

FOUNDATION INVESTIGATION REPORT  
PROPOSED RECONSTRUCTION OF  
NON-STRUCTURAL CULVERTS 21A, 24A, 25A AND 27A  
TOWNSHIP OF COLLINGWOOD  
HIGHWAY 26 FROM MEAFORD TO THORNBURY

G.W.P. 57-00-00  
Agreement # 3006-E-0002



I.E.  
Group



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**Prepared for:**

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## **PART A – FOUNDATION INVESTIGATION**

### **1.0 INTRODUCTION**

This report presents the results of a foundation investigation carried out in July and September 2007 by Infrastructure Engineering Group Inc. (IEG) on behalf of Stantec Consulting Ltd. (Stantec).

This assignment involves the rehabilitation of the pavement structure on Highway 26 from 0.2 km east of the Thornbury west limit (Peel Street) westerly 10.06 km to the Town of Meaford east limit.

It includes the rehabilitation and extension of two existing structural culverts, as well as many non-structural culvert extensions and replacements. The project also includes intersection realignments, intersection improvements, construction of two new 1.5 km long passing lanes, minor horizontal and vertical alignment improvements and electrical work. The original assignment included the re-alignment of the Blue Mountains/Meaford Town Line which has been deleted from the assignment.

Foundation investigation and recommendations are required for the design and construction of culvert replacements and extension as part of the improvement of Highway 26. Two (2) structural culverts, twenty-four (24) non-structural culverts, two shale bin replacements, and a high cut area are to be investigated. There is a change in the scope of work to include two additional culvert extensions which were not part of the original scope of work for foundation investigations, and re-allocation of the foundations investigation work for three (3) CSP culverts to the geotechnical investigation portion of this assignment. This report covers the site of Culverts 21A, 24A, 25A and 27A in the Collingwood Township.

Four (4) non-structural culverts are listed in the following table for replacements as per the information supplied by the RFP documents. There is no work required for Culvert 27A as the project develops and as per the final culvert recommendations provided by Stantec. The foundation data and information for Culvert 27A are left in this report for future reference. The locations of these structures are shown in Appendix A, Borehole Location Plan, Drawing 1.

**Table 1**  
**Summary of location, structure type, dimensions**

<b>Culvert #</b>	<b>New Chainage (m)</b>	<b>Existing Culvert Type and Size, W X H</b>	<b>Existing Overfill (m)</b>	<b>Recommended Replacement Culvert Type and Size</b>	<b>Length (m)</b>	<b>U/S Culvert Invert (m)</b>	<b>D/S Culvert Invert (m)</b>
21A	Relocate to 10+100	Concrete 1.5m X 1.2 m	1.9	Precast Concrete Box 1.5m X 0.9m	20.03	Under Development	Under Development
24A	Relocate 10+840	Concrete 1.5m X 0.9 m	0.8	Precast Concrete Box 2.7m X 0.9m	17.59	Under Development	Under Development
25A	Relocate 11+680	Concrete 0.9m X 0.6m	1.0	Precast Concrete Box 2.7m X 1.2m	18.20	Under Development	Under Development
27A	13+731	Concrete 1.8m X 1.2m	1.2	No Work Required	Not Applicable	Not Applicable	Not Applicable

The existing culverts are to be removed and replaced or relocated with new culverts, with box culverts being the preferred structures as per the PDR report. The purpose of the investigation was to obtain information about the subsurface conditions at the site by means of boreholes and, based on the findings, to provide geotechnical recommendations for the foundation elements.

The work presented herein was undertaken under MTO G.W.P. 57-00-00, Agreement No. 3006-E-0002.

Authorization to complete this assignment was given by Mr. Dan Green, P. Eng., of Stantec Consulting Ltd., the TPM Consultant who is completing this assignment for MTO under Agreement # 3006-E-0002.

## **2.0 SITE DESCRIPTION**

### **2.1 Site Location**

These four (4) culverts are located on Highway 26, approximately 0.1 km to 3.7 km east of the junction of St. Vincent and Collingwood Townships. Table 1 summarizes the locations, structure types and dimensions of the existing and replacement culverts as recommended by the PDR and provided in the RFP documents. Locations of the individual culverts are illustrated in the Borehole Location Plan, Drawing 1 presented in Appendix A. The existing concrete culverts, although in good conditions, are hydraulically under capacity.

These culvert sites are generally located within drainage valleys or surface water flow paths. The overfill heights range approximately between 0.8 m and 1.9 m. The embankment slopes are typically 2.5H to 3H:1V and are grass covered. No signs of embankment slope instability were

observed at the time of this foundation investigation. Site photographs taken during a site visit in March 2006 by Stantec are provided in Appendix C.

## **2.2 Physiography and Topography**

The Town of Meaford is situated at the mouth of the Bighead River where the river enters Nottawasaga Bay, part of the Georgian Bay of Lake Huron.

The subsurface of the Town of Meaford is comprised of predominately silty clay, and smooth to gently sloping topography. Pockets of sand and gravelly sands exist which also exhibit smooth to gently sloping topography.

The Town is located on the coastal plain left by glacial Lake Algonquin. East of Meaford, the Algonquin shore cliff coincides with the base of the Niagara Escarpment. The coastal plain in this area consists of sand and gravel beach terraces overlying the bedrock. Overburden thickness is generally less than 5 m.

Bedrock consists of the shale and limestones of the Georgian Bay Formation. Grey, impure carbonate beds (limestone and dolomite) alternate with grey and blue/grey shale.

West of Meaford, the coastal plain consists of the same beach deposits as found in the east. To the west away from the Lake, overburden becomes a glacio-lacustrine derived silt to clayey till. Numerous drumlins of calcareous till with red shale inclusions are found in the Meaford area.

Progressing west on Highway 26 toward Owen Sound and the Niagara Escarpment, the bedrock types progress from Queenston shales, the Clinton and Cataract shales and dolomites to the cap rock of the Amabel dolomites and limestones. Overburden thickness can be as much as 15 m, but is generally less than 5 m.

## **3.0 INVESTIGATION PROCEDURES**

### **3.1 Field Investigation**

Between July 22 and September 18, 2007, a Bombardier-mounted Dietrich drill rig and a truck-mounted CME 55 drill rig, supplied and operated by London Soil Test Ltd. of London, was used on site for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). Three (3) boreholes at each site were drilled and sampled to obtain data for foundation and bedding design of the proposed replacement culverts. The boreholes were drilled to a minimum depth of 3.0 m (or deeper if required) below the culvert inverts to provide sufficient subsurface information for the evaluation of bearing resistances or support of bedding material for the proposed culvert replacements.

It is noted that Boreholes 25A-1 and 27A-1 were hand drilled as the borehole locations were

inaccessible to a drillrig.

The boreholes were advanced using continuous flight solid stem augers. Soil samples were retrieved at selected intervals throughout the depths of the boreholes in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of depth of 0.75 m to the maximum depth of exploration.

The culvert locations are described as 21A, 24A, 25A and 27A. The culvert borehole numbering system was established from the catchment area numbering system used in the Drainage Report of this project, as agreed with Stantec. A letter "A" or "B" was also added after the culvert numbers to delineate Part A or Part B of this assignment.

For the purpose of proper management of the Borehole Logs within gINT, the borehole logging software, a preceding 0 was added to the culverts numbered 1 to 9, with a letter "A" or "B" also added after the culvert numbers to delineate Part A or Part B of this assignment, and the last number being the borehole number at the culvert site, i.e., "21A-1" refers to Borehole 1 at the location of Culvert 21 in Part A, etc.

Field pocket penetrometer was used on the retrieved SPT samples, where applicable, to determine the undrained shear strength of the cohesive soil deposits. These undrained shear strengths are used to supplement the properties of the cohesive soils. It is noted that the measured shear strength value would be slightly lower than the actual value due to sampling disturbance.

Seepage and water levels were noted in each borehole during and at the completion of drilling and sampling. All boreholes were grouted with a bentonite/cement mix at completion of sampling in accordance with Ontario Regulation 903.

Our field engineer, Mr. Ralph Billings, P. Eng., working under the direction of the project engineer, Mr. Eric Chung, P. Eng., supervised the fieldwork. Our field staff cleared the location of buried utilities and logged the boreholes. The soil samples obtained were placed in labeled containers and transported to our London Office for further examination and laboratory testing.

The stations, offsets and ground surface elevations at the as drilled borehole locations were surveyed by AGM London and provided to Infrastructure Engineering Group Inc. for the purpose of this report.

The results of the drilling, sampling, in-situ testing and groundwater observations are summarized on the Record of Borehole sheets and enclosed in Appendix B.

### **3.2 Laboratory Analysis**

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses, Atterberg Limit tests and unit weight tests were performed on selected samples.

The results of the laboratory testing are presented on the Record of Borehole sheets and in the respective figures presented in Appendix B.

### **4.0 SUBSURFACE CONDITIONS**

Reference is made to the respective appendix of each culvert site for the Record of Borehole sheets and Laboratory Test Results (Appendix B) for detailed subsurface soil, bedrock and groundwater conditions encountered in the boreholes. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and, consequently, represent transitions between soil types rather than exact planes of geological change. The soil profiles depicting the subsurface conditions on the respective Borehole Locations will vary between and beyond the borehole locations.

In general, the subsurface deposits encountered in the boreholes put down on the shoulder area at the culvert sites consist of loose to compact embankment fill placed on dense to very dense sandy silt /silty sand till at Culverts 25A and 27 A and stiff to hard silty clay till at Culverts 21A and 24A.

#### **4.1 Fill, Topsoil**

The boreholes at the shoulders generally encountered a 0.2 to 0.3 m thick layer of granular fill (shoulder gravel). The shoulder gravel is underlain by mixed fill materials consisting of predominantly silty clay to clayey silt with sand, gravel and localized zones of organic inclusions, and extended to or slightly below the bottom of the culverts.

The boreholes near the ends of the existing culverts generally encountered a 0.1 to 0.5 m thick layer of topsoil.

Standard penetration tests taken in the mixed fill yielded “N”-values from 6 to 29 blows per 0.3 m, indicative of typically loose to compact compactness condition. The measured natural moisture contents of the mixed fill ranged from 5 to 28%. The higher moisture contents reflect the presence of topsoil and organic matters, as well as wet silty clay.

Grain size distributions of these fill materials are shown on the first figure of the corresponding culvert site in Appendix B, e.g. Figure C-21A.1 refers to the first figure of Culvert 21A, etc.



### Table of Figures of Laboratory Test Results

<b>Culvert Number</b>	<b>Grain Size Figure</b>
21A	C-21A.1
24A	C-24A.1
25A	C-25A.1
27A	C-27A.1

Unit weight of the fill was only determined on one sample due to the disturbance of the soil samples during sampling and sample retrieval. The unit weight of the clayey silt fill found at Borehole 27A-2 was measured to be at 23.4 kN/m<sup>3</sup>.

### 4.2 Silty Sand to Clayey Gravelly Silty Sand (SM to SC-SM-SW)

At Boreholes 24A-1, 25A-1 and 25A-3, the topsoil layer was underlain by a clayey gravelly silty sand, silty sand and gravel and silty sand respectively and extended to depths between 1.52 and 2.29 m. Standard penetration tests yielded “N”-values of 7 to 69 blows per 0.3 m, indicative of loose to very dense compactness condition. The natural moisture contents were 6 and 19%. The loose to compact condition was encountered immediately below the topsoil layer.

Grain size analyses and Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

### Table of Figures of Laboratory Test Results

<b>Culvert Number</b>	<b>Grain Size Figure</b>	<b>Atterberg Limits Figure</b>
24A	C-24A.2	C-24A.3
25A	C-25A.2	C-25A.3

Three (3) Atterberg Limits determinations yielded the following results:

<b>Atterberg Limits</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Average</b>
<b>Liquid Limit (W<sub>L</sub>)</b>	16.0	27.0	21.0
<b>Plastic Limit (W<sub>P</sub>)</b>	13.0	17.0	15.0
<b>Plasticity Index (I<sub>p</sub>)</b>	3.0	10.0	6.0

### 4.3 Silty Clay Till (CL-CI)

At Culverts 21A and 24A, the topsoil layer at the ends of the culvert, under the embankment fill and clayey gravelly silty sand deposit, were underlain by a silty clay silt till stratum which extended to the full depths of boreholes at Culvert 21A, and/or underlain by shale bedrock at Culvert 24A.

Standard penetration tests taken within the silty clay till yielded “N”-values from 8 to over 100 blows per 0.3 m. The natural moisture contents were between 8 and 22%.

Grain size analyses and Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

**Table of Figures of Laboratory Test Results**

<b>Culvert Number</b>	<b>Grain Size Figure</b>	<b>Atterberg Limits Figure</b>
21A	C-21A.2	C-21A.3
24A	C-24A.4	C-24A.5

Thirteen (13) Atterberg Limits determinations on the silty clay till (CL to CI) yielded the following results:

<b>Atterberg Limits</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Average</b>
<b>Liquid Limit (<math>W_L</math>)</b>	26.0	50.0	37.2
<b>Plastic Limit (<math>W_P</math>)</b>	17.0	26.0	21.3
<b>Plasticity Index (<math>I_P</math>)</b>	11.0	24.0	16.2

Undrained shear strength of the silty clay till generally increased with increasing depths. Localized stiff layers of limited thickness were encountered at Borehole 21A-1. The unit weight of the silty clay till was measured between 21.7 and 23.5 kN/m<sup>3</sup>, with an average of 22.9 kN/m<sup>3</sup>.

Based on the above field and laboratory test results, together with visual and tactile examination, the silty clay till deposit generally exhibited very stiff to hard consistency with localized stiff layers.

### 4.4 Sandy Silt to Silty Sand Till (SM-ML)

At Culverts 25A and 27A, the embankment fill, topsoil and silty sand layer (Borehole 25A-3) were underlain by a silty sand to sandy silt till stratum which extended to the full depths of the boreholes or underlain by shale bedrock (Boreholes 25A-2 and 25A-3). Standard penetration

tests taken within the sandy silt to silty sand till yielded “N”-values of 2 to over 100 blows per 0.3 m. The very loose to compact conditions were encountered immediately under the surficial topsoil layer at Borehole 27A-1. Otherwise, this till deposit was in dense to very dense compactness condition. The natural moisture contents were between 6 and 13%.

A silty clay layer was penetrated within the sandy silt till in Borehole 27A-3 at 3.81 m depth. Its grain size distribution and Atterberg Limits are provided in Figures C-27A.4 and C-27A.5.

Grain size analyses and Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

#### Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
25A	C-25A.4	C-25A.5
27A	C-27A.2	C-27A.3

Two (2) Atterberg Limits determinations on the sand to silt till yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit ( $W_L$ )	17.0	19.0	18.0
Plastic Limit ( $W_P$ )	14.0	14.0	14.0
Plasticity Index ( $I_P$ )	3.0	5.0	4.0

The unit weight of the sandy silt till was measured to be between 24.5 and 25.4 kN/m<sup>3</sup>, with an average of 24.9 kN/m<sup>3</sup>.

#### 4.5 Shale Bedrock

The silty clay till at Culvert 24A and the sandy silt till at Culvert 25A were underlain by a stratum of grey shale of the Georgian Bay Formation. The surface of the shale bedrock at Borehole 24A-2 resembles a shale/till complex. Grey, impure carbonate beds (limestone and dolomite (10 to 20 mm thick layers) alternate with grey and blue/grey shale.

A grain size analysis and Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

### Table of Figures of Laboratory Test Results

<b>Culvert Number</b>	<b>Grain Size Figure</b>	<b>Atterberg Limits Figure</b>
24A	C-24A.6	C-24A.7

The results of the Atterberg Limits test are provided below:

<b>Atterberg Limits</b>	<b>%</b>
<b>Liquid Limit (<math>W_L</math>)</b>	37
<b>Plastic Limit (<math>W_P</math>)</b>	19
<b>Plasticity Index (<math>I_p</math>)</b>	18

Standard penetration tests yielded “N”-values over 100 blows per 0.3 m. The measured natural moisture contents ranged from 5 to 17%. The unit weight of a single sample was measured to be 21.9 kN/m<sup>3</sup>.

### 4.6 Groundwater

The groundwater condition was monitored during and upon completion of sampling. On completion of drilling, groundwater levels noted in the boreholes are summarized in the following table.

<b>Culvert Number</b>	<b>Groundwater Levels - Depth/Elevation (m)</b>		
	<b>Borehole 1</b>	<b>Borehole 2</b>	<b>Borehole 3</b>
21A	3.40/230.92	3.40/231.13	BD&O
24A	BD&O	2.60/232.77	BD&O
25A	BD&O	BD&O	BD&O
27A	0.35/194.61	2.70/194.04	0.75/194.21

**Note:** BD&O means borehole dry and open at completion

In general, the groundwater was encountered as perched condition within the upper fill materials and in the wet to saturated granular deposits. At Culvert 27A, the water table was observed near the ground surface due to high creek water level at the time of investigation. The observed groundwater table represented the shallow groundwater condition at these culvert sites.

