THURBER ENGINEERING LTD.

PRELIMINARY HYDROGEOLOGICAL INVESTIGATION REPORT
MUNICIPAL CLASS EA STUDY FOR KIRBY ROAD WIDENING
FROM JANE STREET TO DUFFERIN STREET
CITY OF VAUGHAN, ONTARIO

Report

to

HDR Inc.

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1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by HDR Inc. (HDR) to prepare a Hydrogeological Investigation in support of the Municipal Class Environmental Assessment (EA) study for the proposed widening of Kirby Road between Jane Street and Dufferin Street in the City of Vaughan, Ontario. It is our understanding that the City of Vaughan (the City) plans to reconstruct the roadway from two to four lanes between Jane Street and Dufferin Street (the Site), construct a grade separation of the Barrie Go Rail line crossing west of Keele Street and eliminate the jog at Jane Street. It is understood that the rail grade separation will comprise either an underpass or overpass structure to convey Kirby Road under or over the railway.

The purpose of the investigation was to establish baseline hydrogeological conditions within the Site in support of the class EA and preliminary design through subsurface investigation, including characterization of the soil and groundwater conditions. Preliminary discussion of potential construction dewatering needs is included, as well as an impact assessment and potential mitigation measures.

A geotechnical investigation was completed concurrently with the hydrogeological investigation. The results of the geotechnical investigation are reported under separate cover and should be read in conjunction with this report.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2 BACKGROUND REVIEW

2.1 Site and Project Description

The Site is an approximate 4.1 km section of the Kirby Road right-of-way (ROW) that extends between Jane Street and Dufferin Street where earthwork activities and materials management are anticipated to accommodate the proposed design. The Barrie Go Rail line crosses the Site alignment to the west of Keele Street in a north to south direction. The study area for the hydrogeological investigation was defined as 500 m from the alignment. The location and approximate boundary of the Site and Study Area are shown on Figure 1.

According to the *City of Vaughan Official Plan* (Schedule 13), the land use adjacent to the Site is low-rise residential and new community areas located to the southern side of the Site and agricultural areas and parks to the northern side of the Site. The Site (from Jane Street to Keele Street) is also a part of the Block 27 New Community Area.

2.2 Topography and Drainage

The Site is mainly located within the Don River Watershed and falls under the jurisdiction of the Toronto and Region Conservation Authority (TRCA). A small portion of the Site is also situated within the Humber River Watershed, which is also within the jurisdiction of the TRCA. The regional topography slopes southerly toward Humber River and Don River West Branch, and eventually drains into Lake Ontario. Ground surface at the Site undulates gently and elevations range from about 310 m to approximately 270 m (Figure 2). Overland flow at the Site is interpreted to follow the existing topography, with the Site draining westerly to Don River West Branch and easterly toward Don River East Branch.

2.3 Physiography

A review of the Physiographic Regions of Southern Ontario indicated that the Site is primarily located within the Physiographic Region of the South Slope, except for the east portion which extends into the Oak Ridges Moraine (ORM). The South Slope is typically a drumlinized area consisting of areas of thin (<1 m) aeolian sand deposits underlain by glacial deposits, primarily till. The ORM is comprised primarily of sandy soils and hummocky terrain. The ORM provides an important groundwater recharge area and hosts the headwaters of several rivers and streams (Chapman and Putnam, 1984). A physiographic region map of the Site and surrounding area is shown on Figure 3.

2.4 Regional Geology and Hydrogeology

Geological and hydrogeological conditions were based on publicly-available information obtained from the Ontario Geological Survey (OGS) and TRCA.

The surficial geology across the majority of the Site primarily consists of clay to silt-textured till (Till) that was derived from glaciolacustrine deposits or shale. The ORM region is dominated by ice-contact stratified deposits that mainly consist of sand and gravel with minor silt, clay and till. Figure 4 illustrates the mapped surficial geology of the Site.

The bedrock underlying the Site consists of the Blue Mountain and Georgian Bay Formation. The Blue Mountain Formation consists of shale with minor interbeds of limestone and the Georgian Bay Formation consists of shale and limestone. The bedrock surface in the area is expected to be at approximate elevation of 110 m, which is approximately 160 to 200 m below ground surface. A bedrock geology map is presented on Figure 5.

A regional west to east geological cross section along Don River watershed is provided on Figure 6. Based on a review of the regional cross section, the following units overlie the bedrock from shallowest to deepest:

- Recent Sediments;
- Halton Till (Aquitard);
- Oak Ridges Aquifer Complex (Aquifer);
- Newmarket Till (Aquitard);
- Thorncliffe Formation (Aquifer);
- Sunnybrook Drift (Aquitard); and
- Scarborough Formation (Aquifer).

The Halton Till is the uppermost overburden unit across the Site and it consists of silt to silty clay with occasional gravel. The uppermost aquifer underlying the Site is the Oak Ridges Aquifer Complex (ORAC), which is interpreted to occur where continuous layers of fine to medium sand were encountered. It is known to be unconfined near the crest of the moraine and is a regional significant recharge area. However, it is confined by the till units both to the north and south of the highland. This layer can reach a thickness of up to 150 m under the crest of the moraine but thins out rapidly towards its margins. In areas around the Site, the ORAC thickness is expected to be between 20 m and 80 m. The lower contact of the ORAC sits on the Newmarket Till that acts as a regional aquitard separating the ORAC from underlying Thorncliffe formation. The Newmarket Till is expected to be thin and/or absent in the vicinity of the Site. The Thorncliffe formation is comprised of sand, silty sand, and pebbly silt and clay deposits and it is expected to have a thickness of up to 20 m around the Site. The Sunnybrook Drift is considered as an aquitard separating the Thorncliffe Formation form the Scarborough Formation and it is interpreted to be a clast-poor, silt to silty clay unit. The water-bearing formation consists of clay, silt, and sand deposited by large, braided melt-water rivers draining from an ice sheet. The Scarborough Formation is largely found in the bedrock valleys (TRCA, 2009).

2.5 Groundwater Users

A search o the Ministry of Environment, Conservation and Parks (MECP) well records database conducted for a 500 m radius around the Site returned a total of 53 records (Figure 7), of which 25 were reported as water supply wells. It is anticipated that some of these wells are still in use and likely service the rural properties in the western portion of the Site whereas the areas around the eastern portion of the Site are likely developed and serviced with municipal water. A general

review of the water well information provided on MECP's Water Well Records database indicated that water levels were generally between depths of approximately 10 m and 40 m, with well depths ranging from approximately 20 m to 55 m. A detailed table summarizing the data provided from MECP's database is provided in Appendix A.

A search conducted in July 2020 identified no active Permits To Take Water within 500 m of the Site. Only one Environmental Activity and Sector Registry (EASR) registration (11650 Keele Street) was found within the study area.

2.6 Environmental Features

Based on regional-scale source protection mapping, the Site is not located within Wellhead Protection Areas (WHPAs) or Significant Groundwater Recharge Areas (SGRAs); however, a small portion of the Site is located within a Highly Vulnerable Aquifer (HVA). The Site is also partially located within the TRCA regulated areas in the vicinity of the tributary crossing.

A number of tributaries of the Don River West Branch, Don River East Branch, and East Humber River are located within 1 km of the Site, including the onsite tributary approximately 750 m east of Jane Street. Based on the Block 27 Subwatershed Study (Cole, 2017), the upstream reach of the onsite tributary is ephemeral. The channel flows through agricultural fields and only conveys surface flows during the spring freshet and after major rainfall events. However, the downstream of this this tributary have permanent stream flow. The tributary is located within the Greenbelt Plan Area.

As discussed in Section 2.4, the east part of the Site is within the ORM. Part of the ORM is identified as an Environmental Significant Areas (ESA), and lies within the eastern portion of the Site. It is known as Maple Spur and is an Area of Natural and Scientific Interest (ANSI).

Ministry of Natural Resources and Forestry (MNRF) online mapping indicates the Site is in close proximity to several wetlands and woodlots. Roadside ditches and/or swales generally existed along both sides of the Site. The ditches were covered with grass, vegetation and shrubs; however, gabion stones lined portions of the south ditch invert to the east of Keele Street.

The natural features located within a 1 km buffer of the Site are illustrated on Figure 8.

3 INVESTIGATION PROCEDURES

3.1 Geotechnical Drilling and Testing

Thurber conducted a geotechnical investigation at the Site in July 2020 (Thurber, 2020). Thirteen boreholes were drilled to depths ranging from 3.7 m to 31.1 m (Boreholes 20-01 to 20-13). The geotechnical borehole logs were used to understand local geology of the Site. The locations of the boreholes and monitoring wells are shown on Figure 9. Record of borehole sheets are provided in Appendix B.

Based on the borehole logs, the overburden material at the Site consists of a thin layer of asphalt or granular fill overlying a complex interbedding of native deposits consisting of silty clay till, silt and sand till, and clayey silt with interspersed layers of sand to silt. The thickness of sand to silt and sand layers ranged from 0.7 m to 3 m. This unit is believed to correspond to the ORM Aquifer.

3.2 Hydrogeological Investigation

To support the hydrogeological investigation, 12 monitoring wells, including 4 pair of nested wells, were installed in selected boreholes. Monitoring wells were considered to be shallow and deep wells depending on the depth of installation and the unit in which they were completed. Each monitoring well was developed following completion of drilling by removing a minimum of 3 well volumes of water or until dry to reduce silt or drilling debris from the sandpack and well casing. A map illustrating the location of the boreholes is provided on Figure 9.

The monitoring wells were used to measure groundwater levels, collect samples for groundwater quality analyses, and estimate hydraulic conductivity of the screened units. The nested deep and shallow monitoring wells were also installed to study the vertical groundwater gradient beneath the Site. Monitoring well details are summarized in Table 3-1.

Table 3-1 – Monitoring Well Details

Monitoring Well No.	Ground Elevation (m)	Well Depth (m)	Well Diameter (m)	Screen Length (m)	Screened Geologic Unit
20-01	271.44	4.55	0.051	1.52	Clay (till) / Sand
20-03-S	272.73	3.03	0.051	1.52	Gravelly Sand/ Organic Silt / Clay(till)

Monitoring Well No.	Ground Elevation (m)	Well Depth (m)	Well Diameter (m)	Screen Length (m)	Screened Geologic Unit
20-03-D	272.72	7.60	0.051	1.52	Silt and Sand / Clay(till)
20-05	290.97	29.13	0.051	3.05	Sand / Silt
20-06	291.49	6.64	0.038	1.52	Sand
20-07	298.20	4.35	0.051	3.05	Clay (till) / Silt and Sand
20-09-S	310.70	3.00	0.051	1.52	Clay(fill) / Organic Silt / Silt
20-09-D	310.68	6.04	0.051	1.52	Clay(till)
20-10-S	291.67	2.79	0.051	1.52	Clay(till) / Silt
20-10-D	291.73	5.94	0.051	1.52	Silt
20-12-S	295.59	2.87	0.051	1.52	Silt and Sand (fill)
20-12-D	295.65	10.65	0.051	1.52	Silt

3.3 Single Well Response Tests

Rising head single well response tests (slug tests) were carried out on all monitoring wells. The tests were completed using the following method:

- In advance of conducting the slug tests, the monitoring wells were developed by withdrawing a minimum of three well volumes of groundwater to remove excess sediment and to improve the transmissivity of the sand pack and well screen;
- Once the water level returned to a stabilized level, the static water level was measured and recorded, and a datalogger was inserted into the well approximately 1 cm to 5 cm from the bottom of the well. The datalogger was set to record water levels every 0.5 to 5 seconds, depending on the anticipated rate of recovery of each well;
- A slug of groundwater was removed from the well to induce a change in hydraulic head (rising head test);
- Manual and electronic measurements of the water level were recorded until the water level in the well recovered sufficiently, and

- Manual measurements were compared to electronic measurements for quality control of the data.

3.4 Groundwater Sampling and Chemical Analysis

Groundwater quality samples were collected from selected wells for the purpose of considering disposal options and potential treatment needs at a preliminary level. The results obtained herein were representative of the water sampled from the selected wells at the time of sampling and provide a general understanding of groundwater quality under those conditions; however, the water quality may vary significantly from the results obtained based on location, time, meteorological conditions, and in particular based on construction and dewatering methods. The concentration of suspended solids in the groundwater or in water that is collected during construction dewatering (e.g., from a sump in an open excavation) will significantly affect the concentrations of many regulated parameters, particularly metals. The value of testing groundwater quality during the investigation is primarily to identify the types of contaminants that may need to be managed, the extent to which they are dissolved and therefore unlikely to be filtered by physical means alone, and the presence of anthropogenic contaminants that are listed in the given discharge criteria that may require specific treatment.

The monitoring wells were developed on July 21, 2020, prior to any sampling or in-situ testing, by purging at least three well volumes or to dry to increase the representativeness of the natural groundwater in the well. Development was assessed to be completed based on the number of well volumes purged, stabilization of general chemistry parameters of the pumped groundwater (pH, temperature, conductivity) over time, and qualitative observations such as a decrease in turbidity of the pumped water.

Groundwater quality samples were collected from 3 monitoring wells (20-03D, 20-06, and 20-09D) on July 29, 2020.The collected samples were sent to SGS Canada Inc. (SGS) for testing against the City of Vaughan Sewer By-law as well as comparison of various parameters such as metals, inorganics and general chemistry parameters to the Provincial Water Quality Objectives (PWQO). In addition to the unfiltered samples, a filtered metals and Total Suspended Solids (TSS) sample was submitted to estimate the extent to which these components can be filtered.

4 TESTING RESULTS AND ANALYSIS

4.1 Groundwater Levels

Groundwater levels at monitoring wells were measured manually on July 28 and September 25, 2020, as summarized in Table 4-1. Additionally, data loggers were installed in 8 monitoring wells to record hourly groundwater levels and capture the range of water level fluctuations at these locations in greater detail.

Table 4-1 – Measured Groundwater Levels at Monitoring Wells

Monitoring Well No.	Ground Elevation (m)	July 28, 2020		September 25, 2020	
		Depth (m)	Elev. (m)	Depth (m)	Elev. (m)
20-01	271.44	2.8	268.6	3.2	268.2
20-03-S	272.73	dry	dry	dry	dry
20-03-D	272.72	4.5	268.2	5.1	267.6
20-05	290.97	26.0	265.0	26.1	264.8
20-06	291.49	3.2	288.3	3.4	288.1
20-07	298.20	2.3	295.9	2.6	295.6
20-09-S	310.70	1.8	308.9	2.00	308.7
20-09-D	310.68	1.7	308.9	2.0	308.7
20-10-S	291.67	dry	dry	dry	dry
20-10-D	291.73	dry	dry	dry	dry
20-12-S	295.59	dry	dry	dry	dry
20-12-D	295.65	10.2	285.4	10.6	285.1

The water level elevations in the monitoring wells ranged from 265.0 m to 308.9 m. The highest groundwater level (Elev.308.9 m, depth 1.8 m) was measured in Monitoring Well 20-09D and the lowest water level (Elev. 265.0 m, depth 26.1 m) was measured in Monitoring Well 20-05.

Based on the measured groundwater levels on July 28, 2020, the local shallow lateral groundwater flow generally follows Site topography. Shallow groundwater in the eastern portion of the Site (within the ORAC) flows easterly toward Don River East Branch while shallow groundwater in the western portion of the Site flows westerly toward Don River West Branch.

Additional groundwater level monitoring events of onsite wells will be conducted on a bi-monthly basis for a duration of two years to July 2022 to capture seasonal groundwater level fluctuations. The additional monitoring results and observed long-term trends in groundwater levels at the Site will be documented in the updated hydrogeological investigation report which will be submitted following the completion of the monitoring program.

The vertical hydraulic gradient was also estimated at the monitoring well nests to characterize the general vertical groundwater flow at the Site. Table 4-2 below summarizes the calculated vertical hydraulic gradient at the well nest pairs for the water level monitoring events conducted on July 28 and September 25, 2020.

Table 4-2 – Calculated Vertical Hydraulic Gradient

Monitoring Well No.	Vertical Hydraulic Gradient	
	July 28, 2020	September 25, 2020
20-03-S/D	-	-
20-09-S/D	-0.01	0.00
20-10-S/D	-	-
20-12-S/D	-	-

Notes:

Negative values indicate an upward gradient; positive values indicate a downward gradient.

'-' indicates that the vertical hydraulic gradient could not be estimated due to water level measurement(s) for one or both wells being unavailable.

The magnitude of vertical hydraulic gradients observed at Monitoring Wells 20-09S/D on July 28, 2020 was estimated to be relatively small (<-0.05 m/m) and can be considered as near neutral gradient. Long-term monitoring data will be used to calculate the vertical hydraulic gradients over time to determine stabilized gradients.

4.2 Hydraulic Conductivities

Single-well hydraulic tests were conducted between July 21, 2020 and July 28, 2020 in 7 selected monitoring wells. Hydraulic conductivity estimates were obtained using the Hvorslev method (1951). Estimated K values are presented in Table 4-3. A summary of Hvorslev calculations and plots of the slug test results are presented in Appendix C.

Table 4-3 – Estimated Hydraulic Conductivities

Monitoring Well No.	Well Screen Bottom Elevation (m)	Well Screen Top Elevation (m)	Screened Geologic Unit(s)	Hydraulic Conductivity (K) (m/s)
20-01	266.92	268.44	Clay (Till) / Sand	4.8×10^{-4}
20-03-S	269.68	271.21	Gravelly Sand/ Organic Silt / Clay(Till)	-
20-03-D	265.10	266.62	Silt and Sand / Clay(Till)	7.7×10^{-5}
20-05	261.86	264.91	Sand / Silt	5.5×10^{-6}
20-06	284.48	286.01	Sand	6.6×10^{-6}
20-07	293.76	296.80	Clay (Till) / Silt and Sand	1.0×10^{-8}
20-09-S	307.70	309.22	Clay(Fill) / Organic Silt / Silt	3.4×10^{-8}
20-09-D	304.71	306.23	Clay(Till)	2.3×10^{-8}
20-10-S	288.90	290.42	Clay(Till) / Silt	-
20-10-D	285.89	287.42	Silt	-
20-12-S	292.75	294.27	Silt and Sand (Fill)	-
20-12-D	285.13	286.66	Silt	-

- Monitoring wells were either dry or did not contain enough water to conduct a slug test.

The estimated in-situ K values for the silty clay and clayey silt overburden materials range between 1.0×10^{-8} m/s and 3.4×10^{-8} m/s. The hydraulic conductivity values observed within the coarser materials (silty sand and gravelly sand) range between 5.5×10^{-6} and 4.8×10^{-4} m/s.

4.3 Groundwater Quality

The groundwater chemical testing results were compared with the City of Vaughan Sewer By-law. Wherever applicable, selected parameters were also compared with the PWQO criteria. The certificates of analysis are provided in Appendix D. Based on laboratory analyses, the results for groundwater samples met the City of Vaughan Sanitary Sewer Discharge criteria. The exceedances of the City of Vaughan Storm Sewer Discharge limits are summarized in Table 4-4 and the exceedances of the PWQO criteria are summarized in Table 4-5.

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Table 4-4 – Table of Measured City of Vaughan Sewer Use by Law Exceedances

Sample ID	Parameter	Units	Measured Concentration	City of Vaughan Storm Sewer Limit
20-03D	Total Suspended Solids	mg/L	39	15
	Manganese (total)	mg/L	0.157	0.15
20-06	Total Suspended Solids	mg/L	59	15
	Manganese (total)	mg/L	0.642	0.15
20-09D	Manganese (total)	mg/L	2.91	0.15
	Total Kjeldahl Nitrogen	N mg/L	2.1	1

Dewatering discharge could not be discharged to storm sewer without pre-treatment.

Table 4-5 – Table of Measured PWQO Exceedances

Sample ID	Parameter	Units	Measured Concentration	PWQO Limit
20-03D	Aluminum (total)	µg/L	1370	75
	Aluminum (0.2µm)	mg/L	0.14	0.075
	Cobalt (Total)	µg/L	1.79	0.9
	Iron (Total)	µg/L	1590	300
	Phosphorus (Total)	mg/L	0.075	0.01
20-06	Aluminum (total)	µg/L	1990	75
	Aluminum (0.2µm)	mg/L	0.23	0.075
	Cobalt (Total)	µg/L	6.5	0.9
	Iron (Total)	µg/L	2410	300
	Phosphorus (Total)	mg/L	0.158	0.01
	Uranium (Total)	µg/L	5.11	5
	Cobalt (Dissolved)	µg/L	2	0.9
20-09D	Cobalt (Total)	µg/L	5.82	0.9
	Phosphorus (Total)	mg/L	0.021	0.01
	Uranium (Total)	µg/L	10.4	5
	Cobalt (Dissolved)	µg/L	5.61	0.9
	Phosphorus (Dissolved)	mg/L	0.013	0.01
	Uranium (Dissolved)	µg/L	8.92	5

On review of the filtered analytical results, including dissolved parameters, filtering lowered some parameters concentrations below the PWQO limits, but not all. Groundwater of the quality that

was observed herein could not be discharged to the natural environment without pre-treatment. Further, the above results suggest that while filtration may have removed some metals, it did not lower all parameters to within PWQO limits.

5 DEWATERING ASESSMENT

5.1 Construction Dewatering

Groundwater taking for construction dewatering is governed by the Ontario Water Resources Act (OWRA), Environmental Protection Act (EPA) and the Water Taking and Transfer Regulation 387/04, a regulation under the OWRA.

If the water taking rate for this project will be greater than 50,000 L/day and less than 400,000 L/day, registration on the Environmental Activity and Sector Registry (EASR) is required. If the water taking rate will be greater than 400,000 L/day, a Category 3 Permit To Take Water (PTTW) is required.

Preliminary assessment of the need for a Category 3 PTTW or registration on the EASR is provided, based on dewatering estimates presented in this report; however, final assessment will need to be determined following detailed design and investigation. For the purpose of water taking permitting, the estimated withdrawal rates are conservatively assessed in order to reduce the likelihood that actual pumping rates might exceed the permitted allowance thereby stopping work and delaying the project.

5.1.1 West Don River Culvert

Based on design information available to date, it is anticipated that dewatering will not be required at the West Don River culvert. One nested Monitoring Well (20-03-S/D) has been installed at the location of the existing culvert. Over the period of the monitoring program to date, the shallow monitoring well was dry. The water level elevations in the deep monitoring well ranged from 268.2 to 267.6 m. The highest groundwater elevation was 268.2 m (depth 4.4 m), measured July 2020. Assuming the maximum depth of excavation for replacing or extending the culvert is less than 4 m, no significant construction dewatering is anticipated. Any perched water or rainfall would need to be managed. Additional groundwater level monitoring events will be conducted to capture seasonal groundwater level fluctuations.

5.1.2 GO Transit Barrie Line Grade Separation

Two monitoring wells have been installed at Kirby Road and Barrie Go Rail Crossing: one shallow monitoring well to a depth of 7 m (MW 20-06) and one deep well to a depth of 29 m (MW 20-05).

Over the course of the monitoring program to date, the highest groundwater elevations at the shallow and deep monitoring wells were 288.3 m (depth 3.7 m) and 264.9 m (depth 26.6 m), respectively. As described in Section 4.1, the local shallow groundwater flow generally follows Site topography and it is anticipated that the ground water levels will be near the ground surface in the low wet area located to the north of Kirby Road and Barrie GO Rail Crossing. However, the groundwater profile cannot be determined based on the limited data obtained during the preliminary investigation and additional monitoring wells are required to be installed to confirm the water levels during the detailed design.

The subsurface stratigraphy encountered in the boreholes generally consisted of a topsoil or fill layer overlying silt deposits. Underlying the silt was a layer of sand, with estimated thicknesses of approximately 1.1 m and 2.3 m as encountered in borehole 20-05 and borehole 20-06, respectively. The sand layer was encountered from Elev. 288.0 m to 286.9 m in Borehole 20-05 and from Elev. 286.6 m to 284.3 m in Borehole 20-06.

Overpass Structure

The preliminary profile drawings indicate that existing road/rail grades are near Elev. 292.3 m and the proposed road grade on the overpass will be near Elev. 302.5 m. Excavation for construction of pile caps for the overpass structure is expected to depths of about 2 to 3 m below the existing grade, to approximate elevation of 288 m to 289 m. It is expected the bridge foundation pile caps will be installed at depths within the surficial fill and clayey silt materials.

Underpass Structure

The preliminary profile drawings indicate that existing road/rail grades are near Elev. 292.3 and proposed road grade in the underpass will be near Elev. 285.0, with foundation construction to elevations of 282 to 283 m. It is understood that the estimated depth of excavation for underpass structure is approximately 8 m for the road excavation, and locally to 10 m depths for foundation elements. As such, the excavation is expected to extend through the sand layer and into the clay till. Based on the borehole logs, these layers will likely behave as an unconfined aquifer.

5.1.3 Municipal Service Installation

At this time, there is not sufficient design information to provide preliminary dewatering estimates for the municipal service installation. Once engineering drawings for municipal services are finalized, detailed dewatering estimates should be completed during detailed design, well in advance of construction to support permitting requirements. Based on our understanding of the geology and water table at the Site, it is anticipated that minimal dewatering will be required for

open cut installation of shallow municipal services, if the services are proposed to be installed not deeper than 3 m. However, it will be necessary to refine the analysis of the hydrogeological conditions, notably near Borehole 20-01, and estimate dewatering rates and radius of influence during the detailed design stage.

It is anticipated that water may be perched locally within the native silty clay till and layers of silts and sands and that it would be of limited volume. It is further anticipated that groundwater flow rates through the silty clay till would be low due to the relatively low hydraulic conductivity of that soil. However, water taking estimates must include rainfall and surface water if they cannot be kept separate from groundwater, and depending on the number and size of the excavations, the need for some form or water taking permit is likely.

5.2 Dewatering Estimates

The following approach was used to estimate the budgeted peak water taking rate for the grade separation options:

- A base ground water extraction flow rate was estimated, and a factor of safety of three was applied to this flow rate to provide an allowance for removal of water from soil storage, variation in hydraulic conductivity, actual excavation dimensions and geometry, and ground water levels due to seasonality or other factors;
- An allowance for removal of rainfall into the excavation was included, assuming 24 hours are used to remove 50 mm of rainfall; and,
- Lowering of groundwater to about 1 m below the base of the excavation to facilitate a dry, stable work area was assumed.

