PATERSON GROUP

# Geotechnical Investigation

## Proposed Residential Building

342 Roosevelt Avenue
Ottawa, Ontario

Prepared for 342 Roosevelt Limited

**Report PG4210-1 Rev. 1 dated March 17, 2025**

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# Appendices

# 1.0 Introduction

Paterson Group (Paterson) was commissioned by 342 Roosevelt Limited to conduct a geotechnical investigation for a proposed residential building to be located at 342 Roosevelt Avenue in the City of Ottawa, 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 boreholes.

❑ Provide geotechnical recommendations for 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.

# 2.0 Proposed Development

The proposed development is understood to consist of a 6.5-storey residential building with 26 units and one basement level, which is surrounded by walkways and a landscaped area. The proposed building is expected to be municipally serviced.

Demolition of the existing structure located on-site will be required as part of the subject development.

# 3.0 Method of Investigation

## 3.1 Field Investigation

### Field Program

The fieldwork for the current investigation was conducted on July 19, 2017, and consisted of excavating 2 test pits to a maximum depth of 0.9 m. The test pits were excavated using a mini-excavator supplied by the client.

The test pits were reviewed in the field by Paterson personnel under the direction of a senior engineer from the geotechnical division. The test pit procedure consisted of reviewing the excavation, and sampling and testing the overburden at selected locations.

The test pits were placed in a manner to provide general coverage of the property taking into consideration existing site features and underground services. The approximate locations of the test pits are shown on Drawing PG4210-1 - Test Hole Location Plan attached to the present report.

### Sampling and In Situ Testing

Grab samples (G) were recovered from the side walls of the test pits. The depths at which the grab samples were recovered from the test pits are shown as G on the Soil Profile and Test Data sheets presented in Appendix 1.

All samples were visually inspected and initially classified on site. The grab samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification.

### Groundwater

Where present, the depth at which groundwater was encountered at the completion of test pit excavations was noted in the field.

## 3.2 Field Survey

The test pit locations, and the ground surface elevation at each test pit location, were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The locations of the test pits, and ground surface elevation at each test pit location, are presented on Drawing PG4210-1 - Test Hole Location Plan in Appendix 2.

## 3.3 Laboratory Review

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

## 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 is currently occupied by a 2-storey residential dwelling with an associated driveway, landscaped areas and mature trees. The ground surface at the subject property is relatively flat and generally at-grade with Roosevelt Avenue. The site is surrounded by the LRT Confederation Line to the north, residential dwellings to the south west, and Roosevelt Avenue to the east.

The West Nepean Collector sewer line extends through the northern portion of the site. Further, an existing 1200 m diameter watermain is located approximately 3 m from the northern limit of the site, and has an invert at approximate geodetic elevation 64 m.

## 4.2 Subsurface Profile

**Overburden**

Generally, the subsurface profile encountered at the test pit locations consisted of topsoil with rootlets overlying a brown silty sand to silty clay fill mixed with topsoil, gravel and cobbles. Glacial till was encountered in test pits TP 2, consisting of brown silty sand to silty clay with trace gravel, cobbles and boulders.

Practical refusal to excavation was encountered on the bedrock surface at approximate depths of 0.6 m and 0.9 m below ground surface in test pits TP 1 and TP 2, respectively. Refer to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test pit locations.

**Bedrock**

Based on available geological mapping, the local bedrock consists of limestone with some shaly partings from the Ottawa formation. The overburden drift thickness is expected between ground surface and 1 m depth.

## 4.3 Groundwater

Groundwater observations were made in the open test pit upon completion of excavation. All test pits were dry upon the completion of the field program, and the groundwater is considered to be located at some depth within the bedrock. However, it should be noted that groundwater levels are subject to seasonal fluctuations, therefore, the groundwater level could vary at the time of construction.

# 5.0 Discussion

## 5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. The proposed residential building is recommended to be founded on conventional spread footings placed on a bearing surface consisting of clean, surface sounded bedrock.

Bedrock removal will be required to complete the foundation construction. The above and other considerations are further discussed in the following sections.

