

DIST. 8 REGION

W.P. No. 2501-91-01/02

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 401

LOCATION Hwy 401 at Gananoque
T. 1. 8

T. 1. 8

No of PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 2501-91-01/02 DIST 8
HWY 401 STR SITE

Weigh Scale at the Gananoque
Truck Inspection Stations

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FOUNDATION INVESTIGATION REPORT

For

Hwy. 401 South and North Sides

Weigh Scale at the Gananoque

Truck Inspection Stations

W.P. 2501-91-01/02

District 8, Kingston

INTRODUCTION

This report summarizes the information obtained from a foundation investigation carried out at the above mentioned site where the existing weigh scales at the South and North Truck Inspection Stations will be replaced with the larger weigh scales at the same locations.

The field work was carried out between 91 04 23 and 91 04 25. Four boreholes (BH 1 to BH 4) were advanced and sampled as part of this project by means of hollow stem augers with a conventional diamond drill (BW casing and BXL rock core barrel) adopted for rock sampling purposes. These boreholes extended down to depths of 7.2 m and 12.5 m below the existing ground surface.

This report contains factual information obtained from this investigation pertaining to weigh scale foundations and related earthworks for the weigh scale pit as shown on Dwg. No. 25019101/02-A.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing South and North Truck Inspection Stations within the right-of-way of Hwy. 401, approximately 8 km east to the Town of Gananoque between Gananoque and Hwy. 137 in Front of Leeds Township, Leeds and Grenville County. The topography of the area is generally flat to gently undulating with ground surface sloping to the northwest. Land use in the vicinity of the site is primarily agricultural and dairy farming.

The geology of the area is dominated by Paleozoic Granitic Gneiss bedrock known as "interlayered Hornblende-Biotite Gneiss and Granite of the Grenville Province". Overburden materials consist of Asphalt pavement or road fill followed by silty clay or sandy silt to silty sand and sand and gravel over the bedrock.

SUBSURFACE CONDITIONS

The subsoil conditions are generally uniform across the site. The generalized subsoil conditions at the site consist of the following:

South Truck Inspection Station (BH's 1 and 2)

<u>Depth (m)</u>	<u>Elevation (m)</u>	<u>Soil Description</u>
0-0.6	94.7	Asphalt
0.6-1.9/2.1	93.4-93.2	Fine Sand (Fill)
1.9/2.1-3.4/4.0	91.9-91.3	Silty Clay (Firm to V. Stiff)
3.4/4.0-5.2/7.6	90.1-87.7	Sandy Silt to Silty Sand (V. Loose to Dense)
5.2/7.6-9.2/9.4	86.1-85.9	Sand, some Gravel (Compact to V. Dense)
9.2/9.4-	from 86.1-85.9	Bedrock Surface

North Truck Inspection Station (BH's 3 and 4)

<u>Depth (m)</u>	<u>Elevation (m)</u>	<u>Soil Description</u>
0-0.6	94.7	Asphalt
0.6-1.4/1.7	93.9-93.6	Fine Sand (Fill)
1.7-2.1	93.2	Clayey Silt to Silt (Fill BH 4)
1.4/2.1-5.2	90.1	Sand, some Gravel (Loose to Dense)
5.2-7.2/7.4	88.1-87.9	Sand and Gravel (V. Dense)
7.2/7.4-	from 88.1-87.9	Bedrock Surface

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole sheets in the Appendix. The locations and elevations of the boreholes, along with sections showing soil stratigraphy based on borehole data, are shown on Dwg. No. 25019101/02-A.

A detailed description of the subsurface conditions encountered is given below.

Fill Material

All four boreholes encountered fill material whose composition is fine sand to clayey silt to silt with a thickness ranged from 0.8 m at BH 3 to 1.5 m at BH's 2 and 4. Grain Size Distribution analyses were carried out on two representative samples of fine sand. Figure 1 in the Appendix shows the results. In this fine sand fill, the 'N' value ranges from 11 to 54 blows/0.3 m indicating the state of compaction of this deposit described as compact to very dense.

Clayey silt to silt fill was encountered at BH 4 immediately underneath the fine sand fill. An Atterberg Limit Test and a Grain Size Distribution Test were carried out on this material (Figures 2 and 3). Through the Atterberg Limit Test, this material can be classified as a clayey silt to silt.

Silty Clay, some Sand

This cohesive stratum was encountered underneath the fill material at two borehole locations (BH's 1 and 2) in the South Truck Inspection Station. This deposit consists of silty clay with some sand and trace of organics. The thickness of this layer ranges from 1.5 m at BH 1 to 1.9 m at BH 2.

Atterberg Limit Tests were performed on two representative samples and the results are plotted on Figure 4 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>
Moisture Content (w)	23.5-25.0
Liquid Limit (w_L)	42.0-44.0
Plastic Limit (w_p)	18.0-21.0
Plasticity Index (I_p)	23.0-24.0

From the Plasticity Chart, it is evident that the layer can be classified as a silty clay (CI). Grain Size Distribution Tests were carried out on this cohesive material. Figure 5 in the Appendix shows the results.

In this stratum, the value ranges from 4 to 17 blows/0.3 m indicating the consistency of this deposit described as firm to very stiff.

Sandy Silt to Silty Sand, trace of Clay

This non-cohesive stratum was encountered underneath the silty clay at two borehole locations (BH's 1 and 2). This deposit consists of sandy silt to silty sand with a thickness ranged from 1.8 m at BH 1 to 3.6 m at BH 2. Grain Size Distribution Tests were carried out on this non-cohesive material. Figure 6 shows the results.

In this stratum, the 'N' value ranges from 1 to 42 blows/0.3 m indicating the state of compaction of this deposit described as very loose to dense.

Sand, some Gravel

This sand stratum was encountered at all four boreholes. However, it should be noted that this material was found underneath sandy silt to silty sand layer at the South Truck Inspection Station, while that was encountered immediately underneath the fine sand fill at the North Truck Inspection Station. The thickness of this layer ranges from 1.8 m at BH 2 to 4.0 m at BH 1. Grain Size Distribution Tests were carried out on this material. Figure 7 in the Appendix shows the results.

In this stratum, the 'N' value ranges from 9 to over 100 blows/0.3 m indicating the state of compaction of this deposit described as loose to very dense.

Sand and Gravel

This non-cohesive stratum was encountered immediately over the bedrock at two borehole locations in the North Truck Inspection Station. the thickness of this layer was found to range from 2.0 m at BH 4 to 2.2 m at BH 3. A Grain Size Distribution Test was carried out on this material. Figure 8 shows the results.

In this stratum, the 'N' value ranges from 50 to over 100 blows/0.3 m indicating the state of compaction described as very dense.

Bedrock

Bedrock was cored at two borehole locations (BH's 2 and 3) by obtaining up to 3.1 m of rock core samples, while the two boreholes were terminated at the probable bedrock surface (BH's 1 and 4). The bedrock surface is undulating with an elevation ranged from 85.9 m at BH 2 to 88.1 m at BH 4 which are corresponded to 9.4 m and 7.2 m below the existing ground surface. The bedrock in the area is "interlayered Hornblende-Biotite Gneiss and Granite of the Grenville Province". Detailed description of the rock are attached in the Appendix entitled "Description of Rock Core".

Core Recoveries (CR) and Rock Quality Designation (RQD) values were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Core Recoveries (CR) range between 87 and 100 percent and Rock Quality Designation (RQD) values range from 70 to 93 percent. Based on these results, the rock can be classified as medium strong rock and predominantly unweathered to slightly weathered.

GROUNDWATER CONDITIONS

Groundwater conditions were observed through the measurement of water level in the open boreholes. The groundwater level after completion was found to be ranged from an elevation of 91.3 m at BH 4 to 93.6 m at BH 2.

The following groundwater levels were observed during the field investigation.

<u>BH No.</u>	<u>Elevation (m)</u>	<u>Depth (m)</u>	<u>Location</u>
1	92.4	2.9	South Truck Inspection Station
2	93.6	1.7	South Truck Inspection Station
3	92.3	3.0	North Truck Inspection Station
4	91.3	4.0	North Truck Inspection Station

DISCUSSION AND RECOMMENDATIONS

It is proposed to remove the existing weigh scales at the South and North Truck Inspection Stations, which were built in 1972, and to replace them with the larger weigh scales at the same locations. Each inspection complex consists of a scale house, a scale pit and two long approach slabs at each side of the scale pit. According to the information available, the approach slabs will be maintained at the same elevation of the existing 95.3 m. Further, the existing scale house will be used for the new proposed weigh scale. The proposed weigh scale may be 24 m long, 3.5 m wide and 2.5 m deep.

Recommendations pertaining to the foundation of the new weigh scales and related earth works are summarized as follows:

Weigh Scale Foundations

The weigh scales should be founded at or below an approximate elevation of 92.8 m (about 2.5 m below the ground surface).

