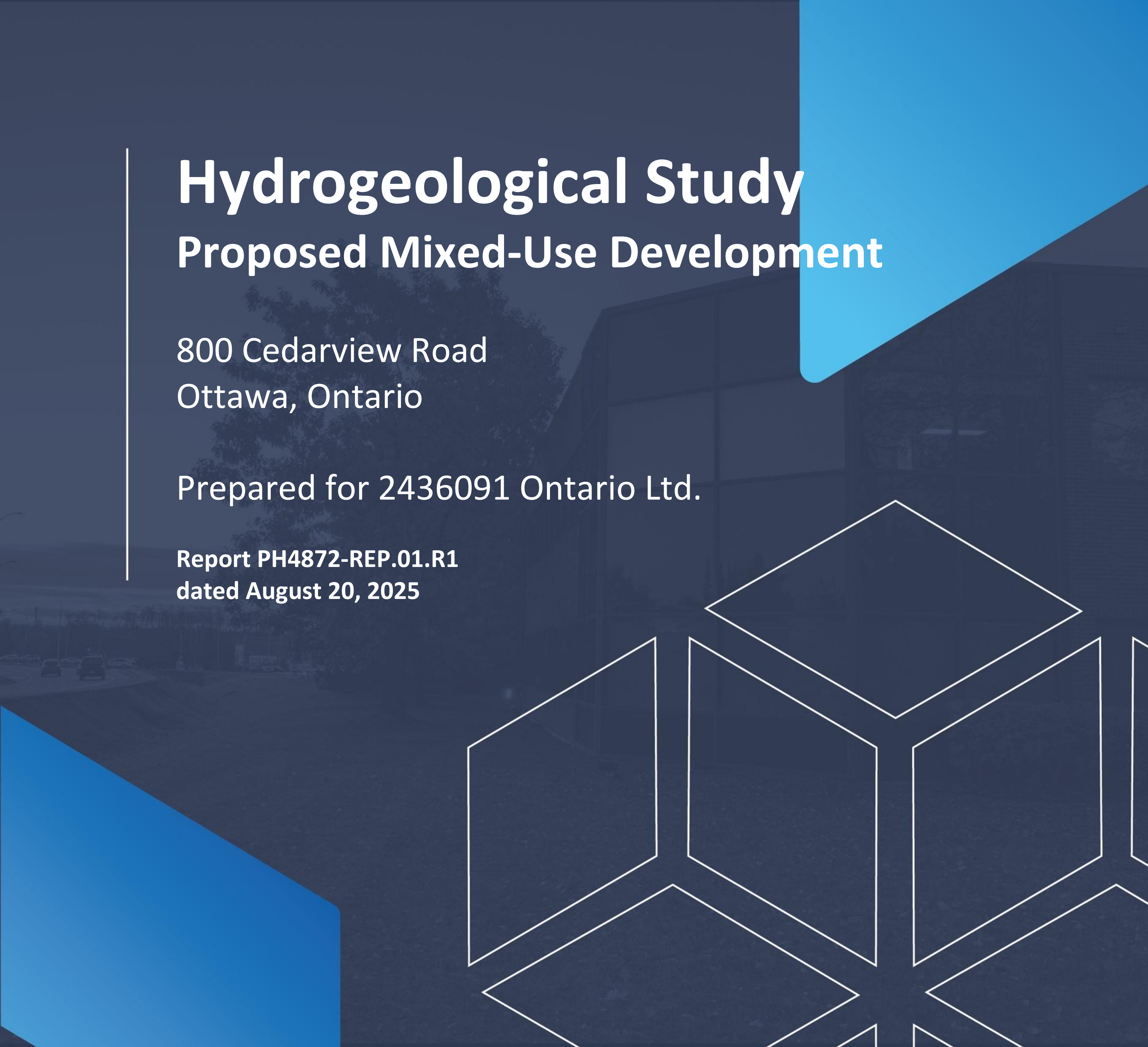

Hydrogeological Study

Proposed Mixed-Use Development

800 Cedarview Road
Ottawa, Ontario

Prepared for 2436091 Ontario Ltd.

Report PH4872-REP.01.R1
dated August 20, 2025

Table of Conetents

Figures

Appendices

1.0 INTRODUCTION

1.1 Background

Paterson Group (Paterson) was retained by 2436091 Ontario Ltd. to conduct a hydrogeological study for the proposed mixed-use development located at 800 Cedarview Road in the City of Ottawa (hereinafter referred to as the “subject site”). The location of the subject site is shown on Drawing PH4872-1 - Site Plan appended to this report. This report incorporates the findings of Paterson Report PG5600-1 Revision 1 dated June 3, 2024.

1.2 Scope of Work

Paterson has completed this report in accordance with the scope prepared by Paterson. As per the agreed upon scope, the purpose of this study was to:

- Characterize the hydrogeological setting of the subject site. Consideration was given to bedrock and surficial geology, aquifer systems, groundwater levels, hydraulic properties and catchment characteristics.
- A groundwater impact assessment to determine potential impacts to adjacent infrastructure, well users and the surrounding environment.

Additionally, the study was to include the standard components of a Water Budget Assessment as per the City of Ottawa’s Water Budget Assessment Terms of Reference, which included the following:

- Review related higher-level studies
- Conduct pre and post-development water budget analyses, including water budget equations, to determine the hydrogeological function of the subject site in order to assess the need for supplemental stormwater management measures.
- Develop a conceptual model to characterize pre and post-development hydrologic and hydrogeologic site conditions.
- Identify sensitive hydrologic and hydrogeologic features (if any) within the study area.
- Identify water budget targets (if applicable) to mitigate post-development hydrologic and hydrogeologic impacts.
- Identify how climate change projections may impact the water budget.

2.0 PREVIOUS REPORTS

In addition to a review of the general literature summarized in the following sections and in the ‘References’ section of this report (MECP water well mapping, available geological and physiographic mapping), Paterson reviewed the following site-specific reports:

- MATT1676.3 “Mattamy Cedarview: Environmental Impact Study to Support Zoning Bylaw Amendment and Draft Plan of Subdivision Applications” - prepared by Kilgour & Associates Ltd. - August 7, 2025
- 14-746 “Functional Servicing Report for 4497 O’Keefe Court” - prepared by David Schaeffer Engineering Ltd. - July 2025
- PE6605-2 “Phase II-Environmental Site Assessment 4497A & 4497B O’Keefe Court Ottawa, Ontario” - prepared by Paterson Group - September 18, 2024
- PG5600-1 Revision 1 “Geotechnical Investigation - 800 Cedarview Road” - prepared by Paterson Group - June 3, 2024.

3.0 METHOD OF INVESTIGATION

3.1 Records Review

A review of available geological, and hydrogeological data was completed as a part of this assessment. However, the literature review and previous reports did not provide site-specific data regarding overburden and bedrock aquifers, recharge and discharge conditions or flow contributions to the nearby water features. Further detail is provided in the following sections.

3.2 Field Program

The geotechnical and hydrogeological field programs were developed to assess geology, groundwater conditions, hydraulic gradients and the overall hydrologic/hydrogeologic function of the subject site. The test holes were advanced to various depths across the site to assess hydrogeological and geotechnical conditions.

Geotechnical field investigations were completed by Paterson at the subject site between December 2020 and April 2024. During this time, test pits and boreholes were advanced to a maximum depth of 6.0 and 6.5 m below ground surface (bgs), respectively. The location of the test holes are shown on Drawing PG5600-1 - Test Hole Location Plan located in Appendix 1.

Soil samples were obtained from the test pits and boreholes by means of grab, split spoon and rock core sampling and the sampling of shallow soils directly from auger flights. Grab samples were taken at each stratigraphic unit. Split-spoon samples were taken at approximate 0.76 m intervals. Rock core samples were taken at approximate 1 m intervals. The depth at which grab, split-spoon, auger and rock core samples were obtained from the test holes are shown as “**G**”, "**SS**", "**AU**" and “**RC**”, respectively on the Soil Profile and Test Data sheets, appended to this report. All samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for further review and testing. Transportation of the samples was completed in accordance with ASTM D4220-95 (2007) - Standard Practice for Preserving and Transporting Soils.

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 ground after an initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

This test was done in accordance with ASTM D1586-11 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils.

Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the subsurface profiles encountered at the test hole locations.

Drawdown Analysis - Hydraulic Conductivity Testing

Hydraulic conductivity testing was completed at all monitoring wells installed during the 2024 geotechnical investigation. 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 testing was completed in April 2024 by Paterson personnel. The general test method consisted of measuring the static water level in the well, followed by inducing a near-instantaneous change of head in the well and subsequent monitoring of water level recovery with an electronic water level meter and a water level data logger. The change in head was induced by the introduction of an acetal slug, 0.9 m in length and 0.19 to 38 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 aquifer of infinite extent 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 and homogeneity 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, which in many cases, is the trendline from the test data.

3.3 Laboratory Testing

All soil samples were retained for laboratory review following the field portion of the subsurface investigation. The soils were classified in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Based on the soil descriptions across the subject site during the geotechnical investigations, these samples are considered to be sufficiently representative of the site.

3.4 Monitoring Well Installations

As part of the March and April 2024 geotechnical field program, monitoring wells were installed in all boreholes to permit the monitoring of groundwater levels and conduct drawdown analyses. The well installations were compliant with ASTM D092 standards.

3.5 Water Level Measurements

Following the completion of the April 2024 drilling program, groundwater levels were measured at the monitoring well locations. Water levels were measured using an electronic water level meter relative to the ground surface elevation at each location and are noted on the Soil Profile and Test Data sheets, appended to this report.

Multiple groundwater level measurement events have been completed to date with measurements occurring between April 2024 and May 2025. Groundwater level measurements are presented in Table 1 in Section 4.3.

Long term groundwater monitoring was undertaken using a VanEssen TD-Diver Water Level Datalogger at the eight monitoring well locations between April 2024 and May 2025. The dataloggers were programmed to continuously measure and record groundwater levels at a minimum rate of one (1) reading every twenty-four (24) hours. The monitoring data is appended in the Figures section of this report.

3.6 Surveying

The test hole locations and ground surface elevations at each test hole location completed by Paterson were surveyed using a GPS unit with respect to a geodetic datum. The locations and ground surface elevations for each test hole are presented on Paterson Drawing PG5600-1 - Test Hole Location Plan.

4.0 REVIEW AND EVALUATION

4.1 Physical Setting

At the time of the field investigations, the study area consisted of mature trees, grass and shrubs. A body of water is located in the northwest corner of the site from the now decommissioned quarry. A wetland is located on the eastern edge of the site, adjacent to Cedarhill Drive. The subject site is bordered to the north by Highway 416 followed by mature forest, to the east by residential developments and the Cedarhill Golf & Country Club, to the south by mature forest and Lytle Park and to the west by Highway 416 followed by industrial developments. The location of the subject site is shown on Drawing PH4872-1 - Site Plan, appended to this report.

The northeast corner of the subject site is located within the Graham creek subwatershed. The remainder of the subject site is located within the Jock Downstream Reach subwatershed. There are numerous surface water features located within 500 m of the subject site. These include tributaries to the O'Keefe Drain, a wetland area and the water filled decommissioned quarry which is currently not in use.

The ground surface across the site is variable but generally slopes downward to the northeast and southeast. The subject site is generally at grade with most adjacent properties with the exception of Highway 416 which is slightly below the grade of the site.

According to available mapping from the Ontario Geologic Survey (OGS; MRD228), the subject site is located in a Limestone Plains physiographic region. The region is characterized by limestone deposits, which is generally consistent with field observations at the subject site (shallow bedrock).

4.2 Geology

Surficial Geology

Surficial geology mapping provided by the OGS was reviewed as part of this assessment. Available mapping (MRD 128) indicates that shallow Paleozoic bedrock is present across the majority of the subject site as well as overburden soils consisting of organic deposits (peat, muck, marl), glaciofluvial deposits and till (stone-poor, sandy silt to silty sand). Surficial geology mapping is shown on Drawing PH4872-2 - Surficial Geology Plan within Appendix 1.

Overburden soils identified during the geotechnical investigation by Paterson between December 2020 and April 2024 were generally consistent with the available mapping. Soils generally consisted of topsoil overlying a glacial till deposit with a silty sand matrix. At select locations, fill or a silty sand layer was observed beneath the topsoil layer.

Specific details are provided on the Soil Profile and Test Data Sheets attached within Appendix 2 of this report. More details regarding the overburden soils can be found in Paterson Report PG5600-1 Revision 1 dated June 3, 2024.

Bedrock Geology

Bedrock was encountered between 0.1 to 5.6 m bgs during Paterson's 2020 and 2024 geotechnical field investigations and cored to a maximum depth of 6.5 m bgs. The bedrock was observed to consist of grey sandstone and grey limestone of fair to excellent quality.

Bedrock mapping, provided by the OGS was reviewed as a part of this assessment. Available mapping (MRD 219) indicates that the northeast corner of the site is located in an area where the bedrock consists of sandstone and minor conglomerate from the Nepean Formation. The western portion of the site is located in an area where the bedrock consists of dolostone, minor shale and sandstone of the Oxford Formation. The eastern portion of the site is located in an area where the bedrock consists of sandstone and dolostone of the March Formation. Based on available mapping and Paterson's field investigations, the overburden drift thickness at the subject site ranges between 0.1 to 10 m. Bedrock geology mapping is shown on Drawing PH4872-3 - Bedrock Geology Plan within Appendix 1.

Karst Features

The term “karst” refers to a geologic formation characterized by the dissolution of carbonate bedrock, such as limestone or dolostone. In order for karstification to occur, precipitation must be able to infiltrate the top of the bedrock, causing dissolution which enlarges previously existing joints and bedding planes. Based on available mapping by the OGS (GRS 005), the subject site is located within an area that does not contain karstic landforms.

4.3 Hydrogeological Setting (Conceptual Model)

Based on the field investigations at the subject site, Paterson used borehole data, existing water well records, topography, monitoring well water levels, hydraulic conductivity to develop a conceptual model of the transport fate of surface water and groundwater at the subject site. Information related to the conceptual flow model is listed below.

Existing Aquifer Systems

Aquifer systems may be defined as geological media, either overburden soils or fractured bedrock, which permit the movement of groundwater under hydraulic gradients. In general, aquifer systems may be present in overburden soils or bedrock. While groundwater was observed within the overburden materials as well as the bedrock, water supply wells in the vicinity of the subject site are anticipated to be accessing deeper bedrock aquifers.

The bedrock aquifer(s) consists of sandstone and minor conglomerate from the Nepean Formation in the northeastern portion of the subject site, dolostone, minor shale and sandstone of the Oxford Formation in the western portion of the subject site and sandstone and dolostone of the March Formation in the eastern portion of the subject site.

Groundwater Levels

Multiple groundwater level measurement events have been completed to date with measurements occurring between April 2024 and May 2025. Groundwater levels measured at the monitoring well locations ranged between being at ground surface to 5.2 m bgs. The measured groundwater levels are presented in Table 1 below.

Table 1 – Summary of Manual Groundwater Level Measurements

BH ID	Ground Surface Elevation (m asl)	Groundwater Depth (m bgs)	Groundwater Elevation (m asl)	Date
BH1-24	104.96	-0.26	105.22	Apr 17, 2024
		Frozen	Frozen	Feb 25, 2025
		0.18	104.78	May 30, 2025
BH2-24	108.74	0.46	108.28	Apr 17, 2024
		0.54	108.20	Feb 25, 2025
		0.65	108.09	May 30, 2025
BH3-24	110.78	0.24	110.54	Apr 15, 2024
		0.70	110.08	May 30, 2025
BH4-24	109.95	1.18	108.78	Apr 17, 2024
		4.01	105.94	Feb 25, 2025
		2.25	107.70	May 30, 2025
BH5-24	116.50	4.26	112.24	Apr 17, 2024
		Dry	-	Feb 25, 2025
		5.17	111.33	May 30, 2025
BH6-24	113.36	1.52	111.84	Apr 15, 2024
		3.23	110.13	Feb 25, 2025
		2.39	110.97	May 30, 2025
BH7-24	112.93	0.68	112.25	Apr 15, 2024
		2.04	110.89	Feb 25, 2025
		2.71	110.22	May 30, 2025
BH8-24	110.77	0.33	110.45	Apr 15, 2024
		0.89	109.88	Feb 25, 2025
		1.26	109.51	May 30, 2025

In addition to manual water level measurements, a long-term water level monitoring program was carried out at the monitoring wells installed at the subject site. The monitoring data was compared with Environment and Natural Resources Canada precipitation data from the Ottawa International Airport over the same timeframe as part of the monitoring program. The monitoring data is appended in the Figures section of this report. The seasonal high and low water levels are presented below in Tables 2 and 3 below.

Table 2 - Minimum Groundwater Levels From Monitoring Program

BH ID	Ground Surface Elevation (m asl)	Groundwater Depth (m bgs)	Groundwater Elevation (m asl)	Date
BH1-24	104.96	1.49	103.47	Oct 29, 2024
BH2-24	108.74	1.26	107.48	Oct 29, 2024
BH3-24	110.78	1.98	108.8	Oct 29, 2024
BH4-24	109.95	3.21	106.74	Oct 29, 2024
BH5-24	116.50	5.09	111.41	May 17, 2025
BH6-24	113.36	3.75	109.61	Nov 2, 2024
BH7-24	112.93	4.59	108.34	Oct 30, 2024
BH8-24	110.77	2.35	108.42	Nov 2, 2024

Table 3 - Maximum Groundwater From Monitoring Program

BH ID	Ground Surface Elevation (m asl)	Groundwater Depth (m bgs)	Groundwater Elevation (m asl)	Date
BH1-24	104.96	-0.51	105.47	Apr 3, 2025
BH2-24	108.74	0.02	108.72	Apr 3, 2025
BH3-24	110.78	0.11	110.67	Apr 3, 2025
BH4-24	109.95	0.43	109.52	Apr 3, 2025
BH5-24	116.50	3.13	113.37	Apr 7, 2025
BH6-24	113.36	1.21	112.15	Apr 4, 2025
BH7-24	112.93	1.41	111.52	Apr 3, 2025
BH8-24	110.77	0.08	110.69	Apr 3, 2025

The groundwater elevations generally follow the topographic profile across the subject site, with the highest groundwater elevations observed within the northwestern portion of the site and the lowest groundwater elevations within the southeastern portion of the site. The initial manual groundwater measurements are displayed on the Soil Profile and Test Data sheets, appended to this report.

Horizontal Hydraulic Gradients

Due to the nature of the water levels obtained from field work conducted at the subject site (groundwater monitoring wells), the absolute direction of horizontal hydraulic gradients in the vicinity of the subject site was not determined. However, using the available data, it was possible to approximate the horizontal hydraulic gradients in the bedrock given that the horizontal hydraulic gradient between any 2 points is the slope of the hydraulic head between those points:

$$i=h_2-h_1/L$$

Where: i = horizontal gradient
h = water elevation (m asl)
L = horizontal distance between test hole locations

Using the above noted formula, the horizontal hydraulic gradients were generally observed to be in an approximate southeasterly orientation with a magnitude ranging between approximately 0.005 to 0.01 m/m in the bedrock. A small portion of the northeastern section of the subject site had a horizontal hydraulic gradient observed to be in a northeastern orientation with a magnitude of approximately 0.002. The two observed hydraulic gradient orientations reflect the two subwatersheds within the subject site and reflect the regional groundwater flow directions. The approximate groundwater flow directions are presented on Drawing PH4872-5 - Groundwater Contour Plan.

Drawdown Analysis - Hydraulic Conductivity

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 testing yielded hydraulic conductivity values of 1.65×10^{-7} to 7.12×10^{-5} m/sec for the bedrock, 1.60×10^{-6} m/sec for the glacial till and 2.32×10^{-5} for the fill. Hydraulic conductivity results are summarized in Table 4 below and are included in Appendix 3.

Table 4 - Summary of Hydraulic Conductivity (Slug) Testing Results

Test Hole ID	Ground Surface Elevation (m asl)	Testing Elevation (m asl)	Hydraulic Conductivity (m/sec)	Test Type	Subsurface Material Tested
BH1-24	104.96	98.48-99.98	6.41×10^{-5}	Falling Head	Bedrock
			7.12×10^{-5}	Rising Head	
BH2-24	108.74	102.42-103.92	4.99×10^{-7}	Rising Head	Bedrock
BH3-24	110.78	104.46-105.96	1.60×10^{-6}	Rising Head	Glacial Till
BH4-24	109.95	103.65-105.15	1.65×10^{-7}	Falling Head	Bedrock
BH5-24	116.50	110.89-112.39	2.32×10^{-5}	Rising Head	Fill
BH6-24	113.36	106.93-108.43	7.90×10^{-7}	Falling Head	Bedrock
BH7-24	112.93	106.78-108.28	4.81×10^{-6}	Falling Head	Bedrock
			5.65×10^{-6}	Falling Head	
BH8-24	110.77	104.60-106.10	3.97×10^{-6}	Falling Head	Bedrock

Groundwater Recharge and Discharge

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

The overburden soils at the subject site consist primarily of topsoil overlying a glacial till layer with a silty sand matrix. At select locations, fill or silty sand was observed below the topsoil. Below the aforementioned overburden materials is bedrock. Based on the presence of shallow bedrock and relatively permeable soils, it is likely that recharge is occurring to the shallow aquifer at various locations across the subject site.

Regarding discharge zones, select surface water features across the subject site were identified in the Environmental Impact Study (EIS) completed by Kilgour & Associates Ltd. as receiving contributions by groundwater and surficial flows. However, as a mitigative measure, the EIS also outlined strategies to ensure that the overall hydrologic function of the site is preserved in the event of any disruptions to groundwater discharge zones following site development.

Catchment Areas

The majority of the subject site is located within the Jock Downstream Reach subwatershed with a northern portion of the subject site located within the Graham Creek subwatershed. Therefore, it is anticipated that the site is characterized by two subwatershed catchment areas.

Based on discussions with civil engineering design team, the site will continue to be characterized by two catchment areas under post development conditions.

Groundwater Inflow/Dewatering Requirements

The main sources of dewatering at the subject site are anticipated to be the building/housing, servicing and stormwater management pond (SWMP) excavations. Details regarding the excavation footprints and depths for each potential dewatering source were unavailable at the time of report preparation. However, based on Paterson’s experience with mixed-use developments with similar infrastructure that are built on silty sand subsoils with shallow bedrock, it is anticipated that groundwater contributions may be moderate to high depending on the excavation depth/sizing per source, and hydrogeologic properties of the excavated material at a given location. Therefore, it is recommended that source specific dewatering calculations be completed once more specific development details are available.

5.0 SITE SPECIFIC WATER BUDGET ASSESSMENT

The site-specific water budget assessment (SSWB) was conducted to determine the hydrogeological function of the subject site, to identify infiltration potential and to identify opportunities for supplemental stormwater management measures. At the time of the field investigations, the study area consisted of mature tree, grass and shrubs and surface water features. Pre and post-development terrain compositions are illustrated on Drawings PH4872-5 - Pre-Development Terrain Composition Plan and PH4872-6 - Post-Development Terrain Composition Plan, appended to this report.

5.1 Calculations

Thornthwaite and Mather Water Balance Calculations

When falling precipitation intercepts the ground, three possible outcomes arise. The water can either evaporate/transpire back into the atmosphere (evapotranspiration), infiltrate into the surface soils (infiltration) or leave the area as runoff.

The method employed by Thornthwaite and Mather (1957) was used along with modelling software by Environment and Climate Change Canada's (ECCC) Engineering Climate Services Unit to determine the partitioning of water throughout various portions of the hydrologic cycle. Inputs into the modelling program included monthly temperature, precipitation, water holding capacities and site latitude. Using the long-term averages of these variables, it was possible to calculate annual potential and actual evapotranspiration, change in soil moisture storage and the water surplus.

The formula employed by Thornthwaite and Mather is as follows:

$$S = R + I = P - ET$$

Where:
S = surplus (mm/year)
R = annual runoff (mm/year)
I = annual infiltration (mm/year)
P = annual precipitation (mm/year)
ET = annual evapotranspiration (mm/year).

Shallow unsaturated soils within the study area generally consisted of topsoil underlain by a glacial till with a silty sand matrix. At select locations, a fill or sandy silt layer was observed below the topsoil layer. Given the similar shallow soil characteristics across the entire study area, the above noted calculations were mostly carried out for the soil moisture holding capacity of a fine sandy loam for pre-development site conditions.

Based on the location of the site within the Ottawa area, climatic data was obtained from the climate station located at the McDonald-Cartier International Airport covering the period of January 1939 to December 2022. The information was provided by Environment Canada's Engineering Climate Services Unit and is presented in Appendix 2 of the report.

Table 5, below, displays the soil types present within the study area and their associated water holding capacities (WHC) as well as the actual evapotranspiration (AET) and surplus data. For the purposes of this study, AET values were used as they account for accumulated soil moisture deficit. This deficit represents the volume of water retained within the available pore spaces of the soil and is subtracted from the potential evapotranspiration (PET) value to more accurately calculate the water surplus. The monthly/annual water balance data is presented in Tables 7-10 in Appendix 2 of the report. For the purpose of this study, 70% of the developed areas are considered to be impervious surfaces (100% of surplus will result in runoff) and 30% are considered to be urban lawns.

