



Ministry
of
Transportation

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONTRACT 94-22 DIST 42
HWY 416 STR SITE 3-539

Settlement at Structure #12
North Approach Embankment
E-S Ramp over Ramp 417W-Acres Road
Hwy. 416/417 Interchange

DISTRIBUTION

E.C. Lane (2)
B. Blum
B. Ruck (2)
S. Cheng (2)
M. Holowka
N. Bot
K. Williams (Cover Only)
F. Bacchus (Cover Only)
✓ File

GEOCRES 31G5-188

DATE SEP 12 1996

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	BACKGROUND	1
3.0	INVESTIGATION PROCEDURE	3
3.1	Field Investigation	3
3.2	Laboratory Analyses	5
4.0	SUBSURFACE CONDITIONS	5
4.1	General	5
4.2	Sand and Gravel (Fill Material)	8
4.3	Irregular Mixture of Clayey Silt, Sand and Gravel with Random Zones of an Irregular Mixture of Silt, Sand and Gravel(Fill Material)	8
4.4	Clayey Silt with interbedded layers/seams of Sandy Silt	12
4.5	Heterogeneous Mixture of Silt, Sand and Gravel(Glacial Till)	13
5.0	GROUNDWATER CONDITIONS	13
6.0	DISCUSSION AND RECOMMENDATIONS	15
6.1	Subexcavation	16
6.2	Placement and Compaction	16
7.0	MISCELLANEOUS	17

FOUNDATION INVESTIGATION REPORT
FOR
SETTLEMENT AT STRUCTURE #12 NORTH APPROACH EMBANKMENT
E-S RAMP OVER RAMP 417W-ACRES ROAD
HWY 416/417 INTERCHANGE
CONTRACT 94-22, SITE 3-539
DISTRICT 42, OTTAWA

1.0 INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the north approach embankment adjacent to Structure #12 immediately south of Structure #2 within the Hwy 416/417 interchange complex. The investigation was carried out at the request of MTO Construction. The purpose of the investigation was to determine the cause of the settlement that had developed at this location and to provide recommendations for the remedial work required to restore the approach embankment.

2.0 BACKGROUND

Structure #12 is one of many structures comprising the Hwy 416/417 interchange that was constructed as part of Contract 94-22. Structure #12 is a single span structure founded on HP 310X110 steel piles driven to bedrock. The abutments for the structure are perched within embankment fills placed on the native soils at the site. Embankment fill heights range up to approximately 12 metres in height and have been constructed with midheight berms of 2 metre width. The structure foundations and approach embankments were designed in accordance with recommendations contained in the Foundation Investigation Report produced by our office in May,

1991.

Construction records reveal that the surficial 3 to 4 metres of the approach embankment fills at Structure # 12 were placed under winter conditions on March 27 & 28, 1996. These fills were placed without MTO field staff present at the site because of the Ontario Public Service Employees Union strike that occurred at this time.

Paving of the approach embankment roadway occurred in early May, 1996. Settlement of the embankment at the north approach to Structure #12 was brought to the attention of the MTO by the Contractor on June 25, 1996. The settlement is pronounced within the area bounded by the approach slab (approximate Station 29 + 413) to the south and approximate Station 29 + 427 to the north. Some cracking of the northerly metre of the approach slab is also evident. The settlement has extended to the concrete barrier walls situated at the western and eastern limits of the embankment fill ramp roadway. The settlements are manifested as vertical cracks within the barrier walls. In addition, depression areas beneath the concrete barrier walls were caused by the settlement.

A settlement monitoring program consisting of a conventional elevation survey of several selected points within and immediately beyond the settlement area has been implemented by MTO Construction field staff. Settlement records reveal magnitudes up to approximately 250 mm. Settlement records illustrate that settlements have stabilized and no further settlement has occurred since July 2, 1996. A copy of the settlement records is attached in Appendix A.

The Regional Geotechnical Section advanced an augered hole at Station 29 +413 situated immediately beyond the approach slab. The soil conditions encountered at this location have been summarized in a borehole log provided in Appendix B. Although the composition of the fill material was concluded to be acceptable at this location, additional information was needed to assess the consistency/compaction of the fill material. As a result, our office was requested to conduct an investigation. The investigation procedure and subsoil conditions determined are described in this report.

3.0 INVESTIGATION PROCEDURE

3.1 Field Investigation

A total of four(4) sampled boreholes were advanced between July 16, 1996 and July 18, 1996 using a truck mounted CME 75 drilling unit. Two boreholes were advanced within the settlement depression area. One borehole was advanced as a "control" borehole north and beyond the settlement area. One borehole was also advanced within the approach slab area approximately 1 metre south of the edge of the slab to investigate the soil conditions beneath the slab. Table 1 summarizes the borehole locations.

Table 1 - Borehole Locations

BH #	Location	Description
1	Station 29 + 417 Centreline	Settlement Area
2	Station 29 + 422 O/S 4.2 m R	Settlement Area
3	Station 29 + 432 Centreline	Control
4	Station 29 + 413 Centreline	Approach Slab

Survey information related to the location and the ground surface elevation of the boreholes was provided by the MTO field staff.

The boreholes were advanced to explore the competence of the fill material at the site and also to verify the native subsoil conditions as determined during the original foundation investigation conducted at the site. Hollow stem and solid stem augers were used to advance the boreholes through the overburden to depths ranging from 6.5 m to 15.6 m. Subsoil samples were generally retrieved either continuously or at 0.76 metre intervals depending on the consistency/denseness of the material in accordance with the Standard Penetration Test (ASTM D1586). Within zones of weaker material of low consistency and denseness, continuous sampling was carried out to delineate the extent of these zones.

All subsoil samples were identified and then sealed in plastic containers in the field to preserve natural moisture contents. The samples were then transported to the laboratory where additional visual classifications and pertinent laboratory tests were conducted.

The open boreholes were monitored throughout the duration of the field investigation to determine the water levels.

All soil cuttings from the borehole were removed by a front end loader supplied by the Contractor. All boreholes were backfilled using either sand fill or gravel fill at the completion of the fieldwork.

3.2 Laboratory Analyses

All subsoil samples were carefully examined in accordance with the procedures outlined in the Visual Method described in Chapter 2 of the MTO Soil Classification Manual. Laboratory testing on selected representative subsoil samples consisted of routine physical property testing. This testing consisted of natural moisture content determination, atterberg limit testing, particle size analyses and unit weight determination. Laboratory test results are shown on the individual borehole logs and discussed below under the subheading Subsurface Conditions.

4.0 SUBSURFACE CONDITIONS

4.1 General

The ground surface elevation at the boreholes advanced at the site range from 76.4 m to 77.1 m. Boreholes 1 and 2 in the settlement depression area were at an obvious lower elevation than the boreholes advanced beyond the depression area.

Two types of fill material exist at the site. The surficial fill material consists of a grey sand and gravel (crushed granular). The thickness of this cohesionless fill material which serves as a roadway base varies between 0.8 m and 1.5 m. This fill material is generally of a compact state of denseness with Standard Penetration Test(SPT) 'N' values generally ranging from 10 blows/0.3m to 30 blows/0.3m

The surficial sand and gravel fill material is underlain by a second fill material comprised primarily of an irregular mixture of a cohesive clayey silt, sand and gravel with random layers of a cohesionless irregular mixture of silt, sand and gravel. The thickness of this fill material varies between 10.6 m and 11.4 m.

Within the settlement depression area, a weaker zone of soft to firm material of approximate thickness 1.2 m to 1.7 m exists immediately beneath the cohesionless sand and gravel fill material. The SPT 'N' values ranged from 2 blows/0.3 m to 8 blows/0.3 m in this zone. In addition, a second weak zone of soft to firm material of approximate thickness of 1.5 m to 2 m exists at a depth of approximately 9.1 metres below the roadway surface. In general, 'N' values within this lower zone ranged from 2 blows/0.3 m to 10 blows/0.3 m. Elsewhere within this fill material, the consistency of the cohesive fill material is generally stiff to very stiff and the denseness of the cohesionless fill material is generally compact. In general, 'N' values within the fill material beyond the weak zones ranged from 12 blows/0.3 m to 30 blows/0.3 m.

The native subsoils encountered at three borehole locations(BH's 1-3) confirms the native subsurface conditions determined during the original foundation investigation. Within the settlement depression

area, the fill material is underlain by a stratum of firm to stiff clayey silt with interbedded seams/layers of sandy silt. This stratum has a thickness of approximately 1.5 metres. SPT 'N' values ranged from 4 blows/0.3 m to 15 blows/0.3 m.

The clayey silt with interbedded seams/layers of sandy silt is in turn underlain by a cohesionless Heterogeneous Mixture of Silt, Sand and Gravel(Glacial Till) deposit. Based on 'N' values ranging from 4 blows/0.3 m to 66 blows/0.3 m, this deposit varies in denseness from very loose to very dense, but is generally dense to very dense. The two boreholes advanced in the settlement depression area were terminated within this deposit.

Beyond the settlement depression area, the fill material is underlain by a stratum of clayey silt with interbedded sandy silt seams. The thickness of this stratum is also greater at this location. Although this stratum was explored only for a thickness of approximately 3.5 metres at BH 3, BH 12-6(Station 29 + 440) advanced during the original foundation investigation indicates a thickness of approximately 6 metres and that the deposit is underlain by a Heterogeneous Mixture of Silt, Sand and Gravel(Glacial Till). The SPT 'N' values within the clayey silt stratum beyond the settlement depression area are lower than in the clayey silt within the settlement depression area ranging from 1 blow/0.3 m to 4 blows/0.3 m indicating a soft to firm consistency.

Groundwater was not encountered during the investigation.

A plan of the site illustrating the locations of the boreholes is shown on Dwg No. 9422-A included

in Appendix C. A stratigraphical section illustrating the subsurface conditions is also provided on Dwg. No. 9422-B. The boundaries between the various soil types, in situ and laboratory test results are shown on the stratigraphical sections and also on the individual record of borehole sheets. The individual record of borehole sheets are included in Appendix C.

4.2 Sand and Gravel (Fill Material)

A grey, compact sand and gravel(Crushed Granular) exists as the roadway base across the site. The thickness of the fill material varies from 0.8m to 1.5m.

Standard Penetration Tests(SPT) carried out within the fill material revealed 'N' values ranging from 9 blows/0.3 m to 40 blows/0.3 m. In general, 'N' values range from 10 blows/0.3 m to 30 blows/0.3 m confirming a compact state of denseness.

