

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 42E-3

DIST. 19 REGION

W.P. No. 335-85-01

CONT. No. 87-202

W. O. No.

STR. SITE No. 48E-8

HWY. No. 11

LOCATION Sturgeon River Bridge #4
52 km E of Beardmore

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 87-202



Ministry of
Transportation and
Communications

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Note: For the purposes of this contract, this report supercedes all other reports prepared by or for the Ministry in connection with the above-noted project.

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/0.3 m)	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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

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						

FOUNDATION INVESTIGATION REPORT
For
Sturgeon River Bridge
Hwy. 11, 18 km± E. of Jellicoe
W.P. 335-85-01
District 19, Thunder Bay

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-noted site on 86 04 22 and 23. The fieldwork consisted of 4 sampled boreholes (BH 1 - BH 4) advanced by hollow stem augers. The boreholes ranged from 4.7 m to 6.6 m in depth below the pavement surface.

In addition to the four boreholes mentioned, two test pits were also excavated through the embankment material.

SITE DESCRIPTION AND GEOLOGY

The site is located on Hwy. 11 approximately 18 km east of Jellicoe, at the Sturgeon River. The site is located in the District of Thunder Bay, Township of Colter.

The site is located on a morainal landform, which consists of a relatively thin till deposit covering bedrock. Rock knobs are associated with this terrain. Bedrock across the site consists of Early Precambrian metavolcanics and metasediments. (ref: O.G.S., Engineering Geology Terrain Study 27, Jellicoe Area, M.N.R., 1979).

In the vicinity of the site the topography is gently to moderately rolling and is generally covered by forest. Rock outcrops are visible.

Sturgeon River has cut a channel approximately 30 m wide and 3 m deep at this location. The river is relatively fast-flowing at this site.

SUBSURFACE CONDITIONS

General

The four boreholes for this investigation were advanced through the embankment fill and into the underlying native material. The embankment fill material consists of up to 2.9 m of sand.

Underlying the fill material on the east side of the river is a relatively thin veneer of sand or organic material, which in turn is underlain by glacial till in the order of 2.5-2.9 m thick.

On the west side of the river, the fill material is underlain by up to 2.5 m of sand.

At the borehole locations bedrock is interpreted to occur between Elev. 335.4 and 337.4.

The boundaries of the subsoil types, in situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets (BH 1 - BH 4) in the Appendix. The location of each borehole is shown in plan on DWG No. 2 , together with the two stratigraphical sections.

The various soils encountered in this investigation are described as follows:

Fill

Fill was encountered in each borehole under approximately 100 mm of asphalt. The fill material varies in thickness between 2.7 and 2.9 m at the structure approaches.

Six grain size distribution tests were carried out on samples of this material. The results are shown in envelope form in Figure 1. The results are summarized as follows:

	<u>Range (%)</u>
Gravel	10 - 33
Sand	47 - 67
Silt	13 - 38
Clay	1 - 3

Based on these results, this non-cohesive material can be identified as sand, some to with silt, gravel, trace clay.

Augering through the fill was made difficult by the presence of boulders. Two test pits were excavated, one on either side of the existing structure. The test pits revealed that within the sand matrix numerous cobbles and boulders are encountered. Some of the boulders were up to 0.5 m in diameter. It is expected, consequently, that some of the higher Standard Penetration Test 'N' values can be attributed the presence of the boulders. Boulders and cobbles were also surficially strewn on the river banks.

Based on the interpretation of the 'N' values, it is believed that the fill material is generally in a well-compacted state.

It should be noted that "boiling" may be experienced when this material is subjected to an unbalanced hydrostatic pressure.

Sand

Sand was encountered immediately below the embankment fill in BH 1, 3 and 4. In BH 2, the sand was found below a layer of organics. On the east side of the river, the sand seam was found to be in the order of 0.5 to 0.8 m thick and was underlain by glacial till. On the west side of Sturgeon River, however, the sand was found to extend down to the bedrock surface and had a thickness of 2.3 and 2.0 m in BH 3 and BH 4 respectively.

Grain size distribution tests were carried out on two samples of this material with the results shown in the Appendix on Figure 2. Based on the results, this

non-cohesive deposit can be identified as a sand, some to with silt. The gravel content varies within this deposit. Occasional cobbles and boulders may also be encountered within this material.

Based on the interpretation of Standard Penetration Test 'N' values ranging between 25 and well over 50 blows/0.3 m, this material can be generally considered to be in a dense to very dense state. Occasional compact layers may also be present.

It should be noted that when this material is subjected to an unbalanced hydrostatic pressure "boiling" may be experienced.

Organics

An 0.6 m thick organic seam composed of silt and peat was encountered in BH 2. This material most likely represents the original ground, as it is found immediately below the embankment fill.

This organic material is considered to be non-cohesive and appears to have been compressed under the weight of the overlying fill.

Glacial Till

Glacial till was encountered in the east side of the river. In BH 1 and BH 2 it was found to have a thickness of 2.9 and 2.7 m respectively, and was found to immediately overlie the bedrock.

The results of Atterberg Limits testing carried out on 5 samples of this deposit are shown on Figure 3 in the Appendix and are summarized as follows:

	<u>Range %</u>
Moisture Content (W)	7.5 - 13.5
Liquid Limit (W _L)	17 - 20
Plastic Limit (W _p)	11 - 13.5
Plasticity Index (I _p)	5.5 - 7.5

These results indicate that the matrix of this material consists of a silt of slight plasticity (ML group) to a silty clay of low plasticity (CL group).

The results of grain size distribution tests carried out on 5 samples of this material are shown in envelope form in Figure 4 in the Appendix. The results can be summarized as follows:

	<u>Range %</u>
Gravel	6 - 18
Sand	29 - 36
Silt	40 - 48
Clay	9 - 16

Based on it's nature, this till can be described as a heterogeneous mixture of gravel, sand, silt and clay.

Generally, the deposit can be considered to be cohesive, however, seams of non-cohesive material can be expected to randomly occur within the deposit.

Occasional boulders can also be anticipated.

The consistency of this deposit is assessed as generally ranging from very stiff to hard based on 'N' values ranging between 15 and 96 blows/0.3 m. Localized firm zones may be present especially towards the upper zone of the deposit.

Bedrock

Bedrock was not proved by coring in any of the boreholes. However, based on the results of the field investigation it is believed that the "refusal to auger" elevation represents the bedrock surface. The bedrock elevation is estimated to be at the following elevations:

<u>BH</u>	<u>ELEV.</u>
#1	335.6
#2	335.7
#3	336.8
#4	337.4

However, it should be noted that it is characteristic for the bedrock surface elevation in this part of the province to vary within relatively short distances.

Groundwater

The groundwater level across the site is governed by the level of water in the river. At the time of the investigation the groundwater elevation was found to be at Elev. 338.3.

MISCELLANEOUS

The fieldwork for this investigation was carried out on 86 04 22 and 23 under the supervision of L. Politano, Project Foundations Engineer. The equipment used was owned and operated by Dominion Soil Investigation Inc. of Thunder Bay.

This report was prepared by L. Politano and was reviewed by M. Devata, Chief Foundations Engineer.



D. H. Dundas

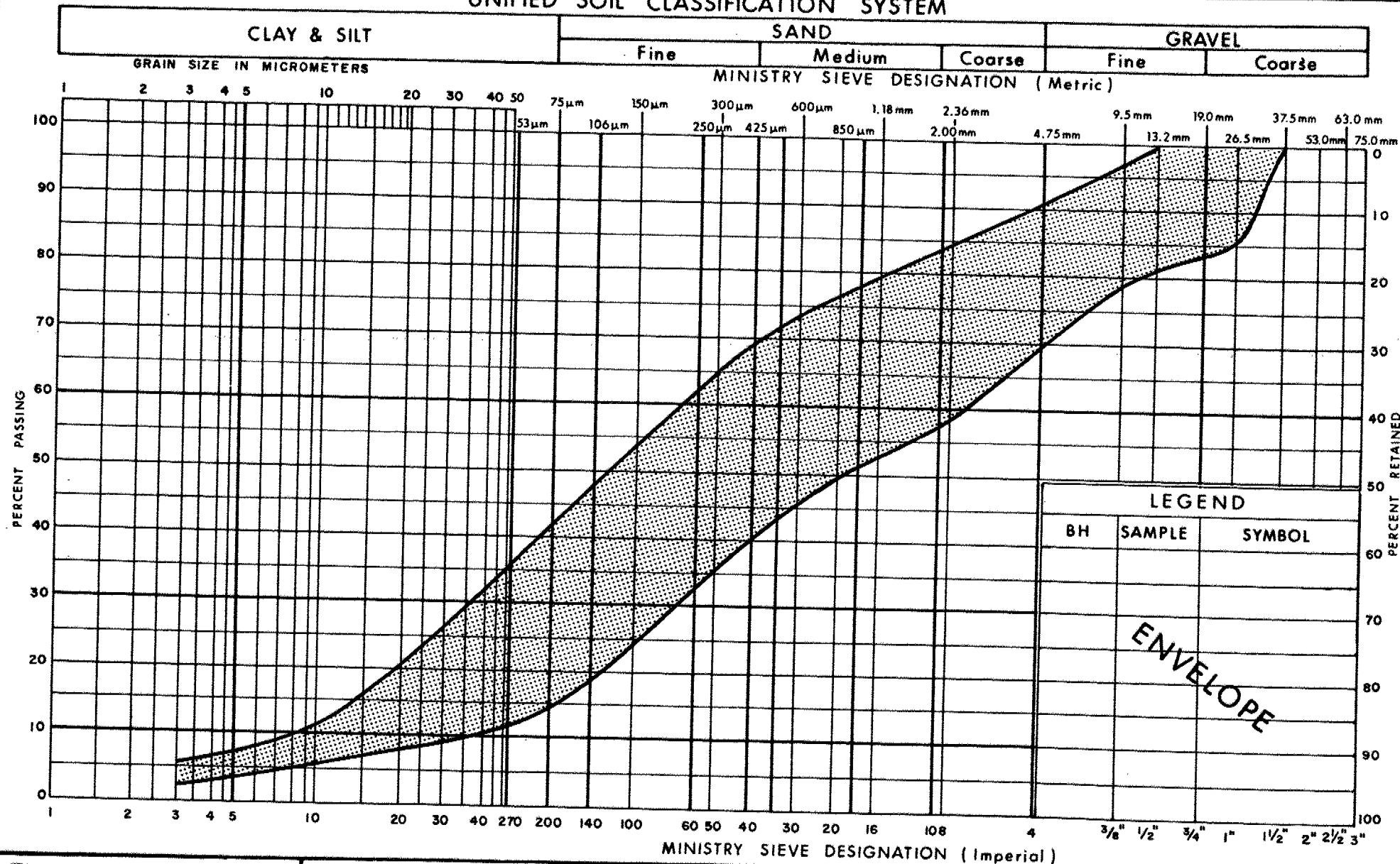
D.H. Dundas, P. Eng.
Senior Foundations Engineer

