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Geotechnical Design Report
Proposed Watermain
570 March Rd. to Terry Fox Dr.
Ottawa, Ontario

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Submitted to:

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Proposed Watermain
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Ottawa, Ontario

July 11, 2025
Project: 103940.007

experience • knowledge • integrity

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1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Broccolini Investment Inc. (Broccolini) to provide engineering services in support of the proposed watermain to be installed along a section of Legget Drive in Ottawa, Ontario.

The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of boreholes and, based on the information obtained, to provide limited engineering guidelines and recommendations on the specific geotechnical design aspects of the project. The guidance outlined in this report is strictly geotechnical and hydrogeological in nature and does not provide an environmental assessment of the site.

A factual presentation of the subsurface investigation for the proposed work is provided in the following report:

- Report titled “Subsurface Investigation Report, Proposed Watermain, 570 March Rd. to Terry Fox Dr. Ottawa, Ontario”, dated July 11, 2025.

The Geotechnical Design Report should be read in conjunction with the Subsurface Investigation Report.

The information in this report is provided for the guidance of the design engineers and is intended for the design of this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

This report is subject to the Conditions and Limitations of This Report, which follows the text of the report, and which are considered an integral part of the report.

2.0 BACKGROUND

2.1 Project Description

In parallel with redevelopment of the property at 570 and 600 March Road plans are being prepared to construct a section of watermain along Legget Drive, from 570 March to the intersection with Terry Fox Drive. The following is known about the proposed watermain, noting that the details had not been finalised at the time of investigation / reporting:

- The proposed watermain will be installed within the northern portion of the Legget Drive roadway Right of Way (RoW).
- The watermain will extend from the intersection between Legget Drive and Terry Fox Drive to beyond the entrance to 535 Legget, and cross Legget Drive to enter 570 March Road

under an intersection that is to be constructed as part of the development of that property. This area is referred to further as “the Site”. The length of the watermain under consideration within the Site is about 270 metres.

- The depth of the watermain has not been established but is assumed to be below about 2.4 metres depth.
- Following installation of the watermain the pavement along Legget Drive above the trench excavation will be reinstated.

2.2 Review of Existing Source of Information on Subsurface Conditions

2.2.1 Public Information Sources

Surficial geology maps indicate a range of soil conditions at the Site. The mapped conditions are summarised below:

- Near surface Paleozoic aged bedrock is mapped beneath Legget Drive near the Terry Fox Intersection.
- Fine textured glaciomarine deposits of silt and clay with minor sand and gravel are mapped within the majority of the Site along Legget Drive.

Bedrock geology maps indicate the presence of Paleozoic aged sandstone, dolomitic sandstone and dolostone of the March Formation below the soil cover. No faults are mapped within or nearby to the Site.

Ontario well records and public borehole records also indicate shallow bedrock at or in the vicinity of the Site.

In addition to the conditions described above, fill material associated with current and previous development in the area should also be anticipated. This may include materials associated with the existing roadways, parking areas, and below ground sewers and services / utilities.

2.2.2 Previous Investigations by Others

The records of previous investigations carried out by others for the proposed redevelopment of the properties at 600 and 570 March Road. These investigations encountered the following subsurface conditions:

- Fill Material – primarily comprised of asphaltic concrete and granular pavement layers;
- Discontinuous layers of silty clay to clayey silt;
- Glacial Till which is typically coarse-grained i.e. silty sand to gravelly sand with varying amounts of gravel and clay and containing cobbles and boulders, which overlies;

- Relatively shallow bedrock. The bedrock type was confirmed by rotary coring to be slightly weathered to fresh, thinly to medium bedded dolomitic sandstone, of fair to excellent quality according to the measured Rock Quality Designation (RQD) of the length of recovered core. The unconfined compressive strength of samples of the rock core ranged from about 127 megapascals to about 155 megapascals.
- Groundwater level was variable but was typically found to be within the bedrock.

3.0 SUMMARY OF SUBSURFACE CONDITIONS

The subsurface conditions encountered during the geotechnical investigation along Legget Drive generally consist of an asphaltic concrete surfacing over pavement structure materials over bedrock. Thin discontinuous layers of fill material or (cohesive) clayey silt are present in parts between the pavement layers and the bedrock.

The borehole locations and surface elevations from GEMTEC's investigation are presented on the Site Plan, Figure 1. Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole Sheets in Appendix A.

The augered portions of the boreholes were dry at the time of drilling to about to up to 1.1 metres below ground surface, and possibly deeper (groundwater observations were not possible in the cored section of the boreholes). The groundwater levels measured in the monitoring wells on June 27, 2025, were at about 3.3 and 3.4 metres (i.e. at the base of the standpipe).

These conditions are similar to those contained in a report titled "Geotechnical Investigation and Hydrogeological Assessment, 600 March Road, Kanata (Ottawa), Ontario", dated March 2024, which was provided to GEMTEC as supplemental information on the subsurface conditions. This investigation and report are referred to further as GHD (2024).