4.3 Irregular Mixture of Clayey Silt, Sand and Gravel with Random Zones of an Irregular Mixture of Silt, Sand and Gravel(Fill Material)

A fill material comprised primarily of a cohesive irregular mixture of clayey silt, sand and gravel underlies the surficial sand and gravel fill material. Distinct zones or layers of a cohesionless irregular mixture of silt, sand and gravel are also randomly present within the fill material. Some coarse grained materials such as boulders and cobbles were inferred from the auger grinding that was encountered in this fill material. In addition, traces of asphalt and concrete were also sampled within

the fill. This fill material, placed to the original ground surface, varies in thickness from approximately 10.6 m to 11.4 m.

The fill material is a mottled brown-grey for most of its thickness. However, discrete black zones indicating traces of organics are also randomly present with the fill material.

Two distinct weak zones of soft to firm material were encountered within the fill material as concluded from examination of the SPT 'N' values. The first zone of approximate thickness 1.2 m to 1.7 m exists immediately beneath the cohesionless sand and gravel fill material. The 'N' values ranged from 2 blows/0.3 m to 8 blows/0.3 m in this zone. A second weak zone of soft to firm fill material of approximate thickness of 1.5 m to 2 m exists at a depth of approximately 9.1 metres below the roadway surface. The 'N' values within this lower zone ranged from 2 blows/0.3 m to 10 blows/0.3 m. Elsewhere within this fill material, 'N' values ranged from approximately 12 blows/0.3 m to 100 blows/0.3 m. The large 'N' values are indicative of boulders and cobbles that are present at some locations within the fill material. In general, the 'N' values beyond the two weak zones range from 12 blows/0.3 m to 30 blows/0.3 m indicating that the cohesive irregular mixture of clayey silt, sand and gravel has a consistency ranging from stiff to very stiff and the denseness of the cohesionless fill material is generally compact

Figure 1 in Appendix C illustrates a grain size distribution produced by mechanical sieve and hydrometer analysis for the irregular mixture of clayey silt, sand and gravel fill material beyond the weak zones. A grain size distribution curve for a sample of the irregular mixture of silt, sand and

gravel fill material beyond the weaker zones has also been plotted on Figure 1. The envelope and the curve illustrates that the fill material is comprised of a broad range of particle sizes. For the irregular mixture of clayey silt, sand and gravel, clay fractions range from 8% to 36%, but are generally between 8% and 23%. Silt percentages range from 17% to 41%. Coarse grained sands and gravels generally comprise 56% to 70%. For the irregular mixture of silt, sand and gravel, the fine grained portion (less than 75 micrometres) was only 16% of the fill material.

Figure 2 illustrates a grain size distribution envelope for the upper weak zone of the irregular mixture of clayey silt, sand and gravel fill material of approximate thickness 1.2 m to 1.7 m that exists immediately beneath the cohesionless sand and gravel fill material. In comparing the envelopes in Figures 1 and 2, it is evident that the range of the composition of the fill material in the weak zone is narrower than the fill material beyond the weak zone. In general, it appears that the fine grained portion of the irregular mixture of clayey silt, sand and gravel appears to be larger within the weak zone. The clay fraction within the upper weak zone ranges from 19% to 24%, silt percentages range from 32% to 42%. Coarse grained sands and gravels generally comprise 34% to 49%.

Atterberg Limit Tests were carried out on the fine grained portion of the fill material (material less than 75 micrometres) to define the behaviour and plasticity of the material. The results are plotted on the Plasticity Chart illustrated in Figure 3 in Appendix C. Different plot symbols were used in an attempt to compare the fill material within and beyond the upper weak zone.

The test results reveal that the fine grained portion of all the fill material samples, both within and

beyond the upper weak zone , range from a clayey silt of low plasticity to a non plastic silt. There appears, however, to be a discernible difference between the Atterberg Limits within the upper weak zone and those beyond the upper weak zone. In general, the samples within the upper weak zone appear to have larger liquid limits and plasticity indices which is usually indicative of larger clay fractions. Table 2 summarizes the Atterberg Limit Test results for samples tested within and beyond the upper weak zone.

Table 2 - Atterberg Limit Test Results

Fill Material	Liquid Limit(w_L %)	Plastic Limit(w_p %)	Plasticity Index(I_p %)
Upper Weak Zone	27-32	14-15	13-17
Beyond Weak Zone	19-31	12-16	6-15

Figure 4 in Appendix illustrates a comparison of the moisture contents determined on samples of the fill material retrieved within the upper weak zone and the fill material retrieved beyond this upper weak zone. The figure shows that the moisture contents within the upper weak zone are generally larger and definitely greater than optimum for compaction for this material. Moisture contents determined on samples within the upper weak zone range from 10.5% to 27.5%, but appear to be generally between the 17.5% to 27.5% range. Moisture contents determined on samples of fill material beyond the weak zone generally range from approximately 7% to 14%.

Bulk unit weights measured confirm the larger moisture contents within the fill material located within the upper weak zone. Bulk unit weights within the upper weak zone were generally larger ranging from 19.5 kN/m³ to 22.5 kN/m³ as compared to bulk unit weights ranging from 20.6 kN/m³ to 24.8 kN/m³ for samples tested within the fill material beyond the weak zone. The bulk unit weights are

included on the Record of Borehole sheets in Appendix C.

4.4 Clayey Silt with interbedded layers/seams of Sandy Silt

The surficial native soil at the site consists of a cohesive stratum of clayey silt with interbedded layers of a cohesionless sandy silt. The boreholes advanced during this investigation confirms that the thickness of this stratum increases in a northerly direction as illustrated in the stratigraphical section on Sheet 453 of the Contract Drawings. Within the settlement depression area, this stratum has a thickness of approximately 1.5 metres and is brown to grey in colour. Beyond the settlement depression area, this stratum is brown to grey and was explored for a minimum 3.5 metres. It is known, however, that this stratum has a thickness of approximately 6 metres at BH 12-6(Station 29 + 440).

Grain size distribution curves as determined by mechanical sieve and hydrometer analysis on two representative samples of the clayey silt with interbedded layers of sandy silt are illustrated on Figure 5 in Appendix C. The curves illustrate clay fractions ranging from 31% to 38%, silt percentages ranging from 38% to 42% and sand percentages ranging from 20% to 31%. The silt and sand percentages reflect the presence of seams or layers of sandy silt to silty sand that are interbedded within the clayey silt. The seams/layers range in thickness from approximately 25mm to 100mm. The grain size distribution curves determined are similar to the grain size distribution curves for this stratum during the original foundation investigation conducted at this time.

Based on 'N' values ranging from 4 blows/0.3 m to 15 blows/0.3 m, it is concluded that this material

has a firm to stiff consistency within the settlement depression area. Beyond the settlement depression area, 'N' values are lower and generally in the 1 blow/0.3 m to 4 blows/0.3 m range indicating a soft to firm consistency.

4.5 Heterogeneous Mixture of Silt, Sand and Gravel(Glacial Till)

The clayey silt with interbedded seams/ layers of Sandy Silt stratum is underlain by a heterogeneous mixture of silt, sand and gravel of glacial till origin. The thickness of this deposit was not explored during this investigation but the original foundation investigation indicates a thickness of up to 6 metres. Figure 6 in Appendix C illustrates a grain size distribution curves for a representative sample of this deposit. The curve illustrates a broadly graded material with primarily silt and sand percentages of 24% and 56% respectively. Some gravel is also present within this deposit. The curve confirms the broadly graded nature of glacial till deposits as identified in the original Foundation Investigation Report.

Based on 'N' values ranging from 4 blows/0.3 m to 66 blows/0.3 m, this deposit varies in denseness from very loose to very dense, but is generally compact to dense.

5.0 GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open

boreholes throughout the duration of the field investigation. All boreholes advanced during the investigation were dry.

6.0 DISCUSSION AND RECOMMENDATIONS

Settlement of the approach embankment north of Structure #12 has occurred between approximate Stations 29+414 and 29+429 in the longitudinal direction and for the full width of the embankment in the transverse direction. The results of a foundation investigation conducted at the site reveals a soft to firm zone of fill material extending from approximate Elevation 75.4 m to Elevation 73.7 m. It is concluded that the cause of this weaker material is construction related. It is our opinion that this zone of weaker irregular mixture of clayey silt, sand and gravel material has settled as a result of the imposed external loadings and also a result of loading under its own weight.

The investigation conducted confirmed that the native subsoil conditions at the site are sufficiently competent and hence not susceptible to consolidation settlement under the existing embankment loadings. In fact, at BH #3 advanced beyond the settlement area, and the area between this borehole and the south approach to Structure #2, no settlement has taken place in an area where the native clayey silt stratum is of greater thickness and of weaker consistency. It is therefore concluded that the settlement is not the result of overstressing the native soils at the site.

In order to remedy the problem and to prevent future settlements, it is recommended that this zone of weak material be subexcavated and replaced with a new fill material as specified in OPSS 212. Details of the subexcavation and placement are described in this section of the report.

6.1 Subexcavation

It is recommended that all the weak material be excavated as illustrated in Figure 7. The subexcavation entails excavation to Elevation 73.7 m or approximate depths of 3 metres between Stations 29+413 and 29+427 for the full width of the roadway. Excavation slopes of 2H:1V are recommended within the granular material at the approach slab location with a 3 metre mid-depth bench immediately adjacent to the ballast wall. At the northern limit of the excavation, the excavation will be primarily within the cohesive irregular mixture of clayey silt, sand and gravel. It is therefore recommended that the excavation be carried out at 1.5H:1V slopes with a 0.6 metre mid-depth bench.

6.2 Placement and Compaction

Prior to the placement of the new granular "B" fill material, it is recommended that the soil at Elevation 73.7 be proof-rolled. Proof-rolling shall be carefully inspected to ensure that any softened material is removed.

The new fill material shall be material as specified in OPSS 212. Consideration can be given to employing a Granular "B" material to improve the quality of the embankment.

The fill materials shall be placed and compacted in accordance with OPSS 206.07.07 and OPSS 501 series. Granular materials shall be placed to 100 per cent maximum dry density and earth materials shall be compacted to 95 per cent maximum dry density. The material shall be spread in uniform full width layers not more than 0.30 m in depth prior to compaction as specified in the Layer Compaction Method.

7.0 MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer and J. Werner, Trainee Engineer, utilizing equipment owned and operated by Eastern Soil Investigation Limited.

