



**Waterloo West Side Employment
Lands, Waterloo ON**

Hydrogeological Investigation

August 2018

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Sign-off Sheet

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Abbreviations

Aardvark	Aardvark Drilling Inc.
AMSL	above mean sea level
ASTM	American Society for Testing and Materials
BGS	below ground surface
EASR	Environmental Activity and Sector Registry
ESA	Environmental Site Assessment
GRCA	Grand River Conservation Authority
GRIN	Grand River Information Network
HDPE	high density polyethylene
HONI	Hydro One Networks Inc.
Levellogger	Solinst Edge Levellogger®
Maxxam	Maxxam Analytics Inc.
MOECC	Ministry of the Environment and Climate Change
ODWS	Ontario Drinking Water Standards
OGS	Ontario Geological Survey
O. Reg.	Ontario Regulation
PTTW	Permit to Take Water
PVC	polyvinyl chloride
Site	928, 960 and 980 Erb Street West, and 100 Wilmot Line, Waterloo,
Stantec	Stantec Consulting Ltd.
TSS	Total suspended solids
WSEL	Waterloo West Side Employment Lands
WHPA	Wellhead Protection Area
WPSA	Wellhead Protection Sensitivity Areas



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Introduction
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1.0 INTRODUCTION

The City of Waterloo retained Stantec Consulting Limited (Stantec) to complete a hydrogeological investigation of the Waterloo West Side Employment Lands (WSEL) (Site) in the City of Waterloo (Figure 1) in support of applications for a Zoning By-Law Amendment, Official Plan Amendment and Draft Plan of Subdivision (Appendix A). The Site is bounded by Columbia Street West to the north, Wilmot Line to the West, Erb Street West to the south, and the Hydro One Networks Inc. (HONI) Transmission Corridor to the east. The Site is approximately 43.6 hectares in size, occupying the municipal properties at 928, 960 and 980 Erb Street West, as well as 100 Wilmot Line (former Golf Academy Lands). The Site is currently comprised of a former golf course, active agricultural and fallow fields, a former cider mill, and a temporary stormwater management facility that serves the adjacent Costco property to the east. The Site will be developed for industrial purposes.

The objectives of the hydrogeological assessment were to:

1. Characterize current geological and hydrogeological conditions throughout the Site, including an evaluation of seasonal groundwater table fluctuations, groundwater flow and quality, and the identification of potential interactions between the onsite wetlands and local groundwater system.
2. Evaluate pre-development infiltration volumes at the Site.
3. Assess whether proposed site servicing will intercept the groundwater table and evaluate the potential need for dewatering and what mitigation measures could be employed to the Site to minimize any potential disturbances to groundwater levels and pre-development flow patterns.
4. Evaluate whether proposed land use activities conform to Source Water Protection requirements as stipulated in the Clean Water Act, S.O. 2006, Chapter 22.
5. Propose other strategies that could be used at the Site to mitigate any of the potential impacts mentioned above.

This report is arranged into eight sections, including this introduction (Section 1). Section 2 presents the physical setting at a regional scale. Section 3 presents the methodology for investigations of site-specific hydrogeological conditions. Section 4 presents the result of the site-specific investigations. Section 5 presents a water balance analysis for the Site. Section 6 presents the potential impacts of the proposed development on the hydrogeological form and function of the Site and discusses potential mitigation measures for identified impacts. Report conclusions are listed in Section 7, with references in Section 8.

All figures and tables referenced in this report are presented in Appendices B and C, respectively. Appendices D to G present the Source Water Protection Land Use Categories, Borehole Logs, Laboratory Certificates of Analysis, and Hydraulic Conductivity Testing Analytical Solutions.



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2.0 PHYSICAL SETTING

2.1 PHYSIOGRAPHY AND DRAINAGE

The Site resides in the physiographic region classified by Chapman and Putnam (1984) as the Waterloo Hills, also commonly referred to as the Waterloo Moraine. The Waterloo Moraine occupies a large portion of the Regional Municipality of Waterloo, with the surface of this physiographic feature consisting of sandy hills, ridges of sandy till, kames or kame moraines and intervening hollows of outwash sand and gravel, which all can be capped by glacial till. In the section of the Waterloo Moraine containing the Site, the regional surface topography tends to slope to the northeast from St. Agatha towards the City of Waterloo (Terraqua, 1995).

The Site is divided by a topographic ridge that runs in a northwest-southeast direction starting from Erb Street West and onward through BH14-17 to BH12-17 to BH10-17, and towards the northern property boundary (i.e., Columbia Street West extension) (Figure 2). This topographic ridge represents a drainage divide, with surface water runoff to the east of the divide flowing to Clair Creek (part of Laurel Creek Subwatershed #314) and west of the divide flowing to Monastery Creek (Laurel Creek Subwatershed #307) (Stantec, 2014). Total topographic relief across the Site is approximately 22 m from a high point of 407 m above mean sea level (AMSL) at the top of the ridge to a low point of 385 m AMSL along the eastern limits of the property.

As per Stantec (2018a), five small wetland areas (i.e., W1 to W5) occupy the Site (Figure 1), with Wetland W1 and W2 being identified on Grand River Conservation Authority (GRCA) Regulation Area Mapping. The Site also contains two dug ponds, which are located within the lands currently occupied by the golf course (Figure 1).

2.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

The Site is located within the Waterloo Moraine, a kame moraine formed in an interlobate position between ice lobes extending from the Lake Ontario Erie, Huron, and Georgian Bay areas (Karrow, 1993). Numerous advances and retreats of the ice lobes during the Wisconsin glacialiation resulted in a complex deposit of ice contact and glacial outwash sands and gravels separated by silt and clay rich tills. The conceptual hydrogeologic model for the Waterloo Moraine therefore comprises four main aquifers and aquitards after Terraqua Investigations Ltd (1995), or 19 different hydrostratigraphic units after Bajc and Shirota (2007). The model generally does not include more recent deposits shown on surficial geology mapping.



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The three regionally based hydrostratigraphic units generally encountered in the area containing the Site and at depths associated with the current investigation include:

- **Aquitard 1 (ATB1):** Surficial and spatially discontinuous glacial till unit, which along the eastern flank of the Moraine consists of the Upper Maryhill Till (clayey silt to silty clay) (Bajc and Shirota, 2007). Aquitard 1 is characterized by low permeability and forms a relatively impermeable barrier that effectively limits the downward movement of surface water to the deeper aquifer systems. Perched groundwater conditions are typically present within this unit.
- **Aquifer 1 (AFB1/ATB2/AFB2):** This hydrostratigraphic unit represents the main water supply aquifer in the core areas of the Waterloo Moraine. Depending on the depositional environment, the composition of Aquifer 1 can vary from a layered silt and fine sand to coarse sand and gravel. Throughout the core areas of the moraine, Aquifer 1 corresponds to a thick, laterally extensive sand and/or gravel aquifer overlying Aquitard 2 and is often exposed at surface in the core areas of the moraine. In some areas, Aquifer 1 is interpreted to be bisected by the Middle Maryhill Till (ATB2), effectively separating Aquifer 1 into two units, AFB1 and AFB2. Along the flanks of the Moraine, Aquifer 1 generally thins as the ground surface elevation decreases and approaches Aquitard 2. As reported in Stantec (2017), the saturated portion of this aquifer unit throughout the local area can be encountered at depths ranging from 21 m below ground surface (BGS) to 45 m BGS, or an elevation of approximately 356 m AMSL.
- **Aquitard 2 (ATB3):** Aquitard 2 corresponds to the Lower Maryhill Till (clayey silt to silty clay) and represents one of the primary regional hydrostratigraphic units. The till has been broken down into a Middle and Lower Maryhill Till by Bajc and Shirota (2007). Along the flanks of the Waterloo Moraine, the Maryhill Till is often found to be discontinuous or has been re-worked and re-deposited as glaciofluvial sediments.

2.3 SOURCE WATER PROTECTION

One of the priorities of the Region of Waterloo Official Plan (ROP) (2015) is the protection of the current and future municipal drinking-water supply system. The ROP designates Wellhead Protection Areas (WHPA) around each municipal drinking water supply well, with these areas representing the total area of land that contributes water to a well. These WHPA are further divided into Wellhead Protection Sensitivity Areas (WPSA), which are designated to prevent land uses involving hazardous chemicals and/or substances, disease-causing organisms, and/or other activities that increase the vulnerability of groundwater from becoming water quantity and/or quality risks to municipal drinking-water supply wells. The WPSA are classified from one (1) to eight (8), allowing for varying degrees of management relative to the vulnerability of the underlying groundwater to contamination, the importance of the subject well to the capacity of the municipal drinking-water supply systems, and the length of time groundwater within the WPSA will take to reach the municipal drinking-water supply well.

As shown in Figure 3, the Site is located within the WPSA of the Erb Street Well Field (W06A/W06B, W07, W08), Waterloo North Well Field (W10) and potentially the Strange Street Well Field (K10A, K11A, K13, K18 and K19). The specific WPSA that intercept the Site is as follows:



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- **WPSA-7:** Intercepting a small area within the southwest portion of the Site, this WPSA indicates that groundwater takes between two to 10 years to flow to the intake of a given municipal production well (i.e., W06A/W06B and/or W07, W08) and that the vulnerability of this underlying groundwater system to contamination is low. Category 'A' land uses are not permitted in this zone, whereas Category 'B' and 'C' land uses will not be permitted outside of the Built-Up Area. Category 'D' land uses and plans of subdivision may be permitted subject to further study in accordance with Policy 8.A.4 (i.e., studies demonstrating that proposed land use will not impact the quantity and/or quality of drinking-water resources in the Source Protection Areas). A copy of Schedule B from the ROP (2015) listing the various land uses associated with each Category is provided in Appendix D.
- **WPSA-8:** This WPSA encompasses the entire Site and indicates that groundwater beneath the property takes 10 years to flow to the intake of a given production well and that the vulnerability of this underlying groundwater system to contamination is low. According to the ROP (2015), Category 'A' land uses are not permitted in this zone, whereas Category 'B', 'C' and 'D' land uses are allowed.

Since Site lies mostly within a WPSA-8, development of the property for industrial purposes will not be subject to those land activity restrictions listed under Categories 'B', 'C' and 'D'. However, for any development occurring in the small area along the western limits of the Site that is intercepted by WPSA-7 of the Erb Street Well Field, additional studies may be required at the time of detail design and/or site plan approval to demonstrate that these proposed land uses will not negatively impact the quantity and/or quality of drinking water resources associated with this protection area.



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3.0 METHODOLOGY

Section 3 provides the methodology used to obtain the data required to complete the hydrogeological investigation of the Site. The major components of the investigation included:

- borehole drilling
- monitoring well and drive-point piezometer installations
- groundwater level monitoring
- groundwater sampling and testing
- hydraulic response testing

The sections below provide detailed descriptions of these study components.

3.1 BOREHOLE DRILLING

Previous subsurface investigations completed by CH2M Hill in 2004 and 2010 at the Site involved the advancement of 10 boreholes, with six of these boreholes being equipped with a single monitoring well. In 2013, Stantec completed a geotechnical investigation at the Site that included the advancement of 24 boreholes, of which three were equipped with monitoring wells. The borehole logs completed for these previously mentioned studies are provided in Appendix E and the locations of the boreholes and monitoring wells are shown on Figure 1.

In 2017, the City of Waterloo retained Stantec to complete a geotechnical investigation of the Site in conjunction with this hydrogeological investigation. The geotechnical investigation is provided under a separate cover (Stantec, 2018b). The geotechnical investigation involved the drilling of 17 boreholes across the Site between May 1 and May 8, 2017. The borehole locations are shown on Figure 1. London Soil Test Limited (LST) drilled the boreholes using a Diedrich D-50 track mounted drill rig equipped with a hollow stem auger drilling system to advance the boreholes. Boreholes were advanced to maximum depths of 3.7 to 12.8 m BGS, and soil samples were collected using a 0.6 m long stainless-steel split spoon sampler at intervals of 0.76 m from the existing grade to at least 3.0 m BGS, and intervals of 1.5 m or less thereafter. Stantec personnel were onsite during drilling to log soil samples using the American Society for Testing and Materials (ASTM) Standard D2487-11 and D2488-09a - *Guidelines for the Manual Description and Identification of Soils* (ASTM, 2000). Borehole logs were prepared for each drilling location, containing descriptions of type, texture, colour, structure, consistency, plasticity, and moisture content of soil samples. Soil samples were collected in field for subsequent grain size analysis. Copies of the borehole logs are provided in Appendix E.

In March 2018, Stantec supervised the drilling of an additional nine boreholes in the southwest portion of the Site near Wilmot Line as part of a Phase II Environmental Site Assessment (ESA) (Stantec, 2017c), with four of these boreholes being equipped with monitoring wells. Strata Drilling Group (Strata) advanced the boreholes using a Geoprobe 7822DT (Direct Push) rig to depths ranging from 4.6 to 6.1 m BGS.



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Copies of the borehole logs containing the monitoring wells installed as a part of the Phase II ESA are provided in Appendix E.

3.2 MONITORING WELL AND DRIVE-POINT PIEZOMETER INSTALLATIONS

3.2.1 Monitoring Wells

LST installed a single monitoring well in seven of the geotechnical boreholes (i.e., BH01-17, BH02-17, BH05-17, BH07-17, BH09-17, BH11-17, BH17-17), and Strata in four of the Phase II ESA boreholes (i.e., MW18-1 to MW18-4), in accordance with *Revised Regulations of Ontario (R.R.O) 1990, Regulation 903: Wells* (MOE, 1990). The monitoring wells allowed Stantec to confirm local groundwater table elevations, groundwater flow direction, and seasonal trends in groundwater fluctuations throughout the Site.

Each monitoring well is constructed with a 51 mm inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) pipe, with a No. 10 slot screen (0.01-inch slot) that is 1.5 to 3.0 m in length. The annular space between the monitoring well pipe and surrounding soil is backfilled with silica sand to the top of screen, followed by granular bentonite to ground surface to prevent a hydraulic connection from occurring between the soils along the pipe length. The monitoring wells were completed with above ground lockable protective steel casings that were cemented into place to 0.3 m BGS. The elevation of the existing grade and top-of-pipe at each monitoring well was surveyed to a geodetic benchmark by the Geomatics division of Stantec. Well construction details and survey data are summarized in Table 1 and on the borehole logs provided in Appendix E.

As per the Region of Waterloo's request and with authorization by the City of Waterloo, Stantec coordinated the installing to two monitoring wells in the south corner of the Site near Wilmot Line (i.e., W-EB-OW1A/B-18; Figure 1). Constructed by Aardvark Drilling Inc. in June 2018, the deep monitoring well (W-EB-OW1A-18) is screened in Aquifer 1 (AFB1) from a depth of 59.2 to 62.2 m BGS, with the shallow well being screened in a silty fine sand layer located within Aquitard 1 (ATB1) from a depth of 12.0 to 13.5 m BGS. The borehole drilling and construction details for each monitoring well is summarized in Table 1 and on the accompanying logs provided in Appendix E.

3.2.2 Drive-Point Piezometers

On July 25, 2017 Stantec personnel installed three drive-point piezometers into selected onsite surface water features. The purpose of the drive-point piezometer installations was to evaluate the vertical hydraulic gradients occurring beneath these features and assess their groundwater recharge and/or discharge function. Stantec personnel installed drive-point piezometers DP1-17 and DP3-17 into the golf course ponds, and DP2-17 into the wetland located along the western property boundary (i.e., W2). The locations of the drive-point piezometers are shown on Figure 1.

Each drive-point piezometer consists of a 19 mm diameter, 0.42 m long steel screen connected to 25 mm diameter steel riser pipes. The installation of the piezometers occurred using a hand-driven fence post



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driver. Construction details for the drive-point piezometers are summarized in Table 1 and presented on the logs provided in Appendix E.

3.3 GROUNDWATER LEVEL MONITORING

Stantec personnel manually measured water levels at the monitoring wells and drive-point piezometers in May, July and November 2017, and July 2018, using a battery operated Solinst™ water level meter. Equipped with an electrode connected to a graduated polyethylene tape, Stantec personnel used the meters to measure the depth to water by slowly lowering the electrode into the well until the buzzer sounded. Stantec personnel recorded the water level measurements in meters to the nearest 0.01 m. A summary of the manual water levels measured in the monitoring wells and drive-point piezometers by Stantec personnel is provided in Tables 2 and 3, respectively.

Selected onsite monitoring wells are instrumented with Levelloggers® (Levellogger). The Levelloggers, consisting of a pressure transducer and datalogger, are suspended into the water column within the wells and set to record water level fluctuations at one hour intervals. Levelloggers are not vented to the atmosphere and, therefore, record total pressure (atmospheric + height of water column). Consequently, data obtained from the Levelloggers are corrected for atmospheric pressure using data obtained from a Solinst Barologger®, which was suspended in the air within BH09-17. Hydrographs presenting the manual water level and corrected Levellogger data from May 2017 to July 2018 are presented in Figures 4 and 5.

3.4 GROUNDWATER SAMPLING AND TESTING

On July 25, 2017 Stantec personnel collected groundwater samples from monitoring wells BH02-17, BH04-17, BH05-17, BH07-17, BH09-17, BH17-17 and MW1-10 for general chemistry and dissolved metals analysis. The exceptions included BH01-17 and BH11-17 as these wells were dry or had too little water in the well at the time of the sampling.

Prior to collecting the groundwater samples, an attempt was made to purge each location of three to 10 volumes to remove stagnant water from the casing using high density polyethylene (HDPE) tubing connected to a Waterra™ foot valve. Following purging, Stantec personnel collected the groundwater sample by pouring water directly from the HDPE tubing into the appropriate pre-labeled sample containers. Stantec personnel field-filtered the groundwater sample for metals analysis using disposable, inline, 0.45 µm (micron) filters attached to the HDPE tubing. Consequently, the metals analysis results for the groundwater sample obtained from the wells represent dissolved concentrations.

Stantec personnel packed the groundwater samples into sample coolers refrigerated with freezer packs and delivered to Maxxam Analytics Inc. (Maxxam) for laboratory analyses. Maxxam analyzed the groundwater samples for general inorganic parameters and metals and compared the results against the Ontario Drinking Water Standards (ODWS). Stantec personnel completed Chain of Custody Forms and sealed the forms in the coolers. A copy of the Laboratory Certificate of Analysis is provided in Appendix F, with the results of the sampling being presented in Table 4.



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3.5 HYDRAULIC RESPONSE TESTING

To estimate the horizontal hydraulic conductivity of the deposits beneath the Site, Stantec performed in-situ hydraulic response testing at monitoring wells BH05-17, BH07-17, BH09-17, BH17-17 and MW4-4. Completed in May 2017, the tests consisted of creating an instantaneous change in the monitoring well water levels by pumping water from the wells (i.e., rising head / pumping test), followed by recording the time taken for the resulting water level to return to static conditions. Leveloggers were used during the testing to record water levels at regular intervals (of 10 second to 15 second intervals). The testing results were analyzed using the Bouwer and Rice (1976) / Bouwer (1989) solution provided in the software package AQTESOLV™ Pro Version 4.5 (Duffield, 2014) to calculate the horizontal hydraulic conductivity of the aquifer sediments within the immediate vicinity of the screened interval of each monitoring well. Table 1 provides a summary of the calculated horizontal hydraulic conductivities, with the analytical solutions for the data being presented in Appendix G.

Stantec estimated infiltration rates for the subsurface soils using the previously mentioned horizontal hydraulic conductivities. Stantec assumed vertical hydraulic conductivities to be an order of magnitude lower than the horizontal hydraulic conductivities (Todd 1980; Freeze and Cherry 1979) and converted these values to infiltration rates using an equation presented in the Credit Valley Conservation and Toronto and Region Conservation Low Impact Stormwater Management Planning and Design Guideline (2010). The resulting infiltration rate estimates are presented in Table 5.



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4.0 LOCAL GEOLOGY AND HYDROGEOLOGY

4.1 GEOLOGY AND HYDROSTRATIGRAPHY

Figure 2 presents the surficial geological conditions within the Site and surrounding area as mapped by the OGS (2003) and the locations of Cross Sections A-A' (Figure 6) and B-B' (Figure 7). These cross-sections were constructed using historical borehole information and the results of onsite drilling investigations recently completed by Stantec. A summary of these drilling results is shown on the borehole logs provided in Appendix E. As shown in Figure 2, the Site is covered by glaciolacustrine-derived deposits of clay to silt-textured till, which is confirmed by the onsite drilling results. A review of borehole logs indicates soil conditions throughout the Site generally consist of topsoil, which can overlay silty sand, sandy silt and/or clay fill material up to a depth of 2.3 m BGS. This fill material in turn is often underlain by native deposits of silt and/or silty clay at depths ranging from 0.8 m to 1.5 m BGS. Beneath these previously mentioned soils is a sandy to silty clay till, interpreted to represent the Upper Maryhill Till of Aquitard 1 (ATB1), that extends to the termination depth of the boreholes (i.e., 3.7 m to 12.8 m BGS; 399.6 to 379.8 m AMSL). Sand to silty sand layers ranging from 0.7 m to 2.7 m in thickness are found to be occasionally interspersed within Aquitard 1 (ATB1).

Based on the subsurface conditions encountered at W-EB-OW1A/B-18, the base of Aquitard 1 (ATB1) in this area of the Site is interpreted to occur at an approximate elevation of 384 m AMSL, which is followed by deposits of medium to fine sand and silty sand with silt seams (i.e., Aquifer 1; AFB1) to an elevation of 342 m AMSL (representing the termination depth of the deep monitoring well).

4.2 HYDROGEOLOGY

4.2.1 Groundwater Levels

Table 2 provides a summary of the manual groundwater level measurements obtained in May, July and November 2017, and July 2018 from selected onsite monitoring wells and the drive-point piezometers. Hydrographs presenting the results of the continuous water level monitoring completed at selected monitoring wells are presented in Figures 4 and 5. Beneath the Site, the groundwater table is encountered within the clayey silt to silt deposits of the Upper Maryhill Till (Aquitard 1; ATB1) and likely represents a perched groundwater system, given that the saturated portion of Aquifer 1 (AFB1) occurs at depths ranging from 21 to 50 m BGS, or an elevation of approximately 354 m AMSL (Table 2; Stantec, 2017b). Over the monitoring period, stabilized groundwater levels (i.e., outside those recovery time periods following water level drawdowns induced by Stantec personnel from sampling and/or hydraulic conductivity testing) ranged from being present at ground surface (BH17-17; MW1-10) to 10.4 m BGS (BH09-17). In general, the groundwater table is closest to ground surface in the topographic low areas of the Site, and deepest in the topographic high areas of the property. Overall, the seasonal fluctuation in the groundwater table ranges from 0.9 m (BH11-17) to 3.2 m (MW1-10) across the Site.



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Seasonal groundwater level fluctuations of 0.9 m to 3.2 m occur throughout the Site, with levels being highest in the early spring and gradually declining over the spring and summer (Figures 4 and 5). This pattern in fluctuations is common within shallow groundwater systems in southern Ontario where high water table conditions occur in the spring due to lower evapotranspiration losses and a melting snowpack, which provide a greater volume of water for recharge. Low groundwater table conditions occur in the late summer to fall as more water is drawn from the subsurface over this period to meet evapotranspiration demands. During the spring freshet (e.g., March to May), groundwater levels experienced notable spikes at BH17-17, MW1-10, and to a lesser extent at BH05-17 and BH07-17, in response to precipitation and/or melt events, suggesting that the upper portions of Aquitard 1 at these locations may be weathered and permit water to more readily infiltrate to the subsurface (Figures 4 and 5). In comparison, groundwater levels at BH02-17 and BH09-17 demonstrated a limited to absent response to precipitation and/or melt events over the same period. Groundwater levels at BH01-17 and BH11-17 remained relatively flat over the monitoring period, suggesting that the measurements are not reflective of the groundwater table positioning, but are likely a product of water that has pooled in the well tip (i.e., groundwater is below the screened interval of these monitoring wells).

Monitoring wells constructed directly adjacent to Wetland W3 (BH11-17) and W5 (BH07-17) suggest that the groundwater table did not intercept these features over the monitoring period, with groundwater level depths seasonally fluctuating from 1.6 m to 5.7 m BGS (Table 2; Figures 4 and 5). Similarly, at BH15-17, which is drilled directly adjacent to Wetland W1 (and completed in May 2017), groundwater occurred in the open borehole at a depth of 3.4 m BGS, noting that the depth at which the soil transitioned from a brown to dark grey (an indicator of a saturated and chemically reducing soil environment and, subsequently, the high groundwater table) was 1.5 m BGS (Appendix E). The borehole log for the former MW2-10 (installed adjacent to Wetland W4) indicates that saturated conditions occur at a depth of 2.4 m BGS (Appendix E).

4.2.2 Groundwater Flow

Groundwater elevation contours derived from groundwater levels measured in July 2018 for the monitoring wells screened in the Upper Maryhill Till unit (Aquitard 1; ATB1) are shown on Figure 8. A groundwater divide is present at the Site, approximately coinciding with the positioning of the onsite subwatershed boundary, with horizontal flow through the perched groundwater system moving from this divide to the northeast and southwest across the Site. This flow interpretation is in general agreement with the flow patterns presented for this area by CH2MHill (2004).

Groundwater flows at an average horizontal hydraulic gradient of 0.03 m/m, as measured between BH05-17 and BH02-17. The average calculated horizontal hydraulic conductivity of the Upper Maryhill Till (Aquitard 1; ATB1), consisting of sandy to silty clay till, is 1.5×10^{-7} m/s (Table 1). This value is consistent with the hydraulic conductivity cited for clayey sands, sandy silts and till of 10^{-6} m/s to 10^{-8} m/s, after Fetter (2001). Applying Darcy's law:



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$$v = \frac{K \nabla}{\theta}$$

where: v = velocity (m/yr)
 K = hydraulic conductivity (1.5×10^{-7} m/s)
 ∇ = hydraulic gradient (0.03 m/m)
 θ = porosity (0.2 for glacial till, after Fetter 2001)

The estimated velocity of horizontal groundwater flow through Aquitard 1 is calculated to be approximately 0.8 m per year.

Data available on the Grand River Information Network (GRIN, 2017) indicates that downward vertical hydraulic gradients occur beneath the entire Site, suggesting that these lands represent a groundwater recharge area; however, the recharge potential of the Site is relatively low with rates being reported to range from 50 mm to 100 mm/year. Vertical hydraulic gradients recorded at the drive-point piezometers installed in the two dug ponds within the onsite golf course (i.e., DP1-17 and DP3-17; Figure 1) indicate that these features are sources of recharge to the perched aquifer system, with calculated vertical hydraulic gradients ranging from 0.00 m/m (neutral) to -1.00 (strong downward) over the monitoring period (Table 3). Similarly, groundwater levels recorded below Wetland W2 over the monitoring period ranged from 1.1 m to 1.7 m BGS, suggesting that this feature does not receive groundwater discharge from the underlying perched groundwater system (i.e., is a groundwater recharge feature). As discussed in Section 4.2.1, the groundwater table appears to remain below the substrates of Wetlands W1, W3, W4 and W5, also suggesting that these wetlands are not areas of groundwater discharge.

4.2.3 Groundwater Quality

Groundwater quality sampling for general chemistry and dissolved metals analysis was completed by Stantec at monitoring wells BH02-17, BH04-17, BH05-17, BH07-17, BH09-17, BH17-17 and MW1-10 on July 27, 2017 and is presented in Table 4 with the laboratory certificate of analysis provided in Appendix F.

Groundwater quality data were assessed against Ontario Regulation 169/03, the Ontario Drinking Water Quality Standard (ODWS). Data show no exceedances of health-related ODWS criteria, i.e., Maximum Acceptable Criteria (MAC) and Interim Maximum Acceptable Criteria (IMAC) for the tested parameters. However, the non-health related Operational Guideline (OG) for hardness (80-100 mg/L) was consistently exceeded. The presence of elevated hardness is not unexpected, given the calcareous nature of the local soils, and is quite common throughout the Waterloo area. Based on the anion to cation ratio of the analytical samples, groundwater can be classified as calcium-bicarbonate type water (Figure 9).

Other non-health related exceedances include iron, magnesium and total dissolved solids (TDS), which exceeded their corresponding Aesthetic Objective (AO). Sodium exceeded the Medical Officer of Health Reporting Limit. Elevated concentrations of iron and magnesium are typical of natural geochemical reactions from aquifers that are anaerobic with low to no dissolved oxygen. Elevated sodium concentrations above 20 mg/L may be considered a concern for consumers on a sodium restricted diet. TDS are comprised mainly of inorganic substances dissolved in water, including but not limited to



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chloride, sulphates, calcium, magnesium, and bicarbonates. TDS above 500 mg/L may affect the palatability of drinking water and can indicate excessive hardness and mineral deposition or corrosion. Consequently, these parameters are not considered to be a concern.

4.2.4 Infiltration Potential

Table 5 presents estimated infiltration rates associated with the predominantly sandy to silty clay till (Aquitard 1; ATB1) deposits that form the shallow overburden beneath the Site. Infiltration rates are calculated based on the results of the horizontal hydraulic conductivity testing performed on BH05-17, BH07-17, BH09-17, BH17-17 and MW4-4. Since hydraulic conductivity in the horizontal direction is generally an order (potentially two orders for clay-based deposits) of magnitude higher than hydraulic conductivity in the vertical direction (Todd 1980; Freeze and Cherry 1979), the vertical hydraulic conductivity of the upper overburden (i.e., from 3.0 to 12.1 m BGS) is estimated to be in the range of 10^{-8} m/s to 10^{-9} m/s. Using the equation derived from the established relationship between vertical hydraulic conductivity and infiltration rate as presented in the Credit Valley Conservation and Toronto and Region Conservation Low Impact Stormwater Management Planning and Design Guideline (2010), these calculated vertical hydraulic conductivities convert to infiltration rates ranging from 9 to 23 mm/hour (average rate of 15 mm/hour).



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5.0 WATER BALANCE

Water balance calculations were completed to quantify pre-development infiltration volumes at the Site, with these volumes serving as a baseline for comparison to future infiltration volumes projected to occur under the post-development scenario (once the development concept is prepared for the Site).

Within the hydrologic cycle, the flow of water into and out of system can be described through a simplified water balance equation as follows:

$$P = ET + S + R + I \quad \text{Equation 1}$$

Where:

- P = precipitation
- ET = evapotranspiration
- S = change in groundwater storage
- R = runoff
- I = infiltration (groundwater recharge)

Equation 1 may be further simplified by ignoring the change in groundwater storage (S), which trends over time to zero. The various components of the hydrologic cycle may be estimated through calculations or based on measurements made in the field. Precipitation (P) is typically a measured value, with the averages (1981 to 2010) used in this assessment being obtained from the Environment Canada operated Roseville Climate Station. Evapotranspiration (ET) is calculated based on measured air temperatures. Infiltration (I) and Runoff (R) are calculated based on P and ET, where the difference between P and ET is the water surplus (WS) available for Infiltration (I) and Recharge (R) as follows:

$$WS = P - ET \quad \text{Equation 2}$$

Where WS is used to calculate I after applying an infiltration factor (IF),

$$I = WS \times IF \quad \text{Equation 3}$$

And R is estimated by subtracting I from WS,

$$R = WS - I \quad \text{Equation 4}$$

For this assessment, ET was calculated using the soil moisture balance model by Thornthwaite and Mather (1955).



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Monthly potential evapotranspiration (PET) is calculated based on the measured average monthly daily temperature (T_a) and a heat index (H_i) value assuming 12 hours of daylight in a day and 30 days in a month, as follows:

$$PET = 16 \times \left(\frac{10T_a}{H_i} \right)^\alpha \quad \text{Equation 5}$$

Where T_a is taken as 0 degrees Celsius for months with negative temperatures, and H_i , the heat index is estimated as,

$$H_i = \sum_{i=1}^{12} \left(\frac{10T_a}{5} \right)^{1.514} \quad \text{Equation 6}$$

For α

$$\alpha = 0.49 + (0.0179 \times H_i) - (0.0000771 \times H_i^2) + (0.000000675 \times H_i^3) \quad \text{Equation 7}$$

PET values are then multiplied by an adjustment factor, after Thornthwaite and Mather (1957), which represents the average number of daylight hours per month at the latitude of the subject property to give the Adjusted Potential Evapotranspiration (PET_{adj}).

Actual Evapotranspiration (AET) is derived as,

$$AET = PET_{adj} - \Delta S \quad \text{Equation 8}$$

Where ΔS is the change in storage for the month, calculated as,

$$\Delta S = S_{mc} \times e^{\left(\frac{APWL}{S_{mc}} \right)} \quad \text{Equation 9}$$

Where:

S_{mc} = soil moisture capacity

$APWL$ = accumulated potential water loss, calculated for $\Delta P < 0$ as $APWL = -\sum_{i=0}^{12} PET_i$, and for $\Delta P > 0$ by rearranging equation 8; with ΔP = net precipitation = $P - PET_{adj}$

WS is derived by subtracting AET from the monthly precipitation,

$$WS = P - AET \quad \text{Equation 10}$$

And the infiltration and runoff calculated per Equation 3 and 4 above.



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The infiltration factor shown in Equation 3 is estimated based on the topography, soil type and land cover after MOE (2003) and the Ministry of the Environment and Energy (MOEE) (1995). To define appropriate infiltration factors, the Site was divided into three Sub-Areas based on similarities in soil type, topography and vegetation cover as follows:

Sub-Area A (15.18 ha)	silty clay, hilly topography, moderately rooted crops
Sub-Area B (10.48 ha)	silty clay, hilly topography, pasture / bare soil with impervious surfaces
Sub-Area C (17.96 ha)	silty clay, hilly topography, urban lawn

The delineated Sub-Areas are shown on Figure 10 and the infiltration factors assigned for Sub-Areas A, B and C are presented in Table 6.

Soil moisture capacity was set between 113 mm to 250 mm among the Sub-Areas depending on the soil type and land cover as specified under MOE (2003). In Sub-Area A, where sandy to silty clay soil and moderately rooted crops cover is present, soil moisture was set at 200 mm corresponding to the soil moisture content for clay loam. For Sub-Area B, where sandy to silty clay soil, long grasses, and bare soil having limited vegetation cover is present, soil moisture content was set at 250 mm corresponding to clay loam with pasture/shrub vegetation. For Sub-Area C, where sandy to silty clay soil and urban lawn (golf course) cover is present, soil moisture content was set at 113 mm corresponding to an average of soil moisture content between silt and clay loam. Pre-development impervious land cover includes existing parking lot and buildings (within Sub-Area B), covering approximately 5% of the total Site area.

Water balance calculations were completed for each Sub-Area and then summed to provide results for the entire Site. The water balance calculations shown in Table 6 generate a rounding error of less than 1%.

Overall, the average annual volume of infiltration occurring across the Site under the pre-development condition is estimated to be approximately 45,500 m³, or equivalent to a rate of 104 mm/year (Table 6). This estimated value is within the range of annual groundwater recharge rates reported for the Site (i.e., 50 to 100 mm; GRIN, 2017) and lies within the range of rates published by the MOEE (1995) for silty clay soil (i.e., 100 to 125 mm/year). The average annual volume of runoff under the pre-development condition at the Site is estimated to be approximately 95,200 m³/yr (218 mm/yr) (Table 6).



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6.0 IMPACT ASSESSMENT AND MITIGATION MEASURES

6.1 POST-DEVELOPMENT INFILTRATION

Under the post-development condition (Appendix A), a large proportion of the Site will likely be converted to impervious surfaces as a part of the proposed development and, subsequently, a reduction in the volume of water infiltrating to the subsurface is anticipated. However, Low Impact Development (LID) infiltration augmentation techniques can likely be used at the Site to address this expected infiltration deficit.