The groundwater condition will fluctuate seasonally and in response to weather events.

## 5.0 STATEMENT OF LIMITATION

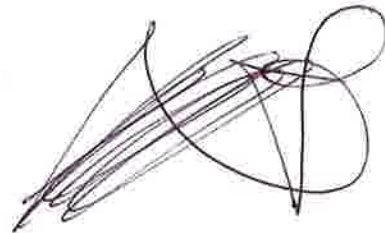
We recommend that once the details of the proposed structure are finalized, our recommendations should be reviewed for their specific applicability.

The Limitations of Report, as quoted in Appendix D, is an integral part of this report.

We trust that we have completed the assignment within the Terms of Reference for this project. If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,  
**Infrastructure Engineering Group Inc.**

  
Eric Y. Chung, M.Eng., P.Eng.  
Designated MTO Contact



Joseph Law, P.Eng.  
Project Manager



Tom O'Dwyer, P. Eng.  
Quality Review Engineer



Ministry of Transportation/Stantec Consulting Ltd.  
G.W.P. 57-00-00  
Rehabilitation of Highway 26 from Meaford to Thornbury  
Agreement Agreement # 3006-E-0002

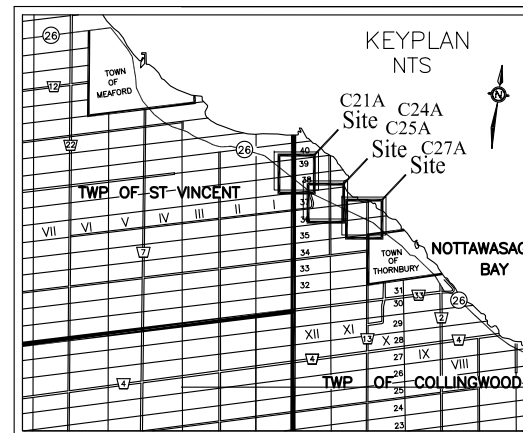
07-6-IEG1-A-COLCR  
Final Report  
Appendix A  
March 13, 2009

## Appendix A

### Drawings 1 & 2

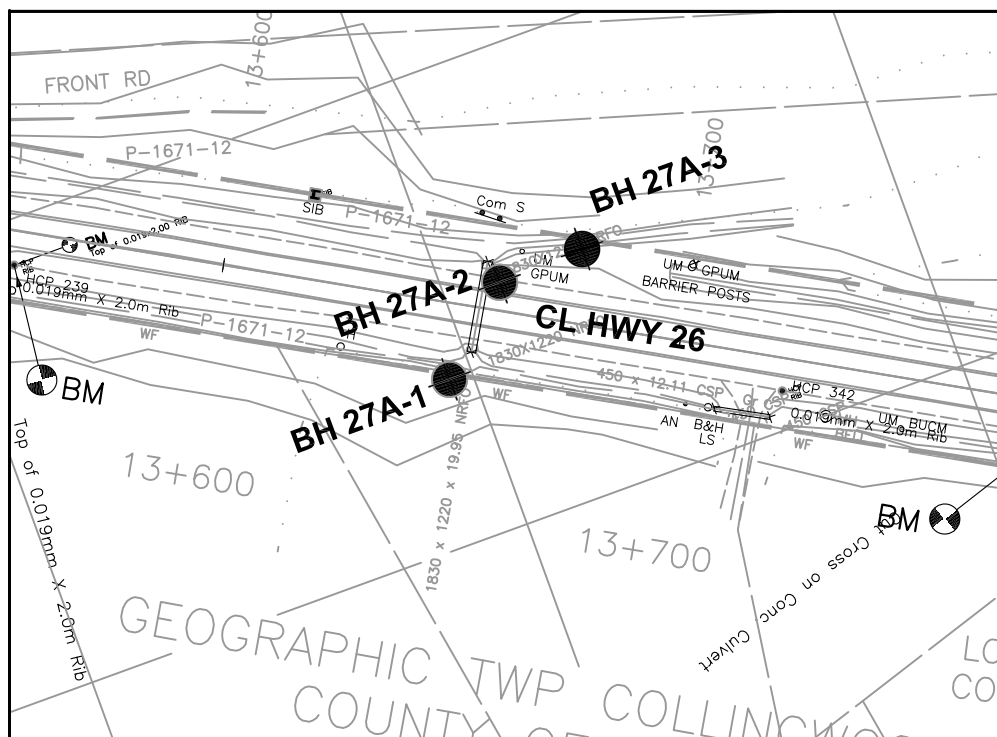
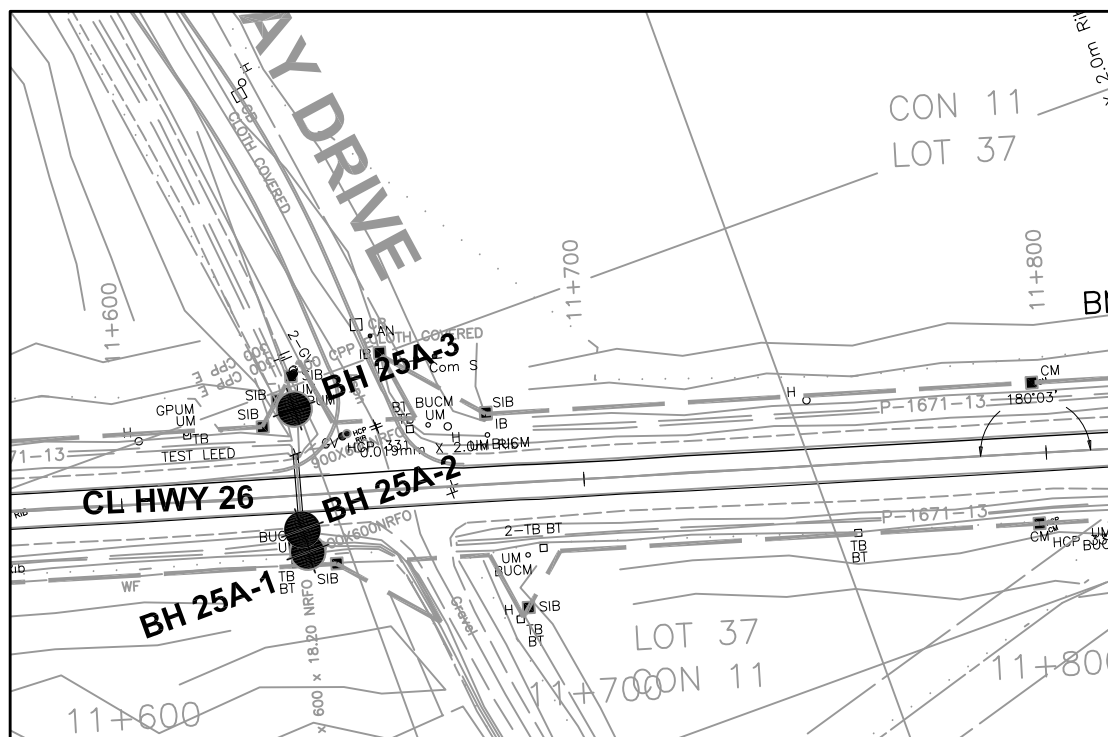
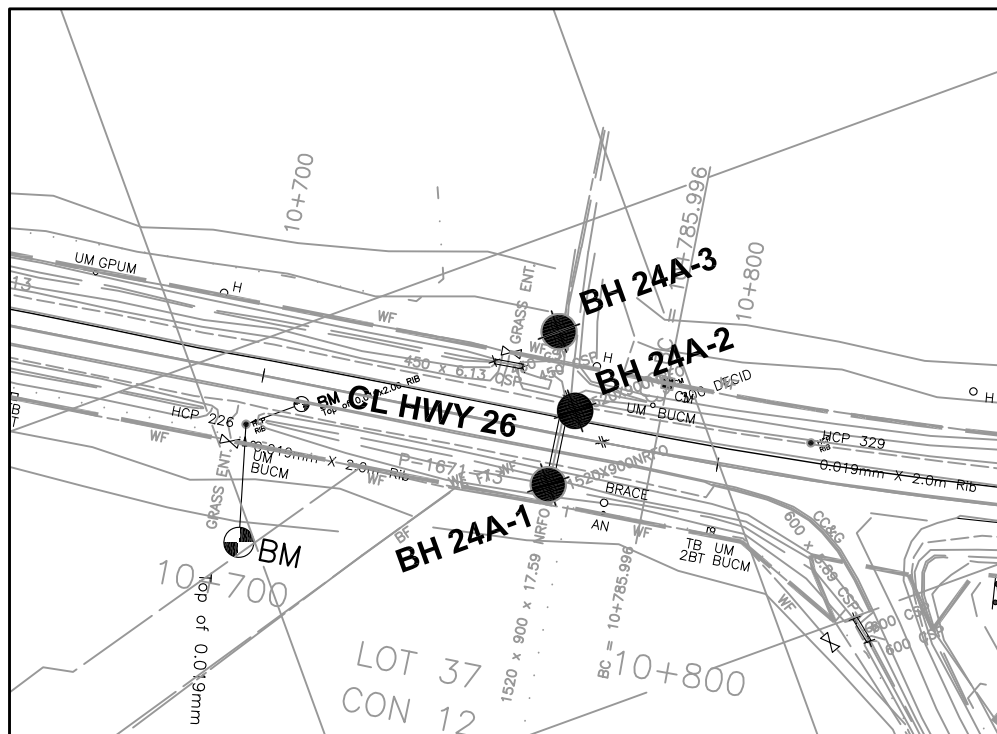
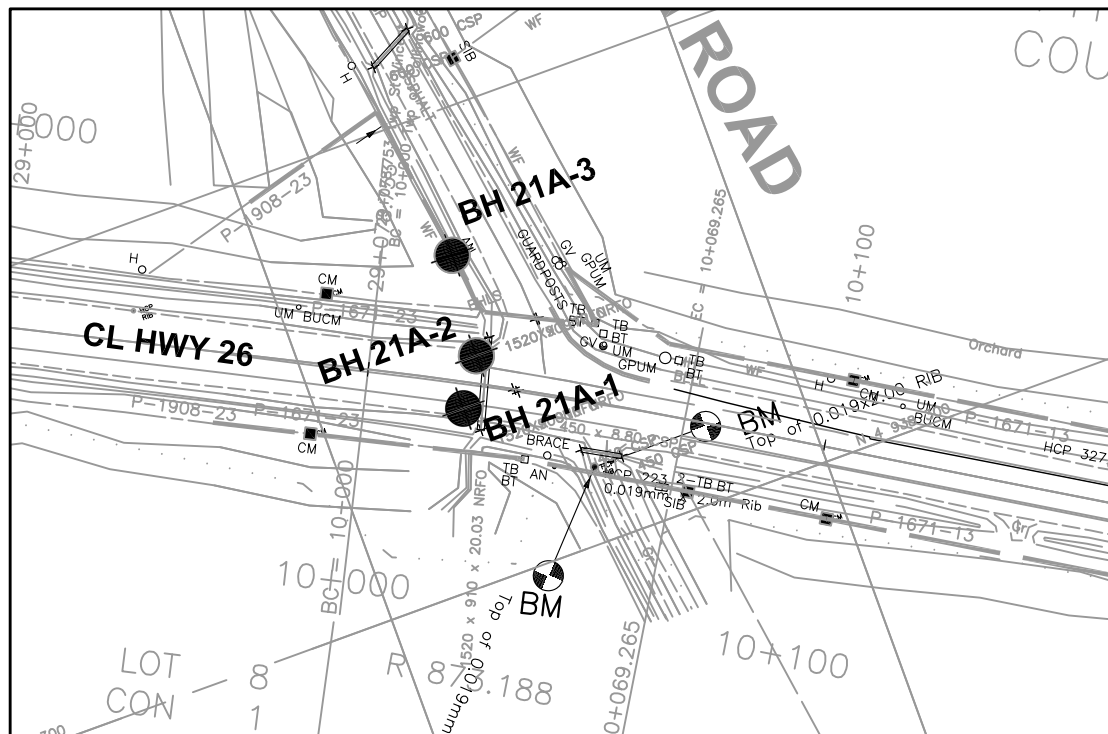
#### Borehole Location Plan & Profile

## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWNCONT No xxxx-xxxx  
WP No GWP 57-00-00Culvert # C21A, C24A, C25A & C27A  
Highway 26  
BOREHOLE LOCATION PLANSHEET  
1I.E. Infrastructure Engineering Group Inc.  
Pavement & Construction Materials Consulting Engineers  
GTA • Kitchener • London • Windsor

## LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation
- Standpipe



## NOTES

- 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 ARE SPECIFICALLY EXCLUDED IN ACCORDANCE WITH THE CONDITIONS OF SECTION GC2.01 of OPS GEN. COND.

BOREHOLE NO.	ELEV.	UTM CO-ORDINATES NORTH	EAST	BOREHOLE NO.	ELEV.	UTM CO-ORDINATES NORTH	EAST	BOREHOLE NO.	ELEV.	UTM CO-ORDINATES NORTH	EAST	BOREHOLE NO.	ELEV.	UTM CO-ORDINATES NORTH	EAST
C21A-1	234.32	4938338	224430	C24A-1	234.17	4937949	225064	C25A-1	223.23	4937665	225891	C27A-1	194.96	4937035	227795
C21A-2	234.54	4938347	224437	C24A-2	235.37	4937962	225075	C25A-2	224.29	4937670	225892	C27A-2	196.74	4937051	227812
C21A-3	232.12	4938370	224439	C24A-3	234.07	4937980	225077	C25A-3	223.05	4937695	225899	C27A-3	194.96	4937052	227831

SCALE



REVISIONS	DATE	BY	DISCUSSION
13/03/09	J.L.	Final	
15/01/08	J.L.	Draft	

MTO GEORES No. 41A-206

HWY No.	HWY 26	DIST	Owen Sound
SUBM'D	J.L.	CHECKED	E.C.
DATE	15/01/08	SITE	21A, 24A, 25A & 27A
DRAWN	J.L.	CHECKED	J.L.
APPROVED	E.C.	DWG	1

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

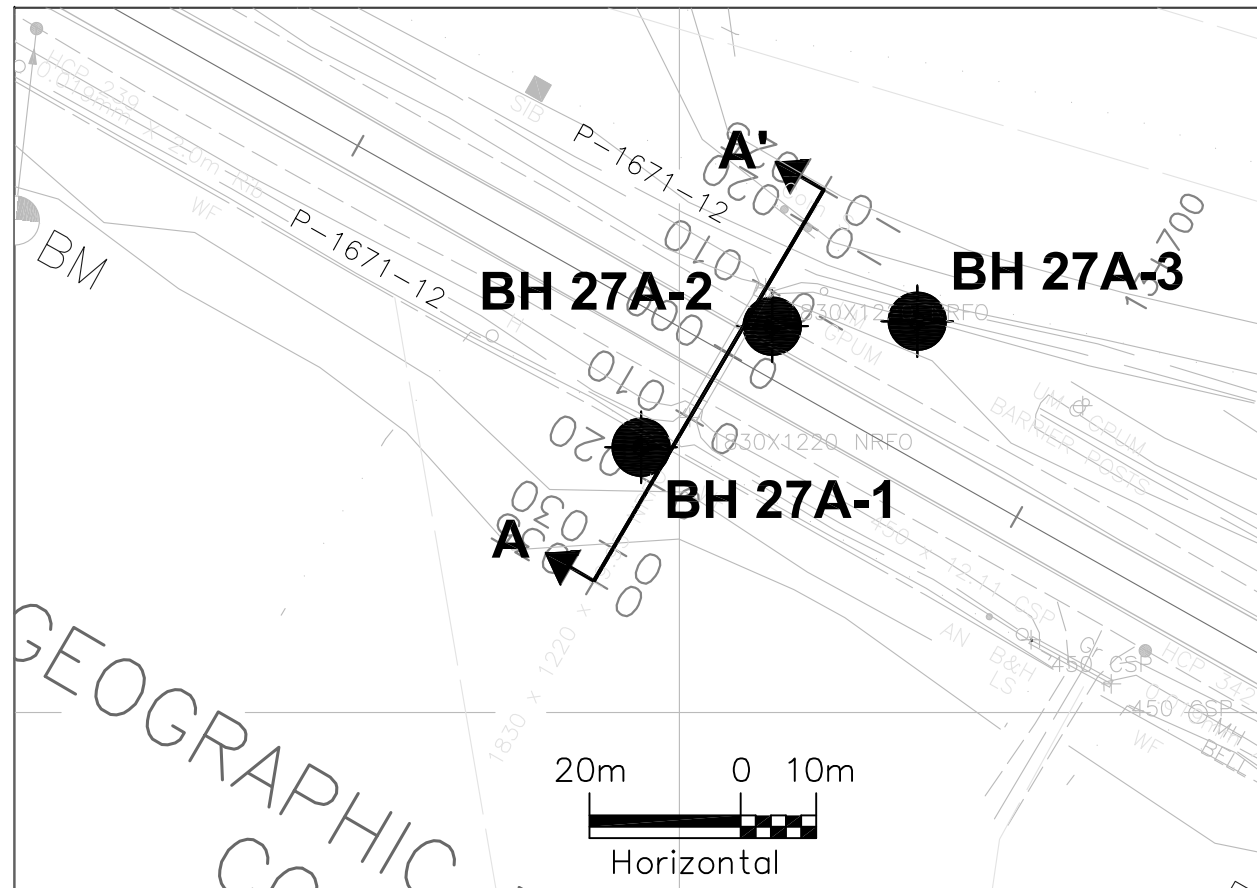
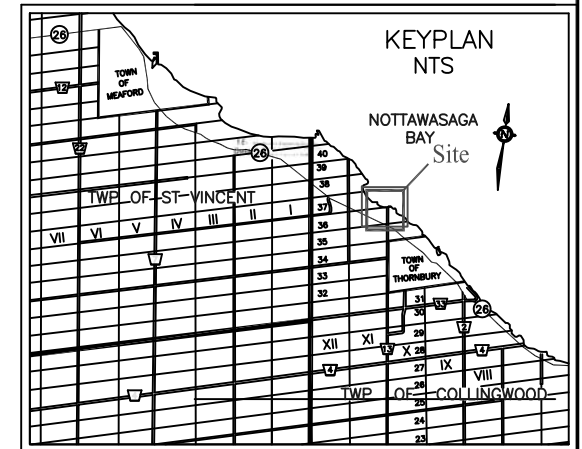
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Culvert C27A  
Highway 26  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET  
2

