Revised Geotechnical Investigation Report

Manotick Estates Phase VI – 5599 First Line Road
North West Half of Lot 3, Concession A
Former Rideau Township now City of Ottawa, Ontario

Prepared For:

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Summary

A geotechnical investigation was undertaken at the site of the proposed residential development to be located on the northwest half of Lot 3, Concession A former Rideau Township, now in the City of Ottawa, Ontario. The development will comprise of 33 residential lots with private wells and septic tile beds.

The initial investigation consisted of drilling nine boreholes to 4.4 m to 12.8 m depth. In addition, the geotechnical information obtained from eighteen test pits and three water wells put down during the Hydrogeology and Terrain Evaluation Study were also incorporated in this report. Subsequent to a peer review of the report, four additional boreholes (Boreholes 10 to 13 inclusive) were drilled at the site in January 2011. The investigation has revealed that beneath a surficial layer of topsoil, the predominant natural soil in west portion of the site is sand and gravel which extends to a depth of 0.7 m to 5.2 m. It is underlain by sand and gravel till which extends to the entire depth investigated. The surficial soil in the majority of the site is silty sand which extends to a depth of 1.2 m to 2 m. The silty sand is underlain by silty clay and/or silty sand and gravel till to the entire depth investigated. The silty clay is overconsolidated by 26 kPa approximately. The recompression and compression indices of the silty clay are 0.042 and 1.29 respectively. In-place rising head permeability tests performed in the silty sand and gravel till and the silty clay have revealed that these materials have a very low permeability (i.e. in the order of 7×10^{-7} to 2×10^{-8} m/s). Three water wells drilled on the site have revealed that limestone bedrock is present at a depth of 19.5 m to 21.6 m (Elevation 68.2 m to 76.6 m approximately). The bedrock is expected to be dolostone of the Oxford Formation.

Water level observations made at the site indicated that the water level in the sand stratum in the west part of the site is at 3.1 m to 4.6 m depth (Elevation 90.4 m to 91.7 m). In the remainder of the site, water levels were recorded at a depth of 1.7 m to 5.3 m (Elevation 84.7 m to 92.2 m). The groundwater table generally slopes down towards the Mud Creek located along the east boundary of the site.

The majority of the site is underlain by a deposit of clay. The silty clay is prone to consolidation settlements if fill is placed on the site. This may result in settlement and cracking of the structures. It is therefore recommended that the grade raise on the site should be limited to a maximum of 1 metre.

The investigation has revealed that the geotechnical conditions at the site are suitable to found the proposed residences on spread and strip footings set in the sand, silty sand till or silty clay stratum below any surficially softened or loose soils. A Serviceability Limit State (SLS) bearing pressure of 50 kPa is expected to be available when founding in the clay. This Serviceability Limit State (SLS) bearing pressure may be increased to 95 kPa when founding in the sand stratum or in the silty sand and gravel till. This recommendation assumes that the grade at the site would not be raised by more than 1 metre. The site grading plan (Plan GP1, Rev 6 and GP2, Rev 5 prepared by Trow Associates Inc., Project No. MP13613A dated February 10, 2011)) was reviewed by this office. Since the grade will be raised by more than 1.0 m on Lots 15, 16, 17, 24, 25, 26 and 30, special provisions as detailed in the report will be required for these lots.

A minimum of 1.5m of earth cover should be provided to exterior footings of a heated structure to protect them from damage due to frost penetration. Settlements of structure designed according to the recommended Serviceability Limit State (SLS) bearing pressure were computed to less than the normally tolerated limits of 25 mm total and 19 mm differential movements. Based on the results of the settlement computations, it is recommended that the top and bottom of the foundation walls should be reinforced.

The floor slabs of the proposed structures may be constructed as slabs-on-grade provided they are set on 200 mm thick of well compacted bed of 19 mm clear stone placed on natural undisturbed soil or on well compacted fill and prepared as recommended within this report. Perimeter drainage system will be required for the structures with basements.

Excavations for installation of underground services are expected to be shallow whereas excavations for construction of the footings are expected to extend to a depth of 2 m to 3 m. The excavations will extend through sand and gravel, till and silty clay and are expected to be above the groundwater table. It should be possible to undertake the excavations as open cut provided they are cut back at 45 degrees. The exception to this is the sand and gravel stratum and the till below the groundwater table where the excavations are expected to stabilize at a slope between 2H:1V and 3H:1V. These excavations will also be prone to 'base heave' type of failure. Therefore, the groundwater table at the site should be lowered to below the maximum anticipated depth of excavation prior to commencement of the excavations. It should be possible to collect any water entering the excavations at low points and to remove it by pumping from sumps.

The backfill in the footing trenches and service trenches should be compactable. It should be compacted to 95 percent of Standard Proctor Maximum Dry Density. The on-site soils from above the groundwater table are expected to be compactible. These soils from below the groundwater table are considered too wet for adequate compaction. It is anticipated that any fill required for backfilling purposes would have to be imported and should preferably conform to the OPSS Specification of a Granular 'B' material. If granular backfill is used, frost taper should be provided to minimize sharp distortions of the pavement due to the differential heave of the backfill/native material. In addition, clay barriers should be provided in the trench backfill to minimize lowering of the groundwater table.

The pavement structure for heavy duty roadways should comprise of 80 mm of asphaltic concrete underlain by 150 mm of Granular 'A' and 375 mm of Granular 'B', Type II. The base and sub-base materials should be compacted to 100 percent of Standard Proctor density. The asphaltic concrete should be compacted to 97 percent of the Marshall Density.

A stability of slope analysis was undertaken to determine the minimum set back required for development purposes. Five cross sections of the slope (Sections 1-1 to Section 5-5 inclusive) were analyzed. The results indicate that the slopes have an adequate factor of safety against potential failure and that a geotechnical set back is not required. Examination of the aerial photographs over the last 70 years and visual examination of the creek banks have revealed that significant erosion of the mud creek banks has not taken place. It is therefore considered that toe erosion allowance is not required. However, it is understood that the limit of development lands was staked on the site in consultation with representatives of Rideau Valley Conservation Authority. This line was surveyed by representatives of DME and has been plotted on Site Plan, Figure 1. It is recommended that no construction should be undertaken beyond the limit of development line.

The above and other related considerations are discussed in greater detail in the body of the report.

Introduction

Trow Associates Inc. was retained by Leimerk Developments Ltd. to undertake a geotechnical investigation at the site of the proposed new residential subdivision to be situated on north west half of Lot 3, Concession A, former Rideau Township now in the City of Ottawa, Ontario (Figure 1). This work was authorized by Mr. Peter Mirsky on behalf of Leimerk Developments Ltd.

The proposed residential subdivision will comprise of 33 one acre residential lots. These lots would be supported by private wells and septic tile beds. Associated services and roadways are also to be constructed. The proposed residences would comprise of one to two storey structures with basements.

The investigation was undertaken to:

a) Establish geotechnical and groundwater profile at the site,

b) Determine limits of the esker that was reportably located on the west part of the site,

c) Make recommendations regarding the most suitable type of foundations, founding depth and Serviceability Limit State (SLS) bearing pressure and factored geotechnical resistance at Ultimate Limit State (ULS) of founding soil,

d) Determine anticipated settlements,

e) Comment on excavation conditions,

f) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes,

g) Recommend pavement structure thickness for access roads and parking areas, and

h) Comment on subsurface concrete requirements.

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

Background Information

Trow Associates Inc. undertook a geotechnical investigation at the site of the proposed new residential subdivision to be situated on north west half of Lot 3, Concession A, former Rideau Township, now in the City of Ottawa, Ontario in 2005. The results of this investigation were reported in the report "Geotechnical Investigation, Manotick Estates Phase VI, 5599 First Line Road, North West Half of Lot 3, Concession A, Former Rideau Township now City of Ottawa, Ontario" under Project No. OTGE00018055A dated December 15, 2005.

The above report was peer reviewed by Golder Associates on behalf of City of Ottawa. In a letter dated December 6, 2010, Golder Associates made the following comments:

(1) The overall test hole spacing does not meet the minimum requirements of the Development Guidelines. Golder Associates recommended that additional test holes should be advanced in the central and eastern part of the site at a maximum spacing of 150 metres.

(2) Golder Associates further commented that in-situ field vane testing was not done in Borehole 5 and in the test pits excavated on the site. Golder Associates indicated that in their opinion, additional in-situ vane testing should be carried out by advancing test holes at a maximum spacing 150 mm and to a minimum depth of 6 to 8 metres as per development guidelines. Golder Associates indicated that lack of in-situ testing makes it very difficult to assess the grading restrictions on the silty clay portion of the site and to assess the maximum allowable bearing pressure which can be used for foundations placed on silty clay.

(3) Golder Associates noted that a horizontal acceleration of 0.1 g was used for seismic loading condition which meets the City of Ottawa guidelines. However, Golder Associates recommended that a horizontal acceleration of 0.21 g should be used instead of 0.1 g in light of the revised Peak Ground Acceleration for the Ottawa area of 0.42 g in the 2006 Ontario Building Code.

(4) Golder Associates opined that a field visual inspection of the state of erosion of the creek should be carried out. In addition, Golder Associates indicated that several residential subdivisions have been development (with several more planned) along this section of Mud Creek. Golder Associates indicated that since these developments are permitted to discharge storm water into Mud Creek. The discharge of storm water will likely increase the overall flow in the creek and possibly change the creek characteristics, which could induce erosion. Therefore Trow should review these issues and re-evaluate if erosion protection or erosion allowance is warranted.

As a result of the above comments, four additional boreholes were drilled at the site. In addition, the slope to Mud Creek was re-analyzed using horizontal acceleration of 0.21 g. The Mud Creek banks were visually examined for erosion.

This revised report therefore includes the results of the original investigation as well as the results of the additional investigation. This revised report supersede the original report.

Procedure

The fieldwork for this investigation was undertaken with a track mounted drill rig equipped with continuous flight hollow stem augers and using manual sampling and drilling techniques. It was supervised on a full time basis by a representative of Trow Associates Inc. The fieldwork was undertaken between July 14, 2005 and July 22, 2005 and on September 6, 2005. It consisted of drilling nine (9) additional boreholes to 4.4 m to 12.8 m depth. The locations of the boreholes are shown on the Site Plan, Figure 1.

Four additional boreholes (Boreholes 10 to 13 inclusive) to 7.6 m to 8.2 m depth were drilled on February 7, 2011 with a bombardier mounted drill rig. The fieldwork was supervised by a geotechnician from Trow Associates Inc. on a full time basis.

Standard penetration tests were performed in all the boreholes at 0.75 to 1.5 m depth intervals and soil samples retrieved by split barrel sampler. The undrained shear strength of the clay was established by field vane shear tests. Relatively undisturbed thin wall tube samples of the clay were also obtained from some of the boreholes from selected depths.

Water levels were measured in the open boreholes on completion of drilling. In addition, long term groundwater monitoring installations consisting of 13 mm diameter PVC (polyvinyl chloride) pipes were placed in some of the boreholes. The installation configuration is documented on the respective borehole logs. All the boreholes were backfilled upon completion of the fieldwork. The locations and elevations of the Boreholes 1 to 8 were established by representatives of H.A. Ken Shipman Surveying Ltd. The elevations of the boreholes refer to the geodetic datum. The locations of Boreholes 9 to 12 inclusive were established by surveyors from Trow Associates Inc. Elevations of these boreholes were estimated from the site contours and therefore are approximate. These elevations also refer to the Geodetic datum.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. The thin wall tube samples were logged, capped and identified. On completion of the fieldwork, all the soil samples were transported to the Trow laboratory in the City of Ottawa, Ontario.

All the soil samples were visually examined in the laboratory and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing natural moisture content, unit weight, grain size analysis, one dimensional oedometer, pH and sulphate content tests on selected soil samples.

Site & Soil Description

The site under consideration is located on the east side of First Line Road in the Village of Manotick now in the City of Ottawa. It comprises of North West Half of Lot 3, Concession A formerly in Rideau Township now in the City of Ottawa, Ontario. The property measures approximately 608 m along the north boundary and 488 m along the south boundary. It is 200 m in width. It is bounded by proposed residential subdivision on the north and south sides, by Mud Creek on the east side and by First Line Road on the west side. The ground surface in the westerly 45 m to 85 m of the property is situated approximately 4.5 m to 5 m higher than rest of the site. The resulting slope inclination varies from 10H:1V close to the south property boundary to 30H:1V close to the north property boundary. The ground surface at the site generally slopes down to the east with ground surface elevation varying from Elevation 91 m to 88.5 m adjacent to Mud Creek. The site is currently covered with vegetation.

A geotechnical profile across the site has been plotted on Figure 2.

A detailed description of the geotechnical conditions encountered in the thirteen boreholes drilled are given on Borehole Logs, Figures 3 to 15 inclusive. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

A review of the borehole logs indicates that site is covered with a surficial layer of topsoil that ranges in thickness between 75 mm and 900 mm except in the case of Borehole 9 where surficial fill was encountered. The fill extends to a depth of 1.5 m (Elevation 88.5 m). It comprises of sandy silt with organics.

The topsoil in Borehole 1 to 4, 7, 8, 10, 12 and 13 and the fill in Borehole 9 are underlain by sandy silt to silty sand stratum which extends to a depth of 0.7 m to 2.6 m (Elevation 84.1 m to 95.3 m). This stratum is generally loose ('N' values of 4 to 9). The moisture content of this stratum varies from 7 to 39 percent.

The sandy silt to silty sand stratum in Boreholes 1 and 2 is underlain by sand which extends to 4.6 m to 5.2 m depth (Elevation 91.3 m to 91.6 m). This stratum is intercepted by a till layer in Borehole 2. The sand is compact to very dense ('N' value of 11 to 100). Its moisture content varies from 6 to 18 percent. A grain size analysis performed on a sand sample indicates that it contains 3 percent clay, 24 percent silt, 66 percent sand and 7 percent grave l (Figure 16).

The sand in Boreholes 5, 6, 9 to 13 is underlain by silty clay which extends to 4.5 m to 8.5 m depth (Elevation 81.5 m to 84.2 m). The silty clay is soft to very stiff with an undrained shear strength of 12 kPa to in excess of 120 kPa as determined by field vane tests. The natural moisture content and unit weight of the silty clay vary from 25 to 54 percent and 17.2 to 18.9 kN/m3 respectively. A grain size analysis performed on the silty clay indicates that this stratum contains 35 percent clay, 55 percent silt and 10 percent sand (Figure 17).

The results of one dimensional oedometer test performed on the silty clay sample are given on Figure 18. This figure indicates that the preconsolidation pressure of the clay is 105 kPa and its effective overburden pressure is 76 kPa. Therefore, the clay is overconsolidated by 29 kPa. The recompression and compression indices of the clay were computed to be 0.042 and 1.29 respectively.

The silt clay in Boreholes 10 and 12 is underlain by silty sand to 8.2 m and 7.6 m depth respectively (Elevation 82.3 m to 83.0 m respectively). This stratum is very loose to loose ('N' values of 1 to 5).

The silty clay in Boreholes 5, 6, 9 and 11 and the silty sand to sand in the other boreholes is underlain by silty sand and gravel till which extends to the maximum depth investigated. The till contains some cobbles and boulders. The till is loose to very dense ('N' values of 4 to 50 blows for 25 mm penetration of the sampler). The results of five grain size analyses performed on the till samples are given on Figures 19 to 23. The review of these figures indicates that the till contains 3 to 7 percent clay, 12 to 26 percent silt, 20 to 46 percent sand and 22 to 65 percent gravel.

The results of the falling head tests performed on the various soil strata are given on Table I. A review of this table indicates that the permeability of the silty clay is in the order of 1.5 x 10^{-7} m/s whereas that of the till is 7 x 10^{-7} to 2 x 10^{-8} m/s.

Table No. I
Permeability of the Soil Strata as determined by In-Situ Falling Head Tests

Borehole	Soil Characteristic	Hydraulic Conductivity (m/s)
BH-1 (deep)	Till	2 x 10^{-8} m/s
BH-2 (deep)	Till	6 x 10^{-8} m/s
BH-4 (deep)	Till	7 x 10^{-7} m/s
BH-9 (deep)	Clay	1.5 x 10^{-7} m/s
BH-1 (shallow)	Shallow sand unit	3 x 10^{-7} m/s
BH-2 (shallow)	Shallow sand unit	Could not dewater[1]

Notes: 1) Indicates that water level could not be lowered during purging of the well

Three boreholes drilled at the site during the previous study revealed that clay and/or till is underlain by limestone bedrock at a depth of 20.7 m in Test Well 1 (Elevation ~76.0 m), 19.5 m (Elevation ~76.6 m) in Test Well 2 and at 21.6 m depth (Elevation ~ 68.2 m) at Test Well 3. Bedrock geology maps of the Ottawa area indicate that the bedrock at the site is dolostone of the Oxford Formation. It is expected to be underlain by dolostone and sandstone of the March Formation.

Water level observations were made in the multi level standpipes installed in the Boreholes 1, 2 and 4 and single level standpipes installed in all the other boreholes. The shallow standpipes in Borehole 1, 2 and 4 were installed in the sand stratum overlying the till. The deep standpipes in Boreholes 1, 2 and 4 and the single level standpipes in the other boreholes were installed either in the till or the silty clay underlying the sand stratum.

Water levels were recorded in the sand stratum at a depth of 3.1 m to 4.6 m i.e. Elevation 90.4 m to Elevation 91.7 m in Boreholes 1, 2 and 4. Water levels were recorded at 1.7 m to 5.3 m depth in Boreholes 1 to 9 in monitoring wells installed in the clay or till stratum (Elevation 84.7 m to 92.2 m). The static water level elevations indicate that the shallow groundwater table within the esker is well below the existing ground surface. The groundwater flow was determined to be in a easterly direction with an average hydraulic gradient of 0.04 m/m.

The static water level in the till and silty clay formation was found to be at a lower level than that in the sand stratum, indicating that there is a vertical hydraulic down gradient from the shallow sand unit to the underlying till.

Water levels were made in the exploratory boreholes at the times and under the conditions stated in the scope of services. These data were reviewed and Trow's interpretation of them discussed in the text of the report. Note that fluctuations in the level of the groundwater may occur due to seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

Site Re-Grading

It is noted that the central and east part of the site contains a deposit of silty clay and that the silty clay at the site is prone to consolidation settlements if fill is placed on the site. This may result in settlements and cracking of any structures founded in the clay. In order to evaluate if the grade at the site can be raised, a one dimensional oedometer test was undertaken on the silty clay sample (Figure 18). The results indicate that the clay is overconsolidated by 26 kPa approximately. In addition, the results of the in-situ shear strength of the silty clay obtained in the additional boreholes drilled at the site were reviewed. Based on the results of the additional shear strength tests performed in Boreholes 10 to 13 and the results of the consolidation test performed previously, it is considered that the permissible increase in load on the clay for the settlements to be within the normally tolerated limits of 25 mm total and 19 mm differential is 22 kPa. It is therefore recommended that the grade raise at the site should be limited to 1.0 metre.

The final grade raises as shown on Site Grading Plan GP1, **exp** Services Inc. March 16, 2009 Rev. 8, dated April 27, 2011 and GP2, **exp** March 16, 2009 Rev. 7, dated April 27, 2011 prepared by Trow Associates Inc. under Project No. MP13613A dated February 10, 2011 were reviewed. The review indicates that more than 1 m of fill will be placed on Lots 15, 16, 17, 24, 25, 26 and 30. Consequently, these lots may require the use of light weight fill under the garage floors and front porches and/or around the exterior walls of the residences. It is therefore recommended that a site specific geotechnical investigation should be conducted on these lots by the owners to determine if special design considerations are required such as reduced Serviceability Limit State and Ultimate Limit State bearing pressures and/or use of light weight fill in the garages and front porches and/or around the perimeter of the structure.

Foundation Considerations

The investigation has revealed that the site is underlain by a deposit of clay. The clay is very stiff to stiff in the upper levels and becomes firm to soft with depth. Consequently, care must be exercised when designing the footings to ensure that the underlying weaker layer is not overstressed.

The proposed one to two storey structures with basements will generate light to medium loads. The proposed structures with one basement level are likely to be founded at a depth of 1.4 m approximately below the existing ground surface since it is anticipated that the grade at the site would be raised by 1 m. The Serviceability Limit State (SLS) bearing pressure and the factored geotechnical resistance at Ultimate Limit State (ULS) for design of footings would be governed by the founding stratum. The Serviceability Limit State bearing pressure of 96 kPa would be available when founding on sand or the till stratum at least 1.5 m below existing ground surface. The factored geotechnical resistance at Ultimate Limit State of these strata is 150 kPa. The Serviceability Limit State bearing pressure of the silty clay is 50 kPa and its factored geotechnical resistance at Ultimate Limit State is 75 kPa. These bearing pressures are expected to be available over the majority of the site. However, it is noted that soft clay pockets may be present on the site and may necessitate lowering of the allowable bearing pressure during construction. The foundation (footing) bases must be cleaned of any soft, loose, or disturbed material prior to placing concrete.

All the footing beds would have to be examined by a geotechnical engineer/geotechnician to ensure that the founding soil is capable of supporting the design bearing pressure and that the footings beds have been prepared satisfactorily.

The recommended bearing capacities have been calculated by Trow Associates Inc. from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes, when foundation construction is underway. The interpretation between boreholes, and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

A minimum of 1.5 m of earth cover should be provided to all the exterior footings of heated structures to protect them from damage due to frost penetration. Where earth cover is less than 1.5 m, an equivalent combination of earth fill and rigid polystyrene insulation (i.e. styrofoam HI-40) should be provided. Footings of unheated structure should be provided with a cover of 2.1 m if snow would not be cleared from their vicinity. If the snow would be cleared from the vicinity of the footings, they should be provided with 2.4 m of earth cover.

Settlements of the residences founded on strip footings and designed for the above recommended allowable bearing pressure are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements provided that the grade raise at the site is limited to 1 metre.

The clay in the Ottawa area is prone to shrinkage on drying. This process is largely not reversible. Therefore settlement and cracking of the structures can result if trees are planted too close to the residences. During dry seasons, the tree roots such moisture from the clay thereby resulting in the clay drying and shrinking.

Published literature indicates that a good working rule is to preferably plant a tree no nearer a building on shrinkable clay than the eventual height to which the tree may be expected to grow. Obviously, evergreens are better as they have a lower water demand than deciduous trees.

In order to assist you in landscaping on the property, following is a list of more common trees in order to decreasing water demand.

- Poplar
- Aspen
- Elm
- Birch
- Beech
- Larch
- Fir
- Alder
- Maple
- Ash
- Oak
- Spruce
- Pine

It is recommended that for more information, an arborist should be consulted.

Floor Slab & Drainage Requirements

The lowest level floors of the proposed buildings may be constructed as slabs-on-grade provided they are set on beds of well compacted 19 mm clear stone at least 200 mm thick placed on the natural soil or on well compacted fill. The clear stone would prevent the capillary rise of moisture from the sub-soil to the floor slab. Any underfloor fill required should conform to OPSS Granular 'B' Type I and should be placed in 300 mm lift thickness and each lift compacted to at least 98 percent of the Standard Proctor Dry Density.

Perimeter drains should be provided for structures with basements (Figure 24). The drainage system should be outletted to storm sewer. All subsurface walls should be properly damp-proofed. The exterior grade should be sloped away from the structures at an inclination of 1 to 2 percent to prevent the ingress of surface runoff.

Earth Pressures

Subsurface walls may be designed to resist earth pressure, "p", acting against the walls at any depth, "h", below the surface by the expression given below. This expression assumes that the water table would be maintained at the founding level by providing subsurface drains and that the backfill adjacent to the walls would be a free draining granular material. Alternatively, mira drains may be provided around the foundation walls in which case on-site material can be used for backfilling purposes.

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

where k = active earth pressure coefficient applicable

= 0.35

γ = is the estimated unit weight of the soil = 21.2 kN/m^3

q = is an allowance for surcharge, kPa

h = depth of interest, m, below the surface

Excavations

Excavations for construction of spread and strip footings and installation of any underground services at the site are expected to extend to a maximum depth of 2 m to 3 m below the existing ground surface. The excavations will be undertaken predominantly in the sand, till and silty clay. These excavations are expected to be predominantly above the groundwater table.

The excavations at the site may be undertaken as "open cut" provided they meet the requirements of the latest version of the Ontario Occupational Health and Safety Act, i.e. they are cut back at 45 degrees above the groundwater table. Below the groundwater table the excavations in the sand stratum and in the till are expected to slough and may eventually stabilize at a slope of between 2H:1V and 3H:1V. Excavations at the site in granular soils below the groundwater table may experience a 'base heave' type of failure. It would therefore be necessary to lower the groundwater table to below the final excavation level prior to commencement of the excavation work.

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps. Although this investigation has estimated the groundwater levels at the time of the field work, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring techniques and which may affect the type and nature of dewatering procedures used by the contractor in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to adequately engineer construction dewatering systems.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

The clay at the site is susceptible to disturbance due to the movement of construction equipment, and personnel on its surface. It is therefore recommended that the excavation at the site should be undertaken by equipment which does not travel on the excavated surface e.g. a gradall or mechanical shovel. It is anticipated that temporary granular roads may be required to gain access to the site.

Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The backfill in footing trenches and service trenches should be compactible i.e. free of organics and debris and with natural moisture content which is within 2 percent of the optimum moisture content. It should be compacted to 95 percent standard Proctor maximum dry density

The material to be excavated during construction of the footings and installation of services are sand and gravel till and clay. These materials from above the groundwater table are expected to be compactible and may be used for backfilling purposes if construction is undertaken during summer months. These soils should not be stockpiled on the site for any length of time as they may absorb moisture due to precipitation etc. and may become too wet for adequate compaction. If fill has to be imported to backfill footing trenches, service trenches etc. it should preferably conform to Ontario Provincial Standard Specifications for Granular 'B'. It should be placed in 300 mm lift thickness and compacted to 95 percent of the standard Proctor maximum dry density.

Access Roads and Parking Areas

Pavement structure thicknesses required for the access roads and parking areas to be used by light automobile traffic and heavy traffic were computed. The pavement structures are shown on Table No. II. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and functional design life of eight to ten years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table No. II: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Subdivision Roads
Asphaltic Concrete (PG 58-34)	92-96% MRD	40 mm SC 40 mm BC
OPSS Granular 'A' Base (crushed limestone)	100% SPMDD*	150 mm
OPSS Granular 'B' II Sub-base	100% SPMDD*	375 mm

Notes:

1. SPMDD denotes standard Proctor maximum dry density, ASTM, D-698
2. The upper 300 m long subgrade fill must be compacted to 98% SPMDD
3. SC Denotes Surface course asphalt and should comprise of SP 12.5 mm (OPSS 1151) (Category C)
4. BC Denotes Base course asphalt and should comprise of SP 19 mm (OPSS 1151) (Category C)
5. MRD Denotes Maximum Relative Density – ASTM, D-2041

Construction procedures for the pavement structure are discussed below.

