2294-2300 QUEENSWAY DRIVE, BURLINGTON
PROPOSED TOWNHOUSE DEVELOPMENT

Geotechnical Investigation Report

Project Location:
2294-2300 Queensway Drive
Burlington, ON

Prepared for:
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1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained by Waggy Inc. (WAGGY) to conduct a geotechnical investigation for a proposed townhouse development at 2294-2300 Queensway Drive in Burlington, Ontario. The property is currently occupied by residential buildings with associated driveways and parking areas. The property is located southwest of the Cleta Street and Queensway Drive intersection, as shown on **Figure 1 in Appendix A**.

It is understood that the existing buildings on site will be demolished and a four new townhouse blocks, with 23 units, will be constructed. At the time of preparing this report, the construction of basements in the townhouse development was not known. We have included some sections for basement construction, if required.

The ground surface is generally level at the site, sloping gently to the southeast, with a grade difference of approximately 0.3 to 0.8 m between the borehole locations.

The purpose of this geotechnical investigation is to determine the soil and groundwater conditions in the area of the proposed development and provide geotechnical engineering recommendations for site grading, site servicing, foundations, basements, and pavement design and subdrainage.

2.0 FIELD AND LABORATORY PROGRAM

The fieldwork for this investigation was carried out on May 28, 2019 and involved the drilling of five boreholes (Boreholes BH101-19 to BH105-19) to depths ranging from 2.6 to 2.9 m. The locations of the boreholes are shown on the Site Plan, **Figure 2 in Appendix A**.

Private and public utility companies were contacted prior to the start of drilling activities in order to isolate underground utilities near the boring locations.

The boreholes were advanced with a Diedrich D50T track mounted drill rig equipped with continuous flight solid stem augers, supplied and operated by London Soil Test Ltd.

Representative soil samples were recovered throughout the depths explored. Standard Penetration Tests (SPT) were carried out during sampling operations in the boreholes using conventional split spoon equipment. The SPT N-values recorded are plotted on the borehole logs in **Appendix B.**

Upon completion of drilling, the boreholes were backfilled with soil cuttings and bentonite in accordance with Ontario Regulation 468/10 (formerly O. Reg. 903) under the provinces Water Resources Act.

The fieldwork was monitored throughout by a member of our geotechnical engineering staff, who directed the drilling procedures; documented SPT tests; documented the soil stratigraphies; monitored the groundwater conditions; and transported the recovered soil samples to our office for further classification.

The geodetic ground surface elevations at the borehole locations were surveyed by MTE.

All of the soil samples collected were submitted for moisture content testing with the results provided on the borehole logs in **Appendix B**. Additionally, three soil samples were submitted for particle size distribution analyses and the results are provided in **Appendix C**. The remaining soil samples will be stored for a period of 1 month and will be discarded of at that time without prior request from the client to extend storage time.

4.0 SOIL CONDITIONS

Reference is provided to the appended borehole logs for soil stratigraphy details, SPT N-values, moisture content profiles, and groundwater observations and measurements. Soil conditions encountered at the site typically include surficial topsoil and/or fill overlying native granular deposits, glacial till and shale bedrock.

4.1 Topsoil and Fill

Topsoil was encountered at the ground surface in Borehole BH101-19 and was about 200 mm thick. Topsoil was determined through visual observation and no nutrient testing for applicable plant growth was performed as part of the scope of work for this project.

Fill was encountered surficially in all of the boreholes, except BH101-19, and extended to depths of 0.2 to 0.8 m (average depth of 0.4 m). The fill typically ranges in composition from dark brown/black sandy silt (topsoil) to black sand and silt. It is noted that the fill material contained varying amounts of organics.

SPT N-values measured in the topsoil/fill material range from 1 to 4 blows per 300 mm penetration of the split spoon sampler indicating very loose conditions.

Insitu moisture contents in the topsoil/fill range from about 17 to 22% indicating moist to wet conditions.

4.2 Granular Deposits

Layers of granular deposits were encountered beneath the topsoil/fill material in all boreholes. The granular deposits range from 0.1 to 0.7 m thick and consisted of sand to silty sand soils. The results of one particle size distribution analysis conducted on the granular deposits is provided in **Appendix C** and summarized in the following table;

TABLE 1 - RESULTS OF GRANULAR DEPOSIT PARTICLE SIZE DISTRIBUTION ANALYSIS

Borehole Number	Sample Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH104-19	0.3 – 0.6	2	76	13	9

SPT N-values measured in granular deposits range from 1 to 41 blows per 300 mm penetration of the split spoon sampler indicating very loose to dense conditions.

Insitu moisture contents in the granular soils range from about 15 to 30% indicating moist to saturated conditions.

4.2 Glacial Till

Glacial till was encountered beneath the granular deposits in all of the boreholes and was continuous to the shale bedrock at all locations. The till typically ranges in composition from brown/red silty gravel to brown/red sandy silt. Shale fragments were encountered within the glacial till in Boreholes BH101-19, BH103-19, BH104-19, and BH105-19. The results of two particle size distribution analyses conducted on the till are provided in **Appendix C** and summarized in the following table;

TABLE 2 - RESULTS OF GLACIAL TILL PARTICLE SIZE DISTRIBUTION ANALYSES

Borehole Number	Sample Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH102-19	1.5 – 1.8	13	27	50	10
BH103-19	0.9 - 1.4	53	15	28	4

SPT N-values measured in the till typically increase with depth and range from 21 to above 50 blows per 300 mm penetration of the split spoon sampler indicating compact to very dense conditions.

Insitu moisture contents in the till range from about 7 to 22% indicating moist to wet conditions.

4.3 Shale

Red shale of the Queenston formation, as per Ministry of Northern Development and Mines Bedrock Geology of Ontario Southern Sheet, Map No. 2544, was encountered beneath the glacial till at depths ranging from 1.4 to 1.8 m below existing ground surface (Elevations 101.4 to 102.2 m). The shale is typically red in color, fine grained and thinly bedded. The shale is very weathered in the depths explored; however, it would be anticipated it becomes sound with depth. SPT N-values in the shale were above 50 blows per 300 mm penetration of the split spoon sampler.

It is noted that coring of the shale was not conducted as part of the current investigation to determine rock quality; however, our experience in the area indicates the weathered shale is typically poor to fair quality. This shale is typically classified under the Canadian Foundation Engineering Manual, 2012 classification rating as Grade R2 or R3 (according to ISRM (1981)) which is a medium to weak rock with typically uniaxial compressive strengths of 5 to 50 MPa.

5.0 GROUNDWATER CONDITIONS

Groundwater observations and measurements were carried out in the open boreholes at the time of drilling and are summarized on the borehole logs. Upon completion of drilling activities, no free groundwater was encountered in any of the boreholes during drilling on May 28, 2019. The majority of the fill and granular deposits were wet to saturated at the time of the fieldwork. Perched water should be expected in the fill materials and granular deposits overlying the glacial till.

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations and local variations.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

The project involves the design and construction of a proposed townhouse block, consisting of 23 units at 2294-2300 Queensway Drive in Burlington, Ontario. The property is currently occupied by residential buildings which will be demolished. At the time of preparing this report, the construction of basements in the townhouse development was not known. We have included some sections for basement construction, if required. It is anticipated that the proposed addition and new building will be provided with full municipal services.

The subsurface stratigraphy at the site generally comprises topsoil and/or fill materials overlying native granular deposits, glacial till and shale bedrock. No free groundwater was encountered upon completion of drilling activities in boreholes, however; perched groundwater seepage may be encountered within the wet deposits of fill material and granular soils.

Based on the results of this geotechnical investigation, the site is suitable for the proposed development; however, the fill thickness and perched water conditions will affect design and construction. The following subsections of this report contain geotechnical recommendations pertaining to development of the property including site grading, site servicing, foundation design, basements, and pavement design and subdrainage.

