HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS 273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

Project No.: CCO-22-1643-01

Prepared for:

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EXECUTIVE SUMMARY

McIntosh Perry ('MP') was retained by Trevor Watkins ('the Client') to conduct a Hydrogeological Assessment and Terrain Analysis in support of a proposed storage facility development for the property located at 273-275 Russ Bradley Road (previously known as 1500 Thomas Argue Road) in Carp, Ontario. It is our understanding that this hydrogeological assessment and terrain analysis is needed based on a requirement from the City of Ottawa as a condition for a privately serviced development, as part of the site plan application process.

Based on documentation provided, the Site is located immediately south of Russ Bradley Road and approximately 70 metres southwest from Carp Road. It is our understanding that the Client is looking to develop a private storage facility, which includes twelve (12) self storage buildings, a small office area, and washroom facilities. The area in which this private storage facility will be placed is approximately 2.4 hectares (ha.) in size.

This report has been prepared using data collected from a drilled test well at 273-275 Russ Bradley Road (Test Well 1, TW1) by Mcintosh Perry staff in September 2022 and August 2023. It is our understanding that this well (TW1) is the well that will be utilized to service the proposed development. Therefore, the hydrogeological data gathered during the pumping test and subsequent analyses are deemed to be wholly representative of hydrogeological conditions at the Site and future groundwater to be utilized by occupants.

The natural ground surface at the Site gently slopes throughout the Site towards the south. Site elevation ranges from approximately 111 – 114 metres above sea level (m asl), however at the time of writing this report, regrading work has begun at the Site. Surface drainage is interpreted to reflect surface topography and is likely controlled via areas of permeable ground surface. An unnamed creek runs along the south border of the Site, flowing southwest. Surface water and shallow groundwater in the vicinity of the Site likely flows toward this creek.

A pumping test at TW1 originally commenced on August 30, 2022. Due to issues with water quality (notably high turbidity levels measured in the field throughout the test), the pumping test evolved into well development only, whereby the well was developed and field parameters observed. The well was pumped for approximately 21 hours, cumulatively. McIntosh Perry staff then returned to the Site on September 13, 2022 to complete a 420-minute pumping test. TW1 was pumped on September 13, 2022 for a duration of 420 minutes and was sampled twice during this time. The pumping rate changed throughout the pumping test in order to adequately reflect a stabilized quantity of water being pumped from the well. The cumulative weighted average pumping rate was 47.8 L/min for the duration of the test, which is considered sufficient to supply future development of a private commercial development.

Water quality results indicate that the bedrock aquifer provides water which is considered generally suitable for the proposed development. All analytical results were compared to the Ontario Drinking Water Standards, Objectives, and Guidelines (ODWS). Based on the analytical results from TW1 on September 13, 2022, the following exceedances were noted:

- Hardness (OG: 100 mg/L): TW1-1 (271 mg/L) and TW1-2 (265 mg/L)
- Sulphide: (AO: 0.05 mg/L): TW1-1 (3.14 mg/L) and TW1-2 (3.36 mg/L)
- Turbidity: (AO: 5 NTU): TW1-1 (34.8 NTU)
- Aluminum: (AO: 0.1 mg/L): TW1-1 (0.68 mg/L) and TW1-2 (0.14 mg/L)
- Iron (AO: 0.3 mg/L): TW1-1 (0.82 mg/L); and
- The health warning limit for sodium (20 mg/L) was exceeded in sample TW1-1 (22.7 mg/L) and TW1-2 (24.1 mg/L)

Due to continued presence of the aesthetic and operational exceedances of the ODWS noted above, McIntosh Perry returned to the Site on August 15, 2023 to complete additional well development and resolve high turbidity values. Approximately 1 hour after pumping had commenced (using a rate of 18-20 L/min), turbidity values were recorded at less than 1.0 NTU (0.55 NTU) using a calibrated LaMotte 2020 turbidity meter.

On-site overburden in the area of the proposed development is listed by the Ontario Geological Survey (OGS) as coarse-textured glaciomarine deposits of sand, gravel, minor silt and clay. This is supported by the MECP WWIS records, which indicate mainly sand, clay, and gravel overburden for wells listed within 500 m of the Site. On-site bedrock is generally characterized as limestone, dolostone, shale, arkose, and sandstone of the Simcoe Group of the Shadow Lake Formation (OGS, 2021), which is supported by a majority of well records in the area that list the bedrock as either "shale" or "limestone". The average depth to bedrock is approximately 34 m below ground surface (bgs) for listed wells within 500 m of the Site.

The City of Ottawa's Hydrogeological and Terrain Analysis Guidelines require that potential septic system impacts be addressed regardless of lot size. A predictive nitrate attenuation calculation was completed for the Site. Utilizing a combined effluent loading of 40,000 mg/day (40 mg/L NO2-NO3, 1000 L/day) and a background nitrate-nitrite concentration of 0.1 mg/L, the predictive attenuation calculation for nitrate – nitrite was calculated at 5.26 mg/L, which is less than the boundary maximum permissible of 10 mg/L.

Based on the analyses performed for this hydrogeological assessment, McIntosh Perry is of the opinion that the aquifer for which the test well intersects can adequately supply water for the proposed private development on-Site.

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1.0 INTRODUCTION

McIntosh Perry ('MP') was retained by Trevor Watkins ('the Client') to conduct a Hydrogeological Assessment and Terrain Analysis in support of a proposed storage facility development for the property located at 273-275 Russ Bradley Road ('the Site', previously known as 1500 Thomas Argue Road) in Carp, Ontario. It is our understanding that the client is looking to develop a private storage facility, which includes twelve (12) self storage buildings. The area in which this private storage facility will be placed is approximately 2.4 hectares (ha.) in size.

The Site location is shown on Figure 1 – Site Location, and an outline of the Site showing the neighbouring properties and the proposed area of future development is presented on Figure 2 – Site Layout.

This report has been prepared using data collected from a drilled test well at 273-275 Russ Bradley Road (Test Well 1, TW1) by Mcintosh Perry staff in September 2022 and August 2023. It is our understanding that this well (TW1) is the well that will be utilized to service the proposed development.

This Hydrogeological Assessment and Terrain Analysis addresses the following:

- Well Record search and evaluation;
- Background hydrogeological evaluation;
- Oversight of a 420-minute pumping test and follow-up testing at 273-275 Russ Bradley Road;
- Water level and flow monitoring, field water quality analyses;
- Sampling and analysis – includes 2 sample analyzed for the 'Subdivision Supply Suite' of parameters (including trace metals and volatiles);
- Summary of infiltration data throughout portions of the Site, completed as part of the infiltration assessment of subsurface materials; and
- Data Evaluation and Report.

1.1 Consultation

McIntosh Perry conducted a pre-consultation with a representative from the City of Ottawa via phone call on August 19, 2022. Michel Kearney, P.Geo. from the City of Ottawa provided information on what would be required for this Hydrogeological Report and Terrain Analysis, including the following:

- The Hydrogeological Report prepared for the Site must follow the guidelines stipulated in Procedure D-5-5 (Private Wells: Water Supply Assessment);
- It was communicated that a 6-hour pumping test would be acceptable if the drilled test well shows sufficient water quality and quantity (proper rate and recovery);
- Volatile organic carbons (VOCs) and metals are to be included in the subdivision package for the water quality analysis; and
- The terrain analysis needs to provide an impact of the septic system at the property line.

2.0 BACKGROUND

2.1 Site Setting

The Site is located in the community of Carp, located in West-Carleton-March Ward in the City of Ottawa, Ontario (Figure 1). The Site is currently unoccupied, vacant land. The Site is unused, with the Carp Airport located in close proximity (west) of the Site. Due to the proximity of the airport, the Site is designated as "Air Transportation Facility Zone" per the City of Ottawa Zoning By-Law No. 2008-250.

At the time of investigation, on-site conditions consisted primarily of a grassed and forested area. Based on a review of aerial photos and field observations, it appears that the Site has never been contemporarily developed.

2.2 Neighbouring Properties and Land Uses

The Site is located south of the intersection of Carp Road and Russ Bradley Road. The Site is within a rural land use area, and is surrounded by Carp Road to the north/northeast, William Mooney Road to the South, the Carp Airport to the west. Land-use on all sides from the Site include mainly commercial and industrial properties.

The proposed total area of the Site, which includes the private storage facility, consists of an approximate 2.4-hectare portion of land. While MECP Water Well Information System (WWIS) records for the area do not provide the detailed locations of most wells, all properties developed in proximity to the Site are assumed to be privately serviced with wells and on-site sewage systems.

Figure 3 – MECP Wells Record Summary, presents the MECP Well Tag numbers and approximate well locations, where available, for wells within approximately 500 m of the Site. Well Records within 500 m of the Site are included in Appendix A.

2.3 Hydrology

Topography was reviewed on the Atlas of Canada Toporama website. Site elevation is approximately 111 – 114 metres above sea level (m asl). Ground surface at the Site is generally gently sloped throughout the site towards the south, towards an unnamed creek which flows west. It is noted that at the time of writing this report, Site regrading has been initiated by the Client.

Surface drainage is interpreted to reflect surface topography and is likely controlled via areas of permeable ground surface. An unnamed creek runs south of the Site, flowing towards the west. Shallow groundwater in the vicinity of the Site likely flows toward this creek. The closest permanent water body is Carp River, located approximately 1.6 km north of the Site, at its closest point. On a regional scale, surface water is likely to flow to the west/northwest towards Carp River, eventually flowing into Lac des Chats.

It is noted that during the initial fieldwork completed for the Hydrogeological Assessment, the Site appeared to be poorly drained; standing water was present in several areas of the Site, which was not consistent with the City of Ottawa's designation of the property as a high-infiltration area. This was further supported by data indicating low infiltration rates, as measured by in-situ testing with a Guelph Permeameter across portions of the Site (as summarized below).

2.4 Geology and Hydrogeology

On-site overburden in the area of the proposed development is listed by the Ontario Geological Survey (OGS) as coarse-textured glaciomarine deposits of sand, gravel, minor silt and clay. This is supported by the MECP WWIS records, which indicate mainly sand, clay, and gravel overburden for wells listed within 500 m of the Site. Refer to Section 5.0 for a more detailed discussion regarding surficial geology.

On-site bedrock is generally characterized as limestone, dolostone, shale, arkose, and sandstone of the Simcoe Group of the Shadow Lake Formation (OGS, 2021), which is supported by a majority of well records in the area that list the bedrock as either "shale" or "limestone".

Based on surrounding topography, shallow groundwater is interpreted to have a west/northwest component.

2.4.1 Recharge and Discharge Areas

Based on a review of topographic data, geological maps, and Site visits, the property slopes slightly upwards to the south. Shallow groundwater and surface water likely flow towards the west/northwest.

Based on previously noted permeability testing, infiltration is relatively low across the Site. This appears to be partly due to high water levels within the overburden soils (see Appendix G), as well as relatively low hydraulic conductivities in the shallow soil. Site observations made in June and August 2022, prior to the pumping test, indicate that the property and development area is highly saturated, with many areas of stagnant standing water. The wooded area on-Site in particular appears to be a local topographic low point.

2.4.2 Potential Sources of Contamination

A windshield survey of the surrounding area was conducted in combination with a Site walkthrough and review of maps and zoning information. The Site is located in a predominantly rural commercial area. This does not appear to pose any significant source of contamination to the proposed development. No obvious potentially contaminating activities (e.g., fuel outlets, improperly maintained bulk fuel storage, salt storage, manure piles, livestock yards, etc.) were observed in the vicinity of the Site at the time of inspection.

The Site and surrounding properties are not connected to municipal services. As such, there are likely private on-site sewage systems at nearby residences.

2.4.3 Water Well Record Review

The MECP's WWIS database indicated twenty-two (22) water wells that are located within 500 m of the centre of the Site. Five (5) of these records have no information available or are listed as abandoned wells. Nine (9) wells are listed for domestic or commercial water supply purposes, four (4) are listed as observation wells, and one (1) well is listed as a test/monitoring well. The MECP WWIS records are shown on Figure 3, and data are summarized in Appendix A.

Wells were completed in varying subsurface materials including clay, sand, gravel, limestone, and shale, ranging in final depths of 0.3 – 48.7 m below ground surface (bgs). The average depth to bedrock was reported to be 34 m bgs. Driller-reported static groundwater levels ranged from 1.1 – 15.2 m bgs.

Driller-reported well yields ranged from 11.4 – 94.7 L/min.

For the on-Site well (TW1), the well was completed primarily in clay (mixed with gravel) from ground surface to 41.5 m bgs), followed by limestone at 41.5 m to 152 m bgs. The driller-reported static groundwater level was 60 m bgs, and the well yield (prior to hydo-fracking), was listed at 18.9 L/min.

2.4.4 Hydro-Fracking

Prior to the pumping test administered on September 13th, 2022, Test Well 1 (TW1) was hydro-fracked by a licensed well driller (Ontario Water Well Fracturing Ltd.) to increase yield. Hydro-fracking (or hydro-fracturing) is a process whereby water is injected into the well at a high pressure to create small fractures within the bedrock material in order to facilitate greater infiltration of groundwater into the well itself. Hydro-fracking was performed on this well as there were previously identified issues with regards to water supply and production.

2.4.5 Hydrogeological Sensitivity

Given the thickness of overburden encountered during field investigations (infiltration testing, monitoring well installation, and geotechnical investigations), as well as a review of well records on the Site and within the area, the Site is not considered to be hydrogeologically sensitive.

Furthermore, a review of mapping for Karst Topography indicates that the Site is not located within an area identified as potential, known, or inferred karst formation. No karst topography was observed during visits to the Site.

3.0 METHODOLOGY – HYDROGEOLOGICAL ASSESSMENT

McIntosh Perry conducted a hydrogeological investigation at the Site to assess the feasibility of servicing the proposed development. The work generally followed the guidance of MECP Procedure D-5-5: Technical Guideline for Private Wells: Water Supply Assessment.

McIntosh Perry tested the drilled test well located at 273-275 Russ Bradley Road (Test Well 1, TW1 – A342436), which is representative of the hydrogeological conditions across the proposed development. The well record is saved in Appendix B, appended to this report.

A pumping test at TW1 originally commenced on August 30, 2022. Due to issues with water quality (notably high turbidity levels measured in the field throughout the test), the pumping test evolved into well development only, whereby the well was developed and field parameters observed for at least 21 hours. McIntosh Perry staff then returned to the Site on September 13, 2022 to complete a 420-minute pumping test. The analytical results and water level data in this report references the pumping test completed on September 13, 2022, only.

Based on correspondence received from the City of Ottawa (dated August 19, 2022), it was expressed that a 6-hour pumping test would be sufficient if the well indicated sufficient water quantity and quality. Based on conditions encountered at the time of the pumping test (involving changing the pumping rate to allow groundwater to stabilize), a 420-minute (7 hour) pumping test was completed.

Groundwater was pumped directly from TW1 using a pump provided and installed by Air Rock Drilling (during both August 30, 2022 well development and the September 13, 2022 pumping test). The pumped water was directed away from the test well and was allowed to flow overland across the Site.

During the testing period, water levels in the well were measured using an electronic water level tape. Water quality (pH, temperature, conductivity, oxygen reduction potential, turbidity, dissolved oxygen, and total dissolved solids) was also monitored and recorded in the field during the test using calibrated instruments (general parameters -Horiba U-52; Turbidity - LaMotte 2020). The LaMotte 2020 turbidity meter is calibrated monthly by McIntosh Perry staff following manufacturers instructions. The calibration certificate for the Horiba U-52 completed by the rental company (Maxim) is included in Appendix C. Additional visual water quality observations were observed including colour, clarity/turbidity, odour, and effervescence, as seen in Table 1 appended to this report. Groundwater chemistry had stabilized prior to collecting samples of the well water.

No samples were collecting during the August 30, 2022 well development. On September 13, 2022, one sample (TW1_1) was collected for laboratory analysis, taken 180 minutes after the start of the pumping test. An additional sample (TW1_2) was collected for laboratory analysis 415 minutes after the start of the test. These sample were analyzed for the full suite of subdivision supply parameters, including metals, microbial, and VOCs.

At the time both samples were collected from TW1, residual chlorine readings indicated a value of 0.0 mg/L using a Hach DR900 colorimeter; the Hach DR900 was zero standardized prior to collecting samples. All groundwater samples were collected unfiltered and unchlorinated, directly into clean bottles supplied by the analytical laboratories (Paracel Laboratories Ltd., Ottawa, ON). The samples were kept on ice and delivered directly to Paracel under strict chain of custody procedures. All of the samples were received by the laboratory within 24 hours of collection.

Paracel is fully accredited by the Standards Council of Canada/Canadian Association for Laboratory Accreditation (SCC/CALA) and has accreditation for Ontario Safe Drinking Water Act (OSDWA) testing.

During the pumping test, water level monitoring consisted of manual readings with an electronic water level tape. Drawdown was measured in the pumped well and measurements were made until at least 95% recovery were achieved, or 24 hours had passed (whichever came first). A data logger was not used as part of this assessment due to concerns with down-hole entanglement.

Drawdown and recovery data from the pumping tests were plotted and analyzed using the Cooper-Jacob solution. The hydraulic conductivity (K, m/s) and transmissivity (T, m^2/d) and long-term yield (Farvolden and Moell Method) of the aquifer were estimated. Storativity could not be assessed properly without the use of an additional observation well, which was not available at the time of the test.

The well development which occurred on August 30, 2022 indicated high levels of turbidity throughout pumping (ranged from 172 to 1000 (maximum value) NTU). Accordingly, McIntosh Perry staff returned to the Site on September 13, 2022 to complete a pumping test. Based on high turbidity values also recorded within the field (ranged from 6.6 to 66 NTU), further well development occurred on August 15, 2023 in an effort to lower turbidity values. The results of this well development indicated turbidity values of less than 1.0 NTU (0.55 NTU), approximately 1 hour after pumping at a rate of 18-20 L/min had commenced.

It is noted that in addition to the pumping test completed, McIntosh Perry completed an infiltration assessment across the Site to determine the general infiltration rates of subsurface materials. Based on this assessment completed in October 2022, permeability across the Site was low given the excess of saturated soils encountered. Two infiltration studies were conducted on-Site. In June of 2022, the advancement of three (3) test locations was completed, two (2) of which were outside of the proposed infiltration infrastructure area. Results of this program indicated low infiltration rates which ranged from 3.4×10^{-6} to 4.9×10^{-7} m/s. In October, additional infiltration testing was completed on-Site where the proposed infiltration infrastructure would be placed. Three (3) test locations were advanced, and low infiltration rates were again found, with rates ranging from 1.74×10^{-8} to 6.4×10^{-6} m/s. Appendix G provides additional information on the June 2022 infiltration program.

4.0 RESULTS

A drawdown curve and tabular data from the pumping test conducted at the Site are available in Appendix D. A summary of groundwater quality data and the official Laboratory Certificates of Analysis are available in Table 2 and Appendix E, respectively.

4.1 Static Conditions

Prior to the initiation of pumping, water levels were measured in the well. The static groundwater level was recorded at 9.87 m below top of casing (btoc) at the time of the original pumping test (t=0). Using survey data captured in 2023, the geodetic elevation of the well is approximately 113 m above sea level (m asl). Based on this elevation, the static water elevation in the well was 103.13 m asl. According to the MECP Well Record for TW1 (A342436) the proposed pump depth was recommended to be 91.4 m bgs – the depth used at the time of the pumping test was 85.3 m bgs. The pumping depth used during the test corresponded to an available water column of approximately 75.5 m.

Standing water or evidence of groundwater discharge was not observed at the test well location at the time of the pumping test.