M. Devata

M. Devata, P. Eng.
Chief Foundations Engineer
(East)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



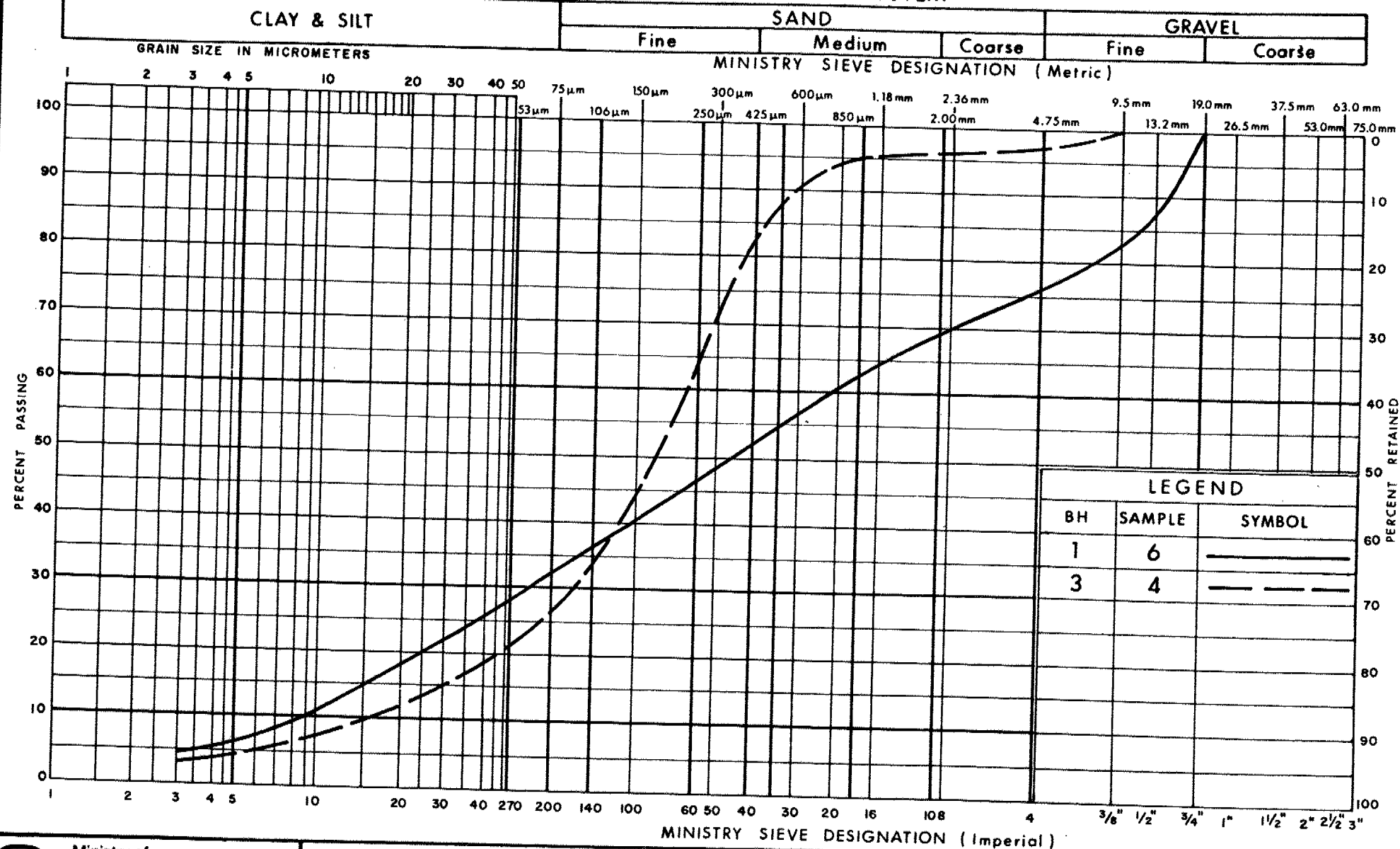
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GRAIN SIZE DISTRIBUTION
SAND, SOME TO WITH SILT, GRAVEL (FILL)
NUMEROUS COBBLES AND BOULDERS

FIG No 1

W P 335-85-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

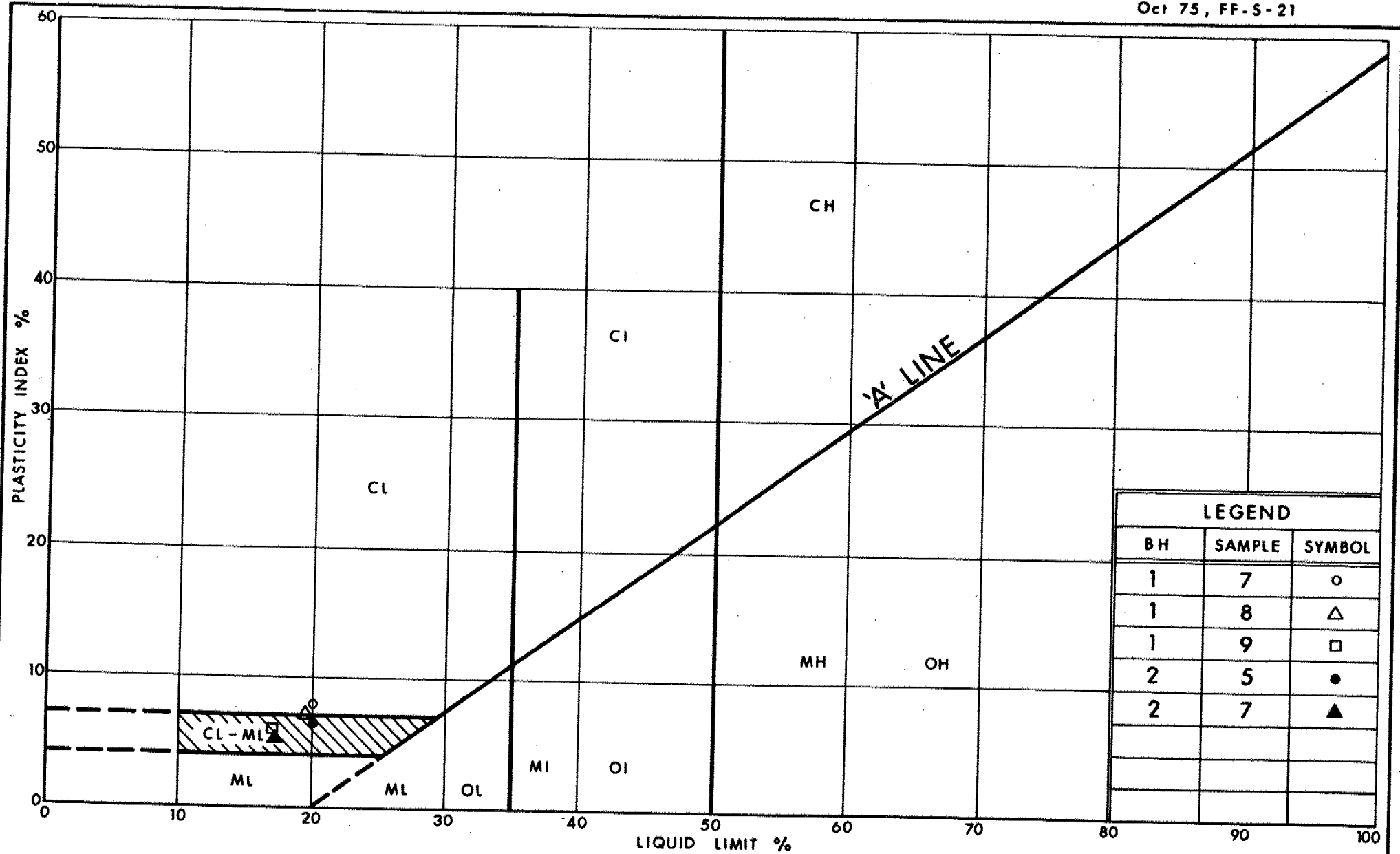
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GRAIN SIZE DISTRIBUTION

SAND WITH SILT, TRACE TO WITH GRAVEL

FIG No 2

W P 335-85-01



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Communications

PLASTICITY CHART HET MIXTURE OF GRAVEL, SAND, SILT, CLAY (Glacial Till)

FIG No 3

W P 335-85-01

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GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
GRAVEL, SAND, SILT, CLAY (Glacial Till)

FIG No 4

W P 335-85-01



RECORD OF BOREHOLE No 1

METRIC

W P 335-85-01 LOCATION STA. 10 + 254.8; °/a 2.0 m Lt. E Hwy. 11
DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger
DATUM Geodetic DATE 86 04 22
ORIGINATED BY LP
COMPILED BY LP
CHECKED BY *LP*

