Geotechnical Investigation and Design Report

Rosseau Springs Limited

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Proposed Rosseau Springs Residential Development
Rosseau, Ontario

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Prepared By:
Yves Beauparlant, P.Eng.
Manager, Earth and Environmental
EXP
885 Regent Street
Sudbury, Ontario, P3E 5M4
t: +1.705.674.9681
f: +1.705.674.5583

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Further to our Proposal No. 22/090/GP dated June 3, 2022 and your subsequent authorization to proceed, EXP Services Inc. (EXP) has completed the field investigation and geotechnical engineering evaluation for the proposed new residential development to be located at Maplehurst Road and North of Little Morgan Road in Rosseau, Ontario. Our comments and recommendations, based on the results of the field investigation and our understanding of the project scope, are provided in this report.

1. Introduction

It is understood by EXP that the development will consist of approximately 50 residential lots (Estate Size/Type Lots). The ground conditions within the proposed residential portion of the subdivision consist mainly of shallow overburden soils with bedrock outcrops that are higher. Based on Ontario Quaternary Geology (1:1000000) Google Earth GIS dowload, the subdivision lies in a Precambrian Bedrock area with undifferentiated igneous and metamorphic rock, exposed at surface or covered by a discontinuous, thin layer of drift.

To assist with the design of the proposed residential buildings, as well as the associated roadways, services and storm water management pond, EXP has completed a geotechnical investigation at the site, with the results of the investigation and design recommendations included within this report.

2. Field Investigation

The field investigation for this project consisted of the advancement of forty-three (43) sampled test pits spread throughout the proposed subdivision along the proposed roads in accessible locations. The location of the test pits are shown on Drawing A-1 in Appendix A. The sampled test pits were advanced using a track mounted excavator supplied by others. The test pits were advanced to depths shown on the attached test pit logs, Figs. B-2 to B-44, in Appendix B. Soil samples were obtained at varying depths where change in stratigraphy was noted and shown on the attached borehole logs in Appendix B.

Groundwater levels were measured within the open test pits prior to backfilling. As no groundwater was observed during the test pit program, no groundwater monitoring wells/piezometers were installed.

The retained soil samples were logged in the field and then carefully packaged and transported to our laboratory for detailed examination and testing.

The locations and elevations of the test pits were determined in the field using a hand-held GPS unit. The locations should be considered accurate only to the degree implied by the method used.

3. Laboratory Testing

A routine geotechnical laboratory testing program was performed on representative soil samples and consisted of moisture content determinations and a grain size analysis. The geotechnical laboratory test results are summarized on the attached borehole logs in Appendix B, with detailed results included in Appendix C.

4. Subsurface Conditions

Details of the soils encountered during the field investigation are summarized on the attached borehole logs in Appendix B. The logs include textural descriptions of the subsoil and indicate the soil boundaries inferred from non-continuous sampling and observations during the field investigation. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. When reading this report, the explanatory notes and definitions provided in Figures B-1A and B-1B in Appendix B should be referenced.

In general, the test pits completed on site encountered surficial organics underlain be native cohesionless soils with shallow to exposed bedrock

Topsoil was encountered at the surface of the majority of the test pits ranged in thickness from near zero up to 0.3 m. The topsoil was generally dark brown to black in colour and wet.

Underlying the topsoil was native cohesionless soils. The cohesionless soils consisted of silt, to sand and silt to sand with various fractions of silt, containing gravel, cobbles and boulders and is likely a Till deposit. The sand extended to refusal depths at most test pits, which was encountered at depths ranging from 0.1 m to 3.0 m. Refusal was not encountered within test pits TP-3A and -2E due to access/level ground for the excavator, and at TP-5D and -6D as the test pits were extend to sample termination depth. The cohesionless soils were brown to grey in colour and generally moist with some wet areas. Measured moisture contents ranged from 8 to 23%.

Refusal was encountered at most test pits as noted above. The refusal depths are noted as follows:

:

Test Pit No.	Refusal Depth (m)	Test Pit No.	Refusal Depth (m)	Test Pit No.	Refusal Depth (m)
1A	0.1	**5B**	0.1	**1C**	0.11
2A	surface	**6B**	1.0	**2C**	1.3
5A	surface	**7B**	0.3	**3C**	0.9
6A	1.6	**8B**	1.3	**4C**	1.2
7A	2.6	**9B**	1.6	**5C**	1.5
8A	0.3	**10B**	0.5	**6C**	surface
9A	0.5	**11B**	1.5	**1D**	2.5
11A	0.1	**12B**	1.7	**2D**	2.0
12A	1.2	**13B**	1.2	**3D**	3.0
1B	0.1	**14B**	0.5	**4D**	0.5
2B	0.9	**15B**	0.6	**7D**	1.2
3B	0.1	**16B**	0.7	**1E**	0.7
4B	0.1	**17B**	1.1	**3E**	0.8

Groundwater levels were measured in the test pits upon completion. No groundwater was observed at the time of completion, prior to backfilling the test pits. Based on the observations in the field, soil colour, moisture contents, groundwater levels are not anticipated to be encountered, however perched groundwater conditions may be present between bedrock ridges. Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions.

5. Preliminary Foundation Recommendations

As the subdivision site is predominantly comprised mainly of shallow bedrock and bedrock outcrops, it is anticipated that the proposed residential structures can be founded on conventional strip or spread footings bearing directly on bedrock or on engineered fill overlying bedrock. While clearing and grubbing, should an area of the site to be developed consist of native silt/sand deposits, EXP can review the building sites on an as needed basis and provide specific bearing capacity recommendations for the lots in question, if required, to avoid excessive digging and re-engineering.

Where fill is required below the structures in excess of 2.0 m, a well graded blast rock/crushed rock fill material not exceeding 300 mm in diameter may be used to raise grades for residential structure foundations. The 300 mm minus rock is to be placed in lifts not exceeding 300 mm and be chinked in place with a heavy tracked machine. Rock fill can be used to raise grades up to 1.0 m below the structures provided the upper 150 mm consists of minus 150 mm dia material that is carefully chinked into the underlying coarse rock fill surface. Following an inspection of the rockfill and it's gradation and effectiveness of chinking, a non-woven geotextile, such as a Terrafix 270R, may be required to be placed on the rock fill, prior to placing the engineered fill discussed in the following sections.

As the lots are quite large, and field work has not been completed over site specific building pads, it is recommended that prior to construction, that site specific geotechnical investigation be completed to better understand the site specific constrains at the proposed sites and to confirm that the below preliminary recommendations are valid for the site specific sites.

5.1 Conventional Strip or Spread Foundations on Bedrock

The proposed residential structures can be founded on strip or spread footings bearing directly on bedrock. Footings founded on sound bedrock can be designed with a factored geotechnical resistance at Ultimate Limit States (ULS) of 250 KPa. A geotechnical resistance factor of 0.5 has been applied to determine this value. Serviceability Limit States (SLS) design does not apply for footings bearing directly on bedrock as failure of the concrete would occur before unacceptable settlement of the foundation. For footings bearing directly on bedrock, settlements will be negligible.

The recommended geotechnical resistance above assumes that all foundation concrete is established on sound, unweathered rock, which has been cleaned of all loose debris and rock shatter using air hose or water jetting procedures. Footings should be placed on fairly level bedrock (i.e., sloping less than 10° from the horizontal). In some instances, lightly loaded spread footings may be placed on bedrock sloping up to 25° to 30° from the horizontal as long as rock dowels are incorporated into the design to ensure sufficient resistance against sliding. As an alternative to levelling the bedrock surface by mechanical or blasting techniques, where the bedrock is irregular with erratic changes in profile, ledges, crevices, etc., the footing beds may be levelled by benching over these areas with mass concrete (min. 20 MPa compressive strength), and anchored into the bedrock where the overall slope of the bedrock across the base of the foundation exceeds 10°. Typically, this decision is made on-site, depending on site specific bedrock conditions.

All bedrock surfaces must be reviewed by EXP prior to pouring foundation concrete. This is necessary to verify the assumed foundation bearing conditions and review the foundation construction procedures, bedrock slope, etc.

Strip and spread footing widths must comply with the Ontario Building Code minimum requirements.

5.2 Rock Dowels and Anchors

If dowels and or anchors are required, the structural engineer normally designs the length and diameter of the steel dowels/anchors for footings, based on the type of bedrock and its strength parameters.

For bedrock in the Rosseau area, failure typically occurs between the dowel/anchor and the grout, or between the grout and the rock, and not from a quasi-conical rock mass failure, provided sufficient dowel/anchor bond lengths have been designed. The bond length or grouted portion of the anchor for this rock mass should be a minimum of 3.0 m. For typical footing dowels on sloping bedrock, a dowel diameter of 20 mm (i.e. 20 M) and an embedment depth of 0.9 m (3 ft) is considered sufficient, with a minimum 200 mm stickup and a 90 degree bend. Empirical methods of analysis, such as pull out tests, have shown that the bond developed between the grout and the dowel/anchor are typically twice that of the bond developed between the grout and the bedrock. Therefore, the design analysis should be based on failure occurring between the grout and the bedrock interface. For straight-shafted dowels, the anchor force, which can be developed, is dependent on the ultimate bond stress of the bedrock or the grout material.

The ultimate bond stress is typically taken as 10% of the unconfined compressive strength of the bedrock or the compressive strength of the grout material, whichever is less, but not more than 3.0 MPa. As unconfined compressive strengths are considered to be quite high for the encountered bedrock in this area of Rosseau, 3.0 MPa should be used for the ultimate bond stress assuming a minimum 30 MPa grout is used. The allowable bond stress, “τ_b” taken between the rock and the grout is normally 50% or less of the ultimate bond stress, (i.e., Safety Factor of 2.0 for competent rock in the Rosseau area).

The required bond length (L, in metres) for the anchor is a function of the core hole diameter (d), and can be calculated as follows:

$$\mathbf{L = P / (\pi \times d \times \tau_b)}$$

where

P = working capacity of anchor (kN)
τ_b = working bond stress
d = core hole diameter (m)

The upper 300 mm of the bedrock is not normally considered part of the bond length, since this area is usually weathered/fractured, and as a result does not usually develop the ultimate bond stress assumed in the above calculations.

During construction, pullout tests equal to the design loads must be performed by a qualified geotechnical engineer to confirm the strength of the anchors. This work can be performed on a representative number of anchors by EXP.

5.3 Conventional Strip or Spread Footings on Engineered Fill Overlying Bedrock

The proposed residential structures can be founded on strip or spread footings bearing on engineered fill overlying bedrock. The foundations on engineered fill overlying bedrock may be designed for a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa, subject to inspection during construction. A geotechnical resistance factor of 0.5 was utilized for the ULS values. With a geotechnical reaction at SLS of 150 kPa, total settlements should be significantly less than the typically acceptable level of 25 mm total.

Bedrock subgrade preparation must be completed as noted in Section 5.1. Pending final bedrock configuration, some bedrock benching may be required prior to placing engineered fill to prevent possible slipping/sloughing of material.

All required up fill beneath the foundations is to consist of a Granular “B” Type II or Granular “A” in accordance with Ontario Provincial Standards Specifications (OPSS) 1010. A final 300 mm thick layer of Granular “A” (OPSS 1010) should be placed directly below the foundation. All fill material should be placed in maximum 200 mm thick lifts and be compacted to 100% of the Standard Proctor Maximum Dry Density (SPMDD) within 1.5% of the optimum moisture content. The minimum required thickness of the engineered fill pad over the bedrock is 300 mm.

The engineered fill pad is to extend laterally a minimum of 1.0 m beyond the edge of the foundation and slope down at a slope of one horizontal to one vertical (1H:1V) to the bedrock surface. Engineered fill placement is to be completed under the full-time supervision of a qualified geotechnical engineer to ensure that the recommendations contained herein are met.

Foundations which are to be placed at different elevations on engineered fill or near service trenches, should be located such that the footings are set below a line drawn up at 10 horizontal to 7 vertical from the near edge of a lower foundation or bottom of a service trench, as indicated on Figure 5-1.

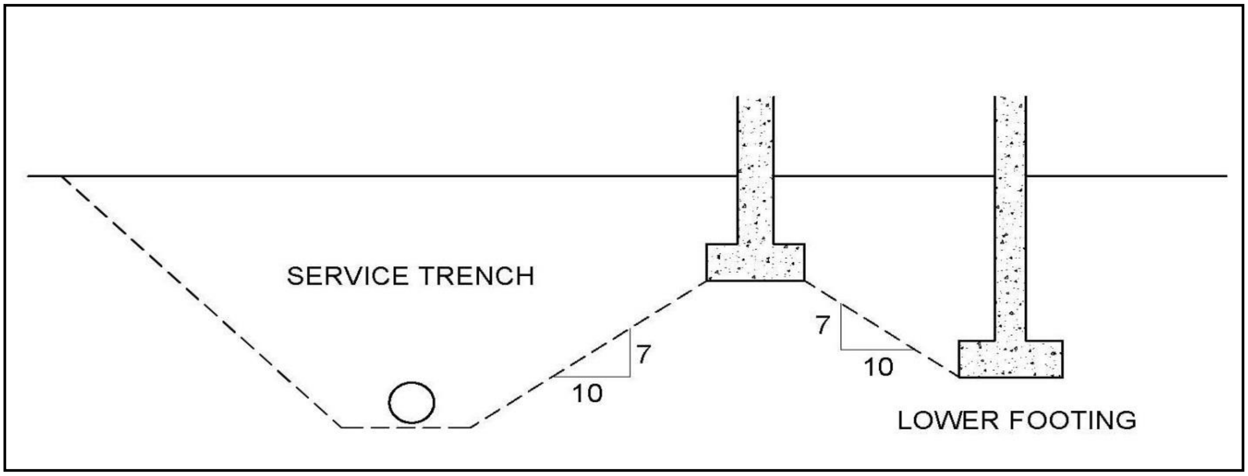


Figure 5-1: Footings near Service Trenches or at Different Elevations

Strip and spread footing widths must comply with the Ontario Building Code minimum requirements.

Foundations bearing on a thickened edge slab-on-grade foundation will not have sufficient earth cover frost protection. As such, insulation will be required as outlined within this report.

5.4 Bedrock to Engineered Fill Transition Zones

Where strip foundations span over bedrock and engineered fill overlying bedrock, on a specific building site, differential settlement could occur. As such, the transition must be treated accordingly. Note that pad foundations must not be founded over transitions and must lie directly on the bedrock or on engineered fill overlying bedrock.

Strip foundations spanning over a transition should be reinforced. In addition, reinforcement should be included in the foundation wall. Should poured foundation walls not be envisioned, all masonry walls must be constructed with appropriate joint reinforcement. Control joints should be further incorporated in the structure at the transition zone.

6. Floor Slab-on-Grade

Floor slab-on-grade construction will be possible at this site provided that all fill, organics and other deleterious materials are removed down to bedrock or competent approved native soils. The subgrade soils should be proof-roll compacted in the presence of EXP prior to placing any engineered fill. Any soft areas encountered during proof-rolling should be excavated and replaced with Granular “B” Type I or II (OPSS 1010) material. Once the native ground surface is prepared, all required up-fill material is to consist of Granular “B” Type I or II (OPSS 1010). If wet soil conditions are present, a non-woven geotextile separator (Terrafix 270R or equivalent) is to be used between the subgrade soils and the Granular “B” material to stabilize the native soils. A final 300 mm thick layer of 19 mm minus clearstone (OPSS 1004) or Granular “A” (OPSS 1010) should be placed directly below the floor slab-on-grade combined with an appropriate moisture barrier, such as a polyethylene membrane, where required. All fill material should be placed in maximum 150 mm thick lifts and be compacted to 100% of the SPMDD (Standard Proctor Maximum Dry Density) within 2% of the optimum moisture content.

7. Site Classification for Seismic Response

The Ontario Building Code (OBC) has adopted the National Building Code of Canada requirements for seismic design considerations. The Site Classification for Seismic Response has been estimated based on the assumption that all foundations will be founded on bedrock or engineered fill overlying bedrock. As the Site Classification for Seismic Response is based on soil conditions in the upper 30 m, assumptions were made by EXP for the anticipated site conditions.

Based on EXP’s assumptions, the site is classified as Site Class C as per the OBC clause 4.1.8.4, Site Properties and Table 4.1.8.4 A, Site Classification for Seismic Response.

These earthquake/seismic design parameters should be reviewed in detail by the structural engineer and incorporated into the design as required. As this site class is based on an assumption of the soil conditions below the borehole termination depths, the site class may not be sufficient, and it may result in an overdesign of the structure.

