West Street, Smithville, ON

Elite Smithville Developments Inc.

Type of Document:
Geotechnical Investigation Report

Project Name:
Proposed Residential Development
West Street
Smithville, Ontario

Project Number:
HAM-22015175-D0

Prepared By:
EXP Services Inc.
1266 South Service Road, Suite C1-1
Stoney Creek, Ontario L8E 5R9
t: +1.905.573.4000
f: +1.905.573.9693

Date Submitted:
August 30, 2024

Table of Contents

List of Appendices

1. Introduction and Background

This report presents the results of the geotechnical investigation carried at the site located to the southeast of the intersection of West Street (Highway 20) and South Grimsby Road 6 in Smithville, Ontario. The investigation was authorized by Mr. Faisal Safi on behalf of Elite Smithville Developments Inc.

Based on the provided site drawings, it is understood that the development is to comprise townhouses constructed in seven blocks and situated on the east side and two adjoining six-storey condominium buildings along the west end of the site. It is understood that the condominium buildings will include one level of underground parking and the townhouses will not include a basement level.

The purpose of this investigation was to determine the subsoil and groundwater conditions at the site by advancing eight (8) boreholes and based on an assessment of the factual borehole data, provide an engineering report containing general geotechnical recommendations pertinent to the proposed development. Additional fieldwork and testing was carried out at the site by EXP as part of a Phase II Environmental Site Assessment and Hydrogeological Study, and a Karst Study, the results of which are presented under separate covers.

The comments and recommendations given in this report assume that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or the requirement of additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description & Geological Setting

The site is situated to the southeast of the intersection of West Street (Highway 20) and South Grimsby Road 6 in Smithville, Ontario and is centred at approximate grid reference 617198 Easting, 4774055 Northing (UTM coordinates). The site is comprised of vacant agricultural land and is currently covered by unkempt grasses. The topography at the site is relatively flat-lying.

Based on the review of the Ontario Geological Survey (OGS), Map P.993, “Quaternary Geology of the Grimsby Area”, the native subsurface soil at the site consists of glaciolacustrine clay and silt. According to the OGS Map 2343 “Paleozoic Geology of the Grimsby area”, the overburden soils are underlain by dark brown or black, bituminous dolostone identified as the Eramosa Member of the Lockport Formation.

3. Field Investigation

EXP advanced a total of eight (8) boreholes at the site, numbered BH-1 to BH-8. The approximate borehole locations are shown on Drawing No. 1 in Appendix A. Boreholes BH-1 to BH-4 were advanced in the area of the proposed townhouses and Boreholes BH-5 to BH-8 were advanced in the area of the proposed six-storey building. The boreholes were advanced using solid stem augers to depths ranging from approximately 5.0 to 7.6 m below existing grade.

The fieldwork for this investigation was carried out on July 27 and 28, 2022. Drilling and sampling operations were completed by a combination of continuous flight solid stem augers and split-spoon techniques using track mounted drilling equipment owned and operated by a specialist drilling subcontractor. Prior to the commencement of the drilling, the public and private-owned underground services were located to minimize the risk of contacting any such services during the investigation.

Soil samples were obtained using a 51 mm (2 inch) outside diameter split-spoon sampler driven in conjunction with Standard Penetration Test procedure (ASTM D1586) at the depths noted graphically on the borehole logs in Appendix A. The retained soil samples were logged in the field and then carefully packaged and transported to our Hamilton laboratory for detailed visual, textural, and olfactory classification. The Standard Penetration Test (SPT) N values, pocket penetrometer, and in-situ shear vane measurements were recorded and used to provide an assessment of the compactness condition or consistency of the soils.

Groundwater levels within the boreholes were measured prior to backfilling. In five (5) boreholes, 50 mm diameter monitoring wells were installed to allow for stabilized groundwater level measurements. The remaining boreholes were backfilled upon completion of drilling in accordance with O.Reg. 903.

The boreholes were located in accessible areas on site by EXP field personnel and were surveyed in reference to a geodetic benchmark provided on the preliminary site topographic plan and described as follows:

TBM:	Top of catch basin located along the West Street (Highway 20) east curb line and approximately 75 m south of South Grimsby Road 6
Elevation:	191.89 m as shown on the Preliminary Site Topographic Plan provided by the client

4. Subsurface Conditions

Details of the subsurface conditions encountered during the drilling program are summarized on the borehole logs in Appendix A. The logs include textural descriptions of the subsoil and groundwater conditions and indicate the soil boundaries inferred from non-continuous sampling and observations during drilling. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The “Notes on Sample Description” preceding the borehole logs form an integral part of and should be read in conjunction with this report.

4.1 Soil Stratigraphy

Surficial topsoil was encountered at all boreholes and was underlain by native silty clay. The native silty clay overlies clayey silt till and/or presumed dolostone/limestone bedrock. The presumed dolostone/limestone bedrock was encountered underlying the native soils at depths ranging from approximately 5.0 to 7.6 m below grade. Details of the encountered materials are provided in the following subsections.

4.1.1 Topsoil

Surficial topsoil was encountered in all boreholes and was noted to have thicknesses ranging from approximately 25 to 100 mm. It is noted that topsoil thicknesses may further vary across the site.

4.1.2 Silty Clay

Native silty clay was encountered in all boreholes underlying the topsoil, extending to the clayey silt till stratum or presumed bedrock at depths ranging from 4.6 to 7.6 m below grade. The silty clay contained traces of gravel, sand, and rootlets (in the upper layer) and was brown, becoming grey at depth. Moisture contents of the stratum ranged from 18 to 34%, indicative of a generally moist to very moist state. SPT N values ranged from 8 to 33 blows per 305 mm penetration. Based on undrained shear strengths ranging from 50 kPa to greater than 225 kPa as determined by pocket penetrometer measurements and in-situ shear vane measurements, the silty clay is classified as stiff to hard in consistency. From about 1 m below ground surface, the strength of the clay decreases with depth.

Two (2) grain size analyses and Atterberg Limits tests were conducted on selected samples of the stratum and the results are summarized in the table below.

Table 4-1: Summary of Grain Size Analyses

Borehole and Sample No.	Sample Depth (m)	Soil Fractions (%)				Liquid Limit	Plasticity Index
		Clay	Silt	Sand	Gravel		
BH-1 SS3	1.5	65	33	2	0	59	35
BH-7 SS5	3.0	52	46	2	0	47	22

The material is classified as a medium to high plasticity clay (CI and CH) with liquid limit values ranging from 47 to 59% and plasticity indices ranging from 22 to 35.

These test results are shown in Drawings B1 and B2 in Appendix B.

4.1.3 Clayey Silt Till

Clayey silt till was encountered in Boreholes BH-1, BH-3, and BH-8 underlying the silty clay, extending to the presumed bedrock at depths ranging from 5.0 to 6.7 m below grade in Boreholes BH-1 and BH-8. The clayey silt till contained some gravel and sand. Dark grey dolostone/limestone fragments were encountered interbedded with the clayey silt till in Boreholes BH-1 and BH-3 below depths of about 6.6 m and 6.1 m respectively. Moisture contents of the stratum ranged from 9 to 21%. SPT N values ranged from 12 to 32 blows per 305 mm penetration. Based on undrained shear strengths ranging from 50 to 75 kPa as determined by pocket penetrometer measurements, the clayey silt till is classified as stiff in consistency.

4.1.4 Bedrock (Inferred)

The presence of bedrock was inferred from the auger refusal encountered in Boreholes BH-1 and BH-5 to BH-8 at depths ranging from 5.0 to 7.6 m below grade. The inferred bedrock surface depths and elevations are summarized in the table below.

Table 4-2: Depths and Elevations of Inferred Bedrock Surface

Borehole No.	Depth of Inferred Bedrock Surface (m)	Geodetic Elevation of Inferred Bedrock Surface (m)
BH-1	6.7	185.4
BH-5	7.6	184.6
BH-6	7.6	184.4
BH-7	6.1	185.2
BH-8	5.0	185.9

According to the Ontario Geological Survey (OGS), the site is situated in an area of potential karst and near areas of known karst. A karst study was undertaken by EXP, with the results presented under separate cover.

4.2 Groundwater Conditions

Groundwater conditions were monitored in the open boreholes during and upon completion of the investigation. Boreholes BH-1, BH-2, and BH-4 were dry upon completion while Boreholes BH-3, BH-5 to BH-8 encountered groundwater at depths of approximately 2.4 m, 7.0 m, 3.3 m, 3.1 m, and 2.6 m respectively below grade upon completion, but groundwater levels are not anticipated to have stabilized during the short term of the investigation. 50 mm diameter groundwater monitoring wells were installed in Boreholes BH-1, BH-3, BH-5, BH-7, and BH-8. The groundwater depths and elevations observed in the wells are summarized in the table below.

Table 4-3: Groundwater Level Measurements at Monitoring Well Locations

Borehole No.	Groundwater Depth Below Grade/ Geodetic Elevation (m)		
	Upon Completion	August 11, 2022	August 24, 2022
BH/MW-1	no free water	2.7 / 189.4	2.9 / 189.2
BH/MW-3	2.4 / 190.0	2.8 / 189.6	3.0 / 189.4
BH/MW-5	7.0 / 185.2	2.5 / 189.6	2.6 / 189.5
BH/MW-7	3.1 / 188.2	1.8 / 189.5	2.0 / 189.3
BH/MW-8	2.6 / 188.3	1.3 / 189.6	1.5 / 189.3

Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions. Reference should be made to the hydrogeological study for further details of the groundwater conditions at this site.

5. Engineering Discussion and Recommendations

Based on the provided site drawings, it is understood that the development is to comprise seven (7) townhouse blocks two adjoining six-storey condominium buildings along the west side of the site. It is understood that the condominium buildings will include one level of underground parking and the townhouses will not include a basement level. The development will also include new access routes and parking areas, outdoor amenity areas, and associated site servicing. The recommendations provided are based on the site plan drawing and general design information for the development.

It should be noted that due to alterations in the site plan following the original study, additional boreholes are recommended to confirm the soil conditions in the unexplored areas of the site. We offer the following comments and recommendations for the proposed construction.

