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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

R-14

*CONT 94-22*  
ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 127-87-02 DIST 9  
HWY 416 STR SITE 3-543

Baseline Road Underpass  
Structure #9

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# FOUNDATION INVESTIGATION REPORT

For

Baseline Road Underpass

Structure #9

W.P. 127-87-02, Site No. 3-543

Hwy. 416, District 9, Ottawa

## INTRODUCTION

This report summarizes the results obtained from a foundation investigation conducted at the aforementioned site. A two span structure is proposed to carry Baseline Road over the proposed Hwy. 416 SB lanes, Hwy. 416 N to 417 E ramp lanes and Hwy. 416 N to 417 W ramp lanes. Excavation cuts in the order of magnitude of 7 metres will be required in the soil and rock at the site to facilitate advancement of the highway.

Discussion and recommendations pertaining to the subsurface conditions, structure foundations, approach cuts and related earthworks are provided in this report.

## SITE DESCRIPTION AND GEOLOGY

The site is located in the area bounded by the quadrants at the intersection of the existing Cedarview Road and Baseline Road, just south of Richmond Road in the City of Nepean, Ottawa-Carleton Municipality. The CNR tracks intersect Cedarview Road approximately 200 metres south of the site.

The terrain is generally flat north of Baseline Road but slopes gently upward southward towards the existing CNR tracks. The land north of the site is occupied by the NCC gardens whilst the land south of Baseline on either side of Cedarview Road consists of grassland.

Physiographically, the site lies in the area known as the Ottawa Valley Clay Plains founded in the Lowlands of the St. Lawrence. The native subsoil consists of clay plains interrupted by ridges of rock or sand. Bedrock at the site is of the March/Nepean and Bobcaygeon Formations consisting of sandstone/dolostone and limestone respectively. Fault scarps are also evident within the area, an illustration of the numerous normal faults that dominate the region.

The overburden was deposited during and immediately following the Wisconsin glacialiation at which time the area was depressed from the effect of the glacialiation. Following the retreat of the glacier, the brackish waters of the Champlain Sea flooded the area and then gradually receded as the land rebounded with the deposition of sediments to its present level.

#### FIELD INVESTIGATION

The fieldwork for the investigation was carried out between 89 08 01 and 89 08 03 and consisted of 8 sampled boreholes advanced to depths ranging from 3.5 m to 7.4 m below ground surface accompanied by 8 dynamic cone penetration tests advanced to depths ranging from 2.7 m to 5.6 m. Additional sampled boreholes (BH's 89-1, 89-2) advanced in conjunction with a previous preliminary investigation (W.P. 127-87-00) at the site conducted between 89 04 04 and 89 04 07 have also been included in this report. Hollow stem auger equipment was used to advance the boreholes in the overburden. Subsoil samples were retrieved at 0.7 m intervals by a split spoon sampler in both cohesionless and cohesive soils encountered in accordance with the Standard Penetration Test (ASTM D1586) and by a Shelby tube sampler in cohesive soils (ASTM 1587). In situ vane tests were carried out in the surficial silty clay to clayey silt deposit at 0.7 m intervals to determine the undrained shear strength of the cohesive material at both the undisturbed and remoulded state. The test was conducted in accordance with ASTM D2573, using the standard MTO 'N' Vane. Bedrock was cored at 6 boreholes at the structure foundation locations using conventional rock coring methods in BXL size. All samples were identified in the field and then returned to the laboratory for applicable testing.

Groundwater levels were obtained in the open boreholes and also in sealed piezometers installed at BH's 9-2 and 9-6. Groundwater levels were monitored throughout the duration of the investigation. Survey information related to the location and elevation of boreholes was provided by Eastern Region Surveys and Plans.

### SUBSURFACE CONDITIONS

Subsoil conditions are generally uniform across the site. The surficial native deposit consists of a cohesive silty clay to clayey silt that extends to a maximum thickness of 4.6 metres at the south approach location (BH 9-7), but generally is of the order of thickness of 2-3 metres across the site. Underlying the silty clay to clayey silt deposit exists a cohesionless deposit consisting of a heterogeneous mixture of silt, sand and gravel. The deposit overlies sandstone or dolostone bedrock and varies in thickness ranging from 0.5 metres to 1.4 metres.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of investigation, are shown on the attached Record of Borehole sheets in the Appendix. A plan of the site illustrating the locations and elevations of the boreholes and subsoil stratigraphical sections are provided on Dwg. 1278702-A.

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

#### Silty Clay to Clayey Silt

This native surficial deposit is generally oxidized (brown) for the upper 1-1.5 metre and unoxidized (grey) for its lower thickness. The maximum thickness of the deposit at BH 9-7 is 4.6 metres but is generally 2 to 3 metres in thickness.

The deposit is generally cohesive in behaviour and contains some sand and occasional random sand seams. A grain size distribution envelope for this deposit as determined by mechanical analysis is given in Figure 1.

Atterberg Limits were obtained to evaluate the plasticity of the soil and the results are plotted in Figure 2. A summary of the indices is provided in Table 1. Unit weights are also included.

Table 1 - Silty Clay to Clayey Silt

	<u>Range</u>	<u># of Samples Tested</u>
Natural Moisture Content (w%)	24-39	6
Liquid Limit (w <sub>L</sub> %)	26-46	6
Plastic Limit (w <sub>p</sub> %)	12-16	6
Unit Weight (kN/m <sup>3</sup> )	17.6-18.8	3
Undrained Shear Strength (kPa)		
- Field Vane	30->120	11
- Lab Tests	27-40	2
Sensitivity	4-11	11

The test results reveal that the deposit varies randomly in plasticity ranging from low (clayey silt) to intermediate (silty clay).

Undrained shear strength measurements (C<sub>u</sub>) were obtained in situ by conducting field vane tests and in the laboratory by conducting unconfined compression tests. Results are plotted on the Record of Boreholes in the Appendix and summarized in Table 1 above. Based on shear strength values ranging from 30->120 kPa, it can be concluded that the soil has a firm to very stiff consistency.

Consolidated undrained tests with pore pressure measurements were conducted in the laboratory to determine the effective strength parameters of the material. The test was carried out on a sample from the same deposit at the proposed Richmond Rd/Hwy. 416 Overpass (WP127-87-01, BH 8-9, TW2). The effective shear strength parameters determined from the test are summarized in Table 2 below:

Table 2

Sample - BH 8-9, TW2  
 Elevation (m) - 75.9  
 Liquid Limit (w<sub>L</sub>%) - 50  
 Plastic Limit (w<sub>p</sub>%) - 17  
 Natural Moisture Content (w%) - 33  
 Effective Angle of Internal Friction (Ø°) - 29  
 Effective Shear Strength Intercept (c') - 25 kPa

For design purposes, a reduced angle of internal friction ( $\phi^\circ$ ) of  $26^\circ$  and a shear strength intercept ( $c'$ ) of 5 kPa was selected to account for the fact that the sample tested was not saturated.

The sensitivity of the soil as defined by the ratio of the undrained strength in the undisturbed state to the undrained strength, at the same water content, in the remoulded state, ranged from sensitive to extra sensitive (4-11) but is generally sensitive.

#### Heterogeneous mixture of Silt, Sand and gravel (Glacial Till)

Underlying the surficial silty clay to clayey silt deposit and extending to bedrock a heterogeneous mixture of silt, sand and gravel (glacial till) exists. The thickness of this deposit ranges from 0.5 m to 1.4 m. Although not encountered during the investigation, boulders are characteristic components of deposits of this origin and hence may exist in this deposit. A grain size distribution envelope for this deposit is provided in Figure 3 in the Appendix.

Standard Penetration tests carried out in this deposit revealed 'N' values ranging from 1 blow/0.3 m to 85 blows/.25 m indicating that the deposit ranges in denseness from loose to very dense. In general, the deposit can be categorized as compact.

#### Bedrock

The glacial till deposit is directly underlain by sandstone with interbedded dolostone of the March/Nepean Formation at all locations of the site except at the southwestern portion (BH 9-6) where limestone of the Bobcaygeon Formation exists.

The bedrock was cored in BXL size up to 3.2 metres in thickness at the proposed structure foundation locations. The sandstone bedrock with interbedded dolostone is sound, competent rock and is medium to very fine grained. The rock is unweathered and contains moderately close to close spaced fractures. The

limestone bedrock, on the other hand, is moderately to highly weathered and contains clay seams in the upper 1 to 1.5 metres, but is unweathered below that depth. The rock contains moderately close to close spaced fractures.

Core recoveries and Rock Quality Designations (RQD) were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Rock recoveries varied between 75 and 100% while RQD's varied between 58 and 100% for the sandstone bedrock. Rock recoveries varied between 83 and 100% while RQD's varied between 0 and 54% for the limestone bedrock. In general, the sandstone bedrock can be classified as strong durable rock while the limestone rock appears to be medium strong and less durable.

#### GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open boreholes and monitoring the water level in piezometers installed in the bedrock and within the native overburden. Measurements obtained at the time of investigation revealed levels at an elevation ranging from 76.8 m to 79.4 m which corresponds to depths ranging from 1.0 to 1.8 m below the existing ground surface. Groundwater levels, however, are subject to seasonal fluctuations and hence can vary from the values given in this report.

## DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a 2 span structure (equal spans of 53.8 m) and approximate width of 25 metres that will carry Baseline Road over the proposed Hwy. 416. The proposed grade for the highway is approximately at elevation 73 metres whilst the proposed grade for Baseline Road varies from approximately 82 metres at the east abutment to 80 metres at the west abutment. Based on a bedrock surface elevation of 75.5 m to 76.0 m, approximately 4 to 6.5 metres of forward earth slopes comprised of both cut and fill will be required at the approaches. The excavation cut is generally 4 metres in the overburden and 2.5 to 3 metres in the bedrock at the structure location.