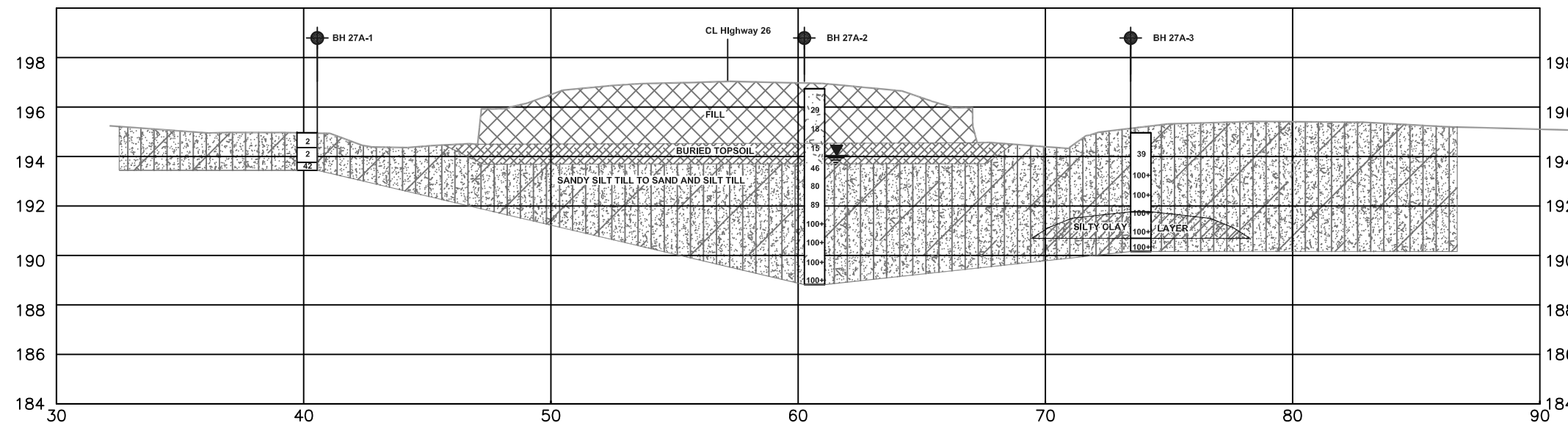
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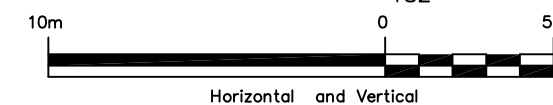
BOREHOLE LOCATION PLAN

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
- Standpipe



SECTION A-A'  
CENTERLINE OF CULVERT



NOTES

- 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 ARE SPECIFICALLY EXCLUDED IN ACCORDANCE WITH THE CONDITIONS OF SECTION GC2.01 of OPS GEN. COND.
- THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES AND BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
- SUBGRADE ELEVATION OF THE EXISTING FOOTING NOT KNOWN AND IS ESTIMATED TO BE AT 1.2m BELOW THE CREEK BED.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

BOREHOLE NO.	ELEVATION	UTM CO-ORDINATES	
		NORTH	EAST
27A-1	194.96	4937035	227795
27A-2	196.74	4937051	227812
27A-3	194.96	4937052	227831

REVISIONS			
	DATE	BY	DISCUSSION
	13/03/09	J.L.	Final
	31/01/08	J.L.	Draft

Geocres : 41A-206

HWY No.		HWY 26			DIST	
SUBM'D		J.L.	CHECKED E.C.	DATE 31/01/08	SITE	
DRAWN		J.L.	CHECKED J.L.	APPROVED E.C.	DWG	
					Owen Sound	
					Culvert C27A	
					2	



## Appendix B

### Explanation of Terms Used in Report Record of Borehole Sheet Laboratory Test Results

<b>Culvert Site</b>	<b>Borehole Logs</b>	<b>Grain Size</b>	<b>Atterberg Limits</b>
21A	21A-1 to 3	Figures C-21A.1 & 2	Figure C-21A.3
24A	24A-1 to 3	Figures C-24A1, 2, 4 & 6	C-24A.3, 5 & 7
25A	25A-1 to 3	Figures C25A.1, 2 & 4	Figures C25A.3 & 5
27A	27A-1 to 3	Figures C27A.1, 2 & 4	Figures C27A.3 & 5

## EXPLANATION OF TERMS USED IN REPORT

**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 1" 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 (RQD), 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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_{\alpha}$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{v0}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_c$	kPa	REMOULDED SHEAR STRENGTH
$S_r$	1	SENSITIVITY = $\frac{c_u}{\tau_f}$
$u_w$	kPa	PORE WATER PRESSURE
$U_p$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### STRESS AND STRAIN

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$i_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{i_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$		CONSISTENCY INDEX = $\frac{w_L - w}{i_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	J	$\text{kN}/\text{m}^3$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						



# RECORD OF BOREHOLE No 21A-2

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4938347, Easting - 224437 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY JL  
 DATUM Geodetic DATE 07.24.07 - 07.24.07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
234.53	Ground																
0.00																	
234.23	300 mm sand and gravel FILL																
0.30																	
	FILL		1	SPT	6		234							3 17 46 35 (81)			
	Brown, moist, loose to compact, consisting of silty clay with topsoil pockets, trace gravel		2	SPT	11		233										
232.24																	
2.29			3	SPT	10		232							0 4 64 32 (96)			
	brown		4	SPT	29		231							30 31 29 10 (40)			
	- Silty CLAY TILL (CL-CI) Moist, stiff to hard, embedded sand and gravel		5	SPT	32		230							9 8 51 32 (83)			
	grey		6	SPT	92												
			7	SPT	70		229										
228.74	End of Borehole													Water level measured @ 3.4m @ completion			
5.79																	

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# RECORD OF BOREHOLE No 21A-3

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4938370, Easting - 224439 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 09.17.07 - 09.17.07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
232.12	Ground						232								
0.00	125mm TOPSOIL														
	brown		1	SPT	20		231								
			2	SPT	19									7 21 42 31 (73)	
	Silty CLAY TILL (CL-CI) Moist, very stiff to hard, embedded sand and gravel		3	SPT	52		230						23.5		
	grey		4	SPT	100+		229							hit cobble	
			5	SPT	25		228							hit cobble @ 4.6 m	
227.40			6	SPT	100+									12 13 47 28 (75)	
4.72	End of Borehole:													Borehole dry and open @ completion.	