Additional details on the subsurface conditions are included in the Subsurface Investigation Report.

4.0 GEOTECHNICAL RECOMMENDATIONS AND GUIDELINES

4.1 General

At the time of preparing this report, limited information was available to GEMTEC on the details for the watermain. The recommendations provided in the following sections may require review as the design of the project progresses and further details are made available to GEMTEC.

4.2 Excavation

Based on the results of the investigation, excavations for the proposed watermain will generally be carried out through the roadway asphaltic concrete surfacing and underlying granular

pavement layers, thin discontinuous layers of fill material and clayey silt, and into the sandstone bedrock. Increased thickness of fill material may be encountered should existing bedrock trench excavations for current / former sewers or services be encountered.

The bedrock will likely break at a horizontal bedding plane below the design depth of the trench base, which may necessitate thickening the watermain bedding material. As such, overbreak should be expected in any bedrock removal.

4.2.1 Overburden Excavation

The overburden (fill material and native soil) is anticipated to be readily excavatable using conventional hydraulic excavation equipment, in general, noting that fill material can contain boulders and other hard materials.

The sides of the excavations within overburden soils should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the soils at the Site, above the groundwater level, can be classified as Type 3. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes above the groundwater level.

If groundwater is encountered within the excavations, the coarse-grained soils would be classified as Type 4 Soil and the excavations should be sloped at 3 horizontal to 1 vertical, or flatter, unless the groundwater level is lowered to below the excavation floor during construction. Refer to Section 4.2.3 for commentary on the use of excavation bracing.

4.2.2 Bedrock Excavation

Bedrock removal at the Site could be carried out using hoe ramming techniques in conjunction with line drilling on close centres. For the bedrock at the Site, it is suggested that allowance be made for line drilling 75 to 100 millimetre diameter holes on 200 to 300 millimetre centres. However, excavation rates will likely be slower by this method than could be achieved using blasting, noting that strong to very strong bedrock is anticipated – according to the results of compressive strength testing by GEMTEC and GHD (2024). Significant ware of excavation equipment should also be anticipated. The vibration effects of hoe ramming are usually minor and localized. Monitoring of the hoe ramming could be carried out, at least initially, to measure the vibrations to ensure that they are below the acceptable threshold value.

Provided that good bedrock excavation techniques are used, the bedrock could be excavated using near vertical side walls. Any loose bedrock should be scaled from the sides of the excavation for worker safety.

An alternative to mechanical excavation is drilling and basting which could be used to increase excavation rates if permissible in this area and provided existing below and above ground structures will not to be impacted to an unacceptable level.

The effects due to vibration from blasting can be controlled by limiting the size and amount of charge, using delayed detonation techniques, and the like. As a guideline for blasting, the peak vibration limits suggested at the nearest structure or service are provided in Table 4.1, below. It is pointed out that the limits provided, although conservative, were established to prevent damage to existing buildings and services in good condition. More stringent criteria may be required to prevent damage to freshly placed (uncured) concrete or vibration sensitive equipment or utilities. A blasting specialist should be consulted on the effects of vibration on nearby services and separation distance between any blasting and existing underground services. Any blasting should be carried out under the supervision of a blasting specialist and monitoring of the blasting should be carried out to ensure that the blasting meets the limiting vibration criteria. Pre-construction condition surveys of the nearby structures and existing buried services and utilities are considered essential.

Table 4.1 – Peak Vibration Limits

Frequency of Vibration (Hz)	Vibration Limits (millimetres/second)
<10	5
10 to 40	5 to 50 (interpolated)
>40	50

4.2.3 Braced Excavations

As an alternative to sloping / battering the excavation side slopes or where space constraints dictate, installation of the watermain could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose. It is noted that some unavoidable inward horizontal movement and settlement of the ground behind the trench box should be anticipated, which could affect existing services located behind the trench box. Additional information on impacts to adjacent services is provided in Section 4.2.5.

4.2.4 Groundwater Management

Excavation depths of up to about 3.0 metres have been assumed. Some groundwater inflow to the excavations is anticipated in the lower portion of the excavation, depending on the time of year the works are carried out – noting that in borehole 06-22 from GHD (2024) groundwater was measured at a depth of about 2.8 metres in April 2023.

GHD (2024) estimates the hydraulic conductivity of the sandstone bedrock to range from 2.1×10^{-8} m/s to 9.2×10^{-6} m/s with an average of about 3.9×10^{-7} m/s, which is within the typical published range of values (Freeze & Cherry, 1979). Groundwater inflow from the bedrock, if encountered,

could likely be managed by conventional dewatering techniques by pumping from sumps within the trench excavation. For reasonably shallow excavations, it is not expected that short term pumping during excavation will have a significant effect on nearby structures.

