Geotechnical Investigation Report

Proposed Residential Subdivision

Agnes Street
Alton, Ontario

TOWN OF CALEDON
PLANNING
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Prepared For:
The Alton Development Inc.

Final Report

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ENGLOBE

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1 Introduction

Englobe Corp. (Englobe) was retained by Jeremy Grant of The Alton Development Inc. (hereinafter referred to as the “Client”) to carry out a geotechnical assessment at a property situated south of Queen Street West between Agnes Street and Emeline Street in the Village of Alton (Caledon), Ontario (hereinafter referred to as the “Site”). A site location plan is provided on Figure 1 in Appendix A. It is understood that the geotechnical assessment will be required as part of the permitting process for proposed site development. The report has been updated to reflect revisions to the development concept and to address review comments prepared by the Town of Caledon and Region of Peel in a letter of April 2024. Authorization to proceed with the supplementary review and report update was provided by Jeremy Grant on November 14, 2024.

A previous subsurface investigation of the site was carried out by Englobe Corp (formerly Terraprobe Inc.) in 2019[1]. The boreholes from this previous investigation have been reviewed and appended as part of the current geotechnical assessment. This report presents the results of all of the known subsurface information from the investigation works completed during our investigations in the area of the proposed development.

The purpose of the work was to investigate and report on the subsurface soil and ground water conditions in a series of boreholes drilled at the site. Based on this information, advice is provided with respect to the geotechnical aspects of the proposed development, including the design of foundations, floor slabs on grade, pavements and a SWM infiltration facility. The anticipated construction conditions pertaining to excavation, backfill and temporary ground water control are discussed also, but only with regard to how these might influence the design.

The recommendations and opinions provided in this report are applicable only to the proposed site works as described above, and the Limitations of the Investigation found in Section 7 is an integral part of this report.

2 Site and Project Description

2.1 Existing Site Conditions

The subject property is situated south of Queen Street West between Agnes Street and Emeline Street in the Village of Alton. The site is an irregular shaped parcel of land covering approximately 4.04 ha (10 acres). The site was primarily used for agricultural operations. Tree lines exist at portions of the southeastern property lines at the rear of the agricultural lands. The surrounding land has primarily been developed for residential use. The topography varies across the site. There is a fall of about 3.5 m in elevation across the 266 m traverse of the site from the north to the south. From the west to the east there is a fall in elevation of about 4.2 m across the 158 m traverse of the site.

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[1] *Geotechnical Investigation, Part of East Half of Lot 22, Concession 4, West of Hurontario Street (Alton) Caledon, Ontario*; prepared by Terraprobe Inc. for Normaple Development Ltd. & Seaton Foxbridge Corporation; File No. 7-18-0158-01; March 29, 2019

2.2 Site Geology

Englobe has reviewed the subsurface information from our previous projects completed in the general area as well as publicly available borehole information and geological mapping. Based on published geological information for the general area of the site, the near surface overburden soil at and in the vicinity of the subject property consists of Pleistocene age sandy silt till.[2] The sandy silt till is underlain by the Amabel Formation. The Amabel Formation consists of grey or blue-grey dolostone.[3]

2.3 Proposed Development

The general arrangement of the site and the proposed development features are shown on Figure 3, as derived from a Concept Plan drawing prepared by Orchard Design Studio Inc. dated August 5, 2024. In this design, it is proposed to construct a residential subdivision consisting of fourteen residential blocks. The development will be provided with municipal water services, private sewage systems and will have roads meeting the standards of the Town of Caledon.

3 Procedure

The field work for this investigation was carried out on February 7 and 8, 2019, during which time eight (8) boreholes were drilled to depths of about 2.5 to 6.7 metres below the existing ground surface (mBGS). The locations of the boreholes are shown on the Borehole Location Plan, Figure 2. The detailed results of the boreholes are shown on the accompanying Borehole Logs in Appendix A.

The borehole drilling and sampling was carried out using a track mounted drill rig supplied and operated by a specialist drill contractor. The boreholes were advanced using conventional interval augering and sampling techniques and soil samples were recovered at regular intervals of depth by split barrel sampling in accordance with ASTM Standard D1586. After the drilling, sampling, and logging was completed, the boreholes were backfilled with auger cuttings and bentonite sealant.

The field work was observed throughout by a member of our engineering staff who also arranged for underground services locates in advance of the work, logged the boreholes and cared for the samples recovered. The boreholes were located in the field with respect to the existing site features. The ground surface elevations at the borehole locations were inferred from spot elevations on a topographical plan of the site provided by Van Harten Surveying Inc. The ground surface elevations at the boreholes were referred to the geodetic datum.

Ground water observations were made in each borehole during and upon completion of drilling and sampling. In addition, monitoring wells were installed in three (3) boreholes namely BH2, BH5 and BH8. The monitoring wells were extended to depths of 4.6 to 6.7 metres below ground surface (m BGS). The monitoring wells were constructed of 50 mm diameter schedule 40 PVC screen and riser with a silica sand pack, and bentonite seal. The screen length used was 1.5 metres and silica sand pack was placed at the tip of the monitoring well and extended at least 0.6 m above the screen. Details of monitoring well construction are also presented on the attached borehole logs in Appendix A. Water levels were measured following drilling on March 4, 2019.

Boreholes that were not equipped with a monitoring well were decommissioned and sealed with bentonite pellets in accordance with Ontario Regulation 903.

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[2] Quaternary Geology, Orangeville Area, Southern Ontario; Ontario Division of Mines; Map P.848; 1973

[3] Reynolds, J.K., Bernier, L.; Paleozoic Geology, Orangeville Area; Ontario Division of Mines; Map P.947; 1974

Geotechnical laboratory testing consisted of moisture content tests on all recovered samples and grain size distribution analyses on two (2) select samples in accordance with ASTM Standards. The results of the grain size analysis are presented in Appendix A.

Chemical analyses of the soils at this site were not included in the scope of this investigation.

4 Subsurface Conditions

The subsurface soil and ground water conditions encountered in the boreholes, and the results of the field and laboratory testing, are shown on the Log of Borehole sheets in Appendix A. A list of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. These boundaries generally represent a transition from one soil type to another and should not be inferred to represent exact planes of geological change. The conditions will vary between and beyond the locations investigated.

4.1 Soil Conditions

The following discussion has been simplified in terms of the major soil strata for the purposes of geotechnical design. In general, the boreholes drilled at the site penetrated topsoil and fill, overlying silty fine sand and silty sand and gravel.

4.1.1 Topsoil

A layer of topsoil was encountered at the ground surface at most borehole locations and generally varied in thickness between about 150 and 600 mm.

4.1.2 Fill

Fill consisting predominantly of silty fine sand with trace gravel and topsoil was encountered immediately beneath the ground cover in boreholes 2, 5, 6, 7, and 8. The fill extended to a depth generally varying from 0.8 to 2.1 m BGS. The N values, as determined in the Standard Penetration testing carried out within the fill or disturbed/weathered native soil, ranged from 3 to 37 blows per 0.3m, inferring a very loose to dense consistency. The higher N values of the fill determined in borehole 6 are due to the presence of large particles and gravel. The in-situ water content of the samples of fill recovered from the standard penetration testing ranged from about 5 to 36 percent.

4.1.3 Silty Fine Sand

Boreholes 1, 5 and 6 penetrated a stratum of silty fine sand to depths ranging from 2.1 to 4.0 m BGS. The N values within the silty fine sand determined from the standard penetration testing ranged from 5 to 27 blows per 0.3 m, inferring a loose to compact relative density. The natural water content of the silty fine sand samples ranged from about 4 to 11 percent.

4.1.1 Silty Sand and Gravel

A deposit of silty sand and gravel with cobbles and boulders was encountered in all boreholes beneath the fill and silty fine sand to depths of about 2.5 to 6.7 m BGS. The N values determined in the silty sand and gravel ranged from 16 to greater than 100 blows per 0.3 m, generally inferring a compact to very dense relative density. The natural water content of samples of the silty sand and gravel recovered from the penetration testing were in the range of about 4 to 13 percent.

4.2 Ground Water Conditions

Ground water levels were measured within four (4) monitoring wells installed within selected boreholes BH2, BH5 and BH8. Monitoring well identification followed the numbering of the boreholes completed as part of this investigation. Geodetic elevations of monitoring well locations were obtained from the topographic survey competed for the Site and monitoring well locations were mapped with a handheld GPS device. Table 1 provides a summary of monitoring well locations established at the Site:

Table 1: Monitoring Well Details

MW ID	Coordinates		Ground Surface Elevation (masl)*	Well Depth	
	Easting (m)	Northing (m)		mbgs**	Masl
MW2-S	574614	4856342	415.8	3.0	412.8
MW2-D				6.1	409.7
MW5	574776	4856396	421.9	6.2	415.7
MW8	574738	4856521	413.9	4.6	409.3

Note:
*masl: meters above sea level
**mbgs: meters below ground surface

Monitoring wells were screened with a 1.5 m length well screen completed within silty sand and gravel deposits. One (1) pair of nested monitoring well was installed at BH2 location to assess vertical groundwater flow gradients. Monitoring wells were identified using the same numbering as borehole locations (i.e., MW5 was completed within BH5). The shallow and deep monitoring wells are identified as MW2-S and MW2-D, respectively. Water levels were monitored at the installed monitoring wells as summarized in the following table (Table 2):

Table 2: Summary of Ground Water Monitoring

Location	Water Levels								Observed Seasonal Variation (m)
	04-Mar-19		04-Apr-19		25-Apr-19		09-Aug-19		
	mbgl *	masl **	mbgl	masl	mbgl	masl	mbgl	masl	
MW2-S	2.3	413.5	1.6	414.2	1.3	414.5	2.4	413.4	1.1
MW2-D	2.4	413.4	1.8	414.0	1.6	414.2	2.6	413.2	1.0
MW5	6.3	415.6	6.2	415.7	>6.4	<415.5	6.1	415.8	>0.3
MW8	2.2	411.7	1.6	412.3	1.1	412.8	2.4	411.5	1.3

Note:
*mbgs: meters below ground surface
**masl: meters above sea level

These conditions may not necessarily represent stabilized conditions. Fluctuation in the ground water levels will also occur due to seasonal variations and precipitation conditions.

Further details and discussion about ground water are provided in the Hydrogeological Investigation Report that was completed concurrently with this geotechnical investigation. These results are reported under separate cover.

5 Geotechnical Design Recommendations

The following discussion is based on our interpretation of the factual data obtained during this investigation and is intended for the use of the design engineer only. Comments made regarding the construction aspects are provided only in as much as they may impact on design considerations. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

It is understood that it is proposed to construct a residential townhouse subdivision. The development will be provided with municipal water services, private sewage systems and will have roads meeting the standards of the Town of Caledon.

5.1 Site Preparation Works

The preliminary site development information indicates that some cutting and filling will be required. Any fill that will be required in areas to be developed for floor slabs on grade must be constructed as an engineered fill. A specification for the creation of an Engineered Fill is provided as Appendix C. It is expected that the site restoration and filling will be carried out in advance of construction.

It is noted that the surficial vegetative cover and topsoil varies in thickness between 150 mm and 600 mm as observed within all boreholes drilled during the geotechnical investigation. Contractors bidding on the work should undertake test pits to better assess topsoil stripping requirements.

Topsoil within the limits of the project shall be salvaged prior to beginning excavating, fill or hauling, operations by excavating topsoil and stockpiling the material at designated locations on drawings or as designated by the owner in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage. All stockpiles (topsoil and/or earth fill) shall be protected from sediment transport by surface roughening and perimeter silt fencing.

