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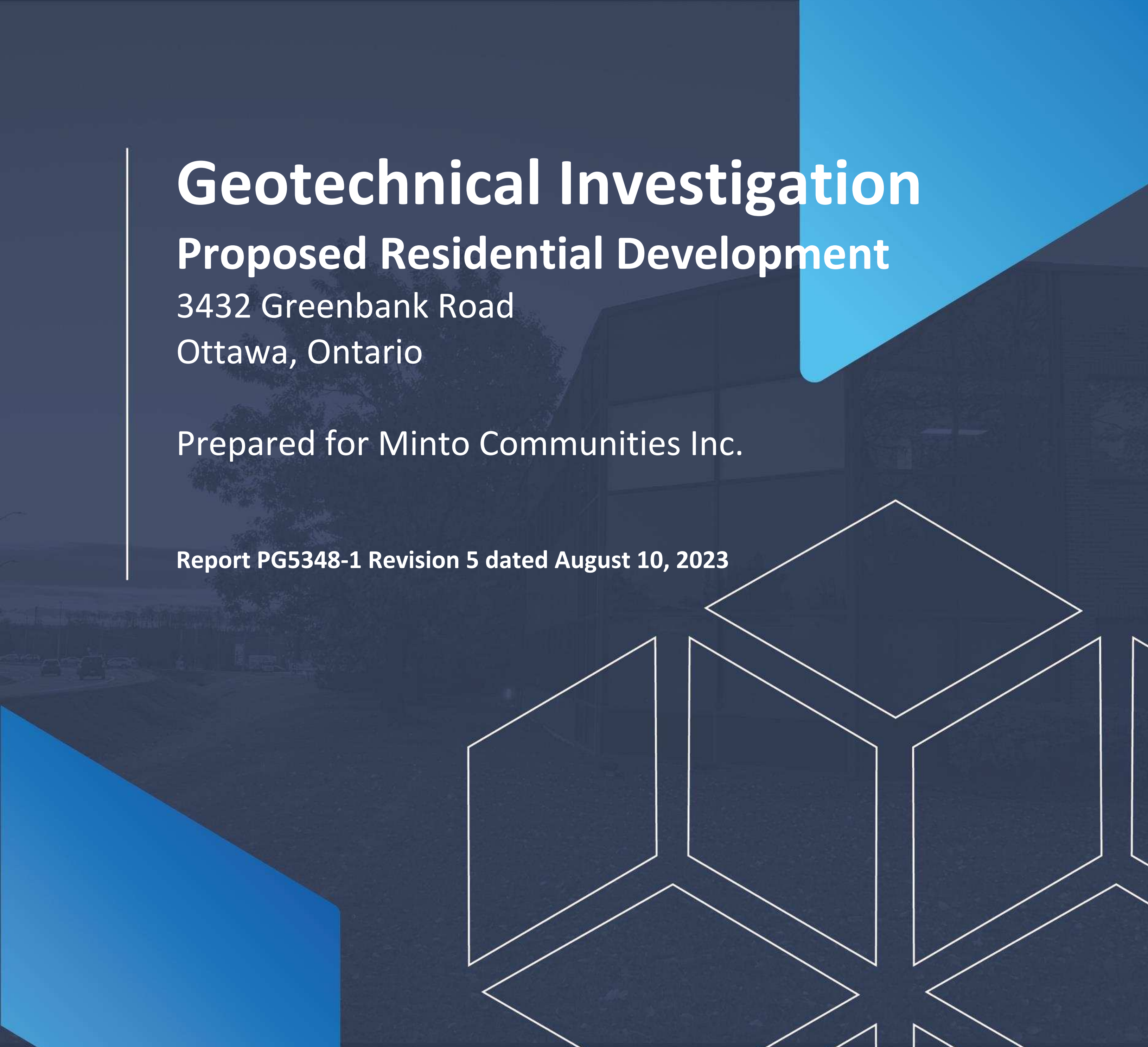


Geotechnical Investigation

Proposed Residential Development

3432 Greenbank Road
Ottawa, Ontario

Prepared for Minto Communities Inc.

Report PG5348-1 Revision 5 dated August 10, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Minto Communities Inc. to undertake a geotechnical investigation for the proposed residential development to be located at 3432 Greenbank Road in the City of Ottawa, Ontario (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

❑ Determine the subsoil and groundwater conditions at this site by means of test holes.

❑ Provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

This report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject site was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed residential development will consist of a combination of two to three-storey townhouses and single family residential dwellings with associated parks, roadways, local access lanes and driveways. It is expected the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on December 9, 10 and 13, 2021 and consisted of advancing 10 boreholes to a maximum depth of 5.1 m below the existing ground surface.

Several previous geotechnical investigations were conducted within the subject site between May 2015 and February 2021. A total of 10 boreholes and 24 test pits were advanced to a maximum of 15.9 and 6.1 m below the ground surface. The test hole locations for the current and preliminary investigations were distributed in a manner to provide general coverage of the subject site. The approximate locations of the boreholes are shown on Drawing PG5348-1 - Test Hole Location Plan in Appendix 2.

Boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. The test pits were completed using a hydraulic excavator at the selected locations and backfilled with the excavated soil upon completion. The test hole procedure consisted of augering or excavating to the required depths at the selected locations and sampling the overburden soils. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department.

Sampling and In Situ Testing

Soil samples collected from the boreholes were either recovered directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. Soil samples collected from the test pits were recovered from the side walls of the open excavation as grab samples. All soil samples were visually inspected and initially classified on site.

The auger and split-spoon samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the auger, split spoon and grab samples were recovered from the test holes are shown as AU, SS and G, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was carried out in cohesive soils using a field vane apparatus.

Overburden thickness was evaluated during the course of a previous investigation by dynamic cone penetration testing (DCPT) at BH5-20 and BH7-20. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment. Due to the low resistance exerted by the silty clay in some boreholes, the cone was often pushed using the hydraulic head of the drill rig until resistance to penetration was encountered. The hammer was then used to further advance the cone to practical refusal.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Monitoring wells were installed in boreholes BH 1-21 to BH 10-21 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. Flexible polyethylene standpipes were installed in select boreholes to permit the monitoring of groundwater levels subsequent to the completion of the field program. Where observed, the depth of groundwater infiltration noted along the test pit sidewalls and/or excavation bases were recorded in detail at the time of the current test pit investigation.

Monitoring Well Installation

Typical monitoring well construction details are described below:

- ☐ Slotted 32 mm diameter PVC screen at the base of each borehole.
- ☐ 51 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- ☐ No. 3 silica sand backfill within annular space around screen.
- ☐ Bentonite hole plug directly above PVC slotted screen.
- ☐ Clean backfill from top of bentonite plug to the ground surface.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific well construction details.

Groundwater Monitoring

All Monitoring wells were equipped with Van Essen Instrument TD-Diver water level dataloggers to continuously monitor fluctuations in the groundwater levels. The dataloggers were programmed to continuously measure and record groundwater levels at a minimum rate of one (1) reading every twenty-four (24) hours. In addition to the continuous datalogger measurements, manual water level measurements were periodically taken throughout the groundwater monitoring program using an electronic water level meter. The groundwater monitoring results are presented in Figures 2-11 - Monitoring Well Water Elevations sheets in Appendix 1.

Hydraulic Conductivity Testing

Hydraulic conductivity testing was completed in select monitoring wells installed during the subsurface investigations. Falling head and rising head tests (“slug tests”) were completed in accordance with ASTM Standard Test Method D 4404 - Field Procedure for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers. Slug Test Results are presented in Appendix 1.

Slug testing was completed in December 2021 by Paterson personnel. The general test method consisted of the measurement of the static water level in the well, followed by inducing a near-instantaneous change of head in the monitoring well and subsequent monitoring of water level recovery with an electronic water level tape and a Mini Diver water level logger. The change in head was induced by the introduction of a metal slug, either 1 m in length and 38 mm in diameter, or 1 m in length 19 mm in diameter, depending on the well diameter. The slug was introduced to raise the groundwater level in the monitoring well, following which the decrease in water level over time was monitored (falling head test). Once the water level had stabilized (or nearly stabilized), the slug was then removed to lower the groundwater level, following which the increase in water level over time was monitored (rising head test).

Following the completion of the slug tests, the test data was analyzed as per the method set out by Hvorslev (1951). Assumptions inherent in the Hvorslev method include a homogeneous and isotropic aquifer of infinite extent, zero-storage assumption, and a screen length significantly greater than the monitoring well diameter. The assumption regarding aquifer storage is considered to be appropriate for groundwater flow through the overburden and bedrock aquifer. The assumption regarding screen length and well diameter is considered to be met based upon a typical length of approximately 1.5 m and a diameter of 0.03 to 0.05 m.

While the idealized assumptions regarding aquifer extent, homogeneity, and isotropy are not strictly met in this case (or in any real-world situation), it has been our experience that the Hvorslev method produces effective point estimates of hydraulic conductivity in conditions similar to those encountered at the subject site. Hvorslev analysis is based on the line of best fit through the field data (hydraulic head recovery vs. time), plotted on a semi-logarithmic scale. In cases where the initial hydraulic head displacement is known with relative certainty, such as in this case where a physical slug has been introduced, the line of best fit is considered to pass through the origin. In cases where the initial hydraulic head displacement is known with less certainty (e.g. a bail test, where water is pumped rapidly from the well), the best-fit line is drawn regardless of the origin.

3.2 Field Survey

The locations and the ground surface elevation at the test hole locations were recovered in the field by Paterson personnel. The ground surface elevations were determined in the field using a handheld GPS unit and are referred to a geodetic datum. The ground surface elevation at each borehole location in the previous investigation completed by others are understood to be referenced to a geodetic datum.

The locations of the test holes and the ground surface elevation at the test hole location are presented on Drawing PG5348-1 - Test Hole Location Plan included in Appendix 2.

3.3 Laboratory Review

The soil samples recovered from the test holes were examined in our laboratory to review the results of the field logging.

A total of three (3) grain size distribution analysis and one (1) Atterberg limit test were completed on selected soil samples recovered during the current investigation. In addition, a total of three (3) grain size distribution analysis and 10 Atterberg limit tests were completed on selected soil samples recovered as part of previous investigations. The results are presented in Subsection 4.2 and on Grain Size Distribution and Hydrometer testing, and Atterberg Limit Results presented in Appendix 1.

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential for sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity, and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently undeveloped and is primarily used for agricultural purposes. The site is relatively flat with a gradual upward slope towards the centre of the site. Four drainage ditches were observed in a north-south orientation along with some tree lines along the ditches and northern property boundary. The site is bordered to the east by Greenbank Road, to the south by a residential subdivision and to the north and west by vacant lands. Jock River meanders throughout the vacant lands to the north and east of the subject site.

4.2 Subsurface Profile

Overburden

East Portion

Generally, the subsurface profile encountered at the test holes locations (BH 1-20 to BH 3-20, TP 1-21 to TP 3-21, TP 16-21 and TP 19-21) at the east portion of the site consists of a topsoil followed by compact to very dense silty sand and/or glacial till. The glacial till layer consisting of dense to very dense silty sand with gravel, cobbles and boulders.

Practical refusal to augering was encountered at all boreholes within the east portion of the site at depths ranging between 1.4 and 4.7 m below existing grade. Practical refusal to excavation was encountered at TP 1-20 at a depth of 3.4 m below existing grade. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

West Portion

Generally, the subsurface profile encountered at the remaining test hole locations throughout the remainder of the subject site consists of a thin layer of topsoil and/or silty sand with clay overlying a silty clay deposit. The upper portion of the silty clay consists of stiff brown silty clay while the lower portion consists of firm grey silty clay. Practical refusal to DCPT was encountered at a depth of 8.9 and 12.6 m below the existing grade at BH 5-20 and BH 7-20, respectively. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Grain Size Distribution and Hydrometer Testing

The results of the soil samples submitted for grain size analysis from the test holes from the current and previous investigations are summarized in Table 1 and presented on the Grain Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 1 - Summary of Grain Size Distribution Analysis

Test Hole	Sample Depth	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
TP 4-21	G4	0	7	57.2	35.8
TP 8-21	G2	0	11.4	54.8	33.8
TP 12-21	G2	0	28.2	46.2	25.6
BH 3-21	SS3	0	9.5	58.5	32.0
BH 6-21	SS3	0	12.3	59.7	28.0
BH 10-21	SS3	0	1.5	41.5	57.0

Atterberg Limits Testing

Atterberg limits testing, as well as associated moisture content testing, was completed on the recovered silty clay samples at selected locations throughout the subject site. The results are summarized in Table 2 and presented on the Grain Size Distribution sheet in Appendix 1.

Table 2 – Summary of Atterberg Limits Tests

Sample	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
TP 4-21 - G4	26.6	35	18	17	CL
TP 5-21 - G3	31.1	44	21	23	CL
TP 6-21 - G3	28.2	37	19	18	CL
TP 7-21 - G2	29.4	38	20	18	CL
TP 8-21 - G2	29.9	39	24	15	CL
TP 9-21 - G2	28.6	35	22	13	CL
TP 10-21 - G2	30.2	35	19	16	CL
TP 11-21 - G2	29.8	36	18	18	CL
TP 12-21 - G2	29.2	38	19	19	CL
TP 13-21 - G2	32.6	42	21	21	CL
BH 10-21 SS2	27.8	33	23	10	CL

Notes: CL: Inorganic Clay of Low Plasticity

The shrinkage limit and ratio of the tested soil sample (TP 4-21) are 16.7 percent and 1.87, respectively.

Bedrock

Based on available geological mapping, the bedrock in this area consists of interbedded limestone and dolomite of the Gull River formation with an overburden drift thickness of 5 to 15 m depth.

Clay Continuity

The boreholes completed within the western portion of the subject site are in conformance with the City of Ottawa borehole spacing guidelines. The native silty clay soils within the study area are considered to be laterally continuous. The boreholes within this portion of the subject site identify a silty clay deposit at the majority of the borehole locations at similar elevations throughout. Therefore, the silty clay deposit is continuous across the proposed western side of the subject development. Reference should be made to the attached Drawing PG5348-2 - Permissible Grade Raise Plan and on Drawing PG5348-3 - Tree Planting Setback Areas in Appendix 2.

4.3 Groundwater

Groundwater levels were measured at the standpipe piezometers at the borehole locations on May 22, 2020 and at the monitoring wells on December 20 and 21, 2021, February 28, 2023, and May 29, 2023. Depths of sidewall groundwater infiltration, as observed during the test pit investigation, were also recorded. The majority of the test pits were dry upon completion with the exception of some minor infiltration noted where test pits were carried out below the long-term groundwater table. The measured groundwater levels in the piezometers, monitoring wells, and groundwater infiltration at the test hole locations are presented in Table 3. It is important to note that groundwater readings at piezometers can be influenced by surface water perched within the borehole backfill material.

The long-term groundwater level can also be estimated based on observations of the recovered soil samples, such as moisture levels, colouring and consistency. Based on these observations, **the long-term groundwater table is anticipated to be at a depth of approximately 2.5 to 3.5 m below the existing ground surface.**

Table 3 – Summary of Groundwater Levels

Test Hole Number	Method	Ground Surface Elevation (m)	Measured Groundwater Level		Date
			Depth (m)	Elevation (m)	
BH 1A-20	Piezometer	91.53	Blocked	n/a	May 22, 2020
BH 2-20	Piezometer	91.78	1.67	90.11	May 22, 2020
BH 3-20	Piezometer	94.08	-	n/a	May 22, 2020
BH 4-20	Piezometer	92.17	5.10	87.07	May 22, 2020
BH 5-20	Piezometer	91.99	1.49	90.50	May 22, 2020
BH 6-20	Piezometer	91.78	1.16	90.62	May 22, 2020
BH 7-20	Piezometer	92.04	1.02	91.02	May 22, 2020
TP 14-21	Infiltration	92.35	2.85	89.50	February 3, 2021
TP 15-21	Infiltration	93.30	1.17	92.13	February 3, 2021
TP 17-21	Infiltration	92.49	1.59	90.90	February 3, 2021
TP 19-21	Infiltration	92.26	1.11	91.15	February 3, 2021
TP 20-21	Infiltration	92.04	2.13	89.91	February 3, 2021
TP 21-21	Infiltration	92.13	1.73	90.40	February 3, 2021
TP 22-21	Infiltration	92.26	4.93	87.33	February 3, 2021
TP 23-21	Infiltration	92.06	1.80	90.27	February 3, 2021
BH 1-21	Monitoring Well	92.00	0.78	91.23	December 20, 2021
BH 2-21	Monitoring Well	92.20	1.01	91.19	December 20, 2021
BH 3-21	Monitoring Well	91.95	0.95	91.01	December 20, 2021
BH 4-21	Monitoring Well	91.99	1.09	90.91	December 21, 2021
BH 5-21	Monitoring Well	92.46	1.34	91.12	December 21, 2021
BH 6-21	Monitoring Well	92.27	1.07	91.20	December 21, 2021
BH 7-21	Monitoring Well	91.79	1.00	90.79	December 21, 2021
BH 8-21	Monitoring Well	92.15	1.11	91.04	December 21, 2021
BH 9-21	Monitoring Well	91.59	1.16	90.43	December 21, 2021
BH 10-21	Monitoring Well	92.24	0.84	91.41	December 20, 2021
BH 1-21	Monitoring Well	92.00	0.71	91.3	February 28, 2023
BH 2-21	Monitoring Well	92.20	0.96	91.24	February 28, 2023
BH 3-21	Monitoring Well	91.95	1.01	90.94	February 28, 2023
BH 4-21	Monitoring Well	91.99	1.12	90.87	February 28, 2023
BH 5-21	Monitoring Well	92.46	1.20	91.26	February 28, 2023
BH 6-21	Monitoring Well	92.27	1.09	91.19	February 28, 2023

Table 3 – Summary of Groundwater Levels

Test Hole Number	Method	Ground Surface Elevation (m)	Measured Groundwater Level		Date
			Depth (m)	Elevation (m)	
BH 7-21	Monitoring Well	91.79	1.01	90.78	February 28, 2023
BH 8-21	Monitoring Well	92.15	1.08	91.07	February 28, 2023
BH 9-21	Monitoring Well	91.59	1.54	90.05	February 28, 2023
BH 10-21	Monitoring Well	92.24	0.58	91.67	February 28, 2023
BH 1-21	Monitoring Well	92.00	0.98	91.02	May 29, 2023
BH 2-21	Monitoring Well	92.20	1.22	90.99	May 29, 2023
BH 3-21	Monitoring Well	91.95	1.06	90.89	May 29, 2023
BH 4-21	Monitoring Well	91.99	1.36	90.63	May 29, 2023
BH 5-21	Monitoring Well	92.46	1.32	91.14	May 29, 2023
BH 6-21	Monitoring Well	92.27	1.19	91.09	May 29, 2023
BH 7-21	Monitoring Well	91.79	1.21	90.59	May 29, 2023
BH 8-21	Monitoring Well	92.15	1.23	90.93	May 29, 2023
BH 9-21	Monitoring Well	91.59	1.44	90.15	May 29, 2023
BH 10-21	Monitoring Well	92.24	0.98	91.27	May 29, 2023

NOTE: The ground surface elevations at the test hole location of the current investigation were surveyed by Paterson using a high precision GPS unit and was referenced to a geodetic datum.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, groundwater levels could vary at the time of construction.

4.4 Hydraulic Conductivity Testing

Hydraulic conductivity testing (slug testing) was completed by Paterson as part of the field investigations at the subject site. The test data was analyzed as per the method set out by Hvorslev (1951). The results of the testing yielded hydraulic conductivity values between 2.28 x 10^{-6} and 4.02 x 10^{-5} m/sec for the silty clay, and 4.8 x 10^{-5} to 6.88 x 10^{-5} m/sec for the glacial till. The hydraulic conductivity results are higher than conventional conductivities in silty clay due to the presence of trace sand within the clay. However, it should be noted that the presence of sand decreased with depth. Hydraulic conductivity results are summarized in Table 4 below and have been included in Appendix 2.

Table 4 – Summary of Hydraulic Conductivity Testing Results

Test Hole ID	Ground Surface Elevation (m asl)	Testing Depth Interval (m bgs)	Testing Elevation Interval (m asl)	Hydraulic Conductivity (m/sec)	Test Type	Soil Type
BH1-21	92.00	1.55-3.05	88.95-90.45	4.8x10-5	FH	Silty Clay/ Glacial Till
				6.88x10-5	RH	
BH2-21	92.20	1.55-3.05	89.15-90.65	1.19x10-5	FH	Silty Clay
BH3-21	91.95	1.55-3.05	88.9-90.4	1.62x10-5	RH	Silty Clay
BH4-21	91.99	1.55-3.05	88.94-90.44	1.00x10-5	FH	Silty Clay
BH5-21	92.46	1.55-3.05	89.41-90.91	2.28x10-6	FH	Silty Clay
BH6-21	92.27	1.55-3.05	89.22-90.72	9.66x10-6	RH	Silty Clay
BH7-21	91.79	1.55-3.05	88.71-90.21	3.06x10-5	RH	Silty Clay
BH8-21	92.15	1.55-3.05	89.1-90.6	1.13x10-5	RH	Silty Clay
BH10-21	92.24	1.55-3.05	89.19-90.69	4.02x10-5	RH	Silty Clay

Notes: * **FH**: Falling Head Test ** **RH**: Rising Head Test

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is satisfactory for the current phase of the proposed development. It is anticipated that the proposed buildings will be founded on conventional style shallow foundations placed on an undisturbed, stiff to firm silty clay, glacial till and/or bedrock bearing surface.

Due to the presence of a silty clay deposit throughout the western portion of the site, recommendations have been provided for permissible grade raise and tree planting setback restrictions for the western portion of the subject site. The areas of the grade raise restrictions and tree planting setbacks may be referenced in further detail on Drawing PG5348-2 - Permissible Grade Raise Plan and on Drawing PG5348-3 - Tree Planting Setback Areas, respectively, in Appendix 2.

Further, the area of the clay deposit indicated throughout the western portion of the subject site and on the above-noted drawings is considered acceptable for the implementation of sump pump systems as part of the proposed residential development, from a geotechnical perspective. This will reduce the need for high grade raises which in turn lowers the possibility of differential settlements due to exceedance of grade raise restrictions.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as material containing a high content of organic materials, should be stripped from under the proposed building footprints and other settlement sensitive structures such as roadways and service pipes.

Fill Placement

Fill used for grading beneath the proposed buildings should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building and paved areas should be compacted to at least 98% of the material’s standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite foundation drainage board.

In-filling the existing ditches should be completed in a stepped fashion within the lateral support of the proposed buildings. The fill should consist of clean imported granular fill, such as OPSS Granular A or OPSS Granular B Type II material. The steps should have a minimum horizontal length of 1.5 m and minimum vertical height of 0.5 m and should be compacted using suitable compaction equipment to a minimum 98% of the material's SPMDD.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 6 m wide, placed in an undisturbed, stiff brown silty clay bearing surface or engineered backfill placed on an undisturbed brown silty clay bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa** incorporating a geotechnical factor of 0.5 at ULS.

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed in an undisturbed, firm grey silty clay bearing surface bearing surface can be designed using a bearing resistance value at SLS of **60 kPa** and a factored bearing resistance value at ULS of **90 kPa** incorporating a geotechnical factor of 0.5 at ULS.

Footings placed in an undisturbed, compact glacial till bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa** incorporating a geotechnical factor of 0.5 at ULS.

Footings placed in a clean, surface sounded bedrock bearing surface can be designed using a bearing resistance value at ULS of **500 kPa** incorporating a geotechnical factor of 0.5.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

The bearing resistance value at SLS given for footings will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

Bedrock/Soil Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on a soil bearing medium to reduce the potential long-term total and differential settlements. At the soil/bedrock transitions, it is recommended that a minimum depth of 500 mm of bedrock be removed from below the founding elevation for a minimum length of 2 m on the bedrock side. This area should be subsequently reinstated with an engineered fill, such as OPSS Granular A or Granular B Type II and compacted to a minimum of 98% of the material SPMDD.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a deposit of silty sand, silty clay and/or glacial till above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil. The lateral support zone for footings placed on bedrock will be 1H:6V from the edge of footings.

Permissible Grade Raise

Based on the undrained shear strength values of the silty clay deposit encountered within the west portion of the site, the recommended permissible grade raise areas for buildings are defined in Drawing PG5348-2 - Permissible Grade Raise Plan in Appendix 2.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the shallow foundations at the subject site. The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.6 Pavement Design

For design purposes, the pavement structure presented in the following tables could be used for the design of driveways, local residential streets and roadways with bus traffic. It should be noted that for residential driveways and car only parking areas, an Ontario Traffic Category A is applicable. For local roadways an Ontario Traffic Category B should be used for design purposes.

Table 5 - Recommended Pavement Structure - Driveways

Thickness (mm)	Material Description
50	**Wear Course** – HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** – OPSS Granular A Crushed Stone
300	**SUBBASE** – OPSS Granular B Type II

Notes:
1 - SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2 - Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this Pavement Structure.

Table 6 - Recommended Pavement Structure – Local Residential Roadways

Thickness (mm)	Material Description
40	**Wear Course** – HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** – HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** – OPSS Granular A Crushed Stone
450	**SUBBASE** – OPSS Granular B Type II

Notes:
1 - SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2 - Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this Pavement Structure.

Table 7 - Recommended Pavement Structure – Arterial Roadways with Bus Traffic

Thickness (mm)	Material Description
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II

Notes:
1 - SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2 - Minimum Performance Graded (PG) 64-34 asphalt cement should be used for this Pavement Structure.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and PG 64-34 asphalt cement should be used for roadways with bus traffic. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, such as material containing a high content of organic materials, the native soil, approved by the geotechnical consultant at the time of excavation, will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab for this purpose.

A clear crushed stone fill is recommended for backfilling below the floor slab for limited span slab-on-grade areas, such as front porch or garage footprints. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone below basement floor slabs.

5.7 Sump Pump Feasibility Analysis

Based on our general review of the current site conditions in conjunction with the City of Ottawa guidelines for the use of sump pump systems, the western portion of the subject site is considered acceptable to received sump pumps from both geotechnical and hydrogeological perspectives. The location of the clay area for sump pumps is outlined in Drawing PG5348-2 - Permissible Grade Raise Plan and on Drawing PG5348-3 - Tree Planting Setback Areas in Appendix 2.

It should be noted that based on the Technical Bulletin ISTB-2018-04 and ISTB-2019-02 issued by the City of Ottawa regarding installation of sump pumps, for typical sites, a minimum 300 mm vertical separation is recommended between the design underside of footing (USF) elevation and the seasonal high groundwater level. If this condition cannot be confirmed before the finalized design drawings are completed, the development should meet the minimum requirements for the following items as per Appendix 8 of the above noted technical bulletin:

☐ Clay Continuity within the site
☐ Estimation of Seasonal High Groundwater Table
☐ Hydraulic Conductivity of the Underlying Silty Clay
☐ The Groundwater Ingress Rate

The following sections summarize our assessment of the above noted requirements and our conclusion on the feasibility of the installation of sump pumps along the eastern portion of the proposed residential development.

Clay Continuity

As discussed in Subsection 4.2, the boreholes completed within the western portion of the subject site are in conformance with the City of Ottawa borehole spacing guidelines. The native silty clay soils within the study area are considered to be laterally continuous. The boreholes within this portion of the subject site identify a silty clay deposit at the majority of the borehole locations at similar elevations throughout. Therefore, the silty clay deposit is continuous across the proposed western side of the subject development. Reference should be made to the attached Drawing PG5348-2 - Permissible Grade Raise Plan and on Drawing PG5348-3 - Tree Planting Setback Areas in Appendix 2.

Seasonal High Groundwater Table

Paterson conducted a groundwater monitoring program from December 2021 to May 2023, to review and confirm the seasonal high groundwater table. Dataloggers were installed within the monitoring wells on December 23, 2021 upon completion of the field program. The data from the dataloggers was retrieved from the monitoring well locations on May 29, 2023 at the completion of the water well monitoring program.

The groundwater monitoring data is presented in Subsection 4.3 and Figures 2-11 in Appendix 2 and illustrates seasonal trends in water levels. From the results of the investigation, the groundwater elevations ranged between 90.05 to 92.25 m. However, it should be noted that the highest seasonal groundwater readings within the western portion of the site, the area where sump pumps are currently proposed, ranged between 91.45 and 91.8 m.

Based on our review of the preliminary roadway grading plans of the subject site, a sufficient separation is anticipated between the seasonal high groundwater table and the proposed USF elevations.

Permeability of Soils and Groundwater Ingress Rate

Based on the site-specific slug testing results, the hydraulic conductivity of the overburden materials ranged between 2.28×10^{-6} to 6.88×10^{-5} m/s, with a geometric mean of 2×10^{-5} m/s.

Based on a single home lot dimension of 10 m x 17 m, a hydraulic conductivity of 2 x 10^{-5} m/sec, and a 0.6 m saturated depth, the groundwater ingress rate was calculated to be approximately 50,000 L/day. However, a 1 m clay seal will lie beneath the building footings as well as a thick clay seal between the exterior of the building foundation and undisturbed native soils, thereby directing water away from the building. The minimum pump sizing shall be designed to allow for the calculated ingress volume; however, the clay backfill will limit the actual ingress to the weeping tile system. Based on the above, the sump pumps are not expected to be overloaded and/or continuously running.

Additional Considerations

It should also be noted that the backfill used against the foundation walls should consist of workable site excavated silty clay. Any imported silty clay should be reviewed and approved by Paterson prior to placement to confirm that the material meets the characteristics of the existing silty clay within the site. All surfaces adjacent to the proposed buildings should be shaped to shed water away from the building's foundation.

All the sump pump installations should be inspected and approved by Paterson at the time of installation.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed structure. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone which is placed at the footing level around the exterior perimeter of the structure. The perimeter drainage pipe should direct water to sump pit(s) located within the lower basement levels or provided a gravity connection to the storm sewer.

Foundation Backfill - Basements Unequipped with Sump Pump Systems

Backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

Foundation Backfill - Basements Equipped with Sump Pump Systems

Backfill against the exterior sides of the foundation walls should consists of workable, brown silty clay extending a minimum of 1.5 m away from and along the perimeter of the foundations. The clay backfill must be implemented in conjunction with a composite drainage system, such as Delta Drain 6000 or an approved equivalent. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, is not recommended to be used for this purpose where sump pump systems are considered.

Sump Pump Systems - Additional Considerations

Service trenches for service lateral extending between the public service alignment and the residential dwelling should be provided with a clay seal. The clay seal should be installed in accordance with City of Ottawa Standard Detail Drawing S8-Clay Seals for Pipe Trenches.

The clay seal must extend a minimum of 300 mm above the dwellings storm service discharge pipe within the service trench. The placement of clay seals should be reviewed and approved at the time of placement by the geotechnical consultant as part of site servicing reviews.

Reference should be made to the latest revision of the *Ottawa Design Guidelines - Sewer, Second Edition* dated 2012, and the latest revision to *Drawing P01 - Standard Sump Pump Configuration Greenfield Subdivisions with Clay Soils and Full Municipal Services* and the associated specifications.

6.2 Protection of Footings and Slabs Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soils are considered to be a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of a minimum of 150 mm of OPSS Granular A material. Where the bedding is located within the firm to stiff grey silty clay or bedrock subgrade, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in a maximum 225 mm thick loose lifts and compacted to a minimum of 99% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in a maximum 225 mm thick loose lifts and compacted to a minimum of 99% of its SPMDD.

Based on the soil profile encountered at the time of the investigation, it is expected that site services will be founded partially on bedrock and overburden soils. At transitions between bedrock and soil subgrade, it is recommended that the founding medium be reviewed in the field to determine how steeply the bedrock surface drops off.

A transition treatment should be provided where the bedrock slopes downwards at more than 3H:1V. At these locations, the bedrock should be excavated, and additional bedding material should be placed to provide a 3H:1V transition form the bedrock subgrade toward the soil subgrade. This treatment will reduce the propensity for bending stresses to occur in the pipes.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in a maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

Clay Seals (within the Western Side)

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall.

Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in a maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Groundwater Control for Building Construction

Due to the relatively impervious nature of the silty clay and existing groundwater table depth, it is anticipated that groundwater infiltration into the excavations should be low to medium and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

Permit to Take Water

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Long-term Groundwater Control

Our recommendations for the long-term groundwater control for proposed construction are presented in Subsection 6.1. Any groundwater encountered along the proposed structure's perimeter or sub-slab drainage system will be directed to the proposed structure's sump pit. It is expected that groundwater flow will be low as noted in Subsection 5.7 with peak periods noted after rain events. It is anticipated that the groundwater flow will be controllable using conventional open sumps.

6.6 Winter Construction

The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity in indicative of an aggressive corrosive environment.

6.8 Tree Planting Restrictions

Tree Planting Restrictions

Paterson completed a soils review of the site to determine applicable tree planting setbacks, in accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines) for trees planted within a public right-of-way (ROW). Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site.

Grain size distribution and hydrometer testing was also completed on selected soil samples. The above-noted test results were completed on samples taken at depths between the anticipated underside of footing elevation and a 3.5 m depth below finished grade. The results of our testing are presented in Tables 1 and 2 in Subsection 4.2 and in Appendix 1.

Based on the results of our review, the two tree planting setback areas are present within the subject site. The two areas are detailed below and have been outlined in Drawing PG5348-3 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - No Tree Planting Setback Restrictions

Cohesive soils were not encountered within the subsurface profile throughout Area 1. Therefore, tree planting restrictions are not required for Area 1 illustrated on Drawing PG5348-3 - Tree Planting Setback Recommendations in Appendix 2.

