GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL DEVELOPMENT
VICTORIA STREET
AYTON, ONTARIO

CMT Project 24-099.R01

Prepared for:

Cobide Engineering Inc.

May 23, 2024

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel: ***519-699-5775***
Fax: ***519-699-4664***
www.cmtinc.net

May 23, 2024 24-099.R01

Cobide Engineering Inc.
517 – 10th Street
Hanover, Ontario
N4N 1R4

Attention: Stephen J. Cobean, P. Eng., FEC

Dear Stephen:

Re: Geotechnical Investigation
Proposed Residential Development
Victoria Street
Ayton, Ontario

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above-referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Brandon Figg

Brandon R Figg, C.Tech.
Senior Soil Technician

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1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Stephen J. Cobean of Cobide Engineering Inc. to conduct a geotechnical investigation for the proposed residential development to be constructed at Victoria Street in Ayton, Ontario. The location of the site is shown on Drawing 1.

It is understood that the residential subdivision development is proposed to comprise the construction of twelve (12) single family residential lots and a potential stormwater management facility. The lots will be serviced by individual potable water wells and on-site septic systems.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; soil design properties; infiltration; percolation rate and a summary of the laboratory results.

The recommendations in this report are solely based on the soil conditions encountered in the boreholes advanced on the subject property during this investigation.

2.0 EXISTING SITE CONDITIONS

The subject site is currently agricultural land which has recently been used for crop production. The site is bounded by existing agricultural land to the north, existing residential developments to the east and the South Saugeen River to the south and west. In general, the site topography slopes down from the north-east to the south-west towards the South Saugeen River.

3.0 FIELD AND LABORATORY PROCEDURES

Prior to the commencement of the field drilling program, public utility locates were organized by CMT Inc. to ensure that underground utilities would not be damaged, or personnel injured.

The field investigation advanced on April 16, 2024 and comprised the advancement of six (6) boreholes (referenced as Boreholes 1 to 6, inclusive), utilizing a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. Borehole 1 was advanced to a depth of approximately 4.57 m (15.0 ft) below the existing ground surface elevation, while Boreholes 2, 3, 4 and 6 were advanced to depths of approximately 5.18 m (17.0 ft) below the existing ground surface elevation and Borehole 5 was advanced to a depth of approximately 2.90 m (9.5 ft) below the existing ground surface elevation.

Standard penetration testing and sampling was carried out in Boreholes 1 to 6, inclusive using a 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) intervals to 3.05 m (10.0 ft) depth, and every 1.52 m (5.0 ft) thereafter, to borehole termination. Macro core (MC5) direct push sampling in accordance with ASTM D6282/D6282M-14 "Standard Guide for Direct Push Soil Sampling" was typically conducted between the SPT soil samples conducted below 3.05 m (10.0 ft) depth at the boreholes.

Technical staff from CMT Inc. observed the drilling operation, as well as collected and logged the recovered soil samples. A small portion of each soil sample was placed in a sealed, marked jar for moisture content determination.

Representative soil samples from the following boreholes and depths were submitted to the CMT Inc. laboratory in St. Clements, Ontario for grain size analyses:

- Borehole 1 - depth 0.76 m to 1.37 m (2.5 ft to 4.5 ft),
- Borehole 2 - depth 3.05 m to 3.66 m (10.0 ft to 12.0 ft),
- Borehole 3 - depth 0.33 m to 0.61 m (1.1 ft to 2.0 ft),
- Borehole 4 - depth 0.76 m to 1.37 m (2.5 ft to 4.5 ft),
- Borehole 4 - depth 3.66 m to 4.57 m (12.0 ft to 15.0 ft),
- Borehole 5 - depth 0.76 m to 1.37 m (2.5 ft to 4.5 ft), and
- Borehole 6 - depth 1.52 m to 2.13 m (5.0 ft to 7.0 ft).

The borehole logs are provided in Appendix A and the resulting grain size analyses are found in Appendix B.

The ground surface elevations at the borehole locations were reported to CMT Inc. by Cobide Engineering Inc, and ranged from approximately 311.76 m to 340.52 m. The locations of the boreholes are shown in Drawing 2.

4.0 __SUBSOIL CONDITIONS__

The soils encountered in the boreholes are described briefly below with more detailed stratigraphic descriptions provided on the borehole logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the borehole locations.

4.1. ***Topsoil***

Very loose to loose, moist, dark brown, silty organic topsoil was encountered at the surface of the boreholes. The thickness of the topsoil encountered at the borehole locations ranged between approximately 125 mm and 325 mm (average 225 mm), and it should be expected that the surficial topsoil thickness will vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.2. ***Sandy Silt/Sandy Gravel/Gravel and Sand/Sand and Gravel***

Grey to brown/dark brown sandy silt, with some gravel and clay and/or sandy gravel, with some silt, trace clay and/or gravel and sand, with some silt, trace clay and/or sand and gravel, with some silt, trace clay was encountered underlying the topsoil in Boreholes 1 to 6, inclusive. The soils were considered to be very loose to very dense, with SPT N-values ranging from 1 to greater than 100 blows per 0.30 m (average 50 blows per 0.30 m). The soils were considered to be moist to wet, with moisture contents ranging from approximately 3.3% to 23.6% (average of 13.5%).

4.3. ***Sandy Gravelly Silt Till***

Brown and/or grey and/or light grey/brown sandy gravelly silt till, with trace clay was encountered underlying the sandy silt in Borehole 1 and 3; underlying the sandy gravel in Borehole 2 and 4; and underlying the sand and gravel in Borehole 6. The till was considered to be compact to very dense, with SPT N-values ranging from 24 to greater than 100 blows per 0.30 m (average 62 blows per 0.30 m). The till was considered to be moist with occasional wet seams, with moisture contents ranging from approximately 6.4% to 11.5% (average of 9.0%).

4.4. ***Groundwater***

Moist to wet soil conditions, with occasional wet seams were encountered in the boreholes. It should be noted that the compact to very dense, typically fine-grained till soils observed in the boreholes have the potential to create perched water conditions. These conditions would be expected to occur near the interface of the looser upper soils and the compact to very dense lower soils. Groundwater conditions (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. Groundwater levels and/or wet to saturated soil conditions (if encountered) during construction could make excavations difficult, and it should be expected that caving or sloughing of the excavation walls will occur when excavating into wet to saturated zones.

The approximate zone of very moist to wet soils observed in all of the boreholes, as well as the ground surface and bottom of borehole elevations, are provided in the following table:

Borehole No.	**Estimated Ground Surface Elevation (m)**	**Estimated Zone of Very moist to Wet Soil at the Time of Investigation Elevation (m)**	**Approximate Depth Below Ground Surface of Estimated Zone of Very Moist to Wet Soil at the Time of Investigation (m)**	**Bottom of Borehole Elevation (m)**
BH 1	340.52	336.10 to 335.95	4.42 to 4.57	335.34
BH 2	329.08	328.32 to 326.03	0.76 to 3.05	323.90
BH 3	324.76	324.44 to 324.00 323.24 to 321.71 321.10 to 320.62	0.33 to 0.76 1.52 to 3.05 3.66 to 4.14	319.58
BH 4	315.53	313.24 to 312.48	2.29 to 3.05	310.35
BH 5	311.76	--	--	308.86
BH 6	316.06	313.01 to 312.40	3.05 to 3.66	310.88

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report.

5.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides an interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the owner and design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like.

Utilizing the information gathered during the geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the boreholes, the following table provides a summary of the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) at the various elevations, including soil type:

Borehole No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevation (m)	Depth to Highest Founding Elevation (m)	Soil Type
BH 1	340.52	150 (3,000)	225 (4,500)	339.00 to 337.47	1.52	Sandy Silt/Till
		250 (5,000)	325 (6,500)	337.47 to 335.34 (termination)	3.05	Till
BH 2	329.08	75 (1,500)	125 (2,500)	327.56 to 326.03	1.52	Sandy Silt
		250 (5,000)	325 (6,500)	326.03 to 323.90 (termination)	3.05	Sandy Gravel/Till
BH 3	324.76	150 (3,000)	225 (4,500)	323.24 to 320.62	1.52	Sandy Silt
		250 (5,000)	325 (6,500)	320.62 to 319.58 (termination)	4.14	Till
BH 4	315.53	250 (5,000)	325 (6,500)	314.77 to 310.35 (termination)	0.76	Sandy Gravel /Till
BH 5	311.76	250 (5,000)	325 (6,500)	311.00 to 308.86 (termination)	0.76	Gravel and Sand
BH 6	316.06	250 (5,000)	325 (6,500)	315.30 to 310.88 (termination)	0.76	Sand and Gravel/Till

Based on the information obtained from the geotechnical investigation and summarized in the table above, native soils suitable to support conventional foundations designed with a minimum estimated bearing capacity of 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS were generally encountered underlying the topsoil and loose native soils encountered on the subject site ranging from depths of approximately 0.76 m to 1.52 m below the existing ground surface, while native soils suitable to support conventional foundations designed with a minimum estimated bearing capacity of 250 kPa (5,000 psf) at SLS and 325 kPa (6,500 psf) at ULS were encountered at depths ranging from approximately 0.76 m to 4.57 m below the existing ground surface.

Should foundations be designed to be constructed at elevations higher than the elevations indicated in the table above, then structural fill will be required in order to achieve the design grades for the proposed foundations. The serviceability limit pressure for good quality granular structural fill placed on suitable subgrade soils and compacted in accordance with Section 5.4.5 of this report is estimated to be at least 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS.

Alternatively, if shallow foundations are considered to be less feasible on the subject site, it would be recommended that deep foundations such as helical piles, driven piles, concrete caissons, or another deep structural method be utilized for the founding of the proposed structures. No large cobbles or boulders, which may hamper the advancement of piles, were encountered during the investigation, however dense to very dense soils were encountered. It should be noted that deep foundations can be installed with many different configurations based on the intended application. It would be prudent to contact a specialized deep foundation designer/installer for project-specific designs, if required for this project. A structural engineer should determine the size, depth and number of piles/caissons that are required, as well as any pile caps or grade beam foundations. If a deep foundation system is to be utilized a deeper supplementary geotechnical investigation must be conducted.

Footings founded on soil may be placed at a higher elevation relative to another footing provided that the slope between the outside face of the footings is separated by a minimum slope of 10 horizontal to 7 vertical (10H:7V) with an imaginary line projected from the underside of the footings.

When constructing new footings adjacent to existing footings, such as those from neighbouring buildings, all existing disturbed backfill material from the existing foundations must be subexcavated to ensure that new footings are founded on approved undisturbed soil. Any areas subexcavated to remove disturbed soils could be backfilled with mass concrete. It is imperative that excavations do not extend below any existing footings or the bottom of foundation walls without providing support to both the footing/underside of the foundation wall through shoring or underpinning, as well as support the foundation wall structure itself (as designed by the structural engineer).

It is recommended that structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively.

All exterior footings must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation in order to provide protection against frost action.

