

GEOCRES No. 30M5-141

DIST. 4 REGION

W.P. No.

CONT. No.

W. O. No. 82-26025

STR. SITE No.

HWY. No. GO-ALRT

LOCATION Fourteen mile Creek Bridge

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



C311

January 26, 1984

Ministry of Transportation and Communications
Pavement and Foundation Design Section
Room 315 Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Attention: Mr. K.G. Selby, P.Eng.,
Senior Foundations Engineer

Dear Sirs:

Re: Foundation Investigation
14-Mile Creek Bridge
W.O. 82-26025 District 4

In accordance with our agreement, we hereby submit a summary of the results of the foundation investigation together with advanced foundation recommendations for the above project.

The site is located at Fourteen Mile Creek, about 40 m north of the CNR tracks and about 320 m east of the Third Line in Oakville. The field work consisted of eight boreholes and was carried out in the period of January 5 to 11, 1984.

The ground level at the location of the structure varies between elevations 97 and 100. The subsurface conditions consist of shale bedrock at or near the ground surface with a weathered zone extending to depths between about 700 and 1900 mm at corresponding elevations varying between 95 and 98.

The groundwater level is at about 96.5, close to the water level of Fourteen Mile Creek.

Design Recommendations

The structure may be founded on spread footings in sound bedrock using a factored bearing capacity of 1500 kPa at ultimate limit states. Bearing capacity at serviceability limit states, Type II, does not govern.

Lateral resistance may be computed using a friction coefficient of 0.25 between the footing and rock. If required, further lateral resistance may be obtained from keying into the rock or by the provision of dowels.

Total and differential settlements in the structure are considered to be negligible.

Backfill behind abutments and retaining walls should consist of granular material and earth pressures acting on the walls should be computed in accordance with Section 6.6.1.2.1 of the O.H.B.D.C. It should be assumed that the foundation is non-yielding, so that "at rest" (K_0) conditions apply. For Granular A or Granular B backfill, $\phi = 35^\circ$ and $\gamma = 22.0 \text{ kN/m}^3$ or $\phi = 30^\circ$ and $\gamma = 21.2 \text{ kN/m}^3$ may be used respectively. Where the nature of the backfill, and therefore its properties, is not known in advance, earth pressures may be determined in accordance with Section 6.6.1.2.2 of the O.H.B.D.C.

Embankments with side slopes of 1 vertical to 2 horizontal should be stable for this site provided that soft clayey and/or organic soil, which may locally exist to depths of the order of 450 mm, be stripped.

General Recommendations

The minimum cover for frost protection is 1.2 m.

Upon exposure of the bearing level for foundations, all soft or loose material should be removed and the final bearing level should be protected from deterioration by a cover of 150 mm of mass concrete.

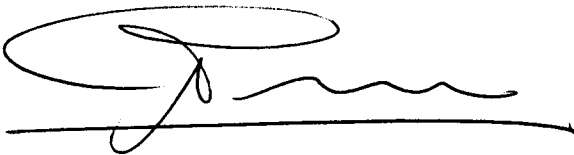
Excavations for foundations will intersect the groundwater level but dewatering problems are not anticipated. Normal pumping from sumps should suffice.

Blasting in rock is not considered necessary and, in any event, not recommended in view of the proximity of the CNR tracks. Normal excavation equipment should suffice but ripper teeth are probably required and the need for occasional pneumatic rock shattering should be anticipated.

We trust that this letter contains sufficient information to proceed with the design. Our final report will be submitted at the earliest possible time.

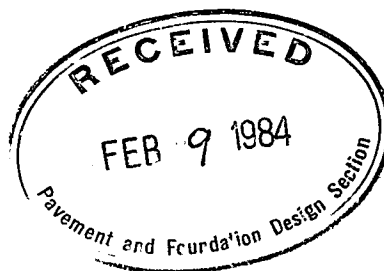
Yours very truly,

L.J. RAK ENGINEERING LTD.

A handwritten signature in black ink, consisting of a large, stylized 'A' followed by a series of wavy lines, all underlined.

