Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

PICKERING-OSHAWA SECTION

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

W O EGG-000-40 DIST 6
HWY GO-ALRT STR SITE

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1.0 INTRODUCTION

On behalf of GO-ALRT, the Ontario Ministry of Transportation and Communications (MTC) has retained Golder Associates to carry out subsurface investigations for five tunnel and culvert structures to be constructed as part of the GO-ALRT project from Pickering to Whitby, Ontario.

The purpose of the investigations was to determine the subsurface conditions at the sites of the proposed structures and, based on assessment and interpretation of these data, to provide engineering recommendations for geotechnical aspects of design of the structures.

The field work was carried out, and this report was prepared, in general accordance with the terms of reference outlined in Golder Associates' proposal letter dated November 9, 1983 to Mr. M. S. Devata, P. Eng., of the Pavement and Foundation Design Section of the Ministry of Transportation and Communications, Downsview, Ontario.

In this report, the various sites have been designated the letters A to E. Subsurface conditions and engineering recommendations are site specific, and these are presented in Sections 3 to 7, covering sites A to E, respectively. The work described in this report was based on information and drawings provided by MTC via a letter dated October 14, 1983 to Mr. M. S. Devata from Mr. P. K. Roy, Senior Structural Engineer, MTC, copied to Golder Associates.

2.0 REGIONAL GEOLOGY

The sites are located in the physiographic region known as the Iroquois plain, an area whose geomorphology was influenced by Lake Iroquois during the last glaciation. The overburden in the area generally consists of glacial till with discontinuous surficial deposits of glacio-lacustrine silts and clays. These lacustrine sediments were deposited in the glacial Lake Iroquois which occupied the Lake Ontario basin at the end of the last ice age. The underlying glacial till consists of a heterogeneous mixture of gravel, sand, silt and clay with numerous sand and gravel lenses. The bedrock is a thinly bedded grey to black calcareous, bituminous, micareous shale of the Whitby formation.

The detailed subsurface conditions are described for each site in their respective sections. It should be noted that the stratigraphic boundaries indicated are not intended to define exact planes of geological change but represent transitions from one soil type to another. Subsurface conditions are only established at the borehole locations, and will vary between boreholes.

3.0 SITE A: DRAINAGE STRUCTURE NO. 13, GO-ALRT AND MILLER CREEK

3.1 Site Description

The site is located north and south of Highway 401 at the crossing of Miller Creek. North of Highway 401 the creek banks range in height from 1 to 6 m at slopes of up to 40 degrees. The creek is directed under the highway embankment through a 6.1 m by 2.4 m concrete culvert and a 4.3 m diameter steel culvert. South of the highway the creek banks over the bottom 3 to 4 m are faced with rip-rap and formed at slopes of 15 to 20 degrees. The creek is directed under a C.N.R. embankment located about 55 m south of the highway, by three steel culverts (diameters 1.5, 3.4 and 4.3 m). A 1.2 m diameter sanitary sewer crosses beneath the existing creek bed about 35 m south of the highway.

3.2 Subsurface Conditions

3.2.1 Soil Stratigraphy

The detailed soil stratigraphy encountered in each boring, together with the results of laboratory tests carried out on representative samples, are given on the Record of Borehole Sheets and on Figures A-1 to A-3, inclusive. The borehole locations, an inferred profile and a section are shown on Drawing No. EGG00040A, Sheet 1.

A silty sand fill was located in places, especially on the west bank south of the highway in Borehole A5. The native soil consisted of a silty clay till and was found immediately below ground surface or underlying the fill, where present. The till is underlain by shale bedrock at relatively shallow depths.

The following is a detailed description of the subsoils encountered:

3.2.1.1 Fill and Topsoil

In Borehole A1 located on the east bank of Miller Creek north of Highway 401, a 2.3 m thick layer of dark brown silty sand and gravel fill was encountered immediately below ground surface. The fill has a loose to compact relative density as indicated by 'N'* values of 7 and 14. The water content of a sample of the material was 20 per-cent.

In Boreholes A2 and A5, 0.6 and 4.6 m, respectively, of silty sand fill was found below ground surface. The material is dark brown and contains traces of clay and gravel. Occasional pieces of decayed wood and organic matter was found in the deposit. The material has a loose to compact relative density as indicated by 'N' values of 7 to 13.

The water content of samples of the silty sand fill ranged from 11 to 19 per cent. The grain size distribution curves of samples of the fill from Boreholes A1 and A5 are shown on Figure A-1.

A 0.7 m thick layer of organic topsoil was found underlying the silty sand fill.

3.2.1.2 Silty Clay Till

Below the ground surface in Boreholes A3 and A4 is a grey and brown mottled, changing to grey with depth, silty clay deposit. The material also contains some sand and traces of gravel, and is inferred to be a till. The thickness of the deposit was found to be 1.1 m and 3.4 m in Boreholes A4 and A3 respectively. Atterberg limit tests give liquid limits of 18 and 22 per cent and plasticity

*'N' values - Refer to Explanation of Terms

indices of 6 and 9 per cent, indicating a clay of low plasticity (CL) according to the Unified Soil Classification System (Figure A-3). The consistency of the deposit ranges from stiff ('N' values of 9 to 20) to hard ('N' values in excess of 70) near the bottom of the stratum. Water contents of typical samples ranged from 8 to 12 per cent. Typical grain size distribution curves are shown on Figure A-2.

3.2.2 Bedrock

Shale bedrock was encountered in all boreholes at elevations between 80.1 and 81.3 m. The boreholes were extended at least 1.4 m into the bedrock by augering, while in Boreholes A2 and A4 the rock was cored in Bx size for depths of 3.2 and 4.0 m respectively.

The shale bedrock is dark grey in colour, and is generally thinly bedded with occasional thin clay seams. The RQD* in the completely to highly weathered zone above approximate elevation 78 m is very poor, while in the underlying moderately to faintly weathered zone the RQD was noted to be poor to fair.

3.2.3 Groundwater Conditions

Groundwater was encountered in all boreholes during the drilling operation. Piezometers were sealed within the various strata encountered in Boreholes A1, A3 and A4. The water levels were monitored throughout the drilling operation and periodically until November 30, 1983. The stabilized groundwater level across the site ranges from elevation 82.0 m in Borehole A4, to elevation 82.4 m in Borehole A1.

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* RQD - Rock Quality Designation - Refer to Explanation of Terms.

3.3 Discussion and Recommendations

3.3.1 Project Description

Preliminary drawings (Numbered PD1-600-432 and PD1-600-433) prepared by Totten Sims Hubicki Associates indicate that the proposed structure is a rigid frame concrete bridge with a 13 m span and a 4 m rise. A 6.1 by 2.4 m concrete culvert extension to the south end of the existing concrete culvert under the highway embankment is also proposed. In addition, a short steel culvert is proposed as an extension to the north end of the 1.5 m diameter culvert under the C.N.R. embankment. The proposed grade of the GO-ALRT embankment is elevation 93 m at the crossing, some 12 m above the existing creek bed.

3.3.2 Foundations

Spread footings founded on the shale bedrock encountered near elevation 80 m are considered to be the most suitable foundation for the proposed concrete frame bridge and culvert structures. The factored bearing capacities at Ultimate Limit States (U.L.S.) and Serviceability Limit States (S.L.S.) for footings founded on the completely to highly weathered shale may be taken as 800 and 400 kPa, respectively. The factored bearing capacity at U.L.S. should be reduced in accordance with Section 6.7.3.3.5 of the Ontario Highway Code for footings supporting an inclined load. The reduction factors for cohesive soils should be used.

All footings should be placed a minimum of 1.2 m below exposed grade for frost protection.

The surface of the completely weathered shale may undulate along the length of the footing. It is essential that all footing foundations are inspected by experienced geotechnical personnel before concrete placement to ensure that the founding stratum has been reached and that the base of the excavations has been adequately prepared.

The foundation for the steel culvert extension immediately north of the C.N.R. embankment should be made in the shale bedrock or hard silty clay till. The culvert should be placed on a 0.3 m bed of well graded granular material with a maximum size of 75 mm to 100 mm to provide some erosion protection. The bottom of the end of the culvert should be haunched in concrete extending to at least the mid height of the culvert to act as a wing wall. Free draining granular material (MTC Granular B) should be compacted to 95 per cent of the Standard Proctor density in and around the culvert to a distance of at least 0.75 m from the face of the culvert.

3.3.3 Earth Pressures

Lateral earth loading on a buried rigid frame structure depends on the type and method of placement of backfill materials and the surcharge on the structure. The following recommendations are made concerning the design of the walls of the proposed concrete bridge and culvert structures. (Refer to Figure A-4)

- Selected "free draining", non frost-susceptible granular fill, in accordance with MTC specifications, should be used as a drainage blanket placed on all perimeters of the proposed structures to a minimum thickness of 1.2 m.

- All granular fill should be compacted in 200 mm thick lifts to not less than 95 per cent of the Standard Proctor density of the material. However, heavy compaction equipment should not be used behind any structure within a horizontal distance equal to the current height of the filled ground.

- Weepholes and/or longitudinal drains located above normal creek level should be installed to provide positive drainage to the granular backfill. This serves to prevent the build-up of water pressures in drawdown conditions. The drainage system should include a properly designed filter to prevent clogging of the pipes. Provision should also be made to allow cleaning or rodding of the pipes, should they become clogged.

- The allowable lateral movement for rigid frame structures is usually very limted. Accordingly, an earth pressure equivalent to the 'at rest' condition should be used for design. The design pressure distributions are shown in Figure A-4.

  At U.L.S.,

  in the 'at rest' condition, K = 0.6

  At S.L.S.,

  in the 'at rest' condition, K = 0.5

- Highway live loads which act on the soil behind the walls within a distance defined by a plane rising at 45 degrees from the underside of the heel of the foundation should be considered in the design as an equivalent load caused by an additional 0.6 m of fill at a unit weight of 21 kN/cu.m.

- Vertical loading on the roof is dictated by the earth cover and the distribution of traffic loading as stated above. The unit weight of the soil depends on the type of material used, but can be assumed equal to 21 kN/cu.m for normal earth fill.

3.3.4 Groundwater Control

The excavation for footing foundations will be made about 2 to 3 m below the existing groundwater and normal creek levels. If possible, the excavations should be made in the dry season to minimize the risk caused by sudden changes in creek levels. The creek can be temporarily confined to a channel formed by earth dykes located at least 3 m away from the nearest footing excavation. The dykes can be formed by sandbags sandwiching a 0.6 m thick compacted clay core.

Seepage into excavations made in the silty clay till should be minimal and can be controlled by sump pumps. More seepage is likely from the sandy fill materials below the water table. This water should be intercepted by sumps placed to the side of the footing excavation. With proper groundwater control, temporary slopes can be formed at a gradient of 1 horizontal to 1 vertical in the till deposit, and at a gradient of 1.5 horizontal to 1 vertical in the sandy fill.

3.3.5 Existing Sewer

The invert level of the existing 1.2 m diameter sewer where it crosses the creek is not known. Presumably it is founded within the rock at shallow depth. The proposed embankment surcharge of up to 2 m of fill (assuming an embankment gradient of 2 horizontal to 1 vertical(will not cause undue distress to a sound pipe. The sewer should be encased in concrete immediately under the bridge footings.

Alternatively, the sewer could be relocated to beyond the northern boundary of the bridge structure.

3.3.6 Approaches

It is understood that up to 8 m of fill will be placed on the existing ground surface for the approaches. The increase in pressure caused by this surcharge is unlikely to cause significant settlement in the stiff to hard silty clay till on the east approach. Settlement induced by the embankment is unlikely to exceed 50 mm there. However, settlement of several times this value will likely occur in the fill and topsoil on the west approach. These materials outside a line of 2 horizontal to 1 vertical from the toe of the CN embankment should be removed prior to construction.

Prior to the construction of the GO-ALRT embankment, all topsoil and other organic materials should be removed and the subgrade proofrolled. In addition, where fill is to be placed abutting the existing C.N.R. embankment, benches in accordance with MTC Standards should be made on the stripped slope surface.

The construction of the GO-ALRT embankment on the proposed alignment will likely impose additional surcharge to the founding subsoils under the existing C.N.R. embankment. This will likely induce further settlement to the existing embankment. A study of the effect is not within the scope of this report.

4.0 SITE B: BRIDGE STRUCTURE, WESTNEY ROAD AND MILLER CREEK

4.1 Site Description

The site is located at about Station 9+300 on the proposed Westney Road extension south of Highway No. 2,where it crosses the realigned Miller Creek to the east of Rotheglen Drive. The terrain is relatively flat on both sides of the creek, with a residential development to the west and an open field to the east. The bank of the realigned Miller Creek is about 3 m high at this location, with side slopes constructed at 15 to 25 degrees. (Refer to Drawing No. EGG00040B, Sheet 1)

4.2 Subsurface Conditions

The detailed soil stratigraphy encountered in each boring, together with the results of laboratory tests carried out on representative samples, are given on the Record of Borehole sheets and on Figures B-1 to B-6, inclusive. The borehole locations, together with an inferred profile and two sections are shown on Drawing No. EGG00040B, Sheet 1.

The surficial natural deposit overlying the site consists of a silty clay which changes in colour, from mottled grey and brown to grey with depth. Underlying the clay is a layer of silty sand, which in turn is underlain by till deposits. Shale bedrock was encountered in Borehole B4 below the till deposit at a depth of 14.5 m (elevation 74.5 m). Up to 3.7 m of fill was found overlying the natural deposits in Boreholes B3 and B4. The fill found to shallow depths in two of the boreholes is a silty sand, mixed with clayey materials in places.

The following is a detailed description of the suboils encountered:

4.2.1 Fill

Below the ground surface in Boreholes B3 and B4 is a layer of silty sand which is identified as fill. This layer is 1.5 m thick at Borehole B4, and attains a thickness of 3.7 m in Borehole B3, where the material is mixed with silty clay, traces of rootlets and organic matter. The fill has a loose to compact relative density with 'N' values ranging from 5 to 16. Two water contents of samples of the fill from Borehole B3 were 18 and 21 per cent.

4.2.2 Silty Clay

Underlying the fill in Boreholes B3 and B4 and immediately below ground surface in the rest of the boreholes is a grey and brown mottled silty clay deposit, which changes to a grey colour with depth. The thickness of this deposit ranges from 3.2 m in Borehole B3 to 8.8 m in Borehole B5. The upper portion of the silty clay appears to be weathered and contains varying amounts of sand and gravel, while the lower portion (coloured grey) contains some thin sand and silt layers throughout. A tendency for the sand content to increase with depth was noted within this lower portion.

Results of water content and Atterberg limits (refer to the plasticity chart, Figure B-6) are summarized as follows:

	Range	Average
Water Content (w) %	13-37	24
Liquid Limit (W_L) %	30-34	32
Plasticity Limit (W_p) %	17-19	18
Plasticity Index (I_p) %	12-16	14

These results indicate that the deposit can be classified as an inorganic clay of low plasticity (CL).

'N' values measured within the upper brown zone are generally higher than those in the lower grey material, and range from 12 to 22; indicating a stiff to very stiff consistency. In the lower grey stratum, 'N' values obtained range from less than 1 (weight of hammer) to 12 indicating a very soft to very stiff consistency.

The undrained shear strength of the grey silty clay as measured by in situ vane tests is between 18 and 24 kPa in the bottom 2 m of the deposit. This strength corresponds to about 30 per cent of the effective overburden pressure and in this zone the deposit appears to be normally consolidated. A much higher strength (38 to 75 kPa) was measured in the same material at lesser depth and although this zone does not exhibit the mottled brown discoloration of the top of the deposit, it has probably been desiccated in the past, inducing some degree of overconsolidation. The sensitivity of the silty clay as determined by field vane remoulded strength is about 3.

Typical grain size distribution curves of the weathered (grey and brown mottled) and unweathered (grey) zones of the deposit are shown on Figures B-1 and B-2, respectively.

4.2.3 Silty Sand

Underlying the silty clay deposit in all borings except Borehole B1 is a grey silty sand deposit, with varying amounts of gravel. The thickness of this deposit varies from 2.1 to 3.7 m, and can be inferred to have a very loose to very dense relative density as 'N' values obtained range from less than 1 to 110.

The water content of samples of the silty sand deposit varied from 9 to 21 per cent. The grain size distribution curve of a silty sand and gravel sample from Borehole B2 is shown on Figure B-3.

4.2.4 Till

Underlying the soil types described above is a grey till deposit, which varies from a sand and silt with some clay in Boreholes B1 and B3, to a sandy clay in Boreholes B2, B4 and B5. The till deposit extends to the maximum depth (13.8 m) investigated except in Borehole B4 where bedrock was encountered at 14.5 m depth. Shale fragments were noted near the bottom of the till deposit.

The consistency of the sandy clay till can be inferred to be hard with 'N' values in excess of 100. 'N' values obtained in the sand and silt till are generally above 50, indicating a very dense relative density. However, near the top 1 m of the stratum, the deposit has a compact to dense relative density as indicated by 'N' values of 17 to 43. An Atterberg limits test on a sample of the sandy clay material gave a liquid limit of 24 per cent and a plasticity index of 9 per cent, indicating that it is a clay of low plasticity (CL).

The water content of samples of the till varied from 7 to 20 per cent. Typical grain size distribution curves are shown on Figures B-4 and B-5.

4.2.5 Bedrock

Shale bedrock was encountered beneath the till deposit in Borehole B4 at elevation 74.5 m. The shale at this location is completely to highly weathered, dark grey in colour and has a slight petroliferous odour.

4.2.6 Groundwater Conditions

Groundwater was encountered in all boreholes during the drilling operation. Piezometers were sealed into the various subsoil strata in completed boreholes and monitored periodically until November 30, 1983. The stabilized water level across the site varies from elevation 86.7 m in Borehole B4 to elevation 87.8 m in Borehole B1. There appears to be little variation from static groundwater conditions at the site.

4.3 Discussion and Recommendations

4.3.1 Project Description

The proposed bridge is a single span structure as indicated on MTC Drawing No. PD1-600-443. About 1.5 m of fill will be placed on the existing ground surface for the approaches to the bridge. The bridge abutments will probably be designed to act as retaining walls to the approach fill.

4.3.2 Foundations

The natural soils encountered at shallow depth are unsuitable for support of the bridge. The structure should be founded on piles driven into the bedrock or the overlying competent till deposits. Steel H-Piles are considered to be suitable.

As a guide, an HP 310 x 110 equipped with standard reinforced flange tip plates and driven to an average set of 1.25 mm per blow for a group of 20 blows, using a hammer energy approaching but not exceeding 60 kJ, will have a factored capacity at Ultimate and Serviceability Limit States of 1600 kN and 1150 kN, respectively. On reaching the required set, the pile should be subjected to two further groups of 20 blows, unless abrupt peaking occurs. The average set measured for each group should not be greater than the set measured for each of the previous groups. Provision should be made in the contract for re-tapping the piles to confirm their capacity after adjacent piles have been driven and for cutting off of piles should the specified set be achieved in till deposits.

Provision should be made for monitoring vibrations induced in adjacent buildings by pile driving. Pre and post-construction crack surveys should also be carried out on the buildings to determine if the piling operation has caused distress.

4.3.3 Bridge Abutments as Retaining Walls

Where the abutments are required to act as retaining walls for the approaches, the lateral earth loads will depend on the type and method of placement of the fill materials. The following recommendations are made for the design of the abutment retaining walls.

- Selected "free-draining" granular fill, in accordance with MTC specifications should be used as backfill immediately behind the structures. The granular fill should be placed in the wedge-shaped zone defined by a 60 degree line extending up and back from the bottom of the rear face of the pile cap.

- All granular fill should be compacted in 200 mm thick lifts to 95 per cent of the Standard Proctor density of the material. However, heavy compaction equipment should not be used behind any structure within a horizontal distance equal to the current height of the filled ground.

- Longitudinal drains located immediately below the base of the walls should be installed to provide positive drainage of the granular backfill.

- If the abutment support and retaining walls will permit lateral yielding at the top of the abutment equal to not less than 1/2 per cent of the retained height then 'active' earth pressure conditions should be used in the design. If, however, the structures are not permitted to yield by 1/2 per cent of their height then 'at rest' pressure conditions should not be used. It is anticipated that retained heights of soil behind retaining walls and/or abutments will not exceed 10 m. Accordingly, the following equivalent fluid pressures may be used in the design.

At U.L.S.,

'active' condition,	8.0 kPa/m
'at rest' condition,	10.0 kPa/m

At S.L.S.,

'active' condition,	6.5 kPa/m
'at rest' condition,	8.5 kPa/m

- Highway live loads which act on the soil behind the walls within a distance defined by a plane rising at 45 degrees from the underside of the rear of the retaining structure's footing should be considered in the design as an equivalent load due to a height of 600 mm of additional fill. The unit weight of normal fill can be taken as 21 kN/cu.m.

4.3.4 Approaches

It is understood that some 1.5 m of approach embankment fill will be placed on the existing ground surface along the Westney Road extension. The increase in pressure caused by this surcharge is unlikely to cause significant settlement in the subsoil apart from the zone of normally consolidated silty clay between elevations 80 and 83 m. Settlement induced by the embankment surcharge is unlikely to exceed 50 mm. Approach slabs to the abutment should be incorporated into the design of abutments, to compensate for longitudinal differential settlement. Consideration should be given to building the approach slab and final paving at least one year after fill placement, to allow most of the induced settlement to take place.

Prior to construction of the embankments, the topsoil and other organic materials should be removed and subgrade proof-rolled. Fill should be placed in lifts not exceeding 200 mm thick and compacted to not less than 95 per cent of the Standard Proctor density of the material.

5.0 SITE C: DRAINAGE STRUCTURE NO. 24, GO-ALRT AND LYNDE CREEK TRIBUTARY

5.1 Site Description

The site is located at about Station 22+350 on the proposed GO-ALRT route between Highway 401 and a C.N.R. embankment. At this location a Lynde Creek tributary flows in the north-south direction, and is directed under the highway embankment by a 3.7 m by 1.5 m concrete culvert, and under the C.N.R. embankment by a 1.5 m by 1.9 m concrete culvert. The creek banks between the two embankments are approximately 1 m high, sloping at 20 to 35 degrees. A small stream from the east joins the creek near the north portal of the existing C.N.R. culvert. In general, the ground on both sides of the creek is relatively flat.

5.2 Subsurface Conditions

5.2.1 Soil Stratigraphy

The detailed soil stratigraphy encountered in each boring, together with the results of laboratory tests carried out on representative samples, are given on the Record of Borehole and Test Pit Sheets and on Figures C-1 to C-4, inclusive. The borehole and test pit locations and an inferred profile are shown on Drawing No. EGG00040C, Sheet 1.

In general, the site is underlain by a silty clay which, at the location of Borehole C2, is a fill containing traces of organic matter. A silty sand till underlies the silty clay deposit. The railway embankment consists of a sandy clay fill with traces of organic matter.

The following is a detailed description of the subsoils encountered.

5.2.1.1 Fill

At the location of Borehole C2, a grey and brown mottled silty clay fill with traces of organic matter, was encountered from ground surface to a depth of 2.1 m. The composition of this material suggests that the native silty clay has been used as the fill material. The consistency of the fill ranges from firm to hard as indicated by 'N' values of 8 and 31. The water content of a sample of the fill was 21 per cent.

The railway embankment consists of a dark brown sandy clay containing some gravel and clay,with traces of organic matter. The gradation of a typical sample of the fill is shown on Figure C-3. The water contents of samples of the material ranged from 14 to 28 per cent while 7 per cent of organic matter was found in a sample from Test Pit C4.

5.2.1.2 Silty Clay

A grey and brown mottled silty clay deposit was encountered below ground surface in Boreholes Cl and C3. The deposit also contains some sand and traces of gravel, and is inferred to be stiff to hard for 'N' values ranging from 12 to 52. The thickness of this deposit is 1.3 and 2.0 m in Boreholes C3 and Cl respectively.

Atterberg limits tests have established the deposit to be a clay of low to medium plasticity (CL-CI). The water content of a representative sample was 24 per cent. A typical grain size distribution curve is shown on Figure C-1.

5.2.1.3 Silty Sand Till

Underlying the above described soils in all boreholes is a silty sand till deposit with varying amounts of gravel and clay. In general, the till can be inferred to have a dense to very dense relative density as indicated by 'N' values of 43 to over 100 but in Borehole C1 the top 1.5 m of this deposit has a loose to compact relative density. The till extends to the maximum depth (6.1 m) investigated.

The water content of samples of the till ranged from 7 to 10 per cent. Typical grain size distribution curves are given on Figure C-2.

5.2.2 Groundwater Conditions

Groundwater was encountered in all boreholes during the drilling operation. Piezometers sealed into the till deposit indicate stabilized water levels at elevations 79.1 and 78.8 m in Boreholes C1 and C3, respectively.

5.3 Discussion and Recommendations

5.3.1 Project Description

Based on a preliminary drawing No. PD1-600-474 prepared by Totten Sims Hubicki Associates, a 3.6 m by 1.5 m concrete culvert is to be provided to direct the creek under the proposed GO-ALRT embankment. A 2 m diameter tunnel is to be constructed immediately west of and parallel to the existing C.N.R. culvert. The small stream from the east will be realigned north of its present course to join the creek just south of Highway 401. The proposed grade of the GO-ALRT embankment is at elevation 81.5 m, about 3 m above the existing creek bed.

5.3.2 Culvert Foundation

The proposed concrete culvert can be founded on spread footings supported on the dense till deposit at about elevation 77 m. The factored bearing capacities at Ultimate Limit States and Serviceability Limit States may be taken as 400 and 250 kPa, respectively. If the footings are founded at elevation 76 m, these bearing capacities can be doubled. The factored bearing capacity at U.L.S. should be reduced in accordance with Section 6.7.3.3.5 of the Ontario Highway Bridge Code for footings supporting an inclined load as in the case of retaining walls. The reduction for granular soils should be used.

All footings should be placed a minimum of 1.2 m below exposed grade for frost protection.

The relative density of the till deposit may vary considerably between the locations investigated. It is essential that all footing excavations are inspected by experienced geotechnical personnel before concrete placement to ensure that the base of the excavation is sound and has been adequately prepared.

5.3.3 Earth Pressures

Lateral earth loading on a buried culvert depends on the type and method of placement of backfill materials and the surcharge on the structure. The following recommendations are made concerning the design of the walls of the proposed rigid concrete culvert.

- Selected "free-draining", non frost-susceptible granular fill, in accordance with MTC specifications, should be used as a drainage blanket placed on all perimeters of the culvert to a minimum thickness of 1.2 m.
- All granular fill should be compacted in 200 mm thick lifts to not less than 95 per cent of the Standard Proctor density of the material. However, heavy compaction equipment should not be used behind any structure within a horizontal distance equal to the current height of the filled ground.
- Weep holes and/or longitudinal drains located above normal creek level should be installed to provide positive drainage to the granular backfill. This serves to prevent the build-up of water pressure in

drawdown conditions. The drainage system should include a properly designed filter to prevent clogging of the pipes. Provision should also be made to allow cleaning or rodding of the pipes, should they become clogged.

- The allowable lateral movement for culvert structures is usually very limited. Accordingly, an earth pressure equivalent to the 'at rest' condition should be used for design. The design pressure distributions are shown in Figure C-5.

  At U.L.S.,

  in the 'at rest' condition, K = 0.6

  At S.L.S.,

  in the 'at rest' condition, K = 0.5

  where K is the earth pressure coefficient as defined in Figure C-5.

- Highway live loads which act on the soil behind the walls within a distance defined by a plane rising at 45 degrees from the underside of the heel of the foundation should be considered in the design as an equivalent load caused by an additional 0.6 m of fill at a unit weight of 21 kN/cu. m.

- Vertical loading on the roof is dictated by the earth cover and the disturbance of traffic loading as stated above. The unit weight of the soil depends on the type of material used, but formal fill materials can be assumed to equal 21 kN/cu. m.

5.3.4 Excavation for Culvert Foundation

The base of the footing excavations will be about 2 to 3 m below the existing groundwater and normal creek levels. If possible, the excavations should be made in the dry season to minimize the risk caused by sudden changes in creek level.

Prior to excavation, the creek should be diverted and the water level in the silty sand till lowered to 1 m below the base of the excavation by means of vacuum well points. Dewatering is necessary to prevent loss of bearing capacity of the silty sand due to upward seepage of groundwater. With proper groundwater control, side slopes can be formed at a gradient of 1.5 horizontal to 1 vertical.

5.3.5 Approaches

It is understood that up to 2 m of fill will be placed on the existing ground surface near the approaches. The increase in pressure caused by this surcharge will unlikely cause significant settlement in the stiff to hard silty clay and dense silty sand till at the approaches. Settlement induced by the embankment is unlikely to exceed 50 mm. The extent of any localized fill, muck and topsoil should be located and excavated as construction for the drainage structure proceeds.

Prior to the construction of the GO-ALRT embankment, all topsoil and other organic materials should be removed and the subgrade proofrolled. In addition, where fill is to be placed abutting the existing C.N.R. embankment, benches in accordance with MTC Standards should be made on the stripped slope surface.

The construction of the GO-ALRT embankment on the proposed alignment will unlikely impose significant additional surcharge to the founding subsoils of the existing C.N.R. embankment. Depending on the properties of the latter, further settlement of the C.N.R. embankment may occur. A study of this effect is not within the scope of this report.

5.3.6 Tunnel in C.N.R. Embankment

Conditions encountered at borehole locations indicate that the subsoil at the proposed invert elevation of 78.2 m are suitable for foundation of the proposed tunnel. Because of access difficulties, the investigation of the embankment was restricted to shallow hand-dug test pits on the slope surface. This implies that the embankment consists of sandy clay material. The construction of the proposed tunnel by a succession of jacking and augering operations appears feasible, but because of the shallow cover, considerable loss of ground under the tracks would probably be induced. In addition, it should be anticipated that some boulders could exist in the fill, even though none has been revealed in the test pits.

