsulated, are expected to be less than 10 mm.

5.6 Site Grading and Drainage

Final site grading should be provided to direct water to areas remote from the proposed structure. Minimum landscape gradients of 2% are recommended to reduce the risk of runoff ponding in localized areas.

Parking lots or landscaping within a zone of approximately two metres of the exterior perimeter of any structure should be graded to drain away from the structure at a minimum gradient of 3%. Downspouts should be positively directed away from the building to beyond the building backfill.

Subsurface drainage below the floor slab is not required, provided the interior floor elevation is at least 200 mm higher than adjacent exterior grades and exterior surface drainage is maintained. If this is not the case, then subsurface drainage should be provided.

5.7 Backfill Materials

Backfill against foundations should consist of an Ontario Provincial Standard Specifications (OPSS) Granular B Type I fill material. Existing native site soils which comprise of silty sand or clay will not be suitable for use as footing backfill as native soil material does not meet the OPSS requirements for Granular B Type I.

Any soft or weak soils below foundation areas including any fill materials, which may be encountered during construction should be excavated under the direction of the geotechnical engineer to competent material and then backfilled either with OPSS Granular B Type I fill material meeting the requirements for OPSS 1010 as amended by Special Provision SSP110S13, compacted to 100% of standard proctor maximum dry density.

Exterior backfill against foundation walls should be capped with an impervious layer. The fill should be placed and compacted in an unfrozen condition.

5.8 Excavations and Dewatering

Based on the advanced geotechnical boreholes within the proposed subject development, the base of excavations will most likely occur within sand or silty sand deposits. At the time of the field investigation, the groundwater level was at an elevation of 94.97 m, corresponding to 9.16 mbgs. Therefore dewatering may not be required if the proposed footing for the new development is above the existing found water table. Groundwater levels may fluctuate seasonally and in response to climatic conditions.

Excavations deeper than 1.2 m should be braced in accordance with the Occupational Health and Safety Act (and Regulations for Construction Projects). The Occupational Health and Safety Act recognize four (4) broad classifications of soils, which are summarized below.

TYPE 1 SOIL

a) Is hard, very dense, only able to be penetrated with difficulty by a small sharp object;
b) Has a low natural moisture content;
c) Has a high degree of internal strength;
d) Has no signs of water seepage; and
e) Can only be excavated by mechanical equipment;

TYPE 2 SOIL

a) Is very stiff, dense and can be penetrated with moderate difficulty by a very sharp object;
b) Has a low to medium natural moisture content;
c) Has a medium degree of internal strength;
d) Has a damp appearance after being excavated.

TYPE 3 SOIL

a) Is stiff to firm and compact to loose in consistency or is previously excavated soil;
b) exhibits signs of surface cracking;
c) exhibits signs of water seepage;
d) if it is dry, may run easily into a well-defined conical pile; and
e) has a low degree of internal strength.

TYPE 4 SOIL

a) is soft to very soft and very loose in consistency;
b) very sensitive and upon disturbance is significantly reduced in natural strength;
c) run easily or flow, unless it is completely supported before excavation procedure;
d) has almost no internal strength;
e) is wet or muddy; and
f) exerts substantial fluid pressure on its supporting system.

Generally the soils in the area of interest classify as Type 3, for soils that are compact to loose in consistency according to Regulations made under Health and Safety Act for construction projects, Part III-Excavations, Section 226. These should be assessed and confirmed in the field as construction progresses.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to twice the depth of the excavation, unless the excavation support/retaining wall system has been designed to accommodate such surcharge.

Attention should be paid to structures or buried service lines close to the excavation. As a general guideline, if a line projected down at 30 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, underpinning or special shoring techniques may be required to avoid damaging earth movements.

The contractor should have suitable equipment to excavate the soils shown on the borehole logs and to meet the requirements of the project schedule and construction methodology.

It is anticipated that the groundwater table is well below the anticipated invert of the building services and excavated trench wall consists of medium to high permeable soil (sand and silt), therefore groundwater control system will not be required for the trench excavation. However, it should be noted that groundwater levels will fluctuate seasonally and in response to climatic conditions.

Excavation without shoring could be completed provided that the soils are sloped back sufficiently to maintain sidewall stability and protect workers. For excavations above the groundwater table, it is recommended that a side slopes no steeper than 1h to 1v for cohesive soils (e.g., clays) and 2h to 1v for cohesionless soils (e.g., sands) are maintained. Alternately, the excavation can be shored, for example, with sheet piling or a trench box, with the understanding that significant ground movements beyond the excavation are to be expected.

5.9 Pavement Design

It is understood that a proposed fire route and an expansion for the existing parking lot will be taking place within the development subject site at the subject Site will include access roads and parking areas, which will be used by heavy and light vehicles. Table 6.1 and 6.2 below summarizes proposed asphalt designs for the parking lot and fire route respectively.

Table 6.1 Parking lot pavement design recommendation

Material	Structure Layer Minimum Thickness (mm)
Super pave 12.5 Level C Asphalt (PG58-34)	50
OPSS Granular A Base	150
OPSS Granular B (Type I)	300

Table 6.2 Fire route pavement design recommendation

Material	Structure Layer Minimum (mm)
Super pave 12.5 Level C Asphalt (PG58-34)	40
Super pave 19 Level C Asphalt (PG58-34) Binder Course	60
OPSS Granular A Base	150
OPSS Granular B (Type I)	300

Paving is to be completed in accordance with the Ministry of Transportation of Ontario OPSS1151 and 310 and related Special Provisions or applicable City of Ottawa standards.

Design grades should ensure that there are no low points where water can stand within the pavement structure. Grades should be uniform with positive slopes. The integrity of the subgrade and pavement structure layers must be protected and maintained during construction against water, frost and traffic.

Prior to constructing the subbase, the subgrade should be cleaned and free of any topsoil and organic materials, debris and deleterious materials. The subgrade shall be compacted to 95% of SPMDD and sloped for drainage at a minimum of 3%.

Excavation of the existing and reinstatement of the granular base material should be such that the surface of the new pavement matches the elevation of the existing pavement surface, as adjusted during the detailed design. Construction traffic is to be controlled to minimize damage and protect the integrity of the subgrade, base and subbase layers during construction. Butt joints, step joints, and tack coating are recommended to tie the new pavement with the existing pavement. At the transition where the new pavement structure meets the existing pavement structure, the subgrade is to be transitioned at a slope of 3 horizontal to 1 vertical (3H: 1V).

All granular pavement materials should meet Ontario Provincial Standard Specification (OPSS) requirements and should be compacted to at least 98% of SPMDD. In particular it is imperative that the fines content does not exceed the 8% limit specified by OPSS for Granular A and B Type I. Asphaltic concrete should also be produced and placed in accordance with OPSS standards. Compaction efforts must be inspected and approved by a geotechnical engineer or his representative. All methods should be in accordance with applicable OPSS standards.

Asphaltic concrete should also be produced and placed in accordance with OPSS standards.

Compaction efforts must be inspected and approved by a qualified professional. All methods should be in accordance with applicable OPSS standards.

5.10 Monitoring During Construction

All foundation design recommendations presented in this report are based on the assumption that an adequate level of construction monitoring by qualified geotechnical personnel during construction will be provided. An adequate level of construction monitoring is considered to be: a) for deep and shallow foundations: full-time monitoring and design review during construction; and b) for earthworks: full-time quality control and compaction testing.

An important purpose of providing an adequate level of monitoring is to check that recommendations, based on data obtained at discrete borehole locations, are relevant to other areas of the site.

In order to provide an adequate level of construction monitoring, qualified geotechnical personnel should manage and supervise the following tasks during construction:

Shallow Foundations:

- Confirm that materials and methods meet specifications.
- Inspect foundation subgrades.
- Inspect excavation.
- Review shallow foundation installation/testing methods.
- Review compaction testing records.
- Provide review comments, including any discrepancies found with respect to specifications as well as this report, and the need for any modifications to the design or methods.

Earthworks:

- Confirm that materials and methods meet specifications.
- Inspect subgrade prior to fill placement.
- Quality control of fill material.
- Review compaction testing records.

Pavement:

- Confirm that materials and methods meet specifications and mix design.

An adequate level of construction monitoring for granular pavement materials is considered to be inspection of the subgrade and compaction testing. An adequate level of construction monitoring for asphalt paving is considered full-time monitoring and testing of the compaction, asphalt cement content, gradation and Marshall properties of the mix.

6. REFERENCES

Bowles Joseph E., (1988). *Foundation Analysis and Design, Fourth Edition*, McGraw-Hill Book Company.

Wolff, T.F. (1989), *Spreadsheet Applications in Geotechnical Engineering*, PWS Publishing Company, Boston, MA.

Canadian Geotechnical Society (2006). *Canadian Foundation Engineering Manual*.

Special Provisions SSP110S13, Amendment to Ontario Provincial Standard Specification OPSS 1010, April 2004, Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material.

Seed, H.B.& Idriss, I.M. (1971), Simplified Procedure for Evaluating Soil Liquefaction Potential, *Journal of the Soil Mechanics and Foundation Division*, 107(SM9), p. 1249-1274, ASCE.

Seed, H.B. & Idriss, I.M. (1982), *Ground Motions and Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute.

Ontario Building Code (2006), Ontario Regulation 350/06

7. LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix A, and forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Alfred Abboud, EIT.
Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
9 Aug 2012
M. W. BO
100129834
PROVINCE OF ONTARIO

Dr M W Bo, PhD., P. Eng, P.Geo, Int. PE, C.Geol, C. Eng, Eur Geol, Eur Eng.
Senior Principal / Director (GeoServices)

APPENDIX A

LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testhole may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the Client.

APPENDIX B

EXPLANATION OF TERMS USED IN REPORT

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

TEXTURAL CLASSIFICATION OF SOILS

BOULDERS	COBBLES	GRAVEL	SAND	SILT	CLAY
GREATER THAN 200 mm	75 TO 200 mm	4.75 TO 75 mm	0.075 TO 4.75 mm	0.002 TO 0.075 mm	LESS THAN 0.002 mm

COARSE GRAIN SOIL DESCRIPTION (50% GREATER THAN 0.075 mm)

TERMINOLOGY	TRACE OR OCCASIONAL	SOME	ADJECTIVE (e.g. SILTY OR SANDY)	AND (e.g. SAND AND SILT)
	LESS THAN 10%	10 TO 20%	20 TO 35%	35 TO 50%

CONSISTENCY*: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (C_U) AND SPT 'N' VALUES AS FOLLOWS

C_U (kPa)	0 – 12	12 – 25	25 – 50	50 - 100	100 - 200	> 200
N (BLOWS / 0.3 m)	<2	2 - 4	4 - 8	8 - 15	15 - 30	>30
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

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

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

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

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100 mm+ IN LENGTH EXPRESSED AS A PERCENTAGE OF THE LENGTH OF THE CORING RUN.

THE ***ROCK QUALITY DESIGNATION*** *(R.Q.D)* FOR MODIFIED RECOVERY IS:

R.Q.D (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

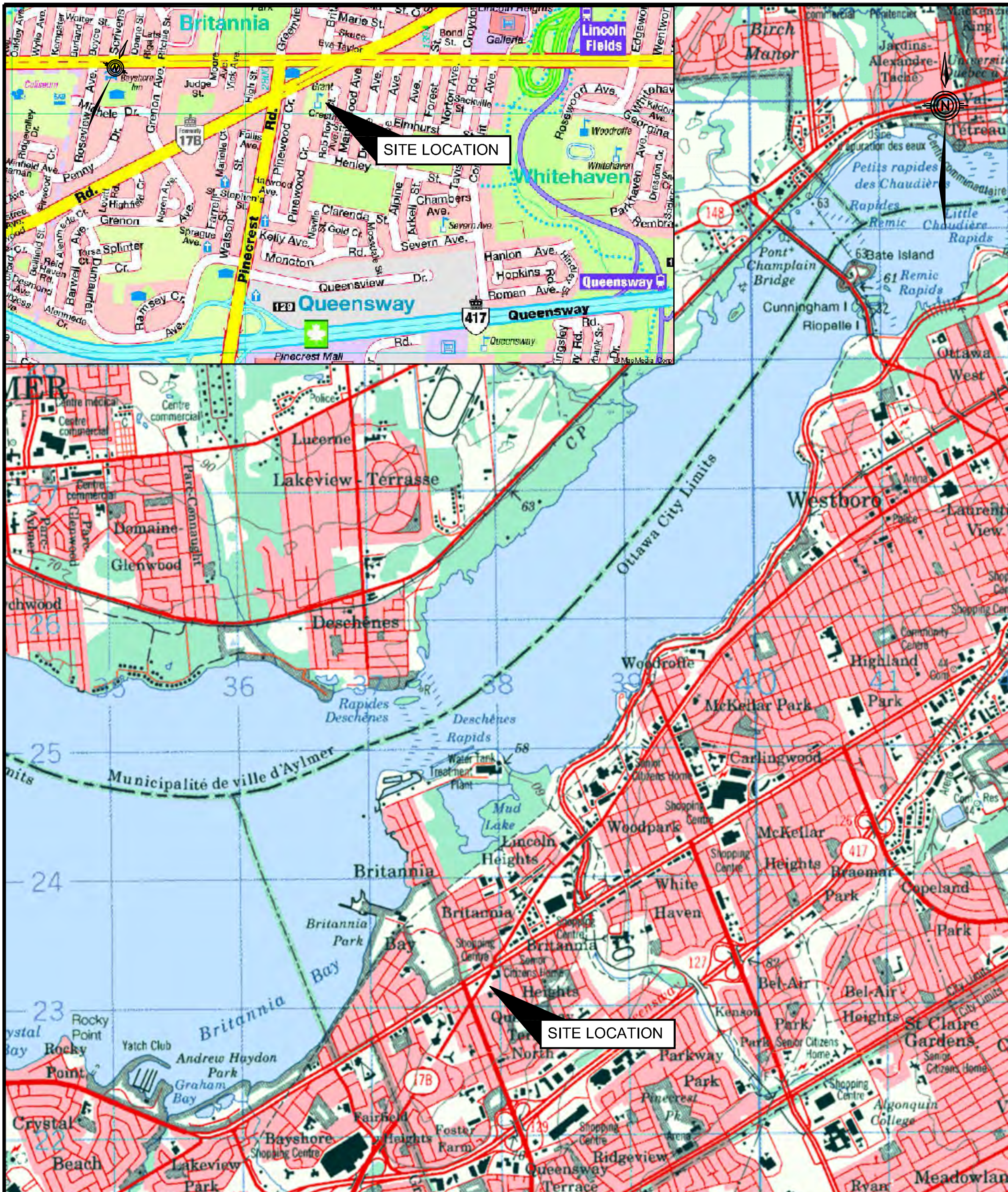
LEGEND OF RECORDS FOR BOREHOLES: SYMBOLS AND ABBREVATIONS FOR SAMPLE TYPE

SS	SPLIT SPOON SAMPLE	WS	WASH SAMPLE
TW	THIN WALL SHELBY TUBE SAMPLE	AS	AUGER (GRAB) SAMPLE
PH	SAMPLER ADVANCED BY HYDRAULIC PRESSURE	TP	THIN WALL PISTON SAMPLE
WH	SAMPLER ADVANCED BY SELF STATIC WEIGHT	PM	SAMPLER ADVANCED BY MANUAL PRESSURE
SC	SOIL CORE	RC	ROCK CORE
▼	WATER LEVEL	$SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLDED\ SHEAR\ STRENGTH}$	

*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.