## 5.2 Site Grading and Preparation

### Stripping Depth

Topsoil, asphalt, and fill, containing deleterious or organic materials or construction debris, should be stripped from under any building, paved areas, pipe bedding and other settlement sensitive structures. Care should be taken to not disturb adequate bearing surfaces during site preparation activities.

### Fill Placement

Where required, engineered fill placed for grading beneath the proposed building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery to the site. The fill should be placed in maximum lift thickness of 300 mm and compacted with suitable compaction equipment. Fill placed beneath the building 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 could be placed as general landscaping fill where surface settlement is of minor concern. The existing materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If the existing materials are to be placed to increase the subgrade level for areas to be paved, the non-specified existing fill should be compacted in 300 mm lifts and compacted to a minimum density of 95% of the respective SPMDD.

### Bedrock Removal

Due to the proximity of the West Nepean Collector sewer line and 1200 mm diameter watermain located near the northern site boundary, bedrock should be completed by line drilling and hoe-ramming.

Prior to proceeding with bedrock removal, the effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey located in proximity of the bedrock removal operations should be conducted prior to commencing construction. The extent of the survey should be sufficient to respond to any inquiries/claims related to the bedrock removal operations.

As a general guideline, peak particle velocity (measured at the structures) should not exceed 50 mm/s during the blasting program to reduce the risks of damage to the existing structures.

### Vibration Considerations

Construction operations could cause vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels, as much as possible, should be incorporated in the construction operations to maintain a cooperative environment with the residents.

Two parameters determine the recommended vibration limit: the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people. A preconstruction survey is recommended to minimize the risks of claims during or following the construction of the proposed building.

## 5.3 Foundation Design

### Bearing Resistance Values

Footings placed on a clean, surface sounded limestone bedrock bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **500 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **1500 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

A clean, surface sounded bedrock bearing surface consists of one from which all topsoil, soils, looks rock and any other deleterious materials have been removed prior to the placement of concrete for footings.

**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. Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or flatter).

**Settlement**

Footings bearing on an acceptable bedrock bearing surface and designed for the bearing resistance values provided herein will be subjected to negligible potential 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 foundations constructed at the subject site. A higher site classification such as Class A or B can be provided if a site-specific shear wave velocity testing is completed. Refer to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements. The soils underlying the subject site are not susceptible to liquefaction.

## 5.5 Slab on Grade Construction

With the removal of all topsoil and fill containing significant amounts of deleterious or organic materials, the bedrock is considered to be an acceptable subgrade on which backfill for basement slab construction.

It is recommended that the upper 200 mm of sub-floor fill consist of 19 mm clear crushed stone. In consideration of the anticipated groundwater conditions, an underslab drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear crushed stone under the lower basement floor of the proposed building. This is discussed further in Section 6.1.

## 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/$m^3$.

### 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 material
> $\gamma$ = unit weight of fill of the applicable retained material (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 ($\Delta P_{AE}$).

The seismic earth force ($\Delta P_{AE}$) can be calculated using $0.375 \cdot a \cdot H^2/g$ where:

> $a_c = (1.45 - a_{max}/g)a_{max}$
> $\gamma$ = 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 0.32g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component ($P_o$) under seismic conditions can be calculated using $P_o = 0.5\, K_o \cdot \gamma \cdot H^2$, 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 2012.

# 6.0 Design and Construction Precautions

## 6.1 Foundation Backfill

### Perimeter Drainage

A perimeter foundation drainage system is recommended to be provided for the proposed structure. The system should consist of a 100 mm or 150 mm diameter perforated and corrugated plastic pipe, which is surrounded on all sides by 150 mm of 19 mm clear crushed stone and 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.

### Underslab Drainage System

Underslab drainage will be required to control water infiltration below the basement slab. For preliminary design purposes, it is recommended that 100 or 150 mm perforated pipes be placed at approximate 6 m centres underlying the basement floor. The spacing of the underslab drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

### Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and are not recommended for placement as backfill against the foundation walls, unless placed in conjunction with a drainage geocomposite board, such as Miradrain G100N or Delta Drain 6000. The drainage geocomposite should be connected to the perimeter foundation drainage system. Otherwise, imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be placed for foundation backfill.

