1147310 Ontario Inc.

Preliminary Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Commercial and Residential Development
112 Montreal Road, Ottawa, Ontario

Project Number
OTT-00214936-B0

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Date Submitted
December 23, 2013

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Attention: Mr. Naushad Jinah

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Date Submitted:
December 23, 2013

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Executive Summary

A preliminary geotechnical investigation was undertaken at the site located at 112 Montreal Road, Ottawa, Ontario to provide preliminary comments regarding the feasibility of construction of high rise structures on the subject property. This work was authorized by Mr. Naushad Jinah of 1147310 Ontario Inc. on August 28, 2013.

The preliminary geotechnical investigation comprised of drilling 10 boreholes from 3.6 m to 15.2 m depth. The investigation revealed that the surficial soil at the site is heterogeneous fill, which extends to 0.2 m to 2.7 m depth. The fill is underlain by compact to very dense silty sand till to 2.1 m to 3.3 m depth. Limestone bedrock underlies the till and extends to the entire depth investigated, i.e. to 5.6 m to 8.1 m. The groundwater table at the site was established at 2.4 m to 4.2 m depth.

The design of the proposed structures would depend on whether the site can be dewatered without adversely impacting the existing structures and services in the neighborhood. If the additional investigation reveals that dewatering of the site will not have an adverse impact on neighboring structures and services, the basement of the proposed structures may be designed to resist lateral earth pressure only and perimeter and subsurface drainage system should be provided to maintain the groundwater table below the founding level(s). If the additional investigation reveals that dewatering of the site will adversely impact existing structures and services in the neighborhood, the basements below the groundwater table would have to be designed as water-tight structures capable of resisting lateral earth as well as hydrostatic pressures. This may have a considerable impact on project costs. The recommendations made in this report are based on the assumption that the site can be dewatered.

Project details were not available at the time of preparation of this report. However, based on the geotechnical conditions encountered at the site, it is considered feasible to found the proposed high rise structures on spread and strip footings set on limestone bedrock. Since the footings will be set on bedrock, factored geotechnical resistance at Ultimate Limit State (ULS) will govern the design. The factored geotechnical resistance at ULS will vary from 1.0 MPa to 3.0 MPa depending on the number of basements incorporated in the proposed structures as the bedrock becomes more competent with depth. Settlements of footings founded on bedrock and properly constructed are expected to be less than 10 mm.

The lowest floor slabs of the proposed structures may be constructed as slabs-on-grade set on the limestone bedrock. Perimeter and underfloor drains would be required for the proposed structures.

Subsurface walls should be designed to resist lateral earth pressure for static loading conditions as well as for seismic loading conditions.

Excavations at the site in the overburden may be undertaken as open-cut provided that they are cut back at 45 degrees. If space restrictions prevent open-cut excavations, the excavations would have to be shored. Excavation of the overburden may be undertaken with conventional mechanical equipment. The bedrock may be excavated with near vertical sides. Excavation of the bedrock would require blasting and

possibly line drilling. Vibrations should be monitored during construction to prevent damage to adjacent structures and services. A condition survey of all the structures and services will be required prior to commencement of construction. Seepage of surface and sub-surface water into the excavations should be anticipated. It should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps. Permit to take water may be required from the Ontario Ministry of the Environment.

Site has been classified as Class C for seismic site response in accordance with Section 4.1.8.4 of the Ontario Building Code, 2012. The site classification may be higher depending on the founding level and the results of shear wave velocity measurements at the site.

The following pavement structure thicknesses may be considered for preliminary design.

Light Duty Traffic Area (driveways, parking areas, etc.)

Asphaltic concrete 75 mm
Granular A Base 150 mm
Granular B Sub-base 300 mm

Heavy Duty Traffic Areas (access roads)

Asphalt Concrete 90 mm
Granular A Base 150 mm
Granular B Sub-base 450 mm

The above and other related considerations are discussed in greater detail in the report.

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1 Introduction

A preliminary geotechnical investigation was undertaken at the site of the proposed commercial and residential development to be located at 112 Montreal Road between Palace Street and Kendall Avenue (see Figure 1) in the City of Ottawa, Ontario. The work was authorized by Mr. Naushad Jinah of 1147310 Ontario Inc. on August 28, 2013.

At the time of preparation of this preliminary report, details were not available as to the height of structures proposed, number of basements, design loads, etc.

The investigation was undertaken to:

1.) Establish the geotechnical and groundwater conditions at the site;

2.) Discuss types of foundations feasible and design bearing pressures available;

3.) Assess feasibility of slab-on-grade floors;

4.) Discuss earth pressures on subsurface walls;

5.) Comment on excavation conditions anticipated;

6.) Comment on backfilling requirements and suitability of on-site soils for backfilling purposes;

7.) Classify the site for seismic site response; and

8.) Discuss pavement structure thickness for access roads and parking areas.

The comments and recommendations given in this report are preliminary and subject to review once the project details are made available. Depending on the results of the review, additional geotechnical investigation or changes to the recommendations contained in this report may be required.

2 Procedure

The fieldwork for the investigations was undertaken with truck-mounted drill rigs equipped with continuous-flight hollow-stem augers and core drilling capabilities. It was supervised on a full-time basis by a representative of **exp** Services Inc. The fieldwork for the geotechnical investigation was undertaken on October 23, 24 and November 7, 2013 and consisted of drilling 10 boreholes to 3.6 m to 15.2 m depth (Borehole Nos. 1A, 1B, and 2 to 9 inclusive). The locations of all the boreholes are shown on the Borehole Plan, Figure 2.

Standard penetration tests were performed in the overburden in all the boreholes at 0.75 m to 1.5 m depth intervals and soil samples retrieved by split barrel sampler. The bedrock was core drilled in most of the boreholes using NX size core barrel. During bedrock coring, a careful record of any sudden drops of the drill rods, colour of wash water and wash water return was kept.

Water levels were measured in the open boreholes on completion of drilling. In addition, groundwater-monitoring wells with 51 mm diameter casing or standpipes consisting of 13 mm diameter PVC (polyvinyl chloride) pipes were installed in all the boreholes. The installation configuration is documented on the respective borehole log. All boreholes were backfilled upon completion of the fieldwork. The locations and elevations of the boreholes were established by a representative of **exp**. Top of manhole cover southeast of main lobby entrance of the motel was used as the benchmark. Its elevation was assumed as 100.0 m.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, all the rock cores were visually examined, placed in core boxes, identified and logged. On completion of the fieldwork, all the soil samples and rock cores were transported to the **exp** laboratory in the City of Ottawa, Ontario.