A. Prior, P.Eng.

AP/mk



OAKVILLE-HAMILTON SECTION
ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WO 82-26025 DIST 4
HWY GO-ALRT STR SITE
Oakville Project-West Extension
Fourteen Mile Creek Bridge

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GEOCRE 3015-141

DATE 84-02-14

Geotechnical and materials testing services

FOUNDATION INVESTIGATION REPORT
FOR
WO 82-26025, Site
District 4, Hamilton
GO-ALRT, West Extension, Oakville Project
Fourteen Mile Creek Bridge

1.0 INTRODUCTION

This report summarizes the results of the foundation investigation for the proposed bridge structure.

The field work was carried out in the period of January 5 to 11, 1984 and consisted of eight boreholes drilled with a CME 75 trackmounted drilling machine supplied and operated by Atcost Soil Drilling Inc.

Elevations referred to in this report are related to Benchmark #679 (elevation 104.241 m), located 62.2 m left of Station 14+768.500 on the GO-ALRT centreline.

2.0 SITE DESCRIPTION

The proposed bridge structure extends approximately between Sta's 14+420 and 14+475 on GO-ALRT and is located in the Ontario Hydro right-of-way at 14 Mile Creek, about 40 m north of the C.N.R. tracks and about 320 m east of the Third Line in Oakville. This area is part of the physiographic region known as the Iroquois Plain which extends between the present shoreline of Lake Ontario and the previous shoreline of Lake Iroquois. The characteristic surficial deposits in the general area consist of cohesive glacial till and/or residual (weathered) bedrock of variable and generally shallow thickness. The overburden rests on reddish-brown shale bedrock of the Queenston Formation.

2.0 SITE DESCRIPTION (Continued)

Fourteen Mile Creek has cut a shallow valley through this area with a relatively flat western slope and a steeper (about 1 vertical to 5.5 horizontal) eastern slope. An eastern branch of the creek joins the main channel at the site of the proposed bridge. The site was snow covered at the time of the investigation, making identification of surficial features difficult. It would appear, however, that the eastern branch of the creek was man made. Shale bedrock is exposed in both channels and their banks.

Land use in the general area is light industrial/commercial.

3.0 SUBSURFACE CONDITIONS

3.1 General

The Record of Borehole Sheets show the subsurface conditions at the borehole locations. The locations and elevations of the boreholes and stratigraphical profiles based on the borehole data are shown on the Borehole Locations and Soil Strata Drawing which together with the Record of Borehole Sheets are appended to this report.

Bedrock was encountered at the ground surface at the location of each borehole.

3.2 Bedrock

The bedrock is of the Queenston Formation and consists of reddish-brown thinly, horizontally or nearly horizontally, bedded fine grained calcareous sandy shale interbedded with thin bands of light brown to grey shale and very thinly laminated fine grained

3.0 SUBSURFACE CONDITIONS (Continued)

calcareous sandstone. The sandstone bands are on the average 400 to 900 mm apart and of the order of 25 to 50 mm in thickness. The shale can be easily scratched by finger nail and the sandstone is easily scratched by pen knife. Both materials are easily broken by hammer.

The upper part of the shale is weathered to depths ranging from 700 to 1900 mm and locally severely weathered to depths of the order of 500 to 1000 mm. The original structure of the severely weathered shale is difficult to recognize and has been reduced to silty clay of low to medium plasticity mixed with shale fragments, some sand and gravel.

Sound shale was encountered at depths ranging from 700 to 1900 mm, at corresponding elevations ranging from 98.4 to 95.2, and core-drilled at all boreholes. Overall core recoveries were generally 100% indicating that the bedrock is sound. R.Q.D.'s ranged from 14% to 82% with a median value of 61% indicating the rock to be of very poor to good and, on the average, of fair quality.

It should be noted that mud seams were encountered in Boreholes 2 and 5 and probable mud seams in Boreholes 6 and 8, occurring within the upper metre of the sound portion of the bedrock. The mud seams appear to be about 10 to 40 mm in thickness. Their approximate elevation is indicated on the Record of Borehole Sheets.

