Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

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Hydrogeological Assessment

Proposed Residential Development
760 River Road
Ottawa, Ontario

Prepared For

Claridge Homes

October 16, 2019

Report PH3939-REP.01

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by Claridge Homes to prepare a hydrogeological assessment for the proposed residential development to be located at 760 River Road in Ottawa, Ontario (refer to Figure 1 - Key Plan within Appendix 1).

Subsurface information was obtained from the geotechnical investigation carried out to determine the subsoil and groundwater conditions at the site by means of test holes.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains the investigation findings and includes hydrogeological assessments pertaining to the proposed program as understood at the time of writing this report.

1.1 Proposed Project

It is our understanding that the proposed residential development, to be located on the west side of River Road and north of Rideau Road, consists of the municipal address 760 River Road. The proposed development will consist of single family residential dwellings with paved parking areas and local roadways, as well as landscaped areas. It is anticipated that the site will be municipally serviced, including a stormwater management pond (SWMP). It is understood at the time of report preparation, the SWMP has already been constructed for the proposed development.

2.0 SITE CONDITIONS

Physical Setting

At the time of the geotechnical investigation, the subject site was undeveloped and in the initial grading stages for the proposed residential development. Access roads and fill piles had been observed throughout the site. A sales centre for the future residential development and an associated gravel parking lot was noted to be under construction within the southeast corner of the subject site. Prior to any of the current works noted above, the site was predominantly grass and tree covered.

A drainage ditch has been identified transecting the eastern and southern portion of the subject site and drains in a southwesterly direction towards the Rideau River. The ground surface is relatively flat within the eastern portion of the subject site, with average elevations of 87.5 m above sea level (asl) and at a slightly lower elevation than River Road. Overall, the site slopes down towards the Rideau River to an elevation of approximately 80 m asl. Although there are no named water bodies known to exist on the subject site, the northwest corner of the subject site is located within the Rideau River flood plain. The subject site is bordered to the north by agricultural land with forested areas, to the east by River Road, to the south by agricultural and residential properties and to the west by residential properties and the Rideau River.

According to available mapping, the subject site is located in the Ottawa Valley Clay Plains physiographic region. The region is characterized by relatively flat clay plains, which is generally consistent with field observations at the subject site.

2.1 Geology

Surficial Geology

The field program for the geotechnical investigation was carried out on November 1, 2018. A total of 5 boreholes were advanced to a maximum depth of 5.9 m below ground surface (bgs). The borehole locations were distributed in a manner to provide general coverage of the proposed development. The approximate locations of the boreholes are shown on Drawing PG4728-1 - Test Hole Location Plan included in Appendix 2.

Overburden soils identified during the geotechnical field investigation were generally consistent with available mapping for the area. Soils typically consisted of topsoil or fill material underlain by a hard to stiff silty clay crust. A stiff to firm grey silty clay deposit was identified underlying the brown silty clay crust. Practical refusal by dynamic cone penetration testing was observed at a depth of 13.6 m bgs.

Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets included in Appendix 2.

Bedrock

Based on available geological mapping, bedrock in the northern half of the subject site consists of interbedded sandstone and dolostone of the March formation, while the southern half of the subject site consists of dolomite of the Oxford Formation. An overburden drift thickness of 10 to 15 m depth is anticipated for the subject site.

Karst Features

The term “karst” refers to a geologic formation characterized by the dissolution of carbonate bedrock, such as limestone or dolostone. In order for karstification to occur, precipitation must be allowed to infiltrate the top of the bedrock to dissolutionally enlarge previously existing joints and bedding planes. Given the depth of surficial soils overlying the dolostone bedrock that are non-conducive to groundwater infiltration, it is highly unlikely that karstification is occurring.

2.2 Hydrogeology

Existing Aquifer Systems

Aquifer systems may be defined as geological media, either overburden soils or fractured bedrock, which permit the movement of groundwater under hydraulic gradients. Although groundwater has been observed within the overburden soils at the subject site, the composition of materials does not allow for the development of significant water supply wells. Water supply wells in the vicinity are instead likely found in bedrock aquifers.

Bedrock aquifer mapping, provided by Natural Resources Canada Urban Geology of the National Capital Region mapping, was reviewed as part of this assessment. Using this tool, the Oxford formation aquifer system was identified as the only water supply aquifer system in the vicinity of the study area.

The Oxford formation aquifer system is present throughout the study area. Wells completed within this formation at the subject site and in proximity to the site encountered water-bearing fractures a depths typically ranging from 10 m to greater than 50 m bgs.

Groundwater Levels

Groundwater was observed in the piezometers installed in the overburden at the borehole locations. Based on a review of water well records, groundwater is also present in the bedrock at depth.