Area 2 – Low to Medium Potential for Soil Volume Change Clay Soils

A clay soil with a low to medium potential for soil volume change was encountered between design underside of footing elevations and 3.5 m below finished grade throughout this area. Based on our Atterberg Limits test results, the modified plasticity limit generally does not exceed 40%. The following tree planting setbacks are recommended for Area 2.

Large trees (mature height over 14 m) can be planted within Area 2 provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g., in a park or other green space).

Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5 m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the following conditions are met:

- The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below. It should be noted that a 1.8 m depth for footings is considered acceptable provided that additional measures be taken. These measures can be discussed upon request under a separate cover.
- A small tree must be provided with a minimum of 25 m3 of available soil volume while a medium tree must be provided with a minimum of 30 m3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.
- The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.
- The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Aboveground Swimming Pools, Hot Tubs, Decks and Additions

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighboring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications. Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

7.0 Recommendations

It is recommended that the following be carried out by Paterson once preliminary and future details of the proposed development have been prepared:

- Review preliminary and detailed grading, servicing plan(s) from a geotechnical perspective.

It is a requirement for the foundation design data provided herein to be applicable that a material testing and observation program be performed by the geotechnical consultant. The following aspects of the program should be performed by Paterson:

- Review and inspection of the installation of the foundation drainage systems.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling and follow-up field density tests to determine the level of compaction achieved.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

All excess soil must be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management*.

8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A geotechnical investigation of this nature is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

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 Minto Communities Inc. or their agents is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Aug 10, 2023
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

Drew Petahtegoose, B.Eng.

Faisal I. Abou-Seido, P.Eng.

Report Distribution:

☐ Minto Communities Inc. (1 digital copy)
☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

SOIL PROFILE & TEST DATA SHEETS BY OTHERS

GRAIN SIZE DISTRIBUTION ANALYSIS RESULTS

ANALYTICAL TESTING RESULTS

HYDRAULIC CONDUCTIVITY RESULTS – FALLING AND RISING HEAD

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

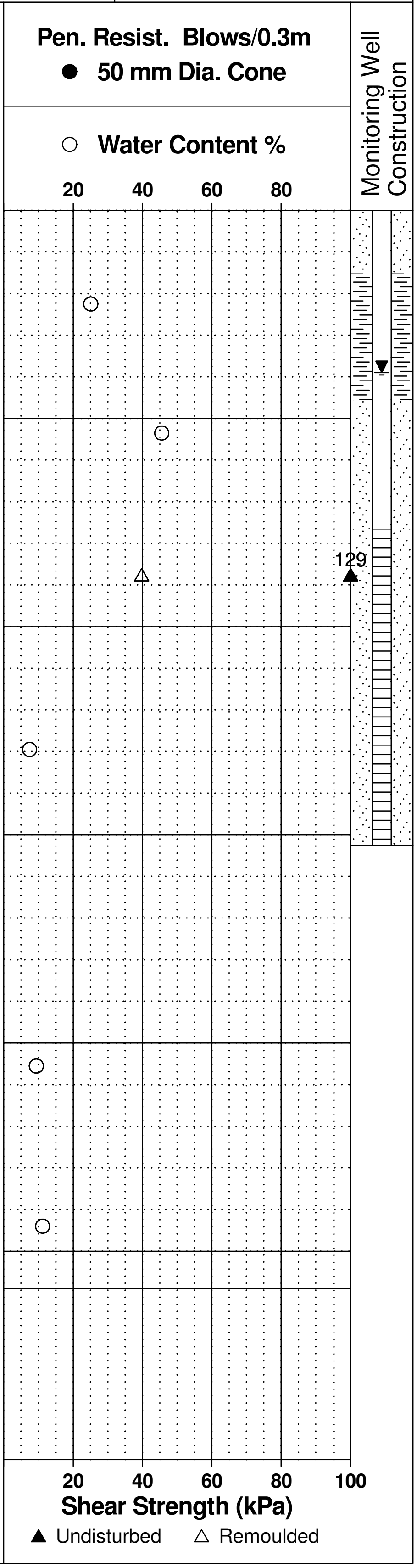
BORINGS BY Track-Mount Power Auger

DATE December 9, 2021

FILE NO. PG5348

HOLE NO. BH 1-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.00
TOPSOIL 0.25							
		AU	1				
						1	91.00
Very stiff, brown **SILTY CLAY,** trace sand		SS	2	33	6		
						2	90.00
2.21							
		SS	3	50	9		
						3	89.00
		SS	4	0	5		
GLACIAL TILL: Loose to compact, grey silty sand with gravel, occasional cobbles							
						4	88.00
		SS	5	67	2		
		SS	6	83	10		
						5	87.00
5.18							
End of Borehole (GWL @ 0.78m - Dec. 20, 2021)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

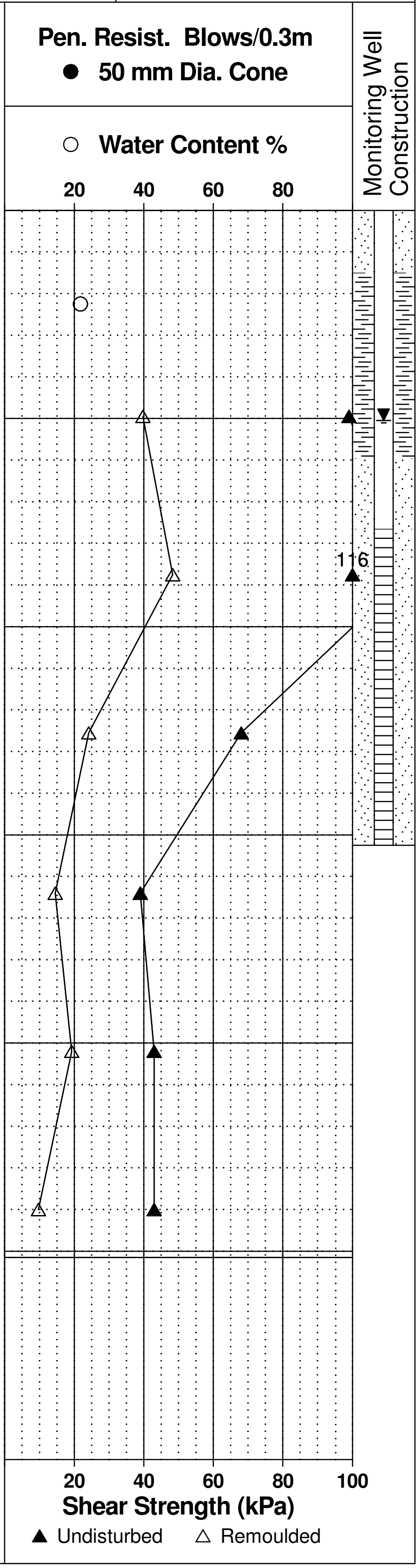
BORINGS BY Track-Mount Power Auger

DATE December 9, 2021

FILE NO. PG5348

HOLE NO. BH 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL						0	92.20
0.28							
		AU	1				
						1	91.20
Very stiff to stiff, brown **SILTY CLAY,** trace sand						2	90.20
- grey by 2.3m depth							
- firm and grey by 3.0m depth						3	89.20
						4	88.20
5.03						5	87.20
End of Borehole							
(GWL @ 1.01m - Dec. 20, 2021)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
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REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 9, 2021

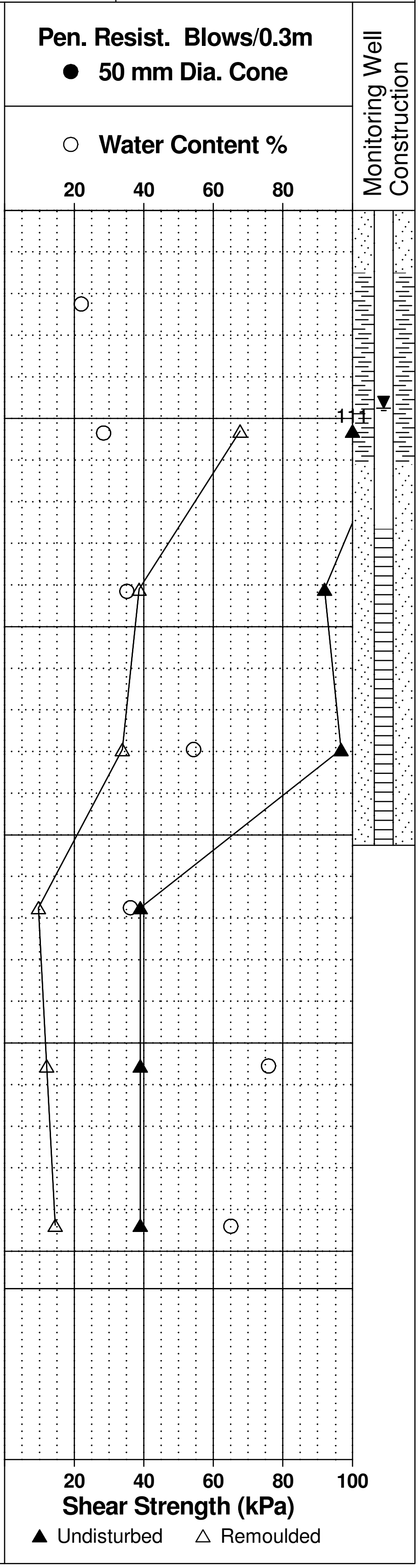
FILE NO. PG5348

HOLE NO. BH 3-21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	91.95
TOPSOIL 0.28						
	AU	1				
	SS	2	67	5	1	90.95
	SS	3	100	3		
Very stiff to stiff, brown **SILTY CLAY**					2	89.95
	SS	4	100	P		
- firm and grey by 3.0m depth					3	88.95
	SS	5	100	P		
	SS	6		P	4	87.95
	SS	7		P		
5.18					5	86.95

End of Borehole

(GWL @ 0.95m - Dec. 20, 2021)



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

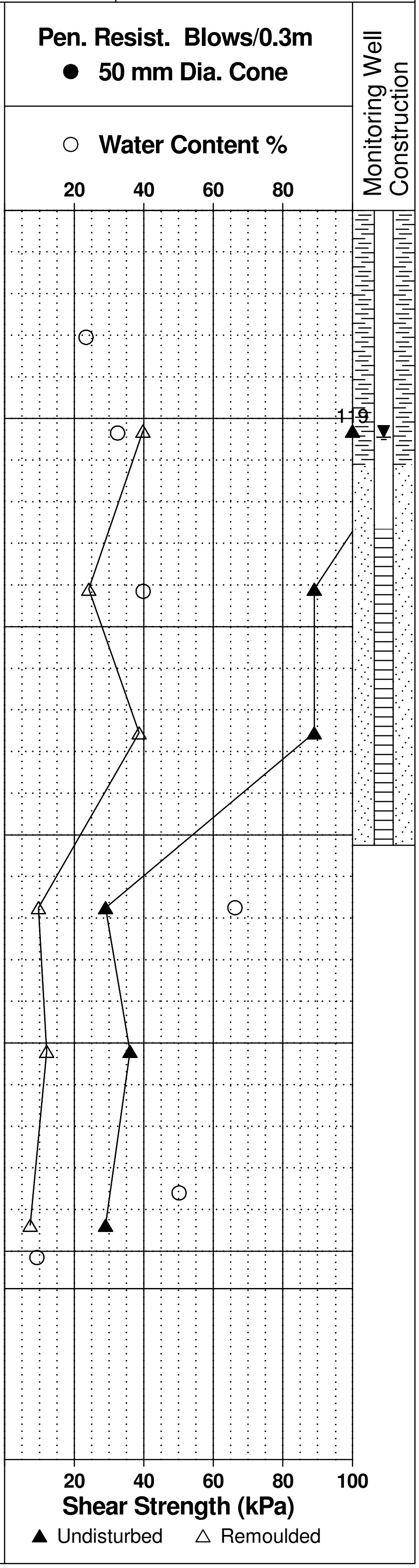
BORINGS BY Track-Mount Power Auger

DATE December 9, 2021

FILE NO. PG5348

HOLE NO. BH 4-21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	91.99
TOPSOIL 0.36						
	AU	1				
	SS	2	100	P	1	90.99
	SS	3	67	P	2	89.99
Very stiff to stiff, brown **SILTY CLAY,** trace sand						
- firm and grey by 3.0m depth					3	88.99
	SS	4	100	P	4	87.99
- trace sand by 4.9m depth 5.03	SS	5	100	P	5	86.99
GLACIAL TILL: Grey silty sand with gravel, occasional cobbles, trace clay 5.18						
End of Borehole						
(GWL @ 1.09m - Dec. 21, 2021)						



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 10, 2021

FILE NO. PG5348

HOLE NO. BH 5-21

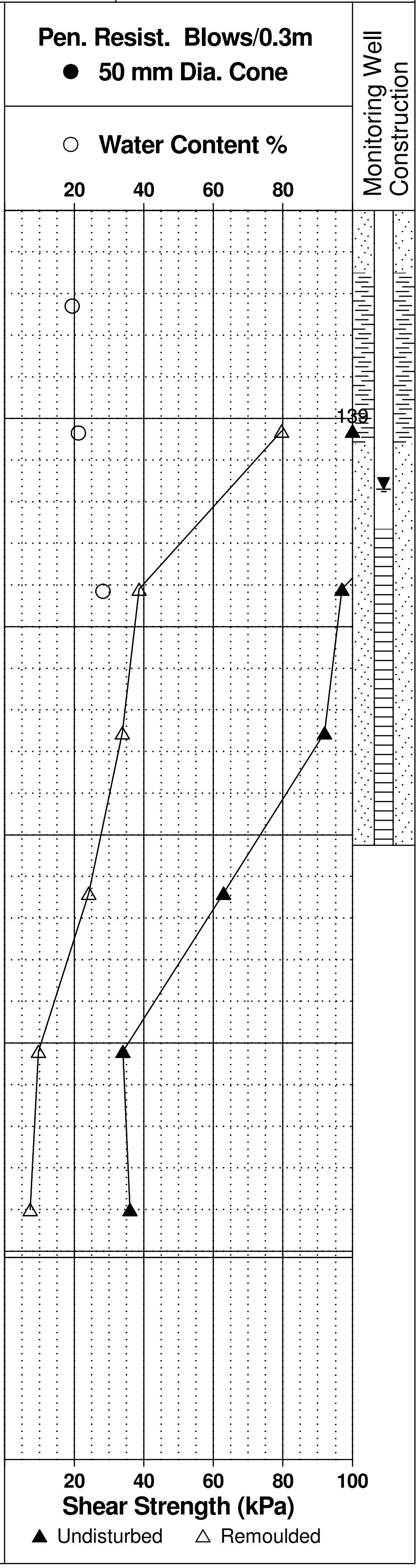
SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.36
Very stiff to stiff, brown **SILTY CLAY,** trace sand - firm and grey by 3.8m depth	5.03

End of Borehole

(GWL @ 1.34m - Dec. 21, 2021)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	50	P
SS	3	67	P

DEPTH (m)	ELEV. (m)
0	92.46
1	91.46
2	90.46
3	89.46
4	88.46
5	87.46



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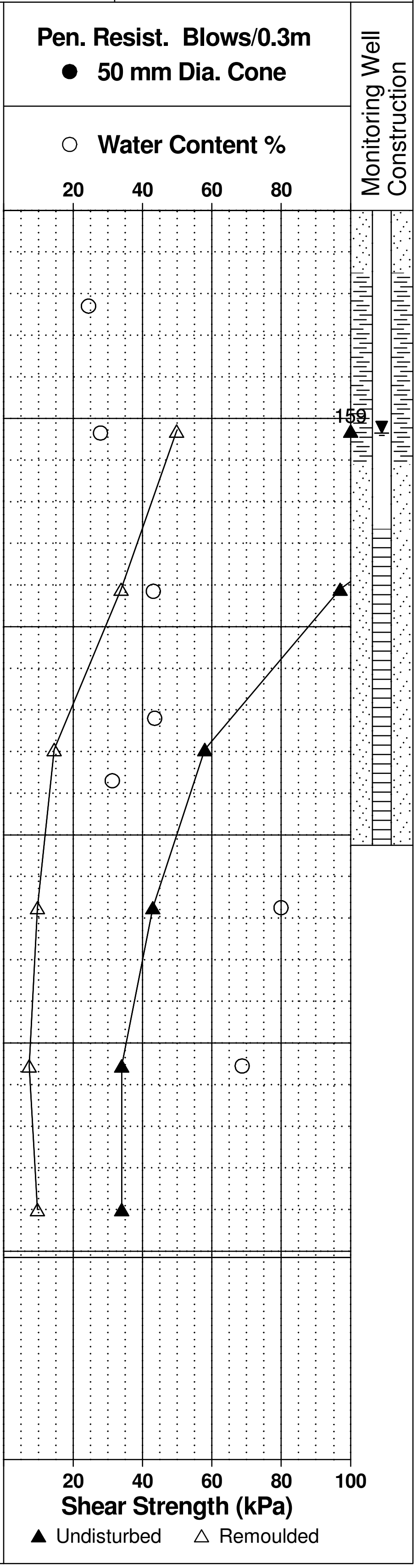
REMARKS
BORINGS BY Track-Mount Power Auger
DATE December 10, 2021
FILE NO. **PG5348**
HOLE NO. **BH 6-21**

SOIL DESCRIPTION	DEPTH (m)	ELEV. (m)
GROUND SURFACE	0	92.27
TOPSOIL	0.33	
Very stiff to stiff, brown **SILTY CLAY,** some to trace sand - firm and grey by 2.4m depth	1	91.27
	2	90.27
	3	89.27
	4	88.27
	5.03	
End of Borehole (GWL @ 1.07m - Dec. 21, 2021)	5	87.27

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	P
SS	3	100	P
SS	4	100	P
SS	5	100	P
SS	6	100	P



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Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

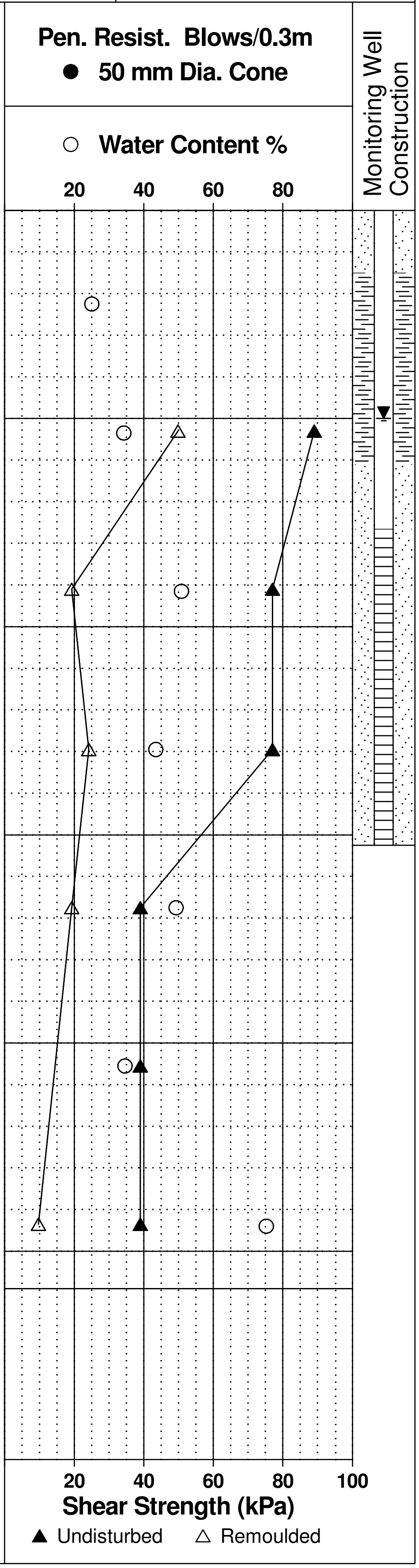
BORINGS BY Track-Mount Power Auger

DATE December 10, 2021

FILE NO. PG5348

HOLE NO. BH 7-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.79
TOPSOIL 0.30							
		AU	1				
		SS	2	100	P	1	90.79
		SS	3	92	P	2	89.79
Stiff, brown **SILTY CLAY,** trace sand - firm and grey by 3.0m depth		SS	4	100	P	3	88.79
		SS	5	100	P		
		SS	6	100	P	4	87.79
		SS	7	100	P	5	86.79
5.18 End of Borehole							
(GWL @ 1.00m - Dec. 21, 2021)							



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

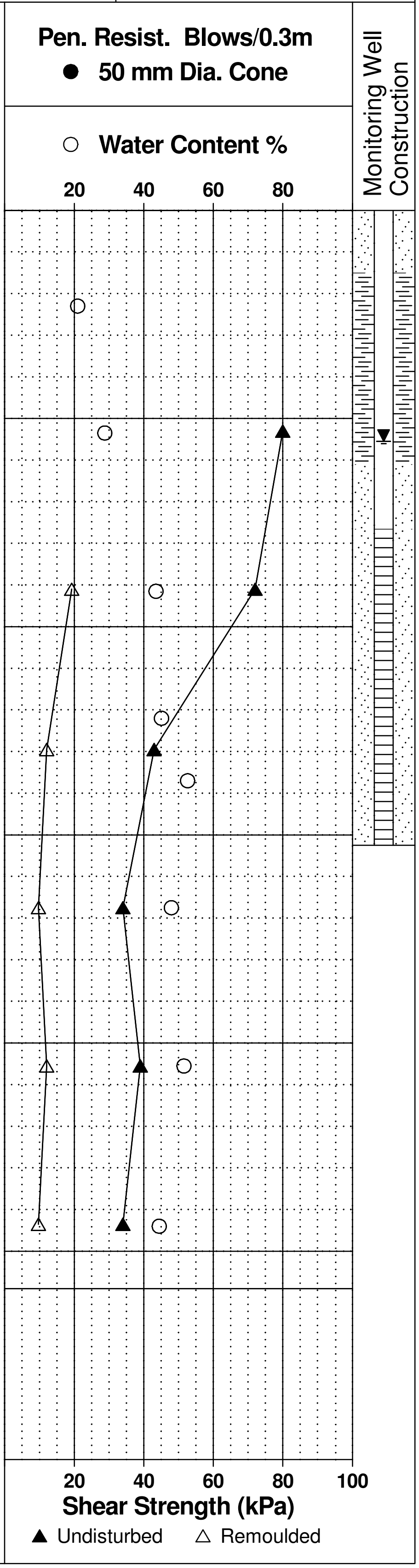
BORINGS BY Track-Mount Power Auger

DATE December 10, 2021

FILE NO. PG5348

HOLE NO. BH 8-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.15
TOPSOIL 0.30							
		AU	1				
		SS	2	67	P	1	91.15
		SS	3	100	P		
Stiff to firm, brown **SILTY CLAY,** some to trace sand						2	90.15
- firm and grey by 2.7m depth		SS	4	100	P		
						3	89.15
		SS	5	100	P		
						4	88.15
		SS	6	100	P		
		SS	7	100	P		
5.18						5	87.15
End of Borehole (GWL @ 1.11m - Dec. 21, 2021)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

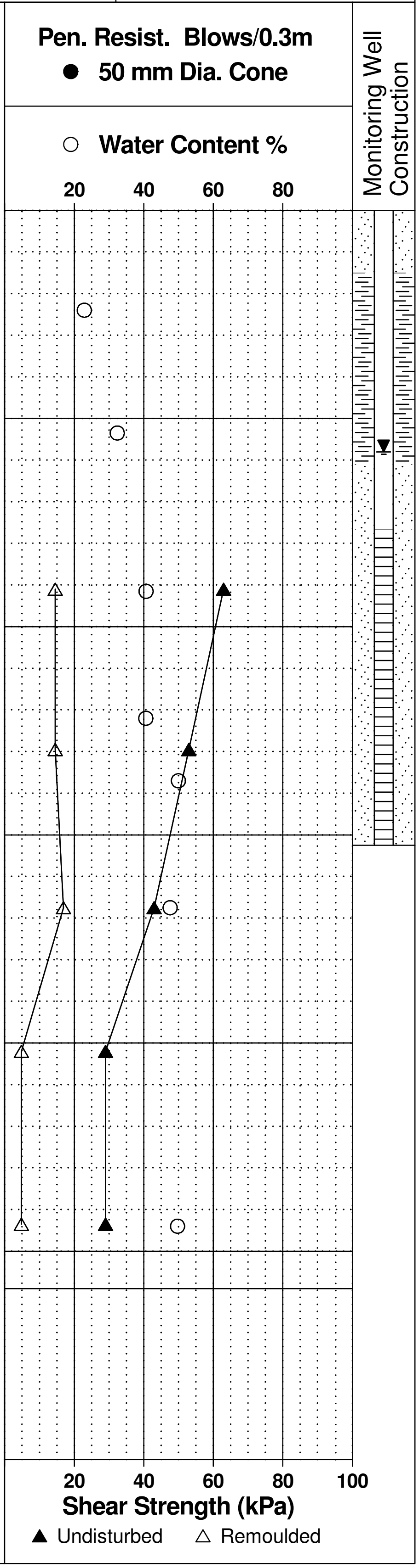
DATE December 13, 2021

FILE NO. **PG5348**

HOLE NO. **BH 9-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL					
0.33					
Very stiff to stiff, brown **SILTY CLAY,** some to trace sand		AU	1		
		SS	2	75	3
		SS	3	100	P
- firm and grey by 2.4m depth		SS	4	100	P
		SS	5	100	P
		SS	6	100	P
5.18					
End of Borehole (GWL @ 1.16m - Dec. 21, 2021)					

DEPTH (m)	ELEV. (m)
0	91.59
1	90.59
2	89.59
3	88.59
4	87.59
5	86.59



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Kennedy Lands - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

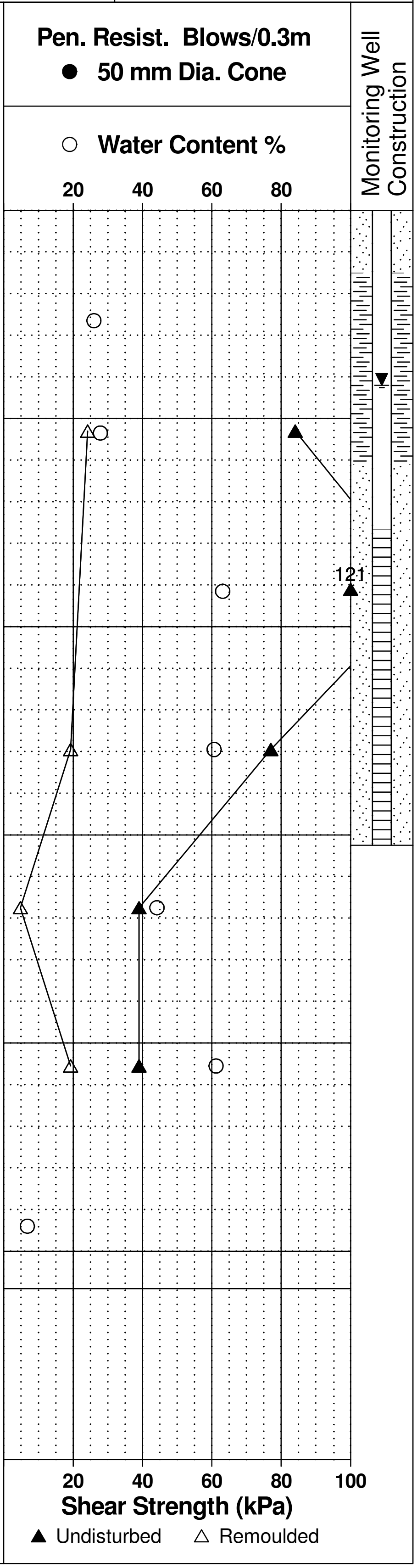
BORINGS BY Track-Mount Power Auger

DATE December 13, 2021

FILE NO. **PG5348**

HOLE NO. **BH10-21**

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.24
TOPSOIL 0.38						
	AU	1				
	SS	2	50	P	1	91.24
	SS	3	100	P		
					2	90.24
Very stiff to stiff, brown **SILTY CLAY,** some to trace sand	SS	4	100	P		
- firm and grey by 3.0m depth					3	89.24
	SS	5	100	P		
	SS	6	100	P	4	88.24
4.72 **GLACIAL TILL:** Very dense, grey silty sand to sandy silt with gravel, cobbles and boulders, trace clay 5.18	SS	7	100	66	5	87.24
End of Borehole (GWL @ 0.84m - Dec. 20, 2021)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. TP 1-21

BORINGS BY Excavator

DATE 2021 January 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.42
TOPSOIL 0.28	■	G	1				
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders, some clay	^^^	G	2			1	90.42
	^^^	G	3			2	89.42
2.33							
GLACIAL TILL: Grey silty sand with clay, gravel, cobbles and boulders	^^^	G	4			3	88.42
3.42							

End of Test Pit

Practical refusal to excavation encountered at 3.42 m depth

(Minor groundwater infiltration noted at 3.40 m depth)

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 January 14

FILE NO. PG5348

HOLE NO. TP 2-21

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.31		G	1			0	94.10		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		G	2			1	93.10		
		G	3			2	92.10		
2.74									
GLACIAL TILL: Grey silty sand with gravel, cobbles and boulders						3	91.10		
		G	4						
						4	90.10		
4.52									
End of Test Pit (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 January 14

FILE NO. PG5348

HOLE NO. TP 3-21

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	92.65		
TOPSOIL 0.34		G	1						
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders, some clay		G	2			1	91.65		
		G	3			2	90.65		
2.44									
GLACIAL TILL: Grey silty sand with clay, gravel, cobbles and boulders						3	89.65		
		G	4			4	88.65		
4.52									
End of Test Pit (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

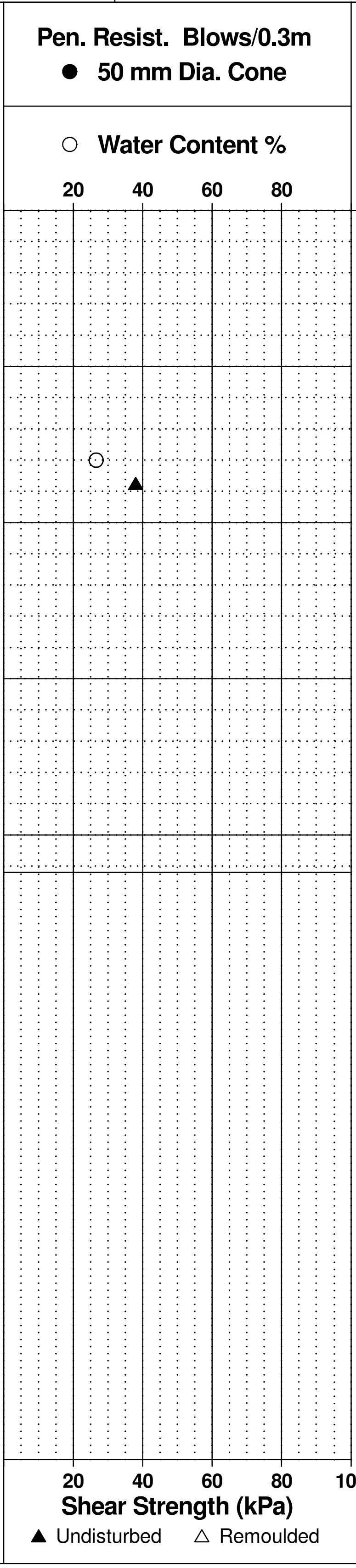
Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Excavator
DATE 2021 January 14
FILE NO. PG5348
HOLE NO. TP 4-21

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.26
Brown **SILTY SAND**, some clay	0.54
Very stiff to stiff brown **SILTY CLAY** some sand seams	2.23
Grey **SILTY CLAY**	4.24
End of Test Pit (TP dry upon completion)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		
G	4		
G	5		

DEPTH (m)	ELEV. (m)
0	92.17
1	91.17
2	90.17
3	89.17
4	88.17



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 January 14

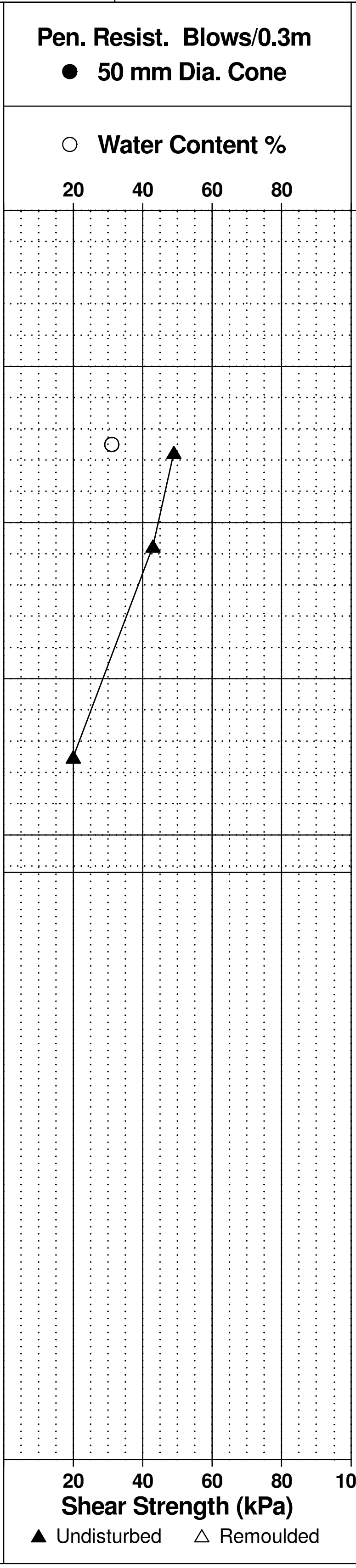
FILE NO. PG5348

HOLE NO. TP 5-21

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.30
Very stiff to firm brown **SILTY CLAY** some sand seams	3.13
Firm grey **SILTY CLAY**	4.24
End of Test Pit (TP dry upon completion)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		
G	4		
G	5		