4.2 Pumping Test – TW1

The pumping test was conducted at TW1 (273-275 Russ Bradley Road) was performed under the supervision of McIntosh Perry on September 13, 2022. Water was pumped directly from the test well using equipment provided by Air Rock. The water discharge was directed away from the test well and was allowed to flow overland across the Site, away from the well. At the time of the pumping test, the weather was approximately 20°C and cloudy.

At 7:40 AM, the pump was turned on and the flow rate adjusted to approximately 60 L/min. This pumping rate was maintained for approximately 35 minutes, at which time the pumping rate was changed to 53.3 L/min for an additional 157 minutes. The pumping rate was changed again 192 minutes after the start of the test to 48 L/min – this rate was maintained for three minutes and was then changed as water levels were not stabilizing. The pumping rate was changed to 42 L/min 195 minutes after the start of the test and remained at that rate until the pump was shut off (420 minutes after the start of the test).

The stepwise reductions in the pumping rate described above were performed as water levels were not stabilizing. The higher pump rate that was originally used at the start of the pumping test was reduced in order to achieve a more sustainable pumping rate which could be maintained for the remainder of the test. All pumping rates used were greater than the minimum daily water demand of approximately 13.7 L/min.

The groundwater level ranged between 9.87 – 53.95 m btoc, with a maximum drawdown of 44.08 m observed. At the end of the test, approximately 38.7 m of the available water column remained. Following pump shutoff (420 minutes), the water level was recorded at 11.7 m btoc (101.2 m asl) within 50 minutes, representing approximately 97% recovery.

All water level measurement data are presented in Table 2, appended to this report.

4.2.1 Well Yield

The pumping test undertaken by McIntosh Perry provides a reasonable indication of the yield of the Test Well. During this test, over 20,000 L of water was pumped from the well. Given that the typical volume (daily flow) required for an individual employee per eight hour work shift is 75 L, the 20,000 L pumped would be sufficient for over 250 employees. It is anticipated that no more than two employees will staff the operations per eight hour shift.

4.2.2 Transmissivity

The transmissivity for TW1 was calculated following the Cooper-Jacob method. The calculations for Transmissivity are presented in Appendix F. Transmissivity was calculated using the following equation:

$$T = \frac{2.3\,Q}{4\,\pi \Delta s}$$

Where:

- T is the transmissivity (m^2/day)
- Q is the pumping rate during the pumping test (L/min); and,
- Δs is the differential for residual drawdown for one log cycle (m)

Using drawdown and recovery data, a transmissivity during the drawdown period was 0.6 m^2/day, and a transmissivity during the recovery phase was calculated at 0.5 m^2/d using the Cooper-Jacob method.

Assuming an aquifer thickness of 109.12 m (as approximated by the interval between the bottom of the casing and the bottom of the well), the screened formation of TW1 was calculated to have an average hydraulic conductivity of 1.08×10^{-7} m/s.

Storativity (S) could not be calculated as no observation wells were available for measurement at the time of the pumping test.

A summary of the well and hydrogeological properties determined during the testing work at the Site are presented in Appendix D. The calculations for Transmissivity are presented in Appendix F.

4.2.3 Long Term Yield

The theoretical long-term safe yield was calculated using both the Farvolden and Moell methods. Drawdown data were used, as they are likely more representative of aquifer conditions (see above Section 4.2.2).

The maximum daily water demand calculation is based on the persons to be using the groundwater, spatial area, and design of the water distribution system. The peak supply rate needed to support the maximum daily water demand is 0.31 L/second, or 18.6 L/min.

Farvolden Equation

The long-term yield (Q_{20}) was calculated using the following Farvolden equation:

$$Q_{20} = 0.68\, T\, Ha\, S_f$$

Where:

- Q_{20} is the twenty-year safe yield;
- T is the transmissivity;
- Ha is the available water column height (above the pump); and
- S_f is a safety factor (0.7).

Based on the Farvolden Method, calculations indicate that a twenty-year safe yield is on the order of 26 L/min. This means that TW1 could theoretically sustain continuous pumping for 20 years at this rate. This is above the requirement of 18.6 L/min.

Moell Method

The Moell Method was also used to calculate the theoretical long-term safe yield for the pumping well. The long-term yield (Q_{20}) was calculated using the following Moell equation:

$$(Q_{20}) = (Q\ Ha\ Sf) / (s100 + 5\ \Delta s)$$

Where:

- Q_{20} is the twenty-year safe yield (m^3/day);
- Ha is the available water column height (m);
- S_f is a safety factor (0.7);
- s100 is the drawdown at 100 minutes (semi-log long-term graph);
- Δs is the change in hydraulic head over one log cycle (drawdown vs. log time, see Appendix D); and
- Q is the pumping rate during the pumping test (L/min).

Using the Moell Method, calculations indicate that a twenty-year safe yield for the well is on the order of 31 L/min. This is above the requirement of 18.6 L/min.

4.2.4 Minimum Pumping Test Rates

Using the rates stipulated in the City of Ottawa's Hydrogeological and Terrain Analysis Guidelines, the per-person requirement shall be 450 L/day. Peak demand occurs for a period of 120 min/day, which is equivalent to a peak demand rate of 3.75 L/min per person. Given that the proposed development is a commercial establishment in which a maximum of only two (2) persons are expected to be present for a full work shift (8 hours), the minimum pumping test rate and well yield is as follows:

Minimum pumping test rate = (3.75 L/min (peak demand) x (number of persons per well (2))

The minimum pumping test rate is calculated to be 7.5 L/min. The pumping test utilized pumping rates no less than 42 L/min, significantly higher than this calculated rate. Furthermore, the twenty-year (long-term) safe yield calculations described above for this supply well ranged from 26-31 L/min. These calculations are inherently conservative, as the pump will likely cycle on and off over a shorter period of time. The peak hourly flow rates will likely be less than the calculated values above. Further, the 7-hour pumping test conducted indicates sustainable flow rates which are considered to be sufficient to support the proposed development. Therefore, Mcintosh Perry is of the opinion that the aquifer is capable of supplying water at a flow rate greater than the minimum of 13.7 L/min (as outlined in Procedure D-5-5), as well as the per-person requirements of 450 L/day, for the proposed private storage facility.

The calculations for the Farvolden and Moell method are presented in Appendix F.

4.2.5 Water Quality

Laboratory Certificates of Analysis for on-site groundwater testing are presented in Appendix E. A summary of field and laboratory results from the Test Well is presented in Tables 1A, 1B, and 2. Two samples were taken during the 420-minute pumping test of TW1 on September 13, 2022. The first sample (TW1-1) was taken 180 minutes after the start of the test, and the second sample (TW1-2) was taken 415 minutes after the start of the test. Both samples were taken directly from the pump discharge hose into laboratory-supplied containers.

Prior to collection of the groundwater samples, the residual chlorine (total and free chlorine) reading using the Hach DR900 colorimeter was 0 mg/L after 164 minutes and 360 minutes after pumping. Prior to usage, the Hach DR900 was calibrated according to the manufacturer's printed instructions.

All analytical results were compared to the Ontario Drinking Water Standards, Objectives, and Guidelines (ODWS).

Based on the analytical results and values measured in the field from TW1 on September 13, 2022, the following exceedances were noted:

- Hardness (OG: 100 mg/L): TW1-1 (271 mg/L) and TW1-2 (265 mg/L)
- Sulphide: (AO: 0.05 mg/L): TW1-1 (3.14 mg/L) and TW1-2 (3.36 mg/L)
- Turbidity (laboratory reported): (AO: 5 NTU): TW1-1 (34.8 NTU)
- Turbidity (measured in field): (AO: 5 NTU); TW1-1 (44.8 NTU), TW1-2 (6.6 NTU)
- Aluminum: (AO: 0.1 mg/L): TW1-1 (0.68 mg/L) and TW1-2 (0.14 mg/L)
- Iron (AO: 0.3 mg/L): TW1-1 (0.82 mg/L); and
- The health warning limit for sodium (20 mg/L) was exceeded in sample TW1-1 (22.7 mg/L) and TW1-2 (24.1 mg/L)

No health-related maximum acceptable concentration (MAC) were exceeded.

The bacteria were all non-detectable (0 cts/100 mL for E-coli, Fecal Coliforms, and Total Coliforms), in the samples that were collected at TW1.

Throughout the test, field-reported turbidity was considerably lower than laboratory-reported turbidity. While turbidity dropped to acceptable levels throughout the test, elevated turbidity is likely a result of the hydrofracking process, and should improve with continued well development. With further well development (pumping and use of the well), any fine-grained material is agitated, causing it to become suspended and then removed during pumping. Thus, with continued use of the well, turbidity values are expected to decrease. It is noted that further well development which occurred on August 15, 2023 indicates that turbidity values have decreased below 1.0 (0.55 NTU).

The Langelier Saturation Index (LSI) and Ryznar Stability Index (RSI) were calculated for TW1 (Appendix F). These results indicate that there is potential for scale to form on pipes, and that any calcium carbonate formation is not likely to form a protective corrosion inhibitor film (LSI=0.34 , RSI=7,2).

4.2.6 Water Treatment

A review of the analytical data collected for the groundwater sample revealed exceedances of the well of Aesthetic Objectives (AO) or Operational Guidelines (OG). No MACs (health related) were exceeded. While the analysis of groundwater did not reveal any health-related issues, treatment can be utilized to make the water more palatable, if so desired. All parameters which exceeded AO and OG can be treated to improve water quality. In addition, aesthetic parameters such as total dissolved solids and iron are expected to either improve with continued development and use or can be readily treated.

After review of the analytical results, the following methodologies for treatment are recommended:

Turbidity:	Carbon filtration, greensand filtration, reverse osmosis
Salts:	Reverse osmosis
Hardness:	Ion exchange, reverse osmosis
Iron:	Reverse osmosis, greensand filter
Sulphide:	Adsorption, aeration, chlorination, greensand filtration, oxidation
Aluminum:	Distillation, reverse osmosis

Filtration is a treatment method that can be used to address the above noted exceedances for turbidity, iron, and sulphide. Several filtration methods exist and offer adequate treatment for issues related to well water treatment. The use of granulated activated carbon filters or greensand, for example, constitute two methods of filtration.

Coagulation is a chemical water treatment process. It involves the use of a material which precipitates into water and causes fine particles to agglomerate into larger particles, which can then be removed via settling and/or filtration.

Distillation is a treatment process in which water is converted into a vapor state, then cooled, condensed, and collected. It is done to remove solids and other impurities from the water.

Reverse osmosis is a treatment process in which dissolved ions are removed from water using a difference in pressure through a semi-permeable membrane. This membrane will filter water and prevent certain undesirable dissolved materials from passing through.

Oxidation/aeration involves the injection of oxygen into the well water, whereby granular media (such as manganese-oxide) is used and allows for the adsorption of iron and manganese.

Ion exchange (often seen in the form of water softeners) is a treatment which can remove ferrous iron from the well water.

Chlorination involves the introduction of chlorine into the well. Chlorine will allow for disinfection and decrease the quantity of sulphide and other undesirable parameters.

Further development of the well is recommended. This will lower turbidity, hardness, iron, and aluminum concentrations. As indicated in Section 4.2.4 above, with continued development (pumping and use of the well), fine-grained materials are agitated and become dissolved, which are then removed from the well during further development.

For more information on the above specific treatment options can be found within the 'Home Water Treatment Fact Sheet', at this link: Home Water Treatment Fact Sheet - MN Dept. of Health (state.mn.us).

4.2.7 Additional Well Development

High turbidity values were originally noted during the initial pumping test which occurred on August 30, 2022. This pumping test evolved into well development only due to high turbidity values, whereby TW1 was developed and field parameters observed for at least 21 hours. McIntosh Perry staff then returned to the Site on September 13, 2022 to complete a 420-minute pumping test.

High turbidity values were additionally observed in the pumping test on September 13, 2022 (ranged from 6.6 to 66 NTU). Accordingly, McIntosh Perry completed additional well development on August 15, 2023. Groundwater was pumped directly from TW1 using a pump provided and installed by Air Rock Drilling. The pumped water was directed away from the test well and was allowed to flow overland across the Site. Pumping was maintained at a rate of approximately 18-20 L/min.

Turbidity values fluctuated throughout the pumping test, and were measured using a Horiba U-52 and Lamotte 2020 (turbidity meter). At approximately 1 hour after pumping had commenced, turbidity values were recorded at less than 1.0 NTU (0.55 NTU).

It is noted that at the onset of the test, McIntosh Perry observed a strong sulfur odour, black suspended sediment, and noted that the oxidation-reduction potential (ORP) of the well water was negative. Due to the potential presence of sulfate-reducing bacteria, a chlorine bleach solution was poured into the well, allowed to circulate, and then discharged overland across a gravelled area of the Site.

4.1 Long-term Groundwater Monitoring

As infiltration throughout the subsurface materials on the Site appears to be low (see Appendix G for the infiltration memo conducted in October 2022), additional information regarding shallow groundwater is needed in the proposed development area. McIntosh Perry has installed a shallow groundwater monitoring well (BH22-2) to assist in characterizing the shallow groundwater regime in proximity to proposed stormwater management infrastructure. This well is in addition to an existing on-site shallow groundwater monitoring well (BH21-1) installed as part of McIntosh Perry's geotechnical scope of work.

Monitoring well BH22-2, installed within the proposed infiltration gallery area, was completed on December 6, 2022. This well was installed by Strata Drilling Group using a Geoprobe to a maximum depth of 15 ft (4.5 m) bgs. It is noted that during the well installation, the saturated soils continued to slough into the open hole, causing a slight upwelling of the well casing/pipe. Immediately after the monitoring well was installed, geodetic elevations of the ground surface of the borehole and monument casing was obtained, as well as geodetic elevations of nearby supply wells.

Groundwater elevation readings at BH22-2 continued at the Site throughout the winter (2022) and spring (2023) months. Data from the long-term monitoring indicated deeper groundwater elevations (0.8 – 1.1 m bgs) within the winter months, followed by shallower groundwater elevations over the spring (ranging from 0.5 – 0.7 m bgs), then increasingly deeper groundwater elevations from May to June (0.7 – 1.1 m bgs). The fluctuations of groundwater levels at the Site in proximity to the proposed stormwater management infrastructure follow trends expected from seasonal variabilities, and appear to be correlated closely with precipitation events. Shallower groundwater levels were recorded in the spring, whereas deeper groundwater levels were recorded in the winter and early summer (Appendix H).

5.0 TERRAIN ANALYSIS

5.1 Preamble

A series of four (4) test holes were advanced by McIntosh Perry staff at various locations throughout the proposed septic area on November 24th, 2022 (see Figure 4). The test hole locations were advanced using a hand auger and shovel, completed to characterize subsurface materials, the depth of overburden, depth to shallow groundwater, and to permit the collection of overburden soil samples for characterization. It is noted that holes were only advanced to a maximum depth of 2.0 m bgs as required for the purposes of assessment for the future septic location.

5.2 General Site Evaluation

5.2.1 Overburden Depth

During the geotechnical investigation, overburden was observed to be at least 6.7 m thick (test hole locations are outlined on Figure 4). Moist to saturated conditions were observed within each test hole advanced within the proposed septic location. Bedrock was not encountered during the geotechnical investigation.

During the terrain analysis, overburden was found to extend to at least 2 m bgs (maximum depth of test holes).

5.2.2 Overburden Characterization

The soil conditions logged in the test holes advanced as part of the terrain analysis are presented in Table 3 below. The test hole summaries indicate the subsurface conditions at the specific test hole locations only; subsurface conditions at other locations outside of the investigated area could differ from those encountered within the investigated area.

Table 3: Summary of Test Holes

Test Pit ID	Total Depth (m)	Approx. Depth to Water (m)	Soil Characteristics
TP-1	1.0	1.0	Grey/brown silty sand, trace clay, loose, moist to wet
TP-2	2.0	1.5 – 2.0	Grey/brown silty sand, trace clay, loose, moist to wet
TP-3	1.0	0.7 – 0.8	Grey/brown silty sand, trace clay, loose, moist to wet
TP-4	1.1	1.0	Grey/brown silty sand, trace clay, loose, moist to wet

The soil descriptions in this report are based on commonly accepted classification and identification employed in engineering practice. McIntosh Perry employed judgement in the classification and description of soil and may not be exact but are accurate to what is common in current engineering practice. The grain size analysis, taken from TP-2, is included in Appendix I.

5.2.3 Soil Classification for Private Sanitary Servicing

Comparison of the soil classification for the Unified Soil Classification as provided in the Ministry of Municipal Affairs and Housing (MMAH) Supplementary Standard SB-6: Time and Soil Descriptions, reveals that the main native soil underlying the upper topsoil appears to be within the following soil group:

- SM: Silty sands, sand-silt mixtures
  - According to Table 2 of SB-6, the SM group of soils has a coefficient of permeability (K) of 10^{-5} to 10^{-3} with a percolation time (T) of 8 to 20 min/cm. This soil type has a medium to low permeability and is deemed acceptable as the native receiving soil for proposed Class 4 sewage systems.

Based on the encountered overburden, it is recommended that the topsoil layer be stripped where the septic system is proposed for construction. The thickness of native overburden has been determined through an overview of well records from the Site, subsurface conditions and depths of overburden encountered during the infiltration assessment, as well as the observation of soil thicknesses encountered during the terrain assessment portion. Given the general thickness of native overburden suitable for septic disposal bed construction, partial or fully raised septic beds may be required due to the shallow depth to the overburden groundwater, to meet the Ontario Building Code (OBC) requirement of 0.9 m separation between bedrock or shallow groundwater and the underside of the disposal bed pipe.

5.2.4 Bedrock

As previously discussed, on-site bedrock is generally characterized as limestone, dolostone, shale, arkose, and sandstone of the Simcoe Group of the Shadow Lake Formation (OGS, 2021). No bedrock was encountered on-Site during the test hole advancements, nor the geotechnical investigation.

5.3 Septic System Impact

The City of Ottawa's Hydrogeological and Terrain Analysis Guidelines require that potential septic system impacts be addressed regardless of lot size. This is based on the hydrogeological sensitivity of the Site, as well as the determination of the size of the lot(s). As the proposed area in which the private storage facility will be placed is 2.4 ha in size, no additional assessment, beyond the determination of hydrogeological sensitivity, needs to be provided. The Site is not considered to be hydrogeologically sensitive. Please see Section 2.4.5 for further information.

In addition, a predictive nitrate attenuation calculation was completed for this Site. The predictive attenuation is based on the land area available for attenuation, water surplus derived from precipitation less evapotranspiration and infiltration factors for topography, type of soil, and land cover.

For this assessment, McIntosh Perry utilized data from the 1981 – 2010 Canadian Climate Normals from the Luskville, QC station (ID: 7034365). Based on the referenced data, it was determined that the precipitation normal was 749.6 mm per year with a potential evapotranspiration in the order of 635.5 mm, which would provide for a water surplus of 114.1 mm per year.

Applying the calculated Infiltration Factor of 0.9 for the Site with the available water surplus, provides for an infiltration of 102.7 mm per year, which in turn provides for an available 2464.9 +/- m^3/year available for dilution of the septic effluent. For this assessment, McIntosh Perry assumed that the entirety of the Site was permeable land, for a total permeable area of 24,000 m2, or 2.4 ha.