Groundwater levels in the overburden at the subject site were observed to vary from 0.5 to 1.3 m bgs at the time of the geotechnical field investigation. It should be noted that groundwater levels may have been influenced by surface water infiltrating the backfilled boreholes. It should also be noted that groundwater levels can fluctuate both seasonally and in conjunction with precipitation events. As such, long-term groundwater levels are also estimated based on other factors such as colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level at the subject site is expected to range from approximately 4 to 5 m bgs.

Hydraulic Gradients

Vertical hydraulic gradients were not measured at the subject site as the previous studies completed did not warrant the installation of monitoring well nests.

With respect to horizontal hydraulic gradients, due to the nature of the water levels obtained from field work conducted at the site (piezometers), the absolute direction of horizontal hydraulic gradients was not determined. However, using the available data, it was possible to approximate the horizontal hydraulic gradients in the overburden material given that the horizontal hydraulic gradient between any 2 points is the slope of the hydraulic head between those points:

$$i=h2-h1/L$$

Where: i=horizontal hydraulic gradient
h=water level (m bgs)
L=horizontal distance between test hole locations

Using the above noted formula, the horizontal hydraulic gradient was observed to have an approximate south orientation and a magnitude ranging from 0.001 to 0.004. Shallow groundwater flow in the vicinity of the subject site is expected to reflect local topography. Regional groundwater flow is considered to be in a westerly direction, towards the Rideau River.

Hydraulic Conductivity

The hydraulic conductivity values were conservatively estimated based upon previous experience at similar sites in the area, information obtained from the results of the geotechnical field program and typical published values for similar stratigraphy. The values are interpreted to be in the order of 1×10^{-7} to 1×10^{-9} m/sec for brown silty clay and 1×10^{-9} to 1×10^{-12} m/sec for grey silty clay.

Groundwater Recharge and Discharge

In general, groundwater will follow the path of least resistance from areas of higher hydraulic head to areas of lower hydraulic head. While upward and downward hydraulic gradients may be indicative of discharge and recharge respectively, other factors must be considered.

Based on the hydraulic conductivity estimates obtained from previous studies and published literature, the silty clay overburden is generally considered to act as a confining layer. It is our interpretation that groundwater will generally flow laterally through the upper layer of the weathered brown silty clay, as opposed to vertically downwards through overburden soils with lower hydraulic conductivity such as the grey silty clay. As such, the volume of recharge occurring within the site boundaries is expected to be minimal.

Groundwater at the subject site will generally flow laterally through the weathered brown silty clay towards topographically low areas, such as the Rideau River. As such, it is our interpretation that the topographical and geological conditions are suitable for minor discharge to be occurring at the western boundary of the subject site.

3.0 POTENTIAL IMPACTS

3.1 Adverse Effects on Adjacent Structures

The overburden in the area generally consists of topsoil or fill material underlain by a hard to stiff silty clay crust. A stiff to firm grey silty clay deposit was identified underlying the brown silty clay crust. The potential dewatering volumes due to groundwater infiltration into the excavation footprints are anticipated to be minimal due to the low hydraulic conductivity of the silty clay. Additionally, given the nature of the development (low lying residential housing and associated servicing), the duration of any excavation on site is expected to be short term in duration. As such, any effects related to ground surface settlement due to the water taking activities during construction are expected to be negligible.

3.2 Adverse Effects on Neighbouring Water Wells

A search of the Ontario Water Well Records online mapping database indicates there are 51 wells within 500 m of the site as depicted on Drawing P3939-1 - MECP Water Well Location Plan included in Appendix 1. While the majority of the water supply wells extended to the bedrock aquifer, a total of 6 wells were noted to be screened in the glacial till between 12.8 and 25 m bgs. However, the above noted wells extend well beyond the maximum depth of any excavation that may take place as part of the proposed development. Construction activities at the site are therefore not expected to cause any interference to the water supply of surrounding properties or other negative impacts.

A series of calculations were carried out on theoretical radii of influence for a typical servicing trench excavation withdrawing water from the upper 2 to 3 m of the saturated zone. These calculations were completed based on Sichardt (1992) using the equation:

$$R = r_e + 3000*\Delta h(k^{0.5})$$

- R = radius of influence (m)
- r_e = equivalent radius of excavation (m)
- Δh = thickness of drawdown within the aquifer (m)
- k = hydraulic conductivity (m/sec)

For the purposes of completing the calculations, the following assumptions were made:

- ❏ r_e = 9.55 m
- ❏ k = 1 x 10^{-7} m/sec, based upon our experience in the area and published values.
- ❏ Δh = 2 to 3 m, to review potential minimum/maximum variable conditions.

Using the above equation and assumptions, a radius of influence of approximately 2 to 3 m will develop as a steady state condition, extending from the edge of the excavation, in the area of the subject site.