CMT Inc. would be pleased to review design drawings when they become available and provide further recommendations with respect to bearing and foundation elevations.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30.0 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 2.90 m to 5.18 m of strata. Based on the information gathered in the geotechnical field investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the native soil at the recommended founding elevations provided in Section 5.1 of this report. For foundations constructed on existing engineered fill or structural fill, placed in accordance with Section 5.5.4 of this report, the site classification for seismic site response would be considered Site Class D (stiff soil). The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides estimated soil design parameters for imported granular fill, as well as the existing fill and the native soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, as required:

Soil Type	**Soil Density (kg/m^3)**	**Friction Angle (Degree)**	**Coefficient of Active Pressure (K_a)**	**Coefficient of Passive Pressure (K_p)**	**Coefficient of At-Rest Pressure (K_o)**	**Coefficient of Friction (µ)**	**Cohesion (Undrained) (kPa)**
Imported Granular 'A'/ (OPSS 1010)	2,100	34 °	0.28	3.54	0.44	0.45	0
Imported Granular 'B' (OPSS 1010)	2,050	32 °	0.31	3.25	0.47	0.41	0
Sandy Silt	1,800	32°	0.31	3.25	0.47	0.41	0
Sandy Gravel	1,900	34°	0.28	3.54	0.44	0.45	0
Gravel and Sand	1,850	32°	0.31	3.25	0.47	0.42	0
Sand and Gravel	1,900	34°	0.28	3.54	0.44	0.45	0
Sandy Gravelly Silt Till	1,900	32 °	0.31	3.25	0.47	0.41	0

5.4. <u>Site Preparation</u>

The site preparation for the proposed residential development is anticipated to include the removal of topsoil and vegetation, removal, or relocation of any existing services (if encountered), the subexcavation of all fill and native soils deemed not suitable for supporting of the design bearing capacity, followed by the placement of structural fill (as required) and site grading to achieve proposed grades.

5.4.1. <u>Topsoil Stripping/Vegetation Grubbing</u>

Any existing topsoil (including any buried topsoil encountered), vegetation (including tree roots and all loose/disturbed soils associated with tree roots) and unsuitable soils must be removed from within the proposed building envelope(s) to expose approved competent subgrade soils. The topsoil or unsuitable soils may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

The volume of topsoil removed during the stripping process is also relative to the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping. If an excavator with a smooth bucket is utilized for stripping, there would generally be less potential for topsoil to become intermixed with the underlying relatively loose subsoil and therefore less concern of over-excavation to remove all topsoil. If the topsoil is stripped with wheeled equipment or bulldozers, then there is an increased potential for the topsoil and subsoil to become intermixed, subsequently requiring additional excavation to remove all topsoil. This is further influenced by rutting which can occur during wet conditions.

5.4.2. Fill/Loose Native Soil Removal

Any existing fill encountered as well as any native soils in a very loose to loose state would be deemed unsuitable to support foundations as well as interior slab-on-grades (without remedial action to improve the soil properties). Therefore, all existing fill (including any existing service trench backfill and backfill of the existing foundation walls), as well as any relatively loose native soils that are deemed to be unsuitable to support foundations or slab-on-grades, must be subexcavated from within the proposed building envelopes, exterior entranceways, perimeter sidewalks and perimeter concrete slab areas to expose approved competent subgrade soils. Should it be decided to leave any relatively loose soils under any proposed slab-on-grade, remedial action may be required to further consolidate any existing fill and/or loose native soils or soil stabilization through the use of geotextiles and/or geogrids may be required. Review of the subgrade, as required, will be addressed at the time of construction.

5.4.3. Removal/Relocation of Existing Services (if encountered)

Any existing underground services (including subdrains and/or field tiles) that may be located within the proposed building envelopes should be removed/relocated. If left in place, the location of existing services must be reviewed to ensure that they do not conflict with proposed foundation locations. All terminated pipes must be completely sealed with watertight mechanical covers, concrete, or grout at termination points to prevent the migration of soils into pipe voids which can result in potential settlement. All existing trench backfill material and any disturbed soils associated with the removal of any services must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

5.4.4. __Site Grading__

Following the subexcavation of any fill and any relatively loose fill or native soils deemed unsuitable of supporting the design bearing capacity, the exposed subgrade must be proof-rolled, and any soft or unstable areas must be subexcavated and replaced with approved fill materials.

If structural fill placement is required, the fill materials required to achieve the design site grades should be placed according to the following procedures:

- It is imperative that excavations do not extend below any existing (neighbouring) footings or bottom of foundation walls without providing support to both the footings or underside of the foundation wall through shoring or underpinning, as well as support the foundation wall structure itself (as directed by the structural engineer). It is recommended that the condition of the below-grade section of the foundation wall (along with a review by the structural engineer) as well as the existing founding elevation be confirmed by means of a series of test pits (hydrovac truck or excavator required) prior to beginning mass excavation for the neighbouring building foundation. This will allow time for a shoring/support system to be designed and priced (if required),

- Prior to placement of any structural fill, the subgrade for the proposed buildings and/or structures and any hard surfaced areas must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed foundations or edge of asphalt/concrete down to the approved competent native founding soils,

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for granular soils (recommended fill materials) and 0.2 m (8") in depth for silts and clays, or the capacity of the compactor (whichever is less). Any wet to saturated native soils (non-organic) would generally be considered unsuitable for reuse as structural fill as it would be expected that significant air-drying would be required in order to achieve the specified density,

- Granular fill materials (OPSS 1010 Type II or Type III Granular 'B' is recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum or padfoot compaction equipment,

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment,

- Approved fill materials must be at suitable moisture contents to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including foundations, interior slab-on-grades, sidewalks, and large expansive exterior slabs) must be compacted to 100% standard Proctor maximum dry density (SPMDD),

- Approved bulk fill (exterior foundation wall backfill in landscaped areas, bulk fill for driveways) must be compacted to a minimum 95% SPMDD. It would be expected that the relatively loose native soils may be suitable for use as bulk fill following air-drying, and

- Granular 'B' subbase and Granular 'A' base materials for roadways must be compacted to 100% SPMDD.

Excavated soils that are considered to be wet or saturated may require significant air-drying along with working of the soils in order to achieve the specified compaction of 100% SPMDD in building envelopes (including 1:1 as required). Utilizing the existing soils during site grading may be more achievable if work is completed during the generally drier summer months. It should be noted, however, that due to the nature of some of the soils, during hot dry weather, the addition of water might be required in order to achieve the specified compaction. Reuse of excavated soils on-site will be subject to approval from qualified geotechnical personnel.

It should be noted that the existing native till soils are considered to be dense to very dense and may be slow and/or difficult to excavate by conventional means. It is imperative that if the dense to very dense soils are utilized as fill, the material must be broken down (pulverized) to minimize void space and reduce the potential for settlement. Problems associated with compacting dense to very dense soils include the potential for long term settlement due to excessive void space caused by the generally blocky structure of the excavated soils. As such, the dense to very dense, blocky material must not be used as structural fill. The contractor must have equipment on-site that can effectively break down (pulverize) the dense to very dense excavated soil into workable sizes (as required). Backfilling utilizing this material must be performed in thin lifts with considerable compactive effort applied, thereby reducing the void space, and minimizing long-term settlement. This process could be difficult and time-consuming.

5.5. ***Foundation Subgrade Preparation***

The native soils encountered in the boreholes are sensitive to changes in moisture content and can become loose/soft if the soils are subjected to additional water from seepage or precipitation, as well as severe drying conditions. The native subgrade soils could also be easily disturbed if traveled on during construction. Once they become disturbed, they are no longer considered adequate for the support of shallow foundations.

To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- During construction, the subgrade should be sloped/ditched to a sump (as required) located outside the building footprint (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions,

- Construction equipment travel and foot traffic on the founding soils should be minimized,

- If construction is to be undertaken during subzero weather conditions, the founding native soils and any potential fill materials must be maintained above freezing,

- Prior to placing concrete for the footings, the footing area must be cleaned of all disturbed or caved materials,

- The foundation formwork and concrete should be installed as soon as practical following the excavation, inspection, and approval of the founding soils. The longer that the excavated soils remain open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur, and

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be placed in order to protect the structural integrity of the founding soils.

5.6. ***Slab-on-Grade/Modulus of Subgrade Reaction***

Prior to the placement of the granular base for the slab-on-grade construction, the subgrade soils should be proof-rolled. Any soft or weak zones, as well as the unsuitable fill or loose native soils in the subgrade, should be subexcavated and backfilled with approved fill materials (see Section 5.4.4 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	**Modulus of Subgrade Reaction (k)**
Granular 'A'/Granular 'B' (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Sandy Silt	61,000 kN/m^3 (225 lb/in^3)
Sandy Gravel	61,000 kN/m^3 (225 lb/in^3)
Gravel and Sand	61,000 kN/m^3 (225 lb/in^3)
Sand and Gravel	61,000 kN/m^3 (225 lb/in^3)
Sandy Gravelly Silt Till	68,000 kN/m^3 (250 lb/in^3)

Any floor slabs should be founded on a minimum thickness of 150 mm (6") of coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve in accordance with the current OBC. The clear crushed granular material should be consolidated to prevent future settlement. Utilizing clear crushed stone for the slab-on-grade base can assist in providing a moisture barrier. Compactive effort is required to consolidate the clear stone. The clean granular material (19 mm clear crushed stone) should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade (sidewalks and accessibility ramps) be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. <u>Excavations</u>

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 2 Soils - In general, the native sandy gravelly silt till soils encountered in the boreholes, in a drained state (not saturated), would be classified as Type 2 soils under Reg 213/91. Type 2 soils must be sloped from within 1.2 m of the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or Type 4 soils that are exposed in the excavation must be treated accordingly as Type 3 or Type 4 soils (see below). Soils in a saturated condition (if encountered) must be treated as Type 4 soils, addressed below.

Type 3 Soils - In general, any existing fill, as well as the native sandy silt, sandy gravel, gravel and sand and sand and gravel soils encountered in a drained state (not wet or saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, all wet to saturated soils encountered, would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily to protect workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

5.8. Construction Dewatering Considerations

Very moist to wet soils were encountered in all boreholes and occasional wet seams were encountered in Boreholes 5 and 6. It should be noted that the dense to very dense till soils encountered in the boreholes has the potential to create perched groundwater conditions in any overlying soils. Groundwater levels (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should generally be adequately controlled using conventional construction dewatering techniques such as pumping from sump pits.

However, if heavy seepage occurs, it may be necessary to increase the number of pumps during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment.

5.9. Service Pipe Bedding

The native soils encountered in the geotechnical investigation are generally considered suitable for indirect support of the site service pipes. Should instability due to wet or saturated soil conditions be encountered, it may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover, and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows:

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the centreline of the pipe. The granular material placed under the haunches of the pipe must be compacted to 95% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible for protecting service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

In order to assist in maintaining dry buildings with respect to surface water seepage, it is recommended that exterior grades around the buildings be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges positive drainage at least 1.5 m away from the building foundations and/or beyond sidewalks to a drainage swale or appropriate storm drainage system.