APPENDIX C

FIGURES



NOTE:
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ASSOCIATED TECHNICAL REPORT.

SCALE 1: 40000

0 500 1000 2000m

REV	DATE	ISSUE	APPROVAL
0	08/08/12	ORIGINAL	G.T.

DRAWN BY H.R.

DATE August 2012

PROJECT MANAGER A.A.

PROJECT NO.: GS-OT-015122

FIGURE No.: FIGURE 1

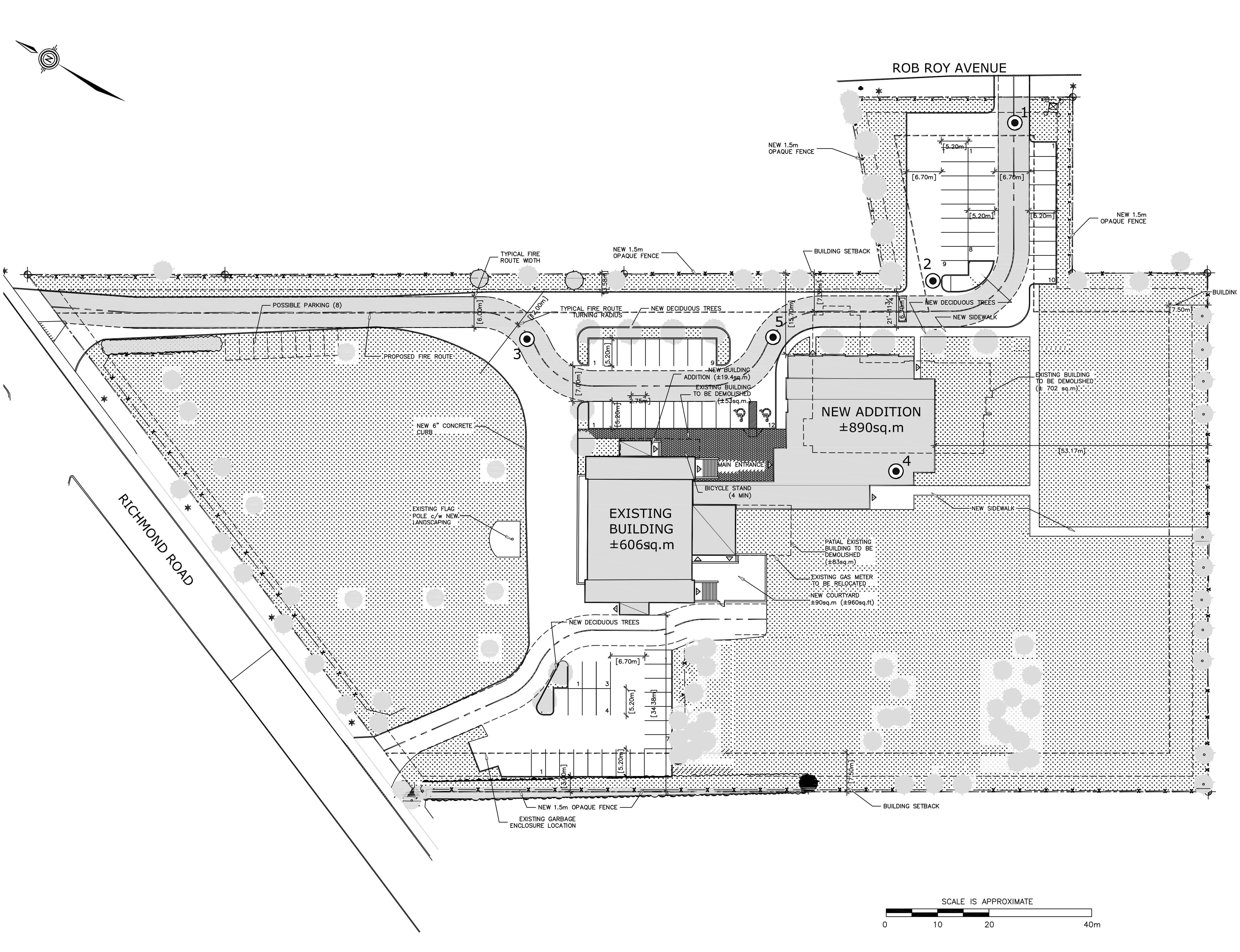
PROJECT TITLE

GEOTECHNICAL INVESTIGATION
2720 RICHMOND ROAD
OTTAWA, ONTARIO

DRAWING TITLE

SITE LOCATION PLAN

DST
consulting engineers
2150 THURSTON DRIVE, SUITE 203
OTTAWA, ONTARIO, K1G 5T9
TEL (613) 748-1415 FAX (613) 748-1356
www.dstgroup.com



DST consulting engineers
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OTTAWA, ONTARIO, K1G 5T9
TEL (613) 748-1415 FAX (613) 748-1356
www.dstgroup.com

LEGEND:

- GEOTECHNICAL BOREHOLE (2012)
- NEW PROPOSED TREE LOCATION
- EXISTING TREE LOCATION
- EXISTING LINE OF TREE LOCATION

NOTE:
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ASSOCIATED TECHNICAL REPORT.

REV	DATE	ISSUE	APPROVAL
0	10/08/12	ORIGINAL	G.T.

PROJECT TITLE

GEOTECHNICAL INVESTIGATION
2720 RICHMOND ROAD
OTTAWA, ONTARIO

DRAWING TITLE

BOREHOLE LOCATION PLAN

DESIGNED BY A.A.	SCALE AS SHOWN
DRAWN BY H.R.	DATE August 2012
PROJECT MANAGER A.A.	PROJECT NO.: GS-OT-015122
FIGURE No.:	FIGURE 2

APPENDIX D

SOILS DATA

LOG OF BOREHOLE BH1

DST REF. No.: **GS-OT-015122**
CLIENT: **Bernard Benoit Project Management Inc**
PROJECT: **Geotechnical Investigation - Proposed Building Expansion**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **83.51 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **108 mm ID**
DATE: **24 July 2012**
COORDINATES: **5024497.8** m N, **360304.1** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l; 20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) × 20 40 60 80 / SPT (N) □ Blows/0.3m DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	83				ASPHALT - 90 mm	AS1				
1.0					FILL - SAND & CRUSHED GRAVEL - trace silt, brown - 150 mm	SS1		4		
	82				FILL - SAND - some silt, trace gravel, brown, loose	SS2		5		
2.0					FILL - CLAY - silty, some sand, brown/grey, firm					1 81 (18)
	81				SAND - some silt, trace gravel, brown/grey, occasional cobbles, compact	SS3		10		
3.0					End of Borehole at 2.6 m					
	80									
4.0										
	79									
5.0										
	78									
6.0										
	77									
7.0										
	76									
8.0										
	75									
9.0										
	74									
10.0										
	73									
11.0										
	72									
12.0										
	71									
13.0										
	70									
14.0										
	69									
15.0										
	68									

BOREHOLE (STANDARD) - OTTAWA GS OT-015122 RICHMOND.GPJ DST_MIN.GDT 9/8/12

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Web: www.dstgroup.com

SAMPLE TYPE LEGEND

Auger Sample; Split Spoon Sample; Bulk Sample; Rock Core; Hiller Peat Sampler; 70mm Thin Wall Tube; Bentonite; Sand

ENCLOSURE 1

LOG OF BOREHOLE BH2

DST REF. No.: **GS-OT-015122**
CLIENT: **Bernard Benoit Project Management Inc**
PROJECT: **Geotechnical Investigation - Proposed Building Expansion**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **83.98 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **108 mm ID**
DATE: **24 July 2012**
COORDINATES: **5024508.7** m N, **360279.3** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l; 20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) × / SPT (N) □ Blows/0.3m / DCPT ◆ (20 40 60 80)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
					TOPSOIL - SAND - some silt, trace organics, brown	AS1	Auger			
1.0	83				FILL - SAND - silty, trace gravel, brown, compact	SS1	Split Spoon	14		2 66 (32)
2.0	82				FILL - CLAY - silty, some sand, brown/red, stiff	SS2	Split Spoon	10		
						SS3	Split Spoon	100+	SPT Result 50 blows / 150 mm	
					End of Borehole at 2.5 m					
3.0	81									
4.0	80									
5.0	79									
6.0	78									
7.0	77									
8.0	76									
9.0	75									
10.0	74									
11.0	73									
12.0	72									
13.0	71									
14.0	70									
15.0	69									

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DST Consulting Engineers Inc.
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Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Bentonite
Split Spoon Sample | Hiller Peat Sampler | Sand
Bulk Sample | 70mm Thin Wall Tube

ENCLOSURE 2

LOG OF BOREHOLE BH3

DST REF. No.: **GS-OT-015122**
CLIENT: **Bernard Benoit Project Management Inc**
PROJECT: **Geotechnical Investigation - Proposed Building Expansion**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.14 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **108 mm ID**
DATE: **24 July 2012**
COORDINATES: **5024572.4** m N, **360238.2** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l; 20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) × 20 40 60 80 / SPT (N) □ Blows/0.3m DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	84				ASPHALT - 100 mm	AS1				
					FILL - SAND & CRUSHED GRAVEL - trace silt, brown - 150 mm					7 79 (14)
1.0	83				FILL - SAND - some silt, trace gravel, brown, very loose	SS1		4		
2.0	82				SAND - trace silt to silty, trace gravel, brown/grey, loose	SS2		7		
						SS3		7		
3.0	81				End of Borehole at 3.0 m					
4.0	80									
5.0	79									
6.0	78									
7.0	77									
8.0	76									
9.0	75									
10.0	74									
11.0	73									
12.0	72									
13.0	71									
14.0	70									
15.0	69									

BOREHOLE (STANDARD) - OTTAWA GS OT-015122 RICHMOND.GPJ DST_MIN.GDT 9/8/12

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Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

Auger Sample	Rock Core	Bentonite
Split Spoon Sample	Hiller Peat Sampler	Sand
Bulk Sample	70mm Thin Wall Tube	

ENCLOSURE 3

LOG OF BOREHOLE BH4

DST REF. No.: **GS-OT-015122**
CLIENT: **Bernard Benoit Project Management Inc**
PROJECT: **Geotechnical Investigation - Proposed Building Expansion**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.25 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **108 mm ID**
DATE: **24 July 2012**
COORDINATES: **5024499.3** m N, **360244.7** m E

DEPTH (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0
ELEV. (m): 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70, 69

Water Data | % MOISTURE: W_p, W, W_l (20, 40, 60, 80) | Symbol | VANE (kPa) × (20, 40, 60, 80) | SPT (N) □ Blows/0.3m, DCPT ◆ (20, 40, 60, 80)

MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
ASPHALT - 75 mm	AS1	Auger Sample		
FILL - SAND & CRUSHED GRAVEL - trace silt, brown - 90 mm				
FILL - SAND - some silt, trace gravel, organics, brown, loose	SS1	Split Spoon Sample	7	0 90 (9)
SAND - trace silt to silty, trace gravel, brown/grey, occasional cobbles and silt lenses, compact to very dense	SS2	Split Spoon Sample	20	
	SS3	Split Spoon Sample	20	
---- - cobbles ----	SS4	Split Spoon Sample	66	
	SS5	Split Spoon Sample	35	
	SS6	Split Spoon Sample	40	
	SS7	Split Spoon Sample	51	2 67 (31)
---- - silt ----	SS8	Split Spoon Sample	36	
	SS9	Split Spoon Sample	40	0 86 (14)
	SS10	Split Spoon Sample	35	
	SS11	Split Spoon Sample	22	
TILL - SAND & SILT - some gravel, clay, grey, compact				
BEDROCK				
RC1 - 1.6 m, RQD - 96%, REC - 100%	RC1	Rock Core		
RC2 - 1.6 m, RQD - 99%, REC - 98%	RC2	Rock Core		
End of Borehole at 14.9 m				

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thin Wall Tube
- Bentonite
- Sand

ENCLOSURE 4

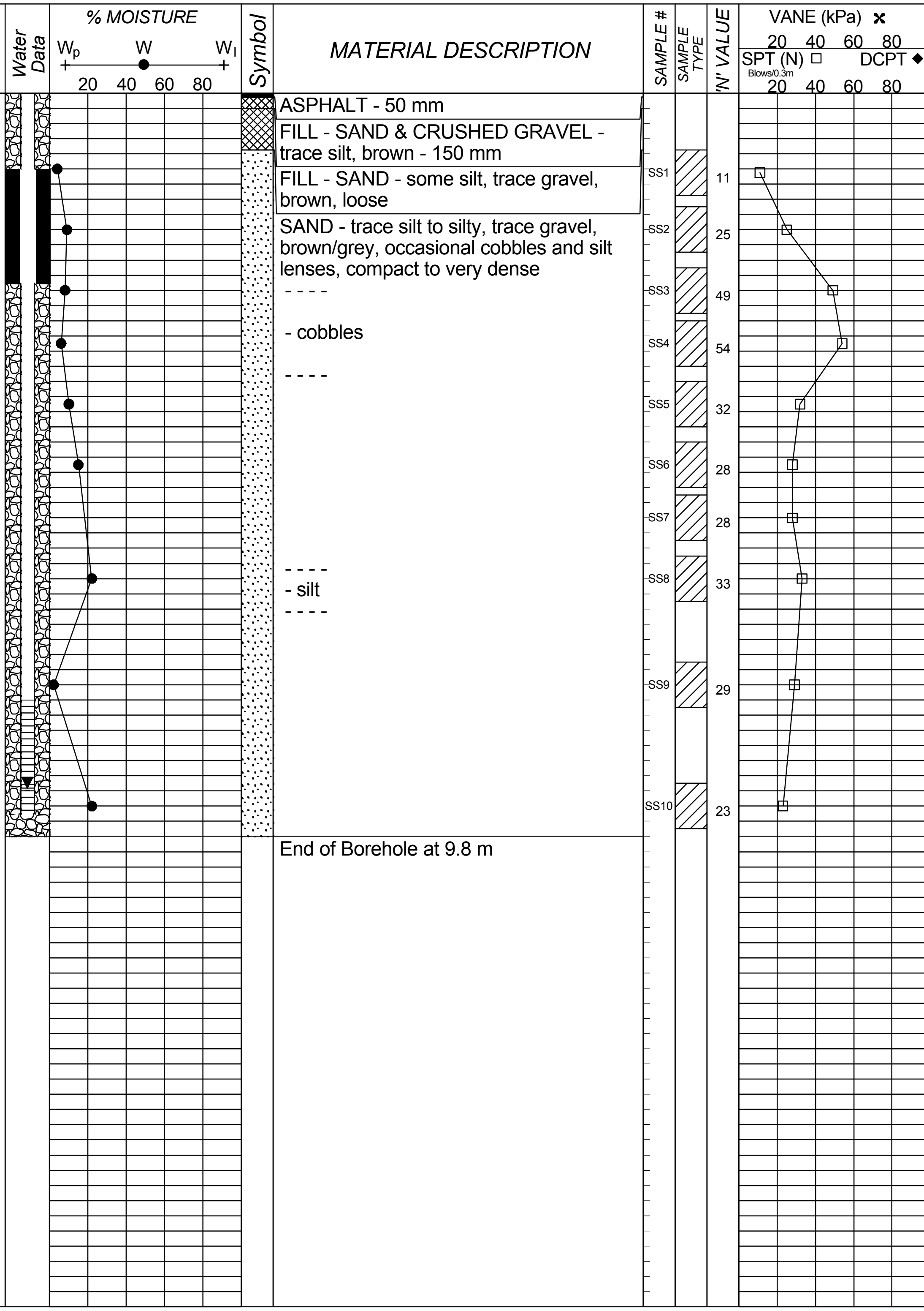
LOG OF BOREHOLE BH5

DST REF. No.: **GS-OT-015122**
CLIENT: **Bernard Benoit Project Management Inc**
PROJECT: **Geotechnical Investigation - Proposed Building Expansion**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.13 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **108 mm ID**
DATE: **25 July 2012**
COORDINATES: **5024527.2** m N, **360265.4** m E