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
342.1	Pavement Surface						342										GR SA SI CL
0.0	Asphalt																
	Fill																
	Sand, Some to with Silt, Gravel		1	SS	18		341										14 53 30 3
	Numerous Cobbles and Boulders		2	SS	100/23 cm												
			3	SS	80/15 cm												
			4	SS	65/8 cm		340										
339.2			5	SS	9												28 47 23 2
2.9	Sand with Silt, Some Gravel		6	SS	30		339										23 44 30 3
338.4	Dense																18 29 40 13
3.7	Heterogeneous Mixture Gravel, Sand, Silt, Clay (Glacial Till)		7	SS	15		338										3 34 47 16
	Very Stiff to Hard		8	SS	51		337										
							336										9 35 43 13
335.5			9	SS	95												
6.6	End of Borehole																
	Refusal to Auger, Probable Bedrock																

OFFICE REPORT ON SOIL EXPLORATION

*3, x5; Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 335-85-01 LOCATION STA. 10 + 244.4; 0/a 2.0 m Lt. 4 Hwy. 11 ORIGINATED BY LP
DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LP
DATUM Geodetic DATE 86 04 22 CHECKED BY GP

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
342.1	Pavement Surface						342										
0.0	Asphalt																
	Fill																
	Sand, Some to with Silt, Gravel																
	Numerous Cobbles and Boulders		1	SS	26		341										
			2	SS	90												
							340										
			3	SS	139												
339.2	Organics																
2.9	Silt and Peat						339										
338.6	Sand Some Silt, Trace Gravel		4	SS	59												
3.5																	
338.1	Heterogeneous Mixture of Gravel, Sand, Silt, Clay (Glacial Till)		5	SS	5		338										
4.0	Firm to Hard		6	SS	23												
							337										
335.7	End of Borehole		7	SS	46		336										
6.4	Refusal to Auger, Probable Bedrock																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

METRIC

W P 335-85-01 LOCATION STA. 10 + 186.8; 0/s 1.6 m Lt. 4 Hwy. 11
 DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 86 04 23
 ORIGINATED BY LP
 COMPILED BY LP
 CHECKED BY *OP*

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
342.0	Pavement Surface																
0.0	Asphalt																
	Fill																
	Sand Some to with Silt, Gravel		1	SS	50		341										
	Numerous Cobbles and Boulders		2	SS	50	14 cm	340										19 67 13 1
339.1			3	SS	21		339										
2.9	Sand, Some Silt Trace Gravel		4	SS	25		338										4 70 24 2
	Compact to Very Dense		5	SS	56	15 cm	337										
336.8																	
5.2	End of Borehole																
	Refusal to Auger, Probable Bedrock																

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

METRIC

W P 335-85-01 LOCATION STA. 10 + 196.6; 0/s 1.5 m Lt. Hwy. 11
 DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 86 04 23
 ORIGINATED BY LP
 COMPILED BY LP
 CHECKED BY [Signature]

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
342.1	Pavement Surface																
0.0	Asphalt						342										
	Fill																
	Sand, Some to with Silt, Gravel		1	SS	9		341										10 50 38 2
	Numerous Cobbles and Boulders		2	SS	79	25 cm	340										
339.4			3	SS	68												
2.7	Sand, with Silt Trace Organics		4	SS	72	20 cm	339										33 50 15 2
			5	SS	32		338										
337.4	Dense to Very Dense		6	SS	*												
4.7	End of Borehole																
	* Spoon Bouncing Probable Bedrock																
	** Spoon Bouncing on Boulder																

*3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 335-85-01

DIST 19

HWY 11

STR SITE 48E-8

STURGEON RIVER BRIDGE
(18 km± East of Jellicoe)

DISTRIBUTION

O. Ramakko (3)
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G.D. Jewell
C.E. Pritchard
K. Bassi
J.H. Peer
T. Yakutchuk
D.E. Moorhouse (Cover Only)
M. MacLean (Cover Only)
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FOUNDATION INVESTIGATION REPORT
For
Sturgeon River Bridge
Hwy. 11, 18 km± E. of Jellicoe
W.P. 335-85-01
District 19, Thunder Bay

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-noted site on 86 04 22 and 23. The fieldwork consisted of 4 sampled boreholes (BH 1 - BH 4) advanced by hollow stem augers. The boreholes ranged from 4.7 m to 6.6 m in depth below the pavement surface.

In addition to the four boreholes mentioned, two test pits were also excavated through the embankment material.

SITE DESCRIPTION AND GEOLOGY

The site is located on Hwy. 11 approximately 18 km east of Jellicoe, at the Sturgeon River. The site is located in the District of Thunder Bay, Township of Colter.

The site is located on a morainal landform, which consists of a relatively thin till deposit covering bedrock. Rock knobs are associated with this terrain. Bedrock across the site consists of Early Precambrian metavolcanics and metasediments. (ref: O.G.S., Engineering Geology Terrain Study 27, Jellicoe Area, M.N.R., 1979).

In the vicinity of the site the topography is gently to moderately rolling and is generally covered by forest. Rock outcrops are visible.

Sturgeon River has cut a channel approximately 30 m wide and 3 m deep at this location. The river is relatively fast-flowing at this site.

SUBSURFACE CONDITIONS

General

The four boreholes for this investigation were advanced through the embankment fill and into the underlying native material. The embankment fill material consists of up to 2.9 m of sand.

Underlying the fill material on the east side of the river is a relatively thin veneer of sand or organic material, which in turn is underlain by glacial till in the order of 2.5-2.9 m thick.

On the west side of the river, the fill material is underlain by up to 2.5 m of sand.

At the borehole locations bedrock is interpreted to occur between Elev. 335.4 and 337.4.

The boundaries of the subsoil types, in situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets (BH 1 - BH 4) in the Appendix. The location of each borehole is shown in plan on DWG No. 3358501-A, together with the two stratigraphical sections.

The various soils encountered in this investigation are described as follows:

Fill

Fill was encountered in each borehole under approximately 100 mm of asphalt. The fill material varies in thickness between 2.7 and 2.9 m at the structure approaches.

Six grain size distribution tests were carried out on samples of this material. The results are shown in envelope form in Figure 1. The results are summarized as follows:

	<u>Range (%)</u>
Gravel	10 - 33
Sand	47 - 67
Silt	13 - 38
Clay	1 - 3

Based on these results, this non-cohesive material can be identified as sand, some to with silt, gravel, trace clay.

Augering through the fill was made difficult by the presence of boulders. Two test pits were excavated, one on either side of the existing structure. The test pits revealed that within the sand matrix numerous cobbles and boulders are encountered. Some of the boulders were up to 0.5 m in diameter. It is expected, consequently, that some of the higher Standard Penetration Test 'N' values can be attributed the presence of the boulders. Boulders and cobbles were also surficially strewn on the river banks.

Based on the interpretation of the 'N' values, it is believed that the fill material is generally in a well-compacted state.

It should be noted that "boiling" may be experienced when this material is subjected to an unbalanced hydrostatic pressure.

Sand

Sand was encountered immediately below the embankment fill in BH 1, 3 and 4. In BH 2, the sand was found below a layer of organics. On the east side of the river, the sand seam was found to be in the order of 0.5 to 0.8 m thick and was underlain by glacial till. On the west side of Sturgeon River, however, the sand was found to extend down to the bedrock surface and had a thickness of 2.3 and 2.0 m in BH 3 and BH 4 respectively.

Grain size distribution tests were carried out on two samples of this material with the results shown in the Appendix on Figure 2. Based on the results, this

non-cohesive deposit can be identified as a sand, some to with silt. The gravel content varies within this deposit. Occasional cobbles and boulders may also be encountered within this material.

Based on the interpretation of Standard Penetration Test 'N' values ranging between 25 and well over 50 blows/0.3 m, this material can be generally considered to be in a dense to very dense state. Occasional compact layers may also be present.

It should be noted that when this material is subjected to an unbalanced hydrostatic pressure "boiling" may be experienced.

Organics

An 0.6 m thick organic seam composed of silt and peat was encountered in BH 2. This material most likely represents the original ground, as it is found immediately below the embankment fill.

This organic material is considered to be non-cohesive and appears to have been compressed under the weight of the overlying fill.

Glacial Till

Glacial till was encountered in the east side of the river. In BH 1 and BH 2 it was found to have a thickness of 2.9 and 2.7 m respectively, and was found to immediately overlie the bedrock.

The results of Atterberg Limits testing carried out on 5 samples of this deposit are shown on Figure 3 in the Appendix and are summarized as follows:

	<u>Range %</u>
Moisture Content (W)	7.5 - 13.5
Liquid Limit (W _L)	17 - 20
Plastic Limit (W _p)	11 - 13.5
Plasticity Index (I _p)	5.5 - 7.5

These results indicate that the matrix of this material consists of a silt of slight plasticity (ML group) to a silty clay of low plasticity (CL group).

The results of grain size distribution tests carried out on 5 samples of this material are shown in envelope form in Figure 4 in the Appendix. The results can be summarized as follows:

	<u>Range %</u>
Gravel	6 - 18
Sand	29 - 36
Silt	40 - 48
Clay	9 - 16

Based on it's nature, this till can be described as a heterogeneous mixture of gravel, sand, silt and clay.

Generally, the deposit can be considered to be cohesive, however, seams of non-cohesive material can be expected to randomly occur within the deposit.

Occasional boulders can also be anticipated.

The consistency of this deposit is assessed as generally ranging from very stiff to hard based on 'N' values ranging between 15 and 96 blows/0.3 m. Localized firm zones may be present especially towards the upper zone of the deposit.