It is therefore recommended that the trench was constructed in an open excavation supported by soldier pile and lagging walls. The soldier piles can form part of a frame structure to support the rail tracks during construction.

Piles for support of the track may be steel H-piles driven at least 3 m below the base of the excavation. As a guide, a HP 310 x 79 pile driven to an average set of 5 mm per blow for a group of 10 blows with a hammer of rated energy of 40 kJ, will have a factored capacity at Ultimate and Serviceability Limit States of 1100 kN and 700 kN, respectively.

The soldier pile and lagging walls should be designed for a rectangular lateral pressure distribution as follows:

$$p_a = 0.3 \ \gamma h + q$$

where γ = unit weight of soil = 21 kN/cu. m

h = retained height

q = surcharge pressure

Passive pressure in front of the soldier pile below the base of the excavation may be calculated by the expression:

$$p_p = K_p \ \gamma' \ z$$

where γ' = "effective" unit weight of soil

= 20 kN/cu. m (above water level)

= 10 kN/cu. m (below water level)

z = depth below the base of the excavation

K_p = passive pressure coefficient = 4.6

The effective width of the soldier piles can be taken as three times the width of the pile or the concreted pile socket, provided that the pile spacing is not less than 5. Stability checks should be made for conditions during each stage of excavation.

The radial pressure on the liner should be designed for the full overburden and surcharge pressures.

6.0 SITE D: PEDESTRIAN TUNNELS, LIVERPOOL ROAD STATION

6.1 Site Description

The site of the proposed tunnels is at the GO train station on Liverpool Road, Pickering. At present, three C.N.R. tracks and a commuter train siding transverse the site in an east-west direction, with parking facilities located north and south of the tracks. Access to the north parking lot is via a descending ramp from Liverpool Road to the west, and the parking lot is connected to a ticket office and the area south of the tracks by an existing pedestrian tunnel. Commuter boarding facilities and a larger parking lot are located south of the tracks. The site is fairly flat with less than 4 m variation in elevation.

6.2 Subsurface Conditions

6.2.1 Soil Stratigraphy

The detailed soil stratigraphy encountered in each boring, together with results of laboratory tests carried out on representative samples, are given on the Record of Borehole Sheets and on Figures D-1 to D-6, inclusive.

The borehole locations and a centreline profile are shown on Drawing No. EGG00040D, Sheet 1. Four sections along the proposed tunnel alignments are shown on Drawing No. EGG00040D, Sheet 2.

The natural surficial deposit overlying the site consists of a silty clay which changes in colour from yellow and grey mottled to grey with depth. Underlying the clay is a till deposit which grades from a sandy silt to a silty clay. In places, shale bedrock was found to underly the till deposit.

Most of the boreholes encountered fill overlying the natural deposits. The fill varies in composition from silty sand to silty clay.

The following is a detailed description of the subsoils encountered.

6.2.1.1 Fill

Below the ground surface in all borings except Borehole D2, a layer of fill was encountered. Less than 1.2 m of fill was encountered in all the other boreholes except in Borehole D10 where it was 2.3 m thick.

In Boreholes D3, D4, D5, D7, D8, D10 and D11, the fill is a brown silty sand with varying amounts of gravel and traces of clay and organic matter. The material has a loose to compact relative density as inferred by 'N' values ranging from 4 to 30. The water content of a sample from Borehole D10 was 13 per cent.

In Boreholes D1, D6 and D9, the fill is a brown sandy to silty clay with traces of gravel and organic matter. The consistency of the material is inferred to be firm to stiff as indicated by 'N' values ranging from 6 to 12.

The water contents of typical samples varied from 11 to 21 per cent, and the grain size distribution curve of a sandy clay sample in Borehole D1 is shown on Figure D-1.

6.2.1.2 Silty Clay

Below the ground surface in Borehole D2 and underlying the fill in all other boreholes is a silty clay deposit which changes colour from yellow and grey mottled to grey with depth. The upper portion of the deposit appears to be weathered and contains some sand and traces of gravel, while the lower portion (coloured grey) contains some thin sand and silt layers throughout. In this lower portion, sand layers of up to 0.8 m thick were found in Boreholes D6, D9 and D11, while in Boreholes D2, D7 and D11 the composition and consistency of the material resembles those of a reworked till. The thickness of the clay layer varies from 2.5 to 8.3 m.

Results of water content and Atterberg limits (Plasticity chart, Figure D-6) testing are summarized as follows:

	Range	Average
Water Content (w) %	14 - 35	24
Liquid Limit (W_L) %	17 - 35	25
Plastic Limit (W_P) %	11 - 20	15
Plasticity Index (I_P) %	6 - 17	10

These results indicate that the deposit has a water content close to its liquid limit, and can be classified as a clay of low plasticity (CL).

The undrained shear strength of the silty clay as measured by field vane tests is very variable with measured shear strengths in the range from 12 kPa to greater than 96 kPa*. No discernible pattern of shear strength variation with depth or elevation could be obtained from the results. It is possible that the variation arises as a consequence of sand and silt layers in the deposit. From the 'N' values obtained it appears that the deposit has a soft consistency at below elevation 84 m at the location of Boreholes D1 and D2 and below elevation 82 m at the other boreholes. This is confirmed by field vane tests carried out as part of the investigation for the existing tunnel by MTC which obtained

*96 kPa represents the upper limit of undrained shear strength which can be measured by 'N' size field vanes.

values of shear strength as low as 16.5 kPa at elevation 80.5 m. Above elevation 82 m the values were in excess of 40 kPa. (MTC Job. No. 70-F-14)

Typical grain size distribution curves of the material are shown on Figures D-2 and D-3.

6.2.1.3 Till

Underlying the deposits described above, a grey till was encountered in all borings except Borehole D7. The till consists of a sandy clay with some silt and traces of gravel. In Boreholes D1 and D4, the composition of this till deposit changes to a sandy silt, while in Borehole D6 an Atterberg Limits test indicated that the material is a clay of medium to high plasticity (CI-CH). The consistency of the till is inferred to be hard as 'N' values are generally over 40. In the sandy portions of the deposit, 'N' values range from 18 to over 100, indicating a compact to very dense relative density.

The water contents of the till deposit are generally less than 10 per cent. Typical grain size distribution curves are shown on Figures D-4 and D-5.

6.2.2 Bedrock

Shale bedrock was encountered beneath the silty clay deposit in Borehole D7 and beneath the sandy clay till in Borehole D8. The bedrock in these locations is highly to moderately weathered, coloured dark grey, and thinly bedded.

6.2.3 Groundwater Conditions

Groundwater was encountered in all boreholes during the drilling operation. Piezometers were sealed into the various subsoil strata in completed boreholes and monitored periodically until November 30, 1983. The water level in the till ranges from elevation 83.7 m in Borehole D4 to elevation 80.5 m in Borehole D10. Water was present in Borehole D3 at elevation 87.1 m during drilling. This could represent a perched water table in the fill.

6.3 Discussion and Recommendations

6.3.1 Project Description

It is proposed to construct four 2.4 m diameter tunnels with invert levels 4 m below the existing C.N.R. embankment. One of the tunnels (Section C-C) will be the extension of an existing pedestrian tunnel.

6.3.2 Tunnel Design

Design of the tunnel lining is governed not only by the in situ overburden pressures but also by any stresses induced during construction. For tunnels with shallow cover, the full overburden and surcharge pressures should be assumed in design. If jacking is used for tunnel installation, the stresses induced by this operation may govern lining design.

6.3.3 Construction Method

Interruption of rail traffic during construction would be minimized by pipe jacking the tunnels. However, at the present proposed invert elevations, only 0.5 to 1.5 m of cover would be present and considerable loss of ground would probably be experienced during construction. The tunnels can be installed by cut and cover techniques, but in the soft clay the potential for basal heave must be considered.

In Boreholes D9, D10 and D11, 'N' values as low as 2 were recorded within 2 m of the proposed invert and a field vane measured an undrained shear strength of 12 kPa at elevation 80 m. With this shear strength, any excavation to a greater depth than 2.4 m would have a factor of safety against basal heave of less than 1.3. For the tunnel along the line of these boreholes (Section D-D, Drawing No. EGG00040D, Sheet 1), it is recommended that the section under the existing C.N.R. embankment (which has the depth of excavation greater than 3 m),is jacked into place and that the rail track is supported throughout the jacking operation. This can be done by driving steel H-Piles on either side of the tunnel and placing a beam/strut between the top of the piles. This beam can be used to support the rails during tunnelling. Sections on either side of the existing embankment can be constructed in open excavations with temporary side slopes of 1.5 horizontal to 1 vertical. Pipe jacking while supporting the rail track as described above should also be carried out along the entire length of the tunnel on Section A-A, where soft clay was found at the proposed invert and 4 to 5 m depth of excavation is required.

The tunnel on Section B-B can be constructed in an open cut apart from the area of the tracks where soldier pile and lagging walls should be provided with the tracks supported on the soldier piles during construction. Temporary open cuts can be excavated at 1.5 horizontal to 1 vertical.

Where the existing tunnel is to be extended (Section C-C) the excavation can be carried out in open cut with temporary side slopes at a gradient of 1.5 horizontal to 1 vertical.

The groundwater level in the till is below the proposed invert elevation of the tunnels and this will not present difficulties to construction. However, perched water is probably present at certain locations in the fill and this will have to be intercepted where it seeps into open excavations.

6.3.3.1 Piles for Support of the Track

Piles for support of the track may be steel H-Piles driven at least 2 m into the dense hard till or onto bedrock. As an example, an HP 310 x 79 pile driven to an average set of 5 mm per blow for a group of 10 blows with a hammer of rated energy 40 kJ, will have a factored capacity at Ultimate and Serviceability Limit States of 1100 kN and 700 kN respectively.

6.3.3.2 Soldier Pile - Lagging Wall

Soldier pile and lagging walls retaining up to 4 m of soil should be designed for the rectangular pressure distribution as follows:

$$p_a = 0.3\ \gamma h + q$$

where γ = unit weight of soil = 21 kN/cu. m
h = retained height
q = surcharge pressure

Passive pressure in front of the soldier pile below the base of the excavation may be calculated by the expression:

$$P_p = \gamma' z + 2\ C_u$$

where γ' = "effective" unit weight of soil
= 20 kN/cu. m (above water level)
= 10 kN/cu. m (below water level)
z = depth below the base of the excavation
C_u = undrained shear strength of soil below the base of the excavation = 15 kPa

The effective width of the soldier piles can be taken as three times the width of the pile or the concreted pile socket, provided that the pile spacing is not less than 5. Stability checks should be made for conditions during each stage of excavation. With proper construction practice, lateral movements of less than 2 per cent of the excavation depth could be expected.

6.3.3.3 Pipe Jacking

The subsoil above and below the proposed springline elevations consists of a firm to stiff silty clay ('N' values range from 4 to 30, averaged 15) with the measured groundwater levels below the invert elevations. Muck removal can be facilitated by hand or augers. It is desirable that the liner precedes the open face at all times. Consideration must be given to the possible existence of boulders in the silty clay deposit, even though none has been revealed in the boreholes. Under such circumstances, hand mining may be used, but the lining should be installed as close to the open face as possible. Provision should be made for partial face excavation using hydraulic shutters, or temporary boarding where soft zones are encountered.

7.0 SITE E: PEDESTRIAN TUNNELS, WESTNEY ROAD STATION

7.1 Site Description

The site is located south of Highway 401 and about 200 m west of the proposed Westney Road Extension (refer to Drawing No. EGG00040E, Sheet 1). Two C.N.R. main lines, a service track and a siding traverse the site in an east-west direction. The ground between the highway and the tracks is plateau-like, with gentle slopes leading to lower ground to the north, east and west. A 6 to 7 m high knoll is located south of the tracks, with a north-facing cut slope formed at about 35 degrees.

7.2 Subsurface Conditions

7.2.1 Soil Stratigraphy

The detailed soil stratigraphy encountered in each borehole together with results of laboratory tests carried out on representative samples, are given on the Record of Borehole Sheets and on Figures E-1 to E-5, inclusive. The borehole locations, a centreline profile and two sections are shown on Drawing No. EGG00040E, Sheet 1.

The natural deposit at the site is a very dense sandy silt till which is overlain by a silty clay deposit at the locations of Boreholes E4 and E5. Fill of variable composition was found overlying the natural deposits in Boreholes E2, E3 and E5.

7.2.1.1 Fill

A greyish brown silty clay fill was encountered below the ground surface in Borehole E3. The fill is 2.7 m thick at this location and contains some sand and traces of gravel.

The consistency of the material is inferred to be very stiff to hard as 'N' values obtained range from 21 to over 100. Atterberg limits testing (Figure E-5) have established that the material is a clay of low plasticity (CL).

The water content of the fill was 11 per cent. A grain size distribution curve for the material is shown on Figure E-1.

A brown silty sand fill with traces of clay and organic matter, was encountered in Borehole E-5. The layer is 1.4 m thick and has a loose relative density as indicated by an 'N' value of 9.

A 1.1 m thick layer of loose coal pieces was encountered at the surface in Borehole E2.

7.2.1.2 Silty Clay

A greyish brown silty clay deposit was encountered below 0.2 m of topsoil in Borehole E4, and underlying the silty sand fill in Borehole E5. The thickness of this deposit is 2 m in both boreholes, and it can be inferred to have a soft to hard consistency as 'N' values obtained in the deposit range from 3 to 52. Atterberg limits testing have established that the material is a clay of low plasticity (CL).

The water content of the deposit varies from 14 per cent in the lower, hard portion to 30 per cent near the ground surface. The grain size distribution curve of a sample from Borehole E4 is shown on Figure E-2.

7.2.1.3 Sandy Silt Till

A greyish brown sandy silt till deposit was encountered in all boreholes.

The till was found under 0.1 m of topsoil in Borehole E1, under the fill in Borehole E2 and E3, and under the silty clay in Boreholes E4 and E5. The deposit was found to extend to the maximum depth investigated. The material contains varying amounts of clay and gravel, with occasional interlayered sand and silt seams. In general, the deposit can be inferred to have a dense to very dense relative density, as indicated by 'N' values in excess of 50. Near the top of the stratum in Boreholes E3 and E4 the till has a loose to compact relative density with 'N' values of 4 to 23.

Water contents of samples of the till ranged from 8 to 19 per cent, and were generally about 15 per cent. The grain size distribution curves of typical till samples are shown on Figure E-4.

7.2.2 Groundwater Conditions

Two piezometers sealed into the till deposit at Boreholes E2 and E4 indicate water levels at elevations 90.8 and 90.4 m, respectively. A water table may be perched in the fill above the silty clay stratum at the location of the proposed east tunnel (at Boreholes E4 and E5).

7.3 Discussion and Recommendations

7.3.1 Project Description

It is proposed to construct two 2.4 m diameter pedestrian tunnels with invert levels 4 m below the existing C.N.R. tracks, as indicated on a preliminary drawing (numbered PD1-600-180) prepared by Totten Sims Hubicki Associates.

7.3.2 Tunnel Design

The maximum cover for the proposed pedestrian tunnel is about 1.6 m. Tunnels with a shallow cover should be designed to resist the full overburden and surcharge pressures.

7.3.3 Construction Method

In view of the shallow cover to the tunnel, the use of jacking techniques is not recommended for construction of the tunnels. Where space permits, the pedestrian underpasses may be constructed in open cut. Within 3 m of the rail tracks, the excavation can be supported by soldier pile and lagging walls. The rail track can be supported by beams spanning between the soldier piles. Temporary open cuts can be formed at side slopes of 1.5 horizontal to 1 vertical.

The highest water table recorded in the till is only 0.5 m above the base of the proposed invert and this should not present a problem to construction. Water seepage from the till can be handled by sumping. Some water may seep from the fill and this should be intercepted as and when it arises.

7.3.3.1 Piles for Support of the Track

Piles for support of the track may be steel H-piles driven at least 3 m below the base of the excavation. As an example, a HP 310 x 79 pile driven to an average set of 5 mm per blow for a group of 10 blows with a hammer of rated energy 40 kJ, will have a factored capacity at Ultimate and Serviceability Limit States of 1100 kN and 700 kN respectively.

7.3.3.2 Soldier Pile - Lagging Wall

Soldier pile and lagging walls should be designed for a rectangular pressure as given by:

$$p_a = 0.3 \, \gamma h + q$$

where γ = unit weight of soil = 21 kN/cu. m

h = retained height

q = surcharge pressure

Passive pressure in front of the soldier pile below the base of the excavation may be calculated by the expression:

$$P_p = K_p \, \gamma' \, z$$

where γ' = "effective" unit weight of soil

= 20 kN/cu. m (above water level)

= 10 kN/cu. m (below water level)

z = depth below the base of the excavation

K_p = passive pressure coefficient = 4.6

The effective width of the soldier piles can be taken as three times the width of the pile or the concreted pile socket, provided that the pile spacing is not less than 5. Stability checks should be made for conditions during each stage of excavation. With proper construction practice, lateral movements of less than 1 per cent of the excavation depth could be expected.

GOLDER ASSOCIATES

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PC/JRB/cg

APPENDIX A

FIELD WORK

The field work for this investigation was carried out between November 1 and 10, 1983. During this period, a total of 29 boreholes were put down at the sites at locations shown on 5 drawings numbered EGG00040A to EGG00040E, inclusive. The boreholes were put down using two power auger drilling machines (a truck mounted CME 45 and a Bombardier mounted CME 55) supplied and operated by Master Soil Investigations Limited.

The boreholes were advanced through the overburden soils using continuous flight solid stem augers. Soil samples were obtained at regular intervals of not more than 1.5 m of depth using conventional 50 mm O.D. split-spoon samplers. N size field vane tests were carried out in the soft cohesive materials encountered in Sites B and D. Shelby samples of 75 mm O.D. were also taken in the silty clay deposit in Site D. Where bedrock was encountered at shallow depths in Site A, core samples were obtained in Bx size in two of the boreholes. Piezometers were sealed into selected borings for monitoring of water levels. Details of the drilling and sampling operations are summarized on the Record of Borehole sheets.

A total of 4 test pits were dug by hand on the C.N.R. embankment slopes at locations shown on Drawing No. EGG00040C, Sheet 1.

The field work was supervised throughout by members of Golder Associates engineering staff who located the boreholes and test pits in the field, directed the drilling, in situ testing and sampling operations, and logged the boreholes.

The borehole and test pit locations were surveyed by Golder Associates. The elevations are referenced to benchmarks established by MTC along the GO-ALRT route in Sites A, C and E. Geodetic benchmarks were used as reference points in Sites D and E.

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 – 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY $= \frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX $= w_L - w_P$
I_L	1	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE

e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_u	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

<u>SITE A</u>

March 1984

831-1272

W P EGG-000-40 LOCATION Co-ordinates N 4,856,503; E 341,376 ORIGINATED BY [illegible]

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY RWR

DATUM Geodetic DATE November 3, 1983 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.0	GROUND SURFACE										
0.0	Fill-Silty sand and gravel, occasional organics										
			1	SS	7		82				
	Loose to compact Dark brown		2	SS	14	elev. 82.4 m Nov. 30, 1983			~20		24 52 16 8
80.7 / 2.3	Shale Bedrock, completely to highly weathered, thinly bedded		3	SS	83						
							80				
			4	SS	87						
78.4	Dark grey		5	SS	100						
4.6	END OF BOREHOLE						78				

$+^3, \times^5$: Numbers refer to Sensitivity

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

RECORD OF BOREHOLE No A 2

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,395; E 341,366 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BQ Rock Core COMPILED BY RWR

DATUM Geodetic DATE November 3, 1983 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_p NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L / WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
81.9	GROUND SURFACE										
0.0	Silty sand Dark brown					Water level in open hole at elev. 81.9m on Nov. 3, 1983					
81.3 0.6	Shale Bedrock, completely to highly weathered, thinly bedded.		1	SS	40						
			2	SS	111		80				
78.8			3	SS	100/75mm						
3.1	Faintly weathered, poor to fair RQD, occasional thin clay seams, thinly bedded.		4	BQ RC	REC 93%		78				
			5	BQ RC	REC 91%		76				
75.6	Dark grey										
6.3	END OF BOREHOLE										
							74				

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No A3

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,236; E 341,399 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY RWR

DATUM Geodetic DATE November 7, 1983 CHECKED BY PC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.5	GROUND SURFACE					
0.0	Till-Silty clay, some sand, trace to some gravel. Grey and brown mottled	1	SS	10		
		2	SS	20	82	16 30 29 25
	Stiff to hard. Grey	3	SS	9		
80.1		4	SS	112	80	
3.4	Shale Bedrock, highly weathered, thinly bedded. Dark grey	5	SS	100/75mm		
78.7 / 4.8	END OF BOREHOLE				78	

Ground water: elev. 82.3m Nov. 30, 1983

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No A4

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,301; E 3?1,384 ORIGINATED BY KLS

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BQ Rock Core COMPILED BY RWR

DATUM Geodetic DATE November 7, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
81.5	GROUND SURFACE						
0.0	Till-Silty clay, some sand, trace gravel						
80.4	Hard Grey	1	SS	71			10 35 35 20
1.1	Shale Bedrock, highly to moderately weathered, thinly bedded, occasional thin clay seams	2	SS	100/75mm	80		
	Very poor RQD	3	BQ RC	REC 80%	78		
	Poor RQD	4	BQ RC	REC 94%	76		
74.4	Dark grey	5	BQ RC	REC 98%			
7.1	END OF BOREHOLE				74		

* Note: Water from top of piezometer tube at 0.5m above ground level (elev. 82.0m) on Nov.30, 1983.

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. A 5 — METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,279; E 341,372 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY RWR

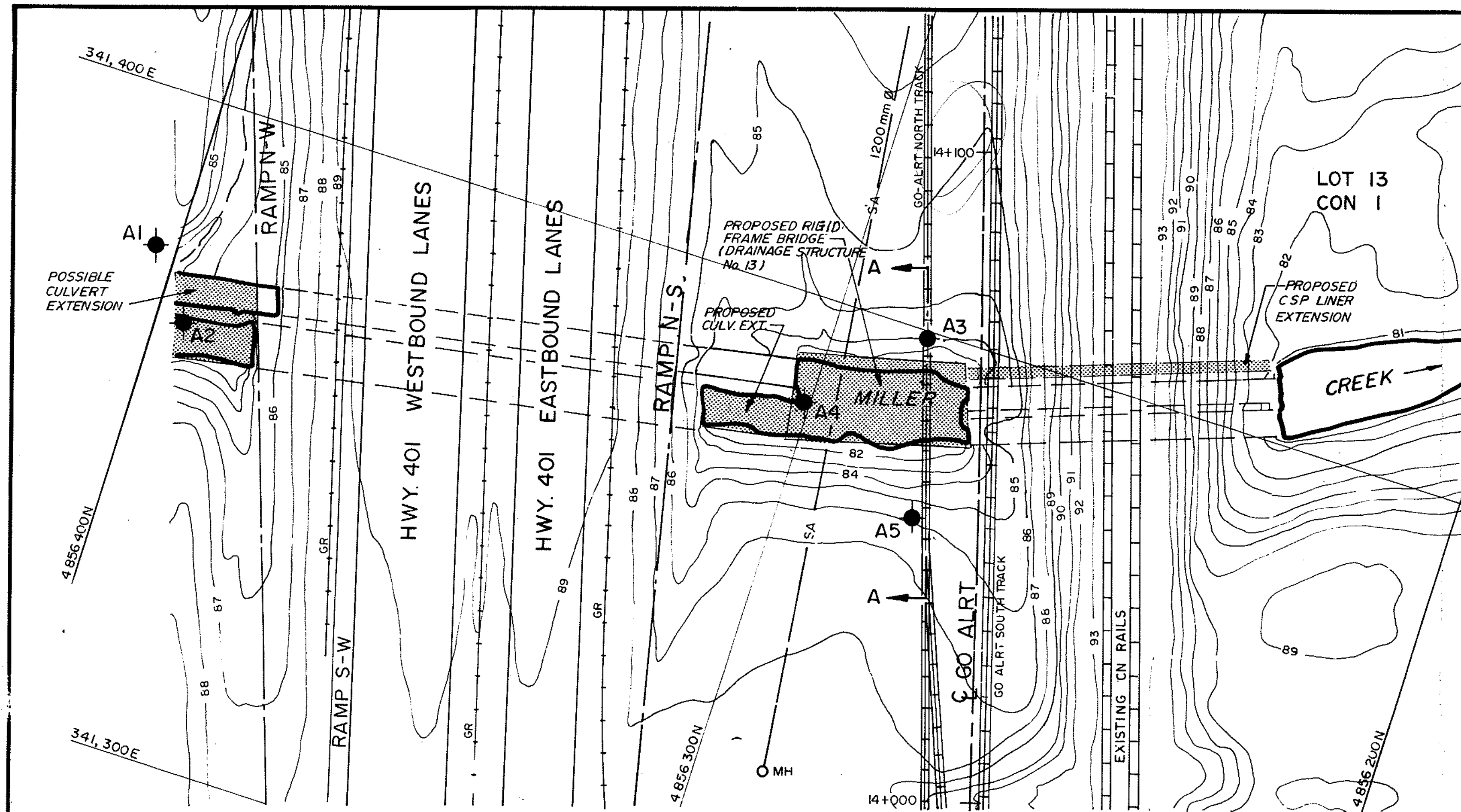
DATUM Geodetic DATE November 8, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
85.8	GROUND SURFACE							
0.0	Fill-Silty sand, some clay, trace of gravel and organics, occasional pieces of wood.	1	SS	10				
		2	SS	9		84		
		3	SS	11				
		4	SS	7				
81.2 / 4.6	Loose to compact Dark brown	5	SS	13	Water level in open hole at elev. 81.5m on Nov.8, 1983.	82		5 52 29 14
80.5	Topsoil	6	SS	8			48	
5.3	Shale Bedrock, highly weathered, thinly bedded. Dark grey	7	SS	100/75mm		80		
78.9		8	SS	100/75mm				
6.9	END OF BOREHOLE					78		

OFFICE REPORT ON SOIL EXPLORATION

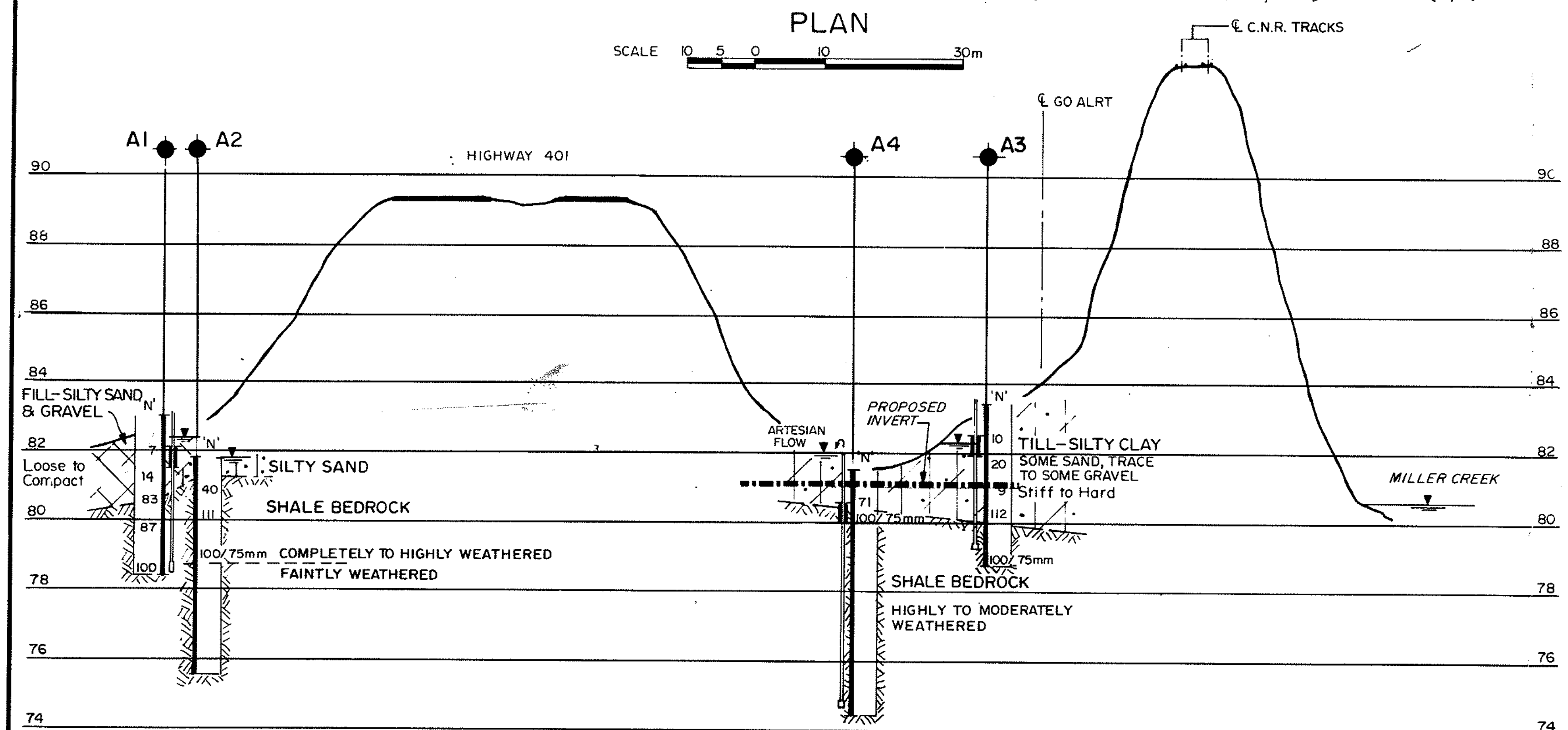
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.

