Geotechnical Investigation

Proposed Elmwood Subdivision
Gananoque, ON

Prepared for: 1000989284 Ontario Inc.

September 11, 2025
File: 1956.00-101-R01

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MALROZ

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Respectfully submitted,

Malroz Engineering Inc.

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1.0 Introduction

Malroz Engineering Inc. (Malroz) was retained by Forefront Engineering Inc. (the Client) to conduct a geotechnical investigation in support of the construction of a new residential subdivision to be constructed on the presently undeveloped land at the existing eastern terminus of John Street in Gananoque, ON (the Site).

We understand that the development will consist of the construction of a typical residential subdivision, consisting of dwelling lots for both detached and semi-detached units, sub-urban local roadways, a green space lot, and typical associated ancillary developments (buried utility infrastructure etc.).

This report summarizes the results of the investigation completed by Malroz in support of the proposed development. Work for this investigation was completed in general accordance with Malroz's approved proposal dated April 21, 2025 (ref. 1956.00-100), with the exception and agreed exclusion of 8 boreholes, that were deemed to be inaccessible to site conditions and observed marshlands in the direct vicinity of these boreholes. Therefore, the agreed scope of work consisted of the following:

1. Advancement of 15 boreholes at locations as specified by the Client across the Site advanced to a depth of 3.0 metres below existing site grades (mbg) or to practical refusal;
2. Submittal of all retrieved samples with sufficient quantity for moisture contents testing, as well as up to four hydrometer grain size analyses and two Atterberg limits tests;
3. Conducting an evaluation of an area identified within the Gananoque Official Plan as an 'unstable slope' in accordance with the Slope Stability Rating system described in the MNR Technical Guide for River and Stream Systems: Erosion Hazard Limit (2002); and
4. Reporting of field and laboratory results.

Based on discussions with you during the course of the work, a total of eight boreholes were abandoned due to access issues (low lying wetland areas etc.).

The recommendations and comments contained herein are based on factual information obtained during the investigation and are intended only for the use of project designers and engineers. They have been prepared with the understanding that the design will be carried out in accordance with applicable codes and standards. The General Conditions and Limitations (Section 7.0 of this report) form an integral part of this report.

2.0 Site Description

The Site is presently an undeveloped, generally tree and brush covered lot (sparser at its periphery), bounded by residential development to the north and west, the St. Lawrence River and wetland area to the south, and generally undeveloped land to the east.

Photograph 1 – Site adjacent to St. Lawrence River (July 2025)

Site topography features several bedrock outcrop prominences, which are apparent in topographical mapping of the site. Relative elevations of these prominances are up to nine metres higher than surrounding topography.

Site topography generally trended downwards to the south towards the St. Lawrence River, however a watercourse runs from southwest to northeast through the middle of the Site, which was locally several metres lower than surrounding land. The watercourse flows south and into the St. Lawrence River at a wetland in the southeast corner of the site. Regional topography trends downward towards the St. Lawrence River to the south.

3.0 Method of Investigation

3.1 Fieldwork – Borehole Investigation

A total of 15 boreholes were advanced at the Site, identified as BH6 through BH7, and BH9 through BH21. BH1 through BH5, BH8, and BH22 through BH23 were removed from the scope of the investigation as discussed with you prior to completing the fieldwork. Borehole locations are approximately as determined by the Client. The fieldwork was completed on July 14 and 15, 2025. A borehole Location Plan (Figure 1) is presented in Appendix A. All boreholes were advanced using a Massenza MI3 Geo/Enviro Combo to a depth of 3.0 metres below existing site grades (mbg) or to practical refusal. Boreholes BH10 and BH19 were further advanced into bedrock using 'N' sized double tube wireline coring equipment to confirm the presence of bedrock and recover samples for detailed description.

Locations and ground surface elevations at each borehole location were surveyed with a Trimble R10 Global Navigation Satellite System survey system, connected to the Can-Net Virtual Reference Station network, and are assumed to be accurate within the operating limits of the device. Locations are reported in the Universal Transverse Mercator (UTM) coordinate system, North American Datum of 1983 (NAD 83), Zone 18T. Survey information is summarized in the following table.

Table 1 – Borehole Locations and Ground Surface Elevations

Test Location	Easting	Northing	Elevation (mASL)
BH6	408283.8	4909424.5	79.9
BH7	408303.3	4909444.1	81.4
BH9	408175.1	4909314.8	83.5
BH10	408155.7	4909277.8	83.6
BH11	408151.8	4909212.5	80.4
BH12	408158.7	4909170.5	80.2
BH13	408154.3	4909191.6	80.1
BH14	408166.7	4909129.3	82.1
BH15	408116.3	4909128.1	81.4
BH16	408206.4	4909130.9	81.3
BH17	408237.1	4909147.8	80.3
BH18	408279.8	4909183.3	80.9
BH19	408307.3	4909222.0	81.0
BH20	408351.0	4909253.3	78.3

Test Location	Easting	Northing	Elevation (mASL)
BH21	408384.0	4909267.5	81.7

Input By: TB
Validated By: RG

Soil samples were collected while performing the Standard Penetration Test (SPT) in general accordance with the procedure as described in ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lb) hammer from a vertical distance of 0.76 m (30 in), to drive a 51 mm (2 in) outer diameter split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground 300 mm (12 in) was recorded as the SPT 'N' value, which correlates to the relative density of non-cohesive soils and is, in certain cases, indicative of the consistency of cohesive soils. Each retrieved sample was placed in a resealable plastic bag.

Boreholes BH6, BH12, BH19 and BH20 were outfitted with PVC monitoring wells upon completion.

3.2 Fieldwork – Slope Assessment

An assessment of the slope along the south limits of the property was carried out in general accordance with the requirements of the Ontario Ministry of Natural Resources and Forestry (MNRF) guidelines as outlined in the MNRF Technical Guide for River and Stream Systems: Erosion Hazard Limit (2002) Slope Stability Rating System. The results of the field observations as per the MNR Slope Stability Rating system are summarized in Section 6.0 of this report.

4.0 Subsurface Assessment

Details of the subsurface conditions encountered are presented in the borehole records presented in Appendix B of this report. We strongly emphasize, however, that the soil types, their sequence, thickness, and physical properties may vary between boreholes, sample and test locations, both vertically and horizontally. This information is solely for general planning purposes and should not be used for detailed quantity take-offs.

Our assessment of subsurface conditions and borehole observations are summarized in the following sections.

4.1 Local Geology / Physiography

Physiography at the Site is mapped by the Ontario Geological Survey (OGS) as clay plains (Chapman and Putnam, 2007). Surficial geology at the Site is described by the OGS (2010) as bedrock-drift complex material in Precambrian terrain, but massive to well laminated silt and clay, minor sand and gravel in fine textured glaciocustrine deposits is also mapped near the Site. Bedrock geology at the Site is mapped as late felsic plutonic rocks, granitic gneisses with metasedimentary xenoliths, migmatites, injection gneisses, and pegmatites. Dolostone and sandstone of the Beekmantown Group are also mapped in the area (to the west) of the Site (Armstrong and Dodge, 2007; OGS, 2011).

4.2 Surficial Materials

4.2.1 Topsoil

A surficial covering of topsoil was observed at boreholes BH6, and BH9 through BH21 with thickness from less than 0.1 m to approximately 0.7 m. In our experience, topsoil thicknesses can vary greatly across a Site, between and beyond test locations. Root balls should also be expected at this Site, given the extent of the tree cover encountered. Topsoil and organics at these locations should be expected to be increased, in addition to some limited disturbance of upper native soils. Topsoil thicknesses presented in this report should not be used for detailed quantity takeoffs. Contractors should ensure they make their own validations of topsoil thicknesses.

4.3 Gravelly Sand Fill

A brown gravelly sand fill with trace silt was observed at borehole BH7, extending to approximately 1.2 m below existing site grades (mbg). This material was visually described as being generally moist with moisture contents of 7% by dry weight. SPT ‘N’ values of 11 to 38 blows per 300 mm of penetration were measured in this material, indicating a compact to dense relative density.

4.4 Native Silty Sand and Gravel

A brown native silty sand and gravel was observed at borehole BH21. This material was visually observed to be generally moist. Moisture contents measured on recovered samples of this material ranged from 17 to 31% by dry weight. A SPT ‘N’ value of 21 blows per 300 mm of penetration was measured in this material, indicating a compact relative density.

4.5 Native Silty Sand

A brown native silty sand was observed at boreholes BH7, BH11, BH13, BH14, BH15 at varying depths with moisture contents of 17 to 22% by dry weight. SPT ‘N’ values of 12 to 13 blows per 300 mm of penetration were measured in this material, indicating a compact relative density.

4.6 Native Silty Clay

A brown native silty clay with some sand was observed at boreholes BH6, BH9, BH11, BH12, and BH15 through BH19. This material was visually observed to be generally moist. Moisture contents measured on recovered samples of this material ranged from 9 to 36% by dry weight. SPT ‘N’ values of 6 to 19 blows per 300 mm of penetration were measured in this material, which is an estimate of a firm to very stiff consistency.

4.7 Native Clayey Silt to Silt

A native clayey silt with some sand and silt with some clay and traces of sand was observed at boreholes BH10, BH11, BH13, BH14, and BH20. This material was visually observed to be generally moist. Moisture contents measured on recovered samples of this material ranged from 19 to 32% by dry weight. SPT ‘N’ values of 3 to 25 blows per

300 mm of penetration were measured in this material, which is an estimate of a soft to very stiff consistency.

4.8 Granitic Bedrock

Sampler refusal on inferred bedrock was encountered at boreholes BH7 through BH10, BH15, BH17 through BH19 and BH21 ranging in depth from 0.5 to 2.2 mbg. The presence of bedrock was confirmed by core drilling at BH10 and BH19 as summarized in the following table. Core information and material descriptions are reported on the respective records of boreholes.

Table 2 – Bedrock Core Information Summary

Borehole / Core Run ID	Depth to Rock Surface (mbg/mASL)	Total Core Recovery, TCR (%)	Solid Core Recovery, SCR (%)	Rock Quality Designation, RQD (%)
BH10/RC1	2.2 / 81.4	100	61	33
BH19/RC1	1.4 / 79.6	100	66	56

Input By: TB
Validated By: RG

Bedrock cores were described as granite gneiss. Core photographs are attached in Appendix C.

