# REPORT ON
# GEOTECHNICAL INVESTIGATION
# 10 WATSON ROAD
# GRAND VALLEY, ONTARIO

**REPORT NO.: 5823-21-GB**
**REPORT DATE: NOVEMBER 12, 2021**

**PREPARED FOR**
**2222183 ONTARIO INC**
**105 WHITWELL DRIVE**
**BRAMPTON, ONTARIO**
**L6P 1E3**

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## 1.0 INTRODUCTION

***Toronto Inspection Ltd.*** was retained by 2222183 Ontario Inc. to conduct a geotechnical investigation for the property, located at 10 Watson Road in Grand Valley, Ontario (hereafter described as "the Site").

It is our understanding that the development at the Site will consist of a warehouse building. The purpose of the investigation was to determine the subsoil and groundwater conditions at the Site and provide our recommendations of the design and construction of the building. In particular, geotechnical data was to be provided for:

- General founding conditions
- Foundation design bearing pressures
- Construction recommendations
- Excavation recommendations

This report is provided on the basis of the above terms of reference and on an assumption that the design of the structure will be in accordance with the applicable guidelines, building codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, our office should be consulted to review the design and to confirm the recommendations and comments provided in the report.

## 2.0 SITE CONDITION

The Site, near rectangle in shape and approximately 0.4ha in area, is located on the north side of Watson Road, approximately 120m east of Water Street, and on the south side of Upper Grand Trailway in Grand Valley, Ontario.

At the time of investigation, the Site was a vacant parcel of land with grass cover at the ground surface, to the east of Grand Valley and District Fire Department. The site gradient slopped down to the north and slightly to the east.

## 3.0 INVESTIGATION PROCEDURE

The field work for the investigation was carried out on October 28, 2021. A total of four sampled boreholes (21BH-1 to 21BH-4), extending to depths of 6.2m to 8.1m from grade, were conducted within the proposed building and pavement areas. The borehole locations were shown in the appended Borehole Location Plan, Drawing No. 1.

An additional borehole, 20BH-10, was drilled within the proposed septic tank area, without sampling, to a depth of 3.0m from grade, to install a solid PVC pipe for the field percolation test.

The boreholes were advanced using a track mounted drill rig, equipped with continuous flight solid stem augers, sampling rods and a drop hammer, supplied by a specialist drilling contractor. Soil samples were taken at 0.76m intervals to depths of 3.0m below the existing ground level. Below the depth, the sampling frequency was increased to 1.5m. The samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs). The soil samples were identified and logged in the field and were carefully bagged for later visual identification and the determination of moisture content. Groundwater observations were made in the boreholes during and upon the completion of drilling.

The locations of boreholes are shown on the appended Borehole Location Plan (Drawing No. 1). The ground elevations at the borehole locations were obtained from interpolation of the survey data shown on Site Survey Plan, Drawing No. 21081601-C-100, prepared by RA Engineering Inc., dated November 11, 2021, provided to our office by the client.

## 4.0 SUMMARIZED SITE AND SUBSURFACE CONDITIONS

Reference is made to the appended Borehole Location Plan (Drawing No. 1), Logs of Boreholes (Drawing Nos. 2 to 5), for details of field work, including soil classification, inferred stratigraphy, and groundwater observations carried out during and on completion of borehole drilling.

The boreholes revealed that the subsoil, below the surficial topsoil and fill, consisted of native sandy silt and sandy silt till deposits. Brief descriptions of the subsoils, encountered at the borehole locations, were as follows:

### 4.1 Surface Course

Topsoil, approximately 225mm to 250mm in thickness, was contacted at the ground surface at Boreholes 21BH-1 to 21BH-4 locations.

### 4.2 Fill

Below the topsoil, a layer of fill was contacted at Boreholes 21BH-1 to 21BH-4 locations. The fill consisted of a mixture of sandy silt, clayey silt, trace gravel, with trace to some topsoil and occasional minor rootlets.

The fill at Boreholes 21BH-1 to 21BH-4 locations extended to depths of 0.6m to 0.9m from grade.

Based on the Standard Penetration N-values of 6 to 7 blows per 0.3m penetration, it appeared that the fill was in a loose condition.

The in-situ moisture content of the soil samples retrieved from the fill ranged from 22% to 38%, indicating very moist conditions. The higher moisture content more than 20% was due to presence of the topsoil.

### 4.3 Sand Silt

A sandy silt deposit was contacted below the fill at Boreholes 21BH-1 to 21BH-4 locations, at depths of 0.6m to 0.9mm from grade. The sand silt deposit contained trace gravel and trace to some clayey silt.

The sandy silt deposit at Boreholes 21BH-1 to 21BH-4 locations extended to depths of 1.4m to 2.1m from grade.

Based on the Standard Penetration N-values of 7 to 16 blows per 0.3m penetration, the relative density of the sandy silt deposit was loose to compact, generally in a loose state.

The in-situ moisture content of the soil samples retrieved from the deposit ranged from 16% to 23%, indicating generally very moist to wet conditions.

### 4.4 Sandy Silt Till

A sandy silt till deposit was contacted below sandy silt deposit at Boreholes 21BH-1 to 21BH-4 locations at depths of 1.4m to 2.1m from grade. The sandy silt till deposit consisted of a heterogeneous mixture of silt, sand, clay, some gravel, with seams or find sand, thin layers of sand with gravel, and occasional cobbles.

Boreholes 21BH-1 to 21BH-4 were terminated in the sandy silt till deposit at depths of 6.2m to 8.1m from grade.

Based on the Standard Penetration N-values of 30 to more than 100 blows per 0.3m penetration, the relative density of the sandy silt till deposit was dense to very dense.

The in-situ moisture content of the soil samples retrieved from the deposit ranged from 8% to 20%, indicating moist to very moist conditions, with some wet pockets.

The sandy silt till deposit was also contacted at Borehole 21P-1 location at a depth of 3.0m from grade and extending to 3.5m from grade.

Grain size analyses were conducted on two selected soil samples, obtained from 21BH-2 (SS3 - at a depth of 1.5m) and 21P-1 (at a depth of 3.0m), using both mechanical sieves and hydrometer. The grain size distributions are shown on the appended Figure No. 1. The results indicate that the sandy silt till deposit also contained layers of clayey silt till.

### 4.5 Groundwater

Free water was recorded in the open Boreholes 21BH-1, 21BH-3 and 21BH-4 at depths of 1.2m to 2.4m from grade, with cave-in at Boreholes 21BH-1 to 21BH-4 locations at depths of 1.8m to 7.2m from grade. No free water or cave-in was recorded at Borehole 21P-1, during and upon completion of drilling and sampling.