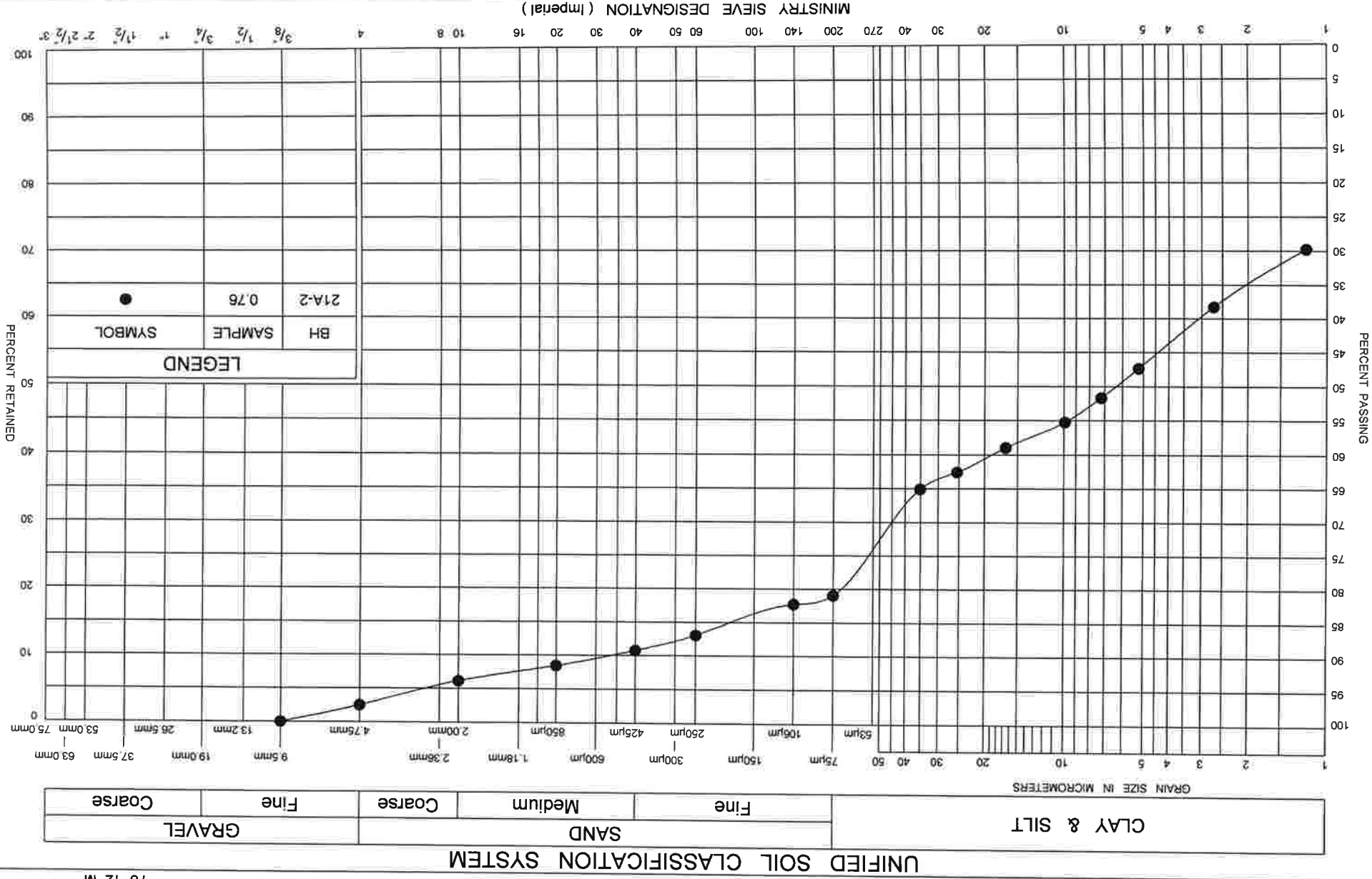
GRAIN SIZE DISTRIBUTION

**FILL**

FIG No C-21A.1

GWP 57-00-00

HWY 26, Thornbury to Meaford





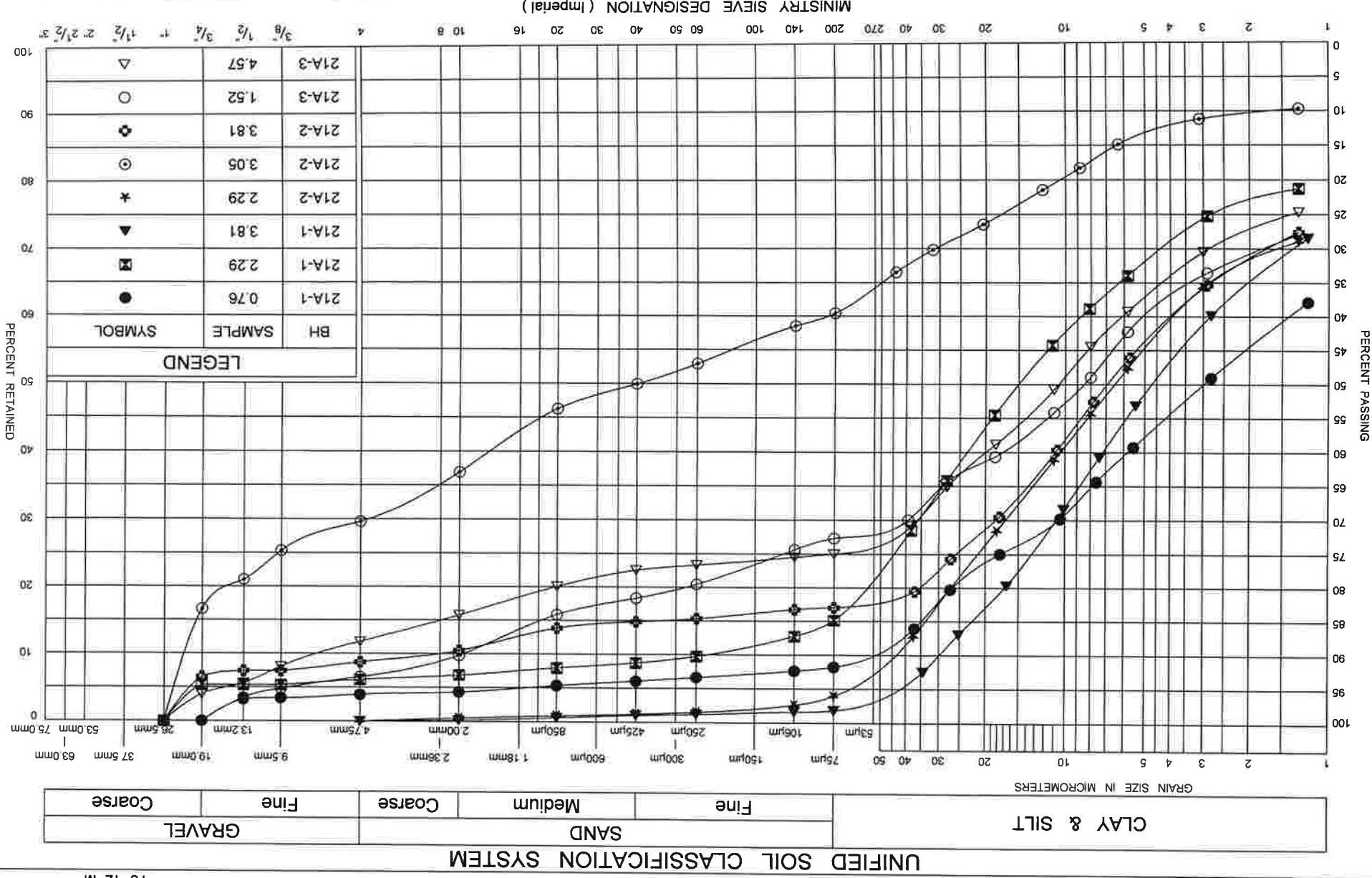
Ministry of  
Transportation

# GRAIN SIZE DISTRIBUTION SILTY CLAY TILL, CL-CH

FIG No C-21A.2

GWP 57-00-00

HWY 26, Thornbury to Meaford

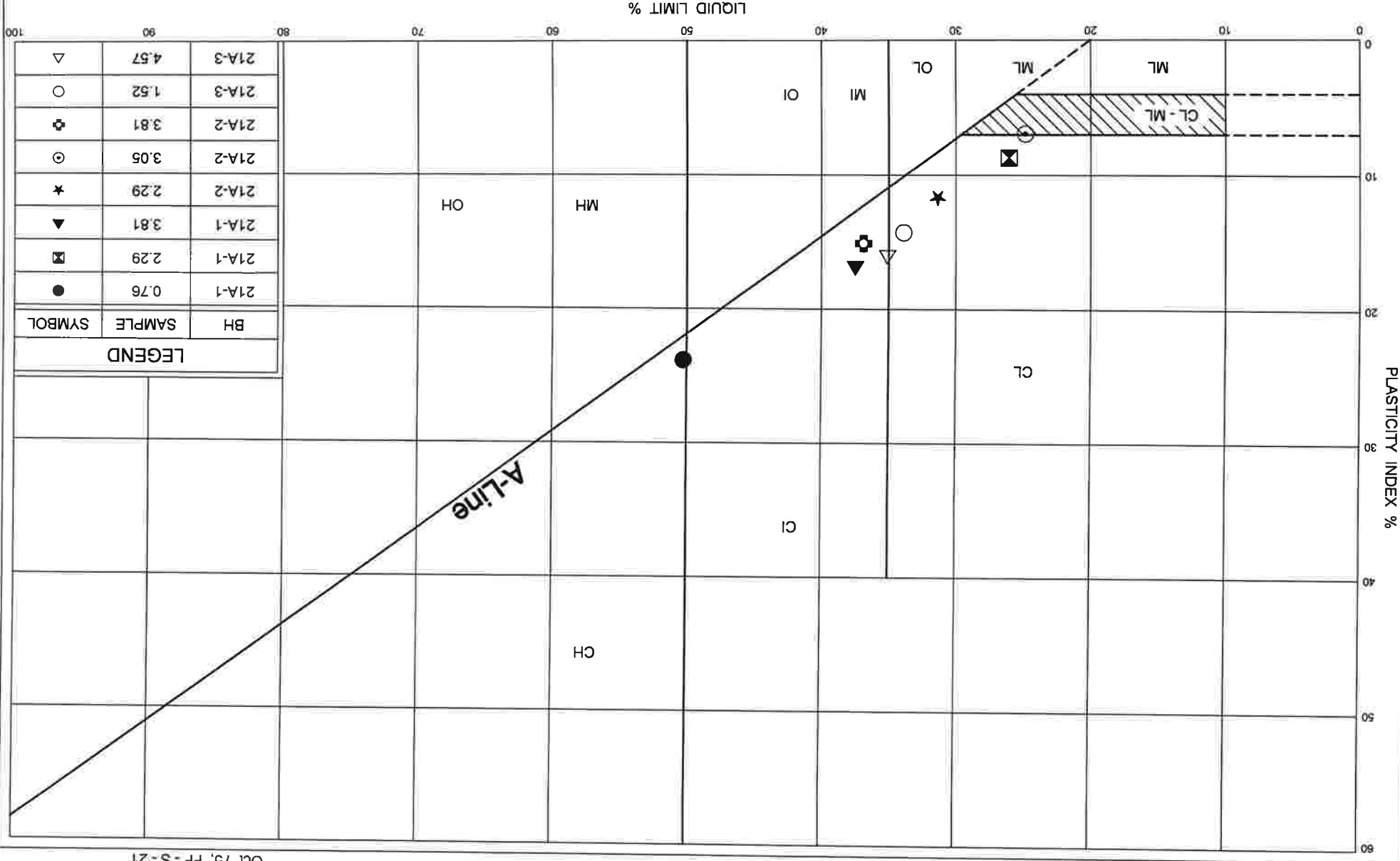


### PLASTICITY CHART

FIG No C-21A.3

GWP 57-00-00

HWY 26, Thornbury to Meaford



Oct 75, FF-S-21



## 1 OF 1

METRIC

DATUM Geodetic DATE 07 24 07 - 07 24 07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						x LAB VANE		
234.17	Ground																	
0.00	150mm TOPSOIL																	
	Clayey Silty Gravelly SAND (SC-SM-SW) Brown, moist, loose to compact, some gravel.		1	SPT	8										11 42 30 16 (46)			
			2	SPT	21										26 45 21 7 (28)			
231.88																		
2.29			3	SPT	21								22.0					
	Silty CLAY TILL (CI) Grey, moist, very stiff to hard, embedded sand and gravel.		4	SPT	26										4 4 59 33 (92)			
230.21			5	SPT	100+													
3.96	End of Borehole														Borehole dry and open @ completion.			

# RECORD OF BOREHOLE No 24A-2

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937962, Easting - 225075 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY JL  
 DATUM Geodetic DATE 07.24.07 - 07.24.07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
						20	40	60	80	100	10	20	30	kN/m <sup>3</sup>	GR SA SI CL
235.37	Ground														
0.00	100 mm Recycled ASPHALT														
235.07	200 mm sand and gravel FILL														
0.30															
	FILL														
	Brown, moist, very stiff, consisting of														
	silty clay, some gravel														
233.08															
2.29	Brown														
	Silty CLAY TILL (CI)														
	Grey, moist, very stiff, embedded														
	sand and gravel.														
	Grey														
231.71															
3.66															
	SHALE BEDROCK														
	Grey, weathered, weak, close to														
	moderately close bedding, fair quality,														
	occ. limestone layers (10 to 20mm														
	thick).														

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+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

○ 150 UNCONFINED SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 24A-3

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937980, Easting - 225077 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 07 24 07 - 07 24 07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
234.07 0.00	Ground 100 mm TOPSOIL.						234							
	Brown		1	SPT	23		233							11 4 45 39 (85)
	Silty CLAY TILL (Cl) Grey, moist, very stiff to hard, embedded sand and gravel.		2	SPT	35		232							1 5 54 40 (94)
			3	SPT	58									
230.87 3.20	Grey SHALE BEDROCK Grey, weathered, weak, close to moderately close bedding, fair quality, occ. limestone layers ( 10 to 20mm thick)		4	SPT	100+		231							
230.11 3.96	End of Borehole.		5	SPT	100+									Borehole dry and open @ completion.

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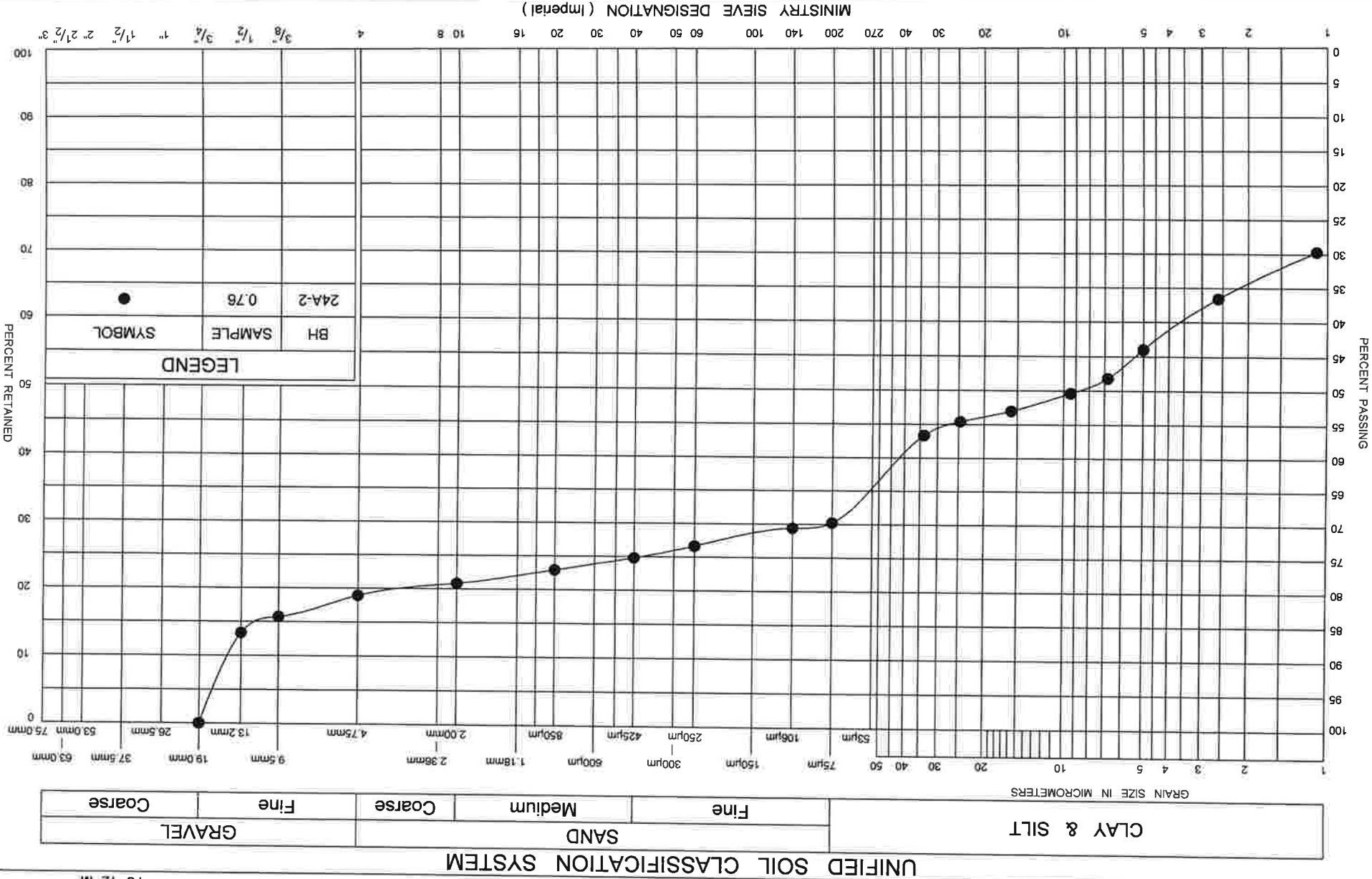
+<sup>3</sup>, x<sup>3</sup>. Numbers refer to  
Sensitivity

○ 150 UNCONFINED SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

GRAIN SIZE DISTRIBUTION  
FILL

FIG No C-24A.1  
GWP 57-00-00

HWY 26, Thornbury to Meaford





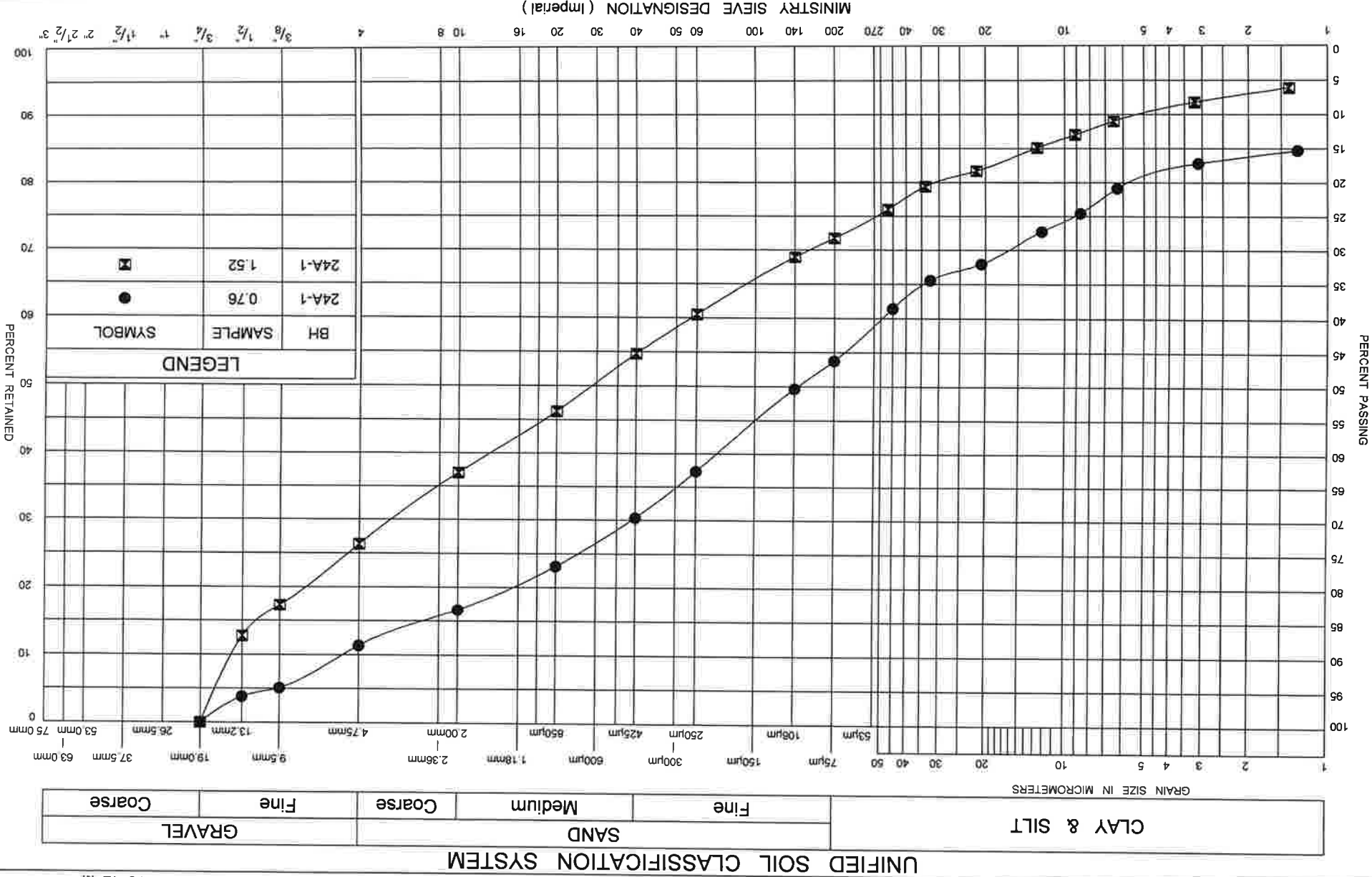
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GRAIN SIZE DISTRIBUTION  
CLAYEY SILTY GRAVELLY SAND, SC-SM-SW

FIG No C-24A.2

GWP 57-00-00

HWY 26, Thornbury to Meaford





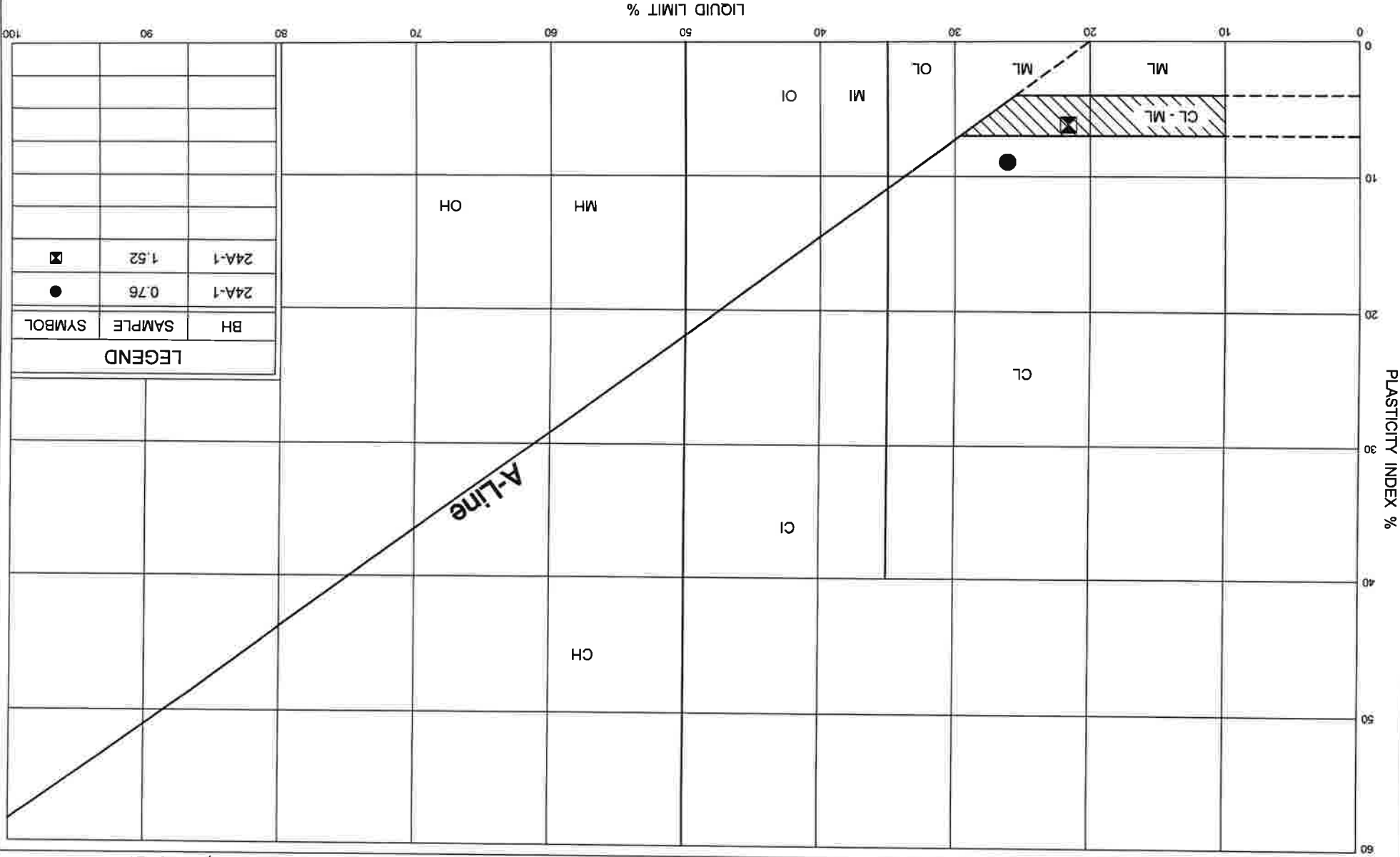
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Transportation