Total core recovery (TCR) of the obtained core was found to be 100% and solid core recover (SCR) was found to be between 61 and 66%. The solid core recovery is generally influenced by the orientations of joints and is low when joints oblique to the axis are intercepted. The rock quality designation (RQD) is highly dependent on the frequency of joints/bedding plane partings in the retrieved cores. On the basis of the recorded RQD values of between 33 and 56%, the rock quality is estimated to be poor, becoming fair with increasing depth, within the depths investigated.

4.9 Groundwater

A detailed hydrogeological investigation was not included as a part of this work. However, water levels were recorded following completion of drilling works in the installed monitoring wells at boreholes BH6, BH12, BH19, and BH20.

Water level observations were made from the monitoring wells on a subsequent visit to the Site on July 31, 2025, summarized in the following table.

Table 3 – Groundwater Observation (July 31, 2025)

Borehole ID	Groundwater Observation (mbg/mASL)
BH6	2.2 / 77.7
BH12	1.2 / 79.0
BH19	2.8 / 78.2
BH20	2.0 / 76.3

Input By: TB
Validated By: RG

Groundwater levels can fluctuate greatly and vary based on the prevailing seasonal and atmospheric conditions (e.g., heavy rains, spring thaw, dry spells).

5.0 Laboratory Testing

Samples recovered during drilling were transported to Malroz's geotechnical laboratory in Kingston, Ontario. Four samples were submitted for hydrometer grain size analysis and two for Atterberg limits testing. All samples with sufficient quantity available to test were submitted for moisture contents testing.

Table 4 – Summary of Hydrometer and Atterberg Limits Test Results

Sample ID	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)
BH6-SS2	0	16	37	47	-	-	-
BH10-SS3	0	19	60	21	-	-	-
BH14-SS2	0	6	72	22	30.5	22.4	8.1
BH20-SS3	0	8	70	22	27.4	20.5	6.9

Input By: TB
Validated By: RG

Unconfined compressive strength testing was conducted on two recovered samples of bedrock.

Table 5 – Summary of Unconfined Compressive Strength

Sample ID	Unconfined Compressive Strength (MPa)
BH10/RC1	158.6
BH19/RC1	109.8

Input By: TB
Validated By: RG

Core photographs are attached in Appendix C. Laboratory test reports are included in Appendix D of this report, and moisture contents are summarized on individual records of boreholes, in Appendix B.

6.0 Discussion and Recommendations

Based on the results of the field investigation, both native soil subgrades and bedrock would provide suitable subgrade surfaces for proposed typical residential structures designed in accordance with Part 9 of the Ontario Building Code (OBC), however structural transition details will be necessary for strip foundations which cross multiple subgrade types (e.g. soil to rock, sandy to clayey native soils, etc.) to prevent minor distress due to differential settlements resulting from differing subgrade stiffness. Groundwater in areas of deeper overburden and in excavations extending into the bedrock may be encountered, based on groundwater observed in installed monitoring wells. Supplemental work would be necessary to estimate potential flowrates and seasonal variations.

6.1 Excavation and Temporary Shoring

Excavations up to a depth of approximately 3 mbg may be necessary for construction of foundations, or for buried utilities. We would expect that sufficient area would be available to backslope excavations to this depth without the use of shoring at this Site. Excavations for buried utilities may extend deeper, depending on final site grading. Once foundations are constructed, excavations should not extend within a zone extending 10 horizontal to 7 vertical from the bottom outside edge of these foundations, to prevent them from becoming undermined.

All excavations and construction of any shoring should be carried out in accordance with the latest edition of the OHSA and Regulations for Construction Projects. The OHSA regulations require that if workers must enter an excavation deeper than 1.2 m, the excavation must be suitably sloped and/or braced in accordance with OHSA requirements. OHSA specifies the maximum slope of excavations into four broad soil types, summarized as follows:

Table 6 – OHSA Soil Types

Soil Type	Maximum Slope Inclination	Base of Slope Location
Type 1	1 horizontal to 1 vertical	Within 1.2 m of base of excavation
Type 2	1 horizontal to 1 vertical	Within 1.2 m of base of excavation
Type 3	1 horizontal to 1 vertical	From bottom of excavation
Type 4	3 horizontal to 1 vertical	From bottom of excavation

At this Site, native sandy and clayey soils unaffected by seepage may be considered as Type 3 to 4. Any soils affected by seepage must be considered as Type 4, and the lowest soil type in any given excavation shall govern its sideslopes.

Excavations into overburden soils should be relatively easy using conventional excavating equipment; however, contractors should be prepared to manage erratic large particles up to boulder sized material that could be found within the overburden. If rock excavation is required, it is expected that the use of rippers in this formation would not be feasible. Significant rock excavation may be required near bedrock prominences at various locations throughout the Site.

Stockpiles of excavated materials should be kept away from the edges of open excavations by a distance at least equivalent to the depth of the excavation to avoid slope instability. Care should be taken to avoid overloading any underground services/structures from any construction stockpiles. It should be noted that this distance is also applicable to the passage of heavy machinery near excavations. This condition should be respected at all times, unless specific studies are conducted for individual cases.

A shoring system will be required anywhere appropriate backsloping is not possible, e.g. potentially in utility excavations. Shoring systems must be designed by a professional engineer licensed in the province of Ontario, in accordance with relevant codes, standards and regulations such as the latest version of the Canadian Foundation Engineering Manual and the Ontario Occupational Health and Safety Act (OHSA) Regulations for Construction Projects. The system should be designed to resist full earth and hydrostatic pressures, as well as surcharges due to construction and highway

traffic loadings. The following parameters may be used in the design of temporary shoring:

Table 7 – Lateral Earth Pressure Parameters

Soil Type	Bulk Unit Weight (kN/m^3)	Angle of Internal Friction (deg.)	Coefficient of Lateral Earth Pressure		
			K_a	K_o	K_p
Native Silty Soils	19	32	0.31	0.47	3.25
Native Clayey Soils	18	29	0.35	0.51	2.88
Native Sandy Soils	20	34	0.28	0.44	3.54
Compacted Gran. 'A'	21	34	0.28	0.44	3.54
Compacted Gran. 'B' Type II	21.5	35	0.27	0.43	3.69

At rest parameters should be utilized for non-yielding shoring elements. We recommend shoring plans be reviewed by a geotechnical engineer prior to the start of construction.

6.2 Dewatering

Based on the groundwater observations made during the drilling program, seepage near the soil-rock interface should be expected. Additional work would be required to quantify groundwater pumping volumes and measure seasonal groundwater variations. Contractors should consider that at a minimum, the use of passive relief wells screened below the lowest point in an excavation may be required to keep excavations in the dry. Carrying out excavations in dry seasonal conditions will reduce dewatering requirements.

6.3 Foundations

Foundations for proposed new residential dwellings can be constructed over either limestone bedrock or undisturbed silty soil subgrades. Native silty and clayey soils at this Site are highly susceptible to freezing, and should be exposed for as little time as possible during cold seasonal periods unless insulation or suitable means of heating are provided.

6.3.1 Conventional Shallow Foundations

Conventional spread, strip or pad foundations placed over native soil subgrades can be designed considering an allowable bearing reaction of 100 kPa, provided structures are designed in accordance with Part 9 of the Ontario Building Code. Foundations constructed on rock may consider a higher allowable bearing reaction of 500 kPa. The stated bearing reactions assume that there will be no load eccentricities, and the foundations will be constructed on flat and level ground. If limit state design bearing reactions are required for a larger structure, Malroz should be contacted to discuss the extent of such a development, its specific design, and to provide appropriate recommendations.

All subgrade surfaces should be inspected by a geotechnical engineer or their designate prior to placement of foundations.

6.3.2 Foundation Dewatering

Surface grades should be sloped away from the building, and landscaped areas directly adjacent to the building should be capped with impermeable soils, if practicable. Foundations at this Site should be provided with suitable waterproofing for below grade levels. Perimeter drains should be installed around any structures with basements or pits, connected to a frost-free outlet.

Buried utilities could be provided with subdrains to reduce groundwater flow towards the building envelopes.

6.3.3 Frost Protection

Design frost depth in the Gananoque area should be considered 1.4 m below unprotected surface grades. If thermal insulation is utilized as opposed to soil cover, it should be noted that some manufacturers recommend placement of foundations directly over top of insulating boards. Providing any surficial weathered rock is removed, we would not expect the granitic rock at this Site to be frost susceptible. Some isolated zones of weathering should be expected around the Site (e.g. at more exposed areas of rock outcrop). Native silty soils at this site are expected to be highly frost susceptible.

6.4 Backfilling

Backfill around the buildings should consist of non-frost susceptible, free draining granular material. Below hardscaped areas, all backfill material should be compacted to a minimum of 98% of its Standard Proctor Maximum Dry Density (SPMDD) to 1 m below the hardscape base or pavement subbase, and 100% thereafter. Elsewhere, all backfill should be compacted to 95% of its SPMDD.

Earth pressure parameters provided in Table 7 above can be used for any walls subjected to such pressures (e.g. below grade levels, sump pits, etc.).

6.5 Slabs on Grade

Both soil subgrades and rock at this Site would be suitable for the construction of slabs on grade. We recommend that a minimum of 150 mm of new Ontario Provincial Standard Specifications (OPSS) Granular ‘A’ be placed under any slabs on grade. Should designers require a subgrade reaction modulus for larger slab designs, Malroz should be provided with the dimensions, estimated contact pressures and proposed location for evaluation.

6.6 Pavement Design

Given the size of the proposed development, a pavement section consisting of a minimum of 50 mm of surface course (HL3 or SP12.5 Cat. A) overlying 60 mm of base course (HL8 or SP19.0 Cat. A) overlying a base layer of 150 mm of new OPSS Granular ‘A’ and subbase layer of 300 mm of OPSS Granular ‘B’ Type II would be suitable for the number and type of units.

6.6.1 Materials and Construction Considerations

For Site preparation, surface vegetation, tree roots, topsoil and organics should be stripped under the pavement areas, and the underlying subgrade surface proof rolled. New fill under pavement areas should be placed as an Engineered Fill operation as described in the section below.

Paving work should be completed in accordance with the requirements of applicable OPSS and municipal standards. All asphalt mix designs should be reviewed prior to the commencement of construction.

HMA used in this project should meet the minimum requirements of OPSS 1150/1151 (depending on whether Marshall or Superpave mixes are utilized). Asphalt cements should be minimum grade of PG 58-28, and meet the requirements of OPSS 1101.

