PATERSON GROUP

Geotechnical Investigation

Proposed Residential Development

Trailsedge West – Block 121
6259, 6267, 6271 & 6273 Renaud Road
Ottawa, Ontario

Prepared for Richcraft

Report PG6405-1 Revision 5 dated November 03, 2026

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Richcraft to conduct a geotechnical investigation for the proposed residential development to be located at 6259, 6267, 6271 and 6273 Renaud Road in the City of Ottawa (reference should be made 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 boreholes and to;
- Provide geotechnical recommendations pertaining to the 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 for the presence or potential presence of contamination on the subject property was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of seven back-to-back townhouse blocks and/or 2.5 storey terraced flats along with an associated slab-on-grade accessory building for the terraced flats. The proposed buildings will be surrounded by associated asphalt-paved driveways and access lanes with landscaped margins. A proposed amenity area will also be located in the north-central portion of the site.

It is further understood that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current supplemental geotechnical investigation was carried out on July 12, 2024, and consisted of advancing a total of 3 boreholes to a maximum depth of 10.4 m below existing ground surface. A previous geotechnical investigation was completed on October 3, 2022, consisting of 4 boreholes advanced to a maximum depth of 8.1 m below the existing ground surface.

Furthermore, an initial geotechnical investigation was completed by Paterson in August 2006 which included 1 borehole and 1 test pit at the subject site, which were advanced to depths of 9.6 m and 3.8 m below ground surface, respectively.

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 approximate borehole locations are shown on Drawing PG6405-1 – Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a low clearance 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 testing procedure consisted of augering to the required depths at the selected locations, and sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected 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) sampler. 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 auger 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.

The 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.

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

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT) completed at boreholes BH 1-24 and BH 4-22. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the 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

The subsurface conditions observed in the boreholes 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

Flexible standpipe piezometers were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. Groundwater level observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The test hole locations, and ground surface elevation at each test hole location, were surveyed by Paterson using a handheld GPS and 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 PG6405-1 – Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. A total of 2 grain size distribution analysis, 1 shrinkage limit test, and 4 Atterberg limits tests were completed on selected soil samples obtained from the current geotechnical investigation.

Paterson has previously completed 1 consolidation test on a select soil sample retrieved during a previous investigation at the subject site. The results of the current and previous testing are discussed in Section 4.2 and are provided in Appendix 1.

3.4 Analytical Testing

Two (2) soil samples were submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The samples were 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 4 contiguous properties: 6259, 6267, 6271 & 6273 Renaud Road. The western portion of the site is currently occupied by 3 residential properties, while the eastern portion is used as a construction staging area, with an office trailer and several storage containers.

The site is bordered by Renaud Road to the south, Compass Street to the east, Melodie Street to the west, and a pedestrian pathway followed by Mud Creek to the north. The ground surface across the subject site is relatively level at approximate geodetic elevation 87 m, however, beyond the site boundary to the north, the existing grades slope downward moderately toward Mud Creek, which is at approximate 82 m.

4.2 Subsurface Profile

Generally, the subsurface profile at the test hole locations consists of topsoil and/ or fill underlain by silty sand and a deep silty clay deposit. Fill was observed to generally consist of loose to compact silty sand with gravel and crushed stone. The fill was observed to extend to depths ranging between about 0.3 to 1.8 m below the existing ground surface.

Underlying the fill, the silty sand layer generally consists of a loose to dense, brown silty sand, and extends to depths ranging from about 0.9 and 1.8 m below the existing ground surface.

The deep silty clay deposit, encountered underlying silty sand layer, was observed to consist of a very stiff to stiff, brown silty clay, extending to depths ranging between 2.1 and 2.4 m, and becoming a firm to soft, grey silty clay below these depths. However, in borehole BH 3-24, a thin interbedded layer of silty sand to sandy silt deposit was encountered at depth of 2.2 m.

No practical refusal to the DCPT was encountered at boreholes BH 1-24 and BH 4 -22 to approximate depths of 30 m.

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

Bedrock

Based on available geological mapping, bedrock in the area of the subject site consists of interbedded limestone and shale of the Lindsay Formation with an overburden drift thickness of about 25 to 50 m in depth.

Grain Size Distribution and Hydrometer Testing

Grain size distribution (sieve and hydrometer analysis) was completed on 2 selected soil samples. The results of the grain size analysis are summarized in Table 1 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 1 – Summary of Grain Size Distribution Analysis – Current Investigation

Borehole	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 4-22	SS4	2.3-2.9	0.0	5.4	36.6	58.0
BH 3-24	SS5	3.1-3.7	0.0	0.9	24.6	74.5

Note: The ground surface elevation at each borehole location was surveyed using a handheld GPS using a geodetic datum.

Atterberg Limits Testing

Atterberg limits testing was completed on the recovered silty clay samples at selected locations throughout the subject site during the current and previous investigations. The results of the Atterberg limits are presented in Table 2 and on the Atterberg Limits Results sheet in Appendix 1.

Table 2 – Atterberg Limits Results – Current Investigation

Borehole	Sample	Depth (m)	LL (%)	PL (%)	PI (%)	Classification
BH 1-22	SS4	2.3-2.9	78	38	40	MH
BH 2-22	SS4	2.3-2.9	49	25	24	CH
BH 3-22	SS4	2.3-2.9	74	36	38	MH
BH 2-24	SS5	3.1-3.7	66	27	39	CH

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plastic Index; CH: Inorganic Clay of High Plasticity. MH: Inorganic Silt of High Plasticity

Shrinkage Testing

Linear shrinkage testing was completed on 1 selected sample. The results are summarized in Table 3 on the next page, and on the Shrinkage Testing Results sheet in Appendix 1.

Table 3 – Linear Shrinkage Results				
Borehole	**Sample**	**Depth (m)**	**Shrinkage Limit**	**Shrinkage Ratio**
BH 4-22	SS4	2.3-2.9	23.55	1.726

Consolidation Testing

Generally, the potential long-term settlement of the silty clay deposit is evaluated based on its compressibility characteristics. A method to evaluate these characteristics is by completing unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes. A total of 1 consolidation test was completed from the Shelby tubes collected during the previous investigation. The results of the consolidation testing are presented on the Consolidation Test sheet in Appendix 1.

4.3 Groundwater

Groundwater levels were measured within the installed piezometers at the time of the investigation. The measured groundwater levels noted at that time are presented in Table 4 on below.

Table 4 – Summary of Groundwater Levels				
Borehole Number	**Ground Surface Elevation (m)**	**Measured Groundwater Level**		**Dated Recorded**
		Depth (m)	**Elevation (m)**	
BH 1-24	87.56	7.29	80.27	July 19, 2024
BH 2-24	87.28	2.18	85.1	July 19, 2024
BH 3-24	87.29	9.06	78.23	July 19, 2024
BH 1-22*	86.87	2.98	83.89	October 13, 2022
BH 2-22*	86.86	1.82	85.04	October 13, 2022
BH 3-22*	86.79	1.84	84.95	October 13, 2022
BH 4-22*	86.84	5.72	81.12	October 13, 2022
BH 1-08*	86.83	1.74	85.09	August 28, 2008
TP 1-08 *	86.83	2.00	84.83	August 28, 2008

Note: Ground surface elevations at borehole location are referenced to a geodetic datum.

* - Denotes ground water levels from previous investigation

Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at approximately 2 to 3 m below ground surface.

However, it should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is recommended that the proposed structures be founded on conventional spread footings placed on the undisturbed, firm to stiff silty clay bearing surface.

Due to the presence of a silty clay deposit at the site, the proposed development will be subjected to grade raise restrictions. Our permissible grade raise recommendations are discussed in Section 5.3.

Further, as the existing ground surface slopes downward to Mud Creek, beyond the northern boundary of the site, a slope stability assessment has been completed, which is provided in Section 6.9.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, containing significant amounts of organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Disturbance of the subgrade may result in sub-excavating the disturbed material and the placement of additional suitable fill material.

Fill Placement

Fill used 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. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness.

Fill placed beneath the proposed building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath exterior parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least 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 95% of their respective SPMDD.

5.3 Foundation Design

Bearing Resistance Values – Conventional Spread Footings

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, founded on an **undisturbed, stiff silty clay** bearing surface (generally encountered above geodetic elevation 84.5 m), can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**.

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, founded on an **undisturbed, firm silty clay** bearing surface (generally encountered at or below geodetic elevation 84.5 m), can be designed using a bearing resistance value at serviceability limit states (SLS) of **80 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **120 kPa**.

A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

Footings placed on an undisturbed, approved bearing surface and designed using the bearing resistance values at SLS provided above 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 with respect to excavations and different foundation levels. Above the groundwater level, adequate lateral support is provided to the in-situ bearing medium soils 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.

Permissible Grade Raise Recommendations

Consideration must also be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For buildings, a minimum value of 50% of the live load is often recommended by Paterson. A post-development groundwater lowering of 0.5 m was assumed.

Due to the presence of the silty clay deposit, a permissible grade raise restriction of **1.0 m** is recommended for grading at the subject site.

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 X_E** in accordance with the Ontario Building Code (OBC) 2024 for foundations considered at this site. The soils underlying the site are not susceptible to liquefaction. Reference should be made to the latest revision of the OBC 2024 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 footprint of the proposed buildings, the undisturbed, compact silty sand or undisturbed, stiff silty clay will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

Provisions should be made to proof-rolling the soil subgrade using heavy vibratory compaction equipment prior to placing any engineered fill. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, is recommended for backfilling below the floor slabs (outside the zones of influence of the footings).

For underground parking structures, reference should be made to Table 7 in Subsection 5.7 for underground parking rigid pavement and subgrade construction.

For basement slabs which will not be used for underground parking (i.e. mechanical or storage rooms, etc.), it is recommended that the upper 200 mm of sub-slab fill consists of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose lifts and compacted to a minimum 99% of its SPMDD.

For slab on grade buildings, the upper 300 mm below the floor slab should consist of OPSS Granular A crushed stone, placed in 300 mm thick loose lifts and compacted to 98% of the material's SPMDD.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the proposed building. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a drained unit weight of 20 kN/m^3 (effective unit weight 13 kN/m^3).

Lateral Earth Pressures

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil (0.5)
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}). The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a \cdot H^2/g$ where:

$a_c = (1.45-a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.421g for a Site Class X_E according to the OBC 2024. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $Po = 0.5\ K_o \cdot \gamma \cdot H^2$, where K = 0.5 for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2024.

5.7 Pavement Design

For design purposes, the pavement structures presented in Table 5, 6 and 7 below are recommended for the design of driveways, car only parking areas, access lanes, local roadways, and underground parking areas.