Recommendations pertaining to the following geotechnical considerations are provided in the scope of this report:

Structure Foundations

Slope Stability

- Baseline Road Approach
- Hwy. 416 Excavation Cut

Lateral Earth Pressures on Structure

Construction Considerations

### Structure Foundations

#### Spread Footings

In consideration of the shallow bedrock surface and the proposed excavation cut sections at the site, the structure abutments and piers can be founded on conventional spread footings on the dolostone/sandstone bedrock. The footings can be located at or below the bedrock surface which is approximately at elevation 75.5± metres provided that the footing be located at a minimum edge distance of 3 metres from any excavated rock slope. In addition, the footing

base should be scaled of any loose surficial overburden or any loosened/fractured rock. It is also imperative that any weathered rock including clay seams, such as encountered in the rock at BH 9-6 be removed. If the rock is found to be in a widespread deteriorated state, this office should be contacted so that this office can evaluate alternate bearing capacities for the footings on the bedrock.

For purposes of the O.H.B.D.C., it is recommended that the footings be designed using a factored capacity at U.L.S. of 3000 kPa. The bedrock is considered to be an unyielding foundation base and hence the bearing capacity at S.L.S. Type II will not govern design.

Sliding resistance between the concrete footing and the bedrock should be calculated in accordance with Section 6-7.3.3.2 of the O.H.B.D.C. assuming an unfactored angle of friction of  $24^\circ$  between the concrete and the rock. If additional sliding resistance is required, consideration can be given to employing dowels or rock anchors provided the bedrock is not severely fractured. Please contact this office for pertinent design parameters should any of these options be considered.

To prevent potential footing uplift due to heaving pressures exerted caused by freezing of water beneath the footing, it is recommended that the footings be protected against frost penetration. The frost penetration depth in the site area is 1.8 metres. In addition, ascertaining a clean and tight contact between the concrete and the rock will also assist in the prevention of ice accretion.

No dewatering problems are anticipated during footing excavation and construction. Some groundwater inflow into the excavation can be expected predominantly through the glacial till and bedrock. Such inflow, however, can be controlled by conventional pumping techniques. A permanent drainage system in conjunction with permanent cut slopes associated with the highway will be discussed in subsequent sections of this report.

A concrete working slab should be provided immediately following excavation to protect the bearing surface of the bedrock at the footing location from the effects of weathering and other disturbances.

## Slope Stability

### General

The critical condition examined in the evaluation of excavation cuts such as proposed in the advancement of Hwy. 416 at the site location is the long term (drained) condition and consequently an effective stress analysis was implemented. In all cases, stability computations were carried out using Bishop's method on an in-house mainframe program incorporating a factor of safety of 1.3. The properties of the fill material and subsoil and the geometries selected for the Baseline Road approach and the Hwy. 416 cut approach are shown in Figures 4 and 5 respectively in the Appendix. Details of the analysis are described under the appropriate subheadings below. In all cases earth slopes are to be "benched" a distance of 3.0 m from any rock slope, as per OPSD 201.01 and 201.02.

Drained stability analyses of the slopes are very sensitive to groundwater levels and pore pressures that can develop in the slope. Therefore slope protection and drainage measures will be required to ensure their long-term surficial stability. By employing a 1.2 m thick granular blanket consisting of free draining material such as Granular 'A' material, softening of material due to freeze-thaw cycles and development of excess pore water pressures can be prevented. Inabilities to control these parameters usually result in surficial slope failures.

The granular blankets should be designed in conjunction with a permanent drainage system that will discharge drained water both from the slope and the bedrock. It is recommended that toe drains be constructed consisting of a perforated pipe encased with a suitable geotextile filter fabric and in turn surrounded by a suitable granular soil filter material. The toe drains should then be connected to an appropriate integrated drainage system. At the site, the toe drains can be constructed in conjunction with the highway perimeter drainage system (see Figure 4).

Normal slope vegetation should be established as soon as possible after completion of the cut in order to control surficial erosion.

### Baseline Road Approach

Approaches at Baseline Road will require the placement of up to 2 m of fill material at the surface of the Hwy. 416 excavation cut slope. The overburden thickness at the site is approximately 4 m.

The results of the analysis are illustrated on Figure 6 in the Appendix. The "Equivalent Depth of Cut" that identifies the ordinate scale of the graph represents the total depths that includes the approach fill thickness. Based on the results, it can be concluded that for an equivalent depth of 5 metres the forward slopes can be constructed at 2H:1V. For an equivalent depth exceeding 5 metres, such as at the east approach which has an effective depth of 6 m mid-depth benches are recommended. Forward slopes in the order of magnitude of 6 metres will require a 2 metre bench. A bench design configuration is illustrated in Figure 4a. Alternatively for a 6 metre forward slope, the slopes can be constructed at 2.5H:1V, without a midheight berm.

Transverse slopes for the approach fills can be constructed at 2H:1V. Any local softened and/or surficial organic soil should be removed within the plan limits of the fill prior to its placement. The fills should be placed and compacted according to MTO specifications and standards (OPSS 501). Settlements induced by the fill placement are expected to be negligible.

### Hwy. 416 Approach Cut

Excavation cuts in the order of magnitude of 6-7 metres, generally 4-4.5 m in soil, and 2.5-3 m in bedrock, will be required in the advancement of Hwy. 416 at the structure foundation location and immediate approach. At the most southerly extent of the site (BH 9-7), an increased overburden depth of excavation of approximately 6 metres will be required. Deeper excavation cuts associated with the highway advancement south of the site towards the CNR tracks will be addressed in the foundation report for the CNR overpass (Structure #16).

The results of stability analyses indicate excavated overburden slopes with the applied slope surface treatment can be safely constructed at 2H:1V for depths less than or equal to 5 metres. As Figure 7 illustrates, mid-depth benches will

be required for depths exceeding 5 metres. For instance, for a 6 m cut at the south approach as mentioned above, a 3 metre bench is required.

No stability problems are anticipated for bedrock slopes, provided that the bedrock is not severely fractured and permanent cut slopes are 1H:4V or flatter.

#### Lateral Earth Pressures on Structure

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the abutments to prevent hydrostatic pressure build-up. Design parameters of the soil are given below:

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction ( $\phi$ )	35°	30°
Unit Weight (kN/m <sup>3</sup> )	22.8	21.2
Coefficient of Active Earth Pressure ( $K_a$ )	0.27	0.33
Coefficient of Earth Pressure at Rest ( $K_o$ )	0.43	0.5

The earth pressure coefficient at rest is to be used in design if the abutment walls are rigid and unyielding. Weep holes in the abutment walls should be designed to drain any accumulation of water in the backfill.

#### Construction Considerations


Earth and rock excavation shall be carried out in accordance with OPSS 206.07.03 and 206.07.04 respectively. Rock grading shall be carried out in accordance with OPSD 201.02. In order to prevent excess fracturing of the bedrock foundations and slopes, rock excavation shall be carefully monitored.


#### MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer, J. White and A. Lako, Student Engineers utilizing equipment owned and operated by Marathon Drilling and Johnston Drilling. The description of bedrock core samples was carried out by S. Senior,

Geologist. This report was written by T. Sangiuliano under the general supervision of Dr. B. Iyer, Senior Foundation Engineer and reviewed by Mr. M.S. Devata, Chief Foundation Engineer.