Confirmatory measurement of groundwater levels could be obtained closer to the time of construction to verify the depth to groundwater.

During construction, should the volume of pumped groundwater exceed 50,000 litres per day, an Environmental Activity and Sector Registry (EASR) may be required. However, based on the available subsurface conditions at the Site, this is not considered likely; a hydrogeological assessment can be carried out to confirm whether registration is necessary.

4.2.5 Excavation Adjacent to Existing Services

We recommend that that the excavations not encroach within a line extending downwards and outwards at an inclination of 1 vertical to 1 horizontal from the base of the existing services. As previously indicated, some unavoidable inward horizontal movement and settlement of the ground behind the trench box should be anticipated, which could affect existing services located behind the trench box. Where this is not possible, a more rigid shoring system may be required to support the excavation. Additional information could be provided as the design progresses.

It is noted that caution must be exercised during excavation near bends in the existing trunk watermain along Legget. We recommend that the final design drawings be reviewed by a geotechnical engineer to assess whether or not the excavations can be carried out without negatively impacting the thrust restraint for the existing watermain. In addition, a provision should be made in the contract for the contractor to retain a geotechnical engineer during construction to review their excavations near bends in the existing large diameter watermain.

4.3 Pipe Bedding

Pipe bedding material should consist of well graded crushed stone meeting Ontario Provincial Standards Specifications (OPSS) requirements for Granular A. The minimum bedding thickness should be 150 millimetres. In accordance with City of Ottawa standards (refer to S.P. No: F-3147), granular materials used in watermain trench should be composed of virgin (i.e., not recycled) material only. As discussed below, we recommend that a contingency allowance be made in the contract for a sub-bedding layer in the event that unavoidable overexcavation of the bedrock occurs during construction, or where boulders are encountered at subgrade level. In these cases, additional bedding material may be required to fill any voids left following the removal of boulders or overexcavated bedrock. For these areas, or in areas where the subsoil is disturbed, or where unsuitable material exists below the base of trench excavation, a sub-bedding layer of compacted granular material, such as that meeting OPSS Granular B Type II (50 or 100 millimetre minus crushed stone) should be installed.

Extensive zones of silty clay are unlikely to be encountered at the base of the trench excavation. However, should such soils be encountered it should be noted that these deposits are susceptible to weakening under vibration and/or repeated loading.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A.

The sub-bedding, bedding and cover materials should be compacted in maximum 300 millimetre thick lifts to at least 98 percent of the standard Proctor dry density value.

4.4 Thrust Restraint for Watermains

Based on the results of the boreholes, the subsurface conditions at the depth of the proposed watermain will likely consist primarily of sandstone bedrock and engineered fill material – given the thin soil cover that was encountered. The following parameters could be used for design purposes:

Coefficient of friction between granular backfill and smooth plastic pipe:	0.25
Bearing pressure for thrust blocks bearing on native compacted granular material on bedrock:	150 kilopascals

The above allowable bearing pressures for the thrust blocks assume that they are vertical and bear on compacted engineered fil material and bedrock. In areas where the subgrade below the thrust bock is disturbed or where unsuitable material (such as existing fill, trench backfill material, and alluvium) exists below the pipe subgrade level, the disturbed/unsuitable material should be removed and replaced with a layer of compacted granular material, such as that meeting OPSS Granular B Type II. Any compacted Granular B Type II should extend at least 1.5 metres horizontally beyond the thrust block and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. Where removal of the existing fill material is not feasible, thrust restraint for the proposed watermains could be provided by friction (since we cannot provide a reliable bearing pressure for thrust blocks founded on fill material).

4.5 Trench Backfill

The backfill materials within the zone of seasonal frost penetration (i.e., 1.8 metres below finished grade) should match the frost behaviour of the materials exposed on the trench walls – which in this case is likely to be sandstone bedrock (i.e. non-frost susceptible). This will reduce the potential for differential frost heaving between the area over the trench and the adjacent roadway. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type I or II.

To minimize future settlement of the backfill and achieve an acceptable subgrade for any roadways, curbs, etc., the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

4.6 Seepage Barriers

Seepage barriers are not required, from a geotechnical perspective, but may be considered for other purposes. If these are to be implemented, the seepage barriers should begin at subgrade level and extend vertically through the granular pipe bedding and granular surround to within the native backfill materials, and horizontally across the full width of the service trench excavation. The seepage barriers could consist of 1.5 metre wide dykes of compacted silty clay. The silty clay should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

4.7 Pavement Design

4.7.1 Design Sections

It is understood that pavement work related to the watermain reconstruction along Legget Drive is limited to trench reinstatement.

4.7.2 Traffic Data

Detailed traffic data was not available at the time of preparation of this work. However, according to OC Transpo mapping, it is understood that Legget Drive is designated as a bus route with approximately 100 busses per day.

