Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
PROPOSED STONEBROOK RESIDENTIAL DEVELOPMENT
105 MARGARET ELIZABETH AVENUE
MARKDALE, ONTARIO
FOR
2544540 ONTARIO INC.

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PML Ref.: 17CF005
Report: 1
June 2017

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 22, 2017

PML Ref.: 17CF005
Report: 1

Mr. Remo Niceforo
2544540 Ontario Inc.
120 Jevlan Drive
Suite 1
Woodbridge, Ontario
L4L 8G3

Dear Mr. Niceforo

Geotechnical Investigation
Proposed Stonebrook Residential Development
105 Margaret Elizabeth Avenue
Markdale, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this work was provided by Mr. Grant Beeler of C.C. Tatham & Associates Ltd. (CCT) in emails dated April 11 and 27, 2017.

A new residential development is proposed on the approximate 2.6 ha property located east Margaret Elizabeth Avenue and north of Grayview Drive in Markdale Ontario. The development will comprise ten townhouse blocks, each with two or three units. Full basements are proposed. For purposes of this report Margaret Elizabeth Avenue is assumed to run north/south and Grayview Drive east/west. The development will be fully serviced with storm and sanitary sewers and watermain services anticipated to have inverts of 2 to 3 m below existing grade, and as much as 8 m below grade at the location of the existing pump station on Grayview Drive, southeast of the proposed development. Low Impact Development (LID) infiltration features are being considered for storm water management purposes, and a Storm Water Management (SWM) Pond will be incorporated to the northeast of the proposed residential development in the adjacent agricultural field. Site features are shown on Drawing 1, appended.

A geotechnical investigation was requested in order to examine the subsurface conditions at the site, and based on this information, provide comments and geotechnical engineering recommendations for building foundations and basements, site servicing, infiltration parameters for LID, SWM pond, and pavement design.

Geo-environmental services (observations, recording, testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. If excess soils requiring transportation off-site are generated, a program of sampling and chemical testing will be needed to determine the chemical properties of the soil to evaluate receiving site options, in accordance with the MOECC Document, Management of Excess Soil - A Guide for Best Management Practices, January 2014.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

INVESTIGATION PROCEDURES

The three boreholes for this investigation were carried out on April 27, 2017 and were advanced to 4.7 to 8.5 m. Test Pit 101 was excavated on June 7, 2017 to 3.1 m depth as shown on the Borehole and Test Pit Location Plan, Drawing 1, appended.

Co-ordination of clearances of underground utilities was provided by PML, with the aid of a private locating service.

The locations of the boreholes were established in the field by PML based on a plan provided by CCT and cognizant of underground utilities. The location of the test pit was selected by CCT.

The boreholes were advanced using continuous flight hollow stem augers, powered by a rubber track mounted D-50 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor working under the full-time supervision of a member of PML's engineering staff. The test pit was excavated with a track mounted backhoe retained by the Client and working under the direction of PML.

Representative samples of the overburden in the boreholes were recovered at frequent depth intervals for identification purposes using a conventional split spoon sampler. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the substrata. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler, and drill rods as the samples were retrieved, and measurement of the water level in the open boreholes, if any. Boreholes were backfilled in accordance with O.Reg. 903.

As the test pit was excavated, PML sampled and logged the subsurface conditions. The test pit was backfilled upon completion.

Ground surface elevations of the boreholes and test pit were referenced to the following Temporary Bench Mark (TBM), provided by the CCT, as shown on Drawing 1 and described as follows:

TBM: Temporary Bench Mark
Top of Sanitary Manhole 157A

Elevation 423.14 (metric, geodetic)

All recovered soil samples were returned to our laboratory for moisture content determinations and detailed examination to confirm field classification. Grain size analyses were carried out on five samples of the major soil units, the results are presented on Figures 1 to 5, appended. Atterberg limits testing was completed on three of these samples.

SITE DESCRIPTION AND SUMMARIZED SUBSURFACE CONDITIONS

The approximately 2.6 ha undeveloped property is located in the northeast quadrant of Margaret Elizabeth Avenue and Grayview Drive intersection behind the existing residences. Based on the topographic plan provided by C.C. Tatham and Associates Ltd., the site generally slopes down from the west (Borehole 1) and east (Borehole 3) towards the centre of the site (Borehole 2), and from the south towards the north. There is about 6 m of relief from the subdivision area, down to the proposed SWM pond.

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, inferred stratigraphy, Standard Penetration test N values, ground water observations and the results of laboratory moisture content determinations and Atterberg limits testing. The Log of Test Pit sheet provides details of the subsurface conditions in the test pit, including soil classifications and ground water observations.

Due to the soil sampling procedures and limited sample size, the depth demarcations on the borehole logs must be viewed as "transitional" zones between layers, and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in determining geologic boundaries in the field during construction, if required.

The stratigraphy encountered in the boreholes consisted typically of a topsoil mantle over deposits of native sand till, sand and gravel and/or sand, with a clayey silty layer locally. Fill was noted beneath the topsoil in Borehole 3. The test pit showed topsoil over a sand and gravel deposit.

Topsoil

A 120 to 250 mm layer of topsoil was found at the surface of all boreholes and the test pit.

Fill

A local fill layer was encountered below the topsoil in Borehole 3 extending to 0.7 m depth (elevation 423.70). The fill comprised silty sand, trace gravel and was moist, with a moisture content of 5%.

Sand

A sand layer was encountered below the topsoil in Boreholes 1 and 2 extending to 0.7 m depth (elevation 417.85 to 423.70). The material was very loose to compact. Moisture contents ranged from 6 to 20% with the material being moist to wet.

Sand Till

A gravelly silty sand till deposit was encountered in all boreholes, below the sand down to 4.0 m depth (elevation 420.4) in Borehole 1, and to the 4.7 and 8.5 m depth of exploration in Boreholes 2 and 3. Samples of the material from Borehole 1 and 3 were submitted for gradation and the results are presented on Figures 1 and 2, attached. Atterberg limits testing showed the samples were non-plastic. The material was typically loose at the top of the unit becoming compact/dense or very dense with depth. Moisture contents ranged from 7 to 17%.

Clayey Silt

A 1.1 m thick clayey silt layer was encountered within the sand till deposit between 2.9 and 4.0 m depth. A sample was submitted for gradation analyses and the results are presented on Figure 3, attached. Accompanying Atterberg limits testing showed the sample has a plastic limit of 16% and a liquid limit of 22%. The layer was very stiff and about the plastic limit with a water content of 16%.

Sand and Gravel

A sand and gravel layer was encountered below the till in Borehole 1 extending to the 4.7 m depth of exploration, and below the clayey silt in Borehole 3, down to 5.5 m depth (elevation 417.3). The unit was also encountered beneath the topsoil in Test Pit 101. Two samples of the unit from the test pit were submitted for grain size analyses and the results are presented on Figures 4 and 5, appended. The material was very dense and wet in the boreholes, with a moisture content of 7 to 8%. The unit was judged to be compact to dense in the test pit and moist to very moist.

Auger Refusal

Borehole 3 encountered auger refusal at 8.5 m depth (elevation 414.3). Refusal could have been due to boulders or bedrock and would need to be confirmed by rotary diamond coring.

MOECC well records show limestone bedrock to be at 3 to 26 m depth in the area.

