**REPORT ON**
**PRELIMINARY GEOTECHNICAL INVESTIGATION**
**115 WATSON PKWY NORTH**
**GUELPH, ONTARIO**

**REPORT NO.: 4515-22-GC**
**REPORT DATE: MARCH 4, 2022**

**PREPARED FOR**
**TERCOT COMMUNITIES**
**406 - 56 THE ESPLANADE**
**TORONTO, ONTARIO**
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## 1.0 INTRODUCTION

***Toronto Inspection Ltd.*** was retained by Tercot Communities to conduct a preliminary assessment at a property, located at 115 Watson Parkway North (& Starwood Drive) in Guelph, Ontario (hereafter described as "the Site").

It is our understand that the development of the Site will consist of a number of 10-storey buildings and 3-storey townhouse blocks.

The preliminary investigation, carried out at the Site, consisted of drilling a very limited number of boreholes to determine the subsoil and groundwater conditions in the area and, based on the data obtained at the borehole locations, provide our assessment on the design and construction of the conceptual structures. In particular, geotechnical data was to be provided for:

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

It should be noted that the assessment, provided on the basis of the above terms of reference, is based on a very limited data and is intended for the design team for initial construction budgeting.

***Additional investigation will have to be carried out to delineate the subsoil and groundwater conditions, especially at the 10-storey buildings, by additional boreholes, and to confirm the opinions expressed in this report.***

## 2.0 SITE CONDITION

The Site, approximately 6.45 hectares in area, is located between Watson Pkwy North and Watson Road North, beyond the end of Starwood Drive, in Guelph, Ontario.

At the time of the geotechnical investigation, the Site was a vacant parcel of land with sparse grass cover and scattered water accumulation. The site gradient within was relatively flat, slightly dropping towards the south and east.

## 3.0 INVESTIGATION PROCEDURE

The field work for the investigation was carried out on February 17 and 18, 2022. A total of five sampled boreholes (22BH-1 to 22BH-5), extending to depths of 6.4m to 15.7m from grade, were carried out at the locations shown in Drawing No. 1.

The boreholes were advanced using a track mounted drill rig, equipped with continuous flight hollow 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 interpolated from the Topographic Survey of part of Lot 5, Concession 3, Division 'C', City of Guelph, prepared by Speight, Van Nostrand & Gibson Limited, dated February 2, 2004, 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 6) and a section (Drawing No. 7), 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 consisted of a layer of fill, overlying native deposits of sand and gravel, sandy silt till and silty sand deposits.

Brief descriptions of the subsoils, encountered at the borehole locations, were as follows:

### 4.1 Surface Course

It is our understanding that the Site was uplifted / graded with placement of fill in the past. Scattered vegetation was evident at the ground surface at the Site.

## 4.2 Fill

A layer of fill, contacted at the ground surface, at all the borehole locations, consisted of a mixture of sandy silt to silty sand, some gravel with trace to some clayey silt and contained occasional minor rootlets and topsoil.

The fill, at all borehole locations, extended to depths of 0.6m to 2.1m from grade.

Based on the soil quality and the Standard Penetration N-values, in the range of 5 to 28 blows per 0.3m penetration, it appears that the fill might have been placed and compacted under some supervision.

The in-situ moisture content of the soil samples obtained from the fill ranged from 8% to 18%, indicating moist to very moist conditions, with some wet pockets, especially at the ground surface.

## 4.3 Sand and Gravel

Sand and gravel deposit was contacted at all borehole locations, below the fill, at depths of 0.6m to 2.1m from grade. The sand and gravel deposit contained some silty sand and / or sandy silt, with occasional cobbles. Some river sand and gravel was evident at Boreholes 22BH-2 and 22BH-3 locations.

Borehole 22BH-3 was terminated in the sand and gravel deposit at a depth of 6.6m from grade. The sand and gravel, at the remaining boreholes, extended to depths of 4.0m to 6.2m from grade.

Based on the Standard Penetration N-values of 21 to more than 100 blows per 0.3m penetration, the relative density of the sand and gravel deposit were compact to very dense, generally dense to very dense.

The in-situ moisture content of the soil samples retrieved from this deposit ranged from 2% to 25%, indicating moist to wet conditions.

A grain size analysis was carried out on one soil sample from this deposit, obtained from Borehole 22BH-4 (SS6 – at a depth of 4.6m), using mechanical sieves. The grain size distribution is shown on the appended Figure No. 1.

## 4.4 Sandy Silt Till

A sandy silt till deposit was contacted at Boreholes 22BH-1, 22BH-2, 22BH-4 and 22BH-5 locations, below the sand and gravel deposit, at depths of 4.0m to 6.2m from grade. The deposit consisted of a heterogeneous mixture of silt, sand, some clay, some gravel, with occasional layers of silty sand or sandy silt.

Boreholes 22BH-2, 22BH-4 and 22BH-5 were terminated in the sandy silt till deposit at depths of 6.4m to 9.6m from grade. The sandy silt till deposit at Borehole 22BH-1 extended to a depth of 10.1m from grade.

A lower sandy silt till deposit was contacted at Borehole 22BH-1 location, below a silty sand deposit, at a depth of 12.5m from grade. Borehole 22BH-1 was terminated in the lower sandy silt till deposit at a depth of 15.7m from grade.

Based on the Standard Penetration N-values of 24 to more than 100 blows per 0.3m penetration, the relative density of the sandy silt till deposit was compact to very dense, generally dense to very dense.

The in-situ moisture content of the soil samples retrieved from these deposits ranged from 8% to 17%, indicating moist to very moist conditions, with some wet pockets.

## 4.5 Silty Sand

A silty sand deposit was contacted at Boreholes 22BH-1 location, below the sandy silt till deposit, at a depth of 10.1m from grade. The deposit was fine to medium grained and contained trace gravel.

The silty sand deposit, at Borehole 22BH-1 location, extended to a depth of 12.5m from grade.

Based on the Standard Penetration N-values of 79 to 83 blows per 0.3m penetration, the relative density of the silty sand deposit was very dense.

The in-situ moisture content of the soil samples retrieved from this deposit ranged from 16% to 18%, indicating very moist to wet conditions.

## 4.6 Groundwater

Free water and wet cave-in were recorded in the open boreholes, 22BH-2, 22BH-4 and 22BH-5, at depths of 2.4m to 2.9m and 2.9m to 3.0m from grade, respectively, during and upon completion of drilling and sampling. Free water and wet cave-in could not accurately recorded at Boreholes 22BH-1 and 22BH-3 locations, and these boreholes were completed as monitoring wells to determine the static groundwater levels across the Site.

On March 1, 2022, the water levels, measured in the monitoring wells at Boreholes 22BH-1 and 22BH-3, were documented at depths of 3.56m and 4.16m from grade, respectively.

Based on the moisture content profile of the soil samples retrieved from the boreholes, our field observations at the Site and the water levels measured in monitoring wells, it is our opinion that the depths of the free water represent a continuous groundwater table within sand and gravel, and silty sand deposits.

## 5.0 RECOMMENDATIONS

A review of a set of Architectural Drawings of Option 1 for Feasibility Study, prepared by Turner Fleischer, dated February 8, 2022, indicated that the development of the Site will consist of five 10-storey buildings with two levels of underground parking along Watson Parkway North, and a number of townhouse blocks, without basements, at the remaining area, with the associated roadways or parking lot. The ground floor elevations of the proposed buildings and townhouses were not known at the time of preparation of this report. We have assumed that the finished ground floor elevations will be at or above the existing ground level and the slab-on-grade of P2 level will be at depths of 6.0m from grade. The founding levels of the spread footings are assumed to be 1.0m bower than the above slab-on-grade depths, i.e. at or below depths of 7.0m from grade. However, the elevator and the surrounding foundations are anticipated to be deeper than the above assumed levels, at depths of 9.0m from grade.