Bedrock

Bedrock was not proved by coring in any of the boreholes. However, based on the results of the field investigation it is believed that the "refusal to auger" elevation represents the bedrock surface. The bedrock elevation is estimated to be at the following elevations:

<u>BH</u>	<u>ELEV.</u>
#1	335.6
#2	335.7
#3	336.8
#4	337.4

However, it should be noted that it is characteristic for the bedrock surface elevation in this part of the province to vary within relatively short distances.

Groundwater

The groundwater level across the site is governed by the level of water in the river. At the time of the investigation the groundwater elevation was found to be at Elev. 338.3.

DISCUSSION AND RECOMMENDATIONS

Rehabilitation of the Sturgeon River structure is scheduled for 1987. Part of the work involves the stabilization of the forward movement of the abutments. In order to undertake this work, it will be necessary to provide roadway protection so as to maintain one lane open to traffic at all times.

Based on the original design drawings it appears that the abutments are founded on timber piles driven to bedrock while the two piers are founded directly on the bedrock.

In order to stabilize the forward movement of the abutments consideration has been given to the use of deadman anchors constructed within the approach fills.

Based on the results of the subsurface investigation, it appears that the subsoils are relatively competent and the forward movement of the abutments is not caused by the subsidence of the underlying soil.

It is quite possible that in an attempt to drive the timber piles to bedrock, some may have been damaged, or possibly shattered. As a result, the abutments may not have the adequate support and consequently are experiencing instability.

If the deep foundations are not adequate to support the lateral or vertical loads, deadman anchors may not provide the required resistance to the forward movement.

Instead, consideration should be given to the option where the existing abutments are provided with "wingwalls" such that a closed abutment is created. The wingwalls should be supported on steel piles driven to bedrock and battered as required. The intent of this scheme is to transfer as much of the lateral and vertical loads as possible from the existing timber piles on to the proposed piles.

The following design details could be used for this scheme:

Steel H-Piles

The wingwalls could be supported on HP 310 x 110 steel-H piles driven to bedrock. For design purposes, such piles are capable of resisting 1600 kN/pile at the U.L.S. and 1150 kN/pile at the S.L.S. Type II. These piles should be battered as necessary in order to resist the lateral loads.

For estimating purposes, it can be assumed that the tip elevations of these piles are as follows:

West Abutment : Elev. 337.0 ±
East Abutment : Elev. 335.5 ±

Soldier Piles and Lagging

For the design of the soldier pile and lagging temporary roadway protection wall an angle of internal friction of 30° , and a unit weight of 20.5 kN/m^3 can be assumed for the surrounding soil.

It would be advisable to drive the soldier piles down to bedrock. When the temporary wall is no longer required the soldier piles should be cut-off and abandoned in-place.

Temporary Slopes

Temporary cut slopes will be stable at 1.5H:1V provided that precautions are taken to ensure that surface run-off does not wash away the non-cohesive material. Cut slopes should be protected by polyethylene sheets or tarpaulins.

Dewatering

No dewatering problems are anticipated provided that excavations do not extend below the prevailing groundwater level.

Lateral Earth Pressures

The existing material behind the abutments will be excavated and removed. Backfill to the abutments should consist of granular material in accordance with MTC Standard Special Provision #121 (dated October 1983). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C. For design purposes, the physical properties of the backfills are as follows:

<u>Material</u>	<u>ϕ</u>	<u>γ</u>
Granular 'A'	35°	22.0 kN/m ³
Granular 'B'	30°	21.2 kN/m ³

MISCELLANEOUS

The fieldwork for this investigation was carried out on 86 04 22 and 23 under the supervision of L. Politano, Project Foundations Engineer. The equipment used was owned and operated by Dominion Soil Investigation Inc. of Thunder Bay.

This report was prepared by L. Politano and was reviewed by M. Devata, Chief Foundations Engineer.



A handwritten signature in black ink, appearing to read "L. Politano".

L. Politano, P.Eng.
Project Foundations Engineer

A handwritten signature in black ink, appearing to read "M. Devata".

M. Devata, P.Eng.
Chief Foundations Engineer
(East)

APPENDIX

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:

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

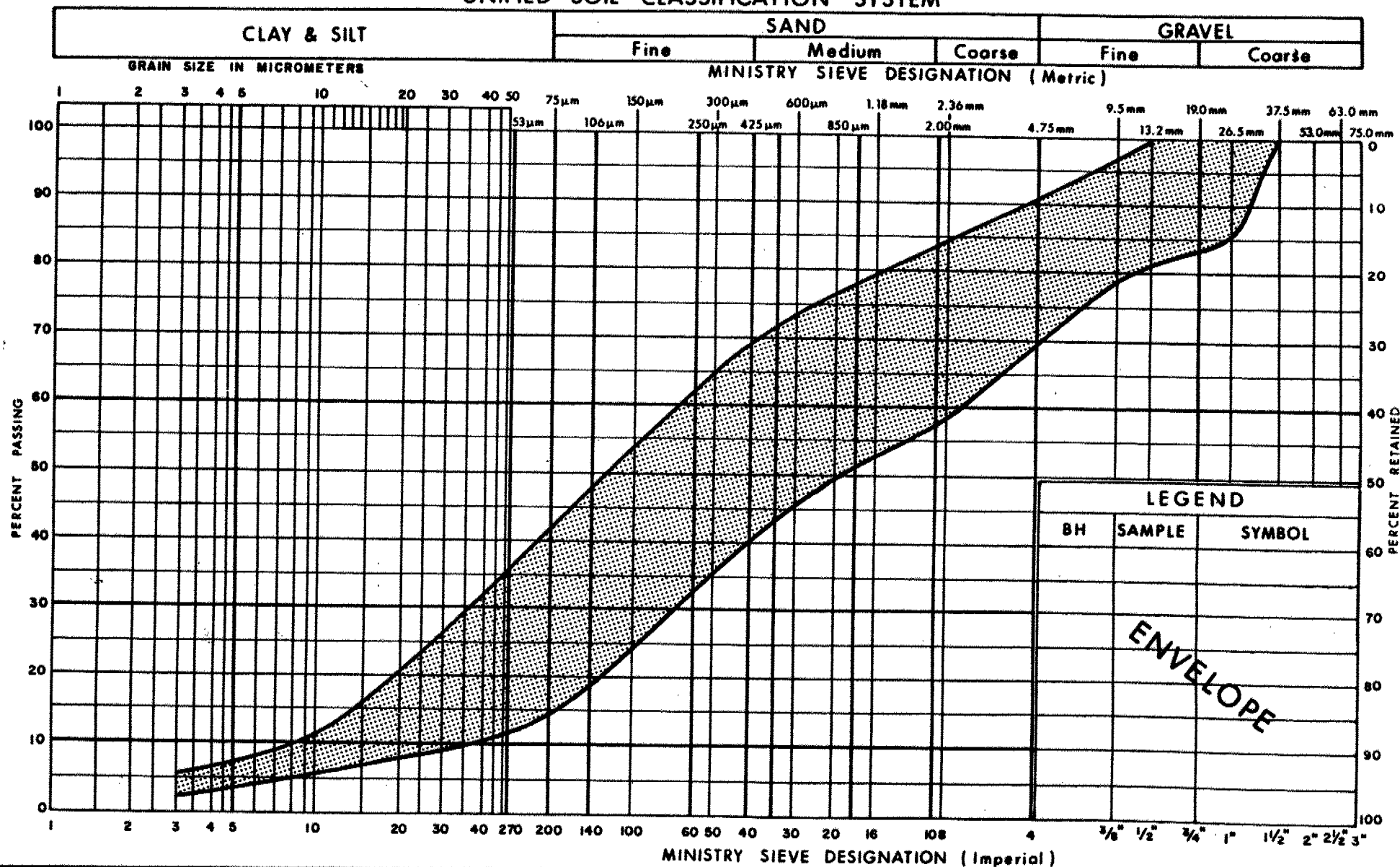
MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{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 = $\frac{c_u}{\tau_r}$

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^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