Ground Water

The ground water levels measured in the boreholes upon completion of augering, as well as first water strike depths, are summarized in the table below on a borehole by borehole basis:

BOREHOLE / TEST PIT	WATER LEVEL IN BOREHOLES UPON COMPLETION DEPTH (m)/ELEVATION	FIRST WATER STRIKE DEPTH (m)/ELEVATION
1	4.0 / 420.4	2.4 / 422.0
2	4.4 / 414.2	2.2 / 416.4
3	2.4 / 420.4	1.6 / 421.2

Ground water was not noted in the open test pit to the 3.1 m depth of excavation (elevation 409.6).

Ground water levels are subject to seasonal fluctuations, and in response to variations in precipitation.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

General

A new residential development is proposed on the approximate 2.6 ha property located east Margaret Elizabeth Avenue and north of Grayview Drive in Markdale Ontario. The development will comprise ten townhouse blocks, each with two or three units. Full basements are proposed. For purposes of this report Margaret Elizabeth Avenue is assumed to run north/south and Grayview Drive east/west. The development will be fully serviced with storm and sanitary sewers and watermain services anticipated to have inverts of 2 to 3 m below existing grade, and as much as 8 m below grade at the location of the existing pump station on Grayview Drive, southeast of the proposed development. Low Impact Development (LID) infiltration features are being considered for storm water management purposes, and a Storm Water Management (SWM) Pond will be incorporated to the northeast of the proposed residential development in the adjacent agricultural field. Site features are shown on Drawing 1, appended.

Site Grading and Engineered Fill

Final grading was not available at the time of this investigation. For purposes of this report, it is assumed that only minor (less than 0.5 m) of cut and fill will be needed. If grades are to be raised more than 0.5 m then recommendations for engineered fill can be provided.

Foundations

Under the topsoil mantle (and local fill in Borehole 3) the near surface native soils comprise a discontinuous sand layer over a major gravelly silty sand till. The native soils are typically loose in the upper 2 m becoming compact to very dense below about 2 m depth.

For footings supported in the loose native soils between 0.6 m and 2.0 m depth below existing grade, a net geotechnical bearing resistance at Serviceability Limit State (SLS) of 75 kPa and factored bearing resistance at Ultimate Limit State (ULS) of 110 kPa are available for footing design.

For footings founded on compact soil below 2 m below existing grade a net geotechnical bearing resistance at SLS of 200 kPa and a factored bearing resistance at ULS of 300 kPa are available.

The bearing resistance at SLS is based on total settlement of 25 mm in the bearing stratum with differential settlement of 75% of this value.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent.

Prior to placement of structural concrete, all founding surfaces should be reviewed by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions revealed in the excavation.

Seismic Design

Based on the soil profile revealed in the boreholes, Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the type and relative density of the soil cover at the site there is a low potential for liquefaction of soils to occur.

Basement Walls and Floor Slabs

Based on first water strike observations in the boreholes the ground water table was near elevation 421 to 422, about 1.5 to 2.5 m below existing grade, and is subject to seasonal variation. In general it is recommended that basements be established a minimum 0.5 m above the ground water level. In this regard, further monitoring of the ground water levels is recommended.

Full depth basements are proposed. Perimeter walls must be designed to resist the unbalanced horizontal earth pressure imposed by the backfill adjacent to the walls. The lateral earth pressure, P, may be computed using the following equation and assuming a triangular pressure distribution:

$$P = K(\gamma h + q) + C_p$$

Where
- P = lateral pressure at depth h (m) below ground surface (kPa)
- K = lateral earth pressure coefficient of backfill = 0.5
- h = depth below grade (m) at which lateral pressure is calculated
- γ = unit weight of compacted backfill = 20.0 kN/m^3
- q = surcharge loads (kPa)
- C_p = compaction pressure

The above equation assumes that drainage measures will be incorporated to prevent the buildup of hydrostatic pressure. In this regard, foundation wall backfill should comprise free draining granular material conforming to OPSS Granular B in conjunction with a weeping tile system. In lieu of imported Granular B, a proprietary drainage board product can be utilized with on-site soils as backfill. The weeping tiles should be protected by a properly designed granular filter or geotextile to prevent migration of fines into the system. The drainage pipe should be placed on a positive grade and lead to a frost-free outlet. The basement walls should be damp proofed.

Foundation/basement wall backfill should be placed in thin lifts compacted to a minimum 95% Standard Proctor maximum dry density. Over compaction close to the walls should be avoided as this could generate excessive pressure on the walls.

Basement floor slab construction is feasible on native soils. A minimum 200 mm thick base layer of crushed stone (nominal 19 mm size) is recommended directly under the slab. Underfloor drains are recommended in addition to a polyethylene sheet vapour barrier under the ground floor slab.

Exterior grades should be established to promote surface drainage away from the buildings.

Reference is made to appended Figure 6, for general recommendations regarding drainage and backfill requirements for basement walls and floor slabs.

Site Servicing

Design details were not finalized at the time of this report. However, inverts are generally expected to be 2.0 to 3.0 m below existing grade and as much as 8 m below grade near the existing sewage pond station.

Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

Bedding

It is anticipated that services will be supported in native soils where bearing capacity issues are not anticipated. Where poor subgrade soils are encountered at the design invert, it may be necessary to sub-excavate and provide an increased thickness of bedding, subject to geotechnical field review.

Standard Granular A bedding, in accordance with OPSS, compacted to 95% Standard Proctor maximum dry density should be satisfactory. For flexible pipes, bedding and cover material should comprise OPSS Granular A. For rigid pipes, the bedding material should comprise OPSS Granular A and cover material may comprise select native soil free of oversized material (200 mm diameter or less) or excessively wet material.

Trench Backfill

Trench backfill should comprise select inorganic soil placed in maximum 200 mm thick lifts compacted to minimum 95% Standard Proctor maximum dry density, to minimize post construction settlement. Topsoil, organic/peat, excessively wet, frozen, oversized (greater than 200 mm diameter), or otherwise deleterious material should not be incorporated as trench backfill. The moisture content should be within 2% of optimum in order to achieve the specified compaction, and should be closer to the optimum moisture content in the upper 1 m to prevent instability issues. Ideally the backfill should comprise excavated site soil in order to minimize differential frost heave.

The excavated soil will comprise the predominant native granular soils which should be suitable for use as trench backfill subject to moisture content adjustments if required. Weather will also impact the moisture conditions of the soil and suitability for reuse. Geotechnical review of the excavated soil and approval for use as backfill will be necessary during construction.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

Excavation and Ground Water Control

Excavation for the buildings is assumed to about 2 m below existing grade for basements. Excavation for site servicing is assumed to be 2 to 3 m below existing grade, locally 8 m near the existing pump station. Excavation will encounter sand locally over the gravelly silty sand till deposit. Harder digging and the presence of cobbles and boulders should be anticipated in the till.

Subject to effective ground water control, the site soils should be considered as Type 3 soil requiring excavation side walls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

The ground water table was interpreted to be near the 1.5 to 2.5 m depth and subject to seasonal variations. For the shallow excavation to 2 to 3 m depth, sump pumping should suffice to control seepage.

