Soil-Eng Limited CONSULTING SOIL, FOUNDATION & ENVIRONMENTAL ENGINEERS
100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516
BRANCH OFFICES: BARRIE TEL: (705) 721-7863 FAX: (705) 721-7864 • MISSISSAUGA TEL: (905) 542-7605 FAX: (905) 542-2769 • BOWMANVILLE TEL: (905) 623-8333 FAX: (905) 623-4630 • NEWMARKET TEL: (905) 853-0647 FAX: (905) 853-5484

A REPORT TO
GREEN GINGER DEVELOPMENTS INC.

A SOIL INVESTIGATION FOR PROPOSED RESIDENTIAL SUBDIVISION

271 DUNDAS STREET EAST

TOWN OF OAKVILLE

Reference No. 0008-S99

OCTOBER 2000

DISTRIBUTION

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1.0 INTRODUCTION

In accordance with verbal authorization given on August 18, 2000, from Mr. Alain Bergeron of Great Gulf Group of Companies, on behalf of Green Ginger Developments Inc., a soil investigation was carried out at Part of Lots 13 and 14, Concession 1, North of Dundas Street (NDS), which is located at the northwest quadrant of Dundas Street East and Trafalgar Road (271 Dundas Street East); Town of Oakville, for a proposed Residential Subdivision.

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for the design and construction of the proposed project.

The findings and resulting geotechnical recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Oakville is situated on Halton-Peel till plain, where drift extends onto a shale bedrock of the Queenston Formation at shallow to moderate depths. In places, the drift stratigraphy has been modified by lacustrine sand, silt, and clay derived from the water action in the glacial lake.

The site consists mainly of farm fields with a drainage watercourse (Morrison Creek East and its tributaries linking 2 small ponds) traversing the site from north to south. There are wooded areas located in the northern and mid sectors of the site. A cut-grass field located in the central western area of the property has been used by the Oakville Model Flying Club for about 2 decades.

The ground surface of the site is slightly undulated and is relatively flat and level with the fronting Dundas Street and Trafalgar Road which are lined with gravel shoulders and ditches. The grade of the site generally descends towards the southeast and towards the watercourse.

A long gravel driveway leads from Dundas Street to the model plane flying field in the central western sector. Another gravel driveway leads to the existing bungalow located in the eastern sector of the site. A drilled domestic well is located to the southeast of the house.

The property is fenced along its property limits. Building remnants were observed in the area of the former homestead located on the west side of the long driveway.

A barn with a concrete side and a collapsed storage shed are located in the midsouthern sector. Hay bales are found throughout the site.

The property will be subdivided into residential lots. The development will be provided with municipal services and roads meeting the urban standards.

3.0 FIELD WORK

The field work, consisting of 15 boreholes to depths ranging from 4.6 m and 5.0 m, was performed on August 26, 2000, at the locations shown on the Borehole Location Plan and Subsurface Profile, Drawing No. 1.

The holes were advanced to the sampling depths by a track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration tests, using the procedures described on the enclosed "List of Abbreviations and Terms", were performed at frequent intervals of depth. The test results are recorded as the Standard Penetration Resistance (or 'N' values) of the subsoil. The relative density of the granular strata and the consistency of the cohesive strata are inferred from the 'N' values. Split-spoon samples were recovered for soil classification and laboratory testing.

The field work was supervised and the findings recorded by a Senior Geotechnical Technician.

The elevation at each of the borehole locations was interpolated from the contours on Topographical Maps, dated 1962 and 1989.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 15, inclusive. The revealed stratigraphy is plotted on the subsurface profile, Drawing No. 1, and the engineering properties of the disclosed soils are discussed herein.

Beneath a layer of earth fill 1.0 m thick in Borehole 4 and a veneer of topsoil in the remaining boreholes, a stratum of silty clay till was encountered. It generally beds onto a shale bedrock of Queenston formation, except in Boreholes 1 and 9 which are located in the north sector of the site and where the boreholes were terminated in the silty clay till stratum.

The interface of the till and shale occurs at El. 174.0 m or lower in the north, south and the existing creek area to El. 168.0 to 165.0± m. The ground elevations and the elevations of the bedrock are plotted on Drawing No. 1.

4.1 Topsoil (All Boreholes, except Borehole 4)

The revealed topsoil veneer ranges in thickness from 23 to 33 cm. The topsoil is dark brown in colour, indicating it contains an appreciable amount of roots and humus. These materials are unstable and compressible under loads; therefore, the topsoil is considered to be void of engineering value, but can be used for general landscaping purposes. Due to its humus content, it may produce volatile gases and will generate an offensive odour under anaerobic conditions. Therefore, the topsoil must not be buried within the building envelope or deeper than 1.0 m below the exterior finished grade. This is to avoid imposing an adverse impact on the environmental wellbeing of the developed areas.

As noted, the property is agricultural land; the past cultivation will invariably have filled the localized depressions. Therefore, topsoil thicker than that found in the boreholes is expected to occur in places, particularly in low-lying areas where thick organic soils deposited by erosion from higher areas may also occur. This indicates that the thickness of the topsoil likely varies randomly, rendering it difficult to estimate the quantity of topsoil to be stripped for the development; therefore, stringent control of the stripping operation will be required.

4.2 **Earth Fill** (Borehole 4)

The encountered layer of earth fill is 1.0± m thick. It consists mainly of silty clay till material with topsoil layers and inclusions. The fill appears to be derived from vicinal construction.

In its prevailing state, the fill is void of engineering value and is therefore not suitable to support structures. However, it can be subexcavated, sorted free of topsoil, aerated and properly recompacted for use as structural fill.

The original topsoil was not detected beneath the fill, but may have been obscured by the augering.

The obtained 'N' values of the fill are 11 and 20 blows per 30 cm of penetration. This shows that it has been placed with some compaction, but not in a uniform or controlled manner.

The natural water contents of the earth fill samples were found to be 17% and 18%, indicating that the fill is generally wet. The water content values are plotted on Borehole Log, Figure 4.

Sample examinations show that the fill is amorphous in structure, indicating that it will slough readily when cut steeply, particularly if it is wet or under water seepage conditions. The other engineering properties of the inorganic silty clay are the same as those of the underlying silty clay till which is discussed in the Section 4.3.

One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by laboratory testing and/or test pits.

4.3 **Silty Clay Till** (All Boreholes)

The silty clay till is the predominant stratum encountered in the investigation. It consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties.

The structure of the till is heterogeneous, showing it is a glacial deposit.

Sample examinations detected fissures permeating the upper layers of the till, becoming less prevalent with depth. This shows that the upper layers have been fractured by the weathering process. The badly fissured till generally occurs within a depth of 1.0± m from the prevailing ground surface. Clay till with a platy structure was often found in the samples. This shows that some of the till is derived from shale reversion.

Hard resistance was encountered during augering, showing the till is embedded with occasional cobbles and shale debris. The debris increases with depth, and becomes frequent close to the bedrock. This renders delineation of the interface of the till and shale bedrock very difficult.

The consistency of the till was found to be very stiff to hard, being generally hard below the weathered till zone and the stiff till is restricted to the weathered zone of the till stratum. This is confirmed by the 'N' values which varied from 20 to 100+, with a mean of 52.

The Atterberg Limits of 2 representative samples and the moisture content of all the samples were determined. The results are plotted on the Borehole Logs and summarized below:

Liquid Limit	30% and 32%
Plastic Limit	16% and 17%
Natural Water Content	4% to 23% (mean 11%)

The above results show that the till is a cohesive material with low to medium plasticity. The natural water content generally lies below its plastic limits or between its plastic and liquid limits, confirming the generally very stiff to hard consistency of the till determined by the 'N' values. The low 'N' values and high moisture content were obtained in the badly weathered zone, showing that infiltrating precipitation has wetted the fissures of the till, thus softening its consistency.

Grain size analyses were performed on 2 representative samples; the results are plotted on Figure 16.

According to the above findings, the soil engineering properties pertaining to the project are given below:

- Moderate frost susceptibility and water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- A cohesive soil, its shear strength is primarily derived from consistency which is inversely related to its moisture content. It contains sand; therefore, its shear strength is augmented by internal friction.
- It will generally be stable in a relatively steep cut; however, long exposure will allow the weathered layers and the wet sand seams to become saturated which may lead to localized sloughing.
- A very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3,500 ohm/cm.

4.4 **Shale Bedrock** (All Boreholes except Boreholes 1 and 9)

The shale bedrock encountered is reddish-brown in colour showing that it is of Queenston Formation. It is thin-to thickly-bedded and consists predominantly of mudstone with occasional hard sandstone and limy shale bands. The upper layer of the bedrock can be penetrated by power augering with some difficulty in grinding through the hard layers. The shale, being a silt and clay rock, is susceptible to swelling and disintegration upon exposure to air and water, with subsequent reversion to clay or silty clay.

Standard Penetration tests performed in the shale gave values of 50+ blows per 15 cm of penetration to no penetration. The fact that the shale could be penetrated by the auger and a split-spoon sampler indicates that the shale rock can be laboriously excavated by mechanical means. In sound shale, pneumatic hammering to break up the rock mass will be required for efficient rock removal. Examination of the auger spoil showed that, in places, the shale has reverted to a clayey soil.

The natural water content of the rock samples was determined; the results are plotted on the Borehole Logs. The values range from less than 4% to 9%, with a mean of 6%, and generally decrease with depth from the upper weathered zone to the sound shale.

Occasional pockets of groundwater trapped in the fissures of the shale will be under a moderate subterranean artesian pressure such as in Boreholes 3, 11, 13 and 15; but, upon release through excavation, the water will often drain readily with a limited yield.

From past experience, it has been noted that excavations into sound shale have created lateral movement caused by the release of residual stresses in the rock mantle, and in a few instances this movement has crushed buried structures. Experience has also shown that excavations carried out by rock blasting will create a fracture zone, and the wider excavation filled with sand fill will diminish the load intensity imposed on buried structures by the rock movement.

In using the excavated shale for structural backfill and engineered fill, the spoil should be sorted free of hard sandstone slabs; limy shale fragments larger than 15 cm should either be pulverized by mechanical means or left exposed over the winter to allow weathering by freezing and thawing, and wetting. The shale will revert to a clayey soil which can be properly compacted using mechanical means.

4.5 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied.

As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Silty Clay Fill	17 and 18	15	10 to 21
Silty Clay Till	4 to 23 (mean 11)	15	10 to 21
Broken Shale	4 to 8 (mean 6)	10	7 to 13

According to the above values, the revealed soils are generally suitable for 95% or + Standard Proctor compaction. The weathered silty clay till should either be aerated, which can be effectively carried out during the warm, dry weather, or mixed with drier soils for structural compaction. The damp soil and broken shale will require the addition of water for proper compaction.

The soils should be compacted using a heavy-duty kneading-type roller. When compacting the very stiff to hard silty clay till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts of these soils must be limited to 20 cm or less (before compaction). It is difficult to monitor the lifts of backfill placed in deep trenches; therefore, it is preferable that the compaction of backfill at depths over 1.0 m below the road subgrade be carried out on the wet side of the optimum. This would allow a wider latitude of lift thickness.

The presence of boulders and large shale debris will prevent transmission of the compactive energy into the underlying material to be compacted. If an appreciable amount of boulders and shale debris over 15 cm in diameter is mixed with the material, it must either be sorted or must not be used for construction of engineered fill and/or structural backfill.

As noted, the shale is susceptible to disintegration and will revert to a clay soil. The shale spoil which has been exposed to weathering may be selected for use as structural fill. To achieve this, the shale must be excavated by a rock-ripper to break up the limy shale and sandstone slabs, and piled thinly on the ground for optimum exposure to weathering for a period of at least one and preferably 2 to 3 winters. If shale spoil is to be used immediately for structural fill, it should be pulverized to sizes of 15 cm or less and must be compacted with lifts of 15 cm of less and consistently wetted. It should be compacted to achieve at least 95% of its maximum Standard Proctor dry density. The structural compacted fill must be left for a period of at least one winter to allow the shale to swell prior to the construction of the foundations.

One should be aware that some settlement of the structural fill in vertical trenches stabilized by a trench box may occur as the void left by the removal of the box is slowly filled by the fill. In order to avoid settlement, or minimize it to a tolerable level, the properly compacted fill should also be flooded for a period of 3 days to one week, depending on the fill material.

