

# Terraprobe

*Consulting Geotechnical & Environmental Engineering  
Construction Materials Inspection & Testing*

**HYDROGEOLOGICAL ASSESSMENT  
9541 WESTON ROAD (FIRE STATION NUMBER 7-12)  
CITY OF VAUGHAN, ONTARIO**

**Prepared For:** City of Vaughan  
2141 Major Mackenzie Drive  
Vaughan, Ontario  
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## EXECUTIVE SUMMARY

Terraprobe Inc. (Terraprobe) was retained by the City of Vaughan to conduct a hydrogeological assessment for the proposed development of 9541 Weston Road (Fire Station No. 7-12) in the City of Vaughan, Ontario (the 'Site'). This report is prepared to estimate the potential short-term construction dewatering and long-term foundation drainage requirements associated with the proposed development. Terraprobe was provided with subsurface information. The provided information, along with a fieldwork completed by Terraprobe are considered to estimate a short-term dewatering and long-term foundation drainage flow rates, and provide comments on discharge options. Additionally, a pre- and post-development water balance was completed for the Site.

It is understood that the City of Vaughan is developing a new Fire Station Number 7-12 located at 9541 Weston Road, Vaughan. The Site is bounded by institutional building to the north, Weston Road to the west, a wooded lot to the south and the east. The Site is currently consisting of Vellore Hall Park buildings, local access roads, at-grade parking lot and landscaped/green areas. The current conditions of the Site are presented in **Table I**.

**Table I:** Existing Conditions

Municipal Address	Above Grade Levels	Below Grade Levels
9541 Weston Road, Vaughan	1	Not Available

The proposed development will include construction of a two-storey slab-on-grade fire station (City of Vaughan Fire Station No. 7-12) building with associated at grade parking lots. The Site Plan prepared by Thomasbrown Architects dated November 24, 2021 (drawing numbers CR 1.1) was reviewed for the current assessment. The preliminary Finished Floor Elevation (FFE) is proposed at El. 225.75 metres above sea level (masl) as per the email received on March 17, 2022.

As per Englobe's geotechnical investigation report dated March 30, 2022, base of the excavation is considered as 225.25 masl and the base of footing was considered at El. 222.75 masl (including 0.5 m of granular material beneath the footing). A summary of the proposed development is presented in **Table II**.

**Table II:** Proposed Development

Proposed Development	Above Grade Levels	Underground Levels	Approximate Deepest FFE (masl)	Approximate Base of Excavation for construction of the Slab (masl)	Approximate Base of Deepest Footing (masl)	The Highest Shallow Groundwater Level (masl)
Fire Station Number 7-12	2	Slab-on-grade	225.75	225.25	222.75	221.59

The Subsoil profile and groundwater conditions and requirements for the Site are summarized in **Table III and Table IV**:

**Table III: Summary of Subsoil Profile**

Stratum/Formation	Bottom Depth Range (mbgs)	Bottom Elevation Range (masl)	Hydraulic Conductivity (m/s)
Surface Layers (Topsoil/Asphalt)	0.2-0.4	225.3-224.6	Not Applicable
Clayey Silt/Silty Clay	2.2 to 4.4	222.8 to 220.4	$1.44 \times 10^{-7}$ *
Sandy Silt/Silt	0.6 to 8.2	224.4 to 216.7	$4.23 \times 10^{-7}$ **
Silty Sand	4.4 to 8.2	220.9 to 216.9	$7.23 \times 10^{-7}$ **
Clayey Silt	8.2	216.9 to 216.7	$1.44 \times 10^{-7}$ *

\* Indicates conductivity was estimated using in-situ hydraulic conductivity test

\*\* Indicates conductivity was estimated using grain size analysis

**Table IV: Summary of Groundwater Conditions**

Groundwater Conditions	
The Stabilized Shallow Groundwater Elevation Considered for the dewatering flow rate estimation	221.59 masl
Conceptual Zone of Influence (ZOI)	0 m (The proposed base of the footing for construction of the slab-on-grade building will be developed above groundwater level)

Groundwater quality was assessed in comparison with the Regional Municipality of York Sewer By-Law with the results summarized in **Table V**.

**Table V: Summary of Groundwater Quality Assessment**

	Regional Municipality of York Storm Sewer Limits	Regional Municipality of York Sanitary Sewer Limits
Untreated Groundwater (Sample ID – BH15D)	Exceeds	Meets
Treatment Required Prior to Discharge	Yes	No

The geodetic elevation of the foundation footing is higher than the highest groundwater level. As such, groundwater seepage is not anticipated for short-term dewatering. However, there will be stormwater from precipitation for short-term construction.

Since a slab-on-grade building is proposed above groundwater level, and construction of a drainage system is not proposed by Englobe geotechnical team, there will be no long-term foundation drainage needs. The findings are summarized in **Table VI**.

**Table VI: Summary of Shot-Term Dewatering and Long-Term Foundation Drainage Calculations**

Groundwater Quantity: Short-Term (Construction)						
Description	Groundwater Seepage (Safety Factor of 1.5)		25 mm Design Rainfall Event		Total Estimated Flow Rate	
	L/day	L/min	L/day	L/min	L/day	L/min
Fire Station Number 7-12	0	0	18,000	12.5	<b>18,000*</b>	<b>12.5</b>



<b>Groundwater Quantity: Long-Term Foundation Drainage</b>						
Description	Groundwater Seepage (Safety Factor of 1.5)		Infiltration 25 mm Design Rainfall Event		Total Estimated Flow Rate	
	L/day	L/min	L/day	L/min	L/day	L/min
Fire Station Number 7-12	0	0	0	0	0	0

\*Collecting perched water is anticipated. The potential quantity is not included.

Potential permit requirements for discharging short-term dewatering effluent which expected from precipitation and perched water are summarized in **Table VII**.

**Table VII:** Summary of Permits Required for Shot-Term Dewatering

Regulatory Requirements	
Environmental Activity and Sector Registry (EASR) Posting for Short-Term Discharge	Not Required
Short-Term Permit to Take Water (PTTW)	Not Required
Long-Term Permit to Take Water (PTTW)	Not Required
Short-Term Discharge Agreement Regional Municipality of York	Required (If the collected water is proposed to be directed to the York Region Sewer System.)
Long-Term Discharge Agreement Regional Municipality of York	Not Required

The short-term construction dewatering discharge flow rates are calculated based on the rainfall event. Any stormwater entering the excavation to be pumped and discharged to the City of Vaughan Sewers (as a part of York Region sewer system) will require verification of quality prior to discharge to the City of Vaughan's storm or sanitary sewer system as a part of the water collection system.

Considering the location of the Site within the area designated as WHPA-Q, a pre- and post-development water balance assessment was completed to evaluate opportunities and constraints for developing Low Impact Development (LID) measures for the post development Site. A summary of findings is presented in **Table VIII**.

**Table VIII:** Summary of Pre- and Post-Development Water Balance Components

Pre-Development Site Breakdown Areas	Precipitation (m <sup>3</sup> /year)	Evapotranspiration (m <sup>3</sup> /year)	Infiltration (m <sup>3</sup> /year)	Run off (m <sup>3</sup> /year)
Pre-Development	13,863	4,881	2,201	6,781
Post-Development	13,864	4,479	1,948	7,436
Loss (-) and Gain (+)	-	-402	-253	+655



A review of the findings indicates that a total decrease of 402 m<sup>3</sup>/year and 253 m<sup>3</sup>/year for ET and infiltration, respectively, and an increase of 655 m<sup>3</sup>/year for runoff are expected for the post-development Site.

Low Impact Development (LID) measures such as infiltration trenches and permeable pavements could be considered to manage the generated runoff partially. Remaining volume can be discharged to the Regional Municipality of York storm sewer system. It is assumed that details will be provided in the Stormwater Management Report.

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## 1.0 INTRODUCTION

### 1.1 Site Location and Project Description

Terraprobe Inc. (Terraprobe) was retained by the City of Vaughan to conduct a hydrogeological assessment for the proposed development of 9541 Weston Road (Fire Station No. 7-12) in the City of Vaughan, Ontario (the “Site”). The Site is approximately located 710 m to the north of the main intersection of Rutherford and Weston Road, at the east side of Weston Road in the City of Vaughan. Location of the Site is shown on **Figure 1**.

The Site is bounded by an institutional building to the north, Weston Road to the west, a wooded lot to the south and the east. It currently consists of Vellore Hall Park buildings, local access roads, at-grade parking lot and landscaped/green areas. The proposed development will include construction of a two-storey slab-on-grade fire station (City of Vaughan Fire Station No. 7-12) building with associated at grade parking lots. As such, the proposed study areas at the Site are located within the southwest and south portions of the Site where the existing at-grade parking lot and the portions of the green area are located.

Currently, municipal water and sewer services are provided to the vicinity of the Site. It is understood that future development will be municipally serviced.

The study was undertaken to assess hydrogeological conditions of the Site and to provide general information regarding the hydrogeological impact of the proposed development on the local groundwater function. The report addresses the following areas:

- Identifying the geological and hydrogeological setting of the Site;
- Confirming groundwater level and groundwater flow direction beneath the Site;
- Assessing groundwater quality in comparison with the Regional Municipality of York Sewer Use By-Law and City of Vaughan Sewer Use By-Law;
- Evaluate potential short-term construction dewatering needs for construction of the proposed development;
- Identifying potential impacts to the nearby groundwater receptors including water supply wells and natural heritage features regarding the proposed development;
- Providing mitigation plan on the potential impacts to the groundwater receptors associated to the proposed development; and,
- Providing recommendation on any needs for applying for Permit to Take Water (PTTW), or posting Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation and Parks (MECP).

## 1.2 Scope of Work

The scope of work for the hydrogeological assessment is summarized below:

- Review of Available Background Information: Available background geological and hydrogeological information for the Site including topographic mapping, surface geological and bedrock geological mapping, natural heritage features databases, and MECP water well records were reviewed.
- Review of City of Vaughan Official Plans and Toronto Region Conservation Authority (TRCA) Policy Areas: The City of Vaughan official plans and TRCA maps were reviewed to understand the location of the Site and the proposed development within the policy areas.
- Site Inspection: A visual inspection of the Site and surrounding areas to determine local topography and drainage, and an assessment of significant features was completed.
- Groundwater Monitoring and Hydraulic Conductivity Testing: Groundwater levels within the installed monitoring wells were monitored over four (4) monitoring events. In-situ hydraulic conductivity testing was completed within the installed monitoring wells to estimate the hydraulic conductivity of the strata within the well screen intervals.
- Groundwater Quality Assessment: Groundwater quality was assessed in comparison with the Regional Municipality of York Sewer Use By-Law to assess available options to discharge the potential short-term dewatering effluent.
- Review of Proposed Site Development Concept: The currently proposed site development concept was reviewed with respect to measures being implemented at the Site in order to estimate the potential construction dewatering needs.
- Construction Dewatering Flow Rate Estimate: Considering the proposed development plans, construction dewatering flow rate (short-term dewatering) was estimated using the stable groundwater table and estimated hydraulic conductivity measured in the Site.
- Mitigation Plans for Dewatering: A mitigation plan was recommended to mitigate potential short-term dewatering impacts to the nearby groundwater receptors (including natural heritage features and water supply wells), and structures, if applicable.
- Long-term foundation Drainage Flow Rate Estimate: Long-term foundation drainage flow rate was estimated using the stabilized groundwater level and estimated hydraulic conductivity measured in the Site; and reviewing the proposed development plans.

- Potential Short-Term Dewatering Permits: Considering the estimated short-term construction dewatering flow rates, recommendations were provided on any need for applying for a PTTW or posting on the EASR with the MECP, if required.
- Pre- and post-development Water Balance Assessment: Water balance parameters were assessed for the pre- and post-development Site conditions.

## **2.0 APPLICABLE REGULATIONS AND AGENCIES**

The environmental regulations and policies relevant to this hydrogeological study are briefly discussed below.

### **2.1 Toronto Regional Conservation Authority (TRCA) Policies and Regulation (O. Reg. 166/06)**

Under Section 28 of the Conservation Authorities Act, local conservation authorities are mandated to protect the health and integrity of the regional greenspace system, and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The TRCA, through its regulatory mandate, is responsible for issuing permits under Ontario Regulation (O. Reg.) 166/06, Development, Interference with Wetlands and Alterations to Shorelines and Watercourses for development proposal or Site alteration work to shorelines and watercourses within the regulated areas.

TRCA Regulated Area online mapping was reviewed on February 14, 2022. It is our understanding that the Site is not located within a TRCA Regulated Area. As such, it is anticipated that obtaining a permit from the TRCA under O. Reg. 166/06 will not be required for the proposed development.

### **2.2 City of Vaughan Official Plan**

The City of Vaughan's Official Plan sets up policies that deal with legislative and administrative concerns, guides physical growth, and addresses social, economic, and environmental concerns. The Official Plan provides land use planning designations and identifies areas of environmental significance where more stringent policies may apply for development applications.

City of Vaughan Official Plans were reviewed for the current study with the results summarized as below:

- Schedule 1A (Urban Area) - A review of the map, dated December, 2020, indicates that the Site is located within the Urban Area.
- Schedule 2 (Natural Heritage Network) - A review of the map, dated February, 2021 indicates that the Site is not located within an area designated as "Areas of Natural Heritage Network".
- Schedule 6 (Aquifer Vulnerability) - A review of the map, dated July, 2015, shows that the Site is not located within the high and low vulnerability aquifer zone.
- Schedule 11 (Wellhead Protection Areas) - A review of the map, dated July, 2015, shows that the Site is not located within the wellhead protection areas.
- Schedule 13 (Land Use) - A review of the map, dated July, 2015, shows that the Site is not located within the wellhead protection areas.



## **2.3 Permit to Take Water (PTTW)**

According to Part III of O. Reg. 63/16, for construction dewatering, water takings of more than 50,000 L/day but less than 400,000 L/day is to be registered on EASR, while water takings of more than 400,000 L/day require a PTTW issued by the MECP. If it is identified that an EASR or PTTW is required for the Site, a hydrogeological assessment report will need to be submitted in support of the application. Construction dewatering estimation was completed as a part of the scope of work for the current assessment.

## **2.4 Clean Water Act**

The MECP mandates the protection of existing and future sources of drinking water under the Clean Water Act, 2006 (CWA). Initiatives under the CWA include the delineation of Wellhead Protection Areas (WHPAs), significant groundwater recharge areas (SGRAs) and Highly Vulnerable Aquifers (HVAs) as well as the assessment of drinking water quality and quantity threats within Source Protection Regions. Source Protection Plans are developed under the CWA and include the restriction and prohibition of certain types of activities and land uses within WHPAs.

Based on a regional-scale source water protection mapping (Source Water Protection Information atlas) provided by the MECP, the Site is not located within a WHPA area, issue contributing area, HVA and intake protection zone. However, it is located within areas designated as WHPA Q1/Q2 with moderate stress.

## 3.0 METHODOLOGY

### 3.1 Borehole Advancement and Monitoring Well Installation

Drilling boreholes and construction of monitoring wells were conducted for geotechnical investigation by Englobe Corporation between January 13, 2022 and January 21, 2022. The program consisted of the drilling of sixteen (16) boreholes (BH) and installation of five (5) monitoring wells for geotechnical and hydrogeological assessment purposes. The locations of the boreholes and monitoring wells are shown on **Figure 2**.

Borehole drilling and monitoring well construction were completed by a licensed water well contractor, Drilltech Drilling Ltd., under the full-time supervision of a drilling supervisor from Englobe Corporation. Englobe's geotechnical supervisor logged the soil strata encountered during borehole advancement and collected representative soil samples for textural classification. The boreholes were drilled using continuous flight, solid-stem auguring equipment. Detailed descriptions of the encountered subsoil and groundwater conditions are provided by Englobe and presented on the borehole and monitoring well logs, on the enclosed **Appendix A**.

The monitoring wells were constructed using 50-mm diameter, which were installed in each of the selected geotechnical boreholes. Monitoring wells were equipped with steel flush mount or the monument protective casings at the ground surface as mentioned below in **Table 3-1**.

The UTM coordinates and ground surface elevations at the monitoring wells' locations, as well as the monitoring well construction details, are presented in **Table 3-1**. The ground surface elevations at the boreholes and monitoring wells' locations were provided by Englobe. The elevations provided on the Borehole Logs are approximate only, for the purpose of relating soil stratigraphy and should not be used or relied on for other purposes.

**Table 3-1- Monitoring Well Installation Details**

Monitoring Well ID	Installation Date	UTM Coordinates (m)		Ground El. (masl)	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)	Casing Dia. (mm)	Protective Casing Type
		Easting	Northing					
BH1	January 14, 2022	615968	4854297	225.6	4.0	2.5-4.0	50	Flush Mount
BH8	January 13, 2022	615997	4854284	225.2	7.8	4.8-7.8	50	Flush Mount
BH9	January 13, 2022	615983	4854276	225.2	7.9	4.9-7.9	50	Flush Mount
BH12	January 21, 2022	616022	4854276	225.0	7.7	4.7-7.7	50	Flush Mount
BH15	January 21, 2022	616044	4854318	224.8	4.2	2.7-4.2	50	Monument

Notes:

mbgs metres below ground surface

masl metres above sea level

### 3.2 Groundwater Monitoring

All six (6) installed monitoring wells were utilized to measure and monitor groundwater levels. Monitoring wells were developed, and the groundwater monitoring program confirmed the stabilized groundwater level beneath the Site. The stabilized groundwater levels were monitored over four (4) monitoring events from February 2, 2022 to March 7, 2022, with the results presented in **Section 6.1**.

### 3.3 MECP Water Well Records Review

MECP Water Well Records (WWRs) were reviewed for the registered wells located at the Site and within 500 m radius of the Site boundaries (study area). The findings of the MECP well records are presented in the **Section 4.6** of the current report.

### 3.4 In-Situ Hydraulic Conductivity Test

Monitoring well BH15 was utilized to conduct hydraulic conductivity test since all other monitoring wells (BH1, BH9 and BH12) were found dry and BH8 has an inadequate water for the test. The in-situ hydraulic conductivity test (falling head and rising head) provides estimated hydraulic conductivity (K) for subsoil strata at the depths of the well screens. The monitoring wells were developed in advance of the tests. Well development involves the purging and removal of groundwater from each monitoring well to remove remnants of clay, silt and other debris introduced into the monitoring well during construction, and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths.

The in-situ falling head hydraulic conductivity test involves the placement of a slug of known volume into the monitoring well, below the water table, to displace the groundwater level upward. The in-situ rising head hydraulic conductivity test involves removing a volume of water from the monitoring well to displace the groundwater level downward. The rate at which the water level recovers to static conditions (rising head/falling head) is tracked manually using a water level tape and a data logger. The rate at which the water table recovers to static conditions is used to estimate the K value for the water-bearing strata formation at the well screen depth using the Bouwer and Rice method (1976). The findings for the hydraulic conductivity testing are presented in **Section 6.3.1** of the current report.

### 3.5 Hydraulic Conductivity based on Grain Size Distribution Graphs

The Hazen equation estimation method was also used to estimate the hydraulic conductivity (K) for saturated subsoils at selected depths beneath the groundwater table beneath the Site. The method provides alternative hydraulic conductivity (K) estimates which are derived from the grain size diameter, whereby 10% by weight of the soil particles are finer and 90% are coarser (Freeze and Cherry, 1979). The soils

chosen for Hazen to estimate were selected from different stratigraphic units contacted at the boreholes' locations. Findings are presented in **Section 6.3.2**.

### **3.6 Groundwater Quality Assessment**

Groundwater quality should be assessed in advance of earth work. As such, one (1) set of samples (sewer set) was collected from one (1) selected monitoring well (BH15) on February 14, 2022 to characterize its quality for evaluation against the Regional Municipality of York Storm and Sanitary Sewer Use By-Law (2014-23) parameters. This is performed to assess whether any anticipated dewatering effluent can be disposed of into the Regional Municipality of York sewer system during construction, or following site development for any long-term foundation drainage. Based on the results, recommendations for any pre-treatment for any dewatering/drainage effluent can be developed, if required.

One (1) selected monitoring well (BH15) was developed and purged of multiple well casings volumes of groundwater prior to sample collection. The groundwater sample was collected using a bailer. In accordance with the York Region Storm and Sanitary Sewer Use By-Law sampling protocols, one (1) complete set of groundwater samples was not filtered during collection, prior to placement in the laboratory sample bottles. Upon sampling, all of the bottles were placed on ice and packed in a cooler at about  $6 \pm \text{C}^\circ$  for shipment to the analytical laboratory. Sample analysis were performed by an accredited lab by the Canadian Association for Laboratory Accreditation Inc. (CALA). Results of the analysis are discussed in **Section 6.3**.

### **3.7 Review of Regional Data and Available Reports for the Site**

The maps, data, and documents provided by the MECP, Ontario Geological Survey (OGS), Ministry of Natural Resource and Forestry (MNR), Oak Ridges Moraine Groundwater Program (ORMGP), and TRCA were reviewed. Additionally, an available geotechnical report was reviewed at the time of preparation of the current hydrogeological assessment report, with the findings summarized in **Sections 4 and 5**.

## 4.0 REGIONAL AND LOCAL SITE SETTING

### 4.1 Regional Geology

The current understanding of the surface geological setting of the Site is based on scientific work conducted by the OGS (OGS, 2003). The Site and surrounding area are located within an area mapped as Till deposits (5d), comprising clay to silt-texture till derived from glaciolacustrine deposits or shale. **Figure 3** illustrates the mapped surficial geology for the Site and the surrounding area.

The Oak Ridges Moraine Groundwater Program (ORMGP) produced a cross-sectional geological map to aid in the characterization of the general area. Considering the regional cross-section, it is understood that the overburden units prevalent in this area are as follows, with the youngest unit at the top:

- Undifferentiated Upper Sediments
- Halton Till (equivalent)
- Oak Ridges Moraine
- Channel Silt Aquitard
- Channel Sand Aquifer
- Thorncliffe Formation
- Sunnybrook Drift
- Scarborough Formation

**Undifferentiated Upper Sediments:** Based on the ORMGP cross-section, the undifferentiated upper sediments are mapped in close proximity to the ground surface. The approximate thickness of the undifferentiated upper sediments could reach 2.0 m beneath the Site.

**Halton Till (or Equivalent Upper Till):** The Halton Till is mainly comprised of sandy silt to clayey silt till interbedded with silt, clay, and a number of discontinuous sand and gravel lenses. It was deposited approximately 12,500 years ago. Based on cross-section, the Halton Till or equivalent is present close to the ground surface, with an approximate thickness of up to 20.0 m.

**Oak Ridges Moraine and Channels:** The Oak Ridges Aquifer Complex (ORAC) is a regionally significant aquifer in southern Ontario. The majority of the aquifer's recharge occurs at the crest of the moraine north of the Site. It is primarily composed of interbedded fine sand and silt deposits with localized coarse sand and gravel deposits. The ORAC is approximately 90 m thick beneath the crest of the moraine, but thins out rapidly towards the margins. Approximate thickness of the ORAC and the channels could reach to 48.9 m beneath the Site.

**Thorncliffe Formation:** The Thorncliffe Formation consists of glaciofluvial and glaciolacustrine sand and silt deposited approximately 30,000 to 50,000 years ago. The Thorncliffe Formation shows a

considerable variation in grain size and thickness, both locally and regionally. It acts as a regional aquifer. Based on the ORMGP cross-section, the thickness of the Thorncliffe could reach 0.7 m beneath the Site.

**Sunnybrook Drift:** The Sunnybrook Drift consists of silt to silty clay materials deposited 45,000 years ago and acts as a regional aquitard. The thickness of the Sunnybrook Drift is generally less than 10 m to 20 m. Based on the ORMGP cross-section, the estimated thickness that could reach to 7.9 m beneath the Site.

**Scarborough Formation:** The Scarborough Formation is composed of clay, silt, and sand sediments in a deltaic sequence. It acts as an aquifer of regional extent. This unit is mostly found within bedrock valleys and thins laterally away from the valleys. Based on the ORMGP cross-section, the thickness to the Scarborough Formation could reach 25.4 m beneath the Site.

The underlying bedrock at the Site is the Georgian Bay Formation, which consists of limestone along with shale (OGS, 2007). A review of the ORMGP cross-section indicates that the bedrock could be contacted at an approximate depth of 104.9 metres below ground surface (mbgs) beneath the Site.

## 4.2 Regional Physiography

The Site is located within a regional physiography of Southern Ontario known as Peel Plain. The Peel Plain within the vicinity of the Site comprises a Bevelled Till Plains.

The Peel Plain is a level-to-undulating tract of clay rich soils, covering an area of about 780 km<sup>2</sup> across the central portions of the Regional Municipalities of York, Peel, and Halton. The Peel Plain exhibits a gradual and fairly uniform downward slope, to the south, towards Lake Ontario. Across this plain the Credit, Humber, Don, and Rouge Rivers have cut deep incised valleys into the overburden soil profile, as have other streams such as the Bronte, Oakville, and Etobicoke Creeks. There are no large un-drained depressions, swamps, or bogs in the immediate area, and for many of the local inter-stream areas, drainage is still imperfect. The underlying geological material for the Peel Plain is mapped as glacial till mineral soil. The till unit, within much of the Peel Plain has been modified by a veneer of clay (Chapman and Putnam, 1984). **Figure 4** shows the location of the Site within the regional physiography map.

## 4.3 Regional Topography and Drainage

The ground surface elevation ranges approximately between 224.8 masl to 225.8 masl based on ground surface elevations measured at the borehole locations. Considering the regional topography map, ground surface elevation for the Site and the vicinity of the Site slopes southwesterly direction as shown on **Figure 5**. As such, it is anticipated that generated runoff (if it is not managed) will flow southwesterly direction toward a tributary of East Humber River flowing along the west boundary of the Site in a south/southeasterly direction.

## 4.4 Watershed Setting

TRCA interactive watershed map was reviewed on February 16, 2022. The Site is located at the border of the Don River watershed and the Humber River Watershed, where the southwest portion of the Site is located within the Humber River Watershed and the rest of the Site is mapped within the Don River Watershed. Both watersheds fall under TRCA jurisdiction. The Don River Watershed covers an area of approximately 36,000 ha, including portions of the City of Toronto, the Cities of Vaughan, Markham, and City of Richmond Hill in the Regional Municipality of York. The watershed drains southward from its heights along the ORM in the north (at an elevation of 315 masl) towards Lake Ontario in the south. Three (3) main geological features including the Bedrock Valley System, Oak Ridges Moraine, and areas of in-filling of eroded Quaternary sediments are presented within the watershed (TRCA, 2009). The Humber River Watershed includes 1,800 km of waterways and 600 bodies of water. It consists of the Main Humber, the East Humber, the West Humber, Black Creek, and the Lower Humber sub-watersheds. The Humber River watershed includes portions within 10 local municipalities, including; the City of Vaughan, the City of Richmond Hill, the Township of King and the Town of Aurora in the Regional Municipality of York; the Cities of Brampton and the City of Mississauga and the Town of Caledon in the Regional Municipality of Peel; the City of Toronto, the Town of Mono in Dufferin County, and the Township of Adjala-Tosorontio in Simcoe County (Toronto and Region Conservation Authority, 2008).

## 4.5 Local Surface Water and Natural Heritage Features

MNRF database was reviewed on February 16, 2022 for any natural heritage features including, watercourses, bodies of water, wetland features, Area of Natural and Scientific Interest (ANSI) and wooded areas. **Figure 6** shows the location of the Site within the surrounding Natural Heritage Features, partially.