The use of well points will be needed to temporarily lower the ground water table for the deeper site servicing excavation (anticipated to about 8.0 m depth near Borehole 3). In order to reduce the amount of ground water to be handled, it is recommended that only short sections of trench be excavated at one time and that the site servicing work should be carried out during the dry time of the season when the ground water table is usually at its lowest. Depending on the length and size of excavation, sheet pile shoring may also be employed. Parameters for design can be provided if required.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Takings and Transfer Regulation O. Reg. 387/04. Section 34 of the OWRA requires anyone taking more than 50,000 L/d to obtain a Permit-To-Take-Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering, or permanent drainage improvements. Recently the MOECC made some changes to the PTTW requirements. Where it is assessed than more than 50,000 L/d but less than 400,000 L/d of ground water taking is required, the Owner can register online via the Environmental Activity and Sector Registry (EASR) system. Where it is assessed that more than 400,000 L/d of ground water taking is required then a Category 3 PTTW is required. Based on the discussion above, shallow excavation for houses and servicing along the road will likely not require a PTTW or Registry on EASR. The deeper excavation near Borehole 3 for the servicing (8 m) will likely require a PTTW or Registry on the EASR.

When grading and servicing inverts have been finalized, they should be submitted to PML to review ground water requirements and need for a PTTW.

It is recommended that a test dig be undertaken to allow prospective contractors an opportunity to observe and evaluate the subsurface conditions likely to be encountered and assess preferred means of excavation and ground water control measures based on their own experience.

Infiltration Parameters

LID strategies are being considered at the site for storm water management purposes. The locations of any infiltration infrastructure are yet to be determined.

A summary of the particle size distribution analyses and estimates of permeability are provided below:

FIGURE	BOREHOLE/ TEST PIT	DEPTH (m)	SOIL DESCRIPTION	ESTIMATED PERMEABILITY, k, (cm/sec)
1	3	1.5 to 1.9	Till: Gravelly Silty Sand	$1x10^{-5}$
2	1	1.5 to 1.9	Till: Gravelly Silty Sand	$1x10^{-5}$
3	3	3.1 to 3.5	Clayey Silt	Less than $1x10^{-6}$
4	101	1.5 to 1.9	Sand and Gravel	$1x10^{-3}$ to $1x10^{-4}$
5	101	2.5 to 2.9	Gravelly Silty Sand	$1x10^{-4}$

The following comments are presented for your consideration.

1. The clayey silt (Borehole 3) with estimated coefficient of permeability of less than $1x10^{-6}$ cm/sec is impervious and not suitable for infiltration.

2. The till, sand and gravel and gravelly silty sand with estimated coefficient of permeability of $1x10^{-3}$ to $1x10^{-4}$ cm/sec are permeable to semi-permeable and more suited for infiltration.

3. The ground water table was near the 1.5 to 2.5 m depth which would impact the design.

Storm Water Management Pond

A SWM pond is proposed to the northeast of the site. The pond is yet to be designed and design grading is currently unknown.

Test Pit 101 was conducted in the SWM Pond area. Beneath 250 mm of topsoil, compact to dense sand and gravel and gravelly silty sand were encountered to the 3.1 m depth of excavation (elevation 409.6). Ground water was not encountered in the test pit, however it is understood this is a natural drainage path. The following general geotechnical input is provided below:

- Berms, if required, should be constructed as engineered fill, using select material, compacted to 95% Standard Proctor maximum dry density as discussed earlier in the report. Berm material requirements (permeability) should be assessed when pond details are finalized;

- Interior side slopes should be no steeper than 5H:1V, and protected from erosion by provision of vegetation cover, granular blanket, rip rap or the like. Exterior slopes should be constructed at no steeper than 3H:1V;

- The sand and gravel/silty sand is relatively permeable;

- If the pond is to be a wet pond an impermeable liner will be required.

It is recommended that when the grading and design details of the proposed pond are determined, the drawings should be submitted for review by PML to more fully assess the geotechnical parameters, which may necessitate additional investigations to better define the drainage characteristics and ground water regime.

Pavement Design and Construction

It is anticipated that the pavement subgrade will comprise low to moderately frost susceptible native sand and till soils. The following pavement structure thicknesses are recommended:

	LIGHT DUTY	HEAVY DUTY
Asphalt (mm)	70	110
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	300	450
Total Thickness (mm)	520	710

It is recommended that following rough grading, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy compactor to minimum 95% Standard Proctor maximum dry density under geotechnical review. Any unstable zones identified during this process should be sub-excavated and replaced with compacted select material.

The pavement design considers that construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling operations. If wet subgrade is encountered, then additional subbase material or the use of Granular B Type II may be required, subject to geotechnical review during construction.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to 100% Standard Proctor maximum dry density. Asphalt should be compacted in accordance with OPSS 310.

For the pavement to function properly, it is essential that provisions be made for water to drain out of and not collect in the base material. The incorporation of subdrains is recommended in conjunction with crowning of the final subgrade to promote drainage towards the pavement edge. Subdrains should be installed at least 300 mm below the subgrade level. Refer to OPSD 216 Series for details regarding pipe, filter fabric or filter sock, bedding and cover material.

Maintenance hole/catchbasins should be backfilled with free draining material with frost tapers and stub drains extending out from structures. The above measures will help drain the pavement structure as well as alleviate the problems of differential frost movement between the catchbasins and pavement.

Geotechnical Review and Construction Inspection and Testing

It is recommended that the final drawings be submitted to PML for general geotechnical review for compatibility with the site conditions and the recommendations provided in this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures, and verify that the specified compaction standards are achieved throughout fill materials.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

The comments and recommendations provided in the report are based on the information revealed in the boreholes. Conditions away from and between boreholes may vary. Geotechnical review during construction should be on going to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

LICENSED PROFESSIONAL ENGINEER
G. R. WHITE
June 22/2017
PROVINCE OF ONTARIO

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Enclosure(s):
Figures 1 to 5 – Particle Size Distribution Charts
Figure 6 - General Recommendations Regarding Drainage and Backfill Requirements for Basement Wall and Floor Slab Construction
List of Abbreviations
Log of Borehole Nos. 1 to 3
Log of Test Pit No. 101
Drawing No. 1 - Borehole and Test Pit Location Plan