These assumed foundation depths of the 10-storey buildings are approximately 3.5m to 5.5m below the current static groundwater level at Borehole 22BH-1 location, documented at the monitoring well. Unless a permanent groundwater control system is used to maintain the water level a minimum of 0.5m below the proposed slab-on-grade elevations, we recommend that the part of the underground parking, below the highest anticipated water level, should be designed as a water tight structure and consideration should, therefore, be given to use a raft slab as the foundation of the proposed structure.

Since only a limited number of boreholes were carried out at the Site, additional boreholes must be carried out to obtain additional subsoil and groundwater data and confirm our recommendations.

Based on the borehole profiles, our comments and recommendations are as follows:

## 5.1 Site Preparation

During the site preparation, the contractor must allow for removal of topsoil, deleterious fill and material with high moisture and/or organic content, if encountered, within the building/townhouse envelopes, the access roads and parking area.

The existing fill, as revealed in the borehole locations, appears to have been compacted under some supervision and may be left in place in its current state, for the design and construction of the slab-on-grade of the proposed townhouse. To achieve uniform subgrade conditions, we recommend that after removal of any unsuitable surface soil, the subgrade should be proofrolled, after it has been reviewed by a soils engineer from our office.

Any new fill, placed within the proposed building areas, should consist of organics free soil and compacted in 200mm lifts to at least 98% of its Standard Proctor maximum dry density.

## 5.2 Foundation Design

The proposed buildings and townhouses can be supported on conventional spread/strip footings, founded on the existing fill and native undisturbed strata of sand and gravel, and sandy silt till deposits.

The soils at the proposed building locations consist of predominately non-cohesive fill and native deposits, and vertical excavation, without side supports, will not be stable. Trench and pour method will not be feasible.

**Townhouses (Boreholes 22BH-3 to 22BH-5)**

Spread or strip footings, founded in the existing compact fill or native sand and gravel deposit, at or below depths of 1.2m from the existing grade, can be designed using the following bearing pressures:

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

For strip foundations placed in the compact fill, we recommend 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.

**10-Storey Buildings (Boreholes 22BH-1 and 22BH-2)**

The subsoil at the assumed founding depths of 7.0m to 9.0m from grade are anticipated to consist of very dense sandy silt till deposit at Boreholes 22BH-1 and 22BH-2 locations.

Spread or strip footings, founded in the very dense sandy silt till deposit, at depths of 7.0m to 9.0m from grade, at Boreholes 22BH-1 and 22BH-2 locations, can be designed using the following bearing pressures:

- at Factored Ultimate Limit State = 1000 kPa
- at Serviceability Limit State = 600 kPa

The founding subsoil between and beyond Borehole 22BH-1 and 22BH-2 locations, could vary and it will be necessary to carry out additional investigations, a minimum of two boreholes per building, to confirm that the soil is similar to that encountered at the borehole locations and is capable of saffely sustaining the recommended design bearing pressures.

If the groundwater table cannot be maintained below the slab-on-grade, each building will have to be designed as a watertight structure, below the highest anticipated static groundwater level, founded on a raft slab. The raft foundation can be designed using bearing pressures of 600 kPa at the Serviceability Limit State. A modulus of subgrade reaction of 80 $MN/m^3$ can be used for the design of raft slab on the very dense deposit. The highest anticipated groundwater level should be as established by a hydrogeological study.

For the construction of the raft foundation, provision will have to be made to provide a space between the top of the raft and the slab-on-grade, for the installation of sewers and any other in-ground services.

The base of the raft foundation is anticipated to be up to 5.5m below the current static groundwater levels and will be subject to an uplift pressure of approximately 55 kPa. In addition, provision will have to be made for a rise in the groundwater levels, within the excavation, during heavy rain / wet season. We, therefore, recommend that the temporary dewatering system must not be decommissioned until the total combined weight of the raft and the structure is at least 75 kPa - a factor of safety of F=1.33. The structural engineer will have to certify the loads, before decommissioning the temporary dewatering system.

***Since only a limited number of boreholes were carried out at the Site, additional boreholes will have to be carried out and the geotechnical investigation report revised accordingly.***

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 or provided with an equivalent thermal protection.

There is no official rule governing the footing depth for a fully enclosed unheated garage. Unmonitored experience in the past has shown that footing depths of less than the frost penetration depths of 1.2m in the Greater Toronto Area have been adequate. For the two levels of underground parking, the interior columns / walls and the perimeter wall footings can be founded at depths of 0.8m and 0.6m respectively below the top of the garage slab. However, footings adjacent to the fresh air ducts, the entrance of the garage and any other areas which may be exposed to the outside, a minimum frost cover of 1.2m should be provided. In addition, a nominal 50mm of Styrofoam insulation should be provided under the floor slab within the close proximity to the fresh air ducts.

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. 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. The bedding should be compacted to at least 100% SPMDD.

For raft foundation design, the space between the top of the raft foundation and the slab-on-grade, for installation of sewers and other in-ground services, can be filled with 19mm clear stone. The floor slab can be poured directly over the clear stone backfill.

### 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 in soil should be sloped back to a safe angle of 45° or flatter. For excavation into the saturated soils, the slope of excavation should be flattened to a safe condition.

Groundwater problem is not anticipated for excavations up to a depth of 2.4m from the existing ground level. Slight seepage may be encountered from the fill layer and/or from sand and gravel deposit. It is our opinion that the amount of water will not be great and can be handled by installing filtered sumps in the excavation during construction. The accumulated water can be removed by pumping. Below this depth, de-watering will be required in excavation for the foundations.

Selected on-site excavated soils can be reused for backfilling, provided they are free of organics and compressible material. 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. Clear stone (HL-6 or 19mm maximum) may be used as bedding in saturated/wet subsoils provided that the stone bedding is completely surrounded by a geotextile, Terrafix 270R or equivalent.

At locations where adequate space will not be available for an open cut excavation, temporary shoring will have to be used to support the vertical faces of the excavation. The shoring design parameters and our recommendations on the installation and testing of the shoring system are provided in Appendix A of this report.

## 5.6 Lateral Earth Pressure

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

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

| | | |
|---|---|---|
| where | $P$ = Lateral earth pressure | kPa |
| | $K_o$ = Lateral earth pressure coefficient | 0.4 |
| | $\gamma$ = Bulk unit weight of the soil | 21.5 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.

For part of the structure is below the static groundwater table, it should be designed as a water tight structure. The lateral pressure of the structure, to a minimum of one metre above the static water level, should be computed using the following expression:

$$\mathbf{P_s} = K ( \gamma' H_s + q ) + \gamma_\omega H_s$$

| | | |
|---|---|---|
| where | $\mathbf{P_s}$ = Lateral earth pressure below the water table | kPa |
| | $K$ = Lateral earth pressure coefficient | 0.4 |
| | $\gamma'$ = Submerged unit weight of the soil | 11.7 kN / m$^3$ |
| | $H$ = Depth of the wall below the water level | m |
| | $\gamma\omega$= Unit weight of water | 9.8 kN / m3 |
| | $q$ = Surcharge loads adjacent to the basement wall | kPa |

## 5.7 Permanent Perimeter Drainage

Permanent perimeter drains should be provided around the underground structure. At the shoring location, the permanent perimeter drain should consist of a prefabricated continuous blanket of Miradrain 6000 or its equivalent, as shown in Figure No. 2, provided permanent groundwater control is used to maintain the water level below the slab-on-grade. The installation of this type of vertical drainage system and its connections should be carried out as per the manufacturer's specifications.