5.1 Site Grading

Based on the site grading plan provided, it is understood that the site will be raised by approximately as much about 2 m. The site regrading (cut and fill) operations should be undertaken in accordance with the following procedures, and are applicable for the construction of building, pavement, and amenity areas at the site, where required:

- All topsoil, disturbed soils, and organic/deleterious materials should be removed from the proposed building footprints and the areas to be paved.
- The exposed subgrade surface should be proof-rolled with a heavy roller or partially loaded truck and reviewed by a geotechnical representative. Any soft areas detected during the proof-rolling process should be sub-excavated and replaced with approved material compacted as detailed below.
- Low areas can then be brought up to final subgrade level with approved on-site or imported material placed in lifts not exceeding 200 mm. Fill placed in building floor slab areas must be compacted to 95% of standard Proctor maximum dry density (SPMDD). Fill placed in pavement areas should be compacted to at least 95% SPMDD, with the upper 600 mm compacted to at least 98% SPMDD. The moisture content of the fill should be at or near its optimum moisture content to ensure the specified densities can be achieved with reasonable compactive effort.
- Re-use of the on-site soils should be at the discretion of the geotechnical consultant during construction. In general, the native inorganic soils are considered suitable for re-use in areas accessible to large compaction equipment and where free-draining characteristics are not required, noting that some moisture content adjustment (spreading and drying) should be anticipated. Any re-used materials must also be free from organics and deleterious materials.
- All imported borrow fill material from local sources should be free from organic material and foreign objects (trees, roots, debris, etc.) and should be approved by EXP prior to transport to the site. In addition, the chemical quality of the borrowed fill material should be assessed by EXP in accordance with the most current applicable MECP regulations and guidelines at the time of the construction.

- All excavation, backfilling and compaction operations should be monitored on a full-time basis by EXP's geotechnical staff to approve materials and to ensure the specified degrees of compaction have been obtained.

5.2 Foundation Considerations

It is understood that the townhouses will consist of slab-on-grade construction with no basement. The mid-rise condominium buildings will include one level of underground parking, which corresponds to an assumed founding level in the order of 3 to 4 m below finished grade. The proposed buildings can be founded using conventional strip and spread footing or drilled pier type foundations supported on the undisturbed silty clay. Alternatively, caissons drilled into the bedrock may also be considered for the mid-rise structure. Details of the foundation options are provided in the subsections below.

When the building configuration is finalized, EXP should be contacted to review the details alongside the existing karst study to determine the need for any additional investigation or analysis to mitigate potential risks associated with karst features (i.e. bedrock voids).

5.2.1 Conventional Footing Foundations

Based on the subsurface conditions encountered at the site, the proposed buildings may be founded on the undisturbed native silty clay below any fill or disturbed soils and designed for the geotechnical reactions and geotechnical resistances given in Table 5-1 below, subject to review by EXP during construction.

The recommended bearing capacity for the condominium buildings is valid for footings up to 3 m x 3 m, founded at or above 3 m below ground surface. If the footings are larger than 3 m or have to be placed below 3 m depth, EXP should be consulted for further recommendations.

Table 5-1: Available Geotechnical Resistance

Building Description	Borehole No.	Factored Geotechnical Reaction at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Founding Depth / Geodetic Elevation (m)
Townhouses*	BH-1	200	300	1.0 / 191.1
	BH-2	200	300	1.0 / 191.8
	BH-3	200	300	1.0 / 191.4
	BH-4	200	300	1.0 / 191.9
Mid-rise Condominium Buildings	BH-6	150	225	3.0 / 189.0
	BH-7	150	225	3.0 / 188.3

*The foundation for the townhouse close to the condominium basement must be lowered below a 10 horizontal to 7 vertical line drawn from the base of the condominium foundations. Alternatively, a drilled short pier can be considered in lieu of a spread or strip footing.

5.2.2 Raft Foundation

If the provided bearing capacities cannot satisfy the anticipated building loads for the mid-rise condominium buildings, a raft foundation may be considered. The bearing capacity of a raft foundation can only be provided after completing a settlement analysis.

5.2.3 Caisson on Bedrock

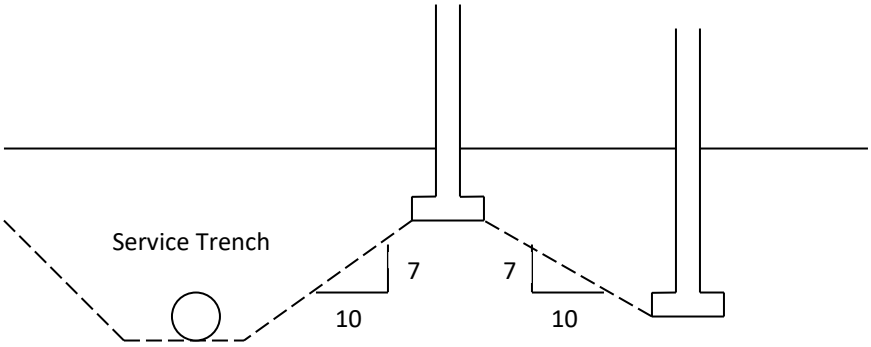
An alternative foundation for the mid-rise condominium buildings is to utilize caissons advanced into the bedrock underlying the site at depths ranging from 5.0 to 7.6 m below grade. For preliminary design purposes, a factored end-bearing capacity of 2,000 kPa at ULS is considered achievable for caissons founded below any upper weathered rock in the sound dolostone/limestone bedrock. The actual sound bedrock elevations should be confirmed by rock coring, but is typically in the order of 1 to 2 m below the rock surface.

The caissons will require temporary liners for installation to prevent the caving and to help control any water seepage into the caissons. The liners must be tightly sealed into the bedrock to prevent the infiltration of soil, loose rock, and groundwater into the hole. Once the caissons have been drilled to the final founding elevation and the rock conditions confirmed by EXP, the base of the caissons must be thoroughly cleaned. One possible method of cleaning is by placing about 0.3 to 0.5 m of concrete into the final base and mixing it with the loose material present at the base. All concrete and loose soil/rock should then be removed prior to placing the reinforcing cage and the structural concrete.

The contractor should be prepared to place concrete by ‘tremmie’ method if the liner cannot form a seal to prevent groundwater infiltration. An experienced contractor should be employed to ensure the above procedures are followed and no ‘necking’ or voids in the concrete occurs in the caisson shaft during the concrete pour. Concrete being placed into the caissons should have a slump of about 150 mm in order to minimize the risk of necking in the shaft. Once the method of construction is established the concrete mix must be reviewed by this office.

5.3 General Foundation Recommendations

Conventional foundations in soil at different elevations should be located such that higher footings are set below a line drawn up at 10:7, horizontal to vertical from the near edge of the lower footing. This concept should also be applied to excavations for new foundations in relation to existing foundations or underground services.



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All foundations or grade beams exposed to freezing conditions must be provided with a minimum of 1.2 m of earth cover or equivalent insulation for frost protection, depending on the final grade requirements.

Provided that the ground is not disturbed due to groundwater, precipitation, traffic, etc., and the aforementioned geotechnical resistance values are not exceeded, then total and differential settlements should be small and within the normally tolerated limits of 25 mm and 19 mm, respectively.

The recommended geotechnical resistances have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, it should be appreciated that modifications to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason, this office should be retained to review final foundation drawings and to provide field inspections during the construction stage.

5.4 Excavations

Excavations for the proposed structures are expected to extend to maximum depths of 3 or 4 m below existing grades. Excavations will be carried out through the native silty clay. Excavation of the overburden soil at this site is generally not expected to pose any difficulty and can be carried out with heavy hydraulic excavators as required. Dolostone/limestone bedrock was encountered at a minimum depth of approximately 5.0 m below grade and as such, is not anticipated to be encountered during the shallow excavations for the foundations and utilities at this site.

All excavations must be completed in accordance with the most recent regulations of the Ontario Occupation Health and Safety Act (OHSA). Within the anticipated excavation depths, the silty clay was generally very stiff to hard and may be classified as Type 2 Soil. In accordance with the OHSA regulations if the excavation contains more than one type of soil, the soil shall be classified as the type with the highest number.

The OHSA requires that excavation slopes be cut at predetermined inclinations, based on the soil types encountered. Type 2 soils are expected to be stable for short construction periods at slopes of approximately 45° to the horizontal (i.e. 1V:1H), sloped to within 1.2 m from the base of the excavation. The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zones are encountered, should

not be overlooked. Water (i.e. surface water runoff) should not be permitted to enter and/or pond within the construction area.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the boreholes. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that EXP be contacted immediately to evaluate the conditions encountered.

5.5 Temporary Shoring

Where there is insufficient space to carry out open excavation, shoring will be required to support the basement excavation. The shoring system could consist of soldier piles with lagging, or contiguous caisson wall, with tied-backs as required. The shoring systems should be designed in accordance with the latest edition of the Canadian Foundation Engineering Manual (CFEM). Based on the manual, the following earth-pressure coefficients are recommended:

0.25 Where minor ground movements can be tolerated.

0.35 Where utilities, roads, sidewalks must be protected from significant movement or where vibration from traffic is a factor.

0.45 Where movements are to be minimized such as near adjacent building footings or movement sensitive services (i.e. gas and watermains).

A natural unit weight of 22.0 kN/m^3 of the soil on site may be used.

Lateral restraints can be obtained by installing soil anchors in the upper very stiff to hard clay. For preliminary design purposes, a grout to silty clay bond of 30 kPa may be used. Where re-groutable anchors are used, the available bond may be higher. Clayey soil will tend to get smeared during installation and will leave a thin disturbed soil around the drill hole, thus resulting in lower bond values. Design tests should be carried out to confirm the available bond resistance of the soil anchors.

The shoring system should be designed by a specialist shoring designer. All drilled vertical holes and tieback holes should be temporary cased to minimize the risk of caving. During winter months, the shoring should be covered with thermal blankets to prevent frost penetration behind the shoring system which may result in unacceptable movements.