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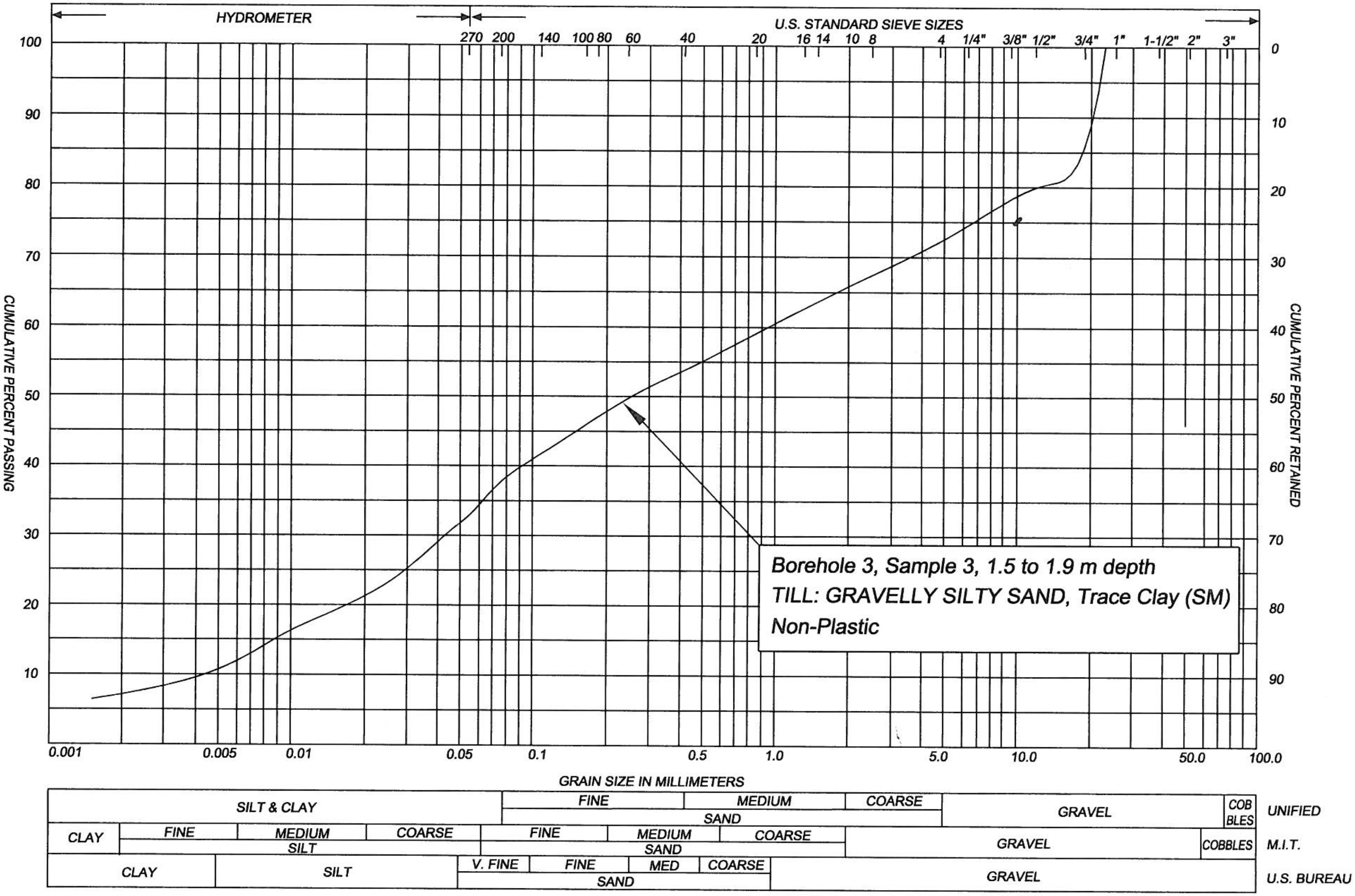
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17CF005
Figure No.: 1



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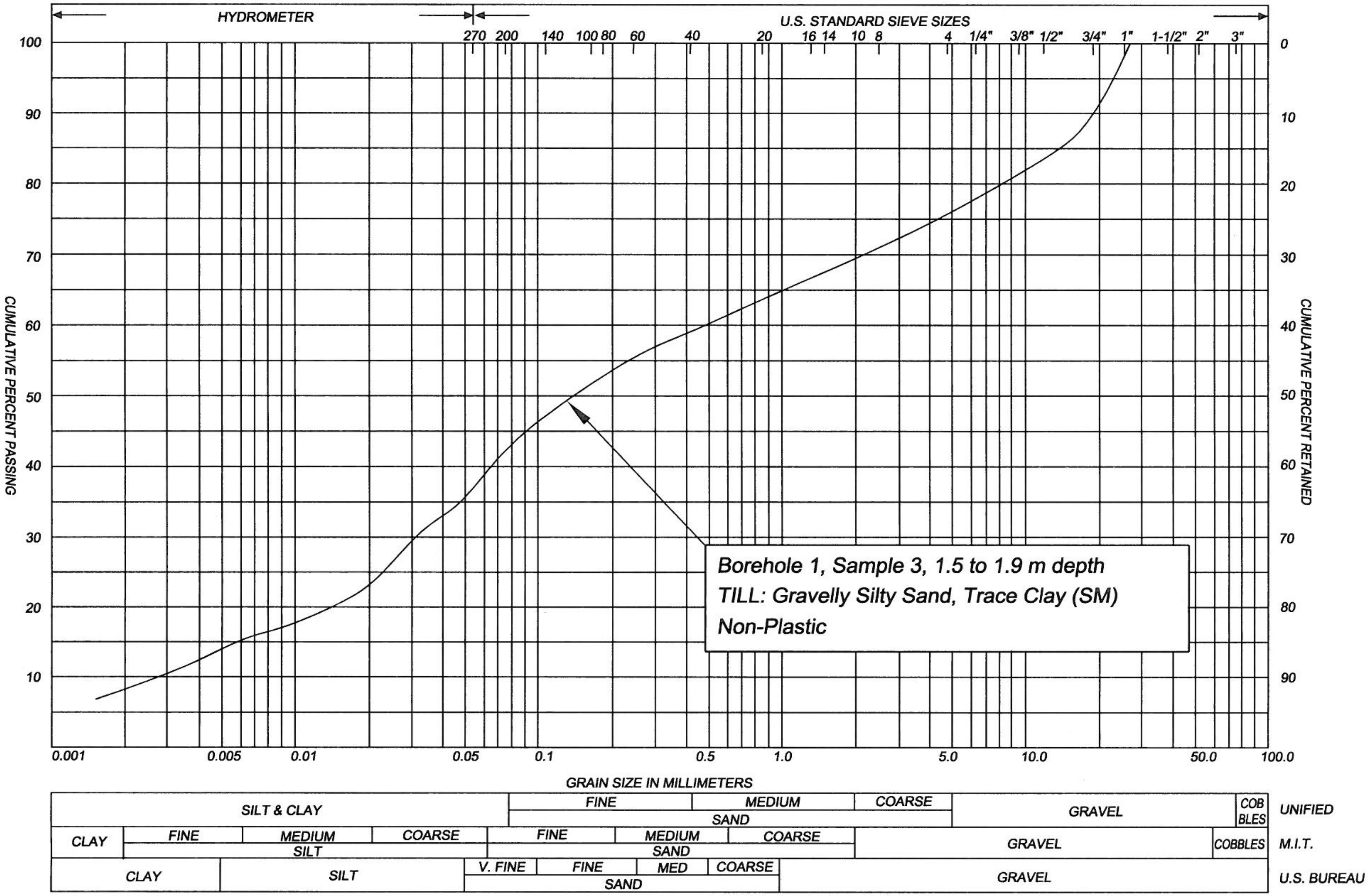
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17CF005
Figure No.: 2