South Truck Inspection Station

In consideration of the weak nature of the subsoil condition, a sandy silt to silty sand layer underneath the founding silty clay layer, a low bearing capacity can be provided for this location.

For the purpose of the O.H.B.D.C., the following values are recommended.

Factored Bearing Capacity at U.L.S. 270 kPa
Bearing Capacity at S.L.S. type II 80 kPa

Alternatively, if a higher bearing capacity is required, it is recommended that the weigh scale foundation may be supported on end-bearing steel 'H' piles. The following design parameters are suggested:

<u>Pile Type</u>	<u>Axial Capacity at S.L.S. Type II</u>	<u>Factored Axial Capacity at U.L.S.</u>	<u>Estimated Pile Tip Elev. (m)</u>
HP310x79	900 kN	1150 kN	85.9-86.1
HP310x110	1150 kN	1600 kN	85.9-86.1

North Truck Inspection Station

Spread footing can be founded on native medium to coarse sand layer at this location.

The following design parameters are suggested for the purpose of the O.H.B.D.C.

Factored Bearing Capacity at U.L.S. 650 kPa
Bearing Capacity at S.L.S. type II 170 kPa

Alternatively, the weigh scale foundation can be supported on end-bearing steel 'H' piles. For the purpose of the O.H.B.D.C., the following values are recommended.

<u>Pile Type</u>	<u>Axial Capacity at S.L.S. Type II</u>	<u>Factored Axial Capacity at U.L.S.</u>	<u>Estimated Pile Tip Elev. (m)</u>
HP310x79	900 kN	1150 kN	87.9-88.1
HP310x110	1150 kN	1600 kN	87.9-88.1

In view of the denseness of the sand and gravel stratum located immediately above the bedrock, the piles should be equipped with reinforced tip in order to facilitate pile penetration through the basal stratum and driven to bedrock. Some piles may not penetrate this dense stratum. In such a case, the pile capacity should be controlled in the field using current MTO pile driving standard. However, attempts should be made in all cases to drive the piles to the bedrock surface. It should also be noted that the pile driving be controlled by maximum capacity of piles.

Other Considerations

Lateral Earth Pressures on Structures

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the weigh scale wall to prevent hydrostatic pressure build-up.

Design parameters of the soil are given below for purpose of O.H.B.C.D.

	Granular 'A'	Granular 'B'
Angle of Internal Friction, ϕ	35°	30°
Unit Weight (kN/m ³) γ	22.8	21.2
Coefficient of Earth Pressure at Rest (K_0)	0.43	0.50

The earth pressure coefficient at rest is to be used in design of the wall of the weigh scales. It should be noted that no heavy vibratory compacting equipment shall be permitted within 3 m of the finished walls of the weigh scale. Compaction in this area should be done with light, hand operated equipment.

Dewatering

No major dewatering difficulty are anticipated for footing excavations in consideration of the low groundwater level at the sites. However, if localized seepage or surface water to accumulate in excavation, it can be controlled by perimeter ditches and pumping from corner sumps.

Frost Protection

The footings should be placed so as to have a minimum earth cover of 1.5 m to allow for frost protection.

Excavation for Weigh Scale Foundation

In consideration of the proximity of the excavation for the foundation to the scale house and the existing Hwy. 401, it is proposed to shore the excavation with soldier-piles and timber lagging during the scale pit construction. The base of all footing excavations should be covered immediately upon exposure with a working slab of lean concrete or Granular 'A' material to protect the exposed founding soils from disturbing and softening within 4 hours of exposure.

Settlement of Weigh Scale Foundation

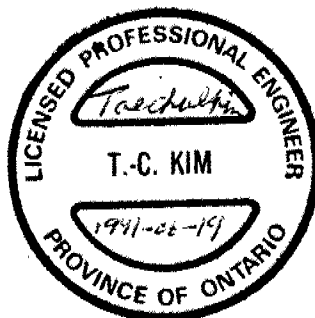
It is understood that the weigh scale is very sensitive to the differential settlement of scale foundations with the maximum allowable settlement of 10 mm. It is also understood that the maximum design load will be in the order of 50 kPa which includes dead and live loads for the weigh scale.

Based on our review, overburden pressure in the order of 50 kPa will be removed at the depth of proposed scale foundations since about 2.5 m overburden will be excavated to build scale pit. Therefore, it is our opinion that no differential settlement problem will be encountered with design load of 50 kPa for the scale foundations, since this is a floating type of foundation.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of Mr. Greg Dare, Student Engineer. The equipment was owned and operated by F.E. Johnston Drilling Co. Ltd, Ottawa.

This report was written by Tae C. Kim, Senior Foundation Engineer, and reviewed by M. S. Devata, Chief Foundation Engineer.



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APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

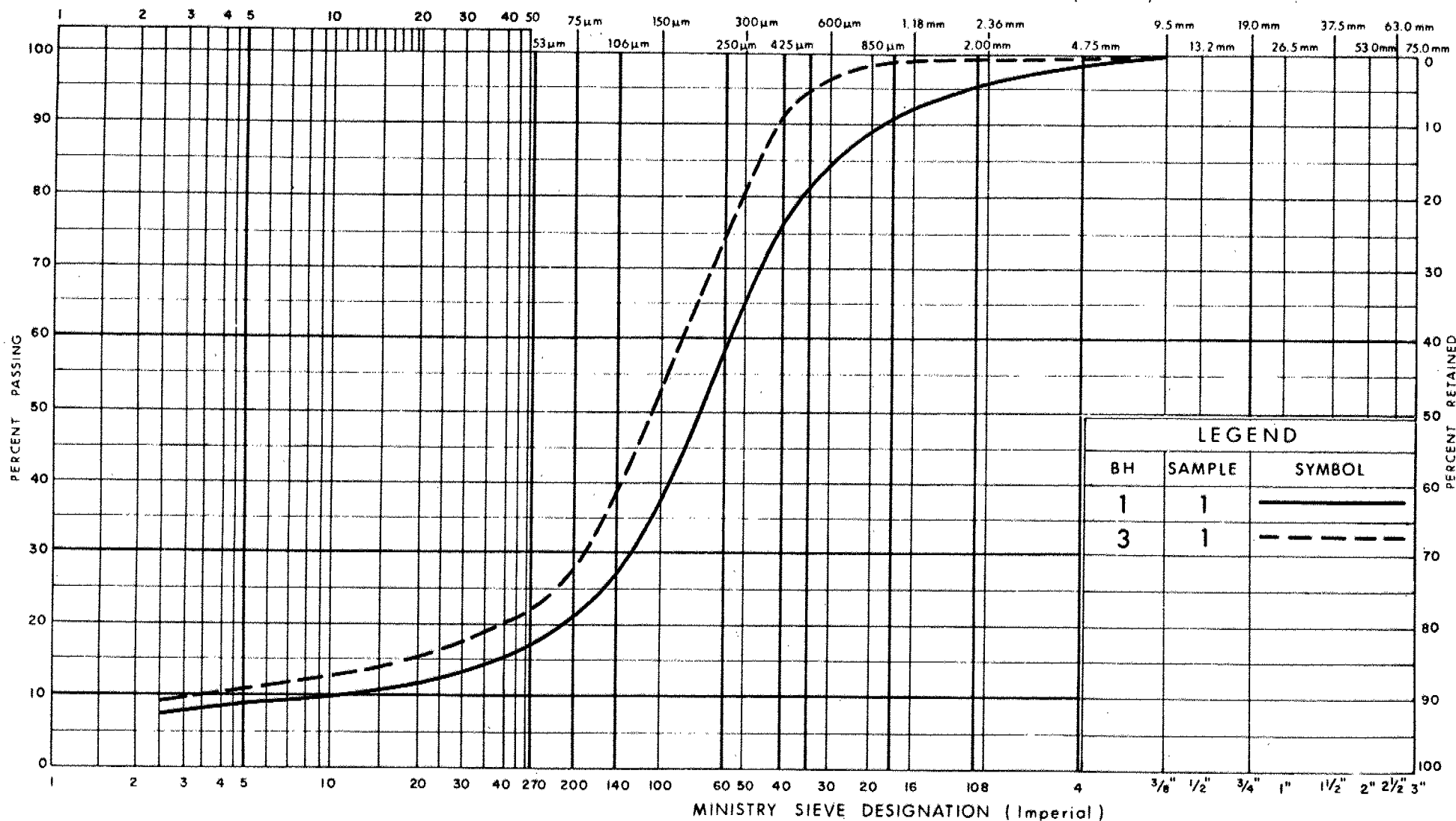
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

