

GEOCREs No. 42E-5DIST. 19 REGION W.P. No. 380-90-01CONT. No. W. O. No. STR. SITE No. 48E-11HWY. No. 584LOCATION Hwy 584 @ Little Longlac
 Bridge , Kenogaminis LakeNo of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



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of
Transportation

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REMARKS _____

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FOUNDATION DESIGN SECTION

WP 380-90-01 DIST 19
HWY 584 STR SITE 48E-11

Little Longlac Bridge

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GEOCRES 42E-5

DATE DEC 05 1994

FOUNDATION INVESTIGATION REPORT

For

Little Longlac Bridge

W.P. 380-90-01, Site 48E-11

Highway 584, District 19, Thunder Bay

INTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned site. The field work was carried out between 1994 04 19 and 1994 04 21, and comprised of four sampled boreholes.

Boreholes were advanced to a maximum depth of 21.9 m (El. 310.6) below the existing ground level using 82 mm I.D. continuous flight hollow stem auger as well as BXW casing.

SITE DESCRIPTION

The site under investigation is located about 2.5 km north of Highway 11 at the crossing of Highway 584 and Kenogamisis Lake in the Township of Errington.

The topography of the area is generally flat to gently undulating with isolated rock outcrops and large swamps. The site is located in an organic landforms. In this area, the peaty organic material is often underlain by variable thickness of outwash sand or lake plain clay and silt which overlie ground moraine till.

SUBSURFACE CONDITIONS

General

Organic terrain is common in most parts of the area, however, the soils encountered at this site are outwash sand to silty sand underlain by silt which overlies glacial till. Generally, the

subsurface deposits consists of 3.6 m to 4.4 m compact to loose granular fill with occasional cobbles is underlain by 3.9 m to 4.9 m loose to compact sand to silty sand. The sandy layer is underlain by 8.2 m to 8.7 m compact to dense silt to low plastic silt which overlies very dense heterogeneous mixture of silt, sand and gravel (glacial till). The glacial till is underlain by meta-sandstone bedrock of the Superior Province. For classification purposes, the soils encountered at this site can be divided into five different zones.

- a) Sand, Some Silt, Some Gravel (Granular Fill)
- b) Sand to Silty Sand, Trace of Gravel
- c) Silt to Low Plastic Silt, Trace of Sand
- d) Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)
- e) Meta-Sandstone Bedrock

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix of this report. A stratigraphical section is shown on Drawing No. 3809001-A. This drawing also shows the location and elevation of the borings. Description of the strata encountered are given below.

Sand, Some Silt, Some Gravel (Granular Fill)

This fill which was placed to raise the finished grade of Highway 584, consists of sand with varying proportions of silt, gravel and cobbles. The thickness of the fill varies from 3.6 m to 4.4 m and extends to elevation 329.0 to 328.1. The Standard Penetration Test values vary over a wide range (6 blows/0.3 m to over 100 blows/0.3m) indicating loose to very dense state of denseness.

Sand to Silty Sand, Trace of Gravel

This sandy deposit was encountered immediately below the fill. The thickness of this deposit varies from 3.9 m to 4.9 m and extends to elevation 324.2 to 323.9. Occasional clayey silt layer varying in thickness from 0.6 m to a maximum of 1.3 m was encountered in BH 1 & 2. The results of the Gradation Test carried out on representative soil samples indicate that this deposit is predominantly composed of sand (64% to 87%). The Standard Penetration Test results in this deposit vary over a wide range (4 blows/0.3 m to 55 blows/0.3 m) indicating loose to very dense state of denseness.

Silt to Low Plastic Silt, Trace of Sand

The sand to silty sand deposit is underlain by this silt to low plastic silt. However, in BH1, the sand to silty sand deposit is followed by bedrock. The thickness of this layer was observed to vary from 8.2 m to 8.7 m and extends to elevation 316.0 to 315.2 in boreholes where the full extent of this strata was proven. The Standard Penetration Test values vary from a minimum of 6 blows/0.3 m to a maximum of 36 blows/0.3m indicating loose to dense state of denseness.