Table 5 - Recommended Pavement Structure – Driveways and Car Only parking Areas

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 6 - Recommended Pavement Structure – Access Lanes and Local Roadways	
Thickness (mm)	**Material Description**
40	**Wear Course** – Superpave 12.5 Asphaltic Concrete
50	**Binder Course** – 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 or fill.	

Table 7 – Recommended Pavement Structure – Underground Parking Level	
Thickness (mm)	**Material Description**
150	**Rigid Concrete Pavement** – 32 MPa concrete with air entrainment
300	**BASE –** OPSS Granular A Crushed Stone
Subgrade – Either fill, in-situ soil, or OPSS Granular B Type I or II material placed over in-situ soil.	

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 load carrying capacity.

Consideration should also be given to installing subdrains during the pavement construction as per City of Ottawa standards. These drains should extend in four orthogonal directions or longitudinally when placed along a curb.

The clear crushed stone surrounding the drainage lines or the pipe should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines. Discharge of the subdrains should be directed by gravity to storm sewers or deeper drainage ditches.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended to be provided for the proposed structures. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated and corrugated plastic pipe which is surrounded on all sides by 150 mm of 19 mm clear crushed stone, and which is placed at the footing level around the exterior perimeter of each structure. The pipe should have a positive outlet, such as to the storm sewer or building sump pit.

Foundation Backfill

A geocomposite drainage board, such as Delta Drain 6000 or an approved equivalent, should be installed over the exterior below-grade foundation walls and connected to the perimeter drainage system.

The exterior foundation walls can then be backfilled with the site excavated materials, provided that they are maintained in an unfrozen state and at a suitable moisture content for compaction. Imported granular materials, such as clean sand or OPSS Granular B Type II granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. A minimum 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 isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure, and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The temporary excavation side slopes anticipated should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertake 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 groundwater level. The subsurface soil is considered to be mainly a Type 2 and 3 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 maintain safe working distance 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

Bedding and backfill materials should be in accordance with the most recent material specifications and standard detail drawings from the department of public works and services, infrastructure services branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

It should generally be possible to re-use the moist (not wet) site-generated fill above the cover material if the excavation and filling operations are carried out in dry weather conditions.

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) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

Clay Seals

To reduce long-term lowering of the groundwater level at this site, it is recommended that clay seals be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, sub-bedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and 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.

Permit to Take Water

Under the current regulations enacted by the Ministry of Environment, Conservation and Parks (MECP), any dewatering in excess of 50,000 L/day requires a registration on the Environmental Activity and Sector Registry (EASR), so long as that dewatering is related to construction. If the dewatering is not related to construction, a Permit to Take Water obtained from the MECP will be required.

In the event that an EASR is required to facilitate dewatering of the proposed development, a minimum of three 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. Should a Permit to Take Water be required, a minimum of five to six months should be allotted for completion of the permit, due to the minimum review period imposed by the MECP.

Impacts to Neighboring Properties

It is not anticipated that the proposed building will be founded significantly below the long-term groundwater level. Accordingly, groundwater lowering will not extend beyond the site boundaries, and will not impact adjacent properties.

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 by the use of 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 (GU – General Use cement) would be appropriate for this site.

The chloride content and pH of the sample indicate that they are not a significant factor in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a moderately to very aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Considerations

Paterson completed a soils review of the site to determine applicable tree planting setbacks, in accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines) for trees planted within a public right-of-way (ROW).

Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. Grain size distribution and hydrometer testing was also completed on selected soil samples.

The results of our testing are presented in Tables 1, 2, and 3 in Section 4.2, and in Appendix 1. Based on these testing results, the plasticity index was found to be less than or equal to 40%. Therefore, the silty clay encountered throughout the subject site is considered to be a clay of low to medium potential for soil volume change.

The following tree planting setbacks are therefore recommended for the low to medium sensitivity silty clay deposit present throughout the subject site. Large trees (mature height over 14 m) can be planted provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g., in a park or other green space). Tree planting setback limits may be reduced to **4.5 m** for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the condition noted below are met:

- ❑ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the center of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

- ❑ A small tree must be provided with a minimum of 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ❑ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❑ Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree).

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and, as such, they should not be considered in the landscaping design.

Above-Ground Swimming Pools, Hot Tubs, Decks and Additions

The in-situ soils are considered acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer's requirements.

Additional grading around the hot tub should not exceed permissible grade raise restrictions. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications. Additional grading around proposed deck or additions should not exceed permissible grade raises restrictions. Otherwise, standard construction practices are considered acceptable.

6.9 Slope Stability Assessment

The slope conditions to the north of the subject site were reviewed by Paterson field personnel as part of the geotechnical investigation. One slope cross-section was studied as the worst-case scenario. The cross-section location is presented on Drawing PG6405-1 - Test Hole Location Plan attached in Appendix 2.

The existing slope bordering Mud Creek is generally grass and shrub covered, with some mature trees along the northern boundary of the subject site, and with an asphalt-paved recreational pathway running approximately east-west about halfway between the subject site and Mud Creek. Some signs of minor erosion, such as rilling, were observed on the lower slope face.

A slope stability analysis was carried out to determine the required construction setback from the top of the slope based on a factor of safety of 1.5. Erosional and access allowances were also considered in the determination of the Limits of Hazard Lands, and are discussed below. The proposed Limit of Hazard Lands and top of slope are shown on Drawing PG6405-1 - Test Hole Location Plan, attached in Appendix 2.

Slope Stability Assessment

The analysis of the stability of the slope was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favouring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain that the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

The cross-section was analyzed based on the existing conditions observed during our site visit, and our review of the available topographic mapping. The slope stability analysis was completed at the slope cross-section under worst-case-scenario by assigning cohesive soils under fully saturated conditions. Subsoil conditions at the cross-section was inferred based on nearby boreholes and general knowledge of the area's geology.

The effective strength soil parameters used for static analysis were chosen based on the subsoil information recovered during the geotechnical investigation. The effective strength soil parameters used for static analysis are presented in Table 8 below.

Table 8 - Effective Soil and Material Parameters (Static Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Silty Sand	18	34	0
Brown Silty Clay Crust	17	33	7
Grey Silty Clay	16	33	10

The total strength parameters for seismic analysis were chosen based on the in situ, undrained shear strengths recovered within the open boreholes completed at the time of the geotechnical investigation and based on our general knowledge of the geology in the area. The strength parameters used for seismic analysis at the slope cross-sections are presented in Table 9 below.

Table 9 - Total Stress Soil and Material Parameters (Seismic Analysis)			
Soil Layer	**Unit Weight (kN/m^3)**	**Friction Angle (degrees)**	**Undrained Shear Strength (kPa)**
Silty Sand	18	34	0
Brown Silty Clay Crust	17	-	80
Grey Silty Clay	16	-	50

Static Loading Analysis

The results for the slope stability analysis under static conditions are shown on Figure 2, attached in Appendix 2. In summary, the factor of safety was found to be greater than 1.5.

Seismic Loading Analysis

The results for the slope stability analysis under seismic conditions are shown on Figure 3, attached in Appendix 2. In summary, the factor of safety was found to be greater than 1.1.

Geotechnical Setback - Limit of Hazard Lands

As the factors of safety exceed 1.5 and 1.1 under static and seismic analysis conditions, respectively, a stable slope allowance is not required from the top of slope.

Based on the cohesive nature of the soils and the minor signs of erosion which were observed, a toe erosion allowance of 1 m is recommended for the slope along Mud Creek, in addition to an erosion access allowance of 6 m. Therefore, a Limit of Hazard Lands setback 7 m applies from the top of slope along Mud Creek.

The existing vegetation on the slope face should not be removed as it contributes to the stability of the slope and reduces erosion. If the existing vegetation needs to be removed, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed be placed across the exposed slope face.

The Limit of Hazard Lands, which include these allowances, is indicated on Drawing PG6405-1Rev.1 - Test Hole Location Plan attached to the present report. The Limit of Hazard Lands does not extend onto the subject site, and will therefore not impact the proposed development.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❑ Review of the Grading Plan, from a geotechnical perspective.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ 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.
- ❑ Field density tests to determine the level of compaction achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

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 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 Richcraft, 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.

LICENSED PROFESSIONAL ENGINEER
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO
November 03, 2026

Faisal I. Abou Seido, P.Eng.

Nancy E. Salloum, M.Sc., B.Eng.

Report Distribution:

- ❑ Richcraft (Email Copy)
- ❑ Paterson Group (1 Copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

CONSOLIDATION TESTING RESULTS

GRAIN SIZE DISTRIBUTION AND HYDROMETER TESTING RESULTS

ATTERBERG LIMITS TEST RESULTS

SHRINKAGE TESTING RESULTS

ANALYTICAL TESTING RESULTS

PATERSON GROUP

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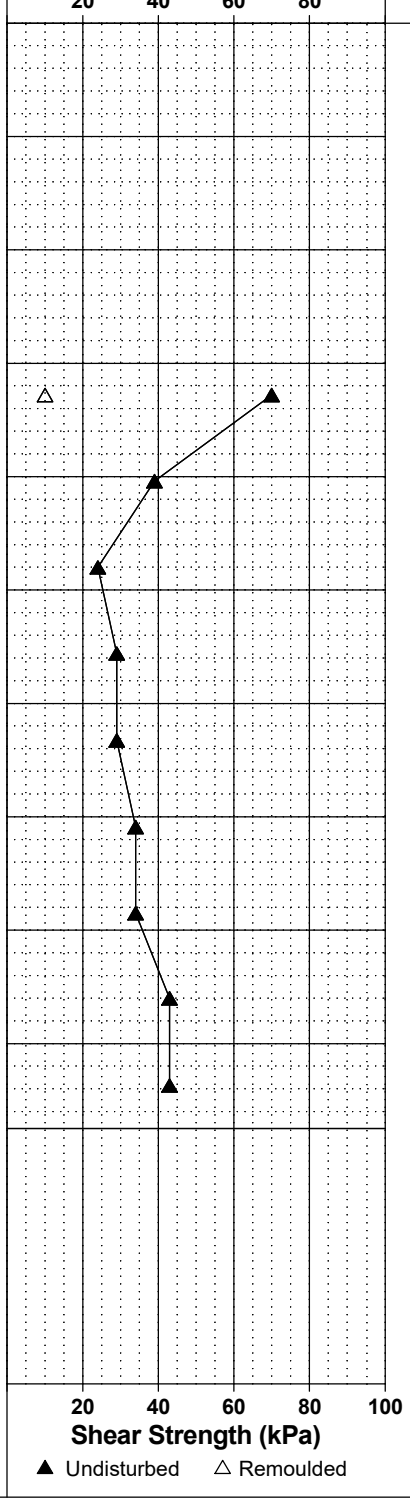
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Trails Edge West - Phase 2 - Block 121
6259, 6267, 6271 Renaud Road - Ottawa, Ontario

