REPORT ON

Geotechnical Investigation
Proposed Residential Development
Union Street Property
Meaford, Ontario

PREPARED FOR:

2774476 Ontario Inc.

DS Project No: 20-115-401
Date: May 4, 2021

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1. INTRODUCTION

DS Consultants Ltd. (DS) was retained by 2774476 Ontario Inc. to undertake a geotechnical investigation for the proposed residential development located at Union Street in Meaford, Ontario.

It is understood that the proposed development will consist of construction of residential units including townhomes and detached homes, public/private roadways, and a stormwater management pond throughout the existing land. All residential units are assumed to have one level of basement.

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions at borehole locations and from the findings in the boreholes to make preliminary engineering recommendations pertaining to the geotechnical design of underground utilities, roads, SWM pond, and to comment on the foundation conditions for the building construction.

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for 2774476 Ontario Inc. and its architect and designers. Third party use of this report without DS consent is prohibited.

2. FIELD AND LABORATORY WORK

A total of seven (7) boreholes (BH21-1 to BH21-7, see **Drawing 1** for borehole location plan) were drilled to depths of 6.8m. The boreholes were drilled with hollow stem augers by a drilling sub-contractor under the direction and supervision of DS Consultants Ltd. personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the DS Consultants Ltd. laboratory for detailed examination by the project engineer and for laboratory testing.

In addition to visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of five (5) soil samples (BH21-2/SS4, BH21-4/SS3, BH21-4/SS6, BH21-7/SS3, and BH21-7/SS6) were conducted and the results are presented in **Drawing 10A and 10B**.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Three (3) monitoring wells of 50mm diameter were installed in Boreholes BH21-1, BH21-4 and BH21-6 for the long-term groundwater levels monitoring. The elevation surveying of the boreholes was undertaken by DS Consultants Ltd. personnel, using the differential GPS unit.

3. SUBSURFACE CONDITIONS

The subject site is located west of Union street to Centre street and south of Russett Drive in Meaford. The land is surrounded by existing residential properties. At the time of our drilling work and surveying, the land was mostly cleared and stripped of topsoil in preparation for development, with the exception of the frontages on Union street and Centre street which remained vacant grassland with planted trees. The previous land use was an orchard.

The borehole location plan is shown on **Drawing 1**. General notes on sample description are provided on **Drawing 1A**. The subsurface conditions in the boreholes by DS are presented in the individual borehole logs presented on **Drawings 2 to 8**. Generalized sub-surface profiles are presented *on* **Drawing 9**.

3.1 SOIL CONDITIONS

Topsoil and Weathered/Disturbed Soils:

A layer of topsoil, varying in thickness from 100 to 150mm, was observed at the ground surface at boreholes BH21-3, and BH21-7. All other boreholes are located on land that has been previously cleared and stripped of topsoil.

It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site. Shallow test pits should be carried out to explore the thickness of topsoil across the site.

The upper level soils consisted of weathered/disturbed silty sand with inclusions of topsoil and organics, extending to depths ranging from 0.8 to 2.3m. The weathered/disturbed silty sand was in a loose to very loose state, with SPT “N” values from 2 to 8 blows per 300 mm penetration. Some weathered/disturbed soils might be fill materials.

Grain size analysis of one (1) soil sample from the weathered/disturbed material (BH21-4/SS3) was conducted and the results are presented on **Drawing 10A**, with the following fractions:

Silt & Clay: 25%

Sand: 75%

Gravel: 0%

Silty Sand/Cohesionless deposit:

Silty sand deposit was present beneath the weathered/disturbed soils. It extended to depths of 2.3 to 4.6 meters below ground surface (mbgs). This sand deposit contained trace gravel and occasionally medium sand layers at depths below 2 mbgs.

This deposit was found in a loose to very dense state, with SPT 'N' values ranging from 9 to 52 blows per 300 mm of penetration. The moisture content of the moist to wet sand deposit varied from 12 to 29%.

Grain size analysis of one (1) soil sample from this cohesionless deposit (BH21-7/SS3) was conducted and the results are presented on **Drawing 10A**, with the following fractions:

Silt & Clay: 22%

Sand: 78%

Gravel: 0%

Gravelly Sand layer:

A gravelly sand layer was observed beneath the silty sand deposit at boreholes BH21-3, BH21-4, BH21-6, and BH21-7. It extended to depths of 4.7 to 6.7mbgs.

This deposit was found in a very dense state, with SPT 'N' values of 57 to greater than 100 blows per 300 mm of penetration. The moisture content of the wet sand and gravel deposit was 9 to 15%.

Grain size analyses of two (2) soil samples from this sand and gravel deposit (BH21-4/SS6, BH21-7/SS6) were conducted and the results are presented on **Drawing 10A**, with the following fractions:

Silt & Clay: 14 to 31%

Sand: 46 to 59%

Gravel: 23 to 27%

Sandy Silt Till with Gravel and rock fragments:

Sandy silt till deposit was present underlying the silty sand or gravelly sand layers where they were present. This layer extended to the maximum limit of investigation at all boreholes. This till deposit contained some gravel and rock fragments with some clay.

This deposit was found in a compact to very dense state, with SPT 'N' values ranging from 18 to greater than 100 blows per 300 mm of penetration. The moisture content of the moist to wet till deposit varied from 7 to 15%.

Grain size analyses of one (1) soil sample from this till deposit (BH21-2/SS4) was conducted and the results are presented on **Drawing 10B**, with the following fractions:

Clay: 15%

Silt: 44%

Sand: 28%

Gravel: 13%

3.2 GROUNDWATER CONDITIONS

During drilling, groundwater and wet soils were found within 1m below the ground surface. Monitoring wells were installed for measurement of stabilized groundwater levels at three boreholes. The groundwater levels in the monitoring wells at BH21-1, BH21-4, and BH21-7 were measured on April 16, 2021 and are presented in Table 1.