All the soil samples and rock cores were visually examined in the laboratory by a geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing natural moisture content on all soil samples and unit weight, grain size analysis and pH, sulphate, chloride and Electrical Resistivity tests on selected samples. In addition, unconfined compressive strength test was completed on selected rock samples.

3 Site and Soil Description

The site under consideration is located at 112 Montreal Road between Palace Street and Vanier Parkway in the City of Ottawa, Ontario. The site is irregular in shape. The site is currently occupied by a number of one- and two-storey structures which are to be demolished. The site is flat lying with ground surface elevations varying from Elevation 99.5 m to Elevation 100.1 m.

A detailed description of the geotechnical conditions encountered in the nine boreholes is given on Borehole Logs, Figures 3 to 12 inclusive. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the location where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

A review of Figures 3 to 12 inclusive indicates the following site stratigraphy in descending order.

3.1 Asphaltic Concrete

The site is covered with a surficial layer of asphaltic concrete 19 mm to 100 mm thick.

3.2 Fill

The asphaltic concrete in the boreholes is underlain by fill, which extends to 0.2 m to 2.7 m depth. (Elevation 97.4 m to 99.9 m). The fill consists of a mixture of silt, sand and gravel with some clay, occasional cobbles, red brick pieces, plaster, etc. The fill is generally loose to compact with its standard penetration resistance varying from 4 to 65 blows for 300 mm penetration of the split-barrel sampler. The natural moisture content of the fill varies from 3 to 35 percent. The unit weight of the fill is 16.9 to 21.1 kN/m^3. A grain-size analysis performed on a sample of the fill revealed that the fill comprises of 14 percent clay, 31 percent silt, 30 percent sand and 25 percent gravel (Figure 13).

3.3 Sandy Gravel Till

The fill in all the boreholes is underlain by sandy gravel till, which extends to 2.1 m to 3.3 m depth (Elevation 97.0 m to 97.9 m). The till is slightly cohesive and contains some silt and occasional cobbles and boulders. It is loose to very dense ('N' values of 7 to 50 for 25 mm penetration of sample). The natural moisture content of the till varies from 3 to 35 percent. It has a unit weight of 19.3 to 23.2 kN/m^3.

Grain-size analysis performed on two samples of the till are given on Figures 14 and 15 and indicate that the till comprises of 19 to 22 percent silt, 16 to 33 percent sand and 45 to 65 percent gravel.

3.4 Limestone Bedrock

The till in all the boreholes is underlain by limestone bedrock to the entire depth investigated, i.e. 5.6 m to 8.1 m (Elevation 92.3 m to 96.0 m). The limestone bedrock contains shaley partings along bedding planes. Its stratification is horizontal to slightly dipping. The principal joints are near vertical and moderately to widely spaced.

When coring the bedrock, a Total Core Recovery (TCR) of 59 to 100 percent and Rock Quality Designation (RRD) of 25 to 100 percent were obtained. On this basis, the bedrock quality may be described as very poor to excellent. Generally, the bedrock quality improves with depth.

Selected rock cores were subjected to unconfined compressive strength test. The results are given on Table No. I.

Table No. I: Results of Compressive Strength Tests on Rock Cores

Borehole #	Depth (m)	Unit Weight (kg/m^3)	Unconfined Compressive Strength (MPa)
1B	3.7 – 3.84	2595	75.6
1B	7.3 – 7.4	2692	89.9
6	4.4 – 4.5	2616	63.9
9	7.1 – 7.25	2630	90.0

A review of the above table indicates that the unit weight of the bedrock varies from 2595 kg/m^3 to 2692 kg/m^3. Its unconfined compressive strength varies from 63.9 MPa to 90 MPa.

3.5 Groundwater Table

Water level observations were made during drilling and in monitoring wells and standpipes installed in the boreholes subsequent to drilling. The observations indicate that the groundwater table at the site was present at a depth of 2.4 to 4.2 m, i.e. Elevation 95.8 to 97.7 m. Generally, the stabilized groundwater table is below the bedrock surface. The groundwater table is subject to seasonal fluctuations and may be at a higher level during wet weather periods.

Water levels were made in the exploratory boreholes at the times and under the conditions stated in the scope of services. These data were reviewed and **exp**'s interpretation of them discussed in the text of the report. Note that fluctuations in the level of the groundwater may occur due to seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

4 Design Considerations

The recommendations made in this report are based on the assumption that the site can be permanently dewatered without impacting the neighboring structures and services. This aspect would need to be investigated during the additional geotechnical investigation. If the additional geotechnical investigation indicates that site dewatering is not feasible, the basements of the proposed structures below the groundwater table may have to be designed as water-tight structures capable of withstanding lateral earth as well as hydrostatic pressures. This may have a considerable impact on construction costs.

5 Foundation Considerations

The investigation has revealed that the geotechnical conditions at the site are well suited to construction of high-rise development with one or more basement levels at the site since the bedrock is present at relatively shallow depth. The surficial fill and silty sand till are underlain by bedrock at a depth of 2.1 m to 3.3 m below the existing grade. Therefore, high rise structures with at least one basement level may be founded on spread and strip footings et on bedrock. Since the structures will be founded on bedrock, factored geotechnical resistance at Ultimate Limit State (ULS) will govern the design. The factored geotechnical resistance at ULS is a function of the bedrock quality and generally increases with depth below the ground surface.

For preliminary design, factored geotechnical resistance at ULS listed on Table No. II may be considered:

Table No. II: Factored Geotechnical Resistance at Ultimate Limit State for Footings Founded on Limestone Bedrock

No. of Basements in Structure	Estimated Founding Depth Below Existing Ground Surface (m)	Factored Geotechnical Resistance at Ultimate Limit State (MPa)
1 Basement	3.0 – 4.0	1.0
2 Basements	6.0 – 7.0	2.0
3 Basements	9.0	3.0

Settlements of the footings designed to the factored geotechnical resistance at ULS listed on Table No. II and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

A review of the footing beds would be required to ensure that the design bearing pressure is available at the founding level and that the footing beds have been prepared properly.

6 Floor Slabs and Drainage Requirements

The lowest level floors of the proposed buildings with basements may be constructed as slabs-on-grade provided they are set on beds of well compacted 19 mm clear stone at least 300 mm thick placed on natural undisturbed soils or on well compacted engineered fill. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

It is anticipated that perimeter as well as underfloor drains would be required for the proposed buildings with basements. The underfloor drainage system may consist of 100 mm diameter perforated pipe or equivalent placed in parallel rows at 5 m to 6 m centres and at least 300 mm below the underside of the floor slab. The drain should be set on 100 mm of pea-gravel and covered on top and sides with 150 mm of pea-gravel and 300 mm of CSA Fine Concrete Aggregate (Figure 16). The perimeter drains may also consist of 100 mm diameter perforated pipe set on the footings and surrounded with 150 mm of pea-gravel and 300 mm of CSA Concrete Aggregate. The perimeter and underfloor drains should be connected to separate sumps so that at least one system would be operational should the other fail. The subsurface walls should be adequately damp proofed.