Given the hydrogeological characteristics of the subject site, the theoretical radii of influence for the potential excavations related to the development and the depth of the water supply wells within 500 m, a long-term groundwater monitoring program is not required to be implemented based on our review.

In the interest of public perception, consideration may be given to undertaking a baseline subdivision sampling program. The premise of the program is to obtain groundwater quality information from the water supply wells in the vicinity of the proposed development prior to the project commencing. This ensures that all parties involved (developer, homeowner and City of Ottawa) are protected should a concern arise during or after construction.

3.3 Groundwater

A search of the MECP Brownfields Environmental Site Registry was conducted as part of the assessment of the site, neighbouring properties and the general area of the site. Using a search radius of 1 km provided no recorded Brownfield sites in that area. No concerns were identified in the review of the MECP Brownfields database.

It is anticipated that the material on site will be disposed of or re-used as per the MECP policy, *Management of Excess Soil - A Guide for Best Management Practices* dated January, 2014.

The groundwater that is pumped from site excavations must be managed in an appropriate manner. The contractor will be required to implement a water management program to dispose of the pumped water.

4.0 STATEMENT OF LIMITATIONS

The recommendations provided in this report are in accordance with our present understanding of the project.

A hydrogeological review of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Claridge Homes or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Nicholas Zulinski, P.Geo.

Michael Laflamme, P.Geo.

APPENDIX 1

Figure 1 - Key Plan

Drawing PH3939-1 - MECP Water Well Location Plan

FIGURE 1

KEY PLAN

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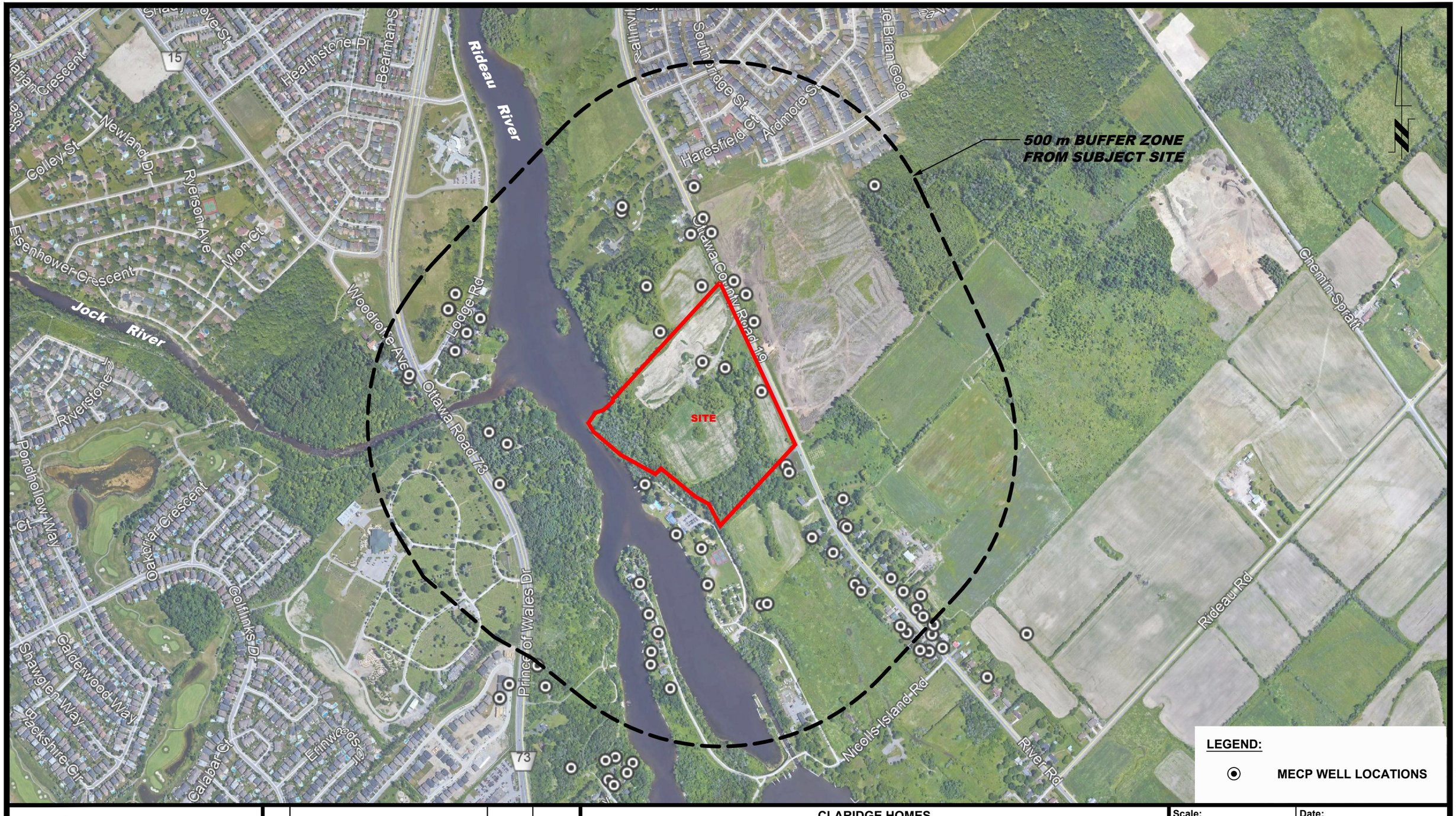