The recommended design parameters should be confirmed by load testing a number of anchors to 200% design load in accordance with the latest edition of the CFEM. The design for the production anchors should then be modified based on the test results, where necessary. All remaining anchors must be installed using similar procedures and proof tested to 1.33 times the design load.

EXP should be retained to review the shoring design, to monitor installation and testing of the system, and to monitor the shoring movements during all phases of the excavation. Inclinometers should be installed at locations where buildings or sensitive services lie close to the excavation. Careful monitoring is needed in any

shored excavation, especially when buildings are located in close proximity. This is necessary not only to anticipate when and if additional support is needed, but also to provide data to meet claims from adjacent property owners. In this regard, it is essential that detailed precondition surveys be made on adjacent structures.

5.6 Lateral Earth Pressure

The lateral earth pressure acting on the foundation walls may be calculated using the following equation:

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

where
- p = lateral earth pressure intensity at depth, h (kPa)
- K = earth pressure coefficient (assume 0.40)
- γ = unit weight of retained soil (assume 21.0 kN/m^3 for granular backfill)
- h = depth to point of interest (m)
- q = surcharge load acting adjacent to the wall at the ground surface (kPa)

The above expression assumes that the perimeter drainage system prevents the build-up of hydrostatic pressure behind the wall and free-draining granular material will be used for backfilling adjacent to the wall. Otherwise, if the building is constructed as a tank without drainage, lateral hydrostatic and uplift pressures below the slab will need to be accounted for using the expression below:

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

where
- p = lateral earth pressure and hydrostatic pressure acting at depth h (kPa)
- K = active earth pressure coefficient, assume 0.40
- γ_w = unit weight of water, 10 kN/m^3
- γ = unit weight of soil surrounding the structure, assume 22.0 kN/m^3
- γ' = effective unit weight of retained soil, assume 12 kN/m^3
- h = depth to point of interest (m)
- q = equivalent value of surcharge on the ground surface (kPa)

5.7 Groundwater Control

The most recent groundwater levels in the monitoring wells on site ranged from 1.5 to 3.0 m below grade. As such, basement excavations are anticipated to extend below the groundwater level and water infiltration from the overburden soil should be anticipated. Given the fine-grained nature of the encountered soils, the groundwater is expected to be controllable using conventional construction sump pumping techniques combined with oversized excavations and ditching, as required. Reference should be made to the hydrogeological study to further assess the construction dewatering rates and established seasonally high groundwater level at the site.

5.8 Floor Slab-on-Grade and Permanent Drainage

The lowest floor slab for the condominium structures and townhouse units may be constructed as slab-on-grade on the native silty clay. It is recommended that the exposed subgrade be examined by a geotechnical engineer prior to constructing the floor slab-on-grade. All exposed subgrades should be proof-rolled as described in Section 5.1 above. The floor slab should be cast on a moisture barrier consisting of 19 mm clear stone with a thickness of at least 200 mm. The clear stone layer will minimize the capillary rise of moisture from the subgrade to the floor slab (moisture barrier). Adequate saw cuts should be provided in the floor slab as directed by the structural engineer to help control cracking.

Perimeter and underfloor drainage is considered necessary for the condominium building with a basement unless the building is constructed as a "tank" and fully waterproofed and designed to resist hydrostatic pressure. Refer to Drawing No. 11 in Appendix A for backfill and drainage recommendations. The spacing of the underfloor drainage should be a maximum of 5 m on centre one way with an invert elevation of at least 300 mm below the underside of the slab. If a raft foundation is used, it can be used as the floor slab. Otherwise, a space of about 600-750 mm will be needed to accommodate services above the raft and 19 mm clear stone can be used as backfill between the raft foundation and the overlying floor slab. In this scenario, underfloor drainage pipe should be installed on top of the raft to collect any seepage.

5.9 Backfill Considerations

Backfill used to satisfy under slab requirements and service trenches, etc. should be compactible fill, i.e. inorganic soil with its moisture content close to its optimum moisture content as determined in the Standard Proctor Test. Fill placed below concrete slab areas should be compacted to 95% Standard Proctor Maximum Dry Density (SPMDD) in lifts not exceeding 200 mm.

To minimize potential problems, any trench backfilling operations should follow closely after excavation so that only minimal length of trench slope is exposed. This will minimize wetting of the subgrade material. Should construction extend to the winter season, particular attention should be given to ensure that frozen material is not used as backfill.

The majority of excavated material will likely consist of silty clay. In general, the excavated material may be reused for backfill subject to the removal of any unsuitable material (oversized particles, organics, etc.) and provided the area is accessible to large compaction equipment. However, moisture content adjustment of re-used soils may be required to achieve efficient compaction. Where large compaction equipment cannot be used or in confined areas and in areas where free drainage characteristics are required, imported granular material conforming to OPSS Granular B Type I or II would be suitable for these purposes.

All backfilling and compaction operations must be closely examined by a qualified geotechnical consultant to ensure uniform compaction to specification requirements, especially in the vicinity of manholes and catch basins, and in all areas that are not readily accessible to compaction equipment.

5.10 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented in the subsections below.

5.10.1 Subsoil Conditions

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 of the OBC 2012. Native, generally stiff to hard, silty clay underlies the site to depths of approximately 4.9 to 7.6 m. There have been no shear wave velocity measurements carried out at this site and therefore, N values and EXP's knowledge of the soil and bedrock conditions in the area have been used to determine the site classification. Estimated undrained shear strengths from pocket penetrometer and in-situ shear vane tests ranged from 50 kPa to greater than 225 kPa.

5.10.2 Site Classification

Based on the known soil conditions and anticipated founding conditions, the recommended Site Class for this site is "D" as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012. The acceleration and velocity-based site coefficients, F_a and F_v, should be determined from Tables 4.1.8.4.B. and 4.1.8.4.C. respectively of the OBC for the above recommended Site Class.

It may be possible to achieve an improved site class through the evaluation of the subsurface conditions using shear wave velocities and depending on the building configuration. EXP can be contacted to provide this service, if required.

5.11 Soil Corrosivity

Analyses of pH, sulphates and chlorides concentrations were performed on selected soil samples. The complete test results are included in the Certificate of Analysis in Appendix C and summarized in the table below.

Table 5-2: Results of pH, Sulphate, and Chloride Concentrations

Borehole and Sample No.	pH	Sulphate (µg/g)	Chloride (µg/g)
BH-1 SS3	7.87	3,100	10
BH-7 SS5	8.11	852	4

According to the Canadian Standards Association (CSA A23.1, Table 3) requirements for concrete subjected to sulphate attack, the use of sulphate resistance concrete is recommended when soluble sulphate concentrations in soils are greater than 1,000 µg/g (0.10%). The test results were also compared to the Corrosion Guidelines (Caltrans, May 2021, version 3.2). According to Caltrans, a site is considered corrosive if, "chloride concentration is 500 ppm [0.05%] or greater, sulphate concentration is 1,500 ppm [0.15%] or greater, or the pH is 5.5 or less". The highest concentration of soluble sulphate and chloride ions in the soil samples tested were 3,100 µg/g (0.31%) and 10 µg/g (0.001%) respectively, indicating a severe degree of sulphate exposure.

Given the sulphate test results, an S-2 exposure class concrete is recommended for used for the below grade structures. It is noted that the results from different areas may potentially indicate higher values of soluble sulphate and chloride concentrations.

5.12 Roadway and Parking Lot Construction

It is understood that new paved areas may be constructed at the site. The proposed residential buildings are anticipated to include medium duty parking/driveway areas as well as heavy duty truck routes.

The recommended pavement structures are provided in the table below and are based on an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and traffic requirements. Consequently, the recommended pavement structures should be considered for preliminary design purposes only.

Table 5-3: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Medium-Duty Parking	Truck Routes & Heavy-Duty Parking
Asphaltic Concrete (OPSS 1150)	Min 92.0% Maximum Relative Density (MRD)	40 mm HL3 50 mm HL8	40 mm HL3 80 mm HL8
Granular A Crusher Run Limestone (OPSS 1010)	100% SPMDD	150 mm	150 mm
Granular B Type II (OPSS 1010)	100% SPMDD	250 mm	350 mm

The granular base and sub-base must be placed in maximum 200 mm lifts and compacted to 100% of the Standard Proctor Maximum Dry Density (SPMDD) at a moisture content within 2% of the optimum moisture content. The subgrade should be compacted to at least 95% SPMDD, or 98% SPMDD for at least the upper 600 mm. The recommended pavement structures outlined assume adequate provision for drainage.

The foregoing design assumes construction is carried out during dry periods and the subgrade is properly shaped, crowned, and then proof-rolled in the full-time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to at least 98% SPMDD. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of sub-base course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent subgrade softening.

Additional comments on the construction of the paved areas are as follows:

- Assuming that satisfactory crossfalls have been provided for subdrainage, subdrains extending from and between catch basins may be sufficient.
- To minimize problems of differential movement between the pavement and catch basins/manholes due to frost action, the backfill around the structures should consist of free draining granular fill.
- The most severe loading conditions on pavement areas and the subgrade may occur during construction. Consequently, special provisions such as half loads during paving, etc. may be required, especially if construction is carried out during unfavourable weather.

6. General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the current geotechnical conditions of the subject property. The conclusions presented in this report reflect site conditions existing at the time of the investigation.