Table 1: Groundwater Levels Observed in Monitoring Wells

Monitoring Well No.	Ground Surface Elevation (m)	Groundwater Table Depth (mbgs)	Elevation of Groundwater Table (m)
BH21-1	215.31	0.18	215.13
BH21-4	217.29	0.92	216.37
BH21-7	217.14	1.63	215.51

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. DISCUSSION AND RECOMMENDATIONS

The groundwater table in the boreholes was 0.2 to 1.6m below the surface. Dewatering will be required for any excavation below groundwater. A hydrogeological study must be carried out for the site for dewatering requirements and for feasibility study of adopting basements below groundwater table.

4.1 SITE GRADING AND ENGINEERED FILL

The site will be developed as residential subdivision with residential lots, underground services, roads and driveways. In the areas where earth fill is required for site grading purposes, an engineered fill can be constructed below house foundations, roads, boulevards, etc.

In all boreholes very loose to loose weathered/disturbed silty sand was encountered at the upper levels from surface to depths ranging from 0.8 to 2.3 m, which must be sub-excavated and replaced with engineered fill.

Prior to placement of engineered fill, all existing surficial organic material/topsoil, fill materials (if encountered) and weathered/disturbed/loose native soils containing topsoil/organics should be stripped to expose the inorganic native subgrade. The exposed subgrade should then be proof rolled with a heavy smooth roller to identify weak areas. Any weak or excessively wet zones identified during proof-rolling should be sub-excavated and replaced with compacted competent material to establish stable and uniform conditions. Prior to placement of engineered fill, the subgrade should be inspected and approved by a geotechnical engineer.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix A** of this report. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

The following is a recommended procedure for an engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained, and samples must be provided to the geotechnical engineer for review, and approval before filling begins.
2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.
3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and

that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS. Without this confirmation no responsibility for the performance of the structure can be accepted by DS. Survey drawing of the pre- and post-fill location and elevations will also be required.

4. The area must be stripped of all topsoil, fill materials, weathered/disturbed and less competent native soils, to be confirmed on site during grading/excavation process. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DS engineer prior to placement of fill.

5. The approved engineered fill must be in 200 mm lifts and compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by DS during placement of engineered fill is required. Work cannot commence or continue without the presence of the DS representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by DS to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DS.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain, and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

4.2 ROADS

The investigation has shown that the predominant subgrade soil, after stripping the topsoil, fill, weathered/disturbed soils, and any other organic and otherwise unsuitable and less competent subsoil, will generally consist of silty sand.

Based on the above and assuming that traffic usage will be residential local road, the following minimum pavement thickness is recommended for roads to be constructed within the development:

40 mm HL3 Asphaltic Concrete

70 mm HL8 Asphaltic Concrete

150 mm Granular 'A'

350 mm Granular 'B'

These values may need to be adjusted according to the Municipality of Meaford standards. The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate the construction. The need for filter fabric/geo-grid can be evaluated during construction stage. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

4.2.1 STRIPPING, SUB-EXCAVATION AND GRADING

The site should be stripped of all topsoil and any organic material, fill (if encountered), weathered or otherwise unsuitable/loose soils to the full depth of the roads, both in cut and fill areas. Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 8 tonnes. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer.

The subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Proper cambering is required to allow the surface water to escape towards the sides, where it can be removed by means of subdrains. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy

construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 98% of its SPMDD or as per the Town Standards. The compaction of the new fill should be checked by frequent field density tests.

4.2.2 ROAD CONSTRUCTION

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading, and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.2.3 DRAINAGE

The Municipality of Meaford requires the installation of full-length subdrains on all roads with curb and gutter. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch-basins. As discussed in Section 4.3.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.3 SEWERS

As a part of the site development, a network of new watermains, storm and sanitary sewers will be constructed. It is assumed that the trenches will generally be within 4 to 5 m below the existing grade.

The type of material for the pipes to be used for watermains or sewers will be the choice of civil engineer.

4.3.1 TRENCHING

The boreholes show that below the existing topsoil, and weathered/disturbed soils, the trenches will be mostly dug through sandy soil. Positive dewatering such as well points will be required prior to any excavation in silty sand or other cohesionless soils (sand, silt, sand & gravel, sandy silt to silty sand till)

below the groundwater table; otherwise it will result in unstable base and flowing sides. The groundwater table should be lowered to a depth of minimum 1 metre below the base of the excavation.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, Silty sand till, sand, silt, sandy silt to silty sand, sand & gravel, and other soils can be classified as Type 3 Soil above the groundwater table and Type 4 Soil below the groundwater table.

The cohesionless deposit near the surface is a coarse-textured glaciolacustrine deposits. Cobbles and boulders are not likely to be found near the surface however they are likely to be present in the underlying till. Possible large obstructions such as buried concrete can also be anticipated in fill material, if any. Provisions must be made in the excavation contract for the removal of possible boulders in the till deposits subject to final grading plans.

4.3.2 BEDDING

The undisturbed native soils encountered in the boreholes are considered to be competent to provide adequate support for the sewer pipes and will allow the use of normal Class B type bedding. The recommended minimum thickness of Class B bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, need to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt.

It is recommended that the bedding material consist of well-graded granular material such as Granular 'A' (OPSS 1010). To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the uniformly graded bedding material.

4.3.3 BACKFILLING OF TRENCHES

Based on visual and tactile examination, the existing inorganic native soils can be reused as backfill material provided its moisture content is within 2 percent of optimum moisture content. Selected imported fill material may also be used following approval from this office.

