Hydrogeological Assessment

FINAL REPORT

W3 – Lambeth Farms c/o York Developments

Project Name:
Sunset Creek Subdivision
3700 Colonel Talbot & 3645 Bostwick Road, London, Ontario
London, Ontario

Project Number:
LON-22023963-A0

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Date Submitted:
December 1, 2023

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Type of Document:

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Executive Summary

EXP Services Inc. (EXP) was retained by **W3 – Lambeth Farms c/o York Developments** to conduct a hydrogeological assessment of the proposed development to be located at 3700 Colonel Talbot Road in London, Ontario, west of the ongoing W3 Farm development, hereinafter referred to as the 'Site'. The Site is also referred to as the 'Sunset Creek' property.

The objective of the hydrogeological assessment was to examine the hydrogeological characteristics of the Site by reviewing the Ministry of the Environment, Conservation and Parks (MECP) Water Well Records (WWR), reviewing the soils and groundwater information provided from a series of sampled boreholes and monitoring wells at the Site, compiling a site wide monthly water balance, collecting several full years of groundwater elevations to identify any seasonal variations, and assess the natural heritage features on the property. It is understood that the hydrogeological assessment will be submitted for review and approval by the City of London and the Upper Thames River Conservation Authority (UTRCA).

Based on the results of the hydrogeological assessment, the following findings are presented:

- There are several mapped surface water features across the Site including an intermittent watercourse which is referred to as Tributary 12 to Dingman Creek. In addition, two (2) Unevaluated Wetlands (UW) are located near the north edge of the Site. All of these features are considered regulated lands of the UTRCA.
- Surface drainage follows Site topography and generally flows towards Tributary 12, which flows to the southwest and eventually drains into Dingman Creek. A topographic low is present in the northwest corner of the Site, in the vicinity of the wetland inclusion area, where some surface water runoff is expected to pool on-Site;
- The stratigraphy at the Site generally consists of an extensive clayey silt to silty clay till layer across the Site, with underlying sand. Sandy silt was present at surface in some areas and thin sand layers were seen within the till at some monitoring wells;
- Groundwater levels were the shallowest at BH301/MW situated in the northwest corner of the Site, with groundwater levels measured within 0.7 meters below ground surface (bgs) corresponding to 262.47 m above mean sea level (amsl);
- The west half of the Site is mapped as a significant groundwater recharge area and a highly vulnerable aquifer;
- A Single Well Response Test (SWRT) was completed at BH209/MW. Based on the test results, the estimated hydraulic conductivity for the underlying sand is 1.4×10^{-7} m/s;
- Infiltration tests completed along Tributary 12 and across the Site resulted in a factored infiltration rate of 10 mm/hour;
- Groundwater chemistry results did not exceed the Ontario Drinking Water Quality Standards (ODWQS) Maximum Acceptable Concentration (MAC) for any of the analyzed parameters, however an elevated nitrate

concentration was reported at BH303/MW. The Ontario Provincial Water Quality Objectives (PWQO) guidelines were exceeded for several analyzed parameters in surface water; however, these exceedances are not considered a concern;

- The monitoring wells on Site have been maintained for ongoing study past the completion of this report. When the wells are no longer required, they should be decommissioned in accordance with O. Reg. 903;
- The post development infiltration target of 80%, can be achieved by a 6% reduction in runoff by using secondary infiltration and run-off reduction techniques;
- Preliminary dewatering calculations suggest an EASR or a PTTW will not be required for dewatering however the dewatering calculations will need to be re-assessed once the design details are finalized; and,
- During construction, short term impacts to the shallow groundwater may occur, where excavations crossing the shallow groundwater require construction dewatering.

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1. Introduction and Background

1.1 Background

EXP Services Inc. (EXP) was retained by **W3 – Lambeth Farms c/o York Developments** to conduct a hydrogeological study and water balance assessment on the proposed development of a residential subdivision to be located on the parcel of land at 3700 Colonel Talbot Road & 3645 Bostwick Road in London, Ontario, hereinafter referred to as the 'Site' (**Appendix A, Drawing 1**). The Site is also referred to as the 'Sunset Creek' property.

The proposed development consists of low and medium density residential units, mixed use multiple residential blocks, park space, stormwater management (SWM) ponds and a naturalized corridor which will connect the property to the north of the Site and act as compensation for the existing natural features on the Site. The conceptual development plan is included in **Appendix B**. There are two (2) Unevaluated Wetlands (UW) located near the north Site boundary. An Intermittent watercourse traverses the Site from the UW in the north, seasonally flowing in a southwest direction towards Colonel Talbot Road and eventually draining into Dingman Creek (**Drawings 2 and 3**). The watercourse, referred to as Tributary 12, collects surface runoff from the Site and flows to Dingman Creek, located approximately 500 m southwest of the Site. Tributary 12 is considered regulated lands of the Upper Thames River Conservation Authority (UTRCA), as shown on **Drawing 4**.

The objective of the hydrogeological study was to examine the hydrogeological characteristics of the Site by reviewing the Ministry of the Environment, Conservation and Parks (MECP) Water Well Records (WWR), reviewing the soil and groundwater information provided from a series of sampled boreholes and monitoring wells at the Site, compiling a Site wide monthly water balance, collecting multiple years of groundwater elevations to identify any seasonal variations; and assess the natural heritage features on the property. The assessment provides comments pertaining to potential impacts on hydrogeological conditions at the Site and provides recommendations and design/construction measures, where applicable, to mitigate this potential for impact. This final report includes four full years of data collection thus fulfilling the requirements in support of the Site Plan Submission.

It is understood that the hydrogeological study and water balance assessment will be submitted for review and approval by the City of London and the UTRCA as part of the Draft Plan Approval for the proposed development. The study design and report have been compiled in accordance with the City of London Design Specification & Requirements Manual (2019) as well as the Conservation Authority Guidelines for Hydrogeological Assessments (2013).

The UTRCA administers a regulation made under Section 28 of the Conservation Authorities Act, known as Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (O.Reg. 157/06). The regulation was approved by the Minister of Natural Resources and Forestry on May 4, 2006. This regulation allows the UTRCA to ensure that proposed development and other activities have regard for natural hazard features. The UTRCA implements the regulation by issuing Section 28 permits for works in or near watercourses, valleys, wetlands, or shorelines, when required.

Property owners must obtain permission and/or a letter of clearance from the local Conservation Authority before beginning any development, site alteration, construction, or placement of fill within the regulated area. Permits are also required for any wetland interference, or for altering, straightening, diverting or interfering in any way with the existing channel of a creek, stream or river. It is EXP's understanding that the Site is subject to this regulation, and requires a Section 28 permit, as the Site contains a water feature.

1.2 Terms of Reference and Scope of Work

The purpose of the assessment was to examine the subsoil and groundwater conditions at the Site by advancing a series of boreholes at the locations chosen by EXP and illustrated on the Field Investigation Location Plan (**Drawing 2**).

The scope of work for the Hydrogeological Assessment consisted of the following tasks:

1. Desktop Study: This task consisted of a review of existing information including Site plans, previous reports, geological maps, geological cross sections, groundwater level information, borehole logs, and MECP WWR.

2. Field Program: Three drilling programs have been completed on this Site. In 2016 eight (8) boreholes were completed in conjunction with a drilling program for the W3 lands located east of the Site. One (1) borehole was completed as a monitoring well (BH3/MW3). An additional drilling program took place in 2018 which included the installation of 4 additional monitoring wells (BH206/MW to BH209/MW). The final drilling program was completed in 2020 with the installation of four (4) monitoring wells (BH301/MW to BH304/MW). A total of two (2) surface water stations were installed within the UW in the north portion of the Site in 2020. Water levels have been measured monthly since installation of each monitoring well and surface water station, resulting in a four-year monitoring period for wells BH206/MW to BH209/MW, and a two-year period for wells BH301/MW to BH304/MW and surface water stations. A single well response test (SWRT) was completed for the purposes of characterizing the hydraulic conductivity of the geological unit the tested well is screened within. Two infiltration testing programs were also completed for the Site with three (3) locations tested along the intermittent watercourse and eleven (11) locations across the Site. Two (2) rounds of groundwater and surface water quality samples were collected and submitted for analysis of general chemistry parameters.

3. Data Evaluation: Evaluation of the available field and laboratory data, preliminary assessment of the dewatering requirements and potential dewatering effects on the surrounding environment, as applicable.

4. Water Balance: Preparation of a water balance assessment of the subject Site evaluating pre- and post-development conditions.

5. Reporting: This task consisted of preparing this hydrogeological assessment report. In preparing this report, EXP has considered the guidance material available in the Conservation Ontario Guidelines for Hydrogeological Assessments (Conservation Ontario, 2013) and City of London Design Specification & Requirements Manual (2019).

Reference is made to **Appendix L** of this report, which contains further information necessary for the proper interpretation and use of this report.

1.3 Proposed Development and Stormwater Management Strategies

The proposed development is a residential subdivision containing low, medium and mixed-use residential properties with local servicing installed to standard depths of approximately 2 to 4 m below grade. Underground parking is planned for the residential and mixed-use blocks located along Colonel Talbot Road. A park block is planned in the south of the Site and there will be a naturalized corridor constructed through the centre of the Site. The corridor will be completed in conjunction with development of the property to the north and will incorporate SWM areas. The development plan for the Site is provided in **Appendix B**.

1.4 Naturalized Corridor Design

A naturalized corridor is proposed to be constructed through the Site, beginning on the property to the north and running through the centre of the Site to the southwest. This corridor will be used to realign the existing intermittent watercourse through the Site and provide compensation for the UWs in the north portion of the Site. Included in the corridor design are four (4) SWM storage ponds which will allow for a more natural SWM strategy and terrestrial and aquatic habitat, and public amenity space in the form of a network of pathways. The proposed width at the top of the valley is 49 to 55 m. Wetland compensation areas are provided throughout the channel alignment, including the portion of the channel extending to the lands south of the Site.

A Section 28 permit is required from the UTRCA in order to alter the alignment of the existing intermittent watercourse.

2. Methodology

2.1 Borehole Drilling and Monitoring Well Installations

The initial drilling program at the Site was completed in conjunction with the program for the Phase 1 W3 lands located east of the Site in February 2016. This program included the completion of 20 boreholes (BH1 to BH20) with the installation of monitoring wells in three (3) of the boreholes (BH12/MW1; BH15/MW2; and BH3/MW3). Of which eight (8) boreholes and one (1) monitoring well were installed on the Sunset Creek property during this investigation.

Additional drilling and monitoring well installations were completed on the Sunset Creek property in November 2018 and included the installation of four (4) deeper monitoring wells (BH206/MW to BH209/MW). A third drilling program was completed on the Site in November 2020 and included the installation of an additional four (4) shallow monitoring wells (BH301/MW to BH304/MW). The location and depth of the boreholes was based on the preliminary subdivision layout which was provided to EXP and locations of significant natural features (wetland pockets/intermittent watercourses). Boreholes were advanced to depths ranging between 3.5 and 17.2 m below ground surface (mbgs). Efforts were made to install well screens within more permeable soils. A summary of the well installation details is provided in **Table 1**, with well locations shown in **Drawing 2**.

During the drilling program in November 2018, monitoring well BH3/MW3 was decommissioned due to damage by farming equipment.

Boreholes were completed within the overburden using a track-mounted drill rig and standard 21 cm (8”) OD hollow stem auger drilling techniques. During the drilling, the stratigraphy in the boreholes was examined and logged in the field by EXP technical personnel. Copies of the borehole (well) logs are provided in **Appendix C**.

Groundwater monitoring wells were installed within selected boreholes. All wells were constructed from 5.1 cm (2”) diameter, schedule 40, polyvinyl chloride (PVC), flush-threaded casing. The appropriate number of risers was coupled with screen sections via threaded joints to construct the well. The well screens consisted of PVC pipe with 0.010-inch factory-generated slots. Well construction details are provided in **Table 1**.

A primary filter pack consisting of silica sand was placed around the well screen in the borehole and extended approximately 0.3 m above the top of the well screen. Hole Plug, a swelling bentonite clay that forms an effective barrier to the vertical movement of fluids when installed in a boring, was used as a seal above the filter pack.

Table 1 – Monitoring Well Construction Details

Well ID	Installation Date	Ground Surface Elevation* (masl)	Top of Standpipe Elevation* (masl)	Completion Depth (m bgs)	Screen Interval (m bgs)	Screened Strata
BH3/MW3	February 2016	265.20	265.98	6.6	3.1 – 6.1	Silty Sand; Silty Clay Till
BH206/MW	November 2018	263.99	264.90	17.2	13.7 – 15.2	Sand
BH207/MW	November 2018	261.90	262.73	15.7	12.2 – 15.2	Sand; Clayey Silt Till
BH208/MW	November 2018	266.20	266.84	12.7	10.7 – 12.2	Sandy Silt
BH209/MW	November 2018	265.20	266.08	12.7	9.1 – 12.2	Sand
BH301/MW	November 2020	263.10	263.78	4.6	3.1 – 4.6	Clayey Silt Till; Sand
BH302/MW	November 2020	262.99	263.86	4.6	3.1 – 4.6	Clayey Silt Till; Sand
BH303/MW	November 2020	268.02	268.84	4.0	2.5 – 4.0	Clayey Silt Till
BH304/MW	November 2020	263.56	264.28	4.6	3.1 – 4.6	Clayey Silt Till; Sand

Notes: 1. masl denotes metres above mean sea level.
2. m bgs denotes metres below ground surface.
* - elevations were collected by a Sokkia GPS unit

2.2 Mini-Piezometer and Staff Gauge Installations

A total of two (2) surface water stations were installed in November 2020 within the UWs in the north portion of the Site. These surface water stations are referred to as P-7 and P-8 and their locations are shown on **Drawing 2**. Each of these surface water stations were instrumented with a shallow groundwater mini-piezometer and P-8 also has a staff gauge. **Table 2** outlines the surface water station and mini-piezometer construction details.

The mini-piezometers were installed with a 6-inch Solinst drive point end (6-inch screen length). The Solinst drive point mini-piezometer ends have a stainless steel, 50 mesh cylindrical filter screen, within a ¾” (20mm) stainless steel drive-point body.

A staff gauge was installed at P-8 within the surface water body to capture monthly surface water elevations. This staff gauge is referred to as SG8.

Table 2 – Surface Water Station Details

Station ID	Mini-Piezometer ID	Ground Surface Elevation (masl)	Top of Mini-Piezometer Elevation (masl)	Completion Depth (m bgs)	Screen Interval (m bgs)	Screened Strata	Staff Gauge Installed
Station 7	**P-7**	261.10	262.28	1.09	0.94 – 1.09	Silt	No
Station 8	**P-8**	263.30	264.30	1.03	0.88 – 1.03	Silt	Yes (SG8)

Notes: 1. masl denotes metres above mean sea level.
2. m bgs denotes metres below ground surface.

2.3 Well Development and Groundwater Sampling

Monitoring wells were developed following installation. The wells were developed to:

- remove fine soil particles adjacent to the well screen that may otherwise interfere with water quality analyses;
- restore the groundwater properties that may have been disturbed during the drilling process;
- improve the hydraulic communication between the well and the geologic materials; and,
- remove water, if any, added during the drilling process.

Wells were generally developed by removing a minimum of ten times the volume of water contained in the well casing (casing volume) where possible using rigid high-density polyethylene (HDPE) tubing fitted with Waterra™ inertial pumps.

Groundwater samples were collected from two (2) selected monitoring wells on November 14, 2020 and March 23, 2021 for analysis of general groundwater quality parameters. Groundwater chemistry results are presented and discussed in **Section 4.4**. Groundwater chemistry results and Lab Certificates of Analysis (COA) are presented in **Appendix D**.

2.4 Surface Water Sampling

Surface water samples were collected from Surface Water Station 7 in March 2021 and from Surface Water Station 8 in November 2020 and March 2021. There was insufficient water to sample at SW Station 7 in November 2020. The samples were submitted to Bureau Veritas in London, Ontario for laboratory analysis of anions and cations, dissolved metals, total metals, nutrients (nitrate, nitrite, ammonia and phosphorous), total dissolved solids, chloride and phosphates. Surface water chemistry results and Lab Certificates of Analysis (COA) are presented in **Appendix D**.

2.5 Long-Term Groundwater Elevation Monitoring

Water level monitoring in all monitoring wells and mini-piezometers installed on Site has been completed on a monthly basis since their respective installation dates until the end of April 2023 for a four-year period in the older wells and a two-year period in the newer wells and SW Stations. Measurements were manually collected using a battery-signal water level tape and are included in **Appendix E**.

Water level dataloggers were installed in two (2) monitoring wells (BH301/MW and BH302/MW) and within P-8 to assist in the evaluation of seasonal water level fluctuation, groundwater/surface water interactions, and the influence of precipitation on surface water and groundwater levels across the Site. An additional logger was placed at surface and used for barometric compensation. The dataloggers were installed in the monitoring wells on May 18, 2021 and in the mini-piezometers on November 14, 2020 and remain in place for continued monitoring. The dataloggers were set to record a measurement every 24 hours.

2.6 Hydraulic Conductivity Testing

A single well recovery test (SWRT) was completed on monitoring well BH209/MW installed in the underlying compact sand unit. The test method used was a falling head test which involved adding clean, filtered water into the well and monitoring the fall of water levels in the well over time. The test results from this well is presented in **Appendix F**.

The mathematical solution by Hvorslev (1951) was used to interpret the data and involved matching a straight-line solution to water-level displacement data collected during the recovery test. The time required for the water level in the well to reach 37% of the initial change (To) is determined from the plot, and used in the following equation to estimate the hydraulic conductivity (K);

$$K = [r^2 \ln(L/R)] / [2 L To]$$

where: r is the radius of the well casing,
R is the radius of the well screen, and
L is the length of the well screen.

In low-permeability aquifers, such as that observed at the Site, Freeze and Cherry (1979) and Fetter (2001) advise using the length and radius of the sand pack in the well annulus for L and R, respectively. The results yield an average hydraulic conductivity value for the length of the well screen.

2.7 Infiltration Testing

An in-situ infiltration testing program was carried out in August 2021 at three locations along Tributary 12. The testing involved using a Guelph Permeameter to obtain infiltration rates for the near-surface soils at depths ranging from 0.30 to 0.65 mbgs. The infiltration calculation methods were referenced from the "Low Impact Development Stormwater Management Planning and Design Guide, Appendix C", published by the Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation Authority (CVC, 2010). An additional infiltration testing program was carried out in November 2022 to identify potential infiltration rates for LID features. Eleven locations were selected by MTE staff for testing to assist their Site design. The results of both programs are summarized in **Appendix G**.

3. Site Description and Geologic Setting

3.1 Site Location and Description

The Site is an irregularly shaped parcel of land bounded by Colonel Talbot Road to the west, the W3 Phase 1 lands to the east and south, and vacant land set to be developed to the north in London, Ontario (**Drawing 1**). The Site measures 30.95 hectares in area and is currently used for agricultural purposes. Development is underway on the lands to the east and south of the Site. Residential development is also present to the west of the Site, across Colonel Talbot Road.

The proposed development plan is provided in **Appendix B** and includes a residential subdivision with low and medium density residential development, and mixed-use residential areas with all associated roadways and servicing set at standard depths. Underground parking is planned for the western residential and mixed-use blocks, and a naturalized corridor will be constructed through the centre of the Site and will incorporate SWM storage ponds and a public pathway network.

3.2 Topography and Drainage

The overall topography of the Site is slightly undulating with relatively low local relief with the Site sloping generally towards the southwest. Elevation ranges from about 261 to 271 masl (**Drawing 2**) across the Site with the highest elevations in the northeast and the lowest elevations found at the outlet of the intermittent watercourse along the west property boundary. Surface runoff across the Site follows topography to Tributary 12, except for the area of the UW in the north where SW Station 8 is installed which represents another low point for surface runoff to pool. The northwest corner of the Site is relatively flat but also has a topographic low area where some surface runoff is expected to pool on Site.

Tributary 12 is an intermittent watercourse which traverses the Site from the larger UW in the north, seasonally flows in a southwest direction towards Colonel Talbot Road and eventually drains into Dingman Creek (**Drawing 3**). It is a small tributary to Dingman Creek located approximately 500 m southwest of the Site. Tributary 12 is generally plowed through and farmed, and water is generally only present in the wetter spring months. General drainage pathways in the area are shown in **Drawing 3**.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) online Agricultural Information Atlas shows the Site is randomly tile drained.

3.3 Wetlands and Ecology

The City of London has identified two (2) UW (City of London, Map 5 – Natural Heritage System) located on the Site. These UWs are shown on **Drawings 2 and 3**. The City of London also designates a Valleyland draining the northern vegetation patch towards Dingman Creek to the west. This valleyland runs through the property located immediately north of the Site and is proposed to be realigned within the naturalized corridor which will be constructed to create a Significant Valleyland through both properties, as shown on the proposed channel design in **Appendix B**.

The ecology of the Site has been studied by MTE Consultants and the Vegetation Communities drawing from their draft Environmental Impact Study (EIS) report is included in **Appendix H** (MTE, 2022). The ecology study identified the intermittent watercourse through the Site as Tributary 12, which originates in the north and runs southwest through the Site where it is ploughed and planted through. In this area it is fed by seasonal overland flow. Tributary 12 eventually travels west through a culvert under Colonel Talbot Road.

MTE identified three (3) vegetation communities within the UWs on the Site. The small depression in which P-8 is installed is identified as a wetland inclusion with an area of 0.05 ha and is labeled A1a on MTE Figure 7 in **Appendix H**. The area around P-7 is identified as a 0.56 ha Mineral Cultural Thicket (CUT1) with a 0.12 ha Mineral Meadow Marsh (MAM2) inclusion, shown as areas 4a and 4b, respectively on MTE Figure 7. Tributary 12 flows through Mineral Cultural Meadow (CUM1), CUT1, and MAM2 areas. These vegetation communities and Tributary 12 are proposed to be realigned and compensated within the naturalized corridor design.

The Vegetation Communities figure provided in Appendix H (MTE, 2022) illustrates an area in the southern portion of the Site as Community 5 with an ecological land classification of SWT2-2 which is characterized as a wetland area in the EIS report. As stated in the EIS, this feature was previously removed as part of the approvals for Draft Plan 1.

3.4 Site Geology

3.4.1 Bedrock Geology

The Site is underlain by limestone, dolostone and shale of the Dundee Formation (OGS, 2011). This formation consists of 18 to 49 m of light brown, medium-grained with some minor chert (Hewitt, 1972), and is part of the Algonquin Arch, which forms a ridge along the southwestern Ontario peninsula between the Michigan Basin (to the northwest) and the Appalachian Basin (to the southwest). Bedrock is generally not exposed in the area.

Review of bedrock topography mapping (**Drawing 5**; OGS, 1978) indicates the bedrock surface at an elevation of approximately 190 masl at the Site. The bedrock surface generally slopes to the south or southwest in this area. Review of MECP Well records for the area (**Appendix I**) indicates that there are three (3) wells within 500 m of the Site that were drilled to bedrock. These wells have limestone bedrock identified at depths ranging from approximately 73 to 78 mbgs, which corresponds to elevations of approximately 187 to 192 masl, similar to the bedrock elevations identified in **Drawing 5**. Bedrock was not encountered during the drilling program completed as part of this investigation.

3.4.2 Overburden Geology

The physiography of Southwestern Ontario was altered significantly by the glacial and interglacial periods that took place throughout the Quaternary period. The overburden deposits which are present in the study area were formed by numerous glacial events during the late Wisconsinan glacial stage approximately 10,000 to 23,000 years before present. There were two distinct glacial lobes present in Southwestern Ontario during this period. The Huron Lobe advanced from Lake Huron southwards, and the Erie Lobe advanced from the northeast, receding to the east.

During the advancement of the glacial ice sheets, bedrock and unconsolidated sediments were eroded. During the recession of the glaciers, the eroded materials were deposited in lakes, rivers and along spillways, contributing to the present configuration of moraines, abandoned spillways, drumlins, eskers, abandoned shorelines, and various still-water sediment deposits.

Deposits in the area can be contributed to the Port Bruce Stadial period. In the London area, a series of east-west recessional and end moraines were formed, along with the Port Stanley Till Plain. Deposition of the basal portion of the Port Stanley Till was formed during the initial advance of the Erie Lobe. Overlying till was deposited during subsequent cycles of advance and retreat, resulting in silt and sand layering within the till plain.

The surficial deposits were mapped and categorized into a number of physiographic regions by Chapman and Putnam (1984). The Site is part of the physiographic region known as the Mount Elgin Ridges (**Drawing 6**). The majority of the Site is located on undrumlinized till plains with a spillway located in the west corner (**Drawing 7**).

Surficial geology has been described by Ontario Geological Society MRD128 (OGS, 2010) as being clay to silt textured till across the east portion of the Site with coarse-textured glaciolacustrine littoral deposits in the west. Modern alluvial deposits are mapped along Tributary 12 in the west half of the Site (**Drawing 8**).

3.4.3 Site Specific Surficial Geology

During the 2016, 2018 and 2020 drilling programs, a total of 16 boreholes were completed by EXP on the Sunset Creek property, with nine (9) boreholes completed as monitoring wells. The locations of the boreholes and monitoring wells are provided on **Drawing 2**. The boreholes were terminated at depths ranging from 3.5 and 17.2 m mbgs. Borehole logs are provided in **Appendix C**.

The results of the drilling programs indicate that the soils on the Site are generally comprised of surficial topsoil underlain by silty clay/clayey silt till and silty sand. Layers of sand and sandy silt were noted immediately below the topsoil in boreholes BH206 and BH207 and were underlain by the till. The till was found to be up to 10 m thick and underlain by dense to very dense sand or sandy silt. Monitoring wells (BH206/MW to BH209/MW) were screened within this underlying sand unit and monitoring wells BH301/MW to BH304/MW were screened within the clayey silt till. Groundwater was encountered within BH303/MW and BH304/MW during drilling.

Three cross sections across the proposed naturalized corridor were completed (**Drawings 10 – 12**) and their locations are shown on **Drawing 9**. The cross sections all show the extensive sandy silt till that extends across the Site. Cross Section A-A' (**Drawing 10**) shows the presence of a sandy silt layer near surface within the till at BH301/MW, as well as a thin sand lens deeper within the till. The south end of this cross-section adjacent to the proposed corridor shows coarse sand with trace gravel at surface and sand underlying the till at BH207/MW. Cross-section B-B' (**Drawing 11**) shows a predominantly continuous clayey silt till/silty clay with surficial sandy silt observed at BH302/MW. The till overlies a sand layer at this location. Cross-section C-C' (**Drawing 12**) includes BH208/MW, which is adjacent to the proposed corridor and indicates the presence of clayey silt till underlain by sand and sandy silt.

4. Hydrogeologic Setting

In additional to the groundwater information collected from the monitoring wells installed at the Site, the following documents were reviewed to gain an understanding of the hydrogeological conditions in the area:

- Dillon Consulting Limited and Golder Associates Ltd. Middlesex-Elgin Groundwater Study, Final Report, submitted to Middlesex and Elgin Counties, dated July 2004, henceforth referred to as the Middlesex-Elgin Groundwater Study;
- Goff, K and D.R. Brown, 1981. Ground-Water Resources – Summary. Thames River Basin Water Management Study Technical Report. Ontario Ministry of the Environment, Water Resources Report 14;
- Thames-Sydenham and Region Source Protection Committee. 2011. Upper Thames River Source Protection Area, Approved Updated Assessment Report. 12 August; and,
- MECP Water Well Records (WWR) within 500 m of the perimeter of the Site.

4.1 Regional Aquifer

Goff and Brown (1981) described the potential for four regional aquifers in the study area; shallow unconfined overburden aquifer, intermediate and deep confined aquifers and a bedrock aquifer.

4.1.1 Overburden Aquifers

The uppermost shallow and unconfined overburden aquifer was described as consisting of lacustrine or glacio-fluvial sands that may, in some locations, be overlain by lower permeability silts and clays. Regionally, the shallow aquifer is generally associated with the Caradoc Sand Plain and glacial deposits and are typically less than 15 m in thickness. Shallow overburden aquifers are discontinuous in nature and are expected to be linked more directly to precipitation and recharge compared to the intermediate and deep overburden aquifers.

Intermediate depth (15 to 30 m bgs) and deep overburden aquifers (>30 m bgs) aquifers generally consist of saturated sand and gravel deposits in the overburden and are very discontinuous in nature due to the heterogeneous nature of glacial deposits. Sand and gravel layers are present in the Port Stanley and Catfish Creek glacial till sheets. The intermediate depth and deep overburden aquifers are generally confined by overlying silt, clay and glacial till deposits which limit vertical migration of shallow groundwater.

Locally, shallow groundwater flow is expected to follow the local topography, and generally drain towards Dingman Creek, to the southwest of the Site. On a regional scale, the deep overburden aquifer flow direction is reported to be towards the south-southwest (Dillon and Golder, 2004).

Based on the well record information reviewed for this investigation (discussed below), the occurrence of shallow overburden water supply wells in the immediate vicinity of the Site is low.

4.1.2 Bedrock Aquifer

The bedrock aquifer is contained within limestone of the Dundee Formation. The water quality is generally good with elevated levels of iron, sodium and chloride in some wells. As with the intermediate and deep overburden aquifers, the bedrock aquifer is confined by the overlying till material, which generally ranges in thickness up to 78 m in the vicinity of the Site. Wells extending into the shallow fractured bedrock (up to about 3 m) are typically considered to be hydraulically connected to the overlying sand and gravel deposits that are present at the bedrock-overburden interface.

Flow direction in the deeper confined aquifer(s) and regional groundwater system has not been assessed as part of this investigation. However, as part of the Middlesex-Elgin Groundwater Study (Dillon and Golder, 2004), groundwater flow within the deeper aquifer is generally in a south-southwest direction towards Lake Erie.

4.2 Site Specific Groundwater Elevations and Flow

Water levels in the monitoring wells have been measured for several years as part of the ongoing hydrogeological investigation of the Site. Details are summarized in **Appendix E**. As previously stated, monitoring well BH3/MW3 was installed in 2016 and was monitored until it was destroyed by agricultural activity in October 2018. Monitoring well BH3/MW3 was installed into the lower till and upper sand unit, as shown in the borehole log in **Appendix C** and the water levels were found to be dry throughout its monitoring period.

Monitoring wells BH206/MW to BH209/MW screened in the underlying sand unit were all found to be consistently dry throughout the monitoring period. These wells were installed in the upper portion of the underlying sand aquifer and it is possible that the water table in the sand aquifer is below the base of the monitoring wells (< 246.2 masl). The full depth of the sand aquifer was not encountered during this investigation.

Monitoring wells BH301/MW (approximately 64 m east of BH206/MW) to BH304/MW screened in the till unit consistently had water present since installation. Groundwater elevations in these wells have ranged from 258.81 masl at BH302/MW in September 2022 to 265.74 masl at BH303/MW in November 2021. Groundwater levels ranged from 0.70 mbgs at BH301/MW in October 2021 to 4.46 mbgs at BH304/MW in November 2020. Dry conditions were noted at BH302/MW, BH303/MW and BH304/MW from fall 2022 to winter 2023. Monitoring well BH301/MW could not be accessed in April 2023 due to flooding surrounding the well. A berm is located to the south and east of BH301/MW which hinders the flow-through of surface water runoff. Based on April 2023 aerial imagery provided by Google Earth, ponding of surface water in the area of BH301/MW is visible. This is likely snowmelt water that has accumulated due to the presence of the berm.

Mini-piezometers P-7 and P-8 were installed in the UW areas in the north portion of the Site in November 2020 and have been monitored monthly since installation. A staff gauge was also installed adjacent to P-8 to monitor surface water elevations. Groundwater elevations in P-7 ranged from 260.27 masl in October 2022 and February 2023 to 262.18 masl in January 2022, corresponding to groundwater levels ranging from 0.87 mbgs to 1.04 m above ground surface (mags). Groundwater elevations at P-8 ranged from 262.26 masl in August 2022 to 263.37 masl in May 2022, corresponding to groundwater levels ranging from 1.01 mbgs to 0.10 mags. Surface water elevations at SG8 ranged from 262.89 masl in September 2021 to 263.50 masl in April 2023. There was no surface water present at SG8 from July to December 2022.

A groundwater flow map was created for the 2020 monitoring wells (BH301/MW to BH304/MW) using groundwater elevations measured on October 22, 2021 (**Drawing 13**). Shallow groundwater flow across the Site is affected by hydraulic conductivity, topography, drainage, and geology. The clayey silt till unit represents an aquitard unit beneath the Site. Completion of water table mapping within aquitards is typically not practical since the head in the well is dependent on the screened interval and depth more than the location (Midwest Geosciences Group, 2018). As such, mapping the water table within aquitards can result in many peaks and closed depressions that do not represent the water table. Since the predominant groundwater flow direction is vertical, water table mapping may not be the best way to illustrate groundwater flow paths in aquitards (Midwest Geosciences Group, 2018).

In general, the groundwater flow direction across an aquifer is horizontal while the groundwater flow across aquitards is primarily vertical (Cherry, et. Al., 2006). Therefore, the predominant groundwater flow direction in the clayey silt till unit is anticipated to be downward with the horizontal component likely following the local topography to the west/southwest and to the south on the Site.

As noted in **Section 3.2**, the Site is randomly tile drained. Since the aim of tile drains are to lower groundwater levels across a broad area, the water levels recorded in the shallow soils may be influenced by the presence of the tile drains. The level of influence of tile drains on a well depends on the soil type and how close the well is to the tile drain. There is limited information about the installation type and location of the tile drains and due to the materials used (clay or plastic), they cannot be located in the field without excavation.

4.2.1 Monitoring Well and Surface Water Station Hydrographs

Water level dataloggers were installed in BH301/MW and BH302/MW, as well as mini-piezometer P-8 on November 14, 2020 for continuous water level monitoring. Pressure readings were recorded by the dataloggers every 24 hours. Hydrographs including precipitation data from the London CS station located approximately 18 km northeast of the Site are provided in **Appendix E**.

The hydrograph for monitoring well BH301/MW, installed in the clayey silt till, shows groundwater elevations fluctuating over a range of approximately 0.90 m through the majority of the monitoring period. In June 2022 groundwater elevations began to decrease to as low as approximately 3.0 m below the typical range of groundwater levels. In January 2023 groundwater levels recovered to typical groundwater levels at this well. This well appears to show a response to larger precipitation events, in particular the events on September 22, 2021 and February 17, 2022, immediately after which the water elevations rose slightly in this well.

The hydrograph for monitoring well BH302/MW, cross-screened in the clayey silt till and underlying sand, shows a larger fluctuation in groundwater elevations throughout the monitoring period, with a range of approximately 2.6 m through most of the monitoring period. Similarly to BH301/MW, groundwater elevations began to decrease steadily in this well in June 2022 until the well reached dry conditions between October and December 2022. In January 2023 groundwater levels recovered to typical groundwater levels at this well. This well shows an immediate response to larger precipitation events, in particular the events on June 25, 2021, September 22, 2021 and February 17, 2022, which caused an immediate increase in groundwater elevation.

The hydrograph for SW Station 8, shows a range of approximately 0.7 m through most of the monitoring period in P-8. Throughout the majority of the monitoring period groundwater level in P-8 were at ground surface. Similar to the monitoring wells, groundwater elevations began to decrease steadily in this well in June 2022 until the mini-piezometer reached dry conditions between August 2022 and January 2023. In January 2023 groundwater levels recovered to typical groundwater levels at P-8. The manual measurements collected at SG8 are also included on this hydrograph and show the surface water levels were generally highest from the fall to spring months and lowest through the summer. Surface water was not present at SG8 from July 2022 to December 2022. This mini-piezometer shows an immediate response to larger precipitation events, in particular the event on September 22, 2021 which caused an immediate increase in groundwater elevation.

Overall, the repeated groundwater level patterns in monitoring wells BH301/MW, BH302/MW and mini-piezometer P-8 suggest they are all screened within the same hydraulically connected till unit and are directly influenced by surface water runoff and/or precipitation.

4.3 Wetland Hydroperiod

The hydroperiod of a wetland is defined as the length of time and portion of the year a wetland holds ponded water (Tarr and Babbitt) and the TRCA (2018) states "The hydroperiod of a wetland is the seasonal pattern of water level fluctuation".

Features 4b (Mineral Meadow Marsh) and A1a (Wetland Inclusion) were assessed for their hydroperiods. A mini-piezometer (P-7) was installed in feature 4b (Mineral Meadow Marsh) and both inside (groundwater) and outside (surface water) measurements were collected throughout the monitoring period at this location. A staff gauge (SG-8) was installed in feature A1a (Wetland Inclusion) to measure the depth of standing water within this feature. Based on water level measurements and field observations, as well as Google Earth imagery, these features appear to start retaining surface water in the fall and winter with maximum free surface water levels reached in the spring before becoming dry in the summer. There appears to be no significant sustained year-round ponded water in either of these features.

4.4 Hydraulic Conductivity

The results from the single well recovery testing (SWRT) testing completed at BH209/MW shows the estimated hydraulic conductivity value to be approximately 1.4×10^{-7} m/s for the underlying sand unit (**Appendix F**). This result is lower than the estimated range of hydraulic conductivity values reported by Freeze and Cherry (1979) for similar soils, which ranges from 10^{-2} to 10^{-6} m/s. The lower hydraulic conductivity may be due to the dense soil texture and silt and clayey layering in the sand noted on the Site, which may reduce the typical hydraulic conductivity for sand.

4.5 Infiltration Testing

The in-situ infiltration testing program for the channel was carried out in August 2021 using a Guelph Permeameter at three (3) locations along Tributary 12. These locations are shown as INF4 to INF6 on **Drawing 2**. Two tests were completed at location INF6. A secondary in-situ infiltration testing program was completed in November 2022 for LID design at eleven (11) locations across the Site selected by MTE. These results were presented in a technical memo which was issued in December 2022. It is noted that an error was found in the calculations provided in the memo. As such, these results have been updated and summarized along with the August 2021 results in **Appendix G**. The combined testing programs resulted in a calculated infiltration rate geometric mean of 35 mm/hour, and a factored infiltration rate of 10 mm/hour using a safety correction factor of 3.5, as outlined in the TRCA and CVC 2010 document.

4.6 Groundwater and Surface Water Quality

Groundwater samples were collected from monitoring wells BH302/MW and BH303/MW in November 2020 and March 2021. Samples were analysed for general chemistry parameters and compared to the Ontario Drinking Water Quality Standards (ODWQS) Maximum Acceptable Concentrations (MAC). There were no exceedances of the criteria, though elevated nitrate levels were observed in BH303/MW during both sampling events.

Surface water quality samples were collected from SW Station 7 in March 2021 and from SW Station 8 in November 2020 and March 2021. There was insufficient water to sample at SW Station 7 in November 2020. Samples were analysed for general chemistry parameters and compared to the Provincial Water Quality Objectives (PWQO). The only exceedance at SW Station 7 was for pH, which was 8.75, exceeding the acceptable range of 6.5 – 8.5. Several metals exceedances were reported at SW Station 8 during both monitoring events. The surface water exceedances are outlined in **Table 4** below.

Table 4: Surface Water Quality Exceedances

Parameter	Units	PWQO	SW Station 7	SW Station 8			
			23-Mar-21	14-Nov-20		23-Mar-21	
pH	pH	6.5 – 8.5	8.75	*	-	*	-
Aluminum (Al)	ug/L	75	*	2200 (Total)	<4.9 (Dissolved)	*	-
Cobalt (Co)	ug/L	0.9	*	2.4 (Total)	<0.50 (Dissolved)	*	-
Iron (Fe)	ug/L	300	*	3600 (Total)	<100 (Dissolved)	1600 (Total)	<100 (Dissolved)
Zinc (Zn)	ug/L	20	*	*	-	35 (Total)	<0.5 (Dissolved)

Note: * meets PWQO

The elevated pH at SW station 7 in March 2021 is not considered a concern since this is marginally higher than the PWQO range and the sample was collected to document existing conditions.

The elevated total aluminum, total cobalt, and total iron concentrations at SW station 8 during the November 2020 sampling event are attributed to the likely higher sediment load within these samples. Since these samples were collected in November during a time of year when surface water levels are low, it is likely that increased sediment was present in the samples collected. This is evidenced by the significantly lower dissolved metals concentrations for these parameters, as shown above. In all three cases, the dissolved metals concentrations were below the detectable limit. Therefore, the total metals concentrations result from the metals that are sorbed to the sediment particles in the samples, which are stripped from the sediment particles by the preservative in the sample bottle. This also appears to be the case in the 2021 sample collected for total iron and total zinc.

Since these samples were collected during the pre-construction period to document existing conditions, the elevated total metals concentrations are not considered a concern. Additionally, since the Site is currently agricultural and is proposed to be residential (i.e. a less sensitive property use) a Record of Site Condition is not required for the Site and assessment of the on-Site soils/sediments for potential contamination is not required. In the event soils/sediments are proposed to be removed from the Site, the Excess Soil Regulation (O. Reg. 406/19) would apply and an assessment of soils/sediments to be moved off-Site would be required.

4.6.1 Water Quality Interpretations

The water quality results were plotted on Piper and Schoeller Diagrams and are presented in **Drawings 14** and **15a-b,** respectively. The Piper Diagram plots the results within the magnesium bicarbonate type waters. The chemical results show that the water quality within the monitoring wells is generally consistent and relatively similar across sampling events.

The Schoeller Diagrams have been separated into Major and Minor ion components for each sampling event. The major ion concentrations were similar for most sampling locations with exceptions in sulfate which was much lower at SW Station 7 than at the other sample locations possibly due to more significant dilution with surface water at this location. The minor ions also showed similar concentrations across all locations with the largest variation seen in nitrate + nitrite, which was higher at BH303/MW than at the other sampling locations in each monitoring event. Given that BH303/MW is situated up gradient approximately 400 m from SW Stations 7 and 8 and BH302/MW, it may be affected by the application of fertilizers in the fields to the east of the Site.

Both groundwater and surface water samples have a similar chemical signature, further indicating that they are part of the same hydraulically connected till unit.

5. Monthly Water Balance Assessment

The monthly water balance assessment for the Site was completed in accordance with the recommendations indicated in the guidance document "Hydrogeological Assessment Submissions: Conservation Authority Guidelines to Support Development Applications" (Conservation Ontario, 2013), and using appropriate site condition values obtained from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003). The results of the water balance are provided in **Appendix J**.

The water balance accounts for all water in and out-flows in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can then run off towards wetlands, ponds, lakes, and streams (R), infiltrate into the ground (I), or evaporate from surface water and vegetation (ET). When long-term average values of P, R, I, and ET are used, then minimal or no net change to groundwater storage (ΔS) is assumed.

The annual water balance can be stated as follows:

$$\mathbf{P = ET + R + I + \Delta S}$$

Where:

P = precipitation (mm/year)

ET = evapotranspiration (mm/year)

R = runoff (mm/year)

I = Infiltration (mm/year)

ΔS = change in groundwater storage (taken as zero) (mm/year)

5.1. Precipitation and Evapotranspiration

The annual total precipitation used for this water balance (1011 mm/yr) is based on data provided by Environment Canada, based on the 30 year average data for climate normals, using the nearest local weather station information (London CS ID 6144478, located approximately 18 km northeast of the Site). In this detailed monthly water balance, precipitation as rain and snow are both considered. Snow storage and resulting snow melt in the winter and early spring months is considered as part of the evapotranspiration volumes.

Evapotranspiration combines evaporation and transpiration and refers to the water lost to the atmosphere. The rate of evapotranspiration is a function of the water holding capacity of the soil and varies with soil and vegetation type and amount of impermeable surface cover.

Monthly evapotranspiration volumes were calculated using the monthly water balance graphical interface created by the U.S. Geological Survey (USGS), Open-File report 2007-1088 (McCabe and Markstrom, 2007). This interface uses the principles outlined by Thornthwaite and Mather (1957) and permits the user to easily modify water balance parameters and provide useful estimates of water balance components for a specified location.

The difference between the annual precipitation and the annual evapotranspiration represents the surplus water which is available for infiltration and surface run-off. Distribution of the surplus water to infiltration is based on an infiltration factor based on site conditions for topography, cover vegetation and soil.

5.2 Infiltration and Runoff

The soil water holding capacities and infiltration rate were determined using values presented in Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003) based on the vegetative cover and the hydrologic soil group. The weighted values based on the Site conditions are presented in the calculation sheets provided in **Appendix J**.

Localized infiltration rates will vary based on factors such as the saturated hydraulic conductivity of surface soils, land slope, rainfall intensity, relative soil moisture at the start of a rainfall event, and type of cover on the ground surface.

The Ministry of Agriculture, Food and Rural Affairs classifies this area of the Site as having B-C-type soils (silt loam) across the majority of the Site. B-C type soils have a moderate to slow infiltration rate when thoroughly wet. These consist chiefly of moderately well drained soils or soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. The drilling and test pitting programs completed on the Site show the dominant soil type to be silty clay to clayey silt (C type soils) at surface across the majority of the property.

It is noted that the Thornthwaite-Mather output has been found to either underestimate or overestimate the volume of annual surplus and/or actual evapotranspiration depending on the soil moisture storage capacity input to the software. As such, a soil moisture storage capacity of 134 mm was selected since the sum of the surplus and actual evapotranspiration was roughly equal to the annual precipitation volume, meaning the total annual precipitation volume for is accounted for in the calculations.

5.3. Pre-development and Post-development Calculations

Pre-development and Post-development monthly water balance calculations have been carried out and are based on available design data and areas provided in the Drainage Report (Stantec, 2023).

The existing catchment for the Site is defined as Catchment S104 in the Drainage Report and is approximately 33.50 ha, with 28.1 ha within the Site boundary. Catchment S104 is described in the Drainage Report as being comprised of actively cropped agricultural lands and includes the portion of the W3 Farms property that contributes runoff to Dingman Creek Tributary 12. All runoff travels to the tributary as shallow surface flow. A portion of Catchment S104 extends beyond the Site boundary to the south. Only the portion within the Site boundary has been considered in this water balance.

Post-development calculations have been completed based on the current Development Plan and the catchments identified in the Drainage Report, as included in **Appendix J**. The catchments contributing to the drainage channel within the Site boundary are Catchments 200, 300, 400, 401, 500, 501, 502 and 602. A portion of Catchment 300 extends to the north of the Site and a portion of Catchment 502 extends to the south of the Site. Only the parts of these catchments within the Site boundary have been considered for this water balance.

Stantec describes Catchments 200, 300, 400, 401, 500 and 501 as areas in which water quality treatment is provided to the runoff by at-source controls. Minor flows will be conveyed to the proposed channel corridor by the proposed local storm sewers and third pipe systems. Major flows are conveyed to the proposed SWM facilities, then to the channel corridor.

Catchment 502 consists of a portion of the Phase 1 W3 lands that cannot drain overland to SWMF P9, so major flows from this catchment are being directed to the integrated channel.

Catchment 602 is comprised of the integrated channel and retained woodlot. All runoff travels directly to the channel corridor as shallow surface flow.

Detailed assumptions for the post-development water balances are included in **Appendix J**, with the primary assumptions listed here:

- It is assumed the catchment area to the proposed channel within the Site boundary will increase from 28.1 ha to 29.88 ha. This includes the increased area of catchments in post-development which will extend to the property boundary; and,
- Under post-development conditions, all runoff within the catchment to the drainage channel will be directed to the channel.

Table 5 provides a summary of the catchment areas and land uses considered in the water balance based on the Major Drainage and Flow Routing Assessment (Stantec, 2023) for the Site. The impervious percentages used in the water balance were obtained from Appendix A of the Major Drainage and Flow Routing Assessment. It is recognized that these areas may have additional controls in order to meet the desired targets.

Table 5: Summary of Water Balance Catchments

	Total Area within Site Boundary (ha)	Hydrologic Soil Type	Pervious Land Use	Impervious Percentage
PRE-DEVELOPMENT				
S104	28.1	C	Agricultural Land	0
POST-DEVELOPMENT				
Catchment 200	7.53	C	Urban Lawn	55%
Catchment 300	2.3	C	Urban Lawn	55%
Catchment 400	5.25	C	Urban Lawn	55%
Catchment 401	3.22	C	Urban Lawn	55%
Catchment 500	3.14	C	Urban Lawn	55%
Catchment 501	2.93	C	Urban Lawn	55%
Catchment 502	1.9	C	Urban Lawn	55%
Catchment 602	3.61	C	Pasture and Shrubs	0

Table 6 provides a summary of the pre and post development water balance calculations.

Table 6 – Summary of Water Balance Estimates

	Pre-Development	Post-Development	Post-Development with Mitigation	% of Pre-Development Conditions No Mitigation	% of Pre-Development Conditions With Mitigation
PROPOSED DRAINAGE CHANNEL					
Estimated Runoff (m^3/year)	100,190	174,861	164,369	175%	164%
Estimated Infiltration (m^3/year)	38,258	21,010	30,453	55%	80%

Due to the increased impermeable surfaces (such as rooftops, roadways, sidewalks, driveways), the proposed development is expected to result in a reduction in the post-development infiltration volumes, and a corresponding increase in the estimated run-off. The suggested target in post-development is 80% of the pre-development infiltration being maintained in the post-development conditions.

In the post-development environment, it is assumed that all surface runoff will be directed to the constructed corridor and SWM ponds. The combined infiltration volumes in post-development without mitigation are 55% of combined pre-development volumes. A 6% reduction in surface runoff would result in post-development infiltration volumes of 80% of pre-development volumes, which meets the target.