Utilizing a combined effluent loading of 40,000 mg/day (40 mg/L NO2-NO3, 1000 L/day) and a background nitrate-nitrite concentration of 0.1 mg/L, the predictive attenuation calculation for nitrate – nitrite was calculated at 5.26 mg/L, which is less than the boundary maximum permissible of 10 mg/L. The predictive attenuation was calculated using the following equation:

$$Cboundary = Cbackground + \frac{Ceff\ x\ Qeff\ x\ N}{(Qeff\ x\ N) + Dw}$$

Where:

- $C_{boundary}$ is the concentration at the boundary;
- $C_{background}$ is the background concentration of nitrate (assumed to be 0.1 mg/L as nitrate and nitrite were not detected within the groundwater samples);
- C_{eff} is nitrate concentration of the effluent (40 mg/L);
- Q_{eff} is flow of effluent;
- N is the number of proposed lots; and,
- D_w is the dilution water available taking into account total precipitation less evapotranspiration, infiltration factors for topography, type of soil and cover and total area available for infiltration.

The calculations for the Predictive Attenuation are presented in Appendix J.

5.4 Infiltration Work Summary

McIntosh Perry completed an infiltration assessment across the Site to determine the general infiltration rates of subsurface materials. Based on this assessment completed in October 2022, permeability across the Site was low, likely due to the degree of saturation in test soils. Two infiltration studies were conducted at the Site.

In June 2022, the advancement of three (3) test locations was completed, two (2) of which were outside of the proposed infiltration infrastructure area. Results of this program indicated low infiltration rates which ranged from 3.4 x 10^{-6} to 4.9 x 10^{-7} m/s.

In October 2022, additional infiltration testing was completed on-Site where the proposed infiltration infrastructure would be placed. Three (3) test locations were advanced, and low infiltration rates were again found, with rates ranging from 1.74 x 10^{-8} to 6.4 x 10^{-6} m/s. Calculations for these rates can be found in Appendix G, alongside additional information on the June 2022 infiltration program.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1.1 Well Yield

McIntosh Perry conducted a 420-minute pumping test at an average pumping rate of approximately 47.8 L/min.

High turbidity values were originally noted during the initial pumping test which occurred on August 30, 2022. This pumping test evolved into well development only due to high turbidity values, whereby TW1 was developed and field parameters observed for at least 21 hours. McIntosh Perry staff then returned to the Site on September 13, 2022 to complete a 420-minute pumping test.

During the pumping test on September 13, 2022, greater than 20,000 litres of groundwater was pumped from the well. Total drawdown resulting from the 420-minute pumping test was 44.08 m. Within 50 minutes following the cessation of pumping, water level recovery for the well was recorded approximately 97%.

Calculations for long term yield ranged from 12 L/min (Moell) to 14 L/min (Farvolden). These calculations are inherently conservative, as the pump will likely cycle on and off over a shorter period of time. The peak hourly flow rates will likely be less than the calculated values above. Further, the 7-hour pumping test conducted indicates sustainable flow rates which are considered to be sufficient to support the proposed development. Therefore, Mcintosh Perry is of the opinion that the aquifer is capable of supplying water at a flow rate greater than the minimum of 13.7 L/min (as outlined in Procedure D-5-5) for the proposed private storage facility.

6.1.1.2 Water Quality and Treatment

All analytical results were compared to the Ontario Drinking Water Standards, Objectives, and Guidelines (ODWS). Based on the analytical results from the groundwater sampled from the on-Site well on September 13, 2022, the following exceedances were noted:

- Hardness (OG: 100 mg/L): TW1-1 (271 mg/L) and TW1-2 (265 mg/L)
- Sulphide: (AO: 0.05 mg/L): TW1-1 (3.14 mg/L) and TW1-2 (3.36 mg/L)
- Turbidity: (AO: 5 NTU): TW1-1 (34.8 NTU)
- Aluminum: (AO: 0.1 mg/L): TW1-1 (0.68 mg/L) and TW1-2 (0.14 mg/L)
- Iron (AO: 0.3 mg/L): TW1-1 (0.82 mg/L); and
- The health warning limit for sodium (20 mg/L) was exceeded in sample TW1-1 (22.7 mg/L) and TW1-2 (24.1 mg/L)

Due to the elevated turbidity throughout in the September 13, 2022 pumping test, McIntosh Perry took additional turbidity measurements in the field following further well development on August 15, 2023. Turbidity readings at this time indicated concentrations of 0.55 NTU, which is below the AO of 5 NTU. No health-related maximum acceptable concentrations (MAC) were exceeded. All other AO and OG exceedances are considered treatable, if so desired.

6.1.2 Terrain Evaluation

Soil materials encountered during the terrain assessment consisted of fine, loose, moist to wet silty sand. It was shown that on-site soils extend to at least 6.7 m bgs based on McIntosh Perry's geotechnical investigation.

Based on the soils encountered during the terrain assessment, review of subsurface materials from the well records, as well as the proposed size of the development, it has been determined that there is sufficient spatial area for the natural attenuation of nitrate-nitrogen at acceptable concentrations based on MECP Procedure D-5-4. Due to the thickness of overburden, the Site is not considered to be hydrogeologically sensitive.

6.2 Recommendations

6.2.1 Well Construction

- Referencing the Well Record for the Site well (A342436), it has been determined that the on-Site supply well meets the requirements under 0.Reg. 903.

6.2.2 Well Yields

- Calculations for long term well yield indicate that the aquifer currently utilized can support the proposed development.

6.2.3 Water Quality Treatment

- If water softening is desired, the use of potassium salts (i.e., KCl) is recommended. With the use of conventional water softeners, it is important to note that sodium concentrations will be elevated;
- Aesthetic parameters such as total dissolved solids and iron are expected to either improve with continued development and use or can be readily treated, if so desired. Iron can be treated through cation exchange, greensand filtration, or oxidation with filtration through proprietary filter media or chlorination followed by sand or multimedia filtration, depending on the iron concentrations; and
- It is recommended that the Client notify the local Medical Officer of Health as the sodium concentration exceeds the health-related warning limit.

6.2.4 Wastewater Treatment

- The overburden for the site is comprised of silty sand to sandy silt mixtures (SM) which have a low to medium permeability and are acceptable for construction of septic systems per the Ontario Building Code (OBC);
- The depth to perched groundwater may be less than 2.0 m, thus the construction of raised or partially raised disposal beds is potentially required; and
- Construction of a septic system will require conformance to the OBC for all aspects including setback distances from residences and wells.

7.0 LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by McIntosh Perry Consulting Engineers Ltd. for the applicants and the regulatory authority. It is intended for the sole and exclusive use of the applicants, their affiliated companies and partners and their respective insurers, agents, employees, advisors, and reviewers. The report may not be relied upon by any other person or entity without the express written consent (Reliance Letter) of McIntosh Perry Consulting Engineers Ltd.

Any use which a third party makes of this report, or any reliance on decisions made based on it, without a reliance letter are the responsibility of such third parties. McIntosh Perry Consulting Engineers Ltd. accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The investigation undertaken by McIntosh Perry Consulting Engineers Ltd. with respect to this report and any conclusions or recommendations made in this report reflect McIntosh Perry Consulting Engineers Ltd. judgment based on the Site conditions observed at the time of the site inspection on the date(s) set out in this report and on information available at the time of the preparation of this report.

This report has been prepared for specific application to this Site and it is based, in part, upon visual observation of the Site, subsurface investigation at discrete locations and depths, and specific analysis of specific chemical parameters and materials during a specific time interval, all as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future Site conditions, portions of the Site which were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters, materials or analysis which were not addressed. Substances other than those addressed by the investigation described in this report may exist within the Site, substances addressed by the investigation may exist in areas of the Site not investigated and concentrations of substances addressed which are different than those reported may exist in areas other than the locations from which samples were taken.

If site conditions or applicable standards change or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations in this report may be necessary.

8.0 CLOSURE

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Respectfully submitted,
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HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

TABLES

McINTOSH PERRY

Table 1
Summary of Field Water Quality Parameters
273-275 Russ Bradley Road (TW1)

Pumping Test at:	TW1	Date:				13-Sep-22			
Time Elapsed (min)	Turbidity (NTU)	pH	Conductivity (us/cm)	Temperature (°C)	Dissolved Oxygen (DO) mg/L	TDS (ppm)	Odour	Effervesence	Flow Rate (L/min)
8	15.4	7.55	596	10.31	2.41	381	Sulfur	N/A	60
11	37.1	7.94	563	9.26	1.13	359	Sulfur	N/A	60
15	30.5	8.03	540	9.02	0.79	349	Sulfur	N/A	60
19	28.4	7.89	546	8.41	0.6	349	Sulfur	N/A	60
24	29.4	7.5	550	8.41	0.37	352	Sulfur	N/A	60
30	32.7	7.47	555	8.43	0.55	355	Sulfur	N/A	60
42	38.8	7.93	563	8.48	1.91	360	Sulfur	N/A	53.3
57	52.3	7.67	565	8.4	0.3	362	Sulfur	N/A	53.3
68	56.6	7.56	560	8.4	0.5	358	Sulfur	N/A	53.3
79	65.1	7.52	562	8.4	1.0	360	Sulfur	N/A	53.3
94	66.9	7.53	562	8.4	1.1	360	Sulfur	N/A	53.3
108	62.6	7.56	562	8.41	0.89	360	Sulfur	N/A	53.3
128	53.8	7.58	563	8.41	0.7	360	Sulfur	N/A	53.3
143	50.7	7.63	563	8.44	-	360	Sulfur	N/A	53.3
170	46.1	7.66	562	8.45	0.84	360	Sulfur	N/A	53.3
180	44.8	7.55	563	8.47	0.98	360	Sulfur	N/A	48
218	41.3	7.45	568	8.68	0.98	364	Sulfur	N/A	42
228	38.4	7.38	570	8.6	0.32	365	Sulfur	N/A	42
266	17.7	7.48	573	8.57	0.93	367	Sulfur	N/A	42
285	18	7.55	584	8.54	0.36	374	Sulfur	N/A	42
300	12.8	7.6	584	8.51	0.37	374	Sulfur	N/A	42
334	12.4	7.7	583	8.51	0.37	373	Sulfur	N/A	42
355	10.1	7.7	577	8.52	-	369	Sulfur	N/A	42
368	7.8	7.73	574	8.56	1	368	Sulfur	N/A	42
376	7.3	7.75	572	8.56	-	366	Sulfur	N/A	42
413	6.6	7.87	572	8.64	0.33	0.366	Sulfur	N/A	42
Notes:									

(us/cm)	Microsiemens per centimetre
(°C)	Degrees celsius
mg/L	Milligrams per litre
L/min	Litres per minute
N/A	Not Analyzed

Table 2
Summary of Laboratory Water Quality Results
273-275 Russ Bradley Road

Sample ID / Sample Date / Location / Parameter:	Units	MDL	ODWSOG	Limit Type	TW1-1	TW1-2
					13-Sep-22	13-Sep-22
Microbiological Parameters						
E. Coli	CFU/100 mL	1	0 CFU/100 mL (0 CFU/100mL)	MAC	ND (1)	ND (1)
Fecal Coliforms	CFU/100 mL	1	-	-	ND (1)	ND (1)
Total Coliforms	CFU/100 mL	1	0 CFU/100 mL (0 CFU/100mL)	MAC	ND (1)	ND (1)
General Inorganics						
Alkalinity (as CaCO3)	mg/L	5	500 mg/L	OG	187	186
Ammonia as N (N-NH3)	mg/L	0.01	-	-	0.11	0.07
Dissolved Organic Carbon (DOC)	mg/L	0.5	5 mg/L	AO	1.4	1.5
Colour	TCU	2	5 TCU	AO	4	ND (2)
Conductivity	uS/cm	5	-	-	499	509
Hardness	mg/L	0.824	100 mg/L	OG	271	265
pH	pH Units	0.1	-	-	7.9	7.9
Phenols	mg/L	0.001	-	-	ND (0.001)	ND (0.001)
Total Dissolved Solids	mg/L	10	500 mg/L	AO	278	270
Sulphide (S2)	mg/L	0.02	0.05 mg/L	AO	3.14	3.36
Tannin & Lignin	mg/L	0.1	0.05 mg/L	AO	ND (0.1)	ND (0.1)
Total Kjeldahl Nitrogen	mg/L	0.1	-	-	0.1	ND (0.1)
Turbidity	NTU	0.1	5 NTU	AO	34.8	3.3
Anions						
Chloride (Cl)	mg/L	1	250 mg/L	AO	22.5	25.6
Fluoride (F)	mg/L	0.1	1.5 mg/L	MAC	0.8	1.4
Nitrate as N (N-NO3)	mg/L	0.1	10 mg/L	MAC	ND (0.1)	ND (0.1)
Nitrite as N (N-NO2)	mg/L	0.05	1 mg/L	MAC	ND (0.05)	ND (0.05)
Phosphate as P	mg/L	0.2	-	-	ND (0.2)	0.3
Sulphate (SO4)	mg/L	1	500 mg/L	AO	35.1	34.3
Metals						
Mercury	ug/L	0.1	0.001 mg/L (1 ug/L)	MAC	ND (0.1)	ND (0.1)
Aluminum	ug/L	1	0.1 mg/L (100 ug/L)	AO	680	140
Antimony	ug/L	0.5	0.006 mg/L (6 ug/L)	MAC	ND (0.5)	ND (0.5)
Arsenic	ug/L	1	0.01 mg/L (10 ug/L)	MAC	ND (1)	ND (1)
Barium	ug/L	1	2 mg/L (2000 ug/L)	MAC	295	277
Beryllium	ug/L	0.5			ND (0.5)	ND (0.5)
Boron	ug/L	10	5 mg/L (5000 ug/L)	MAC	89	94
Cadmium	ug/L	0.1	0.007 mg/L (7 ug/L)	MAC	ND (0.1)	ND (0.1)
Calcium	ug/L	100			72,200	71,600
Chromium	ug/L	1	0.05 mg/L (50 ug/L)	MAC	2	ND (1)
Cobalt	ug/L	0.5			ND (0.5)	ND (0.5)
Copper	ug/L	0.5	1 mg/L (1000 ug/L)	AO	ND (0.5)	ND (0.5)
Iron	ug/L	100	0.3 mg/L (300 ug/L)	AO	820	139
Lead	ug/L	0.1	0.005 mg/L (5 ug/L)	MAC	0.2	ND (0.1)
Magnesium	ug/L	200			22,100	21,000
Manganese	ug/L	5	0.05 mg/L (50 ug/L)	AO	19	6
Molybdenum	ug/L	0.5			ND (0.5)	ND (0.5)
Nickel	ug/L	1			ND (1)	ND (1)
Potassium	ug/L	100			5,330	4,940
Selenium	ug/L	1	0.05 mg/L (50 ug/L)	MAC	ND (1)	ND (1)
Silver	ug/L	0.1			ND (0.1)	ND (0.1)
Sodium	ug/L	200	20 mg/L (20,000 ug/L)	AO	22,700	24,100
Strontium	ug/L	10	7 mg/L (7000 ug/L)	MAC	3120	3290
Thallium	ug/L	0.1			ND (0.1)	ND (0.1)
Tin	ug/L	5			ND (5)	ND (5)
Titanium	ug/L	5			77	15
Tungsten	ug/L	10			ND (10)	ND (10)
Uranium	ug/L	0.1	0.02 mg/L (20 ug/L)	MAC	0.1	ND (0.1)
Vanadium	ug/L	0.5			2.5	ND (0.5)
Zinc	ug/L	5	5 mg/L (5000 ug/L)	AO	9	ND (5)
Volatiles						
Acetone	ug/L	5.0			N/A	ND (5.0)
Benzene	ug/L	0.5	0.001 mg/L (1 ug/L)	MAC	N/A	ND (0.5)
Bromodichloromethane	ug/L	0.5			N/A	ND (0.5)
Bromoform	ug/L	0.5			N/A	ND (0.5)
Bromomethane	ug/L	0.5			N/A	ND (0.5)
Carbon Tetrachloride	ug/L	0.2	0.002 mg/L (2 ug/L)	MAC	N/A	ND (0.2)
Chlorobenzene	ug/L	0.5	0.08 mg/L (80 ug/L)	MAC	N/A	ND (0.5)

Table 2
Summary of Laboratory Water Quality Results
273-275 Russ Bradley Road

Sample ID / Sample Date / Location / Parameter:	Units	MDL	ODWSOG	Limit Type	TW1-1	TW1-2
					13-Sep-22	13-Sep-22
Chloroethane	ug/L	1.0			N/A	ND (1.0)
Chloroform	ug/L	0.5			N/A	ND (0.5)
Chloromethane	ug/L	3.0			N/A	ND (3.0)
Dibromochloromethane	ug/L	0.5			N/A	ND (0.5)
Dichlorodifluoromethane	ug/L	1.0			N/A	ND (1.0)
Ethylene dibromide (dibromoethane, 1,;	ug/L	0.2			N/A	ND (0.2)
1,2-Dichlorobenzene	ug/L	0.5	0.2 mg/L (200 ug/L)	MAC	N/A	ND (0.5)
1,3-Dichlorobenzene	ug/L	0.5			N/A	ND (0.5)
1,4-Dichlorobenzene	ug/L	0.5	0.005 mg/L (5 ug/L)	MAC	N/A	ND (0.5)
1,1-Dichloroethane	ug/L	0.5			N/A	ND (0.5)
1,2-Dichloroethane	ug/L	0.5	0.005 mg/L (5 ug/L)	MAC	N/A	ND (0.5)
1,1-Dichloroethylene	ug/L	0.5	0.014 mg/L (14 ug/L)	MAC	N/A	ND (0.5)
cis-1,2-Dichloroethylene	ug/L	0.5			N/A	ND (0.5)
trans-1,2-Dichloroethylene	ug/L	0.5			N/A	ND (0.5)
1,2-Dichloroethylene, total	ug/L	0.5			N/A	ND (0.5)
1,2-Dichloropropane	ug/L	0.5			N/A	ND (0.5)
cis-1,3-Dichloropropylene	ug/L	0.5			N/A	ND (0.5)
trans-1,3-Dichloropropylene	ug/L	0.5			N/A	ND (0.5)
1,3-Dichloropropene, total	ug/L	0.5			N/A	ND (0.5)
Ethylbenzene	ug/L	0.5	0.14 mg/L (140 ug/L)	MAC	N/A	ND (0.5)
Hexane	ug/L	1.0			N/A	ND (1.0)
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0			N/A	ND (5.0)
Methyl Butyl Ketone (2-Hexanone)	ug/L	10.0			N/A	ND (10.0)
Methyl Isobutyl Ketone	ug/L	5.0			N/A	ND (5.0)
Methyl tert-butyl ether	ug/L	2.0			N/A	ND (2.0)
Methylene Chloride	ug/L	5.0	0.05 mg/L (50 ug/L)	MAC	N/A	ND (5.0)
Styrene	ug/L	0.5			N/A	ND (0.5)
1,1,1,2-Tetrachloroethane	ug/L	0.5			N/A	ND (0.5)
1,1,2,2-Tetrachloroethane	ug/L	0.5			N/A	ND (0.5)
Tetrachloroethylene	ug/L	0.5	0.01 mg/L (10 ug/L)	MAC	N/A	ND (0.5)
Toluene	ug/L	0.5	0.06 mg/L (60 ug/L)	MAC	N/A	ND (0.5)
1,1,1-Trichloroethane	ug/L	0.5			N/A	ND (0.5)
1,1,2-Trichloroethane	ug/L	0.5			N/A	ND (0.5)
Trichloroethylene	ug/L	0.5	0.005 mg/L (5 ug/L)	MAC	N/A	ND (0.5)
Trichlorofluoromethane	ug/L	1.0			N/A	ND (1.0)
1,3,5-Trimethylbenzene	ug/L	0.5			N/A	ND (0.5)
Vinyl Chloride	ug/L	0.5	0.001 mg/L (1 ug/L)	MAC	N/A	ND (0.5)
m/p-Xylene	ug/L	0.5			N/A	ND (0.5)
o-Xylene	ug/L	0.5			N/A	ND (0.5)
Xylenes, total	ug/L	0.5	0.09 mg/L (90 ug/L)	MAC	N/A	ND (0.5)

Notes:	
1050	Exceeds Ontario Drinking Water Standards, Objectives, and Guidelines
21	Exceeds health warning limit for sodium (20 mg/L)
MDL	Method Detection Limit
ODWSOG	Ontario Drinking Water Standards, Objectives, and Guidelines (MOECC, 2003 rev. 2006; PIBs 4449e01)
AO	Aesthetic Objective
MAC	Maximum Allowable Concentration (Health-Related Parameter)
OG	Operational Guideline
ug/L	Micrograms per litre
mg/L	Milligrams per litre
TCU	True Colour Units
uS/cm	Microsemens per centimeter
NTU	Nephelometric Turbidity Units
CFU/100 mL	Colony-forming units (bacteria) per 100 mL

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

FIGURES

McINTOSH PERRY

LEGEND

- Site Location
- Local Road
- Major Road
- Railroad
- Watercourse
- Waterbody
- Wooded Area

REFERENCE

GIS data provided by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry, 2022.