These native sand soils have considerable fines and will need to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the silty materials are properly pulverized and compacted in sufficiently thin lifts, post-construction settlements could occur Their use in narrow trenches such as laterals (where heavy compaction equipment cannot be operated) may not be feasible.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content and each layer should be compacted to at least 95% SPMDD. In the upper 1.0 m of the subgrade, underneath the road base, the compaction should be increased to 98% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

Granular B material should be used as backfill for trenches located under slab on grade or paved areas. Compaction of the granular soils should be carried out with vibratory compactors and loose lifts not exceeding about 200 mm.

Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular B may also be used.

4.4 FOUNDATION CONDITIONS

It is understood that the proposed subdivision will consist of single-family townhomes and detached homes with one level of basement.

Subject to design grades, and based on the borehole information and soil conditions, the proposed detached houses can be supported by conventional footings founded on engineered fill for bearing capacity values of 150 KPa at SLS and 225 kPa at ULS, provided all requirements in section 4.1 and Appendix A for engineered fill are adhered to. Competent soils are only found at depths significantly below the water table. Any excavations below the groundwater will require positive dewatering prior to excavations, otherwise it will result in loss of bearing capacity and loss of ground. Alternatively, footings can be founded on competent native soils. Soil bearing resistance and founding depths/elevations of competent native materials are presented in Table 2.

Table 2: Bearing Values and Founding Levels of Footings on Native Soils

BH No.	Ground Surface Elevation (m)	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Ground (m)	Founding Level at or Below Elevation (m)
BH21-1	215.31	100	150	1.5	213.8
BH21-2	215.78	150	225	2.3	213.5
BH21-3	217.58	100	150	3.0	214.6
BH21-4	217.29	100	150	2.1	215.1
BH21-5	216.84	100	150	1.5	215.8
BH21-6	216.18	100	150	2.0	214.2
BH21-7	217.14	100	150	1.5	215.6

At all borehole locations, loose native sand soils and weathered/disturbed soils must be excavated to indicated depths to found footings on native ground.

In addition, potential differential settlements are to be evaluated by our office after completion of the foundation drawings and subgrade assessment.

The encountered sand at the base of footings can be easily disturbed by construction activities. A concrete skim coat, about 50 mm in thickness, on the founding subgrade immediately after its approval might be required, on a case-by-case basis, to prevent its disturbance by construction activities.

Again, subject to design grades, should the proposed footings be founded above the competent native soils, then the proposed houses can also be supported by spread and strip footings founded on engineered fill for a bearing capacity of 100 kPa at the serviceability limit states (SLS) and for a factored geotechnical resistance of 150 kPa at the ultimate limit states (ULS), provided all requirements on **Appendix A** and section 4.1 are adhered to.

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footings exposed to seasonal freezing conditions must have at least 1.5 metres of soil cover for frost protection.

All footings bases must be inspected by this office to confirm the bearing capacity values, prior to pouring concrete.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower

footing must be installed first to help minimize the risk of undermining the upper footing. This scenario is not likely due to the flat existing grade however it is subject to final design grades.

It should be noted that the recommended bearing capacities have been calculated by DS from the limited borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by DS to validate the information for use during the construction stage.

4.5 EARTH PRESSURES AND RETAINING WALLS

The lateral earth pressures acting on basement walls, and retaining walls may be calculated from the following expression:

$$p = k(\gamma h + q)$$

where, p = Lateral earth pressure in kPa acting at depth h

K = Earth pressure coefficient, K = 0.4

γ = Unit weight of backfill, a value of 21 kN/m3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the build up of any hydrostatic pressure behind the wall.

4.6 FLOOR SLAB AND PERMANENT DRAINAGE

The floor slab can be supported on grade provided all organic materials/topsoil, fill (if encountered), and surficial softened/disturbed native soils are removed and the base thoroughly proof rolled.

The fill required to raise the grade can consist of inorganic soil, approved by this office, placed in shallow lifts and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

Where engineered fill is used to support the foundations, the floor slab can also be supported by engineered fill.

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab.

A perimeter and underfloor drainage system will be required around the exterior basement walls due to the shallow depth of groundwater, subject to design grades.

A hydrogeologic investigation must be carried out for the feasibility study of basements below groundwater table, to estimate the seepage rate from permanent perimeter and underfloor drainage of the basements. Consideration can be given to raising the basements above the groundwater table.

4.7 STORMWATER MANAGEMENT POND

The proposed stormwater management pond will be located at the east side of the subject site, just south of the Union street entrance. The pond design grades are not available at this stage. **Therefore, our recommendations are considered preliminary and must be updated and confirmed when the design drawings are available.**

Based on the subsurface conditions encountered in borehole BH21-7 and subject to design grades, the soils at the pond sides and base after removing the existing topsoil/fill (if encountered) and disturbed materials will consist of silty sand. The groundwater level measured in the monitoring well within the pond area was about 1.63 m below existing grade (BH20-7), corresponding to an elevation of 215.5 masl.

The sloped sides of the pond should be constructed at a 3 horizontal to 1 vertical (3H:1V) or flatter above the pond water. Below the high water level of the pond, the side slopes should be 4H:1V or flatter. The native sandy soils are subject to erosion from rainfall events and therefore the final grade of the pond should be covered with topsoil and vegetation.

Positive dewatering will be required for any excavations below the groundwater table. The groundwater table must be lowered to at least 1.0 m below the excavation base.

A clay liner will be required to retain water in the pond, and to avoid interaction with the groundwater table. The liner must be installed at the bottom of the pond and side slopes, extending to 0.3m above the design High Water Level (HWL) of the pond. The thickness of the clay liner will depend on uplift resistance requirements if installed below the groundwater table, but must be minimum 1.0 m. The clay liner should consist of silty clay material with minimum 20% clay content (finer than 0.002 mm) and a plasticity index (PI) of minimum of 8.0. The clay liner should be compacted to 100% SPMDD.