3.3 Groundwater

Piezometers were installed in Boreholes 2, 4, 5 and 8 and the groundwater level in the piezometers as well as in the other (open) boreholes was monitored throughout the period of the field work. Final readings were taken on January 16, 1984 and

3.0 SUBSURFACE CONDITIONS (Continued)

these readings are shown on the borehole logs and on the stratigraphic profiles. On the basis of these observations it is concluded that the groundwater level at the site, at the time of the investigation, was at about elevation 96.5, i.e. at or close to the water level in Fourteen Mile Creek at the crossing.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

The proposed bridge is understood to be a single, 13 m span, simply supported structure carrying the GO-ALRT tracks over Fourteen Mile Creek which will be re-channelled at this location. The elevation of the finished creek bed at the crossing will be at about elevation 95.3 and the top of rail is to be at elevation 103.870.

4.2 General Foundation Design Considerations

The structure and its retaining walls may be founded on footings in the shale bedrock. Footings should be placed below the depth of frost influence, i.e. not higher than about 1200 mm below final grade. A further limiting factor in the determination of founding elevations is the possibility of scour at the abutment footings. The latter consideration is subject to the results of a hydrological study which is outside the scope of this report.

4.0 DISCUSSION AND RECOMMENDATIONS (Continued)

Based on the current conceptual design, it would appear that the footings for the abutments would be placed at or below about elevation 93.8. The founding elevations for the retaining walls are, in terms of frost protection requirements, influenced by the final grading in the area of the approach embankments. On the basis of the present topography of the general area, it is considered that the founding elevation of the footings for the western retaining walls would probably be of the order of 95 over the full length of the wall. At the eastern approach the current topography suggests that footing levels could rise gradually from about elevation 95 to 97 along the length of the wall in an eastern direction.

4.3 Foundation Recommendations

The founding conditions at the locations of the abutments may be judged on the basis of the results of Boreholes 2 and 6 for the east abutment and of Boreholes 3 and 7 for the west abutment. In Boreholes 3 and 7, sound shale bedrock occurs below about elevation 95.2. In Boreholes 2 and 6 sound shale bedrock was encountered below about elevation 95.4 and 96.3 respectively. It is therefore concluded that the probable founding level for the abutments (at or below elevation 93.8) is well within sound bedrock.

The founding conditions at the locations of the western retaining walls may be judged on the basis of the results of Boreholes 3, 4, 7 and 8. The lowest elevation where sound bedrock commenced in any of these four boreholes was elevation 95.2. It is therefore probable that the anticipated founding level of elevation 95 will be wholly in sound rock.

4.0 DISCUSSION AND RECOMMENDATIONS (Continued)

In the area of the eastern retaining walls (Boreholes 1, 2, 5 and 6) the lowest elevation of sound bedrock appears to be at about elevation 95.4 at Borehole 2 rising to 96.3 at Borehole 6 and 96.8 and 98.3 at Boreholes 1 and 5 respectively. Consequently the anticipated founding levels between elevations 95 and 97 would seem to be generally in sound rock.

It is recommended that all footings be founded in sound shale bedrock at a factored bearing capacity at ultimate limit states of 1500 kPa. As far as the bearing capacity at serviceability limit states is concerned, the design of the foundations is not governed by settlement as the loading required to cause detrimental settlement of the structure will be much larger than 1500 kPa.

Total and differential settlements in the structure are considered to be negligible.

4.4 Lateral Pressures

Backfill behind abutments and retaining walls should consist of granular material and earth pressures acting on the walls should be computed in accordance with Section 6.6.1.2.1 of the O.H.B.D.C. It should be assumed that the foundation is non-yielding, so that "at rest" (K_0) conditions apply. For Granular A or Granular B backfill, $\phi = 35^\circ$ and $\gamma = 22.0 \text{ kN/m}^3$ or $\phi = 30^\circ$ and $\gamma = 21.2 \text{ kN/m}^3$ may be used respectively. Where the nature of the backfill, and therefore its properties, is not known in advance, earth pressures may be determined in accordance with Section 6.6.1.2.2 of the O.H.B.D.C.