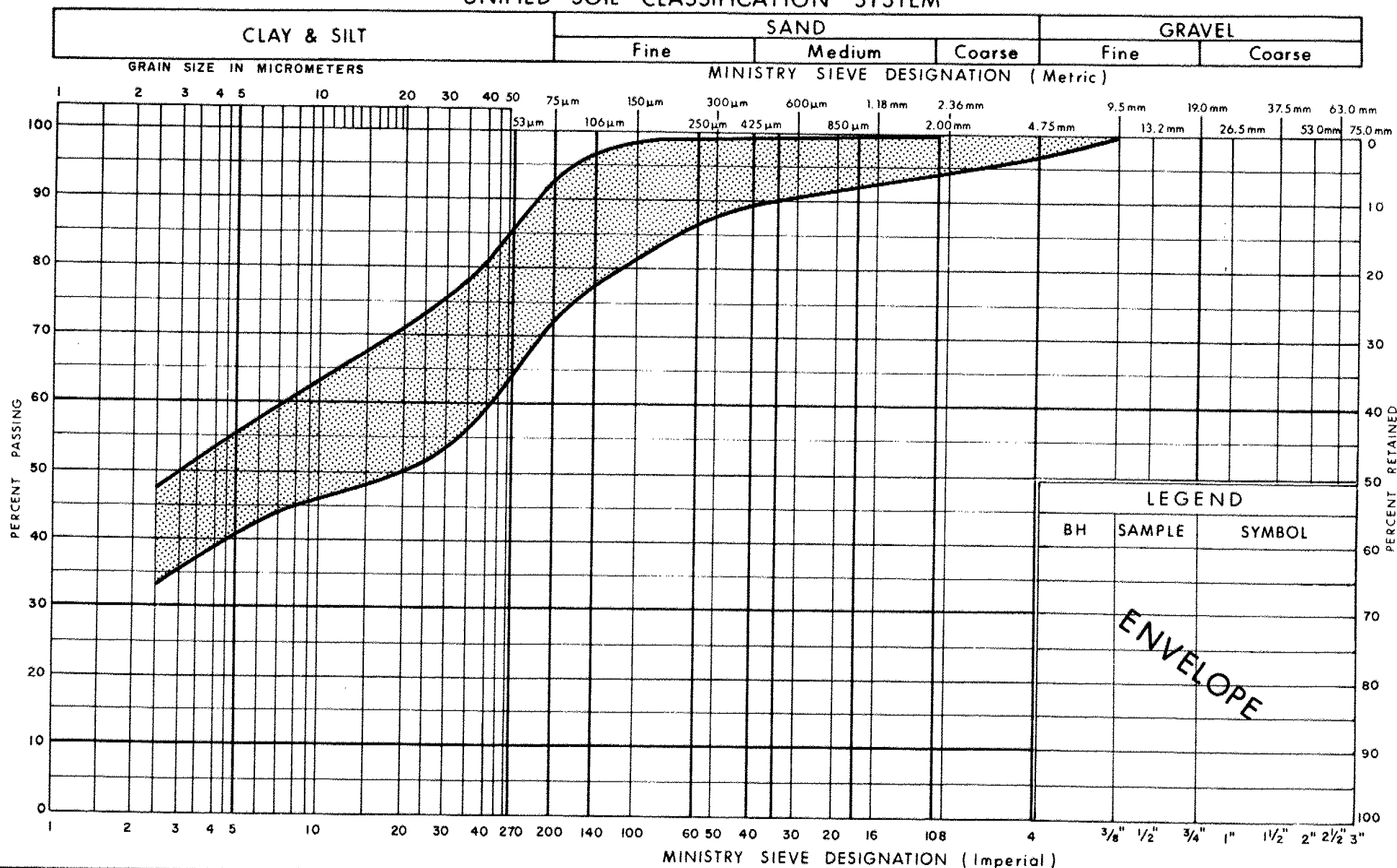


  
T. Sangiuliano, P.Eng.  
Foundation Engineer

  
M.S. Devata, P.Eng.  
Chief Foundation Engineer

APPENDIX

## UNIFIED SOIL CLASSIFICATION SYSTEM

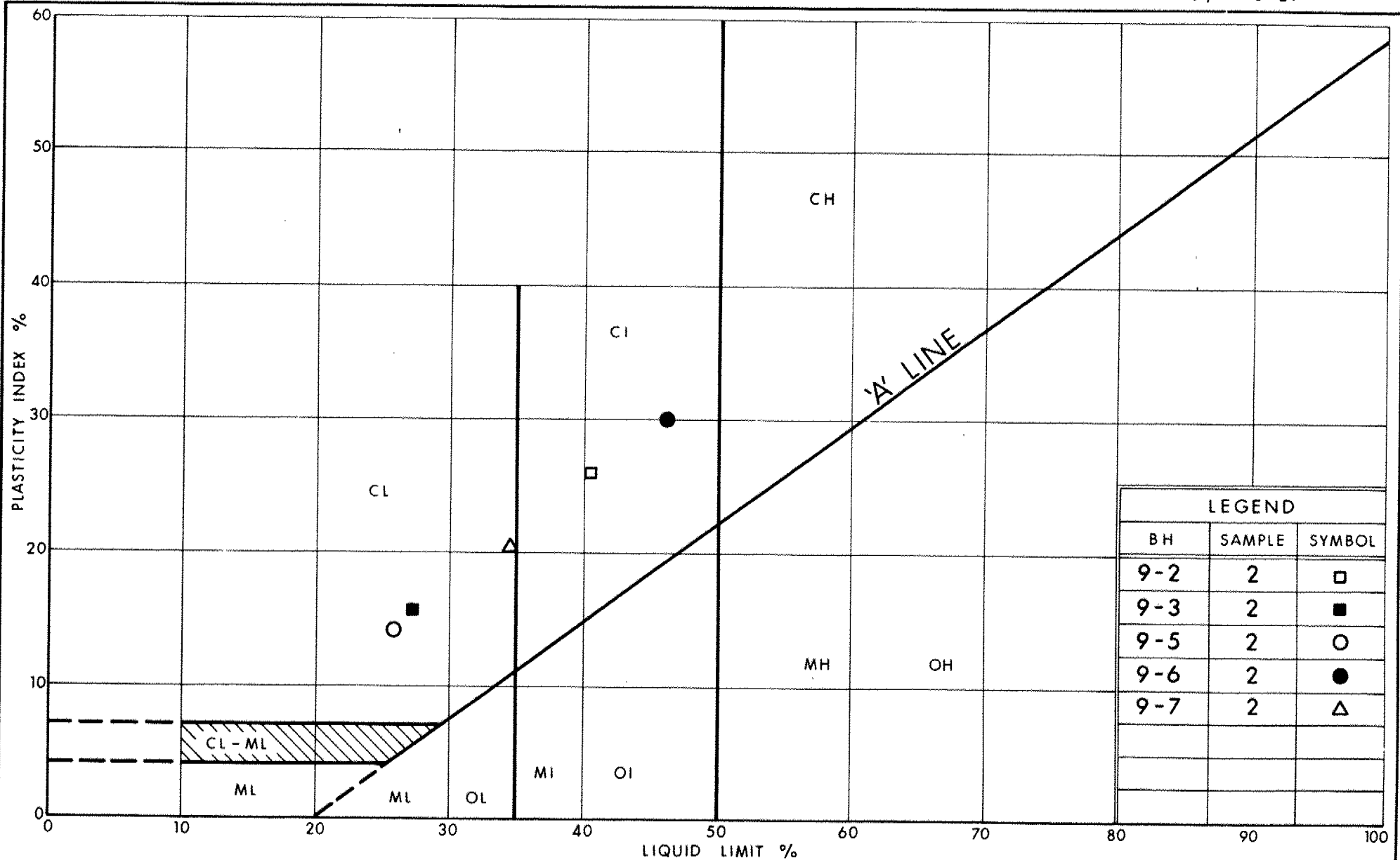


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GRAIN SIZE DISTRIBUTION  
SILTY CLAY TO CLAYEY SILT, SOME SAND

FIG No 1

W P 127-87-02



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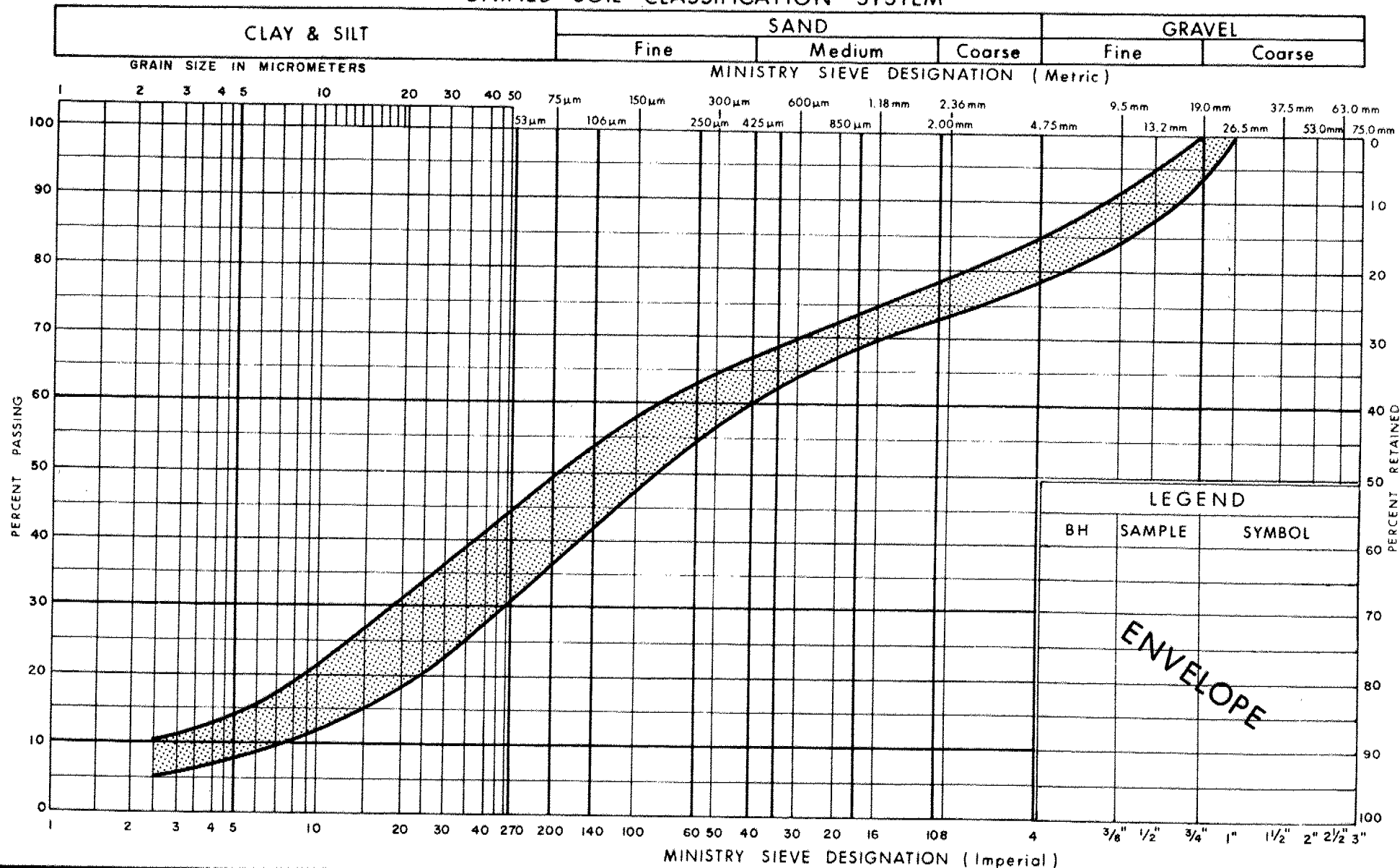
Ontario