If a precise Site Classification is required, EXP can provide a quote to perform the necessary testing.

8. Frost Considerations

The freezing index in the Rosseau area is approximately 900 C degree-days. There is potential for up to 1.8 m of frost penetration to occur over the winter months in unprotected. In non-frost susceptible conditions, pending site review, the potential for frost penetration can be lowered to 1.8 m in unprotected areas. There is a potential for up to 1.5 m for heated structures. For foundations directly founded on bedrock, frost protection of the footing is not required, provided there is no opportunity for entrapment of surface water within the foundation area where the water surface would be less than 1.5 m depth below final grade .

As such, foundations for unheated structures should be provided with a minimum of 1.8 m (or 1.5 m pending geotechnical review of the sites) of earth cover frost protection and heated structures should be provided with 1.5 m of earth cover frost protection. Note that to be considered a heated structure; the building must be maintained continuously at a minimum temperature of 18°C. If this will not occur, the building/structure shall be considered unheated.

If sufficient earth cover frost protection is not provided for the foundations, insulation would be required. Insulation should consist of rigid extruded polystyrene, have a minimum compressive strength of 275 kPa, and an R-Value of 5 for every 25.4 mm of thickness, (i.e. Styrofoam HI 40). Any exposed insulation is to be protected against sunlight and physical damage. A rough estimate for cost evaluation purposes can be made by assuming that 25.4 mm of rigid insulation designed for below grade installation is equivalent to 300 mm of soil cover. Note that insulation for heated structures should be placed both horizontally and vertically along the outside edge of the foundation. Insulation for unheated structures must extend below the entire foundation.

Detailed insulation recommendations can be provided by EXP, if necessary, once the final foundation designs have been determined.

9. Backfill

All imported backfill material used to backfill foundation walls should consist of Granular "B" Type I or Granular "B" Type II (OPSS.MUNI 1010) material, with a maximum aggregate size not exceeding 120 mm. The Granular "B" material must be placed in lifts no greater than 150 mm in thickness and must be compacted to 98% of the SPMDD. Care must be taken to ensure damage to the foundation walls does not occur.

10. Drainage

The exterior grade around buildings should be sloped away from the walls to prevent surface runoff from entering the building. Permanent perimeter weeping tile should be installed where any floor is less than 150 mm above final grade and is required to be dry, unless site conditions consist of a minimum of 2.0 m or engineered rock fill below the foundations (properly sloped to promote runoff away from the footings). Perforated drainage tile must be placed at the base of the footings to drain the foundation wall backfill. The drainage tile, with appropriate filter sock, should have a minimum diameter of 100 mm and be surrounded by well-draining filter material. The filter material, if open graded, should be surrounded with a non-woven geotextile. The perforated drainage tile should drain to a suitable drainage area or interior sump. All subsurface walls should be adequately damp-proofed above the water table and waterproofed below the water table. The roof drains should discharge away from the building to appropriate drainage areas.

11. Pavement Structure Design Recommendations

11.1 Pavement Structure Analysis Methodology

Pavement structure analysis was undertaken using The Routine (Empirical) Design Method following the guidelines provided in the MTO "Pavement Design and Rehabilitation Manual (PDRM)". The Routine (Empirical) Design Method is based on the concept of a Granular Base Equivalency (GBE), which relates the structural contribution of various pavement materials to an equivalent Granular "A" thickness. A target GBE value is selected based upon the anticipated AADT (Average Annual Daily Traffic) and the in-situ native soils conditions. The contribution of various pavement materials is shown below on the table below.

Material	Equivalency Factor
New or Recycled Asphalt	2.0
New Base (Granular "A")	1.0
New Subbase (Granular "B")	0.67

11.2 Recommended Pavement Structure

The AADT for the new subdivision has been assumed by EXP to be less than 1,000, with truck traffic assumed to account for less than 10% of the AADT. As such, in order to comply with the recommendations in the PDRM, and with an assumed worst case native silt subgrade with 40-55%. material between 5 and 75 µm, a target GBE of 440 is considered appropriate.

The following pavement structure is recommended for the proposed roadway based on Table 3.3.2 and 3.3.3 of the PDRM. As recommended in the PDRM, modifications must be made to account for deep frost penetration and marginal soil conditions in Northern Ontario. As such, granular depths should be no less than those for 3000-4000 AADT. The recommended pavement structure is outlined on the table below.

Material	Thickness	Equivalency Factor	GBE
Asphalt	40 mm Surface (SP12.5) 50 mm Binder (SP19)	2.0	180
Base	150 mm	1.0	150
Subbase	600 mm	0.67	402
TOTAL	**840 mm**	--	**732**

As noted, the resulting GBE of 732 far exceeds the target GBE of 440 and as such, the recommended pavement structure is considered adequate.

The subbase thickness noted above can be reduced to 300 mm where bedrock is present or where blast rock fill is used raise subgrade elevations overlying bedrock.

It is understood that asphalt may not be form part of the road development. As such the below alternative gravel surface road design has been provided should asphalt not be utilized, and is considered equivalent.

Material	Thickness	Equivalency Factor	GBE
Base	300 mm	1.0	300
Subbase	600 mm	0.67	402
TOTAL	**840 mm**	--	**702**

A conventional asphalt pavement structure as noted above will typically have a functional service life of 12 years provided adequate subgrade support and proper drainage is available. This represents the number of years to the first rehabilitation (via overlay or resurfacing), assuming that regular maintenance and crack sealing is completed. Subsequent resurfacing is typically expected to last at least 10 years.

11.3 Subgrade Preparation

The long-term performance of pavement is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved.

All topsoil, organics, or other deleterious materials are to be removed below the proposed roadways. Prior to the placement of any engineered fill, the subgrade must be properly shaped, crowned (a minimum of 3%), and proof-rolled in the presence of a qualified geotechnical engineer to ensure uniform conditions. Should soft or spongy areas be encountered, these areas should be sub-excavated and the material replaced with Granular “A” or Granular “B” Type II.

General upfill below the proposed pavement structure should consist of Granular “B” Type I or II or Select Subgrade Material (SSM). Alternatively, where the site consists mainly of shallow bedrock and blasting will be undertaken, a well graded blast rock/crushed rock fill material ranging from 300 mm to 450 mm in size may be used to raise grades to the design road subbase elevation. The 300 mm to 450 mm minus rock is to be placed in lifts not exceeding 600 mm and must be chinked in place with a heavy tracked machine.

The most severe loading conditions on the pavement subgrade usually occur during construction. Consequently, special provisions, such as additional granular subbase, may be required, especially if construction is completed during unfavourable weather conditions.

Where the subgrade soils are wet or soft, or chinking of the rock fill materials is inadequate, it may be necessary to place a geotextile over the exposed subgrade/subgrade fill.

11.4 Drainage

To ensure pavement structure performance and maximum life expectancy, the need for adequate drainage cannot be overemphasized. The finished pavement surface and underlying subgrade must be sloped to provide effective drainage towards the proposed drainage system (i.e., curb, catchbasins, ditching, and/or subdrains). Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Any ditching inverts should be at least 0.5 m below the bottom of the subbase layer.

Subdrains can be placed along the full length of the roadway to provide additional drainage, if necessary. The subdrains should consist of 150 mm diameter rigid slotted plastic pipes and should be completely surrounded with a minimum of 50 mm of 19 mm minus Clear Stone gravel (OPSS 1004). The Clear Stone gravel is to be completely wrapped with a non-woven geotextile (Terrafix 270R or equivalent) to prevent any materials from migrating into the Clear Stone.

In blast rock fill areas, where a minimum of 1.0 m of rock fill is present overlying bedrock, the subdrains may be omitted, provided the bedrock is properly sloped to promote drainage and prevents standing water from occurring.

11.5 Material Requirements

Asphalt

The surface asphalt placed as part of this project should consist of superpave mixes consisting of a SP1.25 and binder asphalt should consist of SP19.0.

The surface asphalt should be placed in a single compacted 40 mm thick lift and binder asphalt should be placed in a single compacted 50 mm thick lift. All asphalt shall be in accordance with OPSS 1150 (HL mixes) or OPSS 1151 (Superpave Mixes). Placement and compaction of the asphalt shall be in accordance with OPSS 310.

Granular Materials

The granular base material should consist of Granular “A” in accordance with OPSS.MUNI 1010. Although a 60% crushed Granular “A” material may be used as specified in OPSS 1010, EXP recommends the Granular “A” material be 100% crushed, as this material will enhance drainage and offer better structural support.

Subbase material should consist of Granular “B” Type I or Type II in accordance with OPSS.MUNI 1010. Granular “B” Type II is preferred as it offers increased stability, easier placement, and compaction, and is readily available in the area, however Granular “B” Type I can be used, however additional compaction effort will be required as well as the addition of water to achieve the required compaction.

All roadway granular material should be placed full width in maximum 200 mm thick lifts and compacted to 98% of the Standard Proctor Maximum Dry Density (SPMDD) within 1.5% of optimum moisture content.

Horizontal Transition Treatment

Where subgrade materials below the pavement structure transition from one soil/rock type to another, transition treatments to mitigate differential settlement should be incorporated as outlined in OPSD 205.010 to 205.050, as included in Appendix D.

12. Buried Service Recommendations

Recommendations for proposed buried services are included in the following sections.

12.1 Frost Protection

Protection against freezing is an integral part of a sewer and water system design. The standard solution calls for burying the top of the utility lines in the ground below the anticipated frost penetration depth (1.8 m in Rosseau). Where this cannot be achieved, an alternate solution involves incorporating rigid polystyrene insulation (i.e., Styrofoam HIGHLOAD-40), which can be used to reduce the depth of trench required. The two design configurations frequently used are horizontal placement, and the inverted “U”. Both of these methods require suitable design, as well as correct construction procedures. Installing insulation does not alter conventional utility line construction practice to an appreciable extent. However, in some cases, a wider trench may be required to accommodate the horizontal layer of insulation. Another option is to use pre-insulated pipe.

A rough estimate for cost evaluation can be made by assuming that 25 mm of rigid insulation designed for below grade installation is equivalent to 300 mm of soil cover. This and any other design values should, however, be confirmed with the insulation manufacturer.

Maintaining compatibility with adjacent subgrade conditions should minimize annual differential frost heaving. This is usually accomplished by backfilling the service trenches with materials matching the surrounding soils. Another approach to minimizing the annual differential heaving of subgrade soil is to construct frost tapers in conformance with OPSD 803.030 and/or 803.031 included in Appendix D. The same amount of heaving will occur whether a frost taper is installed, or the trench is backfilled with excavated material. However, the heaving of a frost taper is spread across the length of the taper causing the differential heaving to be less abrupt.

12.2 Pipe Embedment and Bedding

All fill materials, organics, and deleterious material are to be removed down to competent native soils or bedrock prior to placement of the bedding material. Pipe bedding requirements as outlined in the OPSD 802.010, and 802.013 for flexible pipes and OPSD 802.031, 802.032 and 802.033 for rigid pipes (included in Appendix D) will be sufficient for sanitary, storm and watermain pipes. The pipe bedding should consist of a Clear Stone gravel (OPSS 1004) or Granular “A” material (OPSS.MUNI

1010) with a minimum thickness of 150 mm beneath the pipe and raised to the pipe springline. The granular bedding should be placed in lifts not exceeding 150 mm and compacted to 98% of the material's SPMDD. Particular care should be taken when compacting beneath the pipe haunches. The cover material should consist of a compacted sand material with no sizes greater than 25 mm or a Granular "A" material.

Bedding thicknesses may be increased in areas where the native soil base supporting the bedding is wet, or subject to disturbance. Where soft or loose base conditions are encountered below the water table, base stabilization may be required. This may include the placement of crushed stone sub-bedding, wrapped in a non-woven geotextile, to prevent base disturbance and to allow the removal of water through standard filtered sump and pump methods.

If construction proceeds during the winter months, the base and sides of the trenches, as well as all fill materials, should not be allowed to freeze.

12.3 Excavated Soil and Trench Backfill

It is typical practice in Northern Ontario to re-use a portion of the in-situ excavated native material as fill within exterior (outside) trench utility services, especially where these trenches interrupt traveled sections of a roadway. This is to ensure compatibility with adjacent subgrade soils to minimize annual differential frost heaving.

The non-organic material from the service trench excavation may be re-used as random fill above the top of the pipe cover material to the underside of the pavement structure subbase materials. All re-used materials must be placed in lifts not exceeding 200 mm and be compacted to 95% of the SPMDD within 2% of the optimum moisture content. EXP cautions that any native material below the groundwater level may not meet the above compaction requirements without significant reworking and drying prior to placement. If stockpiling of trench excavated material for re-use is required, it is recommended that it be covered to prevent exposure to rain and it cannot be allowed to freeze. All unsuitable materials from the trench excavation not reused must be disposed of off-site.

Where, trench excavation is completed within areas of blasted rock or engineered rock fill, a geotextile separator may not be required, however, this can be confirmed following an inspection based on field conditions.

Any excavated material contaminated with organics must not be re-used as backfill material. This material may be re-used for general landscaping purposes, provided it is environmentally safe to do so. It is also recommended that any blast rock fill material not be used as trench backfill.

12.4 Lateral Earth Pressure

Any foundations or retaining structures should be designed to resist lateral earth pressure. The expression for calculating lateral earth pressure "p" at any depth "h" is given by the following:

$$\mathbf{p = K(\gamma h + q) + \gamma_w h_w}$$

where p = Lateral earth pressure (kPa)
K = Coefficient of earth pressure
γ = Unit weight of backfill (kN/m^3)
γ_w = Unit weight of water (kN/m^3)
h = Depth to point of interest (m)
h_w = Depth of water above point of interest (m)
q = Surcharge load acting adjacent to the wall at the ground surface (kPa)

The below tables list various earth pressure properties for given materials.

Table 6-1: Material Types and Earth Pressure Parameters

Material	Friction Angle ø´ (unfactored)	Coefficient of Active Earth Pressure (k_a)	Coefficient of Passive Earth Pressure (k_p)	Coefficient of Earth Pressure at Rest (k_o)	Unit Weight γ (kN/m^3)
Granular "A"	38°	0.24	4.2	0.38	22
Granular "B" Type I	35°	0.27	3.7	0.43	21
Granular "B" Type II	38°	0.24	4.2	0.38	21

Note: Values given for horizontal earth pressures are for horizontal backfill. For sloping backfill, the design requirements outlined in the Canadian Foundation Engineering Manual should be used.

The mobilization of full active or passive resistance requires a measurable and perhaps significant wall movement or rotation. Therefore, unless the structural element can tolerate these deflections, the at-rest earth pressure should be used in design.

The effects of compaction surcharge should be taken into account in the calculations of active and at rest earth pressures. The lateral pressure due to compaction should be taken as at least 12 kPa at the surface, and its magnitude should be assumed to diminish linearly with depth to zero at the depth where the active (or at rest) pressure is equal to 12 kPa. This pressure distribution should be added to the calculated active (or at rest) pressure. Notwithstanding, lighter compaction equipment and smaller lifts should be used adjacent to walls to prevent overstressing.

13. Excavations

Any encountered in-situ native soils may be classified as Type 3 soils for excavations terminating above the groundwater level in conformance with the Ontario Occupational Health and Safety Act (OHSA). Temporary excavation side slopes in Type 3 soils should remain stable at a slope of 1H:1V. The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zone are encountered, should not be overlooked.

For the encountered bedrock, the method selected for excavation will depend on the local block size and degree of weathering of the rock. In areas where weathering is not present, explosives will likely be required to break or to loosen the rock. Hoe Ramming may be used where minimal rock removal is required.

Water (i.e., surface water runoff) should not be permitted to enter and/or pond within the construction area.

All excavations must be completed in accordance with the most recent regulations in the Ontario Occupational Health and Safety Act. The contractor should be aware that slope height, slope inclination, or excavation depths, should in no case, exceed those specified in local, provincial or federal safety regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor or earthwork or utility subcontractor could be liable for substantial penalties.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the assumption of shallow deposits of materials between any current bedrock outcrops. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that EXP be contacted immediately to evaluate the conditions encountered.

13.1 Re-Use of Excavated Material

Re-use of excavated material is possible for trench backfill to match adjacent soil conditions provided the material is within +/-2% of optimum moisture content. As the upper materials are generally free draining, they can be stockpiled on site and re-tested prior to re-use. Provided the materials contain less than 8% fines, they can be considered as free draining.

