ORBITENGINEERING
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PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED SUBDIVISION – 101 MAIN STREET, MARKDALE, ON

Prepared For:

Nivas Development Ltd.

C/O: Delbrook Triumphant Builders Inc.)

By:

Orbit Engineering Limited

Project No. OE211312 AG

Feb 28, 2022

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C/O: Delbrook Triumphant Builders Inc.
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Attention: Mehdi Shafiei

Dear Mr. Shafiei,

RE: Geotechnical Investigation
Proposed Subdivision – 101 Main Street, Markdale, ON

Enclosed please find the geotechnical investigation report related to the above noted site.

For and on behalf of Orbit Engineering Limited

Hafiz Muneeb Ahmad, M.Sc., M.Eng., P.Eng. QP_{ESA}
Senior Principal Engineer

EXECUTIVE SUMMARY

A geotechnical investigation was carried out for the proposed residential and commercial developments located at 101 Main Street, Markdale, Ontario. The project will entail a residential subdivision consisting of single-family houses, commercial development, roads, and sewers.

The topsoil thickness generally ranged from 150mm to 250mm at the borehole locations. Thickness of topsoil may vary between and beyond the boreholes. The surficial topsoil was underlain by the following layers of native soils:

The Upper Weathered Zone to depths ranging from 0.8 to 1.4 m below the existing grade was consisted of weathered/disturbed clayey silt, trace gravel and organics and rootlets, dark brown colour, moist, and in loose to compact state.

The Middle silty sand till layer extending to depths ranging from 1.5 to 3.2 m below the existing grade and was dry to moist, brown to radish brown, and in loose to compact state.

The Lower sand and gravel layer which extended to explored depth of 5.5 m and was generally moist to wet, brown to light brown, and in loose to very dense state.

During drilling and at the completion, the short term (not stabilized) groundwater was found in boreholes at shallow depths below the existing ground surface. The groundwater levels in monitoring wells installed at the location of boreholes (BH2/MW, BH4//MW, and BH6/MW) were measured on Feb 15, 2022 (after about 4 weeks of installation) at approximate depths of 3.2 to 4.5 m below the existing grade. It should be noted that groundwater levels can vary and are subjected to seasonal fluctuations and can respond to major precipitation events. The depth of groundwater table can also be influenced by the presence of underground features such as utility trenches.

In light of borehole information, the proposed residential/commercial structures foundations can be supported on undisturbed native soils or engineered fill for a geotechnical reaction of 100 kPa at the Serviceability Limit States (SLS) and a factored geotechnical resistance of 150 kPa at the Ultimate Limit States (ULS). These values would be suitable for the use of normal spread footing foundations to support normal single-family dwellings.

The engineered fill supporting footings should be constructed in accordance with the guidelines presented in **Appendix C**. Other requirements of engineered fill are given in Section 4.4.

The floor slab can be supported on grade, provided all topsoil, existing weathered/disturbed and surficially softened or loose materials are removed, and the subgrade thoroughly proof rolled. Any loose spots or areas revealed from proof rolling must be sub-excavated, backfilled and compacted.

Prior to the placement of the engineered fill, all existing weathered/disturbed and softened or loose native soils must be removed, and the exposed surface proof rolled.

Where the excavation base for engineered fill consists of cohesionless sandy soils below the groundwater level, dewatering will be required to lower the water table below the excavation base. It is possible to lower the groundwater table for about 1.0 m by pumping from perimeter sumps and trenches.

Where the excavations extend well into the cohesionless soils below the groundwater level, such as for the deep service trenches, a positive dewatering system such as well points will be required to lower the water table below the excavation base.

Discussion and recommendations for the construction of roads, sewers, excavations and backfill, and stormwater management pond are presented in Section 4.

Based on the borehole information, the subject site for the proposed building structures can be classified as “Class D” for seismic site response. Consideration can be given to conduct an earthquake site assessment with the use of in-situ testing of the seismic characteristics (i.e., Geophysical testing – Multi-channel Analysis of Surface Waves “MASW”), which can lead to an improved site classification (i.e., from Class D to Class C).

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1 INTRODUCTION

Orbit Engineering Limited (Orbit) was retained by Nivas Development Ltd. (the client) to undertake a geotechnical investigation for the proposed subdivision located at 101 Main Street, Markdale, Ontario. Considering the information provided to us by the client, it is our understanding that the project will entail a residential/commercial subdivision consisting of 14 semi-detached, 155 townhouses, 18 dwellings above commercial building, 48-unit apartment building, sewer, watermain, and roads. The site plan and approximate location of the proposed development are shown on Drawings 1 and 1A respectively.

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions by means of a limited number of boreholes (BH1 to BH10) and from the findings in the boreholes to make recommendations pertaining to the geotechnical design of underground utilities and subdivision roads and to comment on the foundation conditions for general building construction.

This report contains the findings of the investigation, together with our recommendations and comments. The anticipated construction conditions are also discussed but only to the extent that they may affect the geotechnical design. The construction methods discussed express our opinion only and are not intended to direct contractors how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all factors that may influence construction.

This report is provided based on 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 Nivas Development Ltd. and its designers/builder (Delbrook Triumphant Builders Inc.) Third party use of this report without Orbit consent is prohibited. The limitation conditions presented in **Appendix A** form an integral part of the report and they must be considered in conjunction with this report.

2 FIELD AND LABORATORY WORKS

Prior to drilling operations, underground utilities were cleared at the borehole locations by representatives of the public utilities company working with personnel from Orbit.

A total of ten (10) boreholes (see **Drawing 1A** for locations) were drilled on January 7, 2022, to a maximum depth of 5.5 m with hollow stem continuous flight augers by a drilling sub-contractor under the direction and supervision of Orbit personnel. Samples were retrieved with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 63.5 kg and dropping 760mm in accordance with the Standard Penetration Test (SPT) method (ASTM D1586). The samples were logged in the field and returned to the Orbit's laboratory for detailed examination by the project engineer and for index laboratory testing.

As well as visual examination in the laboratory, all the soil samples were tested for moisture content and selected samples for grain size analyses.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Three boreholes were converted to monitoring wells (BH/MW2, BH/MW4, and BH/MW6) to monitor the fluctuation of groundwater levels at the subject site for hydrogeological investigation.

The ground surface elevations at the borehole locations were provided by the surveyor (retained by the owner) to Orbit. Note these elevations are approximate only for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

3 SITE AND SUBSURFACE CONDITIONS

The project site is at 101 Main Street, Markdale, Ontario. The site is in residential area and located, approximately, at the north-east of Cambrai and Main Street (**Drawing 1**). A total of ten (10) boreholes (BH1 to BH10) were advanced at this site. The approximate borehole locations are shown on **Drawing 1A**. Notes on sample descriptions are presented on **Drawing 1B**. Detailed subsurface conditions are presented on the Borehole Logs, **Drawings 2 to 11**.

The borehole logs indicate the subsurface conditions only at the borehole locations. Note the material boundaries indicated on the borehole logs are approximate and based on visual observations. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should be pointed out that the subsurface conditions will vary across this site. The subsurface soil conditions are summarized as follows.

3.1 Topsoil

The thickness of the topsoil explored in the boreholes generally ranged from 150 to 200 mm. The data provided here pertaining to the topsoil thickness is confirmed at the borehole locations only and may vary

between and beyond the boreholes. This information is not considered to be sufficient for estimating topsoil quantities and associated costs.

3.2 Native Soils

The surficial topsoil layer was underlain by the following layers of native soils.

