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A REPORT TO
SORBARA/TRIBUTE BRUBACHER HOLDINGS INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

6586 BEATTY LINE NORTH
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

REFERENCE NO. 2311-S044

JANUARY 2025
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TABLE OF CONTENTS

TABLES

ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization dated November 3, 2023, from Mr. James Bujak, Managing Director of Sorbara/Tribute Brubacher Holdings Inc., a geotechnical investigation was carried out at 6586 Beatty Line North, in the Township of Centre Wellington (Fergus).

The purpose of this investigation was to reveal the subsurface conditions and determine the engineering properties of the disclosed soils for the design and construction of a proposed residential development. The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Township of Centre Wellington (Fergus) is situated on Guelph Drumlin Field, the area dominantly consists of stoney drift with sand and gravel terraces of meltwater spillways formed during the past glacial retreat. The overburden beds onto limestone bedrock of Guelph Formation at moderate depths.

The subject lands are located on the west side of Beatty Line North, south of the Beatty Line North and Sideroad 15 intersection, and directly north of Fergus and Elora-Salem's delineated urban settlement area. The subject property is approximately 43.2 hectares in size, rectangular in shape and has approximately 300 metres of frontage along Beatty Line North. It is currently vacant except for one single-detached dwelling and an abandoned railway traverses through the Subject Lands in a northwest/southeast direction. Phases 2A and 2B of the existing Storybrook Subdivision are located immediately south of the Subject Lands.

Based on the Conceptual Servicing Plan prepared by SCS Consulting Group Ltd. (SCS), dated December 2024, the land will be subdivided into lots and blocks for a residential development. The development will be provided with municipal roadways, services and a stormwater management facility at the southwest portion of the site.

3.0 FIELD WORK

The field work, consisting of 13 sampled boreholes extending to depths ranging from 6.2 to 10.9 m, was performed between August 29 and September 5, 2024. The locations of the boreholes are shown on the Borehole and Monitoring Well Location Plan, Drawing No. 1.

The boreholes were advanced at intervals to the sampling depths by a track-mounted machine equipped with solid stem and hollow stem augers and split spoon sampler for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed "List of Abbreviations and Terms," were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or 'N' values) of the subsoil. The relative density of the non-cohesive strata and the consistency of the cohesive strata are inferred from the 'N' values. Split-spoon samples were recovered for soil classification and laboratory testing. The field work was supervised and the findings were recorded by a Geotechnical Technician.

Upon completion of drilling and sampling, monitoring wells were installed at 10 borehole locations, with a monitoring well at 8 borehole locations and a set of nested wells at 2 borehole locations. A suffix of 'S' or 'D', representing the shallow and deep wells, respectively, was used to differentiate the well depths at the nested well locations. The depth and details of the monitoring wells are shown on the corresponding Borehole Logs.

The geodetic elevation at each of the borehole locations was obtained using the Global Navigation Satellite System (GNSS).

4.0 SUBSURFACE CONDITIONS

The investigation revealed that beneath a topsoil veneer and a layer of earth fill in places, the site is underlain by strata of sandy silt till, sand, silt, and silty clay.

Detailed descriptions of the encountered subsurface conditions from the boreholes are presented on the Borehole Logs, comprising Figures 1 to 13, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing Nos. 2 and 3. The engineering properties of the disclosed soils are discussed herein.

4.1 Topsoil

A layer of topsoil, approximately 15 to 23 cm in thickness, was contacted in all boreholes except Borehole 1. Thicker topsoil may be contacted in areas beyond the borehole locations.

4.2 Earth Fill

A layer of earth fill, extending to a depth of 2.3 m below the existing ground surface, was encountered in Borehole 1, along the access driveway to the abandoned house. The surficial fill material is black in color and consists of sand and gravel, it overlies a layer of peat and a grey silty clay fill.

The recorded ‘N’ values are 3, 7 and 18 blows per 30 cm of penetration.

The natural water content values of the fill samples are 5% and 13%.

The peat layer has a water content value of 126%. It contains fine, fibrous decayed vegetation and is formed by the progressive accumulation of incompletely decomposed plants in a wet environment.

One must be aware that the samples retrieved from the borehole may not be truly representative of the geotechnical quality of the earth fill. The extent of the fill and the quality of the fill can be assessed by laboratory testing and/or test pits if necessary.

4.3 **Sandy Silt Till**

The sandy silt till predominates the soil stratigraphy within the investigated depth of all boreholes. It consists of a random mixture of soil particle sizes ranging from clay to gravel with the sand and silt being the predominant fractions. Sample examination indicates that it contains a trace to some clay, with a trace of gravel. In places, it also contains occasional cobbles. Grain size analyses were performed on 6 representative samples of the sandy silt till; the results are plotted on Figures 16 and 17.

The recorded ‘N’ values range from 2 to over 100, with a median of 28 blows per 30 cm of penetration, indicating the sandy silt till is very loose to very dense, being generally compact in relative density. The till is generally weathered to a depth of up to 1.2 m below the ground surface.

The natural water content values range from 7% to 19%, with a median of 10%, indicating that the sandy silt till is in a damp to wet, generally moist condition.

The engineering properties of the sandy silt till are given below:

- High frost susceptibility and moderately low water erodibility.
- The till will be relatively stable in steep excavation; however, the till may slough after prolonged exposure.

4.4 Sand

The native sand deposit was contacted beneath the silty clay, overlying the sandy silt till deposit in all boreholes except Boreholes 1, 5, 9 and 13. The sand is fine grained with a trace to some silt. Grain size analyses were performed on 2 representative samples of the sand deposits; the results are plotted in Figure 18.

The recorded 'N' values range from 8 to over 100, with a median of 19 blows per 30 cm of penetration, indicating the sand is loose to very dense, being generally compact in relative density.

The natural water content values range from 12% to 21%, with a median of 16%, indicating that the sand is generally in a very moist to wet, generally wet condition.

The engineering properties of the sand are presented below:

- High frost susceptibility, with high soil-adfreezing potential.
- High water erodibility; its fine particles are susceptible to migration through small openings, particularly under seepage pressure.
- The strength of the wet silty sand is susceptible to impact disturbance, which will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction in shear strength.
- In excavation, the sand will slough readily, run with seepage and boil under a piezometric head of 0.3 m.

4.5 Silt

The native silt deposit was contacted at various depths in Boreholes 1, 3, 4, 7, 9, 10 and 13. It contains some sand to being sandy, with a trace of clay. Grain size analyses were performed on 3 representative samples of the silt; the results are plotted on Figure 19.

The recorded 'N' values range from 8 to 33, with a median of 16 blows per 30 cm of penetration, indicating the silt is loose to dense, generally being compact in relative density. The silt is weathered extending to a depth of 1.2 m below the ground surface.

The natural water content values of the silt deposit range from 12% to 22%, with a median of 18%, indicating that the silt is in a moist to wet, generally wet condition.

The engineering properties of sandy silt are listed below:

- High frost susceptibility, with high soil-adfreezing potential.
- High water erodibility; it is susceptible to migration through small openings, particularly under seepage pressure.
- The wet silt is susceptible to impact disturbance, which will induce a build-up of pore pressure, resulting in soil dilation and a reduction in shear strength.
- In excavation, the silt will slowly slump, run with groundwater seepage, and boil under a piezometric head of 0.4 m.

4.6 Silty Clay

The silty clay deposit was contacted generally near the ground surface in Boreholes 2, 3, 8, 12 and 13. Grain size analysis was performed on a representative sample of the silty clay; the result is plotted in Figure 20.

The recorded ‘N’ values range from 3 to over 100, with a median of 8 blows per 30 cm of penetration, indicating the silty clay is soft to hard, being generally stiff in consistency. The soft to firm clay is restricted to the weathered zone, within a depth of 1.2 m below the ground surface.

The natural water content values of the silty clay range from 14% to 21%, with a median of 18%, indicating that it is generally in a moist condition. Atterberg Limits test was completed on a silty clay sample and the resulting Liquid Limit and Plastic Limit are 33% and 18% respectively, showing that the silty clay is low in plasticity.

The engineering properties of the silty clay deposit are presented below:

- High frost susceptibility and low water erodibility.
- In excavation, the firm silty clay will slough readily in relatively steep cuts; however, the stiff clay will be stable in steep cut and may slough or experience shrinkage under prolonged exposure.

4.7 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	**Range for 95% or +**
Earth Fill	5 and 13	14	8 to 20
Sandy Silt Till	7 to 19 (median 10)	13	8 to 17
Silt	12 to 22 (median 17)	12 to 13	8 to 17
Sand	12 to 21 (median 16)	10	5 to 15
Silty Clay	14 to 19 (median 18)	17	13 to 26

* The above values are provided as a guideline. Standard Proctor Tests must be performed on bulk samples collected from site during construction prior to backfill and compaction.

5.0 GROUNDWATER CONDITION

The boreholes were checked for the presence of groundwater on the completion of drilling. The groundwater levels observed on borehole completion are summarized in Table 2.

Table 2 - Groundwater Levels on Completion

Borehole No.	Ground Elevation (m)	Borehole Depth (m)	Groundwater Levels on Completion	
			Depth (m)	**Elevation (m)**
1D	418.7	6.6	Dry	-
2	419.7	6.6	2.4	417.3
3	419.0	6.4	3.7	415.3
4	419.7	6.4	4.3	415.4
5	417.2	6.5	1.5	415.7
6	416.7	8.1	0.6	416.1
7	416.7	6.4	1.5	415.2
8D	415.5	6.4	2.4	413.1
9	415.3	6.2	Dry	-
10	416.2	6.4	5.5	410.7
11	415.9	5.1	Dry	-
12	415.2	9.4	Dry	-
13	415.2	10.9	6.4	408.8

The observed groundwater level in 9 of the 13 boreholes ranges from 0.6 m to 6.4 m below the prevailing ground surface, or between El. 408.8 m and El. 417.3 m. At Boreholes 1, 9, 11 and 12, the boreholes remain dry on borehole completion. The groundwater level on the property is subject to seasonal fluctuations.

Groundwater level was recorded in the monitoring wells on 3 occasions and summarized in Table 3.

Table 3 - Groundwater Levels in Monitoring Wells

Borehole/ Monitoring Well No.	Ground El. (m)	Well Depth (m)	Sept 24, 2024		Oct 7, 2024		Oct 24, 2024	
			Depth (m)	El. (m)	Depth (m)	El. (m)	Depth (m)	El. (m)
1D	418.7	6.0	1.8	416.9	1.8	416.9	1.8	416.9
1S	418.7	4.6	1.6	417.1	1.6	417.1	1.7	417.0
2	419.7	6.1	3.1	416.6	3.0	416.7	3.0	416.7
3	419	6.0	2.4	416.6	2.4	416.6	2.5	416.5
4	419.7	5.3	2.8	416.9	2.9	416.8	2.9	416.8
5	417.2	6.1	2.1	415.1	2.2	415.0	2.3	414.9
6	416.7	6.2	5.1	411.6	5.6	411.1	5.9	410.8
7	416.7	5.8	1.5	415.2	1.6	415.1	1.7	415.0
8D	415.5	6.0	2.5	413.0	3.6	411.9	3.6	411.9
8S	415.5	4.6	1.5	414.0	1.6	413.9	1.6	413.9
10	416.2	5.0	2.8	413.4	2.9	413.3	3.0	413.2
13	415.4	10.2	Dry	-	Dry	-	Dry	-

The groundwater level measured in the monitoring wells ranges from 1.5 to 5.9 m below the ground surface, or between El. 411.1 m and El. 417.1 m. Further groundwater monitoring data and the groundwater level interpretation will be presented in the hydrogeological assessment under separate cover.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a topsoil veneer and a layer of earth fill at 1 location, the site is underlain by strata of sandy silt till, sand, silt, and silty clay.

The groundwater level was measured in the monitoring wells on 3 occasions. The recorded water level ranges from 1.5 to 5.9 m below the ground surface, or between El. 411.1 m and El. 417.1 m.

A review of the Conceptual Servicing Plan prepared by SCS indicates that the land will be subdivided into residential lots and blocks, and a stormwater management facility at the southwest portion of the site. The project will be provided with municipal services and roadways. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil must be removed from the area of construction. It can be stockpiled and reused in landscaping areas only. Any surplus will have to be disposed off-site.
2. The cavity of any demolished structure must be properly backfilled with compacted inorganic soil prior to site grading. All debris must be removed off-site.
3. The existing earth fill and weathered soils, in their present state, are not suitable to support any structure sensitive to moment. It must be subexcavated, sorted free of organics and other deleterious material before reusing for structural backfill or engineered fill construction. If they cannot be segregated, they must be removed off site.
4. Where the site will be graded with additional fill, the earth fill can be constructed in an engineered manner for foundation, site services and pavement construction.
5. The proposed structures can be constructed on conventional spread and strip footings founded on the undisturbed native soils or on engineered fill.
6. A Class ‘B’ bedding, consisting of compacted 19-mm Crusher Run Limestone (CRL) or equivalent, is recommended for the construction of the underground services.
7. Any excavation must be carried out in accordance with the O. Reg. 213/91.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 **Site Preparation**

Topsoil must be stripped for site development and can be used for landscaping purpose only. Any surplus must be removed off-site. Any existing structures must be demolished and the cavities should be properly backfilled with inorganic soil, compacted to engineered fill specifications.

Where additional fill is required for site grading, the earth fill should be constructed in an engineered manner for foundation support, pavement and underground services constructions. The engineering requirements for a certifiable fill are presented below:

1. The peat encountered in Borehole 1 must be removed.
2. The badly weathered soils should be subexcavated, sorted free of topsoil inclusions and deleterious materials, if any, aerated and properly compacted in layers. The exposed subgrade must be proof-rolled and inspected prior to fill placement. Any weak soil must be further subexcavated to competent ground.
3. Inorganic soils must be used for engineered fill construction, and they must be uniformly compacted in 20 cm thick lifts to at least 98% Standard Proctor dry density (SPDD) up to the proposed finished grade. The soil moisture must be properly controlled near the optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% SPDD.
4. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
5. If imported fill is to be used, it should be inorganic soils, free of deleterious or any material with environmental issue (contamination). Any potential imported earth fill from off site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
6. The engineered fill must not be placed during the period where freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
7. The bank of the engineered fill must be maintained at a gradient not steeper than 3 Horizontal (H):1 Vertical (V), so that proper compaction can be achieved.
8. The fill operation must be supervised and monitored on a full-time basis by a technician under the direction of a geotechnical engineer.
9. The engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented.
10. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who supervised the fill placement in order to document the locations of the excavation and/or to supervise reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.

11. Foundations founded on engineered fill must be reinforced and designed by a structural engineer to allow distribution of stress induced by the abrupt differential settlement in engineered fill.

6.2 **Foundations**

The property will be subdivided into lots and blocks for a residential development. These structures can be supported on conventional footings founded on engineered fill or sound native soils. The recommended soil bearing pressures for the design of footings are provided below:

- Maximum Soil Bearing Pressure, at Serviceability Limit State (SLS) = 150 kPa
- Factored Ultimate Bearing Pressure, at Ultimate Limit State (ULS) = 240 kPa

The total and differential settlements of the conventional spread and strip footings, designed for the bearing pressure at SLS, are estimated to be 25 mm and 20 mm, respectively.

The footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to assess its suitability for bearing the designed foundations.

Footings exposed to weathering, or in unheated areas, should have at least 1.4 m of earth cover for protection against frost action, or must be properly insulated.

The foundations should meet the requirements specified in the latest Ontario Building Code, and the structure should be designed to resist an earthquake force using Site Classification 'D' (stiff soil).

6.3 **Basement Structures**

The perimeter walls should be designed to sustain a lateral earth pressure calculated using the soil parameters stated in Section 6.8. Any applicable surcharge loads adjacent to the basement must also be considered in the wall design.

In conventional design of a basement, the foundation walls must be provided with perimeter subdrain at wall base, connected to a positive outlet. The subdrains should be encased in fabric filter and connected into a positive outlet. Details of the perimeter subdrains are illustrated on Drawing No. 4.

The basement floor subgrade should consist of sound native soils or engineered fill. The subgrade must be inspected prior to the placement of granular bedding. Any soft/weak subgrade encountered, it must be subexcavated and replaced with approved inorganic soils compacted to 98% SPDD.

The floor slab should be constructed on a minimum 15 cm thick granular bedding, consisting of 19-mm clear stone, or equivalent.

6.4 Underground Services

The subgrade for the underground services should be founded on sound native soil or properly compacted inorganic earth fill. A Class ‘B’ bedding, consisting of 19-mm CRL or equivalent, is recommended for construction of the underground services. Where erodible wet sand or silt subgrade is encountered or where extensive dewatering is required, a Class ‘A’ concrete bedding should be considered.

The pipe joints connecting into manholes and catch basins should be leak-proof or wrapped with an appropriate waterproof membrane to prevent the subgrade migration. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

In order to prevent pipe floatation when the service trench is deluged with water, a soil cover with a thickness equal to the diameter of the pipe should be in place at all times after completion of the pipe installation.

All metal fittings for the underground services should be protected against soil corrosion. For estimation of anode weight requirements, the estimated electrical resistivity of the disclosed soils presented in Table 5 in Section 6.8 can be used. The proposed anode weight must meet the minimum requirement as specified by the Township and Municipality standard.

6.5 Backfilling in Trenches and Excavated Areas

The backfill in service trenches should be compacted to at least 95% SPDD in 20 cm layers, or the lift thickness should be determined by test strips. Below slab-on-grade and in the zone within 1.0 m below the pavement subgrade, the material should be compacted to at least 98% SPDD with the water content at 2% to 3% drier than the optimum.

The in-situ native soils are generally suitable for 95% or + Standard Proctor compaction. Any wet soil will require aeration prior to compaction. Aeration can be achieved by spreading the wet soil thinly on the ground in the dry and warm weather. All soils must be sorted free of concentrated topsoil and organics inclusions, before aeration for reuse as structural backfill. The existing fill must be sorted free of topsoil inclusions and deleterious materials, if any, prior to its use as structural backfill. The peat must be removed and disposed of off-site.

When compacting the till and clay on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts must be limited to 20 cm or less (before compaction). Boulders over 15 cm in size must be sorted and removed from the backfill.

In normal construction practice, the problem areas of settlement largely occur adjacent to manholes, catch basins, service crossings, foundation walls and columns. In areas which are inaccessible to a heavy compactor, sand backfill should be used for compaction with a smaller vibratory compactor.

One must be aware of the possible consequences during trench backfilling and exercise caution as described below:

- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the sides is flattened to 2H:1V, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 98% SPDD, with the moisture content on the wet side of the optimum. In confined areas where the desired slope cannot be achieved or the proper operation of a kneading-type roller cannot be facilitated, imported sand fill, which can be appropriately compacted by using a smaller vibratory compactor, must be used.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand and the compaction must be carried out diligently prior to the placement of the backfill above this sector, i.e., in the upper sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section.
- In areas where groundwater movement is expected in the pipe bedding or trench backfill mantle, anti-seepage collars (OPSS 802.095) should be provided.

- When construction is carried out in freezing weather, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent wetting of the backfill or when it is required, such as when the trench box is removed. The above will invariably cause backfill settlement in the next few years.
- In areas where the underground services construction is carried out during winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to final surfacing of the new pavement.

6.6 Pavement Design

The recommended pavement design for local and collector residential roads is presented in Table 4.

Table 4 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder		HL4
Local	50	
Collector	60*	
Granular Base	150	Granular 'A'
Granular Sub-base		Granular 'B'
Local	450	
Collector	600	

* If the road is designated as a transit route, the asphalt binder must be thickened to 100 mm.

In preparation of pavement subgrade, all topsoil and compressible material should be removed. The final subgrade must be proof-rolled. Any soft spot as identified must be rectified by subexcavation and replacing with selected dry inorganic material. The subgrade within 1.0 m below the underside of the granular sub-base must be compacted to at least 98% SPDD, with the water content at 2% to 3% drier than its optimum.

All the granular bases should be compacted in 150 to 200 mm lifts to 100% SPDD.

The pavement subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated in the construction procedures and road design:

- The subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained prior to pavement construction.
- Lot areas adjacent to the roads should be properly graded to prevent ponding of large amounts of water. Otherwise, the water will seep into the subgrade mantle and induce a regression of the subgrade strength, with costly consequences for the pavement construction.
- Fabric filter-encased curb subdrains connecting to a positive outlet of catch basin, will be required on both sides of the roadway, as required by the city.
- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

6.7 **Stormwater Management Facility**

A review of the Conceptual Servicing Plan prepared by SCS indicates that a SWM retention pond is proposed at the southwest corner of the property, in the vicinity of Boreholes 12 and 13. The proposed pond has a headwall invert and normal water level of El. 413.40 m and the pond bottom is at El. 410.40 m.

Based on the borehole findings, the area of the SWM facility consists of predominantly silty clay and sandy silt till, with a localized silt layer. Borehole 12 was dry and groundwater was recorded at the depth of 6.4 m, or at El. 408.8 m, in Borehole 13 on borehole completion. The monitoring well at Borehole 13 remained dry.

The sandy silt till and silt along the side and base of the pond are expected to have a permeability of 10^{-4} to 10^{-5} cm/sec, which indicates it is relatively pervious, therefore, a clay liner will be required for the pond construction.

The clay liner should consist of inorganic material having at least 30% in clay content. Where the source of clay is not available, geosynthetic clay liner (GCL) should be used instead. A ballast, at least 1.0 m in thickness, should be placed on top of the GCL. The clay soil or the ballast should be compacted to 98% SPDD in lifts no more than 20 cm in thickness.

The side slopes of the SWM facility should be designed at a slope not steeper than 3H:1V above the wet perimeter, and 4H:1V or flatter below the wet perimeter.

Where earth berm is proposed around the SWM facility, topsoil must be removed prior to construction. The subgrade must be proof-rolled before placement of earth fill for the berm. Selected on site clay material, free of organics, can be used for the berm compacted to 98% SPDD in 20 cm layers.

All exposed side slopes must be vegetated and/or sodded to prevent surface erosion.

Where inlet, outlet and control structures are proposed, they should be designed according to the recommendations in Section 6.2.

It is recommended that additional review be carried out once the detailed design of the SWM facility is available.

6.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 5.

Table 5 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight γ (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Earth Fill/Weathered Soils/Silty Clay	20.5	10.5	1.25	1.00
Sandy Silt Till	22.5	12.5	1.30	1.03
Sand	20.0	10.0	1.25	1.00
Silt	21.0	11.0	1.20	1.00
Lateral Earth Pressure Coefficients		**Active K_a**	**At Rest K_o**	**Passive K_p**
Silty Clay		0.39	0.56	2.56
Sandy Silt Till/Silt		0.32	0.48	3.12
Sand		0.29	0.46	3.39

Table 5 - Soil Parameters (Cont'd)

Estimated Coefficient of Permeability (K) and Percolation Time (T)	**K (cm/sec)**	**T (min/cm)**
Silty Clay	10^{-7}	Over 80
Sandy Silt Till	10^{-5} to 10^{-7}	20 to over 80
Sand	10^{-2} to 10^{-3}	4 to 8
Silt	10^{-4}	12
Estimated Electrical Resistivity	**ohm·cm**	
Silty Clay	3000 ohm.cm	
Sandy Silt Till/Silt	4500 to 5000 ohm.cm	
Sand	6000 ohm.cm	
Coefficients of Friction		
Between Concrete and Granular Base		0.50
Between Concrete and Sound Native Soils		0.35
Maximum Allowable Soil Pressure (SLS) For Thrust Block Design		
Engineered Fill and Sound Native Soils		75 kPa

6.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 6.

Table 6 - Classification of Soils for Excavation

Material	**Type**
Sandy Silt Till	2
Earth Fill, Weathered Soils, Silty Clay and drained Silt and Sand	3
Saturated Silt and Sand	4

Excavation into the tills containing boulders may require extra effort and the use of a heavy-duty excavator.

The dewatering requirement will be presented in the hydrogeological assessment under separate cover.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 1.0 m below the intended bottom of the excavation. These test pits should be allowed to remain open for a few hours to assess the stability and trenching conditions.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Sorbara/Tribute Brubacher Holdings Inc., and for review by its designated consultants and government agencies. Use of this report is subject to the conditions and limitations of the contractual agreement.

The material in the report reflects the judgement of Penchala Harish Mannepalli, M.Eng., EIT and Kelvin Hung, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL ENGINEERS LTD.

Penchala Harish Mannepalli, M.Eng., EIT

Kelvin Hung, P.Eng.
PHM/KH:dd

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 1.0 m below the intended bottom of the excavation. These test pits should be allowed to remain open for a few hours to assess the stability and trenching conditions.

7.0 LIMITATIONS OF REPORT

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SOIL ENGINEERS LTD.

Penchala Harish Mannepalli, M.Eng., EIT

Kelvin Hung, P.Eng.
PHM/KH:dd

LICENSED PROFESSIONAL ENGINEER
01/29/25
K. W. K. HUNG
100124295
KH
PROVINCE OF ONTARIO

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Standard Penetration Resistance or 'N' Value:

The number of blows of a 63.5 kg hammer falling from a height of 76 cm required to advance a 51 mm outer diameter drive open sampler 30 cm into undisturbed soil, after an initial penetration of 15 cm.

Plotted as '○'

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows per each 30 cm of penetration of a 51 mm diameter, 90° point cone driven by a 63.5 kg hammer falling from a height of 76 cm.

Plotted as '—●—'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/30 cm)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
>50	very dense

Cohesive Soils:

Undrained Shear Strength (kPa)	'N' (blows/30 cm)	Consistency
<12	<2	very soft
12 to <25	2 to <4	soft
25 to <50	4 to <8	firm
50 to <100	8 to <15	stiff
100 to 200	15 to 30	very stiff
>200	>30	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test

METRIC CONVERSION FACTORS

1 ft = 0.3048 m
1 inch = 25.4 mm
1 lb = 0.454 kg
1 ksf = 47.88 kPa

JOB NO.: 2311-S044

LOG OF BOREHOLE: 1D

FIGURE NO.: 1

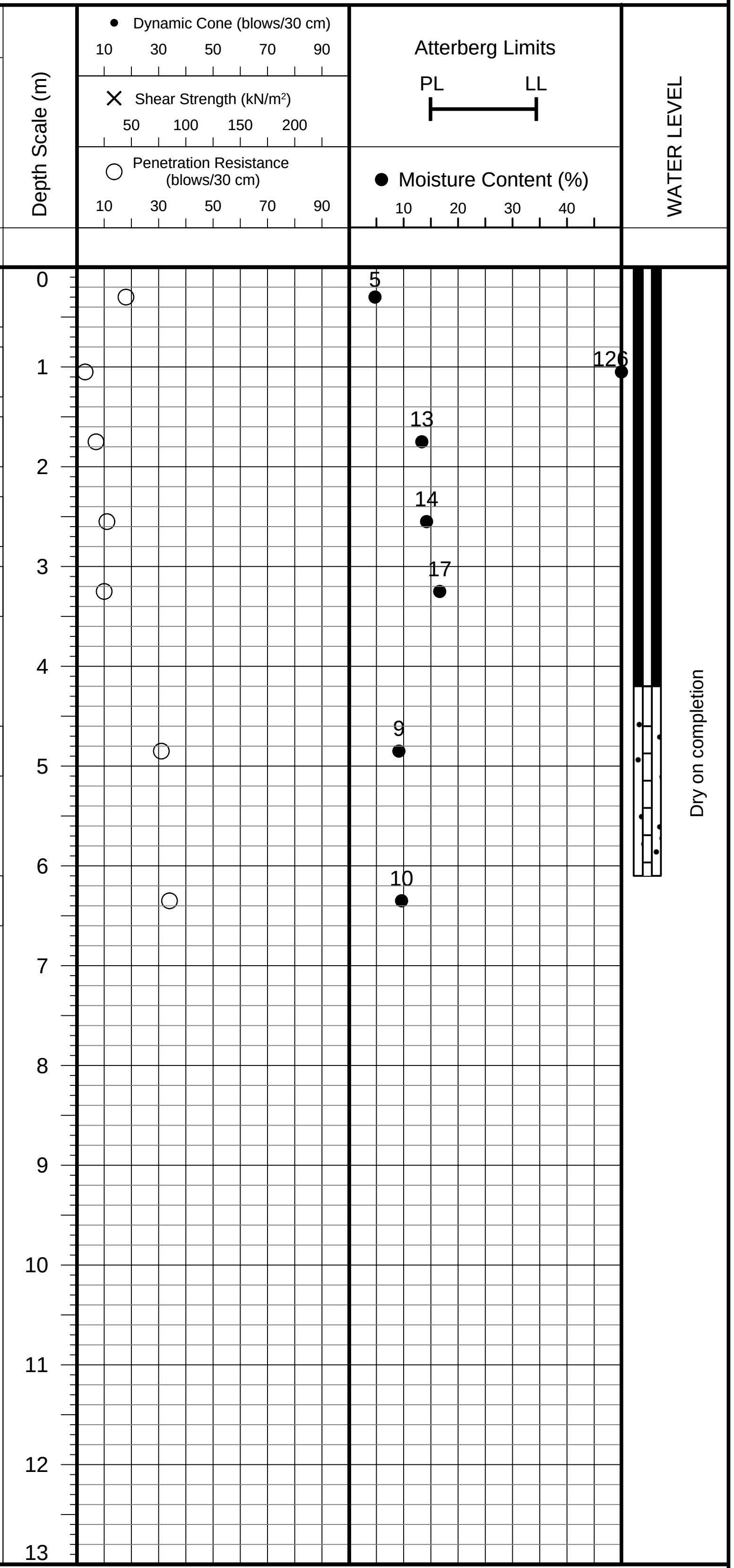
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 5, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
418.7	Ground Surface			
0.0	Black **EARTH FILL** sand and gravel	1	DO	18
	PEAT LAYER	2	AS	3
	Grey **EARTH FILL** silty clay with sand and gravel	3	DO	7
416.4 2.3	Brown, compact **SILT** some sand to sandy occ. sand layers wet	4 5	DO DO	11 10
414.7 4.0	Grey, dense **SANDY SILT TILL** some clay, a trace of gravel occ. cobbles	6 7	DO DO	31 34
412.1 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m with 1.5 m screen Sand backfill from 4.3 to 6.1 m Bentonite seal from 0.0 m to 4.3 m Provided with a steel monument casing			



Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 1S

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 5, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
418.7	Ground Surface			
0.0	Black **EARTH FILL** sand and gravel			
	PEAT LAYER			
	Grey **EARTH FILL** silty clay with sand and gravel			
416.4 2.3	Brown, compact **SILT** some sand to sandy occ. sand layers wet			
414.7 4.0	Grey, dense **SANDY SILT TILL** some clay, a trace of gravel occ. cobbles			
414.1 4.6	**END OF BOREHOLE**			

(Shallow Well) Installed 50 mm Ø PVC monitoring well
to 4.6 m with 1.5 m screen
Sand backfill from 2.7 to 4.6 m
Bentonite seal from 0.0 m to 2.7 m
Provided with a steel monument casing

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

● Dynamic Cone (blows/30 cm): 10, 30, 50, 70, 90

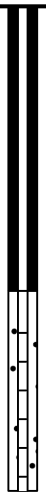
× Shear Strength (kN/m²): 50, 100, 150, 200

○ Penetration Resistance (blows/30 cm): 10, 30, 50, 70, 90

Atterberg Limits: PL, LL

● Moisture Content (%): 10, 20, 30, 40

WATER LEVEL



Dry on completion

Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 2

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

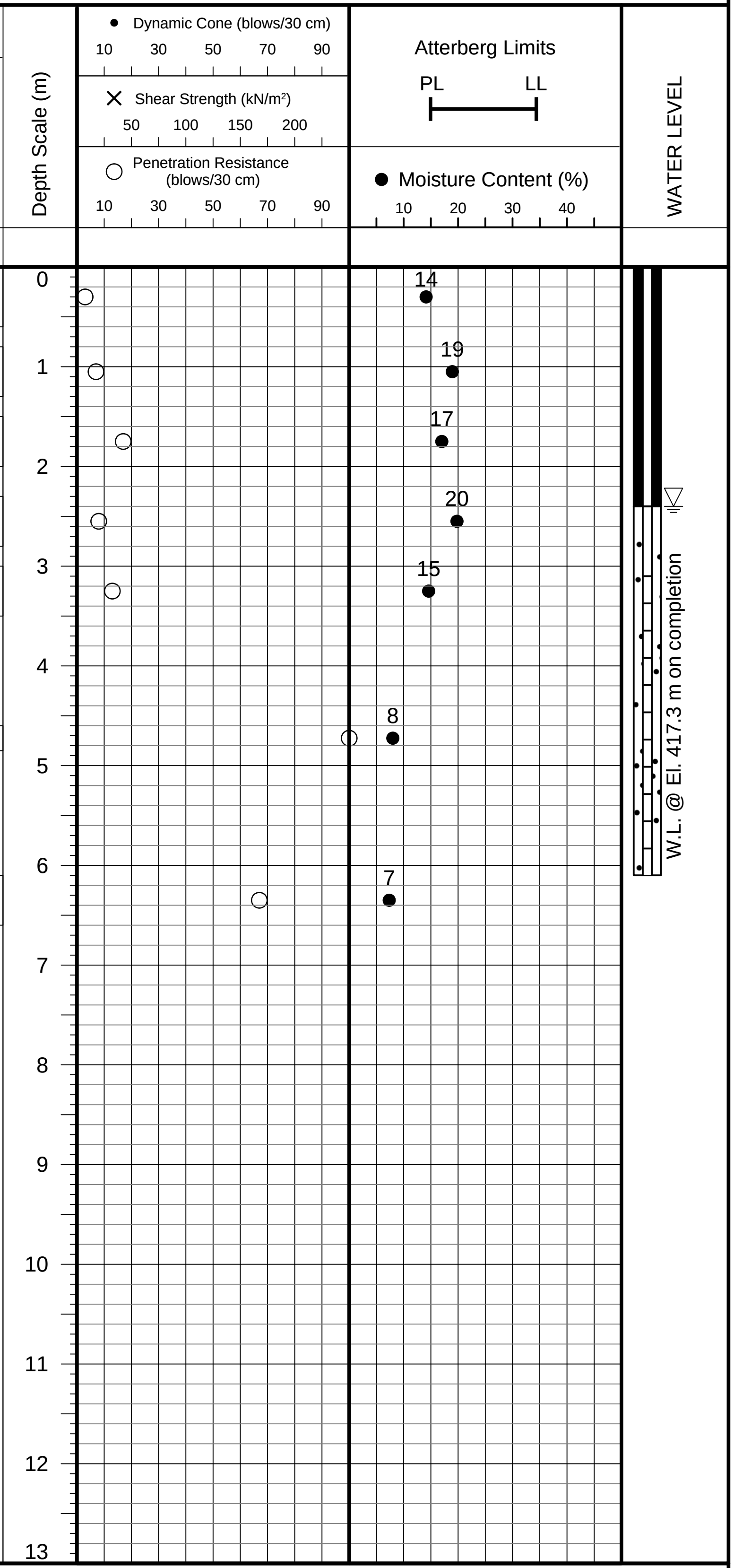
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 29, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
419.7	Ground Surface			
0.0	**18 cm TOPSOIL**	1	DO	3
	Brown, soft to firm **SILTY CLAY** traces of sand and gravel weathered	2	DO	7
418.2 1.5	Brown, loose to compact **SAND** fine grained a trace to some silt wet	3	DO	17
		4	DO	8
		5	DO	13
415.7 4.0	Grey, very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	6	DO	50/8
		7	DO	67
413.1 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 6.1 m with 3.0 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a steel monument casing



JOB NO.: 2311-S044

LOG OF BOREHOLE: 3

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

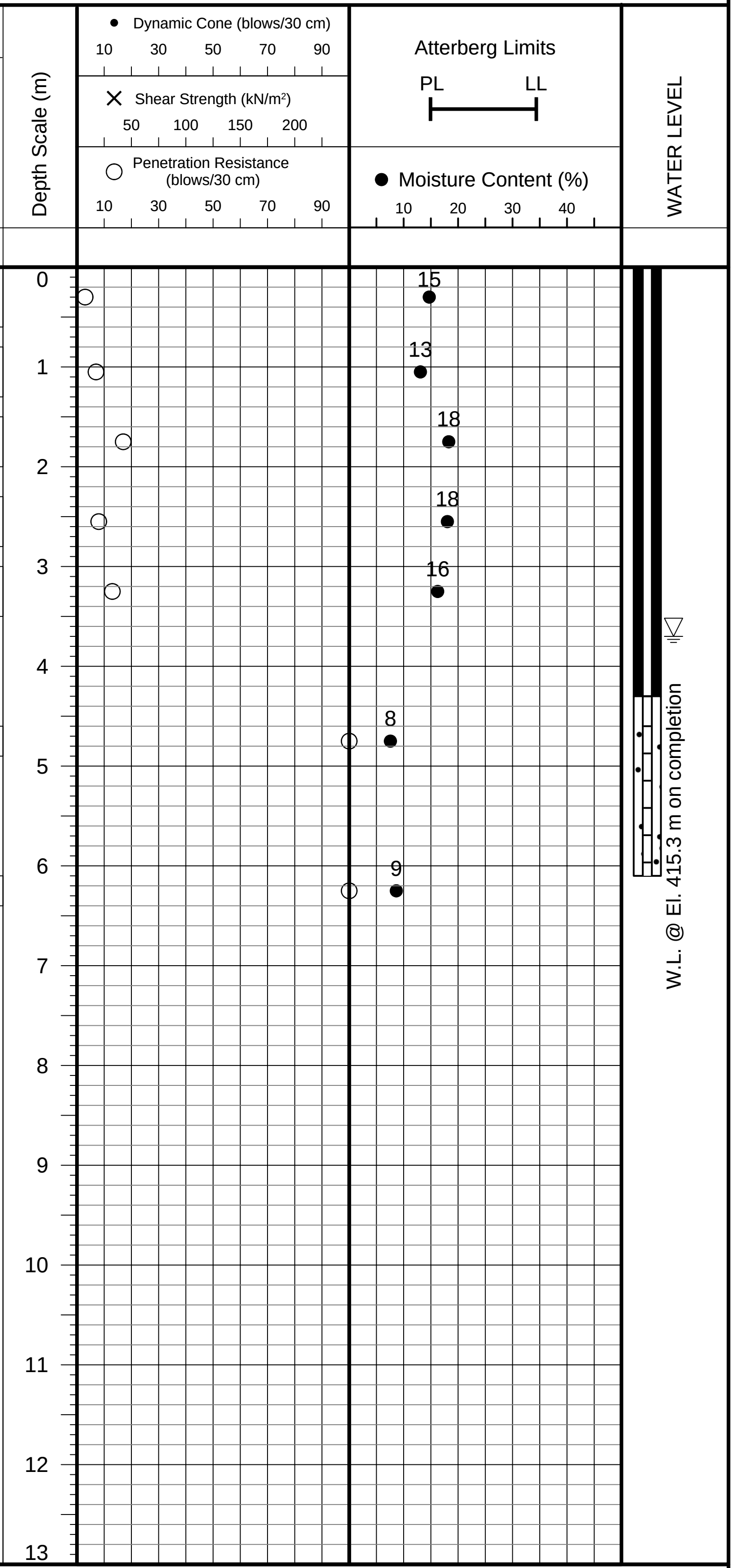
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 5, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
419.0	Ground Surface			
0.0	**15 cm TOPSOIL**	1	DO	8
	Brown, loose to compact **SILT** some sand to sandy a trace of clay — weathered —	2	DO	16
417.6 1.4	Brown, very stiff **SILTY CLAY** a trace of gravel	3	DO	20
416.8 2.2	Brown, compact **SAND** fine grained a trace to some silt wet	4 5	DO DO	19 17
415.0 4.0	Grey, very dense **SANDY SILT TILL** traces of clay and gravel	6 7	DO DO	50/13 50/13
412.6 6.4	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 6.1 m with 1.5 m screen
Sand backfill from 4.3 to 6.1 m
Bentonite seal from 0.0 m to 4.3 m
Provided with a steel monument casing



JOB NO.: 2311-S044

LOG OF BOREHOLE: 4

FIGURE NO.: 5

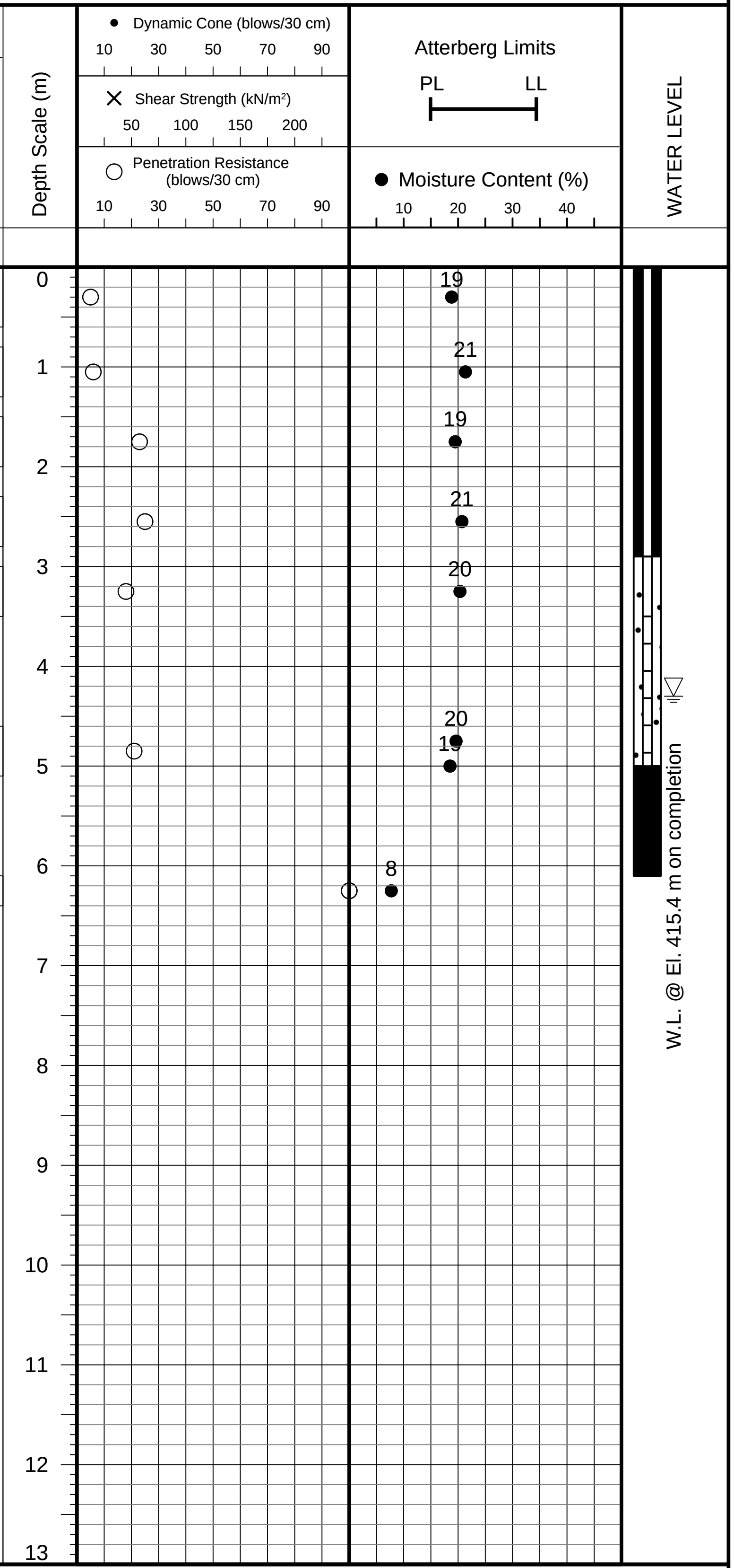
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 29, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
419.7 0.0	Ground Surface **15 cm TOPSOIL**	1	DO	5
	Brown, firm **SILTY CLAY** a trace of sand weathered	2	DO	6
418.3 1.4	Brown, compact **SAND** fine grained a trace to some silt wet	3	DO	23
		4	DO	25
		5	DO	18
		6A	DO	21
414.8 4.9	Brown, compact **SILT** some sand to sandy wet	6B		
414.2 5.5	Grey, compact to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	7	DO	50/15
413.3 6.4	**END OF BOREHOLE**			



Installed 50 mm Ø PVC monitoring well
to 6.1 m with 1.5 m screen
Bentonite seal backfill from 5 m to 6.1 m
Sand backfill from 2.7 to 6.1 m
Bentonite seal from 0.0 m to 2.7 m
Provided with a steel monument casing

Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 5

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

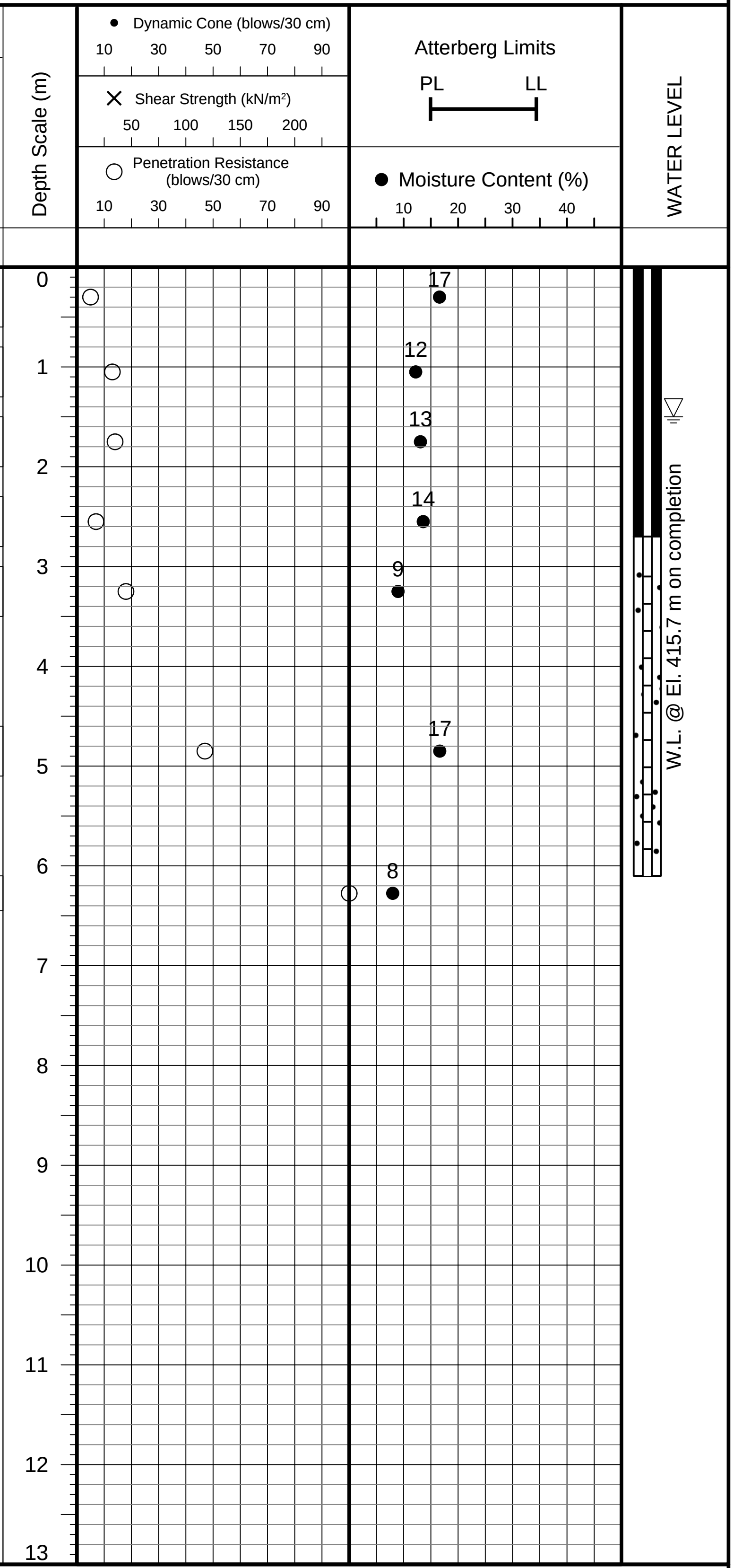
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 4, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
417.2 0.0	Ground Surface			
	20 cm TOPSOIL	1	DO	5
	weathered	2	DO	13
	Loose to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	3	DO	14
	brown grey	4	DO	7
		5	DO	18
	clay layers	6	DO	47
		7	DO	65/20
410.8 6.5	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 6.1 m with 3.0 m screen
Sand backfill from 2.7 to 6.1 m
Bentonite seal from 0.0 m to 2.7 m
Provided with a steel monument casing



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Page: 1 of 1

JOB NO.: 2311-S044

LOG OF BOREHOLE: 6

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

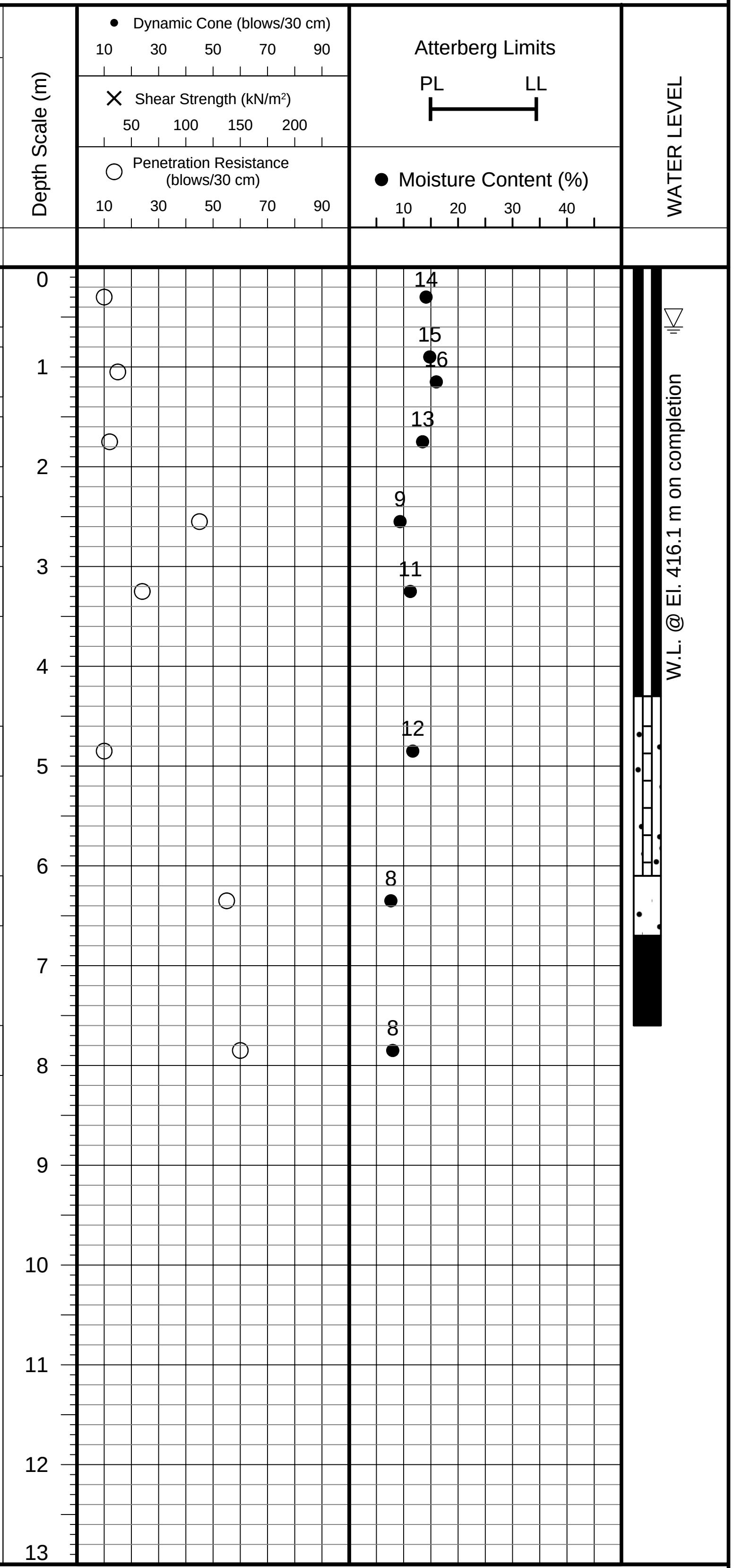
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 4, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
416.7	Ground Surface			
0.0	**15 cm TOPSOIL**			
	Brown, compact **SANDY SILT TILL** traces of clay and gravel — weathered	1	DO	10
415.7 1.0	Brown, compact **SAND** fine grained a trace to some silt wet	2A 2B	DO	15
		3	DO	12
414.5 2.2	Compact to very dense **SANDY SILT TILL** traces of clay and gravel seepage below 4.6 m — — brown / grey	4	DO	45
		5	DO	24
		6	DO	10
		7	DO	55
		8	DO	60
408.6 8.1	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 6.1 m with 1.5 m screen
Bentonite seal backfill from 6.7 m to 7.6 m
Sand backfill from 6.1 m to 6.7 m and 4.3
to 6.1 m
Bentonite seal from 0.0 m to 4.3 m
Provided with a steel monument casing



JOB NO.: 2311-S044

LOG OF BOREHOLE: 7

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Residential Development

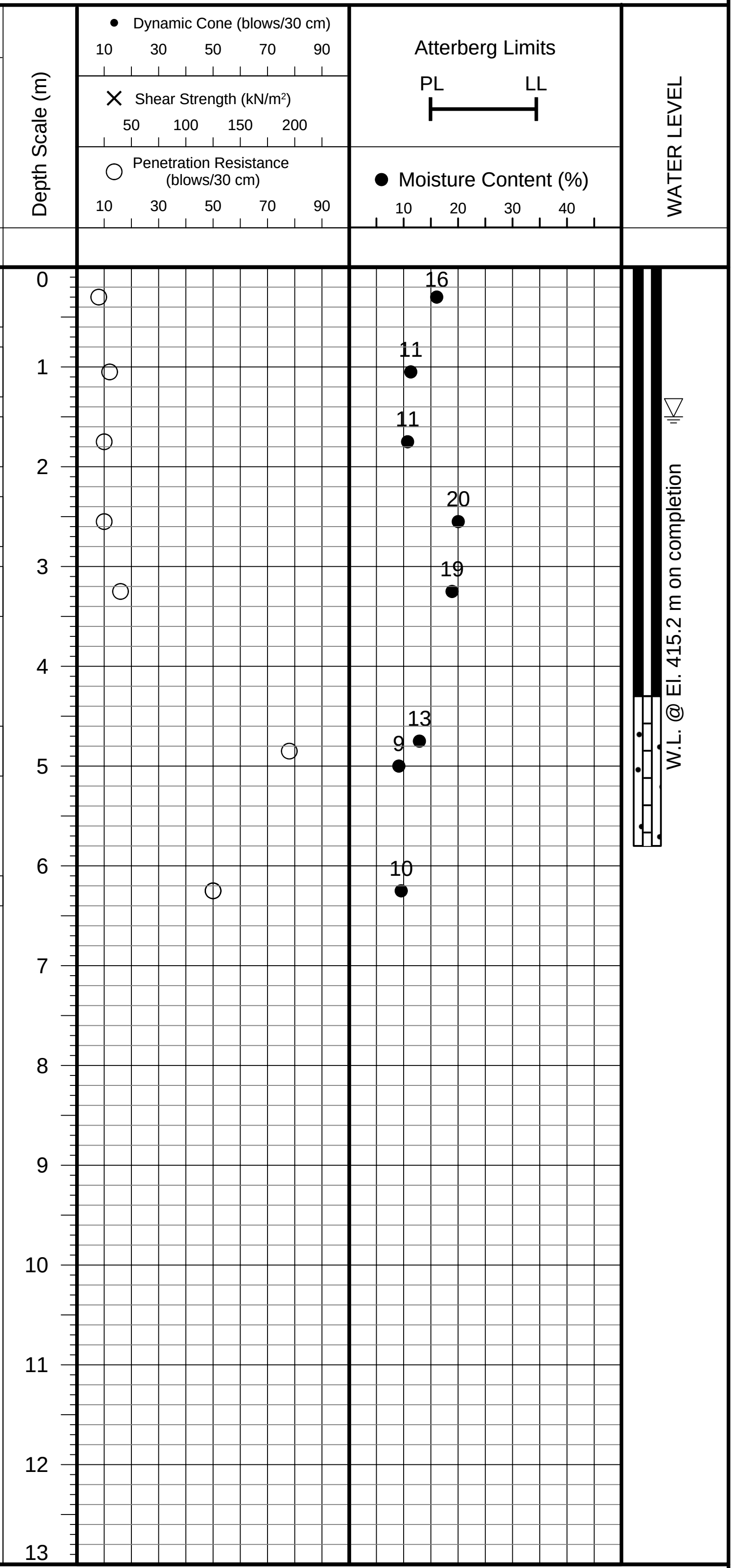
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 30, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
416.7 0.0	Ground Surface **18 cm TOPSOIL**	1	DO	8
	Brown,loose to compact **SANDY SILT TILL** some clay, a trace of gravel weathered	2	DO	12
		3	DO	10
414.5 2.2	Brown, compact **SILT** sandy, a trace of gravel wet	4	DO	10
		5	DO	16
412.9 3.8	Brown, very dense **SAND** fine grained a trace to some silt wet	6A 6B	DO	78
411.8 4.9	Grey, very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	7	DO	50/15
410.3 6.4	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 5.8 m with 1.5 m screen
Sand backfill from 4.3 to 5.8 m
Bentonite seal from 0.0 m to 4.3 m
Provided with a steel monument casing



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JOB NO.: 2311-S044

LOG OF BOREHOLE: 8D

FIGURE NO.: 9

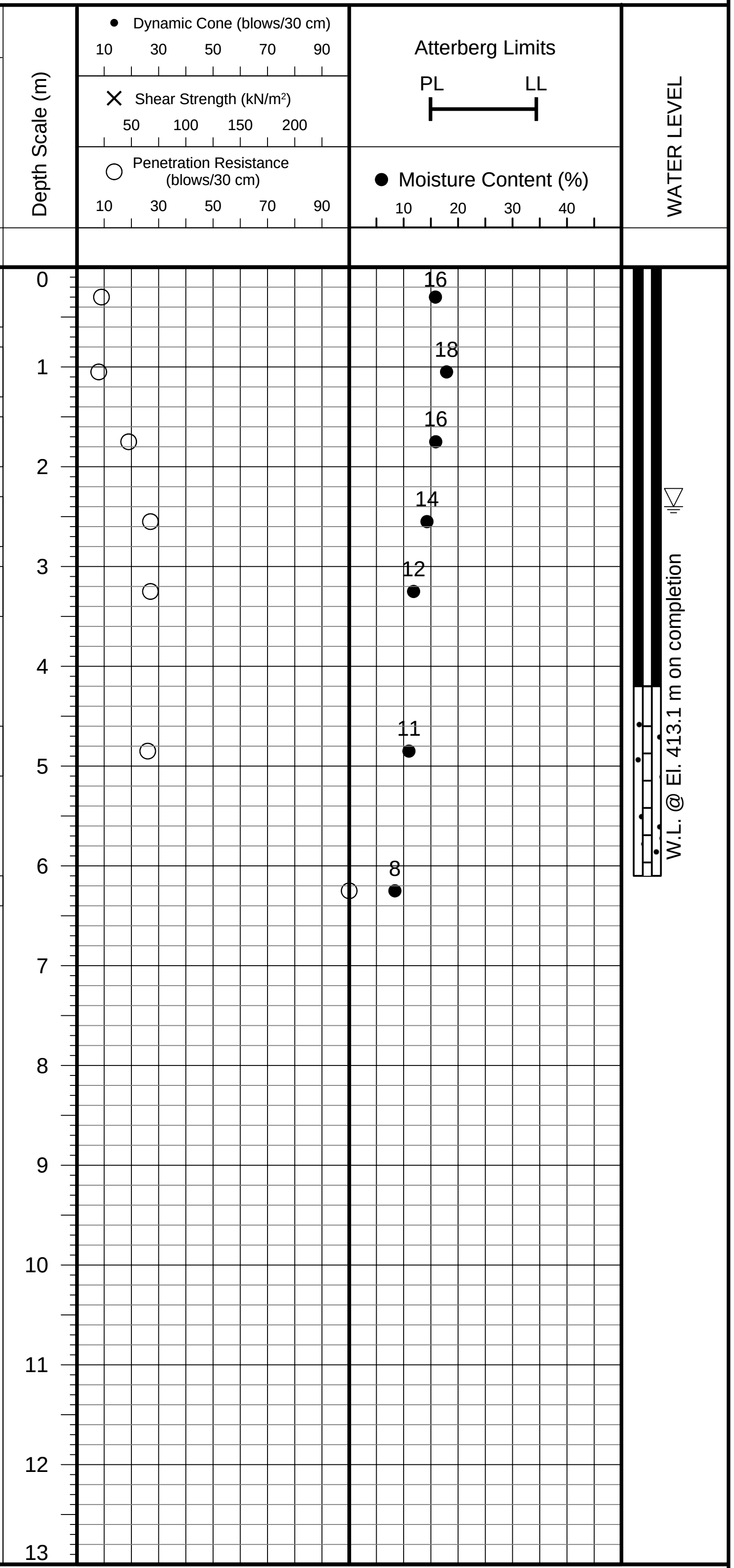
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 3, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
415.5 0.0	Ground Surface **18 cm TOPSOIL**			
	Brown, stiff **SILTY CLAY** a trace of gravel weathered	1	DO	9
		2	DO	8
414.1 1.4	Brown, compact **SAND** fine grained a trace to some silt wet	3	DO	19
		4	DO	27
		5	DO	27
412.2 3.3	Grey, compact to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	6	DO	26
		7	DO	50/13
409.1 6.4	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m with 1.5 m screen Sand backfill from 4.3 to 6.1 m Bentonite seal from 0.0 m to 4.3 m Provided with a steel monument casing			



Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 8S

FIGURE NO.: 10

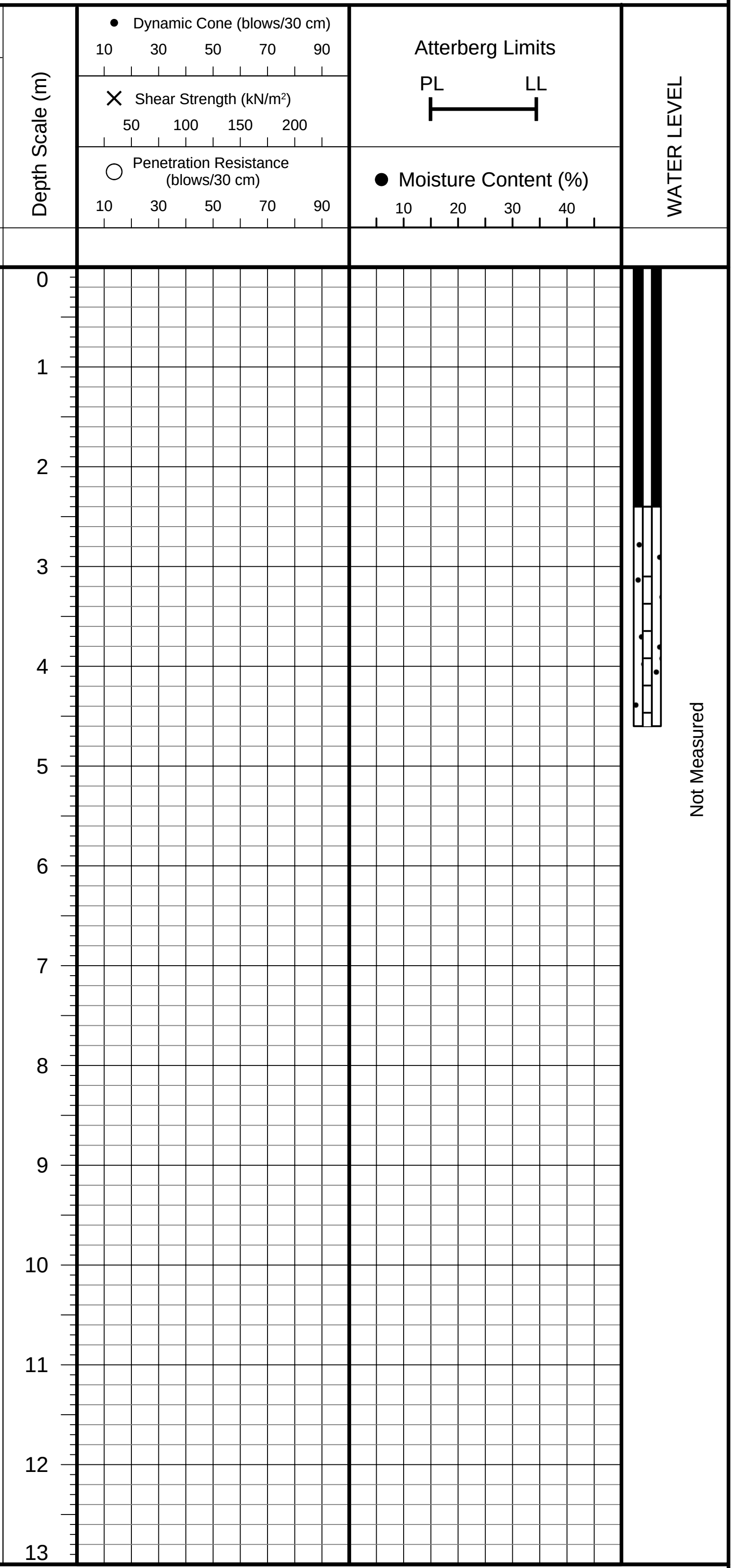
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 3, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
415.5	Ground Surface			
0.0	**18 cm TOPSOIL** Brown, stiff **SILTY CLAY** a trace of gravel weathered			
414.1 1.4	Brown, compact **SAND** fine grained a trace to some silt wet			
412.2 3.3	Grey, compact to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles			
410.9 4.6	**END OF BOREHOLE** (Shallow Well) Installed 50 mm Ø PVC monitoring well to 4.6 m with 1.5 m screen Sand backfill from 2.4 to 4.6 m Bentonite seal from 0.0 m to 2.4 m Provided with a steel monument casing			



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Page: 1 of 1

JOB NO.: 2311-S044

LOG OF BOREHOLE: 9

FIGURE NO.: 11

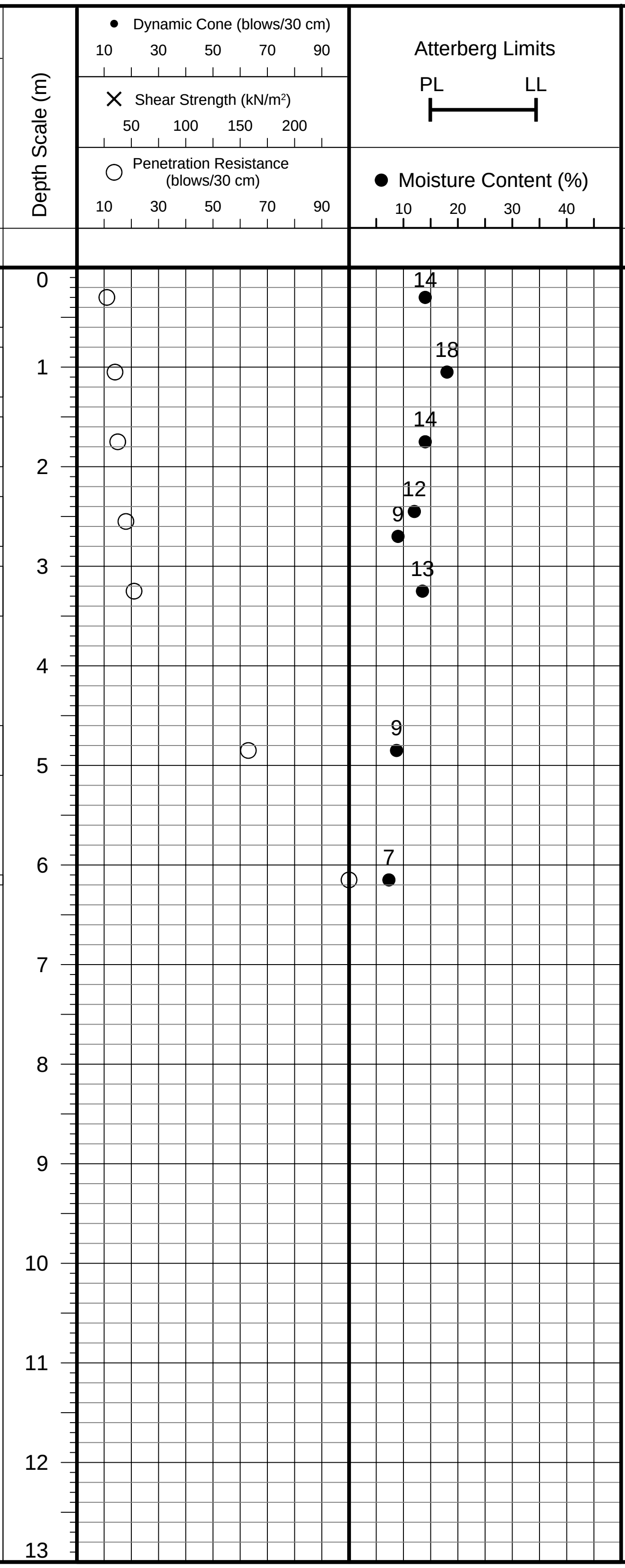
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: September 4, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
415.3	Ground Surface				
0.0	**15 cm TOPSOIL**	1	DO	11	Dry on completion
	Brown, compact **SANDY SILT TILL** traces of clay and gravel weathered	2	DO	14	
		3	DO	15	
413.1 2.2	Brown, compact **SILT** sandy, a trace of clay wet	4A 4B	DO	18	
412.7 2.6	clayey Grey, compact to very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles and boulders	5	DO	21	
		6	DO	63	
409.1 6.2	**END OF BOREHOLE**	7	DO	50/10	



Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 10

FIGURE NO.: 12

PROJECT DESCRIPTION: Proposed Residential Development

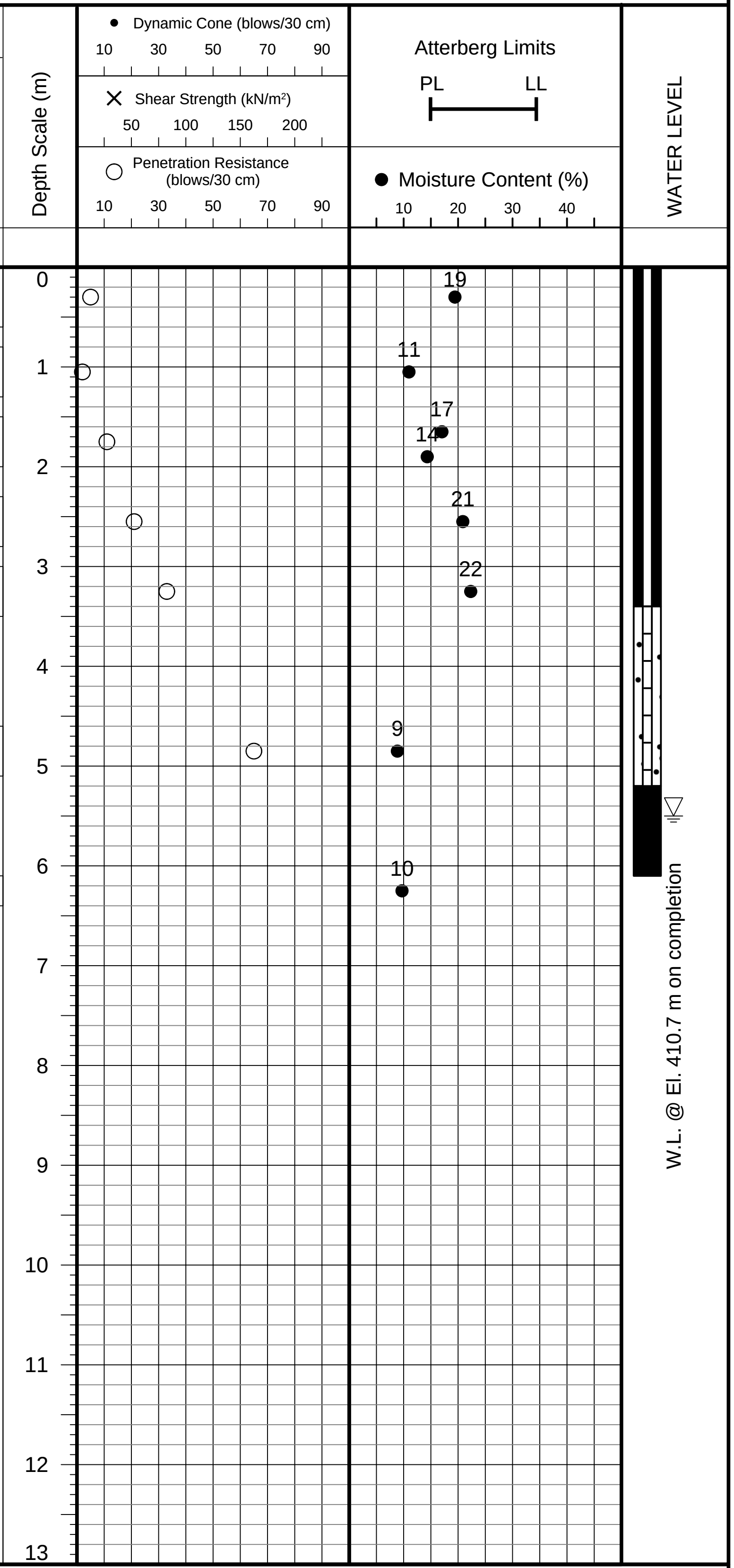
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 30, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
416.2 0.0	Ground Surface **18 cm TOPSOIL**	1	DO	5
	Brown, very loose to loose **SANDY SILT TILL** a trace to some clay a trace of gravel weathered	2	DO	2
414.4 1.8	Brown, compact **SAND** fine grained, a trace to some silt wet	3A 3B	DO	11
413.9 2.3	Brown, compact to dense **SILT** sandy, a trace of clay wet	4	DO	21
		5	DO	33
412.2 4.0	Grey, very dense **SANDY SILT TILL** traces of clay and gravel occ. cobbles	6	DO	65
		7	DO	50/13
409.8 6.4	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 5.2 m with 1.5 m screen
Bentonite seal backfill from 5.2 m to 6.1 m
Sand backfill from 3.4 to 5.2 m
Bentonite seal from 0.0 m to 3.4 m
Provided with a steel monument casing



Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 11

FIGURE NO.: 13

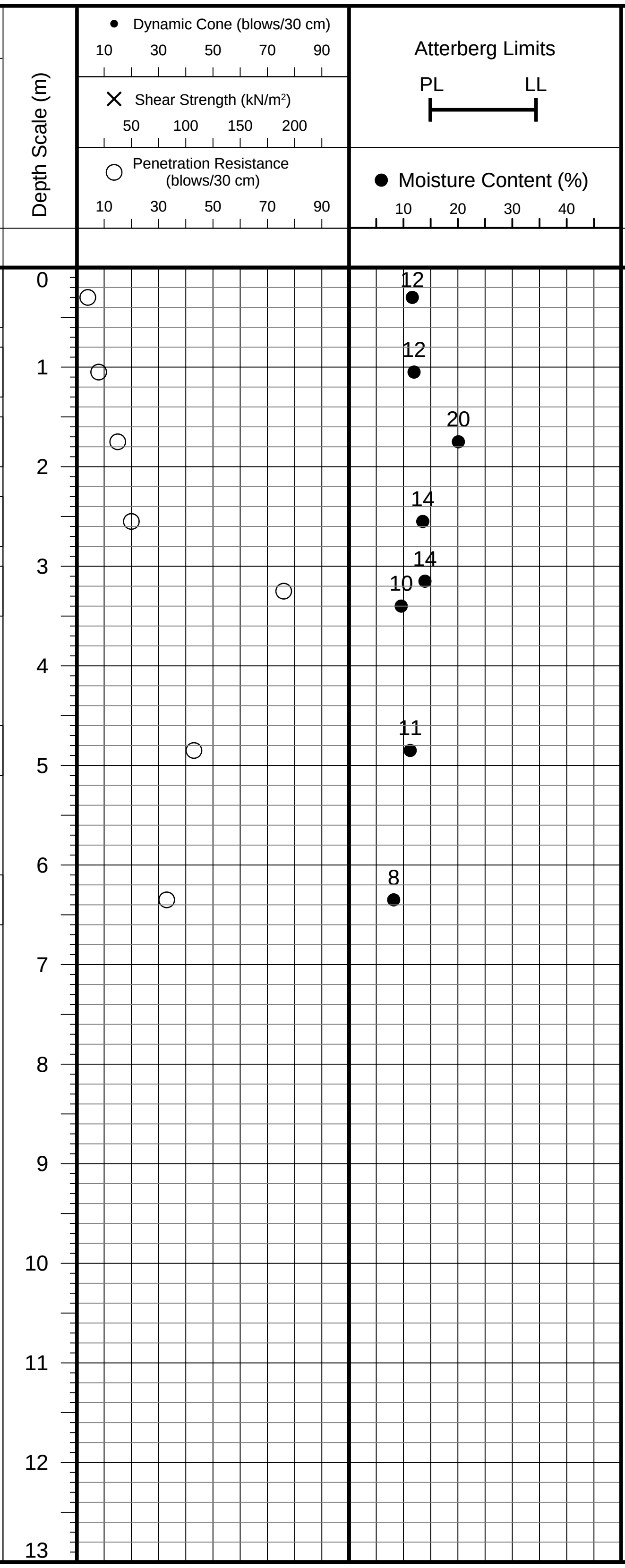
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 29, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
415.9	Ground Surface			
0.0	**23 cm TOPSOIL**			
	Brown, loose **SANDY SILT TILL** a trace to some clay a trace of gravel weathered	1	DO	4
		2	DO	8
414.5 1.4	Brown, compact **SAND** fine grained, a trace to some silt wet	3	DO	15
413.7 2.2	Brown, compact **SANDY SILT TILL** a trace to some clay, a trace of gravel	4	DO	20
413.0 2.9	Brown, very dense **SAND** fine grained, a trace to some silt wet	5A	DO	76
412.6 3.3		5B		
	Dense to very dense **SANDY SILT TILL** a trace to some clay a trace of gravel	6	DO	43
		7	DO	33
409.3 6.6	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 12

FIGURE NO.: 14

PROJECT DESCRIPTION: Proposed Residential Development

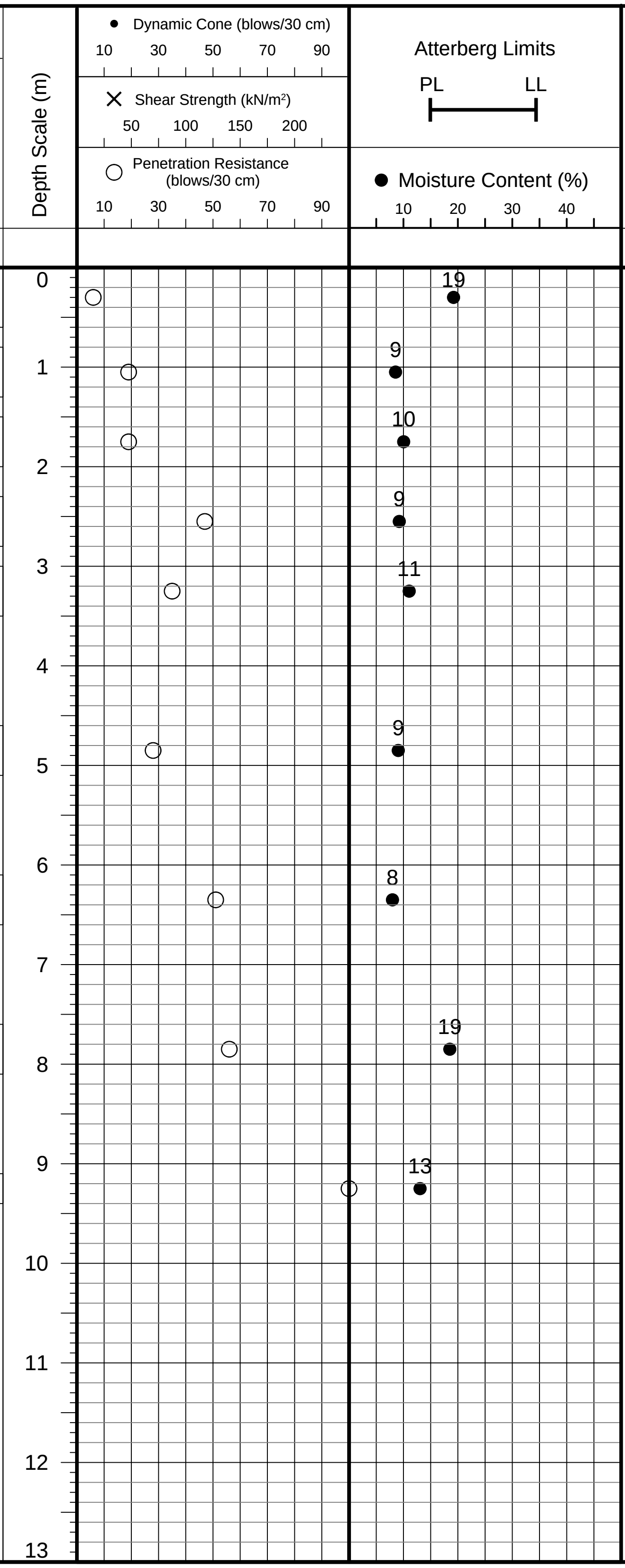
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 29, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	WATER LEVEL
415.2	Ground Surface	
0.0	**23 cm TOPSOIL** Brown, firm **SILTY CLAY** a trace of sand weathered	Dry on completion
414.4 0.8	Compact to very dense **SANDY SILT TILL** a trace to some clay, a trace of gravel brown grey	
408.3 6.9	Brown, hard **SILTY CLAY** traces of sand and gravel	
406.9 8.3	Grey, very dense **SAND** fine grained, a trace to some silt wet	
405.8 9.4	**END OF BOREHOLE**	

SAMPLES Number	Type	N-Value
1	DO	6
2	DO	19
3	DO	19
4	DO	47
5	DO	35
6	DO	28
7	DO	51
8	DO	56
9	DO	50/10



Soil Engineers Ltd.

JOB NO.: 2311-S044

LOG OF BOREHOLE: 13

FIGURE NO.: 15

PROJECT DESCRIPTION: Proposed Residential Development

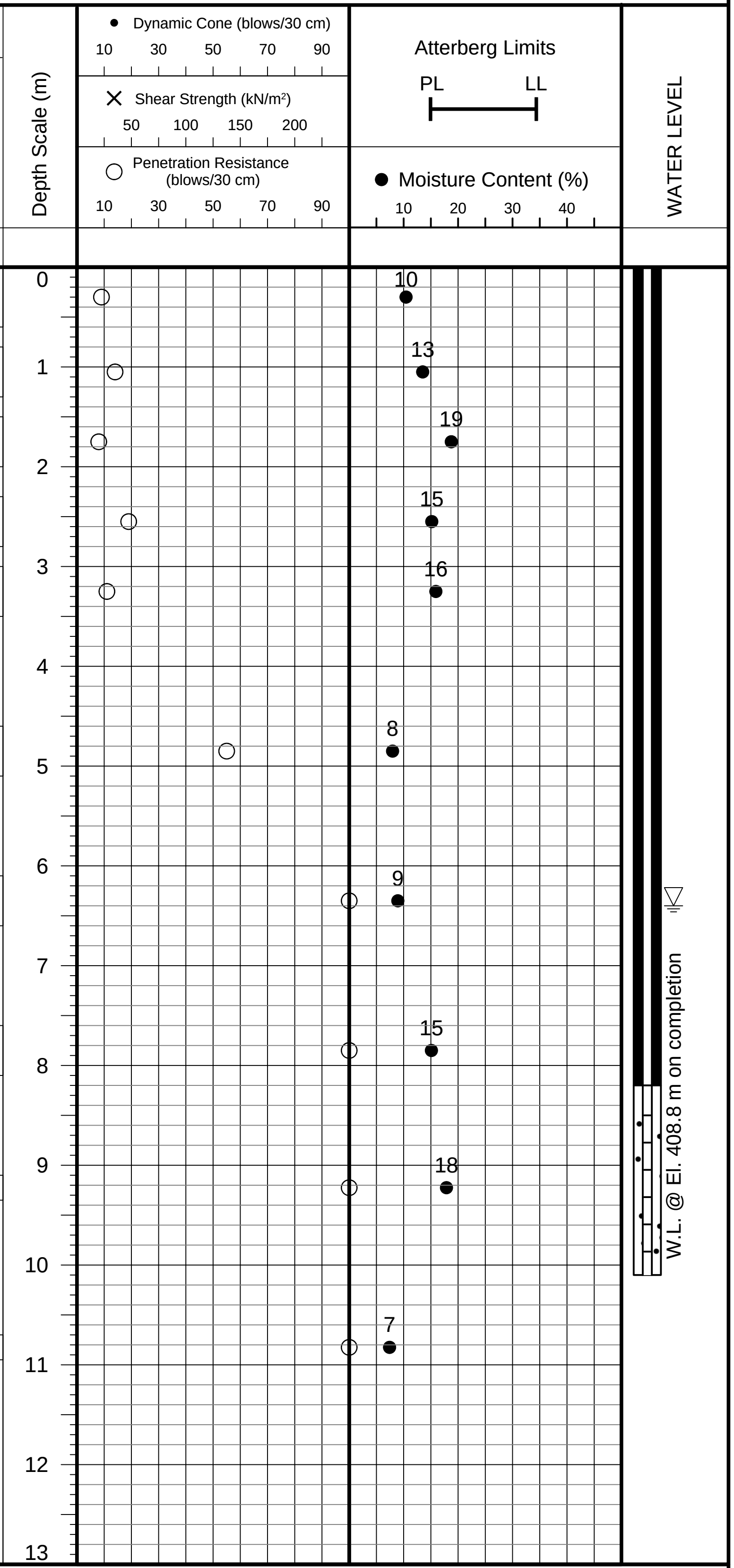
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

DRILLING DATE: August 29, 2024

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
415.2	Ground Surface			
0.0	**18 cm TOPSOIL** Brown, loose to compact **SANDY SILT TILL** a trace to some clay a trace of gravel weathered	1	DO	9
		2	DO	14
414.2 1.0	Brown, loose to compact **SILT** some sand to sandy, a trace of clay wet	3	DO	8
		4	DO	19
412.3 2.9	seepage Grey, compact to very dense **SANDY SILT TILL** a trace to some clay a trace of gravel	5	DO	11
		6	DO	55
		7	DO	85/23
408.2 7.0	Grey, hard **SILTY CLAY** traces of sand and gravel	8	DO	91/25
406.0 9.2	Grey, very dense **SANDY SILT TILL** a trace to some clay a trace of gravel	9	DO	50/8
		10	DO	50/8
404.3 10.9	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well
to 10.1 m with 1.5 m screen
Sand backfill from 8.2 to 10.1 m
Bentonite seal from 0.0 m to 8.2 m
Provided with a steel monument casing



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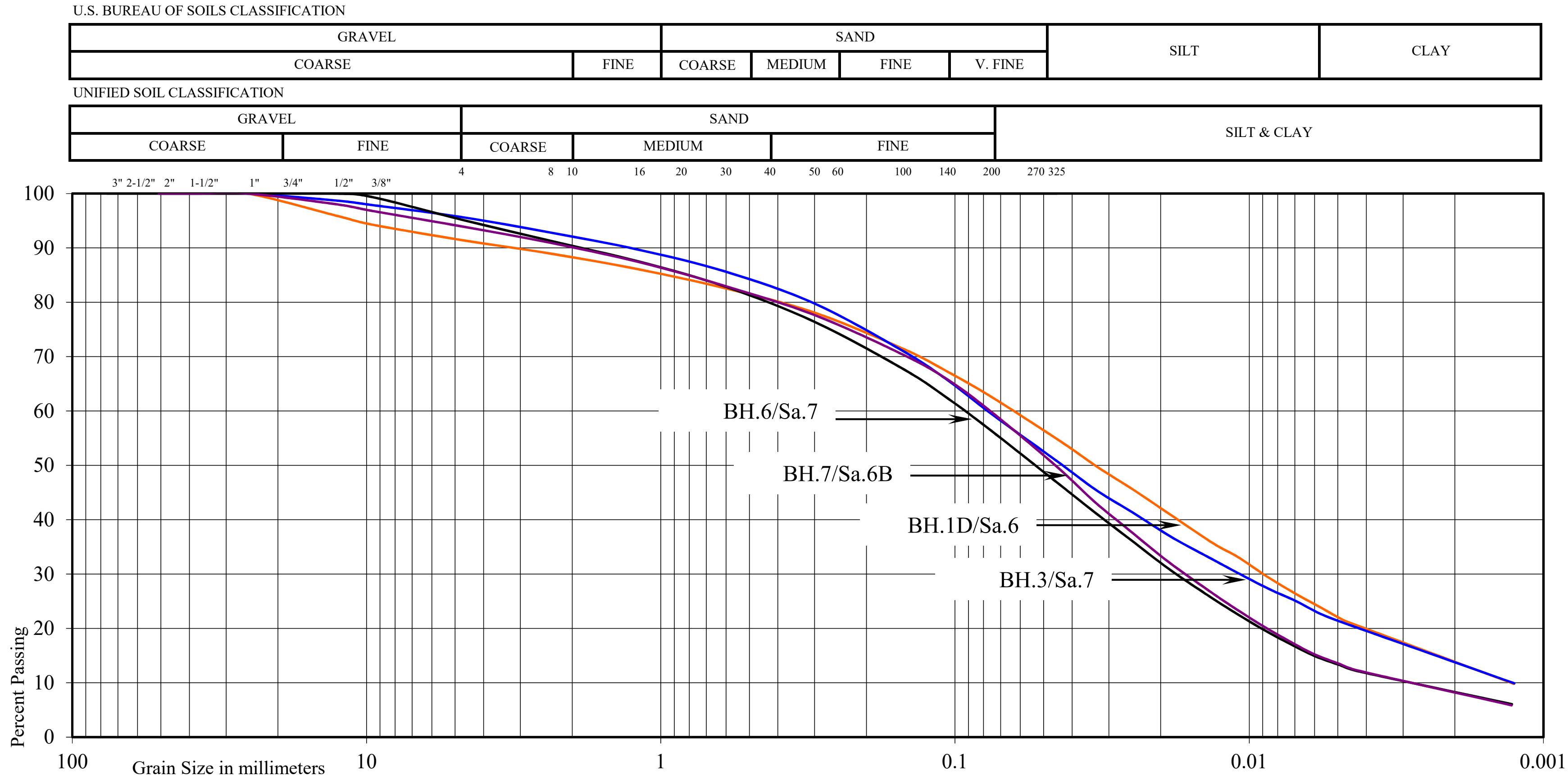
GRAIN SIZE DISTRIBUTION

Reference No: 2311-S044



Project: Proposed Residential Development

Location: 6586 Beatty Line North, Township of Centre Wellington (Fergus)

Borehole No:	1D	3	6	7
Sample No:	6	7	7	6B
Depth (m):	4.6	6.1	6.1	4.9
Elevation (m):	414.1	412.9	410.6	411.8

BH./Sa.	1D/6	3/7	6/7	7/6B
Liquid Limit (%) =	20	-	-	-
Plastic Limit (%) =	15	-	-	-
Plasticity Index (%) =	5	-	-	-
Moisture Content (%) =	9	9	8	9
Estimated Permeability (cm./sec.) =	10^{-6}	10^{-6}	10^{-5}	10^{-5}

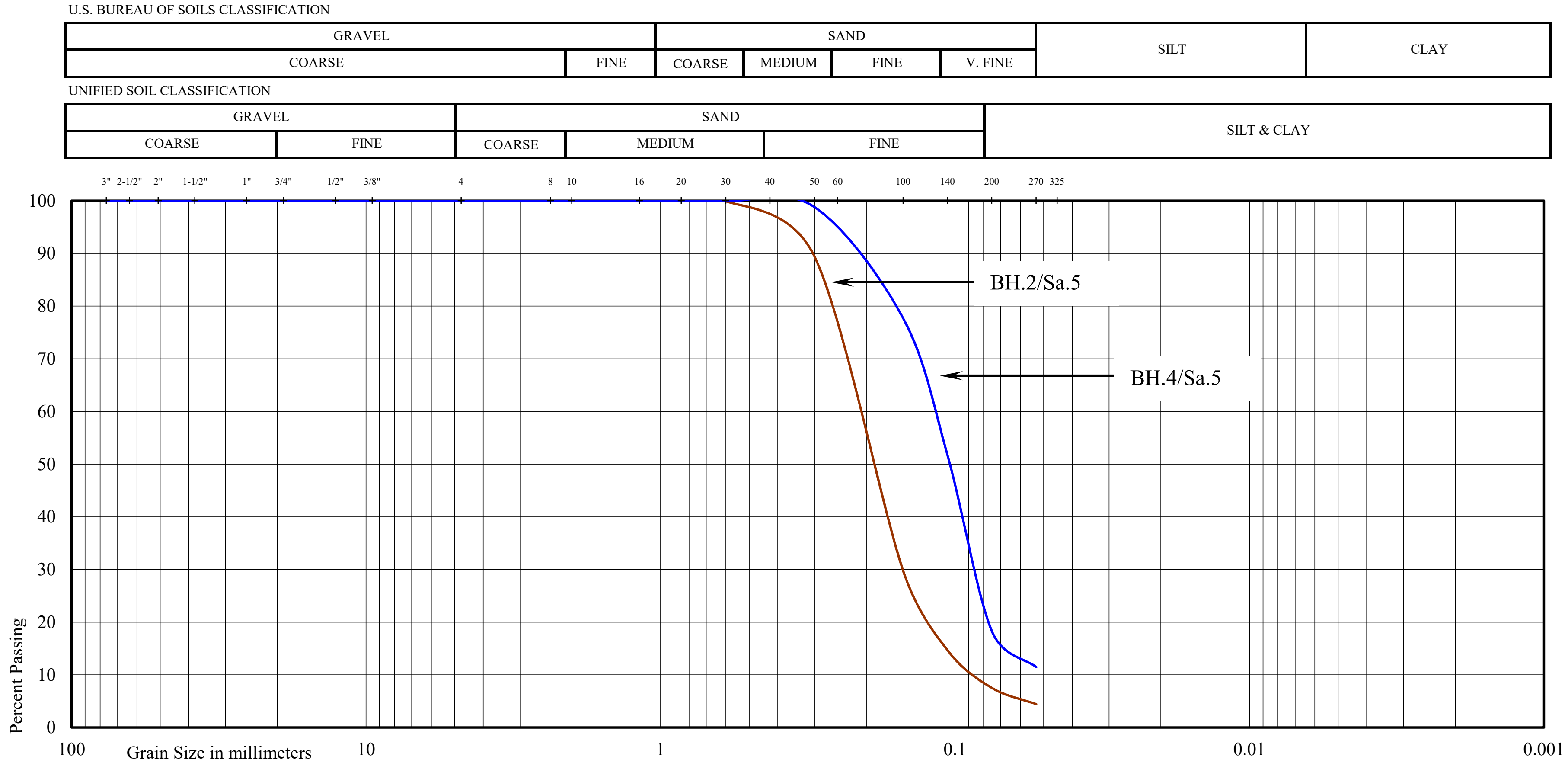
Classification of Sample [& Group Symbol]: SANDY SILT TILL
a trace to some clay, a trace of gravel

Figure: 16

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2311-S044



Project: Proposed Residential Development

Location: 6686 Beatty Line North, Township of Centre Wellington (Fergus)

Borehole No:	2	4
Sample No:	5	5
Depth (m):	3.0	3.0
Elevation (m):	416.7	416.7

BH./Sa.	2/5	4/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	15	20
Estimated Permeability (cm./sec.) =	10^{-2}	10^{-3}

Classification of Sample [& Group Symbol]: FINE SAND, a trace to some silt, a trace of medium sand

Figure: 17

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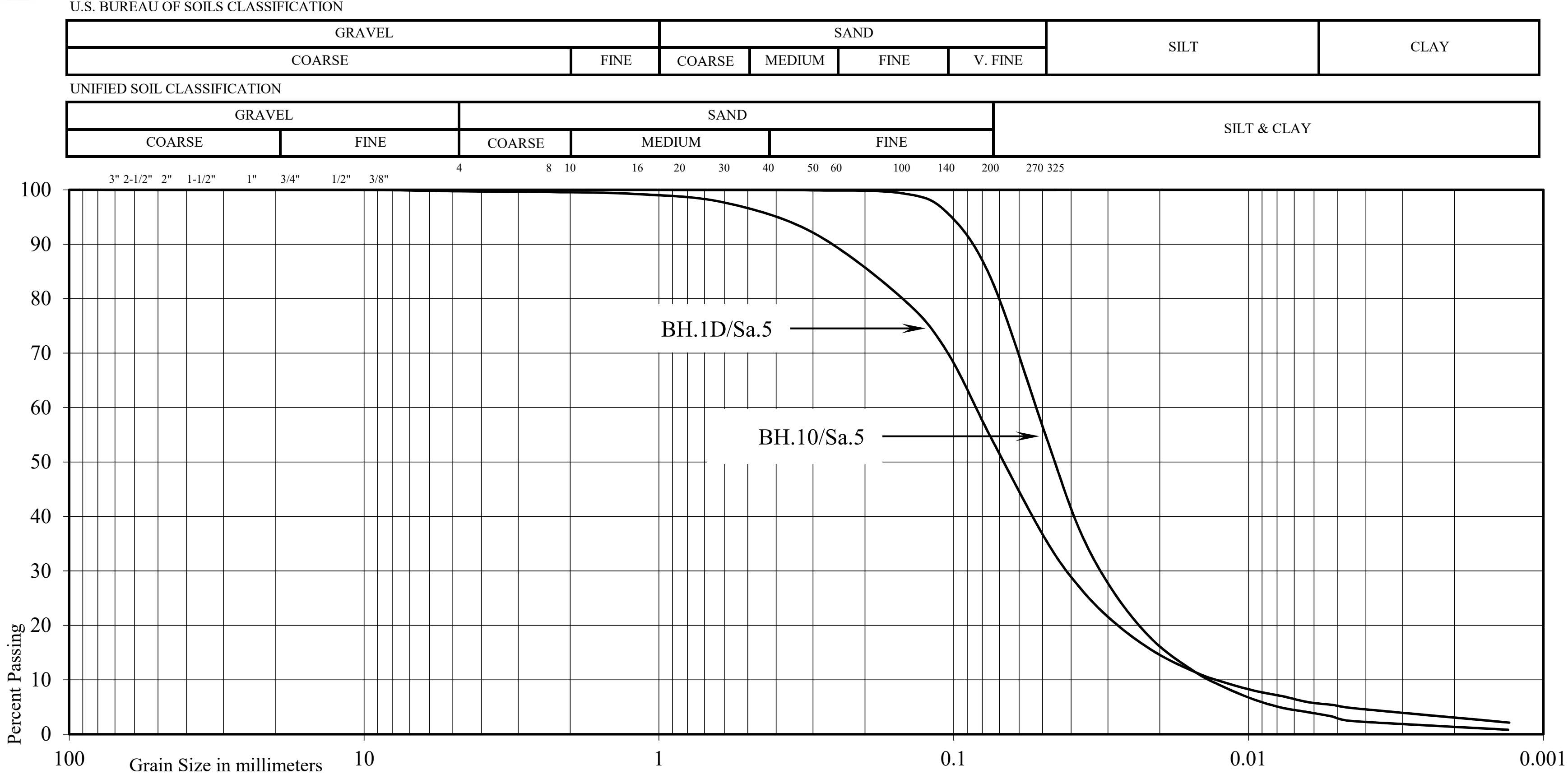
GRAIN SIZE DISTRIBUTION

Reference No: 2311-S044



Project: Proposed Residential Development

Location: 6686 Beatty Line North, Township of Centre Wellington (Fergus)

Borehole No:	1D	10
Sample No:	5	5
Depth (m):	3.0	3.0
Elevation (m):	415.7	413.2

BH./Sa.	1D/5	10/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	17	22
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-4}

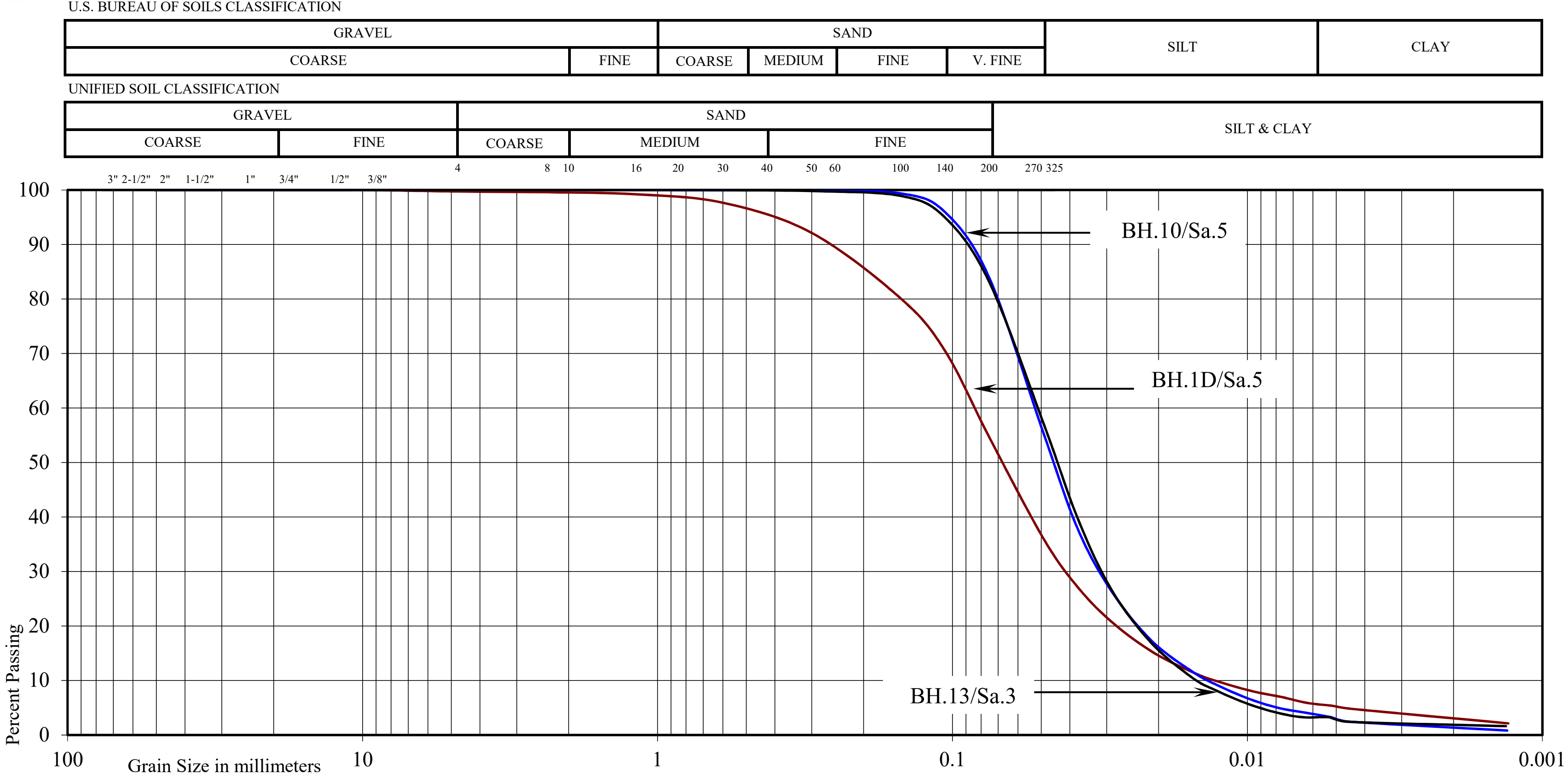
Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

Figure: 18

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2311-S044



Project: Proposed Residential Development

Location: 12734 and 12750 Keele Street, Township of King

Borehole No:	1D	10	13
Sample No:	5	5	3
Depth (m):	3.0	3.0	1.5
Elevation (m):	415.7	413.2	413.7

BH./Sa.	1D/5	10/5	13/3
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	17	22	19
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-4}	10^{-4}

Classification of Sample [& Group Symbol]: SILT

some sand to sandy, a trace of clay

Figure: 19

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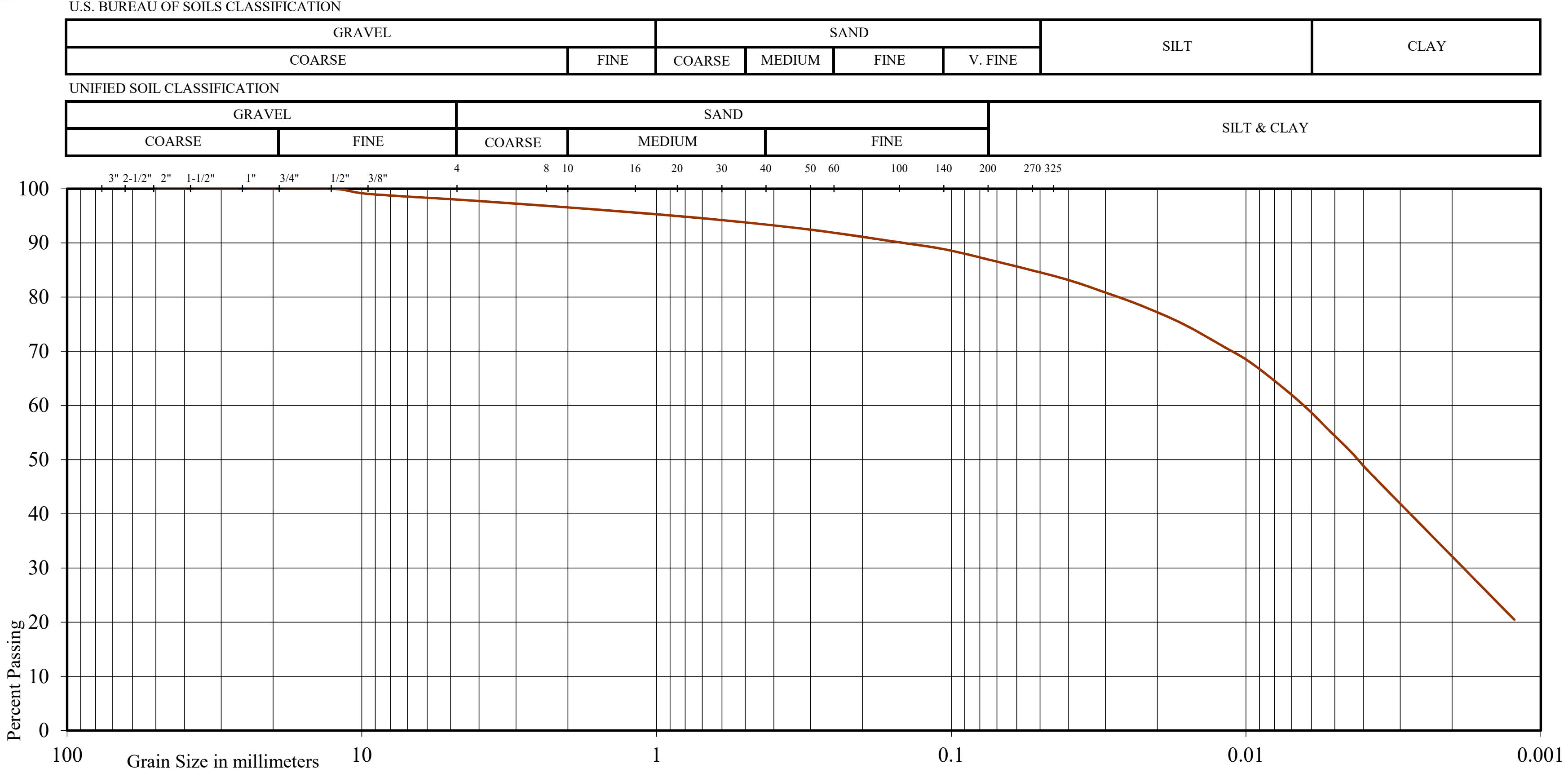
GRAIN SIZE DISTRIBUTION

Reference No: 2311-S044



Project: Proposed Residential Development

Location: 6586 Beatty Line North, Township of Centre Wellington (Fergus)

Borehole No: 13

Sample No: 8

Depth (m): 7.6

Elevation (m): 407.6

Liquid Limit (%) = 33

Plastic Limit (%) = 18

Plasticity Index (%) = 15

Moisture Content (%) = 15

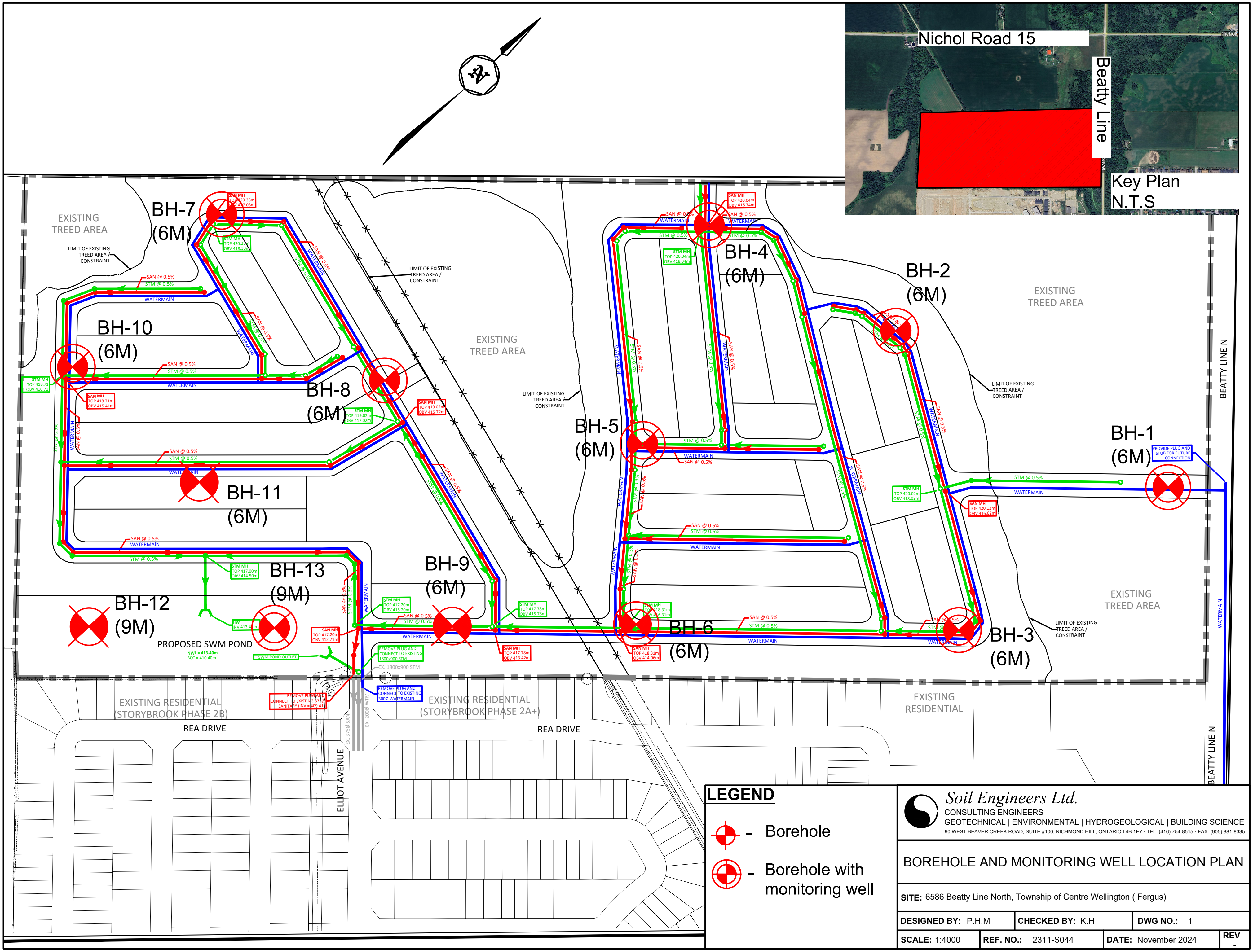
Estimated Permeability

(cm./sec.) = 10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY

some sand, a trace of gravel

Figure 20



LEGEND

⌖ - Borehole

⊕ - Borehole with monitoring well

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GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BOREHOLE AND MONITORING WELL LOCATION PLAN

SITE: 6586 Beatty Line North, Township of Centre Wellington (Fergus)

DESIGNED BY: P.H.M
CHECKED BY: K.H
DWG NO.: 1
SCALE: 1:4000
REF. NO.: 2311-S044
DATE: November 2024
REV -

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GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

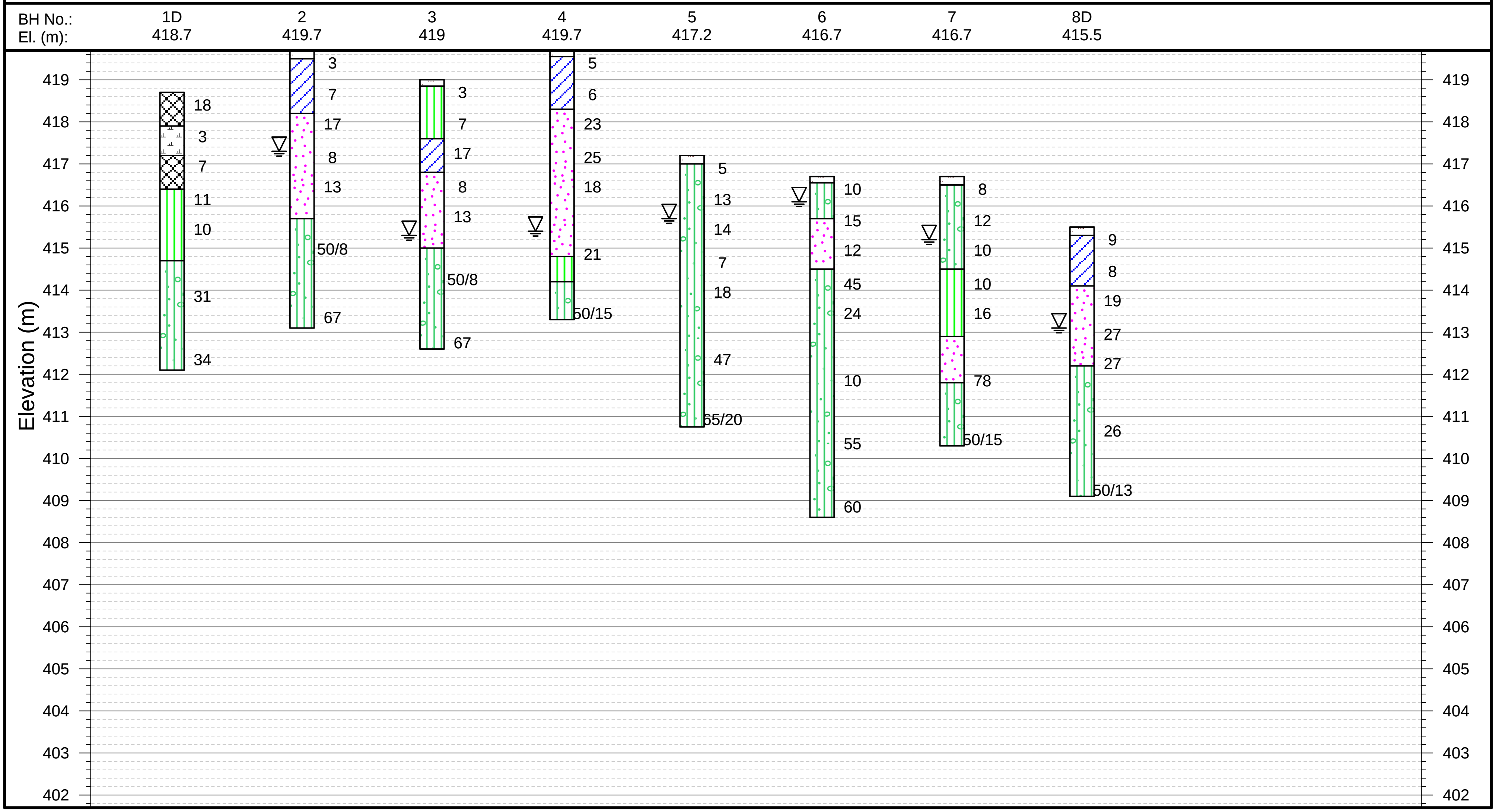
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2311-S044
REPORT DATE: November 2024
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: 6586 Beatty Line North,
Township of Centre Wellington (Fergus)

LEGEND

- ▩ FILL
- ▨ SAND
- ▥ SILT
- ▤ TOPSOIL
- ▦ PEAT
- ▥ SANDY SILT TILL
- ▨ SILTY CLAY
- ∇ WATER LEVEL (END OF DRILLING)



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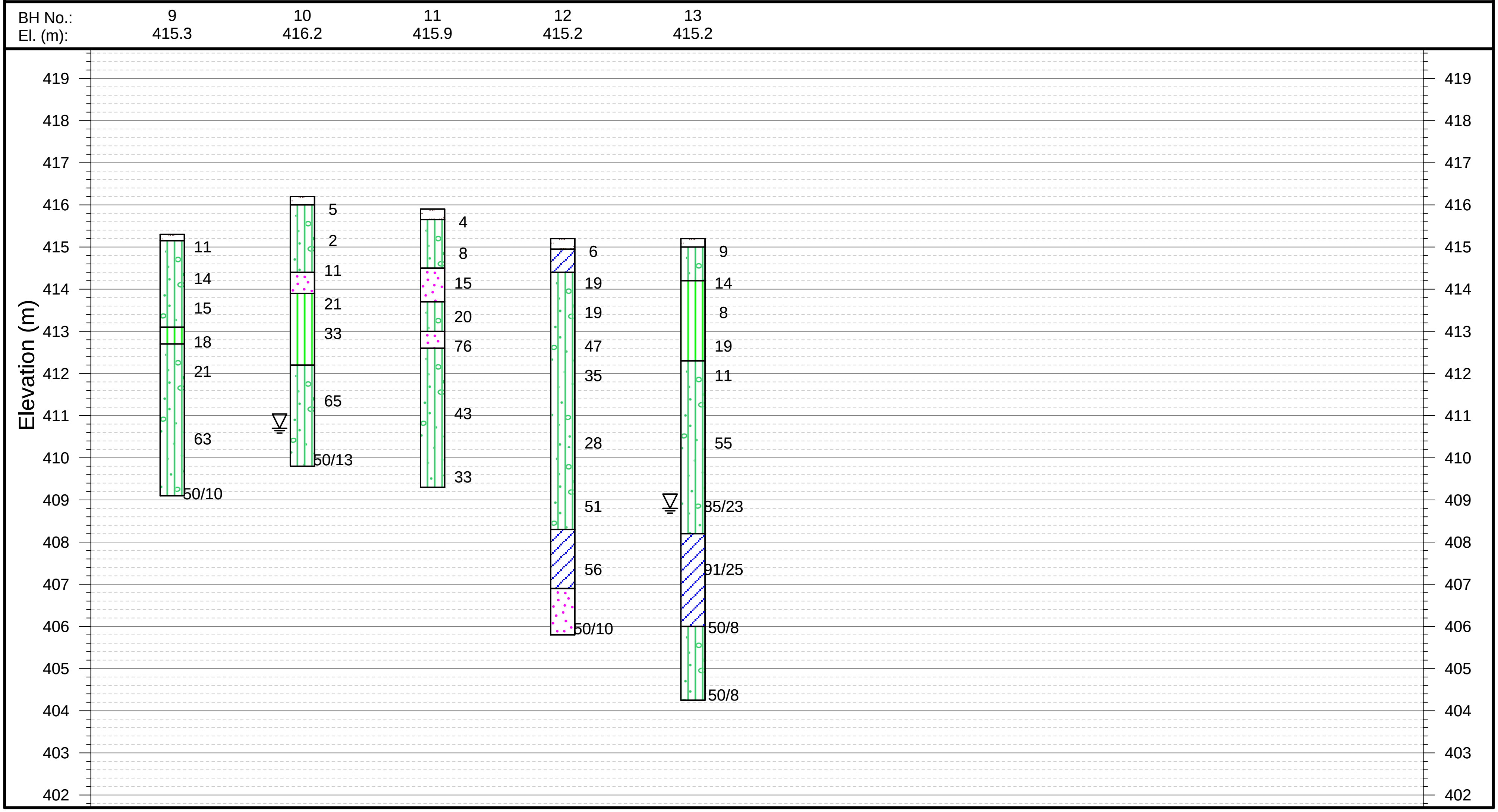
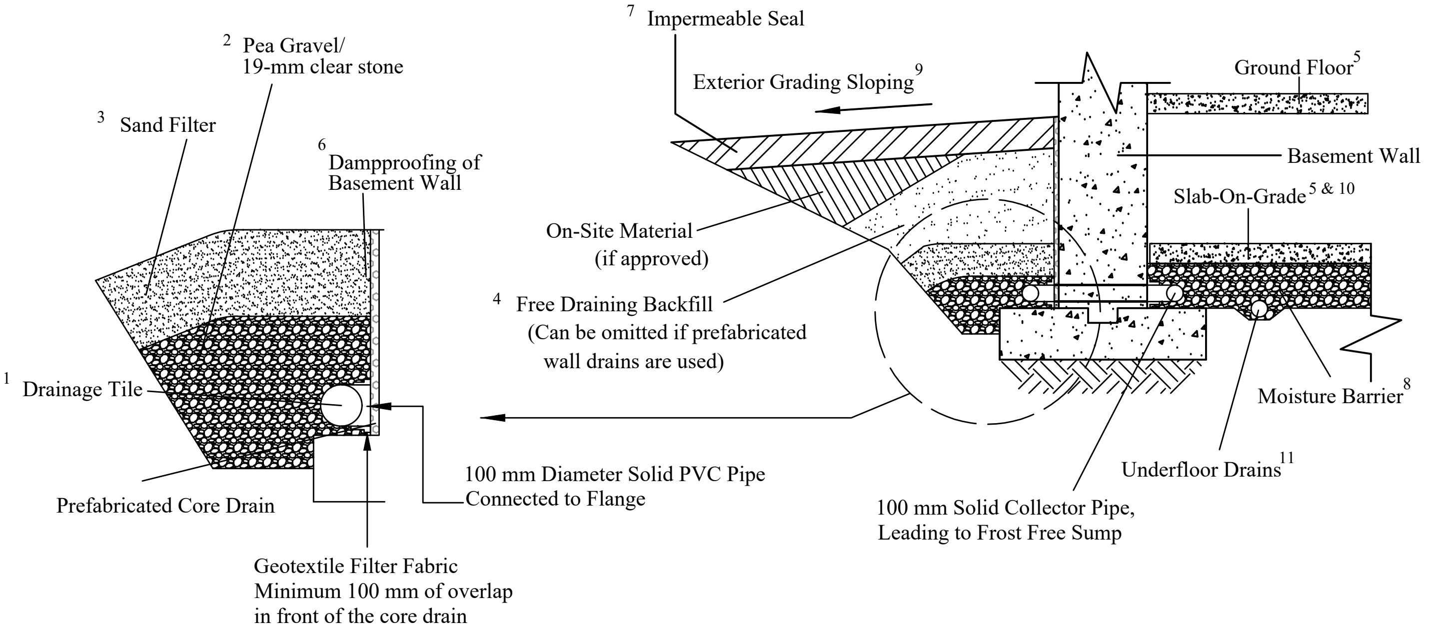
SUBSURFACE PROFILE
DRAWING NO. 3
SCALE: AS SHOWN

JOB NO.:	2311-S044
REPORT DATE:	November 2024
PROJECT DESCRIPTION:	Proposed Residential Development
PROJECT LOCATION:	6586 Beatty Line North, Township of Centre Wellington (Fergus)

LEGEND

- ⁘ SAND
- ▥ SILT
- ▨ SILTY CLAY
- ▤ TOPSOIL
- ▥ SANDY SILT TILL
- ▽ WATER LEVEL (END OF DRILLING)





NOTES:

1. **Drainage tile**: consists of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be at minimum of 150 mm (6") below underside of basement floor slab.

2. **Pea gravel**: at 150 mm (6") on the top and sides of drain. If drain is not placed on concrete footing, provide 100 mm (4") of pea gravel below drain. The pea gravel may be replaced by 19-mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270R or equivalent.

3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300 mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.

4. **Free-draining backfill**: OPSS Granular 'B' or equivalent, compacted to 95% to 98% (maximum) Standard Proctor dry density. Do not compact closer than 1.8 m (6') from wall with heavy equipment. This may be replaced by on-site material if prefabricated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.

5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adequate bracing.

6. **Dampproofing** of the basement wall is required before backfilling

7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free-draining sand, the seal may be omitted.

8. **Moisture barrier**: 19-mm CRL or equivalent. The thickness of this layer should be 150 mm (6") minimum.

9. **Exterior Grade**: slope away from basement wall on all the sides of the building.

10. **Slab-On-Grade** should not be structurally connected to walls or foundations.

11. **Underfloor drains*** should be placed in parallel rows at 6 to 8 m (20'-25') centre, on 100 mm (4") of pea gravel with 150 mm (6") of pea gravel on top and sides. The spacing should be at least 300 mm (12") between the underside of the floor slab and the top of the pipe. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

*Underfloor drains can be deleted where not required.

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PERMANENT PERIMETER DRAINAGE SYSTEM
(FOR SLOPED EXCAVATION)

SITE: 6586 Beatty Line North, Township of Centre Wellington (Fergus)

DESIGNED BY: P.H.M
CHECKED BY: K.H.
DWG NO.: 4
SCALE: N.T.S.
REF. NO.: 2311-S044
DATE: November 2024
REV -