4.7.3 Pavement Structure – Trench Reinstatement

The pavement structure for excavation reinstatement should incorporate the following minimum asphaltic concrete and granular thicknesses following compaction of backfill material:

- 40 millimetres of Superpave 12.5 Traffic Level D with PG 64-34; placed over
- Two (2) lifts each of 60 millimetres of Superpave 19 Traffic Level D with PG 64-34; over
- 150 millimetres of Granular A; over
- 450 millimetres of Granular B Type II.

The above indicated pavement structure should perform as intended while meeting the City of Ottawa minimum standard for bus routes. Furthermore, the layer thicknesses have been selected to closely match the existing pavement structure identified in the boreholes.

4.7.4 Granular Material Compaction

All imported granular materials should be placed in maximum 200-millimetre-thick lifts and should be compacted to at least 99 percent of the Standard Proctor dry density value using suitable vibratory compaction equipment.

4.7.5 Pavement Transitions

As part of the roadway construction, it is anticipated that new pavement will abut the existing pavement at various locations. The following is suggested to improve the performance of the joint between the new and the existing pavements:

- Neatly saw cut the existing asphaltic concrete;
- Remove the asphaltic concrete and slope the bottom of the excavation within the existing granular base and subbase at 1 horizontal to 1 vertical (1H:1V), or flatter, to avoid undermining the existing asphaltic concrete;
- To avoid cracking of the asphaltic concrete due to an abrupt change in the thickness of the roadway granular materials where new pavement areas join with the existing pavements, the granular depths should taper up or down at 5 horizontal to 1 vertical (5H:1V), or flatter, to match the existing pavement structure; and
- Remove (mill off) the existing asphaltic concrete to a depth matching the thickness of the new surface course recommended in this report (typically 40 to 60 millimetres) to a distance of 300 millimetres at the joint and tack coat the asphaltic concrete at the joint in accordance with the requirements in OPSS 310.

It is GEMTEC's experience that joint separation can occur at the joint between the existing granular material and any new (imported) granular materials for the reinstated roadway areas. To reduce the potential for reflective cracking at this location, it is suggested that the joint between the new and existing granular materials be located about 500 millimetres beyond the joint in the asphaltic concrete. Furthermore, a stepped or sloped joint (at 1 horizontal to 1 vertical (1H:1V), or flatter) is suggested to provide a gradual transition and facilitate compaction. Where possible, the thickness of the granular materials in the widened section of the roadway should match those exposed in the adjacent section of the existing roadway.

4.7.6 Effects of Existing Service Trenches

Differential frost heaving could occur in areas where abrupt changes in the frost susceptibility of the subgrade materials exist. The locations of any service trenches that cause differential frost heaving issues during the winter period should be identified at the design stage. To mitigate future differential frost heaving at these locations, granular frost tapers (sloped at 5 horizontal to 1 vertical, or flatter) and/or some subexcavation of materials could be carried out as part of the rehabilitation. The frost heave treatment could be assessed at the time of the construction by geotechnical personnel.

4.8 Corrosion of Buried Concrete and Steel

According to Canadian Standards Association (CSA) "Concrete Materials and Methods of Concrete Construction", the concentration of sulphate can be classified as low. The effects of

freeze thaw in the presence of de-icing chemical (sodium chloride) use on the roadway should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

Based on the resistivity and pH of the sample, the soil in this area can be classified as non-aggressive to aggressive towards unprotected steel. It should be noted that the corrosivity of the soil/groundwater could vary throughout the year due to the application sodium chloride for de-icing.

In contrast, GHD (2024) presents the test results of one sample of soil and three samples of groundwater for corrosion potential of buried concrete and steel. The following was concluded from the testing:

- The soil and groundwater are considered to be extremely corrosive to cast iron piping;
- The degree of exposure of the subsurface concrete structures to sulphate attack is moderate;
- Moderate sulphate resistance cement should be used for below ground concrete (for example in thrust blocks).

The manufacturer of any buried steel elements that will be in contact with the soil and groundwater should be consulted to ensure that the durability of the intended product is appropriate. Confirmatory testing could be carried out prior to construction.

5.0 ADDITIONAL CONSIDERATIONS

5.1 Winter Construction

In order to carry out the work during freezing temperatures, trenches should be opened for as short a time as practicable and the excavations should be carried out only in lengths which allow all of the construction operations, including backfilling, to be fully completed in one working day. The materials on the sides of the trenches should not be allowed to freeze. In addition, the backfill should be excavated, stored and replaced without being disturbed by frost or contaminated by snow or ice.

5.2 Excess Soil Management

Refer to GEMTEC's Sol Quality Report for presentation and discussion of the results of a soil sampling program completed by GMETEC to support excess soil beneficial re-use planning for the project. The report was prepared for Broccolini Investment Inc. and is dated July 2025.