3.2.1 Weathered/Disturbed Clayey Sand Silt

The Upper Weathered Zone to depths ranging from 0.8 to 1.4 m below the existing grade consisted of weathered/disturbed clayey silt, trace gravel and organics and rootlets, dark brown colour, moist, and in loose to compact state. The measured moisture contents of clayey silt sand deposits were ranging from 7 to 40.2%

Typical grain size distribution curve of clayey silt soil samples in borehole BH/MW2 is given on **Figure B1** in **Appendix B** and show the following gradation:

Gravel:	1 %
Sand:	55 %
Silt:	39 %
Clay:	5 %

3.2.2 Silty Sand Till

Layer of silty sand till was encountered below the weathered and/or disturbed zone generally consisted of silty sand till, dry to moist, brown to radish brown, and in loose to compact state, extending to depths ranging from 1.5 to 3.2 m below the existing grade. The measured moisture contents of silty sand till deposits were ranging from 5.4 to 21.5%.

Standard Penetration tests yielded N-values of 2 to 20 blows/0.3 m. The results indicate that the relative density of the silty sand deposit can be described as loose to dense.

Typical grain size distribution curve of silty sand till samples in borehole BH/MW4 is given on **Figure B1** in **Appendix B** and show the following gradation:

Gravel:	26 %
Sand:	39 %
Silt:	30 %
Clay:	5 %

3.2.3 Sand and Gravel

*Below silty sand till, a layer of sand and gravel was encountered at depths ranging for 0.8 to 2.1m below the existing ground level and e*extended to the end of boreholes. This layer consisted of sand and gravel,

weathered limestone, some silt, moist to wet, brown to light brown and in dense to very dense state. The measured moisture contents of the native sand and gravel deposits were ranging from 7.8 to 20.9%.

Standard Penetration tests yielded N-values of 3 to 105 blows/0.3 m. The results indicate that the relative density of the sand and gravel deposits can be described as very loose to very dense.

Typical grain size distribution curve of sand and gravel samples at different depths in boreholes BH/MW2 and BH/MW6 are given on **Figure B1** in **Appendix B** and show the following gradation:

Gravel:	21-38 %
Sand:	39-45 %
Silt:	16-33 %
Clay:	1-7 %

3.3 Groundwater Conditions

During drilling and at the completion, the short term (not stabilized) groundwater was found in boreholes at shallow depths varying from 0.6 to 3.8 m below the existing ground surface. The groundwater levels in monitoring wells installed at boreholes (BH/MW2, BH/MW4, and BH/MW6) were measured and summarized in **Table 3.1**. The average of ground water in monitoring wells are ranging from 00 to 00 m measured below the existing ground level.

Table 3.1 Groundwater Levels Observed in Monitoring Wells

Well No.	Date of Drilling	Date of Water Measurement	Depth of Monitoring Well (m)	Depth/Elevation of Groundwater (m)
BH/MW2	Jan 7, 2022	During drilling	4.3	0.60
		Feb 15, 2022		1.50
BH/MW4	Jan 7, 2022	During drilling	4.5	3.05
		Feb 15, 2022		1.50
BH/MW6	Jan 7, 2022	During drilling	3.2	--
		Feb 15, 2022		3.10

Perched water may be encountered in excavated areas during wet seasons. A perched water condition can develop within and above fine-grained materials especially during and following periods of sustained precipitation.

Note that the groundwater level can vary and is subject to seasonal fluctuations and in response to major weather events. The depth of groundwater table can also be influenced by the presence of underground features such as utility trenches.

4 DISCUSSION & RECOMMENDATIONS

It is proposed to develop the site as a residential/commercial subdivision. The lots therefore will be serviced by a network of roads, storm, and sanitary sewers, and watermains.

4.1 Frost Susceptibility of Soils

The frost depth penetration in this area is considered to be 1.6 m. Based on the grain size analysis and using the Ministry of Transportation (MTO) category for frost susceptibility soils, the on-site native soils is generally classified as low susceptible to frost heaving.

4.2 Roads

The investigation has shown that the predominant subgrade soil, after stripping the topsoil, loose to compact weathered/disturbed clayey sand silt, will generally consist of cohesionless soils. The stabilized groundwater table was found at depths varying from 3.2 to 4.5 m below the existing grade.

Based on the above and assuming that traffic usage will be residential minor local or local, the following minimum pavement thickness is recommended:

- 40mm HL3 Asphaltic Concrete
- 65mm HL8 Asphaltic Concrete
- 150mm Granular ‘A’
- 300mm Granular ‘B’

For bus routes and collector roads, the following minimum pavement thickness is recommended:

- 40mm HL3 Asphaltic Concrete
- 80mm HL8 Asphaltic Concrete
- 150mm Granular ‘A’
- 400mm Granular ‘B’

These values may need to be adjusted according to the Grey County 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. 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, weathered/disturbed native and any topsoil or otherwise unsuitable 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.

In view of the low to medium permeability of the subsoil, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. 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 regarding 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 95% of its Standard Proctor Maximum Dry Density (SPMDD). The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per City/County Standards. The compaction of the new fill should be checked by frequent field density tests.

4.2.2 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 at least 100% of their respective SPMDD. The grading of the material should conform to current OPS (Ontario Provincial Standards) 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

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. Installation of full-length subdrains on all roads is recommended. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

4.3 Sewers

As a part of the site development, a network of new storm and sanitary sewers is to be constructed.

4.3.1 Trenching

As indicated in the boreholes, the trenches will be generally dug through cohesionless soils (sand and gravel to clayey sand silt).

The groundwater levels observed in the monitoring wells were at depths ranging from 3.2 to 4.5 m below the existing grade. Where the anticipated trench base is below the groundwater level, positive dewatering such as well points will be required to lower the water table to at least 1.0 m below the excavation base. Otherwise, it will result in an unstable base and flowing sides. Test pits should be carried to further explore the groundwater and seepage conditions and to confirm the need for positive dewatering if the excavations extend below the anticipated groundwater levels. The wet sand and silt deposits will require flatter slope at 3 horizontal to 1 vertical. A contractor specializing in dewatering should be retained to design the dewatering systems.

Standard geotechnical site investigations may not determine dewatering or depressurizing requirements for situation where there is planned excavation or construction below the groundwater table. To quantify conditions for dewatering purposes and to apply for required permits, both for construction and long-term drainage (if applicable), hydrogeological study can be necessary to adequately engineer a construction dewatering system and/or permanent groundwater control.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the compact to dense cohesionless deposits above the water table can be classified as Type 3 soil. Cohesionless soils below the water table can be classified as Type 4.

As a general rule, the excavations in Type 3 soil can be carried out using minimum side slopes of (1 H to 1.5 V). The excavations in Type 4 soils will require at a minimum, flatter side slopes of 3H to 1V. These slopes should be visually monitored for any movement especially if workers are present within the excavation. These temporary slopes should only be utilized for a short duration.

4.3.2 Bedding

The undisturbed compact cohesionless soils (sand and gravel) can provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have 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 silts and sandy silts to clayey silt. The bedding material should consist of well graded granular material such as Granular 'A' or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

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 poorly graded bedding material.

4.3.3 Backfilling of Trenches

Based on visual and tactile examination, the on-site excavated sandy deposits without topsoils and rootlets are generally considered to be suitable for re-use as backfill in the service trenches provided their moisture contents at the time of construction are at or near optimum. The silts are poorly graded soils and are very sensitive to their moisture contents. As such, they will be very difficult to handle and to compact, especially when excavated below the water table. Under unfavourable conditions, they may not be suitable for trench backfill.

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 last 95% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils may not be used in confined areas (e.g. around catch basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch basins.

In light of borehole information, it is recommended that underground services should be kept as high as possible to avoid penetrating the excavation below the wet sandy deposits.

4.3.4 Thrust Blocks

Pressurized fluids in buried pipelines generate unbalanced, thrust forces at bends, junctions, valves pump starts or stops, valve closures, air vents and all restrictions to, and changes in direction of flows. Generally, the thrust forces depend on the internal pressure, the cross-sectional area of the pipe and the deflection angle. For pipes which are not anchored, the unbalanced thrust forces must be resisted either by thrust blocks and collars or by thrust restraint systems or a combination of both.