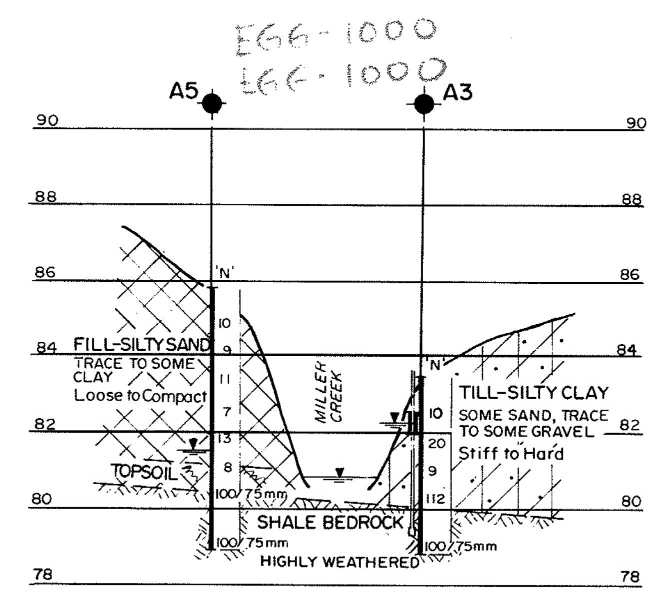


PLAN

SCALE 10 5 0 10 30m



PROFILE ALONG ℄ OF CULVERT

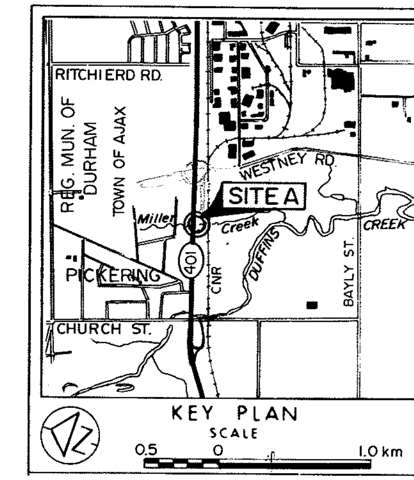


SECTION A-A

SCALE

HORIZ. 10 5 0 10 20 40m

VERT. 2 1 0 2 4 8m



KEY PLAN

SCALE 0.5 0 1.0 km

LEGEND

●	Bore Hole
⊕	Dynamic Cone Penetration Test (Cone)
◈	Bore Hole & Cone
N	Blows/0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
▽	W L at time of investigation, Nov. 1983
	Seal
	Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
A1	83.0	4 856 403	341 376
A2	81.9	4 856 395	341 366
A3	83.5	4 856 286	341 399
A4	81.5	4 856 301	341 384
A5	85.8	4 856 279	341 372

Geocres No

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102.? of Form 100

GO-ALRT REF PDI-600-432/433

450

EGG-1000

REFERENCE DRAWINGS	REVISIONS

DRAWN BY: MHW DATE: FEB. 9, 1984 DESIGNED BY: —

CHK'D BY: PC APPROVED BY: JRB

SCALE: AS SHOWN FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER C.W.P. CHAN PROVINCE OF ONTARIO

Golder Associates — CONSULTING GEOTECHNICAL AND MINING ENGINEERS

GO-ALRT — Ministry of Transportation and Communications

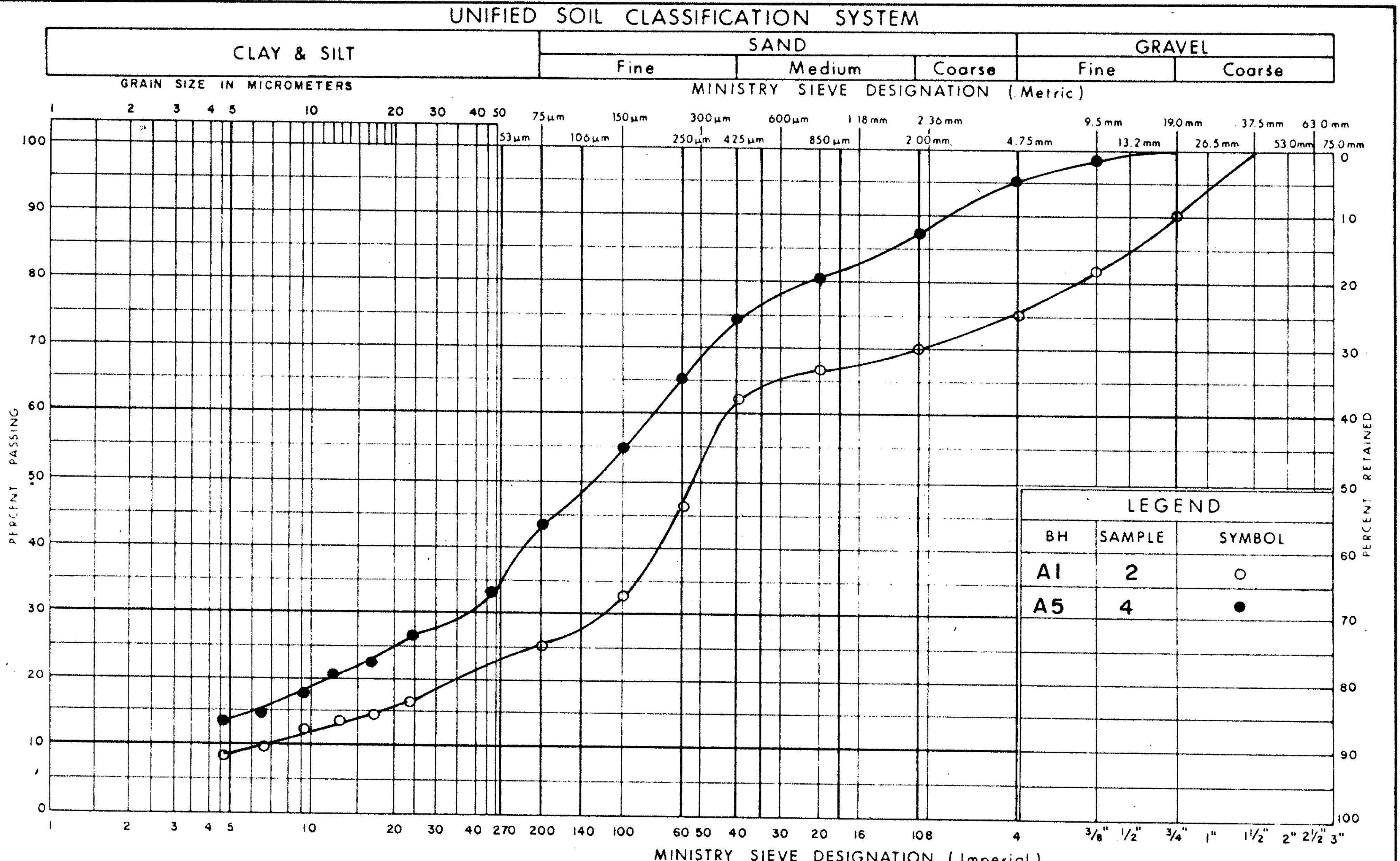
PICKERING TO OSHAWA

PROJECT MANAGER

PROPOSED MILLER CREEK CULVERT
GO ALRT EXTENSION, STA. 14+060
BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO | DWG NO EGG00040A | REV | SHEET

78 12 M



Ministry of Transportation and Communications Ontario

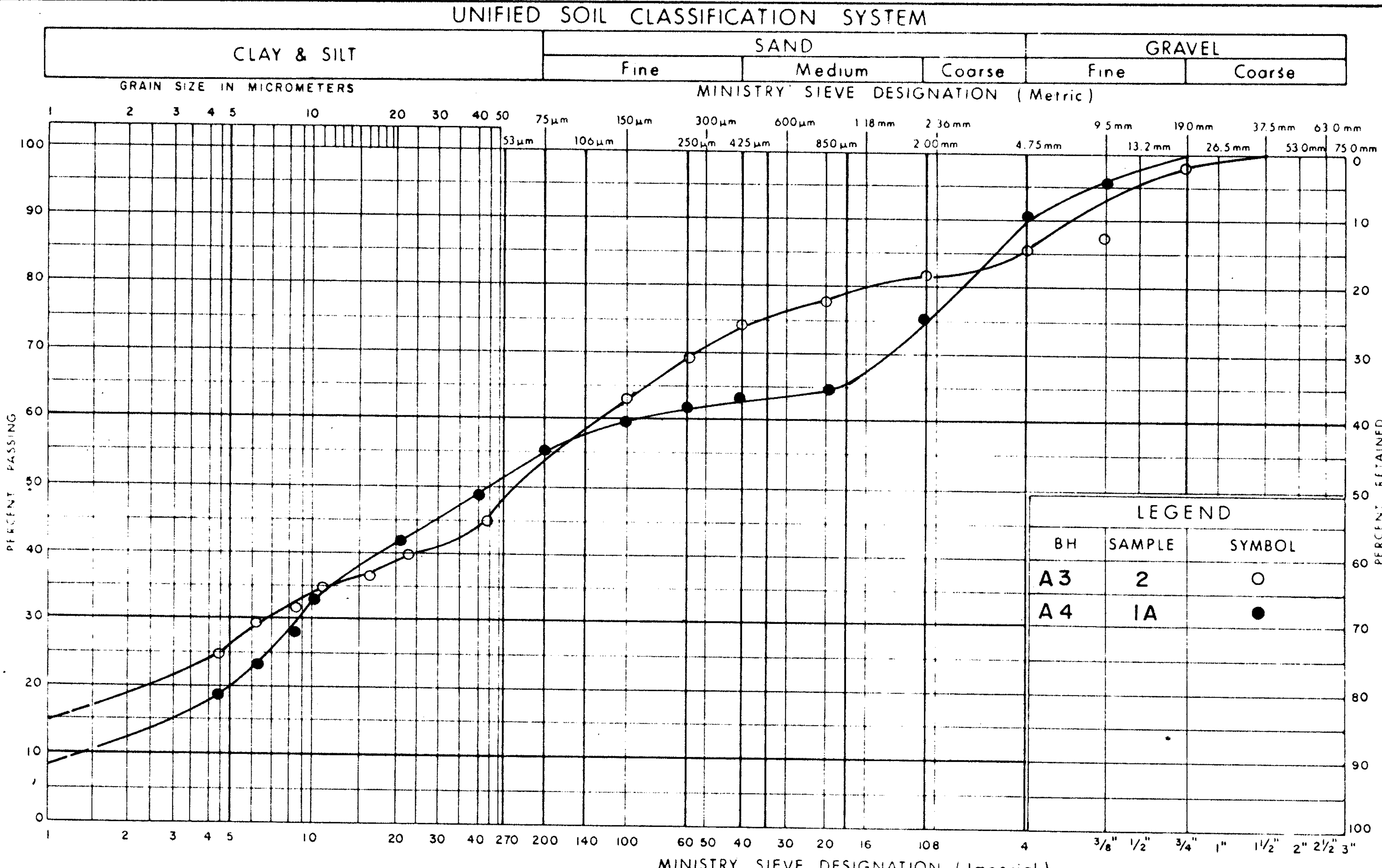
GRAIN SIZE DISTRIBUTION

SILTY SAND (FILL)
(SITE 'A')

FIG No A-1

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications

Ontario

GRAIN SIZE DISTRIBUTION

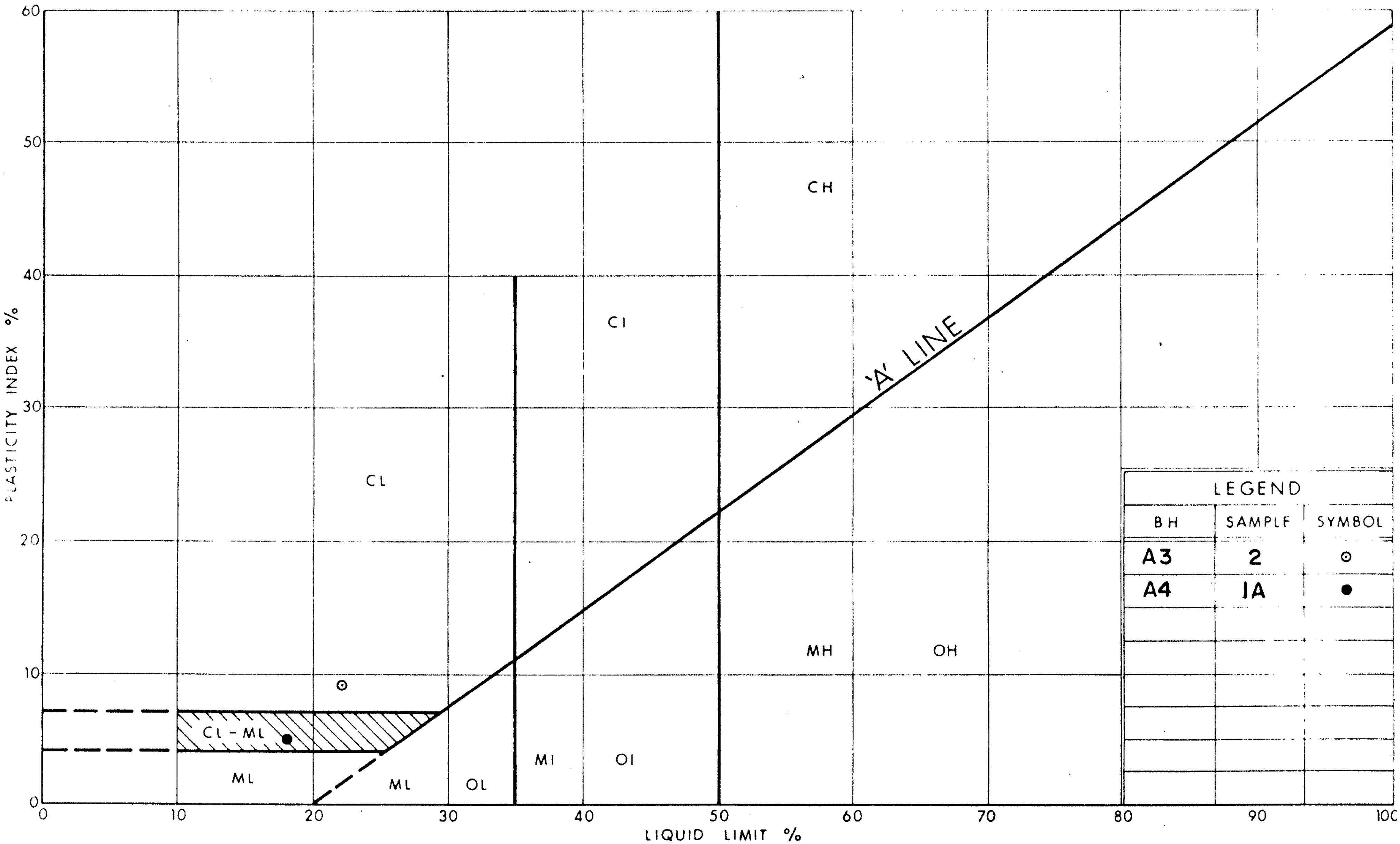
SILTY CLAY SOME SAND (TILL)

(SITE 'A')

FIG No A-2

W P EGG-000-40

Oct 75, FF-S-21



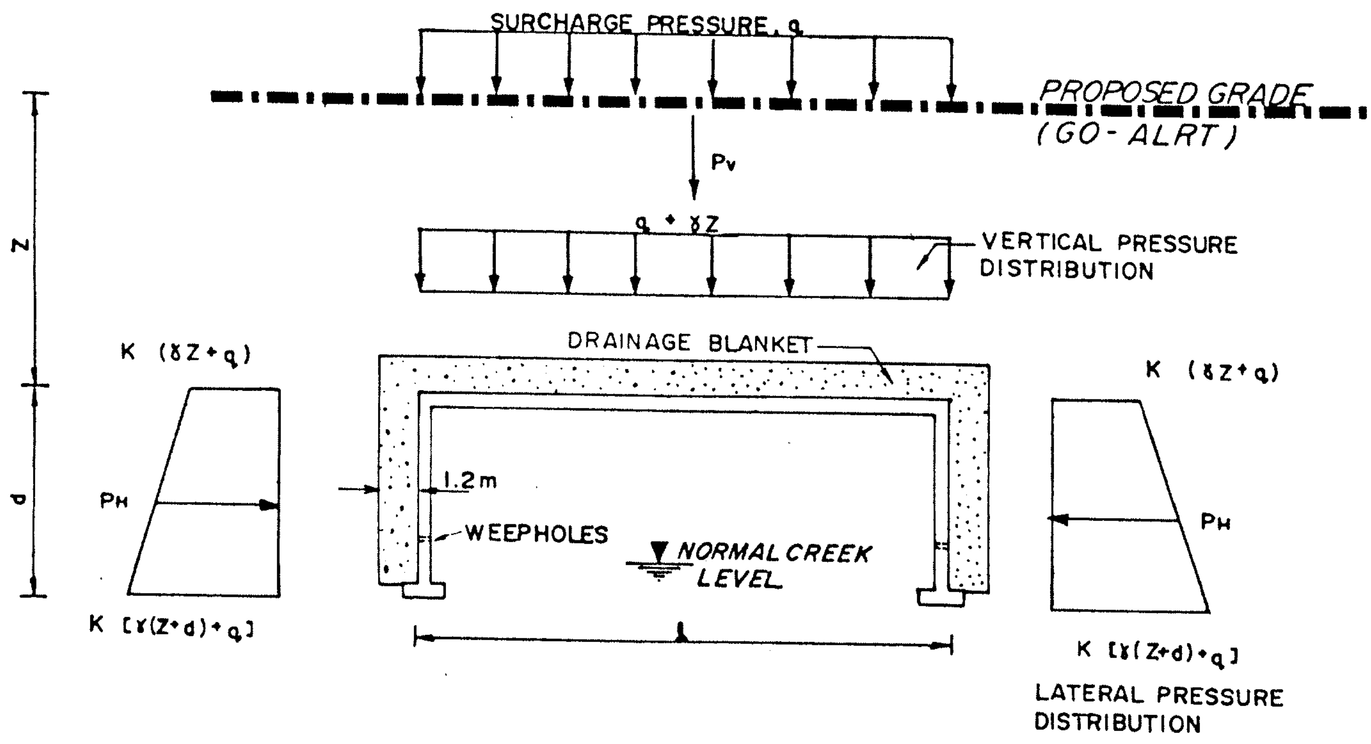
LEGEND

BH	SAMPLE	SYMBOL
A3	2	⊙
A4	IA	●

Ministry of Transportation and Communications
Ontario

PLASTICITY CHART
SILTY CLAY, SOME SAND (TILL)
(SITE 'A')

FIG No A-3
W P EGG-000-40



$P_H = K\, d[\gamma(Z + \frac{d}{2}) + q]$ where

$P_V = \ell\,(\gamma Z + q)$

K = LATERAL EARTH PRESSURE COEFFICIENT.

γ = UNIT WEIGHT OF SOIL = 21 kN/cu m

d = HEIGHT OF STRUCTURE

Z = DEPTH OF COVER

ℓ = WIDTH

NOT TO SCALE

Ministry of Transportation and Communications
Ontario

DESIGN PRESSURES FOR RIGID FRAME BRIDGE

FIG No A-4

W P EGG-000-40

SITE B

March 1984 831-1272

RECORD OF BOREHOLE No. B 1

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,857,124; E 341,662 | ORIGINATED BY: KFS

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: RWR

DATUM: Geodetic | DATE: November 1, 1983 | CHECKED BY: PC

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
88.9	GROUND SURFACE
86.8 / 0.0	Silty clay, trace to some sand. Stiff. Grey and brown mottled
81.3 / 2.1	Silty clay, trace sand, some thin sand and silt layers, increasing sand content below 6.1m depth. Soft to firm. Grey
76.6 / 7.6	Till-Sand and silt, some clay trace gravel, occasional shale fragments below 12.2m depth. Compact to very dense. Grey
12.3	END OF BOREHOLE

SAMPLES

NUMBER	TYPE	'N' VALUES
1	SS	12
2	SS	16
3	SS	7
4	SS	4
5	SS	5
6	SS	5
7	SS	2
8	SS	2
9	SS	8
10	SS	10
11	SS	41
12	SS	58
13	SS	107/150mm
14	SS	116/75mm

GROUND WATER CONDITIONS

elev. 87.8m Nov. 30, 1983

elev. 87.0m Nov. 30, 1983

ELEVATION SCALE / PLOTS

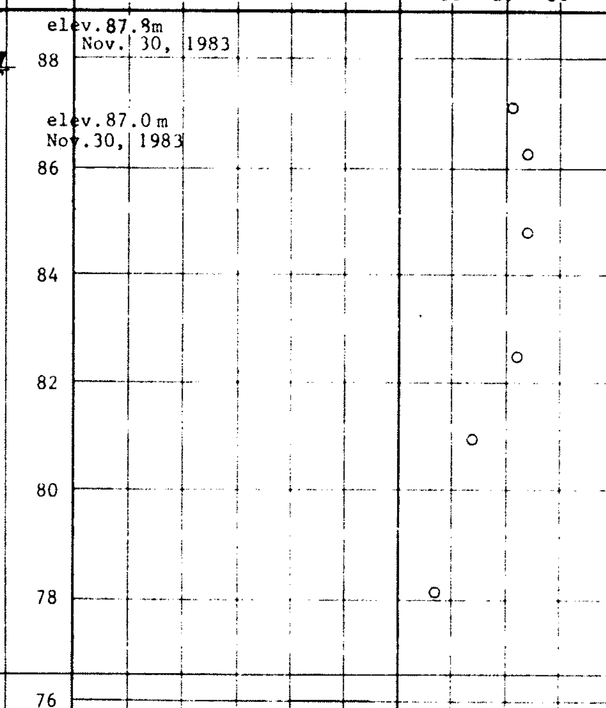
DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%) 10, 20, 30

UNIT WEIGHT γ



REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
8	48	34	10

(at elevation 80, sample 11)

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No. B2

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,857,121; E 341,654 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY RWR

DATUM Geodetic DATE November 1, 1983 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.1	GROUND SURFACE							
0.0	Silty clay, trace to some sand. Grey and brown mottled	1	SS	21		88		0 19 56 25
		2	SS	21				0 2 33 65
87.0	Very stiff							
2.1	Silty clay, trace sand, some thin sand and silt layers, increasing sand content below 6.7m depth.	3	SS	9				
		4	SS	6		86		0 4 48 48
		5	SS	6	▼			
		6	SS	4		84		
		7	SS	3				
		8	SS	2				0 2 24 74
		9	SS	2		82		
80.9	Soft to firm Grey	10	SS	7				
8.2	Silty sand and gravel, grading to silty sand, some gravel below 10.2m depth.	11	SS	17		80		34 39 23 4
		12	SS	43				
		13	SS	52		78		
77.5	Compact to very dense Grey							
11.6	Till-Silty clay, with sand and gravel, occasional shale fragments.	14	SS	100/75mm				16 40 24 20
						76		
75.3	Hard Dark grey	15	SS	100/75mm				
13.8	END OF BOREHOLE					74		

Water level in open hole at elev. 84.5 m on Nov. 1, 1983

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT Wp NATURAL MOISTURE CONTENT W LIQUID LIMIT WL

WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

Ontario Transportation and Communications

RECORD OF BOREHOLE No B 3

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,857,107; E 341,648 | ORIGINATED BY: KES

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: RWR

DATUM: Geodetic | DATE: November 1, 1983 | CHECKED BY: PC

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
89.1	GROUND SURFACE						
0.0	Fill-Silty sand mixed with silty clay, trace organics and rootlets		1	SS	13		88
			2	SS	12		
			3	SS	6		
85.4	Loose to compact Brown		4	SS	5		86
3.7	Silty clay, trace sand, some thin sand and silt layers.		5	SS	4	Water level in open hole at elev. 83.2 m on Nov. 1, 1983	
			6	SS	4		84
			7	SS	3	▼	
82.2	Very soft to soft Grey		8	SS	1		
6.9	Silty sand, trace of clay and gravel, grading to sand and gravel, trace silt below 8.2m depth.		9	SS	9		82
			10	SS	<1		
			11	SS	28		
79.2	Very loose to compact Grey		12	SS	10		80
9.9	Till-Sand and silt, trace of clay and gravel.		13	SS	73		
77.7	Very dense Grey		14	SS	100/25mm		78
11.4	END OF BOREHOLE						
							76

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No. B4

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,857,095; E 341,665 | ORIGINATED BY: KES

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: RWR

DATUM: Geodetic | DATE: November 2, 1983 | CHECKED BY: PC

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
89.0	GROUND SURFACE					
0.0	Fill-Silty sand					88
	Compact, Brown	1	SS	16		
87.5 / 1.5	Silty clay, trace to some sand	2	SS	22	elev. 86.7m Nov. 30, 1983	
	Grey & brown mottled, Very stiff	3	SS	12		
86.9 / 2.1	Silty clay, trace sand, some thin sand and silt layers, increasing sand content below 7.6m depth.	4	SS	7		86
		5	SS	4		
		6	SS	6		84
		7	SS	1		82
	Very soft to firm, Grey	8	SS	<1		80
79.7 / 9.3	Silty sand, trace gravel	9	SS	30		
	Compact to very dense, Grey	10	SS	78		78
77.6 / 11.4	Till-Silty clay, with sand and gravel, occasional shale fragments.	11	SS	100		76
	Hard, Dark grey	12	SS	100/25mm		
74.5 / 14.5	Shale Bedrock, completely to highly weathered slight petroliferous odour. Dark grey	13	SS	100/50mm		74
73.7 / 15.3	END OF BOREHOLE					72

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. B5

METRIC

W P EGG-000-40 — LOCATION Co-ordinates N 4,857,082; E 341,655 — ORIGINATED BY KES

DIST 6 HWY GO-ALRT — BOREHOLE TYPE Solid Stem Auger — COMPILED BY RWR

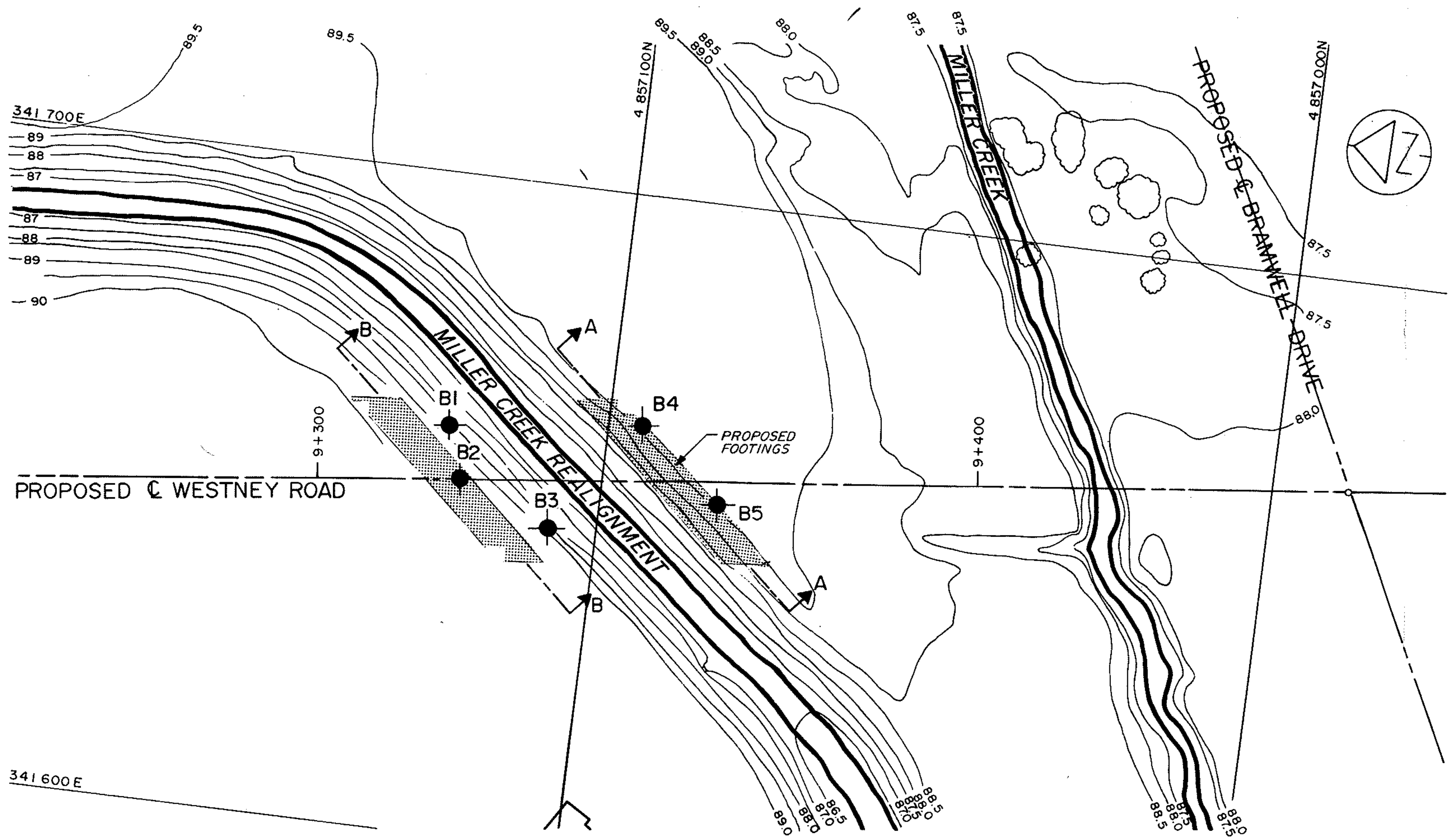
DATUM Geodetic — DATE November 2, 1983 — CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DCPT	WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.0	GROUND SURFACE									
0.0	Silty clay, trace to some sand. Grey and brown mottled. Very stiff	1	SS	17	elev. 87.2 m Nov. 30, 1983	88				
86.9		2	SS	22				~20		
2.1	Silty clay, trace sand, some thin sand and silt layers, increasing sand content below 8.2m depth. Very Stiff	3	SS	17		86				
		4	SS	8			+? +2 (~80)	~24		
	Very soft to stiff	5	SS	5		84	+3 +3 (~40)			
		6	SS	1		82	+3 +4 (~30)			
		7	SS	2			+3 (~60)	~18		
80.2	Grey					80	+ >96 kPa			
8.8	Silty sand, trace gravel.	8	SS	110						
		9	SS	89		78		~20		
76.5	Very dense Grey	10	SS	100/50mm						
12.5	Till-Silty clay, with sand and gravel.					76				
75.2	Hard Dary grey	11	SS	100/25mm						
13.8	END OF BOREHOLE					74				