CLIENT: TREVOR WATKINS

PROJECT: HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS

TITLE: SITE LOCATION

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CCO-22-1643-01	FIGURE:
Date	Sep., 27, 2022	1
GIS	AH	
Checked By	RL	

C:\Users\a.hamed\McIntosh Perry\GIS - Documents\Projects\2022\CCO\CCO-22-1643 Trevor Watkins - EIS - 1500 Thomas Argue\aprx\Environmental\CCO-22-1643_HydrogeologicalAssessmentandTerrainAnalysis.aprx

LEGEND

Borehole Locations

Site Boundary

REFERENCE

GIS data provided by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry, 2022.

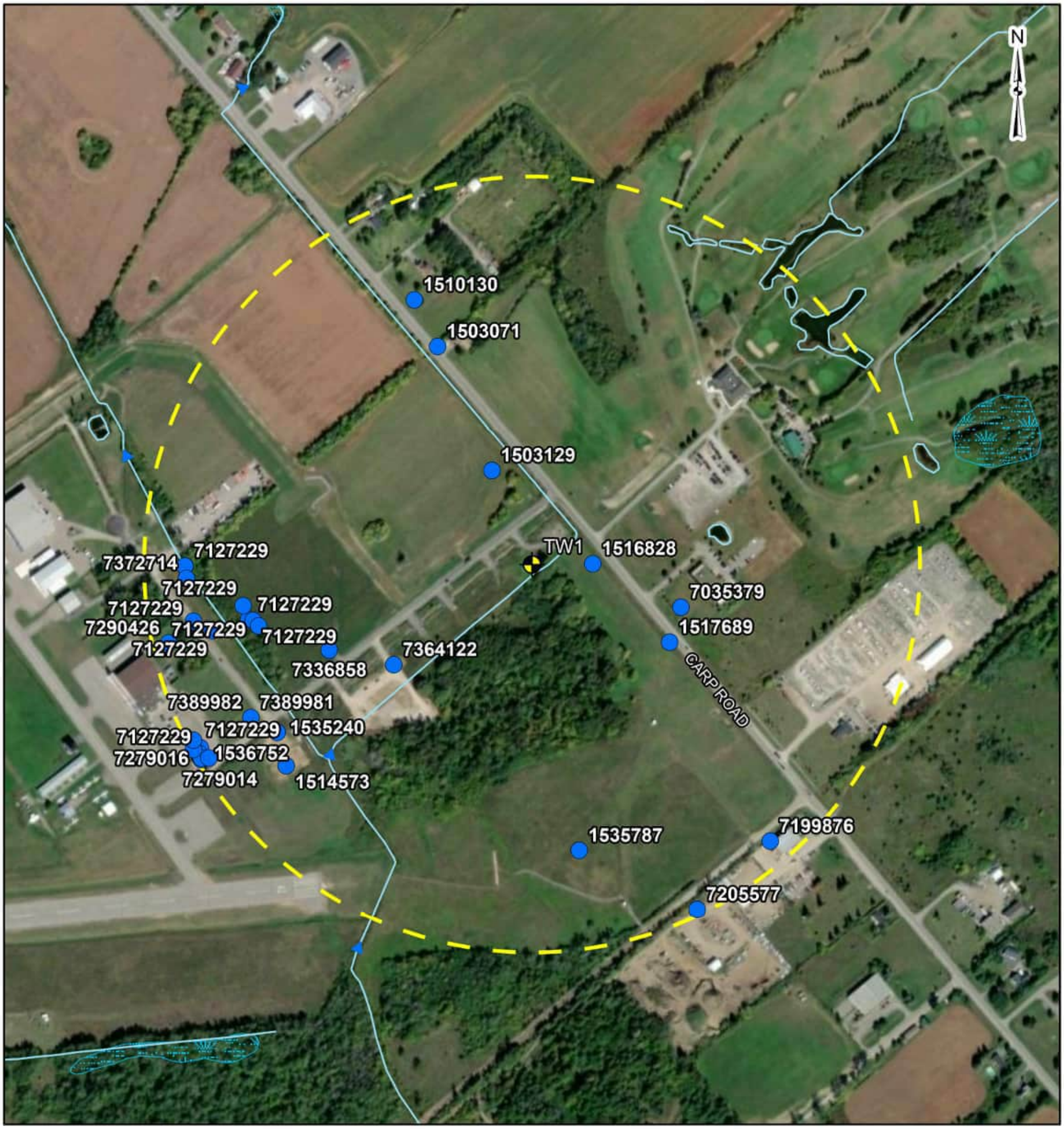
CLIENT: TREVOR WATKINS

PROJECT: HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS

TITLE: SITE LAYOUT

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CCO-22-1643-01	FIGURE:
Date	Sep., 27, 2022	2
GIS	AH	
Checked By	RL	



200 100 0 200

Scale 1:7,000 Metres

LEGEND

- Borehole Locations
- MECP Well Location
- 500m Buffer
- Watercourse
- Unevaluated Wetland
- Waterbody

REFERENCE

GIS data provided by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry, 2022.

CLIENT:	TREVOR WATKINS
PROJECT:	HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
TITLE:	MECP WATER WELL INFORMATION SYSTEM

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CCO-22-1643-01	FIGURE:
Date	Sep., 27, 2022	3
GIS	AH	
Checked By	RL	

50 25 0 50

Scale 1:2,000 Metres

LEGEND

Site Boundary

CLIENT:	TREVOR WATKINS
PROJECT:	HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
TITLE:	TEST HOLE LOCATIONS

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CCO-22-1643-01	FIGURE:
Date	Nov., 28, 2022	4
GIS	AH	
Checked By	RL	

REFERENCE

GIS data provided by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry, 2022.

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX A: MECP WATER WELL INFORMATION SYSTEM DATA

MCINTOSH PERRY

WELL_ID	COMPLETED	WELL DEPTH (m)	STATIC WATER LEVEL (m)	DEPTH TO BEDROCK (m)	BORE_HOLE_ID	FINAL STATUS	USE1	USE2	COUNTY	MUNICIPALITY	CONN	LOT	STREET	CITY	ZONE	EAST83	NORTH83	GEOLOGY	COLOR	FORMATION_TOP_DEPTH	FORMATION_END_DEPTH	UNITS OF MEASUREMENT
1503071	30-Sep-67	61	15.2	41.1	10025114	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	013			18	420630.5	5019702	CLAY,,		0	110	ft
1503071	30-Sep-67	61	15.2	41.1	10025114	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	013			18	420630.5	5019702	LIMESTONE,,		135	200	ft
1503071	30-Sep-67	61	15.2	41.1	10025114	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	013			18	420630.5	5019702	MEDIUM SAND,,		110	135	ft
1503129	14-Jun-58	57	8.5	46.3	10025172	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420700.5	5019542	LIMESTONE,,		152	187	ft
1503129	14-Jun-58	57	8.5	46.3	10025172	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420700.5	5019542	HARDPAN,,		140	152	ft
1503129	14-Jun-58	57	8.5	46.3	10025172	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420700.5	5019542	PREV. DRILLED,,		0	140	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	LIMESTONE,,	GREY	131	200	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	MEDIUM SAND,GRAVEL,	GREY	112	131	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	MEDIUM SAND,,	GREY	100	112	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	CLAY,,	GREY	35	100	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	MEDIUM SAND,,	BROWN	0	6	ft
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	02	014			18	420600.5	5019762	MEDIUM SAND,CLAY,	GREY	6	35	ft
1514573	13-Feb-75	53.3	5.5	37.5	10036546	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420435.5	5019162	SAND,CLAY,PACKED	GREY	115	123	ft
1514573	13-Feb-75	53.3	5.5	37.5	10036546	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420435.5	5019162	LIMESTONE,,	BLACK	123	175	ft
1514573	13-Feb-75	53.3	5.5	37.5	10036546	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420435.5	5019162	SAND,SILT,PACKED	BROWN	0	30	ft
1514573	13-Feb-75	53.3	5.5	37.5	10036546	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420435.5	5019162	CLAY,LOOSE,	BLUE	30	115	ft
1516828	01-Nov-78	44.2	12.2	10.7	10038723	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420830.5	5019422	LIMESTONE,SOFT,	GREY	35	145	ft
1516828	01-Nov-78	44.2	12.2	10.7	10038723	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420830.5	5019422	CLAY,BOULDERS,	BROWN	0	21	ft
1516828	01-Nov-78	44.2	12.2	10.7	10038723	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420830.5	5019422	HARDPAN,BOULDERS,PACKED	GREY	21	35	ft
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420929.5	5019321	CLAY,PACKED,	GREY	0	15	ft
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420929.5	5019321	SILT,STONES,PACKED	GREY	15	57	ft
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420929.5	5019321	SAND,CEMENTED,	GREY	57	61	ft
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420929.5	5019321	TILL,STONES,PACKED	GREY	61	79	ft
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420929.5	5019321	GRANITE,MEDIUM-GRAINED,	GREY	79	215	ft
1535240	20-Sep-04	43.9	0	38.7	11172992	Observation Wells	Not Used		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	3257 CARP RD.	CARP	18	420424	5019205	CLAY,,		0	38.7	m
1535240	20-Sep-04	43.9	0	38.7	11172992	Observation Wells	Not Used		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	3257 CARP RD.	CARP	18	420424	5019205	LIMESTONE,,	GREY	38.7	43.9	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	TOPSOIL,,	BLACK	0	0.3	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	SAND,,	BROWN	0.3	4.5	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	SAND,,	BROWN	4.5	6.7	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	GRAVEL,,	GREY	6.7	8.2	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	SILT,,	GREY	8.2	10.6	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	CLAY,,HARD	GREY	10.6	14.6	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	CLAY,,WATER-BEARING	BLUE	14.6	21.9	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	CLAY,,HARD	GREY	21.9	24.9	m
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1508 THOMAS ARQUE ROAD	CARP	18	420813	5019053	GRAVEL,,PACKED	GREY	24.9	27.4	m
1536752	10-Jul-06	3.7	0	0	11691846	Observation Wells			OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3257 CARP ROAD	OTTAWA	18	420326	5019172	SAND,SILTY,WATER-BEARING	GREY	2.4	3.7	m
1536752	10-Jul-06	3.7	0	0	11691846	Observation Wells			OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3257 CARP ROAD	OTTAWA	18	420326	5019172	SAND,FILL,FINE-GRAINED	BROWN	0	1	m
1536752	10-Jul-06	3.7	0	0	11691846	Observation Wells			OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3257 CARP ROAD	OTTAWA	18	420326	5019172	SAND,WATER-BEARING,	GREY	1	2.4	m
7035379	28-Jul-06	3.8	0	0	11760829				OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3275 CARP ROAD		18	420944	5019366	TOPSOIL,LOOSE,	BROWN	0	1.22	m
7035379	28-Jul-06	3.8	0	0	11760829				OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3275 CARP ROAD		18	420944	5019366	SAND,SILT,	BROWN	1.22	3.66	m
7035379	28-Jul-06	3.8	0	0	11760829				OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3275 CARP ROAD		18	420944	5019366	CLAY,SILT,WATER-BEARING	GREY	3.66	3.81	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				

7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	TOPSOIL,,	BROWN	0	0.1	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	COARSE SAND,GRAVEL,	GREY	0.1	1.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	ROCK,SAND,GRAVEL	GREY	1.8	2.5	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SAND,GRAVEL,ROCK	GREY	2.5	2.8	m
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	419327	5019365	SILT,CLAY,SAND	GREY	2.8	3.6	m
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420325	5019185	,,				
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420323	5019178	,,				
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420387	5019350	,,				
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420393	5019349	,,				
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420400	5019342	,,				
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420305	5019419	,,				
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420340	5019336	,,				
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420316	5019348	,,				
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	015	CARP AIRPORT	Ottawa	18	420380	5019368	,,				
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3155 CARP RD	CARP	18	421059	5019065	GRAVEL,,	BROWN	0	1	ft
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3155 CARP RD	CARP	18	421059	5019065	SAND,MEDIUM-GRAINED,	BROWN	1	15.5	ft
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3155 CARP RD	CARP	18	421059	5019065	SAND,GRAVEL,	GREY	15.5	16.5	ft
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3155 CARP RD	CARP	18	421059	5019065	SHALE,,	BROWN	16.5	20.5	ft
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			3155 CARP RD	CARP	18	421059	5019065	LIMESTONE,,	GREY	20.5	160	ft
7205577	05-Jun-13	48.8	1.1	0	1004473562	Water Supply	Domestic	Test Hole	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	012	3119 CARP RD	CARP	18	420965	5018977	SAND,,	RED	0	5	ft
7205577	05-Jun-13	48.8	1.1	0	1004473562	Water Supply	Domestic	Test Hole	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	012	3119 CARP RD	CARP	18	420965	5018977	SAND,,	BROWN	5	14	ft
7205577	05-Jun-13	48.8	1.1	0	1004473562	Water Supply	Domestic	Test Hole	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	012	3119 CARP RD	CARP	18	420965	5018977	SAND,,	GREY	14	48.5	ft
7205577	05-Jun-13	48.8	1.1	0	1004473562	Water Supply	Domestic	Test Hole	OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	012	3119 CARP RD	CARP	18	420965	5018977	LIMESTONE,,	GREY	48.5	160	ft
7279014	08-Oct-13	0	0	0	1006332325				OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420326	5019170	,,				
7279016	08-Nov-13	0	0	0	1006332655				OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420326	5019172	,,				
7279017	08-Nov-13	0	0	0	1006332664				OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013			18	420336	5019172	,,				
7290463	25-May-17	33	0	0	1006626009	Abandoned-Other			OTTAWA-CARLETON	HUNTLEY TOWNSHIP			1500 THOMAS ARGUE RD (CARP AIRPORT)	Ottawa	18	420316	5019183	UNKNOWN TYPE,,		0	33	m
7290426	25-May-17	0	0	0	1006629284	Abandoned-Other			OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1500 THOMAS ARGUE RD	Ottawa	18	420284	5019320	,,				
7290427	25-May-17	0	0	0	1006629297	Abandoned-Other			OTTAWA-CARLETON	HUNTLEY TOWNSHIP			1500 THOMAS ARGUE RD	Ottawa	18	420316	5019195	,,				
7336858	24-May-19	48.8	0	0	1007516881	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			RUSS BRADLEY AIRPORT	CARP	18	420491	5019311	CLAY,,		0	136	ft
7336858	24-May-19	48.8	0	0	1007516881	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			RUSS BRADLEY AIRPORT	CARP	18	420491	5019311	LIMESTONE,,	GREY	136	150	ft
7336858	24-May-19	48.8	0	0	1007516881	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP			RUSS BRADLEY AIRPORT	CARP	18	420491	5019311	LIMESTONE,,	GREY	150	160	ft
7364122	26-Jun-20	54.9	8.7	0	1008415608	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1550 THOMAS ARQUE ROAD	CARP	18	420574	5019292	CLAY,,	GREY	0	158	ft
7364122	26-Jun-20	54.9	8.7	0	1008415608	Water Supply	Domestic		OTTAWA-CARLETON	HUNTLEY TOWNSHIP	03	013	1550 THOMAS ARQUE ROAD	CARP	18	420574	5019292	SHALE,LIMESTONE,	GREY	158	180	ft
7372714	04-Jan-20	0	0	0	1008507840				OTTAWA-CARLETON	HUNTLEY TOWNSHIP					18	420307	5019403	,,				

WELL_ID	COMPLETED	WELL DEPTH (m)	STATIC WATER LEVEL (m)	DEPTH TO BEDROCK (m)	BORE_HOLE_ID	FINAL STATUS	USE1	USE2	EAST83	NORTH83	PIPE_ID	PUMP TEST	PUMPING RATE	FLOWING RATE	RECOM RATE	WATER STATE AFTER TEST	PUMP METHOD	PUMPING DURATION (h)
1503071	30-Sep-67	61	15.2	41.1	10025114	Water Supply	Domestic		420630.5	5019702	10573684	50,58,80 ft	10 GPM		5GPM	CLOUDY	PUMP	1 h
1503129	14-Jun-58	57	8.5	46.3	10025172	Water Supply	Domestic		420700.5	5019542	10573742	28,45, ft	3 GPM		GPM	CLEAR	PUMP	3 h
1510130	27-Jun-69	61	9.8	39.9	10032160	Water Supply	Industrial	Irrigation	420600.5	5019762	10580730	32,165,170 ft	25 GPM		20GPM	CLEAR	PUMP	1 h
1514573	13-Feb-75	53.3	5.5	37.5	10036546	Water Supply	Domestic		420435.5	5019162	10585116	18,30,70 ft	20 GPM		5GPM	CLOUDY	BAILER	2 h
1516828	01-Nov-78	44.2	12.2	10.7	10038723	Water Supply	Domestic		420830.5	5019422	10587293	40,55,60 ft	25 GPM		5GPM	CLEAR	PUMP	1 h
1517689	11-Nov-81	65.5	2.4	24.1	10039561	Water Supply	Domestic		420929.5	5019321	10588131	8,200,200 ft	4 GPM		4GPM	CLEAR	PUMP	1 h
1535240	20-Sep-04	43.9	0	38.7	11172992	Observation Wells	Not Used		420424	5019205	11181511	,,						h
1535787	20-Sep-05	27.4	5.9	0	11316326	Water Supply	Municipal	Public	420813	5019053	11331181	5.91,, m	160.1 LPM		LPM	CLEAR	PUMP	h
1536752	10-Jul-06	3.7	0	0	11691846	Observation Wells			420326	5019172	11696712	,,						h
7035379	28-Jul-06	3.8	0	0	11760829				420944	5019366	11768519	,,						h
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	15-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	15-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	15-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	15-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	15-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	15-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	15-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	15-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	15-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	15-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7127229	16-Jun-09	0	0	0	1002636945	Test Hole	Monitoring		419327	5019365	1002810706	,,						h
7127229	16-Jun-09	0	0	0	1002810625	Test Hole	Monitoring		420325	5019185	1002810630	,,						h
7127229	16-Jun-09	0	0	0	1002810634	Test Hole	Monitoring		420323	5019178	1002810639	,,						h
7127229	16-Jun-09	0	0	0	1002810643	Test Hole	Monitoring		420387	5019350	1002810648	,,						h
7127229	16-Jun-09	0	0	0	1002810652	Test Hole	Monitoring		420393	5019349	1002810657	,,						h
7127229	16-Jun-09	0	0	0	1002810661	Test Hole	Monitoring		420400	5019342	1002810666	,,						h
7127229	16-Jun-09	0	0	0	1002810670	Test Hole	Monitoring		420305	5019419	1002810675	,,						h
7127229	16-Jun-09	0	0	0	1002810679	Test Hole	Monitoring		420340	5019336	1002810684	,,						h
7127229	16-Jun-09	0	0	0	1002810688	Test Hole	Monitoring		420316	5019348	1002810693	,,						h
7127229	16-Jun-09	0	0	0	1002810697	Test Hole	Monitoring		420380	5019368	1002810702	,,						h
7199876	20-Mar-13	48.8	4.9	0	1004271965	Water Supply	Commerical		421059	5019065	1004797174	16.07,37.89,150 ft	5 GPM		7GPM	OTHER		8 h
7205577	05-Jun-13	48.8	1.1	0	1004473562	Water Supply	Domestic	Test Hole	420965	5018977	1004889467	3.66,42.48,150 ft	12 GPM		12GPM	CLEAR		1 h
7290463	25-May-17	33	0	0	1006626009	Abandoned-Other			420316	5019183	1006694088	,,						h
7290426	25-May-17	0	0	0	1006629284	Abandoned-Other			420284	5019320	1006691800	,,						h
7290427	25-May-17	0	0	0	1006629297	Abandoned-Other			420316	5019195	1006691807	,,						h
7336858	24-May-19	48.8	0	0	1007516881	Water Supply	Domestic		420491	5019311	1008002295	,113,150 ft	20 GPM		20GPM			1 h
7364122	26-Jun-20	54.9	8.7	0	1008415608	Water Supply	Domestic		420574	5019292	1008688117	28.583,36.333,100 ft	20 GPM		20GPM			1 h