The bottom of the pond should be kept as high as possible and above the groundwater table if possible. If the clay liner is installed below the groundwater table, permanent under-liner drainage will likely be required to prevent uplift failure, depending on the depth of the pond and the thickness of the clay liner.

Any berms/embankments (if any) constructed to retain water in the pond should consist of silty clay material with minimum 20% clay content (finer than 0.002 mm) and a plasticity index (PI) of minimum of 8.0. The berm fill should be compacted to 100% SPMDD.

5. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Ltd. (DS) should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, DS will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DS at the time of preparation.

Unless otherwise agreed in writing by DS, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably.

The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. DS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

DS CONSULTANTS LTD.

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Drawings

C:\Project\20-115-401\BH Location Map.qgs

Legend

- Approx Site Boundary
- Borehole
- Monitoring Well

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Project: Geotechnical Investigation - Union Street, Meaford, ON

Title: **BOREHOLE LOCATION PLAN**

N

Client: 2774476 Ontario Inc.

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W.	M.Z.	April 2021
Rev: 0	Scale: As Shown	Project No.: 20-115-401	Figure No.: 1

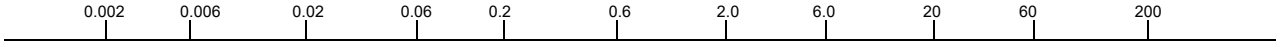
Image/Map Source: *Google Satellite Image*

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

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



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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

UNIFIED SOIL CLASSIFICATION

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

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

LOG OF BOREHOLE BH21-1

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4938036.568 E 532185.85

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/05/2021

REF. NO.: 20-115-401
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.3												
0.0	**SILTY SAND:** some organics, brown, wet, very loose to loose (weathered/disturbed)		1	SS	3		W. L. 215.1 m Apr 16, 2021					
1			2	SS	7		Bentonite					
213.8							214					
1.5	**SILTY SAND:** brown, wet, compact		3	SS	13							
2	trace gravel below 2.3m		4	SS	11		213					
3	grey below 3m		5	SS	12		212					
211.3												
4.0	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, very dense						Sand					Augering becomes hard at 4m
							Screen					
5			6	SS	66		210					
6												Grinding while augering
			7	SS	>100		209					
208.5												
6.8	**END OF BOREHOLE:** Notes: 1) 50 mm diameter monitoring well installed upon completion 2) Water level Readings: Date: April 16, 2021 — Water Depth (mbgs): 0.18 m											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6

LOG OF BOREHOLE BH21-2

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4938011.944 E 532107.147

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/05/2021

REF. NO.: 20-115-401
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.8												
0.0	**SILTY SAND:** some organics, brown, wet, very loose to loose (weathered/disturbed)		1	SS	3							
			2	SS	5		215					
			3	SS	8		214					
2	grey below 2m											
213.5												
2.3	**SANDY SILT TILL:** some gravel and rock fragments, some clay, grey, moist, dense to compact		4	SS	31		213					13 28 44 15
			5	SS	36		212					
	some clay below 4.6m		6	SS	22		211					
			7	SS	29		210					
209.0							209					
6.8	**END OF BOREHOLE:** Notes: 1) Water at depth of 0.8m during drilling											

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-3

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4937921.075 E 532095.629

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/05/2021

REF. NO.: 20-115-401
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.6												
217.5 0.1	**TOPSOIL:** 100mm											
	SILTY SAND: trace organics, brown, moist, very loose to loose (weathered/disturbed)		1	SS	3		217					
1	wet below 0.9m, no organics below 1.0m		2	SS	3							
			3	SS	7		216					
2 215.3												
2.3	**SILTY SAND:** trace gravel, brown, wet, compact		4	SS	10		215					
3	grey below 3m		5	SS	14							
4 213.3							214					
4.3 212.9	**SAND AND GRAVEL:** grey, dense						213					
4.7 5 212.5	**SANDY SILT:** grey, dense		6	SS	38							
5.1	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, dense to compact						212					
6			7	SS	18							
210.8							211					
6.8	**END OF BOREHOLE:** Notes: 1) water at depth of 0.9mbgs during drilling											

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-4

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4937856.875 E 532139.86

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/05/2021

REF. NO.: 20-115-401
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.3												
0.0	**SILTY SAND:** trace topsoil at upper level, brown, moist to wet, very loose to loose (weathered/disturbed)		1	SS	3		217					
1			2	SS	6	▽		W. L. 216.4 m Apr 16, 2021				
			3	SS	8		216					0 75 (25)
2 215.0												
2.3	**SILTY SAND:** trace clay, trace gravel, brown, wet, compact		4	SS	11		215					
3	grey below 3m		5	SS	10		214					
213.3												
4.0	**GRAVELLY SAND:** silty, with rock fragments, trace clay, grey, moist, very dense							Sand				
			6	SS	57			Screen				23 46 (31)
5 212.1												
5.2	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, very dense						212					
6			7	SS	>100		211					
210.5												
6.8	**END OF BOREHOLE:**											

Notes:
1) 50 mm diameter monitoring well installed upon completion
2) Water level Readings:

Date:	Water Depth (mbgs)
April 16, 2021	0.92m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6