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

This glacial deposit was encountered only in BH 2 and BH 4 between elevation 316.0 and 315.2. The full extent of this deposit was not proven below El. 310.6, however, the thickness of this deposit was observed to be about 1.3 m in BH 4. The Standard Penetration Test results indicate very dense state of denseness (N-values over 100 blows/0.3m).

Meta-Sandstone Bedrock

The rock cores were obtained from BH 4 only, using BXL size core barrel and the description of the bedrock is included in the Appendix of this report.

The bedrock was encountered only on the south side (BH 1 and BH 4) between elevation 324.1 and 314.7. The quality of the bedrock may be described as very poor to fair (RQD values 23% to 69%). The bedrock at this site may be classified as unweathered meta-sandstone of the Superior Province.

Groundwater Conditions

The groundwater level measurements were taken in open boreholes and was observed at or near lake level ie. elevation 329.5. Seasonal fluctuation of the groundwater level may be expected due to the influence of the lake. The water level in each borehole is as follows:

<u>Borehole No.</u>	<u>Elevation</u>
1	329.4
2	329.1
3	329.4
4	329.5

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to replace the existing timber bridge at the crossing of Highway 584 and Kenogamisis Lake (Little Longlac). Two alternatives are under consideration for the replacement structure and the alternatives are as follows:

- 1) Single span 44.0 m long with minimum profile grade elevation 333.9 which is about 1.1 m higher than the existing grade (Option 1).
- 2) Three spans (approximately 12.0 m end spans and 16.0 m centre span) with minimum profile grade elevation 333.2 which is about 0.4 m higher than the existing grade. (Option 2). Since this option was not included in the request for foundation investigation, no borehole was located at the pier locations.

The new structure will be constructed along the same alignment as the existing bridge. Two construction alternatives are under consideration for the replacement structure and the alternatives are as follows:

- 1) Replace the structure on existing alignment with single lane detour located 15 m west of the existing bridge.
- 2) Staged construction utilizing half of existing bridge for traffic.

The existing timber bridge consists of nine spans with a length of approximately 4.7 m and total length of 42.3 m. The structure is supported by timber piles which are extended to the bridge deck. The founding level or embedded length of the piles is not available. A number of piles as well as the deck have deteriorated at several locations.

Although, the approach fill is protected by gabion on both sides of the abutments, the embankment is severely eroded in the proximity of the abutments, and in addition, surface erosion has been noticed near both abutments.

Structure Foundations

Option 1

Considering the subsoil conditions at this site, it is recommended that the abutments be supported on steel H-piles driven to about elevation 315.0. The following axial capacity values are recommended for the design of the pile.

	<u>HP 310 X 110</u>	<u>HP 310 X 79</u>
Factored Axial Capacity at U.L.S	1600 kN	1150 kN
Axial Capacity at S.L.S.	1150 kN	900 kN

Option 2

The recommendation given under Option 1 should be used for the abutment and centre pier foundations as well as for the design of piles. Considering the lake water level and construction difficulties, it is suggested that pile bents be used to support the bridge deck.

The pile tips should be reinforced with pile driving shoes as per MTO Standard (DD-3301 latest revision). In the area where piles are to be driven, it may be advisable to pre-auger down to the lake bottom or remove and replace the existing fill with granular backfill containing particle size less than 75 mm to avoid any difficulties in driving of piles.

Pile cap at the abutments should have a minimum of 2.6 m earth cover to protect against the frost penetration.

Lateral Earth Pressure

Earth pressure should be computed as per Section 6.7.4.5 of the O.H.B.D.C, and the coefficient of earth pressure at rest shall be used for rigid and unyielding walls. The granular "A" or "B" backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular backfill.