DEPTH (m)	ELEV. (m)	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	84	ASPHALT - 50 mm				Water level at 9.16 mbgs on July 26, 2012
		FILL - SAND & CRUSHED GRAVEL - trace silt, brown - 150 mm				3 70 (27)
1.0	83	FILL - SAND - some silt, trace gravel, brown, loose	SS1	Split Spoon	11	
2.0	82	SAND - trace silt to silty, trace gravel, brown/grey, occasional cobbles and silt lenses, compact to very dense	SS2	Split Spoon	25	
		----	SS3	Split Spoon	49	
3.0	81	- cobbles	SS4	Split Spoon	54	

4.0	80		SS5	Split Spoon	32	
5.0	79		SS6	Split Spoon	28	5 67 (29)
			SS7	Split Spoon	28	
6.0	78	---- - silt ----	SS8	Split Spoon	33	
7.0	77					
8.0	76		SS9	Split Spoon	29	
9.0	75		SS10	Split Spoon	23	
10.0	74	End of Borehole at 9.8 m				
11.0	73					
12.0	72					
13.0	71					
14.0	70					
15.0	69					



BOREHOLE (STANDARD) - OTTAWA GS OT-015122 RICHMOND.GPJ DST_MIN.GDT 9/8/12

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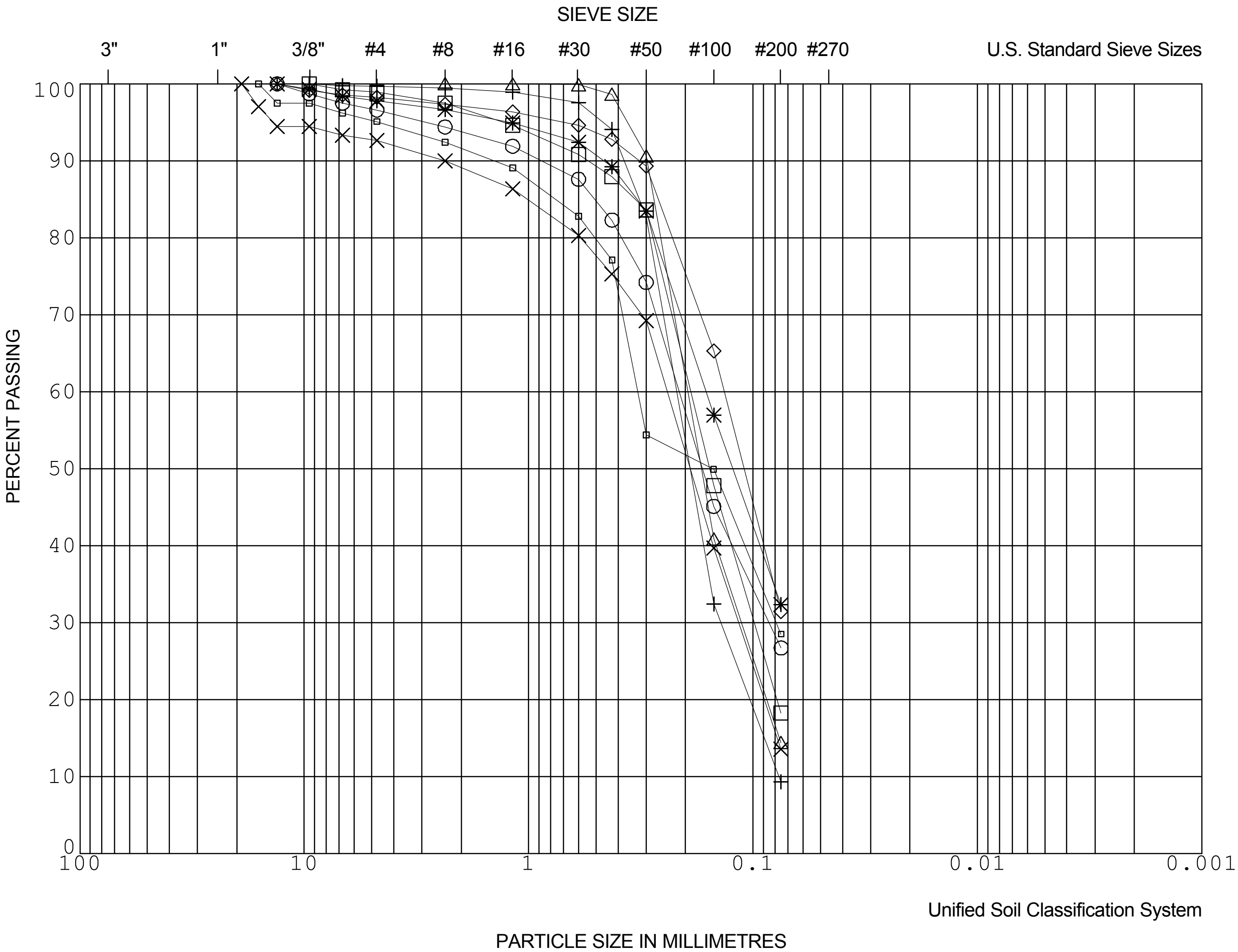
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

Auger Sample, Split Spoon Sample, Bulk Sample, Rock Core, Hiller Peat Sampler, 70mm Thin Wall Tube, Bentonite, Sand

ENCLOSURE 5

GRAINSIZE ANALYSIS



COB'L	GRAVEL		SAND			SILT & CLAY
	Coarse	Fine	Coarse	Medium	Fine	

LEGEND:

- □ BOREHOLE BH1 DEPTH 2.0
- ✳ BOREHOLE BH2 DEPTH 1.5
- × BOREHOLE BH3 DEPTH 0.8
- + BOREHOLE BH4 DEPTH 1.5
- ◇ BOREHOLE BH4 DEPTH 6.0
- △ BOREHOLE BH4 DEPTH 9.1
- ○ BOREHOLE BH5 DEPTH 0.8
- ▫ BOREHOLE BH5 DEPTH 5.3

August 2012

Reference No.: GS-OT-015122

Geotechnical Investigation - Proposed Building Expansion

DST CONSULTING ENGINEERS INC.

ENCLOSURE 6

GS GS OT-015122 RICHMOND.GPJ DST_MIN.GDT 30/7/12

APPENDIX E

SHEAR WAVE VELOCITY ASSESSMENT – SITE CLASSIFICATION

2005 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: , DST Consulting Engineers Inc

July 30, 2012

Site Coordinates: 45.3579 North 75.7929 West

User File Reference: 2720 Richmond Road

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

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.666	**0.322**	**0.133**	**0.044**	**0.417**

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2005 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.104	0.273	0.411
Sa(0.5)	0.043	0.120	0.192
Sa(1.0)	0.016	0.050	0.080
Sa(2.0)	0.005	0.016	0.025
PGA	0.071	0.193	0.278

References

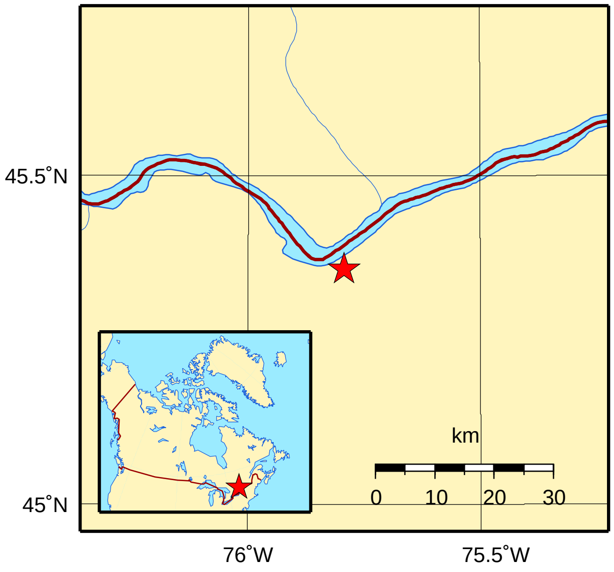
National Building Code of Canada 2005 NRCC no. 47666; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2005, Structural Commentaries NRCC no. 48192F (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2005 National Building Code of Canada (in preparation)

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

Aussi disponible en français



APPENDIX F

2008 GEOTECHNICAL INVESTIGATION REPORT BY DST

PRELIMINARY GEOTECHNICAL INVESTIGATION

2720 Richmond Road
Ottawa, Ontario

Prepared for

City of Ottawa
Corporate Service Department
Real Property Asset Management
110 Laurier Avenue West, 5th Floor
Ottawa, ON K1P 1J1

February 2008

FINAL REPORT

5 Copies – City of Ottawa
1 Copy – DST Consulting Engineers Inc.

DST File No.: OE-OT-008319

DST Consulting Engineers Inc.
2150 Thurston Drive, Suite 203, Ottawa, Ontario, K1G 5T9
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Table of Contents

Appendices

Appendix A	**Limitations of Report**
Appendix B	**Figures**
Appendix C	**Borehole Logs**
Appendix D	**Grain Size Analysis and Slug Test Results**
Appendix E	**Copy of MOE Well Record (to be included in the final report)**

1. Introduction

1.1 General

DST Consulting Engineers Inc. has carried out a preliminary geotechnical investigation at 2720 Richmond Road, in Ottawa, Ontario (the "Site"). The investigation was completed in accordance with the workplan described in the DST proposal dated February 4, 2008.

Authorization to proceed with this work was received from Mr. Greg Montcalm of the City. This report is prepared for the sole use of the City and any use of the report, or any reliance on it by any other party, is the responsibility of such party.

It is understood that the possible future use of the Site is low to medium density (20 to 40 units per hectare or 8 to 16 units per acre) residential land use. The purpose of the preliminary geotechnical investigation was to explore the subsurface conditions as per the Terms of Reference at the southern part of the Site (Ref.: Figure 2 provided in Appendix B showing extent of the Geotechnical Investigation), and provide geotechnical recommendations pertaining to the Site preparation and foundation design for the proposed development. Once the building design details are known for the development, a more thorough geotechnical investigation should be completed based on final building designs.

2. Site Description

The Site is located on the east (south-east) side of Richmond Road between Carling Avenue and Pinecrest Road in Ottawa, Ontario. The Site location is illustrated on Figure 1, Appendix B.

The Site is approximately trapezoidal-shaped, 2.31 ha in area, with a frontage of 125.3 m along Richmond Road and a maximum depth of approximately 203 m along its eastern boundary. Vehicular access to the Site is by a U-shaped asphalt driveway from Richmond Road. Major Site features include a three-storey main building and a one-storey slab-on-grade building (annex building). The immediate areas surrounding the buildings are covered by asphalt pavement followed by green spaces.

The City has indicated that the front yard and the exterior of the three storey building are designated heritage.

A site plan is illustrated as Figure 2, Appendix B.

3. Field Investigation

The number of boreholes/monitoring wells and their general locations were determined in consultation with the City's Project Manager as well as to satisfy the requirements of the proposed workplan. The geotechnical boreholes were located at various parts of the Site to provide a representative coverage of the Site in order to evaluate subsurface soil conditions. The preliminary geotechnical investigation included the advancement of four (4) boreholes equipped with monitoring wells for groundwater sampling and static groundwater level measurement within the Site. The approximate borehole/monitoring well locations are illustrated on the Borehole Location Plan, Figure 2, provided in Appendix B.

The drilling was carried out on February 4 and 5, 2008, under the supervision of a field supervisor from DST. All boreholes were advanced using a CME 75 truck-mounted drill rig equipped with hollow stem augers. Within each Borehole, a standard split spoon sampler was used for soil sampling and performing standard penetration tests (SPT) at regular 0.75 m intervals. The SPT provides indications of relative density of subsurface soil. Boreholes at locations BHMW1, BHMW2 and BHMW4 were advanced to depths of approximately 10 metres below surface grade (mbsg). Augur refusal was not encountered at borehole locations BHMW1, BHMW2 and BHMW4 during this investigation. Borehole location BHMW3 was advanced to a depth of 11.20 mbsg, where it encountered Auger refusal. The soil samples were visually examined for textural classification and identification, and preserved in plastic bags. All soil samples were transported to the DST's laboratory in Ottawa for laboratory testing on selected samples

At borehole location BHMW3, bedrock was confirmed by coring 4 m into the bedrock to a final depth of 15.25 mbsg using rotary core drilling equipped with BX size diamond bit. The cores were visually described, measured and placed in core boxes for further identification and observation by DST's geotechnical engineer.

A monitoring well was installed into each borehole on its completion in accordance with the Ontario Water Resources Act – R.R.O. 1990, Regulation 903, as amended. The monitoring wells were constructed using 50 mm diameter, schedule 40, flush-joint threaded polyvinyl chloride (PVC) screen and solid riser. Details of the installed monitoring wells at each borehole location are provided on the borehole logs in Appendix C. Clean sand (sand pack) was added around annular space of well screen to at least 30 cm above the top of the screen, followed by bentonite seal to approximately 15 cm below the existing ground surface. The tops of the riser pipes were sealed with a j-plug and concealed with a flush-mount casing. A copy of the MOE Well Record is also included in Appendix E.

A slug test was conducted at monitoring well location BHMW3 to determine in-situ hydraulic conductivity of the soil. The test was initiated by causing an instantaneous change in the water level within the monitoring well. The recovery of water level with time was then observed. Following this sudden change, the well's water level returns to static conditions as water moves into it in response to the hydraulic gradient. The Hvorslev method of analysis, which assumes a homogenous, isotropic and infinite medium, was used. The result for the borehole/monitoring well BHMW3 which was tested indicates a hydraulic conductivity of approximately 2.2×10^{-4} cm/sec for the silty sandy layer. Given that the testing was done only at a single location, it is possible that hydraulic conductivities at other borehole locations may be different from that indicated by testing at monitoring well location BHMW3.

The ground surface elevations at each borehole location were provided by City of Ottawa, and are understood to be referenced to geodetic datum. Approximate ground surface elevations are shown on borehole logs presented in Appendix C.

4. Laboratory Testing

The soil samples were visually re-examined in the laboratory by a geotechnical engineer for textural classification. Laboratory tests were carried out on a number of selected soil samples to acquire information with regards to the physical and geotechnical properties of the subsurface soil condition. Soil sampling and classification were completed in accordance with the Canadian Foundation Engineering Manual (CFEM, 2006). Classification and laboratory tests, including grain size analysis and moisture content were performed in the laboratory on selected soil samples to aid in the selection of engineering properties.