## 6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover, or an equivalent thickness of soil cover and foundation insulation, should be provided.

Exterior unheated footings, such as 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.

However, foundations which are founded directly on clean, surface-sounded bedrock with no cracks or fissures, and which is approved by Paterson at the time of construction, is not considered frost susceptible and does not require soil cover.

Where the bedrock is considered frost susceptible, foundation insulation will need to be provided or the frost susceptible bedrock will need to be removed and replaced with lean concrete (minimum 17 MPa 28-day strength).

## 6.3 Excavation Side Slopes

**Temporary Side Slopes**

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes in soil and 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 subsoil at this site is considered to be mainly 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 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.

**Bedrock Stabilization**

Excavation side slopes in sound bedrock can be carried out using vertical side walls. A minimum 1 m horizontal ledge should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system.

Horizontal rock anchors may be required at specific locations to prevent pop-outs of the bedrock, especially in areas where bedrock fractures are conducive to the failure of the bedrock surface.

The requirement for temporary chainlink fencing, shotcrete, and/or rock bolts should be evaluated during the excavation operations and should be discussed with the structural engineer during the design stage of the project.

## 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 of private 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.

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 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.

## 6.5 Groundwater Control

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

### Groundwater Control for Building Construction

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 Persons as stipulated under O.Reg. 63/16.

**Impacts on Neighbouring Properties**

Given the shallow bedrock present at, and in the vicinity of, the subject site, the neighbouring structures are expected to be founded on bedrock. Therefore, no issues are expected with respect to groundwater lowering that would cause damage to adjacent structures surrounding the proposed development.

## 6.6 Winter Construction

If winter construction is considered for this project, precautions should be provided for frost protection. The subsurface soil conditions mainly consist of frost susceptible materials. In 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 installation of straw, propane heaters and tarpaulins or other suitable means. The excavation base should be insulated from subzero 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.

The trench excavations should be completed in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. Where excavations are constructed in proximity of existing structures precaution to adversely affecting the existing structure due to the freezing conditions should be provided.

## 6.7 Corrosion Potential and Sulphate

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

# 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:

- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ 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 request, following the completion of a satisfactory material testing and observation program by geotechnical consultant.

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should 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 pit 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 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 342 Roosevelt Limited. 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
Mar. 17, 2025
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**Report Distribution:**

❑ 342 Roosevelt Limited (e-mail copy)
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# APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

**patersongroup** Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

# SOIL PROFILE AND TEST DATA

Geotechnical Investigation
342 Roosevelt Avenue
Ottawa, Ontario

**DATUM** TBM - Top of grate of catch basin. Geodetic elevation = 66.77m.

**FILE NO.** PG4210

**REMARKS**

**HOLE NO.** TP 1

**BORINGS BY** Excavator **DATE** July 19, 2017

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | % RECOVERY | N VALUE or RQD | DEPTH (m) | ELEV. (m) | Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80) | Piezometer Construction |
|---|---|---|---|---|---|---|---|---|---|
| GROUND SURFACE | | | | | | 0 | 66.92 | | |
| **TOPSOIL** 0.17 | | | | | | | | | |
| **FILL:** Brown silty clay, trace sand, gravel, cobbles and construction debris 0.59 | | G | 1 | | | | | | |
| End of Test Pit<br>TP terminated on bedrock surface at 0.59m depth<br>(TP dry upon completion) | | | | | | | | | |

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

**patersongroup** Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

# SOIL PROFILE AND TEST DATA

Geotechnical Investigation
342 Roosevelt Avenue
Ottawa, Ontario

**DATUM** TBM - Top of grate of catch basin. Geodetic elevation = 66.77m.

**REMARKS**

**BORINGS BY** Excavator

**DATE** July 19, 2017

**FILE NO.** PG4210

**HOLE NO.** TP 2

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | % RECOVERY | N VALUE or RQD | DEPTH (m) | ELEV. (m) | Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80) | Piezometer Construction |
|---|---|---|---|---|---|---|---|---|---|
| GROUND SURFACE | | | | | | 0 | 66.99 | | |
| **TOPSOIL** 0.13 | | G | 1 | | | | | | |
| **FILL:** Brown silty sand, trace gravel, cobbles, organics and construction debris 0.49 | | G | 2 | | | | | | |
| **GLACIAL TILL:** Brown silty sand to silty clay, trace gravel, cobbles, boulders and organics 0.91 | | G | 3 | | | | | | |
| | | G | 4 | | | | | | |
| End of Test Pit<br><br>TP terminated on bedrock surface at 0.91m depth<br><br>(TP dry upon completion) | | | | | | | | | |