Table 5 - Site Specific Water Surplus Information

Land Use Unit	Water Holding Capacity (mm)	Actual Evapotranspiration (mm/year)	Surplus Water (mm/year)
Impervious Surfaces	N/A	145*	759
Fine Sandy Loam (Urban Lawn)	75	535	378
Fine Sandy Loam (Pasture and Shrubs)	150	574	329
Clay Loam (Pasture and Shrubs)	250	600	304
Fine Sandy Loam (Mature Forest)	300	605	298

Table reproduced using WHC values from MOE (2003) - Stormwater Management Planning and Design Manual and modelling data from Environment Canada's Engineering Climate Services Unit.
*Values based on evaporation information for urban areas (16% of precipitation) included in the Eastern Ontario Water Resources Management Study prepared by CH2M HILL Canada Limited (March 30, 2001).

Infiltration Factors

In order to break down the surplus water values for the various materials into infiltration and runoff, various factors must be considered. The Ministry of the

Environment (MOE) Stormwater Management Planning and Design Manual (2003) lists three main factors that contribute to surface water infiltration rates.

The first factor is topography, which is broken down further into three sections: flat and average slope, rolling land and hilly land. Flat and average slope provides the greatest potential for infiltration and has the largest infiltration factor applied to it (0.3), while the other two have progressively lower infiltration factors (rolling land is 0.2 and hilly land is 0.1).

The second factor is soil, which is also broken down further into three sections: tight impervious clay, medium combinations of clay and loam and open sandy loam. Open sandy loam provides the greatest potential for infiltration (infiltration factor of 0.4) while the other two have progressively lower potential for infiltration to occur (infiltration factor for medium combinations of clay and loam is 0.2 and for tight impervious clay is 0.1).

The final factor the MOE manual uses to partition infiltration from runoff is land cover. It is broken down into two sections: open fields/cultivated lands and woodlands. Woodlands have greater infiltration potential and an infiltration factor of 0.2. Open fields and cultivated lands have lower potential and with an infiltration factor of 0.1. A summary of the MOE manual's descriptors and their associated infiltration factors is shown below in Table 6.

Table 6 - MOE (2003) Infiltration Factors

Description of Area/Development Site	Value of Infiltration Factor
Topography	
Flat and average slope (<0.6 m/km)	0.30
Rolling land (slope of 2.8-3.8 m/km)	0.20
Hilly land (slope of 28-47 m/km)	0.10
Soil	
Tight impervious clay	0.10
Medium combinations of clay and loam	0.20
Open sandy loam	0.40
Cover	
Open fields/cultivated lands	0.10
Woodlands	0.20

Table reproduced from MOE (2003) - Stormwater Management Planning and Design Manual.

The topography of the study area is classified between rolling land and hilly land. Therefor, a pre-development topography infiltration factor of 0.15 was given for the materials analysed on this property. In order for development to proceed, it is expected that alterations will be made to the topography of the site. In general, it is expected that the overall slope of the site will be reduced to accommodate buildings and parking areas. However, it is expected that the site will still contain some topographic relief. Therefore, under post-development conditions, the site was therefore assigned a post-development topography infiltration factor of 0.15. An infiltration factor of 0 was assigned to the impervious surfaces due to the negligible infiltration capacity.

As previously discussed, soils within the study area generally consisted of topsoil overlying a silty sand layer or glacial till deposit with a silty sand matrix. Therefore, a pre-development soil infiltration factor of 0.3 was given for the majority materials analysed on this property. However, at select areas, a silty clay fill was identified beneath the topsoil and was assigned a soil infiltration factor of 0.2. Under post-development conditions, the majority of the site will consist of either conservation lands (unchanged from pre-development conditions) landscaped areas and impervious surfaces, with soil infiltration factors of 0.3 for silty loam, 0.2 for clay loam and 0 for impervious surfaces.

At the time of the field investigations, the subject site generally consisted of mature forests with some areas with grass and shrubs. Therefore, a pre-development vegetation infiltration factor of 0.2 was used for the majority of the site with the exception of the areas with grass and shrubs which were given a vegetation infiltration factor of 0.1. Post-development, it is expected the majority of the trees remaining on site will be removed to accommodate buildings, parking areas and roadways. As such, a post-development vegetation infiltration factor of 0.1 was assigned to the majority of the site, except for select areas where forested areas are anticipated to remain in place, which were given an infiltration factor of 0.2. Impervious surfaces were assigned a post development vegetation infiltration factor of 0 due to its negligible potential to benefit from vegetation cover.

The pre and post-development infiltration factors for all materials considered are included in the water budget calculations provided in Table 11 and Table 12 included in Appendix 2 of this report.

5.2 Pre and Post-Development Water Budget

The pre-development water budget analysis conducted for the study area determined that an estimated 118,841,296 L/year of surplus water currently infiltrates the surface soils. The remaining estimated 72,302,777 L/year of surplus leaves the site as runoff, draining towards localized surface water features throughout the subject site.

The post-development water budget analysis determined that an estimated 49,825,869 L/year of surplus water will infiltrate the surface soils and approximately 305,163,217 L/year will leave the site as runoff. These values equate to an approximate decrease in infiltration of 58% and an increase in runoff of 322%.

The main variable that changed from pre-development conditions to post-development conditions was the addition of approximately 36 hectares of impervious surfaces. This results in reducing the area of pervious materials throughout the subject site, therefore, reducing the overall infiltration potential of the subject site. The remaining areas that are not being converted to impervious surfaces will either become landscaped surfaces characterized by clay loam (urban lawn) material, or remain as fine sandy loam (mature forest) material. The infiltration potential difference between the urban lawn and mature forest materials are negligible when compared to the addition of impervious surfaces across the subject site. Also, it should be noted that the SWMP and surface water feature areas were excluded from the water budget analysis given that these areas do not contribute to the infiltration or runoff potential of the site.

It is important to note that the post-development water budget analysis for the subject site does not consider any potential infiltration of the anthropogenic sources (100% runoff was taken as a conservative approach). In reality, some portion of surface water that lands on impervious surfaces either evaporates, infiltrates (asphalt is not 100% impervious) or is diverted to grassed areas where additional infiltration may occur. As such, the post-development runoff volumes should be considered a conservative estimate, and not expected to definitively represent future conditions.

Details of pre-development water budget analyses are presented in Table 11 and 12 included in Appendix 2 of this report.

6.0 GROUNDWATER IMPACT ASSESSMENT

6.1 Impact of Proposed Development on Surrounding Infrastructure

As previously discussed, the subsurface profile at the subject site is generally comprised of topsoil overlying a glacial till layer with a silty sand matrix. At select locations, the topsoil is underlain by fill or silty sand. The above noted layers are underlain by bedrock. The adjacent structures are anticipated to be founded on the dense overburden materials or bedrock with minimal compressibility. Furthermore, water takings are expected to be short term in duration, given the nature of the development. Therefore, adverse effects related to dewatering activities at the subject site are expected to be negligible.

The steady-state radius of influence calculations completed were based upon the Sichardt equation as shown below.

$$R = 3000 * \Delta h(K^{0.5})$$

Where: R = radius of influence (m)
Δh = expected groundwater drawdown (m)
K = hydraulic conductivity (m/sec).

For the purposes of completing the calculations, the following values were used in the analysis for the glacial till:

- ☐ Δh = 3 to 8 m (based on estimated servicing depths and 2 levels of underground parking)
- ☐ K = 1.65×10^{-7} to 7.12×10^{-5} m/sec (based on site specific hydraulic conductivity values)

Using the above equation and assumptions, a radius of influence of <5 to 203 m will develop as a steady state condition, extending from the edge of the excavation, depending on the groundwater levels and hydraulic properties of the subsurface materials encountered.

The adjacent structures are anticipated to be founded on the dense overburden materials or bedrock with minimal compressibility. Furthermore, water takings are expected to be short term in duration, given the nature of the development. Therefore, adverse effects related to dewatering activities at the subject site are expected to be negligible. A more detailed assessment may be required once additional excavation details are available closer to construction.

6.2 Impact of Proposed Development on Existing Well Users

A search of the Ontario Water Well Records database indicated that there are several wells within a 500 m radius of the proposed development as shown on Drawing PH4872-7 - MECP Water Well Location Plan in the Figures section of this report. Upon investigation, it was determined that the majority of the wells in the area are either no longer in use or are monitoring well installations. Given that the residential development located east of the subject site is municipally serviced, the wells that are anticipated to remain in use are limited to those along Lytle Avenue northeast of the subject site and those associated with the industrial properties along Moodie Drive, west of the subject site. The wells that are anticipated to still be in use are accessing a deeper bedrock aquifer well below the anticipated excavation depths associated with the proposed development. Therefore, it is anticipated that the existing wells have adequate vertical and horizontal separation from proposed construction activities and are not expected to be negatively impacted by the proposed development.

6.3 Impact of Proposed Development on the Environment

A search of the Ministry of the Environment Conversation and Parks (MECP) Environmental Site Registry for Records of Site Condition (RSC) was conducted as part of the assessment of the site, neighbouring properties and the general area. No RSCs were identified within the 500 m buffer from the subject site.

A Phase II Environmental Site Assessment (ESA) was completed by Paterson for the subject site. All soil samples were found to be in compliance with MECP Table 8 Standards. The elevated levels of barium in select soil samples were determined to be naturally occurring and thus compliant with Table 8 Standards. All groundwater samples were found to be in compliance with MECP Table 8 Standards.

There are numerous surface water features located within 500 m of the subject site. These include unnamed drainage ditches and the north end of the O'Keefe Drain which is located south of the subject site. Within the subject site boundaries are surface water features which include tributaries to the O'Keefe Drain, a wetland area and the water filled decommissioned quarry which is currently not in use. Kilgour & Associates Ltd. was retained to assess the impact of the proposed development on these surface water features. Based on the findings within the Environmental Impact Study (EIS) prepared by Kilgour & Associates Ltd. dated August 7, 2025, it is Paterson's understanding that select surface water features located within the subject site are expected to be re-aligned/removed as part of the proposed development. However, the proposed stormwater management strategy is expected to be developed in a manner that maintains the overall hydrologic function of the subject site. Mitigation measures to manage the impacts of construction related activities on surface water features should be adhered to as outlined in the EIS.

Considerations relevant to the water budget analyses are discussed in Section 7.5 below.

6.4 Adjacent PTTW/EASRs/ECAs

A search of the MECP Permit to Take Water (PTTW) and Environment Activity Sector Registry (EASR) database provided two (2) PTTWs and one (1) EASR within a 500 m radius of the subject site and one (1) within the subject site boundary.

PTTW 2553-ANDJ4Y is registered to Lafarge Canada Inc. and is located approximately 450 west of the subject site. The above noted permit contains four (4) sources (Old Quarry, Old Quarry, Quarry Sump and Quarry Sump) with a maximum taking of 40,676,000 L/day.

PTTW P-300-1188288367 is registered to R. W. Tomlinson Limited and is located approximately 450 m west of the subject site. The above noted permit contains seven (7) sources (Primary Sump, Primary Sump, Primary Sump, Primary Sump, Secondary Sump, Secondary Sump and Secondary Sump) with a maximum taking of 4,233,600 L/day.

EASR R-009-6110525609 is registered to Ottawa D-Squared Construction and is located approximately 300 m to the north of the proposed development and has a maximum water taking volume of 400,000 L/day.

Despite there being two (2) PTTW and (1) EASR surrounding the proposed development, they are located at a greater distance from the subject site than the anticipated radius of influence that may develop as a result of water taking activities. Furthermore, given the nature of the proposed development, water taking activities are anticipated to be short-term in nature. Therefore, cumulative impacts related to anticipated dewatering activities for the proposed development from the adjacent PTTW and EASR are not anticipated.

PTTW 2625-C4MQ5Y is registered to Cedarhill Golf Enterprises Inc. and is located within the subject site. The above noted permit contains two (2) sources (Stony Swamp (Beaver Pond) and Miron Quarry with a maximum taking of 4,027,240 L/day. It is Paterson's understanding that 2436091 Ontario Ltd. is in discussions with Cedarhill Golf Enterprises Inc. to devise an alternative irrigation strategy for the adjacent golf course once development begins.

With respect to Environmental Compliance Approvals (ECAs), given the nature of the development in the area, there are a few ECAs that exist in the areas bordering the site. Upon review of the ECAs, it was determined that they are primarily related to existing stormwater management systems in the area. Therefore, it is anticipated that the proposed development will have minimal impacts to the existing ECAs.

7.0 ASSESSMENT AND RECOMMENDTIONS

7.1 Sources of Contamination

Based on the soil and groundwater samples collected at the subject site as part of the Phase II ESA investigation, all soil and groundwater samples were found to be in compliance with MECP Table 8 Standards.

Prior to and during site development, it is recommended that construction best management practices with respect to fuels and chemical handling, spill prevention, and erosion and sediment control be followed. This will minimize the potential for the introduction of contaminants to the soil, surface water, or groundwater at the subject site.

It is anticipated that the material on site will be disposed of as per Ontario Regulation 406/19 – On-site and Excess Soil Management.

With respect to stormwater runoff quality, it is recommended that best management practices with respect to operational standards be maintained for any stormwater management facilities constructed for the proposed development. It is also recommended that adherence to the City of Ottawa Salt Management Plan - Appendix A (October, 2011) included in Appendix 4 is enforced to ensure that chloride levels in stormwater runoff are minimized.

7.2 Surface Water Features

There are numerous surface water features located within 500 m of the subject site and within the site boundary itself. These include tributaries to the O’Keefe Drain, a wetland area and the water filled decommissioned quarry which is currently not in use. However, as previously discussed and as per the EIS prepared by Kilgour & Associates Ltd., it is understood that the stormwater management strategy will include measures to mitigate potential impacts and maintain the overall hydrologic function of the site.

With respect to water discharge, water that is pumped from on site excavations must be managed in an appropriate manner. The contractor will be required to implement a water management program to dispose of the pumped water. If the discharge point for the pumped water is directed to overland drainage, it is expected that a multi-barrier approach (such as hay bales, geosocks, silt fence, etc.) to a non-frozen, well vegetated area will be utilized in order to promote re-infiltration prior to reaching a watercourse. Furthermore, if the discharged water is to be directed to overland drainage within 30 m of a water body/watercourse, the turbidity of the water shall not exceed 8 NTU above background levels of the nearest water body. The contractor will be required to maintain appropriate BMPs with respect to sediment and erosion control to ensure negative effects to the surrounding environment are minimized.

7.3 Existing Wells

Any wells within the subject site must be decommissioned prior to construction in accordance with Ontario Regulation 903.

If construction activities are shown to cause negative impacts to the water supplies of existing well users, the contractor shall take action to make available a supply of water equivalent in quality and quantity of their typical takings, or shall compensate those affected for reasonable costs for doing so, or shall reduce water taking amounts to alleviate the negative impacts. The contractor shall provide temporary water supplies, to those affected, to meet their typical takings or compensate such persons for reasonable costs associated to do so until permanent restoration of the affected water supply or an equivalent source. As the potential to interfere with the water quality/quantity of existing well users in the area is negligible, a water well monitoring program is not recommended for the proposed development.

7.4 Permit To Take Water

If water taking volumes are greater than 50,000 L/day, a MECP Permit to Take Water (PTTW) or water taking Environmental Activity and Sector Registry (EASR) will be will be required. Depending on the nature of the proposed water takings, an additional hydrogeological investigation may be required.

7.5 Infiltration Potential

As previously discussed, surficial soils within the study area generally consisted of topsoil overlying a glacial till with a silty sand matrix. At select locations, fill or silty sand was observed below the topsoil layer. Site specific testing may be required to determine the infiltration potential of the soils at the subject site for the purpose of developing a stormwater management strategy.

As noted above, the results of the water budget analyses completed at the subject site indicated that 118,841,296 L/year of infiltration and 72,302,777 L/year of surface runoff are occurring under pre-development conditions. Under post development conditions, it is expected that there will be a 58% infiltration deficit and a 322% increase in runoff. Therefore, it will likely be necessary to incorporate various stormwater management measures into the design of the development. It should be noted that Paterson's water budget assessment is based on mean water budget values for the soil types at the subject site that were calculated by modeling conducted by Environment Climate Change Canada (ECCC). The ECCC model is calibrated to historical climate data and does not account for climate change predictions. Therefore, based on the National Capital Commission and City of Ottawa climate change predictions, the stormwater management design team could consider potential seasonal changes (longer spring and shorter winter) and increases in temperature and precipitation when developing their stormwater management strategy.

Based on soils at the subject site, infiltration based Low Impact Development (LID) measures could potentially be incorporated into the overall stormwater management strategy for the site, dependant on location and final grades at a given location. However, there are also various factors restricting the viability of infiltration, including the presence of shallow groundwater and bedrock as well as the composition of the subsoils. The stormwater management strategy must comply with the City of Ottawa's Technical Bulletin IWSTB-2024-04 and the MECP's Consolidated Linear Infrastructure Environmental Compliance Approval documentation. Therefore, it is recommended that alternative stormwater management measures to infiltration are also considered. The stormwater management team should target a stormwater management strategy that is best suited to mitigate the impacts that may arise due to the post-development decrease in infiltration and increase in runoff at the subject site, and to maintain the overall hydrologic function of the area as discussed in the EIS prepared by Kilgour & Associates Ltd. This may include, but should not be limited to, alternative LID strategies such as filtration and/or retention.

8.0 CLOSURE

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only, and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than 2436091 Ontario Ltd or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Michael Laflamme, P.Geo.

PROFESSIONAL GEOSCIENTIST
Aug. 20, 2025
MICHAEL LAFLAMME
PRACTISING MEMBER
3017
ONTARIO

Oliver Blume, P.Geo.

9.0 REFERENCES

Government of Ontario. Provincial Policy Statement 2020 Under the Planning Act.

Transportation Association of Canada, “Syntheses of Best Practices – Road Salt Management”, dated 2013.

“Characterization of Ottawa’s Watersheds”, Prepared for the City of Ottawa, dated March 2011.

“Surficial Geology of Southern Ontario (MRD128)”, Prepared by the Ontario Geological Survey, 2010

“Karst of Southern Ontario and Manitoulin Island (GRS005)” Prepared by the Ontario Geological Survey, 2008

“Paleozoic Geology of Southern Ontario (MRD219)”, Prepared by the Ontario Geological Survey, 2007

“Physiography of Southern Ontario (MRD228)”, Prepared by the Ontario Geological Survey, 2007

Chapman, L.J., and Putnam, D. F. “The Physiography of Southern Ontario, Third Edition”. Ontario Ministry of Natural Resources, 1984.

Freeze, R.A., and Cherry, J.A. “Groundwater”. Prentice-Hall, Inc., 1979.

FIGURES

PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL

2436091 ONTARIO LTD.
HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

SITE PLAN

Scale: 1:10000

Date: 05/2024

Drawn by: GK

Report No.: PH4872-REP.01

Checked by: OB

Dwg. No.: **PH4872-1**

Approved by: ML

Revision No.:

11x17

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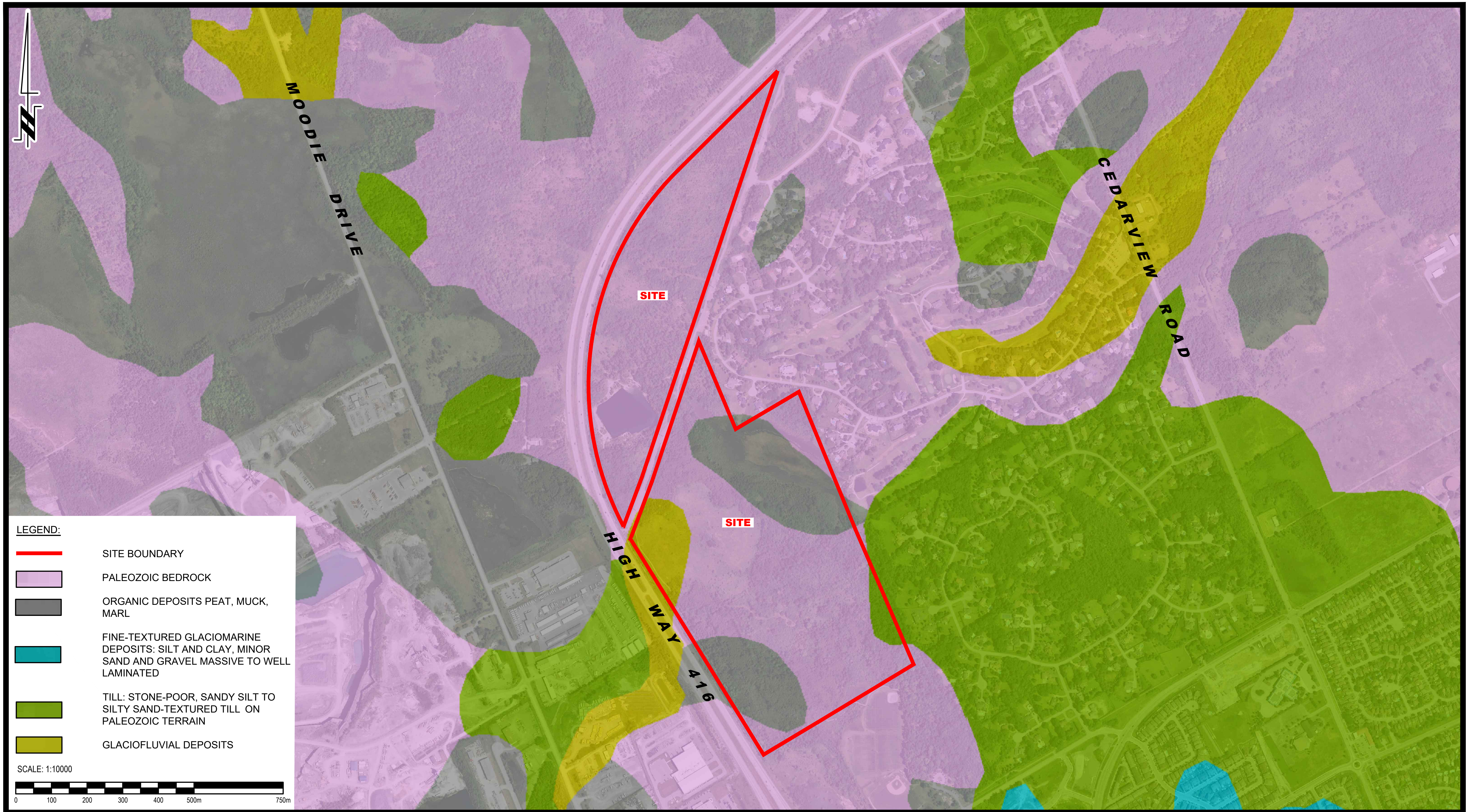

LEGEND:

🟥	SITE BOUNDARY
🟪	PALEOZOIC BEDROCK
⬛	ORGANIC DEPOSITS PEAT, MUCK, MARL
🟦	FINE-TEXTURED GLACIOMARINE DEPOSITS: SILT AND CLAY, MINOR SAND AND GRAVEL MASSIVE TO WELL LAMINATED
🟩	TILL: STONE-POOR, SANDY SILT TO SILTY SAND-TEXTURED TILL ON PALEOZOIC TERRAIN
🟨	GLACIOFLUVIAL DEPOSITS

SCALE: 1:10000

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2436091 ONTARIO LTD.
HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

SURFICIAL GEOLOGY PLAN

Scale: 1:10000
Date: 05/2024
Drawn by: GK
Report No.: PH4872-REP.01
Checked by: OB
Dwg. No.: PH4872-2
Approved by: ML
Revision No.:

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11x17

LEGEND:

- 🟥 SITE BOUNDARY
- ■ OXFORD , DOLOSTONE, MINOR SHALE AND SANDSTONE
- ■ BOBCAYGEON, LIMESTONE, WITH MINOR SHALES IN UPPER PART
- ■ GULL RIVER, LIMESTONE, DOLOSTONE, SHALE, SANDSTONE
- ■ MARCH, SANDSTONE, DOLOMITIC SANDSTONE, DOLOSTONE
- ■ NEPEAN, SANDSTONE, MINOR CONGLOMERATE

SCALE: 1:10000

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2436091 ONTARIO LTD.
HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

BEDROCK GEOLOGY PLAN

Scale: 1:10000	Date: 05/2024
Drawn by: GK	Report No.: PH4872-REP.01
Checked by: OB	Dwg. No.: PH4872-3
Approved by: ML	Revision No.:

11x17

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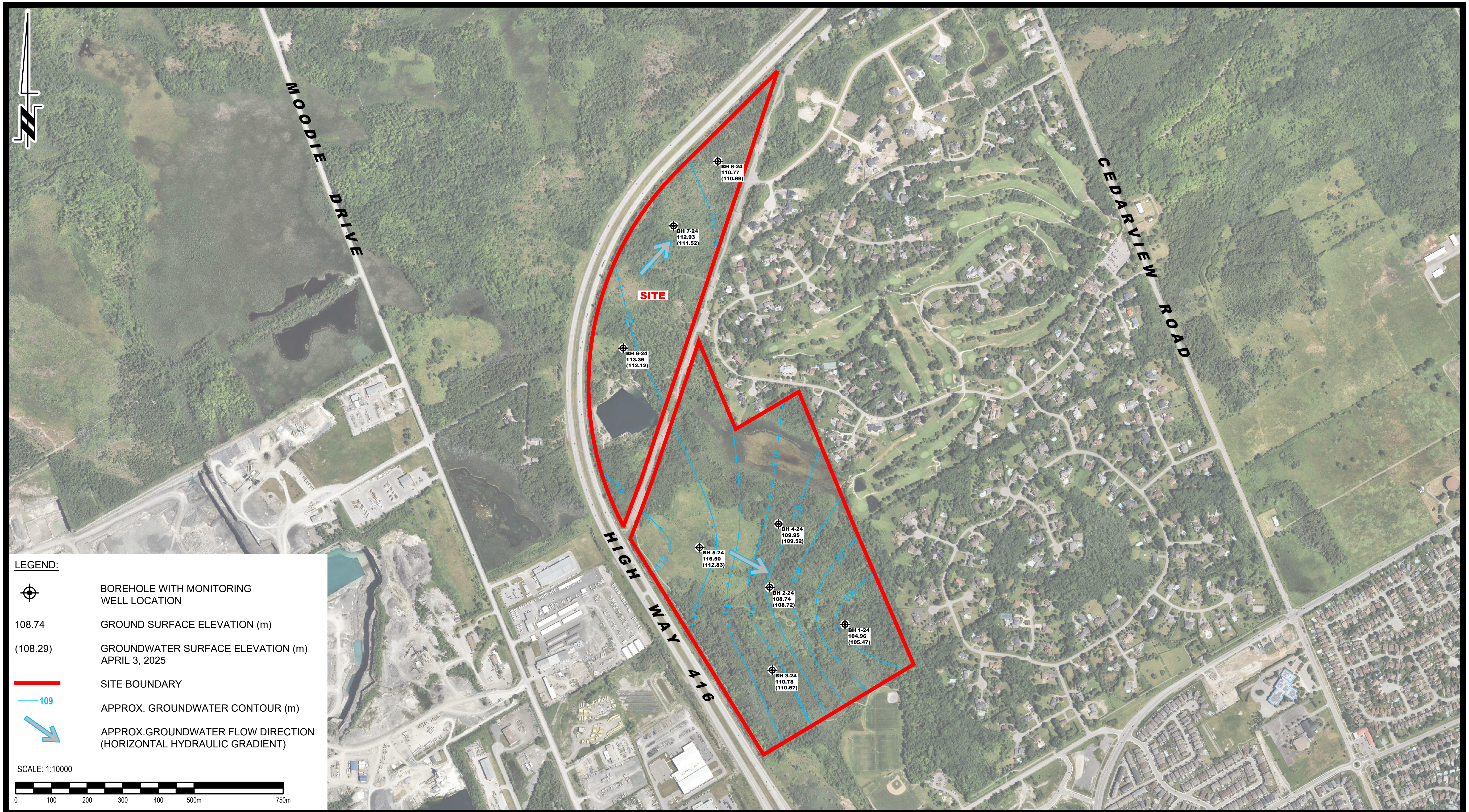

LEGEND:

⌖	BOREHOLE WITH MONITORING WELL LOCATION
108.74	GROUND SURFACE ELEVATION (m)
(108.29)	GROUNDWATER SURFACE ELEVATION (m) APRIL 3, 2025
🟥	SITE BOUNDARY
—109	APPROX. GROUNDWATER CONTOUR (m)
➘	APPROX.GROUNDWATER FLOW DIRECTION (HORIZONTAL HYDRAULIC GRADIENT)

SCALE: 1:10000

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NO.	REVISIONS	DATE	INITIAL
1	UPDATED GROUNDWATER CONTOURS	07/07/2025	ML

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HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:10000
Date: 06/2024
Drawn by: GK
Report No.: PH4872-REP.01
Checked by: OB
Dwg. No.: PH4872-4
Approved by: ML
Revision No.: 1

11x17

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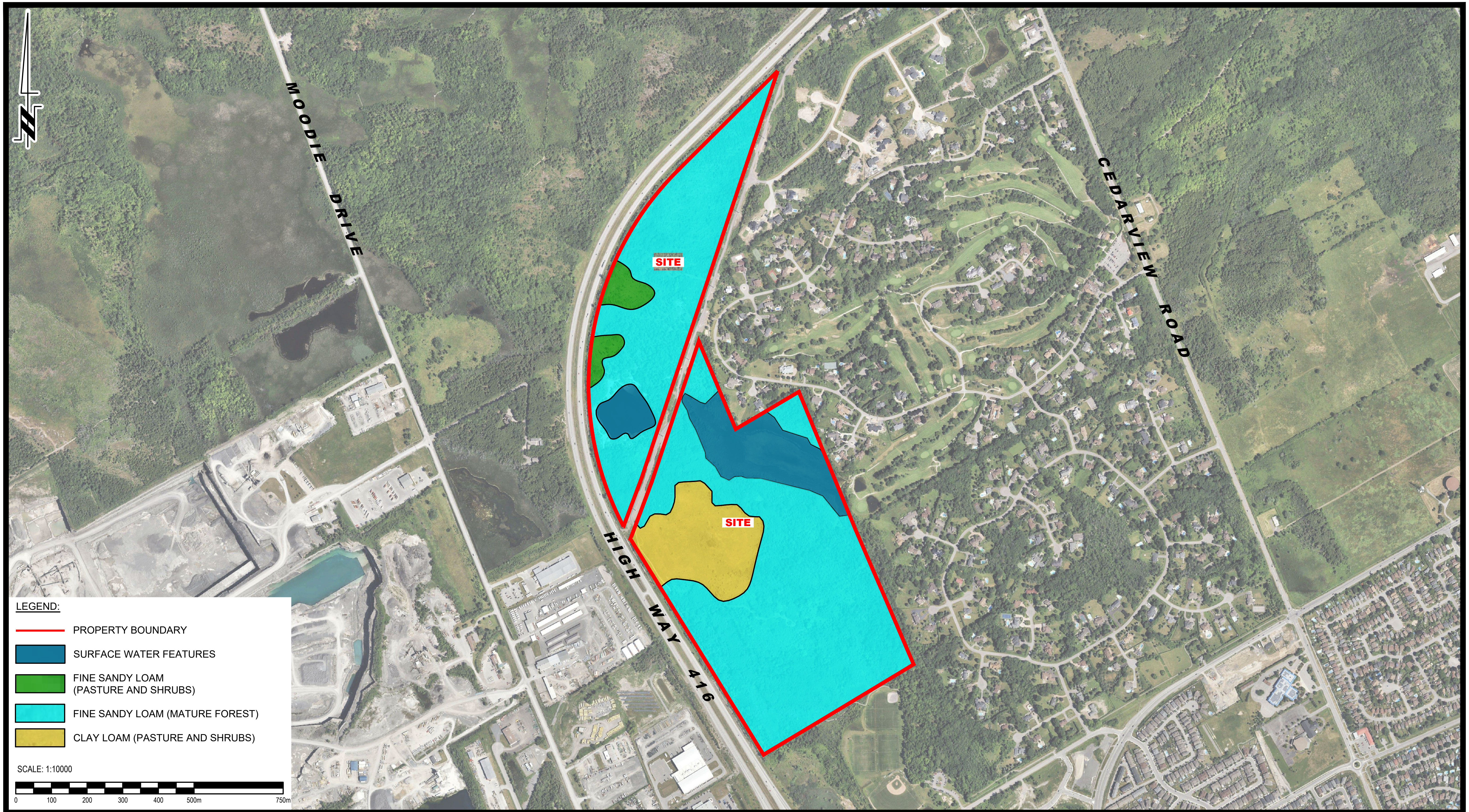

LEGEND:

- 🟥 PROPERTY BOUNDARY
- 🟦 SURFACE WATER FEATURES
- 🟩 FINE SANDY LOAM (PASTURE AND SHRUBS)
- 🟦 FINE SANDY LOAM (MATURE FOREST)
- 🟨 CLAY LOAM (PASTURE AND SHRUBS)

SCALE: 1:10000

0 100 200 300 400 500m 750m

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K2E 7T9
TEL: (613) 226-7381

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HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD
OTTAWA, ONTARIO

Title:

PRE-DEVELOPMENT TERRAIN COMPOSITION PLAN

Scale: 1:10000
Drawn by: GK
Checked by: OB
Approved by: ML
Date: 05/2024
Report No.: PH4872-REP.01
Dwg. No.: PH4872-5
Revision No.:

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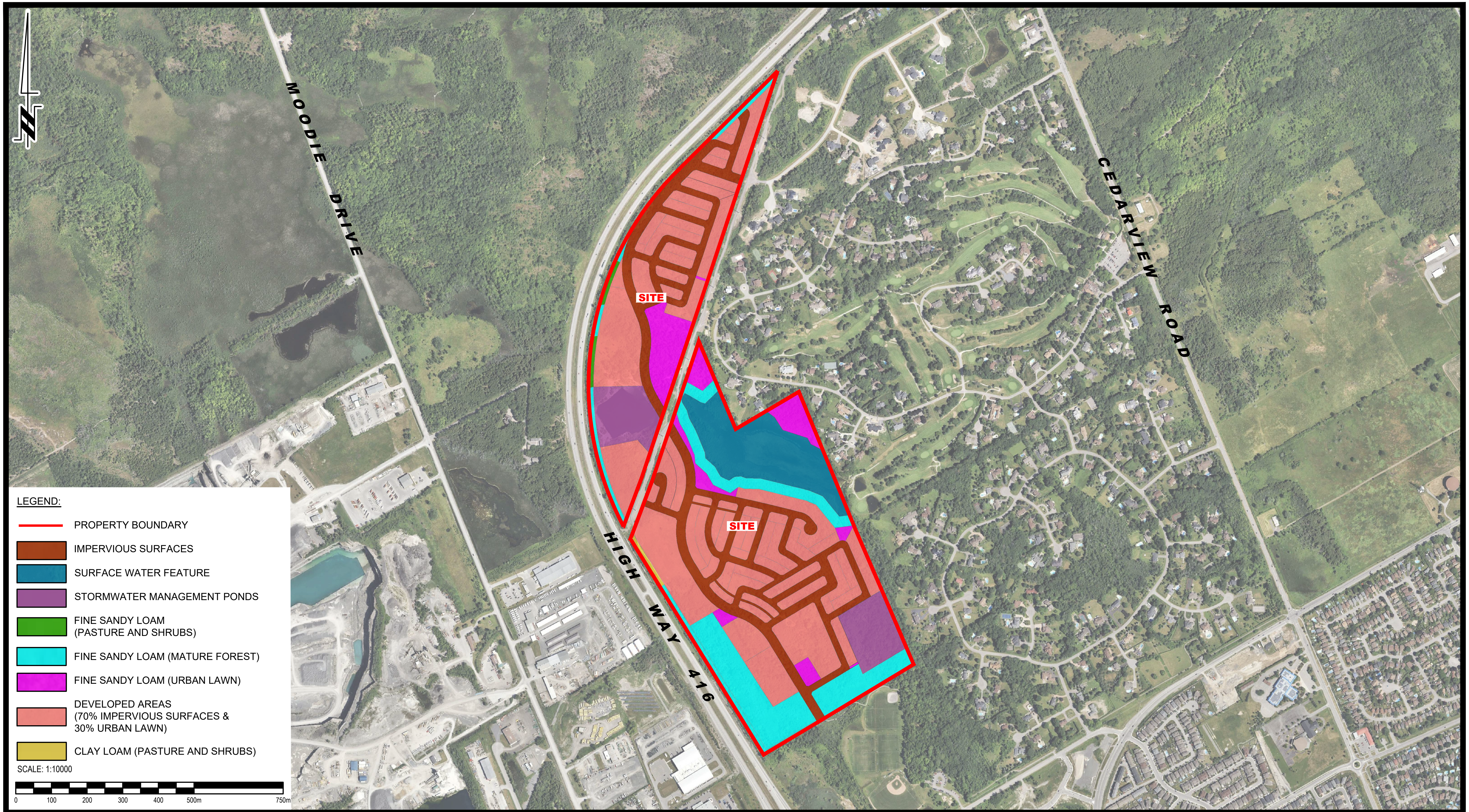

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2436091 ONTARIO LTD.
HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:
POST-DEVELOPMENT TERRAIN COMPOSITION PLAN

Scale: 1:10000
Date: 05/2024
Drawn by: GK
Report No.: PH4872-REP.01
Checked by: OB
Dwg. No.: PH4872-6
Approved by: ML
Revision No.:

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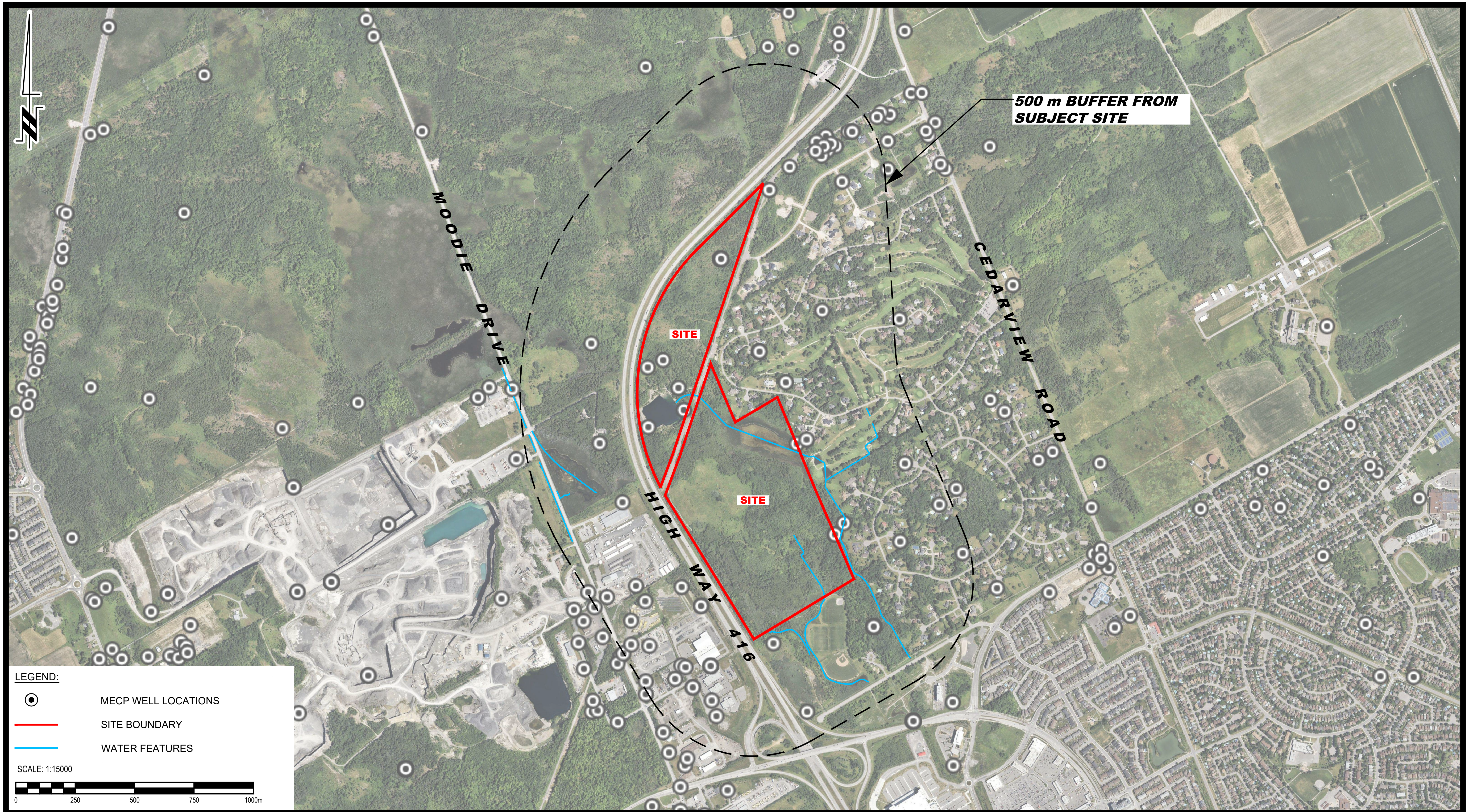

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2436091 ONTARIO LTD.
HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

MECP WATER WELL LOCATION PLAN

Scale: 1:15000

Drawn by: GK

Checked by: OB

Approved by: ML

Date: 05/2024

Report No.: PH4872-REP.01

Dwg. No.: PH4872-7

Revision No.:

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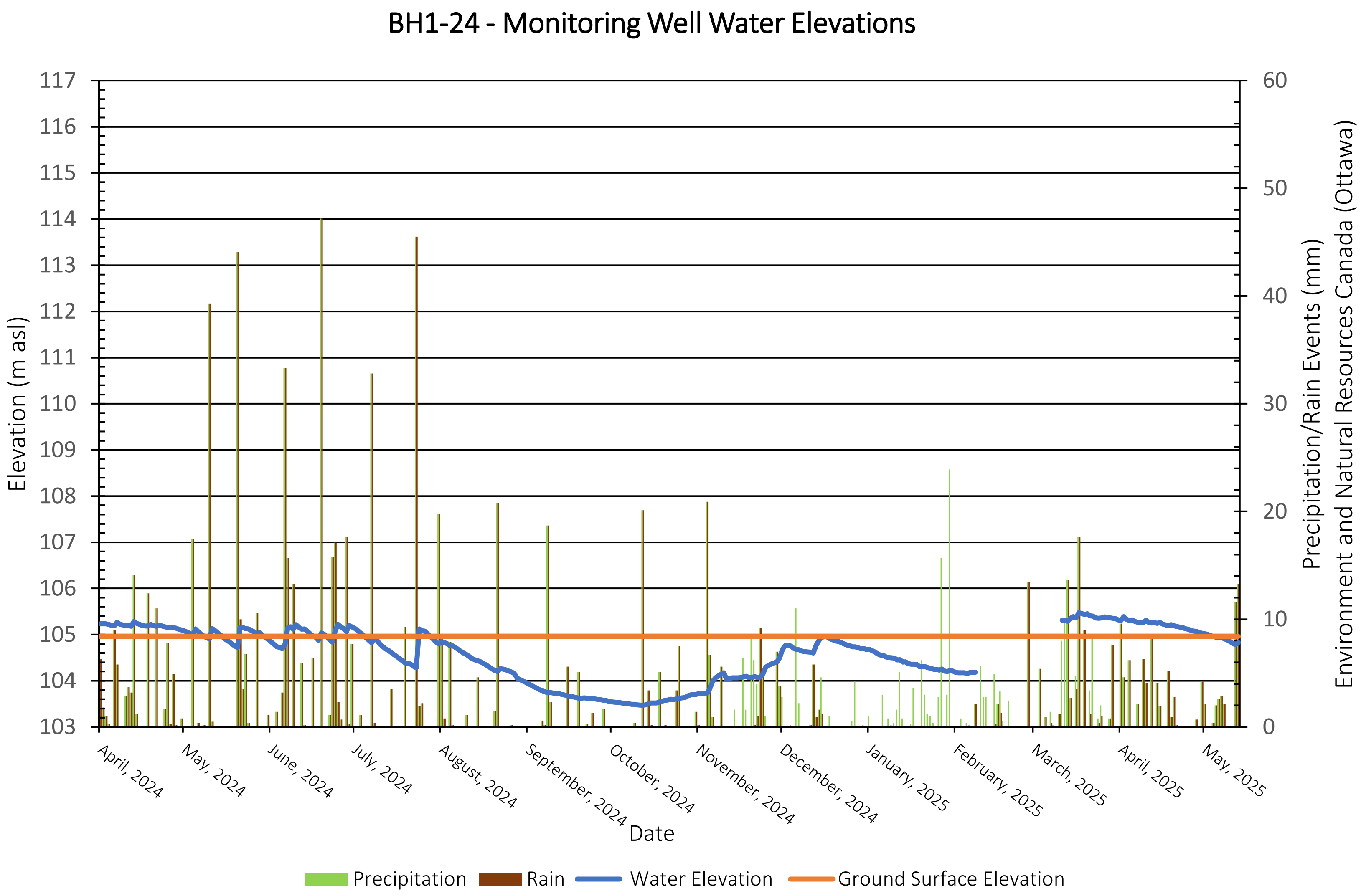
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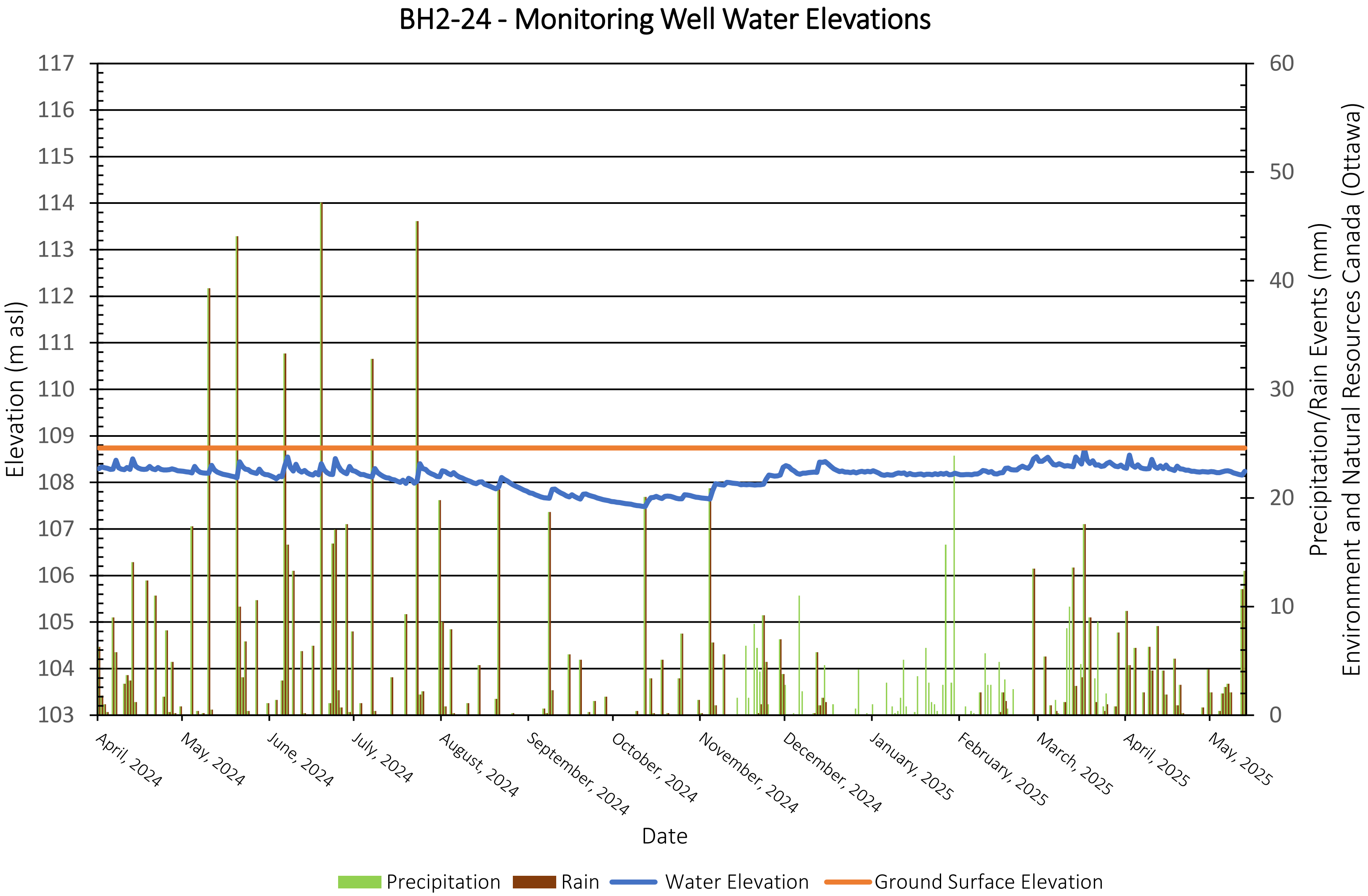
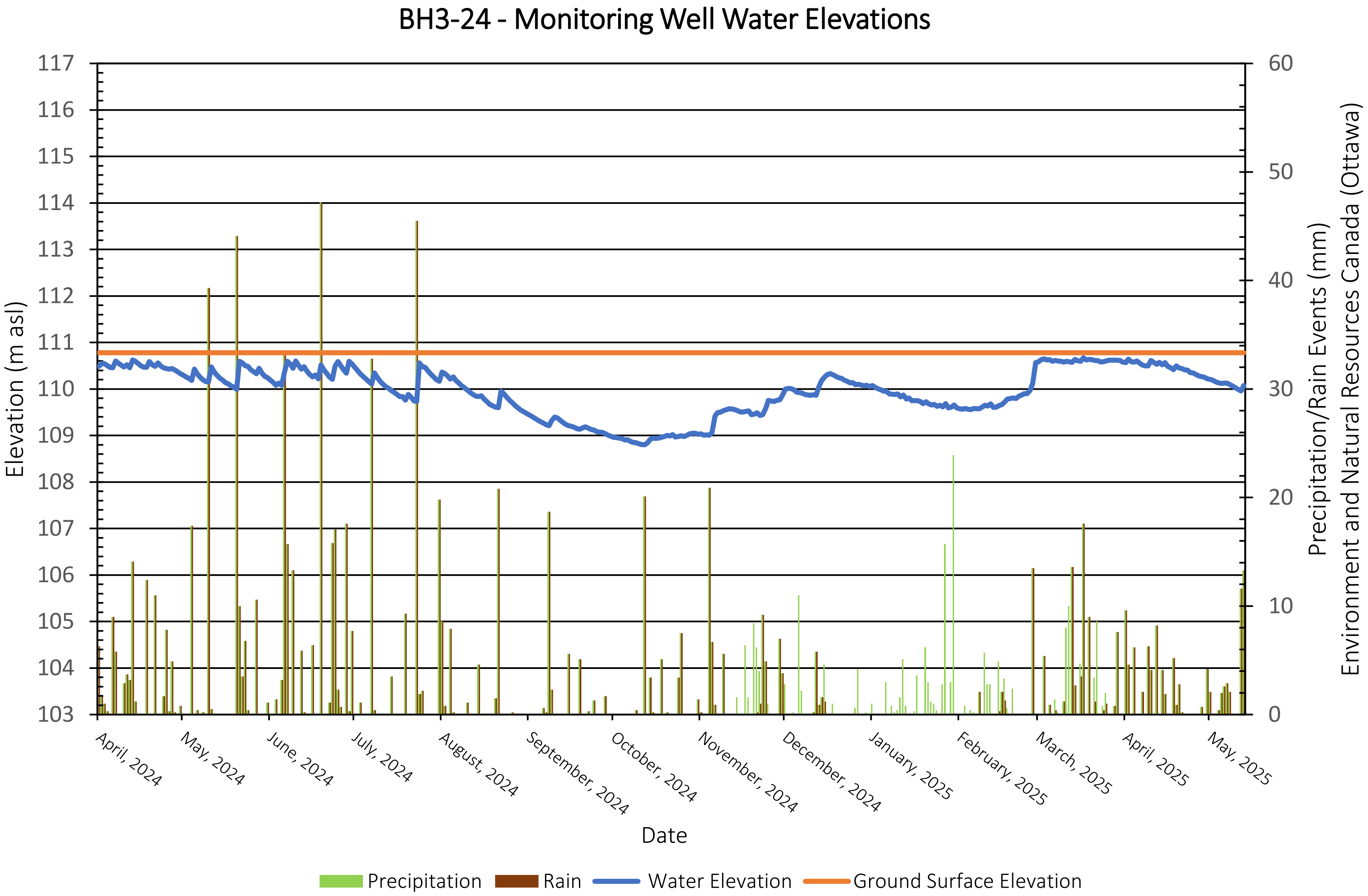
Elevation (m asl)
117
116
115
114
113
112
111
110
109
108
107
106
105
104
103
Precipitation/Rain Events (mm)
Environment and Natural Resources Canada (Ottawa)
60
50
40
30
20
10
0
April, 2024
May, 2024
June, 2024
July, 2024
August, 2024
September, 2024
October, 2024
November, 2024
December, 2024
January, 2025
February, 2025
March, 2025
April, 2025
May, 2025
Date
Precipitation
Rain
Water Elevation
Ground Surface Elevation

