Proposed New Birches Nursing Home Site

Musquodoboit Harbour, NS

The Birches Nursing Home
Geotechnical Investigation, Phase 2, Revision #1

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The Birches Nursing Home

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1 Introduction

At the request of The Birches Nursing Home, Englobe Corp. carried out a preliminary geotechnical investigation (Phase 1) in February 2023 at the site of the proposed new Birches Nursing Home located in Musquodoboit Harbour, Nova Scotia. The purpose of the work was to characterize subsurface conditions and make geotechnical comments regarding the general suitability of the site for the proposed development, earthworks, and foundation design. Six test pits (TP1 to TP6) were excavated on February 15, 2023, and a preliminary geotechnical report dated March 6, 2023, was prepared by Englobe presenting observations and engineering recommendations associated with the geotechnical investigation of the site. A summary of subsurface conditions at the six test pit locations is included below in Table #1. The Phase 1 report should be read in conjunction with the current report.

Based on the findings of the Phase 1 investigation, a scope of work for a more detailed Phase 2 geotechnical investigation was prepared and the fieldwork was carried out on June 14 and 15, 2023.

This report presents our observations and engineering recommendations associated with the Phase 2 geotechnical investigation of the site. Included herein are the factual results of the field investigation including discussion of field procedures, subsurface conditions, laboratory analysis and recommendations for site development.

2 Site and Project Description

It is understood that the new development will be located in Musquodoboit Harbour, Nova Scotia and will be constructed on a 7.2-acre site, including a new building structure for the Birches Nursing Home, parking lot, and access roads.

Currently, the location is a greenfield site and tree covered except for an access road from Darius Lane which was tree-cleared at the time of the investigation. The topography of the proposed site can be generally described as sloping downward from northwest to southeast. During a site walkover and test pitting, large boulders were evident at the ground surface across the site.

3 Investigation Procedure

Fieldwork for the current investigation was carried out on June 14 and 15, 2023 when twenty (20) additional test pits were excavated at select locations across the proposed building site (see Figure 1). Test pit locations were pre-determined by Englobe and the client in advance of the investigation. The test pits were excavated with a 20-tonne tracked excavator supplied by a local contractor.

The investigation was carried out under the supervision of Englobe field engineering personnel who logged the subsurface conditions. Disturbed soil samples were obtained from the test pits. Following field sampling and visual description, overburden samples were placed in waterproof bags and transported to our Dartmouth laboratory for further examination and scheduling for geotechnical index testing.

4 Subsurface Conditions

Subsurface conditions encountered at the test pit locations consisted of a rootmat/topsoil layer overlying glacial till or glacial till and inferred bedrock/boulders. At twelve test pits underlying the glacial till, bedrock/large boulders were inferred by the refusal of the excavator bucket to advance the test pit. Bedrock depth ranged from 0.76 m to 3.81 m from the ground surface. Groundwater seepage was detected at twenty-one test pit locations. Groundwater depth ranged from 0.30 metres to 2.90 metres. Table 1 below summarizes the encountered subsurface conditions.

Table 1: Summary of Subsurface Conditions at Test Pit Locations

Location	Elevation (metres)	Thickness of topsoil/rootmat (metres)	Depth to Glacial Till (metres)	Depth to Groundwater (metres)	Depth to Inferred Bedrock/Large Boulder (metres)	Total Depth of Test Pit (metres)
TP1*	29.10	0.36	0.36	0.37	1.98	1.98
TP2*	29.60	0.31	0.31	2.30	3.66	3.66
TP3*	29.20	0.31	0.31	0.45	3.81	3.81
TP4*	28.60	0.31	0.31	0.30	NE	2.90
TP5*	27.60	0.46	0.46	0.30	NE	2.59
TP6*	27.40	0.46	0.46	0.30	NE	2.90
TP 7	30.30	0.41	0.41	0.76	0.76	0.76
TP 8	29.40	0.61	0.61	0.61	1.22	1.22
TP 9	29.30	0.61	0.64	0.61	1.22	1.22
TP 10	29.60	0.61	0.61	0.61	2.44	2.44
TP 11	29.40	0.41	0.41	0.41	1.52	1.52
TP 12	28.80	0.46	0.46	0.61	2.13	2.13
TP 13	29.60	0.31	0.31	0.61	NE	3.66
TP 14	29.70	0.31	0.31	NE	NE	3.81
TP 15	27.90	0.45	0.45	0.30	2.29	2.29
TP 16	30.00	0.31	0.31	2.90	2.90	2.90
TP 17	30.20	0.46	0.46	2.43	NE	3.35
TP 18	29.50	0.76	0.76	0.76	3.05	3.05
TP 19	30.20	0.31	0.31	0.30	NE	3.20
TP 20	30.10	0.31	0.31	NE	NE	3.35
TP 21	29.50	0.31	0.31	NE	NE	3.51
TP 22	29.30	0.31	0.31	NE	NE	3.12
TP 23	28.40	0.46	0.46	2.74	NE	3.20
TP 24	29.40	0.31	0.31	NE	NE	3.35
TP 25	30.10	0.31	0.31	1.83	NE	3.51
TP 26	29.20	0.41	0.41	0.41	NE	3.35

NE - Not Encountered

* Phase 1 Test Pits

Approximate test locations and an explanation of the terms and symbols used in the report are provided in Appendix A. A summary of the encountered geologic conditions is provided in the Test Pit Logs in Appendix B. Laboratory Testing results are provided in Appendix C.

It should be noted that the stratigraphic boundaries on the Test Pit logs typically represent a transition of one soil type to another and do not necessarily indicate an exact plane of geologic change. Subsurface conditions may vary between and beyond the test pit locations.

4.1 Rootmat/Topsoil

A layer consisting of rootmat and topsoil was observed in all test pits at the ground surface. The thickness ranged from 0.31 to 0.76 metres. The topsoil portion of the layer is generally brown to greyish brown and contains organic matter (roots, decayed organic matter, etc.). Cobbles and boulders were observed at many test pit locations at the ground surface and within the rootmat/topsoil layer.

4.2 Glacial Till

Available geological mapping of the area indicates that glacial deposits referred to as Stoney Till Plain and Drumlins underlie the development site. These deposits are derived from local bedrock sources and released from ice sheets by melting or dislodgement. Flat to rolling topography with many surface boulders; drumlins-elongate or oval hills veneered by stony till with underlying multiple till layers.

During the subsurface investigation, glacial till deposits have been encountered at all test pit locations. The glacial till deposits encountered generally varied from a silty sand and gravel mixture with some cobbles and boulders to a sand and clay mixture with some silt and trace gravel. The glacial till was typically compact to dense, moist to wet, and reddish brown in colour. The till was proven to depths up to 3.81 metres below the existing ground surface at TP3 and TP14, where the test pits were terminated in the till.

Laboratory gradation testing was completed on a total of five (5) select glacial till samples and indicated a material with a gravel content ranging from 5.6 to 16.4 percent, a sand content ranging from 33.4 to 66.0 percent, and fines (i.e. silt and clay sizes) content ranging from 28.0 to 61.0 percent. Please note that over-sized fractions (i.e. coarse gravel, cobbles, and boulders) were not sampled and included as part of the index testing. Moisture content testing on seven (7) test pit samples indicated values ranging from 12.9 to 17.1 percent. Laboratory test results can be found in Appendix C.

4.3 Bedrock

Available geologic mapping of the proposed development area indicates that the site is underlain by the Meguma Group and that the site is adjacent to a contact zone between the Goldenville Formation and Halifax Formation. These formations consist mainly of metasandstone/greywacke and slate and are typically grey in colour.

During the subsurface investigation for Phase 1 and Phase 2, inferred bedrock or large boulders were encountered at twelve test pit locations. Inferred bedrock/large boulders were encountered at depths ranging from 0.76 metres at test pit TP7 to 3.81 metres at test pit TP3. Bedrock, or large boulders, were inferred by excavator bucket refusal during the excavation of the test pits.