## 5.8 Groundwater Control

The hydrogeological study should be carried out and referred for source of the groundwater, the groundwater table and the temporary / permanent groundwater control.

## 5.9 Pavement Construction

The subgrade soils of the proposed roads, driveways and parking lot are anticipated to consist of sandy silt to silty sand with gravel and clayey silt.

The following minimum pavement design thicknesses are recommended 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 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.

Roads and driveways to be assumed by the local municipality should be constructed to the municipal standards.

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.

Continuous perforated, OPSS 405, longitudinal drains, minimum diameter of 100mm, should be used as sub-drains, on both sides of the roadways. The sub-drains should be installed on a positive gradient towards the outlets (collecting into catch basins), at a minimum depth of 800mm below the pavement level, 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 sub-base of the pavement. This will help in draining the pavement structure and minimize the differential heave of the pavement.

Catch basins and manholes should be backfilled with OPSS Granular B material. The catch basins should be perforated just above the drain level and the weep holes should be screened with a filtered fabric. This will help the pavement structure as well as alleviate the differential movement of the catch basins or the manholes due to the frost action.

## 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.**

LICENSED PROFESSIONAL ENGINEER
S. WANG
100131918
March 4, 2022
PROVINCE OF ONTARIO

David S. Wang

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

REGISTERED PROFESSIONAL ENGINEER
USS
U.S. SAPPAL
March 4, 2022
PROVINCE OF ONTARIO

**Upkar S. Sappal, P.Eng.**
**Principal Engineer**

# ***Drawings & Figures***

Borehole Location Plan

Borehole Logs

Section

Gradation Curve

Permanent Perimeter Drainage System


LEGEND:

Borehole and Monitoring Well Location

Site Boundary

NOT TO SCALE


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| | |
|---|---|
| TITLE: | Borehole and Monitoring Well Location Plan |
| LOCATION: | 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario |

| PROJECT NO. | DATE : | DRAWING NO. |
|---|---|---|
| 4515-22-GC | February 2022 | 1 |


LEGEND:

Borehole and Monitoring Well Location

Site Boundary

NOT TO SCALE


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|---|---|---|
| 4515-22-GC | February 2022 | 1 |

# Log of Borehole 22BH-1 (MW)

Project No. 4515-22-GC

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

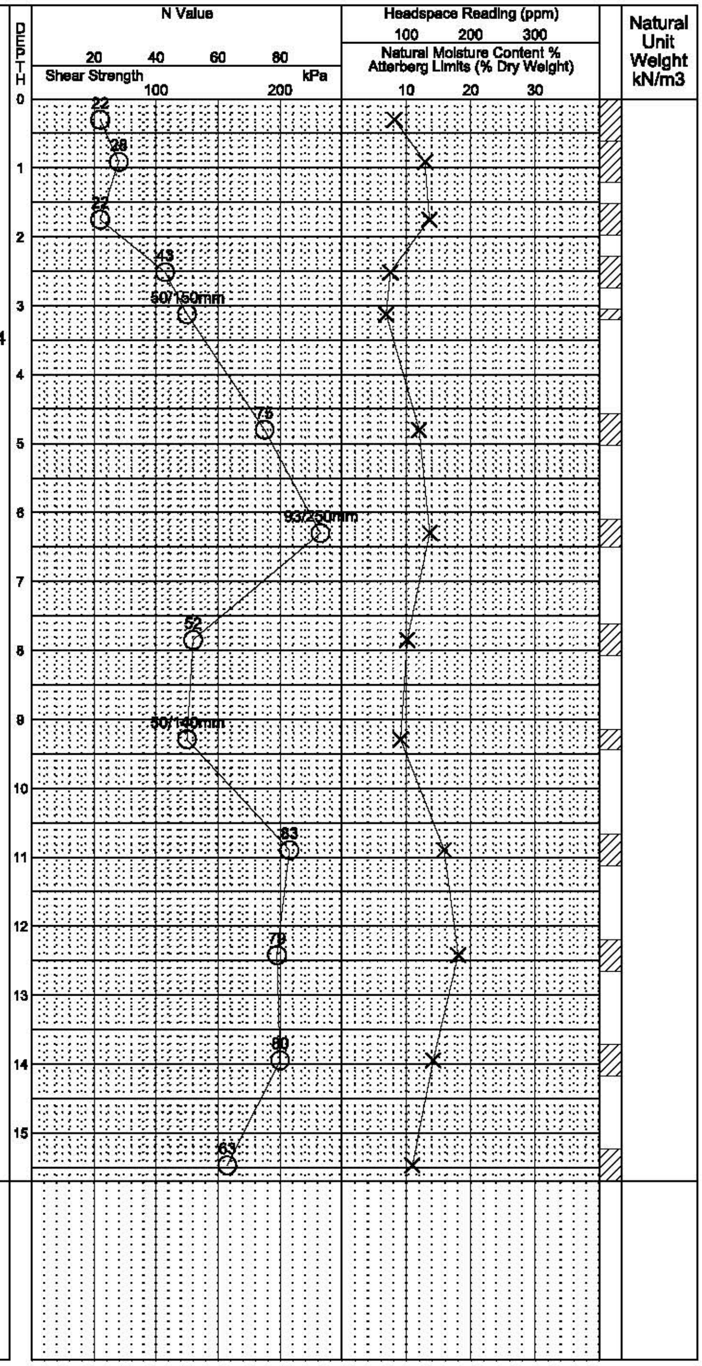
Date Drilled: 2/17/22

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 | ✚ S | Penetrometer | ▲ |

| Soil Description | ELEV. m |
|---|---|
| Ground Surface | 327.20 |
| **FILL**<br>- brown sandy silt<br>- some sand, some gravel<br>- some silty sand<br>- occasional pockets of topsoil<br>- moist to very moist, wet pockets | 325.07 |
| **SAND AND GRAVEL**<br>- dense to very dense, brown<br>- some silty sand<br>- moist | 323.64<br>321.71 |
| **SANDY SILT TILL**<br>- very dense<br>- brown, grey below 7.5m<br>- a layer of silty sand at 6.1m<br>- some gravel, some clayey silt<br>- moist to very moist, wet pockets | 317.14 |
| **SILTY SAND**<br>- very dense, grey<br>- fine to medium grained<br>- trace gravel<br>- very moist to wet | 314.70 |
| **SANDY SILT TILL**<br>- very dense, grey<br>- some gravel, some clayey silt<br>- moist to very moist, wet pockets | 311.50 |
| **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling: | |




LGBE3 4515-22-GC.GPJ 3/3/22

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) |
|---|---|---|
| Mar. 1, 2022 | 3.56m | |