Tack coat should be applied between any vertical surfaces or joints including curbs, abutting and walls, etc., butt and lap joints and at all tie-ins to other existing asphalt. SS-1 emulsified asphalts used for this purpose should meet requirements of applicable OPSS.

6.7 Engineered Fill

Engineered Fill application may be required on this project to raise subgrade elevations during construction of the lowest elevation slab. For any operation to be considered Engineered Fill, the following criteria must be satisfied:

- Materials used as Engineered Fill must be uniform and homogenous. The material should be free of deleterious materials and organics;
- Prior to the placement of Engineered Fill, it must be assessed in a geotechnical laboratory for, at a minimum, gradation and Standard Proctor analyses;
- The material must be within +/- 2% of its optimum moisture content, as determined through laboratory testing;
- Engineered Fill operations must take place under the supervision of a geotechnical engineer or their designate;
- Suitable compaction equipment must be selected for the operation, based on the material to be compacted;
- Materials should be placed in lifts which are suitable for the compaction equipment utilized, but generally not greater than 0.2 m loose lifts;
- Density testing must be taken on each lift of Engineered Fill. Any Engineered Fill which is tested and found to be outside of the specified density range shall be either removed, reworked or retested; and

- Under no circumstances shall frozen material be placed in any Engineered Fill operation.
- Site activities may be carried out in the winter months and periods of cold weather. The following procedures are recommended for the placement of engineered or structural fill during cold weather conditions:

    - The fill placement must be inspected by qualified field personnel on a full time basis under the supervision of a geotechnical engineer, with the authority to stop the fill operations at any time when conditions are considered to be unfavorable.
    - The intended area of fill must be clearly identified in the field prior to commencing the work.
    - Ramps for access must be constructed outside of the limits of intended fill.
    - The fill material must be comprised of OPSS Granular 'B' - Type 1, or other approved equivalent granular material when temperatures are below 0^0C.
    - Imported fill containing ice, snow or any frozen material cannot be accepted for use and should be returned to the source.
    - Overnight frost penetration into the fill mantle in areas below intended structure construction, parking lots, and on side slopes of the fill mantle within this area must be prevented by using insulation blankets. Any frozen fill must be completely removed prior to placing subsequent lifts. Breaking the frost and frozen fill in situ will not be accepted. Following removal of frozen materials the remaining exposed surface should be compacted to a minimum of 98% of SPMDD prior to placement of new fill.
    - During periods of cold where ambient temperatures are -5°C or less, placement of engineered fill shall stop and the existing fill materials must be protected from frost penetration.

It should be noted that the placement of engineered or structural fill materials during cold weather conditions requires extra effort beyond that typical in better climatic conditions. At any time where conditions are deemed unfavourable, the Engineered Fill operation must be suspended.

6.8 Slope Evaluation

Malroz conducted an evaluation of the slopes of two rock prominences (synclinal faces of a synclinal/anticlinal formation in the rock near boreholes BH9 and BH19), hereafter referred to as the northern prominence and the southern. The prominences are located in the approximate area identified in the Gananoque Official Plan (as provided by the Client), in general accordance with the Ontario Ministry of Natural Resources and Forestry (MNRF) Technical Guide for River and Stream Systems: Erosion Hazard Limit (2002) Slope Stability Rating System. As the features of the two prominences were consistent, comprising of granitic bedrock outcrop prominences, one evaluation sheet was completed in this area.

The MNRF Slope Stability Rating System employs a semi-quantitative scoring system based on the categories summarized below. A higher assigned score identifies a greater level of risk associated with the categories. A photo log and the completed slope evaluation forms are enclosed in Appendix E. A photo key figure (Figure 2) is enclosed in Appendix A.

Slope Inclination and Height:

The inclination of the prominences past the crests were measured during the Site visit to be up to approximately 24% on the south prominence, and estimated to be similar on the north (toe of the slope in this area being inaccessible), or approximately 13.5 degrees. Slope height of the prominences was estimated to be between approximately 7 and 8.5 m during the Site visit based on survey data we collected at the crest of both the north and south prominence and the toe of the south prominence. These observations are generally consistent with available topographic mapping.

Based on the above, we have assigned a score of 10 (6 for inclination and 4 for height) for this category under the MNRF’s Slope Stability Rating System.

Soil Stratigraphy:

Based on the observations of exposed rock on the faces of the slopes, we have assigned a score of 0 for this category.

Seepage:

No seepage was observed from the face of the prominences, nor were any watercourses present along the slopes. Based on the above, we have assigned a score of 0 for this category. Marshy ground was present between the north and south prominences, however any standing water was stagnant and not significantly flowing.

Vegetative Cover:

In areas with topsoil drift, the slopes were well covered, with significant undergrowth and mature trees. Accordingly, we have assigned a score of 0 for this category.

Drainage:

Signs of some light drainage over the faces of both prominences was observed, however given the shallow rock, no appreciable active erosion has occurred. Accordingly, we have assigned a score of 2 for this category.

Toe of Slope:

While access was not readily available to the south toe of the north prominence, no toe erosion was observed on the south prominence. Vegetative cover should be maintained at the toe of the slopes where possible order to prevent erosion if possible, however given the well-established root mat from tree growth, we would not consider this an absolute requirement. Given the thin drift of overburden and rock face, toe erosion causing instability would not be expected to occur.

Landslide History:

No obvious evidence of local landslides in the immediate area of the Site were observed (i.e. bowed trees, tension cracking, slumped ground etc.). We have assigned a score of 0 for this category.

Summary:

Following our review of the Site in accordance with the MNR Slope Stability Rating System, a summation of rating values/total score of 12 has been achieved. Accordingly, the slopes are considered to have a low potential for instability. Given the lightly loaded nature of typical Part 9 residential structures, the generally well vegetated nature of the slope face, we are of the opinion that no viable failure (planar, wedge, circular, block or buckling) is likely to occur. Vegetation should be maintained on the face of the slopes where possible, and no modifications to the toe of the slopes should be made without geotechnical review. Final grading plans should be provided for our review when available.

6.9 Shoreline Lot Stability and Erosion Hazard

A semi-natural stone retaining wall/erosion protection was in place along the proposed shoreline lots, as shown in the photo below. No significant slope along the shoreline is present that would pose a risk from a global stability perspective.

Malroz reviewed the risk of shoreline erosion based on the Technical Guide for Great Lakes–St. Lawrence River Shorelines (MNR, 1996). In accordance with Section 4.6.1(a) of the guide, the potential for shoreline erosion at this location would be low provided no appreciable grade raises are made near the shoreline. Subsurface investigation identified shallow granitic bedrock across the site, which provides an erosion-resistant shoreline condition. Unlike unconsolidated sediments, bedrock is not subject to appreciable long-term recession under wave action. The risk of measurable shoreline retreat over the design life of the development is therefore minimal, and the standard erosion allowance can be reasonably reduced in this context. Any significant shoreline alterations should be reviewed by a qualified professional. It is noteworthy that the shoreline is well sheltered by the presence of islands, reducing fetch and presence of strong currents.

7.0 General Conditions and Limitations

This report was completed for the specific needs of 1000989284 Ontario Inc. and is based on a specific scope of work which is defined in the mutually agreed upon workplan. The scope of work has limitations as described throughout the report and in the notice to reader. Data, tables, charts, and interpretive illustrations presented in this document are instruments of service for this mandate and can only be properly evaluated when reviewed together with the accompanying report. Reference to this report should only be made to the complete signed document.

By issuing this report, Malroz is the Geotechnical Engineer of Record for this project. It is recommended that Malroz be retained during construction of all foundations, for earthwork operations and for paving. The intent of this requirement is to verify conditions encountered during construction are consistent with the findings in the report and, that inherent knowledge developed as a part of our study is correctly carried forward to construction phases. We should be retained to review whether our recommendations have been applied appropriately, once drawings and specifications are complete. Without this review, Malroz will not be liable for any misunderstanding of our recommendations or their application and adaptation into final designs.

The work performed in this report was carried out in accordance with the terms and conditions made as a part of our proposal and/or contract pursuant to which this report was issued, in a manner consistent with that level of care and skill ordinarily exercised by members of the Geotechnical Engineering profession currently practicing under similar conditions in the same locality. The conclusions presented in the report are based solely upon the scope of services, governed by the time and budgetary considerations to which this work was subject.

The factual data, recommendations and comments in this report pertain to the specific project as described in the report, and are not applicable to any other project or location. If the project is conceptually modified or changes location, or if it is not initiated within twelve months of the date of this report, Malroz should be given an opportunity to confirm that the information in this report is still valid and/or applicable.

The comments in this report are intended only for the guidance of project designers and engineers. Contractors bidding on or undertaking the work should rely on their own

investigations, as well as their own interpretations of the factual test pit and in-situ test information, and how subsurface conditions may affect their work.

This report must be read as a whole, as sections taken out of context can be misleading. Drafts and working copies, whether or not marked as “draft”, “for discussion purposes” or otherwise, do not necessarily reflect Malroz’s final opinion following consideration of all matters which are subject to the study giving rise thereto; they are issued for comment and information purposes only, and are subject to change and should not be relied upon in any way or for any purpose.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based solely on the results obtained at the borehole locations only. Soil and groundwater conditions between and beyond the test pit locations may differ both horizontally and vertically from those encountered at the test pit locations and may become apparent during construction, which could not be detected or anticipated at the time of our investigation. Should any conditions at the site be encountered which differ from those found during this investigation, we request that we be notified immediately in order to permit a reassessment of our comment and recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by Malroz has been completed.

8.0 Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us should there be any further questions or comments.

Respectfully Submitted,

Malroz Engineering Inc.,

per: Tristan Brundridge, C.Tech.
Senior Technologist, Project Coordinator

per: Dylan Hill, P. Eng.
Senior Geotechnical Engineer

reviewed: David Hodgson, P.Eng.
Senior Engineer, Principal

9.0 References

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Appendix A
Figures

Legend

- proposed borehole location inaccessible
- approximate borehole location
- approximate monitoring well location

Data Sources: Figure based on Malroz field observations and Google Earth imagery.