During the Phase 1 investigation a sample of the slate bedrock was obtained from within a test pit. The sample was broken off the surface of the bedrock with the excavator bucket and retained for acid-producing potential testing. The purpose of the current testing was to determine if the rock sample is sulphide bearing (i.e., has a sulphide sulphur content exceeding 0.4% and acid-producing potential

over 12.51 kg H2SO4 / t) as defined in the Nova Scotia *Sulphide Bearing Material Disposal Regulations*. The rock sample was submitted to the MEC of Dalhousie University in Halifax, NS for crushing and analysis of total sulphur content and acid-producing potential. The laboratory reported a total sulphur content (wt. %) of 0.005 and an acid-producing potential of 0.2 H2SO4/t. Based on these results, the slate rock sample tested would be considered non-sulphide bearing. A copy of the MEC laboratory certificate of analysis is attached.

Sulphide sulphur content may change with depth within the bedrock profile. If excavation (blasting or braking) into bedrock is required, additional sampling should be carried out in those areas at the depths of excavation.

4.4 Groundwater

Groundwater observations were made during the field investigation through open-hole measurements at the test pit locations. A summary of the accumulated groundwater information is provided in the Test Pit Logs in Appendix B.

At the time of excavation of the test pits, groundwater levels were inferred within twenty-one (21) test pits by seepage into the test pits. Groundwater depths ranged from 0.30 metres to 2.90 metres from the ground surface. The observed rate of infiltration into the test pits ranged from slight seepage to heavy seepage.

Perched groundwater should be expected during construction. Seasonal variations in groundwater levels can be expected.

5 Site Recommendations

5.1 Site Development – General

In the following paragraphs, a discussion of site development is presented in light of the observed subsurface conditions. The recommendations outlined in the following sections assume that the structure(s) will be located generally in the area investigated, as shown in Figure 1. Currently, it is understood that the new structure(s) and associated works will be of conventional design. Current recommendations are based on preliminary information currently available for the project. Finalized design details, when available for the project may affect some of the recommendations provided. Reassessment should be carried out as required with additional input by the geotechnical engineer as applicable.

The subsurface conditions encountered at test pit locations generally consist of a layer of rootmat/topsoil, underlain by glacial till or glacial till and bedrock/large boulders. Cobbles and large boulders were observed at the ground surface in the development area.

5.2 Site Preparation, Excavation and Earthworks

5.2.1 Excavation to Building Subgrades (Conventional Shallow Foundations)

In preparation for site construction, unsuitable materials should be removed from the underlying undisturbed glacial till, or inferred bedrock for any proposed foundation, parking, roadways, and areas

where underground services are to be located. Unsuitable materials include any rootmat and topsoil layers, peat deposits (if encountered), loose cobble and boulder deposits, and saturated, softened, or disturbed soils should be sub-excavated and where necessary, reconstructed with approved structural fill.

In addition, the test pit locations within the proposed design areas should be re-excavated and reinstated with structural fill as recommended in this report.

5.2.2 Hydraulic Breaking and Blasting Operations

Bedrock, or large boulders, were encountered at twelve test pit locations. Depending on final design grades, hydraulic breakers and/or blasting would be required if bedrock removal is required for design grading. Blasting operations, if required, should be carried out in accordance with applicable regulations and bylaws including Nova Scotia's Blasting Safety Regulations and Halifax Regional Municipality's Blasting Bylaw. Following bedrock removal, the exposed subgrade should be suitably prepared, levelled and recompacted prior to the placement of additional fill or foundations.

5.2.3 Proof-Roll of Subgrade

Areas excavated to the proposed design subgrade should be proof rolled using a loaded tandem, or a minimum 10-tonne smooth drum vibratory roller. Any softened or weak areas evident upon proof rolling should be removed and replaced with suitably compacted structural fill as recommended in this report and as directed by geotechnical engineering personnel.

From our experience, weathered till subgrades can perform as suitable construction bases; however, the weathered till layer is slightly more susceptible to softening than the unweathered portions of the till layer. It is prudent that the earthworks contractor understands the limitations and is experienced in working with similar soil conditions as encountered at the project site.

The existing glacial till soils are considered to be susceptible to loosening/softening when trafficked with equipment/vehicles under wet site or weather conditions. This includes saturated soil conditions associated with perched groundwater, precipitation, ponded water, etc. Disturbed subgrade soils should be sealed and compacted immediately after grading work using a smooth drum vibratory roller to reduce the potential for saturation and softening. Where saturated soil conditions exist at the subgrade level within undisturbed native soils, the use of vibratory compaction equipment should be avoided to prevent further loosening/softening of the strata from hydraulic action. The use of approved rockfill above saturated deposits is recommended to provide a hydraulic break and permit effective compaction of fills above. Loosened, saturated or softened materials should be removed prior to additional fill placement. Where practical, excavated surfaces should be graded away from work areas to promote runoff and limit ponding of surface water.

5.2.4 Frost Susceptible Soils

The glacial till at the site is considered to be frost susceptible. Cold weather construction practices should be employed during winter conditions, and when ambient air temperatures fall below 1º C.

Excavated subgrades and subsequently placed structural fill should be protected from rain, snow, freezing temperatures, excessive drying, and the ingress of water during site preparation, and structural fill placement. Where construction concerns during site preparation and structural fill placement may arise due to wet or freezing weather conditions, consideration should be given to using a well-graded, clean rockfill material as described further in this report.

Frozen existing subgrade or previously placed structural fill should be sub-excavated prior to placement of additional fill. Covering frozen lifts of previously approved native or structural fill layers is not permitted.

Where shallow groundwater conditions, artesian groundwater, springs, poor drainage conditions, etc. exist in pad areas, the use of clean rockfill for fill preparation is recommended. The use of subdrains and perimeter ditches may also be acceptable where groundwater levels can be depressed such that the effects of frost action and subsequent damage to pad areas can be kept minimal.

5.3 Structural Fill

Any imported materials and re-use of existing on-site glacial till soils, blasted rockfill, and processed site cobbles and boulders intended for use as structural fill should be assessed by geotechnical personnel as earthworks and site preparation operations are carried out.

5.3.1 Imported Structural Fill

Imported structural fill should consist of a predominately angular, well-graded granular material such as pit-run sand and gravel, or well-graded rockfill. The maximum particle size diameter for the structural fill should generally not exceed 200 mm and the fines content should not exceed 8%.

For deeper fills (i.e. 2.0 metres and deeper) a larger 200 to 300 mm minus quarried blast rock material can be used when placed in level lifts not exceeding 450 mm in thickness and compacted with a minimum 10-tonne smooth drum vibratory roller. The use of larger compaction equipment may permit the use of thicker lifts and larger maximum particle size material subject to geotechnical evaluation.

Water and loose/soft soils should be removed from excavations, and the bearing stratum approved prior to structural fill placement. Quality control inspection and testing of structural fill is recommended.

5.3.2 Site Native Structural Fill

Site excavated glacial till soil would be considered suitable for re-use as backfill and structural fill provided the moisture content is maintained at or below the optimum value and is free of deleterious materials (e.g., snow/ice, excess moisture, organic matter, construction debris, large boulders, etc.). If consideration is given to reusing on-site till soils, care should be taken to ensure the material does not exceed the optimum moisture content.

For the current investigation, gradation analysis of the site glacial soils indicates a high fines content (i.e. 27% to 61.0%) and are sandy/silty/clayey in nature. Their reuse should take into consideration their high moisture and frost susceptibility and avoid re-use in wet weather, site, and seasonal conditions.

Without good construction drainage practices (e.g. grading lifts to permit runoff, perimeter ditching, provision of drainage corridors or layers as required, etc.) a perched water condition could be created in the prepared pad. This may adversely affect building construction (e.g. lot development, trench excavation, foundation construction) and subsurface installations if carried out within a short period following site preparation, under these conditions. For these types of soils, a rockfill cap (e.g. 0.5 m thickness) is recommended for the finished pad surface. Note, that excavations taken to levels within saturated native soils or prepared glacial fill materials, are subject to loosening/softening in the presence of accumulated water, seepage, hydrostatic conditions, and require special consideration and preparation. These conditions if encountered should be reviewed by experienced geotechnical personnel for recommendations.