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX B: WELL RECORD (TW1)

McINTOSH PERRY

CERTIFICATE OF WELL COMPLIANCE

Ottawa

I (Jeremy Hanna) AIR ROCK DRILLING CO. LTD. - DO HEREBY CERTIFY

that I am licensed to drill water wells in the Province of Ontario, and that I have

supervised the drilling of the water well on the property of :

OWNER: 2852569 ONTARIO INC (Trevor Watkins)

Location: #273-275 Russ Bradley Road, Carp

LOT: Block **CON:** 15-16 **PLAN #** 4R-1511 **S/L #** X

Ottawa-Carleton / Geographical Township of MARCH

I CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 5TH Day of JULY, 2022

Jeremy Hanna (T3632) Air Rock Drilling Co. Ltd. (C-7681)

The Engineer on behalf of the Landowner set out above, Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg 903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

Signed this ____________ day of ____________________________, __________

222464
TAG A342436

(Engineer)

Ontario — Ministry of the Environment, Conservation and Parks

Tag#:A342436 (Print Below)

A342436

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Page ____ of ____

Well Owner's Information

First Name	Last Name/Organization	E-mail Address	☐ Well Constructed by Well Owner
	2852569 Ontario Inc. C/O Trevor Watkins		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
971 Melrose Road	Shannonville	ON	K0K 3A0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
273-275 Russ Bradley Road	March	Block 15-16	X

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	420743	5019433	4R-1511	

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Blue	Clay	mixed w/ Gravel		0	136
Grey & Black	Limestone			136	200
Grey & Black	Limestone			200	500

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
142	132	Neat cement	12.48
132	0	Bentonite slurry	29.4

Method of Construction

☐ Cable Tool ☐ Diamond ☐ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☒ Air percussion ☐ Other, specify SURGED X3

Well Use

☐ Public ☒ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify ☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning ☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/4"	Steel	.188	+2	142
6"	Open Hole		142	500

Status of Well

☒ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify **Not tested**

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 300

Pumping rate (l/min / GPM): 5 US

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 150

If flowing give rate (l/min/GPM): X

Recommended pump depth (m/ft): 400

Recommended pump rate (l/min/GPM): 5 GPM

Well production (l/min/GPM): 5

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	33'4		150
1	36.5	1	142
2	39.7	2	140
3	42.8	3	138
4	45.6	4	137
5	48.4	5	135
10	63.2	10	126
15	77.3	15	119
20	85.9	20	114
25	95.2	25	108
30	104	30	102
40	122	40	92.7
50	135	50	84.5
60	150	60	75.1

Water Details

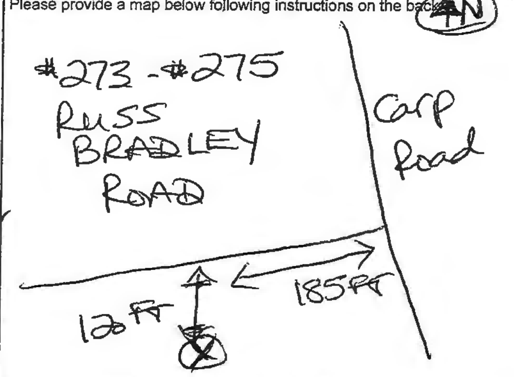
Water found at Depth	Kind of Water
200 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	142	9 3/4"
142	500	6"

Map of Well Location

Please provide a map below following instructions on the back.



Comments: 1 HP 5 GPM SET AT 400 FEET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	C7681

Business Address (Street Number/Name)	Municipality
3858 Franktown Road	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Hanna, Jeremy

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted (YYYYMMDD)
T3632	[signature]	2022 07 31

Well owner's information package delivered: ☒ Yes ☐ No

Date Package Delivered: 2022 07 11; 20220705

Ministry Use Only — Audit No. Z379045 — Received

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX C: CERTIFICATE OF CALIBRATION

McINTOSH PERRY

Maxim

CERTIFICATE OF CALIBRATION

The HORIBA Instrument listed below has been inspected and calibrated following the Manufacturer's specifications and methods.

Instrument Model: **HORIBA U-52** *Serial Number:* **R86W200F** *Calibration Date:* **September 12, 2022**

2-POINT pH	CONDUCTIVITY	TURBIDITY	DISSOLVED OXYGEN	OXIDIZATION-REDUCTION POTENTIAL	TEMPERATURE
4.00 pH, 7.00 pH	4.49mS/cm ZERO CHECKED	0 & 100 NTU	9.09 mg/L @ 20 DegC SODIUM SULFITE ZERO	240mV	Fisher Scientific s/n 210412377 exp: May 18/2023
AutoCal 4.00 pH Solution LOT # 2GE898	AutoCal Solution LOT # 2GE898	AutoCal Solution LOT# 2GE898	Oakton Zero Solution LOT # 754262	Hanna ORP LOT # 5766	
Expiry Date: May 31, 2023	Expiry Date: May 31, 2023	Expiry Date: May 31, 2023	Expiry Date: May 1, 2023	Expiry Date: October 1, 2025	
pH 7.00 LOT # 1GF003	@25 DegC LOT # 1GF256	Turb. 100 NTU LOT # A2018			
Expiry Date: June 1, 2023	Expiry Date: May 31, 2023	Expiry Date: February 28, 2024			

The calibration standard used is considered to be a certified standard and is traceable to the National Institute of Standards and Technology (NIST). Certificate of Analysis is available upon request.

The instrument indicated above is now certified to be operating within the Manufacturer's specifications. This does not eliminate the requirement for regular maintenance and pre-use sensor response checks in order to ensure continued complete and accurate operating condition.

Certified By: Jeff Loney

Maxim **Environmental and Safety Inc.**

sales@maximenvironmental.com
www.maximenvironmental.com

Head Office:
9 - 170 Ambassador Dr., Mississauga, ON L5T 2H9
(905)670-1304 | Toll Free (888)285-2324

Ottawa Office:
9 - 148 Colonnade Rd., Ottawa, ON K2E 7R4
(613)224-4747 | Toll Free (888)285-2324

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

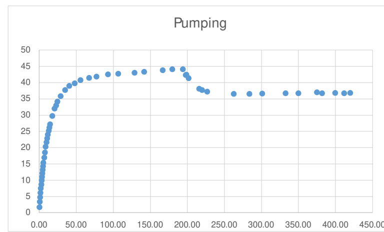
APPENDIX D: WATER LEVEL DATA AND PUMPING TEST ANALYSES

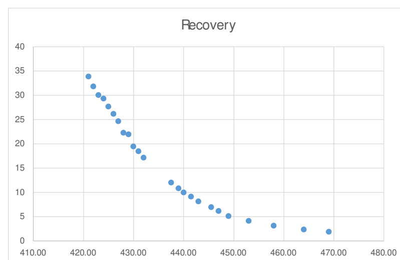
McINTOSH PERRY

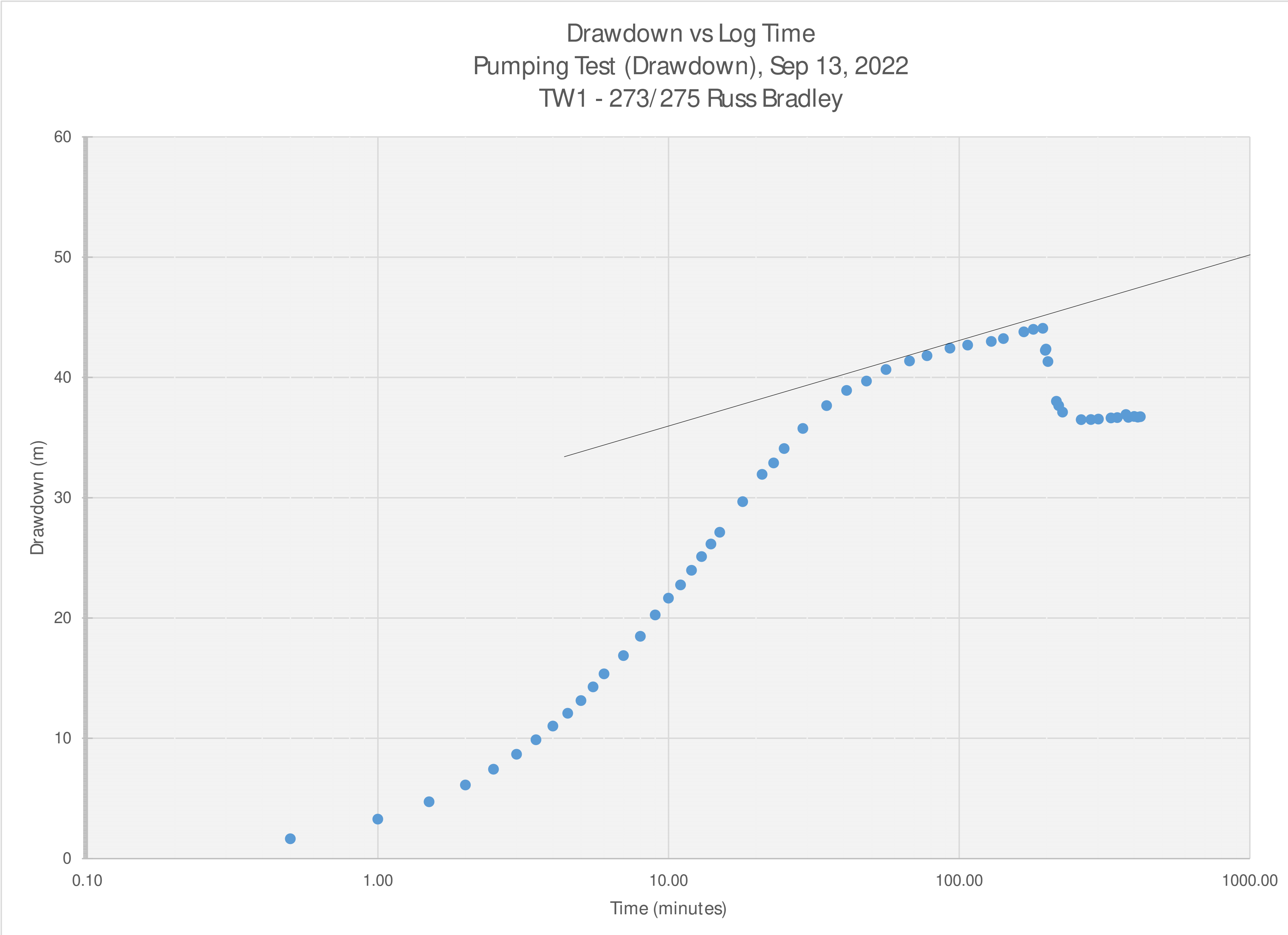
Summary of Water Level Data
Pumping Test - TW1 September 13, 2022

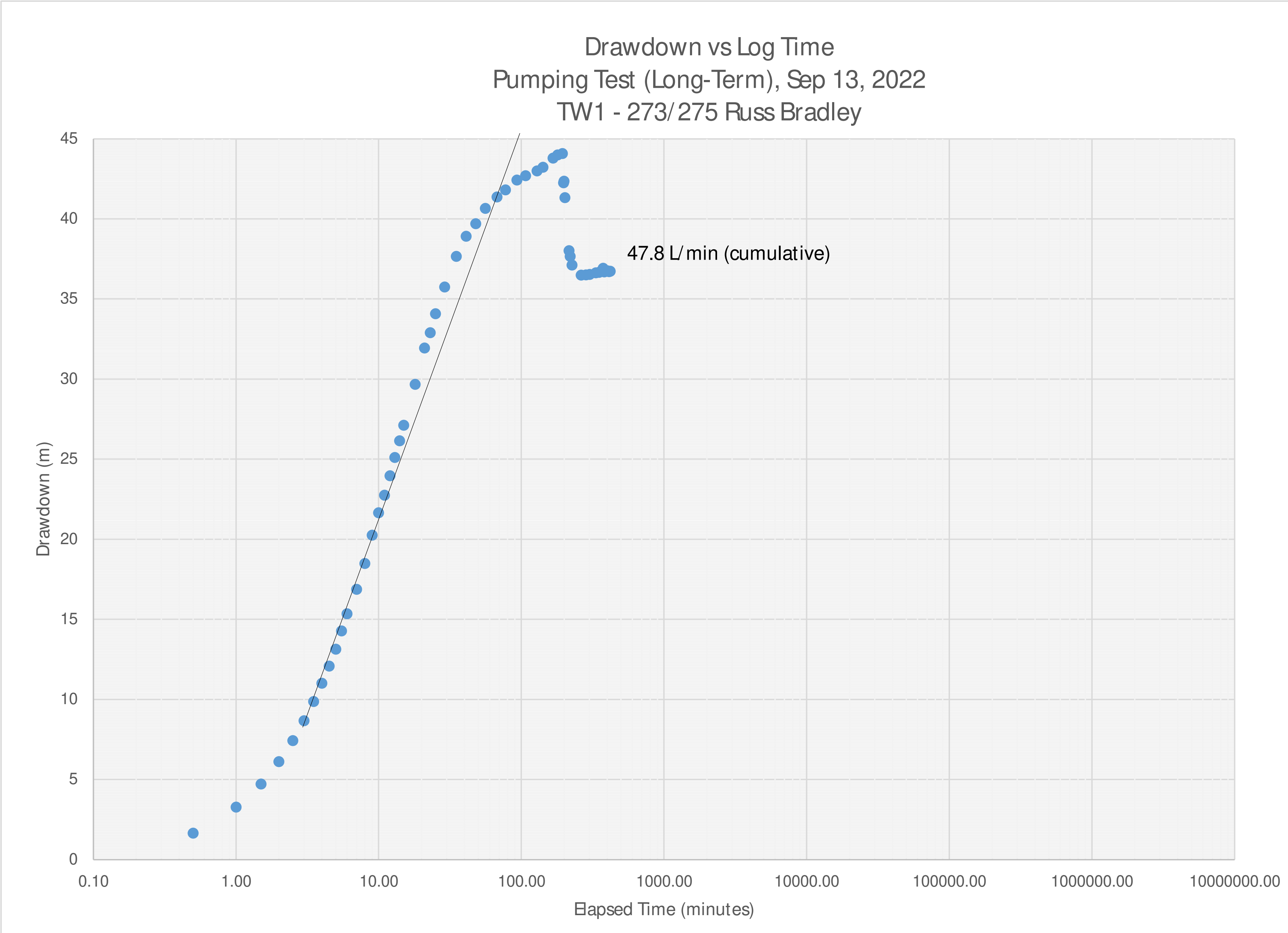
TOC Elevation (assumed)	113 m asl (above sea level)	
Static Water Level	9.87 m BTOC	
Static Water Elevation	103.13 m asl	
95% Recovery	12.07405 m BTOC	
	100.92595 m asl	
Well depth	152.4 m BTOC	500 FT
Pump Depth	85.34 m BTOC	280 FT