File: PH4872

2436091 Ontario Ltd.
800 Cedarview Road
Ottawa, Ontario




BH3-24 - Monitoring Well Water Elevations
Elevation (m asl)
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116
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103
Precipitation/Rain Events (mm)
Environment and Natural Resources Canada (Ottawa)
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50
40
30
20
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April, 2024
May, 2024
June, 2024
July, 2024
August, 2024
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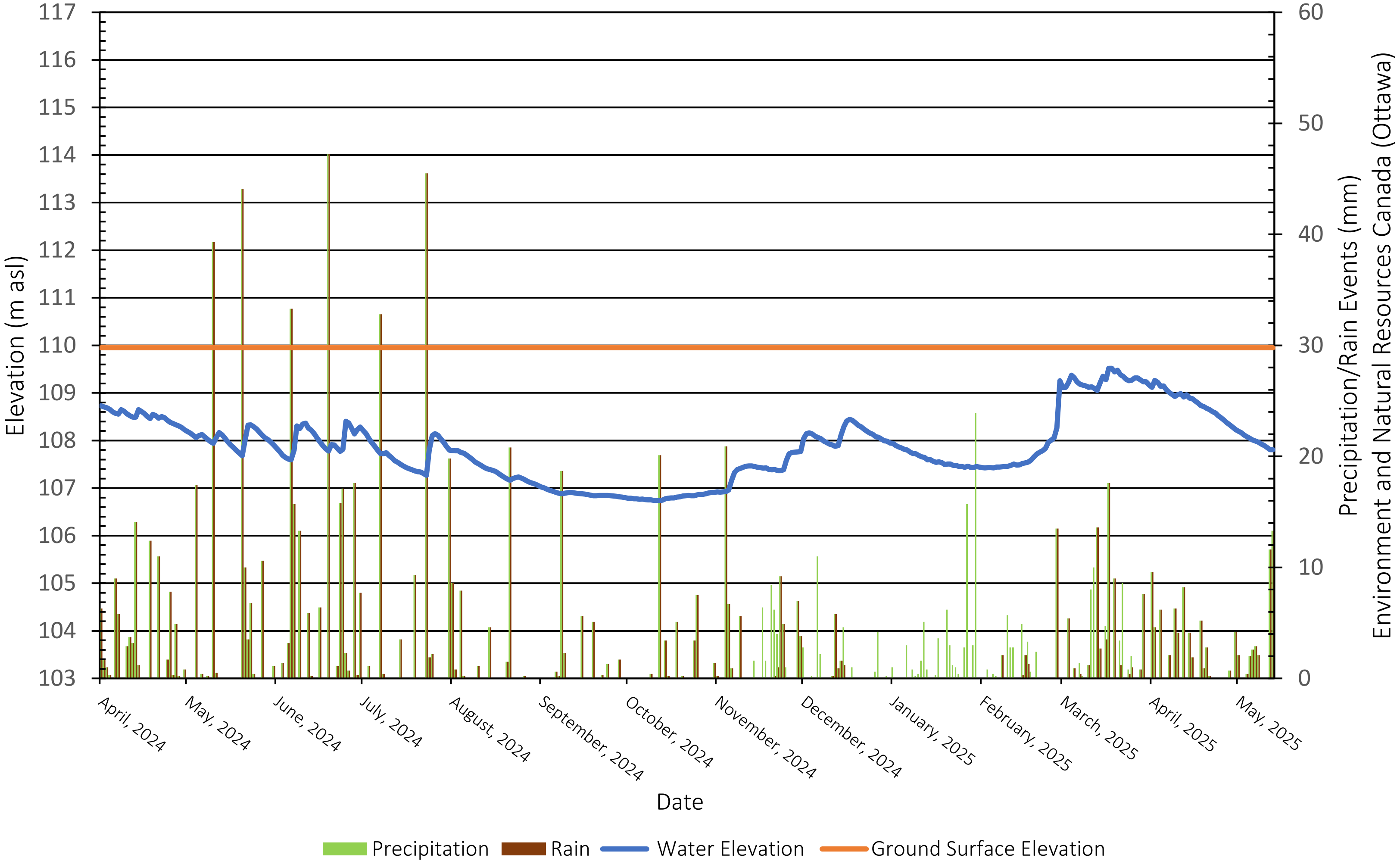
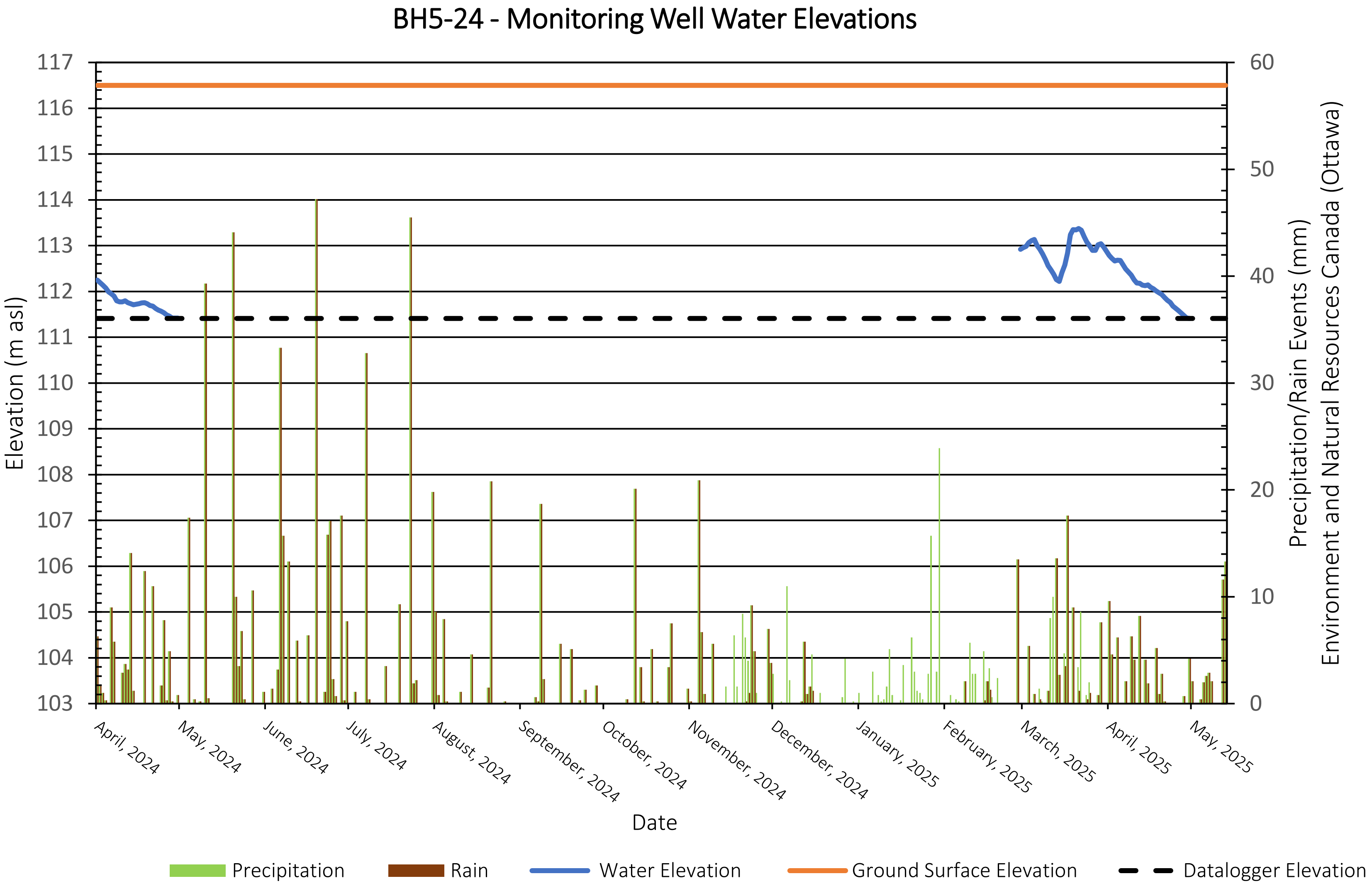
April, 2025
May, 2025
Date
Precipitation
Rain
Water Elevation
Ground Surface Elevation

BH4-24 - Monitoring Well Water Elevations



File: PH4872

2436091 Ontario Ltd.
800 Cedarview Road
Ottawa, Ontario



PATERSON GROUP

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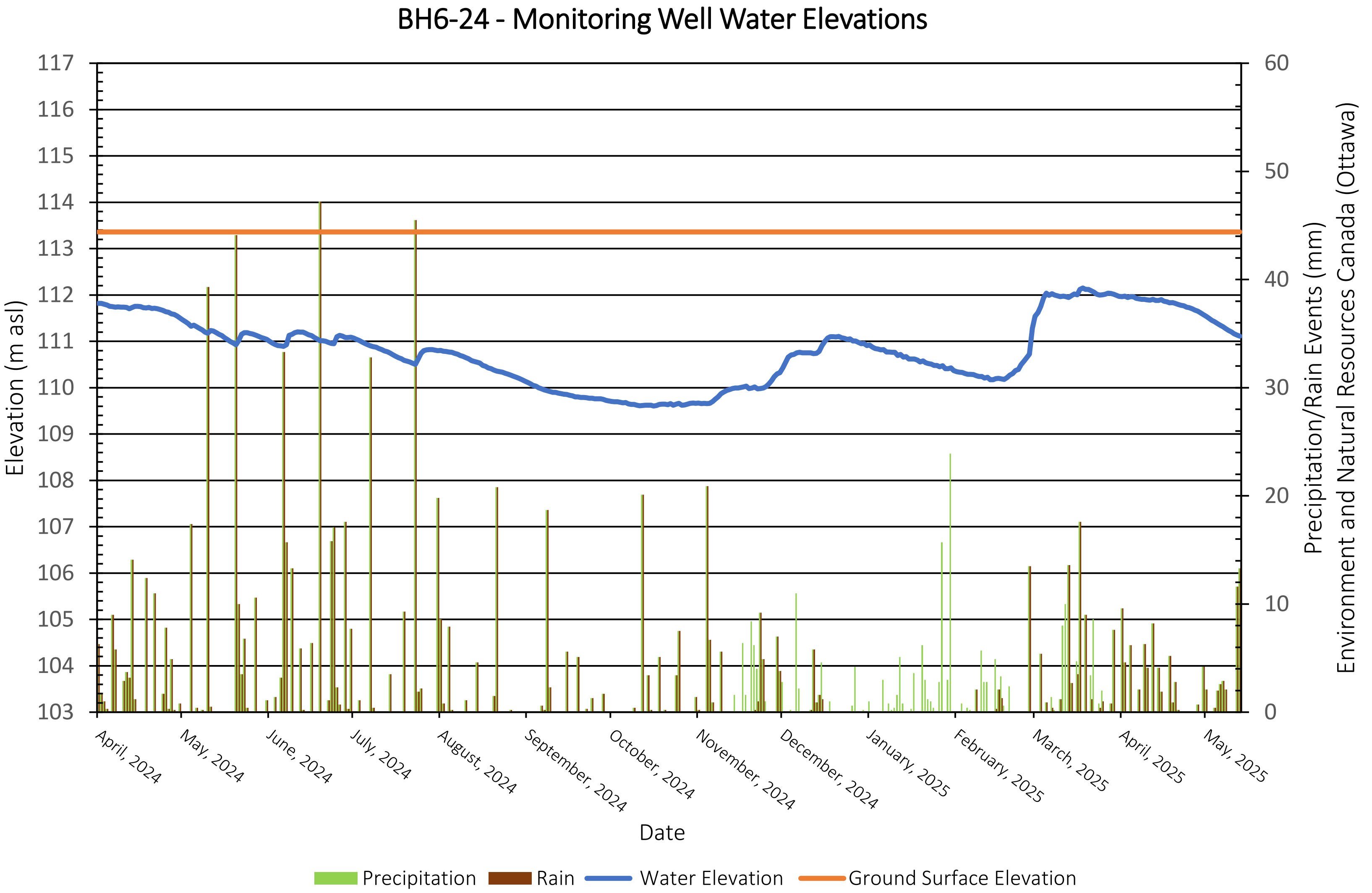
2436091 Ontario Ltd.
800 Cedarview Road
Ottawa, Ontario



PATERSON GROUP

File: PH4872

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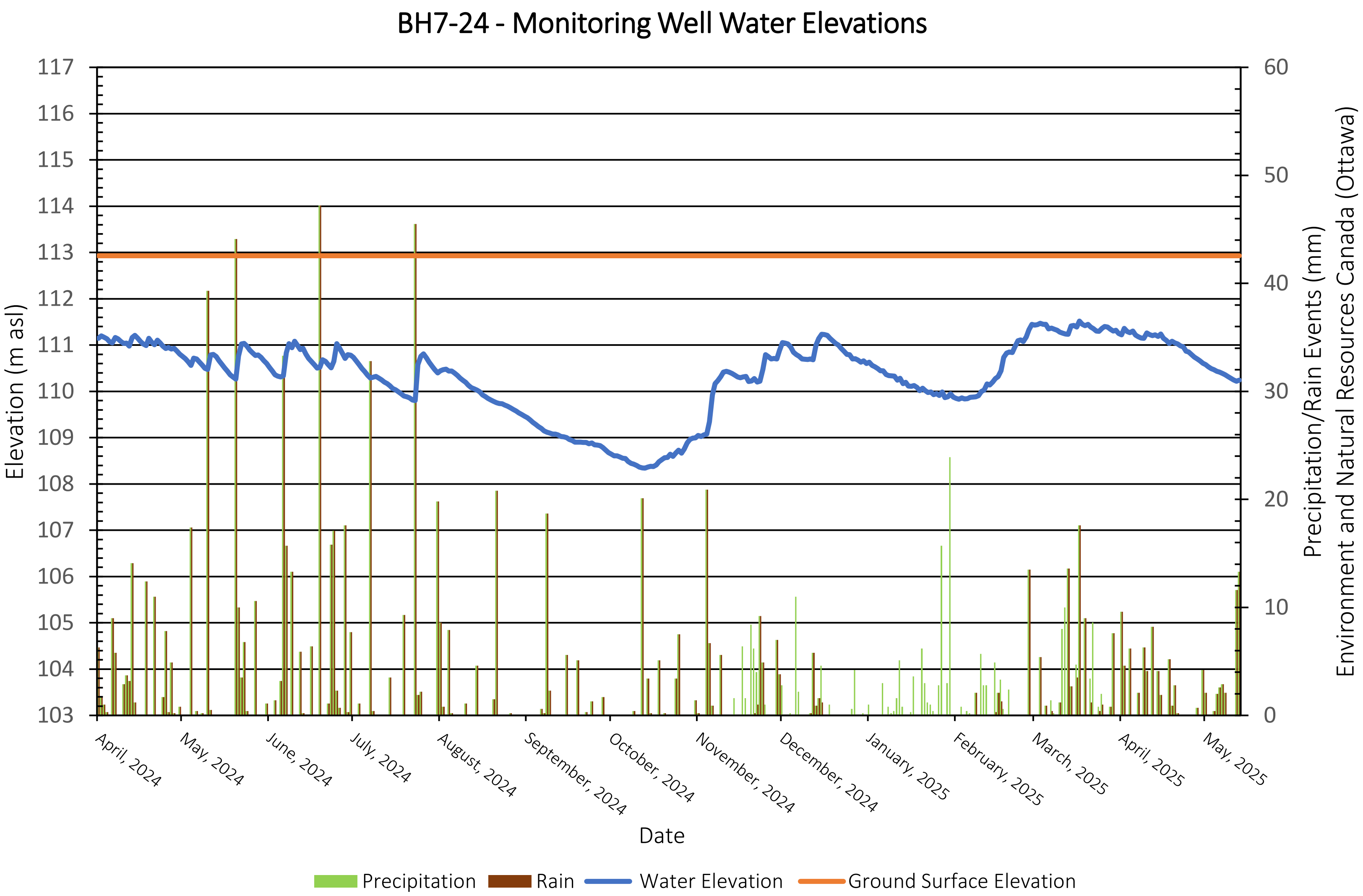
800 Cedarview Road
Ottawa, Ontario



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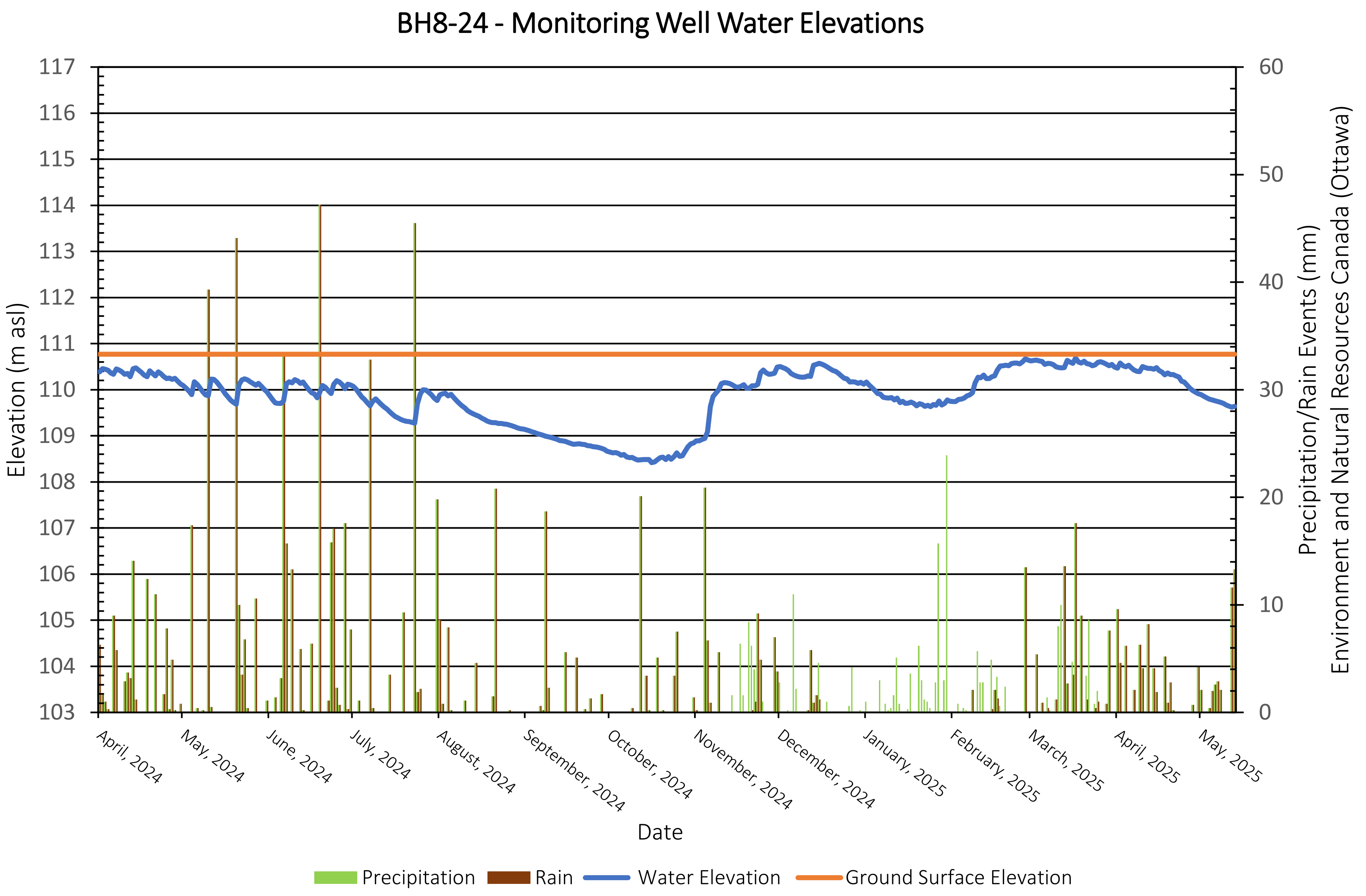
BH8-24 - Monitoring Well Water Elevations
Elevation (m asl)
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106
105
104
103
Precipitation/Rain Events (mm)
Environment and Natural Resources Canada (Ottawa)
60
50
40
30
20
10
0
April, 2024
May, 2024
June, 2024
July, 2024
August, 2024
September, 2024
October, 2024
November, 2024
December, 2024
January, 2025
February, 2025
March, 2025
April, 2025
May, 2025
Date
Precipitation
Rain
Water Elevation
Ground Surface Elevation

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

DRAWING PG5600-1 - TEST HOLE LOCATION PLAN

patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

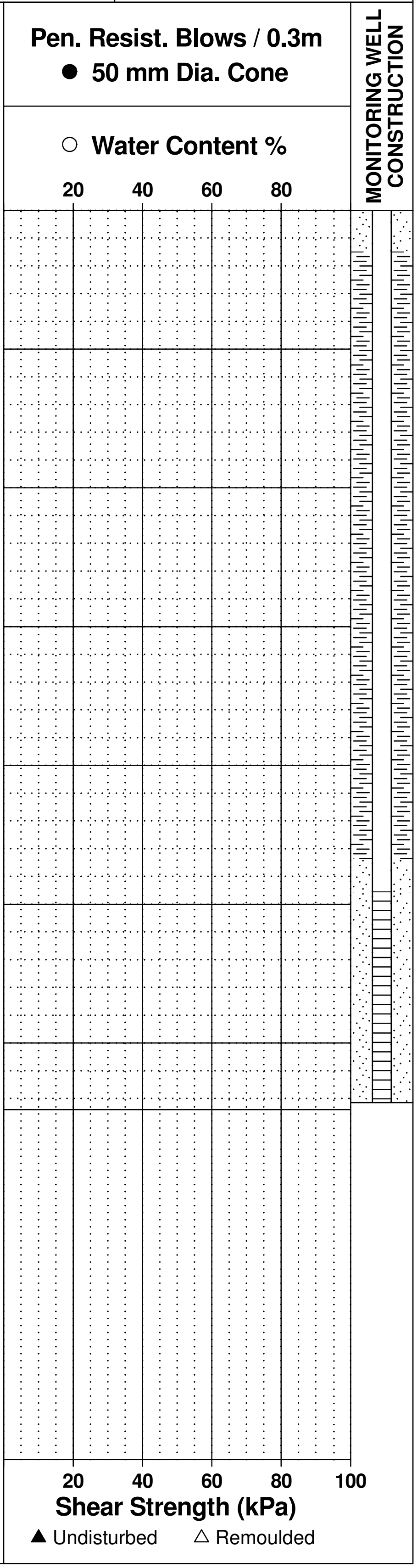
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 360042.722 **NORTHING:** 5015631.119 **ELEVATION:** 104.96
DATUM: Geodetic
REMARKS:
BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** March 27, 2024