The water taking will be temporary in nature for the purpose of construction dewatering. Dewatering rates were estimated using the Dupuit analytical solution for an unconfined aquifer provided in Powers et al. (2003).

For the purpose of estimating water taking flow rates, it is assumed that support of excavation would not be watertight. The use of watertight support of excavation would greatly reduce the required water taking rates.

The estimated maximum construction dewatering pump rates and radii of influence for the analyzed excavations are summarized in Table 5-1. Dimensions for the excavations of the proposed grade separation are based on the preliminary profile design provided by HDR. The calculations and equations for the peak flow rate and radius of influence are provided in Appendix E. Figure 10 shows the extent of the estimated Zone of Influence (ZOI)

Table 5-1 – Table of Estimated Construction Dewatering Volumes

Construction Element	Base Groundwater Flow (L/day)	Groundwater Flow with Safety Factor of 3 (L/day)	Stormwater Allowance (L/day)	Estimated Peak Flow Rate (L/day)	Approx. Radius of Influence (m)
Overpass Option	22,000	66,000	8,000	74,000	10
Underpass Option	259,000	777,000	313,000	1,090,000	70

5.3 Permanent Drainage

Excavation for construction of the underpass is expected to extend 6.3 m below the groundwater level, through a silt layer, a permeable sand layer, and into silty clay till. If the underpass will be designed to be fully waterproof then it will need to be designed to resist uplift. Otherwise permanent drainage of groundwater is anticipated to be required, subject to approval by external agencies including TRCA, as part of the location appears to be within TRCA regulated area.

6 IMPACT ASSESSMENT

Within the construction dewatering zone of influence, potential impacts such as ground subsidence, reduction in groundwater flow to groundwater users and watercourses, and other impacts must be considered. The potential impacts are discussed herein, and monitoring and potential mitigation measures are discussed in the following section.

6.1 Geotechnical Impacts

Dewatering of open excavations for the underpass within the shallow silty sand and till materials is expected to result in a drawdown of the water table within the overburden for a maximum estimated radius of influence of 70 m. A maximum drawdown of 7.3 m was estimated for the underpass excavation.

In general, the land uses surrounding the Site are primarily agricultural, with a few residential, commercial and natural uses. The underpass is generally underlain by hard native clay till or very dense sand and silt till.

The potential for settlement is most likely to occur where the estimated drawdown is significant, structures are located within close proximity to the dewatering, and soils within the drawdown depths are compressible. The potential settlement of the railway was analyzed assuming the general stratigraphy is consistent with the closest boreholes (Boreholes 20-05 and 20-06). Although the magnitude of the drawdown is high and the structure is within close proximity to the maximum drawdown, the drawdown occurs primarily in very stiff to hard/very dense glacial till overburden. Under these conditions the estimated settlement is anticipated to be less than 15 mm.

A preconstruction survey of all structures and utilities within the radius of influence should be considered prior to dewatering activities, and a survey should be considered during dewatering to assess if any undesirable deformation has occurred.

A settlement monitoring program will need to be designed and implemented in accordance with railways requirements. The monitoring of track settlement should be accomplished by means of surface and subsurface settlement points. The finalized monitoring program should be reviewed and approved by the railway and their review consultant.

If significant sediment and fines are removed during the dewatering due to improperly filtered extraction wells then ground loss and settlement beyond that described above could occur.

6.2 Impact to Surface Water and Natural Environment

The lowering of the shallow groundwater level due to construction dewatering could potentially reduce the groundwater input into nearby groundwater dependant features. There is one surface water (Don River West Branch) crossing along the Site. However, this tributary is not groundwater-dependant in this part of the watershed, and is not likely to be affected by changes to the groundwater system. In addition, given the low permeability of the silty clay till which underlies the Site, and given the limited radius of influence of the dewatering, the impact of water taking for construction on water quantity in the nearby tributaries is anticipated to be minimal.

Permanent drainage may be required for a drained underpass grade separation configuration if permitted, which may affect local groundwater features if implemented. If either the overpass configuration is selected, or if a watertight underpass configuration is selected, then permanent drainage would not be anticipated for the construction elements and thus long-term impact to water quantity for the surface water features would not be anticipated.

Dewatering discharge that may be directed to nearby tributaries could potentially alter the physical, chemical and thermal regime of the receiving streams. Groundwater of the quality that was tested herein could not be discharged to the natural environment without pre-treatment due

to exceedances of the PWQO limits and sewer use limits; however, with sufficient treatment it is anticipated that the groundwater could be discharged without impacting surface water quality.

6.3 Impacts to Water Well Users

Construction dewatering for the underpass is expected to result in a maximum radius of influence of approximately 70 m in the shallow silty sand and silty clay to clayey silt till. Groundwater dewatering in these shallow materials would not be anticipated to impact domestic wells that are assumed to be screened within the deeper aquifers.

A door-to-door well survey was not requested for the scope of the hydrogeological investigation. While no well users are anticipated to be affected, it is recommended that a private well survey be conducted if one has not been previously conducted by others in advance of construction to identify potential well users in the area and to establish baseline water levels and water quality prior to, during, and following construction.

6.4 Other Potential Impacts

With prolonged dewatering activities there can be potential for inorganic or organic chemical compounds present within the radius of influence to migrate and to enter open excavations where sufficient flow rate and time permit. Considering the temporary duration of dewatering activities, as well as the limited commercial and industrial development in the area, there is a low likelihood that contaminants would be mobilized during dewatering activities. If any contaminated groundwater is collected from the dewatering operations it must be treated to meet any discharge criteria or disposed of at a facility licensed to handle such materials.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Water Taking Permit

Given that the estimated peak water taking rate for the underpass option appears to be greater than 400,000 L/day, it is anticipated that a Category 3 Permit To Take Water would be required. The PTTW would include terms and conditions that must be followed, which include performance, monitoring and reporting requirements among others. The current fee from MECP for the Category 3 PTTW application is $3,000.

Since the preliminary dewatering estimate for the overpass option appears to be less than 400,000 L/day but greater than 50,000 L/day, registration on the EASR would be required.

Regardless of the preliminary analysis herein; the dewatering estimates and permitting requirements will need to be determined during detailed design.

7.2 Discharge of Groundwater

It is anticipated that with sufficient dewatering and treatment methods designed by the Contractor and its dewatering and water treatment specialists, groundwater that is removed from the subsurface could be discharged either to the natural environment by meeting the PWQO limits or to storm or sanitary sewer by meeting the City of Vaughan sewer use Bylaw limits.

Groundwater of the quality that was observed herein could not be discharged to the natural environment or to storm sewer without pre-treatment due to exceedances of the PWQO limits and storm limits of the City of Vaughan sewer use Bylaw, respectively.

Water quality observed during construction will vary from the results obtained herein based on a number of factors, and in large part are a function of the amount of solids/sediment in the water. The Contractor would need to consult with its dewatering and water treatment specialists to develop methods and means to meet the PWQO or selected sewer-use limits based on the results presented herein and on any additional testing by the Contractor and/or its consultant. An experienced dewatering contractor and water treatment specialist are recommended to be retained by the Contractor to design and operate dewatering and/or treatment operations as required.

Prior to discharge to a sewer, a discharge agreement would need to be obtained by the Contractor from the City of Vaughan. Confirmation of discharge water quality and sufficient sewer capacity may be required. Discharge to the natural environment may required approval by MECP, MNRF, TRCA, and/or others depending on the location and approach.

7.3 Control of Impacts and Monitoring Program

The following measures are recommended to mitigate the potential for the dewatering activities to cause negative impacts as assessed previously:

- Monitoring of water quality for groundwater collected within the excavation dewatering system to confirm the water quality is appropriate for the selected discharge option.
- Where possible, if discharging to the natural environment, it is recommended that groundwater be discharged at least 30 m away from any water bodies including streams.

- If discharge to sewers or the natural environment is proposed, sufficient dewatering and treatment methods are required to ensure the discharge water quality meets the required limits. Suitable field methods and/or treatment would likely include measures to address suspended sediment and associated metals, and potentially to adjust temperature to acceptable levels. The operation and monitoring of discharge facilities should be carried out by an experienced dewatering contractor and water treatment specialist familiar with fisheries and water quality requirements.

- Where discharge is to ground surface or water course, temporary erosion control measures should be developed and installed to control erosion at the discharge points.

- A door-to-door well survey was not requested for the scope of the hydrogeological investigation. While no well users are anticipated to be affected, it is recommended that a private well survey be conducted if one has not been previously conducted by others in advance of construction to identify potential well users in the area and to establish baseline water levels and water quality prior to, during, and following construction.

- During the detailed design stage, it will be necessary to refine the analysis of the hydrogeological conditions along the servicing alignment to estimate dewatering rates and radius of influence. These findings will be used to confirm the water takings requirements and the appropriate approvals from the MECP prior to commencement of construction. They will also assist in determining whether a private well survey is warranted.

- Actual daily water taking volumes must be recorded daily. The values must be registered on the Regulatory Self-Report System by March 31 for the previous year.

- Additional monitoring and terms and conditions will apply as determined by the water taking permitting, by any discharge agreement or permit, and by other regulatory or jurisdictional bodies.

8 CLOSURE

We trust that this report provides the information you require at this time. If you have any questions regarding this report, please contact the undersigned at your earliest convenience.

Yours truly,
Thurber Engineering Ltd.

Alireza Hejazi, Ph.D., P.Eng.
Senior Hydrogeologist

David Hill, M.A.Sc., MBA, P.Eng., P.Geo.
Senior Hydrogeologist / Review Engineer

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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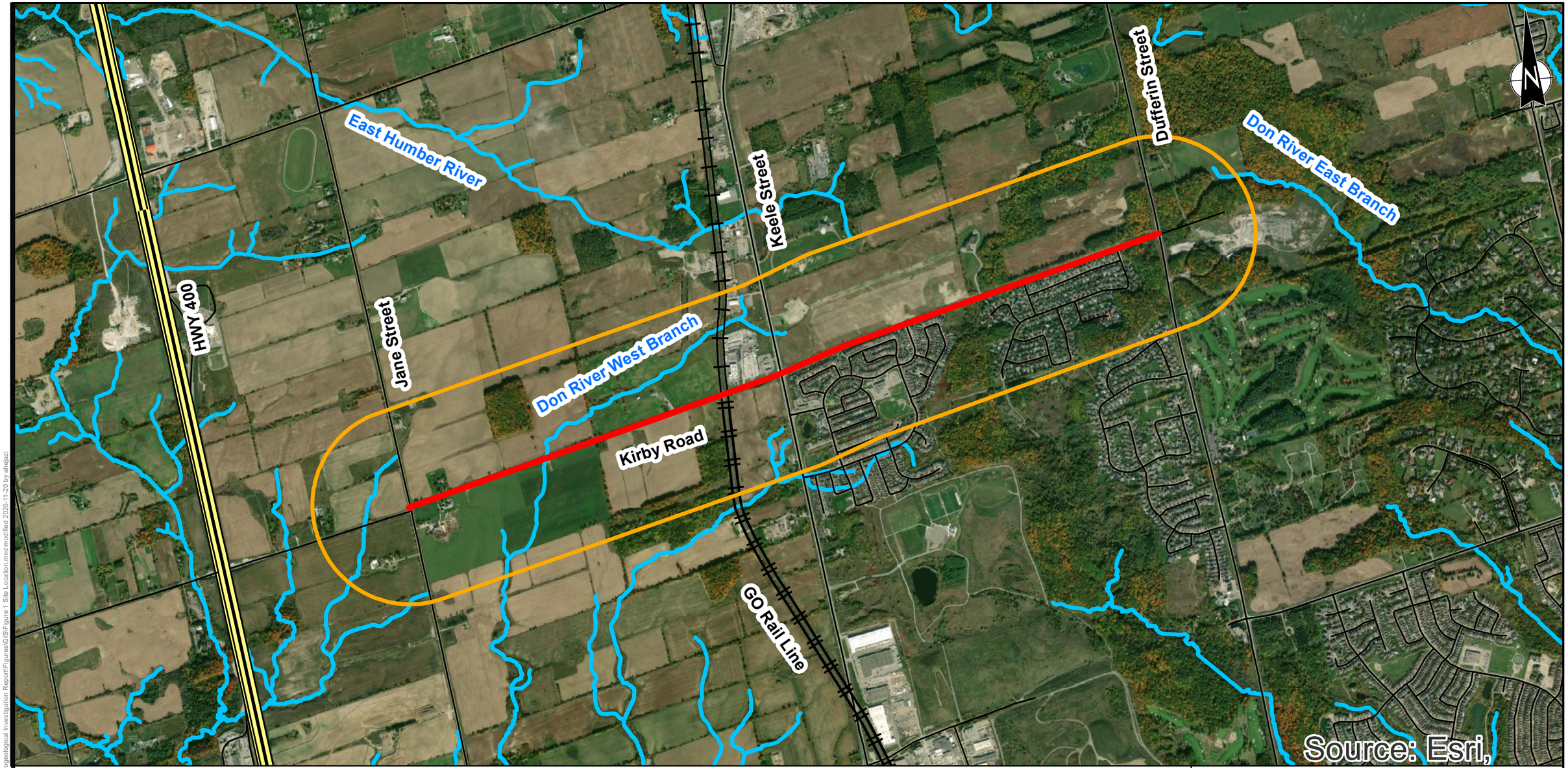
Figures



LEGEND:

- Site
- Study Area (500 m Buffer)
- Road
- Freeway
- Railway
- Watercourse

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

SITE LOCATION

FIGURE 1

DRAWN BY	AH
DESIGNED BY	AH
APPROVED BY	DH
SCALE	1:20,000
DATE	JULY 22, 2020
PROJECT No.	26130

THURBER ENGINEERING LTD.

H:\20000-29999\26000-26999\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 1 Site Location.mxd modified 2020-11-20 by aheijzi

East Humber River
Don River West Branch
Jane Street
Keele Street
Dufferin Street
HWY 400
Kirby Road

Source: Esri,

LEGEND:

- Site
- Road
- Freeway
- Watercourse
- Contour (masl)

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

TOPOGRAPHY

FIGURE 2

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SCALE	1:20,000
DATE	JULY 22, 2020
PROJECT No.	26130

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East Humber River

HWY 400

Jane Street

Keele Street

Dufferin Street

Don River West Branch

Kirby Road

N

Source: Esri,

LEGEND:

- Site
- Road
- Freeway
- Watercourse

REGION

- Oak Ridges Moraine
- South Slope

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

PHYSIOGRAPHIC REGIONS

FIGURE 3

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APPROVED BY	DH
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DATE	JULY 22, 2020
PROJECT No.	26130

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East Humber River

HWY 400

Jane Street

Keele Street

Dufferin Street

Don River West Branch

Kirby Road

N

Source: Esri,

LEGEND:

Site

Road

Freeway

Watercourse

Surficial Geology

Modern Alluvial

Organic Deposit

Till

Ice-contact stratified deposits

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
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HDR INC.

SURFICIAL GEOLOGY

FIGURE 4

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PROJECT No.	26130

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East Humber River

HWY 400

Jane Street

Keele Street

Dufferin Street

Don River West Branch

Kirby Road

N

Source: Esri,

H:\20000s-29999\26000\26990\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 5 Bedrock Geology.mxd modified 2020-07-22 by ahelgazi

LEGEND:

- Site
- Road
- Freeway
- Watercourse

FORMATION

- Blue Mountain
- Georgian Bay
- Lindsay

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
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BEDROCK GEOLOGY

FIGURE 5

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PROJECT No.	26130

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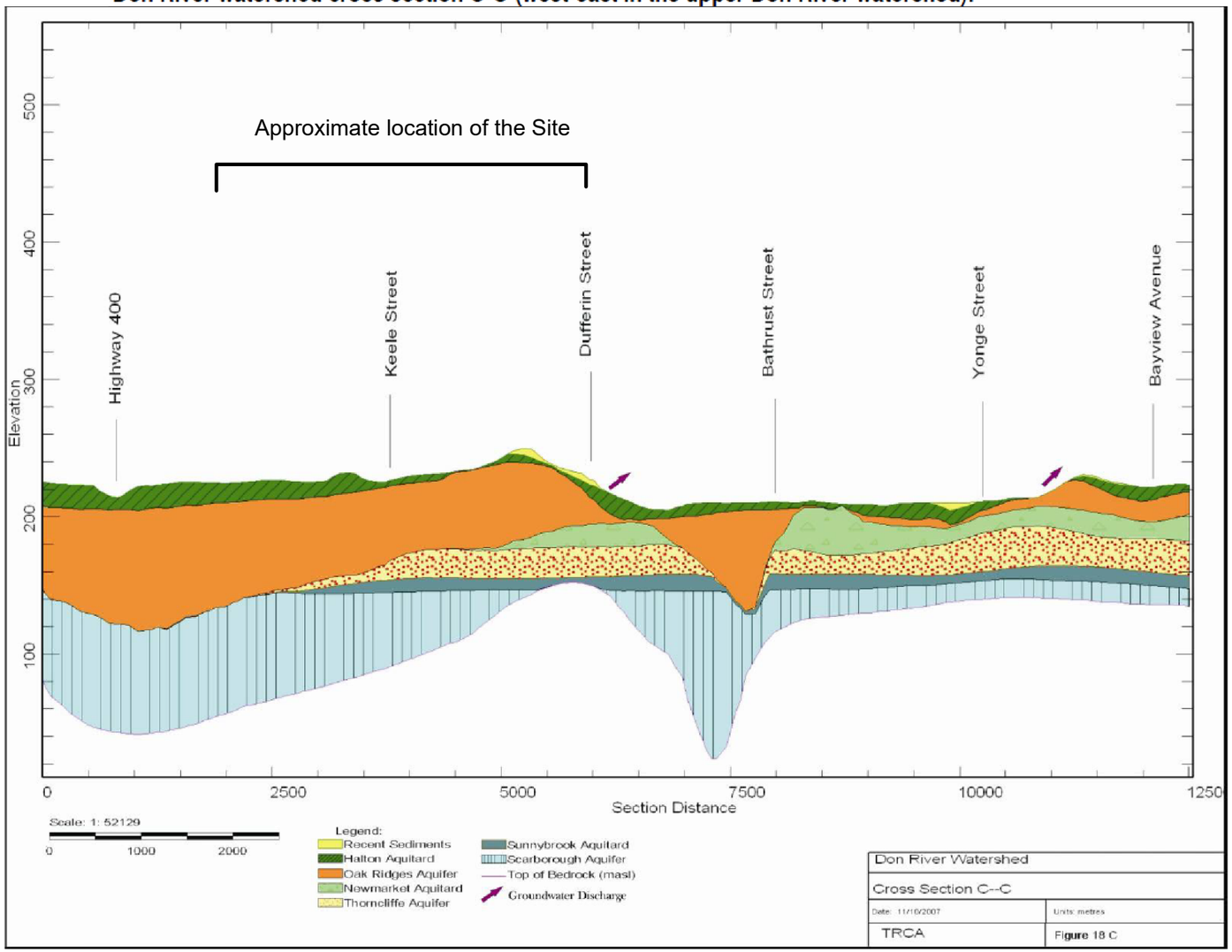
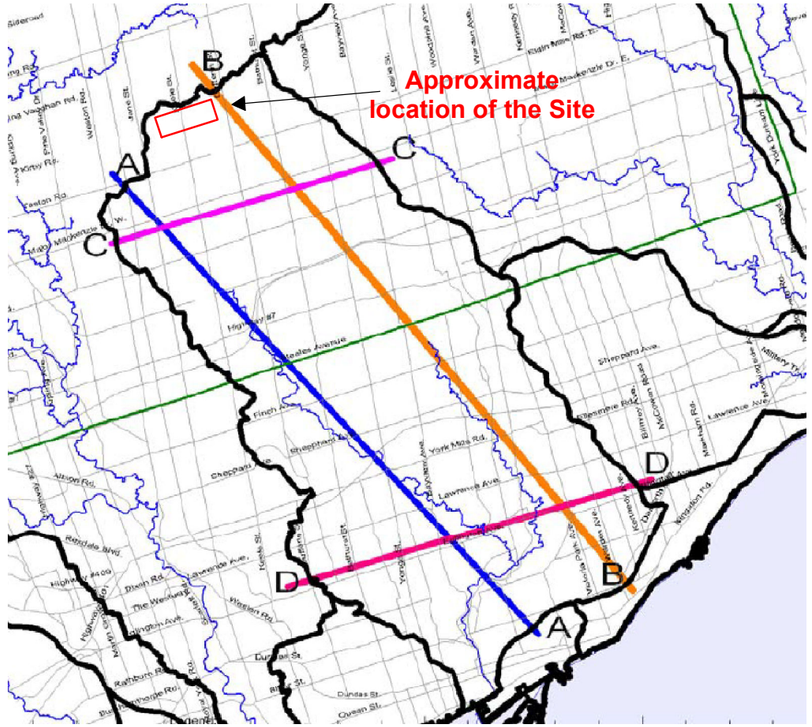
Don River watershed cross section C-C (west-east in the upper Don River watershed).



Geologic Cross-section Location Plan



Reference: Don River Watershed Plan, Geology and Groundwater Resources Report and Current Conditions, TRCA 2009

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REGIONAL CROSS-SECTION

FIGURE 6

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East Humber River
HWY 400
Jane Street
Keele Street
Dufferin Street
Don River West Branch
Kirby Road
N
Source: Esri,

LEGEND:

- Site
- Study Area (500 m Buffer)
- Road
- Freeway
- Watercourse
- MECP Well Records (500 m Buffer)

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
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MECP WELL RECORDS

FIGURE 7

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DATE	JULY 22, 2020
PROJECT No.	26130

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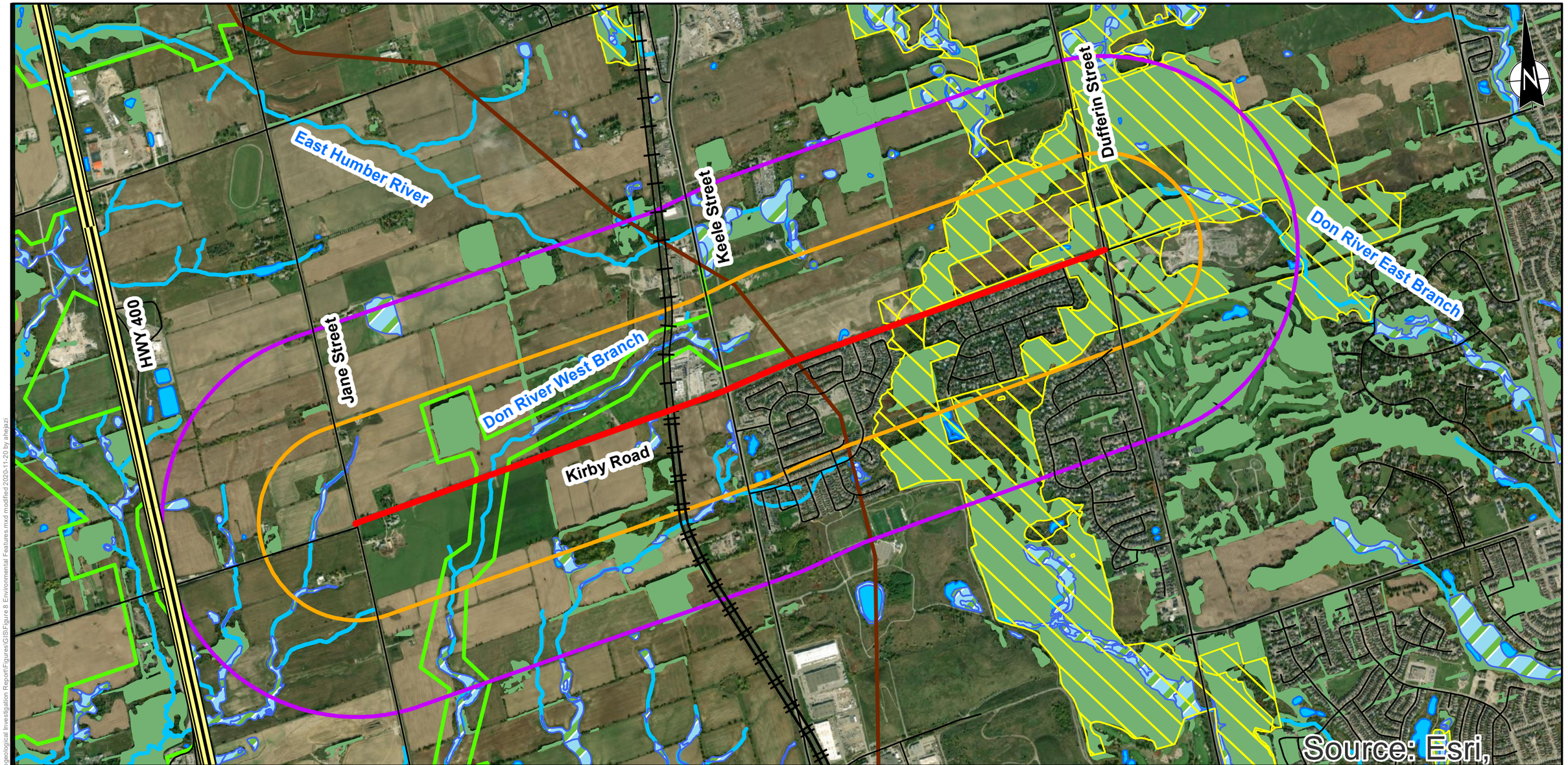
H:\20000-29999\26000-26998\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 8_MECP Well Records.mxd modified 2020-07-27 by ahejazi



LEGEND:

- Site Boundary
- Railway
- Road
- Freeway
- Study Area (500 m Buffer)
- 1 km Buffer
- ANSI
- Oak Ridges Moraine Boundary
- Green Belt Plan Area
- Wetland
- Watercourse
- Waterbody
- Wooded Area

Data Source: Ontario Ministry of Natural Resources and Forestry - Provincial Mapping Unit

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

NEARBY ENVIRONMENTAL FEATURES

FIGURE 8

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DESIGNED BY	AH
APPROVED BY	DH
SCALE	1:20,000
DATE	JULY 22, 2020
PROJECT No.	26130

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H:\20000-29999\26000-26999\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 8 Environmental Features.mxd modified 2020-11-20 by abejazi