# PLASTICITY CHART SILTY CLAY TO CLAYEY SILT, SOME SAND

FIG No 2

W P 127-87-02

## UNIFIED SOIL CLASSIFICATION SYSTEM



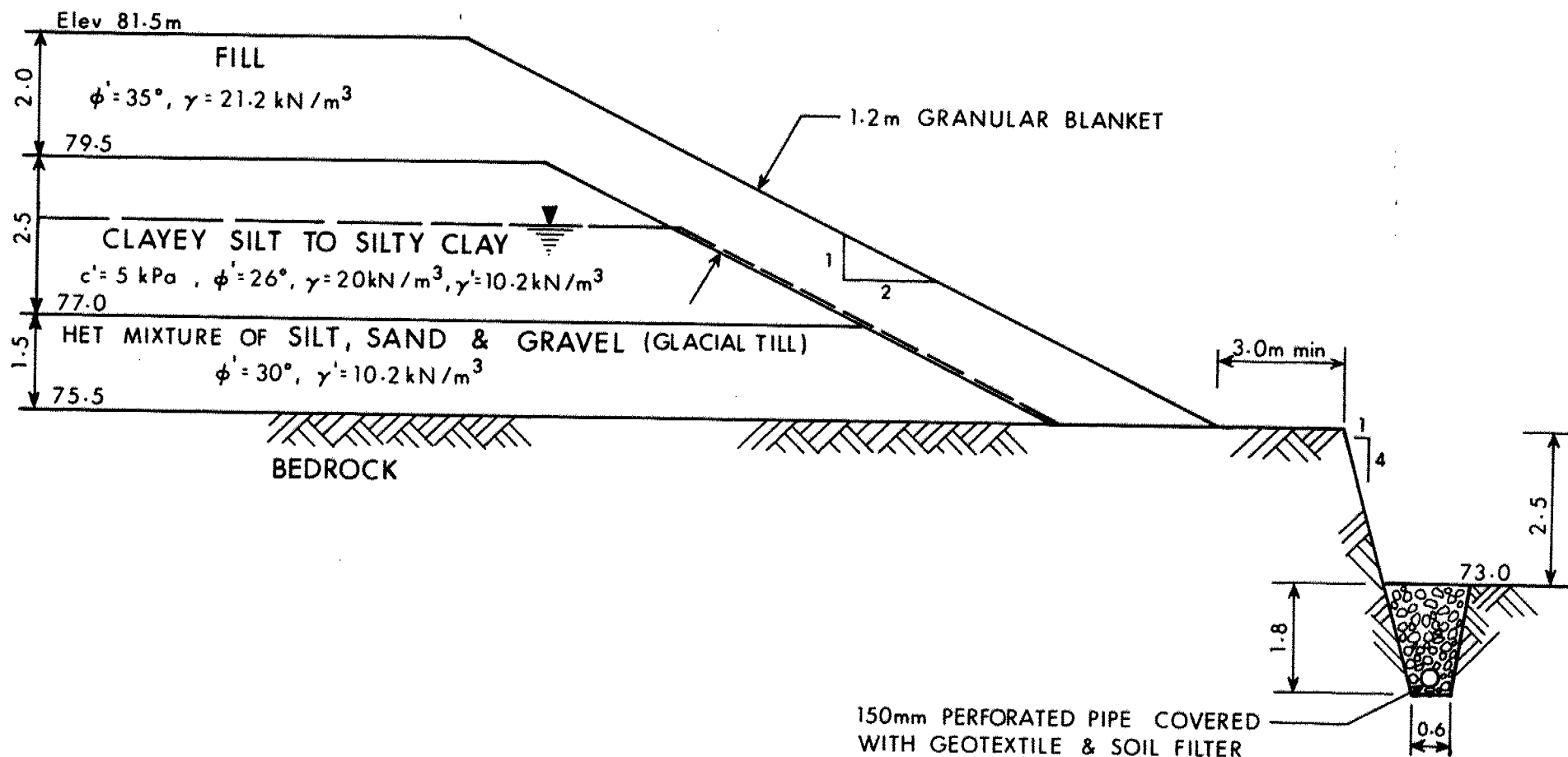
Ontario

Ministry of  
Transportation

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

FIG No 3

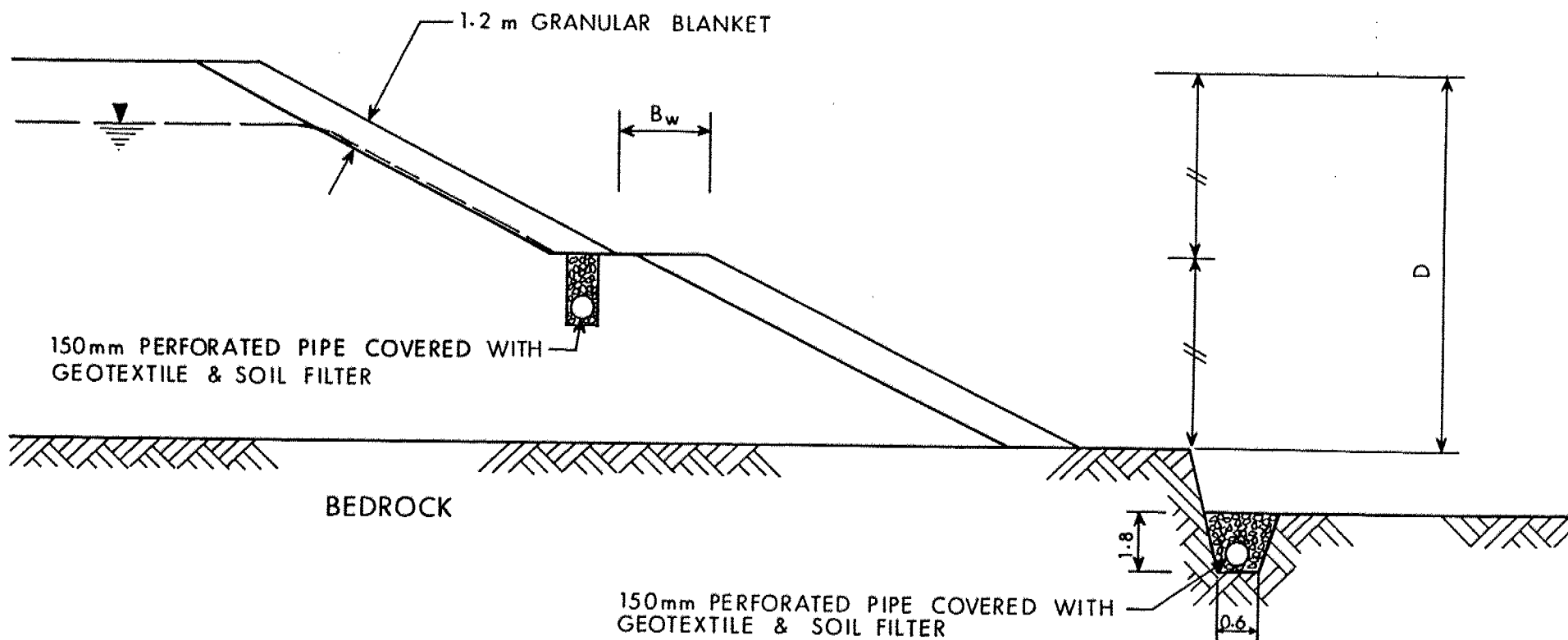
W P 127-87-02



BASELINE RD APPROACH

FIG 4

WP 127-87-02



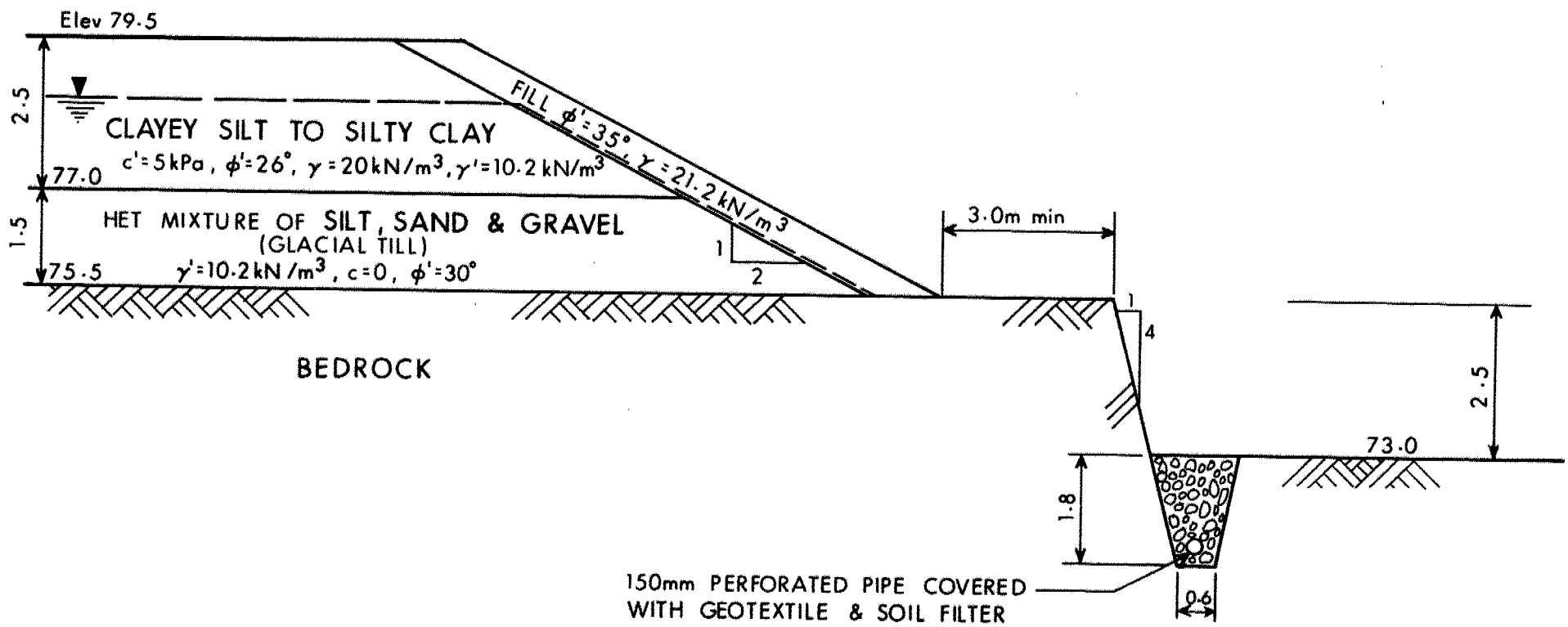
$B_w$  = BENCH WIDTH

$D$  = DEPTH OF CUT IN OVERBURDEN

## BENCH DESIGN

FIG 4A

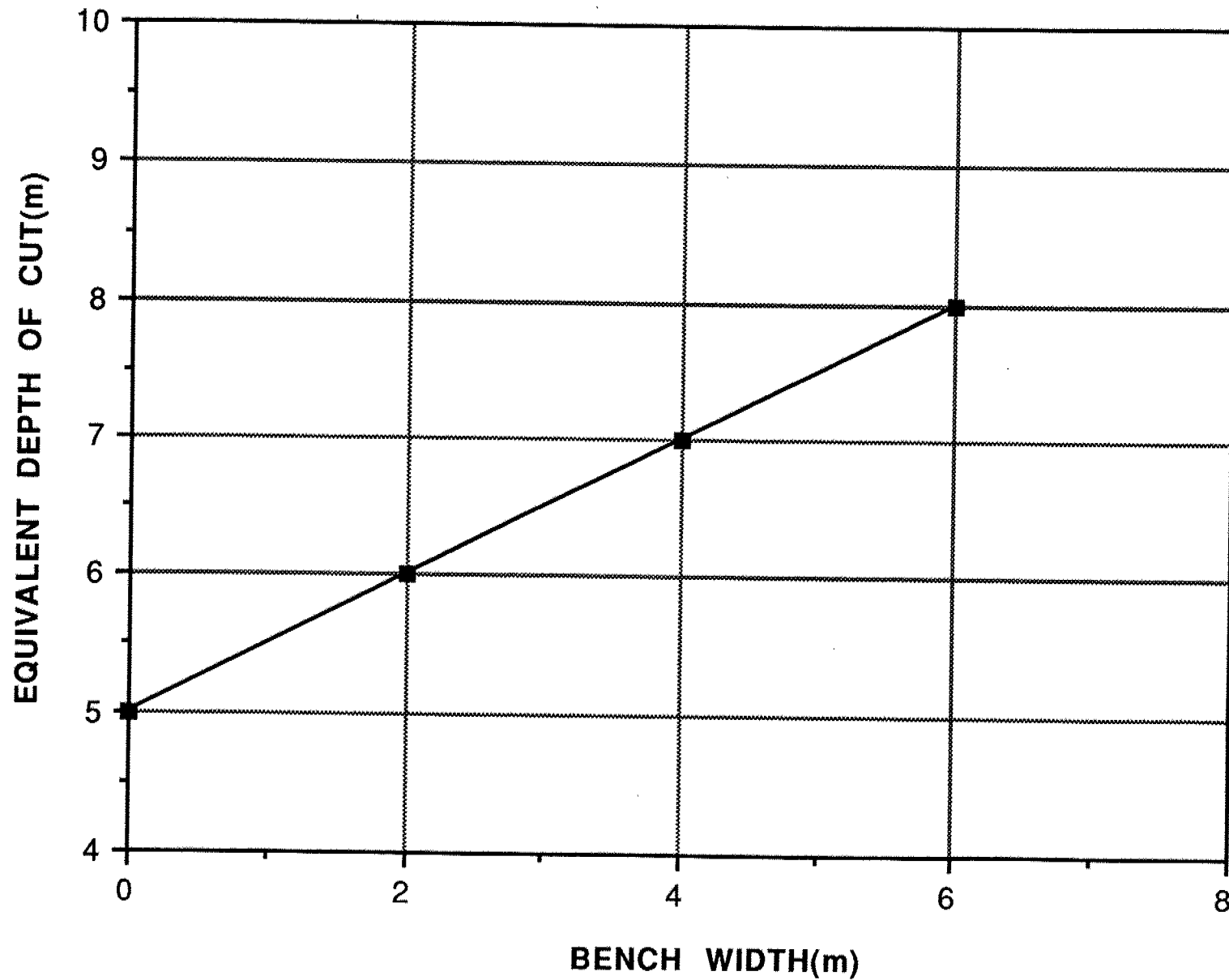
WP 127-87-02



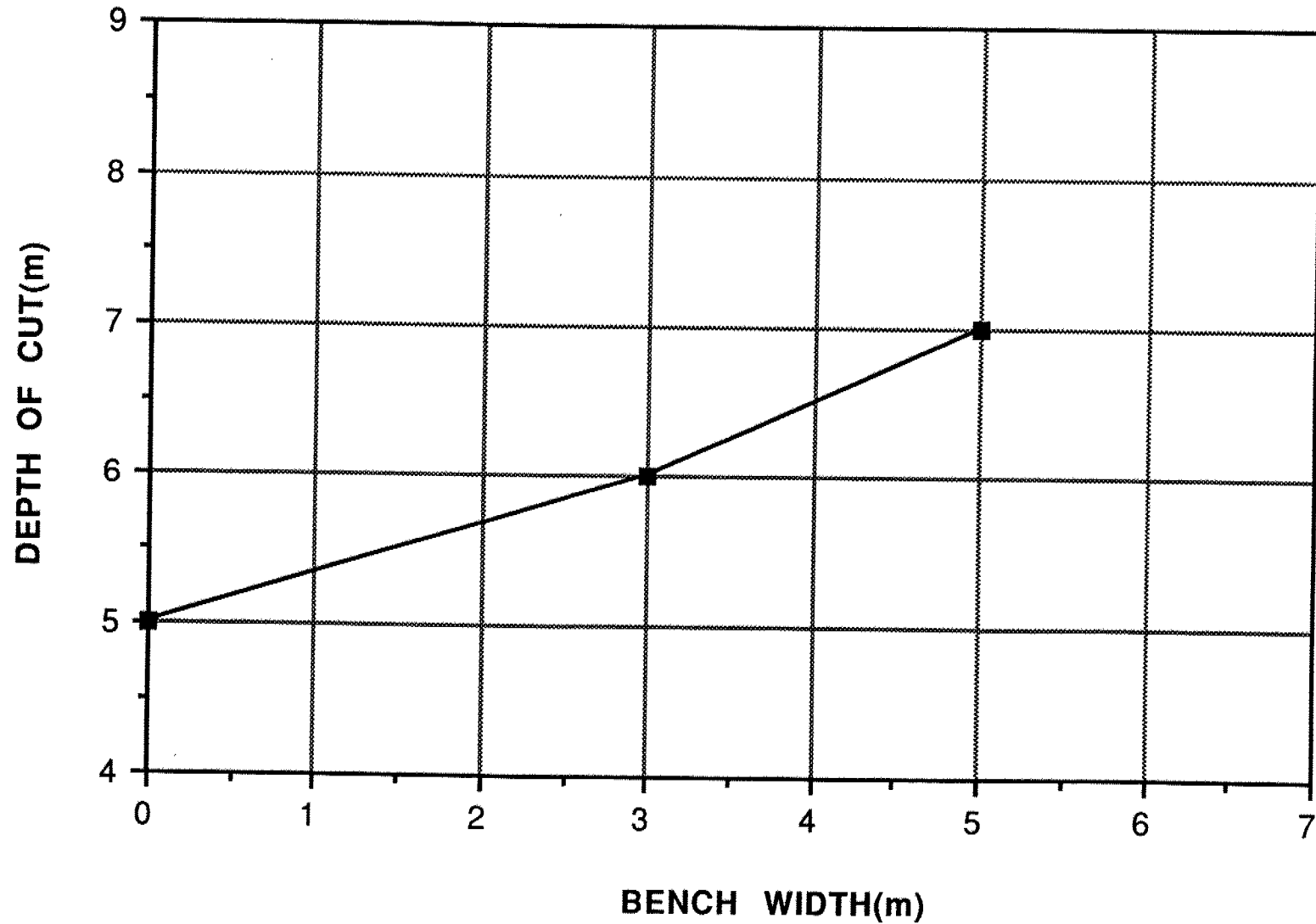
HWY 416 EXCAVATION CUT  
 SLOPE TREATMENT

FIG 5

**FIG. 6 - BASELINE RD APPROACH**



**FIG.7 - HIGHWAY 416 EXCAVATION CUT  
SLOPE TREATMENT**



# RECORD OF BOREHOLE No 9-1

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 510.2; E 358 841.5  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test  
 DATUM Geodetic DATE 89 08 02  
 ORIGINATED BY AL  
 COMPILED BY AL  
 CHECKED BY

SOIL PROFILE			- SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
79.4	Ground Surface													
0.0	Silty Clay to Clayey Silt Occ. Sand Seams Brown Grey		1	SS	7									