Depending on the design founding elevations and groundwater conditions at the time of construction, it may be necessary to install a granular drainage layer to provide a suitable base for the foundations as well as the slab-on-grade. If required, the granular drainage layer must conform to the requirements of Section 9.14.4 of the OBC 2012. The groundwater conditions should be expected to exist even following backfilling.

Should the proposed structures have basements as anticipated, an exterior perimeter drainage system comprising perforated drainage pipe with a factory installed filter sock, bedded in 19 mm clear crushed stone, and wrapped in a geotextile filter fabric such as Terrafix 270R (or equivalent), must be installed at an elevation that is below any proposed basement slab elevations and provided with positive drainage into a sump pit or other suitable outlet. The portion of the piping that connects the exterior drainage system into the sump pit must comprise solid piping to prevent exterior water from being introduced into the interior subslab stone. It would be prudent to install perforated drainage pipe within any interior basement as well to provide an outlet for any water that may collect in the subslab stone. It is also recommended that a capped cleanout port(s) be extended up to the ground surface elevation to provide future access (if required). The rainwater leaders must not be connected to the perimeter weeping tile system.

It should be noted that based on the observations in the boreholes, there is potential for wet soils and/or groundwater to be encountered. The construction of foundations, slabs-on-grade, and deep structures such as sump pits within or below zones of saturation will require design of site-specific waterproofing and dewatering systems constructed in accordance with the 2012 OBC. A waterproofing specialist should be consulted to provide site-specific recommendations. It is recommended that a good quality sump pump(s) be utilized, and that the systems be equipped with a battery backup in the event of power failure.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as approved Granular 'B' Type I or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extend a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. The design of bracing and lateral supports must be provided by the project structural engineer. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 98% SPMDD.

The native soils, as well as approved fill materials (non-organic) are generally considered suitable for reuse as trench backfill, however, any wet soils may require air-drying in order to achieve the specified compaction. Air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project.

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy smooth drum (non-cohesive soils) or padfoot (cohesive soil) vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil,

- Loose lift thicknesses should not exceed 0.3 m (12") for granular (non-cohesive) soils or 0.2 m (8") for fine grained (cohesive) soils or the capacity of the compactor (whichever is less),

- The soils must be at suitable moisture contents to achieve compaction to a minimum 95% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD,

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved,

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials, and

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

The existing native soils were observed to become dense to very dense with depth. It is imperative that when the dense to very dense soils are utilized as backfill, the material must be broken down (pulverized) to minimize void space and reduce the potential for settlement.

5.11. <u>Pavement Design/Drainage</u>

Any soils containing buried topsoil, organics or other deleterious materials must be subexcavated from within the proposed roadways, driveways, and parking areas. It is recommended to either subexcavate any existing loose subgrade materials or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable subgrade. Prior to placement of the granular base, the subgrade soils must be proof-rolled, and any soft or unstable areas should be subexcavated and replaced with suitable fill materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structures is critical to ensure long-term performance. The existing silt-based subgrade soils are considered highly frost-susceptible; therefore, it is recommended to install subdrains for this project (provided gravity drainage to a suitable outlet can be provided). Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If Granular 'A' bedding (OPSS 1010) is utilized, the subdrains should be equipped with a factory installed filter sock. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain (recommended for this application), then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent). Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that subdrains be installed at regular intervals (to be designed based on layout of catch basins and storm sewers) along any curb line of any proposed new roads as well as in low areas of the paved driveways and parking areas. It is also recommended to install subdrains through any areas that cannot tolerate differential frost heave such as accessibility ramps/sidewalks. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native subgrade soils are sensitive to changes in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

Should wet to saturated conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement base. These options may include subexcavation of wet soils and increasing the thickness of the granular base, the use of reinforcing geotextiles or geogrids, or a combination of all.

It is understood that the proposed roads will mostly be used be personal vehicles, with occasional delivery trucks and emergency vehicles, and will be generally subject to light to moderate traffic and loading.

Based on the anticipated loading, the following pavement design is provided:

Material	**Recommended Thickness For New Pavement**
Asphaltic Concrete	HL3 surface course - 40 mm (1.5") HL4 or HL8 binder course - 50 mm (2.0")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	400 mm (16.0")

Construction joints in the surface and intermediate binder asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Where new asphalt is joined into any existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 80 mm and a width of 300 mm as per OPSD 509.010. It is recommended that a tack coat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed, and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation, or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt and intermediate binder asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The condition is further intensified during hot weather. In high traffic areas or areas subjected to frequent turning of heavy vehicles such as delivery trucks and tractor trailers, it is recommended that rigid Portland cement pavement be considered.

5.12. Retaining Wall Recommendations (if constructed)

An engineer must design any proposed retaining walls for the site if the walls are over 1.0 m in height. Retaining walls over 1.0 m in height are considered designated structures under the building code (OBC 1.3.1.1., 2012). In the past, cast-in-place concrete retaining walls, pre-cast gravity segmental block retaining walls and mechanically stabilized earth (MSE) precast segmental block retaining walls have been cost effective methods for earth retention.

The site plans should ensure that if the retaining wall is retaining the neighboring property (subject site is on the low side and neighbor is on the high side) near the property line, sufficient space is left to keep the retaining wall structure (including all components such as geogrid and granular fill) and corresponding excavation entirely on the subject site (as per section 5.8. excavation requirements). The widths of retaining structures vary depending on the type and retained height. Generally, all trees should not be planted within 3.0 m from the back of the retaining wall structure or within a 1H:1V envelope measured from the back of the bottom of the retaining wall structure (whichever is greater).

5.13. Excess Soil Management

5.13.1. Chemical Testing was NOT Undertaken by CMT Engineering Inc.

Generally, if surplus soils are to be exported off-site, it will be necessary to perform chemical analysis of the soils. Chemical analysis was not undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by the general contractor.

5.13.2. Leachate Testing Requirement

If soils are transported to a landfill facility, additional chemical testing in accordance with Ontario Regulation 347, Schedule 4, as amended to Ontario Regulation 558/00, dated March 2001, Toxicity Characteristic Leaching Procedure (TCLP) will be required.

When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, who must agree to receive the material.
- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material.
- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the pre-approved site.
- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

5.14. Stormwater Infiltration

As part of the geotechnical investigation completed at this site, gradation analyses were performed on representative samples of the native soil. The following table provides the sample location (borehole number), sample depth, corresponding estimated coefficient of permeability (k) as well as soil type:

Borehole No.	Depth (m)	Estimated Coefficient of Permeability (k) cm/s	Soil Type
1	0.76 – 1.37	4.10×10^{-7}	Sandy silt, some gravel and clay, (ML)
2	3.05 – 3.66	1.50×10^{-3}	Sandy gravel, some silt, trace clay, (GM)
3	0.33 – 0.61	7.40×10^{-7}	Sandy silt, some gravel and clay, (ML)
4	0.76 – 1.37	7.40×10^{-5}	Sandy gravel, some silt, trace clay, (GM)
4	3.66 – 4.57	2.90×10^{-6}	Sandy, gravelly silt, trace clay, (SM)
5	0.76 – 1.37	7.40×10^{-5}	Gravel and sand, some silt, trace clay (GM)
6	1.52 – 2.13	6.00×10^{-5}	Sand and gravel, some silt, trace clay (SM)

The native soils encountered in the boreholes have estimated coefficient of permeability values (k) that range from approximately 7.4×10^{-7} cm/sec to 1.5×10^{-3} cm/sec respectively. In general, all soils will support some amount of infiltration however an acceptable 'k' value for infiltration galleries is 1.0×10^{-3} cm/sec. As such, the native soils encountered on the subject site do not generally provide favourable conditions for significant groundwater infiltration.

5.15. Percolation Rate (T-Time)

As part of the geotechnical investigation completed at this site, gradation analyses were performed on representative samples of the native soils for the purposes of septic design for the proposed residential development. The following table provides the sample location (borehole number), sample depth, corresponding estimated percolation rate (T-time), as well as soil type that may be encountered in the septic leaching bed areas:

Borehole No.	Depth (m)	T = min/cm	Soil Type
1	0.76 – 1.37	30	Sandy silt, some gravel and clay, (ML)
2	3.05 – 3.66	12	Sandy gravel, some silt, trace clay, (GM)
3	0.33 – 0.61	30	Sandy silt, some gravel and clay, (ML)

Borehole No.	**Depth (m)**	**T = min/cm**	**Soil Type**
4	0.76 – 1.37	12	Sandy gravel, some silt, trace clay, (GM)
4	3.66 – 4.57	20	Sandy, gravelly silt, trace clay, (SM)
5	0.76 – 1.37	12	Gravel and sand, some silt, trace clay (GM)
6	1.52 – 2.13	15	Sand and gravel, some silt, trace clay (SM)

5.16. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock, and water. When radon escapes the earth in the outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

6.0 SITE INSPECTION

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading and site servicing. This will ensure that footings are founded in the proper strata and that proper material, and techniques are used and the specified compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed development.

7.0 LIMITATIONS OF THE INVESTIGATION

This report is intended for the Client named herein and for their Client. The report should be read in its entirety, and no portion of this report may be used as a separate entity. 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.

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made. We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by:

Brandon

Brandon R Figg, C.Tech.
Senior Soil Technician

LICENSED PROFESSIONAL ENGINEER
2024/05/23
N. J. CHORTOS
100210851
PROVINCE OF ONTARIO

Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotech. Engineer

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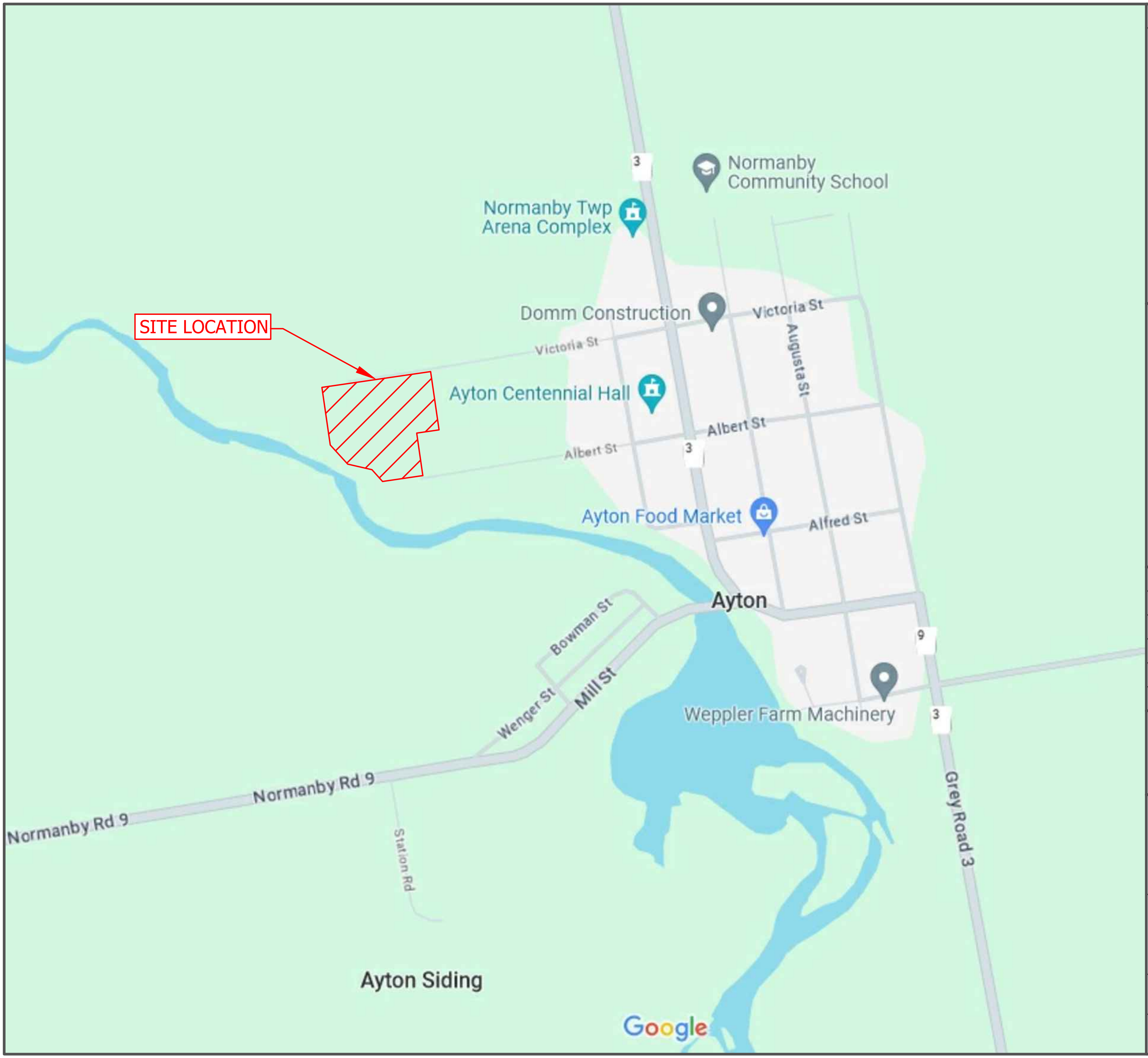


NOTES:

Base map provided by Google Maps.

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

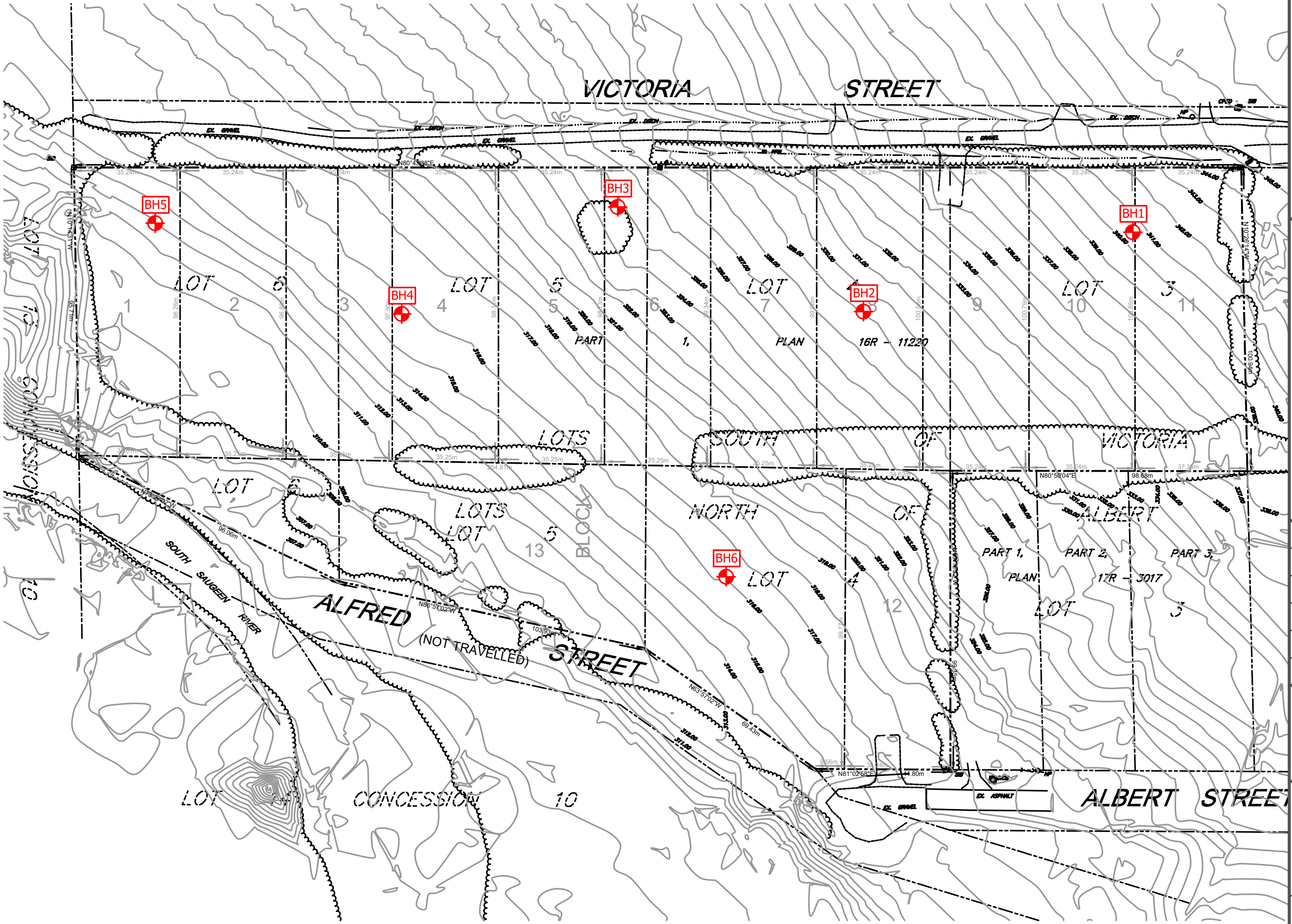
PROJECT:

PROPOSED RESIDENTIAL DEVELOPMENT
Victoria Street,
Ayton, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
24-099	April 30, 2024
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

Drawing provided by client.

Legend

⊕ CMT Borehole (2024)

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

PROJECT:
PROPOSED RESIDENTIAL DEVELOPMENT
Victoria Street,
Ayton, Ontario

DRAWING TITLE:
DRAFT SITE PLAN SHOWING BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
24-099	April 30, 2024
SCALE:	DRAWING NO.
1:2000	2

APPENDIX A

BOREHOLE LOGS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER BH1

PAGE 1 OF 1

PROJECT: Proposed Residential Development

PROJECT ADDRESS: Victoria Street

PROJECT NUMBER: 24-099

PROJECT LOCATION: Ayton, ON

DRILLING DATE: 4-16-24

GROUND ELEVATION: 340.52 m

DRILLING CONTRACTOR: CMT Drilling Inc.

LOGGED BY: BRF

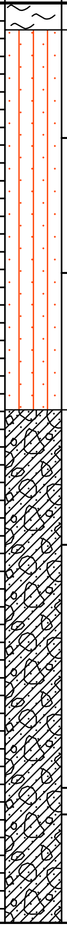
DRILLING EQUIPMENT: Geoprobe 7822DT

SAMPLING METHOD: SPT/MC5

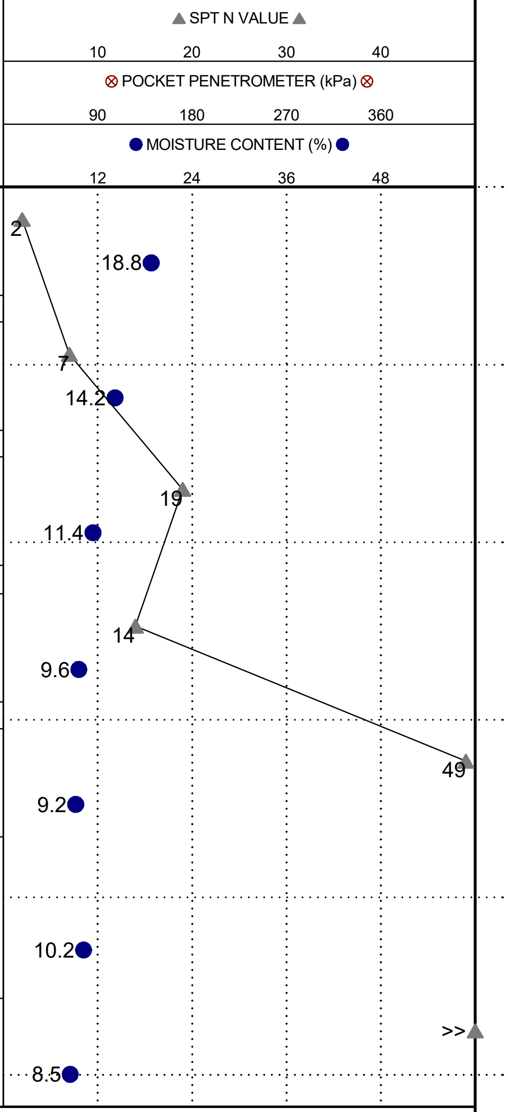
MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
TOPSOIL: Very loose, dark brown, silty organic topsoil, moist (150 mm)	0.00, 340.52	SPT 1	75	1-1-1-1 (2)
SANDY SILT: Very loose, grey, sandy silt, some gravel and clay, moist	0.15, 340.37			
becoming loose	0.76, 339.76	SPT 2	54	5-2-5-9 (7)
becoming compact	1.52, 339.00	SPT 3	87	8-11-8-9 (19)
SANDY GRAVELLY SILT TILL: Compact, grey, sandy, gravelly, silt till, trace clay, moist	2.29, 338.23	SPT 4	100	9-7-7-8 (14)
becoming dense	3.05, 337.47	SPT 5	92	21-26-23-17 (49)
		MC5 6	100	
slightly wet seam encountered	4.42, 336.10			
becoming very dense	4.57, 335.95	SPT 7	75	21-27-27-31 (54)

DEPTH (m)

1
2
3
4
5



GRAPHIC LOG



Caving was encountered upon completion of the borehole at a depth of approximately 4.57 m (El. 335.95 m) below ground surface.

Bottom of borehole at 5.18 m, Elevation 335.34 m.