5.4. Secondary Infiltration Opportunities

Low Impact Development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible (TRCA, 2010). Effective management of stormwater is critical to the continued health of our streams, rivers, lakes, fisheries and terrestrial habitats. The primary objectives of stormwater management includes maintaining the hydrologic cycle, protecting water quality, and preventing increased erosion and flooding.

The following list provides some mitigation measures which may be taken into consideration, during the detailed design stage of the development. These measures may include secondary infiltration by directing and capturing run-off water from impervious surfaces into landscaped areas where existing infiltration capacity can be utilized. More specifically, considerations may include the following:

- Landscaped areas should be graded to promote infiltration of surface water. Increased topsoil depth throughout yard and green space areas to reduce runoff. In general, a run-off reduction up to 30% may be possible in areas where increased topsoil thicknesses are utilized depending on final topsoil thickness, storm duration and intensity;
- Collection of rooftop run-off into side yard and rear yard swales and/or vegetative filter strips, which can be directed to infiltration trenches to promote infiltration;
- Installation of linear bioswales to collect and promote infiltration;
- Use of permeable pavers where feasible such as driveways and parking lots;
- Use of pervious pipes to promote infiltration of water collected in the storm sewer system;

- Planting of trees and bushes;
- Installing soakaway areas;
- Implementing rainwater harvesting (i.e. to re-use in toilet flushing and irrigation, etc.);
- Installing green roof technologies;
- Using filters/bio-retention (i.e. islands, parking areas, etc.);
- Installing absorbent landscaping; and,
- Installing oil/grit separators.

It is noted that water quality will need to be accounted for in the design of any mitigation measure, such as permeable pavers and pervious pipes, to account for potential impacts from contaminate sources such as winter maintenance on roads and parking lots.

If LID measures are being considered as part of the post-development design, in-situ infiltration testing at the proposed LID locations and depths will be required.

In terms of maintaining infiltration rates in post-development, the most effective stormwater management practices include installing infiltration trenches, lot grading, roof leader discharge to soakaway pits/pervious areas, using pervious pipes, and installing pervious catch-basins.

It is recommended that some of these practices be utilized in site planning and design in order to mitigate the impact of increased runoff and stormwater pollution. By implementing LID practices during development, infiltration volumes can be effectively stored and returned to the natural environment by various development technologies and methods described above.

6. Source Water Protection Considerations

6.1 Significant Groundwater Recharge Areas (SGRA)

Groundwater recharge is largely controlled by soil conditions, and typically occurs in upland areas. The groundwater flow direction has been previously identified as flowing in a southwesterly direction.

As defined in the Clean Water Act (2006), an area is a significant groundwater recharge area if,

1. the area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or

2. the area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapotranspiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

An assessment report for the Upper Thames River Source Protection Area was completed by the Thames-Sydenham and Region Source Protection Committee. As defined by the Clean Water Act (2006) and identified by the Thames-Sydenham and Region Source Protection Committee, the western half of the Site is located within a SGRA (**Drawing 16**).

Low Impact Development (LID) solutions in the form of infiltration facilities are being considered within the entire proposed channel corridor, where possible.

6.2 Highly Vulnerable Aquifers (HVA)

The susceptibility of an aquifer to contamination is a function of the susceptibility of its recharge area to the infiltration of contaminants. As defined in the *Clean Water Act (2006)*, the vulnerability of groundwater within a source protection area shall be assessed using one or more of the following groundwater vulnerability assessment methods:

1. Intrinsic susceptibility index (ISI).

2. Aquifer vulnerability index (AVI).

3. Surface to aquifer advection time (SAAT).

4. Surface to well advection time (SWAT).

In the Thames-Sydenham and Region, HVAs were mapped using the ISI method. The ISI method is an indexing approach using existing provincial Water Well Information System (WWIS) database. The ISI method is described in detail in the MECP's Technical Terms of Reference (2001). However, in short, the ISI method is a scoring system that takes into consideration the unique hydrogeologic conditions at a particular location. The scores are determined using a combination of the saturated thickness of each unit and an index number related to the soil type, and as such, the scores reflect the susceptibility of the aquifer to contamination.

As defined in the MECP's 2001 Technical Rules,

- an area having an ISI score of less than 30 is considered to be an area of high vulnerability;
- an area having an ISI score greater than or equal to 30, but less than or equal to 80, is considered to be an area of medium vulnerability; and,
- an area having an ISI score of greater than 80 is considered to be an area of low vulnerability.

The Thames-Sydenham and Region Source Protection Committee has determined, using the ISI method, that the western half of the Site is located within an HVA (**Drawing 17**).

7. Impact Assessment

7.1 Water Well Users

A search of the Ontario MECP WWR database was completed using a buffer of 500 m from the perimeter of the Site. This resulted in the identification of 77 records (**Drawing 18**). The majority of the wells were found to be located west of the Site across Colonel Talbot Road.

Water uses in the area include the following:

- Monitoring, test holes or observation wells (39 wells);
- Domestic supply (10 wells);
- Municipal Supply (3 wells);
- Industrial Supply (1 well);
- Livestock/Irrigation (2 well);
- Commercial Supply (1 well);
- Unknown or Not used (6 wells); and
- Abandoned wells (15 wells).

The approximate locations of identified wells are shown on **Drawing 18**, with the MECP WWR Summary provided in **Appendix I**.

Domestic water supply in the local area wells is generally drawing from the confined intermediate sand and gravel aquifer or from the bedrock aquifer. There are 17 water supply wells within 500 m of the Site, including wells used for domestic, municipal, industrial, livestock/irrigation, and commercial purposes. These wells are installed at depths ranging from 9 to 75 mbgs. The livestock well (MECP WWR Well ID 4106519) is the only supply well recorded as being less than 10m deep. This well was installed in 1973 and may no longer be in use given that much of the surrounding area is now developed and connected to municipal services. Based on the well construction details and their location, it is not anticipated the dewatering activities will impact private water supply in the vicinity of the Site.

Monitoring wells have been installed at the Site as part of the Site investigations to document stabilized groundwater conditions. Prior to the Site grading work, and when the monitoring wells are determined to be no longer required, the wells should be properly decommissioned in accordance with Ontario Regulation 903. Decommissioning a well which is no longer in use helps to ensure the safety of those in the vicinity of the well, prevents surface water infiltration into an aquifer via the well, prevents the vertical movement of water within a well, conserves aquifer yield and hydraulic head and can potentially remove a physical hazard.

7.1.1 General Comments

As due diligence, the following comments are provided with recommendations to help minimize impact to the surface water features on Site:

- During the site grading work, suitable sedimentation controls will be required to help control and reduce the turbidity of run-off water;

- A Best Management Practice (BMP) and spill contingency plan (including a spill action response plan) should be in place for fuel handling, storage and onsite equipment maintenance activities to minimize the risk of contaminant releases as a result of the proposed construction activities;
- Re-establishing vegetative cover in disturbed areas following the completion of the construction work;
- Limit the use of commercial fertilizers in landscaped areas which border a habitat feature; and,
- Limit the use of salts or other additives for ice and snow control on the roadways and parking areas.

7.2 Preliminary Construction Dewatering Considerations

Daily construction water takings in excess of 50,000 L/day require an Environmental Activity and Sector Registry (EASR) in accordance with Ontario Regulation 63/16. For volumes of 400,000 litres or more per day, a Category 3 permit to take water (PTTW) applications will need to be approved by the MECP according to Sections 34 and 98 of the Ontario Water Resources Act R.S.O. 1990 and the Water Taking and Transfer Regulation O. Reg. 387/04.

Initial groundwater levels in the till across the Site have been relatively high and near ground surface with groundwater levels up to 0.7 m bgs. For the dewatering calculations, groundwater elevations were assumed at 0.5 m bgs, for the purposes of calculating the 'worst case scenario'.

Dewatering calculations were completed based on the following conservative assumptions:

- Basement and underground parking excavations of 20 x 20 m;
- sanitary sewer excavations of 5 x 50 m;
- steady state unconfined flow conditions are occurring;
- a groundwater elevation at 0.5 m bgs was assumed based on shallow groundwater levels found seasonally across the Site;
- dewatering target is assumed to be 0.5 m below base of excavation at 4.0 m bgs (underground parking foundation) and 3.5 m bgs (sanitary sewer);
- the base of the saturated till was encountered at approximately 249.6 masl (12.3 m bgs) at its deepest; and,
- the predominant soil to be encountered is clayey silt till with pockets of sand in some areas. The hydraulic conductivity of the sand is 1.4×10^{-7} m/s and has been used to be conservative.

The Dupuit Forcheimer Equation for unconfined flow into a radial excavation for the basement and underground parking and linear excavation for the sanitary sewer (Powers et al., 2007) were used to estimate lateral flow into the proposed excavations. Based on the assumptions above, the estimated maximum dewatering rate at the proposed excavations is 21,776 L/day with a Safety Factor of 2 for the basement and underground parking and 33,860 L/day with a Safety Factor of 2 for the sanitary sewer. Dewatering calculations are provided in **Appendix K**.

Based on these preliminary dewatering calculations, neither an EASR nor a PTTW are expected to be required. The preliminary dewatering estimates should be re-assessed once the detailed design is finalized.

Any collected water from service trenches and temporary excavations should be discharged a sufficient distance away from the excavated area to prevent the discharge water from returning to the excavation. Sediment control measures should be provided at the discharge point of the dewatering system.

During construction, short term impacts to the near surface and shallow groundwater quantity may be anticipated as a result of construction dewatering where wet soils are present in open excavations. The length of time where this impact would occur would be limited to the time when active pumping of the groundwater is being carried out. Once construction activities are complete, the shallow groundwater levels would be expected to stabilize.

8. Qualifications of Assessors

EXP Services Inc. provides a full range of environmental services through a full-time Earth and Environmental Services Group. EXP's Environmental Services Group has developed a strong working relationship with clients in both the private and public sectors and has developed a positive relationship with the Ontario MECP. Personnel in the numerous branch offices form part of a large network of full-time dedicated environmental professionals in the EXP organization.

This report was prepared by Ms. Kassandra Wallace, B.B.R.M. Ms. Wallace has more than 7 years' experience in the environmental consulting industry that includes conducting hydrogeological assessments for various types of development projects, Phase One and Phase Two Environmental Site Assessments, and remediation projects. She obtained her Bachelor's degree in Bio-Resource Management (Environmental Management Major) from the University of Guelph and obtained her Ontario College Graduate Certificate in Environmental Engineering Applications from Conestoga College.

This report was reviewed by Ms. Hagit Blumenthal M.Sc., P.Geo. Ms. Blumenthal has experience in conducting hydrogeological assessments. Ms. Blumenthal is a hydrogeologist and environmental geoscientist with more than 10 years' experience in the environmental field, and is a licensed Professional Geoscientist (P.Geo.) in Ontario. She obtained a Master of Science (M.Sc.) in 2010 from the University of Waterloo and has worked in the Hydrogeological and Environmental fields since then.

9. References

Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, 270p.

Cherry, J. A., Parker, B. L., Bradbury, K. R., Eaton, T. T., Gotowitz, M. B., Hart, D. J., & Borchardt, M. A. (2006). Contaminant Transport Through Aquitards: A State-of-the-Science Review. Awwa Research Foundation.

Conservation Ontario. 2013. Hydrogeological Assessment Submissions - Conservation Ontario Guidelines to Support Development Applications. June.

Corporation of the City of London. 2019. Design Specifications & Requirements Manual. Updated August 2019.

Dillon Consulting Limited and Golder Associates Ltd. (Dillon and Golder). 2004. Middlesex-Elgin Groundwater Study, Final Report, submitted to Middlesex and Elgin Counties.

Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice-Hall Inc. New Jersey. 604 pp

Goff, K. and Brown D.R. 1981. Ground-Water Resources – Summary. Thames River Basin Water Management Study Technical Report. Ontario Ministry of the Environment, Water Resources Report 14.

Hewitt D. F. 1972. Paleozoic Geology of Southern Ontario, Ontario Div. Mines, GR105, Map 2254.

McCabe, G.J., and Markstrom, S.L., 2007. A monthly water-balance model driven by a graphical user interface: U.S. Geological Survey Open-File report 2007-1088, 6 p.

Midwest Geosciences Group. 2018. *Hydrogeology of Aquitards and Low-Permeability Materials Part 2: Head Distributions, Vertical Gradients and Solute Transport.* Presented by Madeline Gotkowitz, PhD., and David Hart, PhD., Hydrogeologists with the Wisconsin Geological and Natural History Survey.

Ministry of the Environment: Water Well Records. https://www.ontario.ca/environment-and-energy/map-well-records.

Ministry of the Environment (MOE). 2001. Groundwater Studies 2001/2002, Technical Terms of Reference

Ministry of the Environment (MOE). 2008. Technical Rules: Assessment Report, Clean Water Act, 2006

Ontario Department of Mines. 1978. St. Thomas Sheet, Southern Ontario, Bedrock Topography Series, Map P 482.

Ontario Geological Survey (OGS). 2010. Surficial geology of Southern Ontario, Miscellaneous Release--Data 128-REV.

Ontario Geological Survey (OGS). 2011. Bedrock Geology of Ontario, 1:250 000 scale, Miscellaneous Release Data 126-Revision 1.

Ontario Geological Survey (OGS). 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14. Revised.

Stantec Consulting Ltd. 2023. Integrated Channel Corridor Functional Design Report, Colonel Talbot Road Development Area. 17 May.

Stantec Consulting Ltd. 2023. Major Drainage and Flow Routing Assessment, Colonel Talbot Road Development Area. 20 January.

Tarr, M. and Babbitt, K. (n.d.) University of New Hampshire Cooperative Extension. The Importance of Hydroperiod in Wetland Assessment.

Thames-Sydenham and Region Source Protection Committee. 2011. Upper Thames River Source Protection Area, Approved Updated Assessment Report. 12 August.

TRCA. 2018. Wetland Water Balance Monitoring Protocol.

10. General Limitations

The information presented in this report is based on a limited investigation designed to provide information to support an assessment of the current environmental conditions within the subject property. The conclusions and recommendations presented in this report reflect Site conditions existing at the time of the investigation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, EXP Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. EXP has qualified personnel to provide assistance in regard to any future geotechnical and environmental issues related to this property.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession. It is intended that the outcome of this investigation assist in reducing the client's risk associated with environmental impairment. Our work should not be considered 'risk mitigation'. No other warranty or representation, either expressed or implied, is included or intended in this report.

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in this report

This report was prepared for the exclusive use of **W3 – Lambeth Farms c/o York Developments** and may not be reproduced in whole or in part, without the prior written consent of EXP, or used or relied upon in whole or in part by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Appendix A - Drawings

-LEGEND-

Sunset Creek Property Boundary

Image Source: Google Earth Pro - Imagery September 2021

Hydrogeological Assessment

Proposed Development

3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT: W3 - Lambeth Farms c/o York Developments

TITLE: Site Location

Prepared By: K.D.

Reviewed By: H.B.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE:	PROJECT NO.	FIG.
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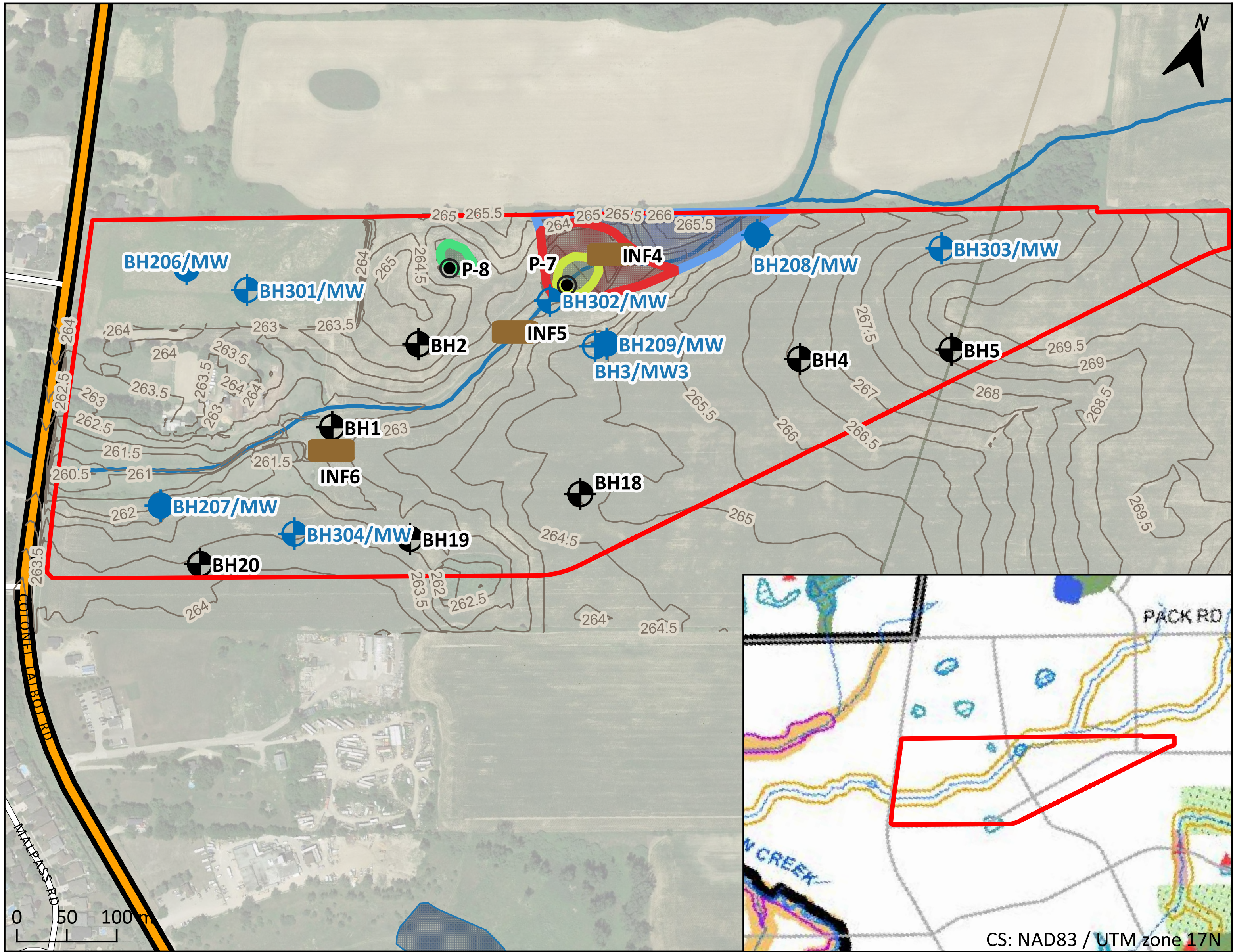

-LEGEND-

- Site Boundary
- Watercourse (OHN)
- Ground Surface Elevation Contours (mamsl)

Vegetation Communities (Approx.) (MTE, 2022)

- A1a - Wetland Inclusion
- 3 - Mineral Cultural Meadow\
- 4b - Mineral Meadow Marsh
- 4a - Mineral Cultural Thicket

Investigative Locations

- Monitoring Well (2020)
- Monitoring Well (2018)
- Monitoring Well (2016)
- Minipiezometer (2020)
- Borehole (2016)
- Infiltration Testing Location

Notes:
Inset Map - Map 5 (Natural Heritage) from the City of London Official Plan, Consolidated May 25, 2022.
Ground surface elevation contours are from topographical mapping provided by the Client.
Vegetation communities shown are discussed in Hydrogeological Report. Refer to EIS Report (MTE, 2022) for additional vegetation communities present within the Site.
Data Sources:
Contains information licensed under the Open Government License - Ontario
Google Earth Imagery (c) 2022 City of London, First Base Solutions, Maxar Technologies

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Field Investigation Location Plan
Prepared By: K.W.	Reviewed By: H.J. / K. D.

exp. EXP Services Inc.
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DATE	SCALE	PROJECT NO.	DWG.
November 2022	1:6,000	LON-22023963-A0	2

-LEGEND-

- Sunset Creek Property Boundary
- Constructed Open/Unknown Drain
- Constructed Closed/Tiled Drain
- Vegetation Community (MTE, 2022)
- Watercourse

Image Source: Google Earth Pro (September 2021).

Hydrogeological Assessment

Proposed Development

3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT	W3 - Lambeth Farms c/o York Developments
TITLE	Site Area Drainage
Prepared By: K.D.	Reviewed By: H.B.

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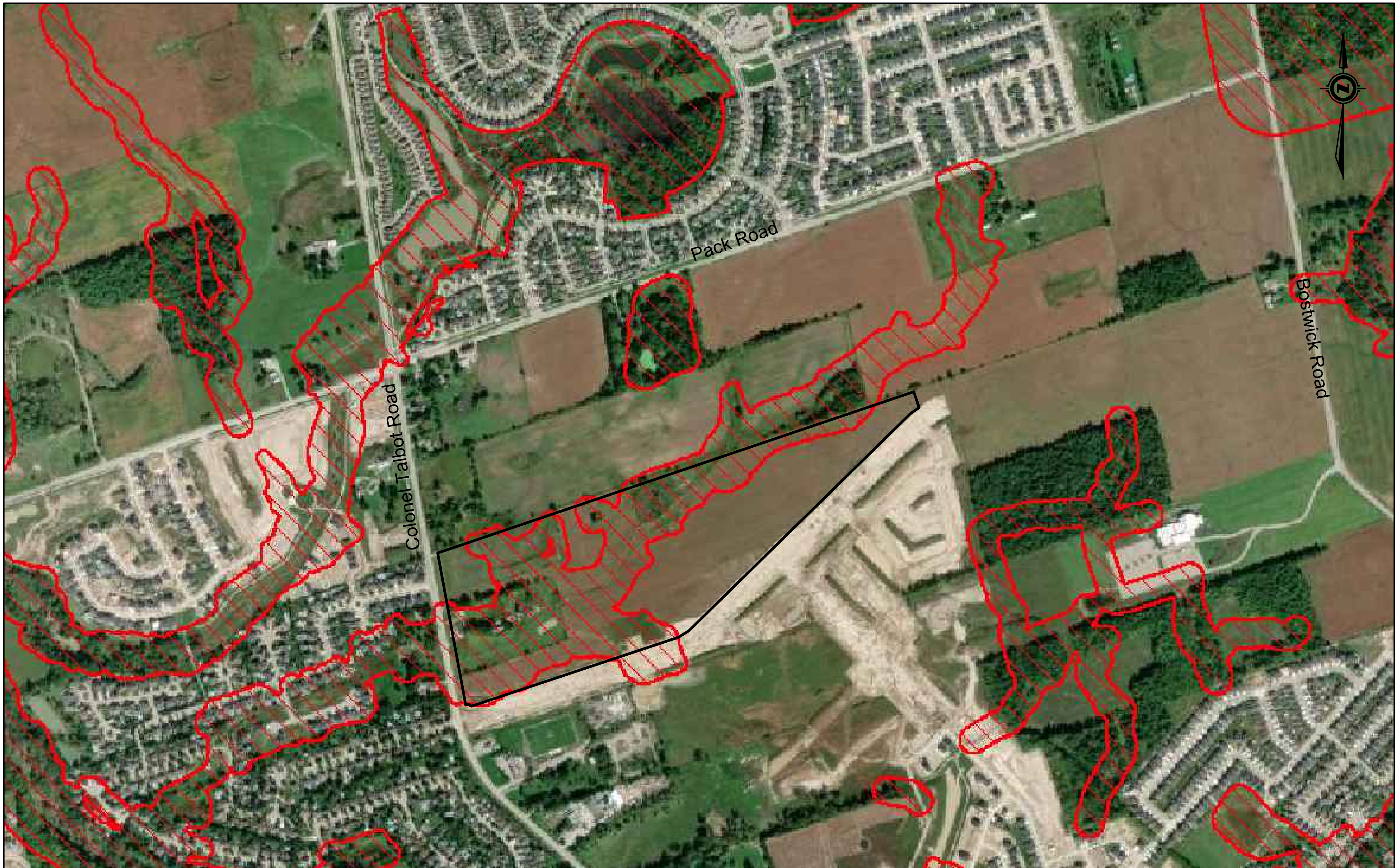

-LEGEND-

Sunset Creek Property Boundary

Regulated Lands of the Upper Thames River Conservation Authority - Screening Area (Under Review)

Image Source: ESRI World Imagery; maps.thamesriver.on.ca

Hydrogeological Assessment

Proposed Development

3700 Colonel Talbot & 3645 Bostwick Road
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CLIENT	W3 - Lambeth Farms c/o York Developments
TITLE	Regulated Lands of the UTRCA
Prepared By: K.D.	Reviewed By: H.B.
exp.	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE:	PROJECT NO.	FIG.
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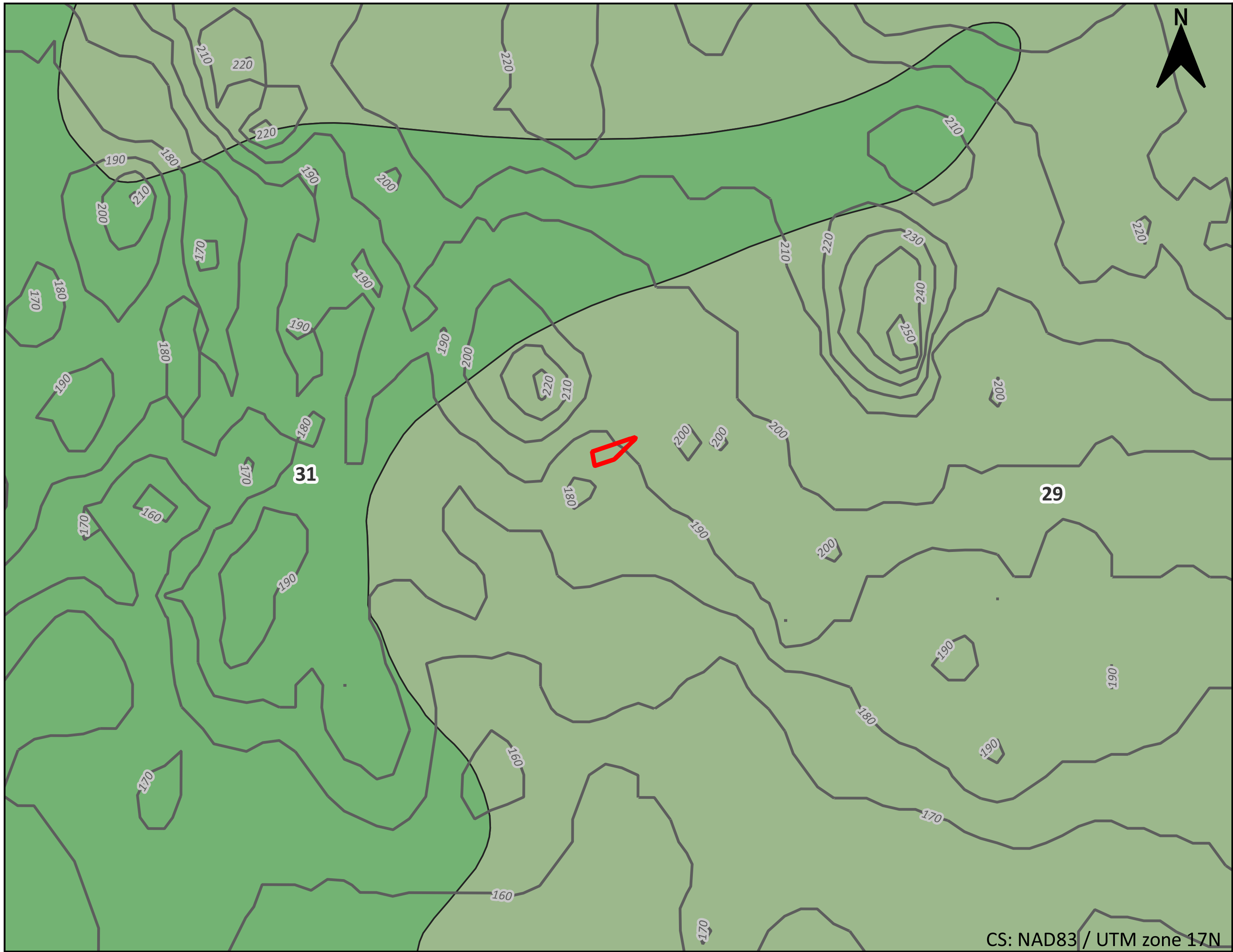

-LEGEND-

Site Boundary

Paleozoic Geology

Bedrock Topography Contours (mamsl) (10m)

29 Dundee Formation

31 Hamilton Group

Notes:

Data Sources:
Bedrock topography contours extrapolated from Paleozoic Geology data provided by the Ministry of Northern Development, Mines, Natural Resources and Forestry OGSEarth Mapping.
Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release - Data 219.

Hydrogeological Assessment

Proposed Development

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TITLE Bedrock Geology & Topography

Prepared By: K.W.

Reviewed By: H.J. / K. D.

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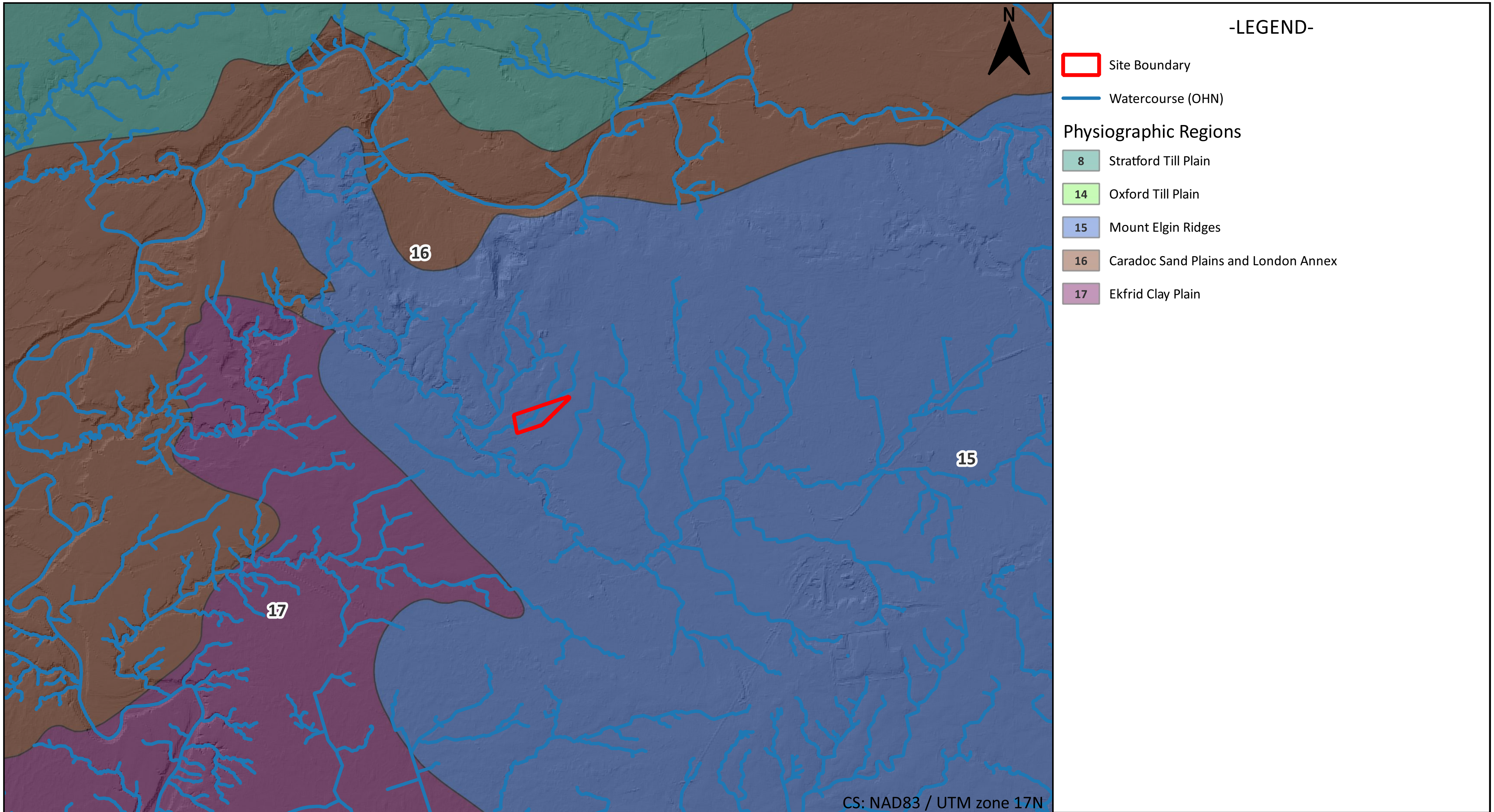

Notes:

Data Sources:
Contains information licensed under the Open Government Licence – Ontario.
Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT W3 - Lambeth Farms c/o York

TITLE Physiographic Regions

Prepared By: K.W. | Reviewed By: H.J. / K. D.

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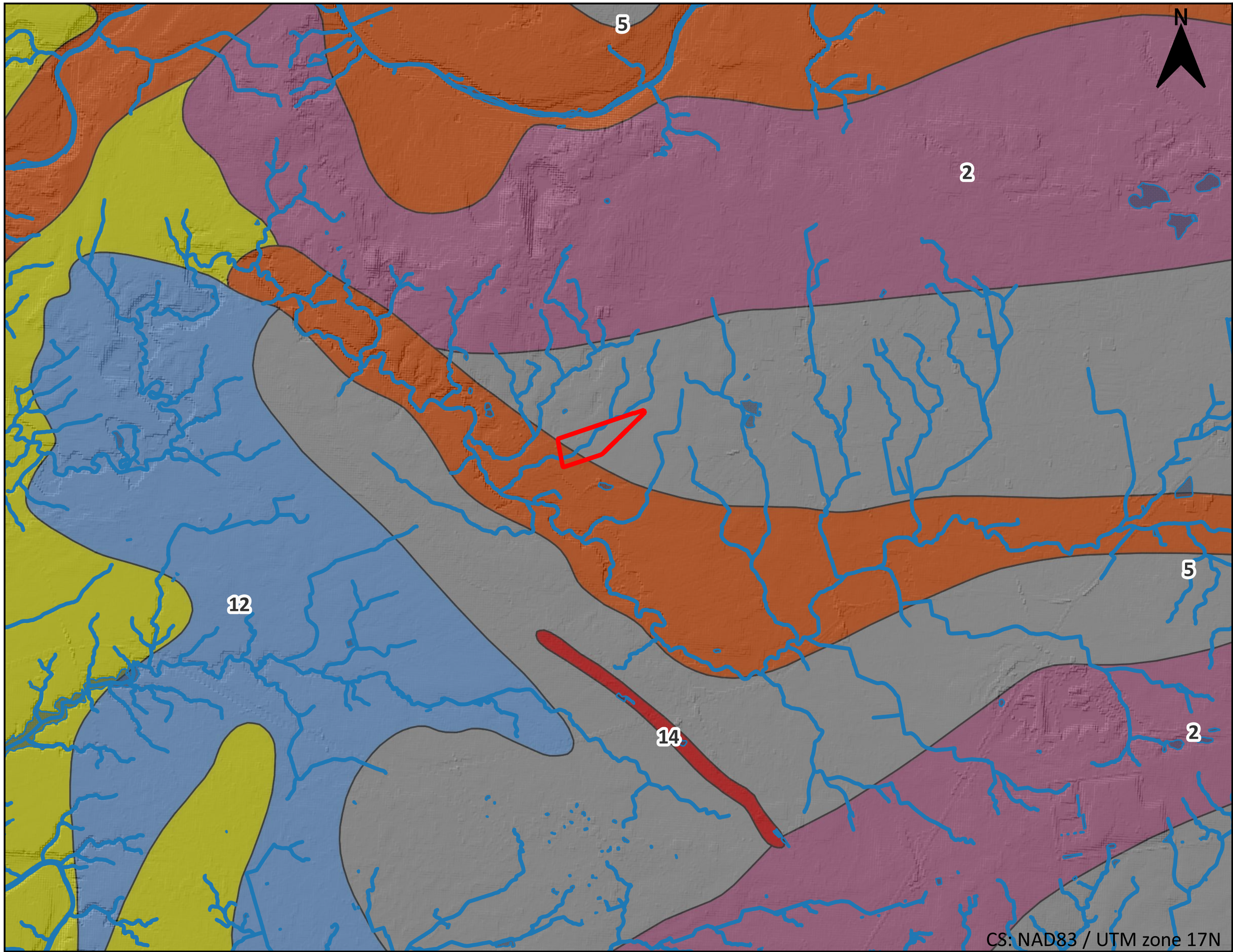

-LEGEND-

- Site Boundary
- Watercourse (OHN)
- Waterbody (OHN)

Physiographic Landforms

- 2 Till Moraines
- 3 Spillways
- 5 Till Plains (Undrumlinized)
- 11 Sand Plains
- 12 Clay Plains
- 14 Beaches

Notes:

Data Sources:
Contains information licensed under the Open Government Licence – Ontario.
Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT W3 - Lambeth Farms c/o York

TITLE Physiographic Landforms

Prepared By: K.W. | Reviewed By: H.J. / K. D.

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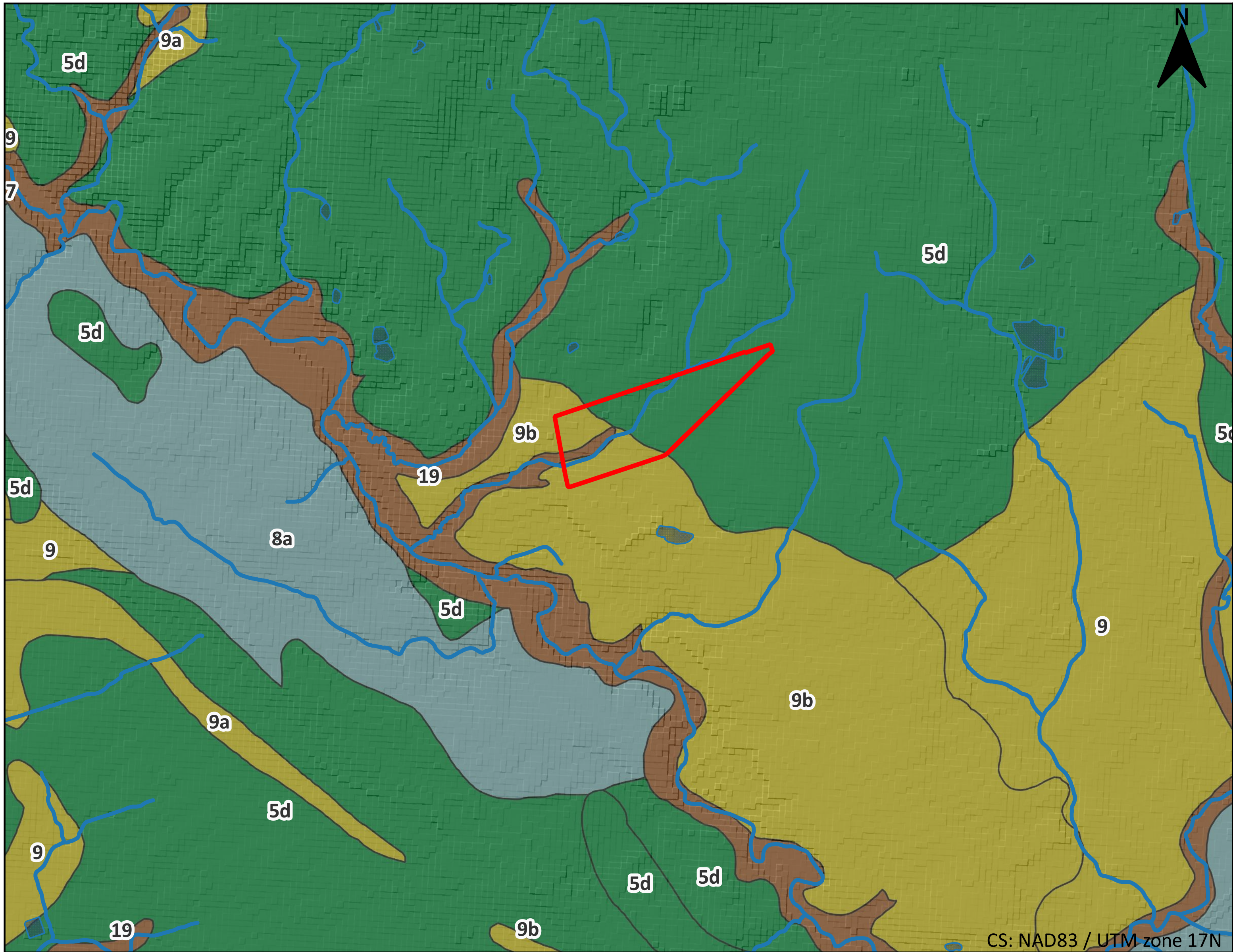

-LEGEND-

- Site Boundary
- Watercourse (OHN)
- Waterbody (OHN)

Surficial Geology

- 19 — Modern Alluvial Deposits: clay, silt, sand, gravel, may contain organic remains
- 9 — Coarse-textured Glaciolacustrine Deposits: sand, gravel, minor silt and clay
- 9b — Littoral Deposits
- 8 — Fine-textured Glaciolacustrine Deposits: silt and clay, minor sand and gravel
- 8a — Massive to well laminated
- 5d — Clay to silt-textured till (derived from glaciolacustrine deposits or shale)

Notes:

Data Sources:
Contains information licensed under the Open Government Licence – Ontario.
Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised.

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Surficial Geology
Prepared By: K.W.	Reviewed By: H.J. / K. D.

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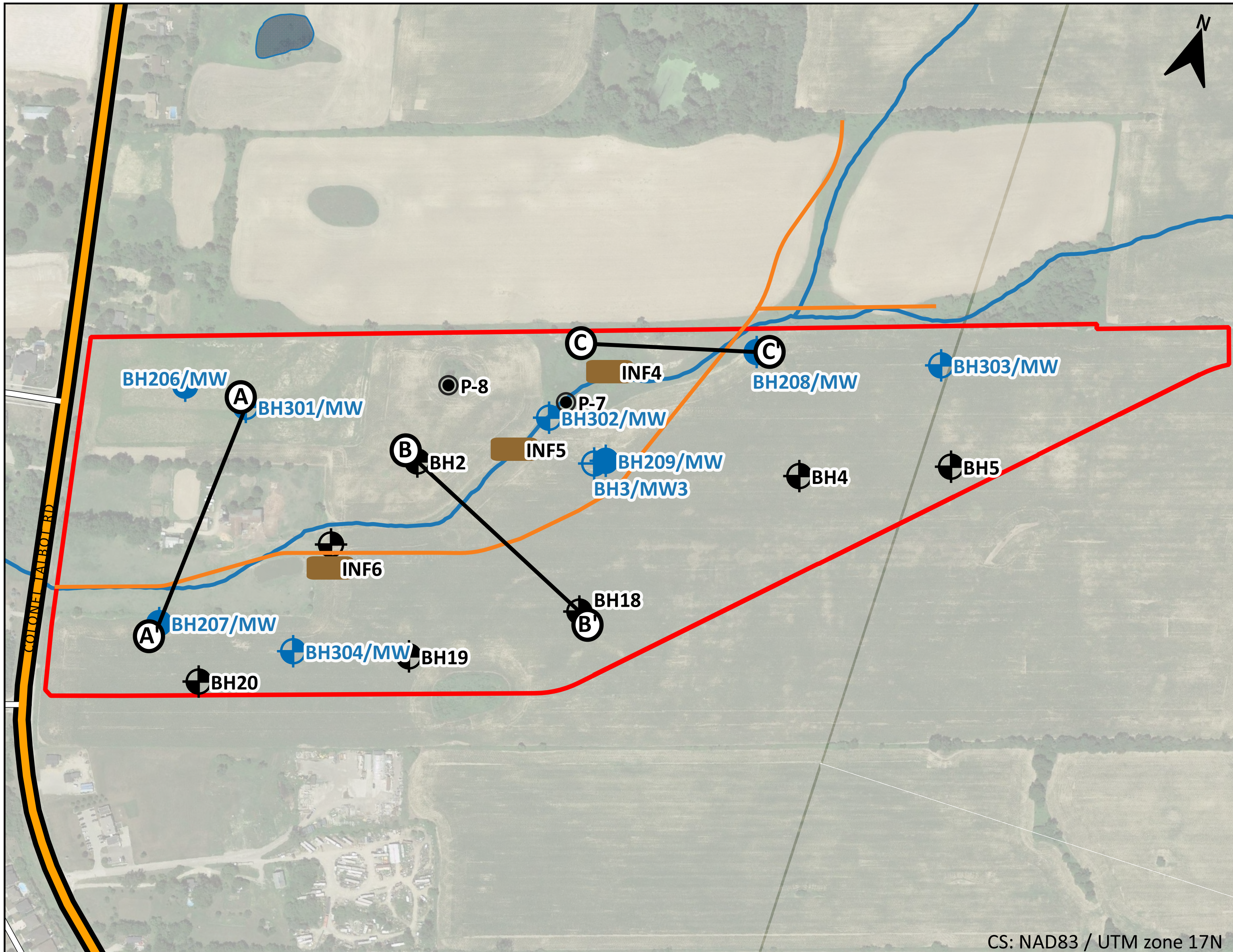

-LEGEND-

- Site Boundary
- Watercourse (OHN)
- Proposed Channel Alignment
- Geological Cross-Section

Investigative Locations

- Monitoring Well (2020)
- Monitoring Well (2018)
- Monitoring Well (2016)
- Minipiezometer (2020
- Borehole (2016)
- Infiltration Testing Location

Notes:
OHN - Ontario Hydro Network

Data Sources:
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Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT W3 - Lambeth Farms c/o York

TITLE Geological Cross-Section Location Plan

Prepared By: K.W. | Reviewed By: H.J. / K. D.

exp.