5.3 Design Review and Construction Observation

It is recommended that the final design drawings be reviewed by GEMTEC to ensure that the guidelines provided in this report have been interpreted as intended.

The engagement of the services of GEMTEC during construction is recommended to confirm that the subsurface conditions throughout the proposed excavations do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design. The subgrade surfaces for the proposed watermain and roadway reconstruction should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

6.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Daire Cummins, M.Sc.,
Geotechincal Analyist

Brent Wiebe, P.Eng.
Principal Geotechnical Engineer

GEMTEC
Consulting Engineers and Scientists

CONDITIONS AND LIMITATIONS OF THIS REPORT

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty expressed or implied is made.

2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.

3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC cannot be responsible for use of portions of the report without reference to the entire report.

4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.

5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.

6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety, and equipment capabilities.

7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in Property Value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.

9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions, misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information

and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

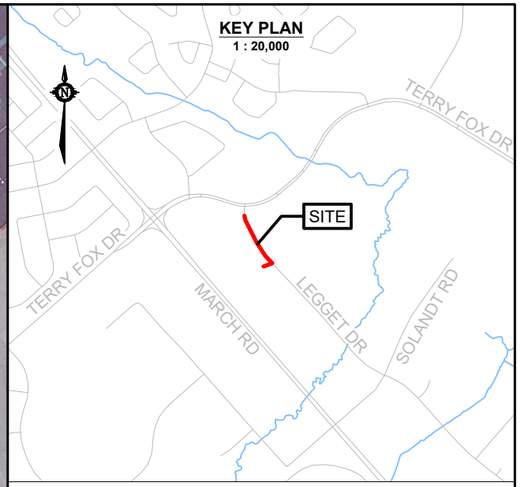
12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

KEY PLAN
1 : 20,000



LEGEND

- **BH #** — BOREHOLE ID
- **XX.XX** — GROUND SURFACE ELEVATION, IN METRES
- APPROXIMATE BOREHOLE LOCATION (current investigation by GEMTEC)
- PROJECT LIMIT

DATA SOURCES AND REFERENCES

1. Coordinate system: CSRS.UTM-18N
2. Distances, elevations, and coordinates are shown in metres unless denoted otherwise
3. This drawing is a schematic representation and should not be taken as a substitute for a legal survey.
4. Image @2025 Google Maps, CNES / Airbus, First Base Solutions, Maxar Technologies
5. Contains information licensed under the Open Government Licence – Ontario
6. Geographic dataset source: Ontario GeoHub

SCALE
1:1,000
0 20 40 60m

DRAWING
SITE PLAN

CLIENT
BROCCOLINI INVESTMENT INC.

PROJECT
SUBSURFACE INVESTIGATION
PROPOSED WATERMAIN
570 LEGGET DRIVE TO TERRY FOX DRIVE
OTTAWA, ONTARIO

DRAWN BY	CHECKED BY
SL	DC
PROJECT NO. 103940.007	REVISION NO. 0
DATE JULY 2025	FIGURE NO. **FIGURE 1**

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APPENDIX A

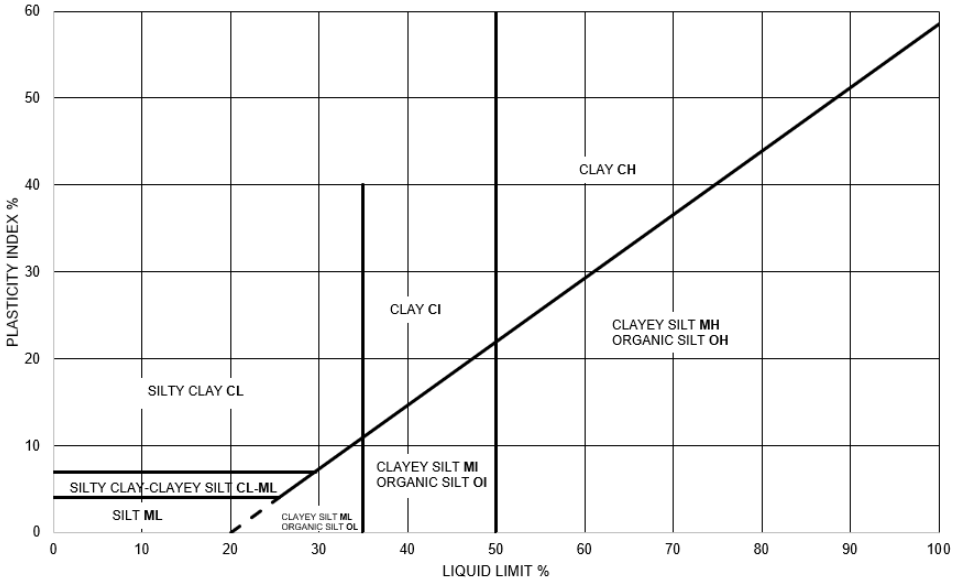
Record of Borehole Logs
List of Abbreviations and Symbols
Boreholes 25-101 to 25-104