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NO.	REVISIONS	DATE	INITIAL

CLARIDGE HOMES

HYDROGEOLOGICAL ASSESSMENT
760 RIVER ROAD

OTTAWA, ONTARIO

Title:

MECP WATER WELL LOCATION PLAN

Scale: 1:8000	Date: 10/2019
Drawn by: YA	Report No.: PH3939-REP.01
Checked by: NZ	Dwg. No.: **PH3939-1**
Approved by: CDS	Revision No.:

p:\autocad drawings\hydrogeology\ph39xx\ph3939\ph3929-1-mecp water well location plan.dwg

11x17

APPENDIX 2

Soil Profile and Test Data

Drawing PG4728-1 - Test Hole Location Plan

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

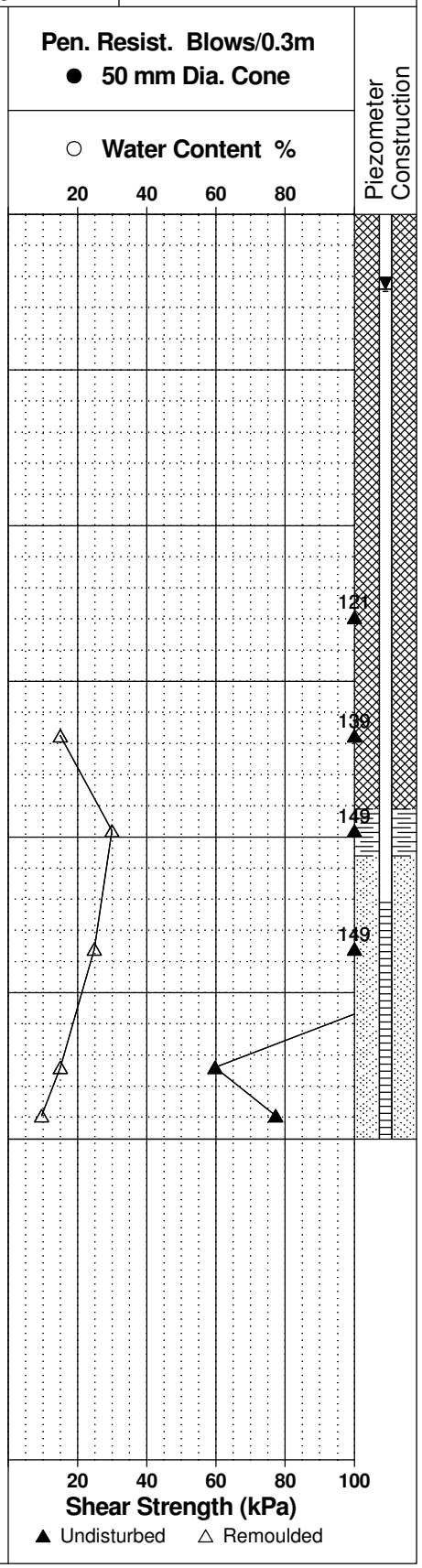
FILE NO. PG4728

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.09
FILL: Brown silty clay with sand and gravel		AU	1				
0.60							
		SS	2	62	6	1	87.09
		SS	3	96	5	2	86.09
Very stiff to stiff, brown **SILTY CLAY**		SS	4	96			
		SS	5	50		3	85.09
						4	84.09
						5	83.09
- grey by 5.5m depth							
5.94							
End of Borehole							
(GWL @ 0.48m - Nov. 13, 2018)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