LID is a stormwater management strategy that seeks to mitigate the impacts of increased runoff by managing runoff as close to source as possible, with the implementation of such strategies also providing the residual benefit of offsetting potential infiltration losses associated with the increase in impervious surfaces associated with a given development. As discussed in Section 4.2, the sandy to silty clay till of Aquitard 1 (ATB1), which predominantly forms the upper overburden of the Site, is characterized by hydraulic conductivities in the range of 10^{-7} m/s to 10^{-8} m/s (Table 1; Appendix G), estimated infiltration rates ranging from 9 to 23 mm/hour (average 15 mm/hour) (Table 5), and reported average annual groundwater recharge rates of 50 mm to 100 mm (GRIN, 2017). As such, traditional post-development infiltration measures such as infiltration trenches / basins, soakaway pits, and pervious pipes may not be suitable for the Site. However, the infiltration augmentation options (as described in CVC-TRCA, 2010) that could be potentially available for use across the Site to assist in maximizing infiltration under the post-development condition are as follows:

- Roof downspout disconnection
- Vegetated filter strips
- Grass swales or enhanced grassed swales.

The suitability of using these infiltration augmentation options at the Site will be evaluated at the detailed design stage of the project. Overall, it is reasonable to conclude that the application of some or all the previously mentioned infiltration augmentation measures at the Site will assist in achieving the maximum groundwater recharge possible throughout the property under the post-development condition.

6.2 WETLANDS

Pursuant to Ontario Regulation 150/06, the GRCA must first provide permission for any proposed alteration of, or interference with, a wetland to occur as part of a land development project. The GRCA will permit development to occur within, or result in the removal of, a naturally occurring wetland of less than 0.5 ha or an anthropogenic wetland covering an area less than 2 ha, if the wetland is not:

1. part of a Provincially Significant Wetland
2. located within a floodplain or riparian community



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3. part of a Provincially or municipally designated natural heritage feature, a significant woodland, or hazard land
4. a bog or fen
5. fish habitat
6. significant wildlife habitat
7. confirmed habitat for a Provincially or regionally significant species as determined by the Ministry of Natural Resources and Forestry or as determined by the municipality
8. part of an ecologically functional corridor or linkage between larger wetlands or natural areas
9. part of a groundwater recharge area
10. a groundwater discharge area associated with any of the above

The hydrogeological information previously presented in this report will be used to address GRCA Criteria 9) and 10), with the remaining criteria being addressed in Stantec's accompanying *Environmental Impact Study* (Stantec, 2018a) report.

9) The onsite wetland is not a notable groundwater recharge area

Wetlands W1 to W5 each cover an area ranging from 0.03 ha to 0.13 ha in size, for a total combined area of 0.39 ha, representing less than 1% of the total Site area. Consequently, it is reasonable to assume that the loss of recharge function associated with these wetland areas will not detrimentally impact the overall groundwater recharge function of the Site.

10) The onsite wetlands are not a groundwater discharge features

As discussed in Section 4.2, subsurface soil and groundwater conditions observed near each of the onsite wetlands suggests that the seasonally high groundwater table does not intercept these features, indicating that the form and function of these wetlands are not sustained by groundwater inputs (i.e., are not groundwater discharge features).

6.3 SITE SERVICING

The proposed development is expected to be connected to underground utility infrastructure (e.g., storm and sanitary sewers), with the invert levels of the servicing typically occurring up to 3.0 m to 4.0 m BGS. Below ground site servicing could intercept the groundwater table, particularly near BH05-17, BH17-17, MW1-10, and MW4-4 where the depth to the groundwater table is the shallowest. Consequently, groundwater dewatering may be required to facilitate the installation of this infrastructure.

Construction dewatering activities are expected to be completed on an as-required basis, with the rate of this dewatering dictated by the amount of construction occurring on the Site at a given time, the type of subsurface material and groundwater elevations encountered in the excavations, and the elevation to



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which the groundwater table must be lowered to install infrastructure. Overall, potential dewatering efforts are expected to be limited given that the sandy to silty clay deposits of Aquitard 1 (ATB1) in which the servicing will be constructed are characterized by low to moderate horizontal hydraulic conductivity on the order of 10^{-7} m/s to 10^{-8} m/s (Table 1). However, larger volumes of groundwater seepage, and by extension dewatering, could occur where excavations encounter sand to silty sand layers within Aquitard 1 (ATB1). If construction dewatering volumes are projected to exceed 50,000 L/day, registration of an Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) will be required for dewatering to occur. A dewatering assessment can be completed during the detailed design to determine dewatering and water taking permitting requirements.

If site servicing infrastructure, once installed, occurs below the groundwater table, mitigation measures may be required to minimize the disturbance that site servicing could have on pre-development groundwater flow patterns. Typically, the most common mitigation measure is the installation of anti-seepage (cut-off) collars to prevent the preferential movement of groundwater along the servicing alignments. The use of anti-seepage collars will likely be required given that the subsurface of the Site is largely characterized by deposits where groundwater movement is more restricted (e.g., silt to clay-based soils). An assessment for the need, total number and exact placements of anti-seepage collars along the servicing alignments can be explored in more detail during the detailed design phase of the project.

6.4 SPILL CONTAINMENT AND RESPONSE

The potential exists for spills during any construction activity, with the most probable type of spill occurring being attributable to the refueling of major construction equipment that cannot readily leave the site (e.g., earth movers). The potential impacts of a spill could be the contamination of soils, groundwater and/or surface water. By implementing proper protocols for the handling of fuels and lubricants during construction, the risk of a spill occurring will be greatly reduced. The procedures to be implemented to prevent onsite spills are as follows:

- All trucks or other road vehicles would be refueled and maintained offsite, where practicable
- Refueling and lubrication of other construction equipment would not be allowed within 30 m of a drainage system or dewatering excavation
- Regular inspections of hydraulic and fuel systems on machinery, with leaks being repaired immediately upon detection or the equipment being removed from Site
- Spill kits containing absorbent materials would be kept on hand
- Implement best management practices and develop an emergency spill response plan

Given that anticipated construction activities at the Site are not expected to involve the storage or use of bulk chemicals or fuels, any potential spill that does occur would be localized and involve a small volume of material. Standard containment facilities and emergency response materials are to be maintained onsite as required, with refueling, equipment maintenance, and other potentially contaminating activities being confined to designated areas. As appropriate, spills are to be reported immediately to the Ministry of Environment and Climate Change (MOECC) Spills Action Centre.



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7.0 CONCLUSIONS

Based on the hydrogeological assessment, using the existing data collected at the Site and information obtained from a background review of regional data, the following conclusions are provided:

1. Subsurface conditions across the Site consist predominantly of sandy to silty clay till, which is interpreted to represent the Upper Maryhill Till of Aquitard 1 (ATB1). This deposit is generally found to extend from existing grades to the termination depths of the boreholes (i.e., 3.7 m to 12.8 m BGS; 399.6 to 379.8 m AMSL). Sand to silty sand layers ranging from 0.7 m to 2.7 m in thickness are found occasionally interspersed within Aquitard 1.
2. Beneath the Site, the groundwater table is encountered within the clayey silt to silt deposits of Aquitard 1, representing a perched groundwater system given that the saturated portion of Aquifer 1 (AFB1) is reported to occur at depths ranging from 21 to 50 m BGS near the Site, or an elevation of approximately 354 m AMSL. Over the monitoring period, stabilized groundwater levels ranged from being at ground surface to 10.4 m BGS throughout the Site, with seasonal fluctuations in the groundwater table ranging from 0.9 m to 3.2 m.
3. The horizontal movement of groundwater through Aquitard 1 (ATB1) is interpreted to flow to the northeast and southwest from a subwatershed divide that bisects the Site. Groundwater is calculated to flow through the deposits of Aquitard 1 at a velocity of 0.8 m/year. This interpretation is in general agreement with the flow patterns presented for this area by the CH2MHill (2004).
4. Regional studies together with groundwater level data collected from the onsite drive-point piezometers indicate that vertical groundwater flow at the Site is downward, with onsite surface water features recharging the underlying perched groundwater system; however, infiltration will be limited by the low permeability deposits of sandy to silty clay till that characterize the subsurface of the Site.
5. The onsite wetlands (Wetlands W1 to W5) are not groundwater discharge features and provide minimal contributions to the overall recharge function of the Site, given that the total area occupied by the wetlands is 0.39 ha (i.e., covering less than 1% of the total Site area).
6. Groundwater in the perched groundwater system of Aquitard 1 (ATB1) is calcium-bicarbonate type water. No tested parameters having health-related Ontario Drinking Water Standards (ODWS) were detected above their applicable standards.
7. Since the Site lies mostly within a WPSA-8, development of the property for industrial purposes will not be subject to those land activity restrictions listed under Categories 'B', 'C' and 'D' of the Region of Waterloo Official Plan. However, for any development occurring in the small area along the western limits of the Site that is intercepted by WSPA-7 of the Erb Street Well Field, additional studies may be required at the time of detail design and/or site plan approval to confirm that proposed land uses will not negatively impact the quantity and/or quality of drinking-water resources associated with this protection area.



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8. The average annual volume of infiltration occurring across the Site under the pre-development condition is estimated to be approximately 45,600 m³, or equivalent to a rate of 104 mm/yr. This estimated value is within the range of annual groundwater recharge rates reported for the Site (i.e., 50 to 100 mm). This pre-development infiltration volume will serve as a baseline for comparison to future infiltration volumes projected to occur at the Site post-development, as well as for the evaluation of post-development infiltration measures to address potential infiltration deficits (if such measures are deemed to be necessary).
9. Construction dewatering for groundwater control is an expected requirement during installation of storm and sanitary sewers in some areas of the Site. Limited dewatering volumes are expected given that low permeability deposits characterize the subsurface of the Site. However, under high groundwater table conditions or in isolated areas of high permeability sand and gravel deposits, dewatering volumes may be higher. A dewatering assessment can be completed during the detail design phase to determine dewatering volumes and potential water taking permitting requirements.
10. Servicing may occur below the groundwater table in some areas of the Site. Efforts may be required to minimize the disturbance that this servicing could have on pre-development groundwater flow patterns. Typically, the most common mitigation measure is the installation of anti-seepage (cut-off) collars to prevent the preferential movement of groundwater along the servicing alignments. An assessment for the need, total number and exact placements of anti-seepage collars along the servicing alignments can be explored in more detail during the detailed design phase of the project.



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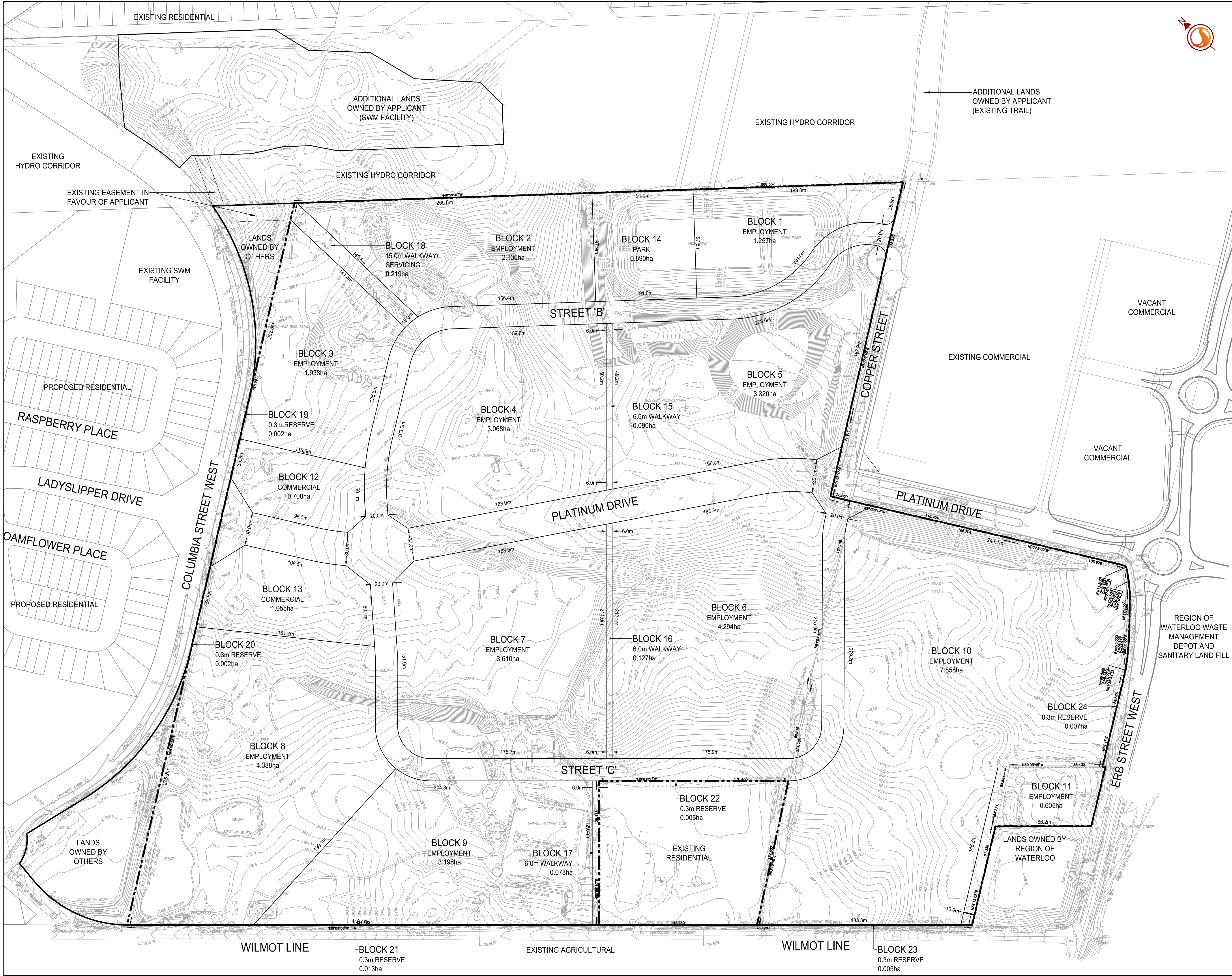
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APPENDIX A:

Draft Plan of Subdivision

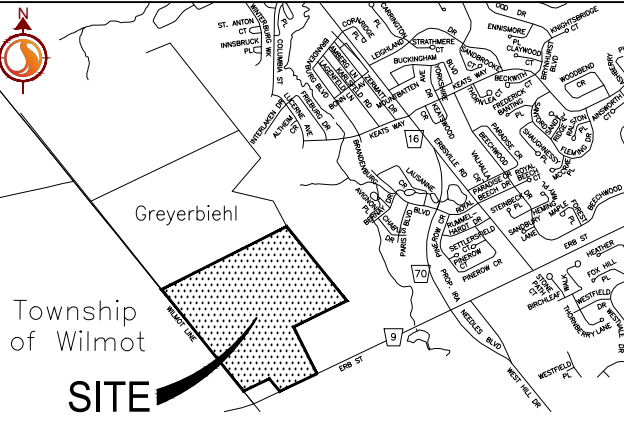


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Key Map N.T.S.



Legal Description

Part of Lot 41,
German Company Tract,
City of Waterloo,
Regional Municipality of Waterloo

Information Required

Under Section 51(17) of the Planning Act,
R.S.O. 1990 c.P.13 as Amended

- a) - As Shown
- b) - As Shown
- c) - As Shown
- d) - As Listed Below
- e) - As Shown
- f) - As Shown
- g) - As Shown
- h) - Municipal Water Supply
- i) - Glacial Till
- j) - Municipal Sanitary and Storm Sewers
- k) - None
- l) - As Shown

Surveyor's Certificate

I hereby certify the boundaries of the subject land to be subdivided on this plan and their relationship to the adjoining lands have been accurately and correctly shown.

Signed _____
O.L.S.
Company

Date _____

Owner's Certificate

I hereby authorize Stantec Consulting Ltd. to submit this Draft Plan of Subdivision on my behalf.

Signed _____
Owner's Name
Company

Date _____

Land Use Schedule

Lots/Blocks	Land Use	Area (ha)	Potential # of Units
BLOCKS 1-11	EMPLOYMENT	35.672	
BLOCKS 12-13	COMMERCIAL	1.763	
BLOCK 14	PARK	0.890	
BLOCKS 15-17	6.0m WALKWAY	0.295	
BLOCK 18	15.0m WALKWAY/SERVICING	0.219	
BLOCKS 19-24	0.3m RESERVE	0.034	
ROADS		4.737	
TOTAL		43.610	

Revision	By	Appd.	YY.MM.DD
File Name: 161413446_R-DP.dwg	JJ	KW	JJ 18.07.11
	Dwn.	Chkd.	Dgn.

Permit-Seal

APPROVED: _____ DATE: _____
I hereby certify that the plan was prepared under the supervision of a registered professional planner, within the meaning of the Ontario Professional Planners Institute Act, 1994.

Client/Project

CITY OF WATERLOO

WATERLOO WEST SIDE
EMPLOYMENT LANDS
WATERLOO, ON

Title

DRAFT PLAN OF SUBDIVISION

Project No. 161413446	Scale 1:1500	0 15 45 75m
Drawing No.	Sheet	Revision

DP-100

1 of 1

0

APPENDIX B:

Figures

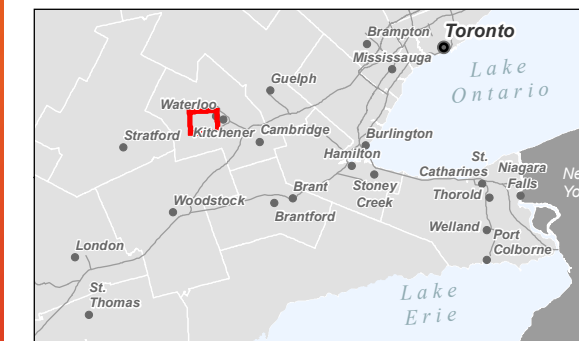


Legend

- | | |
|--|---|
| Study Area | Borehole (Stantec, 2013) |
| Property Boundary | Borehole (Stantec, 2017) |
| Subdivision Boundary | Monitoring Well (CH2MHILL, 2004) |
| Constructed Drain | Monitoring Well (CH2MHILL, 2010) |
| Cross-section Location | Monitoring Well (Stantec, 2011) |
| Subwatershed Boundary (CH2MHILL, 2004) | Monitoring Well (Stantec, 2013) |
| Watercourse | Monitoring Well (Stantec, 2017) |
| Wetland (Stantec and GRCA, 2017) | Monitoring Well (Stantec, 2018) |
| Wetland Designation | Region of Waterloo Monitoring Well (2018) |
| Borehole (CH2MHILL, 2004) | Drive-point Piezometer (Stantec, 2017-18) |

0 100 200 metres
1:5,000 (At original document size of 11x17)

- Notes**
1. Borehole Locations are Approximate
 2. Existing Boreholes from 2004/2010 CH2MHILL Investigation and 2013 Stantec Investigation.
 3. Coordinate System: NAD 1983 UTM Zone 17N
 4. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
 5. Site Plan provided by Stantec 2018-07-18. 161413446_R-DP.dwg
 6. Orthoimagery © First Base Solutions, 2018. Imagery Date, 2017.



Project Location 161413446 REV A
City of Waterloo Prepared by PRM on 2018-07-20
Technical Review by GW on 2017-11-30

Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

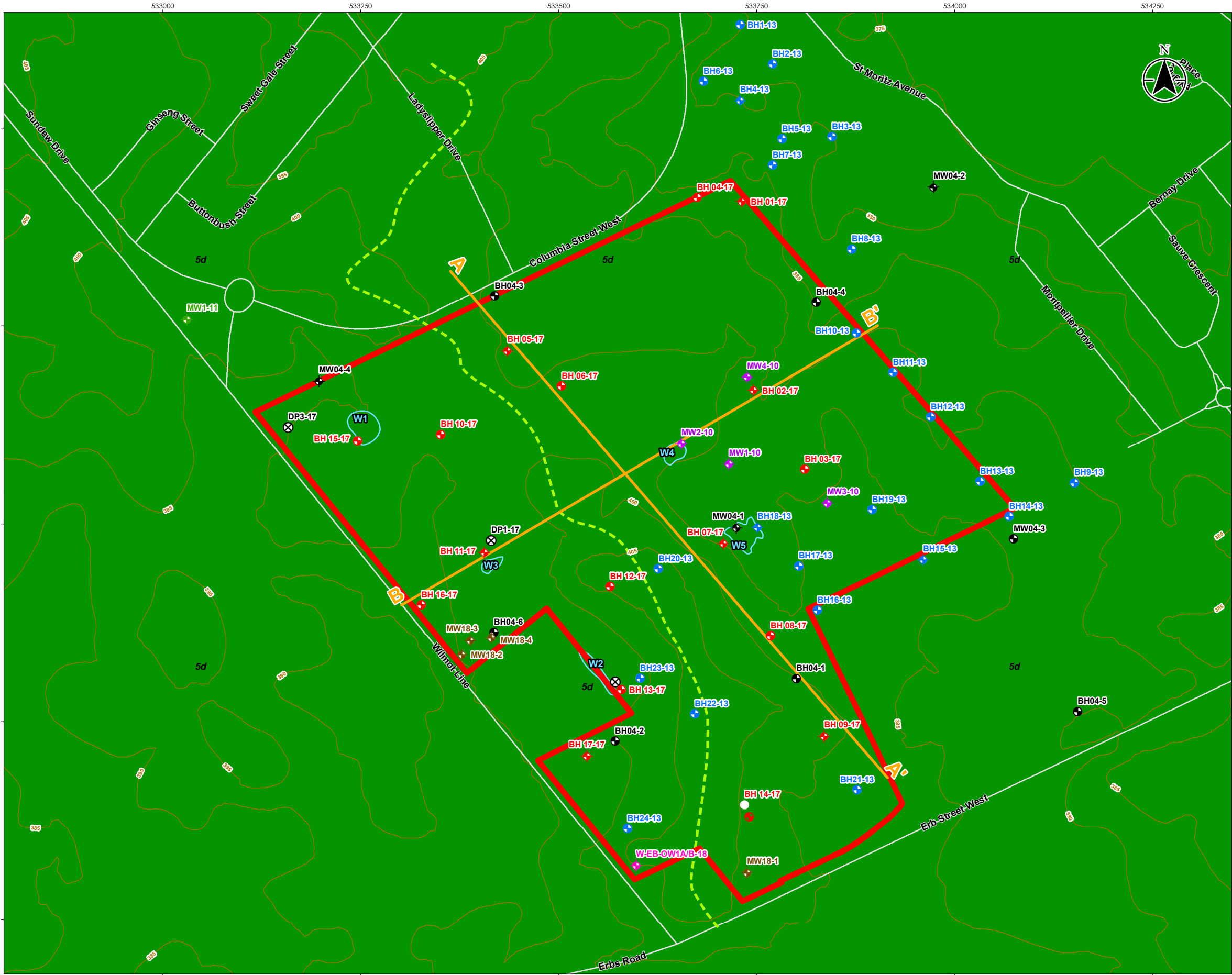
Figure No.

1

Title

Site Plan

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Revised: 2018-07-20 By: mawalace

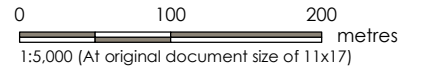


Legend

- Study Area
- Borehole (CH2MHILL, 2004)
- + Borehole (Stantec, 2013)
- Borehole (Stantec, 2017)
- ⊕ Monitoring Well (CH2MHILL, 2004)
- ⊕ Monitoring Well (CH2MHILL, 2010)
- ⊕ Monitoring Well (Stantec, 2011)
- ⊕ Monitoring Well (Stantec, 2013)
- ⊕ Monitoring Well (Stantec, 2017)
- ⊕ Monitoring Well (Stantec, 2018)
- ⊕ Region of Waterloo Monitoring Well (2018)
- ⊗ Drive-point Piezometer (Stantec, 2017-18)
- Contour
- Cross-section Location
- Road
- - - Subwatershed Boundary (CH2MHILL, 2004)
- Wetland (Stantec and GRCA, 2017)

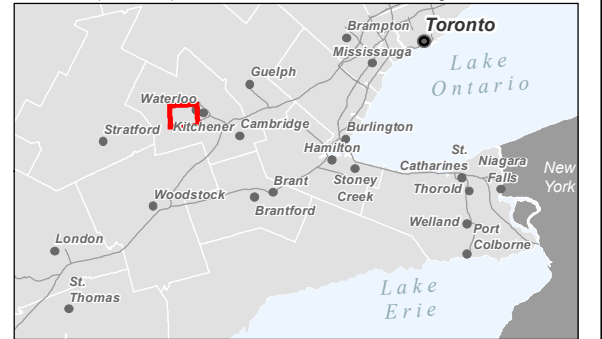
Surficial Geology

- 5d: Glaciolacustrine-derived silty to clayey till (Upper Maryhill Till)



Notes

- Borehole Locations are Approximate
- Existing Boreholes from 2004/2010 CH2MHILL Investigation and 2013 Stantec Investigation.
- Coordinate System: NAD 1983 UTM Zone 17N
- Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
- Site Plan provided by Stantec 2018-07-18, 161413446_R-DP.dwg



Project Location 161413446 REVA
City of Waterloo Prepared by MDW on 2018-07-20
Technical Review by GW on 2017-11-30

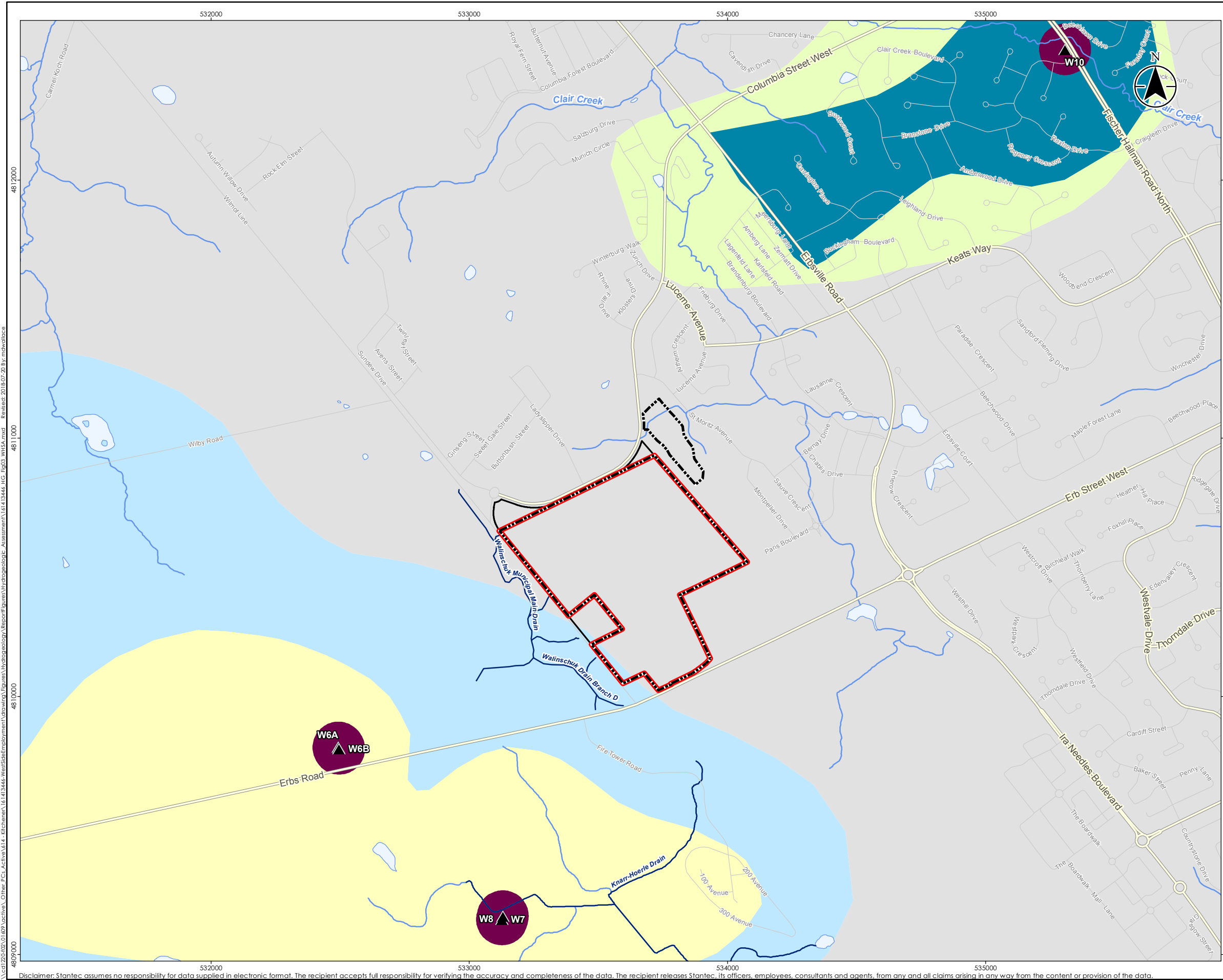
Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

Figure No.

2

Title

Surficial Geology



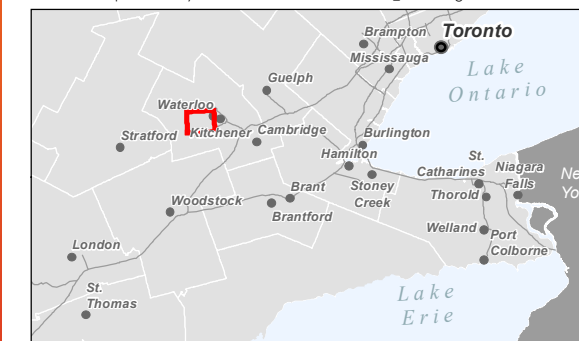
Legend

- Study Area
 - Property Boundary
 - Subdivision Boundary
 - Production Well
 - Constructed Drain
 - Expressway / Highway
 - Major Road
 - Minor Road
 - Watercourse
 - Waterbody
- #### Wellhead Protection Sensitivity Areas
- WPSA-1
 - WPSA-2
 - WPSA-3
 - WPSA-4
 - WPSA-5
 - WPSA-6
 - WPSA-7
 - WPSA-8

0 250 500 metres
1:15,000 (At original document size of 11x17)

Notes

- Borehole Locations are Approximate
- Coordinate System: NAD 1983 UTM Zone 17N
- Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
- Contains information provided by the Regional Municipality of Waterloo under licence, 2016.
- Site Plan provided by Stantec 2018-07-18, 161413446_R-DP.dwg



Project Location 161413446 REVA
City of Waterloo Prepared by PRM on 2018-07-20
Technical Review by GW on 2017-11-30

Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

Figure No.

3

Title

Wellhead Protection Sensitivity Areas

\\cd\220402\01\69\active\Other PCs\Active\14 - Kitchener\161413446-WestSideEmployment\Drawings\Figures\Hydrogeology\Report\Figures\Hydrogeologic_Assessment\161413446_HG_Fig03_WPSA.mxd Revised: 2018-07-20 By: mdwallace

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Client/Project
West Side Employment Lands
City of Waterloo
Hydrogeological Assessment

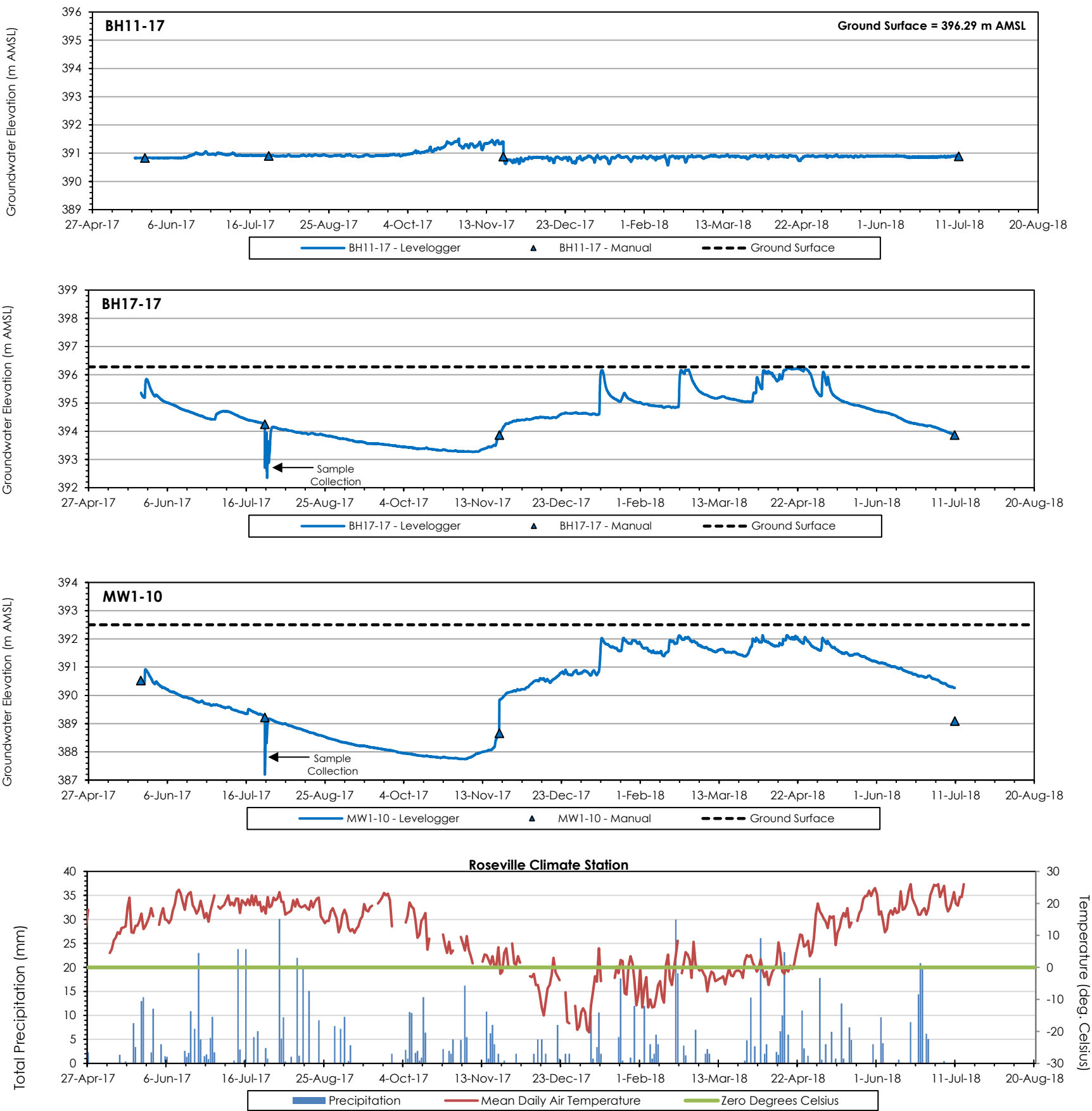
Figure No.