LOG OF BOREHOLE BH21-5

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4937864.886 E 532224.019

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/01/2021

REF. NO.: 20-115-401
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
216.8												
0.0	**SILTY SAND:** trace topsoil, trace gravel, brown, moist to wet, very loose (weathered/disturbed)		1	SS	2							
216.0												
0.8	**SILTY SAND:** trace clay, brown, wet, loose to dense		2	SS	11		216					
			3	SS	9		215					
	grey below 2.5m		4	SS	12		214					
			5	SS	34		213					
212.3												
4.5	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, very dense		6	SS	46		212					
			7	SS	57		211					
210.0												
6.8	**END OF BOREHOLE:** Notes: 1) Water at depth of 0.8mbgs during drilling											

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-6

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4937939.959 E 532223.443

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/01/2021

REF. NO.: 20-115-401
ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
216.2												
0.0	**SILTY SAND:** trace topsoil, trace gravel, brown, moist to wet, very loose to loose (weathered/disturbed)		1	SS	3		216					
1			2	SS	7		215					
214.7												
1.5	**SILTY SAND:** trace clay, brown, wet, loose to very dense		3	SS	9							
2			4	SS	10		214					
3			5	SS	52		213					
4												
211.9							212					
4.3	**SAND AND GRAVEL:** grey, wet, compact											
211.5												
4.7	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, compact to dense		6	SS	27							
5							211					
6												grinding while augering
			7	SS	43		210					
209.4												
6.8	**END OF BOREHOLE:** Notes: 1) Water at depth of 0.8m during drilling											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH21-7

PROJECT: Geotechnical Investigation
CLIENT: 2774476 Ontario Inc.
PROJECT LOCATION: Union Street, Meaford, ON
DATUM: Geodetic
BH LOCATION: N 4937929.871 E 532318.981

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200
Date: Apr/01/2021

REF. NO.: 20-115-401
ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 3000 6000 9000 12000 15000	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.1												
217.0 0.0	**TOPSOIL:** 150mm											
0.2	**SILTY SAND:** trace topsoil, brown, moist to wet, very loose to loose (weathered/disturbed)		1	SS	2		217					
1	wet below 1m		2	SS	7							
215.6							Bentonite					
1.5	**SILTY SAND:** trace clay, brown, wet, loose to compact		3	SS	9		W. L. 215.5 m Apr 16, 2021					0 78 (22)
2	trace gravel below 2.3m		4	SS	10		215					
3			5	SS	12		214					
4							213					
212.5							Sand					
4.6	**GRAVELLY SAND:** with rock fragments, some silt, grey, wet, compact to dense		6	SS	>100		Screen 212					27 59 (14)
6												
211.0			7	SS	21		211					
210.4												
210.3 6.8	**SANDY SILT TILL:** with gravel and rock fragments, some clay, grey, moist, dense											spoon bouncing in last 150mm
	END OF BOREHOLE:											

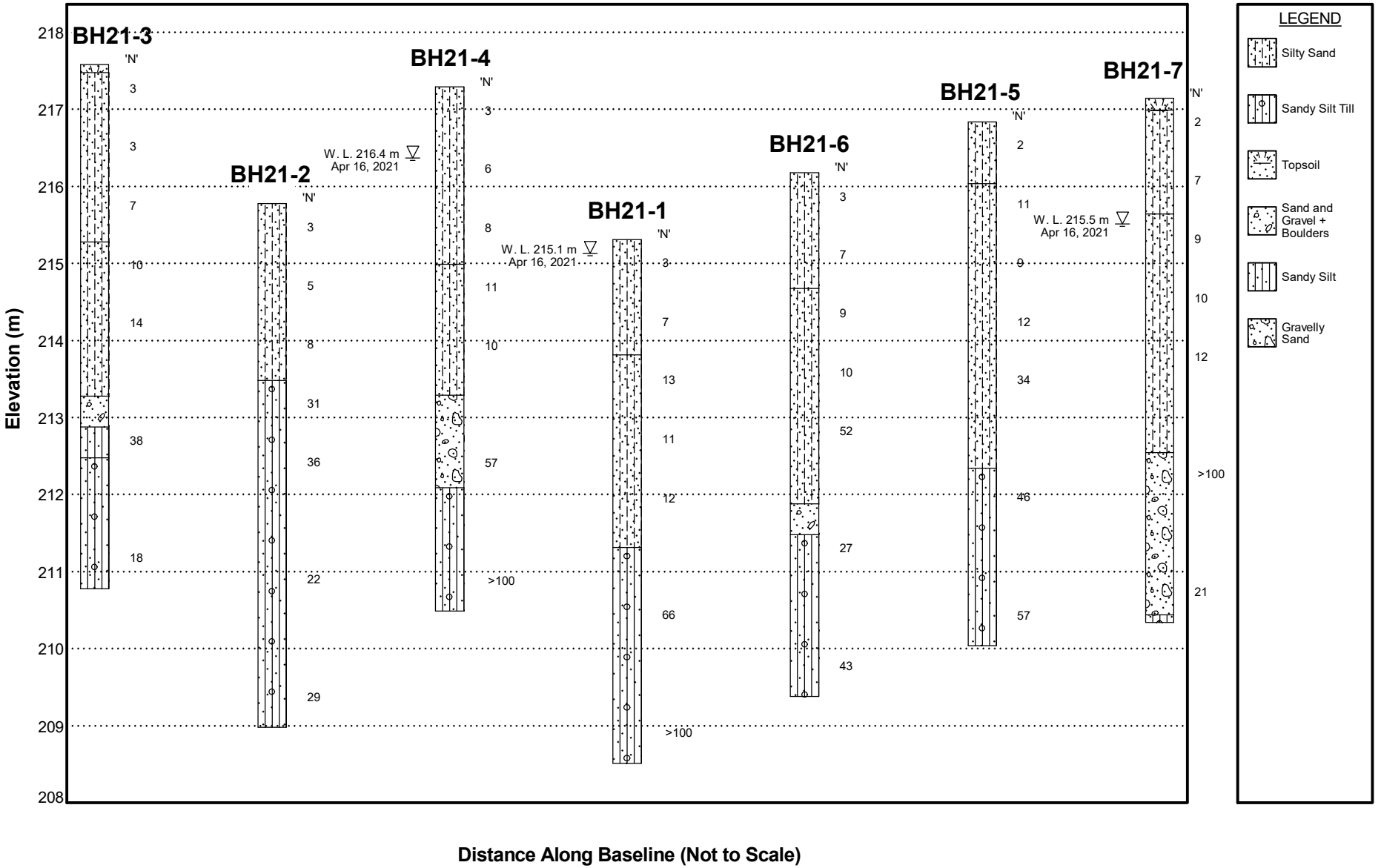
Notes:
1) 50 mm diameter monitoring well installed upon completion
2) Water level Readings:

Date:	Water Depth (mbgs)
April 16, 2021	1.63m

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG /W VOC 0~1800 PPM-2014 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 21/5/6



Distance Along Baseline (Not to Scale)

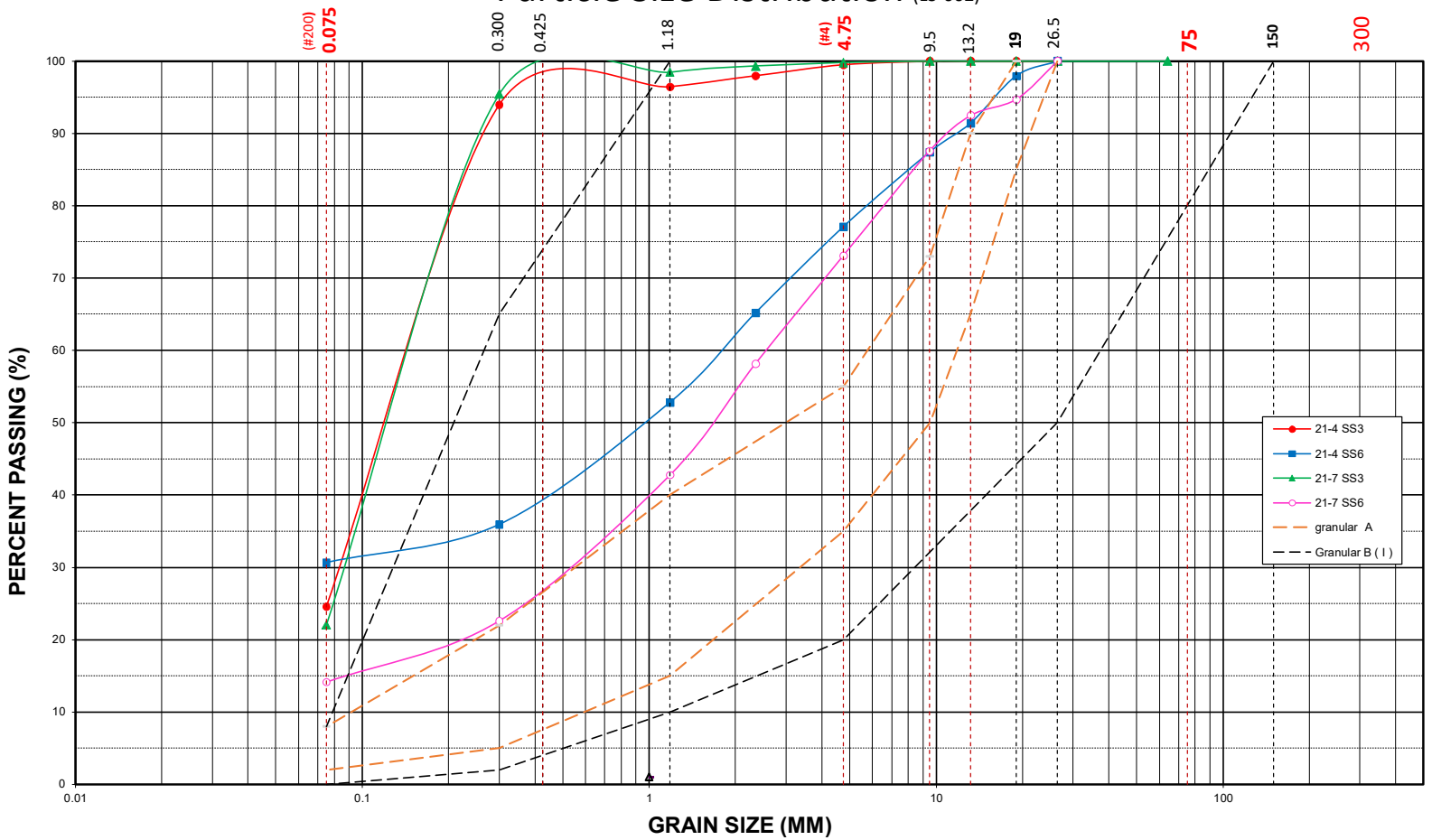
DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

Generalized Sub-surface Profile

DRAWING NO.	9
JOB NO.	20-115-401
DATE	May 6, 2021

DS FENCE (M) 20-115-401 BOREHOLE LOGS.GPJ DS.GDT 5/6/21

Particle Size Distribution (LS-602)