	Firm to Stiff		2	TW	PH									
76.4														
3.0	Het. Mixture of Silt, Sand & Gravel (Glacial Till)		3	SS	20									
75.3			4	SS	15/	15cm*								
4.1	Bedrock Sandstone with Interbedded Sandy Dolostone		5	BXL RC	REC 100%									
73.7	Sound, Unweathered													
5.7	End of Borehole *Sampler Bouncing													

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 9-2

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 465.8; E 358 861.4 ORIGINATED BY AL  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test COMPILED BY AL  
 DATUM Geodetic DATE 89 08 02 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
80.0	Ground Surface													
0.0	Silty Clay to Clayey Silt Some Sand, Occ. Sand Seams		1	TW	PH		79							
	Brown Grey		2	TW	PH		78						18.8	0 18 45 37
	Stiff													
77.0							77							
3.0	Het. Mixture of Silt, Sand & Gravel (Glacial Till)		3	TW	PH		76							
76.0							75							
4.0	Bedrock Sandstone with Interbedded Sandy Dolostone		4	BXL RC	REC 97%		74							RQD = 67%
	Sound, Unweathered		5	BXL RC	REC 100%		73							RQD = 80%
72.8			6	BXL RC	REC 100%		72							RQD = 100%
7.2	End of Borehole													