5.0 GROUNDWATER CONDITIONS

The majority of the boreholes remained dry during and upon completion of the field work; the data are plotted on the Borehole Logs. The data for the 4 boreholes in which seepage was encountered during augering and/or in which groundwater was measured upon completion of the field work are listed in Table 2.

Table 2 - Groundwater Levels

	Borehole	Seepage Encountered During Augering			Measured Groundwater Level	
BH No.	**Depth (m)**	**Depth (m)**	**El. (m)**	**Remarks**	**Depth (m)**	**El. (m)**
3	4.6	3.5	166.5	Under pressure in bedrock	1.2	168.8
11	4.6	3.6	170.4	Under pressure in bedrock	2.5	171.5
13	4.6	3.5	167.5	Under pressure in bedrock	3.1	167.9
15	4.6	3.5	168.5	Under pressure in bedrock	3.1	168.9

The above findings show that groundwater seepage occurred in places from the bedrock within the investigated depths.

The groundwater seepage was derived from the fissures in the bedrock layers; this indicates that the groundwater in the bedrock is under subterranean artesian conditions.

However, in the wet seasons, shallower groundwater seepage will likely occur in places as a result of the infiltrating precipitation which is perched in the fissures and sand and silt layers in the till mantle.

The shale, however, is generally considered to be a poor aquifer; therefore, the water yield from the bedrock may be appreciable initially and be reduced with time. The yield from the till will be small, and since the groundwater is largely derived from infiltrating precipitation, it will often dissipate during dry seasons.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that the site is underlain by a stratum of very stiff to hard, generally hard, silty clay till overlying shale bedrock of the Queenston formation. The interface of the till and shale occurs at depths ranging from 1.0 to 5.0+ m from the prevailing ground surface.

A layer of silty clay fill 1.0 m thick, was detected in Borehole 4 which is located in the southeast sector of the site.

Groundwater was detected in 4 of the 15 boreholes; the groundwater was encountered in the bedrock and was under subterranean pressure. The water yield from the bedrock may be slow to appreciable initially and will become reduced with time and can generally be drained by continuous pumping for a short duration.

The geotechnical findings which warrant special consideration are presented below:

1. The earth fill layer detected in Borehole 4 in the southeast sector of the site must be removed for the project construction.
2. As revealed, the topsoil varies from 23 to 33 cm in thickness; however, because the property is farmland, thicker topsoil is likely to occur in places, particularly in localized depressions which are likely to have been filled by the yearly cultivation, and in the low-lying areas where topsoil is thickened by the yearly flooding cycles. As noted, the topsoil contains an appreciable amount of humus and may generate volatile gases under anaerobic conditions, therefore the topsoil should be placed in landscaped areas and

must not be buried within the building envelopes or deeper than 1.0 m below the exterior finished grade. This is to alleviate any risk of an adverse impact on the environmental wellbeing of the development.

3. Weathered soil generally extends to within a depth of 1.0± m, from the prevailing ground surface; therefore, caution should be exercised during house footing construction.
4. The revealed shale was encountered at shallow depths of 1.0 to 5.0+ m. Savings in areas may be realized by proper manipulation of the site grading and underground services to minimize rock excavation.
5. In areas where the ground is to be raised for lot grading purposes, the cost of footing and services construction on engineered fill, compared with the cost of the extension of the foundations to the natural sound soil should be carefully examined. In many instances, the cost of the latter may be appreciable.
6. The overburden above the shale is thin to moderate. The excavated shale may be suitable to use for construction of engineered fill, but it must be properly broken up during excavation and properly piled to allow the spoil to disintegrate under weathering for use as engineered fill.
7. Sewer construction may require extensive rock excavation. In general, it can be carried out by using a backhoe equipped with a rock-ripper, but where deep trench excavations are required, pneumatic hammering to break up the shale may be necessary for efficient rock removal.
8. Curb subdrains will likely be required by the Town of Oakville for road construction.

9. Perimeter subdrains and dampproofing of the foundation walls will be required for basement construction. The subdrains should be shielded by a fabric filter to prevent blockage by silt.
10. A detailed investigation must be carried out by performing additional boreholes when the precise locations and depths of the sewer become available.

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

6.1 Foundations

The foundations should be placed onto the sound natural soil or on engineered fill. As a general guide, Maximum Allowable Soil Pressures of 150 to 300 kPa are recommended for the design of the foundations.

The appropriate founding levels on the natural soils, as inferred from the borehole findings, are generally at a depth of 0.8± m from the original ground surface.

The footings must also meet the minimum size requirements as specified in the Ontario Building Code.

The recommended soil pressures incorporate a safety factor of 3 against shear failure of the underlying soil and rock. The total and differential settlements are estimated to be 25 mm and 15 mm, respectively, on the soil and much less on the rock.

The footing subgrade must be inspected by a building inspector or by a geotechnical engineer to ensure that the revealed subgrade conditions are compatible with the foundation design requirements.

In order to prevent infiltrated precipitation from accumulating against the foundation walls, perimeter subdrains and dampproofing of the basements will be required.

All the subdrains should be encased in a fabric filter to protect them against blockage by silting.

The footings exposed to weathering or in unheated areas should be protected against frost action by a 1.2 m earth cover, irrespective of the subgrade material beneath the foundations.

6.2 Landscaping and In-ground Structures

The grading for slab-on-grade in open areas should prevent the ponding of surface water. Where the slab is structurally sensitive to ground heave, insulation should be provided and where interlocking stone pavement is to be constructed, the subgrade must consist of a free-draining granular base, at least 1.0 m thick, which must be provided with positive drainage.

6.3 Engineered Fill

Where earth fill is required to raise the site, it is generally economical to place engineered fill for normal footing, sewer and road construction.

The engineering requirements for a certifiable fill for road construction, municipal services, and footings designed with a 150 kPa Maximum Allowable Soil Pressure are presented below:

1. All of the topsoil and organics must be removed, and the subgrade surface must be inspected and proof-rolled prior to any fill placement. All of the earth fill and the badly weathered soil must be subexcavated and recompacted.
2. Inorganic soils and selected decomposed shale spoil must be used, and they must be uniformly compacted in lifts 20 cm thick to 95% or + of their maximum Standard Proctor dry density up to the proposed lot grade and/or road subgrade. The moisture of the fill must be properly controlled on the wet side of the optimum, i.e. water will need to be added to some of the *in situ* silty clay till and all of the selected decomposed shale. The excavated shale which is to be used for structural fill must be left exposed for a period of at least one and preferably two winters to allow the freezing and thawing process to decompose the shale. The decomposed shale must be sorted free of limy shale and sandstone slabs.

3. If imported fill is to be used, the hauler is responsible for its environmental quality and must provide a document to certify that the material is free of hazardous contaminants.
4. If the engineered fill is to be left over the winter months, adequate earth cover or equivalent must be provided for protection against frost action.
5. The engineered fill must extend over the entire graded area, and the fill envelope must be clearly and accurately defined in the field and precisely documented by qualified surveyors. Lots with partial engineered fill are not recommended since the differential settlement between the engineered fill and the native soil will be detrimental to normal building foundations.
6. The engineered fill must not be performed during the period from late November to early April, when freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
7. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement, particularly if it is to be carried out on sloping ground or a bank.
8. Where the fill is to be placed on sloping ground, the sides must be flattened 1 vertical:3 + horizontal so that it is suitable for safe operation of the compactor and to ensure that the fill mantle is uniformly compacted.
9. The fill operation must be fully supervised and monitored by a technician under the direction of a geotechnical engineer.
10. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that supervised the engineered fill placement. This is to ensure that the foundations are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim

construction, environmental degradation and/or disturbance by the footing excavation.

11. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who supervised the fill placement in order to document the locations of excavation and/or to supervise reinstatement of the excavated areas to engineered fill status.
12. Despite stringent control in the placement of the engineered fill, occasional minor variations in the soil density may occur in the fill mantle. Therefore, the strip foundations must be continuously reinforced longitudinally with two, properly overlapped, No. 6 (20-mm) steel bars or the foundation walls must be adequately dowelled into the reinforced foundations. In sewer construction, the engineered fill is considered to have the same structural proficiency as a natural inorganic soil.

6.4 Underground Services Construction

A Class 'B' bedding is recommended for the underground services. The bedding material should consist of 20 mm Crusher Run Limestone or its equivalent.

The subsoil and the shale bedrock are practically impervious; therefore, the pipe should have an earth cover at least equal in thickness to the outside diameter of the pipe at all times to prevent floatation should runoff or groundwater seepage become ponded in the trench.

Due to the residual stress relief phenomenon and swelling characteristics of the shale, the sides of trenches in the sound shale should be sloped rather than vertical.

The suggested side slope is at 2 vertical:at least 1 horizontal, or the sound shale should be blasted to create a fracture zone behind the rock face which may be larger than normal and filled with sand to act as a cushioning layer and reduce the residual stress being exerted on the buried structure.

6.5 Trench Backfilling

The on-site inorganic soils are suitable for trench backfill. The backfill should be compacted to at least 95% of its maximum Standard Proctor dry density. In the zone within 1.0 m below the road subgrade, the backfill should be compacted with the moisture content 2% to 3% drier than the optimum. In the lower zone, the compaction should be carried out on the wet side of the optimum. The natural water content of some of the *in situ* silty clay till lies on the dry side of the optimum; therefore, the addition of water will be necessary. The lift thickness of the placed backfill before compaction must be limited to less than 20 cm or the thickness must be determined by test strips performed by the equipment which will be used during construction.

The excavated shale should be pulverized to sizes less than 15 cm and thoroughly mixed with the overburden soils, or the trench can be backfilled by levelling the shale debris using a bulldozer. The lifts should be no more than 15 cm thick (loose), wetted, and compacted using a vibratory sheepsfoot roller. Another alternative is the flooding method. This practice has proved to be successful because the broken shale fragments absorb the water and swell. This process allows sufficient time for the voids in the backfill to collapse and any remaining voids will largely be filled by swelling of the shale fragments.

For road construction, the following flooding procedures are recommended:

1. Dump the shale spoil to a level 1.0 m below the road subgrade.
2. Flood the shale spoil and allow it to remain submerged until no further settlement can be detected by visual inspection. A period of 3 to 4 weeks will generally be required.
3. Surface-compact the settled rock fill. The 1.0 m zone below the road subgrade should be backfilled with inorganic soils uniformly compacted to at least 98% of their maximum Standard Proctor dry density.

In normal sewer construction practice, the problem areas of road settlement largely occur adjacent to manholes, catch basins, and service crossings. The lumpy clays and broken shale are generally difficult to compact in these close quarters, and it is recommended that a sand backfill be used.

The narrow trenches for service crossings should be cut at 1 vertical:2 horizontal so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches will prevent the achievement of proper compaction. In this case, imported sand fill which can be appropriately compacted by using a smaller vibratory compactor must be used. The areas at the interface of the native soil and the sand backfill should preferably be flooded for at least 4 days.

In areas where the underground services construction is carried out during freezing weather, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. After these areas have been backfilled, this may result in further settlement as the frost recedes, and the settlement may be appreciable.

6.6 Flexible Pavement

The subgrade will generally consist of silty clay till material. Using a CBR pavement design approach, the recommended pavement structures are given in Table 3.

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder		HL-8
Local	60	
Collector	85	
Granular Base	150	Granular 'A'
Granular Sub-base		Granular 'B'
Local	300	
Collector	380	

The shear strength of the silty clay till is moisture dependent; thus, it is imperative that the subgrade within the 1.0 m zone below the underside of the granular sub-base be compacted to at least 95% of its maximum Standard Proctor dry density, with the moisture content 2% to 3% drier than the optimum.

Water will often soften a well-prepared subgrade; therefore, for the purpose of preventing the infiltration of precipitation, the surface should be properly crowned and smooth-rolled. The lot areas fronting the roads should also be properly graded to prevent water ponding. Otherwise, weakening of the road subgrade due to lateral water seepage will occur.

Prior to construction of the granular bases, the subgrade should be inspected and proof-rolled in order to detect any soft spots, which should then be subexcavated and replaced with compacted granular or drier inorganic soils.

If the subgrade is soft, or has been softened by prolonged exposure to wet weather, the granular sub-base should be replaced with an equal thickness of 50-mm Crusher-Run Limestone.