After all the underground services have been installed, backfilled and satisfactorily compacted, the entire road should be excavated to the subgrade level. The subgrade should be crowned with a centre edge to edge slope of at least 2 percent. It should then be proof rolled with a heavy roller. Any soft areas which become evident should be sub-excavated and replaced with approved native fill or free draining granular material. All subgrade fill should be placed in maximum 300 mm lifts and compacted to 98 percent of standard Proctor maximum dry density. In-place density tests should be performed at regular intervals to ensure that the specified degree of compaction is being achieved.

It is stressed that the overall satisfactory performance of the recommended pavement structure is contingent upon the provisions of good drainage. It is therefore recommended that subsurface drains should be provided on both sides of the pavement. The drains should be located with their invert approximately 300 mm below the subgrade level. Drainage facilities may consist of 150 mm diameter perforated pipe set on 100 mm of 19 mm clear stone and covered top and sides with 150 mm of 19 mm stone. The stone should be surrounded with a suitable filter cloth, such as Terrafix 270 R or equivalent. The remainder of the trench should be backfilled with well compacted, free draining granular material. Alternatively, drainage may be provided by ditches located on both side of the roadways. The ditches should extend at least 300 mm below the subgrade level.

To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular "B", Type II material. Weep holes should be provided in the catchbasins and manholes to facilitate drainage of the granular fill.

The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.

Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level.

The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS) for Granular "A" and Granular "B" and should be compacted to 100 percent of the standard Proctor maximum dry density. The asphaltic concrete used and its placement should meet OPSS requirements. It should be compacted to 97 percent of the Marshall Density.

Slope Stability Analysis

The stability of the existing slopes to be Mud Creek located at the east property boundary was analyzed by using Bishop's Modified Method. Slope/W.Geoslope office, Version 4.23 computerized system was used to assess stability of the slope. The purpose of the analysis was to assess the stability of the existing slopes and to determine the required set back of the proposed residences from the crest of the slopes. Five cross-sections of the slope were analysed to provide a complete coverage of the slopes at the site. These cross-sections have been shown as Sections 1-1, 2-2, 3-3, 4-4 and 5-5 on Figure 1. The cross-sections of the slopes were surveyed by representatives of H.A. Ken Shipman Surveying Ltd. and supplement by topographic survey. The cross-sections were verified in the field with a clinometer.

The slopes were analysed for the following conditions:

(i) Total stress analysis,

(ii) Total stress analysis with seismic loading, and

(iii)Effective stress analysis.

The following assumptions were made:

(1) Surveyed Cross-Sections 1-1, 2-2, 3-3, 4-4 and 5-5 represent the existing slopes at the locations shown on Site Plan, Figure 1. The toe of the slope at Section 1-1 is at Elevation 86.5 m and the crest of the slope at Elevation 89.5 m with overall slope inclination of 2.6H:1V. At Cross-Section 2-2, the toe of the slope is at Elevation 86.5 m and the crest at Elevation 89.5 m. The slope inclination is 3.75H:1V. The toe of the slope at Section 3-3 is at Elevation 85 m and the crest at Elevation 89 m with overall slope inclination of 10H:1V. The crest and toe of the slope at Section 4-4 are at Elevation 88.5 m and 84.5 m respectively resulting in our overall slope inclination of 8H:1V. The upper portion of the slope is at an inclination of 5.4H:1V whereas close to the toe the slope is at an inclination of 2H:1V. The crest of the slope at Cross-Section 5-5 is at Elevation 88.5 m and the toe at Elevation 84.5 m. The overall slope is at an inclination of 8.9H:1V with the upper steeper section being at an inclination of 4.4H:1V.

(2) The soil stratigraphy for the various cross-sections is shown on Figures 25 to 42 inclusive. The soil stratigraphy was established from the boreholes drilled at the site for the geotechnical investigation.

(3) The engineering properties of the various soils used in the slope stability analysis are given on Table III. The unit weight of the various soils was established from laboratory tests. The undrained shear strength of the silty clay was established by

performing in-situ field vane tests. The shear strength parameters were selected based on literature search. Previous work undertaken on the Ottawa Area Clays by Mitchell (1970), Sangrey & Paul (1971), Eden, Fletcher and Mitchell (1971), Eden & Jarret 1971, Mitchell & Eden 1972 was reviewed. In addition, a certain number of back analysis of the natural slopes in Champlain clay have been presented in the literature (Crawford & Eden 1967, Eden & Mitchell 1970, Lefebvre & La Rochelle 1974, Lo & Lee 1974) and were reviewed. The review indicated that values of the effective cohesion (c') and effective angle of internal friction (Ø') of the clay obtained by the various researchers varied from 5.3 kPa to 11.5 kPa and 31 degrees to 35 degrees respectively. The effective cohesion (c') and effective angle of internal friction (Ø') values applicable in this case depend on the stress conditions in the slopes. Based on the review of the literature and site conditions, and using somewhat conservative approach an effective cohesion of 10 kPa and effective angle of internal friction of 27 degrees was used in the analysis.

Table III
Engineering Properties of Various Soils

Soil Type	Unit Weight	Effective Stress Parameters		Total Stress Parameters	
		Cohesion, c' (kPa)	Angle of Internal Friction, Ø'	Shear Strength (kPa)	Angle of Internal Friction, Ø'
Silty Sand	18	0	30	-	-
Silty Clay 1	19	10	27	120	0
Silty Clay 2	17	10	27	50	0
Till	22	0	35	-	-
Sandy Peat	12	5	30	50	0

(4) Groundwater table was recorded at a depth of 4.2 m and 4.5 m (Elevation 84.3 m to 84.2 m) in Boreholes 5 and 6 located close to the crest of the slope and at a depth of 1.7 m (Elevation 83.9 m and 83.7 m) respectively in Boreholes 7 and 8 located close to the toe of the slope. However, as a somewhat conservative approach the slope was assumed to be fully saturated with the groundwater table at the surface of the slope.

(5) The slopes were re-analysed using a horizontal force of 0.21 g during a seismic event.

The results of the analysis of the slopes are given on Figures 25 to 42 inclusive and have been summarized on Table IV.

Table IV
Result of Stability of Slope Analyses

Section Analysed	Condition	Factor of Safety	Figure No.
1-1	Effective Stress Analysis	2.24	25
1-1	Total Stress Analysis	8.0	26
1-1	Total Stress Analysis with Seismic Loading	3.61	27
2-2	Effective Stress Analysis	2.48	28
2-2	Total Stress Analysis	8.51	29
2-2	Total Stress Analysis with Seismic load with line load located 10 m from crest of slope	3.76	30
3-3	Effective Stress Analysis, toe failure	4.56	31
3-3	Effective Stress Analysis – deep seated failure	3.89	32
3-3	Total Stress Analysis	19.63	33
3-3	Total Stress Analysis with Seismic load	6.87	34
4-4	Effective Stress Analysis, toe failure	1.82	35
4-4	Effective Stress Analysis – upper slope failure	3.66	36
4-4	Total Stress Analysis	9.74	37
4-4	Total Stress Analysis with Seismic load	3.14	38
5-5	Effective Stress Analysis, toe failure	4.03	39
5-5	Effective Stress Analysis – deep seated failure	3.35	40
5-5	Total Stress Analysis	9.74	41
5-5	Total Stress Analysis with Seismic load	3.06	42

It is noted that the factors of safety computed for Sections 4-4 and 5-5 for Total Stress Analysis and Total Stress Analysis with seismic loading are higher than reported previously in the original geotechnical investigation report for peak horizontal acceleration of 0.1 g. The reason for this is that in the original report, inadvertently creek slope had been analysed for these two cross-sections instead of the table land slope.

Current practice of the City of Ottawa requires a minimum acceptable factor of safety of 1.5 for static loading conditions. The minimum acceptable factor of safety for seismic loading conditions is 1.1 (Mitchell 1983). The computed factor of safety for the static loading conditions varies from 1.82 to 19.63. These factors of safety satisfy the requirement of a minimum factor of safety of 1.5. The factor of safety for seismic loading conditions varies from 3.06 to 6.87 and satisfies the minimum required factor of safety of 1.1. It is therefore concluded that the slopes on the site are stable and that a geotechnical set back from the crest of the slope for construction purposes is not required.

The following recommendations are made to ensure that construction on the site will not adversely affect the stability of the slopes.

(1) Care should be exercised during construction to ensure that the existing slopes are not steepened by placement of fill close to the crest of the slope since this would reduce the stability of the slope.

(2) Excavations should not be undertaken at the toe of the slopes since this would adversely affect the stability of the slopes.

(3) Natural drainage paths should not be blocked by placement of fill on the slope.

(4) Vegetation should not be removed from the faces of the slopes to prevent erosion. Additional vegetation should be planted on the slopes wherever necessary.

Toe Erosion

A series of air photographs of Mud Creek taken in the vicinity of the proposed development were analyzed using stereoscopic viewing technique. Air photos from 1936, 1968, 1975, 1984, 1997, 2001 were analyzed at their respective scales and compared through time. The study reach spanned from the creek crossing under First Line Road in the southwest to the Bankfield Road crossing in the north. In general, there appeared to be no significant change in stream morphology from 1936 to 2001. Water levels were confined to the stream bed with no signs of unconfined flow in the floodplain. Water levels appeared to vary between the photographs, as did vegetation canopy cover as a result of seasonal variation between the photographs. There also did not appear to be any sign of slope failures (slumping, ground cracks, ground subsidence, upheaval etc.) or erosion along the creek. It is therefore considered that a 'toe erosion' allowance is not required.

Subsequent to a peer review by Golder Associates, the site was revisited by a senior geotechnical engineer and senior geotechnician from Trow Associates Inc. on January 25, 2011. At the time of the visit, the creek banks were partially covered with snow. However, intermittent vegetation was visible in spite of the snow cover. There was no evidence of erosion of the creek banks.

It is understood that a meeting was held on-site on August 21, 2007 between the representatives of Rideau Valley Conservation Authority, City of Ottawa staff, David McManus Engineering Ltd and Trow Associates Inc. staff. During the site visit, stakes were planted to define the limit of development as determined in consultation with representatives of Rideau Valley Conservation Authority for Maple Creek and Leimerk Developments. The stakes were surveyed by David McManus Engineering Ltd. and the limit of development line plotted. This limit of development line is shown on Site Plan, Figure 1. It is recommended that no construction should be undertaken at the site beyond the limit of development line.

General Comments

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

The information contained in this report is not intended to reflect on environmental aspects of the soils. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

We trust that the information contained in this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Trow Associates Inc.

LICENSED PROFESSIONAL ENGINEER
June 16/
S. K. AGGARWAL
PROVINCE OF ONTARIO

Surinder K. Aggarwal, M.Sc., P.Eng.
Senior Project Manager
Earth and Environment

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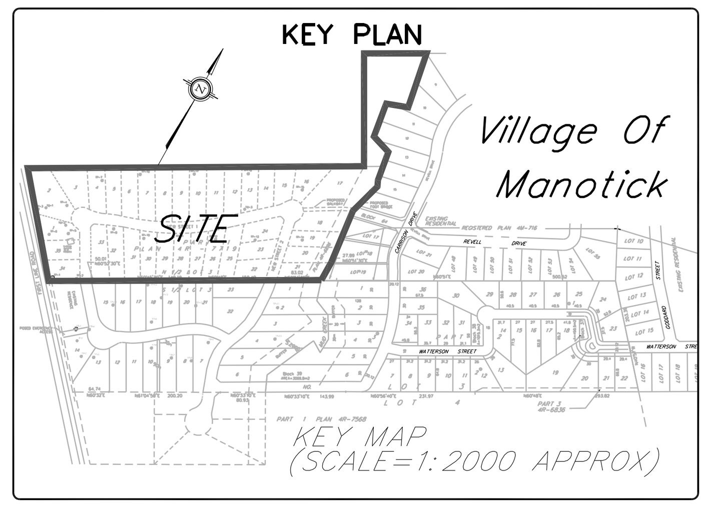
Earth and Environment

Figures

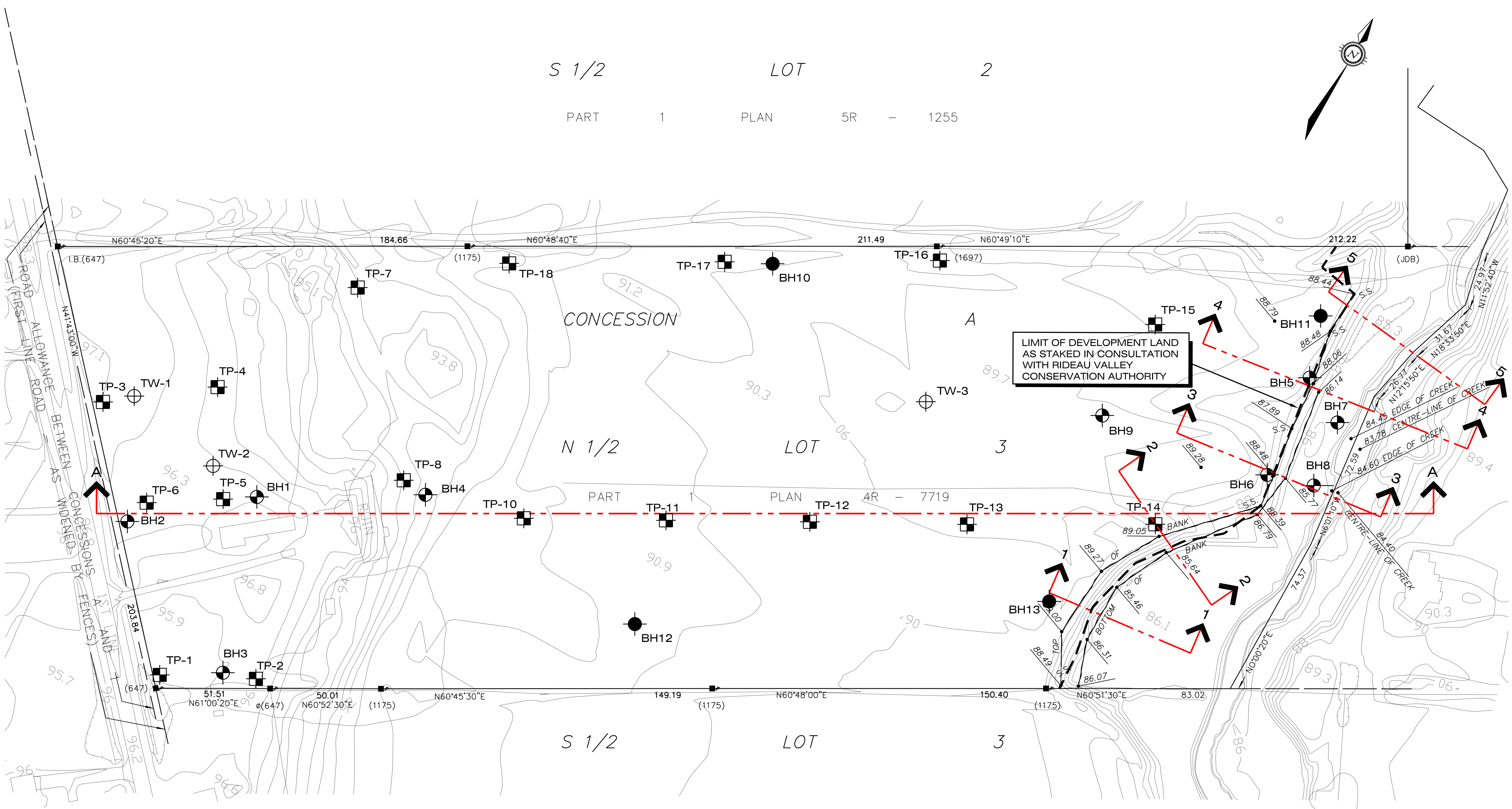


LEGEND

- BH10 — BOREHOLE LOCATION, TROW ASSOCIATES INC., PROJECT OTGE00018055A, FEB. 2011
- BH1 — BOREHOLE LOCATION, TROW ASSOCIATES INC., PROJECT OTGE00018055A, NOV. 2005
- TP-2 — TEST PIT LOCATION, TROW ASSOCIATES INC., PROJECT MP13613A, OCT. 2004
- TW-3 — TEST WELL LOCATION, TROW ASSOCIATES INC., PROJECT MP13613A, OCT. 2004

NOTE :

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.



No.	DESCRIPTION	DATE	BY	APP'D

R E V I S I O N S

Trow Associates Inc.
100-2650 Queensview Drive, Ottawa, Ontario K2B 8H6
Tel: (613) 688-1899 Fax: (613) 225-7337

CLIENT
LEIMERK DEVELOPMENT LTD.

PROJECT
PROPOSED SUBDIVISION
NORTH WEST HALF OF LOT 3, CON. A
(FORMER RIDEAU TOWNSHIP)
CITY OF OTTAWA

TITLE
BOREHOLE & TEST PIT LOCATION PLAN

design by	S.K.A.	project no.	OTGE00018055A
drawn by	M.N.	figure	1
checked by	S.K.A.		
date	JUNE 2011		
scale	HORIZ 1:1000		

KEY PLAN

LEGEND

NOTE :

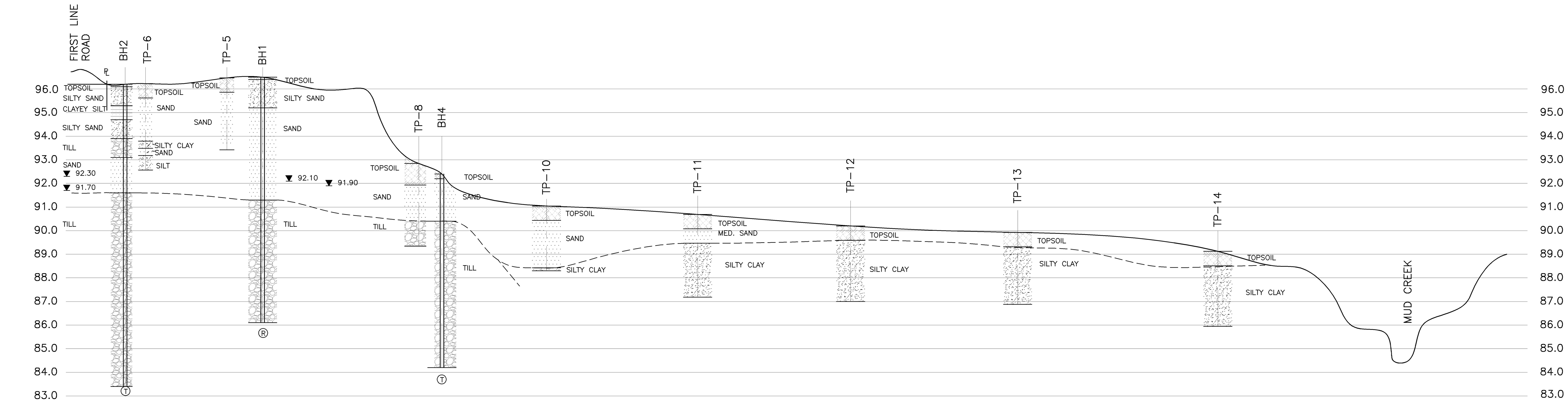
1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.

LEGEND

(T) TERMINATED

(R) REFUSAL TO AUGERS

ELEV. ▼ WATER LEVEL



SECTION A-A

No.	DESCRIPTION	DATE	BY	APP'D

R E V I S I O N S

Trow Associates Inc.
100-2650 Queensview Drive, Ottawa, Ontario K2B 8H6
Tel: (613) 688-1899
Fax: (613) 225-7337

CLIENT

LEIMERK DEVELOPMENT LTD.

PROJECT

PROPOSED SUBDIVISION
NORTH WEST HALF OF LOT 3, CON. A
(FORMER RIDEAU TOWNSHIP)
CITY OF OTTAWA

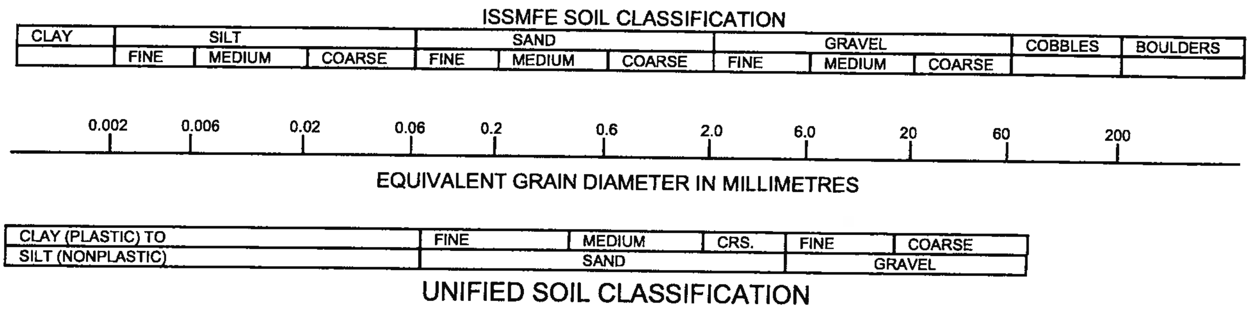
TITLE

GEOTECHNICAL PROFILE

design by	S.K.A.	project no.	OTGE00018055A
drawn by	M.N.	figure	2
checked by	S.K.A.		
date	FEB. 2011		
scale	HORIZ 1:1000 VERT 1:100		

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Trow Associates Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



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

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole 1

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: July 18th, 2005

Drill Type:

Datum: Geodetic Elevation

Logged by: ________ Checked by: ________

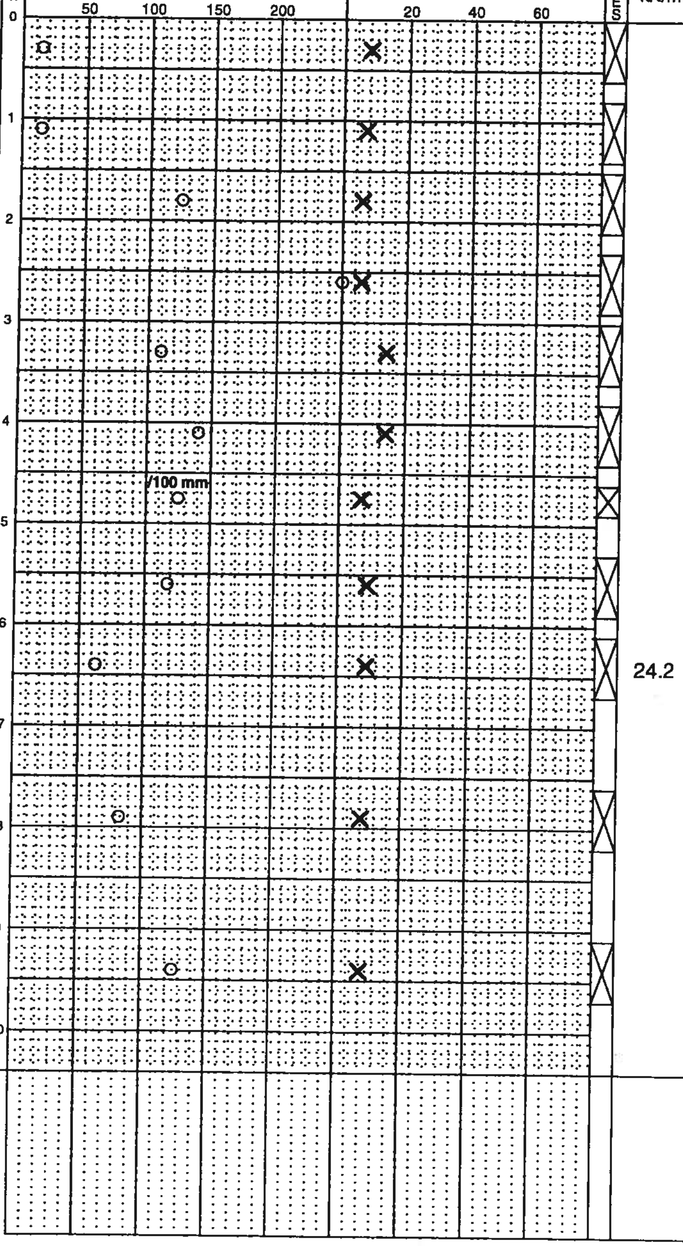
Legend		Legend	
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~75 mm	96.5	0
		SILTY SAND Fine to medium grained, some gravel and cobbles, moist to wet, (loose).	96.4	
		SAND Fine to medium grained, some gravel and cobbles, moist to wet, (dense to very dense). Second water level measured at 4.6 m depth.	95.2	1
▼			92.1	
		TILL Silty sand and gravel, some cobbles and boulders, grey, moist to wet, (compact to dense).	91.3	
		Auger Refusal @ 10.4 m depth	86.1	10

Standard Penetration Test N Value: 20, 40, 60, 80; Shear Strength (kPa): 50, 100, 150, 200

Combustible Vapour Reading (ppm): 250, 500, 750; Natural Moisture Content %, Atterberg Limits (% Dry Weight): 20, 40, 60

SAMPLES; Natural Unit Wt. kN/m³: 24.2



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
103 Days	4.4	n/a
103 Days	4.6	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 2

Trow

Project No: OTGE00018055A

Figure No. 4

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Date Drilled: July 18th, 2005

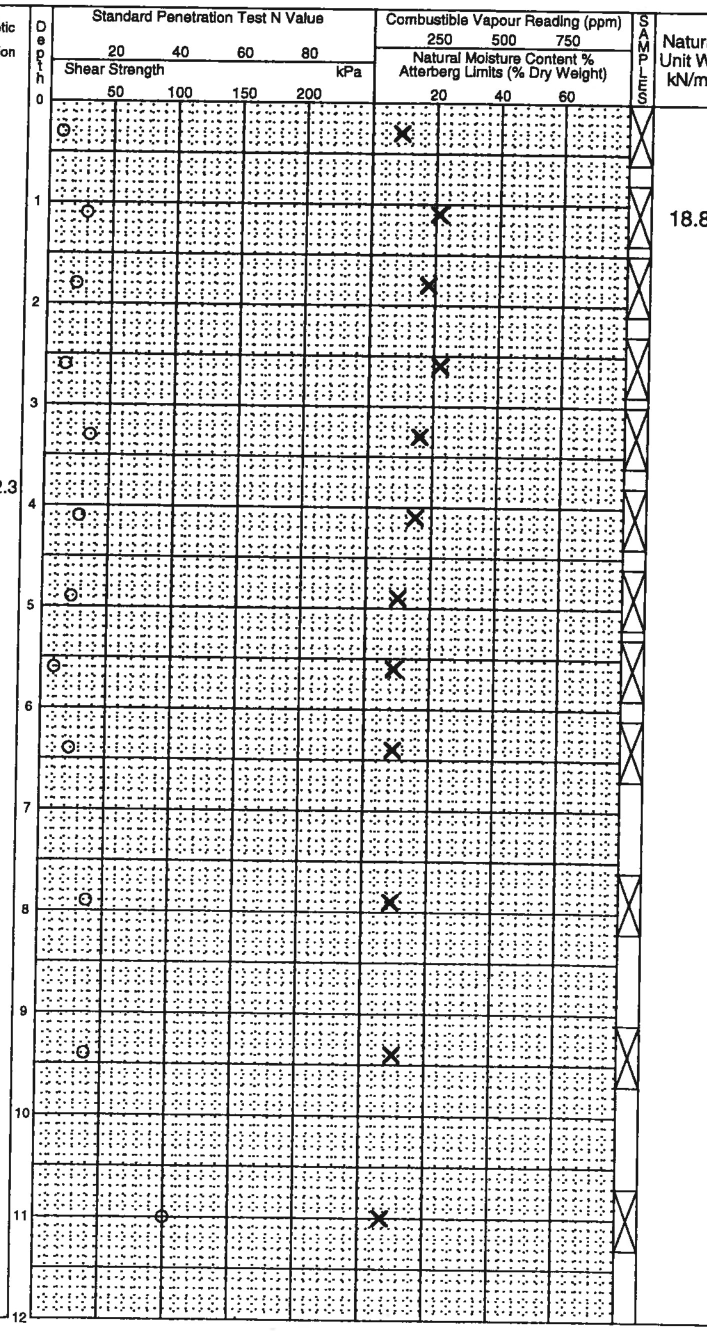
Drill Type:

Datum: Geodetic Elevation

Logged by: ________ Checked by: ________

Symbol	Legend	Symbol	Legend
⊠	Split Spoon Sample	□	Combustible Vapour Reading
◫	Auger Sample	✕	Natural Moisture Content
○	SPT (N) Value	⊢⊖	Atterberg Limits
———	Dynamic Cone Test	⊕	Undrained Triaxial at % Strain at Failure
■	Shelby Tube	▲	Shear Strength by Penetrometer Test
+ S	Shear Strength by Vane Test		

Geodetic Elevation (m)	SOIL DESCRIPTION
96.2 / 96.1	**TOPSOIL** ~90 mm
	SILTY SAND Some organics, brown, moist, (loose).
95.3	**CLAYEY SILT** Some sand seams, brown, moist, (stiff).
94.7	**SILTY SAND** Brown, moist, (loose).
93.9	**TILL** Sandy silt to clayey silt, some gravel and cobbles, grey, moist to wet, (loose to compact).
93.1	**SAND** Fine to medium grained, some limestone fragments, grey, moist to wet, (compact).
92.3	
91.6	Second water level measured at 4.5 m depth.
	TILL Sandy silt to clayey silt, some gravel, grey, moist to wet, (loose to dense).