Based on the moisture content profile of the soil samples retrieved from the boreholes and our field observations at the Site, during and upon completion of the drilling process, it is our opinion that the free water represents the water in the sandy silt deposit, and in the seams or thin layers of fine sand within the sandy silt till deposit.

## 5.0 RECOMMENDATIONS

A review of the Preliminary Site Plan, Drawing No. 21081601-C-100, prepared by RA Engineering Inc., dated September 1, 2021 (Revision 2), indicated that the development at the Site will consist of a warehouse building, including an office building attached to it, without a basement at the west portion, with the associated asphalt driveway and parking lots at the east portion; a septic tank at the north end of the pavement area; and an underground stormwater storage tank at the northeast part of the pavement area.

The slab-on-grade of the proposed building was not known at the time of preparation of this report. For the purpose of this report, we have assumed the finished floor elevation of the building will be at or above the street level or the existing ground level.

Based on the subsoil and groundwater conditions encountered at the borehole locations, our comments and recommendations for the design and construction of the proposed structure are as follows:

### 5.1 Site Preparation

The soil description and depth of fill, shown on the Borehole Logs, are specific depths at the borehole locations only. The thickness of topsoil and the depth of fill at locations beyond the boreholes may be thicker or deeper. We recommend that the contractor bidding for the job should  determined the depths of deleterious fill and material by test pits and allow for removal of any deleterious fill and material, with high moisture content and/or organic content, during the site preparation for site grading.

The existing fill may not be suitable to be left in place in the proposed building and pavement areas, and should be sub-excavated and replaced with organic free soil.

Depending on the final grades, the Site may have to be regraded for the proposed development. If cut and fill operation is proposed, the on-site excavated fill material and native soils, to be used for site grading, should be organic free and maintained at or close to its optimum moisture content during placement and compaction. The new fill should be compacted in lifts of 200mm to at least 98% of its Standard Proctor maximum dry density (SPMDD).

To support the building footings, the new fill within the footprints of the building should be placed and compacted in lifts of 200mm to at least 100% of its SPMDD in accordance with the engineered fill guidelines, after the existing topsoil and fill, and loose native sandy silt deposit, has been completely removed within the proposed building envelope, to the compact native deposit. The guideline for placement and compaction of engineered fill is provided in Appendix A.

Compressible topsoil and the fill material, containing relatively high organic content, will not be suitable for reuse in areas where future settlement cannot be tolerated. This material will have to be disposed off-site or reused in landscaped areas, subject to approval by the landscape architect.

## 5.2 Foundation Design (21BH-1 to 21BH-3)

The existing fill, and the underlying native sandy silt deposit, generally in a loose condition, are not suitable to support the proposed building. The proposed building should be supported on conventional spread/strip footings, founded on the engineered fill and / or the native sandy silt till deposit.

Conventional spread/strip footings of the proposed building, founded on the engineered fill, can be designed using the following bearing pressures of:

- 150 kPa at Serviceability Limit State
- 220 kPa at Factored Ultimate Limit State

Conventional spread/strip footings of the proposed building, founded on the compact to dense sandy silt till deposit, at or below depths of 2.4m, 1.7m and 2.4m from grade, at the borehole locations of 21BH-1 to 20BH-3, respectively, can be designed using the following bearing pressures of:

- 250 kPa at Serviceability Limit State
- 370 kPa at Factored Ultimate Limit State

For strip footings placed in the engineered fill, we recommends that all perimeter footings should be reinforced with at least 2-15M bars, continuously. This reinforcement will bridge any loose pockets of fill, if any, under the footings and minimize the differential settlement of the footings.

The total and differential settlement of footings, designed for the above Serviceability Limit State, will not exceed 25mm and 20mm, respectively.

All perimeter footings or any footings, which may be exposed to freezing conditions, should be placed below the frost penetration depth of 1.2m below the outside grade.

It should be noted that the above recommendations for foundations have been analysed by ***Toronto Inspection Ltd.*** from the subsoil information obtained at the borehole locations. The bearing material, the interpretation between the boreholes and the recommendations of this report must be checked through field inspection provided by ***Toronto Inspection Ltd***. to validate the information for use during the construction stage.

## 5.3 Floor Slab Construction

The floor slab can be designed and constructed as a conventional slab-on-grade method, provided that the subgrade should be thoroughly proof-rolled under the supervision of a geotechnical technician from ***Toronto Inspection Ltd***. Any compressible, loose, or weak spots encountered during the proof rolling process, should be sub-excavated to a firm ground. Any backfill of the sub-excavated areas or new fill, below the slab-on-grade, should consist of organic free soils, compacted to at least 98% of its Standard Proctor maximum dry density (SPMDD).

A bedding consisting of at least 150 mm of granular A (OPSS Form 1010) or its approved equivalent, is recommended as a moisture barrier under a light to medium loaded floor slab. The bedding should be compacted to at least 100% SPMDD.

## 5.4 Earthquake Consideration

The Ontario Building Code requires that all buildings be designed to resist earthquake forces. In accordance with Table 4.1.8.4.A of the Ontario Building Code, the site classification for the Seismic Site Response is Class C (very dense soil).

The acceleration and velocity based site coefficients, Fa and Fv, should conform to Tables 4.1.8.4.B and 4.1.8.4.C. These values should be reviewed by the Structural Engineer.

## 5.5 Excavation and Backfilling

All excavations should comply with the Ontario Occupational Health and Safety Act. Any excavation deeper than 1.2m in the native strata should be sloped back to a safe angle of 45$^{o}$ or flatter. A flatter slope will be required for excavation in the fill or in saturated soils.

The current in-situ moisture content of the fill is apparently slightly higher than its optimum moisture content. Selected on-site excavated soils can be reused for backfilling, provided they are free of organics and allowed to air dry to the dry side of its optimum, prior to placement. The use of the compressible fill should be limited to backfilling of locations where future settlement will be of little consequence.

Topsoil and other compressible fill removed from the Site may be reused in landscape areas, subject to the approval of the landscape architect.

Bedding for the underground services, including catch basins and manholes, should consist of OPSS Granular A, 20mm crusher run limestone, or equivalent.

No significant groundwater conditions are anticipated in excavations of foundations and the underground tanks. However, the perched water may be encountered in the fill and the native sandy silt deposit. Therefore, provision should be made to use filtered sumps to remove any groundwater seepage from the overburden or saturated soils, if encountered.