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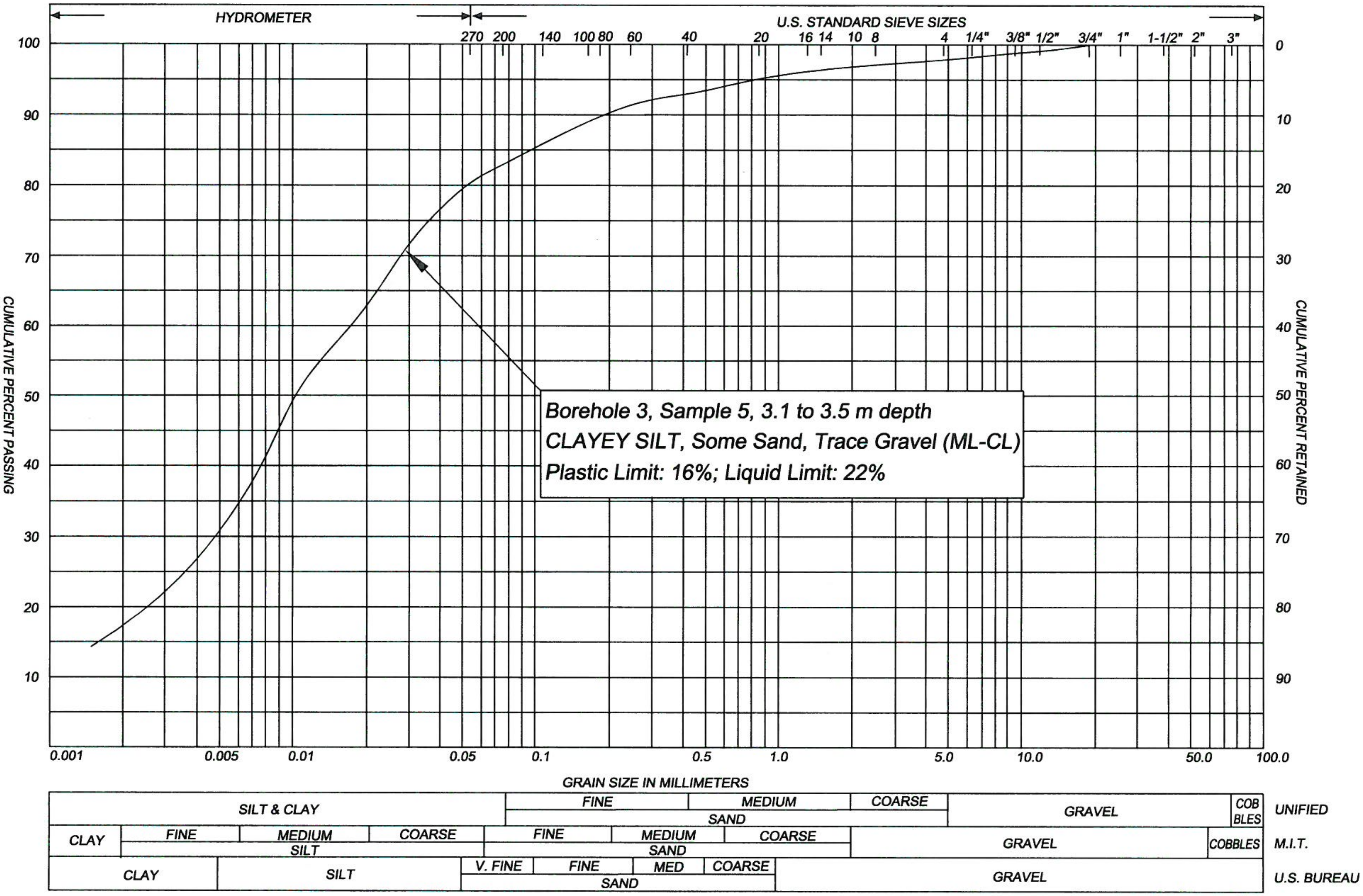
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17CF005
Figure No.: 3



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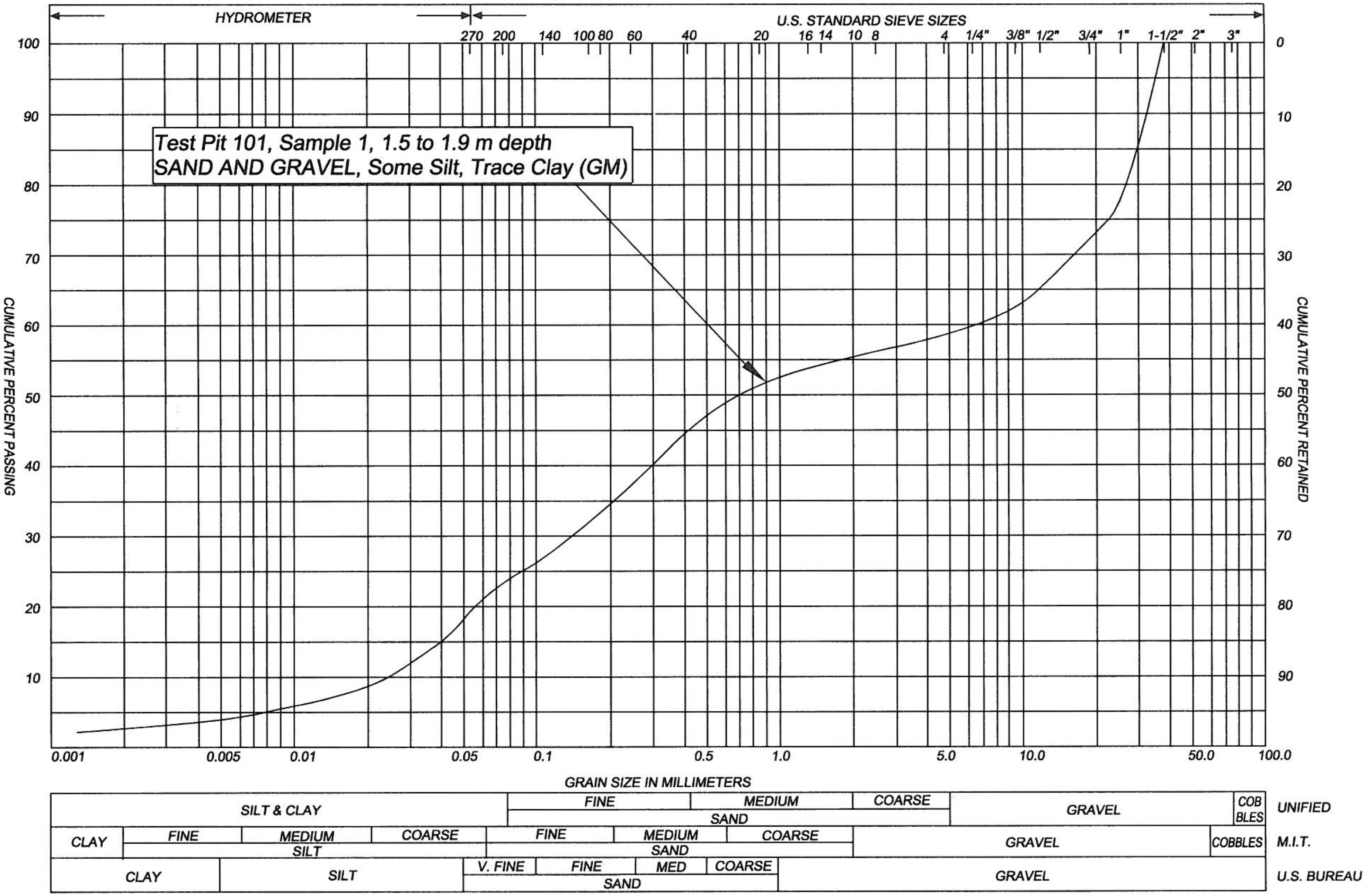
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17CF005
Figure No.: 4