Continued Next Page

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
103 Days	3.9	n/a
103 Days	4.5	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

Log of Borehole 2

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Figure No. 4

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value (20 40 60 80) / Shear Strength kPa (50 100 150 200)	Combustible Vapour Reading (ppm) (250 500 750) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (20 40 60)	SAMPLES	Natural Unit Wt. kN/m³
		TILL Sandy silt to clayey silt, some gravel, grey, moist to wet, (loose to dense). *(continued)*	84.2	12				
			83.4					
		Borehole Terminated @ 12.8 m depth						

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
103 Days	3.9	n/a
103 Days	4.5	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

Log of Borehole 3

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: July 18th, 2005

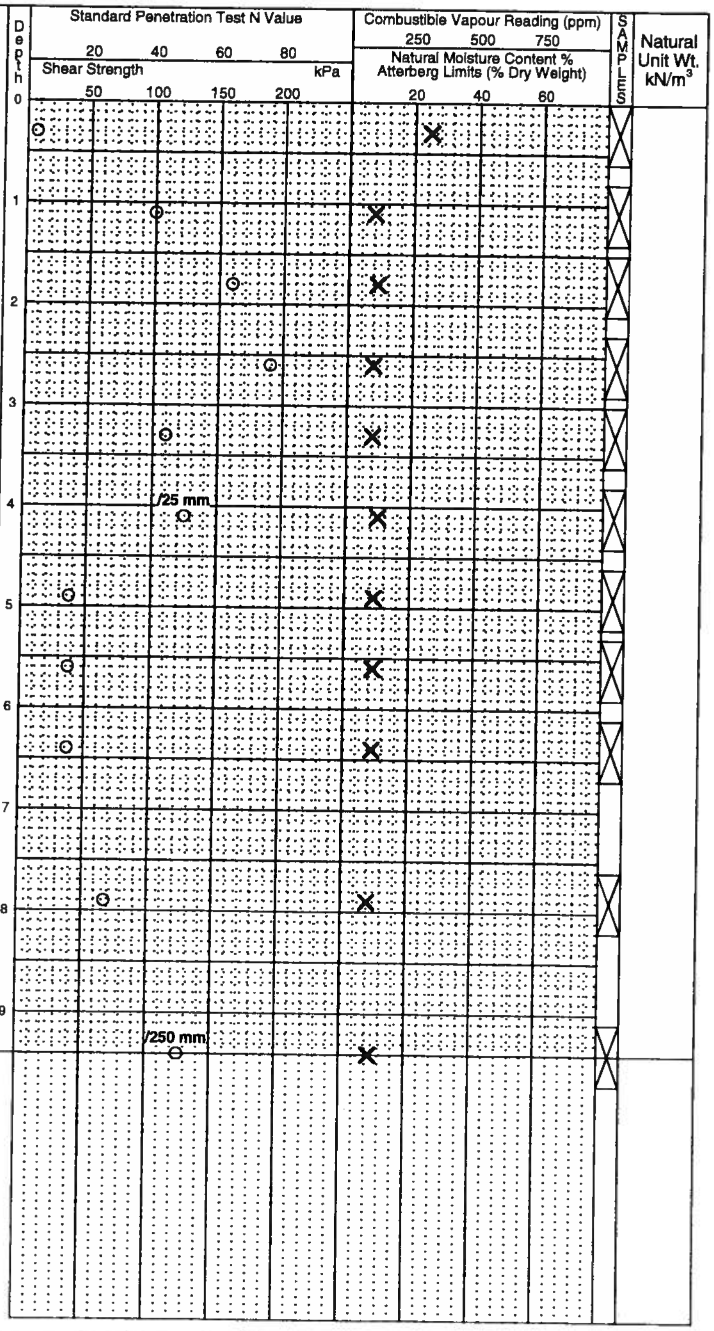
Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Symbol	Legend
Split Spoon Sample	☒
Auger Sample	◫
SPT (N) Value	○
Dynamic Cone Test	―
Shelby Tube	■
Shear Strength by Vane Test	+ S
Combustible Vapour Reading	□
Natural Moisture Content	✕
Atterberg Limits	├─○
Undrained Triaxial at % Strain at Failure	⊕
Shear Strength by Penetrometer Test	▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
			95.8	0
		TOPSOIL~180 mm	95.6	
		SANDY SILT TO SILTY SAND Some organics, grey, moist, (loose).	95.1	
		TILL Sandy silt to silty sand, some gravel, grey, moist to wet, (compact to dense).	90.5	
			86.4	
		Auger Refusal @ 9.4 m depth		



LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

NOTES:

1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
103 Days	5.3	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 4

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: July 21st, Sept 6th, 2005

Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	⊢⊖
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

Geodetic Elevation (m)	Depth (m)	Soil Description
92.4	0	**TOPSOIL** ~150 mm
92.3		**SAND** Medium to coarse grained, brown, moist, (dense).
90.4		**TILL** Sandy silt to silty sand, some gravel, frequent cobbles and boulders, grey, moist to wet, (compact to very dense). Second Water Level Measured at 2.38 m
90.15		(water level)
	4	- Began coring till @ 4.0 m depth
84.2	8.2	Borehole Terminated @ 8.2 m

Chart columns: Standard Penetration Test N Value (20, 40, 60, 80); Shear Strength kPa (50, 100, 150, 200); Combustible Vapour Reading (ppm) (250, 500, 750); Natural Moisture Content %, Atterberg Limits (% Dry Weight) (20, 40, 60); Samples; Natural Unit Wt. kN/m³

SPT annotations: /75 mm; /125 mm; /40 mm

LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
103 Days	2.3	n/a
103 Days	2.4	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 5

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Date Drilled: July 22nd, 2005

Drill Type:

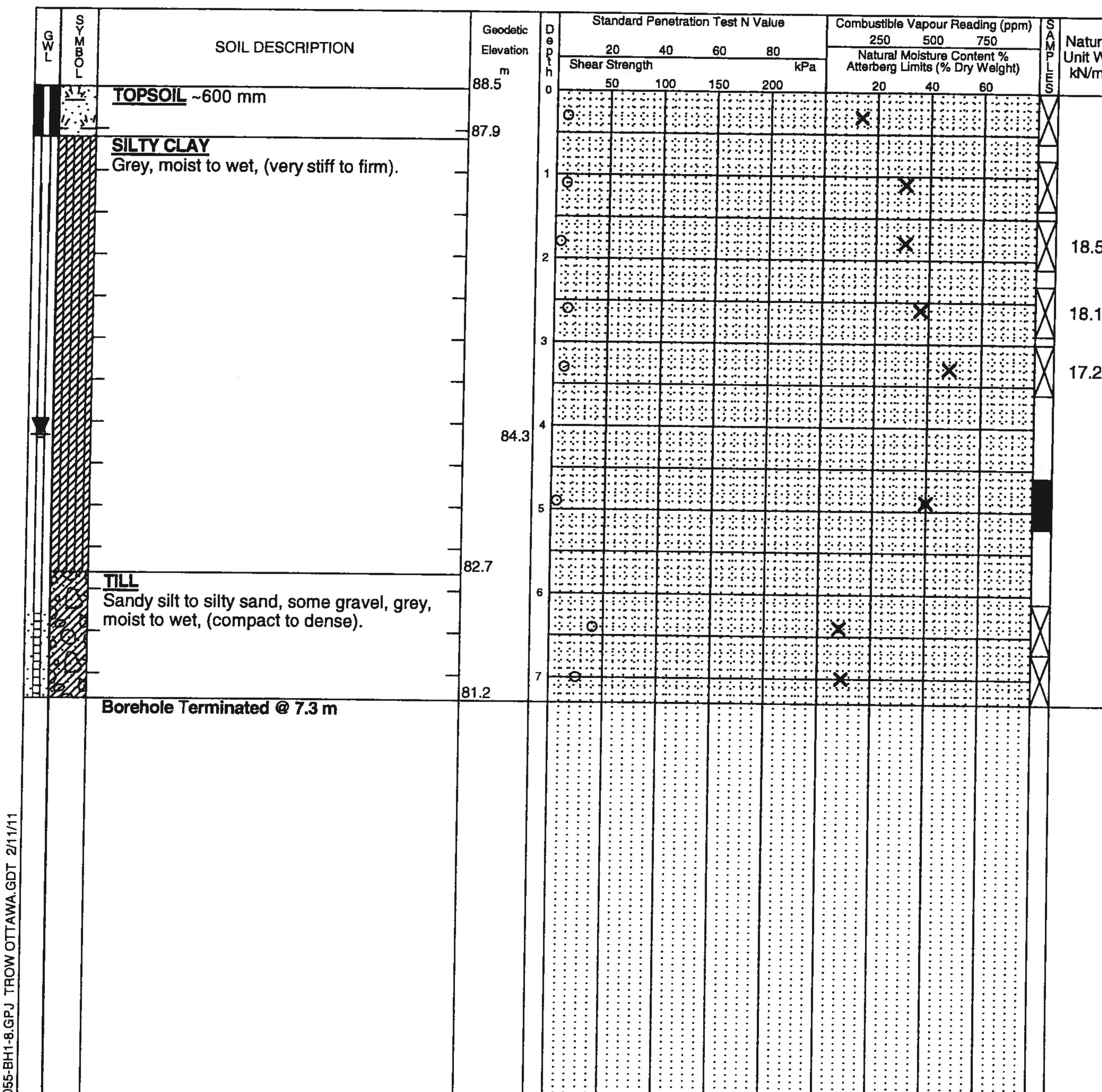
Datum: Geodetic Elevation

Logged by: ________ Checked by: ________

Figure No. 7

Page. 1 of 1

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─⊖
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
102 Days	4.2	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 6

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 8

Date Drilled: July 21st, 2005

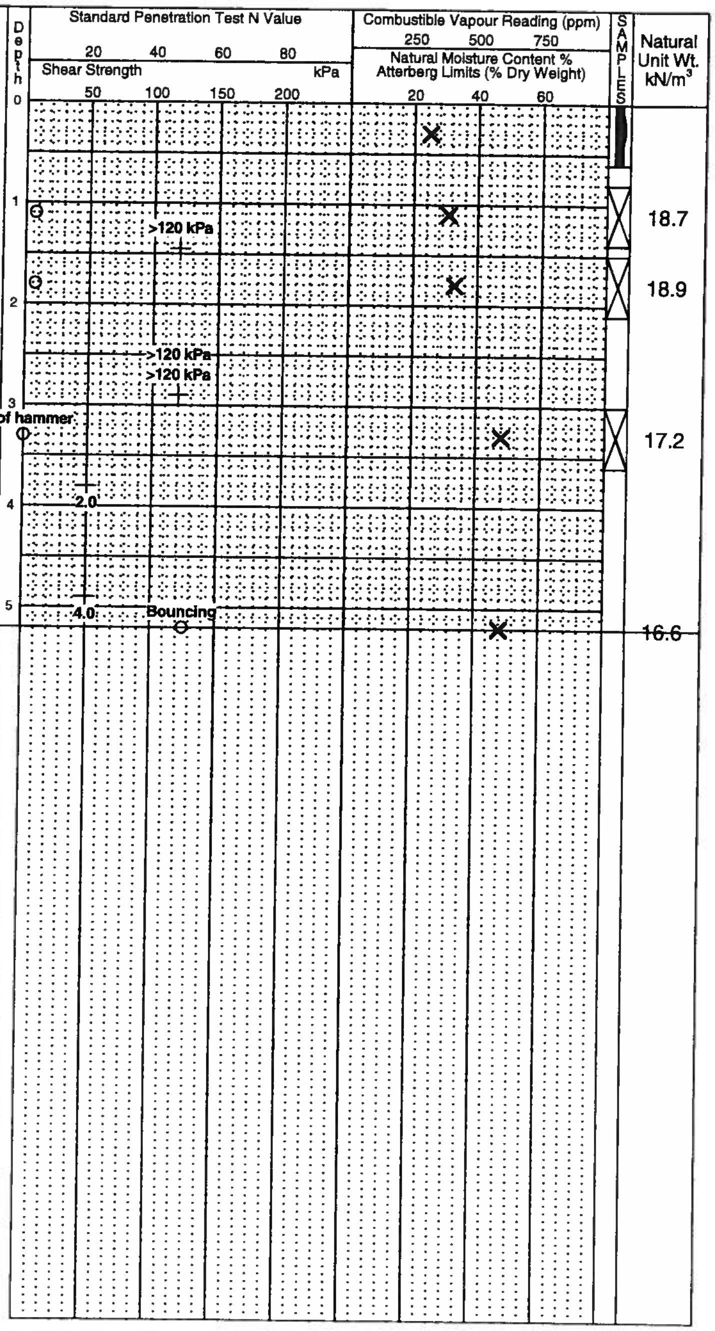
Drill Type:

Datum: Geodetic Elevation

Logged by: ________ Checked by: ________

Symbol legend		Symbol legend	
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	▥	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	⊢⊖
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
			88.7	0
		CLAYEY SILT TO SILTY CLAY Brown/grey, moist to wet, (very stiff).		
		TILL Sandy silt to silty sand, some gravel, grey, moist to wet, (compact to dense).	84.2 84.2	
		Refusal To Augers @ 5.2 m	83.5	5



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
102 Days	4.5	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 7

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 9

Date Drilled: July 22nd, 2005

Drill Type:

Datum: Geodetic Elevation

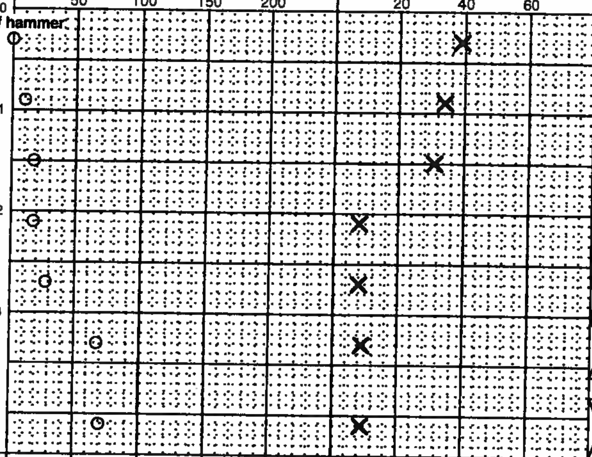
Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	▥	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─⊖
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

GWL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		85.6	0
	TOPSOIL ~125 mm	85.5	
	SILTY SAND Some decomposing wood pieces, brown, moist to wet, (loose).		1
▼ (83.9)	**TILL** Silty clay, some gravel, grey, moist to wet, (stiff).	84.1	2
	TILL Silty sand, some gravel and cobbles, grey, moist to wet, (compact).	82.6	3, 4
	Borehole Terminated @ 4.4 m	81.2	

Standard Penetration Test N Value: 20, 40, 60, 80
Shear Strength kPa: 50, 100, 150, 200
Combustible Vapour Reading (ppm): 250, 500, 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20, 40, 60
SAMPLES
Natural Unit Wt. kN/m³

Wt of hammer



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
102 Days	1.8	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 8

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: July 22nd, 2005

Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	X
SPT (N) Value	O	Atterberg Limits	⊢—O
Dynamic Cone Test	——	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value (20, 40, 60, 80) / Shear Strength kPa (50, 100, 150, 200)	Combustible Vapour Reading (ppm) (250, 500, 750) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (20, 40, 60)	SAMPLES	Natural Unit Wt. kN/m³
			85.4	0				
		TOPSOIL ~90 mm	85.3					
		SANDY PEAT			O	X	⊠	
				1	O	X	⊠	
			84.2					
▼		**TILL** Silty sand, some gravel and cobbles, grey, moist to wet, (compact to dense).	83.7		O	X	⊠	
				2	Bouncing O	X	⊠	
			83.1					
		Refusal To Sampling @ 2.3 m						

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
102 Days	1.7	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 9

¥Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 11

Page. 1 of 1

Date Drilled: Sept 6th, 2005

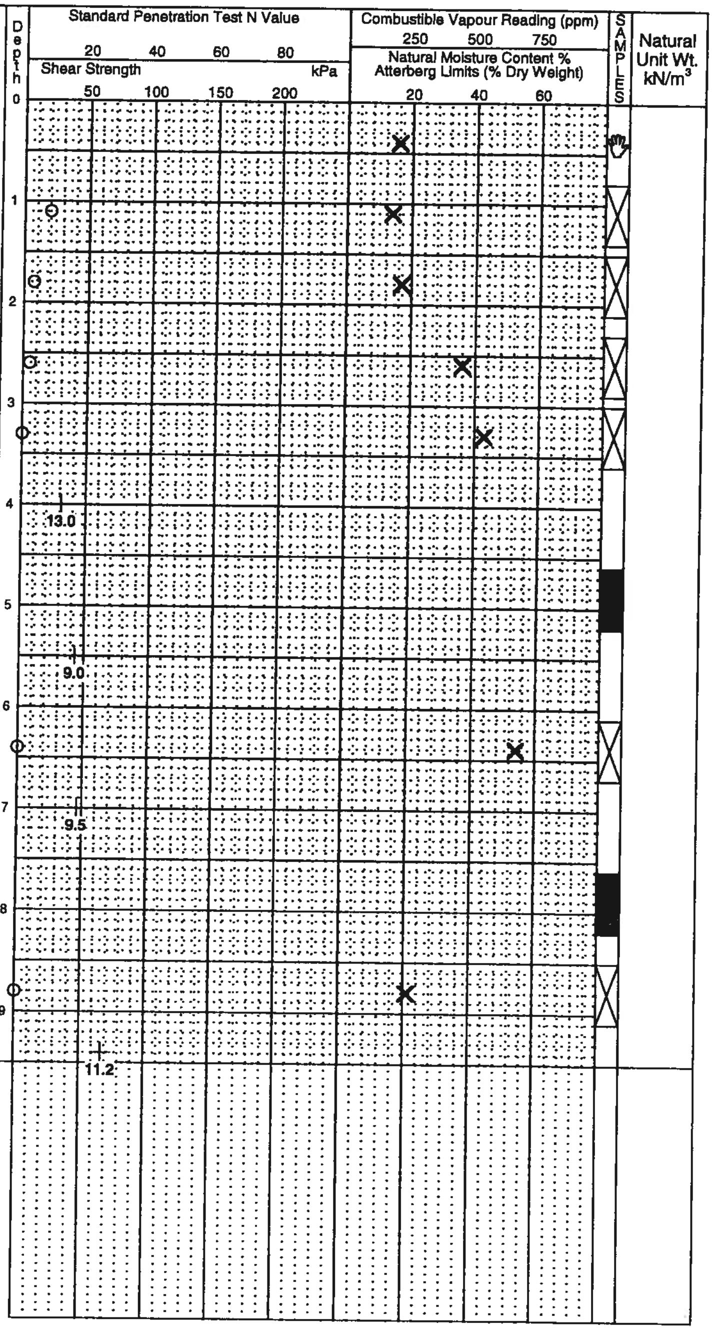
Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		90	90	0
		FILL Sandy silt with roots, highly organic, dark grey to black, slightly moist, (loose to very loose).		
		SANDY SILT Some organics, dark grey, moist, (very loose).	88.5	
		SILTY CLAY Grey, very moist to wet, (firm to stiff).	87.9	
		CLAYEY SILT Trace to some sand, grey, wet, (stiff).	81.5	
		Borehole Terminated @ 9.5 m	80.5	



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	n/d	n/d
102 Days	2.7	n/a

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 10

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 12

Page. 1 of 1

Date Drilled: 'February 7, 2011

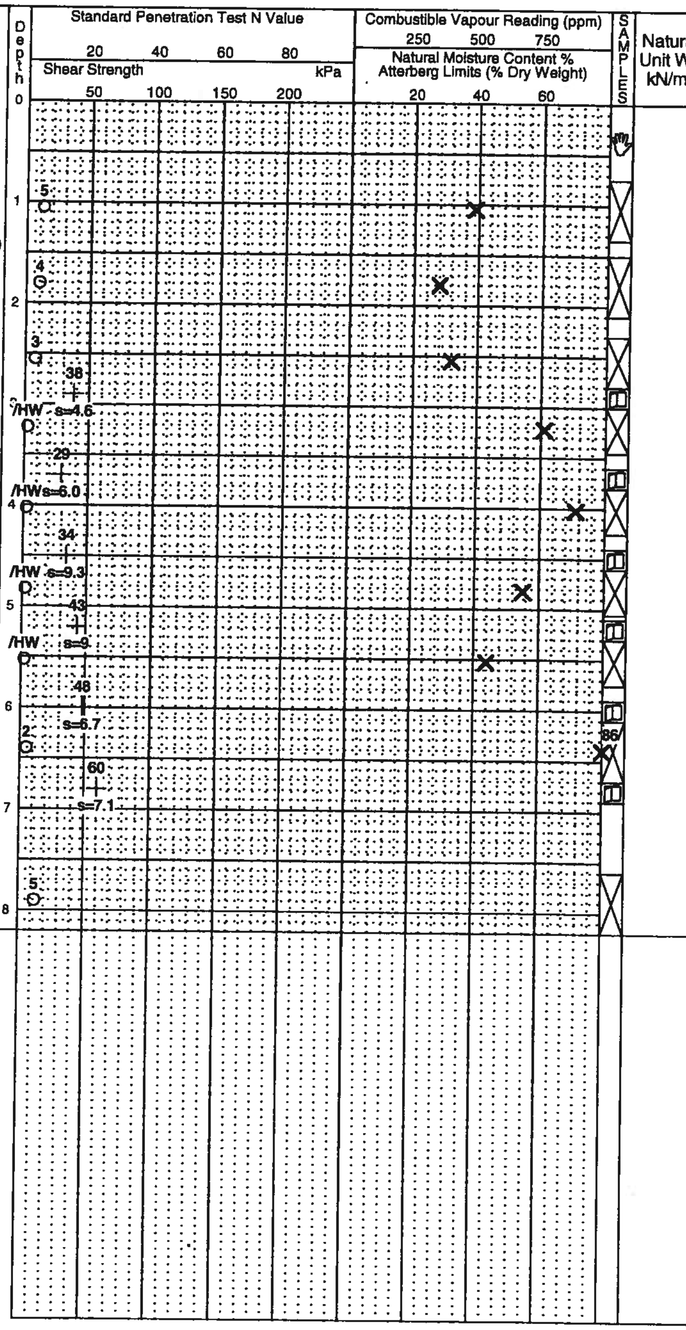
Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	▥	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

SOIL DESCRIPTION	Geodetic Elevation m	Depth (m)
	90.5	0
TOPSOIL ~ 900mm		
	89.6	
SILTY SAND Some gravel, slightly cohesive, brown to grey, moist to wet (very loose to loose)	89	1
	87.9	2
SILTY CLAY Silty sand seams or pockets, very moist to wet (firm to stiff)		3 – 7
	82.9	
SILTY SAND Some gravel, grey, wet (loose)	82.3	8
Borehole Terminated @ 8.2 m		



