

MEMORANDUM

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab.

Attention: Mr. S. McCombie

DATE: June 7, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Underpass Structure
At the
Crossing of Gilmore Rd. and the Q.E.W.
District No. 4 (Hamilton)
W.J. 68-F-24 -- W.P. 448-65

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
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Foundations Files
Gen. Files

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Underpass Structure
At the
Crossing of Gilmore Rd. and the Q.E.W.
District No. 4 (Hamilton)
W.J. 68-F-24 -- W.P. 448-65

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the site of the crossing of Gilmore Rd. and the Q.E.W. in the Twp. of Bertie, County of Welland. The request was contained in a memo from the Bridge Division (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated March 22, 1968. An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the proposed structure and the stability of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about 2 miles north-west of the town of Fort Erie. At this location the Queen Elizabeth Highway grade is some 2 ft. above the surrounding ground surface. The highway itself consists of four paved lanes with grassed median and associated gravel shoulders. Along each side of the highway there is a wide drainage ditch the invert of which is some 4 to 5 ft. below the surrounding ground surface; the ditch side slopes are approximately 4:1. Gilmore Road crosses the Q.E.W. diagonally, rising from ground level to meet the Q.E.W. grade at the intersection. Gilmore Road is paved at the approaches, and in the easterly direction towards Fort Erie. West of the Q.E.W. Gilmore Road becomes a narrow gravel road. The surrounding area is flat and open with a light brush cover to the south of Gilmore Rd. A long distance Bell underground cable runs just outside the east property line of the Q.E.W.

2. DESCRIPTION OF THE SITE AND GEOLOGY: (cont'd.) ...

Physiographically, the site is situated in the "Haldimand Clay Plain". Based on available geological information, it is known that the overburden of this region consists of lacustrine clay deposited in glacial Lake Warren, formed during the retreat of the last continental glacier.

The bedrock in the area is a dolomite of the Norfolk formation.

3. FIELD AND LABORATORY WORK:

Five boreholes, each with an accompanying dynamic cone penetration test, were carried out during the field investigation. Five additional dynamic cone penetration tests were carried out to give a well defined bedrock profile. The borings were advanced by means of a conventional diamond drill rig adapted for soil sampling purposes.

Samples were obtained at required depths in a 2-inch O.D. split-spoon sampler which was hammered into the soil in accordance with the specifications for the standard penetration test. Bedrock was proven in all of the borings by obtaining AXT size rock core samples. During sampling and drilling operations, detailed logs of the borings were made; these logs contain a record of the drilling and sampling techniques used, together with the soil types encountered, and the groundwater elevations observed in the borings during the period of the investigation.

The locations and elevations of all the borings were surveyed in the field by personnel from the Central Regional Engineering Surveys Section, and are shown on Drawing 68-F-24A, together with the estimated stratigraphical profile.

All samples were subjected to a careful visual inspection in the field and laboratory. Following this inspection, tests were carried out on certain samples to determine the engineering properties of the overburden, namely:

Natural Moisture Contents
Atterberg Limits
Grain-Size Distributions

cont'd. /3 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

On completing these tests, the various soil samples were classified as to type and consistency, or relative density in accordance with the Unified Soil Classification System - (Oct. 1963).

The results of the laboratory tests are summarized and plotted on the Record of Borelog sheets contained in the Appendix of the report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site generally consists of a thin (6") surface layer of topsoil over a 6 to 7.5 ft. deposit of clay to silty clay with traces of sand and gravel which, in turn, is underlain by a 3 to 9 ft. thick deposit of clayey silt to silt with sand and some gravel. The overburden is underlain by sound siliceous and shaley dolomite bedrock.

In the low areas, e.g., ditches, the topsoil is underlain directly by the clayey silt to silt with sand and gravel deposit.

The boundaries between the various soil strata are shown on the Record of Borelog sheets contained in the Appendix of the report. The estimated stratigraphical profiles shown on Dwg. 68-F-24A, are based on this information.