Thrust blocks are passive systems which prevent the pipe joint leaking by blocking the pipe movements and the separation of unrestrained joints. Depending on the source of the thrust force, their resistance comes either from the mobilization of soil bearing capacity or dead weight: the bearing type thrust blocks resist thrust forces corresponding to concave vertical and horizontal bends, while the gravity ones secure the convex vertical bends. Because they need to immobilize the pipes, the allowable soil stresses must be considerably smaller than those required to cause ultimate failure of the thrust block itself. The thrust block design is satisfactory if the design force, F_d, is less than the ultimate resistance R_{ult}, reduced by a suitable reduction (safety) factor which will ensure that the displacements will be relatively small.

Values for thrust reduction factors for thrust blocks are given in **Table 4.1** for different soil and rock types. If these lead to unacceptably large thrust blocks, the reduction factor may be re-assessed by determining the actual relationship between thrust reduction factor and displacement under defined load and ground conditions.

Table 4.1 Reduction Factors for Thrust Blocks

Soil or Rock Type	Reduction Factor (T_r)
Dense sandy deposit	2 to 3
Compact sandy deposit	3 to 4
Very loose to loose sandy deposit	4 to 5

Thrust blocks normally consist of a volume of concrete, usually of nominal strength (20-40 MPa), which may be lightly reinforced. The size and shape of the block is decided on the basis of the forces to be restrained, the size and style of the pipe fitting or component, and local ground conditions. The effectiveness of any thrust block is determined by its mass, shape, position relative to the pipeline, the soil reactions on the block, and friction between the pipeline and the surrounding ground.

Thrust blocks for the underground services under pressure may be constructed in native soils in areas where there is no risk of future excavations. The back of the thrust blocks should be vertical and should be cast

directly against undisturbed natural soils. The ultimate lateral resistance of thrust blocks can be calculated in accordance with **Drawing 12**.

Thrust restraint systems are alternative to thrust blocks. They are active systems in the sense that they rely on the mobilization of pipe/soil friction and/or passive resistance in the soil for a sufficient length away from the junction. The length of pipeline required to develop the resisting force crucially depends on the type of junction, pipeline material, type and compaction/consistency of the backfill, etc.

4.4 Engineered Fill and Sub-Excavation

The elevation of the existing grade varies across the site. Detailed site grading plans for the proposed development were not available to us at the time of preparation of this report. However, based on the existing topography at the site, cut and fill operations are expected to require as part of the proposed development.

In the areas where earth fill is required for site grading purposes, engineered fill can be constructed below building foundations, roads, boulevards, etc.

Prior to the placement of the engineered fill, all of the existing topsoil and surficial weathered/disturbed native soils must be removed and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The depths of sub-excavation required for the construction of engineered fill at the borehole locations approximately ranged from 0.8 to 2.6 m below the existing grade. as listed in **Table 4.2**.

The groundwater levels observed in boreholes were at depths ranging from 3.2 to 4.5 m below the existing ground surface (refer to **Table 3.1**). Where the excavation base for engineered fill consists of cohesionless soils (sand and gravel or silt sand to clayey silt sand silt) below the groundwater level, dewatering will be required to lower the water table below the excavation base. It is possible to lower the groundwater table for about 0.6m to 1.0m by pumping from perimeter sumps and trenches.

Where the excavations extend well into the cohesionless soils (sand and gravel deposits) below the groundwater level, such as for the deep service trenches, a positive dewatering system such as well points will be required to lower the water table below the excavation base.

Table 4.2 Depths of Sub-Excavation for Engineered Fill Construction

Borehole No.	Depth of Sub-Excavation of weathered/disturbed Materials (m)	Depth of Groundwater (m)
BH1	1.2	0.8 (at the completion)
BH/MW2	0.8	4.3 (after about 4 weeks)
BH3	1.4	3.8 (at the completion)
BH/MW4	0.8	4.5 (after about 4 weeks)
BH5	0.8	Dry (at the completion)
BH/MW6	0.8	3.2 (after about 4 weeks)
BH7	2.3	Dry (at the completion)
BH8	1.5	Dry (at the completion)
BH9	0.8	Dry (at the completion)
BH10	2.6	3.1 (at the completion)

It is however highly prudent that all footings and underground utilities be placed at elevations as high as possible to avoid penetration into wet native sand deposits and required dewatering systems.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix C**. A geotechnical reaction 150 kPa (3000psf) at the Serviceability Limit States (SLS) and factored geotechnical resistance 225 kPa at the Ultimate Limit States (ULS) can be used on engineered fill, provided that all requirements on **Appendix C** are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential. Despite full time supervision, it has been found that contractors frequently bulldoze loose fill into areas and compact only the surface. The inspector, either busy on other portions of the site or absent during “off hours” will be unaware of this condition. For this reason, we cannot guarantee the performance of the engineered fill, and this guarantee must be the responsibility of the contractor. The owner and his representatives must accept the risk involved in the use of engineered fill and offset this risk with the monetary savings of avoiding deep foundations. This potential problem must be recognized and discussed at a pre-construction meeting. Procedures can then be instigated to reduce the risk of settlement resulting from un-compacted fill.

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below building foundations, roads, boulevards, etc.

The following is a recommended procedure for 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 Orbit Engineering Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by Orbit Engineering Limited. 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 weathered/disturbed materials. Subgrade must be proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by Orbit Engineering Limited engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard SPMDD 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 Orbit Engineering Limited during placement of engineered fill is required. Work cannot commence or continue without the presence of the Orbit 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.

8. A geotechnical reaction of 150 kPa (3000psf) may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested, and footings should 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 pad, a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by Orbit 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 Orbit.

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.

The native soils are considered suitable for use as engineered fill, provided that they comprise no topsoils and rootlets and their moisture contents at the time of construction are at or near optimum. The silts are poorly graded soils and are very sensitive to their moisture contents. As such, they will be very difficult to handle and to compact, especially at wet conditions. Under unfavourable conditions, they may not be suitable for engineered fill as mentioned in Section 4.3.3.

4.5 Foundations

The proposed structures can be founded on undisturbed native soils or engineered fill for a geotechnical reaction of 100 kPa at the Serviceability Limit States (SLS) and a factored geotechnical resistance of 150 kPa at the Ultimate Limit States (ULS). These values would be suitable for foundations to support normal single-family dwellings.

The engineered fill supporting footings should be constructed in accordance with the guidelines presented in **Appendix C**. Other requirements of engineered fill are given in Section 4.4.

Variations in the soil conditions are expected in between the borehole locations, and during construction, the soil bearing pressures should be confirmed by the Geotechnical Engineer after excavation.

The base of all footings must be inspected by this office to ensure of their placement on the competent native soil.

Foundations designed to the specified bearing values are expected to settle less than 25smm total and 20mm differential.

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

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.

It should be noted that the recommended bearing capacities have been calculated by Orbit Engineering Limited from the 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 test pits and 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 Orbit Engineering Limited to validate the information for use during the construction stage.

4.6 Floor Slab and Permanent Drainage

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

The weathered/disturbed layer present on the site is not suitable for supporting the slab-on-grade. The floor slab can be supported on grade, provided all topsoil, existing weathered/disturbed and surficial softened or loose materials are removed, and the subgrade thoroughly proof rolled. Any loose spots or areas revealed from proof rolling must further be sub-excavated and replaced with imported Granular A and/or Granular B Type 2.

The imported granular material must meet the specifications defined in OPSS-1010-13. The existing weathered/disturbed soil free from topsoil and rootlets may be used to raise the grade, provided it is confirmed by a qualified geotechnical professional from Orbit at the time construction. The fill required to raise the grade must be placed in shallow lifts (each lift not more than 200mm) and compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200 mm thick layer of well compacted 19 mm clear crushed stone is recommended to place directly under the floor slab. The stone bed would act as a barrier and prevent capillary rise of moisture from the subgrade to the floor slab. This moisture barrier has been proven to be effective for conventional floor surfaces such as carpet, vinyl tile and ceramic tile. However, if special floor coverings such as sheet P.V.C. with heat sealed seams, as is used in gymnasiums, is considered, either a high efficiency vapour barrier or venting may be required to prevent moisture accumulating between the concrete floor and the P.V.C. flooring.