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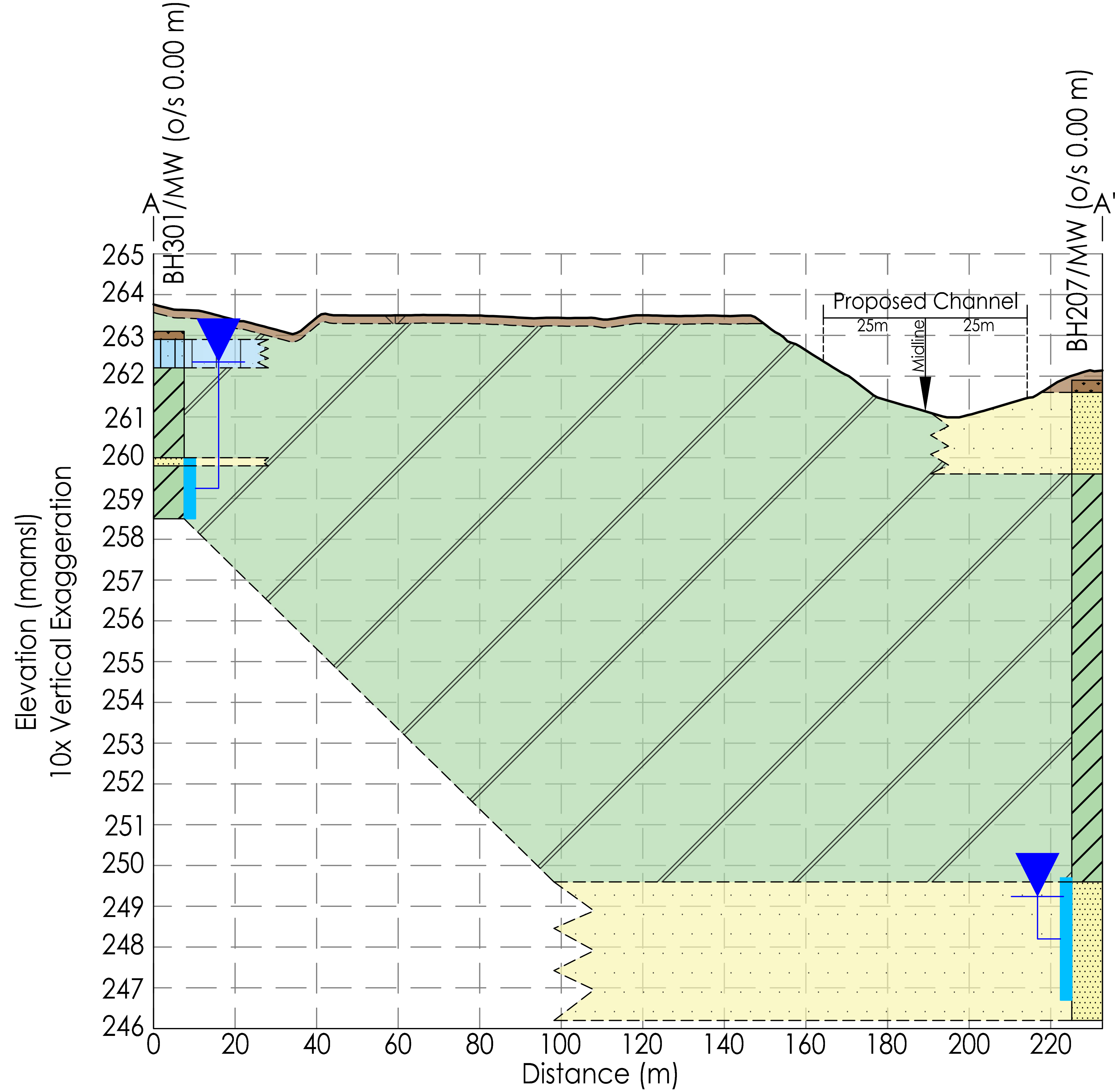


-LEGEND-

Ground Surface (See Notes)

Lithologies

- Topsoil
- Fill
- Sand
- Clayey Silt Till
- Sandy Silt Till
- Sandy Silt

Borehole

Manual Water Level

Well Screen

-NOTES-

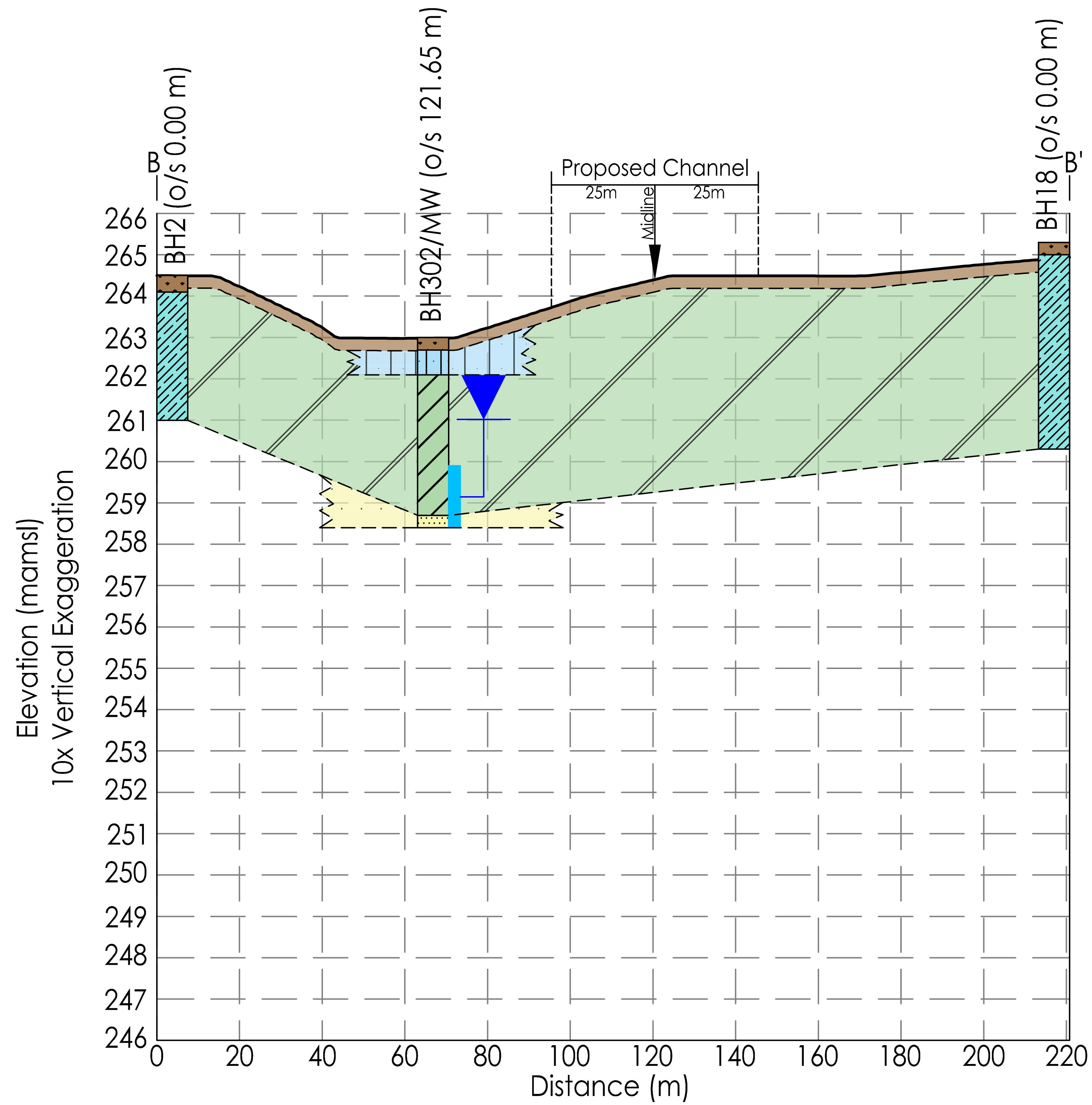
1. The cross section should be read in conjunction with EXP's Hydrogeological Report.
2. The geological interpretation is based on subsurface observations made at each borehole location. Subsurface conditions between and beyond boreholes may vary.
3. The projected ground surface is from the topographical mapping provided by the Client.
4. Groundwater elevations were measured on November 17, 2021.
5. Illustrated extents are approximate.

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Geological Cross Section A - A'
DRAWN BY: K.W.	REVIEWED BY: H.J. / K.D.
DATE	November 2022
EXP Services Inc.	405 Maple Grove Road, Cambridge, ON, N3E 1B6
SCALE: As Shown	PROJECT NO. LON-22023963-A0
DWG.	10



-LEGEND-

Ground Surface (See Notes)

Lithologies

- Topsoil
- Fill
- Sand
- Silt to Clayey Silt Till
- Sandy Silt Till
- Sandy Silt
- Silty Clay

Borehole

Manual Water Level

Well Screen

-NOTES-

1. The cross section should be read in conjunction with EXP's Hydrogeological Report.
2. The geological interpretation is based on subsurface observations made at each borehole location. Subsurface conditions between and beyond boreholes may vary.
3. The projected ground surface is from the topographical mapping provided by the Client.
4. Illustrated extents are approximate.

Hydrogeological Assessment

Proposed Development

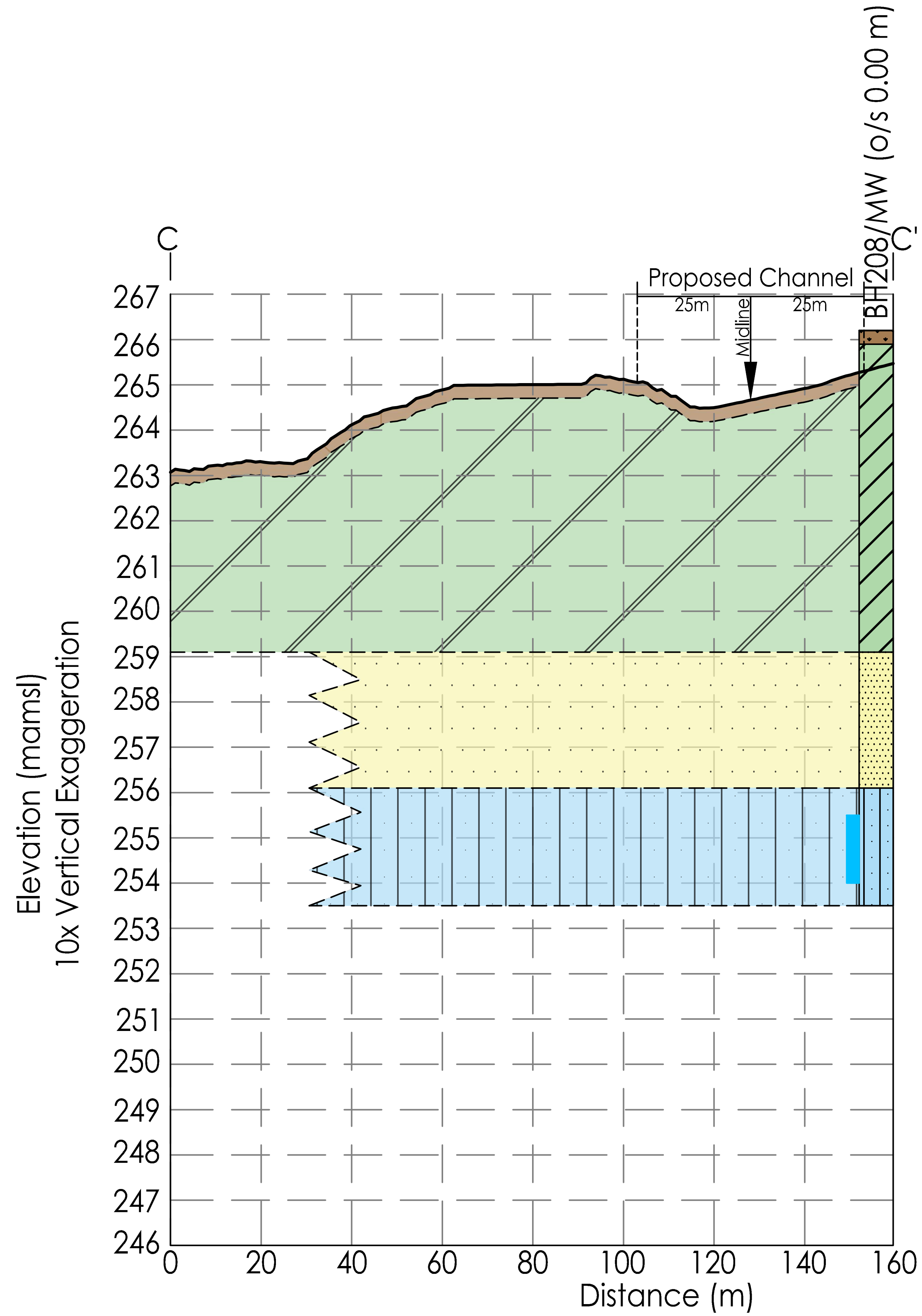
3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Geological Cross Section B - B'
DRAWN BY: K.W.	REVIEWED BY: H.J. / K.D.
DATE	November 2022

exp.

EXP Services Inc.
405 Maple Grove Road,
Cambridge, ON, N3E 1B6

SCALE	PROJECT NO.	DWG.
As Shown	LON-22023963-A0	11



-LEGEND-

Ground Surface (See Notes)

Lithologies

- Topsoil
- Fill
- Sand
- Clayey Silt Till
- Sandy Silt Till
- Sandy Silt

Borehole

Manual Water Level

Well Screen

-NOTES-

1. The cross section should be read in conjunction with EXP's Hydrogeological Report.
2. The geological interpretation is based on subsurface observations made at each borehole location. Subsurface conditions between and beyond boreholes may vary.
3. The projected ground surface is from the topographical mapping provided by the Client.
4. Illustrated extents are approximate.

Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT W3 - Lambeth Farms c/o York

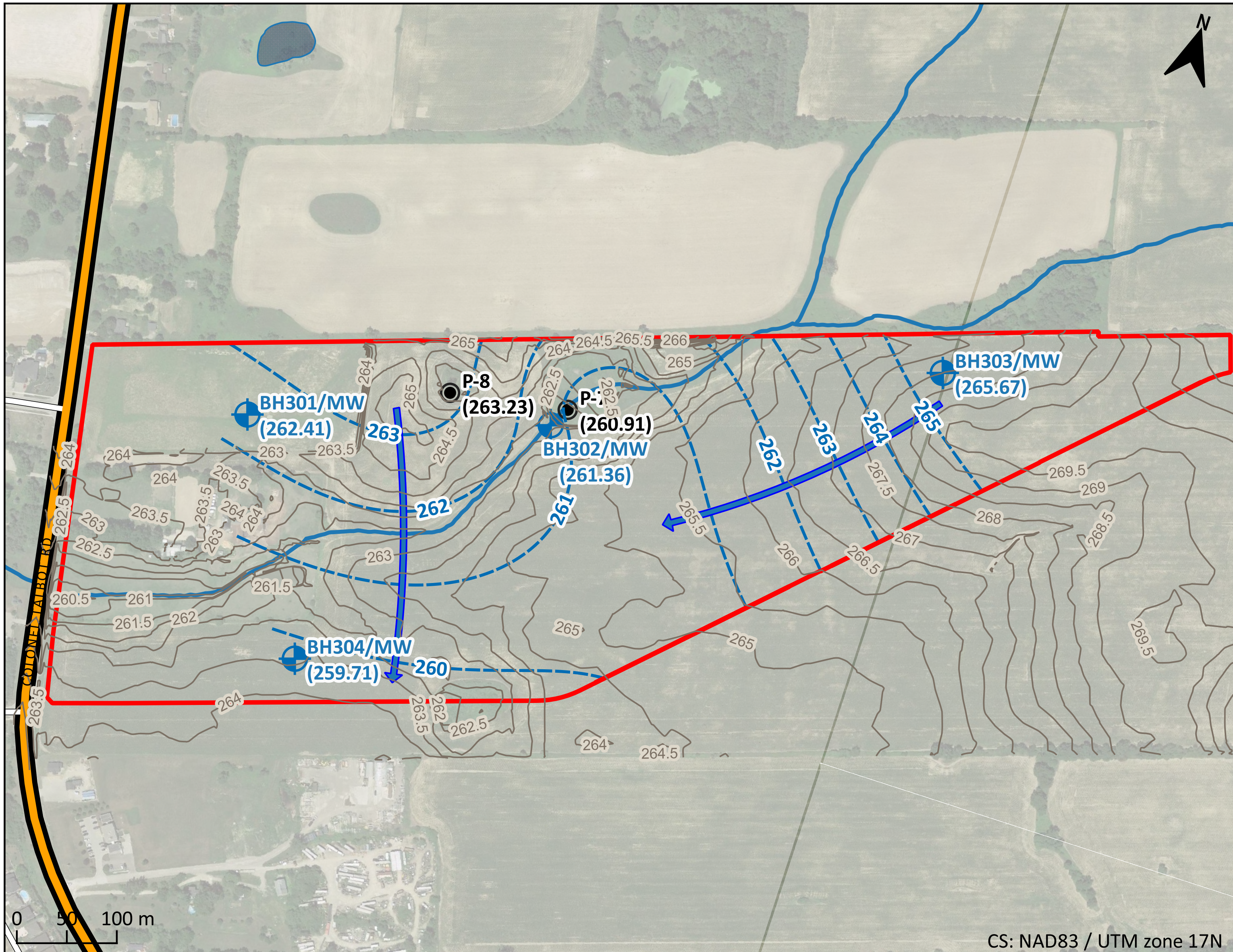
TITLE Geological Cross Section C - C'

DRAWN BY:	REVIEWED BY:	DATE
K.W.	H.J. / K.D.	November 2022

exp.

EXP Services Inc.
405 Maple Grove Road,
Cambridge, ON, N3E 1B6

SCALE	PROJECT NO.	DWG.
As Shown	LON-22023963-A0	12



-LEGEND-

- Site Boundary
- Ground Surface Elevation Contours (mamsl)
- Watercourse (OHN)
- Waterbody (OHN)
- Monitoring Well (2020) (Groundwater Elevation, mamsl)
- Minipiezometer (2020) (Groundwater Elevation, mamsl)
- Groundwater Elevation Contour (mamsl)
- Interpreted Groundwater Flow Direction

Notes:
Ground surface elevation contours are from topographical mapping provided by the Client.
OHN - Ontario Hydro Network

Data Sources:
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Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Shallow Groundwater Flow Direction Interpretation
Prepared By: K.W.	Reviewed By: H.J. / K. D.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

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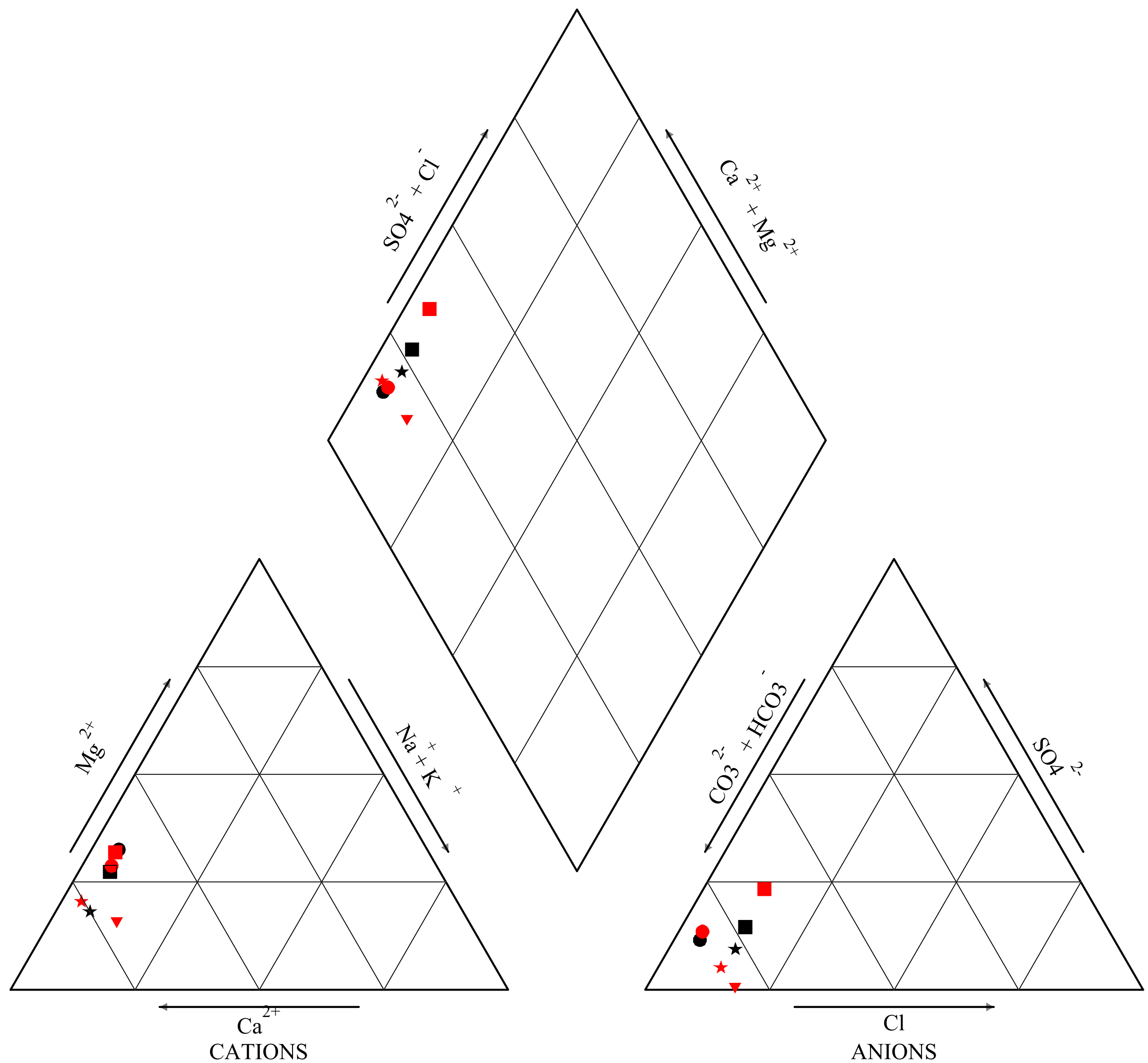


-LEGEND-

- ● MW302 - November 14, 2020
- ■ MW303 - November 14, 2020
- ★ SW Station 8 - November 14, 2020
- ● MW302 - March 23, 2021
- ■ MW303 - March 23, 2021
- ▼ SW Station 7 - March 23, 2021
- ★ SW Station 8 - March 23, 2021

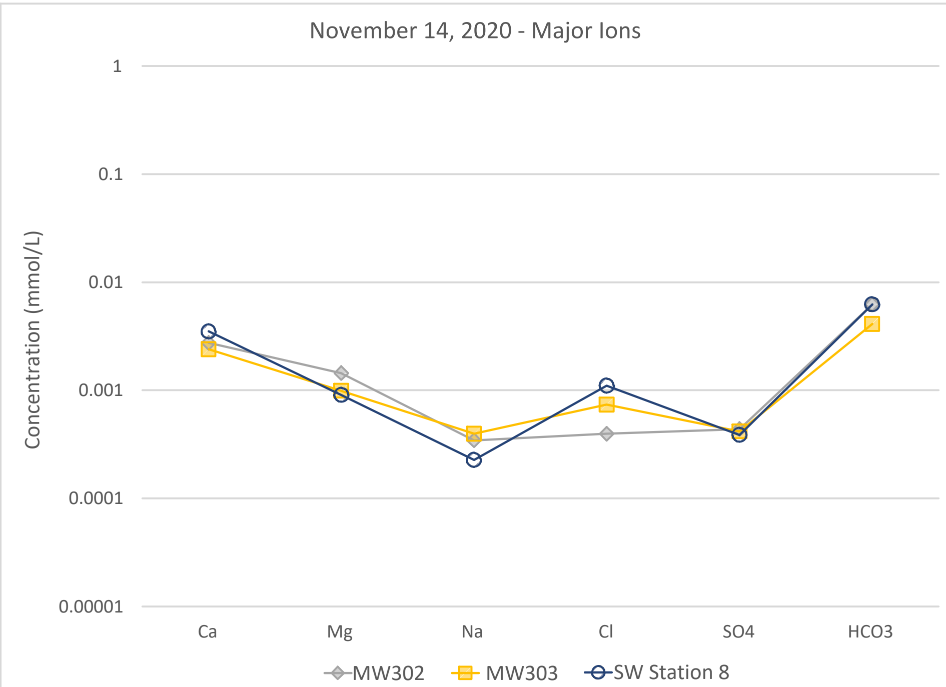
Hydrogeological Assessment

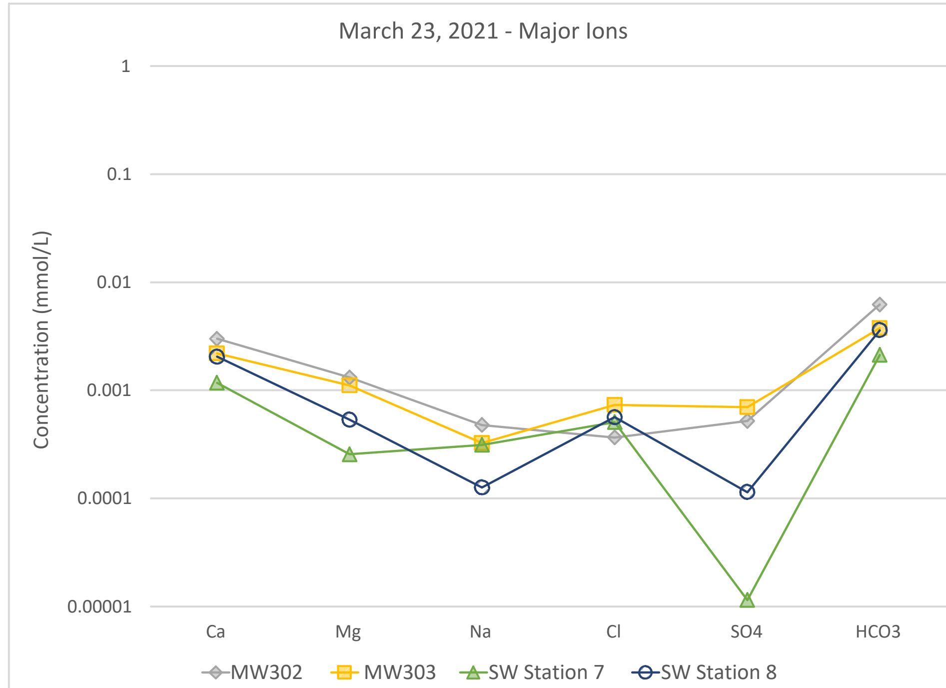
Proposed Development

3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT	W3 - Lambeth Farms c/o York Developments
TITLE	Piper Diagram for Water Quality
Prepared By: K.D.	Reviewed By: H.B.
exp.	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE:	PROJECT NO.	FIG.
September 2021	N/A	LON-22023963-A0	14





Hydrogeological Assessment

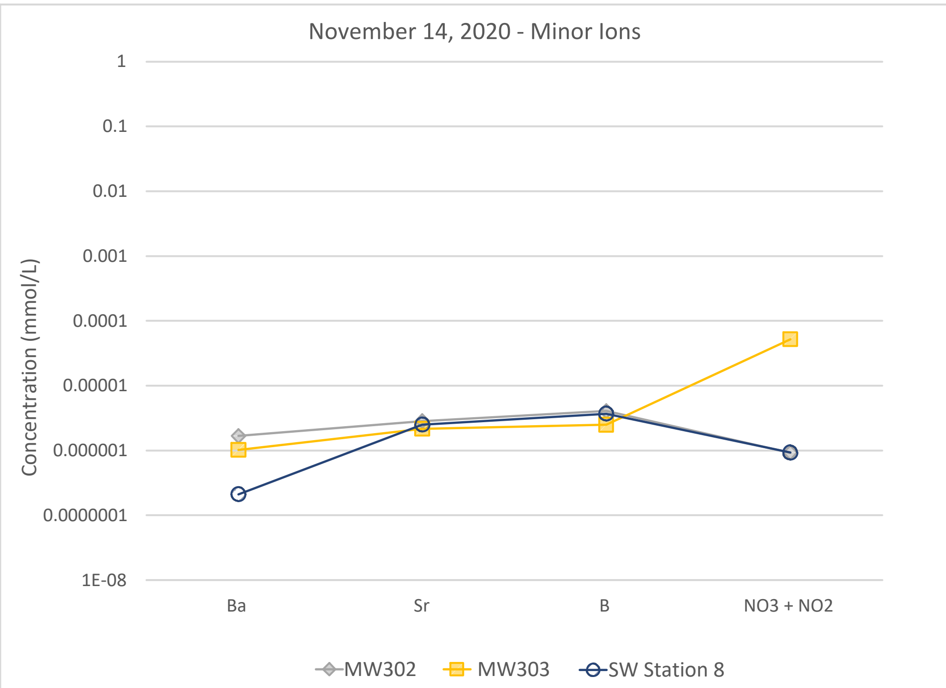
Proposed Sunset Creek Subdivision

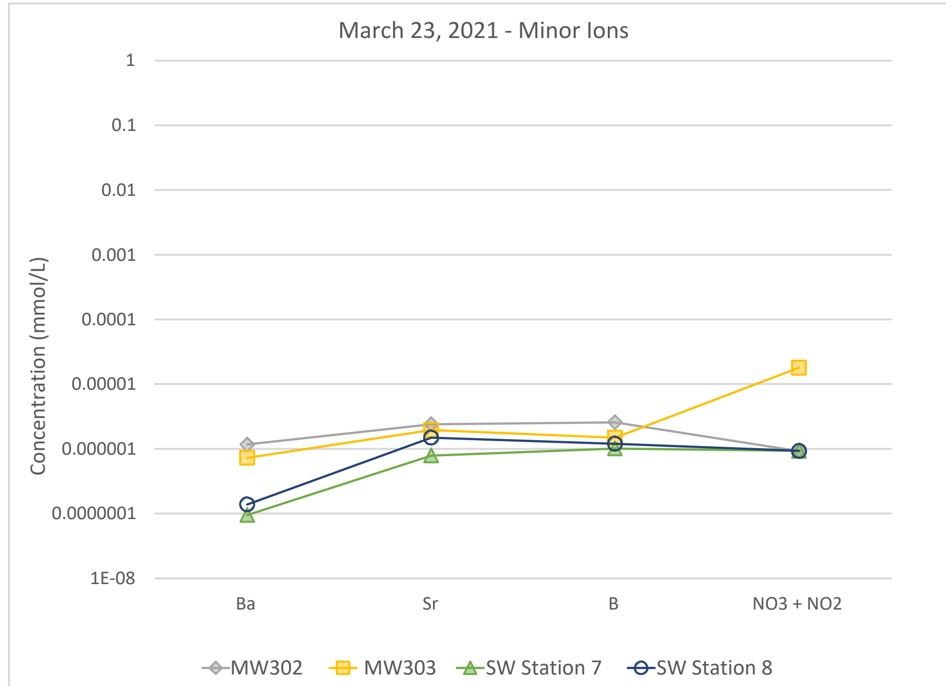
3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT	W3 - Lambeth Farms c/o York Developments
TITLE	Schoeller Diagram for Water Quality - Major Ions
Prepared By: K.D.	Reviewed By: H.B.

exp. EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE:	PROJECT NO.	FIG.
September 2021	N/A	LON-22023963-A0	15a





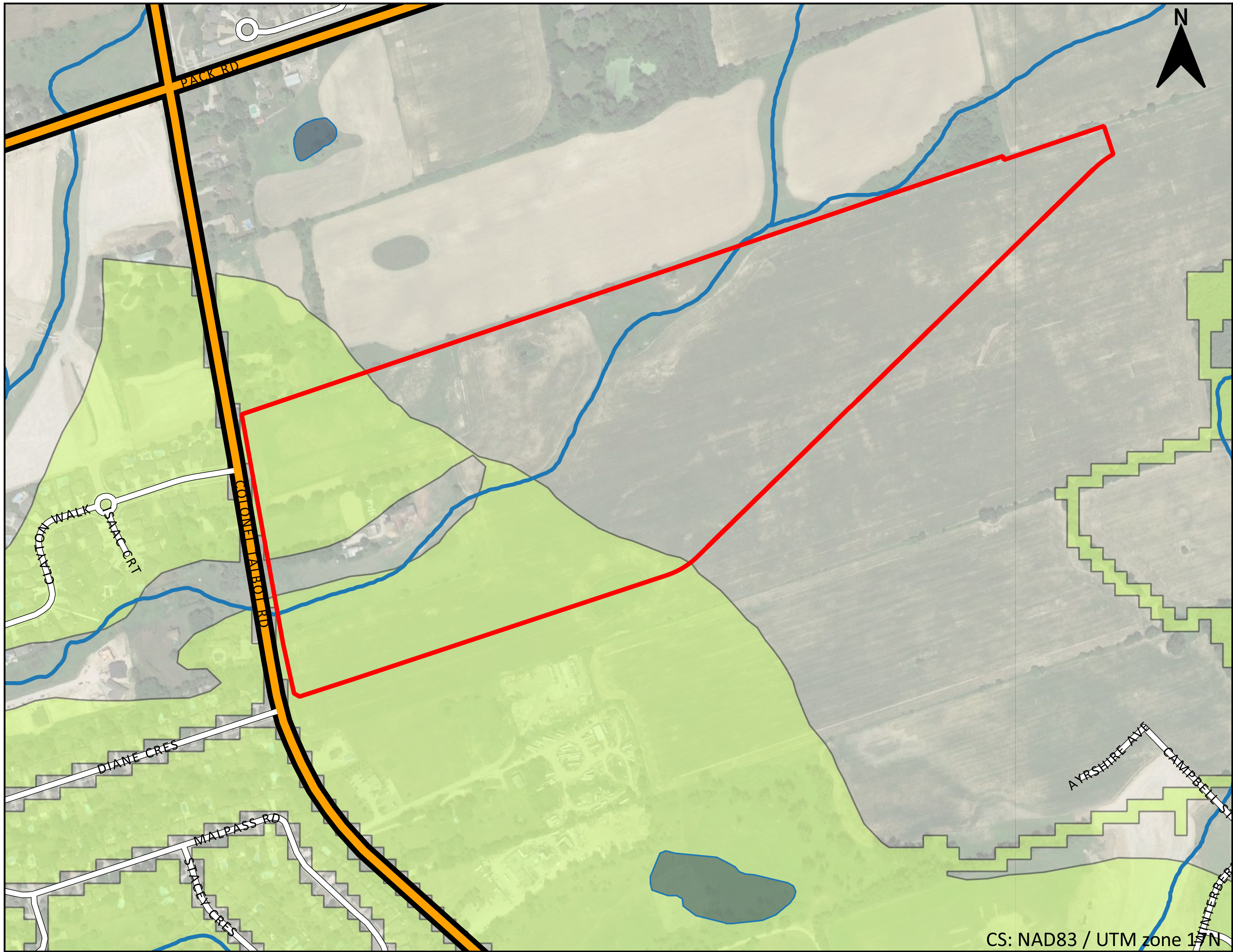
Hydrogeological Assessment

Proposed Sunset Creek Subdivision

3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT	W3 Lambeth Farms Inc. c/o York Developments
TITLE	Schoeller Diagram for Water Quality - Minor Ions
Prepared By: K.D.	Reviewed By: H.B.
exp.	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	FIG.
September 2021	N/A	LON-00014456-HG	15b



-LEGEND-

- Site Boundary
- Watercourse (OHN)
- Waterbody (OHN)
- SGRA (UTRCA)

Notes:

Data Sources:
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Hydrogeological Assessment

Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

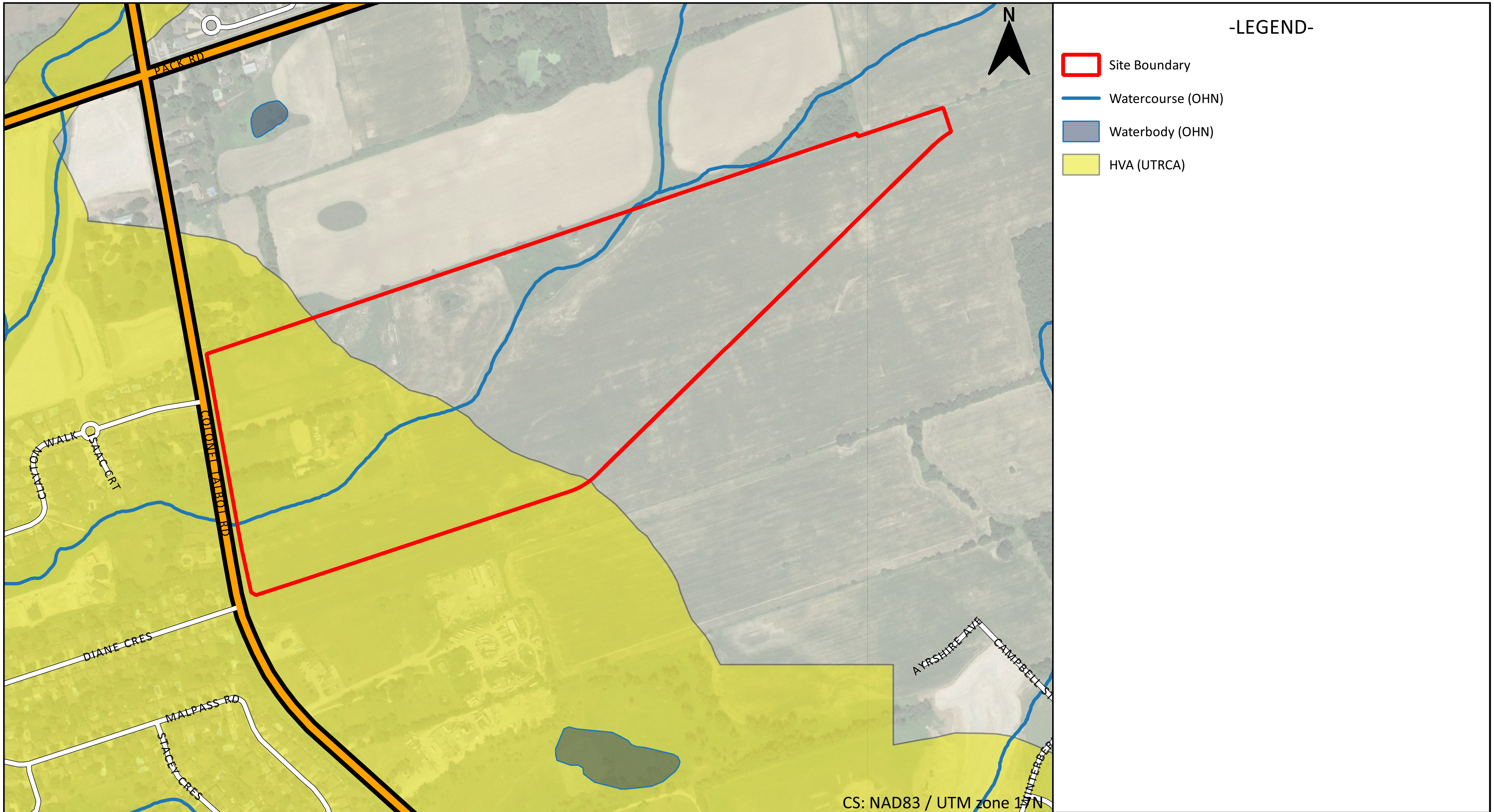
CLIENT W3 - Lambeth Farms c/o York

TITLE Significant Groundwater Recharge Areas

Prepared By: K.W. | Reviewed By: H.J. / K. D.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
November 2022	1:7,500	LON-22023963-A0	17



Notes:

Data Sources:
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Hydrogeological Assessment

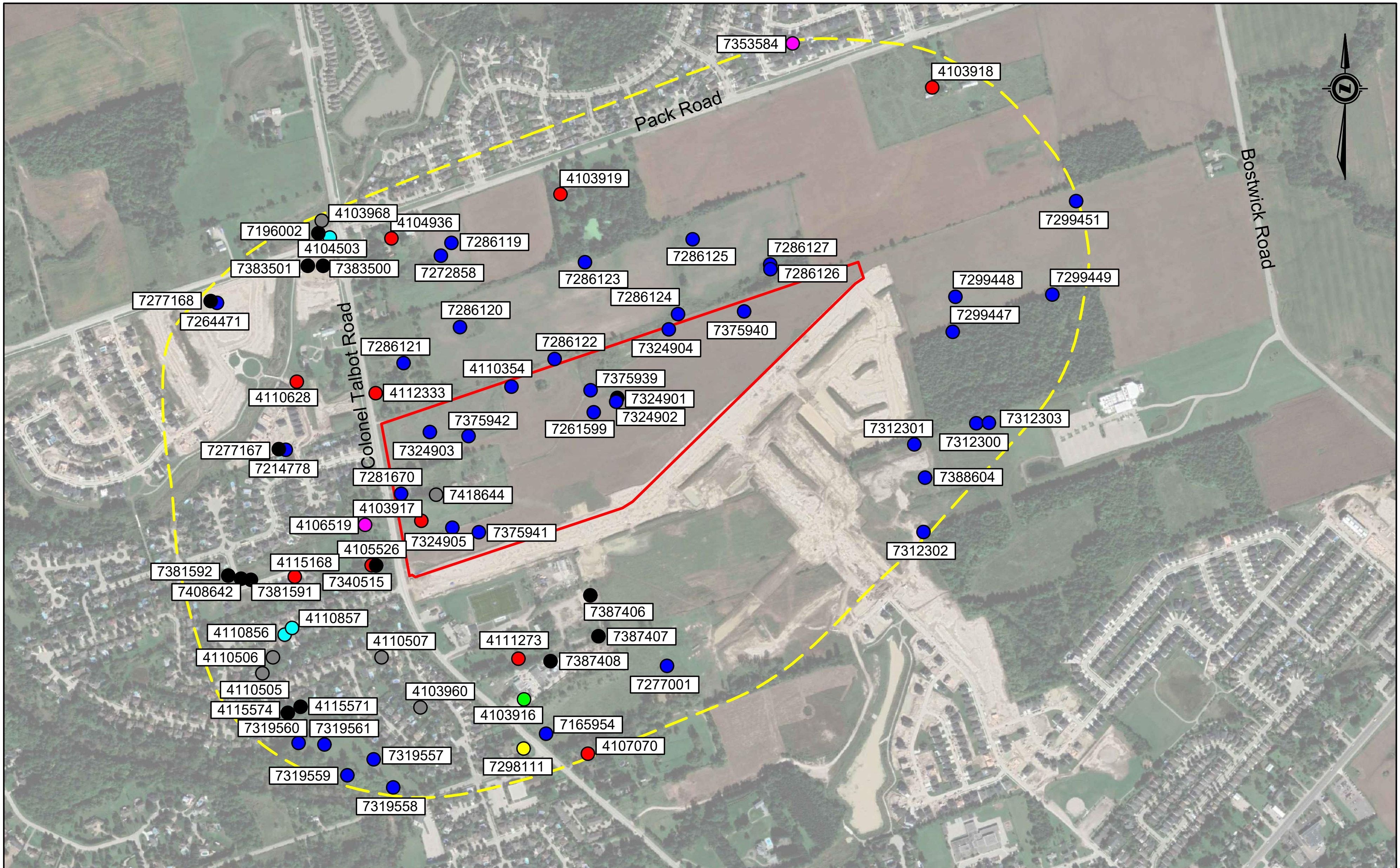
Proposed Development

3700 Col. Talbot Rd. & 3645 Bostwick Rd., London, ON

CLIENT	W3 - Lambeth Farms c/o York
TITLE	Highly Vulnerable Aquifers
Prepared By: K.W.	Reviewed By: H.J. / K. D.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
November 2022	1:7,500	LON-22023963-A0	18



-LEGEND-

Site Boundary

- Monitoring/Test Hole
- Domestic Supply
- Municipal Supply
- Industrial Supply
- Livestock/Irrigation
- Commercial Supply
- Abandonment Record
- Not Used/Unknown

Image Source: Google Earth Pro (September 2021)

Hydrogeological Assessment

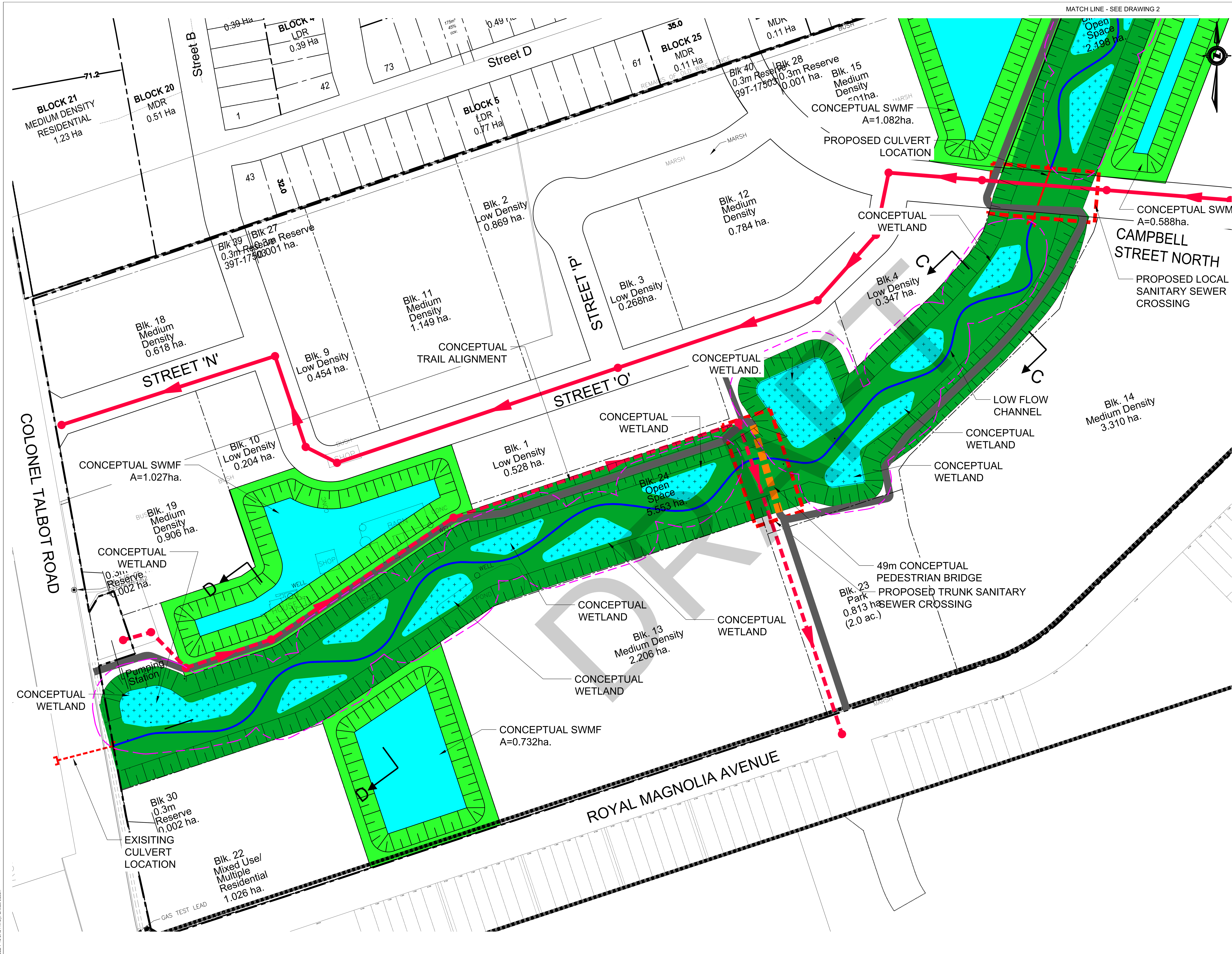
Proposed Development

3700 Colonel Talbot & 3645 Bostwick Road
London, Ontario

CLIENT	W3 - Lambeth Farms c/o York Developments
TITLE	Approximate Location of MECP Registered Wells
Prepared By: K.D.	Reviewed By: H.B.
exp.	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE:	PROJECT NO.	FIG.
April 2023	1:12,000	LON-22023963-A0	19

Appendix B – Development Plan



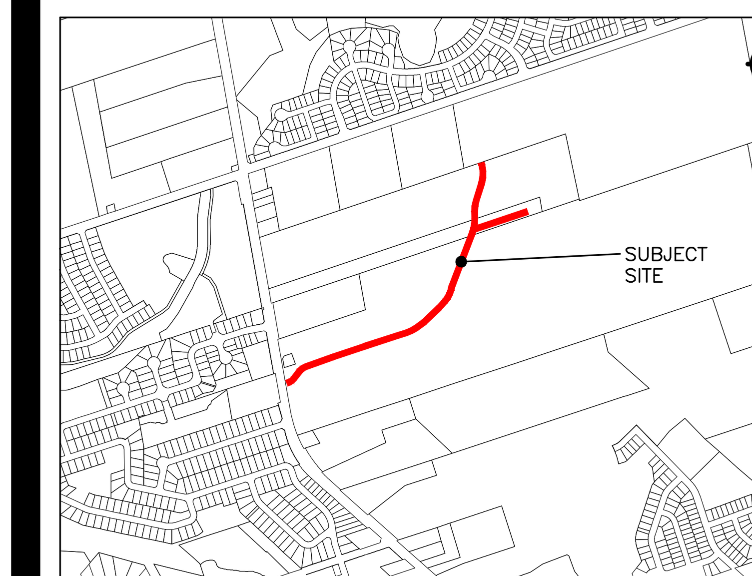
Stantec

Stantec
600-171 Queens Avenue
London ON N6A 5J7
Tel. 519-645-2007
www.stantec.com

Liability Note:

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.

Key Map



Legend

CONCEPTUAL SWM FACILITY		INTEGRATED CORRIDOR A=7.419ha.	
CONCEPTUAL TRAIL ALIGNMENT LENGTH=1,225m		CONCEPTUAL LOW FLOW CHANNEL	
CONCEPTUAL WETLANDS • HUDSON PARK = 0.960ha. • SUNSET CREEK = 0.750ha.			
PROPOSED CULVERT		PROPOSED SANITARY SEWER CROSSING	
EXISTING CULVERT			
PROPOSED SANITARY TRUNK SEWER			
PROPOSED SANITARY SEWER		15m WETLAND BUFFER	

4.	REVISED WETLAND LAYOUT	JAC	HA	22.09.12
3.	REVISED SWMF LAYOUT	JAC	AK/HA	22.07.11
2.	REVISED SWMF LAYOUT	JAC	AK/HA	22.04.20
1.	REVISED CHANNEL LAYOUT	JAC	AK/HA	22.03.14
Revision		By	Appd.	YY.MM.DD

4.	ISSUED FOR CLIENT REVIEW	JAC	HA	22.09.12
3.	ISSUED FOR CLIENT REVIEW	JAC	AK/HA	22.07.11
2.	ISSUED FOR CLIENT REVIEW	JAC	AK/HA	22.04.20
1.	ISSUED FOR CLIENT REVIEW	JAC	AK/HA	22.03.14
Issued		By	Appd.	YY.MM.DD

Permit-Seal

PRELIMINARY NOT FOR CONSTRUCTION

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project

SIFTON PROPERTIES LIMITED/W3 FARMS INC.

HUDSON PARK / SUNSET CREEK SUBDIVISION

London, ON Canada

Title

INTERGRATED CORRIDOR CONCEPT PLAN

Project No.	Scale
161414170	HORZ – 1 : 1000

Drawing No.	Sheet	Revision
3	3 of 5	4

ORIGINAL SHEET - ANSI D

Appendix C – Borehole Logs

BOREHOLE LOG

BH01
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	263.7	**TOPSOIL**					
	263.2	**SILTY CLAY** - brown, trace sand and gravel, stiff to hard, moist					
1		- 75 mm, very moist sand lamination near 1.1 m bgs.	SS	S1	275	12	17
			SS	S2	320	26	16
2		- becoming grey, very stiff below 2.3 m bgs.	SS	S3	320	20	17
3	260.2		SS	S4	370	18	18
		End of Borehole at 3.5 m bgs.					