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 11

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 13

Page. 1 of 1

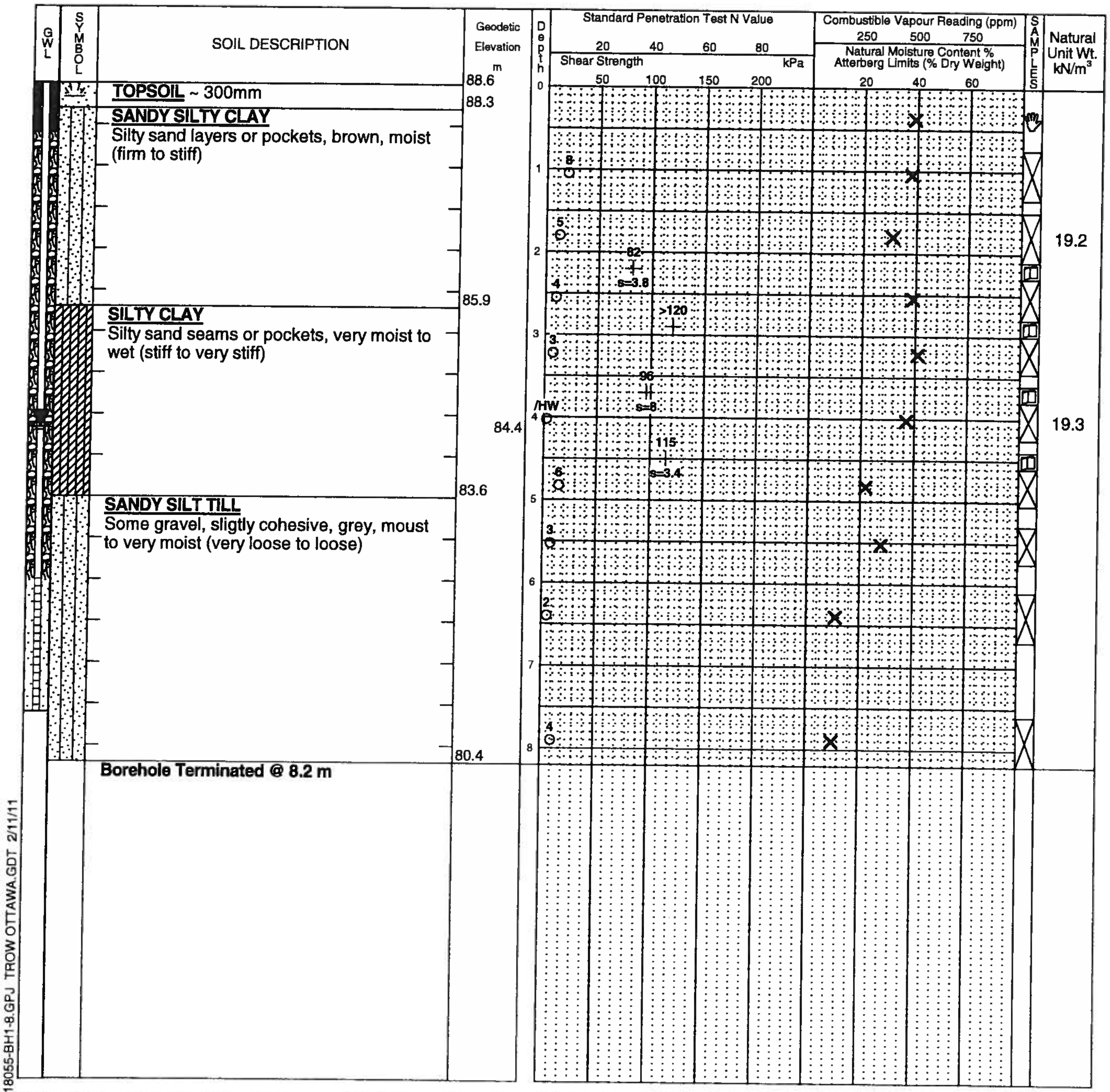
Date Drilled: 'February 7, 2011

Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	X
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	——	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		



LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	4.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 12

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Date Drilled: 'February 7, 2011

Drill Type:

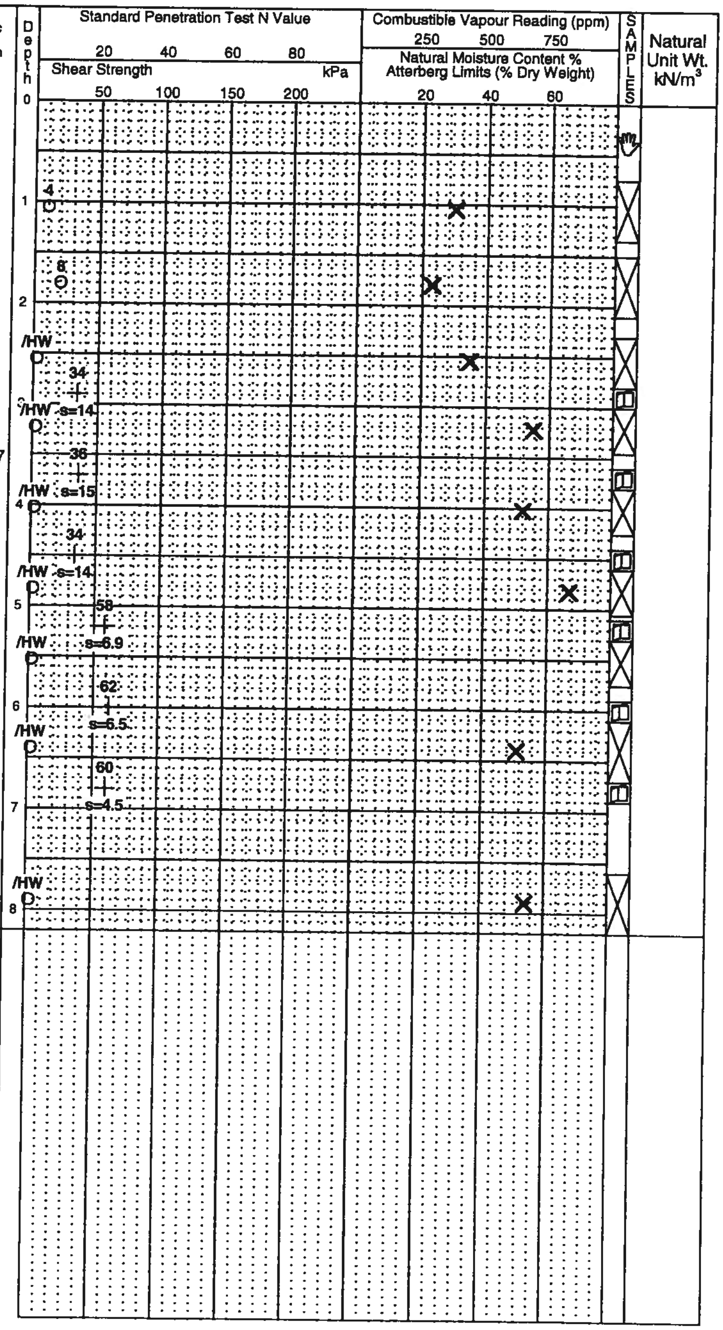
Datum: Geodetic Elevation

Logged by: ________ Checked by: ________

Figure No. 14

Symbol	Legend
Split Spoon Sample	⊠
Auger Sample	▥
SPT (N) Value	○
Dynamic Cone Test	———
Shelby Tube	■
Shear Strength by Vane Test	+ S
Combustible Vapour Reading	□
Natural Moisture Content	✕
Atterberg Limits	⊢—○
Undrained Triaxial at % Strain at Failure	⊕
Shear Strength by Penetrometer Test	▲

SOIL DESCRIPTION	Geodetic Elevation (m)
	90.6
TOPSOIL ~ 900mm	
SILTY SAND Some gravel, clayey, fine sand layers or pockets, brown, moist to wet (loose)	89.7
SILTY CLAY Silty sand seams or pockets, grey, very moist to wet (firm to stiff)	88.3
	87
SILTY SAND Occasional gravel, grey, wet (very loose)	83.6
Borehole Terminated @ 8.2 m	82.4



NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	3.6	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole 13

Trow

Project No: OTGE00018055A

Project: Geotechnical Investigation - Proposed Residential Subdivision

Location: 5599 First Line Road, Rideau Township, Ontario

Figure No. 15

Page. 1 of 1

Date Drilled: 'February 7, 2011

Drill Type:

Datum: Geodetic Elevation

Logged by: Checked by:

Legend	Symbol	Legend	Symbol
Split Spoon Sample	☒	Combustible Vapour Reading	□
Auger Sample	▥	Natural Moisture Content	X
SPT (N) Value	o	Atterberg Limits	├─o
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ s		

Soil Description	Geodetic Elevation (m)	Depth (m)
TOPSOIL ~ 600mm	90 – 89.4	0
SILTY SAND Some gravel, oxidized silt seams or pockets, brown, moist to very moist (very loose to loose)	89.4 – 87.9	
SILTY CLAY Silty sand seams or pockets, grey, very moist to wet (firm to stiff)	87.9 – 81.8	2
Borehole Terminated @ 8.2 m	81.8	8.2

Groundwater level: 87.6

Standard Penetration Test N Values: 5, 2; /HW (weight of hammer) at subsequent samples.

Shear Strength by Vane Test (kPa): 72 (s=6), 34 (s=7), 48 (s=6.7), 48 (s=20), 41, 48 (s=20), 58 (s=24)

NOTES:
1. Borehole/Test Pit data requires interpretation by Trow before use by others
2. Piezometer installed upon completion.
3. Field work supervised by a Trow representative
4. See Notes on Sample Descriptions
5. This Figure is to read with Trow Associates Inc. report OTGE00018055A

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On completion	2.4	

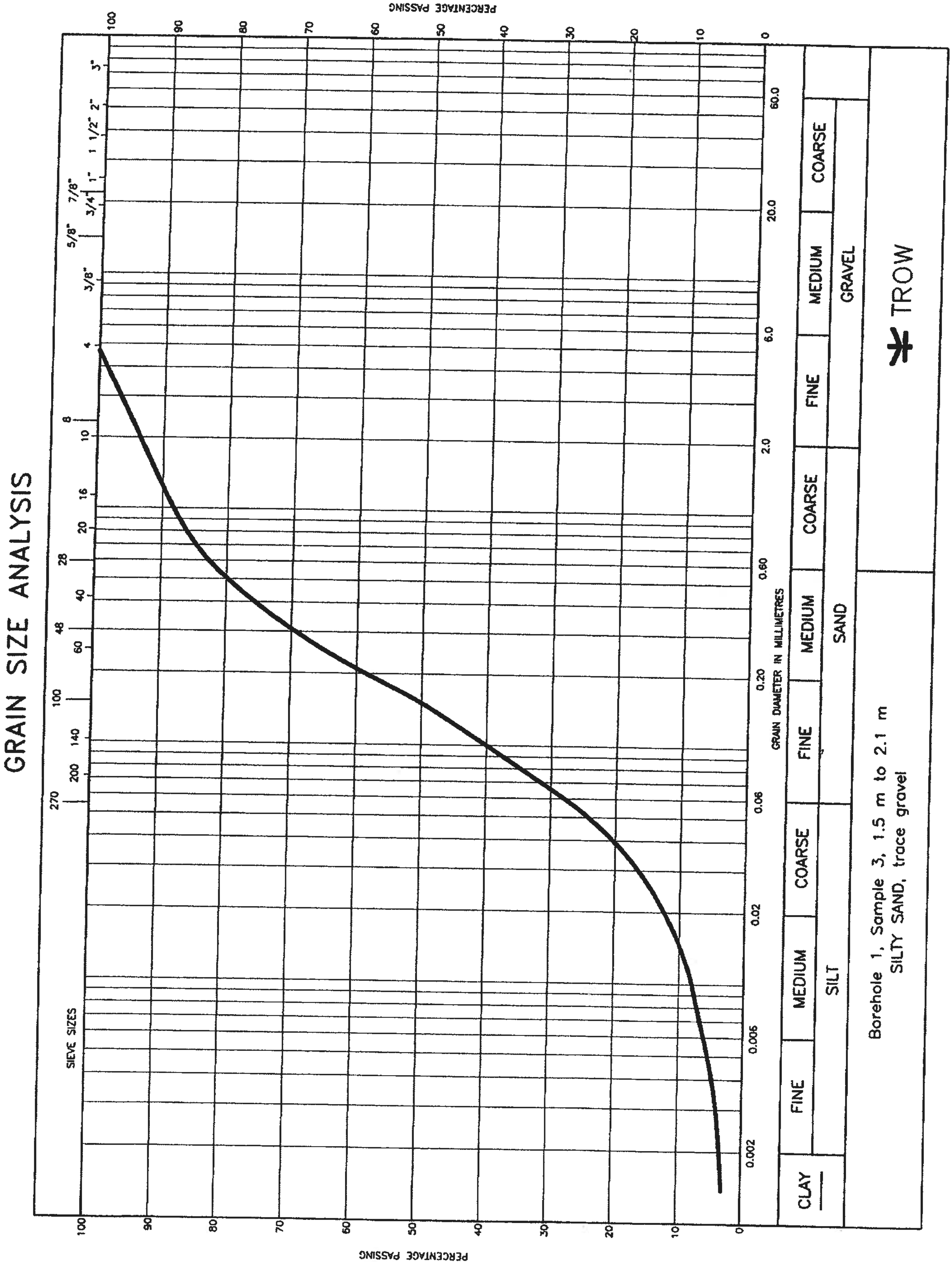
CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTGE00018055-BH1-8.GPJ TROW OTTAWA.GDT 2/11/11

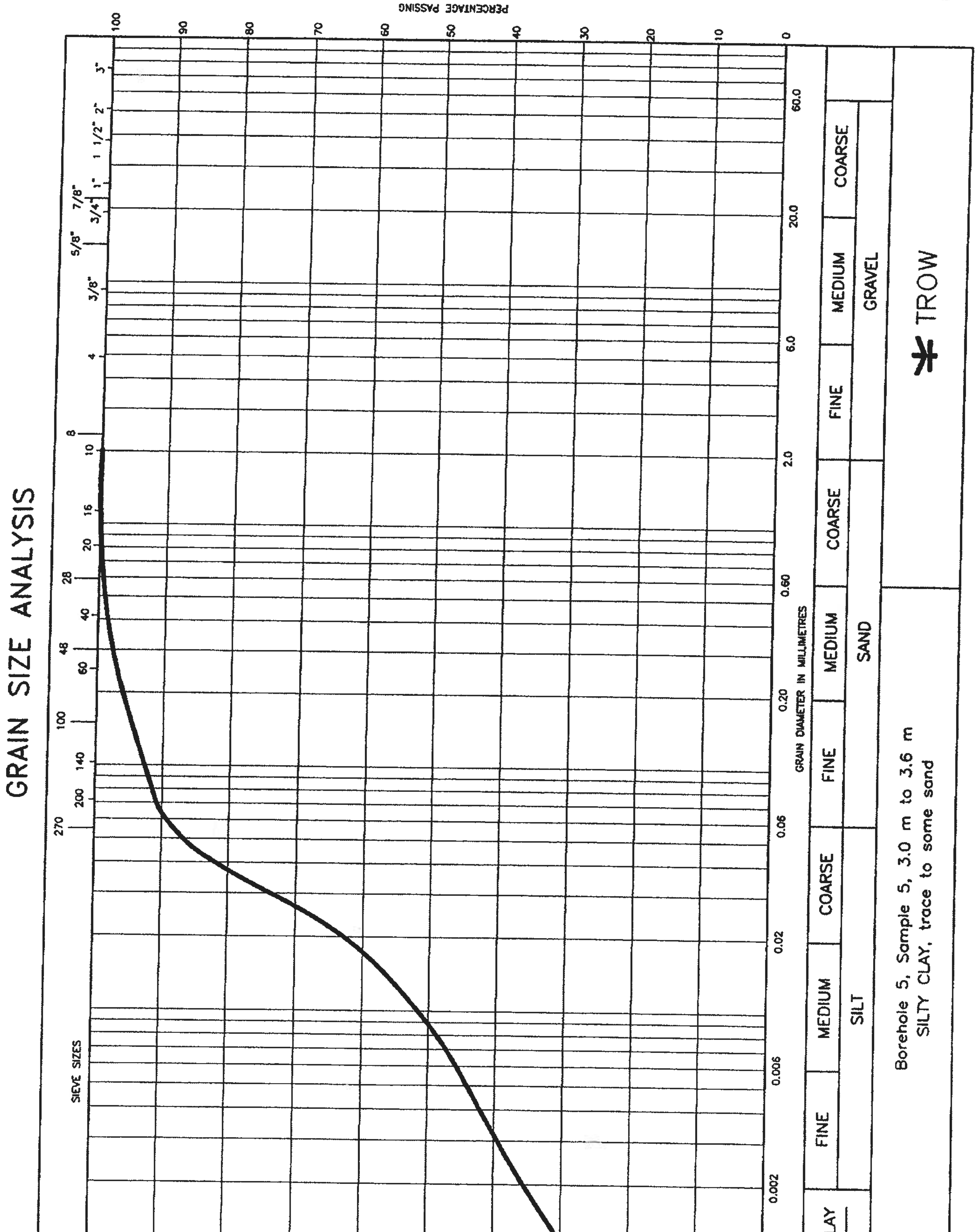
PROJ. No. OTGE00018055A

FIG. No 16



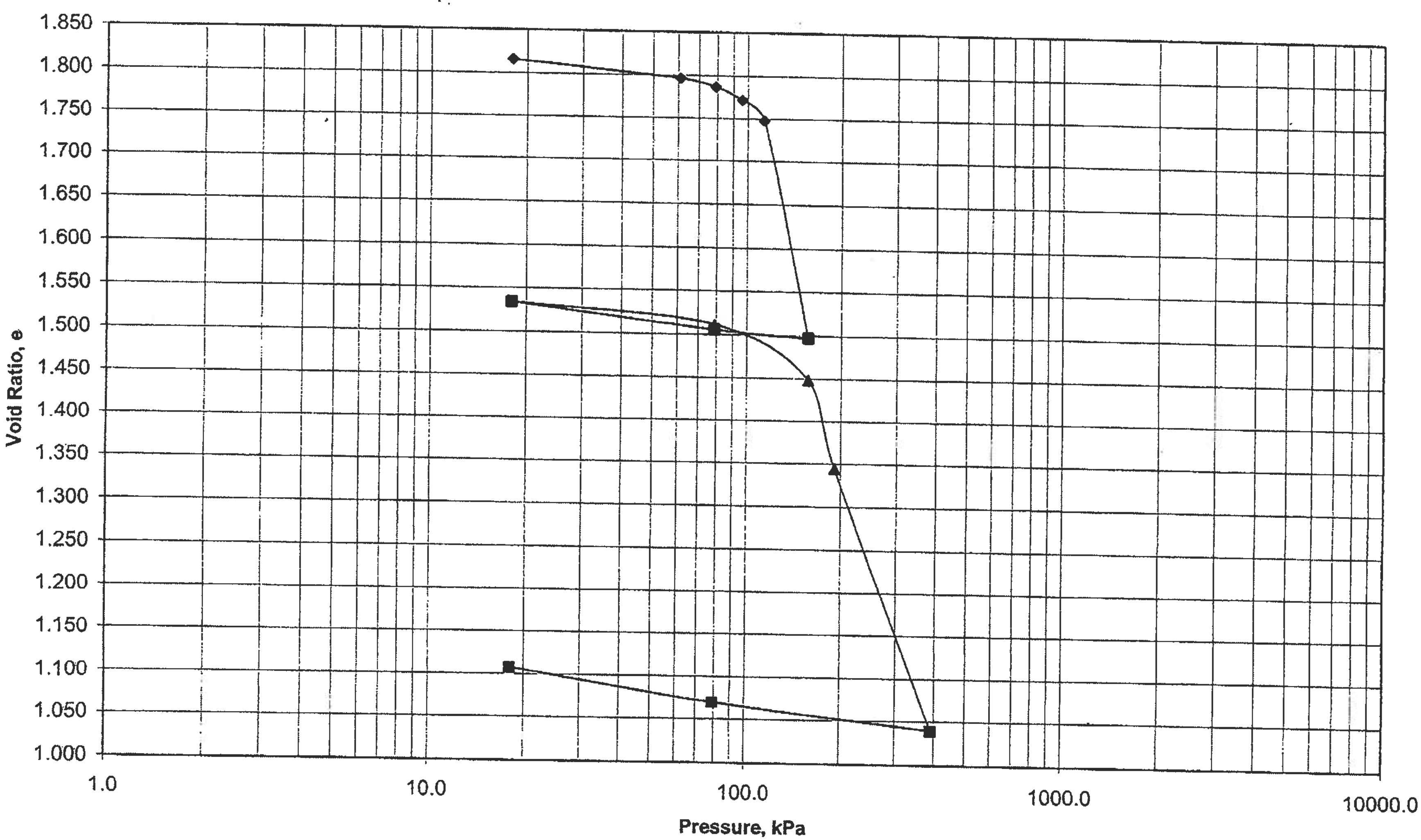
PROJ. No. OTGE00018055A

FIG. No. 17



Project No.: OTGE00018055A

Consolidation Test Result - Void Ratio versus Pressure



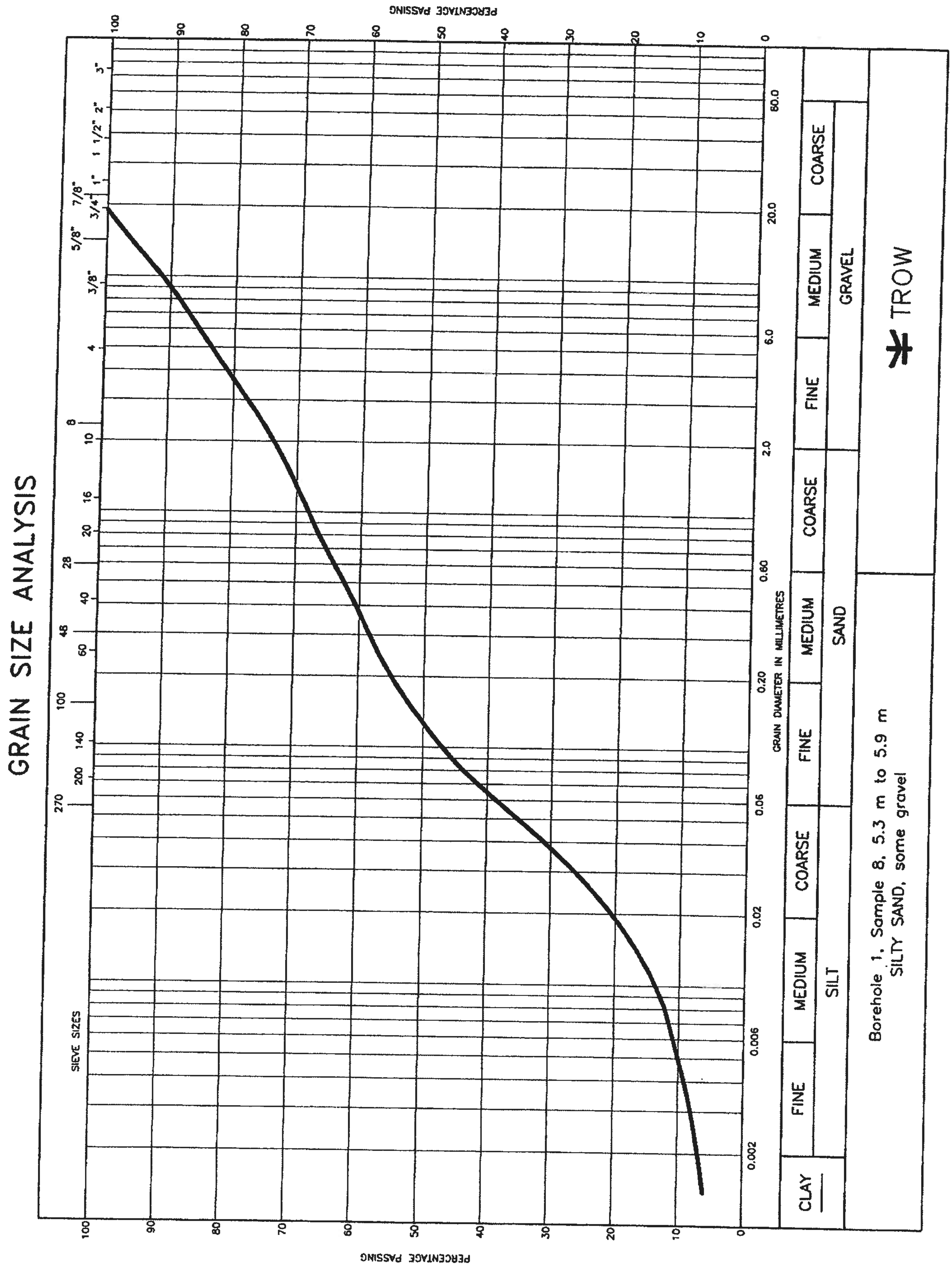
Effective O/B Pressure (po1) = 79 kPa
Effective Preconsolidation Pressure (pc1) = 105 kPa
Recompression Index = 0.042
Compression Index = 1.29