The estimated modulus of subgrade reaction (k_s) equal to 25 MN/m^3 may be used for the design of slab-on-grade supported on native or structural fill soils, provided that the construction is in accordance with the recommendations provided herein. If structural fill (Granular A or B Type II) having minimum thickness of 300 mm, this value can be increased to 30 MN/m^3. The estimated value provided above may need to be adjusted based on the structure size and locations of detail design.

The floor slabs should not be tied to any load-bearing walls or columns unless they have been designed accordingly. Contraction/expansion joints should be provided for the slabs as required by the structural engineer.

If the floor slab is more than about 200mm higher than the exterior grade, then perimeter drainage is not considered to be necessary. If the floor is lower, then use of a perimeter drainage system (**Drawing 13**) is recommended.

4.7 Earth Pressures

The lateral earth pressures acting on retaining walls (if any) may be calculated from the following expression:

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

where:

- p : Lateral earth pressure in kPa acting at depth z
- K : Earth pressure coefficient equal to 0.4 for vertical walls and horizontal backfill used for permanent construction. Water pressure must be considered, if continuous wall drains are not used.
- γ : Unit weight of backfill, a value of 20.5 kN/m^3 may be assumed
- z : Depth to point of interest in meters
- 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.

4.8 Earthquake Considerations

Based on boreholes information and according to the 2012 Ontario Building Code (OBC 2012), the subject site seismic response for the proposed building structures can be classified as “Class D” (Table 4.1.8.4.A of OBC 2012). Accordingly, the foundation factors F_a can be obtained from Table 4.1.8.4.B and F_v from Table 4.1.8.4.C of the OBC for the design of the buildings.

Consideration can be given to conduct an earthquake site assessment with the use of in-situ testing of the seismic characteristics (i.e., Geophysical testing – Multi-channel Analysis of Surface Waves “MASW”), which can lead to an improved site classification (i.e., from Class D to Class C).

4.9 Corrosivity Evaluation

Two (2) selected soil samples that were a mixture of the weathered/disturbed layer and the native sand and gravel deposit (BH1–SS5 and BH3–SS2) were submitted for corrosivity analysis to assess the

aggressiveness of soil. The test results for pH and water-soluble sulphate content are presented in **Appendix D** and are also shown in **Table 4.3**.

Table 4.3 Sulphate and PH Test Results of Soil Samples

Sample No.	Depth (m)	pH	Water Soluble Sulphate Content (ppm)
BH1–SS5	3.1 - 3.6	8.25	<20
BH3–SS2	0.8 – 1.4	7.79	<20

According to Table 3 of CSA Standard, CAN/CSA-A23.1-04 the degree of exposure to sulphate attack is negligible at the two selected soil samples, therefore normal Portland cement (GU) can be used in the subsurface concrete.

The need for cathodic protection to grey or ductile cast iron pipe as given in the AWWA C105/A21.5-10, Table A1 “Soil-test evaluation”, is evaluated and a summary of the evaluation based on the test values is summarized on **Table 4.4**.

Table 4.4 Summary of Test Results for Cathodic Protection

Sample No.	Depth Below the Existing Ground Surface (m)	Assigned Points
BH1–SS5	3.1 - 3.6	3
BH3–SS2	0.8 – 1.4	3

According to the AWWA rating system, the test results give a maximum of 3 points, thus cathodic protection is not required.

It should be noted that there may be other overriding factors in the assessment of corrosion potential, such as the application of de-icing salts on the roadway and subsequent leaching into the subsoils, stray currents, etc.

4.10 Stormwater Infiltration

Grain size analysis were carried out on selected two (2) soil samples of BH2/MW-SS2 and BH2/MW-SS5 at specified location of stormwater management pond (as presented in borehole location - **Figure 1A**). The grain size curves were compared to published MOEE grain size curves compared with given hydraulic conductivity’s (Manual of policy, Procedures and Guidelines for Onsite Sewage Systems). Based on these criteria, the estimated coefficient of permeability (k) and percolation time of the on-site soils are presented on **Table 4.5.**

Table 4.5 Estimated Coefficient of Permeability & Percolation Time

Sample No.	Depth (m)	Soil Description	Coefficient of Permeability, k (cm/sec)	Percolation Time, T (mins/cm)	Note
BH2/MW-SS2	0.8 - 1.4	Sand and Silt with trace gravel and clay	10^{-3}–10^{-5}	8-20	Medium to low permeability
BH2/MW-SS5	3.1 - 3.7	Sand and gravel with some silt trace clay	10^{-3} - 10^{-4}	4-12	Medium permeability

Based on visual observations and the grain size distribution and the estimated percolation time presented above, the subsurface soils consist of mainly sand and silt to sand and gravel materials are considered as free draining materials. The estimated percolation time of these materials is generally 4 to 20 minutes per centimetre.

5 GENERAL COMMENTS

The recommended bearing capacities and the corresponding founding elevations would need to be confirmed by the representative of Orbit during construction. It should be noted that the recommended bearing capacities have been calculated by Orbit from the 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 Orbit to validate the information for use during the construction.

In this regard, Orbit 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, Orbit will assume no responsibility for interpretation of the recommendations in the report.

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

The information in this report in no way reflects on the environmental aspects of the soil condition at the site and has not been specifically addressed in this report, since this aspect was beyond the scope and terms of reference. Should specific information be required, additional testing may be required.

7 CLOSURE

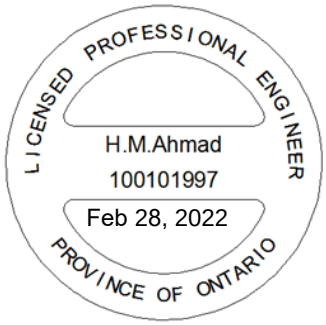
We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