The report was prepared by T. Sangiuliano and reviewed by D. Dundas, Senior Foundation Engineer.



A handwritten signature in black ink, appearing to read "T. Sangiuliano".

T. Sangiuliano, P. Eng.
Foundation Engineer



A handwritten signature in black ink, appearing to read "D. Dundas".

D. Dundas, P. Eng.
Senior Foundation Engineer

APPENDIX A

SETTLEMENT MONITORING RECORDS

LAYOUT

DT

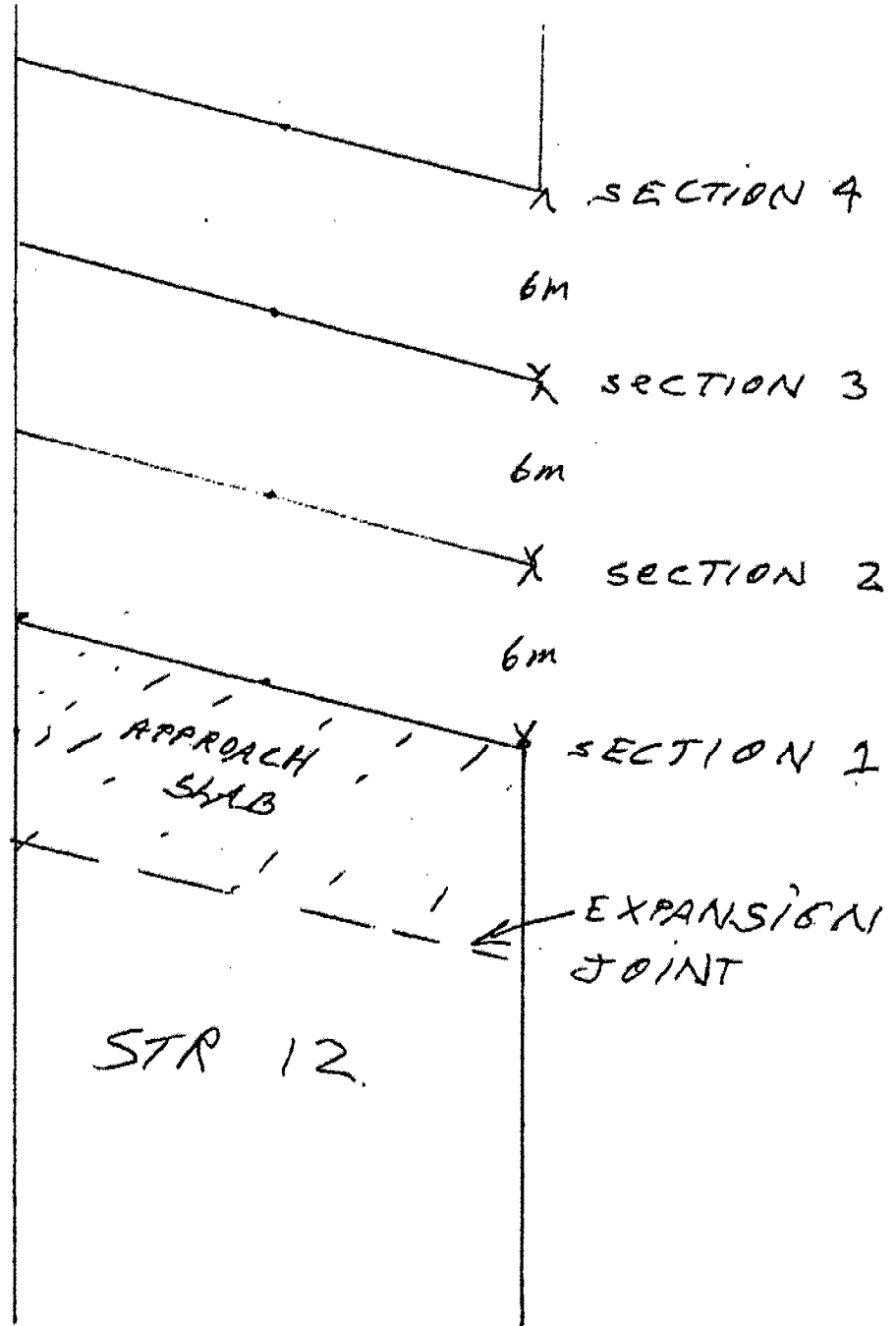
SECT

JUL 19 '96 10:49AM

LT
EP

Q

RT
EP



PLAN

JUL-19-96 FRI 11:49 MINISTRY OF TRANS ONT. P.05
JUL 19 '96 10:49AM

DATE	SECTION #	LOCATION	ELEVATION	MOVEMENT
JUNE 26, 1996	1	LT EP	100.391	0 *
		CL	100.136	0 *
		RT EP	99.883	0 *
	2	LT EP	100.177	0 *
		CL	99.953	0 *
		RT EP	99.716	0 *
	3	LT EP	100.213	0 *
		CL	100.008	0 *
		RT EP	99.818	0 *
	4	LT EP	100.265	0 *
		CL	100.031	0 *
		RT EP	99.821	0 *
JUNE 28, 1996	1	LT EP	100.388	-.003
		CL	100.139	+.003
		RT EP	99.883	0 *
	2	LT EP	100.174	-.003
		CL	99.953	0 *
		RT EP	99.718	+.002
	3	LT EP	100.216	+.003
		CL	100.007	-.001
		RT EP	99.820	+.002
	4	LT EP	100.266	+.001
		CL	100.034	+.003
		RT EP	99.825	+.004

Notes: * - movement shown in the chart is deviation from elevations taken on June 26, 1996.

SETTLEMENT TABLE

JUL-19-96 FRI 11:48 MINISTRY OF TRANS ONT. P.04
JUL 19 '96 10:49AM

DATE	SECTION #	LOCATION	ELEVATION	MOVEMENT
JULY 2,1996	1	LT EP	100.392	+0.001
		CL	100.137	+0.001
		RT EP	99.884	+0.001
	2	LT EP	100.165	-.012
		CL	99.944	-0.009
		RT EP	99.708	-.008
	3	LT EP	100.210	-.003
		CL	100.006	-.002
		RT EP	99.818	0 *
	4	LT EP	100.265	0 *
		CL	100.032	+0.001
		RT EP	99.820	+0.002
JULY 4,1996	1	LT EP	100.390	-.001
		CL	100.138	+0.002
		RT EP	99.886	+0.003
	2	LT EP	100.163	-.014
		CL	99.944	-.009
		RT EP	99.704	-.014
	3	LT EP	100.209	-.003
		CL	100.009	+0.001
		RT EP	99.817	-.001
	4	LT EP	100.266	+0.001
		CL	100.033	+0.002
		RT EP	99.824	+0.003

Notes: * - movement shown in the chart is deviation from elevations taken on June 26, 1996.

SETTLEMENT TABLE

JUL-19-96 FRI 11:48 MINISTRY OF TRANS ONT. P.03
JUL 19 '96 10:49AM

DATE	SECTION #	LOCATION	ELEVATION	MOVEMENT
JULY 9,1996	1	LT EP	100.387	-.004
		CL	100.135	-.001
		RT EP	99.882	-.001
	2	LT EP	100.152	-.025
		CL	99.942	-.011
		RT EP	99.699	-.017
	3	LT EP	100.206	-.007
		CL	100.007	-.001
		RT EP	99.816	-.002
	4	LT EP	100.264	-.001
		CL	100.031	0 *
		RT EP	99.822	+.001
JULY 15,1996	1	LT EP	100.391	0. *
		CL	100.139	+.003
		RT EP	99.892	0 *
	2	LT EP	100.153	-.024
		CL	99.945	-.008
		RT EP	99.701	-.015
	3	LT EP	100.209	-.004
		CL	100.008	0 *
		RT EP	99.815	-.003
	4	LT EP	100.267	+.002
		CL	100.034	+.003
		RT EP	99.825	+.004

Notes: * - movement shown in the chart is deviation from elevations taken on June 26, 1996.

SETTLEMENT TABLE

APPENDIX B

BOREHOLE LOG - REGIONAL GEOTECHNICAL SECTION

HIGHWAY 416 CONT. 94-22

NORTH APPROACH SLAB AT STRUCTURE 12

29+413	0.5 Rt	PA
0 - 80 mm	Asph	
80 - 350 mm	Gry Cr Gr	
350 - 2.25 m	Gry Cr Gr (75mm "B")	
2.25 - 2.75 m	Gry Cr Gr (75mm "B" Damp)	
2.75 - 3.25 m	Gry Sa Cl Stny w Si (M&F) (Fill)	
3.25 - 3.55 m	Br Sa Cl Stny w Si (M&St) (Fill)	
3.55 - 4.25 m	Br Cl Sa Stny (Fill)	
4.25 - 4.50 m	Gry Sa Cl Stny w Si (M&So) (Fill)	
4.50 - 4.80 m	Br Cl Sa Stny (Fill)	
4.80 - 5.80 m	Gry Si Cl Stny w Sa (M&So) (Fill)	