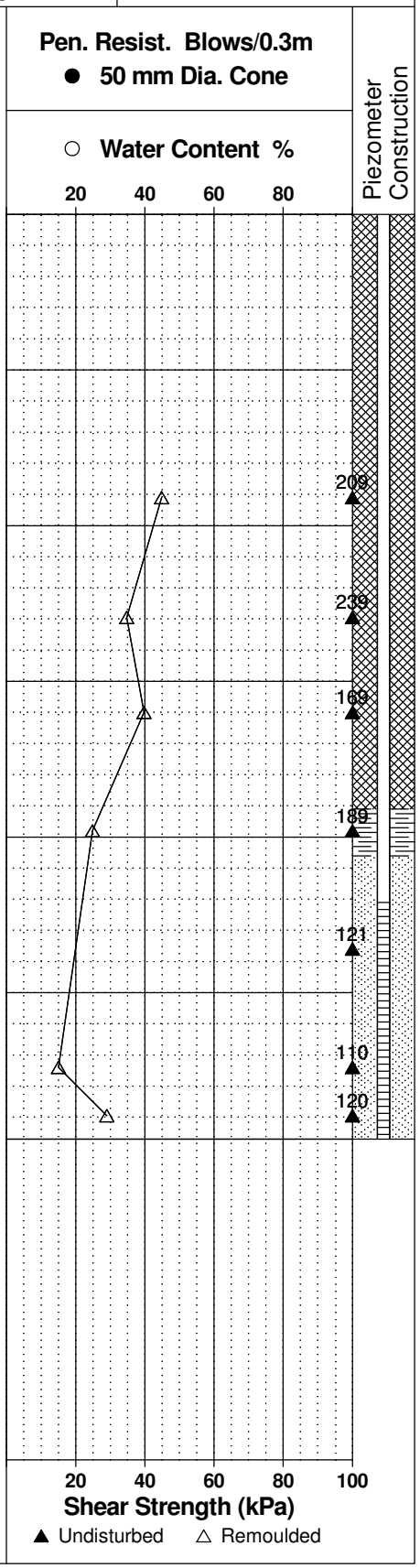
FILE NO. PG4728

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.63
FILL: Brown silty clay, trace gravel		AU	1				
0.60							
		SS	2	96	4	1	86.63
		SS	3	96		2	85.63
Hard to very stiff, brown **SILTY CLAY**		SS	4	96		3	84.63
						4	83.63
						5	82.63
5.94							
- grey by 5.9m depth							
End of Borehole							
(Piezometer damaged - Nov. 13, 2018)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

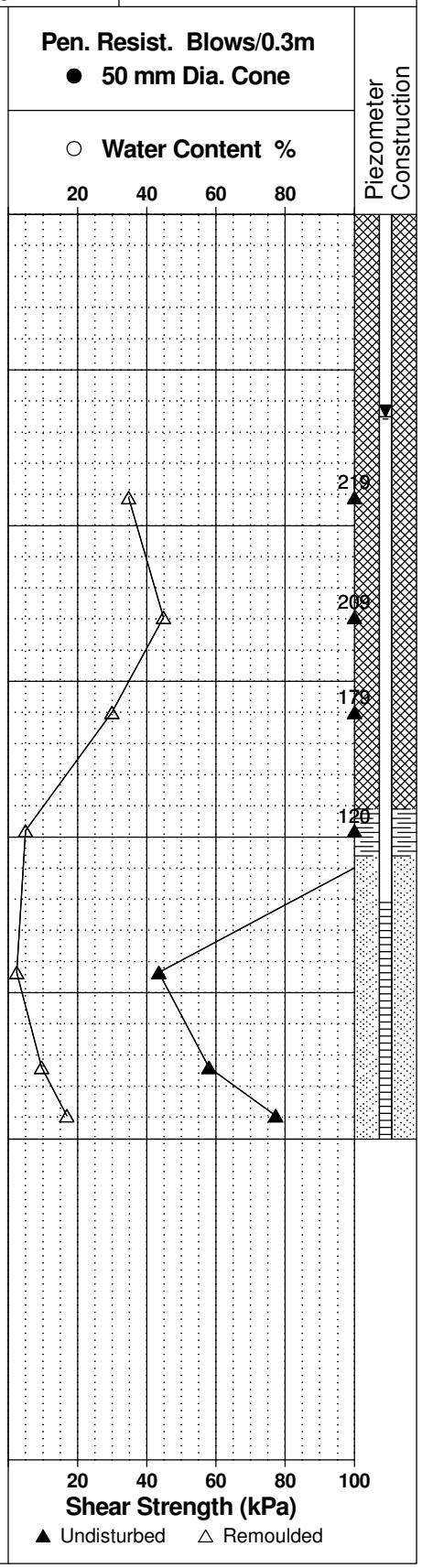
FILE NO. PG4728

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.55
FILL: Brown silty clay with organics		AU	1				
0.60							
		SS	2	96	4	1	86.55
		SS	3	96		2	85.55
Hard to very stiff, brown **SILTY CLAY**		SS	4				
						3	84.55
						4	83.55
- firm to stiff and grey by 4.6m depth		SS	5	88			
						5	82.55
5.94							
End of Borehole							
(GWL @ 1.30m - Nov. 13, 2018)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

