BURNSIDE

Hydrogeological Assessment and Water Balance
376 & 390 Derry Road and 0 Oaktree Circle
Mississauga, Ontario

Ballymore (Uptown Meadowvale) Corporation

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R.J. Burnside & Associates Limited
17345 Leslie Street, Suite 303
Newmarket ON   L3Y 0A4 CANADA

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R.J. Burnside & Associates Limited

Report Prepared By:

Melinda Morris, P.Geo.
Hydrogeologist
MM:cl

PROFESSIONAL GEOSCIENTISTS ONTARIO
6/Dec/2023
MELINDA L. MORRIS
PRACTISING MEMBER
3839

Report Reviewed By:

Jackie Shaw, P.Eng.
Groundwater Resources Engineer
JS:cl

LICENSED PROFESSIONAL ENGINEER
J. R. SHAW
100120731
6/Dec/2023
PROVINCE OF ONTARIO

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Ballymore (Uptown Meadowvale) Corporation to complete a hydrogeological study of the properties located at 376 and 390 Derry Road and 0 Oaktree Circle in the City of Mississauga (herein referred to as the subject lands). The subject lands are located on the south side of Derry Road West, approximately 170 m east of McLaughlin Road (Figure 1) and currently consist of two vacant dwellings and associated outbuildings and a gravel parking area that was formerly used for vehicle storage. The subject lands are located within the jurisdiction of Credit Valley Conservation (CVC).

The purpose of the hydrogeological assessment is to provide site-specific soil and groundwater information for the subject lands in support of draft plan approval (Figure 2). The report was developed to meet the requirements outlined in “Hydrogeological Assessment Submissions-Conservation Authority Guidelines for Development Applications” and the City of Mississauga Hydrogeological Report Terms of Reference. The hydrogeological assessment was designed to characterize the geological and hydrogeological conditions on the subject lands, identify potential development impacts on local surface water and groundwater resources, and recommend mitigation measures to address potential impacts. As part of the assessment, water balance calculations have been completed to determine the pre-development water balance components, determine potential changes to the water balance as a result of the proposed development concept, and to provide appropriate infiltration targets as input to Low Impact Development (LID) strategies and stormwater management plans for the subject lands. Additionally, assessment considerations of groundwater related constraints for the development in regard to the depth to groundwater table and potential need for construction dewatering and need for either a permit to take water (PTTW) or an Environmental Activity Sector Registry (EASR) are addressed herein.

1.1 Scope of Work

The scope of work for the hydrogeological assessment included the completion of the following tasks.

1. Review of the Ministry of Environment, Conservation and Parks (MECP) well records: A list of the available MECP water well records are provided in Appendix A, and the well locations are shown on Figure 5. It is noted that well locations listed in the MECP well records are approximations only and may not accurately reflect well locations in the field.

2. Review of published geological and hydrogeological information: A review of existing mapping for the area was completed, including topography (Figure 3),

surficial geology (Figure 4) and recharge mapping prepared by Credit Valley, Toronto and Region and Central Lake Ontario Conservation Authorities (CTC) Source Protection Committee.

3. Review of site-specific reports: Site-specific Phase I (Fisher Environmental Ltd., 2017 and Soil Engineers Ltd., 2023), Phase II (Fisher Environmental Ltd., 2017 and Soil Engineers Ltd., 2023) and geotechnical (Soil Engineers Ltd., 2022) reports were reviewed for relevant soil and groundwater data. Data from these reports have been included as part of the analysis.

4. Review of existing borehole logs for the subject lands: Boreholes were advanced across the subject lands as part of the Phase II Environmental Site Assessment (ESA) studies and geotechnical study. Fisher Environmental Ltd. (Fisher) advanced ten boreholes across the subject lands in 2017 as part of a Phase II ESA. Soil Engineers Ltd. (Soil Eng.) advanced nine boreholes (BH1-22 to BH9-22) in 2022 as part of the geotechnical study and another ten (BH1-23 to BH5-23 and BH101-23 to BH105-23) between 2022 and 2023 as part of a Phase II ESA. The borehole and monitoring well locations are shown on Figure 5 and borehole logs are provided in Appendix B.

5. Review of laboratory grainsize distribution testing: Analyses were completed by the geotechnical consultant (Soil Eng.) on representative soil samples obtained during the geotechnical drilling program. These data were reviewed to characterize the surficial sediments and estimate the hydraulic conductivity of the soils encountered. Copies of the soil grainsize analyses are provided in Appendix C.

6. In situ hydraulic conductivity testing: Single well response tests were completed in three groundwater monitoring wells (MW1-23, MW4-22 and MW104-23) to assess the in situ hydraulic conductivity of the shallow soils on the subject lands. The hydraulic conductivity field testing results are provided in Appendix D.

7. Groundwater level monitoring: Following site reconnaissance, a total of seven groundwater monitoring wells were located across the subject lands and deemed suitable for monitoring. One monitoring well was installed by Fisher (MW8-17) and six monitoring wells were installed by Soil Eng. (MW1-23, MW3-23, MW4-23, MW101-23, MW102-23 and MW104-23). Monitoring has been completed to measure the depth to the water table and assess the horizontal groundwater flow conditions. Groundwater level measurements commenced in April 2023 and are monitored on a bi-monthly interval. Automatic water level recorders (dataloggers) are installed in four monitoring wells (MW1-23, MW3-23, MW101-23 and MW104-23) in order to record continuous water level

fluctuations. The groundwater monitoring data collected to date and hydrographs are provided in Appendix E.

8. Water quality testing: One groundwater sample was collected at MW8-17 to characterize background water quality. The water sample was submitted to AGAT Laboratories Ltd. for the analysis of select organic (i.e., oil and grease, nonylphenols, etc.) inorganic (i.e., pH, total suspended soils and total metals) parameters. The water quality results were compared to the Mississauga Storm Use Bylaw [BY-LAW 0046-2022] to assess the suitability of discharging to the City's infrastructure in the event of dewatering activities. A summary of the water quality results, and the laboratory Certificate of Analysis are provided in Appendix F.

9. Water balance calculations: Pre-development and post-development water balance calculations were completed to document existing conditions, evaluate post-development conditions, establish an infiltration target, and assess the potential effectiveness of the proposed LID measures to mitigate the changes land development may have on the local groundwater infiltration volumes. The local climate data and detailed water balance calculations are provided in Appendix G.

10. Dewatering assessment: A dewatering assessment was completed based on the proposed servicing depths, as well as the soil and groundwater conditions on the subject lands, to determine if dewatering is expected during construction. The dewatering calculations are provided in Appendix H.

2.0 Physical Setting

2.1 Physiography and Topography

The subject lands are located within two physiographic regions known as the Peel Plain and South Slope (Chapman and Putnam, 1984). The Peel Plain, which is mapped in the northern portion of the subject lands along Derry Road West, consists of clay till soils which have a flat to rolling topography with generally more incised slopes in the vicinity of watercourses. The South Slope, mapped in the southern portion of the subject lands, is characterized by low-lying ground moraines with clay soils.

The subject lands generally have a topographic relief of approximately 3 m, with maximum elevation of 199.6 metres above sea level (masl) located along the northern boundary to a low elevation of 196.8 masl located along the southern boundary of the 376 Derry Road West property (Figure 3). Berms have been constructed along the southern boundary of the 390 Derry Road West property. The berms have a topographic relief ranging from 1 m to 2 m in height. The berm has a maximum elevation of 199.8 masl. It is noted that the topography has been influenced from previous earthworks with the presence of fill noted in borehole logs across the subject lands (Section 2.3.1, Appendix B).

2.2 Drainage

The subject lands are located within the Fletchers Creek subwatershed of the Credit River watershed and is under the jurisdiction of Credit Valley Conservation (CVC). Runoff from the subject lands drains to the south, toward storm sewers located within the existing residential subdivision which borders the subject lands to the south and west. There are no watercourses, wetlands or drainage features on the subject lands (Figure 3).

2.3 Geology

2.3.1 Surficial Geology

Surficial geology mapping published by the Ontario Geological Survey (2003) shows that the subject lands are covered by low permeability silty to clayey glaciolacustrine derived till (Halton till, Figure 3). River deposits and bedrock are mapped along the valley located east of the subject lands.

Drilling programs were completed across the subject lands by Fisher (2017) and Soil Eng. (2022 and 2023). The Phase II ESA investigation completed by Fisher included the drilling of ten boreholes across the subject lands up to depths of 9.8 m below ground surface (mbgs) to 7.6 mbgs. The Soil Eng. investigations consisted of drilling 19 boreholes across the subject lands up to depths of 7.6 mbgs. Borehole locations are shown on Figure 5, and borehole logs are provided in Appendix B. The results of these investigations show that anthropogenic material (fill and concrete) has been deposited across the subject lands. Underlying the fill is the native silty clay till/sandy silt till, corresponding to Halton till.

2.3.2 Bedrock Geology

Underlying the till across the subject lands is shale bedrock of the Queenston Formation. The bedrock surface regionally slopes from the north to south, with the lowest bedrock areas underlying nearby watercourse valleys (i.e., the topography in the area generally reflects the bedrock topography).

Fifteen drilling locations across the subject lands encountered bedrock at depths ranging from 4.2 mbgs to 9.1 mbgs (Appendix B). Nearby MECP well records, recorded shale from 4.3 mbgs to 16.4 mbgs (Appendix A). The shale is reddish brown and is heavily weathered (Appendix B) at the overburden/bedrock contact and becomes more competent with depth.

2.3.3 Local Stratigraphy

Based on the geological data from site-specific geological information obtained from the boreholes drilled on the subject lands (Appendix B), two schematic cross-sections through the subject lands have been prepared to illustrate the subsurface conditions. On these cross-sections, an interpretation of the main stratigraphic layers has been made based on the overall sediment characteristics. The cross-section locations are shown on Figure 5 and the interpreted cross-sections are shown on Figure 6 and Figure 7.

The cross-sections show that the subject lands are partially covered by a layer of anthropogenic material (fill and concrete), approximately 2 m thick. The anthropogenic material is underlain by a native fine texture till layer (silty clay till/sandy silt till) about 9 m thick. Shale bedrock is interpreted to be below the till layer at an elevation of approximately 190 masl to 194 masl.

2.3.4 Soil Hydraulic Conductivity

Various methods can be used to evaluate soil hydraulic conductivity (K), i.e., the ease with which water can move through soil. Soil characteristics and grainsize data provide a general estimate of bulk hydraulic conductivity, whereas single well response tests are used to assess in situ conditions at specific locations. Both methods were used to estimate the K of the soils on the subject lands.

2.3.4.1 Grainsize Estimates of Hydraulic Conductivity

A summary of the hydraulic conductivity values estimated from the individual grainsize analyses and soil type using the Hazen approximation method is presented below in Table 1. The Hazen method is most reliable when used to approximate the hydraulic conductivity of coarse-grained sediments; however, it is still considered useful for providing a general indication of the hydraulic conductivity of finer grained sediments. The grainsize analyses completed as part of the geotechnical study are provided in Appendix C. Based on grainsize results, the estimated K values of the soils tested across the subject lands are considered low and generally correspond to till and silty/clayey soils.

Table 1: Hydraulic Conductivity Estimates based on Grainsize Analyses

Sample Description	Test Location	Sample Depth (m)	D_{10} (mm)	Hydraulic Conductivity (cm/s) Hazen Estimation
Silty Clay Till	BH2-22, SS3	1.8	<0.001	<1 x 10^{-6}
	BH4-22, SS5	3.3	<0.001	<1 x 10^{-6}
	BH7-22, SS4	2.5	<0.001	<1 x 10^{-6}
	BH9-22, SS5	3.3	<0.001	<1 x 10^{-6}

2.3.4.2 In Situ Estimates of Hydraulic Conductivity

To assess the in situ hydraulic conductivity of the shallow soils across the subject lands, single well response tests were completed in MW1-23, MW4-23 and MW104-23 (refer to Figure 3 for monitoring well location and Appendix B for borehole logs). The hydraulic conductivity test results are provided in Appendix D and show the following:

- The test completed at monitoring well MW1-23, screened in silty clay till suggests a K value of 2.0 x 10^{-5} cm/s. This is somewhat higher than expected for these till soils and may be due to the presence of trace gravel that was identified in the till deposits in the borehole log.

- The tests completed at monitoring wells MW4-23 and MW104-23, screened in silty clay till, suggest a K value of 1.8 x 10^{-8} cm/s to 5.2 x 10^{-8} cm/s. The hydraulic conductivity rates are relatively low and typical for fine textured soil.

3.0 Hydrogeology

3.1 Local Groundwater Use

The adjacent residential development is serviced by municipal water and sewer, and the proposed development will also be municipally serviced. There is no proposed on-site groundwater taking planned for the new development. It is possible the residential properties located northeast of the subject lands, may be serviced by private wells or cisterns, and septic systems.

The MECP maintains a database that provides geological records of water supply wells drilled in the province. The local MECP well locations are plotted on Figure 5. It is noted that the well locations listed in the MECP records are approximations only and may not be representative of the precise well locations in the field. A review of the MECP well records within a 500 m radius of the subject lands indicates a total of 32 well records. Of the 32 water well records, ten are monitoring/test holes/observation wells, eight are abandonment records, two have unknown uses and the remaining 12 are/were used for water domestic purposes. Copies of the MECP well records are included in Appendix A. Stratigraphic information shows that two of the water supply wells are installed in the overburden (12.8 mbgs to 31.1 mbgs), and the remaining water supply wells are installed in the bedrock (shale) and range in depths from 11.3 mbgs to 24.4 mbgs.

Wellhead Protection Areas (WHPAs) are zones around municipal water supply wells where land uses must be carefully planned and restricted to protect the quality and quantity of the water supply. Review of WHPA mapping available from Source Protection Information Atlas compiled by the MECP shows that the subject lands are not located in a WHPA for water quality or a WHPA-Q for water quantity.

3.2 Aquifer Vulnerability

Aquifer vulnerability refers to the susceptibility of an aquifer to potential contamination. Some degree of protection for groundwater quality from natural and human impacts is provided by the soil above the water table. The degree of protection is dependent upon the depth to the water table (for unconfined aquifers) or the depth of the aquifer (for confined aquifers) and the type of soil above the water table or aquifer. As these two properties vary over any given area, the degree of protection or vulnerability of the groundwater to contamination also varies. Some land use restrictions may apply to areas of high aquifer vulnerability, which pose a risk of contaminating the underlying aquifers. Residential land uses are not considered ‘high risk’ in terms of potential aquifer contamination.

Review of the Aquifer Vulnerability mapping prepared by the CTC Source Protection Committee shows that the subject lands are not mapped within an area of high aquifer vulnerability.

3.3 Groundwater Levels

A total of seven groundwater monitoring wells are located across the subject lands. One monitoring well was installed by Fisher (MW8-17) in 2017 and six monitoring wells were installed by Soil Eng. (MW1-23, MW3-23, MW4-23, MW101-23, MW102-23 and MW104-23) in 2022 and 2023. Refer to Figure 3 for well locations and Appendix B for borehole logs.

Groundwater level measurements commenced in April 2023 and are monitored on a bi-monthly interval. Automatic water level recorders (dataloggers) are installed in MW1-23, MW3-23, MW101-23 and MW104-23 in order to record continuous water level fluctuations. The groundwater monitoring data tables and hydrographs are provided in Appendix E.

The groundwater monitoring data recorded in the monitoring wells to date show the following:

- Preliminary groundwater level highs were recorded in July 2023 across most of the subject lands (MW1-23, MW3-23, MW8-17, and MW102-23). Groundwater levels range from 0.9 mbgs (MW101-23, Figure E-5) to 3.0 mbgs (MW104-23, Figure E-7). Seasonally high groundwater levels are generally within 2 m of ground surface.

- Datalogger data suggests groundwater levels show minimal response to precipitation.

- Seasonal groundwater fluctuations were minimal in all monitoring wells, varying by less than 0.5 m throughout the monitoring period. Groundwater levels across all monitoring wells generally decreased through the summer under seasonally drier conditions.

3.4 Groundwater Flow Conditions

Groundwater elevation data from April 2023 are shown on Figure 8 with the interpreted groundwater elevation contours and shallow groundwater flow directions. It is interpreted that the shallow water table will generally reflect the surface topography and that the shallow groundwater flow patterns will mimic the surface water flow patterns. As shown on Figure 8, groundwater is interpreted to flow moving from the north to the south across the subject lands.

3.5 Significant Groundwater Recharge Areas

Areas where water from precipitation percolates or infiltrates into the ground and moves downward from the water table are known as recharge areas and occur as a result of regional and/or local flow systems. Significant Groundwater Recharge Areas (SGRAs) are areas where precipitation more readily recharges aquifers. As such, they can be sensitive to land use changes that impact infiltration from precipitation sources. Review of mapping available from the Source Protection Information Atlas compiled by CTC Source Protection Committee shows that the subject lands are not located within an SGRA.

3.5.1 Groundwater Quality

A groundwater sample was collected from monitoring well MW8-17 on October 2, 2023 and was submitted to AGAT Laboratories for analysis. The purpose of the sampling was to characterize the background water quality and assess discharge options during construction dewatering. The results of the analyses were compared to the Mississauga Storm Sewer Use By-law (0046-2022 criteria) for discharge to municipal sewers and are presented in Table F-1 and Table F-2 in Appendix F. The groundwater testing results from the analytical laboratory show the groundwater quality meets the City of Mississauga Storm Sewer Use By-law (0046-2022) criteria. No inorganic or organic exceedances were reported.

4.0 Water Balance

To assess potential land development impacts on the local groundwater conditions, a detailed water balance analysis has been completed to determine the pre-development infiltration volumes (based on existing land use conditions) and the post-development infiltration volumes that would be expected based on the proposed land use plan. The water balance calculations are provided in Appendix G and discussed below.

4.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

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

where:
P = precipitation
S = change in groundwater storage
ET = evapotranspiration/evaporation
R = surface water runoff
I = infiltration

The components of the water balance vary in space and time and depend on climatic, soil, and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Accurate measurement of the water balance components is difficult; consequently, approximations and simplifications are made to characterize the study area. Field observations of the drainage conditions, land cover and soil types, groundwater levels, and local climate records are important inputs to the water balance calculations. The groundwater balance components for the subject lands are discussed below.

Precipitation (P)

The long-term average annual precipitation for the area is 786 mm based on data from the Environment Canada Toronto Lester B. Pearson International Airport climate station (Station 6158733 - 43°40’38.000” N, 79°37’50.000” W, elevation 173.40 masl) for the period between 1981 and 2010. Average monthly records of precipitation and temperature from this station have been used for the water balance component calculations in this study (Table G-1, Appendix G)

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET)/Evaporation (E)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is often less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the monthly PET and AET have been calculated based on a soil-moisture balance approach using average temperature data and climate information adjusted to the local latitude (refer to Table G-1 in Appendix G).

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff and the remainder infiltrates the surficial soil.

Infiltrating precipitation either moves vertically downward to the groundwater table or laterally through the shallow soils as interflow that re-emerges locally to surface (i.e., as runoff). Compared to the “direct” component of surface runoff that occurs as overland flow, shallow interflow becomes an “indirect” component of runoff. The interflow component of surface water runoff is not accounted for separately in the water balance equation cited above since it is difficult to distinguish between interflow and direct (overland) runoff. Both interflow and direct runoff contribute to the overall surface water runoff component.

4.2 Approach and Methodology

The analytical approach to calculate a water balance for the subject lands involved monthly soil-moisture balance calculations to determine the pre-development (based on existing land use conditions) and post-development (based on the proposed development concept plan) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as “potential infiltration” while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deeper infiltration).

The SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding runoff component was calculated for the soil moisture storage conditions. Considering the silty clay till soils in the area, a soil moisture storage capacity of 100 mm was used for the urban lawns (clay loam soils) in pre-development calculations. Table G-1 (Appendix G) details the monthly potential evapotranspiration calculations accounting for latitude and climate, and the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The calculated water balance components are used to assess the pre-development infiltration volumes based on the existing land use and a post-development water balance is calculated for the subject lands based on the proposed land development plan.

4.3 Component Values

The detailed monthly calculations show that a water surplus is generally available from December to April (Table G-1, Appendix G). Infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. In winter climates, frozen conditions affect when the actual infiltration will occur; however, the monthly balance calculations show the potential volumes available for these water balance components.

The monthly calculations are summed to provide estimates of the annual water balance component values (Table G-1, Appendix G). A summary of these values for existing conditions is provided in Table 2.

Table 2: Existing Conditions Water Balance Components

Water Balance Component	Urban Lawns/Agricultural Lands (Silty Clay Till)
Average Precipitation	786 mm/year
Actual Evapotranspiration	560 mm/year
Water Surplus	226 mm/year
Infiltration	102 mm/year
Runoff	124 mm/year

4.4 Pre-Development Infiltration (Existing Conditions)

Using the water balance component values calculated for the subject lands, and the existing land use areas, the pre-development water balance calculations were completed for the subject lands and are presented in Table G-2 in Appendix G. In summary, from Table G-2 (Appendix G), the total calculated pre-development infiltration volume is about 1,430 m^3/year. It is acknowledged that infiltration rates depend on the hydraulic conductivity of soils and that hydraulic conductivity may naturally vary over several orders of magnitude, so the margins of error on the calculations are high. As such the calculated volumes are considered as general estimates only.

4.5 Potential Urban Development Impacts to Water Balance

Development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with a healthy vegetation cover (about 71% of precipitation in the study area). So, the net effect of the development of the lands is expected to be an increase in the water surplus resulting in a decrease in infiltration and an increase in runoff.

The calculated potential water surplus for impervious areas is shown at the bottom of Table G-1 in Appendix G. For the purposes of the calculations in this study, the evaporation from impervious surfaces has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there would be a potential water surplus from impervious areas of 668 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and wastewater services. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater taking or from septic effluent.

4.6 Post-development Water Balance With No Mitigation

To assess the potential development impact on infiltration, the post-development infiltration volume was calculated for the subject lands based on the proposed development plan (Figure 2). These calculations assume no mitigation is in place, resulting in quantification of an infiltration target for the design of a LID strategy for stormwater management.

The total areas for the proposed land uses have been provided by SCS based on the development concept and the same infiltration and runoff components calculated for the pre-development conditions have been used for post-development conditions as shown on Table G-1 in Appendix G. The total calculated post-development infiltration volume (without mitigation) is then calculated in Table G-2 in Appendix G, and found to be 620 m^3/year.

Comparing the existing (pre-development) and post-development infiltration volumes from the water balance calculations shows that development has the potential to reduce the natural infiltration on the subject lands by 56% (810 m^3/year). Again, it is noted that with the assumptive nature of the input values and the wide margins of error associated with this type of analysis, the estimated infiltration deficit volume is simply considered as a reasonable estimate and may not reflect the actual volume of water that may infiltrate on the subject lands.

4.7 Water Balance Mitigation Strategies

The basic premise for low impact development is to try to manage stormwater to minimize the runoff of rainfall and increase the potential for infiltration. As outlined in the SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide (2010), there are a wide variety of mitigation techniques that can be used to try to reduce the increases in direct runoff that occur with land development and increase the potential for post-development infiltration.

Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, and other pervious areas throughout the development where possible can considerably increase the volume of infiltration in developed areas. These types of surface LID techniques promote natural infiltration simply by providing additional water volumes in the pervious areas (i.e., these areas would receive precipitation as well as extra water from roof runoff). This may be particularly effective in the summer months, when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit.

Other mitigation techniques that can be considered to mitigate increases in runoff and reductions in infiltration include such measures as: permeable pavements, rain gardens, rain barrels, bioswales, subsurface infiltration trenches, galleries and pervious pipe systems. Subsurface methods should only be considered in areas where there is sufficient depth to water table to accommodate the systems within the unsaturated zone and sufficient soil hydraulic conductivity to function effectively. The 2003 SWM Manual recommends that subsurface galleries or trenches should generally be about 1 m above the seasonally high water table.

4.8 Post-development with LID Measures in Place

The proposed SWM strategy by is detailed in the Functional Servicing Report prepared by SCS (December 2023) and includes the following LID measures for infiltration:

- Rear roof areas from freehold structures will be discharged to pervious areas. The TRCA and CVC Stormwater Management Criteria (2010) indicates that a conservative estimate for the reduction in runoff due to roof leader disconnection is 25% for silt to clayey soils.

- Runoff from rear roof and rear yard areas from select townhouse blocks as shown on SCS Figure 3.3 in Appendix G will be directed to a rear yard infiltration trench designed to accommodate the 10 mm storm event. To calculate the annual 10 mm runoff volume, the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006) was used to correlate the storm event size to a percentage of the average annual rainfall depth, which was then applied to the areas directed to the trench. It is reported in these Guidelines, based on the review of rainfall data from 16 rainfall stations across Toronto, the 10 mm storm event accounts for approximately 61% of the annual rainfall volume (~61% of annual precipitation).

As discussed in Sections 2.3.4 and 3.3 herein, the surficial soils have low hydraulic conductivity and the seasonally high groundwater level is more than 1.5 mbgs in the general area of the trenches. It is recommended that the seasonally high groundwater levels be reviewed relative to the proposed bottom of the infiltration trench to confirm if the recommended 1 m of separation is feasible.

Quantification of these LID techniques is challenging and there are no widely accepted quantification standards. To assess the potential effectiveness of the proposed LID measures for infiltration across the subject lands, the water balance was re-calculated with these LID measures in place. These calculations suggest the infiltration deficit can be reduced from a potential 56% (810 m^3/year) to 21% (300 m^3/year) with the implementation of the proposed LID strategy (Table G-3, Appendix G) . This shows the significant benefit of the proposed LID strategy in increasing recharge volumes in the developed area.

5.0 Development Considerations

5.1 Construction Below Water Table

The construction of buried services below the water table, particularly in lower hydraulic conductivity soils, has the potential to capture and redirect groundwater flow through permeable fill materials typically placed in the base of excavated trenches. Over the long-term, these impacts can lower the local groundwater table. To mitigate this effect, services to be installed below the water table should use appropriate best management techniques to prevent redirection of groundwater flow (e.g., the use of cut-off collars and/or trench plugs in service trenches). Based on review of the proposed servicing depths and groundwater elevations, servicing is proposed to be installed above the seasonally high water table.

5.2 Dewatering Requirements

As noted in Section 3.3, groundwater data collected to date indicates the seasonally high water table ranges from approximately 0.9 mbgs to 3.0 mbgs across the subject lands. Excavations for installation of municipal services may extend into the groundwater requiring dewatering. The volume of water required for dewatering depends on the size and depth of the excavation with respect to the water table and the hydraulic conductivity of the soils. Sandy soil layers may produce significant volumes of groundwater and require more active dewatering, whereas excavations into the silt and till deposits may encounter less groundwater inflow that may be controlled by localized pumping from sumps.

In addition, water may accumulate in excavations during and immediately after rain events. In all cases, water will have to be pumped from the work area to allow for construction to occur in the “dry”.

The total dewatering volume is anticipated to comprise of the following components:

- Groundwater seepage
- Precipitation and runoff

Preliminary dewatering volumes have been calculated for the subject lands using a conservative approach based on deepest excavation inverts, highest water levels and highest hydraulic conductivity values being used to estimate groundwater seepage. Calculations are provided in Appendix H.

5.2.1 Groundwater Seepage

The extent of groundwater dewatering required in the excavations can be estimated using the following formulae as presented in Groundwater Lowering in Construction - A Practical Guide to Dewatering, 2nd Edition” (Cashman & Preen, 2013).

The following equation is suitable for maintenance holes or short excavation lengths which groundwater infiltration is approximated as flow to an equivalent well:

$$Q = \pi K(H^2-h^2)/(\ln R_o/r_s)$$

The following equation is appropriate for long narrow trenches (pipe trenches):

$$Q = [\pi K(H^2-h^2)/(\ln R_o/r_s)] + 2[xK(H^2-h^2)/2L]$$

Where:

Q = Discharge (m^3/s)
K = Hydraulic Conductivity (m/s)
H = Initial water level relative to datum (m)
h = Final water level relative to the datum required for dewatering (m)
R_0 = Radius of influence of dewatering (m)
r_s = Equivalent radius of dewatering well (m)
π = 3.1416
x = length of trench (m)
L = distance from line source (m)

The required drawdown has been estimated using available water table elevation information and the proposed depths of the excavations. Based on information provided by the site's engineers (SCS), installation of municipal services will occur at depths up to 6 m below ground existing grade requiring drawdowns of close to 5 m in some areas. Two Cultec systems will also be installed for stormwater retention, and may require drawdowns of up to 3.9 m at Cutltec #1 and 2.9 m at Cultec #2.

The amount of groundwater seepage into the open excavations that will be encountered is controlled by the hydraulic conductivity of the sediments that make up the subsurface deposits, as well as the local hydraulic gradients. Conditions such as the degree of weathering and fracturing, as well as the amount of silt and sand or gravel and layering, may affect the overall effective hydraulic conductivity of the overburden deposits.

As described in Section 2.3.1, the subject lands are underlain by fine-grained silty clay till/sandy silt till. To determine a potential dewatering volume for the servicing trenches which extend across the subject lands the highest hydraulic conductivity determined through in situ testing of monitoring wells on the subject lands (2.0×10^{-5} cm/s) was used.

The dewatering calculations are presented in Table H-1 (for linear trench excavations), and Table H-2 (for excavations of similar lengths and widths, radial flow) in Appendix H and summarized in Table 3 below.