4.0 DISCUSSION AND RECOMMENDATIONS (Continued)

4.5 Stability

The lateral resistance of the foundation to sliding may be computed using a friction coefficient of 0.25 between the footing and the bedrock. If required, further lateral resistance may be obtained from keying into the rock or by the provision of dowels.

4.6 Scour Protection

The proposed level of the creek bottom is at elevation 95.3. This level is well within the rock and, on the basis of the results of the boreholes, generally below the weathered part of the rock. Although scour protection requirements appear to be minimal, they should be properly evaluated from a hydrological study which is outside the scope of this report.

4.7 Construction

The present eastern channel of Fourteen Mile Creek can readily be diverted into the western channel so that the main structure can be built without impeding the main flow. At the time of this investigation, groundwater was present in the shale at about elevation 96 to 96.5. As there is no reason to assume that the groundwater regime in the area is subject to significant changes, it can be anticipated that excavations will intersect groundwater. However, this is not expected to cause unusual construction problems.

It should be noted however that the sound shale, when allowed to become wet upon exposure, will quickly begin to disintegrate to the extent that the bearing capacity can be seriously affected

4.0 DISCUSSION AND RECOMMENDATIONS (Continued)

or destroyed. It is therefore recommended that excavations be dewatered as required. Upon exposure of the founding level, all soft or loose material should be removed and the final bearing level should be protected from deterioration by a cover of 150 mm of mass concrete.

On the basis of the core recovered from the boreholes it is our opinion that the rock can be removed with normal excavating equipment, but it is probably necessary to use ripper teeth. Blasting is unlikely to be required and, in any event, not recommended in view of the proximity of the CNR tracks.

4.8 Embankments

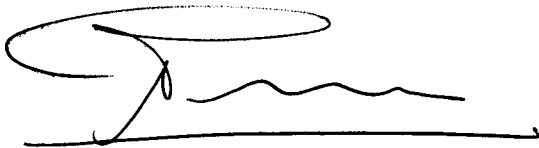
The maximum height of the approach embankments appears to be of the order of 7 m in the vicinity of the structure. The surficial weathered rock in the area is generally clayey and locally soft and compressible and/or organic to depths of the order of 500 mm. It is recommended that such materials be stripped to depths below which the natural soil or weathered rock has at least a stiff consistency, i.e. an in-situ shear strength of not less than 100 kPa. This requirement is important and its object is to remove weak horizontal planes which, at shallow depths, can create potential slip surfaces. The natural soil or weathered rock, when at least of stiff consistency is suitable for the support of embankments with normal side slopes of 1 vertical to 2 horizontal.

5.0 MISCELLANEOUS

The field work for this investigation was carried out under the direction of Mr. G. Niculae, P.Eng. The report was prepared under the guidance of Mr. A. Prior, P.Eng.

Submitted by

L.J. RAK ENGINEERING LTD.

A handwritten signature in black ink, featuring a large, stylized initial 'A' followed by a series of wavy lines and a horizontal stroke at the bottom.

A. Prior, P.Eng.

AP/mk

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:

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'_{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						



Ministry of
Transportation and
Communications

RECORD OF BOREHOLE No 101

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 986.5 E 287 236.5 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 09 CHECKED BY AP

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	SHEAR STRENGTH					
98.35	Ground Surface		1	SS	4								
0.00	Shale Bedrock Queenston Formation		2	SS	11								
	weathered sound		3	SS	112/	125mm							
			4	RC BXL	REC 93% RQD 60%								
			5	RC BXL	REC 92% RQD 62%								
			6	RC BXL	REC 100% RQD 46%								
92.48	End of Borehole												
5.87	* severely weathered to ± 800 mm												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



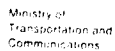
Ministry of
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Ontario