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

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

More specific information, with respect to the conditions between samples, or the lateral and vertical extent of materials, may become apparent during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, EXP Services Inc. should be contacted to assess the situation and additional testing and reporting may be required. EXP Services Inc. has qualified personnel to provide assistance in regard to future geotechnical and environmental issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Cedric Ramos, B.A.Sc.
Geotechnical-Engineering-in-Training

Jeffrey Golder, P.Eng.
Manager, Hamilton Geotechnical Services

LICENSED PROFESSIONAL ENGINEER
J. K. GOLDER
100155552
PROVINCE OF ONTARIO

Appendix A

Drawings & Borehole Logs

EXP Services Inc.
t: +1.905.573.4000 | f: +1.905.573.9693
1266 South Service Rd. Unit C1-1
Stoney Creek, ON L8E 5R9
Canada

www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:

APPROXIMATE BOREHOLE LOCATION

TITLE AND LOCATION:

BOREHOLE LOCATION PLAN
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
WEST STREET, SMITHVILLE, ON

JOB NO.: HAM-22015175-D0	DRAWN BY: CR
SCALE: 1:2000	CHECKED BY: JG
DATE: AUGUST 2024	DWG NO.: 1

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

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

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

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

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

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	"trace" (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	"some" (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	"and" (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance "N" Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance "N" Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of Borehole BH-1

Project No. HAM-22015175-D0 | Drawing No. 3

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

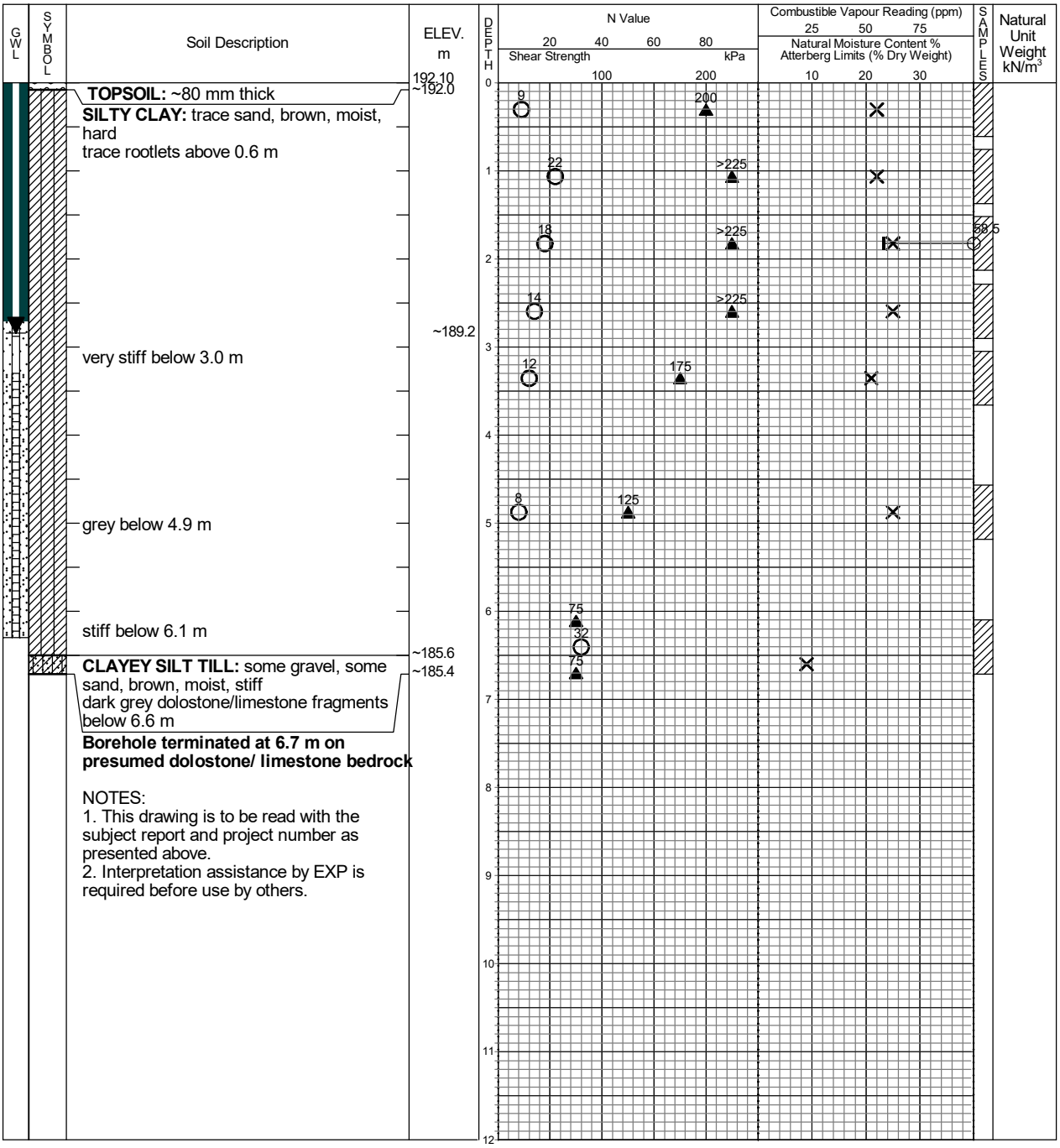
Date Drilled: July 27, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	no cave
August 11, 2022	2.7	
August 24, 2022	2.9	

Log of Borehole BH-2

Project No. HAM-22015175-D0 | Drawing No. 4

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

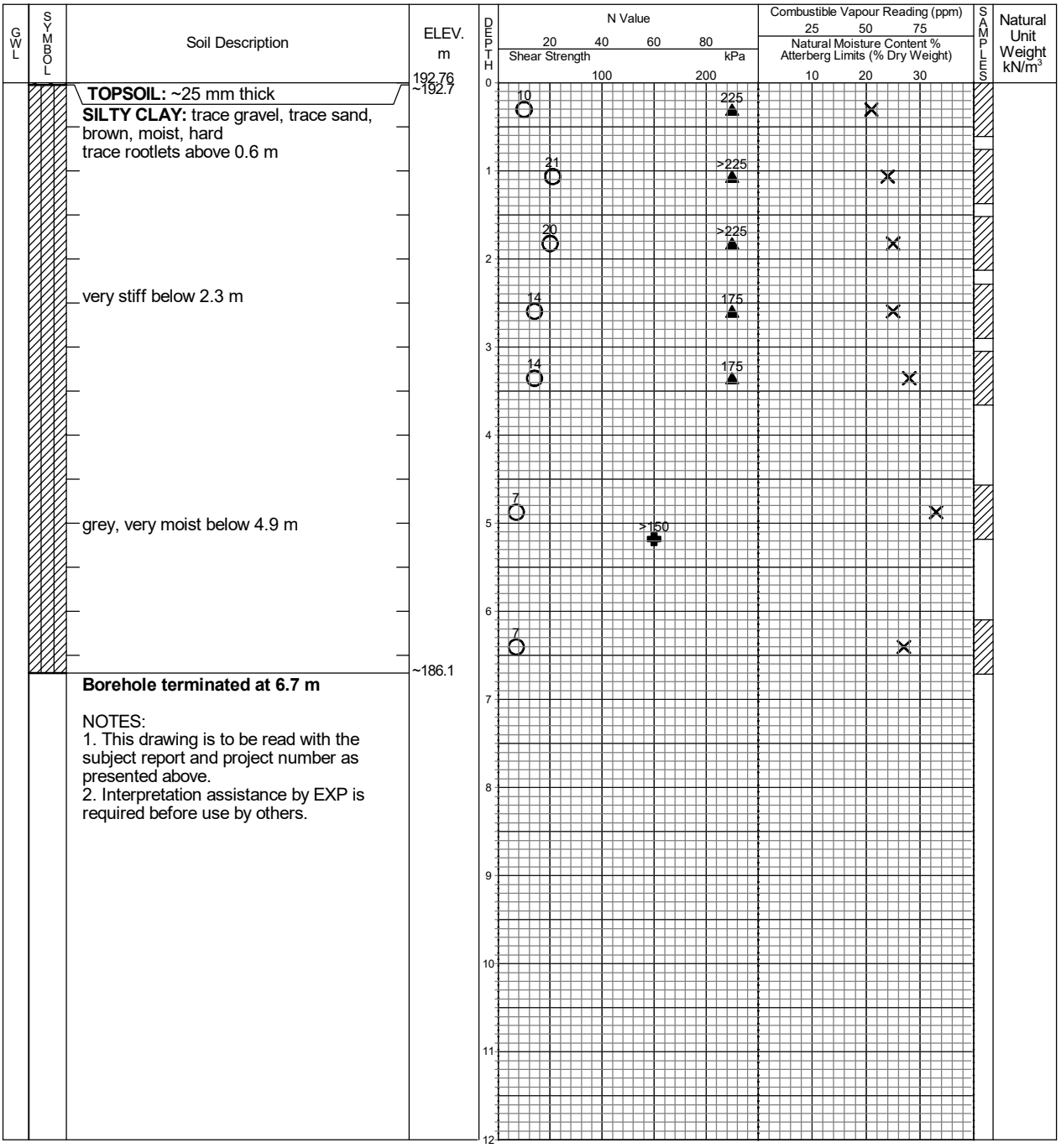
Date Drilled: July 27, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	no cave