APPENDIX C

Site Plan

Borehole Location Plan - Dwg 9422-A

Stratigraphical Section - Dwg 9422-B

Record Of Borehole Sheets

Figures 1-7 Inclusive

APPROACH EMBANKMENT SETTLEMENT AREA

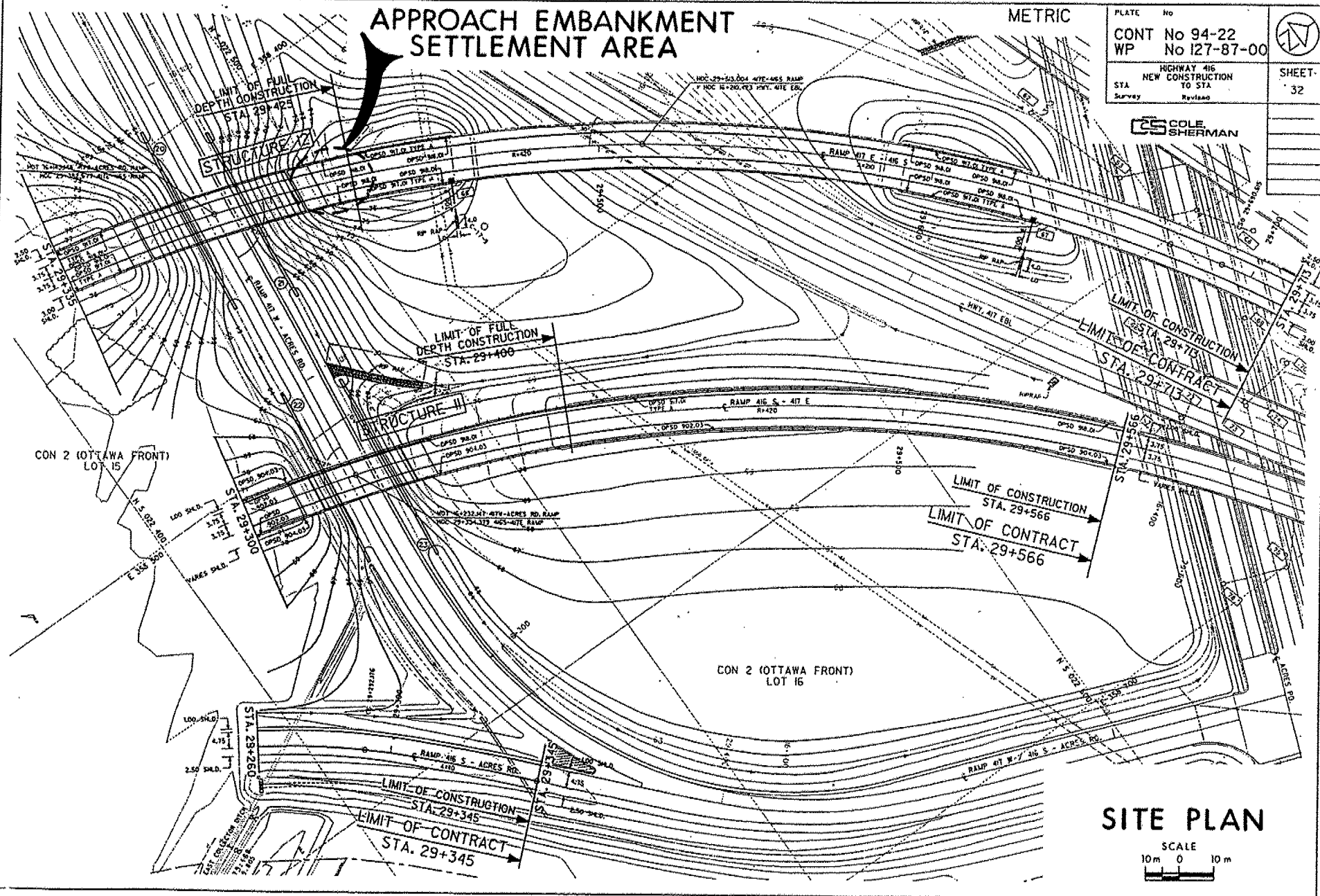
METRIC

PLATE No	CONT No 94-22
WP	WP No 127-87-00
STA Survey	Highway 416 NEW CONSTRUCTION TO STA
Revision	Revised

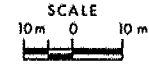


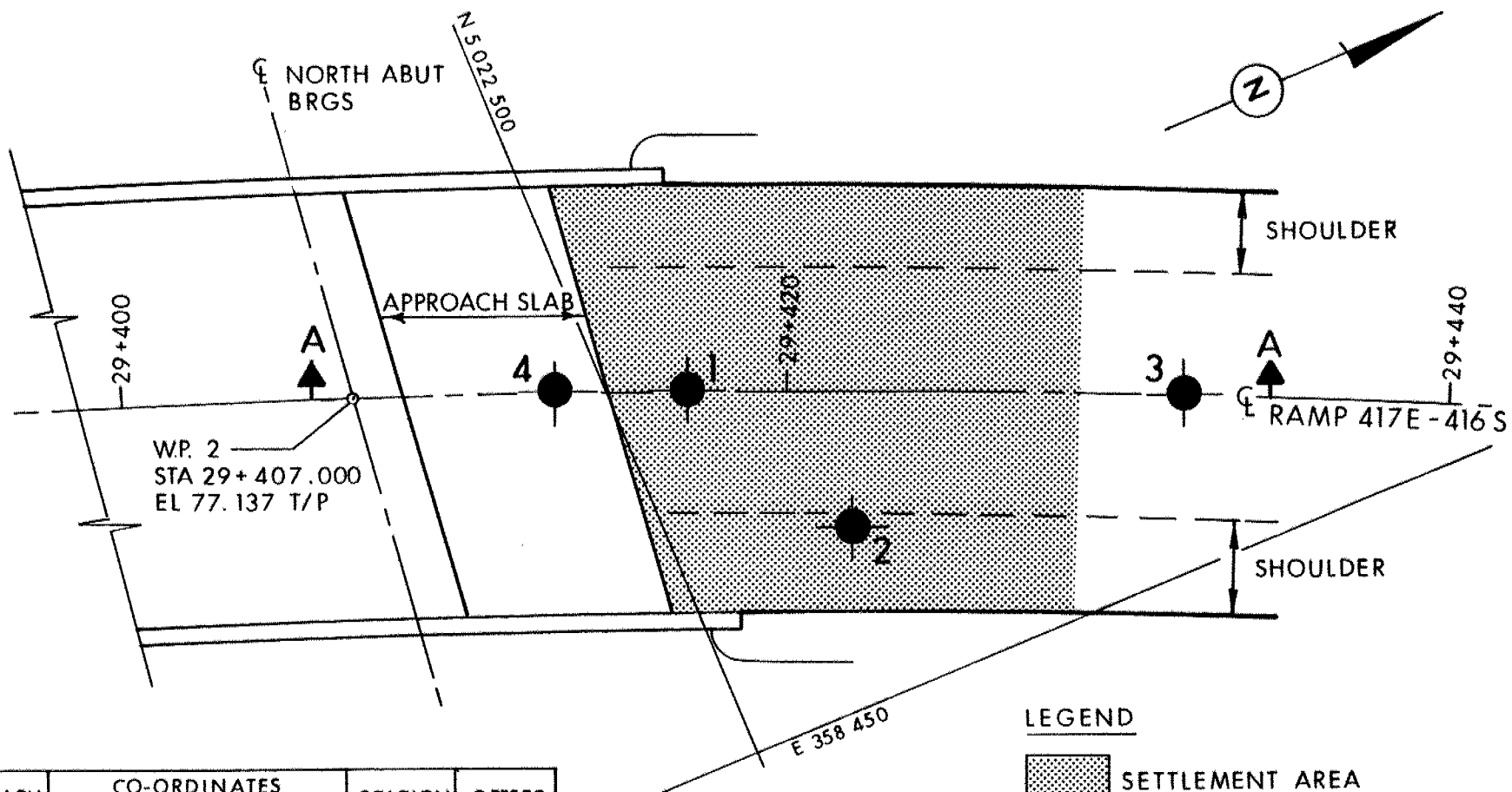
SHEET
32

COLE
SHERMAN



SITE PLAN





BH No	ELEV	CO-ORDINATES		STATION	OFFSET
		NORTH	EAST		
1	76.9	5 022 502.5	358 439.0	29 + 417	CL
2	76.4	5 022 505.0	358 445.0	29 + 422	4.2m RT
3	76.8	5 022 516.0	358 445.0	29 + 432	CL
4	77.1	5 022 498.5	358 437.5	29 + 413	CL

NOTE

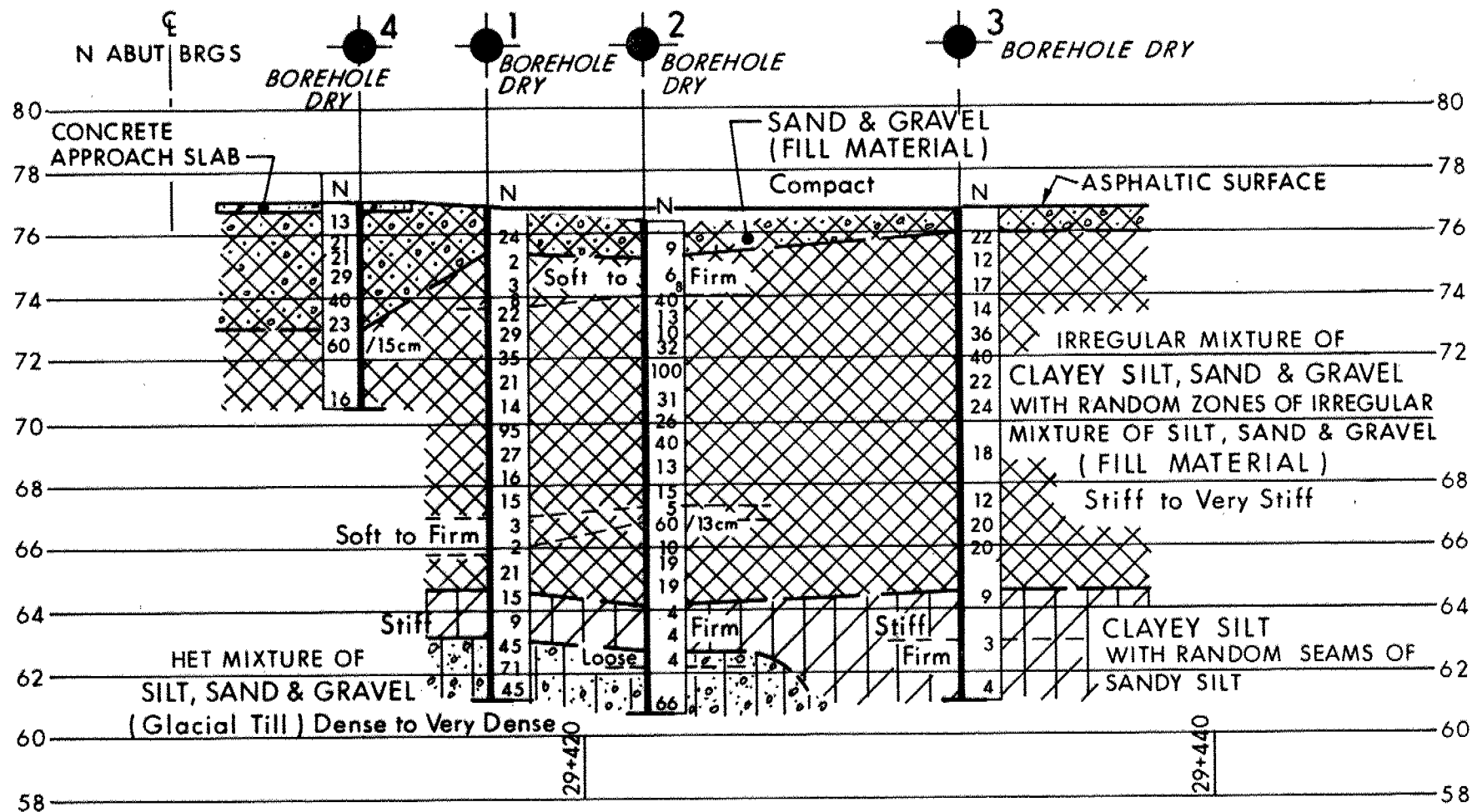
FOR SECTION REFER TO DWG 9422-B

LEGEND

- SETTLEMENT AREA
- BORE HOLE



SETTLEMENT AT STR 12
NORTH APPROACH EMBANKMENT
 E-S RAMP OVER RAMP 417 W-ACRES RD
 HWY 416 DIST 42 SITE 3-539
 CONT No 94-22 DATE 96 09 03
 Geocres No 31G5-188 DWG 9422-A



RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 94-22 LOCATION Ramp 417E - 416S; Station 29+417 Centreline ORIGINATED BY TS
 DIST 42 HWY 416 BOREHOLE TYPE HS Auger COMPILED BY TS
 DATUM Geodetic DATE 96 07 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
76.9	Asphaltic Roadway															
0.0	Sand and Gravel (Fill Material)					DRY										
75.4	Grey, Compact		1	SS	24		76									
1.5			2	SS	2											
			3	SS	3											
	Soft to Firm		4	SS	8		74								22.5	10 34 34 22
	Stiff to Very Stiff		5	SS	22										21.5	13 36 32 19
			6	SS	29										21.1	34 36 19 11
	Irregular Mixture of Clayey Silt, Sand and Gravel with random zones of an Irregular Mixture of Silt, Sand and Gravel (Fill Material)		7	SS	35		72									
			8	SS	21											
	Brown to Grey		9	SS	14											
			10	SS	95		70									
	Silt, Sand, Gravel, Cobbles		11	SS	27											
			12	SS	16		68								22.9	22 47 23 8
	trace Organics		13	SS	15											
			14	SS	3											
	Soft to Firm		15	SS	2		66									
64.7			16	SS	21										20.5	0 20 47 33
12.2	Clayey Silt with random seams of Sandy Silt		17	SS	15										20.3	0 31 38 31
63.2	Brown, Stiff		18	SS	9		64									
13.7	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)		19	SS	45											
			20	SS	71											
61.2	Grey, Dense to Very Dense		21	SS	45		62									12 56 24 8
15.7	End of Borehole															
	* 96 07 16															

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 94-22 LOCATION (Co-ords N 5 022 505.0 E 358 445.0) ORIGINATED BY TS
 DIST 42 HWY 416 BOREHOLE TYPE HS Auger COMPILED BY TS
 DATUM Geodetic DATE 96 07 16-17 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100									
							WATER CONTENT (%) 10 20 30										
76.4	Roadway Shoulder																
0.0	Sand and Gravel (Fill Material)					DRY *	76										
75.2	Grey, Compact		1	SS	9												
1.2			2	SS	6												
	Soft to Firm		3	SS	8												
			4	SS	40												
	Irregular Mixture of Clayey Silt, Sand and Gravel with random zones of an Irregular Mixture of Silt, Sand and Gravel (Fill Material)		5	SS	13												
			6	SS	10												
			7	SS	32												
	Boulders		8	SS	100												
			9	ss	31												
	trace Organics		10	SS	26												
	Brown to Grey		11	SS	40												
	Stiff to Very Stiff		12	SS	13												
			13	SS	15												
	Soft to Firm		14	SS	5												
			15	SS	60												
			16	SS	10												
			17	SS	19												
54.2			18	SS	19												
12.2	Clayey Silt with random seams of Sandy Silt		19	SS	4												
62.7	Brown, Firm		20	SS	4												
13.7	Loose		21	SS	4												
	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)																
60.7	Very Dense Grey	22	SS	66													
15.7	End of Borehole * 96 07 17																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 94-22 LOCATION (Co-ords N 5022 516.0 E 358 445.0) Ramp 417E - 416S; Station 29+432 Centreline
 DIST 42 HWY 416 BOREHOLE TYPE HS Auger ORIGINATED BY TS
 DATUM Geodetic DATE 96 07 17 COMPILED BY TS
 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE									
							WATER CONTENT (%) 10 20 30										
76.8	Asphaltic Surface																
0.0	Sand and Gravel (Fill Material) Grey, Compact																
0.8			1	SS	22		76						24.7				
			2	SS	12												
			3	SS	17												
			4	SS	14		74						21.8	37 32 17 14			
	trace Organics		5	SS	36												
			6	SS	40		72										
	Irregular Mixture of Clayey Silt, Sand and Gravel with random zones of an Irregular Mixture of Silt, Sand and Gravel (Fill Material)		7	SS	22												
			8	SS	24		70										
	Brown		9	SS	18								46 38 12 4				
	Stiff to Very Stiff						68										
			10	SS	12												
	Brown to Black some Organics		11	SS	20		66										
			12	SS	20												
64.6																	
12.2			13	SS	9		64						0 20 42 38				
	Brown, Stiff																
	Grey, Firm		14	SS	3		62										
	Clayey Silt with random seams of Sandy Silt																
61.1			15	SS	4												
15.7	End of Borehole																
	* 96 07 17																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

(Co-ords N 5 022 498.5 E 358 437.5)

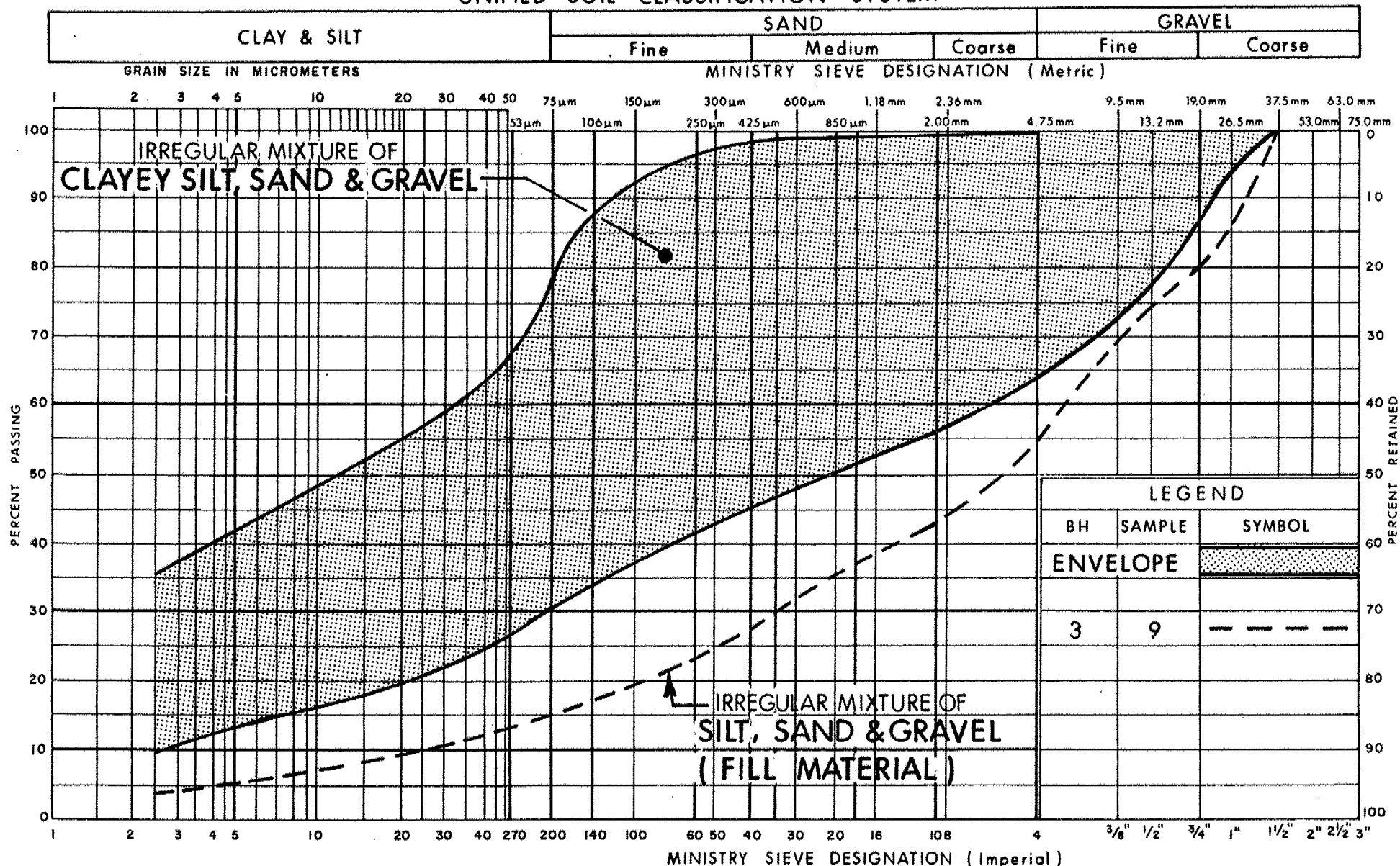
W.P. 94-22 LOCATION Ramp 417E - 416S: Station 29+413 Centreline ORIGINATED BY TS
DIST 42 HWY 416 BOREHOLE TYPE SS Auger COMPILED BY TS
DATUM Geodetic DATE 96 07 18 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
77.1	Asphaltic Surface													
76.8	**					DRY *								
0.3	Sand and Gravel (Fill Material)		1	SS	13		76							
			2	SS	21									
			3	SS	21									
	Grey, Compact		4	SS	29		74							
			5	SS	40									
73.0			6	SS	23									
4.1	Irregular Mixture of =====Boulders===== Clayey Silt, Sand and Gravel with random zones of an Irregular Mixture of Silt, Sand and Gravel (Fill Material)		7	SS	60	/15cm	72							
70.5	Brown to Grey, Stiff		8	SS	16									
6.6	End of Borehole													
	* 96 07 18													
	** Concrete Approach Slab													