Record review indicates that there are no records for natural heritage features including water bodies, watercourses and ANSI within the Site.

Tree lines and wooded areas are scattered around the Site. Don River West Branch flows approximately 1.5 km to the east, and East Humber River and associated tributaries, wetlands and wooded areas are located approximately 2.9 km to the west of the Site. Local ponds including Storm Water Management ponds are scattered around the Site with the closest record located approximately 500 m to northeast of the Site. Additionally, two (2) small ponds are mapped within the wooded area located adjacent to the east boundary of the Site. Record review indicates that wetland features are scattered around the Site, with the closest record located approximately 100 m to the southeast of the Site.

## 4.6 Ground Water Resources (MECP Well Records)

MECP well record database was reviewed for records located within a radius of 500 m from the approximate Site boundary (Study Area). The location of the well records is presented on **Figure 7** with the details for each record summarized in **Appendix B**. A total of 21 records were located within the Study Area. A summary of data obtained from record review is presented in **Table 4-1**.

**Table 4-1 - MECP Well Record Summary**

Number of the Well Records	21
Unknown Status	3 (14%)
<b>Well Type</b>	
Drilled Well	18 (86%)
Unknown	3 (14%)
<b>Depth Ranges</b>	
6.0 m to 30 m (20 ft to 100 ft)	7 (33%)
Greater than 30 m (100 ft)	6 (29%)
Unknown	8 (38%)
<b>Water Use (Final Status)</b>	
Water Supply	15 (71%)
Abandoned/Other	2 (10%)
Monitoring and Test Hole	3 (14%)
Unknown	1 (5%)
<b>Reported Groundwater Static Level</b>	
0 to 5 m (0 to 16 ft)	1 (5%)
6 to 30 m (100 ft)	13 (62%)
Greater than 30 m (100 ft)	1 (5%)
Unknown	6 (28%)

The above summary indicates that most of the local wells are registered as water supply wells. All fifteen water supply wells are used for domestic purposes. Thirteen of the registered wells are completed deeper than 6.0 mbgs. Static groundwater level was recorded in between 6 to 30 mbgs for 62% of the wells.

As there are water supply wells within the Study Area, a door to door well survey is required in advance of, during and after construction if dewatering is required.

## 4.7 Active Permit to Take Water Application Records Review

MECP website was reviewed for any active PTTW application records within 1.0 km radius of the Site on February 17, 2022. Record review indicates there are no records for active PTTW within the Study Area.



## 5.0 LOCAL GEOLOGY AND SUBSURFACE INVESTIGATION

Englobe completed a geotechnical investigation on January 13, 14 and 21, 2022. The fieldwork consisted of drilling of a total of fifteen (15) boreholes extending to maximum depths of investigation at 8.2 mbgs. Five (5) boreholes were equipped with monitoring wells to monitor groundwater conditions beneath the proposed structures. Information regarding borehole logs is presented in **Appendix A**. The approximate locations of boreholes are shown on **Figure 2**. A review of the geotechnical investigation report indicates that the stratigraphy beneath the investigated areas of the Site generally consists of the followings:

### 5.1 Pavement Structure

A flexible pavement structure was encountered at eleven (11) of the borehole locations within the project limits (Study Areas). The asphalt thickness ranges from 80 to 110 mm. The granular base/subbase material at the borehole locations consisted of sand and gravel that ranges from 120 mm to 300 mm. The in-situ moisture content of this material ranged from 8 to 26 percent presenting a moist to wet condition.

### 5.2 Topsoil

A surficial topsoil layer of an average depth of 0.2 m in thickness was encountered in BH4, BH13, BH15 and BH16. Beneath the topsoil, native deposits of sandy silty clay and silty clay till were encountered in BH15 and BH16, respectively. Granular material was also found below the topsoil layer in BH4 and BH13.

### 5.3 Native Soil

#### 5.3.1 Sandy Silt

The native subsoil at the borehole locations within the project limits (Study Area) predominantly consisted of sandy silt. This material was encountered below the pavement structure. The sandy silt was generally in a loose to dense state with SPT 'N' values ranging from 4 to 49 per 300 mm penetration recorded. The natural moisture content of this material ranged from 11 to 20 percent indicating moist to wet conditions.

#### 5.3.2 Silt

Silt deposit was encountered below the sandy silt in BH1, BH2, BH8 and under the pavement structure in BH11. This material extended to the termination depth of investigation in the above noted boreholes except for BH8. The silt was generally in a compact to very dense state with SPT 'N' values ranging from 10 to 71 per 300 mm penetration recorded. The natural moisture content of the layer ranged from 9 to 22 percent indicating moist to wet conditions.

### **5.3.3 Silty Sand**

The subsoil below the sandy silt predominantly consisted of silty sand and generally extended to the termination depth of investigation. The silty sand deposit was generally in a loose to very dense state with SPT 'N' values ranging from 7 to 73 per 300 mm penetration recorded. The natural moisture content of this material ranged from 6 to 23 percent presenting a moist to wet condition.

### **5.3.4 Clayey Silt/Silty Clay**

A stratum of clayey silt/silty clay/sandy silty clay was encountered below the silty sand in BH5, BH6, BH8, BH10, BH12, BH13, BH15 and BH16 extending to the termination depth of investigation in the above mentioned boreholes. In BH12 and BH16 clayey silt was also encountered below the pavement structure and topsoil, respectively. The clayey silt was generally in a firm to hard state with SPT 'N' values ranging from 6 to 32 per 300 mm penetration recorded. The natural moisture content of this material ranged from 9 to 20 percent indicating moist to wet conditions.

### **5.3.5 Sandy Silty Clay**

Sandy silty clay was encountered below the cohesionless deposit in boreholes BH8, BH12 and BH13 respectively. This material extended to the depth of exploration in these three boreholes. The clayey sandy silt till was generally in a loose to compact state with SPT 'N' values ranging from 4 to 21 per 300 mm penetration recorded. The natural moisture content of this material ranged from 6.7 to 17.6 percent indicating a moist condition.

## 6.0 LOCAL HYDROGEOLOGICAL STUDY

### 6.1 Monitoring Well Development and Groundwater Level Monitoring

A groundwater monitoring program was completed between February 2, 2022 and March 7, 2022 as a part of the hydrogeological assessment. Five (5) monitoring wells, installed for the hydrogeological assessment (BH1, BH8, BH9, BH12 and BH15), were considered for monitoring program.

Groundwater levels were monitored over four (4) monitoring events. Terraprobe measured the groundwater levels using an interface probe (Solinst Interface Metre, Model 122). The measured groundwater levels, along with other monitoring wells details and findings, are presented in **Appendix C**. A summary of the groundwater level observations is provided in **Table 6-1**.

**Table 6-1-** A Summary of Groundwater Monitoring

MW* ID	Unit	Screen Interval	Groundwater Level				
			February 2, 2022	February 14, 2022	February 24, 2022	March 7, 2022	March 9, 2022
BH1	mbgs	2.5-4.0	Dry	Dry	4.00	4.01	4.01
	masl	224.6-221.6	Dry	Dry	221.59	221.58	221.58
BH8	mbgs	4.8-7.8	Dry	7.57	Dry	7.68	7.62
	masl	220.4-217.4	Dry	217.59	Dry	217.48	217.54
BH9	mbgs	4.9-7.9	Dry	Dry	7.73	7.69	7.76
	masl	220.3-217.3	Dry	Dry	217.43	217.47	217.40
BH12	mbgs	4.7-7.7	Dry	Dry	7.57	Dry	Dry
	masl	220.3-217.3	Dry	Dry	217.45	Dry	Dry
BH15	mbgs	2.7-4.2	2.71	2.69	1.29	1.00	1.18
	masl	225.7-223.7	222.14	222.16	223.56	223.85	223.67

Notes:

\*MW Monitoring Well

mbgs metres below ground surface

masl metres above sea level

As shown in **Table 6-1**, the highest shallow groundwater level was measured at El. 223.85 metres above sea level (masl) at BH15. Since BH15 is outside the footprint of the proposed building and considering subsoil profile, the highest groundwater level for the design purposed is taken from BH1 at 221.59 masl.

### 6.2 Shallow Groundwater Flow Pattern

Groundwater level elevations measured on March 7, 2022 were considered to interpret the shallow groundwater flow pattern beneath the Study Areas. **Figure 8** presents the interpreted shallow groundwater elevation contours. A review of the plan indicates that the shallow groundwater is interpreted flowing a southerly direction in general towards the East Humber River.

## 6.3 Hydraulic Conductivity Testing

### 6.3.1 In-Situ Hydraulic Conductivity Testing

Monitoring well BH15 underwent single well response tests (SWRTs) to assess the hydraulic conductivity (K) for saturated shallow aquifer subsoils at the depths of the well screens as other wells were found dry or inadequate water for the tests. A monitoring well was equipped with a digital transducer to record the fluctuation made to complete the SWRT. Estimated hydraulic conductivity for the monitoring well BH15 was analysed using the Bouwer and Rice method (1976). The result of the SWRT test is presented in **Appendix D**, with a summary of the findings provided in **Table 6-2**.

**Table 6-2-** A Summary of Falling Head Hydraulic Conductivity Testing

Well ID	Ground El. (masl)	Monitoring Well Depth (mbgs)	Screen Interval (mbgs)	Screened Soil Strata	Hydraulic Conductivity (K in m/s)	Test Method
BH15	224.8	4.2	2.7 – 4.2	Silty Clay with Sand	$1.44 \times 10^{-7}$	Rising Head Test

Notes:

mbgs metres below ground surface

masl metres above sea level

### 6.3.2 Hydraulic Conductivity Test Using Grain Size Distribution Graphs

The Hazen Equation method was adopted to estimate the hydraulic conductivity (K) for different soil layers which may contain groundwater during the seasonal high water table (spring) period, or if they are not encountered within the screen intervals.

The Hazen Equation method relies on the interrelationship between hydraulic conductivity and effective grain size,  $d_{10}$ , in the soil media. This empirical relation predicts a power-law relation with K, as follow:

$$K = Ad_{10}^2$$

where;

$d_{10}$ : Value of the soil grain size gradation curve as determined by sieve analysis, whereby 10% by weight of the soil particles are finer and 90% by weight of the soil particles are coarser.

A: Coefficient; it is equal to 1 when K in cm/sec and  $d_{10}$  is in mm

The Hazen Equation estimation provides an indication of the groundwater yield capacity for saturated soil strata at the depths where soils samples were selected for grain size analysis. The grain size distribution graphs prepared for the geotechnical investigation were used to estimate the hydraulic conductivity, with the details are presented in **Appendix E**. The results of the Hazen equation are provided in **Table 6-3**, below.

Due to significant amount of clay and silt, values for hydraulic conductivity with acceptable accuracy cannot be estimated from grain size analysis for BH8(SS8), BH9(SS8), BH12(SS8), BH13(SS1) and BH15(SS5).

**Table 6-3 -A Summary of Hydraulic Conductivity Using Hazen Equation**

Borehole/ Monitoring Well ID	Soil Sample Depth (mbgs)	Soil Sample Elevation (masl)	Soil Strata	Hydraulic Conductivity (m/s)
BH1	3.5 (SS5)	222.1	silt trace clay	$3.03 \times 10^{-7}$
BH2	2.0 (SS3)	223.0	silt trace clay and sand	$4.23 \times 10^{-7}$
BH8	5.0 (SS7)	220.2	silt with sand trace clay	$3.60 \times 10^{-7}$
BH10	2.5 (SS4)	222.6	silt trace clay and sand	$5.63 \times 10^{-7}$
BH11	1.0 (SS2)	224.0	silt with clay	$2.03 \times 10^{-7}$
BH12	5.0 (SS7)	220.0	silty sand trace clay	$7.23 \times 10^{-7}$
BH16	2.0 (SS3)	222.9	silty clay with sand	$1.69 \times 10^{-8}$

Notes:

mbgs metres below ground surface  
masl metres above sea level

## 6.4 Groundwater Quality

One (1) set of unfiltered groundwater sample was collected by Terraprobe and analyzed by a laboratory accredited by SGS, laboratory the Canadian Association for Laboratory Accreditation. The sample was collected directly from monitoring well BH15 on February 14, 2022.

Monitoring well BH15 was purged and one (1) set of unfiltered groundwater samples was collected in accordance with York Region Storm and Sanitary Sewer Use By-Law sampling protocols. Upon sampling, all of the bottles were placed in a cooler for shipment to the analytical laboratory. Sample analysis was performed by SGS, a third party CALA-accredited laboratory. The groundwater quality test results and a certificate of analysis, including test results, are presented in **Appendix F**.

The analytical results for the unfiltered groundwater samples obtained from monitoring well BH15 indicates that the concentrations for all the analyzed parameters meet the Regional Municipality of York sanitary sewer use limits. There are exceedances for Total Suspended Solids (TSS), total manganese and total cyanide in comparison with the Regional Municipality of York storm sewer by-law limits. The exceedances, together with the storm and sanitary sewer use criteria, are presented in **Table 6-4**.

**Table 6-4-** Groundwater Quality Analysis Results Exceeded

Exceeded Parameter	Groundwater Quality Results (mg/L)	Regional Municipality of York Sanitary Sewer use By-Law Limits (mg/L)	Regional Municipality of York Storm Sewer Use By-Law Limits (mg/L)
TSS	<b>234</b>	350	<b>15</b>
Total Manganese	<b>0.241</b>	5.0	<b>0.15</b>
Total Cyanide	<b>0.03</b>	2.0	<b>0.02</b>

The results suggest that any construction dewatering or foundation drainage effluents should be acceptable for discharge to the Regional Municipality of York sanitary sewer. The anticipated effluent would not be acceptable for discharge to the Regional Municipality of York storm sewer system. However, implementing pre-treatment to lower TSS, total manganese and total cyanide to meet the Regional Municipality of York storm sewer by-law limits could permit its discharge to the Regional Municipality of York storm sewer system.

Pre-treatment to lower TSS could involve use of settling weir tanks and/or filter bags during construction. The final design for any dewatering effluent pre-treatment system is the responsibility of the contractors undertaking construction.

## 7.0 CONSTRUCTION DEWATERING

### 7.1 Proposed Development Plan Review

The proposed Site Plan provided by City of Vaughan and prepared by Thomasbrown Architects dated November 24, 2021 (drawing no. CR1.1) and the geotechnical report prepared by Englobe, dated March 30, 2022 were reviewed for the current assessment. The reviewed design drawings are presented in **Appendix G**.

Based on a review of the Site Plan prepared by Thomasbrown Architects dated November 24, 2021 (drawing numbers CR 1.1), the proposed development will include construction of a slab-on-grade Fire Station Number 7-12 and associated at-grade parking lot. The preliminary Finished Floor Elevation (FFE) is proposed at El. 225.75 masl as per the email received on March 17, 2022. As per Englobe's geotechnical report dated March 30, 2022, the base of the excavation is considered as 225.25 masl and the base of footing was considered at El. 222.75 masl (including 0.5 m of granular material beneath the footing).

### 7.2 A review of Geotechnical Report

A review of the Geotechnical report prepared by Englobe Corporation dated March 30, 2022 indicates that:

- The topsoil must be removed from all new foundation areas. Footing must be founded on the native silty sand/sandy silt or on engineering fill. In areas where the silty clay or clayey silt is encountered, it is recommended that the existing inorganic native soil is removed at the footing locations and a granular pad (extending 0.5 m width on either side of the footing) shall be placed with minimum thickness of 1.0 m below the foundation depths.
- Strip and spread footings can be designed using limit state static bearing pressures and the depth of the footing is 2.5 m as tabulated in Table 9, section 4.2.1 of the geotechnical report.
- The frost penetration depth for the Site is estimated at 1.2 m. All footings subject to frost action should be provided with a minimum of 1.2 m of soil cover.
- Based on the field evaluation of the subsurface conditions excavations for all footings must be cut back at side slopes of 1:1 (H:V).
- Perimeter drainage is not considered to be necessary for areas without basement.
- Underlying the topsoil and pavement structure, native deposits mainly comprise clayey silt/silty clay, sandy silt/silty sand, silt and clayey sandy silt.

### 7.3 Summary of Hydrogeological Conditions of Site Development

The results of the findings provided by Englobe Corporation, and the investigation completed by Terraprobe indicate the following hydrogeological features for the Site:

- The shallow groundwater table for design purposes should be considered to be at El. 221.59 ± masl (4.0 mbgs) measured at BH1 located north west of the proposed building footprint.
- The estimated hydraulic conductivity of  $1.44 \times 10^{-7}$  m/s,  $4.23 \times 10^{-7}$  and  $7.23 \times 10^{-7}$  m/s is considered for the clayey silt, silt, and sandy silt/silty sand units, respectively.

### 7.4 Short-Term Groundwater Control Requirements (Construction Dewatering)

Based on a review of the Site Plan prepared by Thomasbrown Architects dated November 24, 2021 (drawing numbers CR 1.1), the proposed development will include construction of a slab-on-grade Fire Station Number 7-12 and associated at-grade parking lot. The preliminary Finished Floor Elevation (FFE) is proposed at El. 225.75 masl as per the email received on March 17, 2022. As per Englobe's geotechnical report dated March 30, 2022, the base of the excavation for construction of the slab is considered as 225.25 masl and the base of footing was considered at El. 222.75 masl (including 0.5 m of granular material beneath the footing).

The highest known stabilized groundwater level, measured over the monitoring period within the proposed building footprint, is recorded at 221.59 masl (BH1) which is 1.16 m below the underside of the footing.

Considering the shallow groundwater level and proposed invert elevations, construction dewatering is not required for excavation and construction of the proposed slab-on-grade building. However, anticipated precipitation should be collected from the excavation trench that will be developed for construction of the proposed footings. The total wall length of the building is calculated from the drawing no. CR 1.1 prepared by Thomasbrown Architects dated November 24, 2021. Based on the reviewed plan, the total footing length of 143.4 m was considered for the proposed building. Additionally, based on a review of the geotechnical investigation report, the width of 4.0 m (1.0 m footing width and 1H:1V slope cutting) should be considered for construction of the footing. As such a trench with a length and width of 143.4 and 4 m was assumed as an average width of the trench for dewatering assessment from rainfall sources.

Volumes for a 30.8 mm was estimated using the Ministry of Transportation IDF Curve ([http://www.mto.gov.on.ca/IDF\\_Curves/results\\_out.shtml?coords=43.832922,-79.557421](http://www.mto.gov.on.ca/IDF_Curves/results_out.shtml?coords=43.832922,-79.557421)). The details are presented in **Appendix G**. The estimated construction dewatering flow rates for the proposed development is summarized below:



- Anticipated construction dewatering for developing the proposed slab-on-grade building is 18,000 L/day from precipitation source if the excavation and construction of the trench is completed over 1 day. If a trench with a length of 50 m is excavated and constructed per day, a flow rate of 6,000 L/day is expected over storm event.

Additionally, considering the subsoil profile perched water may be contacted over the excavation and construction period.

As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of storm water from a 100-year storm. The volume that will be generated in the occurrence of a 100-year storm event is approximately 59,000 L/day for construction of the proposed slab-on-grade building. Details are presented in **Appendix H**.

## **7.5 Long-Term Foundation Drainage**

A slab-on-grade 2 storey building is proposed for the future development. Additionally, the proposed building will be constructed above shallow groundwater level. Additionally, construction of a foundation drainage is not proposed in the geotechnical investigation report. As such, discharge plan for long-term foundation drainage is not required for the post development structure.

Any localized protrusions extending below the base of the excavation, including elevator or sump pits should be waterproofed in the long-term

## **7.6 Permit Requirements**

The total anticipated short-term dewatering flow rate reaches 18,000 L/day, which remains below the MECP Environmental Activity and Sector Registry (EASR) lower threshold limit of 50,000 L/day. As such, filing EASR with the MECP is not required. However, obtaining a discharge agreement from the City of Vaughan/York Region will be required.

The anticipated foundation-drainage flow rate is not anticipated. As such, applying for PTTW with the MECP is not required as well as obtaining a discharge agreement from the City of Vaughan/York Region will not be required for the long-term.

## **7.7 Zone of Influence (ZOI) Groundwater**

The proposed excavation and construction will be completed above the stabilized shallow groundwater level. As such, ZOI with respect to dewatering activities is not anticipated.

## **7.8 Potential Dewatering Impacts and Mitigation Plan**

### **7.8.1 Short-Term Discharge of Pumped Groundwater (Construction Dewatering)**

The dewatering system must be appropriately filtered in order to prevent the pumping of fines and loss of ground during the dewatering activities.

The proposed excavation and construction will be completed above shallow groundwater level and the current quality assessment is presenting the groundwater quality. It is recommended the quality of the collected water is tested in advance of discharging to the Region's Sewer System if it is proposed to be directed to the Region's Sewer System. Alternatively, collected water could be hauled and disposed off-site using a licenced contractor.

### **7.8.2 Ground Settlement**

Since the proposed building will be constructed above shallow groundwater table, Zone of Influence (ZOI) for dewatering is not expected. As such, no concerns are anticipated for ground settlement with respect to the proposed excavation and construction above shallow groundwater table.

### **7.8.3 Surface Water, Wetlands and Areas of Natural Significance**

Record review indicates that no natural heritage features including water bodies, watercourses, wetland features and ANSI were identified on the Site. As such, no impacts to natural heritage features are anticipated pertaining the proposed development. However, the Site is located within areas designated as WHPA Q1/Q2 with moderate stress. As such, obtaining a permit from Toronto Regional Conservation Authority may be required.

### **7.8.4 Water Supply Wells and Zone of Influence**

A review of the MECP well records confirmed that there are 21 records within the Study Area, of which fifteen (15) active water supply wells are registered within 500 m of the Site. As there are water supply wells within or in close proximity to the Site, a door to door well survey may be required in advance of, during and after construction. However, since the excavation and construction will be completed above shallow groundwater table, impacts to the nearby water supply wells are not anticipated.

### **7.8.5 Contamination Sources**

Terraprobe is not aware of any available Phase One Environmental Site Assessment (ESA) and a Phase Two ESA for the Site.

## 8.0 PRE- AND POST-DEVELOPMENT WATER BALANCE

As a part of the hydrogeological assessment, a pre- and post-development water balance analyses were completed to compare pre-development and post-development hydrological conditions to evaluate potential changes in recharge and runoff volumes due to the proposed development.

The discussion below provides details on the methodology used and the results obtained from the analysis. A summary of the calculations is provided in **Appendix I**.

### 8.1 Site Water Balance Components

A site scale water balance analysis was completed following the Toronto and Region Source Protection Authority (TRSPA) tool provided by TRCA. The water balance method roughly estimates annual evapotranspiration, infiltration and runoff volumes. The modified water balance components were used for the pre- and post-development water balance analyses. **Table 8-1** summarizes the details for the water balance parameters adopted from TRSP tool.

**Table 8-1-** Summary of Water Balance Components

Precipitation (mm/year)	Evapotranspiration (mm/year)	Infiltration (mm/year)	Runoff (mm/year)
852	391	193	268

#### 8.1.1 Methodology

A Site scale water balance analysis was completed in order to estimate the components of the hydrological cycle for the Site, and was modelled using the following equation:

$$P = DGS + ET + R + I$$

Where:

P= Precipitation, which represents the sum of all rainfall and snowfall

DGS=Change in groundwater storage

ET= Evapotranspiration

R= Runoff

I= Infiltration

Based on the TRCA tool; (<https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/>), the evapotranspiration in pervious areas at the Site is 391 mm/yr, runoff is 268 mm/yr and infiltration (groundwater recharge) is 193 mm/yr.

Although groundwater storage experiences both gains and losses on a short-term basis, the net change in groundwater storage (DGS) over the long-term is generally zero. For this reason, the change in groundwater storage (zero (0)) has not been included in the water balance calculations.

Evapotranspiration (ET) refers to the transfer of water from vegetation and the soil surface to the atmosphere in the form of water vapour. The term considers evaporation from the soil surface and from man-made surfaces together with transpiration from plants.

## 8.2 Site Water Balance

Water balance analyses were completed for pre-development and post-development conditions, separately with the details presented below:

### 8.2.1 Pre-Development Water Balance

Based on an email received on March 11, 2022 from the City of Vaughan via Englobe, the total Site area is 16,271 m<sup>2</sup>. The pre-development water balance for the pervious areas at the Site is calculated by multiplying the existing landscape areas by the various, averaged annualized depth estimates for precipitation, ET, infiltration and runoff. The estimates for runoff and ET for impervious surfaces are 90% and 10% of the average annual precipitation, respectively. The average annual area-based estimates for each water balance component are summarized in **Table 8-2**.

**Table 8-2-** Summary of Pre-Development Volumetric Water Balance Components

Pre-Development Site Breakdown Areas	Coverage Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> /year)	Evapotranspiration (m <sup>3</sup> /year)	Infiltration (m <sup>3</sup> /year)	Run off (m <sup>3</sup> /year)
Existing Buildings	701	598	60	0	538
Existing Pavements Areas	4,155	3,540	354	0	3,186
Existing Landscaped Areas	11,415	9,725	4,467	2,201	3,057
<b>Total</b>	<b>16,271</b>	<b>13,863</b>	<b>4,881</b>	<b>2,201</b>	<b>6,781</b>

### 8.2.2 Post-Development Water Balance

As previously mentioned, the total Site area is 16,271 m<sup>2</sup> out of which building areas, paved areas and landscaped areas are 1,595 m<sup>2</sup>, 4,572 m<sup>2</sup> and 10,104 m<sup>2</sup>, respectively. Detailed breakdown area for buildings, parking spaces, paved area and landscaped area are based on the email received on March 11, 2022 from the City of Vaughan.

The post-development water balance is calculated using the same depth based components that were used for the pre-development water balance calculations, i.e., average annual precipitation and average annual ET. The estimates for runoff and ET for impervious surfaces are 90% and 10% of the average annual precipitation, respectively. The estimated post-development water balance volumes are provided in **Table 8-3**.

**Table 8-3-** Summary of Post-Development Volumetric Water Balance Components

Post-Development Site Breakdown Areas	Coverage Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> /year)	Evapotranspiration (m <sup>3</sup> /year)	Infiltration (m <sup>3</sup> /year)	Run off (m <sup>3</sup> /year)
Proposed and Existing Buildings Areas	1,595	1,358	135	0	1,223
Proposed and Existing Paved Areas	4,572	3,896	390	0	3,506
Proposed Landscaped Areas	10,104	8,609	3,954	1,948	2,707
Total Area	16,271	13,863	4,479	1,948	7,436

### 8.3 Water Balance Analysis Results

The volumetric comparisons in evapotranspiration, infiltration and runoff between the pre-developed and post-developed Site are summarized in **Table 8-4**.

**Table 8-4-** Pre- and Post-Development Volumetric Water Balance Components

Pre-Development Site Breakdown Areas	Precipitation (m <sup>3</sup> /year)	Evapotranspiration (m <sup>3</sup> /year)	Infiltration (m <sup>3</sup> /year)	Run off (m <sup>3</sup> /year)
Pre-Development	13,863	4,881	2,201	6,781
Post-Development	13,864	4,479	1,948	7,436
Loss (-) and Gain (+)	-	-402	-253	+655

A review of the findings indicates that a total decrease of 402 m<sup>3</sup>/year and 253 m<sup>3</sup>/year for ET and infiltration, respectively, and an increase of 655 m<sup>3</sup>/year for runoff are expected for the post-development Site. Low Impact Development (LID) measures, such as infiltration trenches and permeable pavements, could be considered to manage the generated runoff partially. Remaining volume can be discharged to the Regional Municipality of York storm sewer system. It is assumed that details will be provided in the Stormwater Management report.