The finished exterior grade should be sloped away from the buildings to prevent surface ponding of water close to the exterior walls.

7 Lateral Earth Pressure against Subsurface Walls

The subsurface walls should be backfilled with free draining material, such as SSP110S13 Granular B, Type II and equipped with a permanent drainage system to prevent the buildup of hydrostatic pressure behind the wall. The walls will be subjected to lateral static and dynamic (seismic) earth forces.

The lateral static earth thrust against the subsurface wall may be computed from the following equation:

$$P = K_0 H (q + \tfrac{1}{2} \gamma H)$$

where P = lateral earth pressure acting on the subsurface wall; kPa

K_0 = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.5

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

H = depth of interest below final grade behind wall, m

q = surcharge load, kPa

The lateral force due to seismic loading may be computed from the equation given below:

$$\Delta P_E = (a_h/g).F_p .\gamma.H^2 = 0.15 \gamma H^2$$

where ΔP_E = resultant force due to seismic activity; kN/m

a_h = pseudo-static horizontal acceleration, a_h=0.16 g (Ottawa).

Fp = dimensionless dynamic thrust factor, (Wood, 1973).

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

H = height of backfill behind wall, (m)

The ΔP_E value does not take into account the surcharge load. The surcharge load should be assumed to act at 0.6 H from the bottom of the wall.

8 Excavations

Details regarding the lateral extent of excavations at the site and depth of the excavations are not available at this stage. The geotechnical conditions at the site comprise of 2.4 m to 3.5 m thick overburden, which is underlain by limestone bedrock. The groundwater table at the site is at a depth of 2.4 m to 4.2 m below the existing ground surface.

Excavations at the site must comply with the latest version of Ontario Occupational Health and Safety Act, 1991. Excavations in the overburden above the groundwater table are expected to be stable when out back at 45 degrees. Below the groundwater, the excavation sides are expected to slough and may eventually stabilize at a slope of 2H:1V to 3H:1V. If space restrictions at the site do not permit open-cut excavations, the excavations would have to be shored. Excavation of the overburden may be undertaken by commercial mechanical equipment. Depending on the proximity of the excavations to any existing structures or services, underpinning of these structures may be required.

Excavation of the bedrock may be undertaken with near vertical sides. Excavation of the bedrock would require the use of blasting, and possibly line drilling. In order to prevent any damage to the surrounding structures and services, the blasting operations would have to be carefully planned and closely monitored. It is recommended that the blasting contractor should retain the services of a blast specialist to provide him with a blasting plan. The contractor should have a licensed blaster on site at all times during the blasting and a vibrations engineer on retainer. A condition survey of all the structures in the vicinity of the site should be undertaken prior to commencement of the excavation work.

Vibration monitoring should be carried out during blasting operations. Vibrations should be monitored at property boundaries and should be limited so that there will be no damage to the existing structures or services.

Water inflow into the excavation should be expected. However, it should be possible to adequately handle this inflow by collecting the water in perimeter ditches and pumping from properly filtered sumps. It is possible that additional localized sumps may be required in areas where the seepage is more extensive. It is noted that permit to take water may be required from Ontario Ministry of the Environment if the quantity of water to be pumped exceeds 50,000 litres per day. A pump test would be required to estimate the quality of water that would have to be pumped from the excavation(s).

9 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

Conventional backfill against the subsurface walls and backfill in footing and service trenches inside the building should be free draining granular material preferably conforming to the Ontario Provincial Standard Specifications (OPSS) for Granular 'B', Type II. It should be placed in layers not exceeding 150 mm in thickness and compacted to 95 percent of standard Proctor maximum dry density.

The backfill in footing trenches, service trenches outside the building, should be compactible, i.e. free of organics and debris, and with natural moisture content, which is within two percent of the optimum value. It should also be placed in thin lifts and compacted to 95 percent of the standard Proctor maximum dry density.

The majority of the fill required to backfill footing trenches, service trenches and against the subsurface walls would have to be imported and should preferably conform to the OPSS requirements for Granular 'B', Type II.

10 Seismic Site Classification

The subsoil and groundwater information at the site has been examined in relation to Section 4.1.8.4 of the Ontario Building Code (OBC) 2012. The subsoil at the site comprises of surficial fill underlain by silty sand till, which extends to 2.1 m to 3.3 m depth. The silty sand till is underlain by limestone bedrock. Therefore, the structures at the site with basements are expected to be founded on limestone bedrock. Shear-wave velocity measurements were not undertaken for the preliminary report. Assuming that the structures with basements would be founded on bedrock, the current classification of the site would be Class C since the Code does not allow a site to be classified as Class A or B unless shear-wave velocity measurements are undertaken at the site. However, this classification can probably be raised to Class B or A depending on the founding levels of the structures proposed and results of shear-wave velocity measurements at the site.

11 Subsurface Concrete Requirements

Chemical tests limited to pH and sulphate content were performed on selected soil samples retrieved from the site. The test results are given on Table No. III.

Table No. III: Results of Chemical Tests on Soil Samples

Borehole No.	Depth (m)	pH	Sulphate Content (%)
1	0.6 – 1.2	7.7	0.1460
6	1.2 – 1.8	7.7	0.0190
9	2.4 – 3.0	7.9	0.0145

A review of Table No. III indicates that the concentration of water soluble sulphates in the soil varies from 0.0145 to 0.146 percent. This concentration of sulphates is considered to have a moderate potential of sulphate attack on sub-surface concrete. The subsurface concrete for use at the site should be designed in accordance with the requirements of National Standards of Canada, CSA A23.1-09.

12 Access Roads and Parking Areas

The site contains surficial fill, which is underlain by silty sand till over the majority of the site. For the purpose of computing the pavement structure thickness, it has been assumed the subgrade will comprise of silty sand till. The following pavement structure thicknesses are suggested for preliminary design considerations:

Pavement Structure Thicknesses for Light Duty Traffic

75 mm Asphaltic Concrete
150 mm Granular A Base
300 mm Granular B Sub-base

Pavement Structure Thicknesses for Heavy Duty Traffic

90 mm Asphaltic Concrete
150 mm Granular A Base
450 mm Granular B Sub-base

In addition, it is anticipated that sub-surface drains will be required for the roadways and parking areas at the site.