BH	SAMPLE	SYMBOL
1	1	—————
3	1	- - - - -

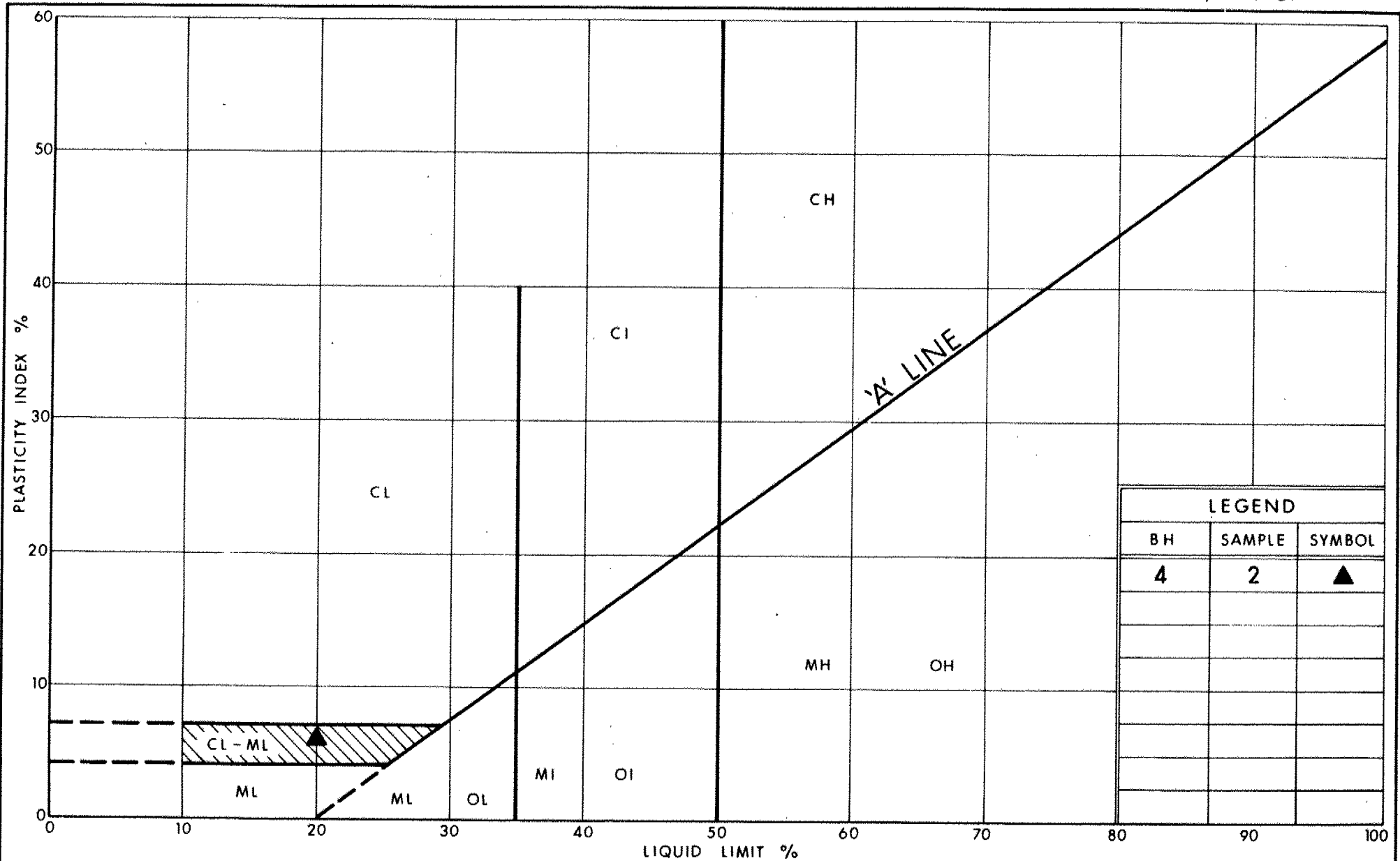
GRAIN SIZE DISTRIBUTION
SAND, SOME SILT (Fill)

FIG No 1

W P 2501-91-01/02



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PLASTICITY CHART CLAYEY SILT TO SILT WITH SAND (Fill)

FIG No 2

W P 2501-91-01/02

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

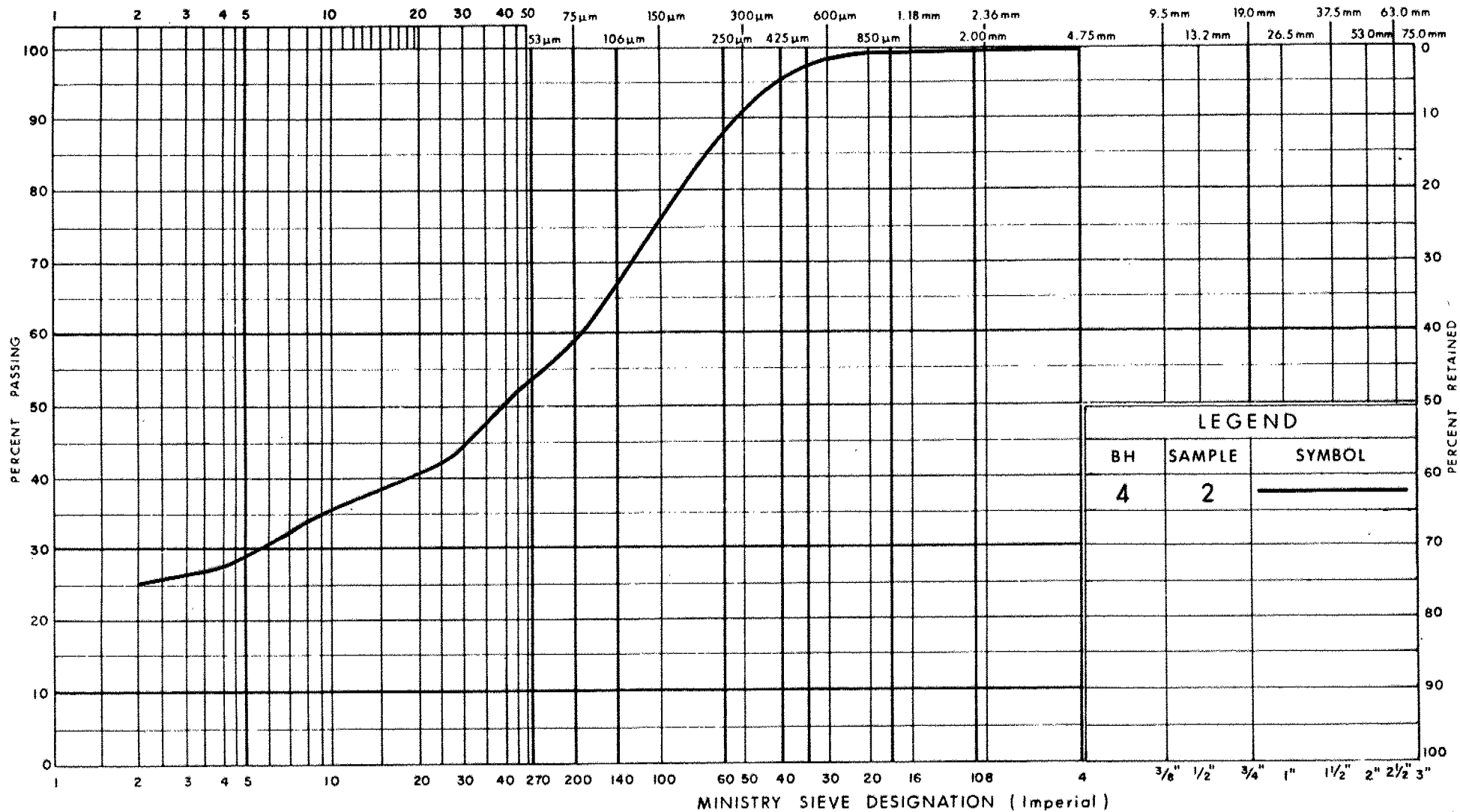
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

