FINAL

Geotechnical Investigation – Proposed Commercial Development

479 Highway 2, Gananoque, Ontario

Prepared for:

Asterisk Engineering Corporation
2263 Princess Street
Kingston, ON K7M 3G1

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Author: Wesley Tabaczuk, P.Eng.
Project Manager, Geotechnical Services
613.592.3387
wtabaczuk@pinchin.com

Reviewer: Jeff Dietz, P.Eng.
Senior Technical Manager, Geotechnical Services
519.589.3768
jdietz@pinchin.com

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION AND SCOPE

Pinchin Ltd. (Pinchin) was retained by Asterisk Engineering Corporation (Client) to conduct a Geotechnical Investigation and provide subsequent geotechnical design recommendations for the proposed commercial development to be located at 479 Highway 2, Gananoque, Ontario (Site). The Site location is shown on Figure 1.

Based on information provided by the Client, it is Pinchin's understanding that the proposed development is to consist of a two-storey, slab-on-grade (i.e., no basement level) office/warehouse building complete with a gravel surfaced access roadway and parking areas, as well as a future parking lot and coverall area. The proposed development will not be municipally serviced; however, it will include a new septic system.

Pinchin's geotechnical comments and recommendations are based on the results of the Geotechnical Investigation and our understanding of the project scope.

The purpose of the Geotechnical Investigation was to delineate the subsurface conditions and soil engineering characteristics by advancing a total of nine (9) sampled boreholes (Boreholes BH1 to BH9), at the Site. The information gathered from the Geotechnical Investigation will allow Pinchin to provide geotechnical design recommendations for the proposed development.

Based on a desk top review and the results of the Geotechnical Investigation, the following geotechnical data and engineering design recommendations are provided herein:

- A detailed description of the soil and groundwater conditions;
- Site preparation recommendations;
- Open cut excavations;
- Anticipated groundwater management;
- Foundation design recommendations including soil bearing resistances at Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design;
- Potential total and differential settlements;
- Foundation frost protection and engineered fill specifications and installation;
- Seismic Site classification for seismic Site response;
- Concrete floor slab-on-grade support recommendations;
- Gravel surfaced parking area and access roadway design recommendations; and
- Potential construction concerns.

Abbreviations, terminology, and principal symbols commonly used throughout the report, borehole logs and appendices are enclosed in Appendix I.

2.0 SITE DESCRIPTION AND GEOLOGICAL SETTING

The Site is located on the south side of Highway 2, approximately 1.8 kilometres northeast of the intersection of Highway 401 and Highway 2 in Gananoque, Ontario. The Site is currently undeveloped and consists of a combination of forested areas with mature trees and open fields. The lands adjacent to the Site predominantly consist of agricultural land complete with single family residential dwellings and single-storey storage buildings.

Data obtained from the Ontario Geological Survey Maps, as published by the Ontario Ministry of Natural Resources, indicates that the Site is located on Paleozoic bedrock and coarse-textured glaciolacustrine deposits: sand, gravel, minor silt and clay. The underlying bedrock at this Site is of the Queenston formation consisting of shale, limestone, dolostone and siltstone (Ontario Geological Survey Map 1972, published 1978).

Data obtained from the Ontario Geological Survey Maps, as published by the Ontario Ministry of Natural Resources, indicates that the majority of the Site is located on a bedrock drift complex in Precambrian terrain, while the northwest portion of the Site is located on a fine textured glaciolacustrine deposit consisting of massive to well laminated silt and clay with minor sand and gravel deposits (Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV). The underlying bedrock at this Site consists of late felsic plutonic rocks consisting of granitic gneisses with metasedimentary xenoliths, migmatites, injection gneisses, and pegmatites (Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1).

3.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY

Pinchin completed a field investigation at the Site on March 2 and 3, 2022 by advancing a total of nine (9) sampled boreholes (Boreholes BH1 to BH9) throughout the Site. The boreholes were advanced to depths ranging from approximately 3.1 to 5.2 metres below existing ground surface (mbgs). The approximate spatial locations of the boreholes advanced at the Site are shown on Figure 2.

The boreholes were advanced with the use of a track mounted CME55 drill rig which was equipped with standard soil sampling equipment. Soil samples were collected at 0.76 and 1.52 m intervals using a 51 mm outside diameter (OD) split spoon barrel in conjunction with Standard Penetration Tests (SPT) “N” values (ASTM D1586). The SPT “N” values were used to estimate the consistency of the cohesive soil.

Approximate shear strengths of the cohesive deposits were measured using a handheld pocket penetrometer and the results are presented on the appended borehole logs.

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling. The groundwater observations and measurements recorded are included on the appended borehole logs.

The approximate ground surface elevations were obtained from a survey entitled “Topographic Plan of Part of Lot 22, Concession 1, Geographic Township of Leeds and the Thousand Islands, County of Leeds”, completed by Hopkins Chitty Land Surveyors Inc., dated December 10, 2021, project number 2021-0841 (Site Topographic Survey).

The field investigation was monitored by experienced Pinchin personnel. Pinchin logged the drilling operations and identified the soil samples as they were retrieved. The recovered soil samples were sealed into plastic bags and carefully transported to an independent and accredited materials testing laboratory for detailed analysis and testing. All soil samples were classified according to visual and index properties by the project engineer.

The field logging of the soil and groundwater conditions was performed to collect geotechnical engineering design information. The borehole logs include textural descriptions of the subsoil in accordance with a modified Unified Soil Classification System (USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations made during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The modified USCS classification is explained in further detail in Appendix I. Details of the soil and groundwater conditions encountered within the boreholes are included on the Borehole Logs within Appendix II.

Select soil samples collected from the boreholes were submitted to a material testing laboratory to determine the grain size distribution of the soil. A copy of the laboratory analytical reports is included in Appendix III. In addition, the collected samples were compared against previous geotechnical information from the area, for consistency and calibration of results.

4.0 SUBSURFACE CONDITIONS

4.1 Borehole Soil Stratigraphy

In general, the soil stratigraphy at the Site comprises surficial organics overlying natural silty clay/silt and clay to the maximum borehole termination depth of approximately 5.2 mbgs. The appended borehole logs provide detailed soil descriptions and stratigraphies, results of SPT and pocket penetrometer testing, and groundwater measurements.

The surficial organics were encountered in all boreholes and were measured to be approximately 450 mm thick.

The natural silty clay/silt and clay was encountered underlying the surficial organics in all boreholes and extended down to depths ranging between approximately 3.1 and 5.2 mbgs. The silty clay/silt and clay generally comprised trace sand. The cohesive material had a firm to very stiff consistency based on shear strengths measured with a handheld pocket penetrometer of 25 to 200 kPa, as well as SPT 'N' values of 4 to 24 blows per 300 mm penetration of a split spoon sampler. The results of three particle size distribution analyses completed on samples of the material indicated that the samples contain 1 to 3% sand, 22 to 61% silt, and 38 to 78% clay sized particles. The water content of the material tested ranged from 27.4 to 43.5% indicating the material was at the plastic limit (ATPL) to wetter than the plastic limit (WTPL).

Boreholes BH3, BH4, and BH6 to BH9 were terminated at depths ranging between approximately 2.9 and 5.2 mbgs due to auger refusal on probable bedrock.

4.2 Groundwater Conditions

Groundwater observations and measurements were obtained in the open boreholes at the completion of drilling and are summarized on the appended borehole logs. Groundwater was not encountered in Boreholes BH1, BH2, and BH5. Groundwater was encountered in Boreholes BH3, BH4 and BH6 to BH9 at depths ranging from approximately 2.1 to 4.7 mbgs.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions.

5.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1 General Information

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from the geotechnical investigation, and Pinchin's experience with similar projects. Since the investigation only represents a portion of the subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different than those encountered during the investigation. If these situations are encountered, adjustments to the design may be necessary. A qualified geotechnical engineer should be on-Site during the foundation preparation to ensure the subsurface conditions are the same/similar to what was observed during the investigation.