Borehole 5, Depth 4.6 – 5.2 m
Natural Moisture = 58%
Initial Void Ratio = 1.833

Figure No.: 18

PROJ. No. OTGE00018055A

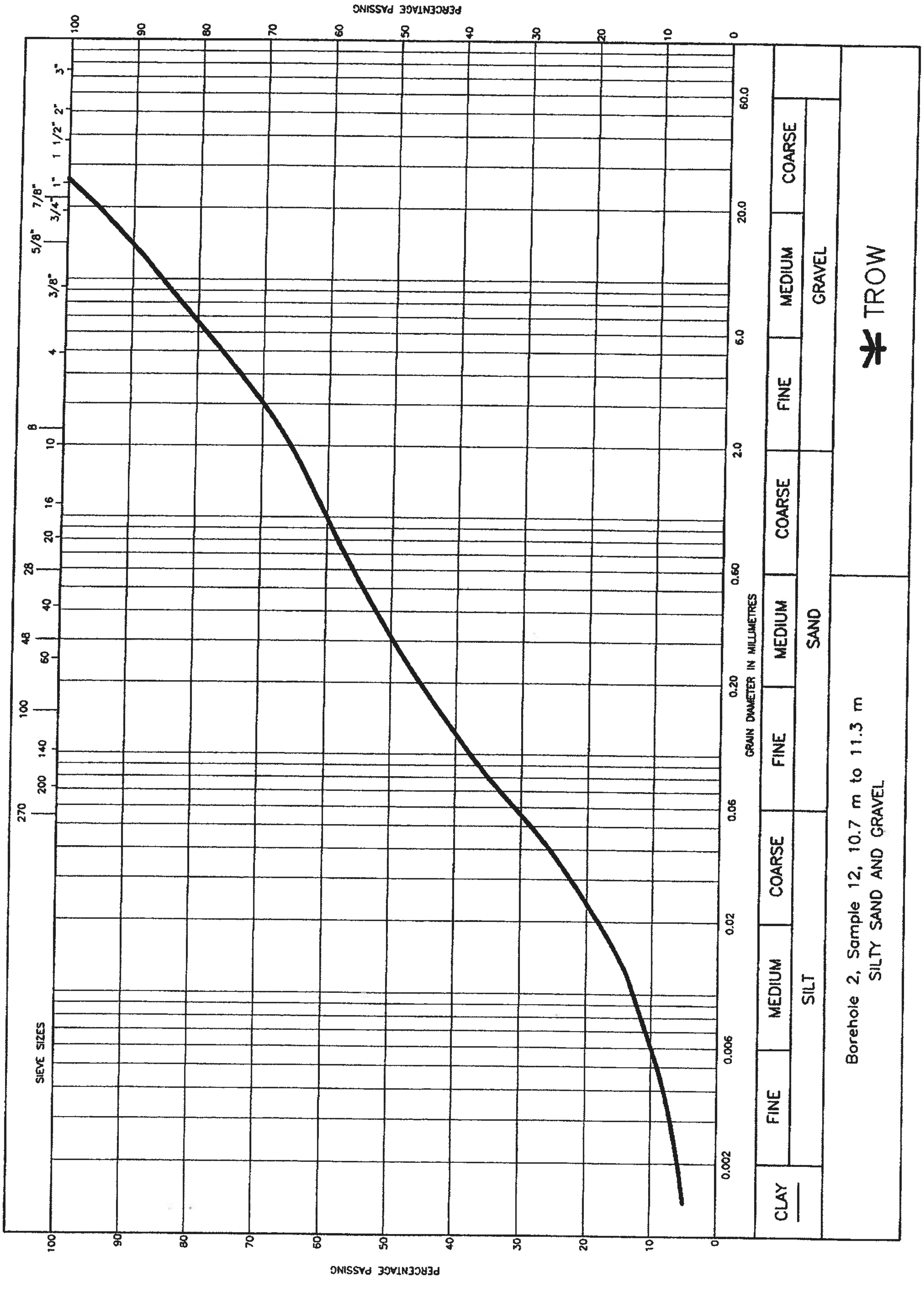
FIG. No. 19



PROJ. No. OTGE00018055A

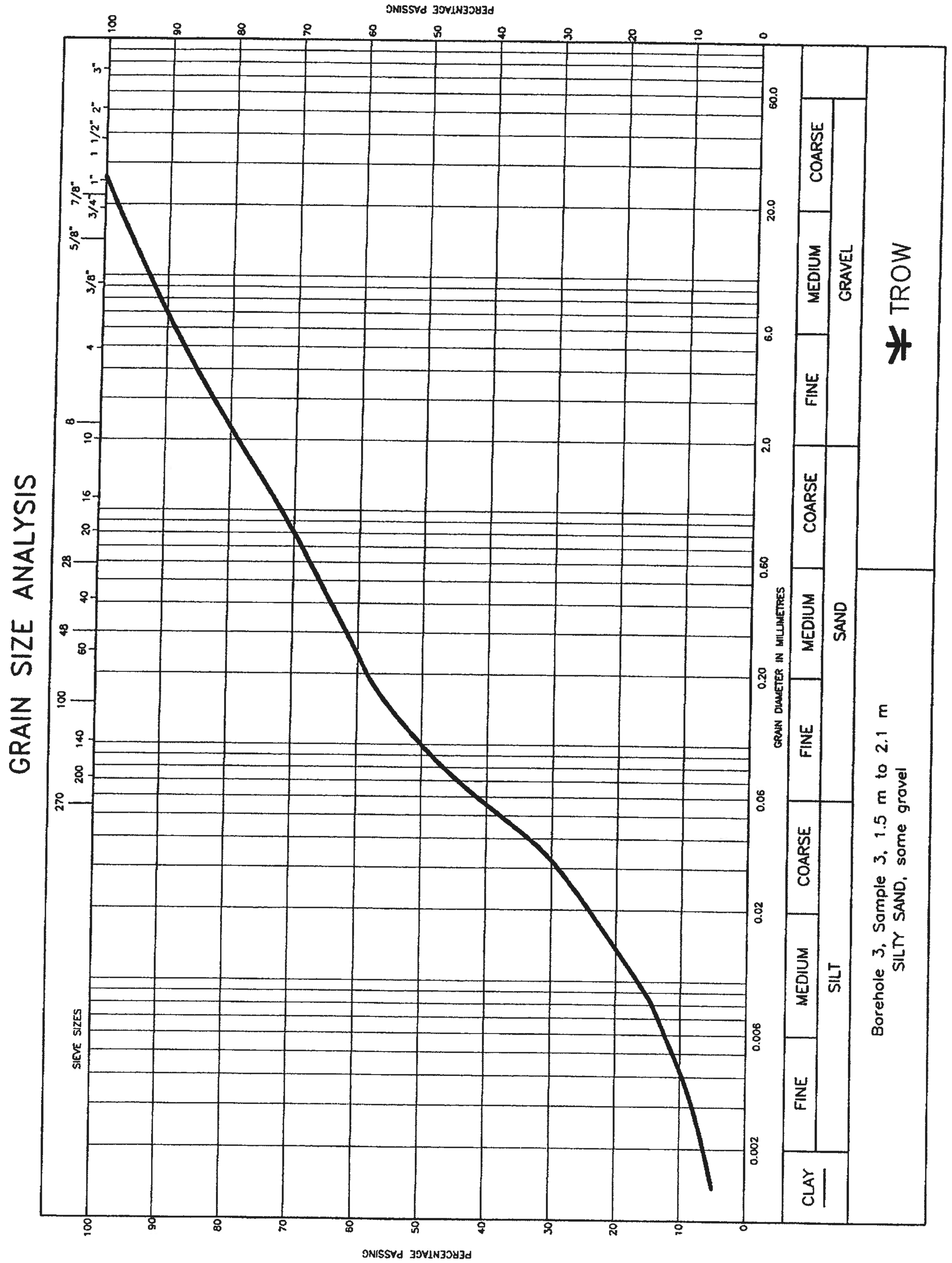
FIG. No. 20

GRAIN SIZE ANALYSIS



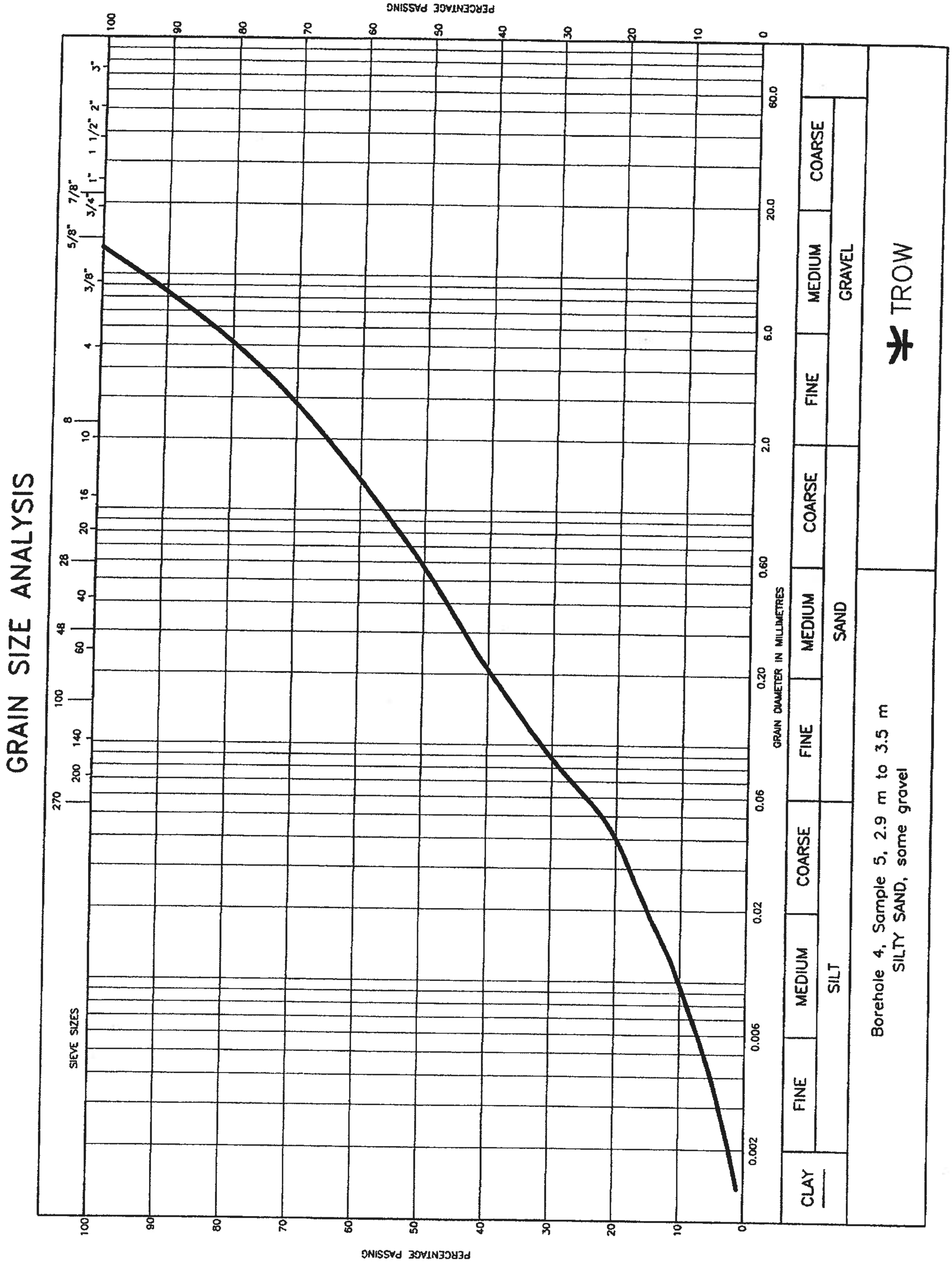
PROJ. No. OTGE00018055A

FIG. No. 21



PROJ. No. OTGE00018055A

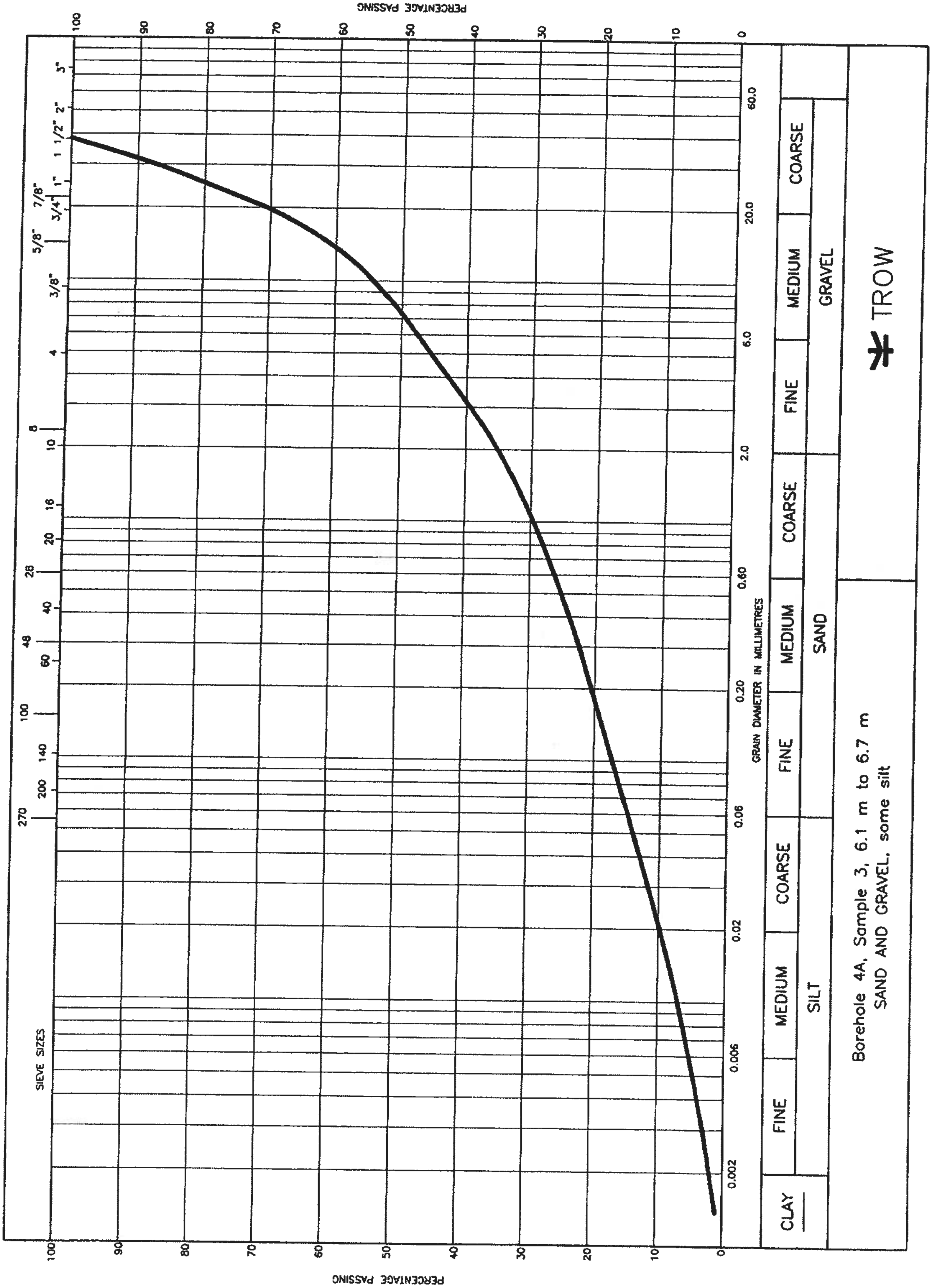
FIG. No. 22



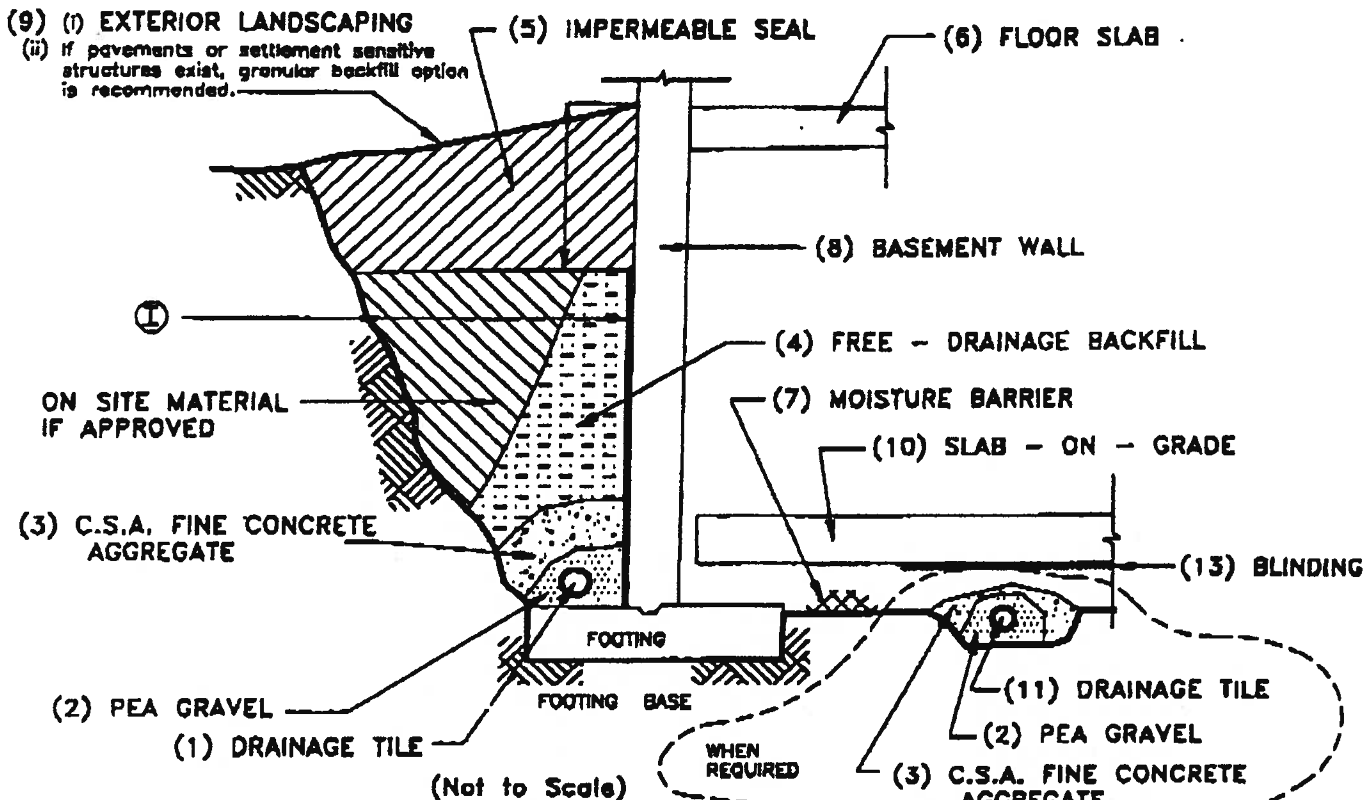
PROJ. No. OTGE00018055A

FIG. No. 23

GRAIN SIZE ANALYSIS



BASEMENT DRAINAGE DRAWING



NOTES

OPTION A — GRANULAR BACKFILL

1. Drainage tile to consist of 100mm (4 in.) diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be minimum of 150mm (6 in.) below underside of floor slab.
2. Pea gravel 150mm (6 in.) top and sides of drain. If drain is not on footing, place 100mm (4 in.) of pea gravel below drain. 20mm (3/4 in.) clear stone may be used provided it is covered by an approved porous geotextile membrane (Terrafix 270R or equivalent).
3. C.S.A. fine concrete aggregate to act as filter material. Minimum 300mm (12 in.) top and sides of drain. This may be replaced by an approved porous geotextile membrane (Terrafix 270R or equivalent).
4. Free-draining backfill — OPSS Granular B or equivalent compacted to 93 to 95 (maximum) percent Standard Proctor density. Do not compact closer than 1.8m (6 ft.) from wall with heavy equipment. Use hand controlled light compaction equipment within 1.8m (6 ft.) of wall.
5. Impermeable backfill seal of compacted clay, clayey silt or equivalent. If original soil is free-draining seal may be omitted.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to consist of compacted 20mm (3/4 in.) clear stone or equivalent free-draining material. Layer to be 200mm (8 in.) minimum thickness.
8. Basement walls to be damp-proofed.
9. Exterior grade to slope away from wall.
10. Slab-on-grade should not be structurally connected to wall or footing.
11. Underfloor drain invert to be a least 300mm (12 in.) below underside of floor slab. Drainage tile placed in parallel rows 6 to 8m (20 to 25ft.) centres one way. Place drain on 100mm (4 in.) of pea gravel with 150mm (6 in.) of pea gravel top and sides. CSA fine concrete aggregate to be provided as filter material or an approved geotextile membrane (as in 2 above) may be used.
12. Do not connect the underfloor drains to perimeter drains.
13. If the 20mm (3/4 in.) clear stone requires surface blinding, use 6mm (1/4 in.) clear stone chips.

NOTE: A) Underfloor drainage can be deleted where not required (see report).

OPTION B — CORE DRAIN

Prefabricated continuous wall drains Ⓘ may be installed and Zone 4 backfilled with on site material compacted to 93 - 95% proctor. Further cost savings may result by placing the wall drains at equal distance strips no greater then 2.5m spacing but the risks of water leakage must by assessed and then assumed by the client.

1. Wall drain option Ⓘ may increase the lateral pressures above those of the conventional detail.
2. The use of waterproofing details at construction and expansion joints may also be required.
3. For Block walls or unreinforced cast in place concrete, the granular backfill option is recommended

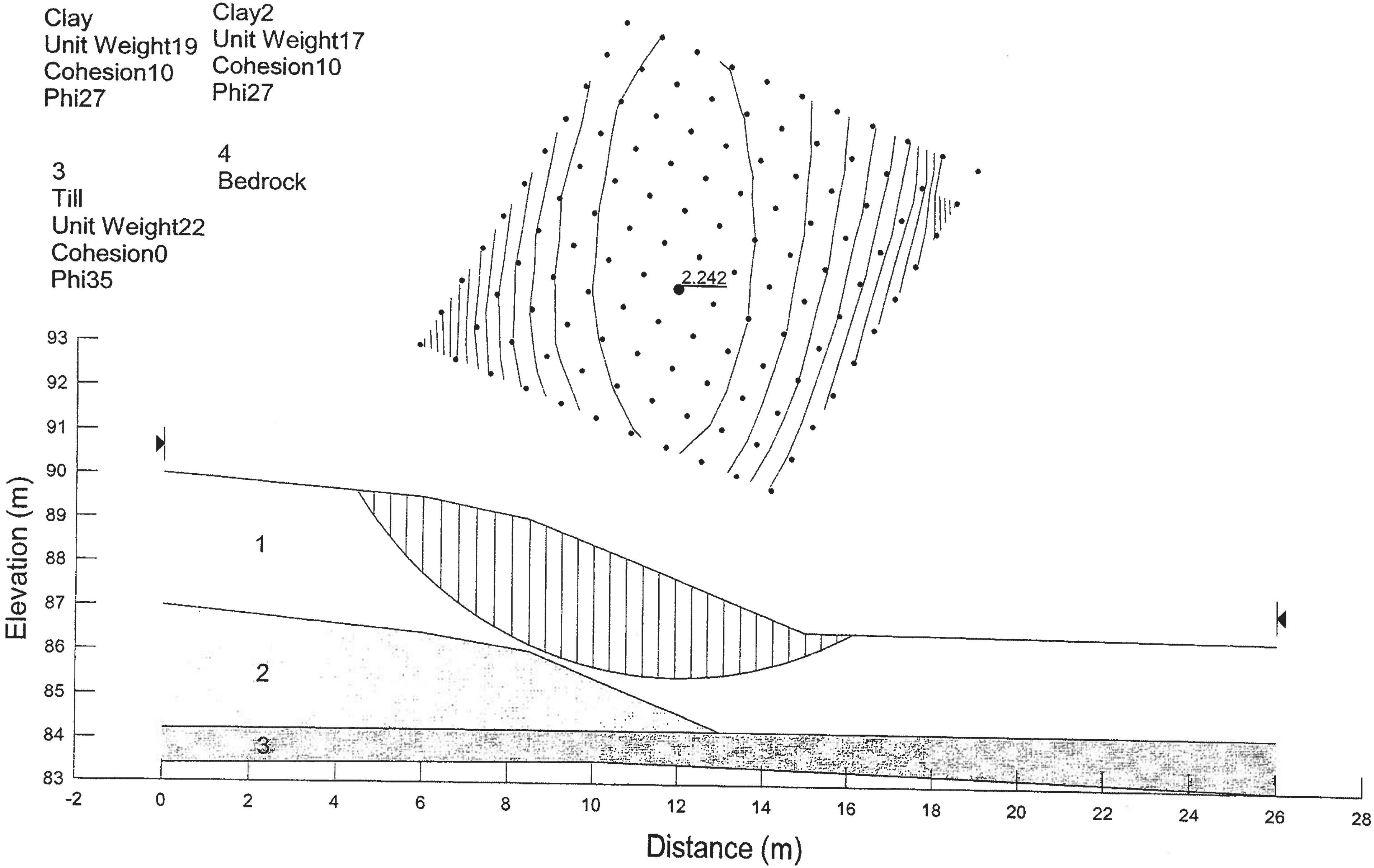
Note: If water table exists above the floor slab, then options of granular in combinations with the wall drain should be reviewed

OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 1
Effective Stress Analysis

Fig. No. 25

1	2
Clay	Clay2
Unit Weight19	Unit Weight17
Cohesion10	Cohesion10
Phi27	Phi27

3	4
Till	Bedrock
Unit Weight22	
Cohesion0	
Phi35	

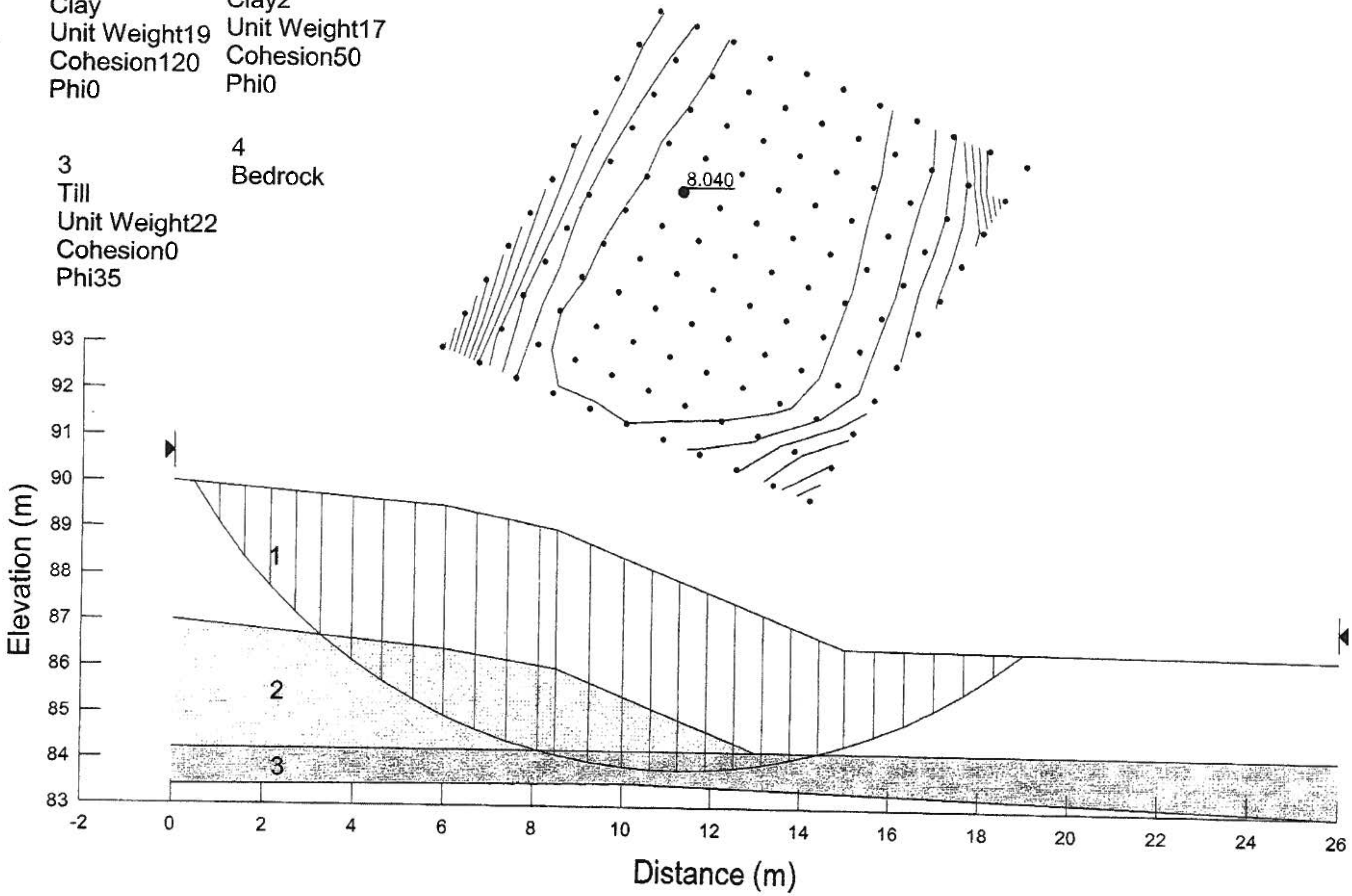


OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 1
Total Stress Analysis

Fig. No 26

1	2
Clay	Clay2
Unit Weight19	Unit Weight17
Cohesion120	Cohesion50
Phi0	Phi0

3	4
Till	Bedrock
Unit Weight22	
Cohesion0	
Phi35	



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 1
Total Stress Analysis
Seismic Loading: 0.21g