The subgrade soils exposed after the removal of the surficial topsoil will consist of existing earth fill or disturbed/weathered native soil. Care will be required during excavation to separate any materials that appears to contain significant topsoil from the clean earth fill. Prior to backfilling or site grading activities, the exposed subgrade soils should be visually inspected, compacted if required, and proof rolled using large axially loaded equipment. Any soft, organic, or unacceptable areas should be removed as directed by the Geotechnical Engineer and replaced with suitable fill materials compacted to a minimum of 98 percent standard Proctor maximum dry density (SPMDD). If the fill used to raise site grades in the building areas is to support foundations, then it will be necessary to remove all existing fill to competent native soils prior to filling. Clean earth fill used to raise grades in the proposed building and pavement areas should be placed in thin layers (150 mm thick or less) and compacted by a heavy sheep-foot type roller to 98 percent of SPMDD. For optimal performance, the placement water content of the fill should be maintained within about 2 percent of the laboratory optimum water content for compaction. Benches should be cut into the existing slopes at a maximum 600 mm height to allow placement of new fill in a horizontal manner.

The quality of imported soil should be consistent with the applicable property use standards of the MECP's document entitled, 'Soil, Ground Water and Sediment Standards for Use Under Part XV. I of the Environmental Protection Act', dated April 15, 2011.

All aspects of the engineered fill construction should be verified by the geotechnical engineer including the final excavation, compacting of the native subgrade, and placement and compaction of the engineered fill. In-situ density testing should be carried out during construction to confirm that each lift has been compacted to the specified degree. Source acceptance testing of materials imported for use as engineered fill must be carried out prior to the importation to the site.

5.2 Foundation Design

The following discussion is provided with the understanding that any and all buildings proposed for the site will be designed in conformance to the current Ontario Building Code (OBC) or other regulatory bodies within the jurisdiction.

The boreholes penetrated fill materials overlying silty fine sand and silty sand and gravel strata. The existing fill and the disturbed/weathered native soil are not suitable for the support of foundations. Based on the results of the boreholes, it is considered feasible to support the building foundations on the undisturbed silty fine sand, silty sand and gravel or engineered fill.

5.2.1 Conventional Spread & Strip Footings

The following Table 3 summarizes the bearing resistance at serviceability limit states (SLS) and factored geotechnical resistance at ultimate limit states (ULS) for design purposes possible for conventional spread footing foundations by borehole location at the highest permissible elevations.

Table 3: Bearing Pressures Possible for Spread Footing Foundations

BH No.	Minimum Depth below existing grade (m)	Geodetic Ground Surface Elevation (m)	Allowable Bearing Pressure (kPa)		Bearing Stratum
			SLS	ULS	
BH 1	0.8	417.4	150	225	Silty Fine Sand
BH 2	1.1	414.7	150	225	Silty Sand & Gravel
BH 3	0.8	417.2	150	225	Silty Sand & Gravel
BH 4	0.8	414.5	150	225	Silty Sand & Gravel
BH 5	1.8	420.1	150	225	Silty Fine Sand
BH 6	2.4	412.3	150	225	Silty Fine Sand
BH 7	1.8	415.2	150	225	Silty Sand & Gravel
BH 8	1.7	412.2	150	225	Silty Sand & Gravel

A minimum footing width of 450 mm is recommended for strip footings, and a minimum footing width of 900 mm should be considered for spread footings. The total and differential settlement (short term and long term) of spread footings established on the competent silty fine sand or silty sand and gravel strata at the above design bearing pressures is expected to be less than 25 mm.

Some variability in the consistency and depth of the native undisturbed strata is expected. For this reason, it is important that all of the foundation excavations be inspected by a qualified geotechnical engineer to confirm that the soft surficial strata have been fully penetrated and to identify any preparatory work required prior to placing the footing concrete. Where deeper excavations are required, the footings should be lowered in a series of steps with maximum vertical increments of 0.6 m and with a rise to run ratio of 1:2.

All footings in unheated areas must be provided with at least 1.2 metres of earth cover for frost protection or equivalent insulation. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

5.3 Foundations on Engineered Fill

Based on the existing site grades, portions of the site will undergo some filling. Recommendations for the construction of engineered fill are provided in Section 5.1 of this report. A maximum net allowable bearing pressure of up to 150 kPa for SLS design and 225 kPa for a factored ULS design can be used for foundations placed within the engineered fill area.

Prior to placing engineered fill, it will be necessary to remove all surficial fill in proposed footing areas to the top of the native soil stratum. The exposed subgrade surfaces should be visually inspected, and proof rolled by an experienced geotechnical engineer to confirm the presence of competent native soils. The excavation for the engineered fill should extend beyond the footprint area of the proposed structure equal to the depth of fill beneath the proposed footing plus 0.5 m. The engineered fill should be placed in 150 mm thick layers and compacted to 98 percent of SPMDD. Foundations constructed on engineered fill must be provided with steel reinforcement designed to minimize the effects of post construction differential settlement.

5.4 Site Classification for Seismic Site Response

Seismic hazard is defined in the 2012 Ontario Building Code (OBC 2012) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 s, 0.5 s, 1.0 s and 2.0 s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g., shear wave velocity (vs), Standard Penetration Test (SPT) resistance, and undrained shear strength (su)) in the top 30 meters of the site stratigraphy below the foundation level, as set out in Table 4.1.8.4A of the Ontario Building Code (2012). There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients Fa and Fv, respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above noted information, it is recommended that the site designation for seismic analysis be ’Site Class C’, as per Table 4.1.8.4.A of the Ontario Building Code (2012). Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to determine the average shear wave velocity in the top 30 metres of the site stratigraphy.

The values of the site coefficient for design spectral acceleration at period T, F(T), and of similar coefficients F(PGA) and F(PGV) shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I of the OBC 2012, as amended January 1, 2020, using linear interpolation for intermediate values of PGA.

5.5 Floor Slabs on Grade

The subsurface conditions within the investigated area are expected to be comprised of existing fill and/or the disturbed/weathered native soil materials. Based on the findings of the investigation, the upper portion the earth fill layer is not considered suitable for construction of a slab-on-grade structure and should be sub-excavated to an appropriate depth equivalent to a minimum of one half of the existing fill thickness and replaced with suitably compacted engineered fill. Test pits may be required in the slab on grade area to determine the existing fill thickness and to assess the sub-excavation requirements. Also, some localized weak zones of native or suitable fill soils may be encountered at the design subgrade for the slab that should be sub-excavated and removed prior to backfilling for construction and replaced with suitable fill materials compacted to a minimum of 98 percent of SPMDD.

Final construction beneath slabs on grade should consist of 200 mm of uniformly compacted Granular A uniformly compacted to 98 percent of standard Proctor maximum dry density. For a slab on grade founded on silty sand and gravel soils, engineered fill, or approved existing fill, the moduli of subgrade reaction appropriate for slab on grade design on the aforementioned soils are as follows:

- Proof-rolled Earth Fill: 18,000 kPa/m
- Engineered fill: 25,000 kPa/m
- Silty Sand & Gravel 30,000 kPa/m

If moisture sensitive floor finishes are proposed, a capillary moisture barrier will be required beneath the slab. The capillary moisture barrier may consist of a layer of suitably graded clear crushed stone rather than the Granular A as outlined above. If a clear stone capillary moisture barrier is selected for the underfloor design, this material has poor stability under wheel loading and can be an impediment to other site activities such as steel and mechanical erection. If this is the case, substitution of the upper 50 mm with compacted Granular A to provide a travel surface, constitutes no technical compromise to the capillary barrier effect intended. The placement of a polyethylene vapour barrier is to be at the discretion of the design engineer and architect, as this may have implications on slab curing and certain floor finishes are more sensitive to moisture diffusion through the slab than others.

All slabs on grade should be structurally separate from foundation walls and columns. Saw cut control joints should be incorporated into the slabs along column lines and at regular intervals. Interior load bearing walls should not be founded on the slab but on spread footings as outlined above.

The soil at this site is susceptible to frost effects which would have the potential to deform hard landscaping adjacent to the building. At locations where buildings are expected to have flush entrances, care must be taken in detailing the exterior slabs / sidewalks, providing insulation / drainage / non-frost susceptible backfill to maintain the flush threshold during freezing weather conditions

5.6 Earth Pressure Design Considerations

The following discussion pertains to the design of walls that will be subjected to unbalanced earth loading. The parameters used in the determination of earth pressures acting on walls retaining earth are defined below. The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Table 4: Appropriate Values for Parameters Used in Determining Earth Pressures

Stratum/Parameter	Φ (˚)	γ (kN/m^3)	K_a	K_o	K_p
Compact Granular Fill **Granular ‘B’ (OPSS 1010)**	32	21.0	0.31	0.47	3.25
Silty Sand or Similar Fill	30	19.0	0.33	0.50	3.00

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where,
P = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (depends on the rigidity of the wall)
h_w = the depth below the ground water level (m)
γ = the bulk unit weight of soil, (kN/m^3)
γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m^3)
q = the complete surcharge loading (including live loading, kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, acting in conjunction with the earth pressure, this equation can be simplified to:

$$P = K [\gamma h + q]$$

The factored geotechnical resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (R) depends on the normal load on the soil contact (N) and the frictional resistance of the soil (tan ϕ) expressed as: $R = N \tan \phi$. This is an unfactored resistance. The factored resistance at ULS is $Rf = 0.8 N \tan \phi$. The K value to be used for the design will depend on the rigidity of the wall.

Alternatively, a hydrostatic pressure equivalent to a ground water level at a depth of 1m below the finished grade should be considered for design purposes.

Heavy compaction equipment should not be used immediately behind the walls, as this may cause deflection or damage to the wall.

5.7 Basement Drainage

To assist in maintaining basements dry from seepage, it is recommended that exterior grades around the buildings be sloped away at a 2 percent gradient or more, for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe surrounded by a granular filter (minimum 150 mm thick). The granular filter should consist of OPSS HL 8 Coarse Aggregate.

The size of the sump pit should be adequate to accommodate the water seepage. The perimeter drain installation and outlet provisions must conform to the plumbing code requirements. Further, the drainage system should be adequately designed to prevent the possibility of back-flow.

The basement wall must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the Ontario Building Code (2012). The basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material (OPSS 1010 Granular 'B') or provided with a suitable alternative drainage cellular media.

5.8 Pavement Design

5.8.1 Subgrade Preparation

All topsoil and deleterious fill should be stripped from all areas to be developed for new pavements. It is recommended that the subgrade be cut as cleanly as possible to minimize disturbance and be proof rolled with a static roller to identify any loose or disturbed areas. The preparation of the subgrade and the compaction of all fills should be monitored by the geotechnical engineer at the time of construction.

If fill is required to raise the grade, there may be some select on-site fill which could be used, provided it is free of topsoil and other deleterious material and is at suitable placement water contents. The fill should be placed in large areas where it can be uniformly compacted in 300 mm thick lifts, with each lift uniformly compacted to at least 95 percent of standard Proctor maximum dry density. The upper 1m of backfill beneath areas to be developed as pavements should be compacted to 98 percent of standard Proctor maximum dry density.

5.8.2 Asphaltic Concrete Pavement Design

The minimum pavement structure for internal condominium roads as per the Town of Caledon Development Standards Manual 2019 is provided in the following Table 5.

Table 5: Minimum Asphaltic Concrete Pavement Structure

Pavement Layer	Compaction Requirements	Minimum Component Thickness
Surface Course Asphaltic Concrete HL3 (OPSS 1150)	92% MRD	40 mm
Base Course Asphaltic Concrete HL8 (OPSS 1150)	92% MRD	65 mm
Base Course: Granular A (OPSS 1010) or 19mm Crusher Run Limestone	98% standard Proctor Maximum Dry Density (ASTM-D1557)	150 mm
Subbase Course: Granular B Type II (OPSS 1010) or 50mm Crusher Run Limestone	98% standard Proctor Maximum Dry Density (ASTM-D1557)	300 mm

Some adjustment to the thickness of the granular subbase material may be required depending on the condition of the subgrade at the time of the pavement construction. The need for such adjustments can be best assessed by the geotechnical engineer during construction.

Consideration should be given to delaying the placement of the final wearing surface for at least one year after construction of the binder course in order to minimize the effects of post construction settlement. Prior to placing the wearing surface, the binder course should be evaluated by the geotechnical engineer and remedial work carried out as required in preparation for final construction.

5.8.3 Drainage

Control of surface water is a significant factor in achieving good pavement life. Grading adjacent to pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward subgrade drains or swales and/or ditches.