Rev	Date	Description	By	Chkd
D0	2025-08-18	issued in draft	TB	DPH

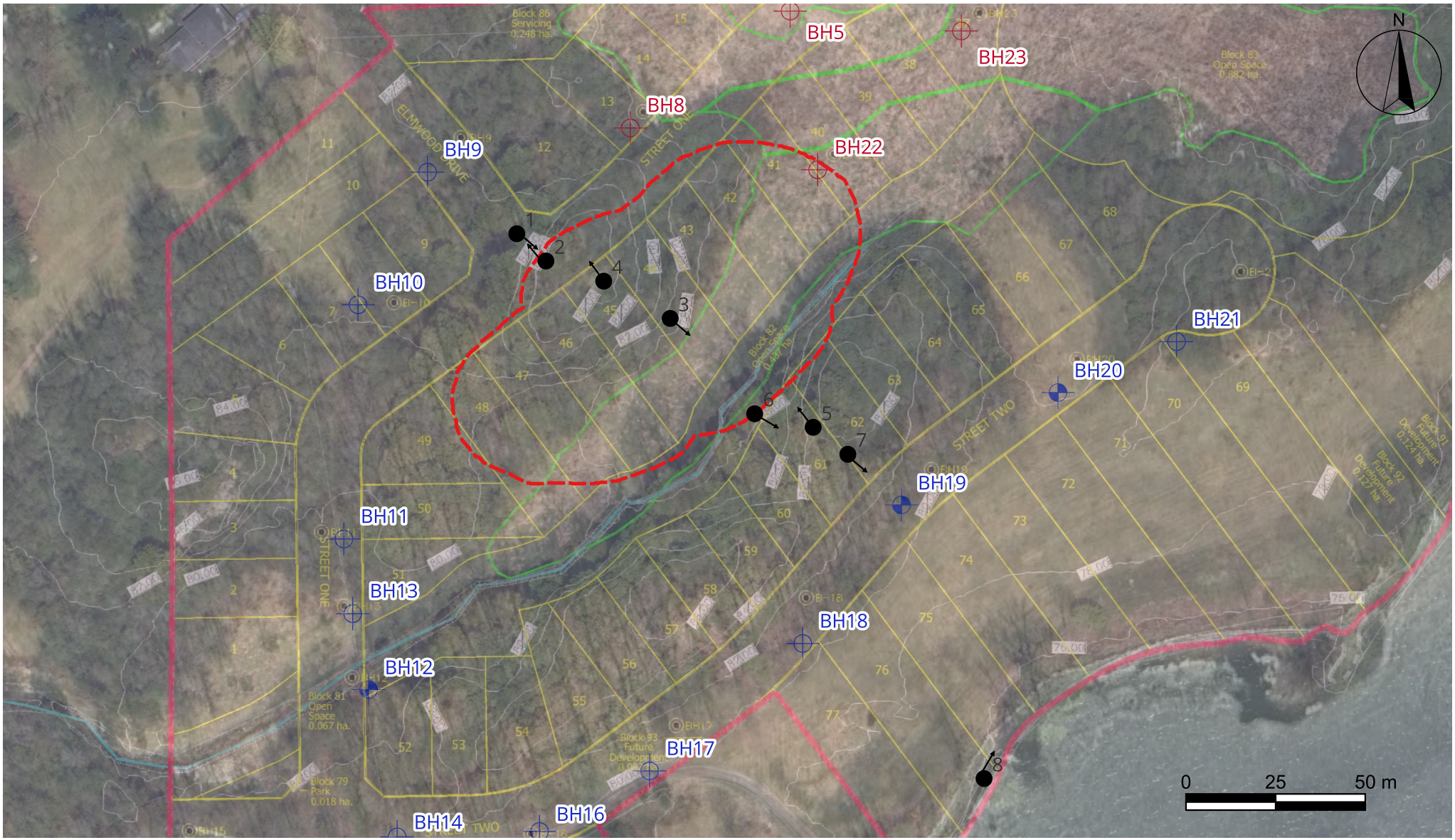
Borehole Location Plan

Elmwood Residential Subdivision
Gananoque, ON

File: 1956.00-100

Figure 1

MALROZ



Legend

- proposed borehole location inaccessible
- approximate borehole location
- approximate monitoring well location
- Photo Number, Location and Direction (Reference to Photo Appendix)
- approximate area of concern as outlined in Official Plan drawing

Data Sources: Figure based on Malroz field observations, Google Earth imagery, and Forefront Engineering Inc. Drawing "BH" dated 2025-09-04

Rev	Date	Description	By	Chkd
D0	2025-09-11	for issue	TB	DPH

Photo Key for Photo Appendix

Elmwood Residential Subdivision
Gananoque, ON

File: 1956.00-101

Figure 2

MALROZ

Appendix B
Record of Boreholes

WELL LOG

Enclosure No.: 1

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Well Number: **BH6**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **79.9 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408283.8 m**	Northing: **4909424.5 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Monitoring Well	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.0	79.8		**TOPSOIL** Brown, moist.	1.0 — 1.0 —					
0.2			**SILTY CLAY** Some sand, brown, moist, stiff to very stiff			SS1	25	12	12 ● ○19
0.4			g: 0%, sa: 16%, si: 37%, cl: 47%.						
0.6									
0.8				50 mm diameter PVC riser, bentonite hole plug					
1.0						SS2	100	12	12 ● ○35
1.2									
1.4				1.4 —					
1.6				1.5 —					
1.8						SS3	100	21	21 ● ○29
2.0									
2.2				50 mm diameter PVC riser, #2 silica sand					
2.4									
2.6				50 mm diameter PVC riser, slotted screen					
2.8						SS4	100	20	20 ● ○26
3.0	76.8		Borehole terminated at target depth (3.0 mbg).						
3.2									
3.4									
3.6									
3.8									

NOTES:

Well Construction Details
0.96 m stickup elev. within PVC casing
Sch. 40 PVC
4.32 mm slotted screen
screen
#2 sand

Groundwater Monitoring Details
monitored on 2025 July 31
DTW[1]: 2.2 m
DTB[1]: 2.7 m
[1]depths are reported from grade

nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 1956.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 25-8-15

BOREHOLE LOG

Enclosure No.: 2

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH7**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **81.4 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408303.3 m**	Northing: **4909444.1 m**
Drilling and Sampling Method: **100mm Solid-Stem Augers, 50mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.2			**FILL** Gravelly sand, trace silt, brown, damp, compact to dense.		SS1	50	11	11
0.4								
0.6								
0.8								
1.0					SS2	42	38	7 38
1.2	80.2		**SILTY SAND** Whiteish brown, moist, very dense.					
1.4								
1.6	79.8		Borehole terminated with practical refusal at 1.6 mbg.		SS3	0	R	
1.8								
2.0								
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 3

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH9**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **83.5 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408175.1 m**	Northing: **4909314.8 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.2	83.5		**TOPSOIL** Brown, moist.					
0.4			**SILTY CLAY** Trace sand, brown, moist, stiff.		SS1	42	10	10 ● ○19
0.6								
0.8	82.8		Borehole terminated with practical refusal at 0.8 mbg.					
1.0								
1.2								
1.4								
1.6								
1.8								
2.0								
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 4

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH10**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **83.6 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408155.7 m**	Northing: **4909277.8 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.0	83.5		**TOPSOIL** Brown, moist.					
0.2			**CLAYEY SILT** Some sand, brown, moist to wet		SS1	42	10	●10 ○27
0.4			g: 0%, sa: 19%, si: 60%, cl: 21%.					
0.6								
0.8								
1.0					SS2	100	5	●5 ○26
1.2			Becoming wet at 1.2 mbg.					
1.4								
1.6								
1.8					SS3	100	3	●3 ○32
2.0								
2.2	81.3		**BEDROCK** Granitic, reddish brown, poor quality					
2.4			scr: 61%.					
2.6								
2.8					RC1	100	33	
3.0								
3.2								
3.4								
3.6	80.1		Borehole terminated in granite bedrock at 3.5 mbg.					
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 5

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH11**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **80.4 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408151.8 m**	Northing: **4909212.5 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Description	Sample Number	Recovery (%)	SPT 'N' / RQD
0.0	80.3	**TOPSOIL** Brown, moist.			
0.2		**SILTY CLAY** Trace sand, brown, moist, stiff.	SS1	25	14
0.4					
0.6					
0.8					
1.0			SS2	100	12
1.2	79.2	**SAND** Brown, moist.			
1.4	79.0	**SILT** Some clay, trace sand, brown, moist, very stiff.			
1.6					
1.8			SS3	100	19
2.0					
2.2					
2.4					
2.6					
2.8			SS4	100	25
3.0	77.4	Borehole terminated at target depth (3.0 mbg).			
3.2					
3.4					
3.6					
3.8					

Shear Strength (kPa)

50 100 150 200

DCPT ■ SPT-N ●

PL MC LL

20 40 60 80

SS1: 14 ● 26 ○

SS2: 12 ● 24 ○

SS3: 19 ● 19

SS4: 25 ○ ●

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

WELL LOG

Enclosure No.: 6

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Well Number: **BH12**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **80.2 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408158.7 m**	Northing: **4909170.5 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Monitoring Well	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.0	80.2		**TOPSOIL** Brown, moist.	0.8 — 0.8 —					
0.2			**SILTY CLAY** Trace sand, brown, moist to wet, firm to stiff.	50 mm diameter PVC riser, bentonite hole plug		SS1	50	6	6 ● ○27
0.4									
0.6									
0.8									
1.0			Becoming wet at 1.1 mbg.	1.1 — 1.2 —		SS2	100	10	10 ● ○28
1.2									
1.4									
1.6									
1.8						SS3	100	15	15 ● ○25
2.0				50 mm diameter PVC riser, #2 silica sand 50 mm diameter PVC riser, slotted screen					
2.2									
2.4									
2.6									
2.8						SS4	100	15	15 ● ○23
3.0	77.2		Borehole terminated at target depth (3.0 mbg).						
3.2									
3.4									
3.6									
3.8									

NOTES:

Well Construction Details
0.78 m stickup elev. within PVC casing
Sch. 40 PVC
4.32 mm slotted screen
screen
#2 sand

Groundwater Monitoring Details
monitored on 2025 July 31
DTW[1]: 1.1 m
DTB[1]: 2.8 m
[1]depths are reported from grade

nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 1956.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 25-8-15