For and on behalf of Orbit,

Aly Ahmed, Ph.D., P.Eng
Senior Engineer

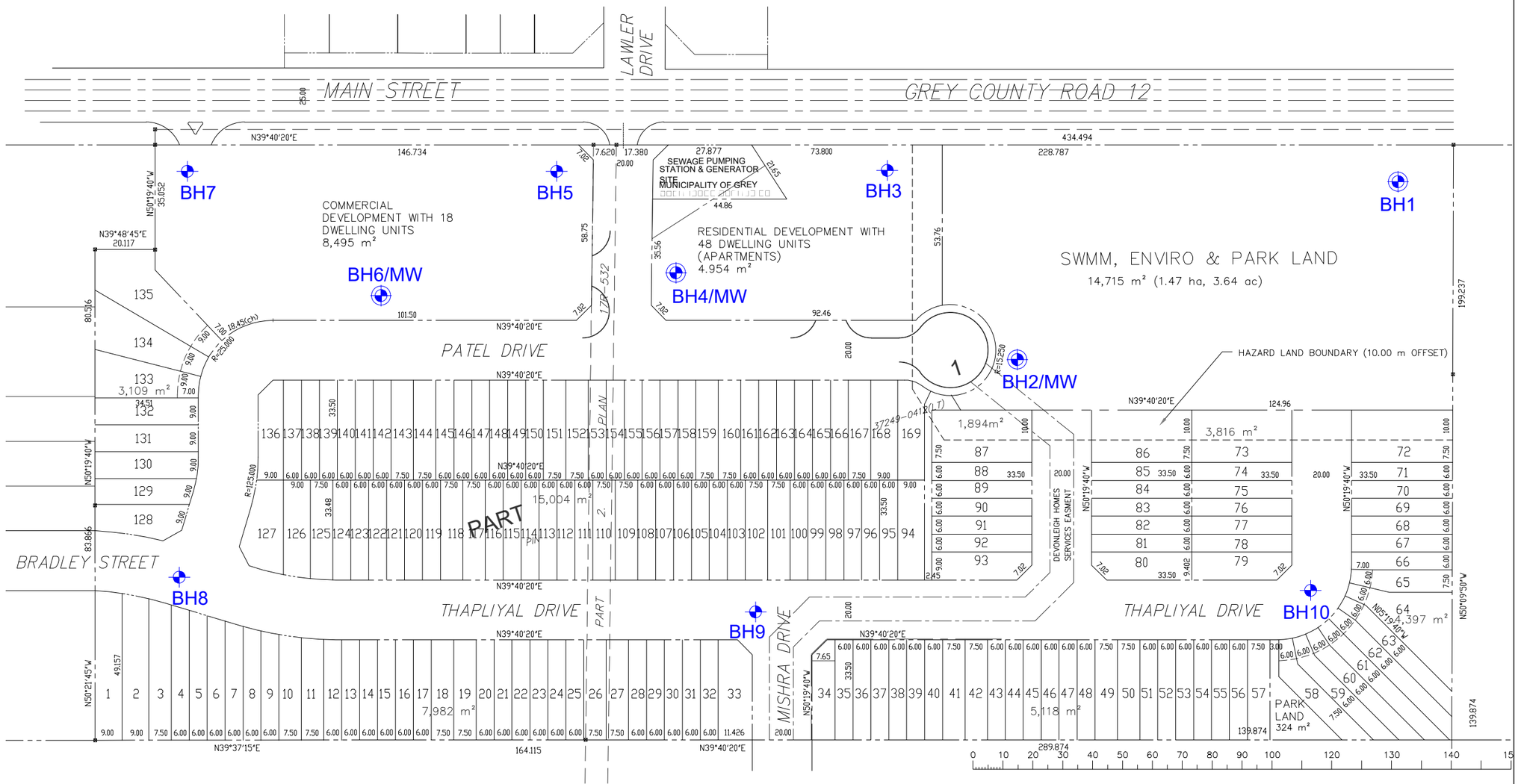
Reviewed by

Hafiz Muneeb Ahmad, M.Eng., M.Sc., P.Eng., QP_{ESA}
Senior Principal



Drawings

ORBITENGINEERING	**APPROXIMATE SITE LOCATION PLAN**		
	Date: **FEB 2022**	**GEOTECHNICAL INVESTIGATION PROPOSED RESIDENTIAL DEVELOPMENT**	Prepared By: **ZA**
			Reviewed By: **HA**
	Project: **OE211312AG**	Prepared for: **NIVAS DEVELOPMENT LTD.**	Drawing No. **1**



NOTES:

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for three months and then destroyed unless the client advises an extended time period is required.
3. Granular base fill quantities should not be established from the information provided at the borehole locations.
4. Borehole elevations should not be used to design building(s) or floor slab(s) or parking lot(s) grades.
5. This drawing forms part of the report (project number as referenced) and should only be used in conjunction with this report.

LEGEND

Approximate Borehole Location For Septic

BH/MW **Approximate Borehole/Monitoring Well Location**

Drawn	ZA
Approved	HA
Date	FEB 2021
Scale	AS SHOWN
Original size	TABLOID

ORBIT ENGINEERING
Consulting Engineers

Client: JAIN INFRASTRUCTURE CONSULTANTS LTD.

Project: GEOTECH AND HYDROG INVESTIGATION
PROPOSED RESIDENTIAL HOUSE ADDITION
15695 CONCESSION ROAD 10, SCHOMBERG, ON

Title: APPROXIMATE BOREHOLE LOCATION PLAN

Project no: OE211312AG

Drawing no: 1A

C:\Users\Orbit Engineering\Orbit Engineering Limited\Orbit Projects - Documents\Projects\2021 Projects\OE211312AG - Nivas - 101 Main Street Markdale - Geot Hydro\Drawings\Drawing Bore Hole Location.dwg

ORBITENGINEERING

LOG OF BOREHOLE BH1

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907980.51 E 528651.44

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	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
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	2							
1			2	SS	4							
1.2	**Silty Sand Till:**brown, dry, compact Wet spoon observed		3	SS	4							
2												
3			4	SS	8							
3.1	**Sand and Gravel:**weathered lime stone, some silt, brown, moist to wet, dense		5	SS	34							
4												
5			6	SS	41							
5.2	**End of Borehole:** Notes: Water Levels: (i) During Drilling: 0.8 m											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

ORBITENGINEERING

LOG OF BOREHOLE BH2/MW

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907902.97 E 528683.15

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 3

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	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
0.0	**Topsoil:** 150mm										
0.2	**Clayey Silt :** 450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	14						
0.8	**Silty Sand Till:** redish brown, wet, loose		2	SS	2						
	wet spoon was observed		3	SS	2						
2.1	**Silty Sand Till:** weathered lime stone, redish brown, wet, compact		4	SS	19						
3.2	**Sand and Gravel:** some silt, brown, wet, loose		5	SS	11						
			6	SS	3						
5.2	**End of Borehole:**										

Notes:

Water Levels:
(i) During Drilling: 0.6 m
(ii) At Completion: (50mm monitoring well installed)

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε_{50}=3% Strain at Failure

ORBITENGINEERING

LOG OF BOREHOLE BH3

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4769625.45 E 585542.15

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 4

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							GR SA SI CL
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose to compact		1	SS	10							
			2	SS	11							
1.4	**Silty Sand Till:**>brown, wet, compact		3	SS	14							
2.1	**Sand and Gravel:** some silt, brown, wet, dense wet spoon was observed		4	SS	36							
			5	SS	34							
3.9	**End of Borehole:**											

Notes:

Water Levels:
(i) During Drilling: 3.8 m
(ii) Collapse: 2.1m
(iii) Augar Refusal @ 3.9m

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

ORBITENGINEERING

LOG OF BOREHOLE BH4/MW

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907870.79 E 528618.07

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
0.0	**Topsoil:** 200mm						
0.2	**Clayey Silt :** 450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	4		
0.8	**Sand and Gravel:** trace rootlets, brown, wet, compact		2	SS	13		
1.5	**Silty Sand Till:** light brown, wet, loose wet spoon was observed		3	SS	8		
2.1	**Sand and Gravel:**some silt, weathered lime stone, light brown, wet, compact		4	SS	29		
			5	SS	16		
			6	SS	50 / 150mm		
4.9	**End of Borehole:** Notes: Water Levels: (i) During Drilling: 3.05 m (ii) At Completion: (50mm monitoring well installed)						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

ORBITENGINEERING

LOG OF BOREHOLE BH5

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907887.27 E 528554.85

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 6

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	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
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	19							
0.8	**Silty Sand Till:**brown, dry, compact		2	SS	16							
			3	SS	15							
2.3	**Sand and Gravel:**weathered lime stone, some silt, brown, moist to wet, dense		4	SS	38							
			5	SS	48							
			6	SS	87							
5.5	**End of Borehole:**											

Notes:

Water Levels:
(i) Augar Refusal @ 5.5m

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

ORBITENGINEERING

LOG OF BOREHOLE BH6/MW

PROJECT: Geotechnical Investigation for Residential Development
CLIENT: Nivas Development Ltd.
PROJECT LOCATION: 101 Main Street, Markdale, ON
DATUM: Geodetic
BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907807.26 E 528540.2

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jan-06-2022

PROJECT NO.: OE211312AG
DRAWING NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	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
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :** 450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	6							
0.8	**Silty Sand Till:** redish brown, dry, compact		2	SS	18							
			3	SS	20							
2.1	**Sand and Gravel:** weathered lime stone, redish brown, dry, very dense		4	SS	60							
			5	SS	52							
			6	SS	105							
5.2	**End of Borehole:**											

Notes:

Water Levels:
(i) During Drilling: Dry
(ii) At Completion: (50mm monitoring well installed)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