UNIFIED SOIL CLASSIFICATION SYSTEM



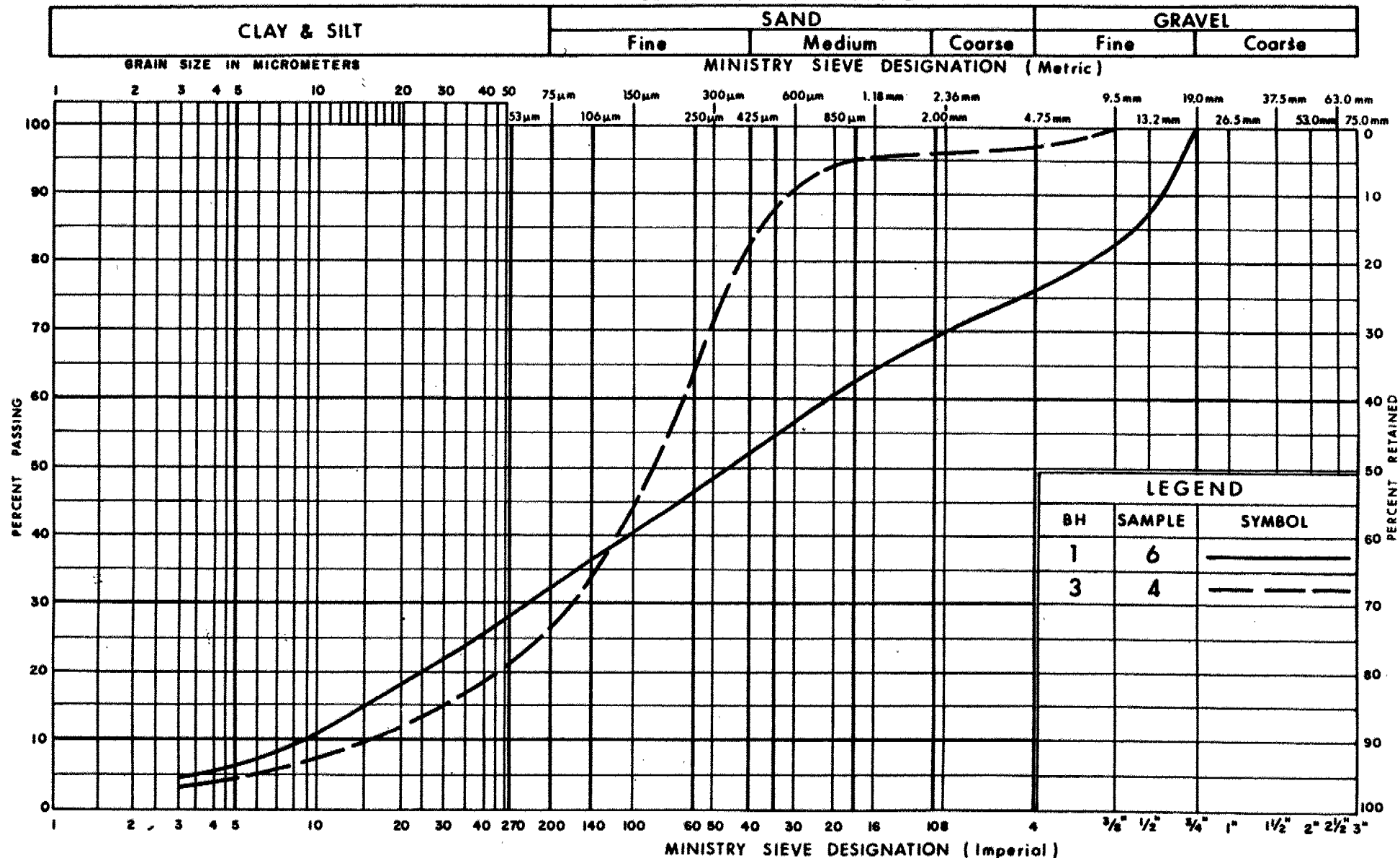
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SAND, SOME TO WITH SILT, GRAVEL (FILL)
NUMEROUS COBBLES AND BOULDERS

FIG No 1

W P 335-85-01

UNIFIED SOIL CLASSIFICATION SYSTEM

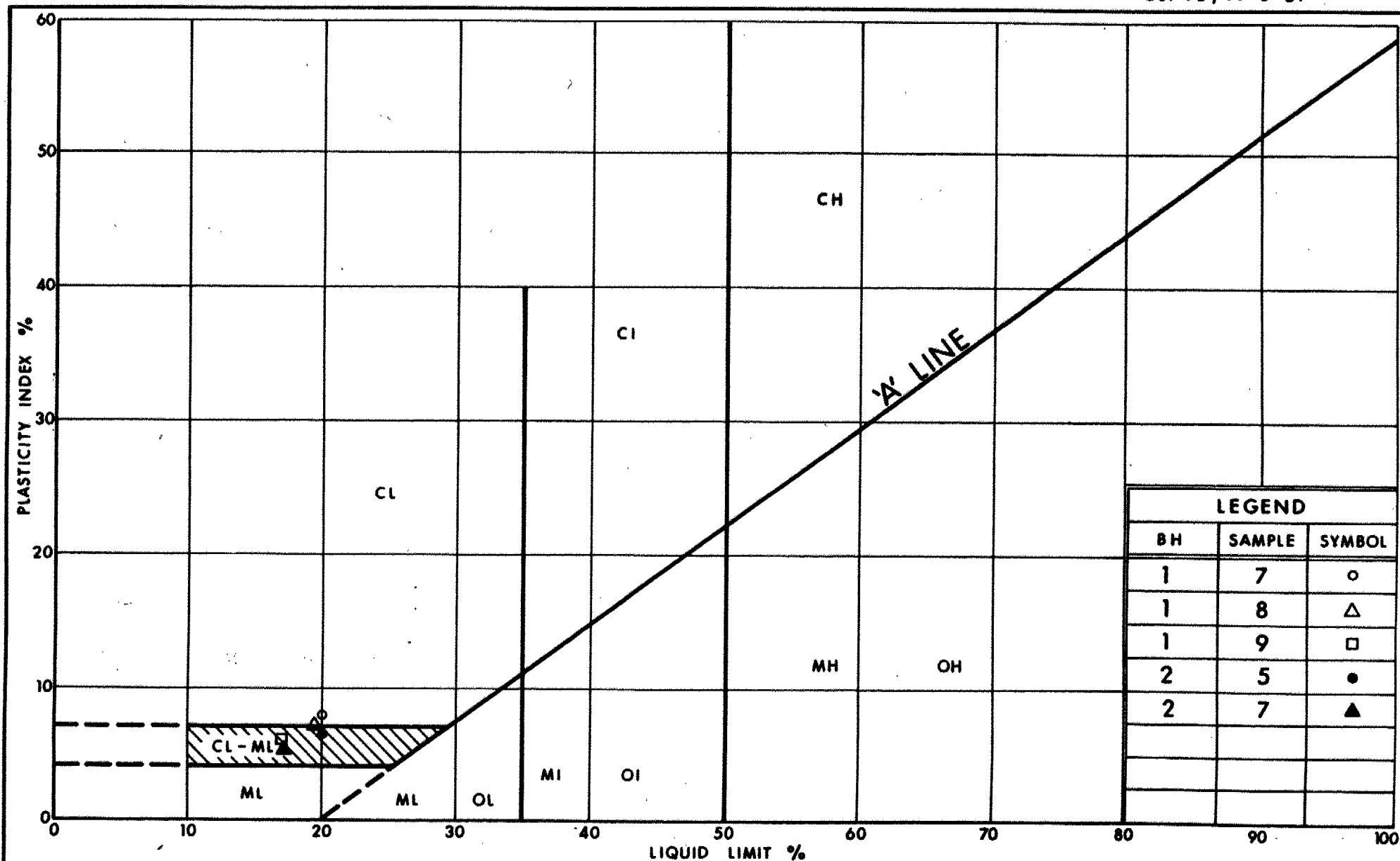


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GRAIN SIZE DISTRIBUTION
SAND WITH SILT, TRACE TO WITH GRAVEL

FIG No 2

WP 335-85-01



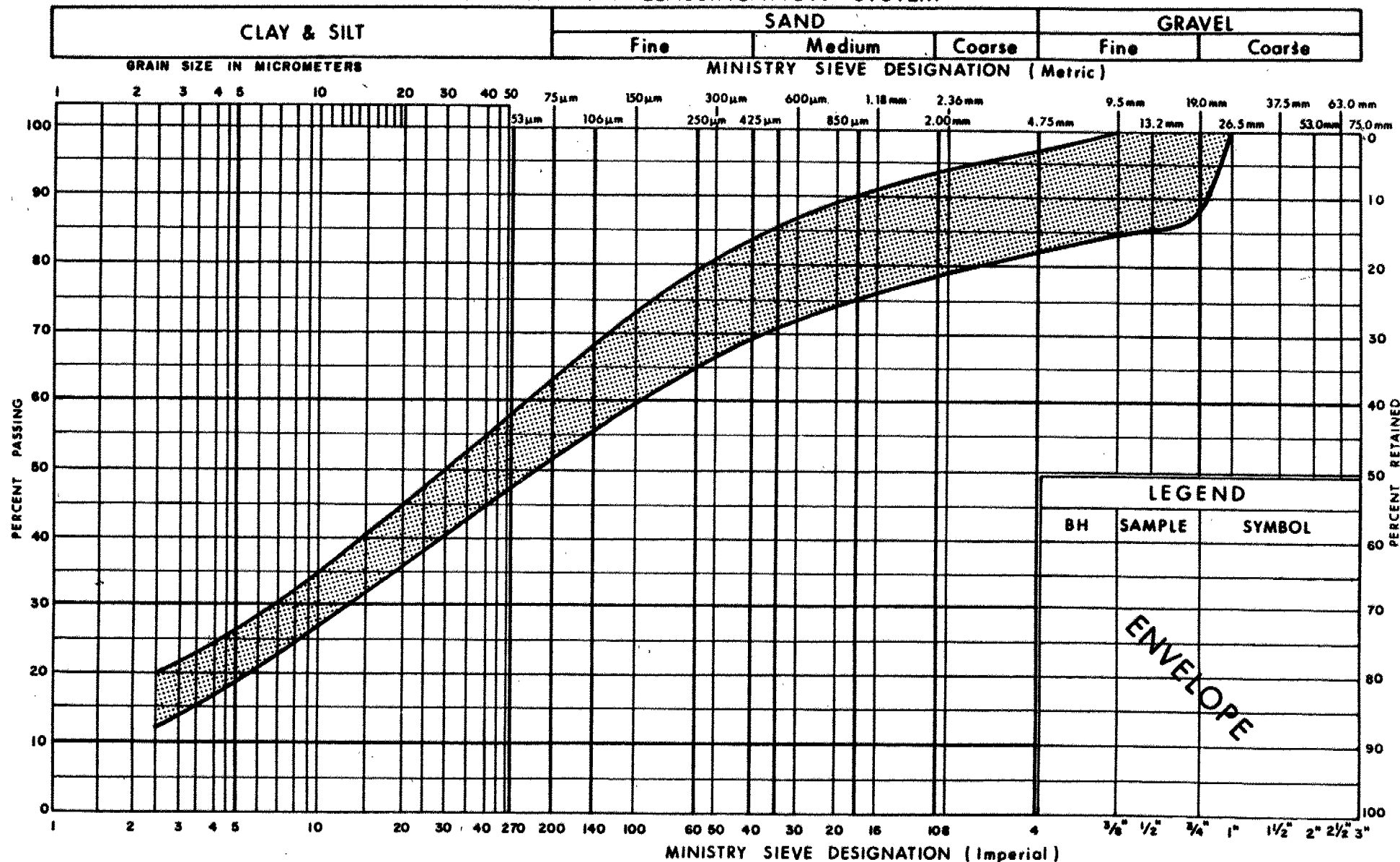
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Ontario