BOREHOLE LOG

Enclosure No.: 7

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH13**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **80.1 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408154.3 m**	Northing: **4909191.6 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.0	80.0		**TOPSOIL** Brown, moist.					
0.2			**SILTY SAND** Some gravel, brown, moist, compact.		SS1	50	12	12 ● ○ 17
0.4								
0.6								
0.8	79.3		**CLAYEY SILT** Trace sand, brown to greyish brown, moist, stiff to very stiff.					
1.0					SS2	100	11	11 ● ○ 29
1.2								
1.4								
1.6								
1.8					SS3	100	19	19 ● 19
2.0								
2.2								
2.4								
2.6								
2.8					SS4	100	17	17 ● ○ 19
3.0	77.0		Borehole terminated at target depth (3.0 mbg).					
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 8

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH14**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **82.1 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408166.7 m**	Northing: **4909129.3 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.2	81.9		**TOPSOIL** Brown, moist.					
0.4			**CLAYEY SILT** Trace sand, brown, moist g: 0%, sa: 6%, si: 72%, cl: 22%.		SS1	88	14	14 ● ○21
0.6								
0.8								
1.0					SS2	100	14	14 ● ~~○24~~
1.2								
1.4								
1.6								
1.8					SS3	100	15	15 ● ○28
2.0								
2.2	79.9		**SILTY SAND** Trace clay, reddish brown, moist, compact.					
2.4								
2.6								
2.8					SS4	100	13	13 ● ○22
3.0	79.0		Borehole terminated at target depth (3.0 mbg).					
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 9

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH15**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **81.4 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408116.3 m**	Northing: **4909128.1 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT■ ●SPT-N● PL MC LL 20 40 60 80
0.2			**TOPSOIL** Trace rootlets, brown, moist.					
0.4					SS1	34	9	9 ● ○24
0.6								
0.8	80.6		**SILTY CLAY** Trace gravel, trace sand, brown, moist, firm.					
1.0					SS2	100	6	6 ● ○28
1.2								
1.4								
1.6					SS3	100	R	○17
1.8	79.6		**SAND** Trace gravel, light brown, moist.					
2.0	79.6		Borehole terminated with practical refusal at 1.8 mbg.					
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 10

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH16**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 15**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 15**	Elevation: **81.3 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408206.4 m**	Northing: **4909130.9 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0.0	81.2		**TOPSOIL** Trace rootlets, brown, moist.					
0.2			**SILTY CLAY** Trace sand, brown, moist, firm to stiff.		SS1	100	7	7 ● ○36
0.4								
0.6								
0.8								
1.0					SS2	100	9	9 ● ○23
1.2								
1.4								
1.6								
1.8					SS3	100	19	19 ● 19
2.0								
2.2								
2.4								
2.6								
2.8					SS4	100	12	12 ● ○28
3.0	78.2		Borehole terminated at target depth (3.0 mbg).					
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 11

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH17**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **80.3 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408237.1 m**	Northing: **4909147.8 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0	80.2		**TOPSOIL** Brown, moist.					
0.2			**SILTY CLAY** Some sand, trace gravel, brown, moist, firm.		SS1	53	9	9 ●9
0.4	79.8		Borehole terminated with practical refusal at 0.5 mbg.					
0.6								
0.8								
1.0								
1.2								
1.4								
1.6								
1.8								
2.0								
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 12

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH18**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **80.9 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408279.8 m**	Northing: **4909183.3 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT ●SPT-N● PL MC LL 20 40 60 80
0	80.8		**TOPSOIL** Brown, moist.					
0.2			**SILTY CLAY** Trace sand, brown, moist, stiff.		SS1	84	11	11 ● ○20
0.4								
0.6								
0.8								
1.0					SS2	0	R	○27
1.2	79.7		Borehole terminated with practical refusal at 1.2 mbg.					
1.4								
1.6								
1.8								
2.0								
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG

Enclosure No.: 13

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Borehole Number: **BH19**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **81.0 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408307.3 m**	Northing: **4909222.0 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Description	Monitoring Well	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa)
0.0	80.9	**TOPSOIL** Brown, moist.	1.1 — 1.1 —				
0.2		**SILTY CLAY** Trace sand, brown, moist, firm to stiff.		SS1	67	12	12 ● 19 ○
0.4							
0.6							
0.8			50 mm diameter PVC riser, bentonite hole plug				
1.0				SS2	100	8	8 ● 33 ○
1.2							
1.4	79.6	**BEDROCK** Granitic, reddish brown, fair quality scr: 66%.	1.4 — 1.5 —				
1.6							
1.8							
2.0							
2.2				RC1	100	56	
2.4			50 mm diameter PVC riser, #2 silica sand 50 mm diameter PVC riser, slotted screen				
2.6							
2.8							
3.0	77.9	Borehole terminated in granite bedrock at 3.0 mbg.					
3.2							
3.4							
3.6							
3.8							

Shear Strength (kPa): 50, 100, 150, 200 — ■ DCPT ■ ● SPT-N ● — PL, MC, LL — 20, 40, 60, 80

NOTES:

Well Construction Details
1.06 m stickup elev. within PVC casing
Sch. 40 PVC
4.32 mm slotted screen
screen
#2 sand

Groundwater Monitoring Details
monitored on 2025 July 31
DTW[1]: 2.8 m
DTB[1]: 3.1 m
[1]depths are reported from grade

nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 1956.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 25-8-15

WELL LOG

Enclosure No.: 14

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Well Number: **BH20**	Page: **1 of 1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **78.3 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408351.0 m**	Northing: **4909253.3 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Description	Monitoring Well	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa)
0.0	78.3	**TOPSOIL** Brown, moist.	1.0 — 1.0 —				
0.2		**CLAYEY SILT** Trace sand, brown, moist, stiff to very stiff g: 0%, sa: 8%, si: 70%, cl: 22%.		SS1	63	9	9 ● 23 ○
0.4							
0.6							
0.8			50 mm diameter PVC riser, bentonite hole plug				
1.0				SS2	100	11	11 ● 27 ○
1.2							
1.4			1.4 —				
1.6			1.5 —				
1.8				SS3	100	14	14 ● ~~21~~ ○
2.0							
2.2							
2.4			50 mm diameter PVC riser, #2 silica sand				
2.6			50 mm diameter PVC riser, slotted screen				
2.8				SS4	100	18	18 ● 28 ○
3.0	75.3	Borehole terminated at target depth (3.0 mbg).					
3.2							
3.4							
3.6							
3.8							

Shear Strength (kPa): 50, 100, 150, 200 — ■ DCPT ● SPT-N — PL, MC, LL — 20, 40, 60, 80

NOTES:

Well Construction Details
- 0.95 m stickup elev. within PVC casing
- Sch. 40 PVC
- 4.32 mm slotted screen
- screen
- #2 sand

Groundwater Monitoring Details
monitored on 2025 July 31
DTW[1]: 2.0 m
DTB[1]: 3.2 m
[1]depths are reported from grade

nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 1956.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 25-8-15

WELL LOG

Enclosure No.: 15

Project Name: **Geotechnical Investigation for Elmwood Residential Subdivison**		Project Number: **1956.00**
Client: **Forefront Engineering Inc.**	Well Number: **BH21**	Page: **1** of **1**
Location: **Gananoque, ON**	Date Started: **2025 July 14**	Datum: **NAD 83 UTM Zone 18N**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2025 July 14**	Elevation: **81.7 m**
Drilling Equipment: **Massenza MI3 Geo/Enviro Combo**	Easting: **408384.0 m**	Northing: **4909267.5 m**
Drilling and Sampling Method: **NW Casing, 50 mm Split Spoons**	Logged By: **T. Brundridge**	Checked By: **D. Hill**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■DCPT■ ●SPT-N● PL MC LL 20 40 60 80
0.0	81.7		**TOPSOIL** Brown, moist.					
0.2			**SAND AND GRAVEL / GRAVEL AND SAND** Silty, greyish brown, moist, compact.		SS1	25	21	21
0.4								
0.6								
0.8					SS2	100	R	31
1.0	80.6		Borehole terminated with practical refusal at 1.1 mbg.					
1.2								
1.4								
1.6								
1.8								
2.0								
2.2								
2.4								
2.6								
2.8								
3.0								
3.2								
3.4								
3.6								
3.8								

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 1956.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 25-8-15

Appendix C
Bedrock Core Photographs

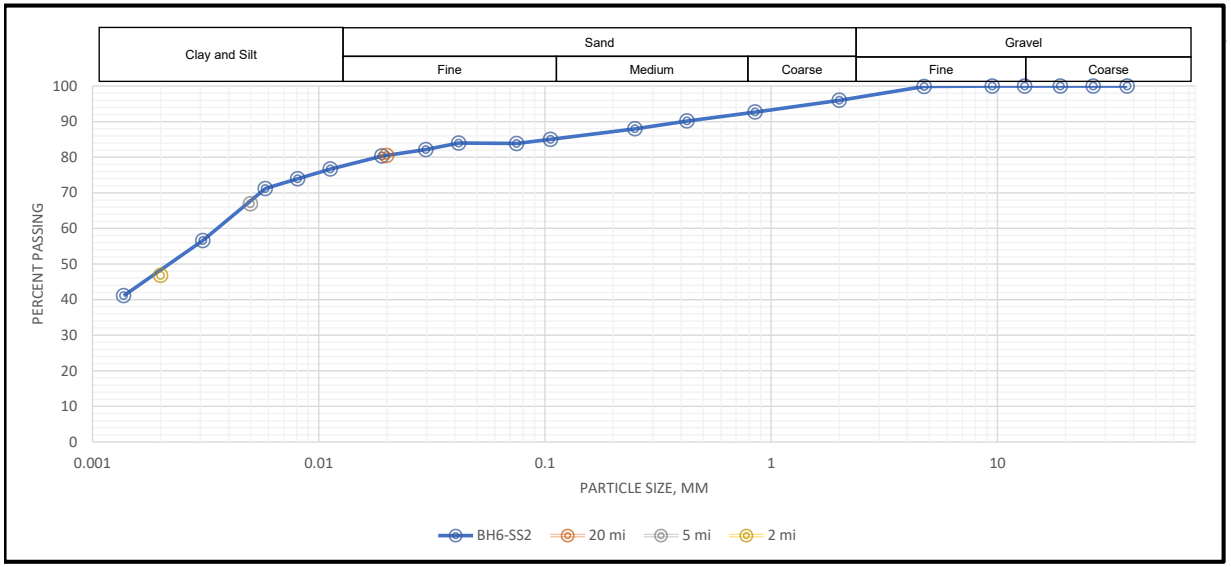
Figure 1 – BH10/RC1

Figure 2 – BH19/RC1

Appendix D
Geotechnical Laboratory Results

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Particle Size Analysis (LS-702)