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane (100, 200 kPa)
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone (10, 20, 30, 40)

NOTES
1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

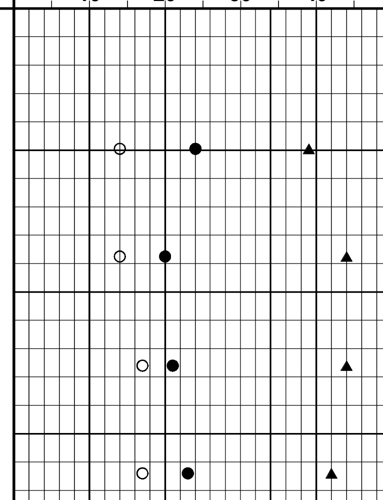
WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH02
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	264.5	**TOPSOIL**					
	264.1	**SILTY CLAY** - brown, trace sand and gravel, very stiff					
1			SS	S1	275	24	14
			SS	S2	320	20	14
2							
			SS	S3	320	21	17
3		- transition from brown to grey with depth.	SS	S4	275	23	17
	261.0	**End of Borehole at 3.5 m bgs.**					



SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane (100, 200 kPa)
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone (10, 20, 30, 40)

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH03/MW3
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level

Depth (m bgs)	Elevation (m)	Strata Description	Sample Type	Sample Number	Recovery (%)	N Value (blows)	Moisture Content (%)
0	265.2	**TOPSOIL**					
	264.8	**SILTY CLAY** - brown, trace sand and gravel, very stiff, moist					
1			SS	S1	275	17	16
			SS	S2	320	25	16
2		- becoming weathered below 2.3 m bgs.	SS	S3	370	28	15
3	261.9	**SILTY SAND** - brown, fine to medium grained, trace clay, some gravel, dense, moist	SS	S4	370	40	12
4–5			SS	S5	370	16	8
6	258.6		SS	S6	320	11	5
		End of Borehole at 6.6 m bgs.					

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 100, 200 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.
4) Water Level Readings:

Date	Depth (m)	Elev (m)
Feb 26, 16		
March 5, 16		

SAMPLE LEGEND
⊠ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH04
Sheet 1 of 1

CLIENT: **W3 - Lambeth Farms, c/o York Developments** PROJECT NO.: **LON-0014456-GE**
PROJECT: **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM: **Geodetic**
LOCATION: DATES: Boring **Feb 26, 2016** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	267.4	**TOPSOIL**					
	267.1	**SILTY CLAY** - brown, trace sand and gravel, stiff to very stiff, moist					
1			SS	S1	275	7	18
2			SS	S2	320	21	16
			SS	S3	415	33	17
3		- becoming grey below 2.8 m bgs	SS	S4	370	28	12
5			SS	S5	370	18	12
6			SS	S6	320	59	7
	260.8	**End of Borehole at 6.6 m bgs.**					

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane (100, 200 kPa)
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone (10, 20, 30, 40)

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
- AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- Apparent
- Measured
- Artesian (see Notes)

BOREHOLE LOG

BH05
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	269.3	**TOPSOIL**					
	269.0	**SILTY CLAY** - brown, trace sand and gravel, stiff to very stiff, moist to very moist					
~1.75			AS	S1			25
~3.3			AS	S2			24
4		- becoming grey below 4.0 m bgs.					
~4.8			AS	S3			20
5	264.3	**End of Borehole at 5.0 m bgs.**					

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 100, 200 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH18
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (%)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture / SPT N Value
0	265.3	**TOPSOIL**								
	265.0	**SILTY CLAY** - brown, trace sand and gravel, stiff to very stiff, moist to very moist								
1										
					AS	S1			16	
2										
3					AS	S2			17	
4		- becoming grey below 4.0 m bgs.								
					AS	S3			18	
5	260.3	**End of Borehole at 5.0 m bgs.**								
6										
7										
8										

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 100, 200 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open and dry upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND

☒ AS Auger Sample	▨ SS Split Spoon	■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.)		◫ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

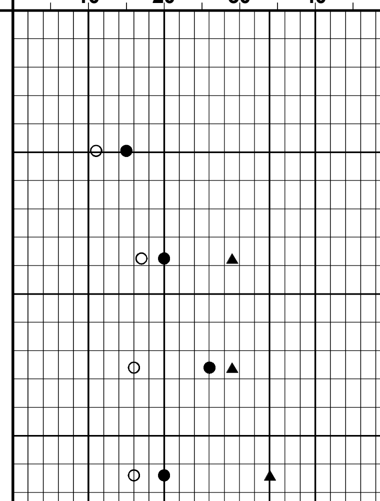
BOREHOLE LOG

BH19
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level **Feb 26, 2016**

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	WELL LOG	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	263.5	**TOPSOIL**						
	263.2	**SAND** - brown, medium grained, trace to some silt, trace clay, trace gravel, compact, very moist.						
1				SS	S1	230	15	11
	262.1	**SILTY CLAY** - brown/grey, trace sand and gravel, very moist						
				SS	S2	275	20	17
2			▽	SS	S3	320	26	16
3				SS	S4	275	20	16
	260.0	**End of Borehole at 3.5 m bgs.**						

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40



NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open to 2.7 m and water at 2.4 m bgs upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH20
Sheet 1 of 1

CLIENT **W3 - Lambeth Farms, c/o York Developments** PROJECT NO. **LON-0014456-GE**
PROJECT **3700 Colonel Talbot Road and 3645 Bostwick Road** DATUM **Geodetic**
LOCATION DATES: Boring **Feb 26, 2016** Water Level **Feb 26, 2016**

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	N VALUE (blows)	MOISTURE CONTENT (%)
0	263.8	**TOPSOIL**					
	263.5	**SILTY CLAY** - brown, trace sand and gravel, firm, moist					
1			SS	S1	140	7	17
	262.2	**SILTY SAND** - brown, trace clay, trace to some gravel, compact to dense, very moist	SS	S2	140	22	9
			SS	S3	90	98	5
3			SS	S4	90	18	5
4	259.8	**SILTY CLAY** - grey, trace sand and gravel, very stiff, moist (water level ∇ apparent at approx. 4.3 m)					
			SS	S5	275	29	17
			SS	S6	275	24	13
6.6	257.2	**End of Borehole at 6.6 m bgs.**					

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane (100, 200 kPa)
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone (10, 20, 30, 40)

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report LON-0014456-GE. For definition of terms used on logs, see sheets prior to logs.
2) Borehole open to 5.5 m and water measured at 4.3 m bgs upon completion of drilling.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
∇ Apparent ▼ Measured ▲ Artesian (see Notes)

BH206/MW
Sheet 1 of 1

BOREHOLE LOG

exp.

Client W3 Lambeth Farms Inc. c/o York Developments
Project No. LON-22023963-A0
Project Name W3 Farms Phase 2
Datum Geodetic
Site Location 3700 Col. Talbot Rd & 3645 Bostwick Rd, London
Boring Date November 7/8, 2018

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	TCV (ppm)	Lab Analysis
0.0	264.0	**SAND** - brown, fine to medium grained, some silt, loose, moist to wet								Well Stickup: 0.78 m Auger Hole Diameter: 200 mm Standpipe Diamter: 50 mm
					SS	S1	300	7		
1.4	262.6	**SANDY SILT** - brown, compact, wet			SS	S2	460	12		
2.1	261.9	**SILTY CLAY TILL** - grey, trace gravel, stiff to very stiff, moist			SS	S3	460	14		
					SS	S4	460	16		
					SS	S5	460	16		
					SS	S6	460	15		
					SS	S7	460	15		
					SS	S8	460	16		
10.9	253.1	**SAND** - grey, fine to medium grained, very dense, moist			SS	S9	460	76		
					SS	S10	460	56		Top of Sand Pack Elev: 250.59 m
					SS	S11	460	50		Top of Screen Elev: 250.29 m
					SS	S12	280	50		Bottom of Screen Elev: 248.79 m
		- occasional silt partings encountered near 16.2 m bgs			SS	S13	460	34		
17.2	246.8	**End of Borehole at 17.2 m bgs.**								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) Borehole was open and dry upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

Monitoring Well Screened From (m):

Monitoring Well Screened to (m):

Bentonite Seal From (m):

Water Level in Well (m):

Date of Measurement:

BH207/MW

Sheet 1 of 1

BOREHOLE LOG

Client: W3 Lambeth Farms Inc. c/o York Developments
Project No.: LON-22023963-A0
Project Name: W3 Farms Phase 2
Datum: Geodetic
Site Location: 3700 Col. Talbot Rd & 3645 Bostwick Rd, London
Boring Date: November 7/8, 2018

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION
0.0	261.9	
0.3	261.6	**TOPSOIL** - 300 mm
		SAND - brown, coarse grained, trace gravel, loose to compact, moist to wet
2.3	259.6	**CLAYEY SILT TILL TO SILTY CLAY TILL** - brown, stiff to very stiff, moist - becoming grey near 2.6 m bgs
12.3	249.6	**SAND** - grey, fine to medium grained, some silt, some gravel, very dense, damp to moist
15.7	246.2	**End of Borehole at 15.7 m bgs.**

SAMPLES TYPE	NUMBER	RECOVERY (mm)	N VALUE (blows)	TCV (ppm)
SS	S1	250	17	
SS	S2	460	9	
SS	S3	460	12	
SS	S4	460	13	
SS	S5	460	8	
SS	S6		13	
SS	S7	460	15	
SS	S8	460	15	
SS	S9	460	16	
SS	S10	460	15	
SS	S11	460	25	
SS	S12	460	19	
SS	S13	460	29	
SS	S14	460	25	
SS	S15	460	23	
SS	S16	460	92	
SS	S17	300	50	
SS	S18	300	50	
SS	S19	150	50*	
SS	S20	150	50*	

Lab Analysis:

Well Stickup: 0.83 m
Auger Hole Diameter: 200 mm
Standpipe Diamter: 50 mm
Top of Sand Pack Elev: 250.3 m
Top of Screen Elev: 249.7 m
Bottom of Screen Elev: 246.7 m

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) Borehole was open and dry upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.
5) * denotes 50 blows per 150 mm split spoon sampler penetration.

Monitoring Well Screened From (m):

Monitoring Well Screened to (m):

Bentonite Seal From (m):

Water Level in Well (m):

Date of Measurement:

BH208/MW
Sheet 1 of 1

BOREHOLE LOG

exp.

Client	W3 Lambeth Farms Inc. c/o York Developments	**Project No.**	LON-22023963-A0
Project Name	W3 Farms Phase 2	**Datum**	Geodetic
Site Location	3700 Col. Talbot Rd & 3645 Bostwick Rd, London	**Boring Date**	November 16, 2018

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	TCV (ppm)	Lab Analysis
0.0	266.2							
0.3	265.9	**TOPSOIL** - 300 mm						Well Stickup: 0.64 m
		CLAYEY SILT TILL - brown, trace to some sand, weathered, some very moist to wet sand layering, stiff to hard, damp	SS	S1	300	13		
			SS	S2	300	9		Auger Hole Diameter: 200 mm
		- becoming grey near 2.1 m bgs	SS	S3	450	20		
			SS	S4	400	27		Standpipe Diamter: 50 mm
			AS	S5				
			SS	S6	450	31		
			SS	S7	100	50*		
7.1	259.1	**SAND** - grey, fine grained, trace silt, very dense, damp						
			SS	S8	200	50**		
			AS	S9				
10.1	256.1	**SANDY SILT** - grey, fine grained, dilatant, very dense, very moist to wet						Top of Sand Pack Elev: 256.1 m
			SS	S10	400	61		Top of Screen Elev: 255.5 m
12.7	253.6		SS	S11	400	87		Bottom of Screen Elev: 254.0 m
		End of Borehole at 12.7 m bgs.						

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) Borehole was open and groundwater encountered near 1.5 m bgs upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.
5) * denotes 50 blows for 100 mm penetration of split spoon sampler.
6) ** denotes 50 blows for 130 mm penetration of split spoon sampler.

Monitoring Well Screened From (m):

Monitoring Well Screened to (m):

Bentonite Seal From (m):

Water Level in Well (m):

Date of Measurement:

BH209/MW
Sheet 1 of 1

BOREHOLE LOG

exp.

Client	W3 Lambeth Farms Inc. c/o York Developments	**Project No.**	LON-22023963-A0
Project Name	W3 Farms Phase 2	**Datum**	Geodetic
Site Location	3700 Col. Talbot Rd & 3645 Bostwick Rd, London	**Boring Date**	November 7/8, 2018

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	TCV (ppm)	Lab Analysis
0.0	265.2									
0.4	264.8	**TOPSOIL** - 430 mm								Well Stickup: 0.66 m Auger Hole Diameter: 200 mm Standpipe Diamter: 50 mm
3.3	261.9	**SILTY CLAY TILL** - brown, trace sand, trace gravel, very stiff, moist								
7.6	257.6	**SILTY SAND** - brown, fine to medium grained, trace clay, some gravel, compact to dense, moist								
		SAND - brown, fine grained, some silt, compact to dense, damp to moist			SS	S1	17	460		Top of Sand Pack Elev: 256.7 m Top of Screen Elev: 256.1 m
					SS	S2	31	460		
		- 100 mm clayey layering encountered near 10.9 m bgs			SS	S3	86	460		
12.7	252.6				SS	S4	100	300		Bottom of Screen Elev: 253.0 m
		End of Borehole at 12.7 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) Borehole was open and groundwater encountered near 1.5 m bgs upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

Monitoring Well Screened From (m):

Monitoring Well Screened to (m):

Bentonite Seal From (m):

Water Level in Well (m):

Date of Measurement:

BOREHOLE LOG

BH301/MW
Sheet 1 of 1

CLIENT **W3 Lambeth Farms Inc. c/o York Developments** PROJECT NO. **LON-22023963-A0**
PROJECT **W3 Farms Development, London, ON** DATUM
LOCATION **3700 Colonel Talbot Rd and 3645 Bostwick Rd** DATES: Boring **November 2, 2020** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION
0	263.1	
	262.9	**TOPSOIL** - 200 mm
	262.2	**SANDY SILT** - brown, moist
1		**CLAYEY SILT TILL** - brown
2		becoming grey near 2.4 m bgs
3	260.0	**SAND** - wet
	259.8	**CLAYEY SILT TILL** - grey
4	258.5	
		End of borehole at 4.6 m bgs.
5		
6		
7		

Other column headings: STRATA PLOT; WELL LOG; SAMPLES: TYPE, NUMBER, RECOVERY (mm), N VALUE (blows); MOISTURE CONTENT (%); SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity), ▲ Penetrometer, ■ Torvane, 100, 200 kPa; Atterberg Limits and Moisture W_P W W_L; ● SPT N Value, × Dynamic Cone, 10, 20, 30, 40

NOTES
1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ◪ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH302/MW
Sheet 1 of 1

CLIENT **W3 Lambeth Farms Inc. c/o York Developments** PROJECT NO. **LON-22023963-A0**
PROJECT **W3 Farms Development, London, ON** DATUM
LOCATION **3700 Colonel Talbot Rd and 3645 Bostwick Rd** DATES: Boring **November 2, 2020** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture / SPT N Value / Dynamic Cone
0	263.0	**TOPSOIL** - 300 mm								
	262.7	**SANDY SILT** - brown, trace clay								
1	262.1	**CLAYEY SILT TILL** - brown, moist								
2		becoming grey near 2.4 m bgs								
3										
4	258.7	**SAND** - very moist								
	258.4	**End of borehole at 4.6 m bgs.**								
5										
6										
7										

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 100, 200 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value ✕ Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH303/MW
Sheet 1 of 1

CLIENT: **W3 Lambeth Farms Inc. c/o York Developments**
PROJECT NO.: **LON-22023963-A0**
PROJECT: **W3 Farms Development, London, ON**
DATUM:
LOCATION: **3700 Colonel Talbot Rd and 3645 Bostwick Rd**
DATES: Boring **November 2, 2020**
Water Level:

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION
0	268.0	
	267.8	**TOPSOIL** - 200 mm
		SANDY SILT - brown, moist
1	267.0	**CLAYEY SILT TILL** - brown, moist
		becoming grey near 2.5 m bgs
3		wet sand layer encountered at 3.0 m bgs
4	264.0	**End of borehole at 4.0 m bgs.**

Column headings: STRATA PLOT; WELL LOG; SAMPLES (TYPE, NUMBER, RECOVERY (mm), N VALUE (blows)); MOISTURE CONTENT (%); SHEAR STRENGTH (✚ S Field Vane Test (#=Sensitivity), ▲ Penetrometer, ■ Torvane; 100, 200 kPa); Atterberg Limits and Moisture (W_P W W_L); ● SPT N Value, × Dynamic Cone (10, 20, 30, 40).

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) bgs denotes below ground surface.

SAMPLE LEGEND
- ⊠ AS Auger Sample
- ▨ SS Split Spoon
- ■ ST Shelby Tube
- ◫ Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- Apparent
- Measured
- Artesian (see Notes)

BOREHOLE LOG

BH304/MW

Sheet 1 of 1

CLIENT **W3 Lambeth Farms Inc. c/o York Developments** PROJECT NO. **LON-22023963-A0**

PROJECT **W3 Farms Development, London, ON** DATUM

LOCATION **3700 Colonel Talbot Rd and 3645 Bostwick Rd** DATES: Boring **November 2, 2020** Water Level

DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES: TYPE	NUMBER	RECOVERY (mm)	N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture / SPT N Value / Dynamic Cone
0	263.6	**TOPSOIL** - 300 mm								
	263.3	**SANDY SILT** - brown, trace clay								
	263.0	**CLAYEY SILT TILL** - brown, moist								
1										
2										
		becoming grey near 2.4 m bgs								
3	260.5	**SAND** - wet								
	260.3	**CLAYEY SILT TILL** - grey								
4										
	259.0	**End of borehole at 4.6 m bgs.**								
5										
6										
7										

Shear strength legend: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; scale 100, 200 kPa. Atterberg Limits and Moisture: W_P W W_L. ● SPT N Value; × Dynamic Cone; scale 10, 20, 30, 40.

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-22023963-A0.
2) bgs denotes below ground surface.

SAMPLE LEGEND
- ☒ AS Auger Sample
- ▨ SS Split Spoon
- ■ ST Shelby Tube
- ◫ Rock Core (eg. BQ, NQ, etc.)
- ◫ VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- ∇ Apparent
- ▼ Measured
- ▲ Artesian (see Notes)

Appendix D – Water Quality Tables and Lab COAs

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Groundwater Quality Results
Sunset Creek, London, ON
Project Number: LON-22023963

CRITERIA	ODWQS MAC	Units	14-Nov-20	23-Mar-21	14-Nov-20	23-Mar-21
			BH302/MW		BH303/MW	
Calculated Parameters						
Anion Sum	NV	me/L	8.86	9.04	6.94	6.96
Bicarb. Alkalinity (calc. as CaCO3)	NV	mg/L	380	380	250	230
Calculated TDS	NV	mg/L	470	480	390	380
Carb. Alkalinity (calc. as CaCO3)	NV	mg/L	3.1	3.1	1.9	2.5
Cation Sum	NV	me/L	9.07	9.32	7.19	6.97
Hardness (CaCO3)	NV	mg/L	430	440	340	330
Ion Balance (% Difference)	NV	%	1.16	1.5	1.82	0.09
Langelier Index (@ 20C)	NV	N/A	1.12	1.15	0.853	0.927
Langelier Index (@ 4C)	NV	N/A	0.868	0.901	0.605	0.679
Saturation pH (@ 20C)	NV	N/A	6.82	6.79	7.07	7.13
Saturation pH (@4C)	NV	N/A	7.07	7.04	7.32	7.37
Inorganics						
Total Ammonia-N	NV	mg/L	<0.050	<0.050	0.073	<0.050
Conductivity	NV	umho/cm	790	800	660	650
Dissolved Organic Carbon (DOC)	NV	mg/L	3.3	1.2	2.2	0.55
Orthophosphate (P)	NV	mg/L	<0.010	<0.010	<0.010	<0.010
pH	NV	pH	7.94	7.94	7.92	8.05
Dissolved Sulphate (SO4)	NV	mg/L	42	50	40	67
Alkalinity (Total as CaCO3)	NV	mg/L	380	380	250	230
Dissolved Chloride (Cl-)	NV	mg/L	14	13	26	26
Nitrite (N)	1	mg/L	<0.010	<0.010	0.01	<0.010
Nitrate (N)	10	mg/L	<0.10	<0.10	5.61	1.94
Nitrate + Nitrite (N)	NV	mg/L	<0.10	<0.10	5.62	1.94
Metals						
Dissolved Aluminum (Al)	NV	ug/L	7.9	<4.9	7.4	6.6
Dissolved Antimony (Sb)	6	ug/L	0.57	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	25	ug/L	<1.0	<1.0	<1.0	<1.0
Dissolved Barium (Ba)	1000	ug/L	230	160	140	100
Dissolved Beryllium (Be)	NV	ug/L	<0.40	<0.40	<0.40	<0.40
Dissolved Boron (B)	5000	ug/L	44	28	27	16
Dissolved Cadmium (Cd)	5	ug/L	<0.090	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	NV	ug/L	110000	120000	96000	88000
Dissolved Chromium (Cr)	50	ug/L	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	NV	ug/L	0.55	<0.50	<0.50	<0.50
Dissolved Copper (Cu)	NV	ug/L	1.3	<0.90	1.1	<0.90
Dissolved Iron (Fe)	NV	ug/L	<100	<100	<100	<100
Dissolved Lead (Pb)	10	ug/L	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	NV	ug/L	35000	32000	24000	27000
Dissolved Manganese (Mn)	NV	ug/L	150	18	94	9
Dissolved Molybdenum (Mo)	NV	ug/L	1.6	2.3	1.2	1.5
Dissolved Nickel (Ni)	NV	ug/L	2.9	1.3	<1.0	<1.0
Dissolved Phosphorous (P)	NV	ug/L	100	<100	110	<100
Dissolved Potassium (K)	NV	ug/L	5600	2600	2500	1300
Dissolved Selenium (Se)	10	ug/L	2	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	NV	ug/L	8400	7400	6800	7200
Dissolved Silver (Ag)	NV	ug/L	<0.090	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	NV	ug/L	7900	11000	9100	7500
Dissolved Strontium (Sr)	NV	ug/L	250	210	190	170
Dissolved Thallium (Tl)	NV	ug/L	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti)	NV	ug/L	<5.0	<5.0	<5.0	<5.0
Dissolved Uranium (U)	20	ug/L	6.3	5	2.4	1.2
Dissolved Vanadium (V)	NV	ug/L	0.66	0.51	<0.50	<0.50
Dissolved Zinc (Zn)	NV	ug/L	<5.0	33	<5.0	7.5

Notes:
Results compared to Ontario Drinking Water Quality Standards Maximum Accepatable Concentration (ODWQS MAC)
NV indicates 'No value'
N/A indicates 'Not Applicable'
Exceeds ODWQS MAC

Surface Water Quality Results
Sunset Creek, London, ON
Project Number: LON-22023963

CRITERIA	PWQO	Units	23-Mar-21	14-Nov-20	23-Mar-21
			SW STATION 7	SW STATION 8	
Calculated Parameters					
Bicarb. Alkalinity (calc. as CaCO3)	NV	mg/L	130	380	220
Calculated TDS	NV	mg/L	160	510	270
Carb. Alkalinity (calc. as CaCO3)	NV	mg/L	6.6	3.3	1.7
Hardness (CaCO3)	NV	mg/L	140	450	260
Langelier Index (@ 20C)	NV	N/A	1.17	1.24	0.765
Langelier Index (@ 4C)	NV	N/A	0.918	0.991	0.516
Saturation pH (@ 20C)	NV	N/A	7.58	6.73	7.16
Saturation pH (@4C)	NV	N/A	7.83	6.98	7.4
Inorganics					
Total Ammonia-N	NV	mg/L	<0.050	<0.050	0.075
Conductivity	NV	umho/cm	300	890	490
Total Organic Carbon (TOC)	NV	mg/L	7.6	22	14
Orthophosphate (P)	NV	mg/L	<0.010	0.053	0.047
pH	6.5 - 8.5	pH	**8.75**	7.97	7.92
Total Phosphorus	NV	mg/L	0.06	0.27	0.39
Dissolved Sulphate (SO4)	NV	mg/L	1.1	37	11
Turbidity	NV	NTU	2	4.3	2.3
Alkalinity (Total as CaCO3)	NV	mg/L	130	390	220
Dissolved Chloride (Cl-)	NV	mg/L	18	39	20
Nitrite (N)	NV	mg/L	<0.010	<0.010	<0.010
Nitrate (N)	NV	mg/L	<0.10	<0.10	<0.10
Metals					
Dissolved Calcium (Ca)	NV	mg/L	47	140	82
Dissolved Magnesium (Mg)	NV	mg/L	6.2	22	13
Dissolved Potassium (K)	NV	mg/L	5	20	4
Dissolved Sodium (Na)	NV	mg/L	7.2	5.2	2.9
Total Aluminum (Al)	75	ug/L	61	**2200**	69
Total Antimony (Sb)	20	ug/L	<0.50	<0.50	<0.50
Total Arsenic (As)	100	ug/L	<1.0	2.2	<1.0
Total Barium (Ba)	NV	ug/L	13	54	23
Total Beryllium (Be)	11	ug/L	<0.40	<0.40	<0.40
Total Boron (B)	200	ug/L	11	39	19
Total Cadmium (Cd)	0.1	ug/L	<0.090	<0.090	<0.090
Total Calcium (Ca)	NV	ug/L	44000	150000	79000
Total Chromium (Cr)	8.9	ug/L	<5.0	<5.0	<5.0
Total Cobalt (Co)	0.9	ug/L	<0.50	**2.4**	<0.50
Total Copper (Cu)	5	ug/L	1.2	2.8	1.5
Total Iron (Fe)	300	ug/L	<100	**3600**	**1600**
Total Lead (Pb)	5	ug/L	<0.50	1.6	<0.50
Total Magnesium (Mg)	NV	ug/L	5900	23000	12000
Total Manganese (Mn)	NV	ug/L	2.3	2000	63
Total Molybdenum (Mo)	40	ug/L	<0.50	1	1.6
Total Nickel (Ni)	25	ug/L	<1.0	3.5	<1.0
Total Potassium (K)	NV	ug/L	4500	18000	3400
Total Selenium (Se)	100	ug/L	<2.0	<2.0	<2.0
Total Silicon (Si)	NV	ug/L	120	7500	990
Total Silver (Ag)	0.1	ug/L	<0.090	<0.090	<0.090
Total Sodium (Na)	NV	ug/L	6500	4900	2900
Total Strontium (Sr)	NV	ug/L	65	240	130
Total Thallium (Tl)	0.3	ug/L	<0.050	<0.050	<0.050
Total Titanium (Ti)	NV	ug/L	<5.0	71	<5.0
Total Vanadium (V)	6	ug/L	0.54	4.3	0.76
Total Zinc (Zn)	20	ug/L	<5.0	18	**35**
Dissolved Aluminum (Al)	NV	ug/L	18	<4.9	<4.9
Dissolved Antimony (Sb)	NV	ug/L	<0.50	<0.050	<0.50
Dissolved Arsenic (As)	NV	ug/L	<1.0	1.2	<1.0
Dissolved Barium (Ba)	NV	ug/L	13	29	19
Dissolved Beryllium (Be)	NV	ug/L	<0.40	<0.40	<0.40
Dissolved Bismuth (Bi)	NV	ug/L	<1.0	<1.0	<1.0
Dissolved Boron (B)	NV	ug/L	11	40	13
Dissolved Cadmium (Cd)	NV	ug/L	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	NV	ug/L	46000	150000	79000
Dissolved Chromium (Cr)	NV	ug/L	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	NV	ug/L	<0.50	<0.50	<0.50
Dissolved Copper (Cu)	NV	ug/L	1.3	<0.90	<0.90
Dissolved Iron (Fe)	NV	ug/L	<100	<100	150
Dissolved Lead (Pb)	NV	ug/L	<0.50	<0.50	<0.50
Dissolved Lithium (Li)	NV	ug/L	<5.0	<5.0	<5.0
Dissolved Magnesium (Mg)	NV	ug/L	6300	22000	13000
Dissolved Manganese (Mn)	NV	ug/L	<2.0	<2.0	<2.0
Dissolved Molybdenum (Mo)	NV	ug/L	<0.50	<0.50	<0.50
Dissolved Nickel (Ni)	NV	ug/L	<1.0	<1.0	<1.0
Dissolved Phosphorous (P)	NV	ug/L	<100	160	<100
Dissolved Potassium (K)	NV	ug/L	4900	19000	3400
Dissolved Selenium (Se)	NV	ug/L	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	NV	ug/L	<50	4300	1500
Dissolved Silver (Ag)	NV	ug/L	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	NV	ug/L	7100	4700	2800
Dissolved Strontium (Sr)	NV	ug/L	69	220	130
Dissolved Tellurium (Te)	NV	ug/L	<1.0	<1.0	<1.0
Dissolved Thallium (Tl)	NV	ug/L	<0.050	<0.050	<0.050
Dissolved Tin (Sn)	NV	ug/L	<1.0	<1.0	<1.0
Dissolved Titanium (Ti)	NV	ug/L	<5.0	<5.0	<5.0
Dissolved Tungsten (W)	NV	ug/L	<1.0	<1.0	<1.0
Dissolved Uranium (U)	NV	ug/L	0.47	4.4	3
Dissolved Vanadium (V)	NV	ug/L	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	NV	ug/L	<5.0	<5.0	14
Dissolved Zirconium (Zr)	NV	ug/L	<1.0	<1.0	<1.0

Notes:
Results compared to Ontario Provincial Water Quality Objectives (PWQO)
NV indicates 'No value'
N/A indicates ' Not Applicabale'
Exceeds PWQO

Your Project #: LON-00014456-GE
Site Location: W3 FORMS
Your C.O.C. #: 797632-01-01

Attention: Mark Bertens

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2020/11/23
Report #: R6421292
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0U4788
Received: 2020/11/16, 08:00

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	2	N/A	2020/11/18	CAM SOP-00448	SM 23 2320 B m
Alkalinity	2	N/A	2020/11/19	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2020/11/19	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2020/11/19	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	2	N/A	2020/11/18	CAM SOP-00414	SM 23 2510 m
Conductivity	2	N/A	2020/11/19	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	2	N/A	2020/11/19	CAM SOP-00446	SM 23 5310 B m
Hardness (calculated as CaCO3)	2	N/A	2020/11/19	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3)	2	N/A	2020/11/20	CAM SOP 00102/00408/00447	SM 2340 B
Lab Filtered Metals Analysis by ICP	2	2020/11/18	2020/11/19	CAM SOP-00408	EPA 6010D m
Lab Filtered Metals by ICPMS	4	2020/11/18	2020/11/19	CAM SOP-00447	EPA 6020B m
Total Metals Analysis by ICPMS	2	N/A	2020/11/19	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	2	N/A	2020/11/20		
Anion and Cation Sum	2	N/A	2020/11/19		
Total Ammonia-N	4	N/A	2020/11/19	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	4	N/A	2020/11/19	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	2	2020/11/18	2020/11/18	CAM SOP-00413	SM 4500H+ B m
pH	2	2020/11/18	2020/11/19	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2020/11/19	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2020/11/20		Auto Calc
Sat. pH and Langelier Index (@ 4C)	4	N/A	2020/11/20		Auto Calc
Sulphate by Automated Colourimetry	4	N/A	2020/11/19	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2020/11/20		Auto Calc
Total Organic Carbon (TOC) (3)	2	N/A	2020/11/20	CAM SOP-00446	SM 23 5310B m
Total Phosphorus (Colourimetric)	2	2020/11/19	2020/11/19	CAM SOP-00407	SM 23 4500 P B H m
Turbidity	2	N/A	2020/11/18	CAM SOP-00417	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Your Project #: LON-00014456-GE
Site Location: W3 FORMS
Your C.O.C. #: 797632-01-01

Attention: Mark Bertens

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2020/11/23
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Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0U4788
Received: 2020/11/16, 08:00

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(3) Total Organic Carbon (TOC) present in the sample should be considered as non-purgeable TOC.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas Laboratories
23 Nov 2020 09:08:37

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

RCAP - COMPREHENSIVE (LAB FILTERED)

BV Labs ID		OEJ363	OEJ364		
Sampling Date		2020/11/14 12:00	2020/11/14 12:30		
COC Number		797632-01-01	797632-01-01		
	UNITS	**MW302**	**MW303**	**RDL**	**QC Batch**
Calculated Parameters					
Anion Sum	me/L	8.86	6.94	N/A	7060505
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	380	250	1.0	7060503
Calculated TDS	mg/L	470	390	1.0	7060508
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.1	1.9	1.0	7060503
Cation Sum	me/L	9.07	7.19	N/A	7060505
Hardness (CaCO3)	mg/L	430	340	1.0	7059929
Ion Balance (% Difference)	%	1.16	1.82	N/A	7060504
Langelier Index (@ 20C)	N/A	1.12	0.853		7060506
Langelier Index (@ 4C)	N/A	0.868	0.605		7060507
Saturation pH (@ 20C)	N/A	6.82	7.07		7060506
Saturation pH (@ 4C)	N/A	7.07	7.32		7060507
Inorganics					
Total Ammonia-N	mg/L	<0.050	0.073	0.050	7063695
Conductivity	umho/cm	790	660	1.0	7062693
Dissolved Organic Carbon	mg/L	3.3	2.2	0.40	7063442
Orthophosphate (P)	mg/L	<0.010	<0.010	0.010	7063051
pH	pH	7.94	7.92		7062698
Dissolved Sulphate (SO4)	mg/L	42	40	1.0	7063043
Alkalinity (Total as CaCO3)	mg/L	380	250	1.0	7062685
Dissolved Chloride (Cl-)	mg/L	14	26	1.0	7063036
Nitrite (N)	mg/L	<0.010	0.010	0.010	7062633
Nitrate (N)	mg/L	<0.10	5.61	0.10	7062633
Nitrate + Nitrite (N)	mg/L	<0.10	5.62	0.10	7062633
Metals					
Dissolved Aluminum (Al)	ug/L	7.9	7.4	4.9	7063245
Dissolved Antimony (Sb)	ug/L	0.57	<0.50	0.50	7063245
Dissolved Arsenic (As)	ug/L	<1.0	<1.0	1.0	7063245
Dissolved Barium (Ba)	ug/L	230	140	2.0	7063245
Dissolved Beryllium (Be)	ug/L	<0.40	<0.40	0.40	7063245
Dissolved Boron (B)	ug/L	44	27	10	7063245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (LAB FILTERED)

BV Labs ID		OEJ363	OEJ364		
Sampling Date		2020/11/14 12:00	2020/11/14 12:30		
COC Number		797632-01-01	797632-01-01		
	UNITS	MW302	MW303	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	<0.090	0.090	7063245
Dissolved Calcium (Ca)	ug/L	110000	96000	200	7063245
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	5.0	7063245
Dissolved Cobalt (Co)	ug/L	0.55	<0.50	0.50	7063245
Dissolved Copper (Cu)	ug/L	1.3	1.1	0.90	7063245
Dissolved Iron (Fe)	ug/L	<100	<100	100	7063245
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	0.50	7063245
Dissolved Magnesium (Mg)	ug/L	35000	24000	50	7063245
Dissolved Manganese (Mn)	ug/L	150	94	2.0	7063245
Dissolved Molybdenum (Mo)	ug/L	1.6	1.2	0.50	7063245
Dissolved Nickel (Ni)	ug/L	2.9	<1.0	1.0	7063245
Dissolved Phosphorus (P)	ug/L	100	110	100	7063245
Dissolved Potassium (K)	ug/L	5600	2500	200	7063245
Dissolved Selenium (Se)	ug/L	2.0	<2.0	2.0	7063245
Dissolved Silicon (Si)	ug/L	8400	6800	50	7063245
Dissolved Silver (Ag)	ug/L	<0.090	<0.090	0.090	7063245
Dissolved Sodium (Na)	ug/L	7900	9100	100	7063245
Dissolved Strontium (Sr)	ug/L	250	190	1.0	7063245
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	0.050	7063245
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	7063245
Dissolved Uranium (U)	ug/L	6.3	2.4	0.10	7063245
Dissolved Vanadium (V)	ug/L	0.66	<0.50	0.50	7063245
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	5.0	7063245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

RCAP - SURFACE WATER (WATER)

BV Labs ID		OEJ365		OEJ366		
Sampling Date		2020/11/14 11:15		2020/11/14 13:00		
COC Number		797632-01-01		797632-01-01		
	UNITS	**POND-PASTURE**	**RDL**	**SW STATION 8**	**RDL**	**QC Batch**
Calculated Parameters						
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	150	1.0	380	1.0	7060503
Calculated TDS	mg/L	160	1.0	510	1.0	7060508
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.4	1.0	3.3	1.0	7060503
Hardness (CaCO3)	mg/L	150	1.0	450	1.0	7059929
Langelier Index (@ 20C)	N/A	0.399		1.24		7060506
Langelier Index (@ 4C)	N/A	0.149		0.991		7060507
Saturation pH (@ 20C)	N/A	7.60		6.73		7060506
Saturation pH (@ 4C)	N/A	7.85		6.98		7060507
Inorganics						
Total Ammonia-N	mg/L	0.090	0.050	<0.050	0.050	7063695
Conductivity	umho/cm	310	1.0	890	1.0	7062535
Total Organic Carbon (TOC)	mg/L	7.6	0.40	22	0.40	7063630
Orthophosphate (P)	mg/L	0.011	0.010	0.053	0.010	7062578
pH	pH	8.00		7.97		7062532
Total Phosphorus	mg/L	0.046	0.004	0.27	0.02	7064712
Dissolved Sulphate (SO4)	mg/L	<1.0	1.0	37	1.0	7062576
Turbidity	NTU	1.7	0.1	4.3	0.1	7061148
Alkalinity (Total as CaCO3)	mg/L	150	1.0	390	1.0	7062527
Dissolved Chloride (Cl-)	mg/L	10	1.0	39	1.0	7062574
Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	7062583
Nitrate (N)	mg/L	<0.10	0.10	<0.10	0.10	7062583
Metals						
Dissolved Calcium (Ca)	mg/L	40	0.05	140	0.05	7063559
Dissolved Magnesium (Mg)	mg/L	11	0.05	22	0.05	7063559
Dissolved Potassium (K)	mg/L	4	1	20	1	7063559
Dissolved Sodium (Na)	mg/L	2.5	0.5	5.2	0.5	7063559
Total Aluminum (Al)	ug/L	18	4.9	2200	4.9	7065205
Total Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	7065205
Total Arsenic (As)	ug/L	<1.0	1.0	2.2	1.0	7065205
Total Barium (Ba)	ug/L	10	2.0	54	2.0	7065205

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RCAP - SURFACE WATER (WATER)

BV Labs ID		OEJ365		OEJ366		
Sampling Date		2020/11/14 11:15		2020/11/14 13:00		
COC Number		797632-01-01		797632-01-01		
	UNITS	**POND-PASTURE**	**RDL**	**SW STATION 8**	**RDL**	**QC Batch**
Total Beryllium (Be)	ug/L	<0.40	0.40	<0.40	0.40	7065205
Total Boron (B)	ug/L	11	10	39	10	7065205
Total Cadmium (Cd)	ug/L	<0.090	0.090	<0.090	0.090	7065205
Total Calcium (Ca)	ug/L	41000	200	150000	200	7065205
Total Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	7065205
Total Cobalt (Co)	ug/L	<0.50	0.50	2.4	0.50	7065205
Total Copper (Cu)	ug/L	<0.90	0.90	2.8	0.90	7065205
Total Iron (Fe)	ug/L	430	100	3600	100	7065205
Total Lead (Pb)	ug/L	<0.50	0.50	1.6	0.50	7065205
Total Magnesium (Mg)	ug/L	11000	50	23000	50	7065205
Total Manganese (Mn)	ug/L	59	2.0	2000	2.0	7065205
Total Molybdenum (Mo)	ug/L	<0.50	0.50	1.0	0.50	7065205
Total Nickel (Ni)	ug/L	<1.0	1.0	3.5	1.0	7065205
Total Potassium (K)	ug/L	3500	200	18000	200	7065205
Total Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	7065205
Total Silicon (Si)	ug/L	410	50	7500	50	7065205
Total Silver (Ag)	ug/L	<0.090	0.090	<0.090	0.090	7065205
Total Sodium (Na)	ug/L	2200	100	4900	100	7065205
Total Strontium (Sr)	ug/L	83	1.0	240	1.0	7065205
Total Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	7065205
Total Titanium (Ti)	ug/L	<5.0	5.0	71	5.0	7065205
Total Vanadium (V)	ug/L	<0.50	0.50	4.3	0.50	7065205
Total Zinc (Zn)	ug/L	<5.0	5.0	18	5.0	7065205

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		OEJ365	OEJ366		
Sampling Date		2020/11/14 11:15	2020/11/14 13:00		
COC Number		797632-01-01	797632-01-01		
	UNITS	**POND-PASTURE**	**SW STATION 8**	**RDL**	**QC Batch**
Metals					
Dissolved Aluminum (Al)	ug/L	14	<4.9	4.9	7063536
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	0.50	7063536
Dissolved Arsenic (As)	ug/L	<1.0	1.2	1.0	7063536
Dissolved Barium (Ba)	ug/L	9.1	29	2.0	7063536
Dissolved Beryllium (Be)	ug/L	<0.40	<0.40	0.40	7063536
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	1.0	7063536
Dissolved Boron (B)	ug/L	<10	40	10	7063536
Dissolved Cadmium (Cd)	ug/L	<0.090	<0.090	0.090	7063536
Dissolved Calcium (Ca)	ug/L	41000	150000	200	7063536
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	5.0	7063536
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	0.50	7063536
Dissolved Copper (Cu)	ug/L	<0.90	<0.90	0.90	7063536
Dissolved Iron (Fe)	ug/L	<100	<100	100	7063536
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	0.50	7063536
Dissolved Lithium (Li)	ug/L	<5.0	<5.0	5.0	7063536
Dissolved Magnesium (Mg)	ug/L	11000	22000	50	7063536
Dissolved Manganese (Mn)	ug/L	2.1	<2.0	2.0	7063536
Dissolved Molybdenum (Mo)	ug/L	<0.50	<0.50	0.50	7063536
Dissolved Nickel (Ni)	ug/L	<1.0	<1.0	1.0	7063536
Dissolved Phosphorus (P)	ug/L	120	160	100	7063536
Dissolved Potassium (K)	ug/L	3500	19000	200	7063536
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	2.0	7063536
Dissolved Silicon (Si)	ug/L	390	4300	50	7063536
Dissolved Silver (Ag)	ug/L	<0.090	<0.090	0.090	7063536
Dissolved Sodium (Na)	ug/L	2300	4700	100	7063536
Dissolved Strontium (Sr)	ug/L	82	220	1.0	7063536
Dissolved Tellurium (Te)	ug/L	<1.0	<1.0	1.0	7063536
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	0.050	7063536
Dissolved Tin (Sn)	ug/L	<1.0	<1.0	1.0	7063536
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	7063536

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		OEJ365	OEJ366		
Sampling Date		2020/11/14 11:15	2020/11/14 13:00		
COC Number		797632-01-01	797632-01-01		
	UNITS	**POND-PASTURE**	**SW STATION 8**	**RDL**	**QC Batch**
Dissolved Tungsten (W)	ug/L	<1.0	<1.0	1.0	7063536
Dissolved Uranium (U)	ug/L	0.82	4.4	0.10	7063536
Dissolved Vanadium (V)	ug/L	<0.50	<0.50	0.50	7063536
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	5.0	7063536
Dissolved Zirconium (Zr)	ug/L	<1.0	<1.0	1.0	7063536

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

TEST SUMMARY

BV Labs ID: OEJ363
Sample ID: MW302
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7062685	N/A	2020/11/18	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7060503	N/A	2020/11/19	Automated Statchk
Chloride by Automated Colourimetry	KONE	7063036	N/A	2020/11/19	Alina Dobreanu
Conductivity	AT	7062693	N/A	2020/11/18	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7063442	N/A	2020/11/19	Nimarta Singh
Hardness (calculated as CaCO3)		7059929	N/A	2020/11/19	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	7063245	2020/11/18	2020/11/19	Nan Raykha
Ion Balance (% Difference)	CALC	7060504	N/A	2020/11/20	Automated Statchk
Anion and Cation Sum	CALC	7060505	N/A	2020/11/19	Automated Statchk
Total Ammonia-N	LACH/NH4	7063695	N/A	2020/11/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7062633	N/A	2020/11/19	Chandra Nandlal
pH	AT	7062698	2020/11/18	2020/11/18	Surinder Rai
Orthophosphate	KONE	7063051	N/A	2020/11/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	7060506	N/A	2020/11/20	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7060507	N/A	2020/11/20	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7063043	N/A	2020/11/19	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7060508	N/A	2020/11/20	Automated Statchk

BV Labs ID: OEJ364
Sample ID: MW303
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7062685	N/A	2020/11/18	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7060503	N/A	2020/11/19	Automated Statchk
Chloride by Automated Colourimetry	KONE	7063036	N/A	2020/11/19	Alina Dobreanu
Conductivity	AT	7062693	N/A	2020/11/18	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7063442	N/A	2020/11/19	Nimarta Singh
Hardness (calculated as CaCO3)		7059929	N/A	2020/11/19	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	7063245	2020/11/18	2020/11/19	Nan Raykha
Ion Balance (% Difference)	CALC	7060504	N/A	2020/11/20	Automated Statchk
Anion and Cation Sum	CALC	7060505	N/A	2020/11/19	Automated Statchk
Total Ammonia-N	LACH/NH4	7063695	N/A	2020/11/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7062633	N/A	2020/11/19	Chandra Nandlal
pH	AT	7062698	2020/11/18	2020/11/18	Surinder Rai
Orthophosphate	KONE	7063051	N/A	2020/11/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	7060506	N/A	2020/11/20	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7060507	N/A	2020/11/20	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7063043	N/A	2020/11/19	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7060508	N/A	2020/11/20	Automated Statchk

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

TEST SUMMARY

BV Labs ID: OEJ364 Dup
Sample ID: MW303
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7062685	N/A	2020/11/18	Surinder Rai
Conductivity	AT	7062693	N/A	2020/11/18	Surinder Rai
pH	AT	7062698	2020/11/18	2020/11/18	Surinder Rai

BV Labs ID: OEJ365
Sample ID: POND-PASTURE
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7062527	N/A	2020/11/19	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7060503	N/A	2020/11/19	Automated Statchk
Chloride by Automated Colourimetry	KONE	7062574	N/A	2020/11/19	Deonarine Ramnarine
Conductivity	AT	7062535	N/A	2020/11/19	Surinder Rai
Hardness (calculated as CaCO3)		7059929	N/A	2020/11/20	Automated Statchk
Lab Filtered Metals Analysis by ICP	ICP	7063559	2020/11/18	2020/11/19	Suban Kanapathippllai
Lab Filtered Metals by ICPMS	ICP/MS	7063536	2020/11/18	2020/11/19	Nan Raykha
Total Metals Analysis by ICPMS	ICP/MS	7065205	N/A	2020/11/19	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7063695	N/A	2020/11/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7062583	N/A	2020/11/19	Chandra Nandlal
pH	AT	7062532	2020/11/18	2020/11/19	Surinder Rai
Orthophosphate	KONE	7062578	N/A	2020/11/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	7060506	N/A	2020/11/20	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7060507	N/A	2020/11/20	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7062576	N/A	2020/11/19	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7060508	N/A	2020/11/20	Automated Statchk
Total Organic Carbon (TOC)	TOCV/NDIR	7063630	N/A	2020/11/20	Nimarta Singh
Total Phosphorus (Colourimetric)	LACH/P	7064712	2020/11/19	2020/11/19	Shivani Shivani
Turbidity	AT	7061148	N/A	2020/11/18	Viorica Rotaru

BV Labs ID: OEJ365 Dup
Sample ID: POND-PASTURE
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Lab Filtered Metals Analysis by ICP	ICP	7063559	2020/11/18	2020/11/19	Suban Kanapathippllai

BV Labs ID: OEJ366
Sample ID: SW STATION 8
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7062527	N/A	2020/11/19	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7060503	N/A	2020/11/19	Automated Statchk
Chloride by Automated Colourimetry	KONE	7062574	N/A	2020/11/19	Deonarine Ramnarine

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

TEST SUMMARY

BV Labs ID: OEJ366
Sample ID: SW STATION 8
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7062535	N/A	2020/11/19	Surinder Rai
Hardness (calculated as CaCO3)		7059929	N/A	2020/11/20	Automated Statchk
Lab Filtered Metals Analysis by ICP	ICP	7063559	2020/11/18	2020/11/19	Suban Kanapathippllai
Lab Filtered Metals by ICPMS	ICP/MS	7063536	2020/11/18	2020/11/19	Nan Raykha
Total Metals Analysis by ICPMS	ICP/MS	7065205	N/A	2020/11/19	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7063695	N/A	2020/11/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7062583	N/A	2020/11/19	Chandra Nandlal
pH	AT	7062532	2020/11/18	2020/11/19	Surinder Rai
Orthophosphate	KONE	7062578	N/A	2020/11/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	7060506	N/A	2020/11/20	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7060507	N/A	2020/11/20	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7062576	N/A	2020/11/19	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7060508	N/A	2020/11/20	Automated Statchk
Total Organic Carbon (TOC)	TOCV/NDIR	7063630	N/A	2020/11/20	Nimarta Singh
Total Phosphorus (Colourimetric)	LACH/P	7064712	2020/11/19	2020/11/19	Shivani Shivani
Turbidity	AT	7061148	N/A	2020/11/18	Viorica Rotaru

BV Labs ID: OEJ366 Dup
Sample ID: SW STATION 8
Matrix: Water

Collected: 2020/11/14
Shipped:
Received: 2020/11/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7062574	N/A	2020/11/19	Deonarine Ramnarine
Lab Filtered Metals by ICPMS	ICP/MS	7063536	2020/11/18	2020/11/19	Nan Raykha
Orthophosphate	KONE	7062578	N/A	2020/11/19	Alina Dobreanu
Sulphate by Automated Colourimetry	KONE	7062576	N/A	2020/11/19	Deonarine Ramnarine