EASTING: 382185.336 **NORTHING:** 5032981.472 **ELEVATION:** 87.56
DATUM: Geodetic
REMARKS:
BORINGS BY: CME-55 Low Clearance Drill **DATE:** 2024 July 12

FILE NO. PG6405
HOLE NO. BH 1-24

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.56
TOPSOIL and organics 0.28							
FILL: Brown silty sand, trace clay and gravel		AU	1				
		SS	2	75	7	1	86.56
- Trace topsoil at 1.5 m depth 1.83		SS	3	58	9	2	85.56
Compact brown **SILTY SAND** 2.21							
Stiff brown **SILTY CLAY**		SS	4	100	4		
- Sand seam by 2.90 m 2.97						3	84.56
Stiff to firm grey **SILTY CLAY**		SS	5	100	P		
- Soft by 4.60 m depth						4	83.56
						5	82.56
						6	81.56
						7	80.56
						8	79.56
						9	78.56
		SS	6	100	P		
9.75							
End of Borehole							
Dynamic Cone Penetration Test commenced at 9.80 m depth. Cone pushed to 30.50 m depth, no refusal encountered, borehole terminated							



PIEZOMETER CONSTRUCTION

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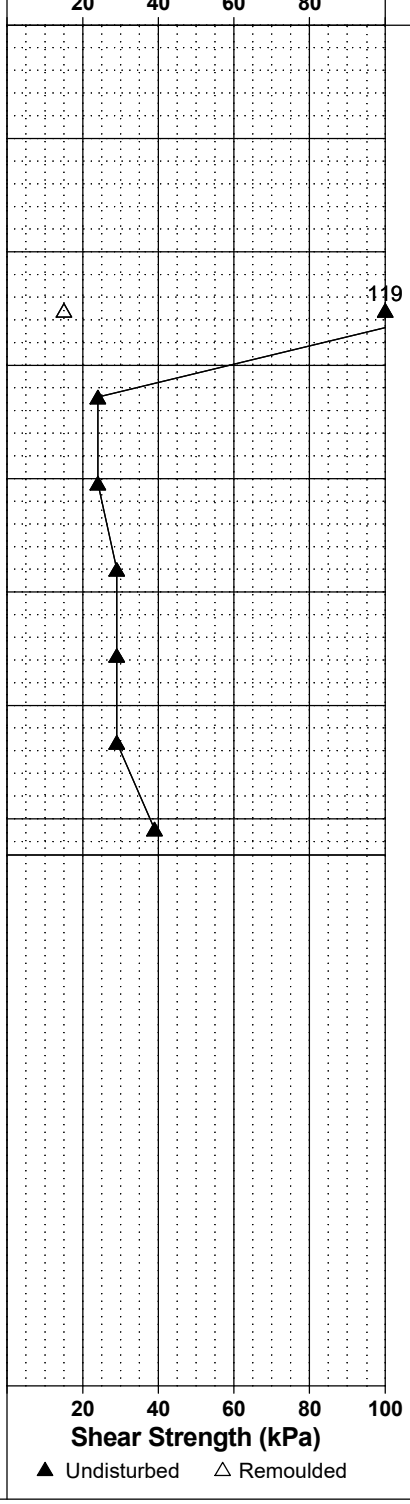
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Trails Edge West - Phase 2 - Block 121
6259, 6267, 6271 Renaud Road - Ottawa, Ontario

EASTING: 382238.419 **NORTHING:** 5033014.07 **ELEVATION:** 87.28
DATUM: Geodetic
REMARKS:
BORINGS BY: CME-55 Low Clearance Drill **DATE:** 2024 July 12

FILE NO. PG6405
HOLE NO. BH 2-24

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.28
TOPSOIL and organics 0.25							
FILL: Brown silty sand, trace gravel 0.69		AU	1				
FILL: Brown silty sand, some topsoil, trace grave and wood 1.45		SS	2	67	8	1	86.28
Compact brown **SILTY SAND** 1.98		SS	3	92	15	2	85.28
Very stiff brown **SILTY CLAY** 2.44		SS	4	100	6	3	84.28
Stiff to firm grey **SILTY CLAY**		SS	5	100	P	4	83.28
- Soft by 3.81 m depth						5	82.28
						6	81.28
7.32						7	80.28
End of Borehole							



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TEL: (613) 226-7381

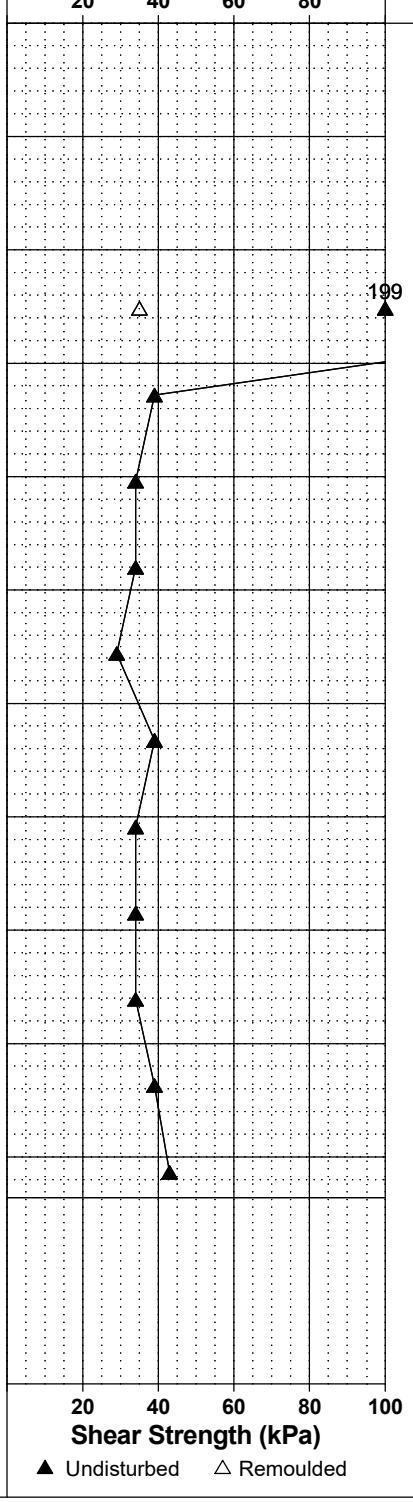
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Trails Edge West - Phase 2 - Block 121
6259, 6267, 6271 Renaud Road - Ottawa, Ontario

EASTING: 382210.381 **NORTHING:** 5033062.33 **ELEVATION:** 87.29
DATUM: Geodetic
REMARKS:
BORINGS BY: CME-55 Low Clearance Drill **DATE:** 2024 July 12

FILE NO. PG6405
HOLE NO. BH 3-24

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.29
TOPSOIL and organics 0.13		AU	1				
FILL: Compact brown silty sand, trace wood 0.69						1	86.29
Compact brown **SILTY SAND**		SS	2	67	11		
1.83		SS	3	83	8	2	85.29
Very stiff brown **SILTY CLAY** 2.21							
Compact brown **SILTY SAND**, trace clay 2.59						3	84.29
- Grey by 2.4 m depth							
Firm grey **SILTY CLAY**		SS	5	100	P	4	83.29
						5	82.29
						6	81.29
						7	80.29
						8	79.29
						9	78.29
						10	77.29
10.36 End of Borehole							



PIEZOMETER CONSTRUCTION

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Development - Trails Edge West - Block 121
Renaud Road at Compass St., Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 3, 2022

FILE NO. PG6405

HOLE NO. BH 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.87
FILL: Crushed stone with silty sand		AU	1				
0.69							
Compact, brown **SILTY SAND**		SS	2	58	12	1	85.87
1.07							
		SS	3	42	6	2	84.87
Very stiff to stiff, brown **SILTY CLAY,** trace sand		SS	4	100	P		
- firm and grey by 2.2m depth		SS	5	100	P	3	83.87
		SS	6	100	P	4	82.87
		SS	7	100	P	5	81.87
		SS	8	100	P	6	80.87
						7	79.87
7.32							
End of Borehole							

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

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Development - Trails Edge West - Block 121
Renaud Road at Compass St., Ottawa, Ontario

DATUM Geodetic

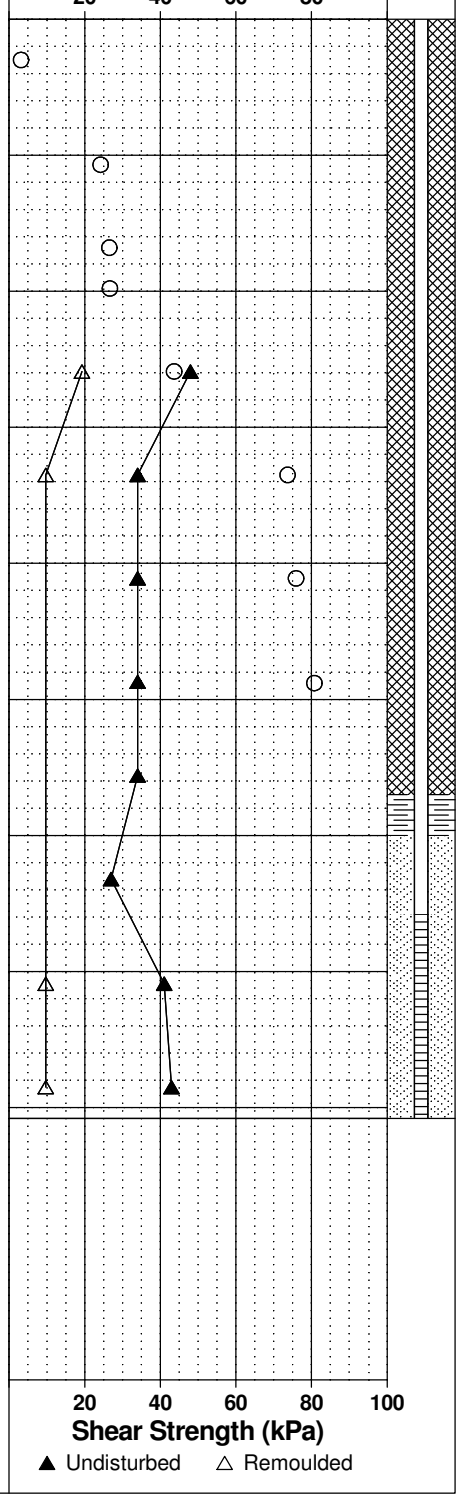
REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 3, 2022