4

Title

HYDROGRAPHS
BH01-17, BH02-17, BH05-17, BH07-17 and BH09-17





Client/Project
West Side Employment Lands
City of Waterloo
Hydrogeological Assessment

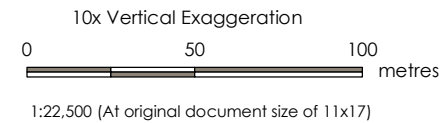
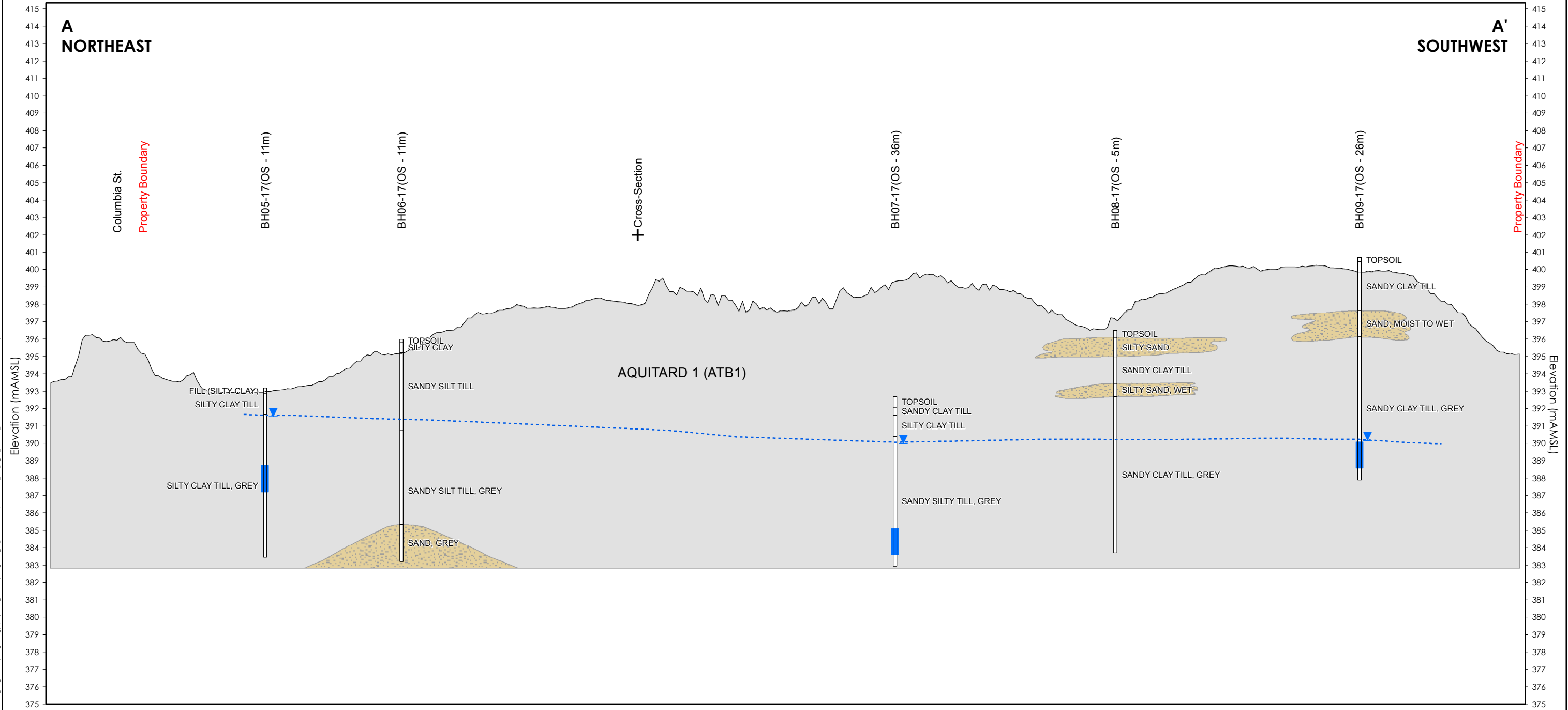
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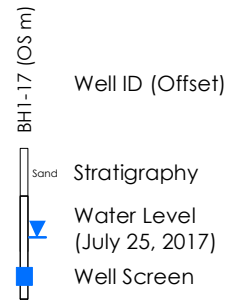
Title

HYDROGRAPHS
BH11-17, BH17-17 and MW1-10

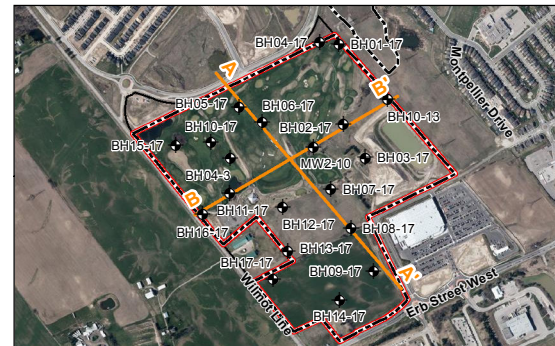
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- Notes**
1. Groundwater elevations shown for monitoring wells collected on July 25, 2017.
 2. Ground surface profile derived from site topography plan from the Southwestern Ontario Orthophotography Project (2015) – Breaklines and Masspoints data © Queen's Printer for Ontario, 2015.
 3. Borehole Locations are Approximate
 4. Coordinate System: NAD 1983 UTM Zone 17N
 5. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
 6. Site Plan provided by Stantec 2018-07-18. 161413446_R-DP.dwg
 7. Orthoimagery © First Base Solutions, 2018. Imagery Date, 2017.



- Legend**
- Ground Surface
 - Interpreted Groundwater Elevation (mAMSLL)
 - Silty Sand to Sand
 - ATB1 Upper Maryhill Till (Silty to Clayey Till)



Project Location
City of Waterloo

161413446 REVA
Prepared by PRM on 2018-07-20
Technical Review by GW on 2017-11-30

Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

Figure No.

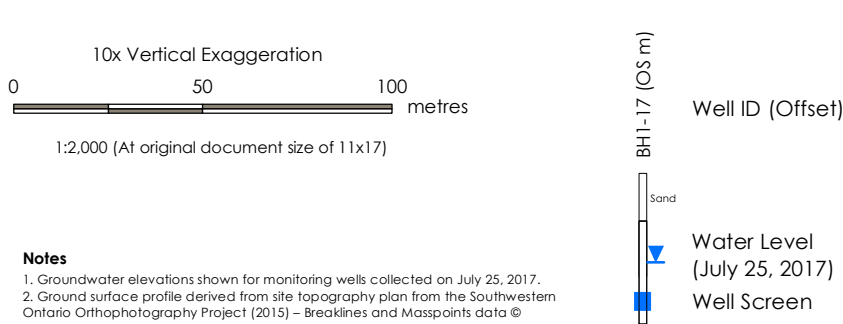
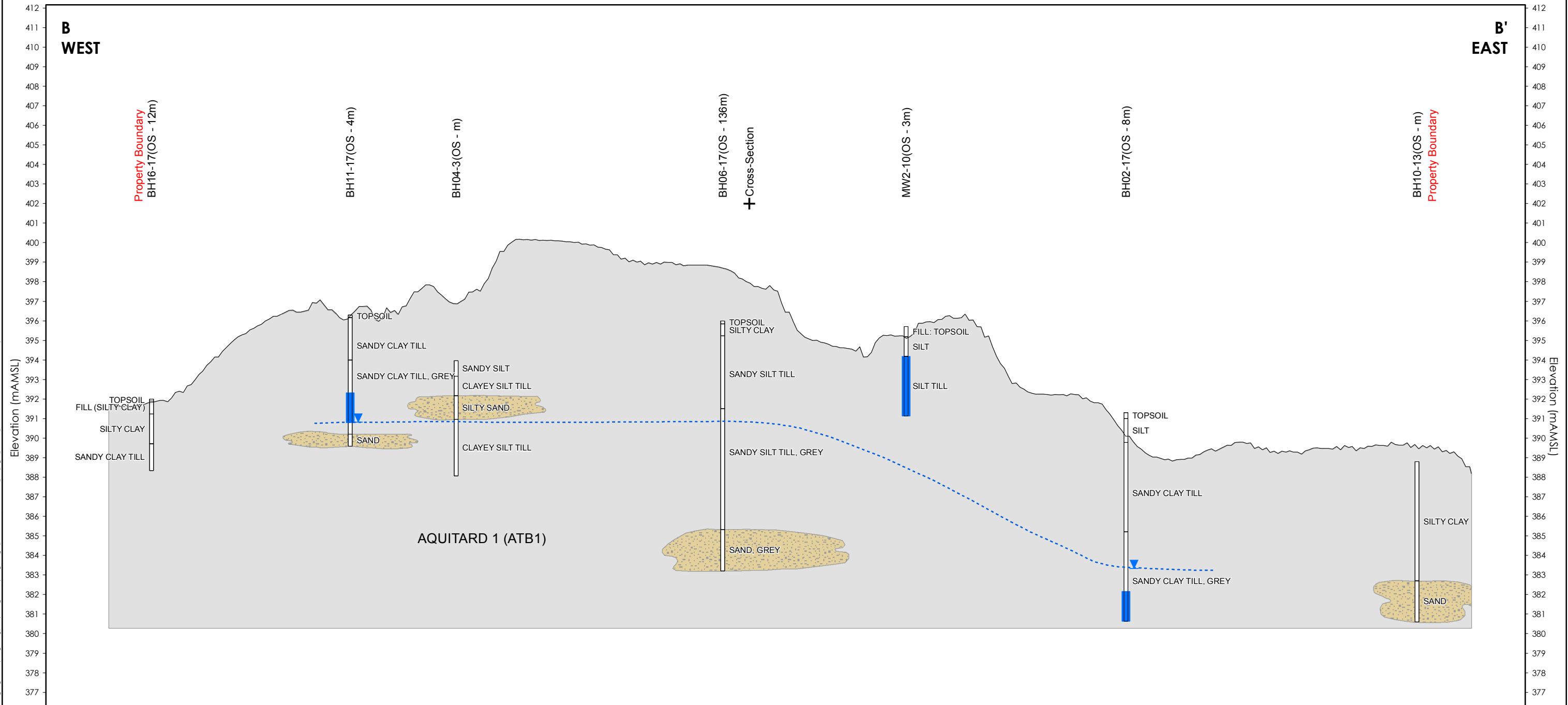
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Title

Cross-Section A-A'

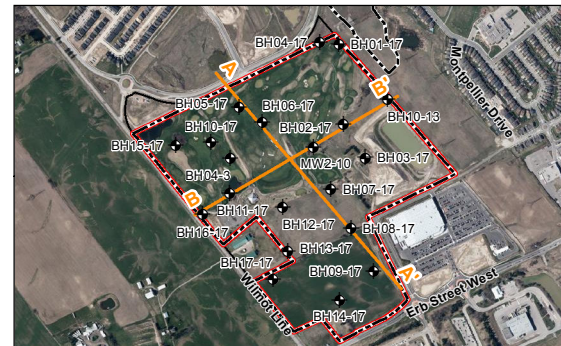
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\\cd120102\01\09\active\Other_PCL\Active\14 - Kitchener\161413446-WestSideEmployment\Drawings\Figures\Hydrogeology\Report\Figures\Hydrogeologic_Assessment\161413446_HG_Fig07_Section_BB.mxd Revised: 2018-07-20 By: mdwallace



- Legend**
- Ground Surface
 - Interpreted Groundwater Elevation (mAMSL)
 - Silty Sand to Sand
 - ATB1 Upper Maryhill Till (Silty to Clayey Till)

- Notes**
- Groundwater elevations shown for monitoring wells collected on July 25, 2017.
 - Ground surface profile derived from site topography plan from the Southwestern Ontario Orthophotography Project (2015) – Breaklines and Masspoints data © Queen's Printer for Ontario, 2015.
 - Borehole Locations are Approximate
 - Coordinate System: NAD 1983 UTM Zone 17N
 - Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
 - Site Plan provided by Stantec 2018-07-18, 161413446_R-DP.dwg
 - Orthoimagery © First Base Solutions, 2018, Imagery Date, 2017.



Project Location
City of Waterloo

161413446 REVA
Prepared by PRM on 2018-07-20
Technical Review by GW on 2017-11-30

Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

Figure No.

7

Title

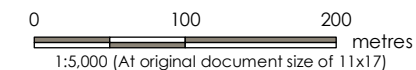
Cross-Section B-B'

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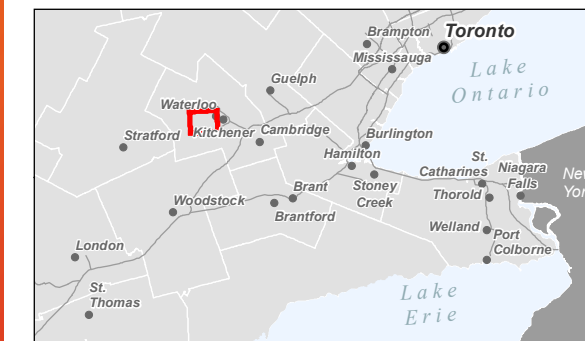
Legend

- Study Area
- Property Boundary
- Subdivision Boundary
- 392.54 Groundwater Elevation (mAMS) - July 2018
- Monitoring Well (Stantec, 2011)
- Monitoring Well (Stantec, 2017)
- Monitoring Well (Stantec, 2018)
- Region of Waterloo Monitoring Well (2018)*
- Constructed Drain
- Groundwater Contour (mAMS)
- Interpreted Direction of Groundwater Flow
- Subwatershed Boundary (CH2MHILL, 2004)
- Watercourse



Notes

1. Groundwater elevation for MW18-2 measured on April 11, 2018.
2. Groundwater elevation presented for W-EB-OW1A/B-18 represents measurement recorded in shallow overburden Monitoring Well.
3. Borehole Locations are Approximate
4. Existing Boreholes from 2004/2010 CH2MHILL Investigation and 2013 Stantec Investigation.
5. Coordinate System: NAD 1983 UTM Zone 17N
6. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
7. Site Plan provided by Stantec 2018-07-18. 161413446_R-DP.dwg
8. Orthoimagery © First Base Solutions, 2018. Imagery Date, 2017.



Project Location 161413446 REV8
City of Waterloo Prepared by MDW on 2018-07-20
Technical Review by ABC on 2018-XX-XX

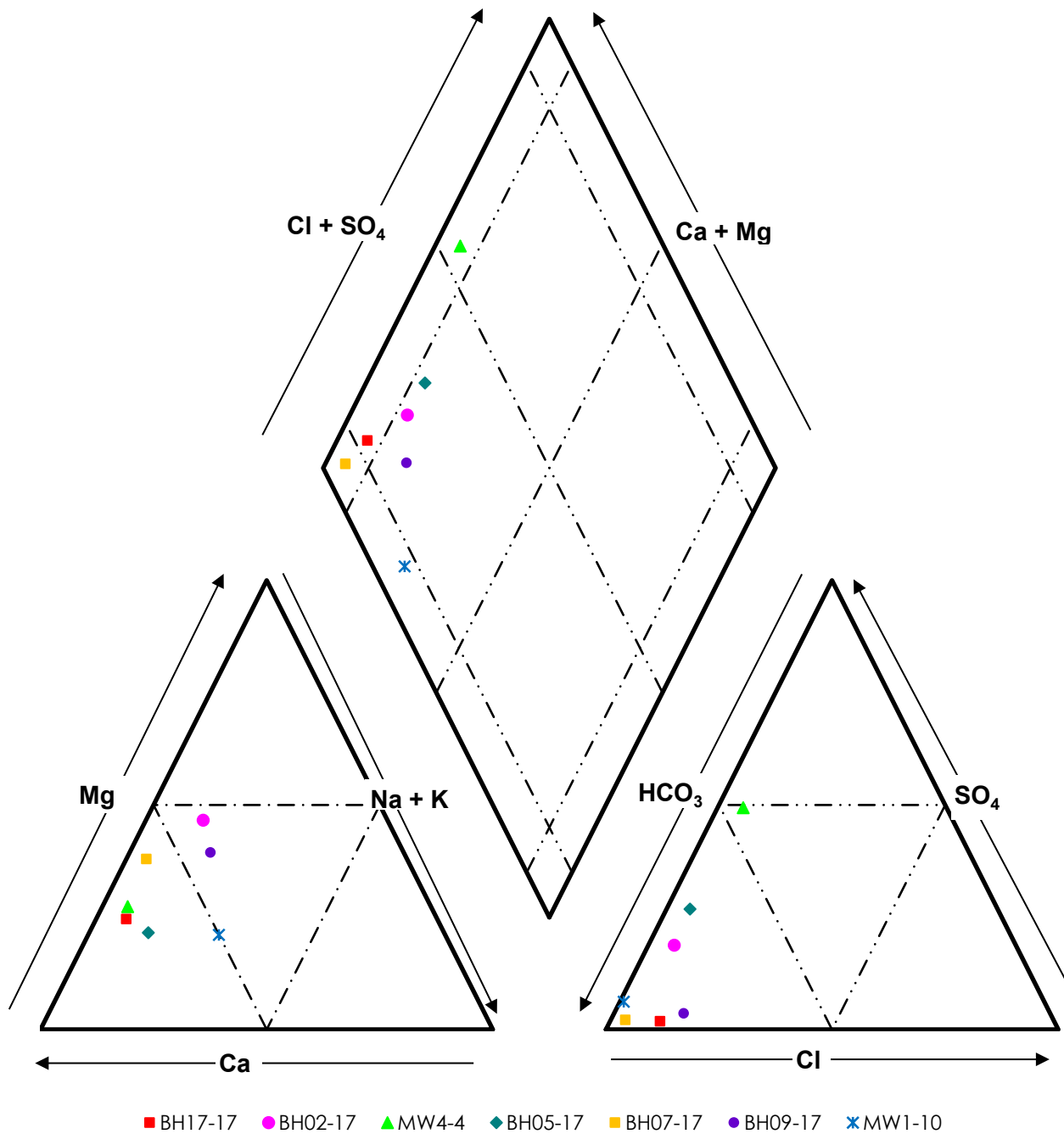
Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

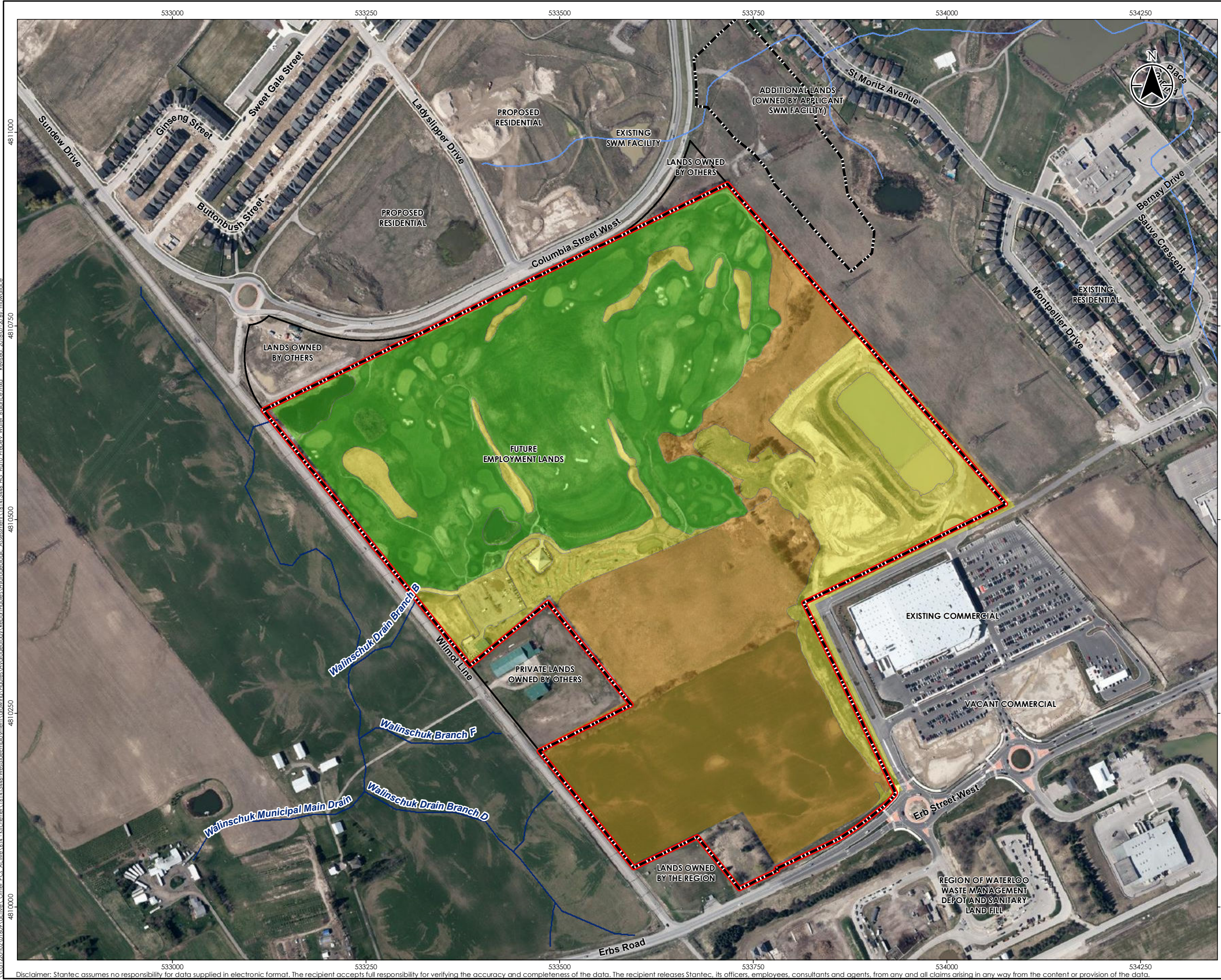
Figure No.

8

Title

Groundwater Flow





Legend

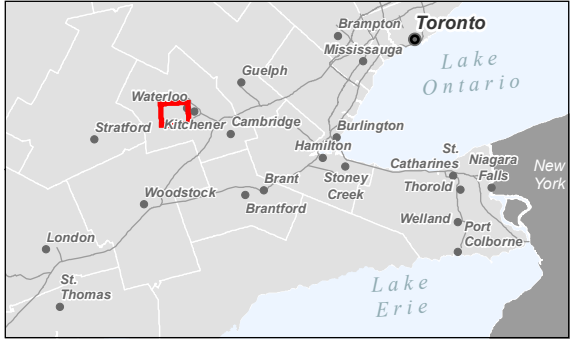
- Study Area
- Property Boundary
- Subdivision Boundary
- Constructed Drain
- Watercourse
- A - Moderate Rooted Crops
- B - Pasture / Bare Soil
- C - Urban Lawn

Sub-Area	Area (ha)
A - Moderate Rooted Crops	15.22
B - Pasture / Bare Soil	10.52
C - Urban Lawn	18.00

0 100 200 metres
1:5,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
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Project Location 161413446 REVA
City of Waterloo Prepared by PRM on 2018-07-20
Technical Review by GW on 2017-11-30

Client/Project
WEST SIDE EMPLOYMENT LANDS
CITY OF WATERLOO
HYDROGEOLOGIC ASSESSMENT

Figure No.
10

Title
Pre-Development Water Balance Sub-Areas

APPENDIX C:

Tables

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS

Well ID	UTM Coordinates		Elevations		Well Stick-up (m)	Well Depth (m BTOC)	Well Depth (m BGS)	Well Base Elevation (m AMSL)	Screened Interval				Screened Material Description	Probable Hydrostratigraphic Unit	Hydraulic Conductivity (m/s)
	Northing	Easting	Top of Casing (m AMSL)	Ground Surface (m AMSL)					Top Elevation (m BGS) (m AMSL)		Bottom Elevation (m BGS) (m AMSL)				
MONITORING WELLS															
BH01-17	4810907	533731	388.42	387.50	0.92	8.32	7.40	380.10	5.88	381.62	7.40	380.10	Sandy CLAY TILL	Upper Maryhill Till	-
BH02-17	4810668	533746	392.21	391.25	0.96	11.58	10.62	380.63	9.10	382.15	10.62	380.63	Sandy CLAY TILL	Upper Maryhill Till	-
BH05-17	4810718	533435	394.24	393.23	1.01	7.03	6.02	387.21	4.50	388.73	6.02	387.21	Silty CLAY TILL	Upper Maryhill Till	1.4E-07
BH07-17	4810475	533708	393.62	392.74	0.88	10.05	9.17	383.57	7.65	385.09	9.17	383.57	Sandy SILT TILL	Upper Maryhill Till	2.4E-08
BH09-17	4810232	533835	401.55	400.66	0.89	12.98	12.09	388.57	10.57	390.09	12.09	388.57	Sandy CLAY TILL	Upper Maryhill Till	2.6E-07
BH11-17	4810463	533406	397.13	396.29	0.84	6.33	5.49	390.80	3.97	392.32	5.49	390.80	Sandy CLAY TILL	Upper Maryhill Till	-
BH17-17	4810207	533536	397.22	396.28	0.94	5.48	4.54	391.74	3.02	393.26	4.54	391.74	Sandy to Silty CLAY TILL	Upper Maryhill Till	1.0E-07
MW1-10	4810757	533031	393.22	392.05	1.17	5.49	4.32	387.73	1.27	390.78	4.32	387.73	Sandy SILT to CLAY	Upper Maryhill Till	-
MW4-4	4810681	533197	-	-	0.94	5.44	4.50	-	2.98	-	4.50	-	-	Upper Maryhill Till	7.6E-07
MW18-1	4810059	533738	405.33	404.61	0.72	6.82	6.10	398.51	3.05	401.56	6.10	398.51	Sandy CLAY TILL	Upper Maryhill Till	-
MW18-2	4810334	533738	395.97	395.27	0.70	6.80	6.10	389.17	3.05	392.22	6.10	389.17	Sandy CLAY TILL (60%) / Silty SAND (40%)	Upper Maryhill Till	-
MW18-3	4810353	533378	397.63	396.84	0.79	5.36	4.57	392.27	1.52	395.32	4.57	392.27	Sandy CLAY TILL (92%) / Silty SAND (8%)	Upper Maryhill Till	-
MW18-4	4810356	533388	397.49	396.60	0.89	5.46	4.57	392.03	1.52	395.08	4.57	392.03	Sandy CLAY TILL (82%) / Silty SAND (18%)	Upper Maryhill Till	-
W-EB-OW1A-18	4810068	533415	405.15	404.35	0.80	62.98	62.18	342.17	59.13	345.22	62.18	342.17	SAND to Silty SAND	Aquifer 1	-
W-EB-OW1B-18	4810068	533600	405.28	404.47	0.81	14.35	13.54	390.93	12.02	392.45	13.54	390.93	Silty Fine SAND	Sand layer within Upper Maryhill Till	-
DRIVE-POINT PIEZOMETERS															
DP1-17	4810478	533415	-	-	1.37	2.64	1.27	-	0.81	-	1.26	-	Sandy CLAY TILL	Upper Maryhill Till	-
DP2-17	4810300	533572	-	-	0.84	2.64	1.80	-	1.35	-	1.80	-	Silty CLAY TILL	Upper Maryhill Till	-
DP3-17	4810621	533159	-	-	1.42	2.64	1.22	-	0.77	-	1.22	-	Sandy CLAY TILL	Upper Maryhill Till	-
														GEOMEAN =	1.5E-07

Notes:
m AMSL = meters above mean sea level
m BGS = meters below ground surface
m BTOC = meters below top of well casing
- = data not available

TABLE 2
GROUNDWATER LEVEL DATA - MONITORING WELLS

Well ID	Date	Time	Well Depth			Top of Casing Elevation (m AMSL)	Ground Surface Elevation (m AMSL)	Pipe Stick-up (m)	Groundwater Level		
			(m BTOC)	(m BGS)	(m AMSL)				(m BGS)	(m BTOC)	(m AMSL)
BH01-17	17-May-17	2:12 PM	8.32	7.40	380.10	388.42	387.50	0.92	7.01	7.93	380.49
	18-May-17	9:46 AM							7.05	7.97	380.45
	25-Jul-17	1:44 PM							7.10	8.02	380.40
	21-Nov-17	2:27 PM							-	DRY	-
	10-Jul-18	6:01 PM							7.31	8.23	380.19
BH02-17	17-May-17	4:18 PM	11.58	10.62	380.63	392.21	391.25	0.96	10.14	11.10	381.11
	23-May-17	2:15 PM							9.98	10.94	381.27
	25-Jul-17	11:34 AM							7.86	8.82	383.39
	21-Nov-17	2:27 PM							7.84	8.80	383.41
	10-Jul-18	3:53 PM							7.82	8.78	383.43
BH05-17	18-May-17	8:36 AM	7.03	6.02	387.21	394.24	393.23	1.01	1.32	2.33	391.91
	23-May-17	3:28 PM							0.88	1.89	392.35
	25-Jul-17	1:24 PM							1.61	2.62	391.62
	21-Nov-17	2:45 PM							1.06	2.07	392.17
	10-Jul-18	5:43 PM							1.80	2.81	391.43
BH07-17	18-May-17	5:03 PM	10.05	9.17	383.57	393.62	392.74	0.88	2.09	2.97	390.65
	23-May-17	2:46 PM							2.35	3.23	390.39
	25-Jul-17	11:17 AM							2.67	3.55	390.07
	21-Nov-17	1:40 PM							2.37	3.25	390.37
	10-Jul-18	3:25 PM							3.04	3.92	389.70
BH09-17	18-May-17	10:22 AM	12.98	12.09	388.57	401.55	400.66	0.89	10.11	11.00	390.55
	23-May-17	2:40 PM							10.43	11.32	390.23
	25-Jul-17	11:00 AM							9.55	10.44	391.12
	21-Nov-17	4:17 PM							10.33	11.22	390.33
	10-Jul-18	5:25 PM							9.29	10.18	391.37
BH11-17	17-May-17	4:00 PM	6.33	5.49	390.80	397.13	396.29	0.84	5.46	6.30	390.83
	18-May-17	12:30 PM							5.46	6.30	390.83
	25-Jul-17	12:40 PM							5.39	6.23	390.90
	21-Nov-17	1:22 PM							5.41	6.25	390.88
	10-Jul-18	3:12 PM							5.40	6.24	390.89
BH17-17	17-Jul-18	8:35 AM							-	DRY	-
	17-May-17	3:32 PM	5.48	4.54	391.74	397.22	396.28	0.94	1.12	2.06	395.16
	23-May-17	2:59 PM							0.92	1.86	395.36
	25-Jul-17	12:24 PM							2.03	2.97	394.25
	21-Nov-17	1:00 PM							2.41	3.35	393.87
	10-Jul-18	2:30 PM							2.41	3.35	393.87
	17-Jul-18	8:25 AM							2.57	3.51	393.71

TABLE 2
GROUNDWATER LEVEL DATA - MONITORING WELLS

Well ID	Date	Time	Well Depth			Top of Casing Elevation (m AMSL)	Ground Surface Elevation (m AMSL)	Pipe Stick-up (m)	Groundwater Level		
			(m BTOC)	(m BGS)	(m AMSL)				(m BGS)	(m BTOC)	(m AMSL)
MW4-4	17-May-17	1:34 PM	5.44	4.50	-	-	-	0.94	0.36	1.30	-
	23-May-17	3:45 PM							0.26	1.20	-
	25-Jul-17	1:00 PM							0.56	1.50	-
	21-Nov-17	3:56 PM							0.40	1.34	-
	10-Jul-18	4:45 PM							0.84	1.78	-
MW1-10	17-May-17	4:38 PM	5.49	4.32	-	393.22	392.05	1.17	0.74	1.91	391.31
	23-May-17	2:00 PM							0.35	1.52	391.70
	25-Jul-17	11:54 AM							1.66	2.83	390.39
	21-Nov-17	1:52 PM							2.22	3.39	389.83
	10-Jul-18	3:40 PM							1.79	2.96	390.26
MW18-1	11-Apr-18	-	6.82	6.10	398.51	405.33	404.61	0.72	1.59	2.31	403.02
	17-Jul-18	8:52 AM							3.72	4.44	400.89
MW18-2	11-Apr-18	-	6.80	6.10	389.17	395.97	395.27	0.70	5.75	6.45	389.52
	17-Jul-18	8:43 AM							-	DRY	-
MW18-3	11-Apr-18	-	5.36	4.57	392.27	397.63	396.84	0.79	4.17	4.96	392.67
	17-Jul-18	8:40 AM							-	DRY	-
MW18-4	11-Apr-18	-	5.46	4.57	392.03	397.49	396.60	0.89	3.99	4.88	392.61
	17-Jul-18	8:52 AM							-	DRY	-
W-EB-OW1A-18	10-Jul-18	12:05 PM	62.98	62.18	342.17	405.15	404.35	0.80	49.98	50.78	354.37
W-EB-OW1B-18	10-Jul-18	12:09 PM	14.35	13.54	390.93	405.28	404.47	0.81	8.65	9.46	395.82

m AMSL = meters above mean sea level
m BGS = meters below ground surface
m BTOC = meters below top of well casing
- = data not available

TABLE 3
GROUNDWATER LEVELS - DRIVE-POINT PIEZOMETERS

Piezometer ID	Surface Water Feature	Depth		Screen Length (m)	Screen Separation ⁽¹⁾ (m)	Pipe Stick-up (m)	Ground Surface Elevation ⁽⁵⁾ (m AMSL)	Top of Casing Elevation (m AMSL)	Date	Time	Groundwater Level			Surface Water Level		Vertical Hydraulic Gradient ⁽⁴⁾ (+) = Upward (-) = Downward
		(m BTOC)	(m BGS)								(m BGS) ⁽²⁾	(m BTOC)	(m AMSL)	(m BTOC) ⁽³⁾	(m AMSL)	
DP1-17	Open Aquatic (Dug Pond)	2.64	1.27	0.45	1.05	1.37	100.00	101.37	28-Jul-17	10:18 AM	0.01	1.38	99.99	0.95	100.42	-0.41
									21-Nov-17	1:10 PM	-0.64	0.73	100.64	0.73	100.64	0.00
									10-Jul-18	4:14 PM	-0.18	1.19	100.18	1.01	100.36	-0.17
DP2-17	Mineral Meadow Marsh (W2)	2.64	1.80	0.45	1.58	0.84	100.00	100.84	28-Jul-17	10:11 AM	1.70	2.54	98.30	DRY	-	-
									21-Nov-17	1:07 PM	1.11	1.95	98.89	DRY	-	-
									10-Jul-18	2:55 PM	1.35	2.19	98.65	DRY	-	-
DP3-17	Open Aquatic (Dug Pond)	2.64	1.22	0.45	1.00	1.42	100.00	101.42	28-Jul-17	10:23 AM	0.72	2.14	99.28	0.90	100.52	-1.00
									21-Nov-17	3:35 PM	0.29	1.71	99.71	1.06	100.36	-0.65
									10-Jul-18	4:38 PM	-0.26	1.16	100.26	0.96	100.46	-0.20

Notes:
(1) Distance between water body substrate and mid-point of piezometer screen.
(2) A negative value indicates that the water level measured within the pipe is located above ground surface.
(3) A negative value indicates that the surface water level is above the top of the piezometer.
(4) Vertical hydraulic gradient between the tributary substrate and the piezometer screened interval. Negative and positive values indicate downward and upward gradients, respectively.
(5) Ground surface not surveyed to geodetic benchmark and set to arbitrary elevation of 100 m AMSL.

m BGS = meters below ground surface
m BTOC = meters below top of casing
DRY = no groundwater or surface water was observed in the piezometer or watercourse, respectively
- = measurement not available

TABLE 4
INFILTRATION TESTING RESULTS

Testing Location ID	Horizontal Hydraulic Conductivity (m/s)	Vertical Hydraulic Conductivity		Infiltration Rate (mm/hr)	Screened Interval (m BGS)	Soil Substrate Tested	Hydrostratigraphic Unit
		(cm/s)	(m/s)				
In-situ Hydraulic Response Testing							
BH05-17	1.4E-07	-	1.4E-08	15	4.5 - 6.0	Silty CLAY TILL	Upper Maryhill Till
BH07-17	2.4E-08	-	2.4E-09	9	7.6 - 9.1	Sandy SILT TILL	Upper Maryhill Till
BH09-17	2.6E-07	-	2.6E-08	18	10.6 - 12.1	Sandy CLAY TILL	Upper Maryhill Till
BH17-17	1.0E-07	-	1.0E-08	14	3.0 - 4.5	Sandy to Silty CLAY TILL	Upper Maryhill Till
MW4-4	7.6E-07	-	7.6E-08	23	3.0 - 4.5	-	Upper Maryhill Till
GEOMEAN =		1.5E-08	15				

Notes:

- (1) Infiltration rate calculated based on established relationship between vertical hydraulic conductivity and infiltration rate presented in *Credit Valley Conservation and Toronto and Region Conservation (2010) Low Impact Stormwater Management Planning and Design Guideline - Version 1.0*.
- (2) Vertical hydraulic conductivities assumed to be one order of magnitude lower than in-situ measured horizontal hydraulic conductivities.