6.2 Site Preparation

It is understood that the existing residential buildings at the site will be demolished. All foundations and slabs must be removed from the existing buildings prior to construction of the townhouse development. Additionally, any surficial asphaltic concrete, topsoil, fill material, vegetation, trees, and deleterious material must be removed from the proposed townhouse building footprints. The topsoil and fill material depth on site was 0.2 to 0.8 m with an average depth of about 0.4 m. The fill could be used in landscaping areas.

It is anticipated the proposed structures will be founded on the native glacial till or shale bedrock; however, if material is required to raise grades beneath the structures, the material must be placed as structural fill.

The subgrade should be proof rolled in the presence of qualified geotechnical personnel to verify if the subgrade will provide support as intended in the original design prior to fill placement. The primary purpose of proof rolling is to identify soft or spongy areas which should be sub-excavated.

The majority of the native soils are suitable for reuse as engineered fill. Structural fill used for raising grades beneath the proposed building footings should comprise granular material such as OPSS 1010 Granular ‘A’. Subgrade fill material beneath the proposed pavement areas and services should meet the requirements of OPSS 1010 Select Subgrade Material. Any imported fill should be tested and verified by a geotechnical engineer prior to placement.

All fill should be placed in maximum 300 mm thick lifts and compacted to the following percentages:

TABLE 3 - ENGINEERED FILL REQUIREMENTS

Fill Use	Minimum Compaction Required
Structural fill to support buildings	100% SPMDD
Subgrade fill beneath pavements or services	95% SPMDD
Bulk fill in landscape areas	90% SPMDD

The glacial till subgrade soils are **susceptible** to disturbance due to the silt content and it is recommended that construction traffic on the subgrade be minimized.

Structural fill pads should extend a minimum 0.3 m beyond the edge of the footing envelope of any building and down to subgrade at an angle of 45 degrees to the horizontal. Full time testing by qualified geotechnical personnel is required during fill placement and compaction to monitor material quality, lift thickness, and verify the compaction by in-situ density testing (as per the 2012 Ontario Building Code).

In order to minimize the effects of weather and groundwater, fill operations onsite should be carried out in the dry summer months.

6.3 Foundation Design

It is understood that the proposed townhouse units will be constructed using conventional footings and basements, if designed. In general, the undisturbed native glacial till soils, shale bedrock or approved structural fill are considered suitable to support the proposed buildings foundations.

Conventional spread footings founded on the suitable undisturbed native glacial till soils at least 0.9 m below the ground surface or about Elevation 102.5 m or approved structural fill may be designed for a factored geotechnical bearing resistance at Ultimate Limit States (ULS) of 225 kPa, and soil bearing resistance for 25 mm of settlement at Serviceability Limit States (SLS) of 150 kPa. All footings should have a minimum 1.2 m of cover for frost protection or applicable insulation.

Footings founded on Queenston shale bedrock may be designed for a factored geotechnical bearing resistance at ULS of 450 kPa and a soil bearing resistance for 25 mm of settlement at SLS of 300 kPa. A higher bearing capacity may be available, however, coring of the bedrock would be required.

The shale materials are highly susceptible to disintegration of the clay rich material when exposed to water and/or alternate cycles of wetting and drying, and freeze and thaw. It is recommended the length of time the shale is exposed be minimized in the excavation base prior to pouring concrete. If there are conflicts with scheduling, a mud mat could be placed to protect the integrity of the working surface and prevention of the

shale being exposed to degradation. The mud mat should comprise a 50 to 75 mm thick layer of low strength concrete.

The founding glacial till soils are **susceptible** to disturbance by construction activity, especially during wet weather and care should be taken to preserve the integrity of the material as bearing strata.

The footing areas must be inspected by qualified geotechnical personnel to ensure that the soil conditions encountered at the time of construction are suitable to support the design resistances prior to pouring concrete. Any loose, disturbed, organic and deleterious material identified during the inspection should be removed from the footing areas and replaced with structural fill or concrete.

Provisions should also be made in the excavation contract for excavation through the shale bedrock if depths of the basements are below the shale.

All exterior floor slabs and footings in unheated areas must be provided with a minimum 1.2 m of earth cover after final grading in order to minimize the potential of damage due to frost action, as per Ontario Provincial Standard Drawing, OPSD 3090.101, dated November 2010. If construction is undertaken during the winter, the subgrade soil and concrete should be protected from freezing.

Where spread footings are constructed at different elevations, the difference in elevation in the individual footing should not be greater than one half of the clear distance between the footings. The lower footing should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with OBC Section 9.15.3.8.

A Site Classification ‘D’ should be used for earthquake load and effects in accordance with Table 4.1.8.4.A. of the 2012 Ontario Building Code. A Site Classification ‘C’ can be used if the footings are placed on Queenston shale bedrock.

All excavations at the site should be carried out in conformance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects. The fill material and granular deposits encountered at the site are classified as Type 3 soils, and temporary side slopes through this material must be cut at an inclination of 1.0 horizontal to 1.0 vertical or less from the base of the excavation. The native glacial till soils encountered at the site are classified as Type 2 soils and the Queenston shale bedrock at the site is classified as Type 1 soils. The temporary side slopes for Type 1 and 2 soils can be cut near vertical up to 1.2 m above the base of excavation and at an inclination of 1 horizontal to 1 vertical or less above this level, exclusive of groundwater effects.

6.3.1 Basements

It is understood that basements may be constructed for the proposed townhouse development at the site. At the time of this report, the design depths of the basements were unknown; therefore, the basements may extend into the shale bedrock encountered at a depth of 1.4 to 1.8 m (Elevation 101.4 to 102.2 m) in the vicinity of the site. Provisions should be made in the excavation contract for excavation through the shale bedrock.

Minor perched groundwater seepage should be expected within the fill and granular deposits. Perched water may be handled using properly filtered sumps and pumps located outside the building footprints.

Basements at this site must be provided with perimeter weeping tile systems as per the Ontario Building Code (Section 9.14). The drain tile or pipe should be laid on undisturbed or well-compacted soil so that the top of the tile or pipe (minimum 100 mm diameter) is below the bottom of the basement floor slab. The top and sides of the drain tile or pipe shall be surrounded with not less than 150 mm of crushed stone or other clean coarse granular material containing no more than 10% of material that will pass the 4 mm sieve. The crushed stone should be wrapped with filter cloth. The weeping tile must drain to a suitable frost-free outlet or sump equipped with an automatic pump that will discharge water into a storm sewer service or other frost free outlet.

The portion of the exterior basement wall and floor slab below finished ground level must be waterproofed as per the Ontario Building Code (Subsection 9.13.3). Free-draining sand materials should be used for basement wall backfill. The basement wall backfill should be graded to allow drainage away from the foundation.

The basement walls should be designed to resist the lateral earth pressure. For calculating the lateral earth pressure, the coefficient of earth pressure (K) may be assumed as 0.50 for cohesionless sandy soils and 1.0 for silt and clay (Section 24.12.3.3 Canadian Foundation Engineering Manual). The bulk unit weight of the retained backfill may be taken as 21 kN/m^3 for well-compacted soil. An appropriate factor of safety should be employed.

The subgrade for the basement floor slabs should comprise undisturbed compact native soil, shale bedrock or well-compacted fill. A minimum 100 mm thick layer of coarse clean granular material containing not more than 10% material that will pass a 4 mm sieve shall be placed beneath slabs in houses as per Subsection 9.16.2 of the Ontario Building Code. If the subgrade soil is wet, we strongly recommend that subfloor weeping tiles be placed and connected to the sump pit.

If a moisture-sensitive floor finish is to be applied to the slab, then we recommend that a 15 mil polyethylene moisture vapour barrier be installed directly beneath the slab as per Article 9.13.2.7 of the Ontario Building Code. The purpose of the vapour barrier is to reduce moisture transfer by diffusion as per Article 5.5.1.2 of the Ontario Building Code. Joints in the vapour barrier should be lapped not less than 100 mm.