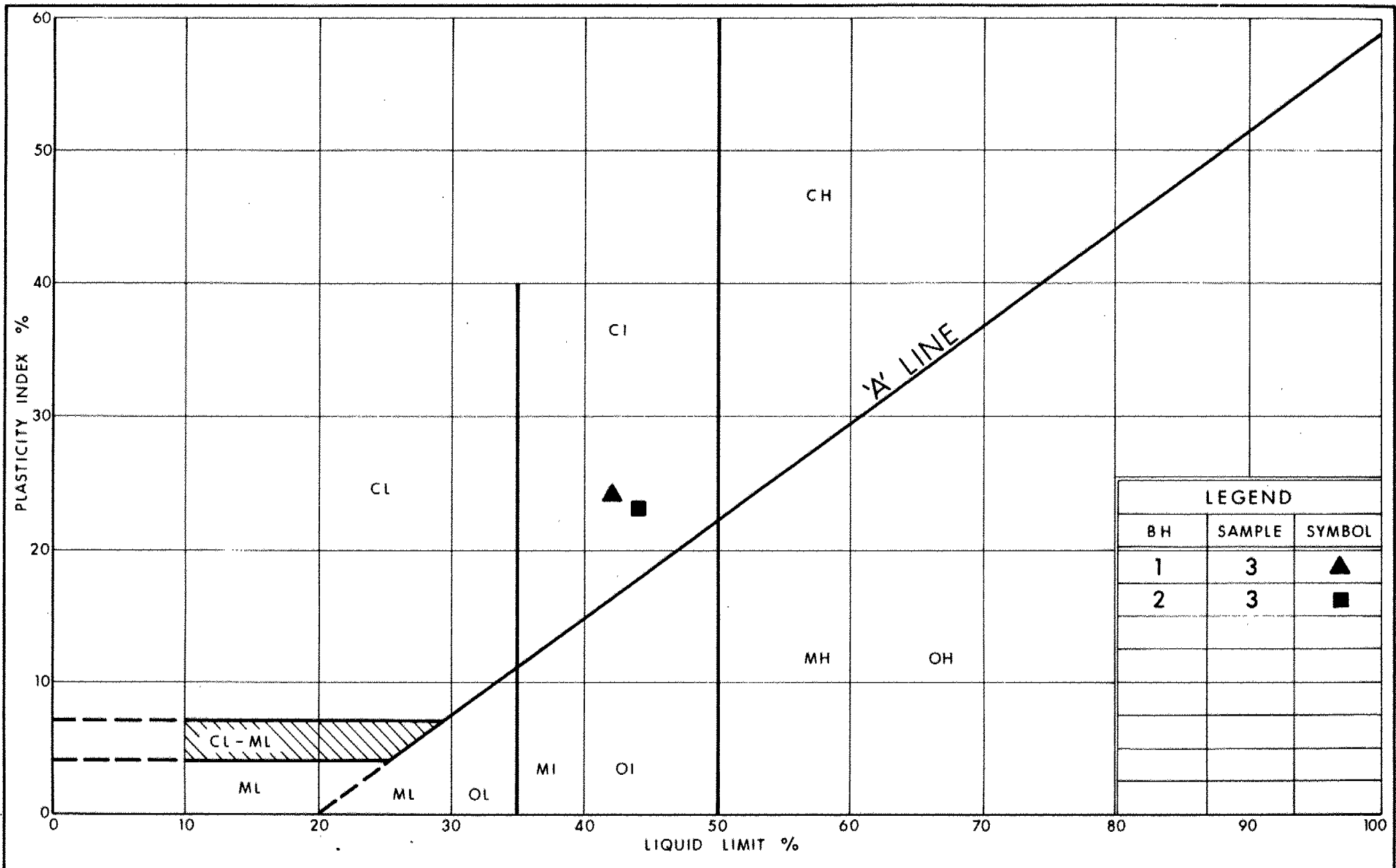
BH	SAMPLE	SYMBOL
4	2	—

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Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILT WITH SAND (Fill)

FIG No 3

W P 2501-91-01/02



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Transportation

PLASTICITY CHART SILTY CLAY, SOME SAND

FIG No 4

W P 2501-91-01/02

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

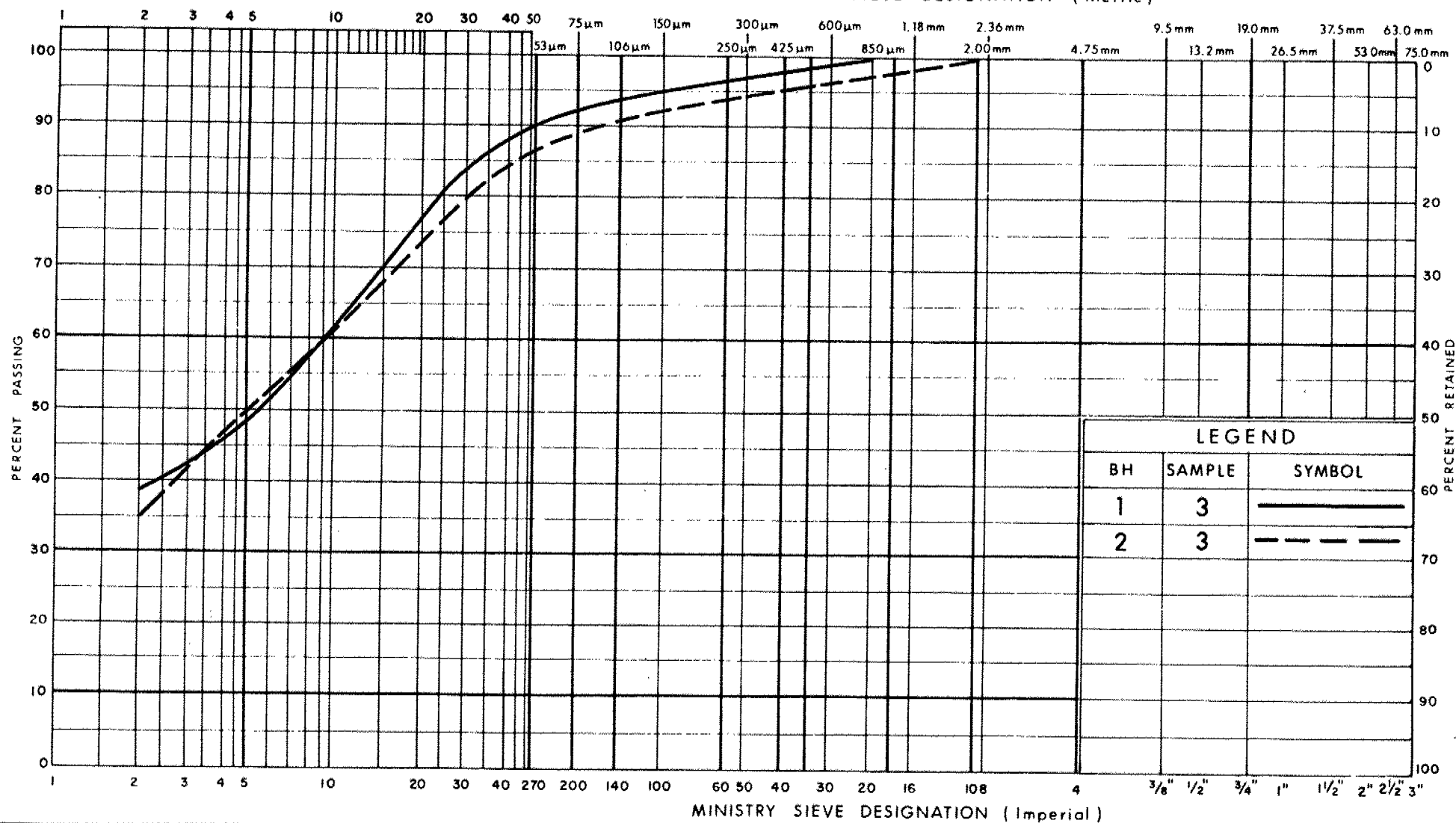
Coarse

Fine

Coarse

GRAIN SIZE, IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

BH	SAMPLE	SYMBOL
1	3	—————
2	3	- - - - -

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TransportationGRAIN SIZE DISTRIBUTION
SILTY CLAY, SOME SAND