Alternatively, excavated materials may be used for general landscaping purposes on site provided it is environmentally safe to do so.

Any soils being removed from the site, must comply with the excess soil regulations (O.Reg. 406/19). While it is the responsibility of the source site to ensure soil exported off-site for reuse is suitable for the intended receiving site, it is highly recommended that the receiving site conduct an independent review of the analytical results to confirm the suitability of the soil to be reused at the specific receiving site.

14. Dewatering

Dewatering for the general construction of the residential units located overlying bedrock is not anticipated. Any potential perched water above the water table should be possible to remove using conventional construction pumps. Should excavations for the buildings be required to extend into the water table, extensive dewatering may be required to maintain the groundwater a minimum of 1.5 m below excavation depth.

Although groundwater was not encountered during the short term of our investigation, groundwater in perched conditions between bedrock ridges must not be overlooked. Dewatering requirements will be governed by the time of the year the construction is performed. It is the responsibility of the Contractor to propose a suitable dewatering system based on the time of construction and groundwater levels. The method used should not undermine any adjacent structures or buried services. The dewatering method is the responsibility of the Contractor and the Contractor should submit his proposal to the Prime Consultant for review and approval prior to construction.

Should extensive dewatering be required a hydrogeological investigation may be required to support the potential requirement for a permit to take water.

15. Construction Quality Control

Construction quality control of the “earthworks” should be provided throughout the project by a representative of EXP to verify all design assumptions, recommendations and confirmation of the subsurface soil conditions. This includes inspection of the excavation and subgrade prior to the placement of any structural fill and foundations, to ensure that any and all deleterious materials have been removed and to ensure that the actual conditions are not markedly different than those on which the recommendations made herein are based. Compaction control of structural fill is also recommended as standard practice, as is sampling and testing of aggregates and concrete.

16. Design Review

The recommendations made in this report are considered preliminary and in accordance with our present understanding of the project and are provided solely for the design team responsible for the project. If there are any changes, such as relocation of any structures or other features which may affect our analysis, the information obtained during this investigation may be inadequate and additional field work and reporting may be required.

EXP Services Inc. should be retained to review the final design and specifications to confirm that we are in general agreement with the assumptions on which our recommendations are based. If not accorded the privilege of making this review, EXP will assume no responsibility for interpretation of the recommendations in this report.

17. Limitations

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered that differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations.

Whereas this investigation has estimated the groundwater level at the time of the fieldwork, and commented on general construction problems, the presence of conditions, which would be difficult to establish from our test holes, may affect the type and nature of dewatering procedures which should be used in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile between the tests, and thin layers of soil with large or small permeabilities compared with the general soil mass, etc.

The comments given in this report are intended only for the guidance of the design team responsible for the project. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., could be greater than has been carried out for preliminary design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual test hole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The investigation and comments are necessarily ongoing as new information of underground conditions becomes available. For example, more specific information is available with respect to in-situ subsurface conditions between test locations once construction is underway. Subsurface soil interpretation between test holes, as well as the recommendations of this report, should be verified through field inspections provided by EXP to validate the current information for use during the construction stage.

Virtually no scope of work, no matter how exhaustive, can identify all contaminants or all conditions above or below ground. For example, conditions elsewhere on the property may differ from those encountered, and conditions may change with time. Therefore, no warranty is provided that the entire site condition is represented by those identified at specific borehole locations.

18. Closure

We trust that these comments provide you with sufficient information to proceed with design. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

EXP Services Inc.

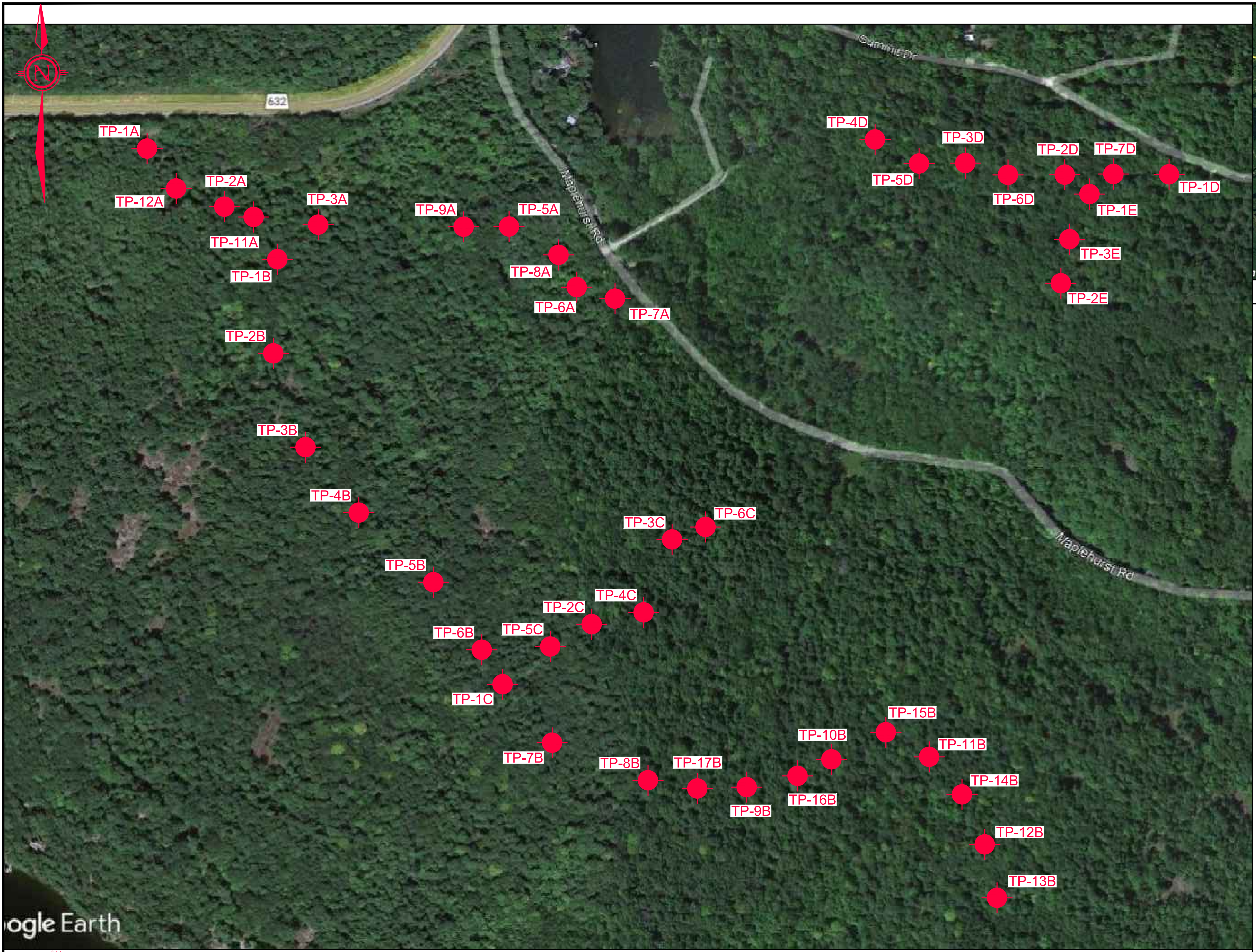
LICENSED PROFESSIONAL ENGINEER
Y. Beauparlant
100060114
PROVINCE OF ONTARIO

Yves Beauparlant

Yves Beauparlant, P.Eng.
Manger, Earth & Environmental Services
Northeastern Ontario

For: Andy Schell, M.Sc., P.Eng.
Senior Geotechnical Engineer
Northeastern Ontario

Appendix A - Drawings



KEYPLAN - N.T.S.

LEGEND

● EXP TEST PIT

– NOTES –

1) The boundaries and soil types have been established only at Test Hole locations. Between Test Holes, they are assumed and may be subject to considerable error.

2) Do not use Test Hole elevations for design purposes.

3) Soil samples will be retained in storage for 3 month and then destroyed unless client advises that an extended time period is required.

4) Quantities should not be established from the information provided at the Test Hole locations.

5) This drawing forms part of the report, project number as referenced, and should be used only in conjunction with this report.

EXP Services Inc.
Sudbury Branch
t: +1.705.674.4401 | f: +1.705.674.5583
885 Regent Street
Sudbury, ON P3E 5M4
Canada

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REVISIONS

No.	DESCRIPTION	DATE

CLIENT
ROSSEAU SPINGS LIMITED

PROJECT
PROPOSED ROSSEAU SPRINGS RESIDENTIAL DEVELOPMENT
ROSSEAU, ON

PROJECT NO.
SUD-22025423-A0

TITLE:
TEST PIT LOCATION PLAN

DATE
NOVEMBER 2022

SCALE:
NTS

DWG NO.
A-1

Nov 24, 2022 – 11:13am   \\exp\data\SUD\SUD-22025423-A0\60 Execution\65 Drawings\SUD-22025423-A0 – TP LOCATION PLAN.dwg

Appendix B – Test Pit Logs

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	“trace” (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	“some” (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	“and” (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance “N” Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance “N” Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of Test Pit TP-1A

Project No.	SUD-22025423-A0	Figure No.	B-2
Project:	Proposed Rosseau Springs Residential Development	Sheet No.	1 of 1
Location:	Rosseau, ON		

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH ON SUSPECTED BEDROCK						

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-2A

Project No. SUD-22025423-A0
Figure No. B-3
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		BEDROCK AT SURFACE						

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-3A

Project No. SUD-22025423-A0
Figure No. B-4
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		SAND, some silt, brown, moist						
		TEST PIT TERMINATED AT ~ 0.6 m DEPTH DUE TO LIMITED ACCESS FOR EXCAVATOR TO AREA						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-5A

Project No. SUD-22025423-A0

Figure No. B-5

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 26, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		BEDROCK AT SURFACE						

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

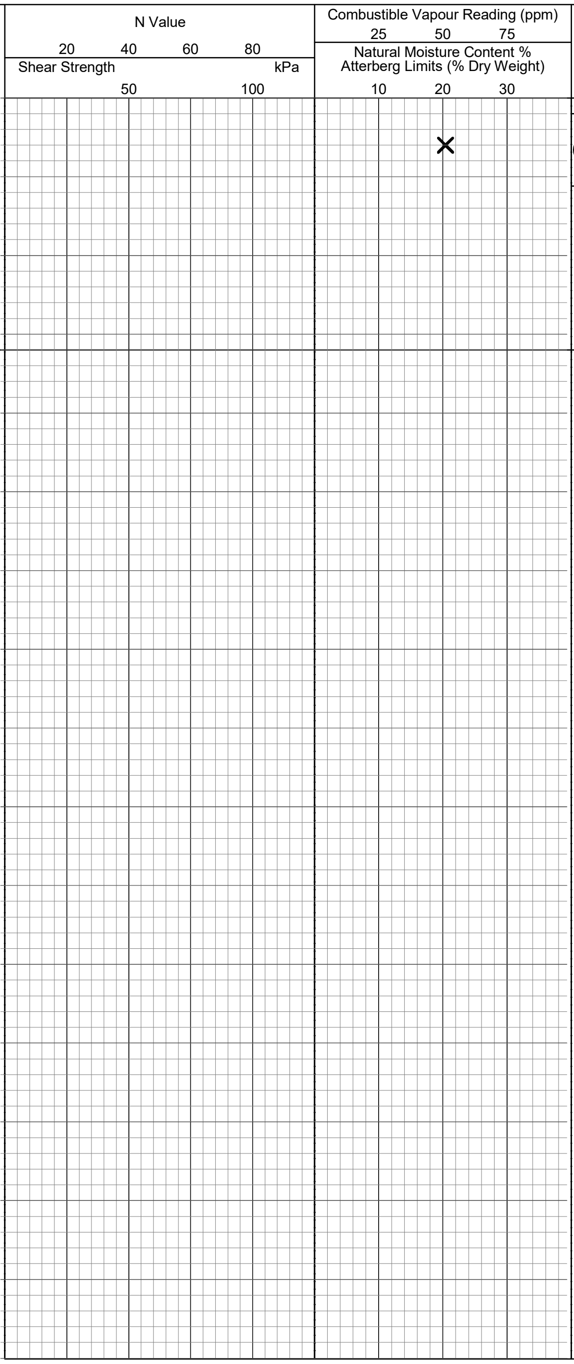
Log of Test Pit TP-6A

Project No. SUD-22025423-A0
Figure No. B-6
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	□
Penetrometer	▲	Natural Moisture	×
Field Vane Test	✚ S	Plastic and Liquid Limit	⊢—○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		SANDY TOPSOIL, ~ 100 mm thick		0		
		SILT, some sand, some boulders, brown to grey, moist			G	
				1		
		sand layer below ~ 1.4 m depth				
		TEST PIT TERMINATED AT ~ 1.6 m DEPTH ON SUSPECTED BEDROCK				



TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

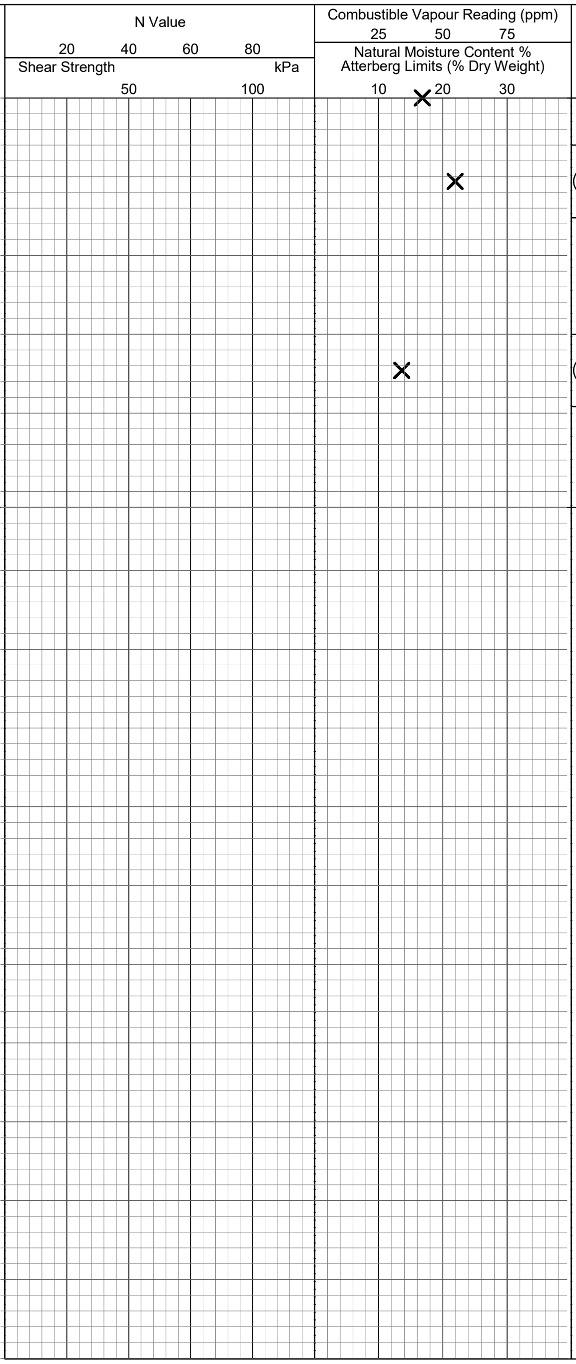
Log of Test Pit TP-7A

Project No. SUD-22025423-A0
Figure No. B-7
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SILTY SAND, some gravel, some boulders, very moist some clay, some silt, trace boulders below ~ 0.6 m depth			G	
				1		
		some boulders, brown to grey, moist below ~ 1.5 m depth			G	
				2		
		TEST PIT TERMINATED AT ~ 2.6 m DEPTH ON SUSPECTED BEDROCK				



EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-8A

Project No. SUD-22025423-A0
Figure No. B-8
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
	▨	**TOPSOIL,** ~ 100 mm thick		0				
	⁚	**SILTY SAND,** brown, moist						
		TEST PIT TERMINATED AT ~ 0.3 m DEPTH ON SUSPECTED BEDROCK						

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-9A

Project No. SUD-22025423-A0
Figure No. B-9

Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	🄶	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├──○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		SAND, some silt, trace gravel, dark brown, wet to moist		0				
		TEST PIT TERMINATED AT ~ 0.5 m DEPTH DUE TO LIMITED ACCESS FOR SHOVEL						

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-11A

Project No. SUD-22025423-A0
Figure No. B-10

Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH ON SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-12A