DEPTH (m)	ELEV. (m)
0	91.87
1	90.87
2	89.87
3	88.87
4	87.87



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

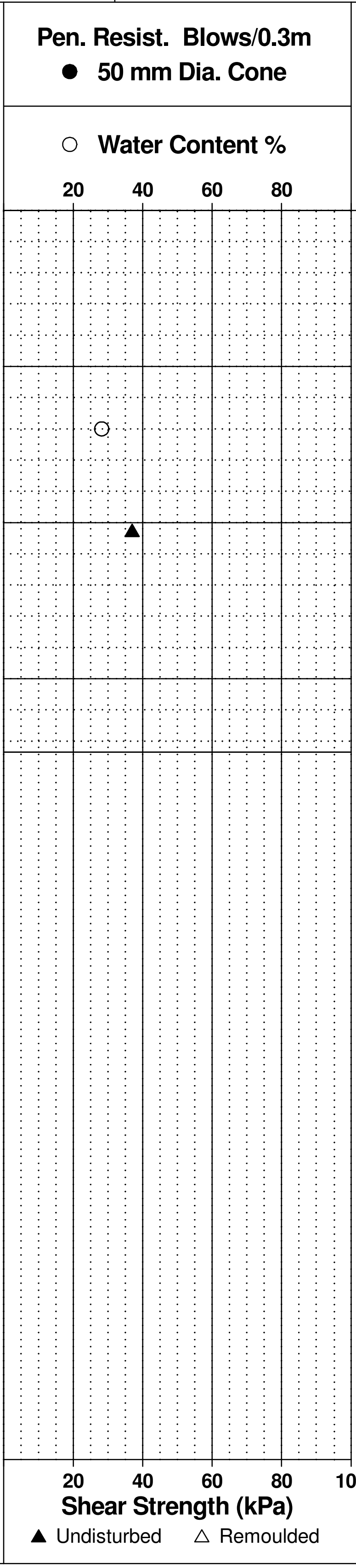
REMARKS

HOLE NO. TP 6-21

BORINGS BY Excavator

DATE 2021 January 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.21
TOPSOIL 0.26		G	1				
Brown **SILTY SAND** with clay 0.56		G	2				
Very stiff to firm brown **SILTY CLAY** some sand seams						1	91.21
		G	3				
		G	4			2	90.21
2.34							
Firm grey **SILTY CLAY**						3	89.21
		G	5				
3.47							
End of Test Pit (Minor groundwater infiltration from base of test pit upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

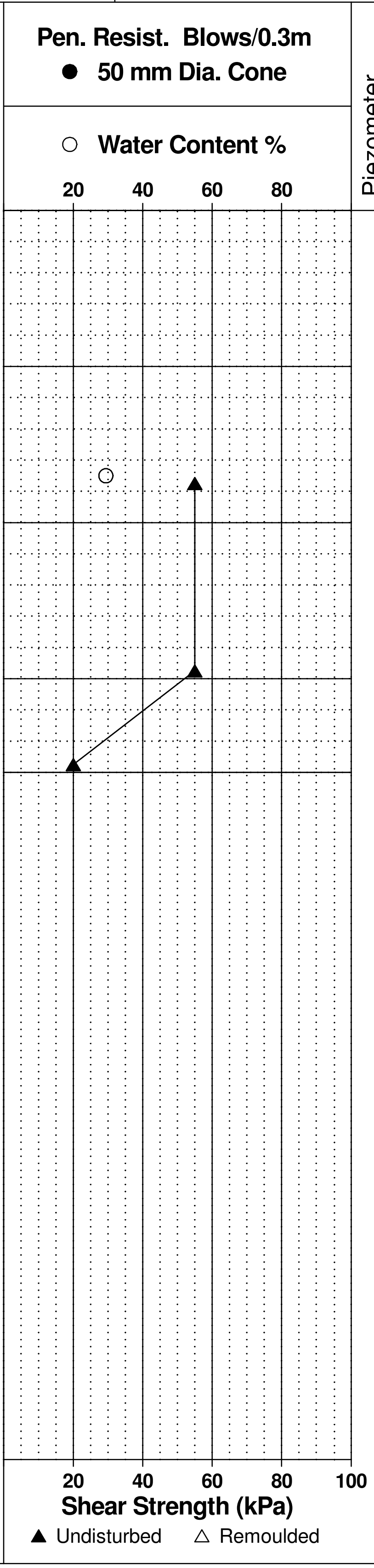
REMARKS

HOLE NO. TP 7-21

BORINGS BY Excavator

DATE 2021 January 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.26	
TOPSOIL 0.26								
Very stiff to firm brown **SILTY CLAY**, some sand seams		G	1					
						1	91.26	
		G	2					
						2	90.26	
3.05		G	3					
						3	89.26	
Firm, grey **SILTY CLAY**								
3.60		G	4					
End of Test Pit (TP dry upon completion)								



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

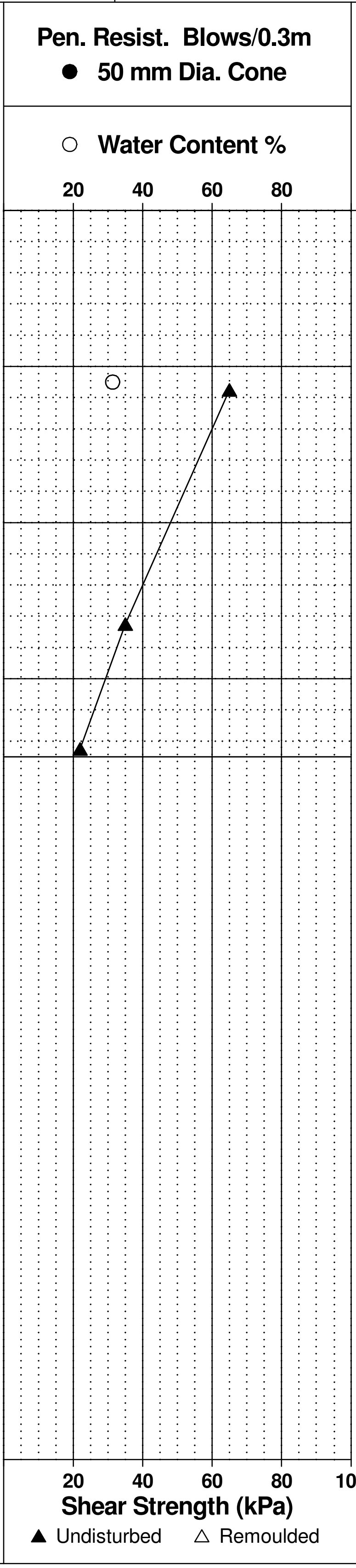
BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

HOLE NO. TP 8-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
						0	92.13
TOPSOIL 0.31							
Very stiff to firm brown **SILTY CLAY**, some sand seams		G	1				
		G	2			1	91.13
						2	90.13
		G	3				
2.93							
Firm, grey **SILTY CLAY**						3	89.13
3.50		G	4				
End of Test Pit (TP dry upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

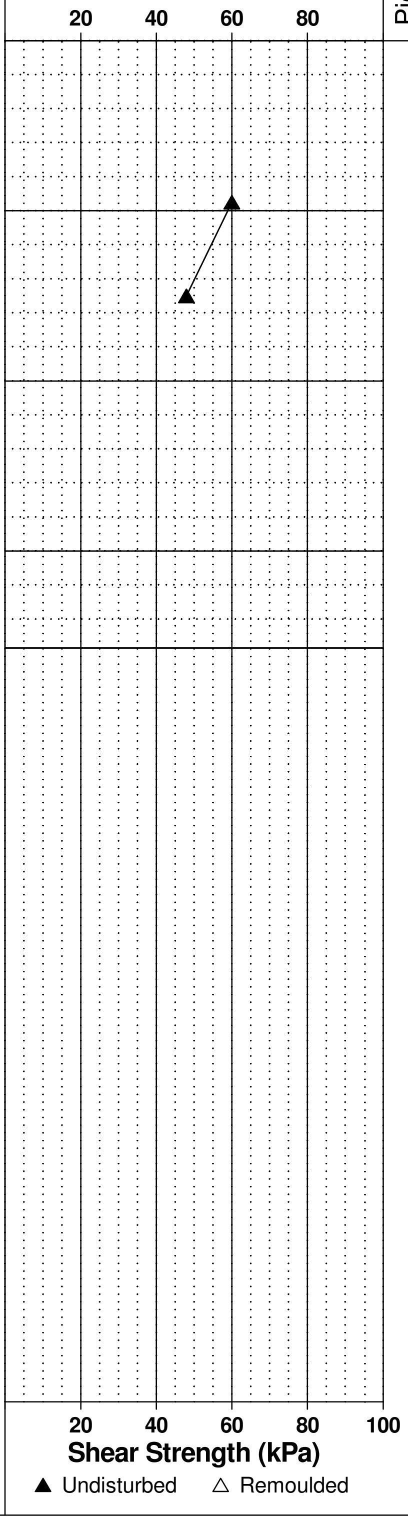
HOLE NO. TP 9-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.42
TOPSOIL 0.31		G	1				
Very stiff to firm brown **SILTY CLAY**, some sand seams		G	2			1	91.42
						2	90.42
		G	3				
3.25						3	89.42
Firm, grey **SILTY CLAY** 3.57		G	4				
End of Test Pit (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

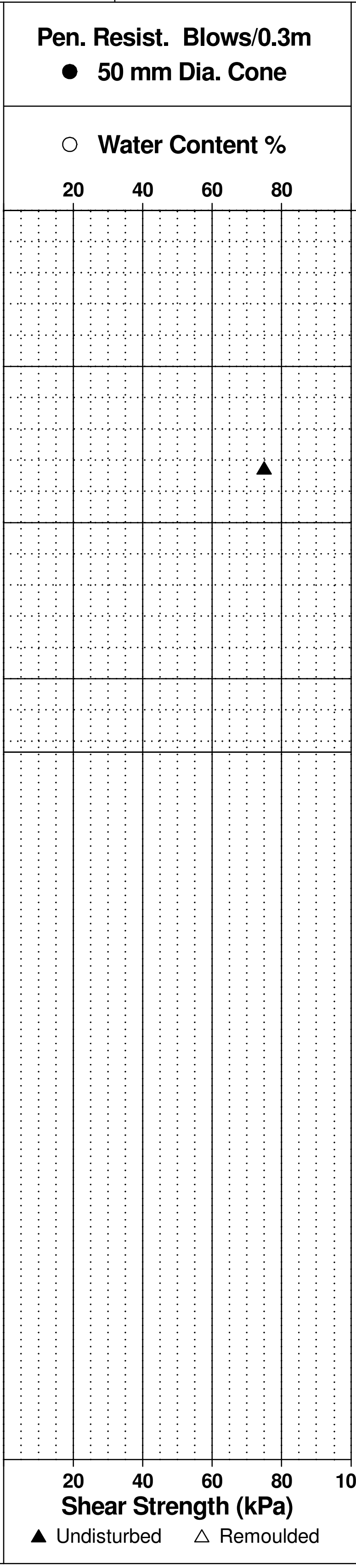
BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

HOLE NO. TP10-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.06
TOPSOIL 0.31	■						
Very stiff to firm brown **SILTY CLAY**, some sand seams	▨	G	1				
	▨					1	91.06
	▨	G	2				
	▨	G	3				
2.38	▨					2	90.06
Firm, grey **SILTY CLAY**	▨						
	▨					3	89.06
3.47	▨	G	4				
End of Test Pit (TP dry upon completion)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

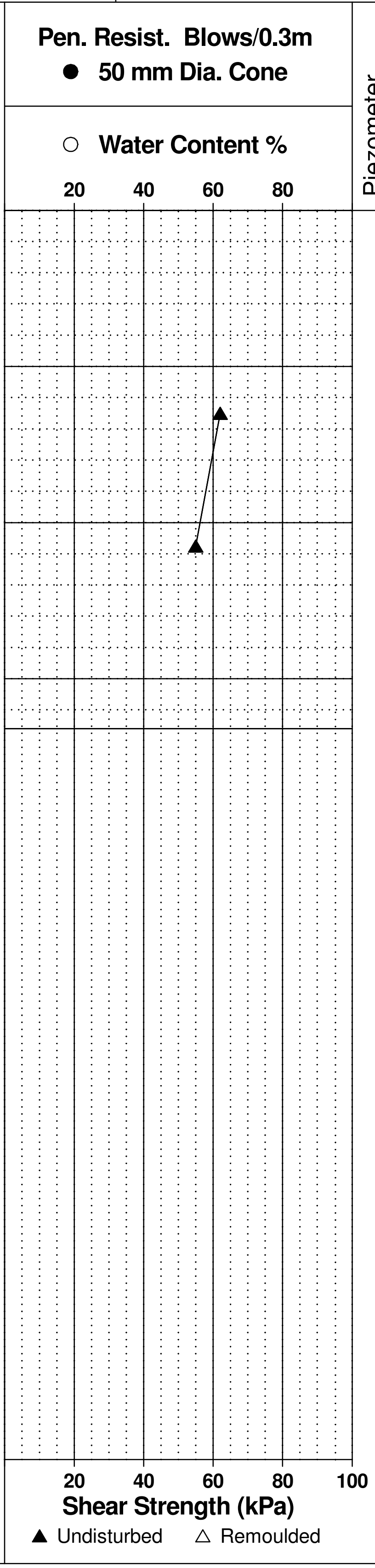
BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

HOLE NO. TP11-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.10	
TOPSOIL 0.31	▇							
Very stiff to stiff brown **SILTY CLAY**, some sand seams	▨	G	1					
	▨					1	91.10	
	▨	G	2					
	▨					2	90.10	
2.85	▨	G	3					
	▨					3	89.10	
Firm, grey **SILTY CLAY** 3.32	▨	G	4					
End of Test Pit (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

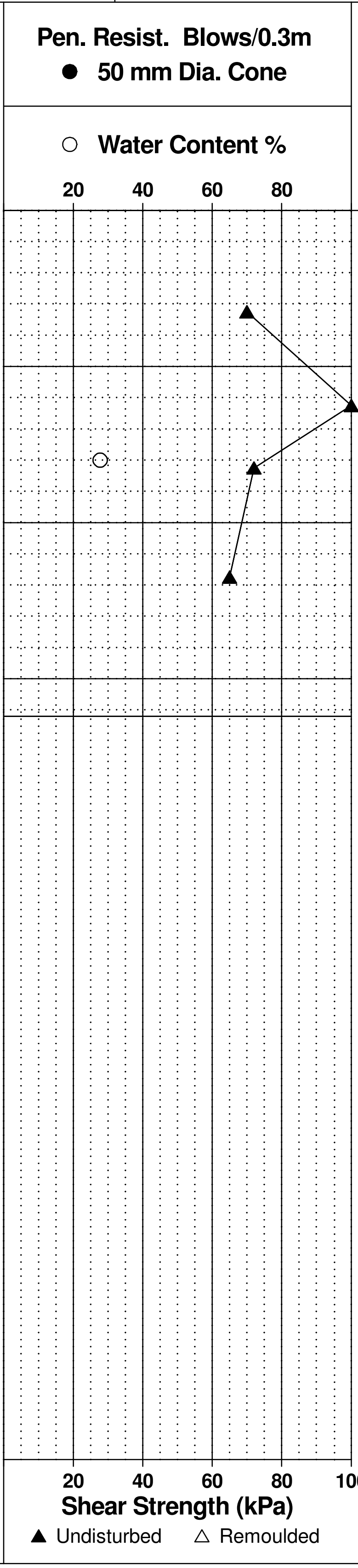
BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

HOLE NO. TP12-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.24
TOPSOIL 0.20							
Very stiff to stiff brown **SILTY CLAY**		G	1				
						1	91.24
		G	2				
		G	3				
						2	90.24
		G	4				
2.51							
Stiff, grey **SILTY CLAY**		G	5				
						3	89.24
3.24							
End of Test Pit (TP dry upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

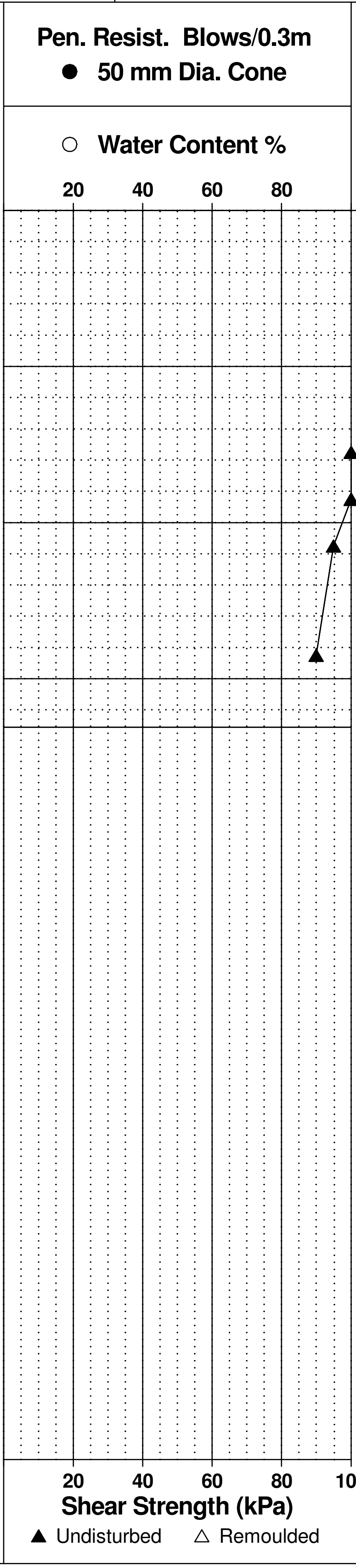
BORINGS BY Excavator

DATE 2021 January 15

FILE NO. PG5348

HOLE NO. TP13-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.95
TOPSOIL 0.20							
Very stiff to firm brown **SILTY CLAY** with sand seams		G	1				
						1	90.95
		G	2				
		G	3				
						2	89.95
2.20		G	4				
Stiff, grey **SILTY CLAY**							
		G	5				
						3	88.95
3.31							
End of Test Pit (TP dry upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 3

FILE NO. PG5348

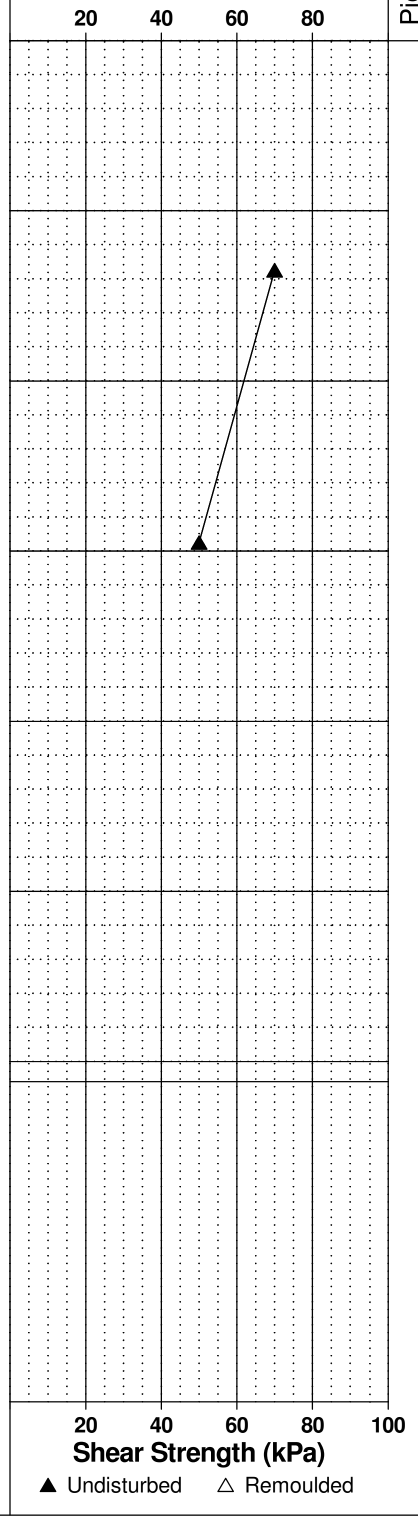
HOLE NO. TP14-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.35
TOPSOIL 0.23	■	G	1				
Very stiff to stiff brown **SILTY CLAY**, with sand seams - Decreasing sand content with depth	▨	G	2			1	91.35
	▨	G	3			2	90.35
2.85							
Stiff grey **SILTY CLAY**	▨					3	89.35
	▨	G	4			4	88.35
	▨	G	5			5	87.35
6.12						6	86.35
End of Test Pit (GWL @ 2.85 m depth based on site observations - Feb 3, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. TP15-21

BORINGS BY Excavator

DATE 2021 February 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	93.30		
TOPSOIL 0.21	■	G	1						
GLACIAL TILL: Compact to dense brown silty sand with clay, gravel, cobbles and boulders	^^^	G	2						
1.17	^^^	G	3			1	92.30		
End of Test Pit (GWL @ 1.17 m based on site observations - Feb 3, 2021)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. TP16-21

BORINGS BY Excavator

DATE 2021 February 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	94.18		
TOPSOIL 0.15		G	1						
Loose brown **SILTY SAND** some gravel, trace clay 0.58		G	2						
GLACIAL TILL: Compact to dense brown silty sand with clay, gravel, cobbles and boulders 1.20		G	3			1	93.18		
End of Test Pit (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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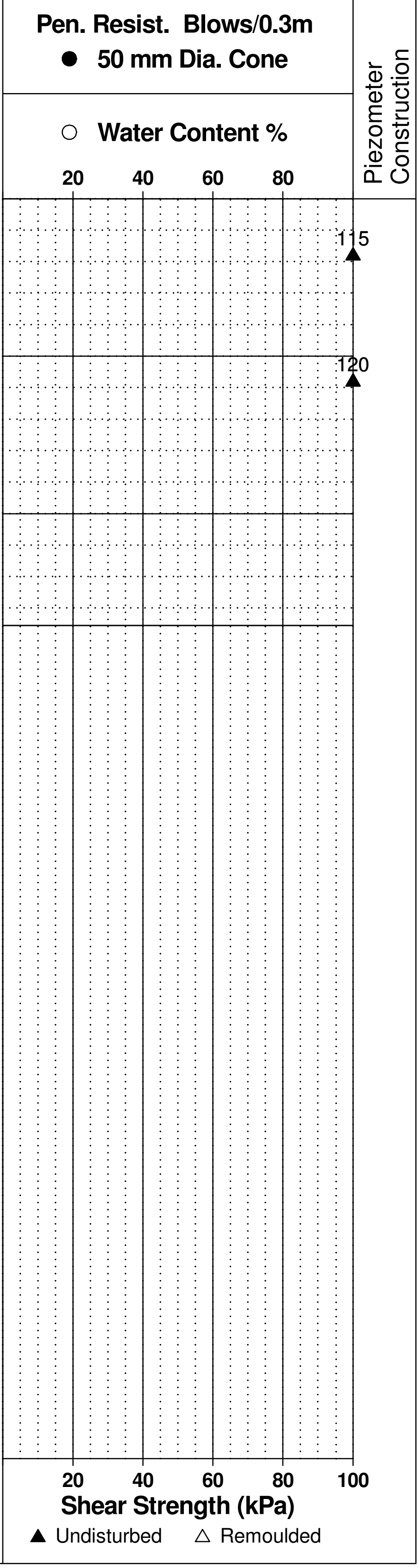
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Excavator **DATE** 2021 February 3

FILE NO. PG5348
HOLE NO. TP17-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.49
TOPSOIL 0.24		G	1				
Very stiff to stiff brown **SILTY CLAY** trace sand - Decreasing sand content with depth 1.56		G	2			1	91.49
GLACIAL TILL: Compact to dense brown silty clay with sand, gravel, cobbles and boulders 2.71		G	3			2	90.49
End of Test Pit (GWL @ 1.59 m depth based on site observations - Feb 3, 2021)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 3

FILE NO. PG5348

HOLE NO. TP18-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.21	■	G	1			0	92.43		
Stiff brown **SILTY CLAY** 0.39	▨								
GLACIAL TILL: Compact to dense brown silty clay with sand, gravel and boulders	^^^	G	2			1	91.43		
1.90		G	3						
End of Test Pit (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 3

FILE NO. PG5348

HOLE NO. TP19-21

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 % (20 40 60 80)	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.22		G	1			0	92.26		
GLACIAL TILL: Compact to dense brown silty sand with clay, gravel, cobbles and boulders		G	2						
1.21		G	3			1	91.26		
End of Test Pit (GWL @ 1.11 m depth based on site observations - Feb 3, 2021)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

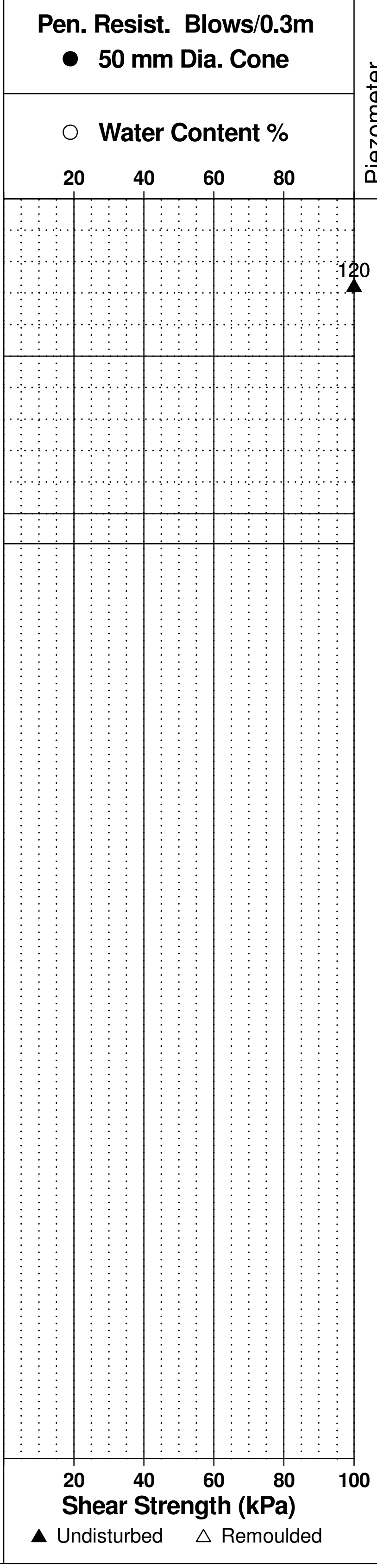
BORINGS BY Excavator

DATE 2021 February 3

FILE NO. PG5348

HOLE NO. TP20-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.04	
TOPSOIL 0.27	■	G	1					
Very stiff to stiff brown **SILTY CLAY** trace sand 1.02	▨	G	2			1	91.04	
GLACIAL TILL: Compact to dense brown silty clay with sand, gravel, cobbles and boulders 2.19	^	G	3			2	90.04	
End of Test Pit (GWL @ 2.13 m depth based on site observations - Feb 3, 2021)								



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Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 3

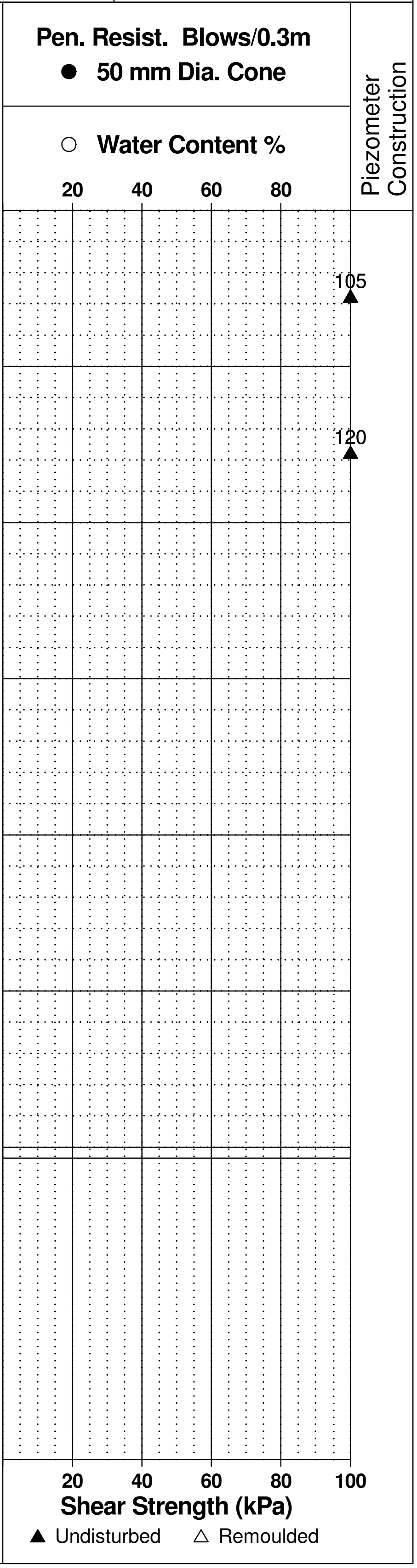
FILE NO. PG5348

HOLE NO. TP21-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.13
TOPSOIL 0.24		G	1				
Very stiff to stiff brown **SILTY CLAY** trace sand		G	2			1	91.13
						2	90.13
		G	3			3	89.13
- Grey by 4.2 m depth						4	88.13
- Sidewall instability encoutered at a depth of 5.5 m		G	4			5	87.13
5.90							
GLACIAL TILL: Compact grey silty clay with sand, gravel, cobbles and boulders 6.07						6	86.13

End of Test Pit

(GWL @ 1.73 m depth based on site observations - Feb 3, 2021)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Excavator
DATE 2021 February 3
FILE NO. PG5348
HOLE NO. TP22-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.18	■	G	1			0	92.26
Very stiff to stiff brown **SILTY CLAY**	▨						
	▨	G	2			1	91.26
	▨					2	90.26
	▨					3	89.26
	▨	G	3				
4.41	▨					4	88.26
GLACIAL TILL: Stiff grey silty clay with sand, gravel, cobbles and boulders 4.93	^^^	G	4				
End of Test Pit (GWL @ 4.93 m depth based on site observations - Feb 3, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG5348**

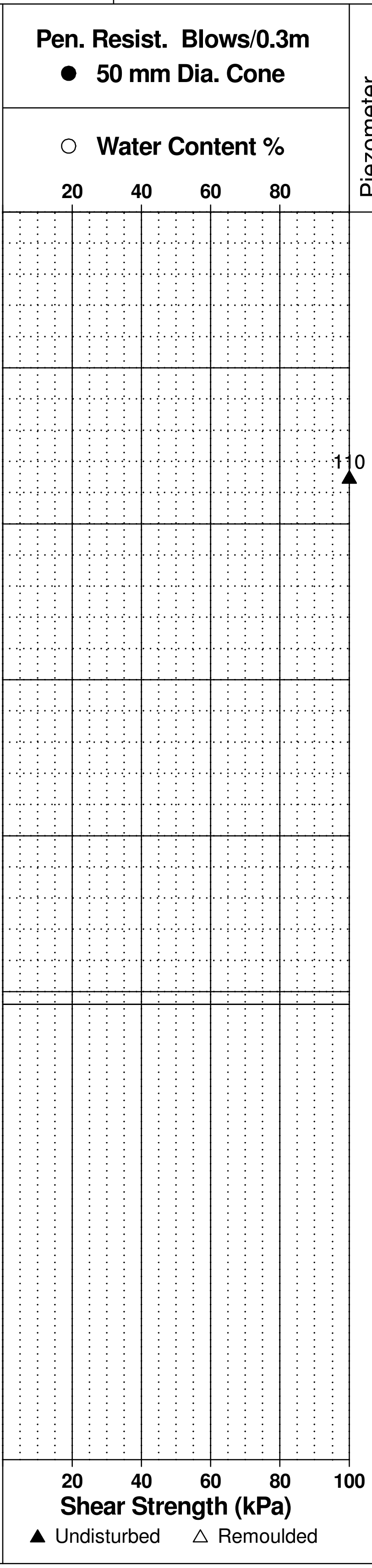
REMARKS

HOLE NO. **TP23-21**

BORINGS BY Excavator

DATE 2021 February 3

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.07
TOPSOIL 0.24	G	1				
Very stiff to stiff brown **SILTY CLAY**	G	2			1	91.07
					2	90.07
	G	3			3	89.07
4.35					4	88.07
GLACIAL TILL: Compact grey silty clay with sand, gravel, cobbles and boulders	G	4				
5.08					5	87.07
End of Test Pit (GWL @ 1.8 m depth based on site observations - Feb 5, 2021)						



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay North - Greenbank Road
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DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 3

FILE NO. PG5348

HOLE NO. TP24-21

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	93.10		
TOPSOIL 0.21	■	G	1						
GLACIAL TILL: Compact to dense brown silty sand with clay, gravel, cobbles and boulders 0.87	^^^	G	2						
End of Test Pit (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

FILE NO. PG5348

HOLE NO. BH 1A-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.30	AU	1		
Compact to dense, brown **SILTY SAND** with gravel, trace clay	SS	2	42	16
	SS	3	33	47
- running sand from 2.7 to 4.0m depth.	SS	4	54	38
	SS	5	46	12
4.04				