East Humber River

Keele Street

Dufferin Street

Jane Street

Don River West Branch

Kirby Road

20-01

20-02

20-03-S/D

20-04

20-05

20-06

20-07

20-08

20-09-S/D

20-10-S/D

20-11

20-12-S/D

20-13

N

LEGEND:

- Borehole
- Monitoring Well
- Site
- Watercourse
- Road

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

BOREHOLE AND MONITORING WELL LOCATIONS

FIGURE 9

DRAWN BY	AH
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SCALE	1:12,000
DATE	JULY 22, 2020
PROJECT No.	26130

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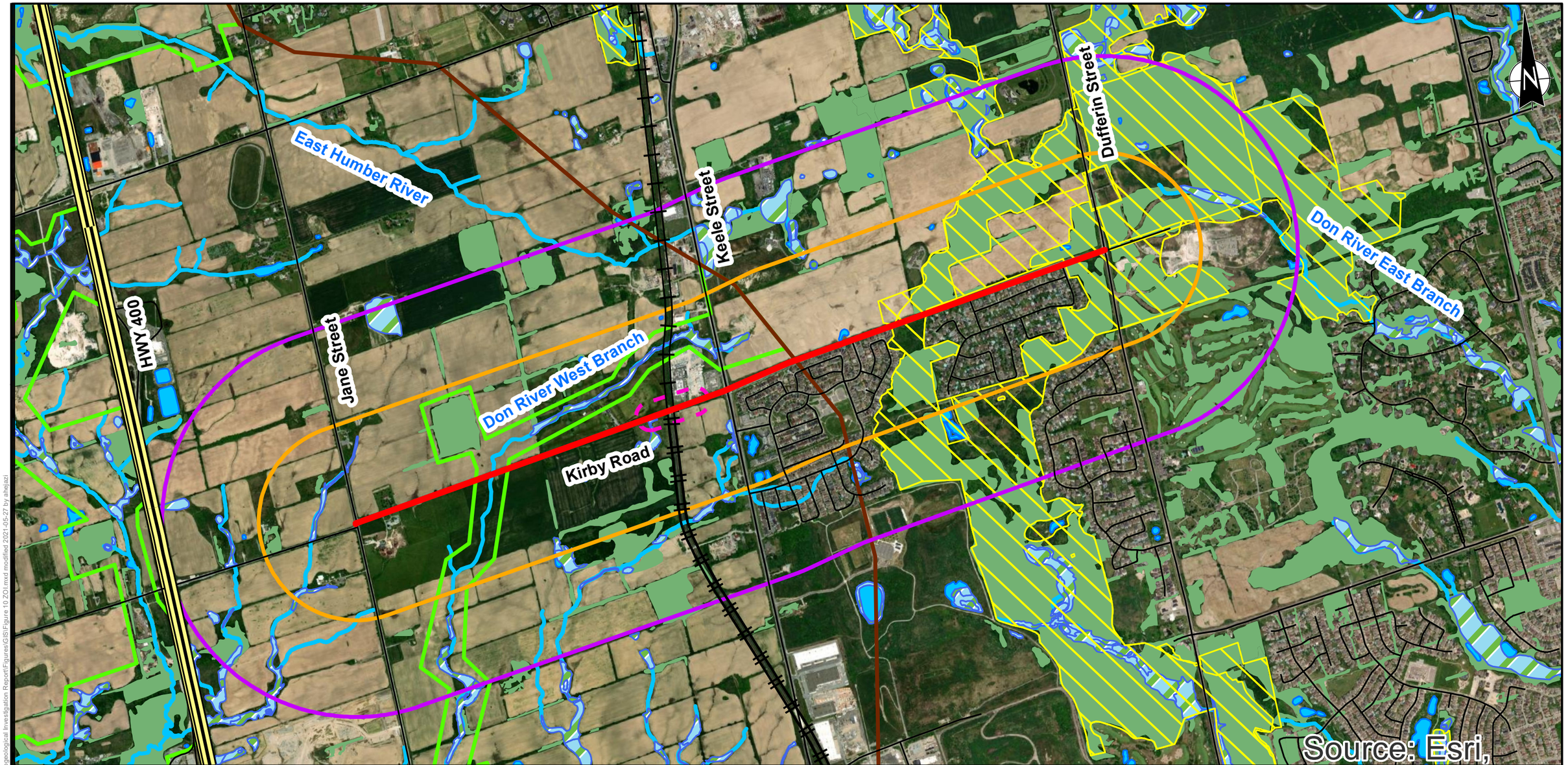
H:\20000-29999\26000-26999\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 9 Borehole and Monitoring Well Locations_v2.mxd modified 2020-11-17 by ahejazi



LEGEND:

- Site Boundary
- Railway
- Road
- Freeway
- Study Area (500 m Buffer)
- 1 km Buffer
- ZOI (Underpass)
- ANSI
- Oak Ridges Moraine Boundary
- Green Belt Plan Area
- Wetland
- Watercourse
- Waterbody
- Wooded Area

Data Source: Ontario Ministry of Natural Resources and Forestry - Provincial Mapping Unit

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
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ZONE OF INFLUENCE

FIGURE 10

DRAWN BY	AH
DESIGNED BY	AH
APPROVED BY	DH
SCALE	1:20,000
DATE	MAY 27, 2021
PROJECT No.	26130

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Appendix A

MECP Well Records

MECP Well Record Summary Table

Well ID	UTM Coordinates Easting	UTM Coordinates Northing	Date Completed	Depth to Bedrock (m)	Well Depth (m)	Static Level (m)	Well Use
6906501	618503.6	4860672	1958-05-31	-	48.2	18.3	Supply Wells
6922776	618140	4860677	1993-03-06	-	0	0	Unknown
6906498	620342.6	4861019	1957-09-04	-	85.3	0	Monitoring and Test Hole
6922757	618012	4860943	1994-04-07	-	0	0	Unknown
6912554	618688.6	4861399	1974-09-06	-	43.6	32	Supply Wells
7052347	616642	4860454	2007-08-09	-	6.1	0	Observation Well
6915399	618814.6	4860573	1979-10-30	-	47.9	33.5	Supply Wells
6912202	620729.6	4861972	1974-07-08	-	70.7	27.4	Supply Wells
6906508	618875.6	4861126	1961-09-11	-	47.5	36.6	Supply Wells
6906612	618164.6	4860812	1958-07-22	-	33.5	9.1	Supply Wells
7239172	616514	4859949	2014-08-05	-	0	0	Unknown
6923932	619821.6	4861058	1997-06-26	-	8.2	6.4	Abandoned
6922649	618262	4861219	1993-03-19	-	0	0	Unknown
6917263	618714.6	4861323	1984-10-04	-	52.7	36.3	Supply Wells
6906496	618951.6	4860771	1954-08-02	-	53.6	36.6	Supply Wells
7115109	616677	4860526	2008-10-04	-	31.7	0	Abandoned
6906505	619970.6	4861241	1959-09-16	-	85	0	Monitoring and Test Hole
6922627	617071	4859955	1994-04-15	-	0	0	Unknown
6922775	617508	4860910	1993-03-08	-	0	0	Unknown
6906507	618886.6	4861302	1960-01-20	-	25.6	12.2	Supply Wells
6922654	618467	4861265	1994-04-29	-	0	0	Unknown
6922626	616395	4860360	1994-05-02	-	0	0	Unknown
6919295	616371	4860195	1987-08-05	-	42.7	4	Supply Wells
6906499	620477.6	4861078	1957-10-21	-	51.5	0	Monitoring and Test Hole
6929027	618171	4860799	2005-05-26	-	48.4	24.7	Supply Wells
6924017	619821.6	4861058	1997-07-21	-	82.9	0	Abandoned
6906610	618036.6	4860545	1954-08-26	-	21.3	18.3	Supply Wells
6906504	619999.6	4861282	1959-09-11	-	85.6	0	Monitoring and Test Hole
6906316	621128.6	4861412	1954-12-18	-	30.2	13.7	Supply Wells
6923114	618885	4861160	1994-09-26	-	51.2	36	Supply Wells
6922625	617363	4860481	1994-03-31	-	0	0	Unknown
6923931	619821.6	4861058	1997-06-26	-	7.6	7.6	Abandoned
6922660	617844	4860650	1994-02-02	-	0	0	Unknown
6915783	616714.6	4860573	1980-07-04	-	31.4	10.7	Supply Wells
6922803	618694	4860983	1994-07-27	-	56.4	39.3	Supply Wells
7280366	620852	4861161	2017-01-14	-	97.5	0	Other Status
6924001	616724	4860517	1997-06-20	-	31.4	11	Supply Wells
6912127	616409.6	4860198	1974-05-27	-	31.7	5.2	Supply Wells

MECP Well Record Summary Table

Well ID	UTM Coordinates Easting	UTM Coordinates Northing	Date Completed	Depth to Bedrock (m)	Well Depth (m)	Static Level (m)	Well Use
7150863	618633	4861317	2010-06-09	-	52.1	33.8	Supply Wells
6906503	620026.6	4861046	1959-08-31	-	83.8	13.1	Supply Wells
6922777	617622	4860197	1993-02-05	-	0	0	Unknown
6913971	617264.6	4860523	1977-04-26	-	29	16.2	Supply Wells
6906506	620498.6	4861537	1959-08-12	-	87.5	0	Monitoring and Test Hole
6906611	616947.6	4860165	1966-08-19	-	29.3	9.1	Supply Wells
6910566	616754.6	4860023	1971-03-11	-	31.4	9.1	Supply Wells
7115110	616656	4860511	2008-10-04	-	29.6	0	Abandoned
6906502	620232.6	4861324	1959-08-20	-	100.6	0	Monitoring and Test Hole
7043889	619356	4860689	2007-04-26	-	9.8	0	Abandoned
6924261	618190	4860748	1997-10-30	-	39.6	21.3	Supply Wells
6922769	616818	4860218	1993-01-26	-	0	0	Unknown
7115111	616706	4860550	2008-10-04	-	25.6	0	Abandoned
7275412	620940	4861221	2016-10-12	-	3.7	0	Monitoring and Test Hole
6914568	616634.6	4860503	1978-05-23	-	29.9	14	Supply Wells

THURBER

Appendix B

Record of Borehole Sheets

RECORD OF BOREHOLE 20-01

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 14, 2020
COMPLETED : July 14, 2020
N 4 860 322.3 E 616 958.3

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		271.44				
		ASPHALT (100mm)						
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)		0.10				
				270.68				
1	Hollow Stem Augers	**CLAY**, silty, some sand, trace gravel, stiff to hard, brown: (TILL)		0.76	1	SS	14	
2					2	SS	15	
3					3	SS	34	Grain Size Analysis: Gr 2%/ Sa 36%/ Si 46%/ Cl 16%
				268.04	4	SS	31	Grain Size Analysis: Gr 0%/ Sa 92%/ Si & Cl 8%
		SAND, trace silt, trace clay, trace gravel, dense, brown, moist		3.40				
4				267.33				
		CLAY, silty, some sand, trace gravel, hard, brown: (TILL)		4.11				
5					5	SS	42	
				266.26				
		END OF BOREHOLE AT 5.18m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		5.18				
6								
7								
8								
9								

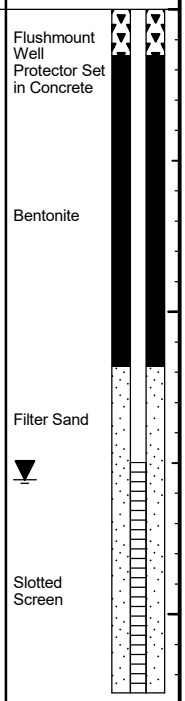
DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Jul 21/20	2.73	268.71
Jul 28/20	2.68	268.76
Sep 25/20	3.11	268.33

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-02

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 13, 2020
COMPLETED : July 13, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 860 411.5 E 617 250.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		273.77							
		ASPHALT (100mm)									
		SAND and **GRAVEL**, trace to some silt, very dense, brown, moist: (FILL)		0.10	1	GS			○		
1					2	SS	57		○		
	Hollow Stem Augers	**SAND**, silty, trace gravel, compact, brown, moist		272.32 1.45	3	SS	15		○		
2		**CLAY**, silty, trace sand, trace gravel, firm, brown; with partings of silt		271.56 2.21	4	SS	7		○		
3					5	SS	6		○		
		END OF BOREHOLE AT 3.66m BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, ASPHALT AT SURFACE.		270.11 3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-03

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 13, 2020
COMPLETED : July 13, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

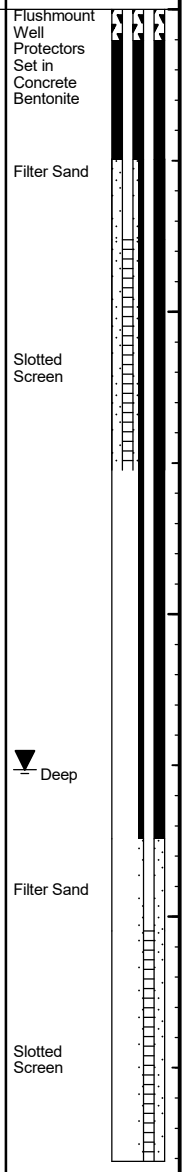
N 4 860 523.5 E 617 584.1

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		272.72				
		ASPHALT (100mm)						
		GRAVEL, sandy to **SAND**, gravelly, dense to compact, brown, moist: (FILL)		0.10	1	GS		Grain Size Analysis: Gr 29%/ Sa 57%/ Si & Cl 14%
1					2	SS	50	
					3	SS	16	
2		**ORGANIC SILT**, some clay to clayey, trace sand, occasional decayed plant matter, compact, brown to black, wet		270.72 2.00				
		CLAY, silty, some sand, trace gravel, firm to hard, brown: (TILL)		2.21	4	SS	7	
3					5	SS	21	
4								
					6	SS	38	
5								
		SILT and **SAND**, trace clay, dense, brown, wet		267.08 5.64				
6					7	SS	35	Grain Size Analysis: Gr 0%/ Sa 55%/ Si 43%/ Cl 2%
7		**CLAY**, silty, trace sand, trace gravel, firm, brown to grey; with partings of silt		265.56 7.16				
					8	SS	7	
8		END OF BOREHOLE AT 8.23m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		264.49 8.23				
9		WATER LEVEL READINGS (DEEP WELL): DATE / DEPTH(m) / ELEV.(m): Jul 21/2020 4.37 268.35; Jul 28/2020 4.36 268.36; Sep 25/2020 5.03 267.69. WATER LEVEL READINGS (SHALLOW WELL): DATE / DEPTH(m) / ELEV.(m): Jul 21/2020 DRY -; Jul 28/2020 DRY -; Sep 25/2020 DRY -						

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160
DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
WATER CONTENT, PERCENT wp w wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-04

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 13, 2020
COMPLETED : July 13, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 860 613.3 E 617 876.3

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		277.43							
		ASPHALT (100mm)		0.10							
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)			1	GS			○		
1					2	SS	28		○		
		TOPSOIL (300mm)		276.24 1.19					○		
	Hollow Stem Augers			275.91							
		CLAY, silty, some sand, trace gravel, firm to very stiff, brown; with partings of silt		1.52	3	SS	6		○		
2					4	SS	11		○		
3					5	SS	19		○		
				273.77							
		END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, ASPHALT AT SURFACE.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-05

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 8, 2020
COMPLETED : July 9, 2020

Project No. 26130
SHEET 1 OF 4
DATUM Geodetic

N 4 860 827.1 E 618 486.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		290.97							
		TOPSOIL (150mm)		0.00							
	Hollow Stem Augers	**SILT**, clayey, some sand, stiff to soft, brown; with partings of silty clay		0.15	1	SS	8				Flushmount Well Protector Set in Concrete
1					2	SS	10				
2					3	SS	7				
					4	SS	4				
3		**SAND**, some gravel, trace silt, loose, brown, moist to wet		288.00 2.97	5	SS	9				
4		**CLAY**, silty, some sand to sandy, trace gravel, stiff to very stiff, grey: (TILL)		286.86 4.11							
5	Mud Rotary/Tricone				6	SS	14				
6					7	SS	10				
7											
8					8	SS	23				
		SILT and **SAND**, trace to some gravel, very dense, grey, moist: (TILL)		282.29 8.69							
9					9	SS	101				

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-05

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 8, 2020
COMPLETED : July 9, 2020

Project No. 26130
SHEET 2 OF 4
DATUM Geodetic

N 4 860 827.1 E 618 486.5

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11	Mud Rotary/Tricone				10	SS	68				
		SILT and **SAND**, trace to some clay, trace gravel, very dense, grey, wet		279.27 11.70							
12					11	SS	73				
13											Bentonite
		CLAY, silty, some sand to sandy, trace gravel, hard, brown: (TILL)		277.57 13.40							
14					12	SS	58				
15					13	SS	61				
16				274.67 16.31							
		SILT, clayey, trace gravel, very stiff, grey, with partings of silty clay									
17					14	SS	81				
18											
					15	SS	27				
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-05

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 8, 2020
COMPLETED : July 9, 2020

Project No. 26130
SHEET 3 OF 4
DATUM Geodetic

N 4 860 827.1 E 618 486.5

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
21					16	SS	20		○		
22											
23					17	SS	75		○		
24											
	Mud Rotary/Tricone			266.38							
25		**SAND**, silty, dense, grey, wet		24.60							
26					18	SS	24	Grain Size Analysis: Gr 0%/ Sa 73%/ Si 24%/ Cl 3%	○		Filter Sand
27											▼
				263.37							
		SILT, clayey, some gravel, very soft to stiff, grey		27.60							Slotted Screen
28											
29					19	SS	0*	*Weight of Hammer			

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-05

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 8, 2020
COMPLETED : July 9, 2020

Project No. 26130
SHEET 4 OF 4
DATUM Geodetic

N 4 860 827.1 E 618 486.5

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
31				259.88	20	SS	14				
		END OF BOREHOLE AT 31.09m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		31.09							
32											
33											
34											
35											
36											
37											
38											
39											

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Jul 21/20	26.63	264.34
Aug 28/20	26.59	264.38
Sep 25/20	26.75	264.22

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-06

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 10, 2020
COMPLETED : July 10, 2020

Project No. 26130
SHEET 1 OF 2
DATUM Geodetic

N 4 860 808.8 E 618 523.6

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) / WATER CONTENT, PERCENT (wp, w, wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		291.49							
0	Hollow Stem Augers	**SILT**, clayey, some sand, trace gravel, stiff, brown; occasional organic inclusions: (FILL)		0.00	1	SS	11				Flushmount Well Protector Set in Concrete
1					2	SS	8				
		SILT, clayey, trace to some sand, firm to stiff, brown, with occasional sand seams, partings of silty clay		290.05 1.45							
2					3	SS	6				
					4	SS	5				Bentonite
3					5	SS	11				
4											
		SAND, trace silt, compact, brown, wet; with layers of clayey silt		286.62 4.88	6	SS	17				
5											Filter Sand
6					7	SS	19	Grain Size Analysis: Gr 6%/ Sa 86%/ Si & Cl 8%			Slotted Screen
7		**CLAY**, silty, some sand to sandy, trace gravel, very stiff to hard, grey: (TILL)		284.33 7.16							
8					8	SS	25				
9					9	SS	72/ 0.275				
		END OF BOREHOLE AT 9.45m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		282.04 9.45							

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-06

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 10, 2020
COMPLETED : July 10, 2020

Project No. 26130
SHEET 2 OF 2
N 4 860 808.8 E 618 523.6
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) Jul 21/20 / 3.73 / 287.76 Jul 28/20 / 3.77 / 287.72 Sep 25/20 / 3.97 / 287.52									
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-07

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 13, 2020
COMPLETED : July 13, 2020
N 4 860 884.1 E 618 707.8

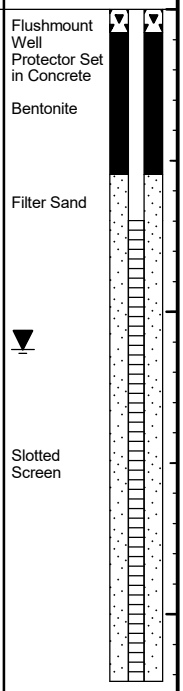
Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		298.20				
		ASPHALT (150mm)		0.00				
		SAND and **GRAVEL** to **SAND**, gravelly, trace to some silt, brown, moist (FILL)		0.15	1	GS		Grain Size Analysis: Gr 29%/ Sa 50%/ Si & Cl 21%
				297.44				
1		**CLAY**, silty, sandy, trace gravel, stiff to firm, grey: (TILL)		0.76	2	SS	15	Grain Size Analysis: Gr 2%/ Sa 33%/ Si 45%/ Cl 20%
					3	SS	6	
2	Hollow Stem Augers			296.10				
		SILT and **SAND**, trace to some clay, very loose, brown, moist		2.10	4	SS	3	Grain Size Analysis: Gr 0%/ Sa 39%/ Si 55%/ Cl 6%
3				295.23				
		CLAY, silty, some sand to sandy, trace gravel, stiff to very stiff, grey: (TILL)		2.97	5	SS	20	
4								
5					6	SS	13	
				293.02				
6		END OF BOREHOLE AT 5.18m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		5.18				
7		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m): Jul 21/20 2.25 295.95; Aug 28/20 2.22 295.98; Sep 25/20 2.56 295.64						
8								
9								

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲)
40 80 120 160
WATER CONTENT, PERCENT
wp w wl
10 20 30 40
DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
July 21, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-08

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 14, 2020
COMPLETED : July 14, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 861 038.5 E 619 130.8

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		308.35							
		ASPHALT (150mm)		0.00							
		SAND and **GRAVEL** to **GRAVEL**, sandy, trace to some silt, brown, moist: (FILL)		0.15	1	GS		Grain Size Analysis: Gr 47%/ Sa 33%/ Si & Cl 20%	○		
				307.59							
1		**CLAY**, silty, some sand, trace gravel, stiff, grey: (TILL)		0.76	2	SS	10		○		
2					3	SS	10		○		
					4	SS	11		○		
3					5	SS	9		○		
				304.70							
4		END OF BOREHOLE AT 3.66m BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, ASPHALT AT SURFACE.		3.66							
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-09

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 15, 2020
COMPLETED : July 15, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 861 144.2 E 619 418.4

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		310.70							
		ASPHALT (125mm)									
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)		0.13	1	GS					Flushmount Well Protector Set in Concrete
				309.93							Bentonite
1		**CLAY**, silty, some sand, trace gravel, stiff to firm, grey: (FILL)		0.76	2	SS	12				
											Filter Sand
2					3	SS	7				Deep / Shallow
				308.49							
		ORGANIC SILT, clayey, soft, black; with occasional inclusions of peat		2.21							Slotted Screen
				308.10	4	SS	4			67	
		SILT, sandy, trace gravel, loose, grey, moist; occasional organics		2.59							
3	Hollow Stem Augers			307.72							
		CLAY, silty, some sand to sandy, trace gravel, occasional cobbles, firm to very stiff, brown to grey: (TILL)		2.97	5	SS	9				
4											Filter Sand
					6	SS	11	Grain Size Analysis: Gr 2%/ Sa 26%/ Si 49%/ Cl 23%			
5											Slotted Screen
6					7	SS	16				
				303.99							
		END OF BOREHOLE AT 6.71m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		6.71							
7		WATER LEVEL READINGS (DEEP WELL):									
		DATE DEPTH(m) ELEV.(m)									
		Jul 21/2020 2.56 308.14									
		Jul 28/2020 1.64 309.06									
		Sep 25/2020 1.87 308.83									
8		WATER LEVEL READINGS (SHALLOW WELL):									
		DATE DEPTH(m) ELEV.(m)									
		Jul 21/2020 1.88 308.82									
		Jul 28/2020 1.70 309.00									
		Sep 25/2020 1.90 308.80									
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 25, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-10

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 15, 2020
COMPLETED : July 15, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 861 284.5 E 619 860.3

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		291.73				
		ASPHALT (125mm)						
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)		0.13				
				290.97				
1		**CLAY**, silty, some sand to sandy, trace gravel, stiff, brown: (TILL)		0.76	1	SS	13	
2					2	SS	11	Grain Size Analysis: Gr 3%/ Sa 27%/ Si 46%/ Cl 24%
				289.52				
		SILT, some clay to clayey, trace sand, firm to very stiff; with occasional partings to layers of silt and silty clay		2.21	3	SS	5	
3					4	SS	21	
4								
5					5	SS	14	Grain Size Analysis: Gr 0%/ Sa 3%/ Si 85%/ Cl 12%
6					6	SS	18	
				285.02				
7		END OF BOREHOLE AT 6.71m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		6.71				
8		WATER LEVEL READINGS (DEEP WELL): DATE / DEPTH(m) / ELEV.(m): Jul 21/2020 DRY -; Jul 28/2020 DRY -; Sep 25/2020 DRY -						
9		WATER LEVEL READINGS (SHALLOW WELL): DATE / DEPTH(m) / ELEV.(m): Jul 21/2020 DRY -; Jul 28/2020 DRY -; Sep 25/2020 DRY -						

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲)
40 80 120 160

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-11

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 15, 2020
COMPLETED : July 15, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 861 403.7 E 620 200.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		282.86							
		ASPHALT (100mm)									
		SAND and **GRAVEL**, trace to some silt: (FILL)		0.10							
1	Hollow Stem Augers	**SILT** and **SAND**, trace to some clay, trace gravel, loose to compact, brown, moist		281.79 1.07	1	SS	9				
2					2	SS	16				
3					3	SS	20				
		SILT, clayey, trace to some sand, firm, brown; with partings of silty clay		279.81 3.05	4	SS	7				
4		END OF BOREHOLE AT 3.66m BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, ASPHALT AT SURFACE.		279.20 3.66							
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-12

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 14, 2020
COMPLETED : July 14, 2020
N 4 861 548.2 E 620 682.8

Project No. 26130
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		295.59							
		ASPHALT (30mm)		0.03							Flushmount Well Protector Set in Concrete
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)			1	GS		Grain Size Analysis: Gr 45%/ Sa 38%/ Si & Cl 17%	○		
				294.91							Bentonite
		SILT and **SAND**, trace gravel, loose to compact, brown, moist: (FILL)		0.69							
1					2	SS	15		○		Filter Sand
					3	SS	28	Grain Size Analysis: Gr 1%/ Sa 37%/ Si 60%/ Cl 2%	○		
2											Slotted Screen
					4	SS	12		○		
3					5	SS	9		○		
4		**SILT** and **SAND**, trace gravel, trace clay, compact to dense, brown, moist: (TILL)		291.48 4.11							
					6	SS	40		○		
5											
6					7	SS	26		○		
7											
					8	SS	41		○		
8				286.91							
		SILT, trace sand and clay, loose to compact, brown, wet		8.69							Filter Sand
9					9	SS	5	Grain Size Analysis: Gr 0%/ Sa 3%/ Si 92%/ Cl 5%	○		
											Slotted Screen

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

August 28, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-12

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 14, 2020
COMPLETED : July 14, 2020

Project No. 26130
SHEET 2 OF 2
DATUM Geodetic

N 4 861 548.2 E 620 682.8

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11					10	SS	11				Deep
				284.31							
		END OF BOREHOLE AT 11.28m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		11.28							
12		WATER LEVEL READINGS (DEEP WELL):									
		DATE DEPTH(m) ELEV.(m)									
		Jul 21/2020 10.18 285.41									
		Jul 28/2020 10.14 285.45									
		Sep 25/2020 DRY -									
		WATER LEVEL READINGS (SHALLOW WELL):									
		DATE DEPTH(m) ELEV.(m)									
13		Jul 21/2020 DRY -									
		Jul 28/2020 DRY -									
		Sep 25/2020 DRY -									
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
August 28, 2020

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

RECORD OF BOREHOLE 20-13

PROJECT : Kirby Road Class EA Study
LOCATION : Kirby Road, Vaughan, Ontario
STARTED : July 14, 2020
COMPLETED : July 14, 2020

Project No. 26130
SHEET 1 OF 1
DATUM Geodetic

N 4 860 225.8 E 616 744.8

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		268.83				
		ASPHALT (110mm)						
		SAND and **GRAVEL**, trace to some silt, brown, moist: (FILL)		0.11	1	GS		
				268.22				
		CLAY, silty, some sand to sandy, trace gravel, stiff, brown: (FILL)		0.61	2	SS	12	
1								
	Hollow Stem Augers			267.38				
		CLAY, silty, some sand, trace gravel, firm to very stiff, brown: (TILL)		1.45	3	SS	7	
2								
					4	SS	21	Grain Size Analysis: Gr 3%/ Sa 22%/ Si 54%/ Cl 21%
3								
					5	SS	23	
				265.17				
		END OF BOREHOLE AT 3.66m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, ASPHALT AT SURFACE.		3.66				
4								
5								
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RB
CHECKED : KF

THURBER

THURBER2S 26130-TEL.GPJ 11/13/20

THURBER

Appendix C

Single Well Response Test Analyses

THURBER ENGINEERING LTD.