FIG No 5

W P 2501-91-01/02

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

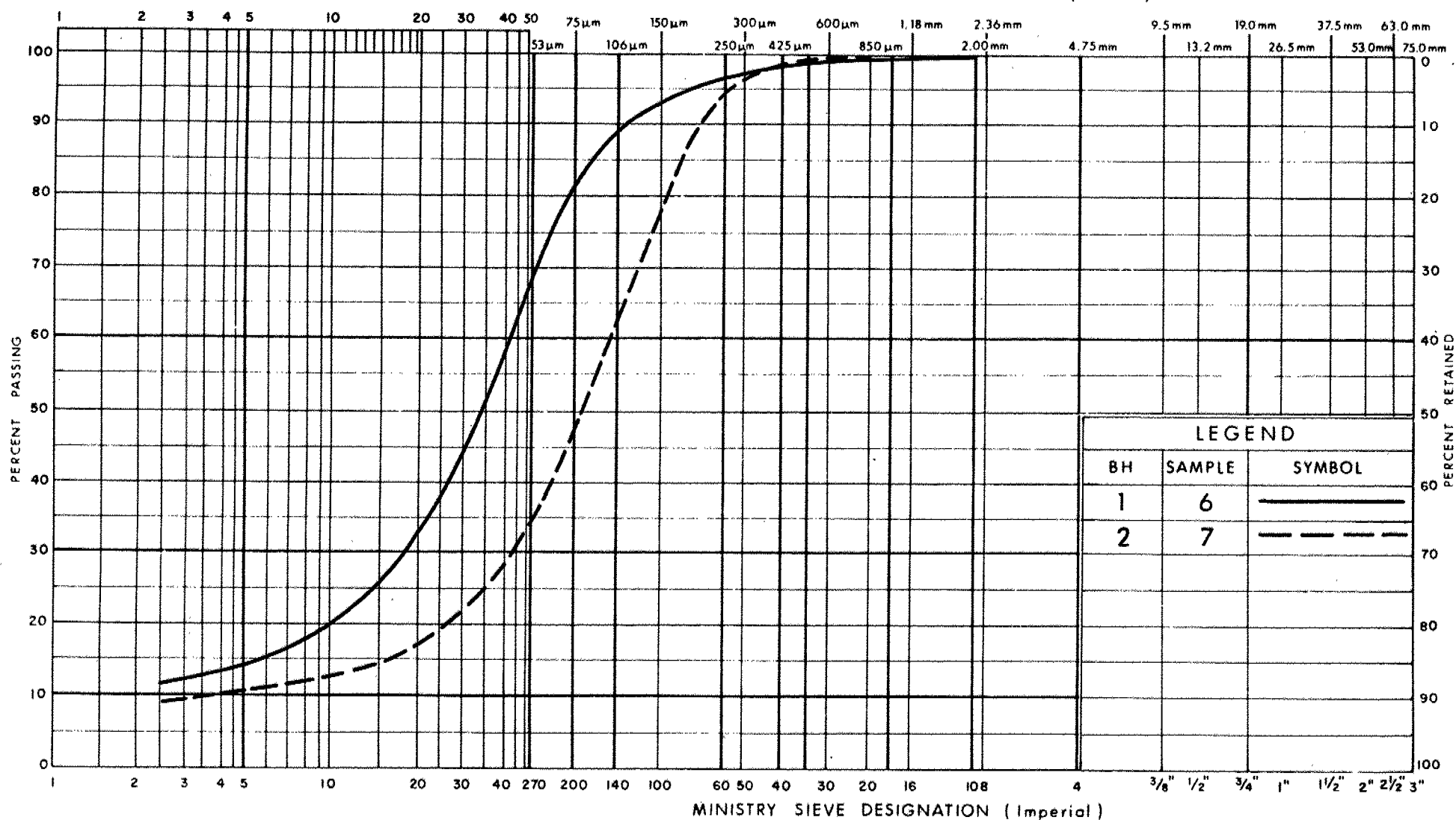
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

BH	SAMPLE	SYMBOL
1	6	—————
2	7	- - - - -

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TransportationGRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No 6

W P 2501-91-01/02

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

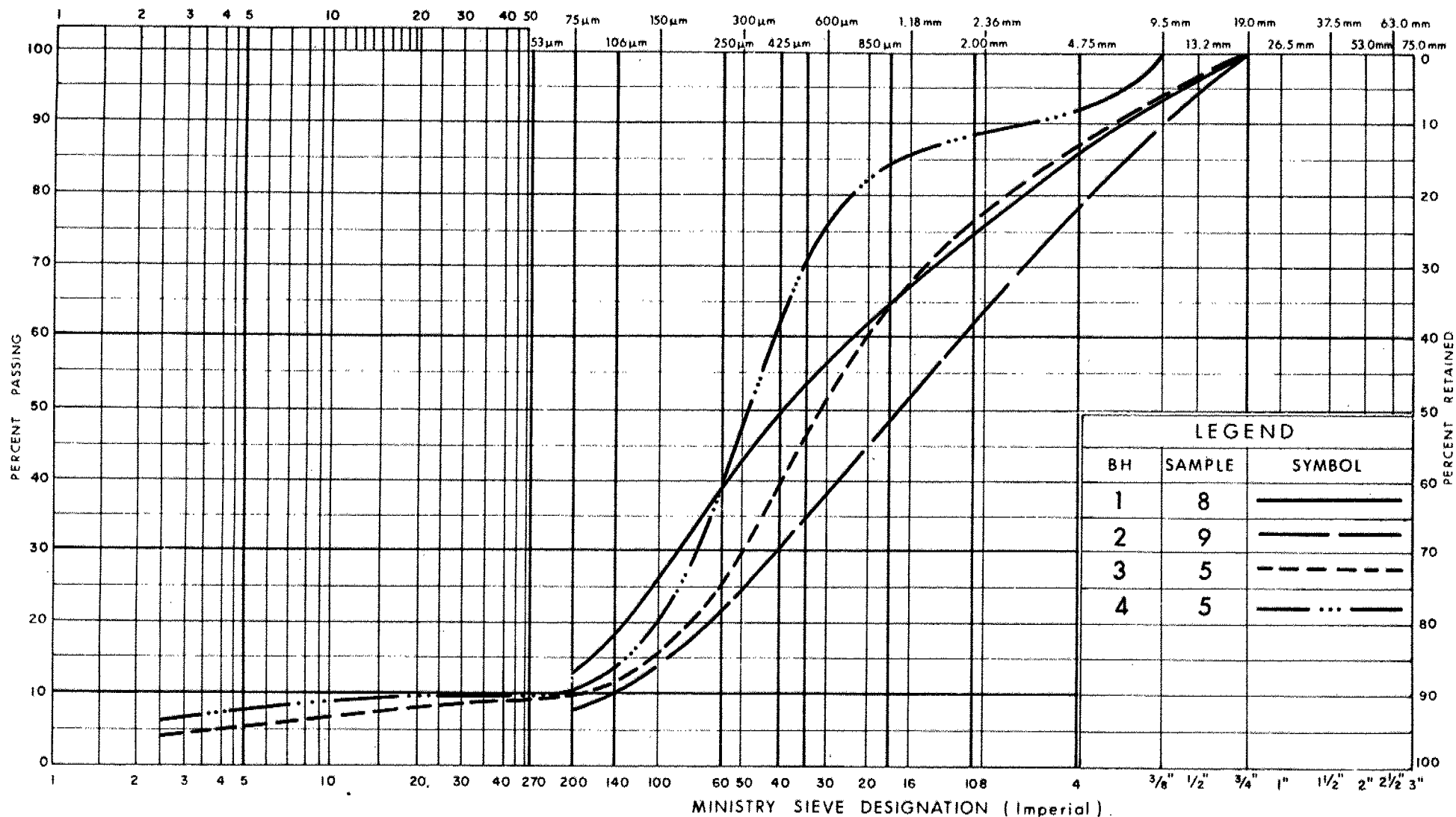
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

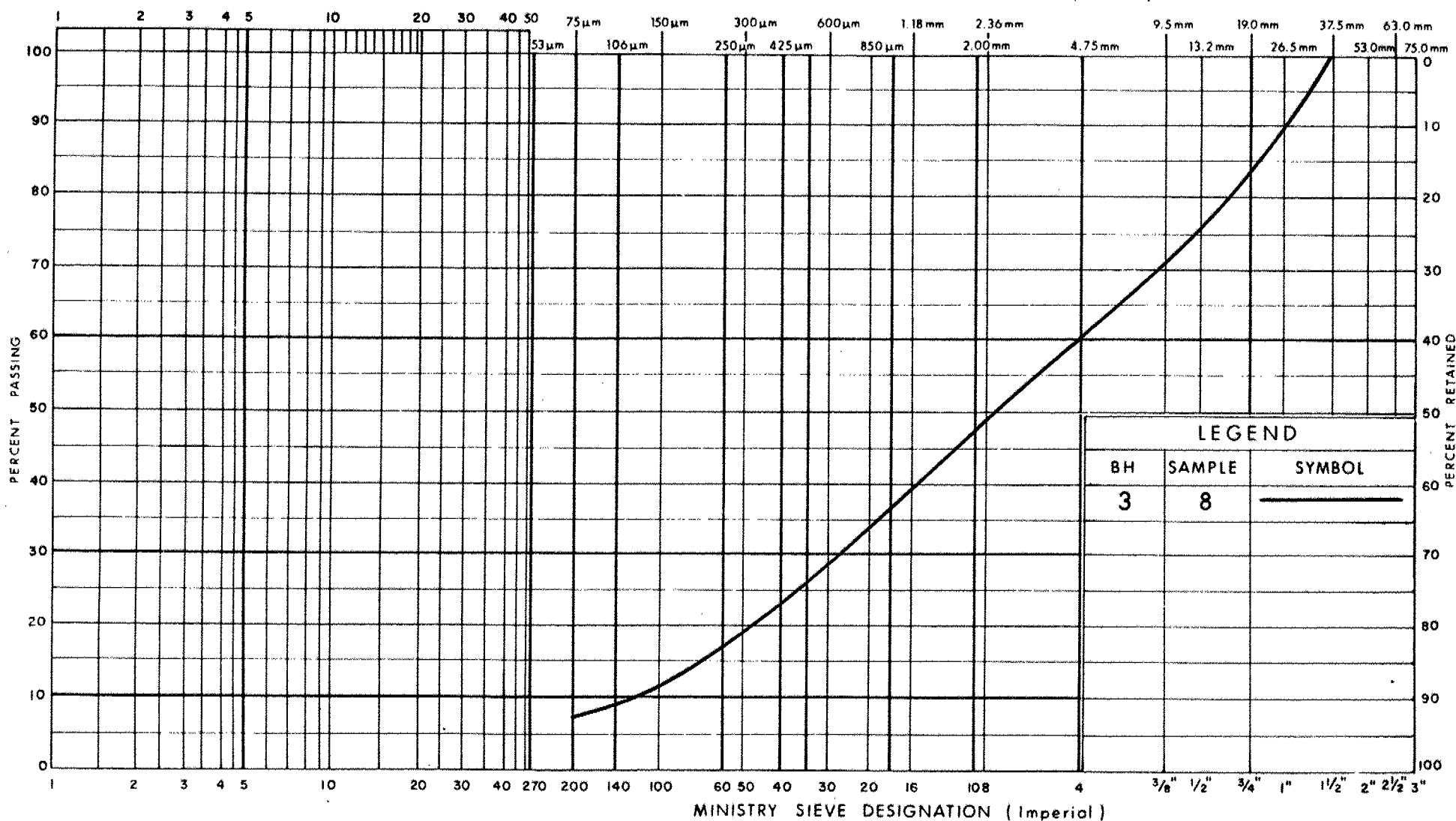
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