Based on Table 3.5.1 of Low Impact Development Stormwater Management Planning and Design Guide, issued by TRCA dated January 2010, 1.0 m interval should be considered between the base of the proposed LID measures and groundwater level. Additionally, percolation rate of the soil, where the LID measures are proposed, should be confirmed using in-situ percolation testing techniques.

## 9.0 CONCLUSIONS AND RECOMMENDATIONS

- The Site is located within the Physiographic Region of Southern Ontario known as the Peel Plain Bevelled Till Plains.
- The Site and surrounding area are located within an area mapped as Till deposits (5d), comprising clay to silt-texture till derived from glaciolacustrine deposits or shale.
- The Site is located at the border of the Don River watershed and the Humber River Watershed, both watershed falls under TRCA jurisdiction, where the southwest portion of the Site is located within the Humber River Watershed and the rest of the Site is mapped within the Don River Watershed. There are no records for natural heritage features including water bodies, watercourses and ANSI within the Site.
- Underlying the topsoil and pavement structure, native deposits mainly comprise clayey silt/silty clay, sandy silt/silty sand, silt and clayey sandy silt to termination depth of investigation at 8.2 mbgs.
- The shallow groundwater table for design purposes should be considered to be at El. 221.59 ± masl (4.0 mbgs) measured at BH1 located north west of the proposed building footprint.
- The estimated hydraulic conductivity of  $1.44 \times 10^{-7}$  m/s,  $4.23 \times 10^{-7}$  and  $7.23 \times 10^{-7}$  m/s is considered for the clayey silt, silt, and sandy silt/silty sand units, respectively.
- Groundwater quality at a selected monitoring well (BH15) exceeds for Total Suspended Solid (TSS), total manganese and total cyanide in comparison with the York Region Storm Sewer By-Law Use Limits. The results review indicates that the water quality meets the York Region Sanitary Sewer By-Law Use Limits.
- Total short-term construction dewatering flow for construction of the proposed slab-on-grade building would be 18,000 L/day that is expected from precipitation source only.
- Total long-term foundation drainage flow for the post construction site is not anticipated.
- Posting EASR with MECP is not required for short-term construction dewatering flow control.
- Applying for PTTW with MECP is not required for long-term foundation drainage control.
- Applying for discharge agreement with the City of Vaughan/York Region is required for discharging short-term dewatering flows if the discharged water is proposed to be directed to the region's sewer system.
- The ZOI is not anticipated as the base of excavation for construction of the footings is proposed above the highest groundwater table.

- There are no records for water bodies, watercourses and ANSI on the Site or within close proximity of the Site.
- There are fifteen (15) water supply wells within the Study Area. Since, the excavation for construction of the footings will be completed above groundwater level, no concerns are anticipated regarding local groundwater users. As such, door to door well survey may not be required.
- A review of the findings indicates that a total decrease of 402 m<sup>3</sup>/year and 253 m<sup>3</sup>/year for ET and infiltration, respectively, and an increase of 655 m<sup>3</sup>/year for runoff are expected for the post-development Site. Low Impact Development (LID) measures, such as infiltration trenches and permeable pavements, could be considered to manage the generated runoff partially. Remaining volume can be discharged to the Regional Municipality of York storm sewer system. It is assumed that details will be provided in the Stormwater Management report.

## 10.0 CLOSURE

We trust that the above-noted information is suitable for your review. If you have any questions regarding this information, please do not hesitate to contact the undersigned.

Yours truly,

**Terraprobe Inc.**



Rachel Geddam, B.Eng., EIT.  
Project Manager



Narjes Alijani, M.Sc., P.Geo  
Senior Hydrogeologist





## 11.0 REFERENCES

1. Chapman, L.J. and D.F. Putnam, 1984. The Physiography of Southern Ontario. Ontario.
2. Freeze, A. and Cherry, J., 1979. Groundwater, Prentice-Hall Inc., New Jersey.
3. Geological Survey. Ontario Geological Survey (OGS), 2003. Surficial Geology of Southern Ontario. Miscellaneous Release – Data 128 – revised.
4. Geological Survey. Ontario Geological Survey (OGS), 2007. Bedrock Geology of Ontario. Miscellaneous Release – MRD 219.
5. Ministry of the Environment, Conservation and Parks, 2022, Source Protection Information Atlas Interactive Map.
6. Ministry of Natural Resources and Forestry, 2022. Natural Heritage Interactive Map.
7. Site Plan provided by the City of Vaughan and prepared by Thomasbrown Architects, dated November 24, 2021 (drawing no. CR 1.1).
8. Toronto and Region Conservation Authority, 2022, Online Regulated Area Map.
9. Toronto and Region Conservation Authority (TRCA), 2008. Humber River State of Watershed Report.
10. Toronto and Region Conservation Authority, Low Impact Development Stormwater Management Planning and Design Guide (Draft), January 2020.
11. Vaughan Fire Station 7-12, 9541 Weston Road, Woodbridge, City of Vaughan, Ontario, Geotechnical Report dated March 30, 2022 prepared by Englobe Corp (Draft).

## 12.0 LIMITATIONS OF LIABILITY

This report was prepared at the request of, and for the exclusive use of City of Vaughan and its affiliates (“the Intended User”) is intended to provide an assessment of the hydrogeological conditions of the Property located at 9541 Weston Road, in the City of Vaughan, Ontario (the Site). No one other than the Intended User has the right to use and rely on the work without first obtaining the written authorization of Terraprobe Inc. and the City of Vaughan.

Terraprobe Inc. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Terraprobe Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The assessment should not be considered a comprehensive audit that eliminates all risks of encountering hydrogeological problems. The information presented in this report is based on information collected during the completion of the hydrogeological study by Terraprobe Inc. It was based on the conditions on the Site at the time of the hydrogeological study by a review of historical information and field investigation to assess the hydrogeological conditions of the Site, as reported herein.

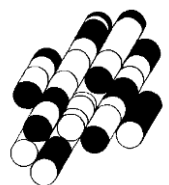
There is no warranty expressed or implied by this report regarding the hydrogeological conditions for the Site. Professional judgement was exercised in gathering and analyzing information collected by reviewing previous reports, data provided by government and are open to public and field work investigation. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

In the event that during future work new information regarding the hydrogeological conditions of the Site is encountered, or in the event that the outstanding responses from the regulatory agencies indicate outstanding issues on file with respect to the Site, Terraprobe Inc. should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.

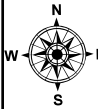
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# FIGURES

**TERRAPROBE INC.**



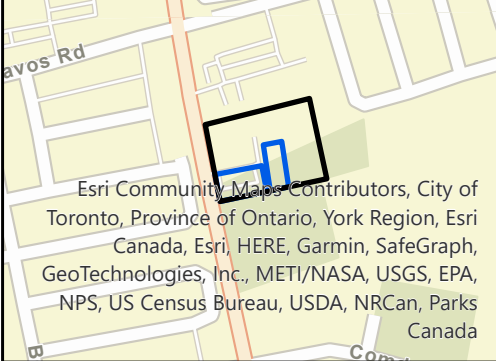




**References:**

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Basemaps

**Key Map**



**Notes:**

**Legend:**

Field



Approximate Site Boundary



Approximate Study Area

**Project Title:**

Hydrogeological Assessment

**Site Location:**

9541 Weston Road, Vaughan, Ontario

**Figure Title:**

Site Location Plan

**Designed By:**

AN

**File No.:**

1-21-0843-46

**Drawn By:**

SSK

**Scale:**

As Shown

**Reviewed By:**

BW

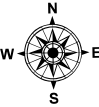
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**Date:**

January 2022

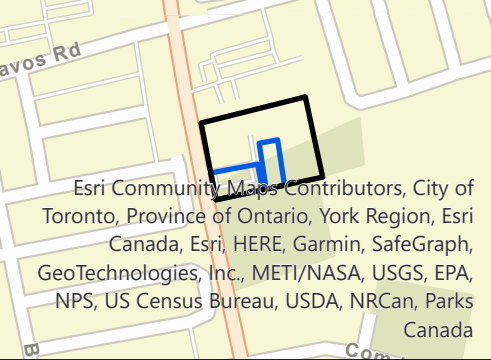




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ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Basemaps

**Key Map**



**Notes:**

**Legend:**

- Approximate Site Boundary
- Approximate Study Area Approximate
- Monitoring Well Location
- Approximate Borehole Location

**Project Title:**

Hydrogeological Assessment

**Site Location:**

9541 Weston Road, Vaughan, Ontario

**Figure Title:**

Borehole and Monitoring Well Plan

**Designed By:**

AN

**File No.:**

1-21-0843-46

**Drawn By:**

SSK

**Scale:**

As Shown

**Reviewed By:**

BW


**Date:**

January 2022

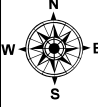
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Consulting Geotechnical & Environmental Engineering  
Construction Materials, Inspection & Testing

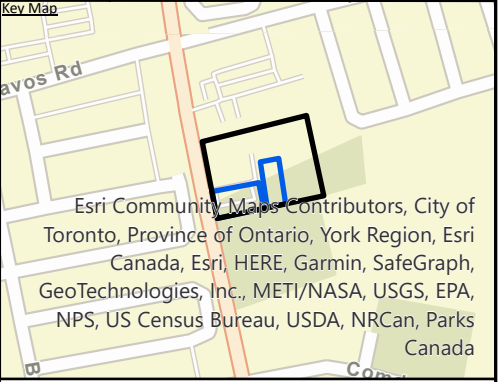


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**References:**

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**Key Map**



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**Notes:**

**Legend:**

-  Approximate Site Boundary
-  Approximate Study Area
-  5d: Glaciolacustrine-derived silty to clayey till
-  Collector
-  Local / Street

**Project Title:**

Hydrogeological Assessment

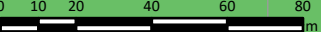
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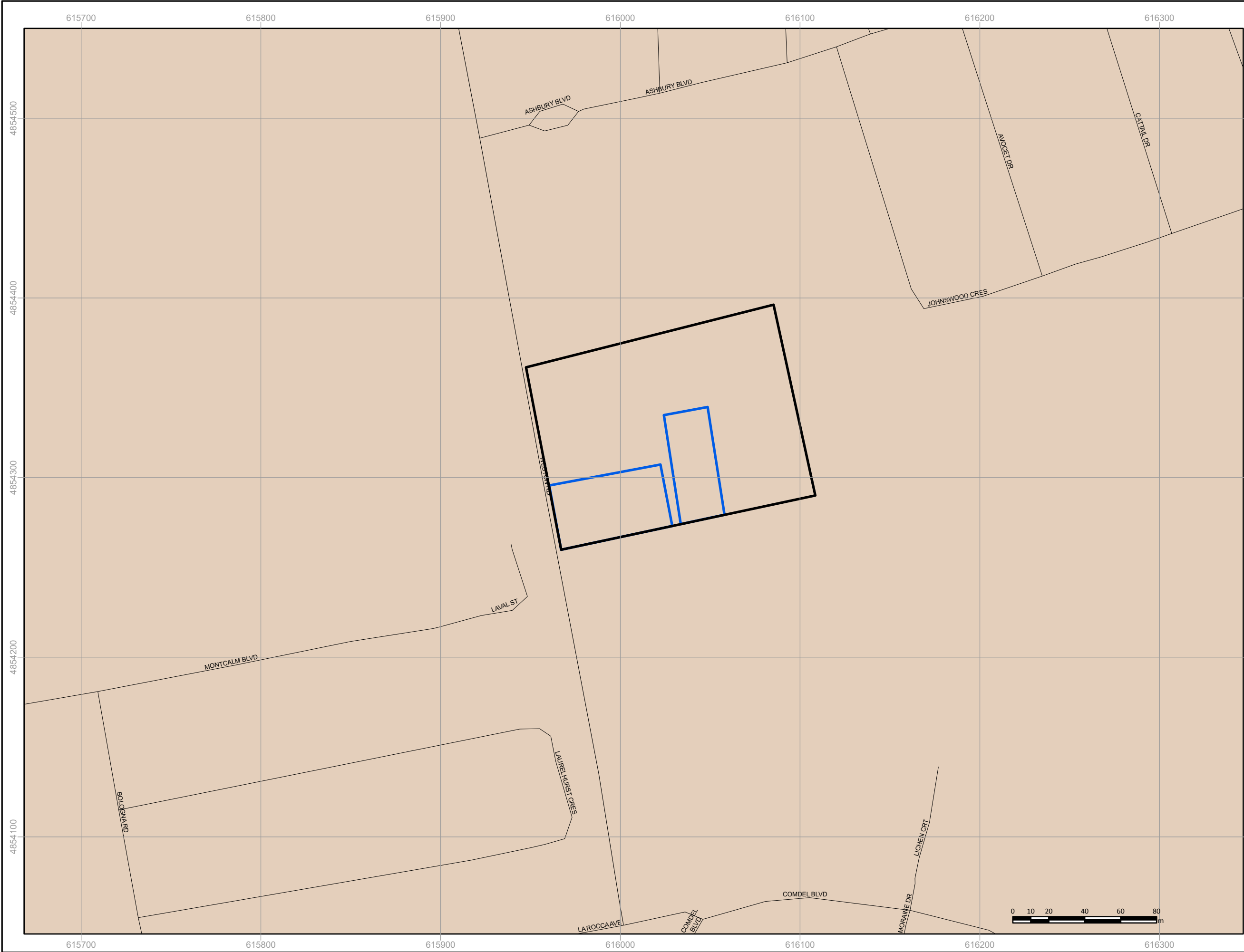
9541 Weston Road, Vaughan, Ontario


**Figure Title:**

Surficial Geology Map

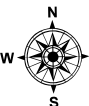
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<b>Reviewed By:</b> BW	<b>Figure No.:</b> 3
<b>Date:</b> January 2022	







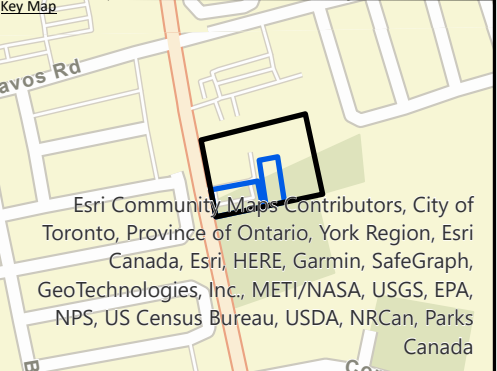
Consulting Geotechnical & Environmental Engineering  
Construction Materials, Inspection & Testing



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**Notes:**

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-  Approximate Study Area
-  Collector
-  Local / Street
-  33, Peel Plain

**Project Title:**

Hydrogeological Assessment

**Site Location:**

9541 Weston Road, Vaughan, Ontario


**Figure Title:**

Physiography Map

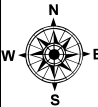
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<b>Date:</b> January 2022	







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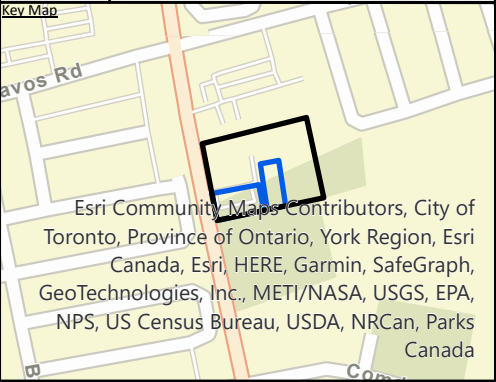


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**Notes:**

**Legend:**

-  Approximate Site Boundary
-  Approximate Study Area
-  Collector
-  Local / Street
-  City of Vaughan, Topographic Contours

**Project Title:**

Hydrogeological Assessment

**Site Location:**

9541 Weston Road, Vaughan, Ontario


**Figure Title:**

Topography Map

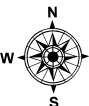
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<b>Date:</b> January 2022	







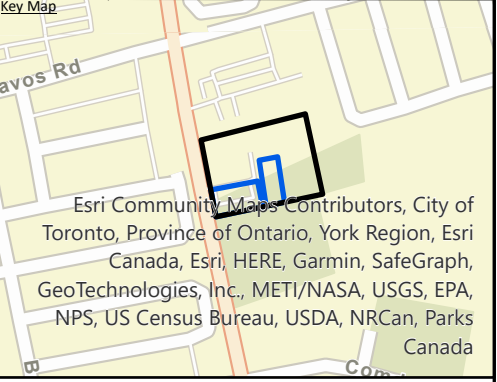
Consulting Geotechnical & Environmental Engineering  
Construction Materials, Inspection & Testing



References:

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Key Map



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Notes:

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-  Approximate Study Area
-  Collector
-  Local / Street
-  Wooded Area

**Project Title:**

Hydrogeological Assessment

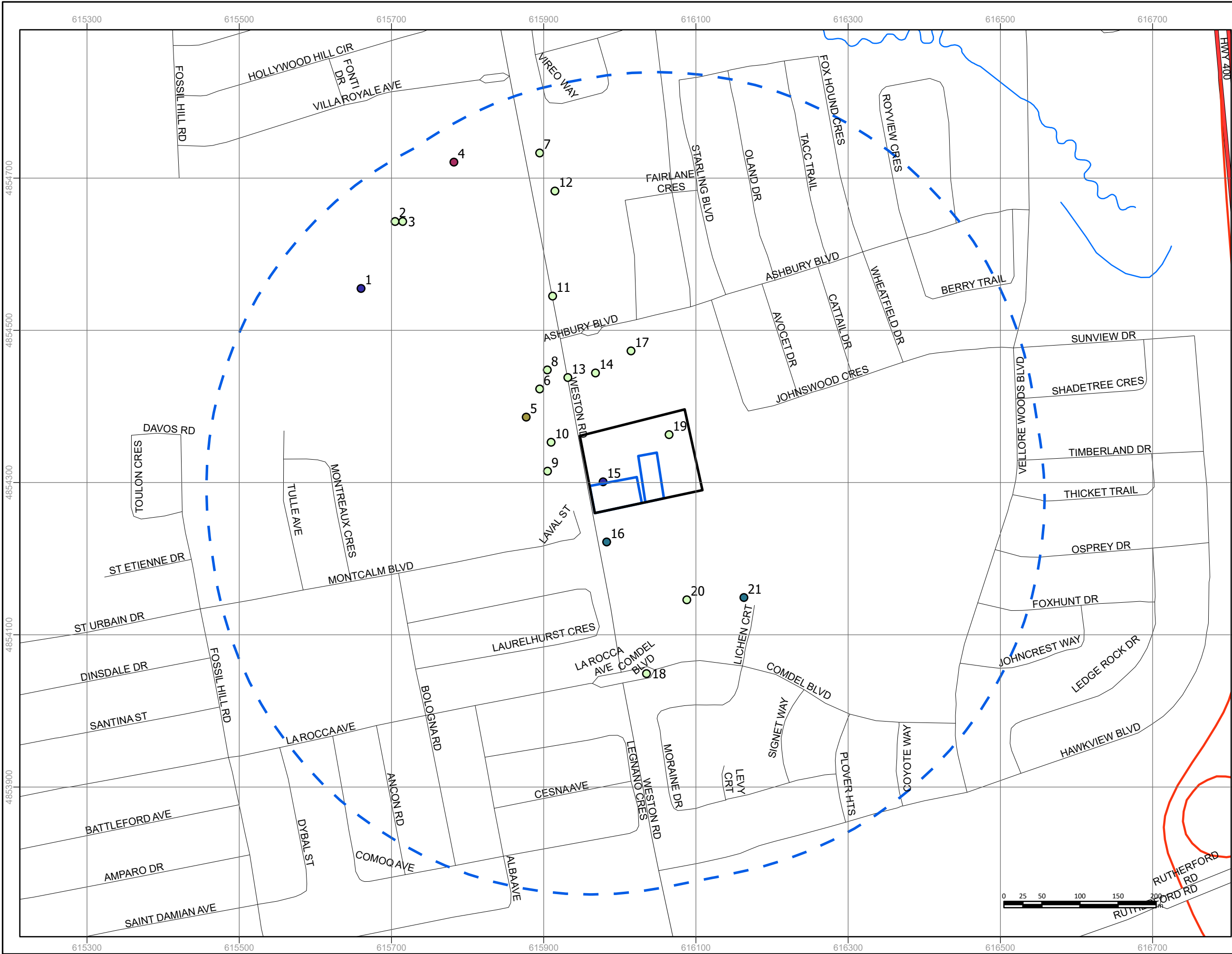
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**Figure Title:**

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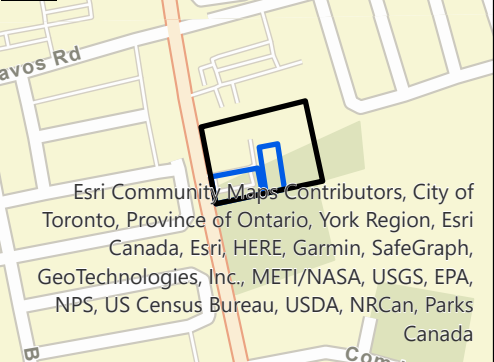
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<b>Date:</b> January 2022	



References:

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Key Map



Notes:

Legend:

- Approximate Site Boundary
- Approximate Study Area
- Approximate Study Area; 500m
- Water Course
- Collector
- Freeway
- Local / Street
- Ramp
- Unknown
- Abandoned-Other
- Monitoring and Test Hole
- Test Hole
- Water Supply

Project Title:

Hydrogeological Assessment

Site Location:

9541 Weston Road, Vaughan, Ontario

Figure Title:

MECP Well Records Map

Designed By:

AN

File No.:

1-21-0843-46

Drawn By:

SSK

Scale:

As Shown

Reviewed By:

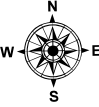
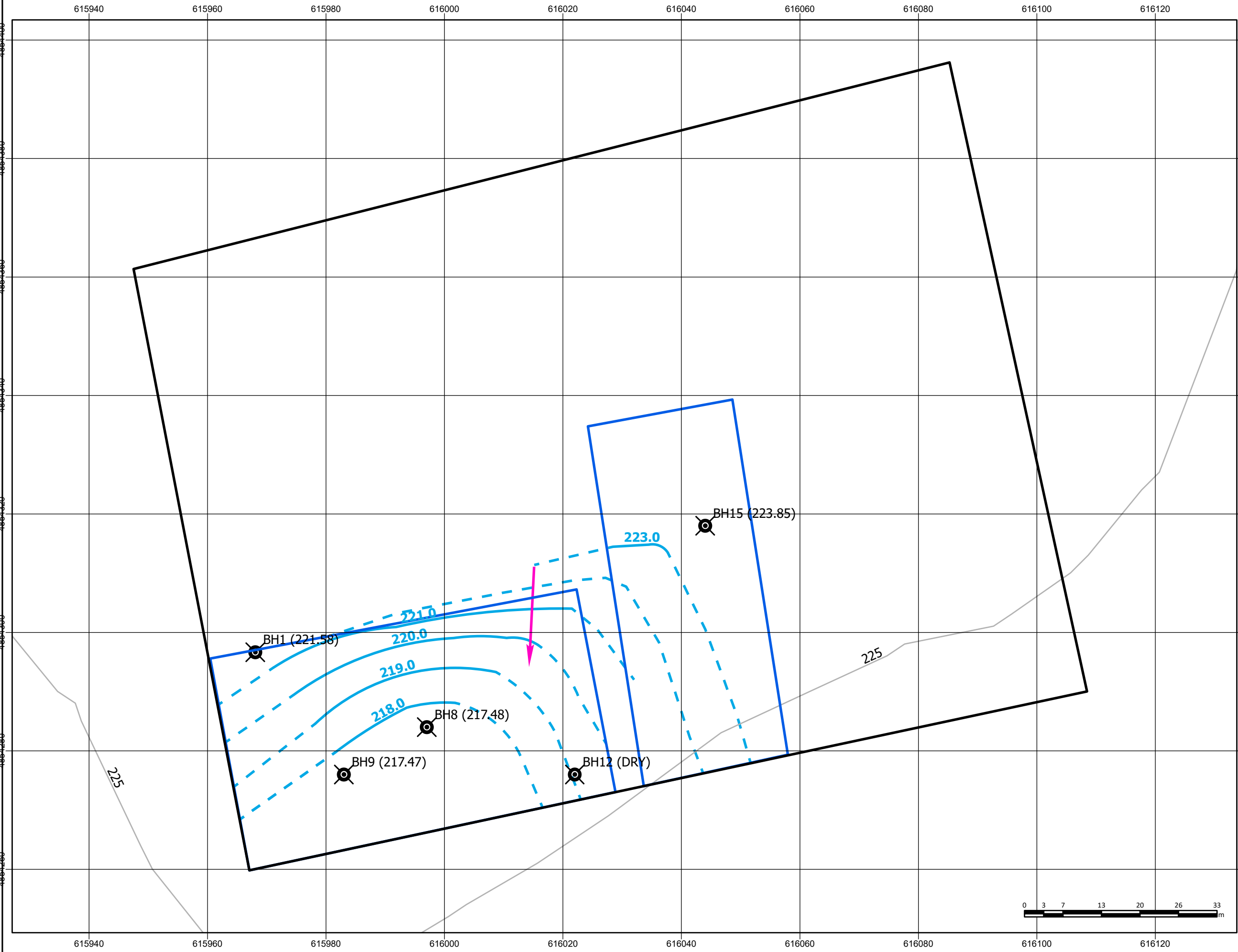
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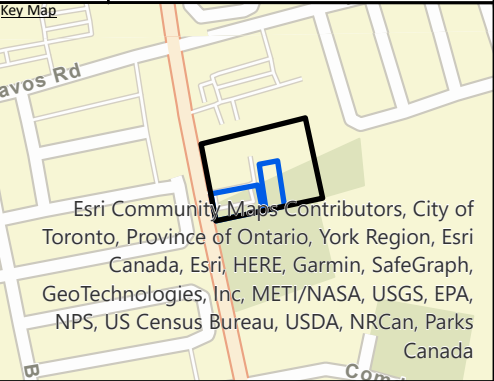
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Date:

January 2022



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**Notes:**

- Legend:**
- Approximate Site Boundary
  - Approximate Study Area
  - Approximate Monitoring Well Location
  - City of Vaughan, Topographic Contours
  - Interpreted Groundwater Contours
  - Inferred Groundwater Contours
  - Interpreted Groundwater Flow Direction

**Project Title:**  
 Hydrogeological Assessment

**Site Location:**  
 9541 Weston Road, Vaughan, Ontario

**Figure Title:**  
 Groundwater Flow Direction

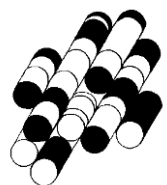
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Reviewed By: BW	Figure No.: 8
Date: January 2022	