Log of Borehole BH-3

Project No. HAM-22015175-D0 | Drawing No. 5

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

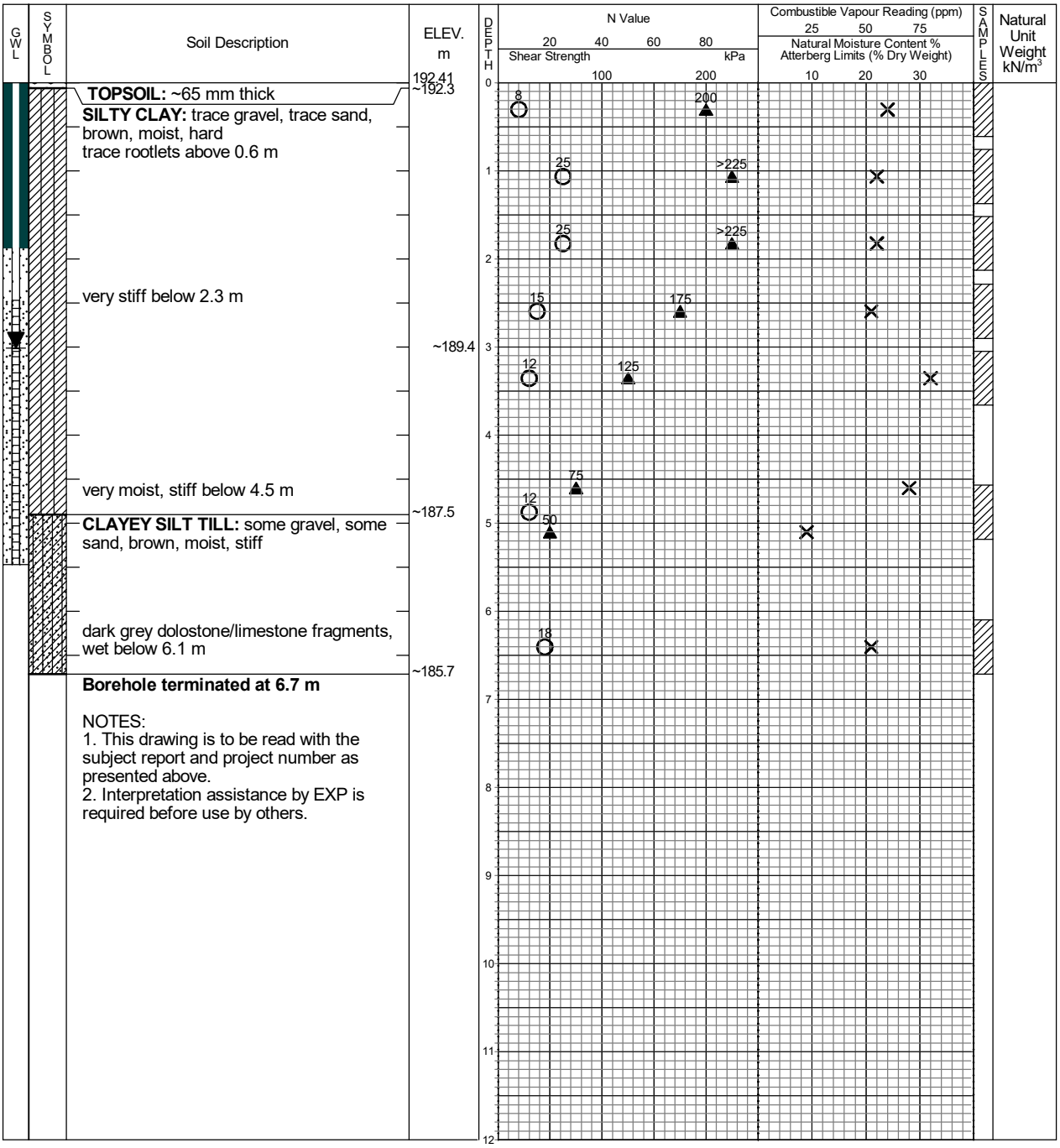
Date Drilled: July 27, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	2.4	no cave
August 11, 2022	2.8	
August 24, 2022	3.1	

Log of Borehole BH-4

Project No. HAM-22015175-D0 | Drawing No. 6

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

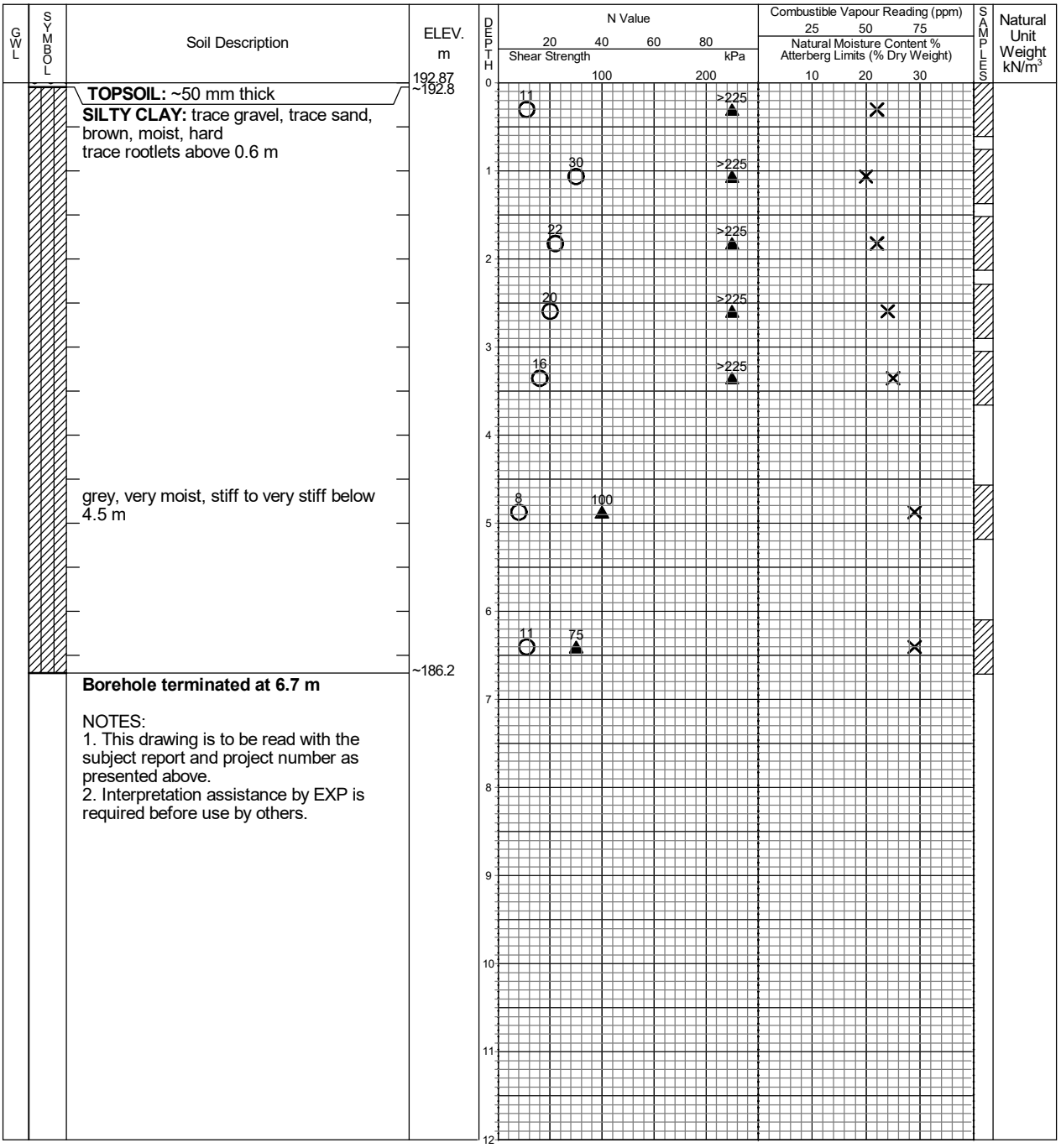
Date Drilled: July 27, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	no cave

Log of Borehole BH-5

Project No. HAM-22015175-D0 | Drawing No. 7

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

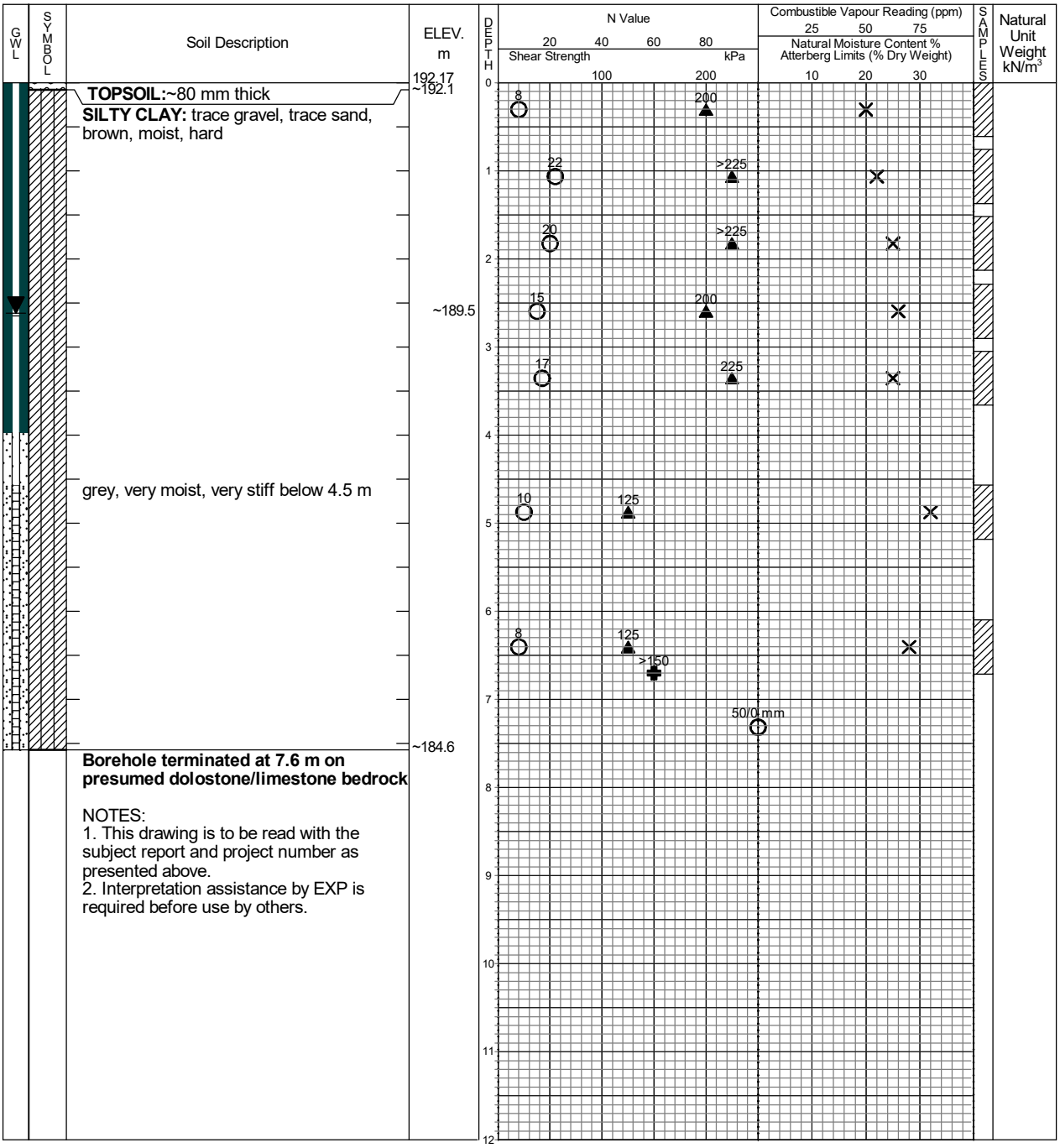
Date Drilled: July 28, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	7.0	no cave
August 11, 2022	2.5	
August 24, 2022	2.7	