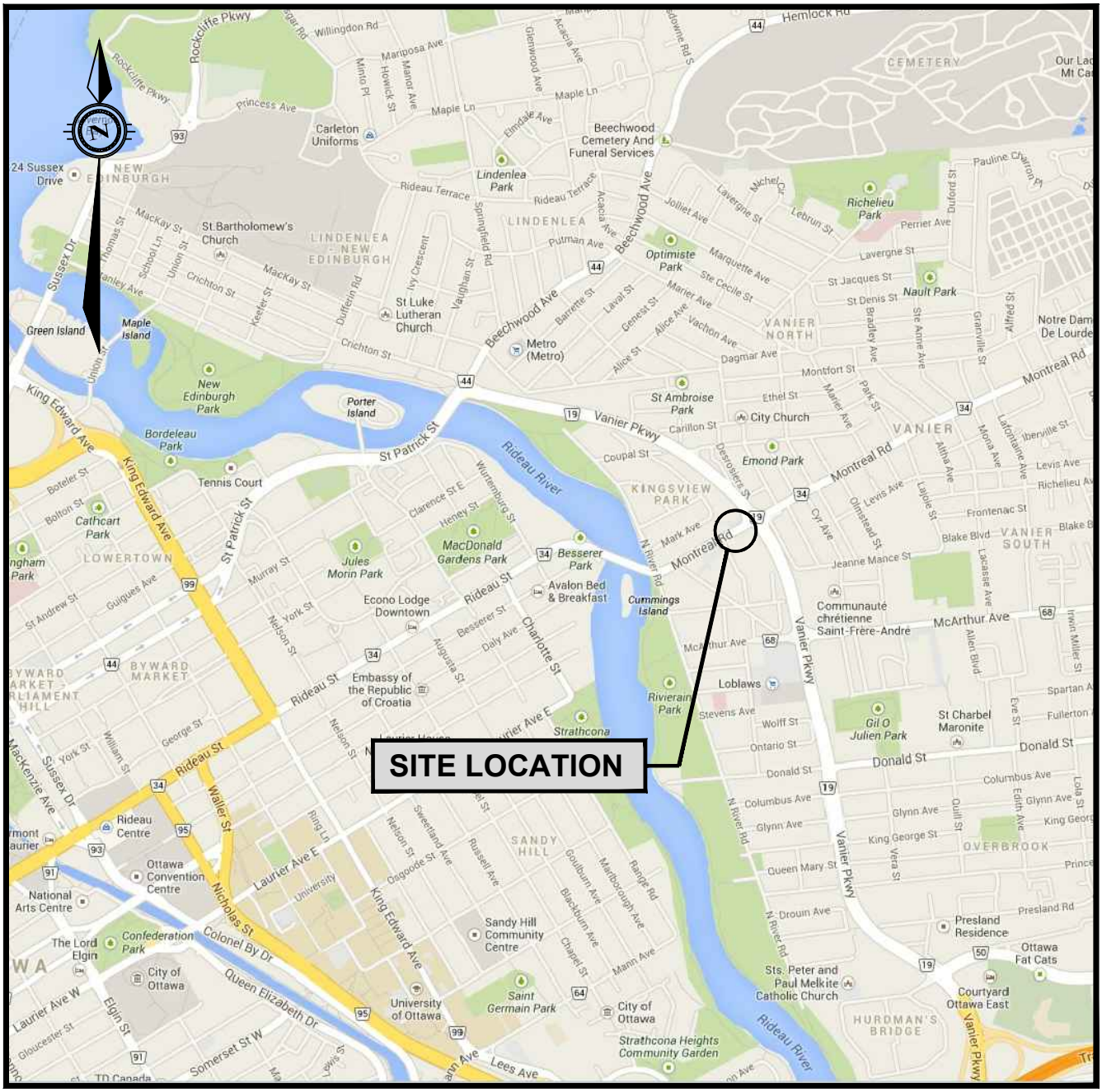
13 General Comments

The proposed prospect development details (i.e. number of basements, building height, design loads, etc.) were not available at the time of the preparation of this report. Therefore, the comments made in this report are preliminary in nature. These preliminary recommendations must be verified by more detailed geotechnical investigation at the site once the lateral extent of construction, design grades, contemplated design loads, etc. are known.

The information contained in this report is not intended to reflect on environmental aspects of the soils.

We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

Figures



0 200m 400m 800m

HORIZONTAL 1:20,000

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Ottawa, ON K2B 8H6, Canada

scale 1:20,000	CLIENT: 1147310 ONTARIO INCORPORATED	project no. OTT-00214936-B0
date DECEMBER 2013	TITLE: SITE LOCATION PLAN 112 MONTREAL ROAD, OTTAWA, ONTARIO	FIG 1
drawn by P. GHAFFARI		

LEGEND

MW13-8 MONITORING WELL LOCATION & NUMBER

0 10m 20m 40m

HORIZONTAL 1:1000

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scale 1:1000	CLIENT: 1147310 ONTARIO INCORPORATED	project no. OTT-00214936-B0
design M.G.M. / checked M.G.M.		date DECEMBER 2013
drawn by P.G.	TITLE: MONITORING WELL LOCATION PLAN 112 MONTREAL ROAD, OTTAWA, ONTARIO	drawing no. FIG 2

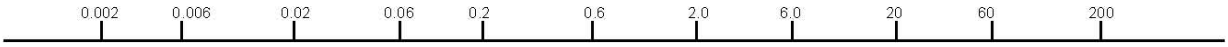
Filename: r:\210000\214000\214936-b0 112 montreal road\214936-a0 - geo - figs 1, 2.dwg
Last Saved: 12/20/2013 2:42:49 PM
Last Plotted: 12/20/2013 3:24:27 PM Plotted by: ghaffarip Pen Table:: trow standard, july 01, 2004.ctb

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole 1-A

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'October 23, 2013 / November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			100.12		20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		ASPHALT ~ 50 mm	100.0	0	43			
		FILL Crushed limestone, sand and gravel, grey, moist, (dense)	99.3					
		FILL Sand, silt and gravel with some brick debris, some boulders and cobbles, dark grey with black and lighter patches, moist (loose to very loose)		1	9			
					5			
				2	4			
			97.82					
			97.4		13			19.2
		SAND AND GRAVEL TILL Some silt with cobbles, trace clay, brown, wet (compact to very dense)		3	69			21.6
			96.5					
		Borehole Terminated at 3.6 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	
7 Days	2.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 1-B