RECORD OF BOREHOLE No 102

METRIC



W O 82-26025 LOCATION Co-ords N 4 808 973.5 E 287 227.0 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 06 CHECKED BY AP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
96.77	Ground Surface		1	SS	3								
0.00	Shale Bedrock Queenston Formation		2	SS	1067	150mm	96						
	weathered sound		3	AS	—		95						
			4	RC BXL	REC 100% RQD 53%		94						
			5	RC BXL	REC 95% RQD 56%		93						
			6	RC BXL	REC 100% RQD 77%		92						
90.52							91						
6.25	End of Borehole						90						
	* severely weathered to ± 500 mm												
	** mud seam ± 25 mm												



METRIC

W O	82-26025	LOCATION	Co-ords N 4 808 962.5 E 287 218.5	ORIGINATED BY	GN
DIST	4 HWY GO-ALRT	BOREHOLE TYPE	Solid Stem Auger, BXL Core	COMPILED BY	AP
DATUM	Geodetic	DATE	84 01 05-06	CHECKED BY	AP

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								
								SHEAR STRENGTH							WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
96.72	Ground Surface															
0.00	Shale Bedrock Queenston Formation		1	SS	54	 125mm 150mm	96									
	weathered sound		2	SS	94/		95									
			3	SS	93/		94									
			4	RC BXL	REC 100% RQD 63%		93									
			5	RC BXL	REC 100% RQD 29%		92									
			6	RC BXL	REC 95% RQD 47%		91									
90.32																
6.40	End of Borehole						90									

+3, x5: Numbers refer to Sensitivity



Ministry of
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Communications
Ontario

RECORD OF BOREHOLE No 104

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 948.5 E 287 208.0 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 05 CHECKED BY AP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
96.76	Ground Surface		1	SS	57								
0.00	Shale Bedrock		2	SS	92	125mm	96						
	weathered												
	sound												
	Queenston Formation		3	RC BXL	REC 100% RQD 42%		95						
			4	RC BXL	REC 100% RQD 14%		94						
92.80							93						
3.96	End of Borehole						92						

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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Transportation and
Communications

RECORD OF BOREHOLE No 105

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 987.5 E 287 222.0 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 09-10 CHECKED BY AP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			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	W _p W W _L	PLASTIC LIMIT	LIQUID LIMIT	WATER CONTENT (%)		
100.18	Ground Surface		1	SS	19		100							
0.00	Shale Bedrock Queenston Formation	*	2	SS	12		99							
	weathered sound		3	SS	102		98							
	**		4	RC BXL	REC 100% RQD 65%		97							
			5	RC BXL	REC 100% RQD 82%		96							
			6	RC BXL	REC 100% RQD 73%		95							
93.63	End of Borehole						94							
6.55	* severely weathered to ± 1000 mm ** mud seam ± 10 mm						93							

RECORD OF BOREHOLE No 106

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 974.5 E 287 212.5 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 10 CHECKED BY AP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			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	W _p W W _L	PLASTIC LIMIT	NATURAL MOISTURE CONTENT		
97.99	Ground Surface												
0.00	Shale Bedrock Queenston Formation	*	1	SS	8								
			2	SS	90/	125mm							
	weathered sound												
	**		3	RC BXL	REC 100% RQD 63%								
			4	RC BXL	REC 100% RQD 62%								
			5	RC BXL	REC 100% RQD 78%								
91.13			6	RC BXL	100% 67%								
6.86	End of Borehole												
	* severely weathered to ± 600 mm												
	** probable mud seam ± 25 mm												



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RECORD OF BOREHOLE No 107

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 963.5 E 287 204.0 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 11 CHECKED BY AP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
96.97	Ground Surface		1	SS	5								
0.00	Shale Bedrock Queenston Formation		2	SS	90 / 125mm								
	weathered sound		3	RC BXL	REC 100% RQD 55%								
			4	RC BXL	REC 100% RQD 50%								
			5	RC BXL	REC 90% RQD 63%								
90.72													
6.25	End of Borehole * severely weathered to ± 500 mm												