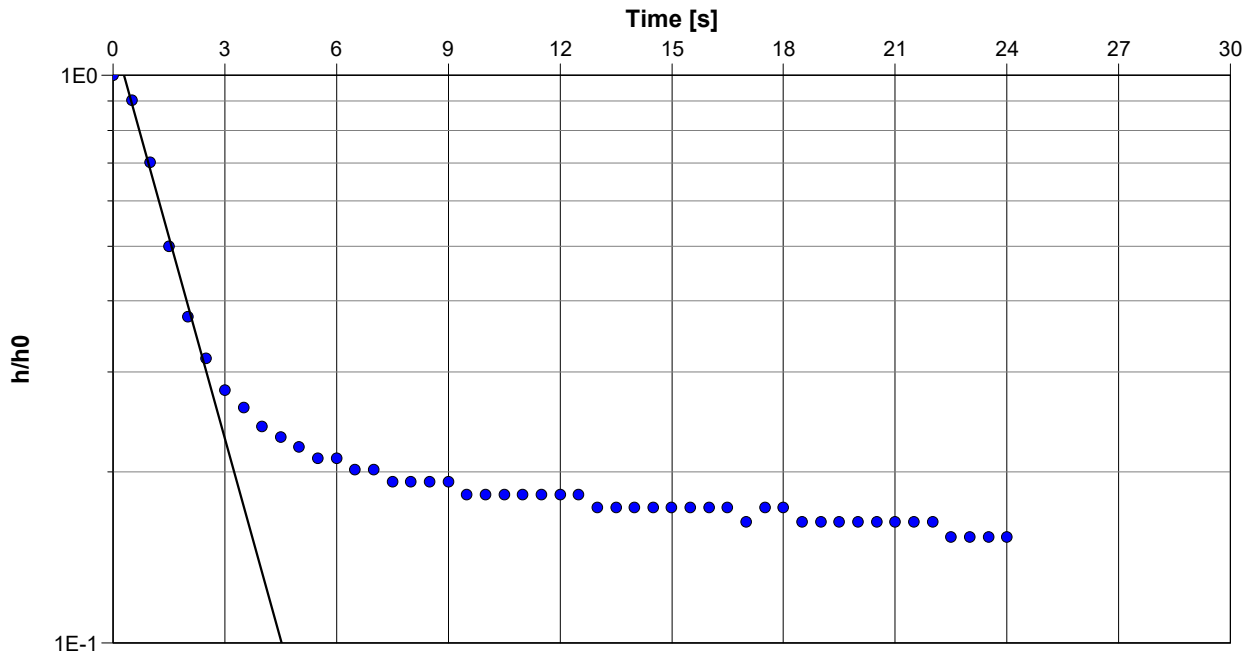
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-01	Test Well: 20-01
Test Conducted by: JZ/RB		Test Date: 2020-07-28
Analysis Performed by: AH	20-01 SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-01	4.8×10^{-4}	

THURBER ENGINEERING LTD.

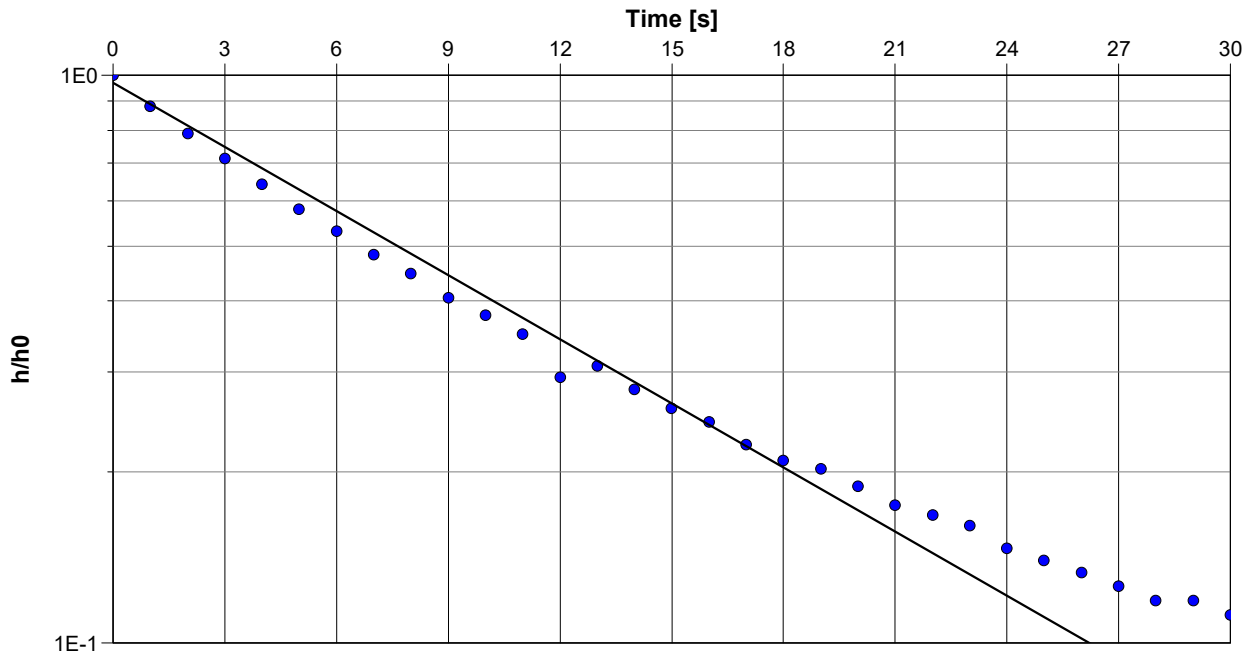
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-03D	Test Well: 20-03D
Test Conducted by: JZ/RB		Test Date: 2020-07-28
Analysis Performed by: AH	20-03D SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-03D	7.7×10^{-5}	

THURBER ENGINEERING LTD.

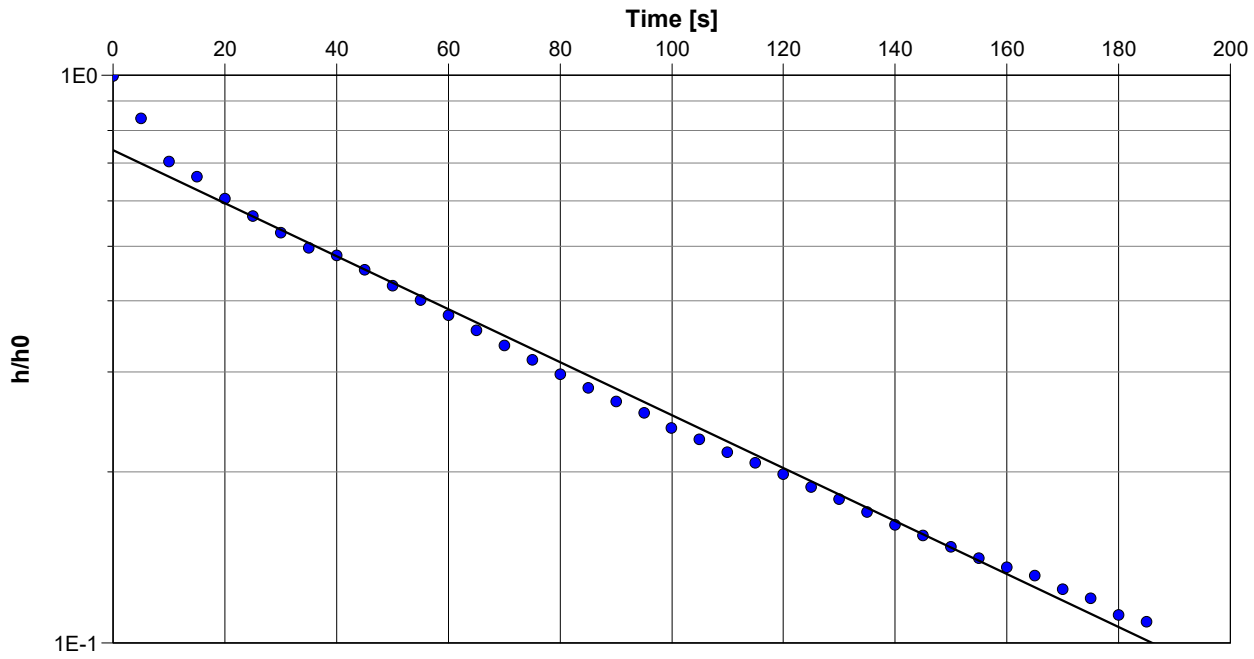
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-05	Test Well: 20-05
Test Conducted by: JZ/RB		Test Date: 2020-07-28
Analysis Performed by: AH	20-05 SWRT Analysis	Analysis Date: 2020-07-29
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-05	5.5×10^{-6}	

THURBER ENGINEERING LTD.

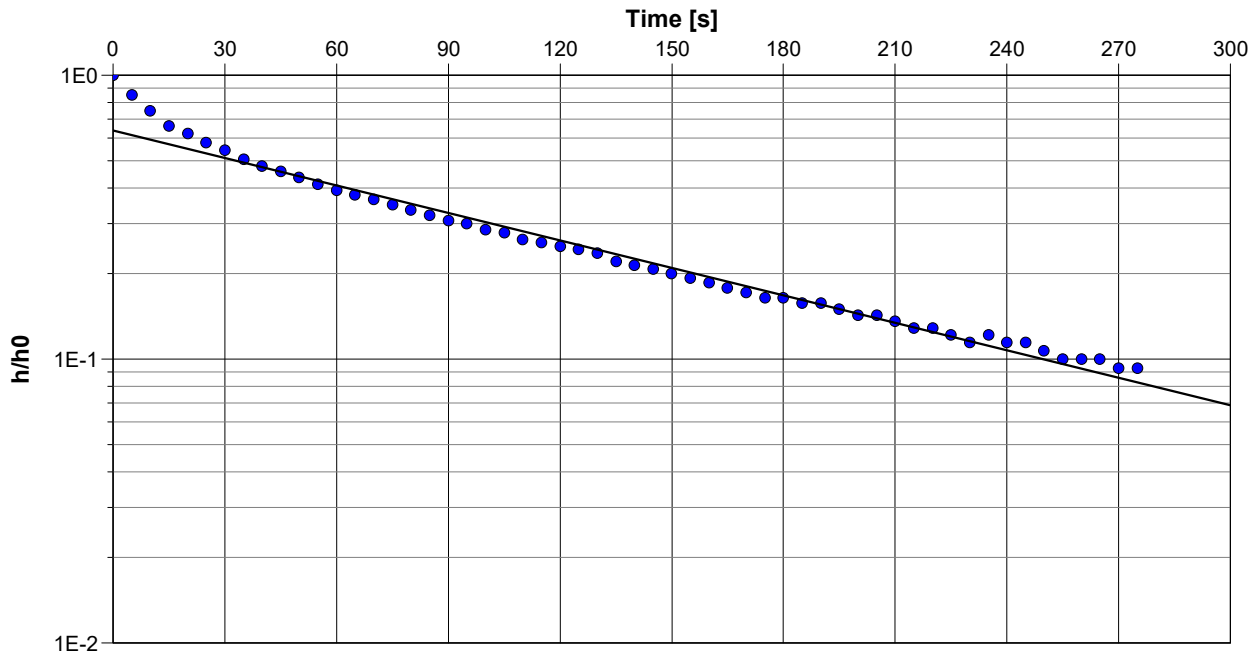
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-06	Test Well: 20-06
Test Conducted by: JZ/RB		Test Date: 2020-07-28
Analysis Performed by: AH	20-06 SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-06	6.6×10^{-6}	

THURBER ENGINEERING LTD.

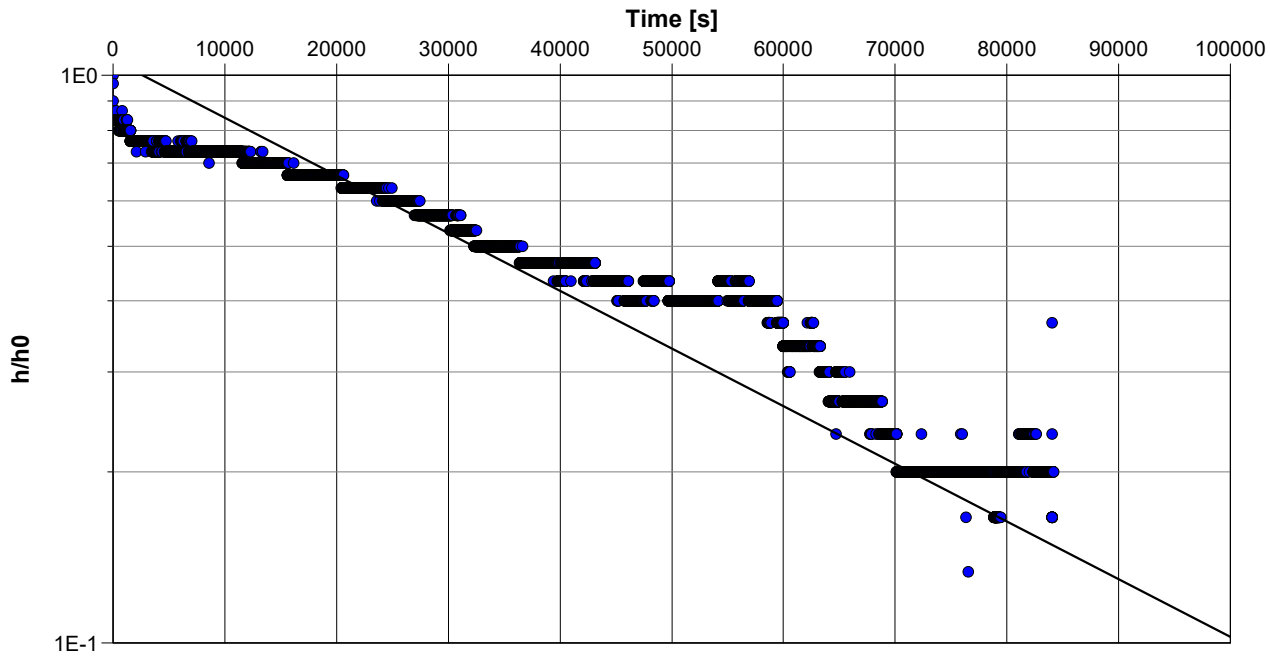
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-07	Test Well: 20-07
Test Conducted by: JZ/RB		Test Date: 2020-07-30
Analysis Performed by: AH	20-07 SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-07	1.0×10^{-8}	

THURBER ENGINEERING LTD.

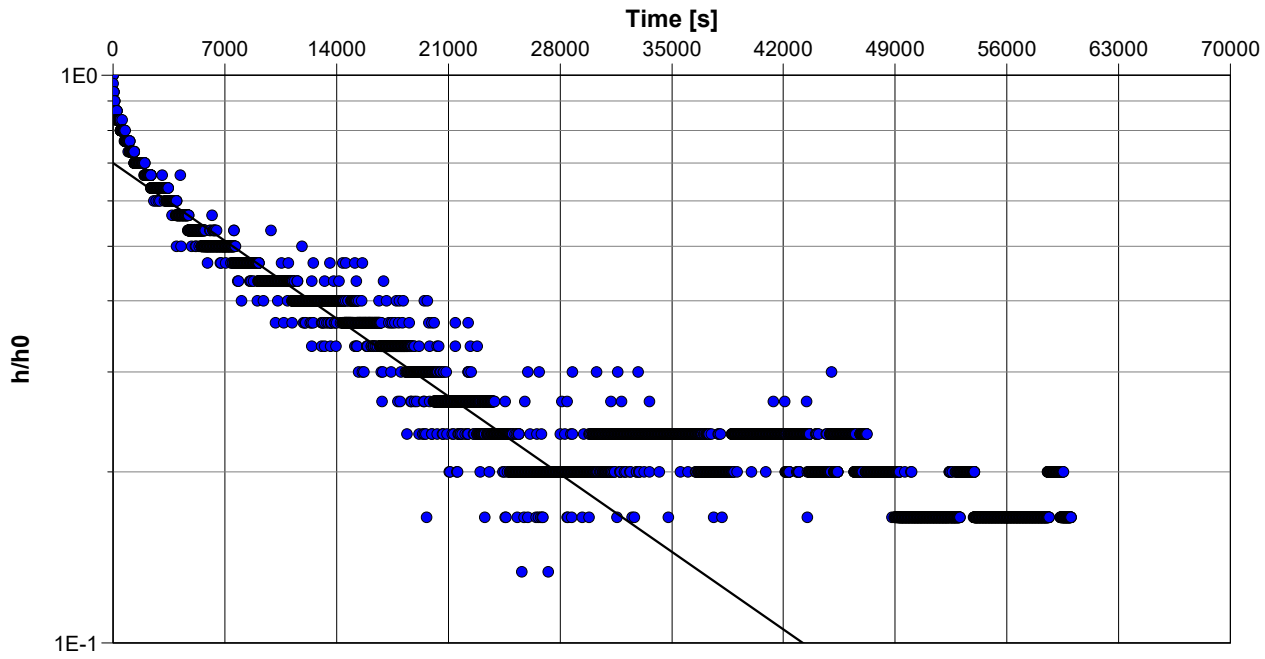
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-09S	Test Well: 20-09S
Test Conducted by:		Test Date: 2020-07-30
Analysis Performed by: AH	20-09S SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-09S	3.4×10^{-8}	

THURBER ENGINEERING LTD.

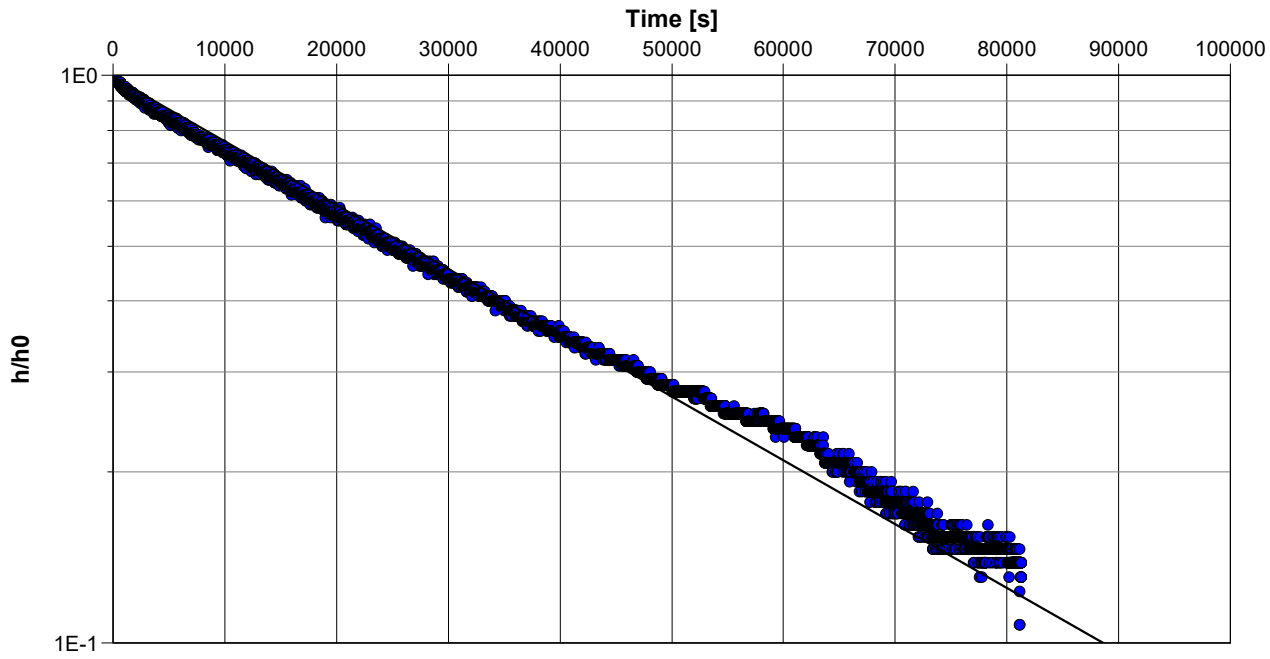
Slug Test Analysis Report

Project: Kirby Road Class EA Study

Number: 26130

Client: HDR

Location: Vaughan	Slug Test: 20-09D	Test Well: 20-09D
Test Conducted by: JZ/RB		Test Date: 2020-07-30
Analysis Performed by: AH	20-09D SWRT Analysis	Analysis Date: 2020-07-30
Aquifer Thickness:		
Checked by: DH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-09D	2.3×10^{-8}	

THURBER

Appendix D

Laboratory Certificates of Analysis

FINAL REPORT

CA15792-JUL20 R1

26130, Kirby Rd. EA

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA15792-JUL20 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Rachel Bourassa	Telephone	705-652-2143
Telephone	905-829-8666 x 263	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	rbourassa@thurber.ca	SGS Reference	CA15792-JUL20
Project	26130, Kirby Rd. EA	Received	07/29/2020
Order Number		Approved	08/06/2020
Samples	Water (3)	Report Number	CA15792-JUL20 R1
		Date Reported	08/06/2020

COMMENTS

RL - SGS Reporting Limit

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:014090

Fluoride spike % recovery low, results accepted based on all other qc

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - General Chemistry** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number	Sample Name	Sample Matrix	Sample Date
					8	20-03D	Water	29/07/2020
					9	20-06	Water	29/07/2020
					10	20-09	Water	29/07/2020
General Chemistry								
Biochemical Oxygen Demand (BOD5)	mg/L	2	300	15	< 4↑	< 4↑	< 4↑	
Total Suspended Solids	mg/L	2	350	15	39	59	10	
Total Kjeldahl Nitrogen	as N mg/L	0.5	100	1	< 0.5	< 0.5	2.1	

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number	Sample Name	Sample Matrix	Sample Date
					8	20-03D	Water	29/07/2020
					9	20-06	Water	29/07/2020
					10	20-09	Water	29/07/2020
Metals and Inorganics								
Cyanide (total)	mg/L	0.01	2	0.02	< 0.01	< 0.01	< 0.01	
Fluoride	mg/L	0.06	10		0.06	0.06	< 0.06	
Sulphate	mg/L	2	1500		23	92	110	
Aluminum (total)	mg/L	0.001	50		0.718	1.04	0.070	
Antimony (total)	mg/L	0.0009	5		< 0.0009	< 0.0009	< 0.0009	
Arsenic (total)	mg/L	0.0002	1	0.02	0.0004	0.0005	0.0010	
Cadmium (total)	mg/L	0.000003	0.7	0.008	0.000005	0.000044	0.000050	
Chromium (total)	mg/L	0.00008	2	0.085	0.00172	0.00219	0.00059	
Cobalt (total)	mg/L	0.000004	5		0.00135	0.00445	0.00594	
Copper (total)	mg/L	0.0002	3	0.05	0.0014	0.0019	0.0027	
Lead (total)	mg/L	0.00001	1	0.12	0.00053	0.00076	0.00010	

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

					Sample Number	8	9	10
					Sample Name	20-03D	20-06	20-09
					Sample Matrix	Water	Water	Water
					Sample Date	29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)							
Manganese (total)	mg/L	0.00001	5	0.15	0.157	0.642	2.91
Molybdenum (total)	mg/L	0.00004	5		0.00114	0.00437	0.00293
Nickel (total)	mg/L	0.0001	2	0.08	0.0026	0.0059	0.0109
Phosphorus (total)	mg/L	0.003	10	0.4	0.042	0.056	0.016
Selenium (total)	mg/L	0.00004	1	0.02	0.00014	0.00015	0.00030
Silver (total)	mg/L	0.00005	5	0.12	< 0.00005	< 0.00005	< 0.00005
Tin (total)	mg/L	0.00006	5		0.00025	0.00033	0.00084
Titanium (total)	mg/L	0.00005	5		0.0369	0.0473	0.00225
Zinc (total)	mg/L	0.002	2	0.04	0.003	0.006	0.006