# **APPENDIX A**

## **Boreholes and Monitoring Well Logs**

**TERRAPROBE INC.**



# LOG OF BOREHOLE No. BH01

Englobe

Project No. 02112512.000

DRAWING No. BH1

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,296.606 E 615,967.529

Date Drilled: 2022-1-14

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

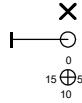


% Strain at Failure

Shear Strength by



Penetrometer Test



GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING LOG	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80					
					Shear Strength kPa	120					
		ASPHALT CONCRETE (110 mm)	225.6	0	50	100	20		SS1		
		SAND AND GRAVEL (Granular Base/Subbase, 180 mm)	225.5		50		7.5				
		SANDY SILT: trace to some clay, brown, moist, loose to compact	225.3								
				1	5		17.5		SS2		
					14		17.6		SS3		
			2.2								
		SILT: trace clay, brown, moist, compact to very dense Gr: 0%, Sa: 0%, Si: 90.7%, Cl: 9.3%	223.4	2	22		14.9		SS4		
				3	62		20.7		SS5		
				4	62		20.8		SS6		
		Terminated at 4.4 m	4.4								
		Borehole advanced using continuous flight solid stem augering equipment on January 14, 2022 by DrillTech Drilling LTD.	221.2								

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

Checked By: A. Rahman

Logged By: P. Jin

Time	Water Level (m)	Depth to Cave (m)
Upon Completion Feb 14, 2022 Feb 24, 2022	Dry Dry 4.0	none

# LOG OF BOREHOLE No. BH02

Englobe

Project No. 02112512.000

DRAWING No. BH2

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,300.325 E 615,988.755

Date Drilled: 2022-1-14

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

% Strain at Failure



Shear Strength by

Penetrometer Test



GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING METHOD	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80	120	160			
		ASPHALT CONCRETE (110 mm)	225.0	0							
		SAND AND GRAVEL (Granular Base/Subbase, 140 mm)	224.9	0.1							
			224.8	0.2							
			224.6	0.4							
		SILTY SAND: brown, moist, compact	224.4	0.6							
		SILT: trace clay, trace sand, brown, moist, compact to dense									
		Gr: 0%, Sa: 0.9%, Si: 91.2%, Cl: 7.9%									
				1							
				2							
				3							
				4							
		Terminated at 4.4 m	220.6	4.4							
		Borehole advanced using continuous flight solid stem augering equipment on January 14, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

Checked By: A. Rahman

Logged By: P. Jin

# LOG OF BOREHOLE No. BH03

Englobe

Project No. 02112512.000

DRAWING No. BH3

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,305.111 E 616,028.716

Date Drilled: 2022-1-14

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at



% Strain at Failure

Shear Strength by



Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING METHOD	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80	120	160			
		ASPHALT CONCRETE (90 mm)	224.9	0							
		SAND AND GRAVEL (Granular Base/Subbase, 120 mm)	224.8								
		SANDY SILT: trace clay, brown, moist, compact to dense	224.7								
				1							
				2							
				3							
				4							
		SILTY SAND: brown, moist, dense to very dense	222.0								
				1							
				2							
				3							
				4							
		Terminated at 4.4 m	220.5								
		Borehole advanced using continuous flight solid stem augering equipment on January 14, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

Checked By: A. Rahman

Logged By: P. Jin

# LOG OF BOREHOLE No. BH04

Englobe

Project No. 02112512.000

DRAWING No. BH4

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,288.738 E 615,980.069

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by  
Vane Test



Natural Moisture Content



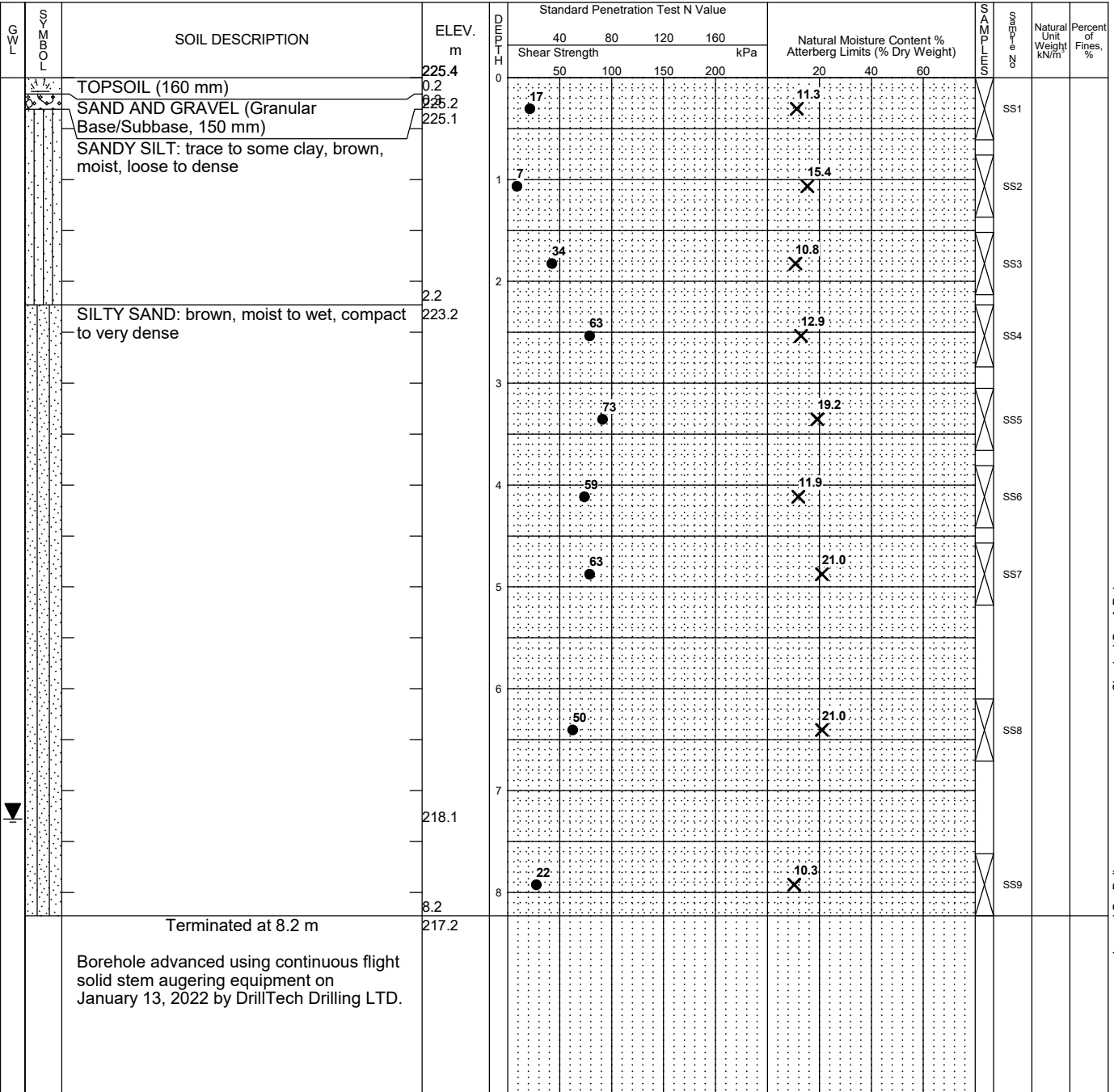
Atterberg Limits



Undrained Triaxial at

% Strain at Failure

Shear Strength by  
Penetrometer Test



Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.3	none



# LOG OF BOREHOLE No. BH05

Englobe

Project No. 02112512.000

DRAWING No. BH5

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,296.052 E 616,010.286

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

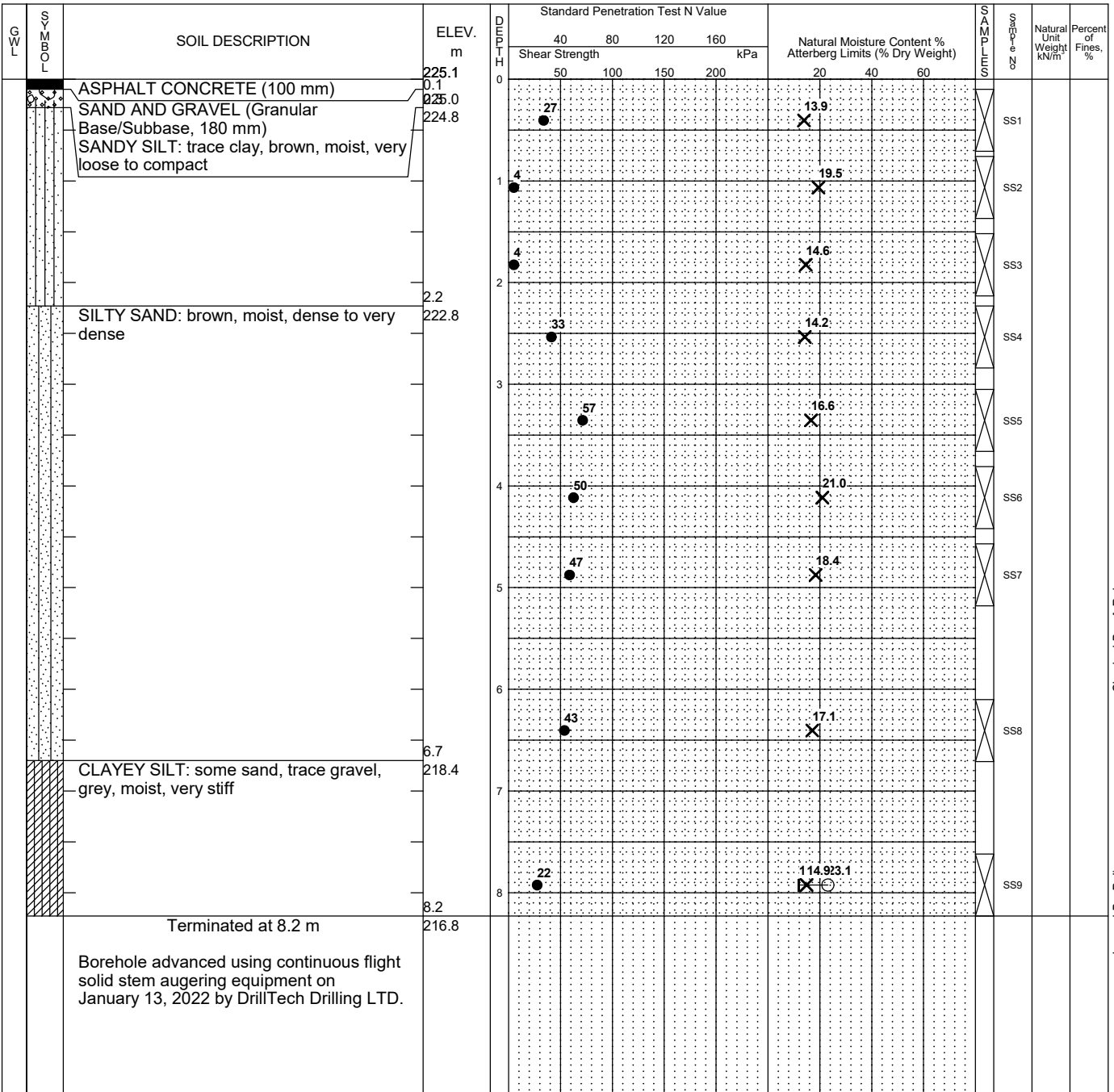
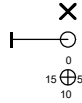


% Strain at Failure

Shear Strength by



Penetrometer Test



Checked By: A. Rahman

Logged By: P. Jin

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH06

Englobe

Project No. 02112512.000

DRAWING No. BH6

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,299.182 E 616,019.578

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

% Strain at Failure



Shear Strength by

Penetrometer Test



0

15

10



GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING LOG	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80					
		ASPHALT CONCRETE (100 mm)	225.0	0	50	100	20		SS1		
		SAND AND GRAVEL (Granular Base/Subbase, 150 mm)	224.9		27		17.8				
		SANDY SILT: trace clay, brown, moist, compact	224.7								
				1	13		10.5		SS2		
				2	22		11.4		SS3		
					25		14.7		SS4		
		SILTY SAND: brown, moist, dense	222.1	3	33		16.6		SS5		
				4	42		12.3		SS6		
				5	40		14.8		SS7		
				6							
					33		18.6		SS8		
		SILTY CLAY: trace gravel, grey, wet, very stiff	218.3	7							
				8	17		115.7.3		SS9		
		Terminated at 8.2 m	216.7								
		Borehole advanced using continuous flight solid stem augering equipment on January 13, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

Checked By: A. Rahman

Logged By: P. Jin

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH07

Englobe

Project No. 02112512.000

DRAWING No. BH7

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,281.299 E 615,973.690

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at



% Strain at Failure

Shear Strength by



Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING SPT	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80	120	160			
		ASPHALT CONCRETE (110 mm)	225.3	0							
		SAND AND GRAVEL (Granular Base/Subbase, 150 mm)	225.2	0.1							
		SANDY SILT: trace to some clay, brown, moist, loose to compact	225.0	0.2	13						
				1	5				15.1		
				2	13				17.5		
				3	32				14.4		
				4	45				14.0		
				5	39				18.6		
		Terminated at 4.4 m	220.9	4.4							
		Borehole advanced using continuous flight solid stem augering equipment on January 13, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

Checked By: A. Rahman

Logged By: P. Jin

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH08

Englobe

Project No. 02112512.000

DRAWING No. BH8

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,284.188 E 615,997.335

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by  
Vane Test



Natural Moisture Content



Atterberg Limits

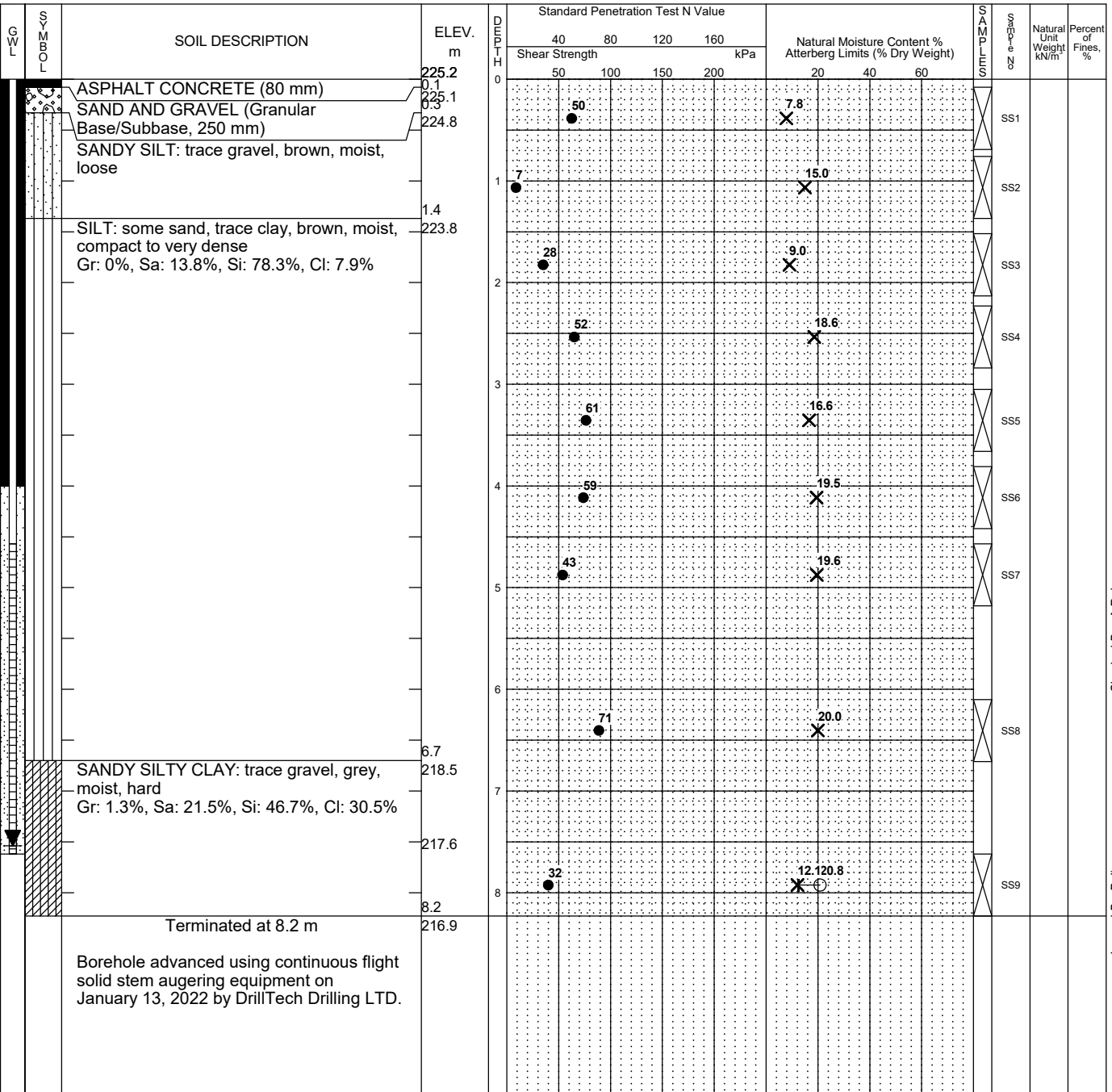


Undrained Triaxial at

% Strain at Failure

Shear Strength by

Penetrometer Test



Checked By: A. Rahman

Logged By: P. Jin

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.6	none
Feb 14, 2022	7.6	
Feb 24, 2022	Dry	

# Englobe

DRAWING No. BH9

Sheet No. 1 of 1

N 4,854,275.648 E 615,983.373

### Split Spoon Sample

Auger Sample

SPT (N) Value

### Dynamic Cone Test

Shelby Tube

### Shear Strength by

## Vane Test

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### Natural Moisture Content


### Atterberg Limits

Undrained Triaxial at

% Strain at Failure

### Shear Strength by

### Penetrometer Test



▲

Checked By: A.Rahman

Logged By: P. Jin

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none
Feb 14, 2022	Dry	
Feb 24, 2022	7.7	

# LOG OF BOREHOLE No. BH10

Englobe

Project No. 02112512.000

DRAWING No. BH10

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,285.523 E 616,013.237

Date Drilled: 2022-1-14

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

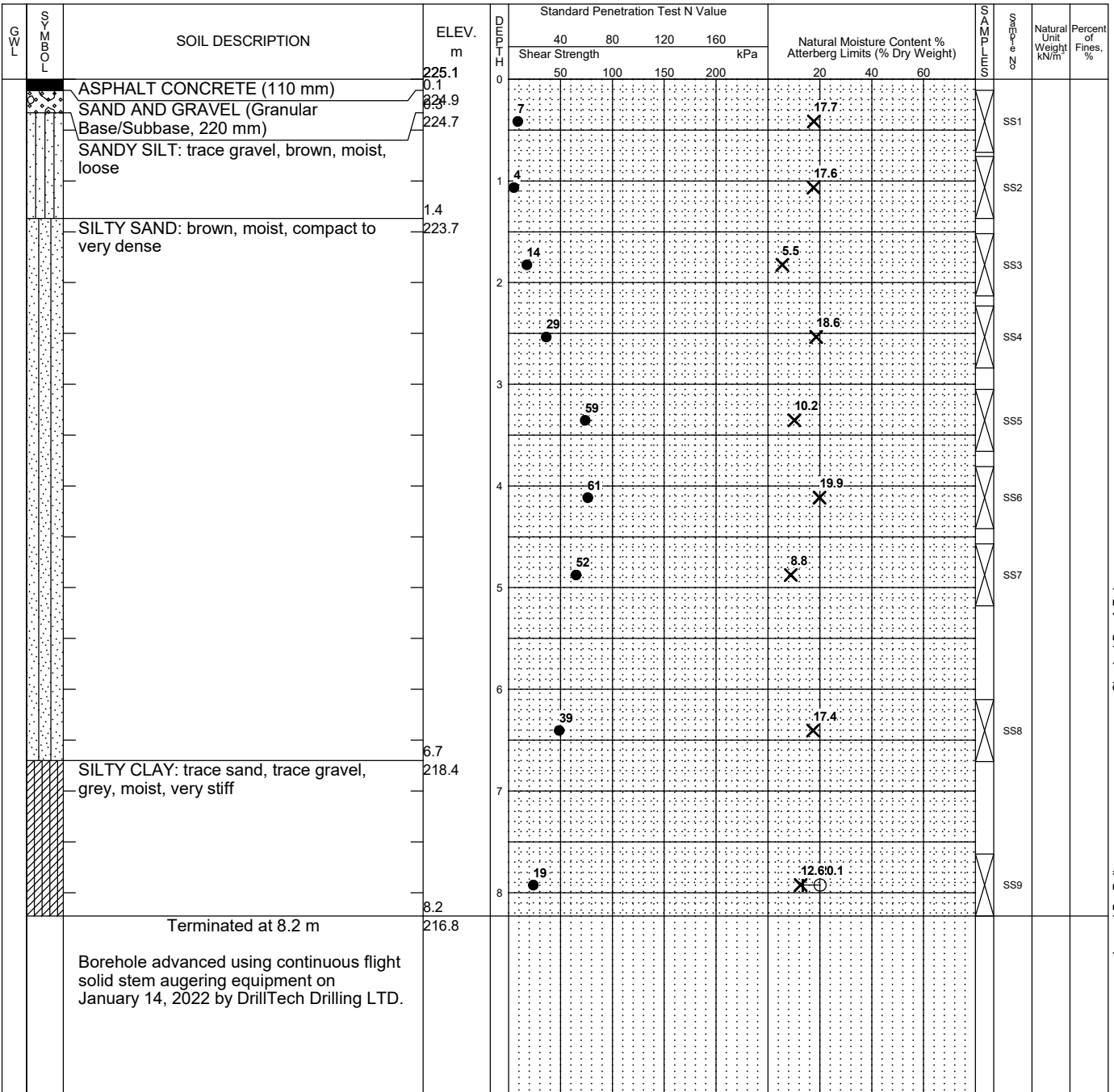
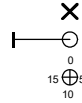


% Strain at Failure

Shear Strength by



Penetrometer Test



Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

Checked By: A. Rahman

Logged By: P. Jin

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH11

Englobe

Project No. 02112512.000

DRAWING No. BH11

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,275.359 E 616,002.160

Date Drilled: 2022-1-21

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

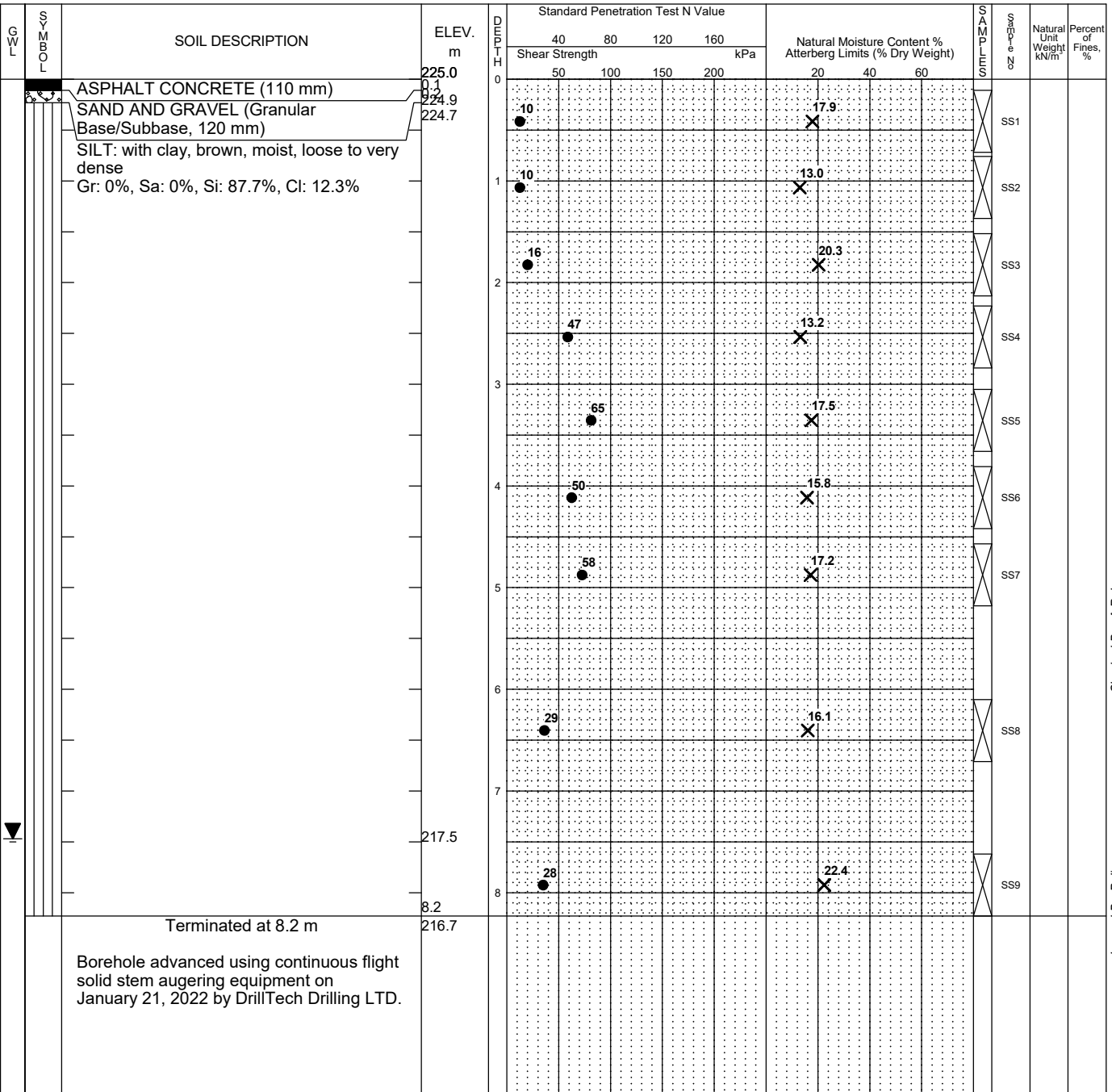


% Strain at Failure

Shear Strength by



Penetrometer Test



Checked By: A. Rahman

Logged By: P. Jin

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.5	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH12