DEPTH (m)	ELEV. (m)
0	91.53
1	90.53
2	89.53
3	88.53
4	87.53

End of Borehole

Practical refusal to augering at 4.04m depth

(Piezometer dry/blocked - May 22, 2020)

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. BH 1B-20

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
TOPSOIL 0.30						0	91.53		
Compact to dense, brown **SILTY SAND** with gravel, trace clay 1.14						1	90.53		
End of Borehole Practical refusal to augering at 1.14m depth									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

FILE NO. PG5348

HOLE NO. BH 1C-20

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.30						0	91.53		
Compact to dense, brown **SILTY SAND** with gravel, trace clay 1.40						1	90.53		
End of Borehole Practical refusal to augering at 1.40m depth									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. BH 2A-20

BORINGS BY CME-55 Low Clearance Drill

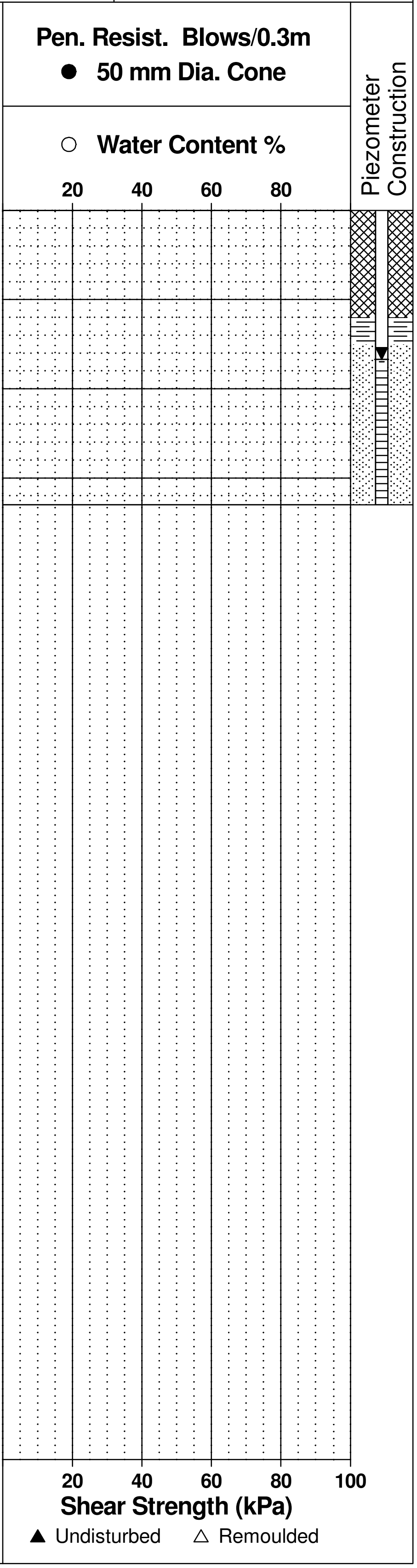
DATE May 20, 2020

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	91.78
TOPSOIL 0.36	AU	1				
Very dense to dense, brown **SILTY SAND** with gravel, trace clay	SS	2	38	59	1	90.78
	SS	3	54	47	2	89.78
2.20						
GLACIAL TILL: Dense to very dense, grey sandy silt to sity fine sand with gravel, cobbles and boulders	SS	4	46	42	3	88.78
3.30	SS	5	40	50+		

End of Borehole

Practical refusal to augering at 3.30m depth

(GWL @ 1.67m - May 22, 2020)



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. BH 2B-20

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	91.78
TOPSOIL 0.36						
					1	90.78
Very dense to dense, brown **SILTY SAND** with gravel, trace clay 2.20						
					2	89.78
GLACIAL TILL: Very dense, grey sandy silt to sity fine sand with gravel, cobbles and boulders					3	88.78
	SS	1	0	50		
					4	87.78
	SS	2	42	61		
4.75	SS	3		50+		
End of Borehole Practical refusal to augering at 4.75m depth						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 19, 2020

FILE NO. PG5348

HOLE NO. BH 3A-20

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	94.08		
TOPSOIL 0.25		AU	1						
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, occasional boulders		SS	2	58	51	1	93.08		
		SS	3	41	39	2	92.08		
2.16 End of Borehole Practical refusal to augering at 2.16m depth.									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

FILE NO. PG5348

HOLE NO. BH 3B-20

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 % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	94.08		
TOPSOIL 0.25									
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, occasional boulders						1	93.08		
2.16						2	92.08		
GLACIAL TILL: Very dense, brown sandy silt to silty fine sand with gravel, cobbles and boulders		SS	1	64	50+				
3.38		SS	2	100	50+	3	91.08		
End of Borehole Practical refusal to augering at 3.38m depth.									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5348

REMARKS

HOLE NO. BH 3C-20

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	94.08		
TOPSOIL 0.25									
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, occasional boulders						1	93.08		
2.16						2	92.08		
GLACIAL TILL: Very dense, brown sandy silt to silty fine sand with gravel, cobbles and boulders 2.90									
End of Borehole									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 20, 2020

FILE NO. PG5348

HOLE NO. BH 3D-20

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	94.08		
TOPSOIL 0.25									
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, occasional boulders						1	93.08		
2.16						2	92.08		
GLACIAL TILL: Very dense, brown sandy silt to silty fine sand with gravel, cobbles and boulders						3	91.08		
3.43									
End of Borehole Practical refusal to augering at 3.43m depth.									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

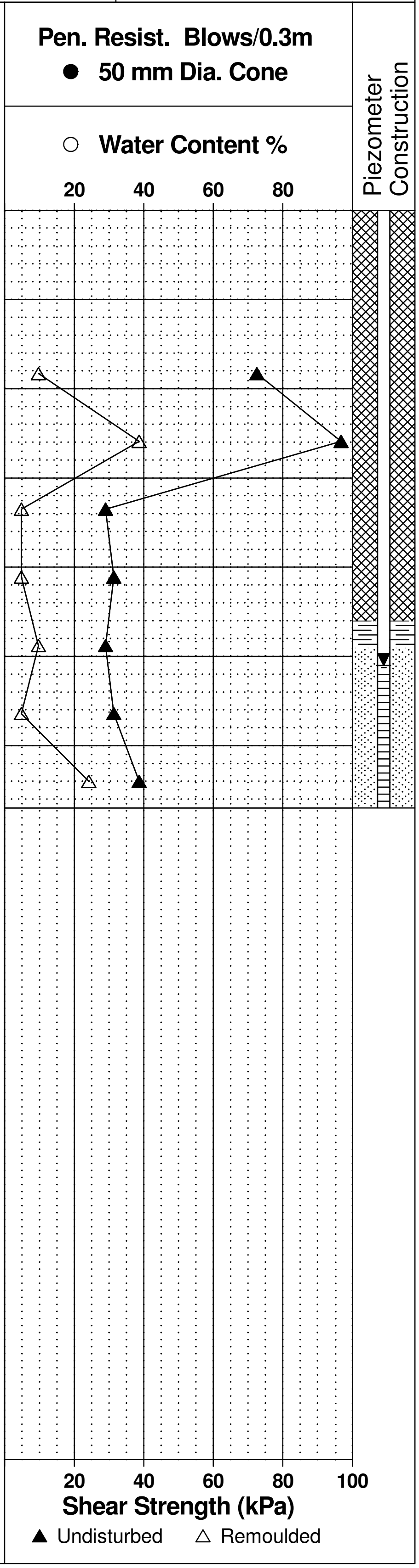
BORINGS BY CME-55 Low Clearance Drill

DATE May 19, 2020

FILE NO. PG5348

HOLE NO. BH 4-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.17
TOPSOIL 0.33		AU	1				
Stiff to firm, brown **SILTY CLAY** with sand seams - grey by 3.0m depth		SS	2	67	4	1	91.17
						2	90.17
						3	89.17
						4	88.17
						5	87.17
6.70						6	86.17
End of Borehole (GWL @ 5.10m - May 22, 2020)							



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
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DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

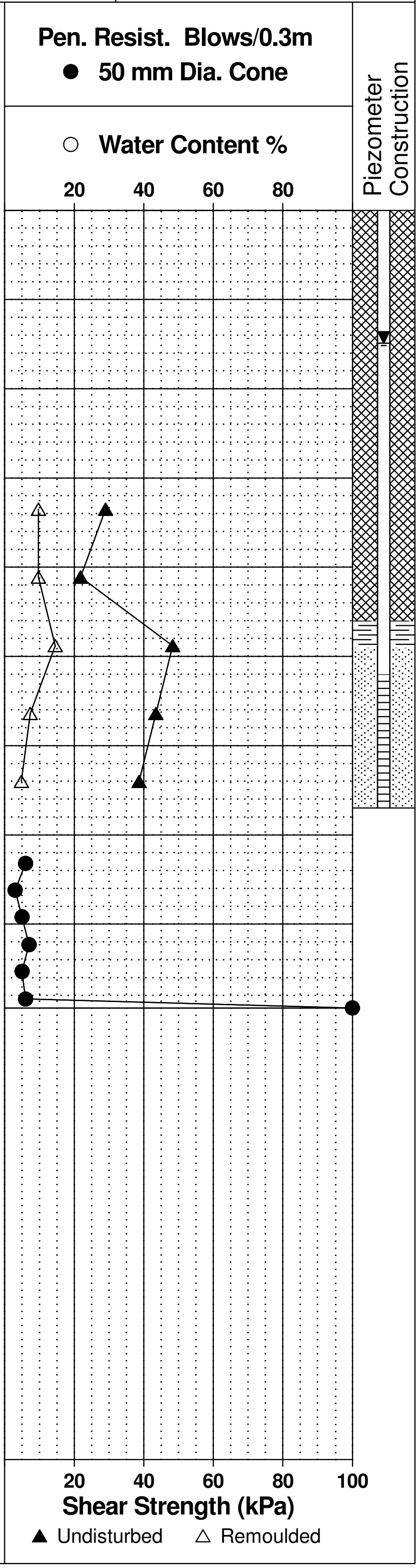
DATE May 19, 2020

FILE NO. PG5348

HOLE NO. BH 5-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.30		AU	1		
Stiff, brown **SILTY CLAY,** some sand - sand content decreasing with depth		SS	2	92	4
		SS	3	100	3
3.00		SS	4	100	2
Firm, grey **SILTY CLAY** 6.70					
Dynamic Cone Penetration Test commenced at 6.70m depth. Cone pushed to 7.0m depth. 8.94					
End of Borehole Practical DCPT refusal at 8.94m depth (GWL @ 1.49m - May 22, 2020)					

DEPTH (m)	ELEV. (m)
0	91.99
1	90.99
2	89.99
3	88.99
4	87.99
5	86.99
6	85.99
7	84.99
8	83.99



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

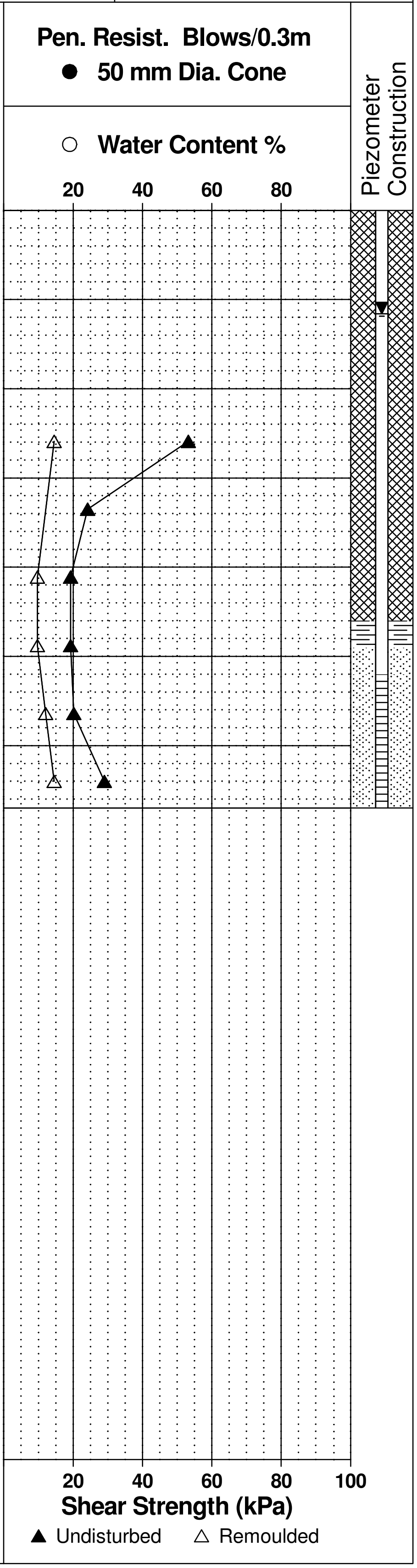
BORINGS BY CME-55 Low Clearance Drill

DATE May 19, 2020

FILE NO. PG5348

HOLE NO. BH 6-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.78
TOPSOIL 0.28		AU	1				
		SS	2	54	5	1	90.78
Stiff to firm, brown **SILTY CLAY,** some to trace sand - soft to firm and grey by 3.0m depth		SS	3	88	2	2	89.78
						3	88.78
						4	87.78
						5	86.78
						6	85.78
6.70							
End of Borehole (GWL @ 1.16m - May 22, 2020)							



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Development - 3432 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE May 19, 2020

FILE NO. PG5348

HOLE NO. BH 7-20

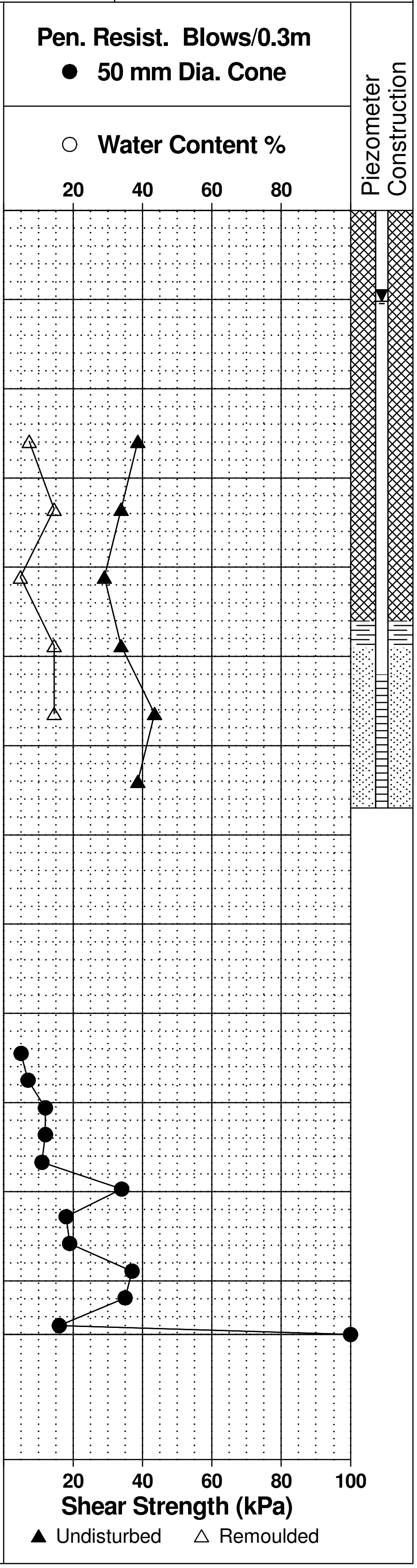
SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.33
Brown **SILTY SAND** with clay	0.60
Stiff to firm, brown **SILTY CLAY** with sand - sand content decreasing with depth	2.90
Firm, grey **SILTY CLAY**	6.70
Dynamic Cone Penetration Test commenced at 6.70m depth. Cone pushed to 9.0m depth.	12.60

End of Borehole
Practical DCPT refusal at 12.60m depth.

(GWL @ 1.02m - May 22, 2020)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	79	4
SS	3	46	2

DEPTH (m)	ELEV. (m)
0	92.04
1	91.04
2	90.04
3	89.04
4	88.04
5	87.04
6	86.04
7	85.04
8	84.04
9	83.04
10	82.04
11	81.04
12	80.04



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))

TW - Thin wall tube or Shelby tube

PS - Piston sample

AU - Auger sample or bulk sample

WS - Wash sample

RC - Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

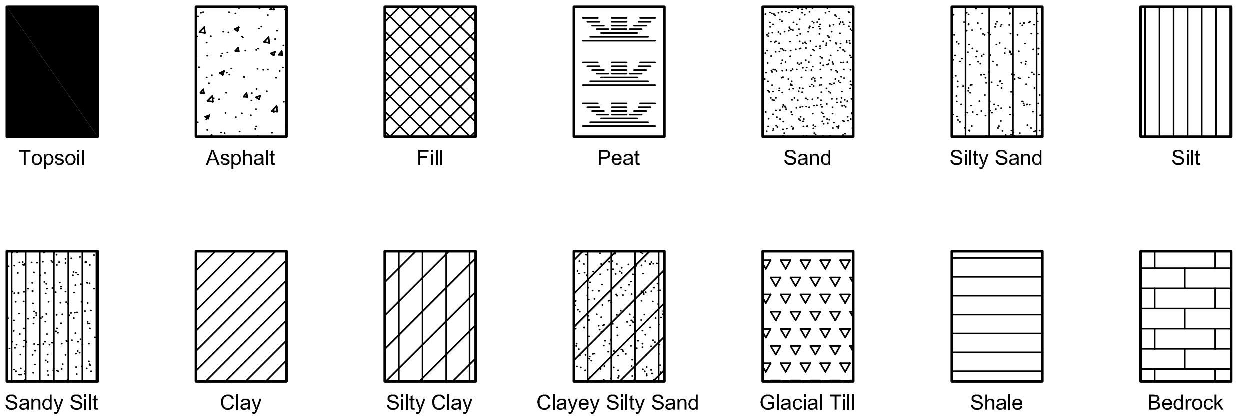
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

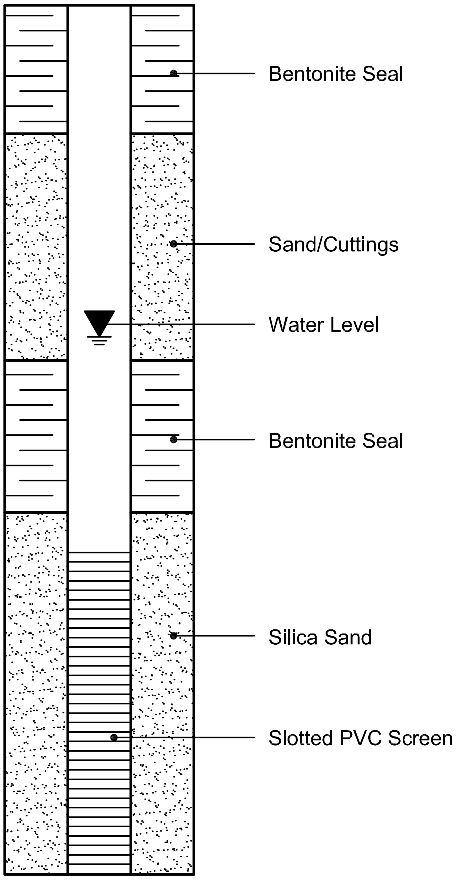
SYMBOLS AND TERMS (continued)

STRATA PLOT

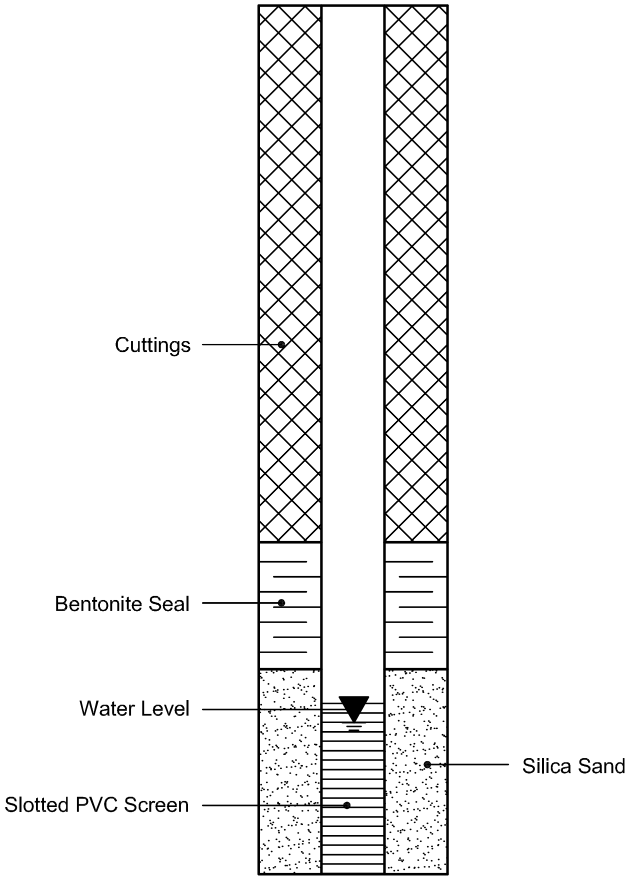


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PROJECT: 1530273

RECORD OF BOREHOLE: 15-1

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 20, 2015

DATUM: Geodetic

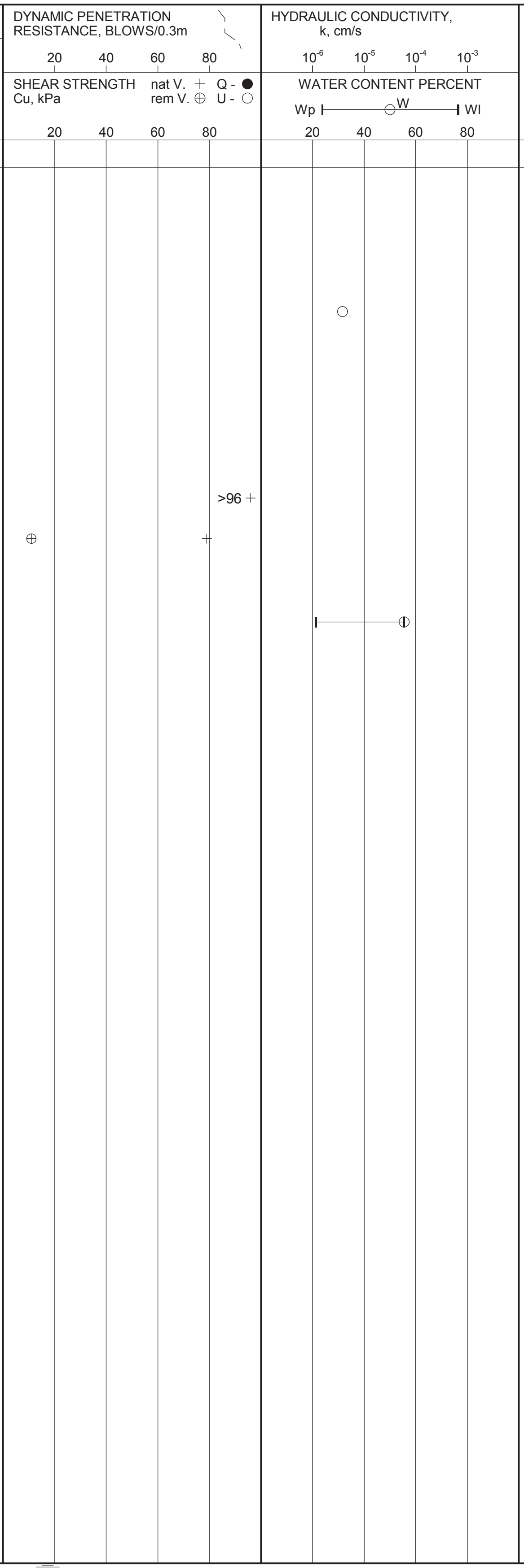
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

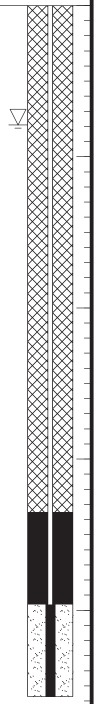
DEPTH SCALE METRES: 0 to 10

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m
GROUND SURFACE	91.83			
TOPSOIL - (CL) SILTY CLAY, some sand, trace gravel; dark brown	0.00			
(SM-CI/CH) SILTY SAND and SILTY CLAY, interbedded; grey brown; non-cohesive, moist, loose	91.58 0.25	1	SS	4
(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown, highly fissured (WEATHERED CRUST); cohesive, w>PL, very stiff to stiff	90.15 1.68	2	SS	2
(CI/CH) SILTY CLAY to CLAY; grey, with thick laminations of silt; cohesive, w>PL, stiff	88.78 3.05	3	SS	WH
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose	88.07 3.76	4	SS	2
End of Borehole	87.26 4.57			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Native Backfill

Bentonite Seal

Standpipe

WL in Standpipe at
Elev. 91.04 m on
May 28, 2015

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI

CHECKED: WAM

PROJECT: 1530273

RECORD OF BOREHOLE: 15-2

SHEET 1 OF 1

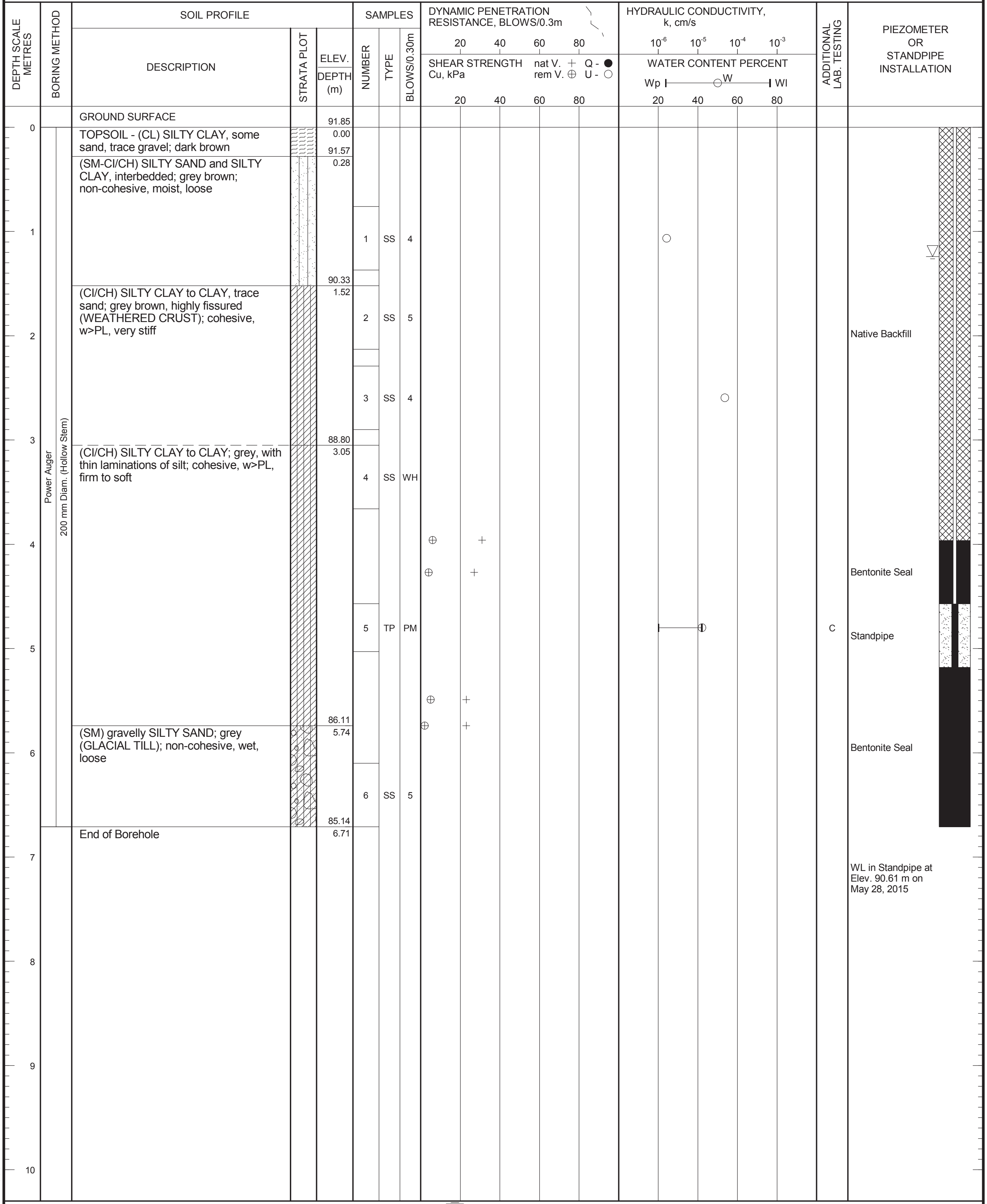
LOCATION: See Site Plan

BORING DATE: May 20, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



ELEV. / DEPTH (m)	DESCRIPTION
91.85	GROUND SURFACE
0.00	TOPSOIL - (CL) SILTY CLAY, some sand, trace gravel; dark brown
91.57 0.28	(SM-CI/CH) SILTY SAND and SILTY CLAY, interbedded; grey brown; non-cohesive, moist, loose
90.33 1.52	(CI/CH) SILTY CLAY to CLAY, trace sand; grey brown, highly fissured (WEATHERED CRUST); cohesive, w>PL, very stiff
88.80 3.05	(CI/CH) SILTY CLAY to CLAY; grey, with thin laminations of silt; cohesive, w>PL, firm to soft
86.11 5.74	(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, loose
85.14 6.71	End of Borehole

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	5	
3	SS	4	
4	SS	WH	
5	TP	PM	C
6	SS	5	

Native Backfill

Bentonite Seal

Standpipe

Bentonite Seal

WL in Standpipe at Elev. 90.61 m on May 28, 2015

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: RI

CHECKED: WAM

PROJECT: 1530273

RECORD OF BOREHOLE: 15-3

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: May 20-21, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE - DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	91.57
TOPSOIL - (ML/SM) SILTY SAND to sandy SILT, trace gravel; dark brown	0.00
(SM-CI/CH) SILTY SAND and SILTY CLAY, interbedded; grey brown; non-cohesive, moist, loose	91.11 0.46
(CH/CI) SILTY CLAY to CLAY, trace sand; grey brown, highly fissured, with thin laminations of silty sand (WEATHERED CRUST); cohesive, w>PL, stiff	90.05 1.52
(CH/CI) SILTY CLAY to CLAY; grey, with black organic mottling and thin to thick laminations of silty sand; cohesive, w>PL, soft to firm	88.52 3.05

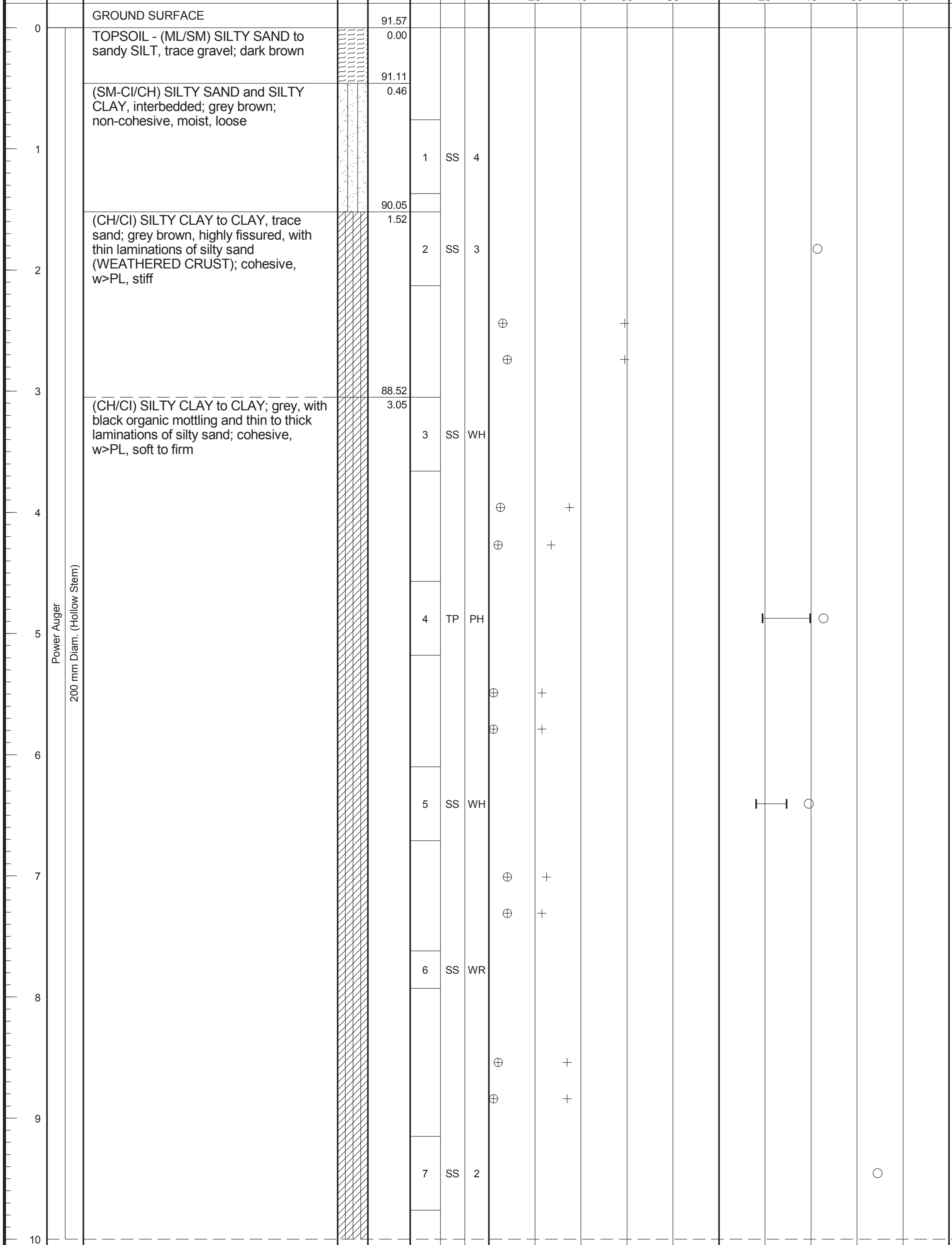
SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	3	
3	SS	WH	
4	TP	PH	C
5	SS	WH	
6	SS	WR	
7	SS	2	