Project No. SUD-22025423-A0
Figure No. B-11
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		SILT, dark brown, wet						
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist				✕	G	S2
				1				
		TEST PIT TERMINATED AT ~ 1.2 m DEPTH ON SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-1B

Project No. SUD-22025423-A0 Figure No. B-12

Project: Proposed Rosseau Springs Residential Development Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH ON SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-2B

Project No. SUD-22025423-A0

Figure No. B-13

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist to wet						
		TEST PIT TERMINATED AT ~ 0.9 m DEPTH DUE TO SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-3B

Project No.	SUD-22025423-A0	Figure No.	B-14
Project:	Proposed Rosseau Springs Residential Development	Sheet No.	1 of 1
Location:	Rosseau, ON		

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├─○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH DUE TO SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-4B

Project No. SUD-22025423-A0
Figure No. B-15
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	□
Penetrometer	▲	Natural Moisture	×
Field Vane Test	✚ S	Plastic and Liquid Limit	├─○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick TEST PIT TERMINATED AT ~ 0.1 m DEPTH DUE TO SUSPECTED BEDROCK		0				

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-5B

Project No. SUD-22025423-A0

Figure No. B-16

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	⊢—○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH DUE TO SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

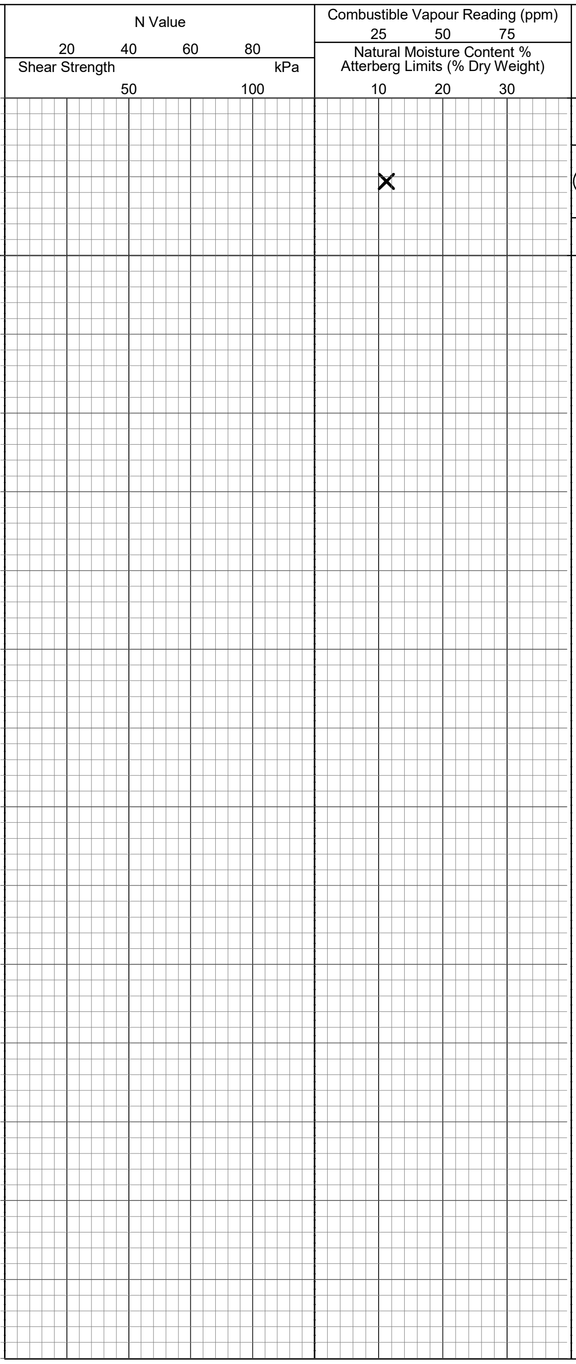
Log of Test Pit TP-6B

Project No. SUD-22025423-A0
Figure No. B-17
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist			G	
		TEST PIT TERMINATED AT ~ 1.0 m DEPTH DUE TO SUSPECTED BEDROCK		1		



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-7B

Project No.	SUD-22025423-A0	Figure No.	B-18
Project:	Proposed Rosseau Springs Residential Development	Sheet No.	1 of 1
Location:	Rosseau, ON		

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.3 m DEPTH DUE TO SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

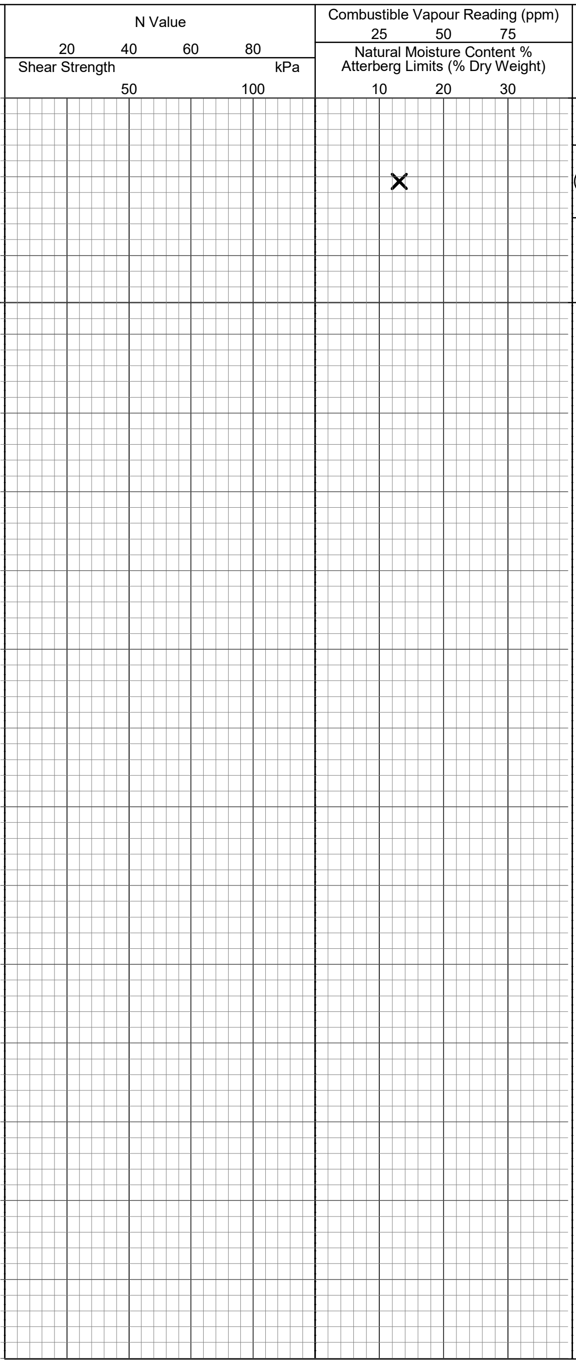
Log of Test Pit TP-8B

Project No. SUD-22025423-A0
Figure No. B-19
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders and cobbles, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.3 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-9B

Project No. SUD-22025423-A0

Figure No. B-20

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

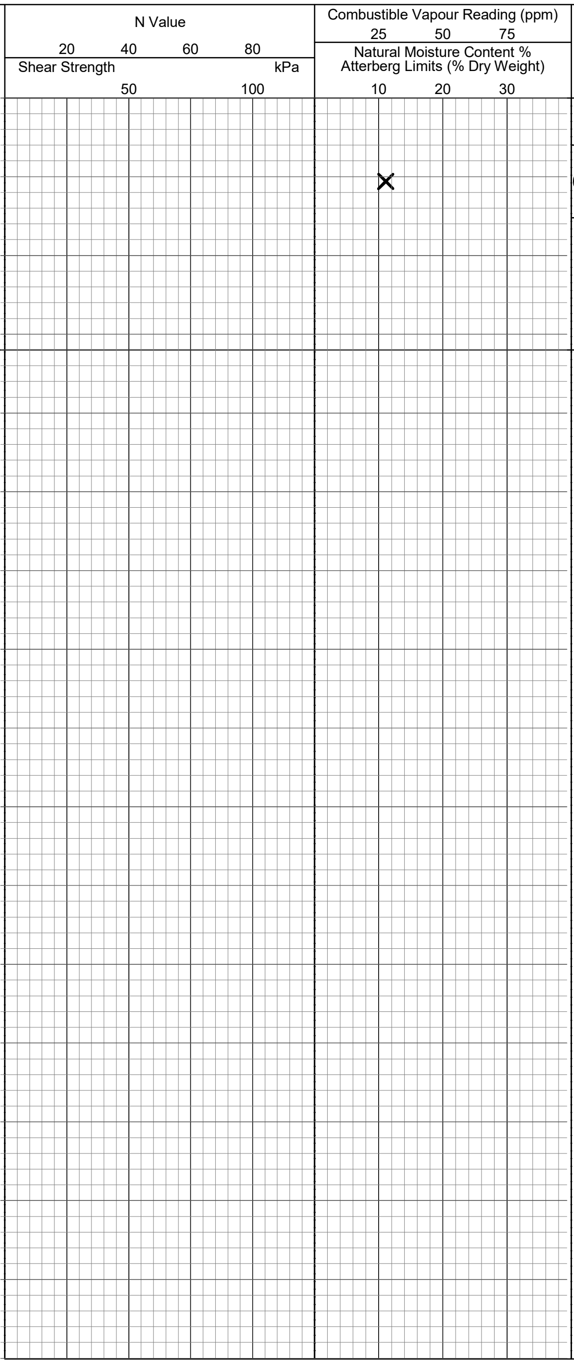
Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.6 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-10B

Project No. SUD-22025423-A0
Figure No. B-21
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├──○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength 50 100 kPa	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, some boulders, dark brown, moist						
		TEST PIT TERMINATED AT ~ 0.5 m DEPTH DUE TO SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

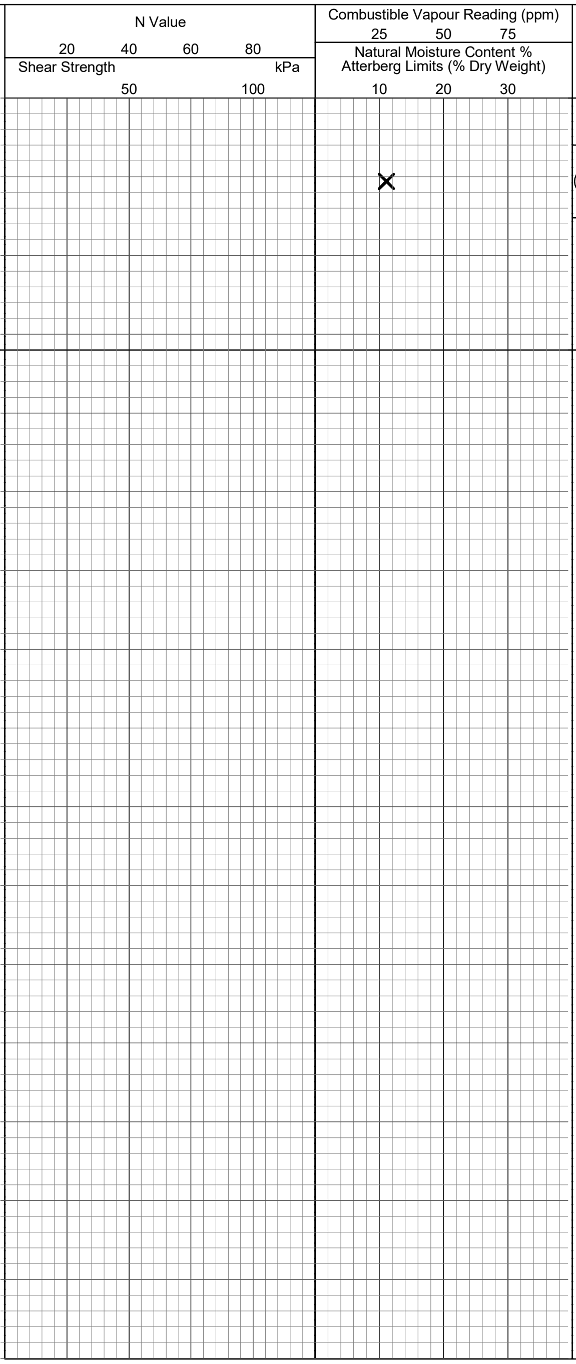
Log of Test Pit TP-9B

Project No. SUD-22025423-A0
Figure No. B-20
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

G W L	S Y M B O L	Soil Description	ELEV. m	D E P T H	S A M P L E S	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.6 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-10B

Project No. SUD-22025423-A0

Figure No. B-21

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 26, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, some boulders, dark brown, moist						
		TEST PIT TERMINATED AT ~ 0.5 m DEPTH DUE TO SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-11B

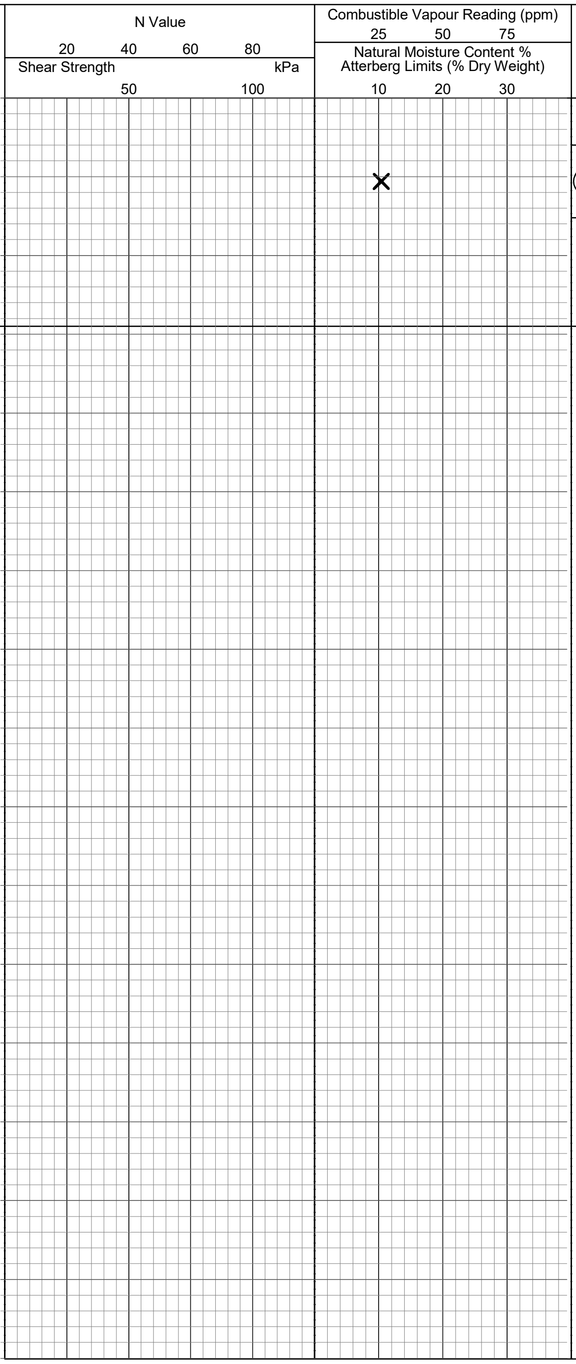
Project No. SUD-22025423-A0
Figure No. B-22
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample G
Penetrometer ▲
Field Vane Test ✚ S

Combustible Vapour Reading ☐
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.5 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