Table 3: Estimated Groundwater Seepage

Source	Groundwater Volume (L/day)	Maximum Groundwater Volume (L/day)
Servicing Trenches (per 100 m)	15,300	22,900
Cultec #1	6,000	9,100
Cultec #2	2,400	3,600

For the servicing trenches it has been assumed that a maximum of 100 m of trench will be open at any given time during construction. To calculate the maximum volume, a safety factor of about 50% was applied. These volumes can be considered maximum takings since they are based on worst-case scenario parameters.

5.2.2 Precipitation and Runoff

It is noted that precipitation events occurring when excavations are open are likely to increase the volume of water requiring removal. It is anticipated that during and after rainfall events the volume of taking may have to be temporarily increased to control volume of runoff and seepage into open excavations. In the event of precipitation, water falling directly on the construction area will likely pool in excavation areas. In order for work to continue, the pooled water will need to be pumped. The volume of water associated with the proposed excavations has been estimated based on a 5 mm rainfall event as summarized below in Table 4 (refer to Table H-3, Appendix H).

Table 4: Estimated Runoff Volume

Source	Width of Excavation (m)	Length of Excavation (m)	Runoff Volume for 5 mm Rainfall Event (L)
Trench Excavations (per 100 m)	4	100	3,100
Cultec #1	16.9	22.5	2,300
Cultec #2	8.75	15.9	1,000

5.2.3 Total Taking

The total taking required has been calculated using both the groundwater seepage and the estimated surface water runoff and is provided in Table 5 (refer to Table H-4, Appendix H).

Table 5: Total Estimated Water Takings

Source	Max Groundwater Seepage (L/day)	Surface Water Runoff (L/day)	Total (L/day)	Total (L/min)
Trench Excavations (per 100 m)	22,900	3,100	26,000	18
Cultec #1	9,100	2,300	11,400	8
Cultec #2	3,600	1,000	4,600	3

The removal of subsurface water (dewatering) to facilitate construction is regulated by the MECP. Water taking in excess of 50,000 L/day but less than 400,000 L/day is regulated via an Environmental Sector Activity Registry (EASR) process. For takings in excess of 400,000 L/day, a Permit to Take Water (PTTW) will be required in accordance with provincial regulations prior to dewatering activities. Detailed groundwater impact assessment and monitoring plans are required to support EASR and PTTW applications. Based on the preliminary calculations completed, no permissions or permits will be required to manage the water taking. It is noted, however, that permissions are required to discharge the water to municipal services as discussed in Section 3.5.1.

5.3 Private Water Wells

The proposed development will be municipally serviced. However, as discussed in Section 3.1, several surrounding properties may still use private water supply wells. It is important that groundwater control during construction does not adversely affect these local groundwater supplies. As such, prior to construction, an appropriate monitoring and mitigation plan will be required during construction to ensure local groundwater supplies are not interrupted.

5.4 Well Decommissioning

In accordance with the Ontario Water Resource Act, Regulation 903 as amended (Wells Regulation), all inactive wells (water supply and monitoring wells) on the subject lands must be located and properly decommissioned by a licensed water well contractor, once they are no longer needed.

At least ten monitoring wells are located within the subject lands. The monitoring wells should be maintained as long as possible for use throughout construction. Once construction is complete, all monitoring wells that are no longer required must be decommissioned in accordance with the Wells Regulation and best management practices.

6.0 References

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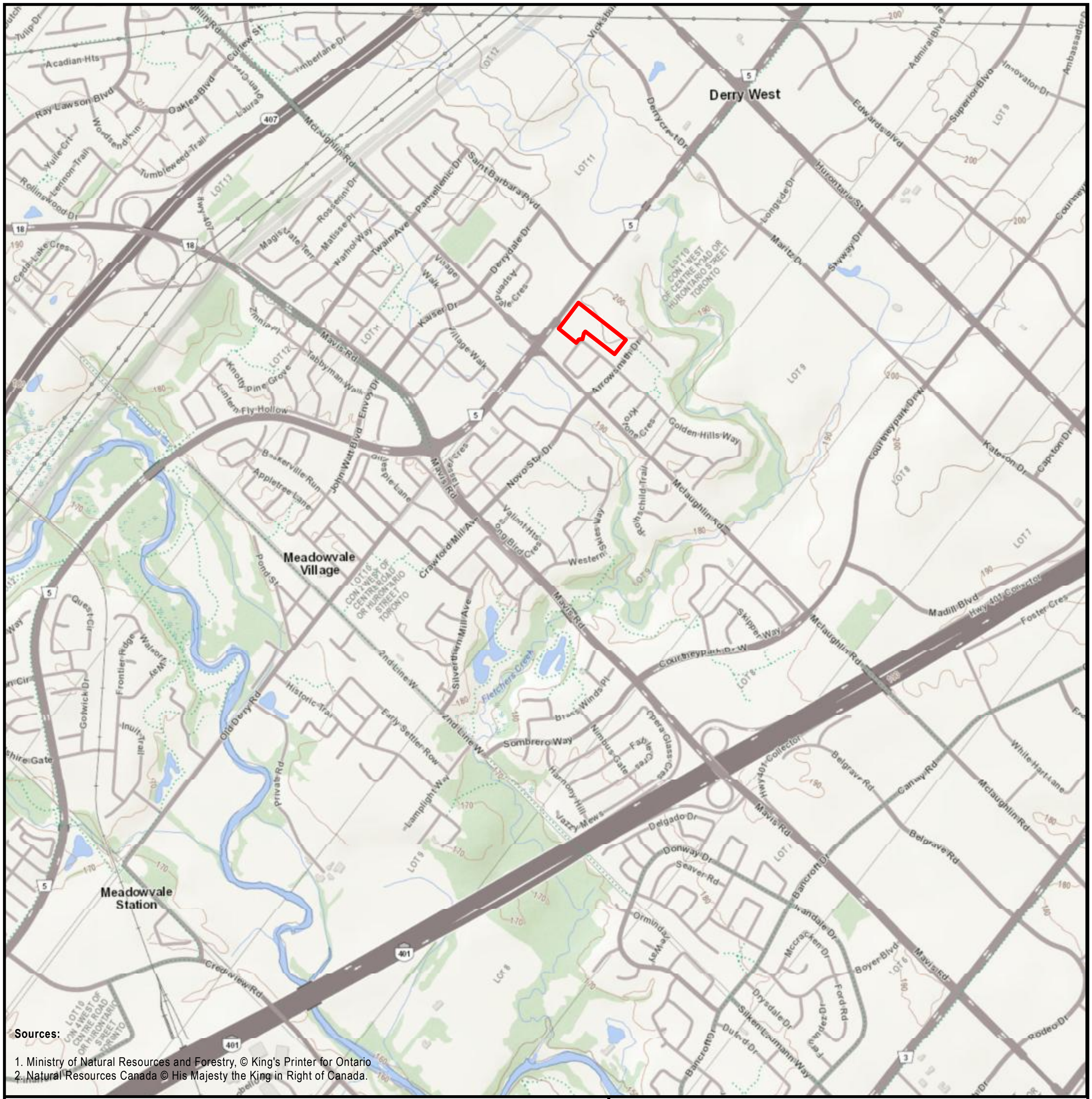
Figures



Sources:
1. Ministry of Natural Resources and Forestry, © King's Printer for Ontario
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LEGEND

🟥 SUBJECT LANDS

0 250 500 1,000 1,500
Metres

N

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Client / Report

BALLYMORE (UPTOWN MEADOWVALE) CORPORATION
376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title:

SITE LOCATION

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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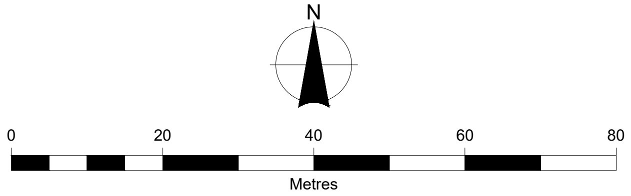
🟥 SUBJECT LANDS

Sources:
Development Concept Plan provided by Glen Schnarr & Associates In.



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376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO
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AND WATER BALANCE

Figure Title

DEVELOPMENT CONCEPT PLAN

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Scale		Project No.	
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File Name:Nigel/Shared Work Areas/055829 Greenvale homes/02_Production/ 056655 HG STUDY FIGURES.dwg Date Plotted: December 6, 2023 - 12:45 PM

Sources:

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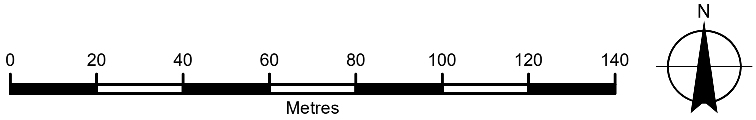
LEGEND

▭ SUBJECT LANDS

— CONTOUR (0.2m intervals - masl)

⊕ MONITORING WELL (FISHER, 2017)

⊕ MONITORING WELL (SOIL ENG., 2023)



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376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title:

MONITORING LOCATIONS AND TOPOGRAPHY

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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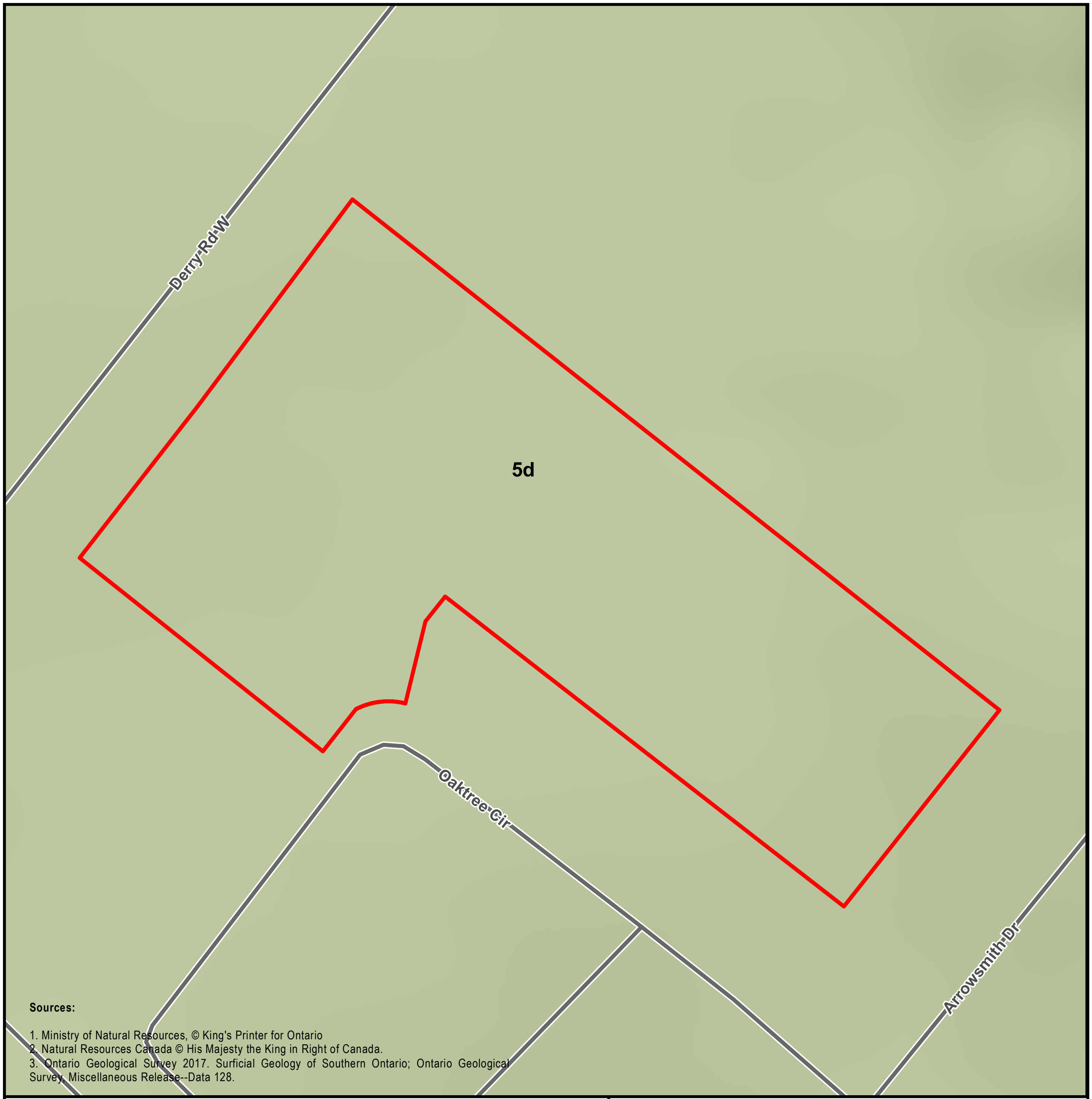
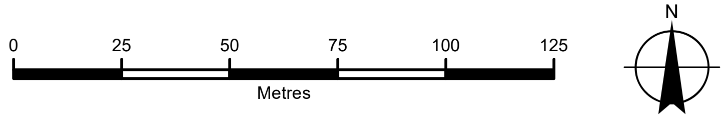


Sources:

1. Ministry of Natural Resources, © King's Printer for Ontario
2. Natural Resources Canada © His Majesty the King in Right of Canada.
3. Ontario Geological Survey 2017. Surficial Geology of Southern Ontario; Ontario Geological Survey Miscellaneous Release--Data 128.

LEGEND

🟥 SUBJECT LANDS
— ROADWAY
🟩 5d: Till: Glaciolacustrine-derived silty to clayey till



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376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title:

SURFICIAL GEOLOGY

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Scale		Project No.	
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LEGEND

▭	SUBJECT LANDS
◐	MONITORING WELL (FISHER, 2017)
◐	MONITORING WELL (SOIL ENG., 2023)
◐	MONITORING WELL (DESTROYED)
⊕	BOREHOLE (SOIL ENG., 2022)
⊕	BOREHOLE (FISHER,2017)
⊕	BOREHOLE (SOIL ENG., 2023)
●	MECP WELL RECORD LOCATION
A A'	CROSS-SECTION LOCATION KEY

N

0 20 40 60 80
Metres

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HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title

BOREHOLE, MONITORING WELL AND CROSS-SECTION LOCATIONS

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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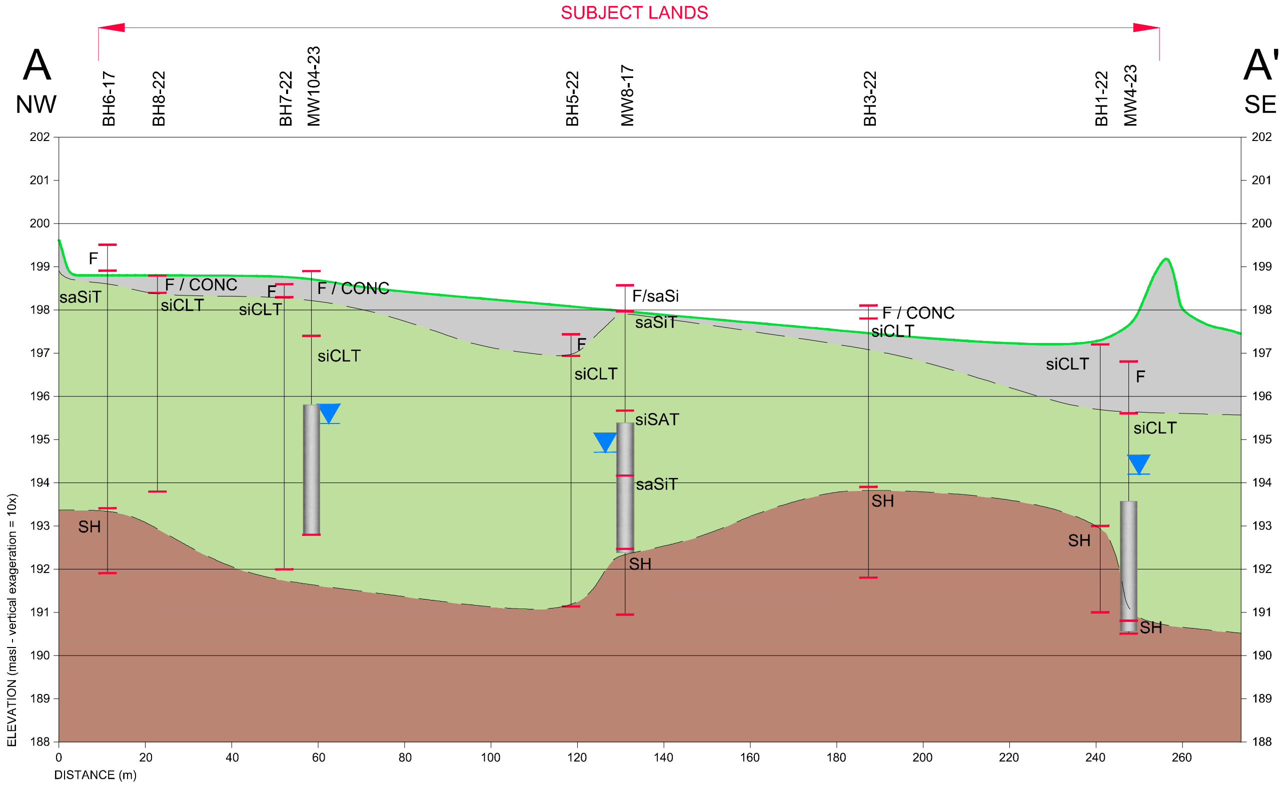

LEGEND

BH1 WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

MEASURED WATER LEVEL (APRIL, 2023)

WELL SCREEN

— — — INTERPRETED STRATIGRAPHY

▨ FILL / CONCRETE

🟩 SILT / CLAY / TILL

🟨 SAND / SILTY SAND

🟫 BEDROCK / SHALE

si	SILTY
sa	SANDY
cl	CLAYEY
TS	TOPSOIL
F	FILL
CONC	CONCRETE
T	TILL
GR	GRAVEL
SA	SAND
Si	SILT
CL	CLAY
ST	STONES
SH	SHALE

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376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION A-A'

Drawn SK	Checked MM	Date December 2023	Figure No. 6
Scale 1:1,000		Project No. 300056655	

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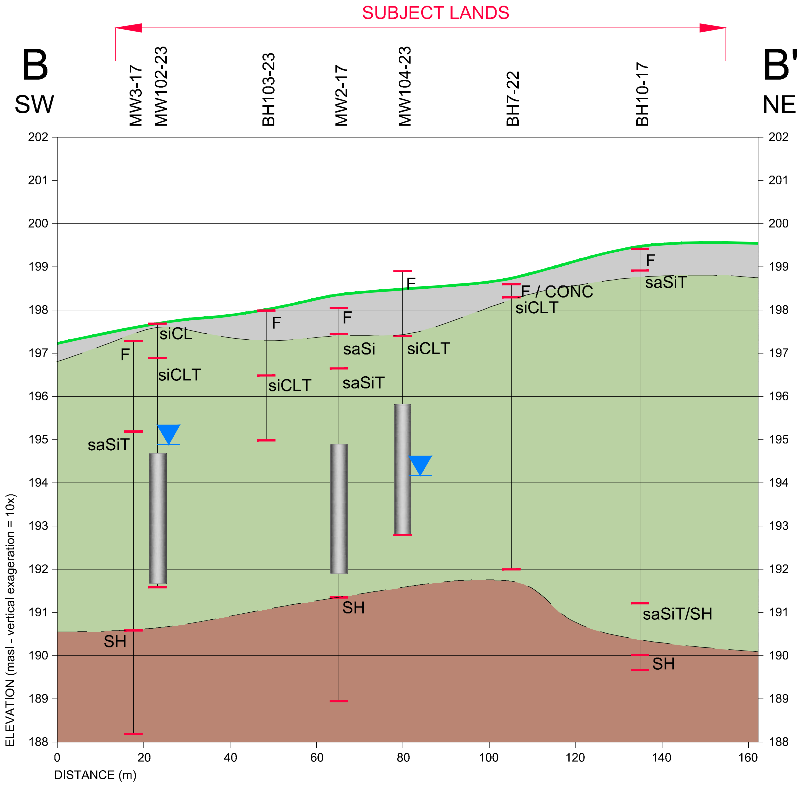

LEGEND

BH1 WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

▼ MEASURED WATER LEVEL (APRIL, 2023)

WELL SCREEN

— — — INTERPRETED STRATIGRAPHY

▨ FILL / CONCRETE

🟩 SILT / CLAY / TILL

🟨 SAND / SILTY SAND

🟫 BEDROCK / SHALE

si	SILTY
sa	SANDY
cl	CLAYEY
TS	TOPSOIL
F	FILL
CONC	CONCRETE
T	TILL
GR	GRAVEL
SA	SAND
Si	SILT
CL	CLAY
ST	STONES
SH	SHALE

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MISSISSAUGA, ONTARIO
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE

Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION B-B'

Drawn SK	Checked MM	Date December 2023	Figure No. 7
Scale 1:1,000		Project No. 300056655	

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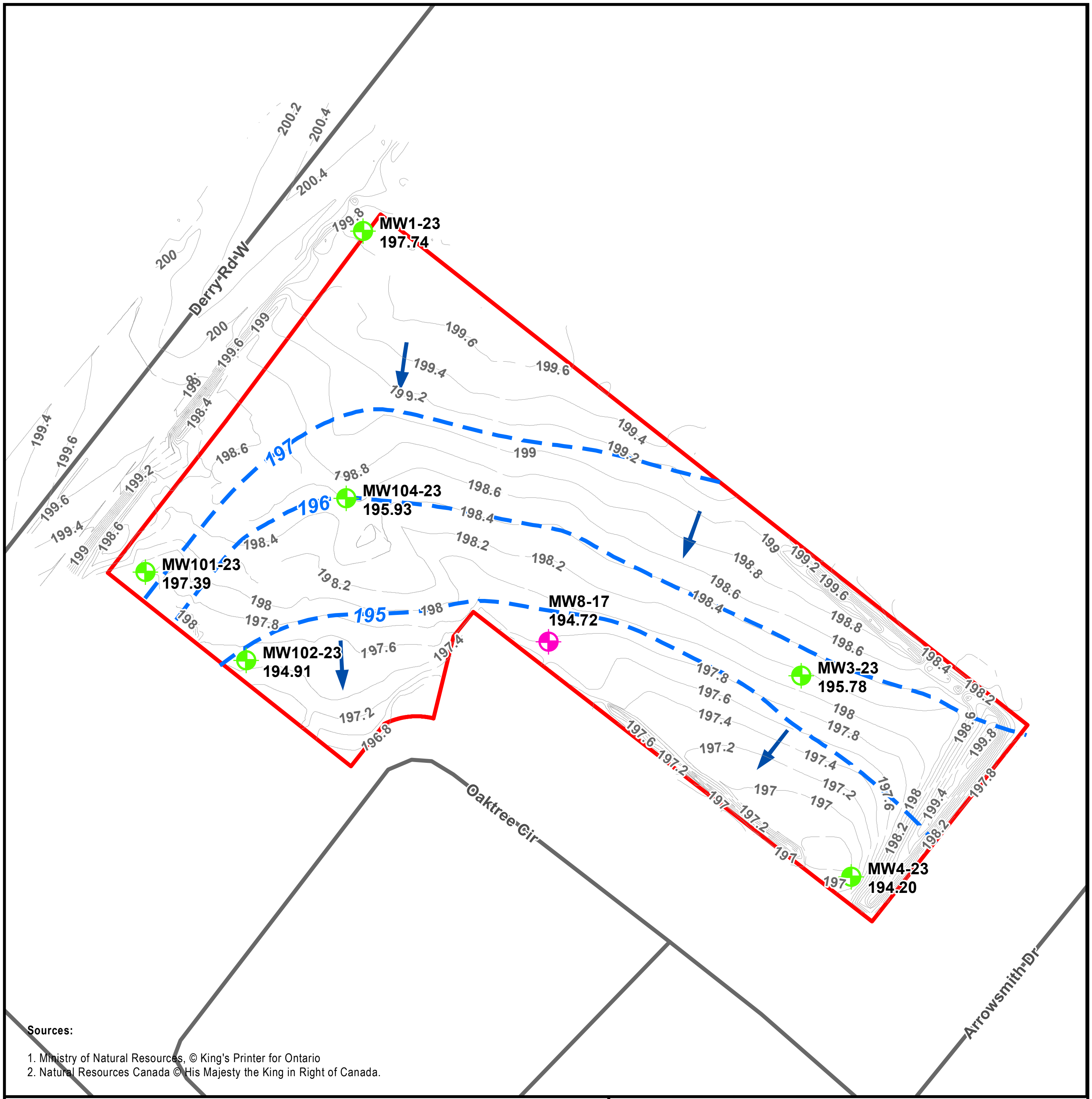

Sources:

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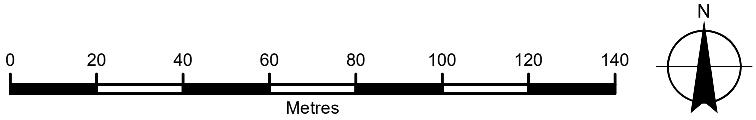
LEGEND

▭	SUBJECT LANDS
—	ROADWAY
—	CONTOUR (0.2m intervals - masl)
⊕	MONITORING WELL (FISHER, 2017)
⊕	MONITORING WELL (SOIL ENG., 2023)
– –	INTERPRETED GROUNDWATER CONTOUR (masl)
253.35	MEASURED WATER LEVEL - masl (April, 2023)
←	INTERPRETED GROUNDWATER FLOW DIRECTION



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376 & 390 DERRY ROAD & 0 OAKTREE CIRCLE
MISSISSAUGA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE

Figure Title:

INTERPRETED SHALLOW GROUNDWATER FLOW

Drawn	Checked	Date	Figure No.
SK	MM	December 2023	8
Scale		Project No.	
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Path:Nigel/Shared Work Areas/ A:\056655 Derry Rd W06_GIS\056655 Groundwater Flow.mxd Date Saved: Tuesday, November 21, 2023

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Appendix A

MECP Water Well Records

Water Well Records

Wednesday, October 18, 2023

11:19:15 AM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
MISSISSAUGA CITY	17 603538 4832335 W	2017/11 7472	2			MO	0162 5	7306441 (Z277205) A234762	GREY ---- HARD 0001 GREY CLAY SILT PCKD 0035 GREY SHLE HARD 0167
MISSISSAUGA CITY	17 603422 4832270 W	2019/03 7241	2		///:	MT	0017 10	7341411 (Z310397) A265760	BLCK ---- 0000 BRWN FILL 0002 BRWN SILT CLAY 0025 RED SHLE 0027
MISSISSAUGA CITY	17 603835 4832378 W	2013/04 7230						7205648 (C20275) A139254 P	
MISSISSAUGA CITY	17 603813 4832631 W	2013/08 7247	2			MT	0017 5	7212109 (Z166400) A144396	BRWN TILL 0010 GREY CLAY TILL 0022
MISSISSAUGA CITY	17 603324 4832399 W	2014/02 7472	2.04			MO	0010 10	7217924 (Z184979) A161344	BRWN GRVL FSND LOOS 0002 BRWN SILT FSND PCKD 0010 BRWN SILT FSND PCKD 0015 GREY SHLE PCKD 0020
MISSISSAUGA CITY	17 603752 4832377 W	2014/07 7383	2	0015		MO	0010 10	7225638 (Z190458) A166504	FILL 0004 CLAY 0018 SHLE 0020
MISSISSAUGA CITY	17 603630 4832400 W	2016/11 6946		UT				7276563 (Z243185) A203347 A	
MISSISSAUGA CITY	17 603575 4832353 W	2006/03 7075	1.76	0021			0005 31	4910137 (Z43572) A039229 A	BRWN CLAY SLTY SAND 0007 BRWN CLAY SLTY SAND 0016 GREY CLAY SLTY SHLE 0021
MISSISSAUGA CITY	17 603719 4832628 W	2017/11 7472	2			MO	0152 5	7306442 (Z277206) A234770	GREY ---- HARD 0001 GREY CLAY SILT PCKD 0050 GREY SHLE HARD 0157
MISSISSAUGA CITY	17 603289 4832091 W	2017/10 7472	2			MO	0155 5	7306443 (Z269104) A234771	GREY ---- HARD 0001 BRWN FILL LOAM PCKD 0014 GREY SHLE LMSN HARD 0180
MISSISSAUGA CITY	17 603909 4832726 W	2017/08 7230						7306842 (C41577) A229434 P	
MISSISSAUGA CITY	17 603443 4832327 W	2019/03 7241	2		///:	MT	0017 10	7341408 (Z310395) A265757	BLCK ---- 0000 BRWN FILL 0002 BRWN SILT CLAY 0025 RED SHLE 0027
MISSISSAUGA CITY	17 603452 4832311 W	2019/03 7241	2		///:	MT	0017 10	7341409 (Z310396) A265758	BLCK ---- 0000 BRWN FILL 0002 BRWN SILT CLAY 0025 RED SHLE 0027

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
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MISSISSAUGA CITY HS W 01 010	17 603945 4832773 W	1984/06 3132	6 6	FR 0054	25/180/13/3:0	DO		4906199 () A	BRWN CLAY STNS DNSE 0033 RED CLAY STNS DNSE 0054 RED SHLE WBRG HARD 0056 BLUE SHLE HARD 0074 BLUE SHLE HARD 0185
MISSISSAUGA CITY HS W 01 010	17 603599 4832400 W	1964/05 1307	30	FR 0037	25//1/:	DO		4902506 ()	BRWN LOAM CLAY 0008 RED CLAY 0025 RED SHLE 0037
MISSISSAUGA CITY HS W 01 010	17 603681 4832203 W	1978/03 3349	6	FR 0102	12/102/10/1:0	DO		4905313 ()	BRWN CLAY SAND 0024 GREY CLAY 0072 GREY FSND 0094 GREY CSND GRVL 0102
MISSISSAUGA CITY HS W 01 010	17 603908 4832767 W	1965/10 1307	30	FR 0040	25//1/:	DO		4902507 ()	BRWN LOAM CLAY 0012 GREY CLAY 0035 RED SHLE 0046
MISSISSAUGA CITY HS W 01 010	17 603664 4832478 W	1955/07 3512	4 4	FR 0069	25/62/5/:	DO		4902503 ()	BLUE CLAY 0026 MSND GRVL 0034 RED CLAY 0038 BLUE CLAY 0048 BLUE SHLE 0078
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MISSISSAUGA CITY HS W 01 010	17 603663 4832418 W	2016/11 6946		UT				7276562 (Z243184) A203346 A	
MISSISSAUGA CITY HS W 01 010	17 603897 4832753 W	2018/11 3108			///:			7325059 (Z305588) A	
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MISSISSAUGA CITY HS W 01 011	17 603695 4832683 W	1978/05 3349	6	FR 0055	26/56/10/1:0	DO		4905539 ()	BLCK LOAM 0001 BRWN CLAY 0023 RED SHLE 0060
MISSISSAUGA CITY HS W 01 011	17 603868 4832827 W	1964/08 1307	30	FR 0037	0//1/:	DO		4902510 ()	BRWN LOAM CLAY 0010 GREY CLAY 0028 RED CLAY 0037 CSND 0038 RED CLAY 0040 RED SHLE 0041
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MISSISSAUGA CITY HS W 02 011	17 603315 4832303 W	1977/09 3349	6	FR 0086	0/48/7/1:0	DO		4905317 ()	BLCK LOAM 0002 BRWN CLAY STNS 0038 GREY SAND 0084 GREY GRVL 0086
MISSISSAUGA CITY HS W 02 011	17 603235 4832403 W	1977/11 3814	30	FR 0025	8/40/3/1:0	DO		4905287 ()	GREY LOAM 0025 GRVL 0027 GRVL WBRG 0042
MISSISSAUGA CITY HS W 02 011	17 603235 4832123 W	1976/01 3349	6 6	FR 0047	10/80/10/0:30	DO		4904911 ()	BLCK LOAM LOOS 0002 BRWN CLAY STNS 0022 RED SHLE 0080
MISSISSAUGA CITY HS W 02 011	17 603215 4832143 W	1975/12 3349	6 6	FR 0064	12/200/10/0:40			4904910 () A	BLCK LOAM LOOS 0002 BRWN CLAY STNS 0021 RED CLAY SHLE 0162 BLUE SHLE HARD 0200
MISSISSAUGA CITY HS W 02 011	17 603267 4832083 W	1973/06 1660	6 6	FR 0060	18/60/1/1:0	DO		4904271 ()	BRWN LOAM 0001 BRWN CLAY BLDR 0015 BLUE CLAY 0024 RED SHLE 0065

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
MISSISSAUGA CITY HS W 02 011	17 603300 4832132 W	1956/07 1612	4 4	FR 0043	8/32/0/2:0	DO		4902561 ()	LOAM 0001 RED CLAY 0010 RED SHLE 0043

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Borehole and Monitoring Well Logs

Appendix B

FISHER ENVIRONMENTAL LTD.