## 5.6 Lateral Earth Pressure

Where subsurface walls will retain unbalanced loads, including the retaining walls, the lateral earth pressure in the overburden may be computed using the following equation:

$$P = K ( \gamma H + q )$$

| | | |
|---|---|---|
| where | $P$ = Lateral earth pressure | kPa |
| | $K$ = Lateral earth pressure coefficient | 0.4 |
| | $\gamma$ = Bulk unit weight of the soil | 21.0 kN/m$^3$ |
| | $H$ = Depth of the wall below the finish grade | m |
| | $q$ = Surcharge loads adjacent to the basement wall | kPa |

The equation assumes that a permanent free draining system will be provided to prevent the buildup of hydrostatic pressure next to the wall. The drainage system should include a free-draining granular backfill or a drainage membrane placed against the concrete wall, together with an effective perimeter weeping tile drainage system at the wall base. The weeping tile should consist of a minimum 100mm diameter perforated pipe, surrounded by a geotextile filter fabric (OPSS 405) and installed on a positive grade leading to a frost free sump or outlet.

## 5.7 Pavement Construction

The existing on-site material, at the proposed asphalt pavement area, consists of sandy silt to clayey silt. These materials are medium to high frost susceptibility.

The following minimum pavement design thicknesses are based on the assumption that perforated sub-drains will be installed to prevent build-up of water in the granular bases of the pavement:

| | | Light Duty Parking | Heavy Duty Fire Routes |
|---|---|---|---|
| **Asphaltic Concrete** | OPSS HL3 or equivalent | 65mm | 40mm |
| | OPSS HL8 or equivalent | - | 60mm |
| **Base:** | OPSS Granular A or 20mm crusher-run | 150mm | 150mm |
| **Sub-base:** | OPSS Granular B or 50mm crusher-run | 200mm | 300mm |

The granular base and sub-base should be compacted to a minimum of 100% SPMDD. Asphaltic concrete should be compacted to at least 96% Marshall density.

The above pavement thicknesses are based on the favourable site conditions and the construction being carried out during the drier time of the year and that the subgrade is stable, not heaving under construction traffic. If the subgrade is wet and unstable, additional thickness of sub-base material may be required.

Following site grading, the subgrade of the entire pavement should be proof-rolled using a heavy vibratory roller. Any soft spots revealed by the proof-rolling should be sub-excavated and replaced with an approved dry material and compacted to at least 98% of its SPMDD. If the subgrade is wet and unstable, the wet material should be removed from the subgrade and additional thickness of subbase be used for road construction.

Provision should be made for the water to drain out of and not collect in the granular base courses for the pavement to function properly. Perforated subdrains should be provided, extending to a distance of 3m in all directions of catch basins, and continuously in locations where a drop in the subgrade elevation is relevant, such as beside the ramp or concrete sidewalk. The subdrains should be at least 800mm below the road pavement level, and installed on a positive gradient to allow for a free flow of water. The backfill above the drains should comprise of free draining Granular B or its equivalent and should be continuous with the granular subbase of the pavement.

## 5.8 Field Percolation Test

For the field percolation test, Borehole 21P-1 was drilled in the proposed septic tank area at the north end of the pavement area, to the proposed depth of 3.0m below the existing grade. The subsoil, at the bottom of Borehole 21P-1, at depths of 3.0m to 3.5m below the existing grade, consisted of sandy silt till deposit. No free water was documented in the open borehole during and upon completion of drilling. The Log of borehole 21P-1 is attached in Drawing No. 6.

In order to keep the Borehole 21P-1 open, a 100mm diameter PVC pipe was installed to the base of the borehole. The base of PVC pipe was covered with 50mm of sand and the pipe was filled with water in order to saturate subsoil to be assessed. The top of the PVC pipe was used as a datum to record the water levels in the pipe.

**Laboratory Testing**

A grain size analysis was carried out on the soil sample, retrieved from Borehole 21P-1, at a depth of approximately 3.0m from grade to estimate the coefficient of percolation. Based on the grain size distribution of the sample, plotted in Figure No. 1, the Percolation time is estimated at 35 minutes / cm.

**Rate of Percolation through Field Testing**

The field percolation test, at Borehole 21P-1, was conducted on November 10, 2021. The documented field test results were as follows:

| Reading No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Time Interval (min) | 10 min | 10 min | 10 min | 10 min | 10 min | 10 min |
| Drop (cm) | 340 mm | 380 mm | 340 mm | 340 mm | 340 mm | 340 mm |

The results at Borehole 21P-1 location had a significant drop, which could be due to presence of  a more permeable layer and should not be relied on.

It is our opinion that the Percolation time, 35 minutes / cm estimated form the grain size distribution, can be used for the design purpose. However, it may very with the depth and the location.

## 6.0 GENERAL STATEMENT OF LIMITATION

The comments and recommendations presented in this report are based on the subsoil and ground water conditions encountered at the borehole locations, indicated in the borehole location plan, and are intended for the guidance of the design engineer. Although we consider this report to be representative of the subsurface conditions at the subject property, the soil and the ground water conditions between and beyond the borehole locations may differ from those encountered at the time of our investigation and may become apparent during construction. Any contractor bidding on, or undertaking the works, should decide on their own investigation and interpretations of the groundwater and the soil conditions between the borehole locations.

Any use and/or the interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third parties. The responsibility of ***Toronto Inspection Ltd.*** is limited to the accurate interpretation of the soil and ground water conditions prevailing in the locations investigated and accepts no responsibility for the loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

Any legal actions arising directly or indirectly from this work and/or ***Toronto Inspection Ltd.'s*** performance of the services shall be filed no longer than two years from the date of ***Toronto Inspection Ltd.'s*** substantial completion of the services. ***Toronto Inspection Ltd.*** shall not be responsible to the client for lost revenues, loss of profits, cost of content, claims of customers, or other special indirect, consequential, or punitive damages.

To the fullest extent permitted by law, the client's maximum aggregate recovery against ***Toronto Inspection Ltd.***, its directors, employees, sub-contractors, and representatives, for any and all claims by clients for all causes including, but not limited to, claims of breach of contract, breach of warranty and/or negligence, shall be the amount of the fee paid to ***Toronto Inspection Ltd.*** for its professional services rendered under the agreement with respect to the particular site which is the subject of the claim by the client.