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

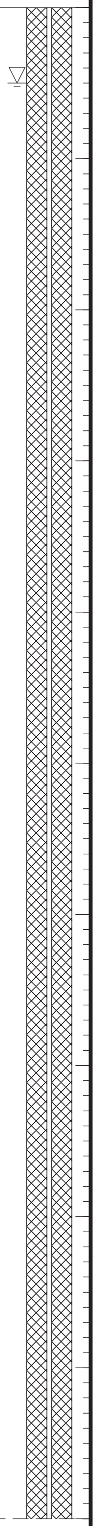
SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}

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



PIEZOMETER OR STANDPIPE INSTALLATION



Native Backfill

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI
CHECKED: WAM

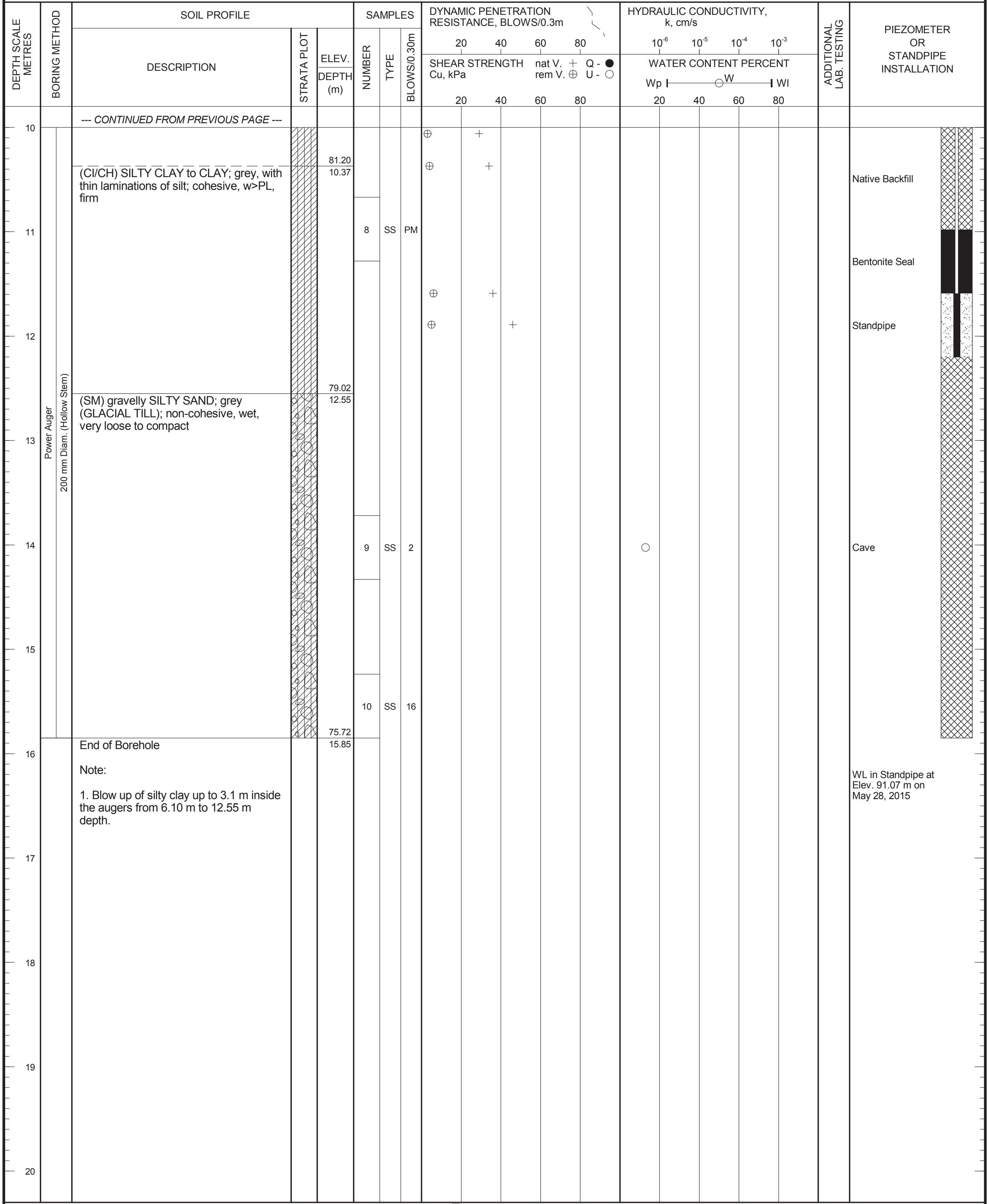
PROJECT: 1530273

RECORD OF BOREHOLE: 15-3

SHEET 2 OF 2

LOCATION: See Site Plan
BORING DATE: May 20-21, 2015
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm



--- CONTINUED FROM PREVIOUS PAGE ---

DESCRIPTION	ELEV. DEPTH (m)
(CI/CH) SILTY CLAY to CLAY; grey, with thin laminations of silt; cohesive, w>PL, firm	81.20 10.37
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, very loose to compact	79.02 12.55
End of Borehole	75.72 15.85

NUMBER	TYPE	BLOWS/0.30m
8	SS	PM
9	SS	2
10	SS	16

Note:

1. Blow up of silty clay up to 3.1 m inside the augers from 6.10 m to 12.55 m depth.

Native Backfill

Bentonite Seal

Standpipe

Cave

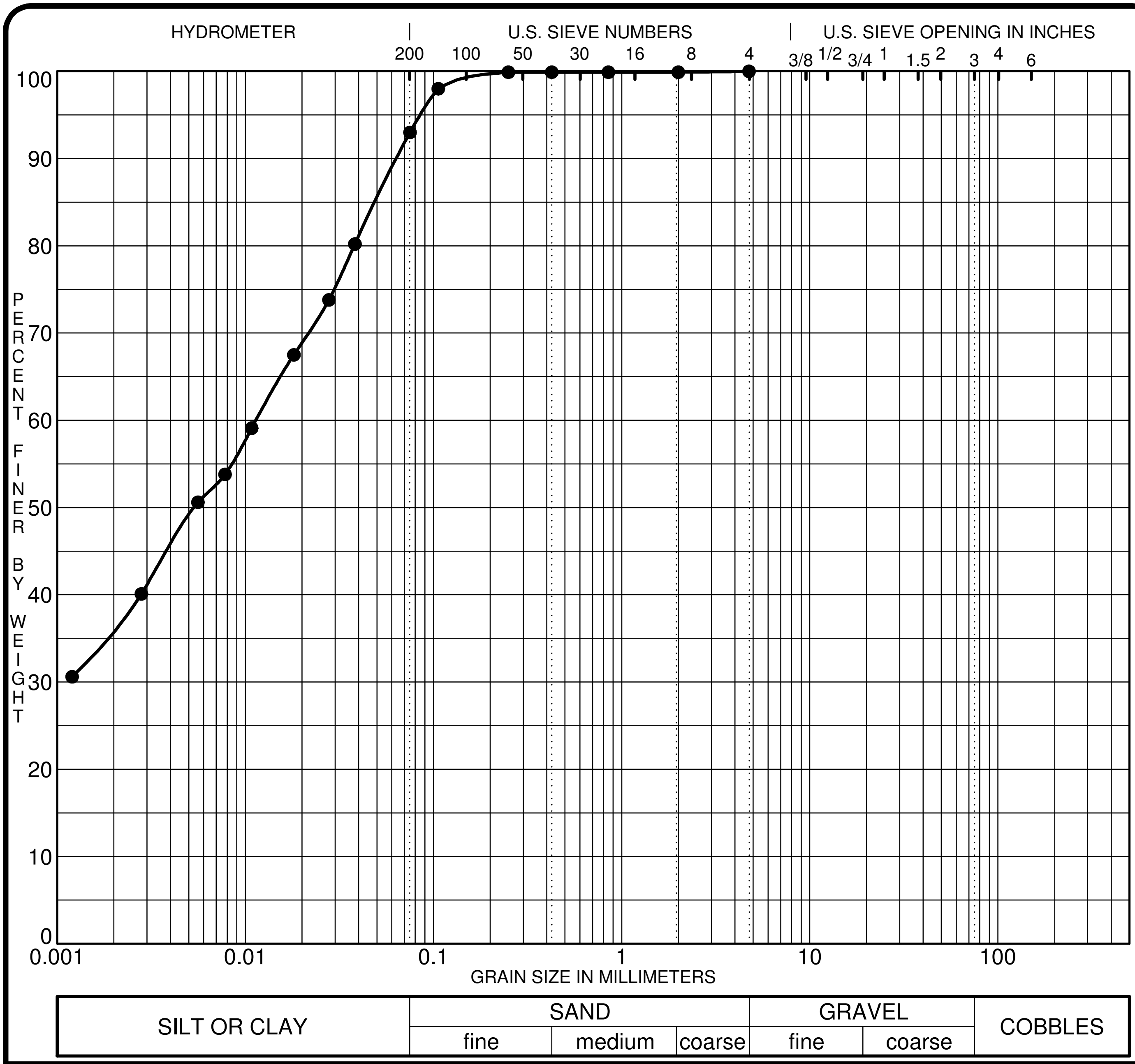
WL in Standpipe at Elev. 91.07 m on May 28, 2015

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI
CHECKED: WAM

MIS-BHS 001 1530273.GPJ GAL-MIS.GDT 08/25/15 JM



Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP 4-21 G4**	CL = Inorganic Clays of Low Plasticity		**35**	**18**	**17**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP 4-21 G4**	**4.75**	**0.01**			**0.0**	**7.0**	**93.0**	

CLIENT **Minto Communities Inc.**

FILE NO. **PG5348**

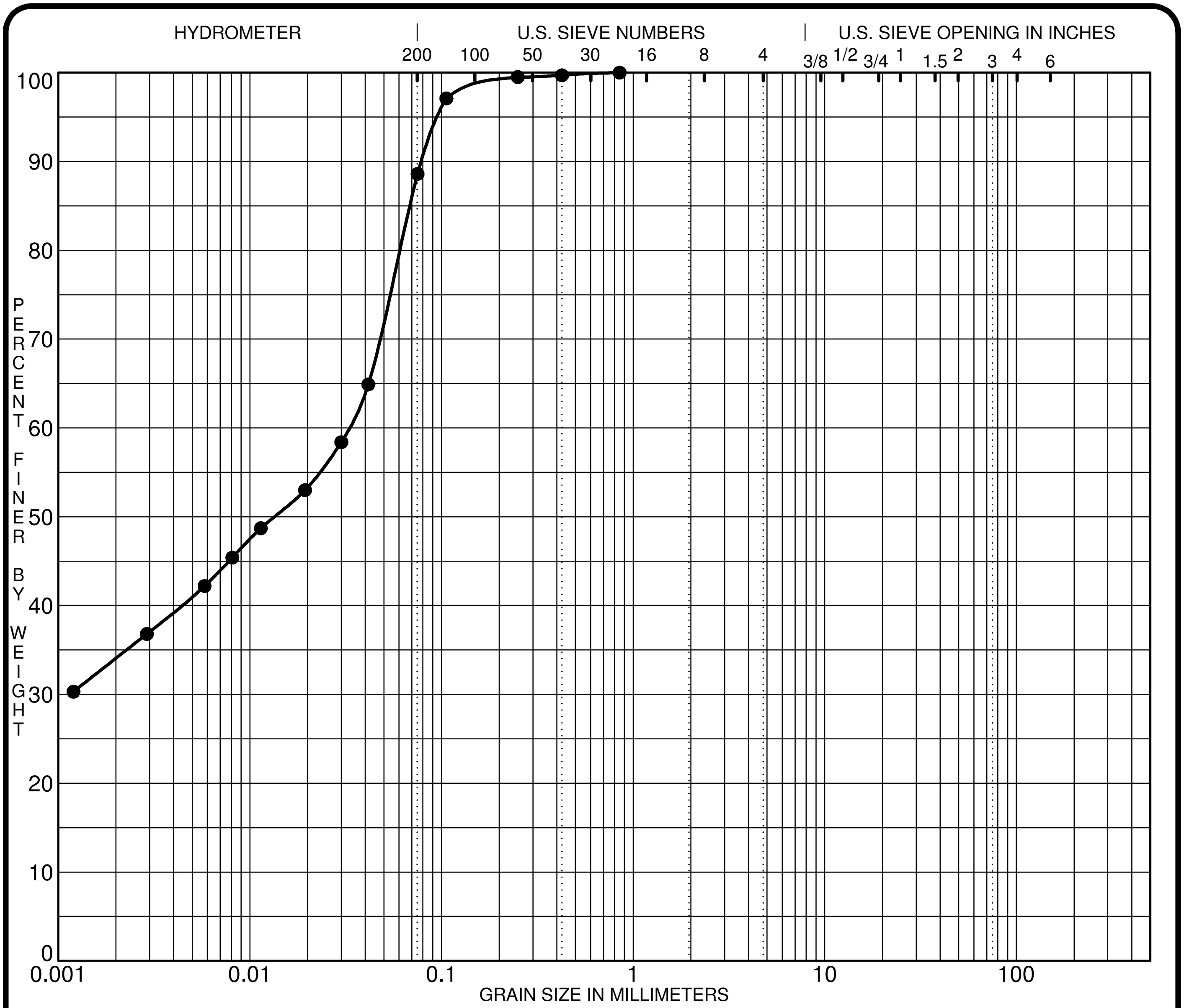
PROJECT **Geotechnical Investigation - Half Moon Bay North**
Greenbank Road

DATE **14 Jan 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



<table>
<tr><td rowspan="2">SILT OR CLAY</td><td colspan="3">SAND</td><td colspan="2">GRAVEL</td><td rowspan="2">COBBLES</td></tr>
<tr><td>fine</td><td>medium</td><td>coarse</td><td>fine</td><td>coarse</td></tr>
</table>

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP 8-21 G2**	CL = Inorganic Clays of Low Plasticity		**39**	**24**	**15**		

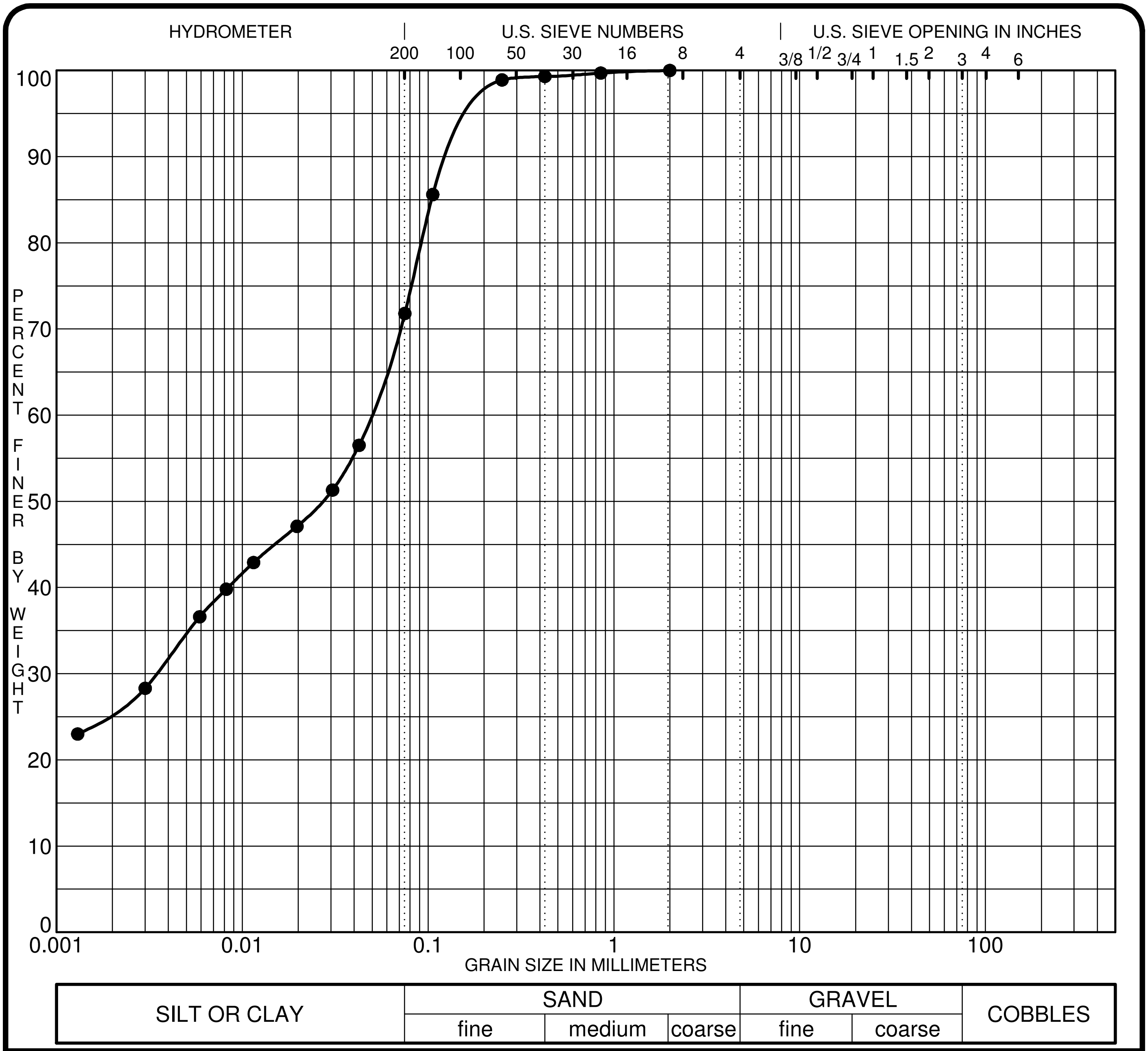
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP 8-21 G2**	**0.85**	**0.03**			**0.0**	**11.4**	**88.6**	

CLIENT **Minto Communities Inc.**
PROJECT **Geotechnical Investigation - Half Moon Bay North**
Greenbank Road

FILE NO. **PG5348**
DATE **15 Jan 21**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP12-21 G3**	CL = Inorganic Clays of Low Plasticity		**38**	**19**	**19**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP12-21 G3**	**2.00**	**0.05**	**0.003**		**0.0**	**28.2**	**71.8**	

CLIENT **Minto Communities Inc.**

PROJECT **Geotechnical Investigation - Half Moon Bay North**
Greenbank Road

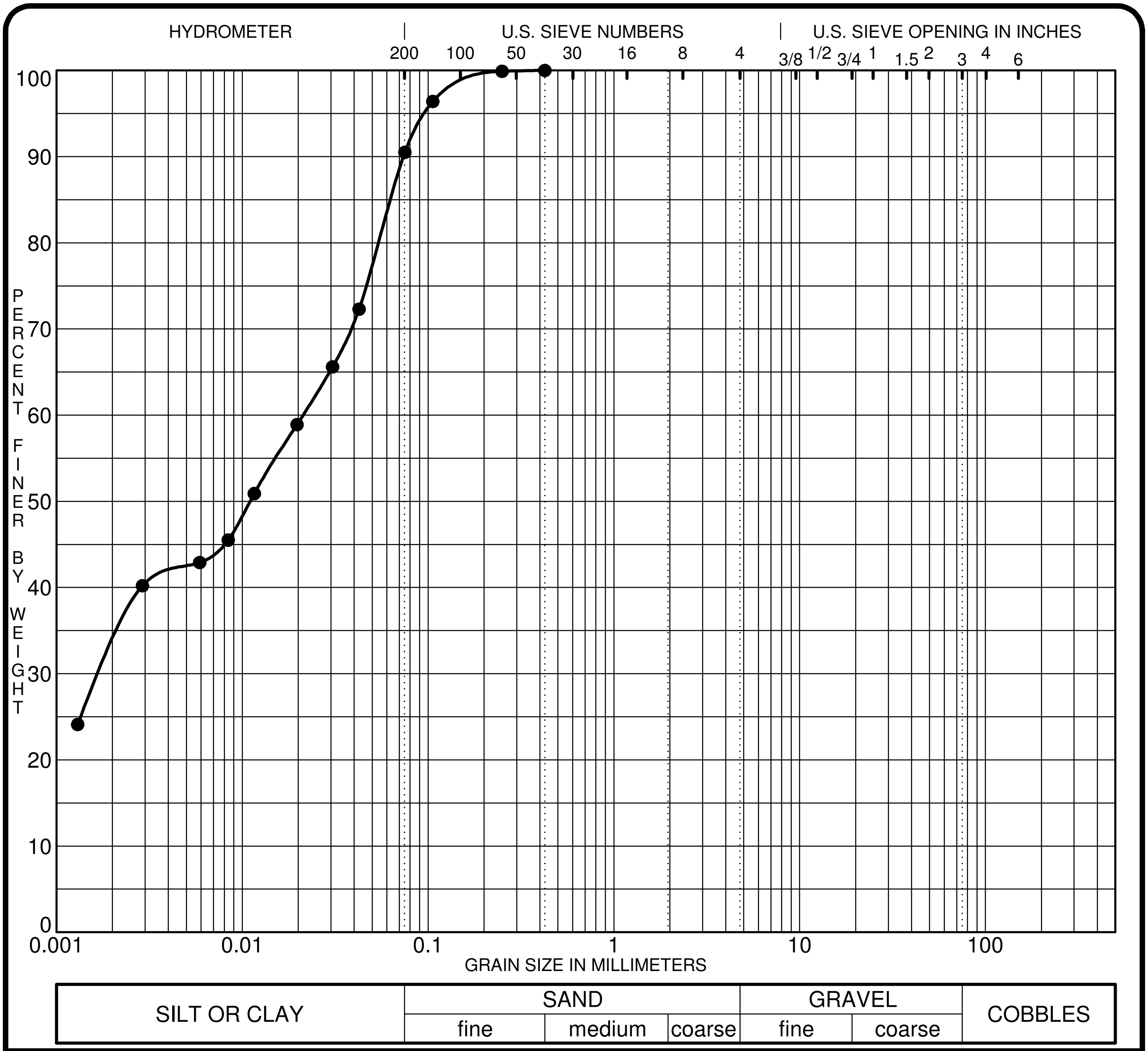
FILE NO. **PG5348**

DATE **15 Jan 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 3-21**	**SS3**	**CL - Inorganic clays of low plasticity**						
☒									
▲									
★									

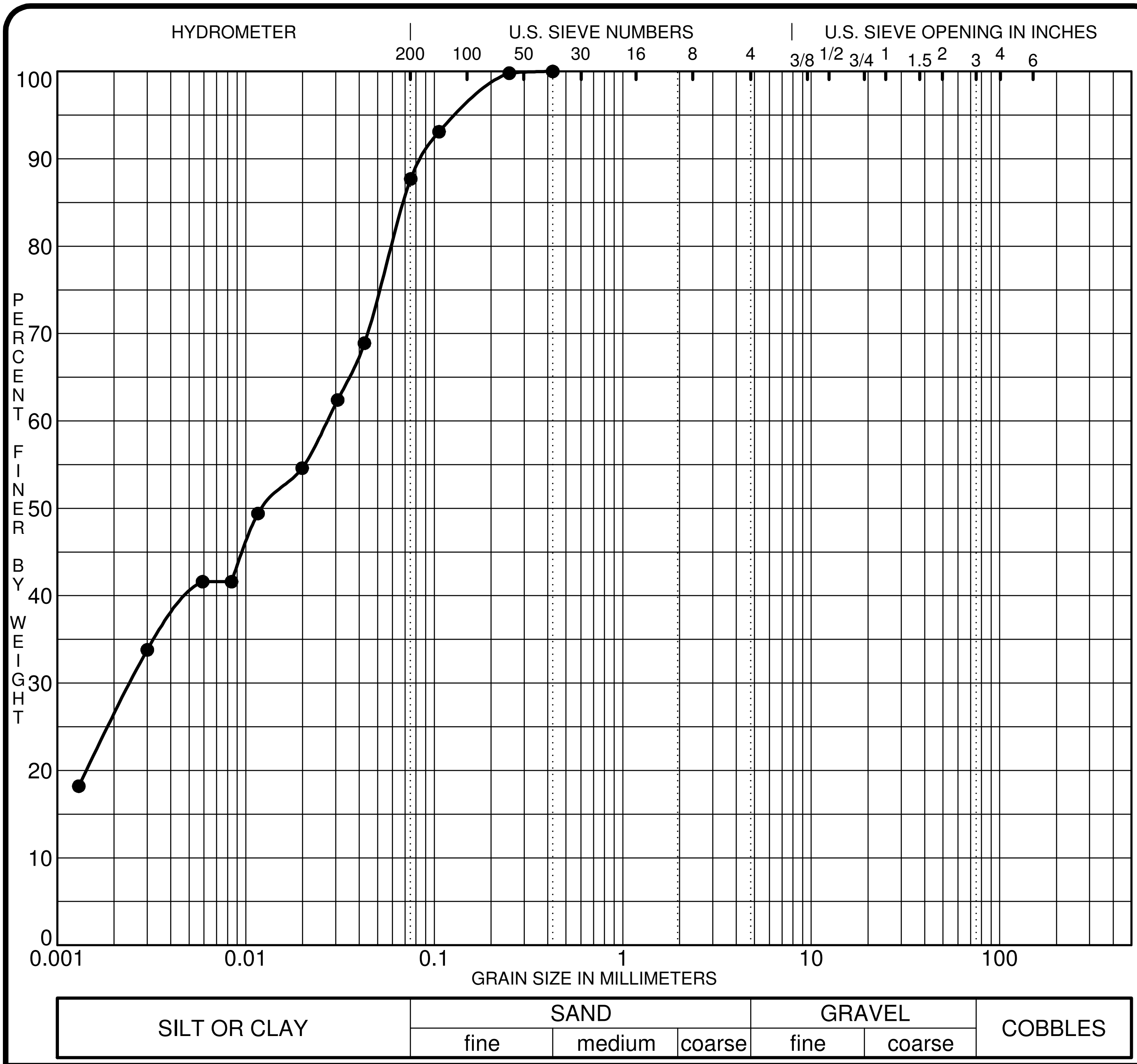
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 3-21**	**SS3**	**0.43**	**0.02**	**0.002**		**0.0**	**9.5**	**90.5**	
☒										
▲										
★										

CLIENT **Minto Communities Inc.**
FILE NO. **PG5348**
PROJECT **Supplemental Geotechnical Investigation -**
Kennedy Lands - 3432 Greenbank Road
DATE **9 Dec 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 6-21**	**SS3**	**CL - Inorganic clays of low plasticity**						
☒									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 6-21**	**SS3**	**0.43**	**0.03**	**0.002**		**0.0**	**12.3**	**87.7**	
☒										
▲										
★										

CLIENT **Minto Communities Inc.**

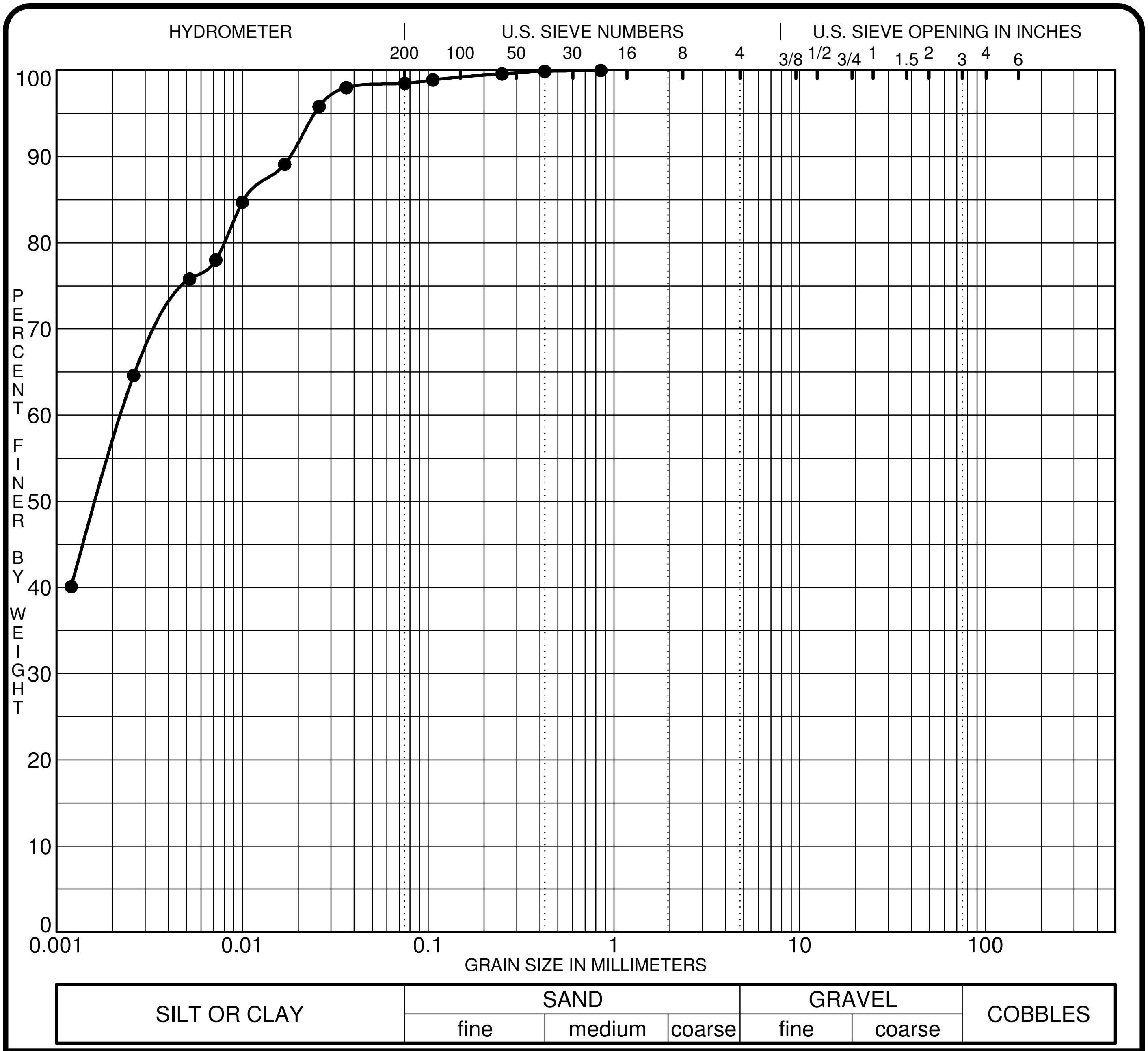
FILE NO. **PG5348**

PROJECT **Supplemental Geotechnical Investigation -**
Kennedy Lands - 3432 Greenbank Road

DATE **10 Dec 21**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH10-21**	**SS3**	**CL - Inorganic clays of low plasticity**						
☒									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH10-21**	**SS3**	**0.85**	**0.00**			**0.0**	**1.5**	**98.5**	
☒										
▲										
★										

CLIENT **Minto Communities Inc.**

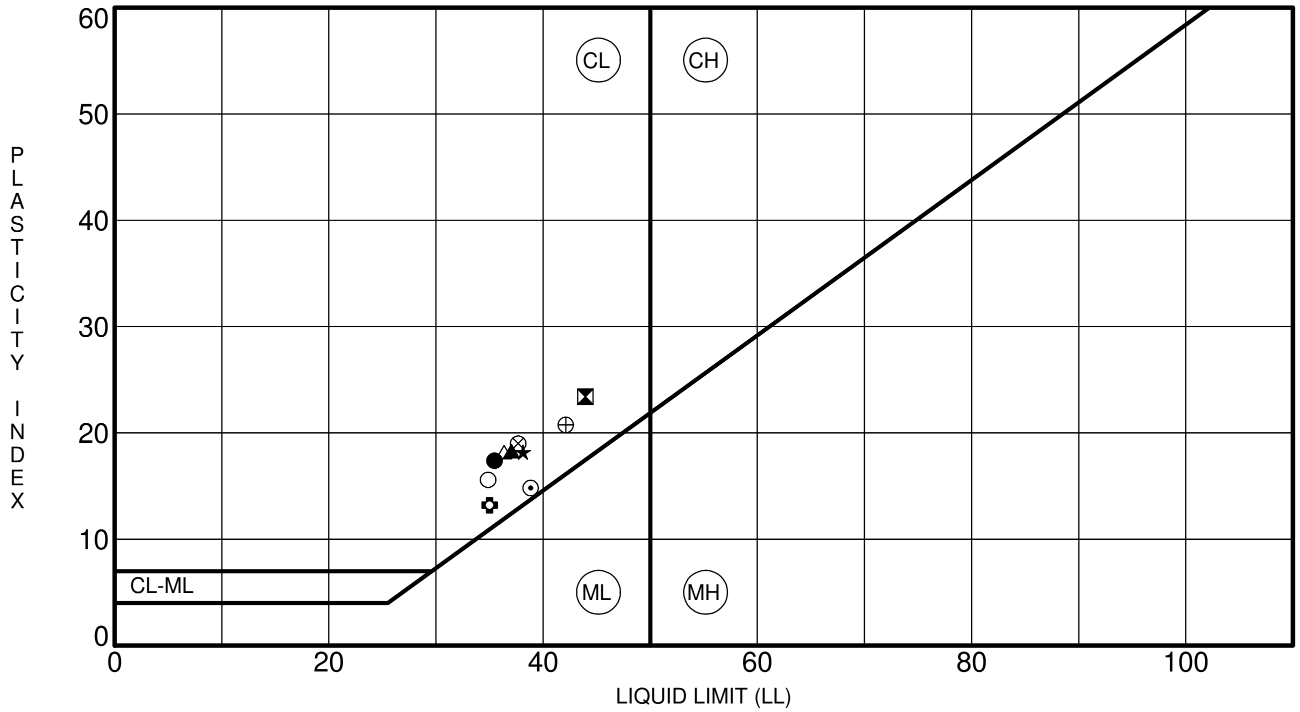
FILE NO. **PG5348**

PROJECT **Supplemental Geotechnical Investigation -**
Kennedy Lands - 3432 Greenbank Road