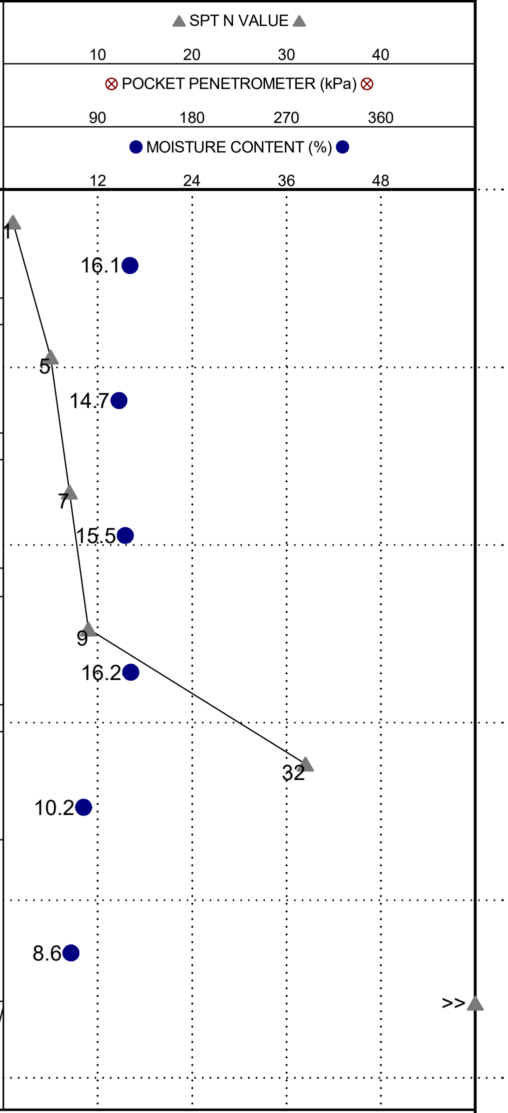
CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER BH2

PAGE 1 OF 1

PROJECT: Proposed Residential Development
PROJECT ADDRESS: Victoria Street
PROJECT NUMBER: 24-099
PROJECT LOCATION: Ayton, ON
DRILLING DATE: 4-16-24
GROUND ELEVATION: 329.08 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BRF
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
TOPSOIL: Very loose, dark brown, silty organic topsoil, moist (275 mm)	0.00, 329.08	SPT 1	75	0-0-1-1 (1)
SANDY SILT: Very loose, dark brown, sandy silt, some gravel and clay, trace organics, moist	0.28, 328.81			
wet sand seam encountered	0.76, 328.32	SPT 2	46	3-3-2-7 (5)
becoming loose, brown, very moist	0.86, 328.22			
		SPT 3	46	7-4-3-4 (7)
		SPT 4	87	2-4-5-6 (9)
becoming compact	3.05, 326.03	SPT 5	87	11-15-17-17 (32)
SANDY GRAVEL: Dense, brown, sandy gravel, some silt, trace clay, moist	3.15, 325.93			
		MC5 6	100	
SANDY GRAVELLY SILT TILL: Very dense, brown, sandy gravelly silt till, trace clay, moist	4.57, 324.51	SPT 7	0	50/0.03



DEPTH (m): 1, 2, 3, 4, 5

Caving was encountered upon completion of the borehole at a depth of approximately 4.27 m (El. 324.81 m) below ground surface.

Bottom of borehole at 5.18 m, Elevation 323.90 m.

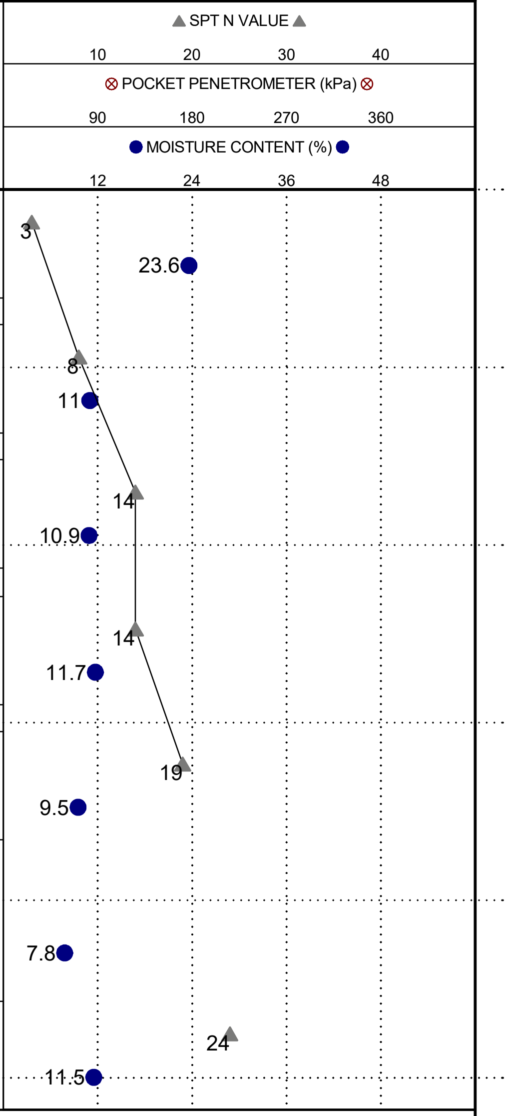
CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER BH3

PAGE 1 OF 1

PROJECT: Proposed Residential Development
PROJECT ADDRESS: Victoria Street
PROJECT NUMBER: 24-099
PROJECT LOCATION: Ayton, ON
DRILLING DATE: 4-16-24
GROUND ELEVATION: 324.76 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BRF
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	TOPSOIL: Very loose, dark brown, silty organic topsoil, moist (325 mm)	0.00, 324.76	SPT 1	100	1-2-1-2 (3)
	SANDY SILT: Very loose, brown, sandy silt, some gravel and clay, very moist	0.33, 324.44			
1	becoming loose, moist	0.76, 324.00	SPT 2	49	12-4-4-4 (8)
2	becoming compact, very moist	1.52, 323.24	SPT 3	75	2-7-7-5 (14)
3			SPT 4	16	12-7-7-7 (14)
	becoming moist	3.05, 321.71	SPT 5	95	7-9-10-14 (19)
4	becoming very moist to wet	3.66, 321.10	MC5 6	100	
	SANDY GRAVELLY SILT TILL: Compact, brown, sandy gravelly silt till, trace clay, moist	4.14, 320.62			
5			SPT 7	75	21-11-13-19 (24)



Caving was encountered upon completion of the borehole at a depth of approximately 3.05 m (El. 321.71 m) below ground surface.

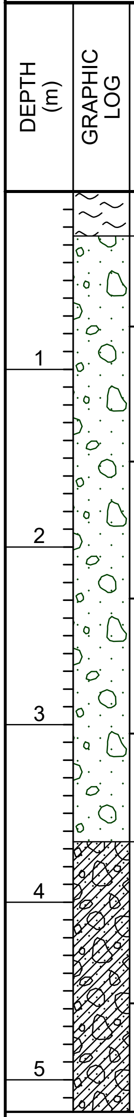
Bottom of borehole at 5.18 m, Elevation 319.58 m.

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

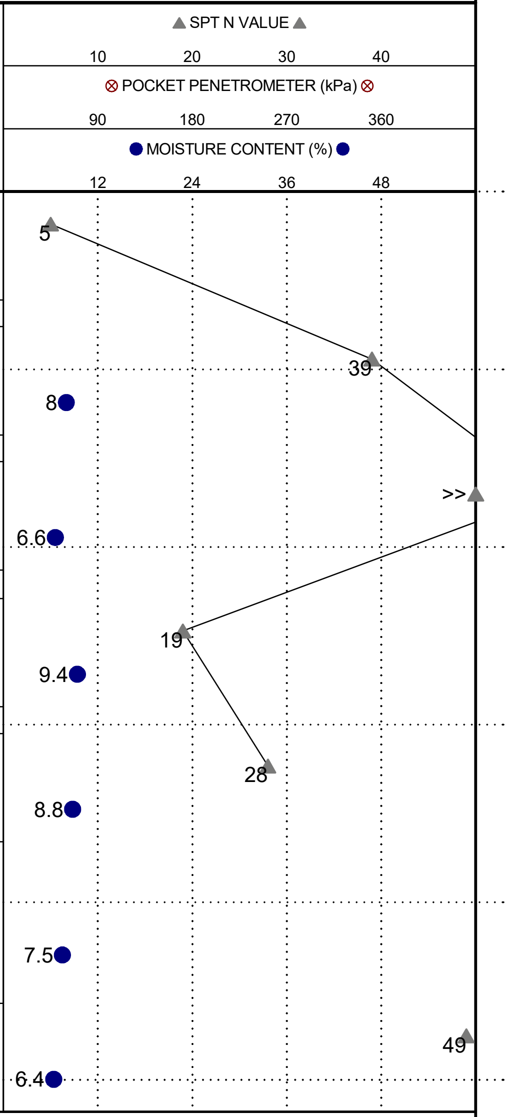
BOREHOLE NUMBER BH4

PAGE 1 OF 1

PROJECT: Proposed Residential Development
PROJECT ADDRESS: Victoria Street
PROJECT NUMBER: 24-099
PROJECT LOCATION: Ayton, ON
DRILLING DATE: 4-16-24
GROUND ELEVATION: 315.53 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BRF
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5



MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
TOPSOIL: Loose, dark brown, silty organic topsoil, moist (250 mm)	0.00, 315.53	SPT 1	49	1-2-3-6 (5)
SANDY GRAVEL: Loose, brown, sandy gravel, some silt, trace clay, moist	0.25, 315.28			
becoming dense	0.76, 314.77	SPT 2	49	13-16-23-21 (39)
becoming very dense	1.52, 314.01	SPT 3	54	32-42-16-16 (58)
becoming compact, very moist	2.29, 313.24	SPT 4	59	15-9-10-11 (19)
becoming moist	3.05, 312.48	SPT 5	33	12-15-13-16 (28)
SANDY GRAVELLY SILT TILL: Compact, brown, sandy gravelly silt till, trace clay, moist	3.66, 311.87	MC5 6	100	
becoming very dense	4.57, 310.96	SPT 7	59	29-27-22-31 (49)



Caving was encountered upon completion of the borehole at a depth of approximately 3.35 m (El. 312.18 m) below ground surface.

Bottom of borehole at 5.18 m, Elevation 310.35 m.

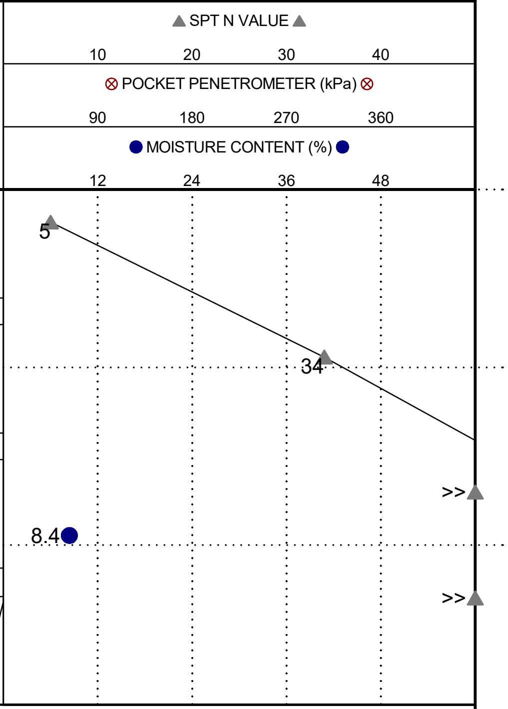
CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER BH5

PAGE 1 OF 1

PROJECT: Proposed Residential Development
PROJECT ADDRESS: Victoria Street
PROJECT NUMBER: 24-099
PROJECT LOCATION: Ayton, ON
DRILLING DATE: 4-16-24
GROUND ELEVATION: 311.76 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BRF
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	TOPSOIL: Loose, dark brown, silty organic topsoil, moist (250 mm)	0.00, 311.76	SPT 1	41	1-2-3-3 (5)
	GRAVEL AND SAND: Loose, brown, gravel and sand, some silt, trace clay, moist	0.25, 311.51			
1	becoming dense	0.76, 311.00	SPT 2	54	12-17-17-12 (34)
2	becoming very dense	1.52, 310.24	SPT 3	75	11-30-30-24 (60)
			SPT 4	0	50/0.03



Caving was encountered upon completion of the borehole at a depth of approximately 2.29 m (El. 309.47 m) below ground surface.