# RECORD OF BOREHOLE No 9-3

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 533.6; E 358 790.7  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test  
 DATUM Geodetic DATE 89 08 01  
 ORIGINATED BY AL  
 COMPILED BY AL  
 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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	20 40 60 80 100	20 40 60 80 100					
78.9 0.0	Ground Surface														
	Silty Clay to Clayey Silt		1	SS	8		78								
	Some Sand Occ. Sand Seams														
	Grey, Firm to Stiff		2	TW	PH		77								3 21 45 31
76.9 2.0	Het. Mixture of Silt, Sand & Gravel														
76.2 2.7	(Glacial Till)		3	SS	17/23cm*										
	Bedrock						76								
	Sandstone with Interbedded Sandy Dolostone		4	BXL RC	REC 82%										
	Sound,						75								RQD = 69%
74.3 4.6	Unweathered Dolostone														
	End of Borehole														
	*Sampler Bouncing														

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 9-4

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 487.9; E 358 813.4 ORIGINATED BY JW  
DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test COMPILED BY JW  
DATUM Geodetic DATE 89 08 03 CHECKED BY \_\_\_\_\_

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
79.9 0.0	Ground Surface										
	Silty Clay To Clayey Silt Some Sand, Occ. Sand Seams Grey, Firm to V. Stiff		1	SS	26		79				
			2	SS	5		78				
77.6 2.3	Het. Mixture of Silt, Sand & Gravel (Glacial Till)		3	SS	17		77			22.1	20 33 40 7
76.4 3.5	Bedrock Sandstone with Interbedded Sandy Dolostone		4	SS	14/25cm*		76	100/20cm			RQD = 58%
74.9 5.0	Sound, Unweathered End of Borehole *Sampler Bouncing		5	BXL RC	REC 100%		75				

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 9-5

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 557.0; E 358 741.7  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test  
 DATUM Geodetic DATE 89 08 01  
 ORIGINATED BY AL  
 COMPILED BY AL  
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
78.8	Ground Surface													
0.0	Silty Clay to Clayey Silt  Some Sand, Occ. Sand Seams  Grey, Firm to V. Stiff		1	SS	3		78							
76.5			2	TW	PH		77							8 38 33 21
2.3	Het. Mixture of Silt, Sand & Gravel  (Glacial Till)		3	SS	2		76							16 42 31 11
75.3			4	SS	4/27cm*									
3.5	Bedrock Sandstone with Interbedded Sandy Dolostone Sound, Unweathered		5	BXL RC	REC 97%		75							RQD = 90%
73.8							74							
5.0	End of Borehole  *Sampler Bouncing													

# RECORD OF BOREHOLE No 9-6

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 510.2; E 358 764.6 ORIGINATED BY JW  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test COMPILED BY TS  
 DATUM Geodetic DATE 89 08 02 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
79.4 0.0	Ground Surface													
	Silty Clay to Clayey Silt Some Sand, Occ. Sand Seams	Brown Grey	1	SS	6								17.6	0 20 45 35
			2	TW	PH									
76.4 3.0	Het. Mixture of Silt, Sand & Gravel (Glacial Till)		3	SS	1									
75.3 4.1	Limestone Bedrock Sound	Clay Seam	4	BXL RC	REC 98%									RQD = 27%
			5	BXL RC	REC 100%									RQD = 54%
			6	BXL RC	REC 83%									RQD = 17%
			7	BXL RC	REC 100%									RQD = 10%
72.0 7.4	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 9-7

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 423.0; E 358 881.0 ORIGINATED BY TS  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger & Cone Test COMPILED BY TS  
 DATUM Geodetic DATE 89 08 03 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)			
81.2 0.0	Ground Surface													
	Silty Clay to Clayey Silt		1	SS	9									
	Brown Grey		2	TW	PH									
	Some Sand, Occ. Sand Seams		3	TW	PH									
	Firm to V. Stiff		4	SS	1									
76.6 4.6	Het. Mixture of Silt, Sand & Gravel		5	SS	1									
75.5 5.7	(Glacial Till)		6	SS	85	25cm								
	End of Borehole Refusal to Auger (Probable Bedrock)													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 9-8

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 452.9; E 358 794.0 ORIGINATED BY JW  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger & Cone Test COMPILED BY JW  
 DATUM Geodetic DATE 89 08 03 CHECKED BY \_\_\_\_\_

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
80.7	Ground Surface											
0.0	Silty Clay to Clayey Silt Some Sand, Occ. Sand Seams  Brown Grey  Firm		1	SS	8							
78.6			2	SS	6							
2.1	Het. Mixture of Silt, Sand & Gravel  (Glacial Till)		3	SS	9							
77.2			4	SS	24/28cm*							20 30 40 10
3.5	End of Borehole Refusal to Auger (Probable Bedrock)  *Sampler Bouncing											

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 89-1

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 553.5; E 358 821.0 ORIGINATED BY SH  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger & Cone Test COMPILED BY JW  
 DATUM Geodetic DATE 89 04 06 CHECKED BY TCK

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
79.1	Ground Surface											
0.0	Silty Clay to Clayey Silt Some Sand Soft	Brown Grey	1	SS	2							1 19 45 35
76.2	End of Borehole Probable Bedrock or Boulders						120/18cm Refusal					

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 89-2

METRIC

W P 127-87-02 LOCATION Co-ords: N 5 021 600.0; E 358 800.0 ORIGINATED BY SH  
 DIST 9 HWY 416 BOREHOLE TYPE H S Auger, BW Casing, BXL Rock Core & Cone Test COMPILED BY JW  
 DATUM Geodetic DATE 89 04 05 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
78.3	Ground Surface										
0.0	Silty Clay to Clayey Silt Some Sand and Gravel	BROWN Grey	1	SS	100	5cm	78	120/8cm Refusal	100		9 27 53 11
76.4	Boulders		2	SS	50	5cm	77				1 29 46 24
1.9	Limestone Bedrock Sound		3	BXL RC	76% REC		76				RQD = 22%
74.4			4	BXL RC	86% REC		75				RQD = 34%
3.9	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

**ROCK CORE DESCRIPTION**  
**WP 127-87-02**

1.. / 2

CORE RECOVERY				CORE DESCRIPTION	
BH - RC #	DEPTH (m)	CR* (%)	RQD* (%)	DEPTH (m)	DESCRIPTION
9-1	5 4.14-5.69	100	92	4.14-5.69	SANDSTONE, with interbedded <b>SANDY DOLOSTONE</b> , light medium grey; medium to very fine grained; strong rock; unweathered; moderately close to close to close spaced fractures (avg 25-30cm spacing): horizontal, rough, clean.
9-2	4 4.01-4.78 5 4.78-6.53 6.53-7.19	97 100 100	67 80 100	4.01-7.19	SANDSTONE, with interbedded <b>SANDY DOLOSTONE</b> , light medium grey; medium to very fine grained; strong rock; unweathered; close spaced fractures (avg 10-15cm spacing): horizontal, rough, clean.
9-3	4 2.67-4.62	82	69	2.67-4.24 4.24-4.62	SANDSTONE, with interbedded <b>SANDY DOLOSTONE</b> , light medium grey; medium to very fine grained; strong rock; unweathered; close spaced fractures: horizontal, rough, clean; vertical irregular, stained. DOLOSTONE, grey to brown; very fine grained, slightly weathered; strong to medium strong rock; close spaced fractures: sub-vertical, planar, rough, stained.

\*CR = CORE RECOVERY (NOTE: Depths are approximated in zones of poor core recovery.)  
\*RQD = ROCK QUALITY DESIGNATION

Logged by: S. A. Senior, Soils and Aggregates Section.

**ROCK CORE DESCRIPTION**  
**WP 127-87-02**

2.. / 2

CORE RECOVERY				CORE DESCRIPTION	
BH - RC #	DEPTH (m)	CR* (%)	RQD* (%)	DEPTH (m)	DESCRIPTION
9-4	3.45-4.98	100	58	3.45-4.98	SANDSTONE, with interbedded <b>SANDY DOLOSTONE</b> , light medium grey; medium to very fine grained; strong rock; unweathered; very close to close spaced fractures (avg 5-8cm spacing): i) horizontal, rough, slightly coated; ii) vertical, open calcite filled - 120 cm length.
9-5	3.48-5.03	99	90	3.48-5.03	SANDSTONE, with interbedded <b>SANDY DOLOSTONE</b> , light medium grey; medium to very fine grained; strong rock; unweathered; moderately close to close to close spaced fractures (avg 30-35cm spacing): horizontal, rough, clean.
9-6	4.06-5.28 5.28-5.99 5.99-6.60 6.60-7.37	98 100 83 100	27 54 17 0	4.06-7.37	LIMESTONE, medium grey weathers yellow brown; fine grained, brecciated; medium strong to very weak rock; moderately to highly weathered, clay seam from 4.57-4.83 m; very close to close spaced fractures: horizontal to slightly inclined, vertical, very rough, open, calcite filled, clay stained.

\*CR = CORE RECOVERY (NOTE: Depths are approximated in zones of poor core recovery.)  
\*RQD = ROCK QUALITY DESIGNATION

Logged by: SAS, Soils and Aggregates Section.