Continuous perimeter subdrains should be provided in paved areas, and short perforated subdrains should be provided at all catch basins locations. The subdrain invert elevations should be maintained at least 0.3 meters below the subgrade level.

It should be noted that in addition to strict adherence to the above pavement design recommendations, a close control on the pavement construction process will be required in order to obtain the desired pavement life. It is therefore recommended that regular inspection and testing should be conducted during the construction to confirm material quality, thickness, drainage and to ensure adequate compaction.

5.9 SWM Infiltration Facility

Stormwater management is proposed through the implementation of a Green Storm underground storage and infiltration chamber proposed within the central common green area, and two underground storage chambers beneath the access road to Agnes Street. It is understood that stormwater management will be finalized as part of detailed design, with the current SWM design completed as part of site plan approvals. Therefore, recommendations made in this section should be viewed as preliminary in nature and should be reviewed by Englobe as part of the detailed design submission once information as become available.

Prior to excavating for the SWM infiltration facility, all topsoil, and any otherwise deleterious material should be stripped and carefully stockpiled to minimize contamination of the underlying subgrade materials which may be reused for general site regrading, for the construction of berms, embankments, and other features.

Cut slopes within the silty fine sand strata with depths approaching about 5 m would be considered stable at inclinations approaching about 3 horizontal to 1 vertical, however operational standards for such facilities usually dictate somewhat flatter inclinations as required for public safety. Side slopes below the permanent water table should be 4 horizontal to 1 vertical or flatter.

It should be noted that the fine grained soils which are predominant to the site and will be encountered during construction, are susceptible to erosion. Measures will be required to control surface runoff and the off-site migration of soil during the construction phase and until the SWM infiltration facility is complete.

Section SG 6 of the Supplementary Guidelines for the Ontario Building Code 1997 (August 2003 update), provides guidance for the selection of a percolation rate on the basis of soil type as outlined in the Unified Soil Classification System. Based on the results of sieve and hydrometer analyses and Atterberg limits, the order of magnitude of soil permeability to be used for any surficial stormwater infiltration system is estimated to be between 10^{-3} to 10^{-5} m/sec which is in medium to low range of soil permeability values.

Further analyses has been completed and reported by Englobe under separate cover as part of a Hydrogeological Investigation Report conducted at the site.

6 Design Considerations

6.1 Excavations

Excavations must be carried out in accordance with the *Occupational Health and Safety Act and Regulations for Construction Projects, Ontario Regulation 213/91 as amended by Ontario Regulation 142/17 (Part III - Excavations, Section 222 through 242).* These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes at this site, the fill strata should generally be regarded as "Type 3 Soil", and the undisturbed silty sand or sand and gravel strata should generally be regarded as “Type 3 Soil”, provided that effective ground water control is achieved where required and surface water is directed away from open excavations. The undisturbed stratum should generally be regarded as “Type 4 Soil” below the ground water level.

Where workmen must enter a trench or excavation deeper than 1.2 m, the soil must be suitably sloped and/or braced in accordance with the regulation requirements. The regulation stipulates safe excavation slopes by soil type as follows:

Table 6: Soil Classification for Excavations

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

Ground water was encountered in the monitoring wells installed at the site. Depending on the actual ground water conditions at the time of construction, seepage from surface drainage and seepage from any preferentially permeable features in the soil should be expected. For the range in excavation depths expected, the volume of water anticipated is such that temporary pumping from properly filtered sumps located as required in the excavations should suffice to control ground water.

6.2 Depth of Frost Penetration

The design frost penetration depth for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2m or its thermal equivalent insulation is required for frost protection of foundations. All exterior footings, footings beneath unheated areas and foundations exposed to freezing temperatures should have at least such earth cover or equivalent synthetic insulation for frost protection. During winter construction exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins, heating, etc.

For buried utility lines, variations from the above noted depth of frost penetration might be considered, depending on various factors such as the type of backfilling materials or the temperature and moisture exposure of the area (prevailing winds, drifting snow, etc.). However, these variations do not generally represent a concern unless special equipment and/or buried utilities have specific requirements regarding the subsurface temperature and moisture regime (i.e., water lines or sensitive electrical utilities etc.). In such special situations further tests and analysis should be conducted on a case-by-case basis.

The depth of frost penetration is also defined as the zone of active weathering where sizeable variations in the moisture content accompany the yearly temperature fluctuations. Therefore, the foundation grades should be established at or below this depth. For the light poles and other light structures that are to be installed on a single footing, if some frost heave (25 mm to 50 mm) cannot be tolerated, the foundation elements should also be provided with the above noted minimum depth of soil cover or equivalent exterior-grade insulation.

6.3 Site Work

The soil at this site is fine-grained and will become weakened when subjected to traffic when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of fill material for site restoration or underfloor fill that is not intrinsic to the project requirements. Attempting to build slabs and pavements at this site during wet weather could significantly increase earthworks and pavement costs.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work are required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is highly susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

6.4 Quality Control

The proposed townhouses will be founded conventional spread footing foundations. All foundation installations must be reviewed in the field by a qualified geotechnical engineer, as they are constructed. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical engineering design function and is required by Section 4.2.2.2 of the Ontario Building Code 2012. If Englobe is not retained to carry out foundation engineering field review during construction, then Englobe accepts no responsibility for the performance or non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice contained in this report.

The long-term performance of the slab on grade is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Englobe at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

The requirements for fill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density (SPMDD). In situ determinations of density during fill and asphaltic pavement placement on site are required to demonstrate that the specified placement density is achieved. Englobe is a CNSC certified operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary, with our qualified technical staff.

Concrete will be specified in accordance with the requirements of CAN3 - CSA A23.1. Englobe maintains a CSA certified concrete laboratory and can provide concrete sampling and testing services for the project, as necessary.

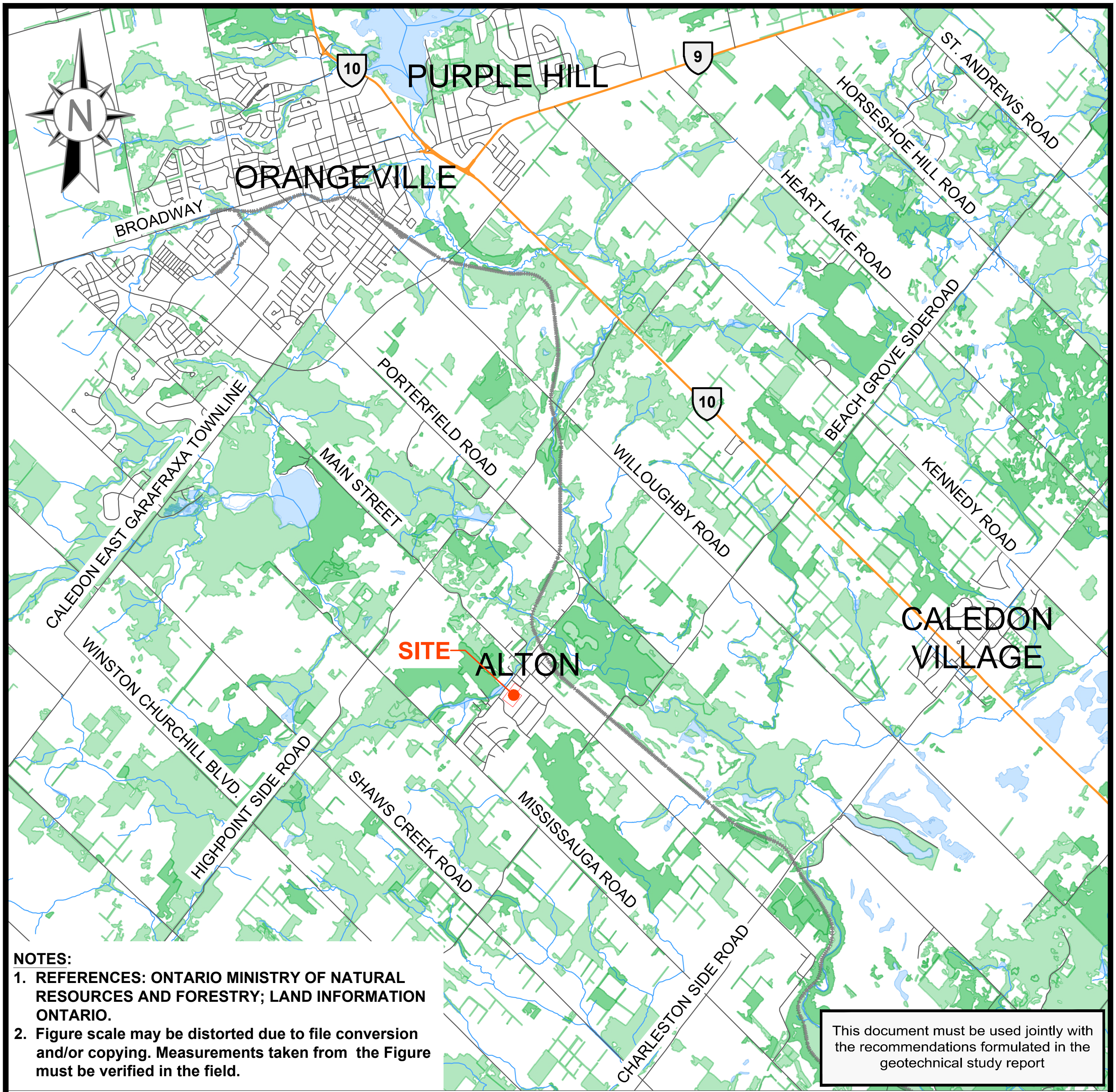
7 Statement of Limitations

The geotechnical recommendations provided 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. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of the project, Englobe should be contacted. We recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the test holes and to ensure that our recommendations are properly understood. Quality assurance testing and inspection services during construction are a necessary part of the evaluation of the subsurface conditions.

The geotechnical recommendations provided in this report are intended for the use of the Client or its agent and may not be used by a Third Party without the expressed written consent of Englobe and the Client. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect their work. Englobe accepts no responsibility and denies any liability whatsoever for any damages arising from improper or unauthorized use of the report or parts thereof.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from noncontinuous sampling and observations during drilling and should not be interpreted as exact planes of geological change. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design. Also, the subsoil and groundwater conditions have been determined at the borehole locations only.

Appendix A
Figures



NOTES:

1. **REFERENCES: ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY; LAND INFORMATION ONTARIO.**
2. **Figure scale may be distorted due to file conversion and/or copying. Measurements taken from the Figure must be verified in the field.**

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

Client
The Alton Development Inc.