Log of Borehole BH-6

Project No. HAM-22015175-D0 | Drawing No. 8

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

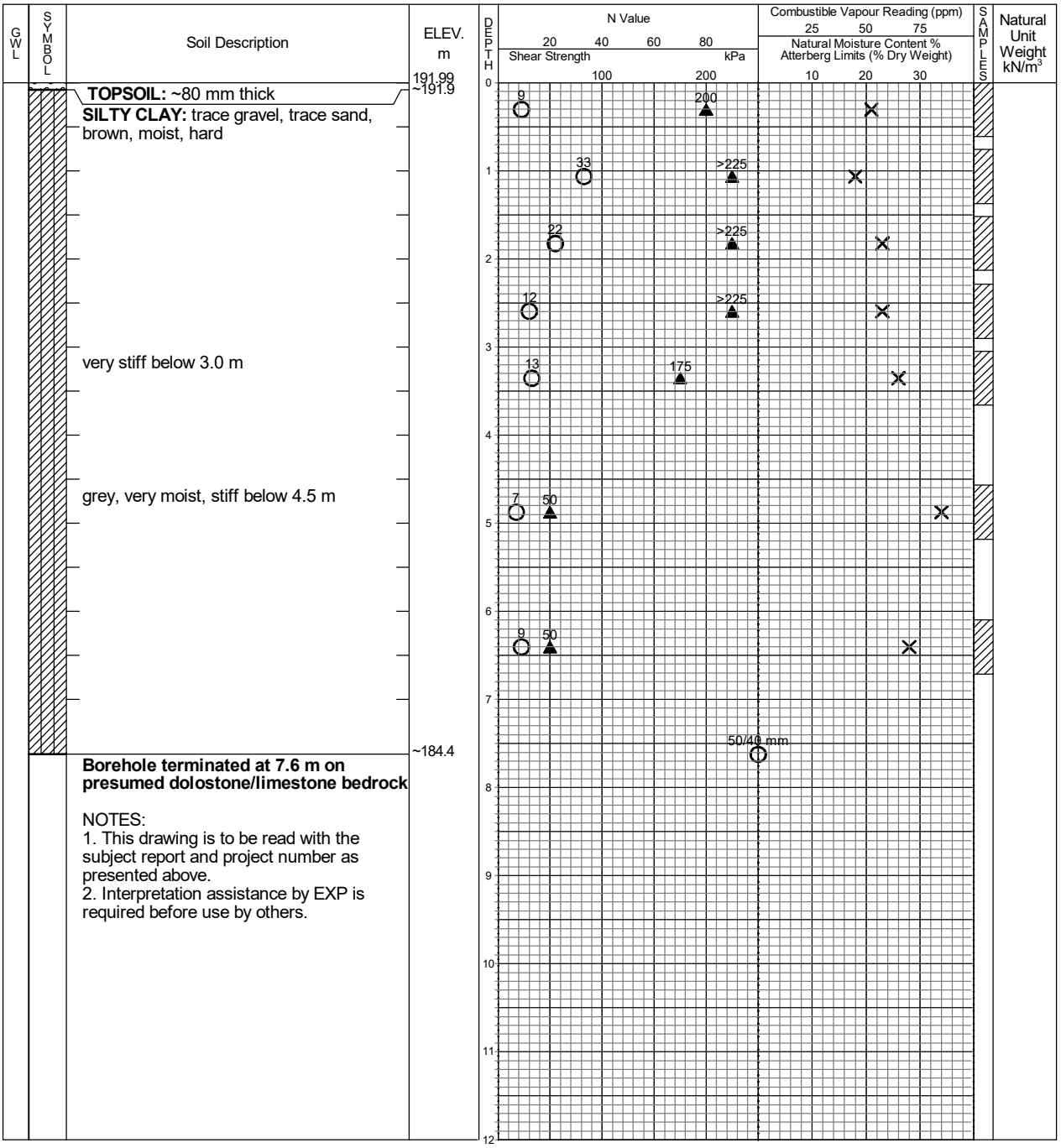
Date Drilled: July 27, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	3.3	no cave

Log of Borehole BH-7

Project No. HAM-22015175-D0 | Drawing No. 9

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

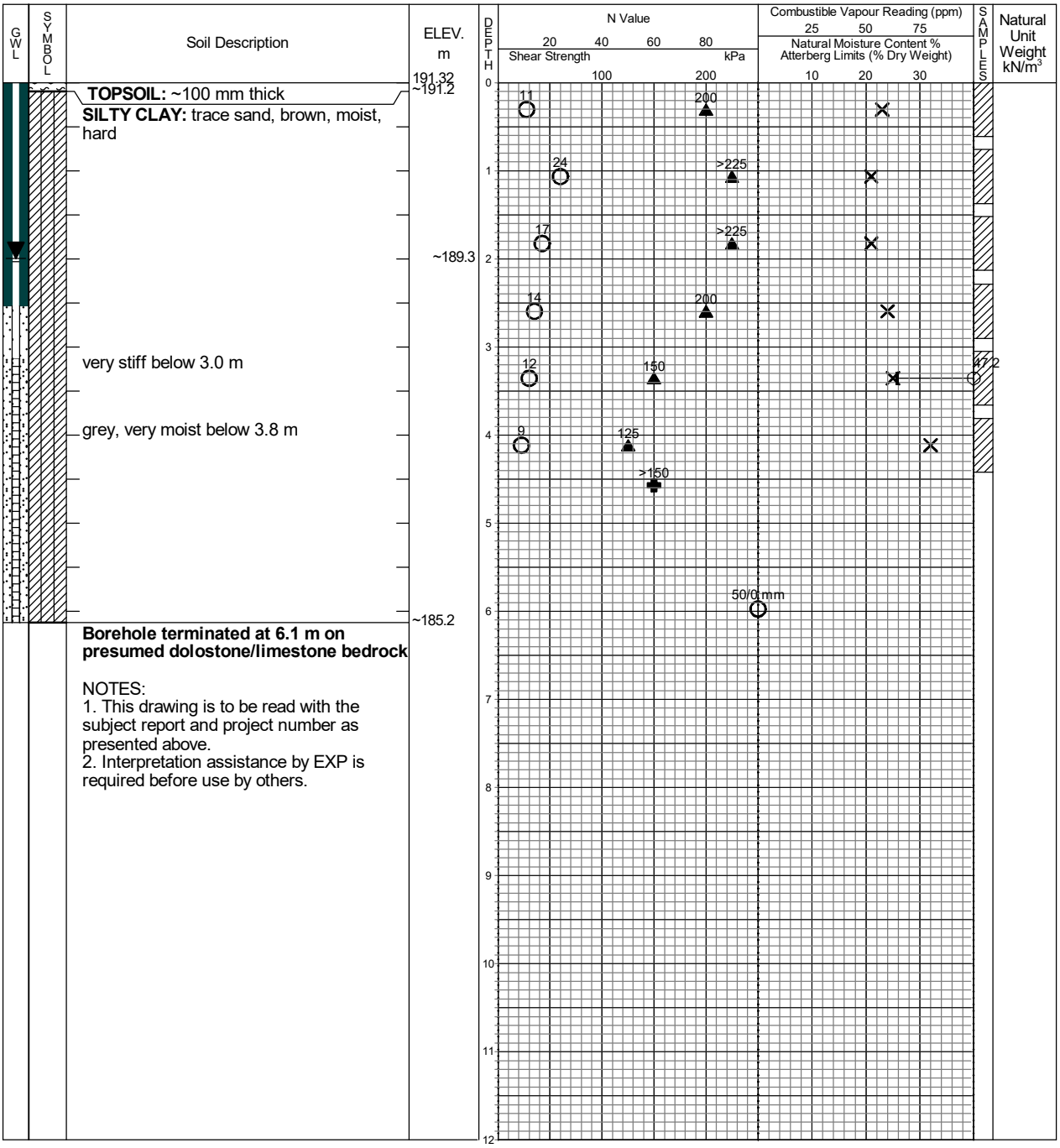
Date Drilled: July 28, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	3.1	no cave
August 11, 2022	1.8	
August 24, 2022	2.0	