Bottom of borehole at 2.90 m, Elevation 308.86 m.

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER BH6

PAGE 1 OF 1

PROJECT: Proposed Residential Development

PROJECT ADDRESS: Victoria Street

PROJECT NUMBER: 24-099

PROJECT LOCATION: Ayton, ON

DRILLING DATE: 4-16-24

GROUND ELEVATION: 316.06 m

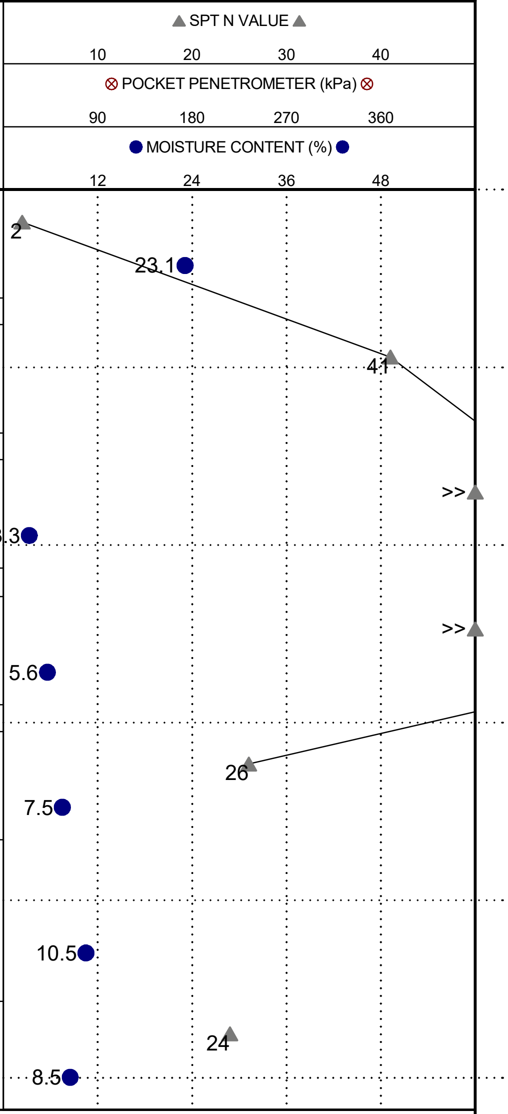
DRILLING CONTRACTOR: CMT Drilling Inc.

LOGGED BY: BRF

DRILLING EQUIPMENT: Geoprobe 7822DT

SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	TOPSOIL: Loose, dark brown, silty organic topsoil, moist (125 mm) **SANDY SILT:** Very loose, brown, sandy silt, some gravel and clay, very moist	0.00, 316.06 0.13, 315.94	SPT 1	100	1-1-1-1 (2)
1	**SAND AND GRAVEL:** Dense, brown, sand and gravel, some silt, trace clay, moist	0.76, 315.30	SPT 2	33	12-20-21-20 (41)
2	becoming very dense	1.52, 314.54	SPT 3	84	17-19-41-41 (60)
3			SPT 4	38	35-44-44-43 (88)
	becoming compact, very moist to wet seam encountered	3.05, 313.01	SPT 5	49	14-16-10-20 (26)
4	**SANDY GRAVELLY SILT TILL:** Compact, light grey/brown, sandy gravelly silt till, trace clay, moist	3.66, 312.40	MC5 6	100	
5			SPT 7	33	23-12-12-14 (24)



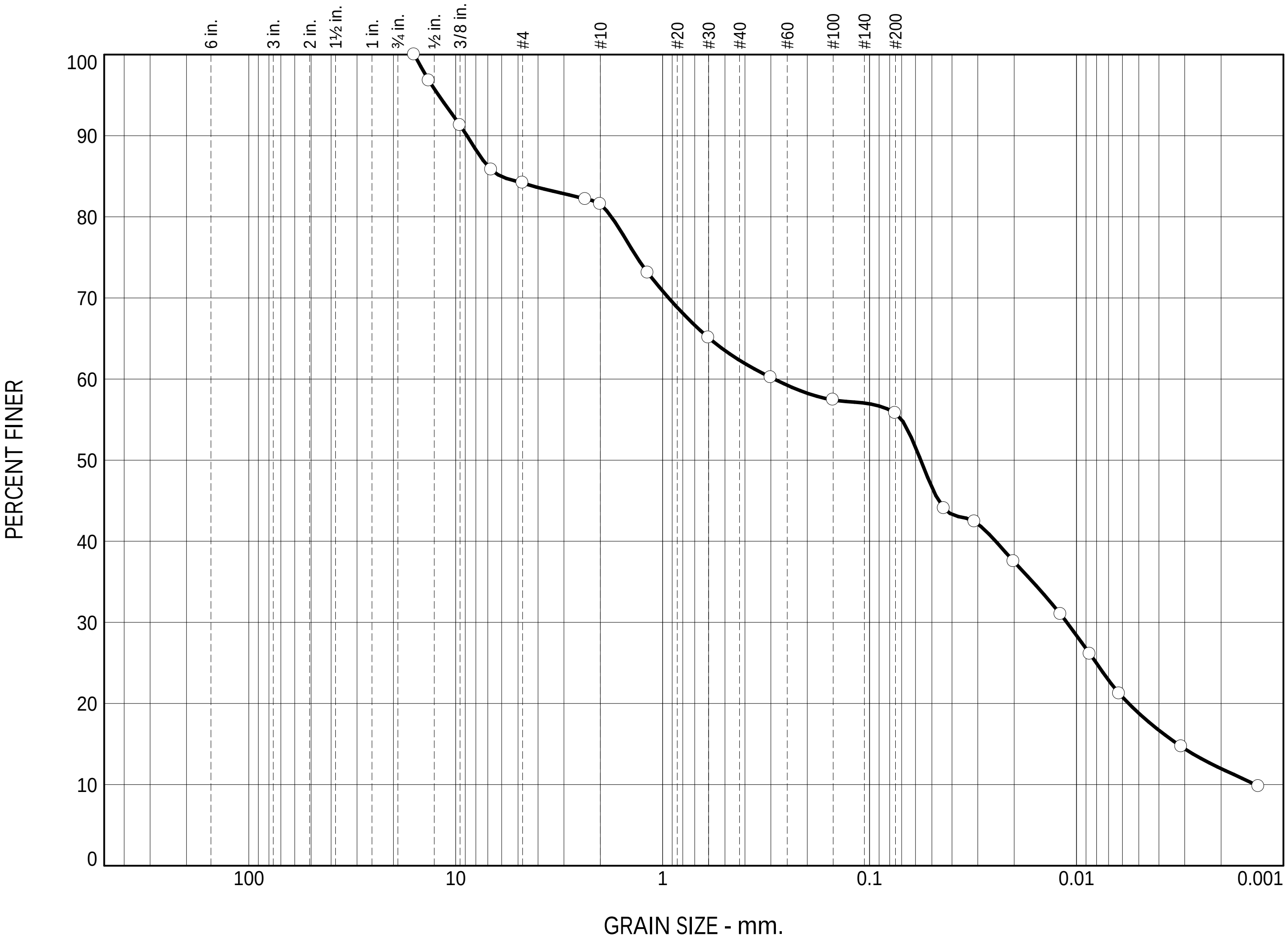
Caving was encountered upon completion of the borehole at a depth of approximately 2.18 m (El. 313.88 m) below ground surface.

Bottom of borehole at 5.18 m, Elevation 310.88 m.

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	15.8	2.6	19.3	6.5	43.8	12.0

SOIL DATA

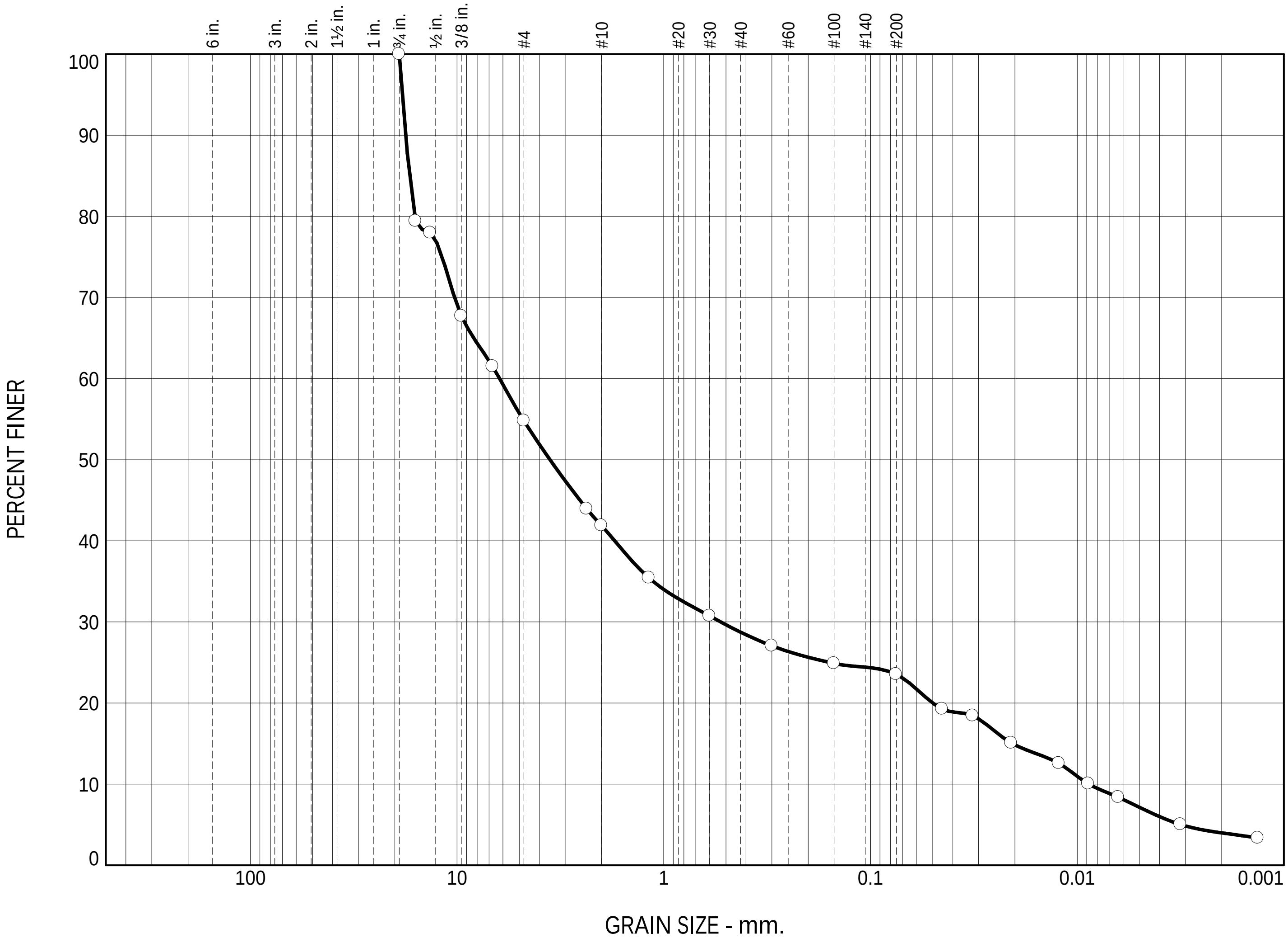
	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	2	0.76-1.37m	sandy silt, some gravel and clay	ML
				Estimated Percolation Rate; T = 30 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

CMT Engineering Inc.