Project No. 4515-22-GC

# Log of Borehole 22BH-2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

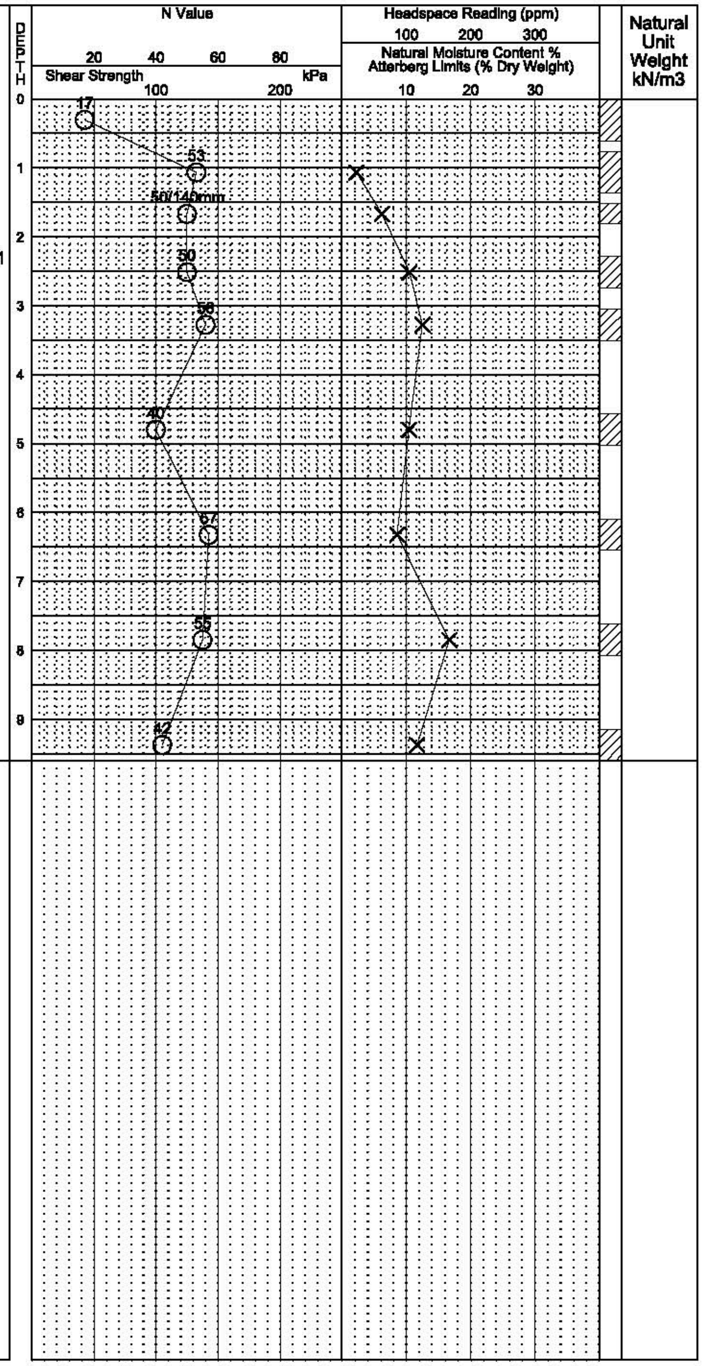
Date Drilled: 2/17/22

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 | ✚ S | Penetrometer | ▲ |

| Soil Description | ELEV. m |
|---|---|
| Ground Surface | 325.71 |
| **FILL** - brown silty sand - some gravel - wet | 325.10 |
| **SAND AND GRAVEL** - very dense, brown - some silt - very moist to wet | 323.31 (GWL) |
| | 321.75 |
| **SANDY SILT TILL** - dense to very dense - brown, grey below 7.5m - some gravel, some clayey silt - occasional layers of sandy silt - moist to very moist, wet pockets | 316.11 |
| **END OF BOREHOLE** **NOTE:** Upon completion of drilling: - water level at 2.4m - cave-in at 2.9m | |




LGBE3 4515-22-GC.GPJ 3/3/22

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. 4515-22-GC

# Log of Borehole 22BH-3 (MW)

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 2/18/22

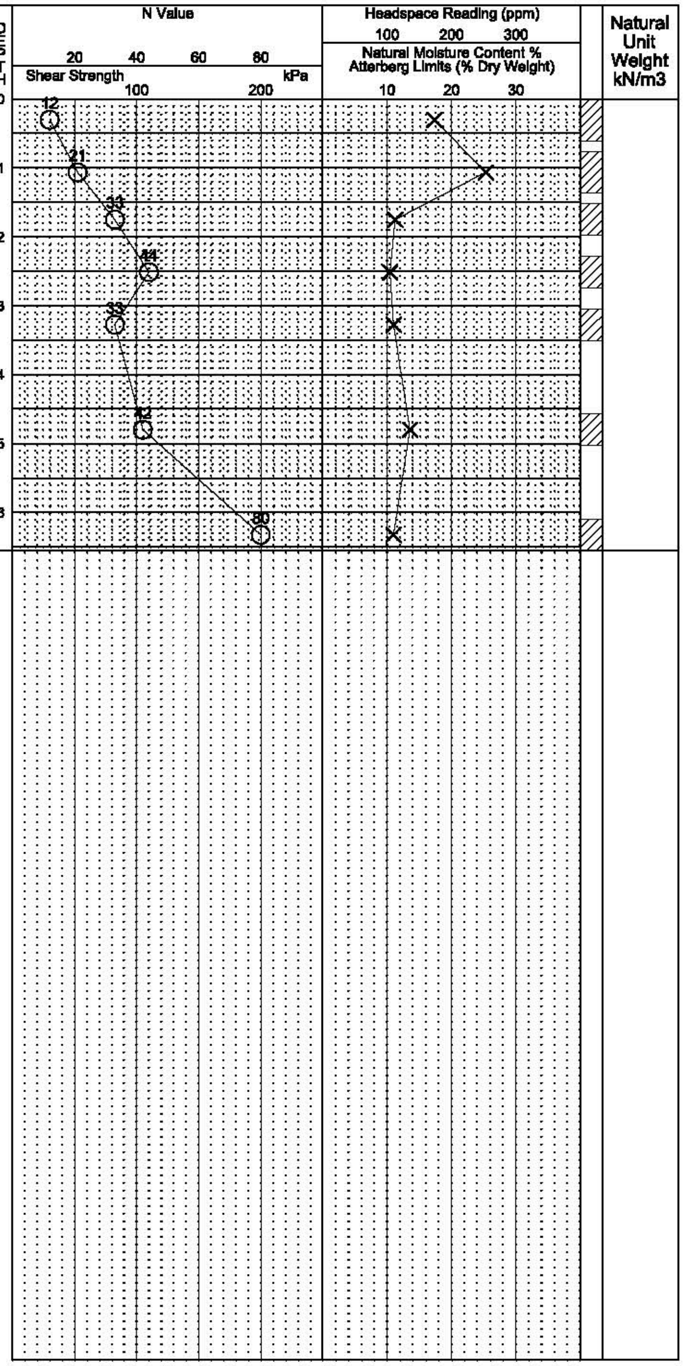
Drill Type: Track Mounted Drill Rig

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 | ▲ |

| G.W.L. | SYMBOL | Soil Description | ELEV. m | DEPTH |
|---|---|---|---|---|
| | | Ground Surface | 324.21 | 0 |
| | | **FILL**<br>- brown sandy silt<br>- very minor rootlets<br>- some gravel, trace clayey silt<br>- wet | 323.30 | 1 |
| | | **SAND AND GRAVEL**<br>- compact to very dense<br>- brown, grey below 4.5m<br>- occasional trace silt<br>- with river sand and gravel below 4.5m<br>- very moist to wet | 322.05 | 2, 3, 4, 5, 6 |
| | | | 317.66 | |