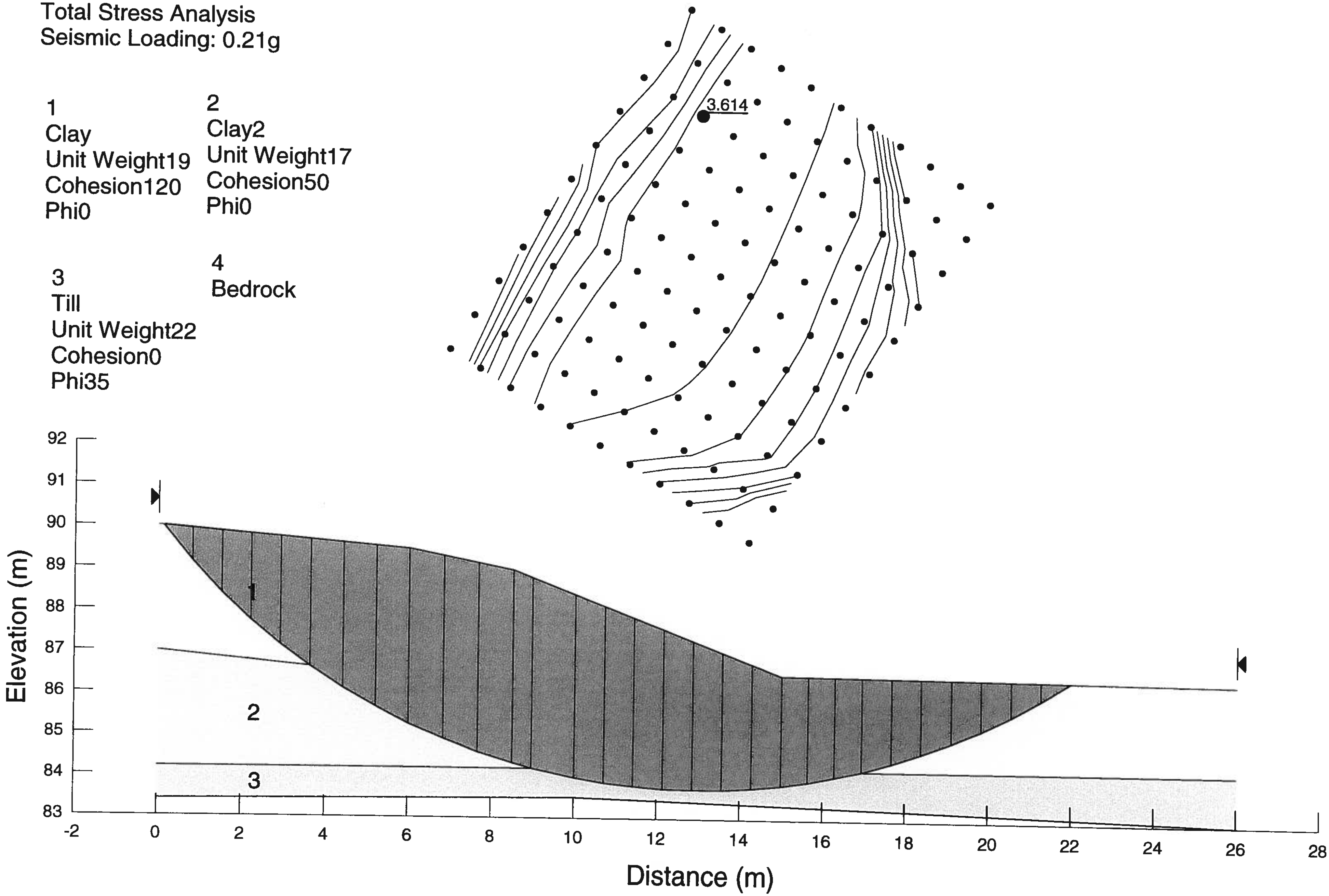
Fig. No. 27

1
Clay
Unit Weight19
Cohesion120
Phi0

2
Clay2
Unit Weight17
Cohesion50
Phi0

3
Till
Unit Weight22
Cohesion0
Phi35

4
Bedrock

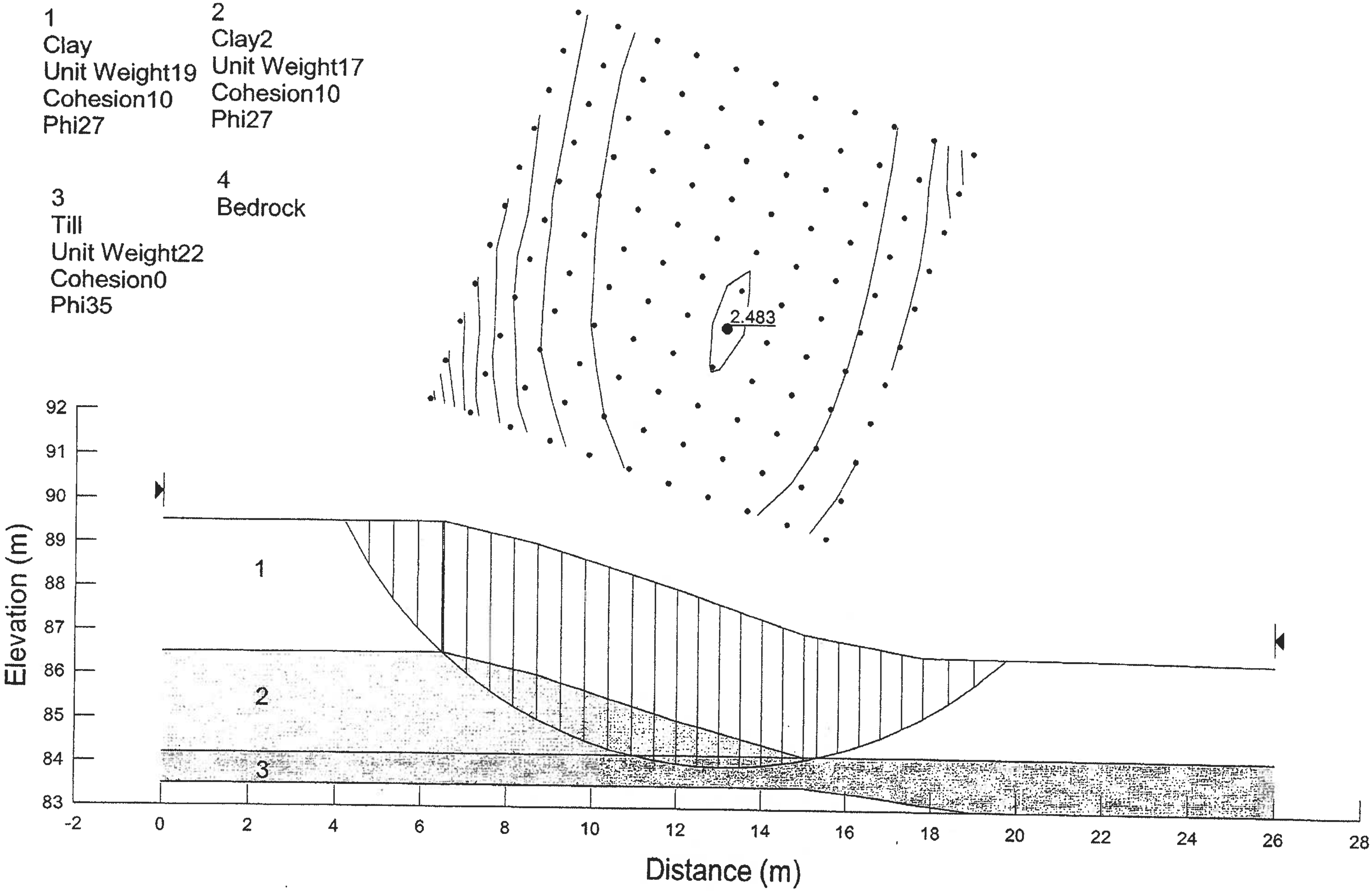


OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 2
Effective Stress Analysis

Fig. No, 28

1	2
Clay	Clay2
Unit Weight19	Unit Weight17
Cohesion10	Cohesion10
Phi27	Phi27

3	4
Till	Bedrock
Unit Weight22	
Cohesion0	
Phi35	



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 2
Total Stress Analysis

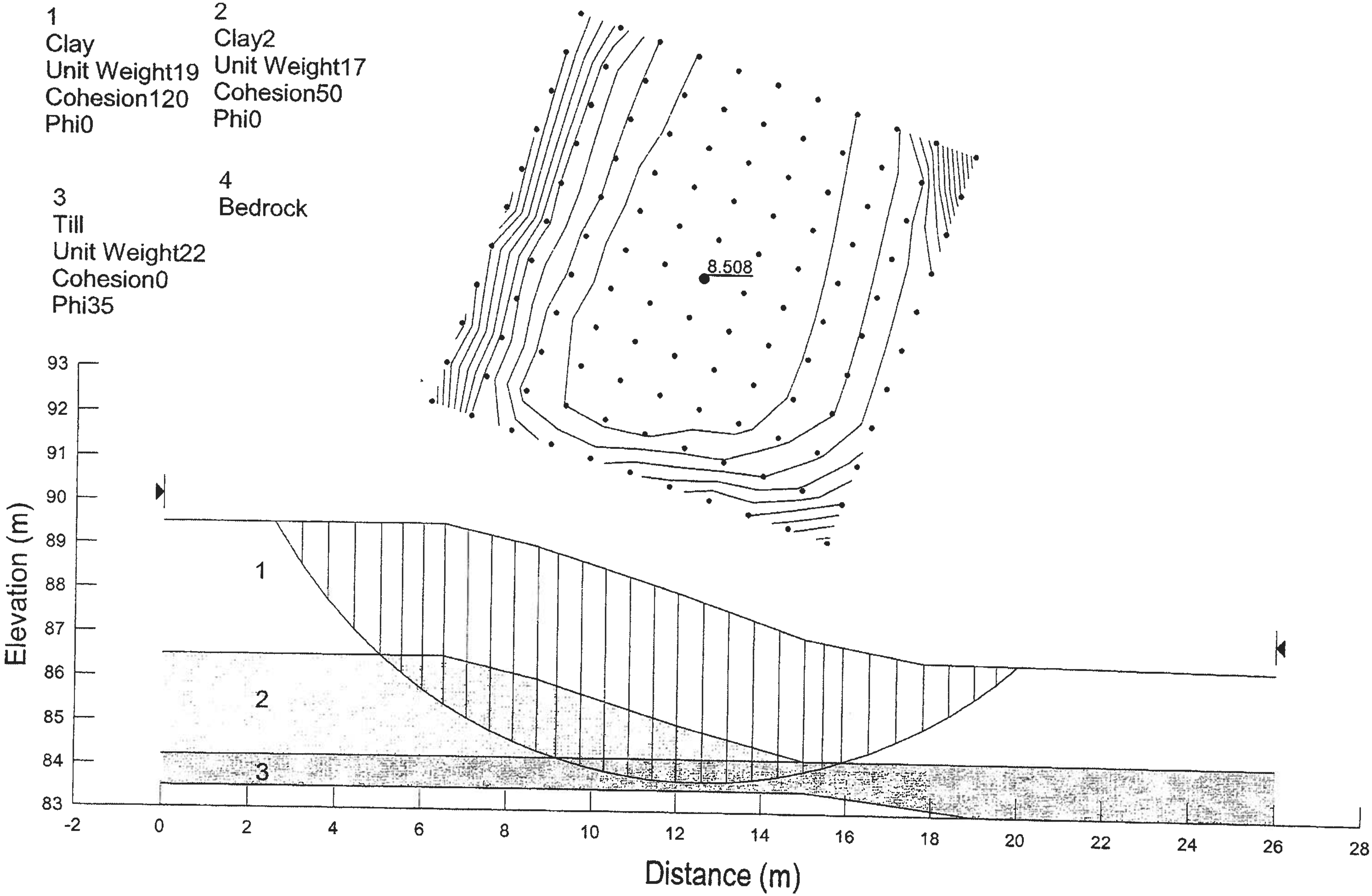
Fig. No. 29

1
Clay
Unit Weight19
Cohesion120
Phi0

2
Clay2
Unit Weight17
Cohesion50
Phi0

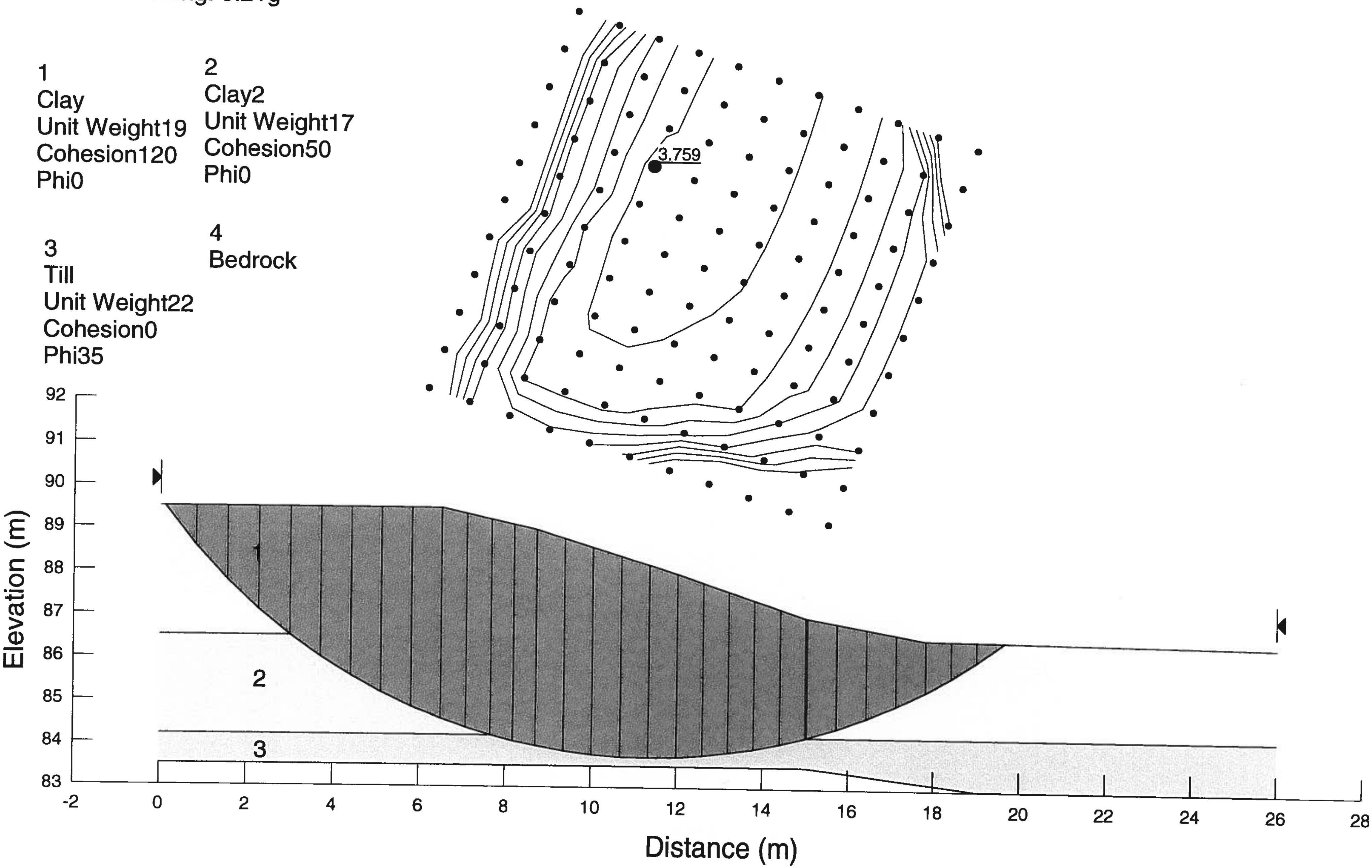
3
Till
Unit Weight22
Cohesion0
Phi35

4
Bedrock



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 2
Total Stress Analysis
Seismic Loading: 0.21g

Fig. No. 30

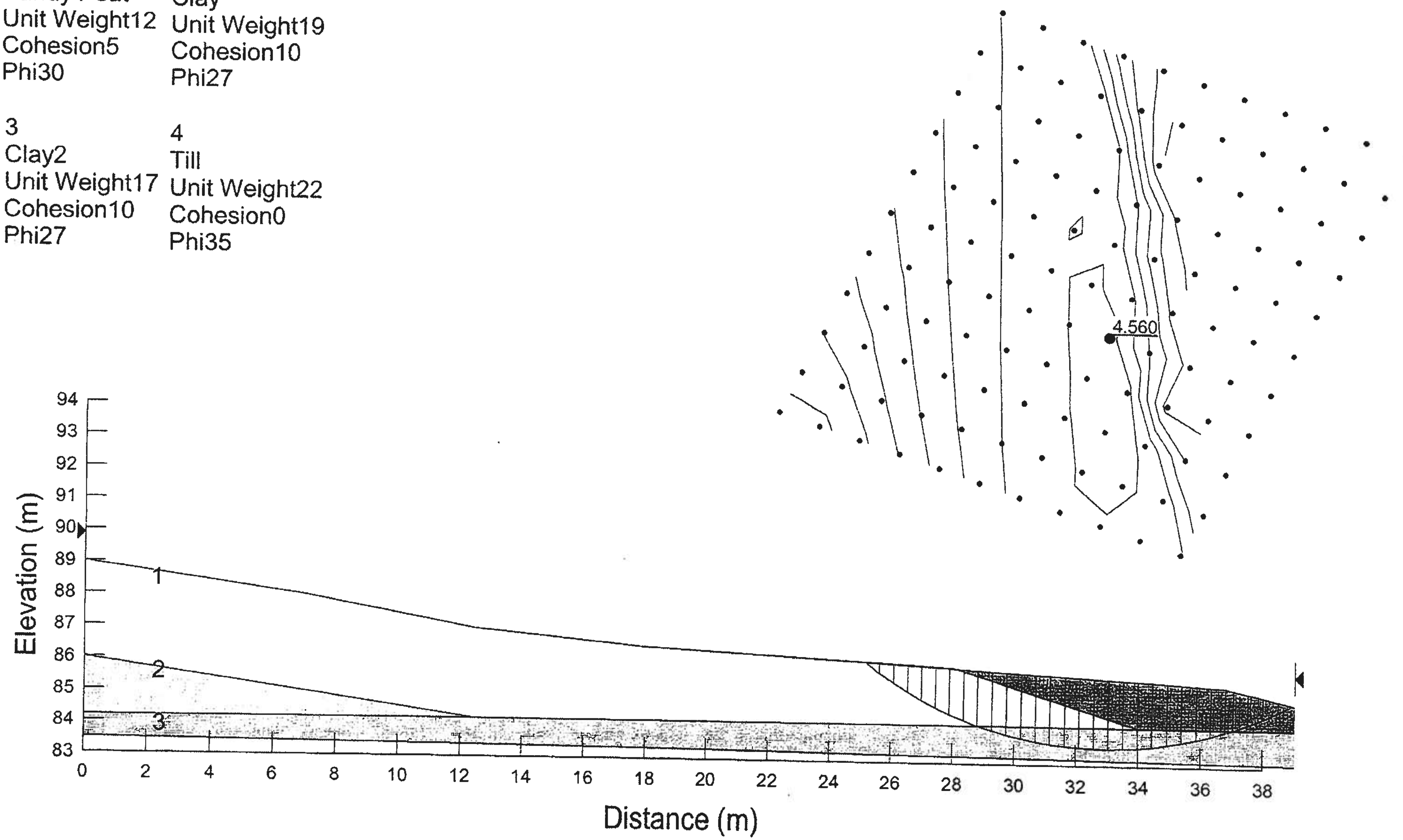


OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 3
Effective Stress Analysis

Fig. No. 31

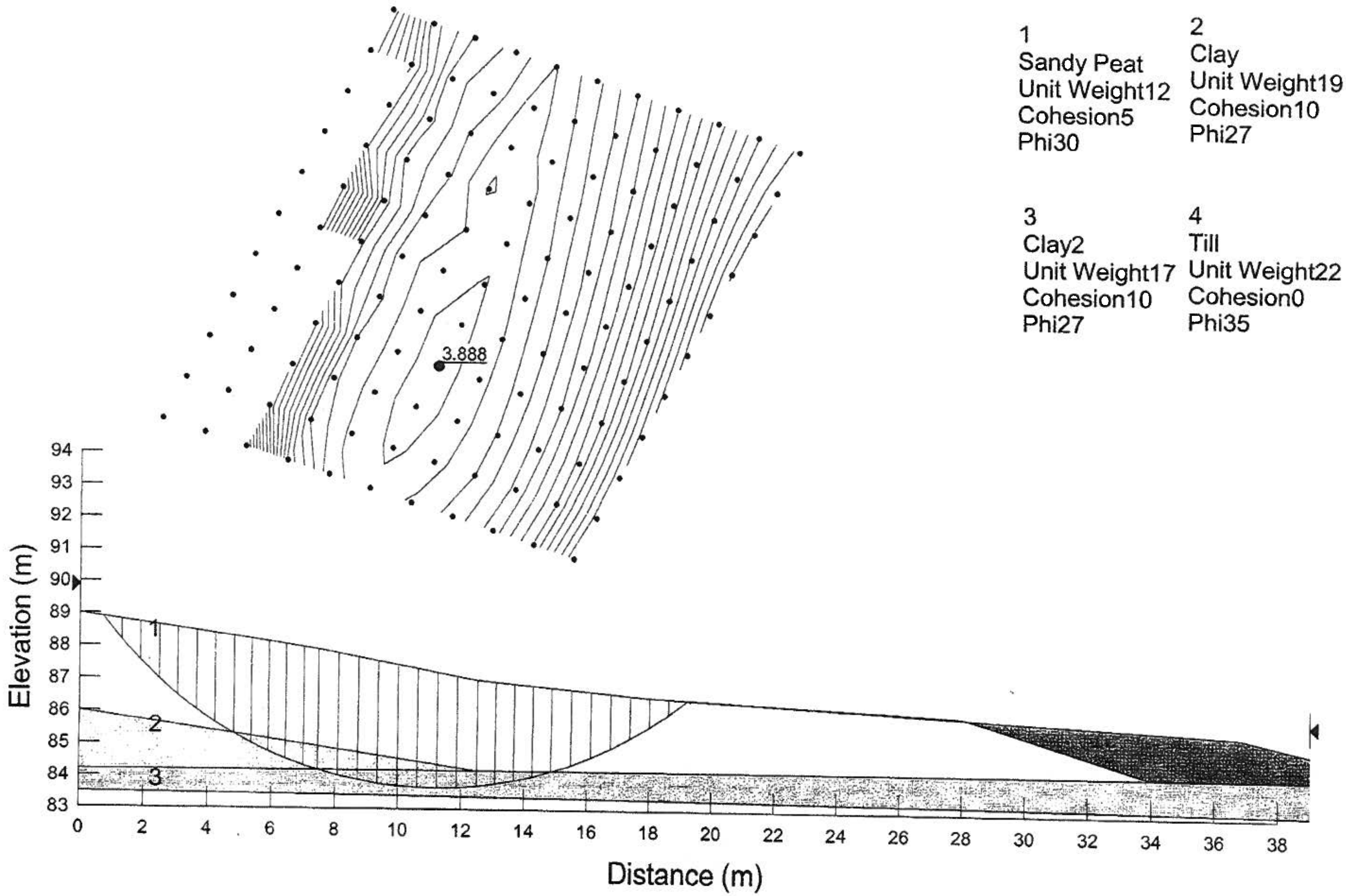
1	2
Sandy Peat	Clay
Unit Weight12	Unit Weight19
Cohesion5	Cohesion10
Phi30	Phi27

3	4
Clay2	Till
Unit Weight17	Unit Weight22
Cohesion10	Cohesion0
Phi27	Phi35



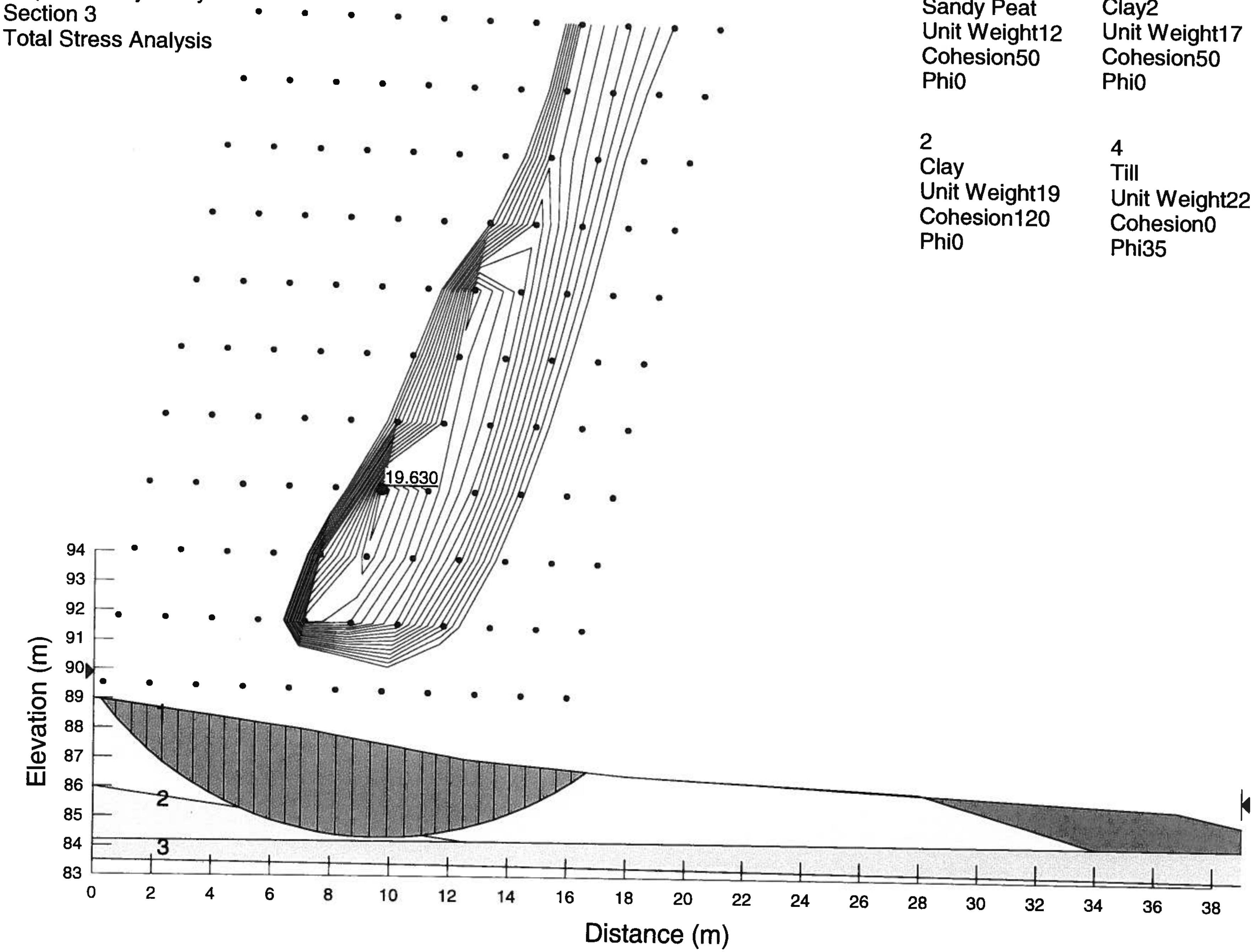
OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 3
Effective Stress Analysis