30M14-174

METRIC

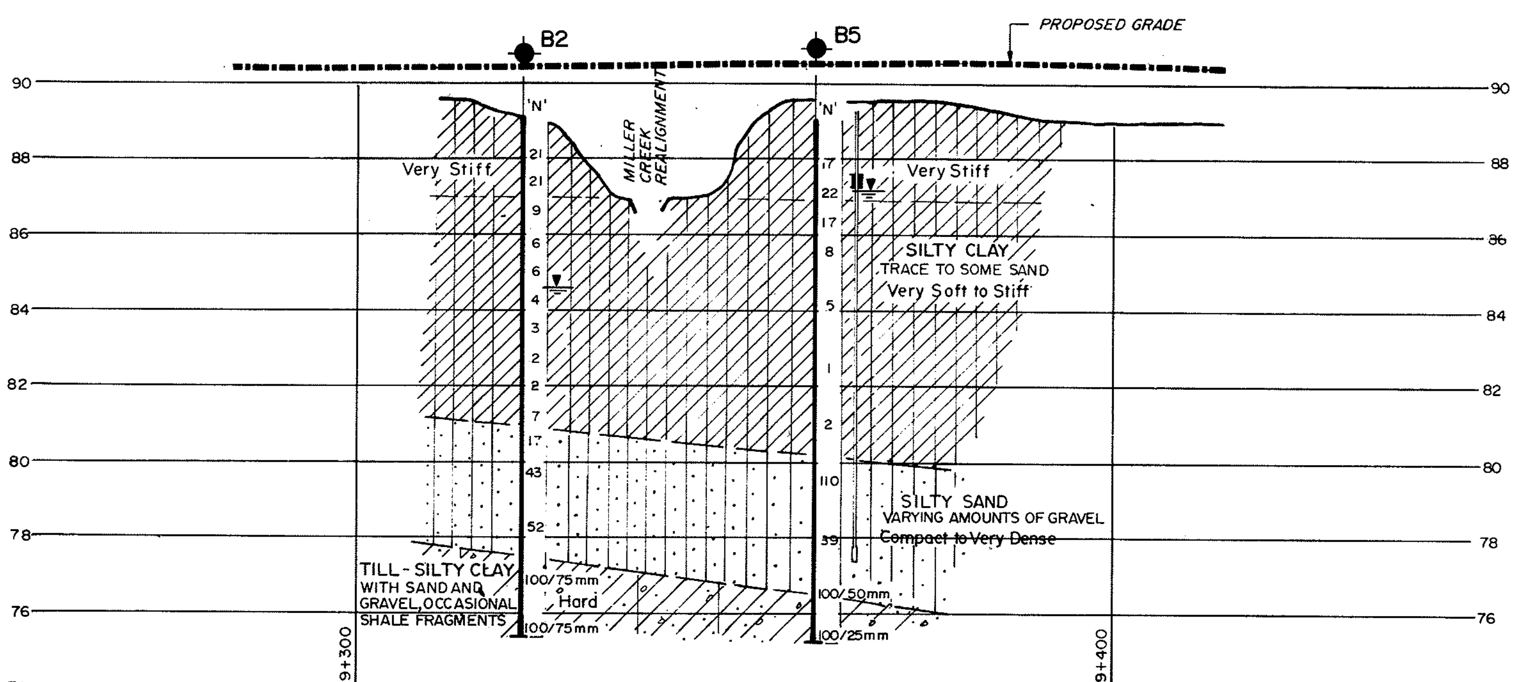
ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



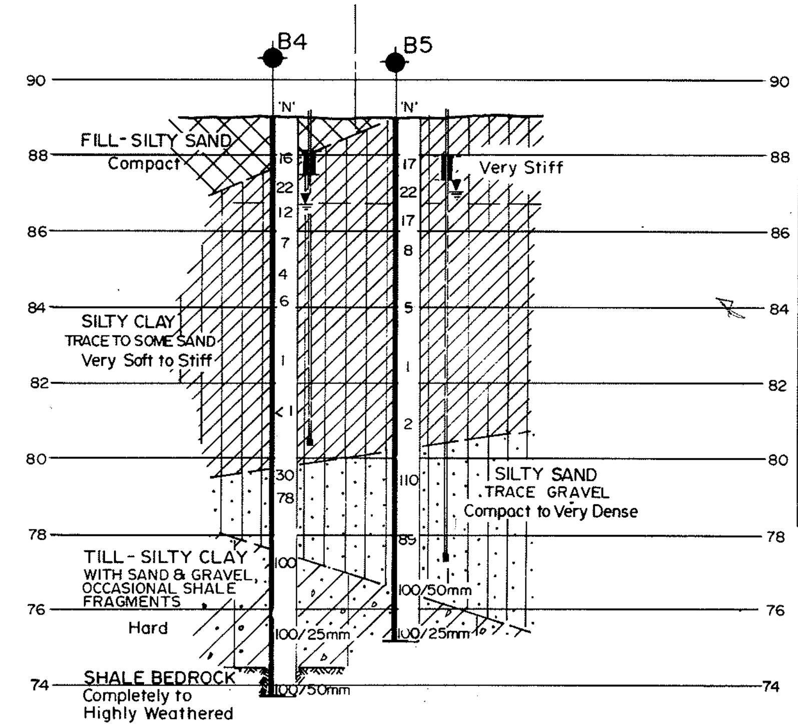
PLAN

SCALE 10m 5 0 10 20 30 40m

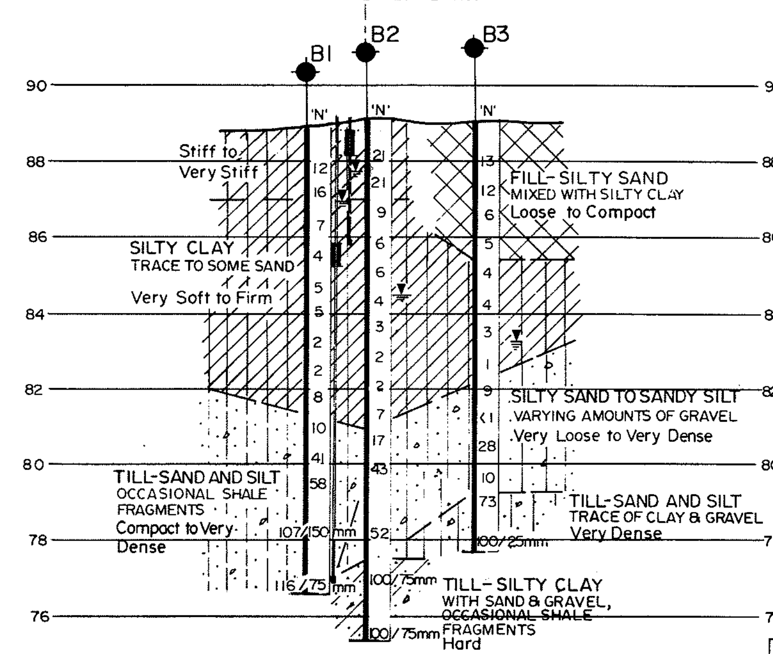
NOTE: CONTOURS DO NOT REPRESENT EXISTING CONDITIONS DUE TO RECENT CONSTRUCTION.



℄ PROFILE WESTNEY ROAD

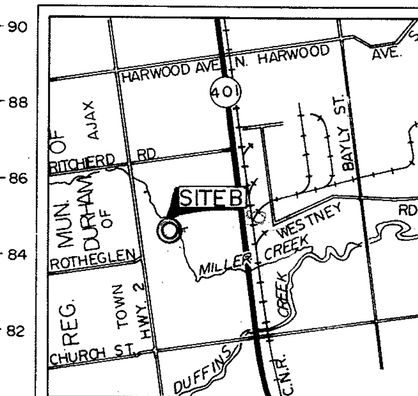


SECTION A-A



SECTION B-B

SCALE
HOR. 10m 5 0 10 20 30 40m
VERT. 2m 1 0 2 4 6 8m



KEY PLAN

SCALE 1km 0.5 0 1 2

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation, Nov. 1983
- Seal
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
B1	88.9	4,857,124	341,662
B2	89.1	4,857,121	341,654
B3	89.1	4,857,107	341,648
B4	89.0	4,857,095	341,665
B5	89.0	4,857,082	341,655

Geocres No

=NOTE=

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

GO-ALRT REF PDI-600-443

REFERENCE DRAWINGS	REVISIONS

DRAWN BY: R.W.R., M.H.W. DATE: FEB. 9, 1984
DESIGNED BY:
CHK'D BY: P.C
APPROVED BY: JRB
SCALE: FULL SIZE ONLY AS SHOWN

REGISTERED PROFESSIONAL ENGINEER C.W.P. CHAN PROVINCE OF ONTARIO

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

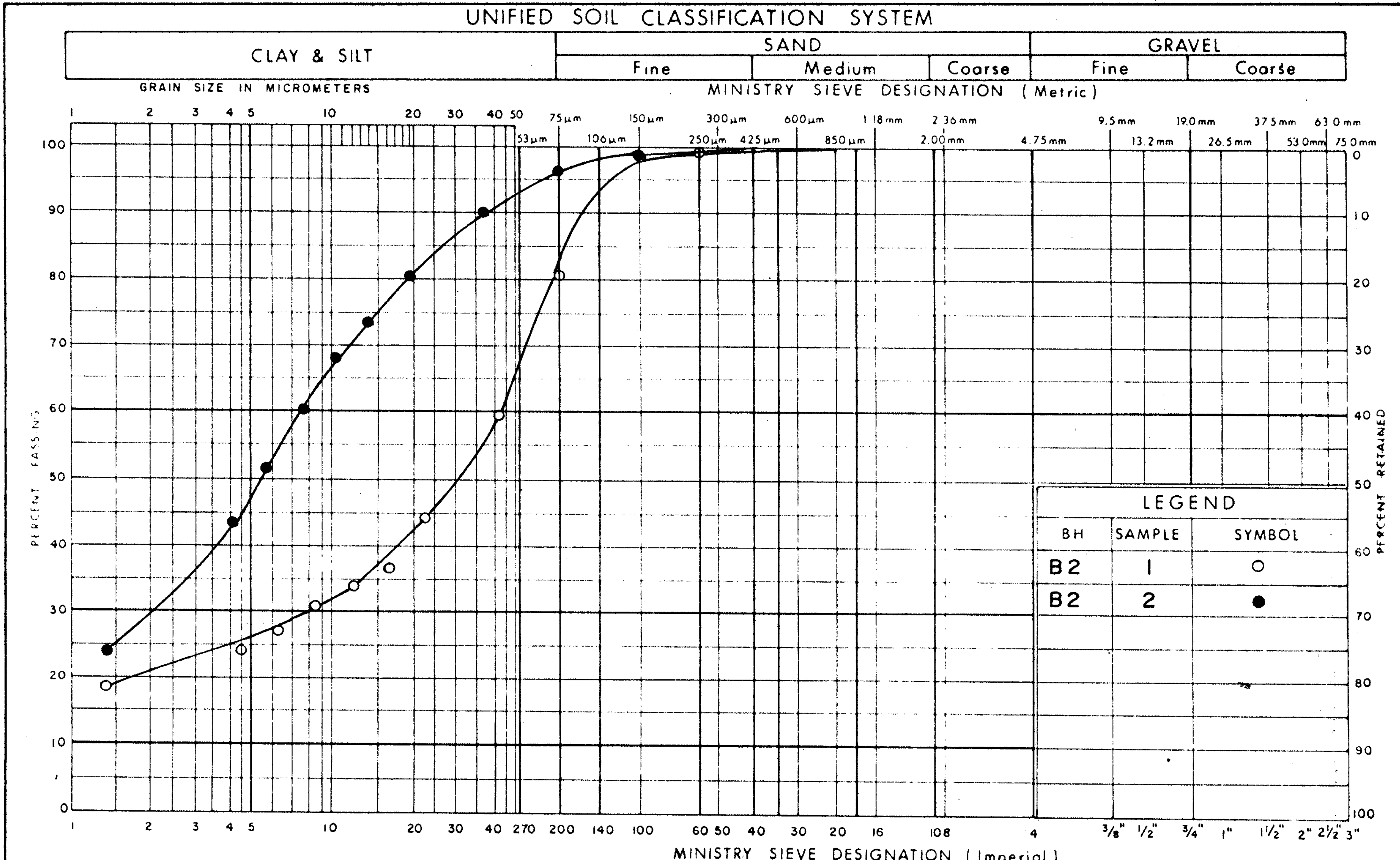
GO-ALRT
Ministry of Transportation and Communications
PICKERING TO OSHAWA

PROJECT MANAGER

PROPOSED WESTNEY ROAD BRIDGE AT MILLER CREEK REALIGNMENT BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO | DWG. NO EGG00040B | REV | SHEET

78 12 M



Ministry of Transportation and Communications
Ontario

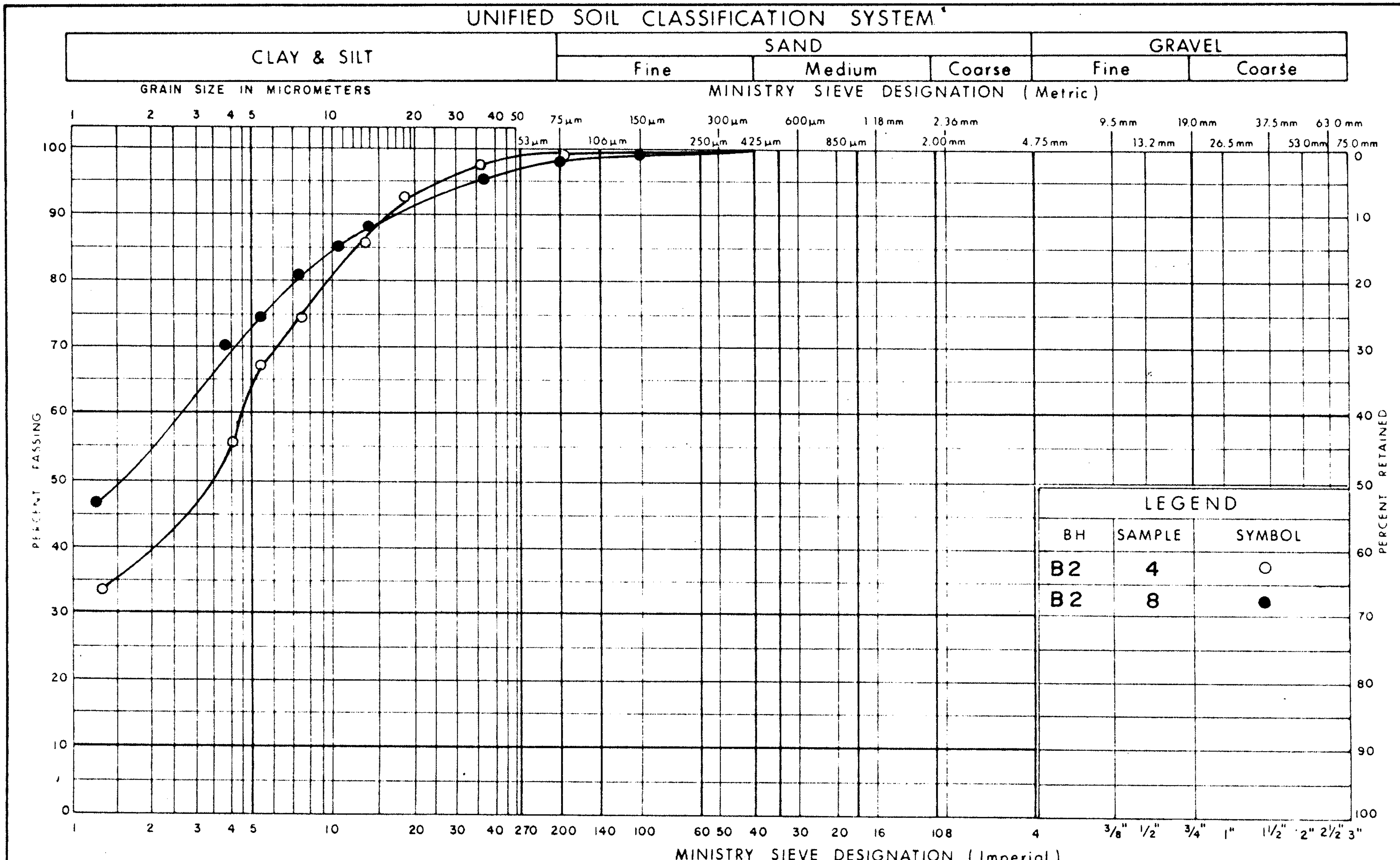
GRAIN SIZE DISTRIBUTION

SILTY CLAY, SOME SAND (SITE 'B')

FIG No B-1

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications
Ontario

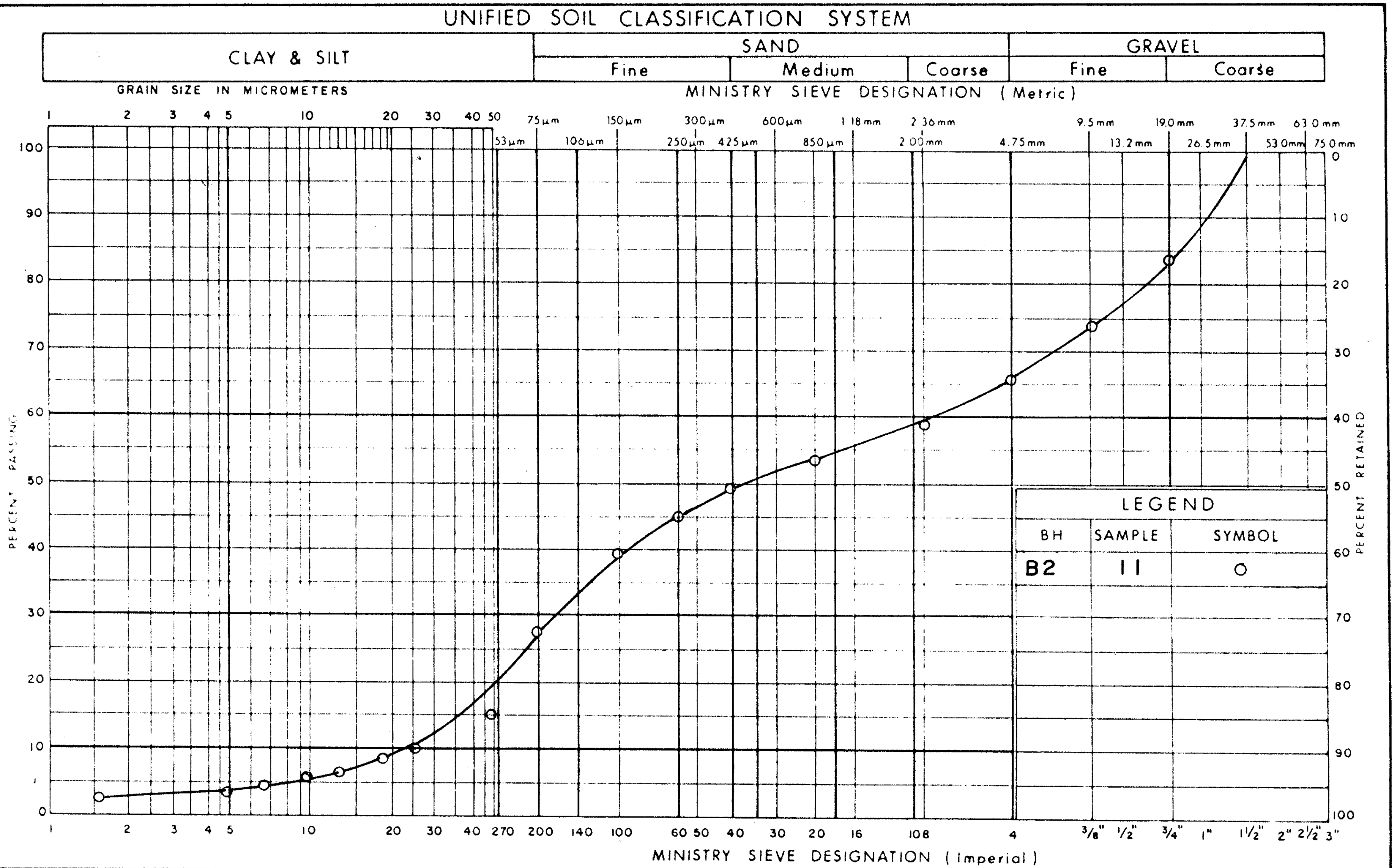
GRAIN SIZE DISTRIBUTION

SILTY CLAY
(SITE 'B')

FIG No B-2

W P EGG-000-40

78 12 M



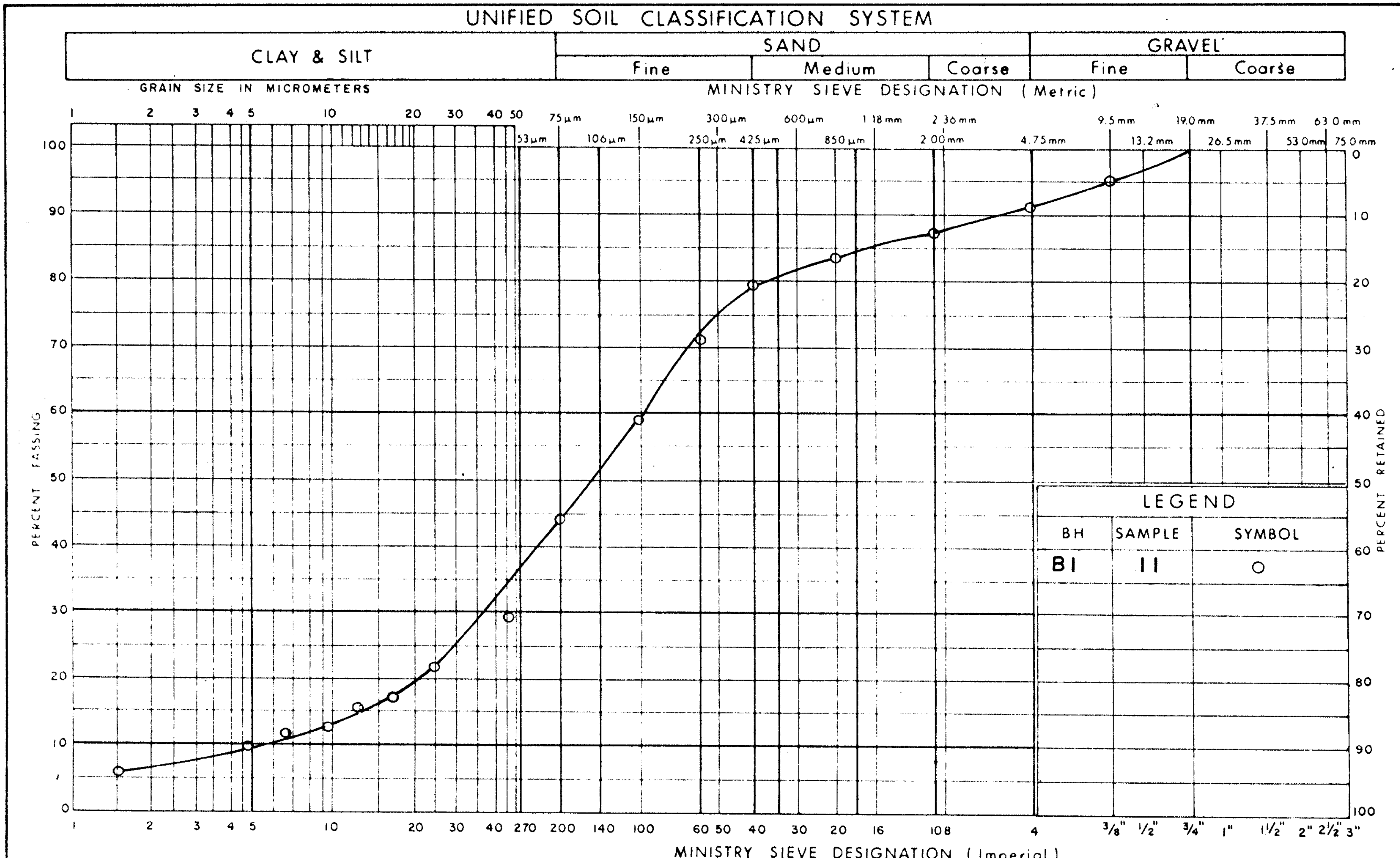
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY SAND AND GRAVEL
(SITE 'B')

FIG No B - 3

W P EGG-000-40

78 12 M

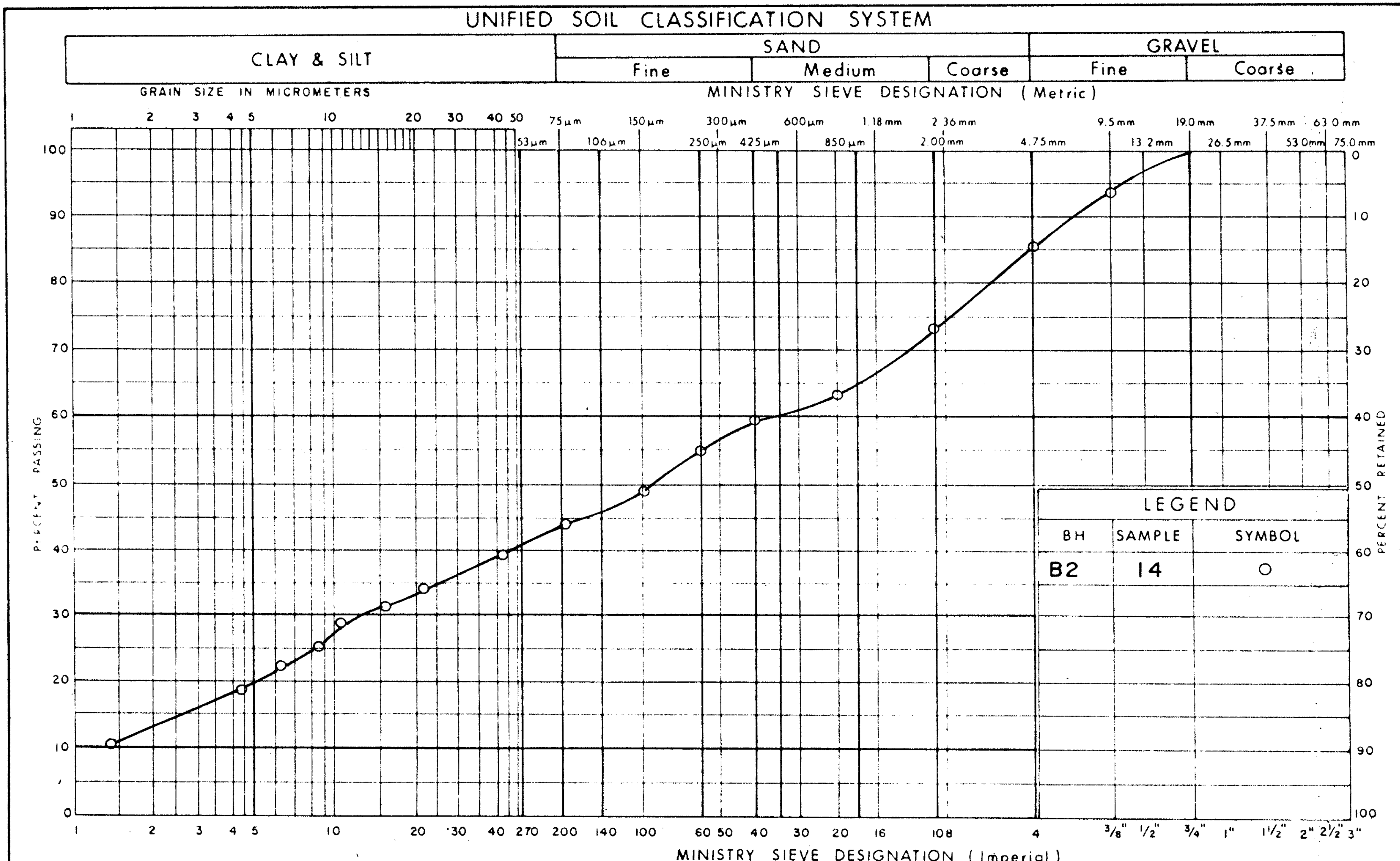


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SAND AND SILT (TILL)
(SITE 'B')