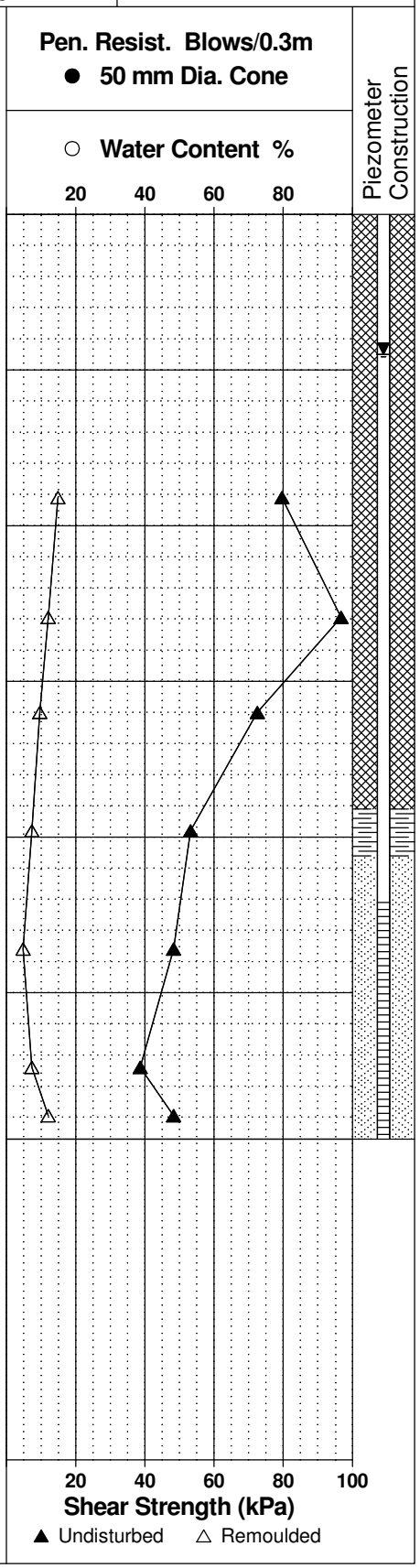
FILE NO. PG4728

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.65
FILL: Brown silty clay, trace organics		AU	1				
0.60							
		SS	2	88	4	1	86.65
		SS	3	79		2	85.65
Stiff to firm, brown **SILTY CLAY**		SS	4	96			
						3	84.65
- grey by 3.0m depth						4	83.65
						5	82.65
5.94							
End of Borehole							
(GWL @ 0.90m - Nov. 13, 2018)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

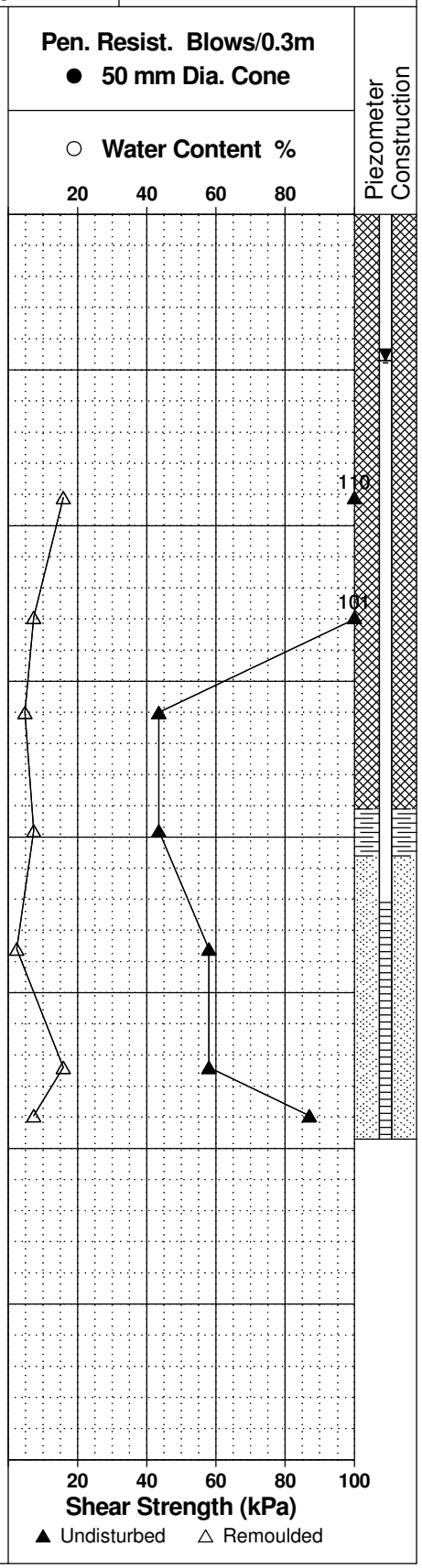
FILE NO. PG4728

REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.01
TOPSOIL, trace gravel							
0.30		AU	1				
		SS	2	71	4	1	86.01
		SS	3	67		2	85.01
Very stiff to stiff, brown **SILTY CLAY**		SS	4	96			
- firm to stiff, and grey by 3.0m depth						3	84.01
						4	83.01
						5	82.01
5.94						6	81.01
Dynamic Cone Penetration Test commenced at 5.94m depth. Cone pushed to 11.6m depth.						7	80.01
						8	79.01