PLASTICITY CHART  
CLAYEY SILTY GRAVELLY SAND, SC-SM-SW

FIG No C-24A.3

GWP 57-00-00

HWY 26, Thornbury to Meaford

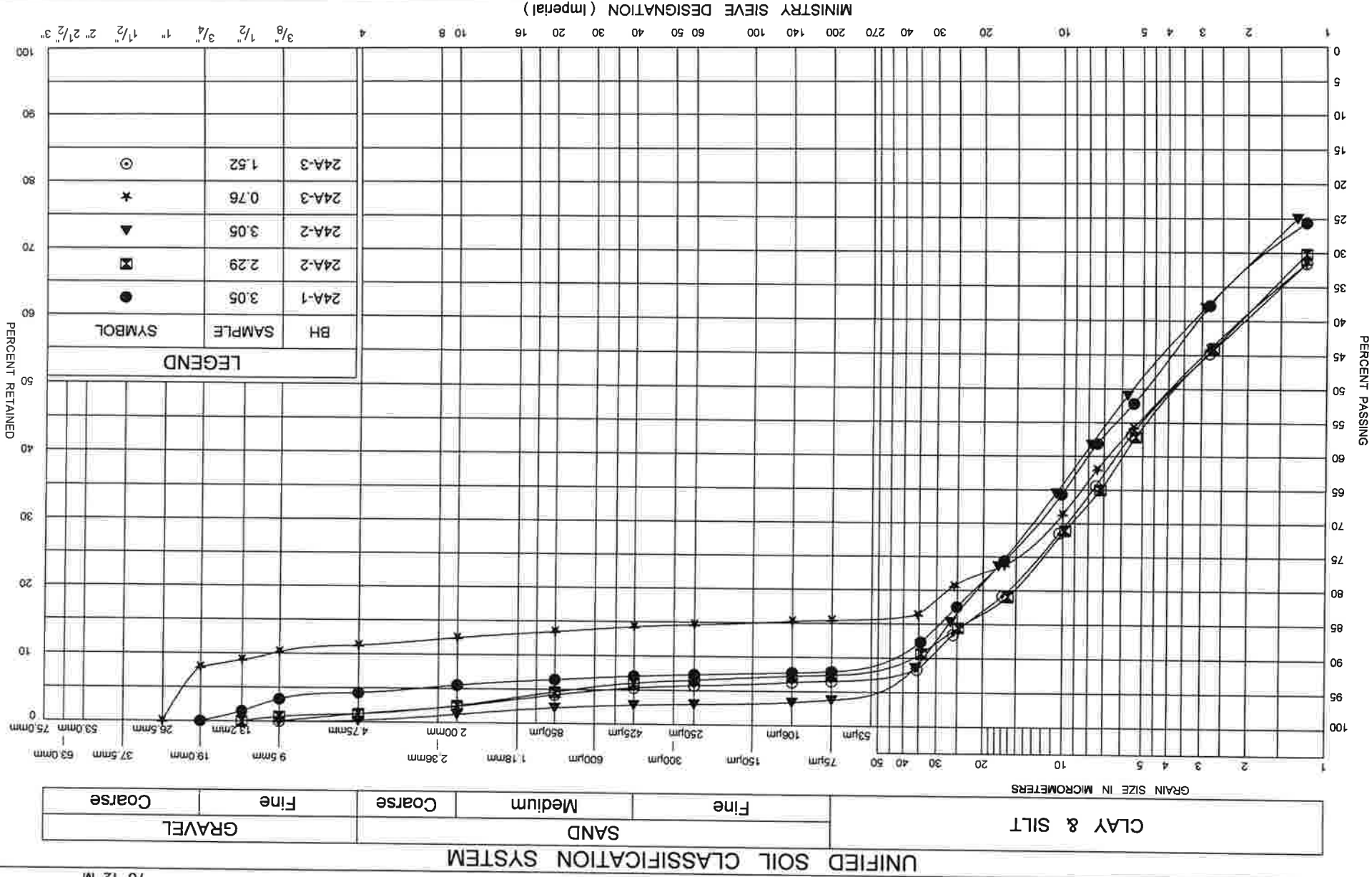




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# GRAIN SIZE DISTRIBUTION SILTY CLAY TILL, CL-CI

FIG No C-24A.4  
GWP 57-00-00  
HWY 26, Thornbury to Meaford





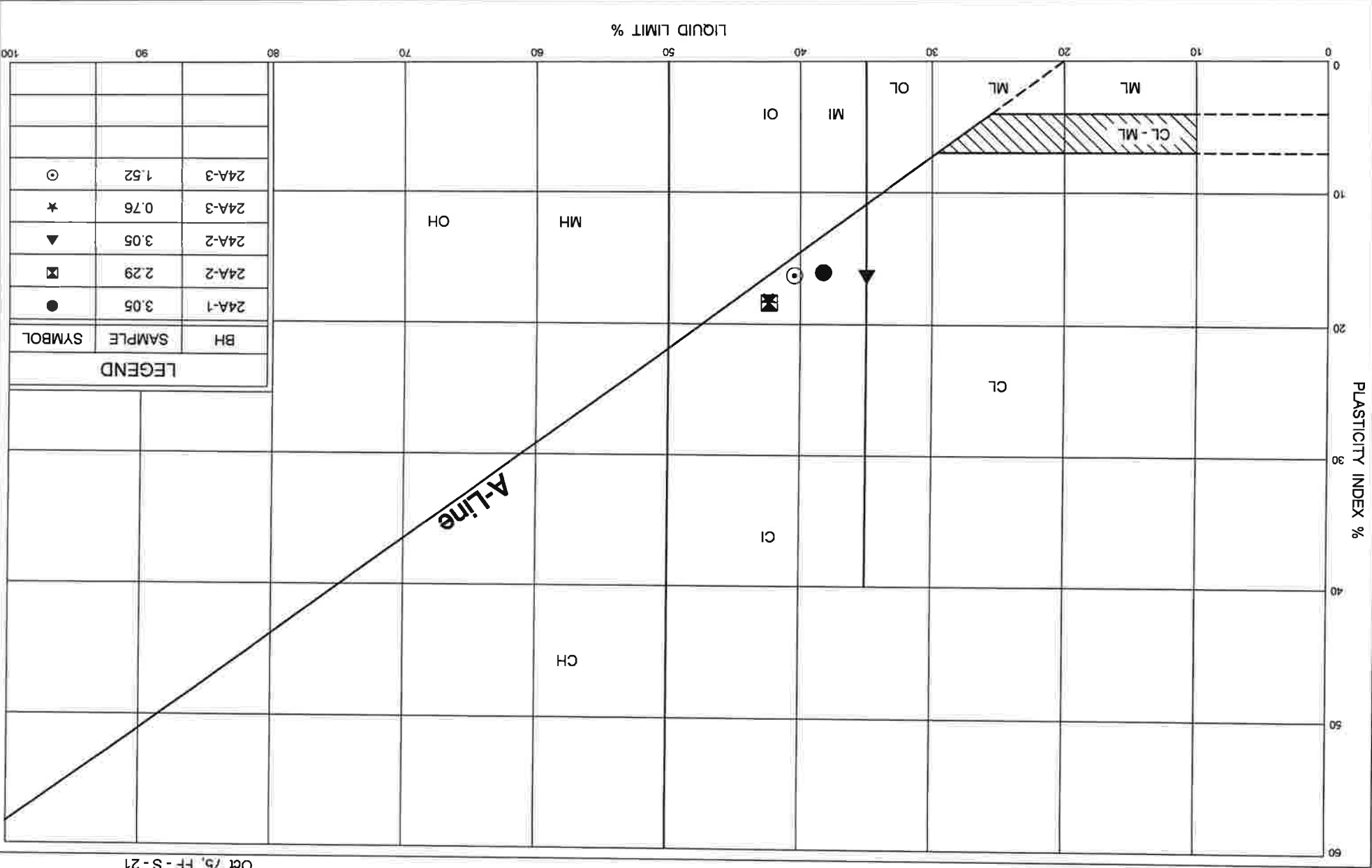
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PLASTICITY CHART  
SILTY CLAY TILL, CL-CI

FIG NO C-24A.5

GWP 57-00-00

HWY 26, Thornbury to Meaford







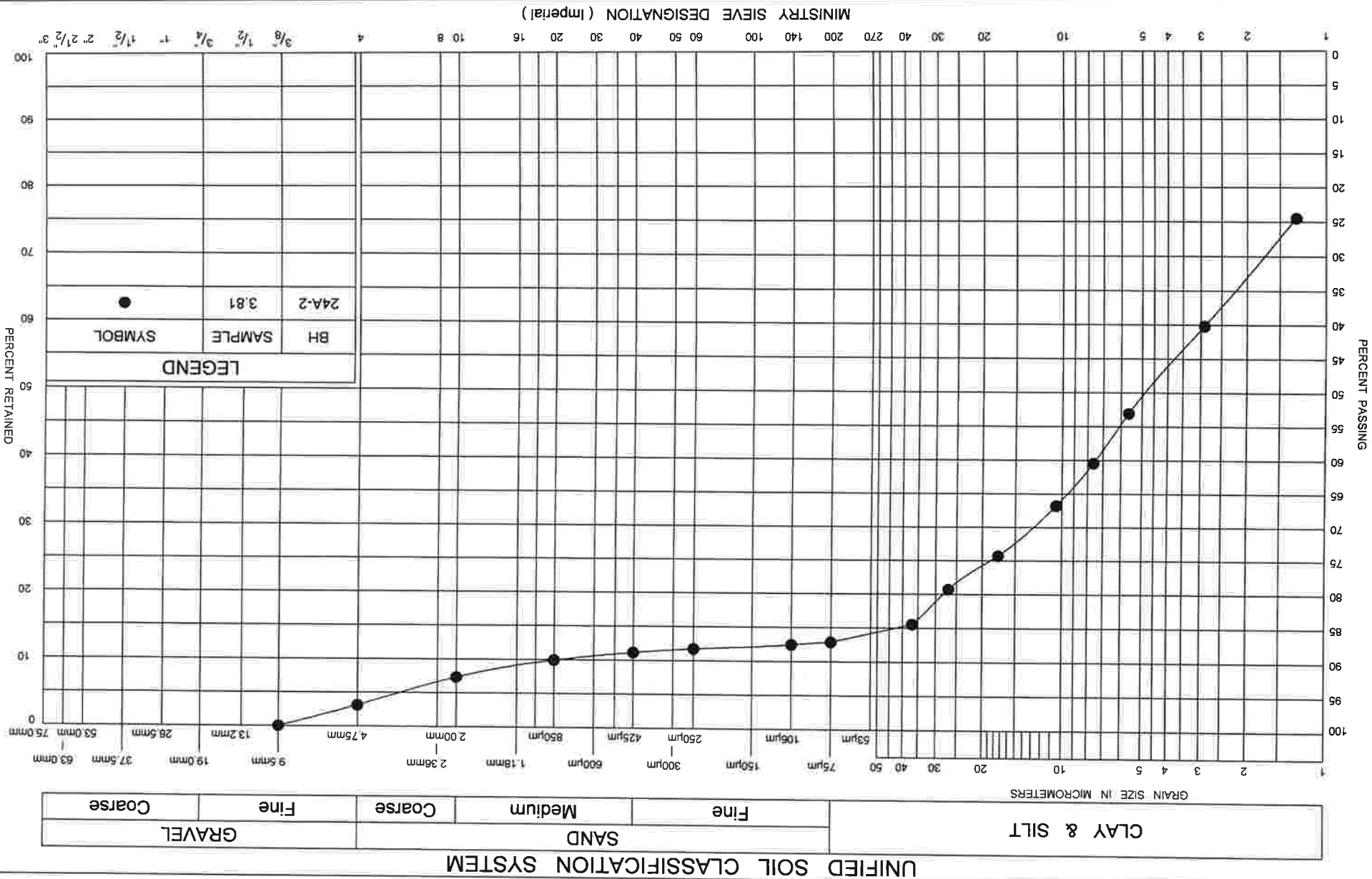
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# GRAIN SIZE DISTRIBUTION WEATHERED SHALE BEDROCK

FIG No C-24A.6

GWP 57-00-00

HWY 26, Thornbury to Meaford





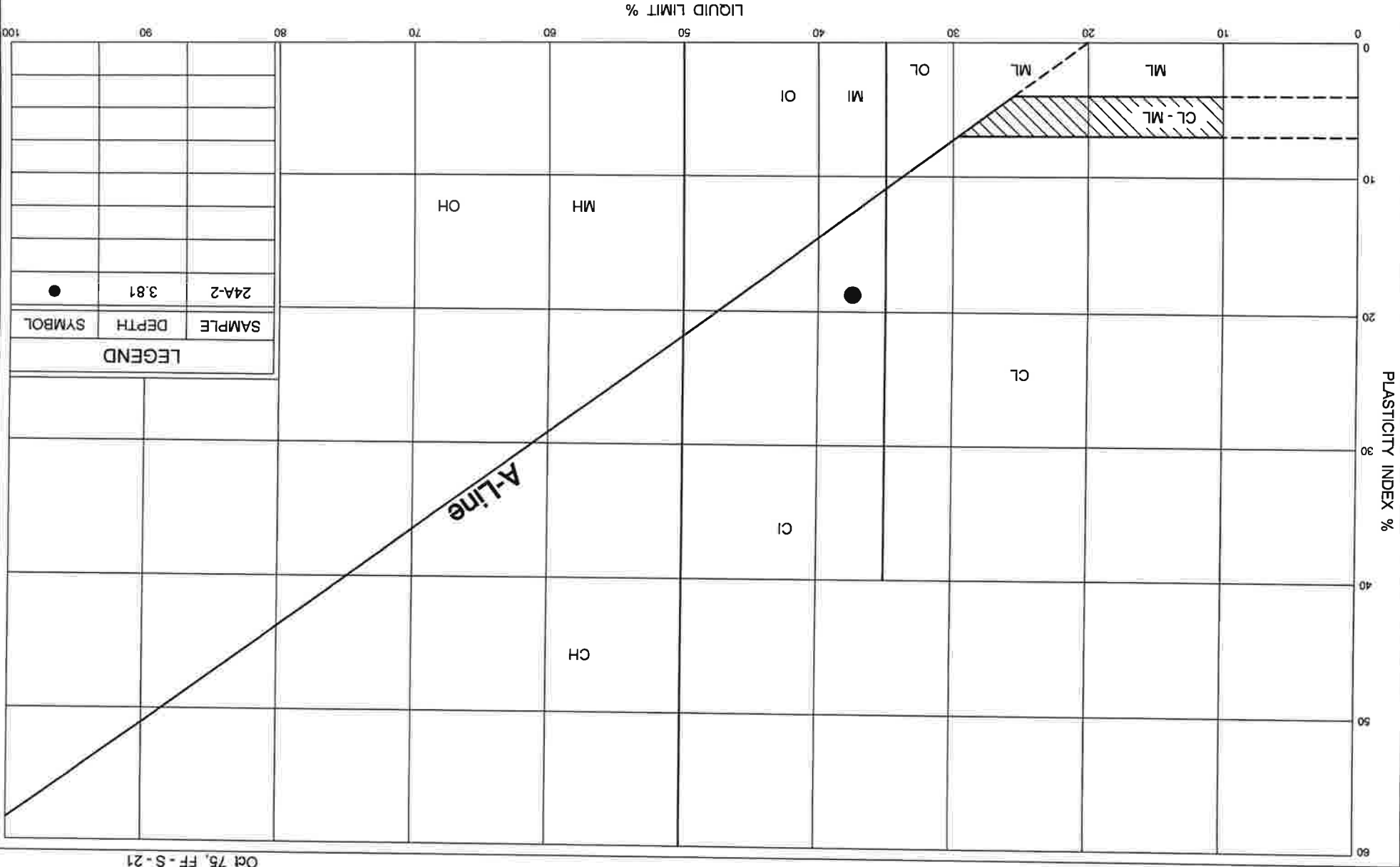
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PLASTICITY CHART  
SHALE/Silty CLAY TILL complex

FIG No C24A.7

GWP 57-00-00

HWY 26, Thornbury to Meaford



# RECORD OF BOREHOLE No 25A-1

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937655, Easting - 225591 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY JL  
 DATUM Geodetic DATE 09 18 07 - 09 18 07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			STANDARD 20 40 60 80 100	DYN. CONE 20 40 60 80 100					
223.23 0.00	Ground													
	75mm TOPSOIL		1	SPT	10		223							GR SA SI CL
	Silty SAND and GRAVEL (SM-GM) Brown, moist, compact, slight plasticity.		2	SPT	20									Hand drilling with 31.75 kg (70 lb.) hammer. N-values are corrected values.
			3	SPT	38		222							35 34 25 7 (32)
221.40 1.83	End of Borehole													Borehole terminated due to difficult retrieval of sampler. Borehole dry and open at completion

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# RECORD OF BOREHOLE No 25A-2

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937670, Easting - 225892 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 07.23.07 - 07.23.07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	+ FIELD VANE							● QUICK TRIAXIAL	x LAB VANE	
224.29 0.00	Ground							20	40	60	80	100						
223.99 0.30	300mm sand and gravel FILL						224											
	FILL Brown, moist, compact, consisting of silty sand, some gravel and rock fragments, trace clay.		1	SPT	18		223										19 47 27 7 (35)	
222.00 2.29			2	SPT	19													
	Sandy SILT TILL (ML) Brown, moist, very dense, some gravel.		3	SPT	52		222											
			4	SPT	100		221										15 34 39 12 (51) non-plastic	
220.48 3.81			5	SPT	100+		220											
	SHALE BEDROCK Grey, weathered, weak, close to moderately close bedding, fair quality, occ. limestone layers (10 to 20mm thick).		6	SPT	100+		219											
218.80 5.49			7	SPT	100+													
	End of Borehole																Borehole dry & open @ completion.	