DATE **13 Dec 21**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**TP 4-21 G4**	**35**	**18**	**17**	**93.0**	**CL= Inorganic Clays of Low Plasticity**
⧗	**TP 5-21 G3**	**44**	**21**	**23**		**CL= Inorganic Clays of Low Plasticity**
▲	**TP 6-21 G3**	**37**	**19**	**18**		**CL= Inorganic Clays of Low Plasticity**
★	**TP 7-21 G2**	**38**	**20**	**18**		**CL= Inorganic Clays of Low Plasticity**
⊙	**TP 8-21 G2**	**39**	**24**	**15**	**88.6**	**CL= Inorganic Clays of Low Plasticity**
✿	**TP 9-21 G2**	**35**	**22**	**13**		**CL= Inorganic Clays of Low Plasticity**
○	**TP10-21 G2**	**35**	**19**	**16**		**CL= Inorganic Clays of Low Plasticity**
△	**TP11-21 G2**	**36**	**18**	**18**		**CL= Inorganic Clays of Low Plasticity**
⊗	**TP12-21 G3**	**38**	**19**	**19**	**71.8**	**CL= Inorganic Clays of Low Plasticity**
⊕	**TP13-21 G2**	**42**	**21**	**21**		**CL= Inorganic Clays of Low Plasticity**

CLIENT **Minto Communities Inc.**

FILE NO. **PG5348**

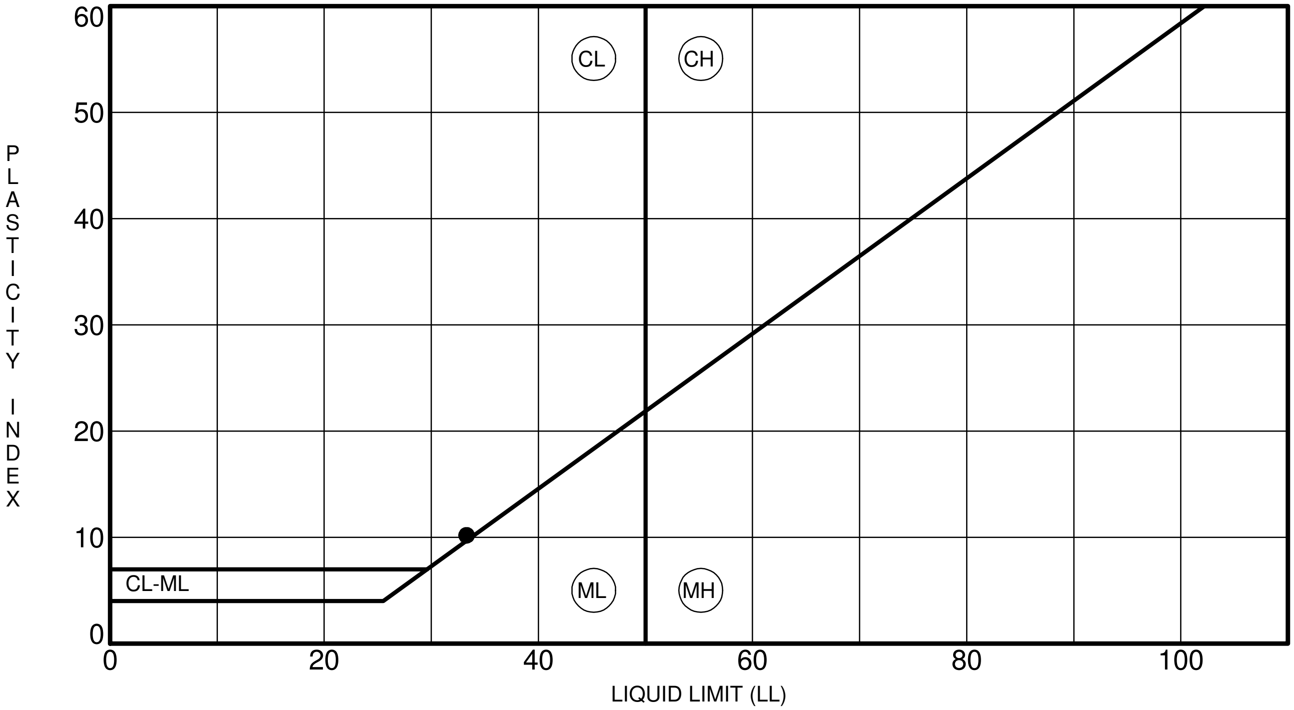
PROJECT **Geotechnical Investigation - Half Moon Bay North - Greenbank Road**

DATE **15 Jan 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH10-21**	**SS2**	**33**	**23**	**10**		**CL - Inorganic clays of low plasticity**

CLIENT **Minto Communities Inc.**

FILE NO. **PG5348**

PROJECT **Supplemental Geotechnical Investigation -**
Kennedy Lands - 3432 Greenbank Road

DATE **13 Dec 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO:

Report Date: 25-May-2020

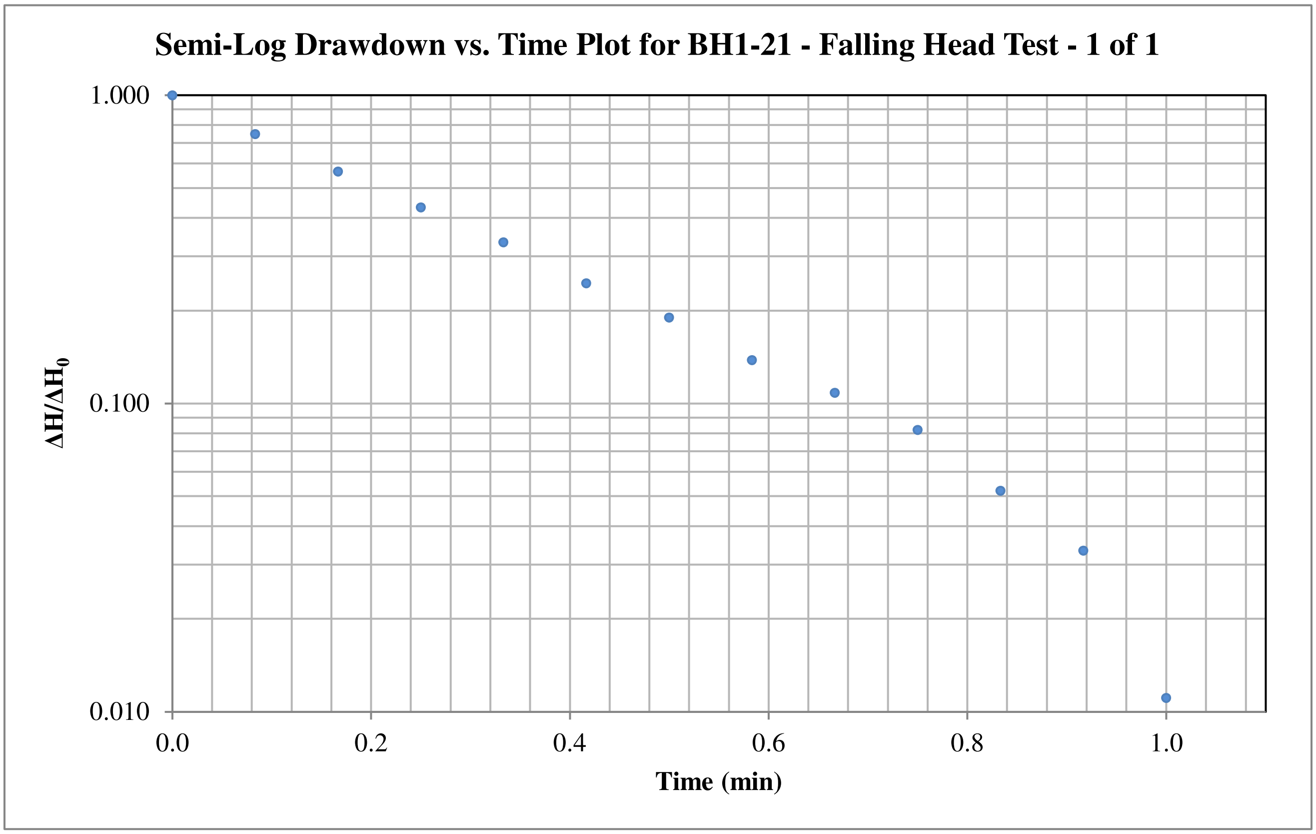
Order Date: 20-May-2020

Project Description: PG5348

	Client ID:	BH4-20 SS2	-	-	-
	Sample Date:	19-May-20 11:00	-	-	-
	Sample ID:	2021151-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	75.1	-	-	-
General Inorganics					
pH	0.05 pH Units	7.37	-	-	-
Resistivity	0.10 Ohm.m	69.6	-	-	-
Anions					
Chloride	5 ug/g dry	11	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH1-21
Test: Falling Head Test - 1 of 1
Date: December 20, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

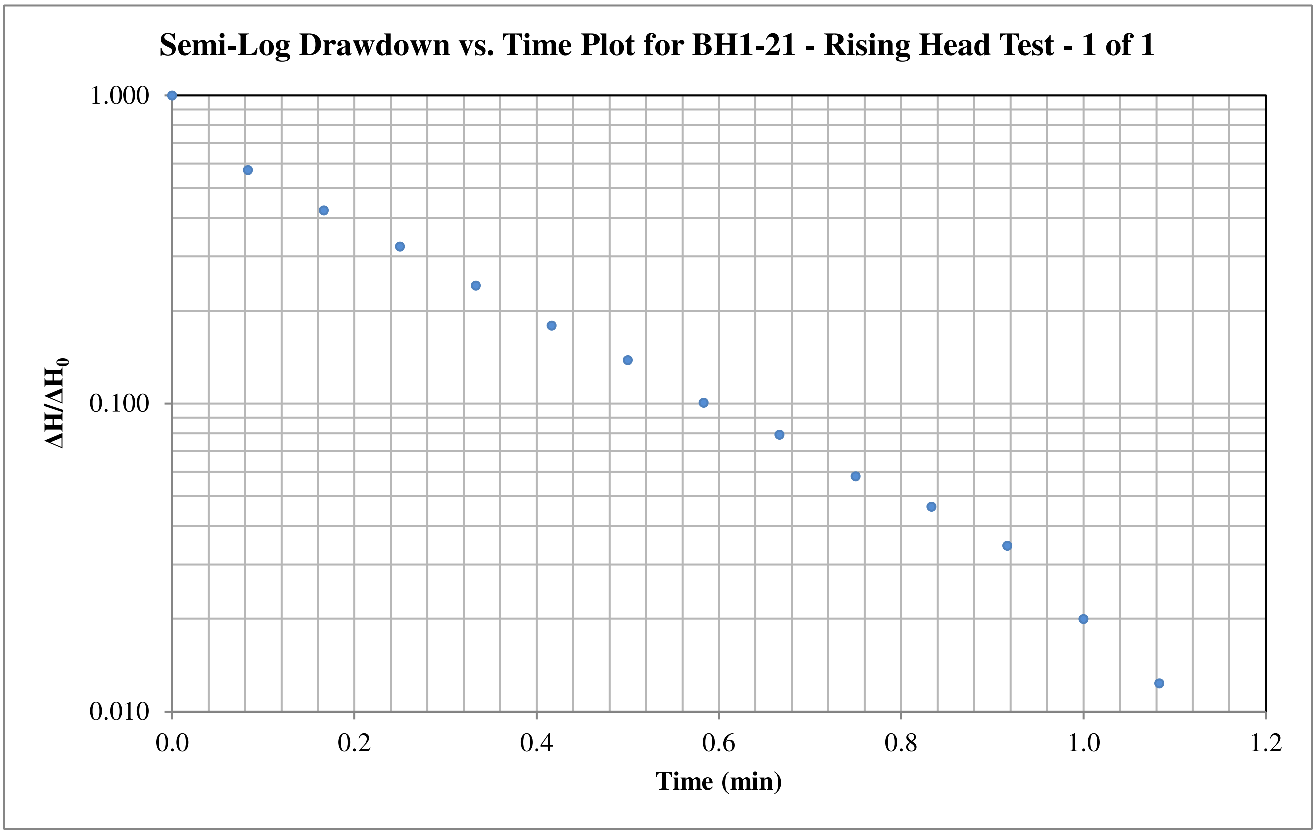
Data Points (from plot):

t*: 0.303 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.80E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH1-21
Test: Rising Head Test - 1 of 1
Date: December 20, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

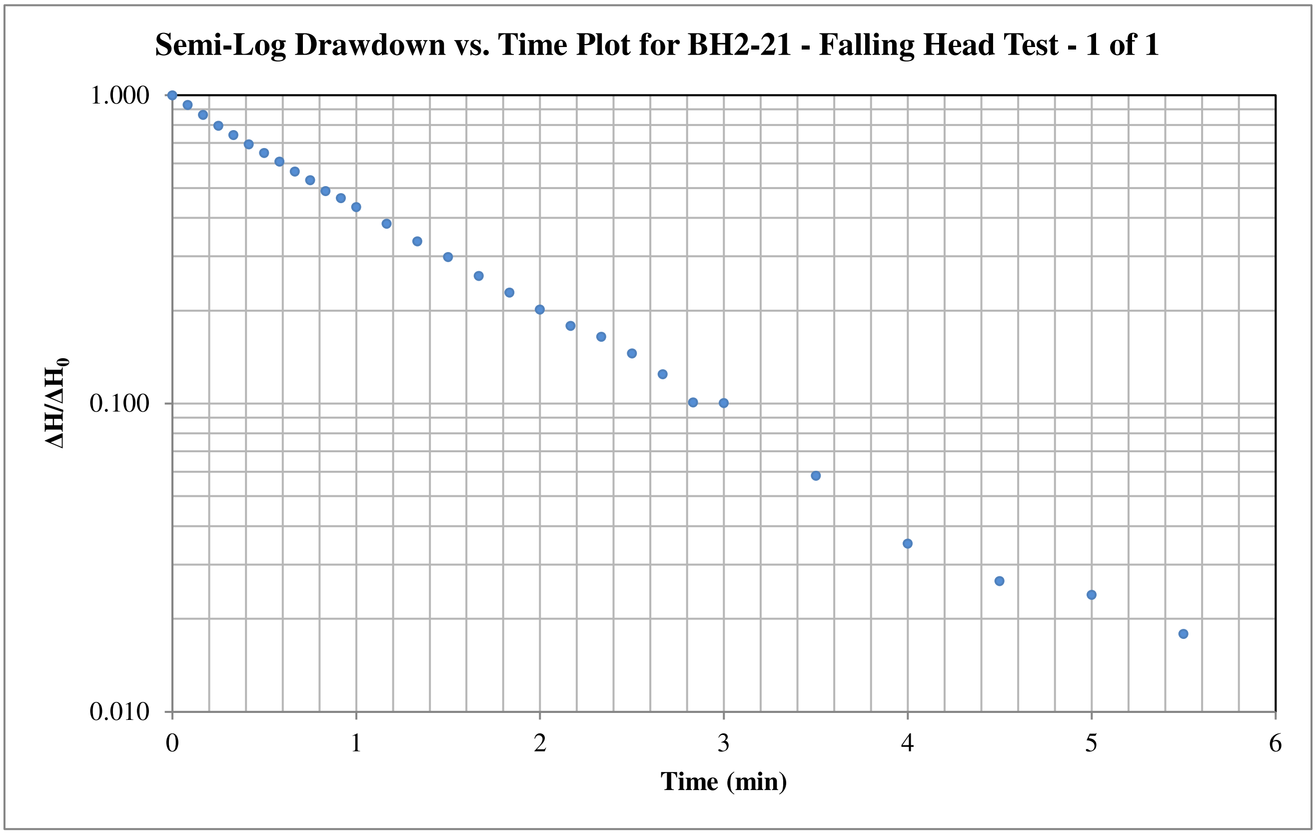
Data Points (from plot):

t*: 0.211 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 6.88E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH2-21
Test: Falling Head Test - 1 of 1
Date: December 20, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

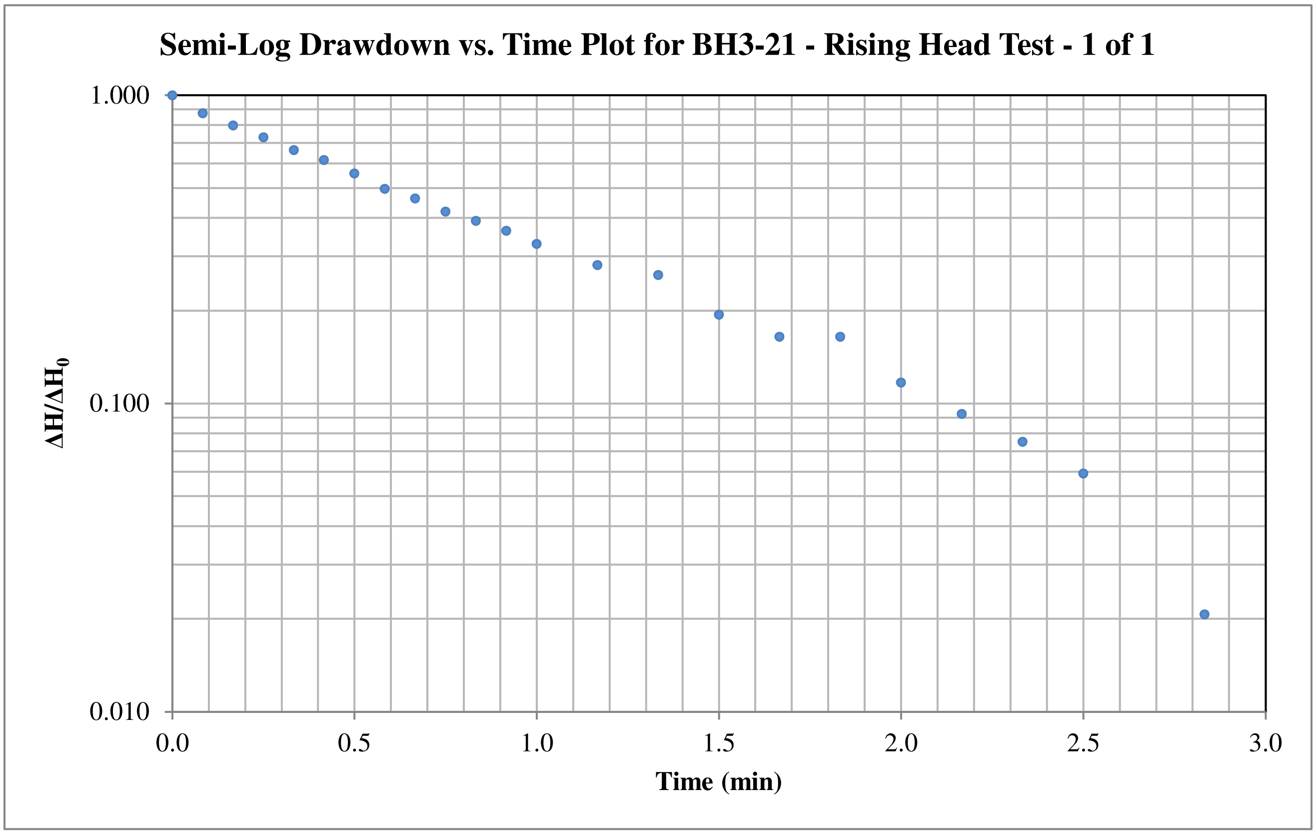
Data Points (from plot):

t*: 1.218 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.19E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH3-21
Test: Rising Head Test - 1 of 1
Date: December 20, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

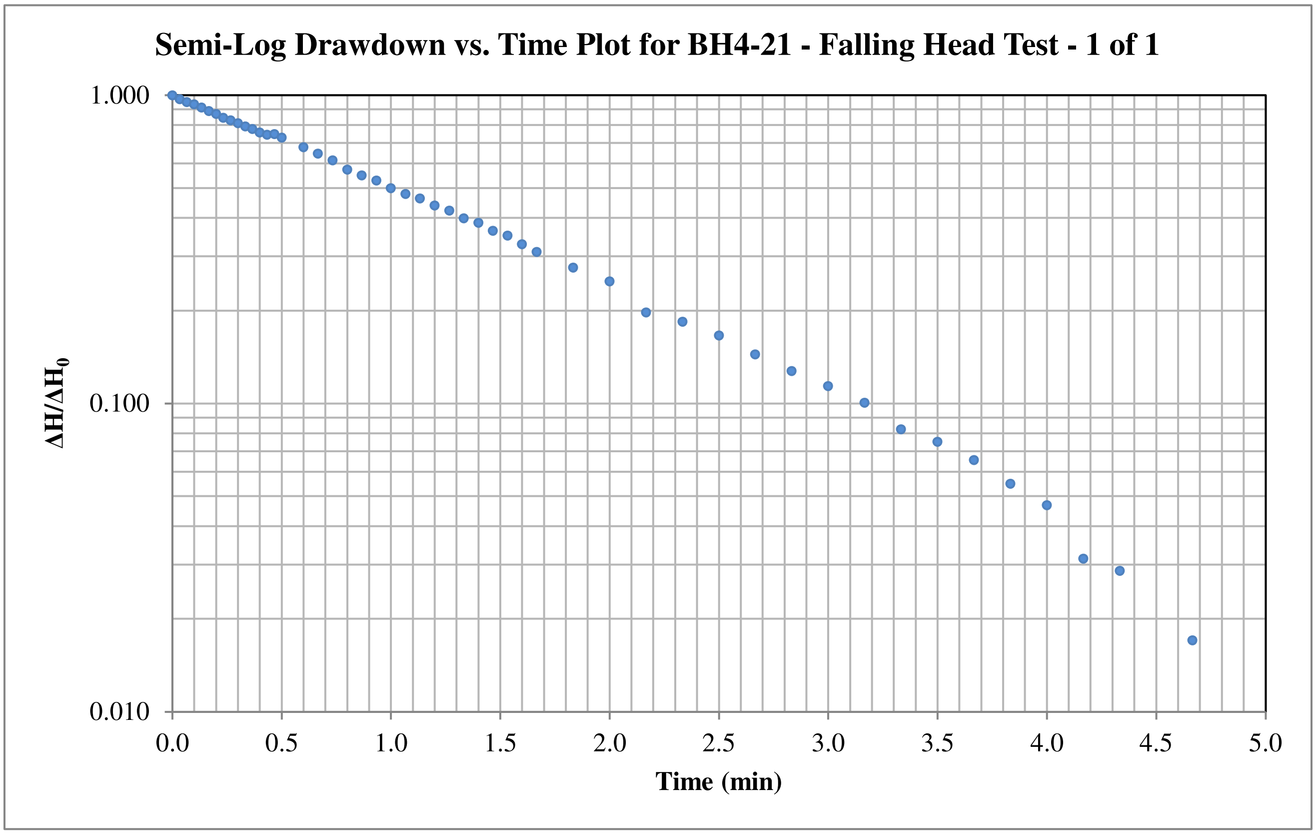
Data Points (from plot):

t*: 0.897 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.62E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH4-21
Test: Falling Head Test - 1 of 1
Date: December 21, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

Data Points (from plot):

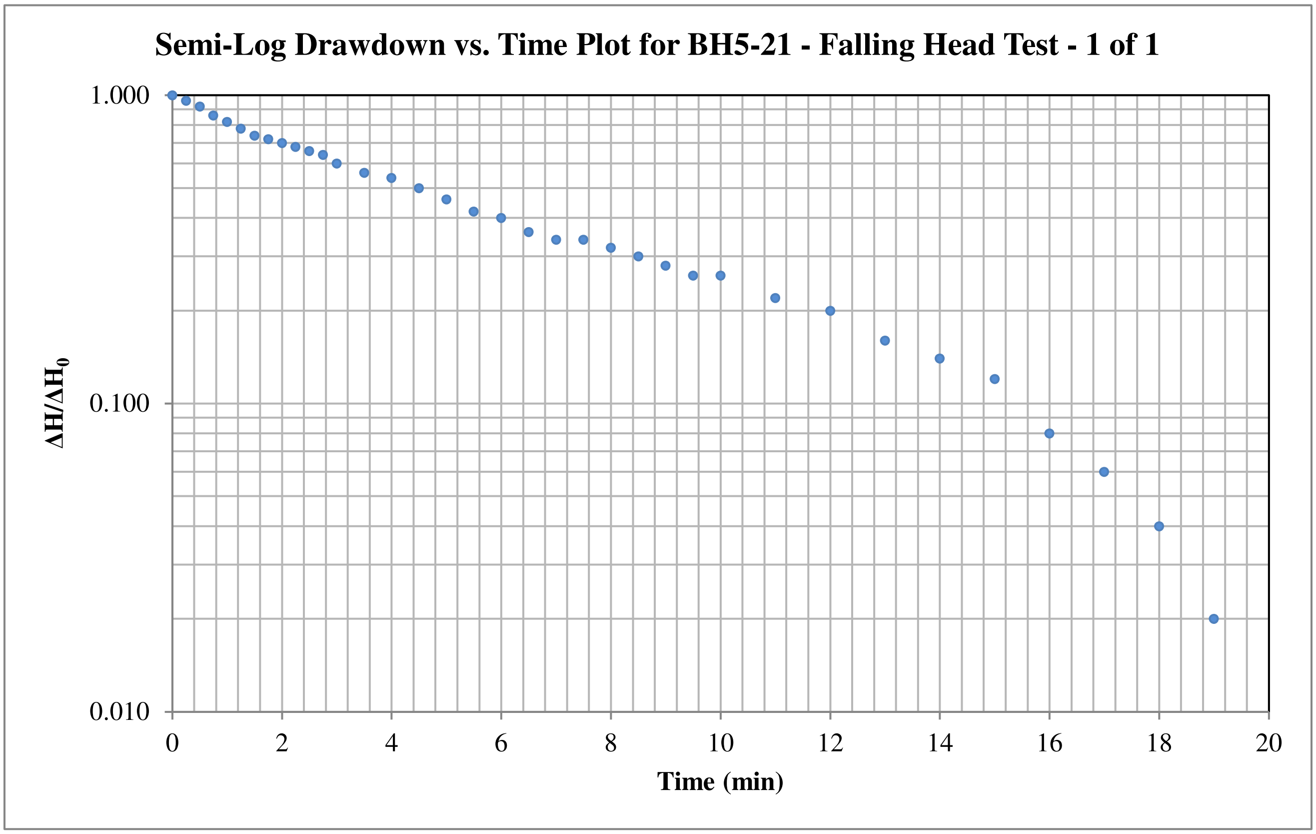
t*: 1.447 minutes

$\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.00E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH5-21
Test: Falling Head Test - 1 of 1
Date: December 23, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

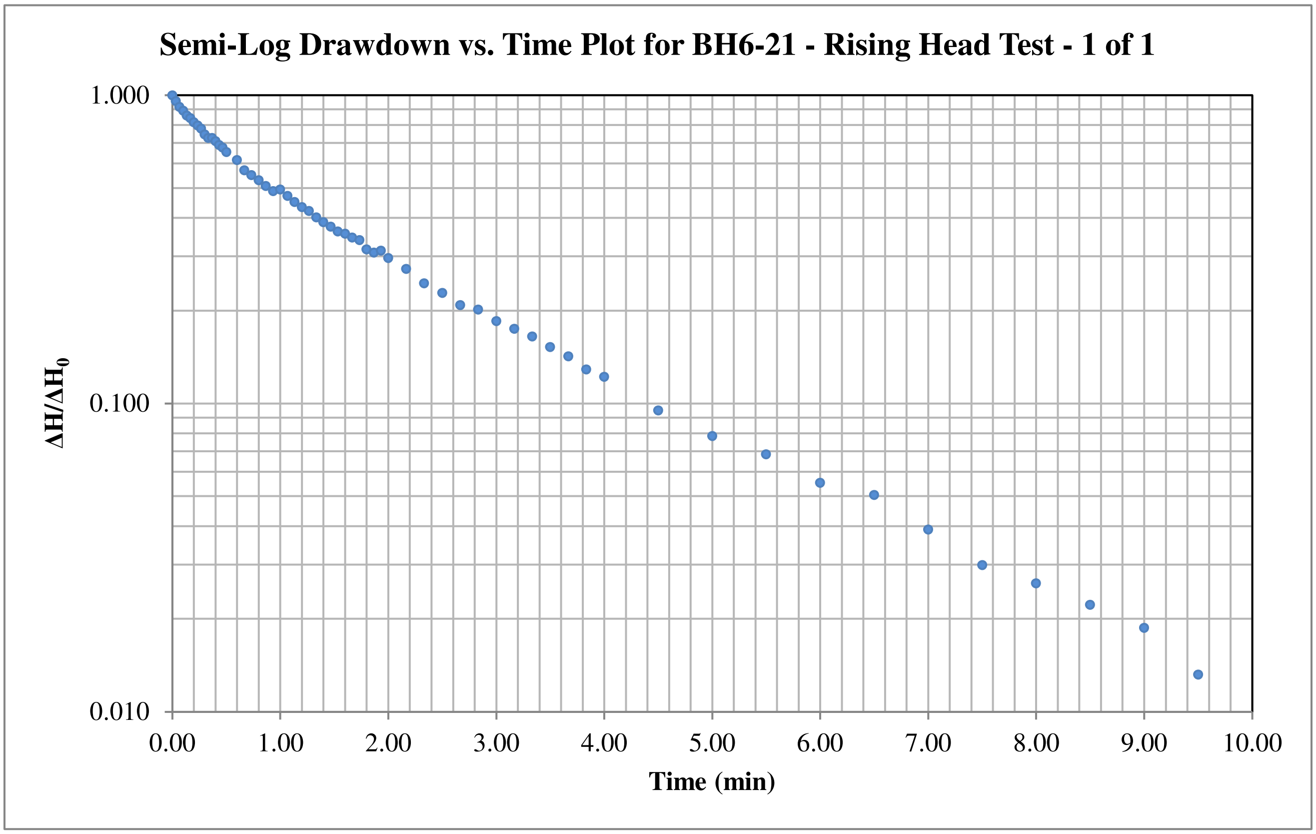
Data Points (from plot):

t*: 6.375 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 2.28E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH6-21
Test: Rising Head Test - 1 of 1
Date: December 21, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

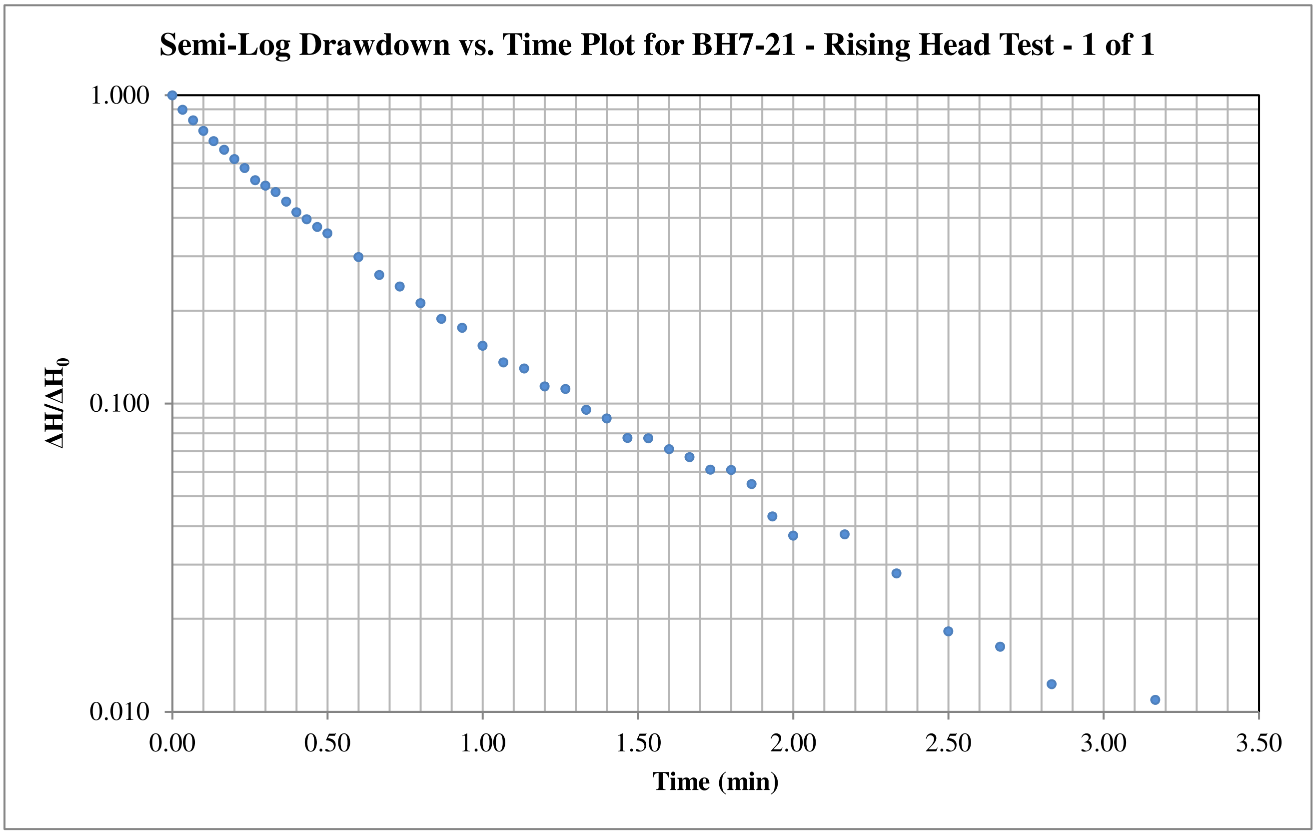
Data Points (from plot):

t*: 1.504 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 9.66E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH7-21
Test: Rising Head Test - 1 of 1
Date: December 21, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