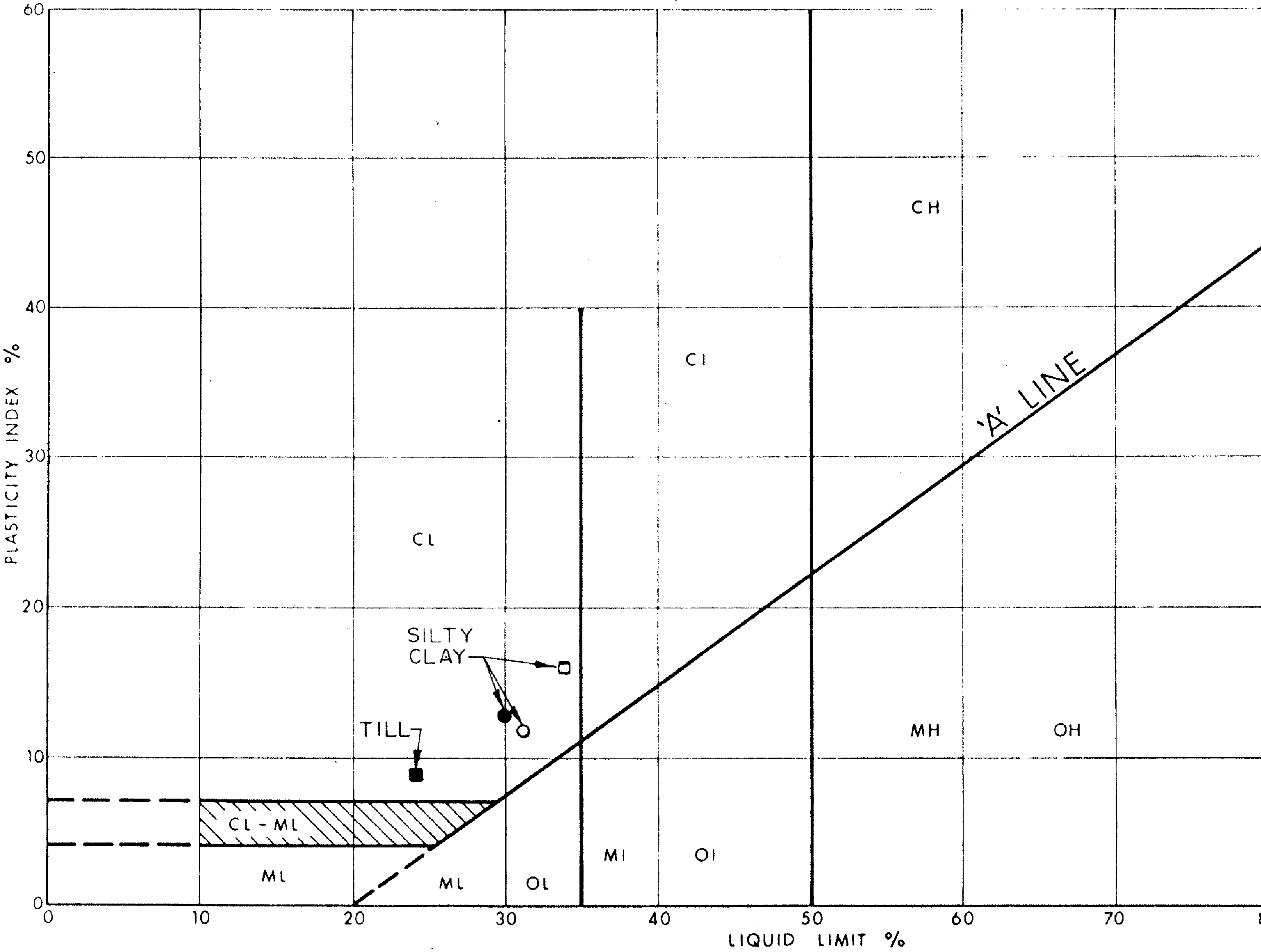
FIG No B-4
W P EGG-000-40

78 12 M



Ministry of Transportation and Communications Ontario	GRAIN SIZE DISTRIBUTION SILTY CLAY, WITH SAND AND GRAVEL (TILL) (SITE 'B')	FIG No B-5 W P EGG-000-40

Oct 75, FF-S-21



LEGEND		
BH	SAMPLE	SYMBOL
B2	2	○
B2	4	●
B2	8	□
B2	14	■

Ministry of Transportation and Communications
Ontario

PLASTICITY CHART
(SITE 'B')

FIG No B-6
W P EGG-000-40

<u>SITE C</u>

March 1984

831-1272

RECORD OF BOREHOLE No. C1

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,858,463; E 348,633 | ORIGINATED BY: KES

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: EFO

DATUM: Geodetic | DATE: November 8, 1983 | CHECKED BY: PC

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.9	GROUND SURFACE							
0.0	Topsoil							
0.1	Silty clay, some sand, trace gravel. Stiff to very stiff. Grey and brown mottled	1	SS	12	elev. 79.1 m Nov. 30, 1983			5 13 39 43
		2	SS	21		78		
77.8 / 2.1	Till- Silty sand, trace to some clay and gravel, occasional sand partings. Loose to very dense. Grey	3	SS	9				12 49 32 7
		4	SS	27				
		5	SS	66		76		
74.1		6	SS	76				
5.8	END OF BOREHOLE					74		

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. C2

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,858,443; E 348,629 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 8, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.6	GROUND SURFACE										
0.1	Topsoil										
	Fill-Silty clay, trace of sand and gravel, trace organics. Grey and brown mottled. Firm to hard		1	SS	8	▼		Water level in open hole at elev. 78.8m on Nov. 30, 1983			
77.5			2	SS	31		78		o		
2.1	Till-Silty sand trace to some clay and gravel. Dense to very dense. Grey		3	SS	76				o		
			4	SS	94		76				
74.8			5	SS	100/150mm				o		
4.8	END OF BOREHOLE						74				
							72				

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No. C3

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,858,415; E 348,635 | ORIGINATED BY: KES

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: EFO

DATUM: Geodetic | DATE: November 9, 1983 | CHECKED BY: PC

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.6	GROUND SURFACE							
0.0	Topsoil							
0.1	Silty clay, some sand, trace gravel. Grey and brown mottled. Hard	1	SS	52	elev. 78.8 m Nov.30, 1983			
78.2 / 1.4	Till-Silty sand, trace to some clay and gravel, numerous cobbles and boulders below 4.0 m depth. Dense to very dense. Grey	2	SS	43		78	o	16 46 27 11
		3	SS	37			o	
		4	SS	100/150mm		76		
			*			74		
73.5 / 6.1	END OF BOREHOLE					72		

*Note: No samples obtained in cobbles and boulders below 4m depth.

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF TEST PIT No C4

METRIC

W P EGG-000-40 LOCATION N 4,858,438; E 348,646 ORIGINATED BY KES

DIST 6 HWY GO-ALRT TEST PIT TYPE Hand Dug COMPILED BY EFO

DATUM Geodetic DATE November 8, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.0	GROUND SURFACE										
0.0	Fill -Silty clay, with sand, some gravel, trace organics. Dark brown		1	CS	-	DRY Nov. 8, 1983			o		19 29 24 28 organic content = 7%
79.5											
0.5	BOTTOM OF TEST PIT										
							79				

OFFICE REPORT ON SOIL EXPLORATION

Transportation and Communications Ontario

RECORD OF TEST PIT No C5

METRIC

W P EGG-000-40 LOCATION N 4,858,435; E 348,645 ORIGINATED BY KES

DIST 6 HWY GO-ALRT TEST PIT TYPE Hand Dug COMPILED BY EFO

DATUM Geodetic DATE November 8, 1983 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
81.2	GROUND SURFACE										
0.0	Fill - Silty clay, with sand, some gravel, trace organics.		1	CS	-	DRY Nov. 8, 1983	81		○		
80.7	Dark brown										
0.5	BOTTOM OF TEST PIT										
							80				

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF TEST PIT No C6

METRIC

W P EGG-000-40 LOCATION N 4,858,438; E 348,634 ORIGINATED BY KES

DIST 6 HWY GO-ALRT TEST PIT TYPE Hand Dug COMPILED BY EFO

DATUM Geodetic DATE December 13, 1983 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
80.3	GROUND SURFACE										
0.0	Fill - Silty clay, with sand, some gravel, trace organics. Dark brown		1	CS	-	DRY Dec. 13, 1983	80		o (approx. 28)		
79.8 / 0.5	BOTTOM OF TEST PIT										
							79				

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF TEST PIT No C7

METRIC

W P EGG-000-40 LOCATION N 4,858,424; E 348,632 ORIGINATED BY KES

DIST 6 HWY GO-ALRT TEST PIT TYPE Hand Dug COMPILED BY EEO

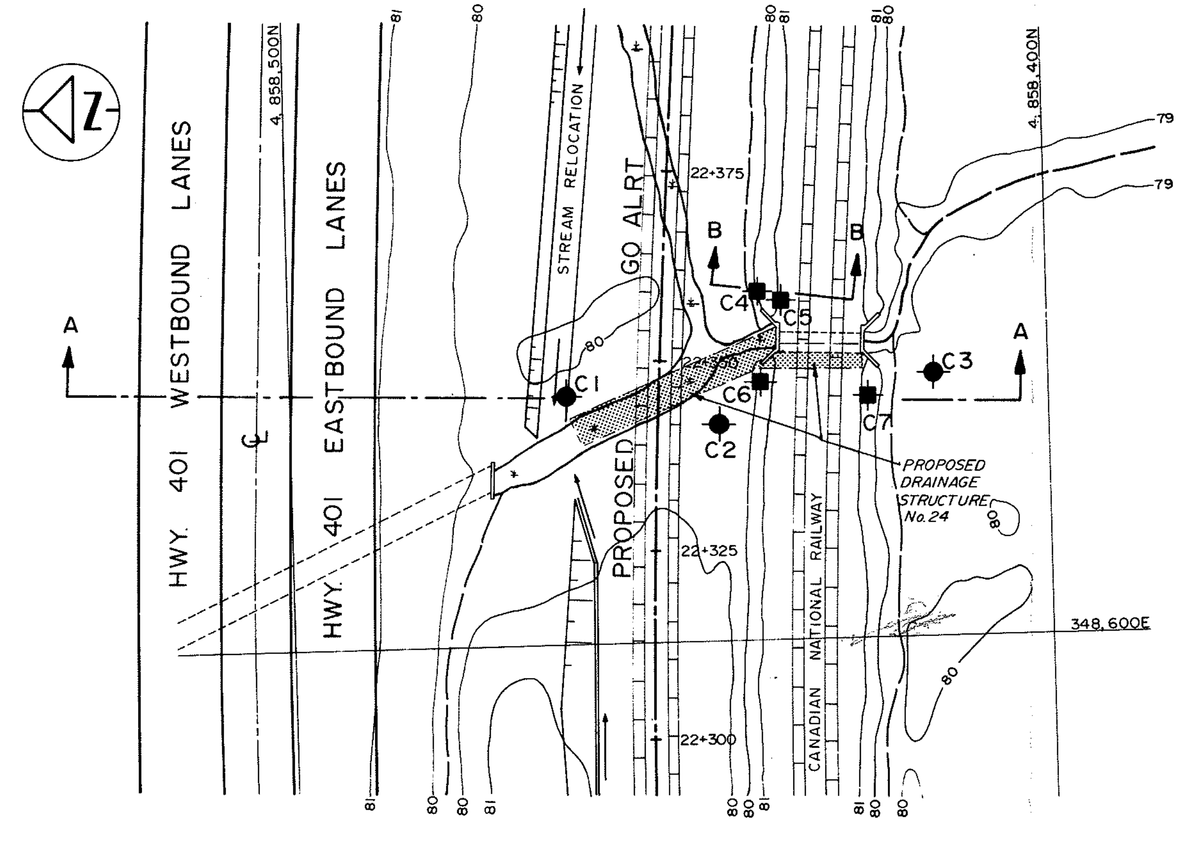
DATUM Geodetic DATE December 13, 1983 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
80.5	GROUND SURFACE										
0.0	Fill - Silty clay, with sand, some gravel, trace organics. Dark brown		1	CS	-	DRY Dec. 13, 1983			○ (approx. 24)		
80.0							80				
0.5	BOTTOM OF TEST PIT										

OFFICE REPORT ON SOIL EXPLORATION

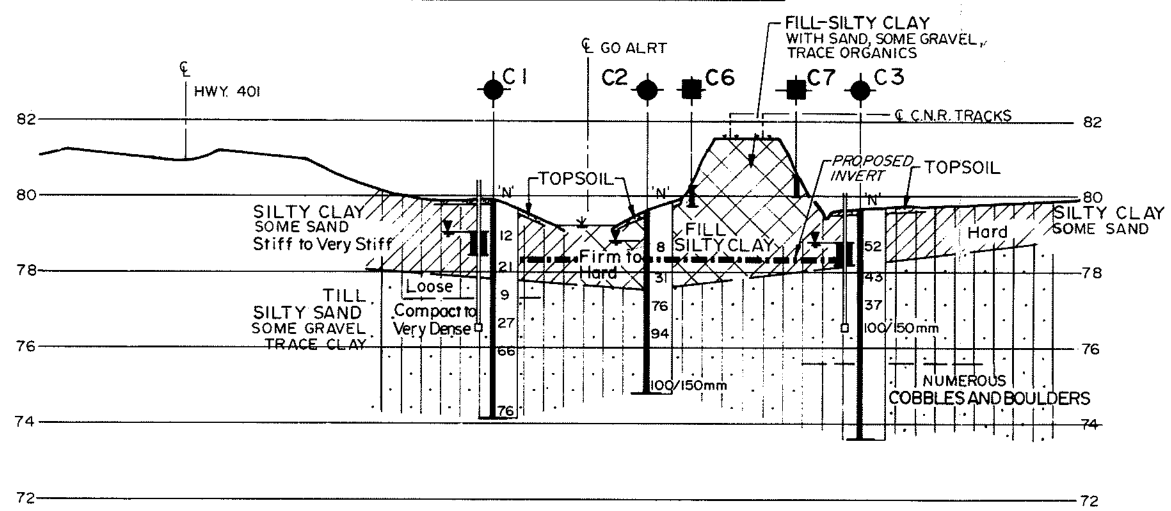
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



PLAN

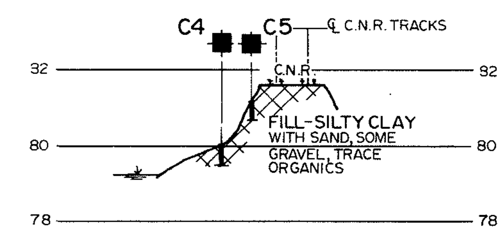
SCALE 10 0 10 20 30 40 50m



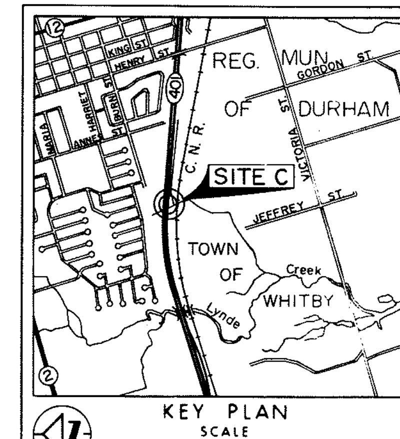
SECTION A-A

HORIZONTAL SCALE 10 0 10 20 30 40 50m

VERTICAL SCALE 2 1 0 2 4 6 8 10m



SECTION B-B



KEY PLAN

SCALE 500 0 500 1000 1500m

LEGEND

- Bore Hole
- Test Pit
- Bore Hole & Cone
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation; NOV., 1983
- Ground Surface
- Bentonite Seal
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
C1	79.9	4,858,463	348,633
C2	79.6	4,858,443	348,629
C3	79.6	4,858,415	348,635
C4	80.0	4,858,438	348,646
C5	81.2	4,858,435	348,645
C6	80.3	4,858,438	348,634
C7	80.5	4,858,424	348,632

Geocres No

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100

GO-ALRT REF PDI-600-474

REFERENCE DRAWINGS	REVISIONS

DRAWN BY: EFO, MHW	DESIGNED BY:
DATE: FEB 10, 1984	
CHK'D BY: PC	APPROVED BY: JRB
SCALE: AS SHOWN	FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER C. W. P. CHAN PROVINCE OF ONTARIO

Golder Associates CONSULTING GEOTECHNICAL AND MINING ENGINEERS

GO-ALRT

Ministry of Transportation and Communications

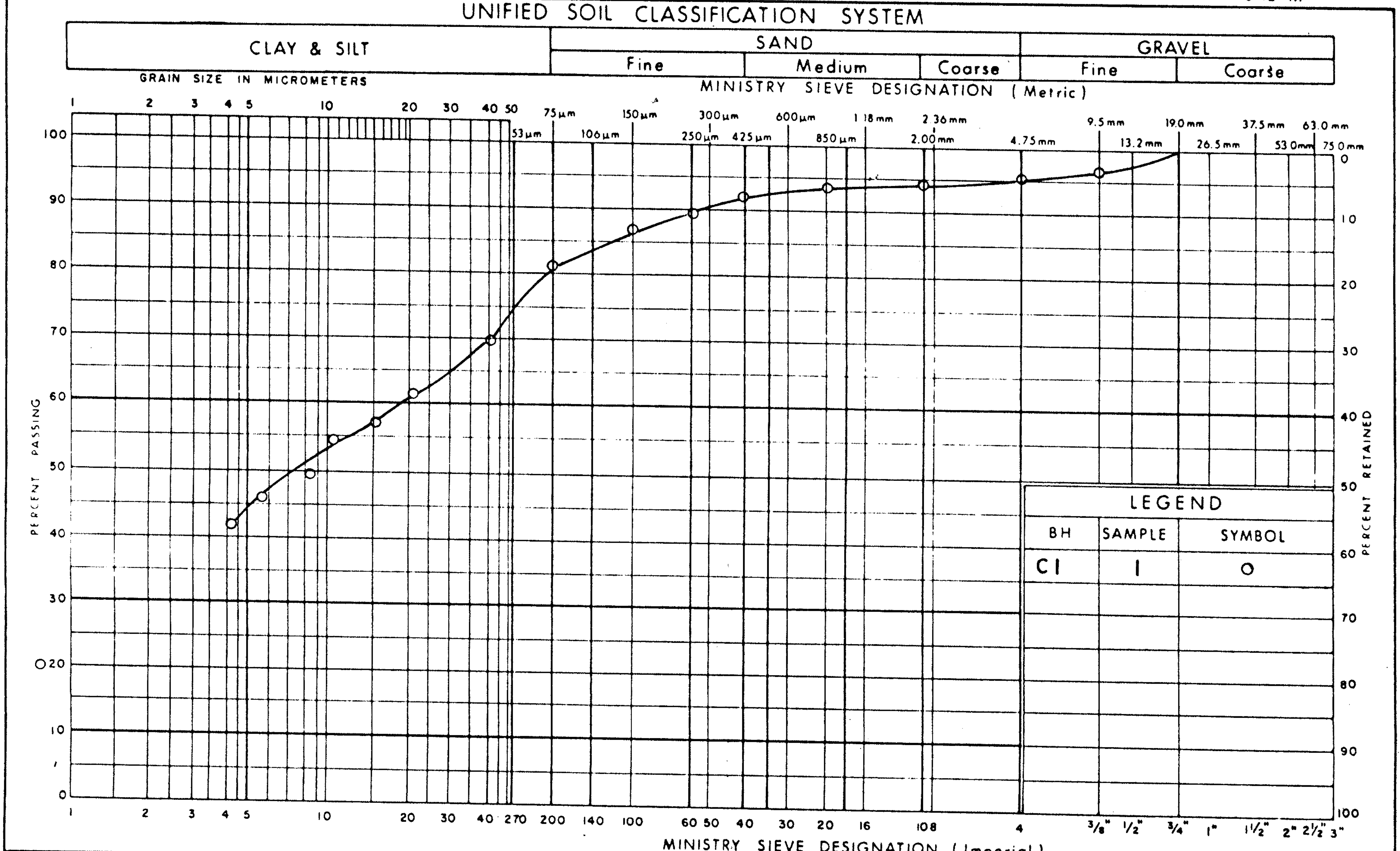
PICKERING TO OSHAWA

PROJECT MANAGER

PROPOSED CULVERT
GO ALRT EXTENSION-WHITBY
STA. 22+345
BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO	DWG NO	REV	SHEET
	EGG00040C		

78 12 M



Ministry of Transportation and Communications
Ontario

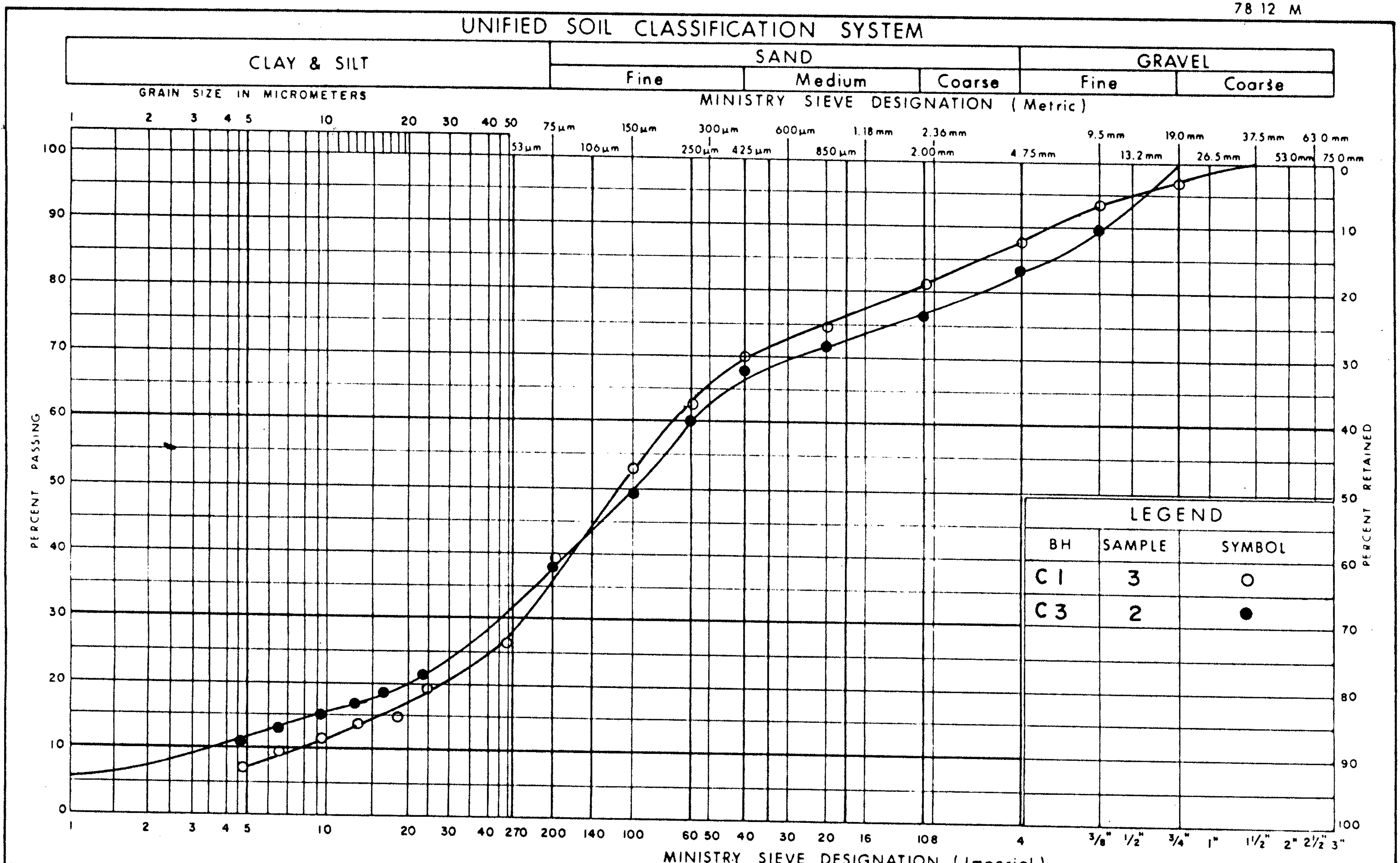
GRAIN SIZE DISTRIBUTION

SILTY CLAY (SITE 'C')

FIG No C-1

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications
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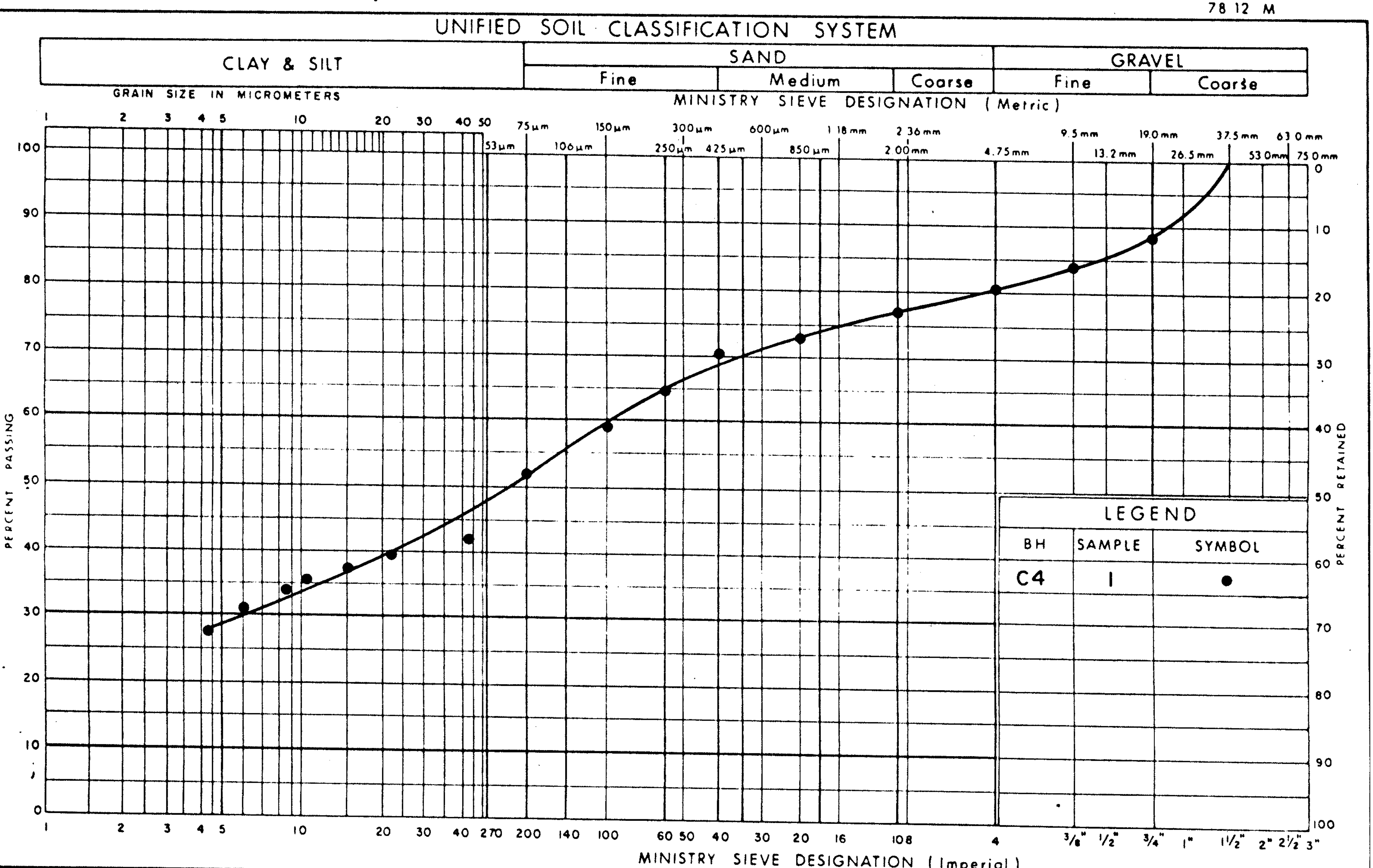
GRAIN SIZE DISTRIBUTION

SILTY SAND (TILL) (SITE 'C')

FIG No. C-2

W.P EGG-000-40

78 12 M



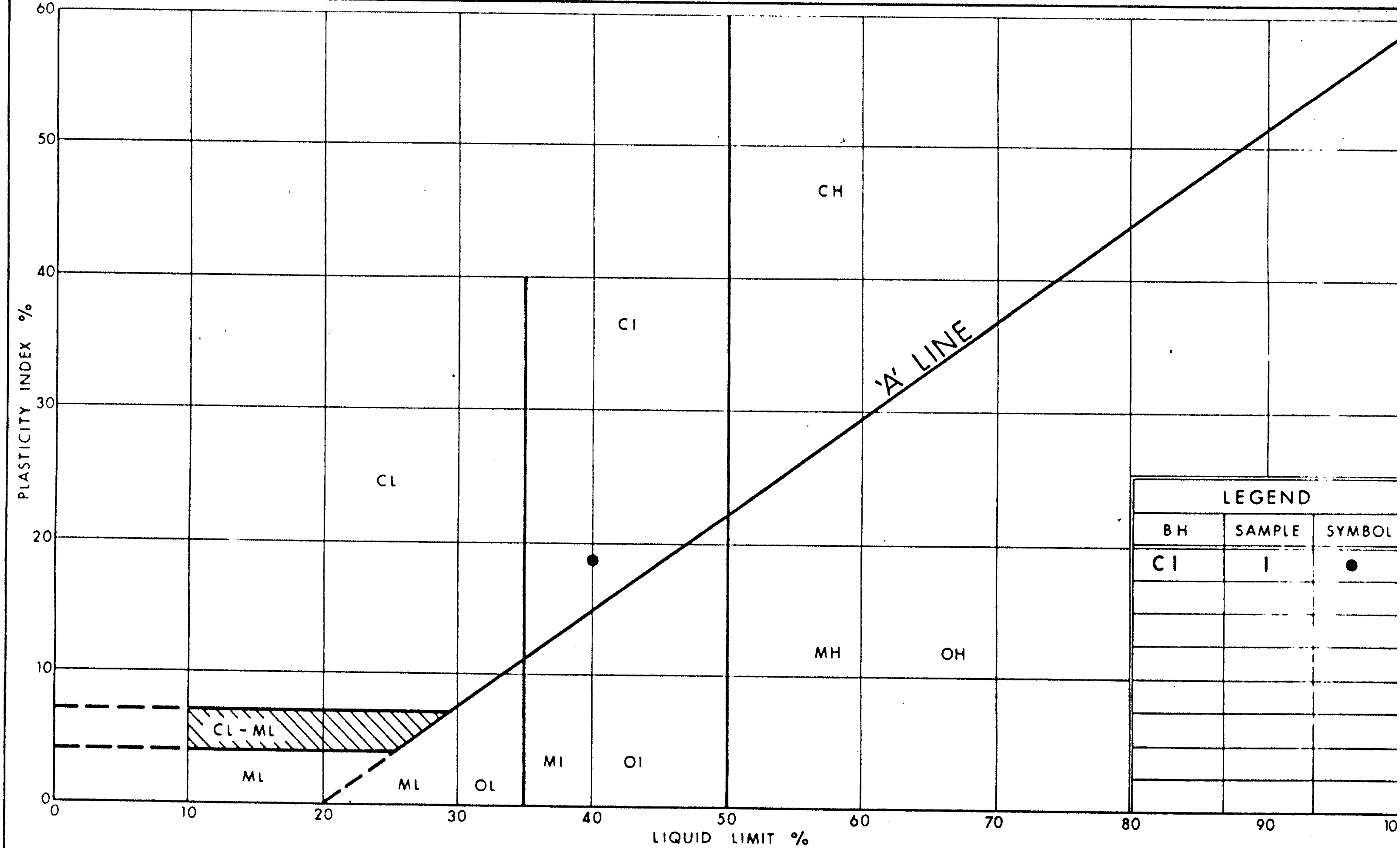
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY, WITH SAND, SOME GRAVEL
(FILL) (SITE 'C')