FILE NO. PG5600
HOLE NO. BH 1-24

SAMPLE DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	104.96
TOPSOIL with organics	0.28						
GLACIAL TILL: Compact, brown silty sand to sandy silt with clay and gravel, occasional cobbles		AU	1				
		SS	2	100	8	1	103.96
	2.21	SS	3	50	14	2	102.96
GLACIAL TILL: Compact to dense, grey silty sand with gravel - cobble and boulder content increases with depth		SS	4	100	28	3	101.96
	3.30	SS	5	80	+50		
BEDROCK: Fair quality, grey limestone bedrock - good to excellent quality by 3.6m depth		RC	1	100	60	4	100.96
		RC	2	100	100	5	99.96
	6.48	RC	3	100	100	6	98.96
End of Borehole							



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359831.302 **NORTHING:** 5015735.647 **ELEVATION:** 108.74

DATUM: Geodetic

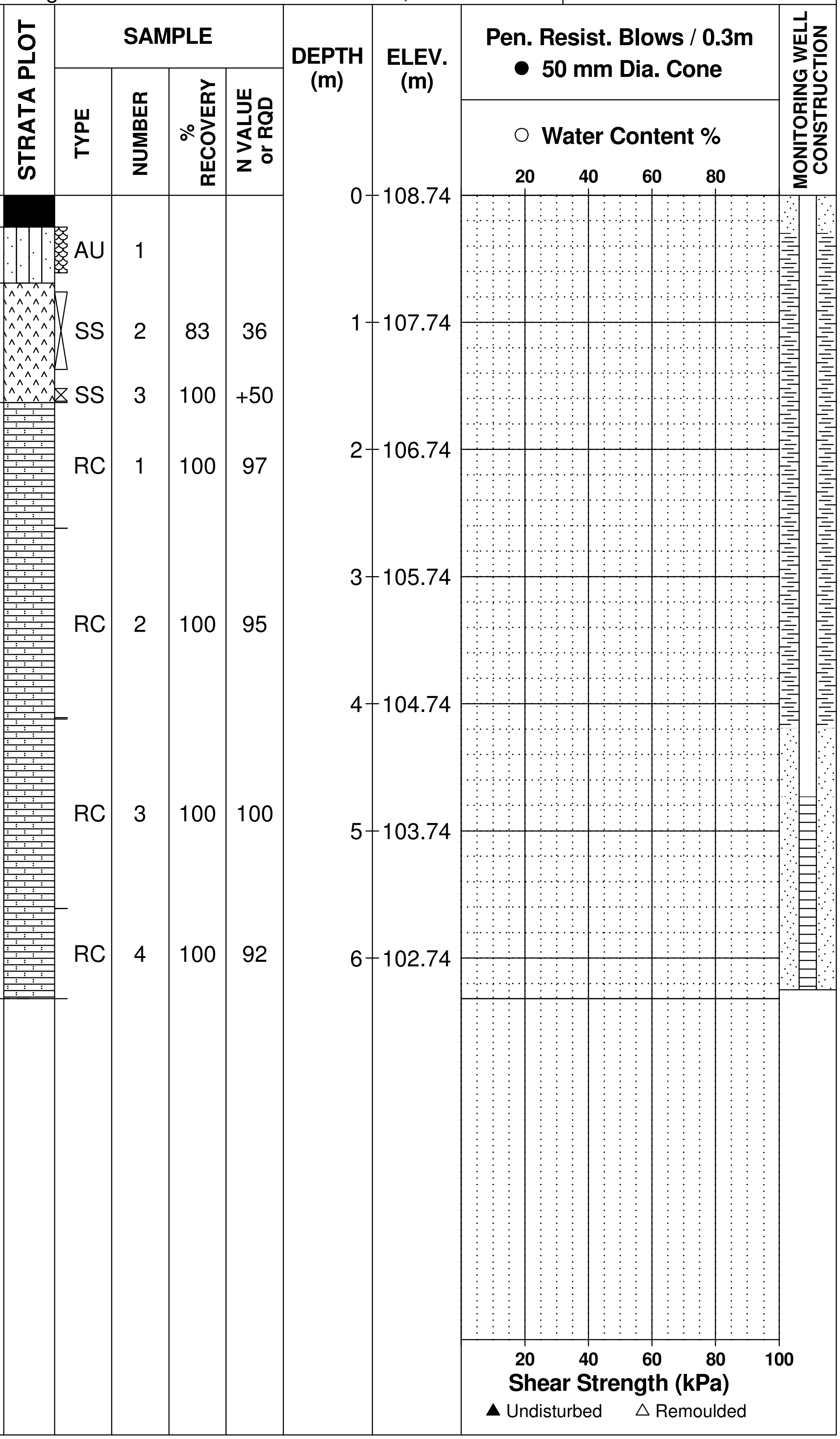
REMARKS:

BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** March 27, 2024

FILE NO. PG5600

HOLE NO. BH 2-24

SAMPLE DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.74
TOPSOIL with organics	0.25						
Compact, brown **SILTY SAND**	0.69	AU	1				
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders		SS	2	83	36	1	107.74
	1.63	SS	3	100	+50		
BEDROCK: Excellent quality, grey limestone bedrock		RC	1	100	97	2	106.74
		RC	2	100	95	3	105.74
		RC	3	100	100	4	104.74
						5	103.74
	6.32	RC	4	100	92	6	102.74
End of Borehole							



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

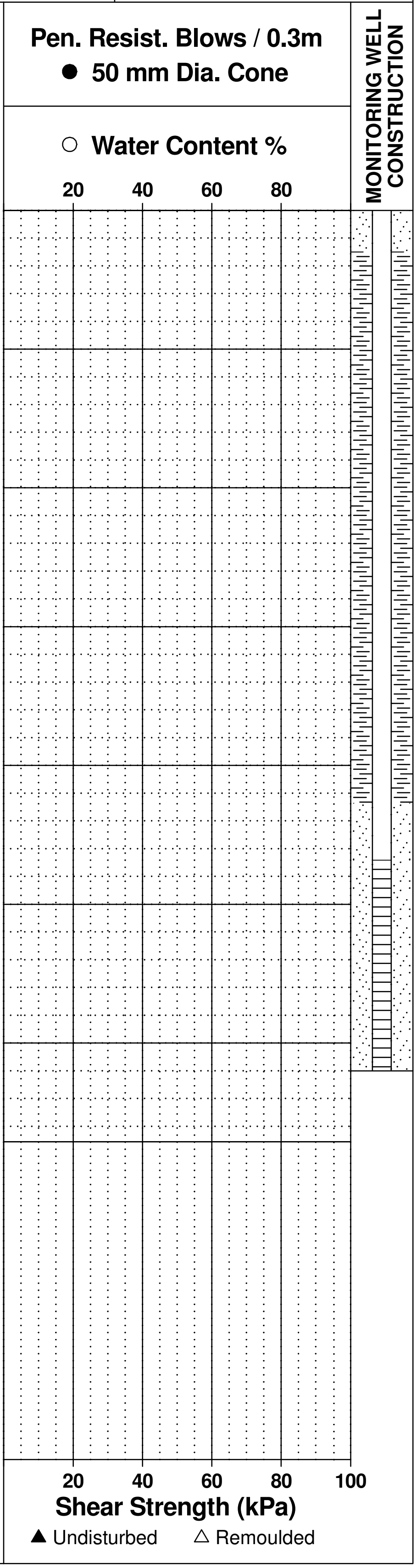
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359838.455 **NORTHING:** 5015502.999 **ELEVATION:** 110.78
DATUM: Geodetic
REMARKS:
BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** March 27, 2024

FILE NO. PG5600
HOLE NO. BH 3-24

SAMPLE DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	110.78
TOPSOIL with organics 0.28						
FILL: Brown silty sand to sandy silt with clay 0.69	AU	1				
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, cobbles and boulders	SS	2	62	+50	1	109.78
	RC	1	32		2	108.78
					3	107.78
	RC	2	29			
					4	106.78
- grey by 4.1m depth	SS	3	55	+50		
	SS	4	80	+50		
					5	105.78
					6	104.78
6.32	SS	5	0	+50		
End of Borehole						



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359856.182 **NORTHING:** 5015913.238 **ELEVATION:** 109.95

DATUM: Geodetic

REMARKS:

BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** March 28, 2024

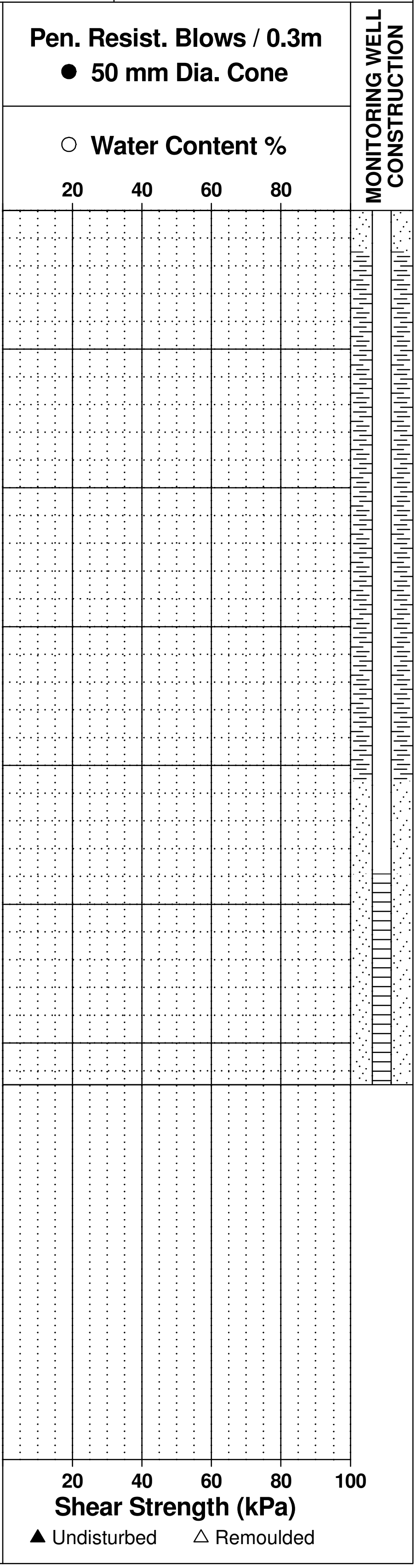
FILE NO. PG5600

HOLE NO. BH 4-24

SAMPLE DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL with organics	0.25
Brown **SILTY SAND**, trace gravel	0.69
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders	0.86
BEDROCK: Excellent quality, grey limestone bedrock - fair to good quality from 1.4m to 2.3m depth	6.30
End of Borehole	

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	0	+50
RC	1	100	100
RC	2	100	64
RC	3	100	86
RC	4	100	100
RC	5	100	100

DEPTH (m)	ELEV. (m)
0	109.95
1	108.95
2	107.95
3	106.95
4	105.95
5	104.95
6	103.95



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359634.713 **NORTHING:** 5015846.98 **ELEVATION:** 116.50

DATUM: Geodetic

REMARKS:

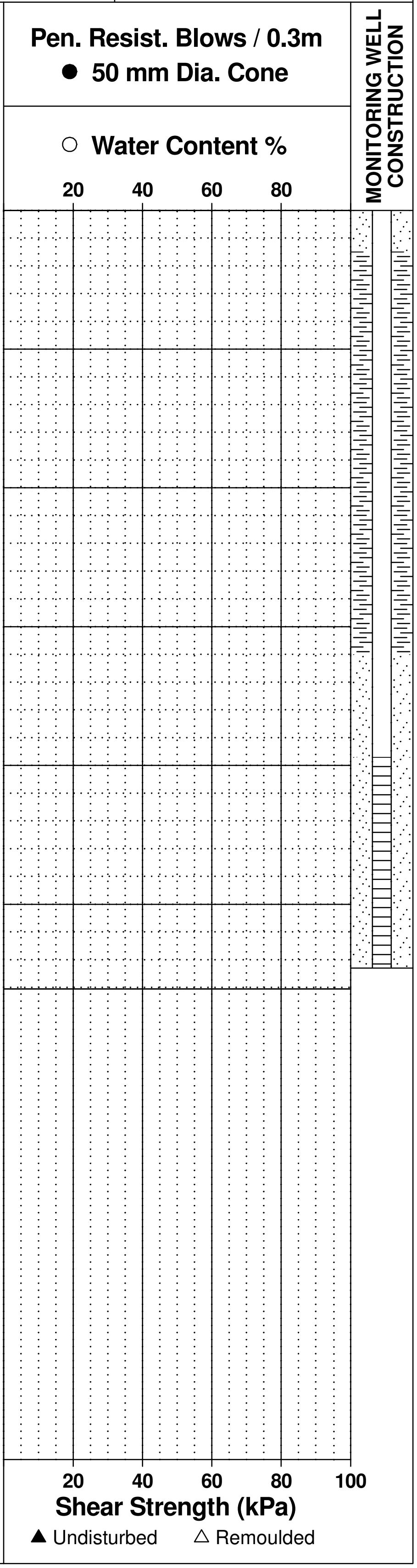
BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** March 28, 2024

FILE NO. PG5600

HOLE NO. BH 5-24

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL with organics 0.05					
FILL: Brown silty clay, trace topsoil and organics		AU	1		
		SS	2	58	6
1.45					
FILL: Brown silty clay with gravel, trace sand, wood and organics		SS	3	50	11
2.21					
FILL: Brown silty clay with sand, gravel and cobbles, trace organics and crushed stone		SS	4	100	+50
2.97					
FILL: Brown silty sand with gravel, cobbles and boulders, trace crushed stone		SS	5	50	39
		SS	6	60	+50
		SS	7	80	+50
5.61					
End of Borehole Practical refusal to augering at 5.61m depth					

DEPTH (m)	ELEV. (m)
0	116.50
1	115.50
2	114.50
3	113.50
4	112.50
5	111.50



SOIL PROFILE AND TEST DATA

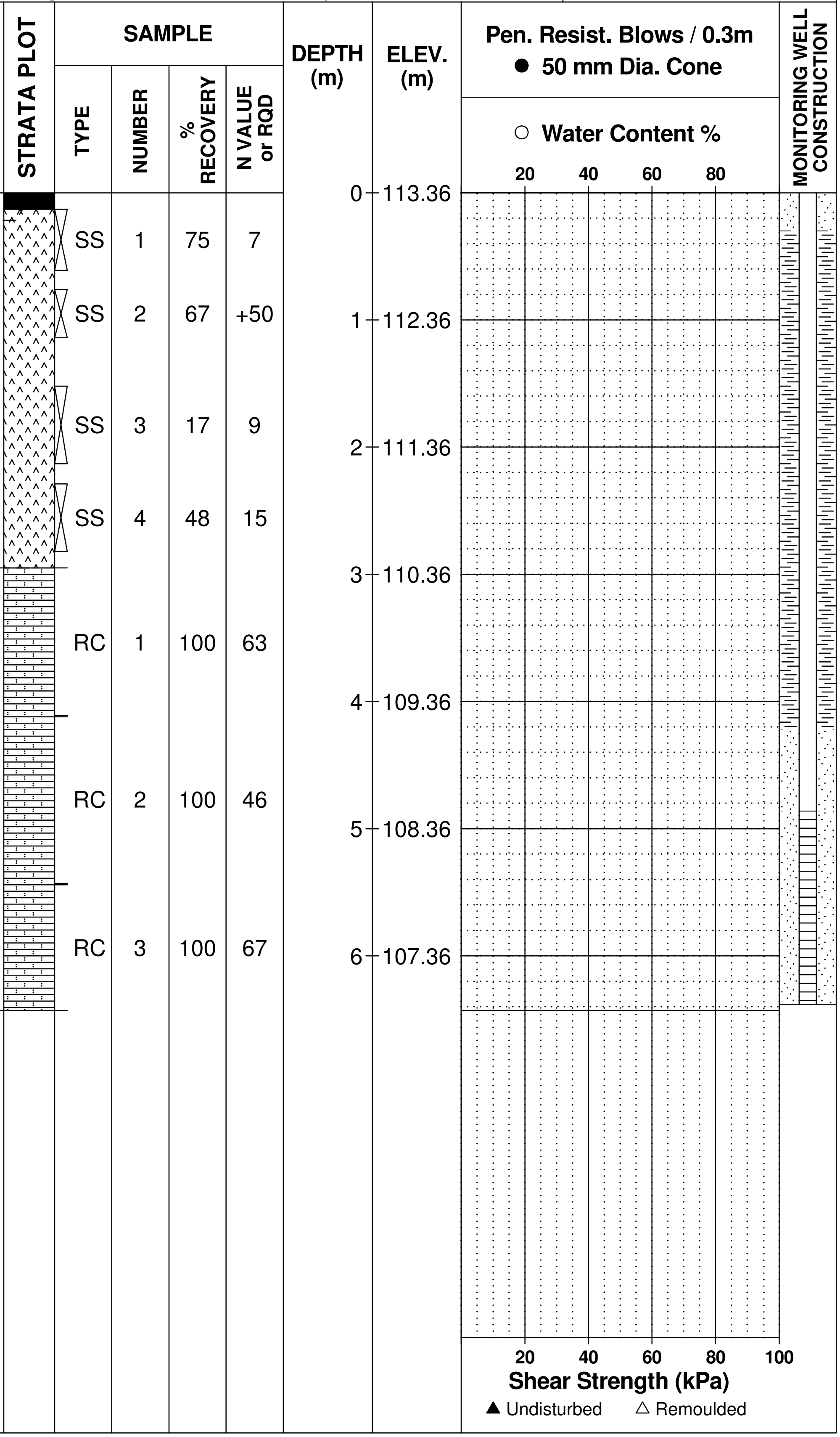
Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359420.374 **NORTHING:** 5016406.742 **ELEVATION:** 113.36
DATUM: Geodetic
REMARKS:
BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** April 1, 2024

FILE NO. PG5600
HOLE NO. BH 6-24

SAMPLE DESCRIPTION		SAMPLE			
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD
TOPSOIL with organics	0.13				
GLACIAL TILL: Compact, brown silty sand with gravel, trace clay, occasional cobbles - very dense from 0.8m to 1.5m depth - boulder content increases with depth		SS	1	75	7
		SS	2	67	+50
		SS	3	17	9
	2.95	SS	4	48	15
BEDROCK: Fair quality, grey limestone bedrock		RC	1	100	63
		RC	2	100	46
	6.43	RC	3	100	67
End of Borehole					

DEPTH (m)	ELEV. (m)
0	113.36
1	112.36
2	111.36
3	110.36
4	109.36
5	108.36
6	107.36



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359561.736 **NORTHING:** 5016749.605 **ELEVATION:** 112.93

DATUM: Geodetic

REMARKS:

BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** April 1, 2024

FILE NO. PG5600

HOLE NO. BH 7-24

SAMPLE DESCRIPTION

GROUND SURFACE

SAMPLE DESCRIPTION	Depth to base (m)
TOPSOIL with organics	0.20
GLACIAL TILL: Very dense, brown silty sand with gravel and cobbles	0.28
BEDROCK: Fair to good quality, grey sandstone bedrock - vertical fractures from 0.8m to 1.1m depth and from 1.3m to 2.1m depth	4.17
BEDROCK: Good to excellent quality, grey limestone bedrock	6.15
End of Borehole	

SAMPLE

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	50	+50
RC	1	100	42
RC	2	100	81
RC	3	100	90
RC	4	100	64
RC	5	100	94

DEPTH (m)	ELEV. (m)
0	112.93
1	111.93
2	110.93
3	109.93
4	108.93
5	107.93
6	106.93

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

○ **Water Content %**

20 40 60 80

MONITORING WELL CONSTRUCTION

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Dev. - 800 Cedarview Road
Ottawa, Ontario

EASTING: 359686.062 **NORTHING:** 5016930.791 **ELEVATION:** 110.77

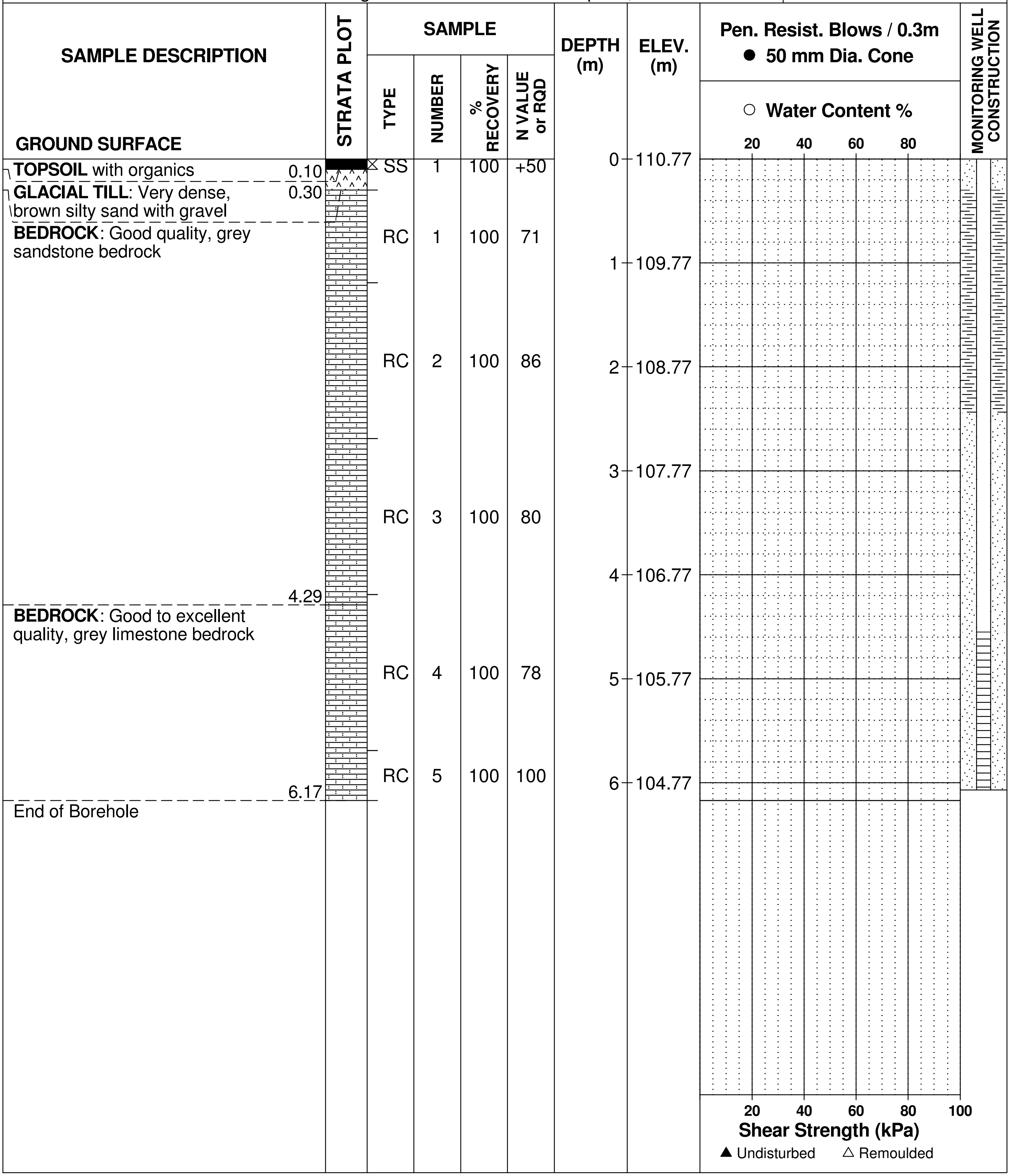
DATUM: Geodetic

REMARKS:

BORINGS BY: CME 55 Mechanical Earth Auger on Track **DATE:** April 1, 2024

FILE NO. PG5600

HOLE NO. BH 8-24



SAMPLE DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL with organics	0.10
GLACIAL TILL: Very dense, brown silty sand with gravel	0.30
BEDROCK: Good quality, grey sandstone bedrock	4.29
BEDROCK: Good to excellent quality, grey limestone bedrock	6.17
End of Borehole	

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	+50
RC	1	100	71
RC	2	100	86
RC	3	100	80
RC	4	100	78
RC	5	100	100

DEPTH (m)	ELEV. (m)
0	110.77
1	109.77
2	108.77
3	107.77
4	106.77
5	105.77
6	104.77

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 1-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE								20 40 60 80	
TOPSOIL 0.10	■	G	1			0	112.09		
End of Test Pit TP terminated on bedrock surface at 0.10m depth. (TP dry upon completion)									
								20 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded	

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 2-20

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	113.06		
TOPSOIL 0.20		G	1						
GLACIAL TILL: Compact, brown sandy silt, trace gravel and cobbles 1.20		G	2			1	112.06		
End of Test Pit TP terminated on bedrock surface at 1.20m depth. (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