From ground level downwards, the different soil types are described in detail as follows:

4.2) Clay to Silty Clay with traces of Sand and Gravel:

Underlying the topsoil in all but two boreholes (B.H.'s #2 and 4), a 6 to 7.5 ft. layer of reddish-brown clay to silty clay with traces of sand and gravel was encountered. Standard Penetration Resistance tests carried out within the deposit gave 'N' values ranging from 14 to 64 blows per foot, indicating a consistency of

cont'd. /4 ...

4. SUBSOIL CONDITIONS:

4.2) Clay to Silty Clay with traces of Sand and Gravel: (cont'd.)...

stiff to hard. The moisture content of the deposit ranges from 18 to 26 percent, which is at or slightly below the plastic limit. In the upper 3 to 4 ft. of this deposit a few thin streaks of organic material derived from old root systems is encountered.

4.3) Clayey Silt to Silt with Sand and some Gravel:

Underlying the clay to silty clay stratum in B.H.'s #1, 7 and 8, and the thin layer of topsoil in B.H.'s #2 and 4, a 3 to 9 ft. deposit of clayey silt to silt with sand and some gravel was encountered. The silt and sand content of this deposit generally increases with depth. The 'N' values within the deposit ranged from 20 to 63 blows per foot, indicating a very stiff to hard consistency and a dense relative density in the non-cohesive part of the deposit. The colour of the deposit varies from light brown to brown. Physical properties of the cohesive portion of the deposit as determined from the laboratory tests, are:

Moisture Content (W) = 9 - 17%

Liquid Limit (W_L) = 16 - 27%

Plastic Limit (W_p) = 12 - 14%

Grain-Size Distribution:

- Gravel = 0 - 10%

- Sand = 5 - 43%

- Silt = 37 - 66%

- Clay = 11 - 29%

4.4) Dolomite Bedrock:

Bedrock was proven in all of the wash borings by obtaining from 5 to 9 feet of AXT rock core. Five additional cone penetration tests were carried out and bedrock was assumed at the elevation at which the cone test met practical refusal. The depth at which bedrock was encountered ranged from elevations 601 to 603 - i.e., some 6 to 15 ft. below existing ground surface. The bedrock is

cont'd. /5 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.4) Dolomite Bedrock: (cont'd.) ...

relatively flat with a slight slope towards the south.

The bedrock is composed of a grey siliceous dolomite with some shaley dolomite layers. It is generally in a sound condition as evidenced by the high core recovery (94% to 100%).

5. GROUNDWATER CONDITIONS:

Groundwater level observations made in the open holes during the period of the investigation. These observations which are recorded on the borehole logs and summarized on Dwg. 68-F-24A, indicate that the groundwater level ranges from about elevation 609 to 612 - i.e., some 0 to 5 ft. below existing ground level.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure to carry Gilmore Rd. over the Queen Elizabeth Way. Present proposals call for a four-span (48'-108'-108'-48') structure with approach fills having a maximum height of about 20 ft. above the Q.E.W. grade.

Subsoil at the site consists of a shallow deposit of clay to silty clay, changing to clayey silt to silt with sand and some gravel. This overburden is underlain, at a depth of 6 to 15 ft. below existing ground surface, by a sound siliceous and shaley dolomite bedrock.

6.2) Structure Foundations:

6.2.1) Pier Footings:

The pier footings may be founded within the overburden or directly on the sound bedrock.

Pier footings in the overburden: Piers can be founded on spread footings in the overburden at the following elevations

cont'd. /6 ...

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Structure Foundations: (cont'd.) ...

6.2.1) Pier Footings: (cont'd.) ...

with a safe bearing pressure of 2.5 t.s.f.

East Pier	-	elev. 608
Central Pier	-	elev. 610
West Pier	-	elev. 608

In all cases a minimum cover of 4.0 ft. should be provided in order to have adequate frost protection. If footings are placed at the above mentioned elevations no major dewatering problems are anticipated, except at the West pier location in view of the presence of permeable silt layers at the footing formation level. A dewatering scheme may therefore be required for the construction of the West pier.