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No 108

METRIC

W O 82-26025 LOCATION Co-ords N 4 808 950.0 E 287 194.0 ORIGINATED BY GN
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY AP
DATUM Geodetic DATE 84 01 11 CHECKED BY AP

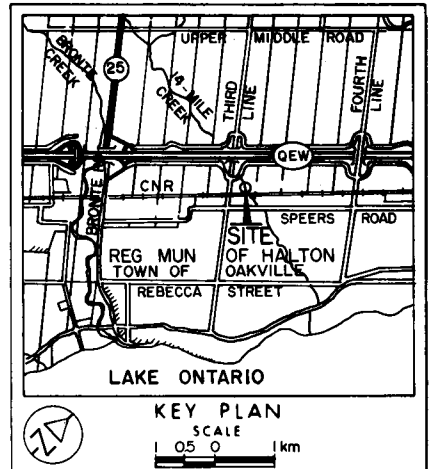
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
96.98	Ground Surface		1	SS	15								
0.00	Shale Bedrock Queenston Formation		2	SS	80	100mm	96						
	weathered sound		3	RC BXL	REC 88% RQD 48%		95						
	**		4	RC BXL	REC 100% RQD 28%		94						
			5	RC BXL	REC 87% RQD 65%		93						
90.88	End of Borehole						92						
6.10	* severely weathered to ± 500 mm						91						
	** probable mud seam ± 10 mm						90						

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

METRIC

ALL DIMENSIONS SHOWN ARE
IN METRES AND/OR MILLI-
METRES UNLESS OTHERWISE
NOTED.



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 8401
- ▬ Piezometer

No	ELEVATION	CO ORDINATES NORTH	EAST
101	98.35	4 808 986.5	287 236.5
102	96.77	4 808 973.5	287 227.0
103	96.72	4 808 962.5	287 213.5
104	96.76	4 808 948.5	287 208.0
105	100.18	4 808 987.5	287 222.0
106	97.99	4 808 974.5	287 212.5
107	96.97	4 808 963.5	287 204.0
108	96.98	4 808 950.0	287 194.0