Concrete testing should be performed onsite to determine the slump, temperature, and air entrainment; and concrete cylinders should be cast for compressive strength testing.

6.4 Site Servicing

6.4.1 Excavations and Dewatering

It is understood that new services will be installed for the proposed townhouse units. It is anticipated that the invert levels for new watermain and storm and sanitary sewers will be at conventional depths.

Temporary excavations to conventional depths for installation of underground pipes at this site must comply with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects. The fill material and granular deposits encountered in the boreholes would be classified as Type 3 soils (O. Reg. 213/91, s. 226 (4)). Temporary side slopes must be cut at an inclination of 1.0 horizontal to 1.0 vertical or less from the base of the excavation for open cut pipe installation. The native glacial till soils encountered at the site are classified as Type 2 soils and the Queenston shale bedrock at the site is classified as Type 1 soils. The temporary side slopes for Type 1 and 2 soils can be cut near vertical up to 1.2 m above the base of excavation and at an inclination of 1 horizontal to 1 vertical or less above this level, exclusive of groundwater effects.

Trench side slopes must be continuously inspected especially after periods of heavy rainfall or snow melt to identify areas of instability. Surface water should be directed away from entering the trench.

Provisions should be made in the excavation contract for excavation through the shale bedrock if depths of the underground pipes are below the shale.

Minor perched groundwater seepage should be expected within the fill material and granular deposits; however, it is anticipated that conventional sump pumping techniques will be sufficient to control the inflow. It will be necessary to flatten the excavation side slopes where groundwater seepage is occurring to ensure stability. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O. Reg. 213/91, s. 230).

6.4.2 Pipe Bedding

It is anticipated invert elevation of the pipes will be at conventional 2 to 3 m depths below ground surface. No bearing problems are anticipated for pipes set on native inorganic subsoil or imported structural fill. The bedding material may need to be thickened if sub-excavation encounters soft or spongy soil from the base of the service trench.

If the pipe bedding is placed directly on highly weathered shale with extensive fractures and cracks, it is recommended that a geotextile cover the shale surface to prevent loss of the bedding material in the cracks. The rock surface should be prepared to avoid any projections which could lead to damage of the pipes.

Pipe bedding for sewer services should be conventional Class 'B' pipe bedding comprising a minimum 150 mm thick layer of OPSS Granular 'A' aggregate below the pipe invert. Granular 'A' type aggregate should be provided around the pipe to at least 300 mm above the pipe and the bedding aggregate should be compacted to a minimum 95% SPMDD.

6.4.3 Trench Backfilling

The trenches above the specified pipe bedding should be backfilled with inorganic on-site soils placed in 300 mm thick lifts and compacted to at least 95% SPMDD. Wet or saturated native soils are not considered suitable for reuse as trench backfill. Any additional material required to be imported at the site should meet OPSS Select Subgrade Material specifications.

Shale should not be used as trench backfill unless adequate heavy equipment is used to break down the material. The properties of the shale can drastically change when exposed to air and water; therefore, it is not recommended to use shale as trench backfill.

To minimize potential problems, backfilling operations should follow closely after excavation so that only a minimal length of trench is exposed. Care should be taken to protect side slopes of excavations by diverting surface run-off away from the excavations. If construction extends into the winter, then additional steps should be taken to minimize frost and ensure that frozen material is not used as backfill.

6.5 Pavement Structure

It is understood that pavements will be constructed for drive aisles and parking areas at the site. The existing asphaltic concrete and fill in the vicinity of the drive aisles and parking areas must be removed. The subgrade soils will consist of native granular deposits, glacial till soils or approved subgrade fill.

The pavement component thicknesses in the following table are recommended based on the proposed pavement usage and the frost-susceptibility and strength of the subgrade soils;

TABLE 4 - PAVEMENT DESIGN

Pavement Component	Drive Aisles (Heavy Duty)	Parking Areas (Light Duty)
Asphalt Hot Mix	110 mm	90 mm
OPSS 1010 Granular 'A' Base	150 mm	150 mm
OPSS 1010 Granular 'B' Subbase	400 mm	300 mm

Heavy duty pavement designs should be used in areas of frequent large vehicle traffic such as garbage trucks or fire truck turn arounds.

Samples of aggregates should be checked for conformance to OPSS 1010 prior to utilization on site and during construction. The Granular 'B' subbase and Granular 'A' base courses must be compacted to 100% SPMDD, as verified by insitu density testing.

The asphaltic concrete paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed and compacted in accordance with OPSS 310. The Performance Graded Asphalt Cement designation for the asphaltic concrete is 58-28.

The asphaltic concrete in heavy duty areas should comprise 50 mm of HL3 surface over 60 mm of HL8 binder for drive aisles and comprise of 40 mm of HL3 surface over 50 mm of HL8 binder for parking areas or light duty areas.

The pavement design is based on the assumption that construction will be carried out during the drier time of the year and that the subgrade soil is stable as determined by proof-rolling inspected by qualified geotechnical personnel. If the subgrade is wet and unstable, additional granular subbase will be required.

All materials and construction services required for the work should be in accordance with the relevant sections of the Ontario Provincial Standard Specifications.

It is **strongly recommended** to install continuous subdrains beneath the pavement structure and connected to catchbasins. The purpose of the subdrains is to remove excess subsurface water in order to improve overall pavement serviceability and increase the pavement life. At a minimum subdrains should be provided in the low areas of the pavement structure.

The work of subdrain installation shall be in accordance with OPSS 405 and OPSD 216.021. The subdrain shall be 100 or 150 mm diameter perforated pipe conforming to OPSS 1801 or 1840, and wrapped with geotextile conforming to OPSS 1860.

6.6 Curbs and Gutter and Sidewalks

The concrete for curbs, gutters and sidewalks should be proportioned, mixed, placed and cured in accordance with the requirements of OPSS 353, and OPSS 1350 and shall meet the following specific requirements (OPSS 353.05.01):

- Minimum compressive strength = 30 MPa at 28 days
- Coarse aggregate = 19.0 mm nominal max. size
- Maximum slump = 60 mm for curb and gutter, 70 mm for sidewalks
- Air entrainment = 7.0 ± 1.5%

During cold weather any freshly placed concrete must be covered with insulating blankets to protect against freezing as per OPSS 904. Three cylinders from each days pour should be taken for compressive strength testing. Air entrainment, temperature and slump tests should be conducted on the same batch of concrete from the test cylinders made.

5.8 Stormwater Infiltration

It is understood that at-source infiltration of stormwater runoff from the development may also be considered for this site. Soak-away pits generally require soils with a minimum percolation rate of 15 mm/hr and a minimum separation between the bottom of the pit and the seasonally high water table of 1 m (MOE, 2003). Three particle size distribution analyses were carried out on the granular deposits and glacial till encountered at the site. They are plotted on **Table 101 in Appendix C**.

The geometric mean vertical hydraulic conductivity (k) is derived from an empirical formulae by Kaubisch. The estimated design infiltration rate is based on recommendations found in the *Low Impact Development Stormwater Management Planning and Design Guide, Appendix C*, Version 1.0, 2011, published by the Toronto and Region (TRCA) and the Credit Valley (CVC) Conservation Authority, and the approximate relationship between hydraulic conductivity and infiltration rate. A Factor of Safety of 2.5 has been applied to the calculated infiltration rates.