ORBITENGINEERING

LOG OF BOREHOLE BH7

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907778.29 E 528464.89

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 8

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	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
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m							
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	4							
0.8	**Silty Sand Till:**brown, dry, compact		2	SS	16							
			3	SS	20							
2.3	**Sand and Gravel:**weathered lime stone, some silt, brown, moist to wet, dense		4	SS	89							
			5	SS	32							
			6	SS	50mm/50							
4.7	**End of Borehole:**											

Notes:

Water Levels:
(i) During Drilling: Dry

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_{50}=3% Strain at Failure

ORBITENGINEERING

LOG OF BOREHOLE BH8

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907676.92 E 528585.71

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 9

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
0.0	**Topsoil:** 150mm						
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	2		
0.8	**Silty Sand Till:**brown, dry, compact		2	SS	4		
1.5	**Sand and Gravel:** some silt, brown, moist , loose to compact		3	SS	25		
			4	SS	8		
			5	SS	11		
4.1	**Sand and Gravel:**weathered lime stone, some silt, brown, moist to wet, dense		6	SS	97		
5.1	**End of Borehole:**						

Notes:

Water Levels:
(i) During Drilling: Dry
(ii) Refusal on 5.03m @ 55N

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

ORBITENGINEERING

LOG OF BOREHOLE BH9

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907800.96 E 528694.16

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	4							
0.8	**Sand and Gravel:** some silt, brown, moist , loose to compact		2	SS	18							
			3	SS	10							
2.3	**Sand and Gravel:**weathered lime stone, some silt, brown, moist to wet, dense		4	SS	41							
			5	SS	40							
3.8	**End of Borehole:**											

Notes:

Water Levels:
(i) During Drilling: Dry
(ii) Augar Refusal @ 3.8m

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

ORBITENGINEERING

LOG OF BOREHOLE BH10

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907873.8 E 528758.61

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	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
0.0	**Topsoil:** 150mm											
0.2	**Clayey Silt :**450mm Weather disturbed, trace gravel, trace organics and rootlets, dark bown, moist, loose		1	SS	5							
0.8	**Silty Sand Till:** dark brown, moist, loose		2	SS	8							
			3	SS	8							
			4	SS	18							
2.6	**Sand and Gravel:**weathered lime stone, some silt, brown, wet, compact Wet spoon observed		5	SS	14							
			6	SS	20							
5.2	**End of Borehole:**											

Notes:

Water Levels:
(i) During Drilling: 3.1m

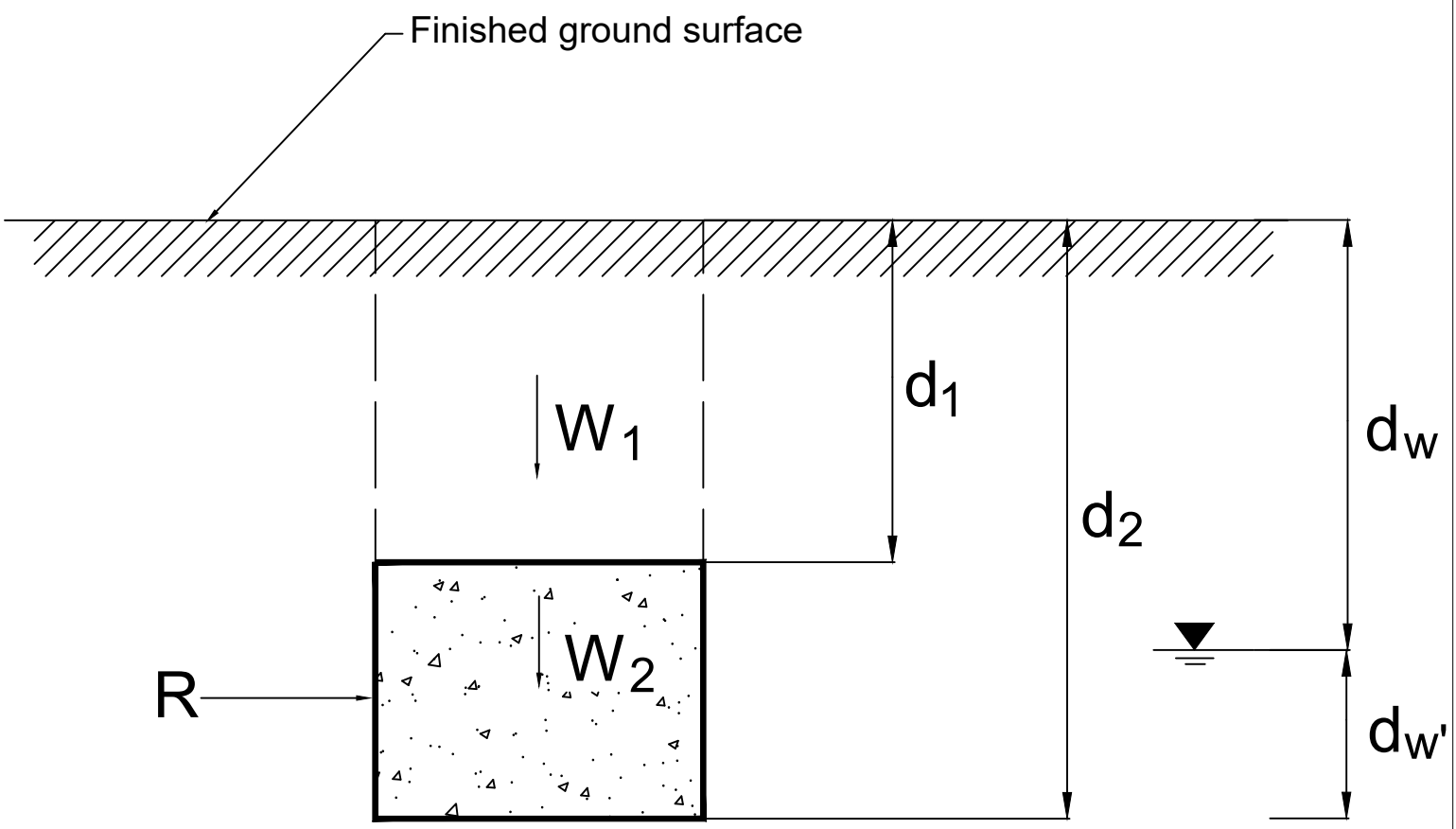
GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure



R = ultimate lateral resistance of thrust block

Case 1 dw < d1

$R = B[1/2\ Kp\gamma'(d2^2 - d1^2) + Kp\ \gamma w\ dw\ (d2 - d1)] + (W1 + W2)f$

Case 2 d1 < dw < d2

$R = B[1/2\ Kp\gamma(d2^2 - d1^2) - 1/2\ Kp\gamma w\ (dw')^2] + (W1 + W2)f$

Case 3 d2 < dw

$R = B[1/2\ Kp\gamma(d2^2 - d1^2)] + (W1 + W2)f$

R = Ultimate earth resistance, kN.

B = width of block, m.