St. Clements, ON

Client: Domm Construction Ltd.
Project: Geotechnical Investigation
1025 Victoria Street, Ayton, Ontario
Project No.: 24-099
Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	45.2	12.9	13.2	5.2	19.5	4.0

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH2	5	3.05-3.66m	sandy gravel, some silt, trace clay	GM
				Estimated Percolation Rate; T = 12 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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St. Clements, ON

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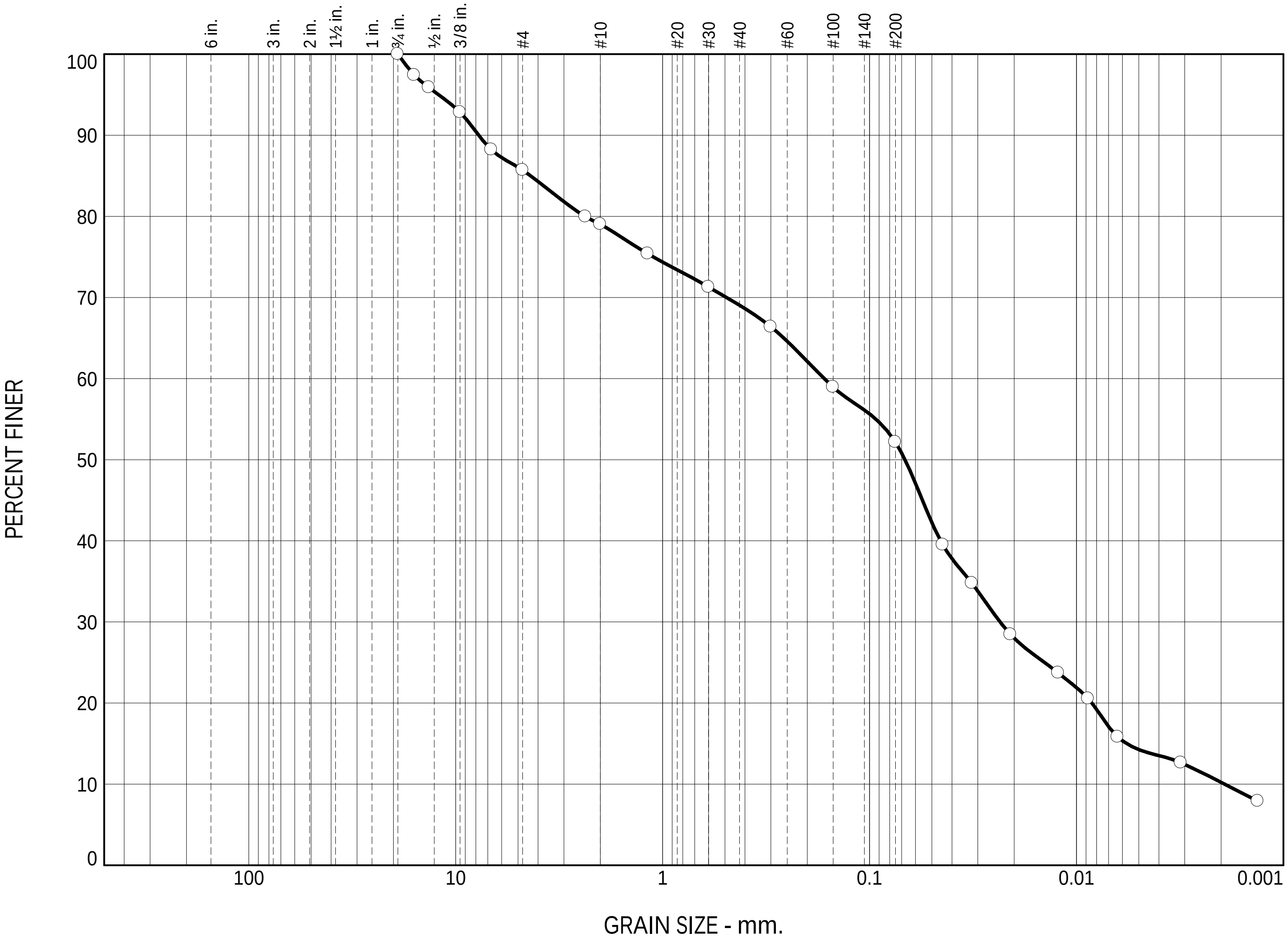
Figure 2

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	14.3	6.7	10.0	16.8	42.0	10.2

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	1	0.33-0.61m	sandy silt, some gravel and clay	ML
				Estimated Percolation Rate; T = 30 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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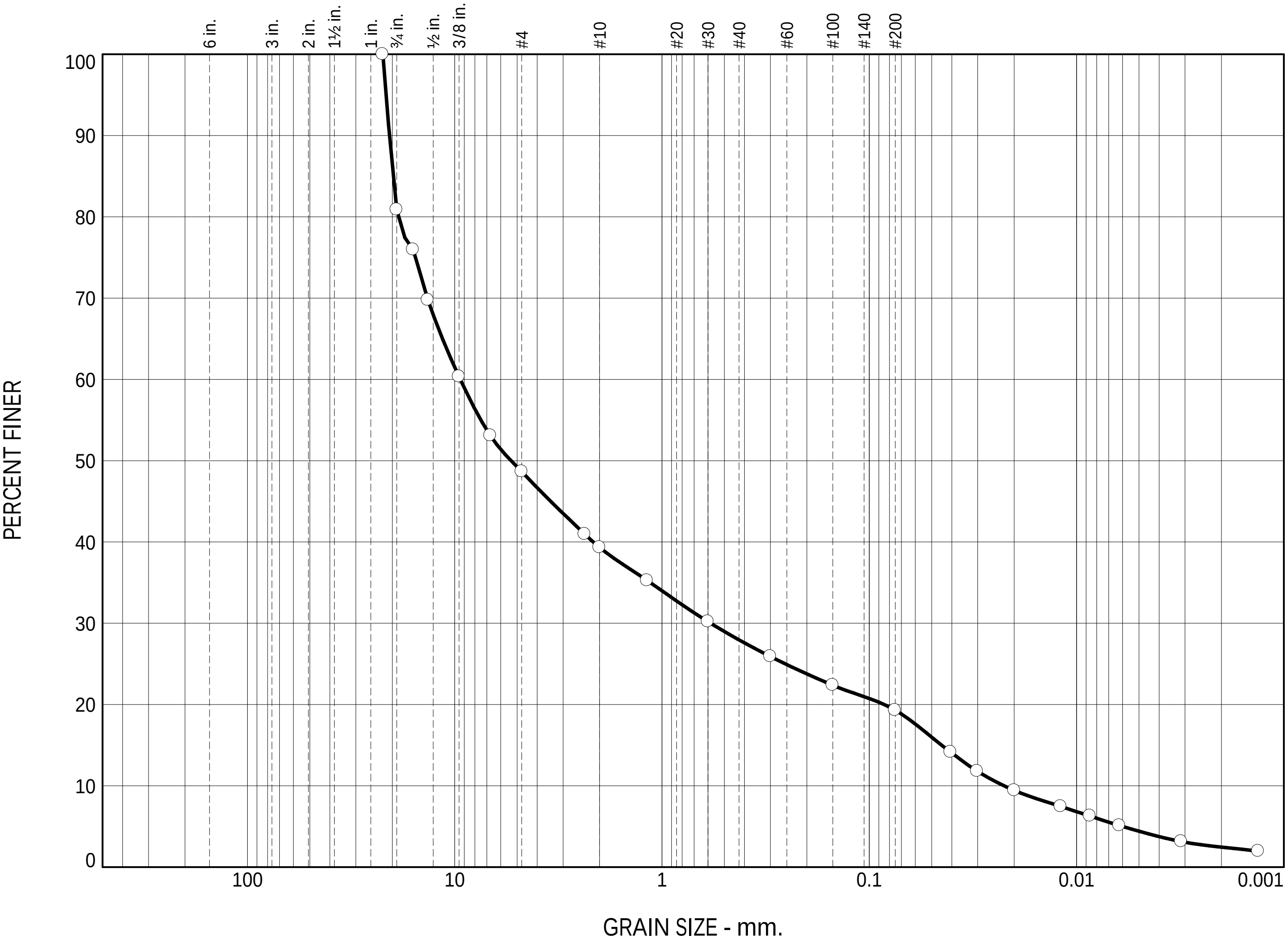
Figure 3

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	19.1	32.2	9.4	11.3	8.7	16.8	2.5