TABLE 5
GROUNDWATER QUALITY RESULTS

Sample Location			BH2-17	BH5-17	BH7-17	BH9-17	BH17-17	MW4-4	MW1-10
Sample Date			27-Jul-17	27-Jul-17	27-Jul-17	27-Jul-17	27-Jul-17	27-Jul-17	25-Jul-17
Sample ID			WG-161413446-20170727-AV04	WG-161413446-20170727-AV07	WG-161413446-20170727-AV03	WG-161413446-20170727-AV02	WG-161413446-20170727-AV05	WG-161413446-20170727-AV06	WG-161413446-20170726-AV01
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX
Laboratory Work Order			B7G0832	B7G0832	B7G0832	B7G0832	B7G0832	B7G0832	B7G0832
Laboratory Sample ID			EVI615	EVI618	EVI614	EVI613	EVI616	EVI617	EVI612
Sample Type	Units	ODWS							
General Chemistry									
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	250	370	350	220	390	370	440
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	3.1	2.1	3.1	3.0	3.1	2.4	3.6
Alkalinity, Total (as CaCO3)	mg/L	30-500 ^E	260	370	350	230	400	370	440
Anion Sum	me/L	n/v	6.77	10.9	7.39	5.61	9.09	16.5	9.55
Cation Sum	me/L	n/v	6.07	10.8	8.73	5.83	8.97	16.9	9.34
Chloride	mg/L	250 ^C	14	20	8.5	31	36	33	2.9
Dissolved Organic Carbon (DOC)	mg/L	5 ^C	1.3	2.4	0.87	2.0	1.1	2.7	3.3
Electrical Conductivity, Lab	µmhos/cm	n/v	550	940	770	590	830	1,400	850
Hardness (as CaCO3)	mg/L	80-100 ^E	260 ^E	470 ^E	420 ^E	240 ^E	420 ^E	800 ^E	330 ^E
Ion Balance	%	n/v	5.43	0.640	8.32	1.91	0.670	1.39	1.11
Langelier Index (at 20 C)	none	n/v	0.788	1.02	1.09	0.783	1.15	1.22	1.08
Langelier Index (at 4 C)	none	n/v	0.540	0.769	0.837	0.533	0.900	0.977	0.835
Nitrate (as N)	mg/L	10.0 _d ^B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.31
Nitrate + Nitrite (as N)	mg/L	10.0 _d ^B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.31
Nitrite (as N)	mg/L	1.0 _d ^B	<0.010	<0.010	0.020	<0.010	0.018	<0.010	<0.010
Orthophosphate(as P)	mg/L	n/v	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5 ^E	8.12	7.79	7.98	8.15	7.92	7.85	7.94
Saturation pH (at 20 C)	none	n/v	7.33	6.77	6.90	7.37	6.77	6.62	6.85
Saturation pH (at 4 C)	none	n/v	7.58	7.02	7.15	7.62	7.02	6.87	7.10
Sulfate	mg/L	500 _h ^C	62	140	7.5	9.8	8.0	390	28
Total Dissolved Solids (Calculated)	mg/L	500 ^C	350	610 ^C	390	290	460	970 ^C	530 ^C
Ammonia (as N)	mg/L	n/v	0.20	0.98	0.11	0.13	0.054	0.31	<0.050
Metals, Dissolved									
Aluminum	mg/L	0.1 ^E	<0.0050	<0.0050	<0.0050	0.0070	<0.0050	<0.0050	0.011
Antimony	mg/L	0.006 ^A	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	mg/L	0.025 ^A	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Barium	mg/L	1 ^B	0.14	0.19	0.32	0.061	0.13	0.071	0.068
Beryllium	mg/L	n/v	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron	mg/L	5 ^A	0.039	0.028	0.024	0.072	0.015	0.30	0.075
Cadmium	mg/L	0.005 ^B	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Calcium	mg/L	n/v	49	140	100	50	120	230	94
Chromium	mg/L	0.05 ^B	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	mg/L	n/v	0.00092	0.00068	0.00087	<0.00050	0.00079	0.00057	<0.00050
Copper	mg/L	1 ^C	<0.0010	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	0.0047
Iron	mg/L	0.3 ^C	<0.10	<0.10	<0.10	<0.10	<0.10	0.59 ^C	<0.10
Lead	mg/L	0.01 _c ^B	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium	mg/L	n/v	34	28	40	28	26	57	24
Manganese	mg/L	0.05 ^C	0.21 ^C	0.31 ^C	0.18 ^C	0.50 ^C	0.36 ^C	0.73 ^C	0.0021
Molybdenum	mg/L	n/v	0.0036	0.0050	0.0026	0.0051	0.0012	0.00055	0.00054
Nickel	mg/L	n/v	0.0025	0.0012	0.0036	0.0018	0.0025	0.0012	<0.0010
Phosphorus	mg/L	n/v	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Potassium	mg/L	n/v	3.6	1.8	3.5	3.4	2.5	1.8	89
Selenium	mg/L	0.05 ^B	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon	mg/L	n/v	6.1	9.6	7.4	5.8	5.3	5.8	7.8
Silver	mg/L	n/v	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium	mg/L	200 _g ^C 20 _g ^D	16	31 ^D	6.8	22 ^D	12	21 ^D	10
Strontium	mg/L	n/v	0.68	0.41	0.44	0.72	0.20	2.1	0.18
Thallium	mg/L	n/v	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Titanium	mg/L	n/v	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	mg/L	0.02 ^B	0.0056	0.0048	0.0011	0.0023	0.0046	0.0041	0.0013
Vanadium	mg/L	n/v	0.00053	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc	mg/L	5 ^C	0.0060	<0.0050	<0.0050	<0.0050	<0.0050	0.0075	<0.0050

Notes:	
ODWS	Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (MOE, 2006, revised July 2017)
A	ODWS Table 2 - Chemical Standards, Interim Maximum Acceptable Concentration
B	ODWS Table 2 - Chemical Standards, Maximum Acceptable Concentration
C	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Aesthetic Objectives
D	ODWS Table 4 - Medical Officer of Health Reporting Limit
E	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Operational Guidelines
6.5 ^A	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
c	This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
d	Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
g ^C	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with pati
g ^D	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.
h	When sulfate levels exceed 500 mg/L, water may have a laxative effect on some people.

TABLE 6
PRE-DEVELOPMENT WATER BALANCE

Model Type: Thornthwaite and Mather (1955)
Client: City of Waterloo
Location: Water Balance - West Side Employment Lands
Total Site Area (ha): 43.60

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A	Hilly, Fine Glaciolacustrine (Silt to Clay), Moderately Rooted Crops
Sub-Area B	Hilly, Fine Glaciolacustrine (Silt to Clay), Pasture to Bare Soil
Sub-Area C	Hilly, Fine Glaciolacustrine (Silt to Clay), Urban Lawn (Golf Course)

Land Description Factors	Sub-Area A	Sub-Area B	Sub-Area C											Total
Topography	0.10	0.10	0.10											
Soils	0.15	0.15	0.15											
Cover	0.10	0.15	0.05											
Sum (Infiltration Factor) [†]	0.35	0.40	0.30											
Soil Moisture Capacity (mm)	200	250	113											43.62
Site area (ha)	15.18	10.48	17.96											
Imperviousness Coefficient	0.00	0.07	0.00											
Impervious Area (ha)	0.00	0.73	0.00											0.73
Percentage of Total Site Area	0.0%	1.7%	0.0%											2%
Remaining Pervious Area (ha)	15.18	9.75	17.96											42.89
Total Pervious Site Area (ha)	15.18	9.75	17.96											42.89
Percentage of Total Site Area	34.8%	22.4%	41.2%											98%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data[†]													
Average Daily Temperature (°C)	-6.5	-5.4	-1	6.5	12.7	18.2	20.5	19.5	15.2	8.7	2.6	-3.5	7.3
Precipitation (mm)	68.1	54.6	55.0	77.2	87.9	76.3	98.2	83.9	85.4	75.3	88.4	68.5	919

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.5	4.1	7.1	8.5	7.9	5.4	2.3	0.4	0.0	37
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.4	60.6	89.5	101.8	96.4	73.6	40.3	10.9	0.0	502
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	33	75	115	128	112	77	37	9	0	585
Precipitation - PET (mm)	68	55	55	44	13	-39	-30	-28	9	38	80	69	333

Evapotranspiration Analysis													
Sub-Area A	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-39	-69	-97	-88	-50	0	0	
Storage (S)	200	200	200	200	200	165	117	72	81	119	200	200	
Change in Storage	0	0	0	0	0	-35	-48	-45	9	38	81	0	
Actual Evapotranspiration (mm)	0	0	0	33	75	112	146	129	77	37	9	0	616
Recharge/Runoff Analysis													
Water Surplus (mm)	68	55	55	44	13	0	0	0	0	0	-1	69	302
Potential Infiltration (I)	24	19	19	16	5	0	0	0	0	0	-1	24	106
Potential Direct Surface Water Runoff (R)	44	35	36	29	9	0	0	0	0	0	-1	45	197
Potential Infiltration (mm)	0	0	0	102	5	0	0	0	0	0	-1	0	106
Pervious Evapotranspiration (m ³)	0	0	0	4990	11310	16928	22172	19558	11652	5615	1335	0	93,561
Pervious Runoff (m ³)	6719	5387	5427	4374	1322	0	0	0	0	0	-145	6759	29,843
Pervious Infiltration (m ³)	0	0	0	15436	712	0	0	0	0	0	-78	0	16,069
Potential Impervious Evaporation (mm)	7	5	6	8	9	8	10	8	9	8	9	7	92
Potential Impervious Runoff (mm)	61	49	50	69	79	69	88	76	77	68	80	62	827
Impervious Runoff (m ³)	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 6
PRE-DEVELOPMENT WATER BALANCE

Evapotranspiration Analysis													
Sub-Area B	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-39	-69	-97	-88	-50	0	0	
Storage (S)	250	250	250	250	250	214	163	110	119	157	250	250	
Change in Storage	0	0	0	0	0	-36	-51	-52	9	38	93	0	
Actual Evapotranspiration (mm)	0	0	0	33	75	112	150	136	77	37	9	0	628
Recharge/Runoff Analysis													
Water Surplus (mm)	68	55	55	44	13	0	0	0	0	0	-13	69	291
Potential Infiltration (I)	27	22	22	18	5	0	0	0	0	0	-5	27	116
Potential Direct Surface Water Runoff (R)	41	33	33	27	8	0	0	0	0	0	-8	41	175
Potential Infiltration (mm)	0	0	0	116	5	0	0	0	0	0	-5	0	116
Pervious Evapotranspiration (m ³)	0	0	0	3204	7261	10934	14581	13278	7481	3605	857	0	61,202
Pervious Runoff (m ³)	3982	3193	3216	2592	783	0	0	0	0	0	-764	4006	17,009
Pervious Infiltration (m ³)	0	0	0	11326	522	0	0	0	0	0	-510	0	11,339
Potential Impervious Evaporation (mm)	7	5	6	8	9	8	10	8	9	8	9	7	92
Potential Impervious Runoff (mm)	61	49	50	69	79	69	88	76	77	68	80	62	827
Impervious Runoff (m ³)	450	360	363	510	580	504	648	554	564	497	584	452	6,066

Evapotranspiration Analysis													
Sub-Area C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-39	-69	-97	-88	-50	0	0.0	
Storage (S)	113	113	113	113	113	80	44	19	27	65	113	113.0	
Change in Storage	0	0	0	0	0	-33	-37	-25	9	38	48	0	
Actual Evapotranspiration (mm)	0	0	0	33	75	109	135	109	77	37	9	0	583
Recharge/Runoff Analysis													
Water Surplus (mm)	68	55	55	44	13	0	0	0	0	0	32	69	336
Potential Infiltration (I)	20	16	17	13	4	0	0	0	0	0	10	21	101
Potential Direct Surface Water Runoff (R)	48	38	39	31	9	0	0	0	0	0	22	48	235
Potential Infiltration (mm)	0	0	0	87	4	0	0	0	0	0	10	0	101
Pervious Evapotranspiration (m ³)	0	0	0	5904	13381	19593	24194	19591	13786	6644	1580	0	104,672
Pervious Runoff (m ³)	8562	6864	6915	5573	1684	0	0	0	0	0	4032	8612	42,241
Pervious Infiltration (m ³)	0	0	0	15654	722	0	0	0	0	0	1728	0	18,103
Potential Impervious Evaporation (mm)	7	5	6	8	9	8	10	8	9	8	9	7	92
Potential Impervious Runoff (mm)	61	49	50	69	79	69	88	76	77	68	80	62	827
Impervious Runoff (m ³)	0	0	0	0	0	0	0	0	0	0	0	0	0

Pre-Development Infiltration	45,512	(m ³ /yr)	104	mm/yr	1.4	L/s
Pre-Development Runoff	95,159	(m ³ /yr)	218	mm/yr	3.0	L/s
Pre-Development Evapotranspiration	259,435	(m ³ /yr)	595	mm/yr	8.2	L/s

Notes:
† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995.
MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.
* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.
‡ Climate Data after Environment Canada, 2017. Canadian Climate Normals 1981-2010, Roseville, Climate ID 6147188. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html Accessed August 17 2017.
N/A - Not Applicable

Assumptions:
[1] The monthly average precipitation collected at the Roseville climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

APPENDIX D:

Source Water Protection Land Use Categories

Schedule B: Source Water Protection Land Use Categories

Category 'A'

- Waste treatment and disposal facilities, including lagoons, landfills, communal/municipal sewage treatment facilities and including large sewage vaults at sewage pumping stations, but not including facilities regulated under the Nutrient Management Act.
- Salvage yards, including automobile wrecking yards or premises
- Bulk storage of hazardous chemicals and hazardous substances (as listed in O.Reg. 347 under the Environmental Protection Act), including bulk storage of oil, gasoline or petroleum products, and including transportation terminals for these substances/chemicals (including truck/trailer/container parking, washing or cleaning depots)

Category 'B'

- Bulk storage of road salt and snow disposal sites
- Primary metal manufacturing, including iron and steel mills and ferro-alloy manufacturing; steel product manufacturing from purchased steel; alumina and aluminum production and processing; non-ferrous metal production and processing; and foundries
- Manufacturing of fabricated metal products, including manufacturing of unfinished metal products and metal finishing operations
- Manufacturing and assembly of transportation equipment, including motor vehicles and parts, aerospace products and parts, rail cars, ships and boats
- Manufacturing of machinery, including agricultural, commercial, industrial, and other machinery
- Chemical manufacturing including chemicals; resins; fertilizers, pesticides and other agricultural chemicals; pharmaceutical and medicines; paint, coating and adhesives; inks and other chemicals but excluding soap and cleaning compound manufacturing. Including manufacturing, packaging, repackaging, and bottling. Excludes uses involving bulk storage of hazardous materials which are included under Category 'A'
- Manufacturing of petroleum and coal products, including manufacturing of asphalt materials. Excludes uses involving bulk storage of hazardous materials which are included under Category 'A'
- Manufacturing of electronic components such as semiconductors, printed circuit boards, and cathode ray tubes
- Manufacturing of electrical equipment, appliances and components
- Commercial or industrial dry cleaning of textiles and textile products, excluding depots not performing on-site dry cleaning
- Manufacturing of leather and allied products including footwear
- Wood and wood product preservation and treatment
- Gasoline stations and other retail establishments with gasoline sales
- Wholesale/distributing of cleaning products, pesticides, herbicides, fungicides and chemicals

Category 'C'

- Manufacturing of rubber products
- Manufacturing of soap, cleaning compounds and toilet preparations
- Textile and fabric finishing and fabric coating
- Manufacturing of plastic products
- Manufacturing of wood products including wood furniture, and excluding wood preservation
- Manufacturing of glass and glass products
- Manufacturing of paper and paper products including newsprint and boxes
- Printing and related support activities, excluding business support services such as photocopy services
- Repair and Maintenance of automobiles and automotive machinery, electronic equipment, industrial and commercial machinery, and personal and household goods repair
- Golf courses
- Airports, train and public transit terminals, except terminals with no fuel storage or transfer of shipped goods or materials
- Medical, health and other laboratories (other than clinics generally associated with commercial plazas)
- Miscellaneous manufacturing not included elsewhere, including jewellery, silverware, medical equipment and signs
- Recycling, recovery, or remanufacturing of materials including the collection, processing, manufacturing, or reuse of post-consumer or post-industrial materials, not including recycling or disposal of hazardous materials, and not including salvage yards or facilities with outdoor operations which are Category 'A' uses

Category 'D'

- Underground parking garages
- *Geothermal wells*
- *Mineral aggregate operations including wayside pits and quarries*

Schedule C: Other information and materials that may be required to process an application**Digital Plans**

- Subdivision/Condominium Plan(s)

Cultural

- *Archaeological Assessment*
- *Cultural Heritage Impact Assessment*

Environmental

- Aggregate/Mineral Resource Analysis
- Local Air Quality Study

APPENDIX E:

Borehole Logs

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 3, 2017 WATER LEVEL _____ TPC ELEVATION 388.42

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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□ Field Vane Test, kPa
 ■ Remoulded Vane Test, kPa
 △ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 3, 2017 WATER LEVEL _____ TPC ELEVATION 392.21

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200												
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m												
										W _p W W _L												
0	391.3	Tall Grass Field			0					10 20 30 40 50 60 70 80 90 100												
	390.9	TOPSOIL 300 mm			1	SS	1	610 610	7													
1		Loose to compact, brown, SILT (ML) - trace to some sand - wet			2																	
				3																		
				4	SS	2	460 610	19														
	389.7				5																	
2		Very stiff, brown sandy clay (CL) TILL - trace fine gravel - APL			6	SS	3	460 610	19													
				7																		
				8																		
					9	SS	4	460 610	23													
3		- stiff, grey			10																	
				11	SS	5	360 610	16														
				12																		
4					13																	
					14																	
					15																	
5					16	SS	6	100 610	22													
				17																		
				18																		
					19																	
6		- very stiff			20																	
				21	SS	7	380 610	15														
				22																		
7					23																	
					24																	
					25																	
8					26	SS	8	460 610	18													
				27																		
				28																		
					29																	
9					30																	
				31	SS	9	460 610	20														
				32																		
10																						
Continued Next Page										Field Vane Test, kPa Remoulded Vane Test, kPa Pocket Penetrometer Test, kPa												

Continued Next Page

- ☐ Field Vane Test, kPa
- ☒ Remoulded Vane Test, kPa
- ☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 3, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%)	
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50100150200											
										WATER CONTENT & ATTERBERG LIMITS											
										DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m											
										STANDARD PENETRATION TEST, BLOWS/0.3m											
										102030405060708090100											
0	386.3	Grass			0																
	386.0	TOPSOIL 300 mm			1	SS	1	360 610	6												
	385.5	Loose, clayey SILT (ML) - some rootlets - moist			2																
1		Firm to stiff, brown sandy clay (CL) TILL			3	SS	2	360 610	6												
		- trace gravel			4																
		- APL			5																
2					6	SS	3	410 610	12												
					7																
					8																
					9	SS	4	100 610	27												
3	383.2	Compact, brown SAND (SP) - trace silt and gravel - moist to wet			10																
					11	SS	5	280 610	20												
					12																
4					13																
	381.7				14																
		Stiff, grey sandy clay (CL) TILL - trace gravel - APL			15																
5	381.1				16	SS	6		13												
		END OF BOREHOLE approximately 5.2 m below existing grade.			17																
6					18																
					19																
		Water noted in open borehole approximately 3.0 m below existing grade.			20																
7					21																
					22																
					23																
					24																
8					25																
					26																
					27																
					28																
9					29																
					30																
					31																
10					32																

Field Vane Test, kPa

Remoulded Vane Test, kPa

Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 2, 2017 WATER LEVEL _____ TPC ELEVATION 394.24

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS W_p W W_L DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▽ STANDARD PENETRATION TEST, BLOWS/0.3m ● 10 20 30 40 50 60 70 80 90 100 REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL										
0	393.2	Grass			0															
	392.9	FILL: topsoil 350 mm			1	SS	1	$\frac{480}{610}$	5		●		○							
1		FILL: brown silty clay - some topsoil inclusions - trace gravel - wet			2															
	391.7				3	SS	2	$\frac{380}{610}$	9		●		○			Δ				
2		Very stiff to hard, brown, sandy silty clay (ML-CL) TILL - trace gravel - WTPL			4															
	390.9				5															
		- grey			6	SS	3	$\frac{460}{610}$	13		●									
					7															
					8															
					9	SS	4	$\frac{410}{610}$	15		●	○						Δ		
3					10															
					11	SS	5	$\frac{460}{610}$	16		●					Δ				
					12															
4					13															
					14															
					15															
5					16	SS	6	$\frac{360}{610}$	23			○	●						>>Δ	
					17															
					18															
6					19															
					20															
					21	SS	7	$\frac{460}{610}$	17		●						Δ			
7					22															
					23															
					24															
					25															
8					26	SS	8	$\frac{460}{610}$	20			●						Δ		
					27															
					28															
9					29															
					30															
					31	SS	9	$\frac{460}{610}$	25			○	●							
10	383.5	END OF BOREHOLE			32															

Continued Next Page

- Field Vane Test, kPa
- Remoulded Vane Test, kPa
- △ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 2, 2017 WATER LEVEL _____ TPC ELEVATION 394.24

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL											
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	WATER CONTENT & ATTERBERG LIMITS																					
										50 100 150 200 10 20 30 40 50 60 70 80 90 100																					
10	383.2	approximately 9.8 m below existing grade.			33																										
					34																										
					35																										
11		Water noted in open borehole approximately 6.1 m below existing grade. 50 mm monitoring well installed in borehole screened from approximately 5.2 m to 6.7 m below existing grade.			36																										
					37																										
					38																										
					39																										
12					40																										
					41																										
					42																										
13					43																										
					44																										
					45																										
14					46																										
					47																										
					48																										
15					49																										
					50																										
					51																										
					52																										
16					53																										
					54																										
					55																										
17					56																										
					57																										
					58																										
18					59																										
					60																										
					61																										
19					62																										
					63																										
					64																										
20					65																										

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

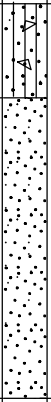
CLIENT City of Waterloo PROJECT No. 161413446
LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
DATES: BORING May 2, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200										
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m										
										W _p W W _L										
0	396.0	Grass			0					10	20	30	40	50	60	70	80	90	100	
	395.9	TOPSOIL 150 mm			1	SS	1	460 610	4	●										
	395.3	Soft, brown silty CLAY (CL-ML) - trace gravel and rootlets - moist			2															
1		Hard, brown, sandy silt (ML) TILL - trace to some clay - trace gravel - APL-WTPL			3	SS	2	410 610	15		●								>>Δ	
					4															
					5															
2					6	SS	3	430 610	14		●								>>Δ	
					7															
					8															
					9	SS	4	430 610	19		●								>>Δ	
3					10															
					11	SS	5	460 610	19		●								>>Δ	
					12															
4					13															
	391.5	- stiff to very stiff, grey			14															
5					15															
					16	SS	6	360 610	17		○ ●			Δ						13 33 37 17
					17															
					18															
6					19															
					20															
					21	SS	7	380 610	18		●						Δ			
7					22															
					23															
					24															
					25															
8					26	SS	8	100 610	21		●									
					27															
					28															
					29															
9					30															
					31	SS	9	100 610	17		○ ●									
10					32															
Continued Next Page										☐ Field Vane Test, kPa ☒ Remoulded Vane Test, kPa ☐ Pocket Penetrometer Test, kPa										

Continued Next Page

- Field Vane Test, kPa
- Remoulded Vane Test, kPa
- △ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 2, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100		150	200
10	386.0				33									
	385.4				34									
11		Loose to compact, grey SAND (SP-SM) - some silt, trace gravel - moist to wet			35									
	36				SS	10	360 / 610	27						
	37													
	38													
12					39									
					40									
	383.2				41	SS	11	460 / 610	10					
13		END OF BOREHOLE approximately 12.8 m below existing grade. Water noted in open borehole approximately 11.6 m below existing grade.			42									
					43									
					44									
					45									
14					46									
					47									
					48									
					49									
15					50									
					51									
					52									
16					53									
					54									
					55									
17					56									
					57									
					58									
18		59												
		60												
		61												
19		62												
		63												
		64												
20		65												

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION 393.62

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

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- Field Vane Test, kPa
- Remoulded Vane Test, kPa
- △ Pocket Penetrometer Test, kPa

Sheet 2 of 2

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50100150200										
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m										
										WpWwL										
0	396.5	Tall Grass Field			0					10	20	30	40	50	60	70	80	90	100	
	396.1	TOPSOIL 400 mm			1	SS	1	180 610	6	•										
1		Loose, brown silty SAND (SP-SM) - trace gravel - moist			2															
					3															
	395.0				4	SS	2	200 610	9	•										
2		Stiff to very stiff, brown, sandy clay (CL) TILL - trace gravel - APL-WTPL			5															
					6	SS	3	560 610	15	•							Δ			
					7															
					8															
	393.5				9	SS	4	460 610	16	•			Δ							
3		Compact, brown silty SAND (SP) - some clay, trace gravel - wet			10															
	392.7				11	SS	5	380 610	18	•										
4		Very stiff to hard, grey, sandy clay (CL) TILL - trace gravel - APL-WTPL			12															
					13															
					14															
5					15															
					16	SS	6	460 610	17	•							Δ			
					17															
					18															
6					19															
					20															
					21	SS	7	460 610	21	•								Δ		
7					22															
					23															
					24															
					25															
8					26	SS	8	480 610	23	•				Δ						
					27															
					28															
9					29															
					30															
					31	SS	9	460 610	35	•									>>Δ	
10					32															
Continued Next Page										☐ Field Vane Test, kPa ☒ Remoulded Vane Test, kPa ☐ Pocket Penetrometer Test, kPa										

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- ☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
 Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) / TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
10	386.5				33							
11					34							
					35							
					36	SS	10	510 / 610	32			
					37							
					38							
					39							
					40							
					41	SS	11	580 / 610	26			
13	383.7	END OF BOREHOLE approximately 12.8 m below existing grade.			42							
					43							
					44							
					45							
14		Water noted in open borehole approximately 8.8 m below existing grade.			46							
					47							
					48							
					49							
15					50							
					51							
					52							
16					53							
					54							
					55							
17					56							
					57							
					58							
18					59							
					60							
					61							
19					62							
					63							
					64							
20					65							

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 5, 2017 WATER LEVEL _____ TPC ELEVATION 401.55

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
											WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m										W _p W W _L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
											10 20 30 40 50 60 70 80 90 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
0	400.7	Farm Field			0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

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- ☐ Field Vane Test, kPa
- ☒ Remoulded Vane Test, kPa
- ☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 5, 2017 WATER LEVEL _____ TPC ELEVATION 401.55

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
10	390.7				33							
					34							
					35							
11					36	SS	10	560 610	31			
					37							
					38							
					39							
12					40							
					41	SS	11	580 610	28			
	387.9				42							
13		END OF BOREHOLE approximately 12.8 m below existing grade.			43							
					44							
					45							
14		Water noted in open borehole at approximately 11.0 m below existing grade. 50 mm monitoring well installed in borehole screened from approximately 10.7 m to 12.2 m below existing grade.			46							
					47							
					48							
15					49							
					50							
					51							
16					52							
					53							
					54							
17					55							
					56							
					57							
18					58							
					59							
					60							
19					61							
					62							
					63							
					64							
20					65							

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
DATES: BORING _____ WATER LEVEL _____ TPC ELEVATION 397.13

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
 Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)											
0	406.3	Grass			0					50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
	405.9	TOPSOIL 300 mm			1	SS	1	560 / 610	4	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
		Firm, brown, sandy clay (CL) TILL - trace gravel - APL-WTPL			2															
1					3	SS	2	560 / 610	5	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
	404.7				4															
		Loose to compact, brown, silty sand (SM) TILL - trace gravel - wet to moist			5															
2					6	SS	3	460 / 610	9	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										11 49 28 12
					7															
					8															
					9	SS	4	460 / 610	14	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
3	403.2				10															
		Stiff, brown, sandy clay (CL) TILL - trace to some gravel - APL			11	SS	5	430 / 610	16	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
					12															
4					13															
					14															
					15															
5					16	SS	6	510 / 610	15	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
					17															
					18															
6					19															
					20															
					21	SS	7	460 / 610	13	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L 10 20 30 40 50 60 70 80 90 100										
	399.5				22															
7		END OF BOREHOLE approximately 6.7 m below existing grade.			23															
					24															
					25															
8		Borehole open and dry upon completion of drilling.			26															
					27															
					28															
9					29															
					30															
					31															
10					32															

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
 Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 4, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50100150200										
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m										
										WpWwL										
0	396.5	Tall Grass			0					10	20	30	40	50	60	70	80	90	100	
	396.3	TOPSOIL 150 mm			1	SS	1	510 610	5	●	△									
		Stiff, brown silty CLAY (ML-CL), TILL			2															
1		- trace gravel			3															
		- moist			4	SS	2		9	●										
	394.9	- very stiff			5															
2					6	SS	3	460 610	9	●				△						
	394.2				7															
		Very stiff to hard, grey, sandy clay (ML-CL) TILL			8	SS	4	410 610	12	●				△						
3		- trace gravel			9															
		- APL			10															
					11	SS	5	430 610	22		●			△						
					12															
4					13															
					14															
					15															
5					16	SS	6	430 610	18		●									
					17															
					18															
6					19															
					20															
					21	SS	7	480 610	22		●							△		
	389.8				22															
7		END OF BOREHOLE approximately 6.7 m below existing grade.			23															
					24															
					25															
8		Water noted in open borehole approximately 3.0 m below existing grade.			26															
					27															
					28															
9					29															
					30															
					31															
					32															
10																				

Field Vane Test, kPa
Remoulded Vane Test, kPa
Pocket Penetrometer Test, kPa

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
 △ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 5, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)											
0	406.1	Bean Farm Field			0					50 100 150 200 WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m W_p W W_L										
	405.9	TOPSOIL 150 mm			1	SS	1	$\frac{410}{610}$	6											
		Loose to compact, brown, silty sand (SM) TILL			2															
		- trace to gravel			3															
1		- moist			4	SS	2	$\frac{130}{610}$	4											
					5															
2					6	SS	3	$\frac{150}{610}$	29											
					7															
					8															
					9	SS	4	$\frac{250}{610}$	23											
3	403.0	Compact, brown, SAND (SP-SM)			10															
		- trace to some silt			11	SS	5	$\frac{180}{610}$	29											
		- damp			12															
4					13															
					14															
					15															
5					16	SS	6	$\frac{200}{610}$	24											
					17															
					18															
					19															
6		- moist to wet			20															
					21	SS	7	$\frac{280}{610}$	24											
7	399.3	END OF BOREHOLE			22															
		approximately 6.7 m below existing grade.			23															
					24															
					25															
8		Borehole open and dry upon completion of drilling.			26															
					27															
					28															
					29															
9					30															
					31															
10					32															

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 1, 2017 WATER LEVEL _____ TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50100150200											
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m											
										W _p W W _L											
0	395.1	Grass			0																
		TOPSOIL 125 mm			1	SS	1	560 610	4												
		Firm, brown, sandy clay (CL) TILL			2																
	394.3	- trace gravel			3																
1		APL			4	SS	2	460 610	23												
		- hard			5																
	393.6	- grey			6	SS	3	560 610	23												
2					7																
					8																
					9	SS	4	250 610	18												
3	392.0	Loose, grey, SAND (SP)			10																
		- trace gravel and silt			11	SS	5	360 610	7												
		- wet			12																
4					13																
					14																
					15																
5					16	SS	6	460 610	7												
					17																
	389.3				18																
6		Very stiff, grey, sandy clay (CL) TILL			19																
		- trace gravel			20																
	388.4	- APL			21	SS	7	460 610	26												
7		END OF BOREHOLE			22																
		approximately 6.7 m below existing grade.			23																
					24																
					25																
8		Water noted in open borehole			26																
		approximately 3.4 m below existing grade.			27																
					28																
					29																
9					30																
					31																
					32																
10																					

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 1, 2017 WATER LEVEL _____ TPC ELEVATION _____

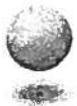
DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)											
0	392.0	Grass			0					WATER CONTENT & ATTERBERG LIMITS W_p W_L 10 20 30 40 50 60 70 80 90 100										
		TOPSOIL 100 mm			1	SS	1	360 / 610	9	DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m 10 20 30 40 50 60 70 80 90 100										
	391.2	FILL: brown, silty clay - some sand and rootlets - moist			2															
1		Soft, brown, sandy silty clay (CL-ML) - trace rootlets - wet			3	SS	2	430 / 610	4											
					4															
					5															
2	389.7				6	SS	3	410 / 610	2											
					7															
		Firm, brown, sandy clay (CL) TILL - trace gravel - WTPL			8															
3	388.9				9	SS	4	360 / 610	5											
		- stiff			10															
	388.3				11	SS	5	300 / 610	21											
4		END OF BOREHOLE approximately 3.7 m below existing grade.			12															
					13															
					14															
					15															
5		Water noted in open borehole approximately 1.5 m below existing grade.			16															
					17															
					18															
					19															
6					20															
					21															
					22															
					23															
7					24															
					25															
					26															
					27															
8					28															
					29															
					30															
					31															
					32															
10																				

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

CLIENT City of Waterloo PROJECT No. 161413446
 LOCATION Erb Street and Wilmot Line, Waterloo, Ontario DATUM _____
 DATES: BORING May 8, 2017 WATER LEVEL _____ TPC ELEVATION 397.22

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
 Pocket Penetrometer Test, kPa



CH2MHILL

RECORD OF MONITORING WELL: MW04-1

Location Coordinates:

Northing: 4810274 m

Easting: 533713 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #: A005260

DATED/DRILLED: January 14, 2004

TOP OF PIPE: 392.356 masl

GROUND ELEVATION: 391.70 masl

LOGGED BY: B Neck

DRILLING METHOD: CME 85 with 0.2-m dia. HSA

DEPTH (mbgs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	MONITORING WELL DETAILS		⊕ ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery (m)	TYPE			(masl) ELEV. DEPTH (mbgs)		25	50	75	100
			Topsoil (OL/OH): Dark brown topsoil, silt with fine sand, rootlets							
	0.46	SS 1	3		391.50					
			SILT with Sand (ML): SILT with fine sand, trace clay, moist, soft.		0.20					
		AUGER								
			SILT with Clay (CL/ML): Dark brown to black SILT with clay, moist, soft, small, orange oxidation spots, trace fine sand		390.94					
			Groundwater measured at 0.905 mbgs on Jan. 19/04.		0.76					
			Groundwater measured at 0.93 mbgs on Jan. 23/04.		390.80					
1	0.28	SS 2	5		0.91					
			Silty SAND (SM): Silty SAND, light brown, moist becoming wet at 1.8 mbgs, soft; at 2.0 mbgs increasing pebbles, trace fine gravel, at 2.13 mbgs trace coarse gravel, trace clay.		390.77					
					0.93					
		AUGER								
	0.38	SS 3	6		390.40					
					1.30					
		AUGER								
2			SILT (ML): Grey SILT trace fine sand and clay, moist, soft becoming firm, trace clasts; at 2.75 mbgs brown silt, trace clay and fine sand, moist (coarse sand with pebbles found in tip of split spoon).		389.41					
					2.29					
	0.29	SS 4	10							
		AUGER								
3			SILT TILL (ML): Grey SILT TILL, trace clay and fine sand, trace clasts, damp, grey throughout, firm.		388.65					
					3.05					
	0.38	SS 5	8							
		AUGER								
			CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, hard, damp, trace clasts, grey, small oxidation spot noted, occasional blue clay streaks, trace sand.		387.89					
					3.81					
4	0.81	SS 6	14							
		AUGER								
			Borehole terminated at 4.57 mbgs.		387.13					
					4.57					
5										



CH2MHILL

RECORD OF MONITORING WELL: MW04-2

Location Coordinates:

Northing: 4810704 m

Easting: 533962 m

LOCATION: City of Waterloo. Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #: A005260

DATE DRILLED: January 15, 2004

TOP OF PIPE: 377.834 masl

GROUND ELEVATION: 377.01 masl

LOGGED BY: B Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	MONITORING WELL DETAILS		ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery (m)	TYPE			ELEV (masl)	DEPTH (m)				
			Topsoil (OL/OH): Grassy surface, dark brown topsoil, sandy silt trace clay, rootlets, organics, trace pebbles, moist.		376.81	0.20				
			Sandy SILT (ML): Sandy SILT trace clay, moist, soft, brown.		376.62	0.39				
			Groundwater measured at 0.39 mbgs on Jan. 23/04.		376.61	0.40				
			Groundwater measured at 0.4 mbgs on Jan. 19/04.							
			SILT with Sand (ML): Light brown SILT with fine sand, moist, soft; at 2.59 mbgs wet, dark brown with sand with gravel.		376.25	0.76				
			CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, firm, tan mottling, clasts, moist to damp, with sand, trace gravel.		375.49	1.52				
			As above, tan mottling, damp, trace small clasts, trace fine sand.							
			As above, brown throughout, soft to firm, trace fine to medium grained sand.							
			As above, dark brown, soft to firm, large clasts, trace gravel.							
			As above, trace fine to medium sand.							
			Borehole terminated at 5.18 mbgs.		371.83	5.18				



Location Coordinates:

Northing: 4810260 m Easting: 534063 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Alcost Soil Drilling Inc.