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - Nonylphenol and Ethoxylates** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020
Nonylphenol and Ethoxylates							
Nonylphenol	mg/L	0.001	0.02		< 0.001	< 0.001	< 0.001
Nonylphenol Ethoxylates	mg/L	0.01	0.2		< 0.01	< 0.01	< 0.01
Nonylphenol monoethoxylate	mg/L	0.01			< 0.01	< 0.01	< 0.01
Nonylphenol diethoxylate	mg/L	0.01			< 0.01	< 0.01	< 0.01

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020
Oil and Grease							
Oil & Grease (total)	mg/L	2			< 2	< 2	< 2
Oil & Grease (animal/vegetable)	mg/L	4	150		< 4	< 4	< 4
Oil & Grease (mineral/synthetic)	mg/L	4	15		< 4	< 4	< 4

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - Other (ORP)** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016
L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020
Other (ORP)							
pH	No unit	0.05	10.5	9	7.45	7.42	6.65
Mercury (total)	mg/L	0.00001	0.01	0.0004	< 0.00001	< 0.00001	< 0.00001

PACKAGE: **SANSEW - PCBs** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016
L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020
PCBs							
Polychlorinated Biphenyls (PCBs) - Total	mg/L	0.0001	0.001	0.0004	< 0.0001	< 0.0001	< 0.0001

PACKAGE: **SANSEW - Phenols** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016
L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020
Phenols							
4AAP-Phenolics	mg/L	0.002	1	0.008	0.003	0.003	0.004

PACKAGE: **SANSEW - SVOCs** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016
L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

Parameter	Units	RL	L1	L2	Sample Number 8	9	10
					Sample Name 20-03D	20-06	20-09
					Sample Matrix Water	Water	Water
					Sample Date 29/07/2020	29/07/2020	29/07/2020

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - SVOCs** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

					Sample Number	8	9	10
					Sample Name	20-03D	20-06	20-09
					Sample Matrix	Water	Water	Water
					Sample Date	29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
SVOCs							
Bis(2-ethylhexyl)phthalate	mg/L	0.002	0.012	0.0088	< 0.002	< 0.002	< 0.002
di-n-Butyl Phthalate	mg/L	0.002	0.08	0.015	< 0.002	< 0.002	< 0.002

PACKAGE: **SANSEW - VOCs** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

					Sample Number	8	9	10
					Sample Name	20-03D	20-06	20-09
					Sample Matrix	Water	Water	Water
					Sample Date	29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
VOCs							
1,2-Dichlorobenzene	mg/L	0.0005	0.05	0.0056	< 0.0005	< 0.0005	< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005	0.08	0.0068	< 0.0005	< 0.0005	< 0.0005
Methylene Chloride	mg/L	0.0005	2	0.0052	< 0.0005	< 0.0005	< 0.0005
Methyl ethyl ketone	mg/L	0.02	8		< 0.02	< 0.02	< 0.02
Styrene	mg/L	0.0005	0.2		< 0.0005	< 0.0005	< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.0005	1.4	0.017	< 0.0005	< 0.0005	< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	1	0.0044	< 0.0005	< 0.0005	< 0.0005
Trichloroethylene	mg/L	0.0005	0.4	0.008	< 0.0005	< 0.0005	< 0.0005
Chloroform	mg/L	0.0005	0.04	0.002	< 0.0005	< 0.0005	< 0.0005
cis-1,2-Dichloroethylene	mg/L	0.0005	4	0.0056	< 0.0005	< 0.0005	< 0.0005
trans-1,3-Dichloropropene	mg/L	0.0005	0.14	0.0056	< 0.0005	< 0.0005	< 0.0005

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd. EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **SANSEW - VOCs - BTEX** (WATER)

L1 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016

L2 = SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016

	Sample Number				8	9	10
	Sample Name				20-03D	20-06	20-09
	Sample Matrix				Water	Water	Water
	Sample Date				29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**
VOCs - BTEX							
Benzene	mg/L	0.0005	0.01	0.002	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	mg/L	0.0005	0.16	0.002	< 0.0005	< 0.0005	< 0.0005
Toluene	mg/L	0.0005	0.27	0.002	< 0.0005	< 0.0005	< 0.0005
Xylene (total)	mg/L	0.0005	1.4	0.0044	< 0.0005	< 0.0005	< 0.0005
m-p-xylene	mg/L	0.0005			< 0.0005	< 0.0005	< 0.0005
o-xylene	mg/L	0.0005			< 0.0005	< 0.0005	< 0.0005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Sanitary Sewer Discharge - BL_087_2016 L1	SANSEW / WATER / - - Vaughan Sewer Use ByLaw - Storm Sewer Discharge - BL_087_2016 L2
20-03D					
Total Suspended Solids	SM 2540D	mg/L	39		15
Manganese	SM 3030/EPA 200.8	mg/L	0.157		0.15
20-06					
Total Suspended Solids	SM 2540D	mg/L	59		15
Manganese	SM 3030/EPA 200.8	mg/L	0.642		0.15
20-09					
Manganese	SM 3030/EPA 200.8	mg/L	2.91		0.15
Total Kjeldahl Nitrogen	SM 4500-N C/4500-NO3- F	mg/L	2.1		1

QC SUMMARY

Anions by discrete analyzer

Method: US EPA 375.4 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-026

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphate	DIO0563-JUL20	mg/L	2	<1	1	20	103	80	120	NV	75	125
Sulphate	DIO0570-JUL20	mg/L	2	1	8	20	100	80	120	99	75	125

Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0059-JUL20	mg/L	2	< 2	10	30	105	70	130	nv	70	130

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0288-JUL20	mg/L	0.01	<0.01	ND	10	92	90	110	100	75	125

QC SUMMARY

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0455-JUL20	mg/L	0.06	<0.06	ND	10	109	90	110	71	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B I Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0021-JUL20	mg/L	0.00001	< 0.00001	ND	20	101	80	120	109	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0165-JUL20	mg/L	0.00005	<0.00005	ND	20	100	90	110	101	70	130
Aluminum (total)	EMS0165-JUL20	mg/L	0.001	<0.001	0	20	102	90	110	116	70	130
Arsenic (total)	EMS0165-JUL20	mg/L	0.0002	<0.0002	8	20	99	90	110	92	70	130
Cadmium (total)	EMS0165-JUL20	mg/L	0.000003	<0.000003	ND	20	98	90	110	100	70	130
Cobalt (total)	EMS0165-JUL20	mg/L	0.000004	<0.000004	ND	20	99	90	110	91	70	130
Chromium (total)	EMS0165-JUL20	mg/L	0.00008	<0.00008	ND	20	106	90	110	120	70	130
Copper (total)	EMS0165-JUL20	mg/L	0.0002	<0.0002	8	20	101	90	110	89	70	130
Manganese (total)	EMS0165-JUL20	mg/L	0.00001	<0.00001	1	20	100	90	110	97	70	130
Molybdenum (total)	EMS0165-JUL20	mg/L	0.00004	<0.00004	16	20	101	90	110	101	70	130
Nickel (total)	EMS0165-JUL20	mg/L	0.0001	<0.0001	15	20	102	90	110	96	70	130
Lead (total)	EMS0165-JUL20	mg/L	0.00001	<0.00001	14	20	100	90	110	114	70	130
Phosphorus (total)	EMS0165-JUL20	mg/L	0.003	0.003	0	20	96	90	110	NV	70	130
Antimony (total)	EMS0165-JUL20	mg/L	0.0009	<0.0009	ND	20	99	90	110	129	70	130
Selenium (total)	EMS0165-JUL20	mg/L	0.00004	<0.00004	16	20	98	90	110	95	70	130
Tin (total)	EMS0165-JUL20	mg/L	0.00006	<0.00006	ND	20	95	90	110	NV	70	130
Titanium (total)	EMS0165-JUL20	mg/L	0.00005	<0.00005	ND	20	91	90	110	NV	70	130
Zinc (total)	EMS0165-JUL20	mg/L	0.002	<0.002	ND	20	103	90	110	116	70	130

QC SUMMARY

Nonylphenol and Ethoxylates

Method: ASTM D7065-06 | Internal ref.: ME-CA-IENVIGC-LAK-AN-015

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nonylphenol diethoxylate	GCM0495-JUL20	mg/L	0.01	< 0.01			76	55	120			
Nonylphenol Ethoxylates	GCM0495-JUL20	mg/L	0.01	< 0.01								
Nonylphenol monoethoxylate	GCM0495-JUL20	mg/L	0.01	< 0.01			82	55	120			
Nonylphenol	GCM0495-JUL20	mg/L	0.001	< 0.001			80	55	120			

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-IENVIGC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0009-AUG20	mg/L	2	<2	NSS	20	103	75	125			

QC SUMMARY

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0009-AUG20	mg/L	4	< 4	NSS	20	NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0009-AUG20	mg/L	4	< 4	NSS	20	NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0442-JUL20	No unit	0.05	NA	0		101			NA		

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0303-JUL20	mg/L	0.002	<0.002	6	10	105	80	120	116	75	125

QC SUMMARY

Polychlorinated Biphenyls

Method: MOE E3400/EPA 8082A | Internal ref.: ME-CA-[ENV]GC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Polychlorinated Biphenyls (PCBs) - Total	GCM0497-JUL20	mg/L	0.0001	<0.0001	ND	30	102	60	140	NSS	60	140

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Bis(2-ethylhexyl)phthalate	GCM0517-JUL20	mg/L	0.002	< 0.002	NSS	30	109	50	140	NSS	50	140
di-n-Butyl Phthalate	GCM0517-JUL20	mg/L	0.002	< 0.002	NSS	30	98	50	140	NSS	50	140

QC SUMMARY

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0452-JUL20	mg/L	2	< 2	6	10	96	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-[ENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0012-AUG20	as N mg/L	0.5	<0.5	4	10	103	90	110	110	75	125
Total Kjeldahl Nitrogen	SKA0292-JUL20	as N mg/L	0.5	<0.5	2	10	98	90	110	118	75	125

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,2,2-Tetrachloroethane	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	99	60	130	105	50	140
1,2-Dichlorobenzene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	100	60	130	104	50	140
1,4-Dichlorobenzene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	101	60	130	103	50	140
Benzene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	99	60	130	103	50	140
Chloroform	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	98	60	130	101	50	140
cis-1,2-Dichloroethylene	GCM0489-JUL20	mg/L	0.0005	<0.0005	4	30	98	60	130	103	50	140
Ethylbenzene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	101	60	130	105	50	140
m-p-xylene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	102	60	130	105	50	140
Methyl ethyl ketone	GCM0489-JUL20	mg/L	0.02	<0.02	ND	30	97	50	140	105	50	140
Methylene Chloride	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	95	60	130	97	50	140
o-xylene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	100	60	130	105	50	140
Styrene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	102	60	130	105	50	140
Tetrachloroethylene (perchloroethylene)	GCM0489-JUL20	mg/L	0.0005	<0.0005	5	30	100	60	130	104	50	140
Toluene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	100	60	130	104	50	140
trans-1,3-Dichloropropene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	101	60	130	106	50	140
Trichloroethylene	GCM0489-JUL20	mg/L	0.0005	<0.0005	ND	30	99	60	130	103	50	140

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 014090 Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Lyall
Received Date: 07/29/2020 (mm/dd/yy)
Received Time: 17 : 30 (hr : min)
Received By (signature):
Custody Seal Present: Yes ☐ No ☐
Custody Seal Intact: Yes ☑ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: Ice
Temperature Upon Receipt (°C): 9.2, 9.2, 9.2
LAB LIMS #: CA15792-93 Jul20

REPORT INFORMATION

Company: Thurber Engineering
Contact: Rachel Bourassa
Address: 103 - 2010 Winston Park Drive Oakville ON
Phone: 905 829 8666
Fax:
Email: rbourassa@thurber

INVOICE INFORMATION

☑ (same as Report Information)
Company: Thurber Engineering
Contact: Atrezza
Address:
Phone:
Email:

Quotation #: 2020966
Project #: 26130
P.O. #:
Site Location/ID: Kirby Rd EA

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ Res/Park ☐ Ind/Com ☐ Agri/Other Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☑ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☑ Sanitary ☑ Storm Municipality: Vaughan

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	20-03D	29/07/20	2:00	23	Water
2	20-03D FF	29/07/20	2:00	3	Water
3	20-06	29/07/20	1:00	23	Water
4	20-06 FF	29/07/20	1:00	3	Water
5	20-09	"	11:00	23	Water
6	20-09 FF	"	11:00	3	Water
7					
8					
9					
10					
11					
12					

M & I: Field Filtered (Y/N); Metals & Inorganics incl CrVI, CN,Hg pH,(B(HWS),EC,SAR-soil) (CI, Nw-water); Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI; ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni, Se,Ag,Tl,U,V,Zn
SVOC: PAHs only; SVOCs all incl PAHs, ABNs, CPs
PCB: PCBs Total ☐ Aroclor ☐
PHC: F1-F4 + BTEX; F1-F4 only no BTEX
VOC: VOCs all incl BTEX; BTEX only
Pest: Pesticides Organochlorine or specify other
Other (please specify): Water Characterization; Dissolved Metals; TSS; Sewer Use: Storm / San. Specify pkg: Vaughan; Water Characterization Pkg ☐ Extended ☐ General
TCLP: Specify TCLP tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.

	Water Characterization	Dissolved Metals	TSS			Sewer Use: Storm / San.	Water Characterization Pkg
1	✓					✓	
2		✓	✓				
3	✓					✓	
4		✓	✓				
5	✓					✓	
6		✓	✓				

COMMENTS:

Observations/Comments/Special Instructions

Sampled By (NAME): Rachel Bourassa Signature: R Bourassa Date: 7/29/20 (mm/dd/yy)
Relinquished by (NAME): Rachel Bourassa Signature: R Bourassa Date: 7/29/20 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.2
Date of Issue: 09 Sept, 2019

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

FINAL REPORT

CA15793-JUL20 R2

26130, Kirby Rd EA

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Rachel Bourassa
Telephone	905-829-8666 x 263
Facsimile	
Email	rbourassa@thurber.ca
Project	26130, Kirby Rd EA
Order Number	
Samples	Water (6)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA15793-JUL20
Received	07/29/2020
Approved	08/06/2020
Report Number	CA15793-JUL20 R2
Date Reported	08/14/2020

COMMENTS

MAC - Maximum Acceptable Concentration
AO/OG - Aesthetic Objective / Operational Guideline
NR - Not reportable under applicable Provincial drinking water regulations as per client.

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:014090

Fluoride spike % recovery low, results accepted based on all other qc

RL raised for nits due to S.M

Colour std appears high, but within acceptance criteria

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **PWQO_L - General Chemistry** (WATER)

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

	Sample Number			7	8	9	10	11	12		
	Sample Name			20-03D	20-03D FF Dissolved	20-06	20-06 FF Dissolved	20-09D	20-09D FF Dissolved		
	Sample Matrix			Water	Water	Water	Water	Water	Water		
	Sample Date			29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**		
General Chemistry											
Total Suspended Solids	mg/L	2			< 2		2		3		
Alkalinity	mg/L as CaCO3	2		273		301		582			
Bicarbonate	mg/L as CaCO3	2		273		301		582			
Carbonate	mg/L as CaCO3	2		< 2		< 2		< 2			
OH	mg/L as CaCO3	2		< 2		< 2		< 2			
Colour	TCU	3		5		4		20			
Conductivity	uS/cm	2		1530		7470		5310			
Turbidity	NTU	0.10		61.1		575		1.09			
Ammonia+Ammonium (N)	as N mg/L	0.04		< 0.04		0.12		2.2			
Phosphorus (total reactive)	mg/L	0.03		< 0.03		< 0.03		< 0.03			
Total Organic Carbon	mg/L	1		< 1		2		8			
Ion Ratio	-	-9999		1.13		1.12		1.06			
Total Dissolved Solids (calculated)	mg/L	-9999		892		4377		3272			
Conductivity (calculated)	uS/cm	-9999		1678		7746		6104			
Langeliers Index 4° C	@ 4° C	-9999		0.65		0.86		1.07			
Saturation pH 4°C	pHs @ 4°C	-9999		7.3		7.06		6.32			

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **PWQO_L - Metals and Inorganics** (WATER)

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

	Sample Number	7	8	9	10	11	12
	Sample Name	20-03D	20-03D FF Dissolved	20-06	20-06 FF Dissolved	20-09D	20-09D FF Dissolved
	Sample Matrix	Water	Water	Water	Water	Water	Water
	Sample Date	29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics							
Chloride	mg/L	0.04		340		2300		1600	
Fluoride	mg/L	0.06		0.07		0.06		< 0.06	
Bromide	mg/L	0.05		0.11		0.68		1.08	
Nitrite (as N)	as N mg/L	0.003		0.003#<MDL		0.03#<MDL#RDS		0.03#<MDL#RDS	
Nitrate (as N)	as N mg/L	0.006		8.73		0.208		0.057	
Sulphate	mg/L	0.04		28		96		120	
Hardness	mg/L as CaCO3	0.05		581	492	979	833	2810	2610
Aluminum	µg/L	1	75	1370		1990		70	
Aluminum (0.2µm)	mg/L	0.001	0.015	0.14		0.23		0.009	
Arsenic	µg/L	0.2	5	0.6	< 0.2	0.9	0.2	0.9	1.1
Boron	µg/L	2	200	15	10	29	19	37	38
Barium	µg/L	0.02		154	122	393	351	472	432
Beryllium	µg/L	0.007	1100	0.057	< 0.007	0.095	< 0.007	0.010	0.008
Cobalt	µg/L	0.004	0.9	1.79	0.656	6.50	2.00	5.82	5.61
Calcium	mg/L	0.01		185	156	340	293	943	876
Cadmium	µg/L	0.003	0.5	0.008	0.007	0.070	0.040	0.048	0.046
Copper	µg/L	0.2	5	2.2	3.0	3.6	1.1	2.6	3.6
Chromium	µg/L	0.08	100	2.35	0.80	3.40	0.16	0.54	1.19
Iron	ug/L	7	300	1590	< 7	2410	< 7	97	10
Potassium	mg/L	0.009		2.90	2.17	8.02	3.83	14.1	14.6

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **PWQO_L - Metals and Inorganics** (WATER)

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

	Sample Number	7	8	9	10	11	12		
	Sample Name	20-03D	20-03D FF Dissolved	20-06	20-06 FF Dissolved	20-09D	20-09D FF Dissolved		
	Sample Matrix	Water	Water	Water	Water	Water	Water		
	Sample Date	29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020	29/07/2020		
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)									
Magnesium	mg/L	0.001		29.1	24.8	31.7	25.0	111	103
Manganese	µg/L	0.01		187	108	970	276	2871	2463
Molybdenum	µg/L	0.04	40	1.10	0.71	5.01	1.86	3.06	2.96
Nickel	µg/L	0.1	25	3.3	1.4	8.5	2.6	10.8	11.5
Sodium	mg/L	0.01		134	112	1420	1180	135	118
Phosphorus	mg/L	0.003	0.01	0.075	< 0.003	0.158	0.004	0.021	0.013
Lead	µg/L	0.01	11~25	1.17	0.11	2.03	0.02	0.08	0.20
Silicon	ug/L	20		10800	7340	8560	4360	9360	8810
Silver	µg/L	0.05	0.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Strontium	µg/L	0.02		419	356	1140	962	1680	1600
Thallium	µg/L	0.005	0.3	0.037	0.013	0.101	0.049	0.093	0.091
Tin	µg/L	0.06		0.34	0.11	0.66	0.11	0.80	3.68
Titanium	ug/L	0.05		61.0	< 0.05	86.7	0.17	1.85	0.42
Antimony	µg/L	0.09	20	< 0.09	0.12	0.48	0.19	0.34	0.84
Selenium	µg/L	0.04	100	0.13	0.16	0.27	0.10	0.38	0.43
Uranium	µg/L	0.002	5	2.32	1.59	5.11	2.53	10.4	8.92
Vanadium	µg/L	0.01	6	3.02	0.31	4.66	0.29	1.43	1.03
Zinc	µg/L	2	20	5	4	8	< 2	4	7
Cation sum	meq/L	-9999		17.79		82.01		62.81	
Anion Sum	meq/L	-9999		15.77		72.91		59.27	
Anion-Cation Balance	% difference	-9999		6.02		5.88		2.9	

Client: Thurber Engineering Ltd.
Project: 26130, Kirby Rd EA
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

PACKAGE: **PWQO_L - Other (ORP)** (WATER)

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

	Sample Number			7	9	11
	Sample Name			20-03D	20-06	20-09D
	Sample Matrix			Water	Water	Water
	Sample Date			29/07/2020	29/07/2020	29/07/2020
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**	**Result**
Other (ORP)						
pH	No unit	0.05	8.6	7.95	7.92	7.39
Mercury (dissolved)	mg/L	0.00001		< 0.00001	< 0.00001	< 0.00001

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
20-03D				
Aluminum	SM 3030/EPA 200.8	µg/L	1370	75
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.14	0.015
Cobalt	SM 3030/EPA 200.8	µg/L	1.79	0.9
Iron	SM 3030/EPA 200.8	µg/L	1590	300
Phosphorus	SM 3030/EPA 200.8	µg/L	0.075	0.01
20-06				
Aluminum	SM 3030/EPA 200.8	µg/L	1990	75
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.23	0.015
Cobalt	SM 3030/EPA 200.8	µg/L	6.50	0.9
Iron	SM 3030/EPA 200.8	µg/L	2410	300
Phosphorus	SM 3030/EPA 200.8	µg/L	0.158	0.01
Uranium	SM 3030/EPA 200.8	µg/L	5.11	5
20-06 FF Dissolved				
Cobalt	SM 3030/EPA 200.8	µg/L	2.00	0.9
20-09D				
Cobalt	SM 3030/EPA 200.8	µg/L	5.82	0.9
Phosphorus	SM 3030/EPA 200.8	µg/L	0.021	0.01
Uranium	SM 3030/EPA 200.8	µg/L	10.4	5
20-09D FF Dissolved				
Cobalt	SM 3030/EPA 200.8	µg/L	5.61	0.9
Phosphorus	SM 3030/EPA 200.8	µg/L	0.013	0.01
Uranium	SM 3030/EPA 200.8	µg/L	8.92	5

QC SUMMARY

Alkalinity

Method: SM 2320 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0445-JUL20	mg/L as CaCO3	2	< 2	0	20	102	80	120	NA		

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0294-JUL20	mg/L	0.04	<0.04	5	10	100	90	110	89	75	125

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nitrite (as N)	DIO0006-AUG20	mg/L	0.003	<0.003	ND	20	94	80	120	100	75	125
Chloride	DIO0017-AUG20	mg/L	0.04	<0.04	3	20	93	80	120	109	75	125
Sulphate	DIO0017-AUG20	mg/L	0.04	<0.04	1	20	97	80	120	98	75	125
Chloride	DIO0032-AUG20	mg/L	0.04	<0.04	1	20	93	80	120	100	75	125
Bromide	DIO0554-JUL20	mg/L	0.05	<0.05	ND	20	103	80	120	104	75	125
Nitrite (as N)	DIO0554-JUL20	mg/L	0.003	<0.003	ND	20	94	80	120	100	75	125
Nitrate (as N)	DIO0554-JUL20	mg/L	0.006	<0.006	ND	20	99	80	120	105	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Organic Carbon	SKA0299-JUL20	mg/L	1	<1	2	10	93	90	110	87	75	125

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0445-JUL20	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0445-JUL20	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0445-JUL20	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0461-JUL20	TCU	3	< 3	0	10	115	80	120	NA		

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0445-JUL20	uS/cm	2	< 2	1	20	98	90	110	NA		

Fluoride by Specific Ion Electrode

Method: SM 4500 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0455-JUL20	mg/L	0.06	<0.06	ND	10	109	90	110	71	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (dissolved)	EHG0021-JUL20	mg/L	0.00001	< 0.00001	ND	20	101	80	120	109	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sodium	EMS0013-AUG20	mg/L	0.01	<0.01	1	20	102	90	110	95	70	130
Silver	EMS0165-JUL20	ug/L	0.05	<0.00005	ND	20	100	90	110	101	70	130
Aluminum	EMS0165-JUL20	ug/L	1	<0.001	0	20	102	90	110	116	70	130
Aluminum (0.2µm)	EMS0165-JUL20	mg/L	0.001	<0.001	0	20	102	90	110	116	70	130
Arsenic	EMS0165-JUL20	ug/L	0.2	<0.0002	8	20	99	90	110	92	70	130
Barium	EMS0165-JUL20	ug/L	0.02	<0.00002	4	20	101	90	110	113	70	130
Beryllium	EMS0165-JUL20	ug/L	0.007	<0.000007	18	20	93	90	110	104	70	130
Boron	EMS0165-JUL20	ug/L	2	<0.002	1	20	96	90	110	NV	70	130
Calcium	EMS0165-JUL20	mg/L	0.01	<0.01	0	20	100	90	110	93	70	130
Cadmium	EMS0165-JUL20	ug/L	0.003	<0.000003	ND	20	98	90	110	100	70	130
Cobalt	EMS0165-JUL20	ug/L	0.004	<0.000004	ND	20	99	90	110	91	70	130
Chromium	EMS0165-JUL20	ug/L	0.08	<0.00008	ND	20	106	90	110	120	70	130
Copper	EMS0165-JUL20	ug/L	0.2	<0.0002	8	20	101	90	110	89	70	130
Iron	EMS0165-JUL20	ug/L	7	<0.007	0	20	100	90	110	NV	70	130
Potassium	EMS0165-JUL20	mg/L	0.009	<0.009	0	20	102	90	110	98	70	130
Magnesium	EMS0165-JUL20	mg/L	0.001	<0.001	0	20	101	90	110	96	70	130
Manganese	EMS0165-JUL20	ug/L	0.01	<0.00001	1	20	100	90	110	97	70	130
Molybdenum	EMS0165-JUL20	ug/L	0.04	<0.00004	16	20	101	90	110	101	70	130
Sodium	EMS0165-JUL20	mg/L	0.01	<0.01	1	20	102	90	110	96	70	130
Nickel	EMS0165-JUL20	ug/L	0.1	<0.0001	15	20	102	90	110	96	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Lead	EMS0165-JUL20	ug/L	0.01	<0.00001	14	20	100	90	110	114	70	130
Phosphorus	EMS0165-JUL20	mg/L	0.003	0.003	0	20	96	90	110	NV	70	130
Antimony	EMS0165-JUL20	ug/L	0.09	<0.0009	ND	20	99	90	110	129	70	130
Selenium	EMS0165-JUL20	ug/L	0.04	<0.00004	16	20	98	90	110	95	70	130
Silicon	EMS0165-JUL20	ug/L	20	<0.02	1	20	100	90	110	NV	70	130
Tin	EMS0165-JUL20	ug/L	0.06	<0.00006	ND	20	95	90	110	NV	70	130
Strontium	EMS0165-JUL20	ug/L	0.02	<0.00002	1	20	102	90	110	99	70	130
Titanium	EMS0165-JUL20	ug/L	0.05	<0.00005	ND	20	91	90	110	NV	70	130
Thallium	EMS0165-JUL20	ug/L	0.005	<0.000005	ND	20	97	90	110	111	70	130
Uranium	EMS0165-JUL20	ug/L	0.002	<0.000002	3	20	97	90	110	108	70	130
Vanadium	EMS0165-JUL20	ug/L	0.01	<0.00001	10	20	98	90	110	93	70	130
Zinc	EMS0165-JUL20	ug/L	2	<0.002	ND	20	103	90	110	116	70	130