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

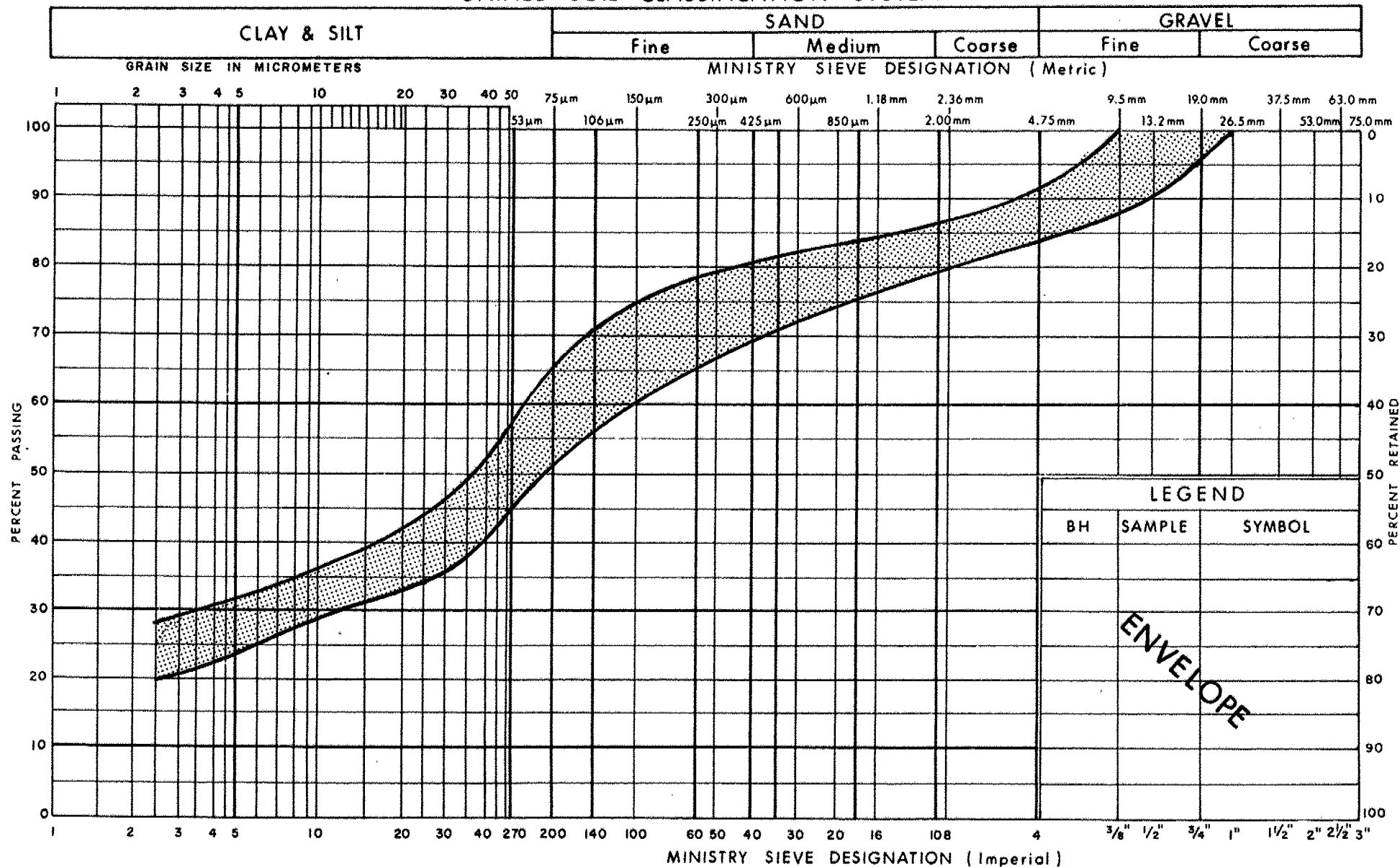
GRAIN SIZE DISTRIBUTION

IRREGULAR MIXT. OF CLAYEY SILT, SAND & GRAVEL WITH RANDOM ZONES
OF AN IRREGULAR MIXTURE OF SILT, SAND & GRAVEL
BEYOND UPPER WEAK ZONE

FIG No 1

CONT 94-22

UNIFIED SOIL CLASSIFICATION SYSTEM

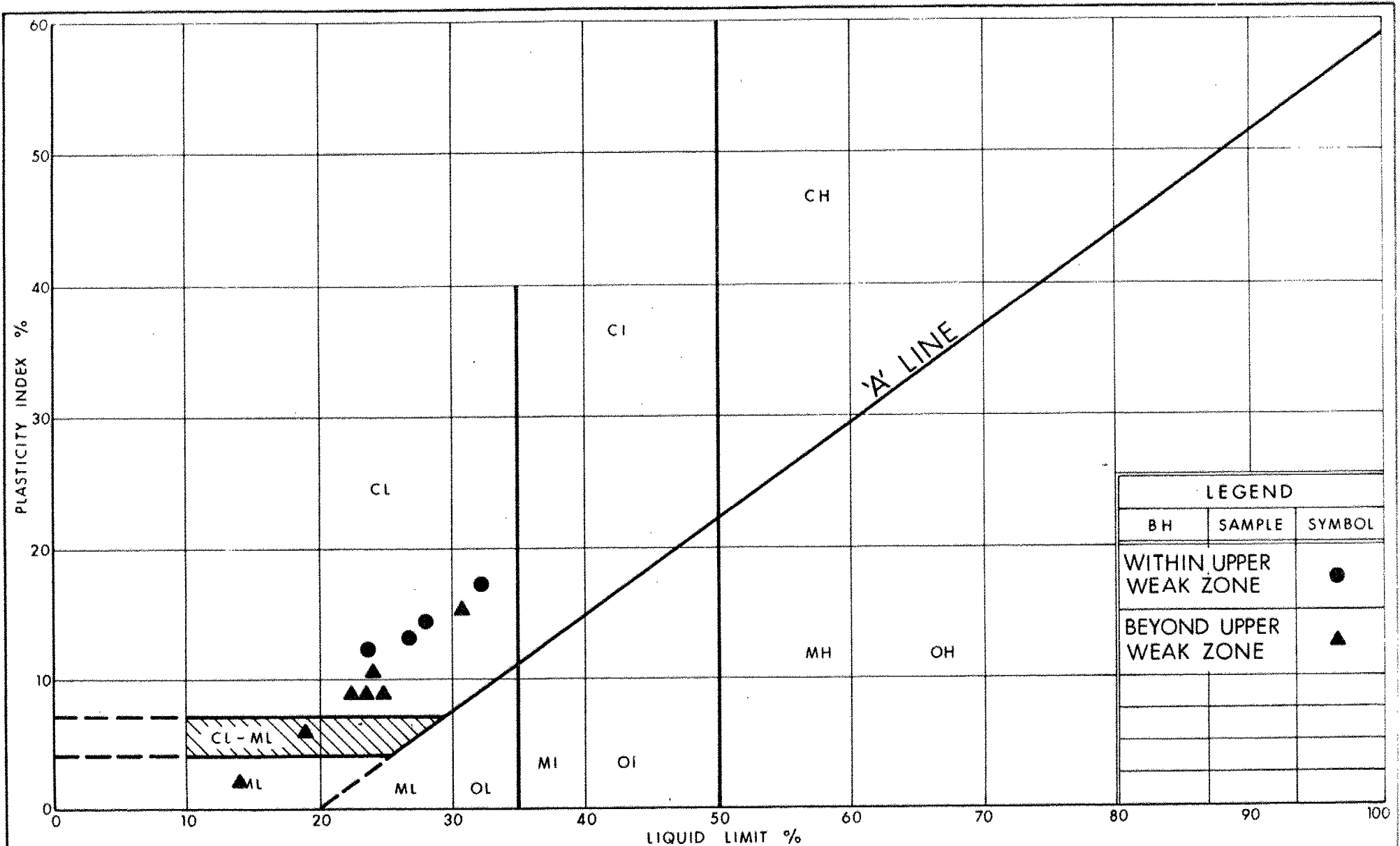


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
IRREGULAR MIXTURE OF
CLAYEY SILT, SAND & GRAVEL (FILL MATERIAL)
WITHIN UPPER WEAK ZONE

FIG No 2

CONT 94 - 22



Ministry of
Transportation

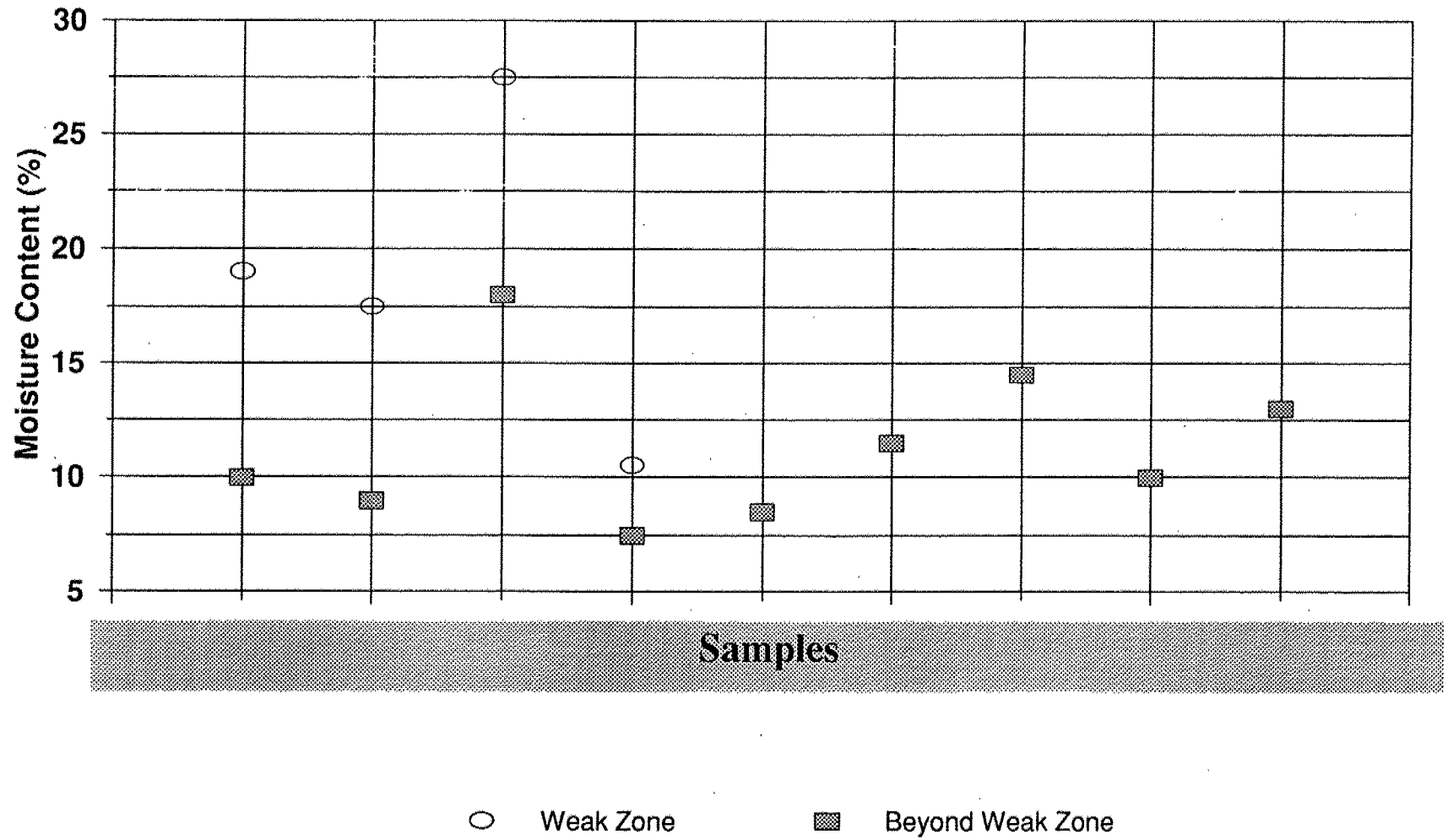
PLASTICITY CHART
IRREGULAR MIXTURE OF
CLAYEY SILT, SAND & GRAVEL (FILL MATERIAL)