BV Labs Job #: C0U4788
Report Date: 2020/11/23

exp Services Inc
Client Project #: LON-00014456-GE
Site Location: W3 FORMS
Sampler Initials: M.B

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.0°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7061148	Turbidity	2020/11/18			110	85 - 115	<0.1	NTU	0.59	20		
7062527	Alkalinity (Total as CaCO3)	2020/11/19			96	85 - 115	<1.0	mg/L	1.8	20		
7062532	pH	2020/11/19			101	98 - 103			1.7	N/A		
7062535	Conductivity	2020/11/19			101	85 - 115	<1.0	umho/cm	0.38	25		
7062574	Dissolved Chloride (Cl-)	2020/11/19	131 (1)	80 - 120	103	80 - 120	<1.0	mg/L	2.5	20		
7062576	Dissolved Sulphate (SO4)	2020/11/19	108	75 - 125	102	80 - 120	<1.0	mg/L	2.0	20		
7062578	Orthophosphate (P)	2020/11/19	107	75 - 125	100	80 - 120	<0.010	mg/L	NC	25		
7062583	Nitrate (N)	2020/11/19	95	80 - 120	97	80 - 120	<0.10	mg/L	1.9	20		
7062583	Nitrite (N)	2020/11/19	104	80 - 120	103	80 - 120	<0.010	mg/L	2.8	20		
7062633	Nitrate (N)	2020/11/19	97	80 - 120	98	80 - 120	<0.10	mg/L	1.2	20		
7062633	Nitrite (N)	2020/11/19	103	80 - 120	103	80 - 120	<0.010	mg/L	6.8	20		
7062685	Alkalinity (Total as CaCO3)	2020/11/18			96	85 - 115	<1.0	mg/L	1.8	20		
7062693	Conductivity	2020/11/18			102	85 - 115	<1.0	umho/cm	0.31	25		
7062698	pH	2020/11/18			101	98 - 103			0.70	N/A		
7063036	Dissolved Chloride (Cl-)	2020/11/19	78 (1)	80 - 120	102	80 - 120	<1.0	mg/L	2.8	20		
7063043	Dissolved Sulphate (SO4)	2020/11/19	97	75 - 125	102	80 - 120	<1.0	mg/L	0.73	20		
7063051	Orthophosphate (P)	2020/11/19	114	75 - 125	101	80 - 120	<0.010	mg/L	NC	25		
7063245	Dissolved Aluminum (Al)	2020/11/19	106	80 - 120	105	80 - 120	<4.9	ug/L	NC	20		
7063245	Dissolved Antimony (Sb)	2020/11/19	105	80 - 120	102	80 - 120	<0.50	ug/L	NC	20		
7063245	Dissolved Arsenic (As)	2020/11/19	98	80 - 120	99	80 - 120	<1.0	ug/L	1.1	20		
7063245	Dissolved Barium (Ba)	2020/11/19	99	80 - 120	103	80 - 120	<2.0	ug/L	1.9	20		
7063245	Dissolved Beryllium (Be)	2020/11/19	103	80 - 120	103	80 - 120	<0.40	ug/L	NC	20		
7063245	Dissolved Boron (B)	2020/11/19	100	80 - 120	98	80 - 120	<10	ug/L	0.27	20		
7063245	Dissolved Cadmium (Cd)	2020/11/19	101	80 - 120	100	80 - 120	<0.090	ug/L	NC	20		
7063245	Dissolved Calcium (Ca)	2020/11/19	104	80 - 120	103	80 - 120	<200	ug/L	2.9	20		
7063245	Dissolved Chromium (Cr)	2020/11/19	98	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
7063245	Dissolved Cobalt (Co)	2020/11/19	96	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
7063245	Dissolved Copper (Cu)	2020/11/19	101	80 - 120	101	80 - 120	<0.90	ug/L	NC	20		
7063245	Dissolved Iron (Fe)	2020/11/19	97	80 - 120	99	80 - 120	<100	ug/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7063245	Dissolved Lead (Pb)	2020/11/19	96	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7063245	Dissolved Magnesium (Mg)	2020/11/19	96	80 - 120	103	80 - 120	<50	ug/L	1.7	20		
7063245	Dissolved Manganese (Mn)	2020/11/19	100	80 - 120	101	80 - 120	<2.0	ug/L	1.6	20		
7063245	Dissolved Molybdenum (Mo)	2020/11/19	104	80 - 120	100	80 - 120	<0.50	ug/L	8.8	20		
7063245	Dissolved Nickel (Ni)	2020/11/19	94	80 - 120	95	80 - 120	<1.0	ug/L	1.7	20		
7063245	Dissolved Phosphorus (P)	2020/11/19	107	80 - 120	128 (1)	80 - 120	<100	ug/L	4.6	20		
7063245	Dissolved Potassium (K)	2020/11/19	104	80 - 120	105	80 - 120	<200	ug/L	2.6	20		
7063245	Dissolved Selenium (Se)	2020/11/19	99	80 - 120	98	80 - 120	<2.0	ug/L	NC	20		
7063245	Dissolved Silicon (Si)	2020/11/19	106	80 - 120	104	80 - 120	<50	ug/L	1.6	20		
7063245	Dissolved Silver (Ag)	2020/11/19	99	80 - 120	99	80 - 120	<0.090	ug/L	NC	20		
7063245	Dissolved Sodium (Na)	2020/11/19	100	80 - 120	102	80 - 120	<100	ug/L	0.76	20		
7063245	Dissolved Strontium (Sr)	2020/11/19	97	80 - 120	97	80 - 120	<1.0	ug/L	0.82	20		
7063245	Dissolved Thallium (Tl)	2020/11/19	98	80 - 120	99	80 - 120	<0.050	ug/L	NC	20		
7063245	Dissolved Titanium (Ti)	2020/11/19	99	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
7063245	Dissolved Uranium (U)	2020/11/19	97	80 - 120	98	80 - 120	<0.10	ug/L	1.2	20		
7063245	Dissolved Vanadium (V)	2020/11/19	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20		
7063245	Dissolved Zinc (Zn)	2020/11/19	97	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
7063442	Dissolved Organic Carbon	2020/11/19	95	80 - 120	102	80 - 120	<0.40	mg/L	1.7	20		
7063536	Dissolved Aluminum (Al)	2020/11/19	104	80 - 120	108	80 - 120	<4.9	ug/L	NC	20		
7063536	Dissolved Antimony (Sb)	2020/11/19	104	80 - 120	102	80 - 120	<0.50	ug/L	NC	20		
7063536	Dissolved Arsenic (As)	2020/11/19	98	80 - 120	100	80 - 120	<1.0	ug/L	8.8	20		
7063536	Dissolved Barium (Ba)	2020/11/19	101	80 - 120	104	80 - 120	<2.0	ug/L	1.9	20		
7063536	Dissolved Beryllium (Be)	2020/11/19	102	80 - 120	102	80 - 120	<0.40	ug/L	NC	20		
7063536	Dissolved Bismuth (Bi)	2020/11/19	96	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
7063536	Dissolved Boron (B)	2020/11/19	97	80 - 120	96	80 - 120	<10	ug/L	2.5	20		
7063536	Dissolved Cadmium (Cd)	2020/11/19	101	80 - 120	100	80 - 120	<0.090	ug/L	NC	20		
7063536	Dissolved Calcium (Ca)	2020/11/19	90	80 - 120	104	80 - 120	<200	ug/L	0.43	20		
7063536	Dissolved Chromium (Cr)	2020/11/19	98	80 - 120	102	80 - 120	<5.0	ug/L	NC	20		
7063536	Dissolved Cobalt (Co)	2020/11/19	96	80 - 120	101	80 - 120	<0.50	ug/L	NC	20		
7063536	Dissolved Copper (Cu)	2020/11/19	101	80 - 120	102	80 - 120	<0.90	ug/L	NC	20		
7063536	Dissolved Iron (Fe)	2020/11/19	97	80 - 120	101	80 - 120	<100	ug/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7063536	Dissolved Lead (Pb)	2020/11/19	96	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7063536	Dissolved Lithium (Li)	2020/11/19	104	80 - 120	103	80 - 120	<5.0	ug/L	NC	20		
7063536	Dissolved Magnesium (Mg)	2020/11/19	97	80 - 120	106	80 - 120	<50	ug/L	0.72	20		
7063536	Dissolved Manganese (Mn)	2020/11/19	99	80 - 120	103	80 - 120	<2.0	ug/L	NC	20		
7063536	Dissolved Molybdenum (Mo)	2020/11/19	103	80 - 120	101	80 - 120	<0.50	ug/L	NC	20		
7063536	Dissolved Nickel (Ni)	2020/11/19	94	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
7063536	Dissolved Phosphorus (P)	2020/11/19	109	80 - 120	127 (1)	80 - 120	<100	ug/L	3.5	20		
7063536	Dissolved Potassium (K)	2020/11/19	98	80 - 120	110	80 - 120	<200	ug/L	0.30	20		
7063536	Dissolved Selenium (Se)	2020/11/19	98	80 - 120	98	80 - 120	<2.0	ug/L	NC	20		
7063536	Dissolved Silicon (Si)	2020/11/19	103	80 - 120	107	80 - 120	<50	ug/L	0.13	20		
7063536	Dissolved Silver (Ag)	2020/11/19	97	80 - 120	99	80 - 120	<0.090	ug/L	NC	20		
7063536	Dissolved Sodium (Na)	2020/11/19	99	80 - 120	105	80 - 120	<100	ug/L	1.8	20		
7063536	Dissolved Strontium (Sr)	2020/11/19	97	80 - 120	100	80 - 120	<1.0	ug/L	1.6	20		
7063536	Dissolved Tellurium (Te)	2020/11/19	102	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7063536	Dissolved Thallium (Tl)	2020/11/19	97	80 - 120	100	80 - 120	<0.050	ug/L	NC	20		
7063536	Dissolved Tin (Sn)	2020/11/19	104	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7063536	Dissolved Titanium (Ti)	2020/11/19	101	80 - 120	102	80 - 120	<5.0	ug/L	NC	20		
7063536	Dissolved Tungsten (W)	2020/11/19	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7063536	Dissolved Uranium (U)	2020/11/19	97	80 - 120	98	80 - 120	<0.10	ug/L	1.4	20		
7063536	Dissolved Vanadium (V)	2020/11/19	100	80 - 120	104	80 - 120	<0.50	ug/L	NC	20		
7063536	Dissolved Zinc (Zn)	2020/11/19	96	80 - 120	101	80 - 120	<5.0	ug/L	NC	20		
7063536	Dissolved Zirconium (Zr)	2020/11/19	107	80 - 120	104	80 - 120	<1.0	ug/L	NC	20		
7063559	Dissolved Calcium (Ca)	2020/11/19	72 (1)	80 - 120	95	80 - 120	<0.05	mg/L	2.0	25		
7063559	Dissolved Magnesium (Mg)	2020/11/19	87	80 - 120	94	80 - 120	<0.05	mg/L	1.5	25		
7063559	Dissolved Potassium (K)	2020/11/19	99	80 - 120	102	80 - 120	<1	mg/L	1.9	25		
7063559	Dissolved Sodium (Na)	2020/11/19	99	80 - 120	101	80 - 120	<0.5	mg/L	1.6	25		
7063630	Total Organic Carbon (TOC)	2020/11/20	96	80 - 120	101	80 - 120	<0.40	mg/L	1.3	20		
7063695	Total Ammonia-N	2020/11/19	97	75 - 125	101	80 - 120	<0.050	mg/L	8.6	20		
7064712	Total Phosphorus	2020/11/19	104	80 - 120	102	80 - 120	<0.004	mg/L	1.4	20	100	80 - 120
7065205	Total Aluminum (Al)	2020/11/19	109	80 - 120	106	80 - 120	<4.9	ug/L				
7065205	Total Antimony (Sb)	2020/11/19	105	80 - 120	103	80 - 120	<0.50	ug/L				

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7065205	Total Arsenic (As)	2020/11/19	102	80 - 120	101	80 - 120	<1.0	ug/L				
7065205	Total Barium (Ba)	2020/11/19	99	80 - 120	98	80 - 120	<2.0	ug/L				
7065205	Total Beryllium (Be)	2020/11/19	104	80 - 120	104	80 - 120	<0.40	ug/L				
7065205	Total Boron (B)	2020/11/19	99	80 - 120	98	80 - 120	<10	ug/L				
7065205	Total Cadmium (Cd)	2020/11/19	103	80 - 120	102	80 - 120	<0.090	ug/L				
7065205	Total Calcium (Ca)	2020/11/19	106	80 - 120	103	80 - 120	<200	ug/L				
7065205	Total Chromium (Cr)	2020/11/19	101	80 - 120	100	80 - 120	<5.0	ug/L				
7065205	Total Cobalt (Co)	2020/11/19	99	80 - 120	98	80 - 120	<0.50	ug/L				
7065205	Total Copper (Cu)	2020/11/19	100	80 - 120	100	80 - 120	<0.90	ug/L	NC	20		
7065205	Total Iron (Fe)	2020/11/19	97	80 - 120	97	80 - 120	<100	ug/L	NC	20		
7065205	Total Lead (Pb)	2020/11/19	98	80 - 120	98	80 - 120	<0.50	ug/L				
7065205	Total Magnesium (Mg)	2020/11/19	99	80 - 120	99	80 - 120	<50	ug/L				
7065205	Total Manganese (Mn)	2020/11/19	99	80 - 120	98	80 - 120	<2.0	ug/L				
7065205	Total Molybdenum (Mo)	2020/11/19	103	80 - 120	102	80 - 120	<0.50	ug/L				
7065205	Total Nickel (Ni)	2020/11/19	99	80 - 120	99	80 - 120	<1.0	ug/L				
7065205	Total Potassium (K)	2020/11/19	101	80 - 120	98	80 - 120	<200	ug/L				
7065205	Total Selenium (Se)	2020/11/19	111	80 - 120	111	80 - 120	<2.0	ug/L				
7065205	Total Silicon (Si)	2020/11/19	104	80 - 120	103	80 - 120	<50	ug/L				
7065205	Total Silver (Ag)	2020/11/19	100	80 - 120	99	80 - 120	<0.090	ug/L				
7065205	Total Sodium (Na)	2020/11/19	100	80 - 120	99	80 - 120	<100	ug/L				
7065205	Total Strontium (Sr)	2020/11/19	98	80 - 120	96	80 - 120	<1.0	ug/L				
7065205	Total Thallium (Tl)	2020/11/19	97	80 - 120	97	80 - 120	<0.050	ug/L				
7065205	Total Titanium (Ti)	2020/11/19	101	80 - 120	104	80 - 120	<5.0	ug/L				
7065205	Total Vanadium (V)	2020/11/19	102	80 - 120	100	80 - 120	<0.50	ug/L				

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7065205	Total Zinc (Zn)	2020/11/19	106	80 - 120	106	80 - 120	<5.0	ug/L	2.7	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories
109 & 110, 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel:(519) 652-9444 Toll-free:800-563-6266 Fax:(519) 652-8189 www.bvlabs.com

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#28124 exp Services Inc	Company Name:	EXP	Quotation #:	B91718	BV Labs Job #:	Bottle Order #: 797632
Attention:	Accounts Payable	Attention:		P.O. #:	LON-00014456-GE		
Address:	15701 Robin's Hill Rd Unit 2	Address:		Project:	~~LON-00015310-GE~~	COC #: C#797632-01-01	Project Manager: Christine Gripton
	London ON N5V 0A5			Project Name:	403 Farms		
Tel:	(519) 963-3000 Fax: (519) 963-1152	Tel:	Fax:	Site #:	~~Parkers Jackson~~		
Email:	AP@exp.com, karen.Burke@exp.com, Lo-Ellen.Mitton	Email:	Mark.Bertens@exp.com	Sampled By:	M. Bertens		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☒ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive (Lab Filtered)	RCAP - Surface Water	Lab Filtered Metals by ICPMS								# of Bottles	Comments
1		MW302	Nov 14/20	12:00	GW		X										3	
2		MW303	Nov 14/20	12:30	GW		X										3	
3					~~GW~~													
4		SW Station 8	Nov 14/20	11:15	SW			X	X								5	
5		Pond- Pasture	Nov 14/20	13:00	SW			X	X								5	
6																		
7																		
8																		after hours
9																		
10																		NO ICE.

RECD IN LONDON

16-Nov-20 08:00
Christine Gripton
C0U4788
DSC ENV-982

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Time Sensitive	Laboratory Use Only	Custody Seal	Yes	No
Mark Bertens	20/11/14	13:30	Dunsin Adeyemi Dennison	2020/11/16	8:00			Temperature (°C) on Recei 3/3/3 C	Present		X
			Gurleen Johal	2020/11/16	17:35				Intact		X

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

3.3.4
BV #204083

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BUREAU VERITAS

Your Project #: LON-00014456
Site Location: W3 FARMS
Your C.O.C. #: 814603-01-01

Attention: Heather Jaggard

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2021/03/31
Report #: R6576902
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C178300
Received: 2021/03/24, 13:10

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	4	N/A	2021/03/26	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2021/03/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	2	N/A	2021/03/26	CAM SOP-00463	SM 23 4500-Cl E m
Chloride by Automated Colourimetry	2	N/A	2021/03/29	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	N/A	2021/03/26	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	2	N/A	2021/03/27	CAM SOP-00446	SM 23 5310 B m
Hardness (calculated as CaCO3)	3	N/A	2021/03/30	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3)	1	N/A	2021/03/31	CAM SOP 00102/00408/00447	SM 2340 B
Lab Filtered Metals Analysis by ICP	2	2021/03/27	2021/03/29	CAM SOP-00408	EPA 6010D m
Lab Filtered Metals by ICPMS	2	2021/03/27	2021/03/30	CAM SOP-00447	EPA 6020B m
Lab Filtered Metals by ICPMS	2	2021/03/30	2021/03/31	CAM SOP-00447	EPA 6020B m
Total Metals Analysis by ICPMS	2	N/A	2021/03/29	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2021/03/30		
Ion Balance (% Difference)	1	N/A	2021/03/31		
Anion and Cation Sum	1	N/A	2021/03/30		
Anion and Cation Sum	1	N/A	2021/03/31		
Total Ammonia-N	2	N/A	2021/03/29	CAM SOP-00441	USGS I-2522-90 m
Total Ammonia-N	2	N/A	2021/03/30	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	4	N/A	2021/03/26	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	4	2021/03/25	2021/03/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	2	N/A	2021/03/26	CAM SOP-00461	EPA 365.1 m
Orthophosphate	2	N/A	2021/03/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	3	N/A	2021/03/30		Auto Calc
Sat. pH and Langelier Index (@ 20C)	1	N/A	2021/03/31		Auto Calc
Sat. pH and Langelier Index (@ 4C)	3	N/A	2021/03/30		Auto Calc
Sat. pH and Langelier Index (@ 4C)	1	N/A	2021/03/31		Auto Calc
Sulphate by Automated Colourimetry	2	N/A	2021/03/26	CAM SOP-00464	EPA 375.4 m

Your Project #: LON-00014456
Site Location: W3 FARMS
Your C.O.C. #: 814603-01-01

Attention: Heather Jaggard

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2021/03/31
Report #: R6576902
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C178300
Received: 2021/03/24, 13:10

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sulphate by Automated Colourimetry	2	N/A	2021/03/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	3	N/A	2021/03/30		Auto Calc
Total Dissolved Solids (TDS calc)	1	N/A	2021/03/31		Auto Calc
Total Organic Carbon (TOC) (3)	2	N/A	2021/03/26	CAM SOP-00446	SM 23 5310B m
Total Phosphorus (Colourimetric)	2	2021/03/26	2021/03/26	CAM SOP-00407	SM 23 4500 P B H m
Turbidity	2	N/A	2021/03/26	CAM SOP-00417	SM 23 2130 B m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(3) Total Organic Carbon (TOC) present in the sample should be considered as non-purgeable TOC.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Your Project #: LON-00014456
Site Location: W3 FARMS
Your C.O.C. #: 814603-01-01

Attention: Heather Jaggard

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2021/03/31
Report #: R6576902
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C178300
Received: 2021/03/24, 13:10

Encryption Key

Christine Gripton
Senior Project Manager
31 Mar 2021 15:52:27

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bureauveritas.com
Phone# (519)652-9444
==
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RCAP - COMPREHENSIVE (LAB FILTERED)

BV Labs ID		PDS753		PDS754		
Sampling Date		2021/03/23 12:00		2021/03/23 13:00		
COC Number		814603-01-01		814603-01-01		
	UNITS	MW302	QC Batch	MW303	RDL	QC Batch
Calculated Parameters						
Anion Sum	me/L	9.04	7266563	6.96	N/A	7266563
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	380	7266523	230	1.0	7266523
Calculated TDS	mg/L	480	7266568	380	1.0	7266568
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.1	7266523	2.5	1.0	7266523
Cation Sum	me/L	9.32	7266563	6.97	N/A	7266563
Hardness (CaCO3)	mg/L	440	7266294	330	1.0	7266294
Ion Balance (% Difference)	%	1.50	7266316	0.0900	N/A	7266316
Langelier Index (@ 20C)	N/A	1.15	7266564	0.927		7266564
Langelier Index (@ 4C)	N/A	0.901	7266565	0.679		7266565
Saturation pH (@ 20C)	N/A	6.79	7266564	7.13		7266564
Saturation pH (@ 4C)	N/A	7.04	7266565	7.37		7266565
Inorganics						
Total Ammonia-N	mg/L	<0.050	7269357	<0.050	0.050	7269357
Conductivity	umho/cm	800	7267569	650	1.0	7267569
Dissolved Organic Carbon	mg/L	1.2	7268303	0.55	0.40	7268303
Orthophosphate (P)	mg/L	<0.010	7269591	<0.010	0.010	7270498
pH	pH	7.94	7267571	8.05		7267571
Dissolved Sulphate (SO4)	mg/L	50	7269590	67	1.0	7270499
Alkalinity (Total as CaCO3)	mg/L	380	7267562	230	1.0	7267562
Dissolved Chloride (Cl-)	mg/L	13	7269566	26	1.0	7270496
Nitrite (N)	mg/L	<0.010	7268014	<0.010	0.010	7268014
Nitrate (N)	mg/L	<0.10	7268014	1.94	0.10	7268014
Nitrate + Nitrite (N)	mg/L	<0.10	7268014	1.94	0.10	7268014
Metals						
Dissolved Aluminum (Al)	ug/L	<4.9	7270416	6.6	4.9	7274526
Dissolved Antimony (Sb)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Arsenic (As)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Barium (Ba)	ug/L	160	7270416	100	2.0	7274526
Dissolved Beryllium (Be)	ug/L	<0.40	7270416	<0.40	0.40	7274526
Dissolved Boron (B)	ug/L	28	7270416	16	10	7274526

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

RCAP - COMPREHENSIVE (LAB FILTERED)

BV Labs ID		PDS753		PDS754		
Sampling Date		2021/03/23 12:00		2021/03/23 13:00		
COC Number		814603-01-01		814603-01-01		
	UNITS	MW302	QC Batch	MW303	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	7270416	<0.090	0.090	7274526
Dissolved Calcium (Ca)	ug/L	120000	7270416	88000	200	7274526
Dissolved Chromium (Cr)	ug/L	<5.0	7270416	<5.0	5.0	7274526
Dissolved Cobalt (Co)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Copper (Cu)	ug/L	<0.90	7270416	<0.90	0.90	7274526
Dissolved Iron (Fe)	ug/L	<100	7270416	<100	100	7274526
Dissolved Lead (Pb)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Magnesium (Mg)	ug/L	32000	7270416	27000	50	7274526
Dissolved Manganese (Mn)	ug/L	18	7270416	9.0	2.0	7274526
Dissolved Molybdenum (Mo)	ug/L	2.3	7270416	1.5	0.50	7274526
Dissolved Nickel (Ni)	ug/L	1.3	7270416	<1.0	1.0	7274526
Dissolved Phosphorus (P)	ug/L	<100	7270416	<100	100	7274526
Dissolved Potassium (K)	ug/L	2600	7270416	1300	200	7274526
Dissolved Selenium (Se)	ug/L	<2.0	7270416	<2.0	2.0	7274526
Dissolved Silicon (Si)	ug/L	7400	7270416	7200	50	7274526
Dissolved Silver (Ag)	ug/L	<0.090	7270416	<0.090	0.090	7274526
Dissolved Sodium (Na)	ug/L	11000	7270416	7500	100	7274526
Dissolved Strontium (Sr)	ug/L	210	7270416	170	1.0	7274526
Dissolved Thallium (Tl)	ug/L	<0.050	7270416	<0.050	0.050	7274526
Dissolved Titanium (Ti)	ug/L	<5.0	7270416	<5.0	5.0	7274526
Dissolved Uranium (U)	ug/L	5.0	7270416	1.2	0.10	7274526
Dissolved Vanadium (V)	ug/L	0.51	7270416	<0.50	0.50	7274526
Dissolved Zinc (Zn)	ug/L	33	7270416	7.5	5.0	7274526

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RCAP - SURFACE WATER (WATER)

BV Labs ID		PDS755		PDS756		
Sampling Date		2021/03/23 13:30		2021/03/23 13:45		
COC Number		814603-01-01		814603-01-01		
	UNITS	**SW STATION 8**	**RDL**	**SW STATION 7**	**RDL**	**QC Batch**
Calculated Parameters						
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	220	1.0	130	1.0	7266523
Calculated TDS	mg/L	270	1.0	160	1.0	7266568
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.7	1.0	6.6	1.0	7266523
Hardness (CaCO3)	mg/L	260	1.0	140	1.0	7266294
Langelier Index (@ 20C)	N/A	0.765		1.17		7266564
Langelier Index (@ 4C)	N/A	0.516		0.918		7266565
Saturation pH (@ 20C)	N/A	7.16		7.58		7266564
Saturation pH (@ 4C)	N/A	7.40		7.83		7266565
Inorganics						
Total Ammonia-N	mg/L	0.075	0.050	<0.050	0.050	7268433
Conductivity	umho/cm	490	1.0	300	1.0	7267569
Total Organic Carbon (TOC)	mg/L	14	0.40	7.6	0.40	7268461
Orthophosphate (P)	mg/L	0.047	0.010	<0.010	0.010	7267589
pH	pH	7.92		8.75		7267571
Total Phosphorus	mg/L	0.39	0.02	0.060	0.004	7268243
Dissolved Sulphate (SO4)	mg/L	11	1.0	1.1	1.0	7267587
Turbidity	NTU	2.3	0.1	2.0	0.1	7267213
Alkalinity (Total as CaCO3)	mg/L	220	1.0	130	1.0	7267562
Dissolved Chloride (Cl-)	mg/L	20	1.0	18	1.0	7267583
Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	7267582
Nitrate (N)	mg/L	<0.10	0.10	<0.10	0.10	7267582
Metals						
Dissolved Calcium (Ca)	mg/L	82	0.05	47	0.05	7270366
Dissolved Magnesium (Mg)	mg/L	13	0.05	6.2	0.05	7270366
Dissolved Potassium (K)	mg/L	4	1	5	1	7270366
Dissolved Sodium (Na)	mg/L	2.9	0.5	7.2	0.5	7270366
Total Aluminum (Al)	ug/L	69	4.9	61	4.9	7268992
Total Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	7268992
Total Arsenic (As)	ug/L	<1.0	1.0	<1.0	1.0	7268992
Total Barium (Ba)	ug/L	23	2.0	13	2.0	7268992

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RCAP - SURFACE WATER (WATER)

BV Labs ID		PDS755		PDS756		
Sampling Date		2021/03/23 13:30		2021/03/23 13:45		
COC Number		814603-01-01		814603-01-01		
	UNITS	**SW STATION 8**	**RDL**	**SW STATION 7**	**RDL**	**QC Batch**
Total Beryllium (Be)	ug/L	<0.40	0.40	<0.40	0.40	7268992
Total Boron (B)	ug/L	19	10	11	10	7268992
Total Cadmium (Cd)	ug/L	<0.090	0.090	<0.090	0.090	7268992
Total Calcium (Ca)	ug/L	79000	200	44000	200	7268992
Total Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	7268992
Total Cobalt (Co)	ug/L	<0.50	0.50	<0.50	0.50	7268992
Total Copper (Cu)	ug/L	1.5	0.90	1.2	0.90	7268992
Total Iron (Fe)	ug/L	1600	100	<100	100	7268992
Total Lead (Pb)	ug/L	<0.50	0.50	<0.50	0.50	7268992
Total Magnesium (Mg)	ug/L	12000	50	5900	50	7268992
Total Manganese (Mn)	ug/L	63	2.0	2.3	2.0	7268992
Total Molybdenum (Mo)	ug/L	1.6	0.50	<0.50	0.50	7268992
Total Nickel (Ni)	ug/L	<1.0	1.0	<1.0	1.0	7268992
Total Potassium (K)	ug/L	3400	200	4500	200	7268992
Total Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	7268992
Total Silicon (Si)	ug/L	990	50	120	50	7268992
Total Silver (Ag)	ug/L	<0.090	0.090	<0.090	0.090	7268992
Total Sodium (Na)	ug/L	2900	100	6500	100	7268992
Total Strontium (Sr)	ug/L	130	1.0	65	1.0	7268992
Total Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	7268992
Total Titanium (Ti)	ug/L	<5.0	5.0	<5.0	5.0	7268992
Total Vanadium (V)	ug/L	0.76	0.50	0.54	0.50	7268992
Total Zinc (Zn)	ug/L	35	5.0	<5.0	5.0	7268992

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		PDS755		PDS756		
Sampling Date		2021/03/23 13:30		2021/03/23 13:45		
COC Number		814603-01-01		814603-01-01		
	UNITS	SW STATION 8	QC Batch	SW STATION 7	RDL	QC Batch
Metals						
Dissolved Aluminum (Al)	ug/L	<4.9	7270416	18	4.9	7274526
Dissolved Antimony (Sb)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Arsenic (As)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Barium (Ba)	ug/L	19	7270416	13	2.0	7274526
Dissolved Beryllium (Be)	ug/L	<0.40	7270416	<0.40	0.40	7274526
Dissolved Bismuth (Bi)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Boron (B)	ug/L	13	7270416	11	10	7274526
Dissolved Cadmium (Cd)	ug/L	<0.090	7270416	<0.090	0.090	7274526
Dissolved Calcium (Ca)	ug/L	79000	7270416	46000	200	7274526
Dissolved Chromium (Cr)	ug/L	<5.0	7270416	<5.0	5.0	7274526
Dissolved Cobalt (Co)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Copper (Cu)	ug/L	<0.90	7270416	1.3	0.90	7274526
Dissolved Iron (Fe)	ug/L	150	7270416	<100	100	7274526
Dissolved Lead (Pb)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Lithium (Li)	ug/L	<5.0	7270416	<5.0	5.0	7274526
Dissolved Magnesium (Mg)	ug/L	13000	7270416	6300	50	7274526
Dissolved Manganese (Mn)	ug/L	<2.0	7270416	<2.0	2.0	7274526
Dissolved Molybdenum (Mo)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Nickel (Ni)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Phosphorus (P)	ug/L	<100	7270416	<100	100	7274526
Dissolved Potassium (K)	ug/L	3400	7270416	4900	200	7274526
Dissolved Selenium (Se)	ug/L	<2.0	7270416	<2.0	2.0	7274526
Dissolved Silicon (Si)	ug/L	1500	7270416	<50	50	7274526
Dissolved Silver (Ag)	ug/L	<0.090	7270416	<0.090	0.090	7274526
Dissolved Sodium (Na)	ug/L	2800	7270416	7100	100	7274526
Dissolved Strontium (Sr)	ug/L	130	7270416	69	1.0	7274526
Dissolved Tellurium (Te)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Thallium (Tl)	ug/L	<0.050	7270416	<0.050	0.050	7274526
Dissolved Tin (Sn)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Titanium (Ti)	ug/L	<5.0	7270416	<5.0	5.0	7274526

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		PDS755		PDS756		
Sampling Date		2021/03/23 13:30		2021/03/23 13:45		
COC Number		814603-01-01		814603-01-01		
	UNITS	**SW STATION 8**	**QC Batch**	**SW STATION 7**	**RDL**	**QC Batch**
Dissolved Tungsten (W)	ug/L	<1.0	7270416	<1.0	1.0	7274526
Dissolved Uranium (U)	ug/L	3.0	7270416	0.47	0.10	7274526
Dissolved Vanadium (V)	ug/L	<0.50	7270416	<0.50	0.50	7274526
Dissolved Zinc (Zn)	ug/L	14	7270416	<5.0	5.0	7274526
Dissolved Zirconium (Zr)	ug/L	<1.0	7270416	<1.0	1.0	7274526

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

TEST SUMMARY

BV Labs ID: PDS753
Sample ID: MW302
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7267562	N/A	2021/03/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7266523	N/A	2021/03/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7269566	N/A	2021/03/29	Deonarine Ramnarine
Conductivity	AT	7267569	N/A	2021/03/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7268303	N/A	2021/03/27	Nimarta Singh
Hardness (calculated as CaCO3)		7266294	N/A	2021/03/30	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	7270416	2021/03/27	2021/03/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7266316	N/A	2021/03/30	Automated Statchk
Anion and Cation Sum	CALC	7266563	N/A	2021/03/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7269357	N/A	2021/03/30	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7268014	N/A	2021/03/26	Chandra Nandlal
pH	AT	7267571	2021/03/25	2021/03/26	Surinder Rai
Orthophosphate	KONE	7269591	N/A	2021/03/29	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7266564	N/A	2021/03/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7266565	N/A	2021/03/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7269590	N/A	2021/03/29	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7266568	N/A	2021/03/30	Automated Statchk

BV Labs ID: PDS753 Dup
Sample ID: MW302
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7269566	N/A	2021/03/29	Deonarine Ramnarine
Orthophosphate	KONE	7269591	N/A	2021/03/29	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7269590	N/A	2021/03/29	Deonarine Ramnarine

BV Labs ID: PDS754
Sample ID: MW303
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7267562	N/A	2021/03/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7266523	N/A	2021/03/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7270496	N/A	2021/03/29	Deonarine Ramnarine
Conductivity	AT	7267569	N/A	2021/03/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7268303	N/A	2021/03/27	Nimarta Singh
Hardness (calculated as CaCO3)		7266294	N/A	2021/03/31	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	7274526	2021/03/30	2021/03/31	Arefa Dabhad
Ion Balance (% Difference)	CALC	7266316	N/A	2021/03/31	Automated Statchk
Anion and Cation Sum	CALC	7266563	N/A	2021/03/31	Automated Statchk
Total Ammonia-N	LACH/NH4	7269357	N/A	2021/03/30	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7268014	N/A	2021/03/26	Chandra Nandlal
pH	AT	7267571	2021/03/25	2021/03/26	Surinder Rai

BV Labs Job #: C178300
Report Date: 2021/03/31

exp Services Inc
Client Project #: LON-00014456
Site Location: W3 FARMS
Sampler Initials: JM

TEST SUMMARY

BV Labs ID: PDS754
Sample ID: MW303
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Orthophosphate	KONE	7270498	N/A	2021/03/29	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7266564	N/A	2021/03/31	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7266565	N/A	2021/03/31	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7270499	N/A	2021/03/29	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7266568	N/A	2021/03/31	Automated Statchk

BV Labs ID: PDS754 Dup
Sample ID: MW303
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7270496	N/A	2021/03/29	Deonarine Ramnarine
Orthophosphate	KONE	7270498	N/A	2021/03/29	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7270499	N/A	2021/03/29	Deonarine Ramnarine

BV Labs ID: PDS755
Sample ID: SW STATION 8
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7267562	N/A	2021/03/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7266523	N/A	2021/03/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7267583	N/A	2021/03/26	Deonarine Ramnarine
Conductivity	AT	7267569	N/A	2021/03/26	Surinder Rai
Hardness (calculated as CaCO3)		7266294	N/A	2021/03/30	Automated Statchk
Lab Filtered Metals Analysis by ICP	ICP	7270366	2021/03/27	2021/03/29	Suban Kanapathippllai
Lab Filtered Metals by ICPMS	ICP/MS	7270416	2021/03/27	2021/03/30	Arefa Dabhad
Total Metals Analysis by ICPMS	ICP/MS	7268992	N/A	2021/03/29	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7268433	N/A	2021/03/29	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7267582	N/A	2021/03/26	Chandra Nandlal
pH	AT	7267571	2021/03/25	2021/03/26	Surinder Rai
Orthophosphate	KONE	7267589	N/A	2021/03/26	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7266564	N/A	2021/03/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7266565	N/A	2021/03/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7267587	N/A	2021/03/26	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7266568	N/A	2021/03/30	Automated Statchk
Total Organic Carbon (TOC)	TOCV/NDIR	7268461	N/A	2021/03/26	Nimarta Singh
Total Phosphorus (Colourimetric)	LACH/P	7268243	2021/03/26	2021/03/26	Shivani Shivani
Turbidity	AT	7267213	N/A	2021/03/26	Tarunpreet Kaur

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BV Labs Job #: C178300
Report Date: 2021/03/31

exp Services Inc
Client Project #: LON-00014456
Site Location: W3 FARMS
Sampler Initials: JM

TEST SUMMARY

BV Labs ID: PDS756
Sample ID: SW STATION 7
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7267562	N/A	2021/03/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7266523	N/A	2021/03/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7267583	N/A	2021/03/26	Deonarine Ramnarine
Conductivity	AT	7267569	N/A	2021/03/26	Surinder Rai
Hardness (calculated as CaCO3)		7266294	N/A	2021/03/30	Automated Statchk
Lab Filtered Metals Analysis by ICP	ICP	7270366	2021/03/27	2021/03/29	Suban Kanapathippllai
Lab Filtered Metals by ICPMS	ICP/MS	7274526	2021/03/30	2021/03/31	Arefa Dabhad
Total Metals Analysis by ICPMS	ICP/MS	7268992	N/A	2021/03/29	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7268433	N/A	2021/03/29	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7267582	N/A	2021/03/26	Chandra Nandlal
pH	AT	7267571	2021/03/25	2021/03/26	Surinder Rai
Orthophosphate	KONE	7267589	N/A	2021/03/26	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7266564	N/A	2021/03/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7266565	N/A	2021/03/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7267587	N/A	2021/03/26	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7266568	N/A	2021/03/30	Automated Statchk
Total Organic Carbon (TOC)	TOCV/NDIR	7268461	N/A	2021/03/26	Nimarta Singh
Total Phosphorus (Colourimetric)	LACH/P	7268243	2021/03/26	2021/03/26	Shivani Shivani
Turbidity	AT	7267213	N/A	2021/03/26	Tarunpreet Kaur

BV Labs ID: PDS756 Dup
Sample ID: SW STATION 7
Matrix: Water

Collected: 2021/03/23
Shipped:
Received: 2021/03/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Organic Carbon (TOC)	TOCV/NDIR	7268461	N/A	2021/03/26	Nimarta Singh

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.3°C

Revised report (2021/03/31): Amended project number.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7267213	Turbidity	2021/03/26			100	85 - 115	<0.1	NTU	8.9	20		
7267562	Alkalinity (Total as CaCO3)	2021/03/26			94	85 - 115	<1.0	mg/L	2.1	20		
7267569	Conductivity	2021/03/26			100	85 - 115	<1.0	umho/cm	0.58	25		
7267571	pH	2021/03/26			102	98 - 103			0.13	N/A		
7267582	Nitrate (N)	2021/03/26	96	80 - 120	103	80 - 120	<0.10	mg/L	NC	20		
7267582	Nitrite (N)	2021/03/26	104	80 - 120	109	80 - 120	<0.010	mg/L				
7267583	Dissolved Chloride (Cl-)	2021/03/26	93	80 - 120	101	80 - 120	<1.0	mg/L	1.7	20		
7267587	Dissolved Sulphate (SO4)	2021/03/26	99	75 - 125	101	80 - 120	<1.0	mg/L	0.73	20		
7267589	Orthophosphate (P)	2021/03/26	108	75 - 125	100	80 - 120	<0.010	mg/L	0.64	25		
7268014	Nitrate (N)	2021/03/26	97	80 - 120	100	80 - 120	<0.10	mg/L	NC	20		
7268014	Nitrite (N)	2021/03/26	104	80 - 120	107	80 - 120	<0.010	mg/L	NC	20		
7268243	Total Phosphorus	2021/03/26	103	80 - 120	98	80 - 120	<0.004	mg/L	0.53	20	95	80 - 120
7268303	Dissolved Organic Carbon	2021/03/27	96	80 - 120	95	80 - 120	<0.40	mg/L	0.82	20		
7268433	Total Ammonia-N	2021/03/29	97	75 - 125	99	80 - 120	<0.050	mg/L	4.2	20		
7268461	Total Organic Carbon (TOC)	2021/03/26	95	80 - 120	95	80 - 120	<0.40	mg/L	3.6	20		
7268992	Total Aluminum (Al)	2021/03/29	107	80 - 120	99	80 - 120	<4.9	ug/L	17	20		
7268992	Total Antimony (Sb)	2021/03/29	105	80 - 120	103	80 - 120	<0.50	ug/L	NC	20		
7268992	Total Arsenic (As)	2021/03/29	101	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7268992	Total Barium (Ba)	2021/03/29	98	80 - 120	97	80 - 120	<2.0	ug/L	1.9	20		
7268992	Total Beryllium (Be)	2021/03/29	98	80 - 120	97	80 - 120	<0.40	ug/L	NC	20		
7268992	Total Boron (B)	2021/03/29	94	80 - 120	95	80 - 120	<10	ug/L	0.57	20		
7268992	Total Cadmium (Cd)	2021/03/29	101	80 - 120	102	80 - 120	<0.090	ug/L	NC	20		
7268992	Total Calcium (Ca)	2021/03/29	84	80 - 120	99	80 - 120	<200	ug/L	1.2	20		
7268992	Total Chromium (Cr)	2021/03/29	97	80 - 120	97	80 - 120	<5.0	ug/L	NC	20		
7268992	Total Cobalt (Co)	2021/03/29	97	80 - 120	97	80 - 120	<0.50	ug/L	NC	20		
7268992	Total Copper (Cu)	2021/03/29	99	80 - 120	99	80 - 120	<0.90	ug/L	NC	20		
7268992	Total Iron (Fe)	2021/03/29	95	80 - 120	95	80 - 120	<100	ug/L	NC	20		
7268992	Total Lead (Pb)	2021/03/29	96	80 - 120	97	80 - 120	<0.50	ug/L	NC	20		
7268992	Total Magnesium (Mg)	2021/03/29	90	80 - 120	94	80 - 120	<50	ug/L	1.4	20		
7268992	Total Manganese (Mn)	2021/03/29	97	80 - 120	97	80 - 120	<2.0	ug/L	17	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7268992	Total Molybdenum (Mo)	2021/03/29	103	80 - 120	101	80 - 120	<0.50	ug/L	7.4	20		
7268992	Total Nickel (Ni)	2021/03/29	97	80 - 120	99	80 - 120	<1.0	ug/L	NC	20		
7268992	Total Potassium (K)	2021/03/29	96	80 - 120	95	80 - 120	<200	ug/L	0.58	20		
7268992	Total Selenium (Se)	2021/03/29	103	80 - 120	104	80 - 120	<2.0	ug/L	NC	20		
7268992	Total Silicon (Si)	2021/03/29	99	80 - 120	98	80 - 120	<50	ug/L	3.5	20		
7268992	Total Silver (Ag)	2021/03/29	99	80 - 120	99	80 - 120	<0.090	ug/L	NC	20		
7268992	Total Sodium (Na)	2021/03/29	64 (1)	80 - 120	94	80 - 120	<100	ug/L	0.80	20		
7268992	Total Strontium (Sr)	2021/03/29	100	80 - 120	97	80 - 120	<1.0	ug/L	0.70	20		
7268992	Total Thallium (Tl)	2021/03/29	96	80 - 120	97	80 - 120	<0.050	ug/L	NC	20		
7268992	Total Titanium (Ti)	2021/03/29	98	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
7268992	Total Vanadium (V)	2021/03/29	100	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
7268992	Total Zinc (Zn)	2021/03/29	99	80 - 120	103	80 - 120	<5.0	ug/L	5.4	20		
7269357	Total Ammonia-N	2021/03/30	99	75 - 125	100	80 - 120	<0.050	mg/L	2.7	20		
7269566	Dissolved Chloride (Cl-)	2021/03/29	118	80 - 120	99	80 - 120	<1.0	mg/L	1.6	20		
7269590	Dissolved Sulphate (SO4)	2021/03/29	118	75 - 125	104	80 - 120	<1.0	mg/L	0.22	20		
7269591	Orthophosphate (P)	2021/03/29	108	75 - 125	99	80 - 120	<0.010	mg/L	NC	25		
7270366	Dissolved Calcium (Ca)	2021/03/29	94	80 - 120	100	80 - 120	<0.05	mg/L	2.0	25		
7270366	Dissolved Magnesium (Mg)	2021/03/29	99	80 - 120	96	80 - 120	<0.05	mg/L	1.2	25		
7270366	Dissolved Potassium (K)	2021/03/29	101	80 - 120	99	80 - 120	<1	mg/L	NC	25		
7270366	Dissolved Sodium (Na)	2021/03/29	101	80 - 120	99	80 - 120	<0.5	mg/L	3.1	25		
7270416	Dissolved Aluminum (Al)	2021/03/30	103	80 - 120	104	80 - 120	11, RDL=4.9	ug/L				
7270416	Dissolved Antimony (Sb)	2021/03/30	104	80 - 120	102	80 - 120	<0.50	ug/L				
7270416	Dissolved Arsenic (As)	2021/03/30	100	80 - 120	101	80 - 120	<1.0	ug/L				
7270416	Dissolved Barium (Ba)	2021/03/30	99	80 - 120	102	80 - 120	<2.0	ug/L				
7270416	Dissolved Beryllium (Be)	2021/03/30	100	80 - 120	98	80 - 120	<0.40	ug/L				
7270416	Dissolved Bismuth (Bi)	2021/03/30	101	80 - 120	104	80 - 120	<1.0	ug/L				
7270416	Dissolved Boron (B)	2021/03/30	101	80 - 120	97	80 - 120	<10	ug/L				
7270416	Dissolved Cadmium (Cd)	2021/03/30	103	80 - 120	103	80 - 120	<0.090	ug/L				
7270416	Dissolved Calcium (Ca)	2021/03/30	91	80 - 120	102	80 - 120	<200	ug/L				
7270416	Dissolved Chromium (Cr)	2021/03/30	99	80 - 120	100	80 - 120	<5.0	ug/L				
7270416	Dissolved Cobalt (Co)	2021/03/30	98	80 - 120	100	80 - 120	<0.50	ug/L				

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7270416	Dissolved Copper (Cu)	2021/03/30	99	80 - 120	101	80 - 120	<0.90	ug/L				
7270416	Dissolved Iron (Fe)	2021/03/30	97	80 - 120	99	80 - 120	<100	ug/L				
7270416	Dissolved Lead (Pb)	2021/03/30	98	80 - 120	97	80 - 120	<0.50	ug/L				
7270416	Dissolved Lithium (Li)	2021/03/30	104	80 - 120	101	80 - 120	<5.0	ug/L				
7270416	Dissolved Magnesium (Mg)	2021/03/30	88	80 - 120	100	80 - 120	<50	ug/L				
7270416	Dissolved Manganese (Mn)	2021/03/30	99	80 - 120	101	80 - 120	<2.0	ug/L				
7270416	Dissolved Molybdenum (Mo)	2021/03/30	102	80 - 120	100	80 - 120	<0.50	ug/L				
7270416	Dissolved Nickel (Ni)	2021/03/30	97	80 - 120	101	80 - 120	<1.0	ug/L				
7270416	Dissolved Phosphorus (P)	2021/03/30	105	80 - 120	105	80 - 120	<100	ug/L				
7270416	Dissolved Potassium (K)	2021/03/30	103	80 - 120	102	80 - 120	<200	ug/L				
7270416	Dissolved Selenium (Se)	2021/03/30	103	80 - 120	103	80 - 120	<2.0	ug/L				
7270416	Dissolved Silicon (Si)	2021/03/30	104	80 - 120	104	80 - 120	<50	ug/L				
7270416	Dissolved Silver (Ag)	2021/03/30	99	80 - 120	99	80 - 120	<0.090	ug/L				
7270416	Dissolved Sodium (Na)	2021/03/30	91	80 - 120	102	80 - 120	<100	ug/L				
7270416	Dissolved Strontium (Sr)	2021/03/30	95	80 - 120	101	80 - 120	<1.0	ug/L				
7270416	Dissolved Tellurium (Te)	2021/03/30	102	80 - 120	101	80 - 120	<1.0	ug/L				
7270416	Dissolved Thallium (Tl)	2021/03/30	101	80 - 120	101	80 - 120	<0.050	ug/L				
7270416	Dissolved Tin (Sn)	2021/03/30	104	80 - 120	101	80 - 120	<1.0	ug/L				
7270416	Dissolved Titanium (Ti)	2021/03/30	102	80 - 120	98	80 - 120	<5.0	ug/L				
7270416	Dissolved Tungsten (W)	2021/03/30	101	80 - 120	102	80 - 120	<1.0	ug/L				
7270416	Dissolved Uranium (U)	2021/03/30	99	80 - 120	99	80 - 120	<0.10	ug/L				
7270416	Dissolved Vanadium (V)	2021/03/30	100	80 - 120	101	80 - 120	<0.50	ug/L				
7270416	Dissolved Zinc (Zn)	2021/03/30	98	80 - 120	111	80 - 120	<5.0	ug/L				
7270416	Dissolved Zirconium (Zr)	2021/03/30	107	80 - 120	105	80 - 120	<1.0	ug/L				
7270496	Dissolved Chloride (Cl-)	2021/03/29	97	80 - 120	100	80 - 120	<1.0	mg/L	0.94	20		
7270498	Orthophosphate (P)	2021/03/29	106	75 - 125	100	80 - 120	<0.010	mg/L	NC	25		
7270499	Dissolved Sulphate (SO4)	2021/03/29	126 (1)	75 - 125	105	80 - 120	<1.0	mg/L	1.7	20		
7274526	Dissolved Aluminum (Al)	2021/03/31	99	80 - 120	101	80 - 120	<4.9	ug/L	NC	20		
7274526	Dissolved Antimony (Sb)	2021/03/31	102	80 - 120	102	80 - 120	<0.50	ug/L	NC	20		
7274526	Dissolved Arsenic (As)	2021/03/31	101	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Barium (Ba)	2021/03/31	98	80 - 120	99	80 - 120	<2.0	ug/L	0.70	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7274526	Dissolved Beryllium (Be)	2021/03/31	96	80 - 120	96	80 - 120	<0.40	ug/L	NC	20		
7274526	Dissolved Bismuth (Bi)	2021/03/31	98	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Boron (B)	2021/03/31	92	80 - 120	91	80 - 120	<10	ug/L	2.9	20		
7274526	Dissolved Cadmium (Cd)	2021/03/31	100	80 - 120	101	80 - 120	<0.090	ug/L	NC	20		
7274526	Dissolved Calcium (Ca)	2021/03/31	97	80 - 120	100	80 - 120	<200	ug/L	2.1	20		
7274526	Dissolved Chromium (Cr)	2021/03/31	93	80 - 120	95	80 - 120	<5.0	ug/L	NC	20		
7274526	Dissolved Cobalt (Co)	2021/03/31	96	80 - 120	97	80 - 120	<0.50	ug/L	NC	20		
7274526	Dissolved Copper (Cu)	2021/03/31	95	80 - 120	98	80 - 120	<0.90	ug/L	NC	20		
7274526	Dissolved Iron (Fe)	2021/03/31	99	80 - 120	100	80 - 120	<100	ug/L	NC	20		
7274526	Dissolved Lead (Pb)	2021/03/31	96	80 - 120	95	80 - 120	<0.50	ug/L	NC	20		
7274526	Dissolved Lithium (Li)	2021/03/31	101	80 - 120	103	80 - 120	<5.0	ug/L	NC	20		
7274526	Dissolved Magnesium (Mg)	2021/03/31	100	80 - 120	102	80 - 120	<50	ug/L	1.0	20		
7274526	Dissolved Manganese (Mn)	2021/03/31	98	80 - 120	100	80 - 120	<2.0	ug/L	NC	20		
7274526	Dissolved Molybdenum (Mo)	2021/03/31	98	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7274526	Dissolved Nickel (Ni)	2021/03/31	95	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Phosphorus (P)	2021/03/31	105	80 - 120	104	80 - 120	<100	ug/L	NC	20		
7274526	Dissolved Potassium (K)	2021/03/31	103	80 - 120	104	80 - 120	<200	ug/L	1.1	20		
7274526	Dissolved Selenium (Se)	2021/03/31	99	80 - 120	98	80 - 120	<2.0	ug/L	NC	20		
7274526	Dissolved Silicon (Si)	2021/03/31	103	80 - 120	103	80 - 120	<50	ug/L	3.7	20		
7274526	Dissolved Silver (Ag)	2021/03/31	95	80 - 120	95	80 - 120	<0.090	ug/L	NC	20		
7274526	Dissolved Sodium (Na)	2021/03/31	99	80 - 120	99	80 - 120	<100	ug/L	0.34	20		
7274526	Dissolved Strontium (Sr)	2021/03/31	99	80 - 120	100	80 - 120	<1.0	ug/L	0.59	20		
7274526	Dissolved Tellurium (Te)	2021/03/31	105	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Thallium (Tl)	2021/03/31	99	80 - 120	98	80 - 120	<0.050	ug/L	NC	20		
7274526	Dissolved Tin (Sn)	2021/03/31	104	80 - 120	104	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Titanium (Ti)	2021/03/31	99	80 - 120	100	80 - 120	<5.0	ug/L	NC	20		
7274526	Dissolved Tungsten (W)	2021/03/31	96	80 - 120	97	80 - 120	<1.0	ug/L	NC	20		
7274526	Dissolved Uranium (U)	2021/03/31	98	80 - 120	96	80 - 120	<0.10	ug/L	5.9	20		
7274526	Dissolved Vanadium (V)	2021/03/31	97	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
7274526	Dissolved Zinc (Zn)	2021/03/31	97	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7274526	Dissolved Zirconium (Zr)	2021/03/31	103	80 - 120	103	80 - 120	<1.0	ug/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

BV Labs Job #: C178300
Report Date: 2021/03/31

exp Services Inc
Client Project #: LON-00014456
Site Location: W3 FARMS
Sampler Initials: JM

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories
109 & 110, 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel:(519) 652-9444 Toll-free:800-563-6266 Fax:(519) 652-8189 www.bvlabs.com

REC'D IN LONDON

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:
Company Name: #28124 exp Services Inc
Attention: Accounts Payable
Address: 15701 Robin's Hill Rd Unit 2
London ON N5V 0A5
Tel: (519) 963-3000 Fax: (519) 963-1152
Email: AP@exp.com, Karen.Burke@exp.com

REPORT TO:
Company Name: EXP SERVICES INC
Attention: HEATHER JAGGARD
Address: HEATHER.JAGGARD J@EXP.COM
JASNEEL.MAHAL
Tel: Fax:
Email: HEATHER.JAGGARD@EXP.COM

PROJECT INFORMATION:
Quotation #: B91718
P.O. #:
Project: ~~LON-21001710-A0~~
Project Name: W3 FARMS
Site #: LON-14456
Sampled By: JM

Laboratory Use Only:
BV Labs Job #:
Bottle Order #: 814603
COC #: C#814603-01-01
Project Manager: Christine Gripton

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ PWQO ☐ Reg 406 Table ☐ Other

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? YES

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required: Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required: ☐
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive (Lab Filtered)	DISSOLVED METALS	# of Bottles	Comments
1		MW302	21/03/23	12:00PM	GW	NO	X		3	
2		MW303	21/03/23	1:00PM	GW	NO	X		3	
3		SW STATION 8	21/03/23	1:30PM	SW	NO	X	X	4	
4		SW STATION 7	21/03/23	1:45PM	SW	NO	X	X	4	
5										
6										
7										
8										
9										
10										On Ice

24-Mar-21 13:10
Christine Gripton
C178300
GV1 ENV-1366

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
JASNEEL MAHAL	21/03/23	1:00PM	Lu Bai	2021/3/24	13:10	
			DIPIKA SINGH	2021/03/24	17:23	

Laboratory Use Only: Time Sensitive | Temperature (°C) on Recei 6, 8, 11 | Custody Seal Present: Yes ✓ | Intact: Yes ✓

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

WB# 204175 5/6/7 Custody Seal Intact

Appendix E – Water Levels, Hydrographs, Hydroperiod Assessment

6-405 Maple Grove Road | Cambridge, Ontario | Canada
t: +1.519.650.4918 | f: +1.519.650.4603 | exp.com

Water Elevation Monitoring

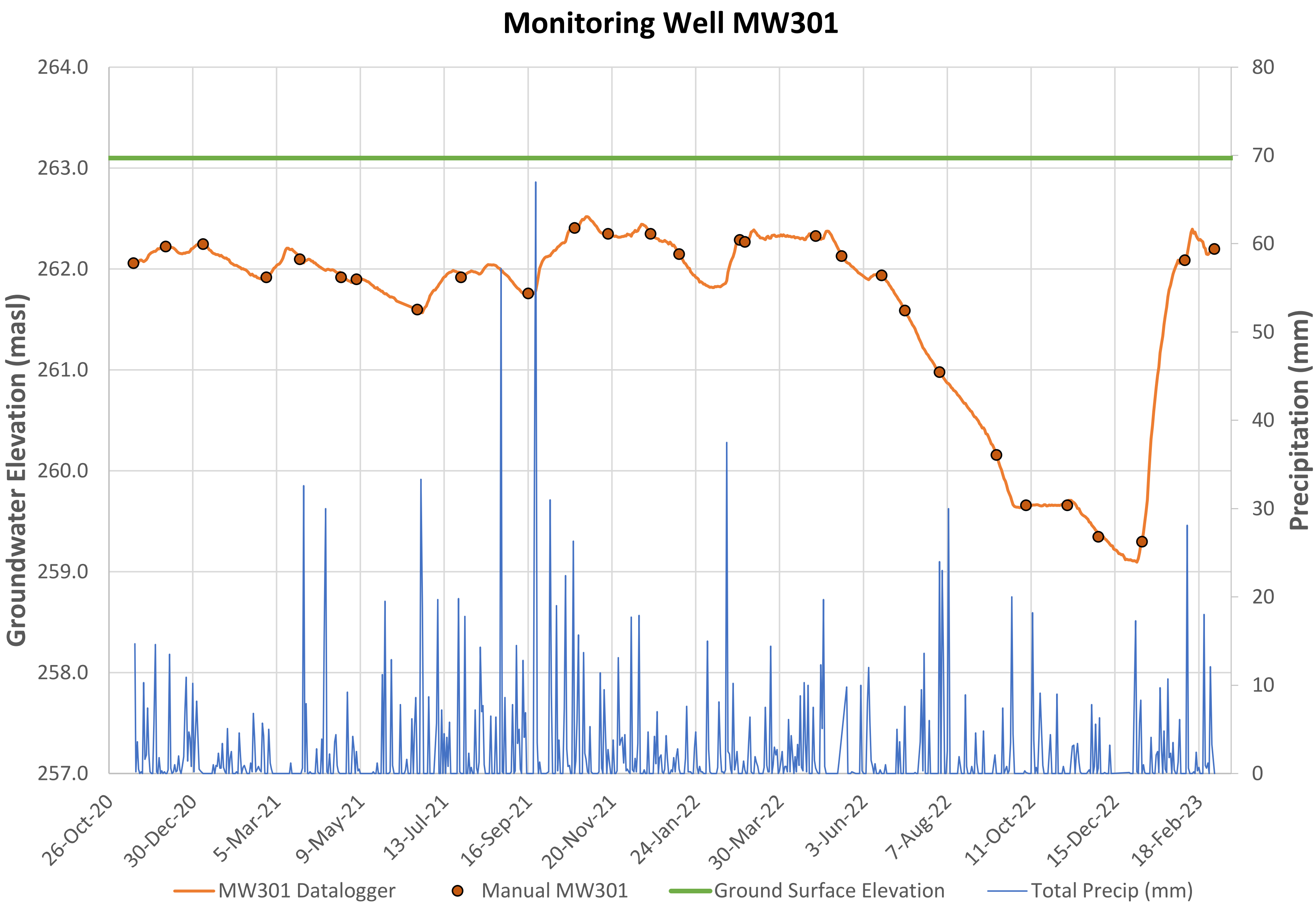
Well ID	BH206/MW	BH207/MW	BH208/MW	BH209/MW	BH301/MW	BH302/MW	BH303/MW	BH304/MW	P-7	P-8	SG8
Ground Surface Elevation (m amsl)	263.99	261.90	266.20	265.20	263.10	262.99	268.02	263.56	261.14	263.27	262.74
Top of Pipe Elevation (m amsl)	264.90	262.73	266.84	266.08	263.78	263.86	268.84	264.28	262.28	264.30	-
Groundwater Elevation (m amsl)											
03-Dec-18	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Jan-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
08-Feb-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
20-Mar-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
11-Apr-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
05-May-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
07-Jun-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Jul-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
13-Aug-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
20-Sep-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
28-Oct-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
25-Nov-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
13-Dec-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Jan-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Feb-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Mar-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
08-Apr-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
29-May-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
10-Jun-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
17-Jul-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
24-Aug-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
29-Sep-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
28-Oct-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Nov-20	Dry	Dry	Dry	Dry	262.06	259.14	265.36	259.10	Installed	Installed	263.02
09-Dec-20	Dry	Dry	Dry	Dry	262.22	260.53	265.63	259.25	----	263.14	263.14
07-Jan-21	Dry	Dry	Dry	Dry	262.25	260.23	264.91	259.25	261.81	263.27	263.14
25-Feb-21	Dry	Dry	Dry	Dry	261.92	260.11	264.78	259.29	260.79	263.26	263.24
23-Mar-21	Dry	Dry	Dry	Dry	262.10	260.99	265.29	259.31	260.90	263.22	263.21
24-Apr-21	Dry	Dry	Dry	Dry	261.92	259.86	265.17	259.65	260.87	263.12	-
06-May-21	Dry	Dry	Dry	Dry	261.90	260.15	264.83	259.68	260.81	263.13	263.17
22-Jun-21	Dry	Dry	Dry	Dry	261.60	259.84	264.42	259.80	260.54	263.04	262.99
26-Jul-21	Dry	Dry	Dry	Dry	261.92	260.26	265.16	259.89	-	263.02	-
30-Aug-21	---	Dry	Dry	Dry	---	259.85	263.98	259.79	260.88	Dry	-
16-Sep-21	Dry	Dry	Dry	Dry	261.76	259.82	263.64	259.73	260.68	262.69	262.89
22-Oct-21	Dry	Dry	Dry	Dry	262.41	261.36	265.67	259.71	260.91	263.23	263.24
17-Nov-21	Dry	Dry	Dry	Dry	262.35	261.02	265.74	259.67	-	263.22	263.24
20-Dec-21	Dry	Dry	Dry	Dry	262.35	261.06	265.45	259.40	261.76	263.27	263.24
11-Jan-22	Dry	Dry	Dry	Dry	262.15	---	265.39	259.36	262.18	Frozen	263.24
27-Feb-22	Dry	Dry	Dry	Dry	262.29	261.56	264.97	259.23	260.28	Frozen	263.48
03-Mar-22	Dry	Dry	Dry	Dry	262.27	261.06	264.86	259.22	261.89	263.16	263.44
27-Apr-22	Dry	Dry	Dry	Dry	262.33	261.07	265.72	259.46	-	263.27	263.37
17-May-22	Dry	Dry	Dry	Dry	262.13	260.83	265.09	259.62	-	263.37	263.27
17-Jun-22	Dry	Dry	Dry	Dry	261.94	259.94	264.50	259.81	261.93	262.46	263.12
05-Jul-22	Dry	Dry	Dry	Dry	261.59	259.84	264.10	259.82	261.64	262.70	Dry
01-Aug-22	Dry	Dry	Dry	Dry	260.98	259.56	263.70	259.85	260.86	262.26	Dry
14-Sep-22	Dry	Dry	Dry	Dry	260.16	258.81	Dry	259.65	260.44	Dry	Dry
07-Oct-22	Dry	Dry	Dry	Dry	259.66	Dry	Dry	259.43	260.27	Dry	Dry
08-Nov-22	Dry	Dry	Dry	Dry	259.66	Dry	Dry	259.11	260.29	Dry	Dry
02-Dec-22	Dry	Dry	Dry	Dry	259.35	Dry	Dry	Dry	260.28	Dry	Dry
05-Jan-23	Dry	Dry	Dry	Dry	259.30	Dry	Dry	Dry	260.44	262.55	263.06
07-Feb-23	Dry	Dry	Dry	Dry	262.09	260.07	264.61	Dry	260.27	263.05	263.28
02-Mar-23	Dry	Dry	Dry	Dry	262.20	260.66	264.74	Dry	260.29	263.11	263.34
06-Apr-23	Dry	Dry	Dry	Dry	---	261.83	265.34	259.34	260.28	263.27	263.50

Notes:
- indicates not measured

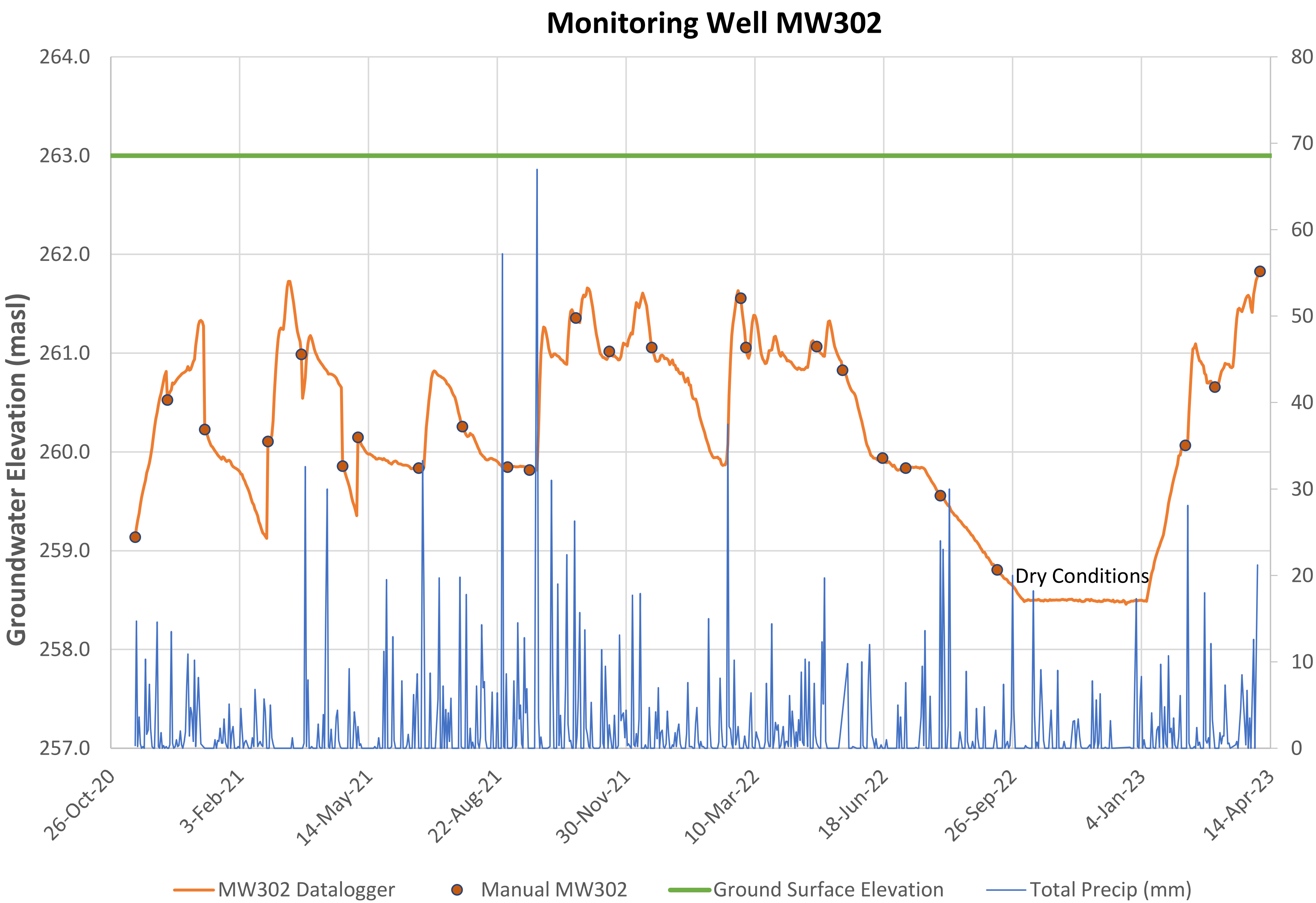
Groundwater Level Monitoring

Well ID	BH206/MW	BH207/MW	BH208/MW	BH209/MW	BH301/MW	BH302/MW	BH303/MW	BH304/MW	P-7	P-8	SG8
Groundwater Level (m bgs)											
03-Dec-18	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Jan-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
08-Feb-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
20-Mar-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
11-Apr-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
05-May-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
07-Jun-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Jul-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
13-Aug-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
20-Sep-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
28-Oct-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
25-Nov-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
13-Dec-19	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Jan-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
16-Feb-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Mar-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
08-Apr-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
29-May-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
10-Jun-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
17-Jul-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
24-Aug-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
29-Sep-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
28-Oct-20	Dry	Dry	Dry	Dry	-	-	-	-	-	-	-
14-Nov-20	Dry	Dry	Dry	Dry	1.05	3.85	2.66	4.46	Installed	Installed	-0.28
09-Dec-20	Dry	Dry	Dry	Dry	0.88	2.46	2.39	4.31	----	0.13	-0.40
07-Jan-21	Dry	Dry	Dry	Dry	0.86	2.76	3.11	4.31	-0.67	0.00	-0.40
25-Feb-21	Dry	Dry	Dry	Dry	1.19	2.88	3.24	4.27	0.35	0.01	-0.50
23-Mar-21	Dry	Dry	Dry	Dry	1.01	2.00	2.73	4.25	0.24	0.05	-0.47
24-Apr-21	Dry	Dry	Dry	Dry	1.19	3.13	2.85	3.91	0.27	0.15	-
06-May-21	Dry	Dry	Dry	Dry	1.21	2.84	3.19	3.88	0.33	0.14	-0.43
22-Jun-21	Dry	Dry	Dry	Dry	1.51	3.15	3.60	3.76	0.60	0.23	-0.25
26-Jul-21	Dry	Dry	Dry	Dry	1.19	2.73	2.86	3.67	-	0.25	-
30-Aug-21	---	Dry	Dry	Dry	---	3.14	4.04	3.77	0.26	Dry	-
16-Sep-21	Dry	Dry	Dry	Dry	1.35	3.17	4.38	3.83	0.46	0.58	-0.15
22-Oct-21	Dry	Dry	Dry	Dry	0.70	1.63	2.35	3.85	0.23	0.04	-0.50
17-Nov-21	Dry	Dry	Dry	Dry	0.76	1.97	2.28	3.89	-	0.05	-0.50
20-Dec-21	Dry	Dry	Dry	Dry	0.76	1.93	2.57	4.16	-0.62	0.00	-0.50
11-Jan-22	Dry	Dry	Dry	Dry	0.96	---	2.63	4.20	-1.04	Frozen	-0.50
27-Feb-22	Dry	Dry	Dry	Dry	0.82	1.43	3.05	4.33	0.86	Frozen	-0.74
03-Mar-22	Dry	Dry	Dry	Dry	0.84	1.93	3.16	4.34	-0.75	0.11	-0.70
27-Apr-22	Dry	Dry	Dry	Dry	0.78	1.92	2.30	4.10	-	0.00	-0.63
17-May-22	Dry	Dry	Dry	Dry	0.98	2.16	2.93	3.94	-	-0.10	-0.53
17-Jun-22	Dry	Dry	Dry	Dry	1.17	3.05	3.52	3.75	-0.79	0.81	-0.38
05-Jul-22	Dry	Dry	Dry	Dry	1.52	3.15	3.92	3.74	-0.50	0.57	Dry
01-Aug-22	Dry	Dry	Dry	Dry	2.13	3.43	4.32	3.71	0.28	1.01	Dry
14-Sep-22	Dry	Dry	Dry	Dry	2.95	4.18	Dry	3.91	0.70	Dry	Dry
07-Oct-22	Dry	Dry	Dry	Dry	3.45	Dry	Dry	4.13	0.87	Dry	Dry
08-Nov-22	Dry	Dry	Dry	Dry	3.45	Dry	Dry	4.45	0.85	Dry	Dry
02-Dec-22	Dry	Dry	Dry	Dry	3.76	Dry	Dry	Dry	0.86	Dry	Dry
05-Jan-23	Dry	Dry	Dry	Dry	3.81	Dry	Dry	Dry	0.70	0.72	-0.32
07-Feb-23	Dry	Dry	Dry	Dry	1.02	2.92	3.41	Dry	0.87	0.22	-0.54
02-Mar-23	Dry	Dry	Dry	Dry	0.91	2.33	3.28	Dry	0.85	0.16	-0.60
06-Apr-23	Dry	Dry	Dry	Dry	---	1.16	2.68	4.22	0.86	0.00	-0.76

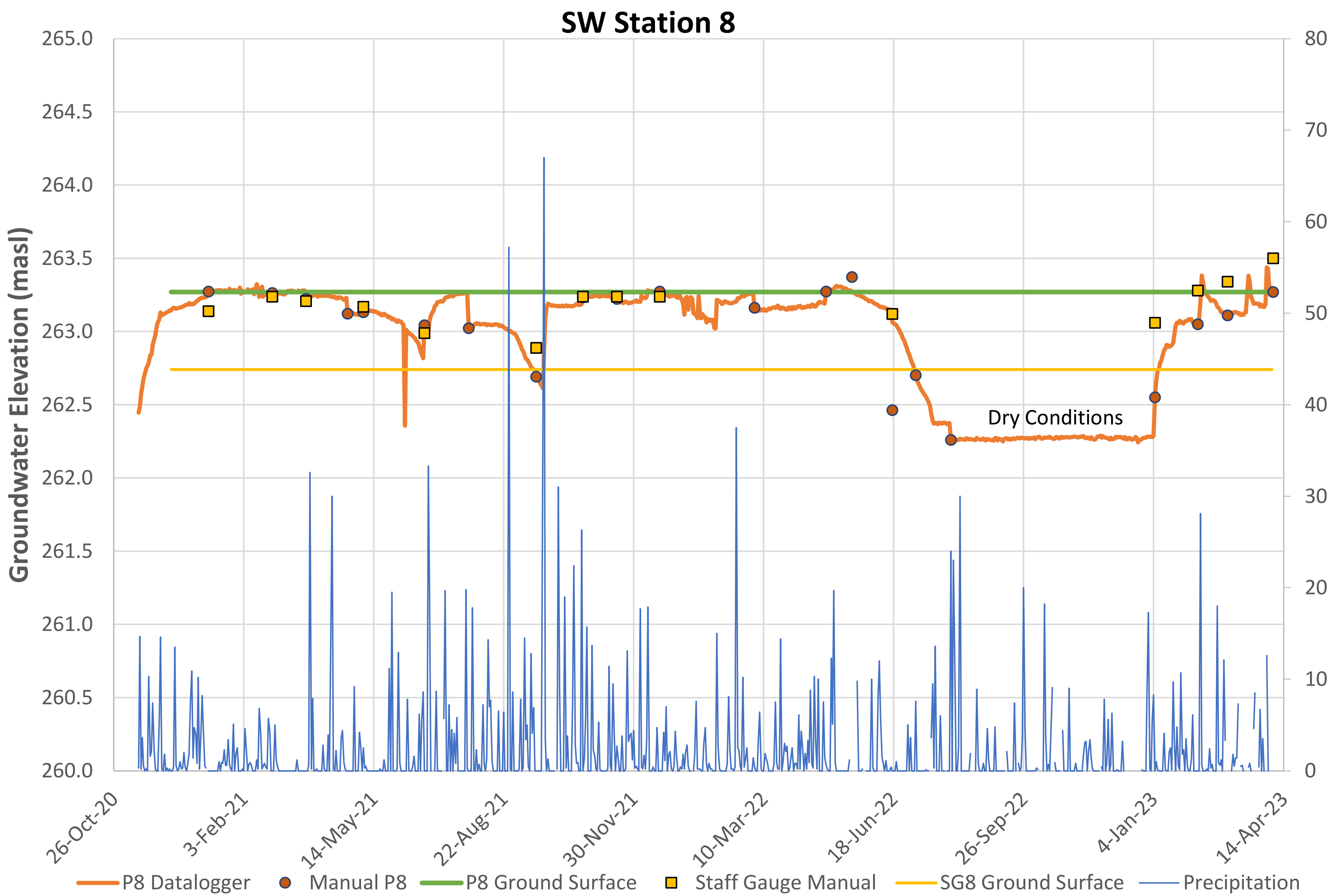
Notes:
--- indicates not measured
Negative values indicate water above ground surface



Monitoring Well MW301
Groundwater Elevation (masl)
264.0
263.0
262.0
261.0
260.0
259.0
258.0
257.0
Precipitation (mm)
80
70
60
50
40
30
20
10
0
26-Oct-20
30-Dec-20
5-Mar-21
9-May-21
13-Jul-21
16-Sep-21
20-Nov-21
24-Jan-22
30-Mar-22
3-Jun-22
7-Aug-22
11-Oct-22
15-Dec-22
18-Feb-23
MW301 Datalogger
Manual MW301
Ground Surface Elevation
Total Precip (mm)



Monitoring Well MW302
Groundwater Elevation (masl)
264.0
263.0
262.0
261.0
260.0
259.0
258.0
257.0
80
70
60
50
40
30
20
10
0
Dry Conditions
26-Oct-20
3-Feb-21
14-May-21
22-Aug-21
30-Nov-21
10-Mar-22
18-Jun-22
26-Sep-22
4-Jan-23
14-Apr-23
MW302 Datalogger
Manual MW302
Ground Surface Elevation
Total Precip (mm)


SW Station 8
Groundwater Elevation (masl)
Precipitation (mm)
265.0
264.5
264.0
263.5
263.0
262.5
262.0
261.5
261.0
260.5
260.0
80
70
60
50
40
30
20
10
0
26-Oct-20
3-Feb-21
14-May-21
22-Aug-21
30-Nov-21
10-Mar-22
18-Jun-22
26-Sep-22
4-Jan-23
14-Apr-23
Dry Conditions
P8 Datalogger
Manual P8
P8 Ground Surface
Staff Gauge Manual
SG8 Ground Surface
Precipitation

HYDROPERIOD ASSESSMENT					
Feature	**4b - Mineral Meadow Marsh**			**A1a - Wetland Inclusion**	
Station ID	**Minipiezometer - P7 (Outside Measurements)**			**Staff Gauge - SG8**	
Ground Surface Elevation (m)	**261.1**			**262.74**	
Top of Pipe Elevation (m)	**262.3**			**-**	
Standpipe Stickup (m)	**1.1**			**-**	
Date	**Surface Water Level (mbtop)**	**Wet (Yes/No)**	**Surface Water Depth (m)**	**Surface Water Level (m)**	**Wet (Yes/No)**
14-Nov-20	Dry	No	-	0.28	Yes
9-Dec-20	NM - Frozen	-	-	0.4 (Frozen)	-
7-Jan-21	0.47 (Frozen)	-	-	0.4 (Frozen)	-
25-Feb-21	0.8 (Frozen)	-	-	0.5 (Frozen)	-
23-Mar-21	0.83	Yes	0.3	0.47	Yes
24-Apr-21	Dry	No	-	NM	-
6-May-21	Dry	No	-	0.43	Yes
22-Jun-21	Dry	No	-	0.25	Yes
26-Jul-21	NM	-	-	Dry	No
30-Aug-21	NM	-		NM	-
16-Sep-21	Dry	No	-	0.15	Yes
22-Oct-21	NM	-	-	0.5	Yes
17-Nov-21	NM - High Water	Yes	NM - High Water	0.5	Yes
20-Dec-21	0.52	Yes	0.6	0.5	Yes
11-Jan-22	0.59 (Frozen)	-	-	0.5 (Frozen)	-
27-Feb-22	NM	-	-	0.74 (Frozen)	-
3-Mar-22	0.38 (Frozen)	-	-	0.7 (Frozen)	-
27-Apr-22	NM - High Water	Yes	NM - High Water	0.63	Yes
17-May-22	NM - High Water	Yes	NM - High Water	0.53	Yes
17-Jun-22	Dry	No	-	0.38	Yes
5-Jul-22	Dry	No	-	Dry	No
1-Aug-22	Dry	No	-	Dry	No
14-Sep-22	Dry	No		Dry	No
7-Oct-22	Dry	No		Dry	No

Appendix F – Single Well Response Test Analysis

6-405 Maple Grove Road | Cambridge, Ontario | Canada
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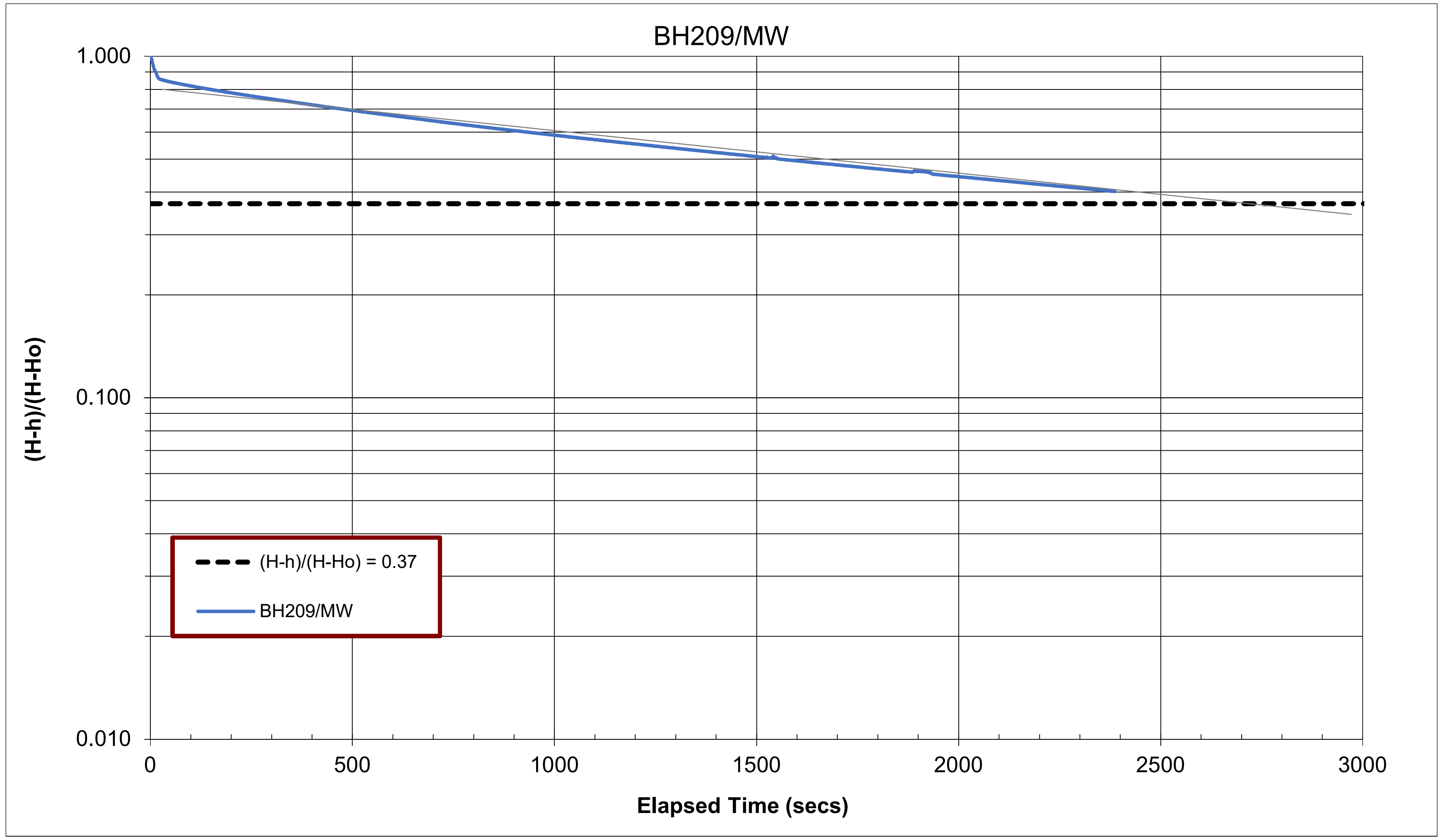
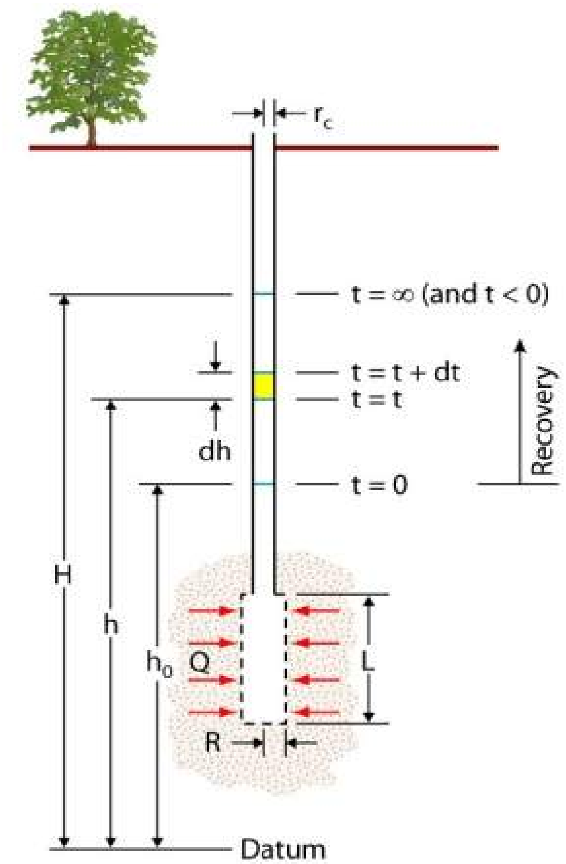
Falling Head - Hvorslev Method (1951)

Project Number	LON-0014456-HG
Date ot Test	4-Dec-18
Completed by	MB





Initial Water Level	DRY	m
Maximum Head of Water	7.42 m	

K = Hydraulic Conductivity
r = radius of well casing
R = Radius of well screen or filter pack
L = Length of the well screen (in Slug Test) or the length of submerged portion of the well screen (in Rising Head)
T_0 = time for water level to rise or fall to 37% of the initial change

r (m) =	0.0254
L (m) =	3.05
R (m) =	0.102
T_o (sec) =	2,600
K (m/s) =	1.4E-07

Note:
1 - Because of clay overburden, R is radius of sand pack
2 - T_o is determined from plots where (H-h)/(H-Ho) = 0.37

Appendix G – Infiltration Testing Results

Summary of Infiltration Rate Calculation[1]

Test Number	Depth (m)	Soil Type	Estimated permeability (K_{fs})[2] (cm/s)	Calculated Infiltration Rate (I)[2] (mm/hr)	Ratio of Mean Measured Infiltration Rates[3]	Safety Factor (C)
August 2021						
INF4	0.30	clayey silt till	1.11E-04	48		
INF5	0.60	clayey silt till	4.85E-07	11		
INF6 Test 1	0.65	silt; some sand	1.13E-04	48		
INF6 Test 2	0.65	silt; some sand	1.24E-04	49		
November 2022						
INF1-S	0.50	silty clay, some sand	2.67E-05	32		
INF1-D	0.90	silty sand	1.74E-04	54		
INF2-S	0.55	silty sand, trace gravel	7.00E-04	78		
INF2-D	0.90	silty sand, trace gravel	1.14E-03	89		
INF3-S	0.45	silty clay, trace sand and gravel	5.01E-05	38		
INF3-D	0.86	silty clay, trace sand and gravel	1.75E-04	54		
INF4-S	0.50	silty clay, trace sand and gravel	6.15E-06	22		
INF4-D	0.85	silty clay, trace sand and gravel	1.00E-04	46		
INF5-S	0.70	silty clay, trace sand	7.68E-06	23		
INF5-D	0.90	silty clay, trace sand	1.54E-06	15		
INF6-S	0.45	silty clay, trace sand	NA	NA		
INF6-D	0.86	silty clay, trace sand	NA	NA		
INF7-S	0.48	silty clay, trace sand and gravel	2.40E-07	9		
INF7-D	0.90	silty clay, trace sand and gravel	NA	NA		
INF8-S	0.50	silty clay, some sand, trace gravel	1.06E-04	47		
INF8-D	0.86	silty sand, trace clay and gravel	8.66E-05	45		
INF9-S	0.45	silty clay, trace sand and gravel	1.74E-05	29		
INF9-D	0.86	silty clay, trace sand and gravel	5.08E-04	71		
INF10-S	0.45	silty clay, trace sand and gravel	6.96E-06	23		
INF10-D	0.90	silty clay, trace sand and gravel	4.70E-05	38		
INF11-S	0.50	silty clay, trace sand and gravel	2.24E-05	31		
INF11-D	0.90	silty clay, trace sand and gravel	NA	NA		
Geometric Mean				**35**		
					3.8	**3.5**
Design Infiltration Rate[4]				**10**		

Safety Correction Factors for Calculating Design Infiltration Rates	
Ratio of Mean Measured Infiltration Rates[3]	**Safety Factor (C)**
<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

Notes:

[1]Inconclusive/negative/zero infiltration results are excluded from the summary of infiltration calculations

[2]The relationship between infiltration rate and hydraulic conductivity is taken as $K_{fs} = 6E\text{-}11(I^{3.7363})$, as described in the "Stormwater Management Criteria" from the Toronto and Region Conservation Authority, dated August 2012

[3]Ratio is determined by dividing the geometric mean measured infiltration rate at the proposed bottom elevation by the geometric mean measured infiltration rate of the least permeable soil horizon within 1.5 meters below the proposed bottom elevation.

***Design Infiltration Rate is calculated by dividing the geometric mean measured infiltration rate at the proposed bottom elevation by the safety correction factor

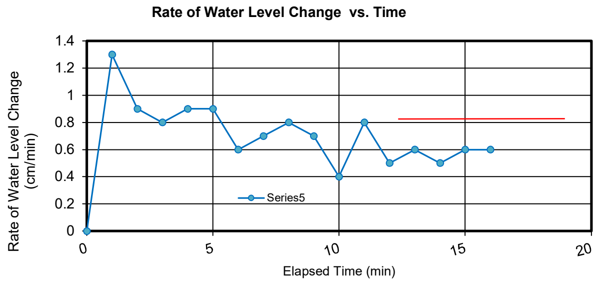
Project number: LON-22023963
Site Location: Sunset Creek Subdivision

Prepared by: K.Dobbin
Date: 07-Jun-23

Constant Head Permeameter Test Report

Sunset Creek

INF4



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	23.3	-	-
1.0	24.6	1.3	1.30
2.0	25.5	0.9	0.90
3.0	26.3	0.8	0.80
4.0	27.2	0.9	0.90
5.0	28.1	0.9	0.90
6.0	28.7	0.6	0.60
7.0	29.4	0.7	0.70
8.0	30.2	0.8	0.80
9.0	30.9	0.7	0.70
10.0	31.3	0.4	0.40
11.0	32.1	0.8	0.80
12.0	32.6	0.5	0.50
13.0	33.2	0.6	0.60
14.0	33.7	0.5	0.50
15.0	34.3	0.6	0.60
16.0	34.9	0.6	0.60

Final Water Level Change Rate: 0.57

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	0.6	cm
Interpreted Rate of Water Level Change (R1) =	**9.4E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.0E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**20**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**9.44E-03**	**cm/s**	
X	**35.220**	**cm^2**	**surface area for combined reservior used**
Y	2.160	cm^2	surface area for inner reservior used
Q1=X1*R1	**0.333**	**cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.020	cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.90307116**		**Shape factor coefficient**

K_{fs} = 1.11E-04 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

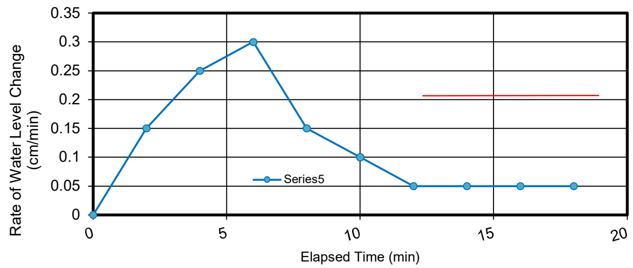
Project No. :	KCH-22023963-A0		
Site Location:	Sunset Creek	Conducted by:	M. Bondi
		Date:	04-Aug-21
		Processed by:	K.Dobbin
Test Location:	INF4	Date:	04-Aug-21

Constant Head Permeameter Test Report

Sunset Creek

INF5

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	39.6	-	-
2.0	39.9	0.3	0.15
4.0	40.4	0.5	0.25
6.0	41.0	0.6	0.30
8.0	41.3	0.3	0.15
10.0	41.5	0.2	0.10
12.0	41.6	0.1	0.05
14.0	41.7	0.1	0.05
16.0	41.8	0.1	0.05
18.0	41.9	0.1	0.05

Final Water Level Change Rate: 0.05

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	0.6	cm
Interpreted Rate of		
Water Level Change (R1) =	**8.3E-04**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.8E-03**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	25	cm

H1	**25 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**8.33E-04 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.029 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.002 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**2.13215625**	**Shape factor coefficient**

K_{fs} = 4.85E-07 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

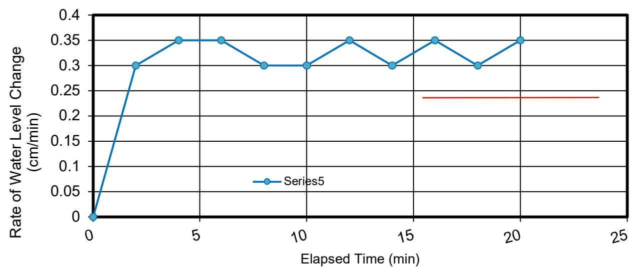
Project No. : KCH-22023963-A0
Site Location: Sunset Creek
Test Location: INF5
Conducted by: M. Bondi
Date: 04-Aug-21
Processed by: K.Dobbin
Date: 04-Aug-21

Constant Head Permeameter Test Report

Sunset Creek

INF6 Test 1

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	4.0	-	-
2.0	4.6	0.6	0.30
4.0	5.3	0.7	0.35
6.0	6.0	0.7	0.35
8.0	6.6	0.6	0.30
10.0	7.2	0.6	0.30
12.0	7.9	0.7	0.35
14.0	8.5	0.6	0.30
16.0	9.2	0.7	0.35
18.0	9.8	0.6	0.30
20.0	10.5	0.7	0.35

Final Water Level Change Rate: 0.33

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	0.65	cm
Interpreted Rate of		
Water Level Change (R1) =	**5.6E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.0E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**10 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**5.56E-03 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservoir used**
Y	2.160 cm^2	surface area for inner reservior used
Q1=X1*R1	**0.196 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.012 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.29023413**	**Shape factor coefficient**

K_{fs} = 1.13E-04 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

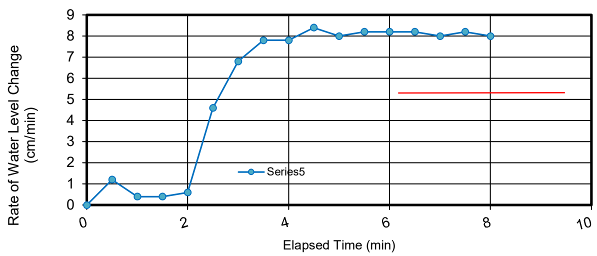
Project No. :	KCH-22023963-A0		
Site Location:	Sunset Creek	Conducted by:	M. Bondi
		Date:	04-Aug-21
		Processed by:	K.Dobbin
Test Location:	INF6 Test 1	Date:	04-Aug-21

Constant Head Permeameter Test Report

Sunset Creek

INF6 Test 2

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	16.0	-	-
0.5	16.6	0.6	1.20
1.0	16.8	0.2	0.40
1.5	17.0	0.2	0.40
2.0	17.3	0.3	0.60
2.5	19.6	2.3	4.60
3.0	23.0	3.4	6.80
3.5	26.9	3.9	7.80
4.0	30.8	3.9	7.80
4.5	35.0	4.2	8.40
5.0	39.0	4.0	8.00
5.5	43.1	4.1	8.20
6.0	47.2	4.1	8.20
6.5	51.3	4.1	8.20
7.0	55.3	4.0	8.00
7.5	59.4	4.1	8.20
8.0	63.4	4.0	8.00

Final Water Level Change Rate | 8.07

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	0.65	cm
Interpreted Rate of Water Level Change (R1) =	**1.3E-01**	**cm/s**
Steady Intake Water Rate (Q_1) =	**4.7E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**1.34E-01 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	4.735 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.290 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**	**Shape factor coefficient**

K_{fs} = 1.24E-04 cm/s

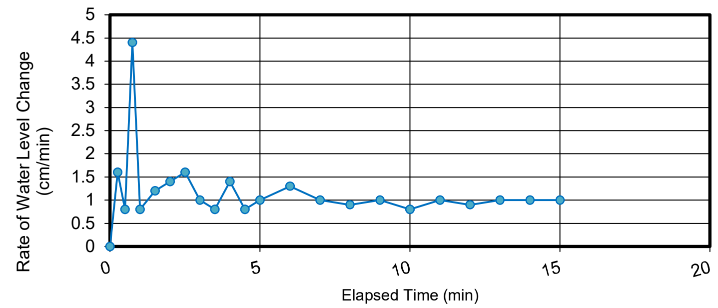
One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project No. :	KCH-22023963-A0		
Site Location:		Conducted by:	M. Bondi
	Sunset Creek	Date:	04-Aug-21
		Processed by:	K.Dobbin
Test Location:	INF6 Test 2	Date:	04-Aug-21