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 760 River Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

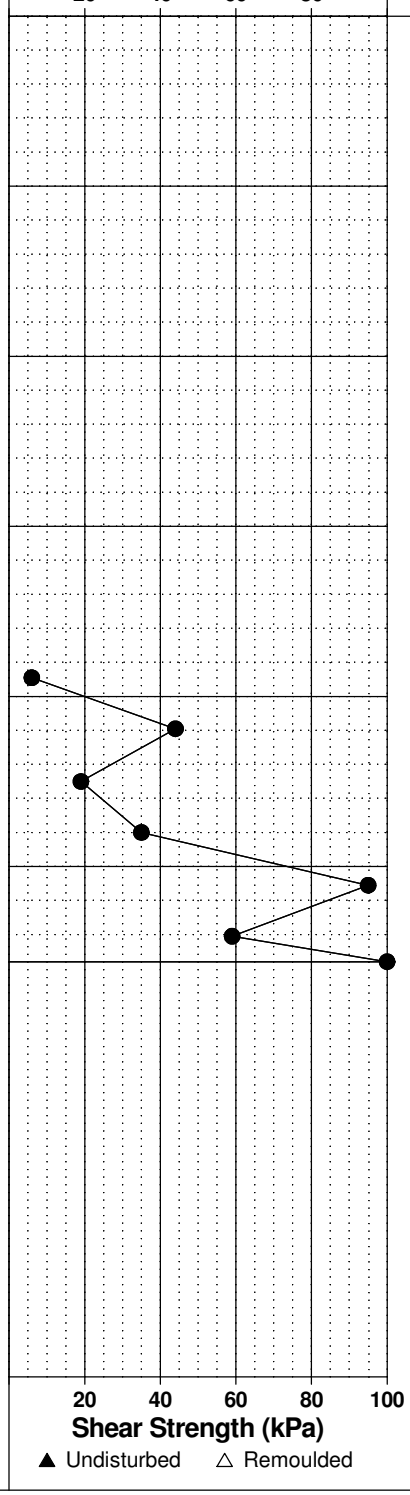
FILE NO. PG4728

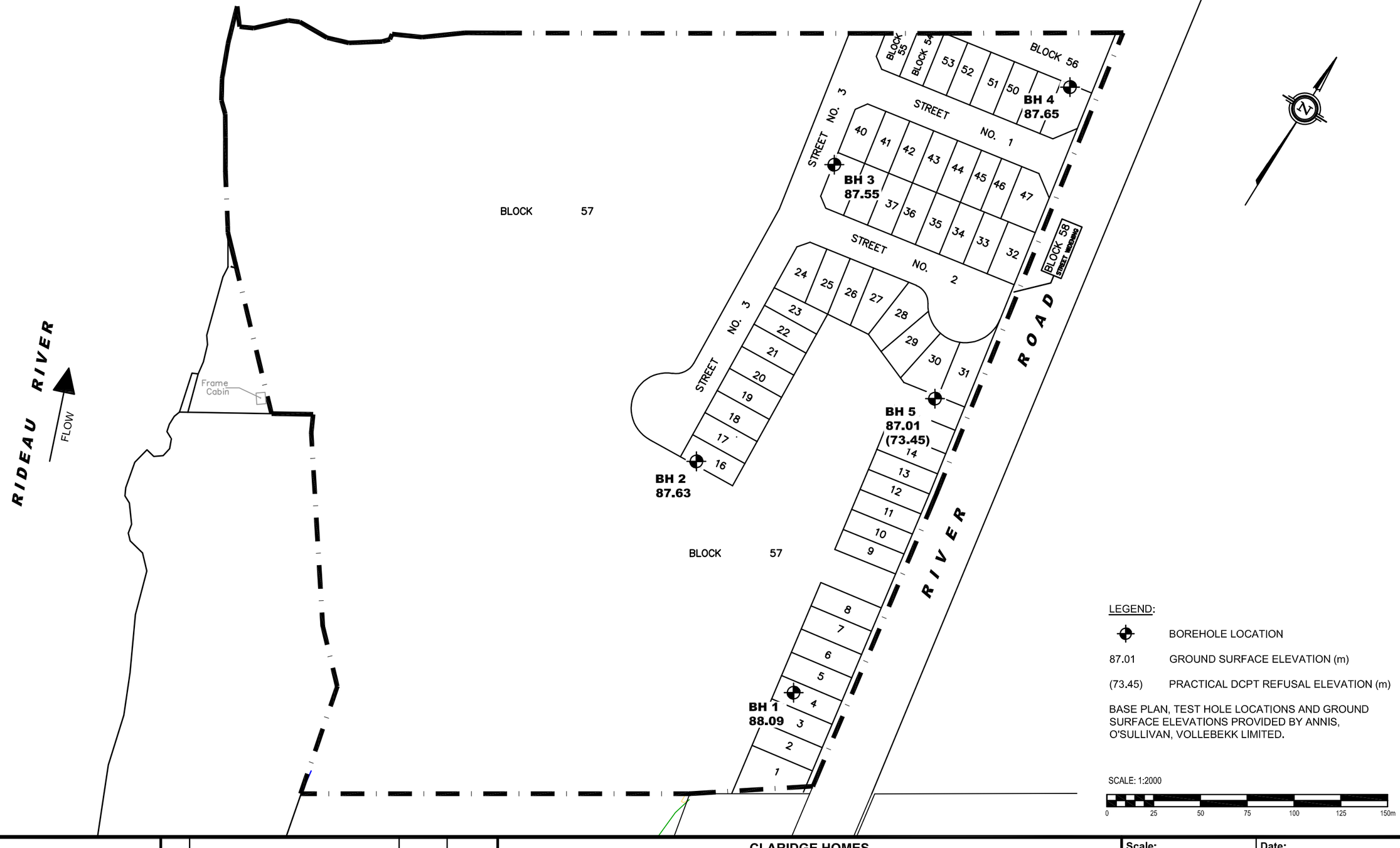
REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** November 1, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						8	79.01		
						9	78.01		
						10	77.01		
						11	76.01		
						12	75.01		
						13	74.01		
13.56									
End of Borehole									
Practical DCPT refusal at 13.56m depth									
(GWL @ 0.94m - Nov. 13, 2018)									





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NO.	REVISIONS	DATE	INITIAL
0			

CLARIDGE HOMES

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - 760 RIVER ROAD
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 11/2018
Drawn by: MPG	Report No.: PG4728-1
Checked by: NZ	Dwg. No.: PG4728-1
Approved by: DJG	Revision No.: 0

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APPENDIX 3

Annis, O'Sullivan, Vollebekk Limited - Draft Plan of Subdivision

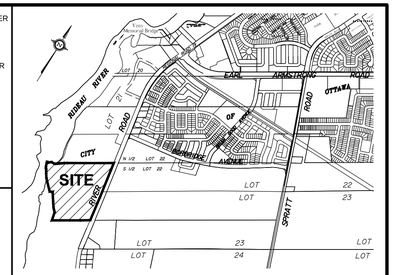
SUBJECT TO THE CONDITIONS, IF ANY, SET FORTH IN OUR LETTER DATED

_____.

THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT, THIS _____ DAY OF _____, 20__.

_____

DON HERWEYER, MCIP RPP, MANAGER
DEVELOPMENT REVIEW-SOUTH
PLANNING, INFRASTRUCTURE AND ECONOMIC
DEVELOPMENT DEPARTMENT, CITY OF OTTAWA