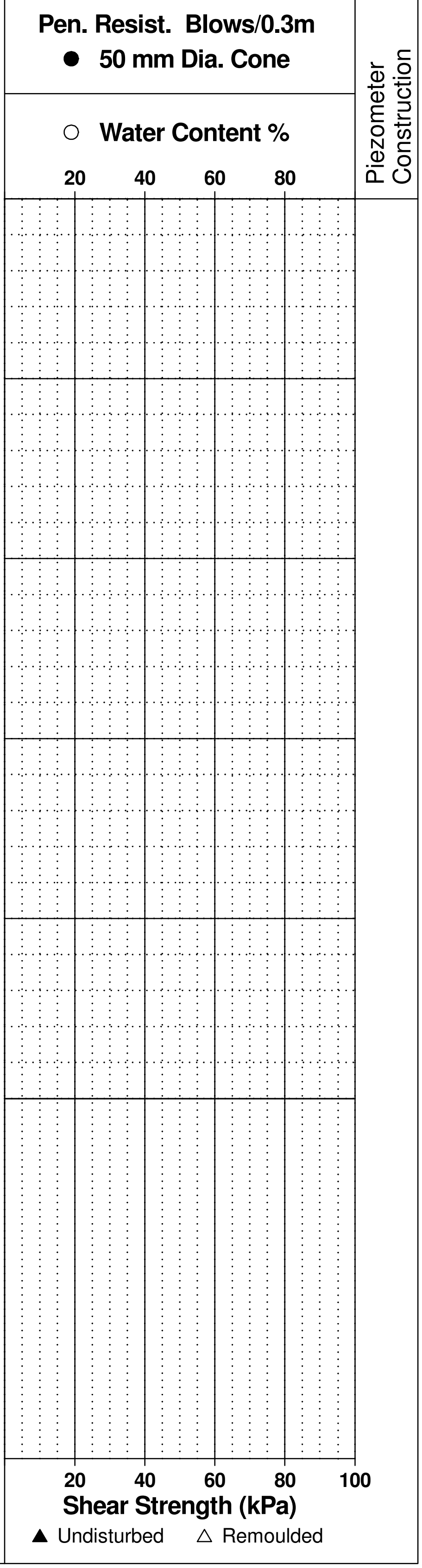
BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 3-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	113.39
FILL: Brown silty clay, trace sand, gravel, cobbles and roots	▨	G	1				
						1	112.39
		G	2			2	111.39
						3	110.39
4.00						4	109.39
TOPSOIL 4.30	■	G	3				
Firm, brown **CLAYEY SILTY FINE SAND** 5.00	▨	G	4			5	108.39
End of Test Pit TP terminated on bedrock surface at 5.300m depth. (TP dry upon completion)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5600

REMARKS

HOLE NO. TP 4-20

BORINGS BY Excavator

DATE December 2, 2020

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	113.64		
TOPSOIL 0.30	■	G	1						
Weathered **BEDROCK** 1.30	▤	G	2			1	112.64		
End of Test Pit (TP dry upon completion)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 5-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	119.76
FILL: Brown silty clay, trace sand, gravel, roots and concrete		G	1				
						1	118.76
		G	2			2	117.76
						3	116.76
						4	115.76
4.30							
TOPSOIL		G	3				
4.50							
GLACIAL TILL: Compact, brown sandy silt, trace gravel		G	4				
						5	114.76
5.30							
End of Test Pit TP terminated on bedrock surface at 5.30m depth. (TP dry upon completion)							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 6-20

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	111.27		
FILL: Dark brown silty clay , trace gravel 0.40		G	1						
Compact, brown **SILTY SAND,** some gravel 0.70		G	2						
GLACIAL TILL: Brown clayey silty fine sand, some gravel 1.10		G	3			1	110.27		
End of Test Pit TP terminated on bedrock surface at 1.10m depth. (TP dry upon completion)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 7-20

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 0.15	■	G	1			0	111.20		
End of Test Pit TP terminated on bedrock surface at 0.15m depth. (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 8-20

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	109.81		
TOPSOIL 0.30	■	G	1						∇
Compact, brown **SILTY SAND** 0.70	⋮	G	2						
End of Test Pit TP terminated on bedrock surface at 0.70m depth. (Groundwater infiltration at 0.3m depth)									

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP 9-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.30		G	1		
GLACIAL TILL: Dense, brown silty sand, some clay, trace gravel, occational cobbles and boulders		G	2		
		G	3		
3.50					

DEPTH (m)	ELEV. (m)
0	104.82
1	103.82
2	102.82
3	101.82

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

Piezometer Construction

▽

End of Test Pit

TP terminated on bedrock surface at 3.50m depth.

(Groundwater infiltration at 2.5m depth)

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG5600**

REMARKS

HOLE NO. **TP10-20**

BORINGS BY Excavator

DATE December 2, 2020

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
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
TOPSOIL 0.20	■	G	1			0	115.84		
End of Test Pit TP terminated on bedrock surface at 0.20m depth. (TP dry upon completion)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP11-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	119.89
FILL: Brown silty sand, some gravel, cobbles and boulders, trace organics	▨	G	1				
						1	118.89
		G	2			2	117.89
						3	116.89
						4	115.89
		G	3			5	114.89
6.00						6	113.89
End of Test Pit (TP dry upon completion)							

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 2, 2020

FILE NO. PG5600

HOLE NO. TP12-20

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	115.44		
FILL: Brown silty clay, trace sand, gravel and organics, occasional cobbles and boulders	▨	G	1			1	114.44		
2.00	▨	G	2			2	113.44		
End of Test Pit TP terminated on bedrock surface at 2.00m depth. (TP dry upon completion)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 3, 2020

FILE NO. PG5600

HOLE NO. TP13-20

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	108.47		
TOPSOIL 0.40	■	G	1						
End of Test Pit TP terminated on bedrock surface at 0.40m depth. (TP dry upon completion)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 800 Cedarview Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE December 3, 2020

FILE NO. PG5600

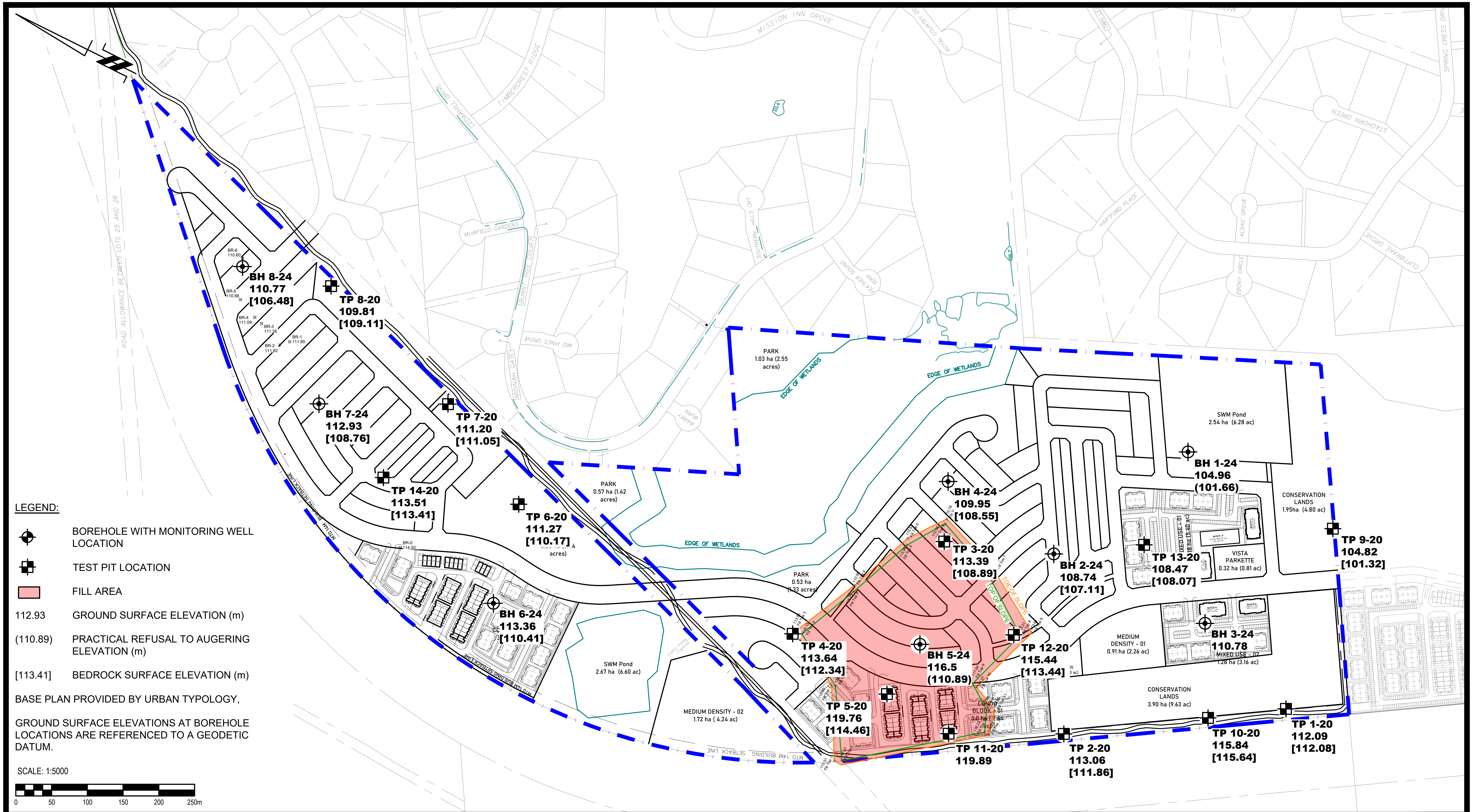
HOLE NO. TP14-20

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 0.10	■	G	1			0	113.51		
End of Test Pit TP terminated on bedrock surface at 0.10m depth. (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded



LEGEND:

⌖	BOREHOLE WITH MONITORING WELL LOCATION
▚	TEST PIT LOCATION
🟥	FILL AREA
112.93	GROUND SURFACE ELEVATION (m)
(110.89)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
[113.41]	BEDROCK SURFACE ELEVATION (m)

BASE PLAN PROVIDED BY URBAN TYPOLOGY,

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:5000

0 50 100 150 200 250m

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

NO.	REVISIONS	DATE	INITIAL
1	UPDATED BASE PLAN AND ADDED BOREHOLES BH 1-24 TO BH 8-24	04\10\2024\	SK

MATTAMY HOMES
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
800 CEDARVIEW ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:5000
Date: 12/2020
Drawn by: YA
Report No.: PG5600-1
Checked by: SK
Dwg. No.: PG5600-1
Approved by: KP
Revision No.: 1

11x17

p:\autocad drawings\geotechnical\pg56xx\pg5600\pg5600-1-test hole location plan (rev.01).dwg

APPENDIX 2

TABLE 7 - MONTHLY WATER BALANCE FOR SOIL WITH 75 mm WATER HOLDING CAPACITY AT THE OTTAWA INTERNATIONAL AIRPORT

TABLE 8 - MONTHLY WATER BALANCE FOR SOIL WITH 150 mm WATER HOLDING CAPACITY AT THE OTTAWA INTERNATIONAL AIRPORT

TABLE 9 - MONTHLY WATER BALANCE FOR SOIL WITH 250 mm WATER HOLDING CAPACITY AT THE OTTAWA INTERNATIONAL AIRPORT

TABLE 10 - MONTHLY WATER BALANCE FOR SOIL WITH 300 mm WATER HOLDING CAPACITY AT THE OTTAWA INTERNATIONAL AIRPORT

TABLE 11 - PRE-DEVELOPMENT ANNUAL WATER BUDGET FOR 800 CEDARVIEW DRIVE

TABLE 12 - POST-DEVELOPMENT ANNUAL WATER BUDGET FOR 800 CEDARVIEW DRIVE

Table 7 - Monthly Water Balance for Soil With 75 mm Water Holding Capacity at the Ottawa International Airport

Month	Temperature (°C)	Total Precipitation (mm)	Actual Evapotranspiration (mm)	Water Surplus (mm)
January	-10.6	62	0	25
February	-9	56	1	26
March	-2.8	65	6	103
April	5.7	73	31	110
May	13.1	75	80	14
June	18.3	85	107	4
July	20.9	88	104	3
August	19.7	85	84	1
September	14.8	82	65	3
October	8.3	77	36	14
November	1.3	76	10	38
December	-6.8	79	1	37
Annual	**6**	**904**	**525**	**378**

Table 8 - Monthly Water Balance for Soil With 150 mm Water Holding Capacity at the Ottawa International Airport

Month	Temperature (°C)	Total Precipitation (mm)	Actual Evapotranspiration (mm)	Water Surplus (mm)
January	-10.6	62	0	21
February	-9	56	1	24
March	-2.8	65	6	99
April	5.7	73	31	109
May	13.1	75	80	14
June	18.3	85	116	4
July	20.9	88	127	3
August	19.7	85	98	1
September	14.8	82	68	2
October	8.3	77	36	7
November	1.3	76	10	20
December	-6.8	79	1	25
Annual	**6**	**904**	**574**	**329**

Table 9 - Monthly Water Balance for Soil With 250 mm Water Holding Capacity at the Ottawa International Airport

Month	Temperature (°C)	Total Precipitation (mm)	Actual Evapotranspiration (mm)	Water Surplus (mm)
January	-10.6	62	0	18
February	-9	56	1	22
March	-2.8	65	6	92
April	5.7	73	31	107
May	13.1	75	80	14
June	18.3	85	116	4
July	20.9	88	135	3
August	19.7	85	111	1
September	14.8	82	72	2
October	8.3	77	37	6
November	1.3	76	10	16
December	-6.8	79	1	19
Annual	**6**	**904**	**600**	**304**

Table 10 - Monthly Water Balance for Soil With 300 mm Water Holding Capacity at the Ottawa International Airport				
Month	**Temperature (℃)**	**Total Precipitation (mm)**	**Actual Evapotranspiration (mm)**	**Water Surplus (mm)**
January	-10.6	62	0	17
February	-9	56	1	21
March	-2.8	65	6	91
April	5.7	73	31	105
May	13.1	75	80	14
June	18.3	85	116	4
July	20.9	88	136	3
August	19.7	85	114	1
September	14.8	82	73	2
October	8.3	77	37	6
November	1.3	76	10	16
December	-6.8	79	1	18
Annual	**6**	**904**	**605**	**298**

Table 11 - Pre-Development Annual Water Budget Calculations

Land Use Unit	Area (m^2)	Water Surplus (mm)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Runoff Factor	Total Infiltration (mm/year)	Total Infiltration (L/year)	Total Runoff (mm/year)	Total Runoff (L/year)
Fine Sandy Loam (Pasture and Shrubs)	20,983	329	0.15	0.3	0.1	0.55	0.45	181	3,796,934	148	3,106,582
Clay Loam (Pasture and Shrubs)	77,500	304	0.15	0.2	0.1	0.45	0.55	137	10,602,000	167	12,958,000
Fine Sandy Loam (Mature Forest)	539,197	298	0.15	0.3	0.2	0.65	0.35	194	104,442,362	104	56,238,195
Surface Water Features	82,226	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	**719,906**								**118,841,296**		**72,302,777**

Table 12 - Post-Development Annual Water Budget Calculations

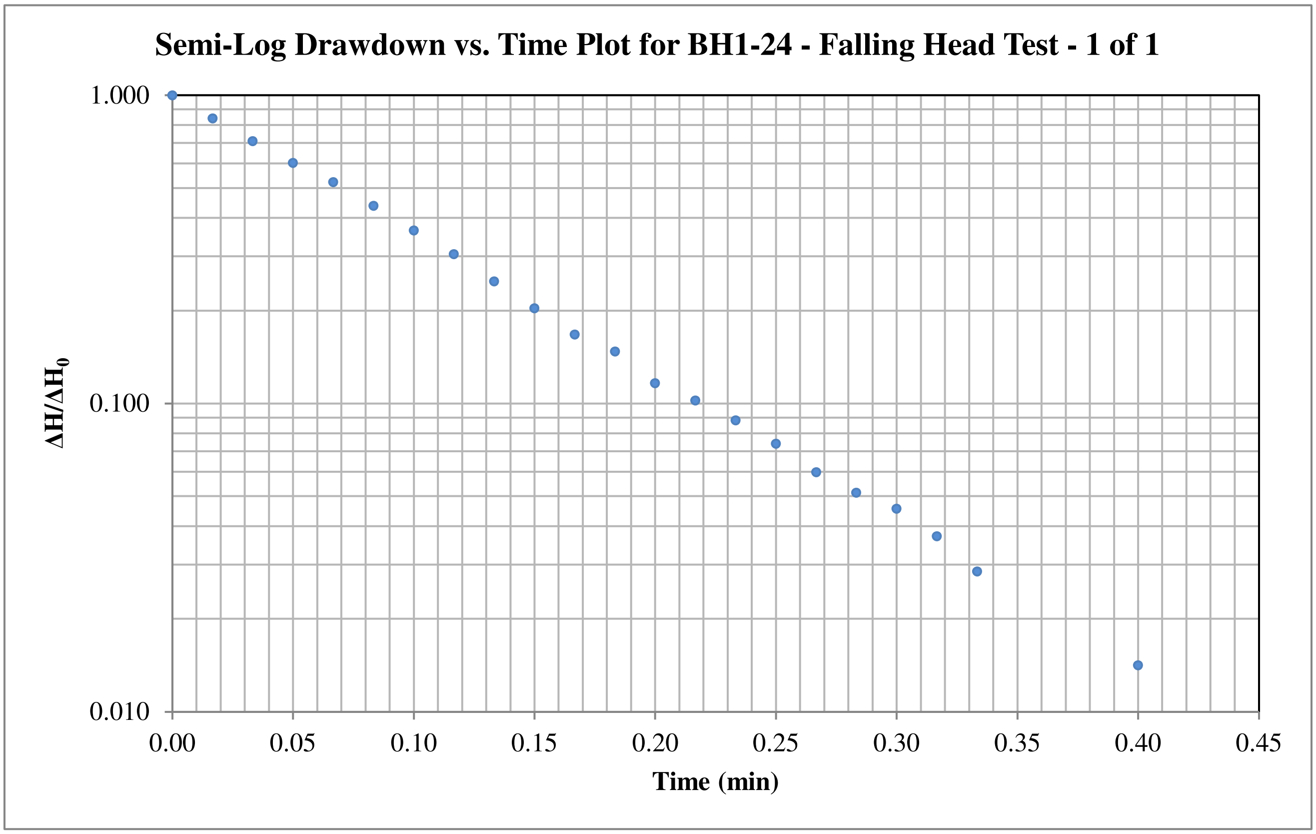
Land Use Unit	Area (m^2)	Water Surplus (mm)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Runoff Factor	Total Infiltration (mm/year)	Total Infiltration (L/year)	Total Runoff (mm/year)	Total Runoff (L/year)
Impervious Surfaces	355,248	759	N/A	N/A	N/A	0	1	0	0	759	269,761,007
Fine Sandy Loam (Urban Lawn)	142,446	378	0.15	0.3	0.1	0.55	0.45	208	29,614,451	170	24,230,005
Fine Sandy Loam (Pasture and Shrubs)	2,648	329	0.15	0.3	0.1	0.55	0.45	181	479,199	148	392,072
Clay Loam (Pasture and Shrubs)	1,658	304	0.15	0.2	0.1	0.45	0.55	137	226,821	167	277,226
Fine Sandy Loam (Mature Forest)	100,699	298	0.15	0.3	0.2	0.65	0.35	194	19,505,398	104	10,502,907
Surface Water Features	65,487	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Storm Water Management Ponds	51,720	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	**719,906**								**49,825,869**		**305,163,217**
Difference (L/year)									**-69,015,426**		**232,860,440**
Percentage Variation									**-58%**		**322%**

APPENDIX 3

HYDRAULIC CONDUCTIVITY RESULTS - FALLING & RISING HEAD TESTS

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH1-24
Test: Falling Head - 1 of 1
Date: April 17, 2024



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: 2.07207

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.03175 m	Diameter of well
r_c	0.01588 m	Radius of well

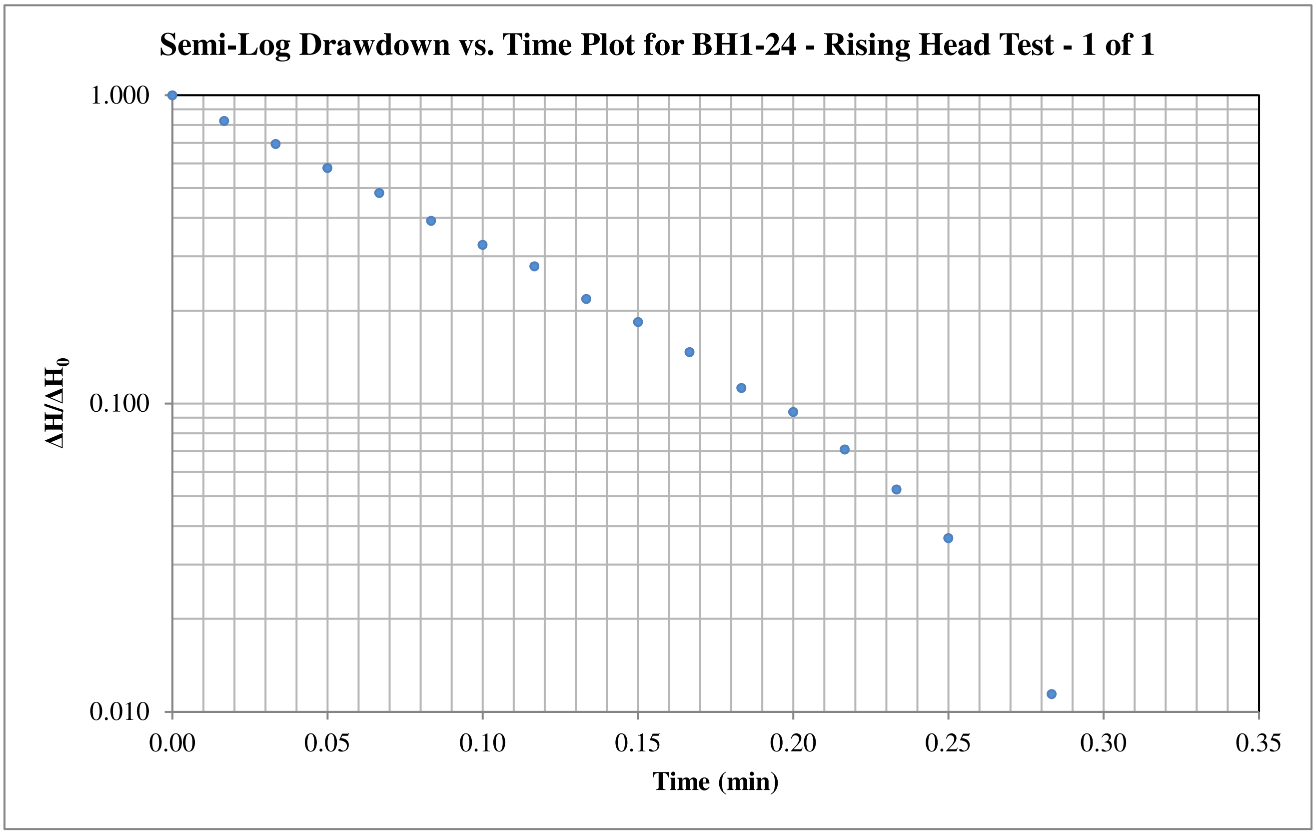
Data Points (from plot):

t^*: 0.099 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 6.41E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH1-24
Test: Rising Head - 1 of 1
Date: April 17, 2024



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: 2.07207

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.03175 m	Diameter of well
r_c	0.01588 m	Radius of well