TABLE 5 - INFILTRATION RATES FOR NATIVE SOILS

Borehole Number	Sample Depth (m)	Borehole Elevation (m)	Soil Type	Geometric Mean K-Value (m/sec)	Infiltration Rate (mm/hr)
BH102-19	1.5 – 1.8	103.9	Sandy Silt Till	2.4E-09	4
BH103-19	0.9 – 1.4	103.6	Silty Gravel Till	2.8E-07	13
BH104-19	0.3 – 0.6	103.1	Sand	1.6E-06	21

Due to the relative thin layer of granular deposits, the density of the glacial till and the relatively shallow bedrock at the site, it is our preliminary opinion that at-source infiltration of stormwater runoff will be challenging for this development. Areas of sands and silty sands may be capable of at-source infiltration but the thickness of these layers, depths encountered and their proximity to the groundwater level is relatively unknown between the borehole locations and may make the design difficult. Additional investigation at the exact locations of the proposed at-source infiltration locations may be necessary to assist in design.

6.7 Construction Inspection and Testing

MTE recommends that geotechnical inspection and testing procedures be conducted throughout the various phases of the project.

Engineer site visits should be conducted to confirm geotechnical bearing resistances for footings. Soil compaction testing should be carried out on structural fill beneath the proposed building addition and new building, foundation wall backfill, subslab granular fill, service pipe bedding and trench backfill. Laboratory and field testing of the pavement structure components (granulars and aphaltic concrete) should be conducted, as well as concrete testing for foundations, curbs and sidewalks.

MTE offers soil compaction, concrete, and asphalt testing as well as soil inspection services through our Stratford office.

7.0 LIMITATIONS OF REPORT

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Geotechnical Engineering & Consulting profession practicing under similar conditions in the same geographic area were the services are provided. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of the Client. This report is not intended to be exhaustive in scope or to imply a risk-free site. As such, this report may not deal with all issues potentially applicable to the site and may omit aspects which are or may be of interest to the reader.

In addition, it should be recognized that a soil sample result represents one distinct portion of a site at the time it is collected, and that the findings of this report are based on conditions as they existed during the time period of the investigation. The material in the report reflects our best judgment using the information available at the time the report was written. The soil and groundwater conditions between and beyond the test holes may differ from those encountered in the test holes. Should subsurface conditions arise that are different from those in the test holes MTE should be notified to determine whether or not changes should be made as a result of these conditions.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because groundwater conditions of a property can change, along with regulatory requirements. All design details were not known at the time of submission of this report and it is recommended MTE should be retained to review the final design documents prior to construction to confirm they are consistent with our report recommendations. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may determine whether it affects the contents of this report.

Any use which another party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by another party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans. The contractors bidding on this project or undertaking the construction should make their own interpretation of the factual information and draw their own conclusions as to how subsurface conditions may affect their work.

The benchmark and elevations provided in this report are primarily established to identify differences between the test hole locations and should not be used for other purposes such as, planning, development, grading, and excavation.

Respectfully submitted,

MTE CONSULTANTS INC.





Brett Thorner, P.Eng.
Geotechnical Engineer

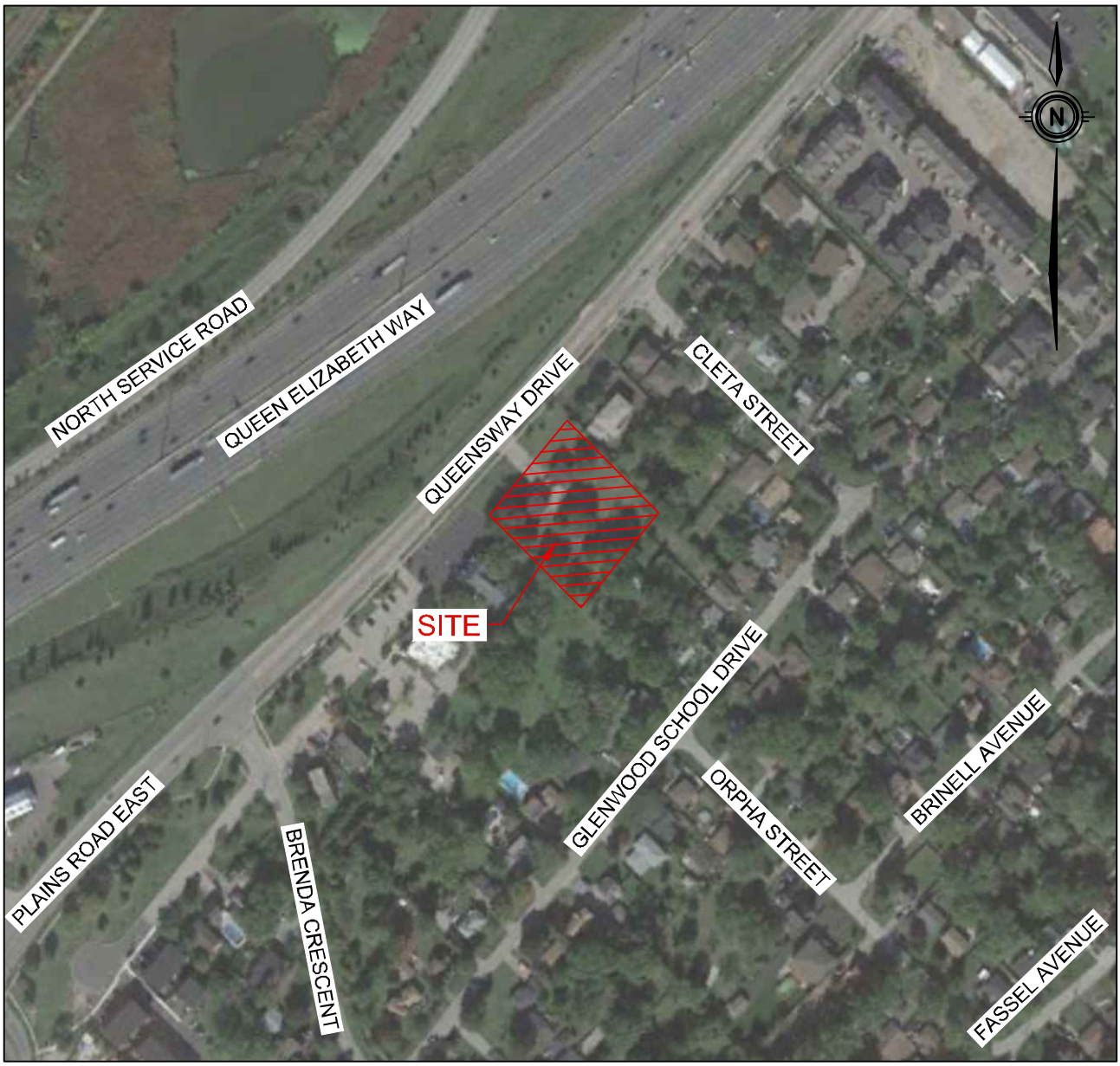
Dan Gonser, P.Eng.
Geotechnical Engineer

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APPENDIX A

FIGURES

Figure 1- Location Plan
Figure 2 - Site Plan



REFERENCES:

- AERIAL IMAGE FROM GOOGLE EARTH PRO.