Englobe

Project No. 02112512.000

DRAWING No. BH12

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,275.874 E 616,022.481

Date Drilled: 2022-1-21

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by  
Vane Test



Natural Moisture Content



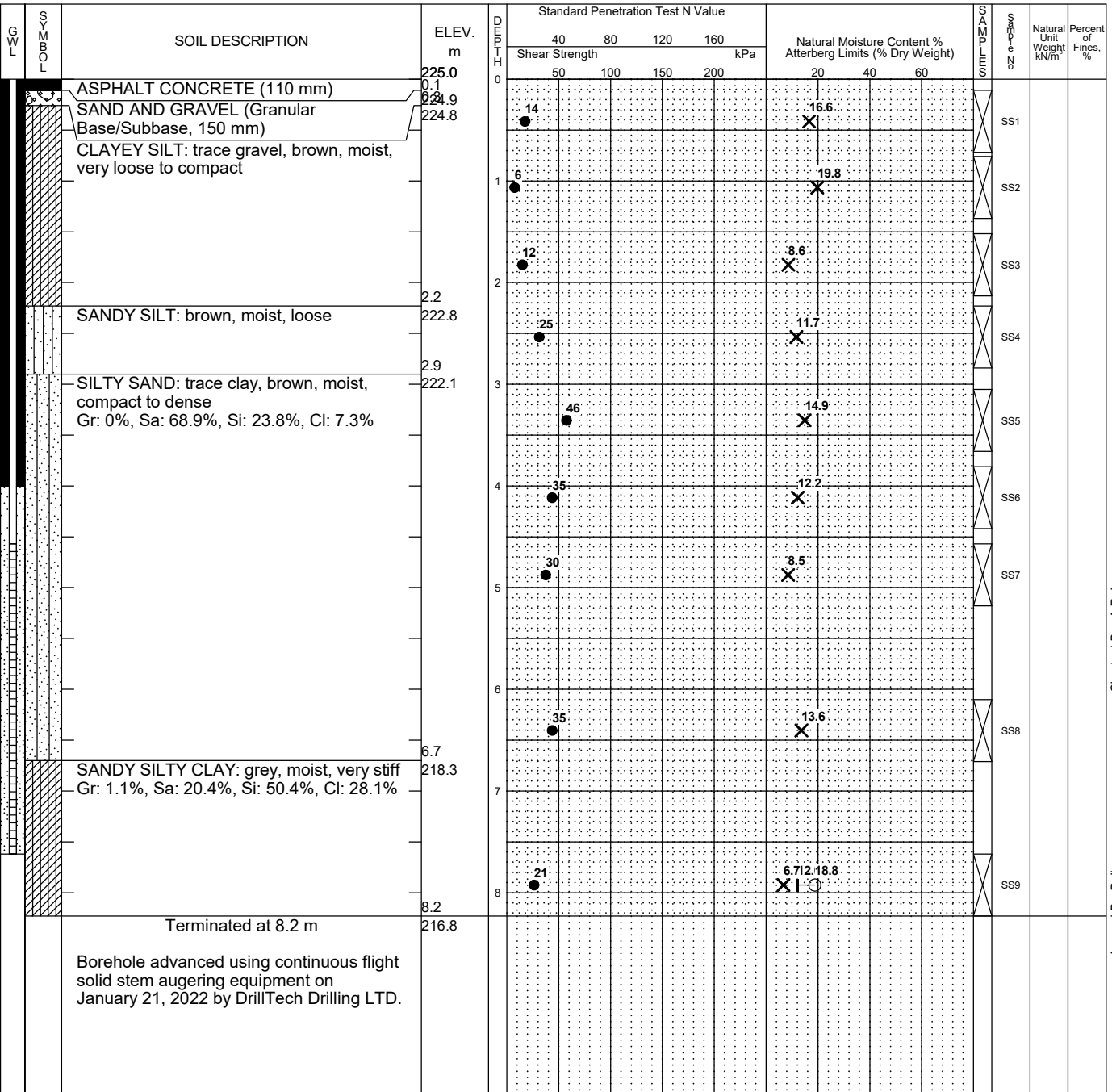
Atterberg Limits



Undrained Triaxial at  
% Strain at Failure



Shear Strength by  
Penetrometer Test



Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none
Feb 14, 2022	Dry	
Feb 24, 2022	7.6	

Checked By: A. Rahman

Logged By: P. Jin



# LOG OF BOREHOLE No. BH13

Englobe

Project No. 02112512.000

DRAWING No. BH13

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,286.170 E 616,050.535

Date Drilled: 2022-1-21

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at



% Strain at Failure



Shear Strength by



Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING LOG	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80	120	160			
		TOPSOIL (200 mm)	225.8	0							
		SAND AND GRAVEL (Granular Base/Subbase, 150 mm)	225.6	0.2							
		SANDY SILTY CLAY: brown, moist, firm to hard Gr: 0.3%, Sa: 25.2%, Si: 43.7%, Cl: 30.8%	225.4	0.4							
				1							
				2							
				3							
				4							
		Terminated at 4.4 m	221.4								
		Borehole advanced using continuous flight solid stem augering equipment on January 21, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

Checked By: A. Rahman

Logged By: P. Jin

# LOG OF BOREHOLE No. BH15

Englobe

Project No. 02112512.000

DRAWING No. BH15

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,317.902 E 616,043.569

Date Drilled: 2022-1-21

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at

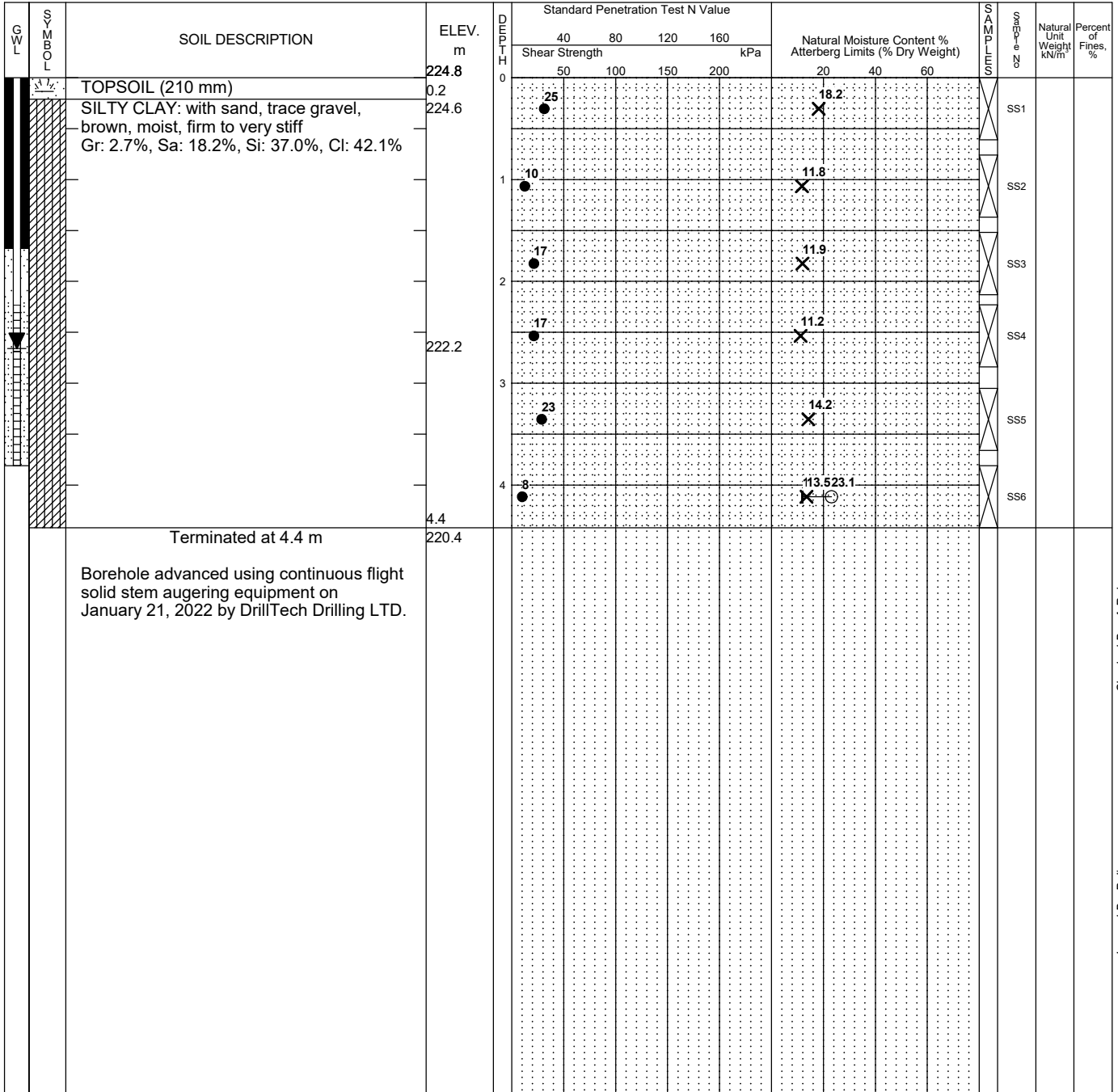


% Strain at Failure

Shear Strength by



Penetrometer Test



Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.7	none
Feb 14, 2022	2.7	
Feb 24, 2022	1.3	

Checked By: A. Rahman

Logged By: P. Jin

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

# LOG OF BOREHOLE No. BH16

Englobe

Project No. 02112512.000

DRAWING No. BH16

Project: City of Vaughan Fire Station - 9541 Weston Road, Woodbridge, Ontario

Sheet No. 1 of 1

Location: Refer to Borehole Location Plan

N 4,854,334.484 E 616,039.548

Date Drilled: 2022-1-13

Drill Type: Solid Stem Augers

Datum: Geodetic

Split Spoon Sample



Auger Sample



SPT (N) Value



Dynamic Cone Test



Shelby Tube



Shear Strength by



Vane Test

Natural Moisture Content



Atterberg Limits



Undrained Triaxial at



% Strain at Failure



Shear Strength by



Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH m	Standard Penetration Test N Value		Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLING LOG	Soil Type	Natural Unit Weight kN/m <sup>3</sup>	Percent of Fines, %
					40	80	120	160			
		TOPSOIL (200 mm)	224.9	0	50	100	150	200	20	40	60
		SILTY CLAY: with sand, brown, moist, compact Gr: 0%, Sa: 10.4%, Si: 65.6%, Cl: 24%	224.7	0.2	15				14.6		
				1	15				12.2		
				2	13				12.4		
				3	23				13.5		
				4	22				20.4		
				4.4	16				20.2		
		Terminated at 4.4 m	220.5								
		Borehole advanced using continuous flight solid stem augering equipment on January 13, 2022 by DrillTech Drilling LTD.									

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	none

CLASSIFICATION LOG 02112512.GPJ LOG A GWGL02.GDT 22-3-1

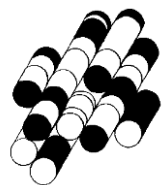
Checked By: A. Rahman

Logged By: P. Jin

# APPENDIX B

**MECP Well Records**

**TERRAPROBE INC.**



## MECP Well Records Summary

WEL L ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Water Found Depth (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use					
1	6925055	Not Known	-	Abandoned-Other	Not Used	-	-	-	-	Tuesday, July 13, 1999
2	6909406	Cable Tool	-	Water Supply	Domestic	30.5	79.3	-	-	Thursday, December 11, 1969
3	6906779	Boring	-	Water Supply	Domestic	3.05	3.05	-	-	Wednesday, October 8, 1958
4	7257448	Rotary (Convent.)	6.1	Monitoring and Test Hole	Monitoring and Test Hole	-	5.795	4.575	6.1	Wednesday, December 2, 2015
5	7276114	-	-	-	-	-	-	-	-	Friday, May 20, 2016
6	6906780	Jetting	32.94	Water Supply	Domestic	28.975	28.365	31.415	32.94	Friday, May 28, 1948
7	6914407	Rotary (Convent.)	23.49	Water Supply	Livestock	13.115	15.25	22.57	23.485	Monday, November 14, 1977
8	6906778	Jetting	23.49	Water Supply	Domestic	16.775	21.96	21.96	23.485	Tuesday, October 16, 1962
9	6921136	Rotary (Convent.)	25.93	Water Supply	Domestic	13.725	19.825	25.01	25.925	Tuesday, January 17, 1989
10	6906777	Cable Tool	35.08	Water Supply	Domestic	14.64	32.635	33.855	35.075	Thursday, August 3, 1967
11	6906660	Cable Tool	30.5	Water Supply	Domestic	12.2	30.5	29.28	30.5	Monday, June 10, 1957
12	6914396	Rotary (Convent.)	33.25	Water Supply	Domestic	14.335	30.5	32.33	33.245	Thursday, October 6, 1977
13	6906659	Cable Tool	27.45	Water Supply	Domestic	15.86	26.23	26.23	27.45	Monday, May 2, 1960
14	6921482	Rotary (Convent.)	33.86	Water Supply	Domestic	12.81	32.635	32.94	33.855	Monday, April 2, 1990
15	6925576	Not Known	-	Abandoned-Other	Not Used	-	-	-	-	Tuesday, August 1, 2000
16	6906658	Rotary (Convent.)	-	Test Hole	-	-	-	-	-	Wednesday, August 19, 1964
17	6913822	Rotary (Convent.)	28.06	Water Supply	Domestic	14.335	27.45	27.145	28.06	Tuesday, October 26, 1976
18	6919834	Cable Tool	-	Water Supply	Domestic	24.4	66.185	-	-	Friday, September 2, 1988
19	6914229	Boring	-	Water Supply	Domestic	6.1	6.1	-	-	Thursday, September 8, 1977
20	6923108	Rotary (Convent.)	32.03	Water Supply	Domestic	7.93	28.67	30.195	32.025	Wednesday, November 2, 1994
21	7320102	Boring	8.54	Test Hole	Test Hole	-	-	5.49	8.54	Friday, August 3, 2018

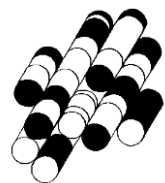
\*MECP WWID: Ministry of the Environment , Conservation and Parks Water Well Records Identification

\*\*metres below ground surface

# **APPENDIX C**

## **Groundwater Monitoring Details**

**TERRAPROBE INC.**



9541 Weston Road, Vaughan

Groundwater Depths (m below ground surface)

Monitoring Well ID	Ground Surface Elevation (masl)	Well Depth (mbgs)	Stick-up (magl)	Top of the Well Screen Depth (mbgs)	1st GW Monitoring Event	2nd GW Monitoring Event	3rd GW Monitoring Event	4th GW Monitoring Event	5th GW Monitoring Event
					Water Depth February 2, 2022 (mbgs)	Water Depth February 14, 2022 (mbgs)	Water Depth February 24, 2022 (mbgs)	Water Depth March 7, 2022 (mbgs)	Water Depth March 9, 2022 (mbgs)
BH1	225.59	4.03	-	1.03	Dry	Dry	4.00	4.01	4.01
BH8	225.16	7.79	-	4.79	Dry	7.57	Dry	7.68	7.62
BH9	225.16	7.85	-	4.85	Dry	Dry	7.73	7.69	7.76
BH12	225.02	7.69	-	4.69	Dry	Dry	7.57	Dry	Dry
BH15	224.85	4.17	0.82	1.17	2.71	2.69	1.29	1.00	1.18

Groundwater Elevations (m above sea level)

Monitoring Well ID	Ground Surface Elevation (masl)	Well Screen Bottom Elevation (masl)	Top of the Riser Elevation (masl)	Top of the Well Screen Depth (masl)	1st GW Monitoring Event	2nd GW Monitoring Event	3rd GW Monitoring Event	4th GW Monitoring Event	4th GW Monitoring Event
					Groundwater Elevation February 2, 2022 (masl)	Groundwater Elevation February 14, 2022 (masl)	Groundwater Elevation February 24, 2022 (masl)	Groundwater Elevation March 7, 2022 (masl)	Groundwater Elevation March 9, 2022 (masl)
BH1	225.59	221.56	-	224.56	Dry	Dry	221.59	221.58	221.58
BH8	225.16	217.37	-	220.37	Dry	217.59	Dry	217.48	217.54
BH9	225.16	217.31	-	220.31	Dry	Dry	217.43	217.47	217.40
BH12	225.02	217.33	-	220.33	Dry	Dry	217.45	Dry	Dry
BH15	224.85	220.68	225.67	223.68	222.14	222.16	223.56	223.85	223.67

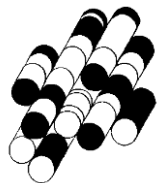
Note: mbgs - metres below ground surface

masl - metres above sea level

# APPENDIX D

## In-situ Hydraulic Conductivity Test Results

**TERRAPROBE INC.**







# Terraprobe

## Slug Test Analysis Report

Project: 9541 Weston Road, Vaughan

Number: 1-21-0843-46

Client: City of Vaughan

Location: Vaughan

Slug Test: BH15

Test Well: BH15

Test Conducted by: AA

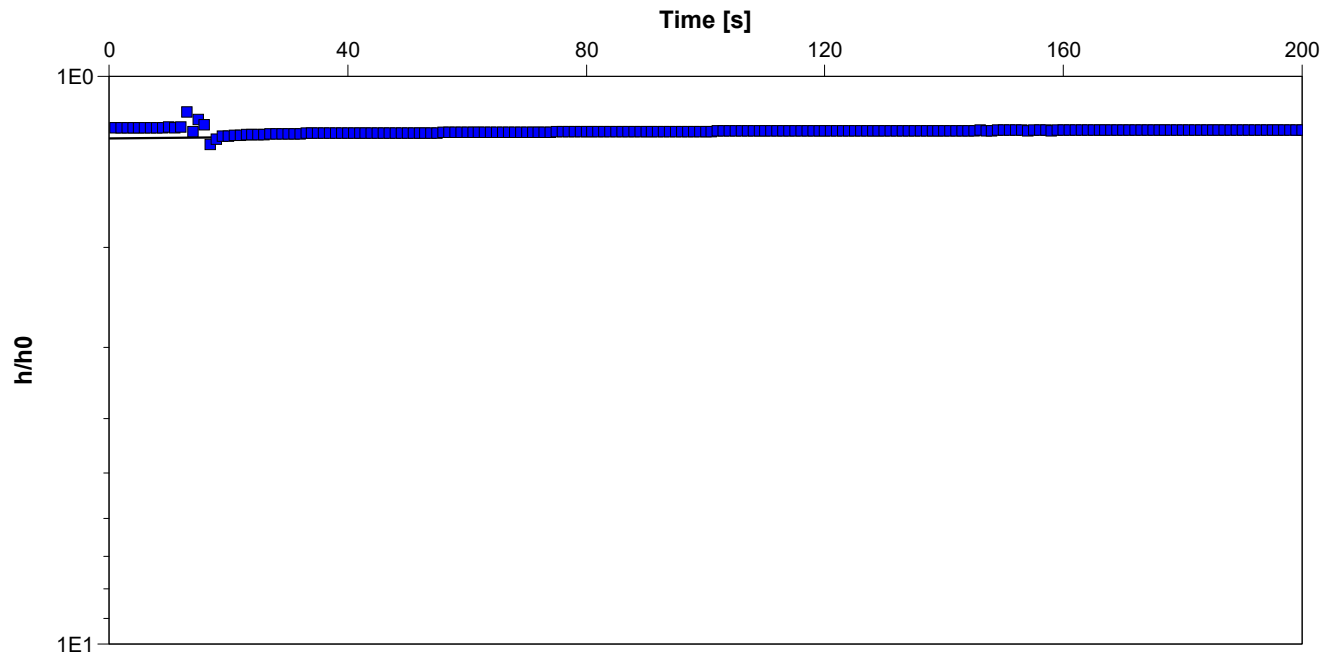
Test Date: 2/24/2022

Analysis Performed by: AN

BH15 - RHT

Analysis Date: 3/1/2022

Aquifer Thickness: 1.40 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity  
[m/s]

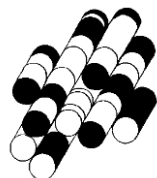
BH15

$1.44 \times 10^{-7}$

# APPENDIX E

## Grain Size Distribution Graphs

**TERRAPROBE INC.**



## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH1\_SS5  
SAMPLING DEPTH, m: 3.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silt trace Clay  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	82.2
37.5	100.0	0.026	67.4
26.5	100.0	0.017	42.4
19.0	100.0	0.010	21.5
13.2	100.0	0.007	13.7
9.5	100.0	0.005	9.3
4.75	100.0	0.003	5.3
2.36	100.0	0.001	2.7
1.18	100.0	ATTERBERG LIMITS, %	
0.60	100.0		
0.30	100.0		
0.15	100.0	Plastic Limit	
0.075	100.0	Liquid Limit	
		Plastic Index	

### GRAIN SIZE PROPORTIONS, %

% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 0.0  
% Silt ( 5 µm to 75 µm): 90.7  
% Clay ( < 5 µm): 9.3  
SUSCEPTIBILITY TO FROST HEAVING: High

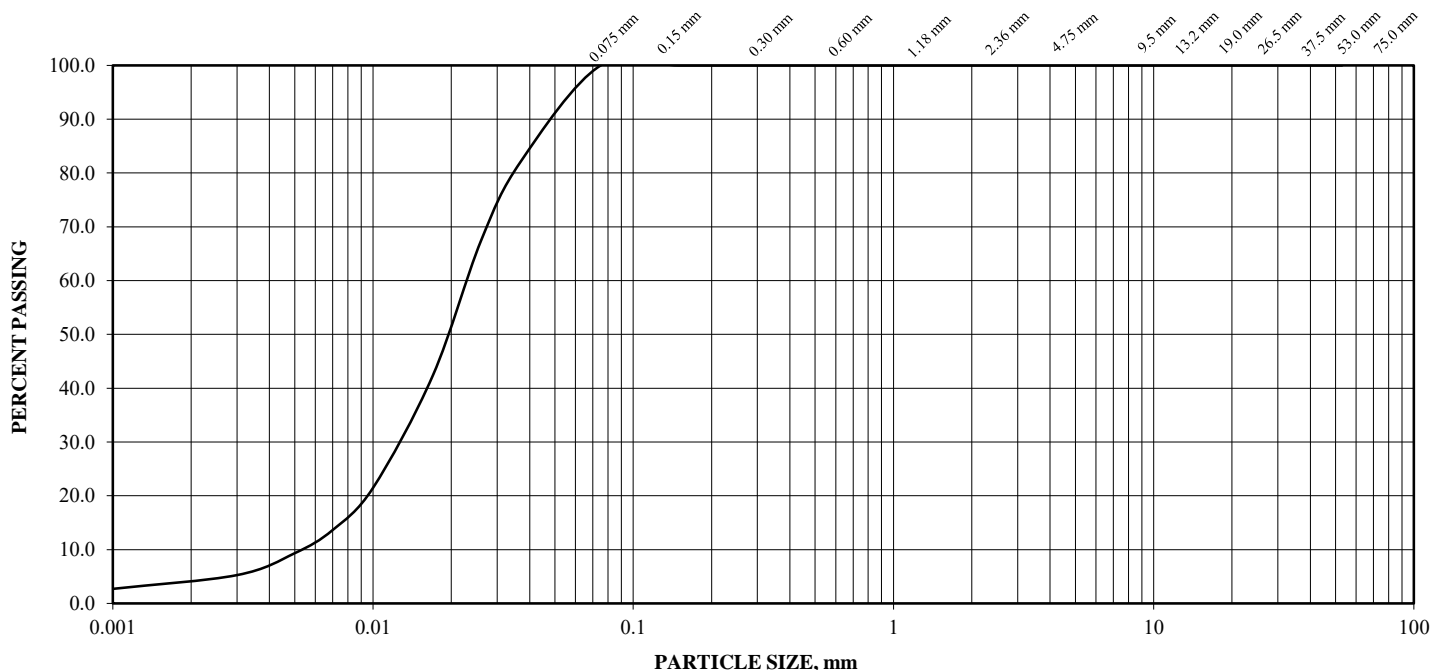
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH2\_SS3  
SAMPLING DEPTH, m: 2.00  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silt trace Clay and Sand  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	75.2
37.5	100.0	0.026	60.1
26.5	100.0	0.017	39.1
19.0	100.0	0.010	20.6
13.2	100.0	0.007	11.8
9.5	100.0	0.005	7.9
4.75	100.0	0.003	4.4
2.36	100.0	0.001	1.8
1.18	100.0	ATTERBERG LIMITS, %	
0.60	100.0		
0.30	100.0		
0.15	100.0	Plastic Limit	
0.075	99.1	Liquid Limit	
		Plastic Index	

### GRAIN SIZE PROPORTIONS, %

% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 0.9  
% Silt ( 5 µm to 75 µm): 91.2  
% Clay ( < 5 µm): 7.9  
SUSCEPTIBILITY TO FROST HEAVING: High

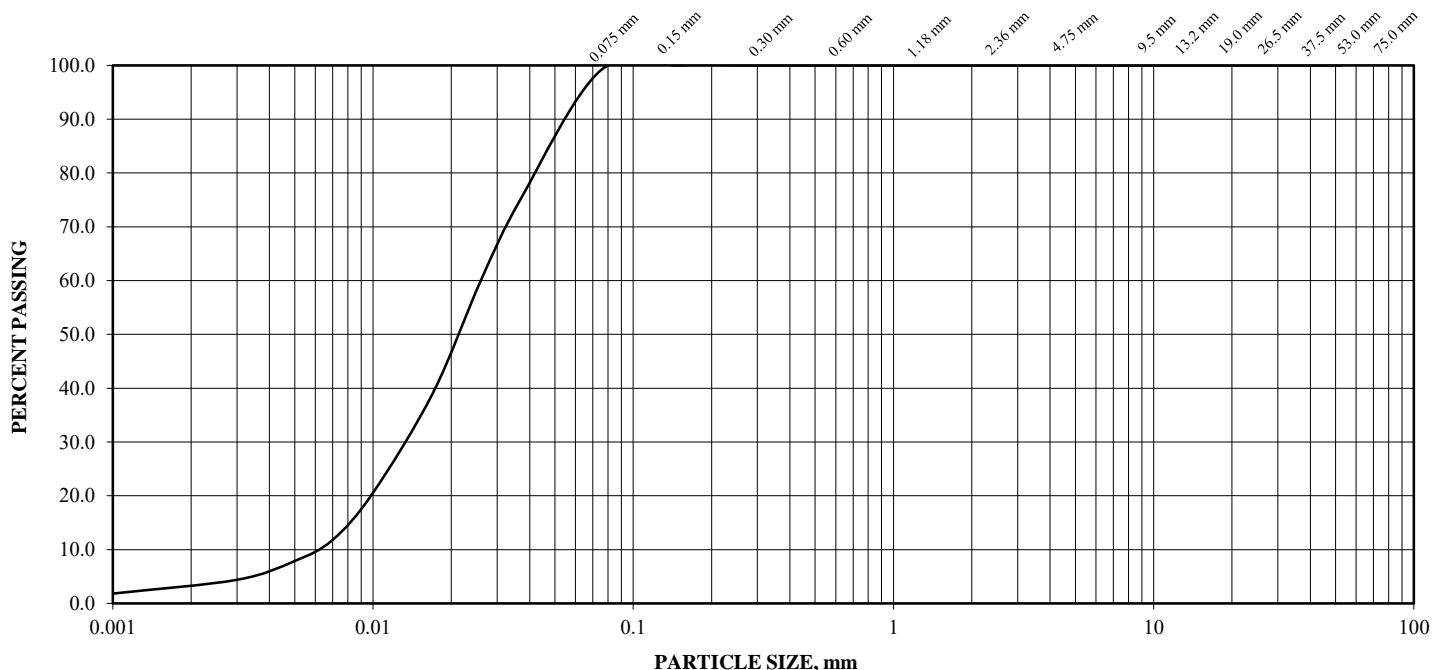
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
------	------	----------------	-----------	-------------	-------------	-------------	--------

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH8\_SS7  
SAMPLING DEPTH, m: 5.00  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silt with Sand trace Clay  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 13.8  
% Silt ( 5 µm to 75 µm): 78.3  
% Clay ( <5 µm): 7.9  
SUSCEPTIBILITY TO FROST HEAVING: High

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	58.5
37.5	100.0	0.026	44.7
26.5	100.0	0.017	31.0
19.0	100.0	0.010	18.7
13.2	100.0	0.007	11.9
9.5	100.0	0.005	7.9
4.75	100.0	0.003	4.5
2.36	100.0	0.001	2.7
1.18	100.0	ATTERBERG LIMITS, %	
0.60	100.0		
0.30	100.0		
0.15	99.4	Plastic Limit	
0.075	86.2	Liquid Limit	
		Plastic Index	

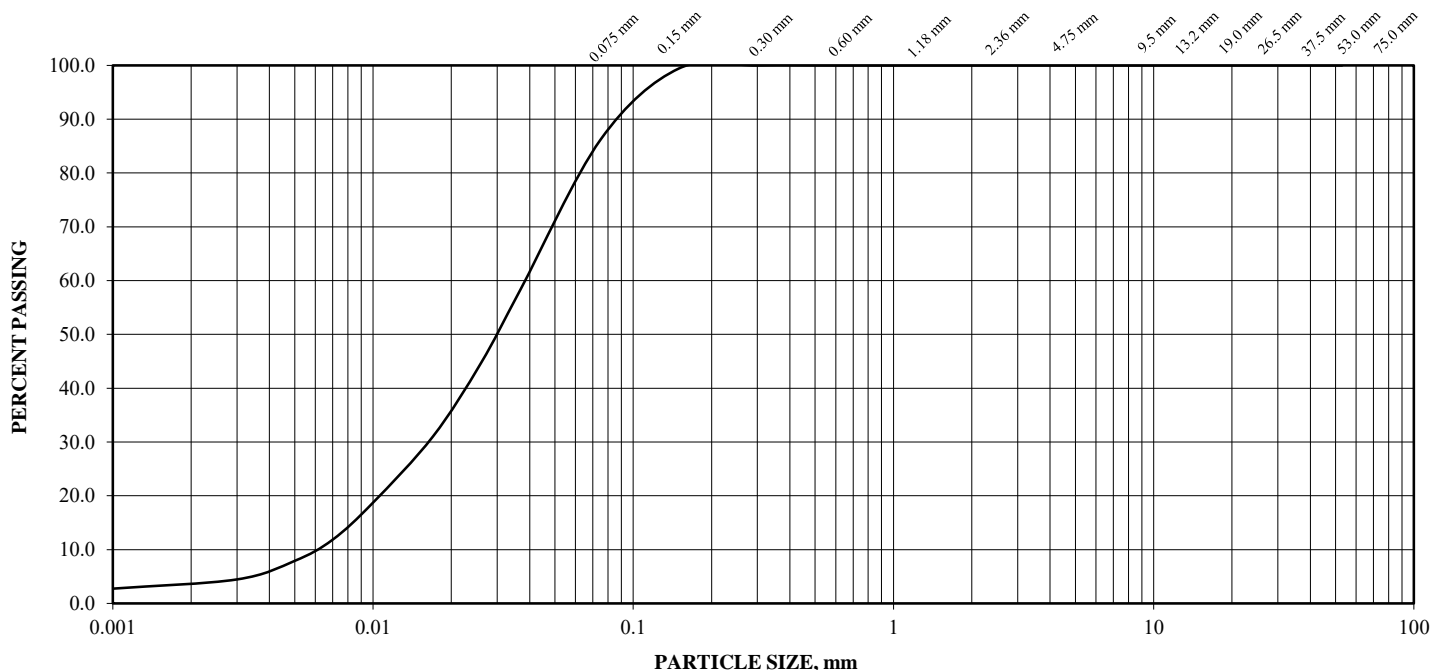
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
------	------	----------------	-----------	-------------	-------------	-------------	--------

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH8\_SS8  
SAMPLING DEPTH, m: 6.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Sandy Silty Clay trace Gravel  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 1.3  
% SAND ( 75 µm to 4.75 mm): 21.5  
% Silt ( 5 µm to 75 µm): 46.7  
% Clay ( < 5 µm): 30.5  
SUSCEPTIBILITY TO FROST HEAVING: Moderate

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	65.9
37.5	100.0	0.026	59.8
26.5	100.0	0.017	52.5
19.0	100.0	0.010	43.1
13.2	100.0	0.007	36.5
9.5	100.0	0.005	30.5
4.75	98.7	0.003	22.3
2.36	97.2	0.001	13.0
1.18	95.5	ATTERBERG LIMITS, %	
0.60	93.2		
0.30	89.7	Plastic Limit	12.4
0.15	84.1	Liquid Limit	20.8
0.075	77.2	Plastic Index	8.4

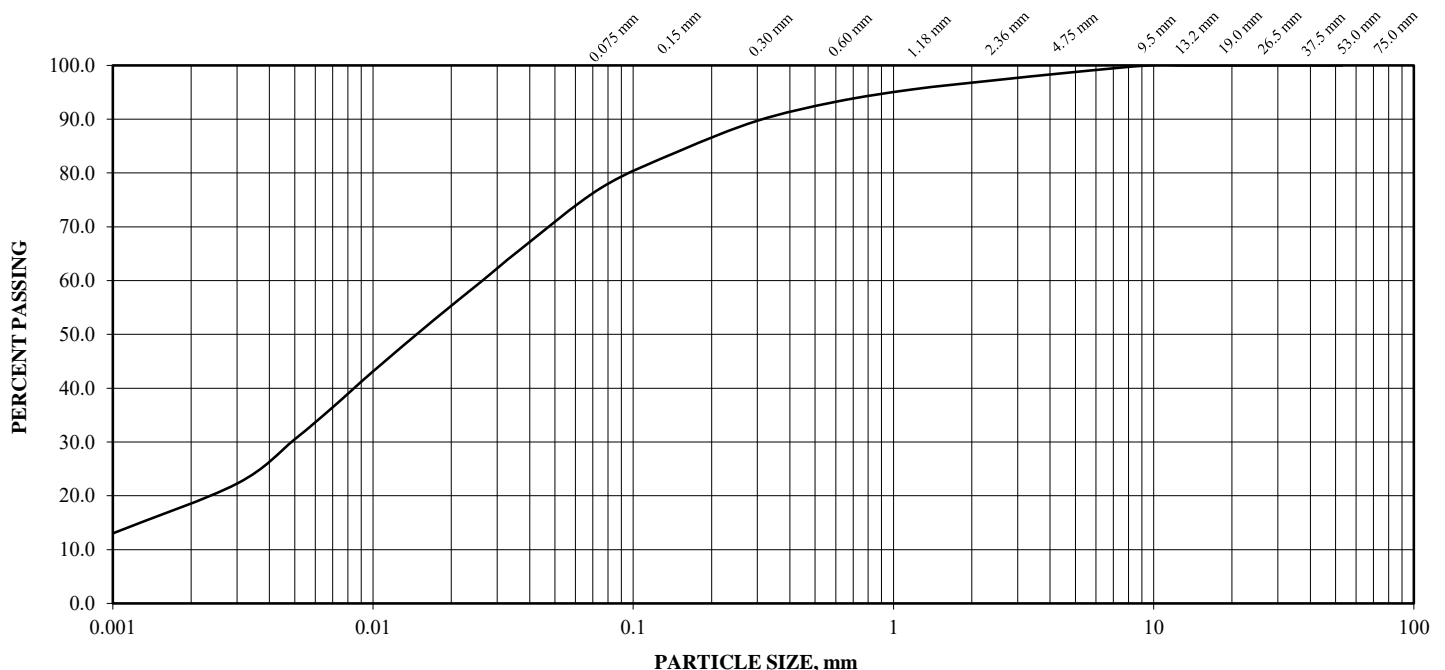
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH9\_SS8  
SAMPLING DEPTH, m: 6.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silty Clay with Sand trace Gravel  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 1.4  
% SAND ( 75 µm to 4.75 mm): 19.2  
% Silt ( 5 µm to 75 µm): 46.0  
% Clay ( < 5 µm): 33.4  
SUSCEPTIBILITY TO FROST HEAVING: Moderate

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	68.7
37.5	100.0	0.026	62.4
26.5	100.0	0.017	54.8
19.0	100.0	0.010	45.0
13.2	100.0	0.007	38.4
9.5	100.0	0.005	33.4
4.75	98.6	0.003	27.3
2.36	97.5	0.001	15.4
1.18	96.7	ATTERBERG LIMITS, %	
0.60	95.6		
0.30	93.4		
0.15	87.3		
0.075	79.4	Plastic Limit	
		Liquid Limit	
		Plastic Index	

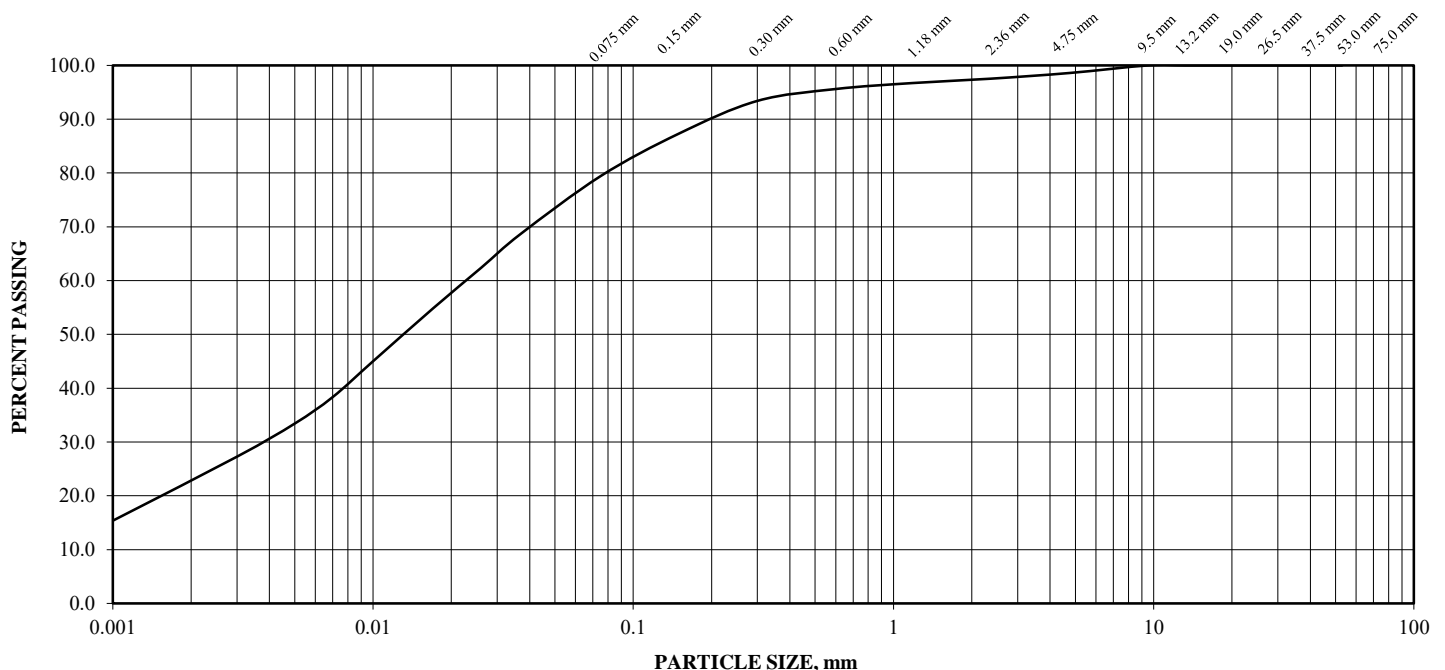
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH10\_SS4  
SAMPLING DEPTH, m: 2.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silt trace Clay and Sand  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 5.5  
% Silt ( 5 µm to 75 µm): 88.0  
% Clay ( <5 µm): 6.5  
SUSCEPTIBILITY TO FROST HEAVING: High

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	54.6
37.5	100.0	0.026	37.3
26.5	100.0	0.017	23.3
19.0	100.0	0.010	13.9
13.2	100.0	0.007	9.1
9.5	100.0	0.005	6.5
4.75	100.0	0.003	4.7
2.36	100.0	0.001	2.9
1.18	100.0	ATTERBERG LIMITS, %	
0.60	100.0		
0.30	100.0		
0.15	100.0	Plastic Limit	
0.075	94.5	Liquid Limit	
		Plastic Index	

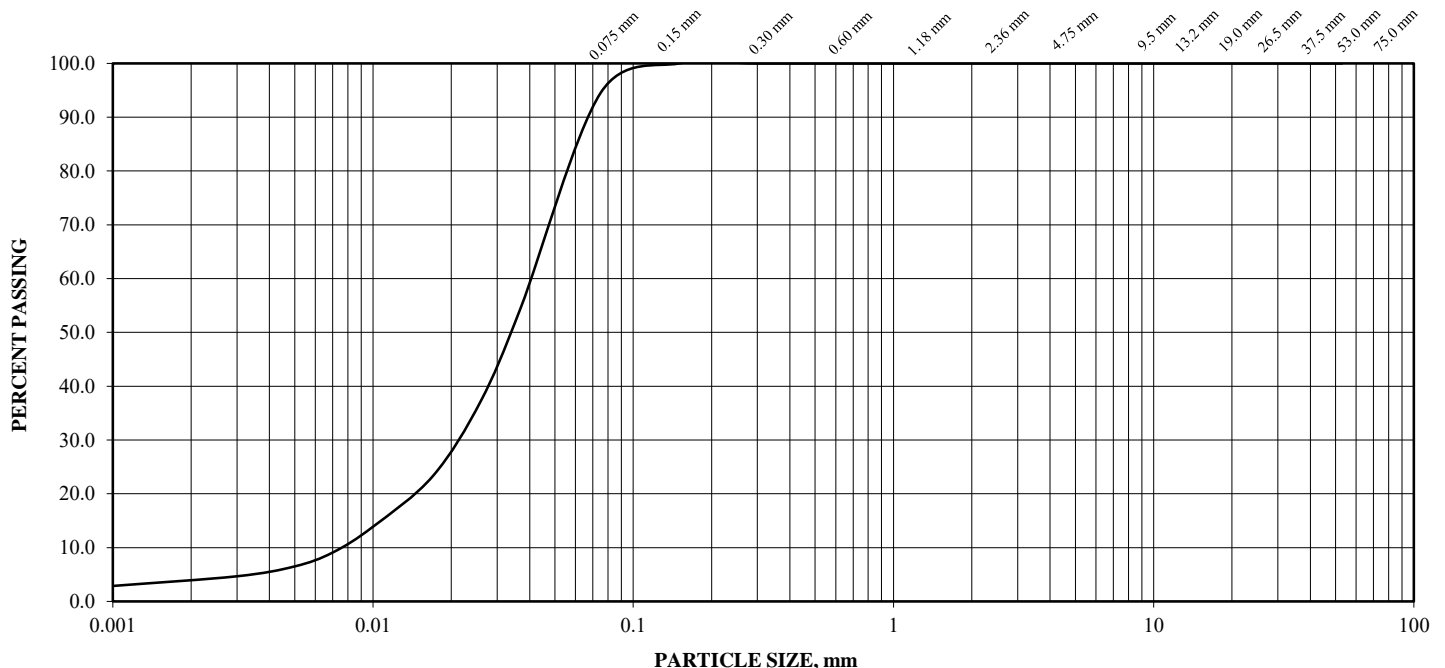
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH11\_SS2  
SAMPLING DEPTH, m: 1.00  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silt with Clay  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	97.7
37.5	100.0	0.026	81.5
26.5	100.0	0.017	60.0
19.0	100.0	0.010	29.7
13.2	100.0	0.007	19.0
9.5	100.0	0.005	12.3
4.75	100.0	0.003	6.3
2.36	100.0	0.001	4.6
1.18	100.0	ATTERBERG LIMITS, %	
0.60	100.0		
0.30	100.0		
0.15	100.0		
0.075	100.0	Plastic Limit	
		Liquid Limit	
		Plastic Index	

### GRAIN SIZE PROPORTIONS, %

% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 0.0  
% Silt ( 5 µm to 75 µm): 87.7  
% Clay ( < 5 µm): 12.3  
SUSCEPTIBILITY TO FROST HEAVING: High

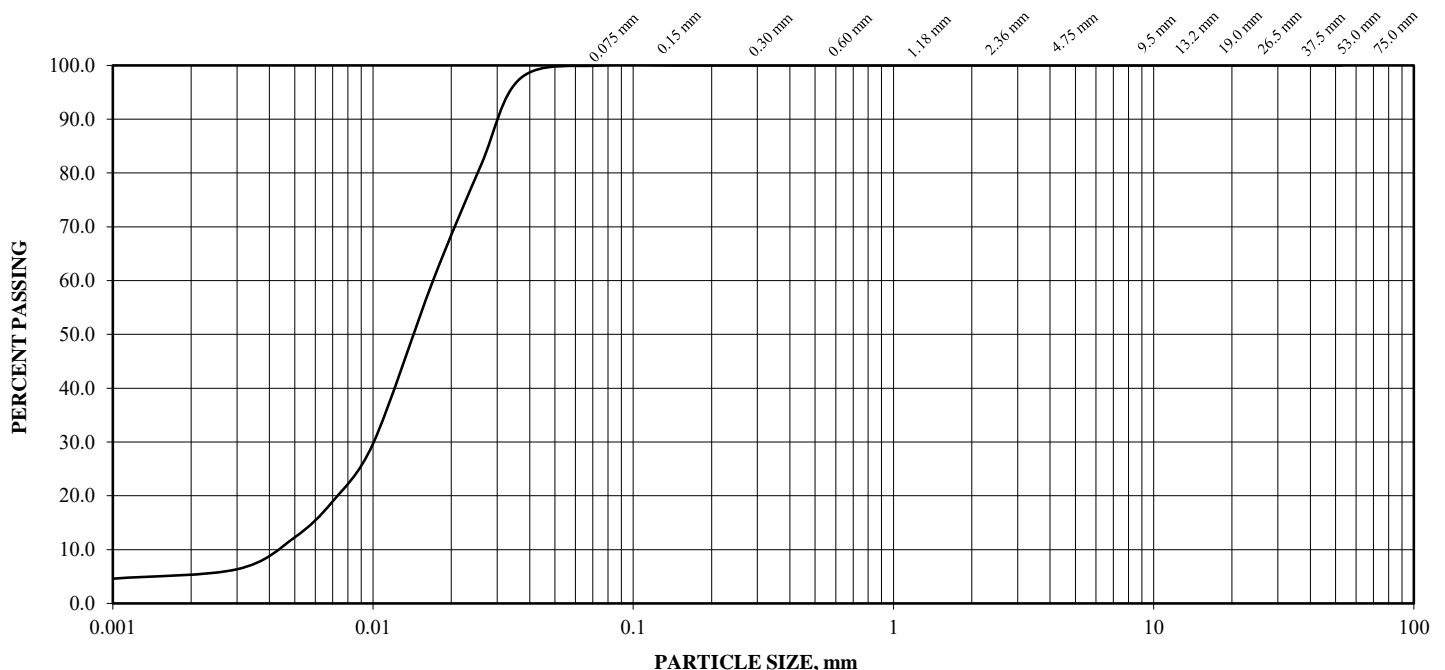
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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#### UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
---------------------	-----------	-------------	-------------	-------------	---------------



## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH12\_SS7  
SAMPLING DEPTH, m: 5.00  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silty Sand trace Clay  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 68.9  
% Silt ( 5 µm to 75 µm): 23.8  
% Clay ( < 5 µm): 7.3  
SUSCEPTIBILITY TO FROST HEAVING: Low

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	20.1
37.5	100.0	0.026	17.0
26.5	100.0	0.017	14.1
19.0	100.0	0.010	10.9
13.2	100.0	0.007	8.9
9.5	100.0	0.005	7.3
4.75	100.0	0.003	5.5
2.36	99.2	0.001	3.7
1.18	98.5	ATTERBERG LIMITS, %	
0.60	97.0		
0.30	88.1		
0.15	56.1	Plastic Limit	
0.075	31.1	Liquid Limit	
		Plastic Index	

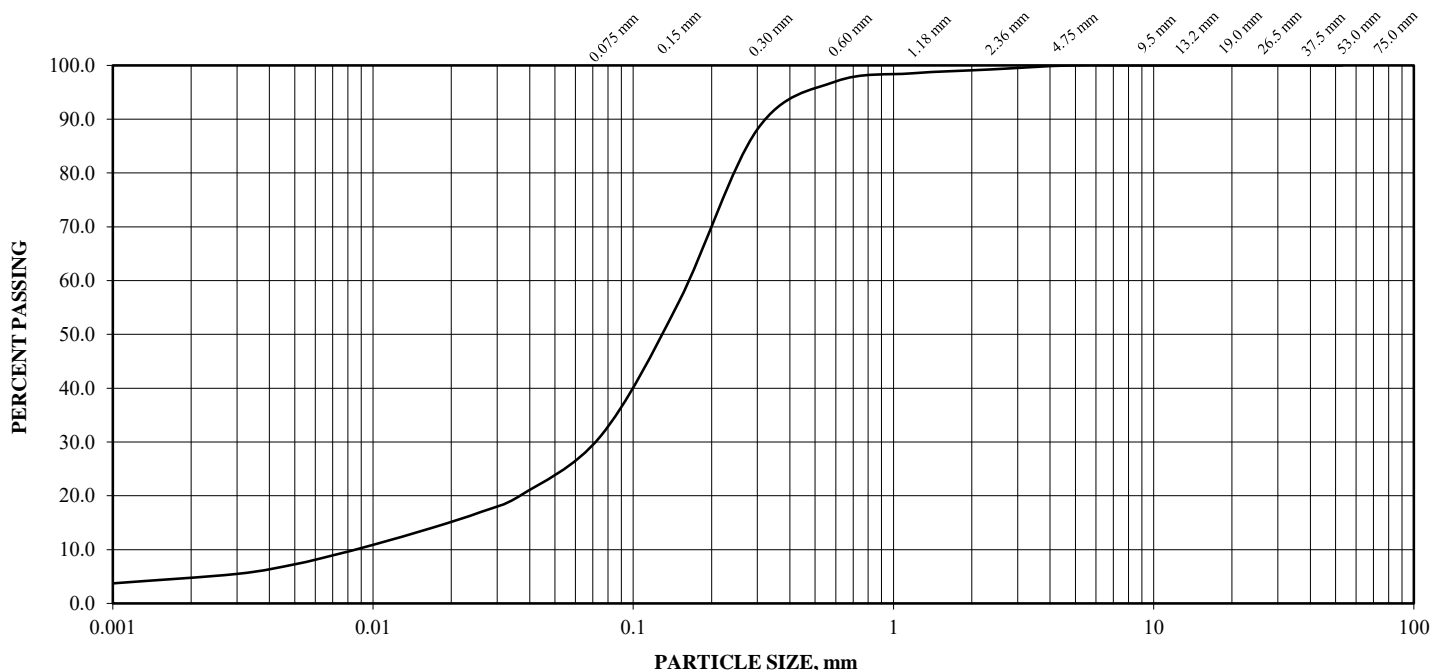
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
------	------	----------------	-----------	-------------	-------------	-------------	--------

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
---------------------	-----------	-------------	-------------	-------------	---------------



## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH12\_SS8  
SAMPLING DEPTH, m: 6.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Sandy Silty Clay trace Gravel  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %

% GRAVEL ( > 4.75 mm): 1.1  
% SAND ( 75 µm to 4.75 mm): 20.4  
% Silt ( 5 µm to 75 µm): 50.4  
% Clay ( < 5 µm): 28.1  
SUSCEPTIBILITY TO FROST HEAVING: Moderate

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	61.5
37.5	100.0	0.026	54.5
26.5	100.0	0.017	47.4
19.0	100.0	0.010	39.0
13.2	100.0	0.007	32.8
9.5	100.0	0.005	28.1
4.75	98.9	0.003	22.1
2.36	97.9	0.001	12.9
1.18	97.2	ATTERBERG LIMITS, %	
0.60	96.5		
0.30	94.2	Plastic Limit	12.0
0.15	88.5	Liquid Limit	18.8
0.075	78.5	Plastic Index	6.8

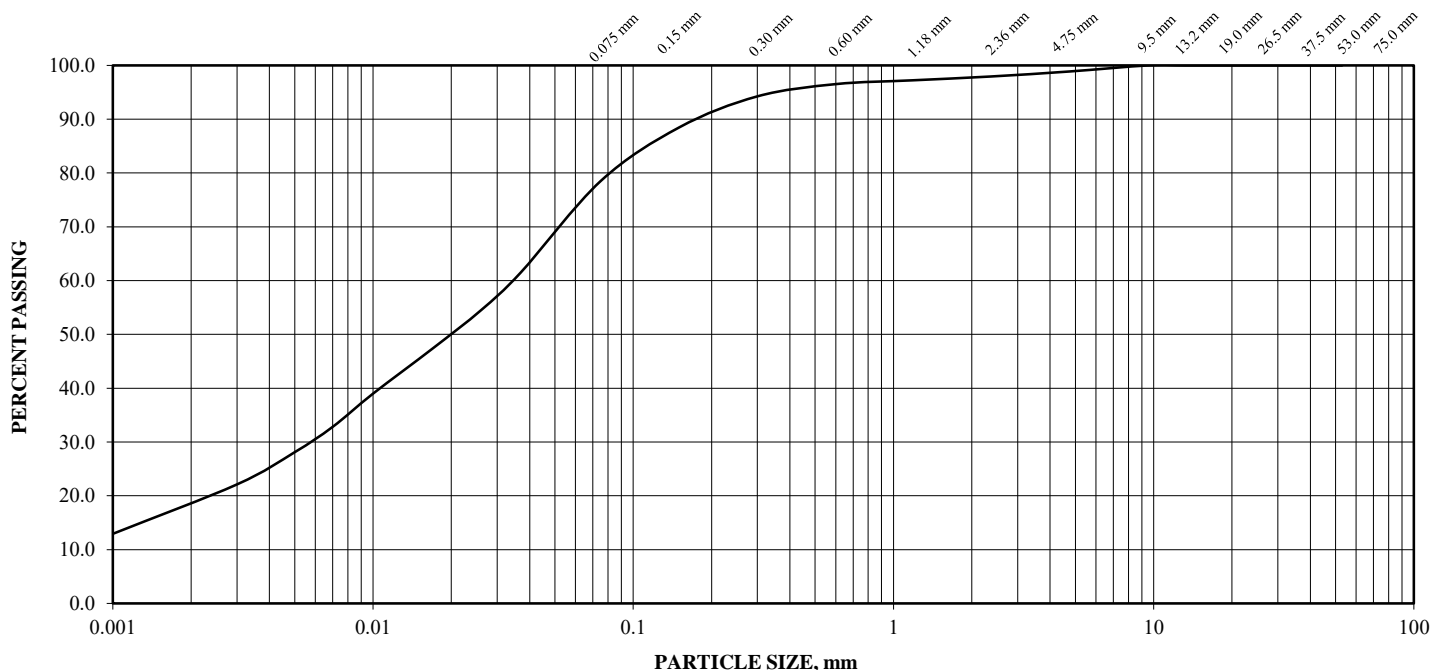
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
------	------	----------------	-----------	-------------	-------------	-------------	--------

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
---------------------	-----------	-------------	-------------	-------------	---------------



## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH13\_SS1  
SAMPLING DEPTH, m: 0.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Sandy Silty Clay trace Gravel  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %

% GRAVEL ( > 4.75 mm): 0.3  
% SAND ( 75 µm to 4.75 mm): 25.2  
% Silt ( 5 µm to 75 µm): 43.7  
% Clay ( < 5 µm): 30.8  
SUSCEPTIBILITY TO FROST HEAVING: Moderate

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	60.2
37.5	100.0	0.026	54.0
26.5	100.0	0.017	47.5
19.0	100.0	0.010	39.7
13.2	100.0	0.007	34.3
9.5	100.0	0.005	30.8
4.75	99.7	0.003	27.1
2.36	99.2	0.001	21.1
1.18	98.7	ATTERBERG LIMITS, %	
0.60	97.7		
0.30	93.8		
0.15	84.9	Plastic Limit	
0.075	74.5	Liquid Limit	
		Plastic Index	

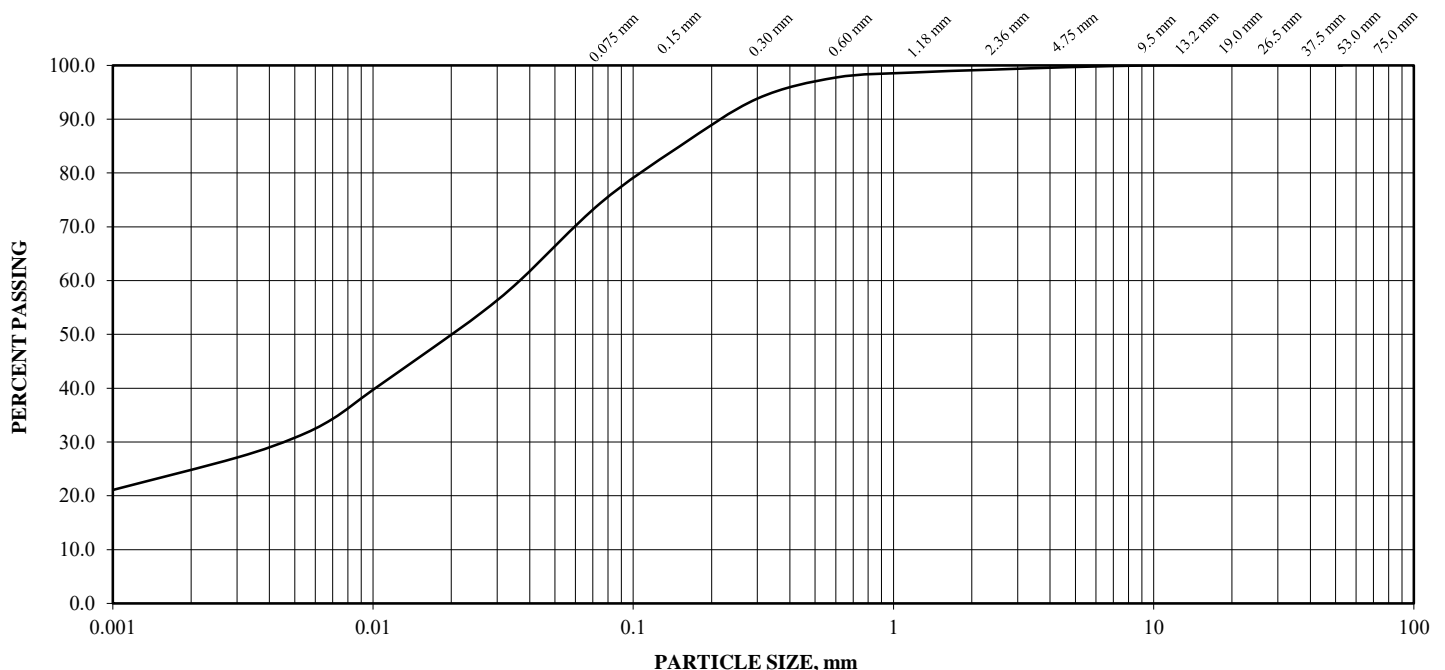
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH15\_SS5  
SAMPLING DEPTH, m: 3.50  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silty Clay with Sand trace Gravel  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 2.7  
% SAND ( 75 µm to 4.75 mm): 18.2  
% Silt ( 5 µm to 75 µm): 37.0  
% Clay ( < 5 µm): 42.1  
SUSCEPTIBILITY TO FROST HEAVING: Low

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	72.2
37.5	100.0	0.026	68.1
26.5	100.0	0.017	62.5
19.0	100.0	0.010	54.6
13.2	100.0	0.007	48.2
9.5	100.0	0.005	42.1
4.75	97.3	0.003	33.8
2.36	96.6	0.001	23.2
1.18	95.4	ATTERBERG LIMITS, %	
0.60	93.9		
0.30	90.5		
0.15	84.9	Plastic Limit	11.9
0.075	79.0	Liquid Limit	23.1
		Plastic Index	11.2

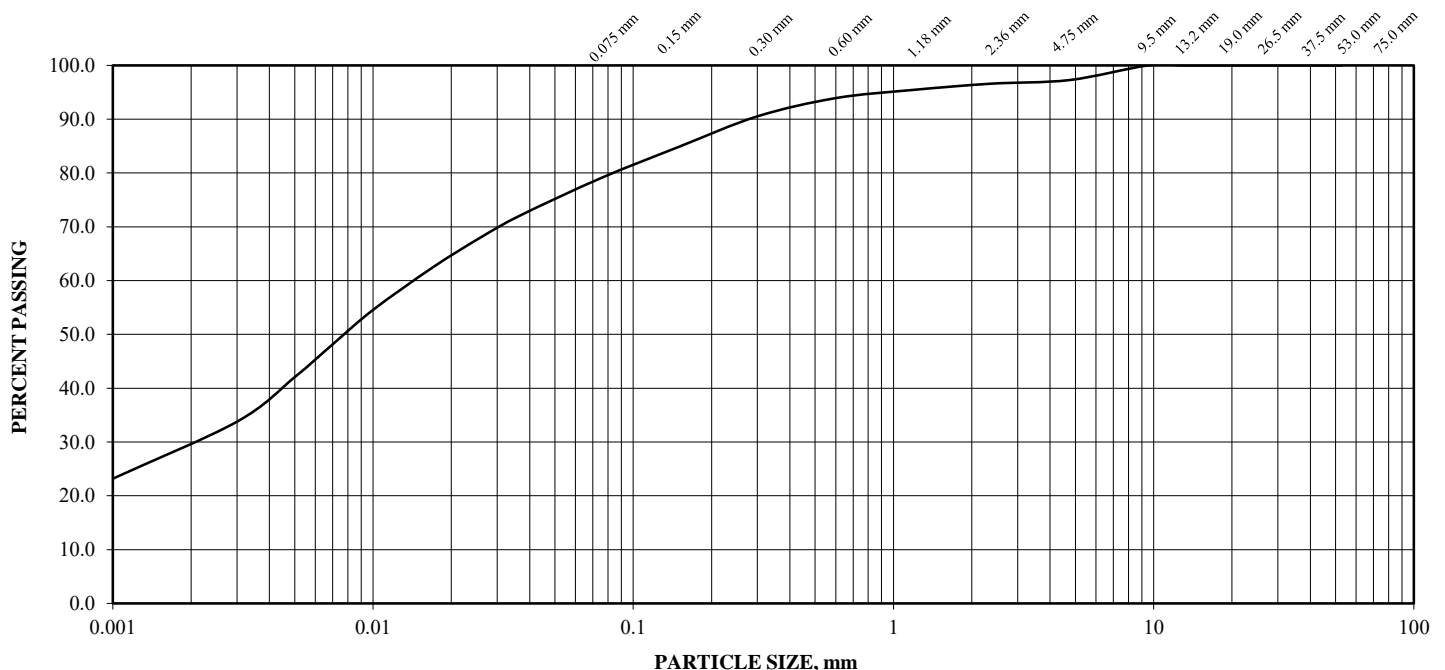
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
------	------	----------------	-----------	-------------	-------------	-------------	--------

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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## GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT MTO LS-602, 702, AND 703/704

PROJECT: 02112512.000 CLIENT/JOB NAME: City of Vaughan CONTRACT NUMBER: -

ROS ID: 101009 PROJECT/LOCATION: Geo. Tech. Investigation / City of Vaughan Fire Station 7-12

SAMPLING LOCATION: BH16\_SS3  
SAMPLING DEPTH, m: 2.00  
SAMPLING METHOD: Split Spoon  
SAMPLED BY: P.J. Englobe Corp  
SAMPLE DESCRIPTION: Silty Clay with Sand  
SAMPLING DATE: 2022-01-21  
SAMPLE RECEIVED DATE: 2022-01-21

GRAIN SIZE PROPORTIONS, %  
% GRAVEL ( > 4.75 mm): 0.0  
% SAND ( 75 µm to 4.75 mm): 10.4  
% Silt ( 5 µm to 75 µm): 65.6  
% Clay ( < 5 µm): 24.0  
SUSCEPTIBILITY TO FROST HEAVING: High

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	72.7
37.5	100.0	0.026	65.0
26.5	100.0	0.017	54.9
19.0	100.0	0.010	41.2
13.2	100.0	0.007	31.1
9.5	100.0	0.005	24.0
4.75	100.0	0.003	16.8
2.36	99.6	0.001	9.3
1.18	99.2	ATTERBERG LIMITS, %	
0.60	98.6		
0.30	97.3		
0.15	95.4	Plastic Limit	
0.075	89.6	Liquid Limit	
		Plastic Index	

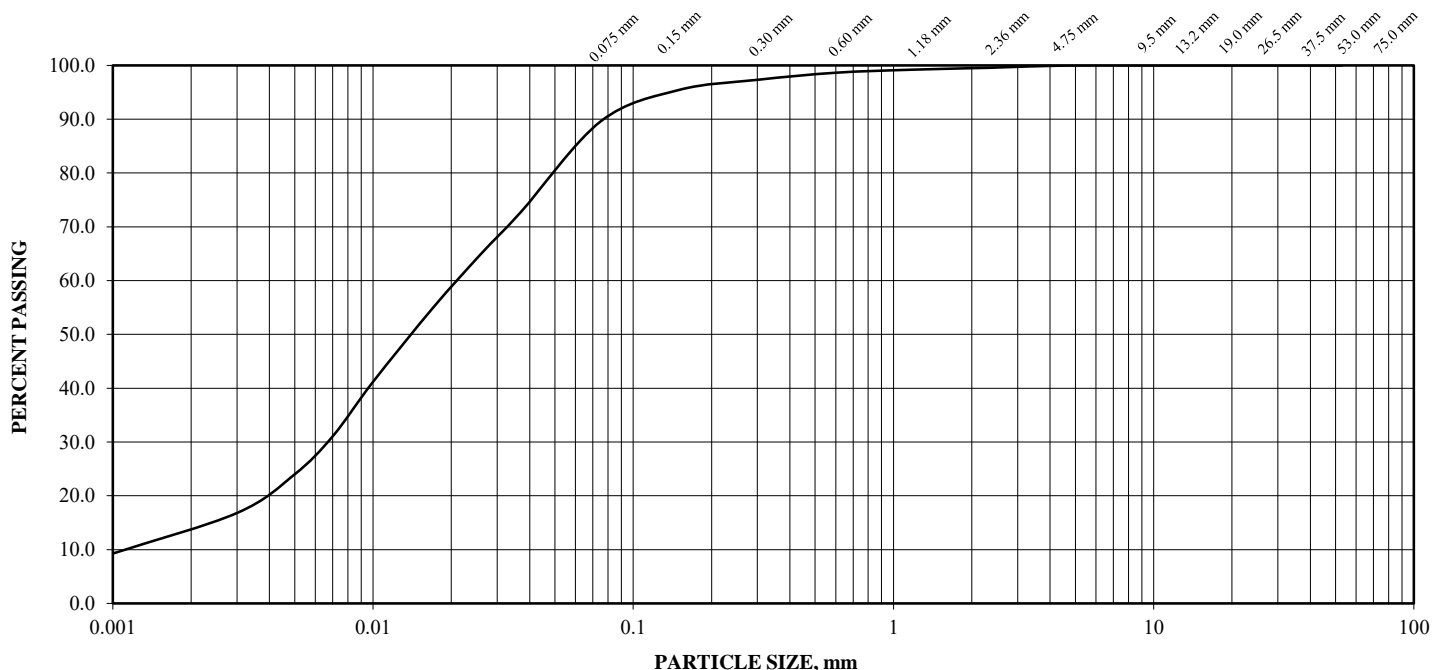
### PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL
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UNIFIED SOILS CLASSIFICATION ASTM D 2487

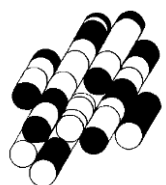
FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL
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# **APPENDIX F**

## **Groundwater Quality Test Results**

**TERRAPROBE INC.**





## FINAL REPORT

CA40166-FEB22 R1

1-21-0843-46, 9541 Weston Rd.

Prepared for

**Terraprobe Inc**





# FINAL REPORT

CA40166-FEB22 R1

## First Page

### CLIENT DETAILS

Client Terraprobe Inc  
Address 11 Indell Lane  
Brampton, ON  
L6T 3Y3, Canada  
Contact Amar Neku  
Telephone (905) 796-2650  
Facsimile (905) 796-2250  
Email aneku@terraprobe.ca  
Project 1-21-0843-46, 9541 Weston Rd.  
Order Number  
Samples Ground Water (1)

### 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 CA40166-FEB22  
Received 02/14/2022  
Approved 02/23/2022  
Report Number CA40166-FEB22 R1  
Date Reported 02/23/2022

### COMMENTS

RL - SGS Reporting Limit

Nonylphenol Ethoxylates is the sum of nonylphenol monoethoxylate and nonylphenol diethoxylate.

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: 024464

Increased O&Gtot RL due to sample matrix

### SIGNATORIES

Brad Moore Hon. B.Sc



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# FINAL REPORT

CA40166-FEB22 R1

**Client:** Terraprobe Inc

**Project:** 1-21-0843-46, 9541 Weston Rd.

**Project Manager:** Amar Neku

**Samplers:** Aloa Alborne

MATRIX: WATER

**Sample Number** 8

**Sample Name** BH15 D  
(unfiltered)

**Sample Matrix** Ground Water

**Sample Date** 14/02/2022

L1 = SANSEW / WATER / - - York - Discharge of Sewage ~ Sanitary Water - BL\_2014\_23

L2 = SANSEW / WATER / - - York - Discharge of Sewage ~ Storm Water - BL\_2014\_23

Parameter	Units	RL	L1	L2	Result
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## General Chemistry

Biochemical Oxygen Demand (BOD5)	mg/L	2	300	15	< 4 ↑
Total Suspended Solids	mg/L	2	350	15	234
Total Kjeldahl Nitrogen	as N mg/L	0.5	100	1	0.7

## Metals and Inorganics

Sulphate	mg/L	0.2	1500		65
Cyanide (total)	mg/L	0.01	2	0.02	0.03
Fluoride	mg/L	0.06	10		1.50
Aluminum (total)	mg/L	0.001	50		4.45
Antimony (total)	mg/L	0.0009	5		< 0.0009
Arsenic (total)	mg/L	0.0002	1	0.02	0.0024
Cadmium (total)	mg/L	0.000003	0.7	0.008	0.000063
Chromium (total)	mg/L	0.00008	2	0.08	0.00724
Cobalt (total)	mg/L	0.000004	5		0.00288
Copper (total)	mg/L	0.0002	3	0.05	0.0077
Lead (total)	mg/L	0.00009	1	0.12	0.00266
Manganese (total)	mg/L	0.00001	5	0.15	0.241
Molybdenum (total)	mg/L	0.00004	5		0.00742
Nickel (total)	mg/L	0.0001	2	0.08	0.0088
Phosphorus (total)	mg/L	0.003	10	0.4	0.185
Selenium (total)	mg/L	0.00004	1	0.02	0.00028
Silver (total)	mg/L	0.00005	5	0.12	0.00009



# FINAL REPORT

CA40166-FEB22 R1

**Client:** Terraprobe Inc

**Project:** 1-21-0843-46, 9541 Weston Rd.

**Project Manager:** Amar Neku

**Samplers:** Aloa Alborne

MATRIX: WATER

**Sample Number** 8

**Sample Name** BH15 D  
(unfiltered)

**Sample Matrix** Ground Water

**Sample Date** 14/02/2022

L1 = SANSEW / WATER / - - York - Discharge of Sewage ~ Sanitary Water - BL\_2014\_23

L2 = SANSEW / WATER / - - York - Discharge of Sewage ~ Storm Water - BL\_2014\_23

Parameter	Units	RL	L1	L2	Result
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## Metals and Inorganics (continued)

Tin (total)	mg/L	0.00006	5		0.00327
Titanium (total)	mg/L	0.00005	5		0.104
Zinc (total)	mg/L	0.002	2	0.04	0.020

## Nonylphenol and Ethoxylates

Nonylphenol	mg/L	0.001	0.02		< 0.001
Nonylphenol Ethoxylates	mg/L	0.01	0.2		< 0.01
Nonylphenol diethoxylate	mg/L	0.01			< 0.01
Nonylphenol monoethoxylate	mg/L	0.01			< 0.01

## Oil and Grease

Oil & Grease (total)	mg/L	2			< 4 †
Oil & Grease (animal/vegetable)	mg/L	4	150		< 4
Oil & Grease (mineral/synthetic)	mg/L	4	15		< 4

## Other (ORP)

pH	No unit	0.05	10.5	9	8.40
Mercury (total)	mg/L	0.00001	0.01	0.0004	< 0.00001



# FINAL REPORT

CA40166-FEB22 R1

**Client:** Terraprobe Inc

**Project:** 1-21-0843-46, 9541 Weston Rd.

**Project Manager:** Amar Neku

**Samplers:** Aloa Alborne

MATRIX: WATER

**Sample Number** 8

**Sample Name** BH15 D  
(unfiltered)

**Sample Matrix** Ground Water

**Sample Date** 14/02/2022

L1 = SANSEW / WATER / - - York - Discharge of Sewage ~ Sanitary Water - BL\_2014\_23

L2 = SANSEW / WATER / - - York - Discharge of Sewage ~ Storm Water - BL\_2014\_23

Parameter	Units	RL	L1	L2	Result
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## PCBs

Polychlorinated Biphenyls (PCBs) - Total	mg/L	0.0001	0.001	0.0004	< 0.0001
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## Phenols

4AAP-Phenolics	mg/L	0.002	1	0.008	0.002
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## SVOCs

di-n-Butyl Phthalate	mg/L	0.002	0.08	0.015	< 0.002
Bis(2-ethylhexyl)phthalate	mg/L	0.002	0.012	0.0088	0.002

## VOCs

Chloroform	mg/L	0.0005	0.04	0.002	< 0.0005
1,2-Dichlorobenzene	mg/L	0.0005	0.05	0.0056	< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005	0.08	0.0068	< 0.0005
cis-1,2-Dichloroethene	mg/L	0.0005	4	0.0056	< 0.0005
trans-1,3-Dichloropropene	mg/L	0.0005	0.14	0.0056	< 0.0005
Methylene Chloride	mg/L	0.0005	2	0.0052	< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.0005	1.4	0.017	< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	1	0.0044	< 0.0005
Trichloroethylene	mg/L	0.0005	0.4	0.008	< 0.0005
Methyl ethyl ketone	mg/L	0.02	8		< 0.02
Styrene	mg/L	0.0005	0.2		< 0.0005



FINAL REPORT

CA40166-FEB22 R1

**Client:** Terraprobe Inc  
**Project:** 1-21-0843-46, 9541 Weston Rd.  
**Project Manager:** Amar Neku  
**Samplers:** Aloa Alborne

MATRIX: WATER

**Sample Number** 8  
**Sample Name** BH15 D  
(unfiltered)  
**Sample Matrix** Ground Water  
**Sample Date** 14/02/2022

L1 = SANSEW / WATER / - - York - Discharge of Sewage ~ Sanitary Water - BL\_2014\_23

L2 = SANSEW / WATER / - - York - Discharge of Sewage ~ Storm Water - BL\_2014\_23

Parameter	Units	RL	L1	L2	Result
VOCs - BTEX					
Benzene	mg/L	0.0005	0.01	0.002	< 0.0005
Ethylbenzene	mg/L	0.0005	0.16	0.002	< 0.0005
Toluene	mg/L	0.0005	0.27	0.002	< 0.0005
Xylene (total)	mg/L	0.0005	1.4	0.0044	< 0.0005
m-p-xylene	mg/L	0.0005			< 0.0005
o-xylene	mg/L	0.0005			< 0.0005



EXCEEDANCE SUMMARY

				SANSEW / WATER / - - York - Discharge of Sewage ~ Sanitary Water - BL_2014_23 L1	SANSEW / WATER / - - York - Discharge of Sewage ~ Storm Water - BL_2014_23 L2
Parameter	Method	Units	Result		

BH15 D (unfiltered)

Total Suspended Solids	SM 2540D	mg/L	234	15
Manganese	SM 3030/EPA 200.8	mg/L	0.241	0.15
Cyanide	SM 4500	mg/L	0.03	0.02



FINAL REPORT

CA40166-FEB22 R1

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
Sulphate	DIO0290-FEB22	mg/L	0.2	<0.2	4	20	99	90	110	84	75	125

Biochemical Oxygen Demand  
Method: SM 5210 | Internal ref.: ME-CA-IENVIEWL-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)	BOD0034-FEB22	mg/L	2	< 2	0	30	99	70	130	NV	70	130

Cyanide by SFA  
Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-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)	SKA0132-FEB22	mg/L	0.01	<0.01	ND	10	104	90	110	88	75	125





FINAL REPORT

CA40166-FEB22 R1

QC SUMMARY

Fluoride by Specific Ion Electrode  
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-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	EWL0260-FEB22	mg/L	0.06	<0.06	6	10	102	90	110	101	75	125

Mercury by CVAAS  
Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-IENVISPE-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)	EHG0030-FEB22	mg/L	0.00001	< 0.00001	ND	20	83	80	120	76	70	130



FINAL REPORT

CA40166-FEB22 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS  
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-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)	EMS0102-FEB22	mg/L	0.00005	<0.00005	2	20	101	90	110	90	70	130
Aluminum (total)	EMS0102-FEB22	mg/L	0.001	<0.001	1	20	95	90	110	116	70	130
Arsenic (total)	EMS0102-FEB22	mg/L	0.0002	<0.0002	11	20	102	90	110	96	70	130
Cadmium (total)	EMS0102-FEB22	mg/L	0.000003	<0.000003	14	20	102	90	110	111	70	130
Cobalt (total)	EMS0102-FEB22	mg/L	0.000004	<0.000004	4	20	102	90	110	101	70	130
Chromium (total)	EMS0102-FEB22	mg/L	0.00008	<0.00008	5	20	105	90	110	114	70	130
Copper (total)	EMS0102-FEB22	mg/L	0.0002	<0.0002	4	20	99	90	110	100	70	130
Manganese (total)	EMS0102-FEB22	mg/L	0.00001	<0.00001	3	20	101	90	110	99	70	130
Molybdenum (total)	EMS0102-FEB22	mg/L	0.00004	<0.00004	1	20	93	90	110	100	70	130
Nickel (total)	EMS0102-FEB22	mg/L	0.0001	<0.0001	4	20	93	90	110	101	70	130
Lead (total)	EMS0102-FEB22	mg/L	0.00009	<0.00001	2	20	102	90	110	103	70	130
Phosphorus (total)	EMS0102-FEB22	mg/L	0.003	<0.003	5	20	92	90	110	NV	70	130
Antimony (total)	EMS0102-FEB22	mg/L	0.0009	<0.0009	ND	20	109	90	110	120	70	130
Selenium (total)	EMS0102-FEB22	mg/L	0.00004	<0.00004	4	20	106	90	110	92	70	130
Tin (total)	EMS0102-FEB22	mg/L	0.00006	<0.00006	7	20	100	90	110	NV	70	130
Titanium (total)	EMS0102-FEB22	mg/L	0.00005	<0.00005	12	20	95	90	110	NV	70	130
Zinc (total)	EMS0102-FEB22	mg/L	0.002	<0.002	6	20	104	90	110	97	70	130



FINAL REPORT

CA40166-FEB22 R1

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	GCM0223-FEB22	mg/L	0.01	<0.01			85	55	120			
Nonylphenol Ethoxylates	GCM0223-FEB22	mg/L	0.01	0								
Nonylphenol monoethoxylate	GCM0223-FEB22	mg/L	0.01	<0.01			87	55	120			
Nonylphenol	GCM0223-FEB22	mg/L	0.001	<0.001			63	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)	GCM0215-FEB22	mg/L	2	<2	NSS	20	98	75	125			



FINAL REPORT

CA40166-FEB22 R1

QC SUMMARY

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | 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 (animal/vegetable)	GCM0215-FEB22	mg/L	4	< 4	NSS	20	NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0215-FEB22	mg/L	4	< 4	NSS	20	NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-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	EWL0241-FEB22	No unit	0.05	NA	0		102			NA		

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-IENVISFA-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	SKA0128-FEB22	mg/L	0.002	<0.002	NV	10	106	80	120	NV	75	125



FINAL REPORT

CA40166-FEB22 R1

QC SUMMARY

Polychlorinated Biphenyls

Method: MOE E3400/EPA 8082A | Internal ref.: ME-CA-IENVIGC-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	GCM0212-FEB22	mg/L	0.0001	<0.0001	ND	30	116	60	140	111	60	140

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-IENVIGC-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	GCM0199-FEB22	mg/L	0.002	< 0.002	NSS	30	119	50	140	NSS	50	140
di-n-Butyl Phthalate	GCM0199-FEB22	mg/L	0.002	< 0.002	NSS	30	112	50	140	NSS	50	140



FINAL REPORT

CA40166-FEB22 R1

QC SUMMARY

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-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	EWL0242-FEB22	mg/L	2	< 2	0	10	100	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-IENVISFA-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	SKA0136-FEB22	as N mg/L	0.5	<0.5	2	10	103	90	110	106	75	125



# FINAL REPORT

CA40166-FEB22 R1

## 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	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	96	60	130	99	50	140
1,2-Dichlorobenzene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	96	60	130	102	50	140
1,4-Dichlorobenzene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	96	60	130	100	50	140
Benzene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	102	50	140
Chloroform	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	97	60	130	100	50	140
cis-1,2-Dichloroethene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	95	60	130	100	50	140
Ethylbenzene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	97	60	130	104	50	140
m-p-xylene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	97	60	130	106	50	140
Methyl ethyl ketone	GCM0221-FEB22	mg/L	0.02	<0.02	ND	30	97	50	140	95	50	140
Methylene Chloride	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	97	50	140
o-xylene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	107	50	140
Styrene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	104	50	140
Tetrachloroethylene (perchloroethylene)	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	104	50	140
Toluene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	97	60	130	103	50	140
trans-1,3-Dichloropropene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	98	60	130	100	50	140
Trichloroethylene	GCM0221-FEB22	mg/L	0.0005	<0.0005	ND	30	97	60	130	103	50	140



# FINAL REPORT

CA40166-FEB22 R1

## 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](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 --



Request for Laboratory Services and CHAIN OF CUSTODY

No. 024464  
Page of

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 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

Received By: Deeth R

Received Date: 02/14/2022 (mm/dd/yy)  
Received Time: 16:45 (hr.: min)

Received By (signature):  
Custody Seal Present: Yes ☒ No ☐  
Custody Seal Intact: Yes ☒ No ☐

Cooling Agent Present: Yes ☐ No ☒  
Temperature Upon Receipt (°C): 6.3

Laboratory Information Section - Lab use only

REPORT INFORMATION

Company: Terraprobe  
Contact: Amar Aneku  
Address: 11 Indellaware, Brampton  
ON, L6T 3Y3  
Phone: 905-264-9393  
Fax:  
Email: aneku@terraprobe.ca

INVOICE INFORMATION

☒ Same as Report Information)  
Company:  
Contact:  
Address:  
Phone:  
Email:

Quotation #:

Project #: 1-21-0843-46

P.O. #:

Site Location/ID: 9541 Weston Rd

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

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

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19  
Table 1 ☐ Res/Park Soil Texture: ☐ Coarse ☐ Medium/Fine  
Table 2 ☐ Ind/Com ☐ Agri/Other ☐ Appx.  
Table 3 ☐ Soil Volume ☐ <350m3 ☐ >350m3  
Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ MISA ☐ ODWS Not Reportable \*See note  
Sewer By-Law: ☒ Sanitary ☒ Storm  
Municipality: York

ANALYSIS REQUESTED

O.Reg 153/04		O.Reg 406/19		Other Regulations:				Sewer By-Law:		M & I												SVOC		PCB		PHC		VOC		Pest	Other (please specify)		SPLP TCLP		COMMENTS:
Table 1	Table 2	Table 3	Table	Res/Park	Soil Texture:	Reg 347/558 (3 Day min TAT)	Sanitary	Storm	Municipality:	Field Filtered (Y/N)	Metals & Inorganics	Full Metals Suite	ICP Metals only	PAHs only	SVOCs	PCBs	F1-F4 + BTEX	F1-F4 only	VOCs	all incl BTEX	BTEX only	Pesticides				Specify tests	Specify tests								

COMMENTS:

York Sewer bylaw

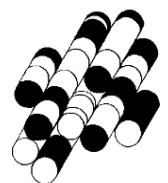
Observations/Comments/Special Instructions

Sampled By (NAME): Alaa Alborne Signature: Alaa Alborne Date: 02/14/2022 (mm/dd/yy)  
Relinquished by (NAME): Signature: Deeth R Date: 02/14/2022 (mm/dd/yy)  
Pink Copy - Client  
Yellow & White Copy - SGS  
Note: Submission of samples to SGS is acknowledged 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](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.