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH4	2	0.76-1.37m	sandy gravel, some silt, trace clay	GM
				Estimated Percolation Rate; T = 12 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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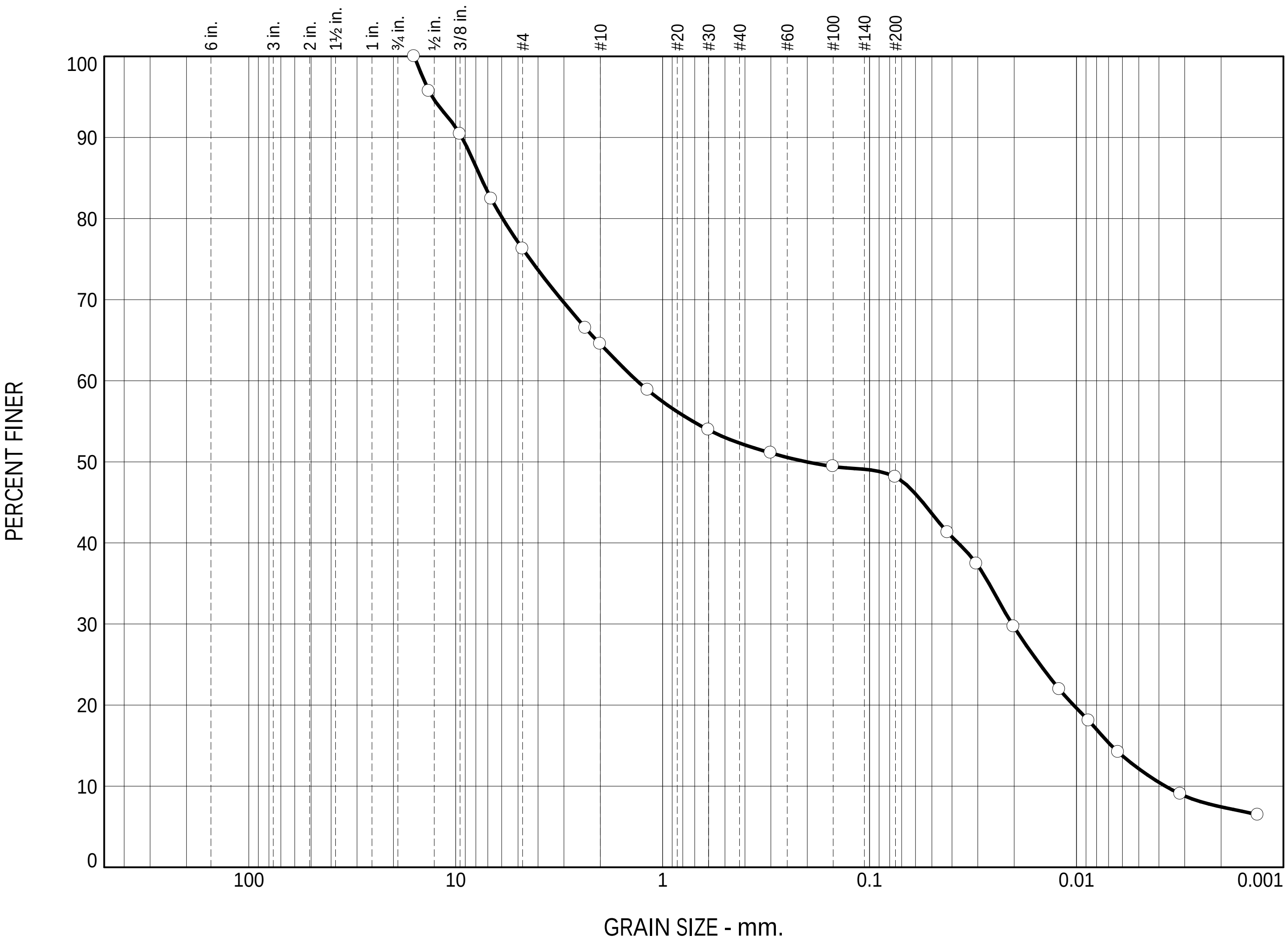
Figure 4

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	23.7	11.8	12.2	4.2	40.7	7.4

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH4	6	3.66-4.57m	sandy, gravelly silt, trace clay	SM
				Estimated Percolation Rate; T = 20 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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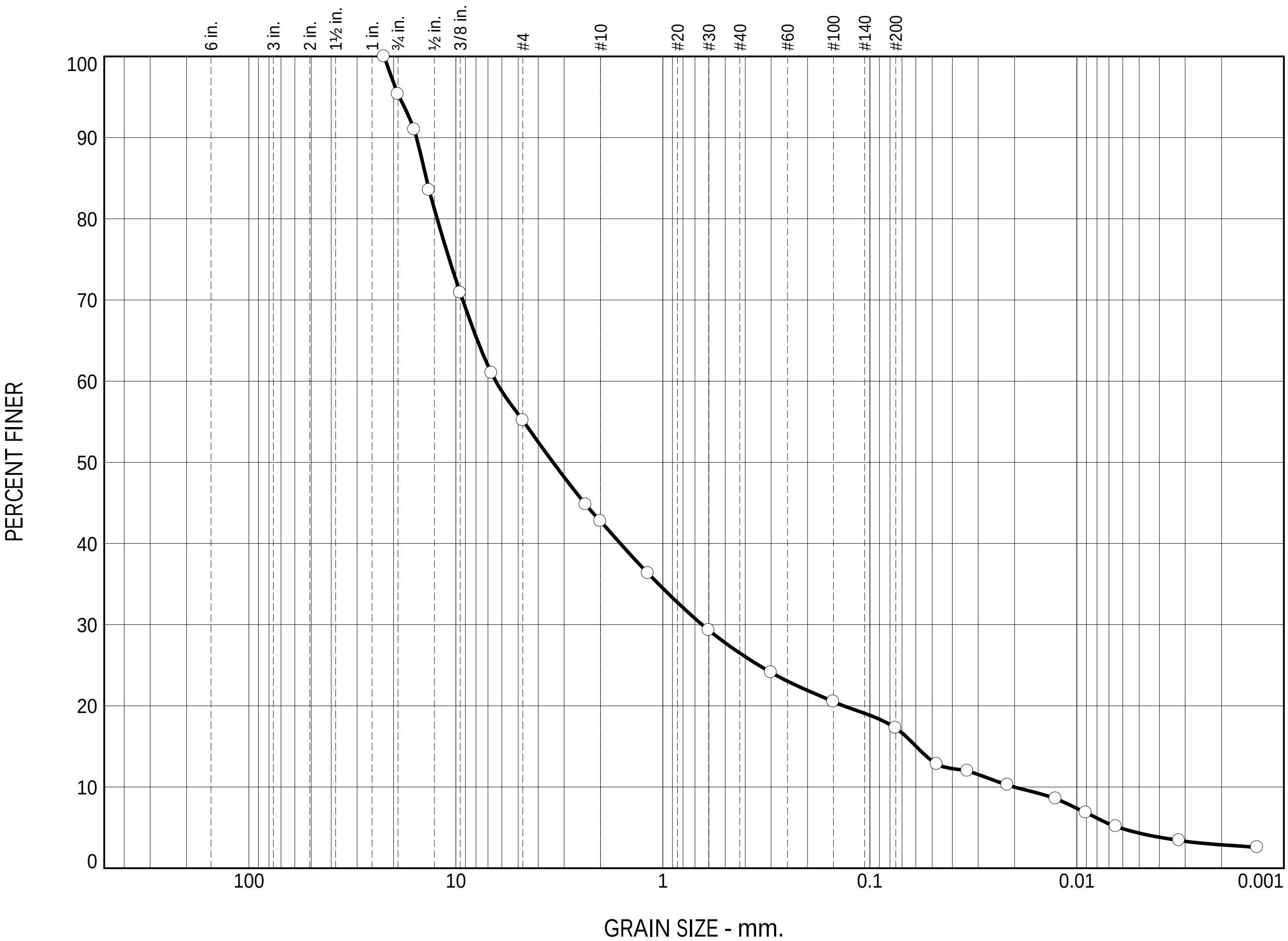
Figure 5

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	4.7	40.1	12.5	16.2	9.2	14.4	2.9

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH5	2	0.76-1.37m	gravel and sand, some silt, trace clay	GM
				Estimated Percolation Rate; T = 12 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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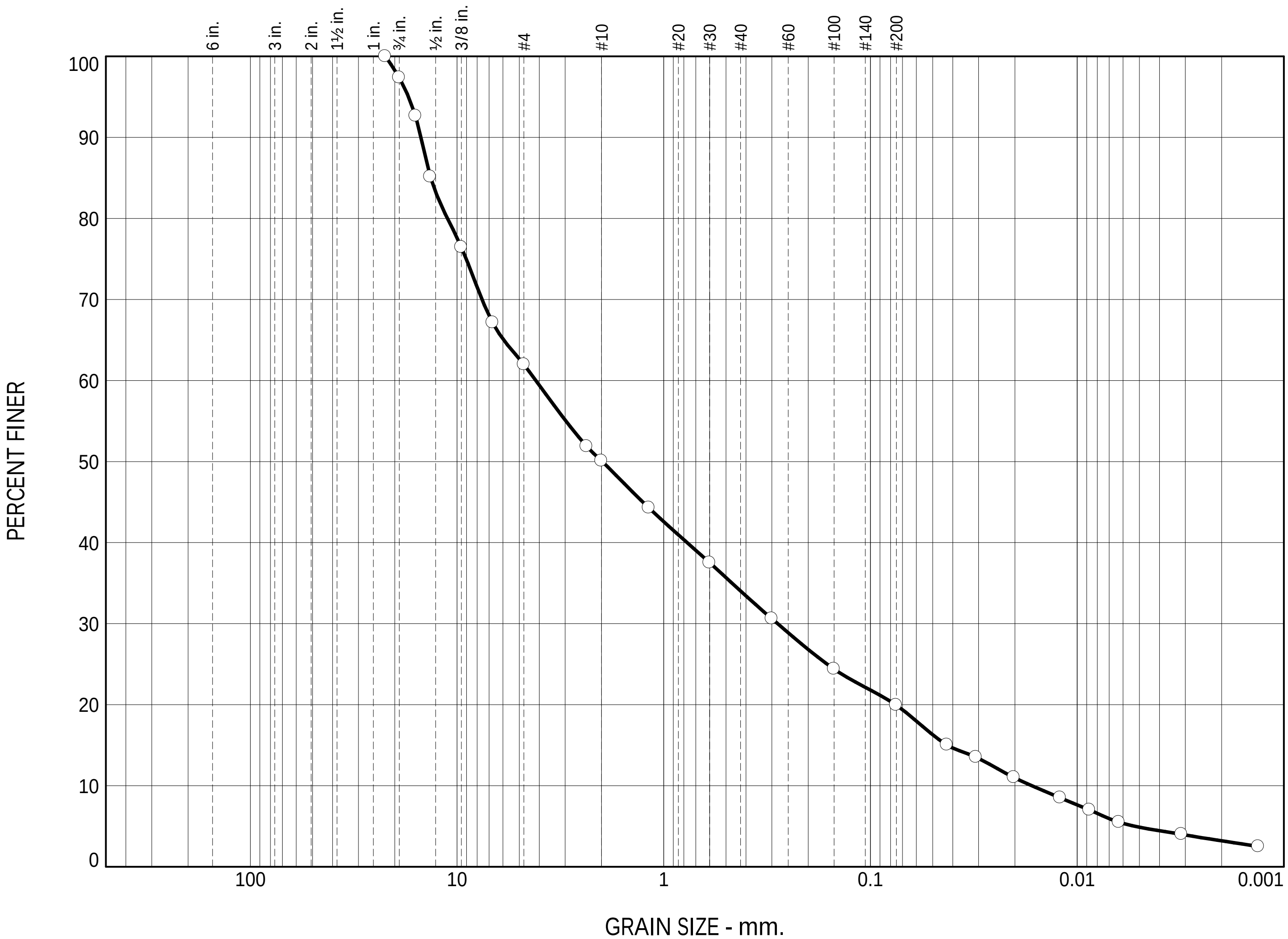
Figure 6

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	2.6	35.4	11.9	16.1	14.1	16.7	3.2

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH6	3	1.52-2.13m	sand and gravel, some silt, trace clay	SM
				Estimated Percolation Rate; T = 15 min/cm	
				Sampled by BRF of CMT Engineering Inc. April 16, 2024	
				Tested by JM of CMT Engineering Inc. April 18, 2024	

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Figure 7