**TORONTO INSPECTION LTD.**

David S. Wang

**David S. Wang, P.Eng.**
**Senior Engineer**

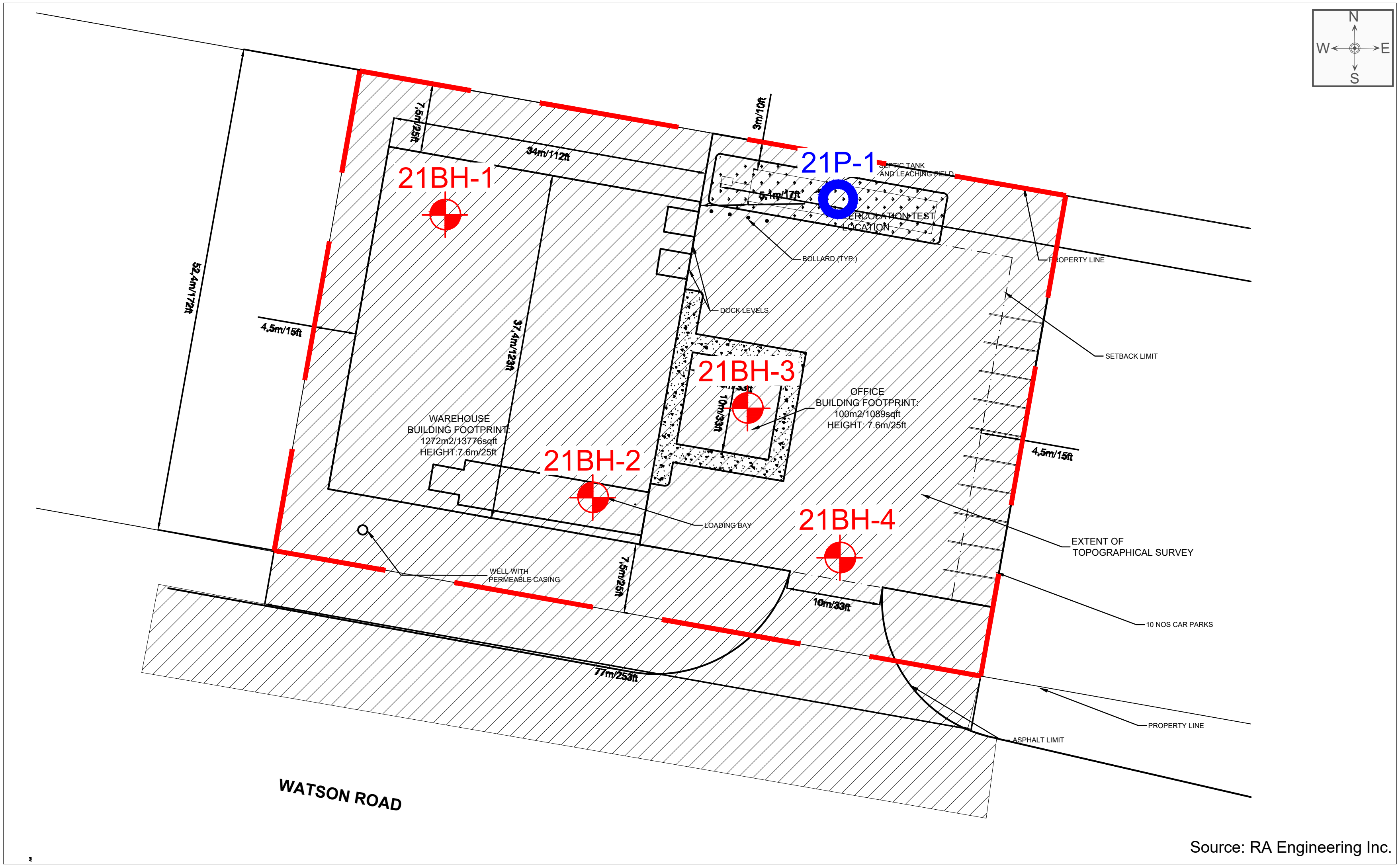
LICENSED PROFESSIONAL ENGINEER
S. WANG
100131918
Nov 12, 2021
PROVINCE OF ONTARIO

# *Drawings & Figure*

Borehole Location Plan

Borehole Logs

Gradation Curve




Source: RA Engineering Inc.

**LEGEND:**

Borehole Location | Percolation Test Location | Site Boundary

NOT TO SCALE

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| | |
|---|---|
| TITLE: | Borehole and Percolation Test Location Plan |
| LOCATION: | 10 Watson Road, East Luther / Grand Valley, Ontario |

| PROJECT NO. | DATE: | DRAWING NO. |
|---|---|---|
| 5823-21-GB | November 2021 | 1 |

Project No. 5823-21-GB

# Log of Borehole 21BH-1

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 10 Watson Road, East Luther / Grand Valley, Ontario

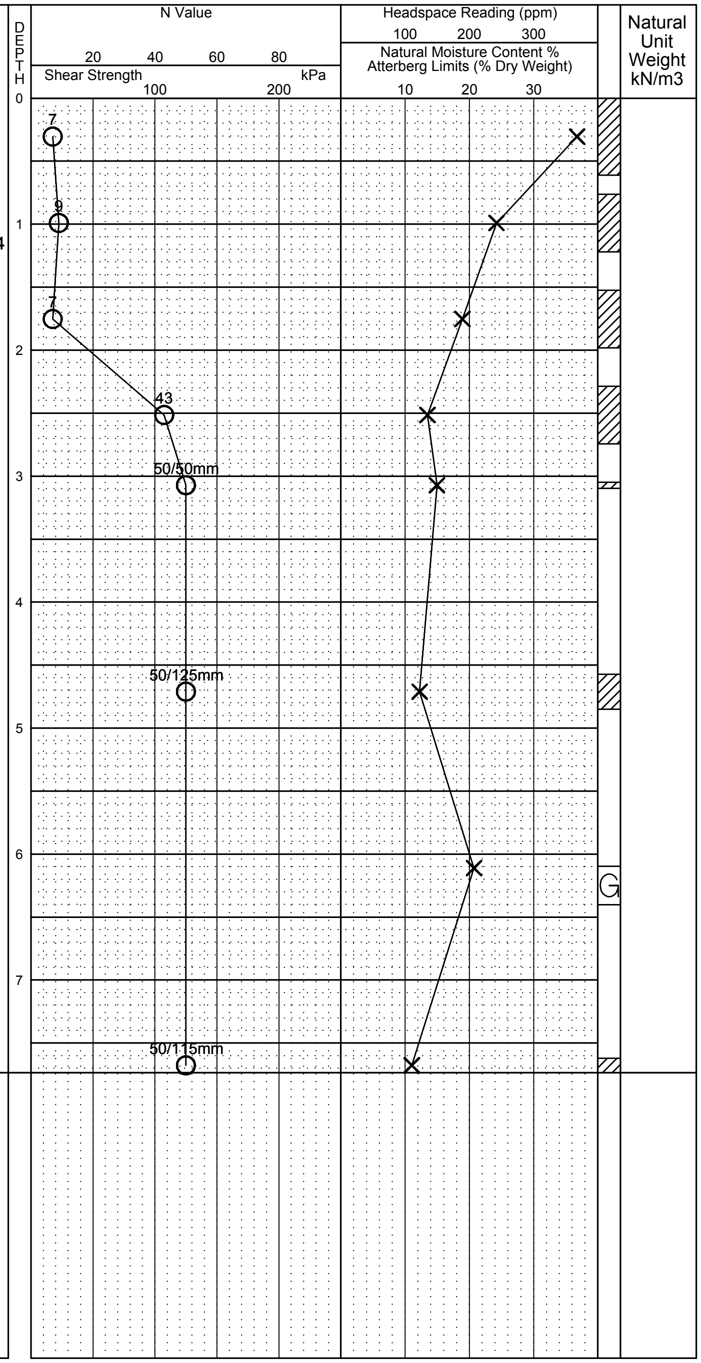
Date Drilled: 10/28/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