LOCATION PLAN

Engineers | Scientists | Surveyors

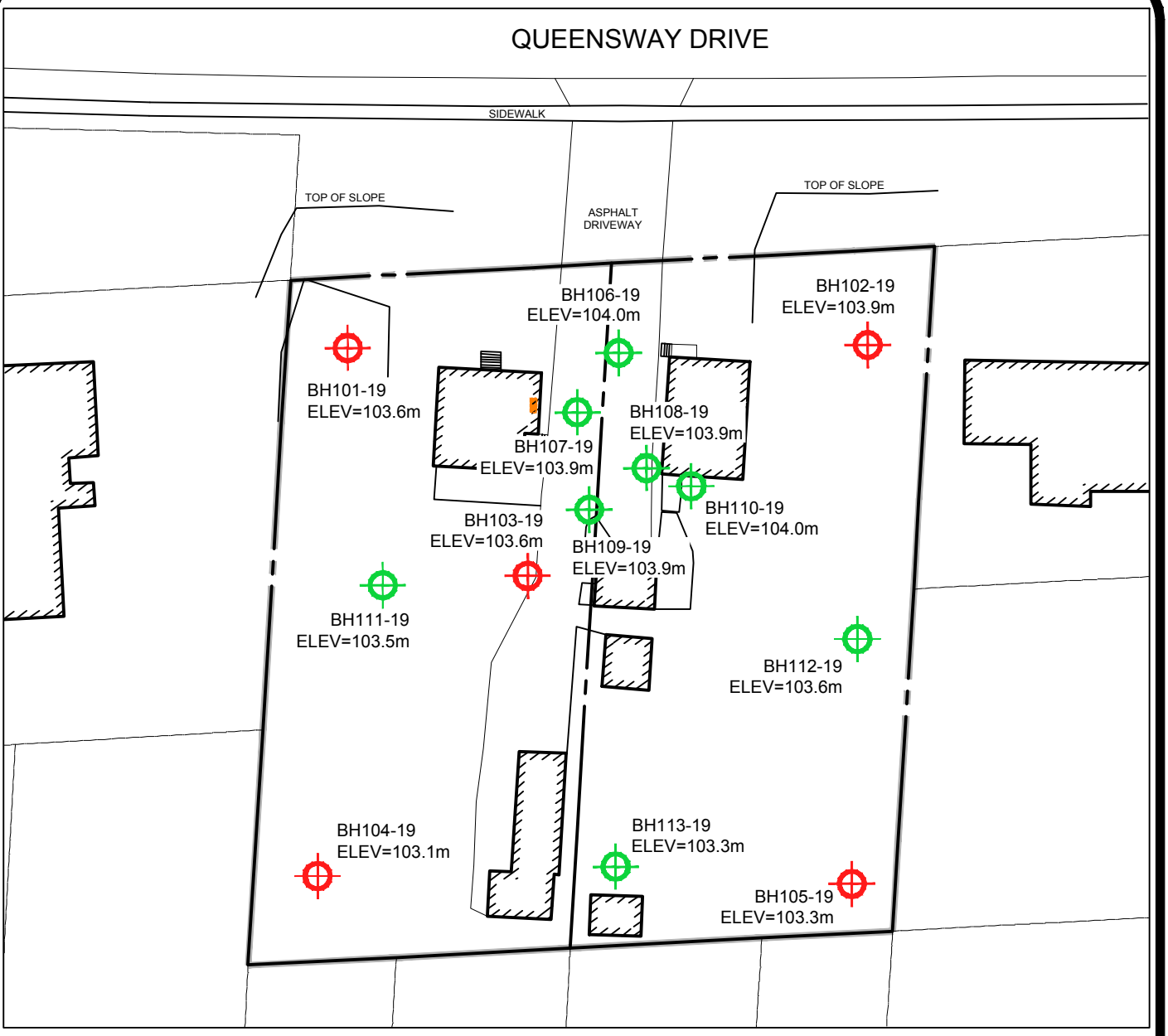
Project Name
PROPOSED TOWNHOUSE DEVELOPMENT

Site	Client
2294-2300 QUEENSWAY DRIVE, BURLINGTION, ON	WAGGY INC.

Scale. (8.5x11)	MTE Project No.	Date	Figure No.
N.T.S	45786-100	JUNE.12.2019	1

June 13, 2019 – 9:21 a.m. – Plotted By: cschaerer FIGURE 1 Project: 45786-100 CAD: P:\P\45786\100\45786-100-BHFIGURES.DWG

June 13, 2019 – 9:21 a.m. – Plotted By: cschaerer
Project: 45786-100 CAD: P:\P\45786\100\45786-100-BHFIGURES.DWG
FIGURE 2



LEGEND

BH101-19
MTE GEOTECHNICAL BOREHOLE

BH106-19
MTE ENVIRONMENTAL BOREHOLE

REFERENCES:

- MTE ENGINERING CONSULTANTS INC. HISTORICAL & CURRENT SITE LAYOUT AND FEATURES. DWG #45786-100-ESA1. DATED MAY, 2019.

SITE PLAN

MTE Engineers | Scientists | Surveyors

Project Name	
PROPOSED TOWNHOUSE DEVELOPMENT	
Site: 2294-2300 QUEENSWAY DRIVE, BURLINGTON, ON	Client: WAGGY INC.

Scale. (8.5x11)	MTE Project No.	Date	Figure No.
1:600	45786-100	JUNE.12.2019	2

APPENDIX B

BOREHOLE LOGS

Abbreviations and Symbols
Boreholes BH101-19 to BH105-19

Drawing on experience...Building on strength.

LIST OF ABBREVIATIONS AND SYMBOLS

The following are abbreviations and symbols commonly used on borehole logs, figures and in the text of reports:

Sample Types			
AS	Auger Sample	**SS**	Split Spoon
CS	Chunk Sample	**RC**	Rock Core
BS	Bulk Sample	**SC**	Soil Core
GS	Grab Sample	**TW**	Thinwall, Open
WS	Wash Sample	**TP**	Thinwall, Piston

Soil Tests	
PP	Pocket Penetrometer
FV	Field Vane
SPT	Standard Penetration Test
CPT	Cone Penetration Test
WC	Water Content
WL	Water Level

Penetration Resistance	
Standard Penetration Test, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) open spilt spoon sampler for a distance of 300 mm (12 in.).
Dynamic Cone Penetration Resistance	The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive an uncased 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

Soil Description		
Cohesive Soils	**Undrained Shear Strength (C_u)**	
Consistency	kPa	psf
Very Soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	above 200	above 4000
Cohesionless Soils		
Relative Density	SPT N Value	
Very Loose	0 to 4	
Loose	4 to 10	
Compact	10 to 30	
Dense	30 to 50	
Very Dense	above 50	

WH	Sampler advanced by static weight of hammer
WR	Sampler advanced by static weight of drilling rods
PH	Sampler advanced by hydraulic force
PM	Sampler advanced by manual force

DTPL	Drier than Plastic Limit
APL	About Plastic Limit
WTPL	Wetter than Plastic Limit
mbgs	Metres below Ground Surface

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ID Number: BH101-19

Project: Proposed Townhouse Development

Project No: 45786-100

Client: Waggy Inc.

Site Location: 2294-2300 Queensway Drive

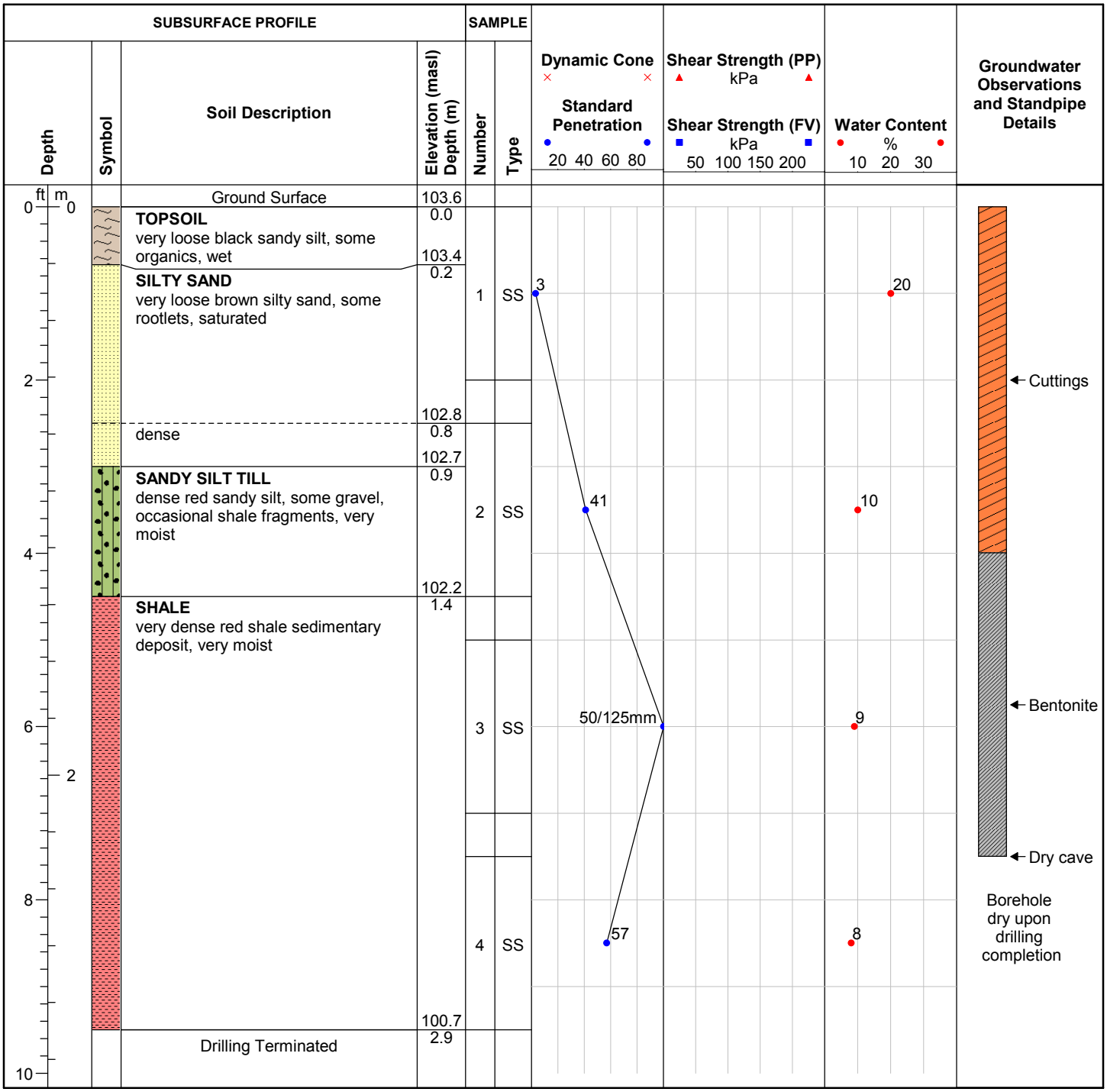
Drill Date: 5/28/2019

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T

Drill Method: Solid Stem Augers

Protective Cover: N/A



Field Technician: M. Dalgliesh

Drafted by: O. Byvelds

Reviewed by: D. Gonser

MTE

Sheet: 1 of 1

ID Number: BH102-19

Project: 45786-100

Project No: Proposed Townhouse Development

Client: Waggy Inc.

Site Location: 2294-2300 Queensway Drive

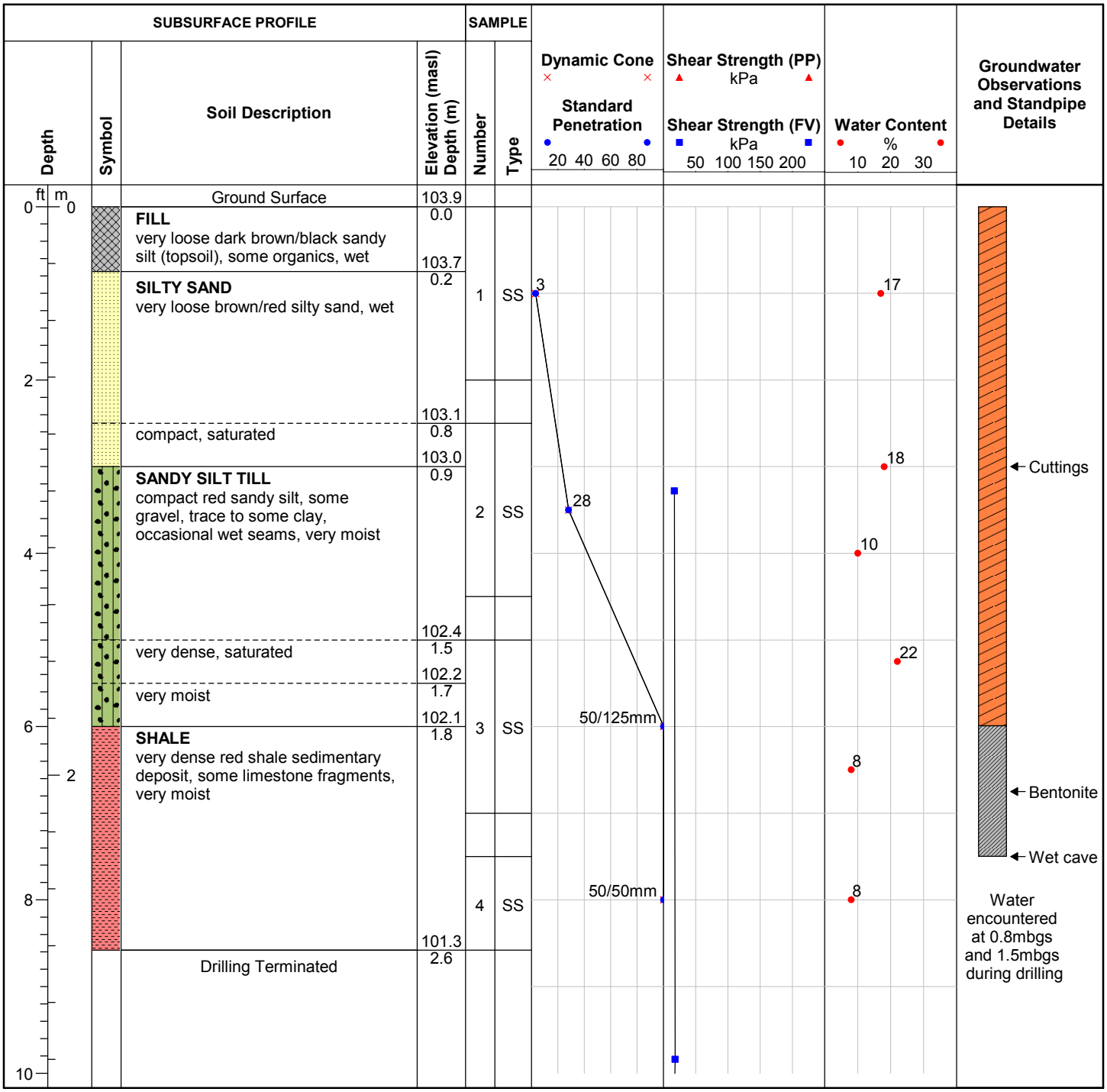
Drill Date: 5/28/2019

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T

Drill Method: Solid Stem Augers

Protective Cover: N/A



Field Technician: M. Dalgliesh

Drafted by: O. Byvelds

Reviewed by: D. Gonser

MTE

Sheet: 1 of 1

ID Number: BH103-19

Project: Proposed Townhouse Development

Project No: 45786-100

Client: Waggy Inc.

Site Location: 2294-2300 Queensway Drive

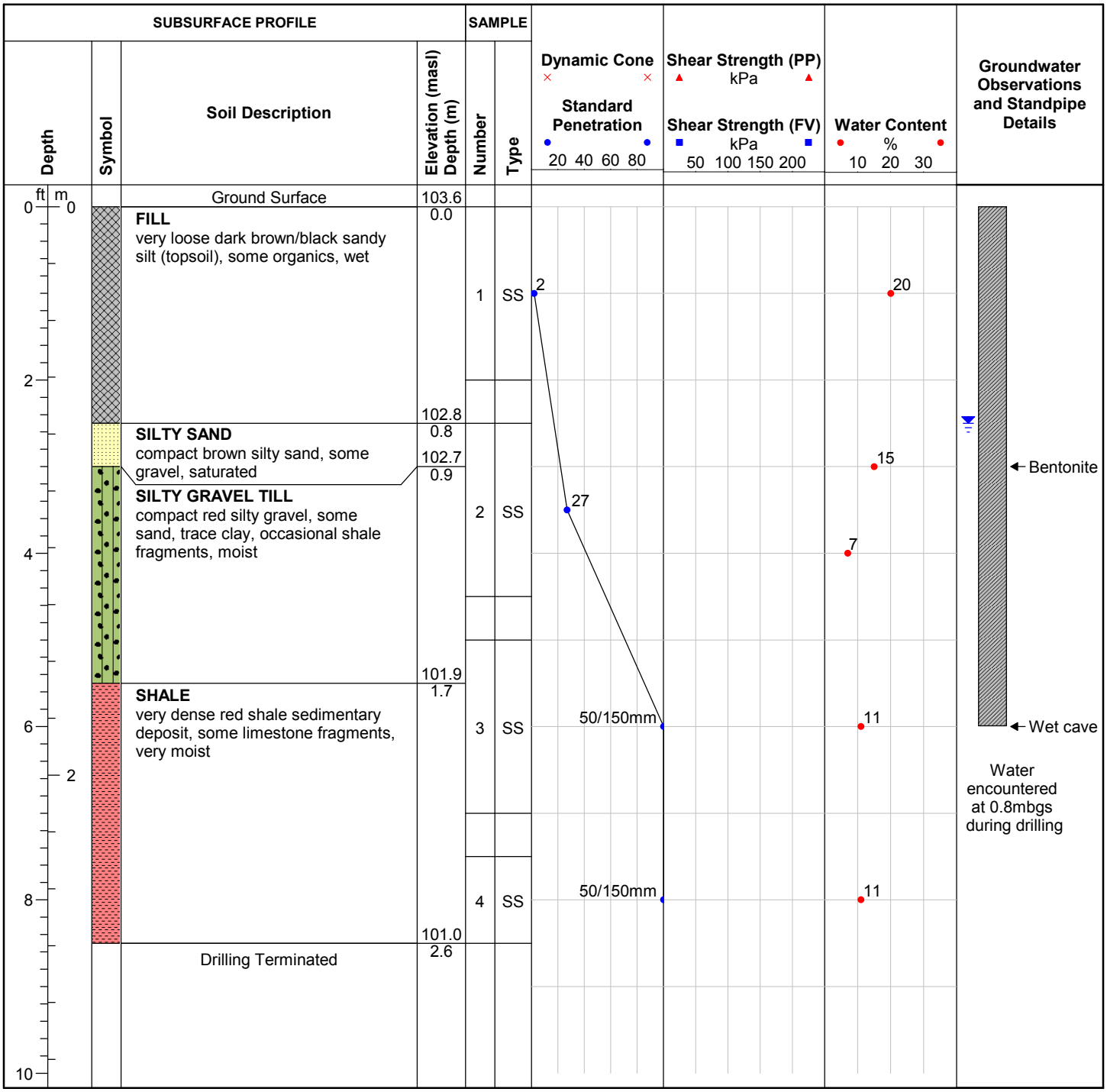
Drill Date: 5/28/2019

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T

Drill Method: Solid Stem Augers

Protective Cover: N/A



Field Technician: M. Dalgliesh

Drafted by: O. Byvelds

Reviewed by: D. Gonser

MTE

Sheet: 1 of 1

ID Number: BH104-19

Project: Proposed Townhouse Development

Project No: 45786-100

Client: Waggy Inc.

Site Location: 2294-2300 Queensway Drive

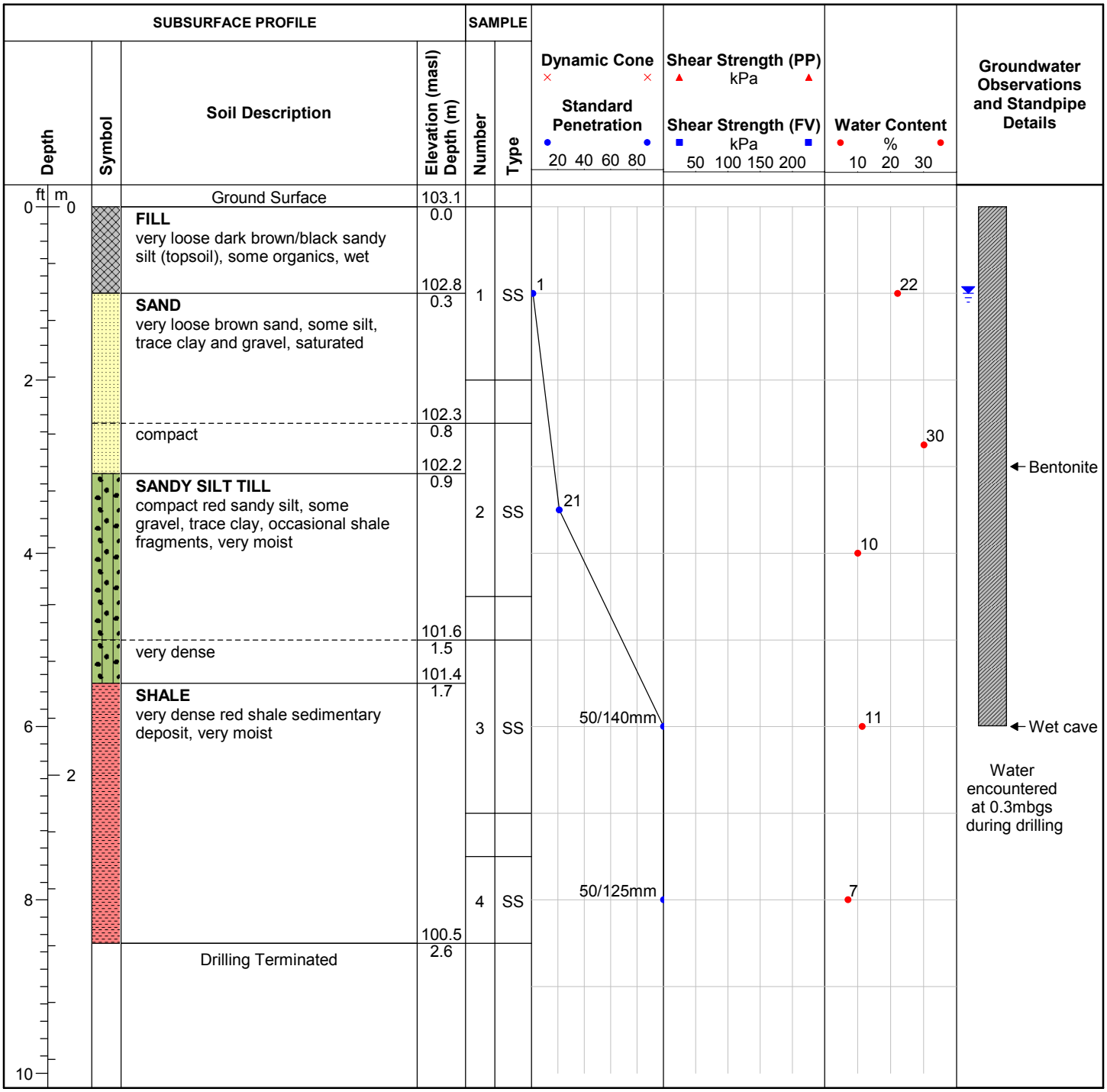
Drill Date: 5/28/2019

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T

Drill Method: Solid Stem Augers

Protective Cover: N/A



Field Technician: M. Dalgliesh

Drafted by: O. Byvelds

Reviewed by: D. Gonser

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Sheet: 1 of 1

ID Number: BH105-19

Project: Proposed Townhouse Development

Project No: 45786-100

Client: Waggy Inc.