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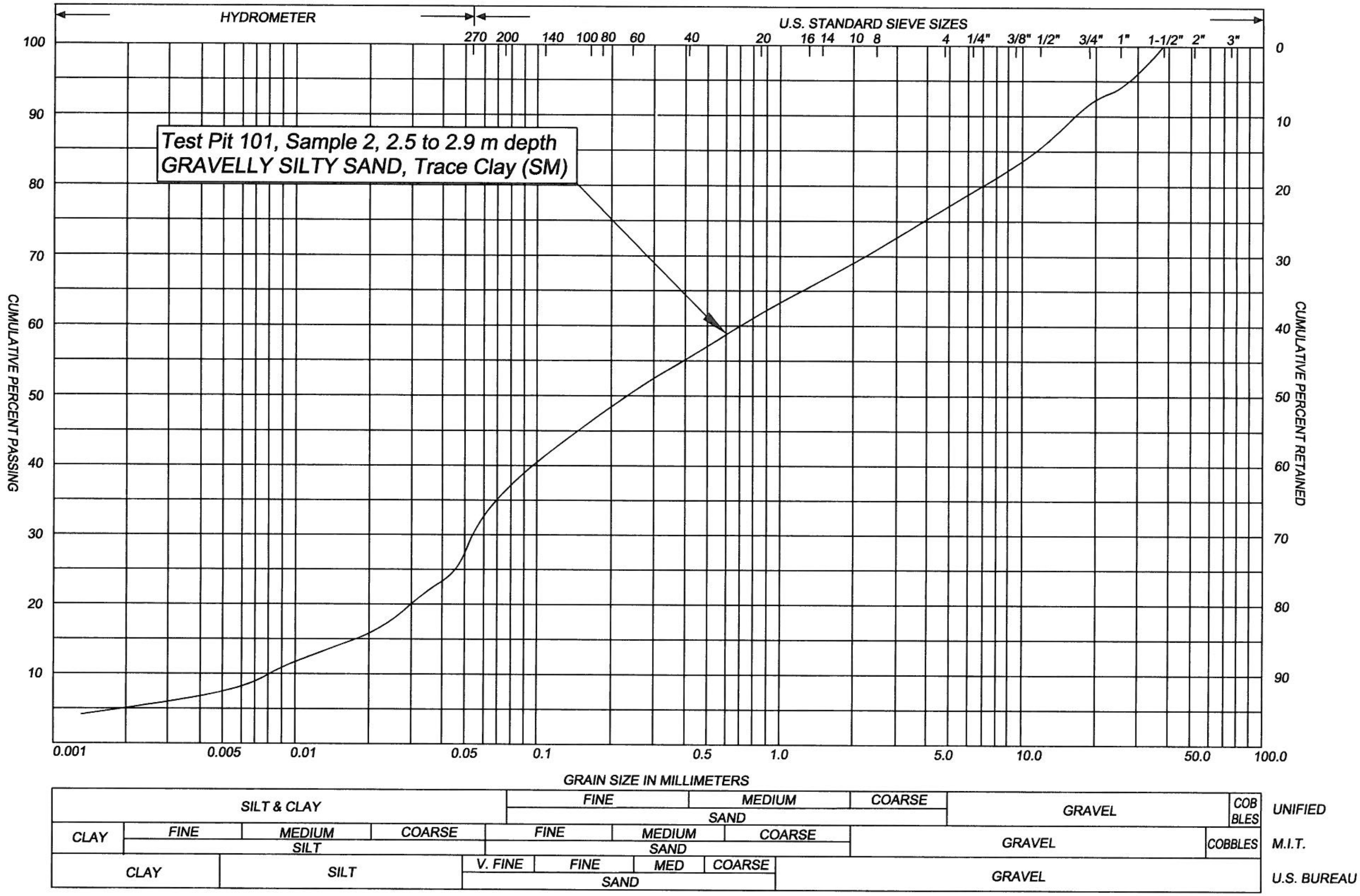
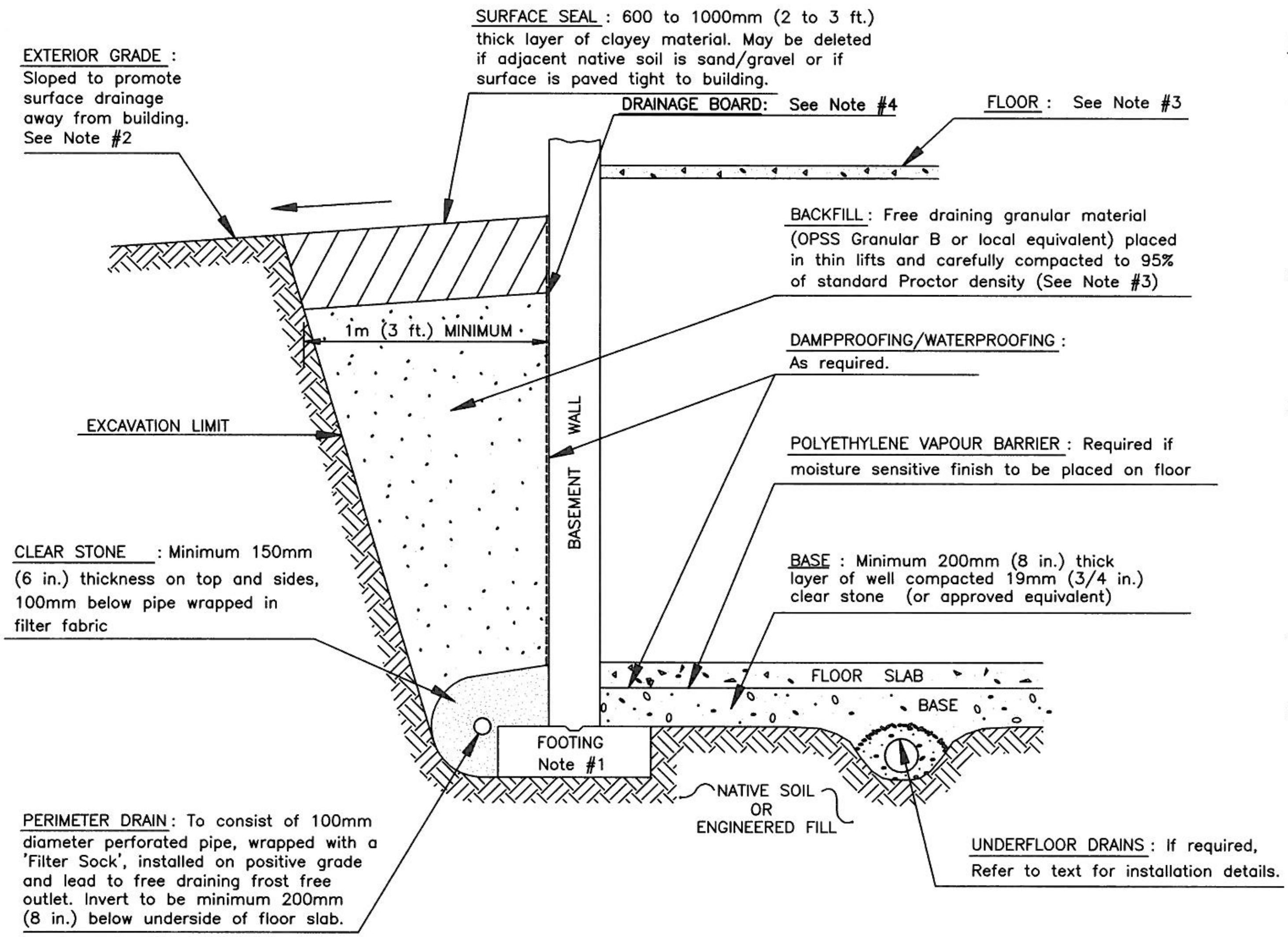
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17CF005
Figure No.: 5



STD – GEO–A REV 1/2004



NOTES

1. Footing may be constructed by placement of structural concrete neat against natural soil. Drain to be installed in a similar manner immediately above footing maintaining 200mm (8 in.) distance between top of drain and underside of floor slab.