BH

SAMPLE

SYMBOL

3

8

—

GRAIN SIZE DISTRIBUTION
SAND & GRAVEL

FIG No 8

W P 2501-91-01/02



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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 (RQD), FOR MODIFIED RECOVERY, IS:

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	T W ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	T W ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	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						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 2501-91-01/02 LOCATION Co-ords: N 4 913 254.7; E 338 186.2 ORIGINATED BY G.D.
DIST B HWY 401 BOREHOLE TYPE H S Auger and Cone Test COMPILED BY L.D.
DATUM Geodetic DATE 91 04 25 CHECKED BY T.K.

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	20 40 60 80 100					
95.3	Ground Surface													
0.0	Asphalt													
94.7														
0.6	Fine Sand, some silt (Fill)		1	SS	50									1 79 13 7
	Compact to Dense													
93.4		Brown	2	SS	11									
		Grey												
1.9	Silty Clay, some sand, trace of organics		3	SS	16									0 9 51 40
	Firm to V. Stiff													
91.9		Grey	4	SS	9									
		Brown												
3.4	Sandy Silt to Silty Sand		5	SS	1									
	V. Loose													
90.1			6	SS	9									0 19 70 11
5.2			7	SS	125									
			8	SS	74									13 75 (12)
	Sand, some gravel occ. boulders													
	Compact to V. Dense													
86.1			9	SS	28									
9.2	End of Borehole at probable Bedrock													

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 2501-91-01/02 LOCATION Co-ords: N 4 913 266.5; E 338 207.0 ORIGINATED BY G.D.
DIST 8 HWY 401 BOREHOLE TYPE H S Auger, BXL Rock Coring & Cone Test COMPILED BY L.D.
DATUM Geodetic DATE 91 04 24 CHECKED BY T.K.

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	20 40 60 80 100					
95.3	Ground Surface													
0.0	Asphalt													
94.7														
0.6	Fine Sand, some silt (Fill) Compact to Dense		1	SS	41									
93.2		Brown	2	SS	15									
2.1		Grey	3	SS	17									
	Silty Clay, some sand, trace of organics Firm to V. Stiff		4	SS	4									
91.3		Grey	5	SS	18									
4.0		Brown	6	SS	7									
	Sandy Silt to Silty Sand Loose to Dense		7	SS	42									
			8	SS	12									
87.7			9	SS	112	/25cm								
7.6	Sand, some gravel Occ. boulders V. Dense		10	SS	80	/3cm								
85.9			11	RC	REC 100%									RQD 92%
9.4			12	RC	REC 87%									RQD 70%
	Bedrock Hornblende-Biotite Gneiss with Granite of the Granville Province		13	RC	REC 100%									RQD 74%
82.8														
12.5	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 2501-91-01/02 LOCATION Co-ords: N 4 913 183.4; E 337 931.0 ORIGINATED BY G.D
 DIST 8 HWY 401 BOREHOLE TYPE H S Auger, BXL Rock Coring & Cone Test COMPILED BY L.D
 DATUM Geodetic DATE 91 04 23 CHECKED BY T.K

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	20 40 60 80 100					
95.3	Ground Surface													
0.0	Asphalt													
94.7														
0.6	Fine Sand, some silt (Fill)	Brown	1	SS	54									0 73 19 8
93.9	V. Dense													
1.4			2	SS	25									
	Sand, some gravel occ. boulders		3	SS	15									
	Compact to Dense		4	SS	25									
			5	SS	37									13 77 6 4
			6	SS	30									
90.1														
5.2			7	SS	50									
	Sand and Gravel occasional Boulders		8	SS	67									40 52 (8)
	V. Dense													
87.9														
7.4			9	RC	REC 90%									RQD 78%
	Bedrock Hornblende-Biotite Gneiss with Granite of the Grenville Province		10	RC	REC 100%									RQD 93%
84.8														
10.5	End of Borehole													

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 2501-91-01/02 LOCATION Co-ords: N 4 913 195.3; E 337 951.9 ORIGINATED BY G.D.
 DIST 8 HWY 401 BOREHOLE TYPE H S Auger, and Cone Test COMPILED BY L.D.
 DATUM Geodetic DATE 91 04 24 CHECKED BY T.K.

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
95.3	Ground Surface														
0.0	Asphalt														
94.7															
0.6	Fine Sand, some silt (Fill) Dense	Brown	1	SS	48										
93.6															
1.7	Clayey Silt to Silt with sand (Fill)		2	SS	16										
93.2															
2.1	Sand, some gravel occ. boulders Loose to Compact		3	SS	13										
			4	SS	13										
			5	SS	9										
			6	SS	16										
90.1															
5.2	Sand and Gravel occasional Boulders V. Dense		7	SS	60	/13cm									
			8	SS	95	/15cm									
88.1															
7.2	End of Borehole at Probable Bedrock														

ROCK CORE DESCRIPTION
WP 2501-91-01/02

Page 1 of 1

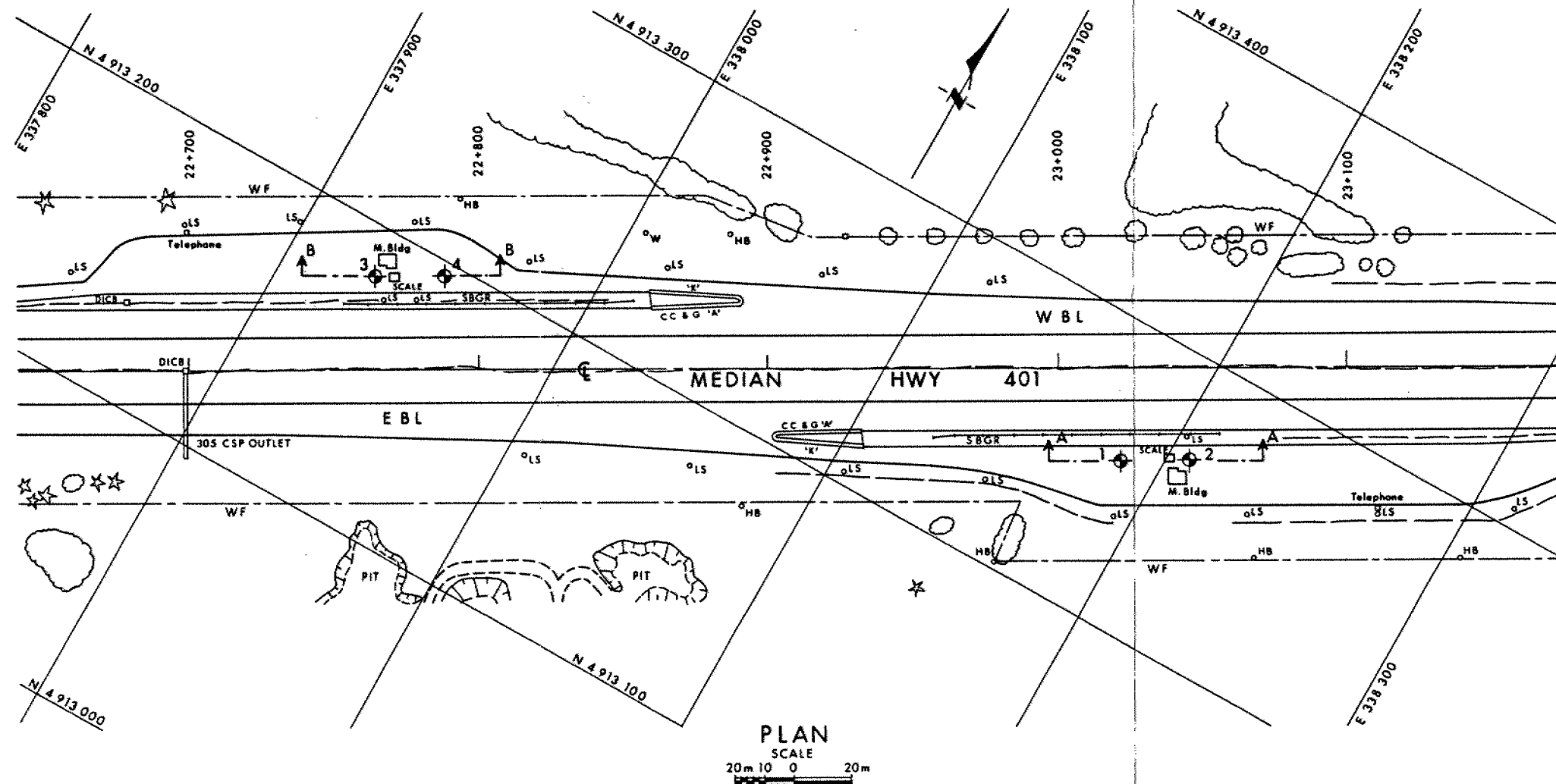
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
2	11	9.45-9.78	100	92	9.45-12.50	HORNBLLENDE-BIOTITE GNEISS , greyish black, with interlayered moderate reddish orange GRANITE (12%); coarse grained; medium strong; unweathered to slightly weathered (moderately weathered, 12.22-12.50 m); fractures wide to very close spaced, near vertical to flat, undulating to planar, smooth to rough.
	12	9.78-11.30	87	70		
	13	11.30-12.50	100	74		
3	9	7.42-8.94	90	78	7.42-10.46	GRANITE , moderate reddish orange, with interlayered greyish black HORNBLLENDE-BIOTITE GNEISS (38%); coarse grained; medium strong; unweathered to slightly weathered; fractures wide to very close spaced, flat to near vertical, undulating to planar, smooth to rough.
	10	8.94-10.46	100	93		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section