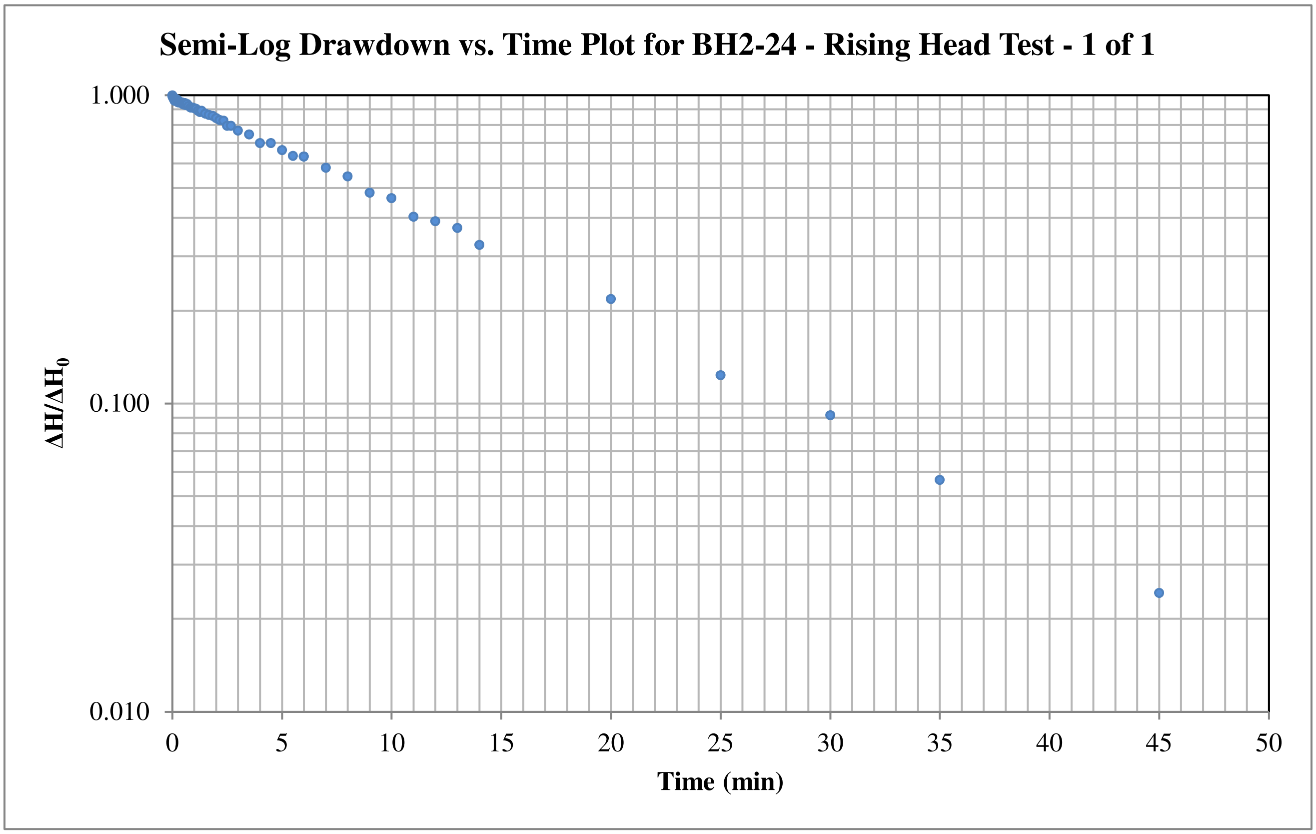
Data Points (from plot):

t*: 0.089 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 7.12E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH2-24
Test: Rising Head - 1 of 1
Date: April 17, 2024



Hvorslev Horizontal Hydraulic Conductivity

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

Hvorslev Shape Factor

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

Valid for L>>D

Hvorslev Shape Factor F: 2.07207

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.03175	m	Diameter of well
r_c	0.01588	m	Radius of well

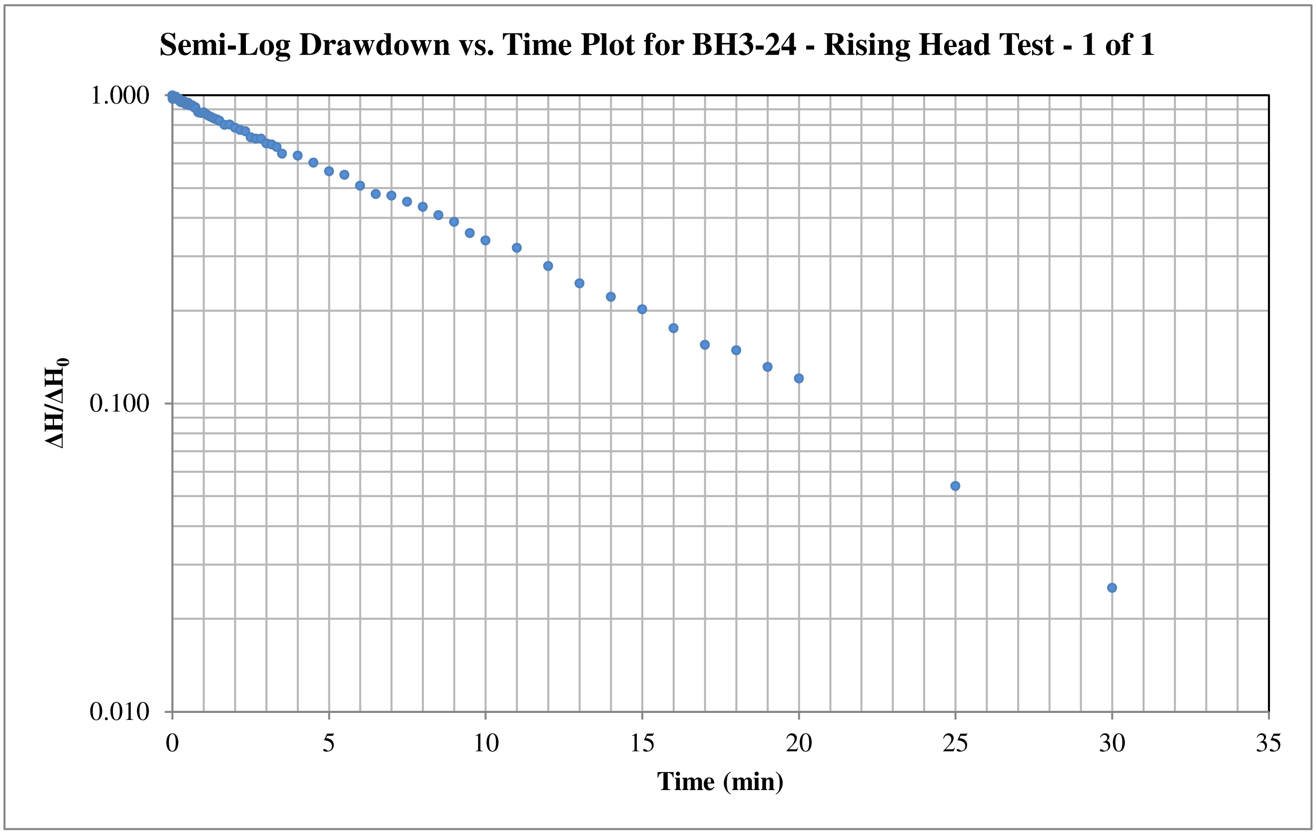
Data Points (from plot):

t*: 12.694 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.99E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH3-24
Test: Rising Head - 1 of 1
Date: April 15, 2024



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

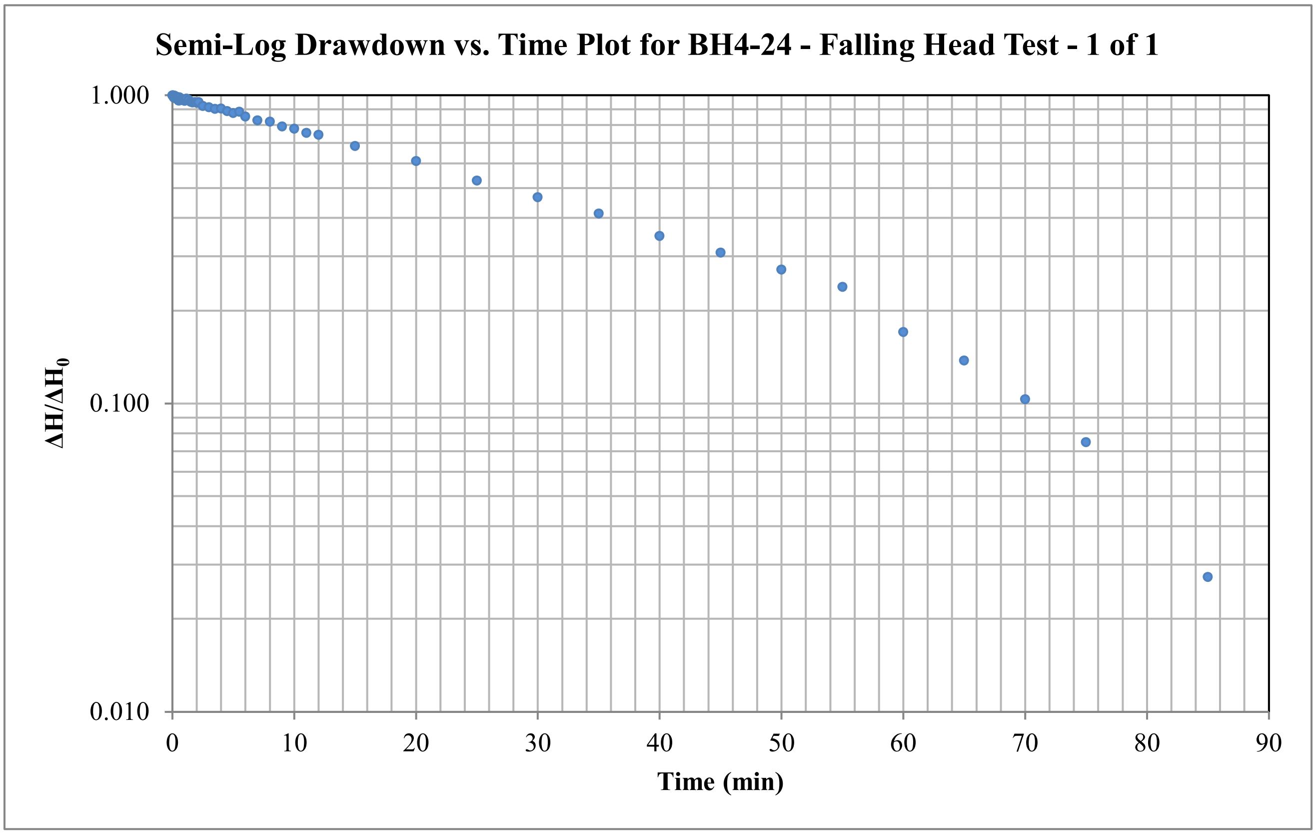
Data Points (from plot):

t^*: 9.065 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.60E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH4-24
Test: Falling Head - 1 of 1
Date: April 17, 2024



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: 2.07207

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.03175 m	Diameter of well
r_c	0.01588 m	Radius of well

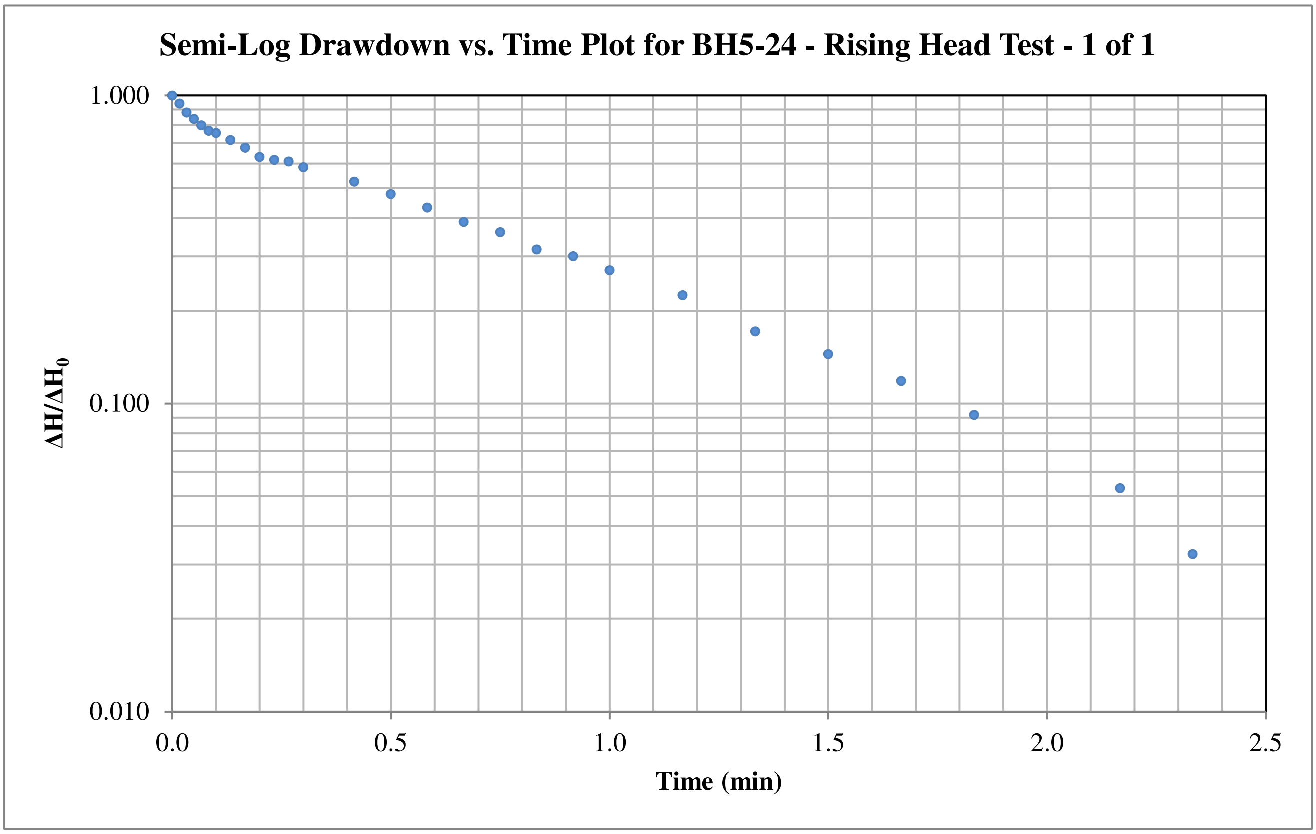
Data Points (from plot):

t*: 38.419 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.65E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH5-24
Test: Rising Head - 1 of 1
Date: April 17, 2024



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: 1.99182

Well Parameters:

L	1.23	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

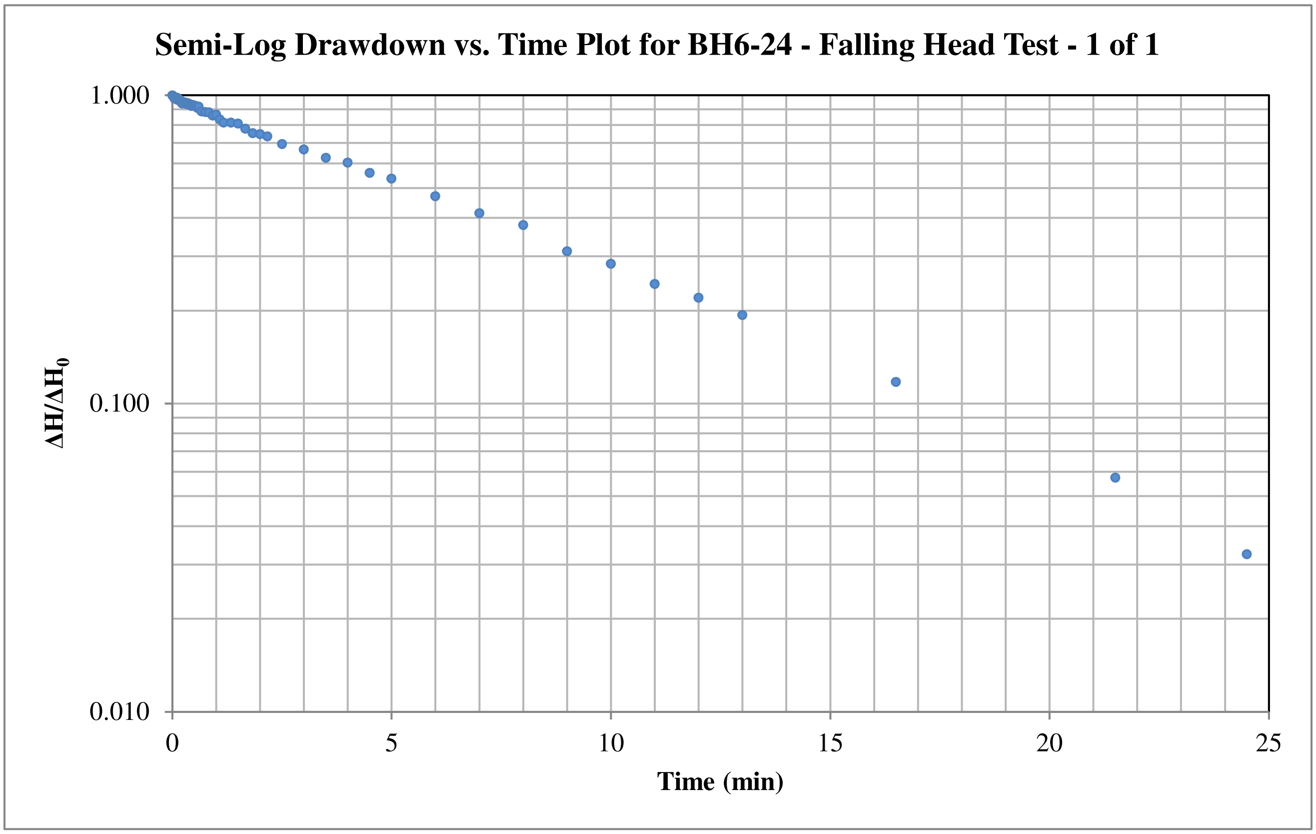
Data Points (from plot):

t*: 0.725 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 2.32E-05 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH6-24
Test: Falling Head - 1 of 1
Date: April 15, 2024



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: 2.07207

Well Parameters:

L	1.5 m	Saturated length of screen or open hole
D	0.03175 m	Diameter of well
r_c	0.01588 m	Radius of well

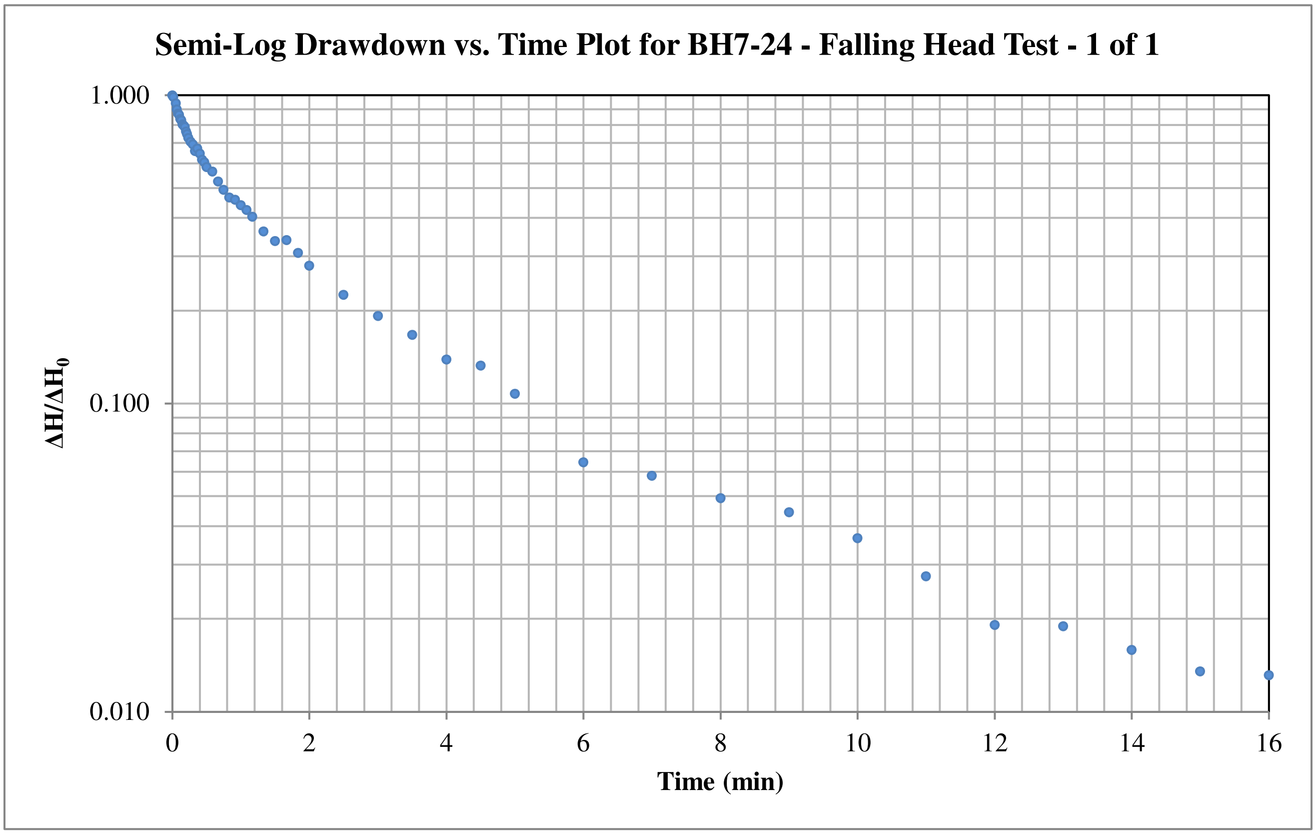
Data Points (from plot):

t*: 8.012 minutes ΔH*/ΔH_0: 0.37

Horizontal Hydraulic Conductivity
K = 7.90E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH7-24
Test: Falling Head - 1 of 1
Date: April 15, 2024



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: 2.07207

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.03175	m	Diameter of well
r_c	0.01588	m	Radius of well

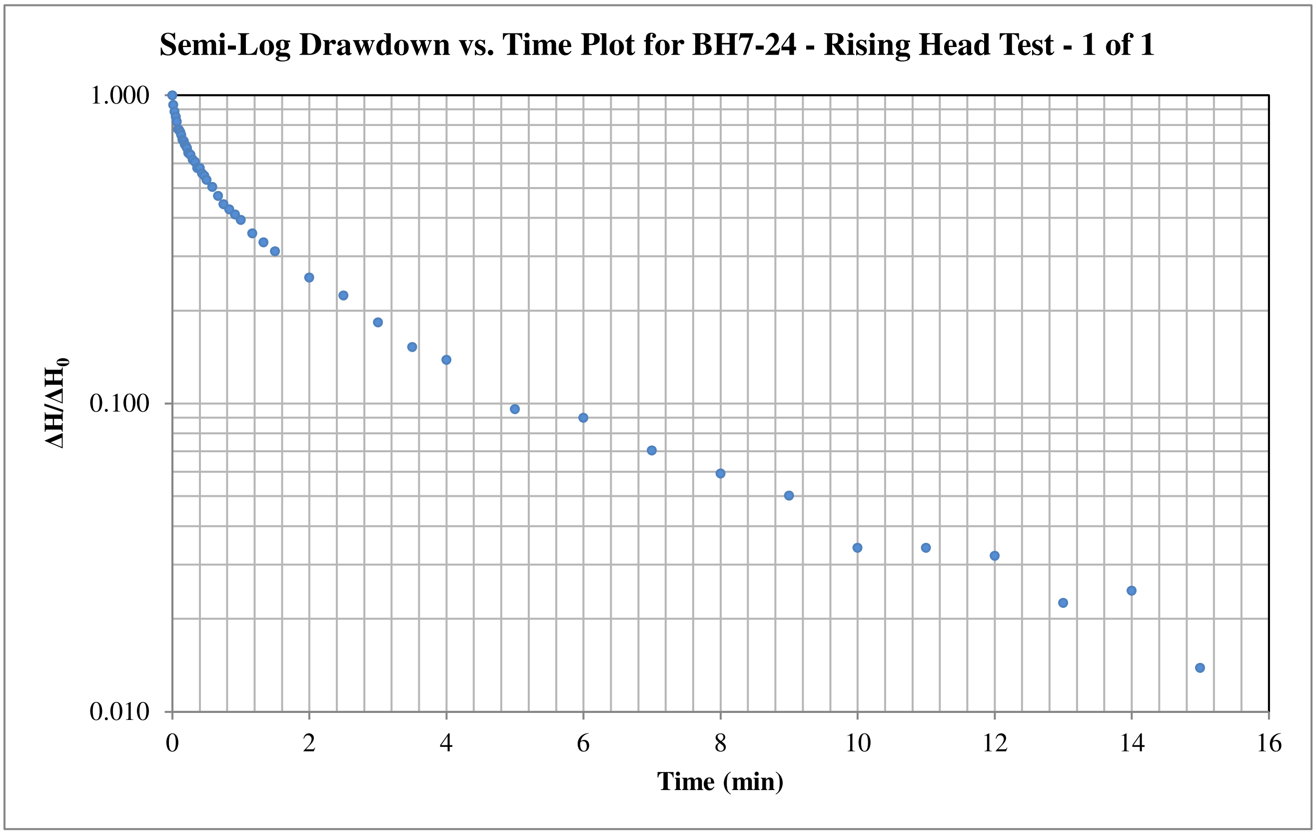
Data Points (from plot):

t*: 1.316 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.81E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH7-24
Test: Rising Head - 1 of 1
Date: April 15, 2024



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: 2.07207

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.03175	m	Diameter of well
r_c	0.01588	m	Radius of well

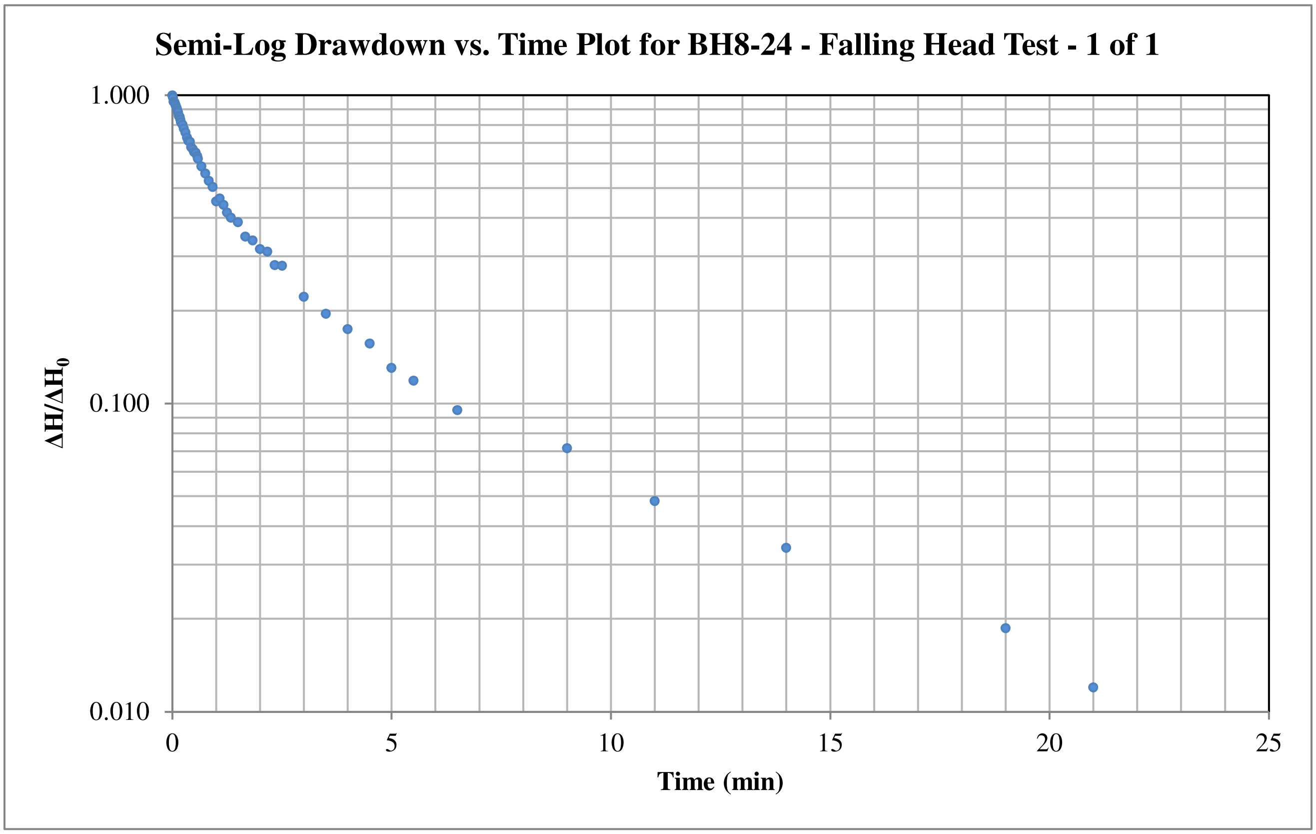
Data Points (from plot):

t*: 1.121 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 5.65E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: Mattamy Homes - 800 Cedarview Road
Test Location: BH8-24
Test: Falling Head - 1 of 1
Date: April 15, 2024



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: 2.07207

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.03175	m	Diameter of well
r_c	0.01588	m	Radius of well

Data Points (from plot):

t*: 1.594 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.97E-06 m/sec

APPENDIX 4

CITY OF OTTAWA - SALT MANAGEMENT PLAN - APPENDIX A - OCTOBER 31, 2011

City of Ottawa

Public Works and Services Department
Surface Operations Branch

Salt Management Plan

Appendix A

MATERIAL APPLICATION POLICY

CONTENT

The Surface Operations Branch District Managers, Area Managers and Zone Supervisors have been consulted through the development of this document.