Method of Soil Classification

GEMTEC's Soil Classification is based on the MTC Soil Classification Manual (January 1980)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} X D_{60}}$	USCS Group Symbol	Group Name
Inorganic (Organic Content less than 30%)	Coarse Grained Soils (>50% is larger than 0.075 mm)	Gravel (>50% of coarse fraction is > 4.75 mm)	Gravel with ≤12% fines	Poorly Graded	<4	≤1 or ≥3	GP	Gravel
				Well Graded	≥4	1 to 3	GW	Gravel
			Gravel with >12% fines	Below A Line	N/A		GM	Silty Gravel
				Above A Line	N/A		GC	Clayey Gravel
		Sand (≥50% coarse fraction is > 4.75 mm)	Sand with ≤12% fines	Poorly Graded	<6	≤1 or ≥3	SP	Sand
				Well Graded	≥6	1 to 3	SW	Sand
			Sand with >12% fines	Below A Line	N/A		SM	Silty Sand
				Above A Line	N/A		SC	Clayey Sand

Soil Group	Type of Soil	Liquid Limit	Field Tests			USCS Group Symbol	Group Name
			Dilatancy	Thread Diameter	Toughness		
Fine Grained Soils (≥50% is smaller than 0.075 mm)	Silts (Non-Plastic or PI and LL plot below A-Line)	<50	Rapid	>6 mm	N/A	ML	Silt
			Slow	3 to 6 mm	None to low	ML	Clayey Silt
			Slow to V. Slow	3 to 6 mm	Low	OL	Organic Silt
		≥50	Slow to V. Slow	3 to 6 mm	Low to Medium	MH	Clayey Silt
			None	1 to 3 mm	Medium to High	OH	Organic Silt
	Clays (PI and LL plot above A-Line)	Liquid Limit <35	None	~3 mm	Low to Medium	CL	Silty Clay
		Liquid Limit 35 to 50	None	1 to 3 mm	Medium	CI	Silty Clay
		Liquid Limit >50	None	<1 mm	High	CH	Clay
Highly Organic (> 30%)	Peat (Amorphous or Fibrous)					PT	Peat



Dual Symbol – Is used to indicate when soils are transitional. For coarse grained soils, it is used when the soil has between 5 and 12% fines (e.g., SP-SC, Sand to Silty Sand). For fine-grained soils it is used when the plasticity index and liquid limit values plot in the area shown in the plasticity chart on this page.

Borderline Symbol – Is used to indicate soils that are not clearly in one soil type but have similar behaviour and properties as similar materials (e.g., CL/CI or GM/SM).

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

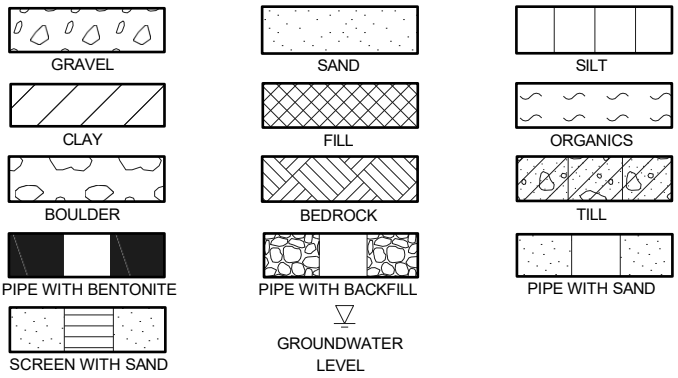
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

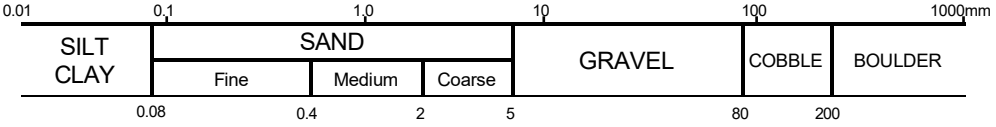
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

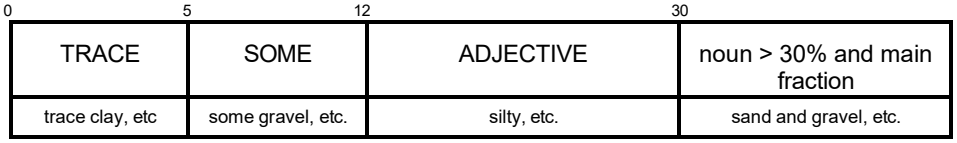
COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	**Description**	**Cu, kPa**	**Description**
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE	
Fresh	No visible sign of rock material weathering
Faintly weathered	Weathering limited to the surface of major discontinuities
Slightly weathered	Penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material
Moderately weathered	Weathering extends throughout the rock mass but the rock material is not friable
Completely weathered	Rock is wholly decomposed and in a friable condition but the rock and structure are preserved

CORE CONDITION
Total Core Recovery (TCR) The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run
Solid Core Recovery (SCR) The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.
Rock Quality Designation (RQD) The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completed broken core to 100% for core in solid segments.