Log of Borehole: MW1

376, 390 Derry Road West
Mississauga, Ontario

Sheet: 1 of 10

Project #: 16-7880

G.S.Elevation: 197.69 m asl

Location:

Drill Method: Diedrich 50

Drilling Date: 20 September 2016

Sample Method: Split Spoon

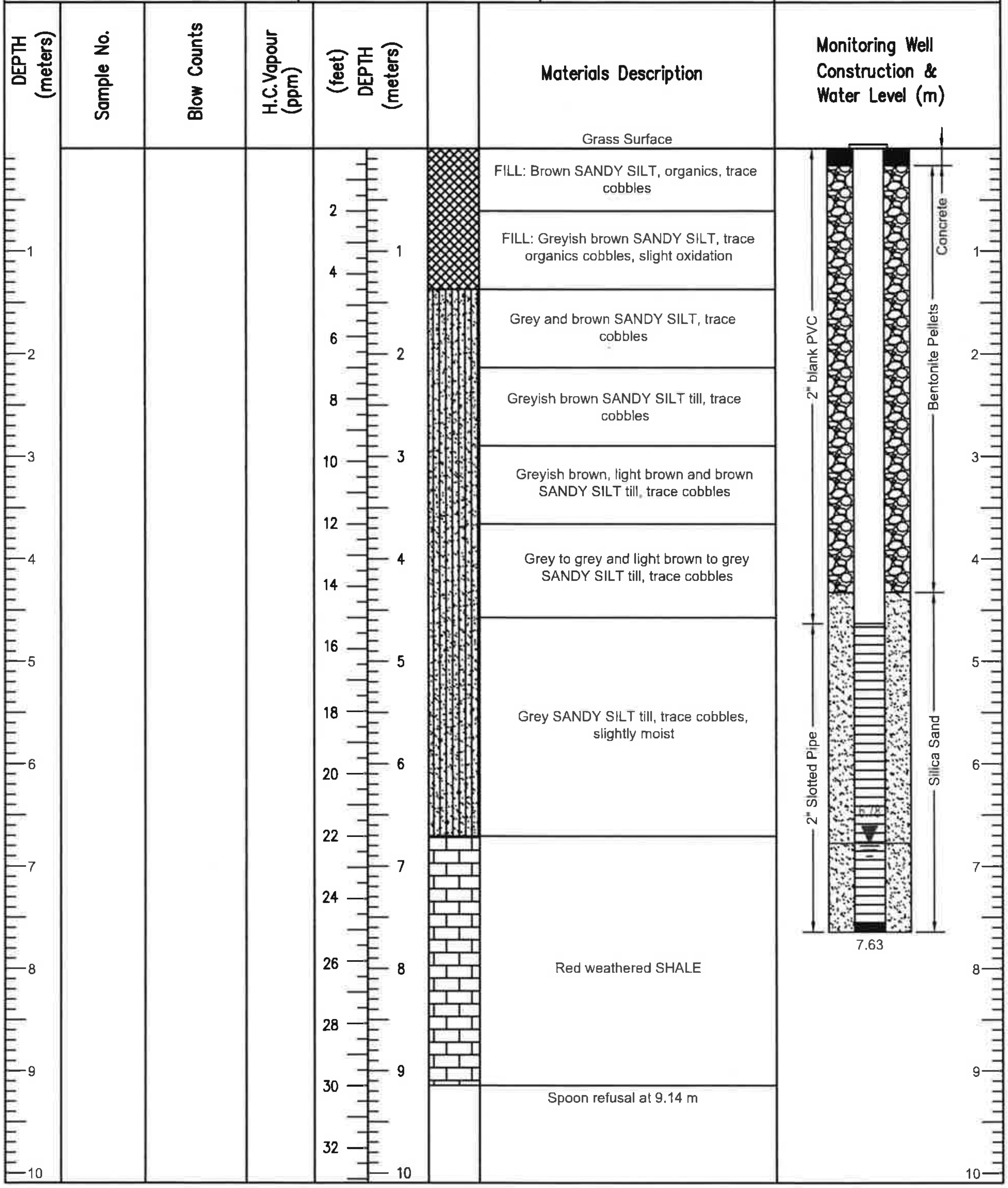
Dates: Water Level 06 October 2016

Borehole Diameter: 4"

Water Level: 6.78m

Logged By: HU

Checked By: KT



Materials Description

Grass Surface

FILL: Brown SANDY SILT, organics, trace cobbles

FILL: Greyish brown SANDY SILT, trace organics cobbles, slight oxidation

Grey and brown SANDY SILT, trace cobbles

Greyish brown SANDY SILT till, trace cobbles

Greyish brown, light brown and brown SANDY SILT till, trace cobbles

Grey to grey and light brown to grey SANDY SILT till, trace cobbles

Grey SANDY SILT till, trace cobbles, slightly moist

Red weathered SHALE

Spoon refusal at 9.14 m

FISHER
ENVIRONMENTAL LTD.

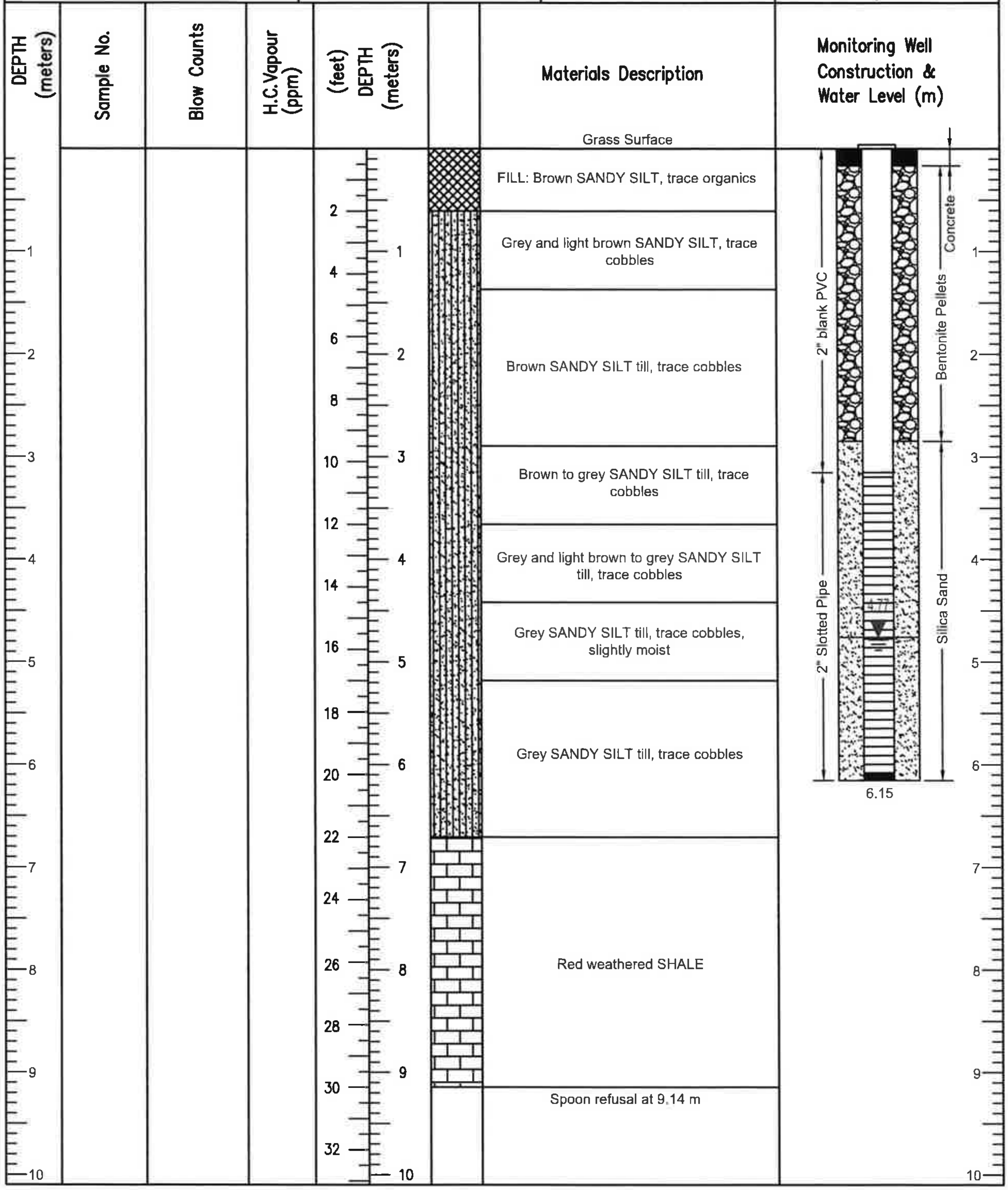
Log of Borehole: MW2
376, 390 Derry Road West
Mississauga, Ontario

Sheet: 2 of 10
Project #: 16-7880
G.S.Elevation: 198.08 m asl

Location:

Drill Method: Diedrich 50
Drilling Date: 20 September 2016
Sample Method: Split Spoon
Dates: Water Level 06 October 2016
Borehole Diameter: 4"
Water Level: 4.77m
Logged By: HU
Checked By: KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)



Grass Surface

- FILL: Brown SANDY SILT, trace organics
- Grey and light brown SANDY SILT, trace cobbles
- Brown SANDY SILT till, trace cobbles
- Brown to grey SANDY SILT till, trace cobbles
- Grey and light brown to grey SANDY SILT till, trace cobbles
- Grey SANDY SILT till, trace cobbles, slightly moist
- Grey SANDY SILT till, trace cobbles
- Red weathered SHALE
- Spoon refusal at 9.14 m

FISHER ENVIRONMENTAL LTD.

Log of Borehole: MW3
376, 390 Derry Road West
Mississauga, Ontario

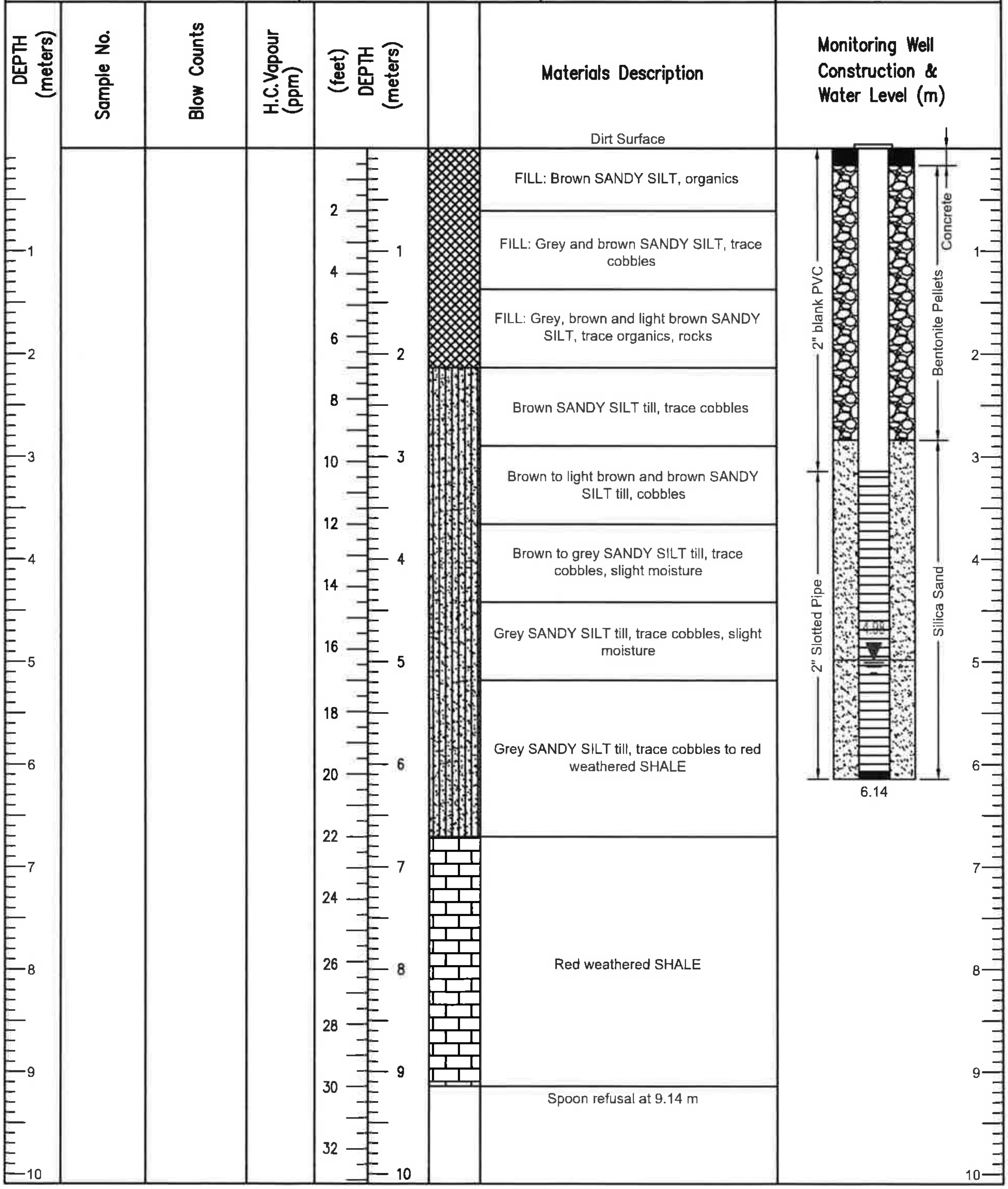
Sheet: 3 of 10
Project #: 16-7880
G.S.Elevation: 197.28 m asl

Location:

Drill Method: Diedrich 50
Drilling Date: 20 September 2016

Sample Method: Split Spoon
Dates: Water Level 06 October 2016

Borehole Diameter: 4"
Water Level: 4.98m
Logged By: HU
Checked By: KT



FILL: Brown SANDY SILT, organics

FILL: Grey and brown SANDY SILT, trace cobbles

FILL: Grey, brown and light brown SANDY SILT, trace organics, rocks

Brown SANDY SILT till, trace cobbles

Brown to light brown and brown SANDY SILT till, cobbles

Brown to grey SANDY SILT till, trace cobbles, slight moisture

Grey SANDY SILT till, trace cobbles, slight moisture

Grey SANDY SILT till, trace cobbles to red weathered SHALE

Red weathered SHALE

Spoon refusal at 9.14 m

FISHER ENVIRONMENTAL LTD.

Log of Borehole: BH4

376, 390 Derry Road West
Mississauga, Ontario

Sheet: 4 of 10

Project #: 16-7880

G.S.Elevation: 197.29 m asl

Location:

Drill Method: Diedrich 50

Drilling Date: 20 September 2016

Sample Method: Split Spoon

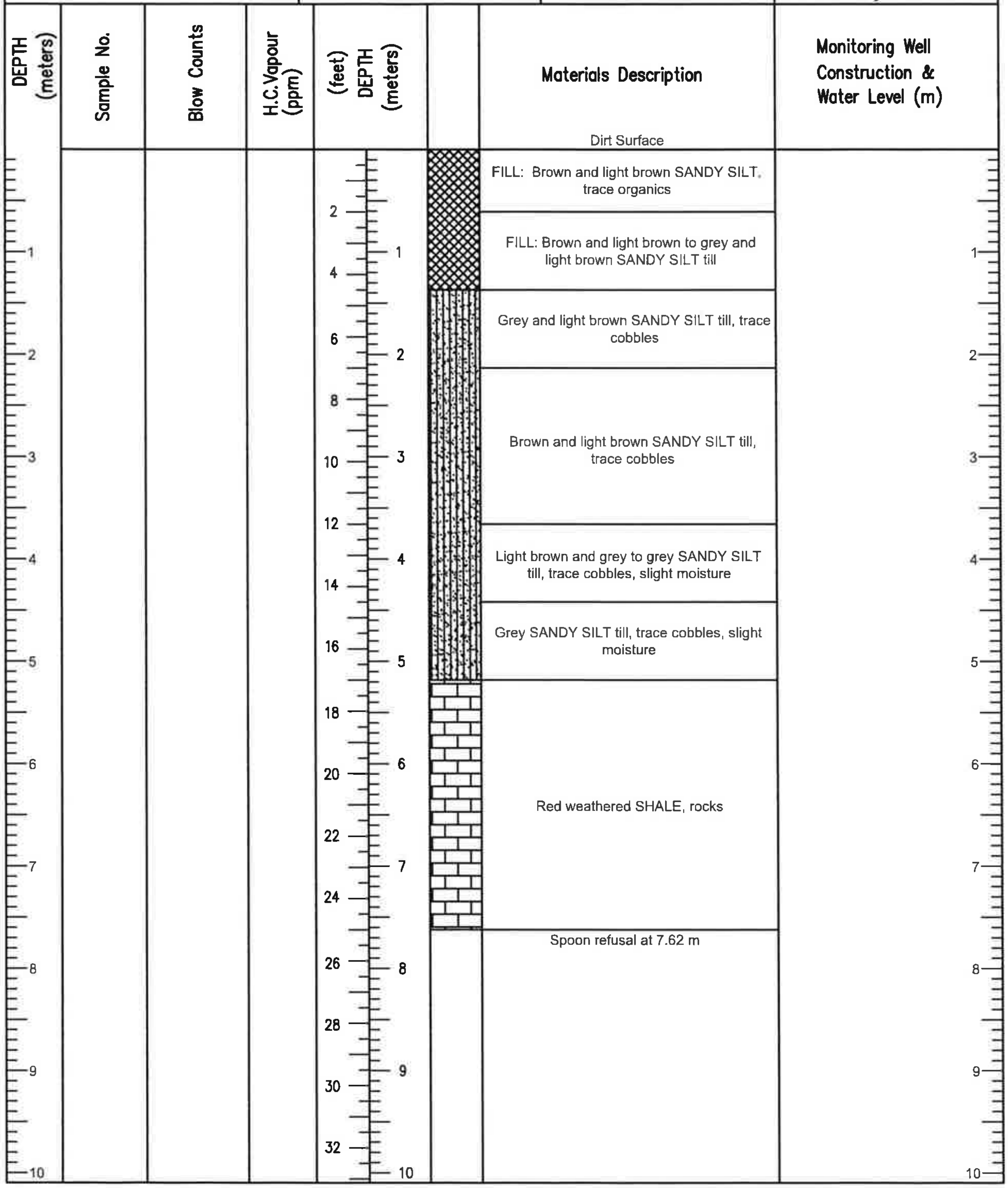
Dates: Water Level

Borehole Diameter: 4"

Water Level:

Logged By: HU

Checked By: KT



Dirt Surface

FILL: Brown and light brown SANDY SILT, trace organics

FILL: Brown and light brown to grey and light brown SANDY SILT till

Grey and light brown SANDY SILT till, trace cobbles

Brown and light brown SANDY SILT till, trace cobbles

Light brown and grey to grey SANDY SILT till, trace cobbles, slight moisture

Grey SANDY SILT till, trace cobbles, slight moisture

Red weathered SHALE, rocks

Spoon refusal at 7.62 m

FISHER ENVIRONMENTAL LTD.

Log of Borehole: BH5

376, 390 Derry Road West
Mississauga, Ontario

Sheet: 5 of 10

Project #: 16-7880

G.S.Elevation: 196.90 m asl

Location:

Drill Method: Diedrich 50

Drilling Date: 21 September 2016

Sample Method: Split Spoon

Dates: Water Level

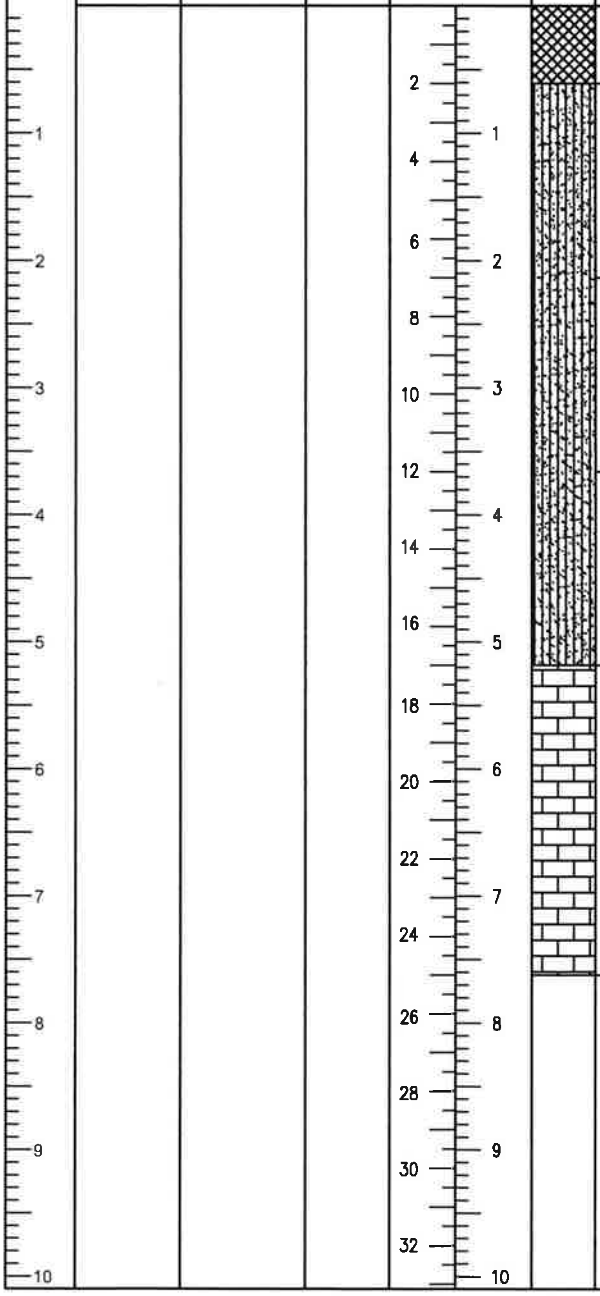
Borehole Diameter: 4"

Water Level:

Logged By: HU

Checked By: KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)
						Dirt Surface	
						FILL: Brown SANDY SILT, trace organics and cobbles	
						Brown SANDY SILT, trace cobbles	
						Brown to light brown and brown SANDY SILT till, trace cobbles	
						Grey SANDY SILT till, trace cobbles, slight moisture	
						Red weathered SHALE, trace cobbles and rocks	
						Spoon refusal at 7.62 m	



FISHER ENVIRONMENTAL LTD.

Log of Borehole: BH6
376, 390 Derry Road West
Mississauga, Ontario

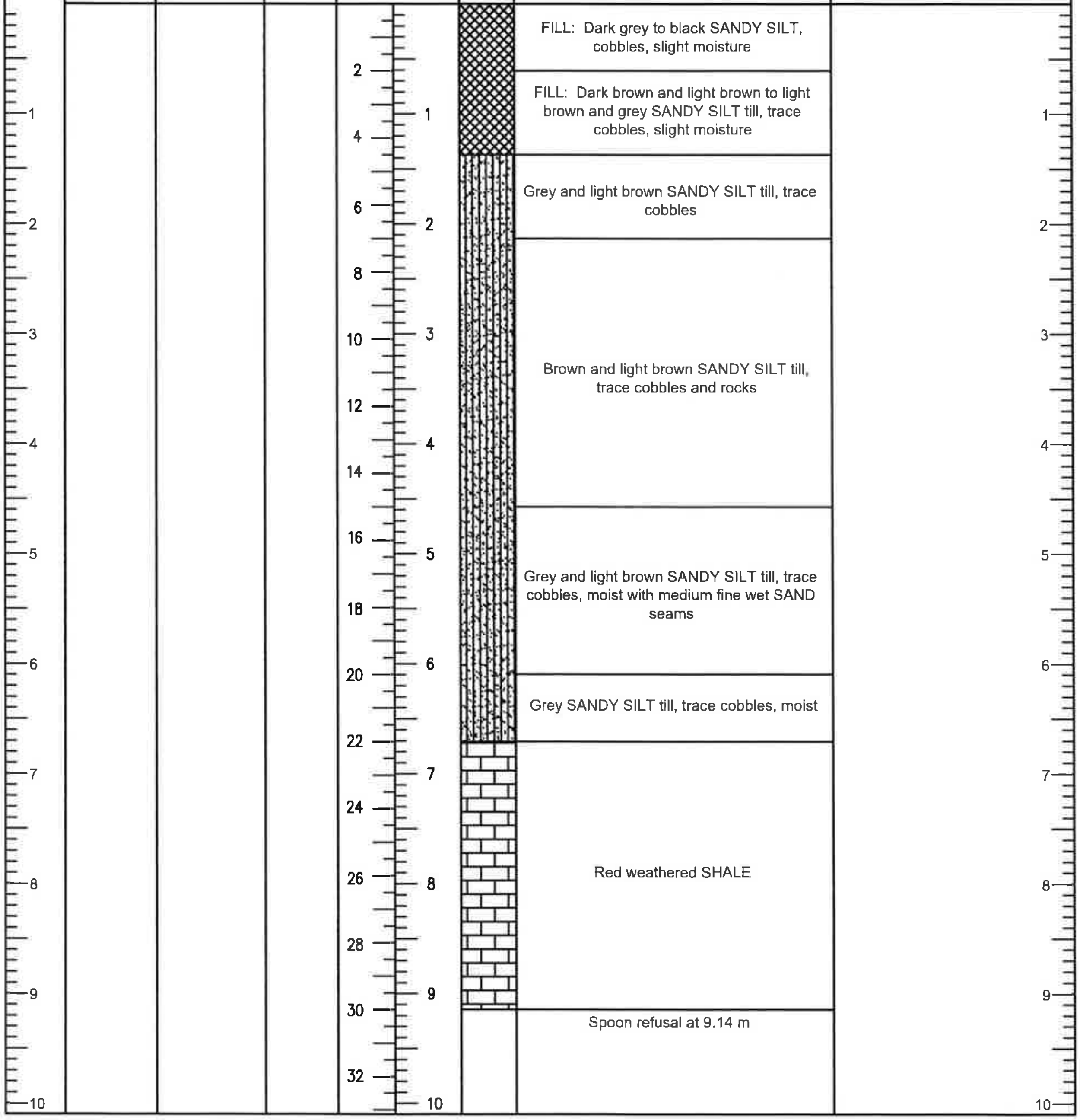
Sheet: 6 of 10
Project #: 16-7880
G.S.Elevation: 198.80 m asl

Location:

Drill Method: Diedrich 50
Drilling Date: 21 September 2016
Sample Method: Split Spoon
Dates: Water Level
Borehole Diameter: 4"
Water Level:
Logged By: HU
Checked By: KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)

Dirt Surface



FILL: Dark grey to black SANDY SILT, cobbles, slight moisture

FILL: Dark brown and light brown to light brown and grey SANDY SILT till, trace cobbles, slight moisture

Grey and light brown SANDY SILT till, trace cobbles

Brown and light brown SANDY SILT till, trace cobbles and rocks

Grey and light brown SANDY SILT till, trace cobbles, moist with medium fine wet SAND seams

Grey SANDY SILT till, trace cobbles, moist

Red weathered SHALE

Spoon refusal at 9.14 m

FISHER ENVIRONMENTAL LTD.