REVISION INFO

Rev	Date	By	Description
3.1	Jan 10 2007		
3.2	Oct 31 2011	D Vander Wal	• Removed 50/50 mix per Dan O'Keefe. • Removed specific references to Sodium and Calcium Chloride as new product for 2011 is a Multi-Chloride Brine. Changed liquid application rate from 46 (6%) to 39L/tonne (5%). • Removed Dry and Wet salt rates for pavement temperatures below -18C. • Updated Epoke rates to match Appendix B and added wet rates to obtain 20% reduction when pre-wetting. • Removed separate rate table for Hwy 174 Epoke spreaders since the resulting lane-km rates are the same as other bare pavement.

COUNCIL APPROVED MAINTENANCE QUALITY STANDARDS

For snow clearing, resources are to be deployed and snow clearing completed as defined in the Table below. If the depth of snow accumulation is less than the minimum for deployment, then resources may be deployed subject to road conditions resulting from previous snow accumulations or from forecasted weather conditions.

For treating icy roads, resources are to be deployed as soon as practicable after becoming aware of the icy conditions. Icy roads are to be treated within the times defined in the Table below after becoming aware of the icy conditions.

**MAINTENANCE QUALITY STANDARD
SNOW AND ICE CONTROL ON ROADS**

Road Maintenance Class		**Road Type**	**Minimum Depth of Snow Accumulation for Deployment of Resources** ***(Depth as per MMSMH)***	**Time to Clear Snow Accumulation From the End of Snow Accumulation or Time to Treat Icy Conditions** ***(Time as per MMSMH)***	**Treatment Standard**		
					Bare Pavement	**Centre Bare**	**Snow Packed**
1	A	High Priority Roads	As accumulation begins *(2.5-8 cm depending on class)*	2 h *(3-4 h)*	√		
	B				√		
2	A	Most Arterials		3 h *(3-6 h)*	√		
	B				√		
3	A	Most Major Collectors		4 h *(8-12 h)*	√		
	B				√		
4	A	Most Minor Collectors	5 cm *(8 cm)*	6 h *(12-16 h)*	√		
	B					√	
	C						√
5	A, C	Residential Roads and Lanes	7 cm *(10 cm)*	10 h *(16-24 h)*			√
	B		10 cm *(not defined)*	16 h *(not defined)*			√

Note - MMSMH refers to Ontario Regulation 239/02, Minimum Maintenance Standards for Municipal Highways shown for comparison purposes.

- **Bare Pavement:** requires that snow and ice be controlled, cleared and/or prevented for the full traveled road pavement width, including flush medians of 2 m width or less, paved shoulders and/or adjacent cycling lanes. It does not include parking lanes.
- **Centre-Bare:** requires that snow and ice be controlled, cleared and/or prevented in a strip down the middle of the road pavement width for a minimum width of 2.5 m on each side of centre-line.
- **Snow-Packed:** requires that snow and ice be cleared and that ruts and/or potholes that may cause poor vehicle control be leveled off. Abrasive or deicing materials are applied at intersections, hills and sharp curves.

LIQUID CHEMICALS

Application Rates and Reductions

USE OF LIQUID CHEMICALS					
Chemical	**Use**	**Application Ratio**	**Chemical Concentration**	**Application Rate**	**Dry Salt Reduction**
CaCl, MgCl, or Multi-Chloride	Pre-Wetting	5% by weight	Varies (28%-35%)	39L / t	20%[1]
CaCl, MgCl, or Multi-Chloride	Straight Liquid Application	N/A	Varies	60 to 100L/ lane-km	-

[1] The Epoke controller does not support setting a separate reduction percentage – the rate will only be reduced by the set liquid application ratio (5%).

Pre-Wetted Salt

- Pre-wetting salt is a recommended practice to enhance the performance of the road salt.
- When salt is pre-wet, the brine solution is formed quicker than dry salt and more material is retained on the road surface. It is the brine solution that prevents or breaks the bond between the road surface and snow/ice.
- The enhanced performance of the salt as well as the retention of salt on the road surface facilitates achieving a bare road more quickly and maintains bare pavement longer. As a result, a reduction in salt application rates can achieve the same effectiveness as dry salt application at traditional rates.

Practical temperature ranges for Pre-Wetted Salt (WET SALT)

- Sodium Chloride Brine (NaCl):
  - From 0 to –9ºC (0 to -12ºC as per pre-wetting practices in urban areas)
- Calcium Chloride ($CaCl_2$), Magnesium Chloride (MgCl), and Multi-Chloride Brines with a minimum eutectic temperature of -30°C:
  - From 0 to –15ºC (0 to -18ºC as per pre-wetting practices in urban areas)

Direct Liquid Applications (DLA)

- Anti-icing by Direct Liquid Application is a recommended practice to treat frost and black ice conditions in the shoulder seasons at pavement temperatures between 0 and –10ºC.
- Liquid should be applied to treat forecasted conditions at the following rates:

Winter Event	**Litres / LaneKm**	**mL / m^2 (at 3m width)**
Frost	60	20
Light Snow	60 to 80	25
Moderate to Heavy Snow, Freezing Rain	80 to 100	30

- DLA should be applied:
  - As close to the beginning of the winter event as possible
  - When the air and pavement temperatures are both below +5°C currently and forecasted to remain below +5°C within the next 12 hours.
  - When the air and pavement temperatures are a minimum of 10°C above the eutectic temperature of the DLA liquid and forecasted to do so for the next 24 hours.
- DLA should NOT be applied:

- When the relative humidity is below 60% and the air and pavement temperatures are between 0°C and +5°C.
- More than once in a three-day period unless a Winter Event (frost, snow, freezing rain or rain) has removed the product from the pavement. Note that DLA liquid can remain on the pavement up to several days after the initial application.

GENERAL INFORMATION

When the Pavement Temperature is below –18ºC

- Below –18ºC, the salt melting action is close to none.
- Below –18ºC, the use of salt shall be discontinued and replaced by an abrasive.
- Multiple factors can affect the performance of de-icing chemicals and abrasives below pavement temperature of –18ºC. Under such conditions, supervisors shall select the most appropriate material based on the current and expected traffic volume, current and forecasted weather and road conditions.

Abrasives

- Accepted abrasives are Sand and Grit
- Straight abrasive does contain salt to prevent the stockpile from freezing. The goal is to minimize the amount of salt mixed with the abrasives. The objective is to use an engineered abrasive of 5% salt / 95% sand or grit by volume. The following interim abrasive ratios are accepted (where the engineered ratio cannot be achieved due to equipment and material storage constraints)
  - 10% salt / 90% sand or grit by volume

Rush Hours and Forecasted Conditions

- Supervisors are responsible for making timely material application calls based on forecasted conditions and expected traffic peak hours.

Freezing Rain

- When Freezing Rain occurs, abrasive materials (sand or grit) will be applied on snow packed roads on a continuous basis (to the full Road Width).
- Snow Packed Roads – where available, graders with ice blades shall drag the roads to aid traction.

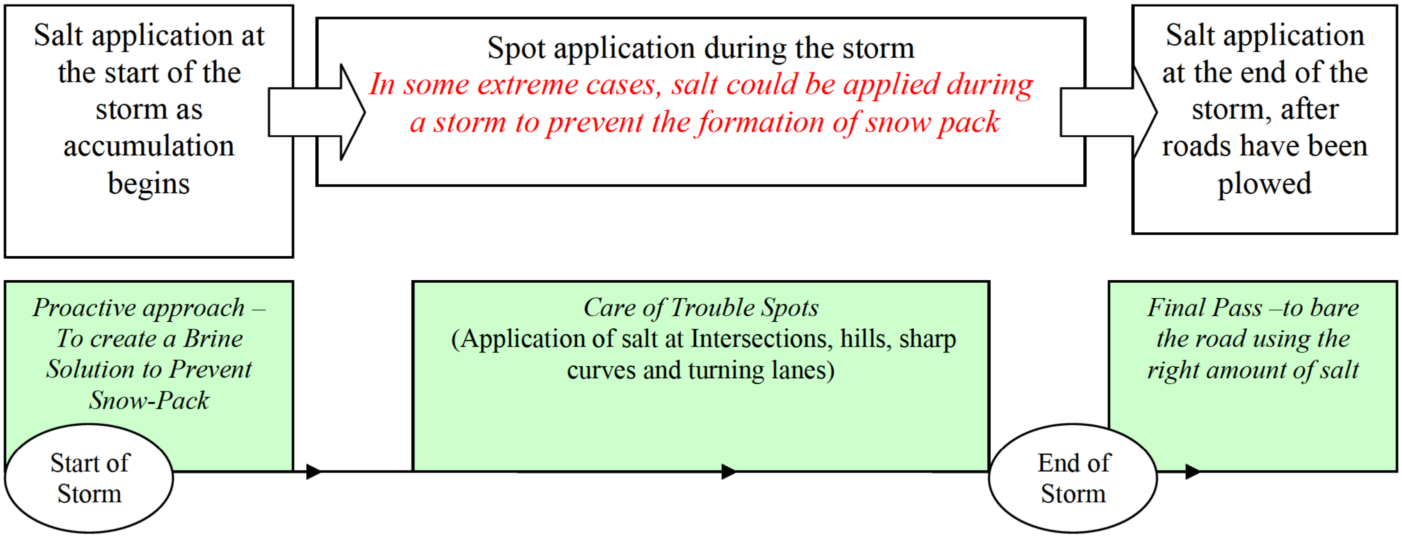
MATERIAL APPLICATION POLICY
BARE PAVEMENT

Pavement Temperature ºC	**Material**	**Frost and Black Ice** ***Kg/2-lane km***	**Light Snow <1cm/hr** ***Kg/2-lane km***	**Heavy Snow >1cm/hr** ***Kg/2-lane km***	**Freezing Rain** ***Kg/2-lane km***
0 to –5ºC	DRY SALT	70	100	140	230
	WET SALT	55	80	110	185
-5 to –10ºC	DRY SALT	85	140	180	230
	WET SALT	70	110	145	185
-10 to –18ºC	DRY SALT	85	180	230	230
	WET SALT	70	145	185	185
< -18ºC*	ABRASIVE	350	350	350	-

* Refer to the General Information Section for additional information when the Pavement Temperature is below –18ºC. When forecasted warming conditions are expected, dry/wet rates of 180/145, and 230/185 may provide some baring-off benefit.

* Note: Use wet rates where pre-wetting capable spreaders and liquid supply is available.

Timing of Application – BARE PAVEMENT ROADS



Start of the Storm

Salt shall be spread just at the beginning of the icy precipitation.

End of Storm

Salt shall not be spread once bare pavement is achieved and when no further precipitation is forecasted.

MATERIAL APPLICATION POLICY
BARE PAVEMENT
(EPOKE SPREADERS)

Pavement Temperature °C	**Material**	**Frost and Black Ice**		**Light Snow <1cm/hr**		**Heavy Snow >1cm/hr**		**Freezing Rain**	
		g/m2	***Width***	***g/m2***	***Width***	***g/m2***	***Width***	***g/m2***	***Width***
0 to –5°C	DRY Salt (WET Salt)*	70kg/2ln-km		100kg/2ln-km		140kg/2ln-km		230kg/2ln-km	
		35 (30)	2m	50 (43)	2m	70 (60)	2m	115 (98)	2m
		23 (20)	3m	35 (30)	3m	45 (38)	3m	77 (65)	3m
		17 (14)	4m	23 (20)	4m	35 (30)	4m	58 (49)	4m
		17 (14)	5m	20 (17)	5m	28 (24)	5m	45 (38)	5m
-5 to –10°C	DRY Salt (WET Salt)*	85kg/2ln-km		140kg/2ln-km		180kg/2ln-km		230kg/2ln-km	
		45 (38)	2m	70 (60)	2m	90 (77)	2m	115 (98)	2m
		28 (24)	3m	45 (38)	3m	58 (49)	3m	77 (65)	3m
		20 (17)	4m	35 (30)	4m	45 (38)	4m	58 (49)	4m
		17 (14)	5m	28 (24)	5m	35 (30)	5m	45 (38)	5m
-10 to –18°C	DRY Salt (WET Salt)*	85kg/2ln-km		180kg/2ln-km		230kg/2ln-km		230kg/2ln-km	
		45 (38)	2m	90 (77)	2m	115 (98)	2m	115 (98)	2m
		28 (24)	3m	58 (49)	3m	77 (65)	3m	77 (65)	3m
		20 (17)	4m	45 (38)	4m	58 (49)	4m	58 (49)	4m
		17 (14)	5m	35 (30)	5m	45 (38)	5m	45 (38)	5m
< -18°C†	ABRASIVE	350kg/2ln-km		350kg/2ln-km		350kg/2ln-km		-	
		175	2m	175	2m	175	2m	-	-
		115	3m	115	3m	115	3m		
		88	4m	88	4m	88	4m		
		70	5m	70	5m	70	5m		

* When the pre-wetting system is engaged, the dry material output is reduced. The Epoke controller does not support setting a separate reduction percentage – the rate is only reduced by the set liquid application ratio (5%). Material 2 was therefore configured with rates reduced by 15%.

* Use wet rates where pre-wetting capable spreaders and liquid supply is available.

† Refer to the General Information Section for additional information when the Pavement Temperature is below –18°C. When forecasted warming conditions are expected, dry/wet rates of 180/145, and 230/185 may provide some baring-off benefit.

<u>Notes</u>

There are 2 variables affecting the material output on an Epoke salt spreader:

-Material Application Rate in **g/m^2** <u>AND</u> Application Width in **m**.

<u>Examples:</u>

1- For a rate of 100kg/2ln-km, the Epoke Setup would be <u>25g/m^2 at a Width of 4m.</u> **OR** a rate of <u>50g/m^2 at a Width of 2m</u>.

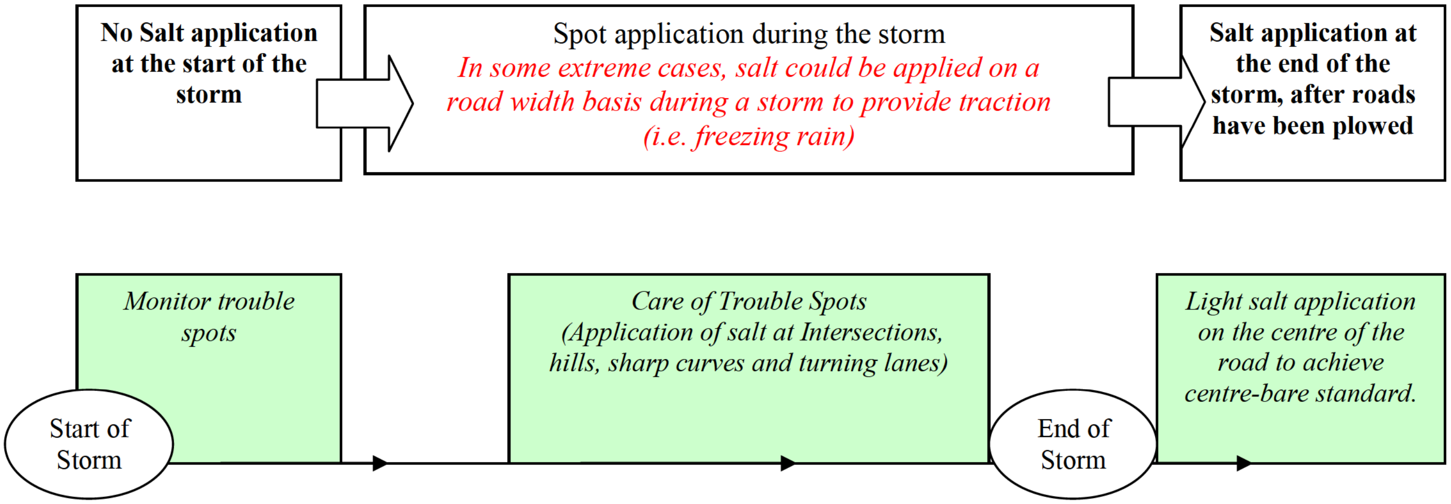
2- For a rate of 170kg/2ln-km, the Epoke Setup would be <u>42g/m^2 at a Width of 4m.</u> **OR** a rate of <u>57g/m^2 at a Width of 3m.</u>

MATERIAL APPLICATION POLICY
CENTRE-BARE PAVEMENT

Pavement Temperature °C	**Material**	**Frost and Black Ice** *Kg/2-lane km*	**Snow** *Kg/2-lane km*	**Freezing Rain** *Kg/2-lane km*
0 to –5°C	DRY SALT	70	100	230
	WET SALT	55	80	185
-5 to –18°C	DRY SALT	85	140	230
	WET SALT	70	110	185
< -18°C	ABRASIVE	350	350	-

Note: Use wet rates where pre-wetting capable spreaders and liquid supply is available.

Timing of Application – CENTRE-BARE PAVEMENT ROADS

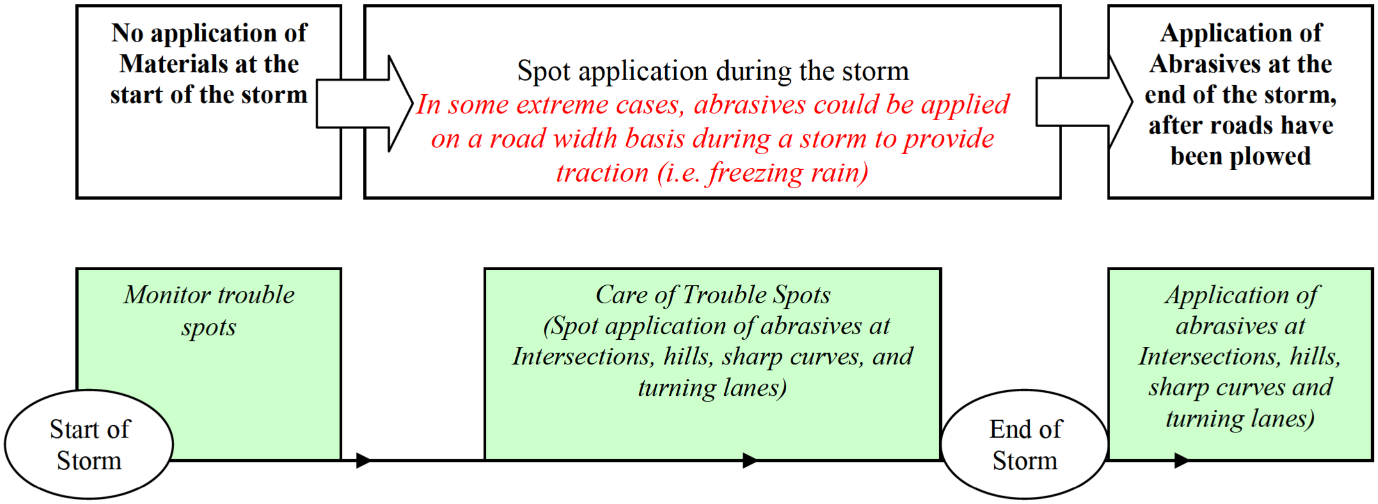


<u>Start of the Storm</u>
No Salt application at the start of the storm. Monitor trouble spots.

<u>End of Storm</u>
Salt shall not be spread once centre-bare pavement is achieved and when no further precipitation is forecasted.

MATERIAL APPLICATION POLICY (Intersections, Hills and Sharp Curves) **SNOW PACKED**				
Pavement Temperature °C	**Material**	**Frost and Black Ice** ***Kg/2-lane km***	**Snow** ***Kg/2-lane km***	**Freezing Rain** ***Kg/2-lane km***
0 to –30°C and below	ABRASIVE	350	350	500

Timing of Application – SNOW PACKED ROADS



No application of Materials at the start of the storm

Spot application during the storm

In some extreme cases, abrasives could be applied on a road width basis during a storm to provide traction (i.e. freezing rain)

Application of Abrasives at the end of the storm, after roads have been plowed

Monitor trouble spots

Care of Trouble Spots (Spot application of abrasives at Intersections, hills, sharp curves, and turning lanes)

Application of abrasives at Intersections, hills, sharp curves and turning lanes)

Start of the Storm
No application of abrasives at the start of the storm. Monitor trouble spots.

End of Storm
Abrasives shall not be spread once traction is provided.

BLASTING POLICY

The On-Board Electronic Controller's Blast function is an important tool for roadway de-icing operations. It allows operational staff to timely increase the amount of spread material at trouble locations such as steep hills and sharp curves. Although the blast function is indispensable, it should be used with care as it its liberal use can lead to significant increases in salt consumption and environmental impacts.

- Supervisory staff shall work toward minimizing the amount of salt being spread using the Blast function to achieve the required maintenance quality standard.
- Many variables come into play during a winter weather event. As such, the call to allow the use of the Blast Function during a winter event is left to the judgment of the supervisory staff, as the first priority is the safety of the traveling public.

The Blast function shall only be used at the following locations:

- Steep Hills
- Elevated Curves
- Intersections (within 30m of the stop line on the approach side only)
- Shade areas
- Right and Left Turning Lanes
- Bus Bays
- Railways (within 30m of the railway crossing on the approach side only)
- Bridge Decks

  Caution: when blasting salt on a bridge deck. Rock salt needs heat to dissolve. Spreading salt on a bridge deck could lower its surface temperature to a point where the brine solution will refreeze.

Application:

- The Blast function shall only be used under severe winter conditions
- The Blast function shall not be used during light winter weather events such as light snow, frost, etc.
- The blast function shall not be used while clearing the roads (stripping) at the end of a storm.

On-Board Electronic Controller's Blast function

- The Epoke controllers will blast at the highest material calibration setting.
- The CS-230 controller will blast to its maximum hydraulic power (which can be adjusted if too high)
- The CS-440 controller can be calibrated at a defined Blast rate for each material.
  - The Blast Rate for Salt is to be set at 300kg/2 lane-km
  - The Blast Rate for Abrasive is to be set at 500kg/2 lane-km. Note: Suburban/Rural District has a requirement to Blast Abrasives on gravel roads at a rate of 700kg/2 lane-km. To achieve this rate, the spreaders need to be calibrated using two gate settings. The District will provide, every fall, a list of spreaders requiring this specific calibration.