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

# 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<br>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 = $(D30)^2 / (D10 \times D60)$ |
| 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

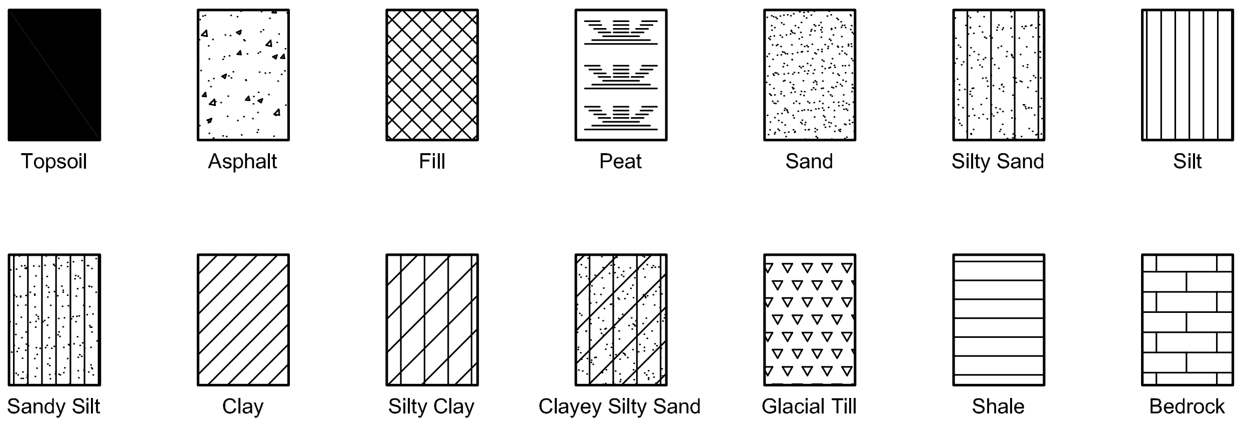
| | | |
|---|---|---|
| $p'_o$ | - | Present effective overburden pressure at sample depth |
| $p'_c$ | - | Preconsolidation pressure of (maximum past pressure on) sample |
| Ccr | - | Recompression index (in effect at pressures below $p'_c$) |
| Cc | - | Compression index (in effect at pressures above $p'_c$) |
| 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. |

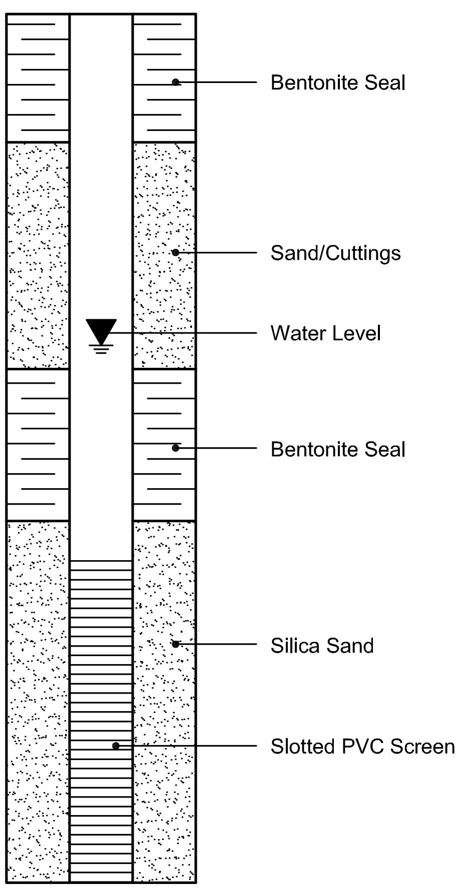
# SYMBOLS AND TERMS (continued)