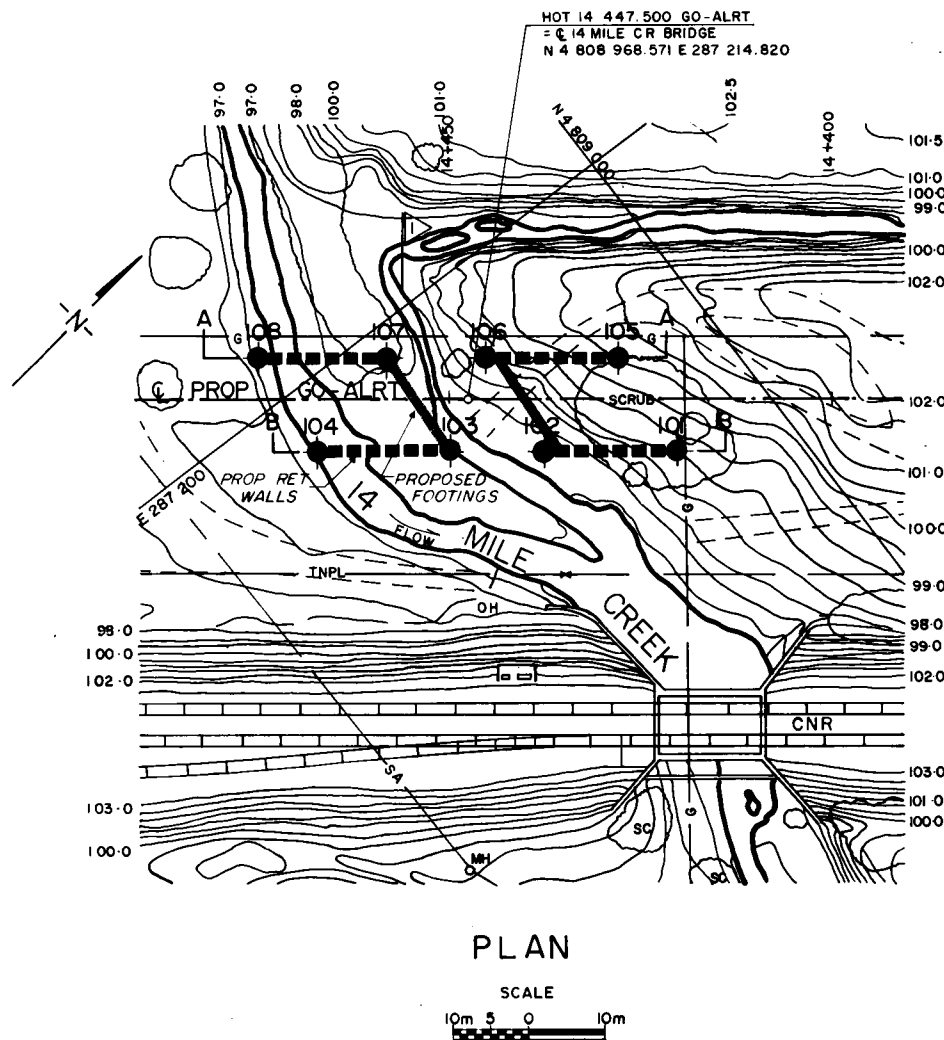
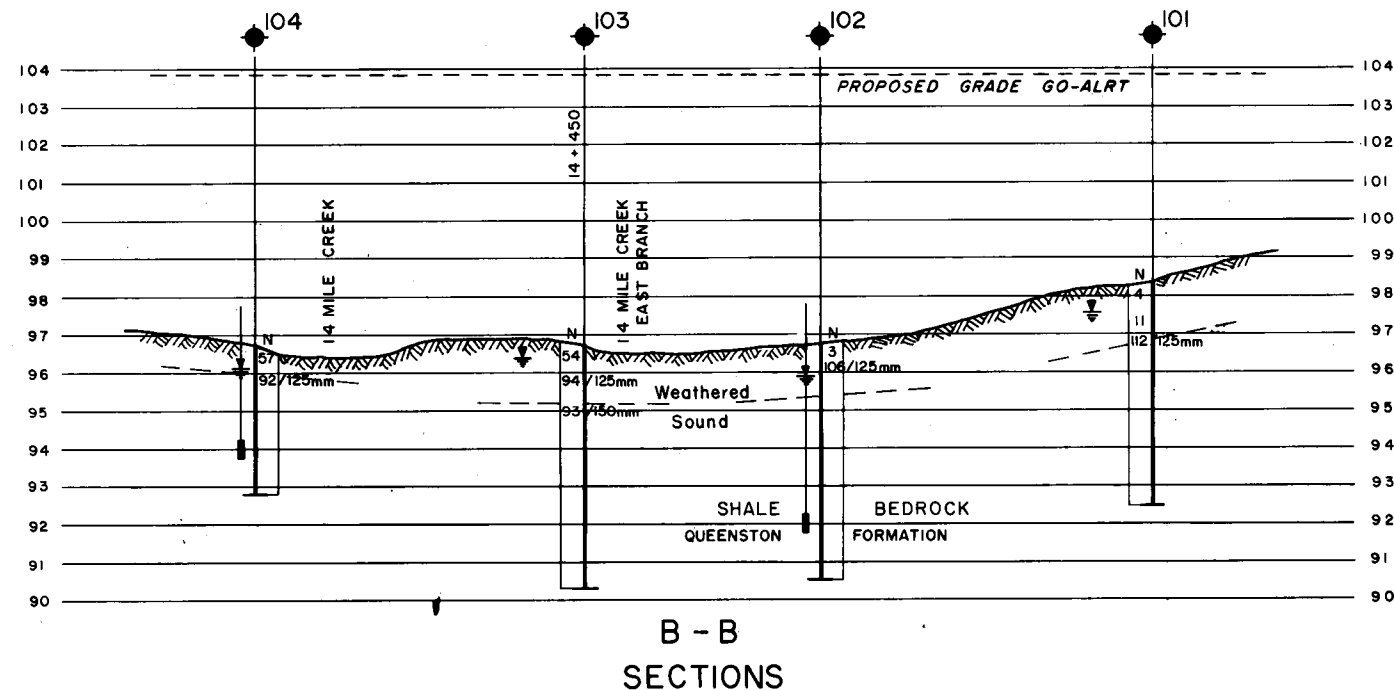
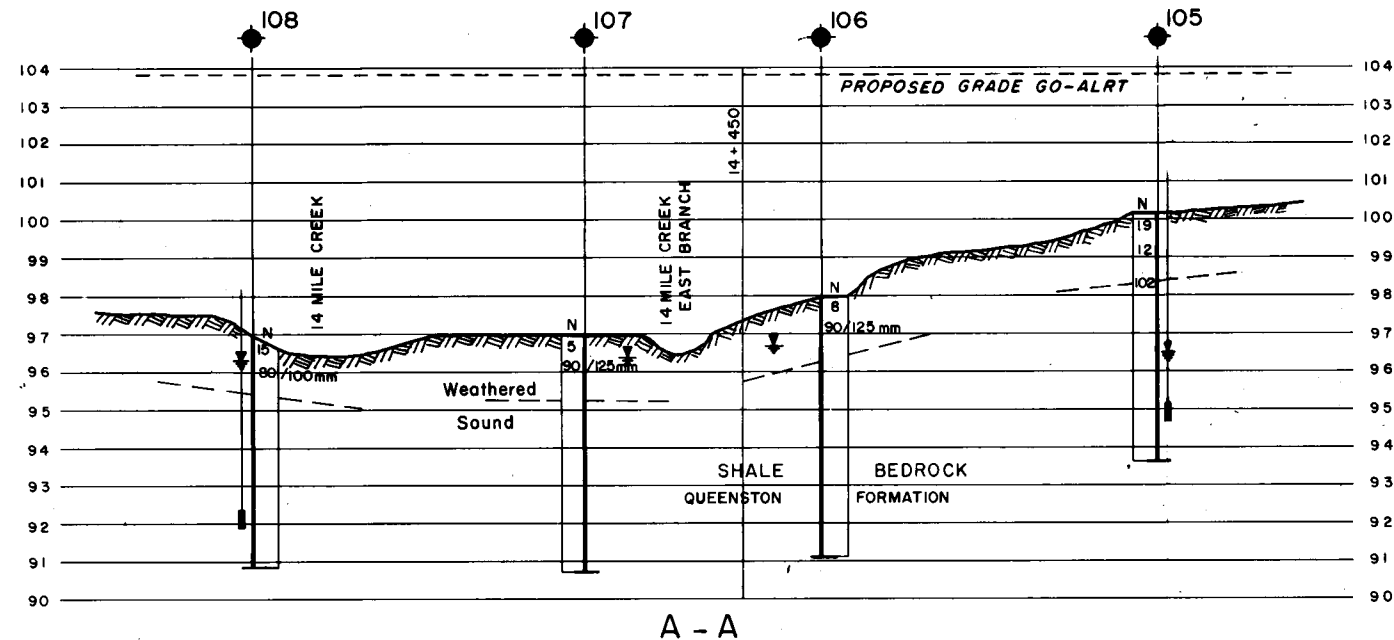
Geocres No


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.

GO-ALRT REF P-007



REFERENCE DRAWINGS		REVISIONS		DRAWN BY: YC	DESIGNED BY:	L.J. RAK ENGINEERING LTD.	 Ministry of Transportation and Communications OAKVILLE PROJECT - WEST EXTENSION PROJECT MANAGER	HALTON REGION FOURTEEN MILE CREEK BRIDGE BOREHOLE LOCATIONS & SOIL STRATA STA 14+447.500 GO ALRT			
				1984 02 06	AP			CONTRACT NO	DWG NO	REV	SHEET
				CHK'D BY: AP	APPROVED BY: AP						
				SCALE: FULL SIZE ONLY AS SHOWN							