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'October 23, 2013 / November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test ——— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth
			100.1	
		ASPHALT ~ 50 mm	100.0	0
		FILL Crushed limestone, sand and gravel, grey, moist, (dense)	99.3	
		FILL Sand, silt and gravel with some brick debris, some boulders and cobbles, dark grey with black and lighter patches, moist (loose to very loose)		1
				2
			97.5	
		SAND AND GRAVEL TILL Some silt, cobbles, trace clay, brown, wet (compact to very dense)	97.1	3
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (poor to excellent quality)	96.2	4
				5
				6
				7
			92.0	8
		Borehole Terminated at 8.1 m		

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES: Run 1, Run 2, Run 3, Run 4, Run 5

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
12 Days	3.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3 - 3.41	100	38
2	3.41 - 4.45	88	85
3	4.45 - 5.98	100	77
4	5.98 - 7.5	92	87
5	7.5 - 8.06	100	100

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

Log of Borehole 2

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth
		ASPHALT ~ 50 mm	99.75	0
		FILL Sand and gravel, grey, moist, (compact)	99.7	
		SANDY GRAVELLY TILL Some silt, shale fragments present, brown/grey to dark grey, moist (compact) - Boulders and cobbles at 2.3 m depth	98.9	1
		LIMESTONE BEDROCK Grey aphanitic to medium grained shaley partings along bedding planes, stratification flat to gently dipping, mainly medium bedding, principal joints near vertical and moderately to widely spread, (excellent quality)	97.0 96.85	2 3 4 5
		Borehole Terminated at 5.6 m Depth	94.2	

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SPT values: 26, 12, 18, 22, 50/51mm

SAMPLES: Run 1, Run 2

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
26 days	2.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.05 - 4.32	100	100
2	4.32 - 5.64	100	100

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

Log of Borehole 3

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 'October 23, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth
		ASPHALT ~ 100 mm	99.75	0
		FILL	99.7	
		Sand, silt and gravel with some brick debris, brown grey and orange, moist (compact)	99.2	
		SANDY GRAVELLY TILL Some silt, shale fragments, brown/grey to dark grey, moist to wet, (loose to very dense)		1
		- Boulders and cobbles at 1.8 m depth		2
			97.35	
			97.0	
		Auger Refusal at 2.8 m Depth, Borehole Terminated		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60
SAMPLES
Natural Unit Wt. kN/m³

10
6
9
60
50/25mm

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	
1 Day	Dry	
27	2.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

Log of Borehole 4

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth
		ASPHALT ~ 19 mm	99.85	0
		FILL Sand, silt and gravel with trace organics, clay and wood debris, dark brownish grey and white, moist, (compact to loose)	99.8	
		SANDY GRAVELLY TILL Some silt, shale fragments, brown/grey to dark grey, moist (compact) - Boulders and cobbles at 2.2 m depth	98.4	1
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	97.2	2
			96.75	3
				4
			94.2	5
		Auger Refusal at 2.7 m Depth, Borehole Terminated at 5.7 m		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SPT values: 31, 5, 12, 50/50mm

SAMPLES: Run 1, Run 2

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
26 Days	3.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.69 - 4.35	95	95
2	4.35 - 5.74	98	96

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

Log of Borehole 5

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth	Standard Penetration Test N Value / Shear Strength kPa (20 40 60 80 / 50 100 150 200)	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~ 50 mm	99.5					
		FILL Sand and gravel, dark brown, moist, (loose)	99.4	0	5			16.9
			98.7	1	34			
		SANDY GRAVELLY TILL Some silt, shale fragments, brown/grey to dark grey, moist (compact) - Boulders and cobbles at 2.3 m depth		2	41			
			97.1					
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (fair to excellent quality)	96	3				Run 1
				4				Run 2
				5				Run 3
				6				Run 4
			92.3	7				
		Auger Refusal at 2.4 m Depth, Borehole Terminated at 7.2 m						

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
7 Days	3.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.42 - 2.78	85	64
2	2.78 - 4.3	100	100
3	4.3 - 5.74	93	93
4	5.74 - 7.24	100	98

Log of Borehole 6

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 9

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth
		ASPHALT ~ 50 mm	99.9	0
		FILL Crushed limestone, sand and gravel, grey, moist, (loose)	99.8	
		SANDY GRAVELLY TILL Some silt, cobbles, dark brown grey, moist, (compact to dense)	99.7	
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	97.3	1
			95.8	2
				3
				4
				5
				6
		Auger Refusal at 2.6 m Depth, Borehole Terminated at 6.9 m	93.0	

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SPT values: 6, 15, 12, 50/130mm

SAMPLES: Run 1, Run 2, Run 3

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
26 days	4.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.64 - 3.86	100	100
2	3.86 - 5.49	100	97
3	5.49 - 6.91	100	98

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

Log of Borehole 7

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~ 50 mm	99.9	0				
		FILL Crushed limestone, sand and gravel, grey, moist, (loose)	99.8 / 99.7		5			21.1
		SANDY GRAVELLY TILL Some silt, brown and black, moist, (loose to very dense)		1	7			19.3
		- Boulders and cobbles at 1.5 m depth			50/130mm			
				2	50/25mm			
			97.3					
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	97.2	3				Run 1
				4				
				5				Run 2
				6				Run 3
				7				
			92.6					
		Auger Refusal at 2.6 m Depth, Borehole Terminated at 7.3 m						

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
12 Days	2.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.64 - 4.22	98	98
2	4.22 - 5.74	93	93
3	5.74 - 7.27	100	100

Log of Borehole 8

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 11

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Assumed m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~ 50 mm	100 99.9	0	9	×		
		FILL crushed limestone, sand and gravel, grey, moist, (loose)	99.8					
		FILL Sand and gravel with silt, dark brown, moist (loose to very dense)	98.6	1	65	×		
		SANDY GRAVELLY TILL Some silt gravel with boulders and cobbles, trace clay, dark brown/grey, moist, (dense)	97.9	2	34	×		23.2
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	95.8	3			Run 1	
				4			Run 2	
				5			Run 3	
				6			Run 4	
		Auger Refusal at 2.1 m Depth, Borehole Terminated at 7.0 m	93.0	7				

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
12 Days	4.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.24 - 2.75	89	89
2	2.75 - 4.25	100	100
3	4.25 - 5.77	100	100
4	5.77 - 7.02	100	100

Log of Borehole 9

Project No: OTT-00214936-A0

Project: Preliminary Geotechnical Investigation

Location: 112 Montreal Road, Ottawa Ontario

Figure No. 12

Page. 1 of 1

Date Drilled: 'October 23, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Assumed