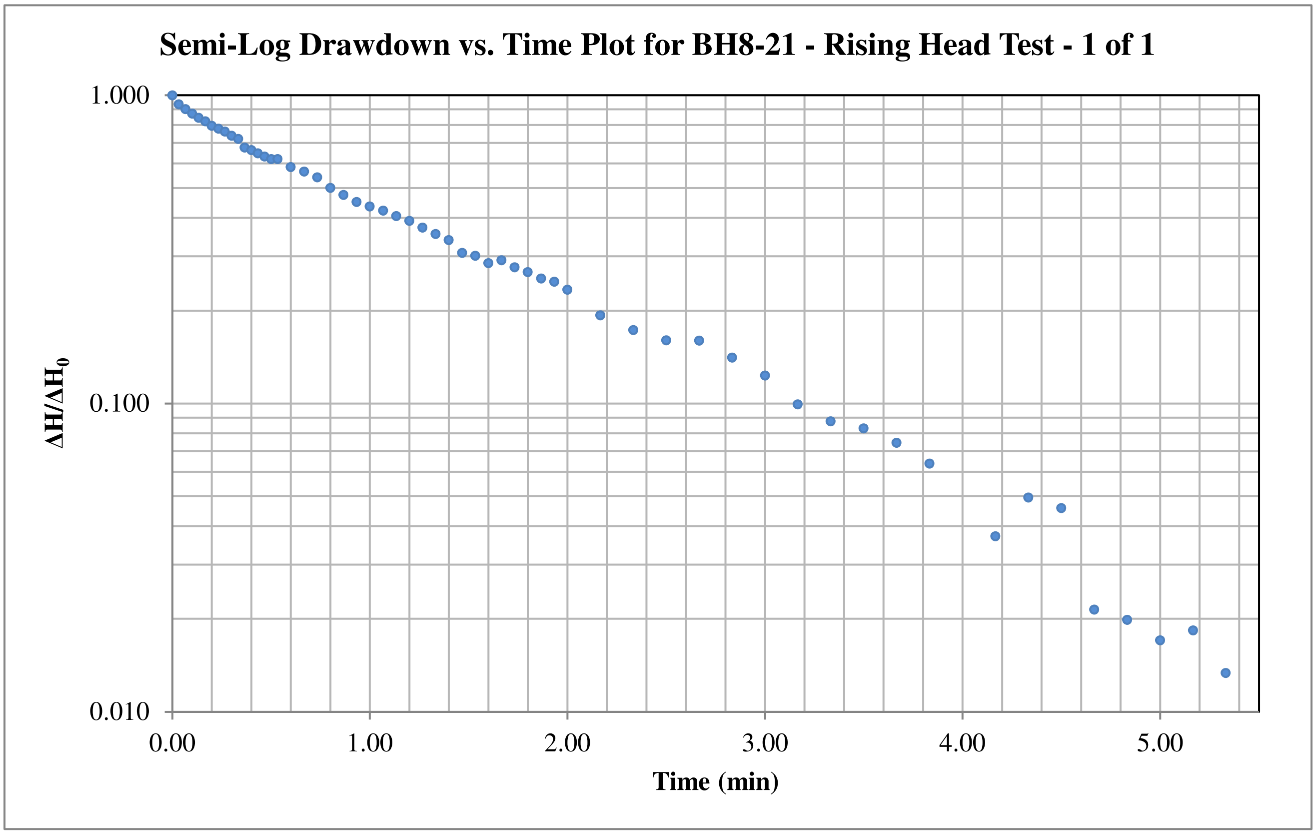
Data Points (from plot):

t*: 0.475 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.06E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH8-21
Test: Rising Head Test - 1 of 1
Date: December 21, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

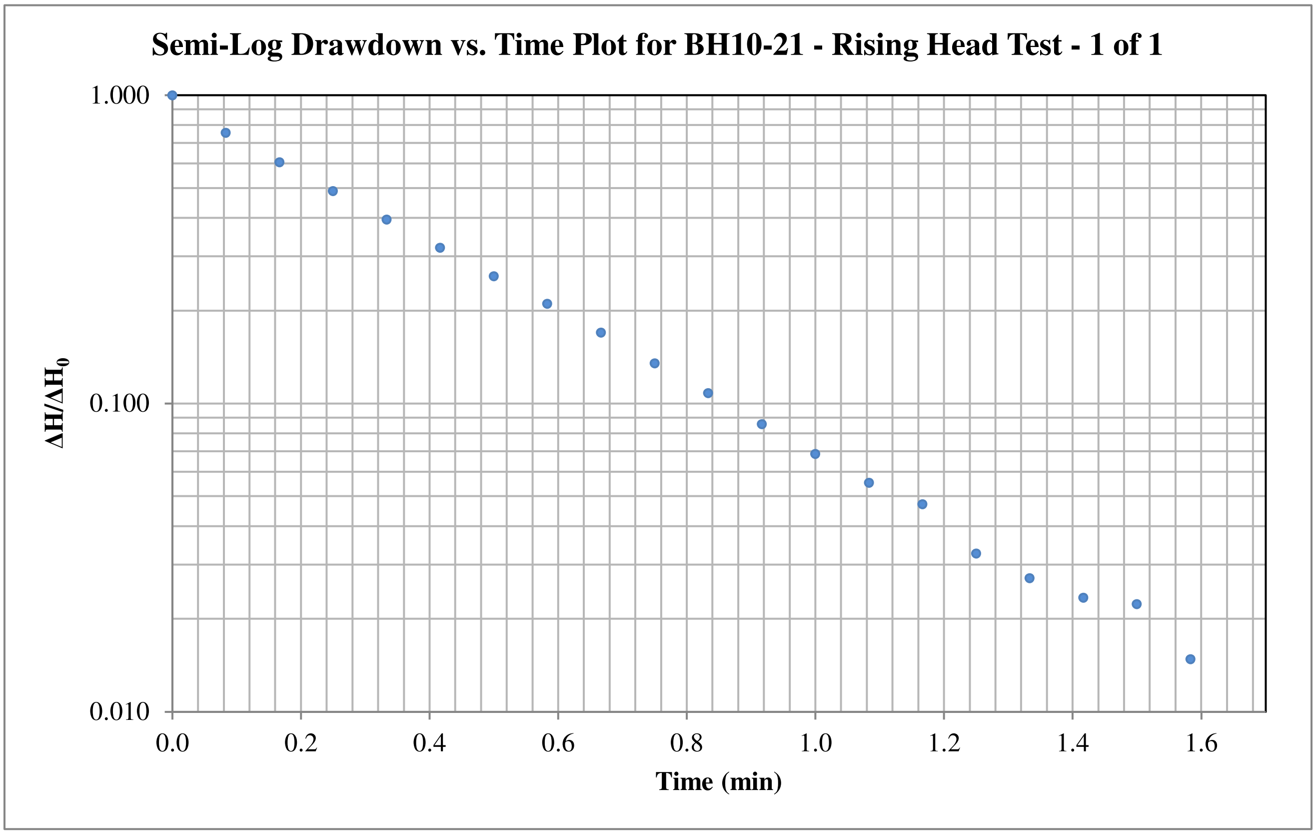
Data Points (from plot):

t*: 1.282 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.13E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Minto Communitites - 3432 Greenbank Road
Test Location: BH10-21
Test: Rising Head Test - 1 of 1
Date: December 20, 2021



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t*}\ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

Data Points (from plot):

t*: 0.361 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.02E-05 m/sec

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURES 2-11 – MONITORING WELL WATER ELEVATIONS

DRAWING PG5348-1 – TEST HOLE LOCATION PLAN

DRAWING PG5348-2 – PERMISSIBLE GRADE RAISE PLAN

DRAWING PG5348-3 – TREE PLANTING SETBACK PLAN

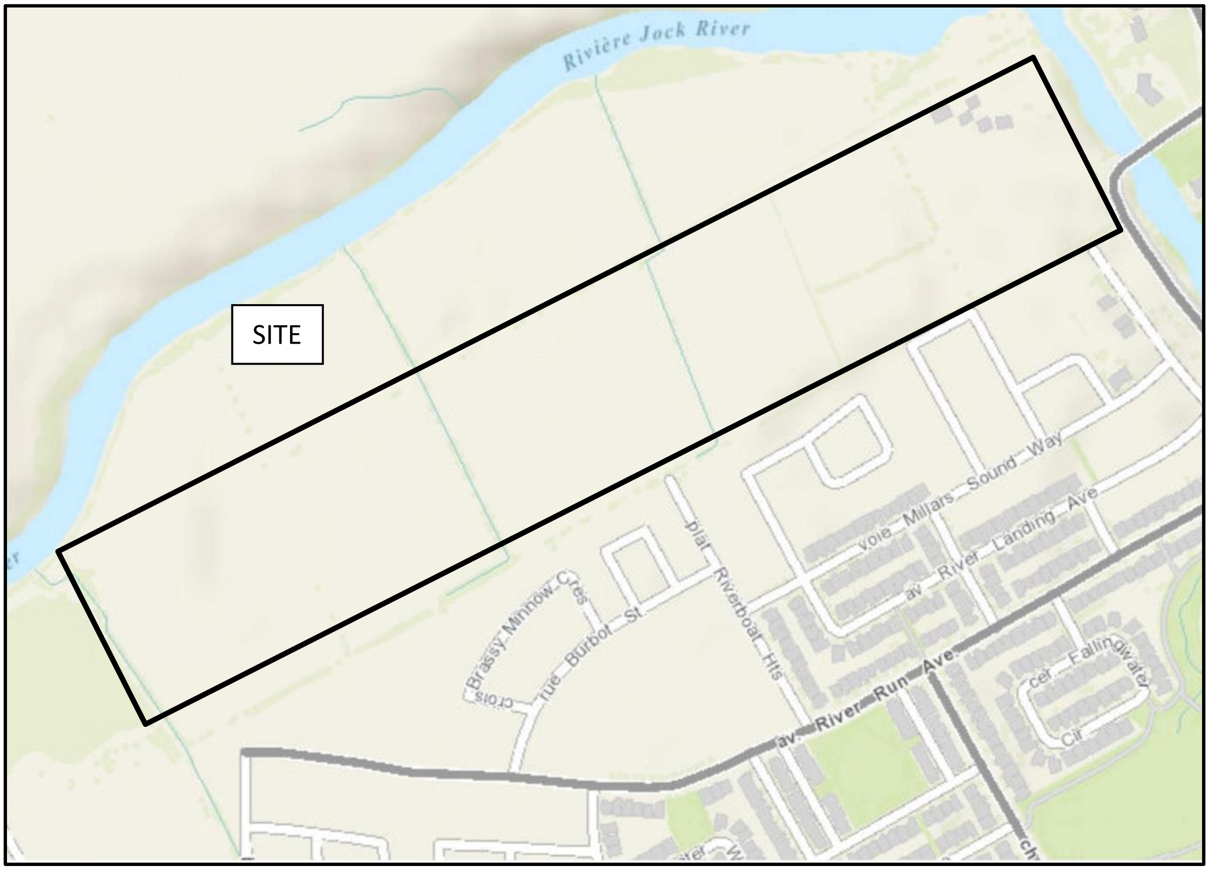


FIGURE 1

KEY PLAN

Figure 2: BH1-21 - Monitoring Well Water Elevations

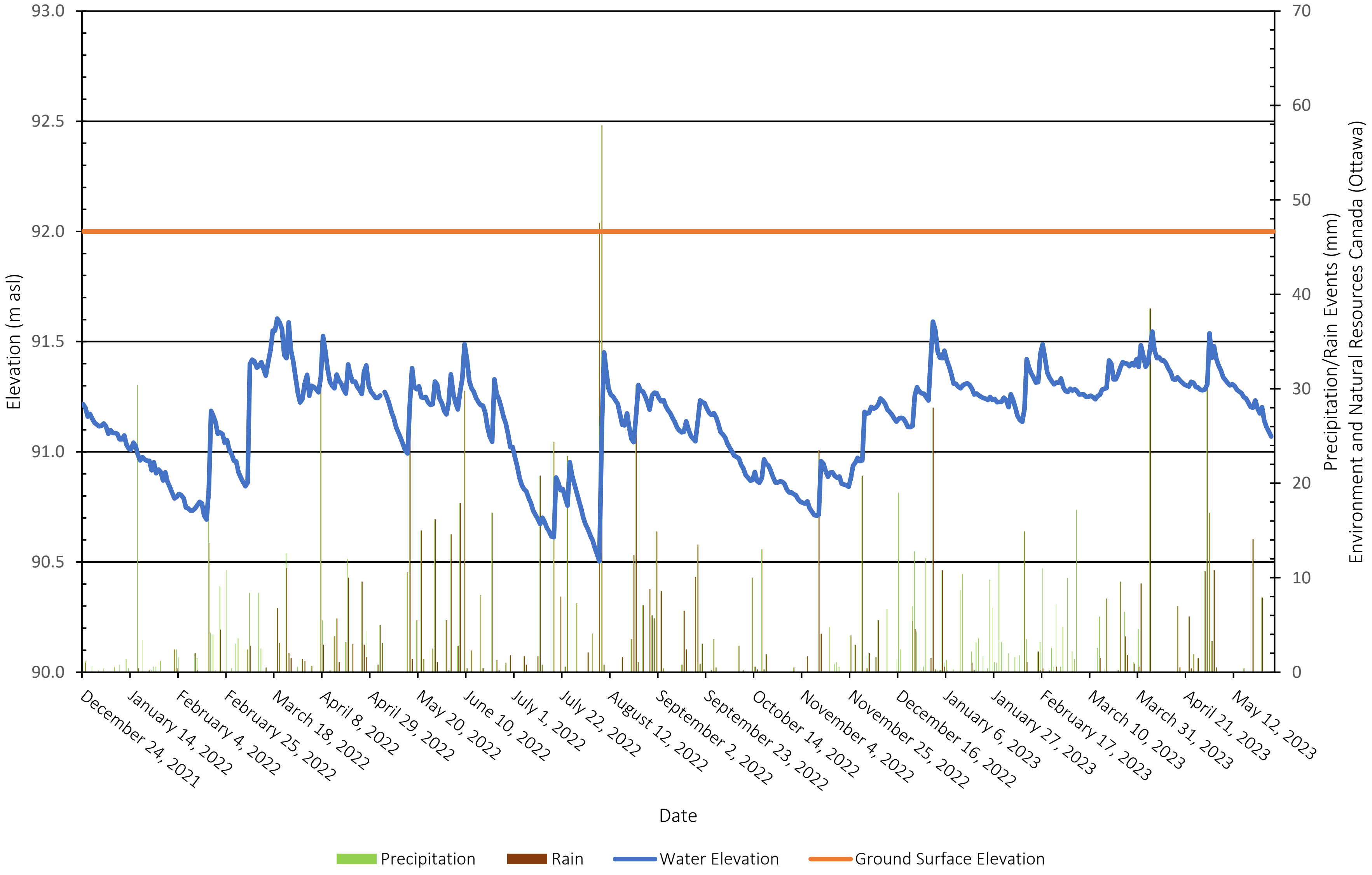


Figure 3: BH2-21 - Monitoring Well Water Elevations

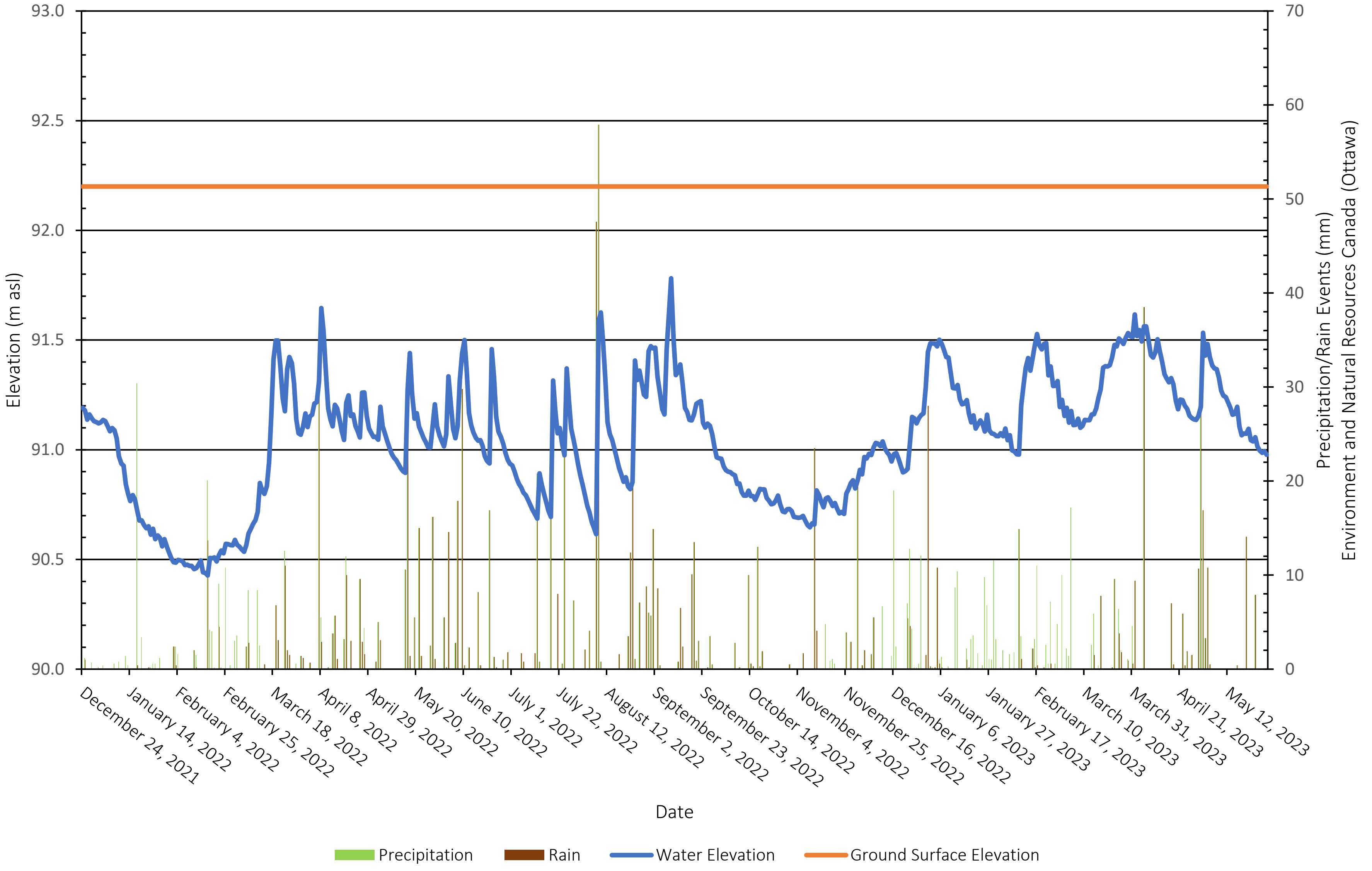
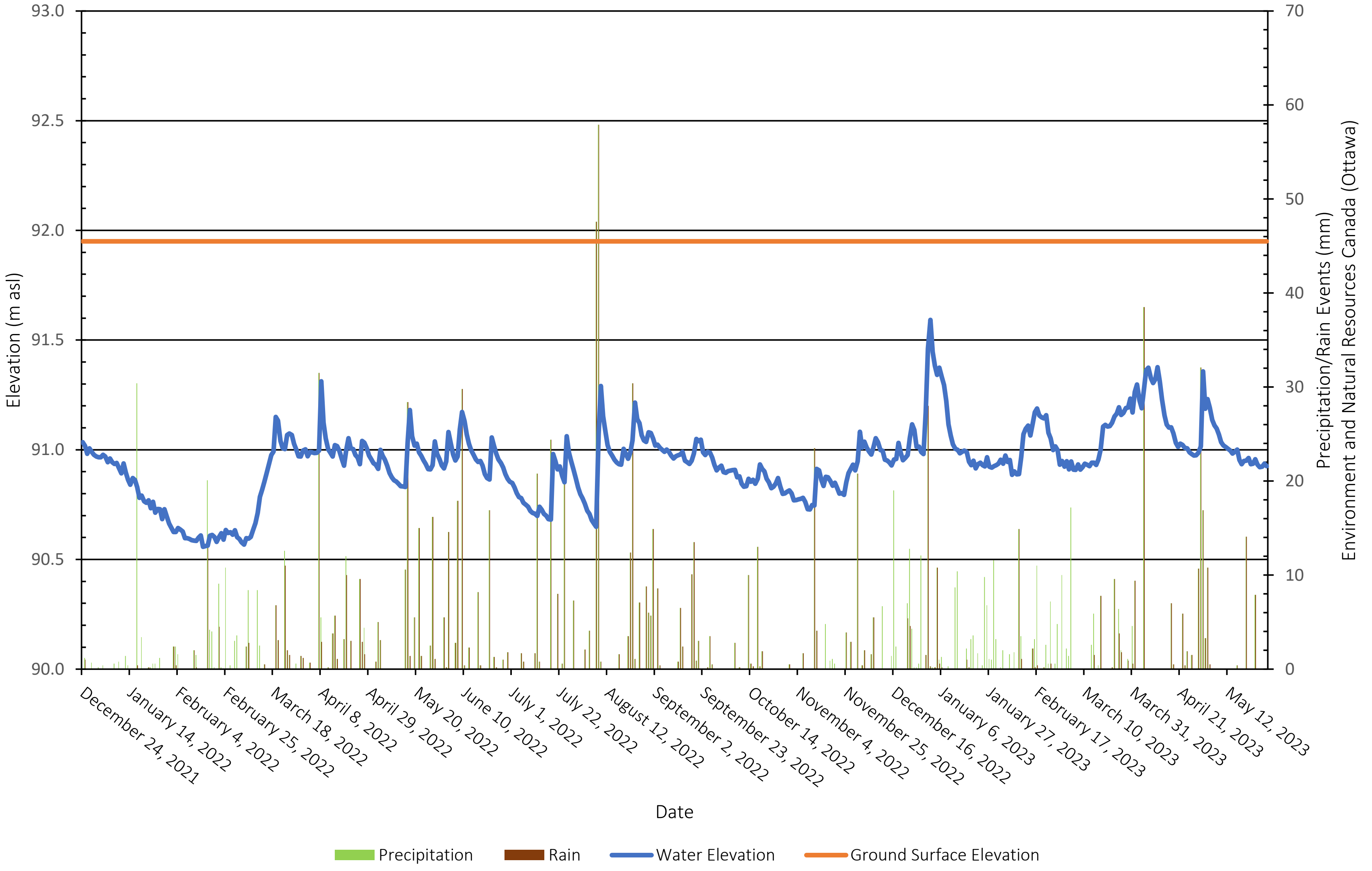


Figure 4: BH3-21 - Monitoring Well Water Elevations



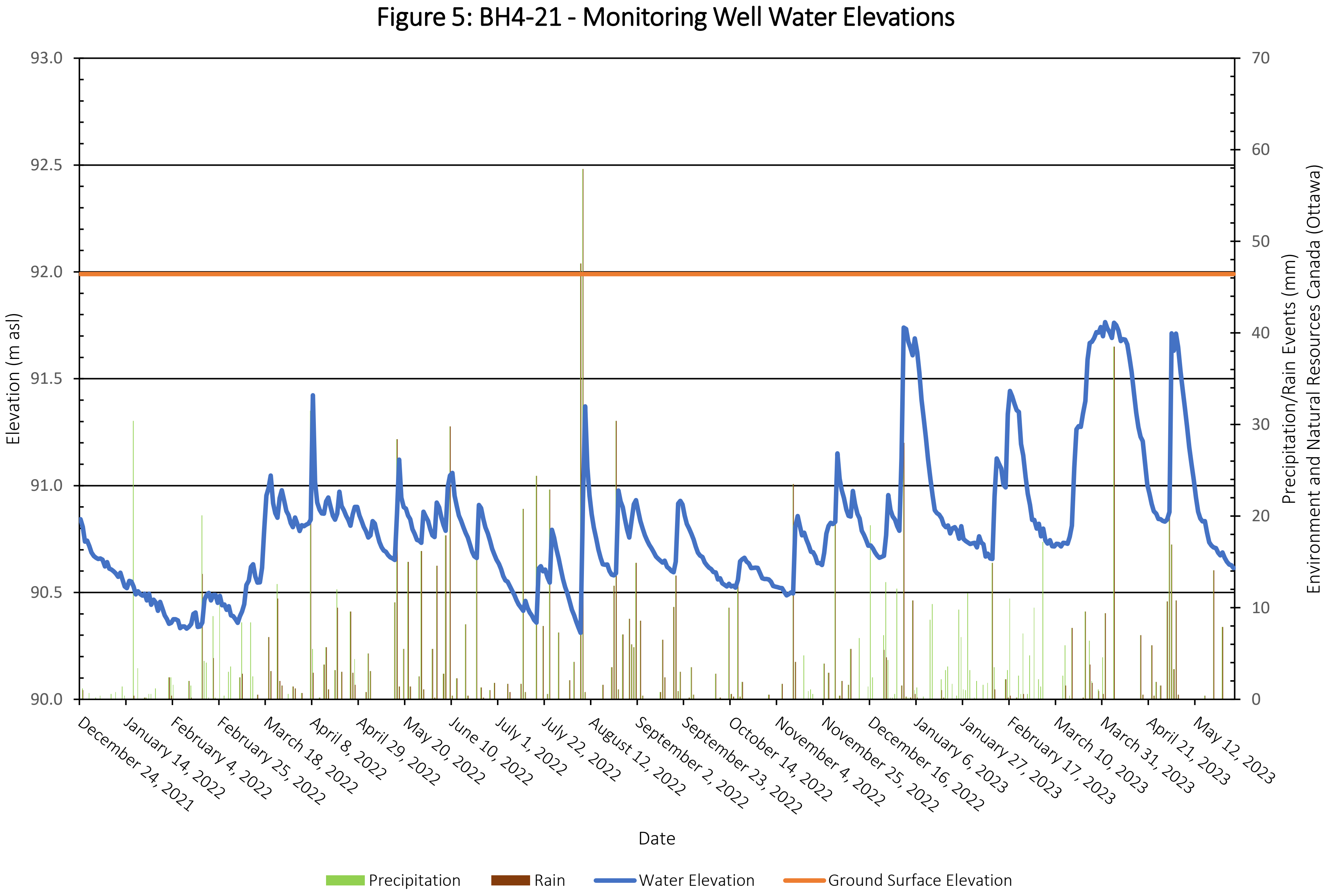
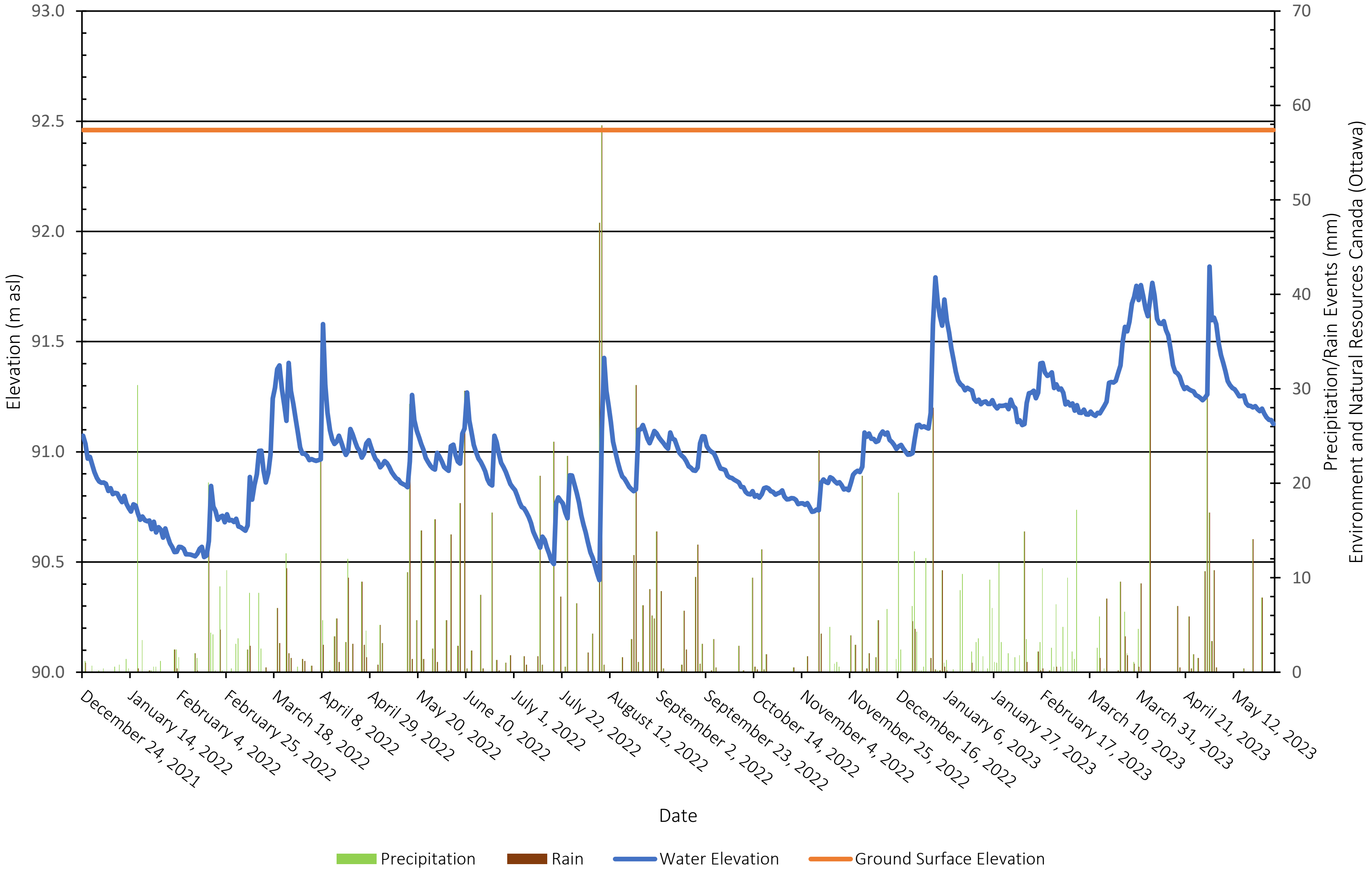


Figure 5: BH4-21 - Monitoring Well Water Elevations
Elevation (m asl)
93.0
92.5
92.0
91.5
91.0
90.5
90.0
Precipitation/Rain Events (mm)
Environment and Natural Resources Canada (Ottawa)
70
60
50
40
30
20
10
0
December 24, 2021
January 14, 2022
February 4, 2022
February 25, 2022
March 18, 2022
April 8, 2022
April 29, 2022
May 20, 2022
June 10, 2022
July 1, 2022
July 22, 2022
August 12, 2022
September 2, 2022
September 23, 2022
October 14, 2022
November 4, 2022
November 25, 2022
December 16, 2022
January 6, 2023
January 27, 2023
February 17, 2023
March 10, 2023
March 31, 2023
April 21, 2023
May 12, 2023
Date
Precipitation
Rain
Water Elevation
Ground Surface Elevation