FIG No C-3

W P EGG-000-40

Oct 75, FF-S-21



LEGEND

BH	SAMPLE	SYMBOL
C I	1	●

Ministry of Transportation and Communications
Ontario

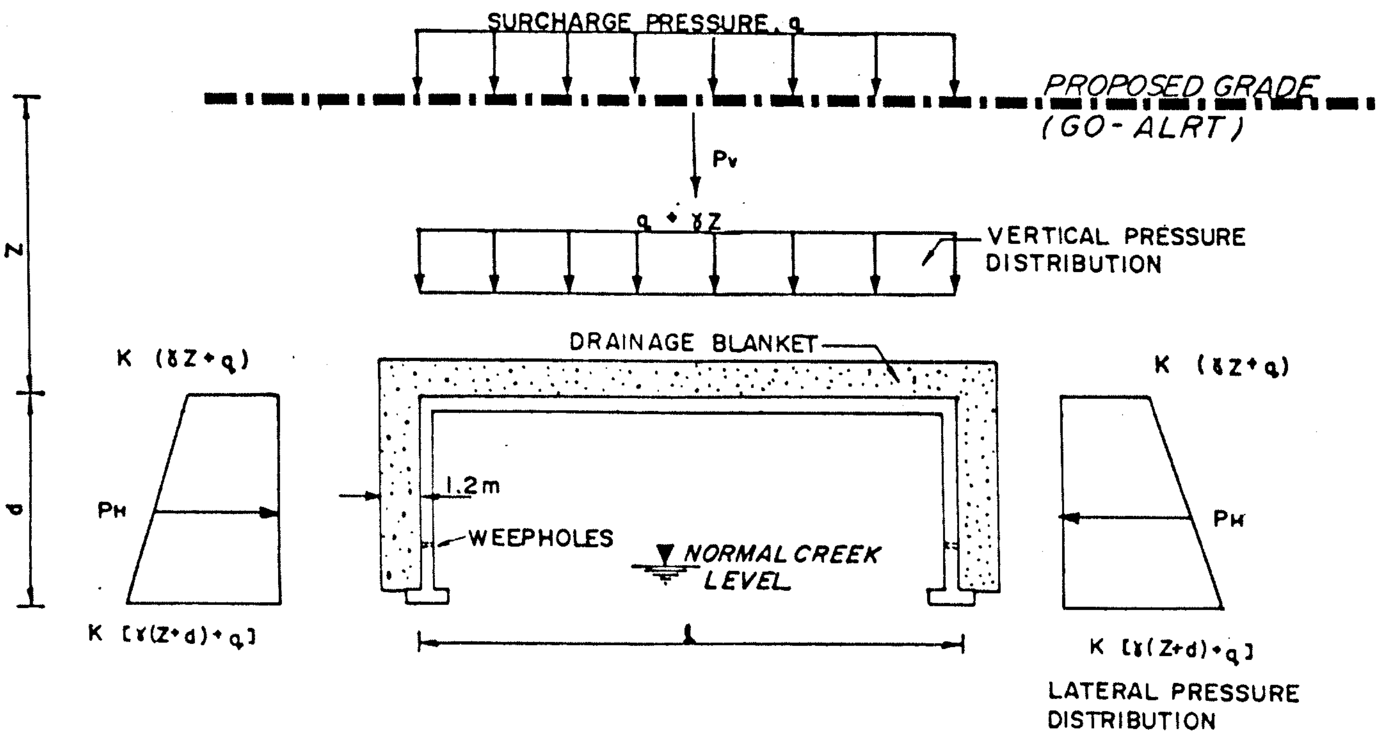
PLASTICITY CHART

SILTY CLAY
(SITE 'C')

FIG No C-4

W P EGG-000-40

· 75 · 5 ·



$P_H = K\ d[\gamma(Z + \frac{d}{2}) + q]$ where

$P_V = \ell(\gamma Z + q)$

K = LATERAL EARTH PRESSURE COEFFICIENT.

γ = UNIT WEIGHT OF SOIL = 21 kN/cu m

d = HEIGHT OF STRUCTURE

Z = DEPTH OF COVER

ℓ = WIDTH

NOT TO SCALE

Ministry of Transportation and Communications
Ontario

DESIGN PRESSURES FOR CONCRETE CULVERT

FIG No C-5

W P EGG-000-40

<u>SITE D</u>

March, 1984

831-1272

Ontario Communications

RECORD OF BOREHOLE No. D10 METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,429; E 338,210 ORIGINATED BY PC

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 7, 1983 CHECKED BY PC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	SHEAR STRENGTH kPa (+ FIELD VANE)	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.0	GROUND SURFACE							
0.1	Asphalt							
	Fill-Silty sand, trace clay, trace organics to 1.2m depth.	1	SS	27				
	Loose to compact Brown	2	SS	8	84			
83.6 / 2.4	Silty clay, some sand trace gravel. Yellow and grey mottled	3	SS	18				
82.3	Stiff	4	SS	8				
3.7	Silty clay, some sand, some thin sand and silt layers.	5	SS	6	82			
						+2; + >96kPa		
		6	SS	4	80	+2; +6; +3; +2		
	Soft to stiff Grey	7	SS	4	78	+4; +2		4 44 26 26
77.1 / 8.9	Till-Silty clay, with sand, trace gravel.	8	SS	29				
75.2	Hard Grey	9	SS	100/150mm	76			
10.8	END OF BOREHOLE				74			

Ground water: elev. 80.5m Nov. 30, 1983

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. D 11

METRIC

W P: EGG-000-40
LOCATION: Co-ordinates N 4,854,472; E 338,181
ORIGINATED BY: KES

DIST: 6 HWY: GO-ALRT
BOREHOLE TYPE: Solid Stem Auger
COMPILED BY: EFO

DATUM: Geodetic
DATE: November 7, 1983
CHECKED BY: PC

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.1	GROUND SURFACE					
0.1	Topsoil					
	Fill-Silty sand, trace gravel, occ. organics	1	SS	4		
84.7 / 1.4	Loose, Brown					
	Silty clay, some sand, trace gravel	2	SS	23		
		3	SS	12		
82.4 / 3.7	Stiff to very stiff, Yellow and grey mottled	4	SS	15	Water level in open hole at elev. 82.4m on Nov. 7, 1983	
	Silty clay, some thin sand and silt layers sand layer between 5.3 and 6.1m depth	5	SS	4		
		6	SS	4		
		7	SS	5		0 2 66 32
		8	SS	5		
		9	SS	4		
78.5 / 7.6	Firm, Grey					
	Silty clay, some sand, trace gravel	10	SS	4		
76.5 / 9.6	Firm, Grey	11	SS	8		
	END OF BOREHOLE					

Elevation scale: 86, 84, 82, 80, 78, 76

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

Transportation and Communications Ontario

RECORD OF BOREHOLE No. D1

METRIC

W P EGG-000-40 — LOCATION Co-ordinates N 4,854,378; E 338,003 — ORIGINATED BY PC

DIST 6 HWY GO-ALRT — BOREHOLE TYPE Solid Stem Auger — COMPILED BY RWR

DATUM Geodetic — DATE November 1, 1983 — CHECKED BY PC

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.5	GROUND SURFACE					
0.1	Topsoil					
	Fill - Silty clay, with sand, trace gravel, trace rootlets.	1	SS	12		
87.4	Stiff Brown	2	SS	9		6 47 28 19
2.1	Silty clay, some sand, trace gravel	3	SS	9		
		4	SS	18		
		5	SS	19		
84.3	Stiff to very stiff, Yellow and grey mottled	6	SS	11		
5.2	Silty clay, some thin sand and silt layers	7	SS	4		
		8	SS	4	elev. 83.0 m Nov. 30, 1983	1 5 26 68
82.3	Soft Grey	9	SS	11		
7.2	Till - Sandy silt, trace clay, trace to some gravel	10	SS	18		
		11	SS	100/250 mm		
		12	SS	101		
76.9	Compact to Very Dense Grey	13	SS	90		
12.6	END OF BOREHOLE					

Elevation scale: 88, 86, 84, 82, 80, 78, 76

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No.D2

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,359; E 338,017 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 9, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.7	GROUND SURFACE										
0.1	Topsoil										
	Silty clay, some sand, trace gravel		1	SS	7						
			2	SS	30		86				
	Firm to very Stiff — Yellow and grey mottled		3	SS	22						
84.0			4	SS	13						
3.7	Silty clay, some sand, trace gravel		5	SS	7		84				
			6	SS	4						14 29 29 28
82.4	Firm — Grey										
5.3	Till-Silty clay, with sand, trace gravel.		7	SS	46		82				
			8	SS	51						
80.7	Hard — Grey					▽	Water level in open hole at elev. 81.0 m on Nov. 9, 1983				
7.0	END OF BOREHOLE						80				

OFFICE REPORT ON SOIL EXPLORATION

Ontario Commu...

RECORD OF BOREHOLE No. D3

METRIC

W P EGG-000-40 | LOCATION Co-ordinates N 4,854,328; E 338,034 | ORIGINATED BY PC

DIST 6 HWY GO-ALRT | BOREHOLE TYPE Solid Stem Auger | COMPILED BY RWR

DATUM Geodetic | DATE November 7, 1983 | CHECKED BY PC

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	WATER CONTENT (%) (PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.0	GROUND SURFACE									
0.1	Asphalt									
87.2	Fill - Silty sand Brown				▼	Water level in open hole at elev. 87.1 m on Nov.7, 1983				
0.8	Silty clay, some sand, trace gravel	1	SS	5						
		2	SS	27		86				
		3	SS	17						6 1 41 52
84.3	Firm to very stiff Yellow and grey mottled	4	SS	18						
3.7	Silty clay, some thin sand and silt layers.	5	SS	6		84	+4, +4, + >96kPa			
82.2	Firm to stiff Grey					82				
5.8	Till - Silty clay, with sand, some gravel.	6	SS	46						19 46 16 19
79.9	Hard Grey	7	SS	88		80				
8.1	END OF BOREHOLE					78				

OFFICE REPORT ON SOIL EXPLORATION

Ontario Communications

RECORD OF BOREHOLE No. D4

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,424; E 338,057 ORIGINATED BY PC

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY RWR

DATUM Geodetic DATE November 2, 1983 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.8	GROUND SURFACE							
0.1	Topsoil; Fill - Silty sand and gravel, Dense, Brown							
86.6 / 1.2	Silty clay, some sand, trace gravel. Stiff to very stiff. Yellow and grey mottled	1	SS	30				
		2	SS	24		86	~20	
		3	SS	19				
84.1		4	SS	12			~20 (Wp ~11)	
3.7	Till - Sandy silt, trace clay, increasing silt content with depth. Compact to very Dense. Yellowish brown changing to grey below 4.6m depth	5	SS	72	elev. 83.7 m Nov. 30, 1983	84		
		6	SS	26			~20	0 47 44 9
		7	SS	85		82		
		8	SS	110/200 mm			~15	
79.9		9	SS	100/150 mm		80		
7.9	END OF BOREHOLE					78		

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. D5 — METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,854,399; E 338,078 | ORIGINATED BY: ASP

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: RWR

DATUM: Geodetic | DATE: November 3, 1983 | CHECKED BY:

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.2	GROUND SURFACE							
	Topsoil							
86.7 / 0.5	Fill-Silty sand & gravel, Brown							
	Fill - Silty clay, trace sand, occ.rootlets	1	SS	9		86	~28	
85.5 / 1.7	Stiff, Brown	2	SS	13				
	Silty clay, some sand, trace gravel	3	SS	23	Water level in open hole at elev. 84.2m on Nov.3, 1983		~13	
		4	SS	22		84		
	Stiff to hard, Yellow and grey mottled	5	SS	53			~10	3 26 46 25
82.3 / 4.9	Till - Silty clay, with sand, some gravel.	6	SS	77		82		
		7	SS	106			~8	13 47 20 20
79.5 / 7.7	Hard, Grey	8	SS	100/150 mm		80		
	END OF BOREHOLE					78		

Chart headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No D6

METRIC

W P EGG-000-40 | LOCATION Co-ordinates N 4,854,360; E 338,094 | ORIGINATED BY PC

DIST 6 HWY GO-ALRT | BOREHOLE TYPE Solid Stem Auger | COMPILED BY EFO

DATUM Geodetic | DATE November 7, 1983 | CHECKED BY PC

SOIL PROFILE		SAMPLES				
ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.0	GROUND SURFACE					
0.1	Asphalt					
86.1 / 0.9	Fill-Silty clay, some sand trace organics & rootlets. Dark brown					
	Firm	1	SS	9	86	
	Silty clay, some sand, trace gravel.	2	SS	11		
		3	SS	14		
	Stiff to very stiff. Yellow and grey mottled	4	SS	17	84	
83.3 / 3.7	Silty sand Very dense. Yellow and grey mottled	5	SS	100/225mm		
82.7 / 4.3	Till - Silty clay, trace sand and gravel	6	SS	45	82	
		7	SS	100/200mm	80	
79.2 / 7.8	Hard Dark grey	8	SS	100/150mm		
	END OF BOREHOLE				78	

GROUND WATER CONDITIONS: elev. 83.1 m Nov. 30, 1983

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ: →50

OFFICE REPORT ON SOIL EXPLORATION

Ontario Transportation and Communications

RECORD OF BOREHOLE No D7

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,461; E 338,108 ORIGINATED BY ASP

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 3, 1983 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	REMARKS
85.9	GROUND SURFACE					
0.1	Asphalt					
85.1	Fill-Silty sand & gravel Brown					
0.8	Silty clay, some sand, trace gravel	1	SS	15		
		2	SS	10	84	
	Firm to stiff Yellow and grey mottled	3	SS	14		
82.5		4	SS	5		
3.4	Silty clay, some thin sand and silt layers.				82	
		5	TW	PH		
79.5	Firm to stiff Grey	6	TW	PH	80	
6.4	Silty clay, some sand, trace gravel	7	SS	8		
77.7	Stiff to very stiff Grey	8	SS	20	78	
8.2	Shale Bedrock, highly to moderately weathered	9	SS	110		
76.7	Grey to brown	10	SS	100/25mm		
9.2	END OF BOREHOLE				76	

Ground water: elev. 81.4m Nov. 30, 1983

Shear strength (field vane): 4, >96kPa, 13, 5

OFFICE REPORT ON SOIL EXPLORATION

Ontario Transportation and Communications

RECORD OF BOREHOLE No D8

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,431; E 338,114 ORIGINATED BY ASP

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 3, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.7	GROUND SURFACE						
0.1	Asphalt						
86.0 / 0.7	Fill-Silty sand and gravel. Brown					86	
85.0 / 1.7	Silty clay, some sand trace gravel. Firm to stiff. Yellow and grey mottled	1	SS	7			
	Silty clay, some thin sand and silt layers	2	SS	16			
		3	SS	9		84	
		4	SS	7			0 1 46 53
		5	SS	6			
		6	SS	2	▼	82	
	Greyish brown, changing to grey below 3.7m depth	7	TW	PH		80	
78.5 / 8.2	Soft to stiff	8	SS	11			
77.5	Till-Silty clay, with sand, trace gravel. Hard. Grey to brown	9	SS	52		78	
9.3	END OF BOREHOLE	10	SS	142/225mm			
	Shale Bedrock highly to moderately weathered. Brown					76	

Water level in open hole at elev. 82.1m on Nov. 3, 1983

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100); field vane values noted: 7, 5, 7, 2

PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No D9

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,854,484; E 338,172 ORIGINATED BY PC

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 2, 1983 CHECKED BY PC

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	UNIT WEIGHT γ kN/m³	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.2	GROUND SURFACE					
0.1	Topsoil					
85.0	Fill-Silty clay, trace to some sand and gravel. Firm, Brown	1	SS	6		
1.2	Silty clay, some sand, trace gravel	2	SS	9		
		3	SS	13		
82.5	Stiff, Yellow and grey mottled	4	SS	14		
3.7	Silty clay, some thin sand and silt layers sand layer between 6.1 and 6.7m depth.	5	SS	2		
		6	TW	PH	19.7	0 1 56 43
		7	SS	5		
		8	SS	3		
76.7	Soft to stiff, Grey	9	SS	4		
9.5	Till-Silty clay, with sand, trace gravel.	10	SS	100/200mm		
75.2	Hard, Dark grey	11	SS	100/150mm		
11.0	END OF BOREHOLE					

GROUND WATER CONDITIONS: elev. 80.7 m Nov. 30, 1983

ELEVATION SCALE: 86, 84, 82, 80, 78, 76, 74

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100

Field vane values: +3, +3, +4, +2, + >84 kPa

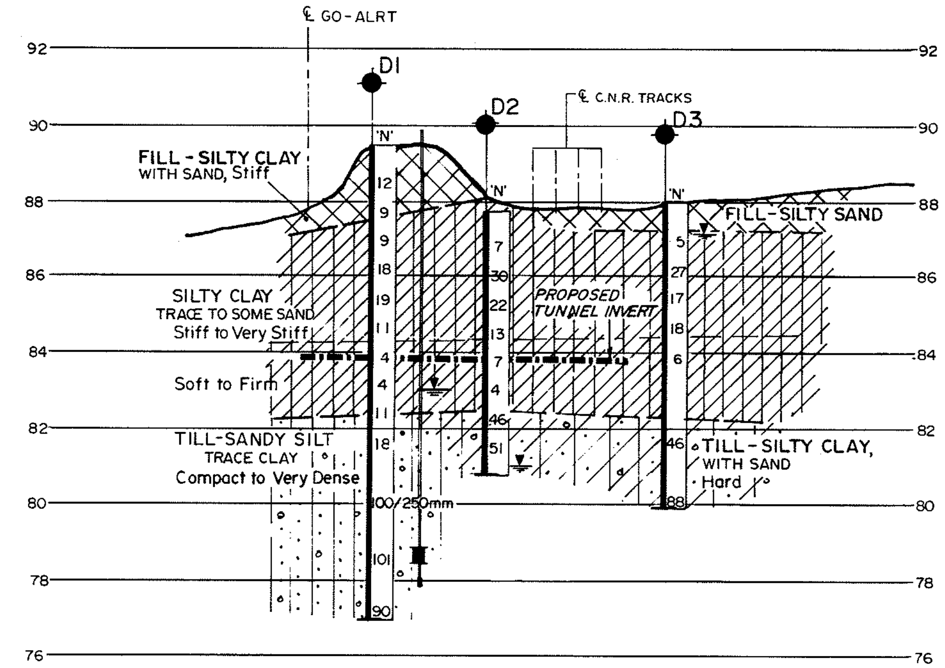
PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L – WATER CONTENT (%): 10 20 30

REMARKS & GRAIN SIZE DISTRIBUTION (%)

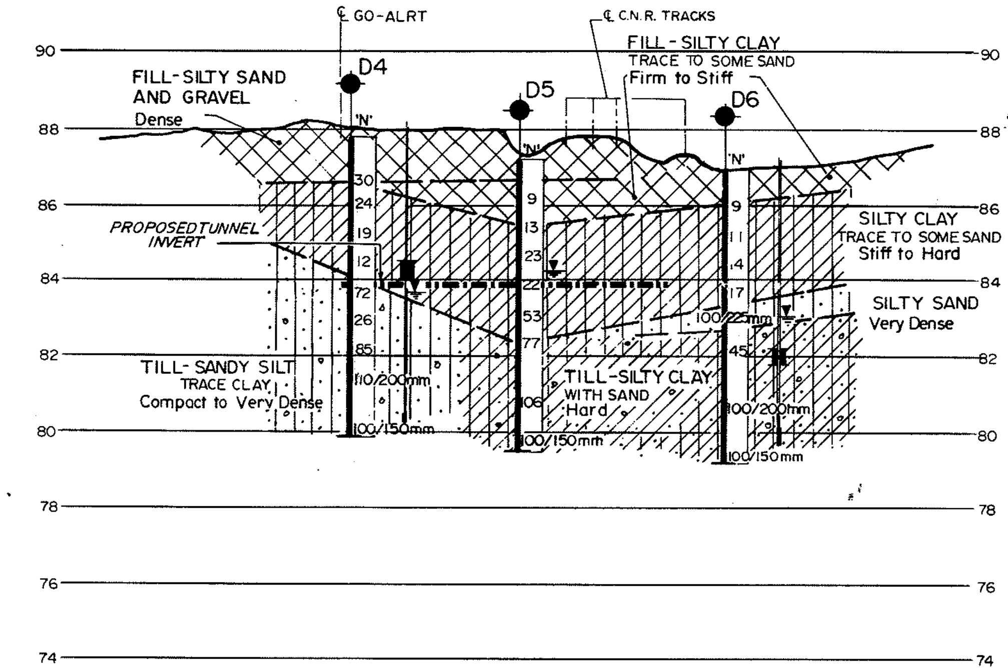
OFFICE REPORT ON SOIL EXPLORATION

METRIC

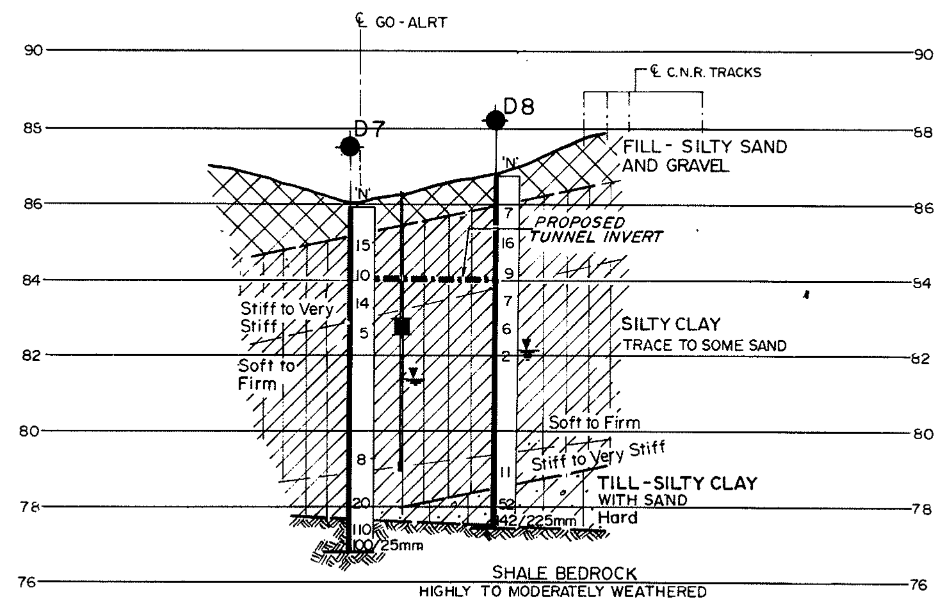
ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



SECTION A-A



SECTION B-B

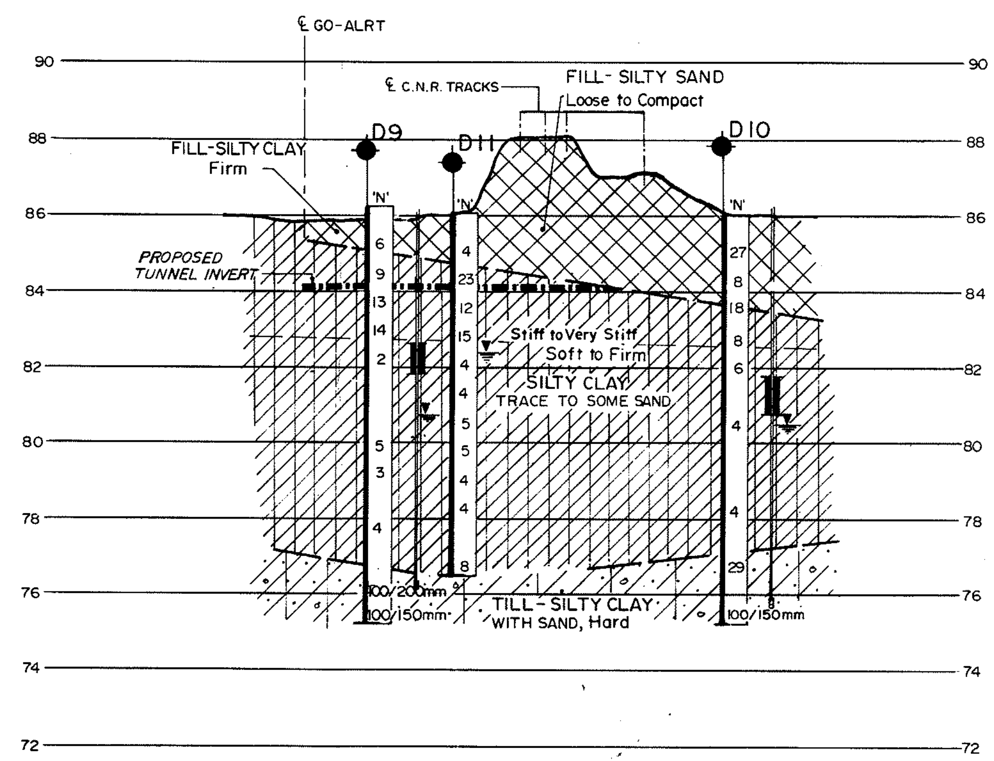


SECTION C-C

SCALE

HOR. 10m 5 0 10 20 30 40 50m

VERT. 2m 1 0 2 4 6m



SECTION D-D

SEE DWG. No. EGG00040D - I

KEY PLAN
SCALE

LEGEND

Symbol	Description
●	Bore Hole
⊕	Dynamic Cone Penetration Test (Cone)
◆	Bore Hole & Cone
N	Blows/0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
▽	W L at time of investigation, NOV. 1983
	Ground Surface
	Bentonite Seal
	Piezometer

No	ELEVATION		
	SEE DWG. No. EGG00040D - I		

Geocres No

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation or design report for this project, and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

GO-ALRT REF PDI-600-185

REFERENCE DRAWINGS	REVISIONS

DRAWN BY: RWR, MHW
DATE: FEB.13,1984
DESIGNED BY:
CHK'D BY: P.C
APPROVED BY: JRB
SCALE: FULL SIZE ONLY AS SHOWN

REGISTERED PROFESSIONAL ENGINEER C.W.P. CHAN PROVINCE OF ONTARIO

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

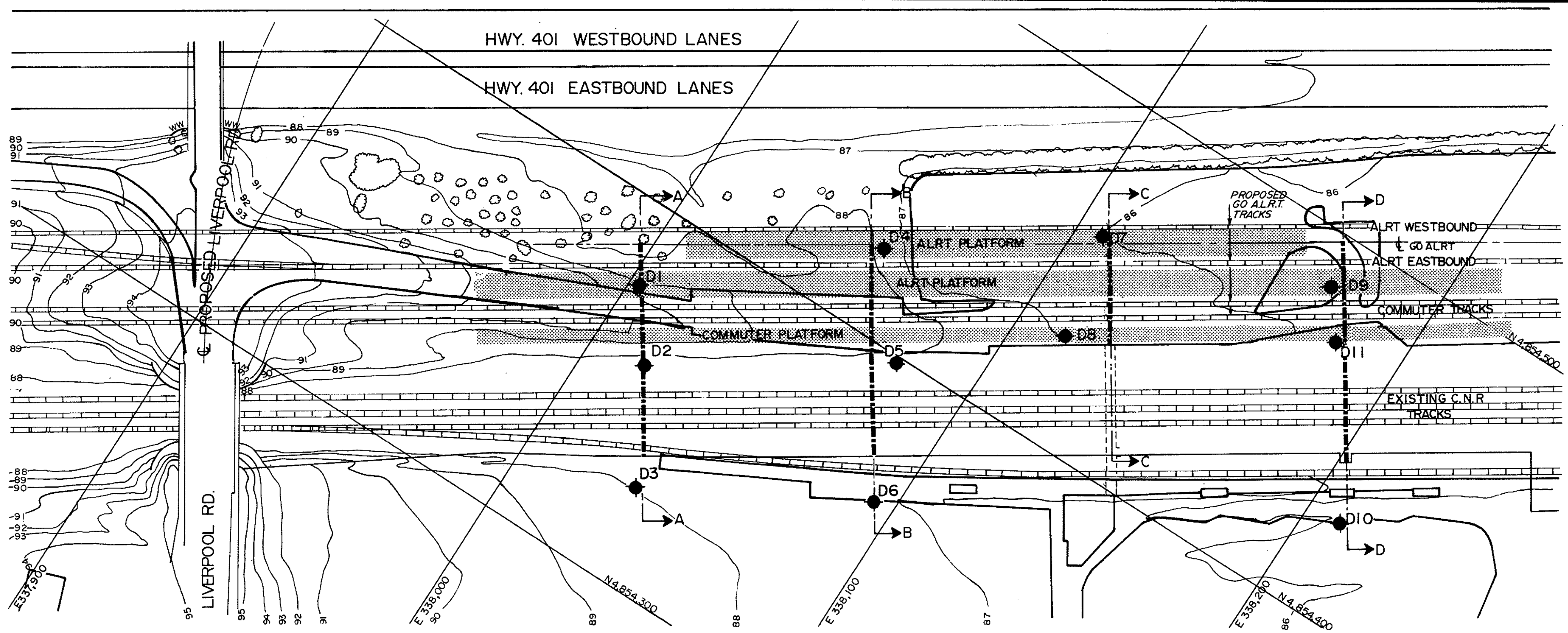
GO-ALRT
Ministry of Transportation and Communications
PICKERING TO OSHAWA
PROJECT MANAGER