Kp = coefficient of passive earth pressure = 2.5

γ = total unit weight of soil = 19 kN/m^3

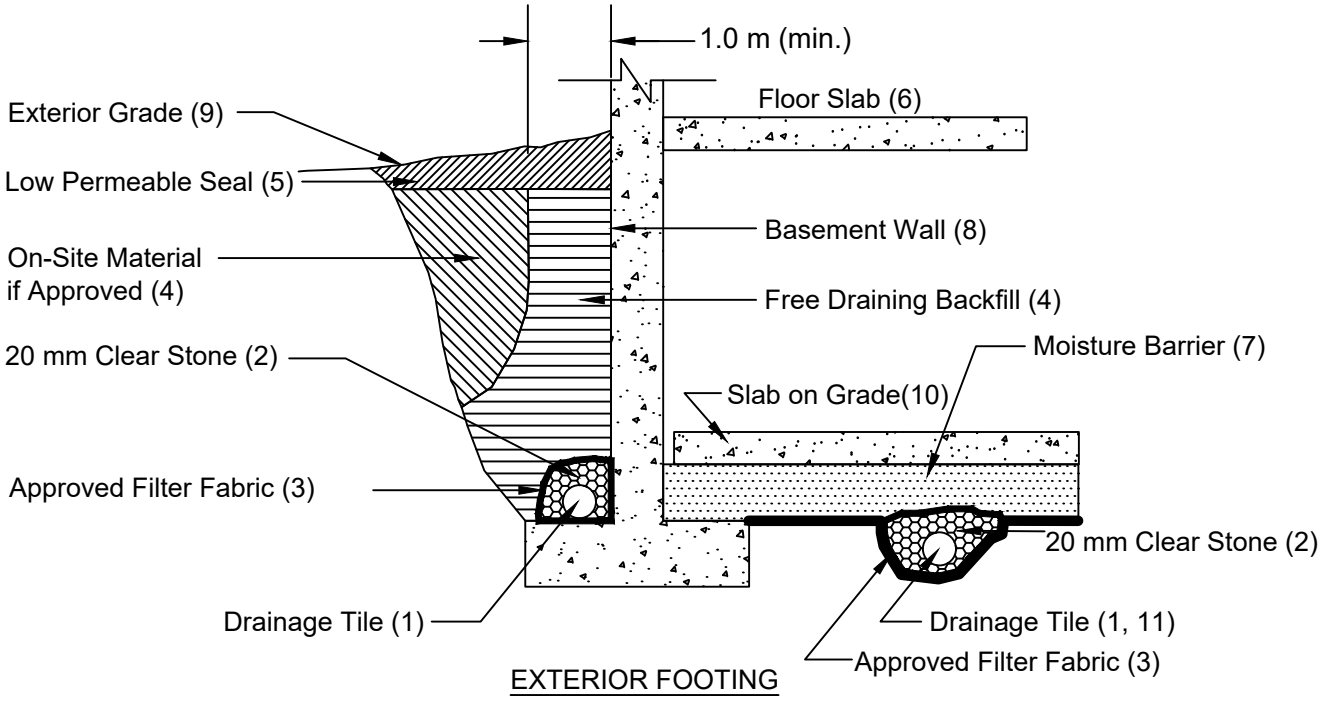
γ' = submerged unit weight of soil = 9 kN/m^3

γw = unit weight of water = 10 kN/m^3

W1 = weight of soil above thrust block

W2 = weight of thrust block

f = coefficient of friction between block and soil = 0.3



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 fabric (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. Low permeable backfill seal - compacted clay, clayey silt or paved with concrete/asphalt 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 for parking garage and water proofed for finished basement.
9. Exterior grade to slope away from building.
10. Typically slab on grade is not structurally connected to the wall or footing. However, if it is connected to the wall, it should be designed accordingly.
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. Final detail must be approved before system is considered acceptable.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

Appendices

Appendix A

Limitations of Report

LIMITATIONS OF 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 Orbit Engineering Limited. at the time of preparation. Unless otherwise agreed in writing by Orbit Engineering Limited, 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 testhole 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 testholes may differ from those encountered at the testhole 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 testhole 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 testholes 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. Orbit Engineering Limited 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. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their officers, agents and employees in excess of the fee paid for professional services.

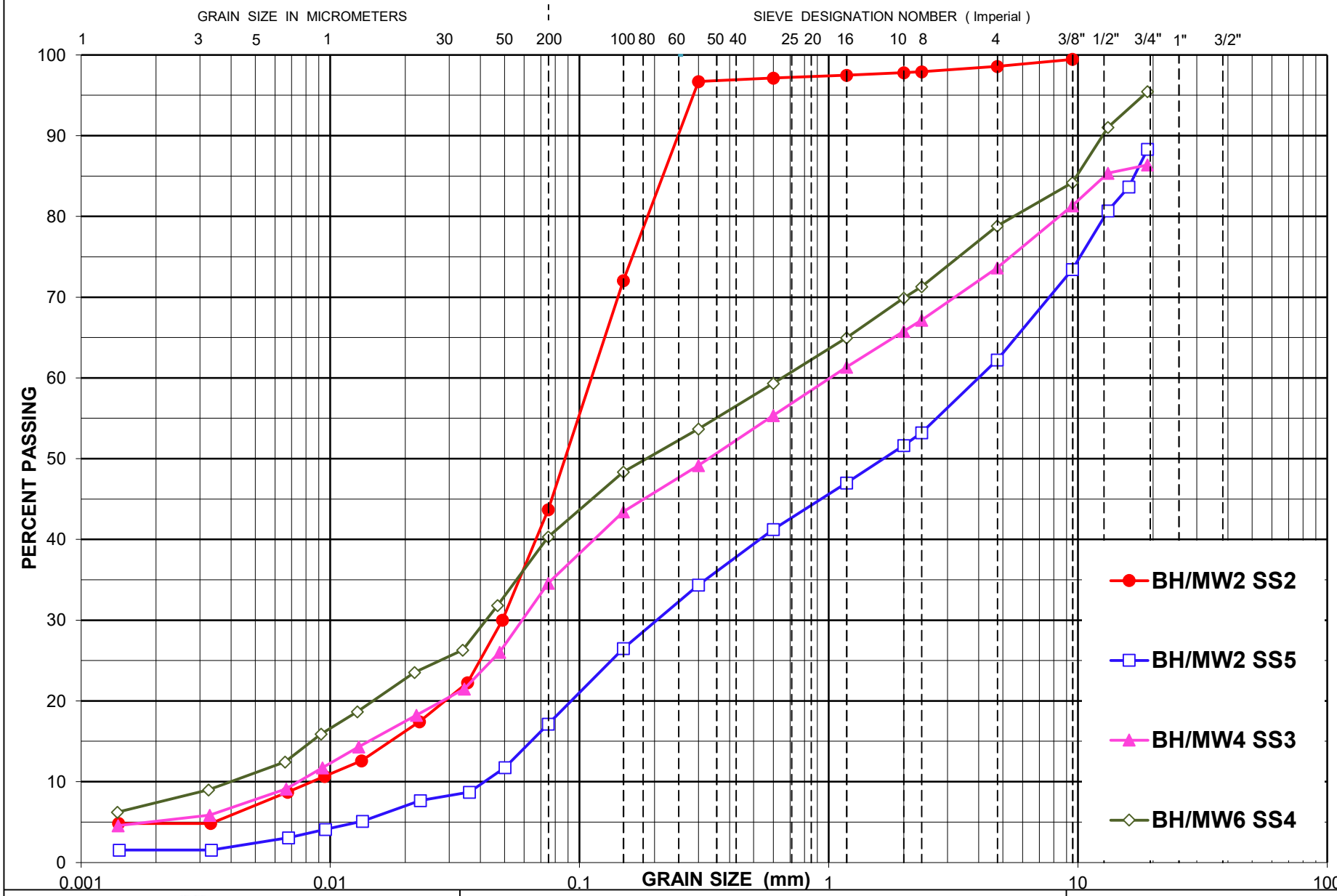
Appendix B

Geotechnical Laboratory Test Results

LS 702/D 422

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



ORBITENGINEERING
Consulting Engineers

GRAIN SIZE DISTRIBUTION

Figure No.:	B1
PROJECT No. :	OE211312AG
DATE :	January 14, 2022

Appendix C

General Requirements for Engineered Fill

APPENDIX B: 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, Coffey recommends use of OPSS Granular 'B' sand and gravel fill material only.

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 soil 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. Foundations placed within the engineered soil 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 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 Coffey Geotechnics. Without this confirmation no responsibility for the performance of the structure can be accepted by Coffey Geotechnics. 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 proofrolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a Coffey Geotechnics engineer prior to placement of fill.