Logged by: MAD Checked by: MGM/SA

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

Assumed m	SOIL DESCRIPTION
100.6	**ASPHALT** ~ 50 mm
100.5	**FILL**
100.4	Crushed limestone, sand and gravel, grey, moist, (compact)
99.7	**FILL**
	Sand and gravel with silt, brick debris, dark grey with black and white, moist (loose compact)
	SANDY GRAVELLY TILL
	Some silt, shale fragments throughout, dark brown/grey, moist, (compact to dense)
97.3	**LIMESTONE BEDROCK**
97.2	Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (fair to excellent quality)
92.8	**Auger Refusal at 3.3 m Depth, Borehole Terminated at 7.8 m**

Standard Penetration Test N Value: 20 40 60 80 — Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750 — Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

Depth: 0 1 2 3 4 5 6 7

SPT values: 15, 6, 12, 29, 40, 50/100mm

Samples: Run 1, Run 2, Run 3

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00214936-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.2	
1 Day	3.4	
27 Days	3.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.28 - 4.71	73	61
2	4.71 - 6.23	59	53
3	6.23 - 7.78	100	100

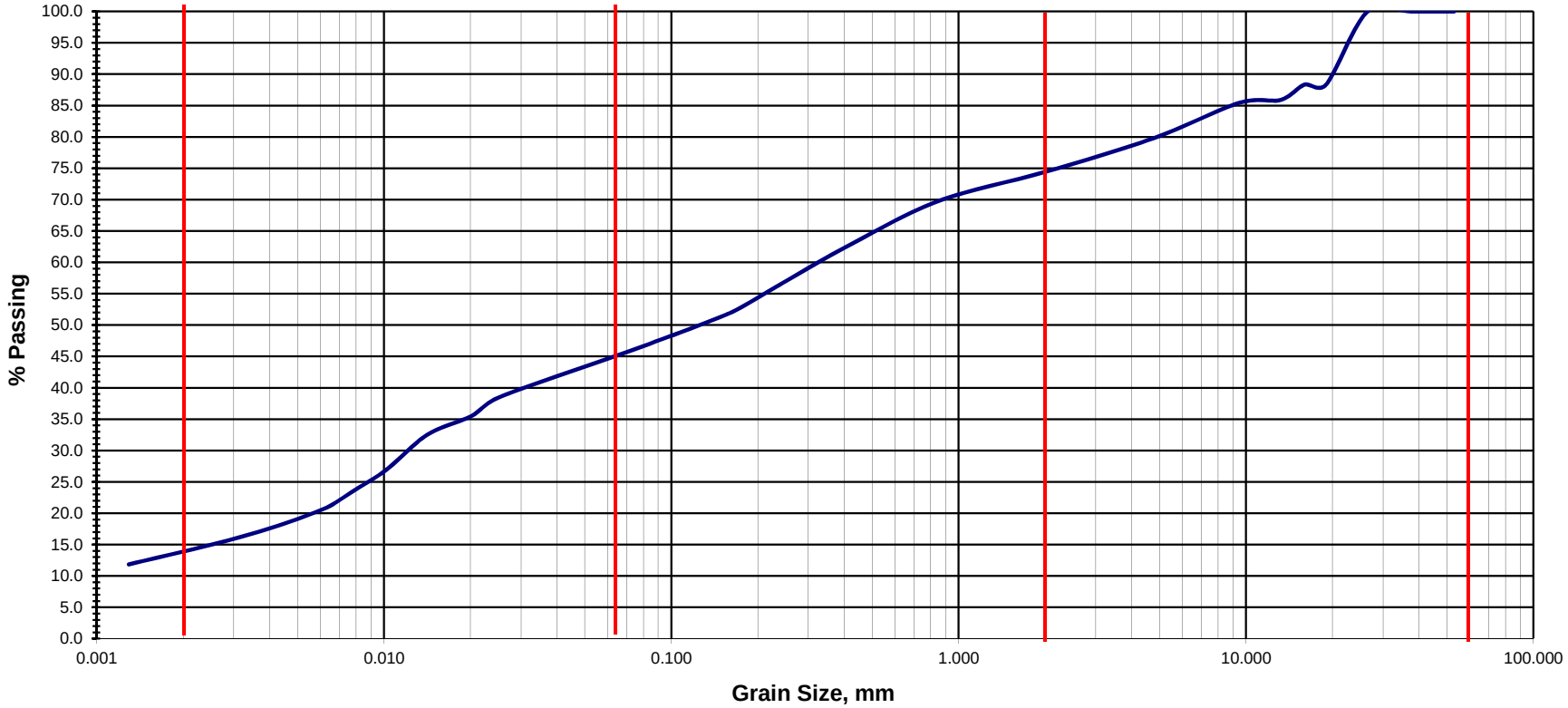
LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 12/20/13

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Method of Test for Particle Size Analysis of Soil