Clay (%)	Silt (%)	Sand (%)	Gravel (%)
47	37	16	0
silty CLAY, some sand			

Lab No.: SA25-060A
Project No.: 1956.00
Sample ID: BH6-SS2
Location: Elmwood Subdivision, Gananoque, ON
Client: Forefront Engineering

Tested: TB
Date: 2025-07-23

Notes: Additional information available upon request

Validated:
Date: 2025-08-15

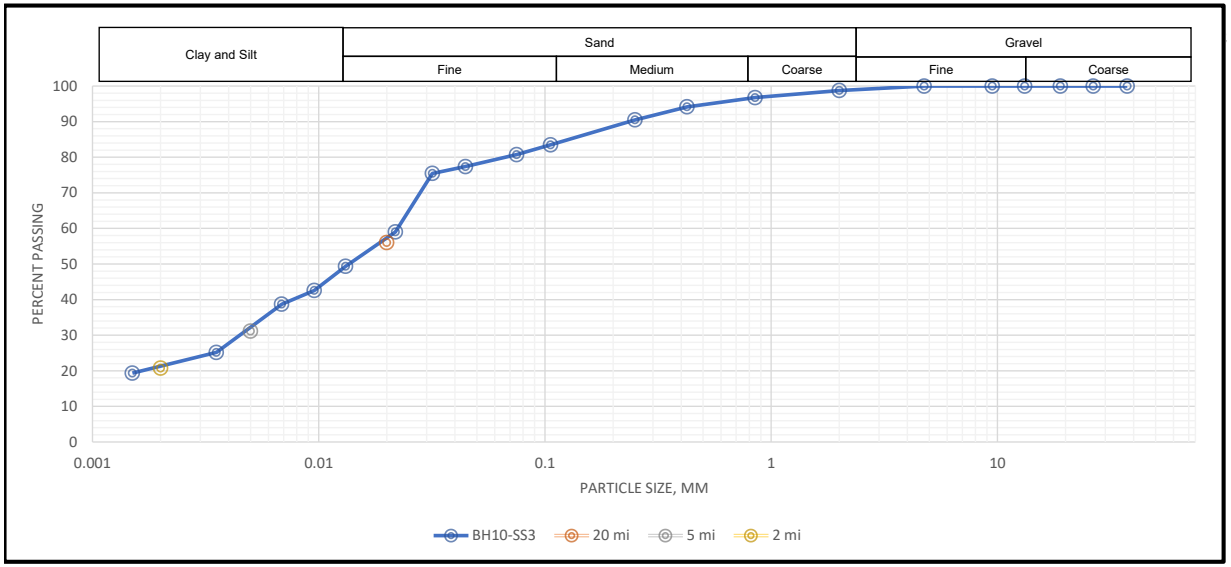
Supplementary Data:

Volume of bulb, V_B (cm^3)	57	Specific Gravity, GS (assumed):	2.7
Length of Bulb, L_2 (cm)	13.60	Dispersing Agent (g/L):	40
Scale Dimension, h_s (cm/Div.)	0.18	Area of Cylinder, A (cm^2)	28.3
Maximum Particle Size (mm):	19	0' to Top of Bulb, L_1 (cm)	11.0

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Particle Size Analysis (LS-702)



Clay (%)	Silt (%)	Sand (%)	Gravel (%)
21	60	19	0
clayey SILT, some sand			

Lab No.: SA25-060B
Project No.: 1956.00
Sample ID: BH10-SS3
Location: Elmwood Subdivision, Gananoque, ON
Client: Forefront Engineering

Tested: TB
Date: 2025-07-23

Validated:
Date: 2025-08-15

Notes: Additional information available upon request

Supplementary Data:

Volume of bulb, V_B (cm^3)	57	Specific Gravity, GS (assumed):	2.7
Length of Bulb, L_2 (cm)	13.60	Dispersing Agent (g/L):	40
Scale Dimension, h_s (cm/Div.)	0.18	Area of Cylinder, A (cm^2)	28.3
Maximum Particle Size (mm):	19	0' to Top of Bulb, L_1 (cm)	11.0

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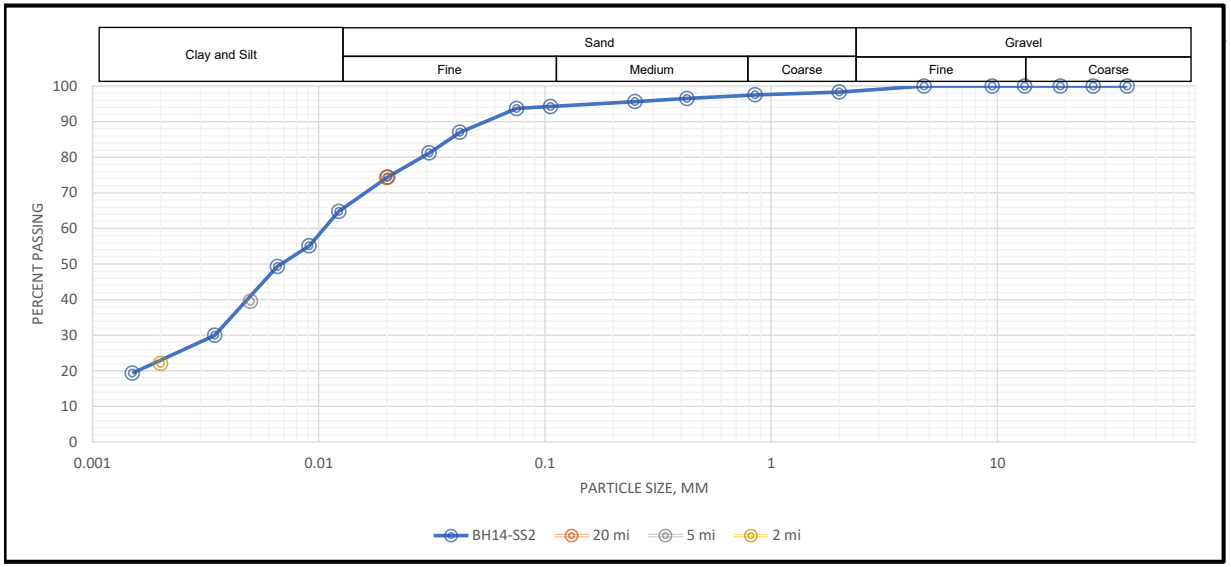
Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Particle Size Analysis (LS-702)



Clay (%)	Silt (%)	Sand (%)	Gravel (%)
22	72	6	0
clayey SILT, trace sand			

Lab No.: SA25-060C
Project No.: 1956.00
Sample ID: BH14-SS2
Location: Elmwood Subdivision, Gananoque, ON
Client: Forefront Engineering

Tested: TB
Date: 2025-07-23

Notes: Additional information available upon request

Validated:
Date: 2025-08-15

Supplementary Data:

Volume of bulb, V_B (cm^3)	57	Specific Gravity, GS (assumed):	2.7
Length of Bulb, L_2 (cm)	13.60	Dispersing Agent (g/L):	40
Scale Dimension, h_s (cm/Div.)	0.18	Area of Cylinder, A (cm^2)	28.3
Maximum Particle Size (mm):	19	0' to Top of Bulb, L_1 (cm)	11.0

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

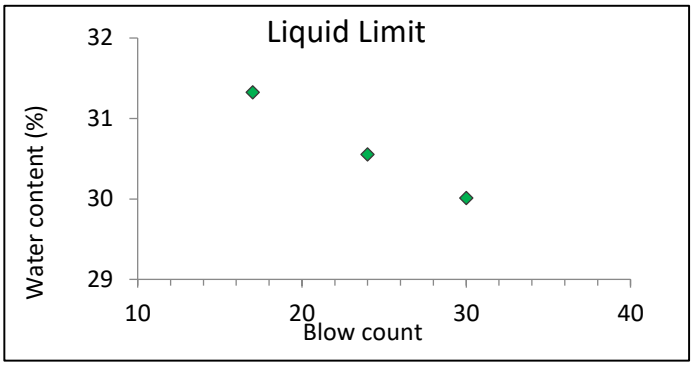
Atterberg Limits Test Summary (LS 703/704)

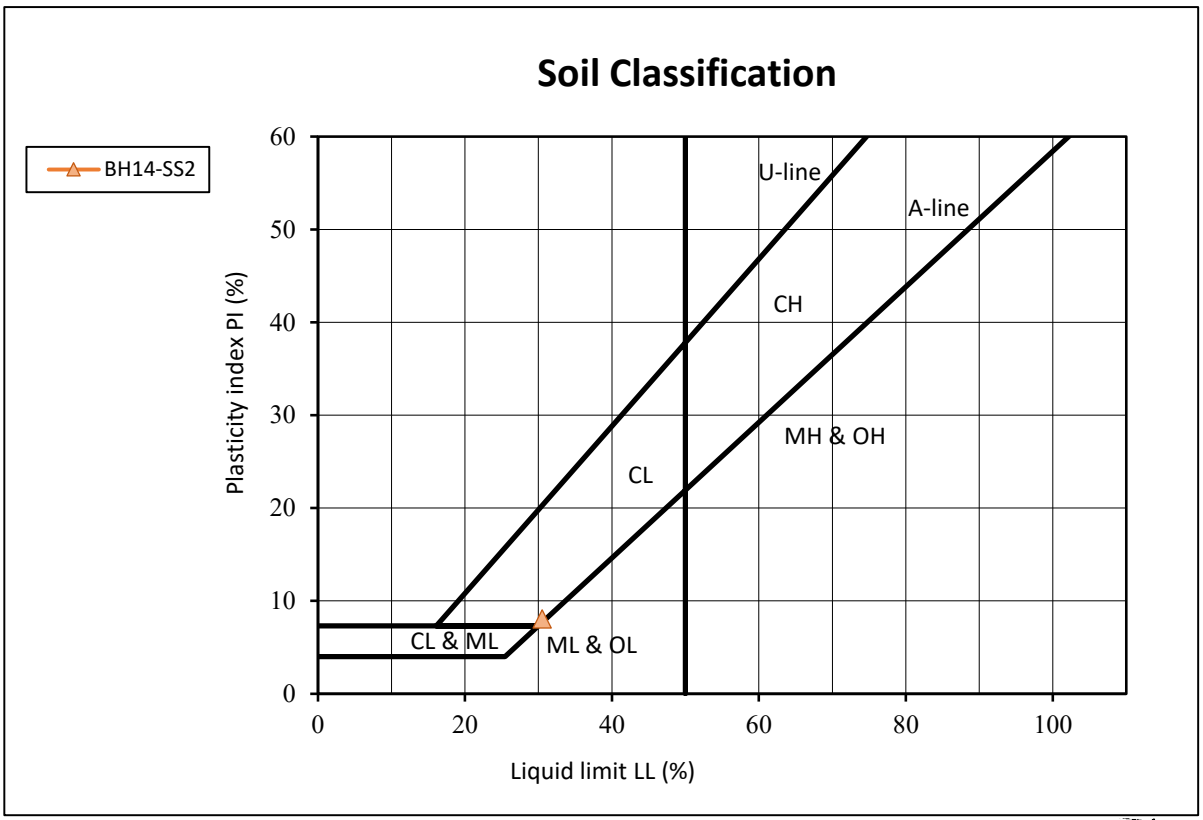
Client: Forefront Engineering
Project No.: 1956
Location: Elmwood Subdivison, Gananoque ON
Sample: BH14-SS2
Depth: 2'6"-4'6"