If the soft condition of the subgrade is extensive the granular sub-base should be strengthened by geogrid reinforcement, or the soft subgrade should be subexcavated and the sub-base thickened. The extent of subexcavation should be assessed at the time of construction by proof-rolling the subgrade.

Curb subdrains should be installed to prevent runoff from the paved areas and fronting lot areas from infiltrating and weakening the subgrade, and to provide proper drainage for the granular base during the interim period before asphalt paving.

6.7 Soil Corrosivity

The subgrade of the water main and the backfill material will generally consist of silty clay till material. It has a moderately high corrosivity to ductile iron pipes and metal fittings; therefore, cathodic protection will be required. The precise size of the anodes can be calculated at the time of the sewer construction when the soils at the water main level are exposed and sufficient samples can be taken to analyze their corrosive potential. For estimation purposes for the anode weight requirements, the electrical resistivity which has been given for each of the occurring soils can be used.

6.8 Filling of the Existing Ponds

Prior to filling the existing ponds, all the mud, loose soils, earth fill and other deleterious materials, must be completely subexcavated and replaced with engineered fill. The procedures listed in section 6.3 must be implemented when filling the pond.

Prior to filling, shallow test pits should be carried out to assess the condition of the subgrade.

6.9 Soil Parameters

The recommended soil parameters for the project design are given in Table 4.

Table 4 - Soil Parameters

Unit Weight and Bulk Factor			
	Unit Weight (kN/m^3)		Bulk Factor
	Bulk	Submerged	
Silty Clay Till and Engineered Fill	22.0	12.0	1.05
Weathered Till	21.0	11.0	0.98
Shale Bedrock	23.5	13.5	1.05 to 1.08

Table 4 - Soil Parameters (Cont'd)

Lateral Earth Pressure Coefficients				
	Internal Friction Angle (ϕ°)	**Active K_a**	**At Rest K_o**	**Passive K_p**
Shale Bedrock	-	0.10	0.15	10.00
Sound Clay Till And Engineered Fill	28	0.35	0.50	2.80
Weathered Till	26	0.40	0.55	2.50

Runoff Coefficients	
Slope	**Silty Clay Till**
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

Coefficient of Permeability	
Silty Clay Till	10^{-7}

Maximum Allowable Soil Pressure For Thrust Block Design (kPa)	
Engineered Fill	75
Sound Natural Soil	100

6.10 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91.

In the bedrock, a steeper vertical cut can be allowed, provided the bedding plane of the rock is horizontal. Loose rocks protruding from the excavation must be removed for safety.

For excavation purposes, the types of soils are classified in Table 5.

Table 5 - Classification of Soils for Excavation

Material	Type
Shale Bedrock	1
Sound Till	2
Weathered Till	3

In the till which is plagued with fissures and saturated sand and silt seams and layers, the sides of excavations above groundwater may suffer localized sloughing or side collapse; therefore, they must be sloped at 1 vertical:at least 1 horizontal for stability.

At depths below the groundwater level, seepage in the till mantles during excavation is expected to be slow; in the shale, it may be slow to appreciable initially and may be reduced with time and can be controlled by pumping from sump wells.

Excavation into the hard till containing boulders and shale debris or the weathered shale, will require extra effort and the use of a heavy-duty backhoe equipped with a rock ripper.

Excavation of the bedrock can be carried out by a heavy-duty backhoe equipped with a rock ripper; if blasting is considered in order to expedite excavation into the sound rock, an expert should be consulted to determine the precautionary measures which should be taken to guard against damage to existing buildings and buried structures from the blasting shock waves.

Prospective contractors must be asked to assess the *in situ* subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the intended bottom of excavation. These test pits should be allowed to remain open for a period of at least 4 hours to assess the trenching conditions.

7.0 LIMITATIONS OF REPORT

It should be noted that a Phase I Environmental Site Assessment has been completed, and an assessment and recommendations have been given under separate cover, Reference No. 0008-S99E, dated September 2000. Therefore, this report deals only with a study of the geotechnical aspects of the proposed project.

This report was prepared by Soil-Eng Limited for the account of Great Gulf Group of Companies, on behalf of Green Ginger Developments Inc. and for review by their designated consultants and government agencies. The material in it reflects the judgement of Daniel Man, P.Eng., and Victor S. Chan, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. Soil-Eng Limited accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL-ENG LIMITED

Per

Daniel Man, P.Eng.

per Victor S. Chan, P.Eng.

DM/VSC:jp

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

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

1. SAMPLE TYPES

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

2. PENETRATION RESISTANCE/'N'

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2" diameter 90° point cone driven by a 140-pound hammer falling 30 inches.
Plotted as ________

Standard Penetration Resistance or 'N' value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.
Plotted as 'O'.

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

3. SOIL DESCRIPTION

a) Cohesionless Soils:

'N' (Blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

b) Cohesive Soils:

Undrained Shear Strength (ksf)	Consistency
Less than 0.25	very soft
0.25 to 0.50	soft
0.50 to 1.0	firm
1.0 to 2.0	stiff
2.0 to 4.0	very stiff
over 4.0	hard

c) Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 - Field vane test in borehole. The number denotes the sensitivity to remoulding.

△ - Laboratory vane test

□ - Compression test in laboratory.

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength.

METRIC CONVERSION FACTORS

1 ft. = 0.3048 metres	1 inch = 25.4 mm
1 lb. = 0.453 kg	1 ksf = 47.88 kN/m^2

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

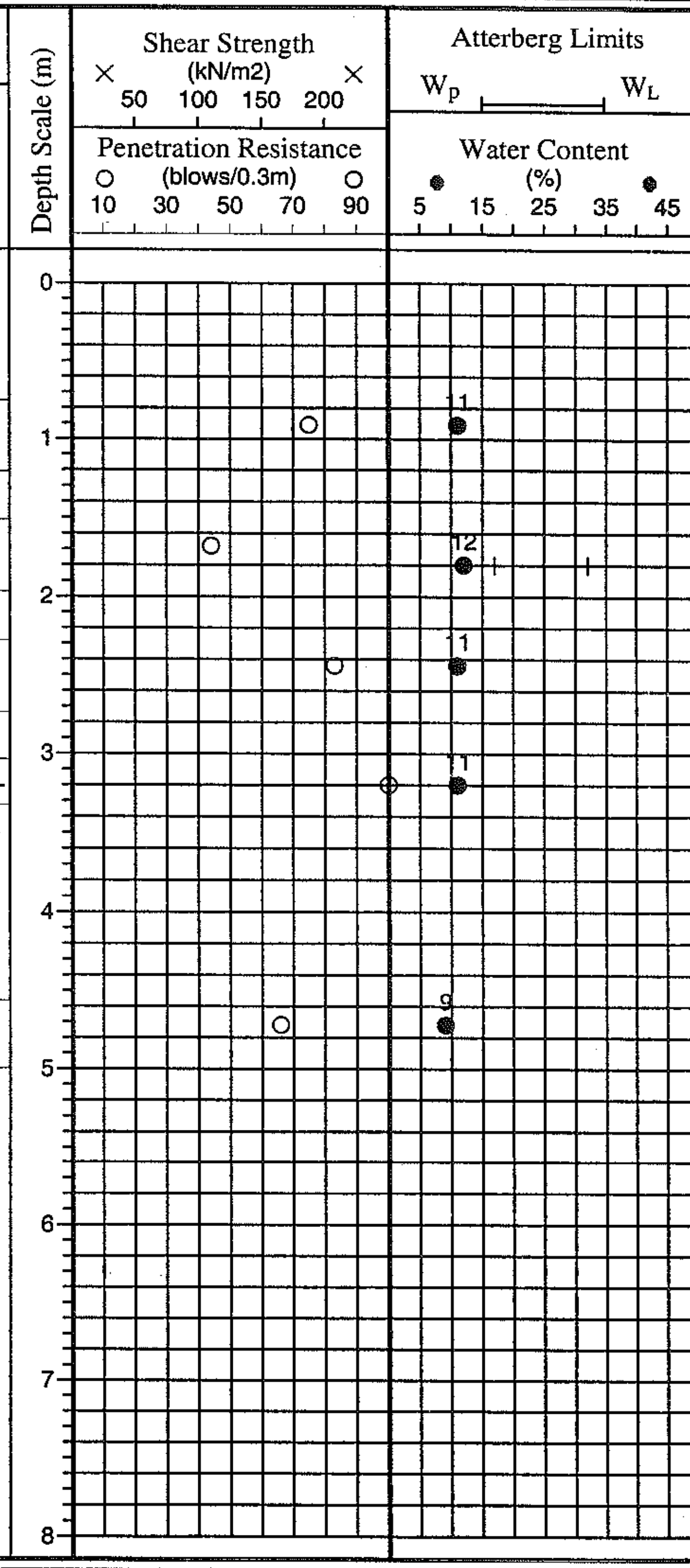
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Number	Type	N-Value
178.0	Ground Surface			
0.0	**30cm TOPSOIL**			
	Hard; weathered; **SILTY CLAY, Till**; sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	75
		2	DO	44
		3	DO	83
		4	DO	100+
	brown / grey / brown			
173.0		5	DO	66
5.0	**END OF BOREHOLE**			



WATER LEVEL: Dry on Completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

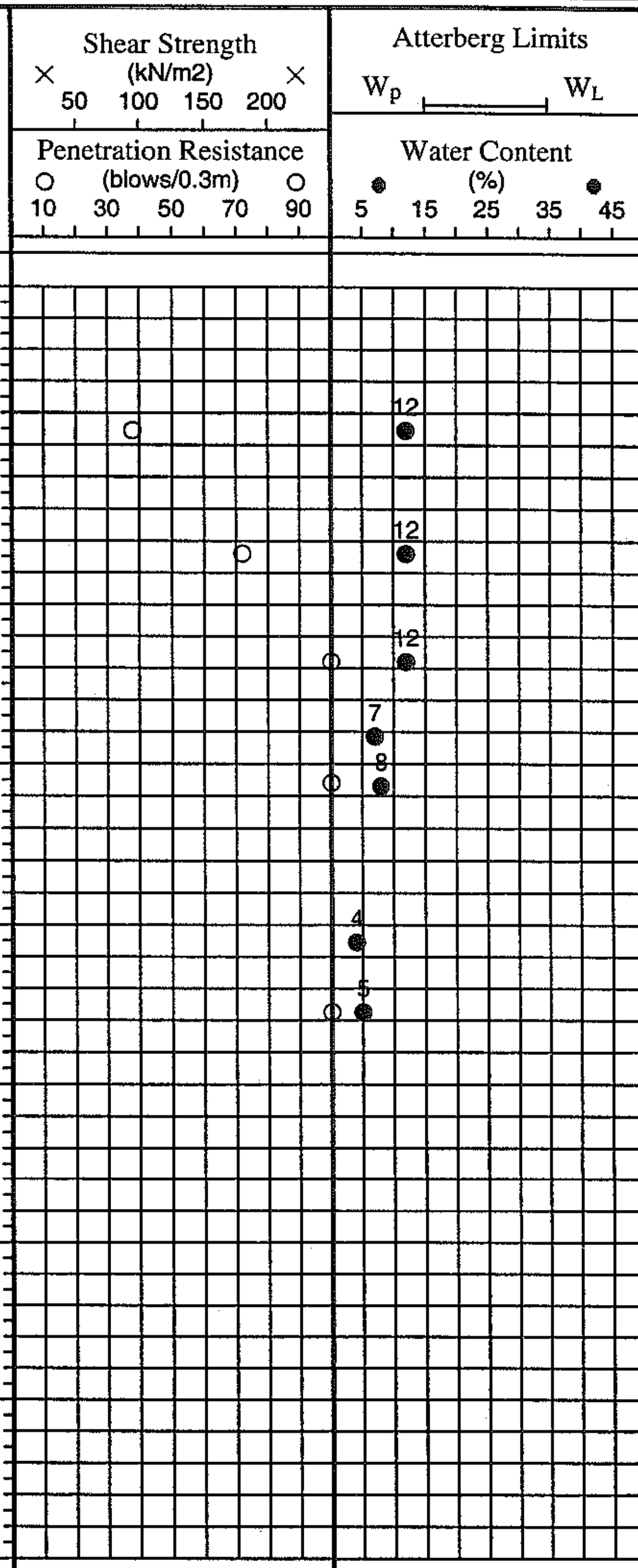
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Samples: Number	Type	N-Value	Depth Scale (m)	WATER LEVEL
176.0	Ground Surface				0	
0.0	**30cm TOPSOIL**					
	Brown and reddish-brown, hard, weathered **SILTY CLAY, TIll** sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	38	1	Dry on completion
		2	DO	72	2	
		3	DO	100+		
		4	AS	-	3	
		5	DO	100+		
172.3 / 3.7	Reddish-brown, weathered **SHALE BEDROCK**	6	AS	-	4	
171.4 / 4.6		7	DO	100+		
	END OF BOREHOLE				5	
					6	
					7	
					8	