## 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

S S	SPLIT SPOON	T P	THINWALL PISTON
WS	WASH SAMPLE	OS	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
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{v0}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

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

**METRIC**

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

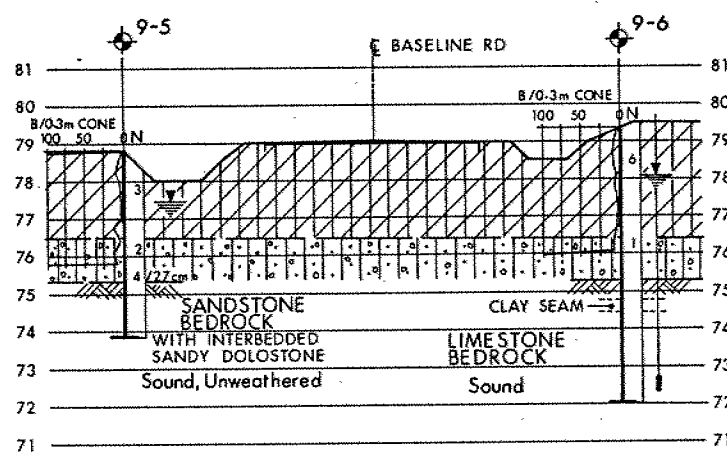
CONT No  
WP No 127-87-02

BASELINE RD UNDERPASS  
(STRUCTURE -9)

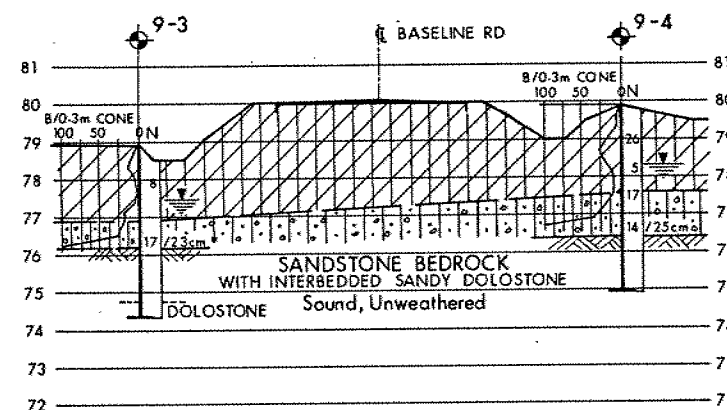
BORE HOLE LOCATIONS & SOIL STRATA



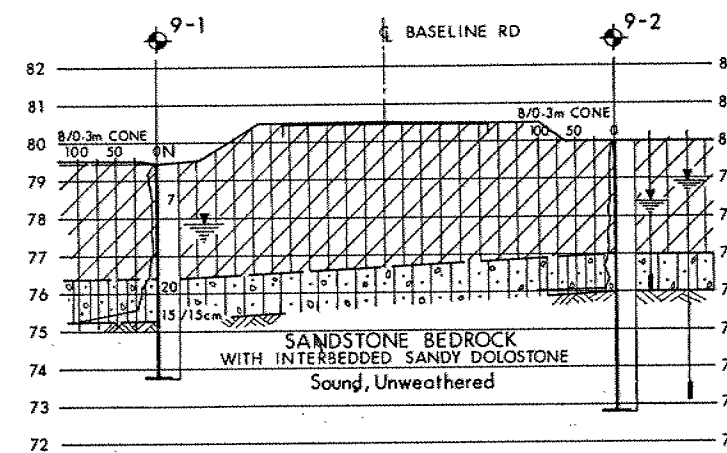
SHEET



A-A

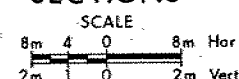


B-B

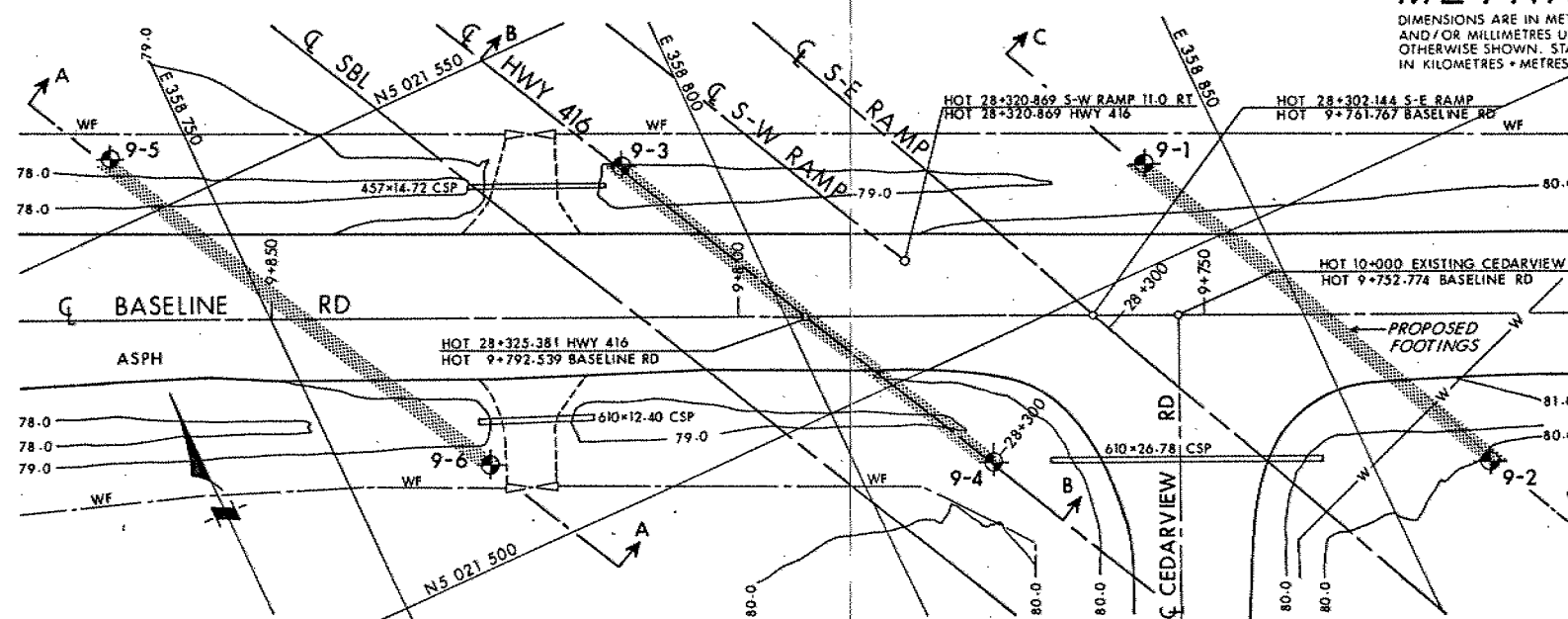
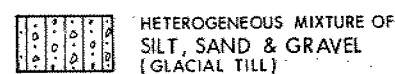
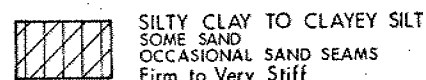


C-C

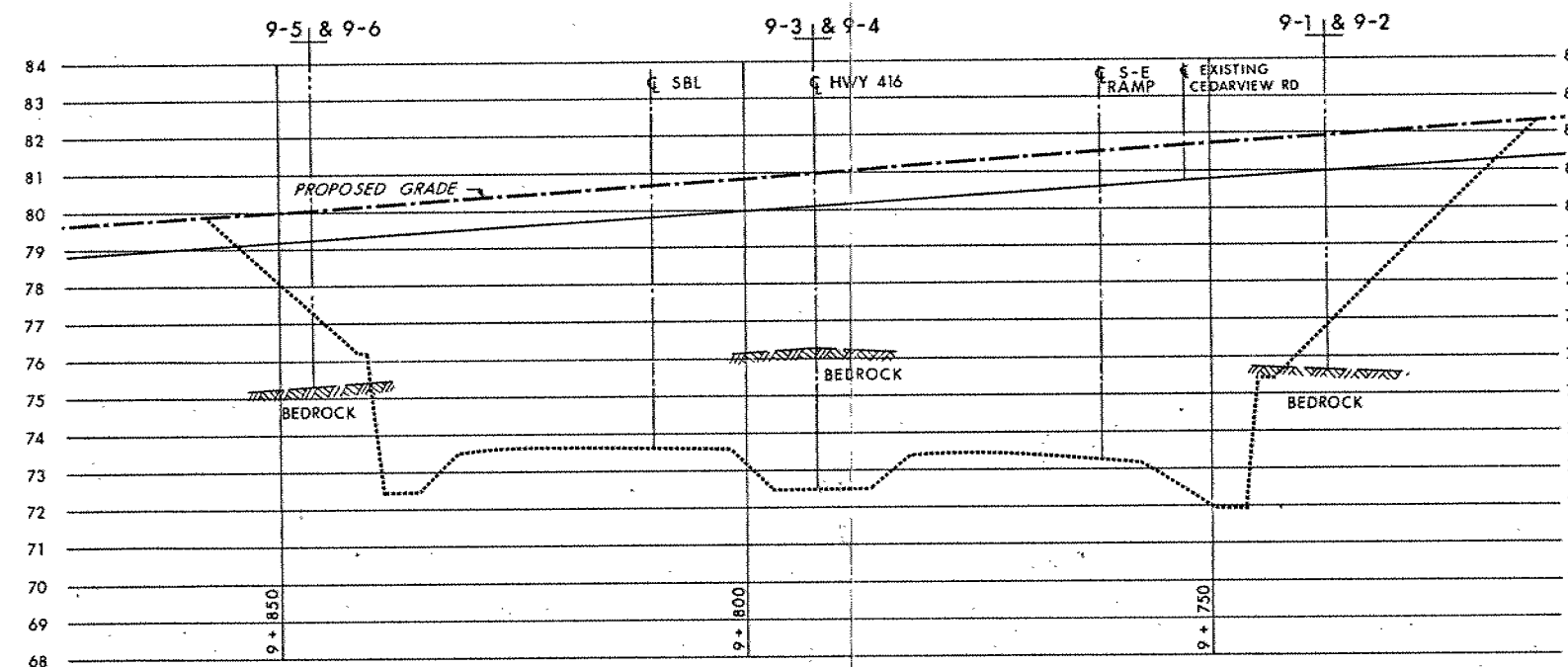
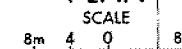
**SECTIONS**