JOE MTO 07-6-JEG1.GPJ ONTARIO MOT.GDT 03/13/09

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

○ 150 UNCONFINED SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

## 1 OF 1

METRIC

LOCATION

Northing - 4937695, Easting - 225899

ORIGINATED BY JL

DIST Owen Sound HWY 26

BOREHOLE TYPE S/S Augering, 110 mm dia

COMPILED BY JL

DATUM Geodetic

DATE 07.24.07 - 07 24.07

CHECKED BY \_\_\_\_\_ EC \_\_\_\_\_

○ <sup>150</sup> UNCONFINED SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS



Ministry of  
Transportation

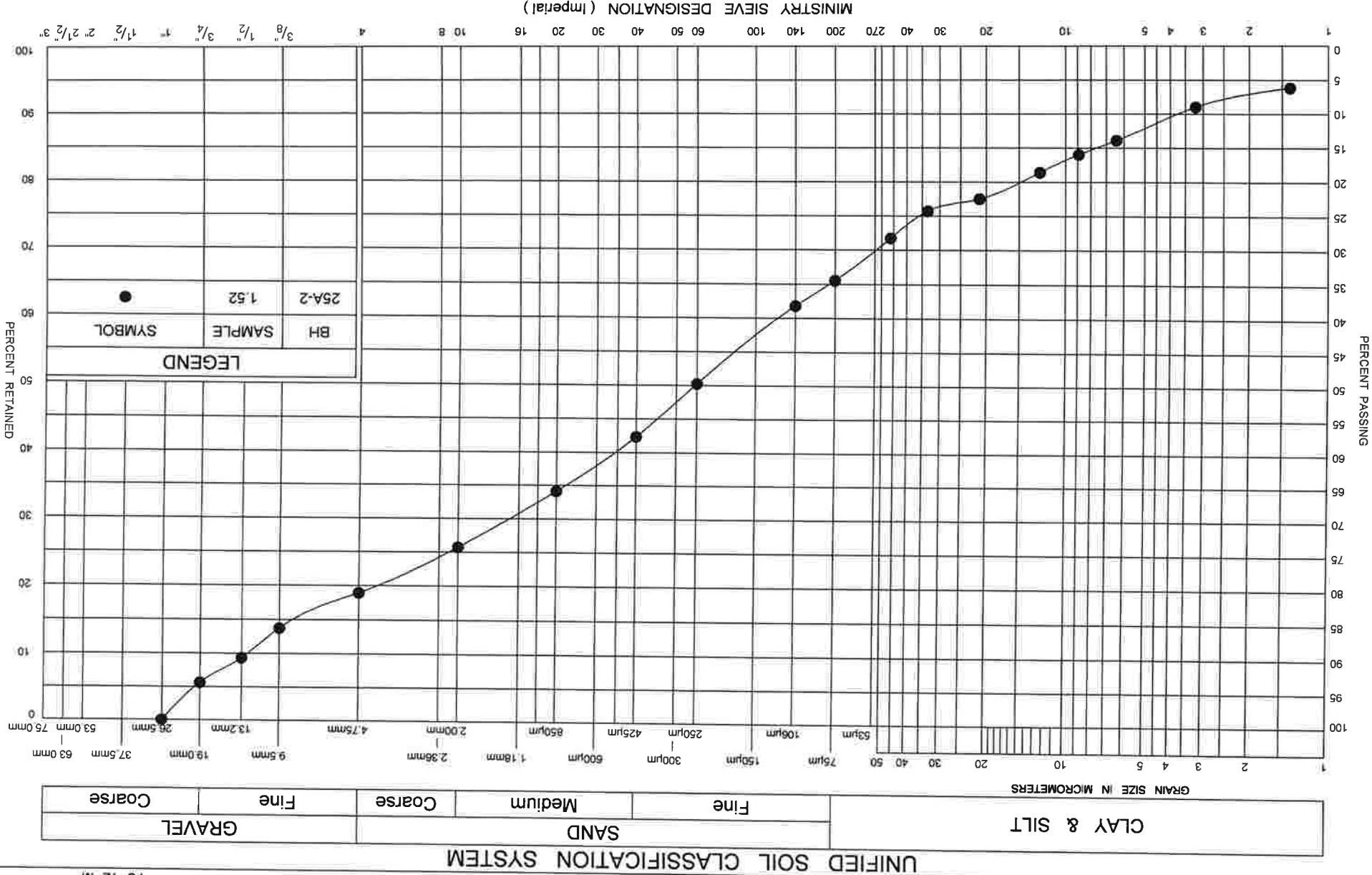
FILL

GRAIN SIZE DISTRIBUTION

FIG No C-25A.1

GWP 57-00-00

HWY 26, Thornbury to Meaford





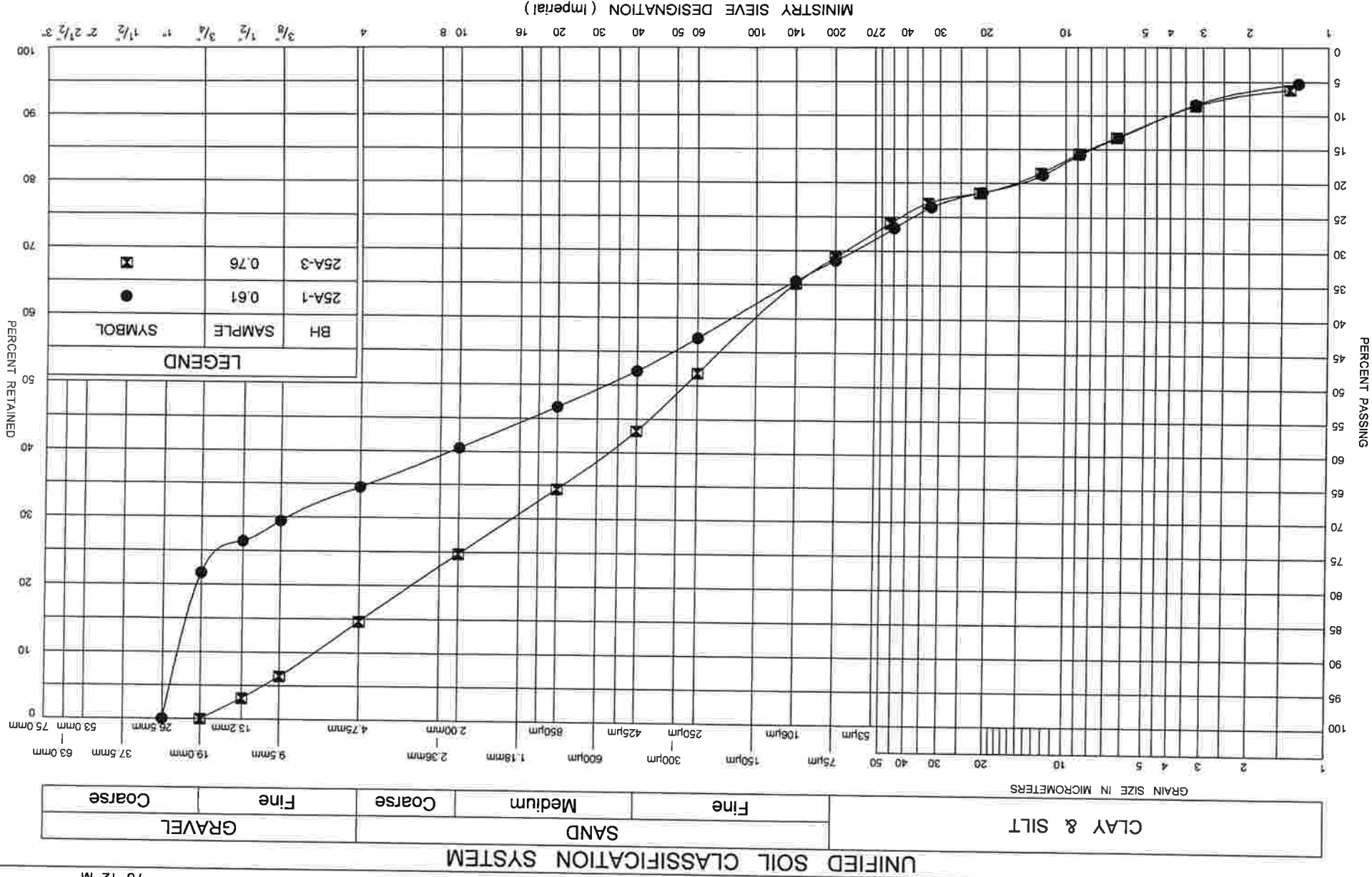
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GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SILTY SAND AND GRAVEL, SM-GM

FIG No C-25A.2

GWP 57-00-00

HWY 26, Thornbury to Meaford

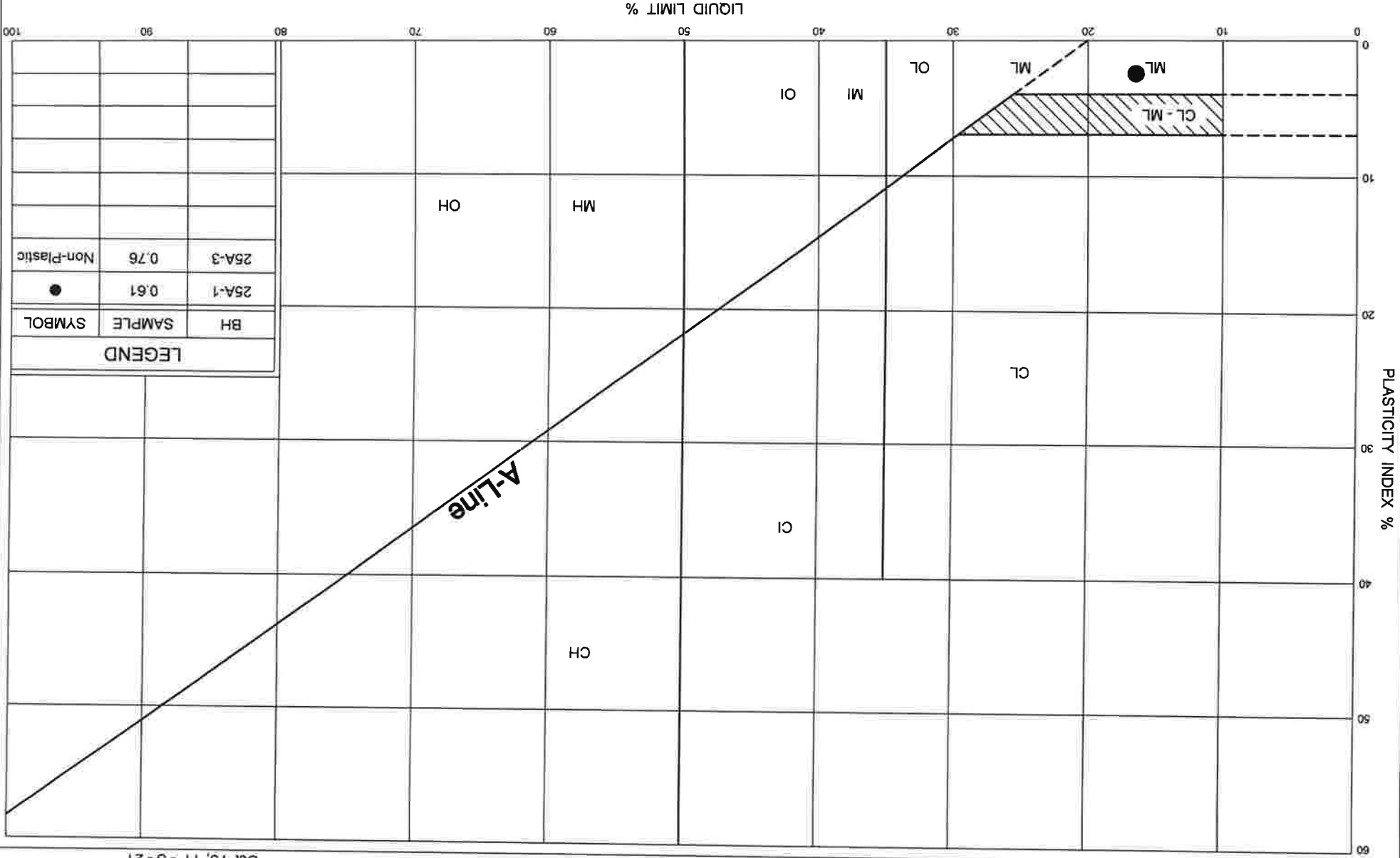




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PLASTICITY CHART  
SILTY SAND TO SILTY SAND AND GRAVEL, SM-GM

FIG No C-25A.3  
GWP 57-00-00  
HWY 26, Thornbury to Meaford







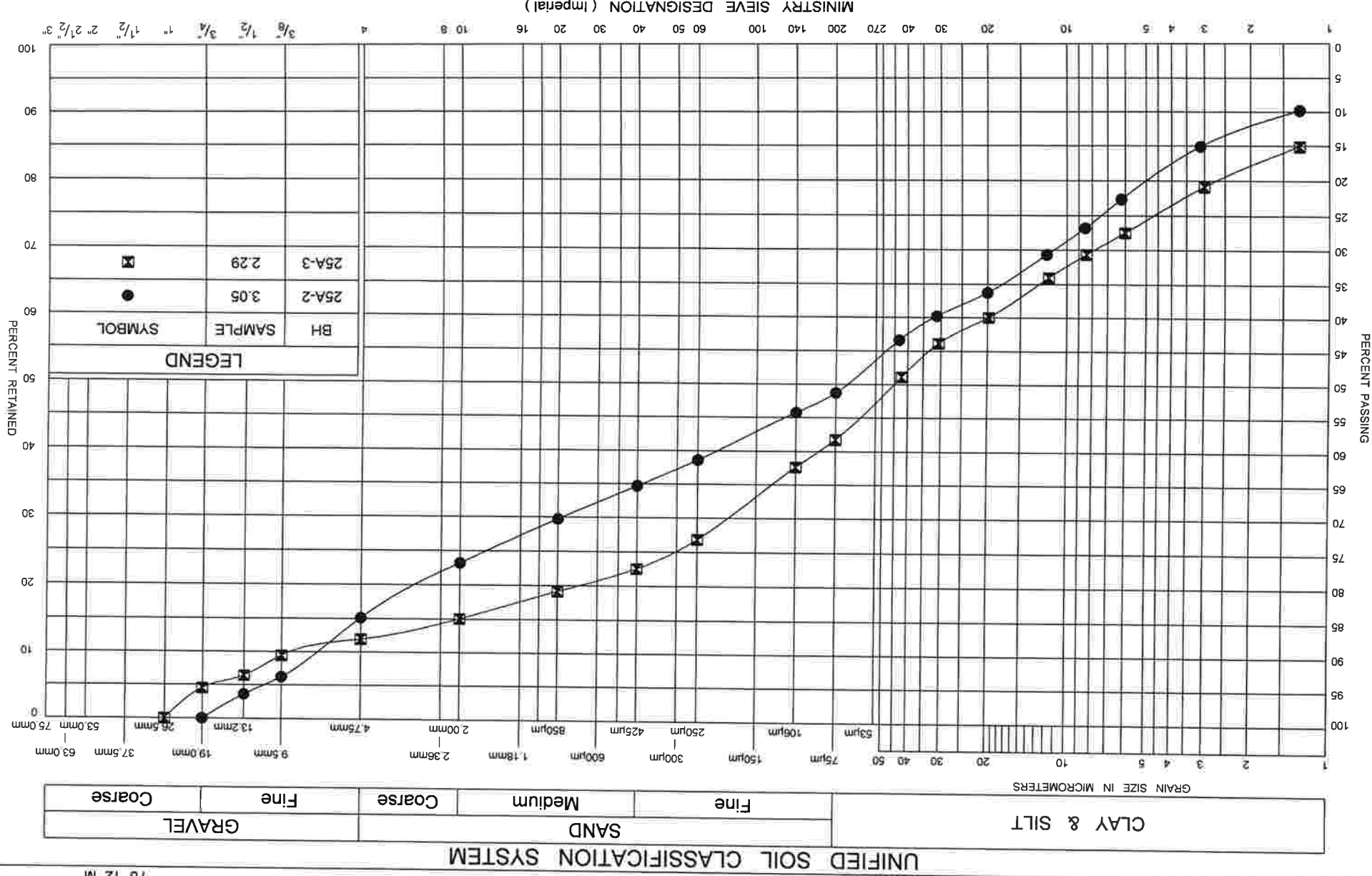
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Transportation