FILE NO. PG6405

HOLE NO. BH 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.86
FILL: Brown silty sand with gravel and crushed stone		AU	1				
0.48							
Compact, brown **SILTY SAND**		SS	2		18	1	85.86
1.68							
		SS	3	88	6	2	84.86
Very stiff to stiff, brown **SILTY CLAY**							
		SS	4	100	P		
- firm and grey by 2.3m depth						3	83.86
- 12mm thick sand seam at 1.8m depth		SS	5	83	P		
		SS	6	100	P	4	82.86
		SS	7	100	P	5	81.86
						6	80.86
						7	79.86
8.08						8	78.86
End of Borehole							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Development - Trails Edge West - Block 121
Renaud Road at Compass St., Ottawa, Ontario

DATUM Geodetic

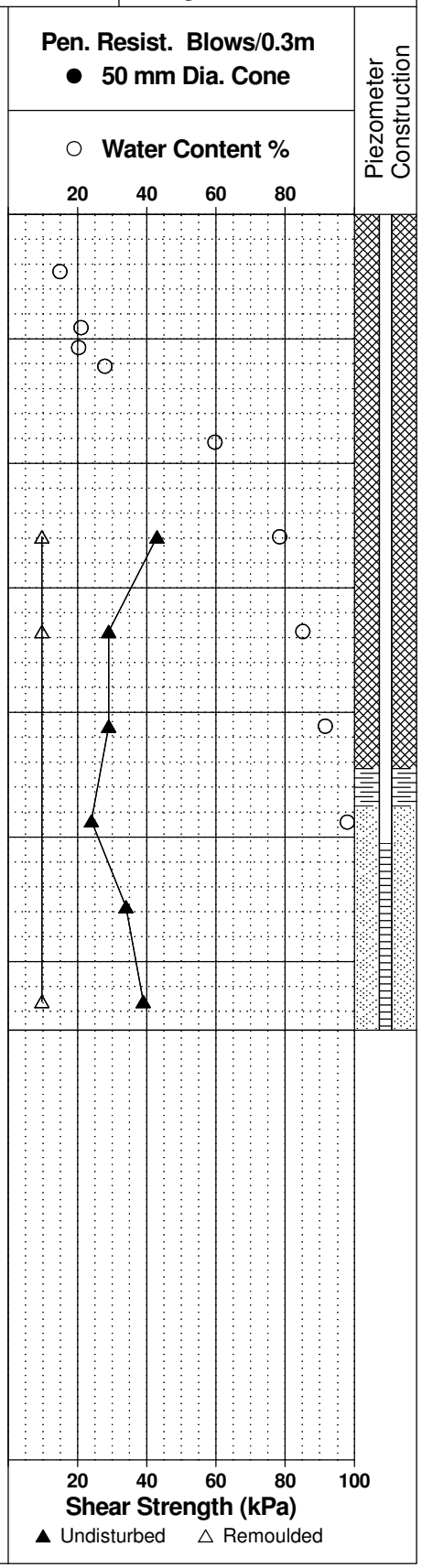
REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 3, 2022

FILE NO. PG6405

HOLE NO. BH 3-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.79
FILL: Brown silty sand with gravel and crushed stone 0.25		AU	1				
FILL: Reddish brown to dark brown silty sand 0.91		SS	2	83	31	1	85.79
Dense, brown **SILTY SAND** 1.22		SS	3	100	5	2	84.79
Very stiff to stiff, brown **SILTY CLAY**		SS	4	100	P	3	83.79
- 12mm thick sand seam at 1.6m depth		SS	5	100	P	4	82.79
- firm and grey by 2.3m depth		SS	6	100	P	5	81.79
		SS	7	100	P	6	80.79
6.55 End of Borehole							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Development - Trails Edge West - Block 121
Renaud Road at Compass St., Ottawa, Ontario

DATUM Geodetic

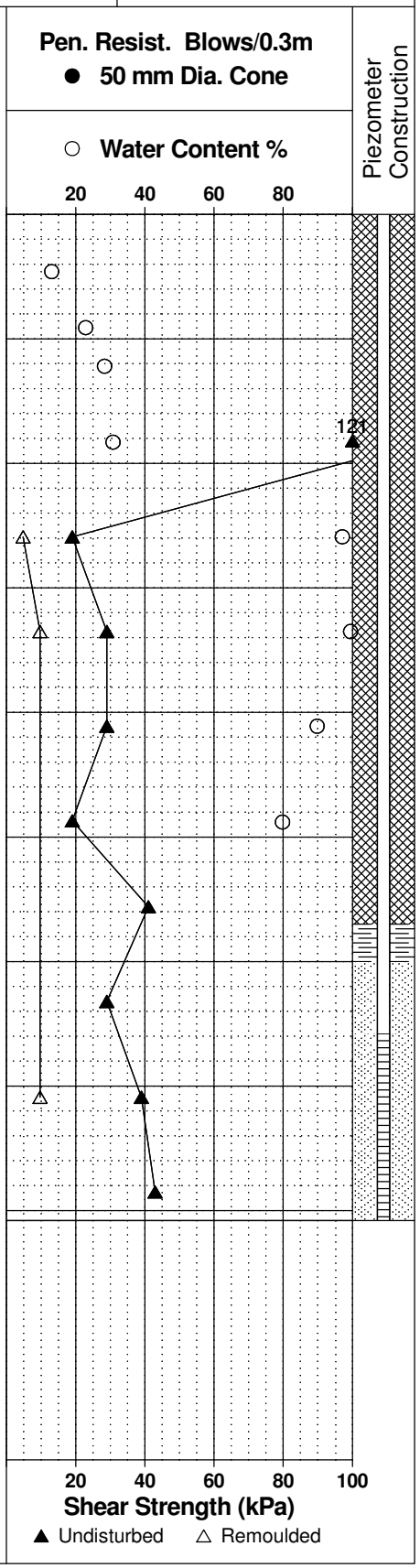
REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 3, 2022

FILE NO. PG6405

HOLE NO. BH 4-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.84
FILL: Brown silty sand with gravel and crushed stone (0.33)		AU	1				
Loose, brown **SILTY SAND** (0.91)		SS	2	83	7	1	85.84
		SS	3	75	P	2	84.84
Very stiff to stiff, brown **SILTY CLAY,** trace sand		SS	4	100	P		
- soft to firm and grey by 2.1m depth		SS	5	100	P	3	83.84
		SS	6	100	P	4	82.84
		SS	7	83	P	5	81.84
						6	80.84
						7	79.84
(8.08)						8	78.84
Dynamic Cone Penetration Test commenced at 8.08m depth. Cone pushed to 30.33m depth, no refusal encountered, borehole terminated.							
(GWL @							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0861

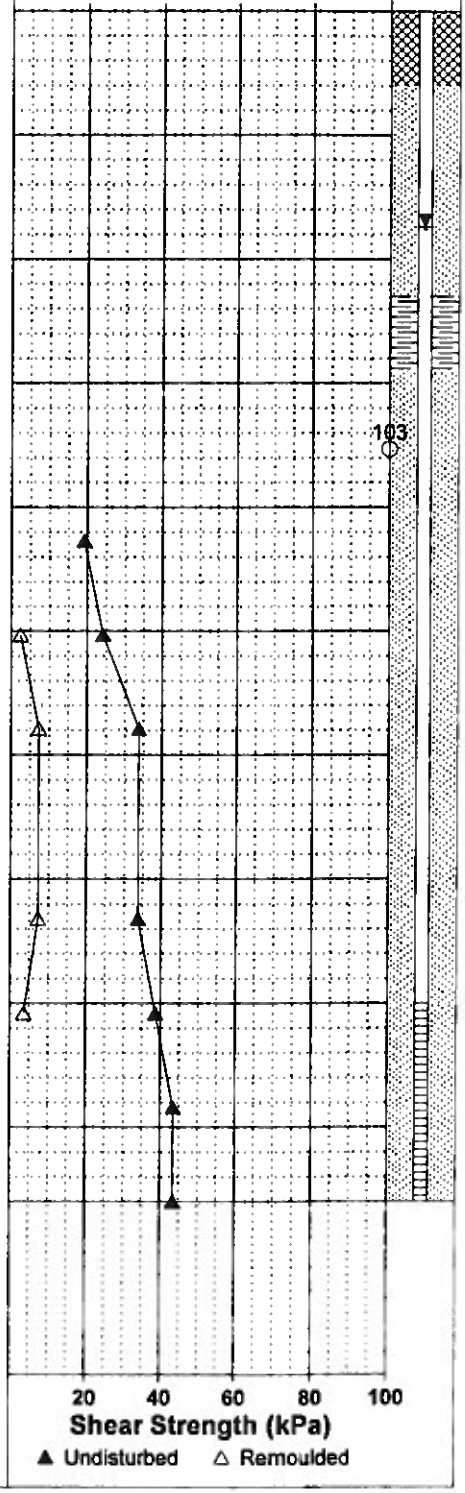
REMARKS

HOLE NO. BH 1-08

BORINGS BY CME 55 Power Auger DATE 5 Aug 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.83
TOPSOIL with red-brown silty sand		AU	1				
0.30							
Compact, red-brown SILTY SAND		SS	2	67	18	1	85.83
1.83		SS	3		6	2	84.83
Stiff to firm, brown SILTY CLAY		SS	4	75	2		
- soft to firm and grey by 2.3m depth		TW	5	75		3	83.83
						4	82.83
						5	81.83
						6	80.83
		TW	6	92		7	79.83
						8	78.83
						9	77.83
9.60							
End of Borehole							
(GWL @ 1.74m-Aug. 28/08)							

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



Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0861

REMARKS

HOLE NO. TP 1-08

BORINGS BY Hydraulic Shovel DATE 28 Aug 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.83
TOPSOIL with red-brown silty sand							
0.30							
Compact, red-brown SILTY SAND		G	1			1	85.83
1.10							
Firm, brown SILTY CLAY						2	84.83
- soft and grey by 2.4m depth						3	83.83
3.85							
End of Test Pit							
(GWL @ 2.0m-Aug. 28/08)							

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

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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 strength of cohesionless soils is the relative density, 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.