Blasted/broken bedrock and boulders would be considered suitable for re-use as structural fill provided the materials are processed to remove segregated or oversized material. Further breaking and crushing would maximize the re-use of blasted materials. Much of the site cobbles and boulders would likely require processing such as breaking, crushing, mixing with blasted materials, etc. to produce materials suitable for re-use as structural fill.

5.3.3 Compaction Requirements

To determine the optimum moisture content for compaction of structural fill materials, completion of Standard Proctor testing (ASTM D698) in a material testing laboratory and verified in the field by a quality control testing program is recommended. For materials not meeting the parameters for laboratory moisture-density relationship (e.g. exceeding 30% of materials retained on the 19.0 mm sieve), verification of the field compaction by visual inspection during proof rolling by geotechnical personnel would be required.

Should any material intended for use as structural fill exceed its optimum moisture during excavation, stockpiling, handling, placement and/or compaction, the material may become unsuitable for use in site earthworks and structural fill applications. In addition, materials that have been successfully compacted and approved may require removal if they subsequently become wet and softened from site construction traffic, water infiltration, precipitation, and/or freeze-thaw. A deficient area may be permitted to dry such that recompaction can be undertaken if site and weather conditions and construction schedule permits.

Structural fill should be placed in uniform near horizontal lifts and compacted to the minimum required percentage of the material's Standard Proctor maximum dry density (ASTM D698) depending on construction application as noted below in Table 3. In addition to the compaction requirements presented in Table 3, visual approval of all structural fill during placement by geotechnical personnel is recommended. Lifts should have a crown or slight grade (e.g. 2%) to provide for runoff during and after construction.

Table 2: Compaction Requirements

Application on Structural Fill or Approved Base	Percent of Standard Proctor Compaction (ASTM D698)
Granular Base and Subbase Courses	100
Fill within Structural Areas (Buildings, etc.)	100
Fill within 300 mm from the Roadway Design Subgrade	98
Fill below 300 mm from the Roadway Design Subgrade	95
Non-Structural Backfill and Landscaping	93

The lift thickness must be compatible with the compaction equipment used and structural fill material type to ensure the required density is achieved throughout the lift. The lift thickness should not exceed 200 mm for compaction utilizing a plate compactor having a minimum operating weight of 450 kg. The lift thickness should not exceed 450 mm for compaction utilizing a minimum 10 to 12-tonne smooth drum vibratory roller compactor.

5.3.4 Placement and Handling

In addition to visual evaluation during proof rolling, engineered roadway granular materials should be periodically tested by the nuclear method (e.g. per ASTM D2922) for each lift and material type used. Segregation of materials should be avoided during handling, placement, and compaction.

To limit the effects associated with freezing, low frost susceptible materials such as gravelly soils with low fines content (i.e. fraction passing the 80-micron sieve size) or clean graded rockfill could be utilized. Non-frost susceptible materials such as clear stone and clear rockfill, or graded rockfill with low sand and fines content could also be utilized for applications where limiting frost action is important.

If the foundation base is too coarse or fine (e.g. silty/clayey), it may be desirable to provide a 100 to 200 mm thick layer of NSTIR subbase aggregate material (e.g. granular Type 2) or a 100 mm minus

well-graded rockfill material underneath footings for constructability purposes and subsoil protection prior to formwork construction.

Care should be taken during the placement of approved materials containing oversized particles to ensure that these particles are not clustered and placed in localized zones. Additional consideration must be given to avoid using dissimilar structural fill material gradations adjacent to each other in order to reduce the potential of migration of finer materials into coarser materials (e.g. till soils placed on coarse rockfill or drain rock). The use of a suitable geotextile filter fabric or a graded soil filter is recommended where the placement of structural fill materials of dissimilar gradations is anticipated.

If encountered at the site and where warranted, larger boulders may be buried in the toe of final slopes, outside of structural bearing zones, or buried in landscaped areas to at least 1.0 m depth below the finished grade. Boulders should be separated to avoid bridging effects and forming of voids upon covering. Boulders should not be buried in foundation, slab, parking, roadway, and buried utility corridor areas. Otherwise, larger boulders should be broken into smaller particles for reuse or removed from the site.

5.4 Construction Dewatering

During earthworks, water may be expected to enter excavations during precipitation events as surface runoff or as seepage from within the soil strata. The rate of infiltration into shallow excavations is expected to range from minor to moderate seepage and can be controlled by conventional dewatering techniques including the use of 75 to 100 mm diameter portable pumps and grading of excavations to sump locations. For areas where natural topography or drainage corridors exist such that larger volumes/flows of water are expected to exist during construction, Englobe recommends the establishment of several excavated sumps or well points located at the limits of the proposed excavations to draw down the groundwater elevation. The use of several large pumps, diversion or temporary berming of water may also be used to control excessive water infiltration. Planning of construction sequences, material types, and scheduling to avoid wet/seasonal conditions may be necessary.

Water pumped from excavations is expected to contain fines and will require care in the disposal. Provision for proper site drainage in accordance with applicable municipal, provincial, and federal environmental requirements should be made at the construction stage.

5.5 Temporary Excavations and Slopes

All excavation work must conform to the regulations of the Occupational Health and Safety Act of the province of Nova Scotia at all times and we recommend that a qualified technician or professional review all proposed excavations and slopes. Workers should not enter unstable excavations or excavations with vertical sides greater than 1.2 m in height unless appropriate shoring or bracing is provided.

5.5.1 General Excavated Slopes

Shallow temporary excavations in competent soils should be cut no steeper than an equivalent angle measured as 1.0 Horizontal to 1.0 Vertical (1.0H:1.0V). Flatter slopes or bracing may be required for cuts deeper than 1.2 m for cuts in fill materials or unstable soils. In addition, we recommend that excavation sides be carefully monitored and, if necessary, the contractor should slope excavation sides appropriately or use adequate shoring methods. A review of all excavation slopes by a qualified professional may be required.

For excavation in difficult or unstable soils, where safe sloping is not practical, the use of shoring or a trench cage may be necessary. Slopes not meeting the requirements of the Department of Labour regulations should be evaluated by geotechnical engineering personnel for recommendations.

Excavations in rock (intact conditions) are expected to be stable at side slopes of 1H:3V subject to geotechnical evaluation of rock mass and discontinuations. Rock excavations terminating within the blast zone should be stable at 1H:1V.

5.5.2 Excavations in Prepared Structural Fill

Where existing unsuitable materials (i.e. surficial organic soils) are required to be excavated and replaced prior to shallow foundation construction, the lateral limits of excavation should be sufficient to accommodate the proposed structural fill at acceptable slope angles and extending at least 1.0 metre horizontally from the base of the exterior foundation line. This would normally be approximately 1H:1V for well-graded rockfill material, and 1.5H:1V for common structural fill materials, though flatter slopes may be required in certain cases. These limits are necessary both to ensure that the influence zone for foundation loads is contained entirely within the structural fill, as well as to ensure that the replacement structural fill can be placed and adequately compacted with stable slopes.

Where the lateral excavation limits cannot be maintained as recommended above due to adjacent infrastructure, then the use of excavation shoring techniques (e.g. trench boxes, temporary sheet pile walls, etc.) should be provided by the earthwork's contractor. A review of any excavation plans, and temporary shoring designs proposed by the earthwork's contractor should be reviewed by a qualified professional.

5.6 Permanent Slopes

In undisturbed glacial till soils and slopes constructed using a structural fill material, permanent fill slope gradients should not be steeper than 2H:1V (26.6 degrees). Final, permanent cut slope gradients should not be steeper than 3H:1V (18.4 degrees). Final, permanent fill and cut slopes steeper than the recommended values should be reviewed by the geotechnical consultant to verify in-place soil conditions and slope stability.

In bedrock conditions, shallow permanent cut slopes up to 1H:3V (71.6 degrees) may be permissible but should be reviewed by the geotechnical consultant to verify bedrock conditions and stability.

For slopes with sod applications and associated care and maintenance requirements, the final slope should be no steeper than 3H:1V (18.4 degrees) or as otherwise mandated by the landscape architect.