**END OF BOREHOLE**
**NOTE:**
Upon completion of drilling:




LGBE3 4515-22-GC.GPJ 3/3/22

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) |
|---|---|---|
| Mar. 1, 2022 | 2.16m | |

Project No. 4515-22-GC

# Log of Borehole 22BH-4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

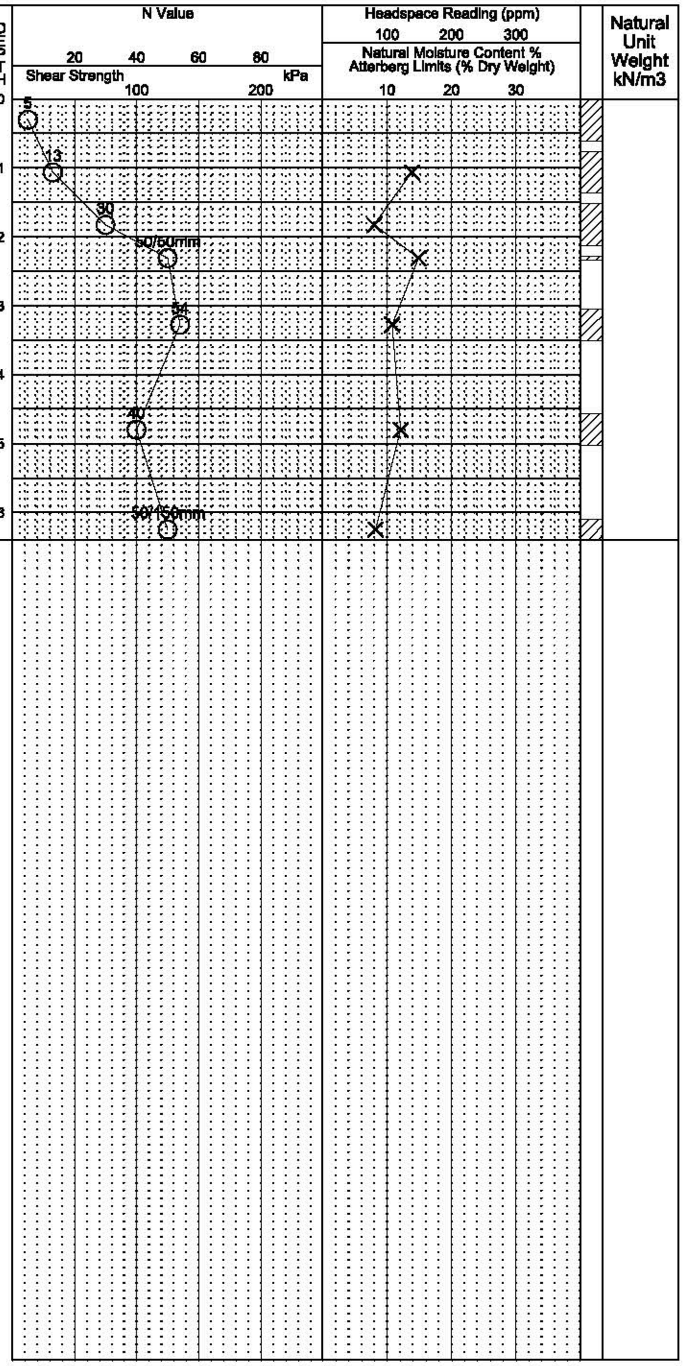
Date Drilled: 2/18/22

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 | ✚ S | Penetrometer | ▲ |

| GWL | SYMBOL | Soil Description | ELEV. m | DEPTH |
|---|---|---|---|---|
| | | Ground Surface | 326.01 | 0 |
| | | **FILL**<br>- brown sandy silt to silty sand<br>- some gravel<br>- trace topsoil at 1.5m<br>- wet to very moist | 324.33 | 1 |
| ▼ | | **SAND AND GRAVEL**<br>- dense to very dense, brown<br>- occasional cobbles<br>- with river sand and gravel below 4.5m<br>- wet | 323.11<br>319.76 | 2<br>3<br>4<br>5<br>6 |
| | | **SANDY SILT TILL**<br>- very dense, grey<br>- some gravel, some clayey silt<br>- moist | 319.61 | |
| | | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- water level at 2.9m<br>- cave-in at 3.0m | | |




LGBE3 4515-22-GC.GPJ 3/3/22

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. 4515-22-GC

# Log of Borehole 22BH-5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

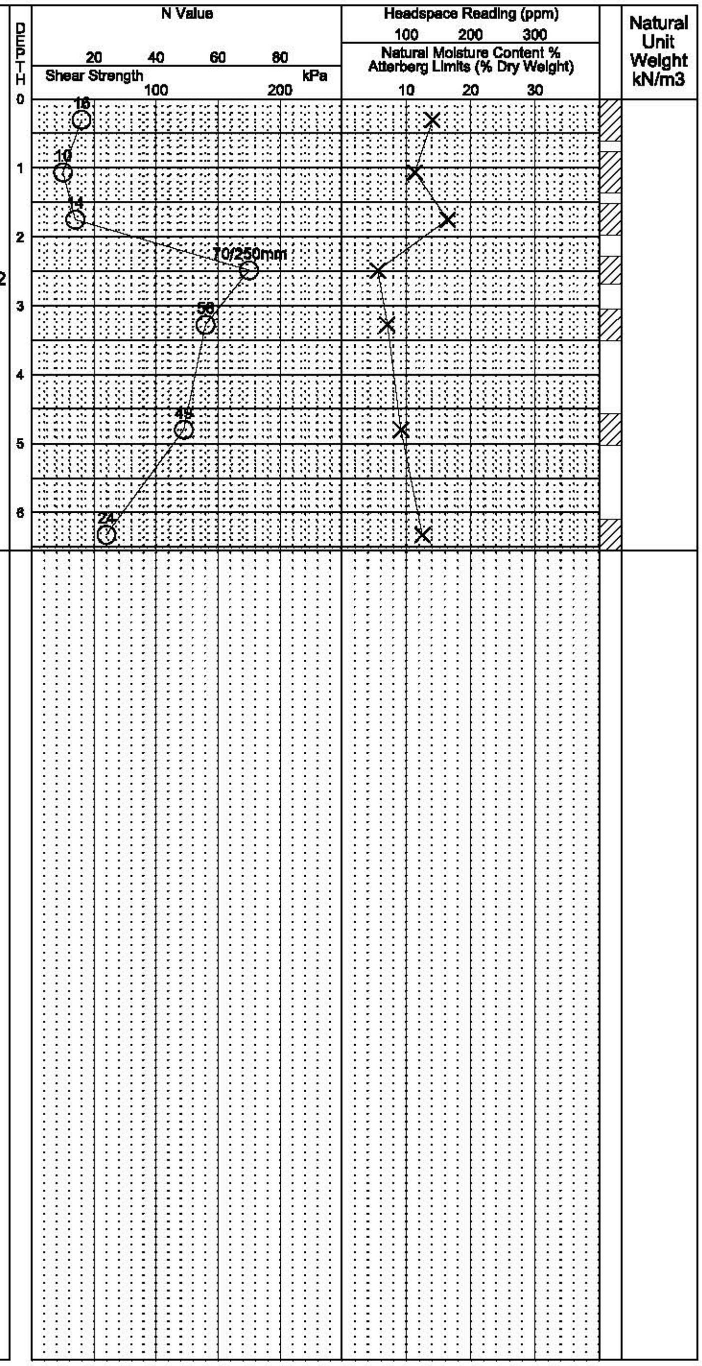
Date Drilled: 2/17/22

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 | ✚ S | Penetrometer | ▲ |

| GWL | Soil Description | ELEV. m |
|---|---|---|
| | Ground Surface | 324.52 |
| | **FILL**<br>- brown sandy silt<br>- some gravel, some sand<br>- minor topsoil at 1.8m<br>- very moist to wet | |
| | | 322.54 |
| ▼ | **SAND AND GRAVEL**<br>- very dense to dense, brown<br>- some silty sand<br>- occasional cobbles<br>- moist to very moist | 321.82 |
| | | 319.03 |
| | **SANDY SILT TILL**<br>- compact, grey<br>- some gravel, some clayey silt<br>- very moist | 317.96 |
| | **END OF BOREHOLE**<br>**NOTE:**<br>Upon completion of drilling:<br>- water level at 2.7m<br>- cave-in at 3.0m | |