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

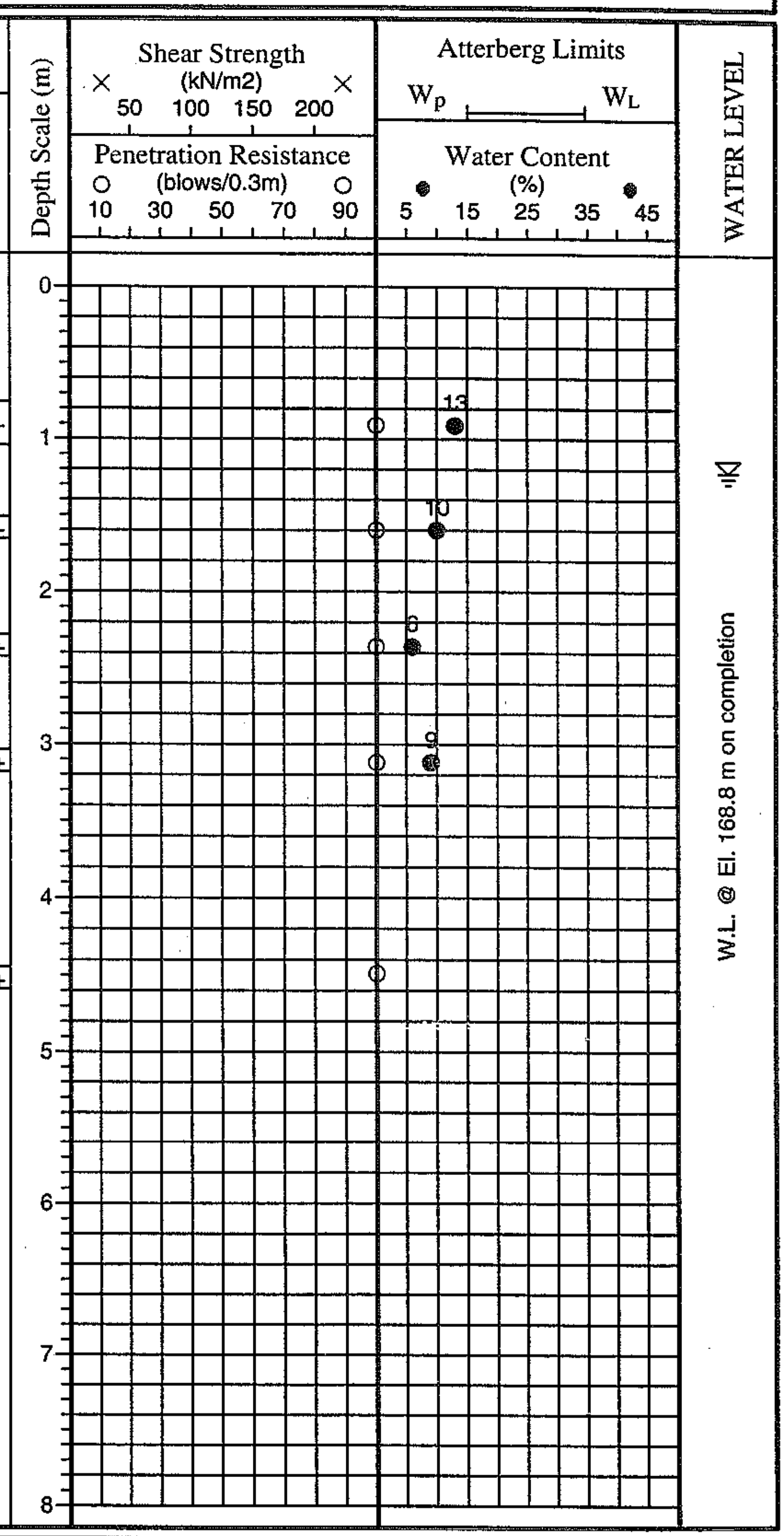
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Samples Number	Type	N-Value
170.0	Ground Surface			
0.0	**23cm TOPSOIL**			
	Reddish-brown, hard, weathered **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	100+
		2	DO	100+
167.5 / 2.5		3	DO	100+
	Reddish-brown, weathered **SHALE BEDROCK**	4	DO	100+
165.4 / 4.6		5	DO	100+
	END OF BOREHOLE			



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

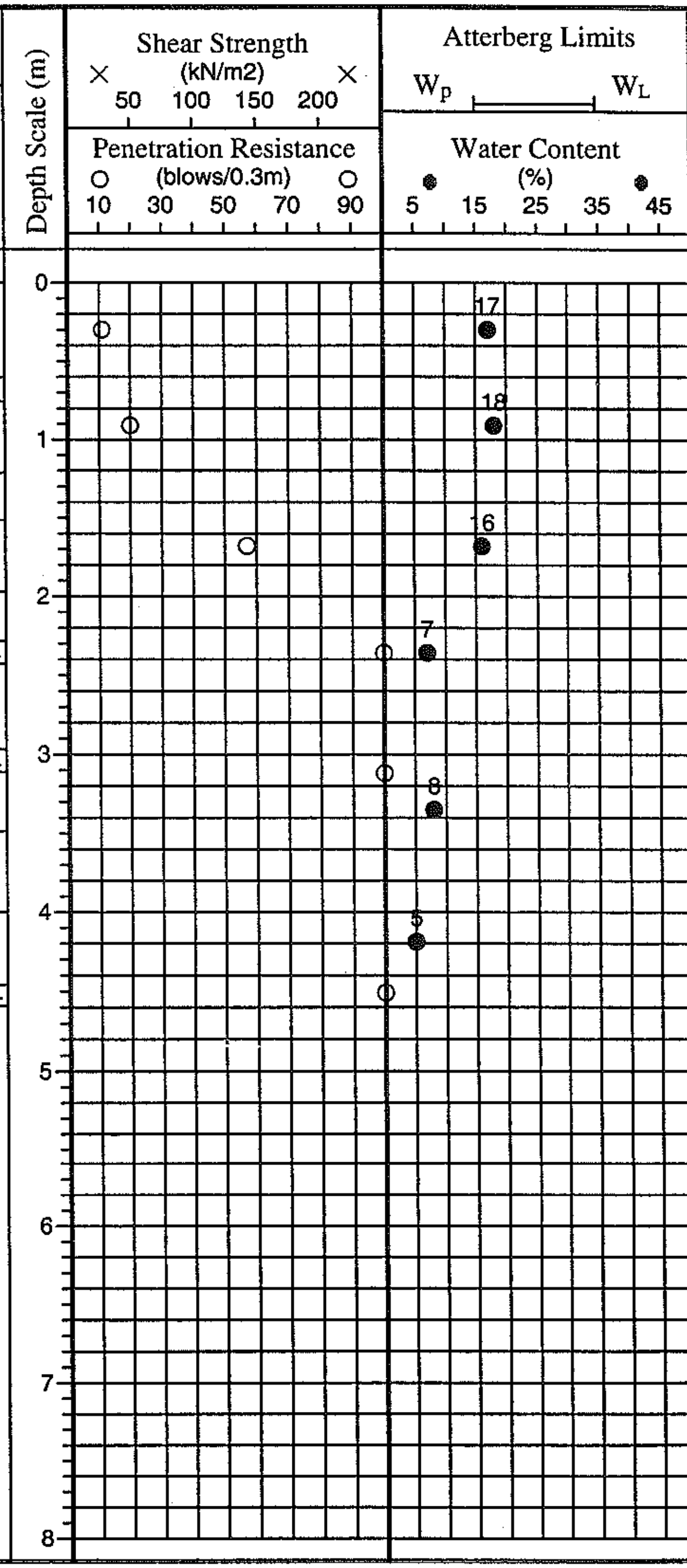
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
167.5	Ground Surface			
0.0	Brown and reddish-brown **SILTY CLAY, Fill** with topsoil layers	1	DO	11
166.5 / 1.0	Brown and reddish-brown, very stiff to hard weathered **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	2	DO	20
		3	DO	57
		4	DO	100+
165.0 / 2.5	Reddish-brown **SHALE BEDROCK**	5	DO	100+
		5A	AS	-
	weathered / sound	6A	AS	-
		6	DO	100+
162.9 / 4.6	**END OF BOREHOLE**			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

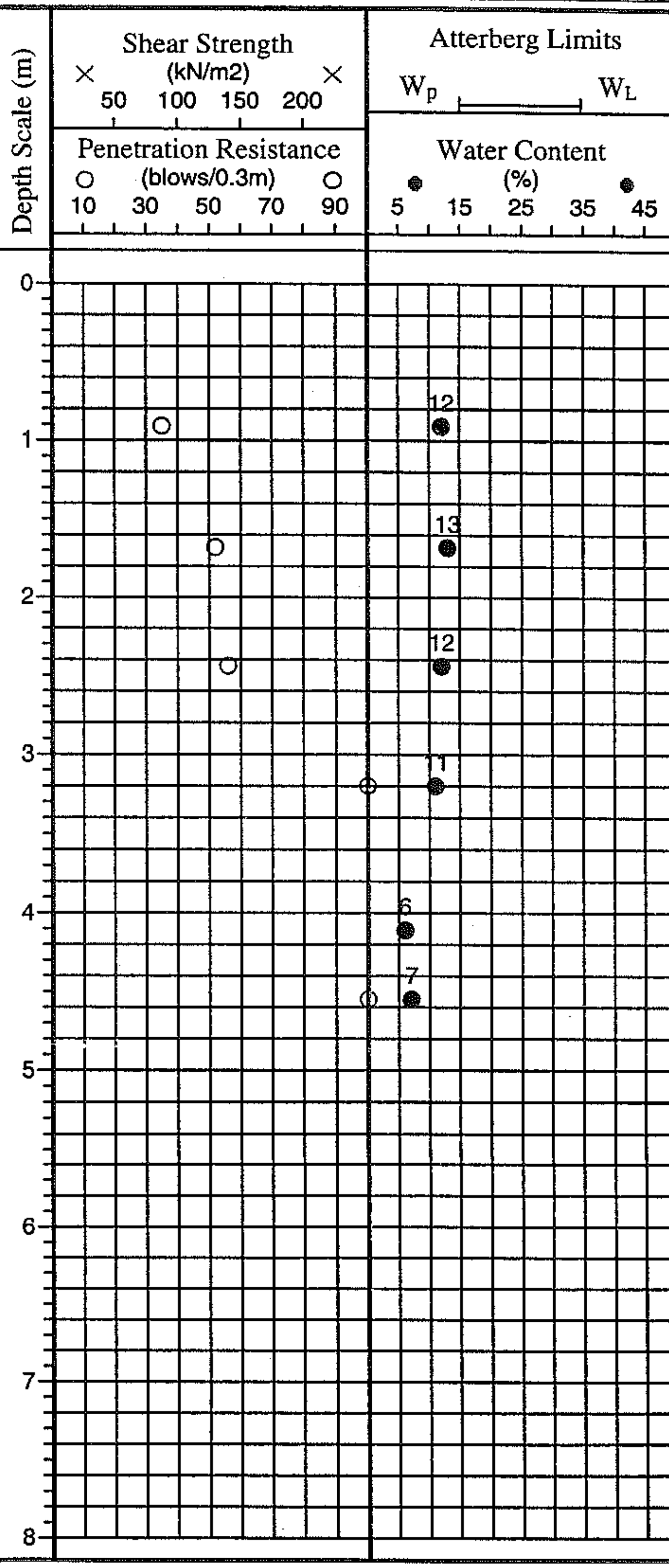
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Sample Number	Type	N-Value
176.0 / 0.0	Ground Surface			
	28cm TOPSOIL			
	weathered			
	Brown and reddish-brown, hard	1	DO	35
	SILTY CLAY, Till	2	DO	52
	sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	3	DO	56
		4	DO	100+
171.6 / 4.4		5	AS	-
171.4 / 4.6	Reddish-brown, weathered **SHALE BEDROCK**	6	DO	100+
	END OF BOREHOLE			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