2. Exterior grade to be minimum 300mm (12 in.) below interior floor slab, or other means established to prevent entry of surface water into building through building openings.

3. Basement wall to be supported by floor system or interior bracing prior to commencement of backfill placement. Heavy construction equipment should not be permited within a distance from the foundation wall equivalent to half the wall height. Overcompaction of backfill to be avoided as excessive lateral earth pressure may result.

4. A proprietary drainage board product may be used with compacted native soil as backfill against the wall.

5. Refer to text for details regarding founding levels, competent bearing material and construction details specific to particular site.

STANDARD DRAWING

GENERAL RECOMMENDATIONS REGARDING DRAINAGE AND BACKFILL REQUIREMENTS FOR BASEMENT WALL AND FLOOR SLAB CONSTRUCTION

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DRAWN: N/A	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED: GW APPROVED: GW	JUNE 2017	N.T.S.	17CF005	6

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL Wetter Than Plastic Limit
APL About Plastic Limit
DTPL Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH Sample Advanced Hydraulically
PM Sample Advanced Manually

SOIL TESTS

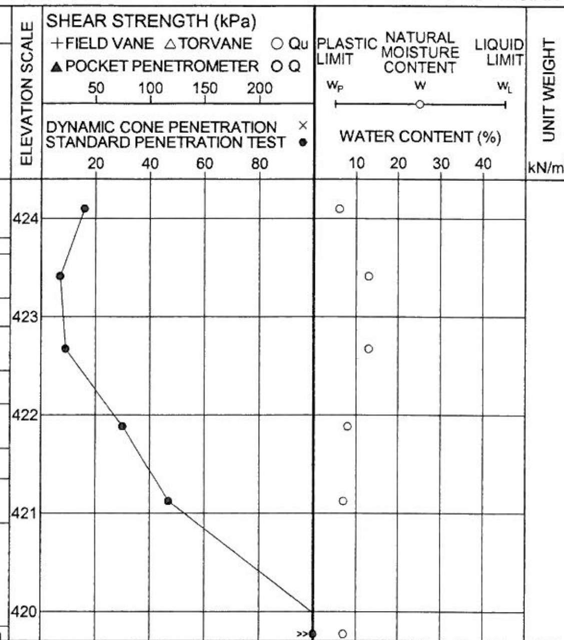
Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

LOG OF BOREHOLE NO. 1

17T 527756E 4907840N

PROJECT Proposed Stonebrook Residential Development
LOCATION Markdale, Ontario
BORING DATE April 27, 2017
BORING METHOD Continuous Flight Hollow Stem Augers
PML REF. 17CF005
ENGINEER GW
TECHNICIAN AT

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	SURFACE ELEVATION 424.40				
0.12 / 424.28	TOPSOIL: Dark brown, silty sand, trace gravel, moist	1	SS	16	
0.70 / 423.70	SAND: Compact, brown, sand, trace silt, trace gravel, moist				
	SAND TILL: Loose, brown, gravelly silty sand, trace clay, cobbles and boulders, very moist	2	SS	7	
		3	SS	9	Non-Plastic
2.1 / 422.3	Becoming dense	4	SS	30	First water strike at 2.4 m
		5	SS	47	
4.0 / 420.4	SAND AND GRAVEL: Very dense, brown, sand and gravel, trace to some silt, wet	6	SS	50/140 mm	
4.7 / 419.7	BOREHOLE TERMINATED AT 4.7 m				Upon completion of augering Water at 4.0 m Cave at 4.3 m



NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 2

17T 527860E 4907965N

PROJECT Proposed Stonebrook Residential Development
LOCATION Markdale, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE April 27, 2017
PML REF. 17CF005
ENGINEER GW
TECHNICIAN AT

SHEAR STRENGTH (kPa): + FIELD VANE, △ TORVANE, ○ Qu, ▲ POCKET PENETROMETER, ○ Q (scale 50, 100, 150, 200)
DYNAMIC CONE PENETRATION ×, STANDARD PENETRATION TEST ● (scale 20, 40, 60, 80)
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (scale 10, 20, 30, 40)
UNIT WEIGHT kN/m³
GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

SURFACE ELEVATION 418.55

DEPTH / ELEV (metres)	DESCRIPTION	Sample Number	Type	"N" Values	Ground Water Observations and Remarks
0.18 / 418.37	TOPSOIL: Dark brown, silty sand, trace gravel, moist	1	SS	4	
0.70 / 417.85	SAND: Very loose, brown, sand, some silt, trace gravel, wet				
	SAND TILL: Loose to compact, brown, gravelly silty sand, trace clay, cobbles and boulders, very moist to wet	2	SS	7	
		3	SS	7	
2.1 / 416.5	Becoming dense to very dense	4	SS	39	First water strike at 2.2 m
3.0 / 415.6	Becoming moist	5	SS	80/290 mm	
		6	SS	50/145 mm	
4.7 / 413.9	BOREHOLE TERMINATED AT 4.7 m				Upon completion of augering Water at 4.4 m No cave

Depth scale: 0.0 – 15.0 m; Elevation scale: 418 – 414

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

17T 527977E 4908007N

PROJECT Proposed Stonebrook Residential Development
LOCATION Markdale, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE April 27, 2017
PML REF. 17CF005
ENGINEER GW
TECHNICIAN AT

SURFACE ELEVATION 422.75

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.12 / 422.63	TOPSOIL: Dark brown, silty sand, trace gravel, moist	1	SS	30	
0.70 / 422.05	FILL: Brown, silty sand, trace gravel, moist				
	SAND TILL: Loose to compact, brown, gravelly silty sand, trace clay, cobbles and boulders, very moist to wet	2	SS	7	
		3	SS	4	Non-Plastic First water strike at 1.6 m
		4	SS	19	
2.9 / 419.9	CLAYEY SILT: Very stiff, brown, clayey silt, some sand, trace gravel, APL	5	SS	29	
4.0 / 418.8	SAND AND GRAVEL: Very dense, brown, sand and gravel, trace to some silt, wet	6	SS	52	
5.5 / 417.3	SAND TILL: Very dense, brown, gravelly silty sand, trace clay, cobbles and boulders, very moist	7	SS	98/270 mm	
		8	SS	88	
8.5 / 414.3	BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 8.5 m				Upon completion of augering Wet cave at 2.4 m

Chart legend: SHEAR STRENGTH (kPa): + FIELD VANE, △ TORVANE, ○ Qu, ▲ POCKET PENETROMETER, ○ Q (50, 100, 150, 200); DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● (20, 40, 60, 80); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10, 20, 30, 40); UNIT WEIGHT kN/m³; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL. Elevation scale 422–415.