## STRATA PLOT

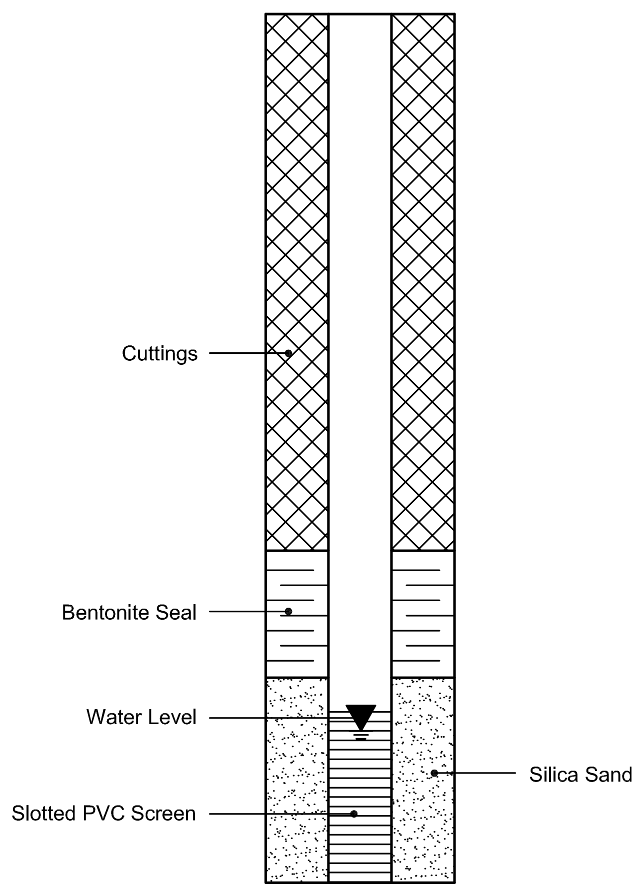



## MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION




PIEZOMETER CONSTRUCTION



Certificate of Analysis
**Client: Paterson Group Consulting Engineers**
**Client PO: 20656**

Report Date: 27-Jul-2017
Order Date: 21-Jul-2017
**Project Description: PG4210**

| | **Client ID:** | TP2-G3 | - | - | - |
|---|---|---|---|---|---|
| | **Sample Date:** | 19-Jul-17 | - | - | - |
| | **Sample ID:** | 1729564-01 | - | - | - |
| | **MDL/Units** | Soil | - | - | - |
| **Physical Characteristics** | | | | | |
| % Solids | 0.1 % by Wt. | 84.1 | - | - | - |
| **General Inorganics** | | | | | |
| pH | 0.05 pH Units | 7.27 | - | - | - |
| Resistivity | 0.10 Ohm.m | 63.8 | - | - | - |
| **Anions** | | | | | |
| Chloride | 5 ug/g dry | <5 | - | - | - |
| Sulphate | 5 ug/g dry | 5 | - | - | - |

# APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG4210-1 - TEST HOLE LOCATION PLAN

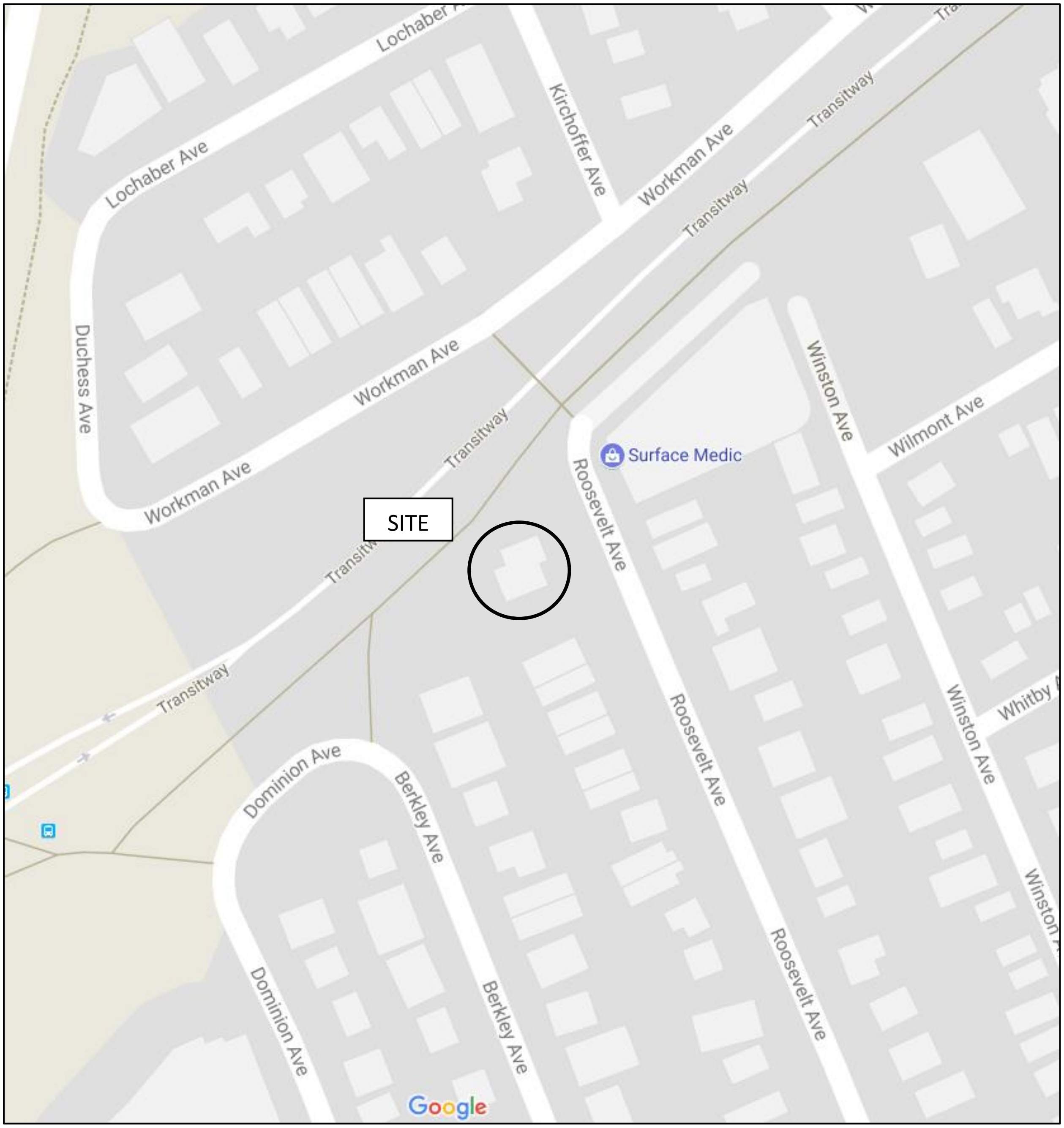
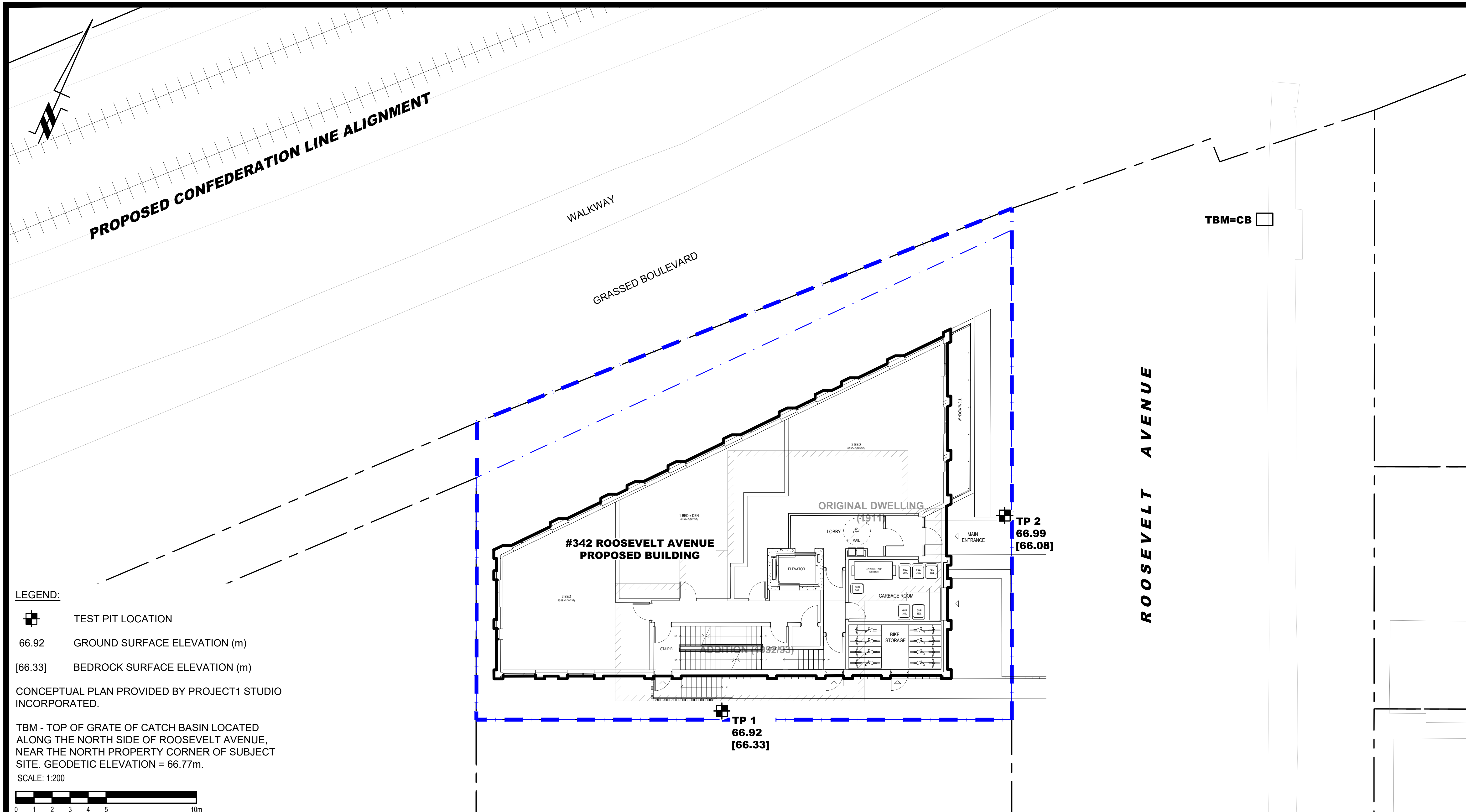