Fig. No. 32



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 3
Total Stress Analysis

Fig. No. 33



1
Sandy Peat
Unit Weight12
Cohesion50
Phi0

2
Clay
Unit Weight19
Cohesion120
Phi0

3
Clay2
Unit Weight17
Cohesion50
Phi0

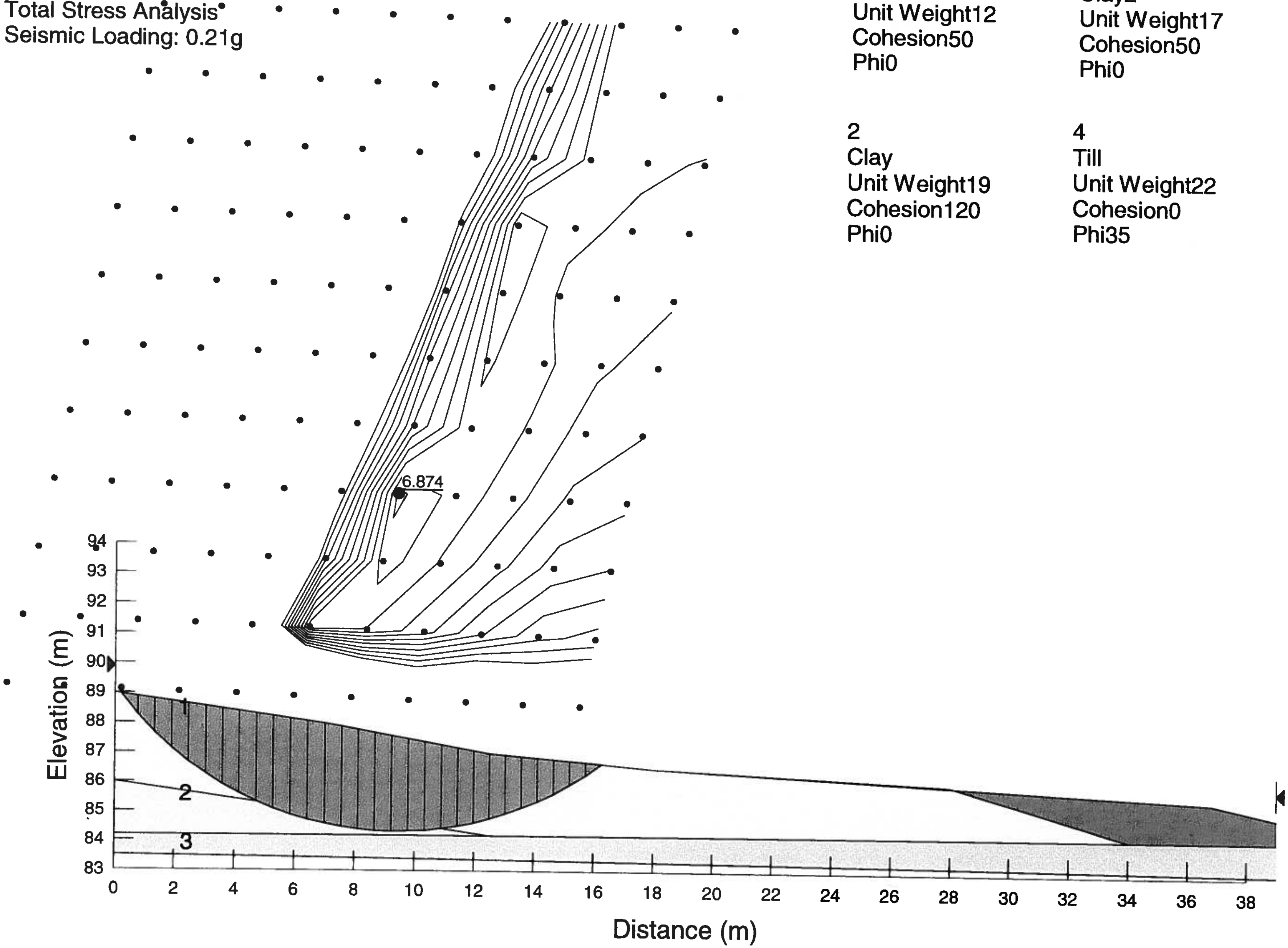
4
Till
Unit Weight22
Cohesion0
Phi35

OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 3
Total Stress Analysis
Seismic Loading: 0.21g

Fig. No. 34

1	3
Sandy Peat	Clay2
Unit Weight12	Unit Weight17
Cohesion50	Cohesion50
Phi0	Phi0

2	4
Clay	Till
Unit Weight19	Unit Weight22
Cohesion120	Cohesion0
Phi0	Phi35

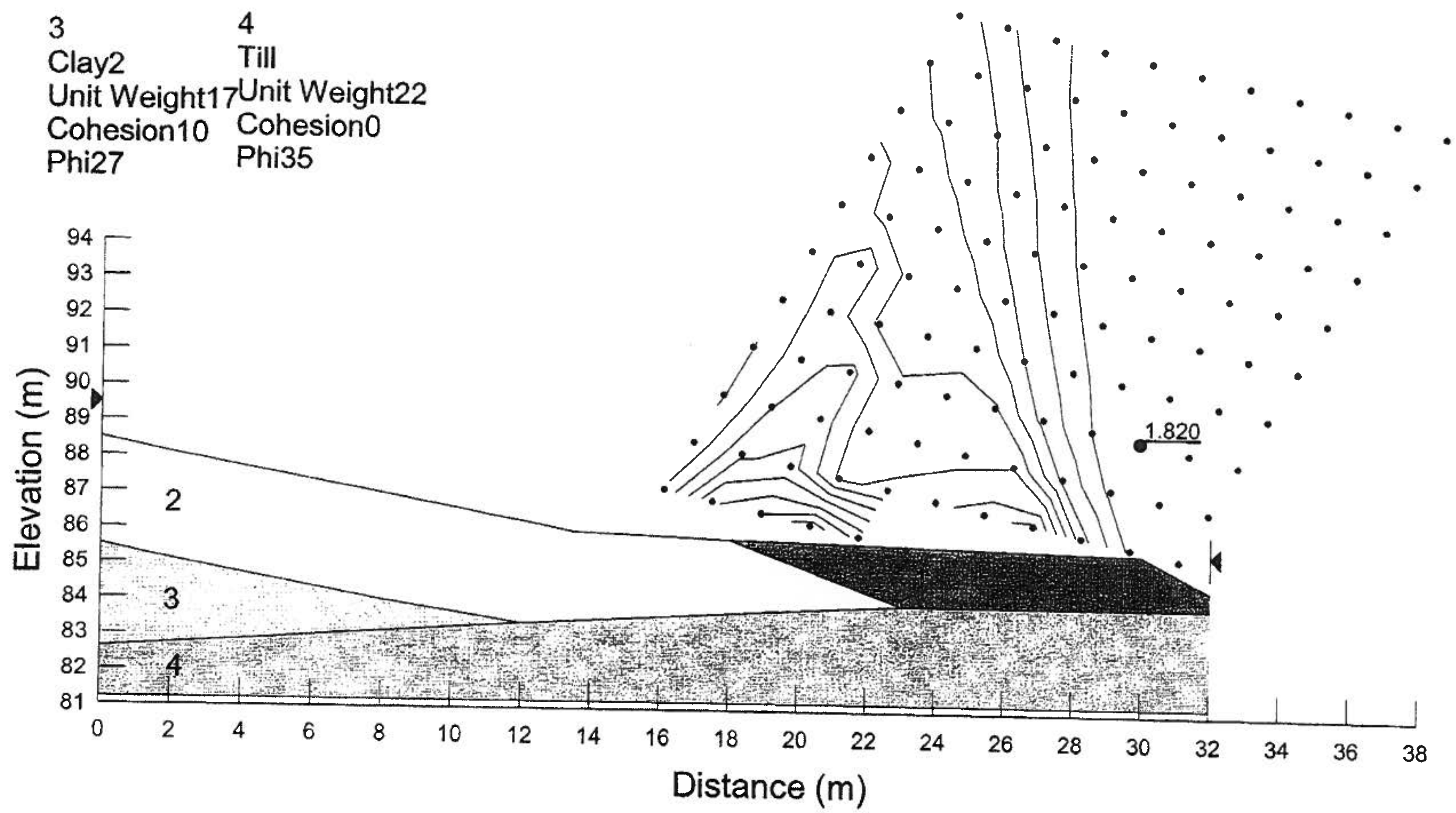


OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 4
Effective Stress Analysis

Fig. No 35

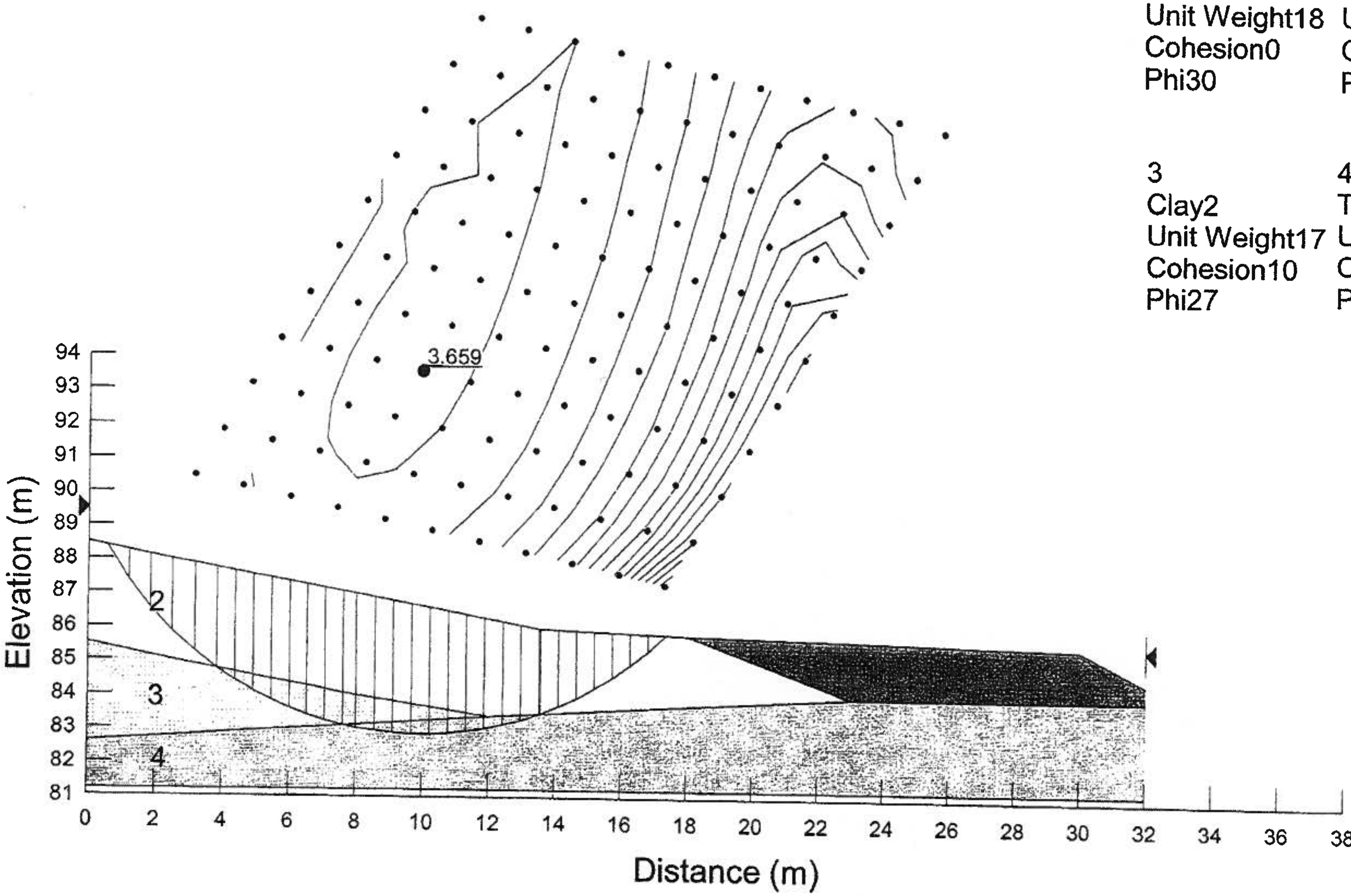
1	2
Silty Sand	Clay
Unit Weight18	Unit Weight19
Cohesion0	Cohesion10
Phi30	Phi27

3	4
Clay2	Till
Unit Weight17	Unit Weight22
Cohesion10	Cohesion0
Phi27	Phi35



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 4
Effective Stress Analysis

Fig. No. 36

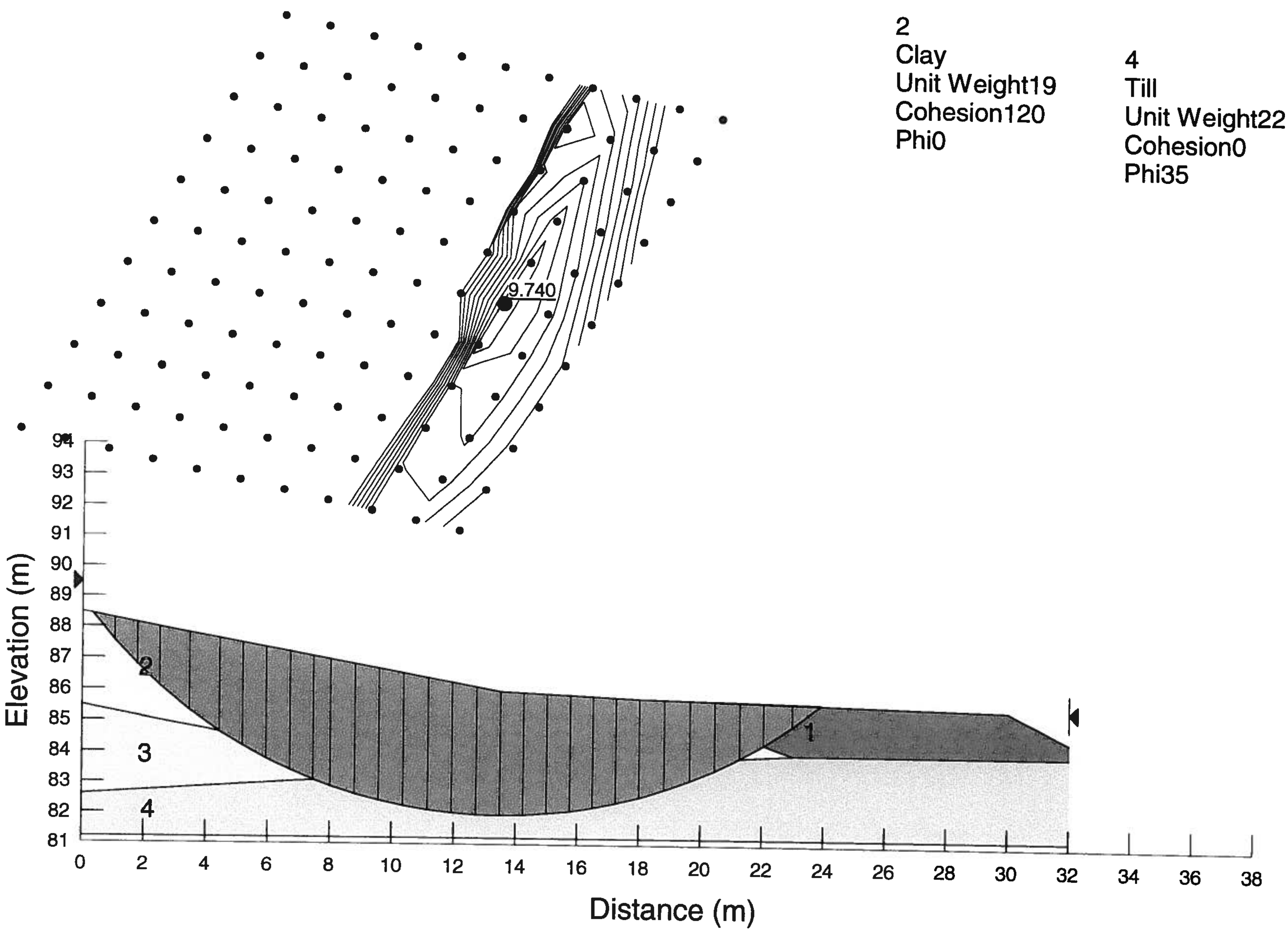


1	2
Silty Sand	Clay
Unit Weight18	Unit Weight19
Cohesion0	Cohesion10
Phi30	Phi27

3	4
Clay2	Till
Unit Weight17	Unit Weight22
Cohesion10	Cohesion0
Phi27	Phi35

OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 4
Total Stress Analysis

Fig. No. 37



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 4
Total Stress Analysis
Seismic Loading: 0.21g

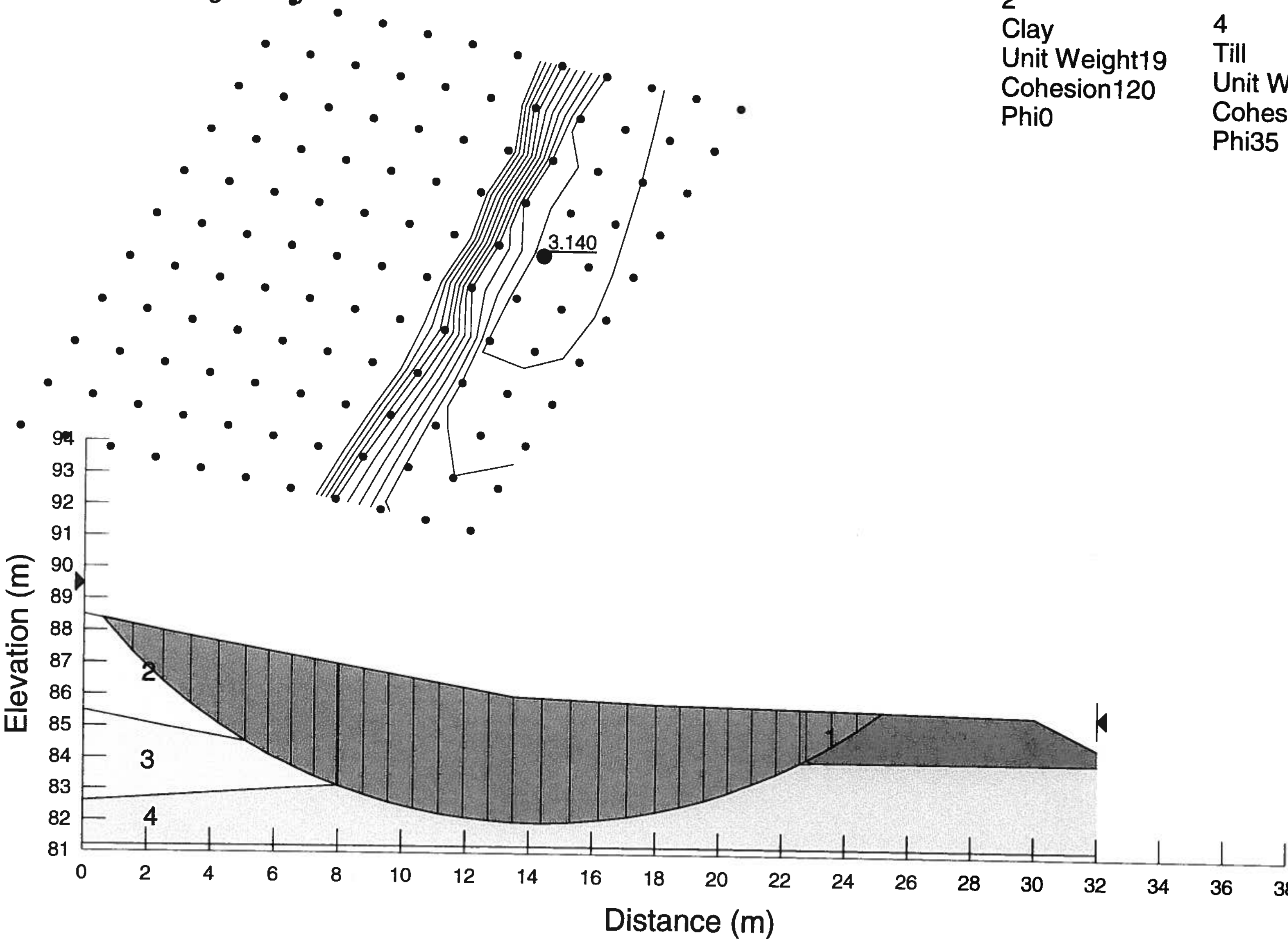
1
Silty Sand
Unit Weight18
Cohesion0
Phi30

2
Clay
Unit Weight19
Cohesion120
Phi0

3
Clay2
Unit Weight17
Cohesion50
Phi0

4
Till
Unit Weight22
Cohesion0
Phi35

Fig. No. 38

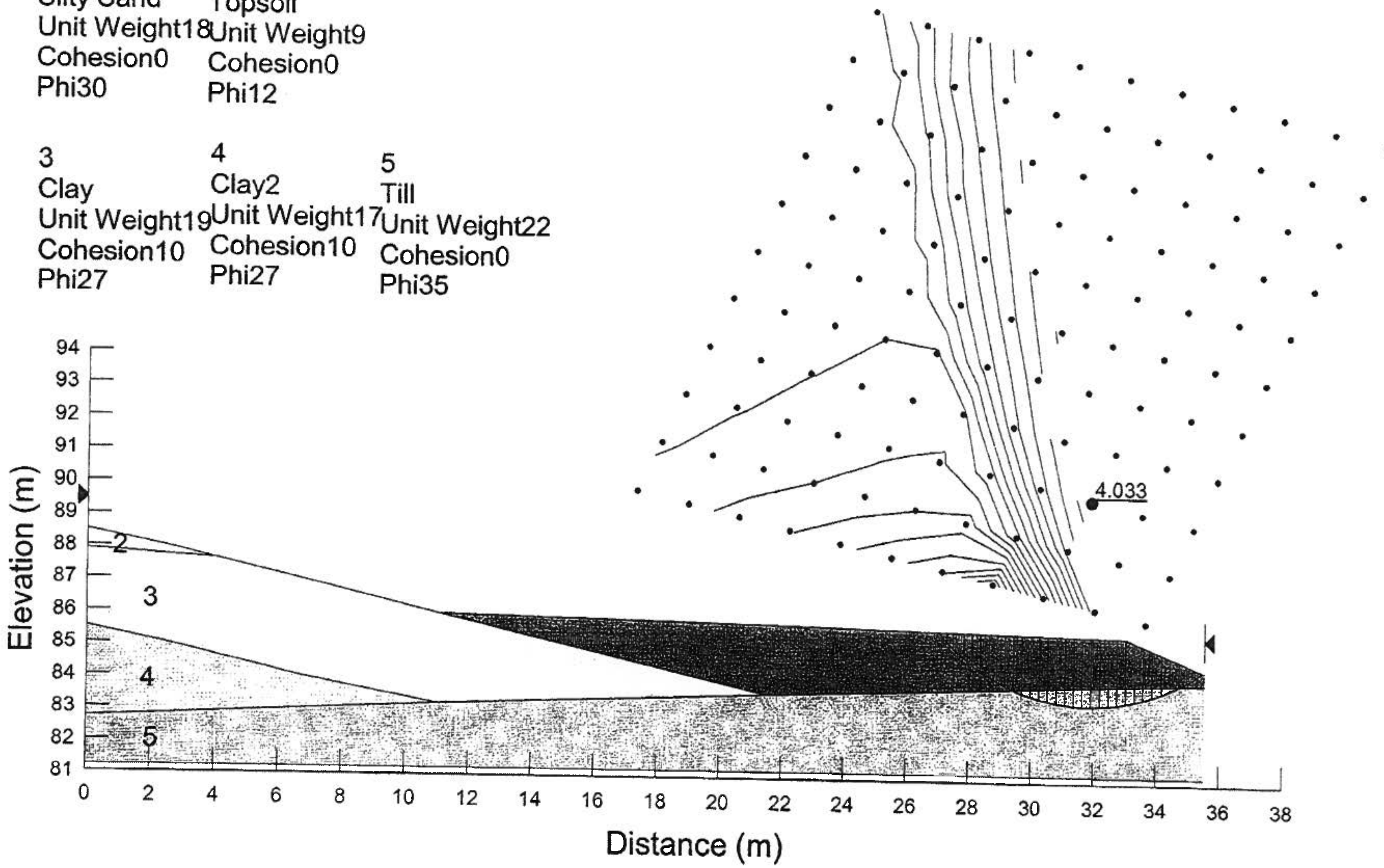


OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 5
Effective Stress Analysis