QC SUMMARY

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0165-JUL20	mg/L as CaCO3	0.05		0	20						

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0445-JUL20	No unit	0.05	NA	0		101			NA		

QC SUMMARY

Reactive Phosphorus by SFA

Method: SM 4500-P F | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total reactive)	SKA0291-JUL20	mg/L	0.03	<0.03	ND	10	93	90	110	90	75	125
Phosphorus (total reactive)	SKA0305-JUL20	mg/L	0.03	<0.03	8	10	100	90	110	93	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0018-AUG20	mg/L	2	< 2	0	10	101	90	110	NA		

Turbidity

Method: SM 2130 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0440-JUL20	NTU	0.10	< 0.10	6	10	99	90	110	NA		

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --

SGS Request for Laboratory Services and CHAIN OF CUSTODY

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 014090 Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Lyof
Received Date: 07/29/2020 (mm/dd/yy)
Received Time: 17:30 (hr : min)
Received By (signature): [signature]
Custody Seal Present: Yes ☐ No ☐
Custody Seal Intact: Yes ☑ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: Ice
Temperature Upon Receipt (°C): 9.2, 9.2, 9.2
LAB LIMS #: CA15792-93 Jul20

REPORT INFORMATION

Company: Thurber Engineering
Contact: Rachel Bourassa
Address: 103 - 2010 Winston Park Drive Oakville ON
Phone: 905 829 8666
Fax:
Email: rbourassa@thurber.ca

INVOICE INFORMATION

☑ (same as Report Information)
Company: Thurber Engineering
Contact: Attiezen
Address:
Phone:
Email:

Quotation #: 2020966
Project #: 26130
P.O. #:
Site Location/ID: Kirby Rd EA

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table ____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☑ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:
☑ Sanitary
☑ Storm
Municipality: Vaughan

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	20-03D	29/07/20	2:00	23	Water
2	20-03D FF	29/07/20	2:00	3	Water
3	20-06	29/07/20	1:00	23	Water
4	20-06 FF	29/07/20	1:00	3	Water
5	20-09	"	11:00	23	Water
6	20-09 FF	"	11:00	3	Water
7					
8					
9					
10					
11					
12					

	M & I				SVOC		PCB	PHC		VOC		Pest	Other (please specify)							TCLP	COMMENTS:
	Field Filtered (Y/N)	Metals & Inorganics incl CrVI, CN,Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na–water)	Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni, Se,Ag,Tl,U,V,Zn	PAHs only	SVOCs all incl PAHs, ABNs, CPs	PCBs Total ☐ Aroclor ☐	F1-F4 + BTEX	F1-F4 only no BTEX	VOCs all incl BTEX	BTEX only	Pesticides Organochlorine or specify other	Water Characterization	Dissolved Metals	TSS			Sewer Use: Storm / San. Specify pkg: Vaughan	Water Characterization Pkg General ☐ Extended ☐		Specify TCLP tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	
1													✓					✓			
2														✓	✓						
3													✓					✓			
4														✓	✓						
5													✓					✓			
6														✓	✓						

Observations/Comments/Special Instructions

Sampled By (NAME): Rachel Bourassa Signature: [signature] Date: 7/29/20 (mm/dd/yy)
Relinquished by (NAME): Rachel Bourassa Signature: [signature] Date: 7/29/20 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.2
Date of Issue: 09 Sept, 2019

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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Appendix E

Dewatering Estimates

Dewatering Calculations for Unconfined Scenarios

Parameter	Units	Underpass	Potential Pile Caps for Overpass
Geologic Unit to Dewater		Sand	Sand
Nearest Monitoring Well		BH20-06	BH20-06
Input Hydraulic Conductivity in cm/s (K)	m/s	6.6E-06	6.6E-06
Hydraulic Conductivity converted to m/day	m/day	5.7E-01	5.7E-01
Highest Groundwater level	m	288.3	288.3
Input height of groundwater pressure (H)	m	9.3	4.0
Input dewatering height (h)	m	2.0	2.7
Input length of excavation (x, a)	m	250.0	30.0
Input width of excavation (b)	m	25.0	5.0
Input/calculate radius of trench (r_w or r_s)	m	12.5	2.5
Length to width ratio	unitless	10.0	6.0
Net water table lowering	m	7.3	1.3
Equation Type		Trench	Trench
Radii of Influence			
Sichardt Equation (Ro based on K, H, h)	m	56.5	10.3
Ro = Sichardt + (rw or rs)	**m**	**69**	**13**
Calculated Flow Rate			
Base groundwater flow	**L/day**	**259,000**	**22,000**
Partial Penetration Factor	unitless	1.00	1.00
Safety factor on groundwater flow	unitless	3	3
Groundwater flow with safety factor	L/day	777,000	66,000
Rainfall entering excavation	mm	50	50
Duration to remove rainfall	hours	24	24
Flow rate to remove rainfall	L/day	313,000	8,000
Budgeted peak flow rate	**L/day**	**1,090,000**	**74,000**
=	L/s	12.6	0.9
=	gal/min	167	11

Flow rate estimates rounded to nearest 1,000 L/day.

Theory and Formulae

Trench flow in unconfined aquifer

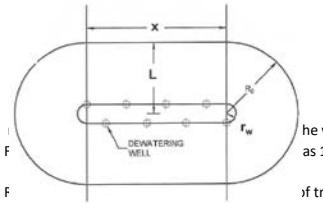
Use this equation when a/b > 1.5.

Equation 4.0

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

Trench flow in confined Aquifer

$$Q = \frac{2\pi KB(H - h)}{\ln(R_0 / r_s)} + 2\left[\frac{xKB(H - h)}{L}\right]$$



he widt
as 1/2 t

f trench to line

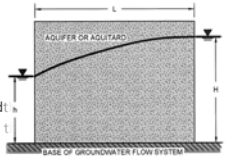
Equation 4.1 (Rectangular)

$$r_w = \frac{a + b}{\pi}$$

OR

Equation 4.1 (Circular)

$$r_s = \sqrt{\frac{a \times b}{\pi}}$$



3

Radial flow to well in unconfined aquifer (Dupuit Equation):

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

Steady-state flow in confined aquifer

Flow per well Q = 2.73 K b (H - h)/log(R/r)

Source: Driscoll, Fletcher G. (1986). *Groundwater and Wells* (2nd ed). St. Paul, Minnesota: Johnson Filtration Systems Inc.

Radius of Influece

Ro is determined by the Sichardt Equation:

Ro = 3000(H-hw)K^0.5 when K is in m/s

Alternative equation by Bear (Bear, J., 1979. **Hydraulics of Groundwater**, McGraw-Hill, New York, 569p) R_o=1.5(Tt/S)$^{0.5}$ where **T** is transmissivity in **m^2/day**, **t** is pumping duration in **days.** R_o will be in **metres.**

ac
rw as indicated in formulae

Hydraulic Conductivity and Grain Size

Partial Pe

F = L/b*(1.

$$K = \left(\frac{\rho g}{\mu}\right)\left[\frac{n^3}{(1-n)^2}\right]\left(\frac{d_{10}^2}{180}\right)$$

where:

L = Vertical length from which water is being extracted

r = single well radius

b = saturated aquifer thickness

L/r must be > 30 L/b must be < 0.5

Assumption made that same factor may be applied to equivalent well and trench equations.

Reference: Powers, J. P., Corwin, A. B., Schmall, Paul C. and Kaeck, W. E. 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, Third Edition, New York, New York: John Wiley & Sons.

Sy to calculate the Radius of Influence of Unconfined aquifer using Bear 1979

The following table shows representative values of specific yield for various geologic materials (from Morris and Johnson 1967):

Material	Specific Yield (%)
Gravel, coarse	21
Gravel, medium	24
Gravel, fine	28
Sand, coarse	30
Sand, medium	32
Sand, fine	33
Silt	20
Clay	6
Sandstone, fine grained	21
Sandstone, medium grained	27
Limestone	14
Dune sand	38
Loess	18
Peat	44
Schist	26
Siltstone	12
Till, predominantly silt	6

The following table provides representative values of specific storage for various geologic materials (Domenico and Mifflin [1965] as reported in Batu [1998]):

Material	S_s (ft^{-1})
Plastic clay	7.8×10^{-4} to 6.2×10^{-3}
Stiff clay	3.9×10^{-4} to 7.8×10^{-4}
Medium hard clay	2.8×10^{-4} to 3.9×10^{-4}
Loose sand	1.5×10^{-4} to 3.1×10^{-4}
Dense sand	3.9×10^{-5} to 6.2×10^{-5}
Dense sandy gravel	1.5×10^{-5} to 3.1×10^{-5}
Rock, fissured	1×10^{-6} to 2.1×10^{-5}
Rock, sound	$< 1\times10^{-6}$

To Convert	Divide By	To Obtain

THURBER ENGINEERING LTD.

To: Michelle Mascarenhas, P.Eng.
HDR Inc.
1000 York Blvd., Suite 300
Richmond Hill, ON L4B 1J8

June 19, 2021

From: Alireza Hejazi, P.Eng.
David Hill, P.Eng., P.Geo.

Thurber File No.: 26130

TECHNICAL MEMORANDUM
GROUNDWATER MONITORING PROGRAM
MUNICIPAL CLASS EA STUDY FOR KIRBY ROAD WIDENING
FROM JANE STREET TO DUFFERIN STREET
CITY OF VAUGHAN, ONTARIO

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by HDR Inc. (HDR) to conduct a Hydrogeological Investigation in support of the Municipal Class Environmental Assessment (EA) study for the proposed widening of Kirby Road between Jane Street and Dufferin Street in the City of Vaughan, Ontario. The investigation includes groundwater level measurements over a duration of two years. This memorandum summarizes the groundwater levels observed over the first year, from July 2020 to June 2021.

Groundwater monitoring was conducted by Thurber staff on a bi-monthly basis from July 2020 to June 2021 (Table 1 and Table 2 in Appendix A). In addition, eight (8) level loggers were instrumented in selected monitoring wells to record groundwater levels on an hourly basis, to measure seasonal groundwater fluctuations. A barologger was also installed to record barometric pressure to correct level logger readings for atmospheric pressure. A map illustrating the location of the monitoring wells is provided on Figure 1. Table 1 and Table 2 summarize the recorded groundwater levels from all on-site monitoring wells. Hydrographs of these groundwater data are provided in Appendix A.

Between the period of July 21, 2020 and June 23, 2021, seven (7) rounds of water level measurements were collected by Thurber staff from twelve on-site monitoring wells. In general, the groundwater table reflects local topography. The water level elevations in the monitoring wells ranged from 264.3 m to 309.3 m. The highest groundwater level (Elev.309.3 m, depth 1.3 m) was measured in Monitoring Well 20-09S and the lowest water level (Elev. 264.3 m, depth 27.27 m) was measured in Monitoring Well 20-05.

The hydraulic gradient across the site is generally neutral to downward (Table 3 in Appendix A). The magnitude of vertical hydraulic gradients observed at Monitoring Wells 20-09S/D was estimated to be relatively small (<-0.05 m/m) and can be considered as near neutral gradient.

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The hydrographs in Appendix A illustrate the seasonal fluctuation in the groundwater levels. Higher groundwater levels were observed during the winter and spring months (December to May), and lower levels were observed during the summer and autumn months (July to November). The range in seasonal fluctuation in each well was from 0.3 m (in Monitoring Well 20-12D) to 2.5 m (in Monitoring Well 20-01) over the course of the monitoring period.

2 CLOSURE

We trust this memo meets your requirements. If you have any questions or require further information, please contact the undersigned at your convenience.

Yours truly,

Thurber Engineering Limited

Alireza Hejazi, Ph.D., P.Eng.
Senior Hydrogeologist and Environmental Engineer

David Hill, M.A.Sc., MBA, P.Eng., P.Geo.
Senior Hydrogeologist / Review Engineer

Attachments:

Figure 1 - Monitoring Well Location Map
Appendix A - Measured Groundwater Levels and Hydrographs

East Humber River

Don River West Branch

Jane Street

Keele Street

Dufferin Street

Kirby Road

20-01

20-02

20-03-S/D

20-04

20-05

20-06

20-07

20-08

20-09-S/D

20-10-S/D

20-11

20-12-S/D

20-13

N

LEGEND:

- Borehole
- Monitoring Well
- Site Boundary
- Watercourse
- Road

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

BOREHOLE AND MONITORING WELL LOCATIONS

FIGURE 1

DRAWN BY	AH
DESIGNED BY	AH
APPROVED BY	DH
SCALE	1:12,000
DATE	JULY 22, 2020
PROJECT No.	26130

THURBER ENGINEERING LTD.

H:\20000-29999\26000-26999\26130 Kirby Road EA\Reports & Memos\Hydrogeological Investigation Report\Figures\GIS\Figure 8 Borehole and Monitoring Well Locations_v2.mxd modified 2020-11-20 by ahejazi

Appendix A
Measured Water Levels and Hydrographs

Table 1 - Measured Groundwater Levels at Monitoring Wells (Elevation: metres above sea level)

Monitoring Well ID	Ground Elevation (m)	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021
BH20-01	271.4	268.71	268.64	268.21	268.49	269.68	270.32	269.03
BH20-03-S	272.7	dry	dry	dry	dry	270.32	270.89	269.91
BH20-03-D	272.7	268.33	268.25	267.58	267.28	267.51	268.74	268.14
BH20-05	291.0	264.95	264.99	264.83	264.72	265.45	264.53	264.31
BH20-06	291.5	288.37	288.33	288.13	288.10	288.98	288.94	288.48
BH20-07	298.2	295.95	295.92	295.58	295.74	296.50	296.16	296.08
BH20-09-S	310.7	308.81	308.91	308.70	308.95	309.28	309.34	308.75
BH20-09-D	310.7	308.11	308.93	308.70	308.93	309.30	309.19	308.88
BH20-10-S	291.7	dry	dry	dry	dry	290.49	290.67	dry
BH20-10-D	291.7	dry	dry	dry	dry	dry	285.93	dry
BH20-12-S	295.6	dry	dry	dry	292.78	292.79	292.71	dry
BH20-12-D	295.6	285.47	285.40	285.09	285.13	285.13	285.13	285.11

Table 2 - Measured Groundwater Levels at Monitoring Wells (Depth: metres below ground surface)

Monitoring Well ID	Well Depth (m)	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021
BH20-01	4.6	2.73	2.80	3.23	2.95	1.76	1.12	2.41
BH20-03-S	3.0	dry	dry	dry	dry	2.41	1.84	2.82
BH20-03-D	7.6	4.39	4.47	5.14	5.44	5.21	3.98	4.58
BH20-05	29.1	26.02	25.98	26.14	26.25	25.52	26.44	26.66
BH20-06	6.6	3.12	3.16	3.36	3.39	2.51	2.55	3.01
BH20-07	4.4	2.26	2.29	2.63	2.47	1.71	2.05	2.13
BH20-09-S	3.0	1.89	1.79	2.00	1.75	1.42	1.36	1.95
BH20-09-D	6.0	2.57	1.75	1.98	1.75	1.38	1.49	1.80
BH20-10-S	2.8	dry	dry	dry	dry	1.18	1.00	dry
BH20-10-D	5.9	dry	dry	dry	dry	dry	5.80	dry
BH20-12-S	2.9	dry	dry	dry	2.81	2.80	2.88	dry
BH20-12-D	10.7	10.18	10.25	10.56	10.52	10.52	10.52	10.54

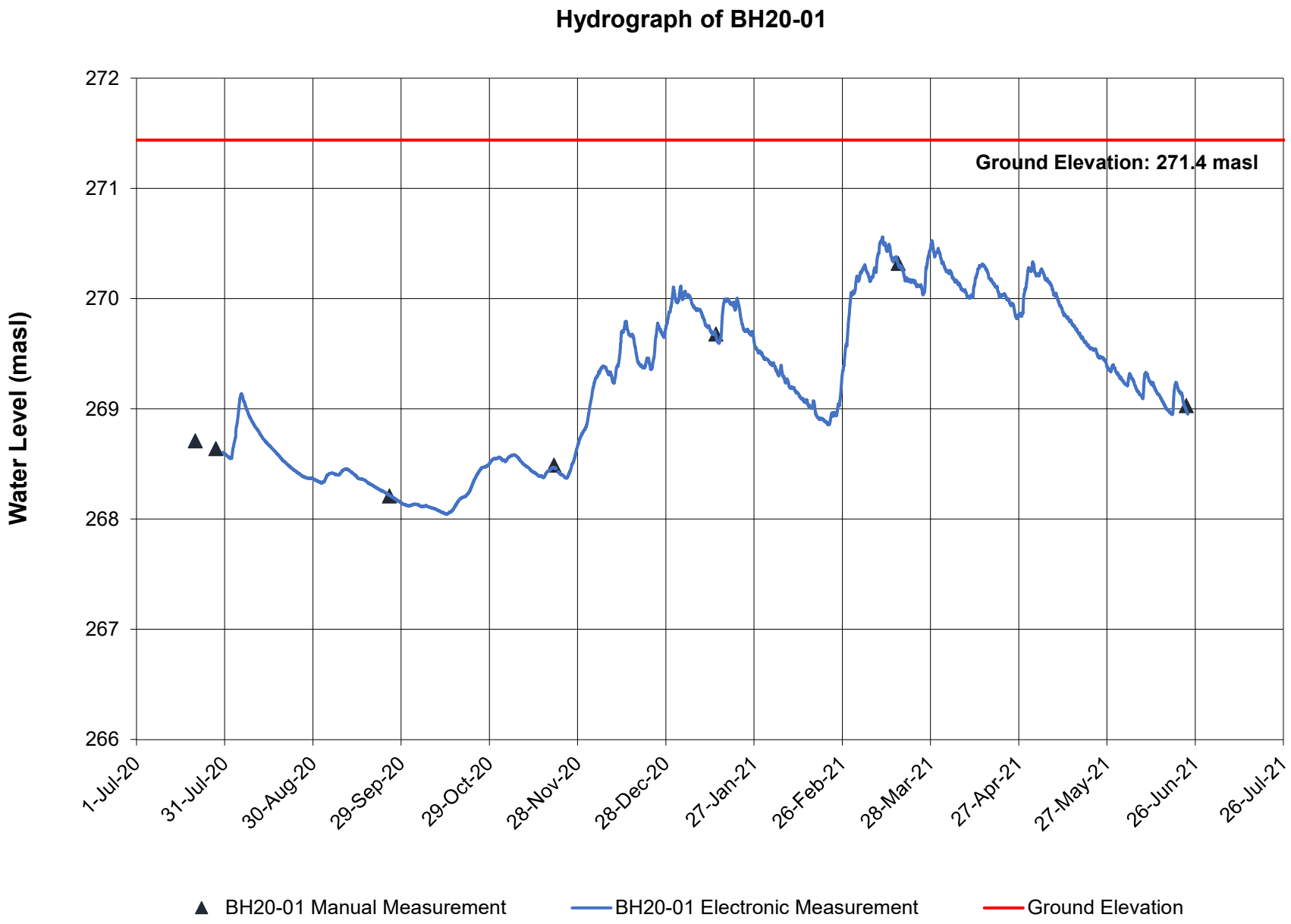
Table 3 - Calculated Vertical Hydraulic Gradient

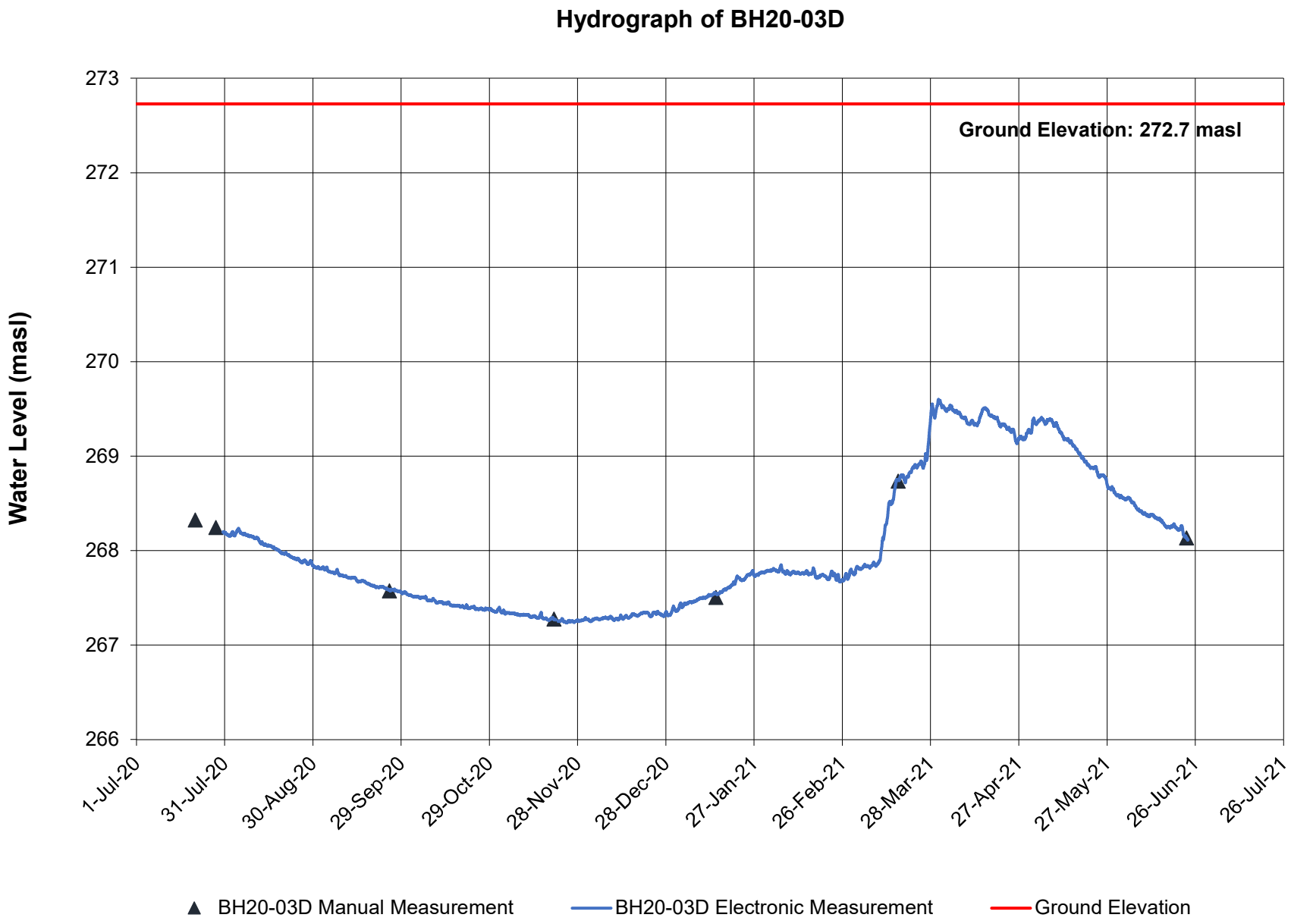
Monitoring Well ID	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021
BH20-03-S/D	-	-	-	-	0.61	0.47	0.39
BH20-09-S/D	0.23	-0.01	0.00	0.01	-0.01	0.05	-0.04
BH20-10-S/D	-	-	-	-	-	1.57	-
BH20-12-S/D	-	-	-	1.01	1.01	1.00	-

Notes:

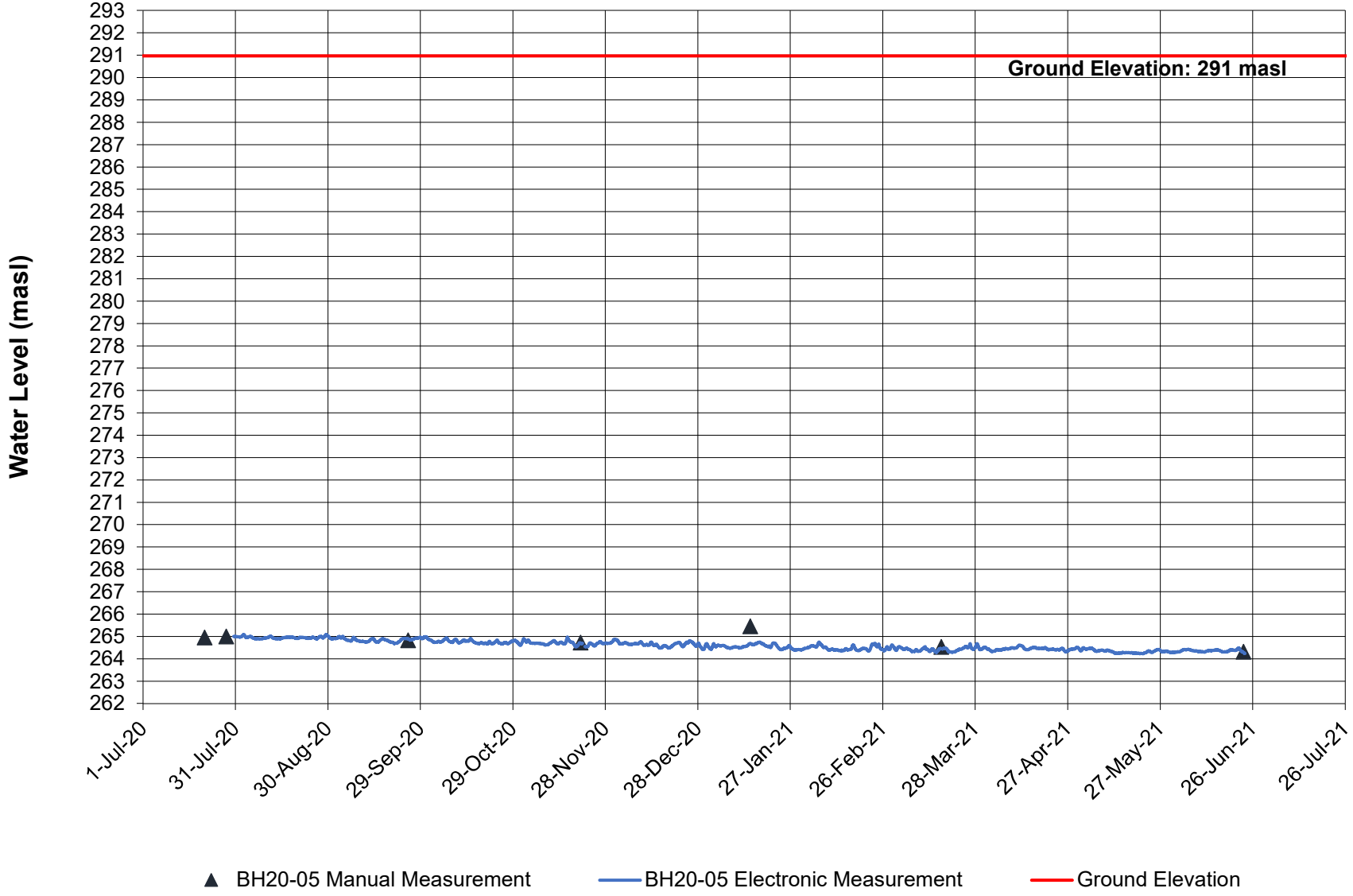
Negative values indicate an upward gradient; positive values indicate a downward gradient.