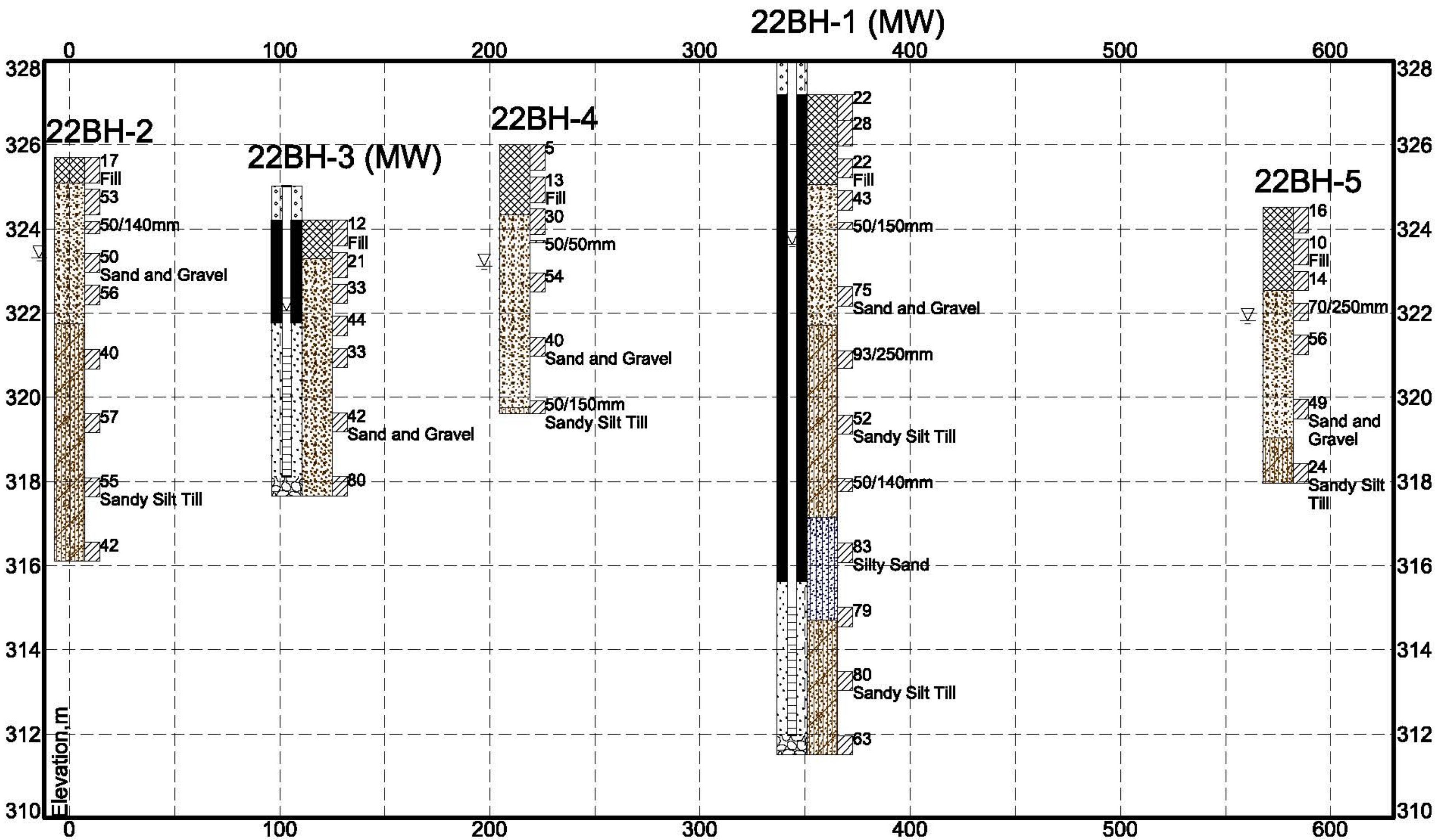



LGBE3 4515-22-GC.GPJ 3/3/22

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) |
|---|---|---|
| | | |



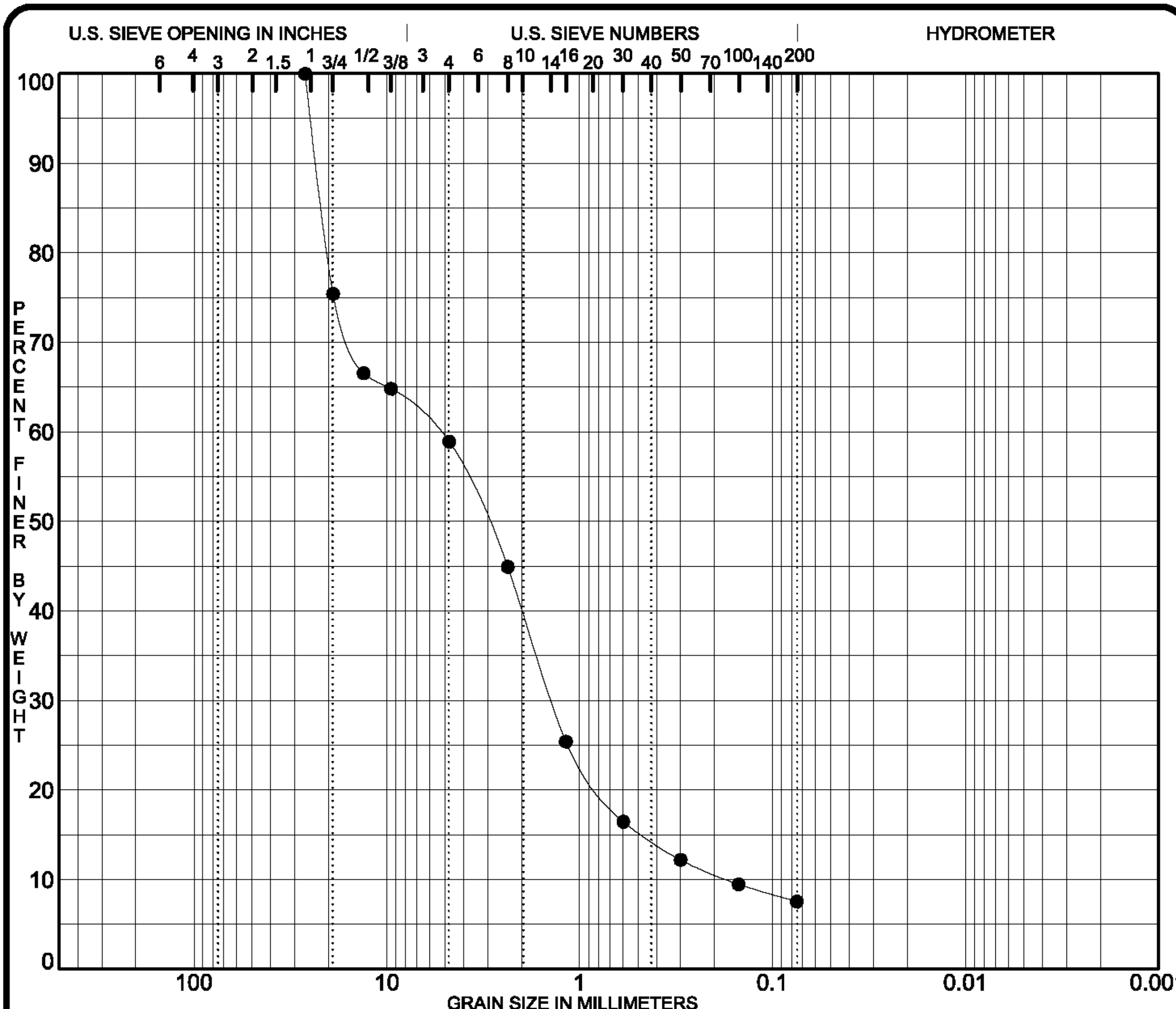

| Borehole No | Elev. | Depth |
|---|---|---|
| 22BH-1 (MW) | 327.2 | 15.7 |
| 22BH-2 | 325.7 | 9.6 |
| 22BH-3 (MW) | 324.2 | 6.6 |
| 22BH-4 | 326.0 | 6.4 |
| 22BH-5 | 324.5 | 6.6 |
| | | |
| | | |

Toronto Inspection Ltd.

SUBSURFACE STRATIGRAPHY
Section

Geotechnical Investigation
115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

| PROJECT # | DATE | DRAWING |
|---|---|---|
| 4515-22-GC | Feb 22 | 7 |




<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT OR CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

| Specimen Identification | | Classification | MC% | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● 22BH-4 | 4.6 | | | | | | 2.08 | 31.4 |

| Specimen Identification | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● 22BH-4 | 4.6 | 26.50 | 5.39 | 1.389 | 0.1716 | 41.1 | 51.4 | 7.5 | |