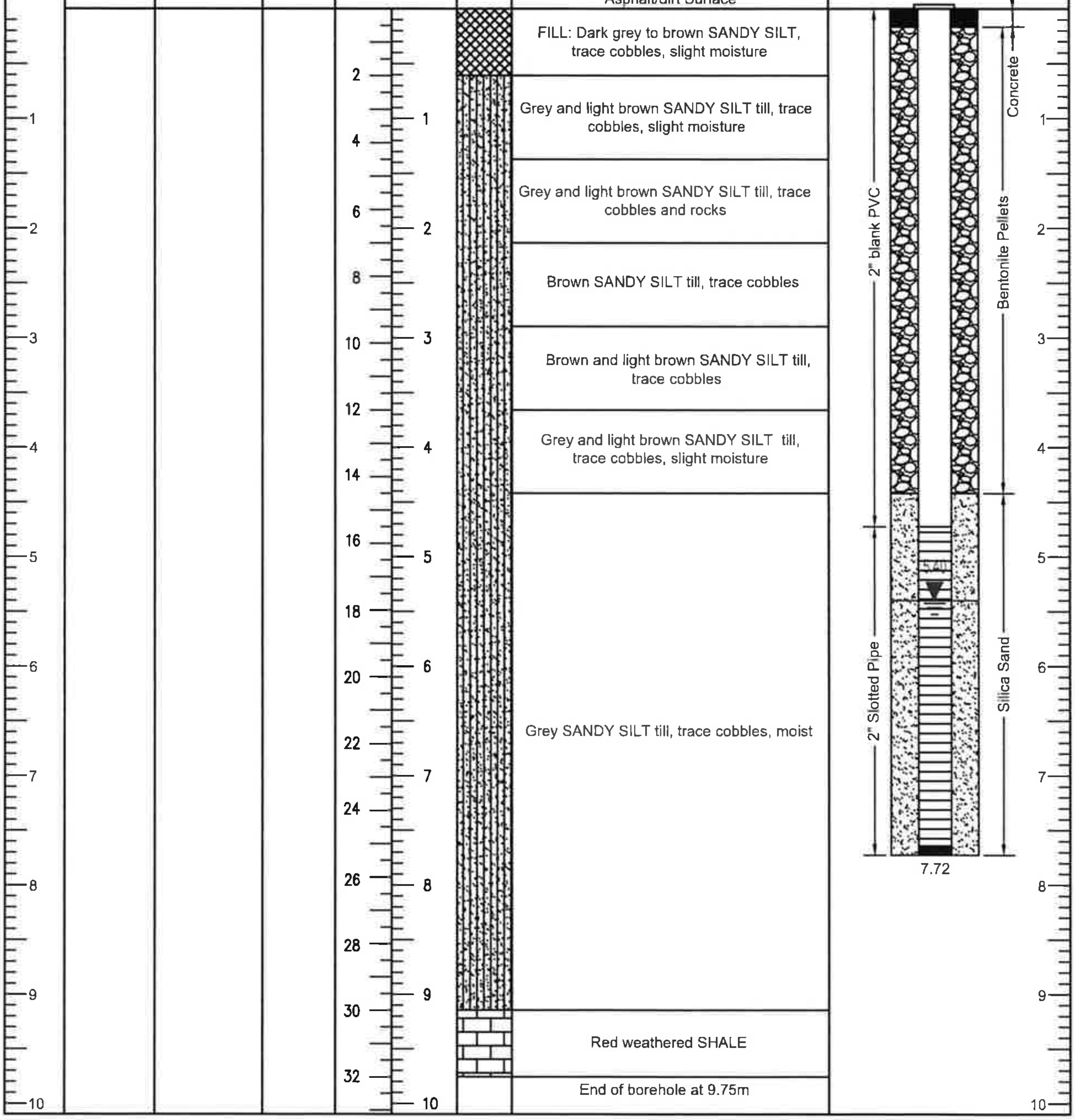
Log of Borehole: MW7
376, 390 Derry Road West
Mississauga, Ontario

Sheet: 7 of 10
Project #: 16-7880
G.S.Elevation: 199.65 m asl

Location:

Drill Method: Diedrich 50
Drilling Date: 21 September 2016
Sample Method: Split Spoon
Dates: Water Level 06 October 2016
Borehole Diameter: 4"
Water Level: 5.40m
Logged By: HU
Checked By: KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)



Asphalt/dirt Surface

FILL: Dark grey to brown SANDY SILT, trace cobbles, slight moisture

Grey and light brown SANDY SILT till, trace cobbles, slight moisture

Grey and light brown SANDY SILT till, trace cobbles and rocks

Brown SANDY SILT till, trace cobbles

Brown and light brown SANDY SILT till, trace cobbles

Grey and light brown SANDY SILT till, trace cobbles, slight moisture

Grey SANDY SILT till, trace cobbles, moist

Red weathered SHALE

End of borehole at 9.75m

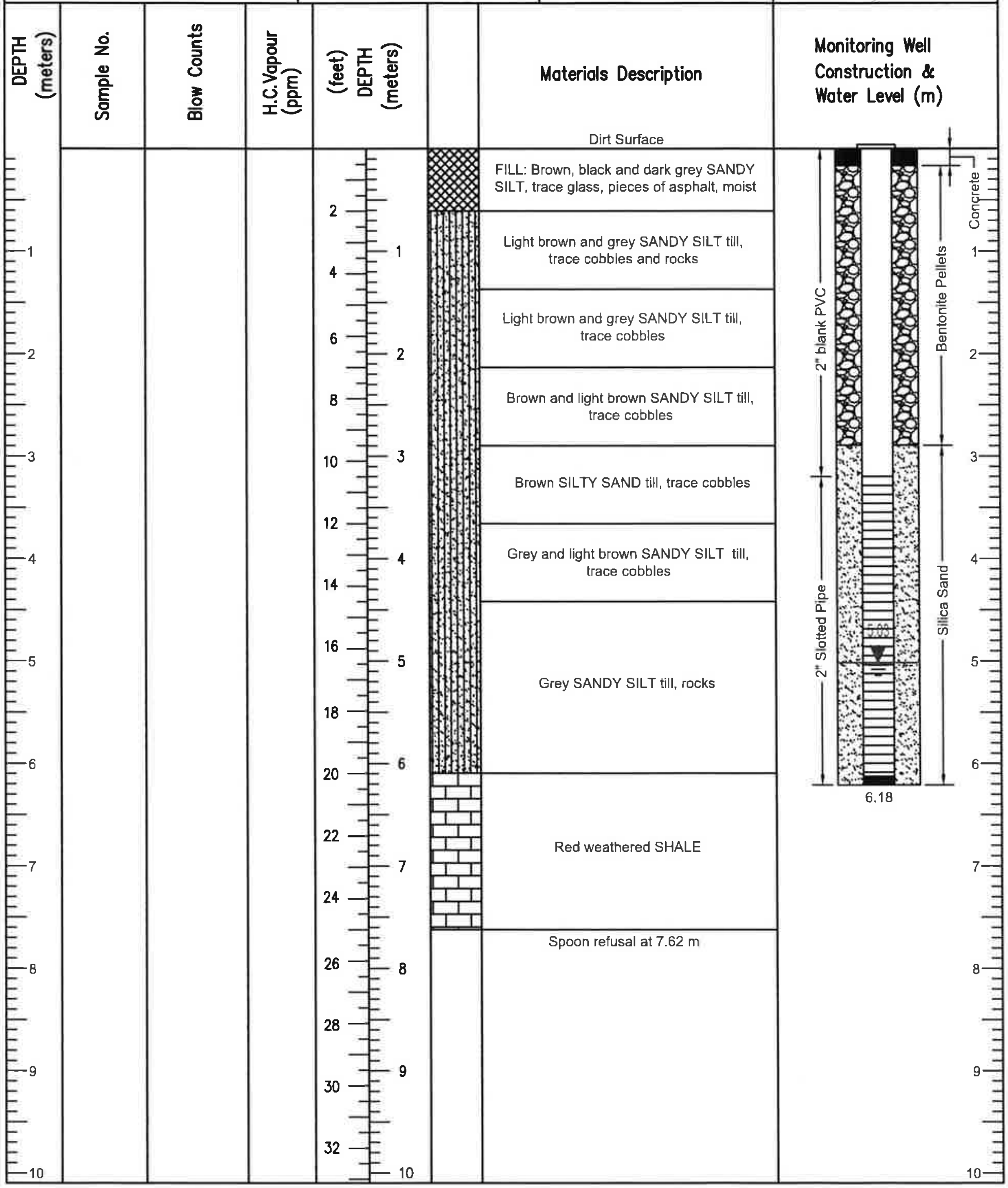
FISHER ENVIRONMENTAL LTD.

Log of Borehole: MW8
376, 390 Derry Road West
Mississauga, Ontario

Sheet: 8 of 10
Project #: 16-7880
G.S.Elevation: 197.57 m asl

Location:

Drill Method: Diedrich 50		**Drilling Date:** 21 September 2016	
Sample Method: Split Spoon		**Dates: Water Level** 06 October 2016	
Borehole Diameter: 4"	**Water Level:** 5.03m	**Logged By:** HU	**Checked By:** KT



Dirt Surface

FILL: Brown, black and dark grey SANDY SILT, trace glass, pieces of asphalt, moist

Light brown and grey SANDY SILT till, trace cobbles and rocks

Light brown and grey SANDY SILT till, trace cobbles

Brown and light brown SANDY SILT till, trace cobbles

Brown SILTY SAND till, trace cobbles

Grey and light brown SANDY SILT till, trace cobbles

Grey SANDY SILT till, rocks

Red weathered SHALE

Spoon refusal at 7.62 m

FISHER ENVIRONMENTAL LTD.

Log of Borehole: MW9
376, 390 Derry Road West
Mississauga, Ontario

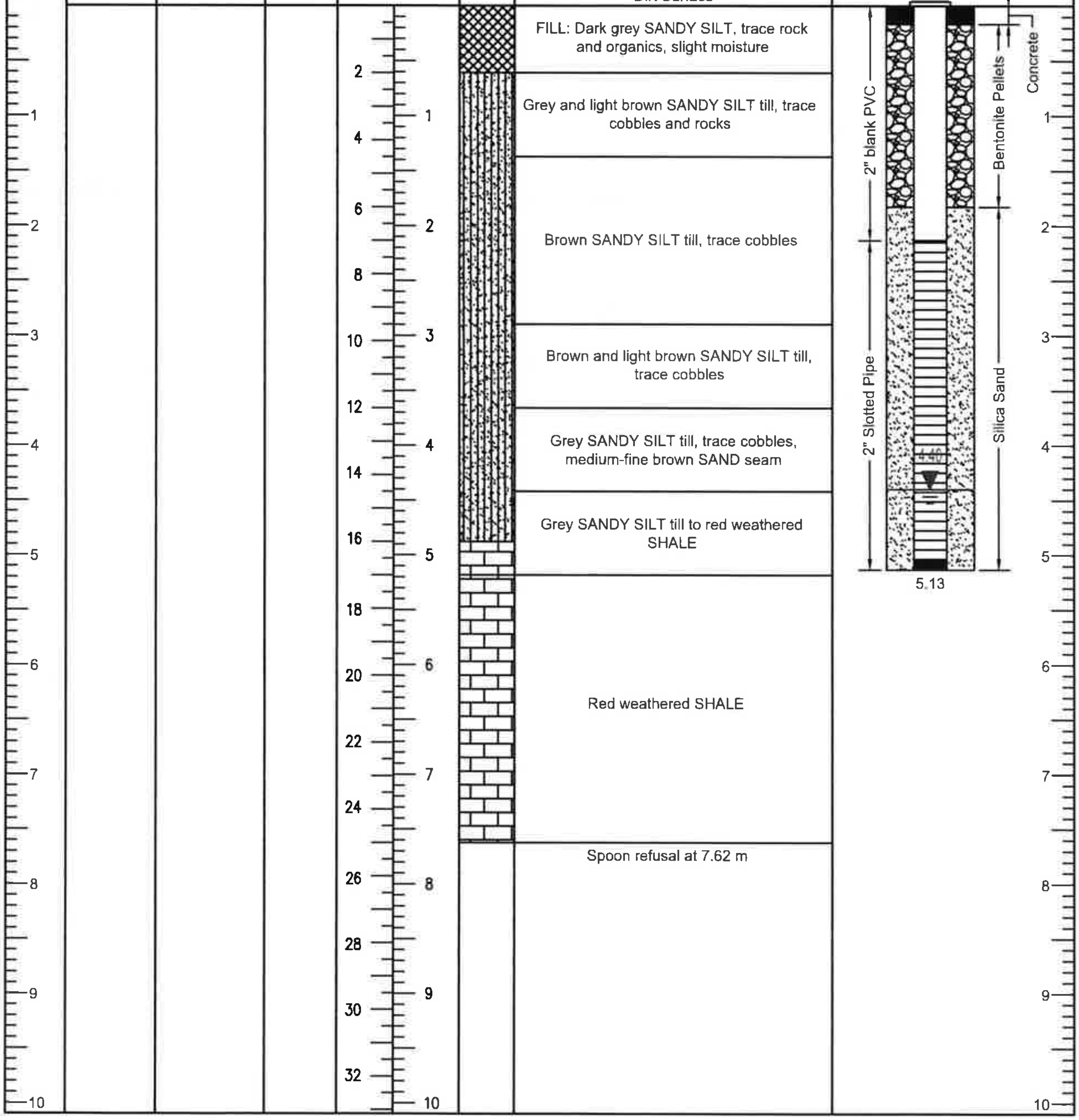
Sheet: 9 of 10
Project #: 16-7880
G.S.Elevation: 198.08 m asl

Location:

Drill Method: Diedrich 50
Drilling Date: 21 September 2016
Sample Method: Split Spoon
Dates: Water Level 06 October 2016
Borehole Diameter: 4"
Water Level: 4.40m
Logged By: HU
Checked By: KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)

Dirt Surface



FILL: Dark grey SANDY SILT, trace rock and organics, slight moisture

Grey and light brown SANDY SILT till, trace cobbles and rocks

Brown SANDY SILT till, trace cobbles

Brown and light brown SANDY SILT till, trace cobbles

Grey SANDY SILT till, trace cobbles, medium-fine brown SAND seam

Grey SANDY SILT till to red weathered SHALE

Red weathered SHALE

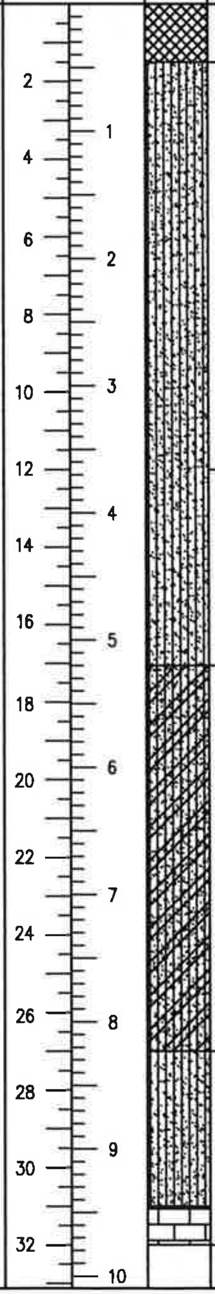
Spoon refusal at 7.62 m

FISHER ENVIRONMENTAL LTD.	**Log of Borehole:** BH10 376, 390 Derry Road West Mississauga, Ontario	**Sheet:** 10 of 10 **Project #:** 16-7880 **G.S.Elevation:** 199.45 m asl

Location:

Drill Method: Diedrich 50		**Drilling Date:** 22 September 2016	
Sample Method: Split Spoon		**Dates: Water Level**	
Borehole Diameter: 4"	**Water Level:**	**Logged By:** HU	**Checked By:** KT

DEPTH (meters)	Sample No.	Blow Counts	H.C.Vapour (ppm)	(feet) DEPTH (meters)		Materials Description	Monitoring Well Construction & Water Level (m)
						Dirt Surface	



FILL: Brown SAND and cobbles, moist

Brown to dark grey SANDY SILT till, trace cobbles

Grey SANDY SILT till

Grey SANDY SILT till, wet SAND seams, some CLAY

Grey SANDY SILT till to red weathered SHALE

End of borehole at 9.75m

JOB NO.: 2203-S020

LOG OF BOREHOLE: 1

FIGURE NO.: 1

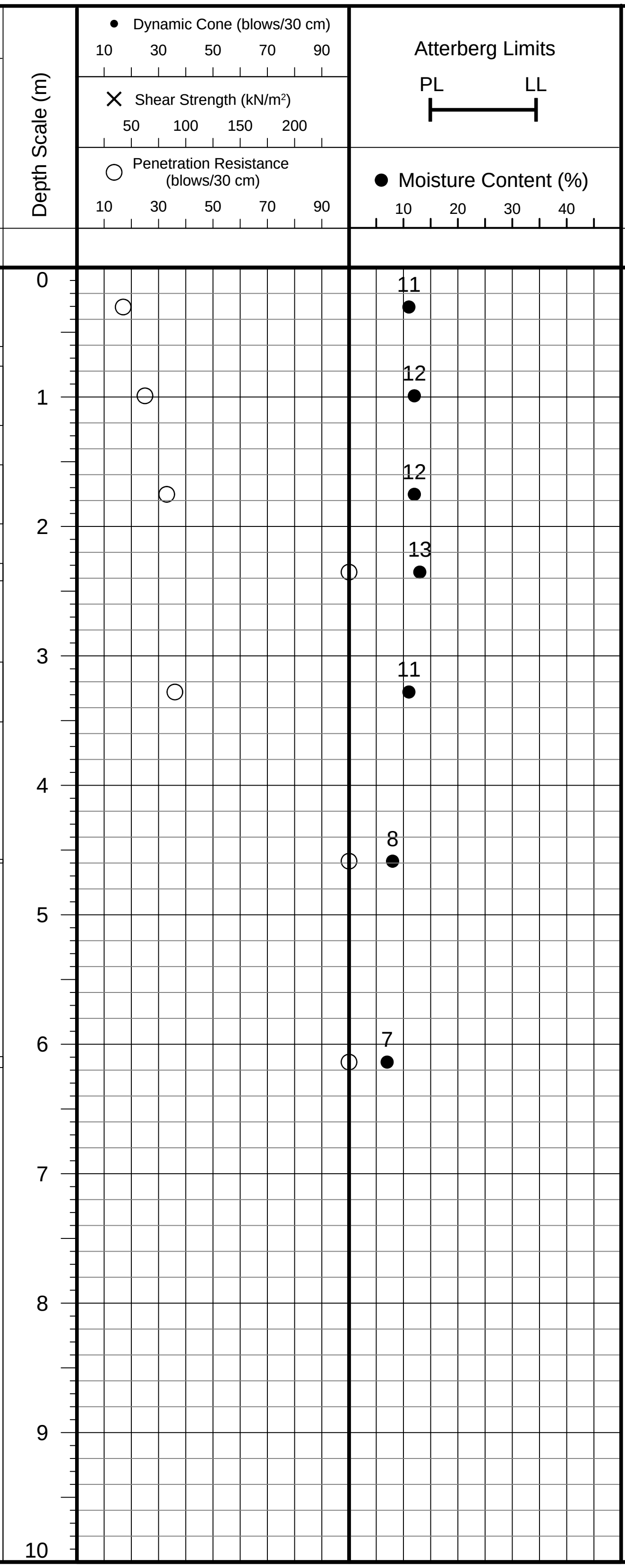
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
197.2	Pavement Surface			
0.0	**20 cm ASPHALT CONCRETE** **10 cm GRANULAR FILL**	1	DO	17
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	25
		3	DO	33
		4	DO	50/13
		5	DO	36
193.0 4.2	Reddish-brown **SHALE** weathered	6	DO	50/3
191.0 6.2	**END OF BOREHOLE**	7	DO	50/8



WATER LEVEL

Dry upon Completion

Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 2

FIGURE NO.: 2

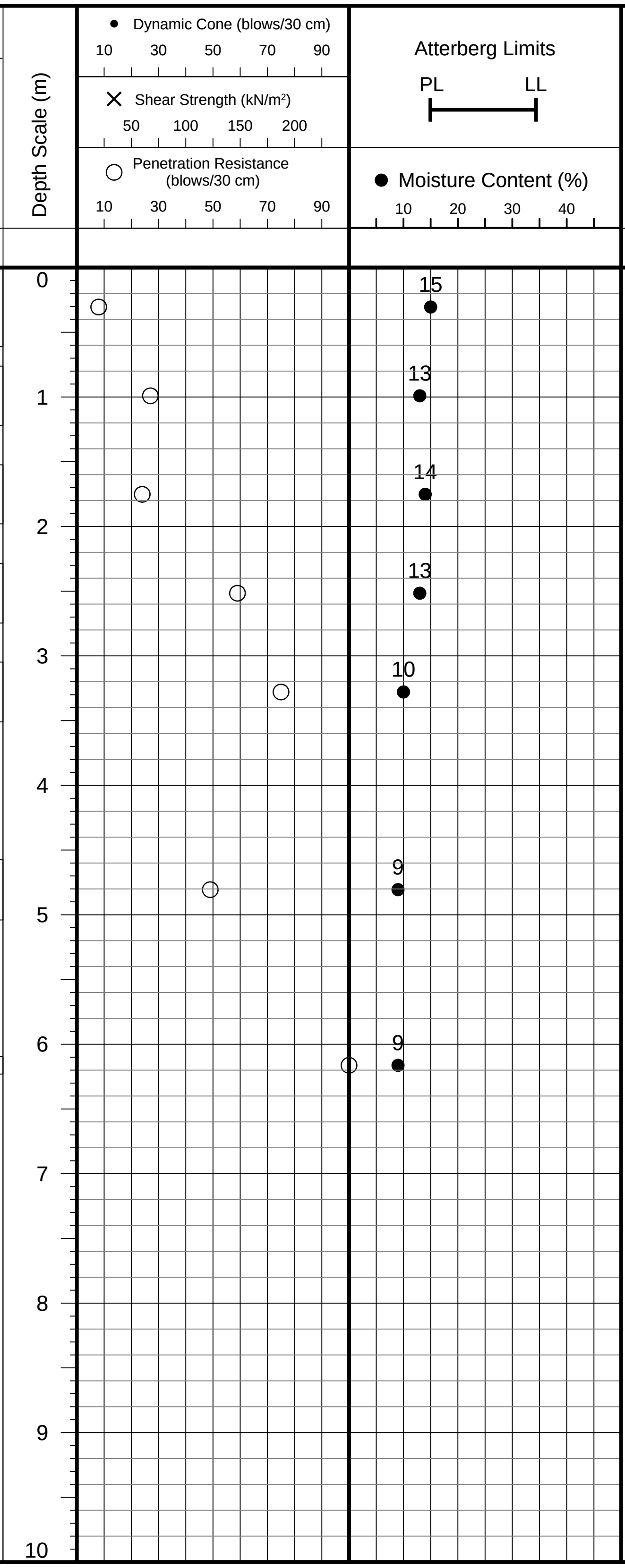
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
197.9	Pavement Surface			
0.0	**17 cm ASPHALT CONCRETE** **13 cm GRANULAR FILL**	1	DO	8
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	27
		3	DO	24
		4	DO	59
		5	DO	75
		6	DO	49
192.6 5.3	Reddish-brown **SHALE** weathered	7	DO	50/13
191.6 6.2	**END OF BOREHOLE**			



WATER LEVEL

Dry upon Completion

Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 2203-S020

LOG OF BOREHOLE: 3

FIGURE NO.: 3

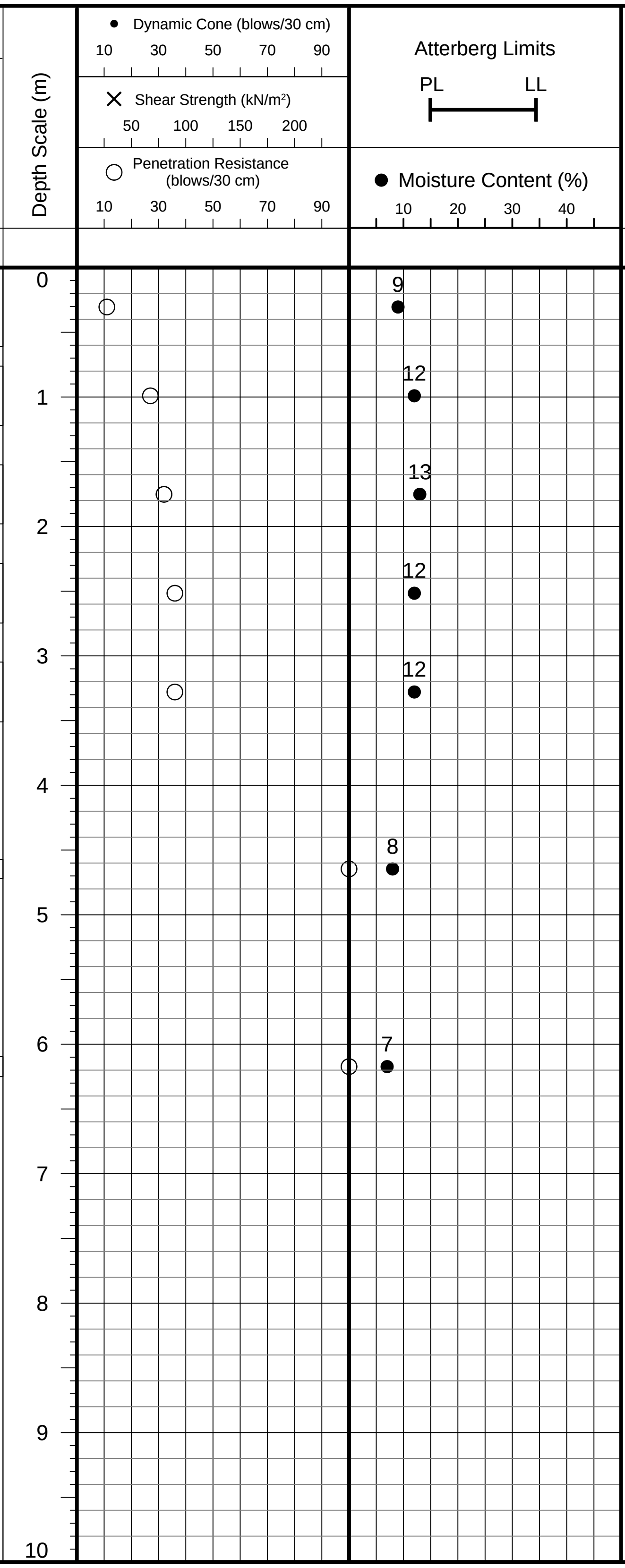
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
198.1	Pavement Surface			
0.0	**15 cm ASPHALT CONCRETE** **15 cm GRANULAR FILL**	1	DO	11
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	27
		3	DO	32
		4	DO	36
		5	DO	36
193.9 4.2	Reddish-brown **SHALE** weathered	6	DO	50/15
		7	DO	50/15
191.8 6.3	**END OF BOREHOLE**			