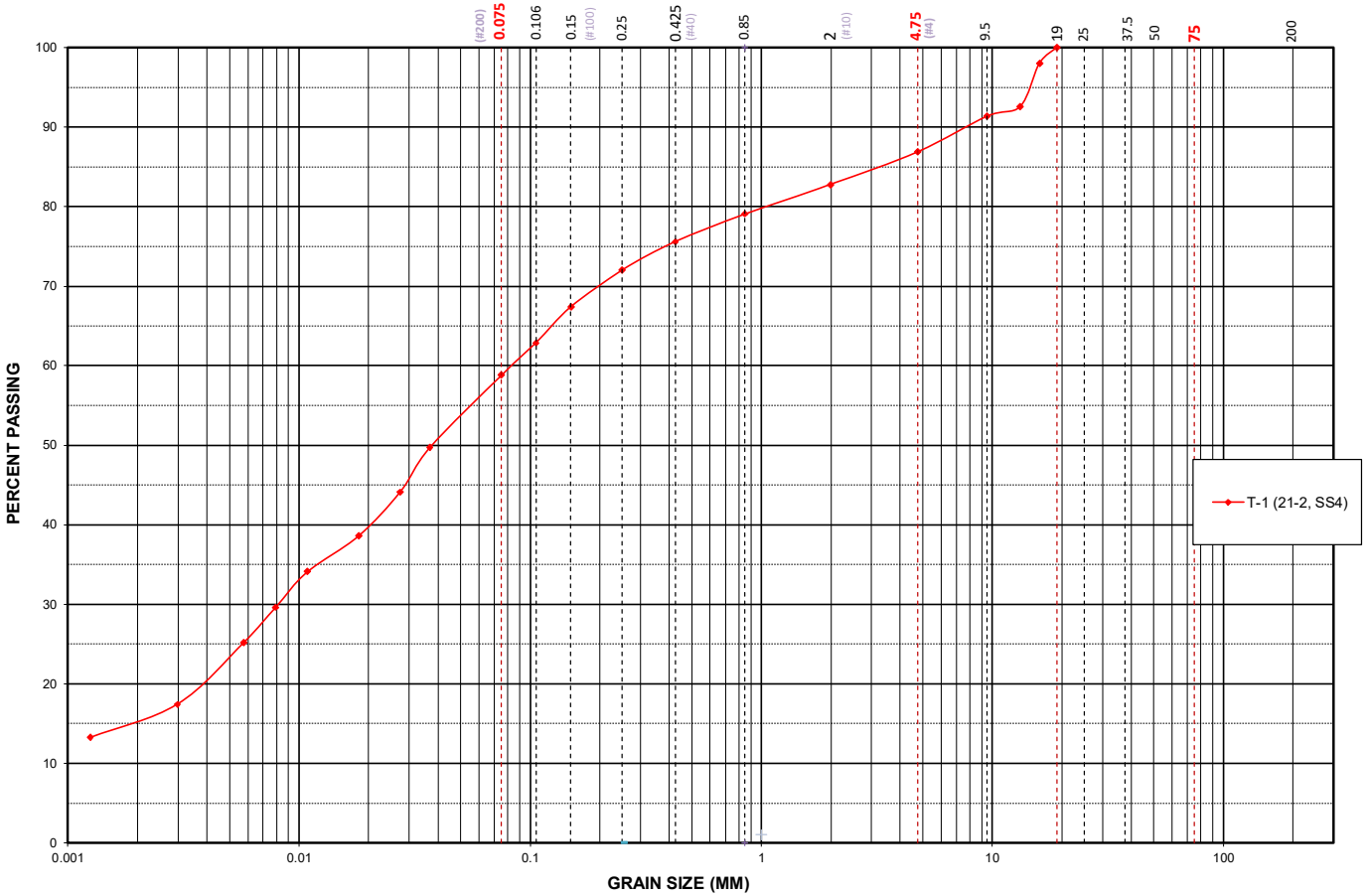
Silt and Clay	Sand			Gravel		Cobble +
Silt -	Fine	Medium	Coarse	Fine	Coarse	

Specification and Comments:	OPSS1010

DS CONSULTANTS LTD.
6221 Highway 7, Unit 16
Vaughan, Ontario, L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project:	**Union Street**	Project No.:	**20-115-401**
Client:	**2774476 Ontario Inc.**	Date:	**Apr/13/2021**
Location:	**Meaford, ON**	Figure No.:	10A

Particle Size Distribution (ASTM-D421/D422)