Project
Agnes Street

Alton, Ontario

Title
Site Location Plan

Englobe Corp.
903 Barton Street, Unit 21, 22 & 23
Stoney Creek, ON L8E 5H5
T 905 643-7560

Discipline: Geosciences
Prepared by: LK
Checked by: AF
Scale: 1:75 000
Drawn by: LK
Approved by: AF
Date: 20/11/2024
Figure N°: 01 of 03
Page setup: 0001
Paper Format: ANSI full bleed A (8.50 x 11.00 Inches)
Register N°:

Resp.	Project	Phase	Disc.	Type	Figure N°	Rev.
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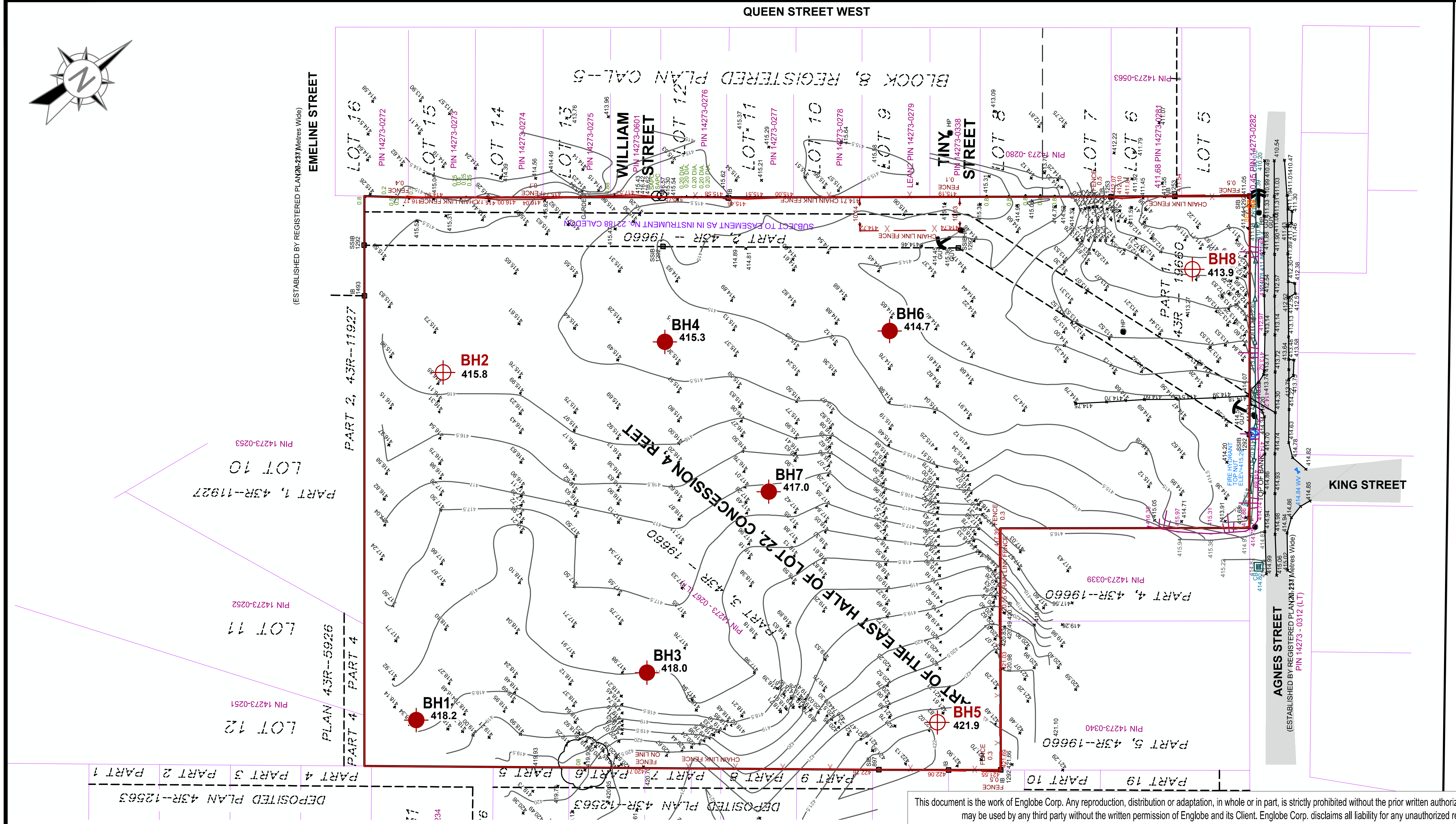

This document must be used jointly with the recommendations formulated in the geotechnical study report

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LEGEND:

● BH-N 00,00	BOREHOLE-NUMBER ELEVATION (m)
⊕ BH-N 00,00	MONITORING WELL-NUMBER ELEVATION (m)

NOTES:

1. REFERENCES:Topographic Survey of part of East half of Lot 22, Concession 4, West of Hurontario Street, Geographic Township of Caledon, County of Peel, Town of Caledon, Regional Municipality of Peel by Van Harten Surveying Inc.
2. Figure scale may be distorted due to file conversion and/or copying. Measurements taken from the Figure must be verified in the field.

Client

The Alton Development Inc.

Project

Agnes Street

Alton, Ontario

Title

Borehole Location Plan

Englobe Corp.
903 Barton Street, Unit 21, 22 & 23
Stoney Creek, ON L8E 5H5
T 905 643-7560

Discipline: Geosciences		Prepared by: LK	Checked by: AF
Scale: 1:1 250		Drawn by: LK	Approved by: AF
Date: 20/11/2024		Figure N°: 02 of 03	
Page setup: 0002	Paper Format: ANSI full bleed B (17.00 x 11.00 Inches)	Register N°:	

Resp.	Project	Phase	Disc.	Type	Figure N°	Rev.
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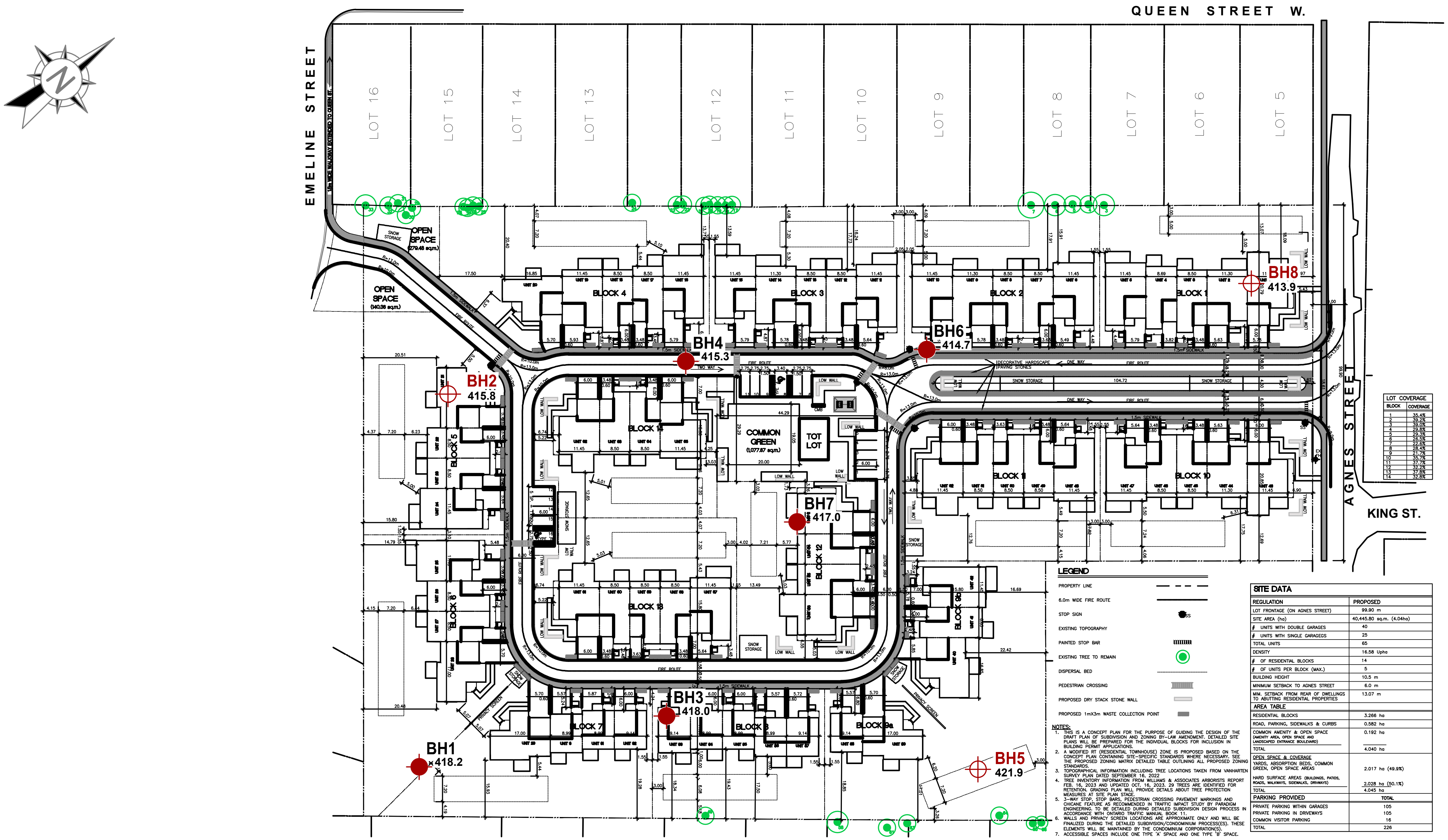

LOT COVERAGE	
BLOCK	COVERAGE
1	35.4%
2	39.2%
3	39.0%
4	29.8%
5	29.3%
6	26.5%
7	22.6%
8	28.4%
9	21.7%
10	35.7%
11	37.7%
12	32.2%
13	37.8%
14	32.8%

LEGEND

PROPERTY LINE	— — —
6.0m WIDE FIRE ROUTE	——
STOP SIGN	● SS
EXISTING TOPOGRAPHY	
PAINTED STOP BAR	▥
EXISTING TREE TO REMAIN	◉
DISPERSAL BED	-------
PEDESTRIAN CROSSING	▥
PROPOSED DRY STACK STONE WALL	▭
PROPOSED 1mX3m WASTE COLLECTION POINT	▬

NOTES:

1. THIS IS A CONCEPT PLAN FOR THE PURPOSE OF GUIDING THE DESIGN OF THE DRAFT PLAN OF SUBDIVISION AND ZONING BY-LAW AMENDMENT. DETAILED SITE PLANS WILL BE PREPARED FOR THE INDIVIDUAL BLOCKS FOR INCLUSION IN BUILDING PERMIT APPLICATIONS.
2. A MODIFIED RT (RESIDENTIAL TOWNHOUSE) ZONE IS PROPOSED BASED ON THE CONCEPT PLAN CONTAINING SITE-SPECIFIC STANDARDS WHERE NECESSARY. SEE THE PROPOSED ZONING MATRIX DETAILED TABLE OUTLINING ALL PROPOSED ZONING STANDARDS.
3. TOPOGRAPHICAL INFORMATION INCLUDING TREE LOCATIONS TAKEN FROM VANHARTEN SURVEY PLAN DATED SEPTEMBER 16, 2022
4. TREE INVENTORY INFORMATION FROM WILLIAMS & ASSOCIATES ARBORISTS REPORT FEB. 16, 2023 AND UPDATED OCT. 16, 2023. 29 TREES ARE IDENTIFIED FOR RETENTION. GRADING PLAN WILL PROVIDE DETAILS ABOUT TREE PROTECTION MEASURES AT SITE PLAN STAGE.
5. 3-WAY STOP, STOP BARS, PEDESTRIAN CROSSING PAVEMENT MARKINGS AND CHICANE FEATURE AS RECOMMENDED IN TRAFFIC IMPACT STUDY BY PARADIGM ENGINEERING. TO BE DETAILED DURING DETAILED SUBDIVISION DESIGN PROCESS IN ACCORDANCE WITH ONTARIO TRAFFIC MANUAL BOOK 11.
6. WALLS AND PRIVACY SCREEN LOCATIONS ARE APPROXIMATE ONLY AND WILL BE FINALIZED DURING THE DETAILED SUBDIVISION/CONDOMINIUM PROCESS(ES). THESE ELEMENTS WILL BE MAINTAINED BY THE CONDOMINIUM CORPORATION(S).
7. ACCESSIBLE SPACES INCLUDE ONE TYPE 'A' SPACE AND ONE TYPE 'B' SPACE.