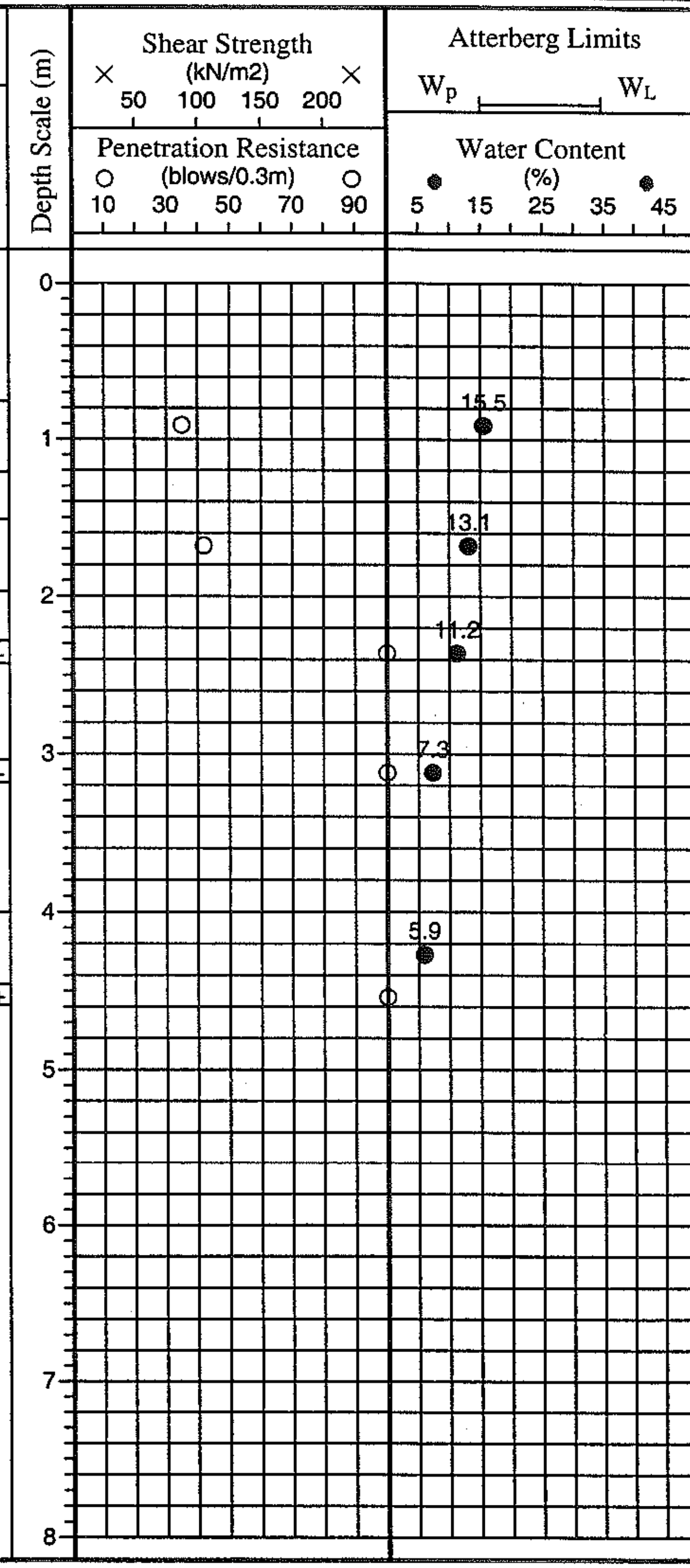
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
173.0	Ground Surface				
0.0	**30cm TOPSOIL**				Dry on completion
	Brown and reddish-brown, hard **SILTY CLAY, TIll** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	35	
		2	DO	42	
		3	DO	100+	
170.4 / 2.6	Reddish-brown, weathered **SHALE BEDROCK**	4	DO	100+	
		5A	AS	-	
		5	DO	100+	
168.4 / 4.6	**END OF BOREHOLE**				



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

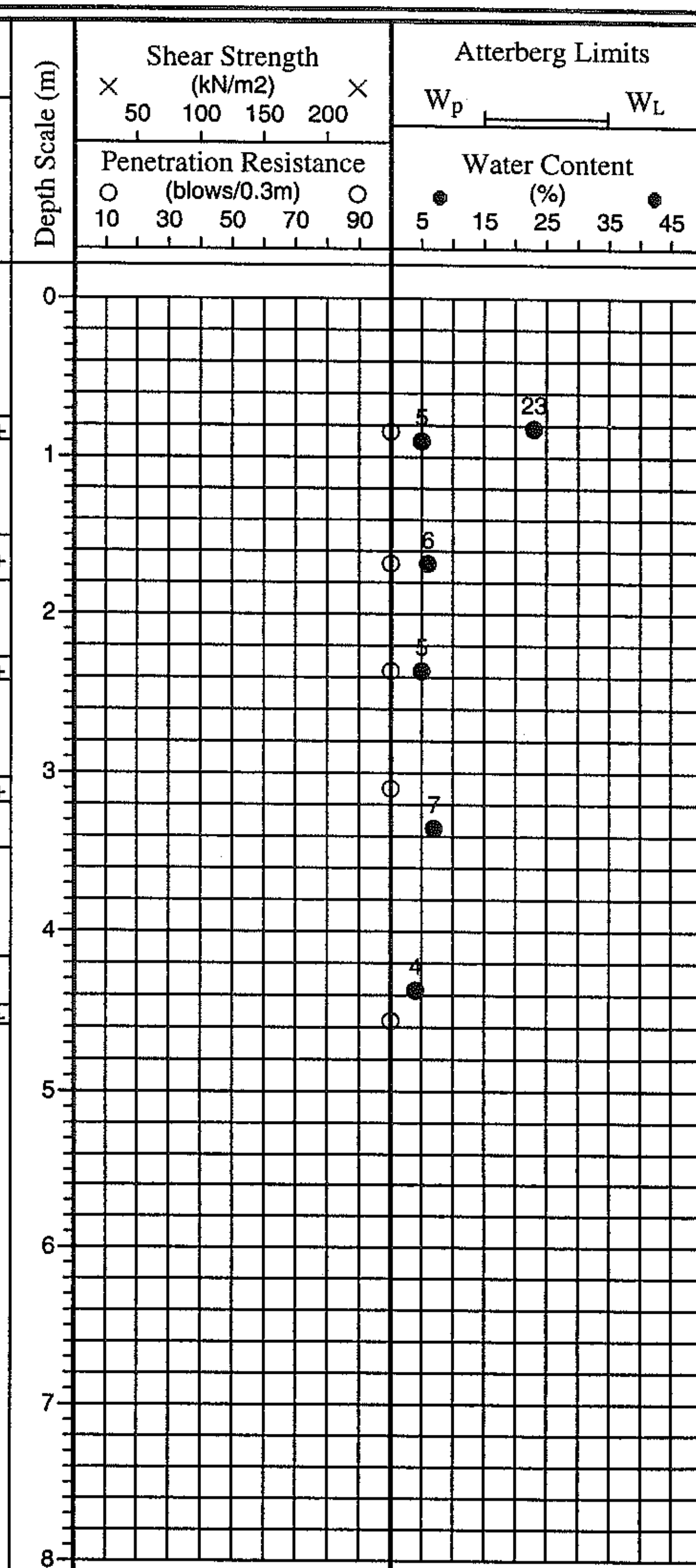
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
169.0	Ground Surface				
0.0	**30cm TOPSOIL**				Dry on completion
	Reddish-brown, hard **SILTY CLAY, Till**	1	DO	100+	
168.0 / 1.0	Reddish-brown, weathered **SHALE BEDROCK**	2	DO	100+	
		3	DO	100+	
		4	DO	100+	
	hard augering	4A	AS	-	
		5A	AS	-	
		5	DO	100+	
164.4 / 4.6	**END OF BOREHOLE**				



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 8

FIGURE NO.: 8

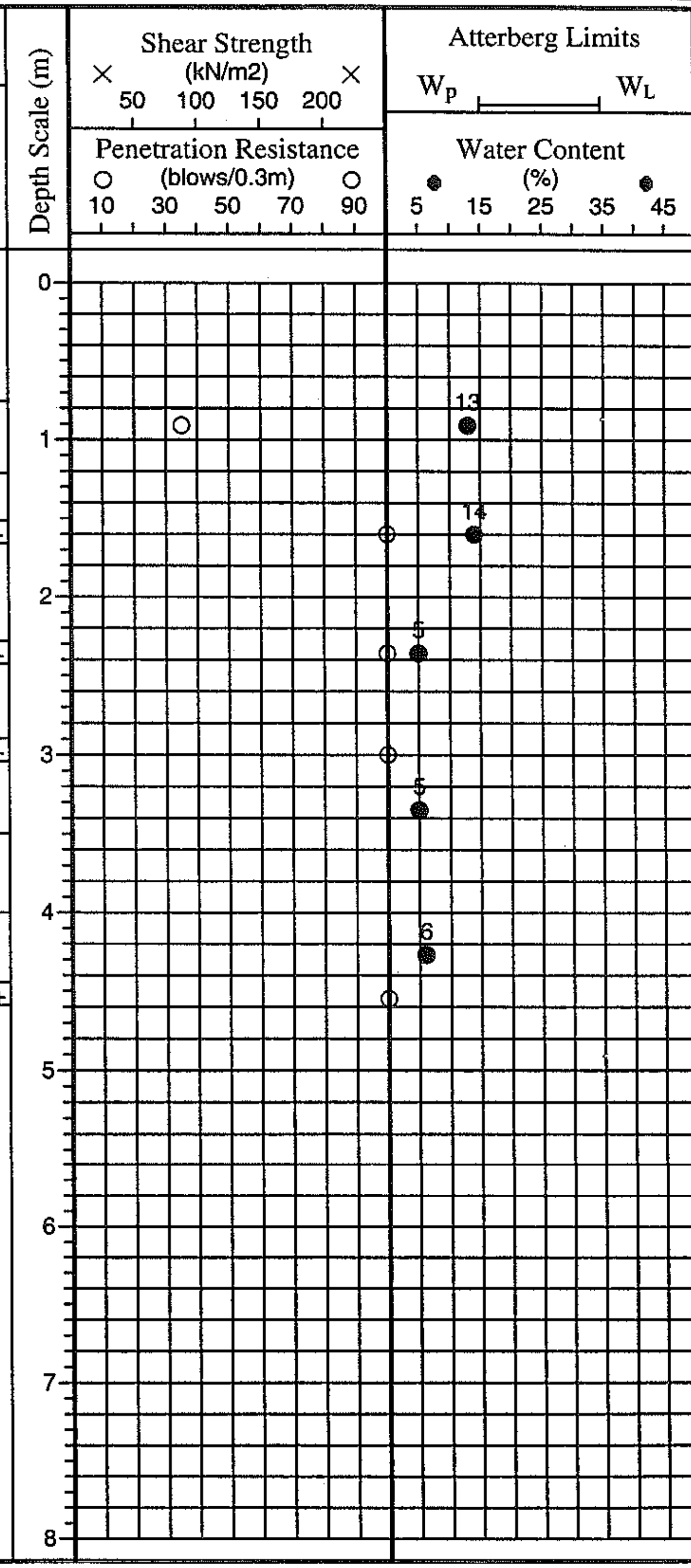
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
170.0	Ground Surface			
0.0	**30cm TOPSOIL**			
	Brown and reddish-brown, hard **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers (weathered)	1	DO	35
		2	DO	100+
168.2 / 1.8	Reddish-brown, weathered **SHALE BEDROCK**	3	DO	100+
		4	DO	100+
		4A	AS	-
		5A	AS	-
		5	DO	100+
165.4 / 4.6	**END OF BOREHOLE**			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 9