KEY MAP
NOT TO SCALE

DRAFT PLAN OF SUBDIVISION OF

PART OF LOTS 22 And 23
BROKEN FRONT CONCESSION
RIDEAU FRONT
Geographic Township of Gloucester
CITY OF OTTAWA

Prepared by Annis , O'Sullivan , Vollebekk Ltd.

Scale 1 : 1000

40 30 20 10 0 20 40 Metres

Metric

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :
The boundaries of the lands to be subdivided and their relationship to adjoining lands have been accurately and correctly shown.

_____ Date

_____
Andre Roy
ONTARIO LAND SURVEYOR

OWNER'S CERTIFICATE

This is to certify that we are the owners of the lands to be subdivided and that this plan was prepared in accordance with our instructions.

_____ Date

_____
Jim Burghout
Authorized Signing Officer
Claridge Homes Corporation
I have the authority to bind the corporation.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51-17 OF THE PLANNING ACT

(a) see plan
(b) see plan
(c) see plan
(d) single family residential housing and storm water management lands
(e) see plan
(f) see plan
(g) see plan
(h) City of Ottawa
(i) see soils report
(j) see plan
(k) sanitary, storm sewers, municipal water, bell, hydro, cable and gas to be available
(l) see plan

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14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com

Ontario Land Surveyors

Job No. 18590-17 Claridge Pt Lts 22 23 BF GL DPS D2 | N