| | | | |
|---|---|---|---|
| Auger Sample | | Headspace Reading (ppm) | |
| SPT (N) Value | | Natural Moisture | |
| Dynamic Cone Test | | Plastic and Liquid Limit | |
| Shelby Tube | | Unconfined Compression % Strain at Failure | |
| Field Vane Test | | Penetrometer | |

| GWL | SYMBOL | Soil Description | ELEV. m |
|---|---|---|---|
| | | Ground Surface | 467.34 |
| | | **TOPSOIL** | 467.11 |
| | | **FILL**<br>- brown sandy silt to clayey silt<br>- minor topsoil, trace gravel<br>- very moist | 466.73 |
| ▼ | | **SANDY SILT**<br>- loose, brown<br>- trace gravel<br>- trace to some clayey silt<br>- very moist, wet pockets | 466.14 |
| | | **SANDY SILT TILL**<br>- very dense, brown<br>- some gravel, some clayey silt<br>- a layer of sand with gravel at 6.0m<br>- moist to very moist, wet at 6.0m | 465.21 |
| | | | 459.61 |
| | | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- water level at 1.2m<br>- cave-in at 1.8m | |




LGBE3 5823-21-GB.GPJ 11/12/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

| Time | Water Level (m) | Depth to Cave (m) |
|---|---|---|
| | | |

Project No. 5823-21-GB

# Log of Borehole 21BH-2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 10 Watson Road, East Luther / Grand Valley, Ontario

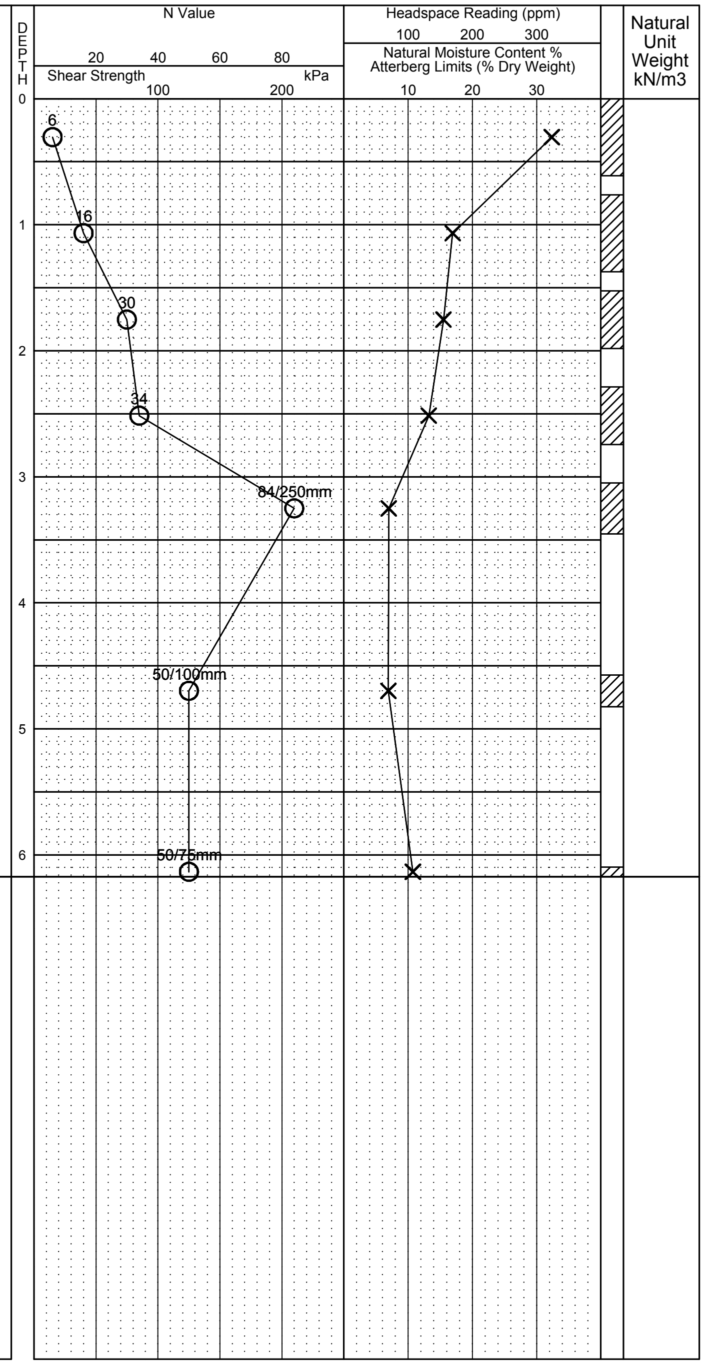
Date Drilled: 10/28/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

| | |
|---|---|
| Auger Sample | ⊠ |
| SPT (N) Value | ○ ▨ |
| Dynamic Cone Test | —— |
| Shelby Tube | ■ |
| Field Vane Test | ✚ S |
| Headspace Reading (ppm) | • |
| Natural Moisture | × |
| Plastic and Liquid Limit | ⊢—⊣ |
| Unconfined Compression % Strain at Failure | ⊗ |
| Penetrometer | ▲ |

| GWL | SYMBOL | Soil Description | ELEV. m |
|---|---|---|---|
| | | Ground Surface | 469.15 |
| | | **TOPSOIL** | 468.90 |
| | | **FILL**<br>- brown clayey silt<br>- some topsoil<br>- some sandy silt<br>- very moist | 468.54 |
| | | **SANDY SILT**<br>- compact, brown<br>- trace clayey silt<br>- moist | 467.78 |
| | | **SANDY SILT TILL**<br>- dense to very dense<br>- brown, grey below 6.0m<br>- a layer of clayey silt till at 1.5m<br>- some gravel<br>- trace to some clayey silt<br>- seams of fine sand, some silty sand<br>- occasional cobbles<br>- moist to very moist | 462.98 |
| | | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- cave-in at 5.8m | |