FIGURE NO.: 9

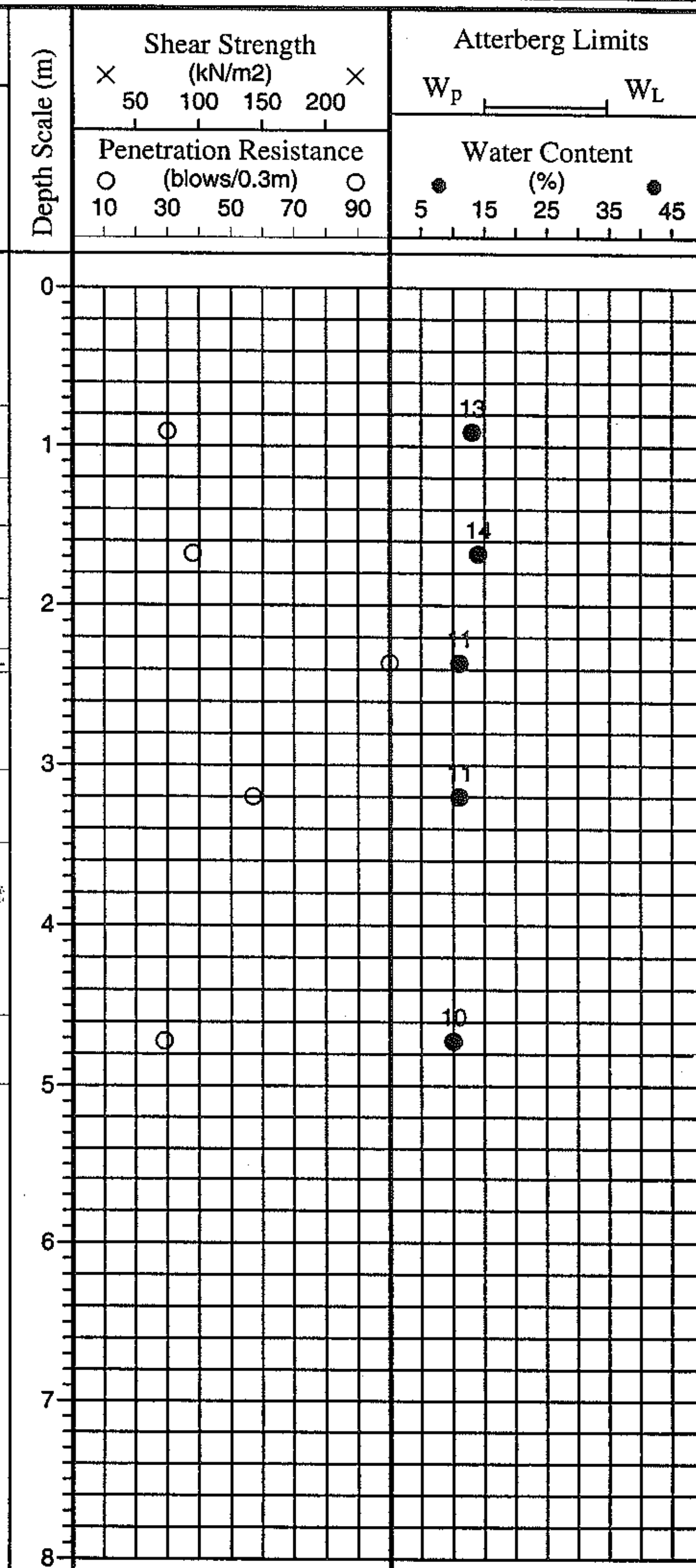
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
179.0	Ground Surface				
0.0	**28cm TOPSOIL**				Dry on completion
	Brown, very stiff to hard — weathered				
	SILTY CLAY, Till	1	DO	30	
	sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	2	DO	38	
		3	DO	100+	
		4	DO	57	
		5	DO	29	
174.0 / 5.0	**END OF BOREHOLE**				



JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 10

FIGURE NO.: 10

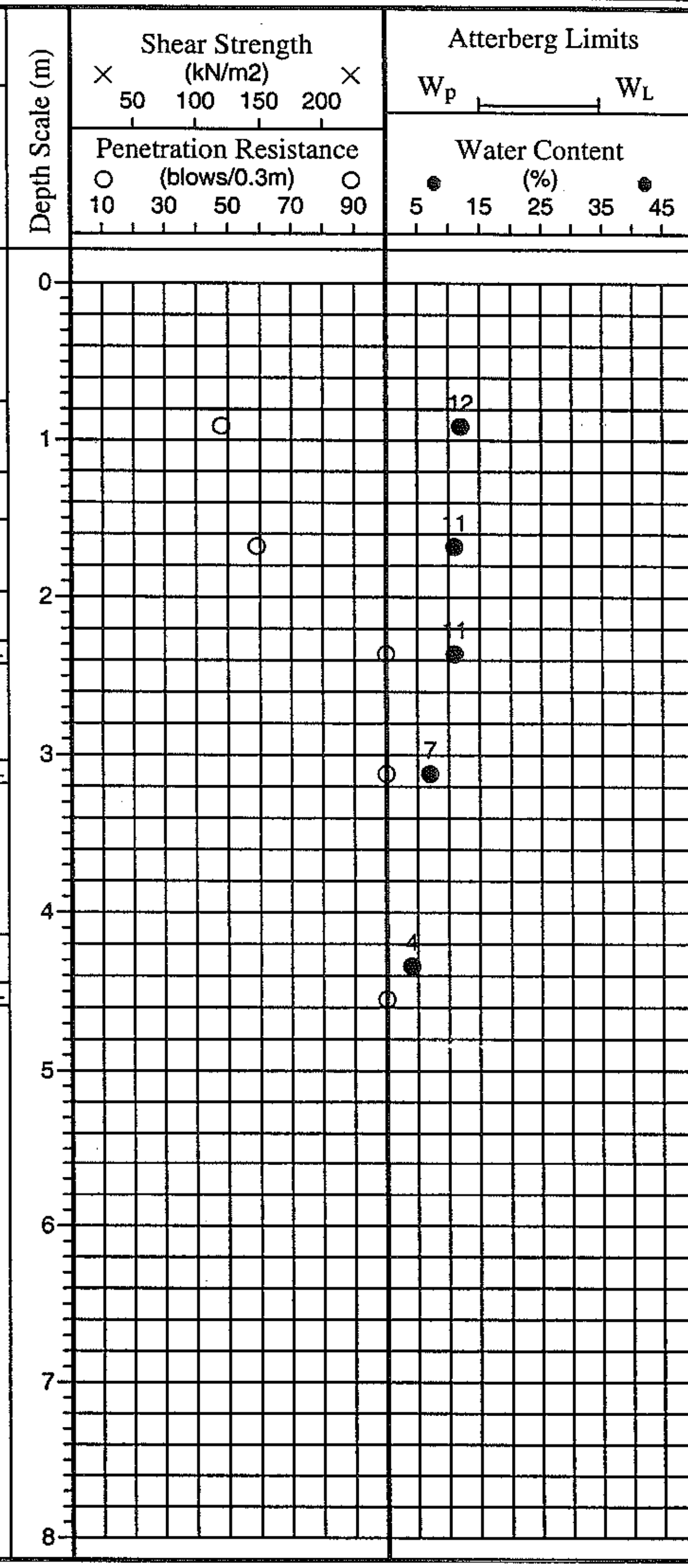
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
176.0	Ground Surface			
0.0	**30cm TOPSOIL**			
	Brown and reddish-brown hard (weathered) **SILTY CLAY, Till** sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	48
		2	DO	59
		3	DO	100+
173.0 / 3.0	Reddish-brown, weathered **SHALE BEDROCK**	4	DO	100+
		5A	AS	-
171.4 / 4.6		5	DO	100+
	END OF BOREHOLE			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 11

FIGURE NO.: 11

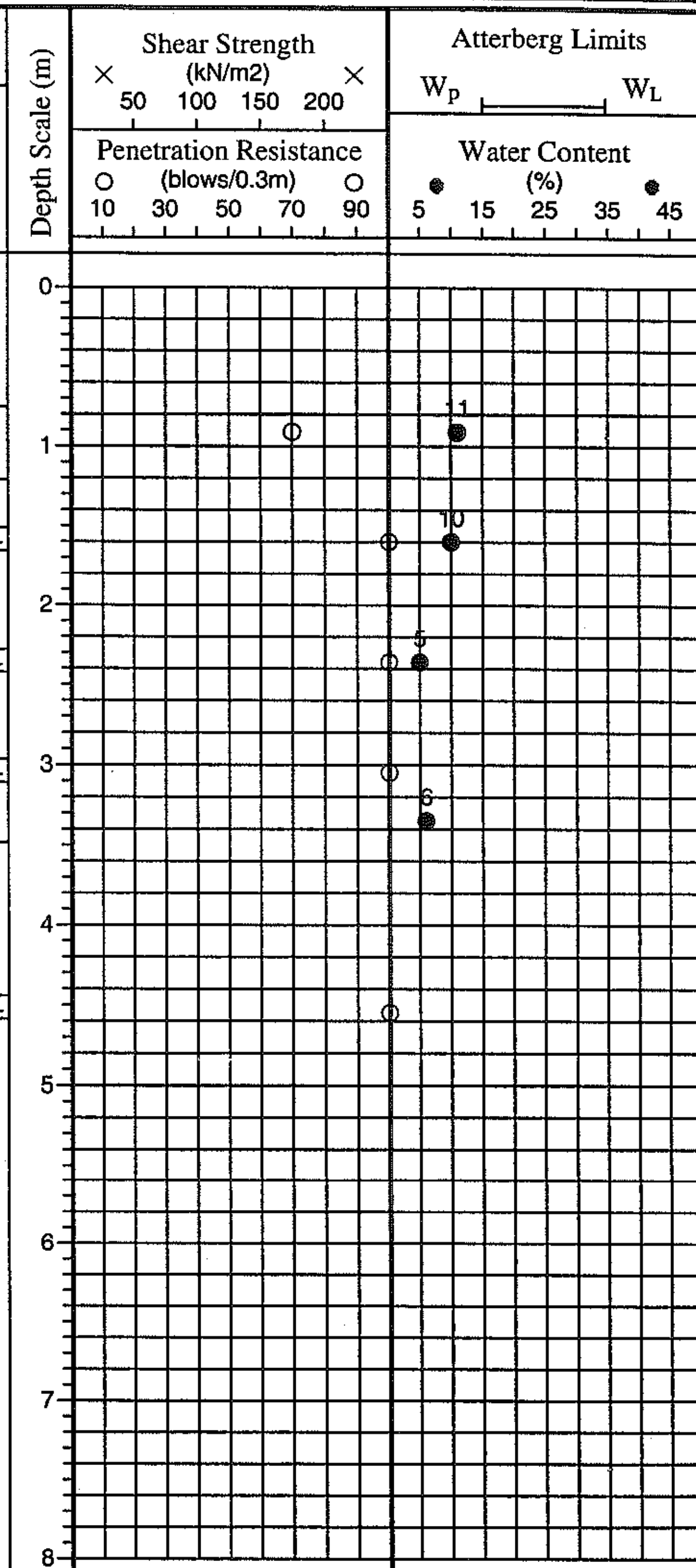
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Sample Number	Type	N-Value
174.0	Ground Surface			
0.0	**30cm TOPSOIL**			
	Reddish-brown, hard **SILTY CLAY, Till** (weathered) sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	70
		2	DO	100+
171.9 / 2.1	Reddish-brown **SHALE BEDROCK**	3	DO	100+
		4	DO	100+
		4A	AS	-
		5	DO	100+
169.4 / 4.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 171.5 m on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 12