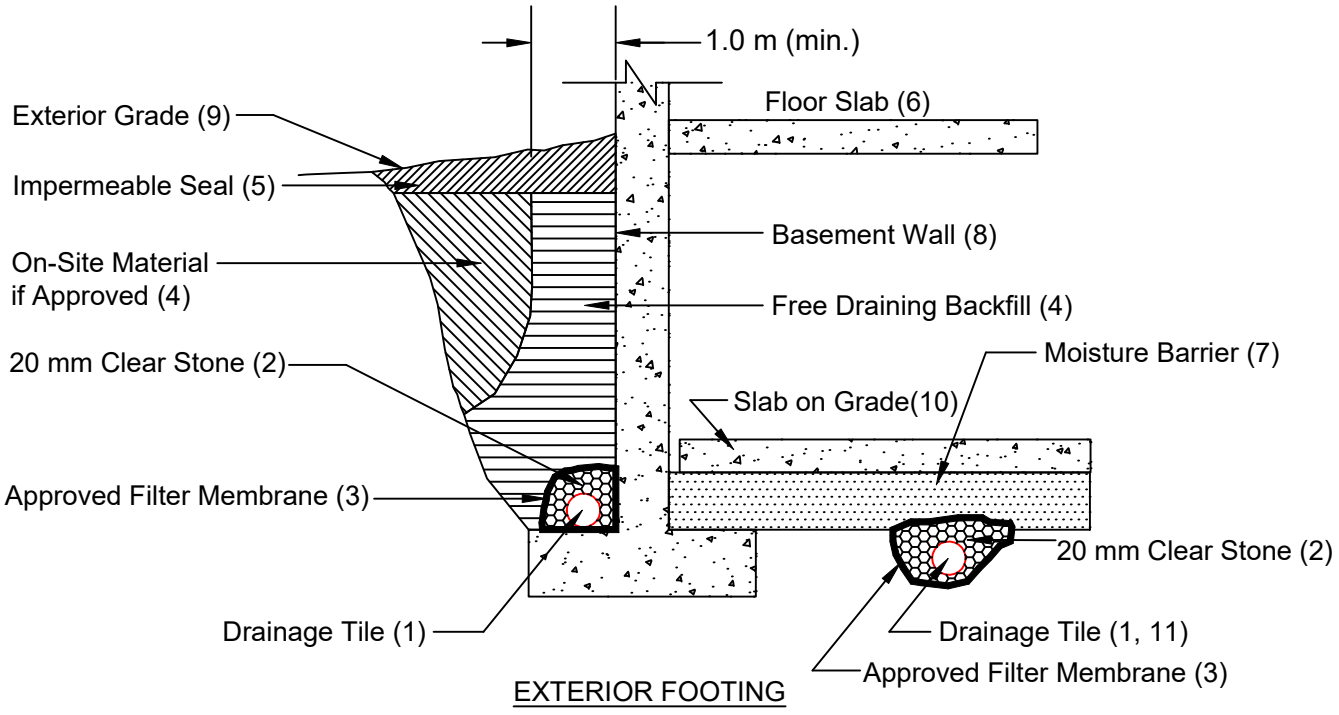


Silt and Clay		Sand			Gravel		Cobble +
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

Specification and Comments:

DS CONSULTANTS LTD.
6221 Highway 7, Unit 16
Vaughan, Ontario, L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project:	Geotechnical Investigation, Union Street subdivision	Tested by :	Matt
Project No.:	20-115-401	Date:	April-12-2021
Client:	2774476 Ontario Inc.	Dwg. No.	10B



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

Appendix A

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS Consultants Ltd (DS). Without this confirmation no responsibility for the performance of the structure can be accepted by DS. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by DS during placement of engineered fill is required. Work cannot commence or continue without the presence of the DS representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

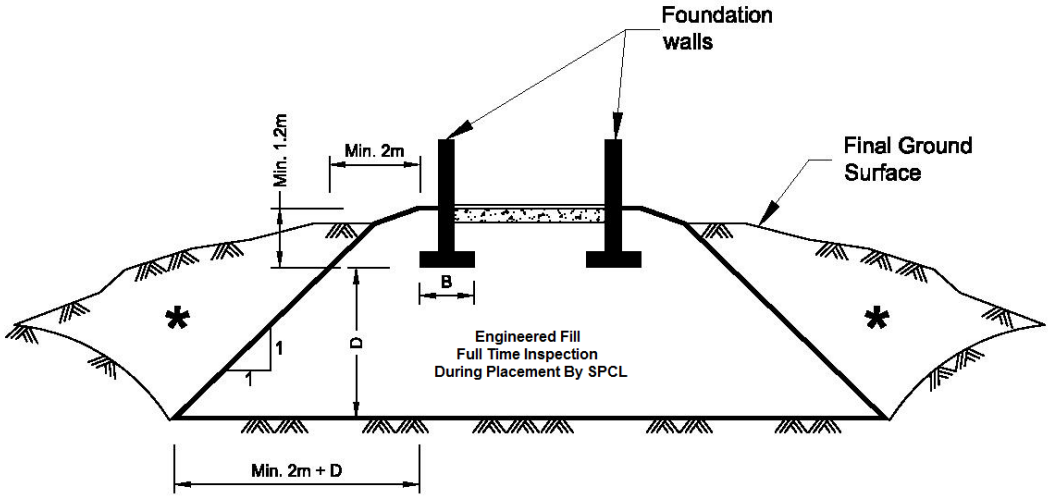
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from DS prior to footing concrete placements. All excavations must be backfilled under full time supervision by DSCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DS.

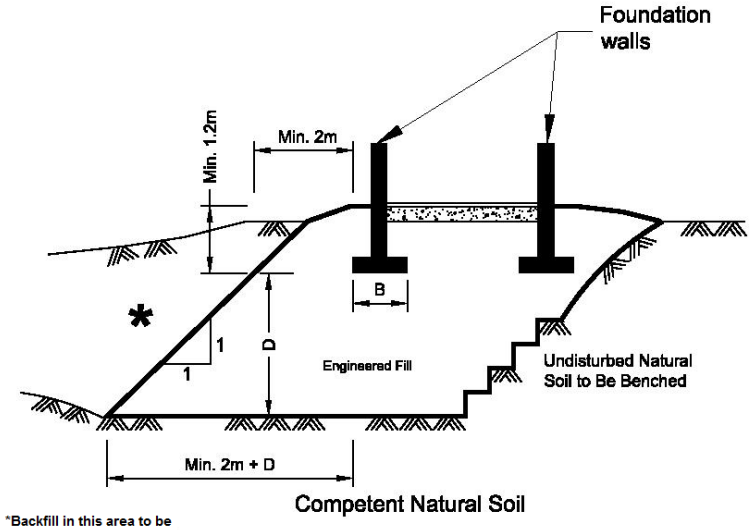
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with DS Consultants Ltd report attached.


Foundation walls
Min. 1.2m
Min. 2m
Final Ground Surface
B
D
1
1
Engineered Fill
Full Time Inspection
During Placement By SPCL
Min. 2m + D
Competent Natural Soil To
Be Confirmed By SPCL


Foundation walls
Min. 1.2m
Min. 2m
B
D
1
1
Engineered Fill
Undisturbed Natural Soil to Be Benched
Min. 2m + D
Competent Natural Soil
*Backfill in this area to be as per the SPCL report