	<u>Granular "A"</u>	<u>Granular "B"</u>
Angle of Internal Friction	$\phi = 35^\circ$	$\phi = 30^\circ$
Unit Weight (kN/m ³)	$\gamma = 22.8$	$\gamma = 21.2$

Approach Embankment

The proposed finished grade of Highway 584, depending on the option, is expected to be about 1.1 m to 0.4 m higher than the existing grade. If the finished grade is set at or below El. 334.0, no major instability problems are anticipated for the approach embankment constructed with 2 horizontal to 1 vertical side slopes. The fill should consist of granular material up to a height of at least 1.0 m above the high water level and the remaining portion may consist of well compacted acceptable material. Any spongy or soft area observed within the base width of the embankment should be removed before placing the fill. The benching for the approach fill should be carried out in accordance with OPSD 208.01. The approach fill should be protected by about 0.6 m thick rock lining consisting of 200 mm to 300 mm boulders to a height of at least 1.0 m above the high water level.

Other Considerations

If the traffic is diverted through a single lane detour during construction, steel H-piles may be used to support the temporary structure and the piles may be designed assuming the axial capacities recommended above.

If staged construction is utilized for traffic, the excavation may be supported by soldier piles and timber lagging. As indicated above, if any difficulty is encountered to drive the soldier piles, the piles may be lowered in larger diameter pre-augered holes and driven to the required depth.

These holes should be backfilled with non-shrinkable grout after driving the piles. The supporting system may be designed assuming the following parameters.

Angle of Internal Friction $\phi = 30^\circ$

Unit Weight (kN/m^3) $\gamma = 20$

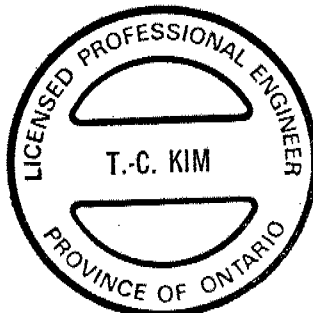
MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer. The equipment used was owned and operated by Dominion Soil Thunder Bay Ltd. This report was prepared by M. Vasavithasan, Foundation Engineer and reviewed by Tae C. Kim, Senior Foundation Engineer.



M. Vasavithasan

M. Vasavithasan, P. Eng.
Foundation Engineer



Tae C. Kim

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

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 380 - 90 - 01 LOCATION STA 12 + 414.2; O/S 4.5m RT. @ HWY. 584 ORIGINATED BY M.V.
 DIST 19 HWY 584 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER COMPILED BY M.V.
 DATUM GEODETIC DATE 94 04 19 CHECKED BY T.C.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
332.6	Hwy. 584 Shoulder																
0.0	SAND, Some Silt, Some Gravel, Occasional Cobbles, Compact to Very Dense (Granular Fill)																
329.0			1	SS	55												
3.6	Clayey Silt		2	SS	24												
			3	SS	12												
	SAND to SILTY SAND, Trace of Gravel, Compact to Very Dense		4	SS	18												
			5	SS	32												
			6	SS	21												
			7	SS	55												
324.1																	
8.5	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 380 - 90 - 01 LOCATION STA. 12 + 487.5; O/S 3.8m RT. @ HWY. 584 ORIGINATED BY M.V.
DIST 19 HWY 584 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER COMPILED BY M.V.
DATUM GEODETIC DATE 94.04.19 & 20 CHECKED BY T.C.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
332.5	Hwy. 584 Shoulder														
0.0	SAND, Some Silt, Some Gravel, Occasional Cobbles, Loose (Granular Fill)						332								
328.8			1	SS	7		330								
3.7	SAND to SILTY SAND, Trace of Gravel, Compact		2	SS	14		328								
			3	SS	10										
			4	SS	17										
			5	SS	13		326								
			6	SS	7										
			7	SS	29										
323.9			8	SS	40		324								
8.8			9	SS	28										
			10	SS	15		322								
			11	SS	24		320								
			12	SS	25										
			13	SS	11		318								
			14	SS	36		316								
315.2			15	SS	28		314								
17.3			16	SS	103		312								
310.8															
21.9	End of Borehole														