FIGURE 1

KEY PLAN




LEGEND:

TEST PIT LOCATION

66.92 GROUND SURFACE ELEVATION (m)

[66.33] BEDROCK SURFACE ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY PROJECT1 STUDIO INCORPORATED.

TBM - TOP OF GRATE OF CATCH BASIN LOCATED ALONG THE NORTH SIDE OF ROOSEVELT AVENUE, NEAR THE NORTH PROPERTY CORNER OF SUBJECT SITE. GEODETIC ELEVATION = 66.77m.

SCALE: 1:200

0 1 2 3 4 5 10m


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


| NO. | REVISIONS | DATE | INITIAL |
|---|---|---|---|
| 1 | UPDATED CONCEPTUAL PLAN | 22/08/2024 | KS |

CONCORDE MANAGEMENT DEVELOPMENT
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
342 ROOSEVELT AVENUE

OTTAWA, ONTARIO

Title:

# TEST HOLE LOCATION PLAN

| | |
|---|---|
| Scale: 1:200 | Date: 07/2017 |
| Drawn by: RCG | Report No.: PG4210-1 |
| Checked by: NC | Dwg. No.: PG4210-1 |
| Approved by: DJG | Revision No.: 1 |

p:\autocad drawings\geotechnical\pg42xx\pg4210\pg4210-1 test hole location plan (rev.01).dwg

11x17