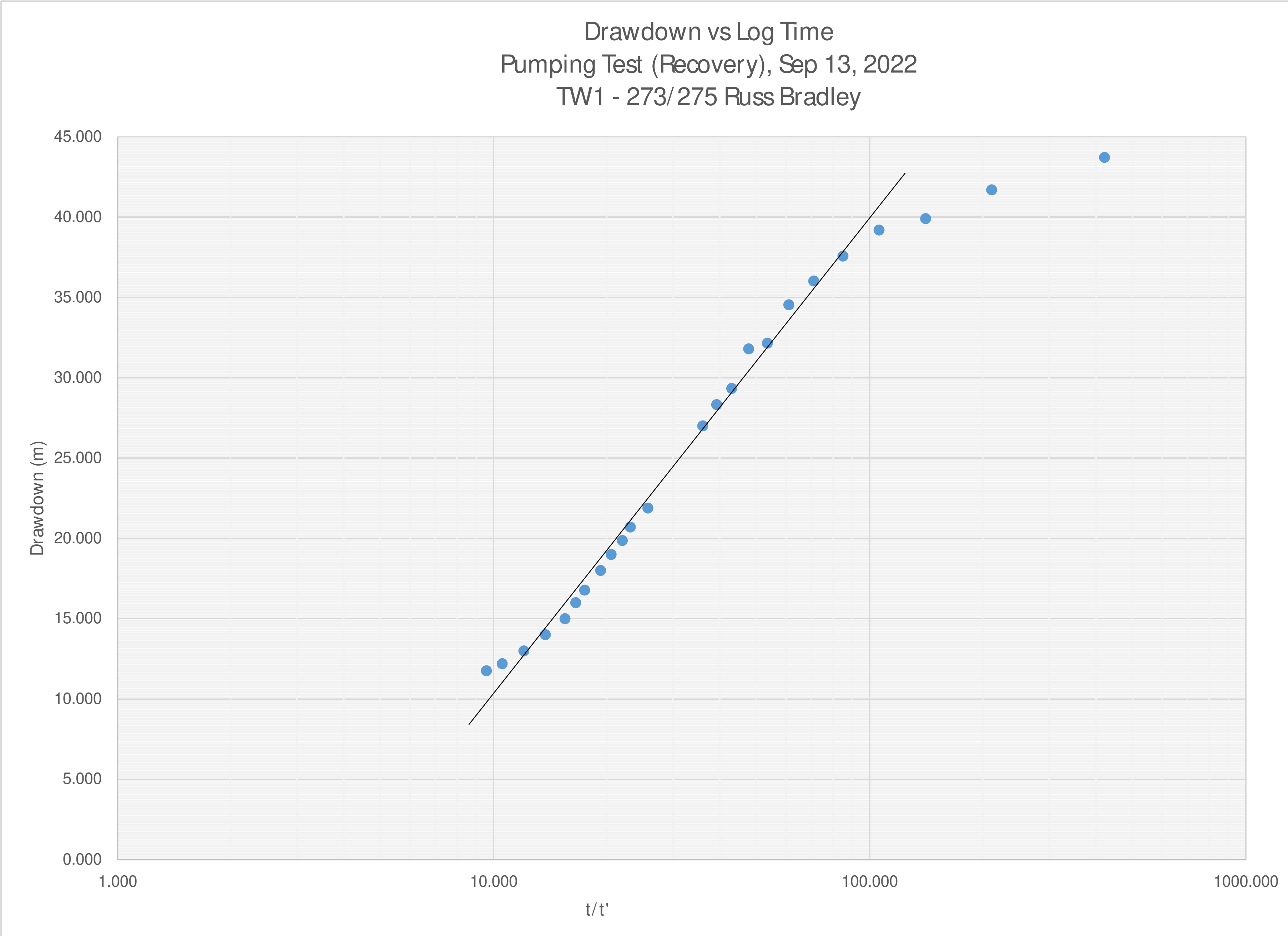
Elapsed Time (minutes)	Water Level (m BTOC)	Elapsed Time after pump shut off(min)	T/t'	Water Level (m asl)	Drawdown (m)	Water Column Remaining (m)	% Utilization	Notes
0.00	9.870			103.13	0	75.47	0.0%	Pump on at 7:40am
0.50	11.515			101.485	1.645	73.825	1.1%	60 LPM until 35 min
1.00	13.140			99.86	3.27	72.2	2.1%	53.3 LPM until 192 min
1.50	14.590			98.41	4.72	70.75	3.1%	48 LPM until 195 min
2.00	15.978			97.022	6.108	69.362	4.0%	42 LPM until 420 min
2.50	17.293			95.707	7.423	68.047	4.9%	
3.00	18.535			94.465	8.665	66.805	5.7%	
3.50	19.740			93.26	9.87	65.6	6.5%	60.122
4.00	20.880			92.12	11.01	64.46	7.2%	
4.50	21.945			91.055	12.075	63.395	7.9%	
5.00	23.000			90	13.13	62.34	8.6%	
5.50	24.140			88.86	14.27	61.2	9.4%	
6.00	25.218			87.782	15.348	60.122	10.1%	
7.00	26.740			86.26	16.87	58.6	11.1%	
8.00	28.345			84.655	18.475	56.995	12.1%	
9.00	30.120			82.88	20.25	55.22	13.3%	
10.00	31.518			81.482	21.648	53.822	14.2%	
11.00	32.615			80.385	22.745	52.725	14.9%	
12.00	33.833			79.167	23.963	51.507	15.7%	
13.00	34.970			78.03	25.1	50.37	16.5%	
14.00	36.015			76.985	26.145	49.325	17.2%	
15.00	36.990			76.01	27.12	48.35	17.8%	
18.00	39.540			73.46	29.67	45.8	19.5%	
21.00	41.810			71.19	31.94	43.53	21.0%	
23.00	42.760			70.24	32.89	42.58	21.6%	
25.00	43.950			69.05	34.08	41.39	22.4%	
29.00	45.620			67.38	35.75	39.72	23.5%	
35.00	47.520			65.48	37.65	37.82	24.7%	
41.00	48.785			64.215	38.915	36.555	25.5%	
48.00	49.565			63.435	39.695	35.775	26.0%	
56.00	50.525			62.475	40.655	34.815	26.7%	
67.50	51.236			61.764	41.366	34.104	27.1%	
77.50	51.673			61.327	41.803	33.667	27.4%	
93.00	52.295			60.705	42.425	33.045	27.8%	
107.00	52.560			60.44	42.69	32.78	28.0%	
129.00	52.863			60.137	42.993	32.477	28.2%	
142.00	53.097			59.903	43.227	32.243	28.4%	
167.00	53.661			59.339	43.791	31.679	28.7%	
180.00	53.865			59.135	43.995	31.475	28.9%	
194.00	53.951			59.049	44.081	31.389	28.9%	
198.00	52.115			60.885	42.245	33.225	27.7%	
199.00	52.225			60.775	42.355	33.115	27.8%	
202.00	51.187			61.813	41.317	34.153	27.1%	
216.00	47.885			65.115	38.015	37.455	24.9%	
220.00	47.525			65.475	37.655	37.815	24.7%	
227.00	46.980			66.02	37.11	38.36	24.4%	
263.00	46.360			66.64	36.49	38.98	23.9%	
284.00	46.367			66.633	36.497	38.973	23.9%	
301.50	46.405			66.595	36.535	38.935	24.0%	
333.00	46.494			66.506	36.624	38.846	24.0%	
350.00	46.530			66.47	36.66	38.81	24.1%	
375.00	46.780			66.22	36.91	38.56	24.2%	
382.00	46.550			66.45	36.68	38.79	24.1%	
400.00	46.621			66.379	36.751	38.719	24.1%	
412.00	46.568			66.432	36.698	38.772	24.1%	
420.00	46.599			66.401	36.729	38.741	24.1%	Pump off at 2:40pm
421.00	43.720	1.0	421.000	69.28	33.85	41.62	22.2%	
422.00	41.700	2.000	211.000	71.3	31.83	43.64	20.9%	
423.00	39.914	3.000	141.000	73.086	30.044	45.426	19.7%	
424.00	39.190	4.000	106.000	73.81	29.32	46.15	19.2%	
425.00	37.570	5.000	85.000	75.43	27.7	47.77	18.2%	
426.00	36.024	6.000	71.000	76.976	26.154	49.316	17.2%	
427.00	34.540	7.000	61.000	78.46	24.67	50.8	16.2%	
428.00	32.153	8.000	53.500	80.847	22.283	53.187	14.6%	
429.00	31.800	9.000	47.667	81.2	21.93	53.54	14.4%	
430.00	29.346	10.000	43.000	83.654	19.476	55.994	12.8%	
431.00	28.335	11.000	39.182	84.665	18.465	57.005	12.1%	
432.00	27.000	12.000	36.000	86	17.13	58.34	11.2%	
437.50	21.880	17.000	25.735	91.12	12.01	63.46	7.9%	
439.00	20.710	19.000	23.105	92.29	10.84	64.63	7.1%	
440.00	19.872	20	22.000	93.128	10.002	65.468	6.6%	
441.50	19.000	21.5	20.535	94	9.13	66.34	6.0%	
443.00	18.000	23	19.261	95	8.13	67.34	5.3%	
445.50	16.785	25.5	17.471	96.215	6.915	68.555	4.5%	
447.00	16.000	27	16.556	97	6.13	69.34	4.0%	
449.00	15.000	29	15.483	98	5.13	70.34	3.4%	
453.00	14.000	33	13.727	99	4.13	71.34	2.7%	
458	13.000	38	12.053	100	3.13	72.34	2.1%	
464	12.200	44	10.545	100.8	2.33	73.14	1.5%	
469	11.765	49	9.571	101.235	1.895	73.575	1.2%	






Drawdown vs Log Time
Pumping Test (Drawdown), Sep 13, 2022
TW1 - 273/275 Russ Bradley
Drawdown (m)
60
50
40
30
20
10
0
0.10
1.00
10.00
100.00
1000.00
Time (minutes)


Drawdown vs Log Time
Pumping Test (Long-Term), Sep 13, 2022
TW1 - 273/275 Russ Bradley
47.8 L/min (cumulative)
Drawdown (m)
45
40
35
30
25
20
15
10
5
0
0.10
1.00
10.00
100.00
1000.00
10000.00
100000.00
1000000.00
10000000.00
Elapsed Time (minutes)


Drawdown vs Log Time
Pumping Test (Recovery), Sep 13, 2022
TW1 - 273/275 Russ Bradley
Drawdown (m)
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
1.000
10.000
100.000
1000.000
t/t'

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX E: LABORATORY CERTIFICATES OF ANALYSIS

McINTOSH PERRY

PARACEL LABORATORIES LTD. | TRUSTED. RESPONSIVE. RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

McIntosh Perry Consulting Eng. (Carp)

115 Walgreen Rd.
Carp, ON K0A 1L0
Attn: Monica Black

Client PO: Russ Bradley
Project: 22-1643-01
Custody: 67014

Report Date: 22-Sep-2022
Order Date: 13-Sep-2022

Order #: 2238202

This Certificate of Analysis contains analytical data applicable to the following samples as submitted :

Paracel ID	Client ID
2238202-01	TW1-1
2238202-02	TW1-2

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Client: McIntosh Perry Consulting Eng. (Carp)

Client PO: Russ Bradley

Report Date: 22-Sep-2022

Order Date: 13-Sep-2022

Project Description: 22-1643-01

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	14-Sep-22	14-Sep-22
Ammonia, as N	EPA 351.2 - Auto Colour	14-Sep-22	14-Sep-22
Anions	EPA 300.1 - IC	21-Sep-22	21-Sep-22
Colour	SM2120 - Spectrophotometric	14-Sep-22	14-Sep-22
Conductivity	EPA 9050A- probe @25 °C	14-Sep-22	14-Sep-22
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	14-Sep-22	14-Sep-22
E. coli	MOE E3407	14-Sep-22	14-Sep-22
Fecal Coliform	SM 9222D	14-Sep-22	14-Sep-22
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	14-Sep-22	14-Sep-22
Metals, ICP-MS	EPA 200.8 - ICP-MS	15-Sep-22	15-Sep-22
pH	EPA 150.1 - pH probe @25 °C	14-Sep-22	14-Sep-22
Phenolics	EPA 420.2 - Auto Colour, 4AAP	14-Sep-22	14-Sep-22
Hardness	Hardness as CaCO3	15-Sep-22	15-Sep-22
Sulphide	SM 4500SE - Colourimetric	15-Sep-22	15-Sep-22
Tannin/Lignin	SM 5550B - Colourimetric	15-Sep-22	16-Sep-22
Total Coliform	MOE E3407	14-Sep-22	14-Sep-22
Total Dissolved Solids	SM 2540C - gravimetric, filtration	14-Sep-22	15-Sep-22
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	15-Sep-22	16-Sep-22
Turbidity	SM 2130B - Turbidity meter	15-Sep-22	15-Sep-22
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	15-Sep-22	15-Sep-22

	Client ID:	TW1-1	TW1-2	-	-
	Sample Date:	13-Sep-22 10:40	13-Sep-22 14:35	-	-
	Sample ID:	2238202-01	2238202-02	-	-
	MDL/Units	Water	Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100mL	ND	ND	-	-
Total Coliforms	1 CFU/100mL	ND [1]	ND [1]	-	-
General Inorganics					
Alkalinity, total	5 mg/L	187	186	-	-
Ammonia as N	0.01 mg/L	0.11	0.07	-	-
Dissolved Organic Carbon	0.5 mg/L	1.4	1.5	-	-
Colour	2 TCU	4	<2	-	-
Conductivity	5 uS/cm	499	509	-	-
Hardness	0.824 mg/L	271	265	-	-
pH	0.1 pH Units	7.9	7.9	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	278	270	-	-
Sulphide	0.02 mg/L	3.14	3.36	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	<0.1	-	-
Turbidity	0.1 NTU	34.8	3.3	-	-
Anions					
Chloride	1.0 mg/L	22.5	25.6	-	-
Fluoride	0.1 mg/L	0.8	1.4	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Phosphate as P	0.2 mg/L	<0.2	0.3	-	-
Sulphate	1.0 mg/L	35.1	34.3	-	-
Metals					
Mercury	0.1 ug/L	<0.1	<0.1	-	-
Aluminum	1 ug/L	680	140	-	-
Antimony	0.5 ug/L	<0.5	<0.5	-	-
Arsenic	1 ug/L	<1	<1	-	-
Barium	1 ug/L	295	277	-	-
Beryllium	0.5 ug/L	<0.5	<0.5	-	-
Boron	10 ug/L	89	94	-	-
Cadmium	0.1 ug/L	<0.1	<0.1	-	-
Calcium	100 ug/L	72200	71600	-	-
Chromium	1 ug/L	2	<1	-	-

PARACEL LABORATORIES LTD.

Order #: 2238202

Certificate of Analysis

Client: McIntosh Perry Consulting Eng. (Carp)

Client PO: Russ Bradley

Report Date: 22-Sep-2022

Order Date: 13-Sep-2022

Project Description: 22-1643-01

Client ID:		TW1-1	TW1-2	-	-
Sample Date:		13-Sep-22 10:40	13-Sep-22 14:35	-	-
Sample ID:		2238202-01	2238202-02	-	-
	MDL/Units	Water	Water	-	-
Cobalt	0.5 ug/L	<0.5	<0.5	-	-
Copper	0.5 ug/L	<0.5	<0.5	-	-
Iron	100 ug/L	820	139	-	-
Lead	0.1 ug/L	0.2	<0.1	-	-
Magnesium	200 ug/L	22100	21000	-	-
Manganese	5 ug/L	19	6	-	-
Molybdenum	0.5 ug/L	<0.5	<0.5	-	-
Nickel	1 ug/L	<1	<1	-	-
Potassium	100 ug/L	5330	4940	-	-
Selenium	1 ug/L	<1	<1	-	-
Silver	0.1 ug/L	<0.1	<0.1	-	-
Sodium	200 ug/L	22700	24100	-	-
Strontium	10 ug/L	3120	3290	-	-
Thallium	0.1 ug/L	<0.1	<0.1	-	-
Tin	5 ug/L	<5	<5	-	-
Titanium	5 ug/L	77	15	-	-
Tungsten	10 ug/L	<10	<10	-	-
Uranium	0.1 ug/L	0.1	<0.1	-	-
Vanadium	0.5 ug/L	2.5	<0.5	-	-
Zinc	5 ug/L	9	<5	-	-
Volatiles					
Acetone	5.0 ug/L	-	<5.0	-	-
Benzene	0.5 ug/L	-	<0.5	-	-
Bromodichloromethane	0.5 ug/L	-	<0.5	-	-
Bromoform	0.5 ug/L	-	<0.5	-	-
Bromomethane	0.5 ug/L	-	<0.5	-	-
Carbon Tetrachloride	0.2 ug/L	-	<0.2	-	-
Chlorobenzene	0.5 ug/L	-	<0.5	-	-
Chloroethane	1.0 ug/L	-	<1.0	-	-
Chloroform	0.5 ug/L	-	<0.5	-	-
Chloromethane	3.0 ug/L	-	<3.0	-	-
Dibromochloromethane	0.5 ug/L	-	<0.5	-	-
Dichlorodifluoromethane	1.0 ug/L	-	<1.0	-	-
1,2-Dibromoethane	0.2 ug/L	-	<0.2	-	-
1,2-Dichlorobenzene	0.5 ug/L	-	<0.5	-	-
1,3-Dichlorobenzene	0.5 ug/L	-	<0.5	-	-

PARACEL LABORATORIES LTD.

Order #: 2238202

Certificate of Analysis

Client: McIntosh Perry Consulting Eng. (Carp)

Client PO: Russ Bradley

Report Date: 22-Sep-2022

Order Date: 13-Sep-2022

Project Description: 22-1643-01

	Client ID:	TW1-1	TW1-2	-	-
	Sample Date:	13-Sep-22 10:40	13-Sep-22 14:35	-	-
	Sample ID:	2238202-01	2238202-02	-	-
	MDL/Units	Water	Water	-	-
1,4-Dichlorobenzene	0.5 ug/L	-	<0.5	-	-
1,1-Dichloroethane	0.5 ug/L	-	<0.5	-	-
1,2-Dichloroethane	0.5 ug/L	-	<0.5	-	-
1,1-Dichloroethylene	0.5 ug/L	-	<0.5	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	-	<0.5	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	-	<0.5	-	-
1,2-Dichloroethylene, total	0.5 ug/L	-	<0.5	-	-
1,2-Dichloropropane	0.5 ug/L	-	<0.5	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	-	<0.5	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	-	<0.5	-	-
1,3-Dichloropropene, total	0.5 ug/L	-	<0.5	-	-
Ethylbenzene	0.5 ug/L	-	<0.5	-	-
Hexane	1.0 ug/L	-	<1.0	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	-	<5.0	-	-
Methyl Butyl Ketone (2-Hexanone)	10.0 ug/L	-	<10.0	-	-
Methyl Isobutyl Ketone	5.0 ug/L	-	<5.0	-	-
Methyl tert-butyl ether	2.0 ug/L	-	<2.0	-	-
Methylene Chloride	5.0 ug/L	-	<5.0	-	-
Styrene	0.5 ug/L	-	<0.5	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	-	<0.5	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	-	<0.5	-	-
Tetrachloroethylene	0.5 ug/L	-	<0.5	-	-
Toluene	0.5 ug/L	-	<0.5	-	-
1,1,1-Trichloroethane	0.5 ug/L	-	<0.5	-	-
1,1,2-Trichloroethane	0.5 ug/L	-	<0.5	-	-
Trichloroethylene	0.5 ug/L	-	<0.5	-	-
Trichlorofluoromethane	1.0 ug/L	-	<1.0	-	-
1,3,5-Trimethylbenzene	0.5 ug/L	-	<0.5	-	-
Vinyl chloride	0.5 ug/L	-	<0.5	-	-
m,p-Xylenes	0.5 ug/L	-	<0.5	-	-
o-Xylene	0.5 ug/L	-	<0.5	-	-
Xylenes, total	0.5 ug/L	-	<0.5	-	-
4-Bromofluorobenzene	Surrogate	-	115%	-	-
Dibromofluoromethane	Surrogate	-	93.0%	-	-
Toluene-d8	Surrogate	-	107%	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1.0	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Phosphate as P	ND	0.2	mg/L						
Sulphate	ND	1.0	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.1	ug/L						
Aluminum	ND	1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Calcium	ND	100	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Iron	ND	100	ug/L						
Lead	ND	0.1	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Potassium	ND	100	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Strontium	ND	10	ug/L						
Thallium	ND	0.1	ug/L						
Tin	ND	5	ug/L						
Titanium	ND	5	ug/L						
Tungsten	ND	10	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						
Zinc	ND	5	ug/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100mL						
Fecal Coliforms	ND	1	CFU/100mL						
Total Coliforms	ND	1	CFU/100mL						
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						

Certificate of Analysis

Client: McIntosh Perry Consulting Eng. (Carp)