BEDDING THICKNESS	
Description	**Thickness**
Thinly laminated	< 6 mm
Laminated	6 - 20 mm
Very thinly bedded	20 - 60 mm
Thinly bedded	60 - 200 mm
Medium bedded	200 - 600 mm
Thickly bedded	600 - 2000 mm
Very thickly bedded	2000 - 6000 mm

DISCONTINUITY SPACING	
Description	**Spacing**
Very close	20 - 60 mm
Close	60 - 200 mm
Moderate	200 - 600 mm
Wide	600 -2000 mm
Very wide	2000 - 6000 mm

ROCK QUALITY	
RQD	**Overall Quality**
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK COMPRESSIVE STRENGTH	
Comp. Strength, MPa	**Description**
1 - 5	Very weak
5 - 25	Weak
25 - 50	Moderate
50 - 100	Strong
100 - 250	Very strong

RECORD OF BOREHOLE 25-101

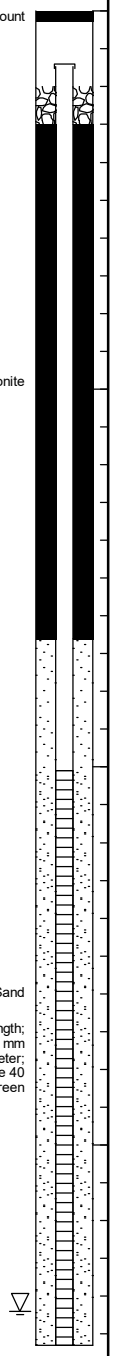
CLIENT: Broccolini Investments Inc.
PROJECT: Nokia March Road Campus Municipal Watermain
JOB#: 103940.007
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 18 2025

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING
0		Ground Surface		78.72						
	Power Auger / Hollow Stem Auger (210mm OD)	ASPHALTIC CONCRETE		78.62						
		BASE - (GP-SP) GRAVEL and SAND, some silt, trace clay; brown, crushed; non-cohesive, moist, dense		0.10 / 78.44						
		SUBBASE - (GP-SP) SAND and GRAVEL, trace to some silt, trace clay; brown, crushed, some cobbles; non-cohesive, moist		0.28 / 78.10	1	SS	305	37		MH
		FILL - (SP) GRAVELLY SAND, trace to some silt; grey brown; non-cohesive; moist; dense		0.62 / 77.65	2	SS	203	79 for 280 mm		
1	Diamond Rotary Core HQ (89mm OD)	Fractured SANDSTONE / BOULDERS		1.07 / 77.45	3	RC	200	TCR= 100%, SCR= 19%, RQD= 0%		
		Fresh, grey SANDSTONE, very thinly to medium bedded. Good to Excellent quality.		1.27	4	RC	1448	TCR= 92%, SCR= 72%, RQD= 71%		UC
2										
3					5	RC	686	TCR= 100%, SCR= 67%, RQD= 100%		
		End of borehole		75.19 / 3.53						
4										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
25/06/27	3.44 ▽	75.3

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LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 103940.007_LOG_BH 101 TO 104_2025-07-07.GPJ GEMTEC 2018.GDT 7/11/25

RECORD OF BOREHOLE 25-102

CLIENT: Broccolini Investments Inc.
PROJECT: Nokia March Road Campus Municipal Watermain
JOB#: 103940.007
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 18 2025

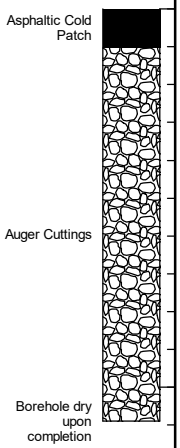
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		79.38				
		ASPHALTIC CONCRETE		79.28				
		BASE - (SP-GP) SAND and GRAVEL, trace to some silt; brown, crushed; non-cohesive, moist		0.10 79.16				
		SUBBASE - (SP-GP) SAND and GRAVEL, trace to some silt; grey brown, crushed; non-cohesive, moist, very dense		0.22 78.62	1	SS	305	74
1	Power Auger / Drive open sampler	FILL - (SP) SAND, some gravel, trace to some silt; grey brown; moist		0.76 78.29	2	SS	178	68 for 0.18 m
		Auger refusal at 0.9 m on inferred bedrock End of borehole		1.09				
2								
3								
4								

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



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LOGGED: A.N.
CHECKED: M.R.