Constant Head Permeameter Test Report Sunset Creek	INF1 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	4.5	-	-
0.3	4.9	0.4	1.60
0.5	5.1	0.2	0.80
0.8	6.2	1.1	4.40
1.0	6.4	0.2	0.80
1.5	7.0	0.6	1.20
2.0	7.7	0.7	1.40
2.5	8.5	0.8	1.60
3.0	9.0	0.5	1.00
3.5	9.4	0.4	0.80
4.0	10.1	0.7	1.40
4.5	10.5	0.4	0.80
5.0	11.0	0.5	1.00
6.0	12.3	1.3	1.30
7.0	13.3	1.0	1.00
8.0	14.2	0.9	0.90
9.0	15.2	1.0	1.00
10.0	16.0	0.8	0.80
11.0	17.0	1.0	1.00
12.0	17.9	0.9	0.90
13.0	18.9	1.0	1.00
14.0	19.9	1.0	1.00
15.0	20.9	1.0	1.00

Final Water Level Change Rate: 1.00

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	50	cm
Interpreted Rate of Water Level Change (R1) =	**1.7E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**3.6E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**1.67E-02 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.587 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.036 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	3	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.66689294**	**Shape factor coefficient**

K_{fs} = 2.67E-05 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

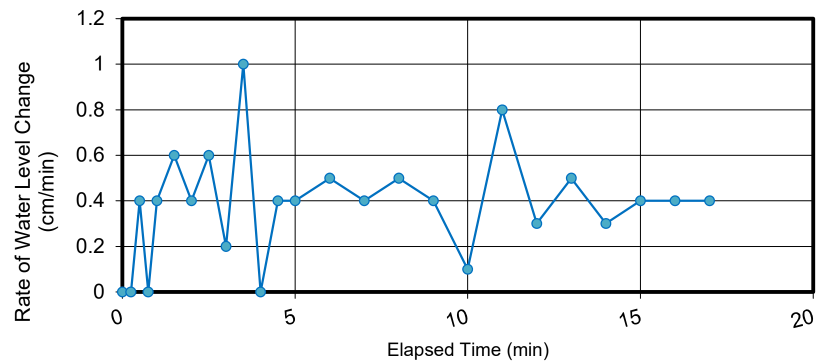
Project No. :	LON-22023963		
Site Location:	Sunset Creek	Conducted by:	JS/MB
		Date:	17-Nov-22
		Processed by:	KD
Test Location:	INF1 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF1 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	0.8	-	-
0.3	0.8	0.0	0.00
0.5	0.9	0.1	0.40
0.8	0.9	0.0	0.00
1.0	1.0	0.1	0.40
1.5	1.3	0.3	0.60
2.0	1.5	0.2	0.40
2.5	1.8	0.3	0.60
3.0	1.9	0.1	0.20
3.5	2.4	0.5	1.00
4.0	2.4	0.0	0.00
4.5	2.6	0.2	0.40
5.0	2.8	0.2	0.40
6.0	3.3	0.5	0.50
7.0	3.7	0.4	0.40
8.0	4.2	0.5	0.50
9.0	4.6	0.4	0.40
10.0	4.7	0.1	0.10
11.0	5.5	0.8	0.80
12.0	5.8	0.3	0.30
13.0	6.3	0.5	0.50
14.0	6.6	0.3	0.30
15.0	7.0	0.4	0.40
16.0	7.4	0.4	0.40
17.0	7.8	0.4	0.40

Final Water Level Change Rate: 0.40

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	90	cm
Interpreted Rate of Water Level Change (R1) =	**6.7E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.3E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**6.67E-03 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservior used**
Y	2.160 cm^2	surface area for inner reservior used
Q1=X1*R1	**0.235 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.014 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	3	**Shape Factor, where:**

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: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc

C1	**1.66689294**	**Shape factor coefficient**

K_{fs} = 1.74E-04 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

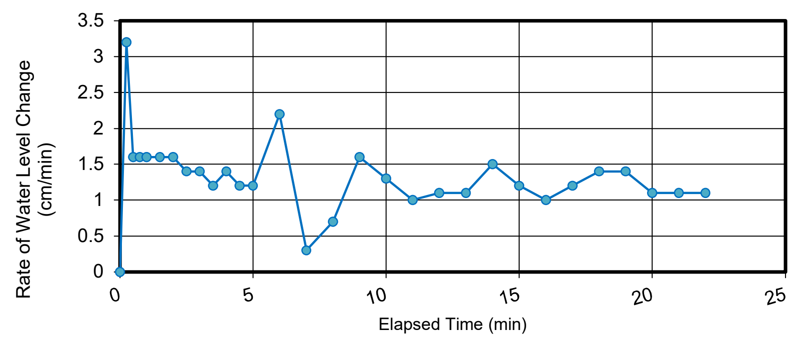
Project No. : LON-22023963
Site Location: Sunset Creek
Conducted by: JS/MB
Date: 17-Nov-22
Processed by: KD
Test Location: INF1 - Deep
Date: 21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF2 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	4.9	-	-
0.3	5.7	0.8	3.20
0.5	6.1	0.4	1.60
0.8	6.5	0.4	1.60
1.0	6.9	0.4	1.60
1.5	7.7	0.8	1.60
2.0	8.5	0.8	1.60
2.5	9.2	0.7	1.40
3.0	9.9	0.7	1.40
3.5	10.5	0.6	1.20
4.0	11.2	0.7	1.40
4.5	11.8	0.6	1.20
5.0	12.4	0.6	1.20
6.0	14.6	2.2	2.20
7.0	14.9	0.3	0.30
8.0	15.6	0.7	0.70
9.0	17.2	1.6	1.60
10.0	18.5	1.3	1.30
11.0	19.5	1.0	1.00
12.0	20.6	1.1	1.10
13.0	21.7	1.1	1.10
14.0	23.2	1.5	1.50
15.0	24.4	1.2	1.20
16.0	25.4	1.0	1.00
17.0	26.6	1.2	1.20
18.0	28.0	1.4	1.40
19.0	29.4	1.4	1.40
20.0	30.5	1.1	1.10
21.0	31.6	1.1	1.10
22.0	32.7	1.1	1.10

Final Water Level Change Rate: 1.10

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	55	cm
Interpreted Rate of Water Level Change (R1) =	**1.8E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**6.5E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**10 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**1.83E-02 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservior used**
Y	2.160 cm^2	surface area for inner reservior used
Q1=X1*R1	**0.646 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.040 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	3	**Shape Factor, where:**

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: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc

C1 1.28754276 **Shape factor coefficient**

K_{fs} = 7.00E-04 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

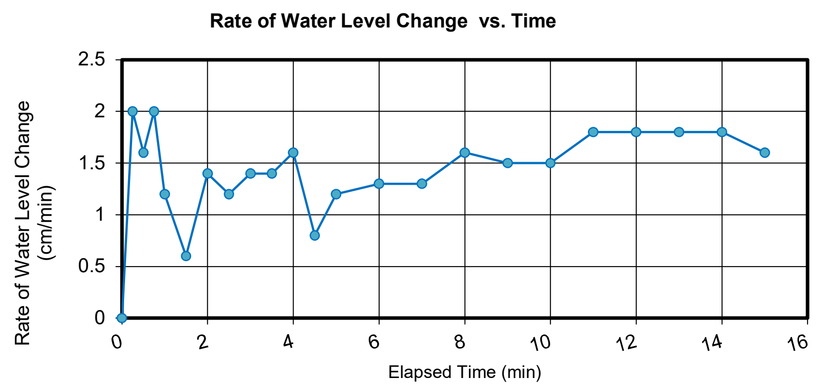
C1-0.36 1.287543

Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	18-Nov-22
		Processed by:	KD
Test Location:	INF2 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF2 - Deep



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	0.0	-	-
0.3	0.5	0.5	2.00
0.5	0.9	0.4	1.60
0.8	1.4	0.5	2.00
1.0	1.7	0.3	1.20
1.5	2.0	0.3	0.60
2.0	2.7	0.7	1.40
2.5	3.3	0.6	1.20
3.0	4.0	0.7	1.40
3.5	4.7	0.7	1.40
4.0	5.5	0.8	1.60
4.5	5.9	0.4	0.80
5.0	6.5	0.6	1.20
6.0	7.8	1.3	1.30
7.0	9.1	1.3	1.30
8.0	10.7	1.6	1.60
9.0	12.2	1.5	1.50
10.0	13.7	1.5	1.50
11.0	15.5	1.8	1.80
12.0	17.3	1.8	1.80
13.0	19.1	1.8	1.80
14.0	20.9	1.8	1.80
15.0	22.5	1.6	1.60

Final Water Level Change Rate: 1.80

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	90	cm
Interpreted Rate of Water Level Change (R_1) =	**3.0E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.1E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**10 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**3.00E-02 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservoir used**
Y	2.160 cm^2	surface area for inner reservoir used
Q1=X1*R1	**1.057 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.065 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	3	**Shape Factor, where:**
C1	**1.28754276**	**Shape factor coefficient**

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: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc

K_{fs} = 1.14E-03 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

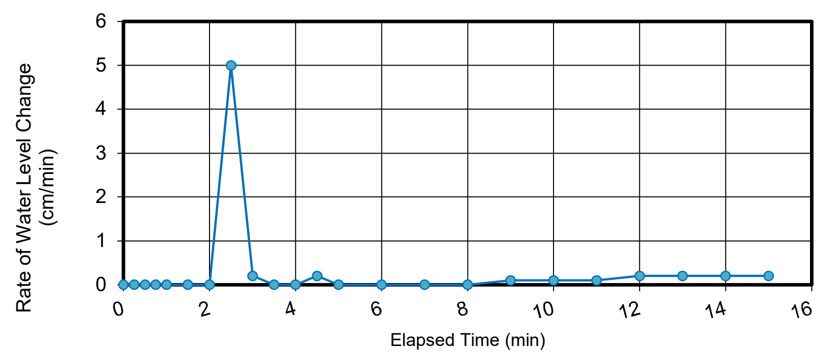
Project No. :	LON-22023963		
Site Location:	Sunset Creek	Conducted by:	JS/MB
		Date:	18-Nov-22
		Processed by:	KD
Test Location:	INF2 - Deep	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF3 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	0.0	-	-
0.3	0.0	0.0	0.00
0.5	0.0	0.0	0.00
0.8	0.0	0.0	0.00
1.0	0.0	0.0	0.00
1.5	0.0	0.0	0.00
2.0	0.0	0.0	0.00
2.5	2.5	2.5	5.00
3.0	2.6	0.1	0.20
3.5	2.6	0.0	0.00
4.0	2.6	0.0	0.00
4.5	2.7	0.1	0.20
5.0	2.7	0.0	0.00
6.0	2.7	0.0	0.00
7.0	2.7	0.0	0.00
8.0	2.7	0.0	0.00
9.0	2.8	0.1	0.10
10.0	2.9	0.1	0.10
11.0	3.0	0.1	0.10
12.0	3.2	0.2	0.20
13.0	3.4	0.2	0.20
14.0	3.6	0.2	0.20
15.0	3.8	0.2	0.20

Final Water Level Change Rate: 0.20

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	45	cm
Interpreted Rate of		
Water Level Change (R1) =	**3.3E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.2E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**3.33E-03 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservior used**
Y	2.160 cm^2	surface area for inner reservoir used
Q1=X1*R1	**0.117 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.007 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**	**Shape factor coefficient**

K_{fs} = 5.01E-05 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

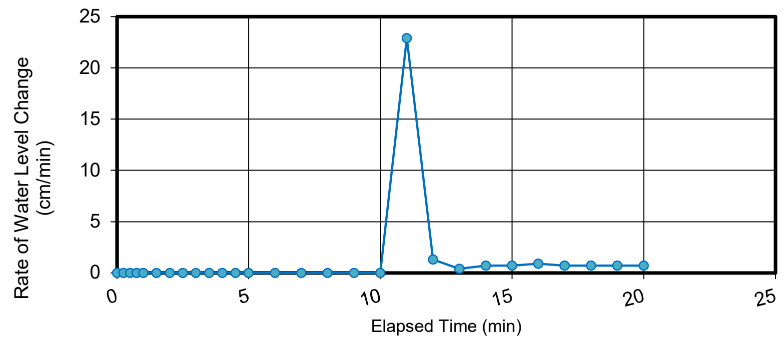
Project No. :	LON-22023963		
Site Location:	Sunset Creek	Conducted by:	JS/MB
		Date:	17-Nov-22
		Processed by:	KD
Test Location:	INF3 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF3 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0		-	-
0.3		0.0	0.00
0.5		0.0	0.00
0.8		0.0	0.00
1.0		0.0	0.00
1.5		0.0	0.00
2.0		0.0	0.00
2.5		0.0	0.00
3.0		0.0	0.00
3.5		0.0	0.00
4.0		0.0	0.00
4.5		0.0	0.00
5.0		0.0	0.00
6.0		0.0	0.00
7.0		0.0	0.00
8.0		0.0	0.00
9.0		0.0	0.00
10.0		0.0	0.00
11.0	22.9	22.9	22.90
12.0	24.2	1.3	1.30
13.0	24.6	0.4	0.40
14.0	25.3	0.7	0.70
15.0	26.0	0.7	0.70
16.0	26.9	0.9	0.90
17.0	27.6	0.7	0.70
18.0	28.3	0.7	0.70
19.0	29.0	0.7	0.70
20.0	29.7	0.7	0.70

Final Water Level Change Rate: 0.70

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	86	cm
Interpreted Rate of Water Level Change (R1) =	**1.2E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**4.1E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**1.17E-02**	**cm/s**	
X	**35.220**	**cm^2**	**surface area for combined reservoir used**
Y	2.160	cm^2	surface area for inner reservior used
Q1=X1*R1	**0.411**	**cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.025	cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**		**Shape factor coefficient**

K_{fs} = 1.75E-04 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

C1-0.36 1.666893

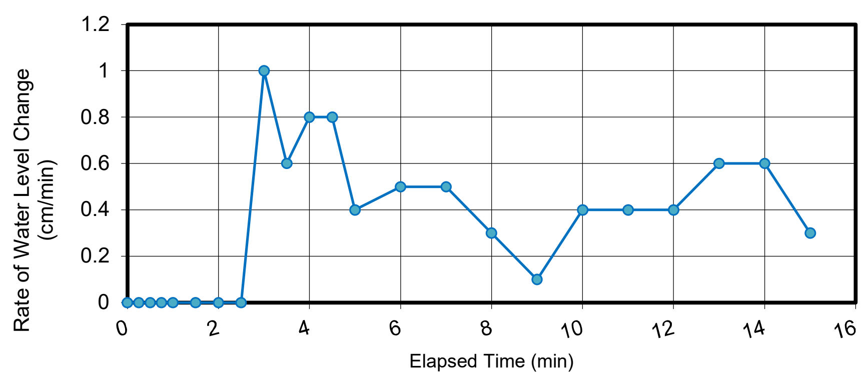
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	17-Nov-22
		Processed by:	KD
Test Location:	INF3 - Deep	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF4 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	12.4	-	-
0.3	12.4	0.0	0.00
0.5	12.4	0.0	0.00
0.8	12.4	0.0	0.00
1.0	12.4	0.0	0.00
1.5	12.4	0.0	0.00
2.0	12.4	0.0	0.00
2.5	12.4	0.0	0.00
3.0	12.9	0.5	1.00
3.5	13.2	0.3	0.60
4.0	13.6	0.4	0.80
4.5	14.0	0.4	0.80
5.0	14.2	0.2	0.40
6.0	14.7	0.5	0.50
7.0	15.2	0.5	0.50
8.0	15.5	0.3	0.30
9.0	15.6	0.1	0.10
10.0	16.0	0.4	0.40
11.0	16.4	0.4	0.40
12.0	16.8	0.4	0.40
13.0	17.4	0.6	0.60
14.0	18.0	0.6	0.60
15.0	18.3	0.3	0.30

Final Water Level Change Rate: 0.40

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	50	cm
Interpreted Rate of Water Level Change (R1) =	**6.7E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.4E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**6.67E-03**	**cm/s**	
X	35.220	cm^2	surface area for combined reservior used
Y	**2.160**	**cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.235	cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.014**	**cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**		**Shape factor coefficient**

K_{fs} = 6.15E-06 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

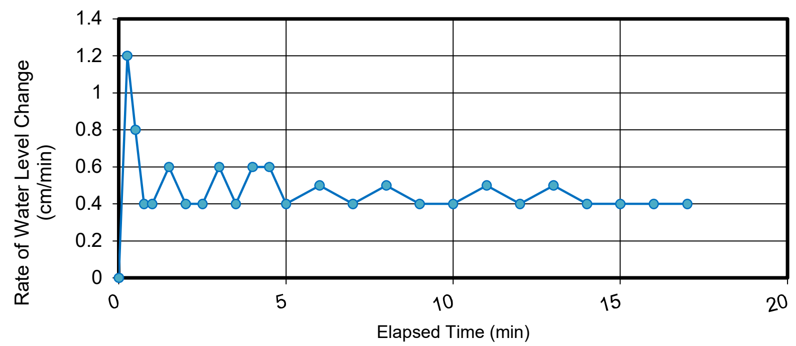
Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey 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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project No. : LON-22023963
Site Location: Sunset Creek
Conducted by: JS/MB
Date: 17-Nov-22
Processed by: KD
Date: 21-Nov-22
Test Location: INF4 - Shallow

Constant Head Permeameter Test Report
Sunset Creek

INF4 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	4.2	-	-
0.3	4.5	0.3	1.20
0.5	4.7	0.2	0.80
0.8	4.8	0.1	0.40
1.0	4.9	0.1	0.40
1.5	5.2	0.3	0.60
2.0	5.4	0.2	0.40
2.5	5.6	0.2	0.40
3.0	5.9	0.3	0.60
3.5	6.1	0.2	0.40
4.0	6.4	0.3	0.60
4.5	6.7	0.3	0.60
5.0	6.9	0.2	0.40
6.0	7.4	0.5	0.50
7.0	7.8	0.4	0.40
8.0	8.3	0.5	0.50
9.0	8.7	0.4	0.40
10.0	9.1	0.4	0.40
11.0	9.6	0.5	0.50
12.0	10.0	0.4	0.40
13.0	10.5	0.5	0.50
14.0	10.9	0.4	0.40
15.0	11.3	0.4	0.40
16.0	11.7	0.4	0.40
17.0	12.1	0.4	0.40

Final Water Level Change Rate: 0.40

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	85	cm
Interpreted Rate of Water Level Change (R_1) =	**6.7E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.3E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**6.67E-03 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservoir used**
Y	2.160 cm^2	surface area for inner reservoir used
Q1=X1*R1	**0.235 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.014 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**	**Shape factor coefficient**

K_{fs} = 1.00E-04 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

C1-0.36 1.666893

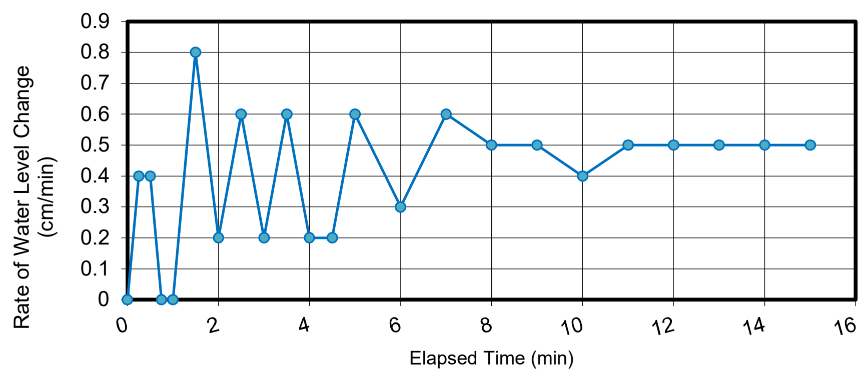
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	17-Nov-22
		Processed by:	KD
Test Location:	INF4 - Deep	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF5 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	2.3	-	-
0.3	2.4	0.1	0.40
0.5	2.5	0.1	0.40
0.8	2.5	0.0	0.00
1.0	2.5	0.0	0.00
1.5	2.9	0.4	0.80
2.0	3.0	0.1	0.20
2.5	3.3	0.3	0.60
3.0	3.4	0.1	0.20
3.5	3.7	0.3	0.60
4.0	3.8	0.1	0.20
4.5	3.9	0.1	0.20
5.0	4.2	0.3	0.60
6.0	4.5	0.3	0.30
7.0	5.1	0.6	0.60
8.0	5.6	0.5	0.50
9.0	6.1	0.5	0.50
10.0	6.5	0.4	0.40
11.0	7.0	0.5	0.50
12.0	7.5	0.5	0.50
13.0	8.0	0.5	0.50
14.0	8.5	0.5	0.50
15.0	9.0	0.5	0.50

Final Water Level Change Rate: 0.50

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	70	cm
Interpreted Rate of Water Level Change (R1) =	**8.3E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.8E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**8.33E-03**	**cm/s**	
X	35.220	cm^2	surface area for combined reservior used
Y	**2.160**	**cm^2**	**surface area for inner reservoir used**
Q1=X1*R1	0.294	cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.018**	**cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**		**Shape factor coefficient**

K_{fs} = 7.68E-06 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

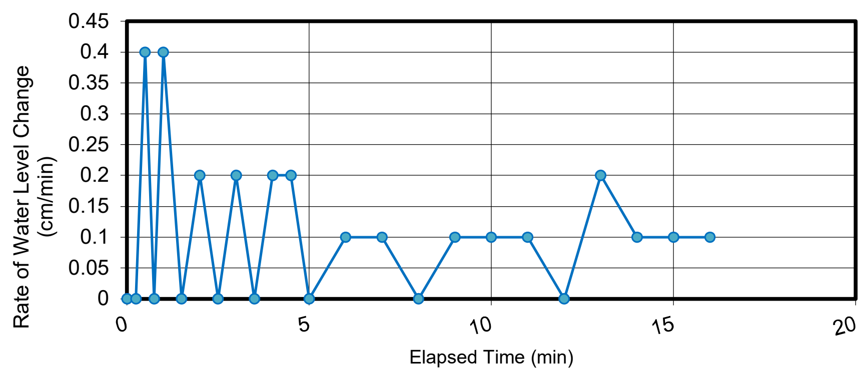
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	17-Nov-22
		Processed by:	KD
Test Location:	INF5 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF5 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	11.9	-	-
0.3	11.9	0.0	0.00
0.5	12.0	0.1	0.40
0.8	12.0	0.0	0.00
1.0	12.1	0.1	0.40
1.5	12.1	0.0	0.00
2.0	12.2	0.1	0.20
2.5	12.2	0.0	0.00
3.0	12.3	0.1	0.20
3.5	12.3	0.0	0.00
4.0	12.4	0.1	0.20
4.5	12.5	0.1	0.20
5.0	12.5	0.0	0.00
6.0	12.6	0.1	0.10
7.0	12.7	0.1	0.10
8.0	12.7	0.0	0.00
9.0	12.8	0.1	0.10
10.0	12.9	0.1	0.10
11.0	13.0	0.1	0.10
12.0	13.0	0.0	0.00
13.0	13.2	0.2	0.20
14.0	13.3	0.1	0.10
15.0	13.4	0.1	0.10
16.0	13.5	0.1	0.10

Final Water Level Change Rate: 0.10

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	90	cm
Interpreted Rate of Water Level Change (R_1) =	**1.7E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**3.6E-03**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**1.67E-03**	**cm/s**	
X	35.220	cm^2	surface area for combined reservior used
Y	**2.160**	**cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.059	cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.004**	**cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**		**Shape factor coefficient**

K_{fs} = 1.54E-06 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

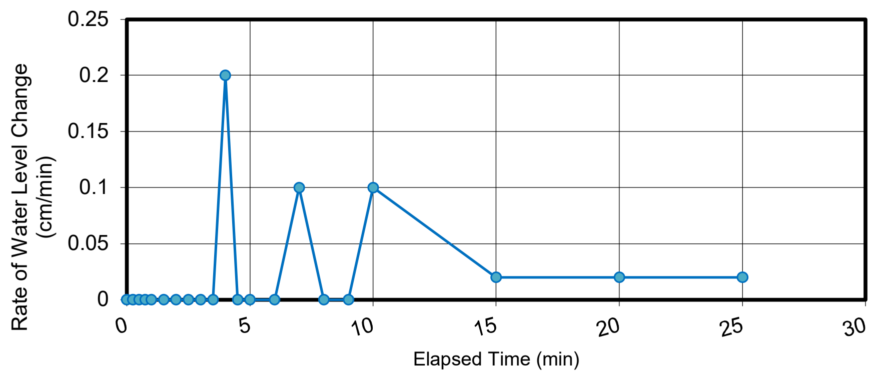
Project No. : LON-22023963
Site Location: Sunset Creek
Conducted by: JS/MB
Date: 17-Nov-22
Processed by: KD
Test Location: INF5 - Deep
Date: 21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF7 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	3.8	-	-
0.3	3.8	0.0	0.00
0.5	3.8	0.0	0.00
0.8	3.8	0.0	0.00
1.0	3.8	0.0	0.00
1.5	3.8	0.0	0.00
2.0	3.8	0.0	0.00
2.5	3.8	0.0	0.00
3.0	3.8	0.0	0.00
3.5	3.8	0.0	0.00
4.0	3.9	0.1	0.20
4.5	3.9	0.0	0.00
5.0	3.9	0.0	0.00
6.0	3.9	0.0	0.00
7.0	4.0	0.1	0.10
8.0	4.0	0.0	0.00
9.0	4.0	0.0	0.00
10.0	4.1	0.1	0.10
15.0	4.2	0.1	0.02
20.0	4.3	0.1	0.02
25.0	4.4	0.1	0.02

Final Water Level Change Rate: 0.02

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	48	cm
Interpreted Rate of Water Level Change (R1) =	**3.3E-04**	**cm/s**
Steady Intake Water Rate (Q_1) =	**7.2E-04**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	20	cm

H1	**20**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**3.33E-04**	**cm/s**	
X	35.220	cm^2	surface area for combined reservior used
Y	**2.160**	**cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.012	cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.001**	**cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.90307116**		**Shape factor coefficient**

K_{fs} = 2.40E-07 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project No. : LON-22023963
Site Location: Sunset Creek
Test Location: INF7 - Shallow

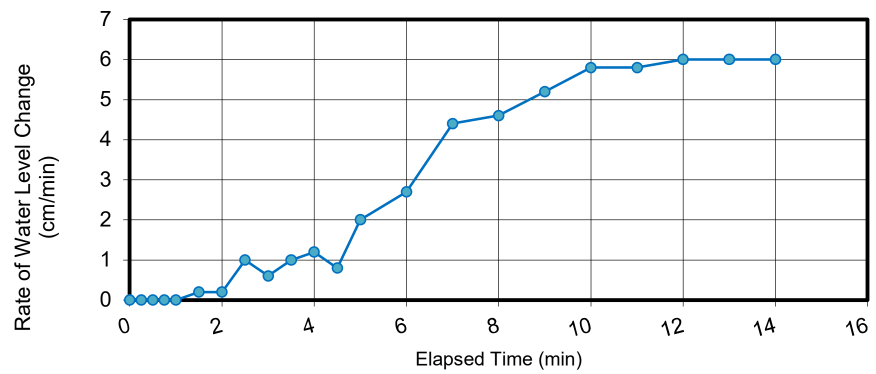
Conducted by: JS/PA
Date: 16-Nov-22
Processed by: KD
Date: 21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF8 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	2.5	-	-
0.3	2.5	0.0	0.00
0.5	2.5	0.0	0.00
0.8	2.5	0.0	0.00
1.0	2.5	0.0	0.00
1.5	2.6	0.1	0.20
2.0	2.7	0.1	0.20
2.5	3.2	0.5	1.00
3.0	3.5	0.3	0.60
3.5	4.0	0.5	1.00
4.0	4.6	0.6	1.20
4.5	5.0	0.4	0.80
5.0	6.0	1.0	2.00
6.0	8.7	2.7	2.70
7.0	13.1	4.4	4.40
8.0	17.7	4.6	4.60
9.0	22.9	5.2	5.20
10.0	28.7	5.8	5.80
11.0	34.5	5.8	5.80
12.0	40.5	6.0	6.00
13.0	46.5	6.0	6.00
14.0	52.5	6.0	6.00

Final Water Level Change Rate: 6.00

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	50	cm
Interpreted Rate of Water Level Change (R1) =	**1.0E-01**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.2E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	22	cm

H1	**22 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**1.00E-01 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	3.522 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.216 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	3	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**2.09154276**	**Shape factor coefficient**

K_{fs} = 1.06E-04 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

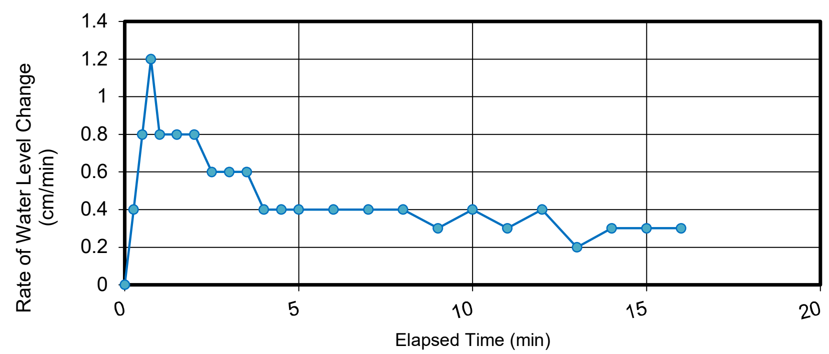
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	15-Nov-22
		Processed by:	KD
Test Location:	INF8 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF8 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	0.0	-	-
0.3	0.1	0.1	0.40
0.5	0.3	0.2	0.80
0.8	0.6	0.3	1.20
1.0	0.8	0.2	0.80
1.5	1.2	0.4	0.80
2.0	1.6	0.4	0.80
2.5	1.9	0.3	0.60
3.0	2.2	0.3	0.60
3.5	2.5	0.3	0.60
4.0	2.7	0.2	0.40
4.5	2.9	0.2	0.40
5.0	3.1	0.2	0.40
6.0	3.5	0.4	0.40
7.0	3.9	0.4	0.40
8.0	4.3	0.4	0.40
9.0	4.6	0.3	0.30
10.0	5.0	0.4	0.40
11.0	5.3	0.3	0.30
12.0	5.7	0.4	0.40
13.0	5.9	0.2	0.20
14.0	6.2	0.3	0.30
15.0	6.5	0.3	0.30
16.0	6.8	0.3	0.30

Final Water Level Change Rate: 0.30

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	86	cm
Interpreted Rate of		
Water Level Change (R1) =	**5.0E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.8E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	22	cm

H1	**22 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.12	slope fitting parameter (estimated based on soil structure)
R1	**5.00E-03 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservior used**
Y	2.160 cm^2	surface area for inner reservoir used
Q1=X1*R1	**0.176 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.011 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	3	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**2.09154276**	**Shape factor coefficient**

K_{fs} = 8.66E-05 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

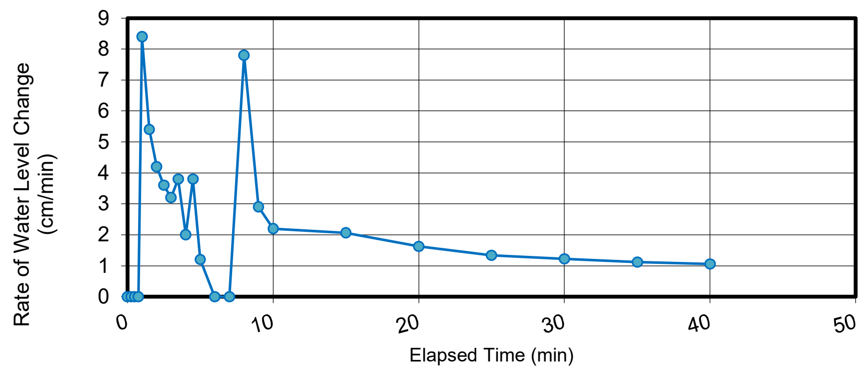
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	15-Nov-22
		Processed by:	KD
Test Location:	INF8 - Deep	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF9 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	2.5	-	-
0.3	2.5	0.0	0.00
0.5	2.5	0.0	0.00
0.8	2.5	0.0	0.00
1.0	4.6	2.1	8.40
1.5	7.3	2.7	5.40
2.0	9.4	2.1	4.20
2.5	11.2	1.8	3.60
3.0	12.8	1.6	3.20
3.5	14.7	1.9	3.80
4.0	15.7	1.0	2.00
4.5	17.6	1.9	3.80
5.0	18.2	0.6	1.20
6.0	18.2	0.0	0.00
7.0	18.2	0.0	0.00
8.0	26.0	7.8	7.80
9.0	28.9	2.9	2.90
10.0	31.1	2.2	2.20
15.0	41.4	10.3	2.06
20.0	49.5	8.1	1.62
25.0	56.2	6.7	1.34
30.0	62.3	6.1	1.22
35.0	67.9	5.6	1.12
40.0	73.2	5.3	1.06

Final Water Level Change Rate: 1.13

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	45	cm
Interpreted Rate of Water Level Change (R1) =	**1.9E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**4.1E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	15	cm

H1	**15 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**1.89E-02 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.665 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.041 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.62914414**	**Shape factor coefficient**

K_{fs} = 1.74E-05 cm/s

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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

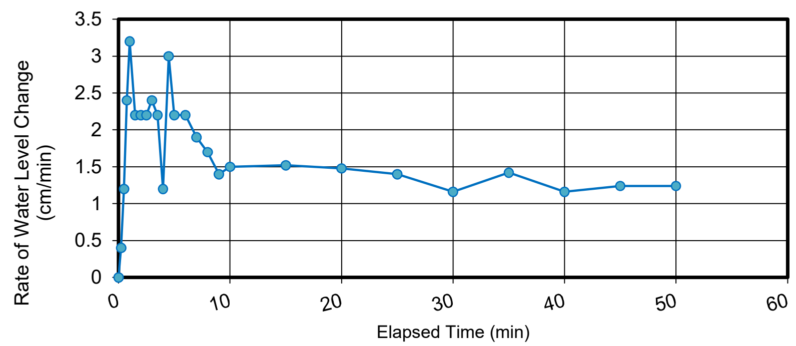
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/PA
	Sunset Creek	Date:	16-Nov-22
		Processed by:	KD
Test Location:	INF9 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF9 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	0.0	-	-
0.3	0.1	0.1	0.40
0.5	0.4	0.3	1.20
0.8	1.0	0.6	2.40
1.0	1.8	0.8	3.20
1.5	2.9	1.1	2.20
2.0	4.0	1.1	2.20
2.5	5.1	1.1	2.20
3.0	6.3	1.2	2.40
3.5	7.4	1.1	2.20
4.0	8.0	0.6	1.20
4.5	9.5	1.5	3.00
5.0	10.6	1.1	2.20
6.0	12.8	2.2	2.20
7.0	14.7	1.9	1.90
8.0	16.4	1.7	1.70
9.0	17.8	1.4	1.40
10.0	19.3	1.5	1.50
15.0	26.9	7.6	1.52
20.0	34.3	7.4	1.48
25.0	41.3	7.0	1.40
30.0	47.1	5.8	1.16
35.0	54.2	7.1	1.42
40.0	60.0	5.8	1.16
45.0	66.2	6.2	1.24
50.0	72.4	6.2	1.24

Final Water Level Change Rate: 1.50

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	86	cm
Interpreted Rate of		
Water Level Change (R_1) =	**2.5E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**8.8E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	10	cm

H1	**10 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**2.50E-02 cm/s**	
X	**35.220 cm^2**	**surface area for combined reservoir used**
Y	2.160 cm^2	surface area for inner reservoir used
Q1=X1*R1	**0.881 cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.054 cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.29023413**	**Shape factor coefficient**

K_{fs} = 5.08E-04 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

C1-0.36 1.287543

Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/PA
	Sunset Creek	Date:	16-Nov-22
		Processed by:	KD
Test Location:	INF9 - Deep	Date:	21-Nov-22

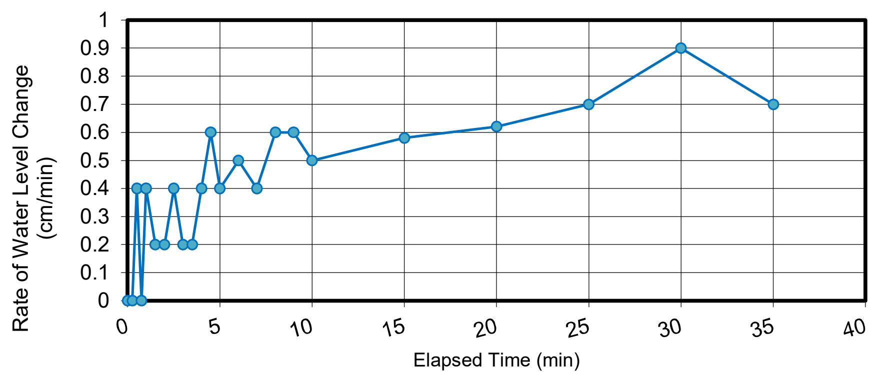
Constant Head Permeameter Test Report

Sunset Creek

INF10 - Shallow

exp.

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	10.9	-	-
0.3	10.9	0.0	0.00
0.5	11.0	0.1	0.40
0.8	11.0	0.0	0.00
1.0	11.1	0.1	0.40
1.5	11.2	0.1	0.20
2.0	11.3	0.1	0.20
2.5	11.5	0.2	0.40
3.0	11.6	0.1	0.20
3.5	11.7	0.1	0.20
4.0	11.9	0.2	0.40
4.5	12.2	0.3	0.60
5.0	12.4	0.2	0.40
6.0	12.9	0.5	0.50
7.0	13.3	0.4	0.40
8.0	13.9	0.6	0.60
9.0	14.5	0.6	0.60
10.0	15.0	0.5	0.50
15.0	17.9	2.9	0.58
20.0	21.0	3.1	0.62
25.0	24.5	3.5	0.70
30.0	29.0	4.5	0.90
35.0	32.5	3.5	0.70

Final Water Level Change Rate: 0.58

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	45	cm
Interpreted Rate of Water Level Change (R1) =	**9.7E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**2.1E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	20	cm

H1	**20 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**9.67E-03 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	0.340 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.021 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.90307116**	**Shape factor coefficient**

K_{fs} = 6.96E-06 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

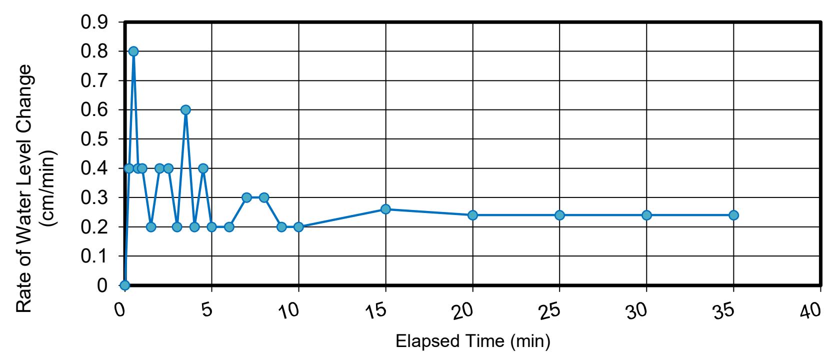
Project No. :	LON-22023963		
Site Location:		Conducted by:	JS/MB
	Sunset Creek	Date:	15-Nov-22
		Processed by:	KD
Test Location:	INF10 - Shallow	Date:	21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF10 - Deep

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	37.8	-	-
0.3	37.9	0.1	0.40
0.5	38.1	0.2	0.80
0.8	38.2	0.1	0.40
1.0	38.3	0.1	0.40
1.5	38.4	0.1	0.20
2.0	38.6	0.2	0.40
2.5	38.8	0.2	0.40
3.0	38.9	0.1	0.20
3.5	39.2	0.3	0.60
4.0	39.3	0.1	0.20
4.5	39.5	0.2	0.40
5.0	39.6	0.1	0.20
6.0	39.8	0.2	0.20
7.0	40.1	0.3	0.30
8.0	40.4	0.3	0.30
9.0	40.6	0.2	0.20
10.0	40.8	0.2	0.20
15.0	42.1	1.3	0.26
20.0	43.3	1.2	0.24
25.0	44.5	1.2	0.24
30.0	45.7	1.2	0.24
35.0	46.9	1.2	0.24

Final Water Level Change Rate: 0.24

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	90	cm
Interpreted Rate of Water Level Change (R1) =	**4.0E-03**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.4E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	20	cm

H1	**20**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**4.00E-03**	**cm/s**	
X	**35.220**	**cm^2**	**surface area for combined reservior used**
Y	2.160	cm^2	surface area for inner reservior used
Q1=X1*R1	**0.141**	**cm^3/s**	**Flow rate based on combined reservoir area and average rate of infiltration**
Q1=Y1*R1	0.009	cm^3/s	Flow rate based on inner reservoir area and average rate of infiltration
	2		**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.90307116**		**Shape factor coefficient**

K_{fs} = 4.70E-05 cm/s

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	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

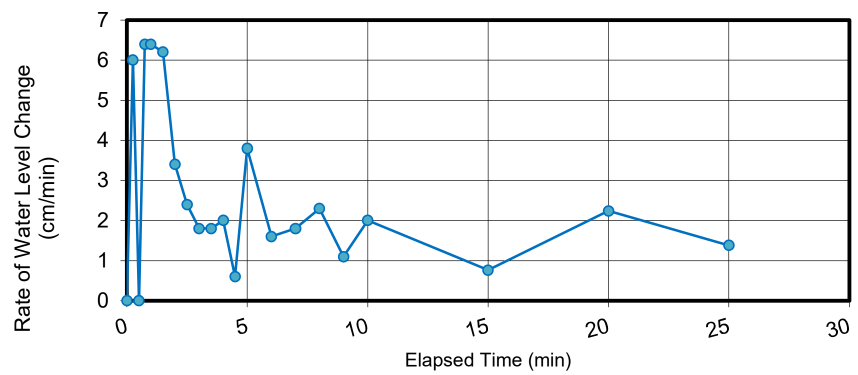
Project No. : LON-22023963
Site Location: Sunset Creek
Test Location: INF10 - Deep
Conducted by: JS/MB
Date: 15-Nov-22
Processed by: KD
Date: 21-Nov-22

Constant Head Permeameter Test Report

Sunset Creek

INF11 - Shallow

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Water level Change Rate (cm/min)
0.0	26.6	-	-
0.3	28.1	1.5	6.00
0.5	28.1	0.0	0.00
0.8	29.7	1.6	6.40
1.0	31.3	1.6	6.40
1.5	34.4	3.1	6.20
2.0	36.1	1.7	3.40
2.5	37.3	1.2	2.40
3.0	38.2	0.9	1.80
3.5	39.1	0.9	1.80
4.0	40.1	1.0	2.00
4.5	40.4	0.3	0.60
5.0	42.3	1.9	3.80
6.0	43.9	1.6	1.60
7.0	45.7	1.8	1.80
8.0	48.0	2.3	2.30
9.0	49.1	1.1	1.10
10.0	51.1	2.0	2.00
15.0	54.9	3.8	0.76
20.0	66.1	11.2	2.24
25.0	73.0	6.9	1.38

Final Water Level Change Rate: 1.87

Combined Reservoir Surface Area =	35.220	cm^2
Borehole Depth =	50	cm
Interpreted Rate of Water Level Change (R1) =	**3.1E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**6.7E-02**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	20	cm

H1	**20 cm**	**water column height in borehole, first test**
a	3 cm	well radius
α	0.04	slope fitting parameter (estimated based on soil structure)
R1	**3.11E-02 cm/s**	
X	35.220 cm^2	surface area for combined reservior used
Y	**2.160 cm^2**	**surface area for inner reservior used**
Q1=X1*R1	1.096 cm^3/s	Flow rate based on combined reservoir area and average rate of infiltration
Q1=Y1*R1	**0.067 cm^3/s**	**Flow rate based on inner reservoir area and average rate of infiltration**
	2	**Shape Factor, where:** 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: Structured soils from clays to loams; also incudes unstructured medium and fine sands 4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks, macropores, etc
C1	**1.90307116**	**Shape factor coefficient**

K_{fs} = 2.24E-05 cm/s

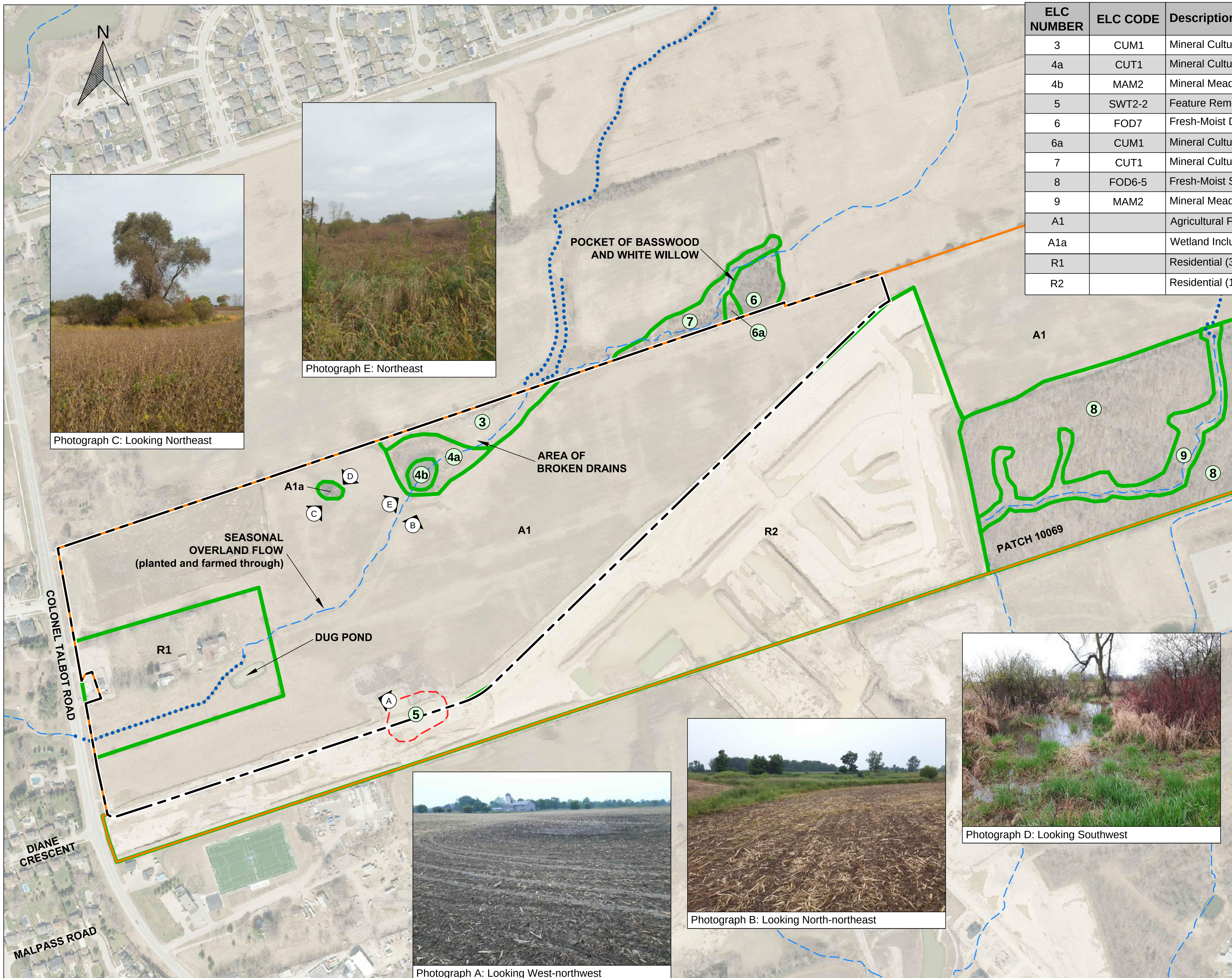
One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined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

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	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
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	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project No. :	LON-22023963		
Site Location:	Sunset Creek	Conducted by:	JS/MB
		Date:	15-Nov-22
		Processed by:	KD
Test Location:	INF11 - Shallow	Date:	21-Nov-22

Appendix H – Ecology

6-405 Maple Grove Road | Cambridge, Ontario | Canada
t: +1.519.650.4918 | f: +1.519.650.4603 | exp.com



ELC NUMBER	ELC CODE	Description
3	CUM1	Mineral Cultural Meadow (0.70ha)
4a	CUT1	Mineral Cultural Thicket (0.56ha)
4b	MAM2	Mineral Meadow Marsh (0.12ha)
5	SWT2-2	Feature Removed as Part of Prior Approval
6	FOD7	Fresh-Moist Deciduous Lowland Forest - Basswood dominant (0.38ha)
6a	CUM1	Mineral Cultural Meadow Inclusion (0.06ha)
7	CUT1	Mineral Cultural Thicket (0.59ha)
8	FOD6-5	Fresh-Moist Sugar Maple-Hardwood Deciduous Forest Type (7.7 ha)
9	MAM2	Mineral Meadow Marsh (1.38ha)
A1		Agricultural Field (49.58ha)
A1a		Wetland Inclusion (0.05ha)
R1		Residential (3.83ha)
R2		Residential (18.98ha)

LEGEND

SUBJECT LANDS
LEGAL PARCEL

WATERCOURSE
EPHEMERAL
PRIMARY
INTERMITTENT

VEGETATION COMMUNITY
FEATURE REMOVED AS PART OF PRIOR APPROVAL (Draft Plan 1)
PHOTOGRAPH (Location and Viewing Direction)