Relative Density	'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 vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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 is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

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 NXL size core. However, it can be used on smaller core sizes, such as BX, 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
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture 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 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

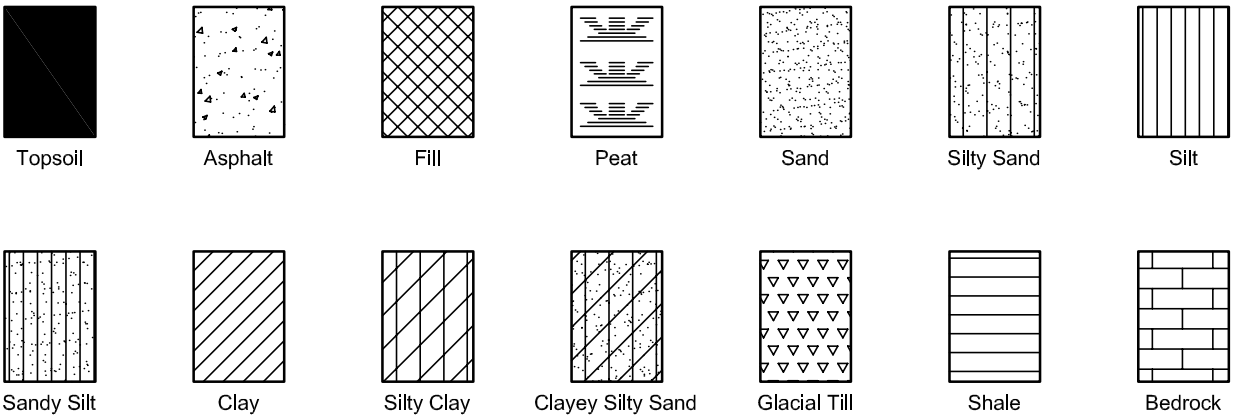
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

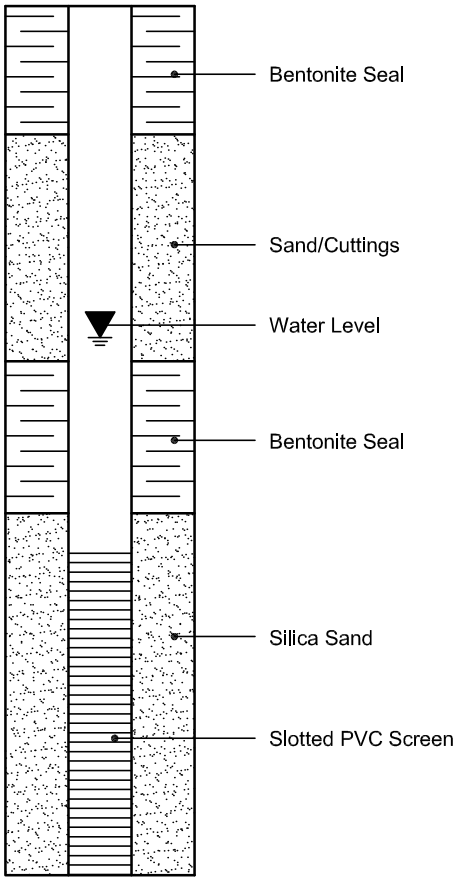
SYMBOLS AND TERMS (continued)

STRATA PLOT

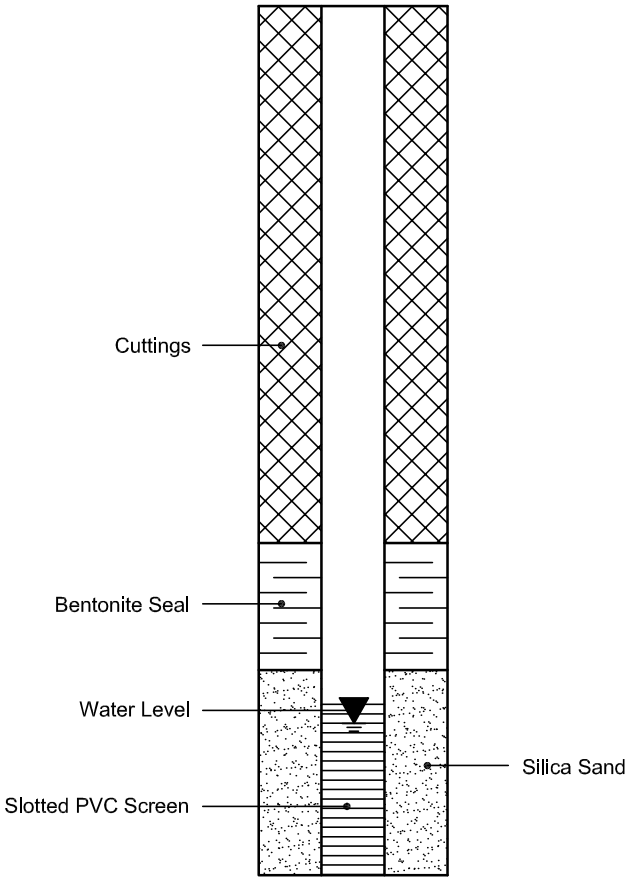


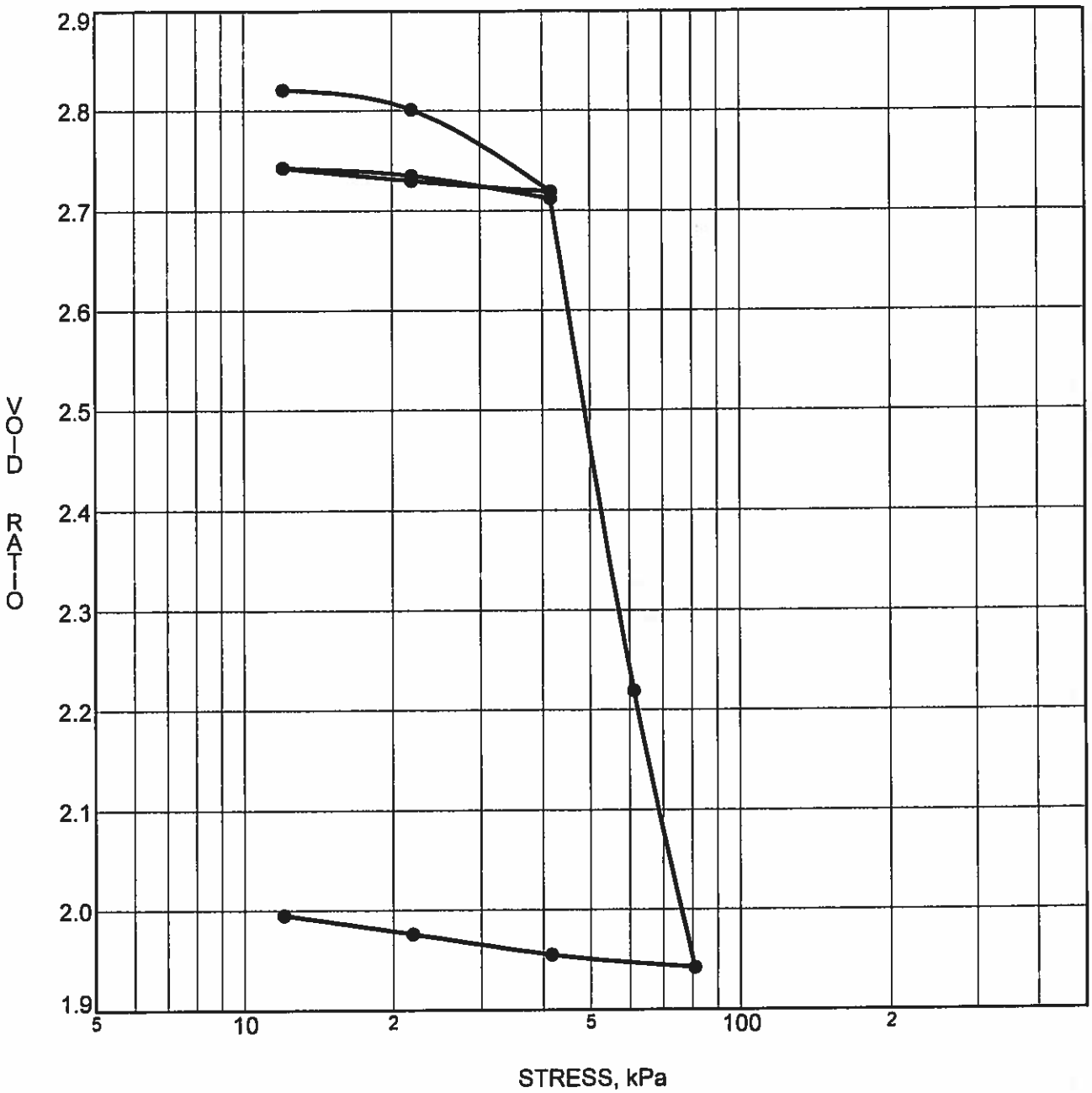
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1-08	p'o	26 kPa	Ccr	0.049
Sample No.	TW 5	p'c	43 kPa	Cc	3.189
Sample Depth	3.53 m	OC Ratio	1.7	Wo	103.3%
Sample Elev.	83.3 m	Void Ratio	2.839	Unit Wt.	15.3 kN/m^3

CLIENT **Richcraft Homes** FILE NO. **PG0861**

PROJECT **Geotechnical Investigation - Prop. Residential Development - Eden Park-Renaud Road** DATE **08/15/08**

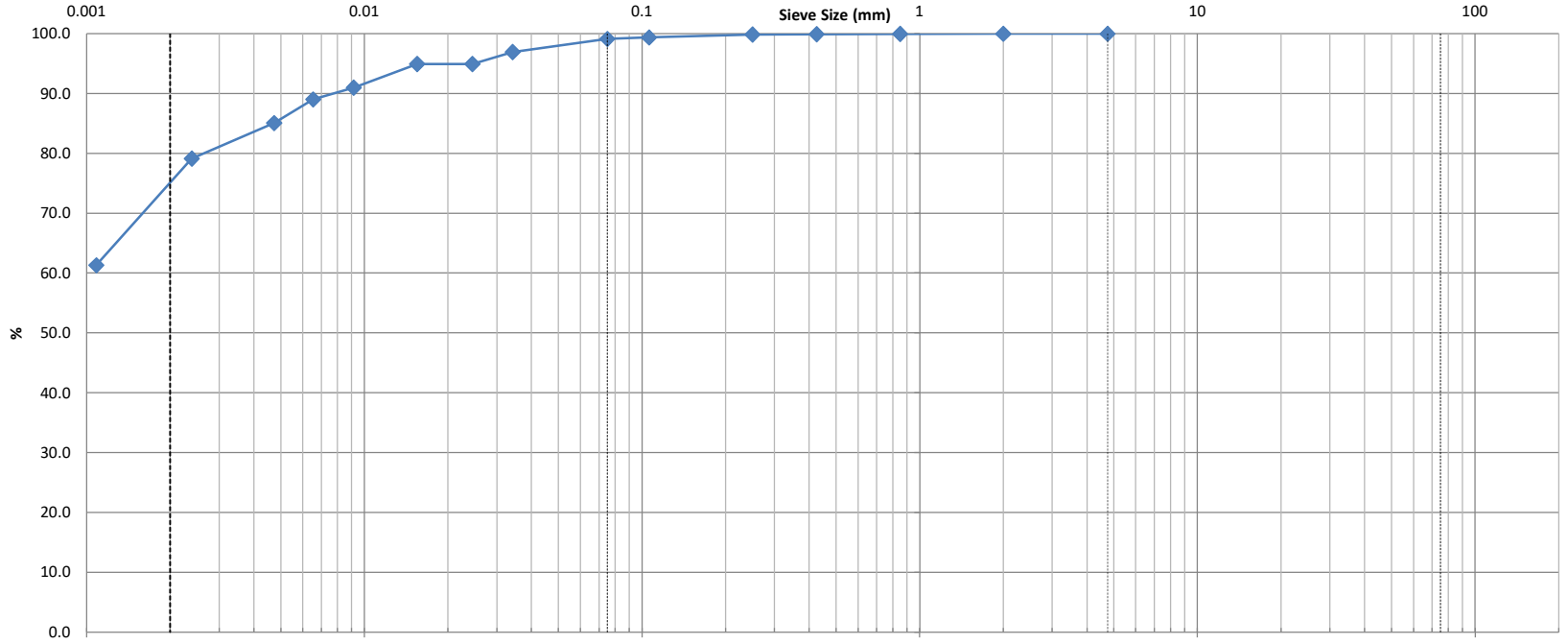
patersongroup Consulting Engineers
28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST

PATERSON GROUP

SIEVE ANALYSIS
ASTM C136

CLIENT:	Richcraft	DEPTH:	10' - 12'	FILE NO:	PG6405
CONTRACT NO.:		BH OR TP No.:	BH3-24 SS5	LAB NO:	54061
PROJECT:	Renaud Rd			DATE RECEIVED:	15-Jul-24
				DATE TESTED:	15-Jul-24
DATE SAMPLED:	-			DATE REPORTED:	23-Jul-24
SAMPLED BY:	A.E.			TESTED BY:	D.K



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						79.7%					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	0.9		24.6		74.5	

Comments:

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

PATERSON GROUP

HYDROMETER
LS-702 ASTM-422

CLIENT:	Richcraft	DEPTH:	10' - 12'	FILE NO.:	PG6405
PROJECT:	Renaud Rd	BH OR TP No.:	BH3-24 SS5	DATE SAMPLED:	-
LAB No. :	54061	TESTED BY:	D.K	DATE RECEIVED:	15-Jul-24
SAMPLED BY:	A.E.	DATE REPT'D:	23-Jul-24	DATE TESTED:	15-Jul-24

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
81.6	2.700

		HYGROSCOPIC MOISTURE		
INITIAL WEIGHT	50.00			
WEIGHT CORRECTED	36.40	TARE WEIGHT	0.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.45	AIR DRY	112.10	112.10
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	81.60	81.60
		CORRECTED	0.728	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5			
19			
13.2			
9.5			
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**81.6**		
0.850	**0.01**	0.0	**100.0**
0.425	**0.03**	0.1	**99.9**
0.250	**0.07**	0.1	**99.9**
0.106	**0.31**	0.6	**99.4**
0.075	**0.43**	0.9	**99.1**
Pan	**0.45**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:57	55.0	6.0	23.0	0.0342	96.9	**96.9**
2	8:58	54.0	6.0	23.0	0.0245	95.0	**95.0**
5	9:01	54.0	6.0	23.0	0.0155	95.0	**95.0**
15	9:11	52.0	6.0	23.0	0.0092	91.0	**91.0**
30	9:26	51.0	6.0	23.0	0.0065	89.0	**89.0**
60	9:56	49.0	6.0	23.0	0.0047	85.1	**85.1**
250	13:06	46.0	6.0	23.0	0.0024	79.1	**79.1**
1440	8:56	37.0	6.0	23.0	0.0011	61.3	**61.3**

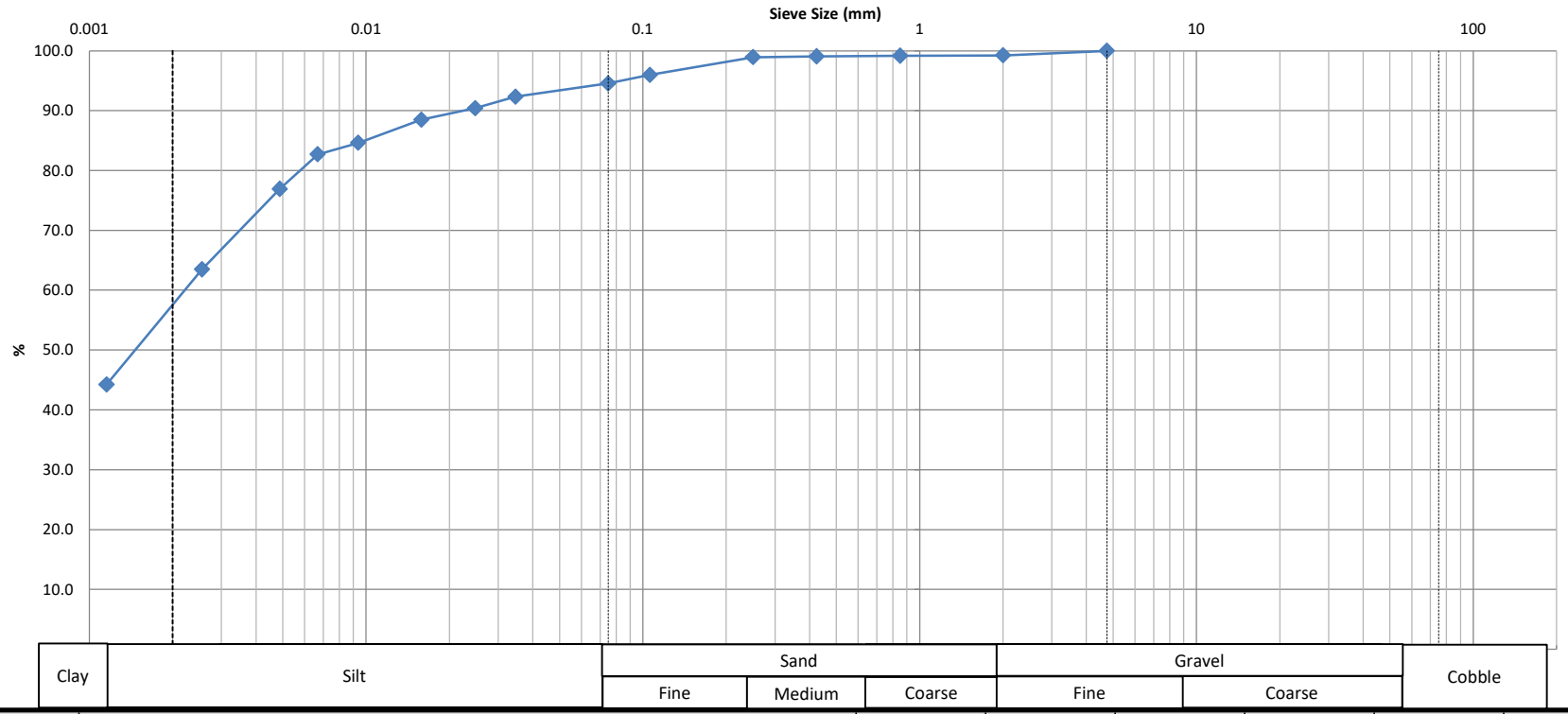
Moisture = 79.7%

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

PATERSON GROUP

SIEVE ANALYSIS
ASTM C136

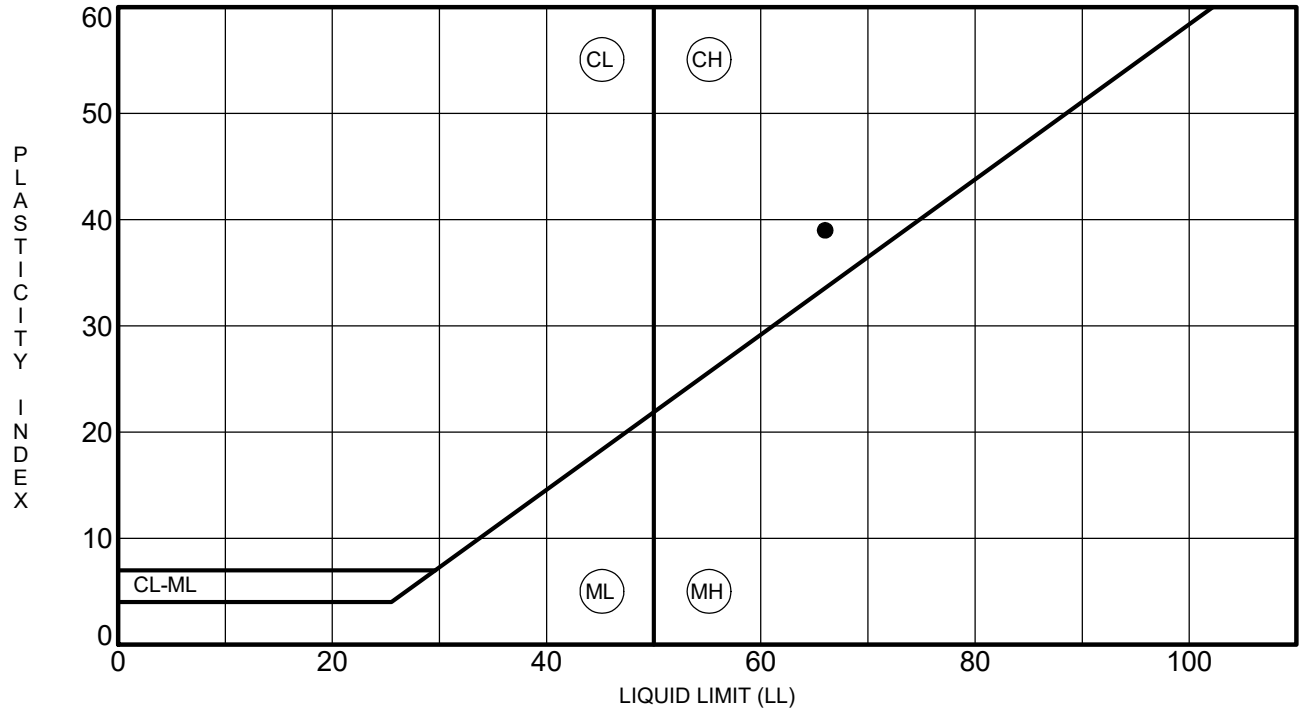
CLIENT:	Richcraft Homes	DEPTH:	7'6" to 9'6"	FILE NO:	PG6405
CONTRACT NO.:		BH OR TP No.:	BH4-22 SS4	LAB NO:	39287
PROJECT:	Trailsedge West Block 121			DATE RECEIVED:	6-Oct-22
				DATE TESTED:	20-Oct-22
DATE SAMPLED:	3-Oct-22			DATE REPORTED:	21-Oct-22
SAMPLED BY:	NS			TESTED BY:	DK/CS