Based on information provided by the Client, it is Pinchin's understanding that the proposed development is to consist of a two-storey, slab-on-grade (i.e., no basement level) office/warehouse building complete with a gravel surfaced access roadway and parking areas, as well as a future parking lot and coverall area. The proposed development will not be municipally serviced; however, it will include a new septic system.

5.2 Site Preparation

The existing organics are not considered suitable to remain below the proposed building, access roadway and parking areas and will need to be removed. In calculating the approximate quantity of topsoil to be stripped, we recommend that the topsoil thicknesses provided on the individual borehole logs be increased by 50 mm to account for variations and some stripping of the mineral soil below.

Pinchin recommends that any engineered fill required at the Site be compacted in accordance with the criteria stated in the following table:

Type of Engineered Fill	Maximum Loose Lift Thickness (mm)	Compaction Requirements	Moisture Content (Percent of Optimum)
Structural fill to support foundations and floor slabs	200	100% SPMDD	Plus 2 to minus 4
Subgrade fill beneath parking lots and access roadways	300	98% SPMDD	Plus 2 to minus 4

Structural fill must extend at least 1 m beyond the edges of proposed foundations, and then outward and downwards to competent soil at 1 horizontal to 1 vertical. Prior to placing any fill material at the Site, the subgrade should be inspected by a qualified geotechnical engineer and loosened/soft pockets should be sub excavated and replaced with engineered fill.

It is recommended that any fill required to raise grades below the proposed building comprise imported Ontario Provincial Standards and Specifications (OPSS) 1010 Granular 'B' Type I or II material. If the work is carried out during very dry weather, water may have to be added to the material to improve compaction. An initial thicker lift of boney sand and gravel may be needed for stability where the groundwater table is near the subgrade level.

A qualified geotechnical engineering technician should be on site to observe fill placement operations and perform field density tests at random locations throughout each lift, to indicate the specified compaction is being achieved.

5.3 Open Cut Excavations

It is anticipated that the foundations will be constructed at conventional frost depths, approximately 1.5 metres below finished floor elevation.

Based on the subsurface information obtained from within the boreholes, it is anticipated that the excavated material will predominately consist of organics and silty clay/silt and clay materials. Groundwater was not encountered in Boreholes BH1 to BH3, BH5 and BH9; however, it was encountered in Boreholes BH4 and BH6 to BH8 at depths ranging from approximately 2.3 to 4.7 mbgs.

Where workers must enter trench excavations deeper than 1.2 m, the trench excavations should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91, Construction Projects, July 1, 2011, Part III - Excavations, Section 226. Alternatively, the excavation walls may be supported by either closed shoring, bracing, or trench boxes complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1). The use of trench boxes can most likely be used for temporary support of vertical side walls. The appropriate trench should be designed/confirmed for use in this soil deposit.

Based on the OHSA, the natural subgrade soils would be classified as Type 3 soil and temporary excavations in these soils must be sloped at an inclination of 1 horizontal to 1 vertical (H to V) from the base of the excavation. Excavations extending below the groundwater table would be classified as a Type 4 soil and temporary excavations will have to be sloped back at 3 H to 1 V from the base of the excavation. Excavations through more than one type of soil must be sloped as per the requirements of the highest numbered soil Type.

In addition to compliance with the OHSA, the excavation procedures must also comply to any potential other regulatory authorities, such as federal and municipal safety standards.

5.4 Anticipated Groundwater Management

As previously mentioned, Groundwater was not encountered in Boreholes BH1 to BH3, BH5 and BH9; however, it was encountered in Boreholes BH4 and BH6 to BH8 at depths ranging from approximately 2.3 to 4.7 mbgs. As such, groundwater is not expected to be encountered during excavations for the proposed development.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. If construction commences during wet periods (typically spring or fall), there is a greater potential that the groundwater elevation could be higher and/or perched groundwater may be present. Any potential precipitation of perched groundwater should be able to be controlled from pumping from filtered sumps.

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade softening.

All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a silt fence, should be installed at the discharge point of the dewatering system. The utmost care should be taken to avoid any potential impacts on the environment

It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. The method used should not adversely impact any nearby structures. Excavations to conventional design depths for the building foundations are not expected to require a Permit to Take Water or a submission to the Environmental Activity and Sector Registry (EASR). It is the responsibility of the contractor to make this application if required.

5.5 Foundation Design

5.5.1 Shallow Foundations Bearing on Natural Silty Clay/Silt and Clay

The existing natural silty clay/silt and clay soil is considered suitable to support the proposed building provided all of the surficial organics are removed, and the subgrade prepared as above.

Conventional shallow strip footings established on the inorganic natural silty clay/silt and clay material encountered approximately 1.5 mbgs, may be designed using a bearing resistance for 25 mm of settlement at Serviceability Limit States (SLS) of 150 kPa, and a factored geotechnical bearing resistance of 225 kPa at Ultimate Limit States (ULS). As the actual service loads were not known at the time of this report, these should be reviewed by the project structural engineer to determine if SLS or ULS governs the footing design. It is noted that the above recommended bearing pressures are provided for foundations installed between approximately 1.5 and 2.0 mbgs. As such, should the underside of the proposed footings be located at a depth of greater than 2.0 mbgs, the bearing pressures should be reviewed by Pinchin to ensure they remain adequate for the proposed building.

It is noted that there is a potential for weaker subgrade soil to be encountered between the investigation locations. Pinchin presumes that any areas of weaker subgrade soil will consist of small pockets of soft/loose natural soil which can be compacted to match the density of the remainder of the Site. As such, the material must be compacted to a minimum of 100% Standard Proctor Maximum Dry Density (SPMDD) prior to installing the concrete formwork. Any soft/loose areas which are not able to achieve the recommended 100% SPMDD are to be removed and replaced with a similar soil type.

Pinchin notes that a qualified geotechnical engineering consultant should be on-Site during the proof roll and foundation preparation activities to verify the recommended level of compaction is achieved and to verify the design assumptions and recommendations. This is especially critical with respect to the recommended soil bearing pressures. If variations occur in the soil conditions between the borehole locations, site verification and site review by Pinchin is recommended to provide appropriate recommendations at that time.

The natural subgrade soil is sensitive to change in moisture content and can become loose/soft if subjected to additional water or precipitation. As well, it could be easily disturbed if travelled on during construction. Once it becomes disturbed it is no longer considered adequate to support the recommended design bearing pressures. It is recommended that a working slab of lean concrete (mud slab) be placed in the footing areas immediately after excavation and inspection to protect the founding soils during placement of formwork and reinforcing steel.

In addition, to ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- Prior to commencing excavations, it is critical that all existing surface water, potential surface water and perched groundwater are controlled and diverted away from the work Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to inclement weather conditions and cause subgrade softening;
- The subgrade should be sloped to a sump outside the excavation to promote surface drainage and the collected water pumped out of the excavation. Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond);
- The footing areas should be cleaned of all deleterious materials such as organics, fill, disturbed or caved materials; and
- If the excavated subgrade soil remains open to weather conditions and groundwater seepage, sidewall stability and suitability of the subgrade soil will need to be verified prior to construction.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided and maintained above freezing at all times.

5.5.2 Site Classification for Seismic Site Response & Soil Behaviour

The following information has been provided to assist the building designer from a geotechnical perspective only. These geotechnical seismic design parameters should be reviewed in detail by the structural engineer and be incorporated into the design as required.

The seismic site classification has been based on the 2012 OBC. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy. If the average shear wave velocity is not known, the site class can be estimated from energy corrected Standard Penetration Resistance (N60) and/or the average undrained shear strength of the soil in the top 30 m.