LGBE3 5823-21-GB.GPJ 11/12/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

| Time | Water Level (m) | Depth to Cave (m) |
|---|---|---|
| | | |

Project No. 5823-21-GB

# Log of Borehole 21BH-3

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 10 Watson Road, East Luther / Grand Valley, Ontario

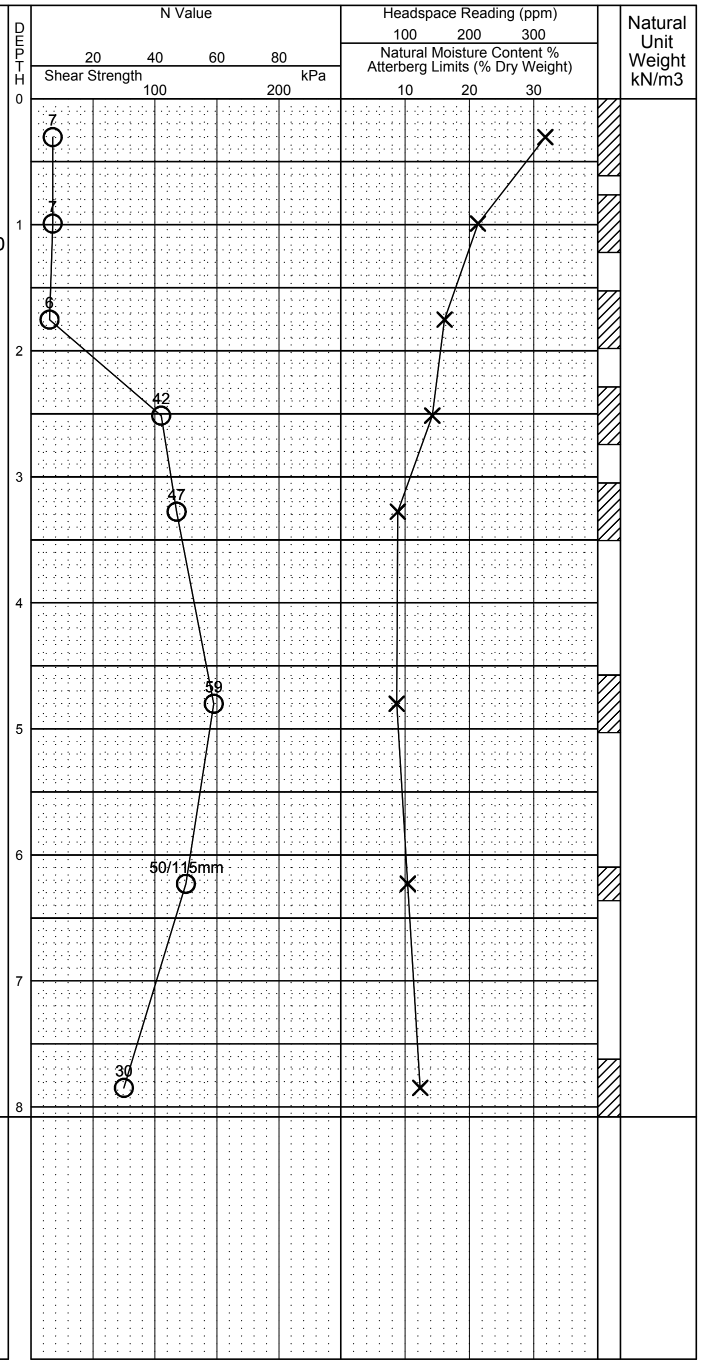
Date Drilled: 10/28/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

| | |
|---|---|
| Auger Sample | ☒ |
| SPT (N) Value | ○ ▨ |
| Dynamic Cone Test | — |
| Shelby Tube | ■ |
| Field Vane Test | ✚ S |
| Headspace Reading (ppm) | • |
| Natural Moisture | × |
| Plastic and Liquid Limit | ├─┤ |
| Unconfined Compression % Strain at Failure | ⊗ |
| Penetrometer | ▲ |

| GWL | Soil Description | ELEV. m |
|---|---|---|
| | Ground Surface | 468.30 |
| | **TOPSOIL** | 468.05 |
| | **FILL**<br>- dark brown to brown clayey silt<br>- some rootlets, topsoil<br>- trace sandy silt<br>- very moist | 467.54 |
| ▼ | **SANDY SILT**<br>- loose, brown<br>- trace gravel, trace clayey silt<br>- very moist, wet pockets | 467.10 |
| | **SANDY SILT TILL**<br>- dense to very dense, brown<br>- some gravel<br>- trace to some clayey silt<br>- seams of fine sand, some silty sand<br>- moist to very moist, wet pockets | 466.17 |
| | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- water level at 1.2m<br>- cave-in at 3.3m | 460.22 |




LGBE3 5823-21-GB.GPJ 11/12/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

| Time | Water Level (m) | Depth to Cave (m) |
|---|---|---|
| | | |

Project No. 5823-21-GB

# Log of Borehole 21BH-4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 10 Watson Road, East Luther / Grand Valley, Ontario