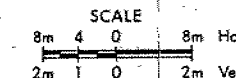
**SOIL STRATIGRAPHY LEGEND**



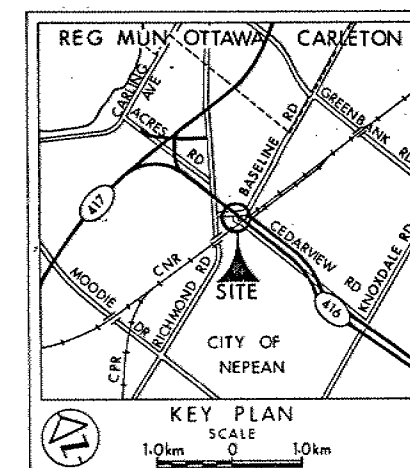
**PLAN**



**PROFILE BASELINE RD**



\* BH's ADVANCED IN CONJUNCTION  
WITH HWY 416 APPROACH EXCAVATION  
(NOT SHOWN ON PLAN)  
FOR SUBSOIL INFORMATION REFER TO  
RECORD OF BOREHOLE SHEETS.



**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 89 08
- W.L. in Piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
9-1	79.4	5 021 510.2	358 841.5
9-2	80.0	5 021 465.8	358 861.4
9-3	78.9	5 021 533.6	358 790.7
9-4	79.9	5 021 487.9	358 813.4
9-5	78.8	5 021 557.0	358 741.7
9-6	79.4	5 021 510.2	358 764.6
9-7	81.2	5 021 423.0	358 881.0
9-8	80.7	5 021 452.9	358 794.0
89-1	79.1	5 021 553.5	358 821.0
89-2	78.3	5 021 600.0	358 800.0

**NOTE**

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

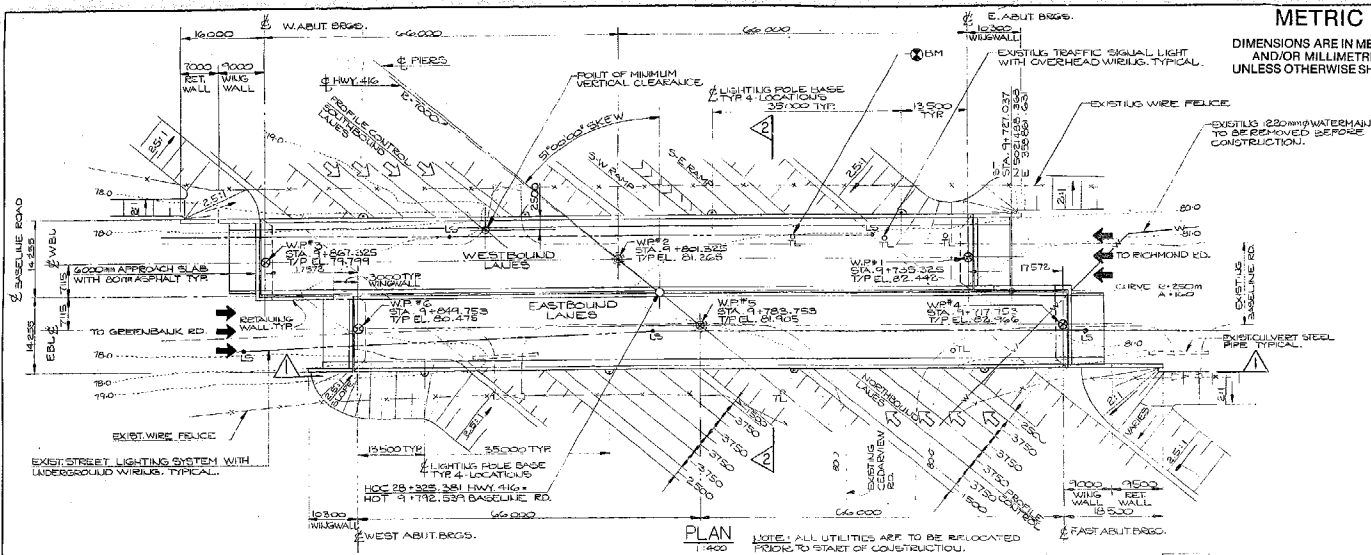
NOTE: The complete foundation investigation and design report for  
this project and other related documents may be examined at the  
Engineering Materials Office, Downsview. Information contained in  
this report and related documents is specifically excluded in  
accordance with the conditions of Section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

REV	DATE	BY	DESCRIPTION
1			

Geacres No 31G5-166

HWY No 416	DIST 9
SUBMITTAL CHECKED	DATE 89 10 11
DRAWN DT	CHECKED

Site 3-543  
DWG 1278702-A



# METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST. 9 HWY. 416

COMP No  
WP No 127-87-02

BASELINE ROAD UNDERPASS  
STRUCTURE NO. 9  
GENERAL ARRANGEMENT

CS COLE  
SI HERMAN  
CONSULTING ENGINEERS



SHEET

## GENERAL NOTES

### Class of Concrete

Deck 35 MPa  
Piers 35 MPa  
Remainder 30 MPa

### Clear Cover to Reinforcing Steel

Footings 100 ± 25

### Abutments, wingwalls

• Front Face 80 ± 20  
• Back Face 70 ± 20

### Piers

80 ± 20

### Deck

• Top of Top Slab 70 ± 20  
• Bottom of Top Slab 40 ± 10  
• Bottom of Top Slab 50 ± 10  
• Web 60 ± 10

Remainder Unless Otherwise Specified 70 ± 20

### Reinforcing Steel

Reinforcing steel shall be grade 400 unless otherwise specified. Bar marks with suffix 'C' denote coated bars.

### CONSTRUCTION NOTES

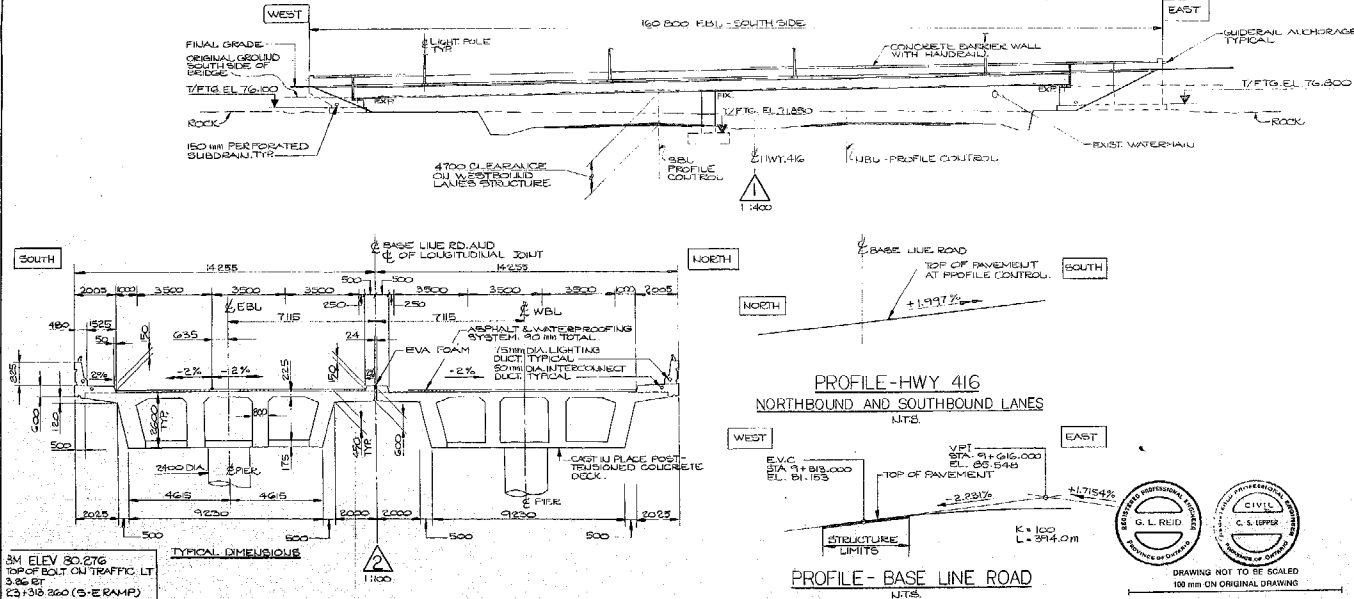
The contractor shall establish the bearing seat elevations by deducting the natural bearing thicknesses from the top of bearing elevations. If the actual bearing thicknesses are different from those given, with the bearing design data, the contractor shall adjust the reinforcing steel as suit.

Concrete barrier walls on retaining walls shall not be cast until the retaining wall backfill has been completed.

- W.P. denotes Working Point
- T.P. denotes Top of Pavement
- E.N.L. denotes Eastbound Lanes
- W.B.L. denotes Westbound Lanes
- T.P.T.G. denotes Top of Footing

### List of Drawings

1P General Arrangement



## APPLICABLE STANDARD DRAWINGS

CPSD 350.0 MILLIGRANULAR BACKFILL REQUIREMENTS



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
1992-10-15	J. D. L.	DESIGN OF BRIDGE UNDERPASS - BASELINE ROAD CLASS AND STRUCTURE NO. 9
1992-10-15	J. D. L.	DATE 3-5-93 REVISION 100% 1P

3M ELEV 80.276  
TOP OF BOLT ON TRAFFIC LT  
3.065  
E2130 260 (S-E RAMP)