ASTM D-422

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

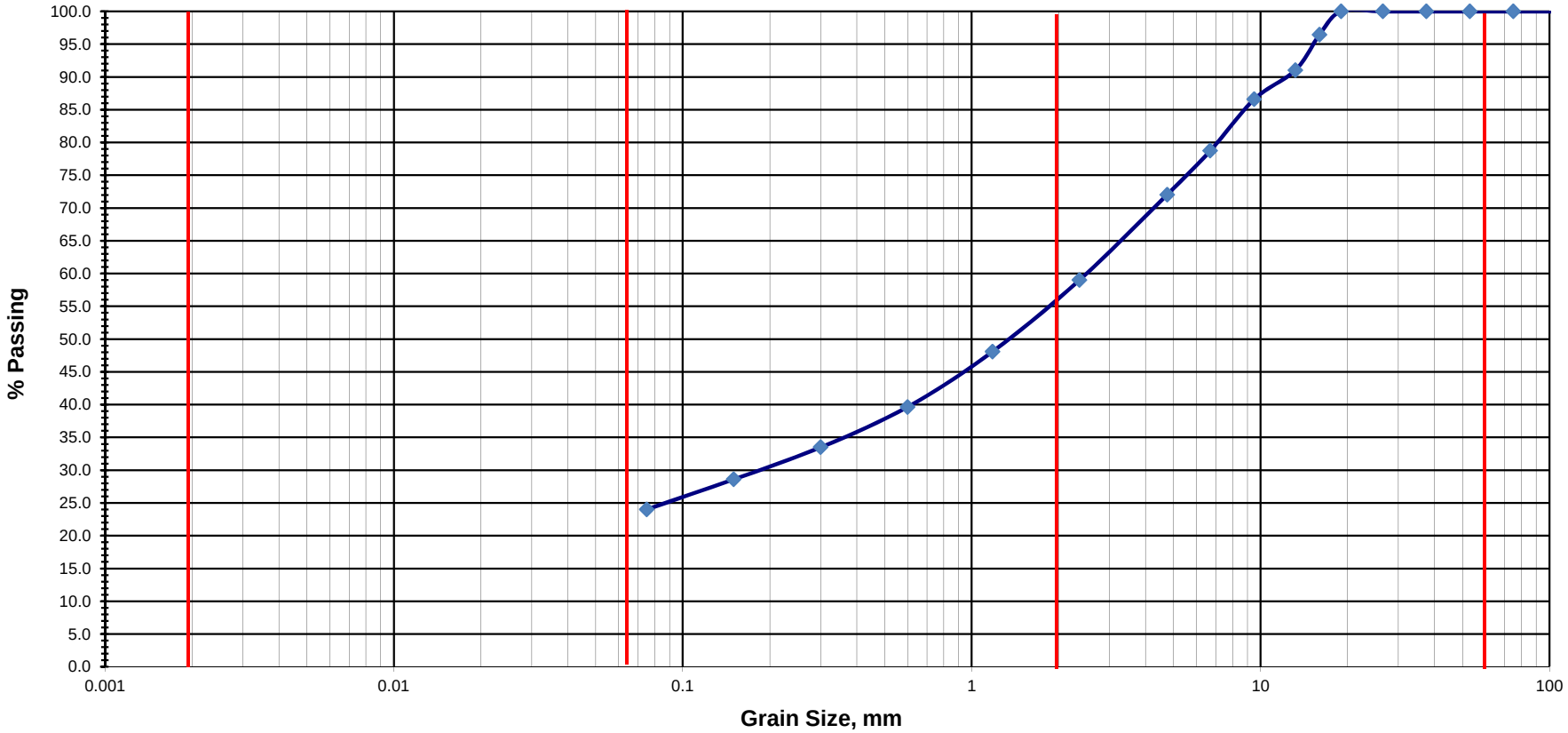
Exp Project No.:	OTT-00214936-B0	Project Name :	Preliminary Geo Investigation		
Client :	1147310 Ontario Inc.	Project Location :	112 Montreal Road		
Date Sampled :	October 23, 2013	Borehole No.	1	Sample No.: SS3	Depth (m) : 1.2-1.8
Sample Description :	Silt, Sand and Gravel, Some Clay				Figure : 13

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

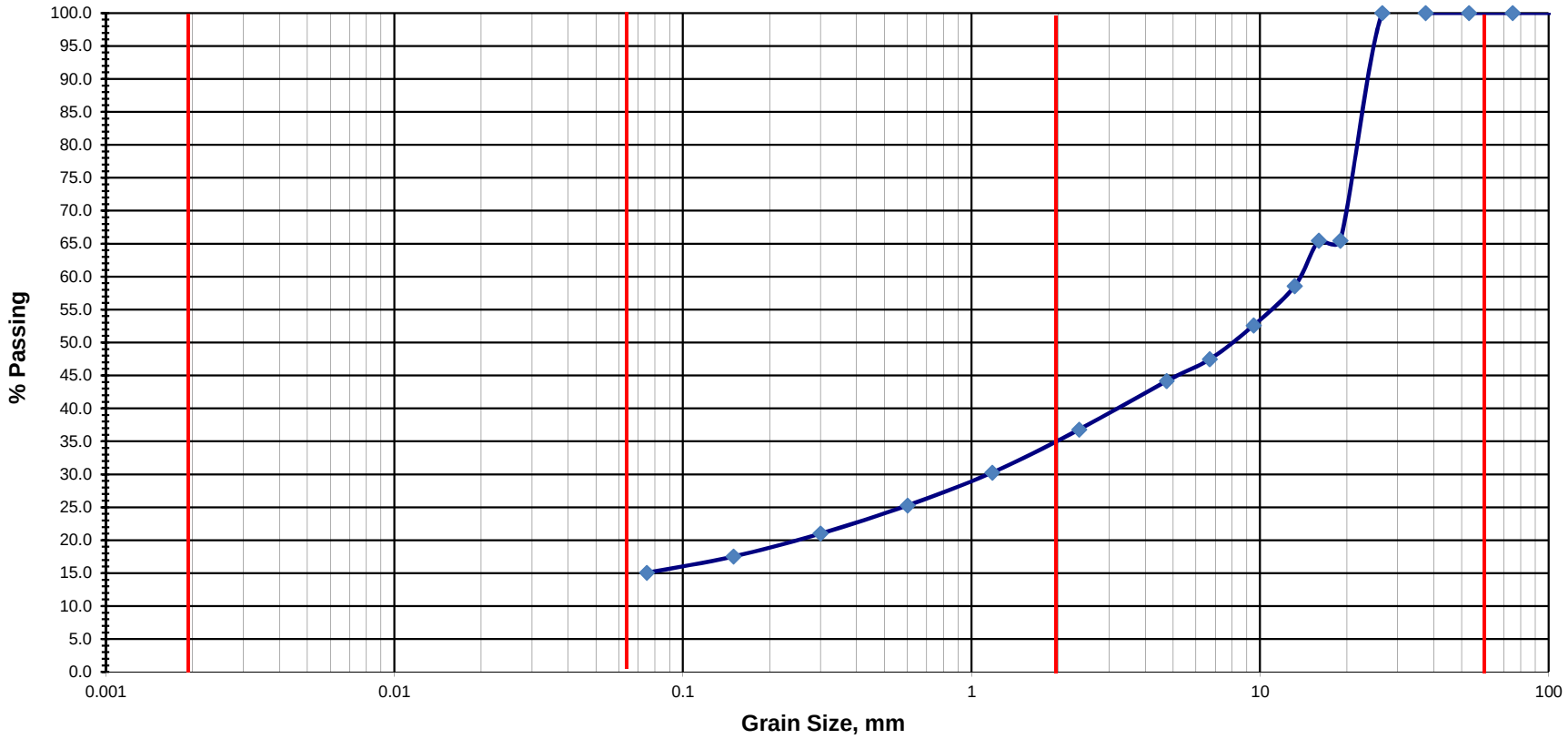
Exp Project No.:	**OTT-00214936-B0**	**Project Name :**	**Preliminary Geo Investigation**		
Client :	**1147310 Ontario Inc.**	**Project Location :**	**112 Montreal Road**		
Date Sampled :	**October 24, 2013**	**Borehole No.**	**6**	**SAMPLE**	**SS2**
Sample Description :	**Silty Sandy Gravel**			**Figure :**	**14**