5. The approved engineered fill must be 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 and should be evaluated prior to placing the fill.

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

8. An allowable bearing pressure of 0.150 MPa (3000 psf) may 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.

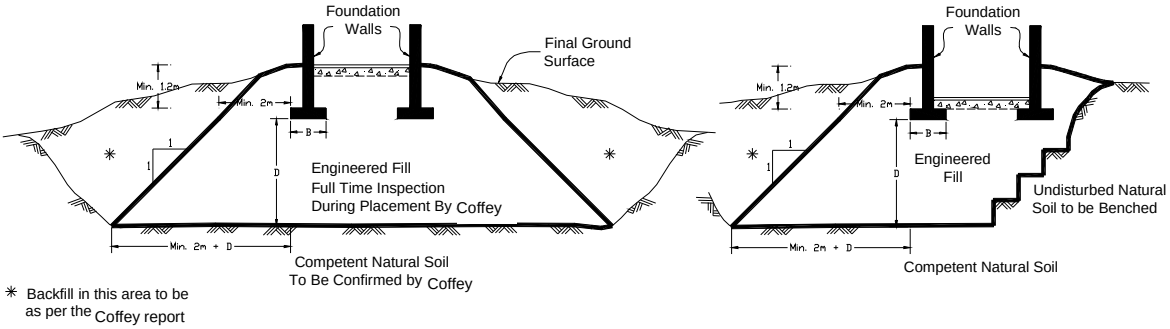
10. After completion of the pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from Coffey prior to footing concrete placements. All excavations must be backfilled under full time Coffey supervision by Coffey to the same degree 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 Coffey.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proofrolled 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 Coffey Geotechnics report attached.


Foundation
Walls
Final Ground
Surface
Min. 1.2m
Min. 2m
B
D
1
1
Engineered Fill
Full Time Inspection
During Placement By Coffey
Min. 2m + D
Competent Natural Soil
To Be Confirmed by Coffey
✳ Backfill in this area to be
as per the Coffey report
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

Appendix D

Certificate of Analysis

Certificate of Analysis

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Hafiz Ahmad
PO#:
Invoice to: Orbit Engineering

Report Number: 1972007
Date Submitted: 2022-02-17
Date Reported: 2022-03-01
Project: OE211312AG
COC #: 886366

Dear Hafiz Ahmad:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____
Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

eurofins | Environment Testing

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Hafiz Ahmad
PO#:
Invoice to: Orbit Engineering

Report Number: 1972007
Date Submitted: 2022-02-17
Date Reported: 2022-03-01
Project: OE211312AG
COC #: 886366

				Lab I.D.	1611079	1611080
				Sample Matrix	Soil153	Soil153
				Sample Type		
				Sampling Date	2022-02-17	2022-02-17
				Sample I.D.	BH3(SS-2)	BH1(SS-5)
Group	**Analyte**	**MRL**	**Units**	**Guideline**		
Anions	SO4	0.01	%		0.03	0.02
Cl in Concrete	Cl	0.002	%		0.006	0.008
General Chemistry	Electrical Conductivity	0.05	mS/cm	STD 0.57	0.27	0.17
	pH	2.00			7.79	8.25
	Resistivity	1	ohm-cm		3700	5880
Redox Potential	REDOX Potential		mV		263	230
Subcontract	S2-	0.20	ug/g		<0.20	<0.20

Guideline = O.Reg 153-T1-All Other Soils *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Hafiz Ahmad
PO#:
Invoice to: Orbit Engineering

Report Number: 1972007
Date Submitted: 2022-02-17
Date Reported: 2022-03-01
Project: OE211312AG
COC #: 886366

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 417438 **Analysis/Extraction Date** 2022-02-22 **Analyst** AA **Method** C CSA A23.2-4B			
Chloride	<0.002 %		80-120
Run No 417482 **Analysis/Extraction Date** 2022-02-23 **Analyst** MW **Method** C SM2580B			
REDOX Potential	193 mV	101	
Run No 417787 **Analysis/Extraction Date** 2022-02-28 **Analyst** IP **Method** AG SOIL			
SO4	<0.01 %	94	70-130
Run No 417791 **Analysis/Extraction Date** 2022-02-28 **Analyst** IP **Method** Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	100	90-110
pH	7.14	101	90-110
Resistivity			
Run No 417836 **Analysis/Extraction Date** 2022-02-24 **Analyst** AET **Method** SUBCONTRACT-A			
S2-	<0.20 ug/g	71	

Guideline = O.Reg 153-T1-All Other Soils *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Appendix E

Drawings Provided by Client

MAIN STREET

LAWLER DRIVE

GREY COUNTY ROAD 12

BH7 BH5 BH3 BH1

COMMERCIAL
DEVELOPMENT WITH 18
DWELLING UNITS
8,495 m²

SEWAGE PUMPING
STATION & GENERATOR
SITE
MUNICIPALITY OF GREY
HIGHLANDS 694.17 m²

RESIDENTIAL DEVELOPMENT WITH
48 DWELLING UNITS
(APARTMENTS)
4.954 m²

SWMM, ENVIRO & PARK LAND
14,715 m² (1.47 ha, 3.64 ac)

BH6- MW BH4- MW BH2 - MW

PATEL DRIVE

HAZARD LAND BOUNDARY (10.00 m OFFSET)

PART PLAN 37249-0412(LT)

PART PIN 2

BRADLEY STREET BH8

THAPLIYAL DRIVE BH9 THAPLIYAL DRIVE BH10

MISHRA DRIVE

DEVONLEIGH HOMES SERVICES EASMENT

PARK LAND 324 m²

SITE STATISTICS:

TOTAL AREA INCLUDING SWM & ENVIRONMENTALLY PROTECTED AREA 8.913 ha

ZONING RM.

TOWNHOUSE LOT AREA 200 m² min. FRONT WIDTH 6.00 m min.
SEMIDETACHED LOT AREA 300 m² min. FRONT WIDTH 9 m min.

TOTAL DWELLING UNITS	235
SEMIDETACHED	14
TOWNHOUSES	155
DWELLINGS ABOVE COMMERCIAL	18
APARTMENTS	48

RESIDENTIAL/COMMERCIAL LOTS NET AREA (EXCLUDING RIGHT OF WAYS, PARK, SWMM & ENVIRO LANDS) = 54,769 m²

RESIDENTIAL DENSITY PROPOSED: 235/5.477 ha = 42.91 UNITS/HECTAR

APARTMENT BUILDING: 48 DWELLING UNITS
SITE AREA 4,954 m²(0.495ha, 1.224 ac)

COMMERCIAL SITE AREA: 8,495 m²(0.850 ha, 2.10 ac)
PROPOSED ZONING C3

SOSCIA
PROFESSIONAL ENGINEERS INC.
10376 Yonge Street, Suite 307
Richmond Hill, ON. L4C 3B8
WWW.ssosciaeng.ca
ph 905 237 5410
fax 905 237 5413

DELBROOK GROUP

DRAFT PLAN SKETCH. OPTION 2

JOB # 21-044
MARKDALE DEVELOPMENT. MUNICIPALITY OF GREY HIGHLANDS
DATE: AUGUST 20, 2021
SCALE: 1:1250


25m MIN TO ESTIABLISH EXISTING GRADE
25m MIN TO ESTIABLISH EXISTING GRADE
SUBJECT LANDS
TOPO PUMP STATION AND INVERTS.
EXTERNAL EASEMENT, REQUIRES COMPLETE SOPE OF WORK SERVICES AS NOTED IN ITEM 1.0 (SEPERATE PRICE PLEASE), EASEMENT TO BE 6.0 m WIDE
ENTIRE R.O.W TOPO,CEN TER LINE ROAD, DITCHES TOP AND BOTTOM BOTH SIDES, INCLUDING CULVERTS
TIE INFO, CURBES CENTERLINE ROAD, INVERTS OF SANITARY AND STORM AT THIS LOCATION
Markdale Golf