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 380 - 90 - 01 LOCATION STA. 12 + 510.6: O/S 4.0m LT. & HWY. 584 ORIGINATED BY M.V.
 DIST 19 HWY 584 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER COMPILED BY M.V.
 DATUM GEODETIC DATE 94 04 20 & 21 CHECKED BY T.C.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _P	W	W _L		
332.5	Hwy. 584 Shoulder																
0.0	SAND, Some Silt, Some Gravel, Occasional Cobbles, Dense to Compact (Granular Fill)		1	SS	35												
328.1			2	SS	16												
4.4	Trace of Organics		3	SS	10												
			4	SS	16												
	SAND to SILTY SAND, Trace of Gravel, Compact		5	SS	12												
			6	SS	13												
324.2			7	SS	31												
8.3			8	SS	33												
	SILT to LOW PLASTIC SILT, Trace of Sand, Occasional Clayey Silt Layers, Dense to Compact		9	SS	20												
			10	SS	26												
319.9			11	SS	20												
12.6	End of Borehole																

RECORD OF BOREHOLE No 4

1 of 1

METRIC

W.P. 380 - 90 - 01 LOCATION STA. 12 + 435.1; O/S 4.3m LT. & HWY. 584 ORIGINATED BY M.V.
DIST 19 HWY 584 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER & BW CASING COMPILED BY M.V.
DATUM GEODETIC DATE 94 04 21 CHECKED BY T.C.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
332.5	Hwy. 584 Shoulder												
0.0	SAND, Some Silt, Some Gravel, Occasional Cobbles, Compact to Loose (Granular Fill) Partly Decomposed Timber & Organics		1	SS	14		332						
328.1			2	SS	6		330						
4.4	Trace of Organics		3	SS	4		328						
	SAND to SILTY SAND, Trace of Gravel, Loose to Compact		4	SS	9								
			5	SS	6		326						
			6	SS	13								
324.2			7	SS	18								
8.3			8	SS	61		324						
			9	SS	27								
	SILT to LOW PLASTIC SILT, Occasional Clayey silt Layers, Compact to Loose		10	SS	15		322						
			11	SS	22		320						
			12	SS	15		318						
			13	SS	6		316						
316.0													
16.5	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)												
314.7													
17.8	META - SANDSTONE BEDROCK Unweathered		14	RC BX	REC 83%		314						RQD = 56%
			15	RC BX	REC 53%								RQD = 23%
312.2			16	RC BX	REC 100%								RQD = 69%
20.3	End of Borehole												

ROCK CORE DESCRIPTION

WP 380-90-01

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
4	1	17.75-18.64	83	56	17.75-20.27	META-SANDSTONE, greenish grey to dark greenish grey; medium grained; medium strong; unweathered to slightly weathered; fractures moderate to extremely close spaced, near vertical to dipping, planar to undulating, smooth to rough.
	2	18.64-19.46	53	23		
	3	19.46-20.27	100	69		