WATER LEVEL

Dry upon Completion

Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 4

FIGURE NO.: 4

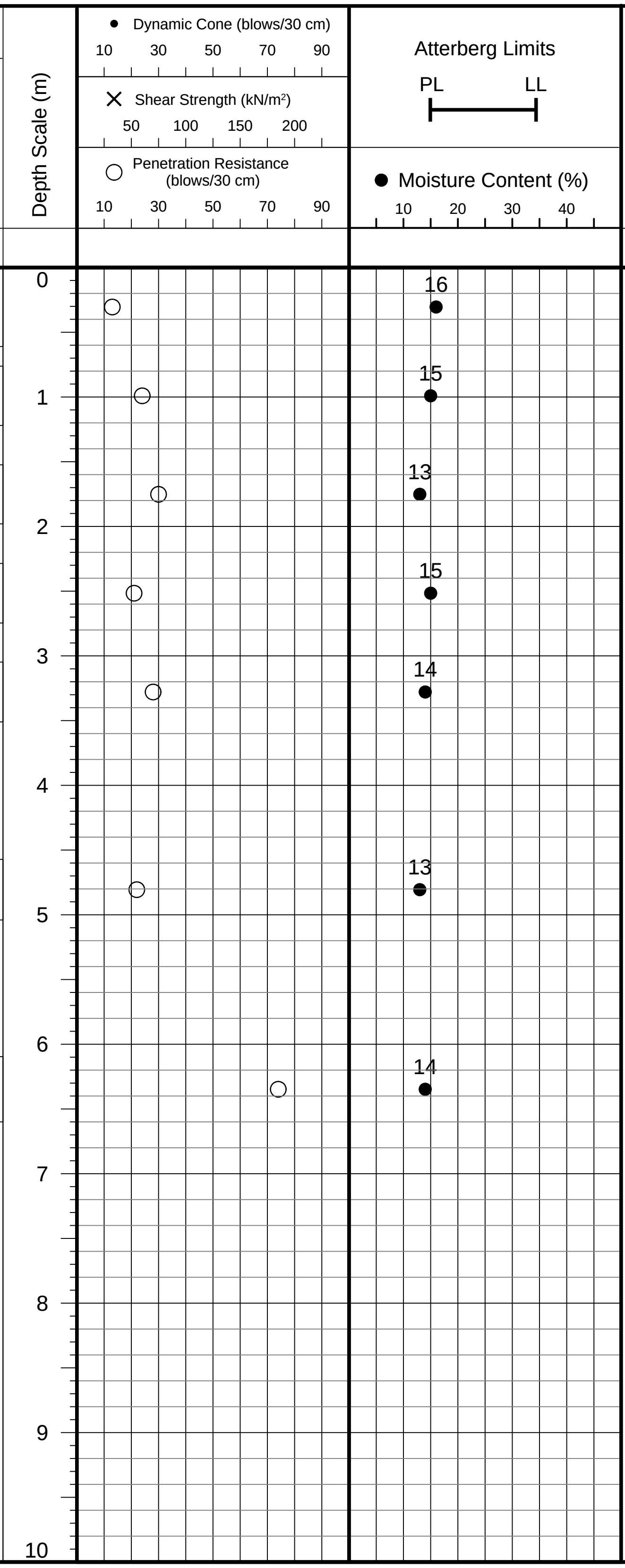
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
198.7	Pavement Surface			
0.0	**25 cm ASPHALT CONCRETE** **15 cm GRANULAR FILL**	1	DO	13
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	24
		3	DO	30
		4	DO	21
		5	DO	28
		6	DO	22
		7	DO	74
192.1 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 194.7 m upon completion

Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 5

FIGURE NO.: 5

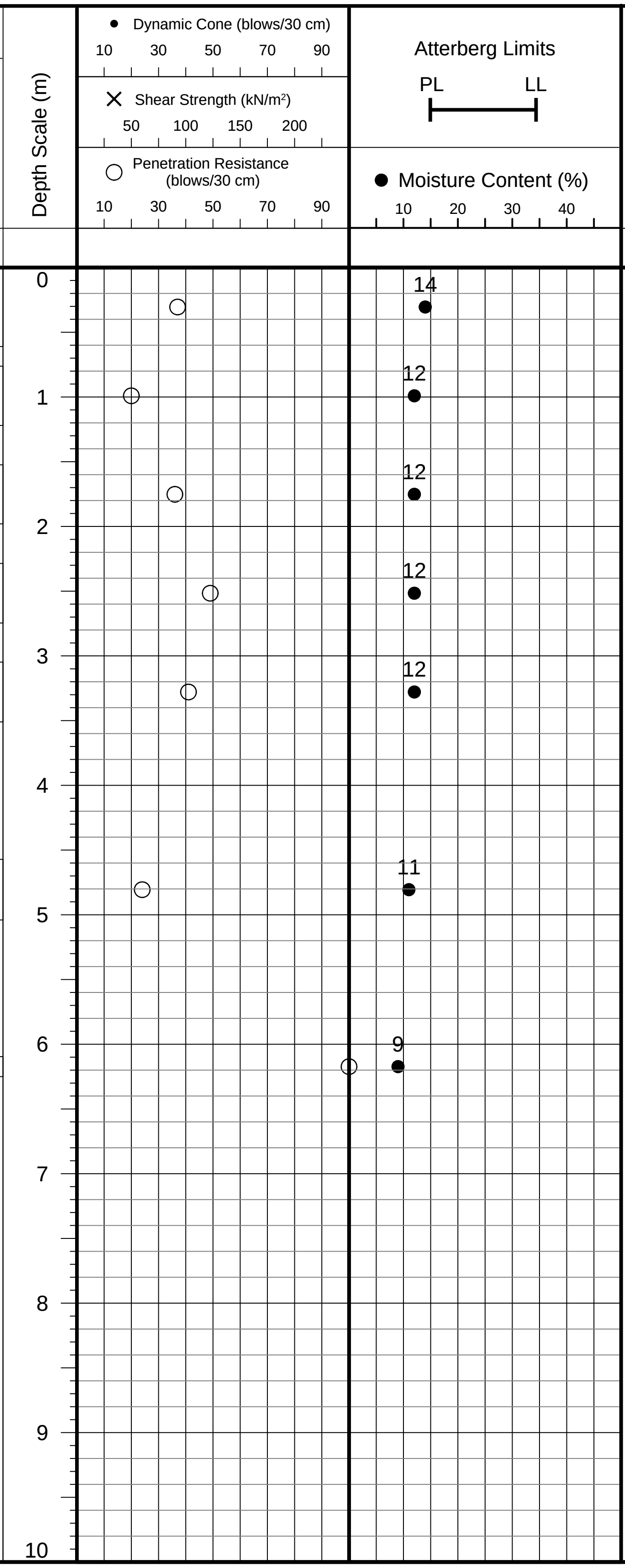
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
197.5	Pavement Surface				
0.0	**23 cm ASPHALT CONCRETE**				
	23 cm GRANULAR FILL	1	DO	37	
0.5	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	20	
		3	DO	36	
		4	DO	49	
		5	DO	41	Dry upon Completion
		6	DO	24	
191.3 6.3	**END OF BOREHOLE**	7	DO	50/15	



Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 6

FIGURE NO.: 6

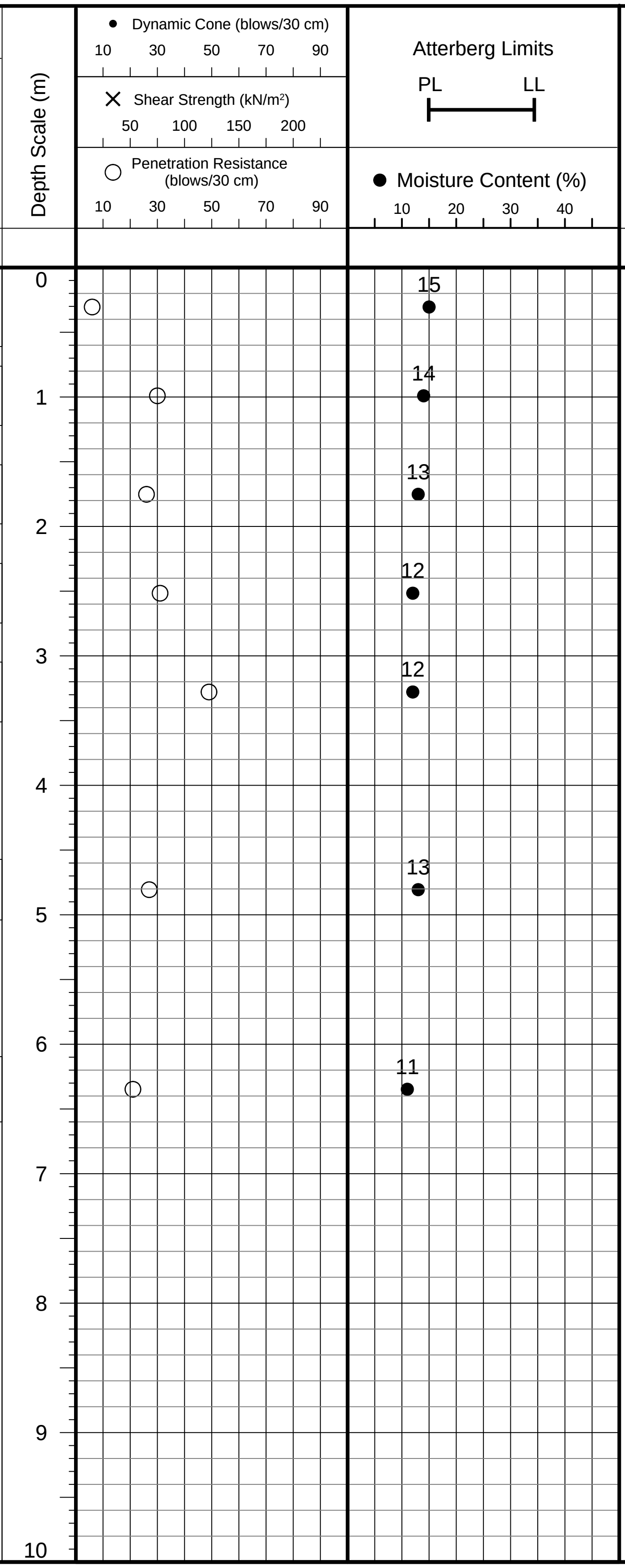
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 28, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Moisture Content (%)	WATER LEVEL
199.5	Pavement Surface					
0.0	**28 cm ASPHALT CONCRETE** **15 cm GRANULAR FILL**	1	DO	6	15	Dry upon Completion
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	30	14	
		3	DO	26	13	
		4	DO	31	12	
		5	DO	49	12	
		6	DO	27	13	
		7	DO	21	11	
192.9 6.6	**END OF BOREHOLE**					



Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 7

FIGURE NO.: 7

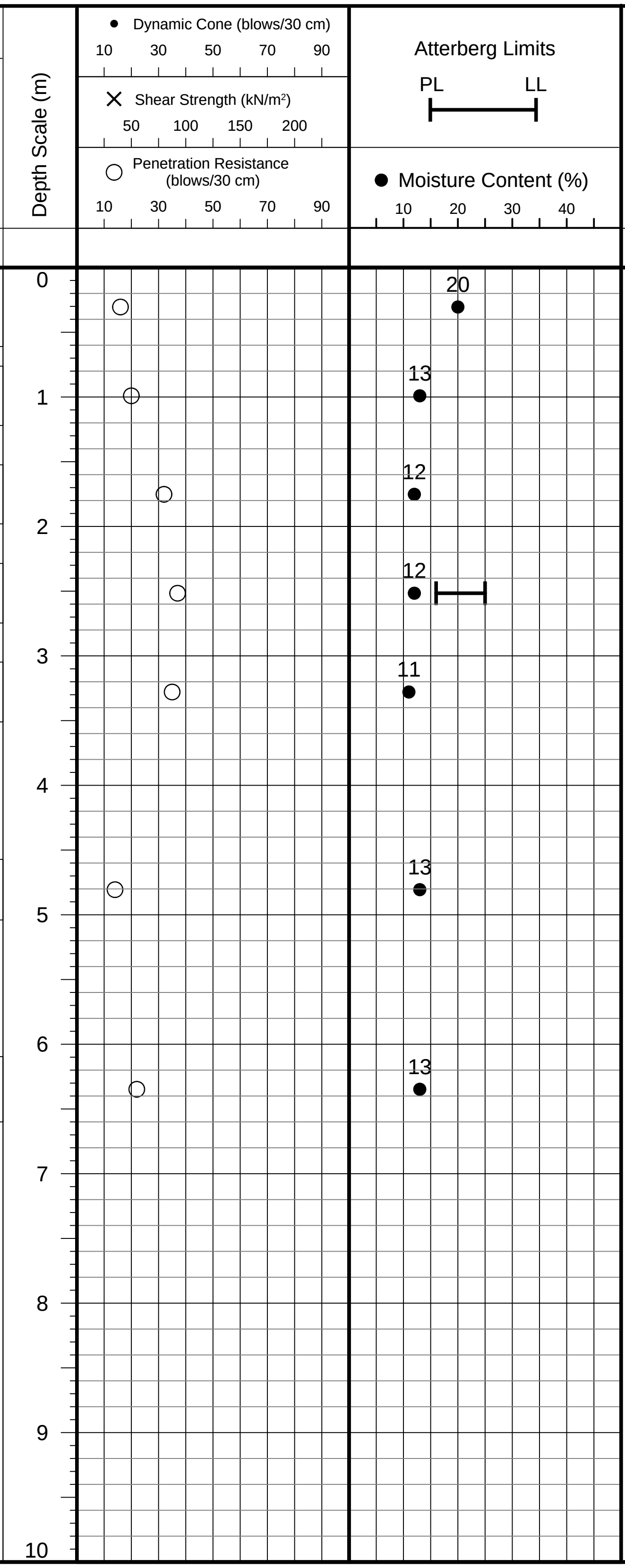
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 28, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
198.6	Pavement Surface				
0.0	**15 cm ASPHALT CONCRETE** **15 cm GRANULAR FILL**	1	DO	16	Dry upon Completion
	Brown, stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	20	
		3	DO	32	
		4	DO	37	
		5	DO	35	
		6	DO	14	
		7	DO	22	
192.0 6.6	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2203-S020

LOG OF BOREHOLE: 8

FIGURE NO.: 8

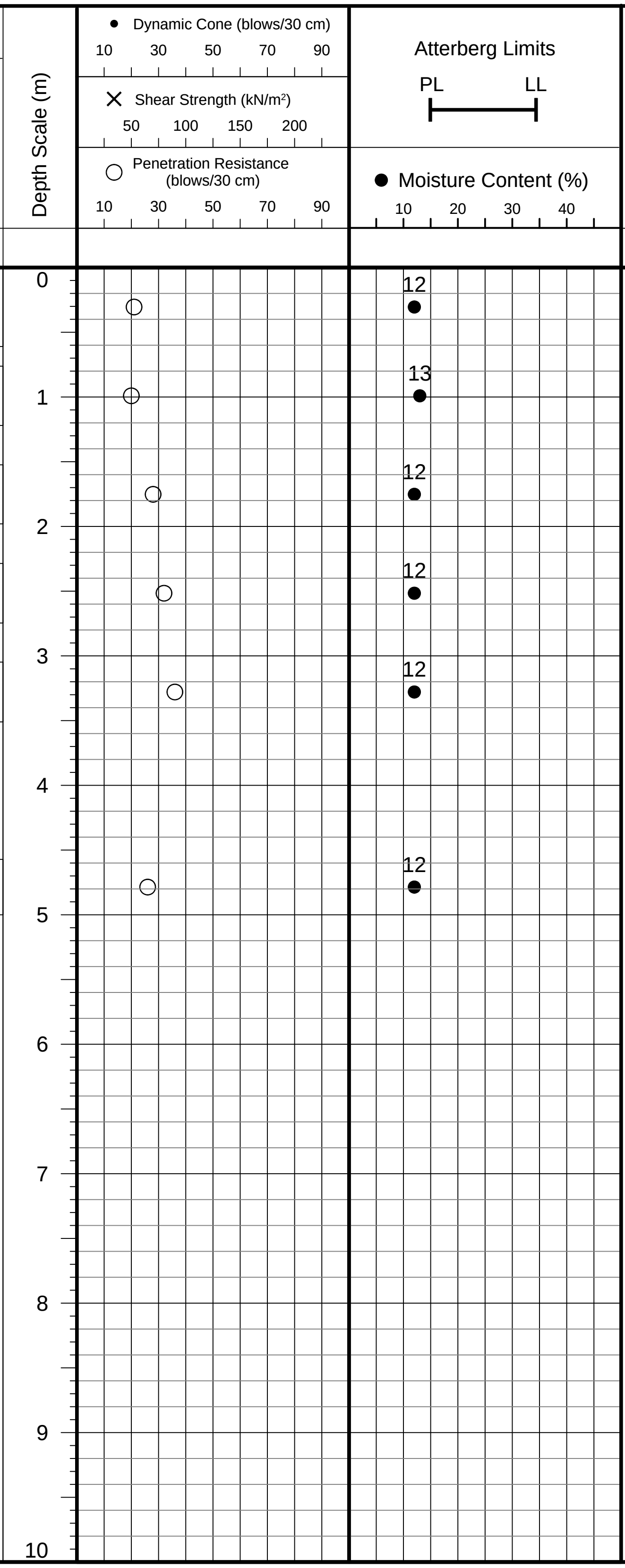
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 28 & April 8, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
198.8	Pavement Surface				
0.0	**23 cm ASPHALT CONCRETE** **17 cm GRANULAR FILL**	1	DO	21	Dry upon Completion
	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	2	DO	20	
		3	DO	28	
		4	DO	32	
		5	DO	36	
		6	DO	26	
193.8 5.0	**END OF BOREHOLE**				



Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 2203-S020

LOG OF BOREHOLE: 9

FIGURE NO.: 9

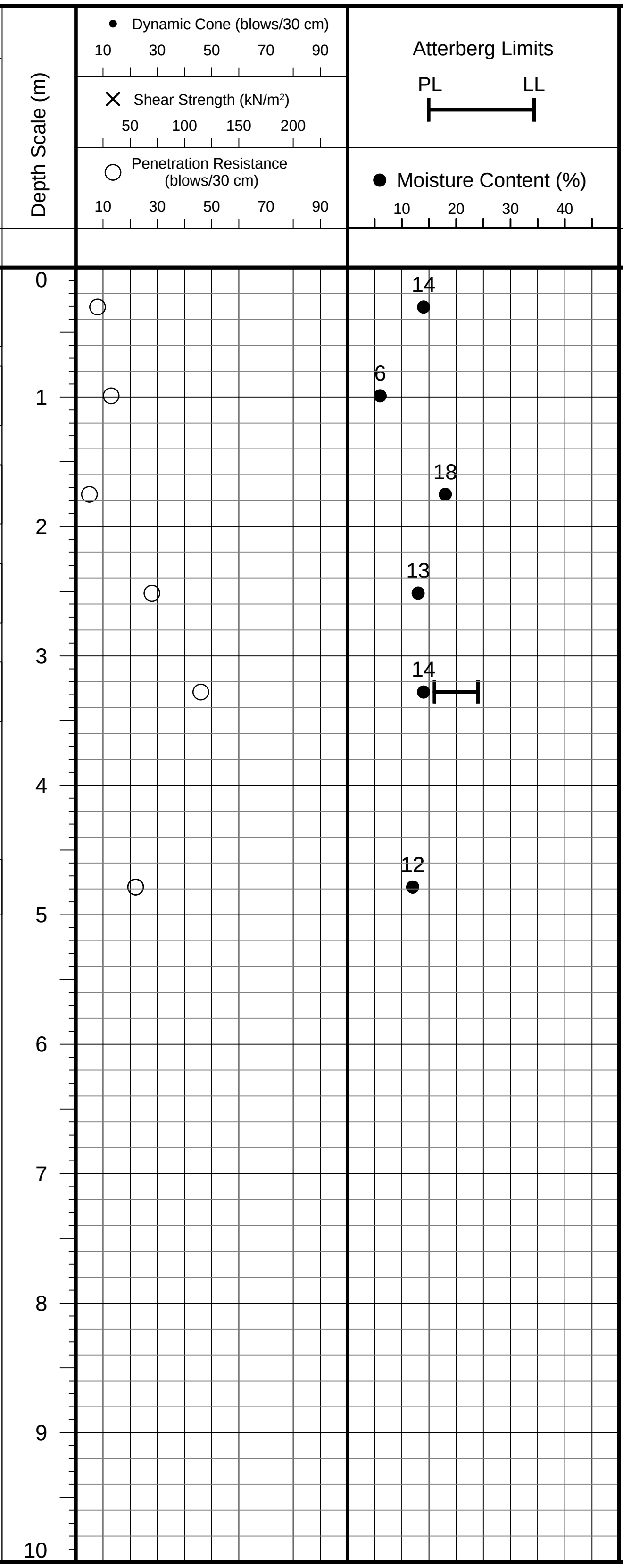
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: 376 Derry Road West, City of Mississauga

DRILLING DATE: March 28 & April 8, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
199.7 0.0	Ground Surface **20 cm TOPSOIL**			
	Brown **EARTH FILL** sandy silt to silty clay occ. topsoil inclusion	1	DO	8
		2	DO	13
		3	DO	5
197.5 2.2	Brown, very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams and layers, cobbles and boulders	4	DO	28
		5	DO	46
		6	DO	22
194.7 5.0	**END OF BOREHOLE**			



WATER LEVEL

Dry upon Completion

Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

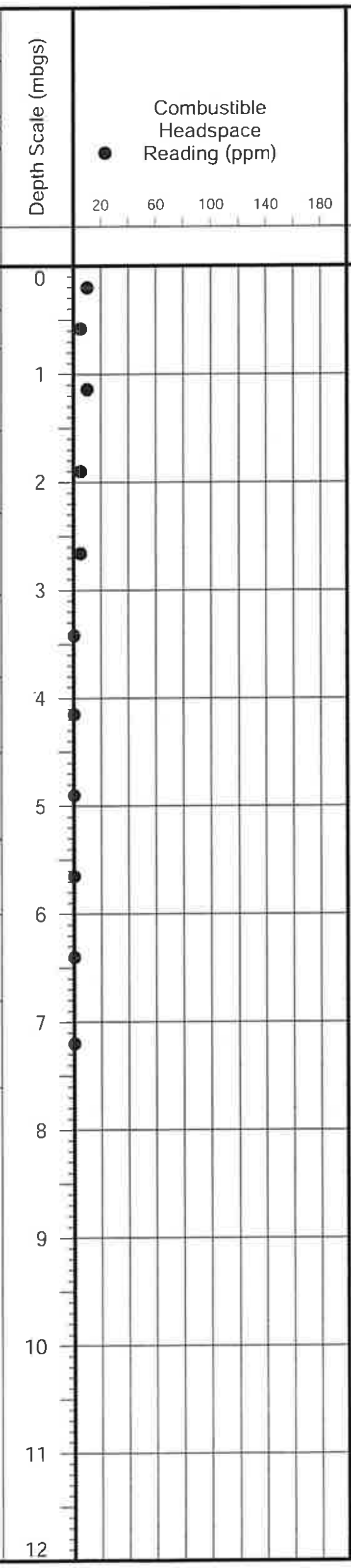
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

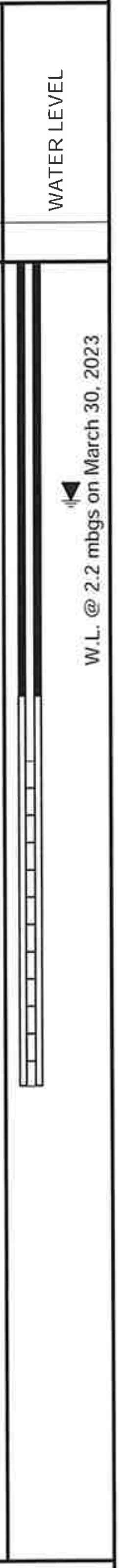
METHOD OF BORING: Geoprobe

PROJECT LOCATION: 376 Derry Road West
City of Mississauga

DRILLING DATE: November 25, 2022

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES Combustible Headspace Reading (ppm)	REMARKS
199.4	Ground Surface				
0.0 0.2	**20 cm TOPSOIL**	1A	TO	10	BH1/1A: PAHs
	Brown **EARTH FILL** sandy silt, some clay, rootlets trace of gravel	1B	TO	5	BH1/1B: Metals, Hg, Cr(VI), pH, Cyanide, EC, SAR
		2	TO	10	BH1/2: PHCs, VOCs, DUPS1: VOCs
197.9 1.5	Redish brown **SILTY CLAY, TILL** trace of gravel	3	TO	5	
		4	TO	5	
		5	TO	0	
		6	TO	0	
		7	TO	0	
		8	TO	0	
		9	TO	0	
		10	TO	0	
191.8 7.6	END OF BOREHOLE Installed 51mm standpipe @ 7.6m Concrete 0.0 to 0.3 Bentonite seal from 0.3m to 4.0m Sand backfill from 4.0m to 7.6m 3m screen from 4.6m to 7.6m Provided with monument protective casing				





Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

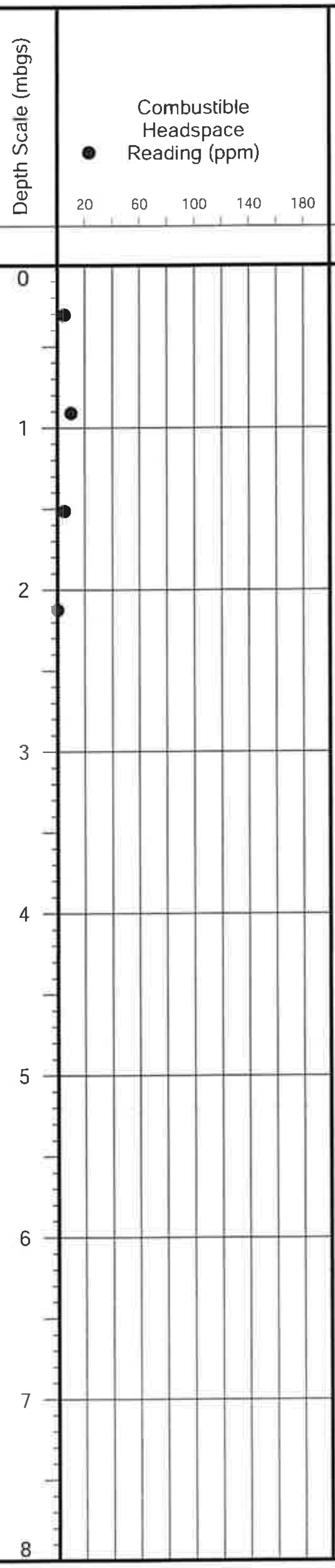
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Geoprobe

PROJECT LOCATION: 376 Derry Road West
City of Mississauga

DRILLING DATE: November 25, 2022

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES Combustible Headspace Reading (ppm)	REMARKS	WATER LEVEL
199.8	Ground Surface					
0.0	**20 cm CONCRETE**					
0.2	Brown **SILTY CLAY** trace of gravel	1	TO	5	BH2/1: Metals	
199.2 0.6	Redish brown **SILTY CLAY, TILL** trace of clay, some sand	2	TO	10	BH2/2: PHCs, VOCs	
		3	TO	5		
		4	TO	0		
197.4 2.4	END OF BOREHOLE					



Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential and Commercial Development

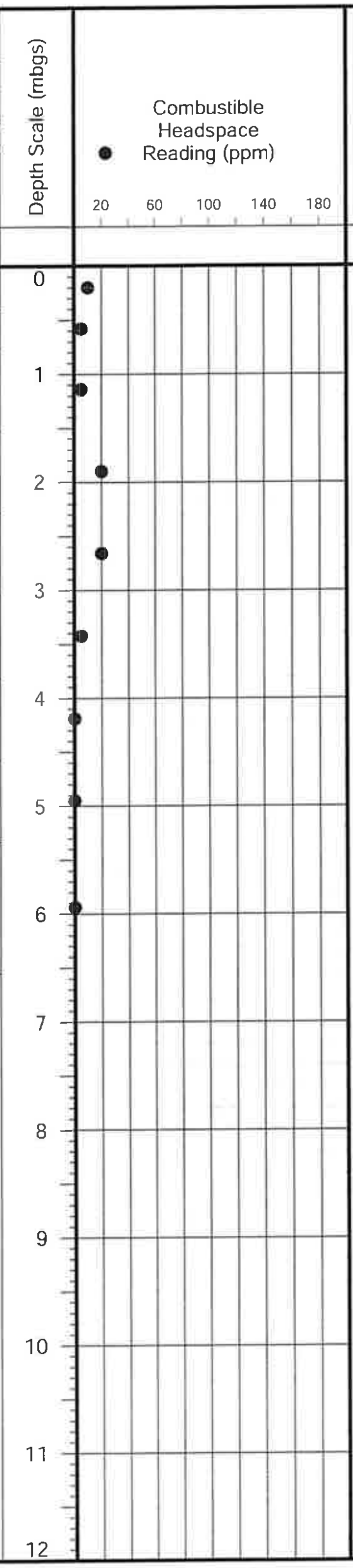
METHOD OF BORING: Geoprobe

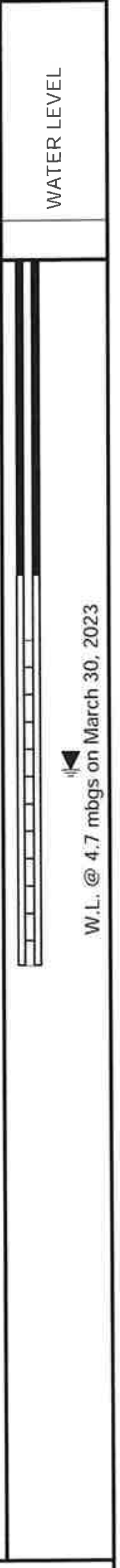
PROJECT LOCATION: 376 Derry Road West
City of Mississauga

DRILLING DATE: November 25, 2022

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	Type	Combustible Headspace Reading (ppm)	REMARKS
197.7	Ground Surface				
0.0 0.2	**20 cm TOPSOIL**	1A	TO	10	BH3/1A: PAHs, Dioxins and Furans
		1B	TO	5	
	Brown to grey **SILTY CLAY, TILL**	2	TO	5	BH3/2: Metals, Hg, Cr(VI), Cyanide, pH
		3	TO	20	BH3/3: PHCs
		4	TO	20	BH3/4: VOCs
		5	TO	5	
		6	TO	0	
		7	TO	0	
		8	TO	0	
191.2 191.0 6.7	Redish-brown **WEATHERED SHALE**				