Client PO: Russ Bradley

Report Date: 22-Sep-2022

Order Date: 13-Sep-2022

Project Description: 22-1643-01

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroethane	ND	1.0	ug/L						
Chloroform	ND	0.5	ug/L						
Chloromethane	ND	3.0	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dibromoethane	ND	0.2	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloroethylene, total	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
1,3,5-Trimethylbenzene	ND	0.5	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*88.0*		*ug/L*		*110*	*50-140*			
Surrogate: Dibromofluoromethane	*73.4*		*ug/L*		*91.8*	*50-140*			
Surrogate: Toluene-d8	*84.7*		*ug/L*		*106*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	22.0	1.0	mg/L	22.5			2.3	10	
Fluoride	0.87	0.1	mg/L	0.81			6.6	10	
Nitrate as N	ND	0.1	mg/L	ND			NC	10	
Nitrite as N	ND	0.05	mg/L	ND			NC	10	
Phosphate as P	0.28	0.2	mg/L	ND			NC	10	
Sulphate	35.0	1.0	mg/L	35.1			0.5	10	
General Inorganics									
Alkalinity, total	312	5	mg/L	319			2.1	14	
Ammonia as N	0.096	0.01	mg/L	0.098			2.1	18	
Dissolved Organic Carbon	3.3	0.5	mg/L	3.8			14.7	37	
Colour	ND	2	TCU	2			NC	12	
Conductivity	35300	5	uS/cm	36000			1.9	5	
pH	7.6	0.1	pH Units	7.5			1.1	3.3	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	280	10	mg/L	278			0.7	10	
Sulphide	0.02	0.02	mg/L	0.02			9.1	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.37	0.1	mg/L	0.31			15.7	16	
Turbidity	34.0	0.1	NTU	34.8			2.3	10	
Metals									
Mercury	ND	0.1	ug/L	ND			NC	20	
Aluminum	15.5	1	ug/L	12.3			22.8	20	QR-05
Antimony	0.51	0.5	ug/L	0.72			NC	20	
Arsenic	2.6	1	ug/L	2.5			4.6	20	
Barium	127	1	ug/L	126			0.5	20	
Beryllium	ND	0.5	ug/L	ND			NC	20	
Boron	107	10	ug/L	108			0.3	20	
Cadmium	ND	0.1	ug/L	ND			NC	20	
Calcium	146000	100	ug/L	147000			1.3	20	
Chromium	ND	1	ug/L	ND			NC	20	
Cobalt	1.79	0.5	ug/L	1.81			1.2	20	
Copper	1.29	0.5	ug/L	1.38			6.6	20	
Iron	275	100	ug/L	275			0.2	20	
Lead	1.74	0.1	ug/L	1.73			0.6	20	
Magnesium	27200	200	ug/L	27500			1.0	20	
Manganese	159	5	ug/L	159			0.1	20	
Molybdenum	8.17	0.5	ug/L	8.33			1.9	20	
Nickel	3.3	1	ug/L	3.3			1.6	20	
Potassium	6030	100	ug/L	6000			0.6	20	
Selenium	ND	1	ug/L	ND			NC	20	
Silver	ND	0.1	ug/L	ND			NC	20	
Sodium	112000	200	ug/L	113000			0.3	20	
Strontium	2130	10	ug/L	2120			0.5	20	
Thallium	0.15	0.1	ug/L	0.15			3.8	20	
Tin	ND	5	ug/L	ND			NC	20	
Titanium	ND	5	ug/L	ND			NC	20	
Tungsten	ND	10	ug/L	ND			NC	20	
Uranium	1.6	0.1	ug/L	1.6			1.0	20	
Vanadium	0.53	0.5	ug/L	0.54			2.1	20	
Zinc	ND	5	ug/L	5			NC	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100mL	ND			NC	30	BAC14
Fecal Coliforms	ND	1	CFU/100mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100mL	ND			NC	30	BAC14
Volatiles									
Acetone	ND	5.0	ug/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Benzene	ND	0.5	ug/L	ND			NC	30	
Bromodichloromethane	4.16	0.5	ug/L	4.03			3.2	30	
Bromoform	ND	0.5	ug/L	ND			NC	30	
Bromomethane	ND	0.5	ug/L	ND			NC	30	
Carbon Tetrachloride	ND	0.2	ug/L	ND			NC	30	
Chlorobenzene	ND	0.5	ug/L	ND			NC	30	
Chloroethane	ND	1.0	ug/L	ND			NC	30	
Chloroform	8.50	0.5	ug/L	9.99			16.1	30	
Chloromethane	ND	3.0	ug/L	ND			NC	30	
Dibromochloromethane	4.18	0.5	ug/L	3.88			7.4	30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND			NC	30	
1,2-Dibromoethane	ND	0.2	ug/L	ND			NC	30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,1-Dichloroethane	ND	0.5	ug/L	ND			NC	30	
1,2-Dichloroethane	ND	0.5	ug/L	ND			NC	30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
1,2-Dichloropropane	ND	0.5	ug/L	ND			NC	30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND			NC	30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND			NC	30	
Ethylbenzene	ND	0.5	ug/L	ND			NC	30	
Hexane	ND	1.0	ug/L	ND			NC	30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND			NC	30	
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L	ND			NC	30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND			NC	30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND			NC	30	
Methylene Chloride	ND	5.0	ug/L	ND			NC	30	
Styrene	ND	0.5	ug/L	ND			NC	30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND			NC	30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND			NC	30	
Tetrachloroethylene	ND	0.5	ug/L	ND			NC	30	
Toluene	ND	0.5	ug/L	ND			NC	30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND			NC	30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND			NC	30	
Trichloroethylene	ND	0.5	ug/L	ND			NC	30	
Trichlorofluoromethane	ND	1.0	ug/L	ND			NC	30	
1,3,5-Trimethylbenzene	ND	0.5	ug/L	ND			NC	30	
Vinyl chloride	ND	0.5	ug/L	ND			NC	30	
m,p-Xylenes	ND	0.5	ug/L	ND			NC	30	
o-Xylene	ND	0.5	ug/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	*90.4*		*ug/L*		*113*	*50-140*			
Surrogate: Dibromofluoromethane	*71.9*		*ug/L*		*89.8*	*50-140*			
Surrogate: Toluene-d8	*85.7*		*ug/L*		*107*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	31.9	1.0	mg/L	22.5	94.2	77-123			
Fluoride	1.85	0.1	mg/L	0.81	104	79-121			
Nitrate as N	1.17	0.1	mg/L	ND	117	79-120			
Nitrite as N	1.06	0.05	mg/L	ND	106	84-117			
Phosphate as P	5.19	0.2	mg/L	ND	104	59-141			
Sulphate	45.2	1.0	mg/L	35.1	100	74-126			
General Inorganics									
Ammonia as N	0.338	0.01	mg/L	0.098	96.0	81-124			
Dissolved Organic Carbon	12.3	0.5	mg/L	3.8	85.1	60-133			
Phenolics	0.028	0.001	mg/L	ND	110	67-133			
Total Dissolved Solids	90.0	10	mg/L	ND	90.0	75-125			
Sulphide	0.48	0.02	mg/L	0.02	90.8	79-115			
Tannin & Lignin	1.1	0.1	mg/L	ND	108	71-113			
Total Kjeldahl Nitrogen	2.38	0.1	mg/L	0.31	103	81-126			
Metals									
Mercury	2.74	0.1	ug/L	ND	91.2	70-130			
Aluminum	55.9	1	ug/L	12.3	87.2	80-120			
Arsenic	52.2	1	ug/L	2.5	99.5	80-120			
Barium	167	1	ug/L	126	82.0	80-120			
Beryllium	41.7	0.5	ug/L	ND	83.4	80-120			
Boron	57	10	ug/L	16	81.9	80-120			
Cadmium	40.2	0.1	ug/L	ND	80.4	80-120			
Calcium	133000	100	ug/L	124000	87.7	80-120			
Chromium	53.0	1	ug/L	ND	105	80-120			
Cobalt	50.5	0.5	ug/L	1.81	97.4	80-120			
Copper	45.3	0.5	ug/L	1.38	87.9	80-120			
Iron	2690	100	ug/L	275	96.6	80-120			
Lead	43.6	0.1	ug/L	1.73	83.7	80-120			
Magnesium	37700	200	ug/L	27900	97.4	80-120			
Manganese	363	5	ug/L	313	99.2	80-120			
Molybdenum	53.0	0.5	ug/L	8.33	89.4	80-120			
Nickel	49.9	1	ug/L	3.3	93.0	80-120			
Potassium	16600	100	ug/L	6000	106	80-120			
Selenium	45.9	1	ug/L	ND	91.3	80-120			
Silver	49.3	0.1	ug/L	ND	98.7	80-120			
Sodium	27700	200	ug/L	17900	98.0	80-120			
Strontium	334	10	ug/L	291	85.6	80-120			
Thallium	42.9	0.1	ug/L	0.15	85.5	80-120			
Tin	45.9	5	ug/L	ND	91.2	80-120			
Titanium	57.9	5	ug/L	ND	114	80-120			
Tungsten	51.3	10	ug/L	ND	91.2	80-120			
Uranium	48.0	0.1	ug/L	1.6	92.8	80-120			
Vanadium	54.3	0.5	ug/L	0.54	108	80-120			
Zinc	46	5	ug/L	ND	91.1	80-120			
Volatiles									
Acetone	71.9	5.0	ug/L	ND	71.9	50-140			
Benzene	35.6	0.5	ug/L	ND	89.1	60-130			
Bromodichloromethane	35.5	0.5	ug/L	ND	88.8	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Bromoform	41.5	0.5	ug/L	ND	104	60-130			
Bromomethane	41.3	0.5	ug/L	ND	103	50-140			
Carbon Tetrachloride	33.0	0.2	ug/L	ND	82.6	60-130			
Chlorobenzene	42.2	0.5	ug/L	ND	105	60-130			
Chloroethane	34.9	1.0	ug/L	ND	87.4	50-140			
Chloroform	40.5	0.5	ug/L	ND	101	60-130			
Chloromethane	35.8	3.0	ug/L	ND	89.4	50-140			
Dibromochloromethane	40.2	0.5	ug/L	ND	100	60-130			
Dichlorodifluoromethane	37.4	1.0	ug/L	ND	93.6	50-140			
1,2-Dibromoethane	39.2	0.2	ug/L	ND	98.0	60-130			
1,2-Dichlorobenzene	42.1	0.5	ug/L	ND	105	60-130			
1,3-Dichlorobenzene	40.4	0.5	ug/L	ND	101	60-130			
1,4-Dichlorobenzene	40.2	0.5	ug/L	ND	101	60-130			
1,1-Dichloroethane	36.2	0.5	ug/L	ND	90.6	60-130			
1,2-Dichloroethane	37.0	0.5	ug/L	ND	92.5	60-130			
1,1-Dichloroethylene	32.2	0.5	ug/L	ND	80.5	60-130			
cis-1,2-Dichloroethylene	40.0	0.5	ug/L	ND	100	60-130			
trans-1,2-Dichloroethylene	36.1	0.5	ug/L	ND	90.2	60-130			
1,2-Dichloropropane	35.6	0.5	ug/L	ND	89.0	60-130			
cis-1,3-Dichloropropylene	38.2	0.5	ug/L	ND	95.5	60-130			
trans-1,3-Dichloropropylene	42.6	0.5	ug/L	ND	106	60-130			
Ethylbenzene	37.2	0.5	ug/L	ND	93.0	60-130			
Hexane	44.1	1.0	ug/L	ND	110	60-130			
Methyl Ethyl Ketone (2-Butanone)	97.9	5.0	ug/L	ND	97.9	50-140			
Methyl Butyl Ketone (2-Hexanone)	66.6	10.0	ug/L	ND	66.6	50-140			
Methyl Isobutyl Ketone	97.3	5.0	ug/L	ND	97.3	50-140			
Methyl tert-butyl ether	66.1	2.0	ug/L	ND	66.1	50-140			
Methylene Chloride	35.6	5.0	ug/L	ND	88.9	60-130			
Styrene	37.1	0.5	ug/L	ND	92.7	60-130			
1,1,1,2-Tetrachloroethane	35.5	0.5	ug/L	ND	88.7	60-130			
1,1,2,2-Tetrachloroethane	33.8	0.5	ug/L	ND	84.6	60-130			
Tetrachloroethylene	38.6	0.5	ug/L	ND	96.6	60-130			
Toluene	38.1	0.5	ug/L	ND	95.3	60-130			
1,1,1-Trichloroethane	31.1	0.5	ug/L	ND	77.8	60-130			
1,1,2-Trichloroethane	40.8	0.5	ug/L	ND	102	60-130			
Trichloroethylene	30.0	0.5	ug/L	ND	75.0	60-130			
Trichlorofluoromethane	39.0	1.0	ug/L	ND	97.6	60-130			
1,3,5-Trimethylbenzene	37.7	0.5	ug/L	ND	94.3	60-130			
Vinyl chloride	40.0	0.5	ug/L	ND	99.9	50-140			
m,p-Xylenes	77.9	0.5	ug/L	ND	97.4	60-130			
o-Xylene	37.4	0.5	ug/L	ND	93.4	60-130			
Surrogate: 4-Bromofluorobenzene	*89.3*		*ug/L*		*112*	*50-140*			
Surrogate: Dibromofluoromethane	*69.4*		*ug/L*		*86.7*	*50-140*			
Surrogate: Toluene-d8	*70.8*		*ug/L*		*88.5*	*50-140*			

Qualifier Notes:

Login Qualifiers :

Container and COC sample IDs don't match - Nutrients and metals bottles read TW1-1; chain of custody reads TW1-2.

Applies to samples: TW1-2

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

BAC14 A2C - Background counts greater than 200

QR-05 Duplicate RPDs higher than normally accepted. Remaining batch QA\QC was acceptable. May be sample effect.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.
NC: Not Calculated

Paracel ID: 2238202

PARACEL LABORATORIES LTD

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2238202	№ 67014

Client Name:	McIntosh Perry	Project Ref:	Russ Bradley
Contact Name:	Monica Black	Quote #:	22-334
Address:	115 Walgreen Road, Carp ON K0A 1L0	PO #:	22-1643-01
Telephone:	613 227 6953	E-mail:	m.black@mcintoshperry.com j.bowman@mcintoshperry.com

Page 1 of 1

Turnaround Time

☐ 1 day ☐ 3 day ☐ 2 day ☒ Regular

Date Required:

☐ REG 153/04 ☐ REG 406/19

☐ Table 1 ☐ Res/Park ☐ Med/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ Table ___

For RSC: ☐ Yes ☐ No

Other Regulation

☐ REG 558 ☐ PWQO ☐ CCME ☐ MISA ☐ SU - Sani ☐ SU - Storm

Mun:

☒ Other: ODWSOG

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	sub dw package, less bacteria	EC, FC, TC	trace metals including strontium	VOCs
1	TW1-1	GW	/	9	13.09.22	10:40 AM	X	X	X	
2	TW1-2	GW	/	11	13.09.22	2:35 PM	X	X	X	X
3										
4										
5										
6										
7										
8										
9										
10										

Comments: these are not drinking water samples → they are raw, untreated groundwater samples

Method of Delivery: Walk in

Relinquished By (Sign): [signature]	Received By Driver/Depot: [signature]	Received at Lab: [signature]	Verified By: [signature]
Relinquished By (Print): Monica Black	Date/Time: [illegible]	Date/Time: Sep 13/22 17:00	Date/Time: Sept 14, 22 8:04
Date/Time: 13.09.22 4:08pm	Temperature: 13.1 °C	Temperature: 13.3 °C	pH Verified: ☐ By:

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX F: TRANSMISSIVITY, FARVOLDEN, AND MOELL CALCULATIONS, AND LANGELIER SATURATION INDEX (LSI) AND RYZNAR STABILITY INDEX (RSI) CALCULATIONS

McINTOSH PERRY

Langelier Saturation Index (LSI)

If LSI is negative: No potential to scale, the water will dissolve $CaCO_3$

If LSI is positive: Scale can form and $CaCO_3$ precipitation may occur

If LSI is close to zero: Borderline scale potential. Water quality or changes in temperature, or evaporation could change the index.

The LSI is probably the most widely used indicator of cooling water scale potential. It is purely an equilibrium index and deals only with the thermodynamic driving force for calcium carbonate scale formation and growth.

$LSI = pH - pH_s$

Where:

pH is the measured water pH

pH_s is the pH at saturation in calcite or calcium carbonate and is defined as:

$pH_s = (9.3 + A + B) - (C + D)$

Where:

$A = (Log_{10} [TDS] - 1) / 10$

$B = -13.12 \times Log_{10} (^oC + 273) + 34.55$

$C = Log_{10} [Ca^{2+} \text{ as } CaCO_3] - 0.4$

$D = Log_{10} [\text{alkalinity as } CaCO_3]$

Test Well 1					
pH	7.9			A	0.143136
TDS	270			B	2.411629
Hardness	265			C	2.023246
Alkalinity	186			D	2.269513
Temp.	8.56				
pHs =					7.562007
LSI =					0.337993
RSI=					7.224013

Ryznar Stability Index (RSI)

RSI = 2(pHs) - pH

Where:

pH is the measured water pH

pHs is the pH at saturation in calcite or calcium carbonate

The empirical correlation of the Ryznar stability index can be summarized as follows:

RSI << 6 the scale tendency increases as the index decreases

RSI >> 7 the calcium carbonate formation probably does not lead to a protective corrosion inhibitor film

RSI >> 8 mild steel corrosion becomes an increasing problem.

Project No.: CCO-22-1643-01

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX G: INFILTRATION WORK SUMMARY FOR 273-275 RUSS BRADLEY ROAD

MCINTOSH PERRY

TP1A

SOILMOISTURE® Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0060

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.006
Q	0.004
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154

$Q =$ 0.003522

$K_{fs} =$ 6.41E-06 cm/sec; 3.84E-04 cm/min; 6.41E-08 m/sec; 1.51E-04 inch/min; 2.52E-06 inch/sec

$\Phi_m =$ 5.34E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0

$Q =$ 0

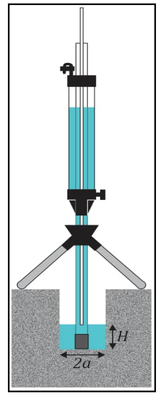
$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/ses; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/s; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/sec; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP1B

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 20
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0001

Res Type	35.22
H	20
a	3
H/a	6.667
a*	0.12
C0.01	1.755
C0.04	1.903
C0.12	1.98
C0.36	1.98
C	1.98
R	0.000
Q	3E-05
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.980192

$Q =$ 3.17E-05

$K_{fs} =$ 1.74E-08 cm/sec; 1.04E-06 cm/min; 1.74E-10 m/sec; 4.10E-07 inch/min; 6.83E-09 inch/sec

$\Phi_m =$ 1.45E-07 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0

$Q =$ 0

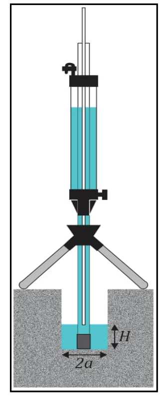
$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/ses; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/s; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/sec; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\text{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP2A

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0023

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.002
Q	0.001
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154
$Q =$ 0.001338

$K_{fs} =$ 2.43E-06 cm/sec
1.46E-04 cm/min
2.43E-08 m/sec
5.75E-05 inch/min
9.58E-07 inch/sec

$\Phi_m =$ 2.03E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

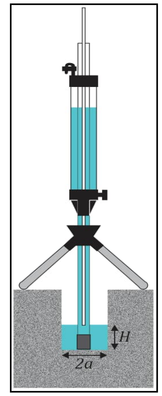
$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\text{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP2B

SOILMOISTURE® Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0006

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	0.001
Q	4E-04
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.287543
$Q =$ 0.000352

$K_{fs} =$	3.82E-07	cm/sec
	2.29E-05	cm/min
	3.82E-09	m/sec
	9.01E-06	inch/min
	1.50E-07	inch/sec

$\Phi_m =$ 3.18E-06 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

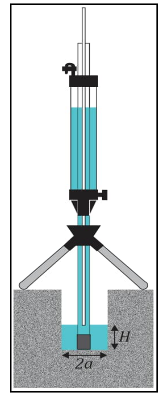
$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/ses
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/sec
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP3A

SOILMOISTURE Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0060

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.36
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	0.006
Q	0.004
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.287543

$Q =$ 0.003522

$K_{fs} =$ 5.40E-06 cm/sec
3.24E-04 cm/min
5.40E-08 m/sec
1.28E-04 inch/min
2.13E-06 inch/sec

$\Phi_m =$ 1.50E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0

$Q =$ 0

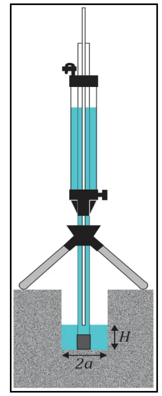
$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

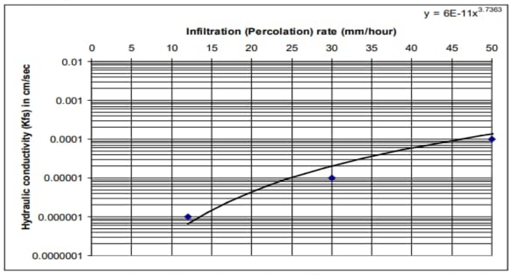
Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Location	Depth of hole (cm)	Refusal (inches)	5 cm head	10 cm head	20 cm head	K_{fs} (cm/s)	Φ_m (cm^2/min)	Infiltration Rate (mm/hour)	Infiltration Rate (with safety factor 2.5)
TP1A	60		X			6.41E-06	5.34E-05	22.18	-
TP1B	130				X	1.74E-08	1.45E-07	-	-
TP2A	60		X			2.43E-06	2.03E-05	-	-
TP2B	130			X		3.82E-07	3.18E-06	-	-
TP3A	100			X		5.40E-06	1.50E-05	21.18	-

Figure C 11: Approximate relationship between infiltration rate and hydraulic conductivity



Source: Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.