GRAIN SIZE DISTRIBUTION  
SANDY TO CLAYEY SILT TILL, ML TO CL-ML

FIG No C-25A.4

GWP 57-00-00

Hwy 26, Thornbury to Meaford





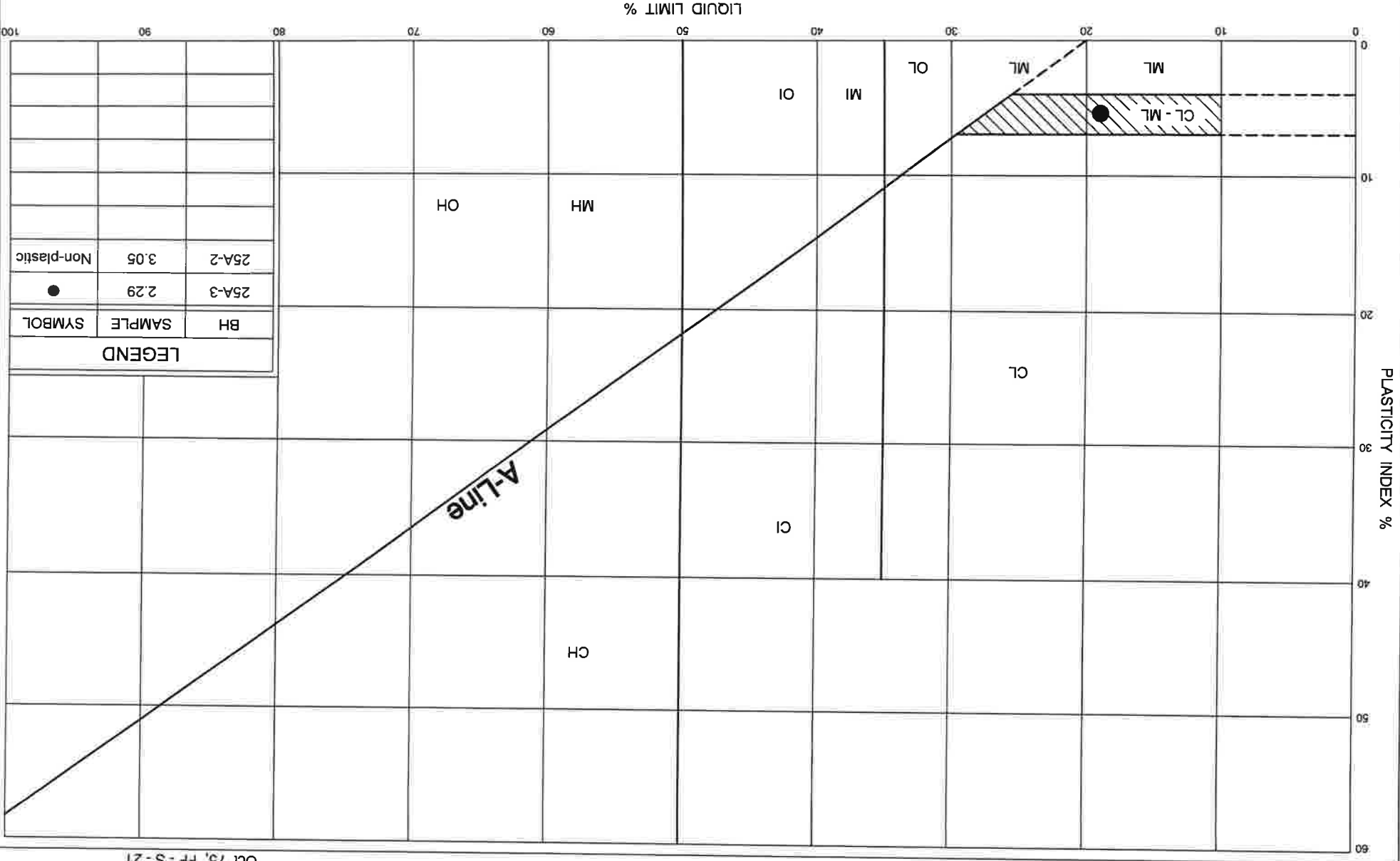
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PLASTICITY CHART  
SANDY TO CLAYEY SILT TILL, ML TO CL-ML

FIG No C-25A.5

GWP 57-00-00

HWY 26, Thornbury to Meaford



Oct 75, FF-S-21

LEGEND		
BH	SAMPLE	SYMBOL
25A-3	2.29	●
25A-2	3.05	Non-plastic

# RECORD OF BOREHOLE No 27A-1

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937035, Easting - 227795 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 09.18.07 - 09.18.07 CHECKED BY EC

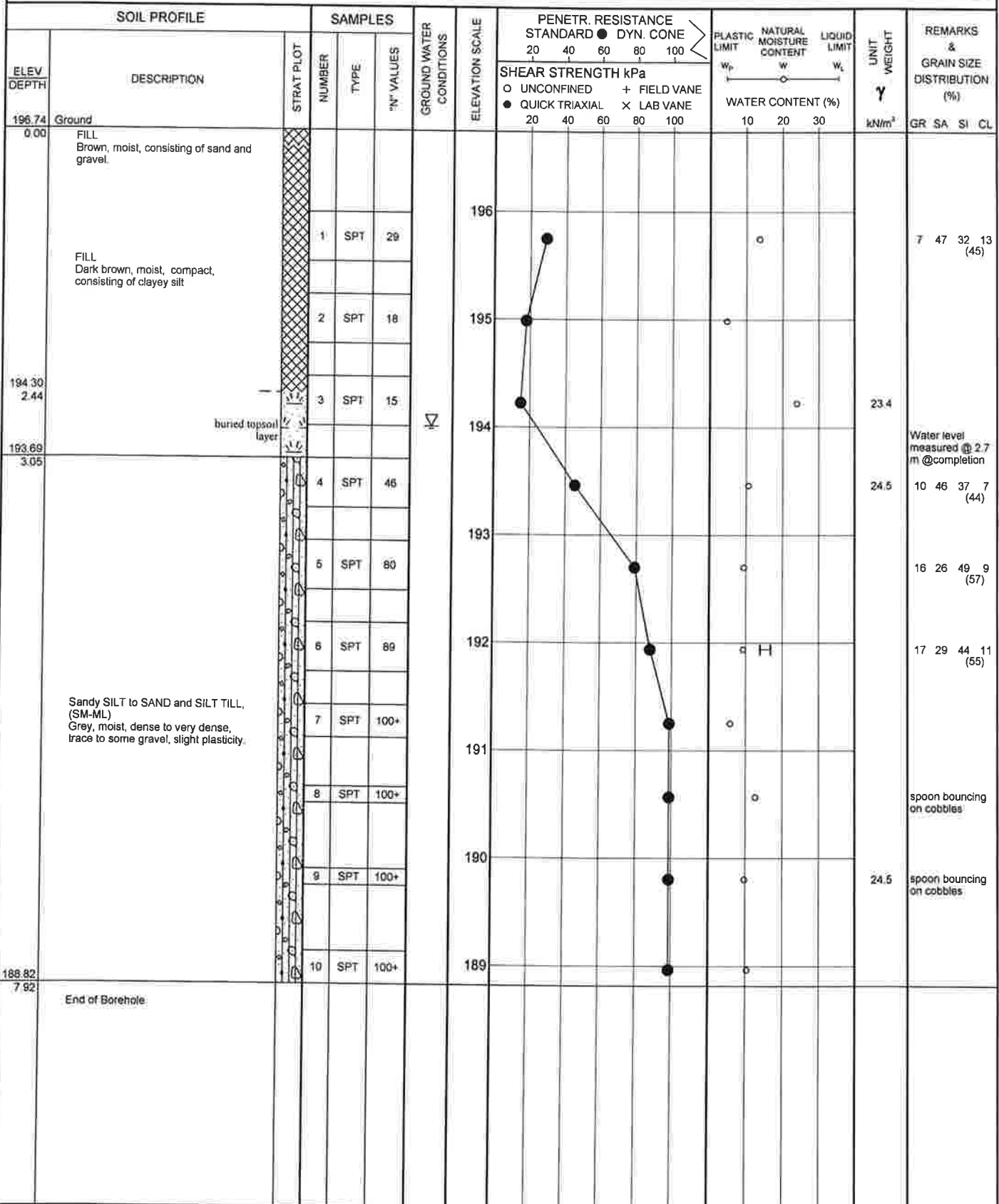
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
194.95	Ground																
0.00	75 mm TOPSOIL		1	SPT	4												Hand drilling with 31.75 kg (70 lb.) hammer N-values are corrected values.
	SAND and SILT TILL, (SM-ML) Brown, wet to moist, very loose to very dense		2	SPT	5		194										4 35 49 11 (60)
193.44			3	SPT	42+												
1.52	End of Borehole																sampler refusal, no further penetration Water level measured @ 0.35 m @ completion.

# RECORD OF BOREHOLE No 27A-2

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937051, Easting - 227812 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 07.22.07 - 07.23.07 CHECKED BY EC



JOE MTO 07-6-LEG1.GPJ ONTARIO.MOT.GDT 03/13/09

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

○ 150 UNCONFINED SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 27A-3

1 OF 1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4937052, Easting - 227831 ORIGINATED BY JL  
 DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia COMPILED BY JL  
 DATUM Geodetic DATE 07.23.07 - 07.23.07 CHECKED BY EC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE						● QUICK TRIAXIAL	x LAB VANE	WATER CONTENT (%)
194.95 0.00	Ground						20	40	60	80	100						
194.45 0.51	510 mm TOPSOIL																
	Brown.		1	SPT	39		194								6	29 50 15 (65)	
			2	SPT	100+		193										
	Sandy SILT TILL, (ML) Moist, dense to very dense, embedded gravel, occasional silty clay layers.		3	SPT	100+		192										
	Grey		4	SPT	100+		191										
190.69 4.27			5	SPT	100+										5	22 50 23 (73)	
190.16 4.80			6	SPT	100+												
	End of Borehole.															Water level measured @ 0.75 m @ completion.	