MOE WELL TAG #: A005260

DATEDRILLED: January 15, 2004

TOP OF PIPE: 392.225 masl

GROUND ELEVATION: 391.520 masl

LOGGEDBY: B. Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	MONITORING WELL DETAILS		ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery (m)	TYPE	SPT (N-count)			ELEV. (masl)	DEPTH (mbgs)				
				Topsoil (OL/OH): Grassy surface, dark brown topsoil, sandy silt trace clay, rootlets, organics, moist, loose		391.32	0.20	Cement seal at surface to secure steel protective casing (above ground)			
	0.46	SS 1	3	Sandy SILT (ML): Sandy SILT with clay, moist, soft, dark brown.				Bentonite gravel seal			
		AUGER									
1						390.50	1.02	Silica sandpack No. 1			
	0.57	SS 2	3	CLAYEY SILT TILL (CL/ML): Brown to light grey CLAYEY SILT TILL, trace fine sand, speckled with tan mottling, moist, very soft.		390.33	1.20				
		AUGER		Groundwater measured at 1.195 mbgs on Jan. 19/04		390.18	1.34				
				Groundwater measured at 1.34 mbgs on Jan. 23/04		390.00	1.52	51 mm-dia. Schedule 40 PVC well riser pipe			
	0.23	SS 3	3	Sandy SILT (ML): Sandy SILT, trace clay, sporadic small pockets (<0.10 m thick) of peat and organics with silt, black, decomposition odour noted, wet.		389.69	1.83	51 mm-dia. machine slotted (10-slot) Schedule 40 PVC well screen			
		AUGER		CLAYEY SILT TILL (CL/ML): Brown to light grey CLAYEY SILT TILL, with fine sand, light tan mottling, moist, very soft.		389.23	2.29	0.15 m-diameter borehole (solid stem augers used for drilling)			
2				Unknown stratigraphy (sample unrecoverable). Inside of split spoon wet when retrieved.							
	0.03	SS 4	13			388.62	2.90				
		AUGER		CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, trace sand, grey to brown in colour, some tan mottling, damp, firm.							
3						387.71	3.81				
	0.43	SS 5	12	Sandy SILT (ML): Sandy SILT trace clay, damp, brown, fine grained, firm.		386.95	4.57	Bentonite gravel seal at bottom of borehole.			
		AUGER		CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, trace sand, brown, trace small clasts, damp, firm, hard.							
4						386.34	5.18				
	0.61	SS 6	12								
		AUGER									
5											
	0.61	SS 7	19								
		AUGER									
				Borehole terminated at 5.18 mbgs.							

**CH2MHILL****RECORD OF MONITORING WELL: MW04-4**

Location Coordinates:

Northing: 4810459 m

Easting: 533186 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Alcost Soil Drilling Inc

MOE WELL TAG #: A005260

DATE DRILLED: January 16, 2004

TOP OF PIPE: 395.329 masl

GROUND ELEVATION: 394.5 masl

LOGGED BY: B Neck

DRILLING METHOD: CME 85 with 0.15 m dia SSA

DEPTH (m,gs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	(masl) ELFV. DEPTH (m,gs)	MONITORING WELL DETAILS		ORGANIC VAPOR READINGS PID (ppm)			
	Recovery (m)	TYPE						25	50	75	100
			Topsoil (OL/OH): Dark brown topsoil, silt with fine sand, rootlets								
			Sandy SILT (ML): Brown sandy SILT with clay, tan mottling, moist to wet, very soft Groundwater measured at 0.245 mbgs on Jan. 19/04 Groundwater measured at 0.25 mbgs on Jan. 23/04		394.30 0.20 394.26 0.25 394.25 0.25		Cement seal at surface Bentonite gravel seal				
1			As above, wet				Silica sandpack No. 1 51 mm-dia. Schedule 40 PVC well riser pipe				
			CLAYEY SILT TILL (CL/ML): Grey with brown CLAYEY SILT TILL trace sand, wet, very soft		392.98 1.52		51 mm-dia. machine slotted (10-slot) Schedule 40 PVC well screen				
2			Silty SAND (SM): Brown, silty SAND trace clay, moist to wet.		392.37 2.13		0.15 m-diameter borehole (solid stem augers used for drilling)				
	AUGER										
3			As above with pebbles								
			CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, with coarse sand, soft to firm, grey to dark brown, moist.		390.23 4.27						
4			Borehole terminated at 4.57 mbgs.		389.93 4.57						
5											

ANDYMW2 122843.GPJ CG&S.GDT 2/5/04



BH04-1

Location Coordinates:

Northing: 4810084 m

Easting: 533789 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc

MOE WELL TAG #

DATE DRILLED: January 14, 2004

TOP OF PIPE: masl

GROUND ELEVATION: 400.492 masl

LOGGEDBY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

2 122

**CH2MHILL****RECORD OF BOREHOLE:****BH04-2**

Location Coordinates:

Northing: 4810005 m

Easting: 533530 m

LOCATION: City of Waterloo, Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #

DATE DRILLED: January 14, 2004

TOP OFFPIPE: mast

GROUND ELEVATION: 396.576 masl

LOGGED BY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. DEPTH (mbgs)	MONITORING WELL DETAILS	ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery(m)	TYPE	SPT (N-count)					25	50	75	100
1	0.43	SS 1	5	Topsoil (OL/OH): Corn stubble at surface, dark brown topsoil, sandy silt, rootlets, soft, rootlets.		396.38	Bentonite gravel seal at top of borehole				
				Sandy SILT (ML): Sandy SILT, brown, soft, trace pebbles damp		0.20					
1		AUGER									
	0.57	SS 2	3	PEAT (OL/OH): Pocket of PEAT and organics with sand and silt, black to dark brown, soft, moist		395.54	Backfilled with clean auger cuttings.				
				SAND and SILT (SW-SM): Reddish brown SAND and SILT trace clay, moist, soft		395.44					
1		AUGER									
				Sandy SILT (ML): Sandy SILT, trace clay, brown, soft, trace pebbles, moist		395.33					
2				CLAYEY SILT TILL (CL/ML): CLAYEY SILT TILL, clasts, trace coarse gravel, damp to moist, firm to hard, tan mottling, grey to brown in colour		395.06					
	0.56	SS 3	13			1.52					
2		AUGER									
3	0.61	SS 4	18	As above, at 2.64 mbgs a pocket of black and tan medium to coarse sand			0.15-m diameter borehole (solid stem augers used for drilling)				
		AUGER									
3	0.51	SS 5	14	As above with a thin orange oxidation layer at 3.28 mbgs. No mottling below 3.28 mbgs, moist, fewer clasts, hard, dark brown							
		AUGER		As above with thin orange oxidation layer.							
4	0.25	SS 6	>50	Split spoon refusal at 4.18 mbgs (likely a boulder). Auger to 4.57 mbgs			Bentonite gravel seal at bottom of borehole				
		AUGER									
5	0.61	SS 7	21	Silty SAND (SM): Silty SAND, brown, hard, fine to medium textured, grey to black coarse sand pockets, damp, compact to dense, trace clay		391.75					
				Sandy SILT TILL (ML): Sandy SILT TILL, trace clay, clasts, firm, small grey moisture pockets, brown grading to dark brown, generally damp		4.83					
5		AUGER		As above, dark brown, firm, moist to wet zone at 5.54 mbgs (25 mm-thick)		391.60					
						4.98					
6	0.56	SS 8	14								
				Borehole terminated at 5.94 mbgs.		390.64					
						5.94					

ANDYBH2 122B43.GPJ CG&S.GDT 2/5/04



CH2MHILL

RECORD OF BOREHOLE:

BH04-3

Location Coordinates:

Northing 4810567 m

Easting 533408 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Alcost Soil Drilling Inc.

MOE WELL TAG #

DATEDRILLED: January 15, 2004

TOP OF PIPE: masl

GROUND ELEVATION: 393.962 masl

LOGGEDBY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	ELEV. DEPTH (mbgs)	MONITORING WELL DETAILS		ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery (m)	TYPE						25	50	75	100
1	0.39	SS 1	3		393.76		Bentonite gravel seal at top of borehole.				
					0.20						
		AUGER			393.20						
2	0.58	SS 2	6		392.16		Backfilled with clean auger cuttings.				
					0.76						
		AUGER			392.16						
3	0.51	SS 3	17		391.15						
					1.80						
		AUGER			391.15						
4	0.56	SS 4	18		390.91		0.15-m diameter borehole (solid stem augers used for drilling).				
					2.81						
		AUGER			390.91						
5	0.58	SS 5	16								
		AUGER									
6	0.36	SS 6	11				Bentonite gravel seal at bottom of borehole.				
		AUGER									
7	0.61	SS 7	9								
		AUGER									
8	0.61	SS 8	9								
		AUGER									
9					388.02						
					5.94						
10											

Borehole terminated at 5.94 mbgs.



CH2MHILL

RECORD OF BOREHOLE:

BH04-4

Location Coordinates:

Northing: 4810559 m

Easting: 533814 m

LOCATION: City of Waterloo, Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #:

DATEDRILLED: January 15, 2004

TOP OF PIPE: masl

GROUND ELEVATION: 382.783 masl

LOGGEDBY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. DEPTH (mbgs)	MONITORING WELL DETAILS		ORGANIC VAPOR READINGS (ppm)			
	Recovery (m)	TYPE	SPT (N-count)						25	50	75	100
				Topsoil (OL/OH): Dark brown topsoil layer, sandy silt, rootlets, soft		382.48	Bentonite gravel seal at top of borehole					
	0.36	SS 1	3	Sandy SILT (ML): Dark brown to brown sandy SILT, damp, loose.		0.30						
		AUGER		As above, with fine gravel, no rootlets, fine to medium grained.								
1	0.30	SS 2	4				Backfilled with clean auger cuttings					
		AUGER										
	0.56	SS 3	5	Silty SAND (SM): Wet silty SAND, trace fine gravel, fine to medium grained, brown, loose.		1.52						
2		AUGER										
	0.47	SS 4	15	As above, brown layers visible in silty sand (approx. 1 cm thick), moist to wet, compact, no gravel.								
3		AUGER										
	0.61	SS 5	22	Sandy SILT (ML): Fine sandy SILT, brown, damp, firm to hard, trace fine gravel and clay.		3.30	0.15-m diameter borehole (solid stem augers used for drilling)					
		AUGER										
4	0.45	SS 6	24	Silty SAND (SM): Moist to wet silty SAND, medium to coarse grained, compact to dense, brown, trace gravel and clay.		3.81						
		AUGER										
5	0.45	SS 7	35			4.98						
		AUGER		Sandy SILT (ML): Silty sand from above grading into sandy SILT, fine to coarse sand, brown, moist, firm to hard, trace clay.								
	0.41	SS 8	32									
6				Borehole terminated at 5.94 mbgs.		5.94	Bentonite gravel seal at bottom of borehole.					

ANDYBH2 122843.GPJ CG&S.GDT 2/5/04



Location Coordinates:

Northing: 4810042 m

Easting: 534144 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #:

DATEDRILLED: January 15, 2004

TOP OF PIPE: masl

GROUND ELEVATION: 391.518 masl

LOGGEDBY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	ELEV. DEPTH (mbgs)	MONITORING WELL DETAILS		ORGANIC VAPOUR READINGS PID (ppm)			
	Recovery(m)	TYPE	SPT (N-count)						25	50	75	100
1	0.27	SS 1	3	Topsoil (OL/OH): Corn stubble at surface. Dark brown topsoil layer, fine grained sandy silt trace clay, trace gravel, some small rootlets, soft.		391.32						
				Silty SAND (SM): Fine silty SAND, trace clay, trace fine to medium grained, trace fine gravel, some small rootlets, brown, loose.		0.20						
		AUGER		As above, faint tan mottling, damp, loose.								
	0.61	SS 2	2									
		AUGER										
	0.38	SS 3	13	SILT and SAND (SW-SM): Layered SILT and SAND, compact, moist to damp, fine grained, brown, trace clay. Wet silt and sand layer from 1.69 mbgs to 1.73 mbgs.		390.00						
2		AUGER										
	0.56	SS 4	16									
3		AUGER										
	0.55	SS 5	27	Sandy SILT (ML): Fine grained sandy SILT, brown, damp, crumbly (drier than plastic limit), trace clay, hard.		388.47						
4		AUGER										
	0.61	SS 6	27	As above.								
		AUGER										
	0.61	SS 7	21									
5		AUGER										
	0.61	SS 8	40	Silty SAND (SM): Damp silty SAND, brown, trace clay, fine grained, dense.		386.19						
6												
				Borehole terminated at 5.94 mbgs.		385.58						

2/5/04

J CG8

12 122



CH2MHILL

RECORD OF BOREHOLE:

BH04-6

Location Coordinates:

Northing: 4810142 m

Easting: 533407 m

LOCATION: City of Waterloo: Scoped Subwatershed Study (307 & 314)

DRILLER: Atcost Soil Drilling Inc.

MOE WELL TAG #

DATE DRILLED: January 16, 2004

TOP OF PIPE: masl

GROUND ELEVATION 396.781 masl

LOGGED BY: B.Neck

DRILLING METHOD: CME 85 with 0.15-m dia. SSA

DEPTH (mbgs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	MONITORING WELL DETAILS		ORGANIC VAPOUR READINGS (ppm)			
	Recovery (m)	TYPE			ELEV (masl)	DEPTH (mbgs)				
1	0.43	SS 1	2		396.58	0.20				
1	0.45	SS 2	12		396.02	0.76				
2	0.61	SS 3	27							
3	0.61	SS 4	30		394.16	2.62				
4	0.61	SS 5	21							
5	0.61	SS 6	17							
6	0.61	SS 7	19							
6	0.61	SS 8	20							
6					390.68	6.10				

Borehole terminated at 6.10 mbgs.

TABLE 8-1
Groundwater Elevations
Phase II Investigation
Hergott Farm, Waterloo, ON

Well ID	Reference Elevation	Water Level	Groundwater Elevation
	Top of Pipe	mbgs	mAMSL
MW1-10	393.22	2.07	391.15
MW2-10	396.44	5.06	391.38
MW3-10	395.36	4.66	390.7
MW4-10	389.19	3.14	386.05
MW4-01	392.36	1.04	391.32

Notes:

mAMSL *metres above mean sea level*

mbgs *metres below ground surface*

**CH2MHILL****RECORD OF PIEZOMETER:****MW1-10**

Location Coordinates: Northing: 4810575 m Easting: 533715 m

LOCATION: Hergott Farm

TOP OF PIPE: 393.22 masl

DRILLER: Strata Soil Sampling

DATE DRILLED: February 1, 2010

GROUND ELEVATION: 392.05 masl

DRILLING METHOD: Geoprobe 7822DT w/ HSA

LOGGED BY: J. Divell

DEPTH (ft/bgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. DEPTH (mbgs)	PIEZOMETER DETAILS		O pH SCREENING MEASUREMENT				
	Recovery (%)	TYPE	SPT (N-count)						6	7	8	9	
									⊕ ORGANIC VAPOUR READINGS PID (cpm)				
									10	20	30	40	
1				Fill: Loose, light brown sandy silt with medium diameter sub-angular gravel, frozen. Sandy silt and organics, dark brown/black, moist.				Concrete. Monument.					
2						391.44 0.61		Bentonite.					
3	60"	DP1		Very moist.									
4			MW1+Dip1	Wet.				Sand.					
5				Stiff, clayey silt with saturated sand seams throughout, interbedded.				10' screen, tip at 15' bgs.					
6			MW1+Dip2										
7													
8	60"	DP2											
9													
10				Saturated, APL									
11													
12				Sandy Clay: Firm to stiff, grey sandy clay, some silt, low plasticity, moist.		388.54 3.51							
13	57"	DP3											
14				Clay with sand, trace silt, moist									
15				End of Borehole at 15' bgs		387.48 4.57							

DOW MW (FT) 398761.GPJ CG4S.GDT 2/12/10

**CH2MHILL****RECORD OF PIEZOMETER:****MW2-10**

Location Coordinates: Northing: 4810601 m Easting: 533655 m

LOCATION: Hergott Farm

TOP OF PIPE: 396.44 masl

DRILLER: Strata Soil Sampling

DATEDRILLED: February 1, 2010

GROUND ELEVATION: 395.7 masl

DRILLING METHOD: Geoprobe 7822DT w/ HSA

LOGGEDBY: J. Divell

DEPTH (ftbgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. DEPTH (mbgs)	PIEZOMETER DETAILS		O pH SCREENING MEASUREMENT			
	Recovery (%)	TYPE	SPT (N-count)						6	7	8	9
									⊕ ORGANIC VAPOUR READINGS PID (ppm)			
									10	20	30	40
1	11"	DP1	Fill: Grass cover overlying dark brown topsoil, some sand and silt, trace organic litter, frozen.				Concrete. Monument					
			Very soft.				Bentonite.					
2			Silt: Firm, brown clayey silt, some fine sand, moist, non plastic.				395.09 0.61					
3												
4							Sand.					
5			Silt Till: Stiff, brown sandy clay, trace small diameter sub-angular gravel, very moist, weathered with horizontal fracturing.			394.18 1.52	10' screen, tip at 15' bgs.					
6												
7												
8	53"	DP2	Vertical sand seams, trace rootlets, wet, low plasticity.									
9		MW2										
10												
11			Uniform, very stiff, silt clay and fine sand, saturated pockets, wet, low plasticity.									
12												
13	56"	DP3										
14												
15			End of Borehole at 15' bgs			391.13 4.57						

DOW MW (FT): 398761.GPJ CG&S.GDT 2/12/10

**CH2MHILL****RECORD OF PIEZOMETER:****MW3-10**

Location Coordinates: Northing 4810526 m Easting 533839 m

LOCATION: Hergott Farm

TOP OF PIPE: 395.36 masl

DRILLER: Strata Soil Sampling

DATEDRILLED: February 1, 2010

GROUND ELEVATION: 394.68 masl

DRILLING METHOD: Geoprobe 7822DT w/ HSA

LOGGEDBY: J. Divell

DEPTH (ft/bgs)	SAMPLES		SOIL DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m/bgs)	PIEZOMETER DETAILS	pH SCREENING MEASUREMENT			
	Recovery (%)	TYPE					6	7	8	9
	SPT (N-count)						ORGANIC VAPOUR READINGS PID (ppm)			
							10	20	30	40
1			Fill: Brown sandy silt and topsoil, frozen.			Concrete. Monument.				
			Dark brown silt, sand, and organics, frozen.			Bentonite.				
2			Sandy silt and medium diameter angular gravel, moist.							
3	56"	DP1			393.77 0.91					
4			Sandy Silt: Firm, brown sandy silt, fine sand, moist.							
5						Sand.				
6			Clayey Silt Till: Firm to stiff, brown clayey silt, trace to some fine sand, large diameter gravel in structure, moist to very moist, low plasticity.		393.00 1.68	10' screen, tip at 15' bgs.				
7										
8	60"	DP2	Medium grained sand seams in structure, very moist.							
9										
10			Sandy Silt: Brown sandy silt, medium sand, interbedded, very moist.		391.63 3.05					
11										
12			Wet with saturated pockets.							
13										
14			Silty Clay: Stiff, grey silty clay, moist, non plastic.		390.41 4.27					
15			End of Borehole at 15' bgs		390.11 4.57					

DOW MW (FT) 398761.GPJ CG&S.GDT 2/12/10

**CH2MHILL****RECORD OF PIEZOMETER:****MW4-10**

Location Coordinates: Northing: 4810685 m Easting: 533738 m

LOCATION: Hergott Farm

TOP OF PIPE: 389.19 masl

DRILLER: Strata Soil Sampling

DATE DRILLED: February 1, 2010

GROUND ELEVATION: 388.37 masl

DRILLING METHOD: Geoprobe 7822DT w/ HSA

LOGGED BY: J. Divell

DEPTH (ft/bgs)	SAMPLES			SOIL DESCRIPTION	STRATA PLOT	PIEZOMETER DETAILS		O pH SCREENING MEASUREMENT				⊕ ORGANIC VAPOUR READINGS PID (ppm)						
	Recovery (%)	TYPE	SPT (N-count)			ELEV. DEPTH												
1	51"	DP1		Fill; Hard, brown sandy silt and topsoil, frozen.				Concrete Monument.										
2				Soft, rootlets, silt with organics, some sand, moist.													387.61 0.76	Bentonite.
3				Silt; Firm, dark brown silt, trace to some sand, moist, non plastic.														
4								Sand.										
5																	Very moist, medium plasticity.	10' screen, tip at 15' bgs.
6																		
7	57"	DP2		Wet with sand seams, horizontal fracturing, weathered.														
8				Trace large diameter sub-angular gravel, wet.														
9																		
10																		
11																	Saturated, highly plastic.	
12																		
13	56"	DP3		Clayey Silt; Stiff, brown clayey silt, trace sand seams, medium sand, moist, non plastic.														
14																		
15				End of Borehole at 15' bgs													383.80 4.57	

DOW MW (FT) 388761.GPJ CG&S GDT 2/12/10



BOREHOLE RECORD

N: 4 811 130 E: 533 729

BH1-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING September 19, 2013

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

- ☐ Field Vane Test, kPa
- ☐ Remoulded Vane Test, kPa
- ☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 811 081 E: 533 770

BH2-13

CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 20, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	376.6	Farm field no crops			0							
	376.3	300 mm TOPSOIL			1	AS	1		-			
1		FILL: brown clayey silt some sand trace topsoil			2							
					3							
					4	SS	2	360 610	11			
2					5							
					6	SS	3	380 610	9			
	374.3	Very stiff brown to grey silty CLAY (CL-ML) - moist to wet			7							
					8	SS	4	430 610	15			
3					9							
					10							
					11	SS	5	510 610	17			
4					12							
					13							
					14	SS	6	460 610	17			
5					15							
					16	SS	7	430 610	21			
6					17							
					18							
					19							
7					20							
					21	SS	8	510 610	23			
8					22							
					23							
					24							
					25							
	368.4	End of Borehole			26	SS	9	610 610	17			
9					27							
		Groundwater level inferred in open borehole on completion of drilling			28							
10					29							
					30							
					31							
					32							
					33							
					34							
					35							
					36							
					37							
					38							
					39							
					40							
					41							
					42							
					43							
					44							
					45							

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



Stantec

BOREHOLE RECORD

N: 4 810 989 E: 533 845

BH3-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING September 18, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%)
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	378.4	Farm field no crops			0							WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m GR SA SI CL
	378.1	300 mm TOPSOIL			1	SS	1	0.0 610	4			
1		Very stiff brown to grey silty CLAY (CL-ML) with sand - moist to wet			2							
					3	SS	2	410 610	22			
2					4							
					5							
3					6	SS	3	330 610	23			
					7							
4					8	SS	4	480 610	20			
					9							
5		- grey			10							
					11	SS	5	460 610	27			
6					12							
					13	SS	6	380 610	14			
7					14							
					15							
8					16	SS	7	460 610	15			
					17							
9					18							
					19							
10					20							
					21	SS	8	0.0 610	23			
11					22							
					23							
12					24							
					25							
13					26	SS	9	510 610	27			
					27							
14	370.2	End of Borehole			28							
					29							
15		No groundwater present in open borehole on completion of drilling			30							
					31							
16					32							
					33							
17					34							
					35							
18					36							
					37							
19					38							
					39							
20					40							
					41							
21					42							
					43							
22					44							
					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 811 034 E: 533 729

BH4-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING September 19, 2103

WATER LEVEL October 8, 2013

TPC ELEVATION 379.71

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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**Stantec****BOREHOLE RECORD**

N: 4 810 986 E: 533 782

BH5-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 19, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SL CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	379.5	Brush and grass			0							
		150 mm TOPSOIL			1	AS	1		-			
		Stiff brown to grey silty CLAY (CL-ML) with sand			2							
1		- moist to wet			3							
					4	SS	2	360 610	11			
					5							
2		- grey			6	SS	3	410 610	15			
					7							
					8							
					9	SS	4	380 610	17			
3					10							
					11	SS	5	510 610	11			
					12							
4					13							
					14	SS	6	530 610	17			
					15							
5					16	SS	7	510 610	12			
					17							
6					18							
					19							
					20							
					21	SS	8	610 610	15			
7					22							
					23							
					24							
					25							
8	371.3	End of Borehole			26	SS	9	610 610	21			
					27							
9		No groundwater present in open borehole on completion of drilling			28							
					29							
					30							
					31							
10					32							
					33							
					34							
					35							
11					36							
					37							
					38							
12					39							
					40							
					41							
					42							
13					43							
					44							
					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 811 059 E: 533 683

BH6-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 19, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	382.0	Brush and grass			0							
	381.8	225 mm TOPSOIL			1	AS	1		-			
1		FILL: brown clayey silt some sand trace topsoil			2							
					3							
					4	SS	2	300 610	6	•		
2					5							
					6	SS	3	230 610	5	•		
					7							
					8	SS	4	300 610	6	•		
3					9							
					10							
					11	SS	5	250 610	2	•		
4					12							
					13							
					14	SS	6	100 610	2	•		
5	377.4	Very loose to compact brown silty SAND (SM) - wet			15							
					16	SS	7	410 610	2	•		
6					17							
					18							
					19							
7	375.6	Very stiff brown silty CLAY (CL-ML)			20							
					21	SS	8	610 610	13	•		
8					22							
					23							
					24							
					25							
9	372.9	Compact brown silty SAND (SM) - damp			26	SS	9	460 610	31	•		
	372.3				27							
10		End of Borehole			28							
					29							
					30							
					31	SS	10	510 610	18	•		
11		Borehole caved to a depth of 6.7 m			32							
					33							
					34							
					35							
					36							
					37							
					38							
					39							
					40							
					41							
					42							
					43							
					44							
14					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 953 E: 533 770

BH7-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING September 18, 2103

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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**Stantec****BOREHOLE RECORD**

N: 4 810 847 E: 533 870

BH8-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 18, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) / TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	380.5	Farm field no crops			0							
	380.2	300 mm TOPSOIL			1	SS	1	150 / 610	12			
1		Very stiff brown to grey silty CLAY (CL-ML) - moist to wet			2							
					3	SS	2	360 / 610	7			
2					4							
					5							
					6	SS	3	380 / 610	16			
3					7							
					8	SS	4	480 / 610	18			
					9							
					10							
					11	SS	5	380 / 610	24			
4					12							
					13							
					14	SS	6	560 / 610	21			
5		- grey			15							
					16	SS	7	360 / 610	20			
6					17							
					18							
					19							
					20							
					21	SS	8	480 / 610	29			
7					22							
					23							
					24							
	372.9				25							
8		Dense brown sandy SILT (ML) - damp			26	SS	9	460 / 610	39			
					27							
9					28							
					29							
					30							
					31	SS	10	510 / 610	27			
10					32							
					33							
					34							
					35							
11	369.2				36	SS	11	510 / 610	35			
		End of Borehole			37							
12		No groundwater present in open borehole on completion of drilling			38							
					39							
					40							
13					41							
					42							
					43							
					44							
14					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 810 552 E: 534 151

BH9-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 18, 2103

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	389.9	Farm field no crops			0							
	389.6	225 mm TOPSOIL			1	SS	1	150 610	8			
1		Very stiff brown to grey silty CLAY (CL-ML) with sand - moist to wet			2							
					3	SS	2	380 610	13			
2					4							
					5							
					6	SS	3	460 610	19			
3		- grey			7							
					8							
					9	SS	4	430 610	22			
4					10							
					11	SS	5	460 610	21			
					12							
					13							
					14	SS	6	410 610	25			
5					15							
					16	SS	7	510 610	22			
6					17							
					18							
					19							
					20							
	383.1				21	SS	8	480 610	23			
7		End of Borehole			22							
		No groundwater present in open borehole on completion of drilling			23							
8					24							
					25							
9					26							
					27							
					28							
10					29							
					30							
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12					37							
					38							
					39							
					40							
13					41							
					42							
					43							
					44							
14					45							

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 810 741 E: 533 876

BH10-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING September 18, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200 WATER CONTENT & ATTERBERG LIMITS W_p W W_L DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼ STANDARD PENETRATION TEST, BLOWS/0.3m ● REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL										
0	388.8	Farm field no crops			0															
	388.5	250 mm TOPSOIL			1	SS	1	150 610	8											
		Very stiff brown silty CLAY (CL-ML)			2															
1		- moist to wet			3	SS	2	380 610	13											
					4															
2					5															
					6	SS	3	460 610	19											
					7															
					8															
					9	SS	4	430 610	22											
3					10															
					11	SS	5	460 610	21											
					12															
4					13															
					14	SS	6	410 610	25											
					15															
5					16	SS	7	510 610	22											
					17															
					18															
6	382.7	Compact brown SAND (SM)			19															
		- damp			20															
					21	SS	8	480 610	23											
7					22															
					23															
					24															
8	380.6	End of Borehole			25															
					26	SS	9	460 610	24											
					27															
9		No groundwater present in open borehole on completion of drilling			28															
					29															
10					30															
					31															
					32															
					33															
					34															
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11					36															
					37															
					38															
12					39															
					40															
					41															
					42															
13					43															
					44															
					45															
14																				

- ☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



N: 4 810 691 E: 533 922

BH11-13

PROJECT No. 160321331

DATUM _____ Geodetic

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	WATER CONTENT & ATTERBERG LIMITS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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**Stantec****BOREHOLE RECORD**

N: 4 810 635 E: 533 970

BH12-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING August 27, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)				REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) / TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200				
0	388.7	Brush and grass			0									
	388.3	350 mm TOPSOIL			1	SS	1	250 / 610	8					
1		Stiff to very stiff brown to grey CLAY (CL) with sand			2									
					3	SS	2	460 / 610	6					
2					4									
					5									
					6	SS	3	610 / 610	9					
3		- grey			7									
					8	SS	4	610 / 610	15					
4					9									
					10	SS	5	610 / 610	17					
5					11									
					12	SS	6	610 / 610	20					
6					13									
					14	SS	7	0.0 / 610	13					
7					15									
					16									
8					17									
					18									
9					19									
					20									
10	382.0	End of Borehole			21	SS	8	410 / 610	29					
11					22									
12		Groundwater level inferred in open borehole on completion of drilling			23									
13					24									
14					25									
					26									
					27									
					28									
					29									
					30									
					31									
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					43									
					44									
					45									

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 554 E: 534 032

BH13-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 27, 2013

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	389.6	Brush and grass			0							
	389.2	300 mm TOPSOIL			1	SS	1	430 610	9			
		Stiff to very stiff brown CLAY (CL) with sand			2							
1					3	SS	2	180 610	5			
	388.0	Very loose black PEAT			4							
		Stiff to very stiff brown CLAY (CL) with sand			5							
2					6	SS	3	230 610	10			
					7							
					8	SS	4	430 610	8			
3					9							
					10							
					11	SS	5	410 610	8			
					12							
4					13							
					14	SS	6	460 610	19			
					15							
5					16	SS	7	510 610	18			
					17							
					18							
6					19							
					20							
	382.8	End of Borehole			21	SS	8	610 610	24			
7					22							
		Groundwater level inferred in open borehole on completion of drilling			23							
					24							
8					25							
					26							
					27							
9					28							
					29							
					30							
10					31							
					32							
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					37							
12					38							
					39							
					40							
13					41							
					42							
					43							
					44							
14					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 509 E: 534 069

BH14-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 27, 2013

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)											REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200											
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m											
										W _p W _L I _p											
0	391.5	Brush and grass			0					10	20	30	40	50	60	70	80	90	100		
	391.2	350 mm TOPSOIL			1	SS	1	300 610	10	●											
		Very stiff brown to grey CLAY (CL) with sand			2																
1						3	SS	2	510 610	15	●										
						4															
						5															
2						6	SS	3	460 610	20	●							△			
						7															
						8	SS	4	610 610	22	●							△			
						9															
3						10															
						11	SS	5	610 610	14	●							△			
						12															
4						13															
						14	SS	6	510 610	12	●						△				
						15															
5				- grey		16	SS	7	610 610	14	●							△			
						17															
				18																	
6				19																	
				20																	
		- sand layer from 6.4 m to 6.5 m		21	SS	8	610 610	17	●							△					
7				22																	
				23																	
				24																	
	383.6			25																	
8	383.3	Very dense brown silty SAND (SM)		26	SS	9	610 610	66								●					
		End of Borehole		27																	
9		Groundwater level inferred in open borehole on completion of drilling		28																	
				29																	
				30																	
10						31															
						32															
						33															
						34															
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11						36															
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12						39															
				40																	
				41																	
13				42																	
				43																	
				44																	
14				45																	

Field Vane Test, kPa

Remoulded Vane Test, kPa

Pocket Penetrometer Test, kPa

- ☐ Field Vane Test, kPa
- ☒ Remoulded Vane Test, kPa
- ☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 454 E: 533 960