Ratio of Mean Measured Infiltration Rates[1]	Safety Correction Factor[2]
≤ 1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

Source: Wisconsin Department of Natural Resources. 2004. Conservation Practice Standards. Site Evaluation for Stormwater Infiltration (1002). Madison, WI.

Ratio	-
Corresponding Safety Factor	-

Notes To select a safety correction factor, calculate the ratio of the mean (geometric) measured infiltration rate at the proposed bottom elevation of the BMP to the rate in the least permeable soil horizon within 1.5 m below the bottom of the BMP

September 7, 2022

To Whom it May Concern:

Re: Infiltration Work Summary for 273-275 Russ Bradley, Ottawa, ON

McIntosh Perry staff completed infiltration testing on June 7, 2022, at the locations shown on Figure 1, below. A Guelph Permeameter (a constant head permeameter used to measure in-situ vertical hydraulic conductivities of soil) was set up in three separate locations (TP1, TP2, TP3) for a total of three double-head infiltration tests. Additional tests were attempted (TP4, TP5) however a majority of the proposed development area was saturated and deemed unsuitable for testing. Test locations were selected based on the permeability of soils and subsequent capacity to complete the infiltration testing. In this case, only one (1) hole (TP1) was completed within the proposed infiltration area, while the remaining (TP2, TP3) were completed in close proximity to Carp Road – outside of the desired infiltration area. Holes were advanced using a hand auger.

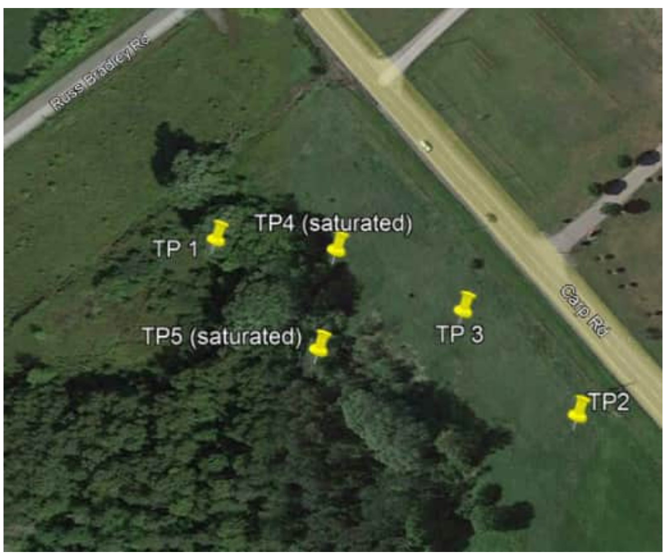


Figure 1 – Guelph Permeameter Test Locations

Where possible, each infiltration test consisted of at least a 5-7 cm head test, based on the level of saturation and presence of water in each hole where testing was attempted. Water was added to the Guelph Permeameter reservoir and allowed to infiltrate into the soil at the specified head pressure. Changes in reservoir water level (h) were recorded at regular intervals and normalized for change in time (t). Each test was considered complete when dh/dt (change in head / change in time) reached a steady-state for at least three consecutive measurements.

Appendix C.2 of the Toronto Region Conservation Authority's (TRCA) Stormwater Management Criteria (August 2012) provides guidance on the calculation of infiltration rates using field saturated hydraulic conductivity (K_{fs}). The recommended calculation is as follows:

$K_{fs} = (6 \times 10^{-11}) (I^{3.7363})$

Where:

- K_{fs} is the field saturated hydraulic conductivity (in cm/s), as measured by a Guelph Permeameter, double-ring infiltrometer, single-ring infiltrometer, or other accepted method
- I is the infiltration rate (in mm/hr)

Based on the above calculation, the estimated soil infiltration rate (I) from the data collected at TP1, TP2, and TP3 is shown in the table below.

Table 1: Infiltration Rates

Borehole ID	K_{fs} cm/s	Corrected I* (mm/hr)
TP1	3.4×10^{-6}	5.35
TP2	1.02×10^{-7}	2.09
TP3	4.9×10^{-7}	3.18

**Includes a safety factor calculated per TRCA guidance*

As shown, the highest infiltration rate was observed in TP1 at a depth of approximately 0.05 m bgs (approximately 113.85 m asl). The lowest infiltration rate was observed in TP2 at a depth of approximately 0.15 m bgs (approximately 113.75 m asl). These values are generally consistent with the observed stratigraphy, in that fine-grain materials will typically have lower hydraulic conductivity rates.

It is noted that the field infiltration testing for TP2 and TP3 were conducted outside of the proposed infiltration infrastructure area, and are situated in close proximity to Card Road. Based on Site observations from June 7 and August 30, 2022, the property and development area appear to be highly saturated, with many areas of stagnant standing water. In particular, the wooded area of the Site appears to be a local topographic low point, and is not considered suitable for infiltration trenches or galleries in its current state. In several instances where infiltration tests were attempted, excess water logging caused no movement in the water column. As noted above, additional testing was done in subsequent holes TP2 and TP3 within an area closer to Carp Road.

TP2 and TP3 were advanced to depths of approximately 0.15 and 0.2 m bgs, respectively. The soil stratigraphy was consistent at all depths, consisting of wet, silty sand with trace clay.

It is McIntosh Perry's opinion that at this particular Site, alternate options for stormwater management should be investigated. It is expected that any infiltrative solutions to stormwater management will be hampered by high groundwater levels, standing water, and fine-grained overburden that is not conducive to infiltration.

Sincerely,

Original Signed

Jordan Bowman, P.Geo., P.Biol.
Manager (Geo-Environmental)
(613) 714-4602
j.bowman@mcintoshperry.com

TP1

Guelph Permeameter

SOILMOISTURE®

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 7
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0080

Res Type 35.22
H 7
a 3
H/a 2.333
a* 0.04
C0.01 0.991
C0.04 1.04
C0.12 1.014
C0.36 1.014
C 1.04
R 0.008
Q 0.005
pi 3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.039608
$Q =$ 0.004696

$K_{fs} =$ 3.40E-06 cm/sec
2.04E-04 cm/min
3.40E-08 m/sec
8.03E-05 inch/min
1.34E-06 inch/sec

$\Phi_m =$ 8.49E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type 0
H 0
a 0
H/a #DIV/0!
a* 0
C0.01 #DIV/0!
C0.04 #DIV/0!
C0.12 #DIV/0!
C0.36 #DIV/0!
C 0
R 0.000
Q 0
pi 3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

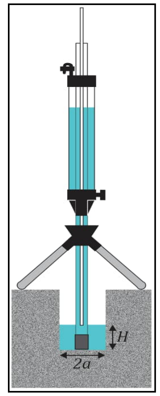
$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type: 2.16
H1/a: #DIV/0!
H2/a: #DIV/0!
C1-0.01: #DIV/0!
C2-0.01: #DIV/0!
C1-0.04: #DIV/0!
C2-0.04: #DIV/0!
C1-0.12: #DIV/0!
C2-0.12: #DIV/0!
C1-0.36: #DIV/0!
C2-0.36: #DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP2

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0002

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.04
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.842
R	0.000
Q	1E-04
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 0.842059

$Q =$ 0.000117

$K_{fs} =$ 1.02E-07 cm/sec
6.14E-06 cm/min
1.02E-09 m/sec
2.42E-06 inch/min
4.03E-08 inch/sec

$\Phi_m =$ 2.56E-06 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0

$Q =$ 0

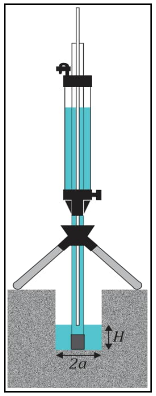
$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\text{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TP3

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0008

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.04
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.842
R	0.001
Q	5E-04
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 0.842059

$Q =$ 0.00047

$K_{fs} =$	
4.09E-07	cm/sec
2.46E-05	cm/min
4.09E-09	m/sec
9.67E-06	inch/min
1.61E-07	inch/sec

$\Phi_m =$ 1.02E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0

$Q =$ 0

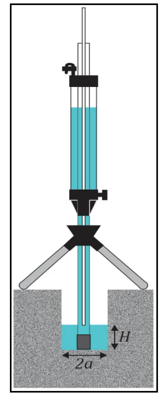
$K_{fs} =$	
#DIV/0!	cm/sec
#DIV/0!	cm/min
#DIV/0!	m/ses
#DIV/0!	inch/min
#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$	
#DIV/0!	cm/sec
#DIV/0!	cm/min
#DIV/0!	m/s
#DIV/0!	inch/min
#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$	
#DIV/0!	cm/sec
#DIV/0!	cm/min
#DIV/0!	m/sec
#DIV/0!	inch/min
#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX H: LONGTERM MONITORING PROGRAM

MCINTOSH PERRY

MW ID	Surface Elevation (m asl)	Stickup (m ags)	Screen Start (m bgs)	Screen End (m bgs)	Screen Base Elevation (m asl)	Installation Date
BH21-1 MW	113.1	-	4.4	5.9	107.2	10-Nov-21
BH22-2 MW	114	0.91	1.5	4.5	109.5	06-Dec-22

	Static GW Level (m below PVC)		Static GW Elevation (m asl)		Static GW Depth (m bgs)	
Date	BH21-1 MW	BH22-2 MW	BH21-1 MW	BH22-2 MW	BH21-1 MW	BH22-2 MW
11-Nov-21	-		112.6		0.5	
17-Nov-21	-		112.9		0.2	
02-Dec-21	-		112.9		0.2	
03-Mar-22	-		112.8		0.3	
06-Oct-22	-		112.5		0.6	
10-Oct-22	-		112.5		0.6	
06-Dec-22	-	1.791	-	113.119	-	0.881
Jan-23	-	1.819	-	113.091	-	0.909
Feb-23	-	2.019	-	112.891	-	1.109
15-Mar-23	-	1.930	-	112.980	-	1.02
30-Mar-23	-	1.466	-	113.444	-	0.556
12-Apr-23	-	1.385	-	113.525	-	0.475
26-Apr-23	-	1.689	-	113.221	-	0.779
10-May-23	-	1.638	-	113.272	-	0.728
24-May-23	-	1.843	-	113.067	-	0.933
07-Jun-23	-	1.972	-	112.938	-	1.062
22-Jun-23	-	2.055	-	112.855	-	1.145

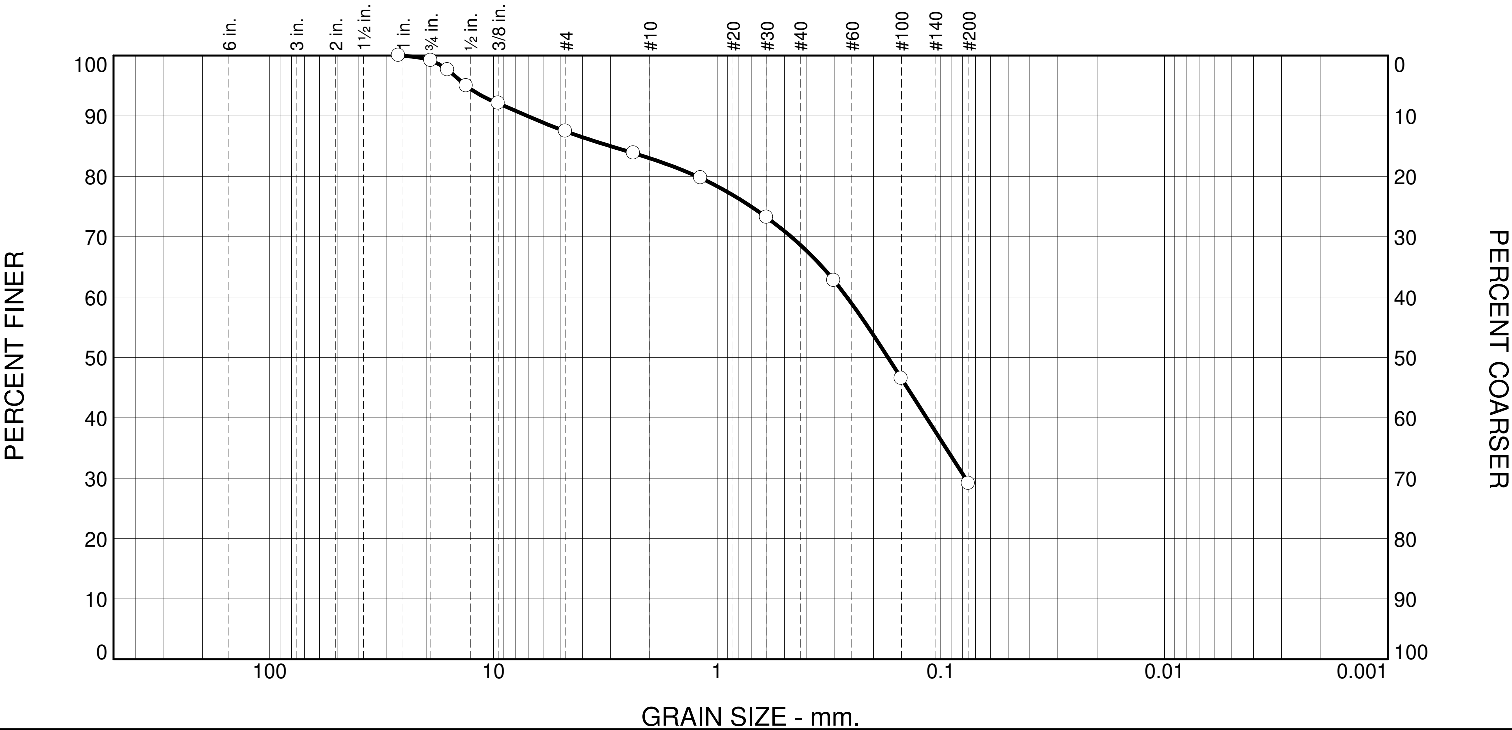
- Well destroyed, could not take measurement

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX I: GRAIN SIZE ANALYSIS

McINTOSH PERRY

Particle Size Distribution Report



% +75mm	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.8	11.8	4.4	14.3	39.6	29.1	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
26.5mm	100.0		
19.0mm	99.2		
16.0mm	97.6		
13.2mm	95.0		
9.5mm	92.1		
4.75mm	87.4		
2.36mm	83.8		
1.18mm	79.7		
0.600mm	73.2		
0.300mm	62.7		
0.150mm	46.5		
0.075mm	29.1		

* (no specification provided)

Material Description

Silty/Clayey Sand some fine Gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 7.0505 D_{85}= 2.9939 D_{60}= 0.2630
D_{50}= 0.1723 D_{30}= 0.0777 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.75

Date Received: Nov 24,2022 **Date Tested:** Nov 28,2022

Tested By: R.C

Checked By: J.Hopwood-Jones

Title: Lab Manager

Location: TP SS-2
Sample Number: SS-2 **Depth:** 25cm-1m

Date Sampled: Nov 24,2022

McINTOSH PERRY

Client: Trever Watkins
Project: 273&275 Russ Bradley Rd.

Project No: CCO-221643-01 **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

2022-11-29

Client: Trever Watkins
Project: 273&275 Russ Bradley Rd.
Project Number: CCO-221643-01
Location: TP SS-2
Depth: 25cm-1m
Sample Number: SS-2
Material Description: Silty/Clayey Sand some fine Gravel
Sample Date: Nov 24,2022
Date Received: Nov 24,2022
Tested By: R.C
Test Date: Nov 28,2022
Checked By: J.Hopwood-Jones
Title: Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
926.14	0.00	0.00	26.5mm	0.00	100.0	0.0
			19.0mm	7.84	99.2	0.8
			16.0mm	22.03	97.6	2.4
			13.2mm	46.69	95.0	5.0
			9.5mm	73.48	92.1	7.9
			4.75mm	116.36	87.4	12.6
			2.36mm	149.73	83.8	16.2
			1.18mm	188.07	79.7	20.3
			0.600mm	248.42	73.2	26.8
			0.300mm	345.28	62.7	37.3
			0.150mm	495.39	46.5	53.5
			0.075mm	656.59	29.1	70.9

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.8	11.8	12.6	4.4	14.3	39.6	58.3			29.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0777	0.1158	0.1723	0.2630	1.2299	2.9939	7.0505	13.2424

Fineness Modulus
1.75

HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS
273-275 RUSS BRADLEY ROAD, CARP, ONTARIO

APPENDIX J: PREDICTIVE ATTENUATION CALCULATIONS

MCINTOSH PERRY

Nitrate Attenuation Calculations
273-275 Russ Bradley Road, Carp, ON

Land Area	Lot		2.40	ha
			24000	m2
	impermeable		0	m2
	total permeable		24000	m2
Water Surplus (Ws)				
Ws = Precipitation - Evapotranspiration				
Precipitation			749.6	mm/yr
Evapotranspiration			635.5	mm/yr
		Ws	114.1	mm/yr
			0.1	m/yr
Infiltration Factor (If)	**per MOEE 1995**			
Topo	Flat Land		0.3	
Soil	Open sandy loam		0.4	
Cover	Woodland brush with some open space		0.2	
		If =	0.9	
Infiltration (I)				
I=Ws * If				
		I =	0.103	m/yr
			102.7030419	mm/yr
Dilution Water Avaiable (Dw)				
Dw = A * I				
		Dw =	2464.9	m3/yr
			6753.08	L/day
Background Nitrate + Nitrite Concentration (summation) (Cb)		Cb =	0.1	mg/L
Effluent Loading (Qe)		Qe =	1000	L/day/Lot
Effluent Nitrate Concentration (Ce)		Ce =	40	mg/L
Number of Lots (N)		N=	1	

Boundary Nitrate Concentration (Cbound)

Cbound= Cb+(Ce*Qe*N)/((Qe*N)+Dw)

Cbound = 5.26

Potential Evapotranspiration

Thornthwaite Method, "Hydrology & Hydraulic Systems", Gupta

Etmonth = 1.62 (10*Tm)/I)^a
where:
a = 675*10^-9*I^3 - 771 *10^-7*I^2 +179*10^-4 * I + 492*10^-3

I = sum (Tm/5)^1.514

Station: **Kemptville**
Climate ID **6104025**

Month	Temp C (d;	I	ET (cm) unadjusted	Daylight Factor	ET (cm) adjusted
January	-11.2			0.89	
Feb	-9.5			0.89	
March	-3.1			1.11	
April	5.9	1.2848	2.8315	1.21	3.43
May	12.6	4.0525	6.2677	1.38	8.64
June	17.7	6.7794	8.9472	1.40	12.51
July	20	8.1568	10.1683	1.41	14.33
Aug	18.9	7.4873	9.5834	1.30	12.43
Sept	14.3	4.9084	7.1560	1.12	8.04
Oct	7.5	1.8476	3.6404	1.03	3.74
Nov	1.1	0.1010	0.4876	0.89	0.43
Dec	-6.9			0.86	0.00
I		34.61767	49.0820		**63.55**
thus a =		1.0473			

ET = Evapotranspiration
Note: Daylight Factor is an adjustment factor for possible hours of sunshine based on latitude.
Monthly temperature from Environment Canada

Input data from user
Set value
Calculated by worksheet