END OF BOREHOLE
Installed 51mm standpipe @ 6.5m
Concrete from 0.0 to 0.3
Bentonite seal from 0.3m to 2.9m
Sand backfill from 2.9m to 6.5m
3m screen from 3.5m to 6.5m
Provided with monument protective casing





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Page: 1 of 1

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential and Commercial Development

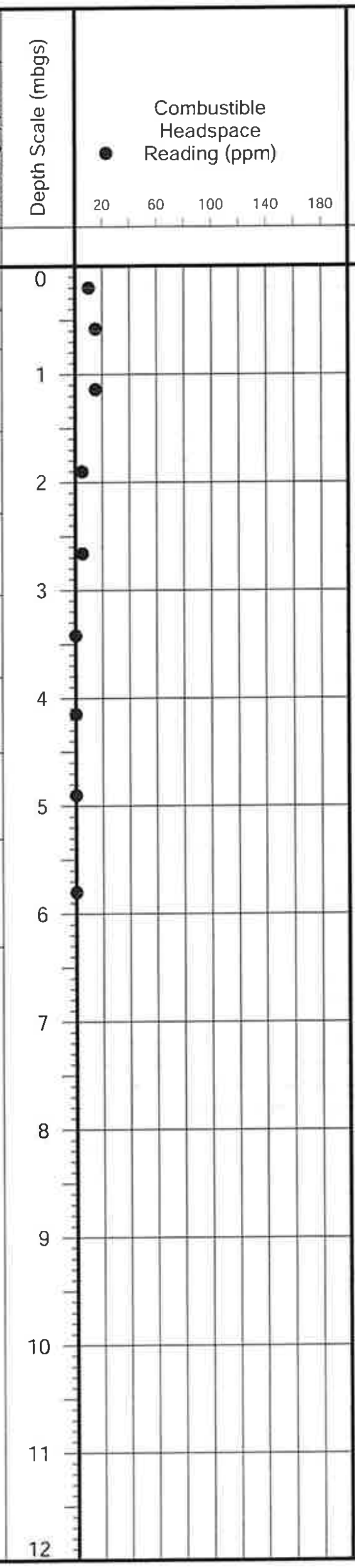
METHOD OF BORING: Geoprobe

PROJECT LOCATION: 376 Derry Road West
City of Mississauga

DRILLING DATE: November 25, 2022

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	Type	Combustible Headspace Reading (ppm)	REMARKS
196.8	Ground Surface				
0.0 0.2	**20 cm TOPSOIL**	1A	TO	10	BH4/1A: PAHs
	Brown **EARTH FILL** sandy silt, some clay, rootlets trace of gravel	1B	TO	15	BH4/1B: DUPS2: Metals, Hg, Cr(VI), Cyanide, pH, EC, SAR
195.6 1.2		2	TO	15	BH4/2: PHCs, VOCs
	Brown **SILTY CLAY, TILL** trace of gravel	3	TO	5	
		4	TO	5	
		5	TO	0	
		6	TO	0	
		7	TO	0	
		8	TO	0	
190.8					
190.5 6.3	Redish-brown **WEATHERED SHALE**				

END OF BOREHOLE
Installed 51mm standpipe @ 6.0m
Concrete from 0.0 to 0.3
Bentonite seal from 0.3m to 2.4m
Sand backfill from 2.4m to 6.0m
3m screen from 3.0m to 6.0m
Provided with monument protective casing



Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

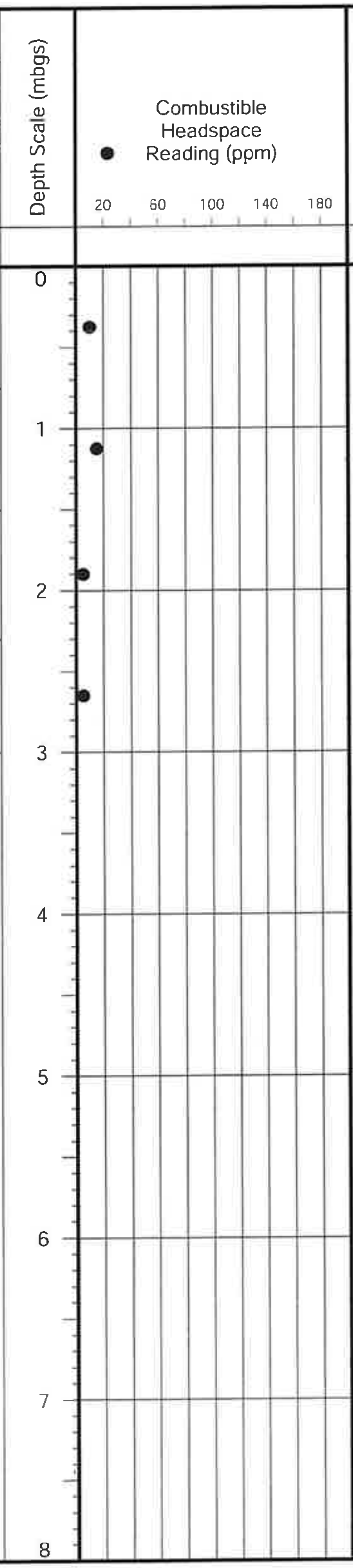
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Geoprobe

PROJECT LOCATION: 376 Derry Road West
City of Mississauga

DRILLING DATE: November 25, 2022

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	Type	Combustible Headspace Reading (ppm)	REMARKS	WATER LEVEL
199.6	Ground Surface					
0.0	**20 cm TOPSOIL**					
0.2	Light brown **EARTH FILL** sandy silt, some clay, rootlets trace of gravel	1	TO	10	BH5/1: PAHs, Metals, Hg, Cr(VI), pH, Cyanide, EC, SAR	
		2	TO	15	BH5/2: PHCs, VOCs	
198.4 1.2	Light brown to grey **SILTY CLAY, TILL**	3	TO	5		
		4	TO	5		
196.6 3.0	END OF BOREHOLE					



Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

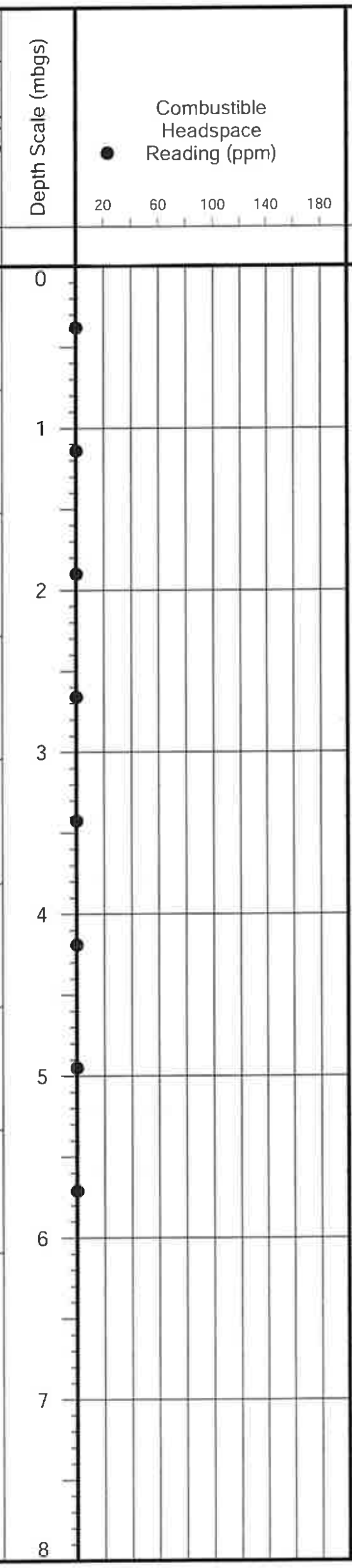
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

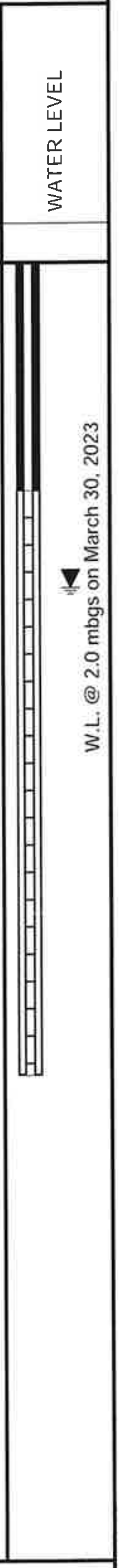
METHOD OF BORING: Geoprobe

PROJECT LOCATION: Blocks 176 and 189 Plan 43M-1484 and
390 Derry Road West
City of Mississauga

DRILLING DATE: March 24, 2023

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES Combustible Headspace Reading (ppm)	REMARKS
198.4	Ground Surface				
0.0	**15 cm TOPSOIL**				
0.1	Grey **SILTY CLAY** some gravel	1	TO	0	
197.6 0.8	Brown **SILTY CLAY, TILL**	2	TO	0	
		3	TO	0	BH101/3: PAHs, Metals, Hg, Cr(VI), pH DUPS101: Metals,Hg, Cr(VI), pH
		4	TO	0	BH101/4: PHCs, VOCs
		5	TO	0	
		6	TO	0	
		7	TO	0	
		8	TO	0	
192.3 6.1	END OF BOREHOLE Installed 51mm standpipe @ 5.0m Concrete from 0.0m to 0.3m Bentonite seal from 0.3m to 1.4m Sand backfill from 1.4m to 5.0m 3m screen from 1.4m to 5.0m Provided with monument protective casing				





Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 102

FIGURE NO.: 2

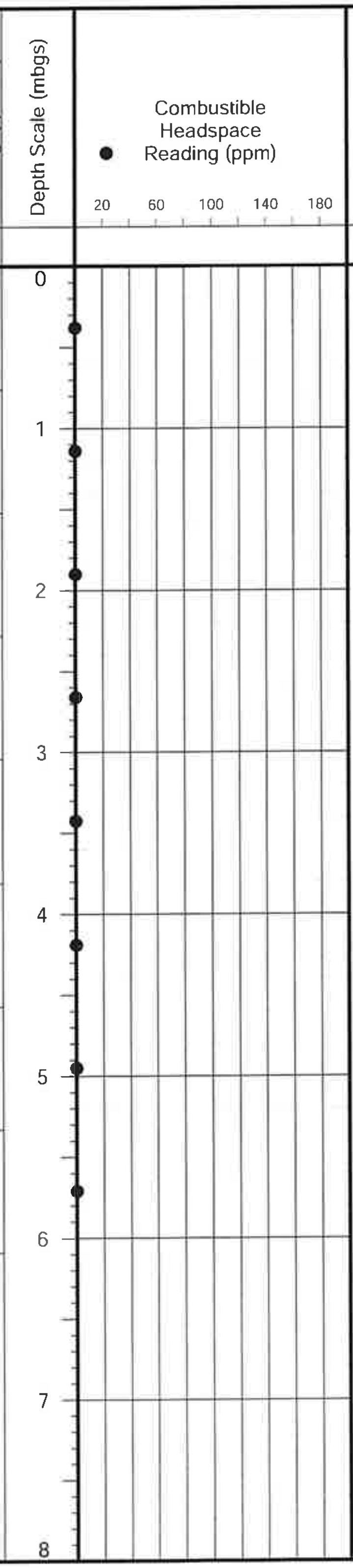
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

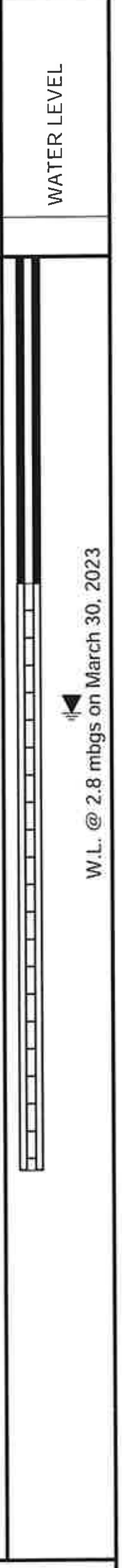
METHOD OF BORING: Geoprobe

PROJECT LOCATION: Blocks 176 and 189 Plan 43M-1484 and
390 Derry Road West
City of Mississauga

DRILLING DATE: March 24, 2023

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES Combustible Headspace Reading (ppm)	REMARKS
197.7	Ground Surface				
0.0	**15 cm TOPSOIL**				
0.1	Grey **SILTY CLAY** some gravel	1	TO	0	
197.0 0.8	Brown **SILTY CLAY, TILL** some sand, trace of gravel	2	TO	0	
		3	TO	0	
		4	TO	0	BH102/4: PAHs, Metals, Hg, Cr(VI), pH
		5	TO	0	BH102/5: PHCs, VOCs
		6	TO	0	
		7	TO	0	
		8	TO	0	
191.6 6.1	END OF BOREHOLE Installed 51mm standpipe @ 5.6m Concrete from 0.0m to 0.3m Bentonite seal from 0.3m to 2.0m Sand backfill from 2.0m to 5.6m 3m screen from 2.0m to 5.6m Provided with monument protective casing				





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Page: 1 of 1

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 103

FIGURE NO.: 3

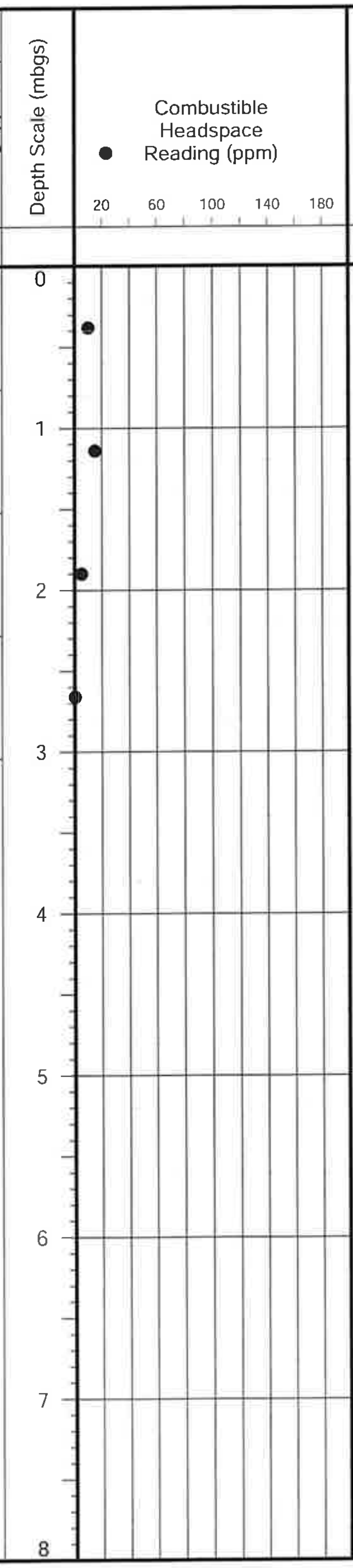
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Geoprobe

PROJECT LOCATION: Blocks 176 and 189 Plan 43M-1484 and
390 Derry Road West
City of Mississauga

DRILLING DATE: March 24, 2023

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	Type	Combustible Headspace Reading (ppm)	REMARKS	WATER LEVEL
198.0	Ground Surface					
0.0 0.1	**15 cm TOPSOIL**					
	Dark grey **EARTH FILL** some sand	1	TO	10	BH103/1: PAHs, Metals, Hg, Cr(VI), Cyanide, pH, EC, SAR	
		2	TO	15	BH103/2: PHCs, VOCs	
196.4 1.5	Brown to grey **SILTY CLAY, TILL**	3	TO	5		
		4	TO	0		
194.9 3.0	END OF BOREHOLE					



JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 104

FIGURE NO.: 4

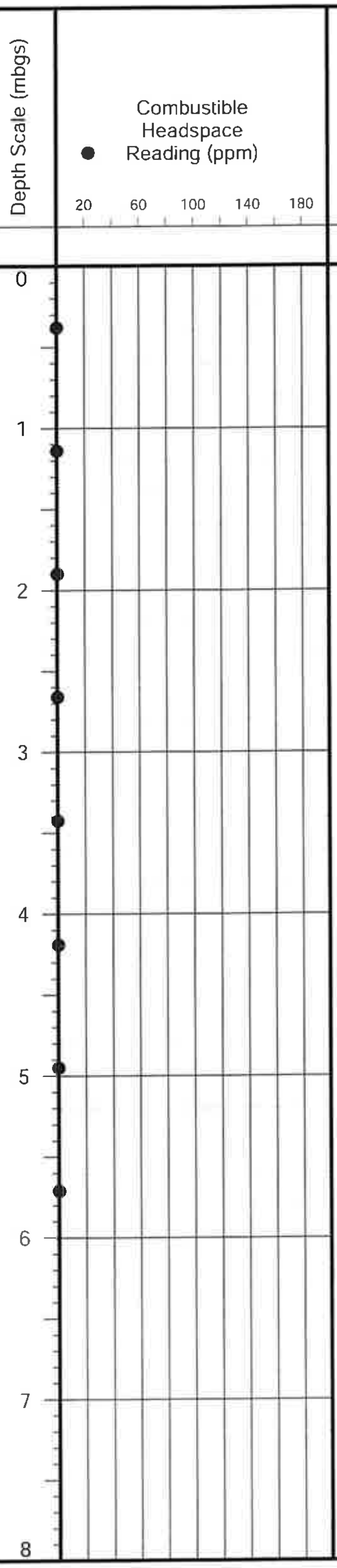
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

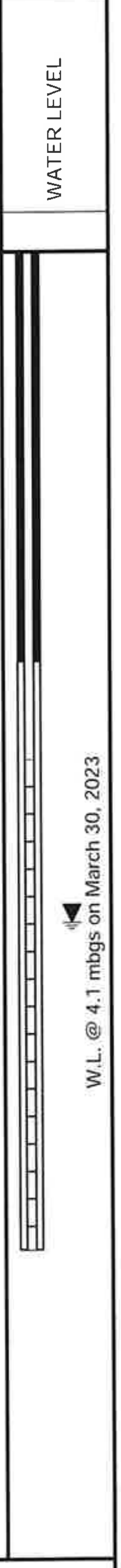
METHOD OF BORING: Geoprobe

PROJECT LOCATION: Blocks 176 and 189 Plan 43M-1484 and
390 Derry Road West
City of Mississauga

DRILLING DATE: March 24, 2023

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES			REMARKS
		Number	Type	Combustible Headspace Reading (ppm)	
198.9	Ground Surface				
0.0 0.1	**15 cm TOPSOIL**				
	Brown **EARTH FILL** some clay	1	TO	0	BH104/1: PAHs, Metals, Hg, Cr(VI), Cyanide, pH, EC, SAR
		2	TO	0	BH104/2: PHCs, VOCs
197.4 1.5	Brown to grey **SILTY CLAY, TILL** trace of gravel	3	TO	0	
		4	TO	0	
		5	TO	0	
		6	TO	0	
		7	TO	0	
		8	TO	0	
192.8 6.1	END OF BOREHOLE Installed 51mm standpipe @ 6.1m Concrete from 0.0m to 0.3m Bentonite seal from 0.0m to 2.5m Sand backfill from 2.5m to 6.1m 3m screen from 3.1m to 6.1m Provided with monument protective casing				





W.L. @ 4.1 mbgs on March 30, 2023

Soil Engineers Ltd.

JOB NO.: 2203-E020

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

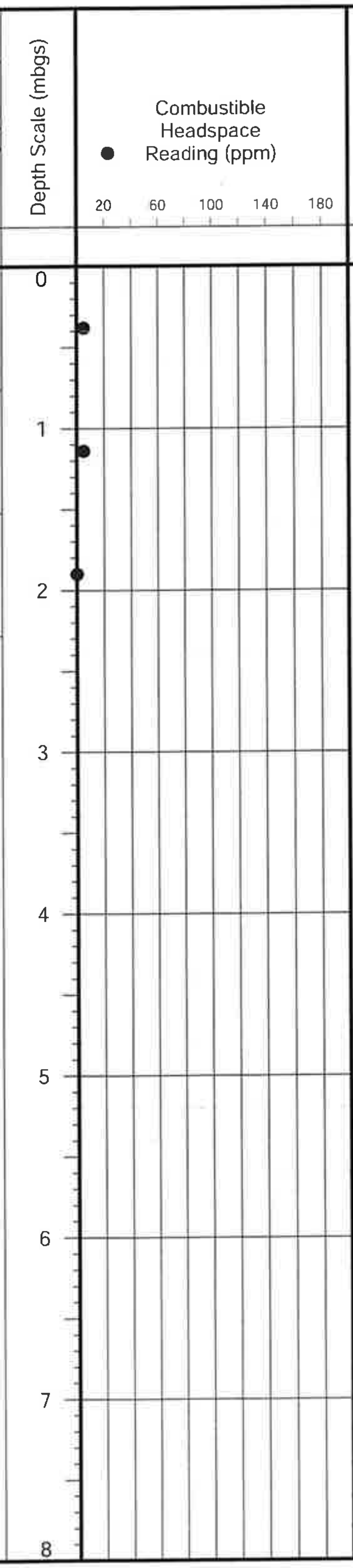
PROJECT DESCRIPTION: Proposed Residential and Commercial Development

METHOD OF BORING: Geoprobe

PROJECT LOCATION: Blocks 176 and 189 Plan 43M-1484 and
390 Derry Road West
City of Mississauga

DRILLING DATE: March 24, 2023

El. (masl) Depth (mbgs)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES Combustible Headspace Reading (ppm)	REMARKS	WATER LEVEL
198.4	Ground Surface					
0.0	**10 cm CONCRETE**					
0.1	Brown to grey **SILTY CLAY, TILL** trace of gravel	1	TO	5	BH105/1: Metals	
		2	TO	5	BH105/2: PHCs, BTEX	
		3	TO	0		
196.1 2.3	END OF BOREHOLE					



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Appendix C

Grainsize Analysis

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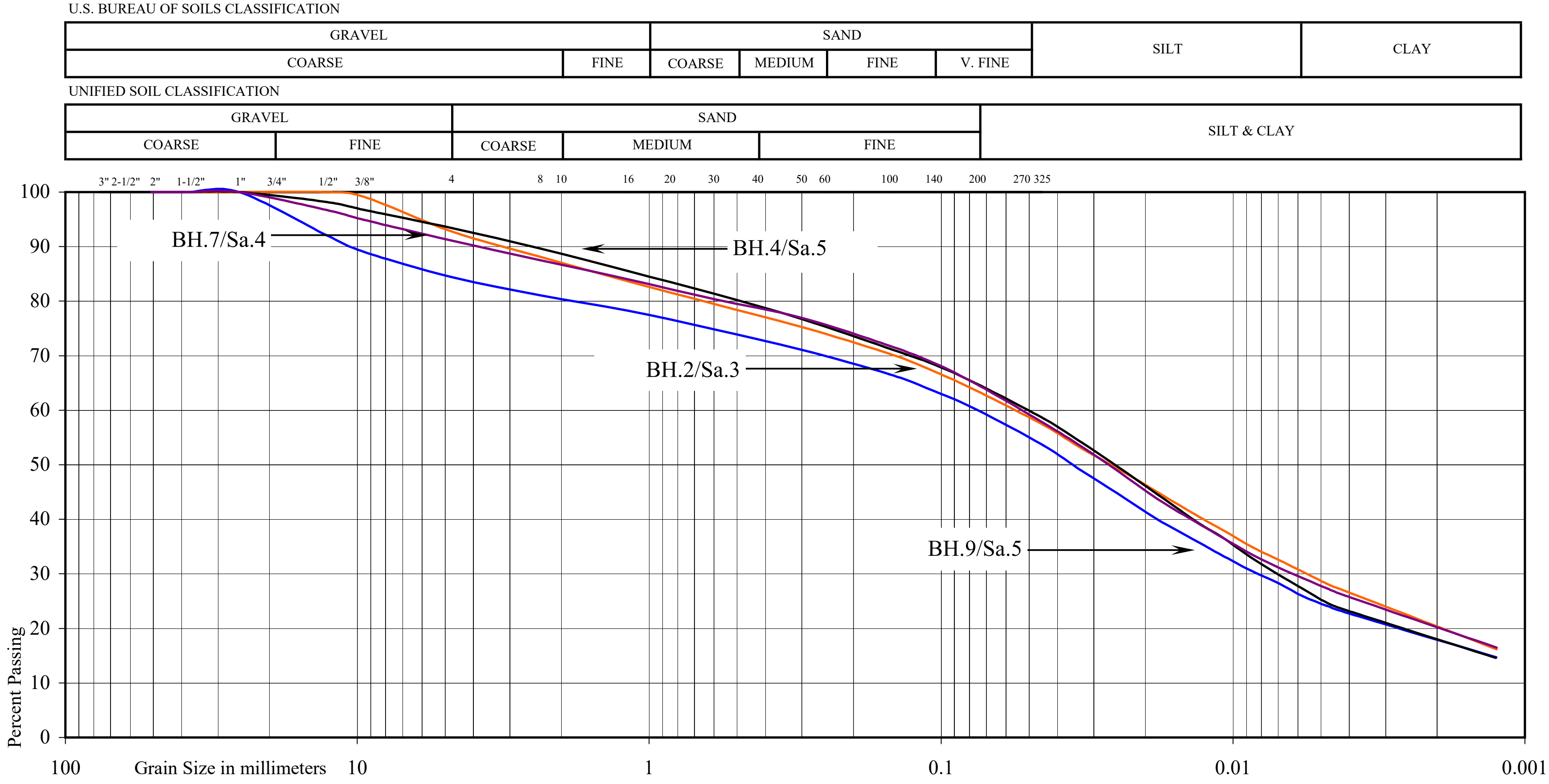
GRAIN SIZE DISTRIBUTION

Reference No: 2203-S020



Project: Proposed Residentiall and Commercial Development

Location: 376 Derry Road West, City of Mississauga

Borehole No:	2	4	7	9
Sample No:	3	5	4	5
Depth (m):	1.8	3.3	2.5	3.3
Elevation (m):	196.1	195.4	190.1	196.4

BH./Sa.	2/3	4/5	7/4	9/5
Liquid Limit (%) =	-	-	25	24
Plastic Limit (%) =	-	-	16	169
Plasticity Index (%) =	-	-	9	8
Moisture Content (%) =	14	14	12	14
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-6}	10^{-7}	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY TILL
a trace of gravel, occasional sand seams and layers

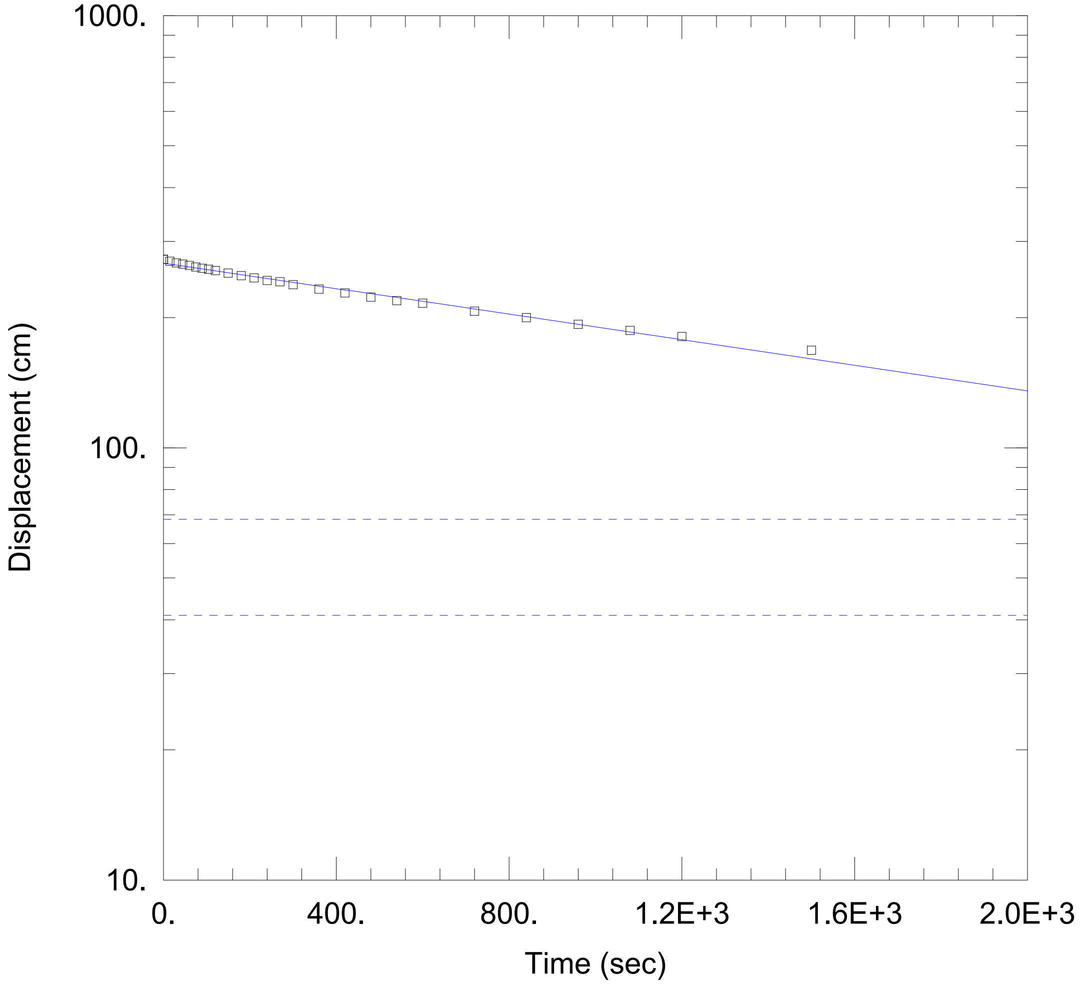
Figure: 10

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Hydraulic Conductivity Tests