RECORD OF BOREHOLE 25-103

CLIENT: Broccolini Investments Inc.
PROJECT: Nokia March Road Campus Municipal Watermain
JOB#: 103940.007
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 20 2025

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		79.65							
		ASPHALTIC CONCRETE		79.50							
		BASE - (SP-GP) SAND and GRAVEL, trace to some silt; grey, crushed; non-cohesive, moist		0.16 79.39							
		SUBBASE - (SM-GM) SILTY SAND and GRAVEL, trace to some clay; grey, crushed; non-cohesive, moist, very dense		0.26	1	SS	279	84		MH	
					2	SS	178	86 for 0.18 m			
1		(CL-ML) CLAYEY SILT, trace sand; grey brown; cohesive, moist		0.91 78.63							
	Diamond Rotary Core HQ (89mm OD)	Fresh, grey SANDSTONE, very thinly to medium bedded. Good to Excellent quality.		1.02	3	RC	254	TCR= 100%, SCR= 70%, RQD= 75%			
2					4	RC	1549	TCR= 98%, SCR= 75%, RQD= 80%		UC	
3					5	RC	660	TCR= 100%, SCR= 90%, RQD= 94%			
		End of borehole		76.14 3.51							
4											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

Flush Mount
Bentonite
#2 Filter Sand
1.52 m length; 51 mm diameter; Schedule 40 PVC Screen

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
25/06/27	3.30 ▽	76.4

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LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 103940.007_LOG_BH 101 TO 104_2025-07-07.GPJ GEMTEC 2018.GDT 7/11/25

RECORD OF BOREHOLE 25-104

CLIENT: Broccolini Investments Inc.
PROJECT: Nokia March Road Campus Municipal Watermain
JOB#: 103940.007
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2025

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		79.73						
		ASPHALTIC CONCRETE		79.70 / 0.04						Asphaltic cold patch
		BASE - (GM-SM) SILTY GRAVEL and SAND, trace clay; grey, crushed; non-cohesive, moist		79.49 / 0.24						Auger cuttings
		SUBBASE - (GP) SANDY GRAVEL, trace silt; grey, crushed; non-cohesive, moist		79.17 / 0.56	1	SS	229	68 for 0.23 m	MH	Borehole dry upon completion
		Auger refusal on inferred bedrock End of borehole								
1										
2										
3										
4										

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

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LOGGED: A.N.
CHECKED: M.R.

BOREHOLE: 25-101
BORING DATE: JUNE 18, 2025
DEPTH: 1.07 TO 3.53 METRES BELOW GROUND SURFACE

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Project
BROCCOLINI INVESTMENT INC.
SUBSURFACE INVESTIGATION
PROPOSED WATERMAIN
570 LEGGET DRIVE TO TERRY FOX DRIVE
OTTAWA, ONTARIO

Drawing
ROCKCORE PHOTOGRAPH
BOREHOLE 25-101

FIGURE A1

Project No.	Drwn By	Chkd By	Rev No.	Date
103940.007	SL	DC	0	JULY 2025

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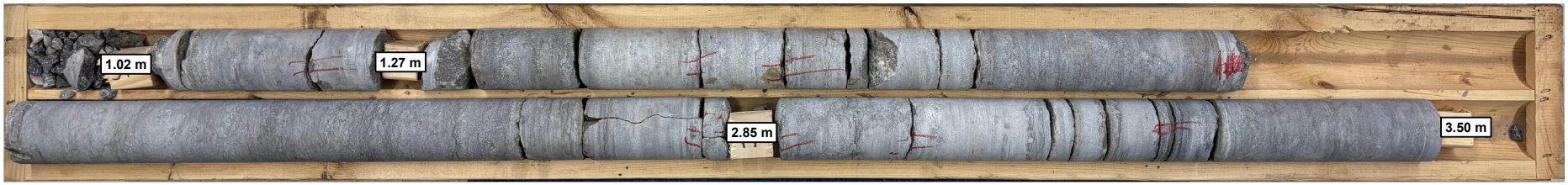
BOREHOLE: 25-103
BORING DATE: JUNE 20, 2025
DEPTH: 1.02 TO 3.50 METRES BELOW GROUND SURFACE



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PROPOSED WATERMAIN
570 LEGGET DRIVE TO TERRY FOX DRIVE
OTTAWA, ONTARIO

Drawing
ROCKCORE PHOTOGRAPH
BOREHOLE 25-103

FIGURE A2

Project No.	Drwn By	Chkd By	Rev No.	Date
103940.007	SL	DC	0	JULY 2025

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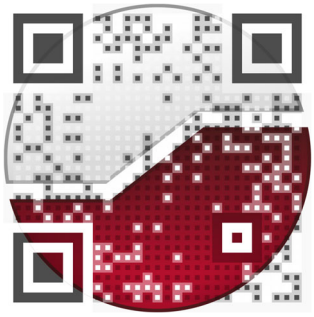
experience • knowledge • integrity



civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité