PATERSON GROUP

Geotechnical Investigation

Proposed Residential Development

2161 Valley Street
Moose Creek, Ontario

Prepared for 809304 Ontario Inc.

Report PG6536 – 1 dated February 8, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by 809304 Ontario Inc. to conduct a geotechnical investigation for the proposed residential development to be located at 2161 Valley Street in Moose Creek, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical investigation were to:

- Determine the subsoil and groundwater conditions at this site by means of test holes.
- Provide geotechnical recommendations pertaining to design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on our review of available drawings, it is anticipated the proposed residential development will consist of low-rise residential dwellings and local roadways. It is anticipated that the residential dwellings will consist of low-rise residential buildings, as well as attached garages and landscaped areas.

It is anticipated that the site will be municipally serviced by future water and storm services. The northern portion of the site will be serviced by future sanitary services while some southern lots will be privately serviced by private septic systems.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was carried out on January 20, 23 and 24, 2023 and consisted of a total of ten (10) boreholes sampled to a maximum depth of 6.8 m below ground surface throughout the subject site.

The test hole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground utilities and site features. The test hole locations are shown on Drawing PG6536-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths and at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples were recovered from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sample. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags.

All samples were transported to our laboratory for further examination and classification. The depths at which the auge and split spoon samples were recovered from the boreholes are shown as AU and SS respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The thickness of the overburden was evaluated during the course of the investigation by a dynamic cone penetration test (DCPT) at one borehole location. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

Undrained shear strength testing was carried out at regular depth intervals in cohesive soils.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Groundwater monitoring wells were installed in boreholes BH 7-23 and BH 8-23, and flexible standpipe piezometers were installed in all other boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. All groundwater observations are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the proposed development taking into consideration the existing site features and underground utilities. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a handheld GPS referenced to a geodetic datum. The locations of the test holes, and the ground surface elevation at each test hole location, are presented on Drawing PG6536-1 – Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were collected from the subject site during the investigation and were visually examined in our laboratory to review the results of the field logging. All samples were submitted for moisture content testing. The test results are included on the Soil Profile and Test Data sheets presented in Appendix 1.

All samples will be stored in the laboratory for a period of one month after issuance of this report. The samples will then be discarded unless otherwise directed.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site consists of land previously used as agricultural fields with small to medium trees sporadically located across the site. The southern portion of the site is tree covered with an open area at the southeast corner of the site. Small ditches varying in depth from 0.5 m to 1 m are located throughout the site. Existing fill piles were noted within the central portion of the site.

The subject site is bordered to the north by a large lot with one residential dwelling, to the west by Valley Street, to the south by VIA Rail Railway and further by single-family residential dwellings, and to the east by agricultural lands. The ground surface across the northern and central portion of the site slopes down from north to south between approximate geodetic elevations 98.8 to 88.4 m. The southern portion of the subject site is relatively flat at an approximate geodetic elevation of 88.4 to 88.8 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile was observed to consist of a thin deposit of topsoil or fill underlain by silty sand and/or glacial till.

Fill, consisting of silty sand with varying amounts of gravel, topsoil and organics was encountered at boreholes BH 1-23, BH 4-23, BH 5-23. The thickness of the fill layer was observed to range between approximately 0.6 m and 1.2 m.

A compact to very dense deposit of glacial till was encountered below the topsoil and/or fill layer at boreholes BH 1-23 to BH 6-23, BH 9-23 and BH 10-23. The glacial till was generally observed to consisted of silty sand with a variable amount of gravel, cobbles, and boulders.

A 1.3 m thick deposit of firm to stiff silty clay to clayey silt with sand was encountered below the topsoil at borehole BH 7-23. Furthermore, compact to dense silty sand with occasional gravel was noted to underlie the silty clay with a thickness of 3.3 m. The silty sand was further underlain by firm grey silty clay extending to the end of the borehole.

A loose to compact deposit of silty sand was encountered below the topsoil layer in borehole BH 8-23.

Practical refusal to DCPT was encountered at BH 7-23 at a depth of 12.6 m.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for details of the soil and bedrock profile encountered at each borehole location.

Bedrock

Based on geological mapping and the results of the field investigation, the overburden drift thickness ranges between 6 and 15 m and is underlain by interbedded shale and limestone of the Lindsay Formation.

4.3 Groundwater

Groundwater level readings were measured on January 31, 2023 and are presented in Table 1 below, and on the Soil Profile and Test Data sheets in Appendix 1.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Recording Date
BH 1-23	98.78	2.06	96.72	January 30, 2023
BH 2-23	98.92	1.45	97.45	January 30, 2023
BH 3-23	98.37	1.10	97.27	January 30, 2023
BH 4-23	96.58	0.87	95.71	January 30, 2023
BH 5-23	93.45	0.70	92.75	January 30, 2023
BH 6-23*	90.39	1.88	88.51	January 30, 2023
BH 7-23*	88.38	0.39	87.99	January 30, 2023
BH 8-23	88.83	1.76	87.07	January 30, 2023
BH 9-23	92.11	0.46	91.65	January 30, 2023
BH 10-23	96.49	0.97	95.52	January 30, 2023

Note:
- The ground surface elevations are referenced to a geodetic datum.
- * Borehole with groundwater monitoring well

It should be noted that groundwater levels can be influenced by surface water infiltrating the backfilled boreholes. Long-term groundwater levels can also be estimated based on the observed color, moisture levels and consistency of the recovered soil samples.

Based on these observations, the long-term groundwater level is anticipated to be at a depth ranging between 1.0 to 2.2 m throughout the western and southern portions of the subject site whereas the long-term groundwater level is anticipated to be at a depth ranging between 3.3 to 4.4 m within the northeast portion of the site. However, groundwater levels are subject to seasonal fluctuations and could vary during the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

Foundation Design Considerations

From a geotechnical perspective, the subject site is suitable for the proposed development. It is recommended that the proposed buildings be founded on conventional spread footings bearing on the undisturbed, compact to dense glacial till, compact silty sand and/or approved engineered fill.

Due to the presence of a silty clay deposit in portions of the site, permissible grade raise restrictions have been provided.

The above and other considerations are discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing significant organic materials, should be stripped from under any buildings and other settlement sensitive structures. The existing fill material, where free of organic materials, should be reviewed by Paterson personnel at the time of construction to determine if the existing fill can be left in place below paved areas and below the slab granular fill layers.

Fill Placement

Fill placed for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The imported fill material should be tested and approved prior to delivery. The fill should be placed in maximum 300 mm thick loose lifts and compacted by suitable compaction equipment. Fill placed beneath the building areas should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 98% of their respective SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geo-composite drainage membrane connected to a perimeter drainage system.

5.3 Foundation Design

Conventional Spread Footings

Strip footings, and pad footings, placed on an undisturbed compact to dense glacial till, or on engineered fill, which is placed and compacted directly over this strata, can be designed using a bearing resistance value at serviceability limit states (SLS) of **75 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **110 kPa**. A geotechnical resistance factor of 0.5 was applies to the bearing resistance value at ULS.

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, compact silty sand, firm to stiff silty clay to clayey silt or on engineered fill, which is placed and compacted directly over these strata, can be designed using a bearing resistance value at serviceability limit states (SLS) of **60 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **90 kPa**. It is expected that all lots found whiting the 1.0 m permissible grade raise (Drawing PG6536-2) will need to be designed using the lower factored bearing resistance. A geotechnical resistance factor of 0.5 was applies to the bearing resistance value at ULS. A field review program is required where compact silty sand or firm to stiff silty clay to clayey silt is encountered at the bearing surface as discussed in Section 7.0 of this report.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support. Adequate lateral support is provided to a soil bearing medium above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise

Due to the presence of the silty clay deposit throughout the southern portion of the subject site, a permissible grade raise restriction is recommended for grading at the subject site where silty clay is present. Reference should be made to Drawing PG6536-2 – Permissible Grade Raise Plan in Appendix 2 of this report for the areas where the permissible grade raise restrictions are recommended.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered as defined in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2020. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest version of the OBC 2020 for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill from within the footprints of the proposed buildings, the existing fill, and/or native soil will be considered an acceptable subgrade surface on which to commence backfilling for floor slab construction.

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

For structures with slab-on-grade construction, the upper 300 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprints of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of its SPMDD.

5.6 Pavement Structure

For design purposes, the following pavement structures, presented below, are recommended for the design of the car parking areas and local roadways.

Table 2 - Recommended Pavement Structure – Driveways	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Pavement Structure – Local Residential Roadways	
Thickness (mm)	**Material Description**
40	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil, bedrock or fill.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the impervious nature of the subgrade materials, consideration should be given to installing subdrains during the pavement construction. The invert of the subdrain pipe is recommended to be located a minimum depth of 300 mm below the pavement structure subgrade and located centrally along the roadway alignment. The subdrain pipe is recommended to consist of a minimum 150 mm diameter corrugated and perforated plastic pipe surrounded by a minimum of 150 mm of 10 mm clear crushed stone on all of its sides. The clear stone layer is recommended to be wrapped by a geotextile layer. The drains should be connected to a positive outlet. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for any proposed buildings with below-grade space. The system, where considered, should consist of a 150 mm diameter perforated and corrugated plastic pipe, surrounded on all-sides by 150 mm of 19 mm clear crushed stone, which is placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

For proposed buildings with below-grade space, backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as Miradrain G100N, Delta Drain 6000 or equivalent) connected to a drainage system is provided.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. Generally, a minimum of 1.5 m thick soil cover (or an equivalent combination of soil cover and foundation insulation) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of the shallow excavations anticipated at this site should either be cut back at acceptable slopes or be retained by temporary shoring systems from the start of the excavation until the structure is backfilled. It is anticipated that sufficient space will be available for the great part of the excavations to be undertaken by open-cut methods (i.e., unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m, should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below ground water level. The subsoil at this site appeared to be mainly a Type 2 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A crushed stone should be used for pipe bedding for sewer and water pipes. However, the bedding thickness should be increased to 300 mm and placed over a woven geotextile for areas where the services are bearing on loose silty sand. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 99% of the material’s standard Proctor maximum dry density.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize potential differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 98% of the material's SPMDD. All cobbles larger than 200 mm in the longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) will be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures using straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at the subject site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

6.8 Stormwater Management Pond Construction

The proposed stormwater management pond (SWMP) is proposed to be constructed within the southeast corner of the subject site. The subsurface profile within the proposed pond footprint consists of a loose to compact silty sand. Based on the field observations, the long-term groundwater level within the proposed pond footprint is expected to be at an approximate geodetic elevation between 86 to 87 m. Given the high permeability of the silty sand layer, it is expected that a clay liner will be required at the bottom and side slopes of the proposed SWMP. It is recommended that the bottom of the pond and the placement of the liner be reviewed by the geotechnical consultant at the time of excavation.

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7.0 Recommendations

It is recommended that the following be carried out by Paterson once preliminary and future details of the proposed development have been prepared:

- Review preliminary and detailed grading, servicing and structural plan(s) from a geotechnical perspective.

For the foundation design data provided herein to be applicable, a material testing and observation services program is required to be completed. The following aspects be performed by Paterson:

- Field review program of the bearing surface and confirmation of the applicable bearing capacity for Lots 45 to Lots 49 (Refer to the attached Drawing PG6536-2 – Permissible Grade Raise Plan in Appendix 2 for the lots within the area of 1.0 m permissible grade raise)
- Observation of all bearing surfaces prior to the placement of concrete.\
- Sampling and testing of the concrete and fill materials.
- Observation of the placement of the foundation insulation, if applicable.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling and follow-up field density tests to determine the level of compaction achieved.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming the construction has been conducted in general accordance with the recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by Paterson.

All excess soil must be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management.*

8.0 Statement of Limitations

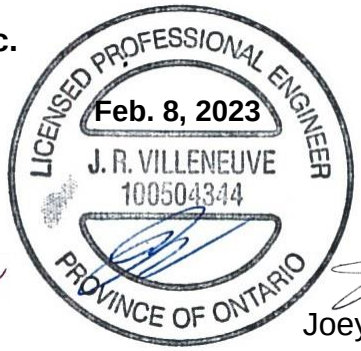
The recommendations provided herein are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than 809304 Ontario Inc., or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.



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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

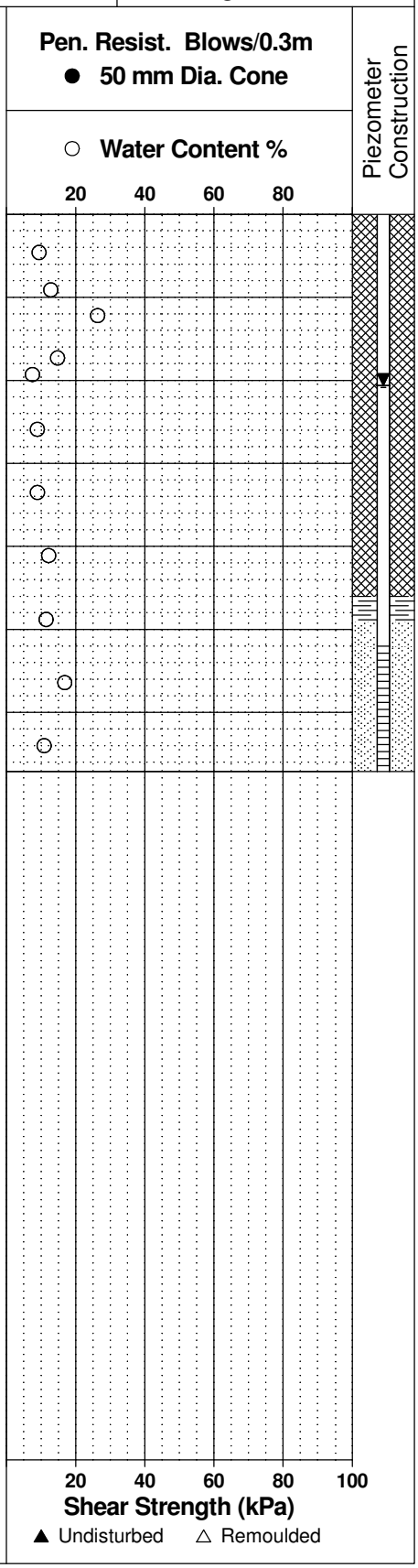
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 20, 2023

FILE NO. PG6536

HOLE NO. BH 1-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.78
FILL: Brown silty sand with gravel, topsoil, organics, occasional cobbles		AU	1				
1.22		SS	2	62	39	1	97.78
		SS	3	79	38	2	96.78
		SS	4	71	38		
GLACIAL TILL: Very dense to dense, brown silty sand, some gravel, occasional cobbles and boulders		SS	5	92	26	3	95.78
		SS	6	91	50+	4	94.78
- grey by 1.7m depth		SS	7	80	50+	5	93.78
		SS	8	100	44	6	92.78
6.71		SS	9	100	32		
End of Borehole							
(GWL @ 2.06m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

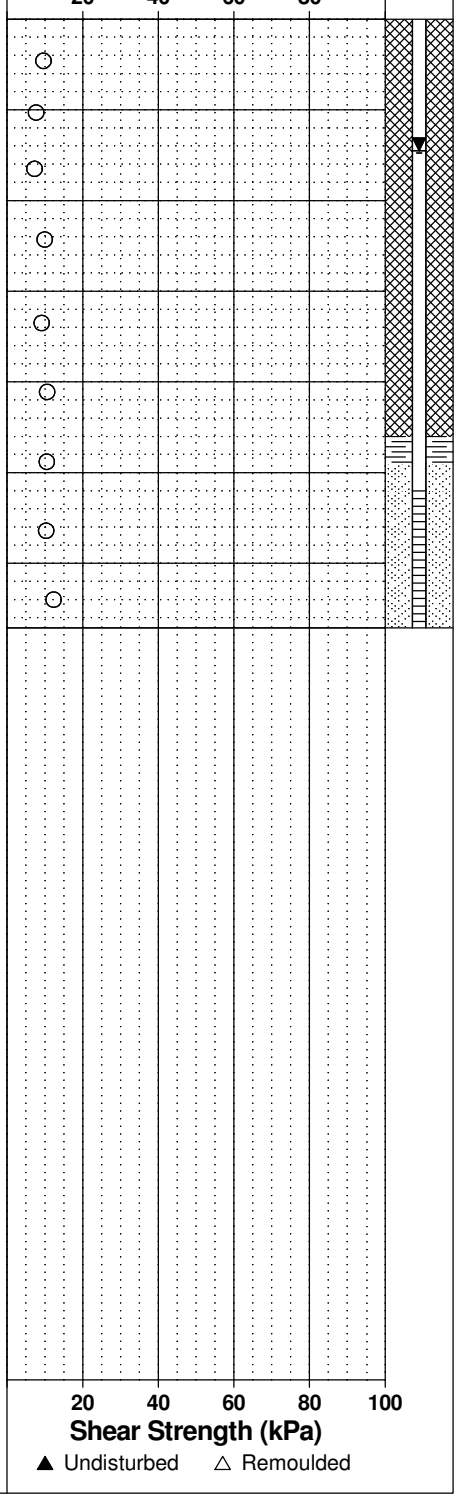
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 20, 2023

FILE NO. PG6536

HOLE NO. BH 2-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.92
TOPSOIL 0.25		AU	1				
		SS	2	48	50+	1	97.92
		SS	3	100	50+		
		SS	4	91	50+	2	96.92
GLACIAL TILL: Very dense to dense, brown silty sand with gravel, occasional cobbles and boulders		SS	5	100	50+	3	95.92
- grey by 2.2m depth		SS	6	100	45	4	94.92
		SS	7	100	47	5	93.92
		SS	8	83	39		
		SS	9	83	33	6	92.92
6.71 End of Borehole							
(GWL @ 1.45m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
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DATUM Geodetic

REMARKS

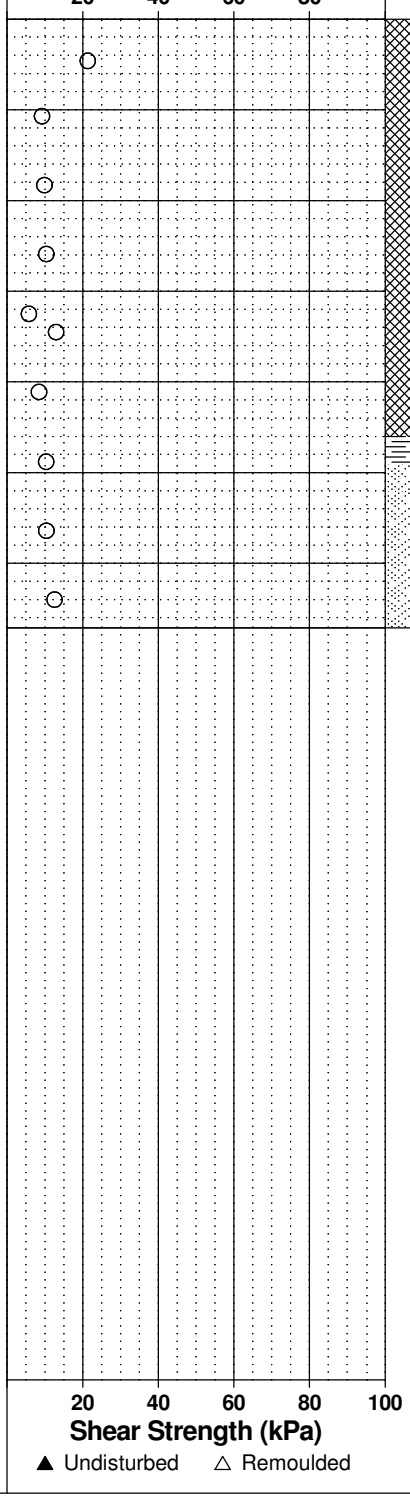
BORINGS BY Track-Mount Power Auger **DATE** January 20, 2023

FILE NO. PG6536

HOLE NO. BH 3-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.37
TOPSOIL 0.30		AU	1				
		SS	2	100	40	1	97.37
		SS	3	100	50+	2	96.37
		SS	4	100	50+		
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, occasional cobbles and boulders		SS	5	79	48	3	95.37
- grey by 3.3m depth		SS	6	100	50+	4	94.37
		SS	7	100	50+	5	93.37
		SS	8	100	50+		
6.71		SS	9	75	46	6	92.37
End of Borehole							
(GWL @ 1.10m - Jan. 30, 2023)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

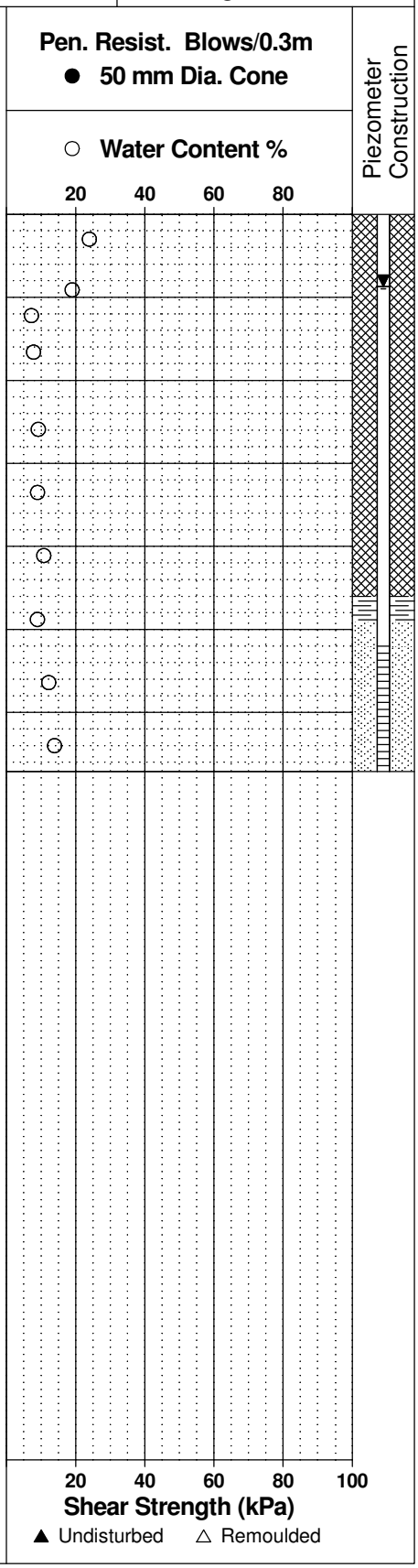
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 23, 2023

FILE NO. PG6536

HOLE NO. BH 4-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.58
FILL: Brown silty sand with topsoil, some gravel and organics		AU	1				
0.56							
		SS	2	75	38	1	95.58
		SS	3	64	50+		
						2	94.58
		SS	4	75	50+		
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, occasional cobbles and boulders		SS	5	75	50+	3	93.58
- grey by 1.1m depth		SS	6	75	49	4	92.58
- dense to compact and grey by 5.2m depth		SS	7	83	50+	5	91.58
		SS	8	75	36		
						6	90.58
		SS	9	83	28		
6.71							
End of Borehole							
(GWL @ 0.87m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

REMARKS

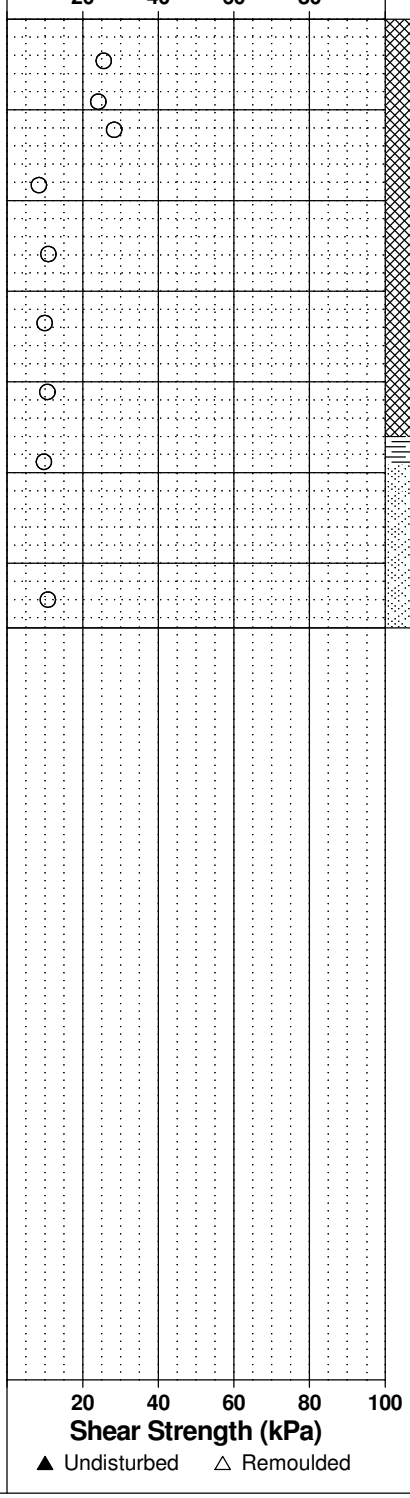
BORINGS BY Track-Mount Power Auger **DATE** January 23, 2023

FILE NO. PG6536

HOLE NO. BH 5-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.45
TOPSOIL 0.23							
FILL: Brown silty sand with topsoil, some gravel and organics 0.91		AU	1				
		SS	2	62	44	1	92.45
		SS	3	67	38	2	91.45
		SS	4	75	50+		
GLACIAL TILL: Dense, brown silty sand with gravel, occasional cobbles and boulders		SS	5	71	34	3	90.45
		SS	6	67	26	4	89.45
- grey by 1.5m depth		SS	7	67	35	5	88.45
						6	87.45
6.71		SS	8	67	37		
End of Borehole							
(GWL @ 0.70m - Jan. 30, 2023)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

REMARKS

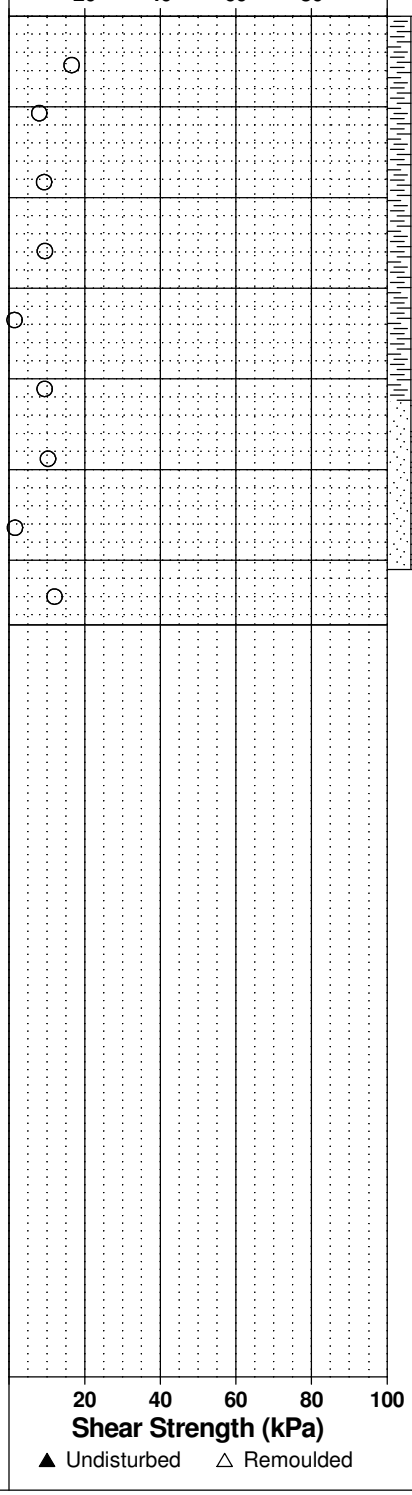
BORINGS BY Track-Mount Power Auger **DATE** January 23, 2023

FILE NO. PG6536

HOLE NO. BH 6-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.39
TOPSOIL 0.41		AU	1				
		SS	2	58	18	1	89.39
		SS	3	42	39	2	88.39
GLACIAL TILL: Compact to dense, brown silty sand with gravel, occasional cobbles and boulders		SS	4	42	26	3	87.39
		SS	5	100	14		
- grey by 1.2m depth		SS	6	79	26	4	86.39
		SS	7	100	13	5	85.39
		SS	8	75	42		
		SS	9	67	44	6	84.39
6.71 End of Borehole							
(GWL @ 1.88m - Jan. 30, 2023)							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**
○ **Water Content %**



Monitoring Well Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

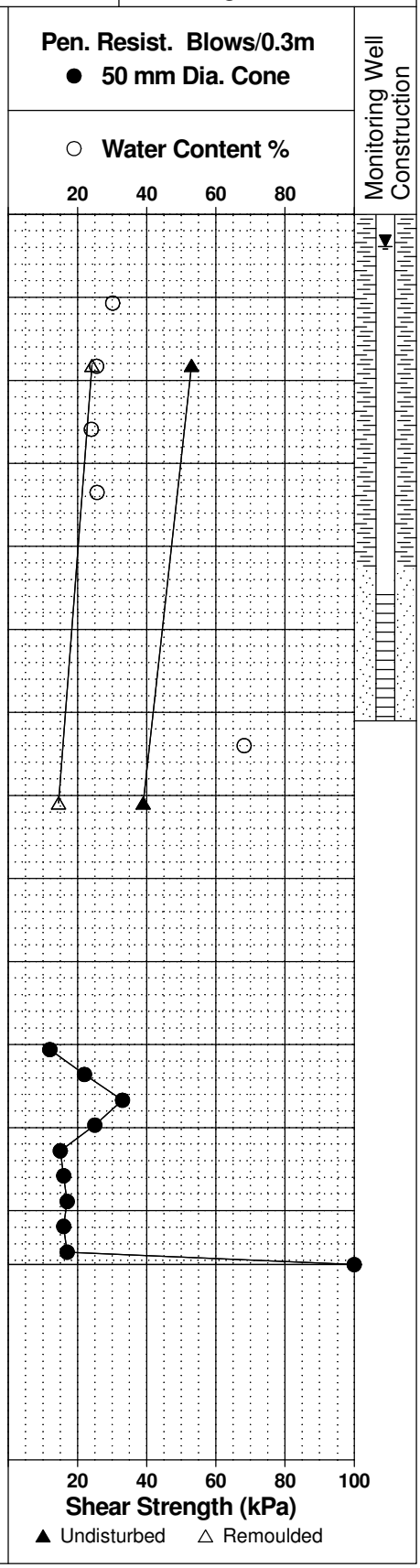
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 24, 2023

FILE NO. PG6536

HOLE NO. BH 7-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.38
TOPSOIL 0.56		AU	1				
Firm to stiff, brown **SILTY CLAY to CLAYEY SILT,** some sand		SS	2	100	1	1	87.38
- sand content increasing with depth 1.91		SS	3	25	P	2	86.38
		SS	4	100	24		
Compact to very loose, brown **SILTY SAND,** trace gravel		SS	5	75	3	3	85.38
5.18						4	84.38
						5	83.38
Firm, grey **SILTY CLAY**		SS	6	100	1	6	82.38
7.32						7	81.38
Dynamic Cone Penetration Test commenced at 7.32m depth. Cone pushed to 9.9m depth.						8	80.38
						9	79.38
						10	78.38
						11	77.38
						12	76.38
12.65							
End of Borehole							
Practical DCPT refusal at 12.65m depth.							
(GWL @ 0.39m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

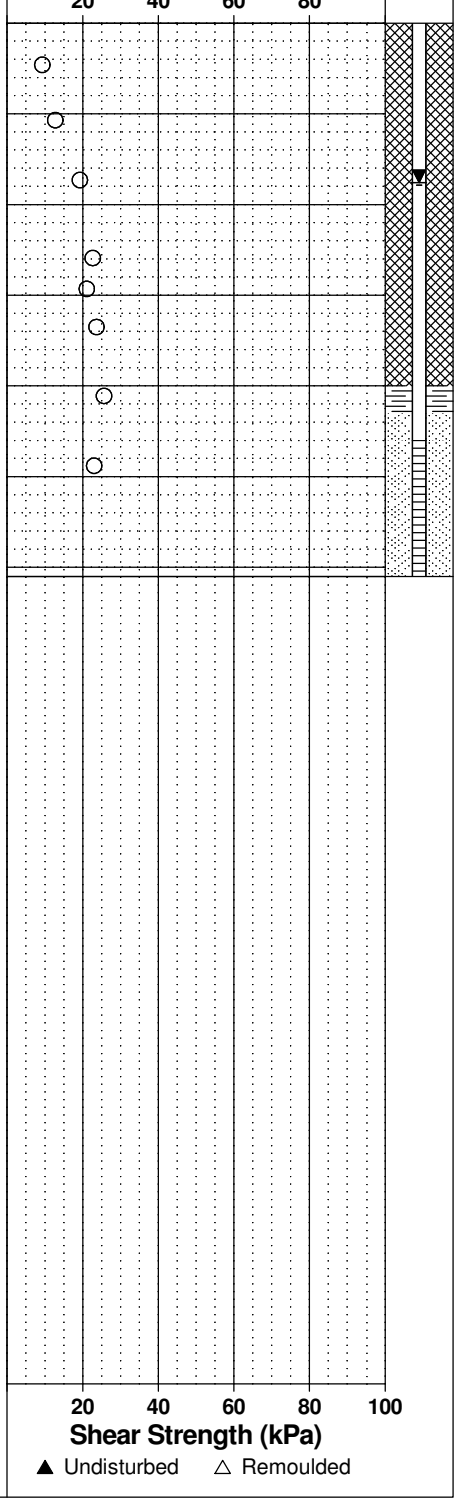
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 24, 2023

FILE NO. PG6536

HOLE NO. BH 8-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.83
TOPSOIL 0.13		AU	1				
Very loose, brown **SILTY SAND**		SS	2	83	3	1	87.83
- some seashells from 1.7 to 1.8m depth		SS	3	62	2	2	86.83
		SS	4	50	4		
- loose to compact and grey by 2.2m depth		SS	5	75	7	3	85.83
		SS	6	71	4	4	84.83
		SS	7	100	14	5	83.83
6.10						6	82.83
End of Borehole							
(GWL @ 1.76m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

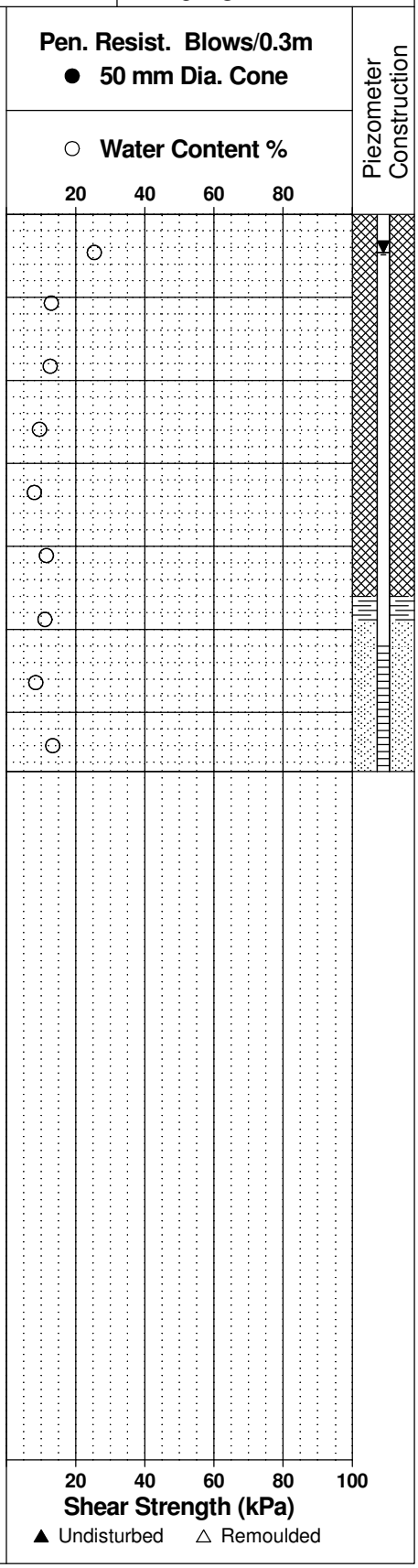
REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 24, 2023

FILE NO. PG6536

HOLE NO. BH 9-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.11
TOPSOIL 0.15		AU	1				
		SS	2	75	24	1	91.11
		SS	3	75	50+	2	90.11
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, occasional cobbles and boulders		SS	4	100	44		
		SS	5	75	36	3	89.11
- dense to compact and grey by 2.2m depth		SS	6	83	27	4	88.11
		SS	7	75	39	5	87.11
		SS	8	75	45		
		SS	9	71	25	6	86.11
6.71							
End of Borehole							
(GWL @ 0.46m - Jan. 30, 2023)							



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SOIL PROFILE AND TEST DATA

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Prop. Residential Development - 2161 Valley Street
Moose Creek, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger **DATE** January 24, 2023

FILE NO. PG6536

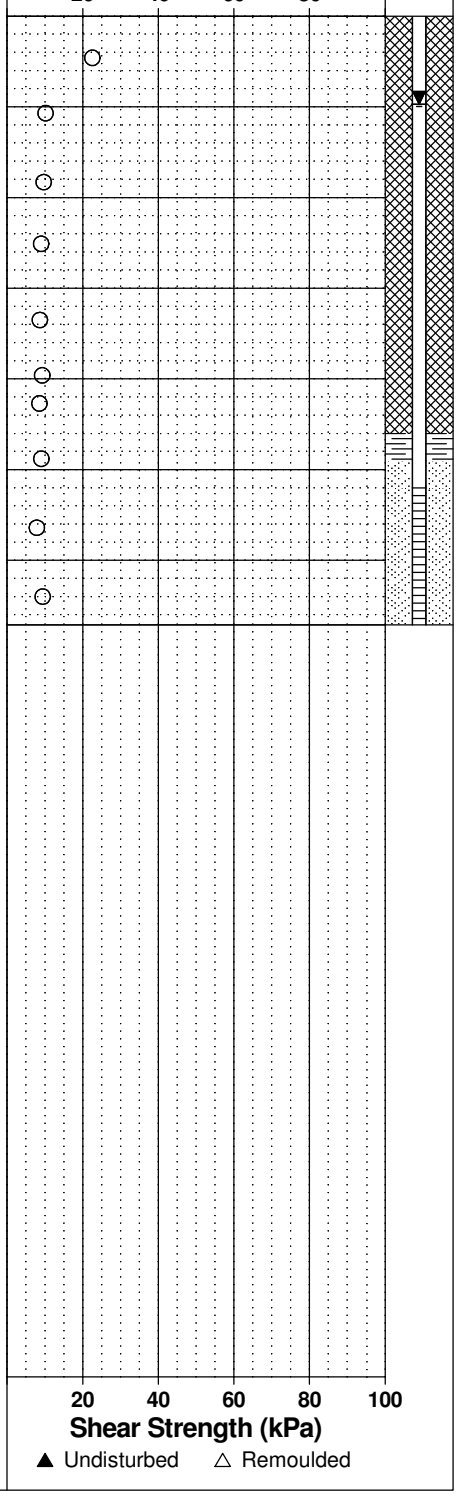
HOLE NO. BH10-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.49
TOPSOIL 0.23		AU	1				
Comapct, brown **SILTY SAND** 0.60		SS	2	71	27	1	95.49
		SS	3	83	50+	2	94.49
		SS	4	76	50+		
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, cobbles and boulders		SS	5	79	50+	3	93.49
		SS	6	100	50+	4	92.49
- dense to compact and grey by 4.4m depth		SS	7	75	37	5	91.49
		SS	8	83	40		
		SS	9	75	28	6	90.49
6.71							
End of Borehole							
(GWL @ 0.97m - Jan. 30, 2023)							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**
○ **Water Content %**

20 40 60 80

Piezometer Construction



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

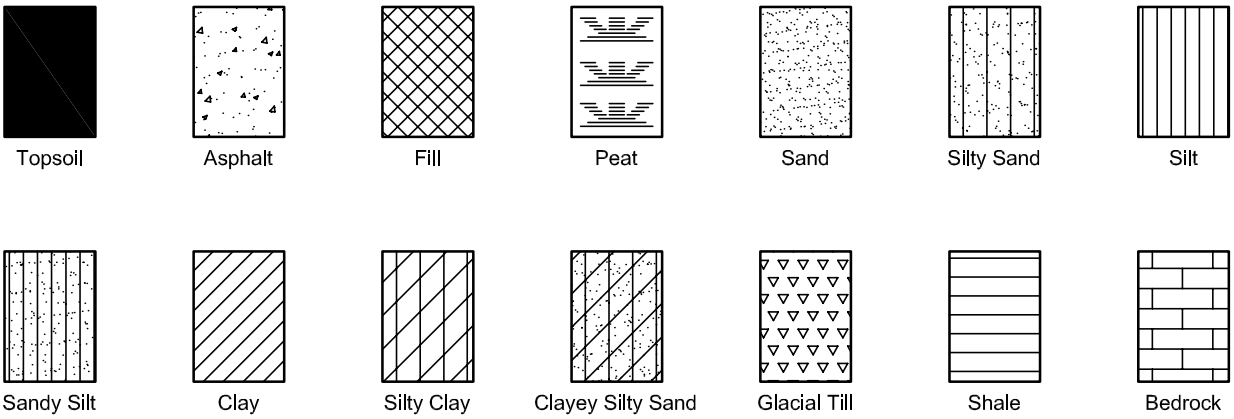
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

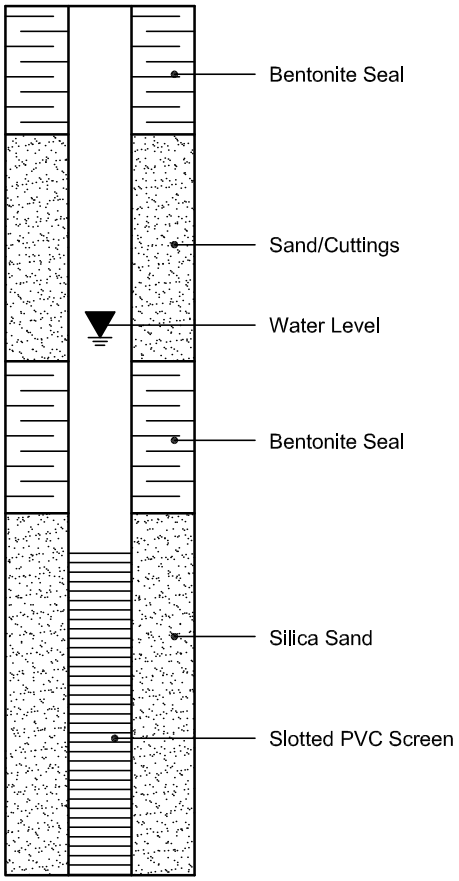
SYMBOLS AND TERMS (continued)

STRATA PLOT

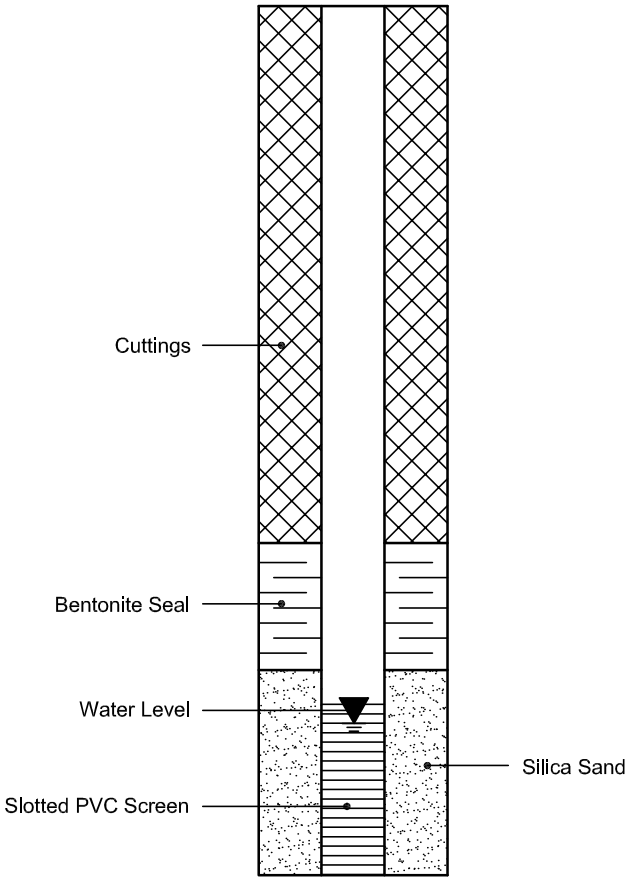


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 31-Jan-2023

Client: Paterson Group Consulting Engineers

Order Date: 25-Jan-2023

Client PO: 56686

Project Description: PG6536

	Client ID:	BH4-23-SS3	-	-	-
	Sample Date:	23-Jan-23 09:00	-	-	-
	Sample ID:	2304334-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	93.0	-	-	-
General Inorganics					
pH	0.05 pH Units	7.75	-	-	-
Resistivity	0.10 Ohm.m	57.9	-	-	-
Anions					
Chloride	10 ug/g dry	19	-	-	-
Sulphate	10 ug/g dry	63	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

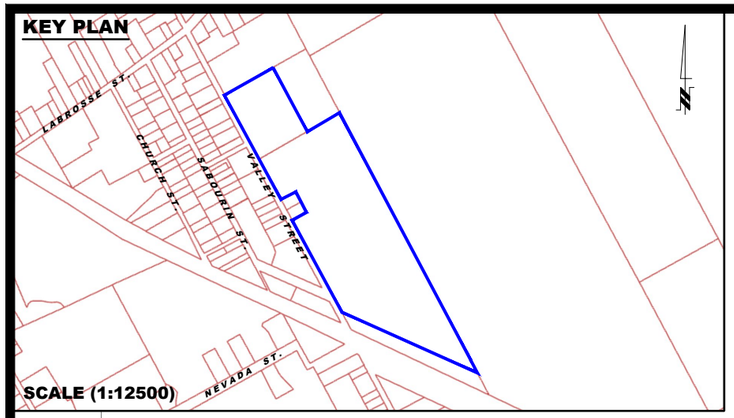
DRAWING PG6536-1 - TEST HOLE LOCATION PLAN

DRAWING PG6536-2 – PERMISSIBLE GRADE RAISE PLAN

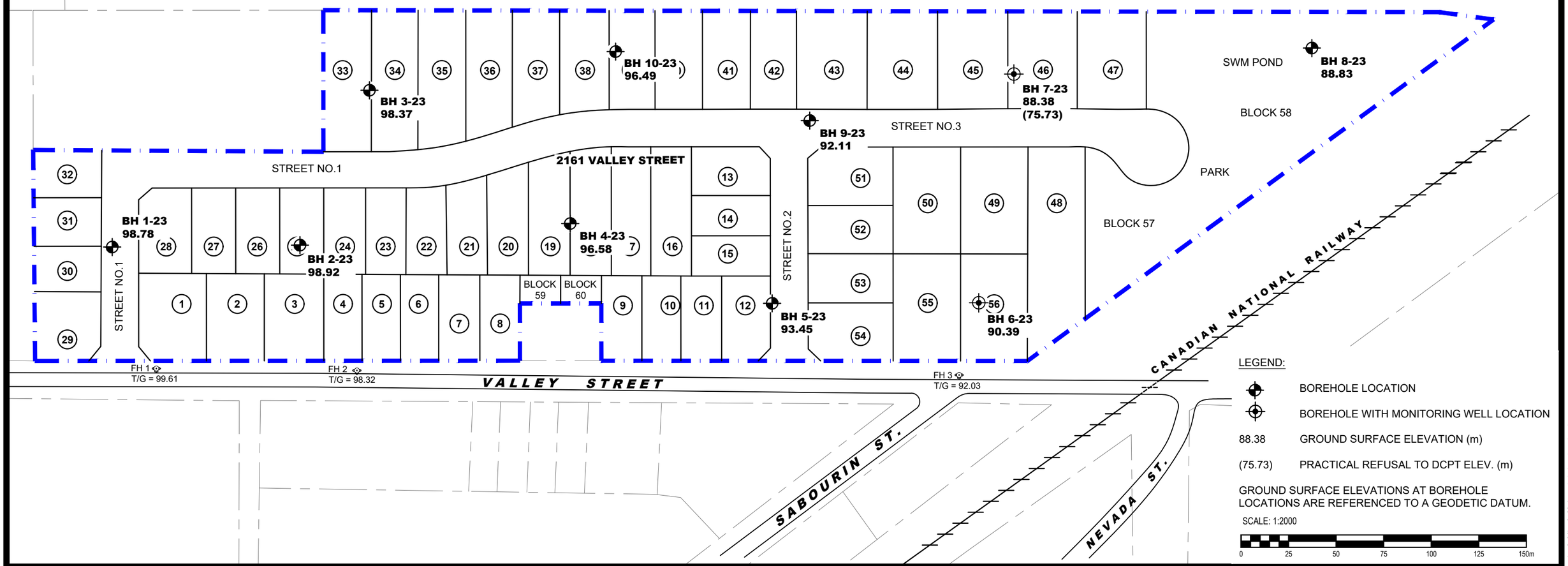
FIGURE 1

KEY PLAN

KEY PLAN



SCALE (1:12500)



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- 88.38 GROUND SURFACE ELEVATION (m)
- (75.73) PRACTICAL REFUSAL TO DCPT ELEV. (m)

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:2000

0 25 50 75 100 125 150m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

809304 ONTARIO INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2161 VALLEY STREET
MOOSE CREEK, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 02/2023
Drawn by: JM	Report No.: PG6536-1
Checked by: NS	Dwg. No.: PG6536-1
Approved by: JV	Revision No.:

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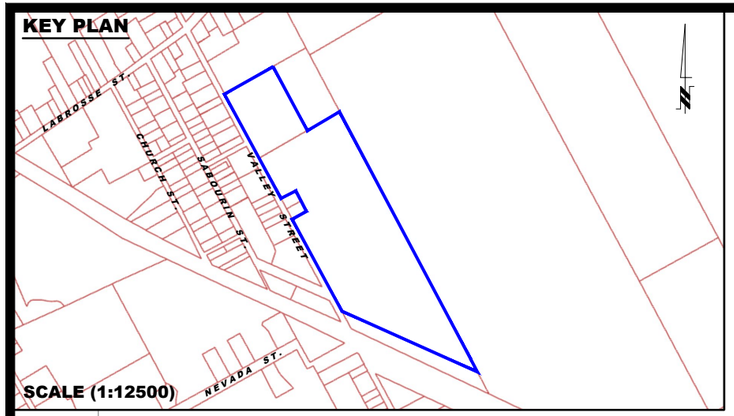
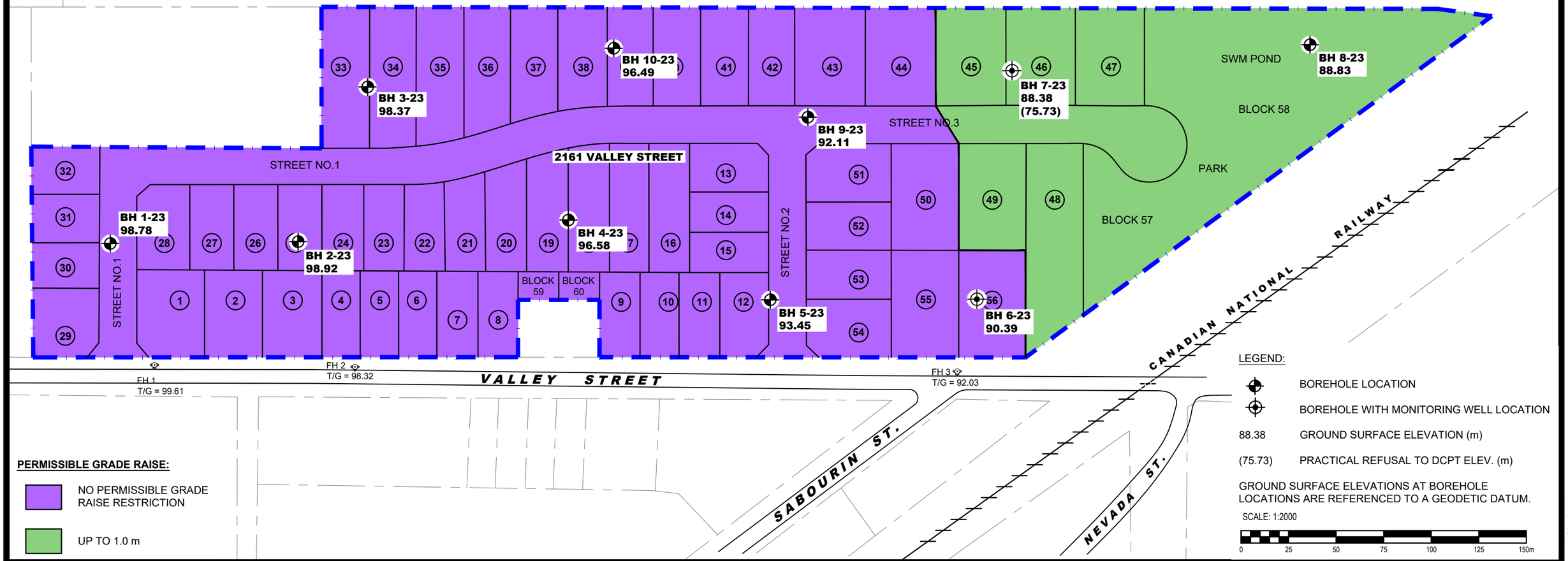
11x17

KEY PLAN



SCALE (1:12500)



PERMISSIBLE GRADE RAISE:

- NO PERMISSIBLE GRADE RAISE RESTRICTION
- UP TO 1.0 m

LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- 88.38 GROUND SURFACE ELEVATION (m)
- (75.73) PRACTICAL REFUSAL TO DCPT ELEV. (m)

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:2000

0 25 50 75 100 125 150m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

809304 ONTARIO INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2161 VALLEY STREET
MOOSE CREEK, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:2000	Date: 02/2023
Drawn by: JM	Report No.: PG6536-1
Checked by: NS	Dwg. No.: PG6536-2
Approved by: JV	Revision No.:

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11x17