REFERENCES

CITY OF 2021 LONDON PARCEL AND AERIAL IMAGERY, CITY OF LONDON ROAD), OPEN DATA SET; MHBC, PROPOSED DRAFT PLAN OF SUBDIVISION, FILE No. 1094 'U', OCTOBER 25 - 2022; AND UPPER THAMES CONSERVATION AUTHORITY (UTRCA) WATER NETWORK.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

SCALE IN METRES
0 100 200m
1:5,000

MTE
Engineers, Scientists, Surveyors

PROJECT
ENVIRONMENTAL IMPACT STUDY
3680 and 3700 COLONEL TALBOT ROAD
LONDON, ONTARIO

TITLE
VEGETATION COMMUNITIES

Drawn DCH	Scale AS SHOWN		
Checked	Project No. 45598-101	FIGURE 7	
Date Nov 30/22	Rev No. 0		

Appendix I – MECP Water Well Summary

6-405 Maple Grove Road | Cambridge, Ontario | Canada
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Water Well Records

May 4, 2023

2:04:53 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
LONDON CITY	17 475052 4751635 W	2016-10 7190	4 2	UT		TH	0020 10	7277001 (Z238686) A177526	BRWN LOAM 0000 BRWN SAND SILT LOOS 0001 GREY CLAY DNSE 0030
LONDON CITY	17 475607 4752152 W	2018-04 7320	2.00			TH	0050 10	7312301 (Z281383) _NO_TAG	BRWN SAND SILT LOOS 0005 BRWN SILT CLAY HARD 0034 BRWN SILT SAND HARD 0060
LONDON CITY	17 475616 4751949 W	2018-04 7320	2.00			TH	0050 10	7312302 (Z281384) _NO_TAG	BRWN SAND SILT LOOS 0005 BRWN CLAY SILT SOFT 0020 BRWN SILT SAND PCKD 0060
LONDON CITY	17 475756 4752199 W	2018-04 7320	5.09	UT		TH	0015 3	7312303 (Z281404) _NO_TAG	BRWN SAND SILT LOOS 0002 BRWN CLAY SILT TILL 0010 BRWN SILT SAND PCKD 0018
LONDON CITY	17 475050 4752409 W	2018-11 7190	2 4	UT 0035	35///:	MO	0035 5	7324904 (Z260105) A235955	BLCK LOAM SOFT 0002 BRWN CLAY SAND SOFT 0005 GREY SILT CLAY HARD 0035 GREY SAND SILT HARD 0040
LONDON CITY	17 474518 4752567 W	2016-08 7190	2	UT 0023		MO	0015 10	7272858 (Z238663) A156741	BRWN SAND SILT 0023 GREY CLAY 0025
LONDON CITY	17 474256 4752551 W	2021-03 7428						7383501 (Z294310) A P	
LONDON CITY	17 474568 4751965 W	2018-11 7190	2 4	UT		MO	0040 10	7324905 (Z290135) A254036	BRWN SAND SOFT 0007 GREY SILT CLAY HARD 0040 BRWN SAND LOOS 0050
LONDON CITY	17 474510 4752180 W	2018-11 7190	2 4	UT		MO	0045 5	7324903 (Z290134) A254035	BRWN SAND SILT SOFT 0005 GREY SILT SAND HARD 0035 BRWN SAND 0050
LONDON CITY	17 475746 4752199 W	2018-04 7320	2.00	UT 0014		TH	0013 5	7312300 (Z281405) _NO_TAG	BRWN SILT SAND LOOS 0005 BRWN CLAY SILT HARD 0016 BRWN SAND SILT WBRG 0017 BRWN SILT CLAY TILL 0018
LONDON CITY	17 474928 4752238 W	2018-11 7190	2 4	UT		MO	0030 10	7324902 (Z290137) A235961	BRWN CLAY SAND SOFT 0005 BRWN SAND LOOS 0040
LONDON CITY	17 474928 4752238 W	2018-11 7190				NU		7324901 (Z290136) A201238 A	
WESTMINSTER TOWNSHIP	17 475288 4752564 W	2017-04 7109	2	UT 0008	5///:	TH MO	0025 10	7286126 (Z246466) A224074	BRWN LOAM 0001 BRWN CLAY SILT TILL 0008 GREY SILT SNDY TILL 0020 GREY CLAY SILT TILL 0035

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
WESTMINSTER TOWNSHIP	17 475288 4752564 W	2017-04 7190	2	UT 0008	5///:	TH MO	0008 2	7286127 (Z246464) A216571	BRWN 0001 BRWN CLAY SILT TILL 0008 GREY CLAY SNDY TILL 0010
WESTMINSTER TOWNSHIP	17 475701 4752463 W	2017-08 7320	2.00			TH	0035 10	7299448 (Z272021) A230191	BRWN CLAY SILT 0022 BRWN SAND SILT 0024 GREY CLAY SILT 0030 GREY SILT SAND 0045
WESTMINSTER TOWNSHIP	17 475918 4752488 W	2017-08 7320	2.00			TH	0030 10	7299449 (Z272060) A230192	BRWN CLAY SILT 0022 BRWN SILT SAND 0040
WESTMINSTER TOWNSHIP	17 475701 4752406 W	2017-08 7320	2.00	UT 0020		TH	0019 5	7299447 (Z268786) A230181	BRWN CLAY SILT 0020 BRWN SAND SILT 0024
WESTMINSTER TOWNSHIP	17 475070 4752432 W	2017-04 7190	2	UT 0007	7///:	TH	0007 5	7286124 (Z255277) A187148	BRWN LOAM SOFT 0002 BRWN CLAY SILT SOFT 0003 BRWN CLAY SILT TILL 0007 BRWN SAND LOOS 0008 BRWN CLAY SILT TILL 0010 BRWN SAND GRVL LOOS 0010 GREY CLAY SILT TILL 0015
WESTMINSTER TOWNSHIP	17 475097 4752602 W	2017-04 7190	2	0035	35///:	TH MO	0025 10	7286125 (Z255276) A224083	BRWN LOAM SOFT 0001 BRWN CLAY SILT SOFT 0002 BRWN CLAY SILT TILL 0015 BRWN SAND SILT TILL 0025 BRWN FSND 0035
WESTMINSTER TOWNSHIP	17 474805 4752335 W	2017-04 7190	2			TH MO	0030 10	7286122 (Z255282) A224091	BRWN LOAM SOFT 0001 BRWN SAND SILT TILL 0020 BRWN SAND GRVL FSND 0030 BRWN SAND FGRD 0040
WESTMINSTER TOWNSHIP	17 474450 4752333 W	2017-04 7190	2			TH MO	0005 2	7286121 (Z255280) A216583	BRWN LOAM SOFT 0001 BRWN SILT 0003 BRWN SILT SAND GRVL 0005 BRWN SAND SLTY GRVL 0006 GREY CLAY 0008
WESTMINSTER TOWNSHIP	17 474577 4752407 W	2017-04 7190	2			TH MO	0008 2	7286120 (Z255283) A224089	BRWN LOAM 0000 BRWN CLAY SILT 0008 GREY CLAY SILT TILL 0010
WESTMINSTER TOWNSHIP	17 474522 4752580 W	2017-04 7190	2			TH MO	0008 2	7286119 (Z255284) A216534	BRWN LOAM LOOS 0001 BRWN FILL CLYY SILT 0006 BRWN SILT 0010 BRWN CLAY SILT 0014 GREY CLAY SILT TILL
WESTMINSTER TOWNSHIP	17 474435 4752036 W	2017-01 7190	2			MO	0010 10	7281670 (Z246429) A216531	BLCK LOAM LOOS 0001 BRWN SAND HARD 0007 BRWN SILT CLAY LYRD 0020
WESTMINSTER TOWNSHIP	17 474027 4752478 W	2016-11 7428						7277168 (Z249031) A201223 A	
WESTMINSTER TOWNSHIP	17 474029 4752478 W	2016-04 7190	2	UT		MO	0020 10	7264471 (Z228520) A201223	BRWN CLAY SAND PCKD 0010 GREY CLAY SAND PCKD 0020
WESTMINSTER TOWNSHIP	17 474896 4752219 W	2016-02 7190	2	UT 0015		MO	0020 10	7261599 (Z228498) A201238	BRWN SAND LOOS 0005 BRWN CLAY TILL 0015 GREY CLAY TILL 0020

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
WESTMINSTER TOWNSHIP	17 474193 4752142 W	2013-12 7190	2			MO	0020 10	7214778 (Z169418) A146263	BRWN SAND LOOS 0010 BRWN CLAY PCKD 0020
WESTMINSTER TOWNSHIP	17 474765 4751498 W	2011-06 7190	2	UK 0020		MO	0022 10	7165954 (Z120272) A076113	BRWN SAND SILT DNSE 0015 GREY SILT TILL DNSE 0032
WESTMINSTER TOWNSHIP	17 474535 4752032 W	2022-04 7343						7418644 (Z380566) P	
WESTMINSTER TOWNSHIP	17 474395 4751441 W	2018-08 7190	2 4	0015	15///:	MO	0018 5	7319557 (Z294628) A254165	BLCK LOAM SILT SNDY 0001 BRWN SILT CLAY SNDY 0002 BRWN CLAY SILT SAND 0005 BRWN SAND GRVL 0012 GREY SILT CLAY 0018 GREY SAND SILT 0023
WESTMINSTER TOWNSHIP	17 474442 4751372 W	2018-08 7190	2 4	0015	15///:	MO	0015 5	7319558 (Z294634) A254166	BLCK LOAM SILT LOOS 0001 BRWN SILT GRVL SNDY 0005 BRWN SAND GRVL DNSE 0012 GREY SILT CLAY 0015 GREY SAND SILT LOOS 0018 GREY SILT CLAY 0020
WESTMINSTER TOWNSHIP	17 474362 4751408 W	2018-08 7190	2 4	0015	15///:	MO	0015 5	7319559 (Z294633) A254167	BLCK LOAM SNDY LOOS 0001 BRWN SILT SAND 0002 BRWN SAND GRVL 0005 BRWN GRVL SAND 0012 GREY SILT CLAY 0015 GREY SAND SILT CLAY 0020
WESTMINSTER TOWNSHIP	17 474224 4751476 W	2018-08 7190	2 4	0015	15///:	MO	0015 5	7319560 (Z294632) A254168	BLCK LOAM SILT SNDY 0001 BRWN SILT SAND 0005 BRWN GRVL SAND 0008 GREY SILT CLAY 0015 GREY SAND SILT CLAY 0020
WESTMINSTER TOWNSHIP	17 474282 4751468 W	2018-08 7190	2 4	0015	15///:	MO	0015 5	7319561 (Z294631) A254169	BLCK LOAM LOOS 0001 BRWN SILT 0005 BRWN GRVL SAND 0012 GREY SILT CLAY 0018 GREY SILT SAND 0020
WESTMINSTER TOWNSHIP	17 475975 4752700 W	2017-08 7320	2.00	0023		TH	0020 5	7299451 (Z272058) A230183	BRWN CLAY SILT 0016 BRWN SILT SAND 0025
WESTMINSTER TOWNSHIP	17 474862 4752557 W	2017-04 7190	2	0008	8///:	TH MO	0003 7	7286123 (Z255279) A216530	BRWN LOAM SOFT 0001 BRWN CLAY SILT FILL 0005 BRWN SILT 0010 GREY CLAY SILT TILL 0015
WESTMINSTER TOWNSHIP NTR E 072	17 474866 4751451 W	1974-11 2552	36 27	FR 0021	21/48/0/2:0	DO		4107070 ()	BRWN SAND 0010 GRVL 0028 BLUE CLAY 0048
WESTMINSTER TOWNSHIP NTR E 073	17 474734 4751583 W	1959-06 1708	7	FR 0112	40/40/50/12:0	IN	0114 10	4103916 ()	GRVL 0023 CLAY 0028 GRVL 0036 CLAY STNS 0097 MSND 0112 GRVL 0124
WESTMINSTER TOWNSHIP NTR E 073	17 474781 4751669 W	2021-04 7320						7387408 (Z358289) A316909 P	
WESTMINSTER TOWNSHIP NTR E 073	17 475626 4752085 W	2021-04 7190	4 2		0///:	MT	0015 5	7388604 (QYKKU9JN) A316460	LOAM 0000 BRWN CLAY SILT TILL 0021 BRWN SAND 0022
WESTMINSTER TOWNSHIP NTR E 073	17 474862 4751801 W	2021-04 7320						7387406 (Z358291) A316911 P	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
WESTMINSTER TOWNSHIP NTR E 073	17 474886 4751715 W	2021-04 7320						7387407 (Z358290) A316910 P	
WESTMINSTER TOWNSHIP NTR E 074	17 474576 4752179 W	2020-11 7190	2 4	UT 0008	8///:	MO	0010 5	7375942 (98EALB5L) A305972	BRWN SILT SAND LOOS 0005 GREY CLAY DNSE 0008 GREY CLAY DNSE 0015
WESTMINSTER TOWNSHIP NTR E 074	17 474615 4751942 W	2020-11 7190	2 4		0///:	MO	0010 5	7375941 (VDX8WU63) A305969	BLCK LOAM SOFT 0001 BRWN CLAY SILT SOFT 0003 BRWN SAND LOOS 0004 BRWN CLAY SILT LOOS 0008 GREY CLAY SOFT 0015
WESTMINSTER TOWNSHIP NTR E 074	17 474868 4752262 W	2020-11 7190	2 4	UT 0010	10///:	MO	0010 5	7375939 (5PXDS6BX) A305963	BRWN SILT SAND LOOS 0005 GREY CLAY DNSE 0008 GREY CLAY DNSE 0015
WESTMINSTER TOWNSHIP NTR E 074	17 474694 4752283 W	1985-11 4741	5 1	FR 0116	116//2/2:0	MN	0122 4	4110354 ()	BRWN CLAY 0016 GREY CLAY 0036 SAND CLAY 0048 GRVL SAND LYRD 0138 SAND SLTY 0142 GREY CLAY 0178
WESTMINSTER TOWNSHIP NTR E 074	17 474514 4751973 W	1967-04 1708	5	FR 0119	84/85/30/8:0	ST DO	0116 14	4103917 ()	CLAY STNS BLDR 0049 MSND CLAY 0119 MSND 0124 MSND SILT 0130
WESTMINSTER TOWNSHIP NTR E 074	17 475224 4752432 W	2020-11 7190	2 4	UT 0010	10///:	MO	0010 5	7375940 (HOGORRSL) A305965	BRWN SILT SAND LOOS 0005 GREY CLAY DNSE 0011 GREY CLAY DNSE 0015
WESTMINSTER TOWNSHIP NTR E 075	17 474394 4752255 W	1991-03 3366	5	FR 0114	72/73/8/12:0	DO	0118 3	4112333 (90648)	BRWN SAND CLAY 0008 CLAY 0016 GRVL 0022 GREY CLAY STNS 0038 GREY FSND GRVL CLAY 0114 BRWN FSND 0118 GREY CSND 0122 GREY CSND CLAY 0125
WESTMINSTER TOWNSHIP NTR E 075	17 474434 4752603 W	1969-09 4741	5	FR 0120	70/75/10/3:0	DO	0121 3	4104936 ()	BRWN CLAY 0030 GRVL 0080 FSND 0100 MSND GRVL 0120 MSND 0124
WESTMINSTER TOWNSHIP NTR E 075	17 474814 4752703 W	1967-07 4712	5	FR 0159	122/130/10/8:0	DO	0156 6	4103919 ()	BRWN CLAY 0015 BRWN CLAY MSND 0023 BRWN CLAY SILT 0056 CSND 0065 BRWN CLAY MSND 0132 GREY MSND SILT 0138 GREY FSND 0155 CSND 0159 FSND 0161 BLUE CLAY 0162
WESTMINSTER TOWNSHIP NTR E 075	17 475654 4752943 W	1962-03 4712	5	FR 0160	115/120/10/12:0	ST DO	0175 3	4103918 ()	BRWN CLAY 0040 MSND 0160 CSND 0180
WESTMINSTER TOWNSHIP NTR E -07	17 475339 4753033 W	2020-02 7343	6.25 6.25	FR 0153 FR 0159	99//15/2:	IR	0151 8	7353584 (Z322110) A272913	BLCK FILL 0005 BRWN CLAY 0017 GREY CLAY 0130 BRWN SAND 0150 GREY GRVL 0162
WESTMINSTER TOWNSHIP NTR W 073	17 474134 4751643 W	1986-05 2801	2 7		48/52/200/24:0	NU	0104 22	4110505 ()	SILT GRVL BLDR 0004 BRWN SILT SAND GRVL 0014 GREY CLAY 0020 GREY CLAY BLDR 0035 GREY CLAY SAND BLDR 0056 GREY CLAY STNY 0065 CLAY GRVL BLDR 0071 GREY CLAY STNY 0076 GRVL SAND BLDR 0100 SAND FGVL 0106 FGVL FSND 0125
WESTMINSTER TOWNSHIP NTR W 073	17 474199 4751545 W	2004-01 2801				NU		4115574 (Z02141) A	
WESTMINSTER TOWNSHIP NTR W 073	17 474484 4751563 W	1961-06 2801	2 2 2	FR	54/57/20/7:0	NU	0115 20	4103960 ()	GRVL CSND 0004 GREY CLAY GRVL 0012 GRVL CSND 0018 GREY CLAY GRVL 0088 GREY CLAY SILT GRVL 0109 GRVL CSND 0135 GREY CLAY GRVL 0254 GREY LMSN 0255

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
WESTMINSTER TOWNSHIP NTR W 073	17 474224 4751558 W	2003-12 2801				NU		4115571 (Z02140) A	
WESTMINSTER TOWNSHIP NTR W 073	17 474714 4751683 W	1988-05 4741	5	FR 0088	68/73/10/2:0	DO	0099 3	4111273 (22291)	BRWN FGVL 0027 BLUE CLAY STNS 0088 GREY FGVL 0123
WESTMINSTER TOWNSHIP NTR W 073	17 474174 4751723 W	1987-06 5466	19 10	FR 0128	43/45/208/24:0	MN PS	0102 25	4110857 (NA)	BRWN CLAY STNS PCKD 0010 BRWN CLAY DNSE 0020 GREY CLAY STNS DNSE 0065 GREY CLAY GRVL 0072 GREY CLAY FSND 0083 GREY CLAY STNS DNSE 0088 GREY GRVL CLAY 0095 GREY GRVL SAND CLAY 0096 GREY GRVL PORS 0128
WESTMINSTER TOWNSHIP NTR W 073	17 474164 4751713 W	1987-06 5466	17 10	FR 0125	43/45/208/24:0	MN PS	0096 280096 28	4110856 (NA)	BRWN CLAY STNS SNDY 0010 BRWN CLAY DNSE 0020 GREY CLAY STNS DNSE 0065 GREY CLAY GRVL 0073 GREY CLAY SAND GRVL 0085 GREY GRVL CLAY 0086 GREY GRVL SAND CLAY 0090 GREY GRVL CMTD LOOS 0096 GREY GRVL PORS 0102 GREY GRVL SAND PORS 0118 GREY GRVL MSND PORS 0121 GREY GRVL PORS 0127
WESTMINSTER TOWNSHIP NTR W 073	17 474394 4751673 W	1986-04 2801	2 1 1	FR	47/48/30/3:0	NU	0110 7 0110 15	4110507 ()	GRVL BLDR 0004 GREY CLAY SLTY 0059 GREY CLAY STNS SOFT 0076 GREY CLAY GRVL 0080 GRVL SAND 0135 GRVL SAND 0143 GREY CLAY GRVL HARD 0170
WESTMINSTER TOWNSHIP NTR W 073	17 474154 4751673 W	1986-04 2801	2 1 1	FR	50/51/30/3:0	NU		4110506 ()	BRWN CLAY GRVL 0013 GREY CLAY GRVL 0017 GREY CLAY STKY 0048 GREY CLAY GRVL 0070 GREY CLAY GRVL 0078 GRVL SAND CLAY 0092 GRVL SAND 0096 GREY CLAY GRVL LYRD 0111 GRVL SAND 0126 BRWN CLAY SAND GRVL 0134 GREY CLAY GRVL PCKD 0155
WESTMINSTER TOWNSHIP NTR W 074	17 474364 4751973 W	1973-10 2552	36	FR 0006	5/30/0/:	ST		4106519 ()	BRWN SAND GRVL 0006 BRWN CLAY 0012 BLUE CLAY 0030
WESTMINSTER TOWNSHIP NTR W 074	17 474384 4751883 W	1971-07 4741	5	FR 0095	73/80/10/6:0	DO	0095 3	4105526 ()	BRWN CLAY 0005 GRVL 0010 BLUE CLAY GRVL 0095 GREY MSND 0102
WESTMINSTER TOWNSHIP NTR W 074	17 474215 4751867 W	2001-05 5466	8	FR 0100	48/60/35/12:0	DO	0097 3	4115168 (215391)	BLCK LOAM PORS 0001 BRWN CLAY SAND 0010 GREY CLAY STNS DNSE 0035 GREY CLAY GRVL 0045 GREY CLAY STNS DNSE 0077 GREY CLAY GRVL 0095 GREY GRVL PORS 0100
WESTMINSTER TOWNSHIP NTR W 074	17 474099 4751843 W	2021-11 7190		UT 0010	///:	OT		7408642 (845TB9XV) A309755 A	
WESTMINSTER TOWNSHIP NTR W 074	17 474073 4751855 W	2021-02 7320						7381592 (Z351937) A309754 P	
WESTMINSTER TOWNSHIP NTR W 074	17 474107 4751845 W	2021-02 7320						7381591 (Z351938) A309755 P	
WESTMINSTER TOWNSHIP NTR W 074	17 474381 4751883 W	2019-08 7343			73///:			7340515 (Z307606) A	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
WESTMINSTER TOWNSHIP NTR W 075	17 474214 4752293 W	1986-08 1708	5	SU 0241	76/121/9/18:0	DO		4110628 (NA)	BRWN CLAY SAND 0009 GREY CLAY GRVL 0023 GREY SAND SILT 0076 GREY CLAY SAND LYRD 0103 GREY CLAY GRVL 0119 GREY SAND CLAY 0133 GREY SAND SILT 0164 GREY CLAY GRVL CMTD 0213 GREY CLAY GRVL SAND 0238 GREY CLAY GRVL 0240 GREY LMSN 0241
WESTMINSTER TOWNSHIP NTR W 075	17 474290 4752563 W	2021-03 7428						7383500 (Z294309) A239827 P	
WESTMINSTER TOWNSHIP NTR W 075	17 474193 4752142 W	2016-11 7428						7277167 (Z249032) A146263 A	
WESTMINSTER TOWNSHIP NTR W 076	17 474294 4752613 W	1938-08 2801	26 14	FR 0118	81///:	MN	0103 10	4104503 ()	CLAY BLDR 0020 CLAY MSND GRVL 0050 MSND GRVL BLDR 0097 MSND GRVL 0118
WESTMINSTER TOWNSHIP NTR W 076	17 474284 4752633 W	1961-04 2801	5	FR 0020 FR 0055 FR 0108 FR 0145		NU		4103968 ()	LOAM 0004 GREY CLAY BLDR 0020 CSND GRVL 0050 GREY CLAY SILT 0055 CSND GRVL 0077 GREY CLAY MSND SILT 0108 CSND GRVL 0130 GREY CLAY GRVL SILT 0145 CSND GRVL 0156 GRVL SILT CLAY 0172 GREY CLAY GRVL 0182 CLAY GRVL 0198 GREY CLAY GRVL 0252 GREY LMSN 0253
WESTMINSTER TOWNSHIP NTR W 076	17 474286 4752616 W	7238				OT		7196002 (Z160007) A	BRWN FILL SAND GRVL 0105
WESTMINSTER TOWNSHIP NTR W -07	17 474730 4751469 W	2017-10 7090	6	FR 0130	60/62/10/1:30	CO	0118 12	7298111 (Z201647) A203195	BLCK LOAM LOAM 0002 BRWN SILT LOOS 0011 BRWN GRVL SILT LYRD 0032 GREY HPAN STNY HARD 0079 BLUE GRVL FSND LYRD 0111 BLUE SAND CSND 0130 GREY CLAY HARD 0131

Notes:

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

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

1. Core Material and Descriptive terms

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

2. Core Color

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

3. Well Use

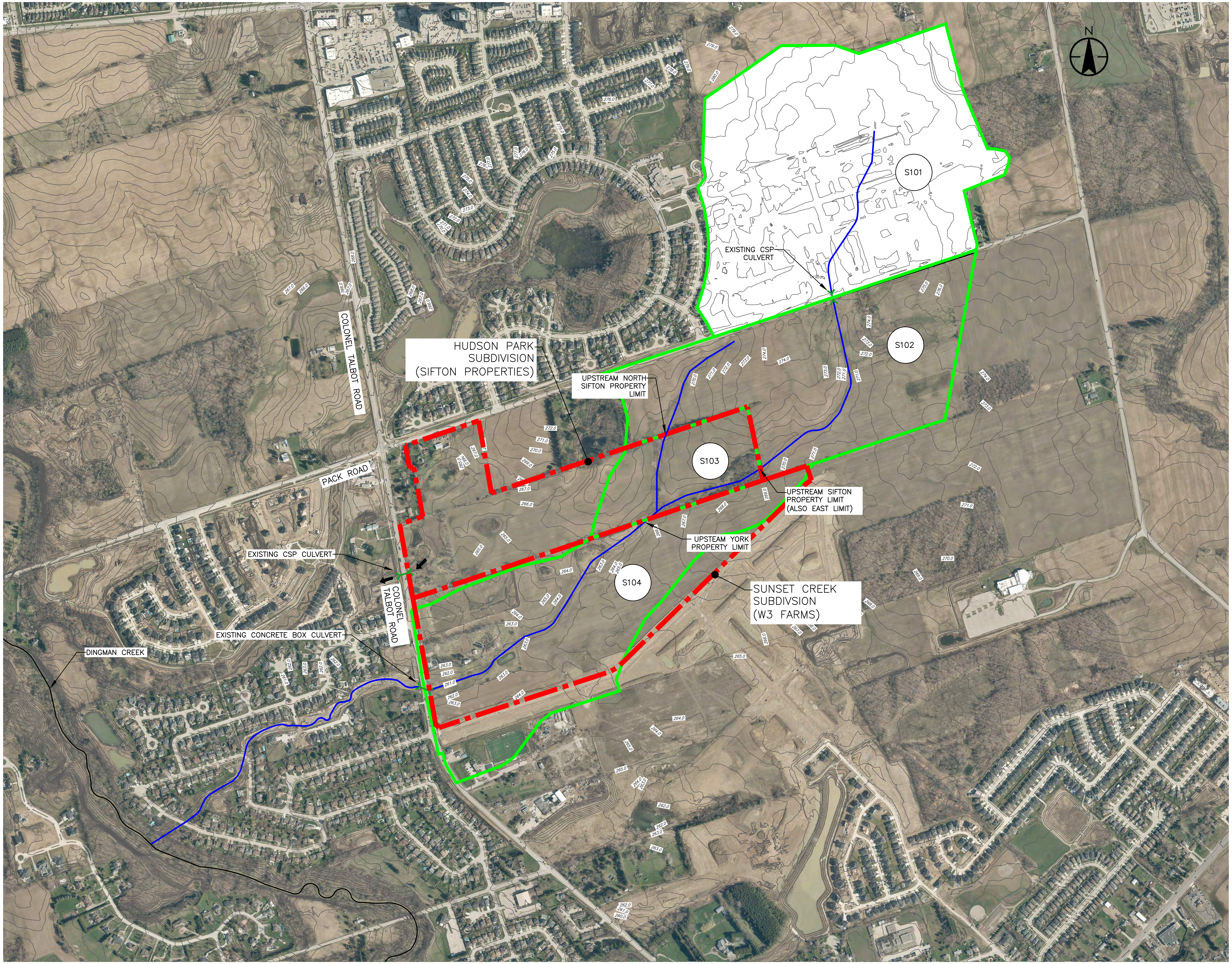
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

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

Appendix J – Water Balance Assessment

6-405 Maple Grove Road | Cambridge, Ontario | Canada
t: +1.519.650.4918 | f: +1.519.650.4603 | exp.com



Stantec

Stantec
600-171 Queens Avenue
London ON N6A 5J7
Tel. 519-645-2007
www.stantec.com

Liability Note:
The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.

Notes

SUBJECT SITE BOUNDARIES
ELEVATION CONTOURS
CATCHMENT ID
CATCHMENT BOUNDARY
EXISTING TRIBUTARY B1 CHANNEL ALIGNMENT

File Name: 161414170_int_channel_pre_dev

Dwn. | Chkd. | Dsgn. | YY.MM.DD

Permit-Seal

Client/Project
SIFTON PROPERTIES LIMITED/W3 FARMS INC.

COLONEL TALBOT / W3 SUBDIVISION

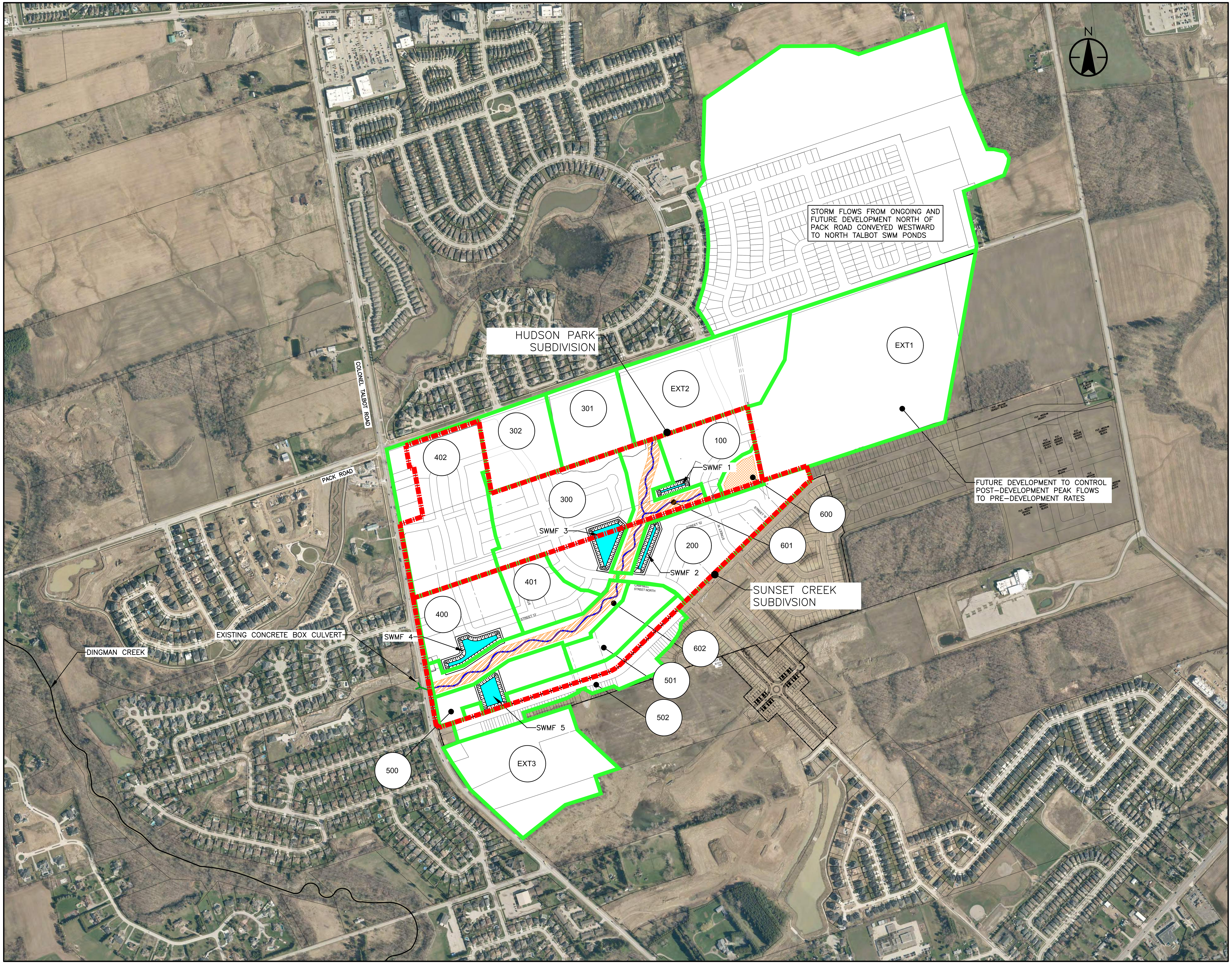
London, ON Canada

Title
PRE-DEVELOPMENT DRAINAGE AREAS

Project No. 161413835
Scale HORZ - 1 : 5000 (50 0 100m)

Drawing No. 1
Sheet 1 of 5
Revision 0

ORIGINAL SHEET - ANSI D



Stantec

Stantec
600-171 Queens Avenue
London ON N6A 5J7
Tel. 519-645-2007
www.stantec.com

Liability Note:
The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.

Notes

SUBJECT SITE BOUNDARIES
ELEVATION CONTOURS
600 CATCHMENT ID
CATCHMENT BOUNDARY
TRIBUTARY B1 CHANNEL ALIGNMENT
LINEAR CHANNEL
NATURAL ENVIRONMENT AREA
MAJOR FLOW DIRECTION

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 161414170_int_channel_post_dev | Dwn. | Chkd. | Dsgn. | YY.MM.DD

Permit-Seal

Client/Project
SIFTON PROPERTIES LIMITED/W3 FARMS INC.

COLONEL TALBOT / W3 SUBDIVISION

London, ON Canada

Title
POST-DEVELOPMENT DRAINAGE AREAS

Project No.	Scale
161413835	HORZ – 1 : 5000 (50 0 100m)

Drawing No.	Sheet	Revision
2	2 of 5	0

ORIGINAL SHEET - ANSI D

Table J1 - PRE-DEVELOPMENT WATER BALANCE CALCULATIONS

Catchment S104	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Soil Type	Soil Group	Water Holding Capacity (mm)	Infiltration Factor	T_{rain} (°C)	T_{snow} (°C)	Meltmax (%/100)
Agriculture	-	281,000	**281,000**	Clayey Silt	C	134	0.45	3.3	-10.0	1

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Totals
Average Temperature (°C)	-5.6	-4.5	-0.1	6.8	13.1	18.3	20.8	19.7	15.5	9.2	3.4	-2.6	
Total Precipitation (mm/month)	74.2	65.5	71.5	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	87.5	1011.5
Precipitation as rain (mm/month)	24.5	27.1	53.2	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	48.7	
Precipitation as snow (mm/month)	49.7	38.4	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.8	
Potential Snow Melt (mm/month)	22.1	34.4	49.9	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Actual Snow Melt (mm/month)	22.1	34.4	49.9	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Snow Storage (mm/month)	44.7	48.8	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	
Agriculture													
Estimated Actual Evapotranspiration (mm/month)	8.9	10.8	20.3	38.4	70.3	102.6	115.8	90.9	56.3	30.5	16.0	10.0	570.8
Surplus (mm/month)	37.8	50.7	82.8	62.1	19.5	-10.9	-33.1	-8.0	46.7	50.8	82.0	60.3	440.7
Estimated Runoff (mm/month)	37.8	50.7	64.2	34.2	10.7	0.0	0.0	0.0	25.7	27.9	45.1	60.3	356.5
Estimated Infiltration (mm/month)	0.0	0.0	18.6	28.0	8.8	0.0	0.0	0.0	21.0	22.9	36.9	0.0	136.2
Estimated Actual Evapotranspiration (m^3/month)	**2501**	**3035**	**5704**	**10790**	**19754**	**28831**	**32540**	**25543**	**15820**	**8571**	**4496**	**2810**	**160395**
Estimated Runoff (m^3/month)	**10613**	**14240**	**18039**	**9604**	**3014**	**0**	**0**	**0**	**7217**	**7851**	**12673**	**16939**	**100190**
Estimated Infiltration (m^3/month)	**0**	**0**	**5237**	**7858**	**2466**	**0**	**0**	**0**	**5905**	**6424**	**10369**	**0**	**38258**

Catchment S104													
Estimated Actual Evapotranspiration (m^3/month)	**2501**	**3035**	**5704**	**10790**	**19754**	**28831**	**32540**	**25543**	**15820**	**8571**	**4496**	**2810**	**160,395**
Estimated Runoff (m^3/month)	**10613**	**14240**	**18039**	**9604**	**3014**	**0**	**0**	**0**	**7217**	**7851**	**12673**	**16939**	**100,190**
Estimated Infiltration (m^3/month)	**0**	**0**	**5237**	**7858**	**2466**	**0**	**0**	**0**	**5905**	**6424**	**10369**	**0**	**38,258**

Table J2 - POST-DEVELOPMENT WATER BALANCE CALCULATIONS

Catchments 200, 300, 400, 401, 500, 501, 502	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Soil Type	Soil Group	Water Holding Capacity (mm)	Infiltration Factor	T_{rain} (°C)	T_{snow} (°C)	Meltmax (%/100)
Urban Lawn	144,485	118,215	**262,700**	Clayey Silt Till	C	134	0.45	3.3	-10.0	1

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Totals
Average Temperature (°C)	-5.6	-4.5	-0.1	6.8	13.1	18.3	20.8	19.7	15.5	9.2	3.4	-2.6	
Total Precipitation (mm/month)	74.2	65.5	71.5	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	87.5	1011.5
Precipitation as rain (mm/month)	24.5	27.1	53.2	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	48.7	
Precipitation as snow (mm/month)	49.7	38.4	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.8	
Potential Snow Melt (mm/month)	22.1	34.4	49.9	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Actual Snow Melt (mm/month)	22.1	34.4	49.9	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Snow Storage (mm/month)	44.7	48.8	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	
Urban Lawn													
Estimated Actual Evapotranspiration (mm/month)	8.9	10.8	20.3	38.4	70.3	102.6	115.8	90.9	56.3	30.5	16.0	10.0	570.8
Surplus (mm/month)	37.8	50.7	82.8	62.1	19.5	-10.9	-33.1	-8.0	46.7	50.8	82.0	60.3	440.7
Estimated Runoff (mm/month)	37.8	50.7	64.2	34.2	10.7	0.0	0.0	0.0	25.7	27.9	45.1	60.3	356.5
Estimated Infiltration (mm/month)	0.0	0.0	18.6	28.0	8.8	0.0	0.0	0.0	21.0	22.9	36.9	0.0	136.2
Estimated Actual Evapotranspiration (m^3/month)	**1052**	**1277**	**2400**	**4539**	**8311**	**12129**	**13689**	**10746**	**6656**	**3606**	**1891**	**1182**	**67477**
Estimated Runoff (m^3/month)	**4465**	**5991**	**7589**	**4040**	**1268**	**0**	**0**	**0**	**3036**	**3303**	**5331**	**7126**	**42150**
Estimated Infiltration (m^3/month)	**0**	**0**	**2203**	**3306**	**1037**	**0**	**0**	**0**	**2484**	**2702**	**4362**	**0**	**16095**
Impervious Surfaces													
Estimated Actual Evapotranspiration (mm/month)	8.4	11.1	18.6	18.1	16.2	16.5	14.9	14.9	18.5	14.6	17.6	12.7	182.1
Estimated Runoff (mm/month)	38.3	50.4	84.6	82.4	73.6	75.2	67.8	68.0	84.5	66.7	80.4	57.6	829.4
Estimated Infiltration (mm/month)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated Actual Evapotranspiration (m^3/month)	**1214**	**1599**	**2682**	**2615**	**2335**	**2385**	**2151**	**2156**	**2679**	**2114**	**2549**	**1828**	**26306**
Estimated Runoff (m^3/month)	**5529**	**7284**	**12219**	**11912**	**10639**	**10864**	**9798**	**9822**	**12203**	**9632**	**11611**	**8327**	**119840**
Estimated Infiltration (m^3/month)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Catchments 200, 300, 400, 401, 500, 501, 502 Totals	**2266**	**2876**	**5082**	**7154**	**10646**	**14514**	**15840**	**12902**	**9334**	**5720**	**4440**	**3010**	**93,784**
Estimated Runoff (m^3/month)	**9994**	**13274**	**19807**	**15952**	**11907**	**10864**	**9798**	**9822**	**15240**	**12935**	**16942**	**15453**	**161,990**
Estimated Infiltration (m^3/month)	**0**	**0**	**2203**	**3306**	**1037**	**0**	**0**	**0**	**2484**	**2702**	**4362**	**0**	**16,095**

Catchment 602	Impervious Area (m^2)	Pervious Area (m^2)	Total Area (m^2)	Soil Type	Soil Group	Water Holding Capacity (mm)	Infiltration Factor	T_{rain} (°C)	T_{snow} (°C)	Meltmax (%/100)
Pasture and Shrubs		36,100	**36,100**	Clayey Silt Till	C	134	0.45	3.3	-10.0	1

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Totals
Average Temperature (°C)	-5.6	-4.5	-0.1	6.8	13.1	18.3	20.8	19.7	15.5	9.2	3.4	-2.6	
Total Precipitation (mm/month)	74.2	65.5	71.5	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	87.5	1011.5
Precipitation as rain (mm/month)	24.5	27.1	53.2	83.4	89.8	91.7	82.7	82.9	103.0	81.3	98.0	48.7	
Precipitation as snow (mm/month)	49.7	38.4	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.8	
Potential Snow Melt (mm/month)	22.1	34.4	49.9	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Actual Snow Melt (mm/month)	22.1	34.4	49.9	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	
Snow Storage (mm/month)	44.7	48.8	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	
Pasture and Shrubs													
Estimated Actual Evapotranspiration (mm/month)	8.9	10.8	20.3	38.4	70.3	102.6	115.8	90.9	56.3	30.5	16.0	10.0	570.8
Surplus (mm/month)	37.8	50.7	82.8	62.1	19.5	-10.9	-33.1	-8.0	46.7	50.8	82.0	60.3	440.7
Estimated Runoff (mm/month)	37.8	50.7	64.2	34.2	10.7	0.0	0.0	0.0	25.7	27.9	45.1	60.3	356.5
Estimated Infiltration (mm/month)	0.0	0.0	18.6	28.0	8.8	0.0	0.0	0.0	21.0	22.9	36.9	0.0	136.2
Estimated Actual Evapotranspiration (m^3/month)	**321**	**390**	**733**	**1386**	**2538**	**3704**	**4180**	**3281**	**2032**	**1101**	**578**	**361**	**20606**
Estimated Runoff (m^3/month)	**1364**	**1829**	**2317**	**1234**	**387**	**0**	**0**	**0**	**927**	**1009**	**1628**	**2176**	**12871**
Estimated Infiltration (m^3/month)	**0**	**0**	**673**	**1009**	**317**	**0**	**0**	**0**	**759**	**825**	**1332**	**0**	**4915**
Catchment 602 Totals													
Estimated Actual Evapotranspiration (m^3/month)	**321**	**390**	**733**	**1386**	**2538**	**3704**	**4180**	**3281**	**2032**	**1101**	**578**	**361**	**20,606**
Estimated Runoff (m^3/month)	**1364**	**1829**	**2317**	**1234**	**387**	**0**	**0**	**0**	**927**	**1009**	**1628**	**2176**	**12,871**
Estimated Infiltration (m^3/month)	**0**	**0**	**673**	**1009**	**317**	**0**	**0**	**0**	**759**	**825**	**1332**	**0**	**4,915**

Total Area	PRE	POST	VOL CHANGE	% Difference
Estimated Runoff (m^3/year)	**100,190**	**174,861**	**74,671**	**175%**
Estimated Infiltration (m^3/year)	**38,258**	**21,010**	**(17,248)**	**55%**

With Mitigation		% Difference
Estimated Runoff	164,369	164%
Estimated Infiltration	30,453	80%
Runoff Reduction	0.06	
Effectiveness	0.9	

Table J3 - WATER BALANCE ASSUMPTIONS

1. AET occurs year round. Although the average temperature is below 0°C in the winter months, fluctuation above and below the freezing temperature of water occurs. The Thornthwaite model used assumes T_{rain} = 3.3°C and T_{snow} = -10.0°C. When the average monthly temperature falls between these values, the monthly precipitation as rain and snow is derived by assuming a linear interpolation between these values, consistent with the methodology used in the accepted USGS reference material (McCabe, G.J., and Markstrom, S.L., 2007, A monthly water-balance model driven by a graphical use interface: U.S. Geological Survey Open-File report 2007-1088, 6 p.). Values of AET were taken from the Thornthwaite model and are considered to be representative of actual site conditions.

2. Monthly surplus is calculated by summing the precipitation as rain and actual snow melt, less estimated evapotranspiration.

3. Negative surplus values can be achieved during the summer months as water storage is the vadose zone of the soil is subject to evapotranspiration and depleted.

4. Infiltration is assumed not to occur between December and February as frost is typically present throughout those months.

5. Infiltration in March (Average temperature of -0.1°C), is assumed to occur during half of the month.

6. No net infiltration or runoff occur in the summer as the rainfall accumulation is stored on site and infiltration was not assigned a negative value. See Assumption 3.

7. Evapotranspiration in impervious areas is the sum of precipitation as rain and snow melt multiplied by a factor of 0.18.

8. Under post-development conditions, all runoff within on Site areas will be directed to the drainage channel and will end up in the channel

9. Under post-development conditions, it is assumed that the residential development areas of the Site will be 55% impervious.

Appendix K – Dewatering Calculations

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APPENDIX K: Short-Term Flow Rate

Table K-1: Underground Parking

Parameters	Symbols	Unit	Value
Geological Formation	-	-	Glacial Deposit
Ground Elevation	-	mASL	261.90
Highest Groundwater Elevation	-	mASL	261.40
Lowest Servicing Bottom Elevation	-	mASL	**257.90**
Base of the Water-Bearing Zone	-	mASL	249.60
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	11.80
Dewatering Target Elevation	-	mASL	257.40
Height of Target Water Level Above the Base of Water-Bearing Zone	**h_w**	m	7.80
Hydraulic Conductivity	**K**	m/s	1.4E-07
Length of Excavation	-	m	20.00
Width of Excavation	-	m	20.00
Equivalent Radius (equivalent perimeter)	**r_e**	m	12.73
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**
Time (15 days)	**t**	s	1296000
Specific Yield	**Sy**		0.30
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	4.01
Radius of Influence	**Ro**	m	16.74
Dewatering Flow Rate (unconfined radial flow component) (rounded)	**Q**	m^3/day	10.89
Factor of Safety	**fs**	-	2.00
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	21.78
Precipitation Event	-	mm/day	0
Volume from Precipitation	-	m^3/day	0
Dewatering Flow Rate **Without Safety Factor** (including stormwater collection)	-	m^3/day	11
Dewatering Flow Rate **With Safety Factor** (including stormwater collection)	-	m^3/day	22

Notes:
mASL - meters above sea level

Analytical Solution for Estimating Radial Flow from an Unconfined Aquifer to a Fully-Penetrating Excavation

$$Q_w = \frac{\pi K (H^2 - h^2)}{Ln\left[\frac{R_o}{r_e}\right]} \qquad r_e = \frac{a+b}{\pi} \qquad R_o = R_{cj} + r_e \qquad R_{cj} = \sqrt{2.25KDt/S}$$

(Based on the Dupuit-Forcheimer Equation)

Where:

Q_w = Flow rate per unit length of excavation (m^3/s)

K = Hydraulic conductivity (m/s)

H = Height of static water table above base of water-bearing zone (m)

h_w = Height of target water level above the base of water-bearing zone (m)

Rcj=Cooper Jacob Radius of Influence (m)

R_o=Radius of influence (m)

re=Equivalent perimeter (m)

Modified DUPUIT Equation: unconfined flow into a long excavation.
No flow from the bottom!

Table K-2: Servicing Dewatering Calculations

Section	GW level	GW Target	Aquifer Bottom	x	w	A	K	s	r_e	R_o	L=R0/2	H_{sat}	Q_{ends}	Q_{ends}	Q_{trench}	Q_{trench}	Q_{total}	Q_{total}	Safety Factor	Q_{total}	Q_{total} with Safety Factor
	m AMSL	m AMSL	m AMSL	m	m	m^2	m/s	m	m	m	m	m	m^3/s	L/d	m^3/s	L/d	m^3/s	L/s		**L/d**	**L/d**
Sanitary/Storm Sewer	261.40	258.40	249.60	50	5	250	1.4E-07	3.00	17.51	20.87	10.44	11.80	0.000155	13,349	0.000041	3,581	0.000196	0.20	2	**16,930**	**33,860**

$$Q = \frac{\pi K(H^2 - h^2)}{Ln\left[\frac{R_o}{r_e}\right]} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

A = dewatered area (m^2)
Q = construction dewatering rate (m^3/sec)
K = saturated and horizontal hydraulic conductivity (m/s)
H = hydraulic head beyond R_0 (m)
h = hydraulic head within A (m)
s = drawdown (=H-h)
r_e = equivalent well radius of A (m)
R_0 = radius of influence of construction dewatering/pumping from equivalent well center (m)
x = length of the trench (m)
w = width (m)
L = distance of influence of construction dewatering/pumping from equivalent well center (m)
π = Pi (1)

Appendix L – Limitations and Use of Report

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LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of EXP may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by EXP. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and EXP's recommendations. Any reduction in the level of services recommended will result in EXP providing qualified opinions regarding the adequacy of the work. EXP can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the test pit results contained in the Report. The number of test pits necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to EXP to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

RELIANCE ON INFORMATION PROVIDED

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