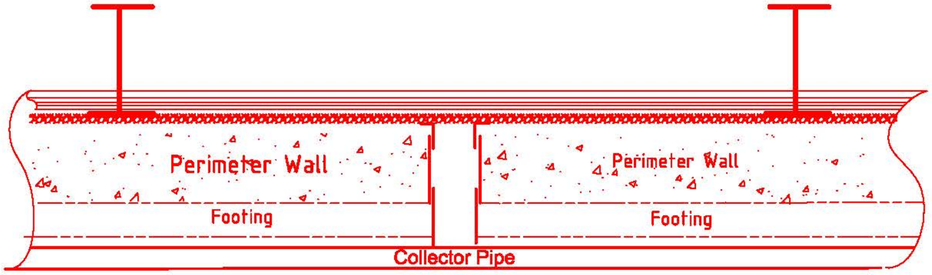
PROJECT **Geotechnical Investigation - 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario**

JOB NO. **4515-22-GC**
DATE **3/1/22**

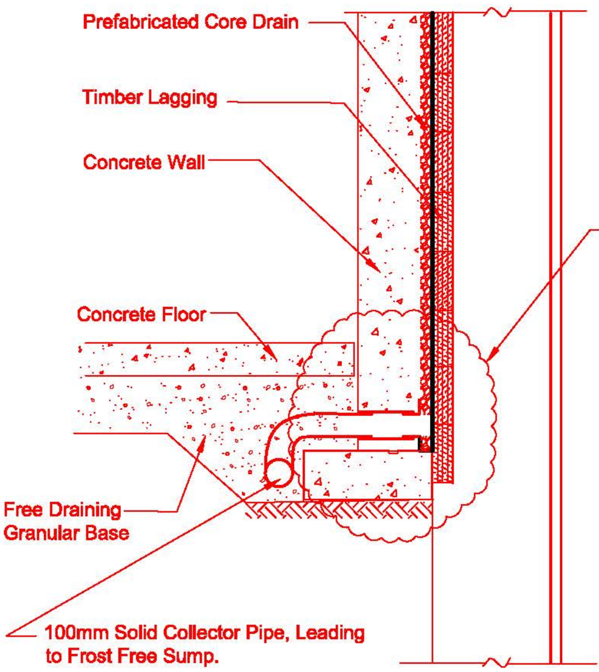
## GRADATION CURVES

**Toronto Inspection Ltd.**

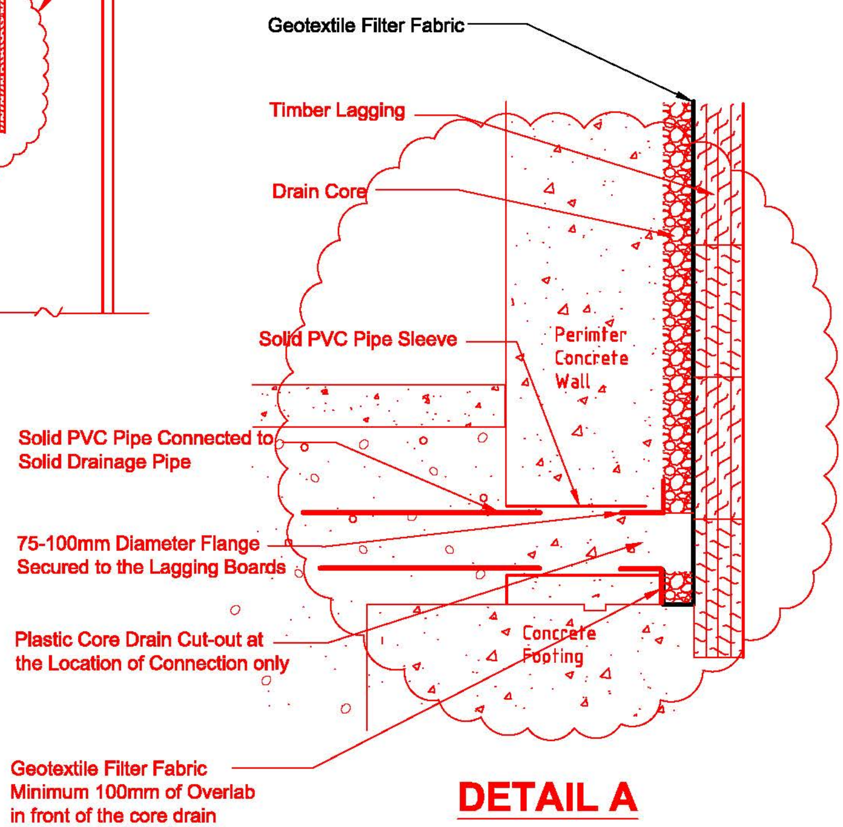
**FIGURE NO.1**




## PLAN




## TYPICAL SECTION




## DETAIL A

**Note:**

1. A continuous blanket of prefabricated drainage system, Miradrain 6000 or equivalent, should extend continuously from the top of footings to approximately 1.2m below the ground surface.
2. All joints of the Miradrain should be taped. All openings, including the exposed end above the footing, must be covered with filter fabic to prevent intrusion of concrete into the core of the drain.
3. The backfill behind the lagging must be free draining. Filter fabric or straw should be used to prevent loss of fines behind the lagging.
4. The perimeter drainage and subfloor drainage systems must be kept separate.