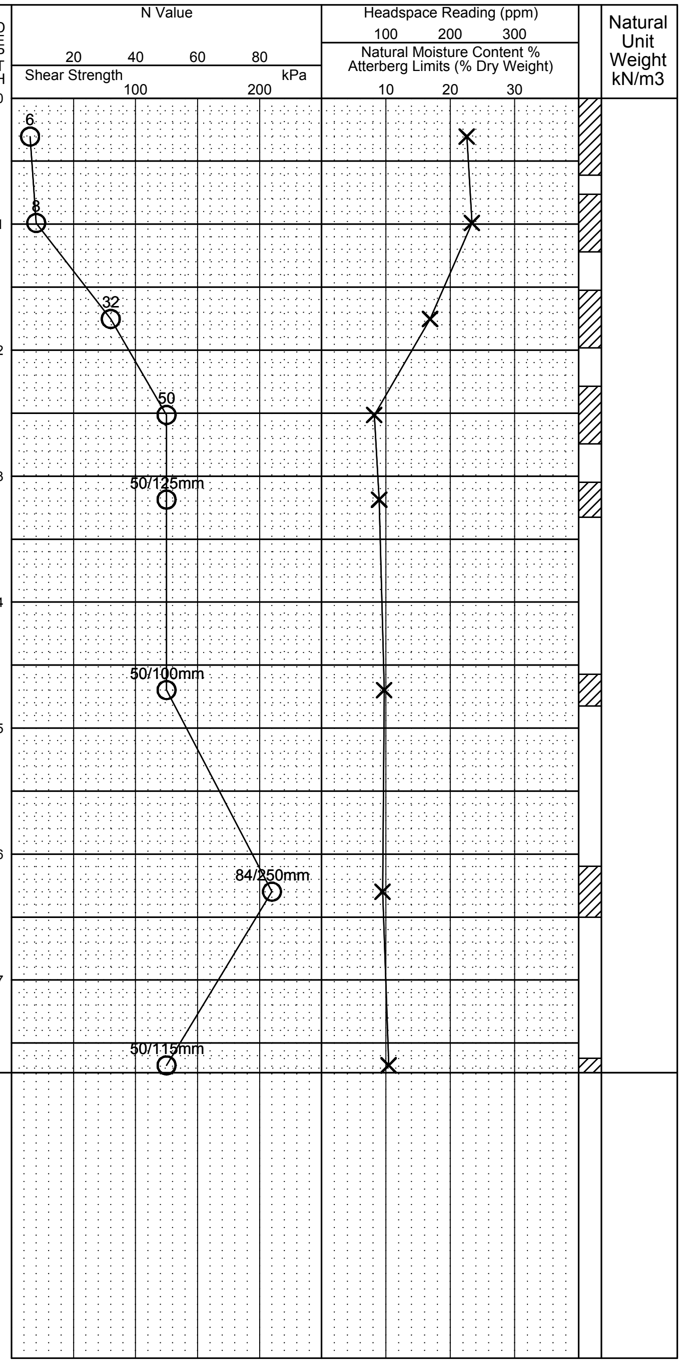
Date Drilled: 10/28/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

| | | |
|---|---|---|
| Auger Sample | Headspace Reading (ppm) | Unconfined Compression % Strain at Failure |
| SPT (N) Value | Natural Moisture | Penetrometer |
| Dynamic Cone Test | Plastic and Liquid Limit | |
| Shelby Tube | | |
| Field Vane Test | | |

| GWL | Soil Description | ELEV. m | DEPTH |
|---|---|---|---|
| | Ground Surface | 469.15 | 0 |
| | **TOPSOIL** | 468.90 | |
| | **FILL**<br>- dark brown to brown sandy silt to clayey silt<br>- some topsoil, minor rootlets<br>- very moist | 468.24 | 1 |
| | **SANDY SILT**<br>- loose, brown<br>- trace gravel, trace clayey silt<br>- very moist | 467.78 | |
| ▼ (466.75) | **SANDY SILT TILL**<br>- dense to very dense<br>- brown to greyish brown<br>- some gravel<br>- trace to some clayey silt<br>- seams of fine sand, some silty sand<br>- occasional cobbles<br>- moist to very moist, wet pockets | 466.75 | 2–7 |
| | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- water level at 2.4m<br>- cave-in at 7.2m | 461.42 | |




LGBE3 5823-21-GB.GPJ 11/12/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

| Time | Water Level (m) | Depth to Cave (m) |
|---|---|---|
| | | |

Project No. 5823-21-GB

# Log of Borehole 21P-1

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 10 Watson Road, East Luther / Grand Valley, Ontario

Date Drilled: 10/28/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

| | |
|---|---|
| Auger Sample | ☒ |
| SPT (N) Value | ○ ▨ |
| Dynamic Cone Test | — |
| Shelby Tube | ■ |
| Field Vane Test | ✚ S |
| Headspace Reading (ppm) | ● |
| Natural Moisture | × |
| Plastic and Liquid Limit | ├─┤ |
| Unconfined Compression % Strain at Failure | ⊗ |
| Penetrometer | ▲ |

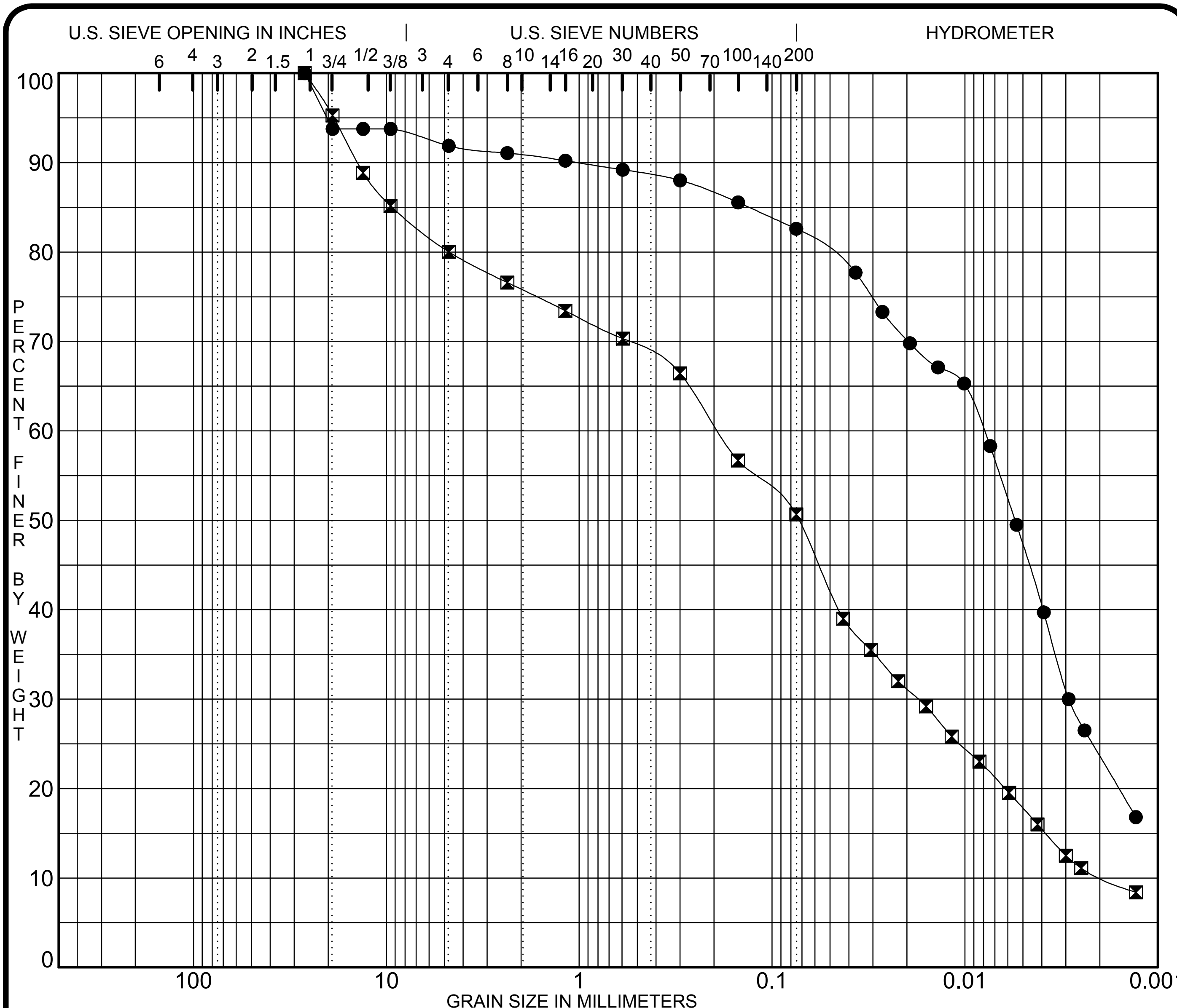
| GWL | SYMBOL | Soil Description | ELEV. m | DEPTH | N Value (20, 40, 60, 80) / Shear Strength kPa (100, 200) | Headspace Reading (ppm) (100, 200, 300) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (10, 20, 30) | Natural Unit Weight kN/m3 |
|---|---|---|---|---|---|---|---|
| | | Ground Surface | 466.01 | 0 | | | |
| | | **(NO SAMPLING)** | | | | | |
| | | | | 1 | | | |
| | | | | 2 | | | |
| | | | 462.96 | 3 | | | |
| | | **SANDY SILT TILL**<br>- very dense, brown<br>- some gravel<br>- trace clayey silt<br>- moist | 462.50 | | 51 | | |
| | | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- no free water | | | | | |