SITE DATA	
REGULATION	PROPOSED
LOT FRONTAGE (ON AGNES STREET)	99.90 m
SITE AREA (ha)	40,445.80 sq.m. (4.04ha)
# UNITS WITH DOUBLE GARAGES	40
# UNITS WITH SINGLE GARAGEGS	25
TOTAL UNITS	65
DENSITY	16.58 Upha
# OF RESIDENTIAL BLOCKS	14
# OF UNITS PER BLOCK (MAX.)	5
BUILDING HEIGHT	10.5 m
MINIMUM SETBACK TO AGNES STREET	6.0 m
MIM. SETBACK FROM REAR OF DWELLINGS TO ABUTTING RESIDENTIAL PROPERTIES	13.07 m
AREA TABLE	
RESIDENTIAL BLOCKS	3.266 ha
ROAD, PARKING, SIDEWALKS & CURBS	0.582 ha
COMMON AMENITY & OPEN SPACE (AMENITY AREA, OPEN SPACE AND LANDSCAPED ENTRANCE BOULEVARD)	0.192 ha
TOTAL	4.040 ha
OPEN SPACE & COVERAGE	
YARDS, ABSORPTION BEDS, COMMON GREEN, OPEN SPACE AREAS	2.017 ha (49.9%)
HARD SURFACE AREAS (BUILDINGS, PATIOS, ROADS, WALKWAYS, SIDEWALKS, DRIVWAYS)	2.028 ha (50.1%)
TOTAL	4.045 ha
PARKING PROVIDED	TOTAL
PRIVATE PARKING WITHIN GARAGES	105
PRIVATE PARKING IN DRIVEWAYS	105
COMMON VISITOR PARKING	16
TOTAL	226

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

LEGEND:

● BH-N 00,00	BOREHOLE-NUMBER ELEVATION (m)
⌖ BH-N 00,00	MONITORING WELL-NUMBER ELEVATION (m)

NOTES:

1. **REFERENCES:** Plan from Orchard Design Studio Inc., Seaton Group, Agnes Street Townhomes, Village of Alton, Caledon, ON, Concept Plan, Project No. 14948, A1.01, 2024/08/05.
2. Figure scale may be distorted due to file conversion and/or copying. Measurements taken from the Figure must be verified in the field.

Client

The Alton Development Inc.

Project

Agnes Street

Alton, Ontario

Title

Concept Plan

ENGLOBE

Englobe Corp.
903 Barton Street, Unit 21, 22 & 23
Stoney Creek, ON L8E 5H5
T 905 643-7560

Discipline: Geosciences		Prepared by: LK	Checked by: AF
Scale: 1:1 250		Drawn by: LK	Approved by: AF
Date: 20/11/2024		Figure N°: 03 of 03	
Page setup: 0003	Paper Format: ANSI full bleed B (17.00 x 11.00 Inches)	Register N°:	

Resp.	Project	Phase	Disc.	Type	Figure N°	Rev.
00	02411762.000	0000	GE	D	0003	00

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Appendix B
Borehole Logs

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	‘N’ value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	‘N’ value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
⧨	1st water level measurement
⧩	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

ENGLOBE

LOG OF BH1

Project No. : 02411762.000
Date started : 2019 February 7
Sheet No. : 1 of 1

Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574695, N: 4856275 (UTM 17T)
Rig type : D50, track-mounted

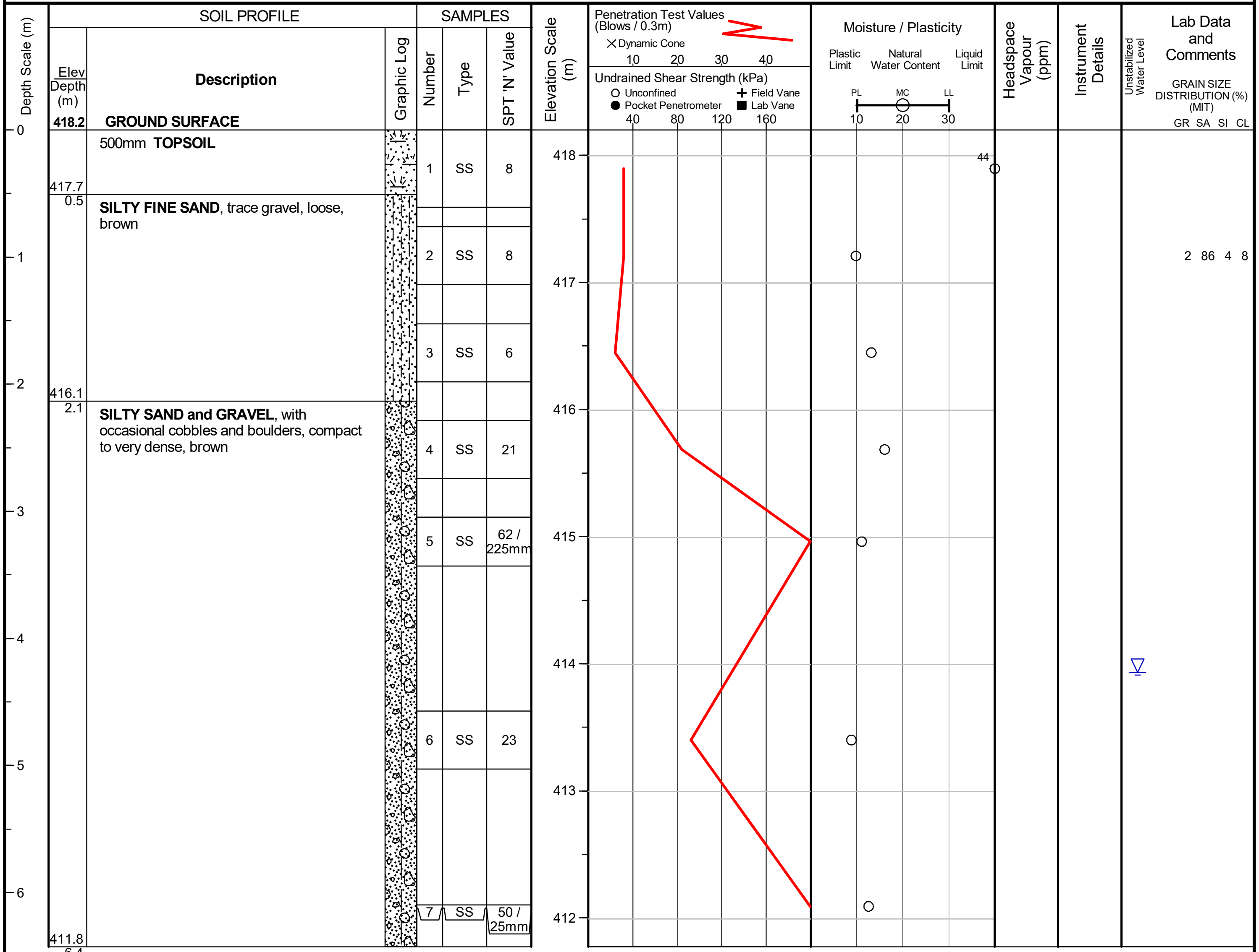
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
418.2	**GROUND SURFACE**
417.7 0.5	500mm **TOPSOIL**
416.1 2.1	**SILTY FINE SAND**, trace gravel, loose, brown
411.8 6.4	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to very dense, brown

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
1	SS	8	
2	SS	8	2 86 4 8
3	SS	6	
4	SS	21	
5	SS	62 / 225mm	
6	SS	23	
7	SS	50 / 25mm	



END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

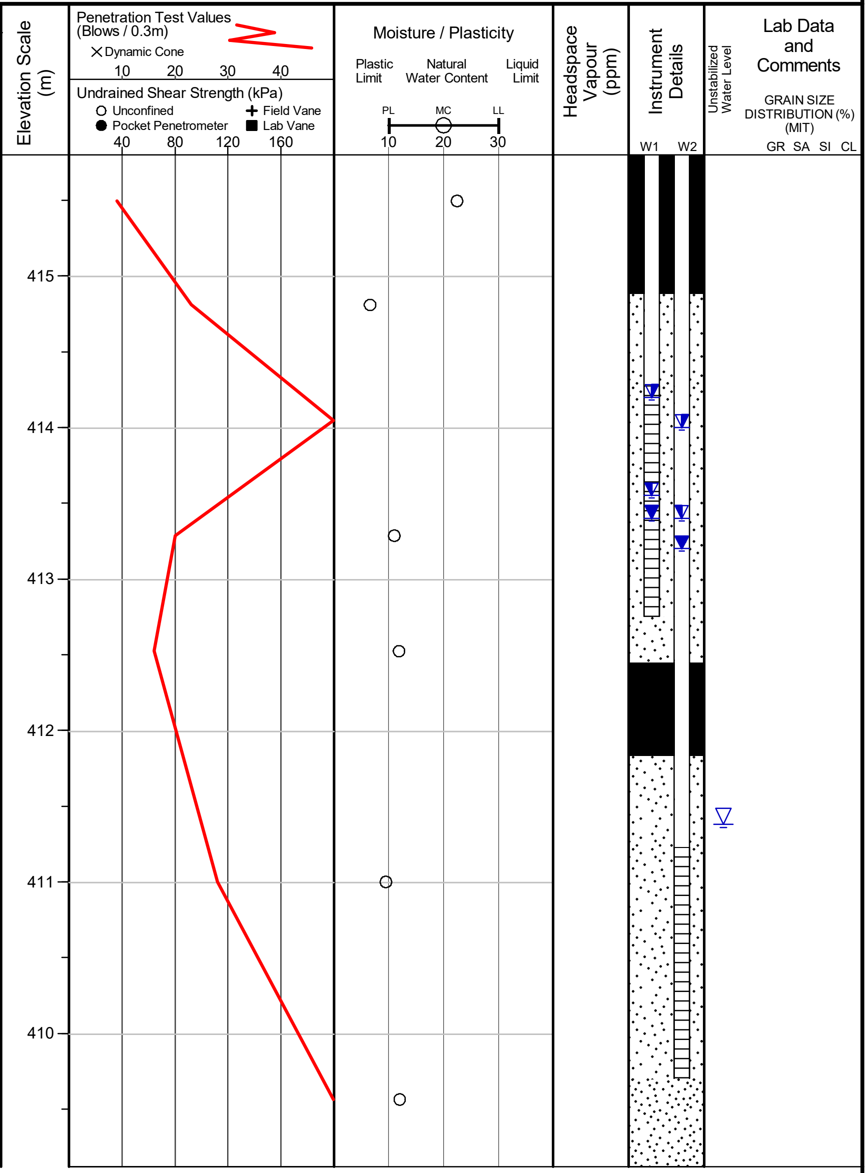
Unstabilized water level measured at 4.3 m below ground surface; borehole was open upon completion of drilling.

LOG OF BH2

Project No.	: 02411762.000	Client	: The Alton Development Inc.	Originated by	: JM
Date started	: 2019 February 7	Project	: Agnes Street	Compiled by	: AF
Sheet No.	: 1 of 1	Location	: Alton, Ontario	Checked by	: PC

Position : E: 574614, N: 4856342 (UTM 17T)
Elevation Datum : Geodetic
Rig type : D50, track-mounted
Drilling Method : Hollow stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
415.8	**GROUND SURFACE**			
	300mm **TOPSOIL**			
415.5 0.3	**FILL**, silty fine sand, trace gravel, loose, brown	1	SS	9
415.0 0.8	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to very dense, brown	2	SS	23
		3	SS	56
		4	SS	20
		5	SS	16
		6	SS	28
		7	SS	50 / 125mm
409.1 6.7				



Depth Scale (m): 0, 1, 2, 3, 4, 5, 6

END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

Unstabilized water level measured at 4.4 m below ground surface; borehole was open upon completion of drilling.

W1: 50 mm dia. monitoring well installed.
W2: 50 mm dia. monitoring well installed.

W1 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Mar 4, 2019	2.3	413.6
Apr 4, 2019	1.6	414.2
Apr 25, 2019	1.3	414.5
Aug 19, 2019	2.4	413.4

W2 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Mar 4, 2019	2.4	413.4
Apr 4, 2019	1.8	414.0
Apr 25, 2019	1.6	414.2
Aug 19, 2019	2.6	413.2

LOG OF BH3

Project No.	: 02411762.000	Client	: The Alton Development Inc.	Originated by	: JM
Date started	: 2019 February 7	Project	: Agnes Street	Compiled by	: AF
Sheet No.	: 1 of 1	Location	: Alton, Ontario	Checked by	: PC

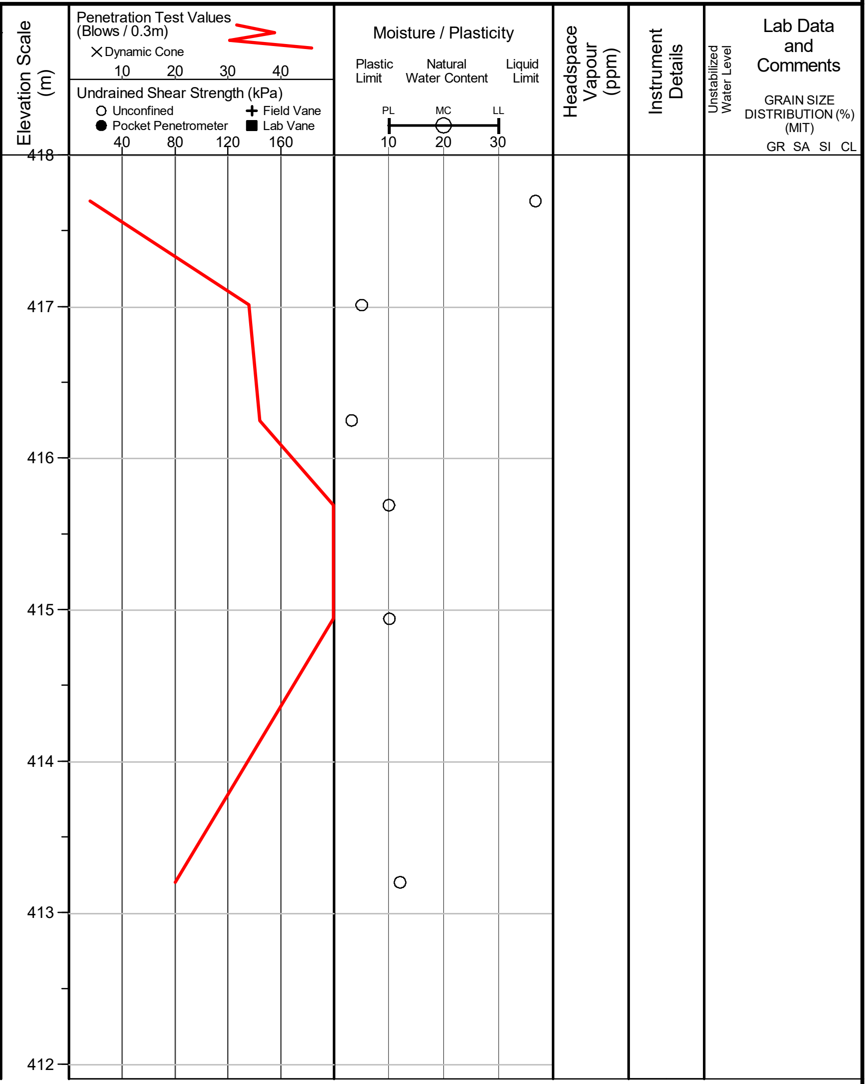
Position	: E: 574728, N: 4856325 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: D50, track-mounted	Drilling Method	: Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
418.0	**GROUND SURFACE**
417.5 0.5	150mm **TOPSOIL**
411.9 6.1	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to dense, brown

SAMPLES

Number	Type	SPT 'N' Value
1	SS	4
2	SS	34
3	SS	36
4	SS	50 / 50mm
5	SS	50 / 25mm
6	SS	20



END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

Borehole was dry and open upon completion of drilling.

file: 02411762.000 - anges st.gpj

LOG OF BH4

Project No. : 02411762.000
Date started : 2019 February 7
Sheet No. : 1 of 1

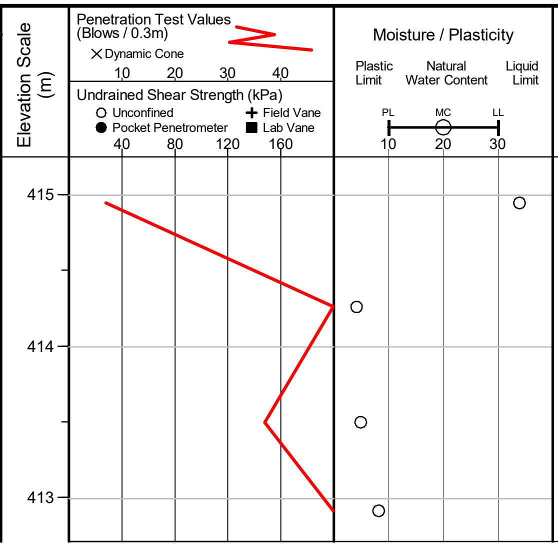
Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574646, N: 4856389 (UTM 17T)
Rig type : D50, track-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	415.3	**GROUND SURFACE**								
		450mm **TOPSOIL**		1	SS	7				
	414.8 0.5	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, dense to very dense, brown								
1				2	SS	58				
				3	SS	37				
2				4	SS	50 / 100mm				
	412.8 2.5	**END OF BOREHOLE** Refusal (obstruction in the hole) Possible cobble or bedrock obstruction in hole. Borehole was dry and open upon completion of drilling.								



LOG OF BH5

Project No. : 02411762.000
Date started : 2019 February 7
Sheet No. : 1 of 1

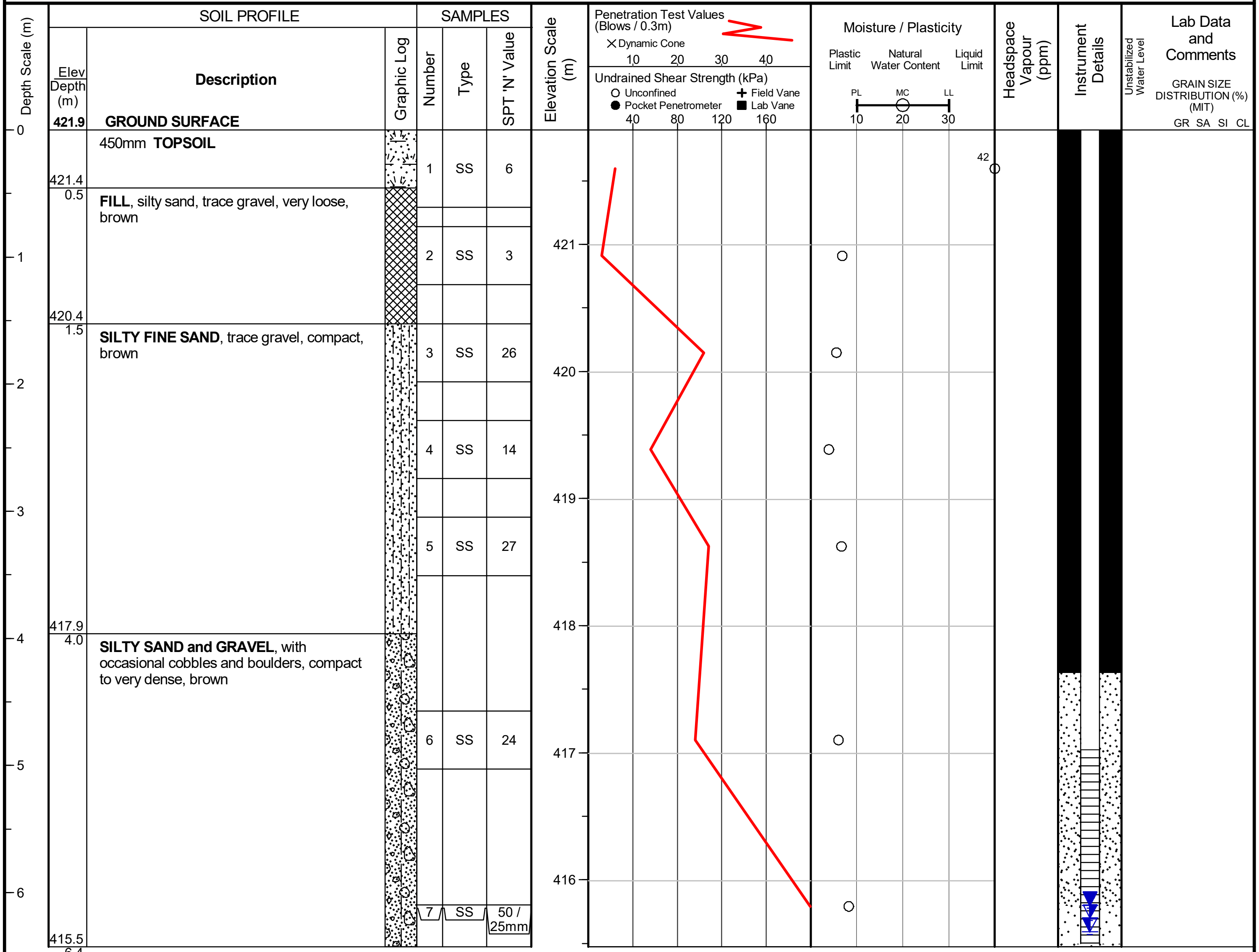
Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574776, N: 4856396 (UTM 17T)
Rig type : D50, track-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value
0	**421.9**	**GROUND SURFACE**			
		450mm **TOPSOIL**	1	SS	6
	421.4 0.5	**FILL**, silty sand, trace gravel, very loose, brown	2	SS	3
	420.4 1.5	**SILTY FINE SAND**, trace gravel, compact, brown	3	SS	26
			4	SS	14
			5	SS	27
	417.9 4.0	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to very dense, brown	6	SS	24
			7	SS	50 / 25mm
	415.5 6.4	**END OF BOREHOLE**			



END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Mar 4, 2019	6.3	415.6
Apr 4, 2019	6.2	415.7
Apr 25, 2019	6.4	415.5
Aug 19, 2019	6.1	415.8

LOG OF BH6

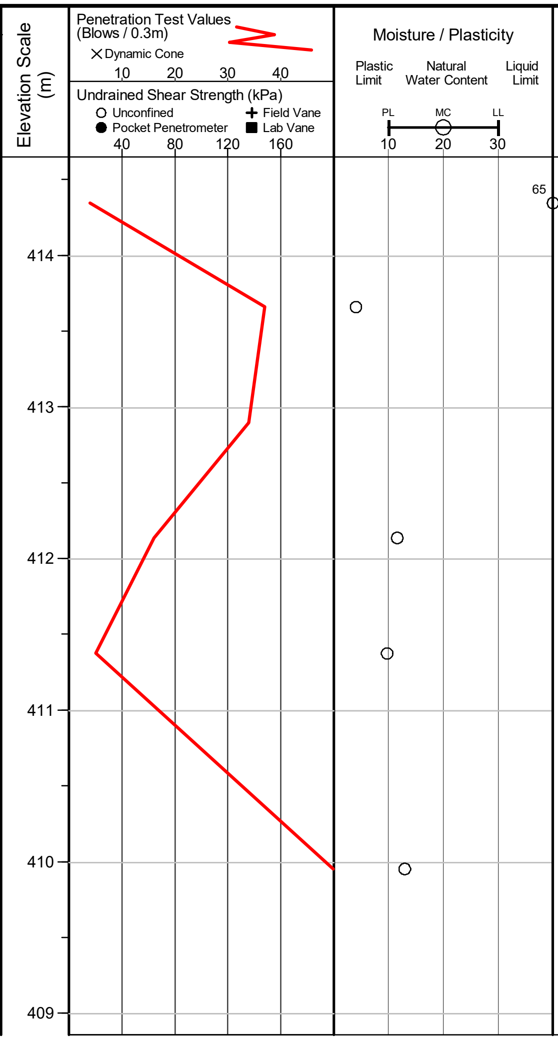
Project No. : 02411762.000
Date started : 2019 February 8
Sheet No. : 1 of 1

Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574690, N: 4856454 (UTM 17T)
Rig type : D50, track-mounted
Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

SOIL PROFILE			SAMPLES				
Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
414.7	**GROUND SURFACE**						
	600mm **TOPSOIL**		1	SS	4		
414.1 0.6	**FILL**, sand and gravel, trace topsoil, dense, brown		2	SS	37		
			3	SS	34		
412.6 2.1	**SILTY FINE SAND**, trace gravel, compact, brown		4	SS	16	▽	
			5	SS	5		
410.9 3.8	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, very dense, brown		6	SS	50 / 100mm		
408.9 5.8							



END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

Unstabilized water level measured at 2.3 m below ground surface; borehole was open upon completion of drilling.

file: 02411762.000 - anges st.gpj

LOG OF BH7

Project No. : 02411762.000
Date started : 2019 February 8
Sheet No. : 1 of 1

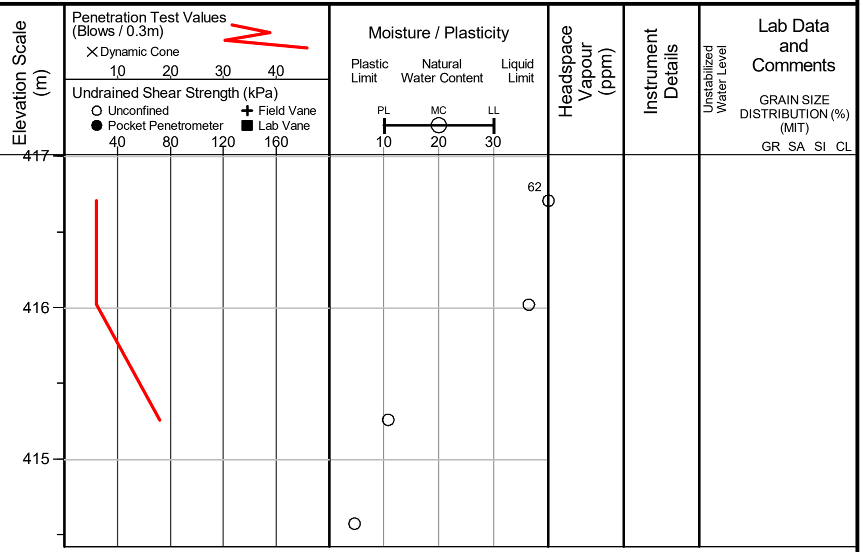
Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574703, N: 4856377 (UTM 17T)
Rig type : D50, track-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
	417.0	**GROUND SURFACE**			
0		600mm **TOPSOIL**	1	SS	6
	416.4 0.6	**FILL**, silty fine sand, trace rootlets, topsoil, loose, brown	2	SS	6
1					
	415.5 1.5	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to very dense, brown	3	SS	18
2			4	AS	
	414.4 2.6	**END OF BOREHOLE** Refusal (obstruction in the hole) Possible cobble or bedrock obstruction in hole. Borehole was dry and open upon completion of drilling.			



ENGLOBE

LOG OF BH8

Project No. : 02411762.000
Date started : 2019 February 8
Sheet No. : 1 of 1

Client : The Alton Development Inc.
Project : Agnes Street
Location : Alton, Ontario

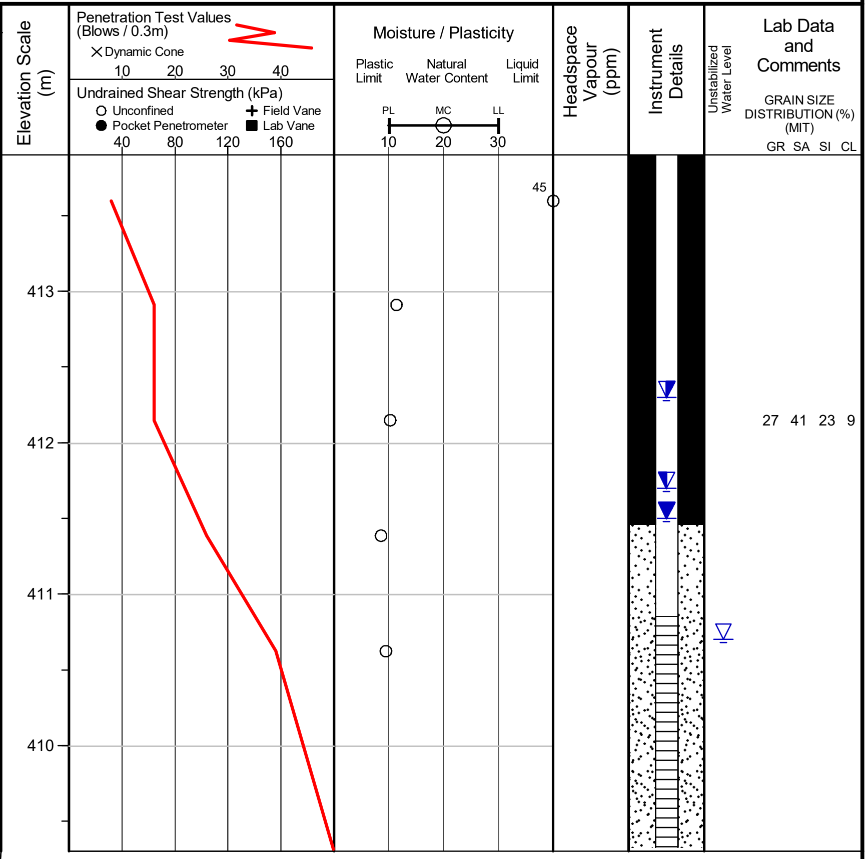
Originated by : JM
Compiled by : AF
Checked by : PC

Position : E: 574738, N: 4856521 (UTM 17T)
Rig type : D50, track-mounted

Elevation Datum : Geodetic
Drilling Method : Hollow stem augers

Elev Depth (m)	Description
413.9	**GROUND SURFACE**
413.4 0.5	450mm **TOPSOIL**
412.5 1.4	**FILL**, silty fine sand, trace gravel, compact, brown
409.3 4.6	**SILTY SAND and GRAVEL**, with occasional cobbles and boulders, compact to very dense, brown

Number	Type	SPT 'N' Value	Lab Data and Comments (GR SA SI CL)
1	SS	8	
2	SS	16	
3	SS	16	27 41 23 9
4	SS	26	
5	SS	39	
6	SS	50 / 25mm	



END OF BOREHOLE
Refusal (obstruction in the hole)

Possible cobble or bedrock obstruction in hole.

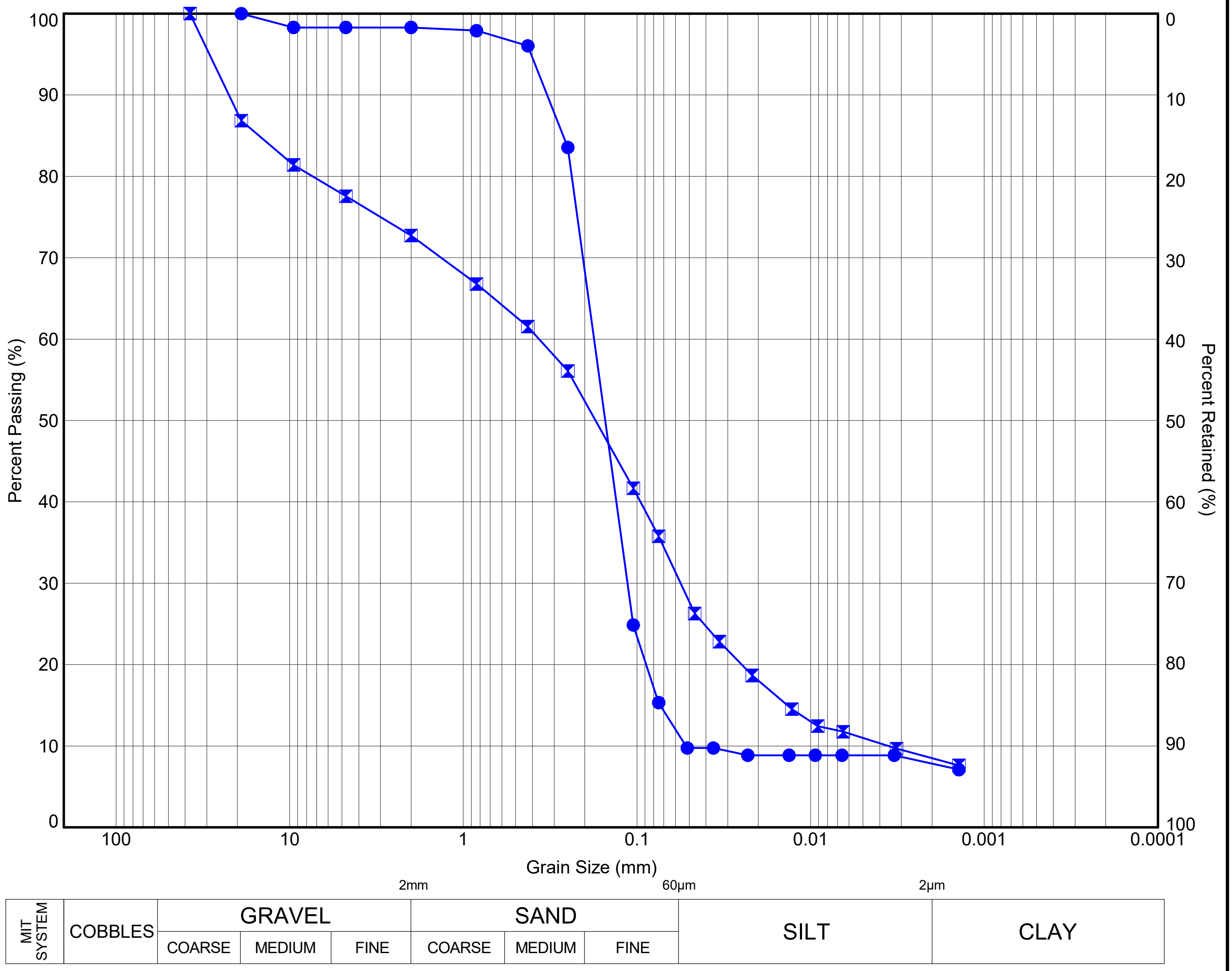
Unstabilized water level measured at 3.2 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Mar 4, 2019	2.2	411.7
Apr 4, 2019	1.6	412.3
Apr 25, 2019	1.1	412.8
Aug 19, 2019	2.4	411.5

file: 02411762.000 - anges st.gpj



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS2	1.0	417.2	2	86	4	8	
⧗	**8**	SS3	1.8	412.1	27	41	23	9	

ENGLOBE

Title:

GRAIN SIZE DISTRIBUTION

File No.: **02411762.000**

Appendix C
"Draft" Engineered Fill Earthworks Specifications

ENGLOBE

PART 1 GENERAL

1.01 Description

Engineered Fill refers to earth fill (earthworks) designed and constructed with engineering inspection and testing, so as to be capable of supporting structure foundations and slabs without excessive settlement. Poured concrete foundation walls must be provided with nominal reinforcing steel to provide stiffening of the foundation walls and to protect against excessive crack formation within the foundation walls.

Preparation for Engineered Fill and Engineered Fill operations must only be conducted under full time inspection and testing by the Geotechnical Engineer, in order to ensure adequate compaction and fill quality.

The work for the construction of Engineered Fill, is shown on the Design Drawings prepared by the Design Civil Engineer and as described by these specifications. The work included in this section includes the following:

a) Stripping of the existing topsoil, fill layer, and weathered/disturbed soil as needed from the ground surface below all areas to be covered with Engineered Fill,

b) Excavation of Test Holes into the subgrade to investigate the suitability of subsurface conditions for support of the Engineered Fill and determine if any prior existing fill materials are present,

c) Proof-rolling or visual inspection (as directed by the geotechnical engineer) of the subgrade below areas to be covered with Engineered Fill, to detect the presence and extent of unstable ground conditions,

d) Excavation and removal of unstable subgrade materials or other approved stabilization measures, if required prior to the placement of Engineered Fill,

e) Surveying of ground elevations prior to placing Engineered Fill,

f) Supply, placement, and compaction of approved clean earth as specified herein, with full time inspection and testing,

g) Surveying of ground elevations on completion of Engineered Fill placement,

h) Providing and maintaining survey layout of areas to receive Engineered Fill, and monitoring of ground elevations throughout the construction of Engineered Fill.

1.02 The Project Parties

A) The term Contractor shall refer to the individual or firm who will be carrying out the earthworks related to preparation and construction of Engineered Fill.

B) The term Geotechnical Engineer shall refer to the individual or firm who will be carrying out the full time inspection and testing of the earthworks related to preparation and construction of Engineered Fill.

C) The term Design Civil Engineer shall refer to the individual or firm who will be carrying out the Site Grading Design (pre-grading), the determination of Design Foundation Grades for the structures on the site, and the choice of lots and site areas to receive Engineered Fill.