*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

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

MECHANICAL PROPERTIES OF SOIL

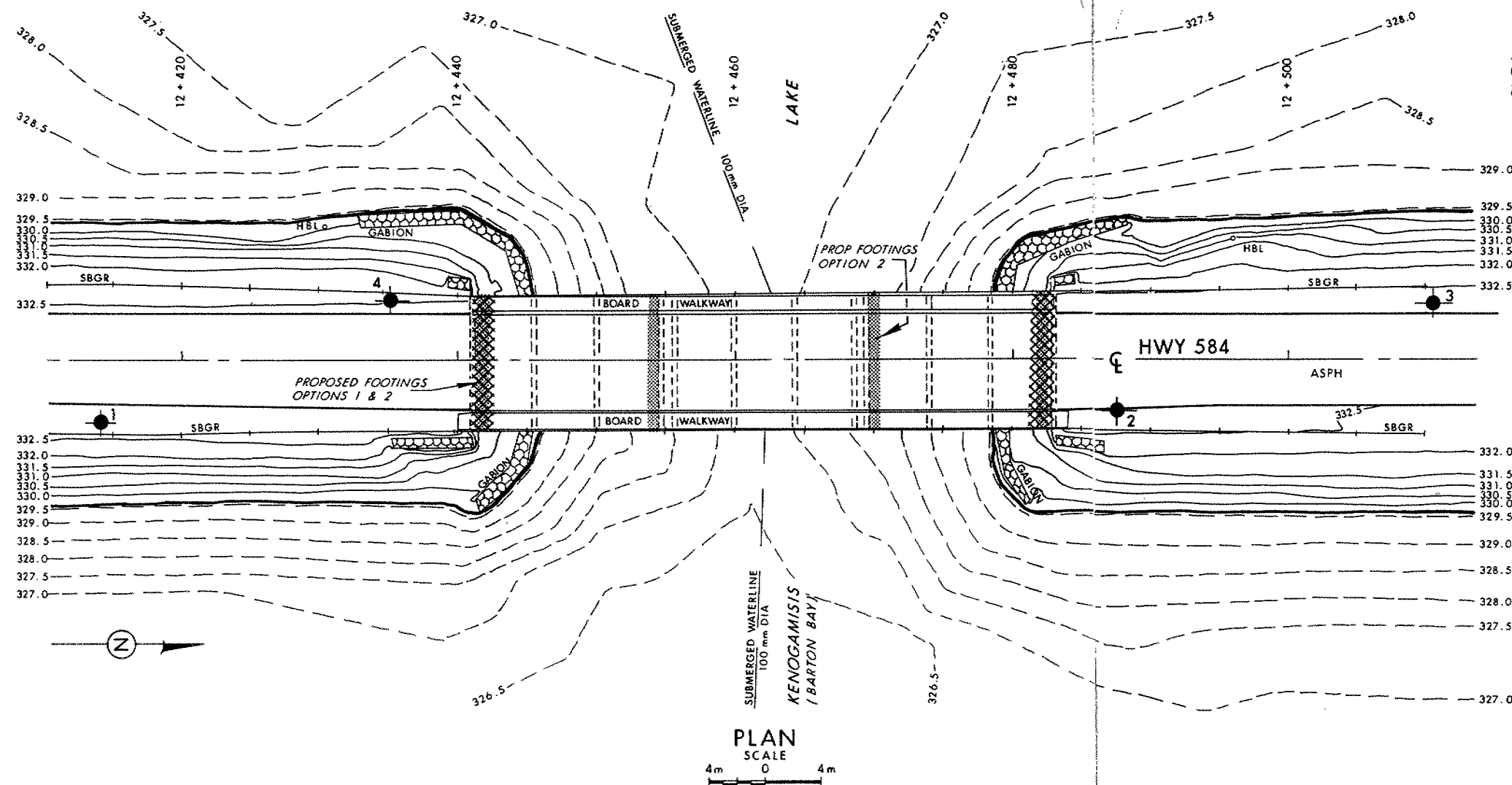
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE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

STRESS AND STRAIN

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

PHYSICAL PROPERTIES OF SOIL

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



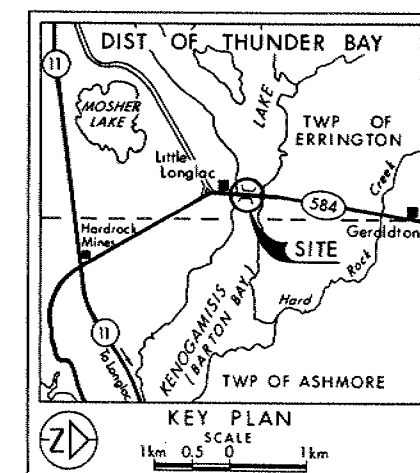
CONT No
WP No 380-90-01

KENOGAMIS LAKE (BARTON BAY)
(2.4 km North of Hwy 11)

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 1994 04

No	ELEVATION	STATION	OFFSET
1	332.6	12+414.2	4.5mRT
2	332.5	12+487.5	3.8mRT
3	332.5	12+510.5	4.0mLT
4	332.5	12+435.1	4.3mLT

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 GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
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Geocres No 42 E - 5

HWY No 584	CHECKED	DATE 1994 11 04	DIST 19
SUBMD MV	CHECKED	DATE 1994 11 04	SITE 48 E-31
DRAWN RS	CHECKED	DATE 1994 11 04	DWG 3809001-A