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						81.1					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	5.4		36.6		58.0	

Comments:

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

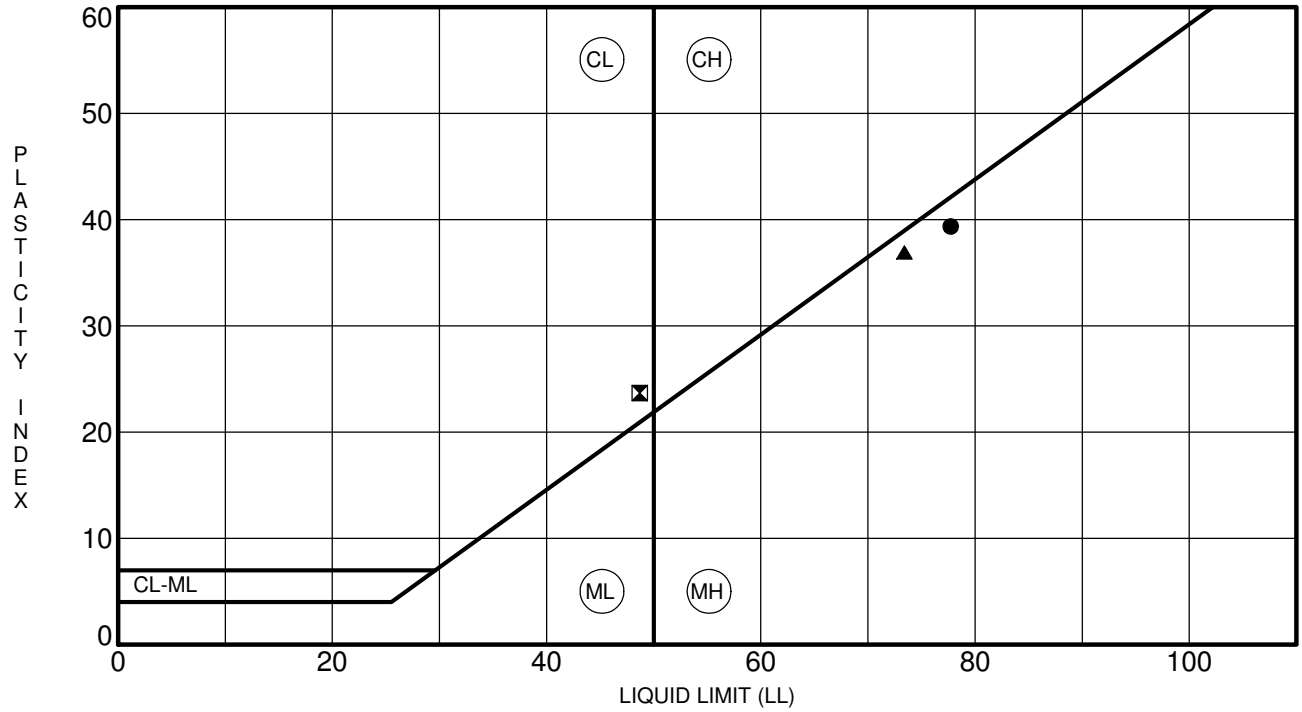


	Specimen Identification	LL	PL	PI	Fines	Classification
●	**BH 2-24**	**66**	**27**	**39**		**Inorganic clays of high plasticity**

CLIENT	**Richcraft Homes**
PROJECT	**Geotechnical Investigation - Trails Edge West - Phase 2 - Block 121**
FILE NO.	**PG6405**
DATE	**12 Jul 24**

patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

ATTERBERG LIMITS' RESULTS



Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 1-22 SS4**	**78**	**38**	**39**		**Inorganic Silt of High Plasticity**
⊠	**BH 2-22 SS4**	**49**	**25**	**24**		**Inorganic Clay of High Plasticity**
▲	**BH 3-22 SS4**	**73**	**36**	**37**		**Inorganic Silt of High Plasticity**

CLIENT

PROJECT **Geotechnical Investigation - Residential Development - Trails Edge West - Block 121**

FILE NO. **PG6405**

DATE **3 Oct 22**

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

ATTERBERG LIMITS' RESULTS

PATERSON GROUP

Linear Shrinkage
ASTM D4943-02

CLIENT:	Richcraft Homes	DEPTH	7'-6" to 9'-6"	FILE NO.:	PG6405
PROJECT:	Trails Edge West	BH OR TP No:	BH4-22	DATE SAMPLED	3-Oct
LAB No:	39287	TESTED BY:	CP/CS	DATE RECEIVED	6-Oct
SAMPLED BY:	N.S	DATE REPORTED:	17-Oct-22	DATE TESTED	14-Oct

LABORATORY INFORMATION & TEST RESULTS

Moisture	**No. of Blows(7)**	**Calibration (Two Trials)**	**Tin NO.(F)**	
Tare	4.87	Tin	4.76	4.76
Soil Pat Wet + Tare	62.76	Tin + Grease	4.87	4.87
Soil Pat Wet	57.89	Glass	48.97	48.97
Soil Pat Dry + Tare	35.92	Tin + Glass + Water	91.36	91.36
Soil Pat Dry	31.05	Volume	37.52	37.52
Moisture	**86.44**	**Average Volume**	**37.52**	

Soil Pat + String	31.15
Soil Pat + Wax + String in Air	32.26
Soil Pat + Wax + String in Water	13.02
Volume Of Pat (Vdx)	19.24

RESULTS:

Shrinkage Limit	**23.55**
Shrinkage Ratio	**1.726**
Volumetric Shrinkage	**108.528**
Linear Shrinkage	**21.725**

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

Certificate of Analysis

Report Date: 19-Jul-2024

Client: **Paterson Group Consulting Engineers (Ottawa)**

Order Date: 15-Jul-2024

Client PO: 60697

Project Description: PG6405

	Client ID:	BH1-24 SS5	-	-	-		
	Sample Date:	15-Jul-24 09:00	-	-	-	-	-
	Sample ID:	2429112-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	56.1	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.82	-	-	-	-	-
Resistivity	0.1 Ohm.m	23.8	-	-	-	-	-
Anions							
Chloride	10 ug/g	150	-	-	-	-	-
Sulphate	10 ug/g	26	-	-	-	-	-

	Client ID:	BH1-22-SS3	-	-	-		
	Sample Date:	03-Oct-22 09:00	-	-	-	-	-
	Sample ID:	2241164-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	65.7	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.47	-	-	-	-	-
Resistivity	0.1 Ohm.m	22.4	-	-	-	-	-
Anions							
Chloride	5 ug/g	38	-	-	-	-	-
Sulphate	5 ug/g	191	-	-	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 & 3 – SLOPE STABILITY ANALYSIS CROSS-SECTIONS

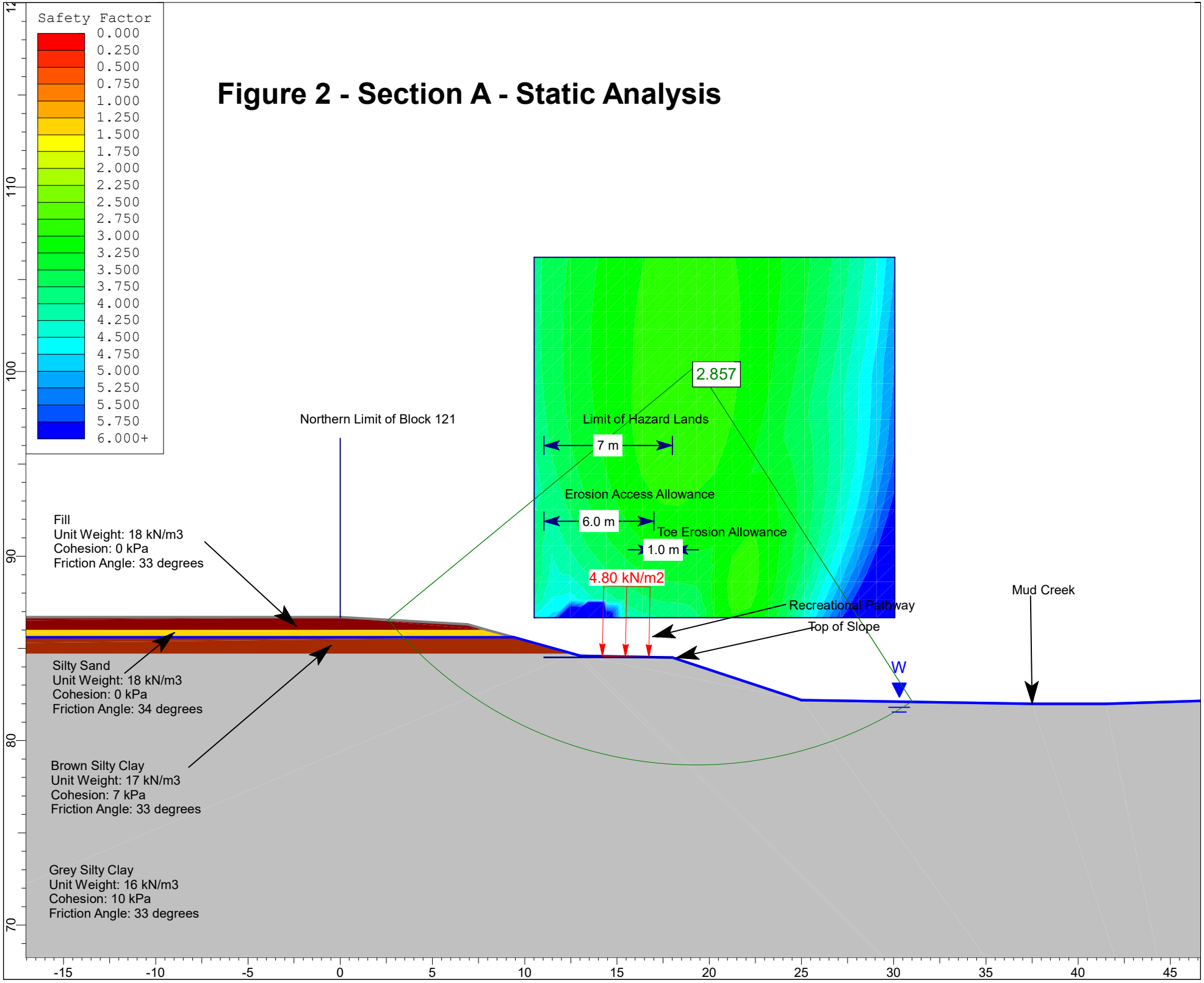
DRAWING PG6405-1 – TEST HOLE LOCATION PLAN