PART 2 MATERIALS

2.01 Definitions

A) Topsoil Layer is the surface layer of naturally organic soil typically found at the ground surface and with thickness on the order of 25 to 250 mm thick.

B) Earth fill is soil material which has been placed by man-made effort and has not been deposited by nature over a long period of time.

C) Weathered/disturbed soil is natural or native soil that has been disrupted by weathering processes such as frost damage.

D) Subgrade soil is the “in situ” (in place) natural or native soil beneath any earth fill and/or weathered/disturbed soil and/or topsoil layer(s).

E) Engineered Fill soils must consist of clean earth materials (not excessively wet), free of organics and topsoil, free of deleterious materials such as building rubble, wood, plant materials, placed in thin lifts not exceeding 150 mm in thickness. Cohesionless soils such as sand or gravel, are the easiest to handle and compact.

F) All values stated in metric units shall be considered as accurate.

PART 3 ENGINEERED FILL DESIGN

3.01 Design Foundation Pressure

A) Engineered Fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the Engineered Fill. The time period over which most of this settlement typically occurs, depends on the composition of the Engineered Fill as follows (after initial placement);

a) Sand or gravel soil;	several days,
b) Silt soil;	several weeks,
c) Clay or clayey soil;	several months.

The placement of Engineered Fill might also result in post-construction settlement of the underlying natural soil.

The timing of foundation construction must take into account the post-construction settlement of the Engineered Fill and the foundation soil.

B) Unless otherwise stated, the Engineered Fill is to be placed over the entire lot or site area.

C) The Engineered Fill is to extend up to 1 m above the highest level of required foundation support. Typically this can be within 1 m of the design final grades. Additional common fill can be placed over the Engineered Fill to provide protection against environmental factors such as wind, frost, precipitation, and the like.

E) A geotechnical reaction at SLS of 150 kPa for 25 mm of settlement is typically recommended for the Engineered Fill, unless it consists of glaciolacustrine silt and clay in which case a lower design foundation pressure will need to be determined on a site specific basis. Foundations shall have minimum widths of 0.6 m for continuous strip footings, and minimum dimensions of 1 m for column footings.

F) At the foundation level, sufficient Engineered Fill shall be constructed to ensure that it extends at least 1.0 m laterally beyond the edge of any foundations, and that it extends outward within an area defined by a 1 to 1 line downward from the edge of any Engineered Fill.

G) Foundations placed on the Engineered Fill must be provided with nominal reinforcing steel for protection against excessive minor cracking. The reinforcing steel must consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls.

H) At the time of foundation construction, foundation excavations must be reviewed by the Geotechnical Engineer to confirm suitable bearing capacity of the Engineered Fill. The Geotechnical Engineer must inspect the foundation subgrade immediately after excavation, and must inspect the foundation subgrade immediately prior to placement of concrete for footings. The Geotechnical Engineer must also inspect the placement of reinforcing steel in the foundation walls. Written approval must be obtained from the Geotechnical Engineer prior to,

- a) placement of footing concrete, and
- b) placement of foundation wall concrete.

PART 4 CONSTRUCTION

4.01 Survey Layout

A) The survey layout shall be carried out and maintained throughout the construction of Engineered Fill activities. A suitable layout stake shall be placed at the corners of the start and finish of every block or work area to receive Engineered Fill.

B) At least two temporary survey elevation benchmarks shall be provided for every work area to receive Engineered Fill, to assist in monitoring the level of the Engineered Fill as it is constructed.

C) The ground elevations of the subgrade approved for receiving Engineered Fill shall be surveyed and recorded on a regular grid pattern. Engineered Fill shall not be placed on any work area without the written approval of the Geotechnical Engineer.

D) The ground elevations of the Engineered Fill on each work area shall be surveyed and recorded on a regular grid pattern at the end of each day during the placement of Engineered Fill.

E) On completion of Engineered Fill construction, the final ground elevations shall be surveyed and recorded on a regular grid pattern.

4.02 Topsoil Stripping

A) The Geotechnical Engineer must observe the stripping of topsoil from the areas proposed for Engineered Fill, from start to finish.

B) Topsoil must be stripped from the entire building site area. The Geotechnical Engineer must photograph the work areas which have had the earth fill suitably stripped.

4.03 Test Holes Into Subgrade

A) After the topsoil has been stripped, the exposed subgrade must be investigated for the presence of weak zones or deleterious material, which may be unsuitable for the support of Engineered Fill.

B) Exploratory test holes must be dug using a small backhoe, on a suitable pattern to obtain a representative indication of the entire site area.

C) The Geotechnical Engineer must observe the digging and backfilling of the test holes; must log the test hole stratigraphy; must obtain soil samples at maximum depth intervals of 0.3m; and must photograph each dug test hole.

D) If the test holes discover any old buried fill or deleterious materials, it must be excavated and removed from the lot area down to undisturbed, stable native soil.

E) All test holes must be properly backfilled and compacted in loose lifts of maximum 150 mm thickness to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent. The Geotechnical Engineer must observe the backfilling and compaction of the test holes.

4.04 Subgrade Proof-rolling

A) Prior to placing any Engineered Fill, the exposed subgrade must be proof-rolled with a static smooth-drum roller and the Geotechnical Engineer must observe the proof-rolling.

B) Cohesive soil will be disrupted by proof-rolling. Competency must be determined by a geotechnical engineer by cutting and inspecting the soil.

C) If unstable subgrade conditions are encountered, the unstable subgrade must be sub-excavated. If wet site conditions exist during filling, stabilization with granular materials may be required.

4.05 Engineered Fill Placement

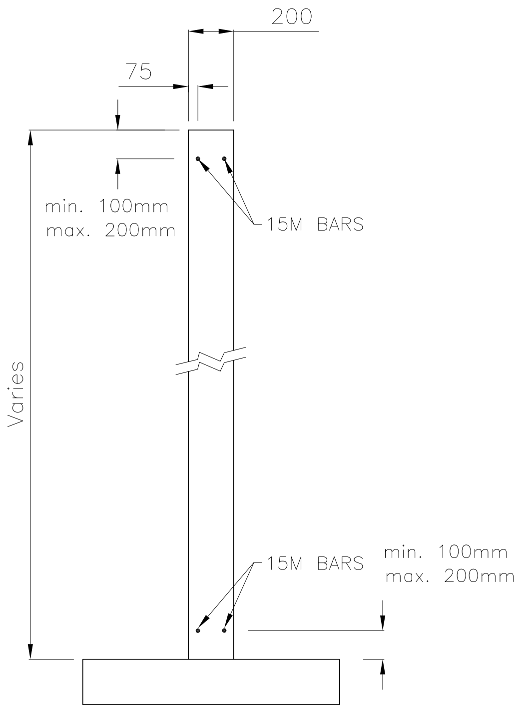
A) Engineered fill must not be placed without the approval of the Geotechnical Engineer. Prior to placing any Engineered Fill, the existing fill must be removed down to native soil subgrade, the subgrade must be investigated for old buried fill or deleterious material, the subgrade must be proof-rolled, and the subgrade elevations must be surveyed.

B) Prior to the placement of Engineered Fill, the source or borrow area for the Engineered Fill must be evaluated for its suitability. Some of the existing site fill that is removed prior to placement of Engineered Fill may be sorted and reused as Engineered Fill, but must first be approved by the Geotechnical Engineer. Samples of the proposed fill material must be obtained by the Geotechnical Engineer and tested in the geotechnical laboratory for Standard Proctor Maximum Dry Density, prior to approval of the material for use as Engineered Fill. The Engineered Fill must be free of organics and other deleterious material (wood, building debris, rubble, cobbles, boulders, and the like).

C) The Engineered Fill must be placed in maximum loose lift thicknesses of 150 mm. Each lift of Engineered Fill must be compacted with a heavy roller, to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent.

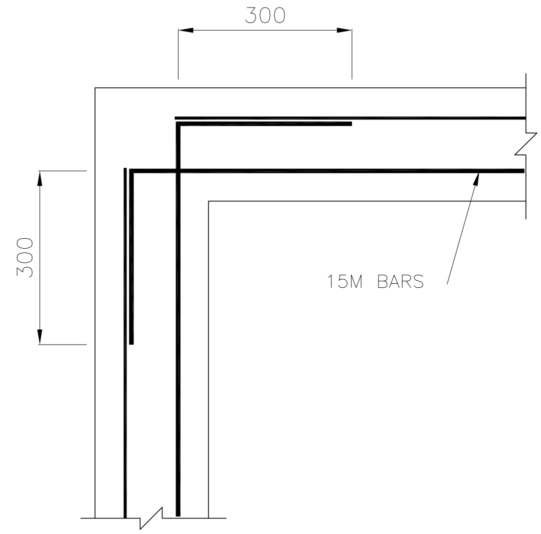
D) Field density tests must be taken by the Geotechnical Engineer, on each lift of Engineered Fill, on each lot area. Any Engineered Fill which is tested and found to not meet the specifications, shall be either removed or, reworked and retested.

E) Engineered fill must not be placed during the period of the year when cold weather occurs, i.e., when there are freezing ambient temperatures during the daytime and overnight.



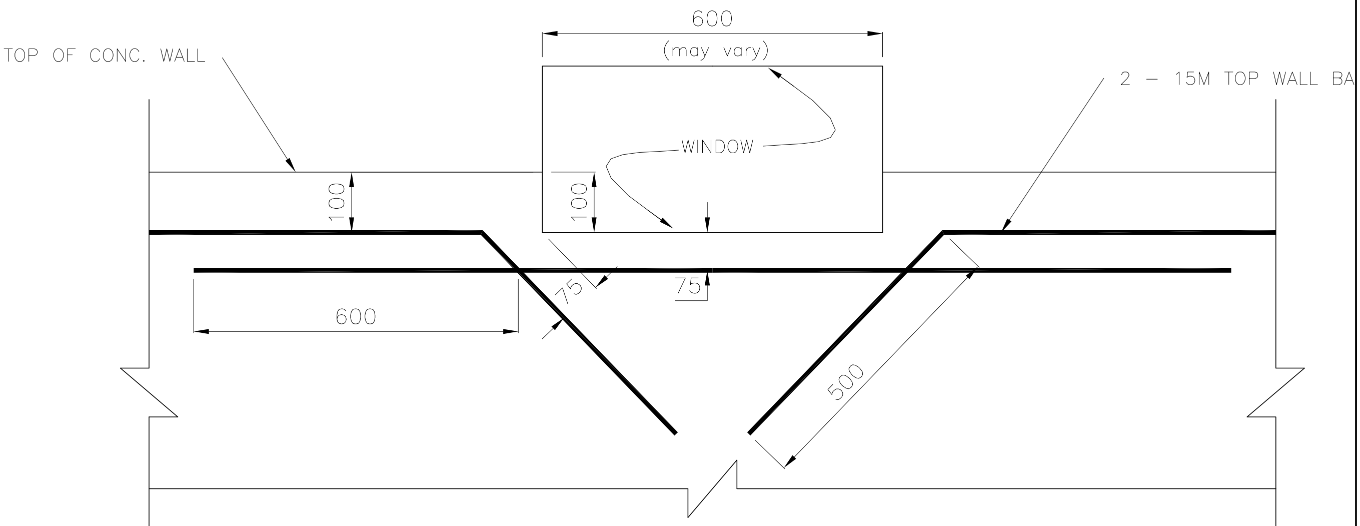
TYPICAL REINFORCED WALL

NOT TO SCALE



TYPICAL SPLICING AT CORNERS

NOT TO SCALE



TYPICAL WINDOW REINFORCING

NOT TO SCALE

NOTES:

1. Reinforcing steel C.S.A. G30.18–09 Grade 400
2. Concrete min. 28 day strength 20MPa (3000psi)
3. Base of all footing excavations to be inspected and approved prior to placing formwork.
4. All dimensions are in mm.

ENGLOBE

Title:

TYPICAL REINFORCED WALL DETAILS FOR
STRUCTURES ON ENGINEERED FILL