Log of Borehole BH-8

Project No. HAM-22015175-D0 | Drawing No. 10

Project: Geotechnical Investigation | Sheet No. 1 of 1

Location: West Street, Smithville, ON

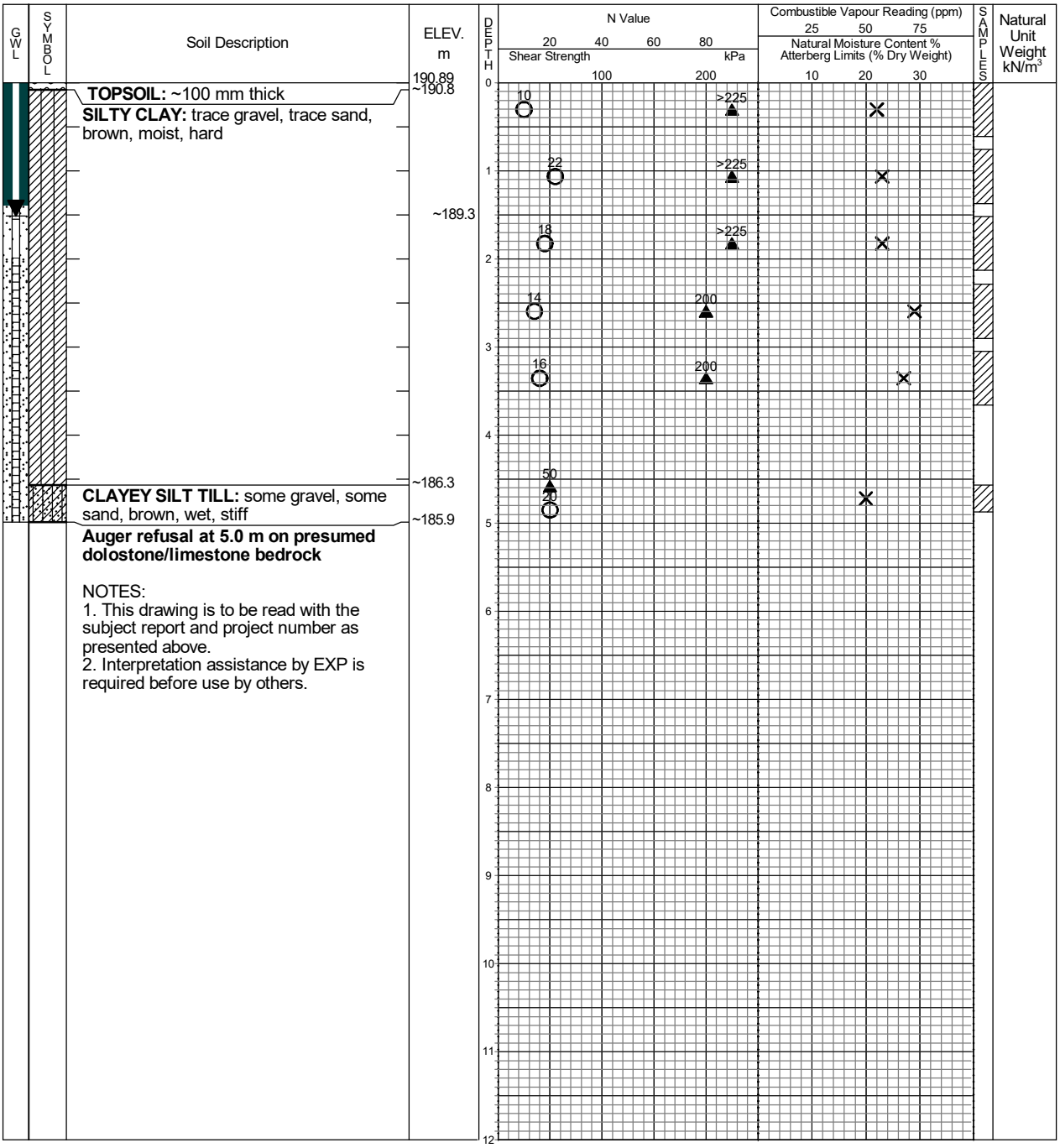
Date Drilled: July 28, 2022

Drill Type: D-50 Track Mount, Solid Stem

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

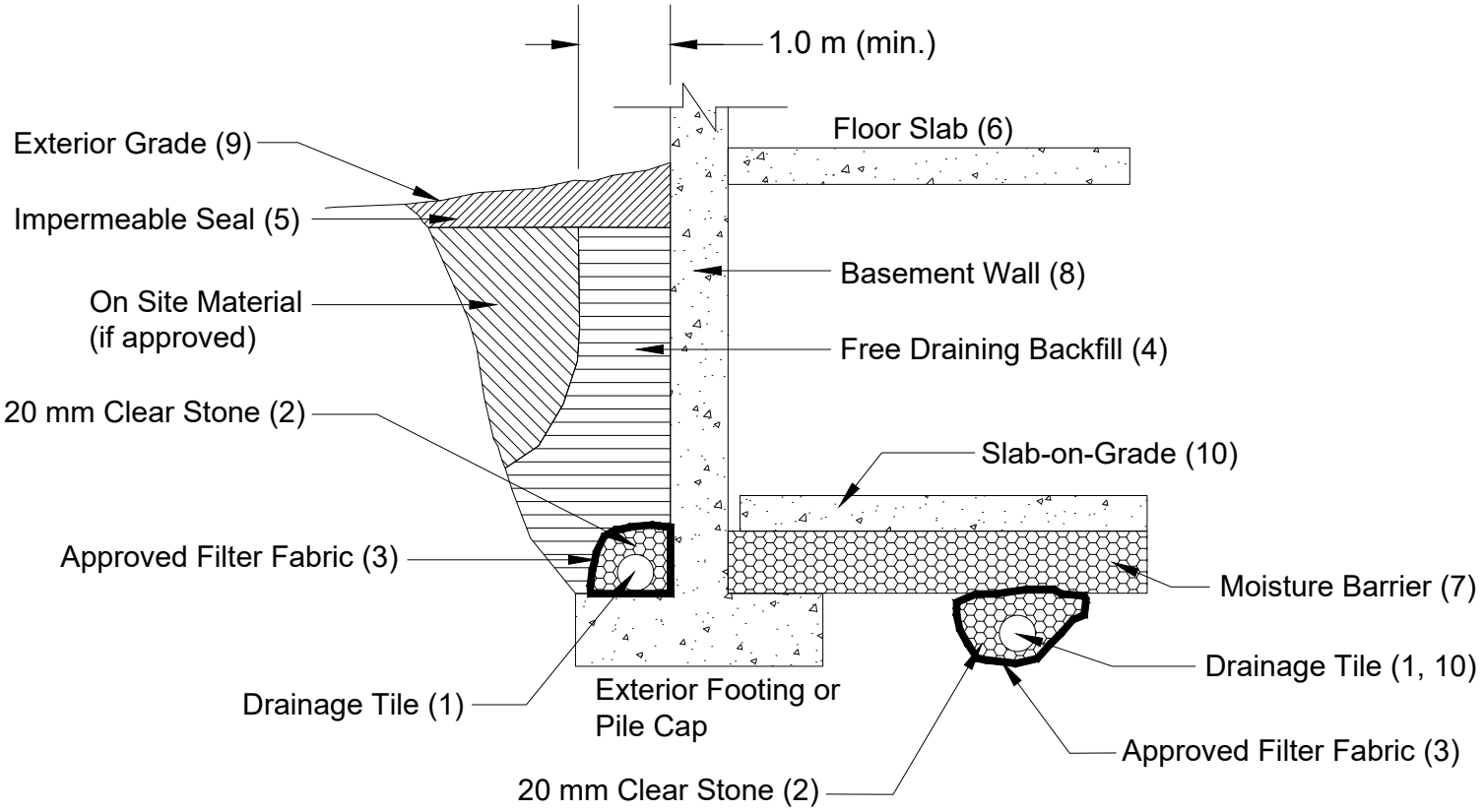


NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.

LAGWGLJFHAM-EXP BHLOGS.GPJ NEW.GDT 8/30/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	2.6	no cave
August 11, 2022	1.4	
August 24, 2022	1.6	



NOTES

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Perimeter invert to be a minimum of 150 mm (6") below underside of floor slab. Under-floor invert to be a minimum of 300 mm (12") below underside of floor slab.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place 100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter fabric (Terrafix 360R or equivalent).
4. OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Entire basement wall should be waterproofed.
9. Exterior grade to slope away from building.
10. Under-floor drainage tile placed in parallel rows to a maximum of 5.0 m centers one way. Under-floor drains should not be connected to perimeter drains.
11. Slab on grade should not be structurally connected to the wall or footing.
12. Review the geotechnical report for specific details.

EXP Services Inc.
t: +1.905.573.4000 | f: +1.905.573.9693
1266 South Service Road, Unit C1-1
Hamilton, ON L8E 5R9
Canada
www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY • INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

TITLE AND LOCATION:

DRAINAGE AND BACKFILL RECOMMENDATIONS - Basement Wall

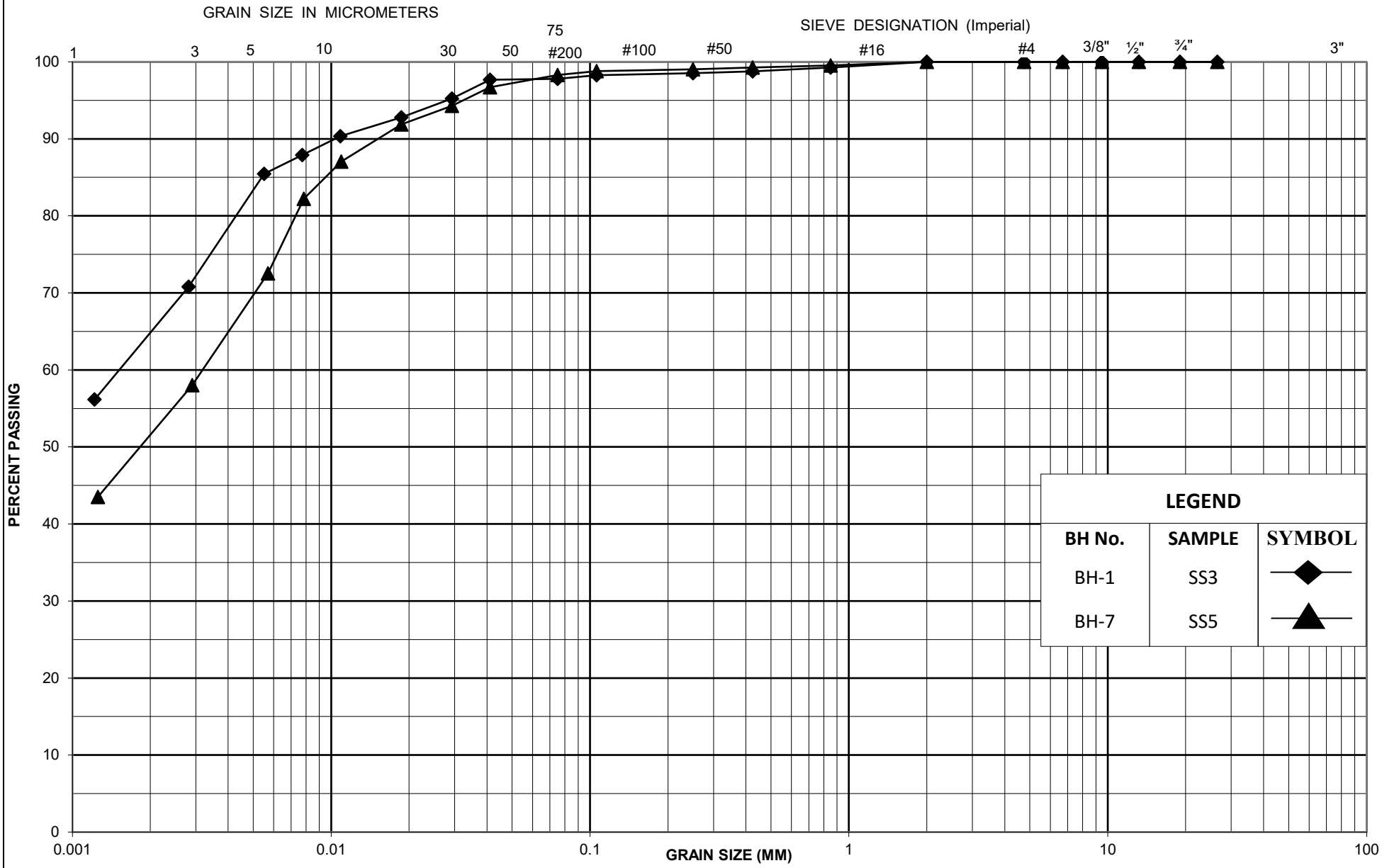
PROJECT NO.:	DWN.:
HAM-22015175-D0	CR
SCALE: NTS	CK: JG
DATE: AUGUST 2024	DWG. NO.: 11