6 Design Recommendations

6.1 Interpreted Geotechnical Soil Design Parameters

Soil parameters recommended for use in the design are outlined in the table below. The parameters indicated have been summarized from laboratory and field testing and from known empirical correlations from published literature. The values indicated below in Table 3 are provided as a guide and their specific use in the design should be confirmed with a geotechnical engineer depending on the intended design application.

Table 3: Interpreted Soil and Bedrock Design Parameters

Parameter	Glacial Till / Structural Common Fill	Bedrock
Bulk Unit Weight, kN/m3	21	26
Effective Unit Weight, kN/m3	11	16
Effective Angle of Internal Friction	32˚	40˚
Active Earth Pressure Coeff. (Ka)	0.31	--
Passive Earth Pressure Coeff. (Kp)	3.3	--

6.2 Foundation Design

Conventional shallow foundations, (i.e., spread or strip footings), are suitable for the proposed development provided that all unsuitable materials as described in the previous sections are removed to a competent base that is inspected and approved by qualified geotechnical engineering personnel. It is assumed that a sufficient thickness of structural fill will be placed as per the recommendations contained herein prior to the placement of the footings and any floor slabs.

For Limit States Design the factored soil bearing resistance (using a bearing resistance factor of 0.5), and serviceability Limit States, for strip footings with a minimum width of 0.6 m and spread footings with 1.2 m minimum dimension are shown in Table 4 below.

Table 4: Limit States Design Parameters

Limit States Design Parameter	Glacial Till or Structural Fill	Overblast Bedrock	Intact Bedrock
Factored Geotechnical Bearing Resistance at Ultimate Limit States (ULS)	350 kPa	575 kPa	1.0 MPa
Geotechnical Resistance at Serviceability Limit States (SLS)	200 kPa	350 kPa	

Final surface preparation for intact bedrock should include the removal of smaller particles and debris by the use of high-pressure air. Final approval of prepared rock surface to be conducted by project geotechnical engineering personnel.

The serviceability limit states are based on a maximum allowable settlement of 25 mm for total settlement and 19 mm for differential settlement. Unfactored loads should be used with the SLS bearing pressures in accordance with the 2015 National Building Code of Canada (NBCC).

Foundations should not be placed on frozen ground, and temporary frost protection during freezing conditions should be provided after the construction of footings. Exterior footings and footings in unheated areas should have a minimum soil cover of 1.2 metres within the soil and 0.6 metres on intact bedrock or the equivalent protection can be provided through design using insulation. Footings for signs, light standards, or similar structures, constructed in hard-surfaced site areas should be placed at a minimum depth of 1.5 m below grade. Deeper founding may be required for structures designed to resist uplift or overturning forces.

The effect of site conditions on seismic response should be considered in the design of foundations. Based on the subsurface soil and bedrock conditions encountered at the test pits and boreholes, the site may be considered Class C for seismic site response (NBCC 2015 Table 4.1.8.4.A). If all footings are founded on bedrock, Class B can be utilized.

6.3 Underground Services

It is our understanding that an on-site water well and septic system will be required for this development. Pipe bedding for underground service piping shall be NSTIR Type 1 Gravel compacted to 95% Standard Proctor Density. Under some conditions (e.g. groundwater issues) the Engineer may approve clear stone as a substitute for NSDPW Type 1 Gravel.

The remainder of the service trench can be backfilled with approved on-site or imported materials in accordance with previous recommendations from this report.

6.4 Flexible Pavement Design

Asphalt paved parking, access, and roadway areas are proposed for this development. It is anticipated that vehicle traffic will consist of a range of light passenger vehicles to commercial transport delivery trucks. Site preparation, placement of structural fill and compaction requirements should be completed in accordance with the recommendations stated in the previous sections above.

Subgrade for pavement areas should be proof roll tested and approved by qualified geotechnical personnel prior to placement of subbase gravel. All unsuitable soils identified during the proof-roll test should be sub-excavated and replaced with approved structural fill. Proper surface and subgrade drainage are recommended to ensure that the pavement structure will perform satisfactorily.

Table 5: Flexible Pavement Design

Item	Light Duty Pavement (Cars and Light Trucks)	Medium Duty Pavement (Main Access to Light Duty Areas)	Heavy Duty Pavement (Access and Delivery Routes for Heavy Trucks and Tractor Trailers)
Asphalt Top Course - C Mix [1]	75 mm	40 mm	50 mm
Asphalt Base Course - B Mix [1]	--	50 mm	75 mm
NSTIR Type 1 Gravel [2]	150 mm	150 mm	150 mm
NSTIR Type 2 Gravel [2]	250 mm	300 mm	400 mm

[1] Minimum compaction (asphalt pavement) - 92 % Theoretical Maximum Density (ASTM D2041)

[2] Minimum compaction (granular(s)) - 100 % Standard Proctor Maximum Dry Density

Based on the sandy/silty nature of the native soils, placement of additional rock fill may be required to properly prepare access roadways and parking lot subgrade areas prior to gravel placement. The amount of subgrade improvement required will be determined on site and will depend on weather conditions at the time of construction and should be reviewed by the Geotechnical Engineer.

The above design assumes a prepared subgrade levelled and compacted to 98 percent standard Proctor Maximum Dry Density. Grading of parking and access areas should ensure positive drainage away from active site areas (i.e. to perimeter/adjacent ditches, catch basins, sheet flow off-site, etc.). At or near the proposed structure a minimum of 2 percent positive grade should be maintained.

7 Comments on Construction

The following comments on specific construction aspects of the project are provided for the guidance of designers. The contractor undertaking the work should make their interpretation of the information provided in this report as it affects their construction procedures, scheduling, and costing.

The in-situ soils are subject to loosening and softening in the presence of water. Construction methods and scheduling should reflect this. In periods of inclement weather or during extended work delays, excavations within the site native soils should be protected by a granular working mat placed over the bearing soil immediately following excavation and preparation of the foundation contact area.

If construction takes place in the winter months care must be taken not to allow the freezing of subsoil. Any fill or native soil that freezes must be sub-excavated and replaced.

We recommend that a licensed professional supervise an inspection and testing program during any earthworks, verification of any bases, structural fill selection, backfill placement, and foundation construction. The program should include verification and approval of excavation bases before placement of structural fill (e.g. founding level inspection); verification of the type of structural fill and material to be used; compaction testing (i.e. proof testing, proof rolling, nuclear density testing) during structural fill placement; and, testing of construction materials (e.g. aggregate, asphalt, and concrete).