PROPOSED PEDESTRIAN TUNNELS
LIVERPOOL ROAD STATION - PICKERING
BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO	DWG NO	REV	SHEET
	EGG 000 40 D-2		

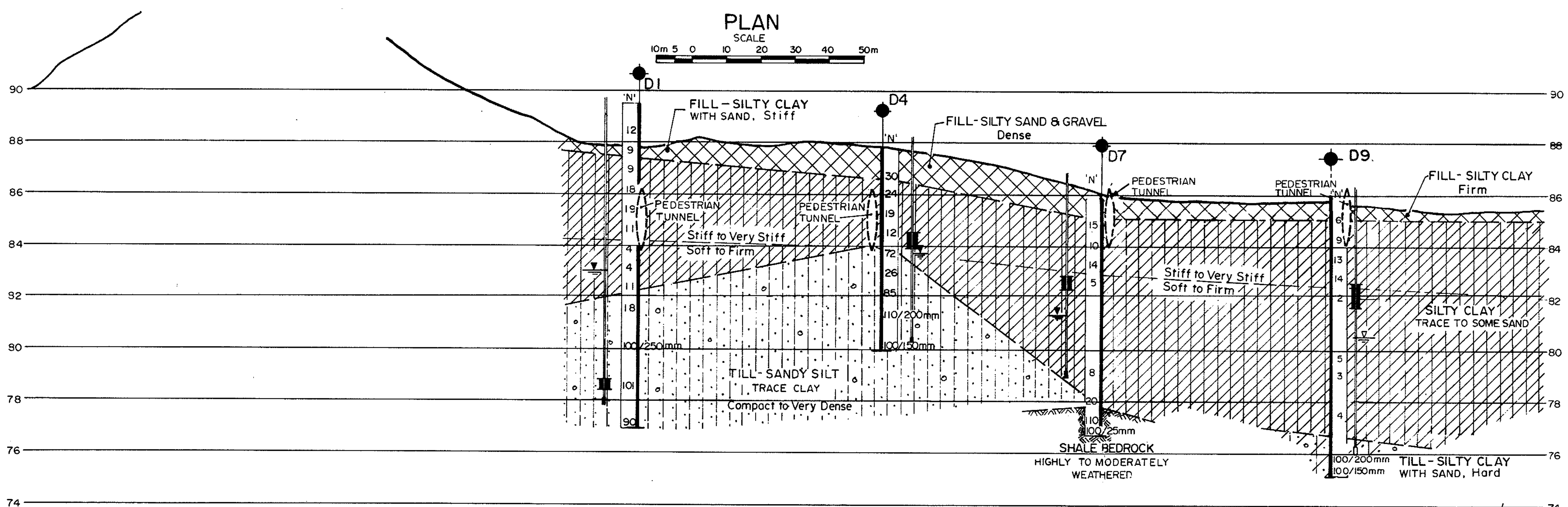
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



PLAN

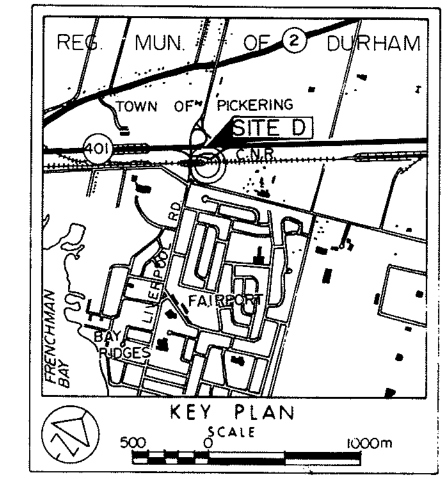
SCALE 10m 5 0 10 20 30 40 50m



GO A.L.R.T ℄ PROFILE

SCALE
HOR. 10m 5 0 10 20 30 40 50m
VERT. 2m 1 0 2 4 6m

NOTE: SEE DWG. EGG00040D-2 FOR SECTIONS A-A TO D-D



KEY PLAN
SCALE 500 0 1000m

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation, Nov. 1983
- Ground Surface
- Bentonite Seal
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
D1	89.5	4,854,378	338,003
D2	87.7	4,854,359	338,017
D3	88.0	4,854,328	338,034
D4	87.8	4,854,424	338,057
D5	87.2	4,854,399	338,078
D6	87.0	4,854,360	338,094
D7	85.9	4,854,461	338,108
D8	86.7	4,854,431	338,114
D9	86.2	4,854,484	338,172
D10	86.0	4,854,429	338,210
D11	86.1	4,854,472	338,181

Geocres No

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

GO-ALRT REF PDI-600-185

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: RWR., MHW. DATE: FEB. 13, 1984	DESIGNED BY:
		CHK'D BY: PC	APPROVED BY: JRB
		SCALE: AS SHOWN	FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER C W P CHAN PROVINCE OF ONTARIO

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

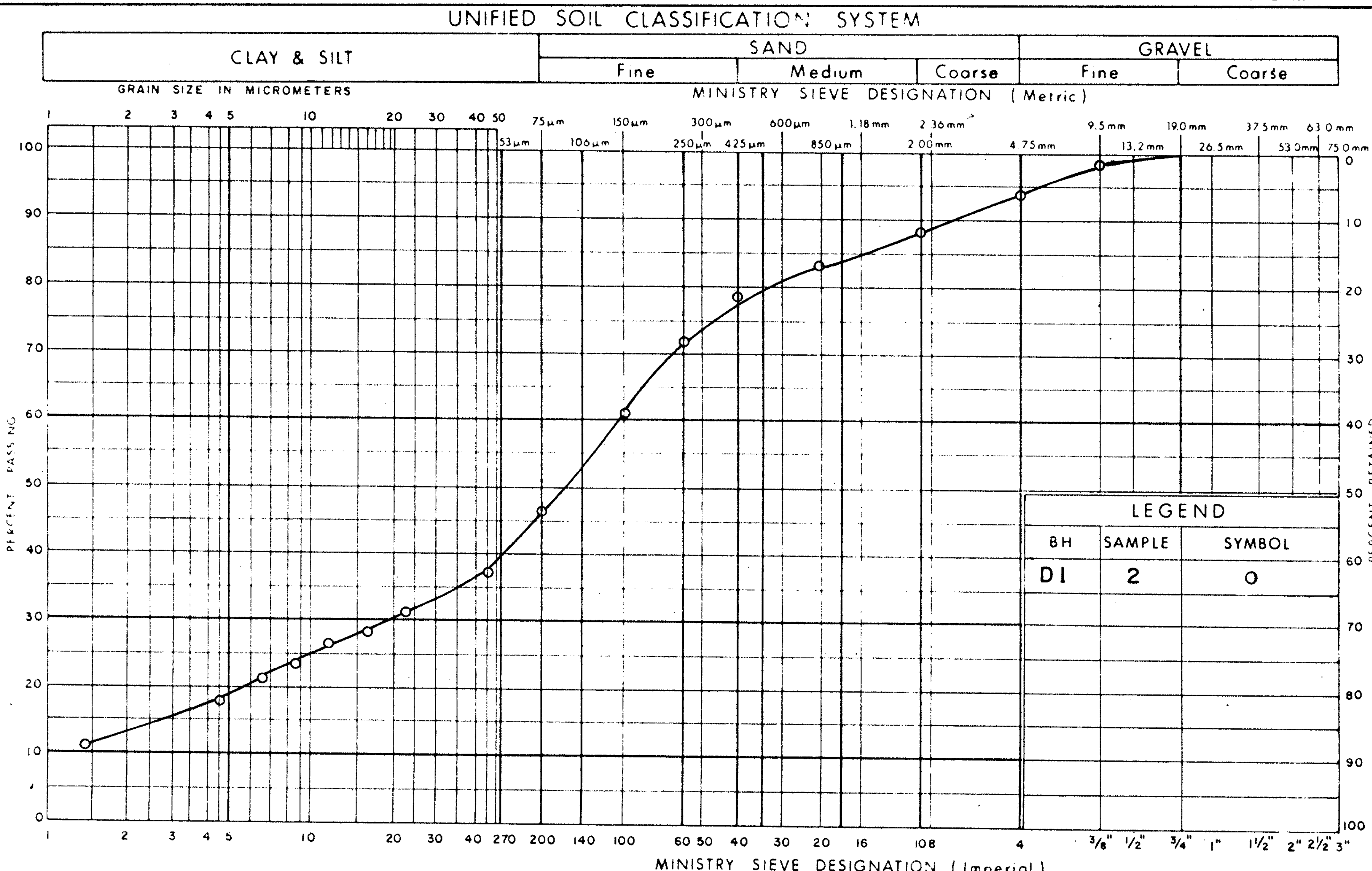
GO-ALRT
Ministry of Transportation and Communications
PICKERING TO OSHAWA

PROJECT MANAGER

PROPOSED PEDESTRIAN TUNNELS
LIVERPOOL ROAD STATION - PICKERING
BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO	DWG NO	REV	SHEET
	EGG 000 40 D-1		

78 12 M



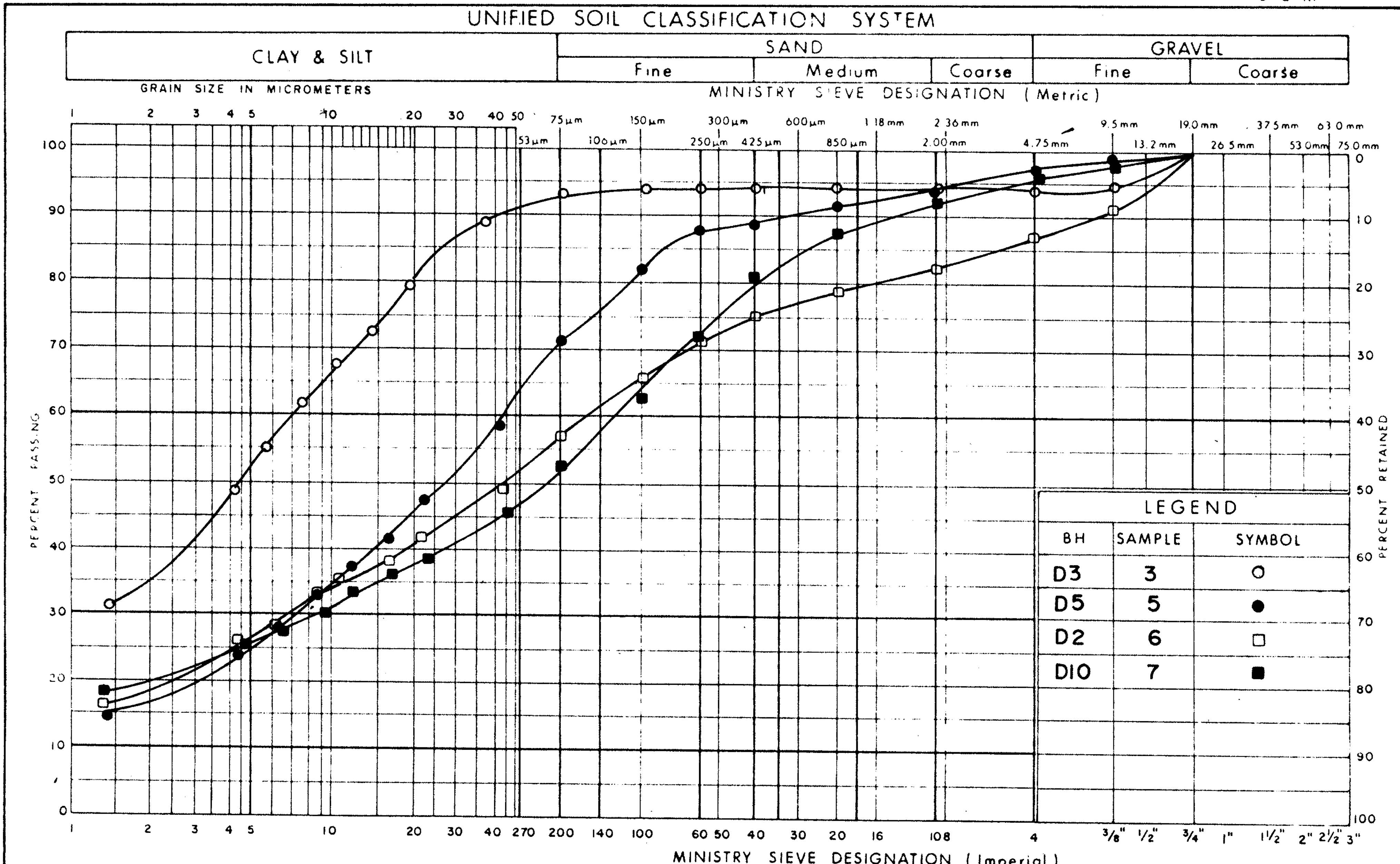
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY, WITH SAND (FILL)
(SITE 'D')

FIG No D-1

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications

Ontario

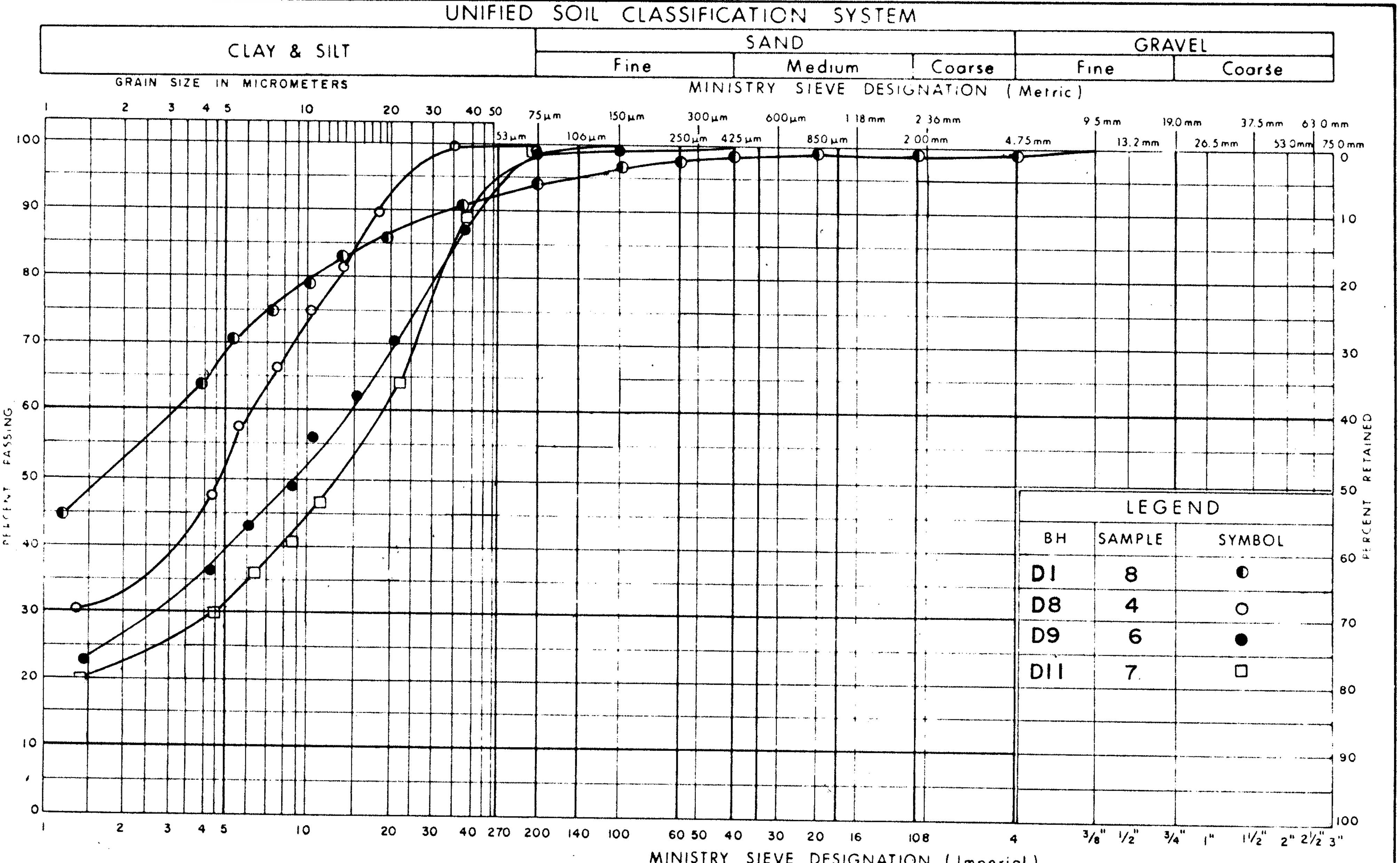
GRAIN SIZE DISTRIBUTION

SILTY CLAY SOME SAND
(SITE 'D')

FIG No D-2

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications
Ontario

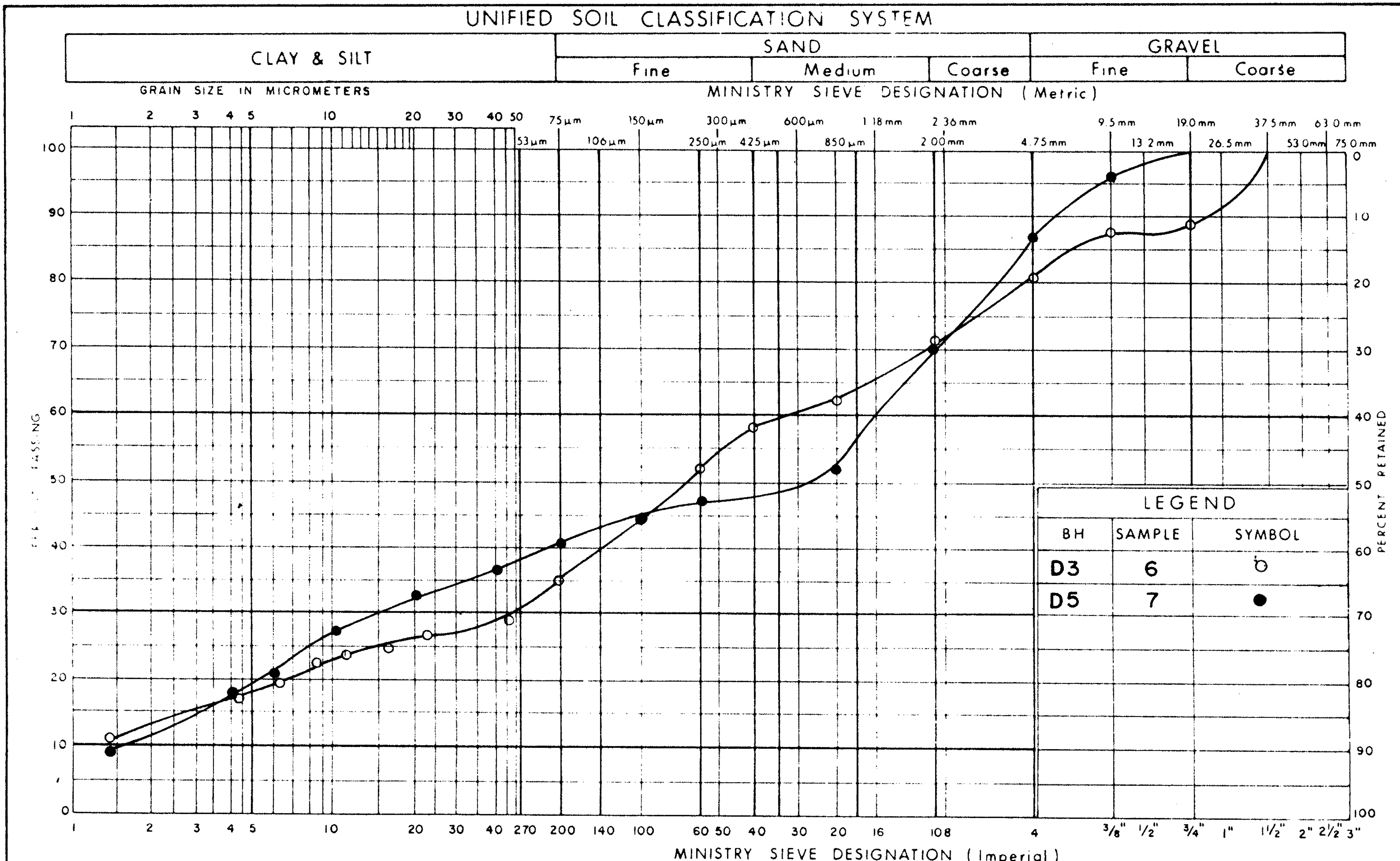
GRAIN SIZE DISTRIBUTION

SILTY CLAY, TRACE SAND
(SITE 'D')

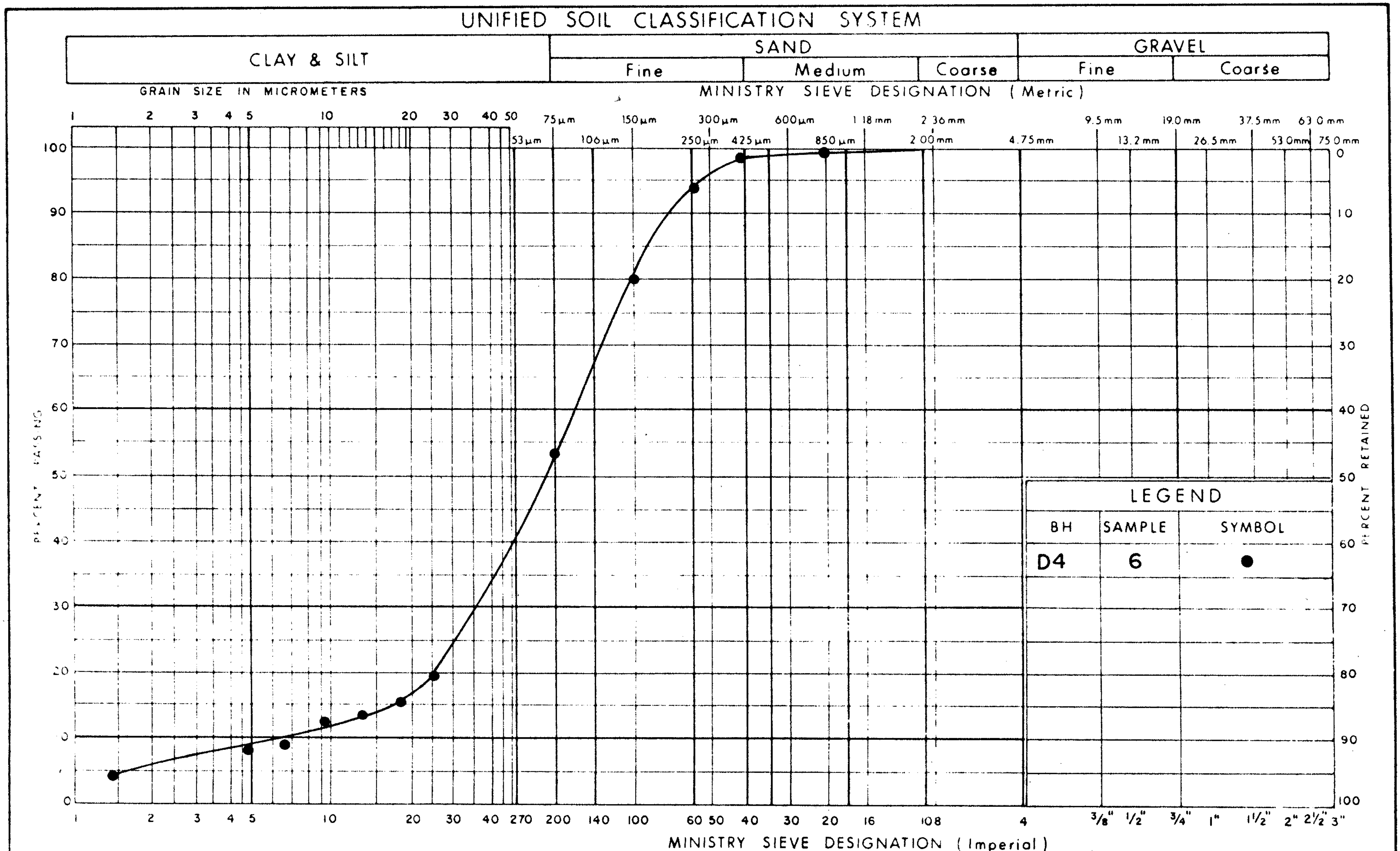
FIG No. D-3

W P EGG-000-40

78 12 M



Ministry of Transportation and Communications, Ontario	GRAIN SIZE DISTRIBUTION SILTY CLAY, WITH SAND, SOME GRAVEL (TILL) (SITE 'D')	FIG No D-4 W P EGG-000-40

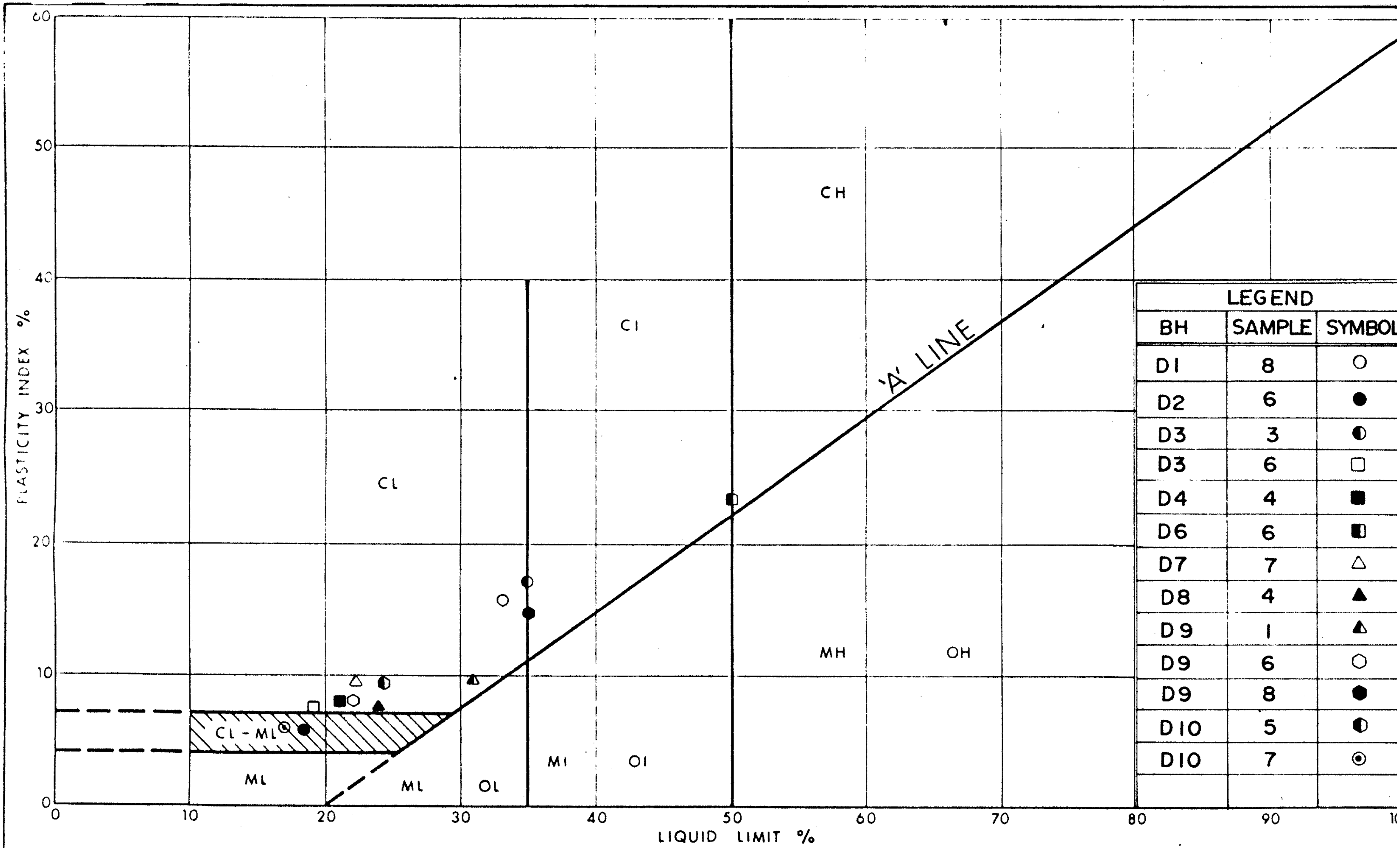


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SANDY SILT (TILL)
(SITE 'D')

FIG No D-5

W P EGG-000-40



Ministry of Transportation and Communications
Ontario

PLASTICITY CHART
SILTY CLAY
(SITE 'D')

FIG No D-6

W P EGG-000-40

<u>SITE E</u>

Ontario Communications

RECORD OF BOREHOLE No. E1

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,335; E 341,559 ORIGINATED BY PC

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 4, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.1	GROUND SURFACE										
0.1	Topsoil					*					
	Till - Sandy silt, some clay and gravel occasional silt partings.		1	SS	59		92				
			2	SS	84				○		
			3	SS	70		90		○		
88.3	Very dense Greyish brown		4	SS	100/250mm						
4.8	END OF BOREHOLE						88				

* Note: Open hole dry on Nov. 4, 1983.