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF TEST PIT NO. 101

METRIC

PROJECT Proposed Stonebrook Residential Development
LOCATION Markdale, Ontario
EXCAVATION METHOD Excavator
BORING DATE June 7, 2017
PML PROJECT NO. 17CF005
ENGINEER GW
TECHNICIAN RB

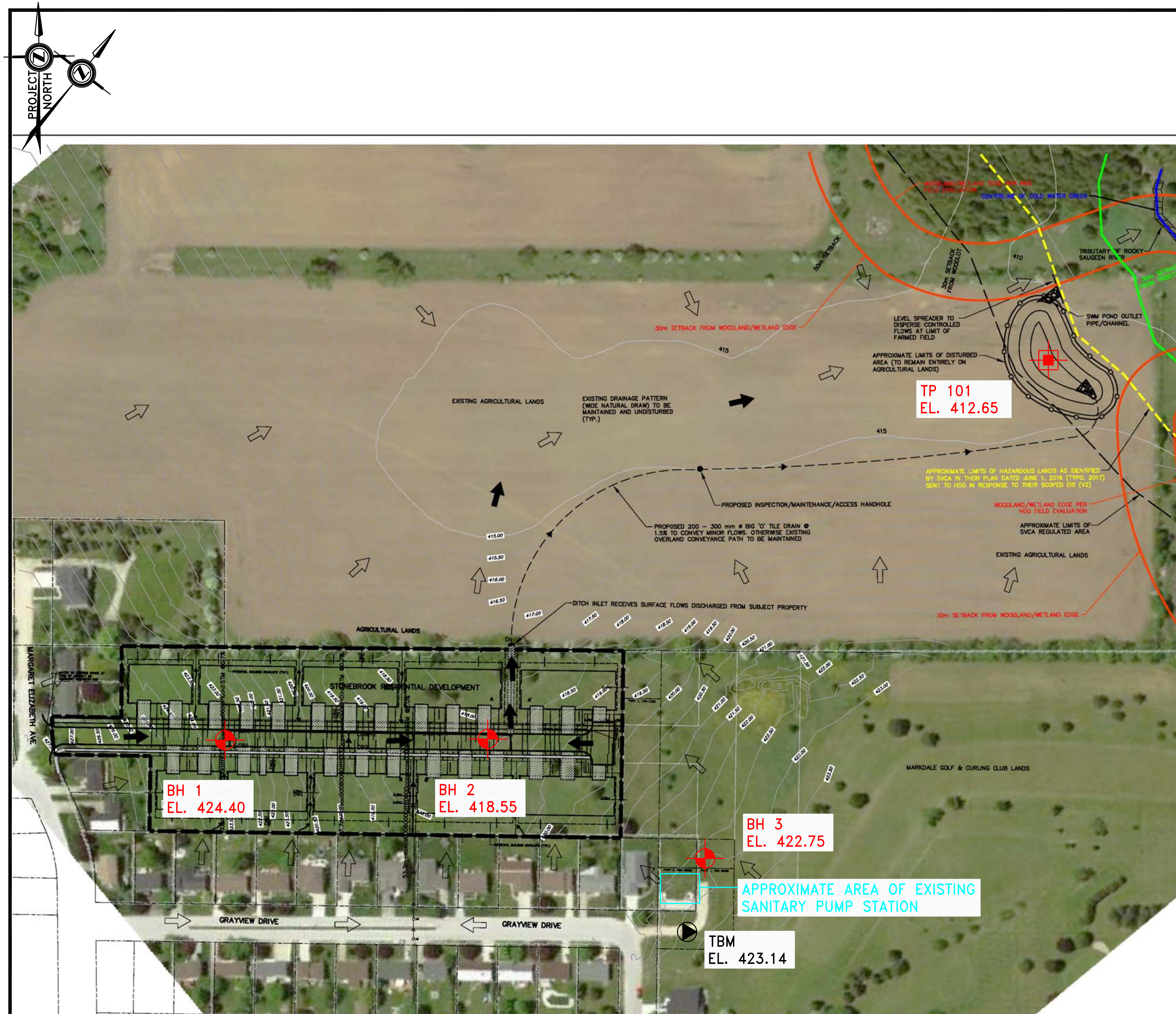
ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH kPa / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	WATER CONTENT (%)	GAS READINGS ppm	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
412.7										
412.4 / 0.3	TOPSOIL: Dark brown, sand, moist									
	SAND AND GRAVEL: Compact to dense, brown, sand and gravel, some silt, trace clay, cobbles and boulders, moist					412				
			1	GS	-	411				
410.6 / 2.0	Becoming gravelly silty sand, trace clay, cobbles and boulders, very moist									
			2	GS	-	410				
409.5 / 3.1	TEST PIT TERMINATED AT 3.1 m									Upon completion of excavating No water No sidewall sloughing

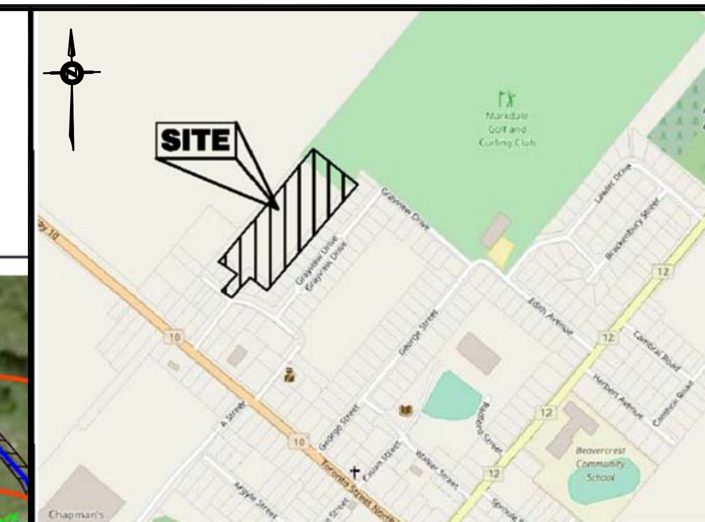
Chart legend: SHEAR STRENGTH kPa — ○ UNCONFINED, + FIELD VANE, ▲/△ POCKET PENETROMETER/TORVANE (50, 100, 150, 200); DYNAMIC CONE PENETRATION ×, STANDARD PENETRATION TEST ● (20, 40, 60, 80); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10, 20, 30, 40).

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0

$+^7$, $\times^5$: Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE





KEY PLAN
MARKDALE, ONTARIO

LEGEND:

BH 1 EL. 424.40	BOREHOLE 1 SURFACE ELEVATION
TP 101 EL. 412.65	TEST PIT 101 SURFACE ELEVATION
TBM EL. 423.14	TEMPORARY BENCHMARK TOP OF SANITARY MANHOLE 157A ELEVATION 423.14 (METRIC, GEODETIC)

NOTE:
BASE PLAN PROVIDED BY CLIENT

0m 20 40 60 80 100
SCALE

BOREHOLE AND TEST PIT LOCATION PLAN

PROPOSED STONEBROOK RESIDENTIAL DEVELOPMENT
MARKDALE, ONTARIO

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

		DATE	SCALE	PML REF.	DRAWING NO.
DRAWN	RB	JUNE 2017	AS SHOWN	17CF005	1
CHECKED	GW				
APPROVED	GW				