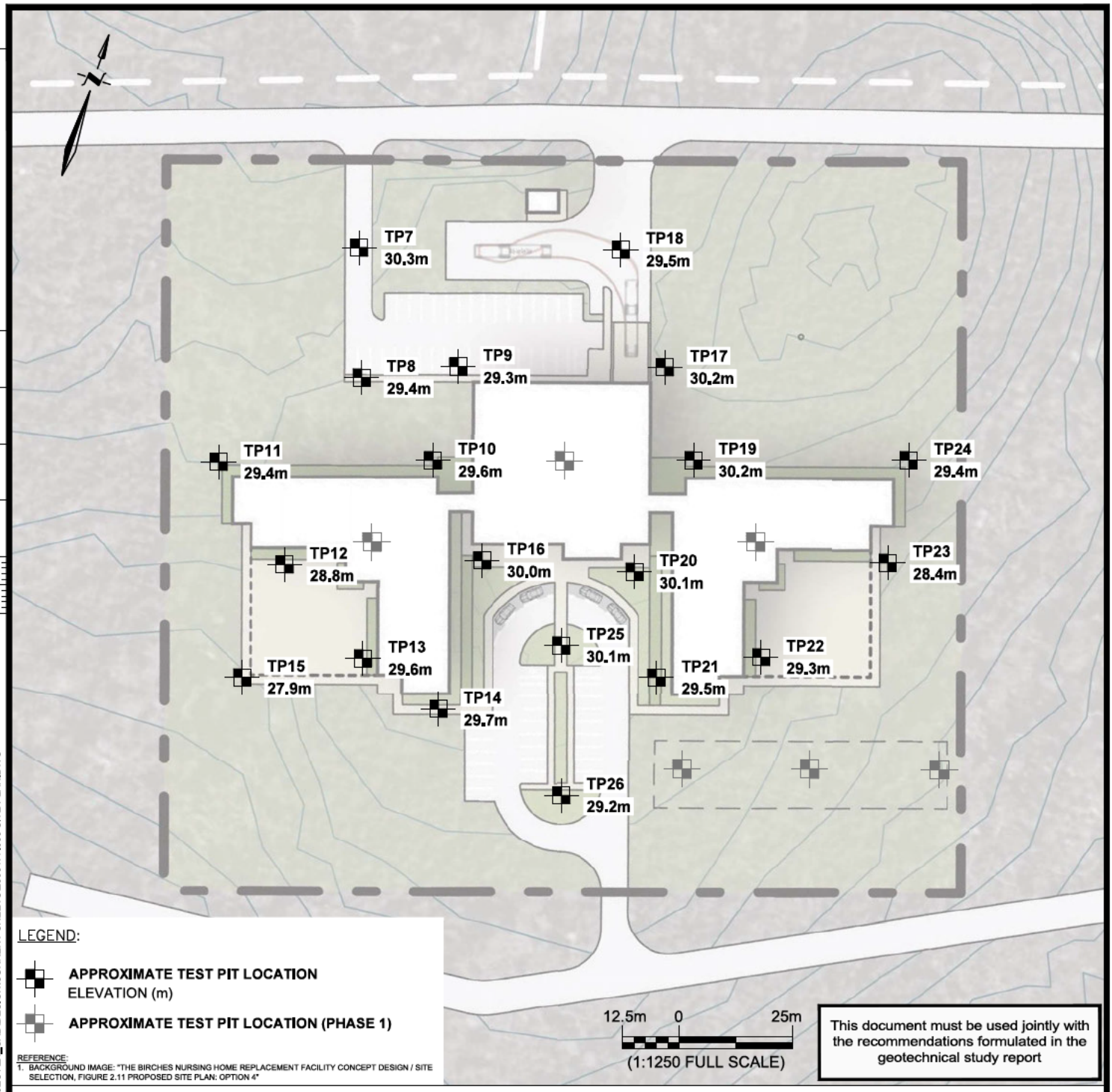
8 Closure

This report has been prepared for the sole benefit of The Birches Nursing Home (the Client), and his agents, and may not be used by any third party without the express written consent of Englobe Corp. and the Client. Any use that a third party makes of this report is the responsibility of such third party. The comments and recommendations made within this report are for preliminary planning and design purposes. As project planning and design proceed, we would be pleased to provide additional geotechnical consultation, if applicable.

A subsurface investigation is a limited sampling of a site and the geotechnical investigation undertaken has involved random sampling of site conditions. The comments and recommendations given herein are based on information gathered at specific sampling locations and can only be extrapolated to an undefined limited area around these locations. Variations in subsurface conditions are expected across the site and could differ from data collected at the sample locations. The extent of the limited area depends on the subsurface conditions encountered (e.g. soil, rock, and groundwater), as well as the history of the site reflecting natural, construction and other activities. Should any conditions be encountered during construction that are contrary to those reported herein, we request immediate notification so that a reassessment of our comments and recommendations can be undertaken.

We trust this report meets your present requirements. Should any additional information be required, please do not hesitate to contact our office at your convenience.

Appendix A
Test Location Plan



LEGEND:

APPROXIMATE TEST PIT LOCATION
ELEVATION (m)

APPROXIMATE TEST PIT LOCATION (PHASE 1)

REFERENCE:
1. BACKGROUND IMAGE: "THE BIRCHES NURSING HOME REPLACEMENT FACILITY CONCEPT DESIGN / SITE SELECTION, FIGURE 2.11 PROPOSED SITE PLAN: OPTION 4"

This document must be used jointly with the recommendations formulated in the geotechnical study report

Client

Eastin Projects Ltd.

Project

The Birches Nursing Home
RFP #TBHM-23-002

Musquodoboit Harbour, Nova Scotia

Title

Test Pit Locations

Englobe Corp.
97 Troop Avenue
Dartmouth, NS B3B 2A7
T 902 468-6486
F 902 468-4919

Discipline: Geosciences		Prepared by: WS	Checked by: WS
Scale: 1:1 250		Drawn by: TL	Approved by:
Date: June 19, 2023			01 of 01
Page setup: LETTRE POR	Paper Format: ANSI full bleed A (8.50 x 11.00 Inches)		

Resp.	Project	Phase	Disc.	Type	Drawing N°	Rev.
148	2300477.000	0000	XX	D	0001	00

10 cm
0 1 2 3 4 5

G:\2023_DELTEK\2300477_THE BIRCHES_GEOTECHNICAL INVESTIGATION\PROJECT\Z4_CAD\DESIGN\CURRENT SHEETS\2300477.000 SITE PLAN.DWG

Appendix B
Test Pit Logs

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

STRATA PLOT

Strata plots symbolize the soil or bedrock descriptions, using a combination of the following basic symbols.

Boulders, Cobbles, Gravel | Sand | Silt | Clay | Topsoil, Organics | Asphalt | Concrete | Fill | Glacial Till | Bedrock

SOIL SAMPLES

Sample Type	
A	- auger sample
B	- block sample
C	- core sample
D	- drive sample
G	- grab (bulk) sample
SS	- split spoon sample
U	- tube sample (thin wall)
W	- wash or air return sample
HQ, BQ, NQ	- Rock core sample

Sample Condition	
	- undisturbed
	- disturbed
	- no recovery

Water Level Measurement	
	Measured in standpipe, piezometer, or well
	Inferred groundwater condition

Standard Penetration Resistance (N-Value) – unless otherwise noted this column refers to the Standard Penetration Test N-Value: the number of blows for a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. Where insufficient penetration was achieved and N-Values cannot be presented, the number of blows is reported over sampler penetration in millimetres (e.g. 50/75). No corrections have been applied to the N-Values presented in the log.

Dynamic Cone Penetration Test (DCPT) – performed using a standard 60-degree apex cone connected to 'A' size drill rods. Applied energy is as per the Standard Penetration Test [140 pound (64 kg) hammer falling 30 inches (760 mm)]. The DCPT value is represented as the number of blows of the hammer required to drive the penetrating cone one foot (300 mm) into the soil.

SOIL TESTING

Soil Testing Descriptors	
MA	- mechanical grain size analysis (reported separately)
Ø	- moisture content
C	- consolidation test (reported separately)
D_R	- relative density
k	- permeability coefficient (reported separately)
pp	- pocket penetrometer strength
q	- triaxial compression test
UCS	- unconfined compressive strength
SB	- shear box test (reported separately)
TV	- torvane shear strength
VS	- vane shear strength
γ	- unit weight of soil or rock
γ_d	- dry unit weight of soil or rock
ρ	- density of soil or rock
ρ_d	- dry density of soil or rock

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

The classification of soil types is made in accordance with the Canadian Foundation Engineering Manual (4th Edition)

SOIL DESCRIPTIONS

Common Soil Descriptors

Rootmat/Topsoil	- Organic matter (roots, moss, topsoil) typically forming a vegetative mattress, and/or is capable of supporting vegetative growth
Fill	- Material identified as placed by others
Till	- Undisturbed in-situ stratified deposit *Glacial Till* – unsorted sediment from glacial sources *Alluvial/Fluvial Till* – material deposited by watercourses, commonly stratified
Peat	- Partially decayed vegetation (humas) material that has accumulated in a water-saturated environment
Bedrock	- Deposit of rock beneath soil and other broken or unconsolidated material (regolith)

Soil Structure Descriptors

Desiccated	- Having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	- Having cracks and, hence, a blocky structure
Varved	- Composed of regular alternating layers of silt and clay
Stratified	- Composed of alternating layers of different soil types (e.g. silt and sand/silt and clay)
Well-Graded	- Having a generally uniform distribution in a range of grain sizes, with no dominating size
Poorly Graded	- predominantly of one-grain size

Terminology used for describing soil strata based on the proportion of individual particle size present:

main component	(gravel, sand, silt, clay)	>35 % and main fraction
"and"	(and gravel, and silt, etc.)	>35 %
adjective	(gravelly, sandy, silty, clayey, etc.)	20 % – 35 %
"some"	(some sand, some silt, etc.)	10 % - 20 %
"trace" or "occasional"	(trace sand, trace silt, etc.)	1 % - 10 %

COMPACTNESS CONDITION

The standard terminology to describe soils, as determined by the Standard Penetration Test N-Value: the number of blows for a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil.