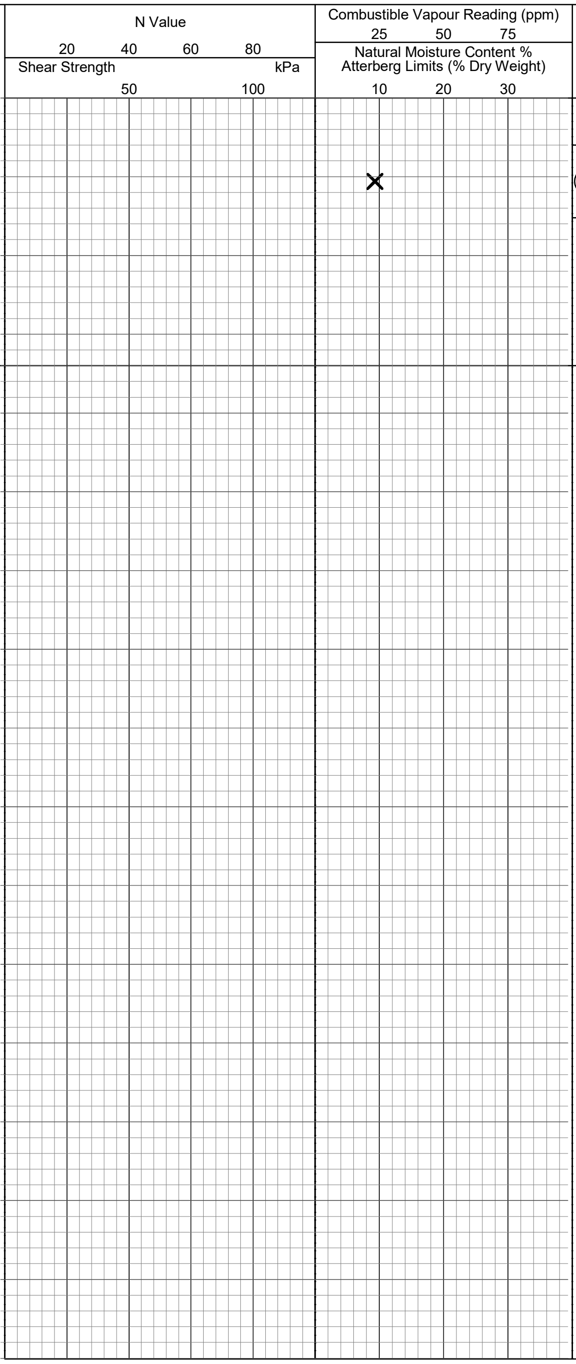
Log of Test Pit TP-12B

Project No. SUD-22025423-A0
Figure No. B-23
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	□
Natural Moisture	×
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 350 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.7 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

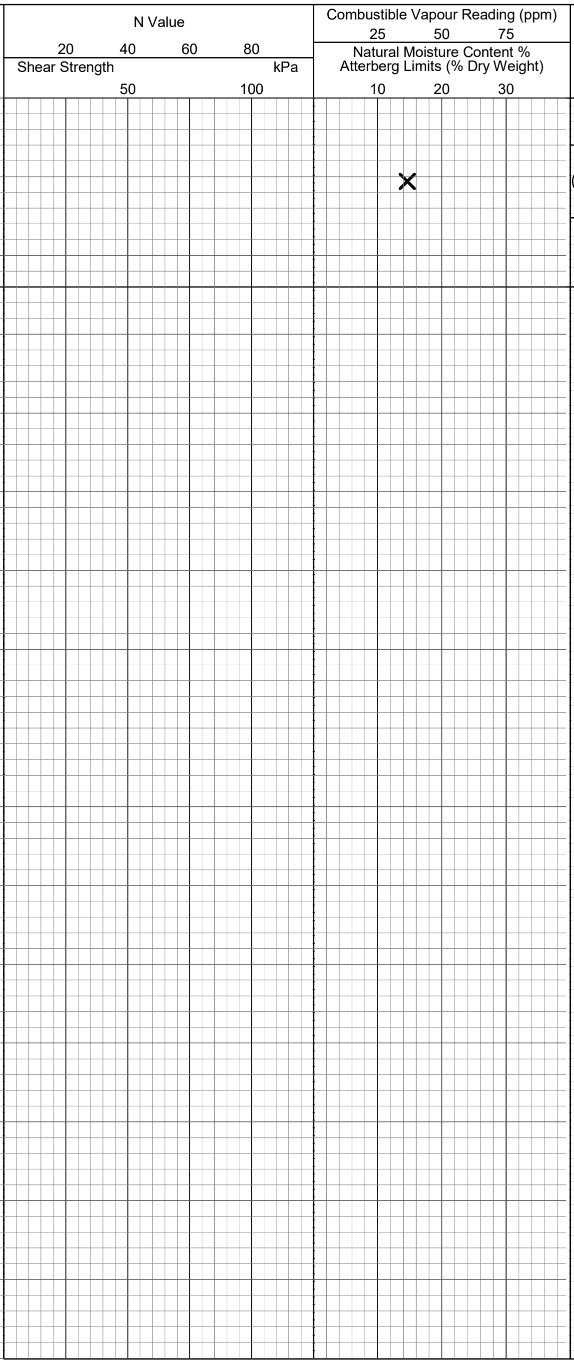
Log of Test Pit TP-13B

Project No. SUD-22025423-A0
Figure No. B-24
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist			G	
				1		
		TEST PIT TERMINATED AT ~ 1.2 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

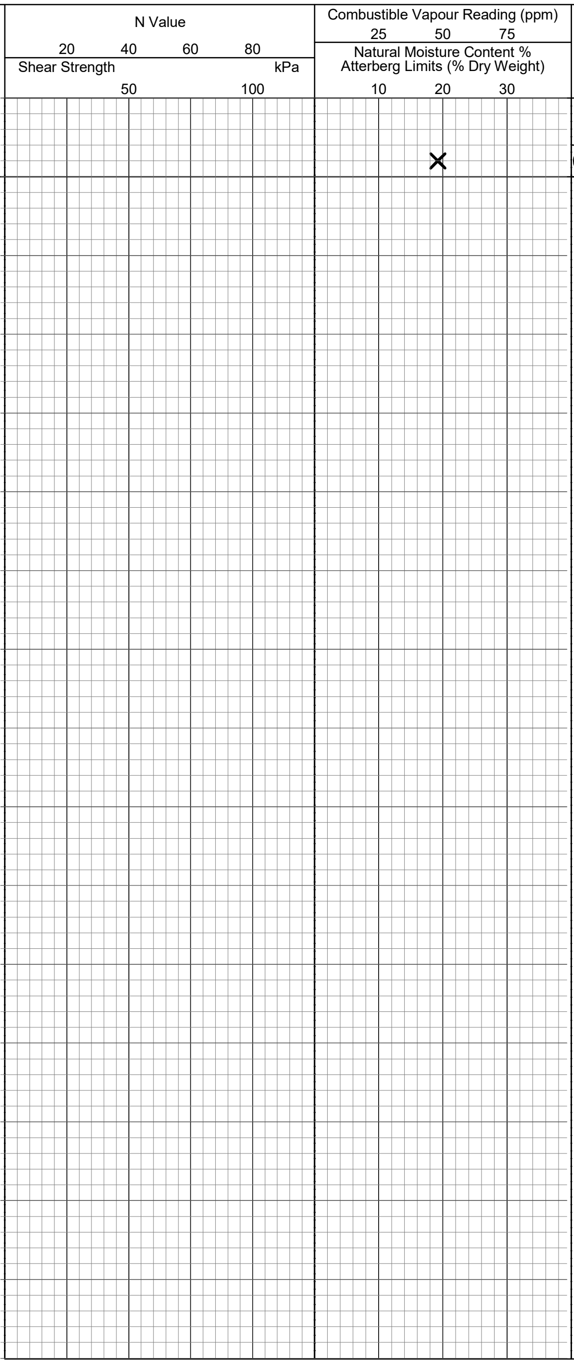
Log of Test Pit TP-14B

Project No. SUD-22025423-A0
Figure No. B-25
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 200 mm thick		0		
		SAND, trace silt, trace boulders and cobbles, brown to grey, moist to wet			G	
		TEST PIT TERMINATED AT ~ 0.5 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-15B

Project No. SUD-22025423-A0
Figure No. B-26
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 26, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	×
Field Vane Test	✚ S	Plastic and Liquid Limit	├──○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, some boulders, brown to grey, moist				×	G	
		TEST PIT TERMINATED AT ~ 0.6 m DEPTH DUE TO SUSPECTED BEDROCK						

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Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-16B

Project No. SUD-22025423-A0

Figure No. B-27

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 26, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	🄶
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, some boulders, brown to grey, moist				×	G	
		TEST PIT TERMINATED AT ~ 0.7 m DEPTH DUE TO SUSPECTED BEDROCK						

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-17B

Project No. SUD-22025423-A0

Figure No. B-28

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

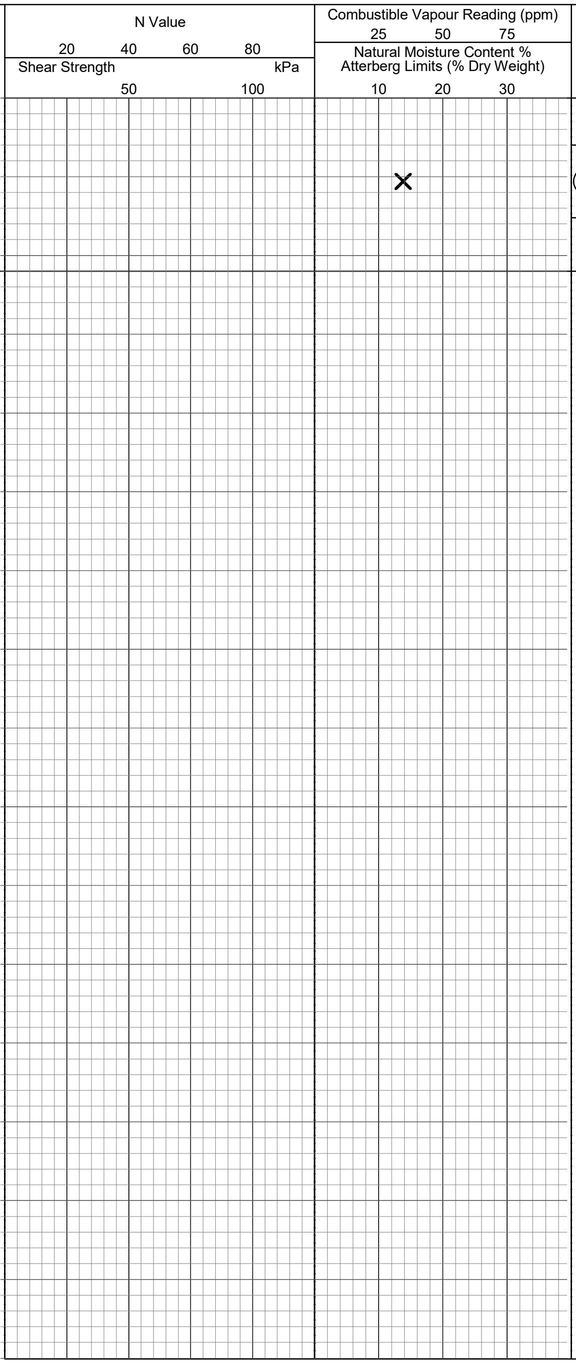
Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, some boulders, brown to grey, moist			G	
				1		
		TEST PIT TERMINATED AT ~ 1.1 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-1C

Project No. SUD-22025423-A0 Figure No. B-29

Project: Proposed Rosseau Springs Residential Development Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├──○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 100 mm thick		0				
		TEST PIT TERMINATED AT ~ 0.1 m DEPTH DUE TO SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-2C

Project No. SUD-22025423-A0

Figure No. B-30

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

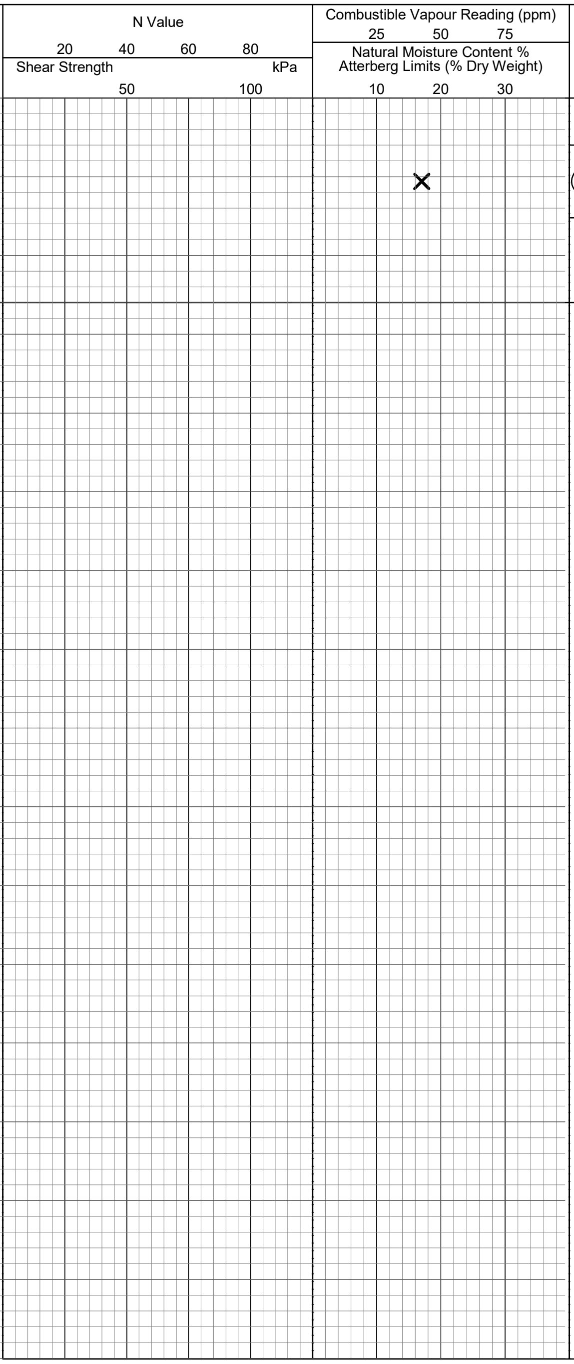
Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	×
Field Vane Test	✚ S	Plastic and Liquid Limit	⊢—○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some silt, trace gravel, trace boulders and cobbles, brown to grey, moist to wet			G	
				1		
		TEST PIT TERMINATED AT ~ 1.3 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-3C

Project No.: SUD-22025423-A0
Figure No.: B-31
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├──○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0				
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist						
		TEST PIT TERMINATED AT ~ 0.9 m DEPTH DUE TO SUSPECTED BEDROCK						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

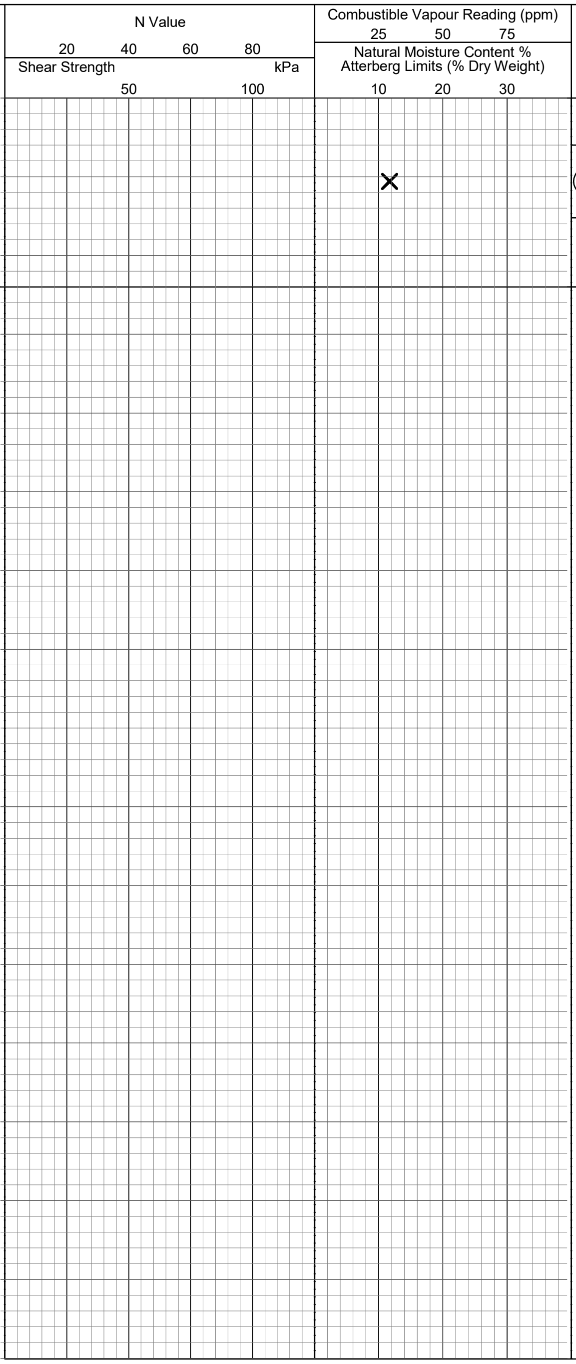
Log of Test Pit TP-4C

Project No. SUD-22025423-A0
Figure No. B-32
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 25, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.2 m DEPTH DUE TO SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