Lab No. SA25-060E
Tested By: TB
Date Tested: 2025-07-23

Atterberg Limits

Liquid Limit	**30.5%**
Plastic Limit	**22.4%**
Plasticity Index	**8.0%**





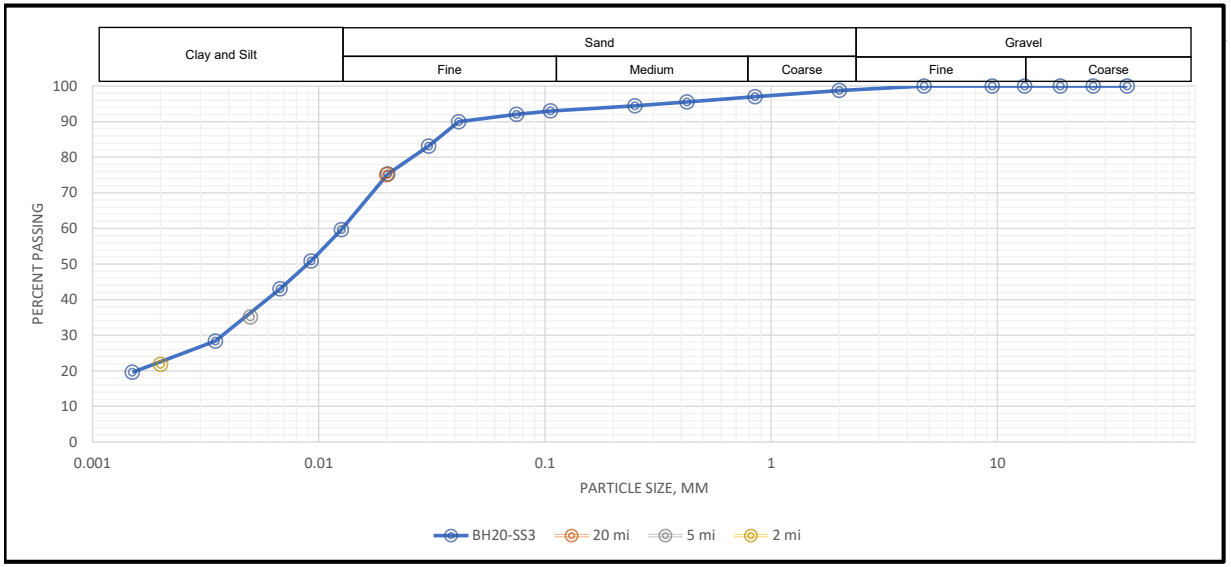
Notes: Additional information available upon request

Validated By:

Date: 18-08-2025

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Particle Size Analysis (LS-702)



Clay (%)	Silt (%)	Sand (%)	Gravel (%)
22	70	8	0
clayey SILT, trace sand			

Lab No.: SA25-060D
Project No.: 1956.00
Sample ID: BH20-SS3
Location: Elmwood Subdivision, Gananoque, ON
Client: Forefront Engineering

Tested: TB
Date: 2025-07-23

Notes: Additional information available upon request

Validated:
Date: 2025-08-15

Supplementary Data:

Volume of bulb, V_B (cm^3)	57	Specific Gravity, GS (assumed):	2.7
Length of Bulb, L_2 (cm)	13.60	Dispersing Agent (g/L):	40
Scale Dimension, h_s (cm/Div.)	0.18	Area of Cylinder, A (cm^2)	28.3
Maximum Particle Size (mm):	19	0' to Top of Bulb, L_1 (cm)	11.0

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Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

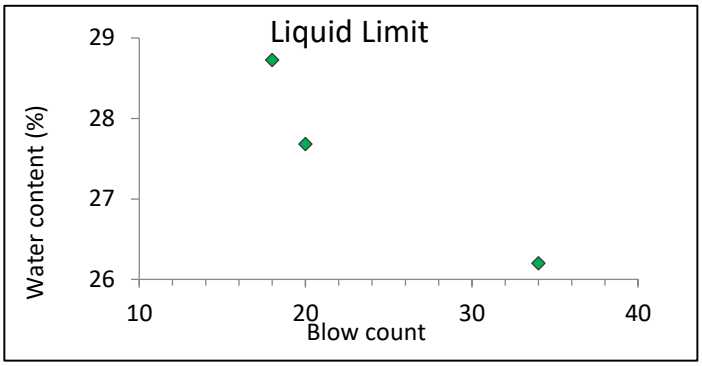
Atterberg Limits Test Summary (LS 703/704)

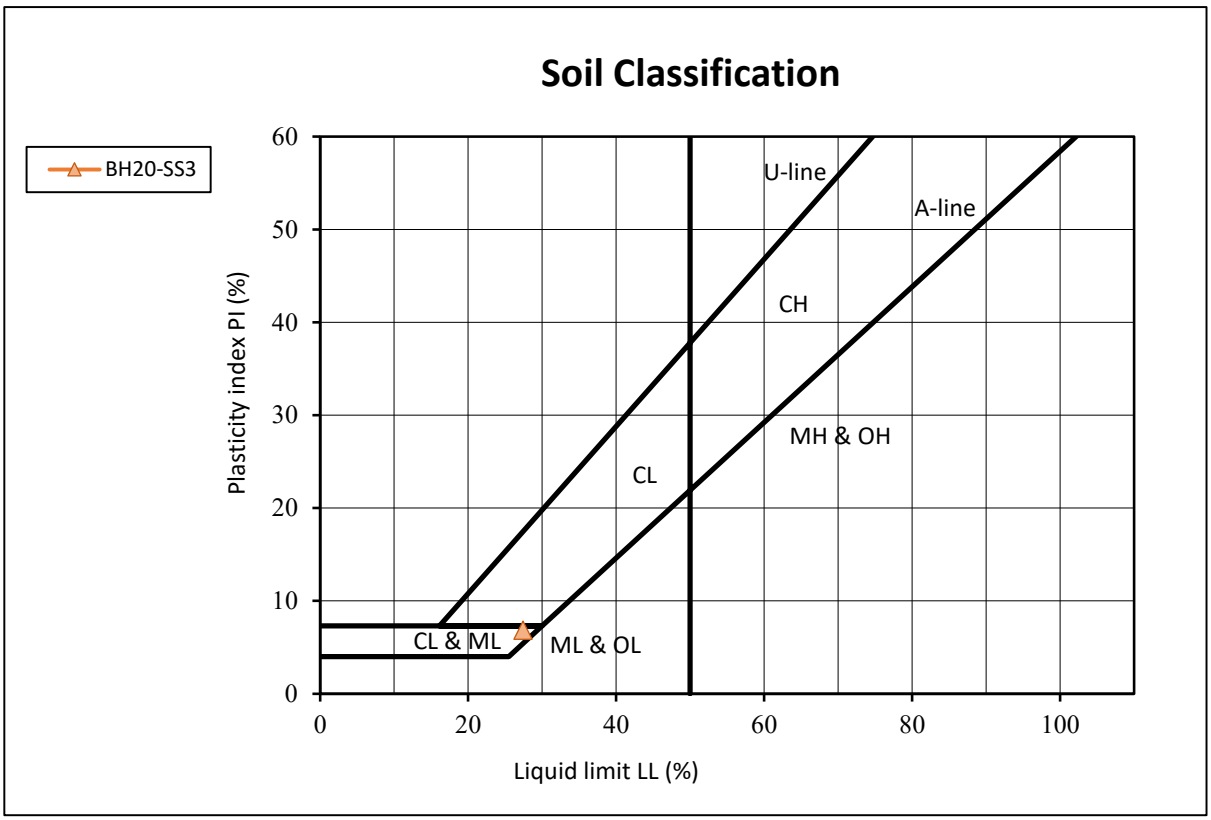
Client: Forefront Engineering
Project No.: 1956
Location: Elmwood Subdivison, Gananoque, ON
Sample: BH20-SS3
Depth: 5'-7'

Lab No. SA25-060F
Tested By: TB
Date Tested: 2025-07-23

Atterberg Limits

Liquid Limit	**27.4%**
Plastic Limit	**20.5%**
Plasticity Index	**6.9%**





Notes: Additional information available upon request

Validated By:

Date: 18-08-2025

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Summary of Results for Unconfined Compressive Strength

Sample ID	Density (g/cm^3)	UCS (MPa)
BH10-RC1	3.43	158.6

Client:	Forefront Engineering
Project No.:	1956
Location:	Elmwood Residential Subdivision, Gananoque, ON
BH:	BH10-RC1
Depth:	7'4"-11'7"
Lab No.:	SA25-060E
Date Sampled:	2025-07-14
Sampled By:	TB
Date Tested:	2025-07-23