HYDRAULIC CONDUCTIVITY TEST AT MW1-23 - SCREENED IN SILTY CLAY TILL

PROJECT INFORMATION

Company: R.J. Burnside & Associates
Client: 376 & 390 Derry Road
Project: 300056655
Location: Mississauga
Test Well: MW1
Test Date: October 2, 2023

AQUIFER DATA

Saturated Thickness: 599. cm

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 273. cm
Total Well Penetration Depth: 881. cm
Casing Radius: 2.54 cm

Static Water Column Height: 599. cm
Screen Length: 302. cm
Well Radius: 7.62 cm

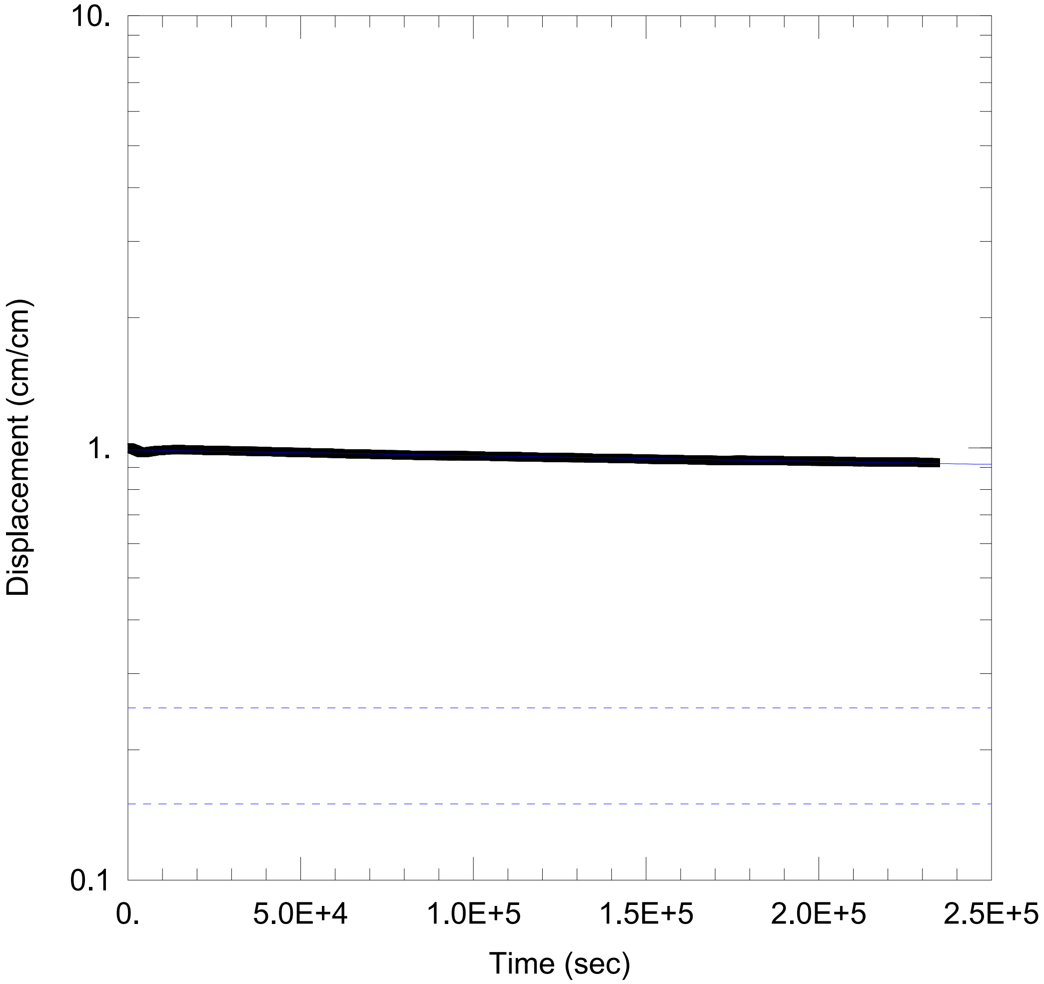
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 2.008E-5 cm/sec

y0 = 267.5 cm



HYDRAULIC CONDUCTIVITY TEST AT MW4-22 - SCREENED IN SILTY CLAY TILL

PROJECT INFORMATION

Company: R.J. Burnside & Associates
Client: 376 & 390 Derry Road
Project: 300056655
Location: Mississauga
Test Well: MW4
Test Date: October 2, 2023

AQUIFER DATA

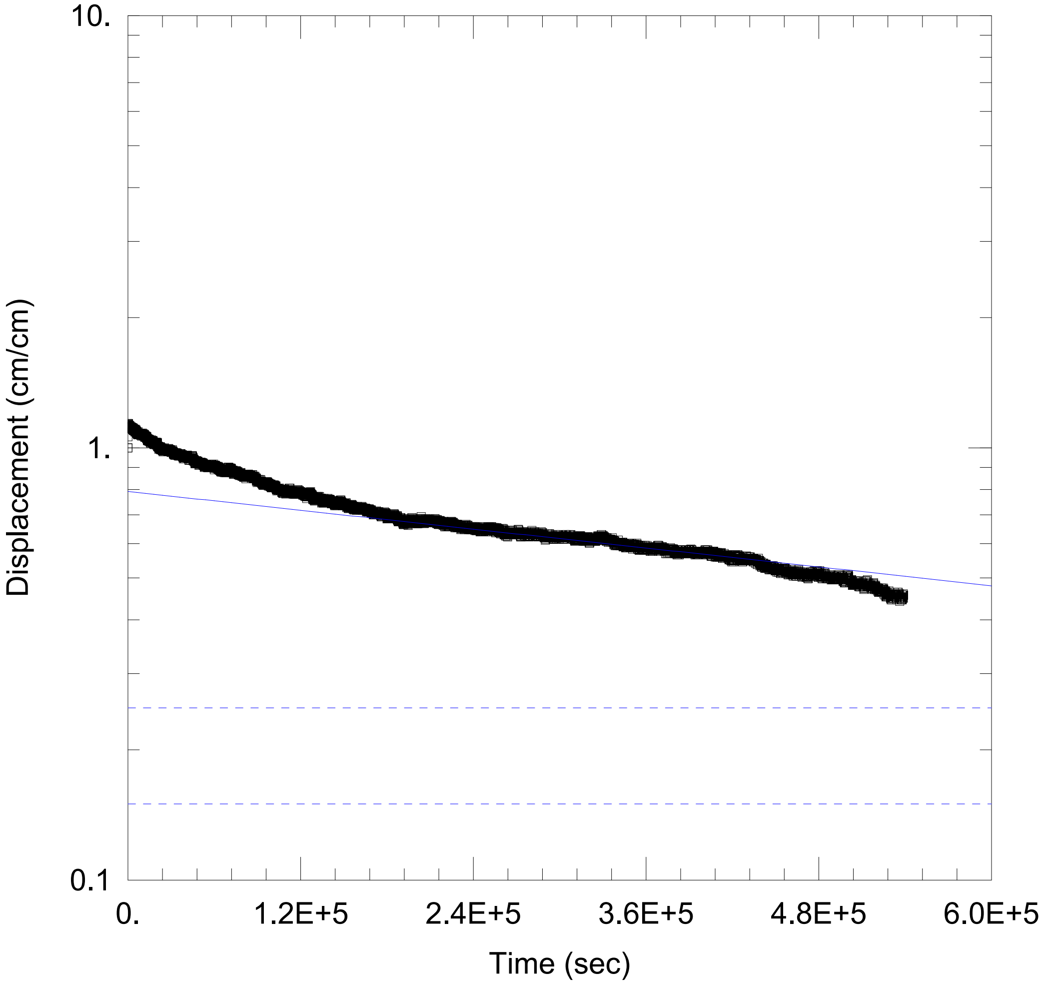
Saturated Thickness: 313. cm
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 364. cm
Total Well Penetration Depth: 721. cm
Casing Radius: 2.54 cm
Static Water Column Height: 313. cm
Screen Length: 302. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.828E-8 cm/sec
y0 = 360. cm



HYDRAULIC CONDUCTIVITY TEST AT MW104-23 - SCREENED IN SILTY CLAY TILL

PROJECT INFORMATION

Company: R.J. Burnside & Associates
Client: 376 & 390 Derry Road
Project: 300056655
Location: Mississauga
Test Well: MW104
Test Date: October 5, 2023

AQUIFER DATA

Saturated Thickness: 274. cm
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 28.3 cm
Total Well Penetration Depth: 725. cm
Casing Radius: 2.54 cm
Static Water Column Height: 274. cm
Screen Length: 302. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 5.224E-8 cm/sec
y0 = 22.42 cm

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Appendix E

Groundwater Elevation Data

Table E-1
Groundwater Elevations - Monitoring Wells

Monitoring Well	Well Depth (mbgl)	Ground Elevation (masl)	28-Apr-23		04-Jul-23		07-Sep-23		02-Oct-23	
			Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)
MW1-23	**7.79**	**199.40**	1.66	197.74	1.59	197.81	1.55	197.85	1.76	197.64
MW3-23	**6.48**	**197.70**	1.92	195.78	1.83	195.87	1.91	195.79	--	--
MW4-23	**6.10**	**196.80**	2.60	194.20	2.61	194.19	2.77	194.03	2.97	193.83
MW8-17	**5.89**	**197.57**	2.85	194.72	1.47	196.10	1.82	195.75	2.01	195.56
MW101-23	**5.00**	**198.40**	1.01	197.39	0.91	197.49	1.33	197.07	--	--
MW102-23	**5.49**	**197.70**	2.79	194.91	2.64	195.06	2.81	194.89	2.97	194.73
MW104-23	**6.22**	**198.90**	2.97	195.93	3.01	195.89	3.29	195.61	3.47	195.43

mbgl - metres below ground level
masl - metres above sea level
' -- ' - data that was not collected

MW1-23
Groundwater Elevation
(Well Depth: 7.8 m, Screened in Silty Clay Till)

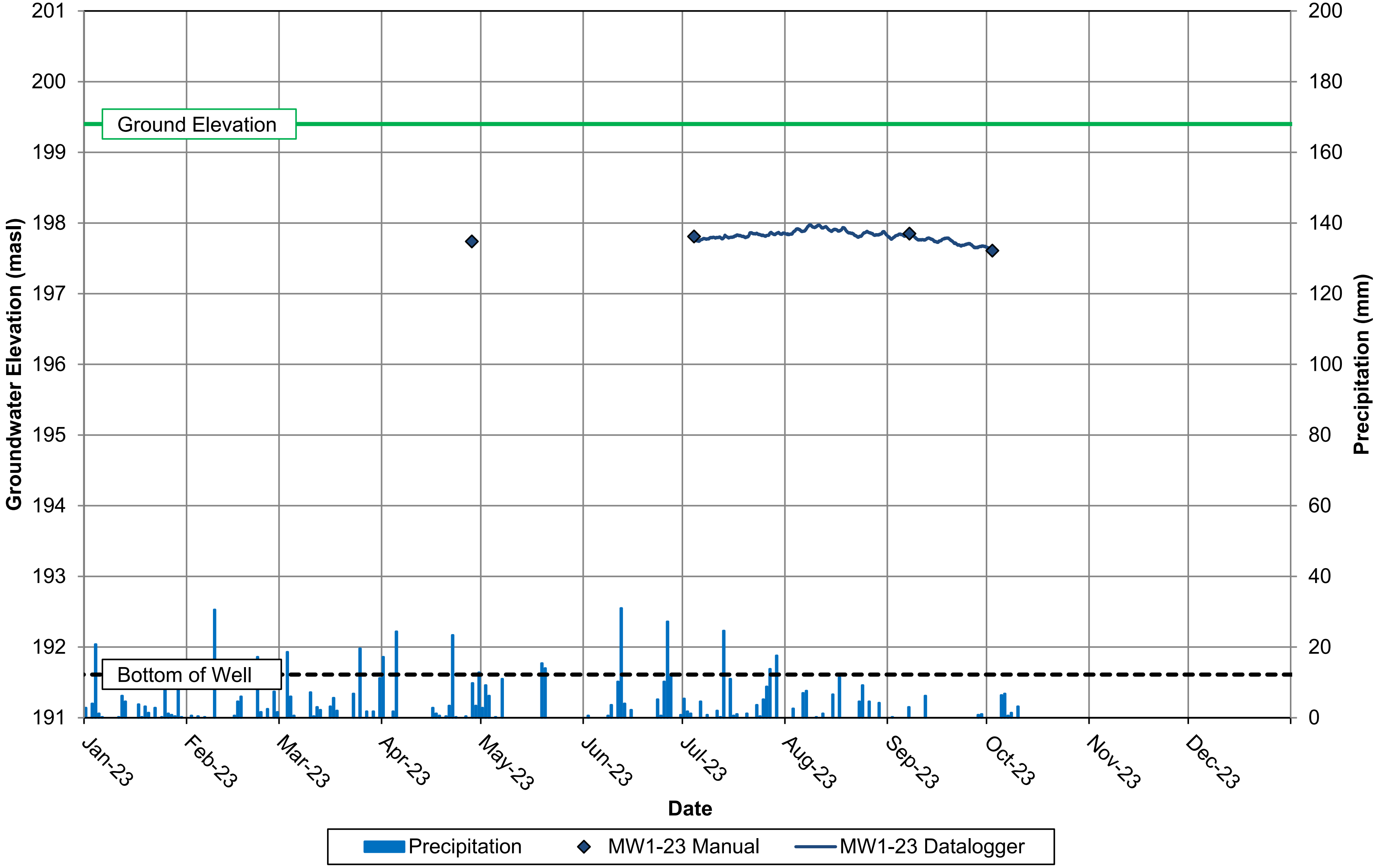

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Figure E-1

MW3-23
Groundwater Elevation
(Well Depth: 6.5 m, Screened in Silty Clay Till)

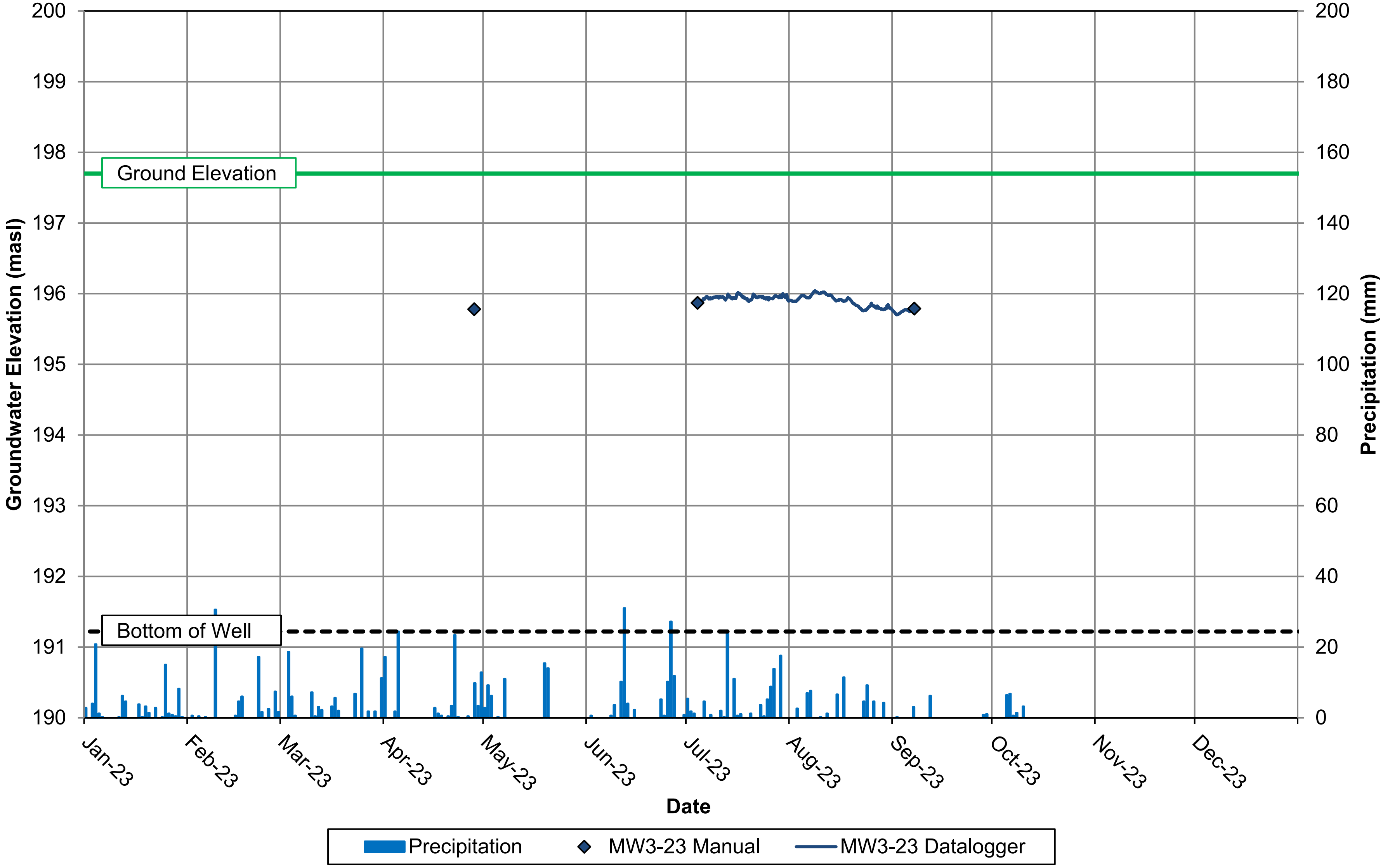

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Figure E-2

MW4-23
Groundwater Elevations
(Well Depth: 6.1 m, Screened in Silty Clay Till)

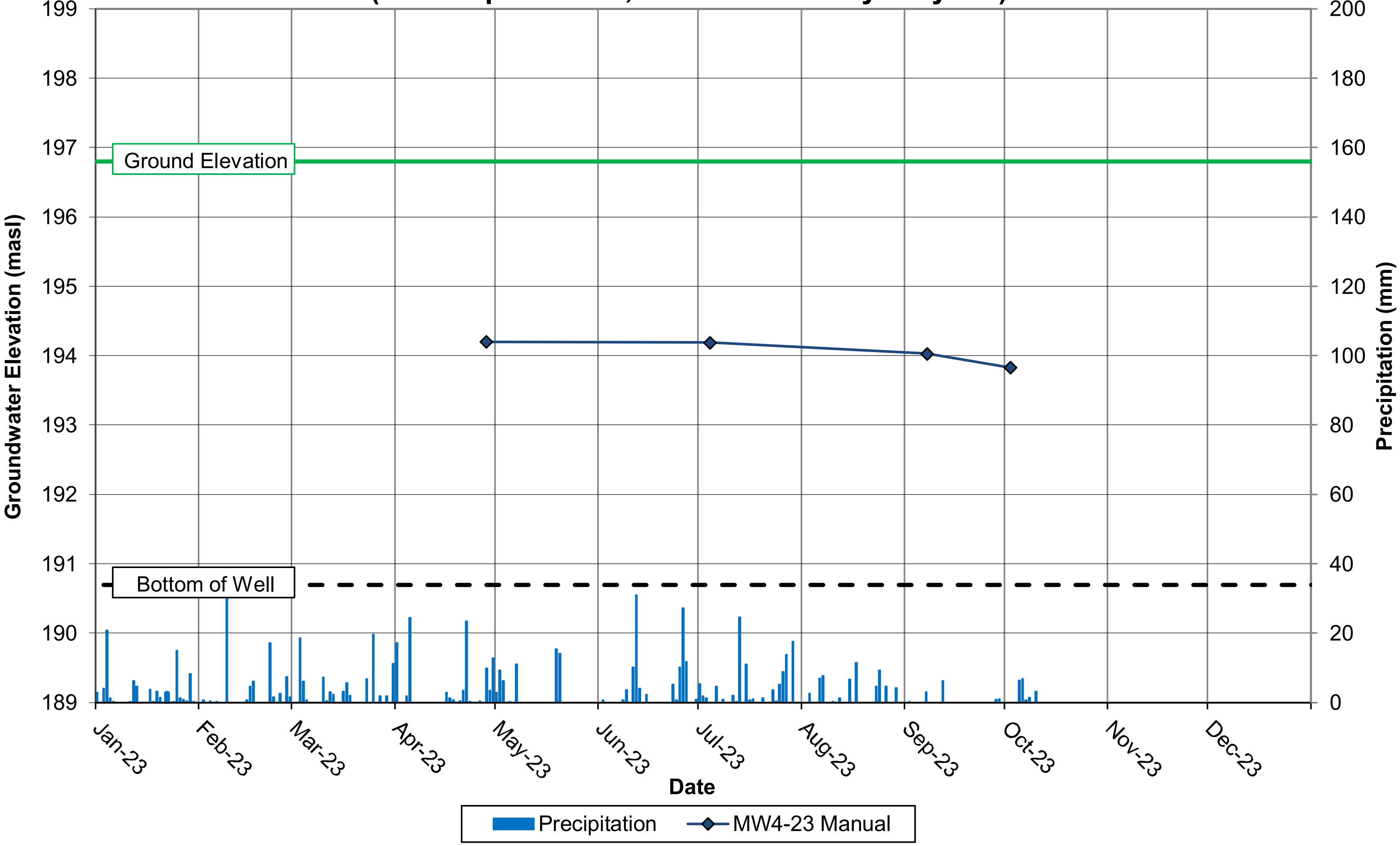

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Figure E-3

MW8-17
Groundwater Elevations
(Well Depth: 5.9 m, Screened in Silty Sand/Sandy Silt Till)

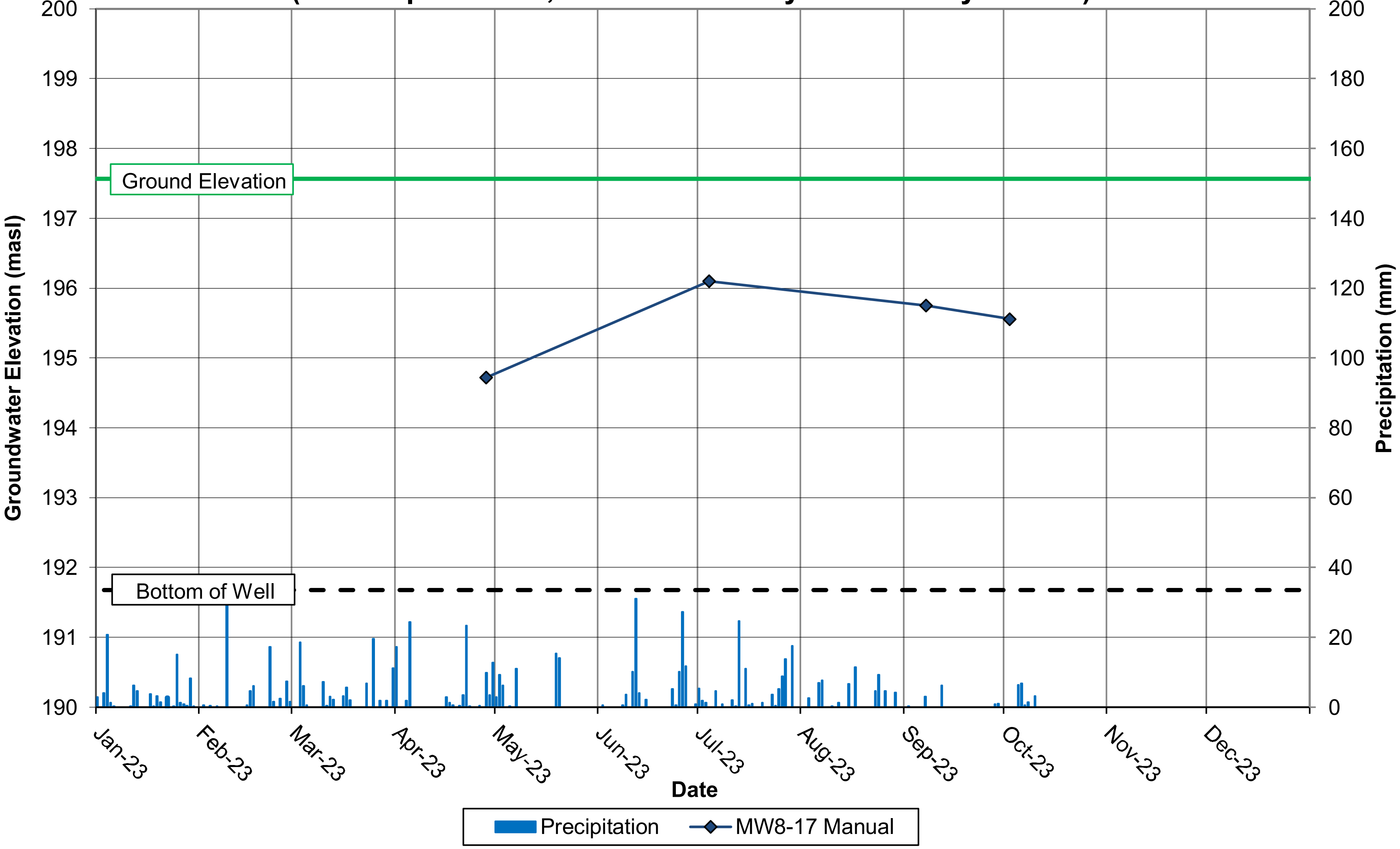

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Figure E-4

MW101-23
Groundwater Elevation
(Well Depth: 5.0 m, Screened in Silty Clay Till)

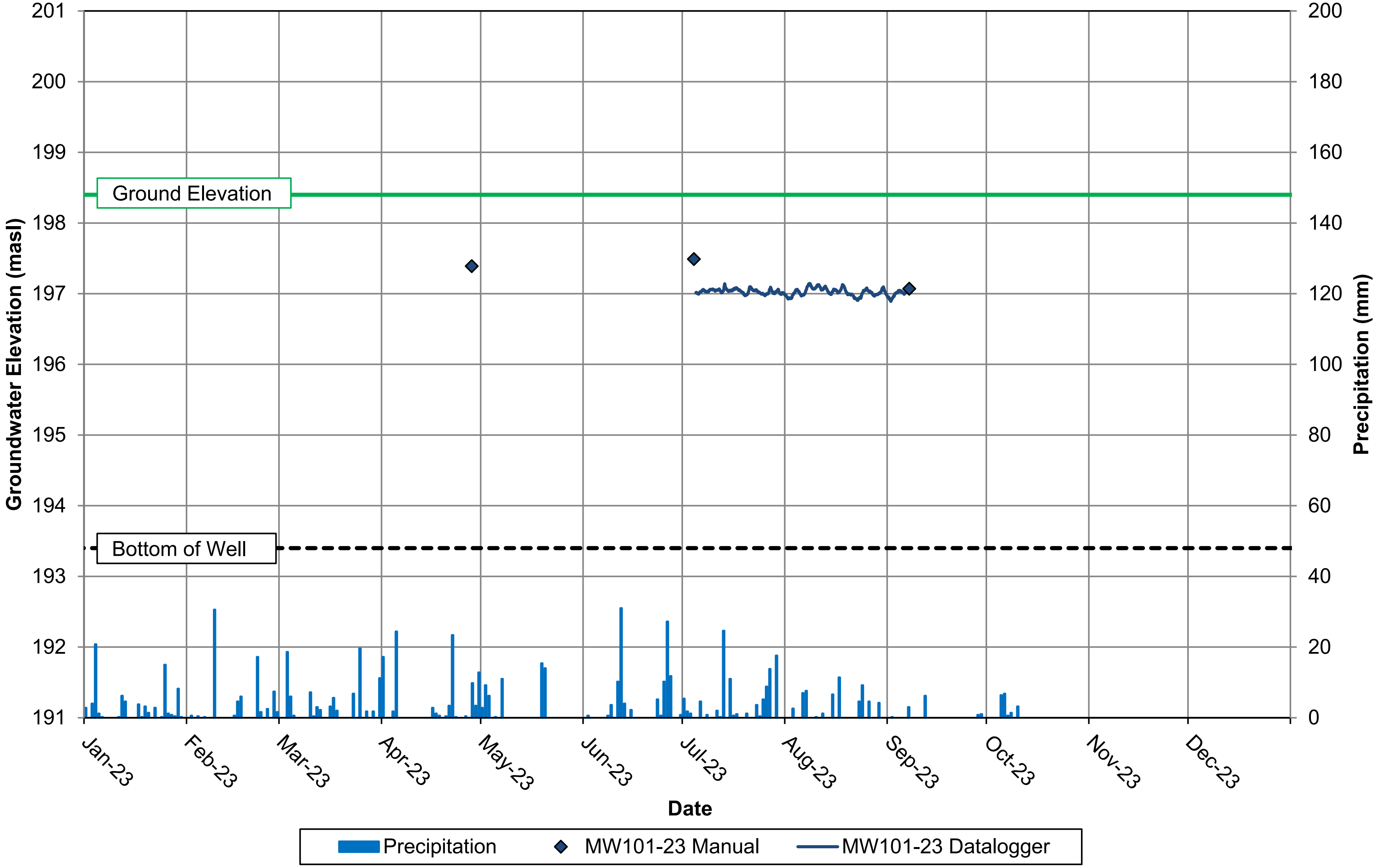

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Figure E-5

MW102-23
Groundwater Elevations
(Well Depth: 5.5 m, Screened in Silty Clay Till)