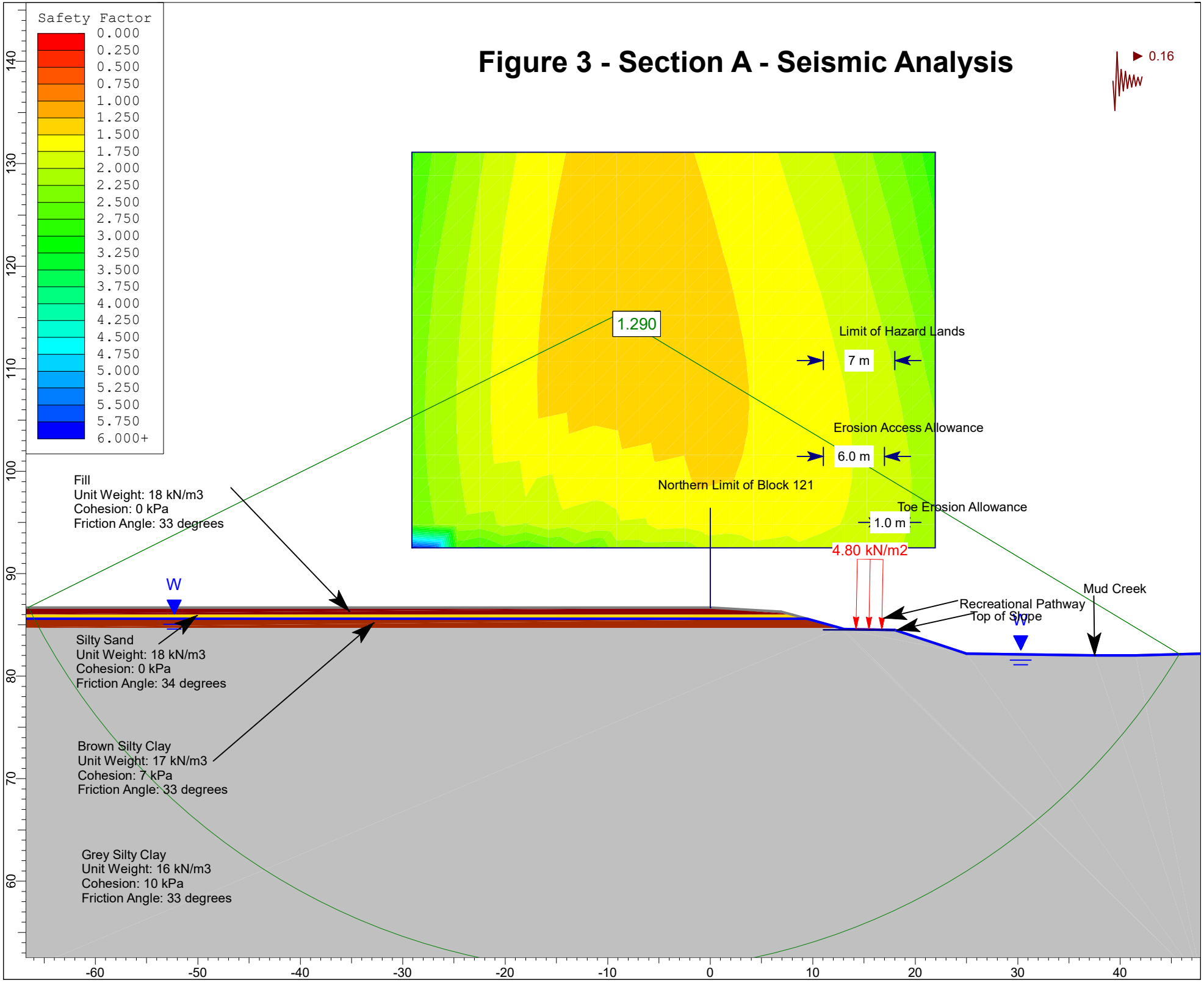


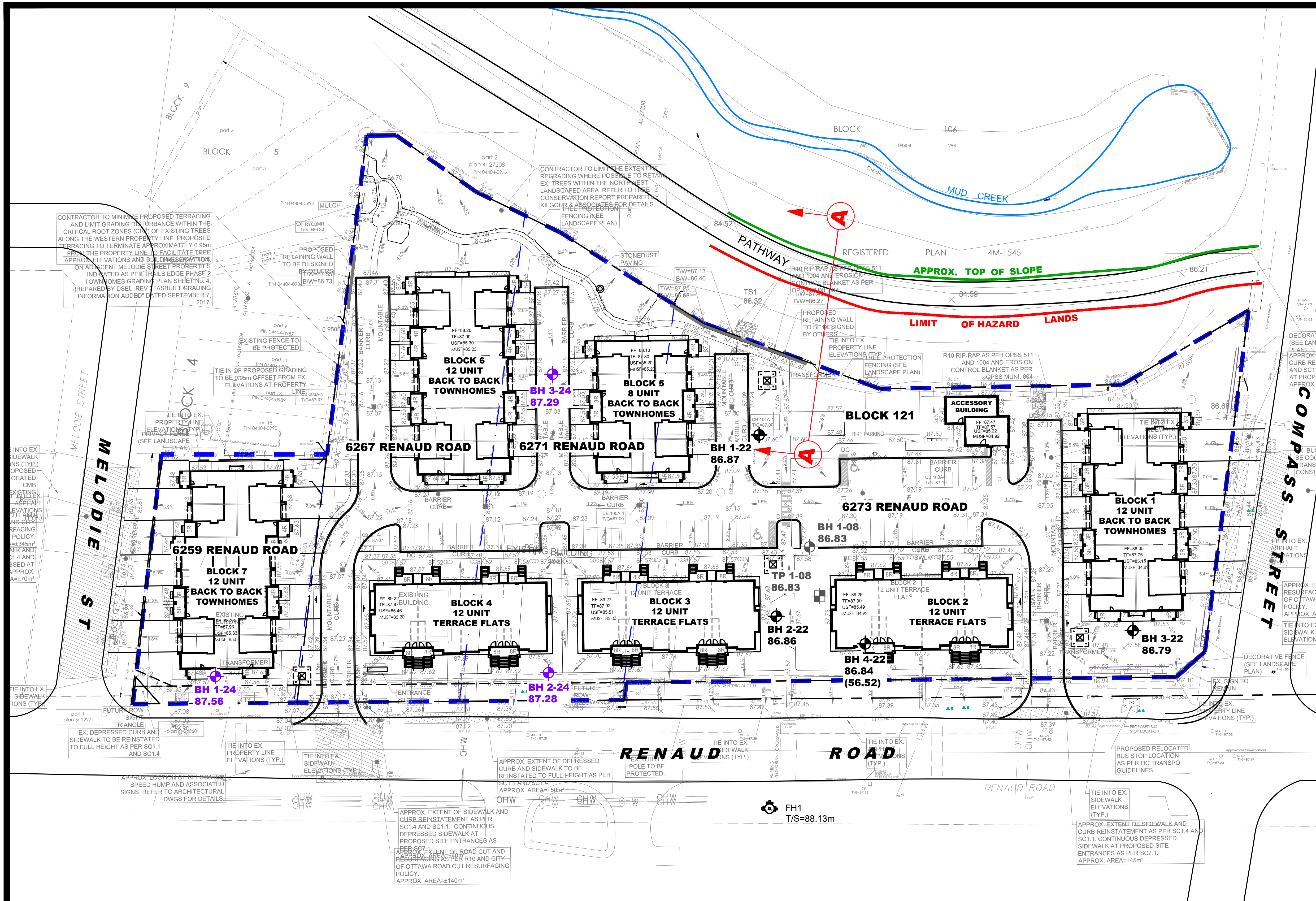
FIGURE 1

KEY PLAN

PATERSON GROUP


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Figure 2 - Section A - Static Analysis
2.857
Northern Limit of Block 121
Limit of Hazard Lands
7 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
1.0 m
4.80 kN/m2
Recreational Pathway
Top of Slope
Mud Creek
W
Fill
Unit Weight: 18 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Silty Sand
Unit Weight: 18 kN/m3
Cohesion: 0 kPa
Friction Angle: 34 degrees
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
Grey Silty Clay
Unit Weight: 16 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
120
110
100
90
80
70
-15
-10
-5
0
5
10
15
20
25
30
35
40
45


Figure 3 - Section A - Seismic Analysis
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
1.290
Limit of Hazard Lands
7 m
Erosion Access Allowance
6.0 m
Northern Limit of Block 121
Toe Erosion Allowance
1.0 m
4.80 kN/m2
Fill
Unit Weight: 18 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
W
Silty Sand
Unit Weight: 18 kN/m3
Cohesion: 0 kPa
Friction Angle: 34 degrees
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
Grey Silty Clay
Unit Weight: 16 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Recreational Pathway
Top of Slope
Mud Creek
140
130
120
110
100
90
80
70
60
-60
-50
-40
-30
-20
-10
0
10
20
30
40



LEGEND:

(symbol)	BOREHOLE LOCATION, 2024
(symbol)	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, 2022
(symbol)	PREVIOUS BOREHOLE LOCATION (PATERSON GROUP REPORT: PG0861 OCTOBER 6, 2008)
(symbol)	PREVIOUS TEST PIT LOCATION (PATERSON GROUP REPORT: PG0861 OCTOBER 6, 2008)
A—A	SLOPE STABILITY CROSS SECTION
86.84	GROUND SURFACE ELEVATION (m)
(56.52)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY RICHCRAFT

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

SCALE: 1:750

0 10 20 30 50m

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

NO.	REVISIONS	DD/MM/YYYY	INITIAL
4	UPDATED SITE PLAN	03/11/2026	NAS
3	UPDATED CONCEPTUAL PLAN	01/10/2026	FA
2	UPDATED CONCEPTUAL PLAN	12/06/2025	PB
1	REVISED TO INCLUDE 2024 BOREHOLES BH 1-24 TO BH 3-24 AND UPDATED CONCEPTUAL PLAN	19/07/2024	DR

RICHCRAFT
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENTS
TRAILSEDGE WEST - BLOCK 121
6273 RENAUD ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750	Date: 10/2022
Drawn by: YA	Report No.: PG6405-1
Checked by: NAS	Dwg. No.: PG6405-1
Approved by: FA	Revision No.: 4

11x17

p:\autocad drawings\geotechnical\pg64xx\pg6405\pg6405-1-test hole location plan (rev.04).dwg