Fig. No. 39

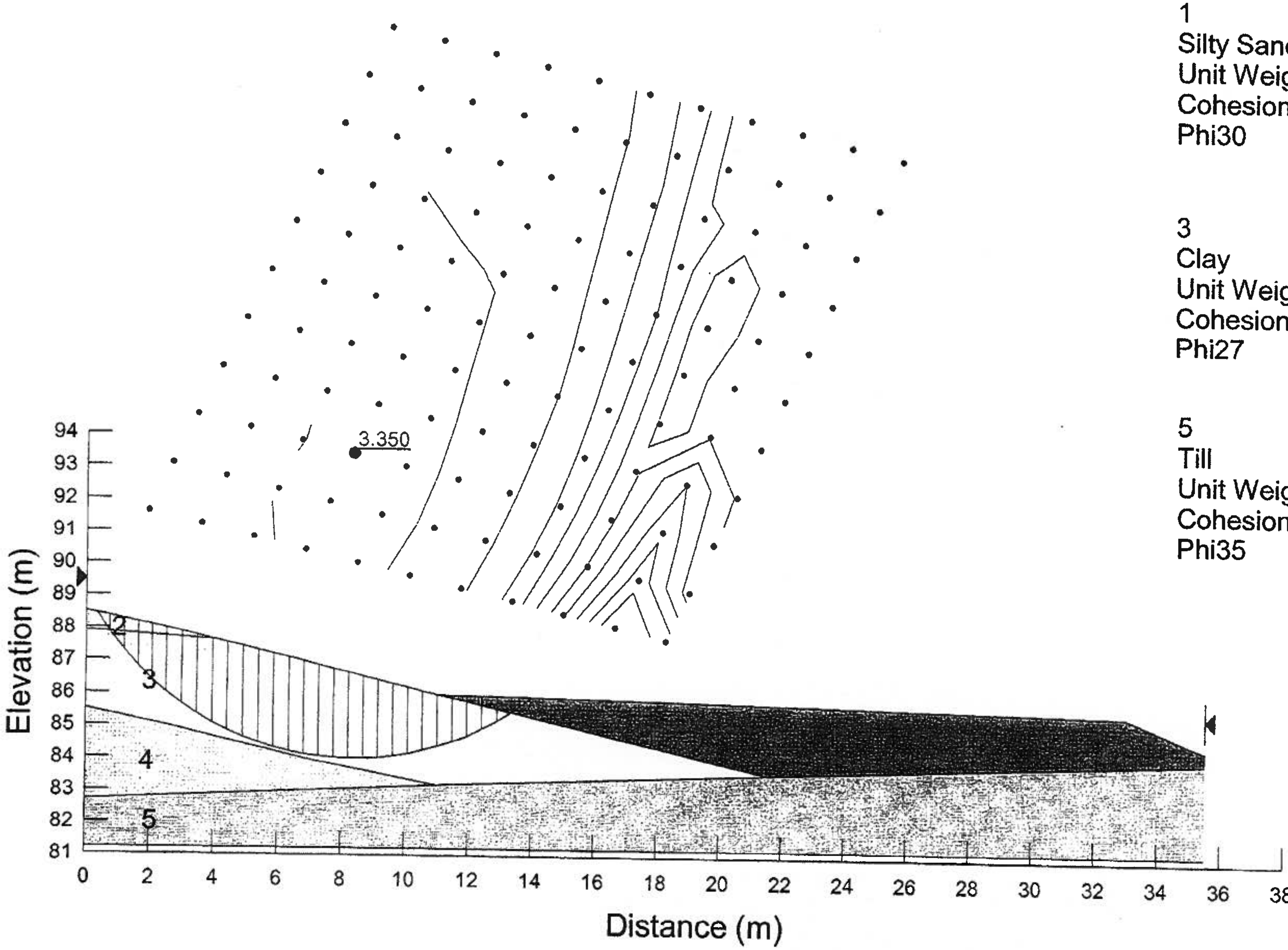
1	2		
Silty Sand	Topsoil		
Unit Weight18	Unit Weight9		
Cohesion0	Cohesion0		
Phi30	Phi12		

3	4	5
Clay	Clay2	Till
Unit Weight19	Unit Weight17	Unit Weight22
Cohesion10	Cohesion10	Cohesion0
Phi27	Phi27	Phi35



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 5
Effective Stress Analysis

Fig. No, 40



1
Silty Sand
Unit Weight18
Cohesion0
Phi30

2
Topsoil
Unit Weight9
Cohesion0
Phi12

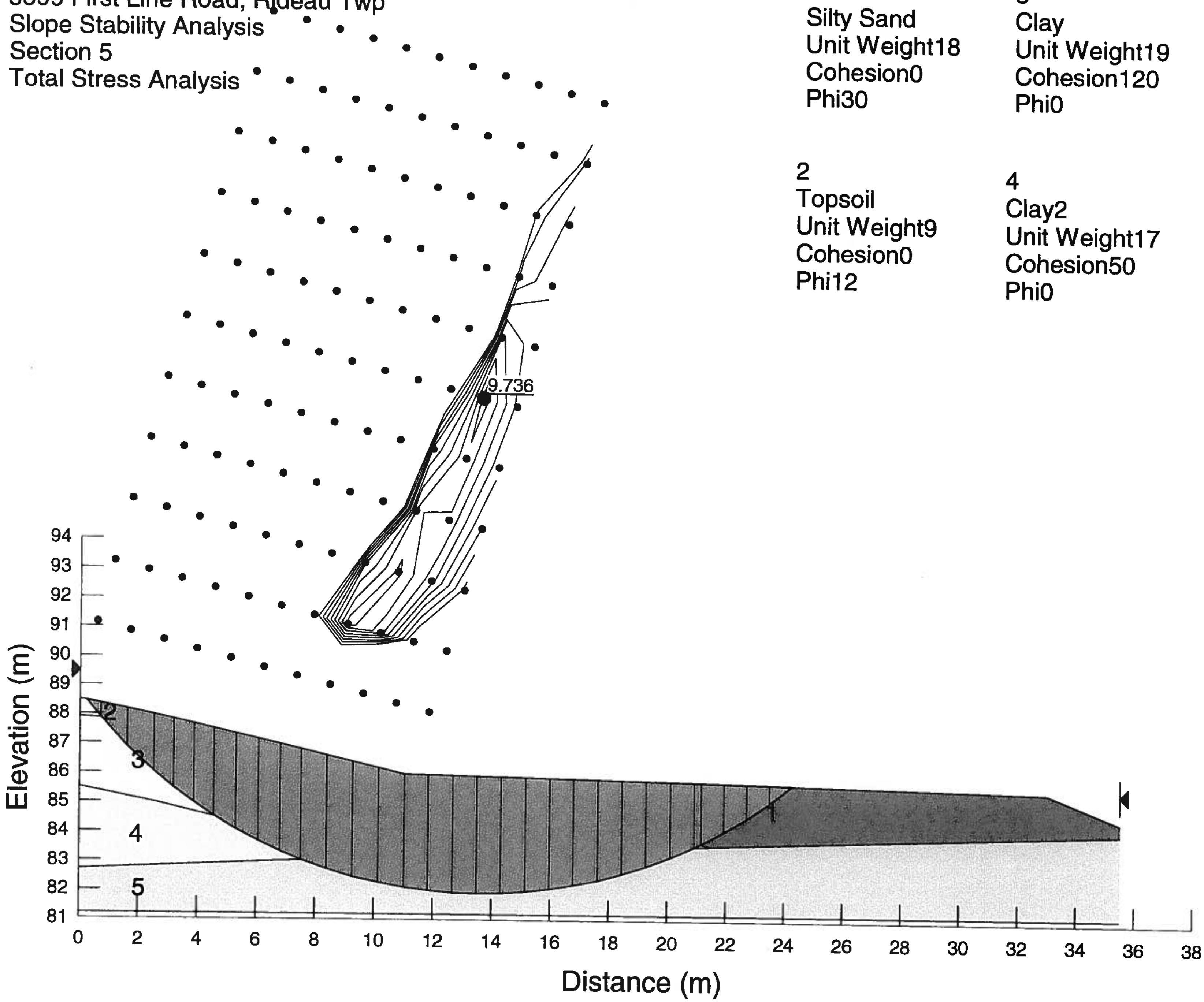
3
Clay
Unit Weight19
Cohesion10
Phi27

4
Clay2
Unit Weight17
Cohesion10
Phi27

5
Till
Unit Weight22
Cohesion0
Phi35

OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 5
Total Stress Analysis

Fig. No. 41



OTGE00018055A
5599 First Line Road, Rideau Twp
Slope Stability Analysis
Section 5
Total Stress Analysis
Seismic Loading: 0.21g

Fig. No. 42

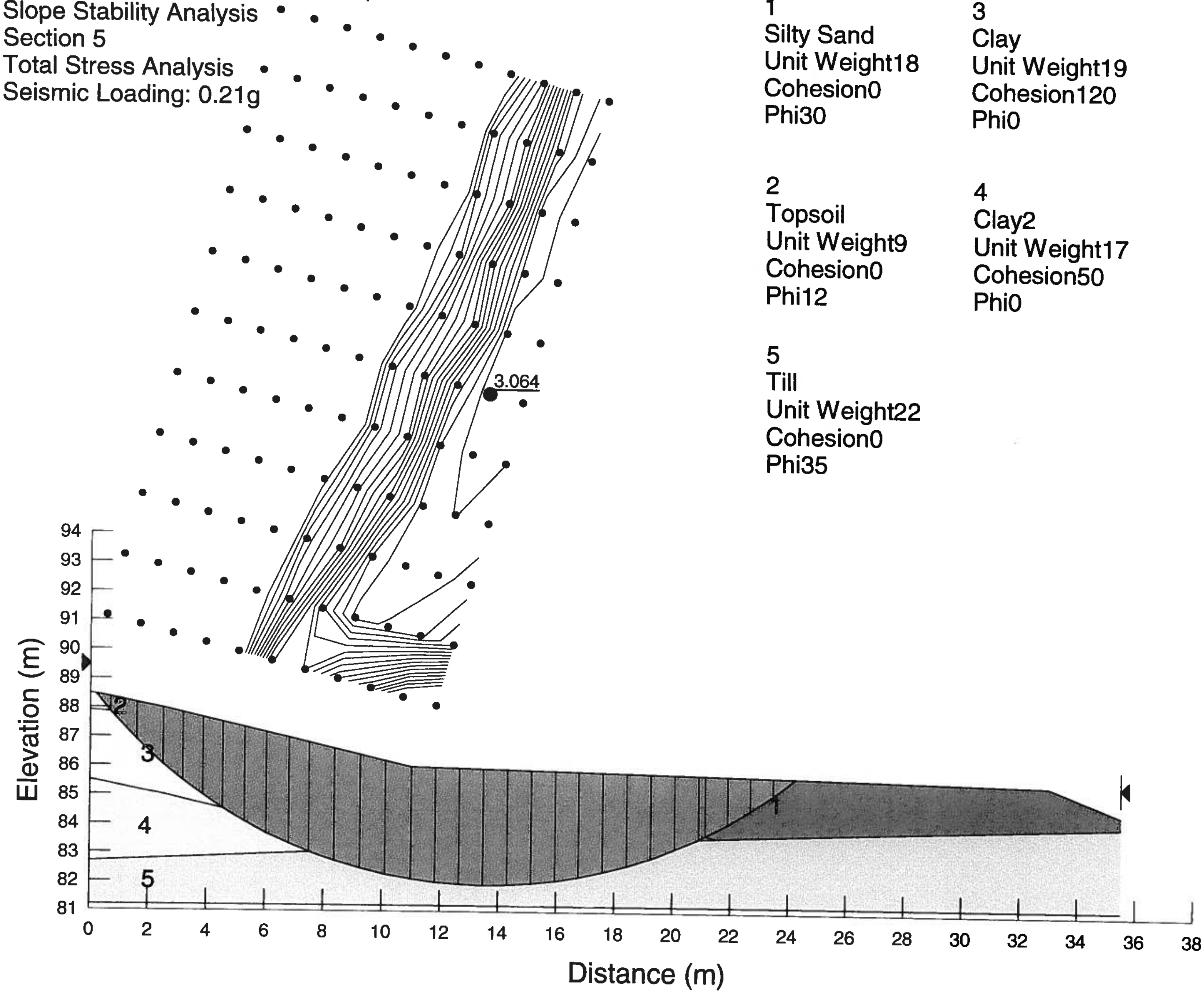
1
Silty Sand
Unit Weight18
Cohesion0
Phi30

2
Topsoil
Unit Weight9
Cohesion0
Phi12

3
Clay
Unit Weight19
Cohesion120
Phi0

4
Clay2
Unit Weight17
Cohesion50
Phi0

5
Till
Unit Weight22
Cohesion0
Phi35



Appendix 'A'

TESTPIT LOGS
MANOTICK ESTATES PHASE VI

Location	Depth	Description
TP-1	0-2	Grass and dark brown to black, moist topsoil
	2-4	Light brown, moist, loose, medium sand
	4-6	Light grey, dense silt till; extensive boulders and cobbles
	6-7'6"	SAA. Refusal at 7'6" due to large boulders
TP-2	0-2	Grass and dark brown to black, moist topsoil
	2-4	Light brown, moist, loose, medium sand
	4-6'7"	Grey/light brown silt till with some medium sand. Refusal at 6'7" due to large boulders
TP-3	0-2	Grass and dark brown to black, moist topsoil
	2-4	Light brown/grey, moist, loose, medium sand with gravel
	4-6	SAA; becoming more grey with depth
	6-8	SAA
	8-10	SAA
	10-10'6"	SAA
	10'6"-11'6"	Grey, moist, compact, silty clay
	11'6"-12	Light brown/grey, moist, loose, medium sand with gravel
TP-4	0-1	Grass and dark brown to black, moist topsoil
	1-2'6"	Light brown/grey, moist, loose, medium sand
	2'6"-4'6"	Grey/light brown, moist, loose, fine sand with some gravel
	4'6"-6	SAA
	6-8	SAA
	8-10	SAA
	10-12.5	SAA
TP-5	0-2	Grass and dark brown to black, moist topsoil
	2-4	Light brown/grey, moist, loose, medium sand
	4-6	Light brown/grey, moist, loose, medium sand with some gravel
	6-8	Grey/light brown, moist, loose, medium sand with some gravel, cobbles and boulders
	8-10	SAA; increasing cobbles and boulders with depth
TP-6	0-2	Grass and dark brown to black, moist topsoil
	2-4	Light brown/grey, moist, loose, medium sand with some gravel
	4-6	SAA
	6-6'8"	Grey/light brown, moist, compact silty medium sand layer
	6'8"-8	Grey/light brown, moist, loose, medium sand with some gravel
	8-10	SAA; Grey, moist, compact, silty clay from 8' to 9'
	10-12	Slightly mottled grey/light brown, moist, dense coarse silt

TESTPIT LOGS - continued
MANOTICK ESTATES PHASE VI

Location	Description	
TP-7	0-2	Grass and dark brown to black, moist topsoil
	2-4	Mottled light brown/grey, very moist, loose, silty medium sand
	4-6	Grey/light brown, wet, loose, coarse sand; water entering hole at approximately 5'9"
	6-7	Grey/light brown, very moist, loose, medium sand
	7-8	SAA; boulder encountered at 7'
	8-10	Grey, very moist coarse sand with cobbles and boulders
	10-11'6"	SAA; wet
TP-8	0-3	Grass, dark brown to black, moist topsoil and scraps from barn demolition (i.e. aluminum siding and metal posts)
	3-5	Light brown, moist, loose, medium sand with gravel, cobbles and boulders; two large boulders (2' by 3') encountered at four feet
	5-7	Interlayered light brown/grey, moist, loose medium and coarse sand with gravel and cobbles
	7-9	SAA; very moist
	9-11'6"	SAA; water entering hole at 11'6"
TP-9	0-2	Grass and dark brown to black, moist, topsoil
	2-4	Mottled grey/light brown, moist, compact silty clay
	4-6	Light brown/grey, moist, loose, medium sand; becoming wet at 6 feet
	6-8	Interlayered light brown/grey, wet, medium and coarse sand lenses; water entering hole at 8'
	8-10	Grey, very moist, soft silty clay
	10-12	SAA
	12-14	SAA
TP-10	0-2	Grass and dark brown to black, moist, topsoil
	2-3	Mottled grey/brown, moist, loose, medium sand
	3-4	Grey, moist, compact, coarse silt
	4-5	Brown, moist, loose medium sand with sea shells
	5-7	Grey/brown, moist, loose, fine sand and silt
	7-9	Grey/brown, wet, loose, coarse sand; water encountered at 7'6" and entering hole quickly; soft, grey, very moist silty clay from 8'7" onwards
TP-11	0-2	Grass and dark brown to black, moist, topsoil
	2-4	Light brown/grey, moist, loose, medium sand
	4-6	Mottled light brown/grey, moist, compact, clayey silt
	6-7	SAA
	7-8	Grey, very moist, compact, clayey silt
	8-11'6"	SAA

TESTPIT LOGS - continued
MANOTICK ESTATES PHASE VI

Location	Depth	Description
TP-12	0-2	Grass and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact, clayey silt
	4-6	SAA
	6-8	SAA; becoming more grey and clayey with depth
	8-10'6"	Grey, moist, dense silty clay; water encountered at 10'6"
TP-13	0-2	Grass and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact clayey silt
	4-6	SAA
	6-8	SAA; becoming more grey and clayey with depth
	8-10	Grey, moist, dense silty clay; water encountered at 8'
TP-14	0-2	Grass and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist very compact silty clay
	4-6	SAA; becoming more grey and clayey with depth
	6-8	SAA
	8-10'5"	SAA
TP-15	0-2	Corn stock and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact, clayey silt
	4-6	Grey, moist, dense, silty clay
	6-8	SAA
	8-11	SAA
TP-16	0-2	Corn stock and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact silty clay
	4-6	Grey, moist, compact, silty clay
	6-8	SAA
	8-10	SAA
TP-17	0-2	Corn stock and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact clayey silt
	4-6	SAA; brown, wet, coarse sand lens from approximately 5'3" to 6'; water flowing rapidly from sand lens
	6-8	Grey, moist, compact clay
	8-10	SAA
TP-18	0-2	Corn stock and dark brown to black, moist, topsoil
	2-4	Mottled grey/brown, moist, compact, clayey silt with some sand
	4-5	SAA
	5-7	Grey, very moist, soft clay
	7-10	SAA

Ontario Ministry of the Environment

The Ontario Water Resources Act

WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
Ottawa-Carleton	Rideau	4	3

Owner's surname / First Name	Address	Date completed
Leimark Farms	Nepean Ont	6 (day) 3 (month) 2001 (year)

Zone | Easting | Northing

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	To
	Sand gravel	& boulders		0	68
grey	limestone			68	185

TW1

WATER RECORD

Water found at - feet	Kind of water
112	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	To
6¼	☒ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	.188	0	75
8¾	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic		0	23
6"	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic		23	120

SCREEN

Sizes of opening (Slot No.)	Diameter inches	Length feet
Material and type	Depth at top of screen feet	

PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at - feet From	To	Material and type (Cement grout, bentonite, etc.)
0	23	Cement grout

PUMPING TEST

Pumping test method	Pumping rate	Duration of pumping
☒ Pump ☐ Bailer	12 GPM	2 Hours __ Mins

Static level	Water level end of pumping	Water levels during ☒ Pumping ☐ Recovery: 15 minutes	30 minutes	45 minutes	60 minutes
33 feet	90 feet	90 feet	90 feet	90 feet	90 feet

If flowing give rate	Pump intake set at	Water at end of test
GPM	feet	☒ Clear ☐ Cloudy

Recommended pump type	Recommended pump setting	Recommended pump rate
☐ Shallow ☒ Deep	110 feet	12 GPM

FINAL STATUS OF WELL

☒ Water supply ☐ Observation well ☒ Test hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Abandoned (Other) ☐ Dewatering ☐ Unfinished ☐ Replacement well

WATER USE

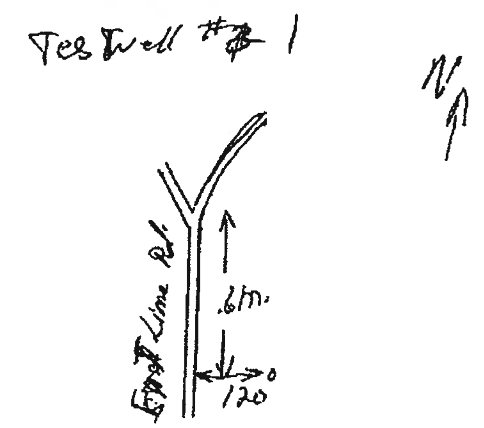
☒ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☐ Municipal ☐ Public supply ☐ Cooling & air conditioning ☐ Not used ☐ Other

METHOD OF CONSTRUCTION

☐ Cable tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☒ Rotary (air) ☒ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



229342

Name of Well Contractor	Well Contractor's Licence No.
Jit-Rock Drilling Co LTD	1119
Address: RR #2 Jasper Ont	
Name of Well Technician: Wallace Desautniers	Well Technician's Licence No.: T3
Signature of Technician/Contractor: [signature]	Submission date: day mo yr

MINISTRY USE ONLY

1 - CONTRACTOR'S COPY

0506 (07/00) Front Form 9

Ontario Ministry of the Environment

The Ontario Water Resources Act

WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
OTTawa Carleton	Rideau	Con A	3

Owner's surname / First Name	Address	Date completed (day / month / year)
Leimark Farms	Nepean	6 / 3 / 2001

Zone: | Easting: | Northing:

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	To
	Sand gravel & boulders			0	64
grey	LimesTone			64	120

TW 2

WATER RECORD

Water found at - feet	Kind of water
114	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	To
6 1/4	☒ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	.188	0	71
	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic			
	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic			

SCREEN

Sizes of opening (Slot No.) | Diameter inches | Length feet
Material and type | Depth at top of screen feet

PLUGGING & SEALING RECORD

☒ Annular space ☐ Abandonment

Depth set at - feet From	To	Material and type (Cement grout, bentonite, etc.)
0	69	CemenT grouT

PUMPING TEST

Pumping test method: ☒ Pump ☐ Bailer		Pumping rate: 16 GPM		Duration of pumping: 1 Hours __ Mins	
Static level	Water level end of pumping	Water levels during ☒ Pumping ☐ Recovery: 15 minutes	30 minutes	45 minutes	60 minutes
28 feet	90 feet	90 feet	90 feet	90 feet	90 feet
If flowing give rate: GPM		Pump intake set at: feet		Water at end of test: ☒ Clear ☐ Cloudy	
Recommended pump type: ☐ Shallow ☒ Deep		Recommended pump setting: 110 feet		Recommended pump rate: 16 GPM	

FINAL STATUS OF WELL

☒ Water supply ☐ Observation well ☒ Test hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Abandoned (Other) ☐ Dewatering ☐ Unfinished ☐ Replacement well

WATER USE

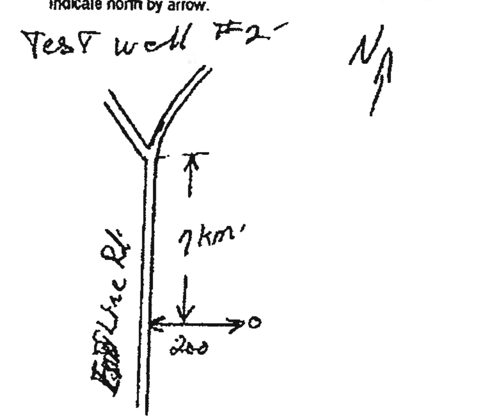
☒ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☐ Municipal ☐ Public supply ☐ Cooling & air conditioning ☐ Not use ☐ Other

METHOD OF CONSTRUCTION

☐ Cable tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☒ Rotary (air) ☒ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



229341

Name of Well Contractor: Air Rock Drilling Ltd	Well Contractor's Licence No.: 1119
Address: R.R. # 2 Jasper Ont	
Name of Well Technician: Wallace DesRoches	Well Technician's Licence No.: T 3
Signature of Technician/Contractor: [signature]	Submission date: day __ mo __ yr __

MINISTRY USE ONLY

Ontario Ministry of the Environment

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
Ottawa Carleton	Rideau	Con A	3

Owner's surname / First Name	Address	Date completed
Leimark Farms	Nepean Ont	7 (day) 3 (month) 200[illegible] (year)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	To
brown	clay			0	61
	sand & gravel, boulders			61	71
grey	Limestone			71	120

TW 3

WATER RECORD

Water found at - feet	Kind of water
110	☒ Fresh (N/A)
115	☒ Fresh

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	To
6¼	☒ Steel	.188	0	78
8¾	☒ Open hole		0	76
6			76	120

SCREEN

Sizes of opening (Slot No.)	Diameter (inches)	Length (feet)

Material and type: — Depth at top of screen: — feet

PLUGGING & SEALING RECORD

☒ Annular space ☐ Abandonment

Depth set at - feet From	To	Material and type (Cement grout, bentonite, etc.)
0	76	Cement grout

PUMPING TEST

Pumping test method	Pumping rate	Duration of pumping
☒ Pump ☐ Bailer	18 GPM	1 Hours ___ Mins

Static level	Water level end of pumping	15 minutes	30 minutes	45 minutes	60 minutes
12 feet	90 feet	90 feet	80 feet	90 feet	90 feet

Water levels during: ☒ Pumping ☐ Recovery

If flowing give rate: ___ GPM
Pump intake set at: ___ feet
Water at end of test: ☒ Clear ☐ Cloudy
Recommended pump type: ☐ Shallow ☒ Deep
Recommended pump setting: 110 feet
Recommended pump rate: 18 GPM

FINAL STATUS OF WELL

☒ Water supply ☐ Observation well ☒ Test hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Abandoned (Other) ☐ Dewatering ☐ Unfinished ☐ Replacement well

WATER USE

☒ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☐ Municipal ☐ Public supply ☐ Cooling & air conditioning ☐ Not used ☐ Other

METHOD OF CONSTRUCTION

☐ Cable tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☒ Rotary (air) ☒ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

LOCATION OF WELL

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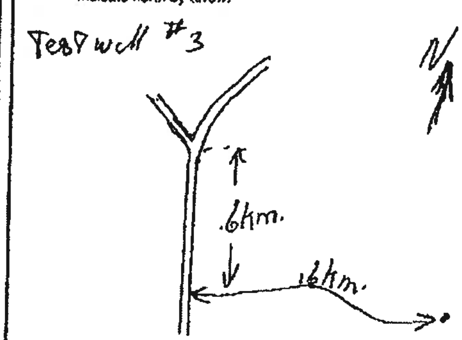

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Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Ltd	1119

Address: RR #2 Jasper Ont

Name of Well Technician	Well Technician's Licence No.
Glenn Purcell	T 3

Signature of Technician/Contractor: [signature]
Submission date: day ___ mo ___ yr ___

MINISTRY USE ONLY