4.1 Water Content

Water content testing was carried out for all soil samples. The results of natural water contents are presented on the borehole logs (Appendix C).

4.2 Grain Size Analysis

Sieve size analysis was performed on representative granular soil samples obtained from various depths and borehole locations shown in Table 4.1. A summary of the grain size analyses results are provided in Table 4.1 and grain size analysis graphs included in Appendix D.

Table 4.1: Summary of Grain size distribution of selected soil samples

Borehole No./ Sample ID	**% Content**			**Soil Classification**	**Sample Conforming to OPSS for:**
	Gravel	**Sand**	**Silt & Clay**		
BHMW1/SS5	2	71	27	SAND – silty, trace gravel	N/A
BHMW2/SS4	1	51	48	SAND & SILT– trace gravel	Select Subgrade Material
BHMW3/SS2	10	64	26	SAND – silty, trace gravel	N/A
BHMW4/SS6	2	83	15	SAND – some silt, trace gravel	Select Subgrade Material

N/A: Soil sample does not conform to OPSS requirements for Granular ‘A’ or ‘B’ or SSM

5. Subsurface Conditions

5.1 Surface Conditions

As discussed previously, the ground surface at the Site is mainly covered by asphalt pavement surrounding the buildings, followed by green spaces. The overall Site topography is relatively flat.

5.2 Subsurface Profile

The subsurface conditions encountered in the boreholes are shown on the borehole logs provided in Appendix C. The results of the laboratory moisture content and standard penetration test resistances (N-values) are also shown on the borehole logs. The results of grain size analyses are presented in Appendix D.

The borehole logs indicate the subsurface conditions and water levels at the borehole locations only. Subsurface conditions and water levels at other locations may differ from conditions observed at the boreholes locations. A review of the borehole logs BHMW1 to BHMW4, inclusive, drilled in the paved area indicate that the sub-surface conditions of the Site consist of surficial layer of Asphalt pavement, which was underlain by a variable fill material consisting of sand and gravel or gravelly sand or sand and silt. A layer of clay material, approximately 0.5 m thick, embedded in the fill material was also encountered at borehole location BHMW2. The fill material was underlain by a layer of silty sand/sand with some silt, which extended to end of the boreholes. The soil overburden is underlain by shale bedrock, which was confirmed at borehole location BHMW3 at 11.2 metres below surface grade (mbsg). The following sections present a more detailed overview of the subsurface conditions encountered in the boreholes.

5.2.1 Asphalt Pavement

All four boreholes were drilled in paved area, which encountered an approximately 50 mm thick surficial layer of asphalt pavement.

5.2.2 Fill material

Beneath the asphalt pavement layer, the boreholes encountered fill material varying from sand & gravel to silty sand at borehole locations BHMW1, BHMW3 and BHMW4 to layers of silty gravelly sand (upper layer), silty clay and sand & silt with trace clay and gravel (bottom layer) at borehole location MHMW2. The thickness of silty clay layer is about 0.5 m at borehole location BHMW2. These materials are inferred to be fills. The inferred fills extend to depth about 3.6 m at BHMW1, 3.0 m at BHMW2, 3.8 m at BHMW3 and 2.6 m at BHMW4. Based on drilling and standard penetration test resistances (N-values varied from 7 to 19 blows per 0.3 m), the fill materials have varied relative density of either loose to compact for granular fill and consistency of stiff for silty clay material.

5.2.3 Silty Sand to Silt and Sand

Beneath the fill materials, the boreholes encountered a native deposit varying from silty sand with trace to some gravel at the top to sand with trace to some silt at the bottom. At borehole locations BHMW1 and BHMW4 also encountered alternating layers of sand and silt separating silty sand above and sand with varying amount of silt below. The thickness of the alternating sand and silt layer ranged from 1.5 m at BHMW4 to 3.8 m at BHMW1. At borehole location BHMW2, only sand with trace to some silt was encountered. The silty sand, silt or sand deposits extended over the remainder of the depths penetrated by the Auger (about 9.8 m at BHMW1, 10.5 m at BHMW2, 11.2 m at BHMW3 and 10.4 at MHMW3) below the fill material.

Standard penetration test resistance (N-values) of 11 to in excess of 100 blows per 0.3 m penetration were obtained. The SPT results indicates that this deposit has variable relative density varying from compact to very dense with increasing depth. It should be noted, however, that the N-values would likely have been affected by presence of gravel size and larger particles.

5.2.4 Auger Refusal and Bedrock

Practical refusal to auguring was encountered at borehole locations BHMW3 and BHMW4 at depths ranging from 11.2 and 10.4 mbgs, respectively. Auger refusal may be due to presence of bedrock or cobbles/boulders. In borehole BHMW3, bedrock was confirmed by coring 4.0 m into the bedrock to a final depth of 15.3 mbsg using rotary core drilling equipped with BX size diamond bit. The bedrock comprised of fresh (i.e., unweathered) shale and generally described as greenish black, fine to medium grained, fossiliferous and with very thin horizontal beddings.

Total core recovery exceeded 90% and the Rock Quality Designation (RQD) values of the recovered cores ranged between 76% to 100%, indicating good to excellent quality bedrock.

5.3 Groundwater Conditions

A monitoring well was installed in each borehole to measure groundwater levels, as well as for environmental groundwater sampling purposes (reported separately). Groundwater levels measured on February 15 and 19, 2008 ranged from 7.62 m to 8.61 m below the existing ground surface. It is possible that the groundwater rises during prolonged precipitation events and the spring thaw, and lowers during dry periods. Results of groundwater level measurements are summarized in Table 5.1 and also shown on individual borehole logs provided in Appendix C.

Table 5.1. Static Groundwater Levels measured on February 15 and 19, 2008

Borehole Location	Existing Surface Grade Elevation (m Geodetic)	Static Groundwater Elevation (m Geodetic)	Depth to Groundwater Table Below existing Surface Grade (m)	Corresponding Subsurface Layer
BHMW1	84.37	75.97	8.40	Sand
BHMW2	83.95	76.33	7.62	Sand
BHMW3	84.0	76.31	7.69	Sand
BHMW4	84.60	76.0	8.61	Sand

6. Discussions and Recommendations

6.1 General

This report present the results of a preliminary geotechnical assessment carried out for the proposed development at the subject Site. The purpose of the preliminary geotechnical investigation was to evaluate the general soil and groundwater conditions at the site and to provide guidelines on the geotechnical design aspects of the project. Further geotechnical assessment and design will be required once a development plan is finalized.

Note that the discussions presented herein are intended for the sole use of the designers of the project in terms of preparation of feasibility assessment (not intended for construction) and are subject to the statement of limitations provided in Appendix A.

6.2 Conceptual Project Details

The purpose of the proposed work is to provide preliminary geotechnical engineering services adequate for evaluating geotechnical characteristics, strength and design parameters for constructing low to medium density residential units (20 to 40 units per hectare or 8 to 16 units per acre) at a conceptual level. The actual scope of future development is not known at this time. However, the conceptual building concept may consist of a one to two-storey residential building with possible basement.

Final Site grades have not been established, although for the purposes of this report, a grade raise not exceeding 0.5 m has been assumed. Exterior pavement areas will likely include vehicle parking and access routes. Unless noted otherwise, preliminary foundation design parameters are given for static, vertically and concentrically loaded foundations in compression. Once the building design details are known for the development, a more thorough geotechnical investigation should be completed at that time. Dynamic, lateral, eccentric and uplift design parameters can be evaluated during the final design, if applicable.

All foundation design recommendations presented in this report are preliminary, to be confirmed by subsequent detailed geotechnical investigations, and based on the assumption that an adequate level of construction monitoring during foundation excavation and installation will be provided by the geotechnical engineer. An adequate level of construction monitoring is considered to be: a) for shallow foundations, examination of all excavation surfaces prior to fill placement to ensure the integrity of the subgrade and that all fill and/or organic material has been removed; (b) full time monitoring of deep foundation installations, and c) for earthwork, full-time monitoring, with a material and compaction testing frequency suitable for the conditions. All such monitoring should be carried out by DST to confirm that recommendations based on data at discrete borehole locations are relevant to other areas of the Site and, where applicable, to meet code and regulation requirements.

6.3 Site Preparation and Grading

All surficial and buried vegetation, root-mat, organic layers, topsoil, fill material and any other deleterious materials from within the influence zone of planned structures (footings, floor slabs, parking lot, and roadway) down to the competent sand layer should be removed. The influence zone is defined by a line drawn at 1 horizontal to 1 vertical (1 H: 1 V) outward and downward from the edge of the planned structures, down to the competent soil.

Exposed subgrade surfaces should be inspected by the geotechnical engineer before construction of the foundations. It is recommended that the founding granular subgrade material should be thoroughly compacted and proof-rolled before placement of any planned structures. Any soft or disturbed areas revealed during subgrade inspections must also be removed and replaced with structural fill described below, as approved by the geotechnical engineer.

Structural fill used for grading beneath the buildings and asphalt concrete paved areas should consist of Ontario Provincial Standard Specifications (OPSS) granular ‘B’, Type II. The fill should be compacted in lifts not thicker than 300 mm to 98% of standard Proctor maximum dry density (SPMDD).

The site-excavated soil should not be used as backfill against foundation walls due to its frost susceptible potential. The site-excavated granular soils can be used for raising the grade beneath the parking areas and access roads provided they are tested in laboratory for meeting the OPSS select subgrade material specifications. The sub-excavated silty clay materials may be used as a general landscaping fill only.

6.4 Foundation

6.4.1 Spread Footings

Based on the subsurface conditions encountered at the four (4) boreholes, the foundation for the proposed structures may be supported on spread footings provided the foundation preparation work described in Section 6.3 is carried out prior to footings placement. A maximum net allowable bearing pressure of 150 kPa should be used for the design of building foundations, subject to the following recommendations:

Spread footings must be placed on compacted native granular soil (silty sand or sand), or on structural fill placed on native soils. A minimum depth of soil cover of 1.5 m over all footing elements is required for the above noted allowable bearing pressure to be realized.

The recommended sizes for the spread footings are as follow:

- Strip footing from minimum 0.6 m to maximum 1.0 m wide; and
- Square footing from minimum 0.6 m x 0.6 m to maximum 1.5 m x 1.5 m.

Dimensions of any spread/strip footing other than those recommended above shall be reviewed by the geotechnical engineer. A minimum distance of one footing width is also required between adjacent footings.

Total settlement is not expected to exceed 25 mm, with differential settlement less than 20 mm for the recommended footing sizes.

Bearing surfaces should be protected at all times from rain, freezing temperatures and the ingress of groundwater before, during and after construction. All footings should be placed on unfrozen soils, which should be at all times protected from frost penetration (Ref.: section 6.7 for frost depth)

Backfill against foundation walls should consist of a Granular ‘B’, Type II fill material capped with an impervious layer.

All bearing surfaces should be cleaned of all loose, disturbed, or slough material prior to concreting. All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to confirm the integrity of the bearing surface.

6.4.2 Pile Foundation

If the recommended allowable bearing capacity is not sufficient to allow for a shallow footing, consideration may be given to supporting the structures on end bearing piles. Based on limited subsurface investigation and bedrock coring at borehole location BHMW3, it is expected that pile refusal may occur at about 11.5 mbgs or greater. However, it should be noted that the depth to refusal (due to presence of bedrock) may vary significantly across the project site. It is recommended that further geotechnical investigation be completed to better define the depth to bedrock or very dense till layer, if this option is selected.

For this site, piles driven to refusal are considered a practical and economical deep foundation option. Piles options such as steel 'H' or concrete filled steel pipe should be considered at this preliminary stage. Driven piles can easily deal with variable conditions and can be tested using dynamic methods to optimize driving requirements.

Piles driven to refusal in bedrock are suitable for high capacities; however, unknowns exist at each pile tip including the exact contact area, the rock quality and the depth of penetration into bedrock. Therefore, the capacity of such a pile using theoretical or semi-empirical methods cannot be made with certainty. Consequently, the capacity should be determined based on driving observations and load testing.

Common sizes of steel piles driven to refusal into the bedrock can be designed to their full structural capacity (cross-sectional area of the pile multiplied by the allowable stress of the pile material). For this site, as a preliminary recommendation a maximum allowable bearing capacity of approximately 800 kN is recommended. Higher allowable bearing capacities may be achievable but would require load testing and likely heavier driving criteria.

The driving equipment should have the capacity to develop the design pile capacity, as demonstrated using dynamic monitoring with a pile analyzer during final driving.

Settlement of the above foundation system is expected to be within tolerable limits for the type of structure proposed (maximum settlement of 15 mm and differential settlement of 10 mm).

The preliminary piling design recommendations will have to be finalized by further investigations once the building loading requirements are known.

Because of the possibility of occurring high stresses induced during pile driving in the bedrock, the pile tips should be reinforced to prevent damage. The piles tips may be equipped with a cast driving shoe.

6.5 Floor Slab-On-Grade

Conventional floor slab-on-grade construction is considered feasible providing certain precautions are undertaken. The slab area should be stripped of all existing topsoil, organic soil, fill material as well as the surface loose material, the area inspected by the geotechnical engineer and any unsuitable or otherwise unapproved materials removed. Any soft areas indentified should be sub-excavated and the subgrade be restored to the required base elevation with a suitable granular fill such as Granular “B” or “A” fill material. Once the sub-grade has been properly prepared, engineered fill consisting of at least 200 mm of OPSS Granular A should be placed immediately beneath the floor slab.

For preliminary design, the floor slab may be designed using a soil modulus of subgrade reaction, k, of 10 MPa/m.

The slab should be structurally independent from walls and columns which are supported on foundations in order to reduce any impacts of differential soil movement. Internal non-load bearing partitions on the slab-on-grade should also be structurally independent from building elements founded on the foundations so that relative vertical movement of the walls can occur freely.

A perimeter drainage system will not be required provided that the finished exterior grade is at least 150 mm lower than the finished floor slab. Where there is a basement, perimeter drains should be provided. The grade at the site should be sloped (at least 2%) away from the building to prevent water ponding adjacent to the exterior walls.

The excavated subgrade beneath slab-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of water. This applies during and after the construction period.

6.6 Pavement Structure

It is understood that development at the subject Site will include access roads and parking areas, which will be used by both cars and light vehicles.

Superpave 12.5 Level B for all Surface Course hot mix pavement requirements will be suitable within this project where car only parking areas are planned. If trucks or other heavy vehicles are anticipated, Superpave 12.5 Level C for all Surface Course hot mix pavement requirements and Superpave 19.0 Level C for all Binder Course hot mix pavement requirements will be suitable.

It is recommended that performance grade (PG) 58-34 asphaltic concrete be used for this project.

Paving is to be completed in accordance with the Ministry of Transportation of Ontario OPSS Specifications 1149 and 313 and related Special Provisions or applicable City of Ottawa standards.