NOT TO SCALE

| | |
|---|---|
| TIL TorontoInspection LTD. GEO-ENVIRONMENTAL CONSULTANTS | TITLE: Permanent Perimeter Drainage System |
| 110 Konrad Crescent, Unit 16, Markham, Ontario L3R 9X2<br>Tel: 905-940 8509 Fax: 905-940 8192 Email: TIL@torontoinspection.com | FIGURE NO. 2 |

# ***APPENDIX A***
## *Shoring Design*

# APPENDIX A
# SHORING DESIGN

All specifications for the design of the shoring system are in accordance with Chapter 26 of the 4th Edition of the Canadian Foundation Engineering Manual (Manual).

The construction of the shoring system should be carried out by a contractor experienced in this type of construction.

## 1. Earth pressure

For a single and multiple level support systems, the recommended earth pressure distributions are shown on Drawing A1.

The lateral earth pressure expressions, recommended in the drawings, assume that there will be no build up of hydrostatic pressure behind the shoring.

## 2. Pile Penetration

The soldier piles should be installed in pre-augured holes which should be filled to excavation level with 20 MPa (3000 psi) concrete and above that with 1-1/2 bag mix.

The depth of pile penetration in the non-cohesive sandy silt till to silty sand deposits should be calculated from the following expressions:

$$R \text{ (sandy silt till to silty sand)} = 1.5\ D\ Kp\ L^2 \gamma$$

| | | | |
|---|---|---|---|
| where | R | = Ultimate Load to be restrained | kN |
| | D | = Diameter of concrete filled hole | m |
| | Kp | = Passive resistance in the sandy silty till deposit | 5.0 |
| | L | = Embedment Depth of the pile | m |
| | $\gamma$ | = Unit weight of the soil - use 21 $kN/m^3$ for unsaturated soils | |

The shoring system should be designed for a factor of safety of F = 2. The overall factor of safety of the anchored block of soil must be considered.

## 3. Lagging Boards

The following thicknesses of lagging boards have been recommended in the Manual:

| Thickness of lagging | Maximum Spacing of Soldier Piles |
|---|---|
| 50 mm ( 2 in ) | 2.0 m (6.5 ft ) |
| 75 mm ( 3 in ) | 2.5 m ( 8.0 ft ) |
| 100 mm ( 4 in ) | 3.0 m ( 10 ft ) |

Local experience has indicated that the lagging thickness of 75 mm has been adequate for soldier pile spacing of 3 m for soil conditions similar to those encountered at the subject site. However, it is important to consider all local conditions, such as the duration of excavation, the weather likely to be encountered, seasonal variations in the ground water and ice lensing causing frost heave in determining the lagging thickness.

**All spaces behind the lagging must be filled with free draining granular fill.** If wet conditions are encountered the space between boards should be packed with geotextile filter fabric or straw to prevent loss of ground.

## 4. Tie Backs

The minimum spacing and the depths of the soil anchors should be as recommended in the Manual.

The tie back anchor lengths, in the non-cohesive sandy silt till to silty sand deposits, can be estimated using an adhesion values of 50 kPa (1000 psf). At least two full scale load tests should be carried out on the tieback anchors in each of the above subsoils. These tests should be taken to 200% of the design load or until there is a significant increase in the pullout rate. In the latter case, the design load must be limited to 50% of the load at which the pullout increases. Based on the results of the pullout test, it may be necessary to modify the anchor design and place limits on the capacity.

In addition, each anchor must be proof loaded. This is done by loading the anchor to 133% of the design load, and the anchor must be capable of sustaining this load for a minimum of 10 minutes without creep. The load may then be relaxed to 100% of design and locked in. The higher the lock in loads, the less will be the outward movement after excavation.

The proposed design of the tie-back system and method of installation must be discussed with this office prior to the finalization. Systems involving high grout pressures should be avoided if working near other basements or buried services.

## 5. Rakers

An alternative to tie backs is to use rakers. Rakers founded in sandy silt till deposit should be designed for allowable bearing pressures of 300 kPa (6.0 k.s.f.), for rakers inclined at an angle of 45 degrees.

The raker footings should be located outside the zone of influence of the buried portion of the soldier piles and at a distance of not less than 1.5 L from the piles, where L = the embedment of the pile. No excavation should be made within two footing width of the raker footings on the side opposite the rakers.

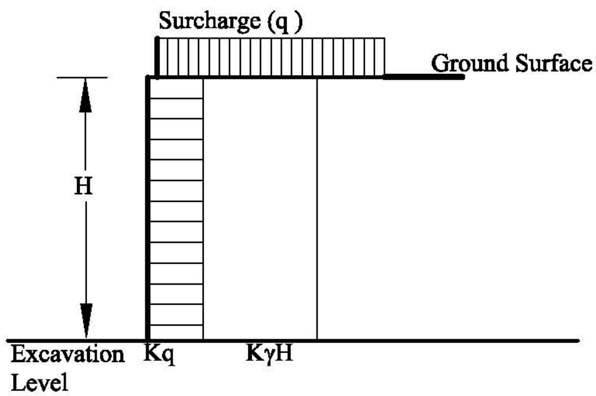
## 6. General Shoring Notes

It is recommended that close monitoring of vertical and lateral movement of the shoring system should be carried out at the site. If movements at the top of the piles are more than 12 mm (0.5 in), extra bracing may be required. In this regard, monitoring by inclinometers and by survey on targets should be instituted to ensure that the contractor maintains movements within design limit.

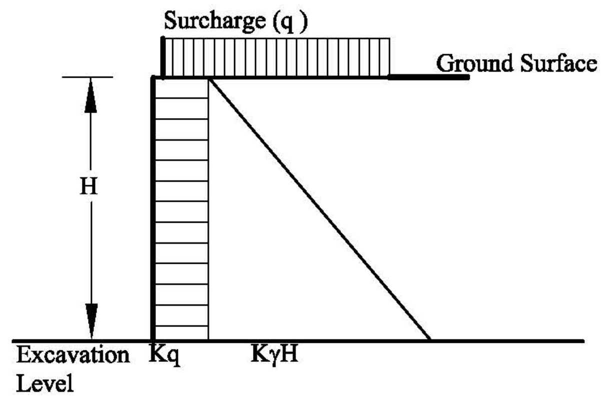
# TEMPORARY SHORING

## Laterial Pressure

### I. Multiple Level Support




### II. Single Level Support




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

where H = Height of Shoring m
$\gamma$ = Unit Weight of Retained Soil 21.0 kN/ $m^3$
q = Surcharge kPa
K = Earth Pressure Coefficient

If moderate ground and shoring movements are permissible then:
K = Ka = Active Earth Pressure Coeffiecient = 0.25

If there are building foundions or underground services within a distance of 0.5 H behind the shoring then:
K = Ko = Earth Pressure at rest = 0.4

If there are building foundations or underground services within a distance of between 0.5 H and H behind the shoring then:
K = 0.5 ( Ka + Ko ) = 0.33

Note:
The lateral pressure equation assumes effective drainage from behind the temporary shoring

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110 Konrad Cresent, Unit 16, Markham, Ontario L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192

TITLE: Temporary Shoring Design

DRAWING NO.: A1