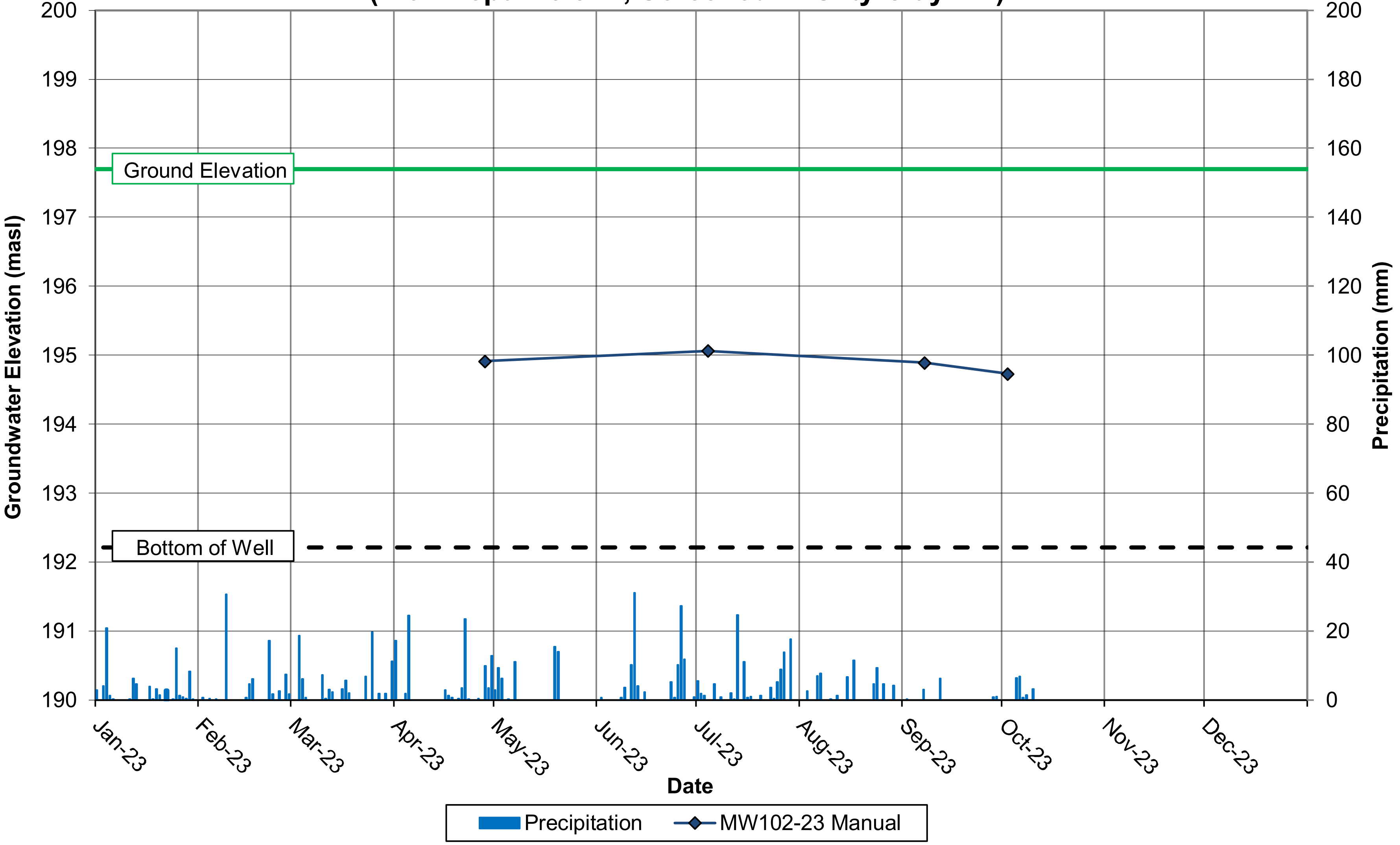

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Figure E-6

MW104-23
Groundwater Elevation
(Well Depth: 6.2 m, Screened in Silty Clay Till)

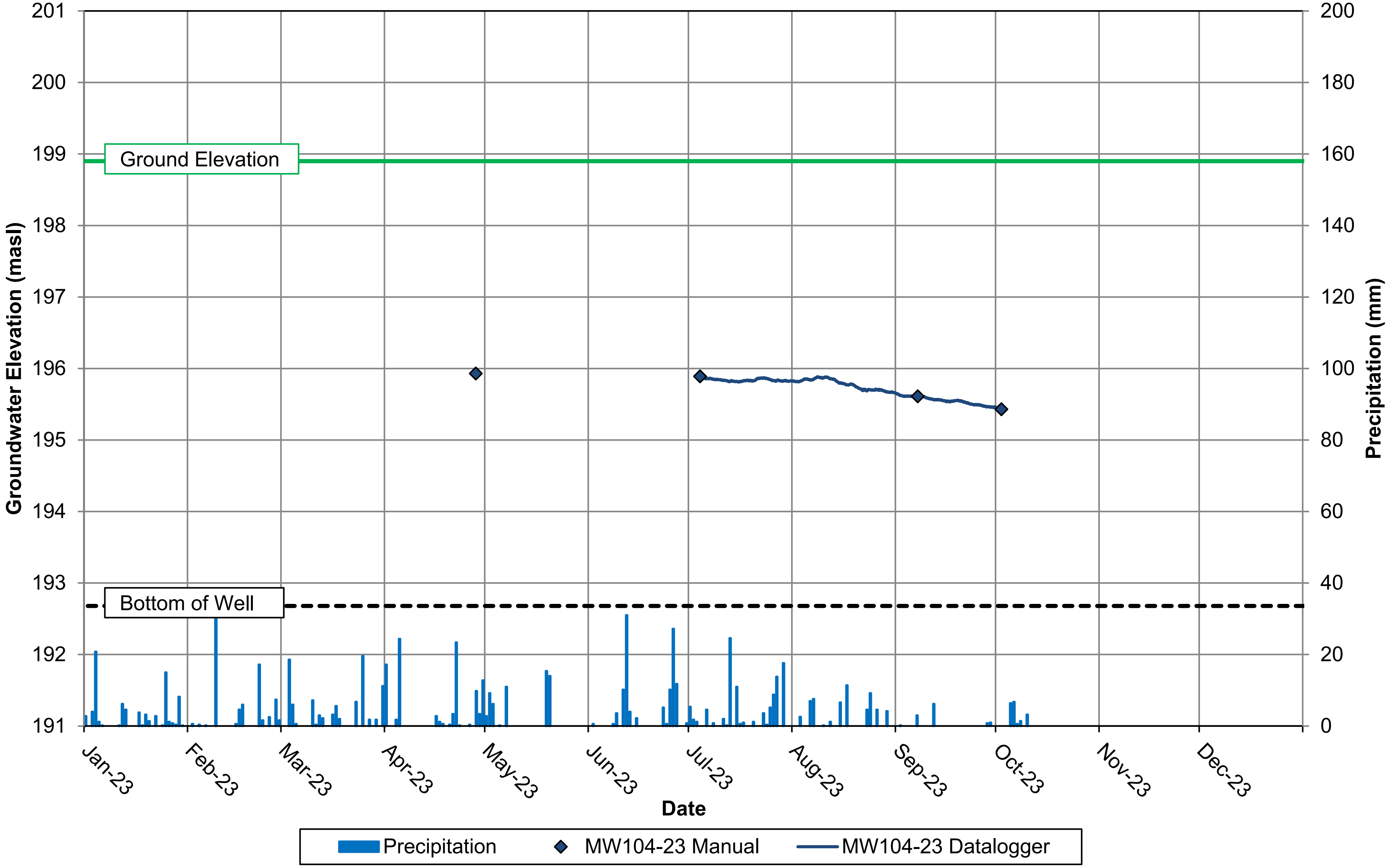

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Figure E-7

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Appendix F

Groundwater Quality

Table F-1: Groundwater Quality
Mississauga Storm Sewer Use Bylaw - Organics

		Sample Description	MW8
		Date Sampled	10/02/2023
Parameter	**Unit**	**G / S**	
Benzene	mg/L	0.002	<0.0002
Toluene	mg/L	0.002	<0.0002
Ethylbenzene	mg/L	0.002	<0.0001
m & p-Xylene	mg/L		<0.0002
o-Xylene	mg/L		<0.0001
Xylenes (Total)	mg/L	0.0044	<0.0001
Toluene-d8	% Recovery		102
4-Bromofluorobenzene	% Recovery		72
Acenaphthene	mg/L		<0.00010
Acenaphthylene	mg/L		<0.00011
Anthracene	mg/L		<0.00007
Benzo(a)anthracene	mg/L		<0.00008
Benzo(a)pyrene	mg/L		<0.001
Benzo(b)fluoranthene	mg/L		<0.00003
Benzo(ghi)perylene	mg/L		<0.00006
Benzo(k)fluoranthene	mg/L		<0.00006
Chrysene	mg/L		<0.00005
Dibenzo(a,h)anthracene	mg/L		<0.00009
Fluoranthene	mg/L		<0.00012
Fluorene	mg/L		<0.0002
Indeno(1,2,3-cd)pyrene	mg/L		<0.00003
Naphthalene	mg/L		<0.0003
Phenanthrene	mg/L		<0.00011
Pyrene	mg/L		<0.00012
Total PAHs	mg/L	0.002	<0.0003
Acridine-d9	%		94
Naphthalene-d8	%		74
Terphenyl-d14	%		77
1,2-Dichlorobenzene	mg/L	0.0056	<0.0001
1,4-Dichlorobenzene	mg/L	0.0068	<0.0001
Dichloromethane	mg/L	0.0052	<0.0001
Tetrachloroethylene	mg/L	0.0044	<0.0001
Trichloroethylene	mg/L	0.0076	<0.0002
Tetrachloroethene	mg/L	0.017	<0.0002
PCBs	mg/L	0.0004	<0.0002
Decachlorobiphenyl	%		104
Escherichia coli	CFU/100mL	200	0
Fecal Coliform	CFU/100mL	0	0

G/S - Guideline Standard - Mississauga Storm Sewer Use Bylaw
Bold - Exceeds Mississauga Storm Sewer Use Bylaw

Table F-2: Groundwater Quality
Mississauga Storm Sewer Use Bylaw - Inorganics

		Sample Description	**MW8**
		Date Sampled	**10/02/2023**
Parameter	**Unit**	**G / S**	
pH	pH Units	6.0-9.0	7.93
BOD (5)	mg/L	15	<2
Total Suspended Solids	mg/L	15	<10
Total Residual Chlorine	mg/L	1.0	0.06
Cyanide, SAD	mg/L	0.02	<0.002
Phenols	mg/L	0.008	0.006
Total Phosphorus	mg/L	0.4	<0.02
Chromium VI	mg/L	0.04	<0.002
Total Aluminum	mg/L	1.0	0.293
Total Arsenic	mg/L	0.02	<0.015
Total Cadmium	mg/L	0.008	<0.005
Total Chromium	mg/L	0.08	<0.015
Total Copper	mg/L	0.04	<0.010
Total Lead	mg/L	0.12	<0.020
Total Manganese	mg/L	2.0	0.086
Total Mercury	mg/L	0.0004	<0.0002
Total Nickel	mg/L	0.08	<0.015
Total Selenium	mg/L	0.02	<0.002
Total Silver	mg/L	0.12	<0.010
Total Zinc	mg/L	0.2	0.035

G/S - Guideline Standard - Mississauga Storm Sewer Use Bylaw
Bold - Exceeds Mississauga Storm Sewer Use Bylaw

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Appendix G

Water Balance Calculations

WATER BALANCE CALCULATIONS
376 & 390 Derry Road and 0 Oaktree Circle
Mississauga, Ontario
December-23
PROJECT No.300056655

TABLE G-1

Pre- and Post- Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 100 mm (urban lawns/agricultural lands in clay loam soils)

Precipitation data from Toronto Lester B. Pearson International Airport Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-5.5	-4.5	0.1	7.1	13.1	18.6	21.5	20.6	16.2	9.5	3.7	-2.2	**8.2**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.70	4.30	7.31	9.10	8.53	5.93	2.64	0.63	0.00	**40.1**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.25	30.43	60.72	90.16	106.17	101.17	77.16	42.26	14.59	0.00	**523**
Adjusting Factor for U (Latitude 43° 57' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	34	77	115	137	121	80	40	12	0	**617**
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	52	48	50	69	74	72	76	78	75	61	75	58	**786**
Potential Evapotranspiration (PET)	0	0	0	34	77	115	137	121	80	40	12	0	**617**
P - PET	52	48	50	34	-2	-44	-61	-43	-6	21	63	58	**169**
Change in Soil Moisture Storage	0	0	0	0	-2	-44	-54	0	0	21	63	16	**0**
Soil Moisture Storage max 100 mm	100	100	100	100	98	54	0	0	0	21	84	100	
Actual Evapotranspiration (AET)	0	0	0	34	77	115	130	78	75	40	12	0	**560**
Soil Moisture Deficit max 100 mm	0	0	0	0	2	46	100	100	100	79	16	0	
Water Surplus - available for infiltration or runoff	52	48	50	34	0	0	0	0	0	0	0	42	**226**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	23	21	22	15	0	0	0	0	0	0	0	19	**102**
Potential Direct Surface Water Runoff (independent of temperature)	28	26	27	19	0	0	0	0	0	0	0	23	**124**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	786	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	118	mm/year											
P-PE (surplus available for runoff from impervious areas)	668	mm/year											

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage 100 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - flat to rolling	0.25	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - relatively tight clay and silt materials, compacted	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn/open space	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.45**	

Latitude of site (or climate station) 43 ^{O} N

WATER BALANCE CALCULATIONS
376 & 390 Derry Road and 0 Oaktree Circle
Mississauga, Ontario
December-23
PROJECT No.300056655

TABLE G-2

Water Balance - Existing Conditions and Post-Development for 376 & 390 Derry Road and 0 Oaktree Circle with No Mitigation

Land Use		Approx. Land Area (m^2)**	Estimated Impervious Fraction for Land Use**	Estimated Impervious Area (m^2)	Runoff from Impervious Area* (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area* (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area* (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Existing Land Use													
Open Space - gravel parking area		19,920	0.50	9,960	0.668	6,654	9,960	0.124	1,236	0.102	1,011	7,890	1,011
Buildings/ Pavement		890	1.00	890	0.668	595	0	0.124	0	0.102	0	595	0
Open Space/ Lawn		4,130	0.00	0	0.668	0	4,130	0.124	512	0.102	419	512	419
TOTAL PRE-DEVELOPMENT		**24,940**	**-**	**10,850**		**7,249**	**14,090**	**-**	**1,748**	**-**	**1,430**	**8,997**	**1,430**
Post-Development Land Use													
Condominiums	Asphalt (Driveway, Roads, Sidewalks)	9,400	1.00	9,400	0.668	6,280	0	0.124	0	0.102	0	6,280	0
	Rooftops	8,310	1.00	8,310	0.668	5,552	0	0.124	0	0.102	0	5,552	0
	Open Space/Lawn	5,970	0.00	0	0.668	0	5,970	0.124	741	0.102	606	741	606
Freeholds	Asphalt (Driveway, Roads, Sidewalks)	60	1.00	60	0.668	40	0	0.124	0	0.102	0	40	0
	Rooftops	1,030	1.00	1,030	0.668	688	0	0.124	0	0.102	0	688	0
	Open Space/Lawn	170	0.00	0	0.668	0	170	0.124	21	0.102	17	21	17
TOTAL POST-DEVELOPMENT		**24,940**	**-**	**18,800**	**-**	**12,560**	**6,140**	**-**	**762**	**-**	**623**	**13,322**	**623**
											% Change from Pre to Post	148	56
											Effect of development (with no mitigation)	1.5 times increase in runoff	56% reduction in infiltration

To balance pre- to post infiltration target (m^3/a)= **807**

* figures from Table G-1

** data provided by SCS

WATER BALANCE CALCULATIONS
376 & 390 Derry Road and 0 Oaktree Circle
Mississauga, Ontario
December-23
PROJECT No.300056655

TABLE G-3

Water Balance - Existing Conditions and Post-Development for 376 & 390 Derry Road and 0 Oaktree Circle with Mitigation

Land Use		Approx. Land Area (m^2)**	Estimated Impervious Fraction for Land Use**	Estimated Impervious Area (m^2)	Runoff from Impervious Area* (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area* (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area* (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Existing Land Use													
Open Space - gravel parking area		19,920	0.50	9,960	0.668	6,654	9,960	0.124	1,236	0.102	1,011	7,890	1,011
Buildings/ Pavement		890	1.00	890	0.668	595	0	0.124	0	0.102	0	595	0
Open Space/ Lawn		4,130	0.00	0	0.668	0	4,130	0.124	512	0.102	419	512	419
TOTAL PRE-DEVELOPMENT		**24,940**	**-**	**10,850**		**7,249**	**14,090**	-	**1,748**	**-**	**1,430**	**8,997**	**1,430**
Post-Development Land Use													
Condominiums	Asphalt (Driveway, Roads, Sidewalks)	9,400	1.00	9,400	0.668	6,280	0	0.124	0	0.102	0	6,280	0
	Roofs to storm sewer	7,650	1.00	7,650	0.668	5,111	0	0.124	0	0.102	0	5,111	0
	Roofs to grass (assume 25% of runoff volume infiltrates[a])	660	1.00	660	0.668	441	0	0.124	0	0.102	0	129	110
	Open Space/Lawn	5,970	0.00	0	0.668	0	5,970	0.124	741	0.102	606	610	606
	Rear Roof and Rear Yards to infiltration trench; assume designed to accommodate 10 mm storm from 660 m^2 of roof area and 1730 m^2 of pervious area; 10 mm storms account for approximately 70% of total rainfall[b] (~61% of total precipitation); so assume 61% of runoff total from select roofs and rear yards calculated above will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	333	N/A	333
Freeholds	Asphalt (Driveway, Roads, Sidewalks)	60	1.00	60	0.668	40	0	0.124	0	0.102	0	40	0
	Roofs to grass (assume 25% of runoff volume infiltrates[a])	407	1.00	407	0.668	272	0	0.124	0	0.102	0	204	68
	Rooftop to Sewer	623	1.00	623	0.668	416	0	0.124	0	0.102	0	416	0
	Open Space/Lawn	170	0.00	0	0.668	0	170	0.124	21	0.102	17	21	17
TOTAL POST-DEVELOPMENT		**24,940**	**-**	**18,800**	**-**	**12,560**	**6,140**	**-**	**762**	**-**	**956**	**12,811**	**1,134**
											% Change from Pre to Post	142	21
											Effect of development (with mitigation)	1.4 times increase in runoff	21% reduction in infiltration

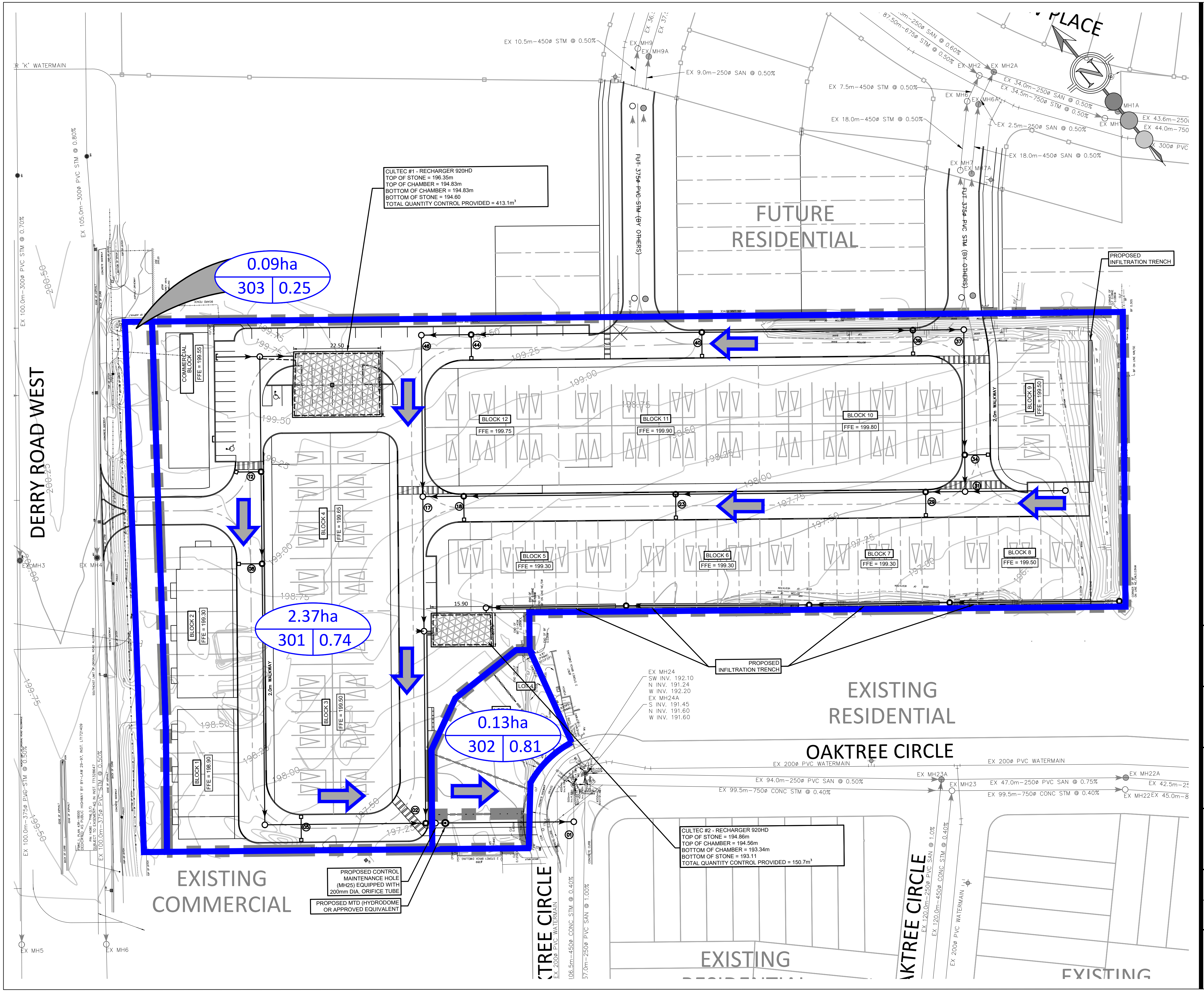
To balance pre- to post infiltration target (m^3/a)= **296**

* figures from Table G-1

** data provided by SCS

[a] based on estimation in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D

[b] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)



LEGEND:

- LIMIT OF DEVELOPMENT
- STORM DRAINAGE BOUNDARY
- PROPOSED STORM SEWER / MANHOLE
- 198.00 EXISTING CONTOUR AND ELEVATION
- 0.09ha — DRAINAGE AREA (HECTARES)
- 303 | 0.25 — RUNOFF COEFFICIENT / CATCHMENT ID
- OVERLAND FLOW

FIGURE IS PRELIMINARY

SCS consulting group ltd

30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

BALLYMORE HOMES
376 & 390 DERRY ROAD WEST

POST-DEVELOPMENT STORM DRAINAGE PLAN

DESIGNED BY:	S.G.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	DECEMBER 2023
PROJECT No:	2509	FIGURE No:	3.3

File: P:\2509 Ballymore – 376 Derry Rd\Drawings\Phase 1\Swm\Report Figures\2509D–STRM–POST–X.X.dwg – Revised by <CTZUMERKAS> : Tue, Dec 05 2023 – 12:15pm

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Appendix H

Dewatering Calculations

Table H-1
Summary of Dewatering Estimates
Groundwater Seepage - Trenches

Trench Excavations	Excavation Invert m asl	Water Table masl	Dewatering		Datum masl	Soil Type	K m/s	H m	h m	R_o m	Width of Excavation m	Length of Trench m	Equivalent Radius (r_s) m	Distance to Line Source (L) m	Q unconfined L/day	Q unconfined L/min
			Level masl	Drawdown m												
Typical	193.60	197.50	192.60	4.90	190	Silty Clay Till	2.00E-07	7.50	2.6	7	4	100	2.0	6.57	15,266	11

Notes:

m	metres
masl	metres above sea level
m/s	metres per second

Dewatering level assumed to be 1 m below the base of the excavation
Datum is based on interpreted bottom of surficial aquifer.
Dewatering methods will be determined by the dewatering contractor retained to do the work.
Water table based on levels collected at closest monitoring wells (Burnside, 2023)
Depths of excavations taken from servicing plan provided by SCS Consulting Group dated November 2023.

H is saturated thickness of aquifer before pumping [m];
h is saturated thickness of aquifer under pumping conditions [m];
R_0 is radius of pumping influence [m];
r_s is equivalent radius of pumping well [m]; (r_s at end of excavation = 0.5 width of excavation)
x is length of trench [m] or excavation;
L is distance from line source [m]; assumed to be radius of influence
Q is pumping rate;
K is hydraulic conductivity [m/s];

$$Q = \frac{\pi K\left(H^2 - h^2\right)}{\ln\left(\frac{R_0}{r_s}\right)} + 2\left[\frac{xK\left(H^2 - h^2\right)}{2L}\right]$$

Where:

$R_0=3000(H-h)K^{0.5}$
Q = pumping rate [m^3/s];
L = distance from line source [m]; assumed to be radius of influence
K = the hydraulic conductivity (m/sec)
H = the existing height of the water table (m)
h = the height of the water table after dewatering (m)
R_0 = the lateral extent of drawdown (m)
r_s = half the width of excavation (m)

Table H-2
Summary of Dewatering Estimates
Groundwater Seepage - Radial Flow for Cultec Systems

Source	Excavation Invert m asl	Water Table masl	Dewatering		Datum masl	Soil Type	K m/s	H m	h m	R_o m	Width of Excavation m	Length of Excavation m	Equivalent Radius (r_s) m	Q unconfined L/day	Q unconfined L/min
			Level masl	Drawdown m											
Cultec #1	194.6	197.5	193.60	3.9	190	Silty Clay Till	2.00E-07	7.50	3.6	16	16.9	22.5	11.0	6,040	4
Cultec #2	193.1	195	192.10	2.9	190	Silty Clay Till	2.00E-07	5.00	2.1	11	8.8	15.9	6.7	2,428	2

Notes:

m	metres
masl	metres above sea level
m/s	metres per second

Dewatering level assumed to be 1 m below the base of the excavation
Datum is based on interpreted bottom of surficial aquifer.
Dewatering methods will be determined by the dewatering contractor retained to do the work.
Water table based on levels collected at closest monitoring wells (Burnside, 2023)
Depths of excavations taken from servicing plan provided by SCS Consulting Group dated September 2023.

H is saturated thickness of aquifer before pumping [m];
h is saturated thickness of aquifer under pumping conditions [m];
R_0 is radius of pumping influence [m];
r_s is equivalent radius of pumping well [m];
Q is pumping rate;
K is hydraulic conductivity [m/s];

The following equation is relevant in the case of radial flow towards the circular shafts:

Unconfined:

$$\boxed{Q = \frac{\pi K\left(H^2 - h^2\right)}{\ln\left(\frac{R_0}{r_s}\right)}}$$

Confined:
(assumed)

$$\boxed{Q = \frac{\pi BK\ \left(H - h\right)}{\ln\left(\frac{R_0}{r_s}\right)}}$$

Where:

$R_0 = 3000\ (H-h)\ K^{0.5} + r_s$

K = the hydraulic conductivity (m/sec)
H = the existing height of the water table (m)
h = the height of the water table after dewatering (m)
R_0 = the lateral extent of drawdown (m)
Q = pumping rate [m^3/s];
r_s = √ (width of excavtion x length of excavation) /π

Table H-3
Summary of Dewatering Estimates
Surface Water Runoff Volumes

					Runoff Event (5 mm event)	
Source	Width of Excavation m	Length of Excavation m	Area of Excavation m^2	Total Area for Runoff m^2	Estimated Runoff Volume m^3	Estimated Runoff Volume L
Trench Excavations	4	100	400	612	3.06	3,060
Cultec #1	17	23	380	463	2.32	2,315
Cultec #2	8.8	15.9	139	192	0.96	962

Notes:
Total area for runoff assumes 2 meter buffer around width of excavation receiving runoff into excavation.
A typical rain event assumed to be 5 mm of rain.

Table H-4
Summary of Dewatering Estimates
Total Volumes

Source	Typical Groundwater Seepage	Runoff Event	Typical Total Volume		Max Groundwater Seepage	Max Total Volume	
	L/day	L/day	L/day	L/min	L/day	L/day	L/min
Trench Excavations	15,266	3,060	18,326	13	22,899	25,959	18
Cultec #1	6,040	2,315	8,356	6	9,060	11,376	8
Cultec #2	2,428	962	3,390	2	3,642	4,604	3

R.J. Burnside & Associates Limited