Log of Test Pit TP-5C

Project No. SUD-22025423-A0

Figure No. B-33

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

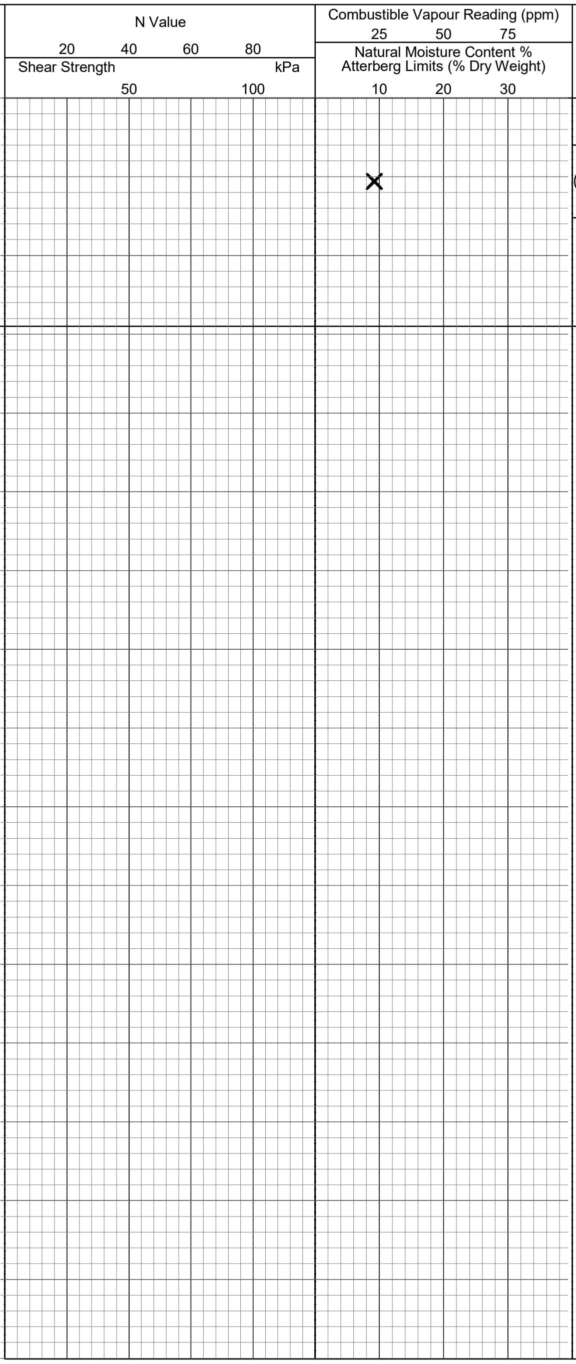
Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some gravel, trace boulders and cobbles, brown to grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.5 m DEPTH DUE TO SUSPECTED BEDROCK				



TESTPIT (GEO) SUD-22025423-A0 - ROSSEAU SPRING GEO.GPJ NEW.GDT 11/24/22

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-6C

Project No. SUD-22025423-A0

Figure No. B-34

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 25, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S

Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		BEDROCK AT SURFACE						

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-1D

Project No. SUD-22025423-A0

Figure No. B-35

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

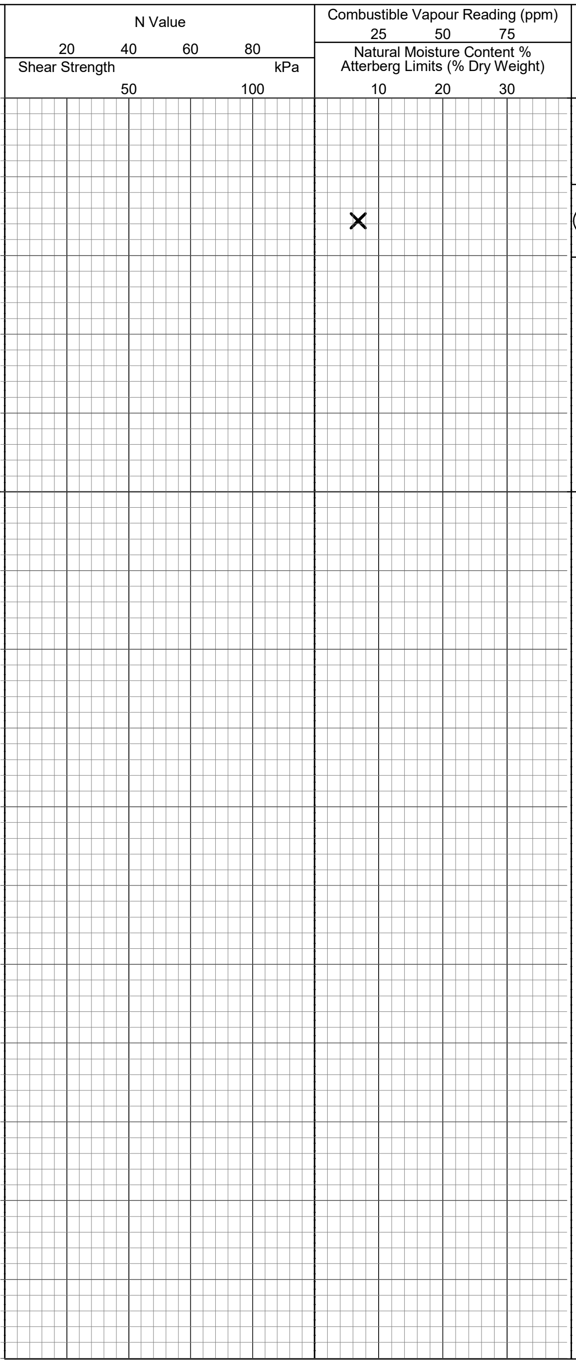
Date Excavated: October 24, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, ~ 300 mm thick		0		
		SAND, some silt, some gravel, trace boulders and cobbles, brown some silt, light brown, dry to moist below ~ 0.6 m depth		1 2	G	
		TEST PIT TERMINATED AT ~ 2.5 m DEPTH ON SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-2D

Project No. SUD-22025423-A0 | Figure No. B-36
Project: Proposed Rosseau Springs Residential Development | Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 200 mm thick		0				
		SAND, some gravel, trace boulders and cobbles, brown to grey, dry to moist		1				
		TEST PIT TERMINATED AT ~ 2.0 m DEPTH DUE TO RESISTANCE ON SUSPECTED BEDROCK		2				

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-3D

Project No. SUD-22025423-A0
Figure No. B-37
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G	Combustible Vapour Reading	☐
Penetrometer	▲	Natural Moisture	✕
Field Vane Test	✚ S	Plastic and Liquid Limit	├─○
		Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength 50 100 kPa	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, ~ 200 mm thick		0				
		SAND, some gravel, trace boulders and cobbles, brown to grey, dry to moist		1 2				
		TEST PIT TERMINATED AT ~ 3.0 m DEPTH DUE TO RESISTANCE ON SUPSECTED BEDROCK		3				

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-4D

Project No. SUD-22025423-A0

Figure No. B-38

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

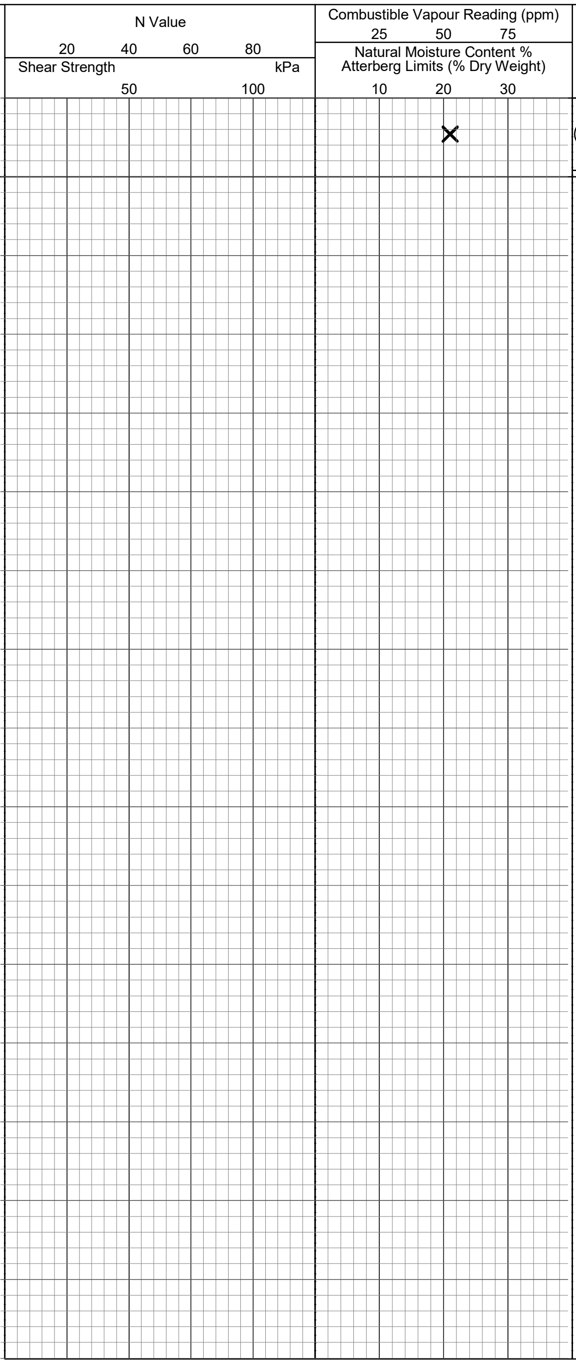
Date Excavated: October 24, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
				0		
	⁙	**SAND,** with topsoil, some silt, some gravel, some boulders and cobble, dark brown, wet			G	
		TEST PIT TERMINATED AT ~ 0.5 m DEPTH ON SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-5D

Project No. SUD-22025423-A0

Figure No. B-39

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

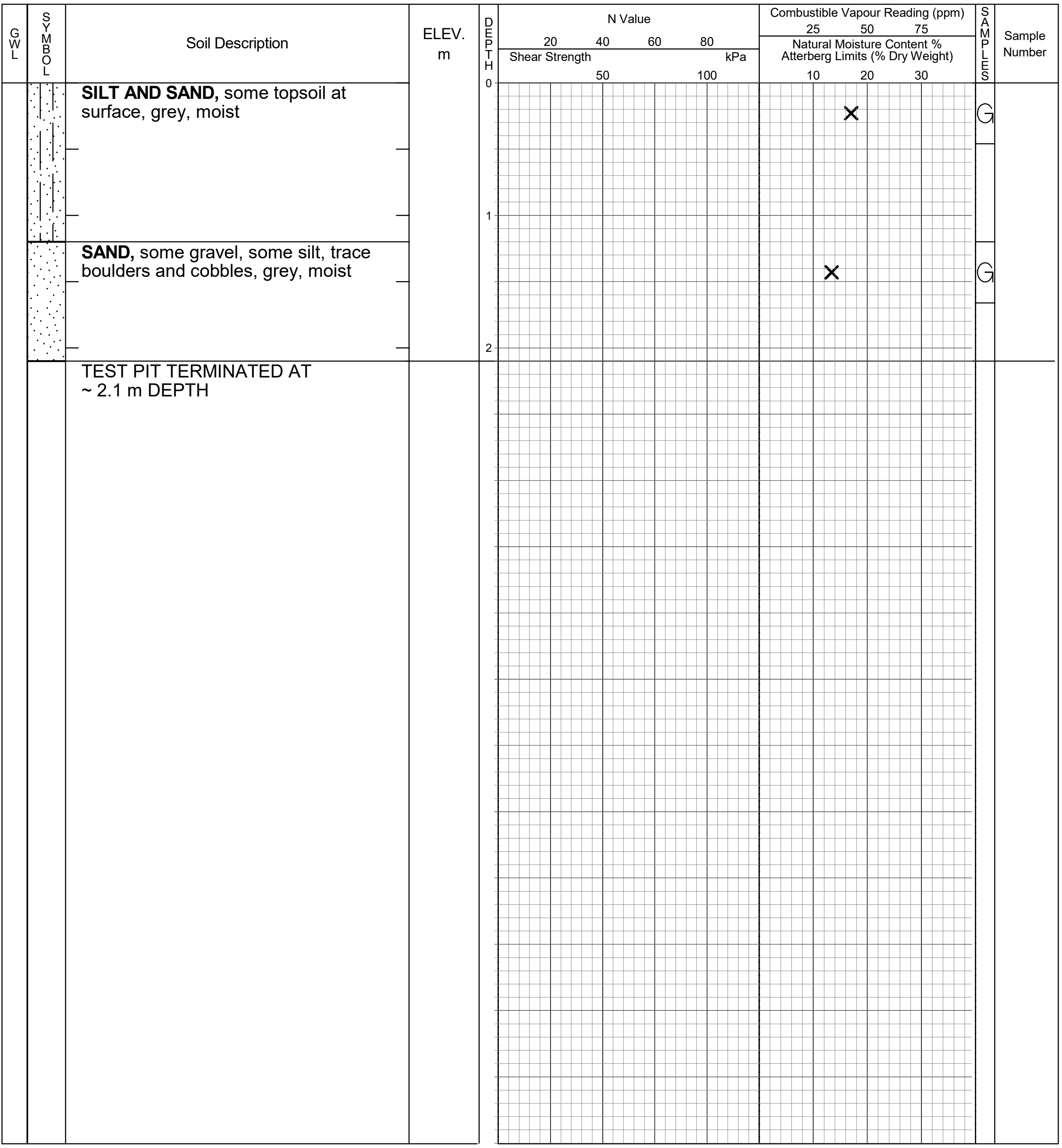
Location: Rosseau, ON

Date Excavated: October 24, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕



SILT AND SAND, some topsoil at surface, grey, moist

SAND, some gravel, some silt, trace boulders and cobbles, grey, moist

TEST PIT TERMINATED AT
~ 2.1 m DEPTH

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-6D

Project No. SUD-22025423-A0
Figure No. B-40

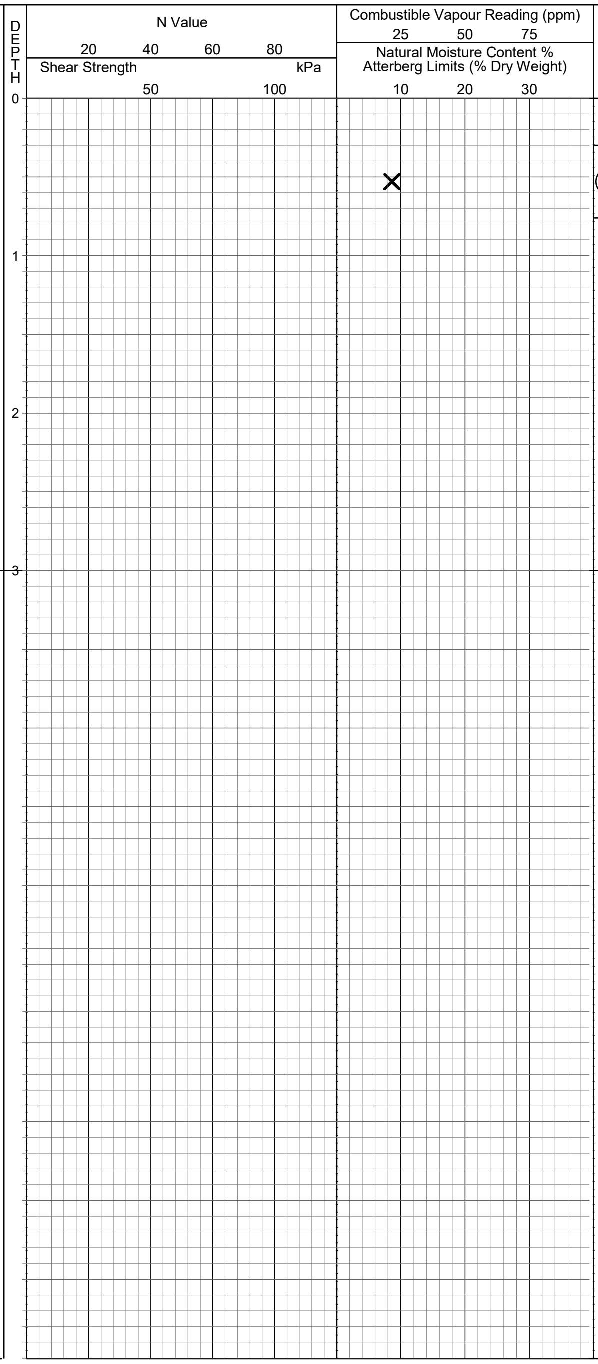
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1

Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, some sand		0		
		SAND, some gravel, trace boulders, grey, moist			G	
		TEST PIT TERMINATED AT ~ 3.0 m DEPTH		3		



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-7D

Project No. SUD-22025423-A0

Figure No. B-41

Project: Proposed Rosseau Springs Residential Development

Sheet No. 1 of 1

Location: Rosseau, ON

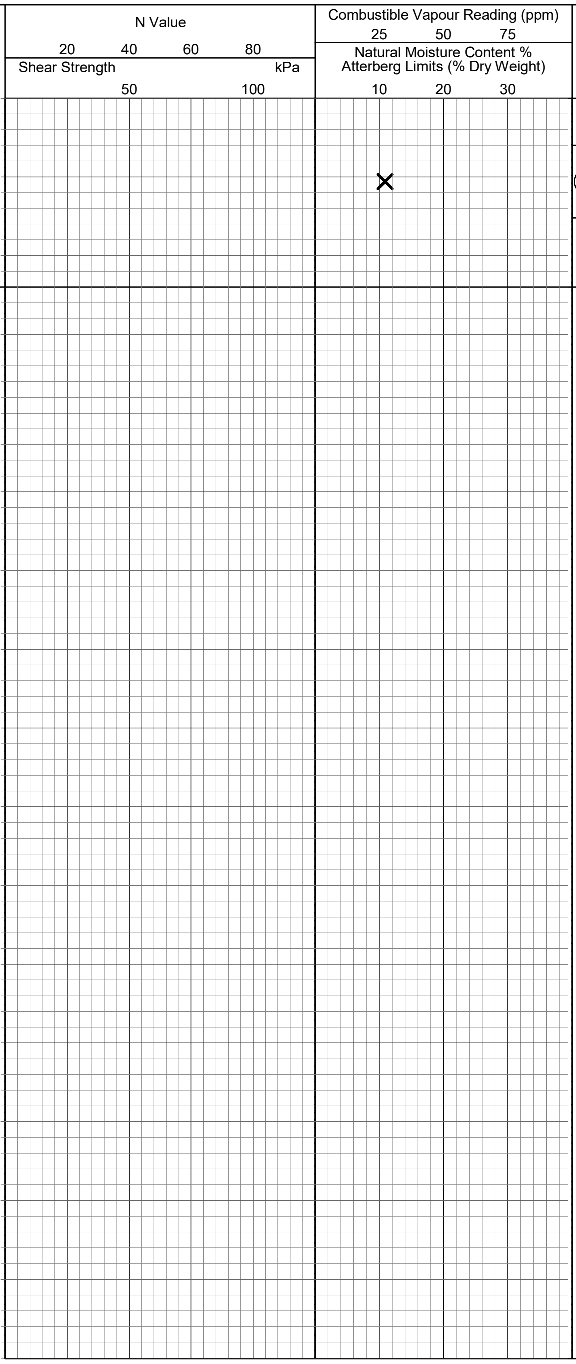
Date Excavated: October 24, 2022

Excavator Type: Excavator

Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
		TOPSOIL, some sand		0		
		SAND, some gravel, trace boulders, grey, moist		1	G	
		TEST PIT TERMINATED AT ~ 1.2 m DEPTH ON SUSPECTED BEDROCK				



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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

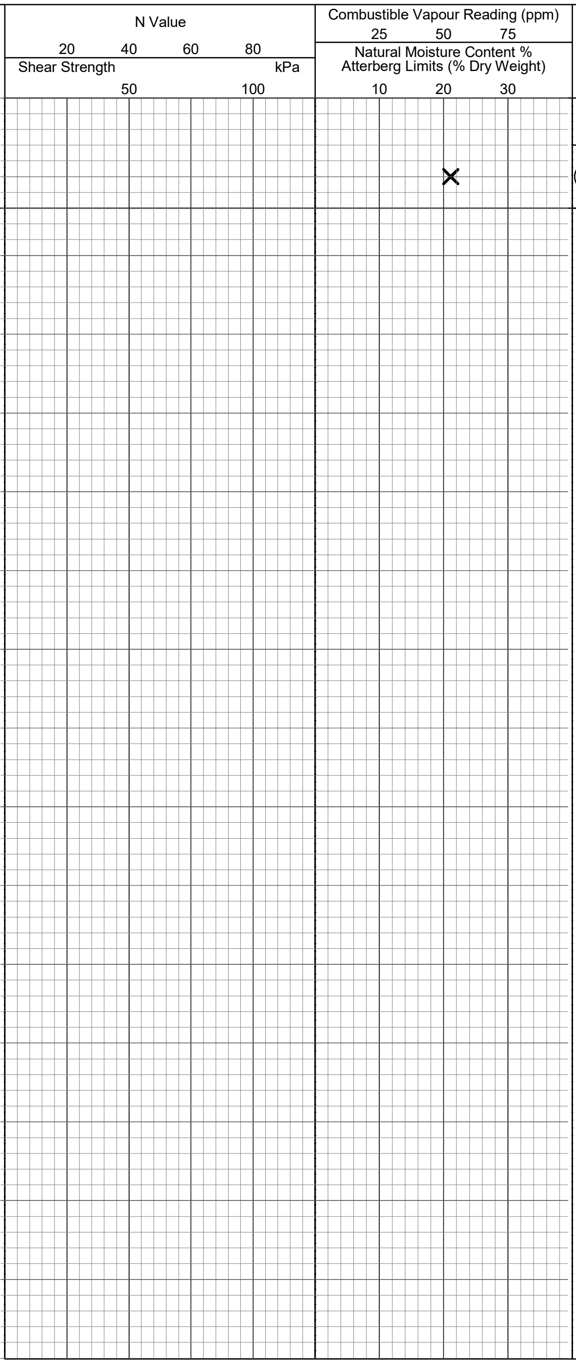
Log of Test Pit TP-1E

Project No. SUD-22025423-A0
Figure No. B-42
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	SAMPLES	Sample Number
	▨	**TOPSOIL,** some silt		0		
	▨	**SAND,** some gravel, some silt, brown, moist			G	
		TEST PIT TERMINATED AT ~ 0.7 m DEPTH DUE TO SUSPECTED BEDROCK				



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Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-2E

Project No. SUD-22025423-A0
Figure No. B-43
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S

Combustible Vapour Reading	☐
Natural Moisture	✕
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, some silt		0				
		TEST PIT TERMINATED AT ~ 0.3 m DEPTH DUE TO NO ACCESS FOR EXCAVATOR						

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Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Log of Test Pit TP-3E

Project No. SUD-22025423-A0
Figure No. B-44
Project: Proposed Rosseau Springs Residential Development
Sheet No. 1 of 1
Location: Rosseau, ON

Date Excavated: October 24, 2022
Excavator Type: Excavator
Datum: Local (Non-Geodetic)

Grab Sample	G
Penetrometer	▲
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	⊢—○
Undrained Triaxial at % Strain at Failure	⊕

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 / Shear Strength kPa 50 100	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Sample Number
		TOPSOIL, some silt		0				
		SAND, some gravel, trace boulder, trace cobbles, brown to grey, moist				×	G	
		TEST PIT TERMINATED AT ~ 0.8 m DEPTH						

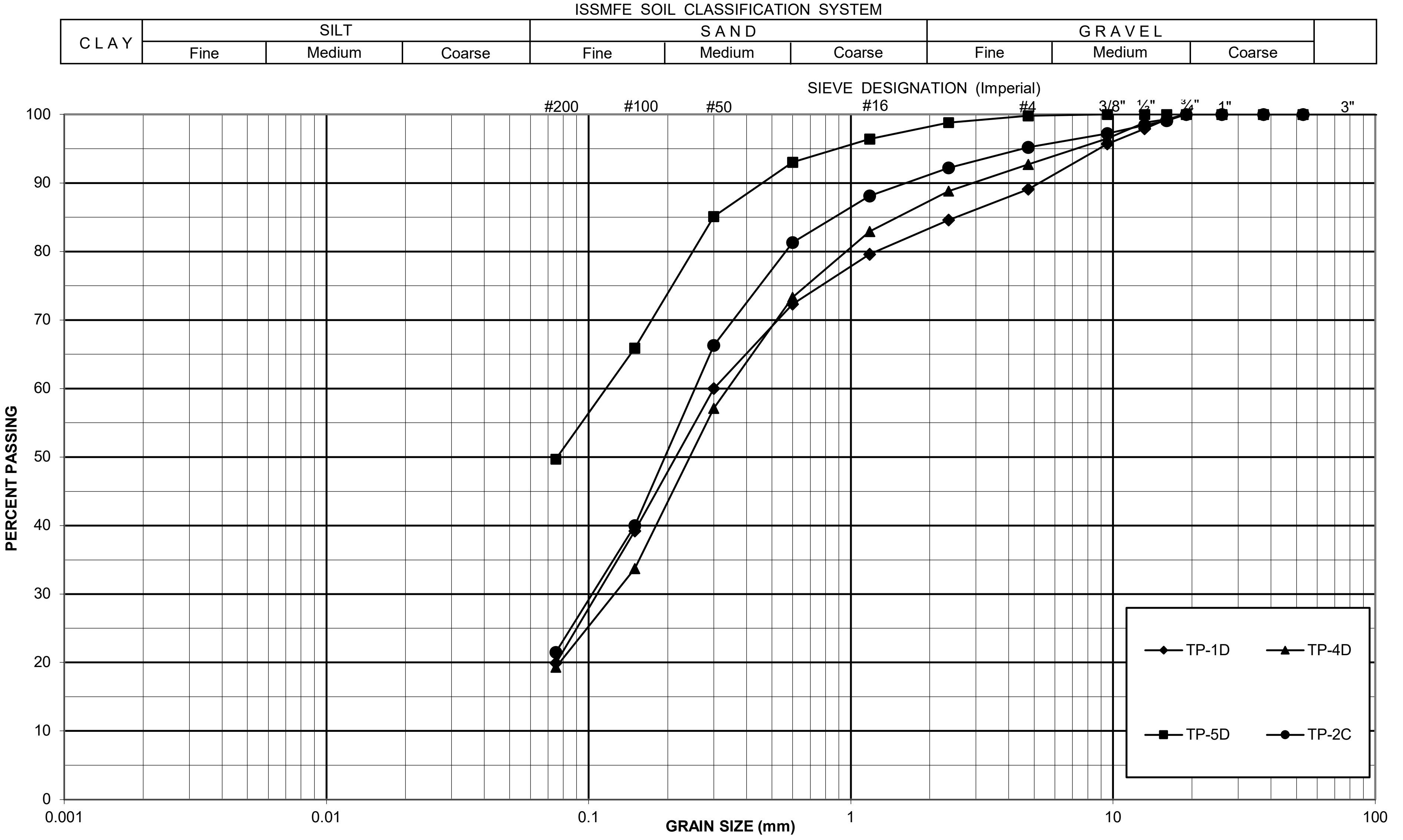
EXP Services Inc.
885 Regent Street
Sudbury, ON P3E 5M4
CANADA
t: +1.705.674.9681
f: +1.705.674.5583

Test Pit data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Appendix C – Laboratory Testing



exp.

GRAIN SIZE DISTRIBUTION

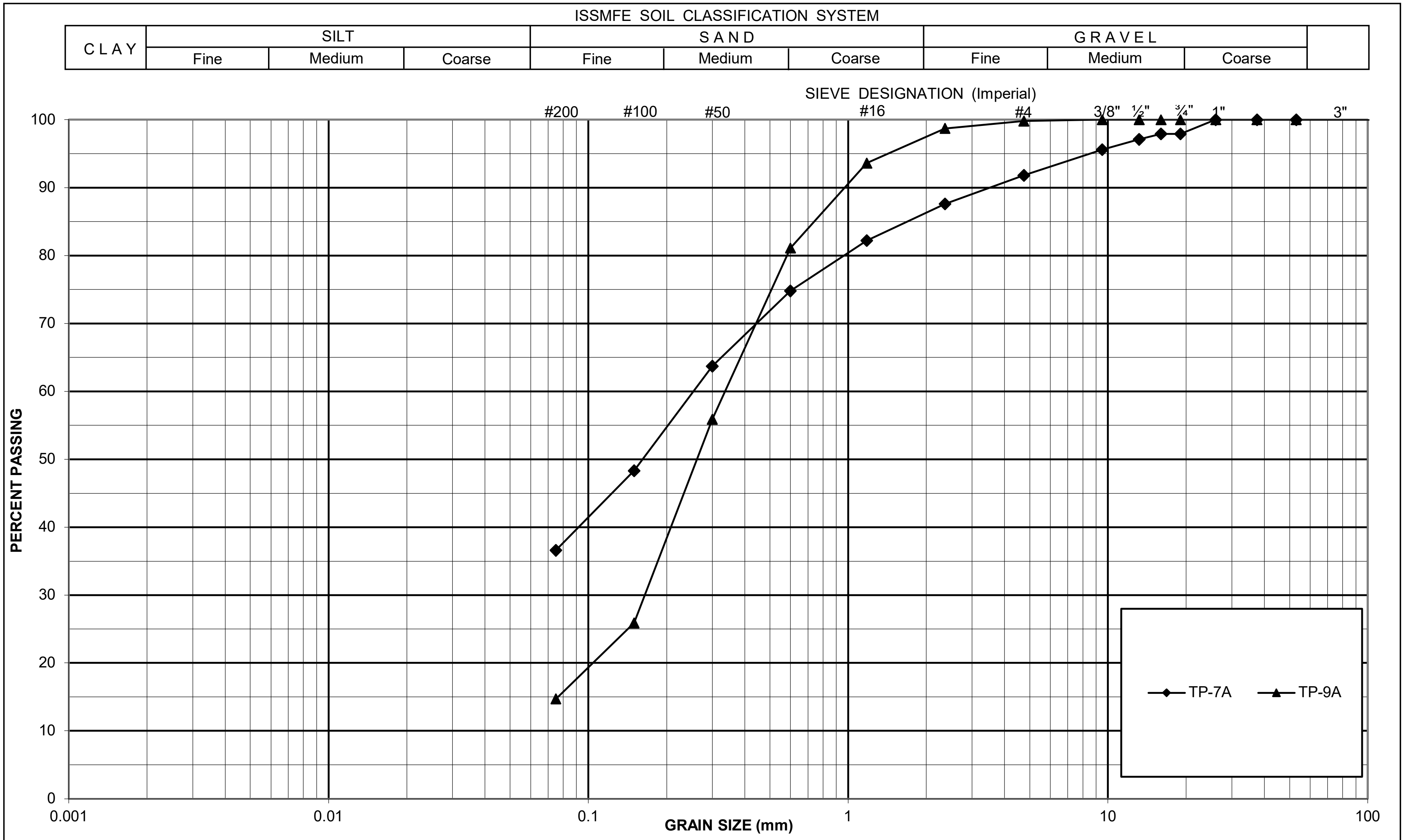
Proposed Rosseau Springs Residential Development