Table 6.1: Pavement Structure
(Cars only Parking Areas)

Material	Structure Layer Minimum Thickness (mm)
Superpave 12.5 Level B Asphalt (PG58-34) Surface Course	40
Superpave 19 Level B Asphalt (PG58-34) Binder Course	60
OPSS Granular A Base	150
OPSS Granular B (Type II) Sub Base	300

Table 6.2: Pavement Structure
(Access Roads, Trucks and Other Heavy Vehicles)

Material	Structure Layer Minimum Thickness (mm)
Superpave 12.5 Level C Asphalt (PG58-34) Surface Course	40
Superpave 19 Level C Asphalt (PG58-34) Upper Binder Course	50
Superpave 19 Level C Asphalt (PG58-34) Lower Binder Course	50
OPSS Granular A Base	150
OPSS Granular B (Type II) Sub Base	450

Construction traffic is to be controlled to minimize damage and protect the integrity of the subgrade, base and sub base layers during construction. These designs are based on dry weather construction conditions and should be modified for winter or wet construction conditions.

All granular materials should meet OPSS requirements or the City of Ottawa Standards and should be compacted to at least 98% of Standard Proctor maximum dry density. It is imperative that the fines content does not exceed the 8% limit specified by OPSS for Granular ‘A’ and ‘B’, and modified where required. Asphaltic concrete should also be produced and placed in accordance with applicable OPSS or City of Ottawa standards. Compaction efforts must be inspected and approved by a qualified professional. All methods should be in accordance with applicable OPSS or City of Ottawa standards.

6.7 Frost Depth

Exterior foundations such as pile caps and grade beams in unheated areas should be provided with a minimum of 1.8 m thick soil cover extending laterally at least 1 m from the foundation. For perimeter structures (footings, pile caps etc.), located within heated area, a minimum of 1.5 m thick soil cover should be provided. The soil cover should consist of free-draining, non-frost susceptible granular material (less than 8% passing 0.075 mm particles).

6.8 Excavations

Trench excavations for this project should be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA) of Ontario.

Excavations for fill removal up to 4 m deep are expected to occur above the groundwater table. Based on groundwater levels measured during this investigation, It is anticipated that no dewatering will be required for excavations. However, groundwater condition may change seasonally and rise due to prolonged rain fall and/or spring thaw, and should be confirmed prior to any construction.

The dominant silty sand strata at the Site may be considered to be a Type 2 if located above the water table and Type 3 if located below the water table as per OHSA. The contractor should make their own assessment based on the Site conditions at the time of construction. The excavations should be constructed with temporary side slopes not exceeding one horizontal to one vertical. It should be noted that in saturated soils, side slopes may have to be flattened to prevent excessive sloughing of the trench wall.

Excavated materials are generally considered as unsuitable for use as backfill under or near the building or pavement areas. However, site excavated silty sand material may meet specifications for Select Subgrade Material and thus may be used as general backfill material (e.g. within the service utilities).

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to twice the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

Trenching and pipe installations should be carried out expeditiously. Care should be taken to prevent excessive traffic and disturbance of the subgrade soils during construction. Sufficient equipment should be available for timely installation to minimize construction difficulties. Excavating only short trench sections at one time can minimize such disturbances.

The possibility of bottom heave in the trench exists below the water table. Note that once heaved, a trench base would be considered unsuitable for pipe support and would require sub-excavation and replacement with approved granular fill. The base of the excavation should be closely monitored for vertical movements and disturbance. Backfilling of the trench should proceed as soon as possible after excavation.

Buried services should be protected from frost action and placed below the maximum frost penetration depth of 1.8 m.

Further details such as bedding layer and trench backfill requirements should be finalized during the final design following a more detailed geotechnical investigation.

6.9 Seismic Liquefaction Hazard Assessment

Seismic liquefaction hazard assessment was not part of the scope of work for this preliminary geotechnical investigation. Therefore, this section identifies current code requirements and recommends further testing during final investigation stages.

It is understood that guidelines and seismic parameter given in the 2006 Ontario Building Code (OBC) is to be used for the project designs. The code requires that geotechnical investigation should be carried out to depths of 30 m at a site to assess ground response in event of design earthquake. The potential for subsoil liquefaction must also be assessed by performing liquefaction analyses using appropriate methods.

The site is underlain by water saturated loose to dense silty sand or sand with some to trace materials that have the potential to liquefy when subjected to design earthquake. The design earthquake motions considered in the OBC 2006 are significantly stronger and have a 2 percent probability of exceedance in 50 year. As a first step to determine seismic design parameters of the site (according to OBC 2006) and suitable foundation types for the proposed structure, a liquefaction analysis should be performed to assess whether subsurface soil would liquefy during the design earthquake. It is to be noted that presence of potentially liquefiable soil may results in excessive vertical settlement and hence render shallow foundation not suitable for the project without ground improvement.

As discussed above, the soil at the project site consist of thick deposit of silty sand/sand with some to trace silt and may liquefy under the design earthquake if saturated. Therefore, it is recommended to perform more detailed site investigations and seismic analyses as details of the proposed development become available such as footprint and location of the proposed structure, height of structure (number of stories), column spacing, structural loading requirements, slab-on-grade construction or basement construction etc.The detailed geotechnical investigation should be carried out meeting the requirements of the 2006 Ontario Building Code for seismic analysis and design of foundation.

7. Summary and Conclusions

DST Consulting Engineers Inc. has carried out a preliminary geotechnical investigation at 2720 Richmond Road, in Ottawa, Ontario.

It is understood that the Site may be developed to accommodate low to medium density residential units (20 to 40 units per hectare or 8 to 16 units per acre) at a conceptual level. The purpose of the preliminary geotechnical investigation was to provide adequate geotechnical information to assist in the feasibility level assessment of the proposed development of the subject Site.

The following is a summary of key conclusions and recommendations arising from this investigation:

1. Based on the limited geotechnical information available from four (4) boreholes advanced at the Site, shallow spread footings are feasible for proposed lightly loaded residential structures. However, development plans and building design details are not known at this time. Once the development plans and building design details are known, a detailed geotechnical investigation will be required to assess the specific requirements of a proposed structure. Specific information such as footprint and location of the proposed structure, height of structure (number of stories), column spacing, structural loading requirements, slab-on-grade construction or basement construction, all will be pertinent information that would be useful during the final geotechnical investigation. The detailed geotechnical investigation should focus on the footprint/specific location of any proposed structure.

2. It is likely that shallow foundations will only be practical for the allowable bearing pressure of 150 kPa. Heavily loaded foundations, whether a result of large live loads or wide column spacing, will require end bearing pile foundation. Based on limited subsurface investigation, it is expected that pile refusal will likely occur at 11.3 mbgs or greater However, it should be noted that the depth to refusal (due to presence of bedrock or very dense native soil material) may vary significantly across the project site and may change due to proposed location of the proposed development. It is recommended that further geotechnical investigation be completed to better define the depth to bedrock or very dense subsurface native soil layer, if this option is selected. The preliminary piling design recommendations will have to be finalized by further investigations once the building loading requirements are known. Dynamic pile testing will also be required.

3. Given the observed groundwater levels during this investigation (7.6 m to 8.6 m below existing grade surface), the construction activities for the proposed activities may not require groundwater control and foundation drainage.

4. The site is underlain by water saturated loose to dense silty sand or sand and gravel materials that have the potential to liquefy when subjected to design earthquake. As a first step to determine seismic design parameters of the site (according to OBC 2006) and suitable foundation types for the proposed structure, a detailed geotechnical investigation should be carried out at the site as details of the proposed development become available. The geotechnical investigation should be

carried out meeting the requirements of the 2006 Ontario Building Code for seismic analysis and design of foundation;

5. The Ontario MOE Well Regulation 903 of the Ontario Water Resources Act defines monitoring wells, standpipes, and open piezometers as a special type of well referred to as “Test Hole”. As such, the monitoring wells installed at the subject Site must be decommissioned in accordance with O. Reg. 903. A copy of the MOE Well Record is included in Appendix E.

In summary, the preliminary geotechnical investigation indicated that the subject property is suitable for the proposed development; however, a detailed geotechnical investigation will be required to determine most suitable foundation types and liquefaction potential of subsoil once the development plans and building design details are known.

8. Closure

8.1 General

A description of limitations which are inherent in carrying out geotechnical investigation studies are given in Appendix A, which forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Sajjad Khan, M.Eng.	Shahid Mansur, P. Eng.
Geotechnical Sector Head, Ottawa	Associate, Sr. Geotechnical Engineer

APPENDIX A

Limitations of Report

LIMITATIONS OF REPORT

The conclusions and recommendations presented in this report are based on information determined at the borehole locations. Subsurface conditions between and beyond the boreholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the Site investigation. It is recommended practice that DST Consulting Engineers Inc. be retained during construction to confirm that the subsurface conditions throughout the Site do not deviate materially from those encountered in the boreholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the borehole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analyses are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the Site or the subsurface conditions.

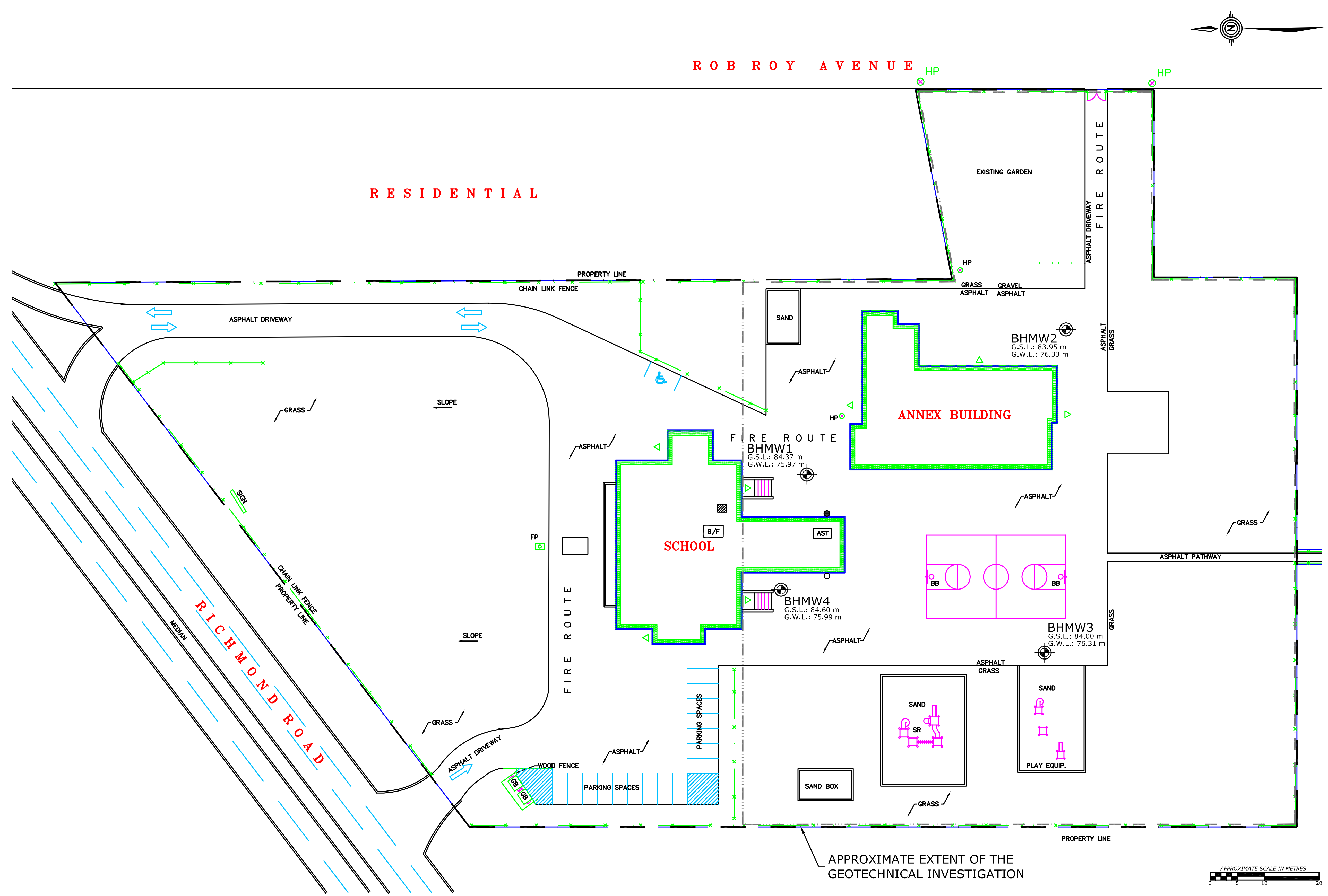
The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

APPENDIX B

FIGURES

Site Location Plan
Borehole Location Plan

DST CONSULTING ENGINEERS 2150 THURSTON DRIVE, SUITE 203 OTTAWA, ONTARIO K1G 5T9 TEL (613) 748-1415 FAX (613) 748-1356	Preliminary Geotechnical Investigation 2720 Richmond Road Ottawa, Ontario	PROJECT NO.: OE-OT-008319	DATE: February 2008
	SITE LOCATION PLAN	FIGURE 1	SCALE: Grid = 1 km



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NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ASSOCIATED TECHNICAL REPORT.
2. BASE DRAWING PROVIDED BY CITY OF OTTAWA.
3. DO NOT SCALE DRAWING.

LEGEND:

BHMW1	APPROXIMATE BOREHOLE/MONITORING WELL LOCATION
	APPROXIMATE EXTENTS OF THE GEOTECHNICAL INVESTIGATION
	APPROXIMATE EXTENTS OF THE GEOTECHNICAL INVESTIGATION
G.S.L.:	GROUND SURFACE ELEVATION (GEODETIC)
G.W.L.:	GROUND WATER ELEVATION (GEODETIC)

REV	DATE	ISSUE	APPROVAL
0	21/02/08	Original	J.M.