Compaction Condition Cohesionless Soils

Compactness Condition	SPT N-Index
Very Loose	0 – 4
Lose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	> 50

Consistency and Undrained Shear Strength of Cohesive Soils

Consistency	Undrained Shear Strength		SPT N-Index
	(Kips/ft^2)	(kPa)	
Very Soft	< 0.25	<12	0 – 2
Soft	0.25 – 0.5	12 – 25	2 – 4
Firm	0.5 – 1.0	25 – 50	4 – 8
Stiff	1.0 – 2.0	50 – 100	8 – 15
Very Stiff	2.0 – 4.0	100 – 200	15 – 30
Hard	> 4.0	> 200	> 30

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

ROCK DESCRIPTIONS

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. Reported as the fraction of all pieces of intact and sound rock core equal to or greater than 4 inches (100 mm) are summed and divided by the total length of core run (as per ASTM 6032)

TCR (Total Core Recovery) denotes the percentage of solid (cylindrical) core retrieved from a borehole of any orientation. Reported as the fraction of all pieces of the solid (cylindrical) core are summed and divided by the total length of the core run.

FI (Fracture Index) denotes the number of naturally occurring fractures within a given length of the core. Reported as a simple count of naturally occurring fractures.

Rock Quality Descriptors

Rock Mass Quality	RQD
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	crushed
Severely Fractured	shattered of very blocky
Fractured	blocky
Moderately Jointed	sound
Intact	very sound

Rock Discontinuity Descriptors

Spacing (mm)	Discontinuities	Bedding
< 20	Extremely close	Laminated
20 – 60	Very close	Very thin
60 – 200	Close	Thin
200 – 600	Moderately close	Medium
600 – 2000	Wide	Thick
2000 – 6000	Very wide	Very thick
> 6000	Extremely wide	-

Rock Strength Descriptors

Strength Classification	Grade	Unconfined Compressive Strength (MPA)	Point Load Index (MPa)
Extremely Weak	R0	0.25 – 1	-
Very Weak	R1	1 – 5	-
Weak	R2	5 – 25	-
Medium Strong	R3	25 – 50	1 – 2
Strong	R4	50 – 100	2 – 4
Very Strong	R5	100 – 250	4 – 10
Extremely Strong	R6	> 250	> 10

Rock Weathering Descriptors

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering, slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces, all rock material may be discoloured
Moderately	W3	Less than half of the rock is decomposed and/or disintegrated into the soil.
Highly	W4	More than half of the rock is decomposed and/or disintegrated into the soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into the soil, original mass is still largely intact.
Residual Soil	W6	All the rock converted to the soil. Structure and fabric destroyed.

TEST PIT RECORD TP 7

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft	DEPTH m	ELEVATION (m)	SOIL SYMBOL	LOCATION: COORD.: Geodetic SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	DRILL TYPE/METHOD: Komatsu PC 200HD Excavator OTHER TESTS/NOTES WELL DETAILS
1		30.300		**ROOTMAT/TOPSOIL** roots up to 50 mm in diameter		
		29.895				
2				**TILL** Silty SAND and GRAVEL, some clay, compact, moist, reddish brown, angular to subrounded clasts		
3	1			***EXCAVATOR BUCKET REFUSAL AT 0.76 m ON INFERRED BEDROCK OR LARGE BOULDER*** *slight seepage at 0.76 m*		
4						
5						
6						
	2					
7						
8						
9						
10	3					
11						
12						
13	4					
14						

TEST PIT RECORD TP 8

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ELEVATION (m)	DEPTH ft	DEPTH m	SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	OTHER TESTS/NOTES WELL DETAILS
29.400	0	0	**ROOTMAT/TOPSOIL** roots up to 25 mm in diameter, some boulders (up to 0.9 m in diameter)		
28.790	4	1	**TILL** Silty SAND and GRAVEL, some cobbles, trace clay, compact to dense, moist, reddish brown to olive brown, angular to subrounded clasts	GS 1	Ø
	13	4	***EXCAVATOR BUCKET REFUSAL AT 1.22 m ON INFERRED BEDROCK OR LARGE BOULDER*** *slight seepage at 0.61 m*		

TEST PIT RECORD TP 9

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

29.300

ROOTMAT/TOPSOIL
some boulders (up to 0.9 m in diameter)

28.690

TILL
Silty SAND and GRAVEL, some cobbles, trace clay, compac to dense, moist, reddish brown to olive brown, angular to subrounded clasts

EXCAVATOR BUCKET REFUSAL AT 1.22 m ON INFERRED BEDROCK OR LARGE BOULDER
heavy seepage at 0.61 m

ft: 1 2 3 4 5 6 7 8 9 10 11 12 13 14
m: 1 2 3 4

TEST PIT RECORD TP 10

97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

DEPTH (ft)	DEPTH (m)	ELEVATION (m)	SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	OTHER TESTS/NOTES WELL DETAILS
0	0	29.600	**ROOTMAT/TOPSOIL** some boulders (up to 0.9 m in diameter)		
2	1	28.990	**TILL** Silty SAND, some gravel and cobbles, compact, very moist to wet, reddish brown, angular to subrounded clasts		
5	2	28.076	**TILL** Silty SAND and GRAVEL, some cobbles and small boulders, dense, wet, reddish brown, angular clasts	GS 1	Ø
8	3		***EXCAVATOR BUCKET REFUSAL AT 2.44 m ON INFERRED BEDROCK OR LARGE BOULDER*** *moderate seepage at 0.61 m*		
13	4				

TEST PIT RECORD TP 11

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

29.400

ROOTMAT/TOPSOIL
roots up to 25 mm in diameter, some boulders (up to 1.2 m in diameter)

28.995

TILL
Silty SAND and GRAVEL, some cobbles with depth, compact to dense, moist to wet, olive brown to reddish brown, angular to subrounded clasts

GS 1

EXCAVATOR BUCKET REFUSAL AT 1.52 m ON INFERRED BEDROCK OR LARGE BOULDER
slight to moderate seepage at 0.41 m

1 2 3 4 5 6 7 8 9 10 11 12 13 14

1 2 3 4

TEST PIT RECORD TP 12

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

28.800

ROOTMAT/TOPSOIL
some boulders (up to 1.2 m in diameter)

28.343

TILL
Silty SAND and GRAVEL, trace small boulders, compact to dense, moist to wet, reddish brown, angular to subrounded clasts

EXCAVATOR BUCKET REFUSAL AT 2.13 m ON INFERRED BEDROCK OR LARGE BOULDER
slight seepage at 0.61 m

TEST PIT RECORD TP 13

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ft	m	ELEVATION (m)	SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	OTHER TESTS/NOTES WELL DETAILS
		29.600	**ROOTMAT/TOPSOIL** roots up to 50 mm in diameter		
1		29.295			
2	1		**TILL** Silty SAND, trace gravel and cobbles, compact, moist, reddish brown	GS 1	Ø
7	2	27.466			
8			**TILL** SAND and CLAY, some silt, some to trace gravel and cobbles, trace small boulders, very stiff to compact, moist, reddish brown		
10	3				
12			***END OF TEST PIT AT 3.66 M*** *slight seepage at 0.61 m*		
13	4				
14					