METRIC

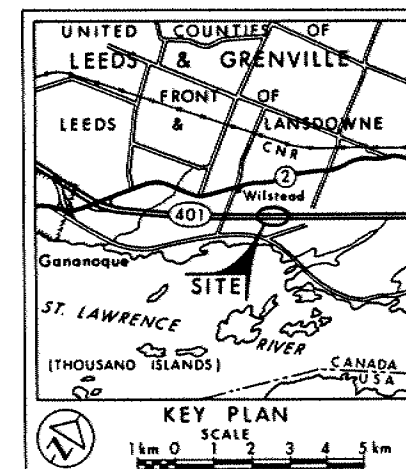
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 2501-91-01/02

HWY 401 WEIGH SCALES
(AT GANANOQUE TIS)
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 91 04

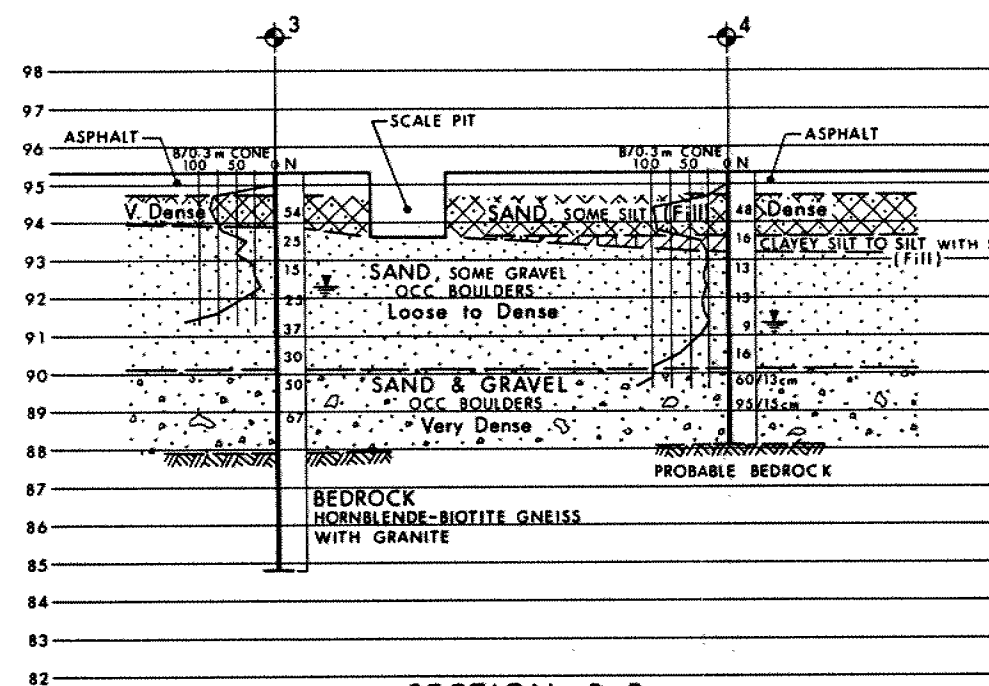
No	ELEVATION	CO-ORDINATES NORTH	EAST
1	95.3	4 913 254.7	338 186.2
2	95.3	4 913 266.5	338 207.0
3	95.3	4 913 183.4	337 931.0
4	95.3	4 913 195.3	337 951.9

NOTE

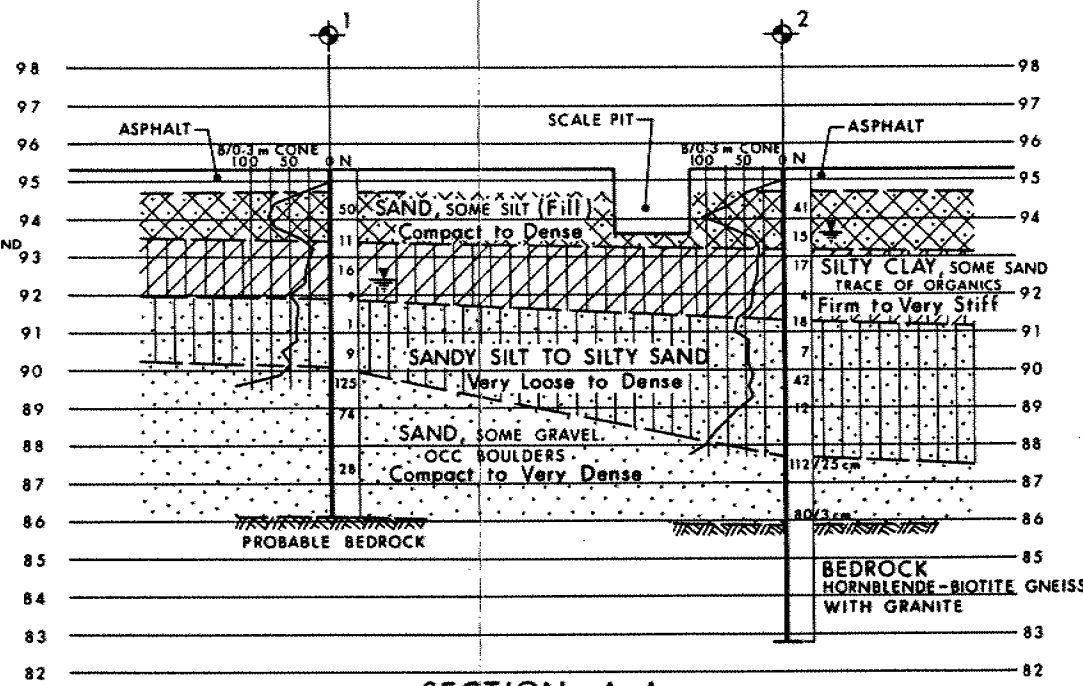
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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
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SECTION B-B



SECTION A-A

SCALES
4m 2 0 4m Hor
2m 1 0 2m Vert

memorandum



To: E.C. Lane
Head, Structural Section
Eastern Region

Date: 1991 06 10

Attn: Q. Islam, Sr. Structural Engineer

From: Foundation Design Section
Room 315, Central Bldg.
Downsview

Re: Review of the Possible Settlement
of Weight Scale Foundations
Hwy. 401 South and North Sides
Weigh Scales at the Gananoque Truck
Inspection Stations
W.P. 2501-91-01/02
District 8, Kingston

Further to the telephone conversation between Mr. Quazi Islam and the writer on June 3, 1991, and subsequent telephone conversation between Mr. Alf Schilter of Marshall Macklin Monaghan Ltd. and the writer on June 4th and June 6th, 1991 concerning the possible settlement of weigh scale foundations at the above sites, this memo summarizes our review on the above project.

It is understood that the weigh scale is very sensitive to the differential settlement of scale foundations with the maximum allowable settlement of 10 mm. It is also understood that the maximum design load will be in the order of 50 kPa which includes dead and live loads for the weigh scale.

Based on our review, overburden pressure in the order of 50 kPa will be removed at the depth of proposed scale foundations since about 2.5 m overburden will be excavated to build scale pit. Therefore, it is our opinion that no differential settlement problem will be encountered with design load of 50 kPa for the scale foundations, since this is a floating type of foundation.