PROJECT TITLE

Preliminary Geotechnical Investigation
2720 Richmond Road
Ottawa, Ontario

DRAWING TITLE

BOREHOLE LOCATION PLAN

DESIGNED BY V.A.	SCALE As Shown
DRAWN BY N.N.	DATE February 2008
APPROVED BY J.M.	PROJECT NO.: OE-OT-008319

FIGURE 2

APPENDIX C

Borehole Logs

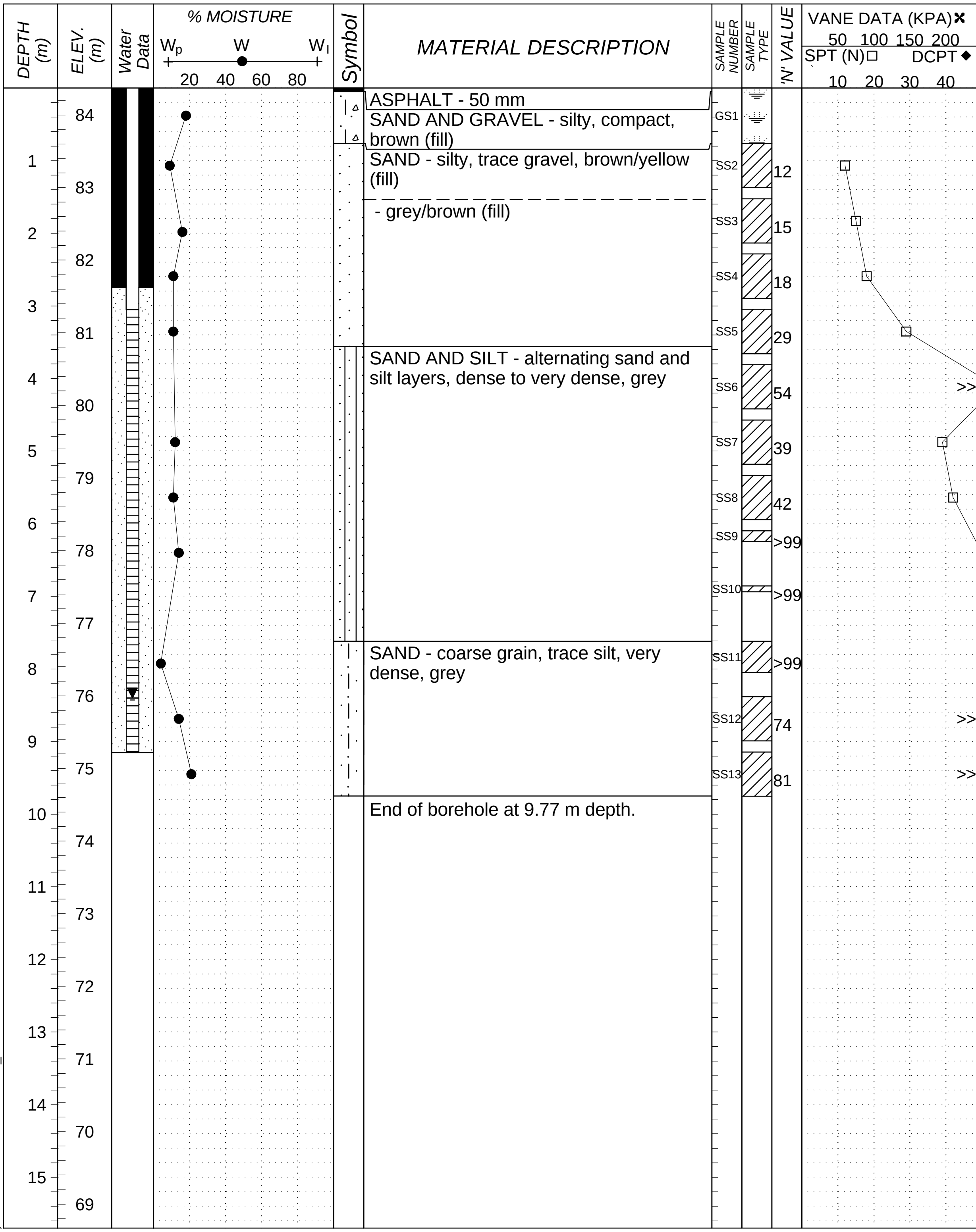
LOG OF BOREHOLE / MONITORING WELL BHMW1

DST REF. No.: **OEOT008319**
CLIENT: **City of Ottawa**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.37 m (geodetic)**

Borehole Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**

DATE: **February 04 2008**

DEPTH (m)	ELEV. (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE	REMARKS
0.00	84.37	ASPHALT - 50 mm			Geodetic elevations provided to DST by the city of Ottawa.
0.05		SAND AND GRAVEL - silty, compact, brown (fill)	GS1		
		SAND - silty, trace gravel, brown/yellow (fill)	SS2	12	
		- grey/brown (fill)	SS3	15	
			SS4	18	Coal noted at the top of SS4 as a result from the auger cave in.
			SS5	29	
		SAND AND SILT - alternating sand and silt layers, dense to very dense, grey	SS6	54	
			SS7	39	
			SS8	42	
			SS9	>99	
			SS10	>99	
		SAND - coarse grain, trace silt, very dense, grey	SS11	>99	
			SS12	74	Groundwater level recorded at 8.40 m below grade on February 15, 2008.
			SS13	81	
9.77		End of borehole at 9.77 m depth.			



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SAMPLE TYPE LEGEND

Auger Sample, Split Spoon Sample, Thin Wall Tube, Rock Core, Side Sampler, Grab Sample, Ponar Sample

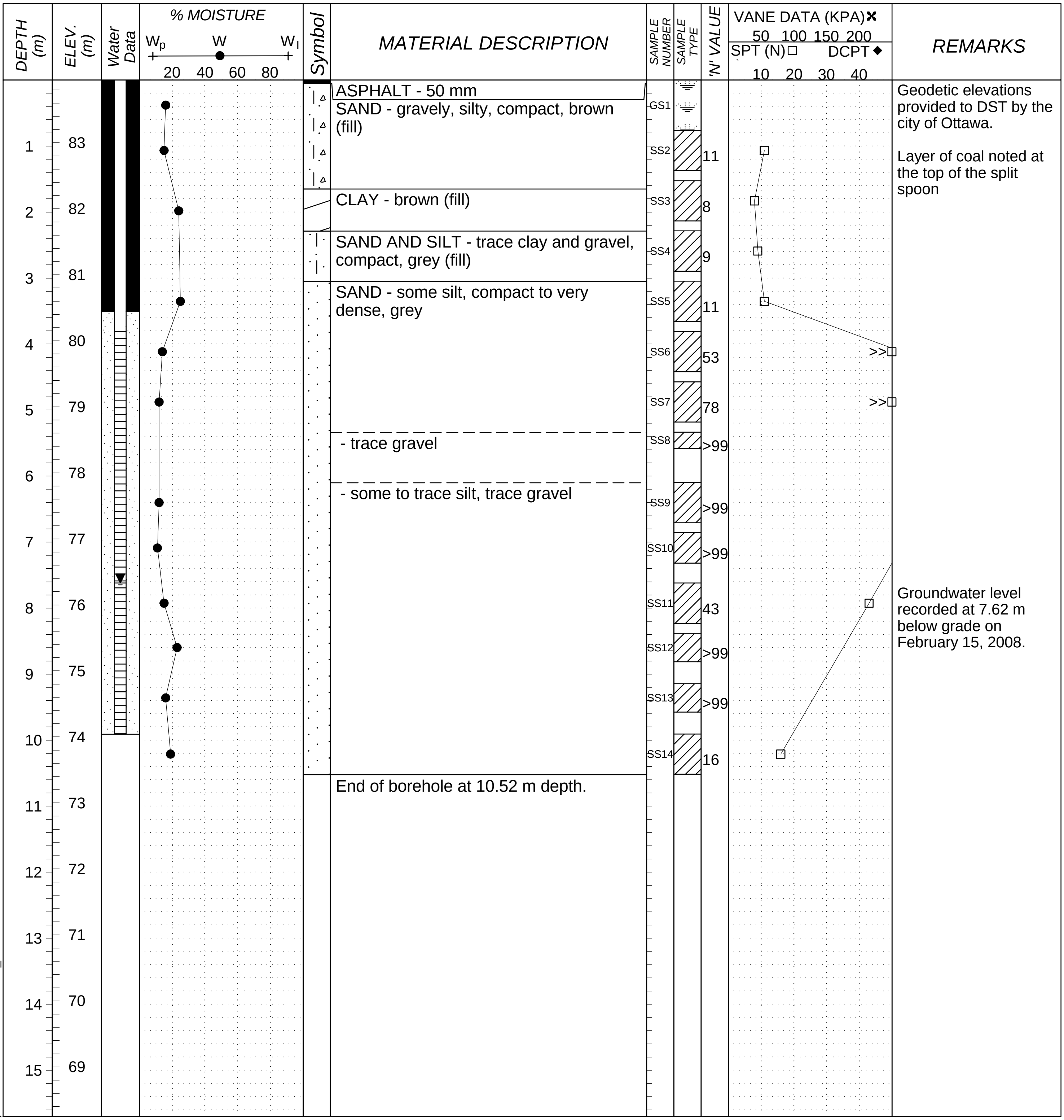
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW2

DST REF. No.: **OEOT008319**
CLIENT: **City of Ottawa**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **83.95 m (geodetic)**

Borehole Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
DATE: **February 04 2008**

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE	REMARKS
0.00–0.05	ASPHALT - 50 mm			Geodetic elevations provided to DST by the city of Ottawa.
0.05–1.65	SAND - gravely, silty, compact, brown (fill)	GS1, SS2	11 (SS2)	Layer of coal noted at the top of the split spoon
1.65–2.30	CLAY - brown (fill)	SS3	8	
2.30–3.05	SAND AND SILT - trace clay and gravel, compact, grey (fill)	SS4	9	
3.05–10.52	SAND - some silt, compact to very dense, grey	SS5, SS6, SS7	11, 53, 78	
	- trace gravel	SS8	>99	
	- some to trace silt, trace gravel	SS9, SS10, SS11, SS12, SS13, SS14	>99, >99, 43, >99, >99, 16	Groundwater level recorded at 7.62 m below grade on February 15, 2008.
10.52	End of borehole at 10.52 m depth.			



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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW3

DST REF. No.: **OEOT008319**
CLIENT: **City of Ottawa**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.00 m (geodetic)**

Borehole Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
DATE: **February 05 2008**

DEPTH (m) | ELEV. (m) | Water Data | % MOISTURE (W_p, W, W_l; 20 40 60 80) | Symbol | MATERIAL DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | 'N' VALUE | VANE DATA (KPA) ✕ 50 100 150 200; SPT (N) □ DCPT ◆ 10 20 30 40 | REMARKS

DEPTH (m)	ELEV. (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE	REMARKS
0	84	ASPHALT - 50 mm			Geodetic elevations provided to DST by the city of Ottawa.
		SAND AND GRAVEL - silty, black to brown (fill)	GS1		
1	83	SAND - silty, trace gravel, compact, light brown (fill)	SS2	16	Possible coal mixed with soil between 0.1 m to 0.8 m.
2	82	- silty, loose, brown/orange (fill)	SS3	7	
		- silty to some silt, light brown (fill)	SS4	16	Coal like material noted at top of the split spoon.
3	81		SS5	19	
4	80	SAND - some silt, compact to very dense, grey	SS6	38	
5	79	- 1 cm silt layer	SS7	26	
6	78	- trace clay in silt layer	SS8	61	
			SS9	96	
7	77	- some to trace silt, grey	SS10	>99	
8	76		SS11	50	Groundwater level recorded at 7.69 m below grade on February 19, 2008.
9	75		SS12	47	
			SS13	41	
10	74		SS14	38	
11	73	SAND AND SILT - clayey, some gravel very dense, (till)	SS15	>99	Bedrock core hole filled with bentonite.
		BEDROCK - shale, green and black			
12	72	Recovery = 92% RQD = 76%	RC1		
13	71	Recovery = 100% RQD = 91%	RC2		
14	70				
15	69	Recovery = 100% RQD = 100%	RC3		
		End of borehole at 15.25 m below grade.			

>> >>

BOREHOLE (STANDARD) GEOTECH - BH.GPJ DST_MIN.GDT 2/29/08

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SAMPLE TYPE LEGEND

Auger Sample — Rock Core — Ponar Sample
Split Spoon Sample — Side Sampler
Thin Wall Tube — Grab Sample

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW4

DST REF. No.: **OEOT008319**
CLIENT: **City of Ottawa**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **2720 Richmond Road, Ottawa, Ontario**
SURFACE ELEV.: **84.60 m (geodetic)**

Borehole Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
DATE: **February 05 2008**

DEPTH (m)	ELEV. (m)	MATERIAL DESCRIPTION	REMARKS
0	84.60	ASPHALT - 50 mm	Geodetic elevations provided to DST by the city of Ottawa.
		SAND AND GRAVEL - silty, grey (fill)	
		SAND - silty, some gravel, compact, brown (fill)	
		- silty, trace gravel, compact to dense, light brown (fill)	
		SAND - some to trace silt, dense, light brown	
		- some silt, trace gravel, very dense	
		- silty, brown	
		SAND AND SILT - alternating layers of sand and silt, trace gravel, very dense, grey	
		SAND - trace silt, very dense, grey/brown	Groundwater level recorded at 8.61 m below grade on February 19, 2008.
		End of borehole at 10.37 m below grade,	

SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE
GS1	Grab Sample	
SS2	Split Spoon Sample	8
SS3	Split Spoon Sample	13
SS4	Split Spoon Sample	36
SS5	Split Spoon Sample	47
SS6	Split Spoon Sample	57
SS7	Split Spoon Sample	53
SS8	Split Spoon Sample	74
SS9	Split Spoon Sample	>99
SS10	Split Spoon Sample	>99
SS11	Split Spoon Sample	>99
SS12	Split Spoon Sample	>99
SS13	Split Spoon Sample	62
SS14	Split Spoon Sample	>99

% MOISTURE: W_p W W_l (20 40 60 80)

VANE DATA (KPA) × (50 100 150 200); SPT (N) □ DCPT ◆ (10 20 30 40)

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2150 Thurston Drive, Suite 203
Ottawa, Ontario, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

Auger Sample · Rock Core · Ponar Sample · Split Spoon Sample · Side Sampler · Thin Wall Tube · Grab Sample

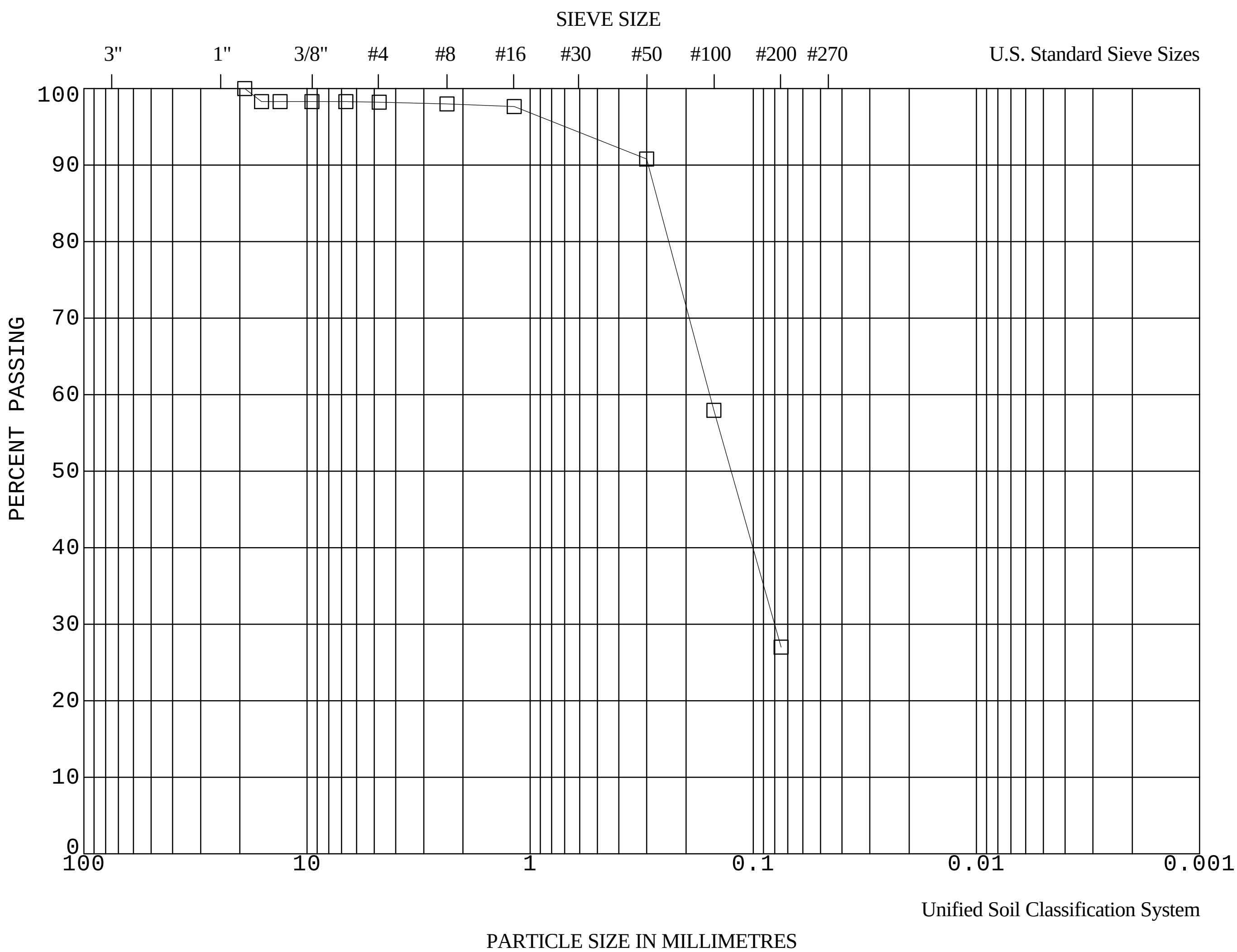
APPENDIX C

APPENDIX D

Laboratory Results:

Grain Size Analysis and Slug Test Results

GRAINSIZE ANALYSIS

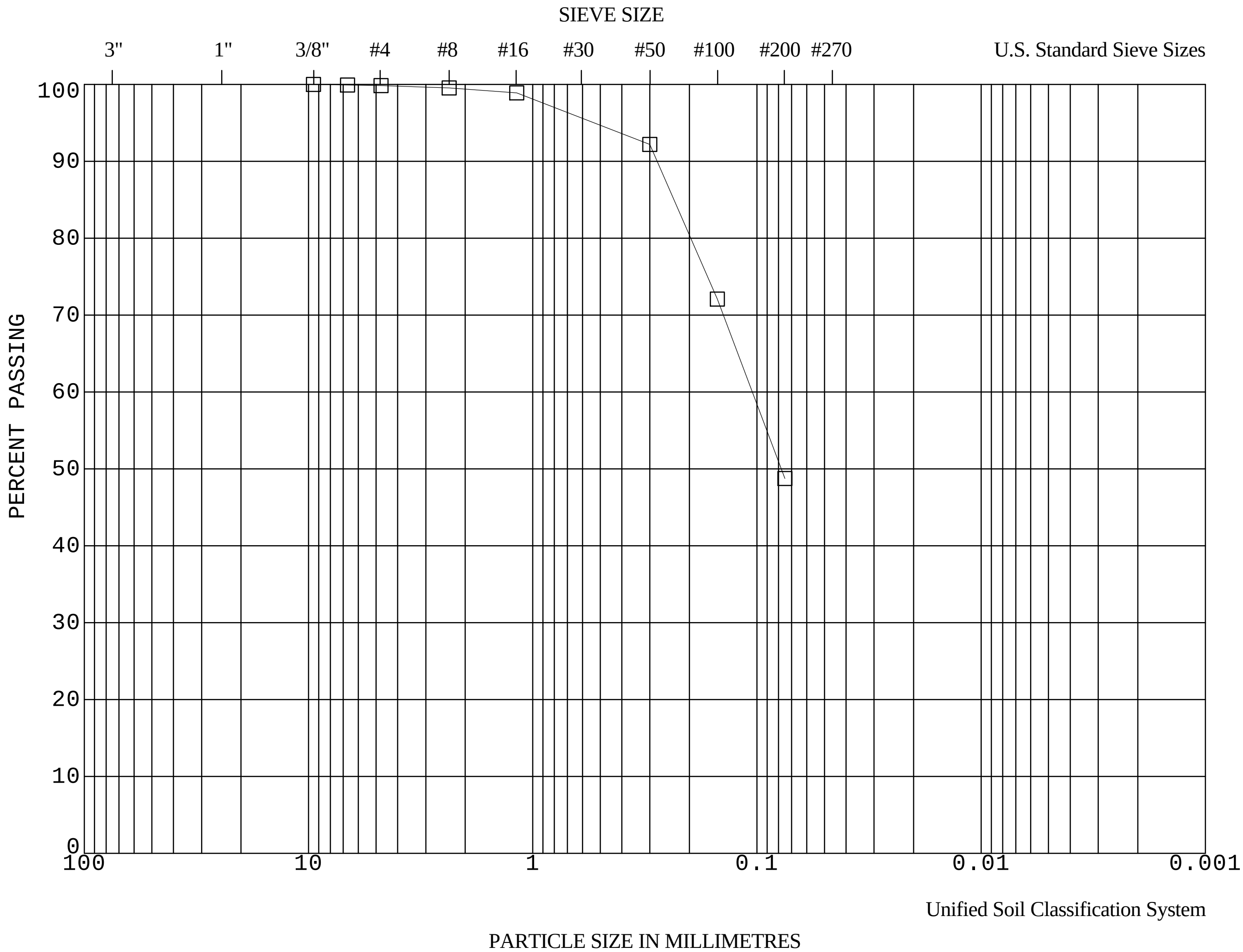


COB'L	GRAVEL		SAND		SILT & CLAY
	Coarse	Fine	Medium	Fine	

LEGEND:

□ BOREHOLE BHMW1 DEPTH 3.35

GRAINSIZE ANALYSIS



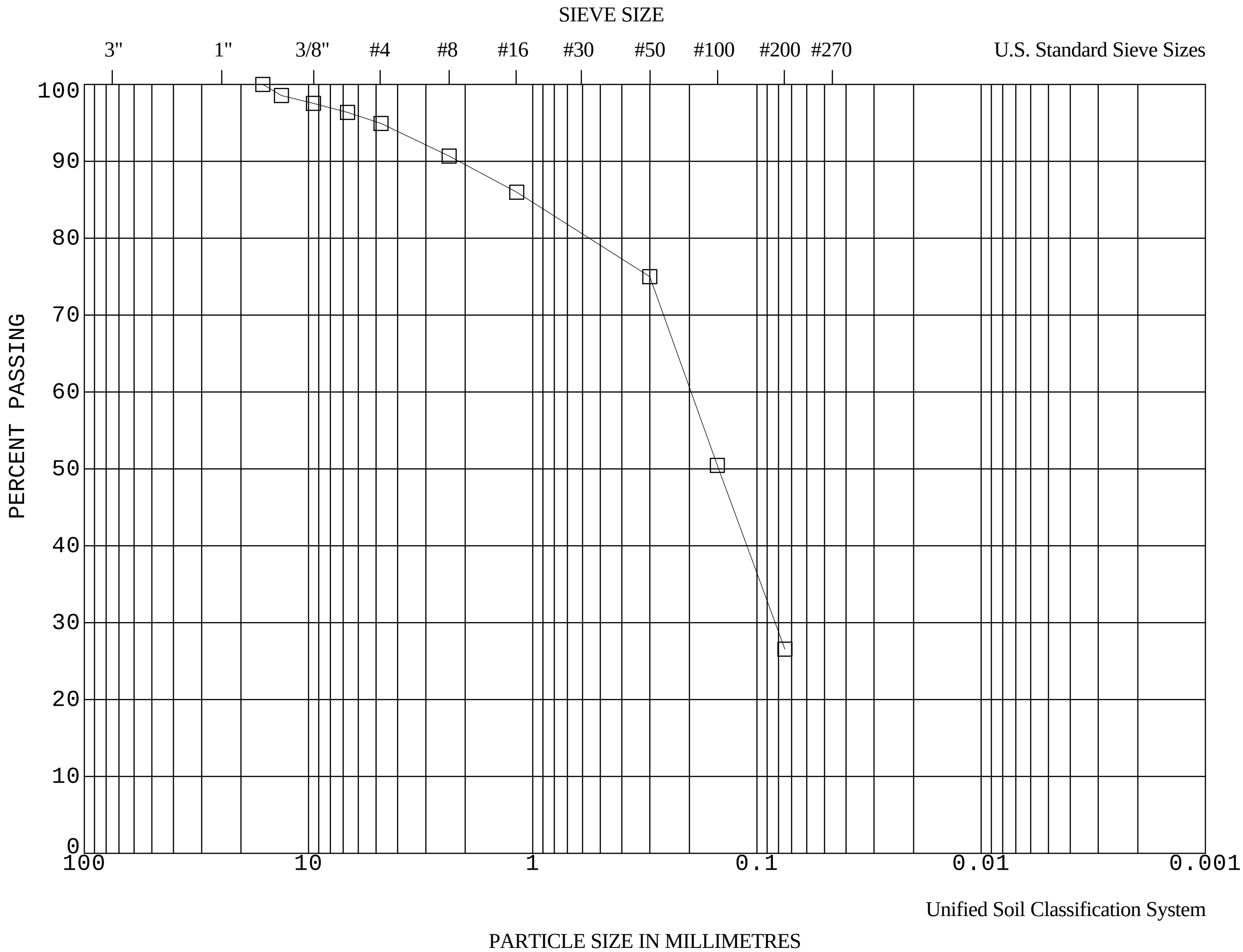
COB'L	GRAVEL		SAND		SILT & CLAY
	Coarse	Fine	Medium	Fine	

LEGEND:

□ BOREHOLE BHMW2 DEPTH 2.59

GS GEOTECH - BH.GPJ DST_MIN.GDT 2/29/08

GRAINSIZE ANALYSIS

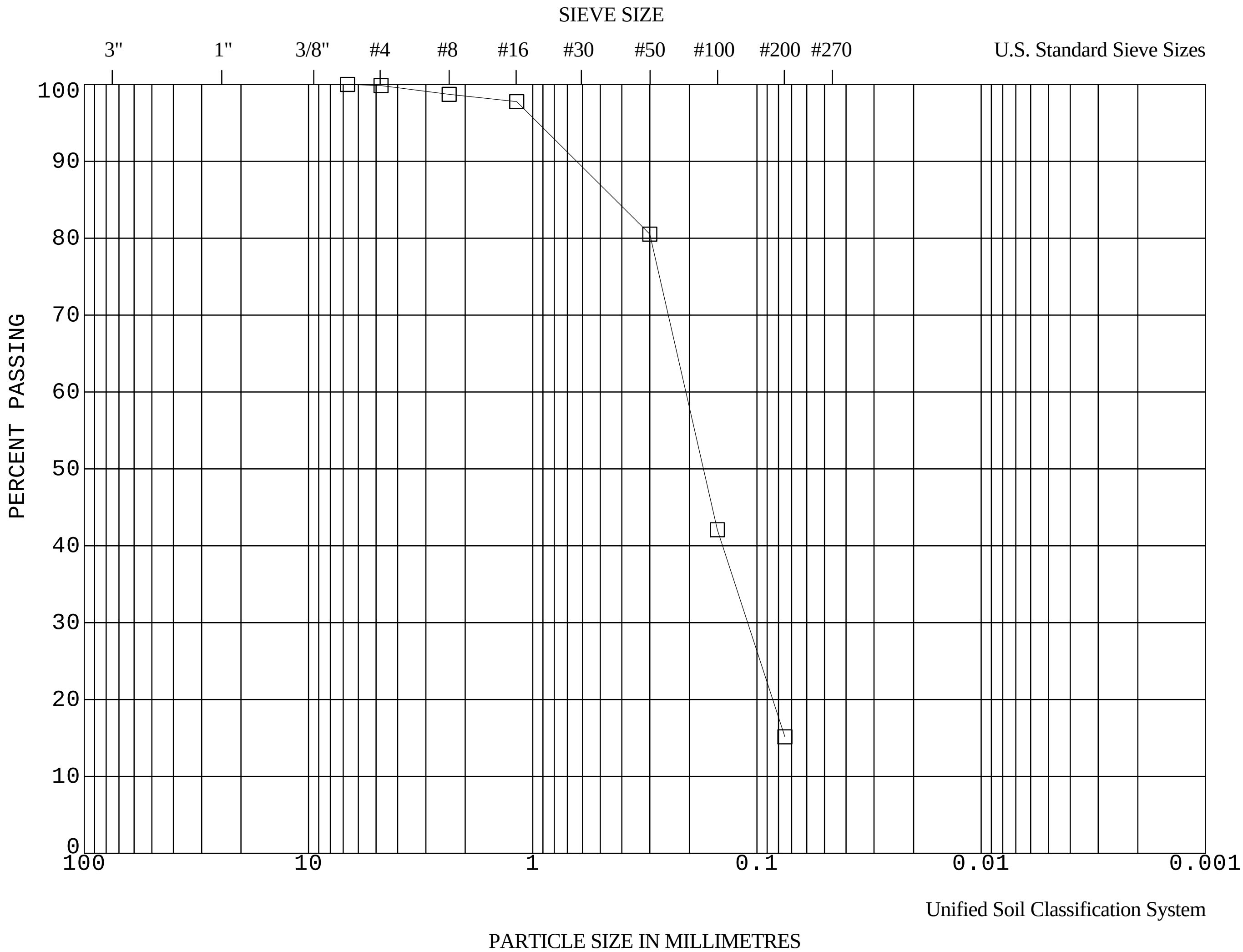


COB'L	GRAVEL		SAND		SILT & CLAY
	Coarse	Fine	Medium	Fine	

LEGEND:

□ BOREHOLE BHMW3 DEPTH 1.07

GRAINSIZE ANALYSIS



COB'L	GRAVEL		SAND		SILT & CLAY
	Coarse	Fine	Medium	Fine	

LEGEND:

□ BOREHOLE BHMW4 DEPTH 4.80

HYDRAULIC TESTING RESULT **WELL No.** **BHMW3**

PROJECT: **Phase II Environmental Site Assessment, 2720 Richmond Road, Ottawa, Ontario**
PROJECT No: **OEOT008319**

Test Date: 19-Feb-08 Tested By: Vahid Arasteh

Pipe Radius (r) =	0.025 m	Saturated Screen Length (L) =	3.11 m
Well Radius (R) =	0.1 m	Static Depth to Water (H) =	7.675 m
Test Type:	bail test (rising head)	To =	155 sec

TEST DATA

Time (s)	Depth to Water (m)	Effective Drawdown (H-h)/(H-Ho)
0.00	9.500	1
10.00	9.243	0.859178082
20.00	9.153	0.809863014
30.00	9.060	0.75890411
40.00	8.990	0.720547945
50.00	8.900	0.671232877
60.00	8.830	0.632876712
70.00	8.770	0.6
80.00	8.700	0.561643836
90.00	8.630	0.523287671
100.00	8.580	0.495890411
110.00	8.520	0.463013699
120.00	8.475	0.438356164
135.00	8.410	0.402739726
150.00	8.335	0.361643836
165.00	8.280	0.331506849
180.00	8.220	0.298630137
195.00	8.170	0.271232877
210.00	8.130	0.249315068
225.00	8.090	0.22739726
240.00	8.050	0.205479452
270.00	7.990	0.17260274
300.00	7.940	0.145205479
330.00	7.895	0.120547945
360.00	7.860	0.101369863
390.00	7.840	0.090410959
420.00	7.820	0.079452055
450.00	7.800	0.068493151