FIG No 3

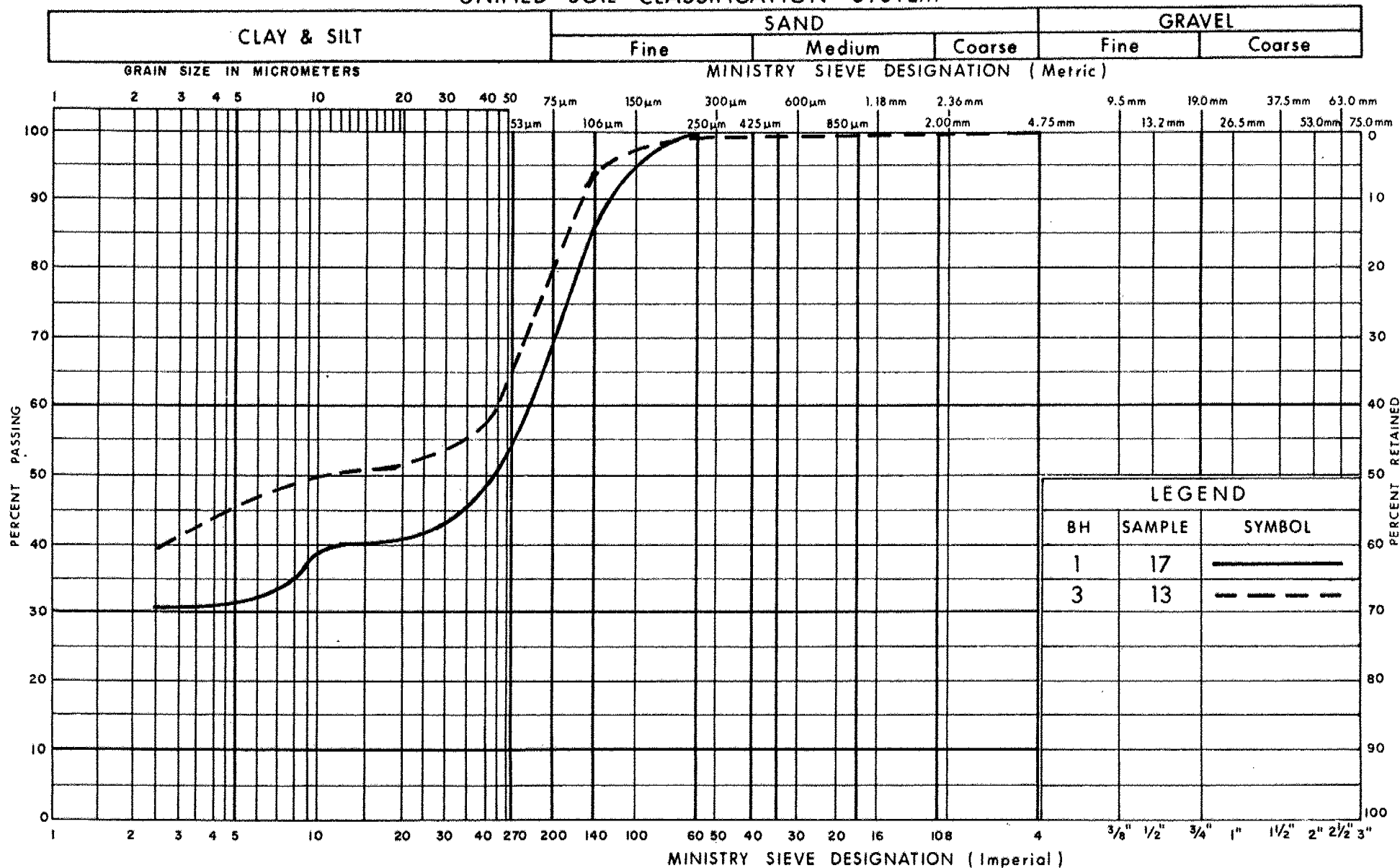
CONT 94-22

Figure 4-Moisture Contents Structure #12 Fill Material

CONT No 94 - 22



UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

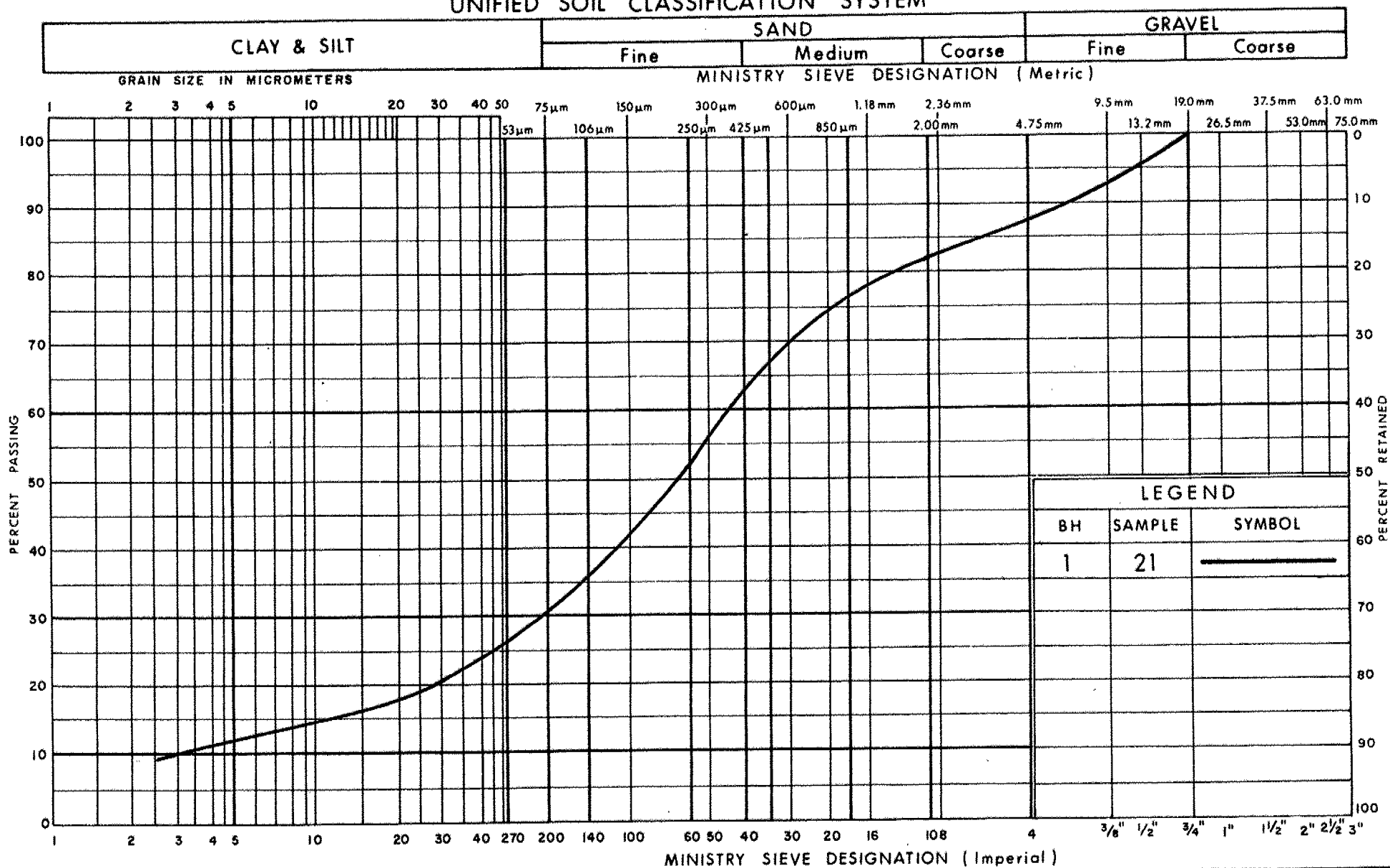
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT
 WITH INTERBEDDED LAYERS OF SANDY SILT