'-' indicates that the vertical hydraulic gradient could not be estimated due to water level measurement(s) for one or both wells being unavailable.

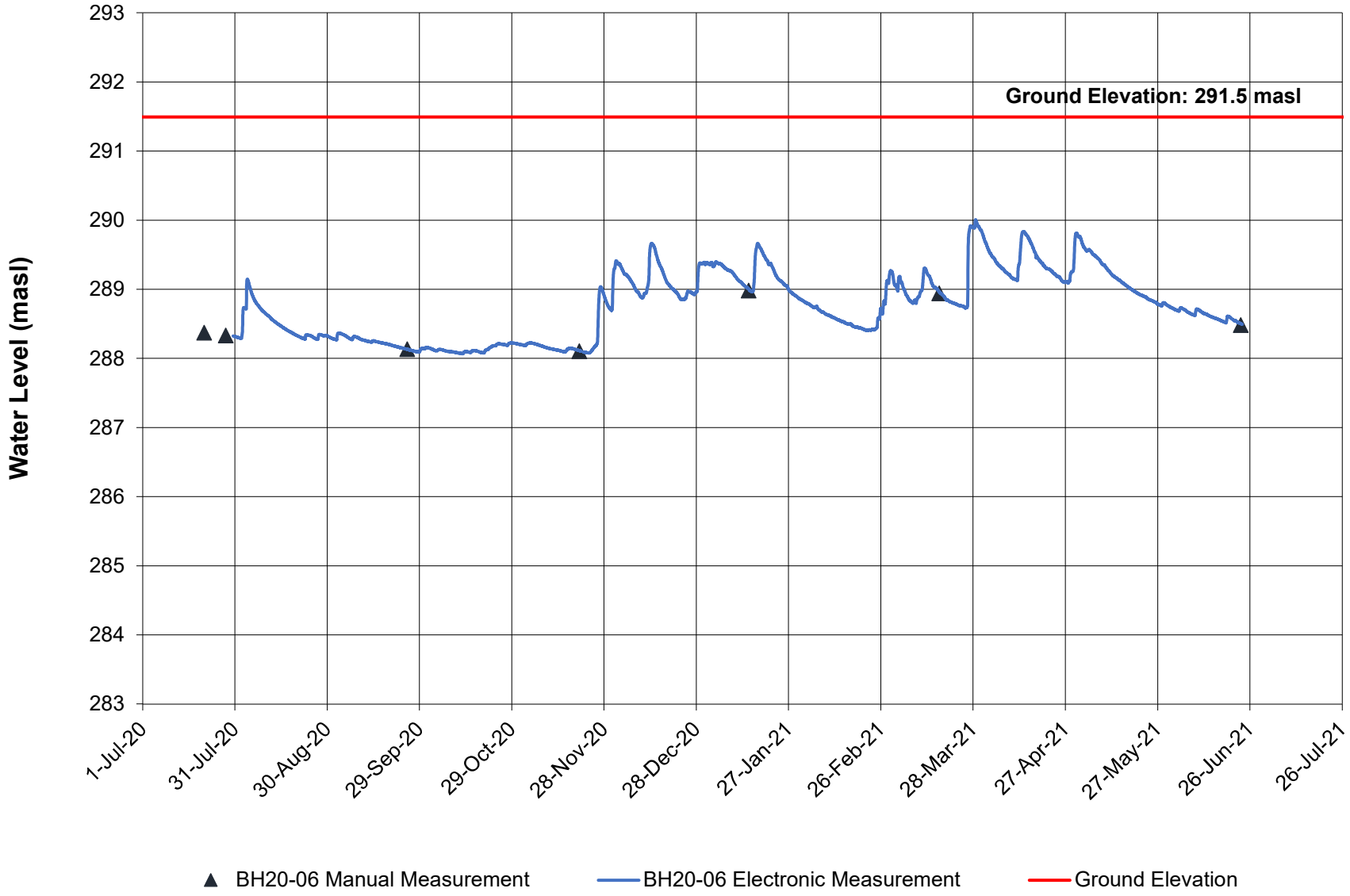

Hydrograph of BH20-01
Water Level (masl)
272
271
270
269
268
267
266
Ground Elevation: 271.4 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
BH20-01 Manual Measurement
BH20-01 Electronic Measurement
Ground Elevation

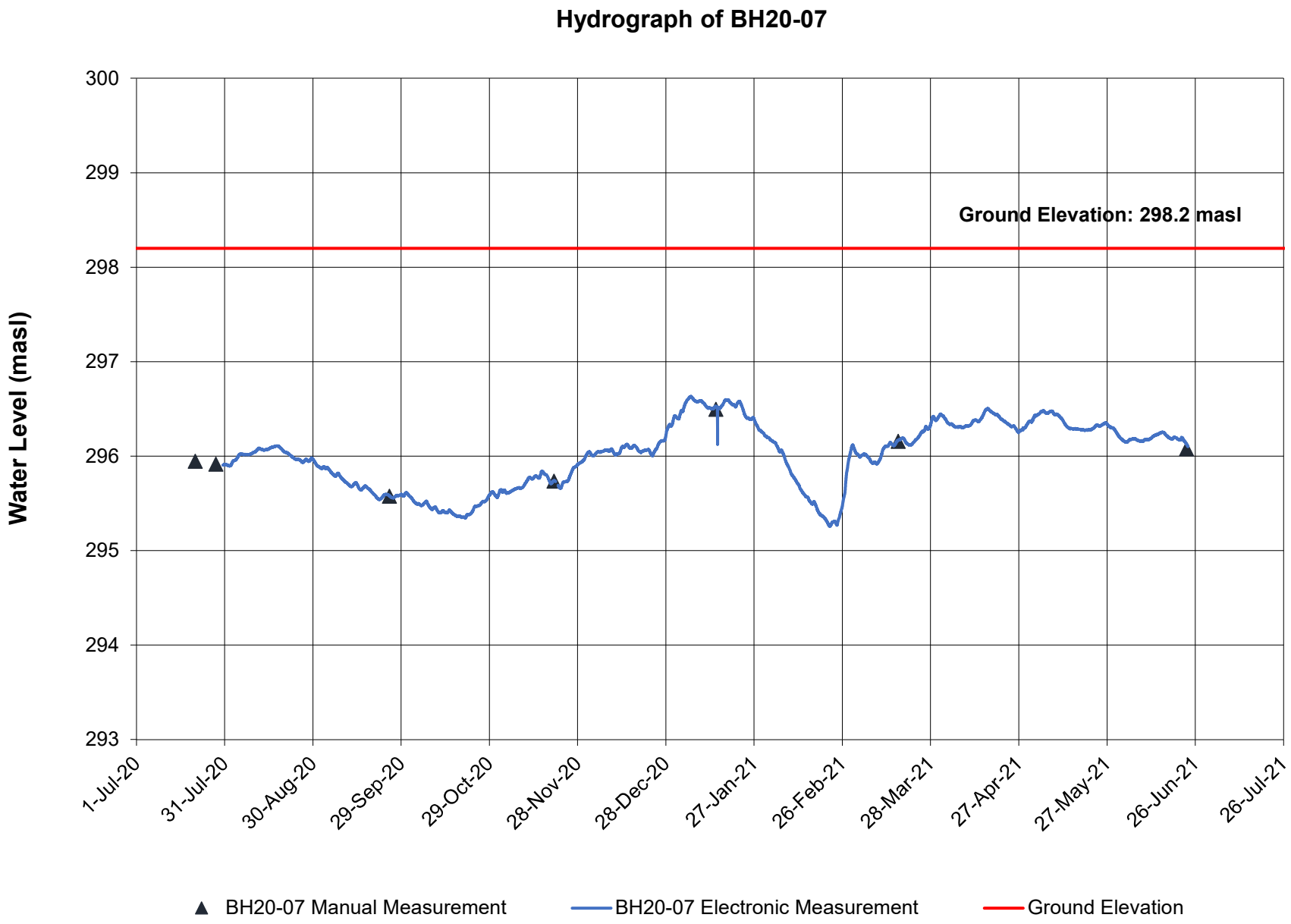

Hydrograph of BH20-03D
Ground Elevation: 272.7 masl
Water Level (masl)
273
272
271
270
269
268
267
266
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
BH20-03D Manual Measurement
BH20-03D Electronic Measurement
Ground Elevation

Hydrograph of BH20-05

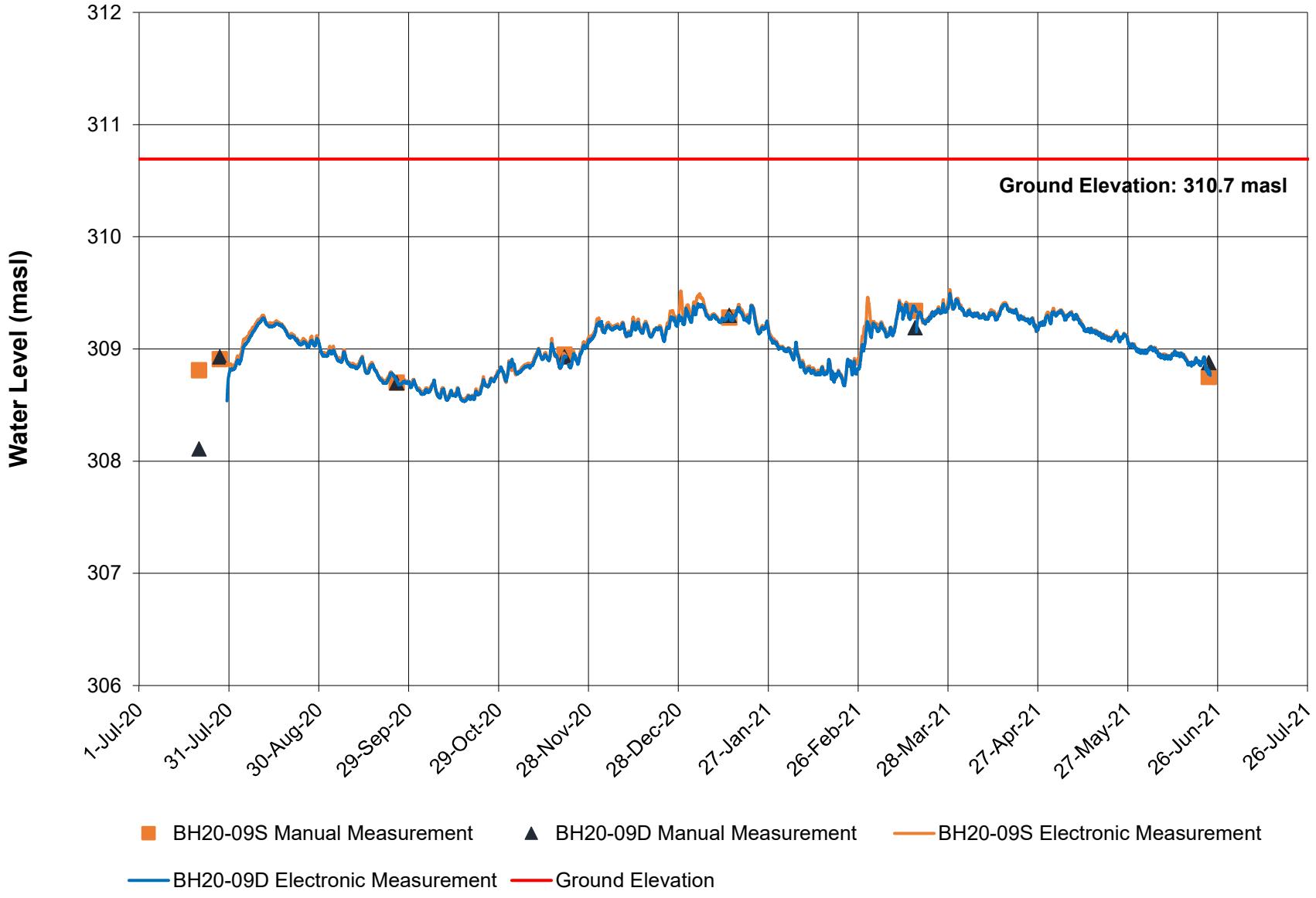


Hydrograph of BH20-06

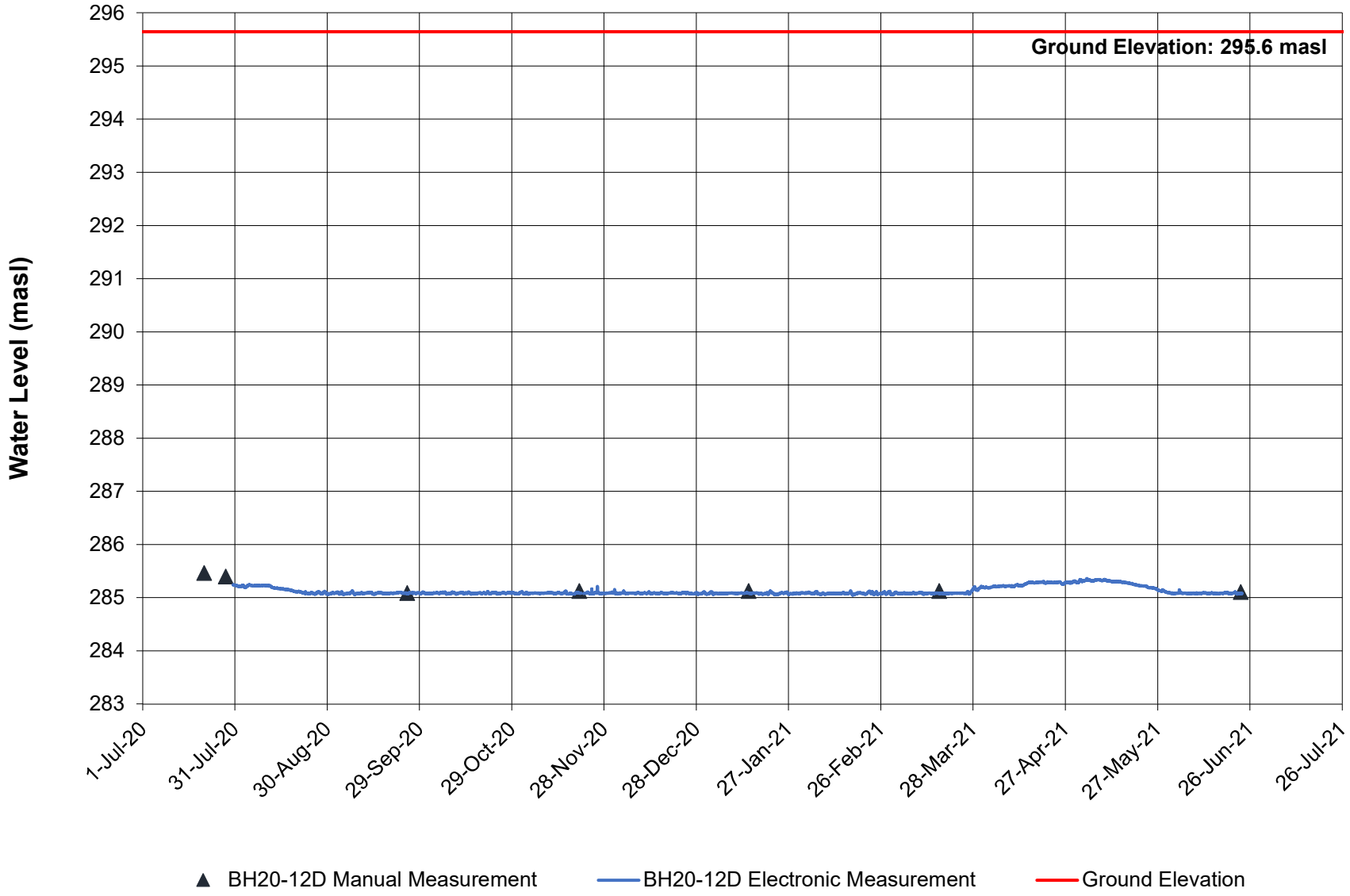



Hydrograph of BH20-07
Water Level (masl)
300
299
298
297
296
295
294
293
Ground Elevation: 298.2 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
BH20-07 Manual Measurement
BH20-07 Electronic Measurement
Ground Elevation

Hydrograph of BH20-09S/D



Hydrograph of BH20-12D



THURBER ENGINEERING LTD.

To: Michelle Mascarenhas, P.Eng.
HDR Inc.
1000 York Blvd., Suite 300
Richmond Hill, ON L4B 1J8

June 01, 2022

From: Alireza Hejazi, P.Eng.
David Hill, P.Eng., P.Geo.

Thurber File No.: 26130

TECHNICAL MEMORANDUM
GROUNDWATER MONITORING PROGRAM
MUNICIPAL CLASS EA STUDY FOR KIRBY ROAD WIDENING
FROM JANE STREET TO DUFFERIN STREET
CITY OF VAUGHAN, ONTARIO

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by HDR Inc. (HDR) to conduct a Hydrogeological Investigation in support of the Municipal Class Environmental Assessment (EA) study for the proposed widening of Kirby Road between Jane Street and Dufferin Street in the City of Vaughan, Ontario. The investigation includes groundwater level measurements over a duration of two years. This memorandum summarizes the groundwater levels observed over two years, from July 2020 to May 2022.

Groundwater monitoring was conducted by Thurber staff on a bi-monthly basis from July 2020 to May 2022 (Table 1 and Table 2 in Appendix A). In addition, eight (8) level loggers were instrumented in selected monitoring wells to record groundwater levels on an hourly basis, to measure seasonal groundwater fluctuations. A barologger was also installed to record barometric pressure to correct level logger readings for atmospheric pressure. A map illustrating the location of the monitoring wells is provided on Figure 1. Table 1 and Table 2 summarize the recorded groundwater levels from all on-site monitoring wells. Hydrographs of these groundwater data are provided in Appendix A.

Between the period of July 21, 2020 and May 20, 2022, 13 rounds of water level measurements were collected by Thurber staff from twelve on-site monitoring wells. In general, the groundwater table reflects local topography. The water level elevations in the monitoring wells ranged from 263.9 m to 309.4 m. The highest groundwater level (Elev.309.4 m, depth 1.3 m) was measured in Monitoring Well 20-09D and the lowest water level (Elev. 263.9 m, depth 27.1 m) was measured in Monitoring Well 20-05.

The hydraulic gradient across the site is generally neutral to downward (Table 3 in Attachment A). The magnitude of vertical hydraulic gradients observed at Monitoring Wells 20-09S/D was estimated to be relatively small (<-0.05 m/m) and can be considered as near neutral gradient.

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The hydrographs in Appendix A illustrate the seasonal fluctuation in the groundwater levels. Higher groundwater levels were observed during the winter and spring months (December to May), and lower levels were observed during the summer and autumn months (July to November). The range in seasonal fluctuation in each well was from 0.7 m (in Monitoring Well 20-12D) to 3.1 m (in Monitoring Well 20-03D) over the course of the monitoring period.

2 CLOSURE

We trust this memo meets your requirements. If you have any questions or require further information, please contact the undersigned at your convenience.

Yours truly,

Thurber Engineering Limited

Alireza Hejazi, Ph.D., P.Eng.
Senior Hydrogeologist and Environmental Engineer

David Hill, M.A.Sc., MBA, P.Eng., P.Geo.
Senior Hydrogeologist / Review Engineer

Attachments:

Figure 1 - Monitoring Well Location Map
Appendix A - Measured Groundwater Levels and Hydrographs

East Humber River

Don River West Branch

Jane Street

Keele Street

Dufferin Street

Kirby Road

20-01

20-02

20-03-S/D

20-04

20-05

20-06

20-07

20-08

20-09-S/D

20-10-S/D

20-11

20-12-S/D

20-13

N

LEGEND:

- Borehole
- Monitoring Well
- Site Boundary
- Watercourse
- Road

200 100 0 200 m

UTM 17 NAD 83

KIRBY ROAD CLASS EA STUDY
VAUGHAN, ONTARIO
HDR INC.

BOREHOLE AND MONITORING WELL LOCATIONS

FIGURE 1

DRAWN BY	AH
DESIGNED BY	AH
APPROVED BY	DH
SCALE	1:12,000
DATE	JULY 22, 2020
PROJECT No.	26130

THURBER ENGINEERING LTD.

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Appendix A
Measure Water Levels and Hydrographs

Table 1 - Measured Groundwater Levels at Monitoring Wells (Elevation: metres above sea level)

Monitoring Well ID	Ground Elevation (m)	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021	30-Jul-2021	20-Sep-2021	26-Nov-2021	26-Jan-2022	9-Mar-2022	20-May-2022
BH20-01	271.4	268.7	268.6	268.2	268.5	269.7	270.3	269.0	269.1	269.0	270.1	269.6	270.6	270.1
BH20-03-S	272.7	dry	dry	dry	dry	270.3	270.9	269.9	270.1	270.1	270.9	frozen	270.0	damaged
BH20-03-D	272.7	268.3	268.2	267.6	267.3	267.5	268.7	268.1	267.8	267.6	269.5	269.0	damaged	269.6
BH20-05	291.0	265.0	265.0	264.8	264.7	265.5	264.5	264.3	264.3	263.9	264.2	263.9	264.1	264.3
BH20-06	291.5	288.4	288.3	288.1	288.1	289.0	288.9	288.5	288.7	288.8	288.4	289.0	290.5	289.5
BH20-07	298.2	295.9	295.9	295.6	295.7	296.5	296.2	296.1	296.2	296.1	295.7	frozen	295.8	296.4
BH20-09-S	310.7	308.8	308.9	308.7	309.0	309.3	309.3	308.8	308.9	308.9	309.2	308.7	309.3	309.3
BH20-09-D	310.7	308.1	308.9	308.7	308.9	309.3	309.2	308.9	308.9	308.8	309.2	308.6	309.4	309.3
BH20-10-S	291.7	dry	dry	dry	dry	290.5	290.7	dry	290.0	289.4	289.2	289.5	dry	290.2
BH20-10-D	291.7	dry	dry	dry	dry	dry	285.9	dry	285.9	285.9	dry	286.0	289.3	287.2
BH20-12-S	295.6	dry	dry	dry	292.8	292.8	292.7	dry	dry	dry	dry	frozen	dry	292.8
BH20-12-D	295.6	285.5	285.4	285.1	285.1	285.1	285.1	285.1	285.1	285.1	285.1	frozen	285.3	285.8

Table 2 - Measured Groundwater Levels at Monitoring Wells (Depth: metres below ground surface)

Monitoring Well ID	Well Depth (m)	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021	30-Jul-2021	20-Sep-2021	26-Nov-2021	26-Jan-2022	9-Mar-2022	20-May-2022
BH20-01	4.6	2.7	2.8	3.2	3.0	1.8	1.1	2.4	2.3	2.4	1.3	1.9	0.8	1.3
BH20-03-S	3.0	dry	dry	dry	dry	2.4	1.8	2.8	2.7	2.7	1.8	frozen	2.7	damaged
BH20-03-D	7.6	4.4	4.5	5.1	5.4	5.2	4.0	4.6	4.9	5.1	3.3	3.7	damaged	3.1
BH20-05	29.1	26.0	26.0	26.1	26.3	25.5	26.4	26.7	26.7	27.1	26.8	27.0	26.8	26.7
BH20-06	6.6	3.1	3.2	3.4	3.4	2.5	2.6	3.0	2.8	2.7	3.1	2.5	1.0	2.0
BH20-07	4.4	2.3	2.3	2.6	2.5	1.7	2.0	2.1	2.0	2.1	2.5	frozen	2.4	1.8
BH20-09-S	3.0	1.9	1.8	2.0	1.7	1.4	1.4	1.9	1.8	1.8	1.5	2.0	1.4	1.4
BH20-09-D	6.0	2.6	1.8	2.0	1.8	1.4	1.5	1.8	1.8	1.9	1.5	2.1	1.3	1.3
BH20-10-S	2.8	dry	dry	dry	dry	1.2	1.0	dry	1.6	2.3	2.5	2.2	dry	1.5
BH20-10-D	5.9	dry	dry	dry	dry	dry	5.8	dry	5.8	5.8	dry	5.8	2.5	4.6
BH20-12-S	2.9	dry	dry	dry	2.8	2.8	2.9	dry	dry	dry	dry	frozen	dry	2.8
BH20-12-D	10.7	10.2	10.3	10.6	10.5	10.5	10.5	10.5	10.5	10.5	10.6	frozen	10.3	9.9