Appendix B

Laboratory Test Results

ISSMFE SOIL CLASSIFICATION SYSTEM

CLAY	SILT			SAND			GRAVEL			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

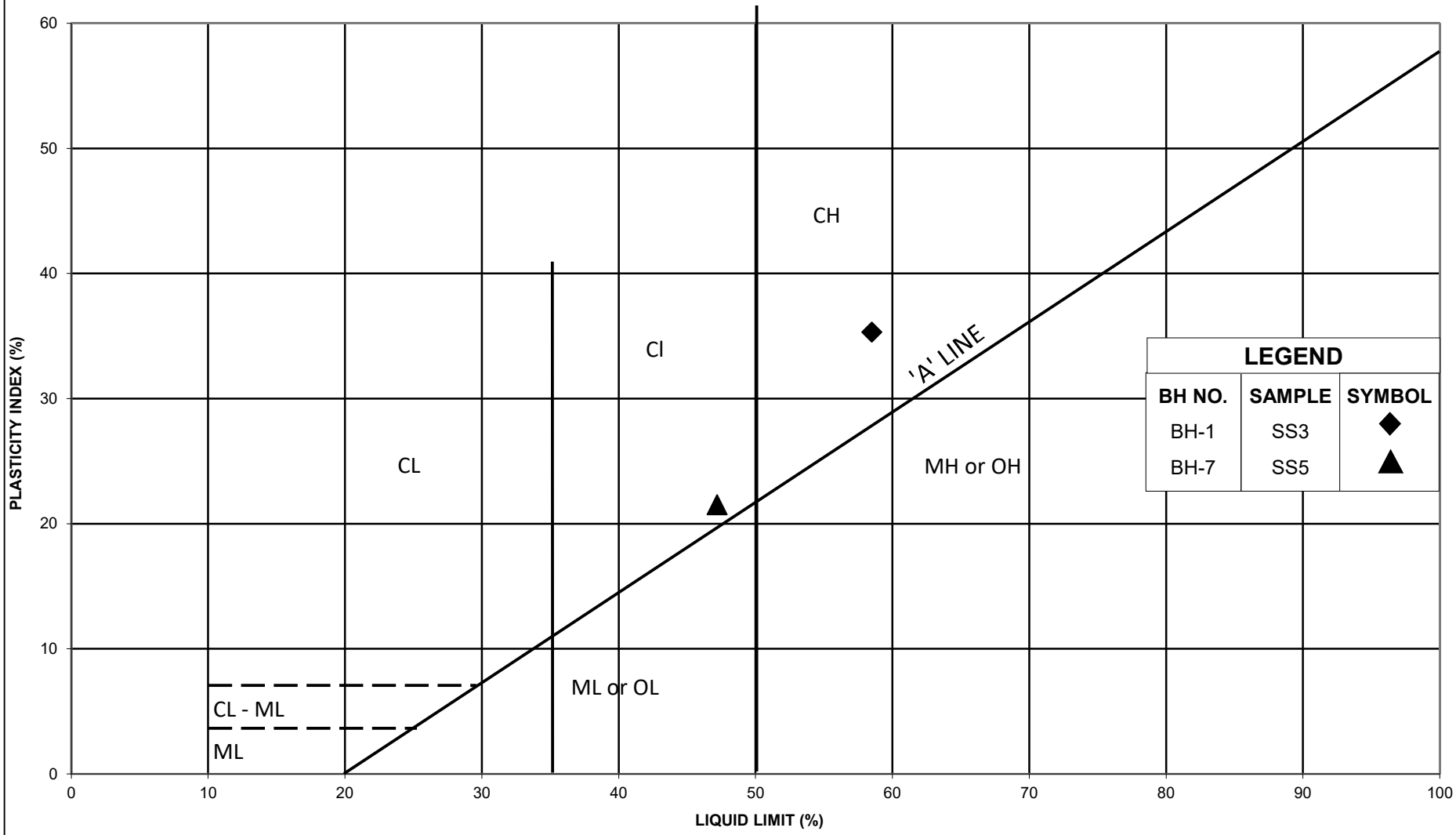


GRAIN SIZE DISTRIBUTION

DRAWING NO.:	B1
PROJECT NO.:	HAM-22015175-D0
DATE:	AUGUST 2024

PROPOSED RESIDENTIAL DEVELOPMENT

West Street, Smithville, ON



exp.

PLASTICITY CHART

SILTY CLAY (CI & CH)

DRAWING NO.:	B2
PROJECT NO.:	HAM-22015175-D0
DATE:	AUGUST 2024

Appendix C

Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
1266 SOUTH SERVICE ROAD, SUITE C1-1
STONEY CREEK , ON L8E 5R9
(905) 573-4000
ATTENTION TO: Isaac Asonya
PROJECT: HAM-22015175-B0
AGAT WORK ORDER: 22H930097
SOIL ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician
DATE REPORTED: Aug 12, 2022
PAGES (INCLUDING COVER): 5
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22H930097

PROJECT: HAM-22015175-B0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Isaac Asonya

SAMPLING SITE:West Street, Smithville

SAMPLED BY:Isaac

Inorganic Chemistry (Soil)

DATE RECEIVED: 2022-08-05

DATE REPORTED: 2022-08-12

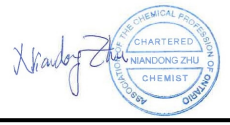
				SAMPLE DESCRIPTION:	BH1-SS3	BH7-SS5
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2022-08-05 13:00	2022-08-05 13:00
Parameter	**Unit**	**G / S**	**RDL**		**4177760**	**4177761**
Chloride (2:1)	µg/g		2		10	4
Sulphate (2:1)	µg/g		2		3100	852
pH (2:1)	pH Units		NA		7.87	8.11

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

4177760-4177761 pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22H930097

PROJECT: HAM-22015175-B0

ATTENTION TO: Isaac Asonya

SAMPLING SITE:West Street, Smithville

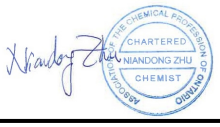
SAMPLED BY:Isaac

Soil Analysis

RPT Date: Aug 12, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
Chloride (2:1)	4177760	4177760	10	11	9.5%	< 2	100%	70%	130%	102%	80%	120%	103%	70%	130%
Sulphate (2:1)	4177760	4177760	3100	3170	2.2%	< 2	106%	70%	130%	104%	80%	120%	NA	70%	130%
pH (2:1)	4177760	4177760	7.87	7.90	0.4%	NA	87%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.
Matrix spike: Spike level < native concentration. Matrix spike acceptance limits do not apply.

Certified By:



AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22H930097

PROJECT: HAM-22015175-B0

ATTENTION TO: Isaac Asonya

SAMPLING SITE:West Street, Smithville

SAMPLED BY:Isaac

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

AGAT Laboratories

1 small 1 Gel

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: EXP Services Inc.
Contact: Isaac Asonya
Address: 1266 South Service Rd, Unit C1-1
Stoney Creek, ON L8E 5R9
Phone: 365-999-2427 Fax:
Reports to be sent to:
1. Email: isaac.asonya@exp.com
2. Email: jeffrey.golder@exp.com

Project Information:

Project: HAM-22015175-B0
Site Location: West Street, Smithville
Sampled By: Isaac
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

☑ Regulation 153/04
Table 1 (Indicate One)
☐ Ind/Com
☑ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☑ Fine

☐ Excess Soils R406
Table _____ (Indicate One)
☐ Regulation 558
☐ CCME

☐ Sewer Use
☐ Sanitary ☐ Storm
_____ (Region)
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
_____ (Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No

Report Guideline on *Certificate of Analysis* ☑ Yes ☐ No

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Laboratory Use Only

Work Order #: 22H930097
Cooler Quantity: 1 Small
Arrival Temperatures: 15.5 | 15.1 | 15.4
8.6 | 8.1 | (on ice)
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: On ice

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	O. Reg 153: Analyze F4G if required ☐ Yes ☐ No	O. Reg 153: PAHs	O. Reg 153: PCBs	O. Reg 153: VOC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Sulphates	Chlorides	PH	Potentially Hazardous or High Concentration (Y/N)
BH1-SS3	Aug 5	1	1	Soil														✓	✓	✓	
BH7-SS5	Aug 5	1	1	Soil														✓	✓	✓	
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			
		AM PM																			

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Isaac Asonya	Aug 5, 22	5 pm	Chris Tahne	Aug 5/22	5:00pm
DIAC	AUG 8/22	3PM			
			Shazmin	Aug 8/2022	4:20 pm

Page 1 of 1

DW# T 130554

Document ID: DW 78 2611 021

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: March 9, 2021