BH15-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 27, 2013

WATER LEVEL October 8, 2013

TPC ELEVATION 395.66

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)									
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200									
										WATER CONTENT & ATTERBERG LIMITS W_p W I_L									
										DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m									
										STANDARD PENETRATION TEST, BLOWS/0.3m									
										REMARKS & GRAIN SIZE DISTRIBUTION (%)									
										GR SA SL CL									
0	394.9	Brush and grass			0														
	394.5	300 mm TOPSOIL			1	SS	1	100 610	10										
		Stiff to very stiff brown to grey			2														
1		CLAY (CL) with sand			3	SS	2	410 610	13										
					4														
					5														
2					6	SS	3	560 610	19										
					7														
					8	SS	4	610 610	19										
3					9														
					10														
					11	SS	5	460 610	19										
4					12														
					13														
					14	SS	6	560 610	11										
5					15														
					16	SS	7	410 610	15										
					17														
6		- grey			18														
					19														
					20														
					21	SS	8	610 610	22										
7					22														
					23														
					24														
8					25														
					26	SS	9	610 610	15										
					27														
9					28														
					29														
					30														
					31	SS	10	610 610	18										
10					32														
					33														
					34														
					35														
11	383.6				36	SS	11	510 610	23										
		End of Borehole			37														
12		Groundwater monitoring well installed with a screen from approximately 7.6 m to 10.7 m			38														
					39														
					40														
13		Groundwater level measure at a depth of approximately 6.5 m below grade on October 8, 2013			41														
					42														
14					43														
					44														
					45														

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 810 391 E: 533 827

BH16-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING August 22, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

- ☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



N: 4 810 447 E: 533 803

BH17-13

PROJECT No. 160321331

DATUM _____ Geodetic

TPC ELEVATION

[illegible]

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 22, 2013

WATER LEVEL October 8, 2013TPC ELEVATION 392.78

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

**Stantec****BOREHOLE RECORD**

N: 4 810 518 E: 533 896

BH19-13

CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING August 26, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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- ☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 443 E: 533 626

BH20-13

SHEET 1 of 2

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 22, 2013

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)									
						TYPE	NUMBER	RECOVERY (mm) / TCR (%) / SCR (%)	N-VALUE OR RQD (%)	50 100 150 200									
										WATER CONTENT & ATTERBERG LIMITS W_p W W_L									
										DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m									
										STANDARD PENETRATION TEST, BLOWS/0.3m									
										10 20 30 40 50 60 70 80 90 100									
										REMARKS & GRAIN SIZE DISTRIBUTION (%)									
										GR SA SI CL									
0	405.8	Brush and grass			0														
	405.5	250 mm TOPSOIL			1	SS	1	51 / 610	5										
		Loose brown silty SAND (SM)			2														
1					3	SS	2	430 / 610	5										
					4														
					5														
2					6	SS	3	460 / 610	7										
	403.5				7														
		Very stiff brown to grey CLAY (CL) with sand			8	SS	4	560 / 610	22										
3					9														
					10														
					11	SS	5	560 / 610	23										
					12														
4					13	SS	6	610 / 610	19										
					14														
					15														
5					16	SS	7	560 / 610	26										
					17														
					18														
6					19														
					20														
					21	SS	8	610 / 610	9										
					22														
7					23														
					24														
					25														
8		- grey			26	SS	9	610 / 610	15										
					27														
					28														
9					29														
					30														
					31	SS	10	560 / 610	23										
					32														
10					33														
					34														
	395.1				35														
11		Very dense brown silty SAND (SM)			36	SS	11	460 / 610	47										
					37														
12					38														
					39														
					40														
13					41	SS	12	530 / 610	93										
					42														
					43														
					44														
14					45														

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa

**Stantec****BOREHOLE RECORD**

N: 4 810 443 E: 533 626

BH20-13

SHEET 2 of 2

CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING August 22, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
14	391.8	Very dense brown silty SAND (SM)			46	SS	13	460 610	56	○	●	
47												
48												
49												
50												
15					51	SS	14	460 610	44	○	●	
16	390.0	End of Borehole			52							
53												
54												
55												
56												
57												
58												
59												
60												
61												
62												
63												
64												
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87												
88												
89												
90												
91												

☐ Field Vane Test, kPa
☒ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 164 E: 533 877

BH21-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 23, 2013

WATER LEVEL

TPC ELEVATION

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200											
						WATER CONTENT & ATTERBERG LIMITS										W _p W _L I _p					
						DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m										▼					
						STANDARD PENETRATION TEST, BLOWS/0.3m										●					
						10 20 30 40 50 60 70 80 90 100															
0	396.0	Brush and grass			0																
	395.6	300 mm TOPSOIL			1	SS	1	300 610	11	●	○							△			
		Very stiff brown to grey CLAY (CL) with sand			2																
1					3	SS	2	610 610	17	●										△	
					4																
					5																
2					6	SS	3	430 610	21		●										
					7																
					8																
					9	SS	4	530 610	15	●									△		
3					10																
					11	SS	5	610 610	16	●	○									△	
					12																
4					13																
					14	SS	6	610 610	16	●										△	
					15																
5				- grey			16	SS	7	610 610	14	●	○						△		
					17																
					18																
6					19																
					20																
					21	SS	8	460 610	11	●	○						△				
7					22																
					23																
	388.3				24																
8	387.7	Loose well graded SAND (SW-SM) with sand			25																
		End of Borehole			26	SS	9	610 610	8	●	○								1 87 11		
					27																
9					28																
					29																
		Groundwater level inferred in open borehole on completion of drilling			30																
					31																
10					32																
					33																
					34																
11					35																
					36																
					37																
12					38																
					39																
					40																
13					41																
			42																		
			43																		
			44																		
14			45																		

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa



N: 4 810 260 E: 533 672

BH22-13

PROJECT No. 160321331

DATUM _____ Geodetic

TPC ELEVATION

[illegible]

**Stantec****BOREHOLE RECORD**

N: 4 810 305 E: 533 603

BH23-13CLIENT West Waterloo Retail LPPROJECT No. 160321331LOCATION 930 Erb Street Waterloo, OntarioDATUM GeodeticDATES: BORING August 23, 2013

WATER LEVEL _____

TPC ELEVATION _____

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)		REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50	100	
0	398.3	Brush and grass			0							
	398.0	300 mm TOPSOIL			1	SS	1	130 610	5			
1		Stiff to very stiff brown CLAY (CL) with sand			2							
					3	SS	2	380 610	12			
2					4							
					5							
3					6	SS	3	610 610	20			
					7							
4					8	SS	4	610 610	16			
					9							
5					10							
					11	SS	5	610 610	14			
6					12							
					13							
7					14	SS	6	610 610	13			
					15							
8					16	SS	7	610 610	16			
					17							
9					18							
					19							
10					20							
					21	SS	8	610 610	13			
11					22							
					23							
12					24							
					25							
13					26	SS	9	610 610	11			
					27							
14					28							
					29							
					30							
					31							
					32							
					33							
					34							
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					38							
					39							
					40							
					41							
					42							
					43							
					44							
					45							

☐ Field Vane Test, kPa
☐ Remoulded Vane Test, kPa
☐ Pocket Penetrometer Test, kPa



BOREHOLE RECORD

N: 4 810 115 E: 533 587

BH24-13

CLIENT West Waterloo Retail LP

PROJECT No. 160321331

LOCATION 930 Erb Street Waterloo, Ontario

DATUM Geodetic

DATES: BORING August 23, 2013

WATER LEVEL

TPC ELEVATION

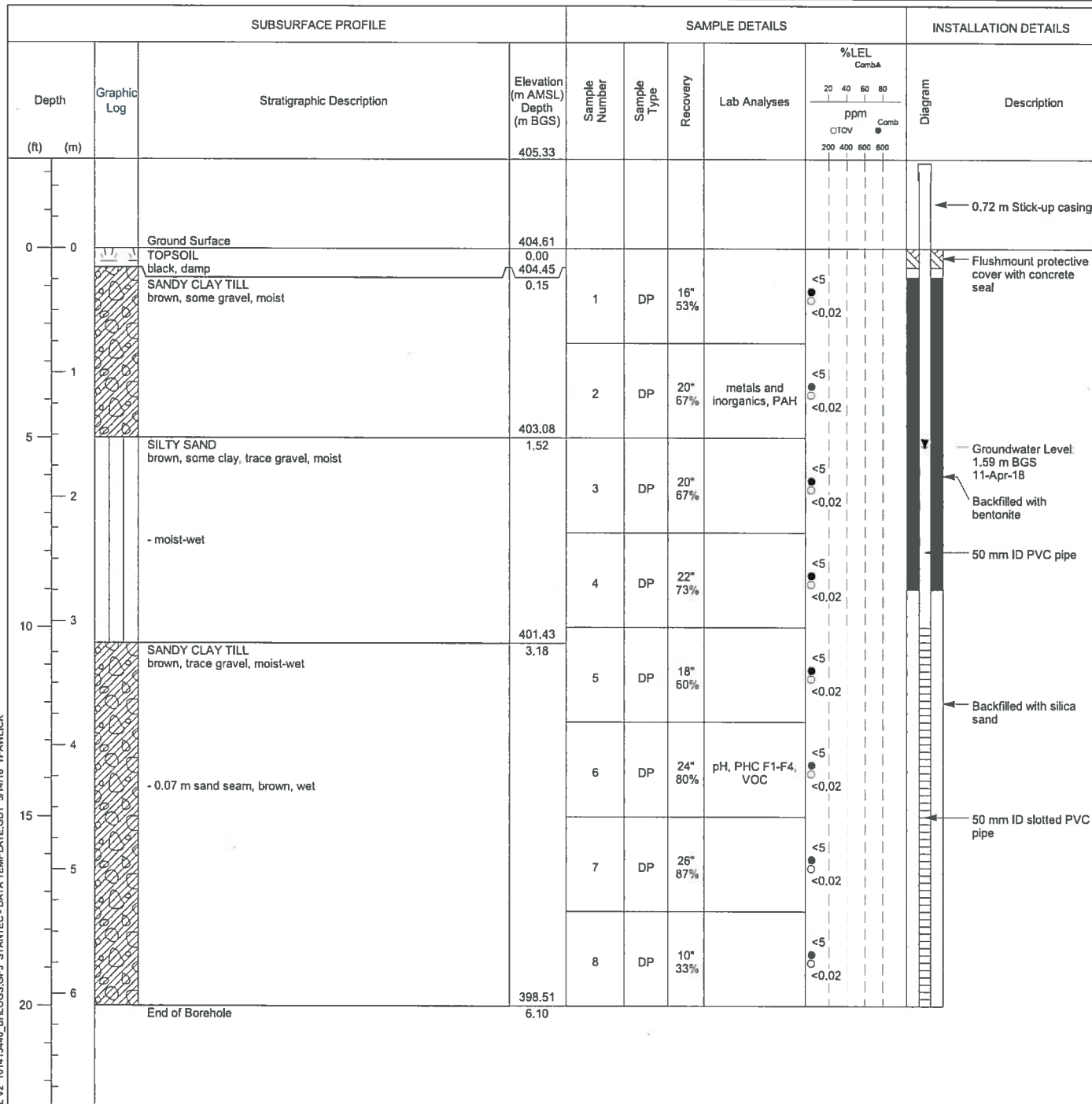
DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH (kPa)										REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
						TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	50 100 150 200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
										WATER CONTENT & ATTERBERG LIMITS DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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- ☐ Field Vane Test, kPa
- ☐ Remoulded Vane Test, kPa
- ☐ Pocket Penetrometer Test, kPa

Monitoring Well: MW18-1

Project: Phase II Environmental Site Assessment
Client: City of Waterloo
Location: Waterloo West Side Employment Lands, Waterloo, Ontario
Number: 161413446
Field investigator: T. Sokolowski
Contractor: Strata Drilling Group

Drilling method: Geoprobe 7822DT (Direct Push)
Date started/completed: 19-Mar-2018
Ground surface elevation: 404.61 m AMSL
Top of casing elevation: 405.33 m AMSL
Easting: 533737.96
Northing: 4810059.24



Screen Interval: 3.05 - 6.10 m BGS
 Sand Pack Interval: 2.74 - 6.10 m BGS
 Well Seal Interval: 0.23 - 2.74 m BGS

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 DP - direct push sample
 ppm - parts per million by volume
 n/a - not available

m RTD - metres relative to datum
 PAH - polycyclic aromatic hydrocarbons
 PHC F1-F4 - petroleum hydrocarbon fractions 1 to 4
 VOC - volatile organic compounds

TOV - total organic soil vapour concentrations
 Comb - combustible vapour concentrations



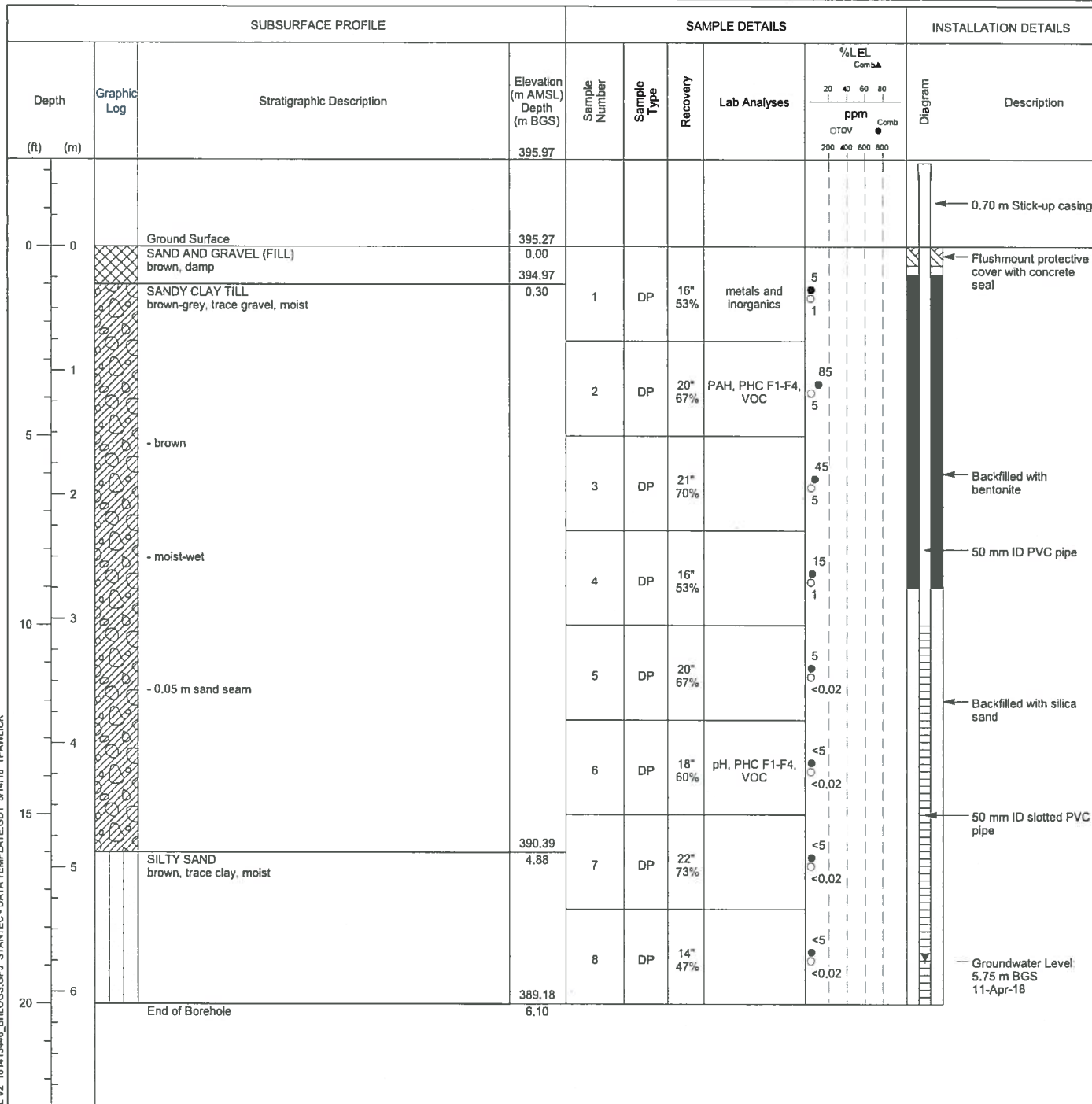
Drawn By/Checked By: T. Pawlick / B. Ferguson

Sheet 1 of 1

Monitoring Well: MW18-2

Project: Phase II Environmental Site Assessment
Client: City of Waterloo
Location: Waterloo West Side Employment Lands, Waterloo, Ontario
Number: 161413446
Field Investigator: T. Sokolowski
Contractor: Strata Drilling Group

Drilling method: Geoprobe 7822DT (Direct Push)
Date started/completed: 19-Mar-2018
Ground surface elevation: 395.27 m AMSL
Top of casing elevation: 395.97 m AMSL
Easting: 533737.96
Northing: 4810334.49



Screen Interval: 3.05 - 6.10 m BGS
 Sand Pack Interval: 2.74 - 6.10 m BGS
 Well Seal Interval: 0.23 - 2.74 m BGS

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 DP - direct push sample
 ppm - parts per million by volume
 n/a - not available

m RTD - metres relative to datum
 PAH - polycyclic aromatic hydrocarbons
 PHC F1-F4 - petroleum hydrocarbon fractions 1 to 4
 VOC - volatile organic compounds

TOV - total organic soil vapour concentrations
 Comb - combustible vapour concentrations



Drawn By/Checked By: T. Pawlick / B. Ferguson

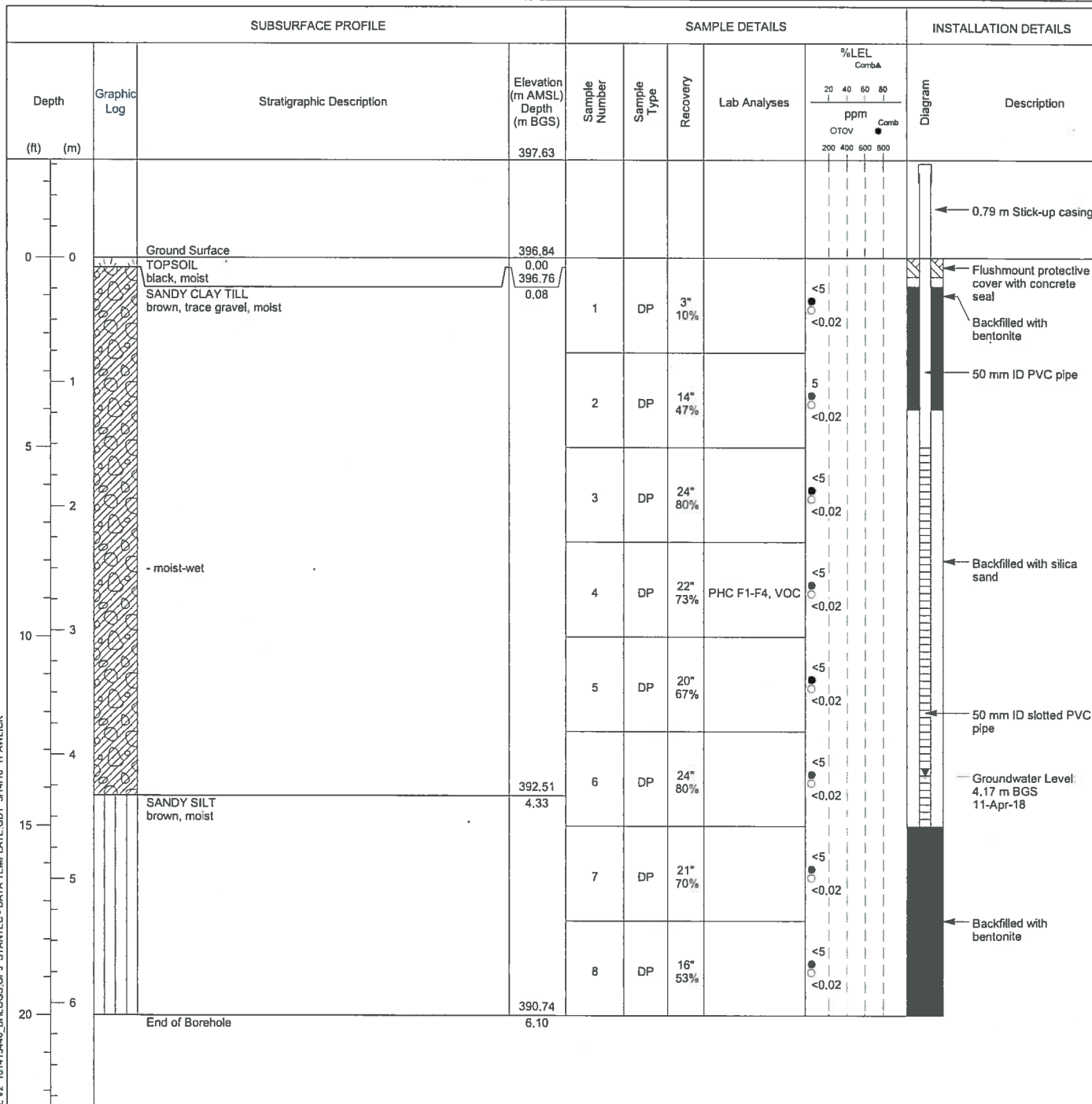
Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2: 161413446_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 5/14/18 TPAWLICK

Monitoring Well: MW18-3

Project: Phase II Environmental Site Assessment
Client: City of Waterloo
Location: Waterloo West Side Employment Lands, Waterloo, Ontario
Number: 161413446
Field Investigator: T. Sokolowski
Contractor: Strata Drilling Group

Drilling method: Geoprobe 7822DT (Direct Push)
Date started/completed: 19-Mar-2018
Ground surface elevation: 396.84 m AMSL
Top of casing elevation: 397.63 m AMSL
Easting: 533391.05
Northing: 4810354.22



Screen Interval: 1.52 - 4.57 m BGS
 Sand Pack Interval: 1.22 - 4.57 m BGS
 Well Seal Interval: 0.23 - 1.22 m BGS

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 DP - direct push sample
 ppm - parts per million by volume
 n/a - not available

m RTD - metres relative to datum
 PAH - polycyclic aromatic hydrocarbons
 PHC F1-F4 - petroleum hydrocarbon fractions 1 to 4
 VOC - volatile organic compounds

TOV - total organic soil vapour concentrations
 Comb - combustible vapour concentrations



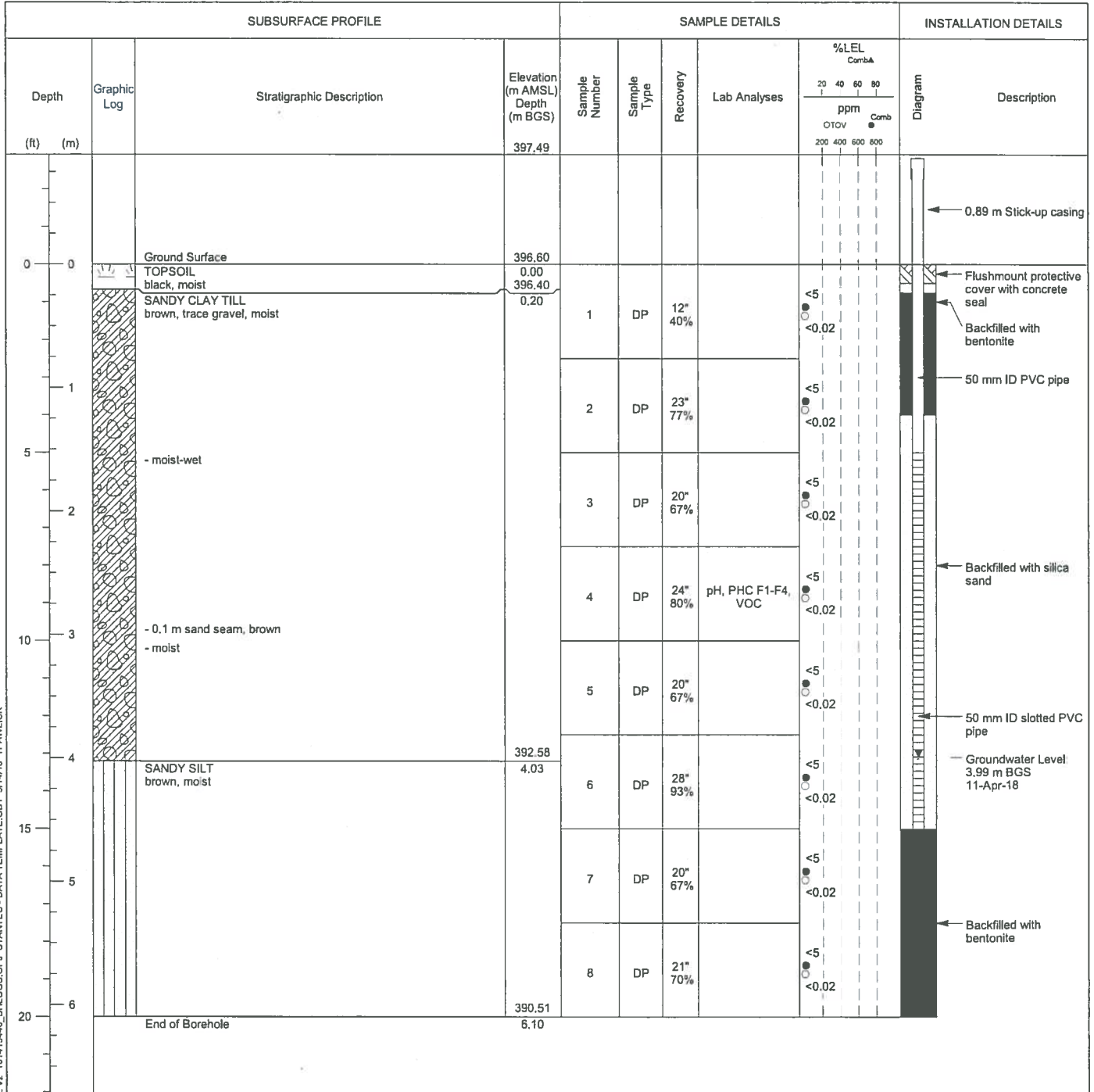
Drawn By/Checked By: T. Pawlick / B. Ferguson

Sheet 1 of 1

Monitoring Well: MW18-4

Project: Phase II Environmental Site Assessment
Client: City of Waterloo
Location: Waterloo West Side Employment Lands, Waterloo, Ontario
Number: 161413446
Field investigator: T. Sokolowski
Contractor: Strata Drilling Group

Drilling method: Geoprobe 7822DT (Direct Push)
Date started/completed: 19-Mar-2018
Ground surface elevation: 396.60 m AMSL
Top of casing elevation: 397.49 m AMSL
Easting: 533415.08
Northing: 4810356



Screen Interval: 1.52 - 4.57 m BGS
 Sand Pack Interval: 1.22 - 4.57 m BGS
 Well Seal Interval: 0.23 - 1.22 m BGS

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 DP - direct push sample
 ppm - parts per million by volume
 n/a - not available

m RTD - metres relative to datum
 PAH - polycyclic aromatic hydrocarbons
 PHC F1-F4 - petroleum hydrocarbon fractions 1 to 4
 VOC - volatile organic compounds

TOV - total organic soil vapour concentrations
 Comb - combustible vapour concentrations



Drawn By/Checked By: T. Pawlick / B. Ferguson

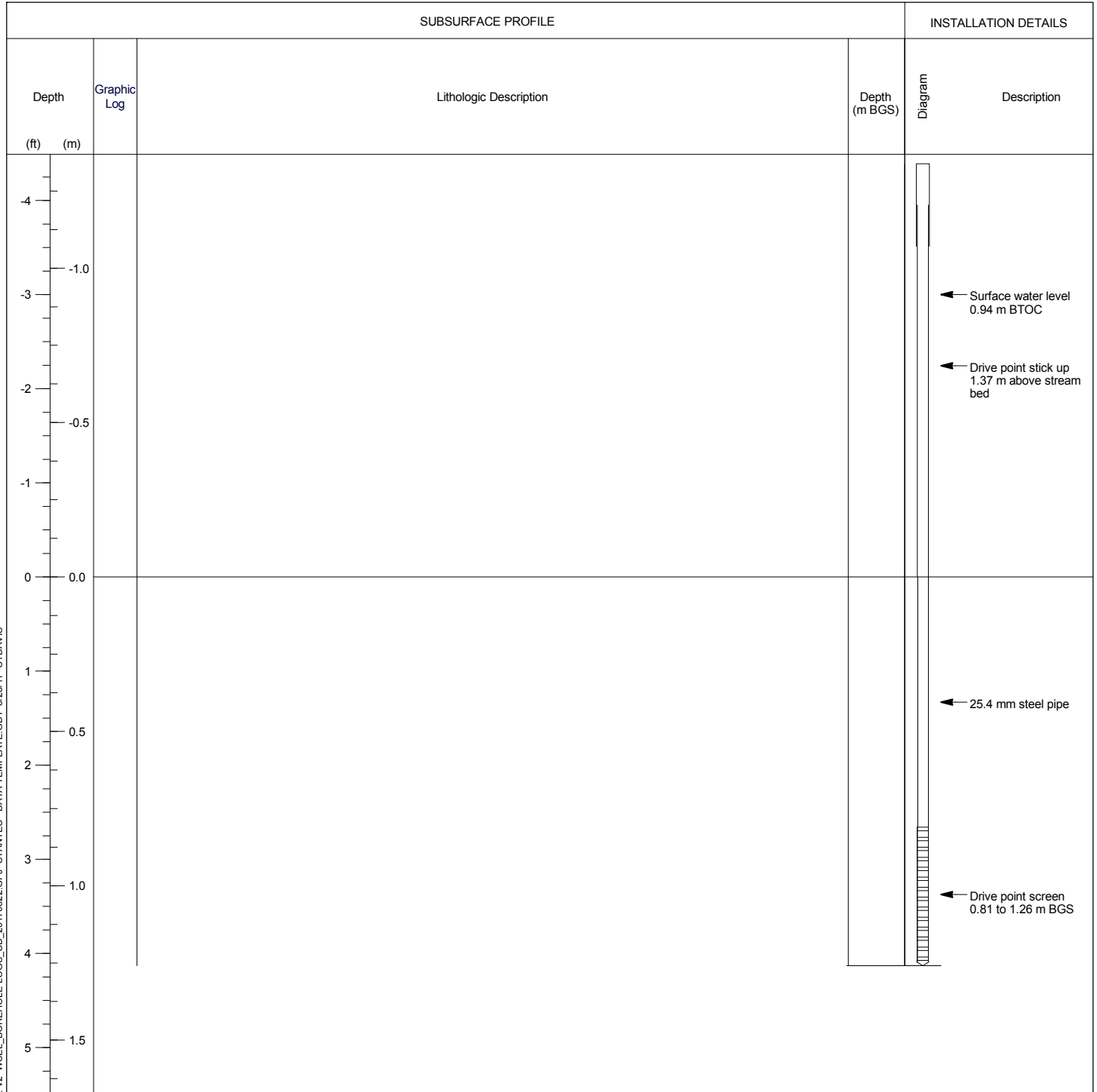
Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 161413446_BHL.BGS.GPJ STANTEC - DATA TEMPLATE.GDT 5/14/18 TP.AWLICK

Drive Point Piezometer: DP1-17

Project: WSEL Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446
Field investigator: AV
Contractor: Stantec

Drilling method: Post Hole Driver
Date started/completed: 26-Jul-2017
Ground surface elevation: n/a
Top of casing elevation: n/a
Easting: n/a
Northing: n/a



Screen Interval: 0.81 - 1.25 m BGS
 Sand Pack Interval: n/a
 Well Seal Interval: n/a

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 n/a - not available



Drive Point Piezometer: DP2-17

Project: WSEL Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446
Field investigator: AV
Contractor: Stantec

Drilling method: Post Hole Driver
Date started/completed: 26-Jul-2017
Ground surface elevation: n/a
Top of casing elevation: n/a
Easting: n/a
Northing: n/a

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram	Description
(ft) (m)					
-2 -0.5 -1					Drive point stick up 0.84 m above stream bed
0 0.0					
1 0.5 2					25.4 mm steel pipe
3 1.0 4					
5 1.5 6					Drive point screen 1.35 to 1.80 m BGS
7 2.0					

Screen Interval: 1.35 - 1.79 m BGS
 Sand Pack Interval: n/a
 Well Seal Interval: n/a

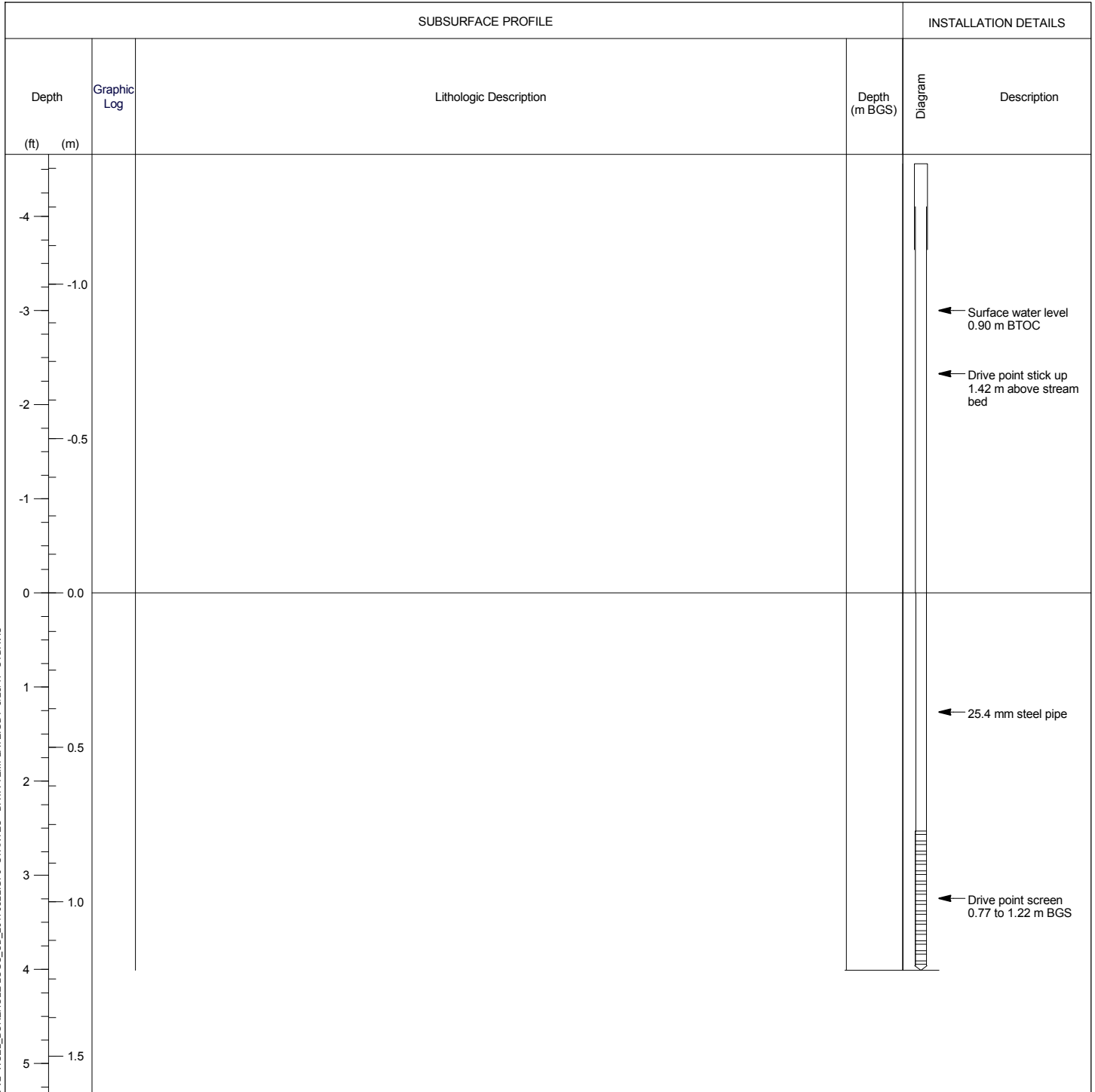
Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 n/a - not available