The boreholes advanced at this Site extended to between approximately 3.1 and 5.2 mbgs and were terminated in the natural silty clay/silt and clay soil. It is noted that bedrock was encountered in Boreholes BH3, BH4, and BH6 to BH9 between approximately 2.9 and 5.2 mbgs. SPT “N” values within the soil deposit ranged between 4 and 24 blows per 300 mm. As such, based on Table 4.1.8.4.A of the OBC, this Site has been classified as Class D. A Site Class D has an average shear wave velocity (Vs) of between 180 and 360 m/s.

5.5.3 Foundation Transition Zones

Excessive differential settlements can occur where the subgrade support material types differ below the underside of continuous strip footings, (i.e., silty clay/silt and clay to engineered fill). As such, where strip footings transition from one material to another the transition between the materials should be suitably sloped or benched to mitigate differential settlements.

Pinchin also recommends the following transition precautions to mitigate/accommodate potential differential settlements:

- For strip footings, the transition zones should be adequately reinforced with additional reinforced steel lap lengths or widened footings;
- Steel reinforced poured concrete foundation walls; and
- Control joints throughout the transition zone(s).

The above recommendations should be reviewed by the structural engineer and incorporated into the design as necessary.

Where strip footings are founded at different elevations, the subgrade soil is to have a maximum slope of 2 H to 1 V, with the concrete footing having a maximum rise of 600 mm and a minimum run of 600 mm

between each step, as detailed in the 2012 Ontario Building Code (OBC). The lower footing should be installed first to mitigate the risk of undermining the upper footing.

Individual spread footings are to be spaced a minimum distance of one and a half times the largest footing width apart from each other to avoid stress bulb interaction between footings. This assumes the footings are at the same elevation.

Foundations may be placed at a higher elevation relative to one another provided that the slope between the outside face of the foundations are separated at a minimum slope of 2H: 1V with an imaginary line drawn from the underside of the foundations. The lower footing should be installed first to mitigate the risk of undermining the upper footing.

5.5.4 Estimated Settlement

All individual spread footings should be founded on uniform subgrade soils, reviewed, and approved by a licensed geotechnical engineer.

Foundations installed in accordance with the recommendations outlined in the preceding sections are not expected to exceed total settlements of 25 mm and differential settlements of 19 mm.

All foundations are to be designed and constructed to the minimum widths as detailed in the 2012 OBC.

5.5.5 Building Drainage

To assist in maintaining the building dry from surface water seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the structure to a drainage swale or appropriate storm drainage system.

Pinchin recommends installing perimeter foundation drains in order to eliminate the potential for water pooling up within the foundation wall backfill. The foundation drains should consist of a minimum 150 mm diameter fabric wrapped perforated drainage tile surrounded by 19 mm diameter clear stone with a minimum cover of 150 mm on top and sides and 50 mm below the drainage tile. Since the original soil contains a significant amount of silt sized particle, the clear stone gravel should be wrapped in a non-woven geotextile (Terrafix 270R or equivalent). The water collected from the weeping tile should be directed away from the building to appropriate drainage areas; either through gravity flow or interior sump pump systems.

5.5.6 Shallow Foundations Frost Protection & Foundation Backfill

In the Gananoque, Ontario area, exterior perimeter foundations for heated buildings require a minimum of 1.5 m of soil cover above the underside of the footing to provide soil cover for frost protection.

Where the foundations for heated buildings do not have the minimum 1.5 m of soil cover frost protection, they should be protected from frost with a combination of soil cover and rigid polystyrene insulation, such as Dow Styrofoam or equivalent product. If required, Pinchin can provide appropriate foundation frost protection recommendations as part of the design review.

To minimize potential frost movements from soil frost adhesion, the perimeter foundation backfill should consist of a free draining granular material, such as a Granular 'B' Type I (OPSS 1010) or an approved sand fill, extending a minimum lateral distance of 600 mm beyond the foundation. The existing silty clay/silt and clay material is not considered suitable for reuse as foundation wall backfill. The backfill material must be brought up evenly on both sides of walls not designed to resist lateral earth pressure. All granular material is to be placed in maximum 300 mm thick lifts compacted to a minimum of 100% SPMDD on the interior of walls and below hard landscaping areas and 95% SPMDD in soft landscaping areas. It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure compaction requirements are achieved.

5.6 Floor Slabs

Prior to the installation of the engineered fill material, all organics and deleterious materials should be removed to the underlying organic free in-situ soil. The natural subgrade soil is to be proof roll compacted with a minimum 10 tonne non-vibratory steel drum roller to observe for weak/soft spots. It is noted that some locations will not be accessible by the steel drum roller; as such, these locations can be proof roll compacted with a minimum 450 kg vibratory plate compactor. Any soft area(s) encountered during proof rolling should be excavated and replaced with a similar soil type.

Once the subgrade soil is exposed it is to be inspected and approved by a qualified geotechnical engineering consultant to ensure that the material conforms to the soil type and consistency observed during the subsurface investigation work.

Based on the in-situ soil conditions, it is recommended to establish the concrete floor slab on a minimum 300 mm thick layer of Granular "A" (OPSS 1010) compacted to at least 100% SPMDD. Any required up-fill should consist of an OPSS 1010 Granular "B" Type I or Type II material.

The installation of a vapour barrier may be required under the floor slab. If required, the vapour barrier should conform to the flooring manufacturers and designer's requirements. Consideration may be given to carrying out moisture emission and/or relative humidity testing of the slab to determine the concrete condition prior to flooring installation. To minimize the potential for excess moisture in the floor slab, a concrete mixture with a low water-to-cement ratio (i.e., 0.5 to 0.55) should be used.

The following table provides the unfactored modulus of subgrade reaction values:

Material Type	Modulus of Subgrade Reaction (kN/m^3)
Granular A (OPSS 1010)	85,000
Granular “B” Type I (OPSS 1010)	75,000
Granular “B” Type II (OPSS 1010)	85,000
Silty Clay/Silt and Clay	18,000

The above-noted values are for loaded areas of 0.3 m by 0.3 m.

5.7 Gravel Surfaced Parking Areas and Access Roadway Design

5.7.1 Discussion

The proposed development will be complete with gravel surfaced parking areas and a gravel surfaced access roadway. The in-situ natural silty clay/silt and clay material is considered a sufficient bearing material for a gravel surfaced parking area and access roadway provided all organics and deleterious materials are removed prior to installing the engineered fill material.

At this time Pinchin is unaware of the proposed final grades for the parking areas and access roadway. As such, provided they are overlying the in-situ natural silty clay/silt and clay material, the following gravel surfaced structure is recommended.

5.7.2 Gravel Surfaced Structure

The following table presents the minimum specifications for a gravel surfaced parking area and access roadway:

Granular Layer	Compaction Requirements	Parking Areas	Access Roadway
Base Course: Granular “A” (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	300 mm
Subbase Course: Granular “B” Type I (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM D698)	450 mm	600 mm

Notes:

I. Prior to placing the pavement structure, the subgrade soil is to be proof rolled with a smooth drum roller without vibration to observe weak spots and the deflection of the soil; and

II. The recommended pavement structure may have to be adjusted according to the Town of Gananoque standards. Also, if construction takes place during times of substantial precipitation and the subgrade soil becomes wet and disturbed, the granular thickness may have to be increased to compensate for the weaker subgrade soil. In addition, the granular fill material thickness may have to be temporarily increased to allow heavy construction equipment to access the Site, in order to avoid the subgrade from “pumping” up into the granular material.

5.7.3 Gravel Surfaced Structure Subgrade Preparation and Granular up Fill

The proper placement of base and subbase fill materials becomes very important in addressing the proper load distribution to provide a durable pavement structure.

The subgrade materials should be thoroughly proof rolled prior to placement of the Granular 'B' subbase course. If any unstable areas are noted, then the Granular 'B' thickness may need to be increased to support construction traffic. This should be left as a field decision by a qualified geotechnical engineer at the time of construction, but it is recommended that additional Granular 'B' be carried as a provisional item under the construction contract.

Where fill material is required to increase the grade to the underside of the gravel surfaced structure it should consist of an OPSS 1010 Granular 'B' Type I or II material. The up-fill material is to be placed in maximum 300 mm thick lifts compacted to 98% SPMDD within 4% of the optimum moisture content.

Samples of both the Granular 'A' and Granular 'B' aggregates should be tested for conformance to OPSS 1010 prior to utilization on Site and during construction. All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.

Post compaction settlement of fine-grained soil can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the parking lot and access roadways for best grade integrity.

Where the subgrade material types differ below the underside of the pavement structure, the transition between the materials should be sloped as per frost heave taper OPSD 205.60.

5.7.4 Drainage

Control of surface water is a critical factor in achieving good gravel surfaced structure life. The gravel thickness designs are based on a drained subgrade via sub-drains or ditches.

The silty clay/silt and clay soils have poor natural drainage and therefore it is recommended that pavement subdrains be installed in the lower areas and be connected to catch basins or a suitable frost-free drainage outlet.

The surface of the roadways should be free of depressions and be sloped at a minimum grade of 1% in order to drain to appropriate drainage areas. Subgrade soil should slope a minimum of 3% toward stormwater collection points. Positive slopes are very important for the proper performance of the drainage system. The granular base and subbase materials should extend horizontally to any potential ditches or swales.

In addition, routine maintenance of the drainage systems will assist with the longevity of the gravel surfaced structure. Ditches, culverts, sewers and catch basins should be regularly cleared of debris and vegetation.

5.8 Septic System Soil Percolation Rate Analysis

Based on information provided by the Client, the proposed development will include a new septic system. As such, Boreholes BH3 and BH4 were advanced in the vicinity of the proposed septic field in order to estimate the soil percolation rate for the soil samples obtained.

The soil conditions encountered within the boreholes advanced for the proposed septic field were noted to be consistent with the soil conditions encountered within the remainder of the boreholes advanced at the Site. Groundwater was encountered within Boreholes BH3 and BH4 at approximately 3.1 and 4.7 mbgs, respectively.

A soil sample was submitted from 0.8 to 1.4 mbgs in Borehole BH4, which is the anticipated depth of the septic field distribution pipes. The results of the particle size distribution analysis indicate that the sample contains 0% gravel, 3% sand, 27% silt, and 70% clay sized particles.

The percolation time of the sample was estimated based on Supplementary Standard SB-6 of the Ontario Building Code (OBC), "Percolation Time and Soil Descriptions". The standard utilizes the soil type as described by the Unified Soil Classification System and is determined by the laboratory test results. Based on the results of the laboratory test results, the soil can be classified as "ML-CL ", for which the OBC specifies a percolation time in the range of 20 to greater than (>) 50 mins/cm. A minimum percolation time of T => 50 mins/cm is appropriate for the samples tested.

In addition to gradation, the percolation time of the soil is dependent upon many on-Site factors that were not considered as part of this assessment, such as density, structure, and moisture content. It is the responsibility of the septic system designer to consider these factors prior to choosing a percolation time suitable for design, and to carry out field inspections at the time of system installation to confirm that the soil and groundwater conditions are consistent with the design assumptions.

It is important to note that the percolation assessment involves a limited sampling of the Site gathered at specific borehole locations and the conclusions in this report are based on this information gathered. The subsurface conditions between and beyond the boreholes will differ from those encountered at the boreholes. Should subsurface conditions be encountered which differ materially from those indicated at the boreholes, Pinchin should be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions.

6.0 SITE SUPERVISION & QUALITY CONTROL

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade material prior to subgrade preparation, pouring any foundations or footings, backfilling, or engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per Pinchin's recommendations. Compaction quality control of engineered fill material (full-time monitoring) is recommended as standard practice, as well as regular sampling and testing of aggregates and concrete, to ensure that physical characteristics of materials for compliance during installation and satisfies all specifications presented within this report.

7.0 TERMS AND LIMITATIONS

This Geotechnical Investigation was performed for the exclusive use of Asterisk Engineering Corporation (Client) in order to evaluate the subsurface conditions at 479 Highway 2, Gananoque, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering for the Site. Classification and identification of soil, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sample locations.

Performance of this Geotechnical Investigation to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the subgrade soil at the Site, and recognizes reasonable limits on time and cost.

Regardless how exhaustive a Geotechnical Investigation is performed, the investigation cannot identify all the subsurface conditions. Therefore, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation. If during construction, subsurface conditions differ from then what was encountered within our test location and the additional subsurface information provided to us, Pinchin should be contacted to review our recommendations. This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.

This report has been prepared for the exclusive use of the Client and their authorized agents. 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 the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

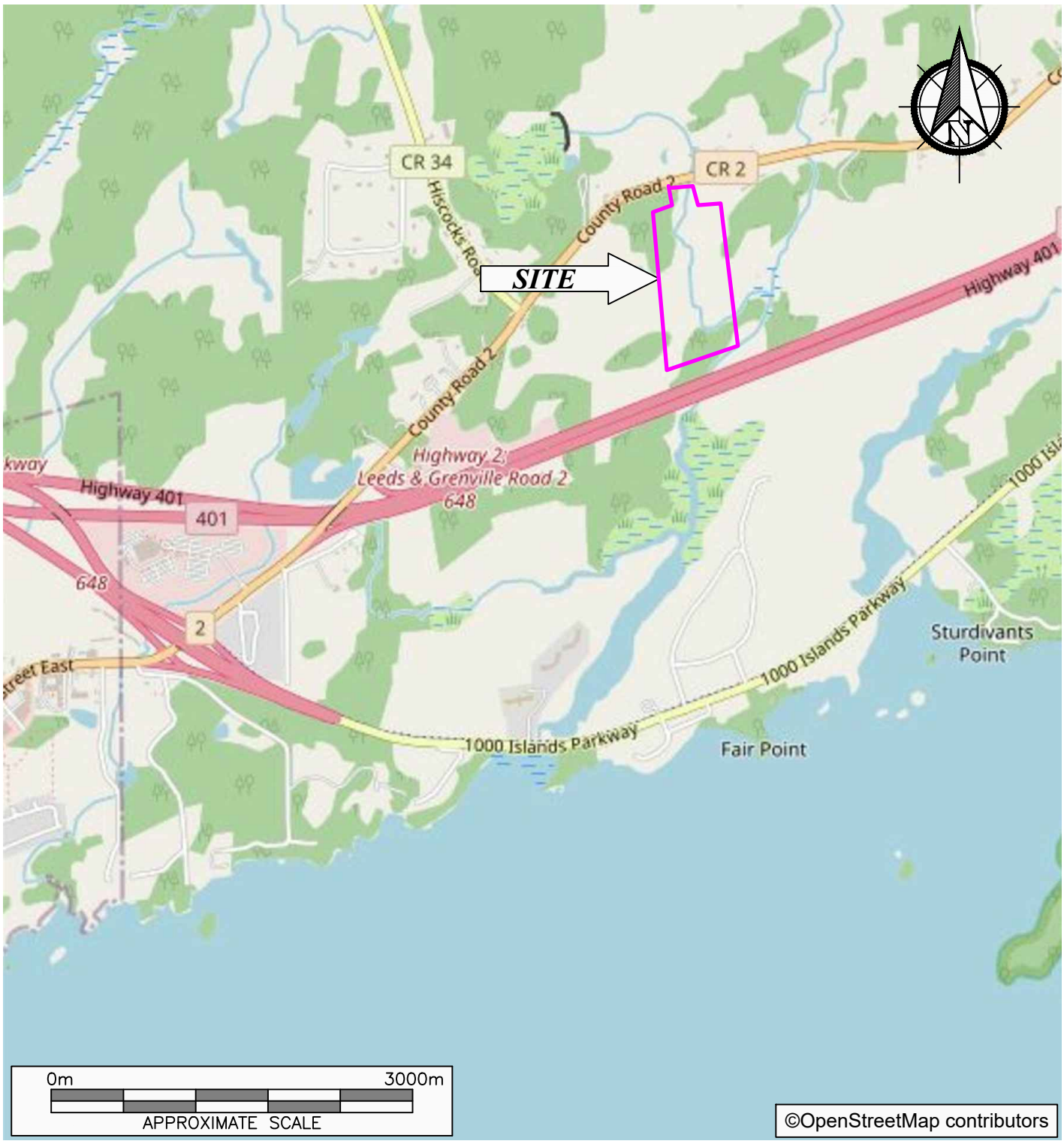
The liability of Pinchin or our officers, directors, shareholders or staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered (Claim Period), to commence legal proceedings against Pinchin to recover such losses or damage unless the laws of the jurisdiction which governs the Claim Period which is applicable to such claim provides that the applicable Claim Period is greater than two years and cannot be abridged by the contract between the Client and Pinchin, in which case the Claim Period shall be deemed to be extended by the shortest additional period which results in this provision being legally enforceable.

Pinchin makes no other representations whatsoever, including those 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 these interpretations may change over time. Please refer to Appendix IV, Report Limitations and Guidelines for Use, which pertains to this report.

Specific limitations related to the legal and financial and limitations to the scope of the current work are outlined in our proposal, the attached Methodology and the Authorization to Proceed, Limitation of Liability and Terms of Engagement which accompanied the proposal.

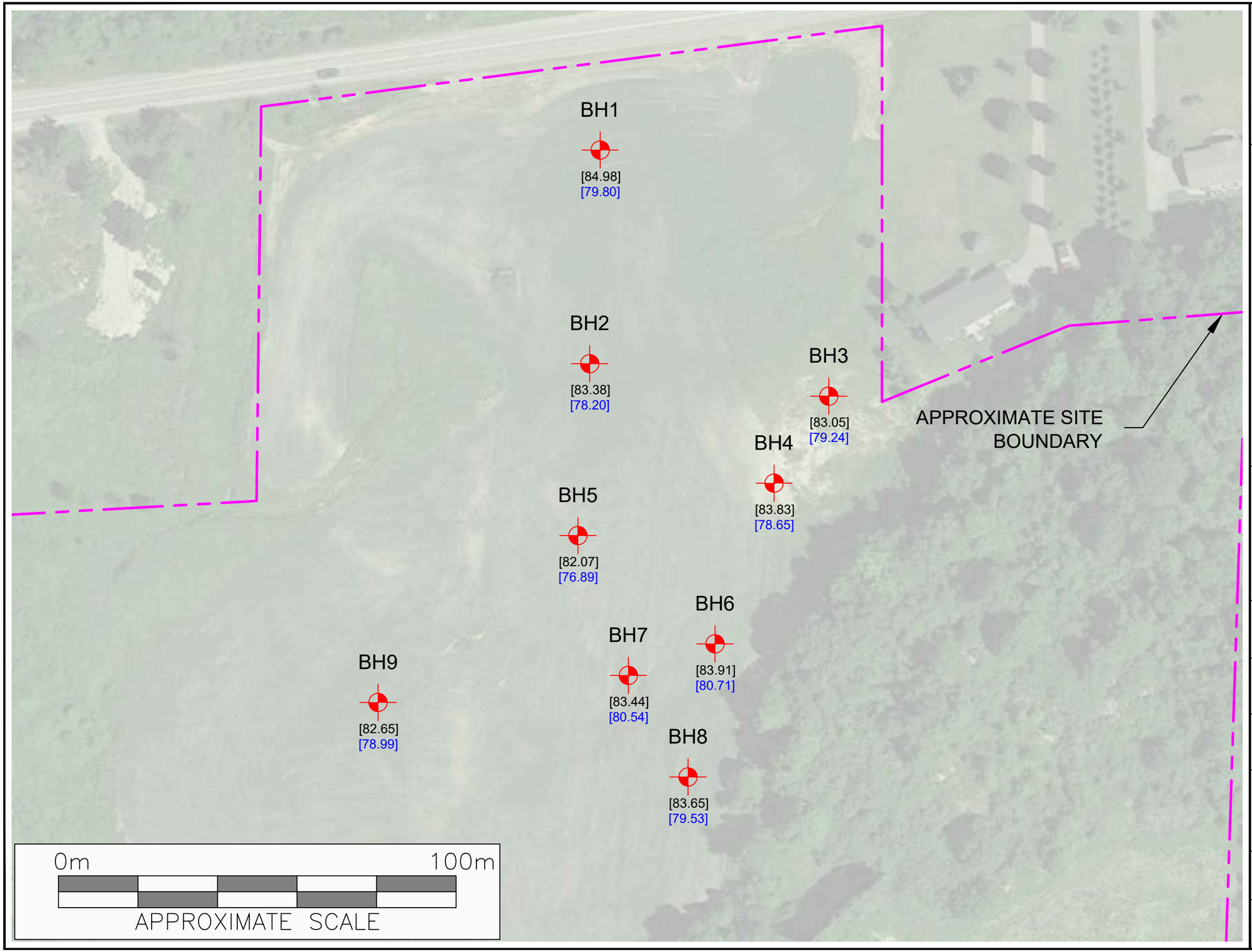
Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

FIGURES



PINCHIN

PROJECT NAME: GEOTECHNICAL INVESTIGATION			
CLIENT NAME: ASTERISK ENGINEERING CORPORATION			
PROJECT LOCATION: 479 HIGHWAY 2, GANANOQUE, ONTARIO			
FIGURE NAME: KEY MAP			FIGURE NO.: 1
APPROXIMATE SCALE: AS SHOWN	PROJECT NO.: 303665.000	DATE: MAY 2022	



LEGEND

- APPROXIMATE BOREHOLE LOCATION
- [XX.XX] APPROXIMATE GEODETIC GROUND ELEVATION (m)
- [XX.XX] APPROXIMATE GEODETIC TERMINATION ELEVATION (m)

PINCHIN

PROJECT NAME
GEOTECHNICAL INVESTIGATION

CLIENT NAME
ASTERISK ENGINEERING CORPORATION

PROJECT LOCATION
479 HIGHWAY 2, GANANOQUE, ONTARIO

FIGURE NAME
BOREHOLE LOCATION PLAN

APPROXIMATE SCALE	PROJECT NO.
AS SHOWN	303665
DATE	FIGURE NO.
MAY 2022	2

APPENDIX I

Abbreviations, Terminology and Principle Symbols used in Report and Borehole Logs

ABBREVIATIONS, TERMINOLOGY & PRINCIPAL SYMBOLS USED

Sampling Method

AS	Auger Sample	**w**	Washed Sample
SS	Split Spoon Sample	**HQ**	Rock Core (63.5 mm diam.)
ST	Thin Walled Shelby Tube	**NQ**	Rock Core (47.5 mm diam.)
BS	Block Sample	**BQ**	Rock Core (36.5 mm diam.)

In-Situ Soil Testing

Standard Penetration Test (SPT), "N" value is the number of blows required to drive a 51 mm outside diameter spilt barrel sampler into the soil a distance of 300 mm with a 63.5 kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved. The SPT, "N" value is a qualitative term used to interpret the compactness condition of cohesionless soils and is used only as a very approximation to estimate the consistency and undrained shear strength of cohesive soils.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60 degree apex attached to "A" size drill rods continuously into the soil for each 300 mm penetration with a 63.5 kg weight free falling a distance of 760 mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm2 base area with a 60 degree apex pushed through the soil at a penetration rate of 2 cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

Soil Descriptions

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained, fine grained and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75 mm. To aid in quantifying material amounts by weight within the respective grain size fractions the following terms have been included to expand the USCS:

Soil Classification		Terminology	Proportion
Clay	< 0.002 mm		
Silt	0.002 to 0.06 mm	“trace”, trace sand, etc.	1 to 10%
Sand	0.075 to 4.75 mm	“some”, some sand, etc.	10 to 20%
Gravel	4.75 to 75 mm	Adjective, sandy, gravelly, etc.	20 to 35%
Cobbles	75 to 200 mm	And, and gravel, and silt, etc.	>35%
Boulders	>200 mm	Noun, Sand, Gravel, Silt, etc.	>35% and main fraction

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, etcetera, dictate the soils engineering behaviour over grain size fractions; and
- With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the compactness condition of cohesionless soil:

Cohesionless Soil	
Compactness Condition	**SPT N-Index (blows per 300 mm)**
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-Index:

Cohesive Soil		
Consistency	**Undrained Shear Strength (kPa)**	**SPT N-Index (blows per 300 mm)**
Very Soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

Note: Utilizing the SPT, N-Index value to correlate the consistency and undrained shear strength of cohesive soils is only very approximate and needs to be used with caution.

Soil & Rock Physical Properties

General

W Natural water content or moisture content within soil sample

γ Unit weight

γ' Effective unit weight

γ_d Dry unit weight

γ_{sat} Saturated unit weight

ρ Density

ρ_s Density of solid particles

ρ_w Density of Water

ρ_d Dry density

ρ_{sat} Saturated density e Void ratio

n Porosity

S_r Degree of saturation

E_{50} Strain at 50% maximum stress (cohesive soil)

Consistency

W_L	Liquid limit
W_P	Plastic Limit
I_P	Plasticity Index
W_S	Shrinkage Limit
I_L	Liquidity Index
I_C	Consistency Index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density Index (formerly relative density)

Shear Strength

C_u, S_u	Undrained shear strength parameter (total stress)
C'_d	Drained shear strength parameter (effective stress)
r	Remolded shear strength
τ_p	Peak residual shear strength
τ_r	Residual shear strength
ø’	Angle of interface friction, coefficient of friction = tan ø’

Consolidation (One Dimensional)

C_C	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
C_S	Swelling index
m_V	Coefficient of volume change
c_V	Coefficient of consolidation
T_V	Time factor (vertical direction)
U	Degree of consolidation
σ'_O	Overburden pressure
σ'_p	Preconsolidation pressure (most probable)
OCR	Overconsolidation ratio

Permeability

The following table outlines the terms used to describe the degree of permeability of soil and common soil types associated with the permeability rates**:**

Permeability (k cm/s)	Degree of Permeability	Common Associated Soil Type
$> 10^{-1}$	Very High	Clean gravel
10^{-1} to 10^{-3}	High	Clean sand, Clean sand and gravel
10^{-3} to 10^{-5}	Medium	Fine sand to silty sand
10^{-5} to 10^{-7}	Low	Silt and clayey silt (low plasticity)
$>10^{-7}$	Practically Impermeable	Silty clay (medium to high plasticity)

Rock Coring

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum**.**

RQD is calculated as follows:

$$\text{RQD (\%)} = \frac{\Sigma \text{ Length of core pieces} > 100 \text{ mm} \times 100}{\text{Total length of core run}}$$

The following is the Classification of Rock with Respect to RQD Value:

RQD Classification	RQD Value (%)
Very poor quality	**<25**
Poor quality	25 to 50
Fair quality	50 to 75
Good quality	75 to 90
Excellent quality	90 to 100

APPENDIX II

Pinchin's Borehole Logs

Log of Borehole: BH1

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 2, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value
0	Ground Surface	84.98				
	Organics ~ 450 mm	84.52	SS	1	80	18
1	**Silty Clay** Silty clay, trace sand, brown, very stiff, ATPL		SS	2	70	9
2			SS	3	70	16
			SS	4	100	13
3		81.93				
	Grey, firm to stiff , ATPL to WTPL		SS	5	100	6
4						
			SS	6	100	4
5		79.80				
	End of Borehole					
6	Borehole terminated at 5.18 mbgs in silty clay. At drilling completion, no free groundwater was encountered.					

Monitoring Well Details: No Monitoring Well Installed

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Water Content (%) | Sample ID | Soil Vapour Concentration (ppm) | Laboratory Analysis

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 84.98 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH2

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 2, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	83.38	No Monitoring Well Installed										
		Organics ~ 450 mm	82.92		SS	1	100	13						
1		**Silty Clay** Silty clay, trace sand, brown, stiff to very stiff, ATPL			SS	2	70	16						
2					SS	3	50	18						
					SS	4	60	18						
3			80.33											
		Grey, ATPL to WTPL			SS	5	100	6						
4														
					SS	6	100	4			43.5			Hyd.
5			78.20											
		End of Borehole												
6		Borehole terminated at 5.18 mbgs in silty clay. At drilling completion, no free groundwater was encountered.												

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.38 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH3

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 2, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	83.05	No Monitoring Well Installed										
		Organics ~ 450 mm	82.59		SS	1	70	6						
1		**Silty Clay** Silty clay, trace sand, brown, stiff to very stiff, ATPL			SS	2	100	12						
2					SS	3	100	11						
					SS	4	100	7						
3		Grey, WTPL	80.00		SS	5	80	10						
			79.24											
4		End of Borehole												
		Borehole terminated at 3.81 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 3.05 mbgs.												
5														
6														

Contractor: Canadian Environmental Drilling & Contractors Inc. **Grade Elevation:** 83.05 m

Drilling Method: Solid Stem Auger/Split Spoon **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 1

Log of Borehole: BH4

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 2, 2022 **Project Manager:** WT

SUBSURFACE PROFILE					SAMPLE									
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	83.83	No Monitoring Well Installed										
		Organics ~ 450 mm	83.37		SS	1	70	24						
1		**Silty Clay** Silty clay, trace sand, brown, stiff to very stiff, ATPL			SS	2	70	15				31.9		Hyd.
2					SS	3	80	11						
					SS	4	90	9						
3			80.78											
		Grey, ATPL to WTPL			SS	5	100	6						
4														
					SS	6	100	4						
5			78.65											
		End of Borehole												
6		Borehole terminated at 5.18 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 4.72 mbgs.												

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.83 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH5

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 2, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	82.07											
		Organics ~ 450 mm	81.61		SS	1	60	10						
1		**Silt and Clay** Silt and Clay, trace sand, brown, stiff to very stiff, ATPL			SS	2	70	13						
2					SS	3	70	18						
					SS	4	80	17						
3			79.02											
		Grey, ATPL to WTPL			SS	5	100	12						
4														
					SS	6	100	4						
5			76.89											
		End of Borehole												
6		Borehole terminated at 5.18 mbgs in soft silty clay. At drilling completion, no free groundwater was encountered.												

No Monitoring Well Installed

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 82.07 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH6

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 3, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength (kPa, 100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	83.91	No Monitoring Well Installed										
		Organics ~ 450 mm	83.45		SS	1	70	18						
1		**Silt and Clay** Silt and Clay, trace sand, brown, very stiff, ATPL			SS	2	80	13						
2					SS	3	90	12						
					SS	4	100	12						
3		WTPL	80.86		SS	5	10	12						
		End of Borehole												
4		Borehole terminated at 3.20 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 3.05 mbgs.												
5														
6														

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.91 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH7

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 3, 2022 **Project Manager:** WT

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	83.44											
		Organics ~ 450 mm	82.98		SS	1	60	19						
1		**Silt and Clay** Silt and Clay, trace sand, brown, stiff to very stiff, ATPL		No Monitoring Well Installed	SS	2	70	18						
2		WTPL	81.31		SS	3	100	18						
			80.54		SS	4	100	13						
3		End of Borehole												
4		Borehole terminated at 2.90 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 2.13 mbgs.												
5														
6														

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.44 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH8

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 3, 2022 **Project Manager:** WT

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
		SUBSURFACE PROFILE			**SAMPLE**									
0		Ground Surface	83.65											
		Organics ~ 450 mm	83.19		SS	1	80	12						
1		***Silt and Clay*** Silt and Clay, trace sand, brown, stiff to very stiff, ATPL		No Monitoring Well Installed	SS	2	90	17						
2					SS	3	100	14			27.4			Hyd.
3			80.60		SS	4	100	16						
		WTPL			SS	5	100	12						
4			79.53											
		End of Borehole												
5		Borehole terminated at 4.11 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 3.20 mbgs.												
6														

Contractor: Canadian Environmental Drilling & Contractors Inc. **Grade Elevation:** 83.65 m

Drilling Method: Solid Stem Auger/Split Spoon **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 1

Log of Borehole: BH9

Project #: 303665 **Logged By:** MK

Project: Geotechnical Investigation

Client: Asterisk Engineering Corporation

Location: 479 Highway 2, Gananoque, Ontario

Drill Date: March 3, 2022 **Project Manager:** WT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	82.65											
		Organics ~ 450 mm	82.19		SS	1	70	16						
1		**Silt and Clay** Silt and Clay, trace sand, brown, very stiff, ATPL		No Monitoring Well Installed	SS	2	70	11						
2					SS	3	90	14						
					SS	4	100	14						
3			79.60											
		WTPL	78.99		SS	1	100	11						
		End of Borehole												
4		Borehole terminated at 3.66 mbgs due to auger refusal on probable bedrock. At drilling completion, groundwater was encountered at 3.05 mbgs.												
5														
6														

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 82.65 m

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: N/A

Well Casing Size: N/A

Sheet: 1 of 1

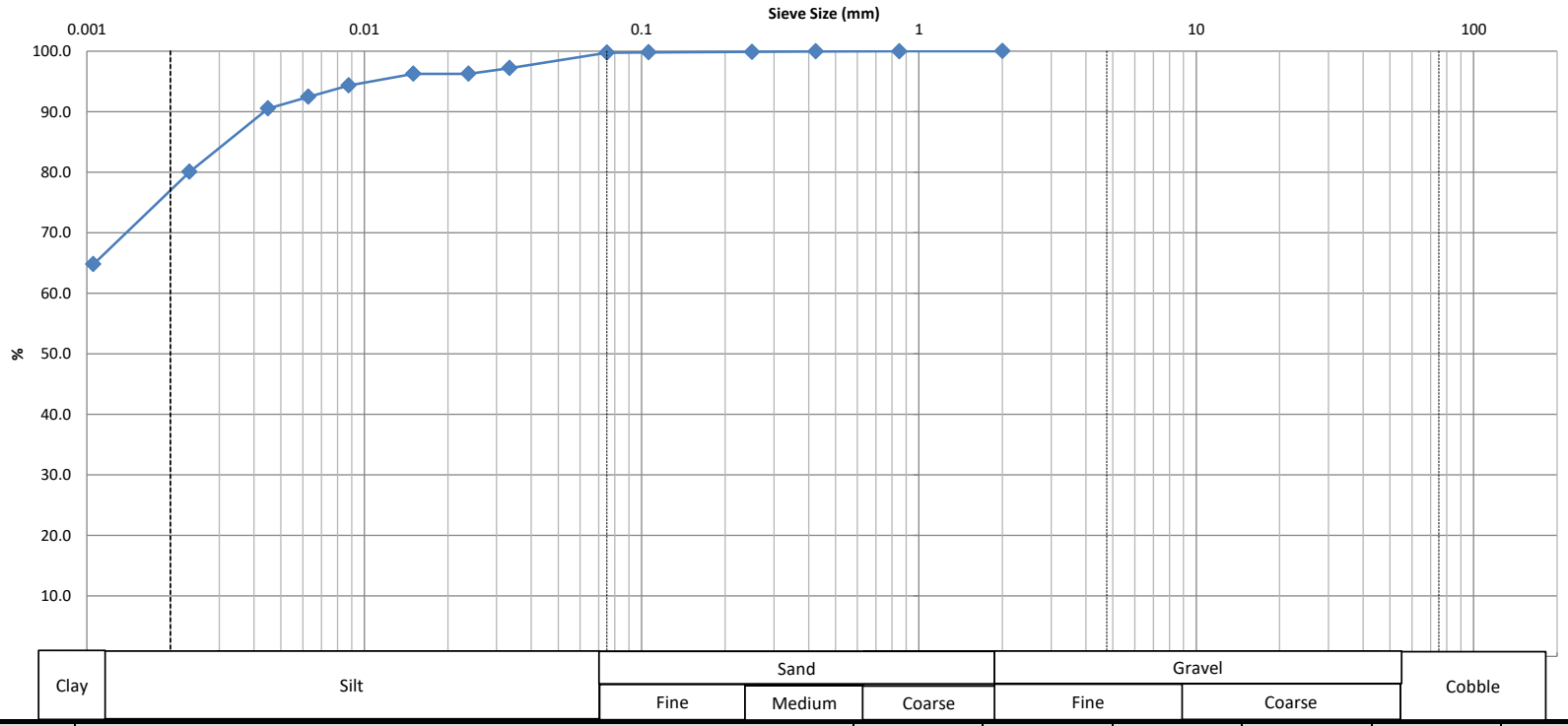
APPENDIX III

Laboratory Testing Reports for Soil Samples

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Pinchin	DEPTH:	15' - 17'	FILE NO:	PM4184
CONTRACT NO.:		BH OR TP No.:	BH2	LAB NO:	31877
PROJECT:	303665			DATE RECEIVED:	8-Mar-22
				DATE TESTED:	10-Mar-22
DATE SAMPLED:	3-Mar-22			DATE REPORTED:	15-Mar-22
SAMPLED BY:	Client			TESTED BY:	CS



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					43.5					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	0.3	21.7	78.0

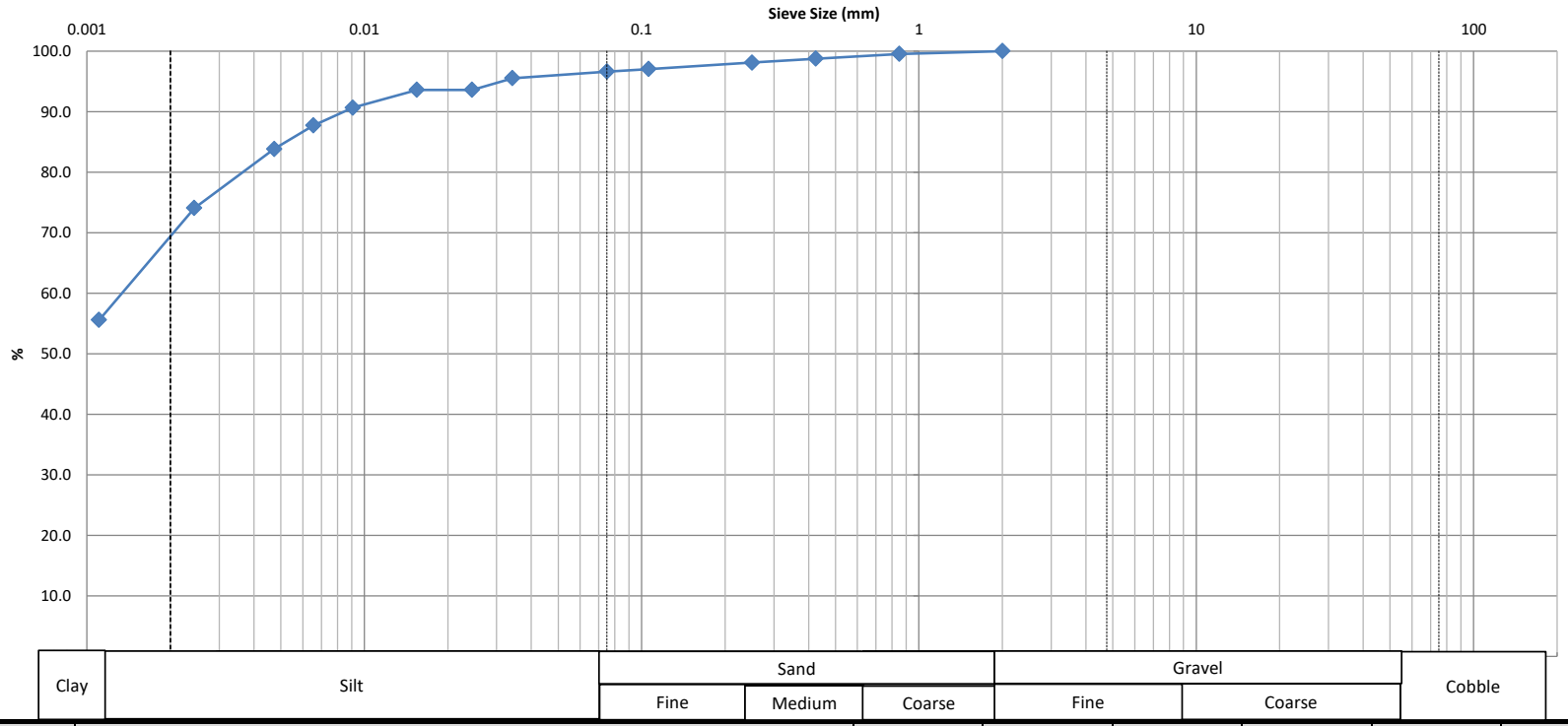
Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Pinchin	DEPTH:	2.5' - 4.5'	FILE NO:	PM4184
CONTRACT NO.:		BH OR TP No.:	BH4	LAB NO:	31878
PROJECT:	303665			DATE RECEIVED:	8-Mar-22
				DATE TESTED:	10-Mar-22
DATE SAMPLED:	3-Mar-22			DATE REPORTED:	15-Mar-22
SAMPLED BY:	Client			TESTED BY:	CS



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						31.9					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	3.4		27.1		69.5	

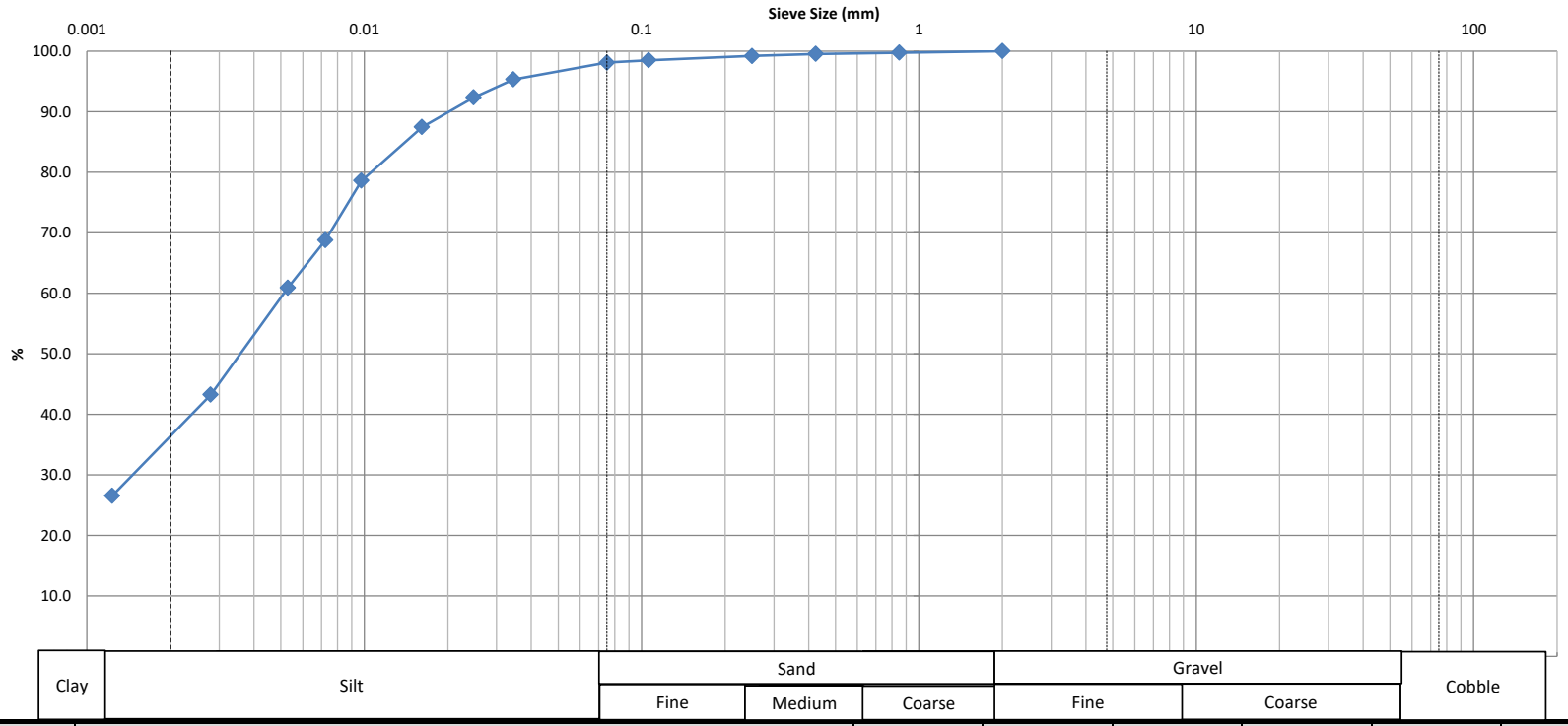
Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Pinchin	DEPTH:	5' - 7'	FILE NO:	PM4184
CONTRACT NO.:		BH OR TP No.:	BH8	LAB NO:	31879
PROJECT:	303665			DATE RECEIVED:	8-Mar-22
				DATE TESTED:	10-Mar-22
DATE SAMPLED:	3-Mar-22			DATE REPORTED:	15-Mar-22
SAMPLED BY:	Client			TESTED BY:	CS



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					27.4					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	1.9		60.6		37.5

Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

APPENDIX IV

Report Limitations and Guidelines for Use

REPORT LIMITATIONS & GUIDELINES FOR USE

This information has been provided to help manage risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report was prepared for the exclusive use of the Client and their authorized agents, subject to the conditions and limitations contained within the duly authorized work plan. 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 the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical report is based on the existing conditions at the time the study was performed, and Pinchin's opinion of soil conditions are strictly based on soil samples collected at specific test hole locations. The findings and conclusions of Pinchin's reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the Site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

LIMITATIONS TO PROFESSIONAL OPINIONS

Interpretations of subsurface conditions are based on field observations from test holes that were spaced to capture a 'representative' snap shot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. Pinchin reviews field and laboratory data and then applies professional judgment to formulate an opinion of subsurface conditions throughout the Site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

LIMITATIONS OF RECOMMENDATIONS

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. Pinchin should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing and consultation should be provided by Pinchin during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the test hole investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing and consultation by Pinchin should be completed to evaluate whether or not earthwork activities are completed in

accordance with our recommendations. Retaining Pinchin for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by Pinchin is over and above the mandate of this geotechnical evaluation and therefore, additional fees would apply.

MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Pinchin confer with appropriate members of the design team after submitting the report. Also retain Pinchin to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Pinchin participate in pre-bid and preconstruction conferences, and by providing construction observation. Please be advised that retaining Pinchin to participation in any 'other' activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

CONTRACTORS RESPONSIBILITY FOR SITE SAFETY

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor's responsibility that the Ontario Occupational Health and Safety Act is adhered to, and Site conditions satisfy all 'other' acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION

This report is geotechnical in nature and was not performed in accordance with any environmental guidelines. As such, any environmental comments are very preliminary in nature and based solely on field observations. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their by-products.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be held liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario), to commence legal proceedings against Pinchin to recover such losses or damage.