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. E2 — METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,856,323; E 341,565 | ORIGINATED BY: PC

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: EFO

DATUM: Geodetic | DATE: November 4, 1983 | CHECKED BY: PC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.8	GROUND SURFACE							
0.0	Fill-Pieces of coal							
92.7 / 1.1	Loose Black	1	SS	6				
		2	SS	40		92	o	7 47 38 8
	Greyish brown	3	SS	79	elev. 90.8m Nov. 30, 1983		o	
	Till-Sandy silt, some clay, trace gravel.					90		
		4	SS	100/100mm			o	
		5	SS	100/180mm		88	o	7 47 34 12
86.2	Very dense Grey	6	SS	50/25mm				
7.6	END OF BOREHOLE					86		

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. E3

METRIC

W P EGG-000-40 LOCATION Co-ordinates N 4,856,294; E 341,567 ORIGINATED BY KES

DIST 6 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY EFO

DATUM Geodetic DATE November 10, 1983 CHECKED BY PC

ELEV DEPTH	DESCRIPTION (SOIL PROFILE)	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.8	GROUND SURFACE						
0.0	Fill-Silty clay, some sand, trace gravel, occasional rootlets.	1	SS	100/25mm			
		2	SS	22		92	4 35 36 25
91.1	Very stiff Greyish brown	3	SS	21			
2.7	Till - Sandy silt, some clay, trace gravel, increasing silt content with depth, occasional sand partings.	4	SS	4			
		5	SS	17		90	4 41 36 19
		6	SS	58			
		7	SS	54		88	
	Greyish brown	8	SS	85			2 37 47 14
	Grey; Loose to very dense				▼ Water level in open hole at elev. 86.9m on Nov. 10, 1983		
85.8		9	SS	73		86	
8.0	END OF BOREHOLE					84	

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

OFFICE REPORT ON SOIL EXPLORATION

Ontario

RECORD OF BOREHOLE No. E4

METRIC

W P: EGG-000-40 | LOCATION: Co-ordinates N 4,856,345; E 341,639 | ORIGINATED BY: PC

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: Solid Stem Auger | COMPILED BY: EFO

DATUM: Geodetic | DATE: November 4, 1983 | CHECKED BY: PC

ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
92.8	GROUND SURFACE						
0.2	Topsoil						
	Silty clay, trace to some sand, occasional sand partings. Soft to stiff, Greyish brown	1	SS	3		92	
90.7		2	SS	11	elev. 90.4m Nov. 30, 1983		0 10 45 45
2.1	Till - Sandy silt, some clay, occasional inter-layered fine and coarse sand seams.	3	SS	23		90	
		4	SS	32			
		5	SS	70			2 27 49 22
		6	SS	60		88	
86.3	Compact to very dense, Grey	7	SS	100 / 250mm			
6.5	END OF BOREHOLE					86	

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ

Bot of caisson

OFFICE REPORT ON SOIL EXPLORATION

Ontario Transportation and Communications

RECORD OF BOREHOLE No. E5

METRIC

W P: EGG-000-40 — LOCATION: Co-ordinates N 4,856,319; E 341,653 — ORIGINATED BY: KES

DIST: 6 — HWY: GO-ALRT — BOREHOLE TYPE: Solid Stem Auger — COMPILED BY: EFO

DATUM: Geodetic — DATE: November 10, 1983 — CHECKED BY: PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS
93.7	GROUND SURFACE							
0.0	Fill-Silty sand, trace of clay and organics		1	SS	9			
92.3	Loose, Brown							
1.4	Silty clay, trace to some sand.		2	SS	27		92	
			3	SS	49			
90.3	Very stiff to hard, Greyish brown		4	SS	52		90	
3.4	Till - Sandy silt, some clay, occasional silt partings.		5	SS	71	Water level in open hole at elev. 89.4 on November 10, 1983		
87.2	Dense to very dense, Greyish brown		6	SS	47		88	
6.5	END OF BOREHOLE						86	

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%): 10 20 30

Water content plotted (natural moisture, approx.): sample 2 ≈ 16%; sample 4 ≈ 15%; sample 6 ≈ 15%

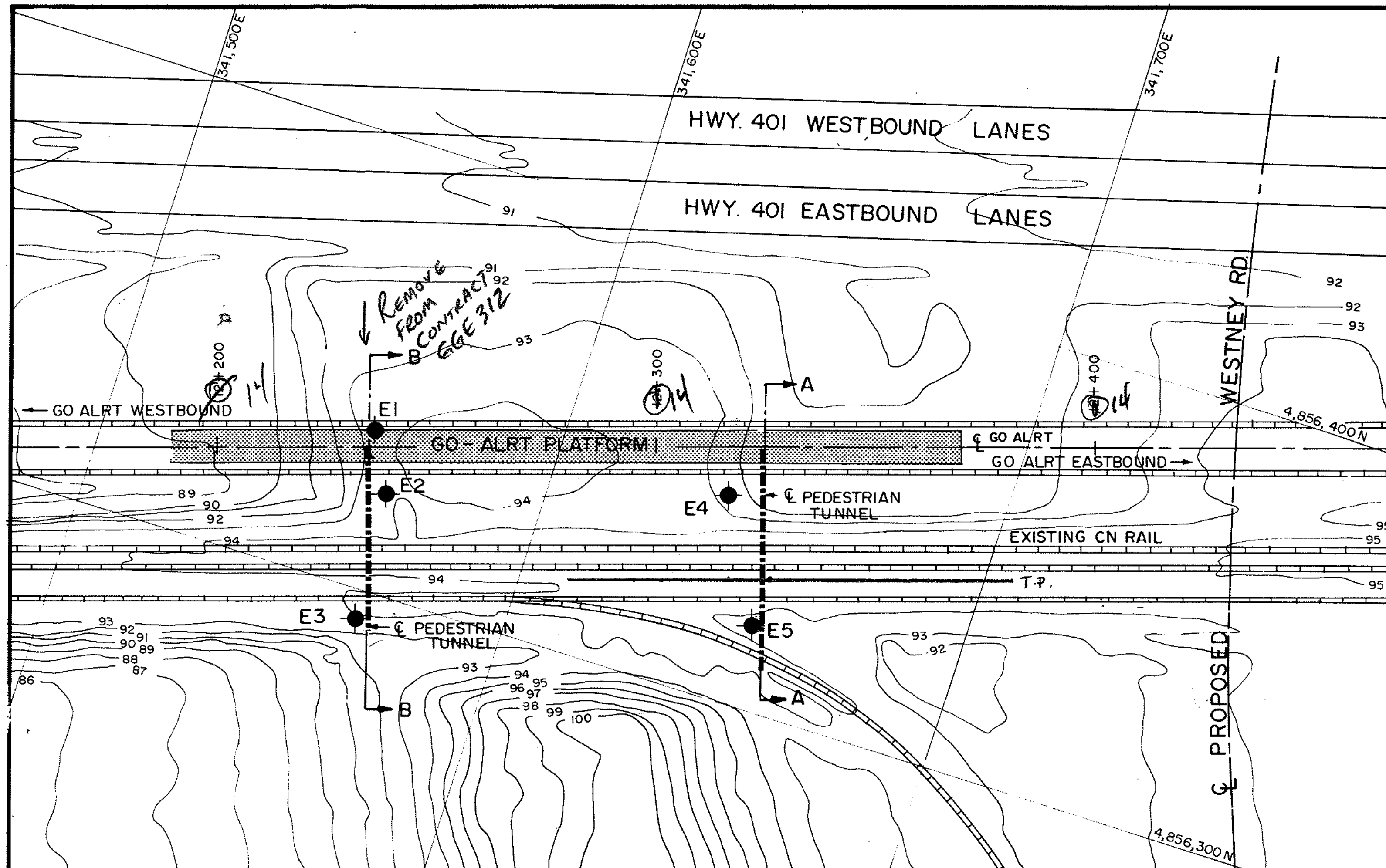
UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

OFFICE REPORT ON SOIL EXPLORATION

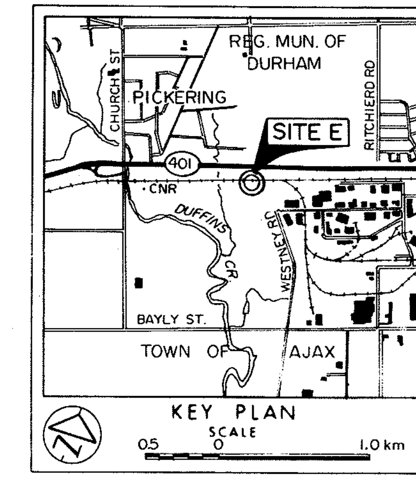
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



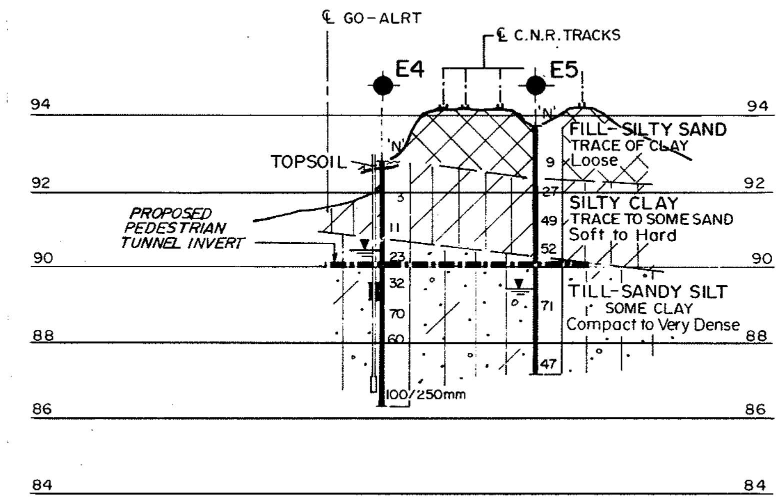
PLAN

SCALE 10 0 10 20 40m



KEY PLAN

SCALE 0.5 0 1.0 km



SECTION A-A

●	Bore Hole
⊕	Dynamic Cone Penetration Test (Cone)
⊕●	Bore Hole & Cone
N	Blows/0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
▽	W.L. at time of investigation, Nov. 83
■	Seal
▯	Piezometer

LEGEND

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
E1	93.1	4,856,335	341,559
E2	93.8	4,856,323	341,565
E3	93.8	4,856,294	341,567
E4	92.8	4,856,345	341,639
E5	93.7	4,856,319	341,653

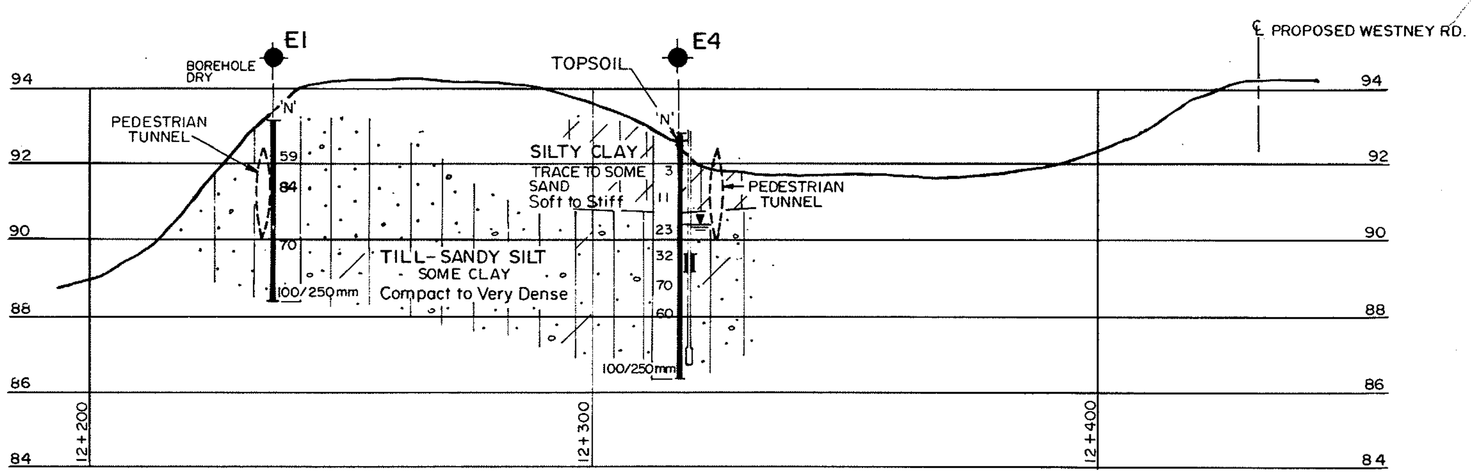
Geocres No

=NOTE=

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100

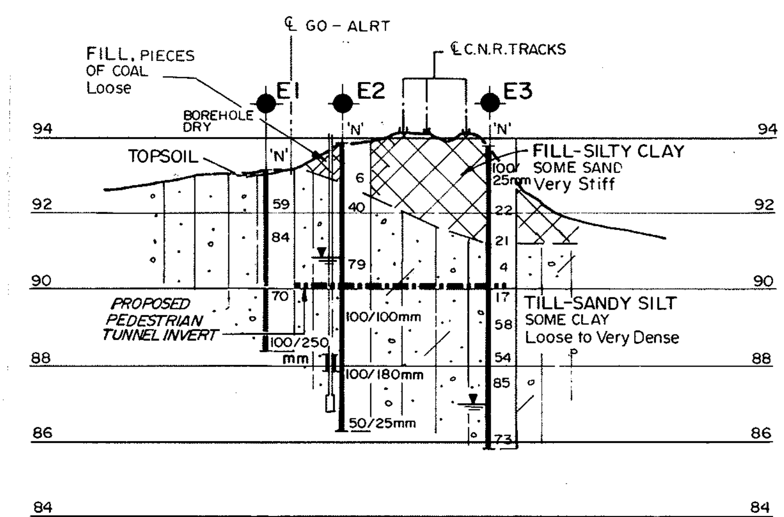
GO-ALRT REF PDI-600-180



GO A.L.R.T. ℄ PROFILE

SCALES, HORIZ. 10 0 10 20 40m

VERT. 2 1 0 2 4m



SECTION B-B

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: MHW DATE: FEB.13,1984	DESIGNED BY:
		CHK'D BY: PC	APPROVED BY: JRB
		SCALE: AS SHOWN	FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER C.W.P. CHAN PROVINCE OF ONTARIO

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

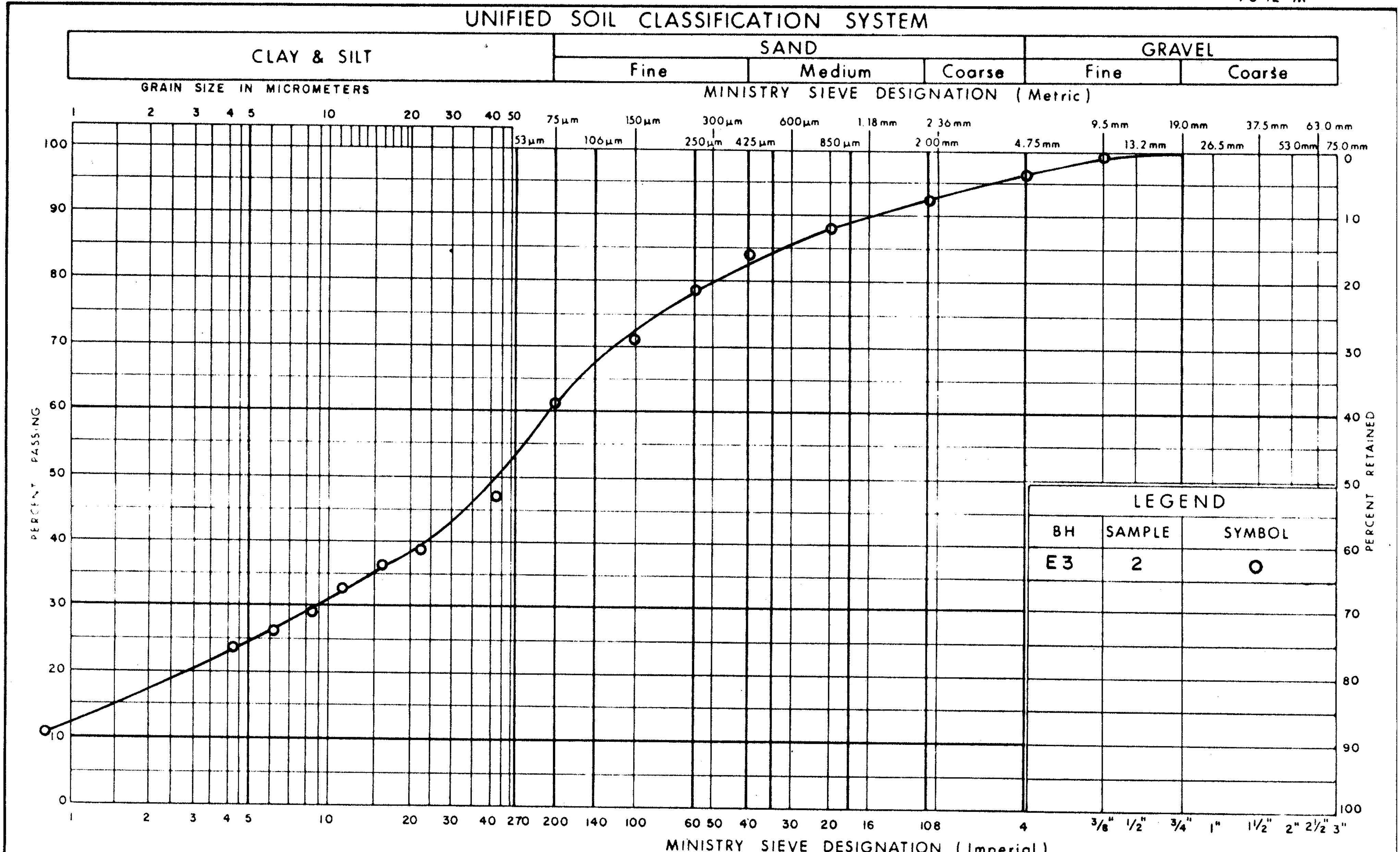
GO-ALRT
Ministry of Transportation and Communications
PICKERING TO OSHAWA

PROJECT MANAGER

PROPOSED PEDESTRIAN TUNNELS
WESTNEY ROAD STATION - AJAX
BOREHOLE LOCATIONS & SOIL STRATA

CONTRACT NO	DWG NO	REV	SHEET
	EGG00040E		

78 12 M



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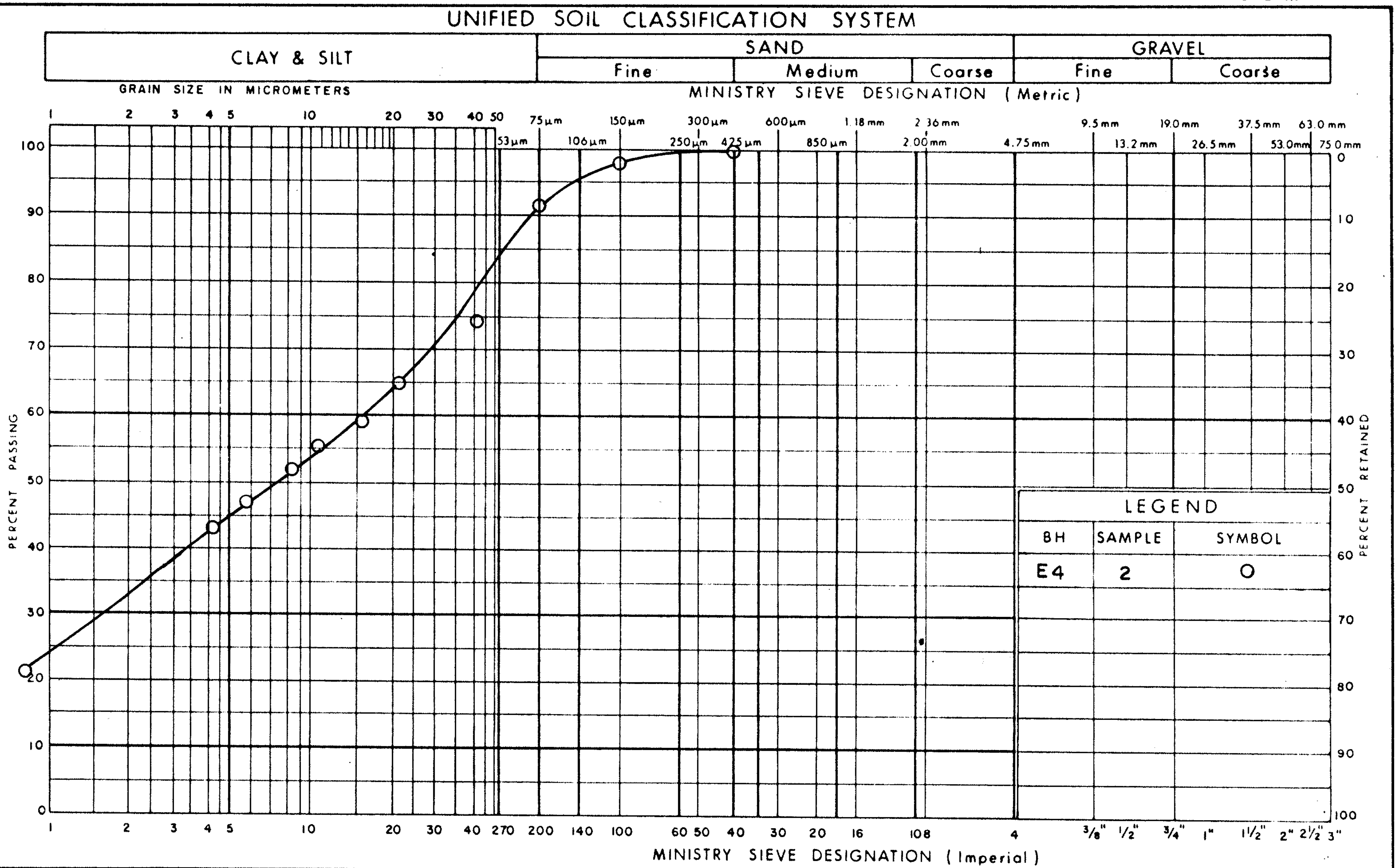
GRAIN SIZE DISTRIBUTION

SILTY CLAY (FILL) (SITE 'E')

FIG No. E-1

W P EGG-000-40

78 12 M



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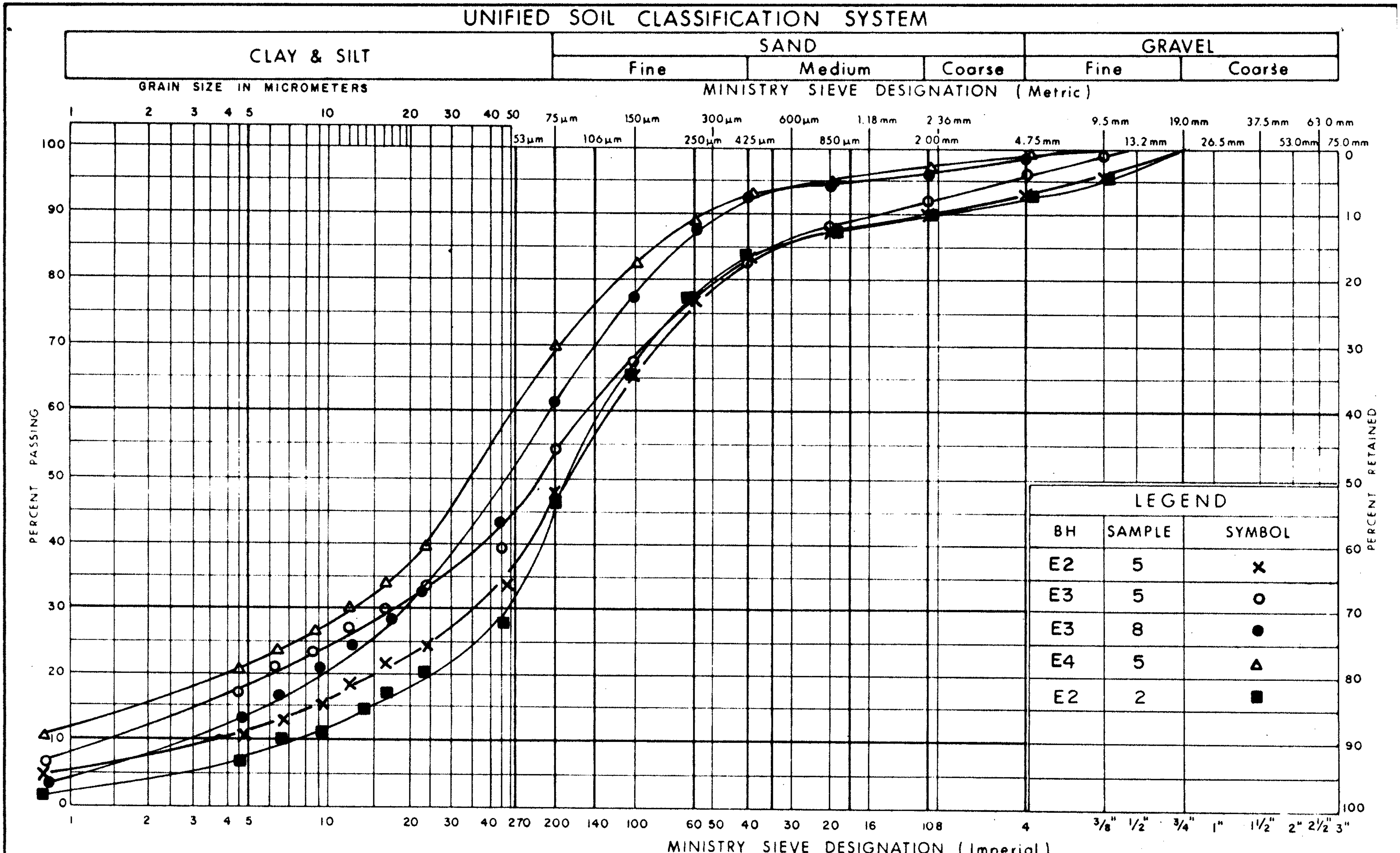
GRAIN SIZE DISTRIBUTION

SILTY CLAY
(SITE 'E')

FIG No E - 2

W P **EGG - 000 - 40**

78 12 M



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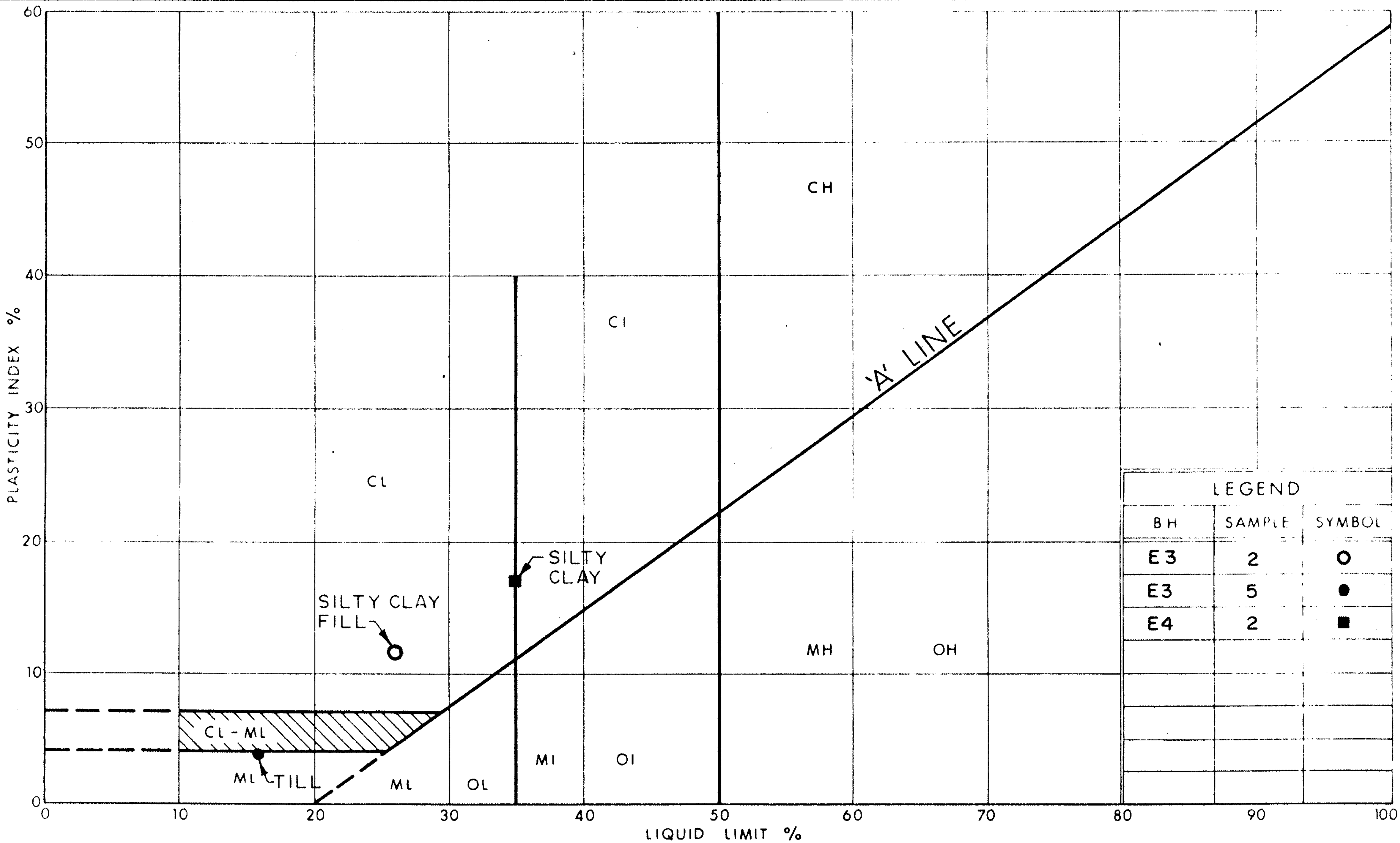
GRAIN SIZE DISTRIBUTION
SANDY SILT (TILL)
(SITE 'E')

FIG No E - 3

W P EGG - 000 - 40

Oct 75, FF-S-21



LEGEND		
BH	SAMPLE	SYMBOL
E3	2	○
E3	5	●
E4	2	■

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PLASTICITY CHART

(SITE 'E')

FIG No E-4

W P EGG - 000 - 40