TEST PIT RECORD TP 14

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ft	m	ELEVATION (m)	SUBSURFACE DESCRIPTION	SAMPLES
0	0	29.700	**ROOTMAT/TOPSOIL** roots up to 50 mm in diameter	
1		29.395		
1	1		**TILL** Silty SAND, trace gravel, compact, moist, reddish brown	
2				
3				
4				
5				
6				
7	2	27.414		
8			**TILL** SAND and CLAY, some silt, gravel, and cobbles, hard to compact, moist, reddish brown, rounded to subangular clasts	
9				
10	3			
11				GS 1
12				
13	4		***END OF TEST PIT AT 3.81 M*** *no seepage observed*	
14				

TEST PIT RECORD TP 15

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

27.900

ROOTMAT/TOPSOIL
roots up to 25 mm in diameter, some boulders (up to 1.1 m in diameter)

27.495

TILL
Silty SAND and GRAVEL, trace cobbles and boulders, compact to dense, moist, reddish brown to brown, angular to subrounded

EXCAVATOR BUCKET REFUSAL AT 2.29 m ON INFERRED BEDROCK OR LARGE BOULDER
moderate seepage at 0.3 m

TEST PIT RECORD TP 16

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/14/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

30.000

ROOTMAT/TOPSOIL
trace cobbles and boulders

29.695

TILL
Silty SAND, some to trace gravel and cobbles, compact to dense, moist, reddish brown

GS 1 Ø

28.019

TILL
Silty SAND and GRAVEL, trace to some cobbles, dense, wet, reddish brown

EXCAVATOR BUCKET REFUSAL AT 2.90 m ON INFERRED BEDROCK OR LARGE BOULDER

heavey seepage at 2.90 m

TEST PIT RECORD TP 17

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ft	m	ELEVATION (m)	SUBSURFACE DESCRIPTION
0	0	30.200	**ROOTMAT/TOPSOIL** roots up to 25 mm in diameter, some boulders (up to 0.9 m in diameter)
4	1	29.743	**TILL** Silty SAND, some gravel and cobbles, compact, moist, reddish brown
		28.981	**TILL** Clayey SAND, some silt and gravel, trace cobbles and small boulders, compact, moist, reddish brown, rounded to subangular clasts
11	3		***END OF TEST PIT AT 3.35 M*** *moderate seepage at 2.43 m*
14	4		

TEST PIT RECORD TP 18

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

29.500

ROOTMAT/TOPSOIL
some boulders (up to 1.2 m in diameter)

28.738

TILL
Silty SAND, some gravel, trace cobbles, compact, very moist to wet, reddish brown

sloughing of sidewalls during excavation due to heavy seepage

GS 1 Ø

EXCAVATOR BUCKET REFUSAL AT 3.05 m ON INFERRED BEDROCK OR LARGE BOULDER
heavey seepage at 0.76 m

TEST PIT RECORD TP 19

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft	DEPTH m	ELEVATION (m)	SOIL SYMBOL	LOCATION: COORD.: Geodetic / SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	DRILL TYPE/METHOD: Komatsu PC 200HD Excavator / OTHER TESTS/NOTES WELL DETAILS
0	0	30.200		**ROOTMAT/TOPSOIL** trace cobbles and boulders		
1		29.895		**TILL** Silty SAND, trace gravel and cobbles, compact, moist, reddish brown		
2						
3	1					
4						
5		28.676		**TILL** SAND and CLAY, some silt and gravel, trace cobbles and boulders, compact to dense, moist, reddish brown		
6						
7	2					
8						
9						
10	3					
11				***END OF TEST PIT AT 3.20 M*** *slight seepage at 0.30 m*		
12						
13	4					
14						

TEST PIT RECORD TP 20

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ft	m	ELEVATION (m)	SUBSURFACE DESCRIPTION	SAMPLES
		30.100	**ROOTMAT/TOPSOIL** trace cobbles	
1		29.795		
1	1		**TILL** Silty SAND, some gravel, trace clay and cobbles, compact, moist, reddish brown	
5		28.576		
5	2		**TILL** Clayey SAND, some silt, trace gravel and cobbles, dense, moist, reddish brown, rounded to subangular clasts	GS 1
9		27.357		
9	3		**TILL** SAND and CLAY, some silt, trace gravel and cobbles, compact to hard, moist, dark reddish brown	
11			***END OF TEST PIT AT 3.35 M*** *no seepage observed*	
13	4			

TEST PIT RECORD TP 21

97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ft	m	ELEVATION (m)	SUBSURFACE DESCRIPTION
0	0	29.500	**ROOTMAT/TOPSOIL** some boulders
1		29.195	
2			**TILL** Silty SAND, trace gravel and cobbles, compact, moist, reddish brown
3	1		
4			
5		27.976	
6			**TILL** SAND and CLAY, some silt, trace gravel, cobbles, and small boulders, dense to hard, moist, reddish brown
7	2		
8			
9			
10	3		
11			
12			***END OF TEST PIT AT 3.51 M*** *no seepage observed*
13	4		
14			

TEST PIT RECORD TP 22

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft	DEPTH m	ELEVATION (m)	SOIL SYMBOL	LOCATION: COORD.: Geodetic / SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	DRILL TYPE/METHOD: Komatsu PC 200HD Excavator / OTHER TESTS/NOTES WELL DETAILS
0		29.300		**ROOTMAT/TOPSOIL** some to trace boulders		
1		28.995		**TILL** Silty SAND, some gravel and cobbles, trace boulders, compact, moist, reddish brown		
2	1					
3						
4		28.081		**TILL** SAND and CLAY, some silt, trace gravel, cobbles, and small boulders, compact to very stiff, moist, reddish brown		
5						
6						
7	2					
8						
9						
10	3			***END OF TEST PIT AT 3.12 M*** *no seepage observed*		
11						
12						
13	4					
14						

TEST PIT RECORD TP 23

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp- □ w- O wl- △ vs- ⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

ELEVATION (m)	DEPTH ft	DEPTH m	SUBSURFACE DESCRIPTION	SAMPLES TYPE / No.	OTHER TESTS/NOTES WELL DETAILS
28.400	1		**ROOTMAT/TOPSOIL** some boulders (up to 1.8 m in diameter)		
27.943	2		**TILL** SAND and CLAY, some gravel and cobbles, trace silt, moist, reddish brown		
	3	1			
	4				
	5			GS 1	Ø / MA
	6				
	7	2			
	8				
	9				
	10	3			
	11		***END OF TEST PIT AT 3.20 M*** *slight seepage at 2.74 m*		
	12				
	13	4			
	14				

TEST PIT RECORD TP 24

eNGLOBe
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

29.400 — **ROOTMAT/TOPSOIL**
some cobbles and boulders

29.095 — **TILL**
Silty SAND, trace to some gravel and cobbles, compact, moist, reddish brown

27.876 — **TILL**
SAND and CLAY, some silt, gravel, and cobbles, compact, very moist, reddish brown
trace boulders at depth (up to 1.2 m in diameter)

sloughing of sidewalls during excavation

END OF TEST PIT AT 3.35 M
no seepage observed

TEST PIT RECORD TP 25

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

30.100

ROOTMAT/TOPSOIL
trace cobbles

29.795

TILL
Silty SAND and GRAVEL, some cobbles, trace boulders, compact, moist, reddish brown

28.271

TILL
SAND and CLAY, some silt, gravel, and cobbles, compact to hard, moist to very moist, reddish brown

END OF TEST PIT AT 3.51 M
slight seepage observed at 1.83 m

TEST PIT RECORD TP 26

ENGLOBE
97 Troop Avenue
Halifax NS
B3B 2A7

CLIENT: The Birches Nursing Home

PROJECT: The Birches Nursing Home - Phase 2, Musquodoboit, NS

DWN.: WS	CKD.: KB	DATE EXCAVATED: 6/15/2023	JOB NO.: 2300477	CONTRACTOR: B&P Enterprises

SPT TEST N-VALUE blows/305mm ●

WC % wp-□ w-○ wl-△ vs-⇩

10 20 30 40 50

DEPTH ft m

ELEVATION (m)

SOIL SYMBOL

LOCATION:

COORD.: Geodetic

SUBSURFACE DESCRIPTION

SAMPLES — TYPE / No.