If higher bearing capacities are required, this can only be achieved by placing the footing on completely unyielding foundation material such as sound bedrock. At these locations, bedrock was encountered as follows:

<u>Location</u>	<u>Depth to Bedrock (m)</u>	<u>Elevation (m)</u>
South T.I.S.	9.2 - 9.4	86.1 - 85.9
North T.I.S.	7.2 - 7.4	88.1 - 87.9

It is believed that piled foundation will provide higher axial capacity as suggested in our advanced recommendations.

We believe that this memorandum meets with your requirements. If you have any questions, please contact this office.

Tae C. Kim
Tae C. Kim, P. Eng.
Sr. Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundation Engineer

MD/TCK/mmj

c.c. J.L. Savinier, P & D Kingston
K.G. Bassi
A. Schliter

memorandum



To: E.C. Lane
Head, Structural Section
Eastern Region

Attn: Q. Islam, Sr. Structural Engineer

From: Foundation Design Section
Room 315, Central Bldg.
Downsview

Re: Advanced Recommendations
Hwy. 401 South and North Sides
Weigh Scales at the Gananoque Truck
Inspection Stations
W.P. 2501-91-01/02
District 8, Kingston

Date: 1991 05 27

The fieldwork for the foundation investigation for the above noted project has been completed. Due to the urgency of this project as per your request, we are herewith submitting our advanced recommendations. This memo provides summary of subsurface conditions and recommendations which will permit your office to proceed with design of the above structure.

The complete foundation investigation and design report will be forwarded to your office at a later date upon the completion of laboratory testing and drafting.

SITE DESCRIPTION

The site is located at existing south and north truck inspection stations within the right-of-way of Hwy. 401, approximately 8 km east of the Town of Gananoque between Gananoque and Hwy. 137 in Front of Leeds Township, Leeds and Grenville County. The topography of the area is generally flat to gently undulating with ground surface sloping to the northwest. Land use in the vicinity of the site is primarily agricultural and dairy farming.

SUBSURFACE CONDITIONS

The subsoil conditions are generally uniform across the site. The generalized subsoil conditions at the site consist of the followings;

South Truck Inspection Station (BH'S 1 and 2)

<u>Depth (m)</u>	<u>Elevation to (m)</u>	<u>Soil Description</u>
0 - 0.6	94.7	Asphalt
0.6 - 1.9/2.1	93.4 - 93.2	Fine Sand (Fill)
1.9/2.1 - 3.4/4.0	91.9 - 91.3	Silty Clay to Clayey Silt (Firm to V. Stiff)

3.4/4.0 - 5.2/7.2	90.1 - 87.7	Sandy Silt to Silty Sand (V. Loose to Dense)
5.2/7.2 - 9.2/9.4	86.1 - 85.9	Sand, Some Gravel (Compact to V. Dense)
9.2/9.4 -	From 86.1 - 85.9	Bedrock Surface

As shown on the above table, the consistency of silty clay to clayey silt layer is described as firm to very stiff, while the state of compaction of underlying sandy silt to silty sand layer is described as very loose to dense.

North Truck Inspection Station (BH'S 3 and 4)

<u>Depth (m)</u>	<u>Elevation to (m)</u>	<u>Soil Description</u>
0 - 0.6	94.7	Asphalt
0.6 - 1.4/1.7	93.9 - 93.6	Fine Sand (Fill)
1.7 - 2.1	93.2	Clayey Silt to Silt (Fill, BH4)
1.4/2.1 - 5.2	90.1	Medium to Coarse Sand (Loose to Dense)
5.2 - 7.2/7.4	88.1 - 87.9	Sand and Gravel (V. Dense)
7.2/7.4 -	From 88.1 - 87.9	Bedrock Surface

As shown on the above table, the state of compaction of medium to coarse sand lay is described as loose to dense.

The bedrock in the area is interlayered Hornblende - Biotite Gneiss and Granite of the Grenville Province.

Groundwater conditions were observed through the measurement of water level in the open boreholes. the groundwater level after completion was found to be ranged from an elevation 91.4 m at BH 4 to 93.6 m at BH 2.

The following groundwater levels were observed during the field investigation.

<u>BH No.</u>	<u>Elevation (m)</u>	<u>Depth (m)</u>	<u>Location</u>
1	92.4	2.9	South Truck Inspection Station
2	93.6	1.7	" " " "
3	92.3	3.0	North Truck Inspection Station
4	91.3	4.0	" " " "

RECOMMENDATIONS

It is proposed to remove the existing weigh scales at the South and North truck inspection stations, which were built in 1972, and to replace them with the larger weigh scales at the same locations. Each inspection complex consists of a scale house, a scale pit and two long approach slabs at each side of the scale pit. According to the information available, the approach slabs will be maintained at the same elevation of the existing 95.3 m. Further, the existing scale house will be used for the new proposed weigh scale. The proposed weigh scale may be 24 m long, 3.5 m wide and 2.5 m deep.

Recommendations pertaining to the foundation of the new weigh scales and related earth works are summarized as follows.

Weigh Scale Foundations

The weigh scales should be founded at or below an approximate elevation 92.8 m (about 2.5 m below the ground surface).

South Truck Inspection Station

In consideration of the weak nature of the subsoil condition, a sandy silt to silty sand layer underneath the founding silty clay to clayey silt layer, a low bearing capacity can be provided for this location.

For the purpose of the O.H.B.D.C., the following values are recommended.

Factored Bearing Capacity at U.L.S. - 270 kPa
Bearing Capacity at S.L.S. Type II - 80 kPa

Alternatively, if a higher bearing capacity is required, it is recommended that the weigh scale foundation may be supported on end-bearing steel "H" piles. The following design parameters are suggested.

<u>Pile Type</u>	<u>Axial Capacity at S.L.S. Type II</u>	<u>Factored Axial Capacity at U.L.S.</u>	<u>Estimated Pile Tip Elev. (m)</u>
HP 310 X 79	900 kN	1150 kN	89.5 - 86.1
HP 310 X 110	1150 kN	1600 kN	" "

North Truck Inspection Station

Spread footing can be founded on native medium to coarse sand layer at this location.

The following design parameters are suggested for the purpose of the O.H.B.D.C.

Factored Bearing Capacity at U.L.S. - 650 kPa

Bearing Capacity at S.L.S. Type II - 170 kPa

Alternatively, the weigh scale foundation can be supported on end-bearing steel "H" piles. For the purpose of the O.H.B.D.C., the following values are recommended.

<u>Pile Type</u>	<u>Axial Capacity at S.L.S. Type II</u>	<u>Factored Axial Capacity at U.L.S.</u>	<u>Estimated Pile Tip Elev. (m)</u>
HP 310 X 79	900 kN	1150 kN	87.9 - 88.1
HP 310 X 110	1150 kN	1600 kN	" "

In view of the denseness of the sand and gravel stratum located immediately above the bedrock, the piles should be equipped with reinforced tip in order to facilitate pile penetration through the basal stratum and driven to bedrock. Some piles may not penetrate this dense stratum. In such a case, the pile capacity should be controlled in the field using current MTO pile driving standard. However, attempts should be made in all cases to drive the piles to the bedrock surface. It should also be noted that the pile driving be controlled by maximum capacity of piles.

Other Considerations

Lateral Earth Pressures on Structures.

Free draining material such as Granular "A" or Granular "B" is recommended as appropriate backfill to the weigh scale wall to prevent hydrostatic pressure build-up.

Design parameters of the soil are given below for purpose of the O.H.B.C.D.

	<u>Granular "A"</u>	<u>Granular "B"</u>
Angle of Internal Friction, ϕ	35°	30°
Unit Weight (kN/m ³), γ	22.8	21.2
Coefficient of Earth Pressure at Rest (k_0)	0.43	0.50

The earth pressure coefficient at rest is to be used in design of the wall of the weigh scales. It should be noted that no heavy vibratory compacting equipment shall be permitted within 3 m of the finished walls of the weigh scale. Compaction in this area should be done with light, hand operated equipment.

Dewatering

No major dewatering difficulty are anticipated for footing excavations in consideration of the low groundwater level at the sites. However, if localized seepage or surface water to accumulate in excavation, it can be controlled by perimeter ditches and pumping from corner sumps.


Frost Protection

The footings should be placed so as to have a minimum earth cover of 1.5 m to allow for frost protection.

Excavation for Weigh Scale Foundation

In consideration of the proximity of the excavation for the foundation to the scale house and the existing Hwy. 401, it is proposed to shore the excavation with soldier-piles and timber lagging during the scale pit construction. The base of all footing excavations should be covered immediately upon exposure with a working slab of lean concrete or Granular "A" material to protect the exposed founding soils from disturbing and softening within 4 hours of exposure.

We believe that this memorandum meets with your requirements. If you have any questions, please contact this office.


Tae C. Kim, P. Eng.
Sr. Foundation Engineer

For

M. Devata, P. Eng.
Chief Foundation Engineer

MD\TCK\jb

cc: J.L. Savlnier - P. & D. - Eastern Region
K. Bassi