Figure 6: BH5-21 - Monitoring Well Water Elevations



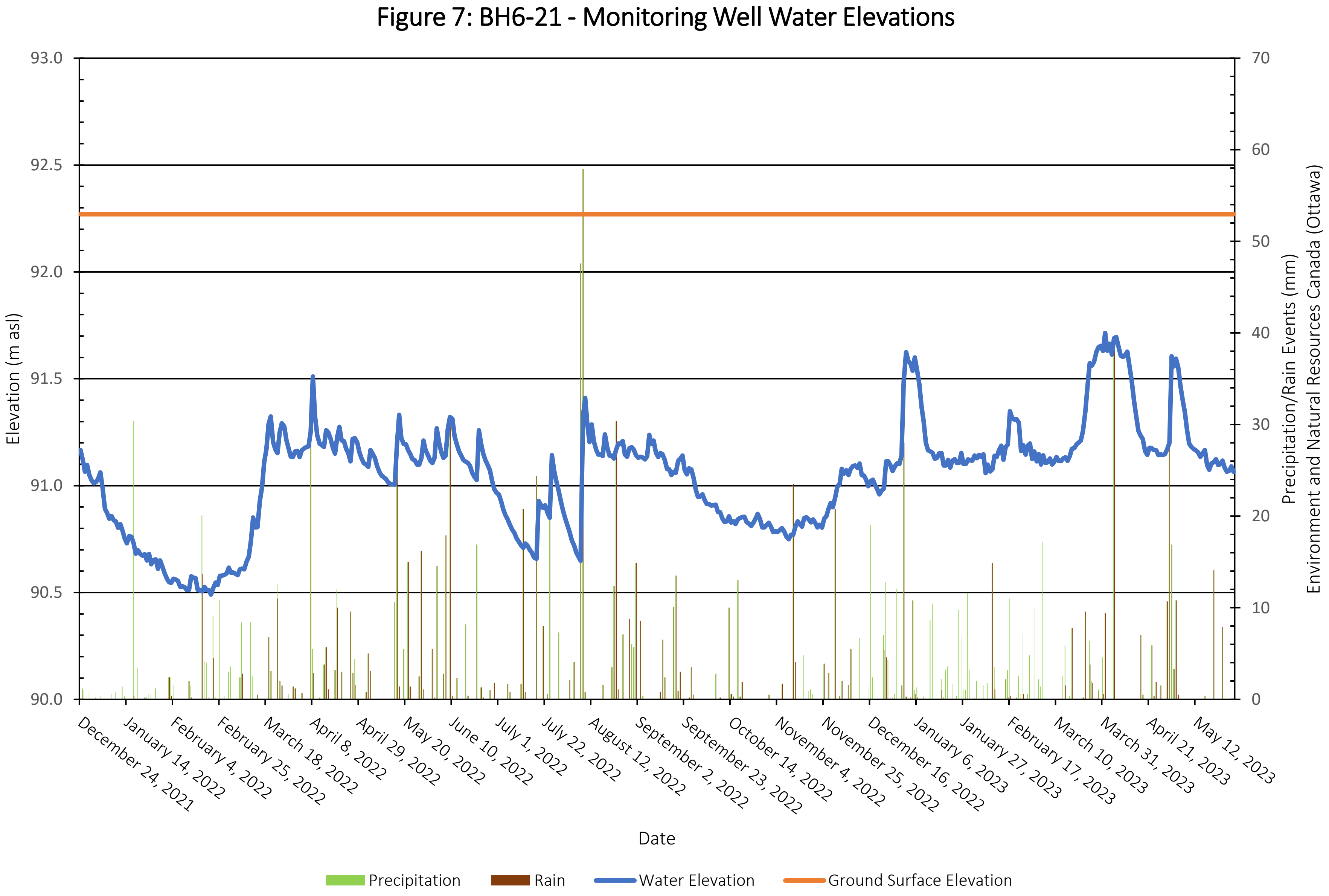


Figure 7: BH6-21 - Monitoring Well Water Elevations
Elevation (m asl)
93.0
92.5
92.0
91.5
91.0
90.5
90.0
Precipitation/Rain Events (mm)
Environment and Natural Resources Canada (Ottawa)
70
60
50
40
30
20
10
0
December 24, 2021
January 14, 2022
February 4, 2022
February 25, 2022
March 18, 2022
April 8, 2022
April 29, 2022
May 20, 2022
June 10, 2022
July 1, 2022
July 22, 2022
August 12, 2022
September 2, 2022
September 23, 2022
October 14, 2022
November 4, 2022
November 25, 2022
December 16, 2022
January 6, 2023
January 27, 2023
February 17, 2023
March 10, 2023
March 31, 2023
April 21, 2023
May 12, 2023
Date
Precipitation
Rain
Water Elevation
Ground Surface Elevation

Figure 8: BH7-21 - Monitoring Well Water Elevations

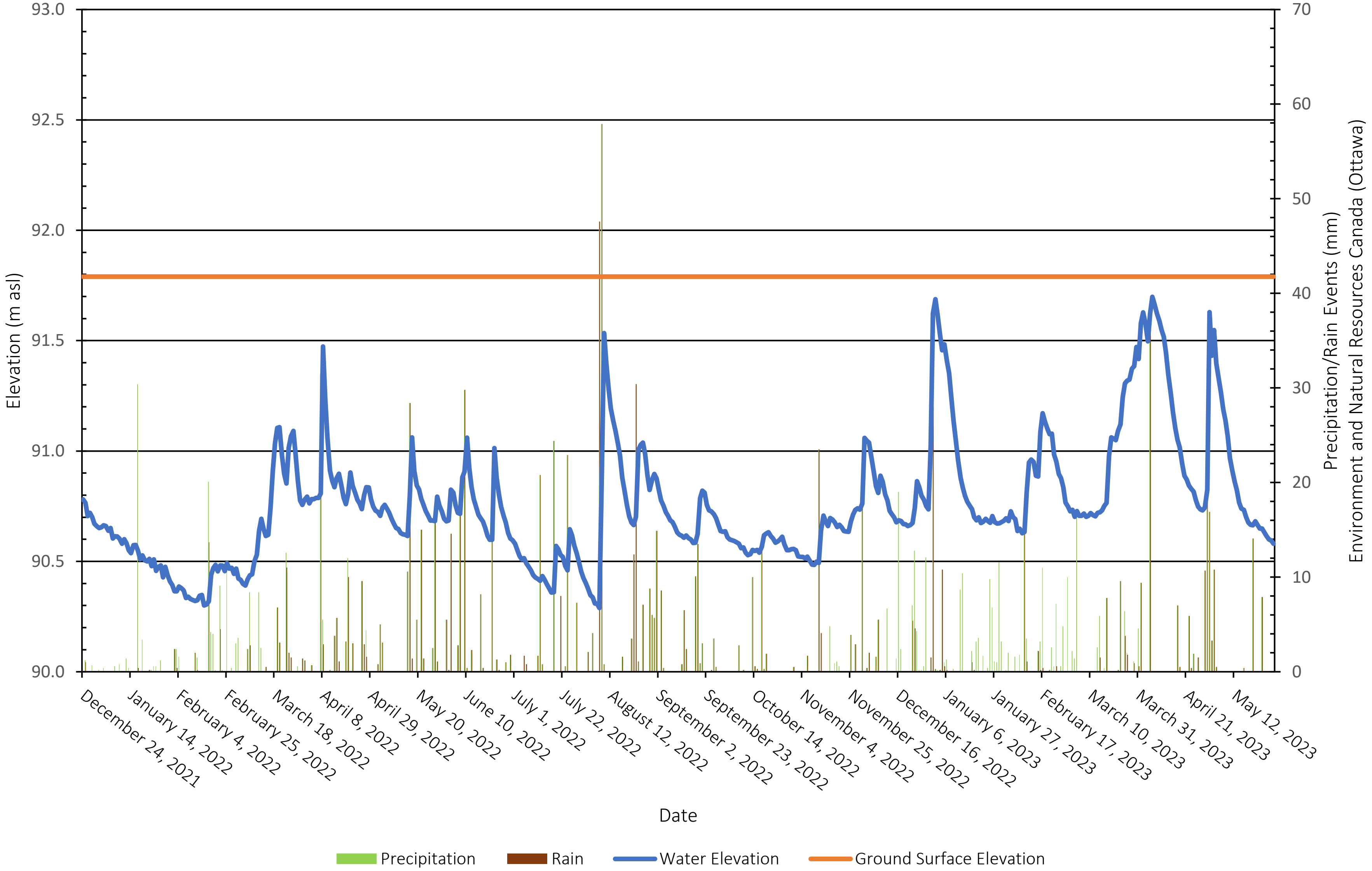


Figure 9: BH8-21 - Monitoring Well Water Elevations

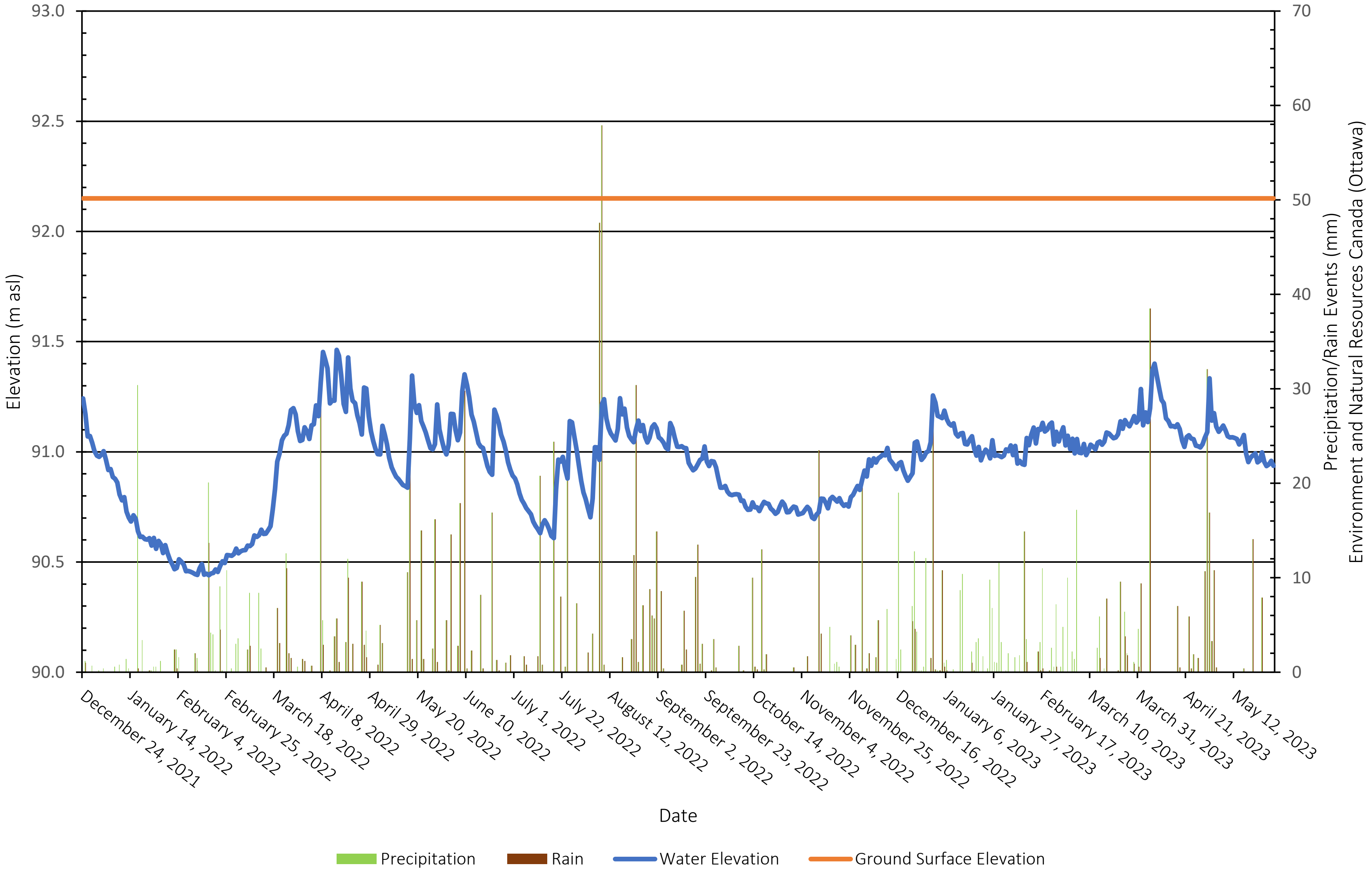


Figure 10: BH9-21 - Monitoring Well Water Elevations

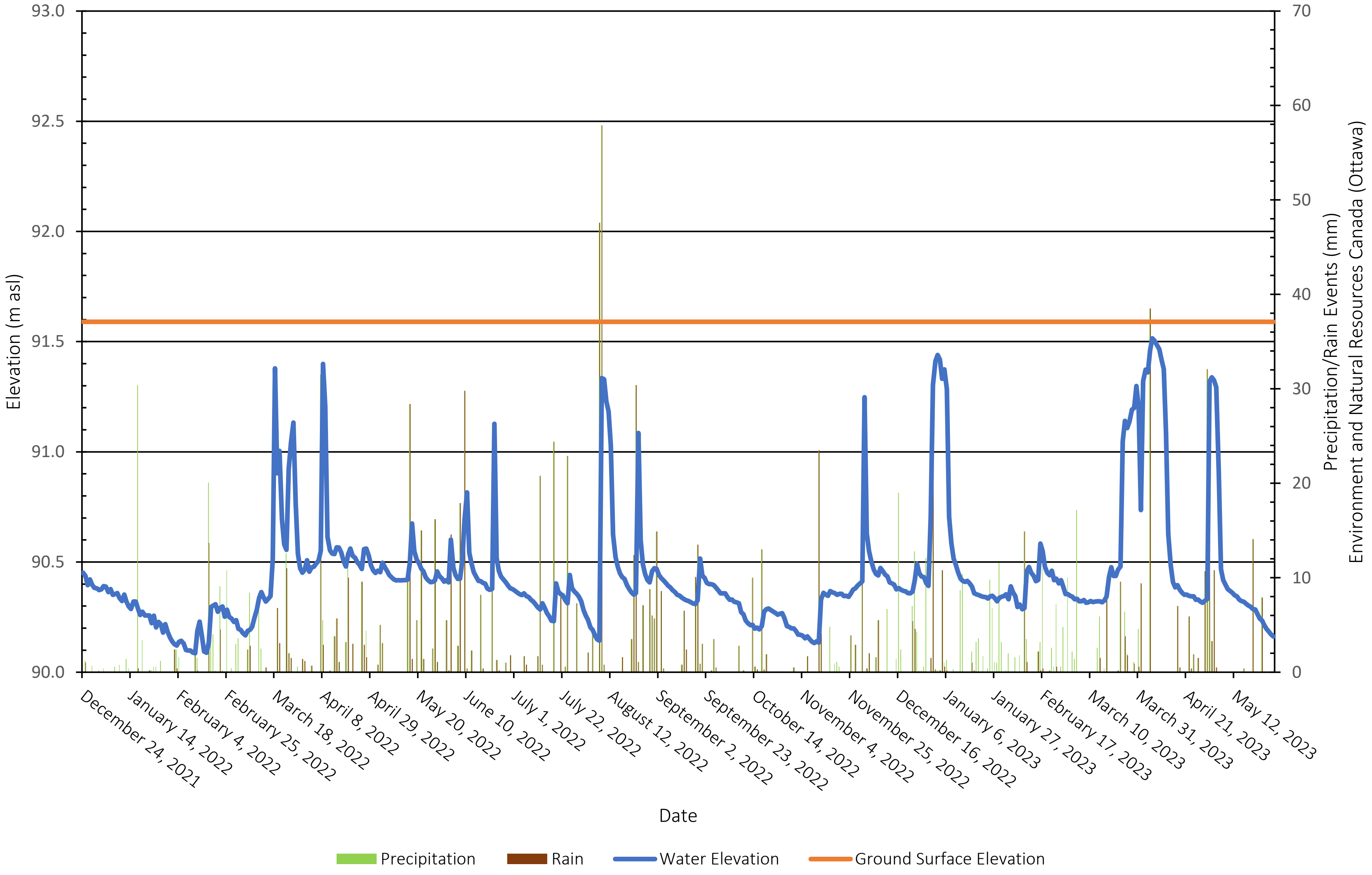
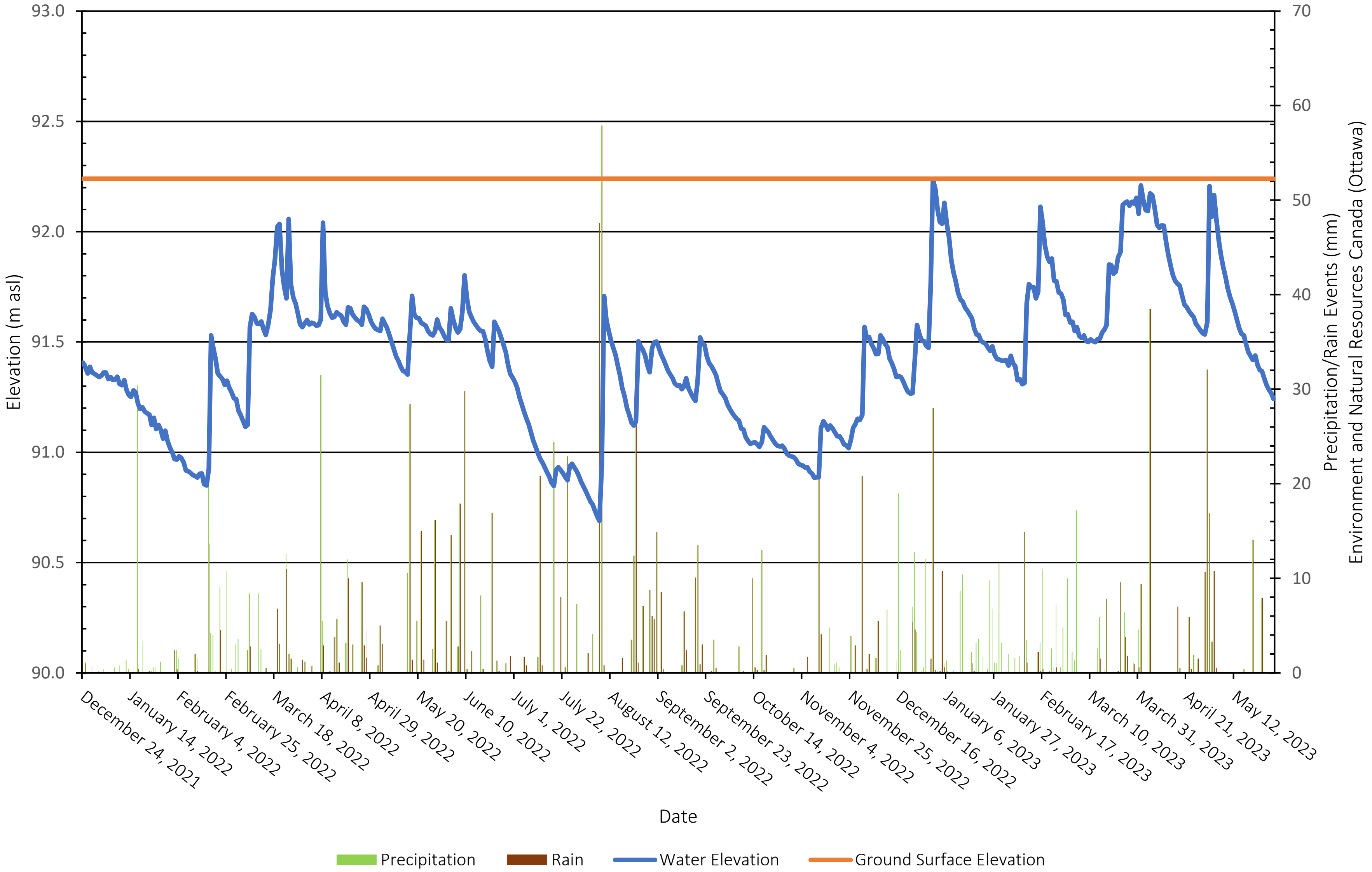
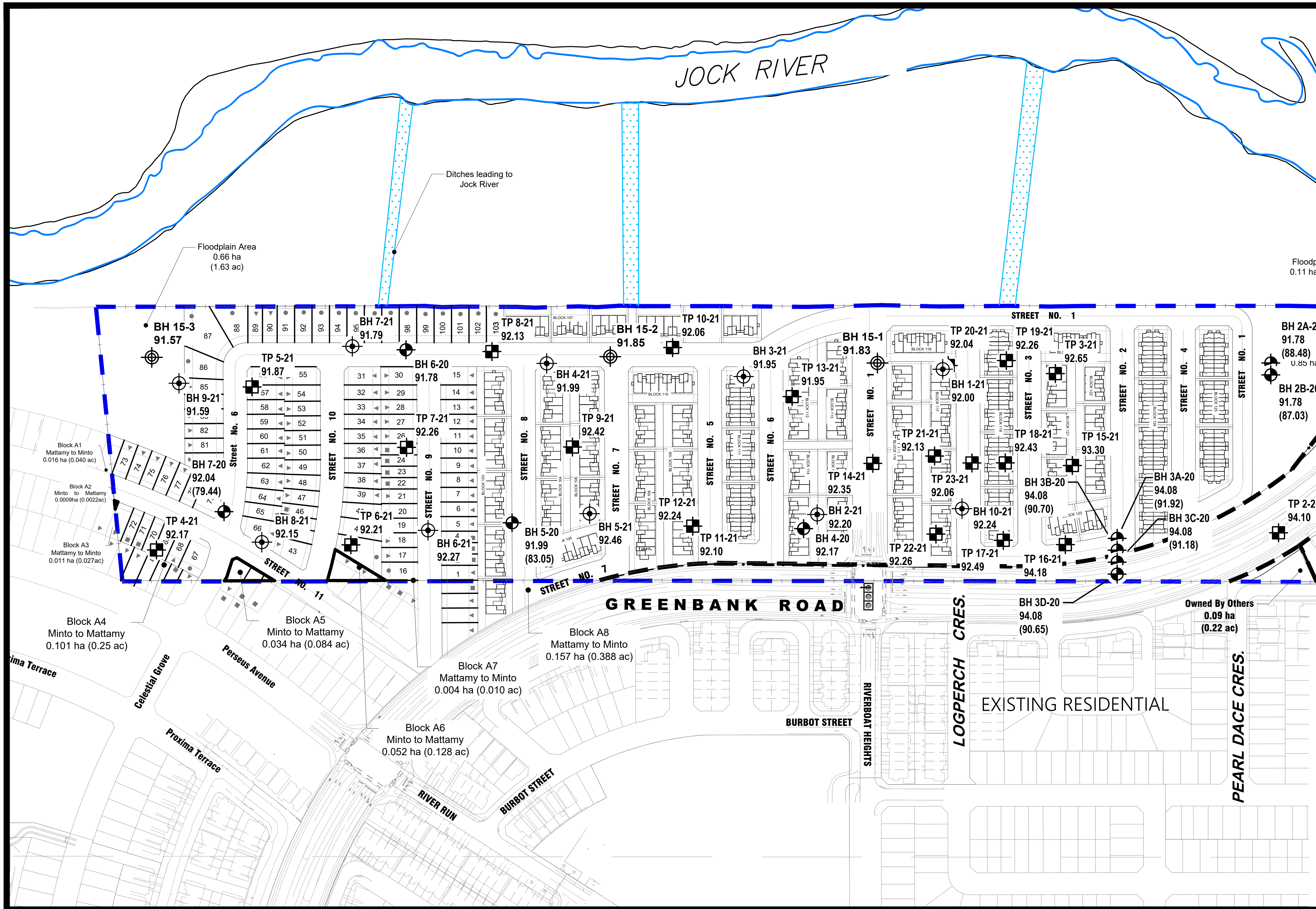


Figure 11: BH10-21 - Monitoring Well Water Elevations





LEGEND:

⊕	BOREHOLE LOCATION
■	TEST PIT LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊕	BOREHOLE LOCATION (GOLDER REPORT, PROJECT 1530273, MAY 2015)
91.53	GROUND SURFACE ELEVATION (m)
(87.49)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

SCALE: 1:3000

0 25 50 75 100 125 150 200m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
5	UPDATED TO NEW CONCEPTUAL PLAN	18/07/2023	DP
4	BH 1-21 - BH 10-21 ADDED TO PLAN	10/01/2022	FC
3	UPDATED TO NEW CONCEPTUAL PLAN	04/08/2021	DJG
2	UPDATED TO NEW CONCEPTUAL PLAN	09/07/2021	FA
1	TP 1-21 TO TP 23-21 ADDED	08/02/2021	DP

MINTO COMMUNITIES INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - 3432 GREENBANK ROAD
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:3000
Date: 02/2021
Drawn by: NFRV
Report No.: PG5348-1
Checked by: DP
Dwg. No.: PG5348-1
Approved by: DJG
Revision No.: 5

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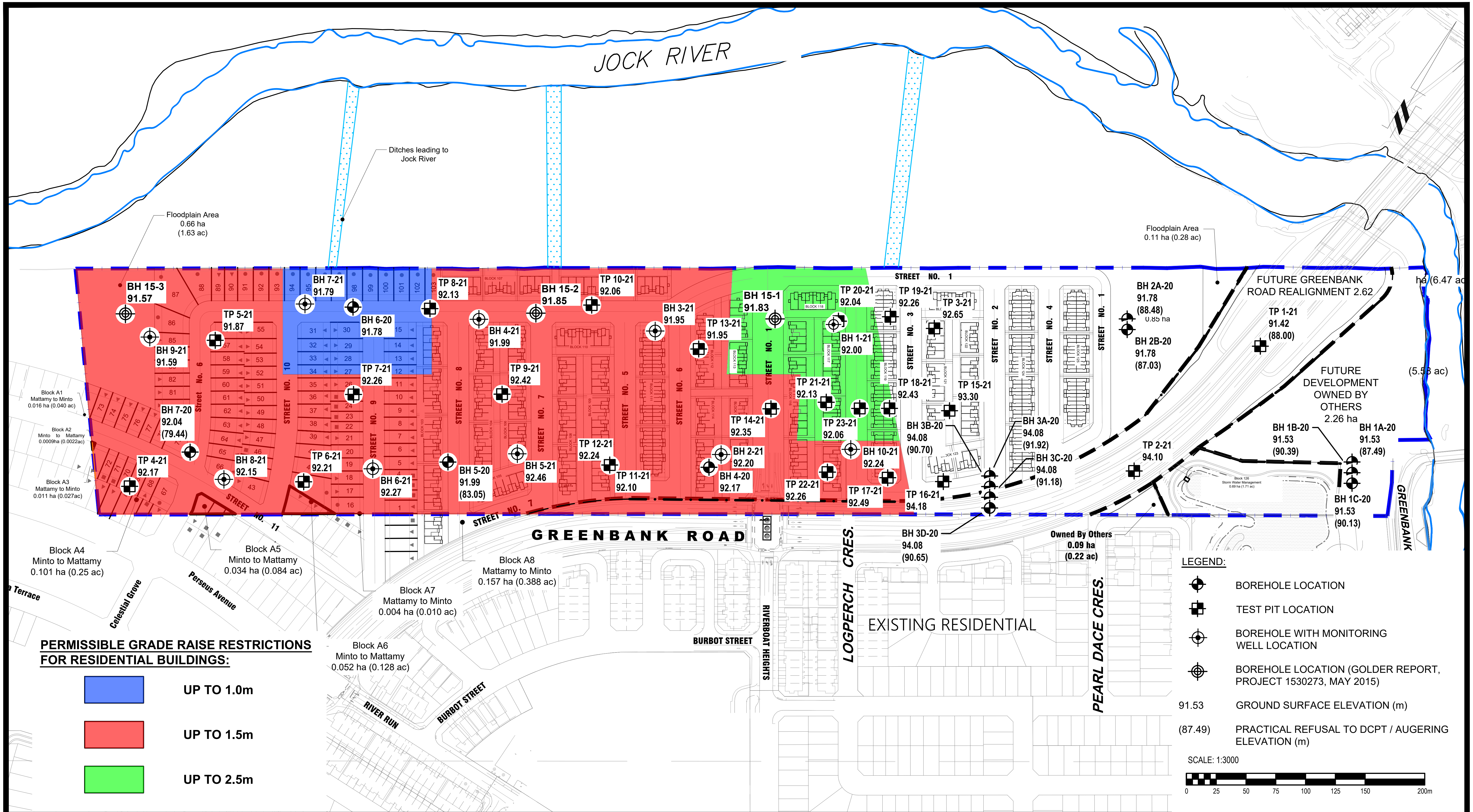

PERMISSIBLE GRADE RAISE RESTRICTIONS FOR RESIDENTIAL BUILDINGS:

- 🟦 UP TO 1.0m
- 🟥 UP TO 1.5m
- 🟩 UP TO 2.5m

LEGEND:

⊕	BOREHOLE LOCATION
▣	TEST PIT LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊕	BOREHOLE LOCATION (GOLDER REPORT, PROJECT 1530273, MAY 2015)
91.53	GROUND SURFACE ELEVATION (m)
(87.49)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

SCALE: 1:3000

0 25 50 75 100 125 150 200m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
5	UPDATED TO NEW CONCEPTUAL PLAN	18/07/2023	DP
4	BH 1-21 - BH 10-21 ADDED TO PLAN	10/01/2022	FC
3	UPDATED TO NEW CONCEPTUAL PLAN	04/08/2021	DJG
2	UPDATED TO NEW CONCEPTUAL PLAN	09/07/2021	FA
1	TP 1-21 TO TP 23-21 ADDED	08/02/2021	DP

MINTO COMMUNITIES INC.
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - 3432 GREENBANK ROAD
OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:3000
Date: 02/2021
Drawn by: NFRV
Report No.: PG5348-1
Checked by: DP
Dwg. No.: PG5348-2
Approved by: DJG
Revision No.: 5

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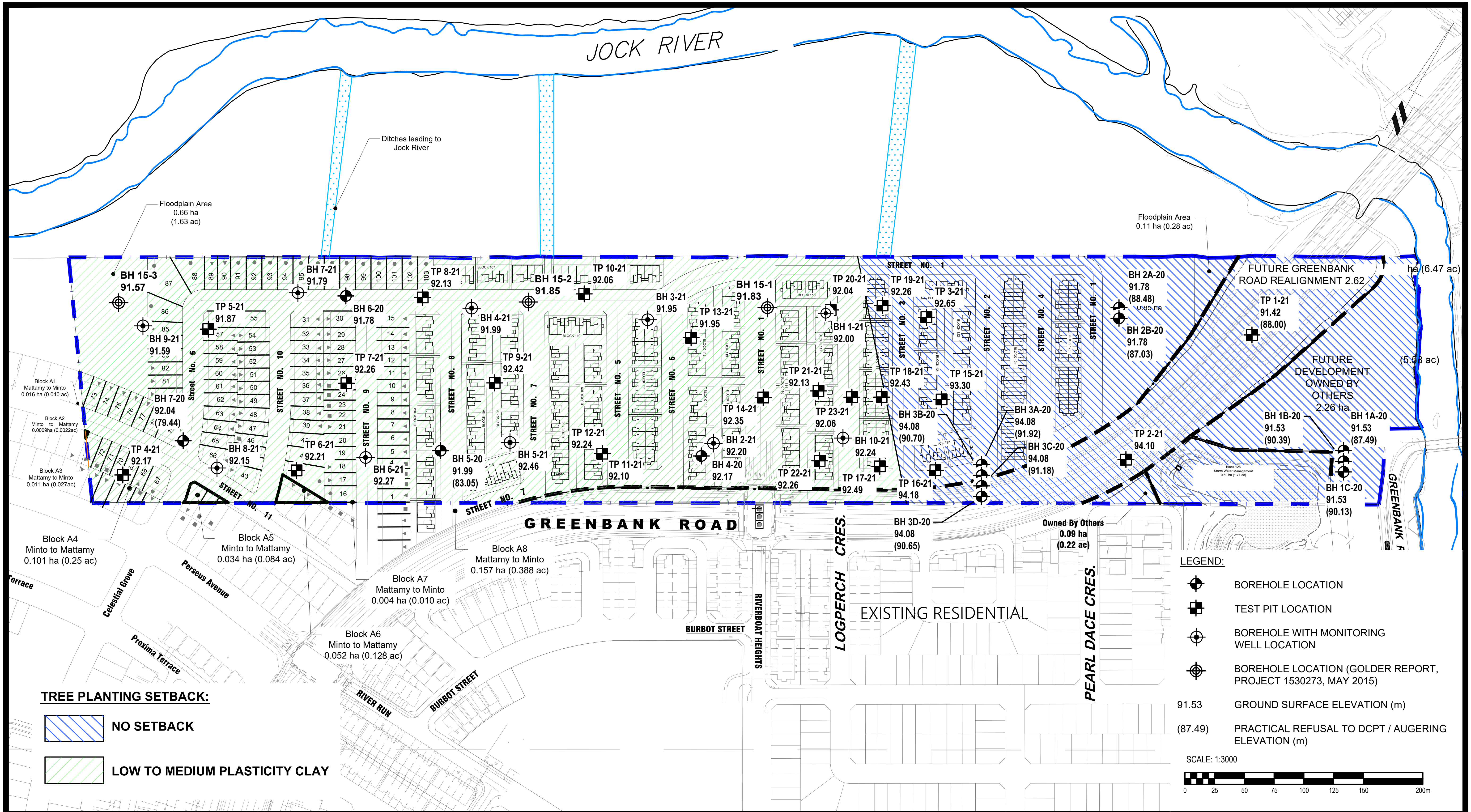

TREE PLANTING SETBACK:

▨ NO SETBACK

▨ LOW TO MEDIUM PLASTICITY CLAY

LEGEND:

⊕	BOREHOLE LOCATION
■	TEST PIT LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊕	BOREHOLE LOCATION (GOLDER REPORT, PROJECT 1530273, MAY 2015)
91.53	GROUND SURFACE ELEVATION (m)
(87.49)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

SCALE: 1:3000

0 25 50 75 100 125 150 200m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
5	UPDATED TO NEW CONCEPTUAL PLAN	18/07/2023	DP
4	BH 1-21 - BH 10-21 ADDED TO PLAN	10/01/2022	FC
3	UPDATED TO NEW CONCEPTUAL PLAN	04/08/2021	DJG
2	UPDATED TO NEW CONCEPTUAL PLAN	09/07/2021	FA
1	TP 1-21 TO TP 23-21 ADDED	08/02/2021	DP

MINTO COMMUNITIES INC.
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - 3432 GREENBANK ROAD
OTTAWA, ONTARIO

Title:
TREE PLANTING SETBACK PLAN

Scale: 1:3000
Date: 02/2021
Drawn by: NFRV
Report No.: PG5348-1
Checked by: DP
Dwg. No.: PG5348-3
Approved by: DJG
Revision No.: 5

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