FIGURE NO.: 12

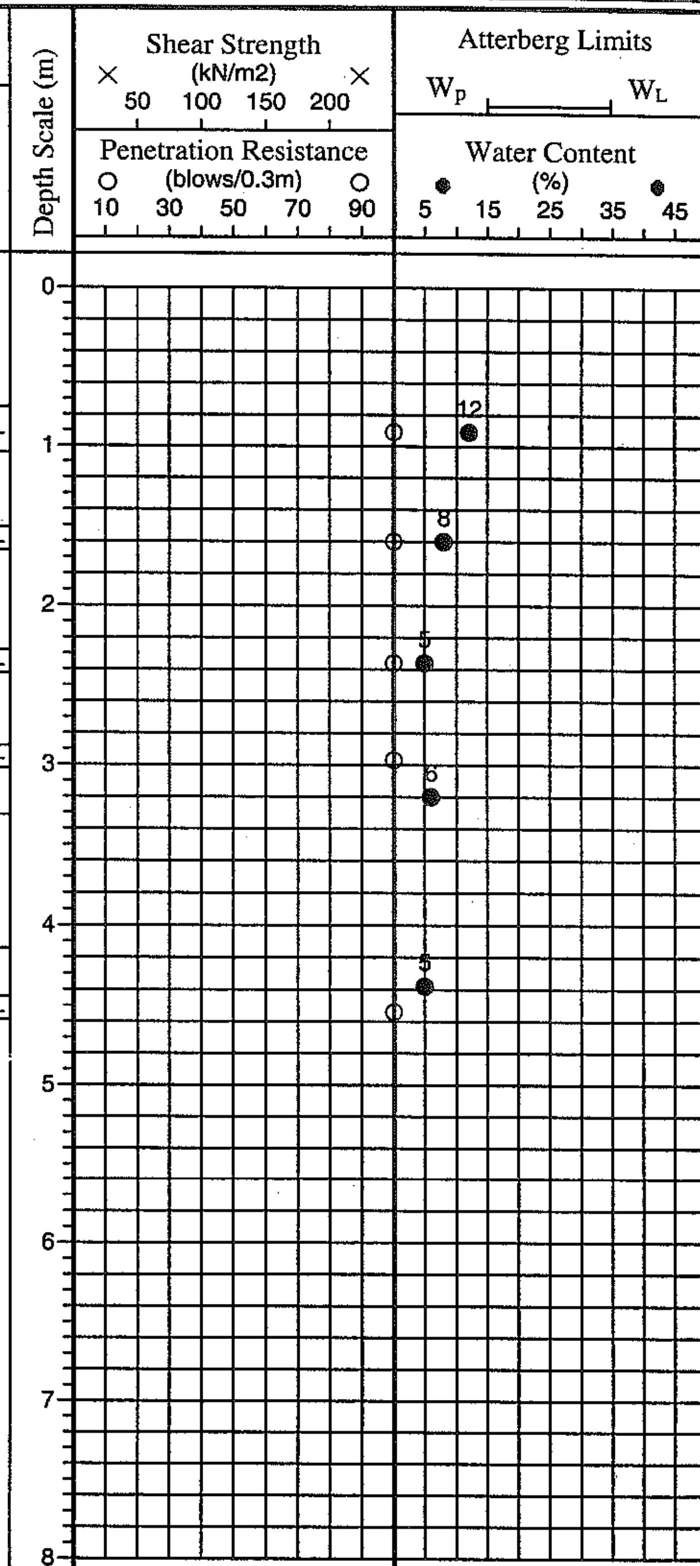
JOB DESCRIPTION: Proposed Residential Subdivisioin

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth (m)	Soil Description	Sample Number	Type	N-Value	Water Level
170.5	Ground Surface				
0.0	**33cm TOPSOIL**				
	Reddish-brown, hard **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers (weathered)	1	DO	100+	Dry on completion
		2	DO	100+	
168.4 / 2.1	Reddish-brown **SHALE BEDROCK**	3	DO	100+	
		4	DO	100+	
		4A	AS	-	
	weathered / sound				
		5A	AS	-	
		5	DO	100+	
165.9 / 4.6	**END OF BOREHOLE**				



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 13

FIGURE NO.: 13

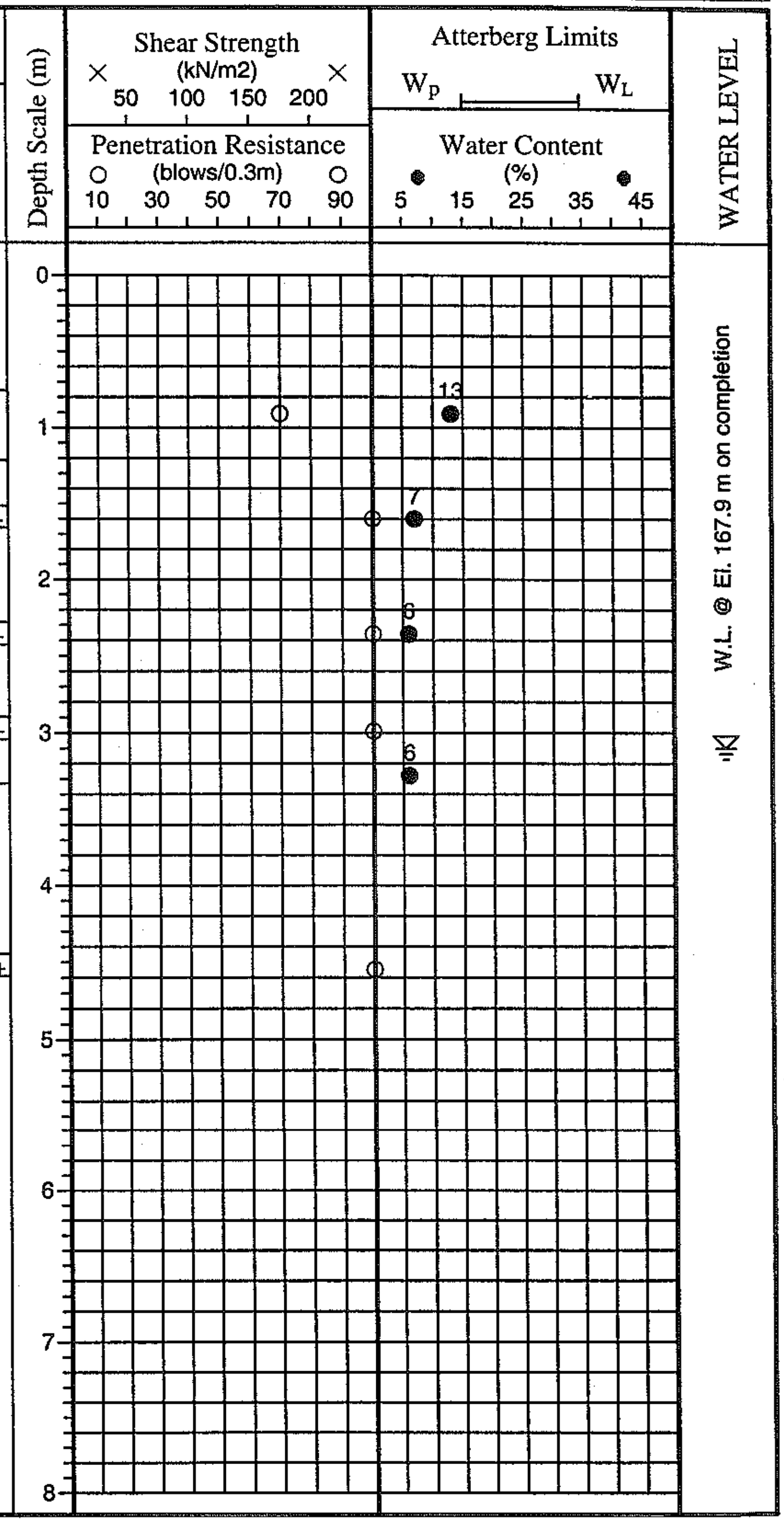
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	Sample Number	Type	N-Value
171.0	Ground Surface			
0.0	**25cm TOPSOIL** Brown and reddish-brown, hard **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers (weathered)	1	DO	70
169.5 / 1.5	Reddish-brown **SHALE BEDROCK**	2	DO	100+
		3	DO	100+
		4	DO	100+
	weathered / sound	4A	AS	-
		5	DO	100+
166.4 / 4.6	**END OF BOREHOLE**			



SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 14

FIGURE NO.: 14

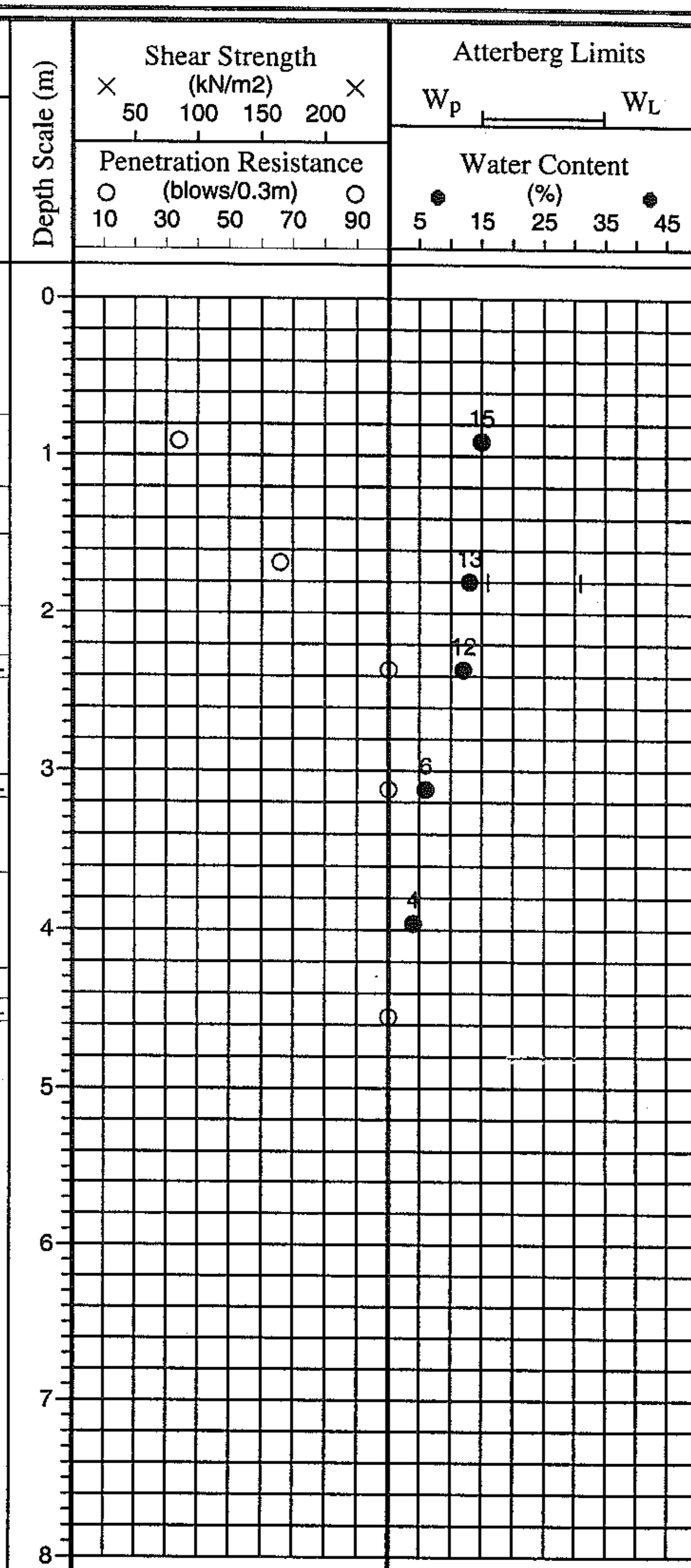
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth m	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
172.0	Ground Surface			
0.0	**25cm TOPSOIL**			
	Brown and reddish-brown, hard, weathered **SILTY CLAY, Till** sandy, a tr. of gravel, occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers	1	DO	34
		2	DO	66
		3	DO	100+
		4	DO	100+
168.7 / 3.3	Reddish-brown, weathered **SHALE BEDROCK**	5	AS	-
		6	DO	100+
167.4 / 4.6	**END OF BOREHOLE**			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0008-S99