# **APPENDIX G**

**Site Plans of Proposed Development**

**TERRAPROBE INC.**





9541 WESTON ROAD, VAUGHAN

6

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO COMMENCEMENT OF THE WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT.

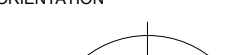
ARCHITECT  
THOMASBROWNARCHITECTS  
187 SPADINA AVENUE, SUITE 500 | TORONTO ONTARIO | M5T 2C9

PROFESSIONAL SEAL

DWG TITLE

SITE PLAN

ORIENTATION



TRUE NORTH

CONSTRUCTION NORTH

DATE 2021-11-24

SCALE	1 : 200	DRAWN BY	Author
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DWG STATUS :

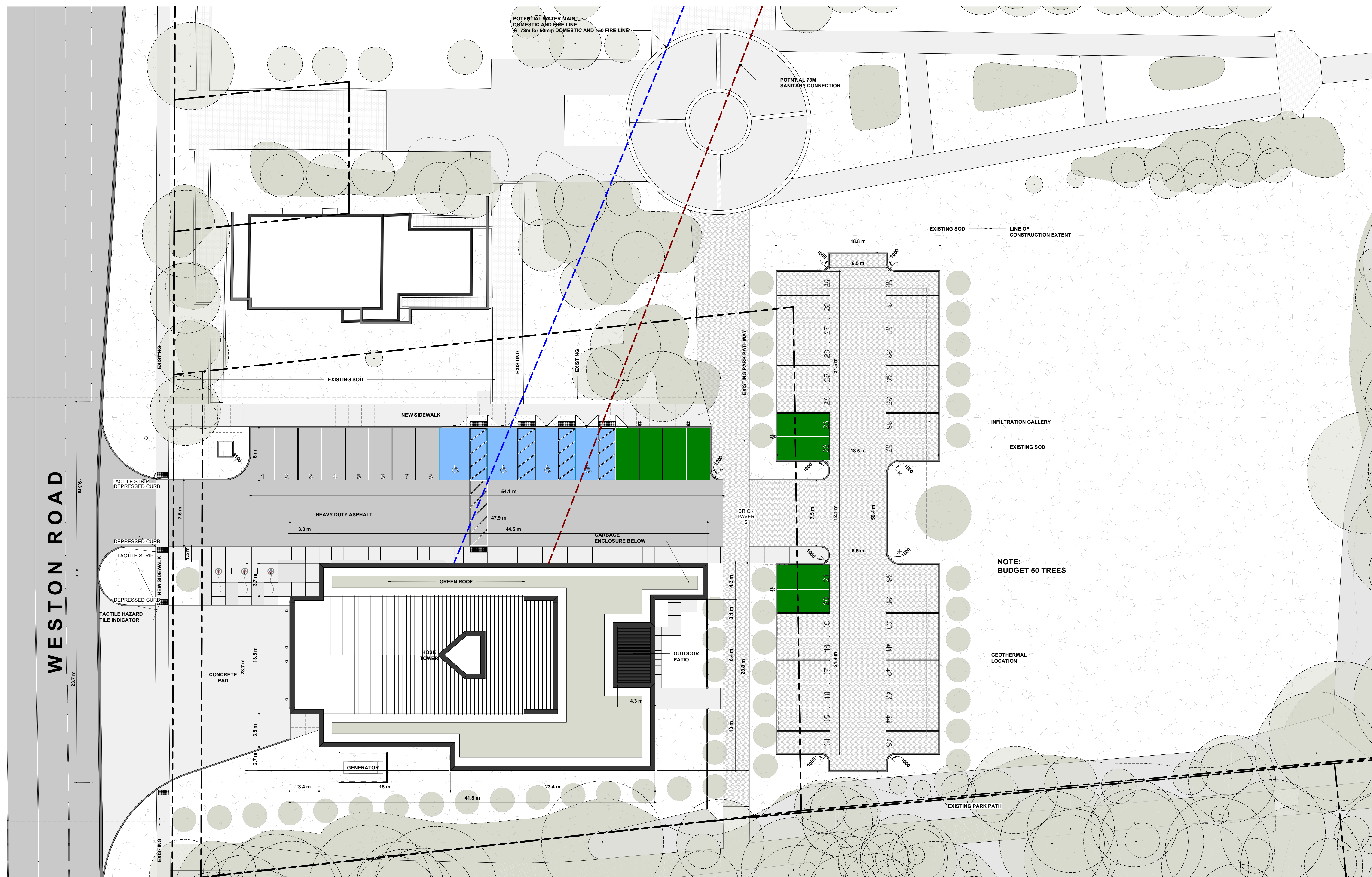
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3-17 PROJECT No. 2104

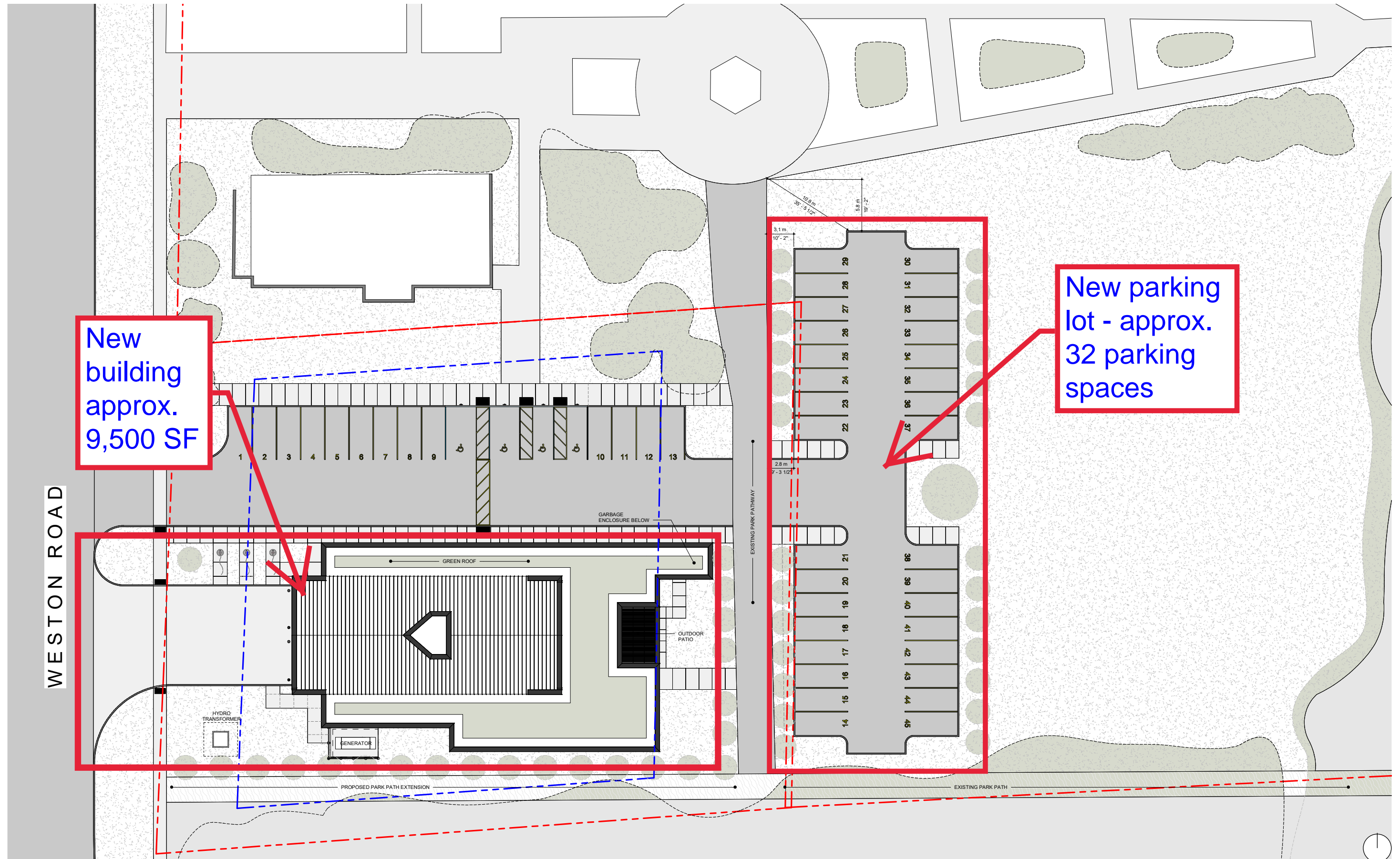
DRAWING No.	REVISION
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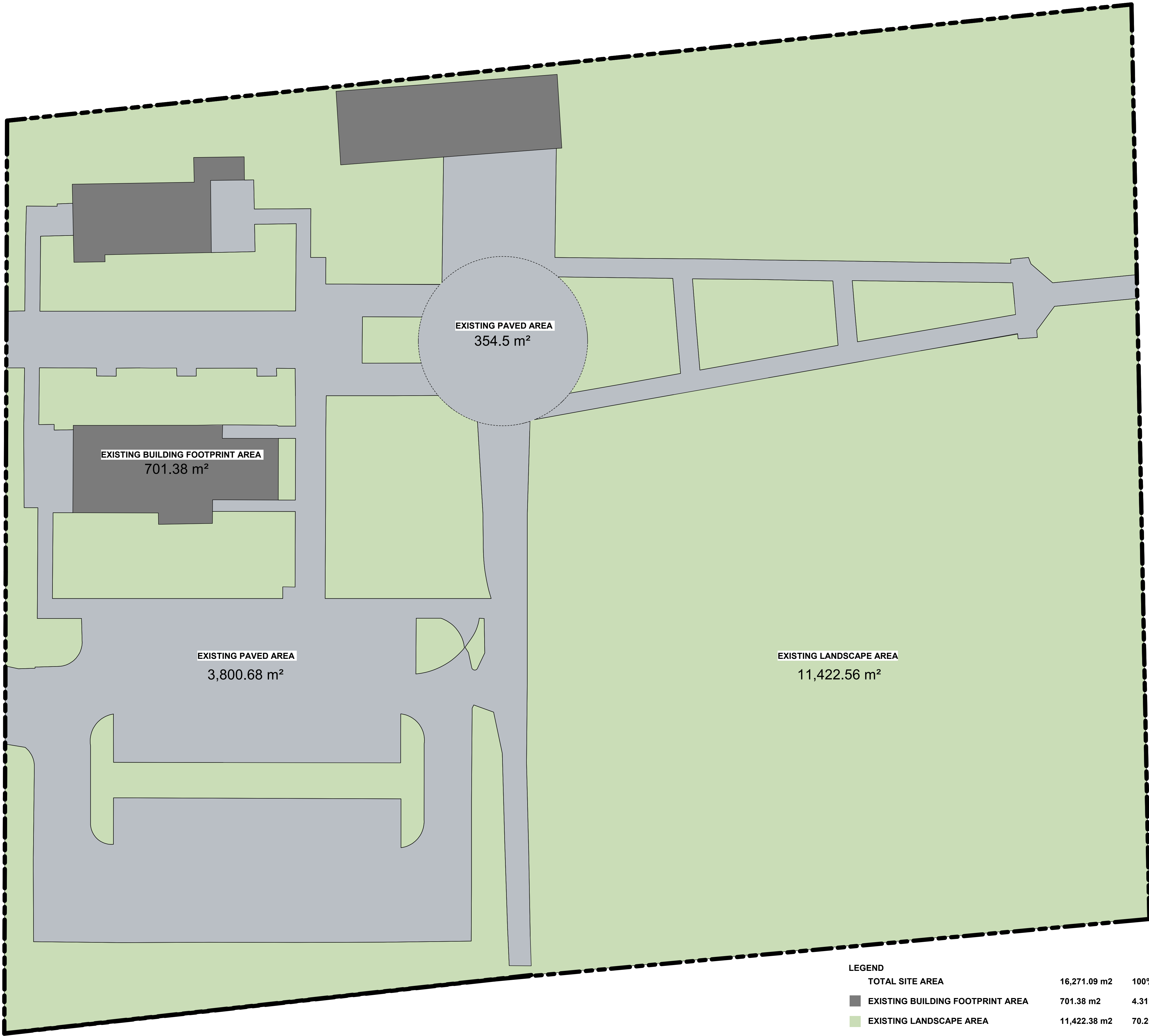
CR 1.1

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1 SITE PLAN - EXISTING - PRE-DEVELOPMENT  
1 : 250

LEGEND			
TOTAL SITE AREA			
		16,271.09 m2	100%
EXISTING BUILDING FOOTPRINT AREA	701.38 m2	4.31%	
EXISTING LANDSCAPE AREA	11,422.38 m2	70.20%	
EXISTING PAVED AREA	4,155.18 m2	25.54%	

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PROJECT :

CITY OF VAUGHAN FIRE  
STATION 7-12  
9541 WESTON ROAD, VAUGHAN

CLIENT

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**THOMASBROWNARCHITECTS**  
197 SPADINA AVENUE, SUITE 500 | TORONTO ONTARIO | M5T 2C9

PROFESSIONAL SEAL

DWG TITLE  
SITE PLAN -  
EXISTING -  
PRE-DEVELOPMENT

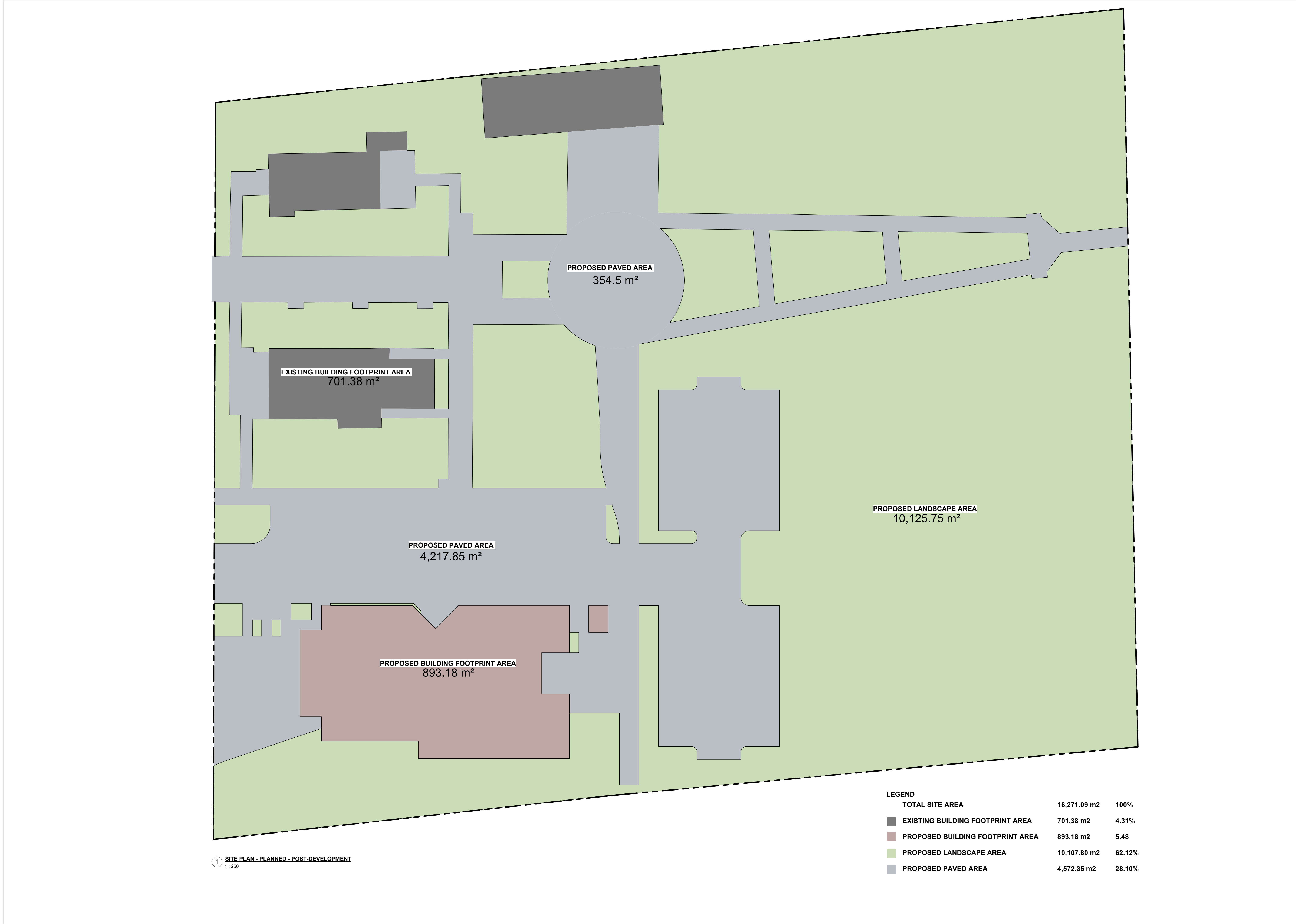
ORIENTATION

TRUE NORTH

CONSTRUCTION NORTH

DATE	2021-11-24		
SCALE	1 : 250	DRAWN BY	AA
DWG STATUS :	SD		
PROJECT No.	2104		
DRAWING No.	D1.15	REVISION	

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PROJECT :

CITY OF VAUGHAN FIRE  
STATION 7-12  
9541 WESTON ROAD, VAUGHAN

CLIENT

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DWG TITLE  
SITE PLAN -  
PLANNED -  
POST-DEVELOPMENT

ORIENTATION

TRUE NORTH

CONSTRUCTION NORTH

DATE  
2021-11-24

SCALE  
1 : 250

DWG STATUS :  
SD

PROJECT No.  
2104

DRAWING No.  
D1.16

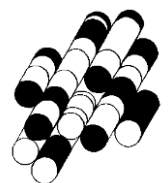
REVISION

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# **APPENDIX H**

## **Short-Term Dewatering Flow Rate Estimates**

**TERRAPROBE INC.**





9541 Weston Road, Vaughan

**Short-Term Construction Dewatering Flow Rate Estimate Details**

<b>Dewatering flow rate from Groundwater Source</b>		
Excavation Dimensions		
<b>Total Footing Length</b>	143.4	
<b>Width of Footing</b>	4	
<b>Area (m<sup>2</sup>)</b>	573.6	
<b>Perimeter (m)</b>	294.8	
<b>Q BASE</b>		
<b>Flow (m<sup>3</sup>/day)</b>	<b>Length of Base (m)</b>	<b>Flow (L/day)</b>
0.0000000	4	0
<b>Q SIDES (m<sup>3</sup>/day)</b>		
<b>Flow</b>	<b>Perimeter (m)</b>	<b>Flow (L/day)</b>
0.00E+00	294.8	0.00E+00
<b>Q Total</b>	L/day	-
<b>Safety Factor</b>		1.5
	L/day	-
	L/day	-

<b>Dewatering Flow Rate from Rainfall Event</b>		
Rainfall Event		
<b>Year</b>	2	100
<b>Hour</b>	3	12
<b>Depth (mm)</b>	30.8	102
<b>Depth (m)</b>	0.0308	0.102
<b>2 Year Event (L/day)</b>	<b>17,667</b>	18,000
<b>100 Year Event (L/Day)</b>	<b>58,507</b>	59,000

**Estimated Short-Term Dewatering Flow Rate**

<b>L/day</b>	18,000.00
<b>L/min</b>	12.50

Project: 1-21-0843-46  
9541 Weston Road, City of Vaughan

MTO IDF Curve Lookup: [http://www.mto.gov.on.ca/IDF\\_Curves/terms.shtml](http://www.mto.gov.on.ca/IDF_Curves/terms.shtml)  
IDF Curve: 43° 49' 45" N, 79° 33' 14" W (43.829167,-79.554167)

Intensity Data

Duration time (min)	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	126.1	77.7	58.5	36	22.2	13.7	6.3	3.9	2.4
5-yr	166.4	102.5	77.2	47.6	29.3	18	8.4	5.2	3.2
10-yr	192.6	118.6	89.3	55	33.9	20.9	9.7	6	3.7
25-yr	226.1	139.3	104.9	64.6	39.8	24.5	11.4	7	4.3
50-yr	250.5	154.3	116.2	71.6	44.1	27.2	12.6	7.8	4.8
100-yr	274.9	169.3	127.6	78.6	48.4	29.8	13.8	8.5	5.2

Plot Data

time (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5	126.1	166.4	192.6	226.1	250.5	274.9
10	77.7	102.5	118.6	139.3	154.3	169.3
15	58.5	77.2	89.3	104.9	116.2	127.6
30	36	47.6	55	64.6	71.6	78.6
60	22.2	29.3	33.9	39.8	44.1	48.4
120	13.7	18	20.9	24.5	27.2	29.8
360	6.3	8.4	9.7	11.4	12.6	13.8
720	3.9	5.2	6	7	7.8	8.5
1440	2.4	2.4	3.7	4.3	4.8	5.2

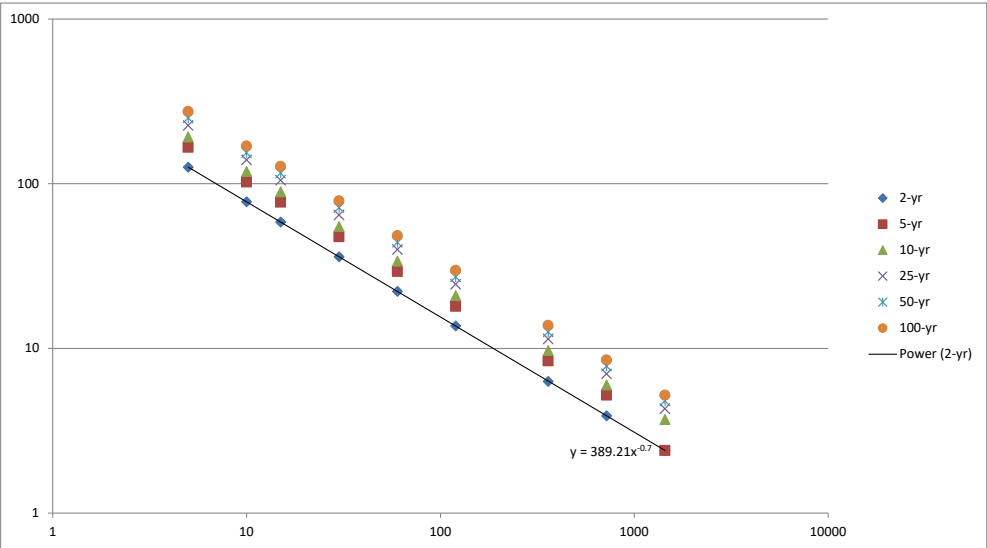
Use a scatter plot  
use logarithmic axes with base 10

2-yr 3hr event

Fit a trendline through the 2-year curve using a power equation  
Show equation of trendline on graph  
Use equation to calculate the intensity of the 3-hr event (x=180)

$$I = 389.21x^{-0.7}$$
$$= 10.26817 \text{ mm/hr}$$
$$\text{depth} = 3\text{hr} * I$$
$$30.80452 \text{ mm}$$

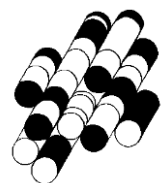
100-yr 12hr event (directly from IDF data)  
I= 8.5 mm/hr  
depth = 102.0 mm



# **APPENDIX I**

**Pre and Post Development Water Balance Analyses**

**TERRAPROBE INC.**



Pre- and Post Water Balance - 9541 Weston Road (Fire Station Number 7-12), Vaughan									
1. Climate Information (using TRSP Water Balance Tool)									
	Row Data	Modified		3. Annual Pre-Development Water Balance					
Precipitation	852 mm/a	852 mm/a	0.85 m/a	Land Use	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> /yr)	Evapotranspiration (m <sup>3</sup> /yr)	Infiltration (m <sup>3</sup> /yr)	Runoff (m3/yr)
Evapotranspiration	412 mm/a	391 mm/a	0.39 m/a	Existing Buildings	701	598	60	0	538
Runoff	282 mm/a	268 mm/a	0.27 m/a	Existing Paved Area	4,155	3,540	354	0	3,186
Recharge	203 mm/a	193 mm/a	0.19 m/a	Existing Landscaped Area	11,415	9,725	4,467	2,201	3,057
				TOTAL	16,271	13,863	4,881	2,201	6,781
The site development area is underlain by clayey silt fill.									
2. Site Statistics									
Pre- Development Site Coverage									
	Subcatchment Areas			4. Annual Post-Development Water Balance					
Area Covered by Existing Buildings (Roof Top)	701 m <sup>2</sup>			Land Use	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> /yr)	Evapotranspiration (m <sup>3</sup> /yr)	Infiltration (m <sup>3</sup> /yr)	Runoff (m3/yr)
Area Covered by Existing Paved Area	4,155			Buildings	1,595	1,358	135	0	1,223
Area Covered by Existing Landscaped Area	11,415			Proposed Paved Area	4,572	3,896	390	0	3,506
TOTAL:	16,271			Proposed Landscaped Area	10,104	8,609	3,954	1,948	2,707
				TOTAL	16,271	13,863	4,479	1,948	7,436
Post-Development Site Coverage									
	Subcatchment Areas								
Area Covered by Existing and Proposed Buildings (Roof Top)	1,595 m <sup>2</sup>				Precipitation (m <sup>3</sup> /yr)	Evapotranspiration (m <sup>3</sup> /yr)	Infiltration (m <sup>3</sup> /yr)	Runoff (m3/yr)	
Area Covered by Proposed Paved Area	4,572 m <sup>2</sup>			Pre-Development	13,863	4,881	2,201	6,781	
Area Covered by Proposed Landscaped Area	10,104 m <sup>2</sup>			Post-Development	13,863	4,479	1,948	7,436	
TOTAL:	16,271 m <sup>2</sup>			Gain/Loss (-)		-402	-253	655	
* <a href="https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/">https://trca.ca/conservation/drinking-water-source-protection/trspa-water-balance-tool/</a>									