FIG No 5

CONT 94 - 22

UNIFIED SOIL CLASSIFICATION SYSTEM



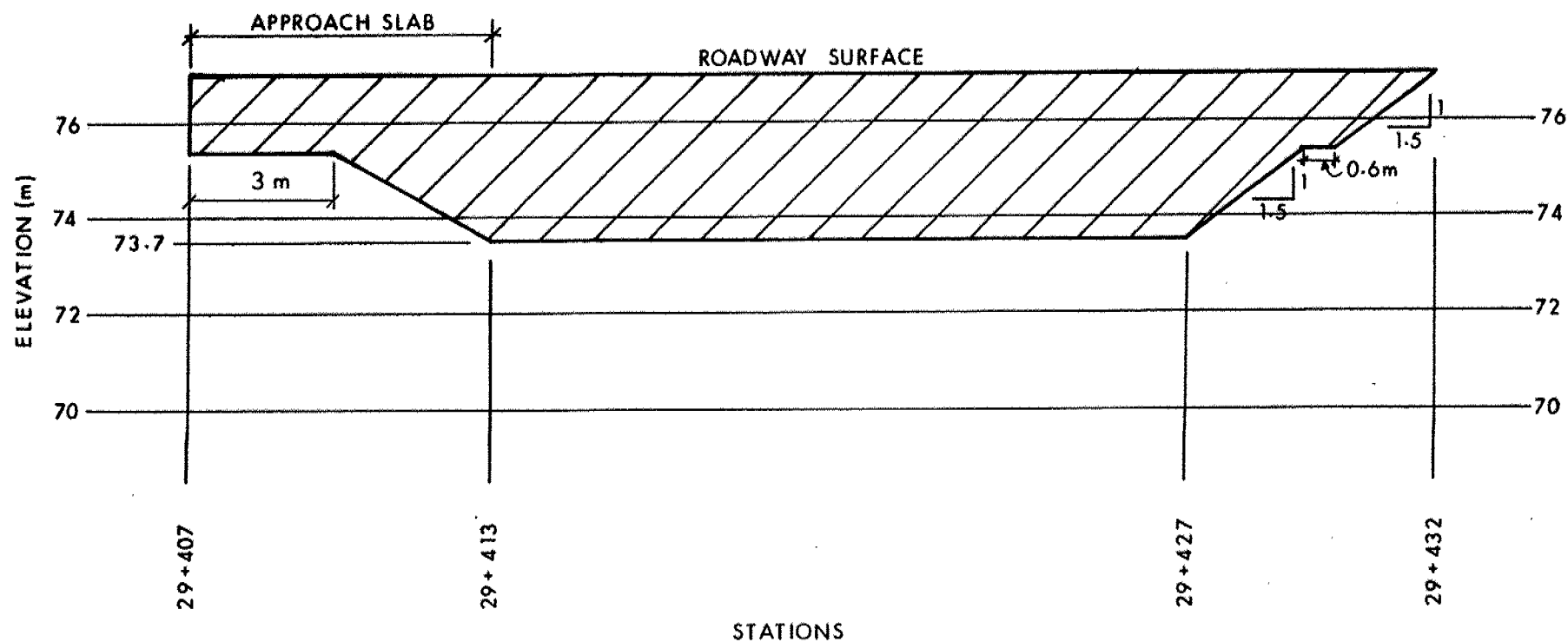
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
 HETEROGENEOUS MIXTURE OF
 SILT, SAND & GRAVEL (Glacial Till)

FIG No 6

CONT 94 -22



PROPOSED EXCAVATION - LONGITUDINAL DIRECTION
NTS

Figure 7
Contract 94-22

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 '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:

R Q D (%)	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	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'_{v0}	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 = $\frac{c_u}{\tau_r}$

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

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

DIST No
CONT No 94-22
WP No 121-87-04

E-S RAMP 100' (30.48) M - AGED 8000
MODIFY E-S RAMP
FOUNDATION LAYOUT

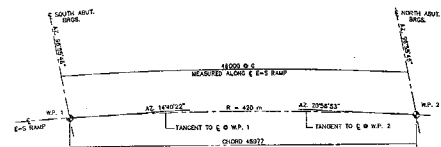
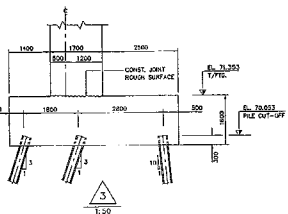
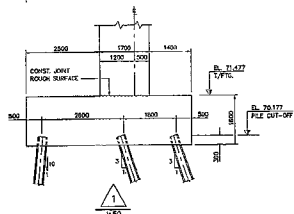
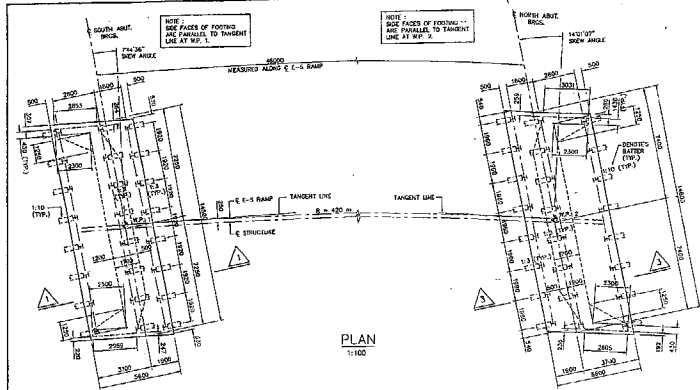
SHEET
454

D.S. Lee Associates Ltd.

PILE DATA			
LOCATION	N.L. NUMBER	LENGTH	BATTERY
NORTH ABUT.	15	12000	1.3
	6	12000	1.10
SOUTH ABUT.	16	10000	1.3
	9	10000	1.10

PIILING NOTES:

1. PILE SPACING MEASURED AT UNDER SIDE OF FOOTING.
2. ALL PILES ARE INFORMATION STEEL "H" PILES.
3. PILES TO BE SPUN TO BEDROCK.
4. ALL PILES TO HAVE DRIVING SHOES.
5. PILE LENGTHS SHOWN ABOVE ARE THEORETICAL LENGTHS
BELOW PILE OUT-CUT.
6. PILE DESIGN DATA:
MAX. COMB. FACTORED LOADS : MAX 8000 kN
MIN 1700 kN



Sheet No.	Scale
1	1:50
2	1:50
3	1:50
4	1:50
5	1:50
6	1:50
7	1:50
8	1:50
9	1:50
10	1:50
11	1:50
12	1:50
13	1:50
14	1:50
15	1:50
16	1:50
17	1:50
18	1:50
19	1:50
20	1:50
21	1:50
22	1:50
23	1:50
24	1:50
25	1:50
26	1:50
27	1:50
28	1:50
29	1:50
30	1:50
31	1:50
32	1:50
33	1:50
34	1:50
35	1:50
36	1:50
37	1:50
38	1:50
39	1:50
40	1:50
41	1:50
42	1:50
43	1:50
44	1:50
45	1:50
46	1:50
47	1:50
48	1:50
49	1:50
50	1:50
51	1:50
52	1:50
53	1:50
54	1:50
55	1:50
56	1:50
57	1:50
58	1:50
59	1:50
60	1:50
61	1:50
62	1:50
63	1:50
64	1:50
65	1:50
66	1:50
67	1:50
68	1:50
69	1:50
70	1:50
71	1:50
72	1:50
73	1:50
74	1:50
75	1:50
76	1:50
77	1:50
78	1:50
79	1:50
80	1:50
81	1:50
82	1:50
83	1:50
84	1:50
85	1:50
86	1:50
87	1:50
88	1:50
89	1:50
90	1:50
91	1:50
92	1:50
93	1:50
94	1:50
95	1:50
96	1:50
97	1:50
98	1:50
99	1:50
100	1:50



APPLICABLE STANDARD DRAWINGS:
QPSD 1301.00 SPLICE AND DRIVING SHOE DETAIL FOR STEEL H-PILES

NO.	DATE	DESCRIPTION
1	1994	ISSUED FOR CONSTRUCTION
2	1994	REVISED
3	1994	REVISED
4	1994	REVISED
5	1994	REVISED
6	1994	REVISED
7	1994	REVISED
8	1994	REVISED
9	1994	REVISED
10	1994	REVISED
11	1994	REVISED
12	1994	REVISED
13	1994	REVISED
14	1994	REVISED
15	1994	REVISED
16	1994	REVISED
17	1994	REVISED
18	1994	REVISED
19	1994	REVISED
20	1994	REVISED
21	1994	REVISED
22	1994	REVISED
23	1994	REVISED
24	1994	REVISED
25	1994	REVISED
26	1994	REVISED
27	1994	REVISED
28	1994	REVISED
29	1994	REVISED
30	1994	REVISED
31	1994	REVISED
32	1994	REVISED
33	1994	REVISED
34	1994	REVISED
35	1994	REVISED
36	1994	REVISED
37	1994	REVISED
38	1994	REVISED
39	1994	REVISED
40	1994	REVISED
41	1994	REVISED
42	1994	REVISED
43	1994	REVISED
44	1994	REVISED
45	1994	REVISED
46	1994	REVISED
47	1994	REVISED
48	1994	REVISED
49	1994	REVISED
50	1994	REVISED
51	1994	REVISED
52	1994	REVISED
53	1994	REVISED
54	1994	REVISED
55	1994	REVISED
56	1994	REVISED
57	1994	REVISED
58	1994	REVISED
59	1994	REVISED
60	1994	REVISED
61	1994	REVISED
62	1994	REVISED
63	1994	REVISED
64	1994	REVISED
65	1994	REVISED
66	1994	REVISED
67	1994	REVISED
68	1994	REVISED
69	1994	REVISED
70	1994	REVISED
71	1994	REVISED
72	1994	REVISED
73	1994	REVISED
74	1994	REVISED
75	1994	REVISED
76	1994	REVISED
77	1994	REVISED
78	1994	REVISED
79	1994	REVISED
80	1994	REVISED
81	1994	REVISED
82	1994	REVISED
83	1994	REVISED
84	1994	REVISED
85	1994	REVISED
86	1994	REVISED
87	1994	REVISED
88	1994	REVISED
89	1994	REVISED
90	1994	REVISED
91	1994	REVISED
92	1994	REVISED
93	1994	REVISED
94	1994	REVISED
95	1994	REVISED
96	1994	REVISED
97	1994	REVISED
98	1994	REVISED
99	1994	REVISED
100	1994	REVISED

DRAWING NOT TO BE SCALED
100 mm OR CLOSER, OTHERWISE

© COPYRIGHTED THE M.C. 25 12 1994

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

DIST No
CONT No 94-22
WP No 121-87-04

E-S RAMP OVER RAMP 417W - ACRES ROAD
 160'WY 416/417 INTERCHANGE
 STRUCTURE No. 12
FOOTING REINFORCEMENT

SHEET
155

DS-LES Associates Ltd.
Consulting Engineers - Planners

Source: *Survey of the U.S. Economy*, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676

PLAN
1:100

A15107
(TYP. EACH SIDE)

1.59

1:59

DRAWING NOT TO BE SCALED
TEXT AND DIMENSIONS GOVERN

DATE	BY	RECORDING
SIGNATURE	NAME NO.	FUND NUMBER-67
		BOND CLASS & DATE DEC 1983
		ISSUE
		CID FEE = \$415004