Drive Point Piezometer: DP3-17

Project: WSEL Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446
Field investigator: AV
Contractor: Stantec

Drilling method: Post Hole Driver
Date started/completed: 26-Jul-2017
Ground surface elevation: n/a
Top of casing elevation: n/a
Easting: n/a
Northing: n/a



Screen Interval: 0.77 - 1.21 m BGS
 Sand Pack Interval: n/a
 Well Seal Interval: n/a

Notes:
 m AMSL - metres above mean sea level
 m BGS - metres below ground surface
 n/a - not available



Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446

Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed: 11-Jun-2018 / 16-Jun-2018

SUBSURFACE PROFILE							SAMPLE DETAILS			WELL DETAILS	
Depth		Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	Name: W-EB-OW1A-18		Name: W-EB-OW1B-18	
(ft)	(m)							GS Elev: 404.35 m AMSL	GS Elev: 404.47 m AMSL	TOC Elev: 405.15 m AMSL	TOC Elev: 405.28 m AMSL
-2	-0.5			405.26							
-1	-0.5										
0	0.0		Ground Surface	404.35							
1	0.0		TOPSOIL loose, organics, dry	0.00							
2	0.10		SILT firm, yellowish brown, trace fine gravel, trace clay starting at 0.69 m BGS	404.25	1	PQ	56" 93%				
3	0.5										
4	1.0										
5	1.5										
6	2.0			402.22							
7	2.13		SILTY CLAY firm, brown, trace fine and coarse gravel, moist from 2.13 to 2.18 m BGS	2.13	2	PQ	45" 75%				
8	2.5										
9	3.0										
10	3.0										
11	3.5		silt seam at 33.96 m, 0.05 m thick								
12	4.0				3	PQ	22" 37%				
13	4.0			400.08							
14	4.27		SILT TILL firm, yellowish brown, trace fine and coarse gravel, dry color change to dark grey at 4.6 m BGS	4.27							
15	4.5										
16	5.0										
17	5.0				4	PQ	60" 100%				
18	5.5										
19	6.0										
20	6.0										
21	6.5										
22	6.5										
23	7.0		SAND dark yellowish brown, medium sand, some silt, wet	397.36	5	PQ	60" 100%				
24	7.19		SILT TILL firm, yellowish brown, some clay, trace to some fine to coarse gravel, dry	6.99							
25	7.19			397.16							
26	8.0										
27	8.0		cobbles from 8.2 to 9.5 m BGS								
28	8.5				6	PQ	39" 65%				
29	9.0										
30	9.0										
31	9.5		transition back to fine to coarse gravel at 9.5 m BGS								
											</

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
PQ - wireline continuous core sample

n/a - not available/applicable



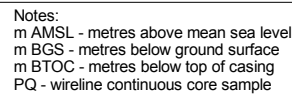
Drawn By/Checked By: CD/GW

Sheet 1 of 6

STANTEC BOREHOLE AND WELL - MASTER 17X11 WSEL BOREHOLE LOGS CD 20170822.GPJ STANTEC - DATA TEMPLATE.GDT 7/20/18 CYDAVIS

Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446

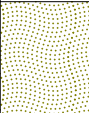
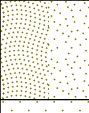
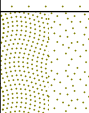
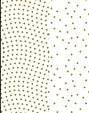
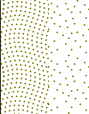
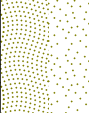
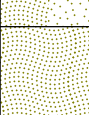
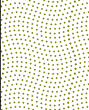
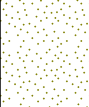
Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed: 11-Jun-2018 / 16-Jun-2018



Drawn By/Checked By: CD/GW

Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446

Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed: 11-Jun-2018 / 16-Jun-2018

SUBSURFACE PROFILE							SAMPLE DETAILS			WELL DETAILS		
Depth		Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	Name: W-EB-OW1A-18		Name: W-EB-OW1B-18		
(ft)	(m)							GS Elev: 404.35 m AMSL	GS Elev: 404.47 m AMSL	TOC Elev: 405.15 m AMSL	TOC Elev: 405.28 m AMSL	Easting: 533415
68	20.5		SAND loose, yellowish brown, fine sand, trace silt, dry		14	PQ	57" 95%		Bentonite Grout 0.91 to 57.6 m BGS			
69	21.0											
70	21.5											
71	22.0											
72	22.5											
73	23.0											
74	23.5											
75	24.0											
76	24.5											
77	25.0											
78	25.5		SAND loose, brown, medium and fine sand, trace silt, dry	380.58	16	PQ	43" 72%					
79	26.0											
80	26.5											
81	27.0		SAND loose, greyish brown, medium and coarse sand, moist	23.77	17	PQ	21" 35%					
82	27.5											
83	28.0											
84	28.5		SAND loose, brown, medium and fine sand, trace silt, moist	379.81								
85	29.0											
86	29.5											
87	30.0			24.54								
88	30.5											
89	31.0											
90	31.5			379.56								
91	32.0											
92	32.5											
93	33.0			24.79								
94	33.5											
95	34.0											
96	34.5											
97	35.0											
98	35.5											
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100	36.5											
101	37.0											
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Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
PQ - wireline continuous core sample

n/a - not available/applicable



Drawn By/Checked By: CD/GW

Sheet 3 of 6

STANTEC BOREHOLE AND WELL - MASTER 17X11 WSEL BOREHOLE LOGS CD 20170822.GPJ STANTEC - DATA TEMPLATE.GDT 7/20/18 CYDAVIS

Monitoring Well: W-EB-OW1A/B-18

Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location:Waterloo, ON
Number: 161413446

Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed:11-Jun-2018 / 16-Jun-2018

SUBSURFACE PROFILE					SAMPLE DETAILS			WELL DETAILS	
Depth	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	Name: W-EB-OW1A-18 GS Elev: 404.35 m AMSL TOC Elev: 405.15 m AMSL Easting: 533415 Northing: 4810068 Stick-up: 0.80 m		Name: W-EB-OW1B-18 GS Elev: 404.47 m AMSL TOC Elev: 405.28 m AMSL Easting: 533600 Northing: 4810068 Stick-up: 0.81 m
(ft)	(m)								
103	31.5			21	PQ	51" 85%			
104									
105	32.0								
106	32.5	SAND loose, pale brown, fine sand, trace to some medium sand, trace silt, moist to wet	372.12 32.23 371.84	22	PQ	52" 87%			
107		SAND loose, greyish brown, medium sand, some fine sand, wet	32.51 371.41						
108	33.0	SAND loose, pale brown, fine sand, trace to some medium sand, trace silt, moist	32.94						
109									
110	33.5								
111	34.0								
112									
113	34.5			23	PQ	55" 92%			
114		silt seam at 34.6 m, 0.05 m thick	369.60						
115	35.0	SAND loose, greyish brown, medium sand, some fine sand, moist	34.75 369.20						
116	35.5	SAND loose, pale brown, fine sand, trace to some medium sand, trace silt, moist black silt laminations between 35.4 and 35.5 m BGS becomes wet at 35.5 to 35.7 m BGS	35.15	24	PQ	54" 90%			
117									
118	36.0								
119									
120	36.5								
121	37.0								
122	37.5	firm, light yellowish brown, silt seam, dry, 37.1 to 37.2 m BGS black silt laminations between 37.3 and 37.7 m BGS		25	PQ	53" 88%			
123									
124	38.0								
125	38.5								
126									
127	39.0	firm, light yellowish brown, silt seam, dry, 38.7 to 38.8 m BGS black silt laminations between 38.9 and 41.1 m BGS, 0.001-0.005 m thick		26	PQ	60" 100%			
128									
129	39.5								
130	40.0								
131	40.5			27	PQ	52" 87%			
132									
133	41.0								
134	41.5								
135									
136		silt content increases to some at 41.4 m BGS	362.64						

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
PQ - wireline continuous core sample

n/a - not available/applicable



STANTEC BOREHOLE AND WELL - MASTER TX11 WSEL BOREHOLE LOGS_CD_20170822.GPJ STANTEC - DATA TEMPLATE GDT 7/20/18 CYDAVIS

Monitoring Well: W-EB-OW1A/B-18

Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location:Waterloo, ON
Number: 161413446

Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed:11-Jun-2018 / 16-Jun-2018

SUBSURFACE PROFILE							SAMPLE DETAILS			WELL DETAILS						
Depth		Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	Name: W-EB-OW1A-18		Name: W-EB-OW1B-18						
(ft)	(m)							GS Elev: 404.35 m AMSL	GS Elev: 404.47 m AMSL	TOC Elev: 405.15 m AMSL	TOC Elev: 405.28 m AMSL	Easting: 533415	Easting: 533600	Northing: 4810068	Northing: 4810068	Stick-up: 0.80 m
138	42.0		SAND loose, greyish brown, medium sand, some fine sand, wet	41.71 362.24	28	PQ	54" 90%									
139	42.5		SILTY SAND firm, light olive brown, fine sand, dry	42.11												
140	42.5			SAND loose, pale brown, fine sand, trace to some medium sand, trace silt, dry to moist	361.37 42.98	29	PQ					57" 95%				
141	43.0				SAND loose, greyish brown, medium sand, some fine sand, moist								360.28 44.07	30	PQ	51" 85%
142	43.5															
143	44.0			SILTY SAND firm, yellowish brown, dry		359.32 45.03										
144	44.5				clayey silt till at 45.72 m BGS 0.15 m thick	356.42 47.93	31					PQ		n/a		
145	45.0														medium sand seam at 46.5 m, 0.18 m thick	355.83 48.52
146	45.5			becomes moist at 47 m BGS												
147	46.0				SAND loose, pale brown, fine sand, trace to some medium sand, trace silt, dry	353.75 50.60	32					PQ		n/a		
148	46.5														SILT firm, dark yellowish brown, dry	50.60
149	47.0			SAND loose, greyish brown, medium sand, some fine sand, dry to moist												
150	47.5				black silt laminations between 49.8 and 50.1 m BGS	50.60										
151	48.0											SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60			
152	48.5			SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist										50.60		
153	49.0				SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60										
154	49.5											SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60			
155	50.0			SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist										50.60		
156	50.5				SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60										
157	51.0											SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60			
158	51.5			SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist										50.60		
159	52.0				SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist	50.60										
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								SAND loose, pale brown, fine sand, trace to some medium sand, trace to some silt, dry to moist								



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
PQ - wireline continuous core sample

n/a - not available/applicable

Drawn By/Checked By: CD/GW

Sheet 5 of 6

Project: Waterloo West Side Employment Lands
Client: City of Waterloo
Location: Waterloo, ON
Number: 161413446

Field Investigator: SB/CD
Contractor: Aardvark Drilling
Drilling method: PQ coring
Date started/completed: 11-Jun-2018 / 16-Jun-2018

n/a - not available/applicable



APPENDIX F:

Laboratory Certificates of Analysis

Your Project #: 161413446
Your C.O.C. #: 621280-01-01

Attention: Grant Whitehead

Stantec Consulting Ltd
300 Hagey Blvd
Suite 100
Waterloo, ON
N2L 0A4

Report Date: 2017/08/03
Report #: R4630743
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7G0832

Received: 2017/07/27, 15:34

Sample Matrix: Water
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	3	N/A	2017/07/29	CAM SOP-00448	SM 22 2320 B m
Alkalinity	3	N/A	2017/08/01	CAM SOP-00448	SM 22 2320 B m
Alkalinity	1	N/A	2017/08/03	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2017/07/31	CAM SOP-00102	APHA 4500-CO2 D
Carbonate, Bicarbonate and Hydroxide	3	N/A	2017/08/01	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2017/07/31	CAM SOP-00463	EPA 325.2 m
Chloride by Automated Colourimetry	2	N/A	2017/08/01	CAM SOP-00463	EPA 325.2 m
Chloride by Automated Colourimetry	1	N/A	2017/08/03	CAM SOP-00463	EPA 325.2 m
Conductivity	4	N/A	2017/07/29	CAM SOP-00414	SM 22 2510 m
Conductivity	3	N/A	2017/08/01	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	4	N/A	2017/07/28	CAM SOP-00446	SM 22 5310 B m
Dissolved Organic Carbon (DOC) (1)	3	N/A	2017/08/01	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	7	N/A	2017/08/02	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	7	N/A	2017/08/02	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	7	N/A	2017/08/02		
Anion and Cation Sum	7	N/A	2017/08/02		
Total Ammonia-N	6	N/A	2017/07/31	CAM SOP-00441	EPA GS I-2522-90 m
Total Ammonia-N	1	N/A	2017/08/02	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	4	N/A	2017/07/31	CAM SOP-00440	SM 22 4500-NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (2)	3	N/A	2017/08/01	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	4	N/A	2017/07/29	CAM SOP-00413	SM 4500H+ B m
pH	3	N/A	2017/08/01	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	5	N/A	2017/07/31	CAM SOP-00461	EPA 365.1 m
Orthophosphate	2	N/A	2017/08/01	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	7	N/A	2017/08/02		
Sat. pH and Langelier Index (@ 4C)	7	N/A	2017/08/02		
Sulphate by Automated Colourimetry	4	N/A	2017/07/31	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	2	N/A	2017/08/01	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	1	N/A	2017/08/03	CAM SOP-00464	EPA 375.4 m

Your Project #: 161413446
Your C.O.C. #: 621280-01-01

Attention: Grant Whitehead

Stantec Consulting Ltd
300 Hagey Blvd
Suite 100
Waterloo, ON
N2L 0A4

Report Date: 2017/08/03
Report #: R4630743
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7G0832

Received: 2017/07/27, 15:34

Sample Matrix: Water
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Total Dissolved Solids (TDS calc)	7	N/A	2017/08/02		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam 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.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam 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 Maxxam, unless otherwise agreed in writing.

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.

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.

Your Project #: 161413446
Your C.O.C. #: 621280-01-01

Attention: Grant Whitehead

Stantec Consulting Ltd
300 Hagey Blvd
Suite 100
Waterloo, ON
N2L 0A4

Report Date: 2017/08/03
Report #: R4630743
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7G0832

Received: 2017/07/27, 15:34

Encryption Key



Tanya Fidlin
Project Manager
03 Aug 2017 16:38:58

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Augustyna Dobosz, Project Manager
Email: ADobosz@maxxam.ca
Phone# (905)817-5700 Ext:5798

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI612		EVI613		
Sampling Date		2017/07/25 09:06		2017/07/27 10:17		
COC Number		621280-01-01		621280-01-01		
	UNITS	WG-161413446- 20170726-AV01	QC Batch	WG-161413446- 20170727-AV02	RDL	QC Batch
Calculated Parameters						
Anion Sum	me/L	9.55	5093524	5.61	N/A	5093524
Bicarb. Alkalinity (calc. as CaCO ₃)	mg/L	440	5093371	220	1.0	5093371
Calculated TDS	mg/L	530	5093528	290	1.0	5093528
Carb. Alkalinity (calc. as CaCO ₃)	mg/L	3.6	5093371	3.0	1.0	5093371
Cation Sum	me/L	9.34	5093524	5.83	N/A	5093524
Hardness (CaCO ₃)	mg/L	330	5094212	240	1.0	5094212
Ion Balance (% Difference)	%	1.11	5093523	1.91	N/A	5093523
Langelier Index (@ 20C)	N/A	1.08	5093525	0.783		5093525
Langelier Index (@ 4C)	N/A	0.835	5093527	0.533		5093527
Saturation pH (@ 20C)	N/A	6.85	5093525	7.37		5093525
Saturation pH (@ 4C)	N/A	7.10	5093527	7.62		5093527
Inorganics						
Total Ammonia-N	mg/L	<0.050	5095854	0.13	0.050	5098497
Conductivity	umho/cm	850	5095711	590	1.0	5097266
Dissolved Organic Carbon	mg/L	3.3	5095623	2.0	0.20	5097229
Orthophosphate (P)	mg/L	<0.010	5099464	<0.010	0.010	5097365
pH	pH	7.94	5095713	8.15		5097267
Dissolved Sulphate (SO ₄)	mg/L	28	5099462	9.8	1.0	5097364
Alkalinity (Total as CaCO ₃)	mg/L	440	5095704	230	1.0	5097265
Dissolved Chloride (Cl)	mg/L	2.9	5099461	31	1.0	5097358
Nitrite (N)	mg/L	<0.010	5095712	<0.010	0.010	5096281
Nitrate (N)	mg/L	0.31	5095712	<0.10	0.10	5096281
Nitrate + Nitrite (N)	mg/L	0.31	5095712	<0.10	0.10	5096281
Metals						
Dissolved Aluminum (Al)	mg/L	0.011	5096206	0.0070	0.0050	5096206
Dissolved Antimony (Sb)	mg/L	<0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Arsenic (As)	mg/L	<0.0010	5096206	<0.0010	0.0010	5096206
Dissolved Barium (Ba)	mg/L	0.068	5096206	0.061	0.0020	5096206
Dissolved Beryllium (Be)	mg/L	<0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Boron (B)	mg/L	0.075	5096206	0.072	0.010	5096206
Dissolved Cadmium (Cd)	mg/L	<0.00010	5096206	<0.00010	0.00010	5096206
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
N/A = Not Applicable						

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI612		EVI613		
Sampling Date		2017/07/25 09:06		2017/07/27 10:17		
COC Number		621280-01-01		621280-01-01		
	UNITS	WG-161413446- 20170726-AV01	QC Batch	WG-161413446- 20170727-AV02	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	94	5096206	50	0.20	5096206
Dissolved Chromium (Cr)	mg/L	<0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Cobalt (Co)	mg/L	<0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Copper (Cu)	mg/L	0.0047	5096206	<0.0010	0.0010	5096206
Dissolved Iron (Fe)	mg/L	<0.10	5096206	<0.10	0.10	5096206
Dissolved Lead (Pb)	mg/L	<0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Magnesium (Mg)	mg/L	24	5096206	28	0.050	5096206
Dissolved Manganese (Mn)	mg/L	0.0021	5096206	0.50	0.0020	5096206
Dissolved Molybdenum (Mo)	mg/L	0.00054	5096206	0.0051	0.00050	5096206
Dissolved Nickel (Ni)	mg/L	<0.0010	5096206	0.0018	0.0010	5096206
Dissolved Phosphorus (P)	mg/L	<0.10	5096206	<0.10	0.10	5096206
Dissolved Potassium (K)	mg/L	89	5096206	3.4	0.20	5096206
Dissolved Selenium (Se)	mg/L	<0.0020	5096206	<0.0020	0.0020	5096206
Dissolved Silicon (Si)	mg/L	7.8	5096206	5.8	0.050	5096206
Dissolved Silver (Ag)	mg/L	<0.00010	5096206	<0.00010	0.00010	5096206
Dissolved Sodium (Na)	mg/L	10	5096206	22	0.10	5096206
Dissolved Strontium (Sr)	mg/L	0.18	5096206	0.72	0.0010	5096206
Dissolved Thallium (Tl)	mg/L	<0.000050	5096206	<0.000050	0.000050	5096206
Dissolved Titanium (Ti)	mg/L	<0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Uranium (U)	mg/L	0.0013	5096206	0.0023	0.00010	5096206
Dissolved Vanadium (V)	mg/L	<0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Zinc (Zn)	mg/L	<0.0050	5096206	<0.0050	0.0050	5096206
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI614		EVI615	EVI615		
Sampling Date		2017/07/27 10:41		2017/07/27 10:57	2017/07/27 10:57		
COC Number		621280-01-01		621280-01-01	621280-01-01		
	UNITS	WG-161413446- 20170727-AV03	QC Batch	WG-161413446- 20170727-AV04	WG-161413446- 20170727-AV04 Lab-Dup	RDL	QC Batch

Calculated Parameters

Anion Sum	me/L	7.39	5093524	6.77		N/A	5093524
Bicarb. Alkalinity (calc. as CaCO ₃)	mg/L	350	5093371	250		1.0	5093371
Calculated TDS	mg/L	390	5093528	350		1.0	5093528
Carb. Alkalinity (calc. as CaCO ₃)	mg/L	3.1	5093371	3.1		1.0	5093371
Cation Sum	me/L	8.73	5093524	6.07		N/A	5093524
Hardness (CaCO ₃)	mg/L	420	5094212	260		1.0	5094212
Ion Balance (% Difference)	%	8.32	5093523	5.43		N/A	5093523
Langelier Index (@ 20C)	N/A	1.09	5093525	0.788			5093525
Langelier Index (@ 4C)	N/A	0.837	5093527	0.540			5093527
Saturation pH (@ 20C)	N/A	6.90	5093525	7.33			5093525
Saturation pH (@ 4C)	N/A	7.15	5093527	7.58			5093527

Inorganics

Total Ammonia-N	mg/L	0.11	5095854	0.20		0.050	5095854
Conductivity	umho/cm	770	5095711	550		1.0	5095711
Dissolved Organic Carbon	mg/L	0.87	5097229	1.3	1.3	0.20	5097229
Orthophosphate (P)	mg/L	<0.010	5097365	<0.010		0.010	5097365
pH	pH	7.98	5095713	8.12			5095713
Dissolved Sulphate (SO ₄)	mg/L	7.5	5097364	62		1.0	5102916
Alkalinity (Total as CaCO ₃)	mg/L	350	5095704	260		1.0	5102683
Dissolved Chloride (Cl)	mg/L	8.5	5097358	14		1.0	5102906
Nitrite (N)	mg/L	0.020	5095712	<0.010		0.010	5095712
Nitrate (N)	mg/L	<0.10	5095712	<0.10		0.10	5095712
Nitrate + Nitrite (N)	mg/L	<0.10	5095712	<0.10		0.10	5095712

Metals

Dissolved Aluminum (Al)	mg/L	<0.0050	5096206	<0.0050		0.0050	5096206
Dissolved Antimony (Sb)	mg/L	<0.00050	5096206	<0.00050		0.00050	5096206
Dissolved Arsenic (As)	mg/L	<0.0010	5096206	0.0014		0.0010	5096206
Dissolved Barium (Ba)	mg/L	0.32	5096206	0.14		0.0020	5096206
Dissolved Beryllium (Be)	mg/L	<0.00050	5096206	<0.00050		0.00050	5096206
Dissolved Boron (B)	mg/L	0.024	5096206	0.039		0.010	5096206
Dissolved Cadmium (Cd)	mg/L	<0.00010	5096206	<0.00010		0.00010	5096206

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI614		EVI615	EVI615		
Sampling Date		2017/07/27 10:41		2017/07/27 10:57	2017/07/27 10:57		
COC Number		621280-01-01		621280-01-01	621280-01-01		
	UNITS	WG-161413446- 20170727-AV03	QC Batch	WG-161413446- 20170727-AV04	WG-161413446- 20170727-AV04 Lab-Dup	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	100	5096206	49		0.20	5096206
Dissolved Chromium (Cr)	mg/L	<0.0050	5096206	<0.0050		0.0050	5096206
Dissolved Cobalt (Co)	mg/L	0.00087	5096206	0.00092		0.00050	5096206
Dissolved Copper (Cu)	mg/L	<0.0010	5096206	<0.0010		0.0010	5096206
Dissolved Iron (Fe)	mg/L	<0.10	5096206	<0.10		0.10	5096206
Dissolved Lead (Pb)	mg/L	<0.00050	5096206	<0.00050		0.00050	5096206
Dissolved Magnesium (Mg)	mg/L	40	5096206	34		0.050	5096206
Dissolved Manganese (Mn)	mg/L	0.18	5096206	0.21		0.0020	5096206
Dissolved Molybdenum (Mo)	mg/L	0.0026	5096206	0.0036		0.00050	5096206
Dissolved Nickel (Ni)	mg/L	0.0036	5096206	0.0025		0.0010	5096206
Dissolved Phosphorus (P)	mg/L	<0.10	5096206	<0.10		0.10	5096206
Dissolved Potassium (K)	mg/L	3.5	5096206	3.6		0.20	5096206
Dissolved Selenium (Se)	mg/L	<0.0020	5096206	<0.0020		0.0020	5096206
Dissolved Silicon (Si)	mg/L	7.4	5096206	6.1		0.050	5096206
Dissolved Silver (Ag)	mg/L	<0.00010	5096206	<0.00010		0.00010	5096206
Dissolved Sodium (Na)	mg/L	6.8	5096206	16		0.10	5096206
Dissolved Strontium (Sr)	mg/L	0.44	5096206	0.68		0.0010	5096206
Dissolved Thallium (Tl)	mg/L	<0.000050	5096206	<0.000050		0.000050	5096206
Dissolved Titanium (Ti)	mg/L	<0.0050	5096206	<0.0050		0.0050	5096206
Dissolved Uranium (U)	mg/L	0.0011	5096206	0.0056		0.00010	5096206
Dissolved Vanadium (V)	mg/L	<0.00050	5096206	0.00053		0.00050	5096206
Dissolved Zinc (Zn)	mg/L	<0.0050	5096206	0.0060		0.0050	5096206
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate							

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI616			EVI617		
Sampling Date		2017/07/27 11:23			2017/07/27 11:49		
COC Number		621280-01-01			621280-01-01		
	UNITS	WG-161413446- 20170727-AV05	RDL	QC Batch	WG-161413446- 20170727-AV06	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	9.09	N/A	5093524	16.5	N/A	5093524
Bicarb. Alkalinity (calc. as CaCO ₃)	mg/L	390	1.0	5093371	370	1.0	5093371
Calculated TDS	mg/L	460	1.0	5093528	970	1.0	5093528
Carb. Alkalinity (calc. as CaCO ₃)	mg/L	3.1	1.0	5093371	2.4	1.0	5093371
Cation Sum	me/L	8.97	N/A	5093524	16.9	N/A	5093524
Hardness (CaCO ₃)	mg/L	420	1.0	5094212	800	1.0	5094212
Ion Balance (% Difference)	%	0.670	N/A	5093523	1.39	N/A	5093523
Langelier Index (@ 20C)	N/A	1.15		5093525	1.22		5093525
Langelier Index (@ 4C)	N/A	0.900		5093527	0.977		5093527
Saturation pH (@ 20C)	N/A	6.77		5093525	6.62		5093525
Saturation pH (@ 4C)	N/A	7.02		5093527	6.87		5093527
Inorganics							
Total Ammonia-N	mg/L	0.054	0.050	5095595	0.31	0.050	5095854
Conductivity	umho/cm	830	1.0	5097266	1400	1.0	5097266
Dissolved Organic Carbon	mg/L	1.1	0.20	5095623	2.7	0.20	5095623
Orthophosphate (P)	mg/L	<0.010	0.010	5099464	<0.010	0.010	5097365
pH	pH	7.92		5097267	7.85		5097267
Dissolved Sulphate (SO ₄)	mg/L	8.0	1.0	5099462	390	2.0	5097364
Alkalinity (Total as CaCO ₃)	mg/L	400	1.0	5097265	370	1.0	5097265
Dissolved Chloride (Cl)	mg/L	36	1.0	5099461	33	1.0	5097358
Nitrite (N)	mg/L	0.018	0.010	5096281	<0.010	0.010	5096281
Nitrate (N)	mg/L	<0.10	0.10	5096281	<0.10	0.10	5096281
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	5096281	<0.10	0.10	5096281
Metals							
Dissolved Aluminum (Al)	mg/L	<0.0050	0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Antimony (Sb)	mg/L	<0.00050	0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Arsenic (As)	mg/L	<0.0010	0.0010	5096206	<0.0010	0.0010	5096206
Dissolved Barium (Ba)	mg/L	0.13	0.0020	5096206	0.071	0.0020	5096206
Dissolved Beryllium (Be)	mg/L	<0.00050	0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Boron (B)	mg/L	0.015	0.010	5096206	0.30	0.010	5096206
Dissolved Cadmium (Cd)	mg/L	<0.00010	0.00010	5096206	<0.00010	0.00010	5096206
RDL = Reportable Detection Limit							
QC Batch = Quality Control Batch							
N/A = Not Applicable							

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI616			EVI617		
Sampling Date		2017/07/27 11:23			2017/07/27 11:49		
COC Number		621280-01-01			621280-01-01		
	UNITS	WG-161413446- 20170727-AV05	RDL	QC Batch	WG-161413446- 20170727-AV06	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	120	0.20	5096206	230	0.20	5096206
Dissolved Chromium (Cr)	mg/L	<0.0050	0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Cobalt (Co)	mg/L	0.00079	0.00050	5096206	0.00057	0.00050	5096206
Dissolved Copper (Cu)	mg/L	<0.0010	0.0010	5096206	<0.0010	0.0010	5096206
Dissolved Iron (Fe)	mg/L	<0.10	0.10	5096206	0.59	0.10	5096206
Dissolved Lead (Pb)	mg/L	<0.00050	0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Magnesium (Mg)	mg/L	26	0.050	5096206	57	0.050	5096206
Dissolved Manganese (Mn)	mg/L	0.36	0.0020	5096206	0.73	0.0020	5096206
Dissolved Molybdenum (Mo)	mg/L	0.0012	0.00050	5096206	0.00055	0.00050	5096206
Dissolved Nickel (Ni)	mg/L	0.0025	0.0010	5096206	0.0012	0.0010	5096206
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	5096206	<0.10	0.10	5096206
Dissolved Potassium (K)	mg/L	2.5	0.20	5096206	1.8	0.20	5096206
Dissolved Selenium (Se)	mg/L	<0.0020	0.0020	5096206	<0.0020	0.0020	5096206
Dissolved Silicon (Si)	mg/L	5.3	0.050	5096206	5.8	0.050	5096206
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	5096206	<0.00010	0.00010	5096206
Dissolved Sodium (Na)	mg/L	12	0.10	5096206	21	0.10	5096206
Dissolved Strontium (Sr)	mg/L	0.20	0.0010	5096206	2.1	0.0010	5096206
Dissolved Thallium (Tl)	mg/L	<0.000050	0.000050	5096206	<0.000050	0.000050	5096206
Dissolved Titanium (Ti)	mg/L	<0.0050	0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Uranium (U)	mg/L	0.0046	0.00010	5096206	0.0041	0.00010	5096206
Dissolved Vanadium (V)	mg/L	<0.00050	0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Zinc (Zn)	mg/L	<0.0050	0.0050	5096206	0.0075	0.0050	5096206
RDL = Reportable Detection Limit							
QC Batch = Quality Control Batch							

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI617			EVI618		
Sampling Date		2017/07/27 11:49			2017/07/27 12:05		
COC Number		621280-01-01			621280-01-01		
	UNITS	WG-161413446- 20170727-AV06 Lab-Dup	RDL	QC Batch	WG-161413446- 20170727-AV07	RDL	QC Batch

Calculated Parameters							
Anion Sum	me/L		N/A	5093524	10.9	N/A	5093524
Bicarb. Alkalinity (calc. as CaCO ₃)	mg/L		1.0	5093371	370	1.0	5093371
Calculated TDS	mg/L		1.0	5093528	610	1.0	5093528
Carb. Alkalinity (calc. as CaCO ₃)	mg/L		1.0	5093371	2.1	1.0	5093371
Cation Sum	me/L		N/A	5093524	10.8	N/A	5093524
Hardness (CaCO ₃)	mg/L		1.0	5094212	470	1.0	5094212
Ion Balance (% Difference)	%		N/A	5093523	0.640	N/A	5093523
Langelier Index (@ 20C)	N/A			5093525	1.02		5093525
Langelier Index (@ 4C)	N/A			5093527	0.769		5093527
Saturation pH (@ 20C)	N/A			5093525	6.77		5093525
Saturation pH (@ 4C)	N/A			5093527	7.02		5093527

Inorganics							
Total Ammonia-N	mg/L		0.050	5095854	0.98	0.050	5095854
Conductivity	umho/cm		1.0	5097266	940	1.0	5095711
Dissolved Organic Carbon	mg/L		0.20	5095623	2.4	0.20	5095623
Orthophosphate (P)	mg/L		0.010	5097365	<0.010	0.010	5097365
pH	pH			5097267	7.79		5095713
Dissolved Sulphate (SO ₄)	mg/L		2.0	5097364	140	1.0	5097364
Alkalinity (Total as CaCO ₃)	mg/L		1.0	5097265	370	1.0	5095704
Dissolved Chloride (Cl)	mg/L		1.0	5097358	20	1.0	5097358
Nitrite (N)	mg/L	0.011	0.010	5096281	<0.010	0.010	5096281
Nitrate (N)	mg/L	<0.10	0.10	5096281	<0.10	0.10	5096281
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	5096281	<0.10	0.10	5096281

Metals							
Dissolved Aluminum (Al)	mg/L		0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Antimony (Sb)	mg/L		0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Arsenic (As)	mg/L		0.0010	5096206	<0.0010	0.0010	5096206
Dissolved Barium (Ba)	mg/L		0.0020	5096206	0.19	0.0020	5096206
Dissolved Beryllium (Be)	mg/L		0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Boron (B)	mg/L		0.010	5096206	0.028	0.010	5096206

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EVI617			EVI618		
Sampling Date		2017/07/27 11:49			2017/07/27 12:05		
COC Number		621280-01-01			621280-01-01		
	UNITS	WG-161413446- 20170727-AV06 Lab-Dup	RDL	QC Batch	WG-161413446- 20170727-AV07	RDL	QC Batch
Dissolved Cadmium (Cd)	mg/L		0.00010	5096206	<0.00010	0.00010	5096206
Dissolved Calcium (Ca)	mg/L		0.20	5096206	140	0.20	5096206
Dissolved Chromium (Cr)	mg/L		0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Cobalt (Co)	mg/L		0.00050	5096206	0.00068	0.00050	5096206
Dissolved Copper (Cu)	mg/L		0.0010	5096206	0.0017	0.0010	5096206
Dissolved Iron (Fe)	mg/L		0.10	5096206	<0.10	0.10	5096206
Dissolved Lead (Pb)	mg/L		0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Magnesium (Mg)	mg/L		0.050	5096206	28	0.050	5096206
Dissolved Manganese (Mn)	mg/L		0.0020	5096206	0.31	0.0020	5096206
Dissolved Molybdenum (Mo)	mg/L		0.00050	5096206	0.0050	0.00050	5096206
Dissolved Nickel (Ni)	mg/L		0.0010	5096206	0.0012	0.0010	5096206
Dissolved Phosphorus (P)	mg/L		0.10	5096206	<0.10	0.10	5096206
Dissolved Potassium (K)	mg/L		0.20	5096206	1.8	0.20	5096206
Dissolved Selenium (Se)	mg/L		0.0020	5096206	<0.0020	0.0020	5096206
Dissolved Silicon (Si)	mg/L		0.050	5096206	9.6	0.050	5096206
Dissolved Silver (Ag)	mg/L		0.00010	5096206	<0.00010	0.00010	5096206
Dissolved Sodium (Na)	mg/L		0.10	5096206	31	0.10	5096206
Dissolved Strontium (Sr)	mg/L		0.0010	5096206	0.41	0.0010	5096206
Dissolved Thallium (Tl)	mg/L		0.000050	5096206	<0.000050	0.000050	5096206
Dissolved Titanium (Ti)	mg/L		0.0050	5096206	<0.0050	0.0050	5096206
Dissolved Uranium (U)	mg/L		0.00010	5096206	0.0048	0.00010	5096206
Dissolved Vanadium (V)	mg/L		0.00050	5096206	<0.00050	0.00050	5096206
Dissolved Zinc (Zn)	mg/L		0.0050	5096206	<0.0050	0.0050	5096206
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate							