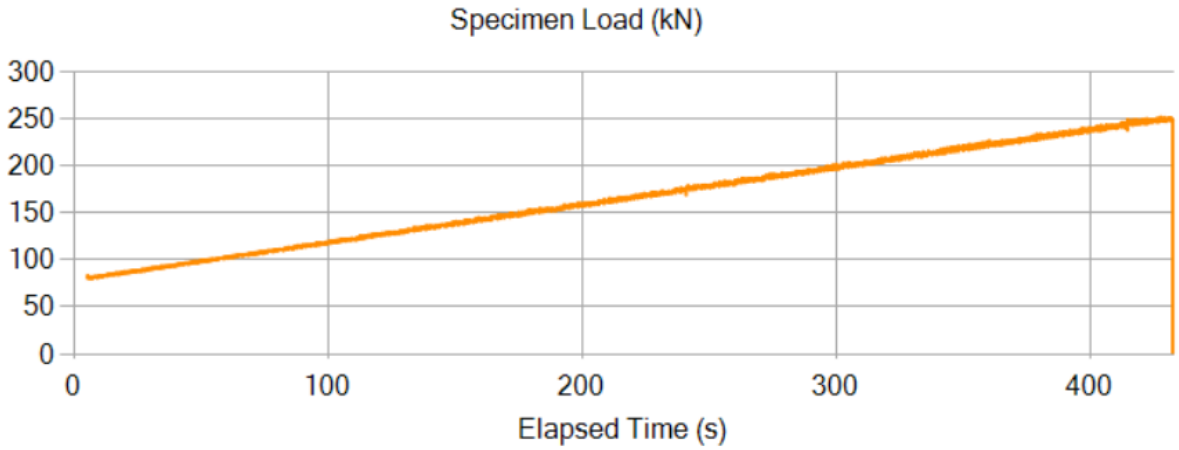


***Figure 1**: Pre- and Post-Test Specimen Photos*

Tested By: Will Archer
Approved:
Date: 2025-07-23

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Summary of Results for Unconfined Compressive Strength

Sample ID	Density (g/cm^3)	UCS (MPa)
BH19-RC1	2.99	109.84

Client:	Forefront Engineering
Project No.:	1956
Location:	Elmwood Residential Subdivision, Gananoque, ON
BH:	BH19-RC1
Depth:	4’7”-10’
Lab No.:	SA25-060F
Date Sampled:	2025-07-14
Sampled By:	TB
Date Tested:	2025-07-23

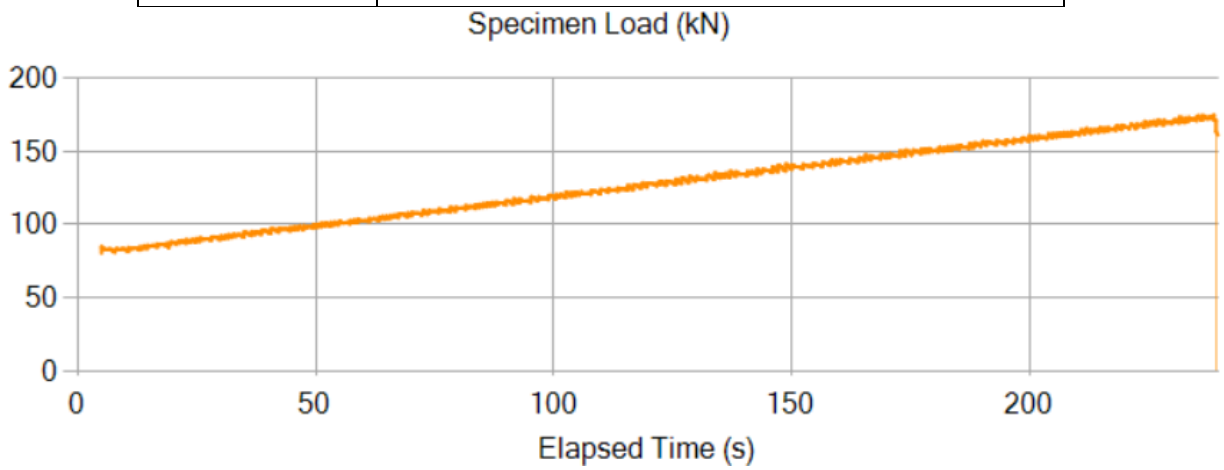


***Figure 1**: Pre- and Post-Test Specimen Photos*

Tested By: Will Archer
Approver:
Date: 2025-07-23

Appendix E
Slope Evaluation Field Sheets and Photo Log

TABLE 4.1 - Slope Inspection Record

1. FILE NAME / NO. 1956.00
INSPECTION DATE (DDMMYY): 09.09.25
WEATHER (circle):
• sunny • partly cloudy • cloudy
• calm • breeze • windy
• clear • fog • rain • snow
• cold • cool • warm • hot
estimated air temperature: 18.0 °C

INSPECTED BY (name): T. Brundridge

2. SITE LOCATION (describe main roads, features) Elmwood Subdivison, Gananoque, ON

SKETCH See attached site plan

3. WATERSHED St. Lawrence River (primary)

4. PROPERTY OWNERSHIP (name, address, phone):

LEGAL DESCRIPTION
Lot
Concession
Township
County

CURRENT LAND USE (circle and describe)
• vacant -field, bush, woods, forest, wilderness, tundra,

• passive -recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools,

• active -habitable structures, residential, commercial, industrial, warehousing and storage,

• infra-structure or public use - stadiums, hospitals,
schools, bridges, high voltage power lines, waste management sites,

5. SLOPE DATA

HEIGHT • 3 - 6 m • 6 - 10 m • 10 - 15 m • 15 - 20 m
• 20 - 25 m • 25 - 30 m • > 30 m
estimated height (m): 7 m

INCLINATION AND SHAPE

• 4:1 or flatter 25 % 14°	• up to 3:1 33 % 18 °	• up to 2:1 50 % 26 °
• up to 1:1 100 % 45°	• up to :1 200 % 63 °	• steeper than :1 > 63 °

6. SLOPE DRAINAGE (describe)

TOP
FACE
BOTTOM

Some exposed rock

7. SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types)

TOP
FACE
BOTTOM

Exposed Granitic, thin drift of topsoil, root mat

8. WATER COURSE FEATURES (circle and describe)

SWALE, CHANNEL

GULLY

STREAM, CREEK, RIVER

POND, BAY, LAKE

SPRINGS

MARSHY GROUND - Base of slope

9. VEGETATION COVER(grasses, weeds, shrubs, saplings, trees)

TOP
FACE
BOTTOM

mature trees, significant undergrowth

10. STRUCTURES(buildings, walls, fences, sewers, roads, stairs, decks, towers,)

TOP

FACE N/A

BOTTOM

11. EROSION FEATURES(scour, undercutting, bare areas, piping, rills, gully)

TOP
FACE
BOTTOM

Exposed rock

12. SLOPE SLIDE FEATURES(tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees)

TOP

FACE N/A

BOTTOM

13. PLAN SKETCH OF SLOPE

See attached

14. PROFILE SKETCH OF SLOPE

See attached

TABLE 4.2 - SLOPE STABILITY RATING CHART

Site Location: File No.
Property Owner: Inspection Date:
Inspected By: Weather:

1. SLOPE INCLINATION			
	degrees	**horiz. : vert.**	
	a) 18 or less	3 : 1 or flatter	0
	b) 18 - 26	2 : 1 to more than 3 : 1	(6)
	c) more than 26	steeper than 2 : 1	16
2. SOIL STRATIGRAPHY			
	a) Shale, Limestone, Granite (Bedrock)		(0)
	b) Sand, Gravel		6
	c) Glacial Till		9
	d) Clay, Silt		12
	e) Fill		16
	f) Leda Clay		24
3. SEEPAGE FROM SLOPE FACE			
	a) None or Near bottom only		(0)
	b) Near mid-slope only		6
	c) Near crest only or, From several levels		12
4. SLOPE HEIGHT			
	a) 2 m or less		0
	b) 2.1 to 5 m		2
	c) 5.1 to 10 m		(4)
	d) more than 10 m		8
5. VEGETATION COVER ON SLOPE FACE			
	a) Well vegetated; heavy shrubs or forested with mature trees		(0)
	b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
	c) No vegetation, bare		8
6. TABLE LAND DRAINAGE			
	a) Table land flat, no apparent drainage over slope		(0)
	b) Minor drainage over slope, no active erosion		(2)
	c) Drainage over slope, active erosion, gullies		4
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE			
	a)15 metres or more from slope toe		(0)
	b)Less than 15 metres from slope toe		6
8. PREVIOUS LANDSLIDE ACTIVITY			
	a) No		(0)
	b) Yes		6
SLOPE INSTABILITY RATING VALUES INVESTIGATION RATING SUMMARY			**TOTAL** 12

2025-09-09

Photo 1: View from the bottom of the northwest slope of the prominence southeast of BH9, facing southeast

2025-09-09

Photo 2: View from the top of the northwest slope of the prominence southeast of BH9, facing northwest

2025-09-09

Photo 3: View from the midslope of the southwest slope of the prominence southeast of BH9, facing southeast

2025-09-09

Photo 4: View from the top of the southwest slope of the prominence southeast of BH9, facing northwest

2025-09-09

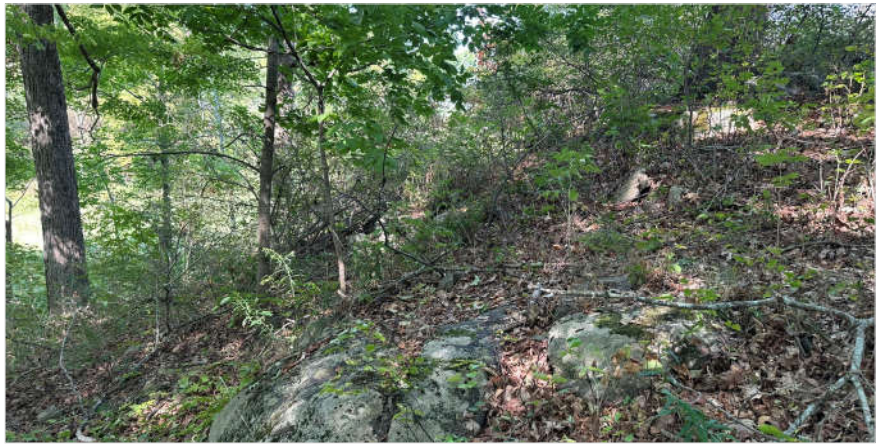


Photo 5: View of the exposed rock at the top of the northwest slope of the prominence northwest of BH19, facing northeast

2025-09-09

Photo 6: View of the exposed rock at the bottom of the northwest slope of the prominence northwest of BH19, facing northeast

2025-09-09

Photo 7: View from the top of the prominence northwest of BH19, facing southeast towards BH19 and the St. Lawrence River

2025-07-31

Photo 8: View of the retaining wall at the shoreline of the St. Lawrence River, facing east