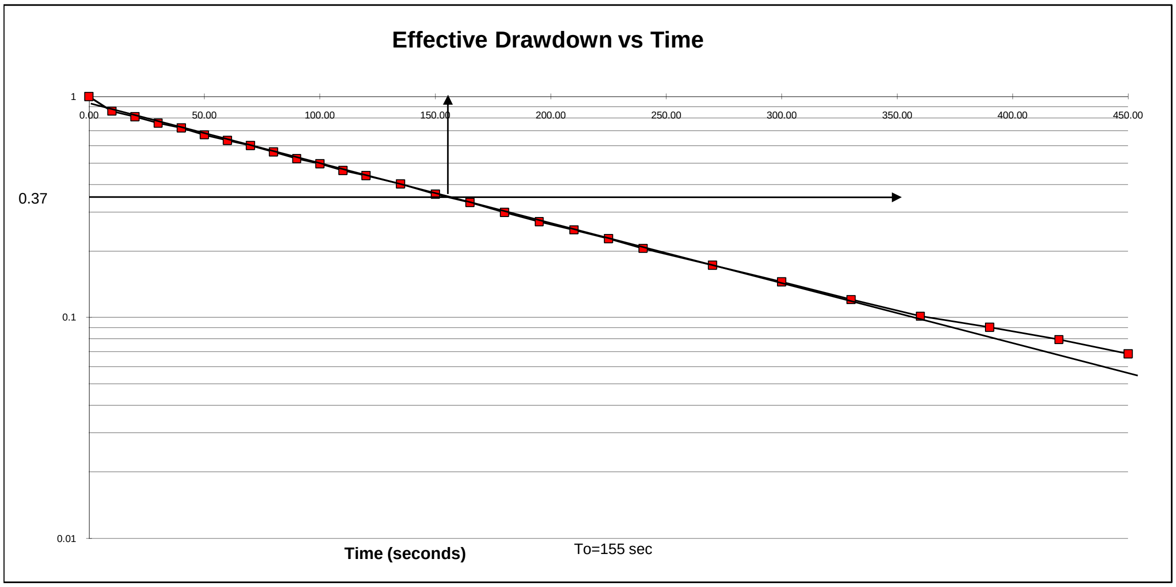
From Hvorslev:

K = (r*r ln(L/R))/(2LTo)
= 2.2E-04 cm/sec

H = static depth to water
Ho = depth to water at t=0
h = depth to water at t=n
r = radius of piezometer
R = radius of well bore
L = length of saturated screen within aquifer
To = time at effective drawdown of 0.37

Bailed to 9.5 m below riser top

Reference: Freeze & Cherry, 1979, pgs. 339 -342


Effective Drawdown vs Time
1
0.1
0.01
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
0.37
Time (seconds)
To=155 sec

APPENDIX E

Copy of MOE Well Record

Ontario Ministry of the Environment

Well Tag No. for Master Well (Place Sticker and/or Print Below)
A 045152
A045152

Master Well Record for Cluster Well Construction

Regulation 903 Ontario Water Resources Act

Page 1 of 2

Master Well Owner's and Land Owner's Information

First Name: Ottawa Carleton District | Last Name: School Board Attn: Daniel Fournier | E-mail Address: Architectural Eng. Dept.

Mailing Address (Street Number/Name, RR): 1224 Stittsville Main Street | Municipality: Ottawa | Province: ON | Postal Code: K2S0E2 | Telephone No. (inc. area code): 6135968211

Location and Construction of the Master Well in the Cluster

Address of Well Location (Street Number/Name, RR): 2720 Richmond Road | Township: | Lot: | Concession:

County/District/Municipality: | City/Town/Village: Ottawa | Province: Ontario | Postal Code:

UTM Coordinates NAD 83 | Zone 18 | Easting 437907 | Northing 5023036 | GPS Unit Make: Magellan | Model: Sportrak | Mode of Operation: ☐ Undifferentiated ☑ Averaged ☐ Differentiated, specify

Overburden and Bedrock Materials (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (Metres) From	To
Black	Asphalt	50mm			
Black/Brown	Sand & gravel			0.1	0.9
Lt. Brown	Sand-silty gravel		Compact to dense	0.9	1.6
Brown	Silty sand		loose	1.6	2.2
Lt brown	Silty to some silt			2.2	3.8
Grey	Silt	trace clay	at 6.0m	3.8	11.0
Grey/Black	Bedrock			11.0	15.25

Hole Details

MW#3

Depth (Metres) From	To	Diameter (Centimetres)
0	11.0	20
11.0	15.2	10

Water Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Not used ☐ Dewatering ☑ Monitoring ☐ Cooling & Air Conditioning ☐ Other, specify

Method of Construction

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Rotary (Air) ☐ Air Percussion ☑ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Boring ☑ Other, specify HSA

Status of Well

☑ Test Hole ☐ Replacement Well ☐ Dewatering Well ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Other, specify ☐ Abandoned, other, specify

Construction Details

Inside Diameter (Centimetres)	Material (steel, plastic, fibreglass, concrete, galvanized)	Wall Thickness	Depth (Metres) From	To
5.1	PVC	Sched 40	0	4.3

No Casing and Screen Used

Open Hole ☐ Yes ☑ No

Static Water Level Test

17.69 Metres

Screen

☐ Galvanized ☐ Steel ☐ Fibreglass ☐ Concrete ☑ Plastic

Outside Diameter (Centimetres): 5.8 | Slot No.: 10

Water Details

Water found at Depth	Kind of Water
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals

Annular Space/Abandonment Sealing Record

Depth Set at (Metres) From	To	Type of Sealant Used (Material and Type)	Volume Used (Cubic Metres)
0	4.3	Bentonite	180 Kgs.
10.8	15.25	Bentonite	

Disinfected ☐ Yes ☑ No If no, provide reason: Monitoring Well

Date Master Well Completed (yyyy/mm/dd): 2008/02/05

Cluster Information (Please also fill out the additional Cluster Well Information for Well Construction for each parcel of land and cluster.)

Total Wells in Cluster: 4

Please indicate Number of Cluster Well Information Log Sheets Submitted: 1

Total Wells on this Property: unknown

Location of Well Cluster

Detailed Map must be provided as an attachment no larger than legal size (8.5" x 14"). Sketches are not allowed.

☑ Check box to confirm detailed map is provided as per Section 11.1 (3)

Consent to release additional information concerning the cluster to the Director upon request

Signature of Technician/Contractor | Date (yyyy/mm/dd): 2008/03/04

Master Well Owner's/Land Owner's consent to use Cluster Form

Signature | Date (yyyy/mm/dd): 08/03/07.

Well Contractor and Well Technician Information

Business Name of Well Contractor: George Downing Estate Drilling Ltd | Well Contractor's Licence No.: 1 8 4 4

Business Address (Street No./Name, number, RR): 410 Rue Principale | Municipality: Grenville sur la Rouge

Province: Qc | Postal Code: J0V1B0 | Business E-mail Address: downing@xplornet.com

Bus.Telephone No. (inc. area code): 8197426469 | Name of Well Technician (Last Name, First Name)

Well Technician's Licence No. | Signature of Technician | Date Submitted (yyyy/mm/dd)

Ministry Use Only

Audit No. M 01041 | Well Contractor No.

Date Received (yyyy/mm/dd) | Date of Inspection (yyyy/mm/dd)

Remarks

Ontario Ministry of the Environment

Well Tag No. for Master Well (Print Well Tag No.)
A 045152
A045152

Cluster Well Information for Cluster Well Construc

Regulation 903 Ontario Water Resource

Page 1 of 1

Property Owner's Information

First Name	Last Name	Mailing Address (Street No./Name, RR)	Municipality
Ottawa Carleton District School Board Attn: Daniel Fournier		1224 Stittsville Main Street	Ottawa

Province	Postal Code	E-mail Address	Telephone No. (inc. area code)
ONTARIO	K2S0E2		6135968211

Cluster Well Information

Address of Well Location (Street Number/Name, RR)	Lot	Concession	Township	County/District/Municipality
2720 Richmond Road				

City/Town/Village	Province	Postal Code	GPS Unit Make	Model	Unit Mode of Operation
Ottawa	Ontario		Magellan	Spotrak	☐ Undifferentiated ☑ Averaged ☐ Differentiated, specify:

Consent

Property Owner's Consent to use cluster form

Signature: [signature] Date (yyyy/...): 08/03

Consent to release additional information to the Direct... upon request

Signature of Technician/Contractor: [signature] Date (yyyy/...):

Well # on Sketch	UTM Coordinates Zone	Easting	Northing	Full Depth of Hole (metres)	Hole Diameter (cm)	Method of Construction	Casing Material	Casing Length (metres)	Screen Interval (metres) From	To	Annular Space Sealant Used	Static Water Level (metres)	Abandonment Sealant Used	Comments	Date of Co... (yyyy/m...)
MW #1	18	437933	5023076	9.7	20	HSA	PVC	3.0	3.0	9.7	Bentonite	8.4			2008/0...
MW #2	18	438001	5023053	10.5				3.5	3.5	10.5		7.6			2008/0...
MW #4	18	437919	5023083	10.3				3.5	3.5	10.3		8.6			2008/0...

Date 1st Well in Cluster Constructed (yyyy/mm/dd): 2008/02/04
Date Last Well in Cluster Cons... (yyyy/mm/dd): 2008/02/0...

Well Contractor and Well Technician Information

Business Name of Well Contractor	Business Address (Street Number/Name, RR)	Municipality	Province
George Downing Estate Drilling Ltd.	410 Rue Principale	Grenville Sur La Rouge	QC

Postal Code	Business Telephone No. (inc. area code)	Well Contractor's Licence No.	Business E-mail Address
J0V1B0	8199424469	1844	downing@xplornet.com

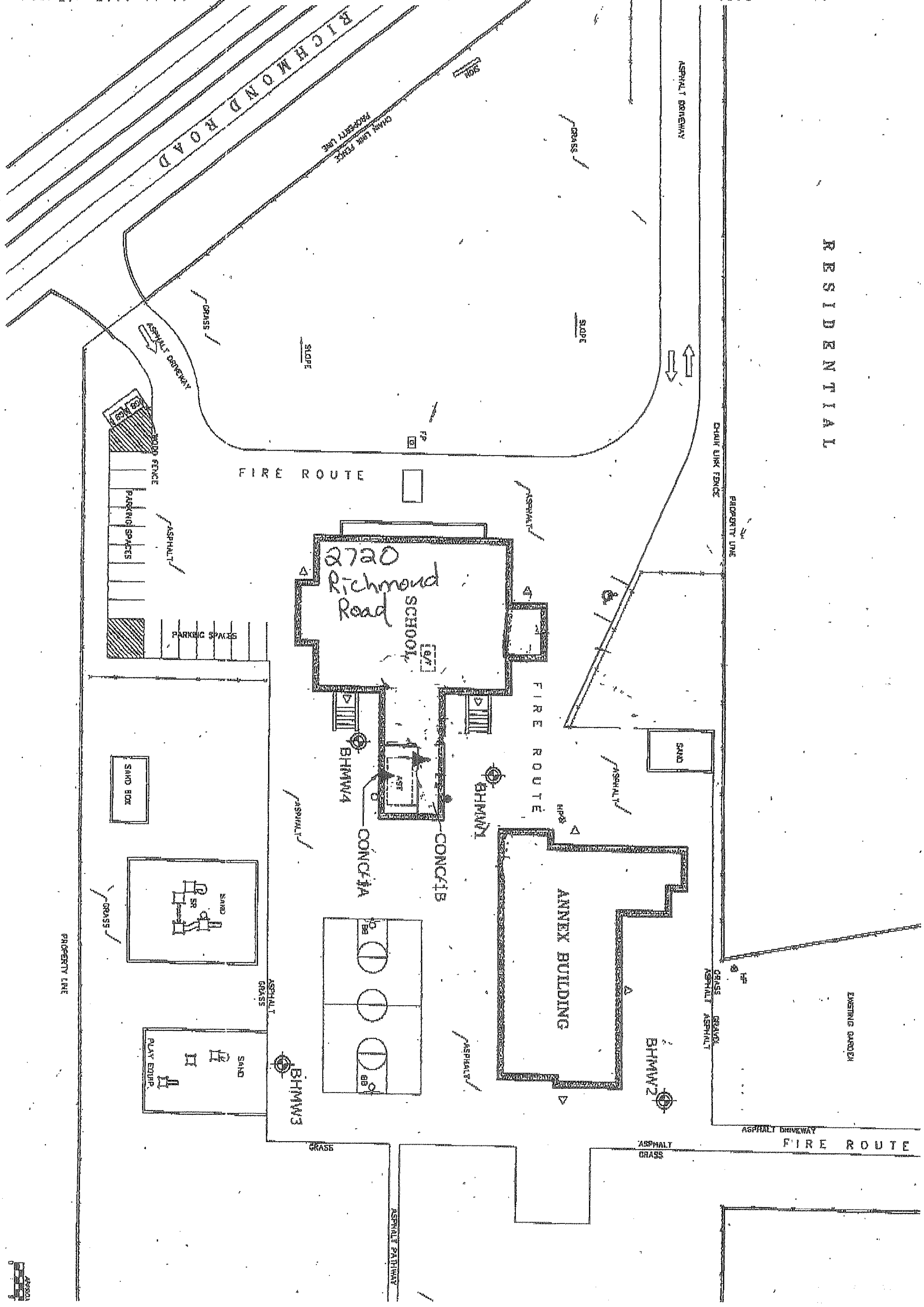
Name of Well Technician (First Name, Last Name)	Well Technician's Licence No.	Date Submitted (yyyy/mm/dd)	Signature of Technician
Stephen Downing	3326	2008/03/04	[signature]

Ministry Use Only

Date Received (yyyy/mm/dd):
Date Inspected (yyyy/mm/...):
Audit No. C 03033
Remarks:

1991 (11/2006)

Ministry's Copy



Total Wells on this Property	
Unknown	1

Location of Well Cluster

Detailed Map must be provided as an attachment no larger than legal size (8.5" x 14"). Sketches are not allowed.

☑ Check box to confirm detailed map is provided as per Section 11.1 (3)

Consent to release additional information concerning the cluster to the Director upon request

Signature of Technician/Contractor	Date (yyyy/mm/dd)
	2008/03/04

Master Well Owner's/Land Owner's consent to use Cluster Form

Signature	Date (yyyy/mm/dd)
	08/03/07

Well Contractor and Well Technician Information

Business Name of Well Contractor		Well Contractor's Licence No.
George Downing Estate Drilling Ltd		1 1 8 4 4
Business Address (Street No./Name, number, RR)	Municipality	
410 Rue Principale	Grenville sur la Rouge	
Province	Postal Code	Business E-mail Address
QC	J0V1B0	downing@xplornet.com
Bus.Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	
8 1 9 2 4 2 6 4 6 9		
Well Technician's Licence No.	Signature of Technician	Date Submitted (yyyy/mm/dd)

Ministry Use Only

Audit No.	Well Contractor No.
M 01041	
Date Received (yyyy/mm/dd)	Date of Inspection (yyyy/mm/dd)

Remarks