Site Location: 2294-2300 Queensway Drive

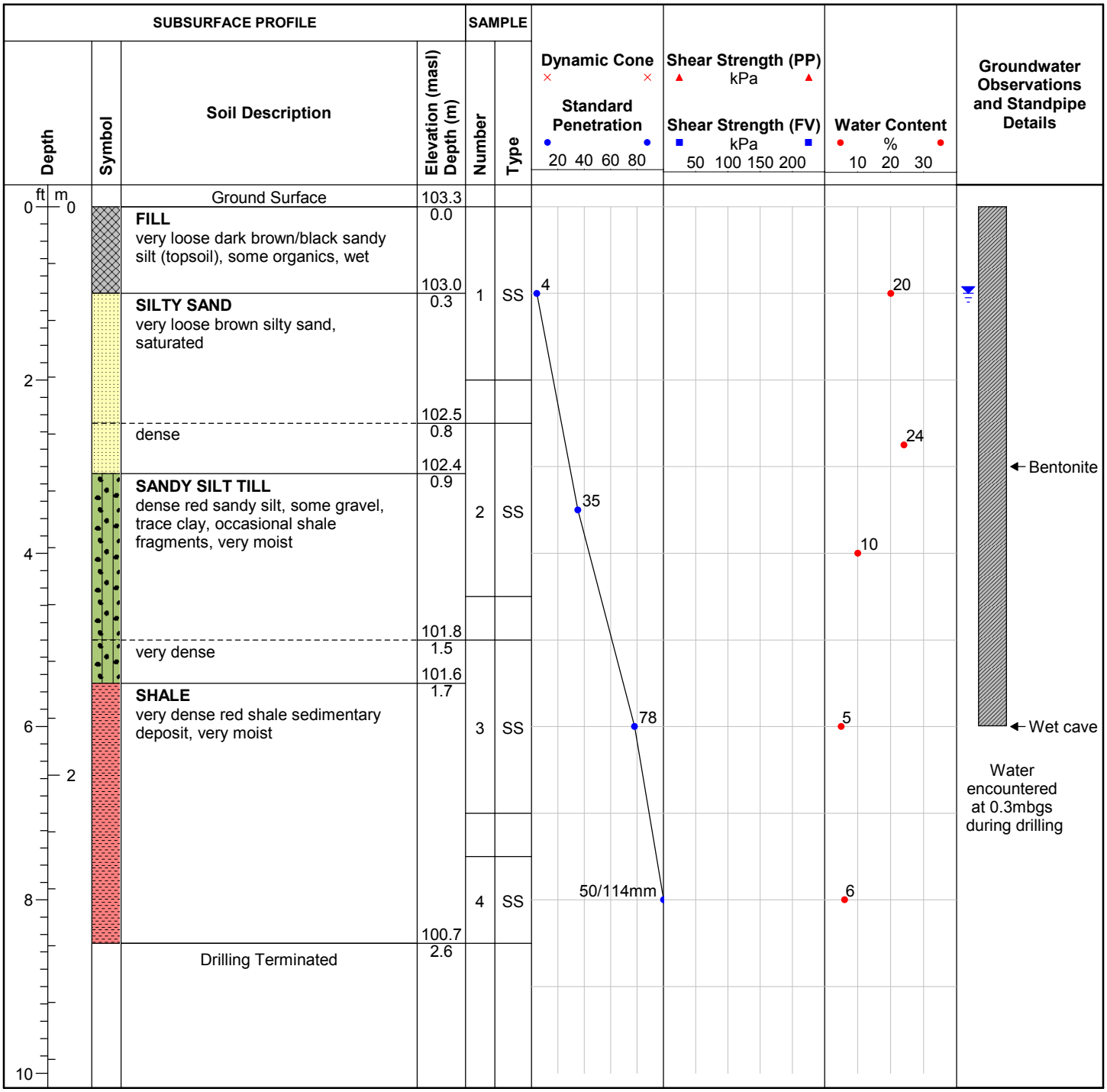
Drill Date: 5/28/2019

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T

Drill Method: Solid Stem Augers

Protective Cover: N/A



Field Technician: M. Dalgliesh

Drafted by: O. Byvelds

Reviewed by: D. Gonser

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Sheet: 1 of 1

APPENDIX C

LABORATORY TEST RESULTS

Table 101

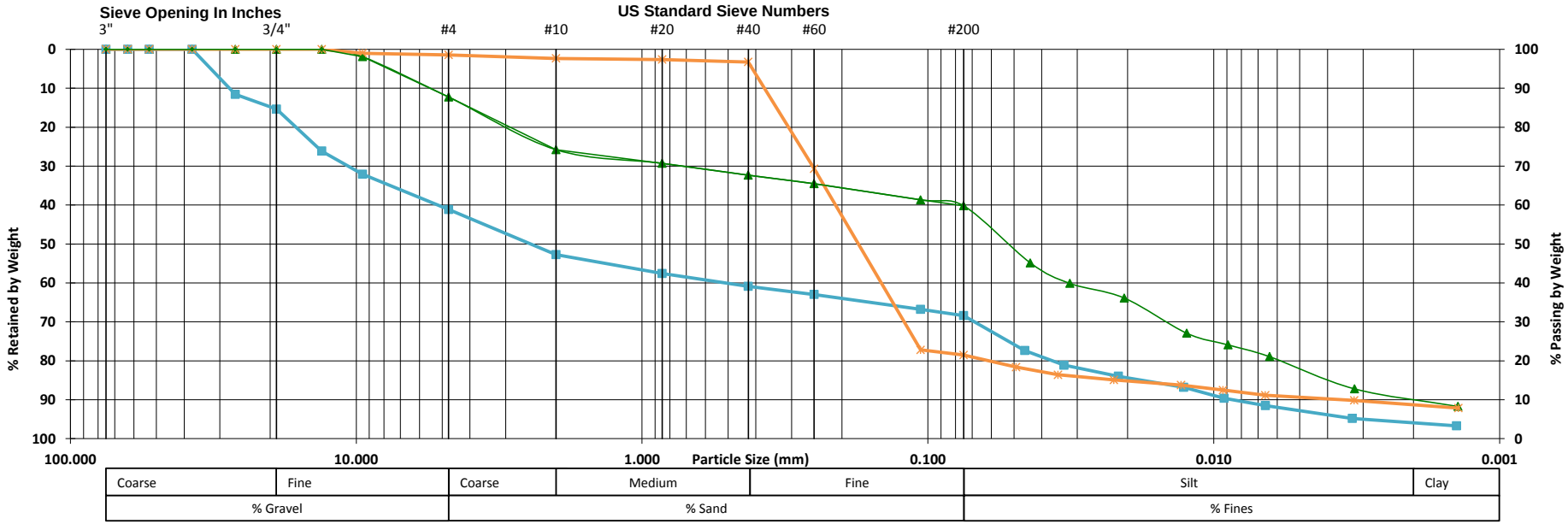
Particle Size Distribution Analysis Test Results

PROJECT NAME: Proposed Townhouse Development
CLIENT: Waggy Inc.
LOCATION: 2294-2300 Queensway Drive, Burlington, ON

DATE SAMPLED: May 28, 2019
DATE TESTED: May 30 - June 4, 2019

FILE No.: 45786-100
TABLE #: 101

Unified Soil Classification



Symbol	Borehole ID	Sample #	*Sample Depth*	Description
▲	BH102-19	SS-3	1.5-1.8 mbgs	Sandy SILT TILL, some Gravel and Clay
■	BH103-19	SS-2	0.9-1.4 mbgs	Silty GRAVEL, some Sand, trace Clay * shale fragments noted in sample
✳	BH104-19	SS-1	0.3-0.6 mbgs	SAND, some Silt, trace Clay and Gravel

CERTIFIED BY CCIL
Canadian Council of Independent Laboratories
For specific tests as listed on www.ccil.com

NOTES:

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560 Wellington Street, Fourth Floor
London, Ontario N6A 3R4
Phone: 519-204-6510
Fax: 519-204-6511

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