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

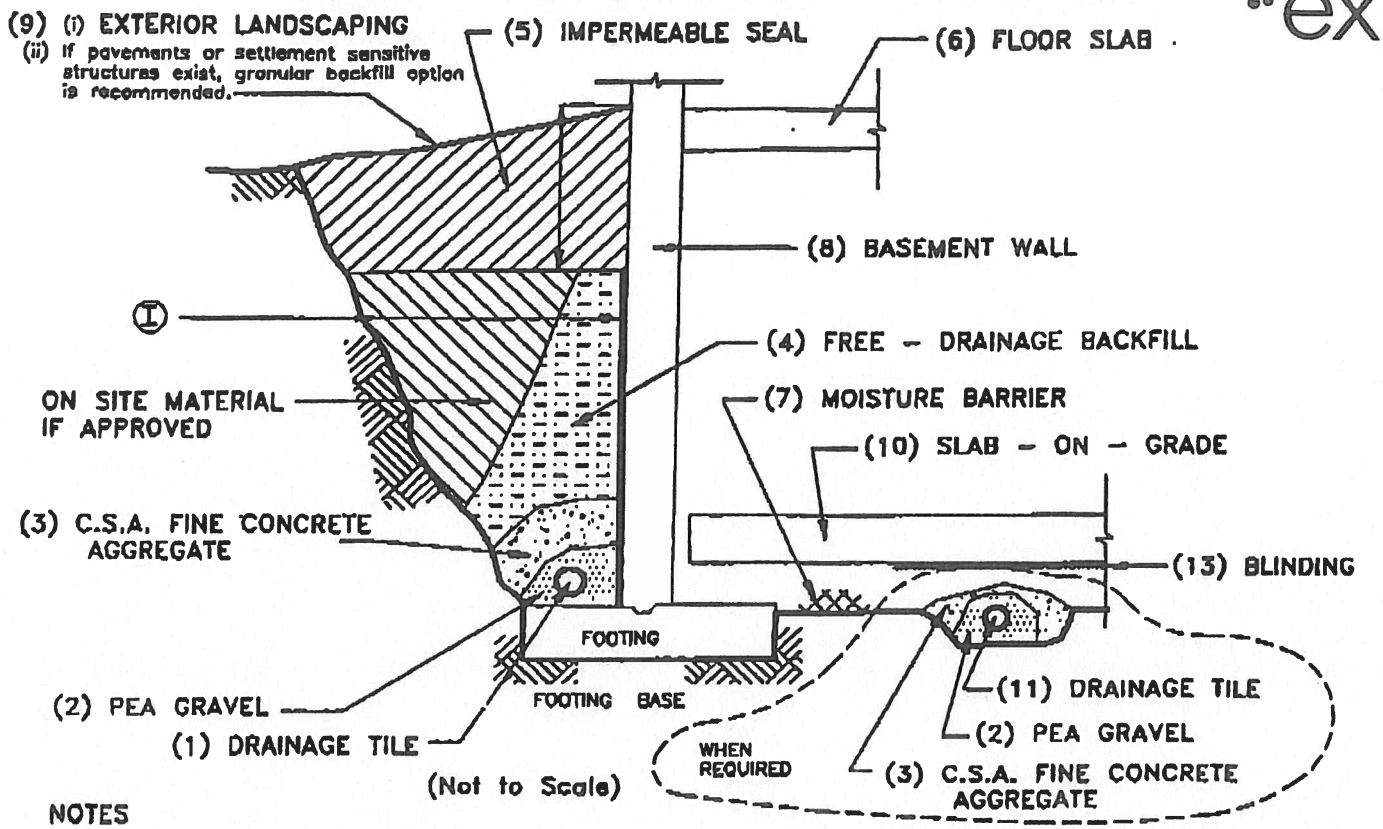
Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

Exp Project No.:	**OTT-00214936-B0**	**Project Name :**	**Preliminary Geo Investigation**		
Client :	**1147310 Ontario Inc.**	**Project Location :**	**112 Montreal Road**		
Date Sampled :	**October 24, 2013**	**Borehole No.**	**9**	**SAMPLE**	**SS5**
Depth (m) :	**1.8-2.4**				
Sample Description :	**Gravel, Some Silt and Sand**			**Figure :**	**15**

BASEMENT DRAINAGE DRAWING



NOTES

OPTION A – GRANULAR BACKFILL

1. Drainage tile to consist of 100mm (4 in.) diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be minimum of 150mm (6 in.) below underside of floor slab.
2. Pea gravel 150mm (6 in.) top and sides of drain. If drain is not on footing, place 100mm (4 in.) of pea gravel below drain. 20mm (3/4 in.) clear stone may be used provided it is covered by an approved porous geotextile membrane (Terrafix 270R or equivalent).
3. C.S.A. fine concrete aggregate to act as filter material. Minimum 300mm (12 in.) top and sides of drain. This may be replaced by an approved porous geotextile membrane (Terrafix 270R or equivalent).
4. Free-draining backfill – OPSS Granular B or equivalent compacted to 93 to 95 (maximum) percent Standard Proctor density. Do not compact closer than 1.8m (6 ft.) from wall with heavy equipment. Use hand controlled light compaction equipment within 1.8m (6 ft.) of wall.
5. Impermeable backfill seal of compacted clay, clayey silt or equivalent. If original soil is free-draining seal may be omitted.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to consist of compacted 20mm (3/4 in.) clear stone or equivalent free-draining material. Layer to be 200mm (8 in.) minimum thickness.
8. Basement walls to be damp-proofed.
9. Exterior grade to slope away from wall.
10. Slab-on-grade should not be structurally connected to wall or footing.
11. Underfloor drain invert to be a least 300mm (12 in.) below underside of floor slab. Drainage tile placed in parallel rows 6 to 8m (20 to 25ft.) centres one way. Place drain on 100mm (4 in.) of pea gravel with 150mm (6 in.) of pea gravel top and sides. CSA fine concrete aggregate to be provided as filter material or an approved geotextile membrane (as in 2 above) may be used.
12. Do not connect the underfloor drains to perimeter drains.
13. If the 20mm (3/4 in.) clear stone requires surface blinding, use 6mm (1/4 in.) clear stone chips.

NOTE: A) Underfloor drainage can be deleted where not required (see report).

OPTION B – CORE DRAIN

Prefabricated continuous wall drains (I) may be installed and Zone 4 backfilled with on site material compacted to 93 – 95% proctor. Further cost savings may result by placing the wall drains at equal distance strips no greater than 2.5m spacing but the risks of water leakage must by assessed and then assumed by the client.

1. Wall drain option (I) may increase the lateral pressures above those of the conventional detail.
2. The use of waterproofing details at construction and expansion joints may also be required.
3. For Block walls or unreinforced cast in place concrete, the granular backfill option is recommended

Note: If water table exists above the floor slab, then options of granular in combinations with the wall drain should be reviewed

List of Distribution

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