Rosseau, Ontario

FIGURE: C-1

PROJECT No: SUD-22025423-A0

DATE: NOVEMBER 2022

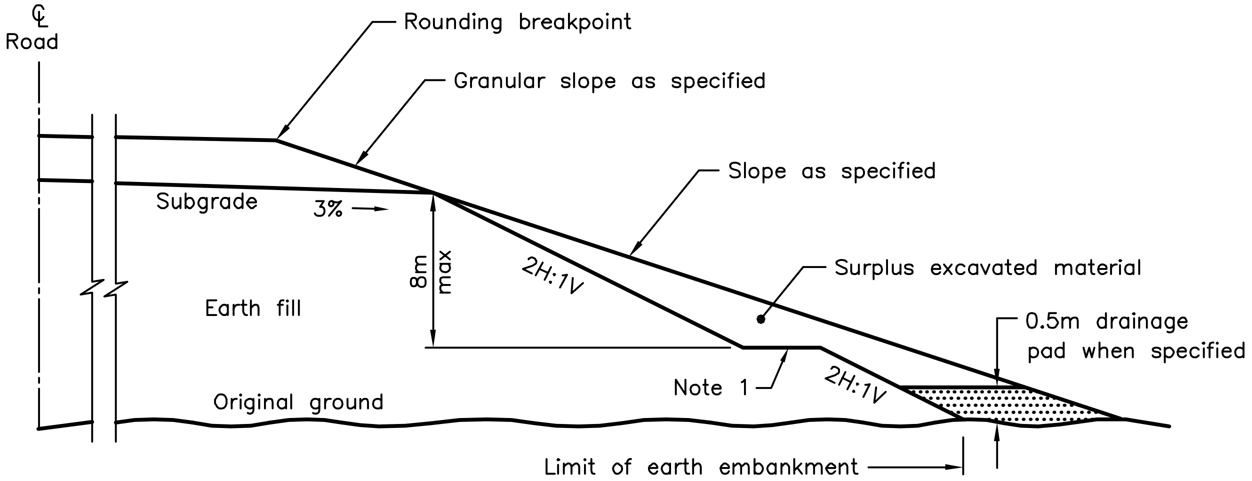


GRAIN SIZE DISTRIBUTION

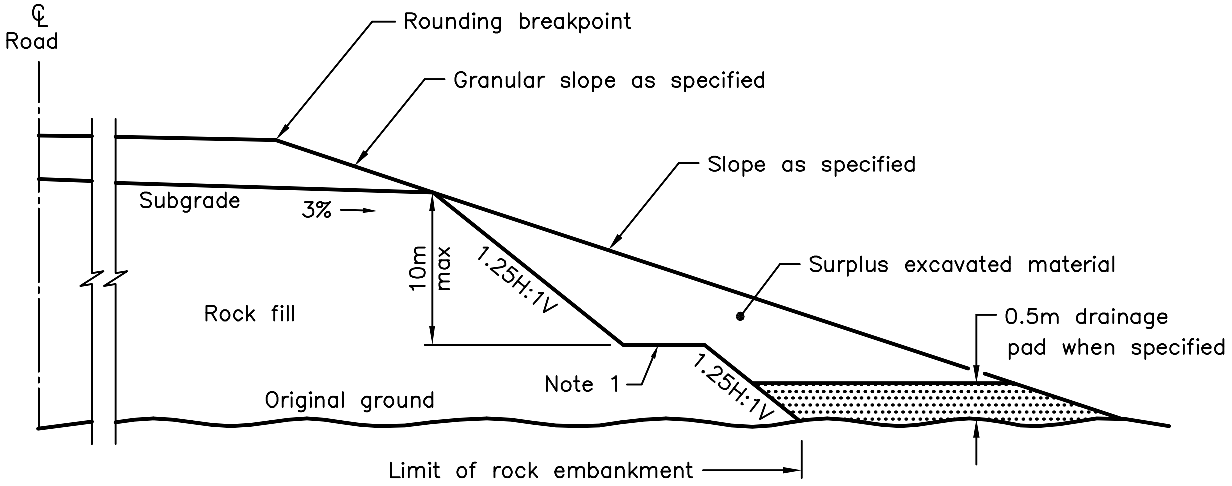
Proposed Rosseau Springs Residential Development
Rosseau, Ontario

FIGURE: C-2
PROJECT No: SUD-22025423-A0
DATE: NOVEMBER 2022

Appendix D – OPSD



EARTH EMBANKMENT



ROCK EMBANKMENT

NOTES:

1 Benches 2m minimum in width are required along slopes at maximum vertical intervals as shown.

A Height of fill is the vertical difference between top of subgrade and top of original ground measured at new road centreline.

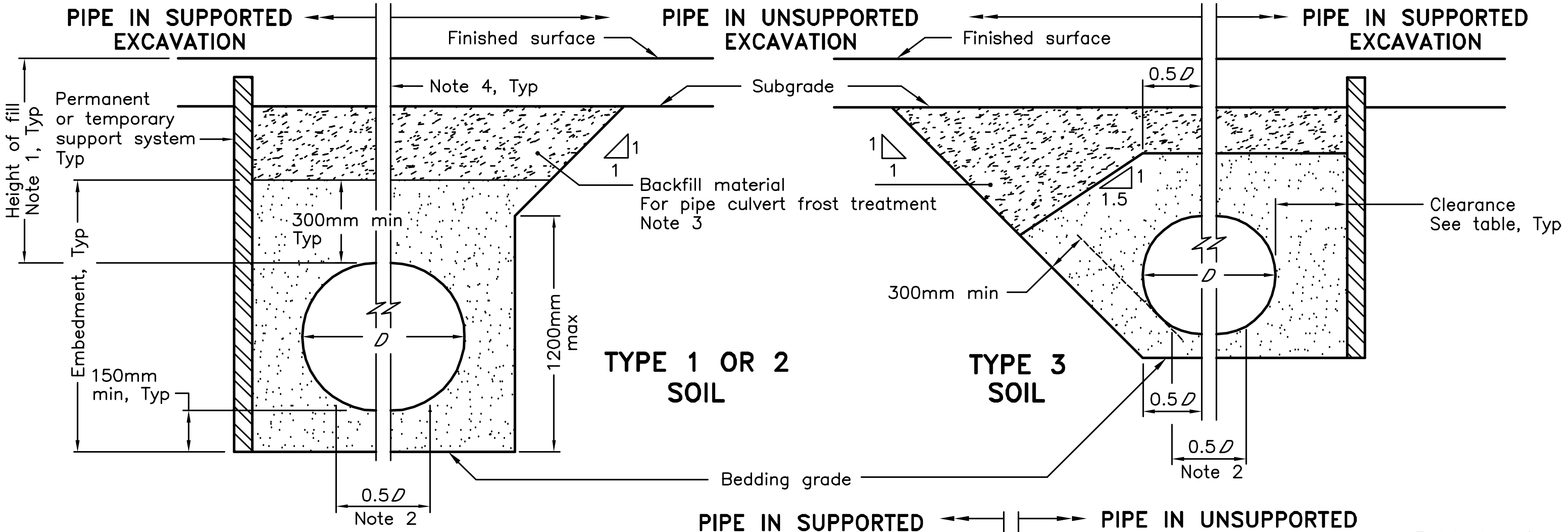
B Surplus excavated material placed shall not extend beyond the right–of–way.

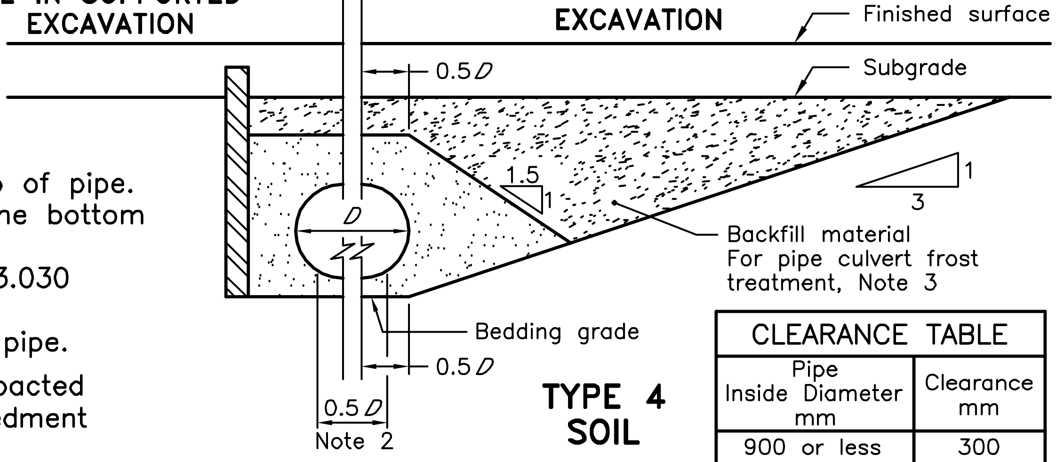
C All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING
Nov 2016 Rev 3

SLOPE FLATTENING
USING SURPLUS EXCAVATED MATERIAL
ON EARTH OR ROCK EMBANKMENT

OPSD 202.010





LEGEND:

D – Inside diameter

NOTES:

1 Height of fill is measured from the finished surface to top of pipe.
2 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
3 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
4 Condition of excavation is symmetrical about centreline of pipe.

A Granular material placed in the haunch area shall be compacted prior to placing and compacting the remainder of the embedment material.
B Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
C All dimensions are in metres unless otherwise shown.

CLEARANCE TABLE

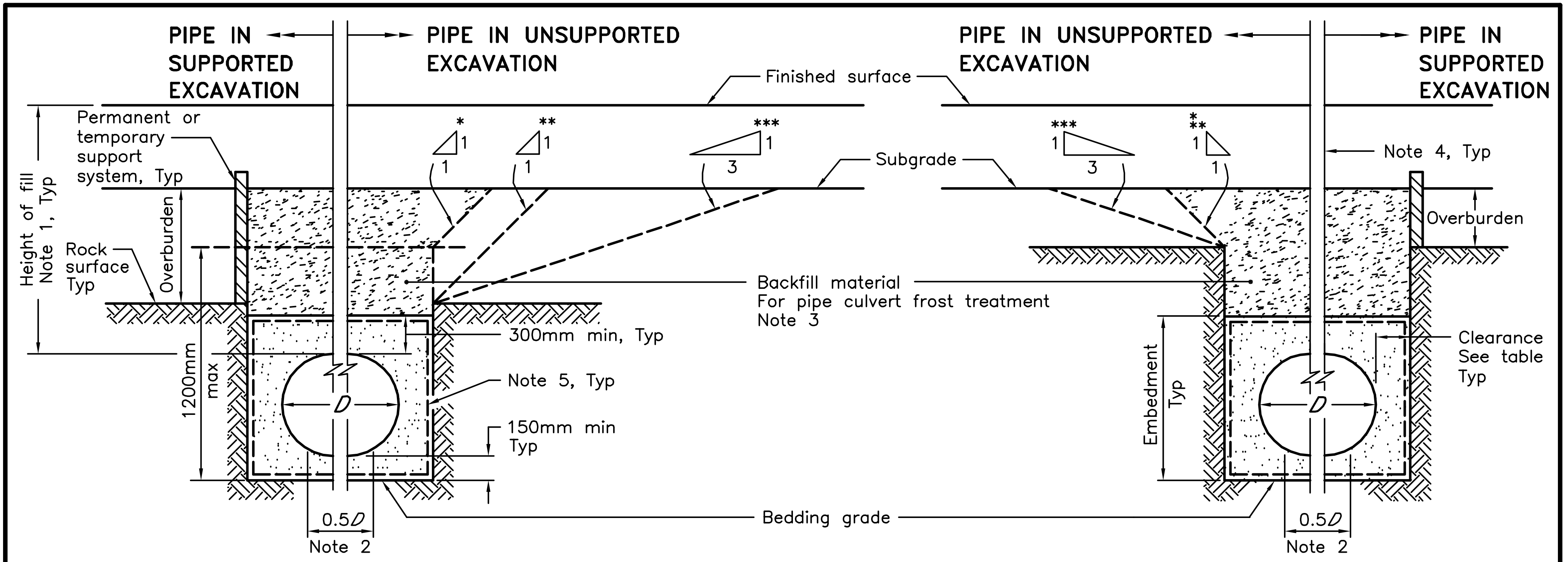
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014 Rev 3

FLEXIBLE PIPE
EMBEDMENT AND BACKFILL
EARTH EXCAVATION

OPSD 802.010



ORIGINAL ROCK < 1200mm ABOVE TRENCH BOTTOM

ORIGINAL ROCK ≥ 1200mm ABOVE TRENCH BOTTOM

NOTES:

1 Height of fill is measured from the finished surface to top of pipe.
2 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
3 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
4 Condition of excavation is symmetrical about centreline of pipe.
5 Embedment material shall be wrapped in non-woven geotextile when specified.

A Granular material placed in the haunch area shall be compacted prior to placing and compacting the remainder of the embedment material.
B Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
C Fractured rock shall be treated as Type 1 soil.
D All dimensions are in metres unless otherwise shown.

LEGEND:

D – Inside diameter
* – Type 1 or 2 soil
** – Type 3 soil
*** – Type 4 soil

CLEARANCE TABLE

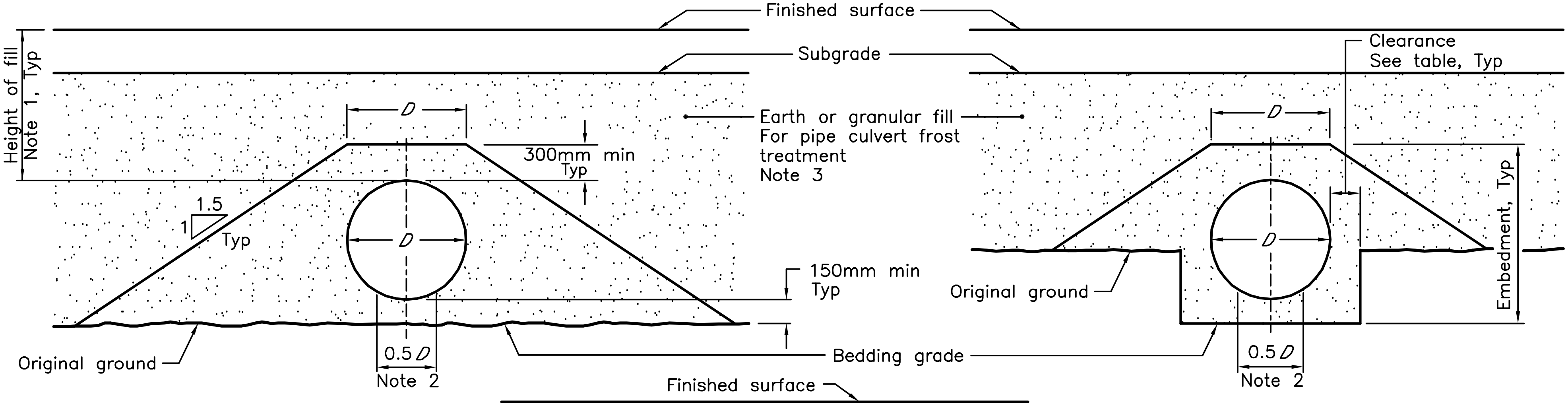
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014 Rev 3

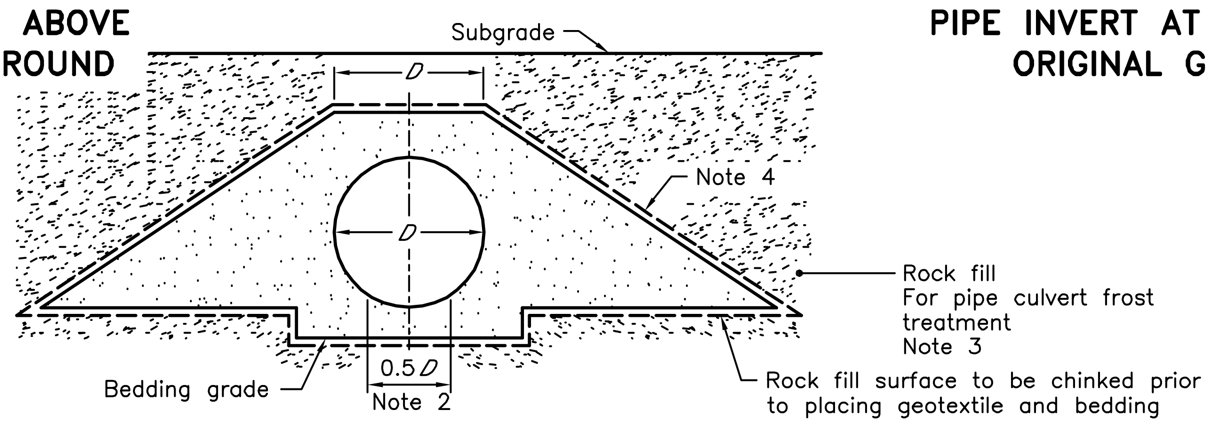
FLEXIBLE PIPE
EMBEDMENT AND BACKFILL
ROCK EXCAVATION

OPSD 802.013



PIPE INVERT ABOVE ORIGINAL GROUND

PIPE INVERT AT OR BELOW ORIGINAL GROUND



PIPE EMBEDMENT
WITH ROCK FILL UNDER AND OVER THE PIPE

LEGEND:

D – Inside diameter

NOTES:

1 Height of fill is measured from the finished surface to top of pipe.
2 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
3 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
4 Embedment material shall be wrapped in non–woven geotextile when specified.

A Granular material placed in the haunch area shall be compacted prior to placing and compacting the remainder of the embedment material.

B All dimensions are in metres unless otherwise shown.

CLEARANCE TABLE

Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING

Nov 2014 Rev 3

FLEXIBLE PIPE EMBEDMENT
IN EMBANKMENT
ORIGINAL GROUND: EARTH OR ROCK

OPSD 802.014