JOE MTO 07-6-IEG1 GPI ONTARIO MOT GDT 03/13/09



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Transportation

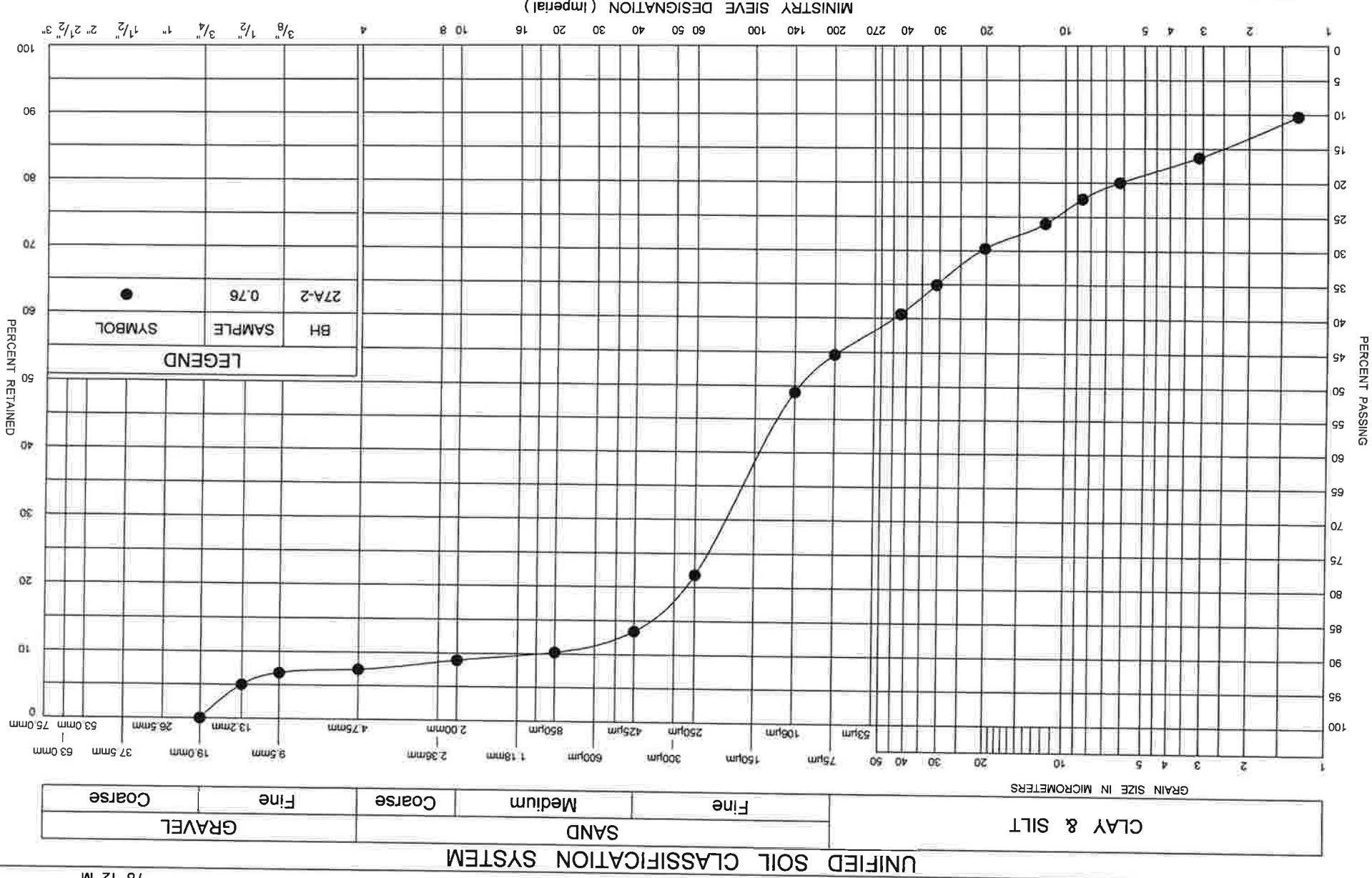
GRAIN SIZE DISTRIBUTION

FILL

FIG No C-27A.1

GWP 57-00-00

HWY 26, Thornbury to Meaford





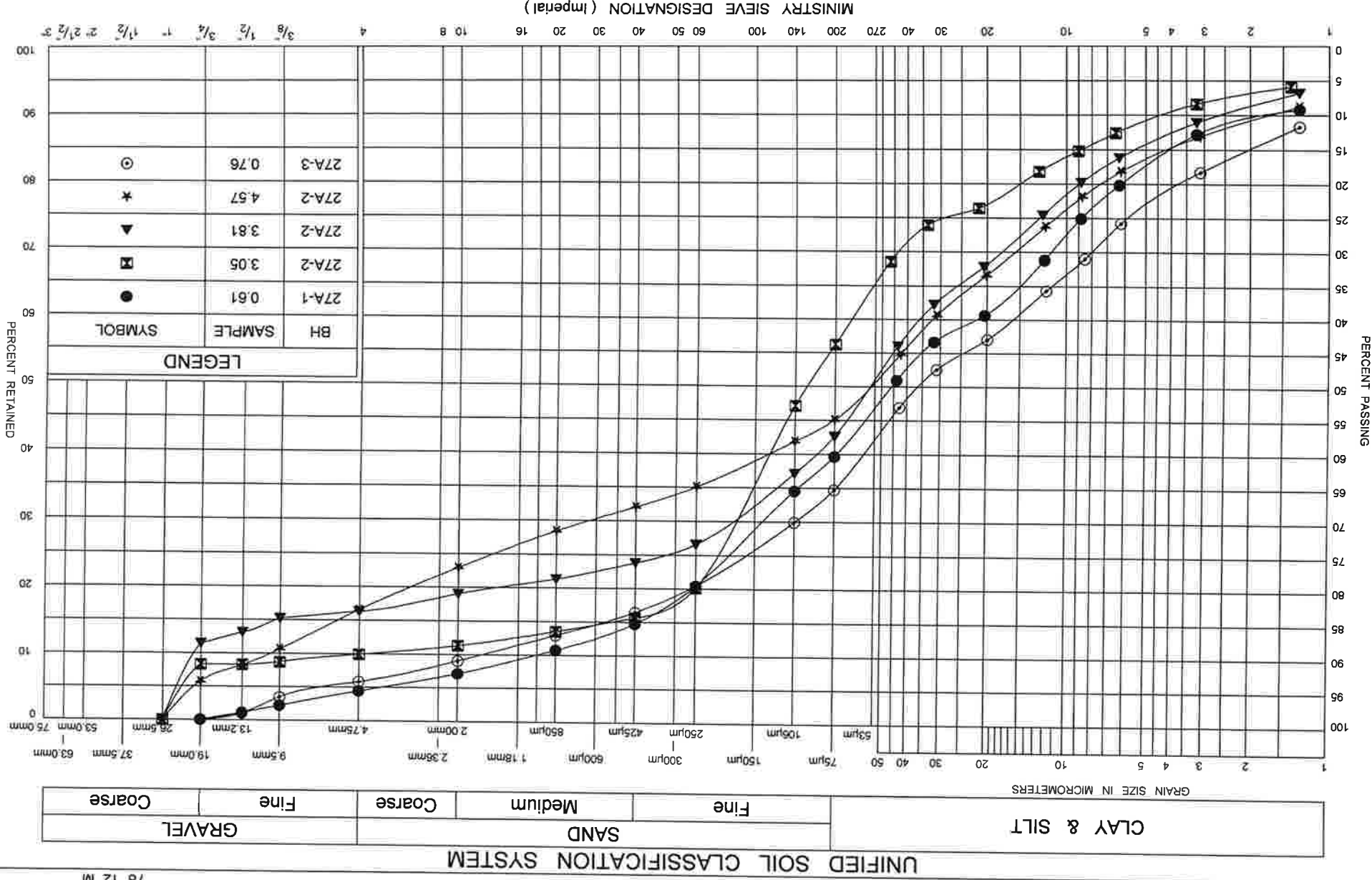
Ministry of  
Transportation

# GRAIN SIZE DISTRIBUTION SANDY SILT TO SAND AND SILT TILL, SM-ML

FIG No C-27A.2

GWP 57-00-00

HWY 26, Thornbury to Meaford

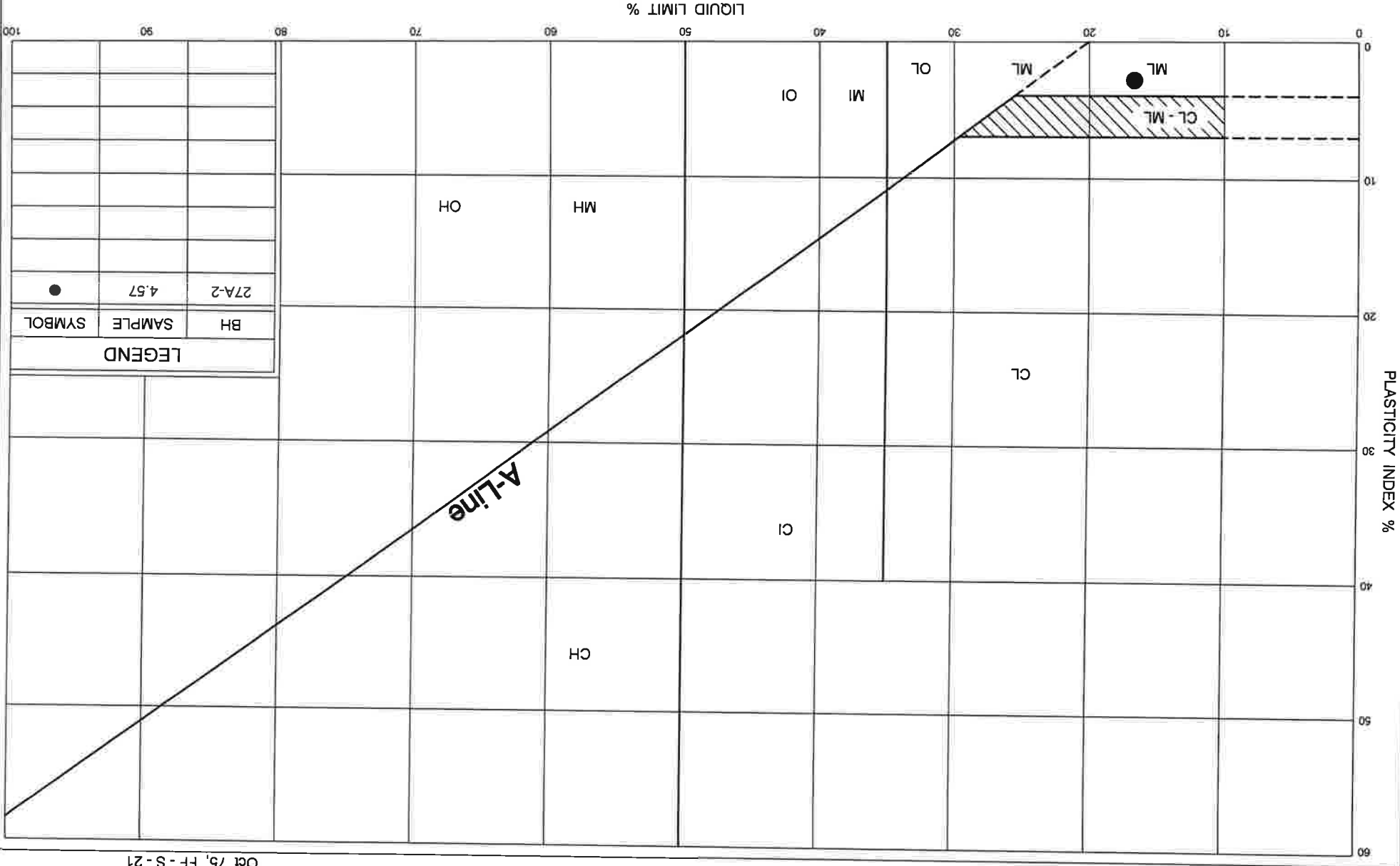


## PLASTICITY CHART

FIG No C-27A.3

GWP 57-00-00

HWY 26, Thornbury to Meaford



Oct 75, FF - S - 21





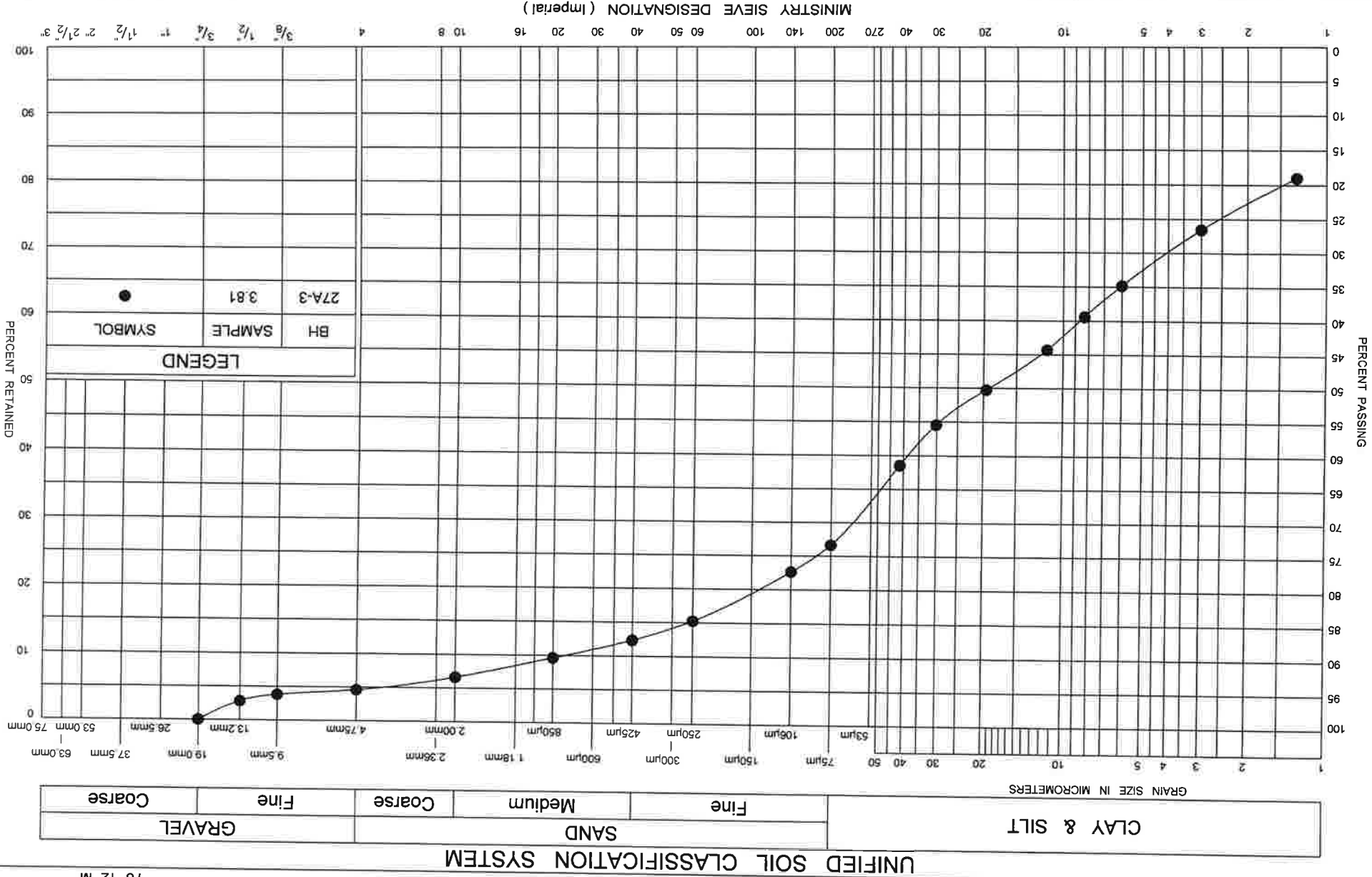
Ministry of  
Transportation

# GRAIN SIZE DISTRIBUTION SILTY CLAY LAYER

FIG No C-27A.4

GWP 57-00-00

HWY 26, Thornbury to Meaford





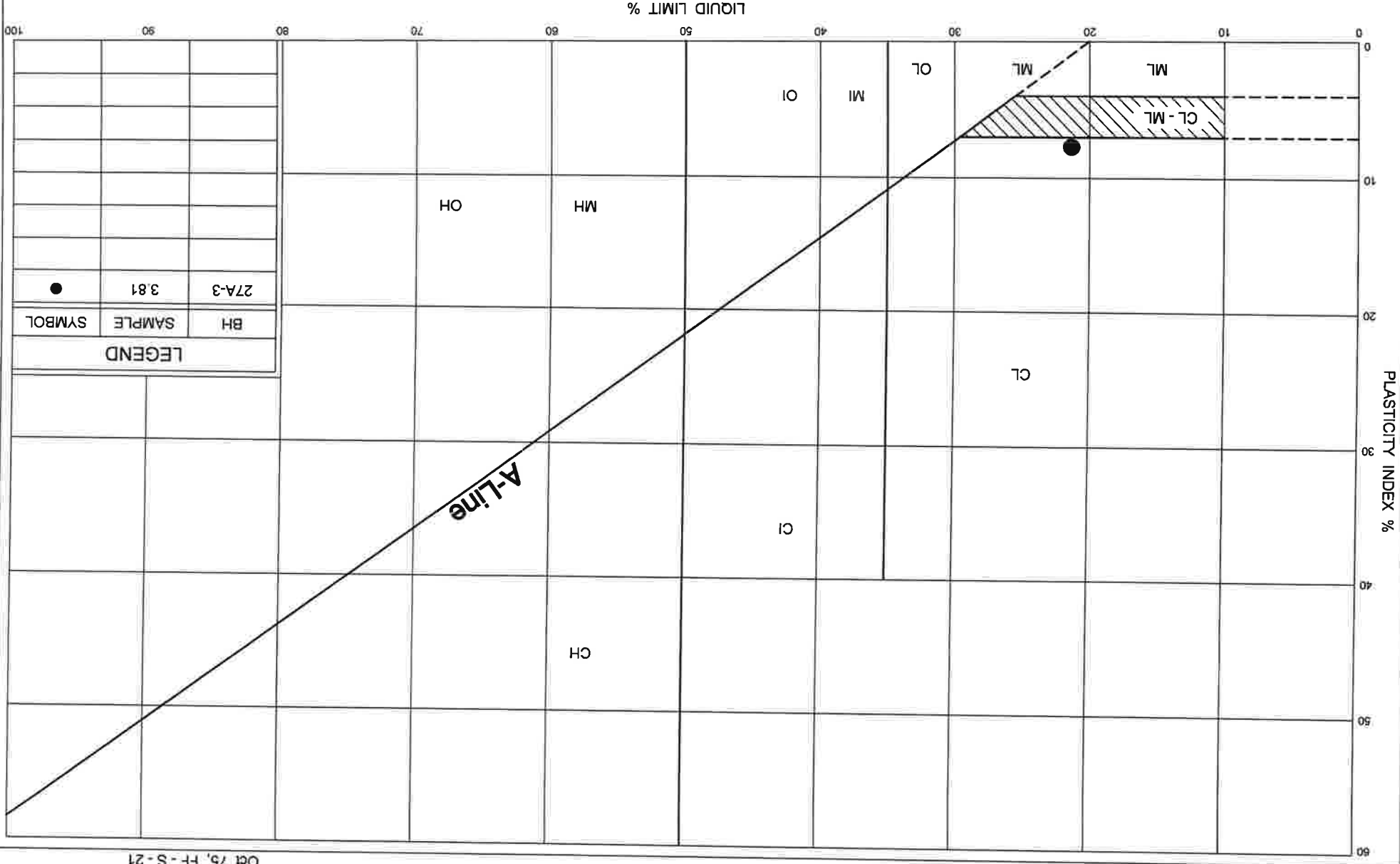
Ministry of  
Transportation

PLASTICITY CHART  
SILTY CLAY LAYER

FIG No C-27A.5

GWP 57-00-00

HWY 26, Thornbury to Meaford



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G.W.P. 57-00-00  
Rehabilitation of Highway 26 from Meaford to Thornbury  
Agreement Agreement # 3006-E-0002

07-6-IEG1-A-COLCR  
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Appendix C  
March 13, 2009

## Appendix C

### Site Photographs





**Station 10+025 – Looking downstream (north)**



**Station 10+ 025 – Looking upstream (south)**



**Station 10+025 – Downstream end (north)**



**Station 10+025 – Upstream end (south)**





**Station 10+765 – Looking downstream (north)**



**Station 10+765 – Looking upstream (south)**



**Station 10+765 – Downstream end (north)**



**Station 10+765 – Upstream end (south)**





**Station 11+638 – Looking downstream (north)**



**Station 11+638 – Looking upstream (south)**



**Station 11+638 – Downstream end (north)**



**Station 11+638 – Upstream end (south)**





**Station 13+656 – Looking downstream (north)**



**Station 13+656 – Looking upstream (south)**



**Station 13+656 – Downstream end (north)**



**Station 13+656 – Upstream end (south)**



Ministry of Transportation/Stantec Consulting Ltd.  
G.W.P. 57-00-00  
Rehabilitation of Highway 26 from Meaford to Thornbury  
Agreement Agreement # 3006-E-0002

07-6-IEG1-A-COLCR  
Final Report  
Appendix D  
March 13, 2009

## Appendix D

### Limitations of Report



## **APPENDIX D**

### **LIMITATIONS OF REPORT**

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Infrastructure Engineering Group Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, IEG recommends that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.