LOG OF BOREHOLE NO.: 15

FIGURE NO.: 15

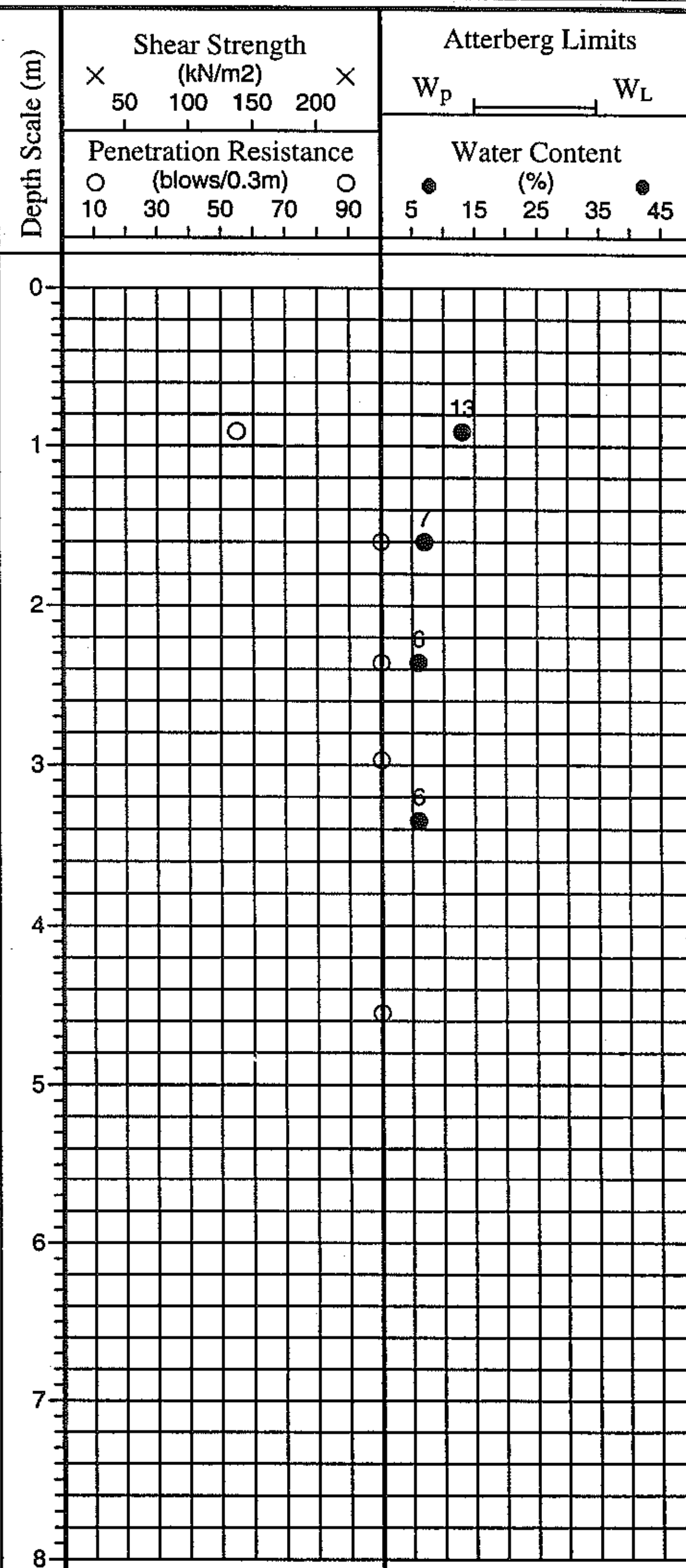
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 26, 2000

Elev. / Depth (m)	SOIL DESCRIPTION	Sample Number	Type	N-Value
172.0	Ground Surface			
0.0	**23cm TOPSOIL**			
	Brown and reddish-brown, hard **SILTY CLAY, Till** sandy, a tr. of gravel occ. cobbles, boulders, shale debris, and wet sand and silt seams and layers (weathered)	1	DO	55
		2	DO	100+
170.2 / 1.8	Reddish-brown, weathered **SHALE BEDROCK**	3	DO	100+
		4	DO	100+
		4A	AS	-
	weathered / sound			
		5	DO	100+
167.4 / 4.6	**END OF BOREHOLE**			



WATER LEVEL: W.L. @ El. 168.9 m on completion

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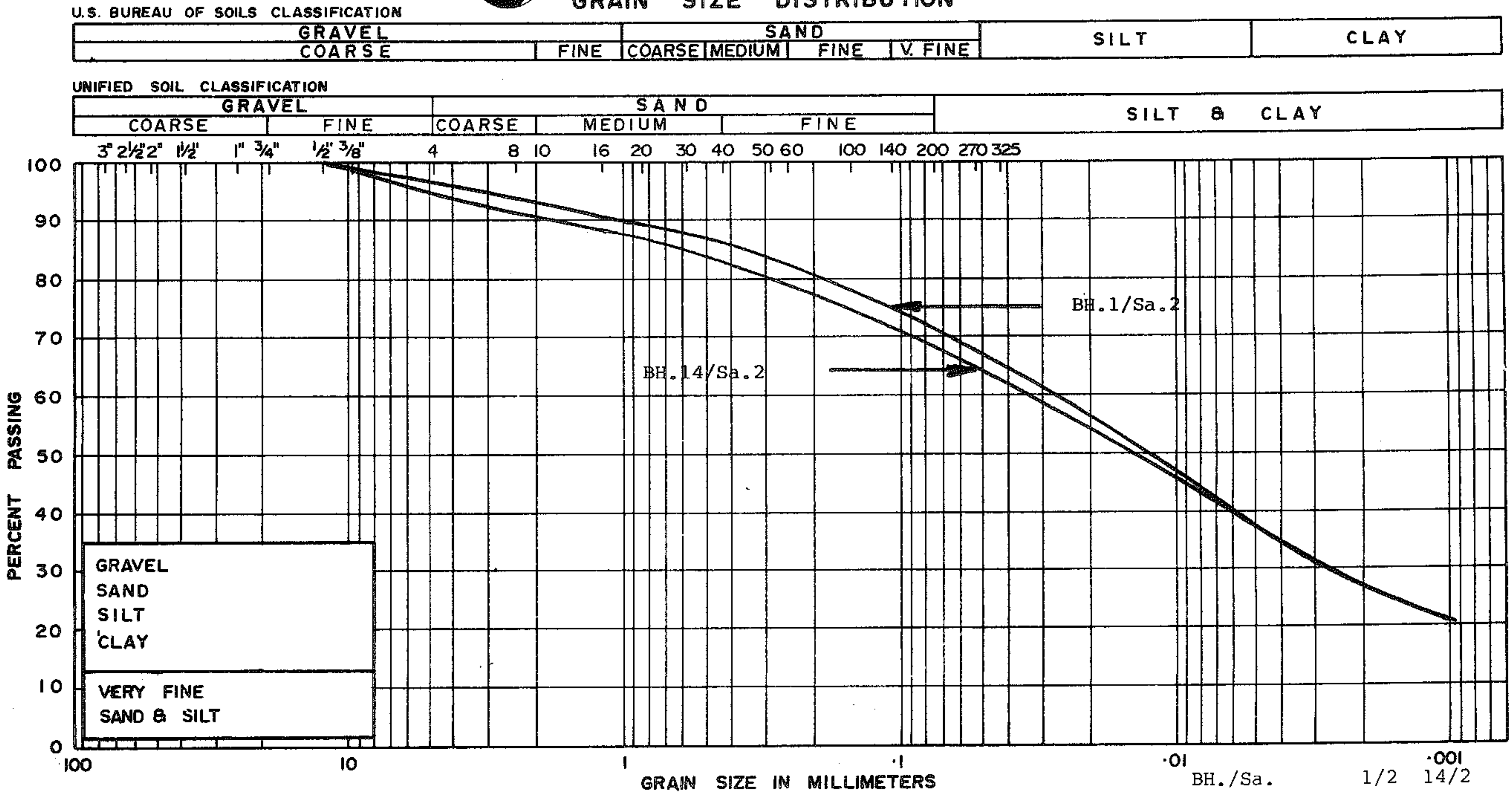
REFERENCE Nº 0008-S99

GRAIN SIZE DISTRIBUTION



BH./Sa.	1/2	14/2
LIQUID LIMIT % =	32	30
PLASTIC LIMIT % =	17	16
PLASTICITY INDEX % =	15	14
MOISTURE CONTENT % =	12	13
PERMEABILITY (cm./sec.) = (Estimated)	10^{-7}	

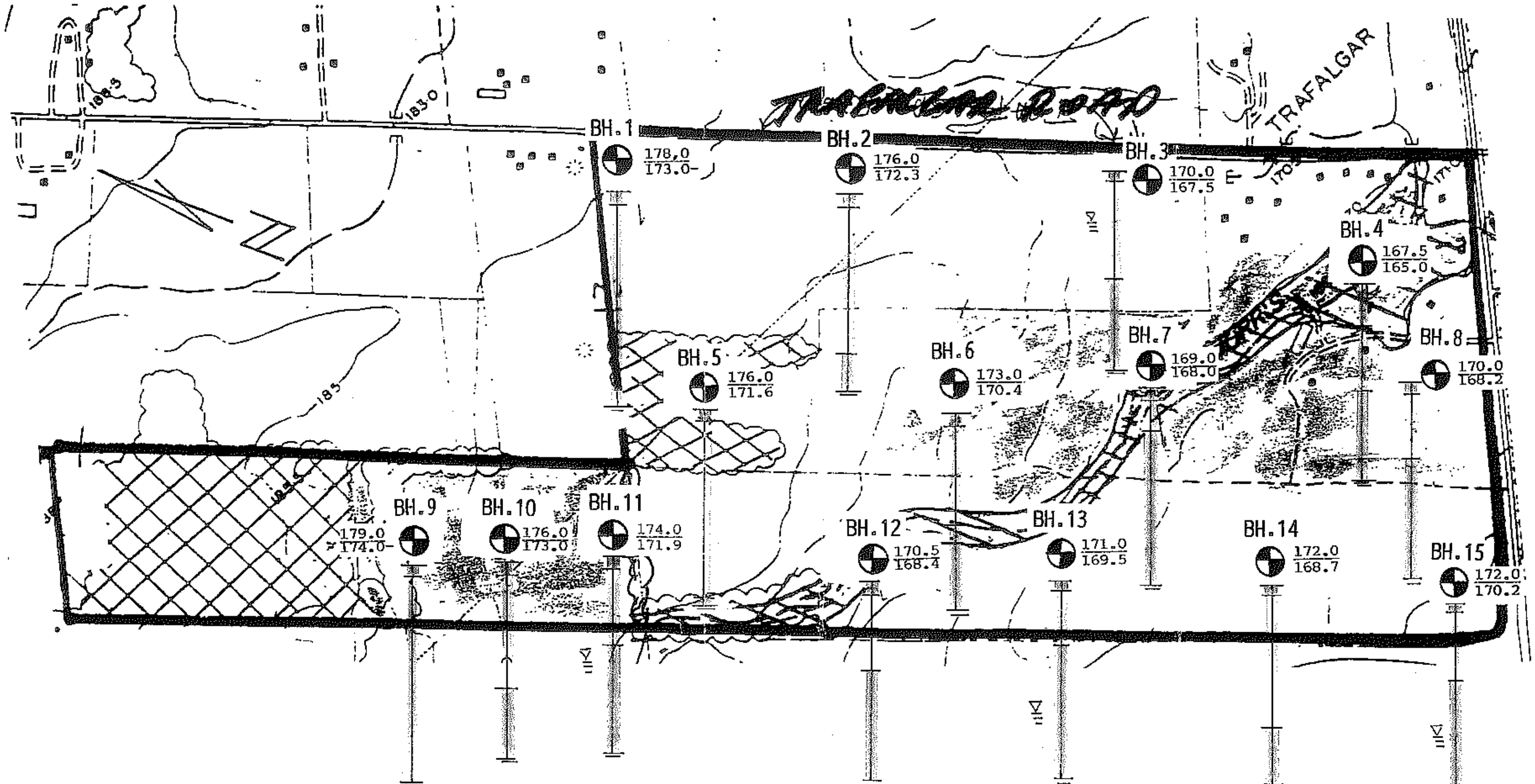
PROJECT: Proposed Residential Subdivision

LOCATION: NW Corner of Dundas St. E. and Trafalgar Rd., Town of Oakville

BOREHOLE Nº:	1	14
SAMPLE Nº:	2	2
DEPTH: (m)	1.8	1.8
ELEVATION: (m)	176.2	170.2

Classification of Sample and Group Symbol:
SILTY CLAY, Till
sandy, a tr. of gravel

FIGURE: 16



LEGEND

xxx.x / xxx.x = Figure denotes Ground El. (m) / Bedrock El. (m)

- TOPSOIL
- EARTH FILL
- SILTY CLAY TILL
- SHALE BEDROCK
- WATER LEVEL

BOREHOLE LOCATION PLAN AND SUBSURFACE PROFILE

Ref. No. 0008-S99

Date: October 2000

Drawing No. 1

Scale: Horiz. - 1:5000 Vert. - 1:100

SOIL-ENG LIMITED