PLASTICITY CHART HET MIXTURE OF GRAVEL, SAND, SILT, CLAY (Glacial Till)

FIG No 3

W P 335-85-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
GRAVEL, SAND, SILT, CLAY (Glacial Till)

FIG No 4

W P 335-85-01



RECORD OF BOREHOLE No 1

METRIC

W P 335-85-01 LOCATION STA. 10 + 254.8; °/s 2.0 m Lt. E Hwy. 11 ORIGINATED BY LP
 DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LP
 DATUM Geodetic DATE 86 04 22 CHECKED BY [Signature]

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
342.1	Pavement Surface					342										
0.0	Asphalt															
	Fill															
	Sand, Some to with Silt, Gravel		1	SS	18	341										
	Numerous Cobbles and Boulders		2	SS	100	23 cm										
			3	SS	80	15 cm										
			4	SS	65	8 cm										
			5	SS	9	340										
339.2																
2.9	Sand with Silt, Some Gravel		6	SS	30	339										
338.4	Dense															
3.7	Heterogeneous Mixture Gravel, Sand, Silt, Clay (Glacial Till)		7	SS	15	338										
			8	SS	51	337										
	Very Stiff to Hard															
335.5			9	SS	95	336										
6.6	End of Borehole															
	Refusal to Auger, Probable Bedrock															

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2

METRIC

W P 335-85-01 LOCATION STA. 10 + 244.4; °/s 2.0 m Lt. 4 Hwy. 11 ORIGINATED BY LP
 DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LP
 DATUM Geodetic DATE 86 04 22 CHECKED BY GP

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
342.1	Pavement Surface															
0.0	Asphalt					342										
	Fill															
	Sand, Some to with Silt, Gravel					341										
	Numerous Cobbles and Boulders		1	SS												18 45 35 2
			2	SS		340										
			3	SS												
339.2	Organics															
2.9	Silt and Peat		4	SS		339										
338.6	Sand Some Silt, Trace Gravel															
3.5	Heterogeneous Mixture of Gravel, Sand, Silt, Clay (Glacial Till)		5	SS		338										7 36 48 9
338.1	Firm to Hard		6	SS		337										
4.0																
						336										6 35 45 14
335.7	End of Borehole		7	SS												
6.4	Refusal to Auger, Probable Bedrock															

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 3

METRIC

W P 335-85-01 LOCATION STA. 10 + 186.8; °/s 1.6 m Lt. 4 Hwy. 11 ORIGINATED BY LP
DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LP
DATUM Geodetic DATE 86 04 23 CHECKED BY *OP*

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
342.0	Pavement Surface																
0.0	Asphalt																
	Fill																
	Sand Some to with Silt, Gravel		1	SS	50		341										
	Numerous Cobbles and Boulders		2	SS	50	14 cm	340						o				19 67 13 1
339.1			3	SS	21		339										
2.9	Sand, Some Silt Trace Gravel						338							o			4 70 24 2
	Compact to Very Dense		4	SS	25		337										
336.8			5	SS	56	15 cm											
5.2	End of Borehole																
	Refusal to Auger, Probable Bedrock																

+³, x⁵: Numbers refer to Sensitivity 20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 335-85-01 LOCATION STA. 10 + 196.6; 0/s 1.5 m Lt. 4 Hwy. 11 ORIGINATED BY LP
DIST 19 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LP
DATUM Geodetic DATE 86 04 23 CHECKED BY *GP*

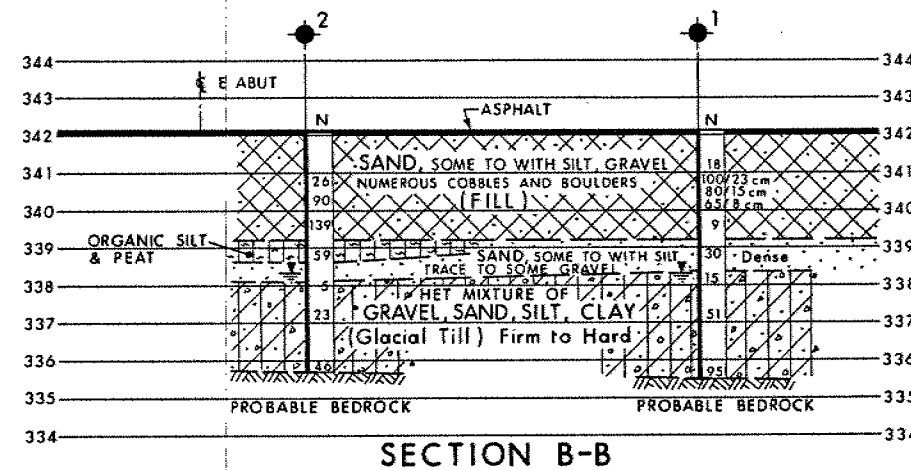
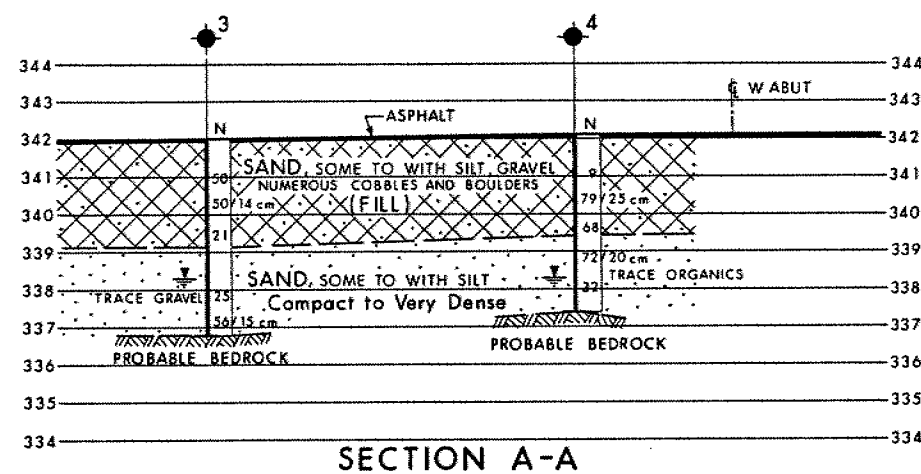
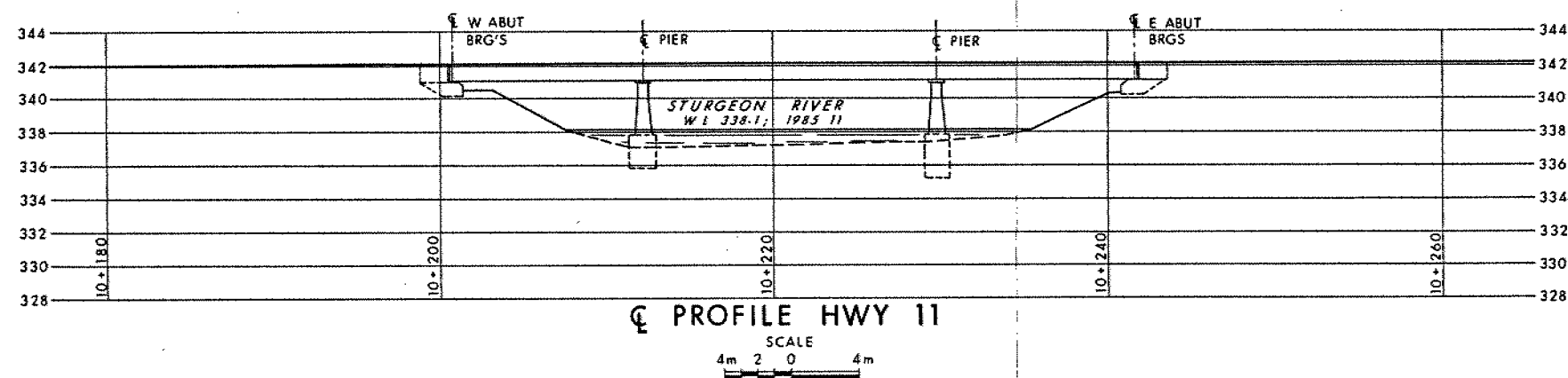
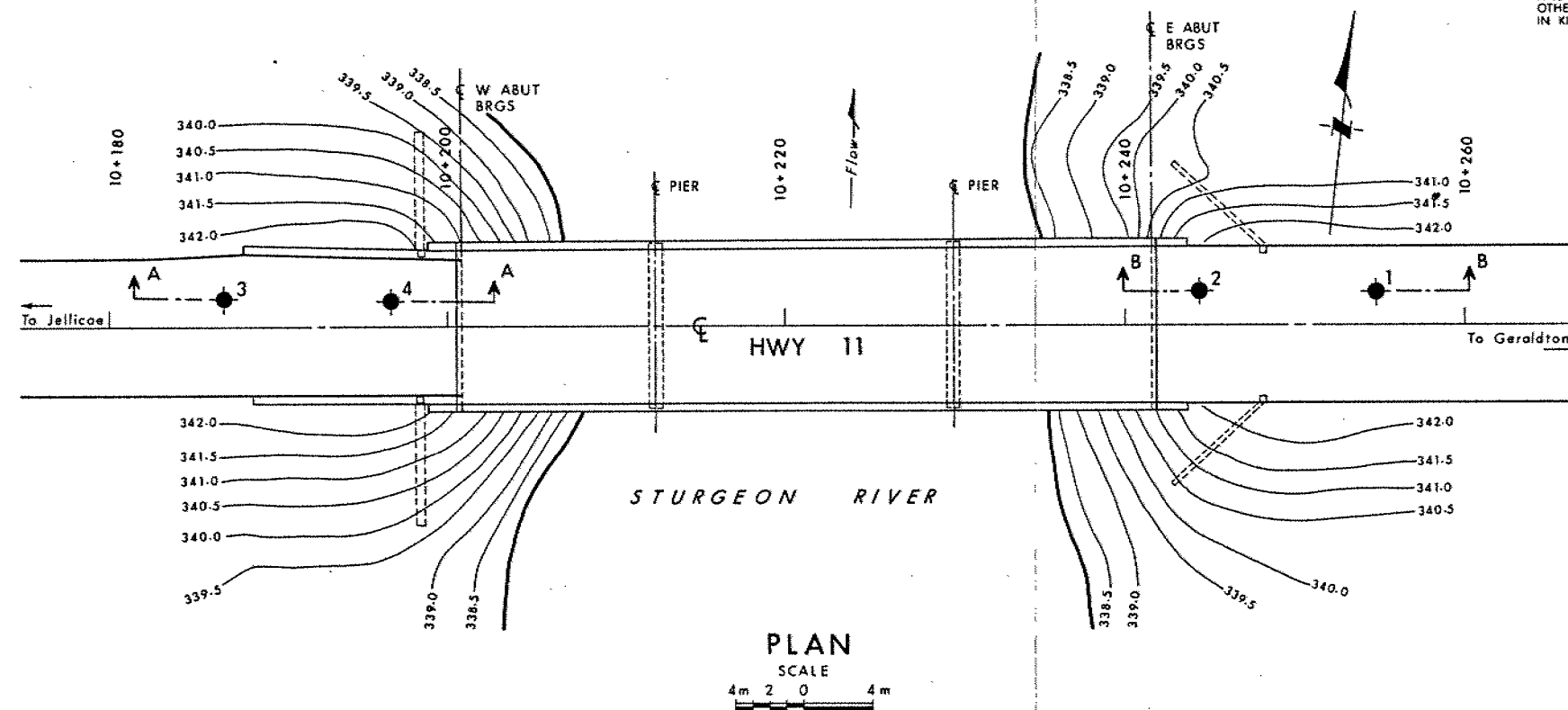
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
							PLASTIC LIMIT W _p			NATURAL MOISTURE CONTENT W		LIQUID LIMIT W _L			
							WATER CONTENT (%)					10 20 30			
342.1	Pavement Surface														
0.0	Asphalt						342								
	Fill														
	Sand, Some to with Silt, Gravel		1	SS	9		341							10 50 38 2	
	Numerous Cobbles and Boulders		2	SS	79	25 cm									
							340								
339.4			3	SS	68									33 50 15 2	
2.7	Sand, with Silt Trace Organics		4	SS	72	** 20 cm	339								
			5	SS	32		338								
337.4	Dense to Very Dense		6	SS	*										
4.7	End of Borehole														
	* Spoon Bouncing Probable Bedrock														
	** Spoon Bouncing on Boulder														