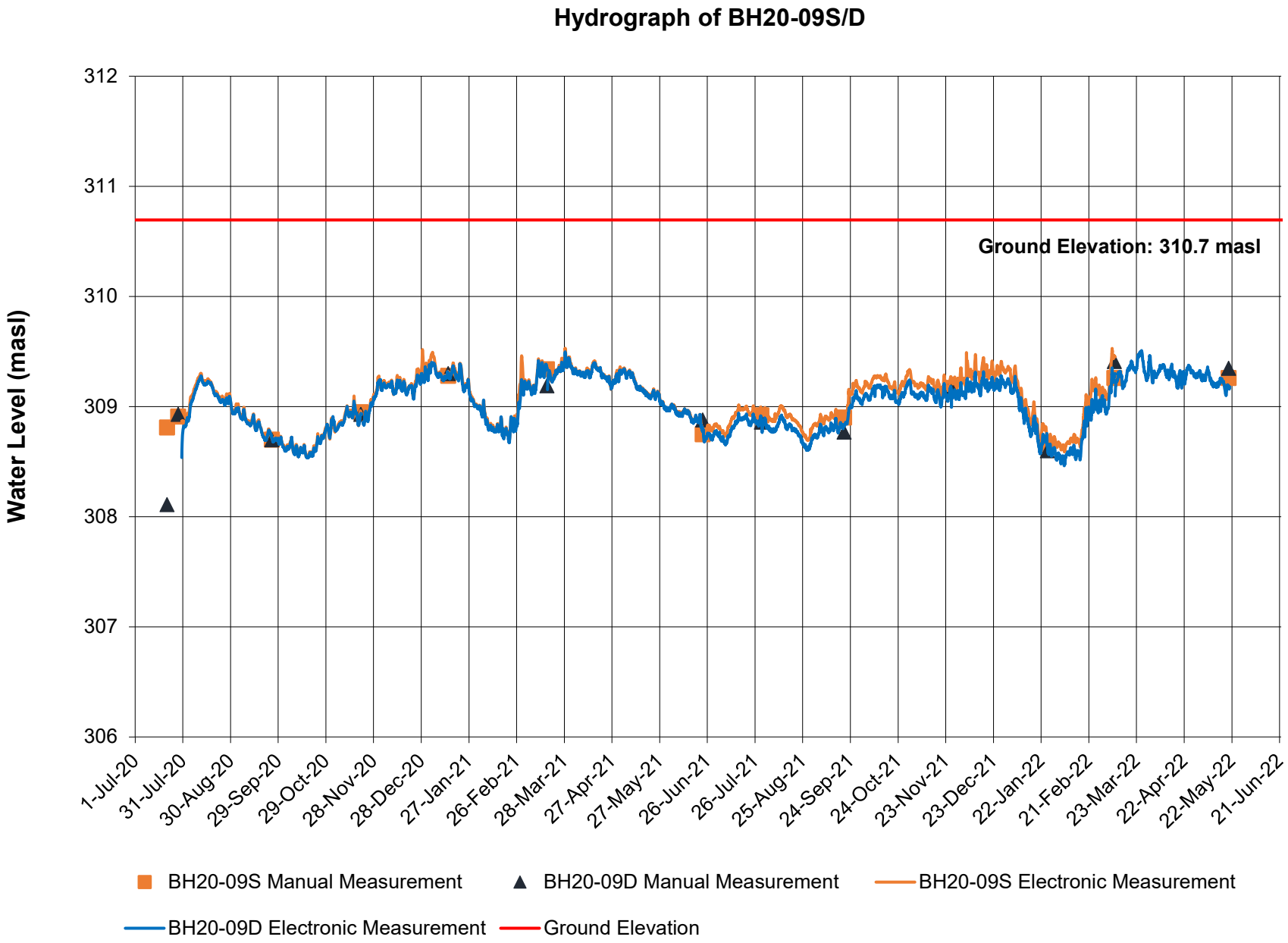
Table 3 - Calculated Vertical Hydraulic Gradient

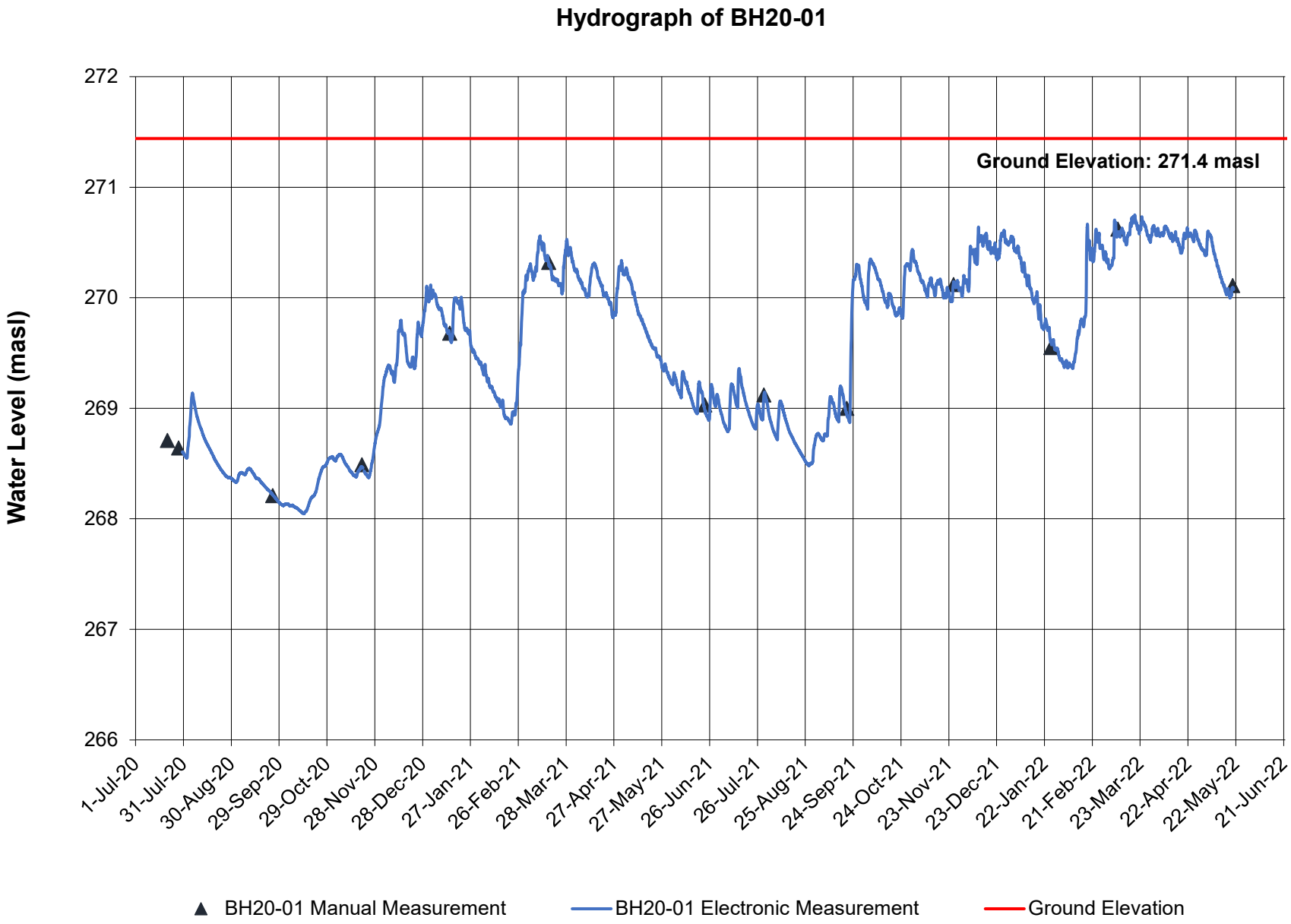
Monitoring Well ID	21-Jul-2020	28-Jul-2020	25-Sep-2020	20-Nov-2020	14-Jan-2021	17-Mar-2021	23-Jun-2021	30-Jul-2021	20-Sep-2021	26-Nov-2021	26-Jan-2022	9-Mar-2022	20-May-2022
BH20-03-S/D	-	-	-	-	0.61	0.47	0.39	0.48	0.54	0.32	-	-	-
BH20-09-S/D	0.23	-0.01	0.00	0.01	-0.01	0.05	-0.04	0.02	0.04	0.00	0.02	-0.05	-0.03
BH20-10-S/D	-	-	-	-	-	1.57	-	1.36	1.15	-	1.17	-	1.01
BH20-12-S/D	-	-	-	1.01	1.01	1.00	-	-	-	-	-	-	0.92

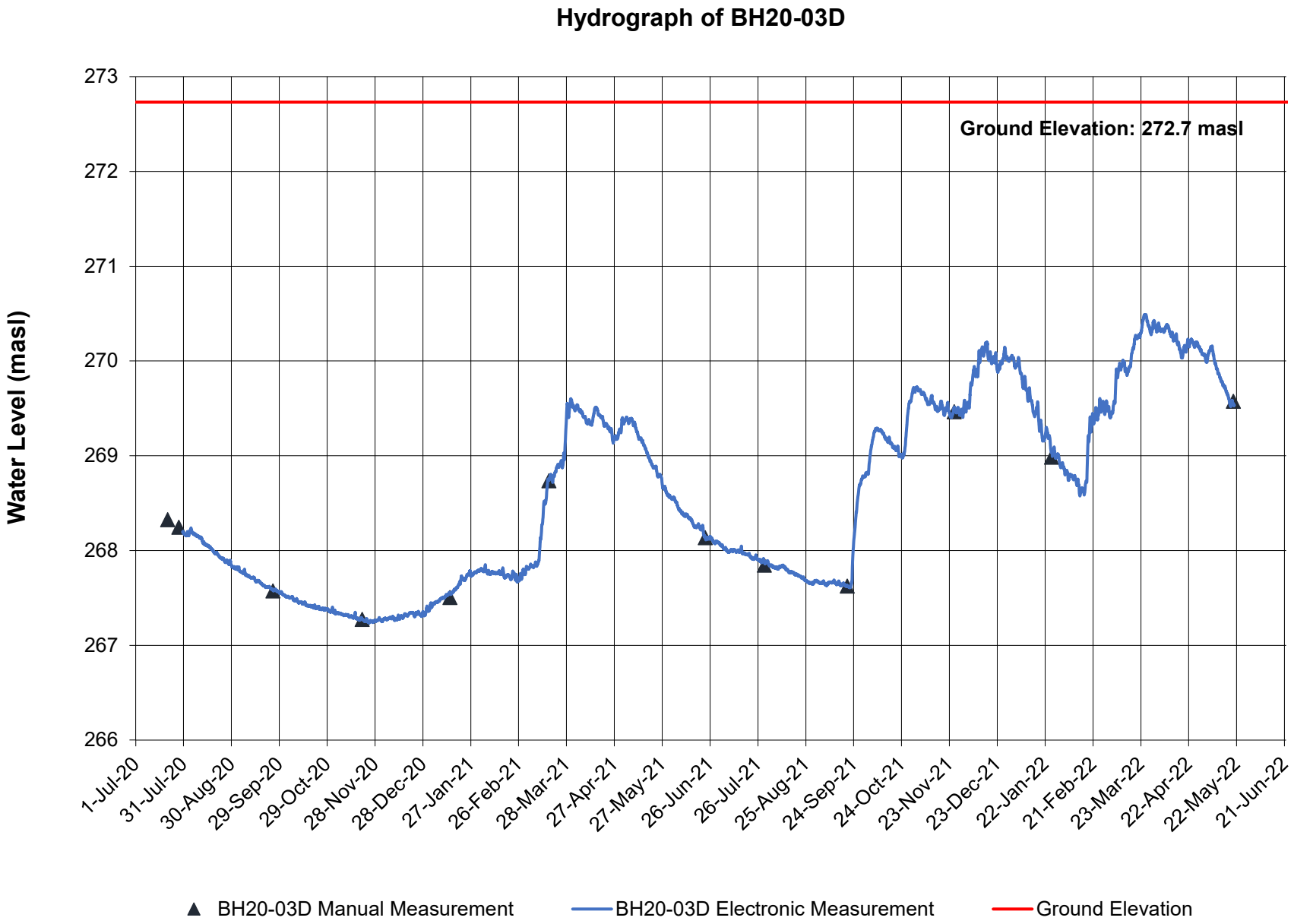
Notes:

Negative values indicate an upward gradient; positive values indicate a downward gradient.

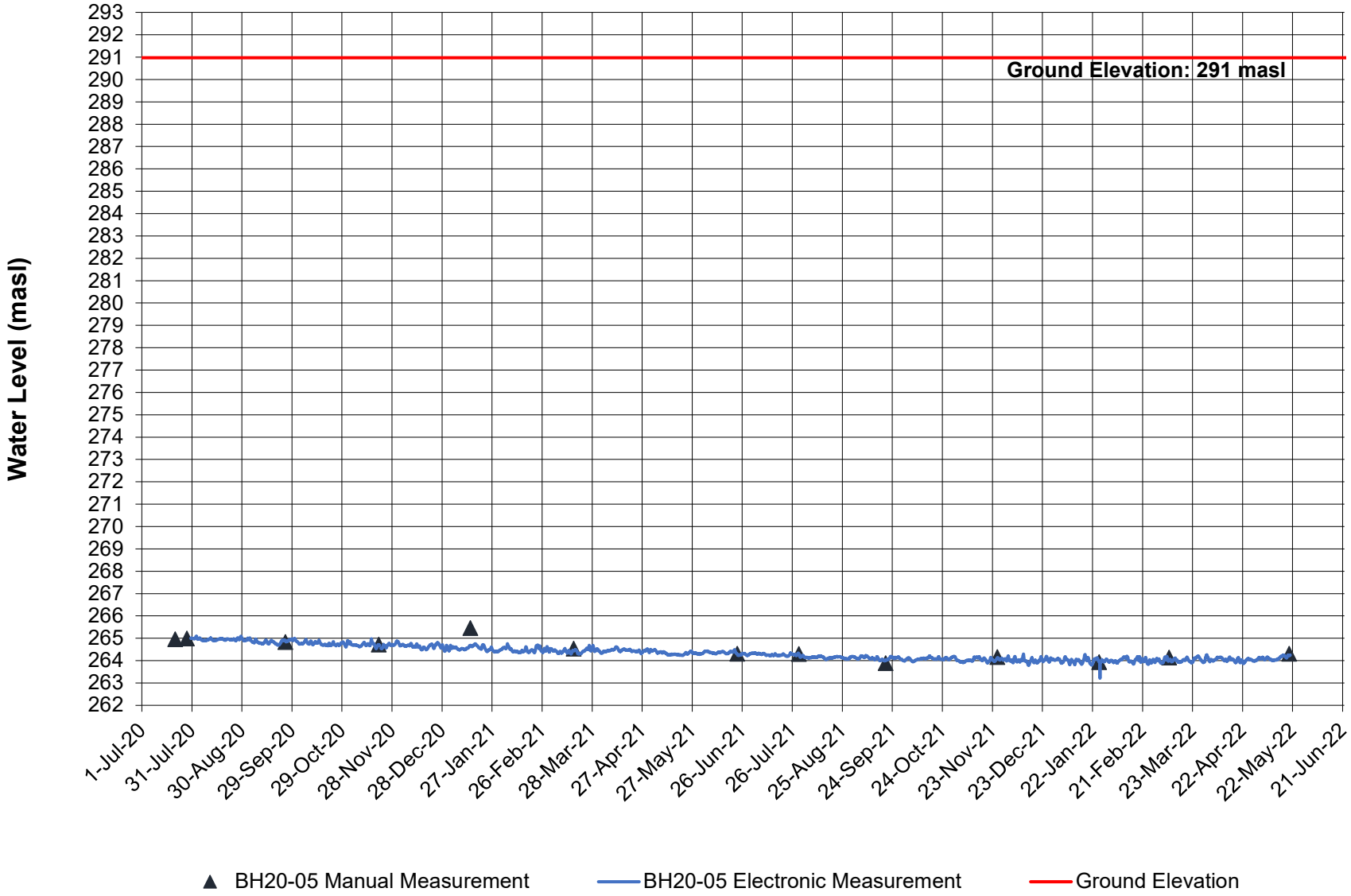
'-' indicates that the vertical hydraulic gradient could not be estimated due to water level measurement(s) for one or both wells being unavailable.

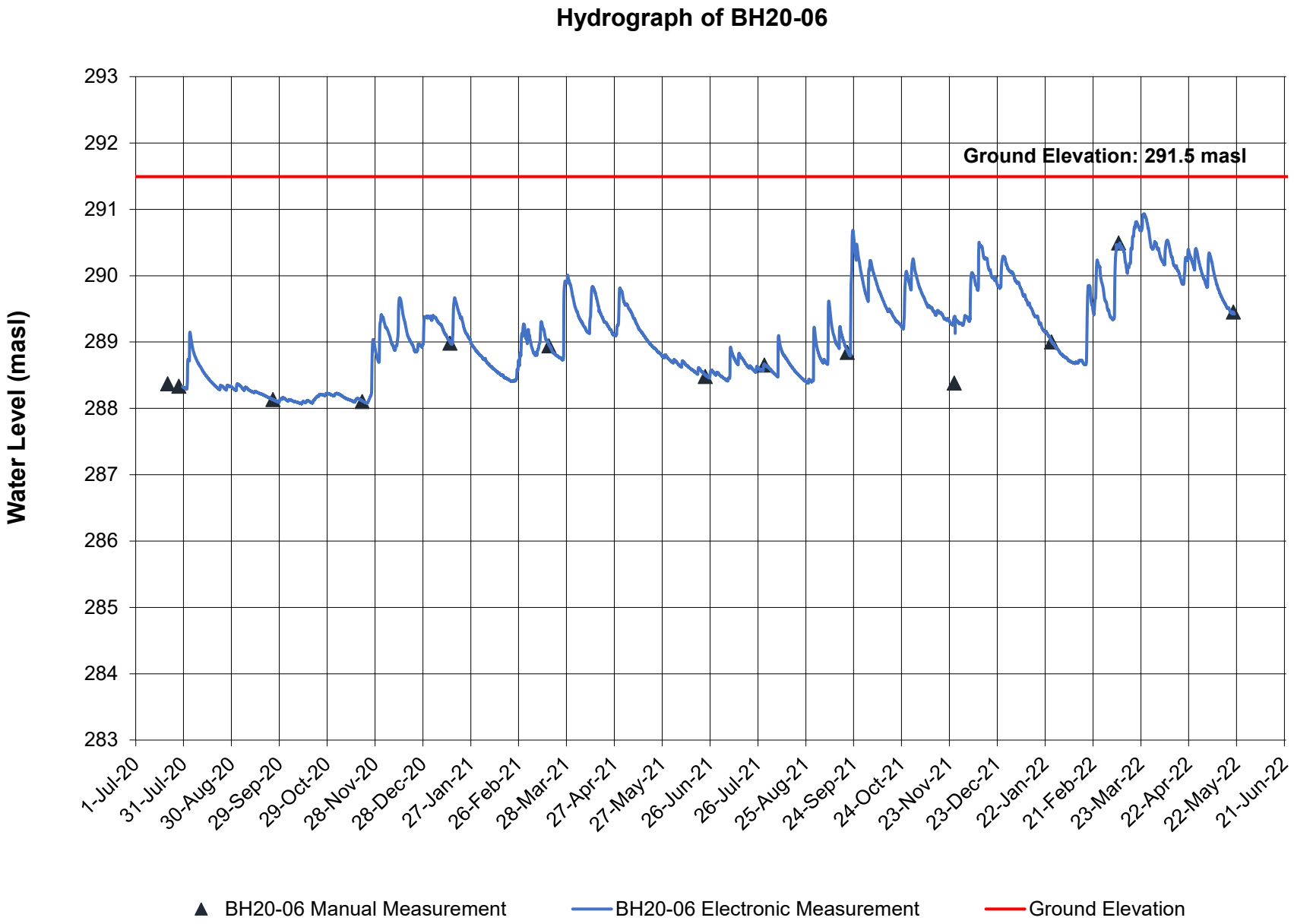

Hydrograph of BH20-09S/D
Water Level (masl)
312
311
310
309
308
307
306
Ground Elevation: 310.7 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
25-Aug-21
24-Sep-21
24-Oct-21
23-Nov-21
23-Dec-21
22-Jan-22
21-Feb-22
23-Mar-22
22-Apr-22
22-May-22
21-Jun-22
BH20-09S Manual Measurement
BH20-09D Manual Measurement
BH20-09S Electronic Measurement
BH20-09D Electronic Measurement
Ground Elevation

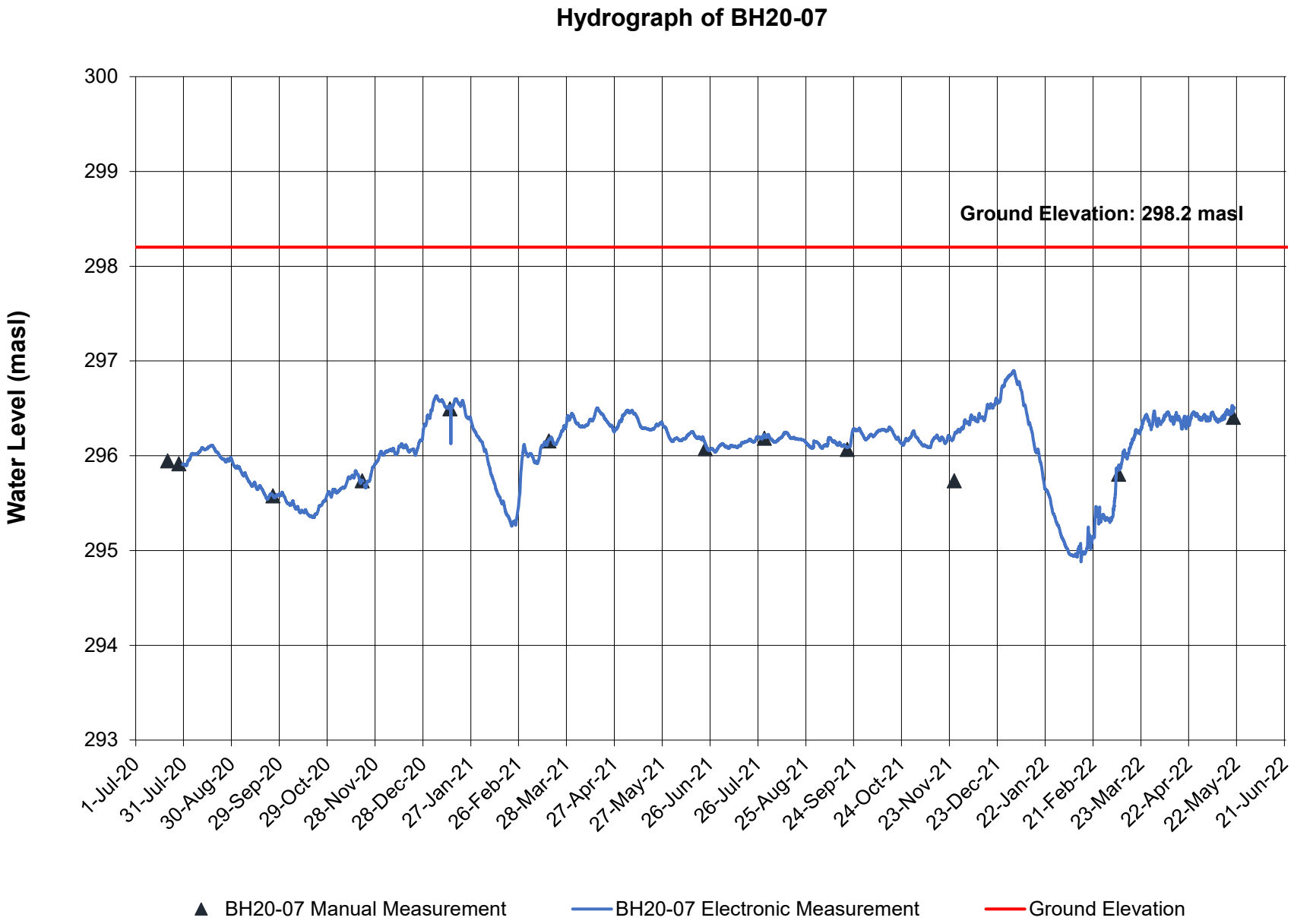

Hydrograph of BH20-01
Water Level (masl)
272
271
270
269
268
267
266
Ground Elevation: 271.4 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
25-Aug-21
24-Sep-21
24-Oct-21
23-Nov-21
23-Dec-21
22-Jan-22
21-Feb-22
23-Mar-22
22-Apr-22
22-May-22
21-Jun-22
BH20-01 Manual Measurement
BH20-01 Electronic Measurement
Ground Elevation


Hydrograph of BH20-03D
Ground Elevation: 272.7 masl
Water Level (masl)
273
272
271
270
269
268
267
266
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
25-Aug-21
24-Sep-21
24-Oct-21
23-Nov-21
23-Dec-21
22-Jan-22
21-Feb-22
23-Mar-22
22-Apr-22
22-May-22
21-Jun-22
BH20-03D Manual Measurement
BH20-03D Electronic Measurement
Ground Elevation

Hydrograph of BH20-05




Hydrograph of BH20-06
Water Level (masl)
293
292
291
290
289
288
287
286
285
284
283
Ground Elevation: 291.5 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
25-Aug-21
24-Sep-21
24-Oct-21
23-Nov-21
23-Dec-21
22-Jan-22
21-Feb-22
23-Mar-22
22-Apr-22
22-May-22
21-Jun-22
BH20-06 Manual Measurement
BH20-06 Electronic Measurement
Ground Elevation


Hydrograph of BH20-07
Water Level (masl)
300
299
298
297
296
295
294
293
Ground Elevation: 298.2 masl
1-Jul-20
31-Jul-20
30-Aug-20
29-Sep-20
29-Oct-20
28-Nov-20
28-Dec-20
27-Jan-21
26-Feb-21
28-Mar-21
27-Apr-21
27-May-21
26-Jun-21
26-Jul-21
25-Aug-21
24-Sep-21
24-Oct-21
23-Nov-21
23-Dec-21
22-Jan-22
21-Feb-22
23-Mar-22
22-Apr-22
22-May-22
21-Jun-22
BH20-07 Manual Measurement
BH20-07 Electronic Measurement
Ground Elevation

Hydrograph of BH20-12D