DRILL TYPE/METHOD: Komatsu PC 200HD Excavator

OTHER TESTS/NOTES WELL DETAILS

29.200 — **ROOTMAT/TOPSOIL**
some boulders (up to 0.8 m in diameter)

28.795 — **TILL**
Silty SAND, some gravel, trace cobbles, compact, moist to very moist, reddish brown

27.981 — **TILL**
SILT and SAND, some gravel and clay, trace cobbles, compact to dense to hard, reddish brown

GS 1 — Ø / MA

END OF TEST PIT AT 3.35 M
slight seepage observed at 0.41 m

Appendix C
Laboratory Test Results

ENGLOBE

ENGLOBE
97 Troop Avenue
Dartmouth, NS B3B 2A7

SUMMARY OF LABORATORY RESULTS

CLIENT The Birches Nursing Home **PROJECT NAME** The Birches Nursing Home - Phase 2

PROJECT NUMBER 2300477 **PROJECT LOCATION** Musquodoboit, NS

Test Pit	Depth (m)	Sample Type	Water Content (%)	% Gravel	% Sand	% Fines	Liquid Limit	Plastic Limit	Plasticity Index	UCS or Organic Content
TP 1	1.52	TILL	12.9							
TP 2	1.07	TILL	16.3	11.0	53.4	35.6				
TP 3	1.68	TILL	14.6							
TP 4	0.91	TILL	14.5	6.0	66.3	27.7				
TP 5	1.52	TILL	13.5	9.0	36.9	54.1				
TP 8	2.56	TILL	13.8							
TP 10	1.65	TILL	16.2							
TP 13	1.19	TILL	16.0							
TP 16	1.34	TILL	14.8							
TP 18	1.34	TILL	14.2							
TP 23	1.49	TILL	17.1	5.3	33.6	61.0				
TP 26	1.65	TILL	13.3	16.2	34.3	49.5				

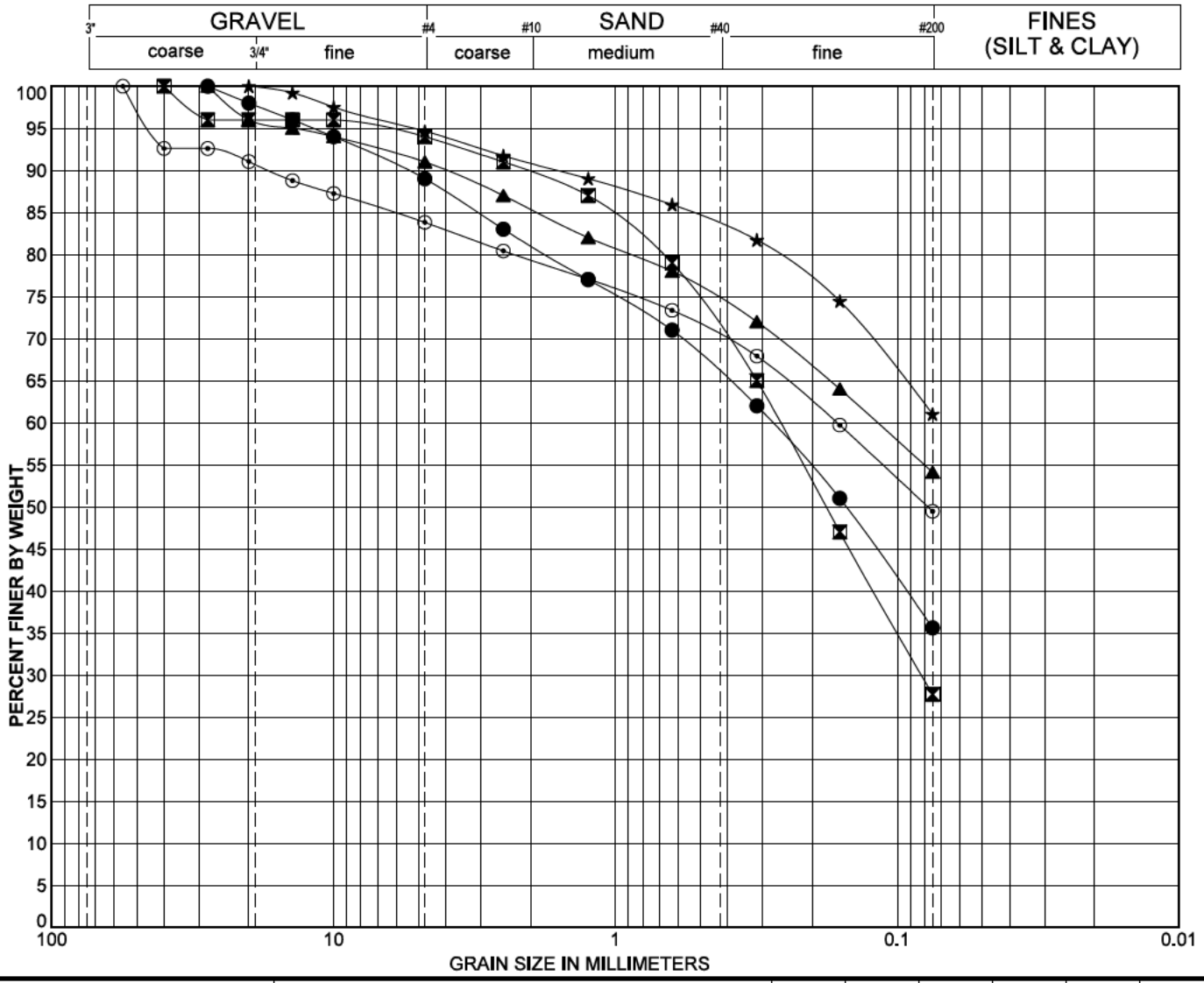
ASTM/USCS System Classification Gradation Chart (US Sieve Sizes):

eNGLOBe
97 Troop Avenue
Dartmouth, NS B3B 2A7

GRADATION CURVES

FIGURE No. 1 Page 1 of 1

CLIENT The Birches Nursing Home
PROJECT NAME The Birches Nursing Home - Phase 2
PROJECT NUMBER 2300477
PROJECT LOCATION Musquodoboit, NS



Specimen Identification		Classification / Notes	MC%	LL	PL	PI	Cc	Cu
●	TP 2 1.07 m	TILL: SILT and SAND, some gravel adn cobbles	16.3					
⊠	TP 4 0.91 m	TILL: Silty SAND, trace clay, some gravel and cobbles	14.5					
▲	TP 5 1.52 m	TILL: SAND and CLAY, some silt, trace gravel	13.5					
★	TP 23 1.49 m	TILL: SAND and CLAY, some silt, trace gravel	17.1					
⊙	TP 26 1.65 m	TILL: SILT and SAND, some gravel	13.3					

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP 2 1.07 m	28.00	0.28			11.0	53.4	35.6	
⊠	TP 4 0.91 m	40.00	0.26	0.082		6.0	66.3	27.7	
▲	TP 5 1.52 m	28.00	0.12			9.0	36.9	54.1	
★	TP 23 1.49 m	20.00				5.3	33.6	61.0	
⊙	TP 26 1.65 m	56.00	0.16			16.2	34.3	49.5	

Reference Test Standard(s):

ASTM C136 / C136M-14 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C117-13 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

DALHOUSIE UNIVERSITY
Inspiring Minds

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June 21, 2023

Englobe Corp.
97 Troop Ave.
Dartmouth, NS
B3B 2A7
Attention: Kevin Bearnes

Re: Results of analysis on submitted samples. BC Initial Research method.
Acid producing potential based on sulphide sulphur, if available.

PO#2300477
Project#2300477.002

Sample	Wt. %			kg H2SO4/t
	S(Total)	S(Sulphate)	S(Sulphide)	Acid Producing Potential
S#1 - Birches	0.005			0.2
S#1 - Birches Dup.	0.010			0.3

Reference Sample:	Wt. %
	S (Total)
KZK-1 (0.80% S)	0.799

Daniel Chevalier, MASc
Manager, Minerals Engineering Laboratory