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

METRICDIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.CONT No
WP No 335-85-01STURGEON RIVER BRIDGE # 4
REHABILITATION
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



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 1986 04

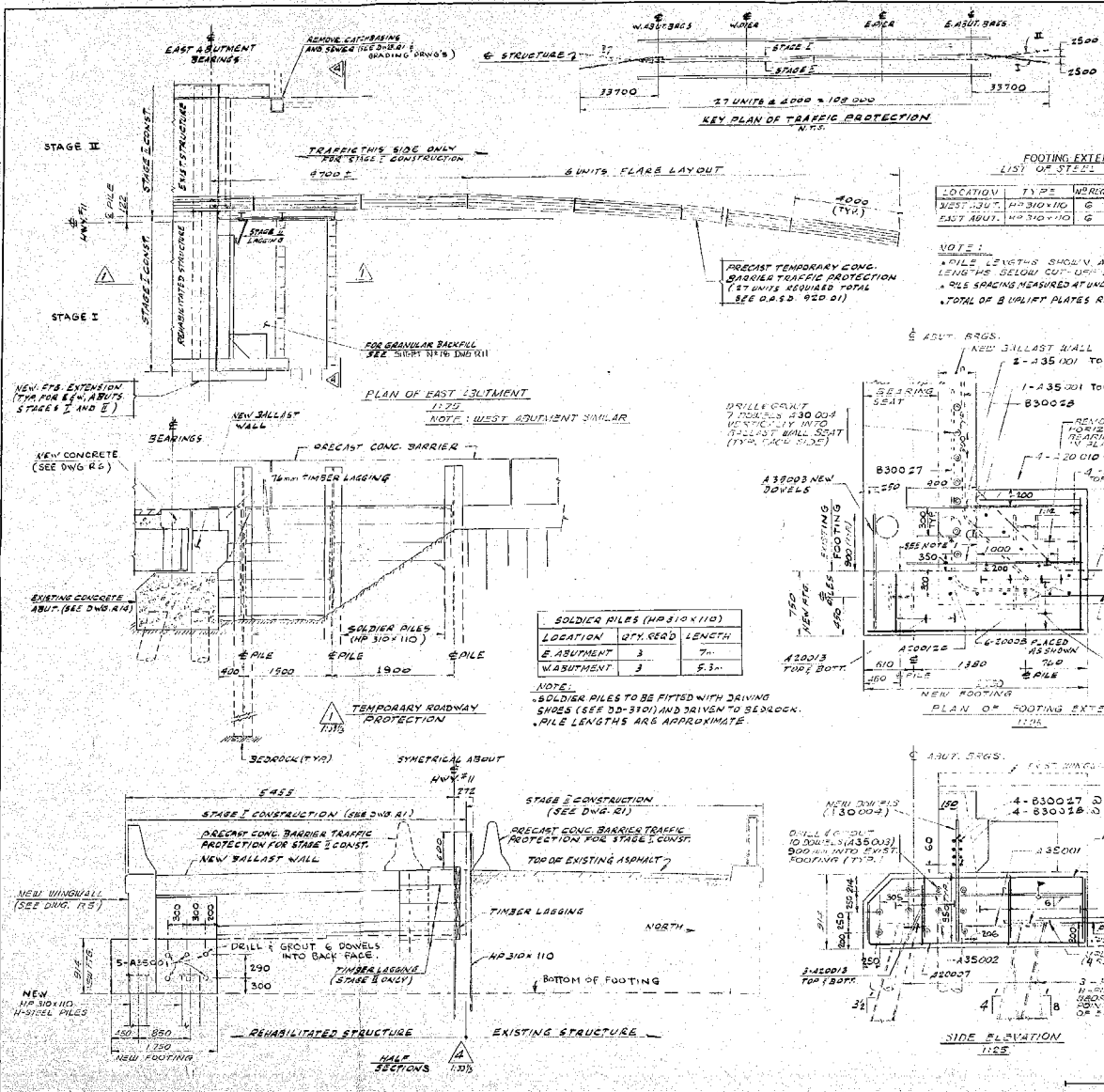
No	ELEVATION	STATION	OFFSET
1	342.1	10+254.8	2.0m Lt
2	342.1	10+244.4	2.0m Lt
3	342.0	10+186.8	1.6m Lt
4	342.1	10+196.6	1.5m Lt

NOTE

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

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

REV.	DATE	BY	DESCRIPTION
Geocres No 42 E - 3			
HWY No 11			DIST 19
SUBMD L P CHECKED	DATE 1986 06 17		SITE 48 E - 8
DRAWN	CHECKED	APPROVED	DWG 3358501-A



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

DIST.19
CONT No 87-202
WP No 335-85-01

STURGEON RIVER BRIDGE
REHABILITATION
ASPIRIMENT FOOTING EXTENSION
AND ROADWAY PROTECTION


SHEET
10

- #1. VERTICAL CONTACT SURFACES OF EXISTING FOOTING TO BE ROUGHENED, SANDBLASTED AND COATED WITH A NEAT CEMENT PASTE PRIOR TO CASTING NEW FOOTING.
- #2. DOWELS INTO EXISTING FOOTING TO BE GROUTED INTO 60% OF CORE-DRILLED HOLES.
- #3. METHOD OF CORE-DRILLING OF HOLES FOR DOWELS NOT TO DAMAGE OR SMOTHER ADJACENT EXISTING CONCRETE.
- #4. BEFORE PLACING THE DOWELS OR GROUTING:
 - a) ALL HOLES TO BE CLEANED OF DUST AND OTHER FOREIGN MATERIAL.
 - b) INSIDE FACES OF HOLES TO BE SATURATED WITH WATER AND THEN FREE WATER REMOVED.
 - c) INSIDE FACES OF HOLES TO BE DRIED TO SATURATED SURFACE DRY CONDITION IMMEDIATELY BEFORE PLACING GROUT AND DOWEL.
- #5. GROUT TO CONFORM TO MTC DS 133 FOR MATERIALS AND BE PUMPED INTO AND COMPLETELY FILL THE HOLES WHEN THE DOWELS ARE INSERTED.
- #6. DOWELS NOT TO BE DISTURBED DURING THE TIME THAT THE GROUT IS CURING.

CONSTRUCTION SEQUENCE:

STAGE I

1. INSTALL TEMPORARY PRECAST CONCRETE BARRIER TRAFFIC PROTECTION.
2. DIVERT TRAFFIC TO A SINGLE LANE OVER THE NORTH HALF OF THE BRIDGE.

STAGE II

3. INSTALL ROADWAY PROTECTION. (SOLIDER PILERS)
4. COMPLETE THE WORK FOR STAGE I AS OUTLINED UNDER SCOPE OF REPAIR WORK (A) & (B) IN DRAWING S1.