LGBE3 5823-21-GB.GPJ 11/12/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

| Time | Water Level (m) | Depth to Cave (m) |
|---|---|---|
| | | |




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen Identification | | Classification | MC% | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | **21BH-2** | **1.5** | | | | | | | |
| ⊠ | **21P-1** | **3.0** | | | | | | **0.84** | **99.1** |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| | Specimen Identification | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | **21BH-2** | **1.5** | **26.50** | **0.01** | **0.003** | | **8.1** | **9.3** | **35.4** | **47.2** |
| ⊠ | **21P-1** | **3.0** | **26.50** | **0.19** | **0.017** | **0.0019** | **20.0** | **29.4** | **32.9** | **17.8** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

PROJECT **Geotechnical Investigation - 10 Watson Road, East Luther / Grand Valley, Ontario**

JOB NO. **5823-21-GB**
DATE **11/8/21**

## GRADATION CURVES

**Toronto Inspection Ltd.**

**FIGURE NO.1**

# *Appendix A*
# Guidelines of Engineered Fill

# GUIDELINES FOR ENGINEERED FILL

The information presented in this guideline is intended for general guidance only. Site specific and prevailing weather conditions may require modification of the material(s) to be used and the compaction standards or procedures changed. The site preparation and the material(s) to be used must be discussed and procedures agreed with ***Toronto Inspection Ltd.*** prior to the start of the earthworks and must be subjected to on going review during construction.

For fill to be classified as engineered fill, suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

## 1. Areal Extent

The engineered fill must extend beyond the envelope of the structure to be supported. The minimum extent should be 2.0m beyond the envelope in all directions at the foundation level, including the loading dock pad and the front sidewalk, and sloping downwards to the sub-grade at 45°. Once the envelope is set, the structure cannot be moved out of the envelope without consultation with ***Toronto Inspection Ltd.*** Similarly, no excavation should encroach on the engineered fill envelope without consultation with ***Toronto Inspection Ltd.***

## 2. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor. During construction. it is necessary to have qualified surveyors providing control stations on the three-dimensional extent of the engineered fill.

## 3. Subsurface Preparation

Prior to placement of the engineered fill, the sub-grade must be prepared to the satisfaction of ***Toronto Inspection Ltd.*** All deleterious material must be removed and in some cases excavation of native mineral soils may also be required. Particular attention must be paid to wet sub-grade and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching will be necessary and natural drainage paths must not be blocked.

## 4. Suitable Fill Material

All material to be used as fill must be approved by ***Toronto Inspection Ltd.*** Such approval will be influenced by weather factors. External sources of fill material must be sampled, tested and approved prior to material being hauled to the job site.

## 5. Trial Test Section

In advance of the construction of the engineered fill pad, the contractor should conduct a trial test section. The compaction criterion will be assessed for the backfill material to be used, using specified lift thicknesses and number of passes for the compaction equipment proposed by the contractor. To achieve a uniform degree of compaction of each layer, the lift thickness of loose material, prior to start of compaction, must not exceed 200mm (8 inches). Additional trial test section(s) may be required throughout the course of the project to reflect changes in material sources, the moisture content of the material and the weather conditions.

## 6. Degree of Compaction

The minimum degree of compaction for the engineered fill should not be less than 100% of the Standard Proctor maximum dry density, or 95% of the Modified Proctor maximum dry density, to the level at or above 0.3m from proposed footing founding level. Each layer must be tested and approved by this office before the next layer is placed.

## 7. Inspection and Testing

Uniform and thorough compaction is crucial to the performance of the fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be done with full time inspection and to the satisfaction of ***Toronto Inspection Ltd.*** All founding surfaces must be inspected and approved by ***Toronto Inspection Ltd.*** prior to placement of concrete.

## 8. Protection of Fill

Fills are generally more susceptible to the effects of weather than are natural soils. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where inadequate protection had been provided, it may be necessary to provide deeper founding level for footings or to strip and re-compact some of the filled layers.

## 9. Limitations

The engineered fill is subjected to the following limitations:

i. Proper drainage must be maintained at all times within the engineered fill pad.
ii. If the engineered fill is left in place during the winter months, adequate protection must be provided against frost penetration to the proposed footing depths.
iii. If the engineered fill depth exceeds 5m below the foundation depth, the construction of the foundations might have to be delayed for a period of 1 year after placement, depending on the type of fill material used.
iv. Strip footings and foundation walls founded on engineered fill must be reinforced continuously with a minimum of two 15mm steel bars with at least 1m of overlap.