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

TEST SUMMARY

Maxxam ID: EVI612
Sample ID: WG-161413446-20170726-AV01
Matrix: Water

Collected: 2017/07/25
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5095704	N/A	2017/07/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/07/31	Automated Statchk
Chloride by Automated Colourimetry	KONE	5099461	N/A	2017/08/01	Deonarine Ramnarine
Conductivity	AT	5095711	N/A	2017/07/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5095623	N/A	2017/07/28	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5095854	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5095712	N/A	2017/08/01	Chandra Nandlal
pH	AT	5095713	N/A	2017/07/29	Surinder Rai
Orthophosphate	KONE	5099464	N/A	2017/08/01	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5099462	N/A	2017/08/01	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam ID: EVI613
Sample ID: WG-161413446-20170727-AV02
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5097265	N/A	2017/08/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/08/01	Automated Statchk
Chloride by Automated Colourimetry	KONE	5097358	N/A	2017/07/31	Deonarine Ramnarine
Conductivity	AT	5097266	N/A	2017/08/01	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5097229	N/A	2017/08/01	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5098497	N/A	2017/08/02	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5096281	N/A	2017/07/31	Chandra Nandlal
pH	AT	5097267	N/A	2017/08/01	Surinder Rai
Orthophosphate	KONE	5097365	N/A	2017/07/31	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5097364	N/A	2017/07/31	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

TEST SUMMARY

Maxxam ID: EVI614
Sample ID: WG-161413446-20170727-AV03
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5095704	N/A	2017/07/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/07/31	Automated Statchk
Chloride by Automated Colourimetry	KONE	5097358	N/A	2017/07/31	Deonarine Ramnarine
Conductivity	AT	5095711	N/A	2017/07/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5097229	N/A	2017/08/01	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5095854	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5095712	N/A	2017/08/01	Chandra Nandlal
pH	AT	5095713	N/A	2017/07/29	Surinder Rai
Orthophosphate	KONE	5097365	N/A	2017/07/31	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5097364	N/A	2017/07/31	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam ID: EVI615
Sample ID: WG-161413446-20170727-AV04
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5102683	N/A	2017/08/03	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/07/31	Automated Statchk
Chloride by Automated Colourimetry	KONE	5102906	N/A	2017/08/03	Alina Dobreanu
Conductivity	AT	5095711	N/A	2017/07/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5097229	N/A	2017/08/01	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5095854	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5095712	N/A	2017/08/01	Chandra Nandlal
pH	AT	5095713	N/A	2017/07/29	Surinder Rai
Orthophosphate	KONE	5097365	N/A	2017/07/31	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5102916	N/A	2017/08/03	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

TEST SUMMARY

Maxxam ID: EVI615 Dup
Sample ID: WG-161413446-20170727-AV04
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5097229	N/A	2017/08/01	Azadeh Shahbazi

Maxxam ID: EVI616
Sample ID: WG-161413446-20170727-AV05
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5097265	N/A	2017/08/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/08/01	Automated Statchk
Chloride by Automated Colourimetry	KONE	5099461	N/A	2017/08/01	Deonarine Ramnarine
Conductivity	AT	5097266	N/A	2017/08/01	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5095623	N/A	2017/07/28	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5095595	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5096281	N/A	2017/07/31	Chandra Nandlal
pH	AT	5097267	N/A	2017/08/01	Surinder Rai
Orthophosphate	KONE	5099464	N/A	2017/08/01	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5099462	N/A	2017/08/01	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam ID: EVI617
Sample ID: WG-161413446-20170727-AV06
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5097265	N/A	2017/08/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/08/01	Automated Statchk
Chloride by Automated Colourimetry	KONE	5097358	N/A	2017/07/31	Deonarine Ramnarine
Conductivity	AT	5097266	N/A	2017/08/01	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5095623	N/A	2017/07/28	Azadeh Shahbazi
Hardness (calculated as CaCO ₃)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH ₄	5095854	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO ₃) and Nitrite (NO ₂) in Water	LACH	5096281	N/A	2017/07/31	Chandra Nandlal
pH	AT	5097267	N/A	2017/08/01	Surinder Rai
Orthophosphate	KONE	5097365	N/A	2017/07/31	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk

Maxxam Job #: B7G0832
Report Date: 2017/08/03

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

TEST SUMMARY

Maxxam ID: EVI617
Sample ID: WG-161413446-20170727-AV06
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate by Automated Colourimetry	KONE	5097364	N/A	2017/07/31	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

Maxxam ID: EVI617 Dup
Sample ID: WG-161413446-20170727-AV06
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5096281	N/A	2017/07/31	Chandra Nandlal

Maxxam ID: EVI618
Sample ID: WG-161413446-20170727-AV07
Matrix: Water

Collected: 2017/07/27
Shipped:
Received: 2017/07/27

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5095704	N/A	2017/07/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5093371	N/A	2017/07/31	Automated Statchk
Chloride by Automated Colourimetry	KONE	5097358	N/A	2017/07/31	Deonarine Ramnarine
Conductivity	AT	5095711	N/A	2017/07/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5095623	N/A	2017/07/28	Azadeh Shahbazi
Hardness (calculated as CaCO3)		5094212	N/A	2017/08/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5096206	N/A	2017/08/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	5093523	N/A	2017/08/02	Automated Statchk
Anion and Cation Sum	CALC	5093524	N/A	2017/08/02	Automated Statchk
Total Ammonia-N	LACH/NH4	5095854	N/A	2017/07/31	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5096281	N/A	2017/07/31	Chandra Nandlal
pH	AT	5095713	N/A	2017/07/29	Surinder Rai
Orthophosphate	KONE	5097365	N/A	2017/07/31	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5093525	N/A	2017/08/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5093527	N/A	2017/08/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5097364	N/A	2017/07/31	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5093528	N/A	2017/08/02	Automated Statchk

GENERAL COMMENTS

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

Package 1	6.3°C
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Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5095595	Total Ammonia-N	2017/07/31	103	80 - 120	101	85 - 115	<0.050	mg/L	NC	20
5095623	Dissolved Organic Carbon	2017/07/28	97	80 - 120	99	80 - 120	<0.20	mg/L	0.25	20
5095704	Alkalinity (Total as CaCO3)	2017/07/28			97	85 - 115	<1.0	mg/L	6.0	20
5095711	Conductivity	2017/07/28			100	85 - 115	<1.0	umho/cm	0.21	25
5095712	Nitrate (N)	2017/08/01	114	80 - 120	103	80 - 120	<0.10	mg/L	NC	20
5095712	Nitrite (N)	2017/08/01	96	80 - 120	96	80 - 120	<0.010	mg/L	1.5	20
5095713	pH	2017/07/28			101	98 - 103			0.36	N/A
5095854	Total Ammonia-N	2017/07/31	93	80 - 120	99	85 - 115	<0.050	mg/L	0.61	20
5096206	Dissolved Aluminum (Al)	2017/08/02	105	80 - 120	99	80 - 120	<0.0050	mg/L		
5096206	Dissolved Antimony (Sb)	2017/08/02	110	80 - 120	104	80 - 120	<0.00050	mg/L	1.4	20
5096206	Dissolved Arsenic (As)	2017/08/02	105	80 - 120	101	80 - 120	<0.0010	mg/L	3.4	20
5096206	Dissolved Barium (Ba)	2017/08/02	105	80 - 120	99	80 - 120	<0.0020	mg/L	2.2	20
5096206	Dissolved Beryllium (Be)	2017/08/02	105	80 - 120	99	80 - 120	<0.00050	mg/L	NC	20
5096206	Dissolved Boron (B)	2017/08/02	101	80 - 120	96	80 - 120	<0.010	mg/L	4.7	20
5096206	Dissolved Cadmium (Cd)	2017/08/02	107	80 - 120	102	80 - 120	<0.00010	mg/L	NC	20
5096206	Dissolved Calcium (Ca)	2017/08/02	NC	80 - 120	96	80 - 120	<0.20	mg/L		
5096206	Dissolved Chromium (Cr)	2017/08/02	100	80 - 120	95	80 - 120	<0.0050	mg/L	NC	20
5096206	Dissolved Cobalt (Co)	2017/08/02	103	80 - 120	99	80 - 120	<0.00050	mg/L	NC	20
5096206	Dissolved Copper (Cu)	2017/08/02	104	80 - 120	103	80 - 120	<0.0010	mg/L	4.7	20
5096206	Dissolved Iron (Fe)	2017/08/02	104	80 - 120	100	80 - 120	<0.10	mg/L		
5096206	Dissolved Lead (Pb)	2017/08/02	104	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20
5096206	Dissolved Magnesium (Mg)	2017/08/02	100	80 - 120	99	80 - 120	<0.050	mg/L		
5096206	Dissolved Manganese (Mn)	2017/08/02	102	80 - 120	98	80 - 120	<0.0020	mg/L		
5096206	Dissolved Molybdenum (Mo)	2017/08/02	109	80 - 120	99	80 - 120	<0.00050	mg/L	3.3	20
5096206	Dissolved Nickel (Ni)	2017/08/02	102	80 - 120	99	80 - 120	<0.0010	mg/L	8.2	20
5096206	Dissolved Phosphorus (P)	2017/08/02	107	80 - 120	104	80 - 120	<0.10	mg/L		
5096206	Dissolved Potassium (K)	2017/08/02	106	80 - 120	102	80 - 120	<0.20	mg/L		
5096206	Dissolved Selenium (Se)	2017/08/02	104	80 - 120	98	80 - 120	<0.0020	mg/L	NC	20
5096206	Dissolved Silicon (Si)	2017/08/02	105	80 - 120	99	80 - 120	<0.050	mg/L		
5096206	Dissolved Silver (Ag)	2017/08/02	101	80 - 120	97	80 - 120	<0.00010	mg/L	NC	20
5096206	Dissolved Sodium (Na)	2017/08/02	104	80 - 120	100	80 - 120	<0.10	mg/L	4.1	20

QUALITY ASSURANCE REPORT(CONT'D)

Stantec Consulting Ltd
Client Project #: 161413446
Sampler Initials: AV

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5096206	Dissolved Strontium (Sr)	2017/08/02	102	80 - 120	98	80 - 120	<0.0010	mg/L		
5096206	Dissolved Thallium (Tl)	2017/08/02	104	80 - 120	100	80 - 120	<0.000050	mg/L	NC	20
5096206	Dissolved Titanium (Ti)	2017/08/02	102	80 - 120	99	80 - 120	<0.0050	mg/L		
5096206	Dissolved Uranium (U)	2017/08/02	104	80 - 120	99	80 - 120	<0.00010	mg/L	4.9	20
5096206	Dissolved Vanadium (V)	2017/08/02	102	80 - 120	97	80 - 120	<0.00050	mg/L	NC	20
5096206	Dissolved Zinc (Zn)	2017/08/02	104	80 - 120	100	80 - 120	<0.0050	mg/L	NC	20
5096281	Nitrate (N)	2017/07/31	111	80 - 120	102	80 - 120	<0.10	mg/L	NC	20
5096281	Nitrite (N)	2017/07/31	101	80 - 120	97	80 - 120	<0.010	mg/L	10	20
5097229	Dissolved Organic Carbon	2017/08/01	97	80 - 120	98	80 - 120	<0.20	mg/L	1.4	20
5097265	Alkalinity (Total as CaCO ₃)	2017/07/31			96	85 - 115	<1.0	mg/L	19	20
5097266	Conductivity	2017/07/31			101	85 - 115	<1.0	umho/cm	0.23	25
5097267	pH	2017/07/31			102	98 - 103			1.9	N/A
5097358	Dissolved Chloride (Cl)	2017/07/31	102	80 - 120	103	80 - 120	<1.0	mg/L	1.7	20
5097364	Dissolved Sulphate (SO ₄)	2017/07/31	NC	75 - 125	100	80 - 120	<1.0	mg/L	0.82	20
5097365	Orthophosphate (P)	2017/07/31	100	75 - 125	100	80 - 120	<0.010	mg/L	NC	25
5098497	Total Ammonia-N	2017/08/02	103	80 - 120	102	85 - 115	<0.050	mg/L	20	20
5099461	Dissolved Chloride (Cl)	2017/08/01	112	80 - 120	103	80 - 120	<1.0	mg/L	NC	20
5099462	Dissolved Sulphate (SO ₄)	2017/08/01	112	75 - 125	101	80 - 120	<1.0	mg/L	0.15	20
5099464	Orthophosphate (P)	2017/08/01	89	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
5102683	Alkalinity (Total as CaCO ₃)	2017/08/03			94	85 - 115	<1.0	mg/L	1.5	20
5102906	Dissolved Chloride (Cl)	2017/08/03	NC	80 - 120	103	80 - 120	<1.0	mg/L	1.0	20
5102916	Dissolved Sulphate (SO ₄)	2017/08/03	NC	75 - 125	106	80 - 120	<1.0	mg/L	1.7	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.

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.

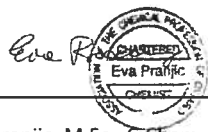
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

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).

VALIDATION SIGNATURE PAGE

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



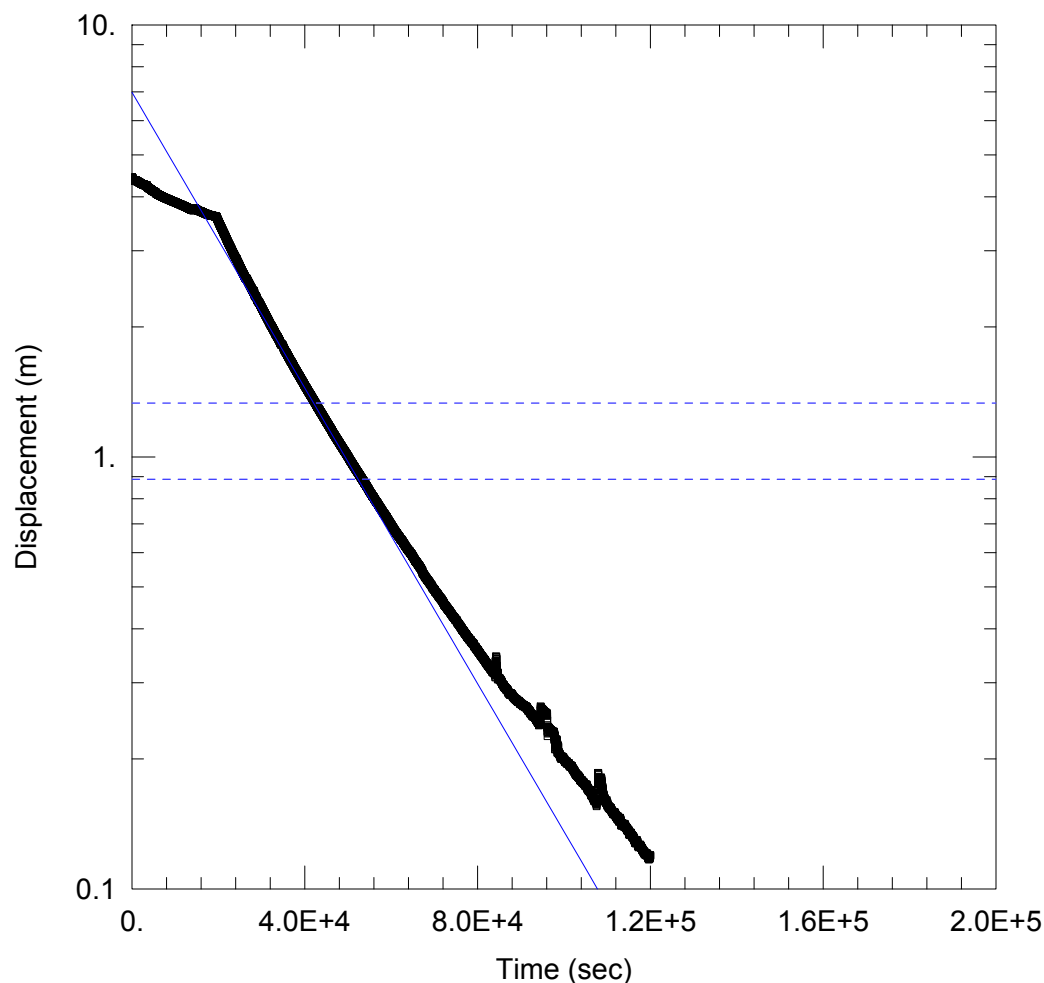
Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam		STANTEC CHAIN OF CUSTODY RECORD	
INVOICE INFORMATION Company Name: #9197 Stantec Consulting Ltd Contact Name: Accounts Payable Address: 300 Hagey Blvd Suite 100 Waterloo ON N2L 0A4 Phone: (519) 579-4410 x Fax: (519) 579-6733 x Email: accounts.payable.invoices@stantec.com		REPORT INFORMATION (if differs from invoice) Company Name: Grant Whitehead Address: 1614 Phone: (519) 595-7400 x Fax: (519) 595-7400 x Email: grant.whitehead@stantec.com	
PROJECT INFORMATION Quotation #: B52646 Task #: 161413446 Project #: 1614 Site #: A.VANDENHOFF Sampled By:		Laboratory Use Only: Maxxam Job #: Bottle Order #: COD #: Project Manager: Augustyna Dobosz	
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)	
Regulation 153 (2011) ☐ Table 1 ☐ Rad/Para ☐ Microb/Pestic ☐ CCME ☐ Sanitary Sewer Uplow ☐ Reg 558 ☐ Storm Sewer Bypass ☐ MISA ☐ Municipality ☐ PWDO ☐ Other: <u>ODWS</u>		Special Instructions	
Include Criteria on Certificate of Analysis (Y/N)?		Field Filtered (please circle) Metals / Hg / Cr / V	
Sample Barcode Label:	Sample Location/Identification:	Date Sampled:	Time Sampled:
1	WG-151413446-20170726-AV01	25-Jul	9:06
2	20170727-AV01	27-Jul	10:17
3	-AV03		10:41
4	-AV04		10:57
5	-AV05		11:23
6	-AV06		11:49
7	-AV07		12:05
8			
9			
10			
RELINQUISHED BY: (Signature/Print) A. J. VAN DER HORST		RECEIVED BY: (Signature/Print) Waverly Kucuk	
Date (YYMMDD): 17/07/17		Date (YYMMDD): 17/07/17	
Time: 15:35		Time: 15:34	
# Jars used and not submitted:		Laboratory Use Only:	
Time Sampled:		Temperature (°C) on Receipt:	
Preservation:		Custody Seal:	
Yes		Yes	
No		No	
White Maxxam Yellow Client		White Maxxam Yellow Client	
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM			

APPENDIX G:

Hydraulic Conductivity Analytical Solutions



WELL TEST ANALYSIS

Data Set: W:\active\161413446\planning\field_data\k-tests\aqtesol\BH05-17_K-test.aqt

Date: 07/11/17

Time: 16:27:40

PROJECT INFORMATION

Company: Stantec Consulting

Client: City of Waterloo

Project: 161413446

Location: Waterloo, Ontario

Test Well: BH05-17

Test Date: 18-May-17

AQUIFER DATA

Saturated Thickness: 4.7 m

Anisotropy Ratio (K_z/K_r): 0.5

WELL DATA (MW5-17)

Initial Displacement: 4.44 m

Static Water Column Height: 4.7 m

Total Well Penetration Depth: 4.7 m

Screen Length: 1.52 m

Casing Radius: 0.0254 m

Well Radius: 0.1048 m

Gravel Pack Porosity: 0.3

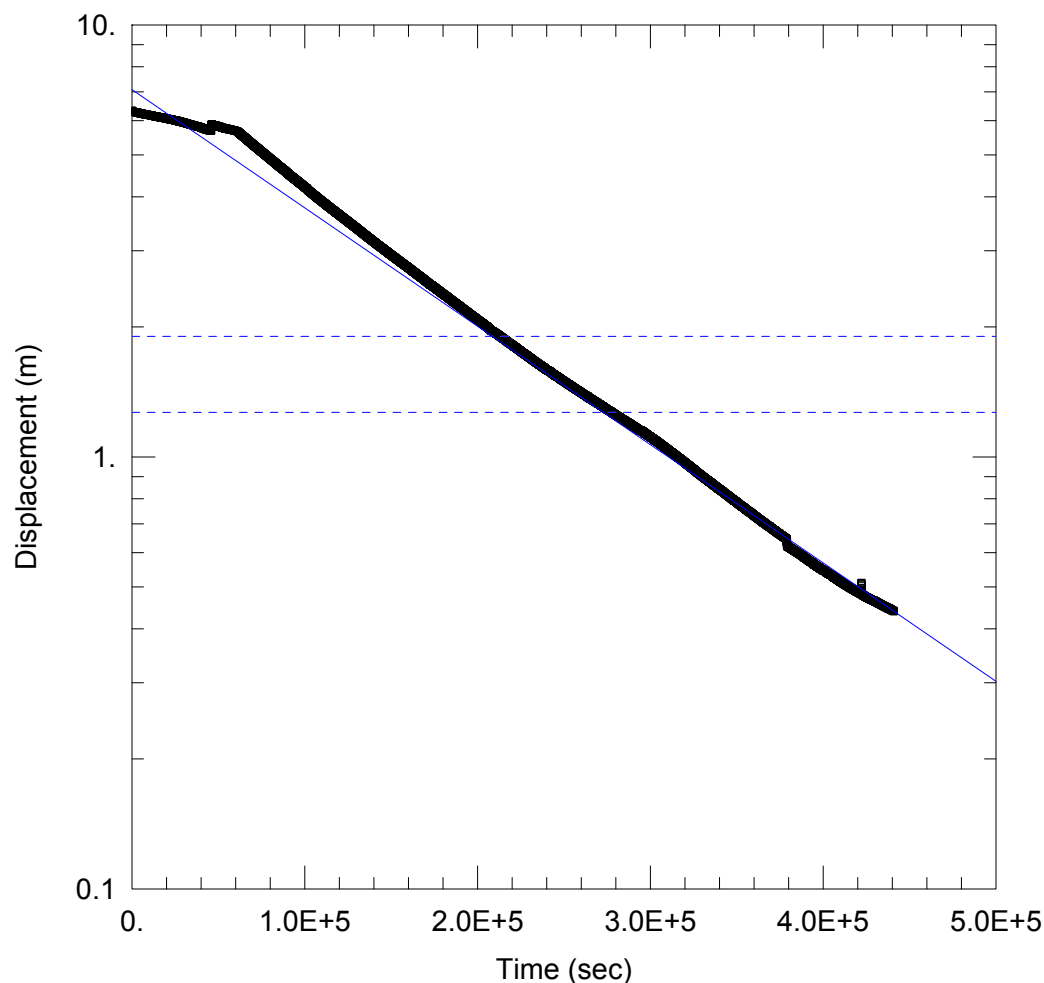
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 1.4E-7$ m/sec

$y_0 = 6.981$ m



WELL TEST ANALYSIS

Data Set: W:\active\161413446\planning\field_data\k-tests\aqtesolv\BH07-17_K-test.aqt

Date: 07/11/17

Time: 16:37:11

PROJECT INFORMATION

Company: Stantec Consulting

Client: City of Waterloo

Project: 161413446

Location: Waterloo, Ontario

Test Well: BH07-17

Test Date: 18-May-17

AQUIFER DATA

Saturated Thickness: 7.08 m

Anisotropy Ratio (K_z/K_r): 0.5

WELL DATA (BH07-17)

Initial Displacement: 6.34 m

Static Water Column Height: 7.08 m

Total Well Penetration Depth: 7.08 m

Screen Length: 1.52 m

Casing Radius: 0.0254 m

Well Radius: 0.1048 m

Gravel Pack Porosity: 0.3

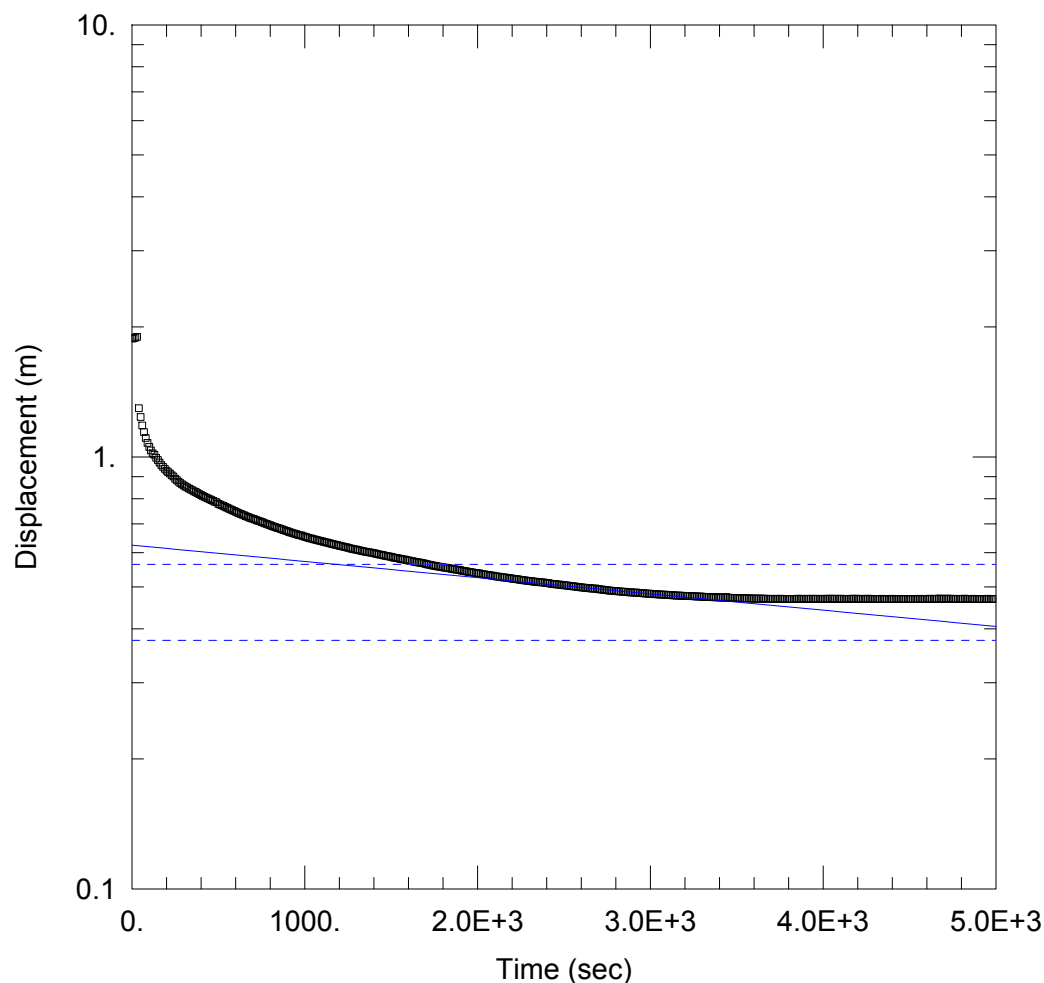
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 2.407E-8$ m/sec

$y_0 = 7.085$ m



WELL TEST ANALYSIS

Data Set: W:\active\161413446\planning\field_data\k-tests\aqtesolv\BH09-17_K-test.aqt

Date: 07/11/17

Time: 16:46:53

PROJECT INFORMATION

Company: Stantec Consulting

Client: City of Waterloo

Project: 161413446

Location: Waterloo, Ontario

Test Well: BH09-17

Test Date: 18-May-17

AQUIFER DATA

Saturated Thickness: 1.98 m

Anisotropy Ratio (K_z/K_r): 0.5

WELL DATA (BH09-17)

Initial Displacement: 1.88 m

Static Water Column Height: 1.98 m

Total Well Penetration Depth: 1.98 m

Screen Length: 1.52 m

Casing Radius: 0.0254 m

Well Radius: 0.1048 m

Gravel Pack Porosity: 0.3

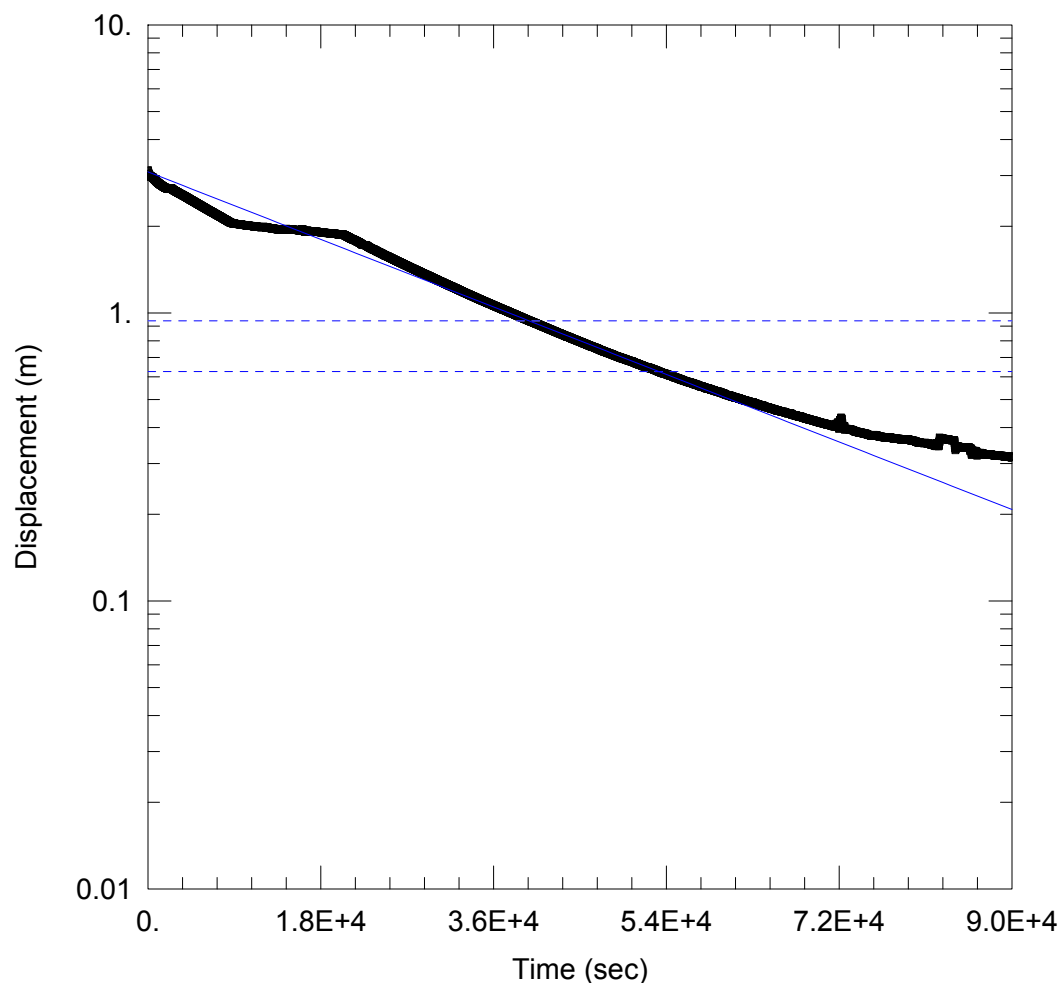
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 2.562E-7$ m/sec

$y_0 = 0.6247$ m



WELL TEST ANALYSIS

Data Set: W:\active\161413446\planning\field_data\k-tests\aqtesol\BH17-17_K-test.aqt

Date: 07/11/17

Time: 16:55:10

PROJECT INFORMATION

Company: Stantec Consulting

Client: City of Waterloo

Project: 161413446

Test Well: BH17-17

Test Date: 18-May-17

AQUIFER DATA

Saturated Thickness: 3.42 m

Anisotropy Ratio (K_z/K_r): 0.5

WELL DATA (BH17-17)

Initial Displacement: 3.13 m

Static Water Column Height: 3.42 m

Total Well Penetration Depth: 3.42 m

Screen Length: 1.52 m

Casing Radius: 0.0254 m

Well Radius: 0.1048 m

Gravel Pack Porosity: 0.3

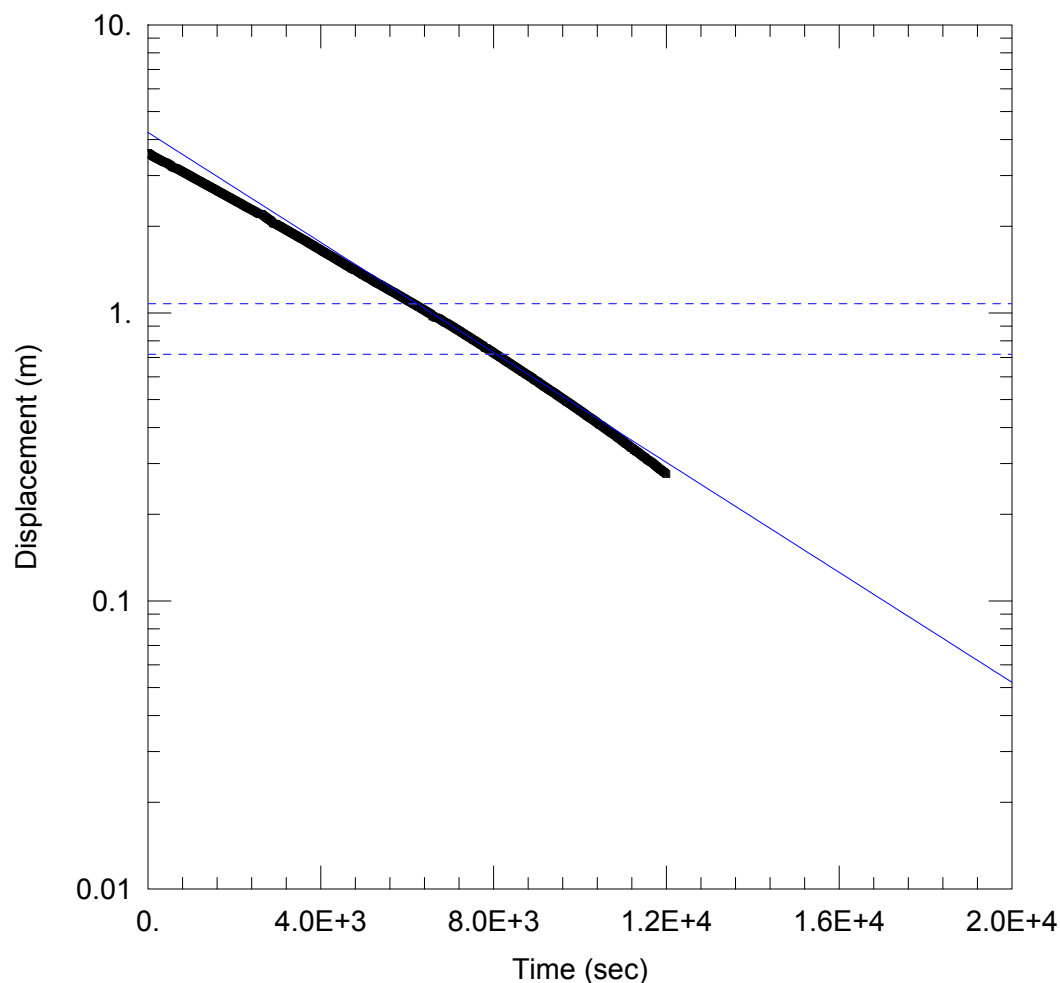
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 1.002E-7$ m/sec

$y_0 = 3.088$ m



WELL TEST ANALYSIS

Data Set: W:\active\161413446\planning\field_data\k-tests\aqtesolv\mw4-4_test 1_ah.aqt

Date: 07/11/17

Time: 17:02:09

PROJECT INFORMATION

Company: Stantec Consulting

Client: City of Waterloo

Project: 161413446

Test Well: MW7-17

Test Date: 18-May-17

AQUIFER DATA

Saturated Thickness: 4.07 m

Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (MW4-4)

Initial Displacement: 3.59 m

Static Water Column Height: 4.07 m

Total Well Penetration Depth: 4.07 m

Screen Length: 1.52 m

Casing Radius: 0.0254 m

Well Radius: 0.1048 m

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 7.603E-7 m/sec

y0 = 4.233 m