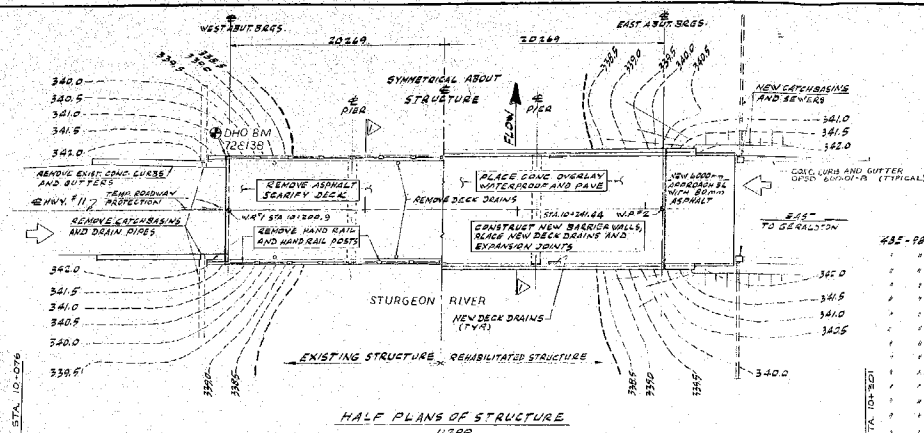
STAGE III

1. MOVE THE TEMPORARY PRECAST CONCRETE BARRIER TRAFFIC PROTECTION TO ITS STAGE II POSITION.
2. DIVERT TRAFFIC ONTO THE FINISHED REPAIRED SOUTH HALF OF THE BRIDGE DECK.
3. PROCEED WITH REHABILITATION AS IN STAGE I.

STEP 4

5. STRUCTURE UNDERGOING AND READY TO COMMENCE COMPLETION OF STAGE I CONSTRUCTION.

REVISIONS	DESCRIPTION						DATE	BY
	DESIGN	CHECK	W/M	LOADING	CH50C-B3	DATE: 5/27/1978		
	DRAWING	CHECK	W/M	SITE No	445-B	DWG 12		

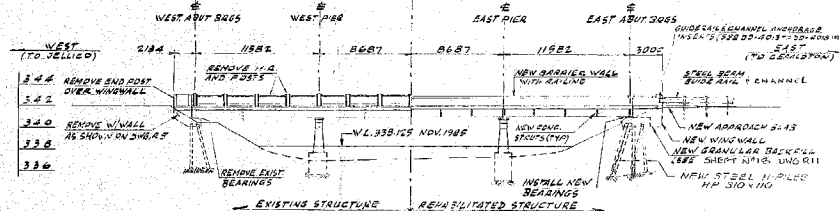


HALF PLANS OF STRUCTURE

LIMIT OF CONTRACT

SYMMETRICAL ABOUT

STRUCTURE

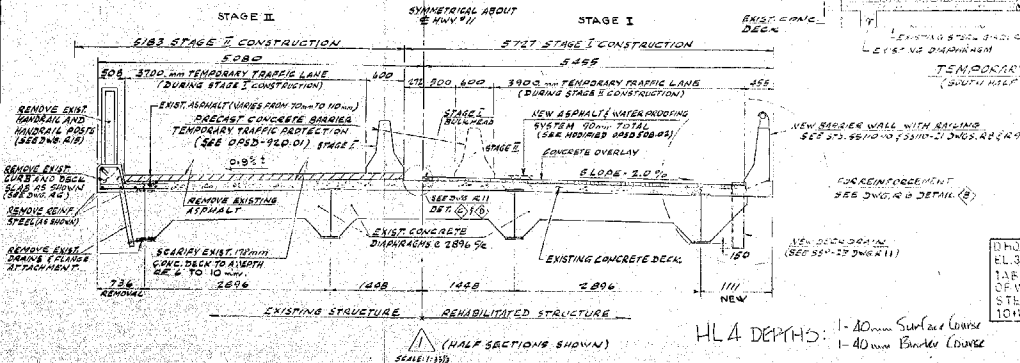


HALF ELEVATIONS

LIMIT OF CONTRACT

SYMMETRICAL ABOUT

STRUCTURE

(HALF SECTIONS SHOWN)
SCALE: 1/10H.L. DEPTHS: 1-40 mm Surface Course
1-40 mm Binder Course

METRIC

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.DIST. 19
CONT No 87-202
WP No 335-85-01STURGEON RIVER BRIDGE
REHABILITATION
GENERAL ARRANGEMENTSHEET
8

GENERAL NOTES:

- CLASS OF CONCRETE: 30 MPa.

- CLEAR COVER TO REINFORCING STEEL
DECK: 75 TO 100, BOTH JOINTS
REINFORCEMENT: 80 TO 100, SIDE FACE TO 100
REMAINDER: 75 TO 100 UNLESS OTHERWISE NOTED

- REINFORCING STEEL SHALL BE GRADE 400. BAR MARKS WITH
SUFFIX 'E' DENOTE COATED BARS.
THE CONTRACTOR SHALL FIELD CHECK AND VERIFY ALL CONDITIONS
AND MEASUREMENTS ASSOCIATED WITH THE WORK TO BE DONE AND
REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEED-
ING WITH THE WORK.

SCOPE OF REPAIR WORK:

A) REMOVALS

- EXISTING ASPHALT (WATERPROOFING FROM BRIDGE DECK), ASPHALT
FOR 30M BEYOND BOTH ABUTMENT EXPANSION JOINTS.
- SEALIFY THE TOP OF EXISTING CONCRETE DECK TO A DEPTH
OF 150 MM.
- EXISTING HAND RAILS, CONCRETE POSTS, CURBS, DECK SLAB CANT-
ILEVERED BEYOND THE EXTERIOR SIDINGS, DECK DRAIN AND
REINFORCING STEEL AS SHOWN ON DWG. R1, R2.
- A FULL DEPTH DECK SLAB IN AREAS SHOWN ON DWG. R6.
- THE ENDS OF DECK TO ACCOMMODATE NEW END JOINT ASSEMBLIES.
- THE BALLAST WALLS TO THE TOP OF THE BEARING SEATS.
- THE EXIST. ABUT. BEARINGS, ANCHOR ROSS AND ABUTMENT BEAR-
ING SEAT BEARING AS SHOWN ON DWG. R4 (R5).
- CONCRETE ON TOP, FRONT & SIDE FACES OF BOTH ABUTMENTS

B) CONSTRUCTION AND REPAIR

- INSTALL TEMP. ROADWAY PROTECTION (TEMP. CONCRETE BARRIER,
2. REPAIR CONCRETE BEARING SEATS AT BOTH ABUTMENTS AND
FRONT FACES OF BOTH ABUTMENTS.
- NEW PILES, FOOTINGS (RELATING TO BEARINGS AT BOTH ABUTMENTS).
- LEVEL SHEAR CONNECTORS ON TOP FLANGES AND OUTSIDE FACES
OF EXTERIOR PILLARS.
- NEW BALLAST WALLS, WIND WALLS, SIDEWALK WALLS, RAILING
EXPANSION JOINTS AT BOTH ABUTMENTS.
- NEW GRANULAR BACKFILL AT BOTH ABUTMENTS.
- NEW CONCRETE FOR DECK SLAB (ITEMS 3, 4, 5 IN (A) ABOVE).
- NEW DECK DRAINS AND CONCRETE BARRIER WALLS.
- NEW APPROACH SLAB ON BRIDGE DECK.
- NEW APPROACH SLABS AT BOTH ABUTMENTS.
- NEW WATERPROOFING AND ASPHALT ON BRIDGE DECK.
- NEW ASPHALT ON APPROACH SLABS AND APPROACHES.

DESIGN CRITERIA

- CONFORMS TO DWG. R3 EXCEPT DECK SLAB
CANTILEVERED BEYOND EXTERIOR SIDINGS
CONFORMS TO A15.10.

NOTES:

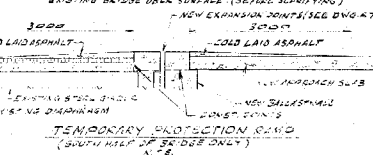
- FOR CONSTRUCTION SEQUENCE AND
STAGING SEE DWG. R3.

LIST OF DRAWINGS

- 435-885-B R1 GENERAL ARRANGEMENT
R2 BOREHOLE LOCATIONS & 60% STRATA
R3 ABUTMENT FOOTING EXTENSION & ROADWAY PROTECTION
R4 BEARING REPLACEMENT
R5 ABUTMENT MODIFICATION
R6 DECK MODIFICATION
R7 JOINT ANCHORAGE AND ARMOURING
R8 BARRIER WALL
R9 RAILING FOR BARRIER WALL
R10 6000 mm APPROACH SLAB
R11 MISCELLANEOUS DETAILS
R12 BRIDGE DATA & SITE NUMBER DATA
R13 AS CONSTRUCTED ELEV. & DIM.
R14 EXISTING STRUCTURE DWG. 1
R15 EXISTING STRUCTURE DWG. 2
R16 EXISTING STRUCTURE DWG. 3
R17 QUANTITIES-STRUCTURE
R18 QUANTITIES-STRUCTURE

NOTE: NEW WATERPROOFING AND ASPHALT TO BE
PLACED FIRST ON THE NORTH HALF OF THE
STRUCTURE DURING STAGE I CONSTRUCTION AND
THEN ON THE SOUTH HALF AFTER TRAFFIC HAS
BEEN DIVERTED.

NOTE: CONCRETE OVERLAY THICKNESS MEASURED FROM TOP OF
EXISTING BRIDGE DECK SURFACE (BEFORE SCARIFYING)
NEW EXPANSION JOINTS (SEE DWG. R7)



DWG. BY: 22135
EL. 341.755
TABLET SET IN PLACE
OF W. 1/2" x 1/2" x 1/2" x 1/2"
ST. PRICE: \$11.11
10/11/87 - ROUTE 62

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISION	DATE	BY	DESCRIPTION
1			
2			
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