Pier footings on bedrock: The piers can be founded directly on the sound bedrock using a safe bearing pressure of up to 15 t.s.f. No major dewatering problems are anticipated; however, any seepage from silt seams in the overburden can be controlled by using ordinary pumping methods.

6.2.2) Abutment Footings:

The abutments may be supported on spread footings placed within the approach fills. The fill material, below the tops of the footing, should consist of well compacted G.B.C., Class 'A' material and should extend for a horizontal distance of at least 10 ft. from the footing edges in the plane of the footing tops. This portion of the fill should be constructed with slopes of 2:1. The remainder of the fill should be completed to above profile grade for a distance of at least 50 feet behind the abutments before re-excavating for the abutment footings. A safe design load of 2 t.s.f. may be used for the abutment foundations.

cont'd. /7 ...

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Structure Foundations: (cont'd.) ...

6.2.2) Abutment Footings: (cont'd.) ...

As an alternative, the entire structure may be founded on drilled-in concrete-lined caissons bearing directly on the sound bedrock. Allowable loads will depend upon the caisson size chosen. For example, a safe design load of 150 tons per caisson may be used for a 30" diameter caisson.

For the above mentioned schemes the differential settlements will be of a negligible order.

6.3) Approach Embankments:

There will be no overall stability problems for the proposed 20-ft. high approach embankments provided that standard slopes of 2 horizontal to 1 vertical are used.

7. SUMMARY:

The results of a foundation investigation for the proposed underpass structure at the crossing of Gilmore Rd. and the Queen Elizabeth Way are presented.

Subsoil at the site generally consists of a layer of stiff to hard clay to silty clay with traces of sand and gravel. Underlying this layer is a deposit of very stiff to hard or dense clayey silt to silt with sand and some gravel followed by sound siliceous and shaley dolomite bedrock.

The pier footings can be founded (i) on spread footings within the overburden using a safe bearing pressure of 2.5 t.s.f., or (ii) directly on the sound bedrock using a safe bearing pressure of up to 15 t.s.f. The abutments can be founded on spread footings located within the approach fill. The differential settlement between the various structure foundations should be within tolerable limits. As an alternative, the entire structure can be founded on drilled-in, concrete-lined caissons bearing directly on the sound bedrock.

7. SUMMARY: (cont'd.) ...

As discussed in the report, a portion of the pier footing excavations may be carried out within the permeable subsoil for which a dewatering scheme may be necessary.

No stability problems are anticipated for the approach fills provided 2:1 slopes are employed.

8. MISCELLANEOUS:

The field work carried out during April 10 to April 17, 1968, was supervised by Mr. W. Hutton, Project Foundation Engineer, who also wrote this report.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

The equipment used was owned and operated by Dominion Soil Investigation Limited.

June, 1968.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 68-F-24 LOCATION Sta. 31 + 41 @ Gilmore Rd. o/s 33' Lt. ORIGINATED BY WGH
W.P. 448-65 BORING DATE April 10-11, 1968 COMPILED BY WGH
DATUM Geodetic BOREHOLE TYPE Diamond Drill - Washboring CHECKED BY JK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W		
614.3	Ground Level															
0.0	Clay to silty clay with traces of sand.		1	C.S.												
608.8	Very stiff, Reddish-Brown		2	SS	22	610										
5.5	Clayey silt with sand & gravel. Some thin (silt) seams.		3	CS												
602.1	Very stiff to hard. Light Brown		4	SS	63											
12.2	Sound siliceous Dolomite with some shaly dolomite inclusions. Grey		5	SS	26											
595.8			6	SS	31 7/8"											
18.5	End of Borehole		7	AXT-RC	97%	600										
			8	AXT-RC	100% Rec.											
						590										

Hammer bouncing

611.5

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

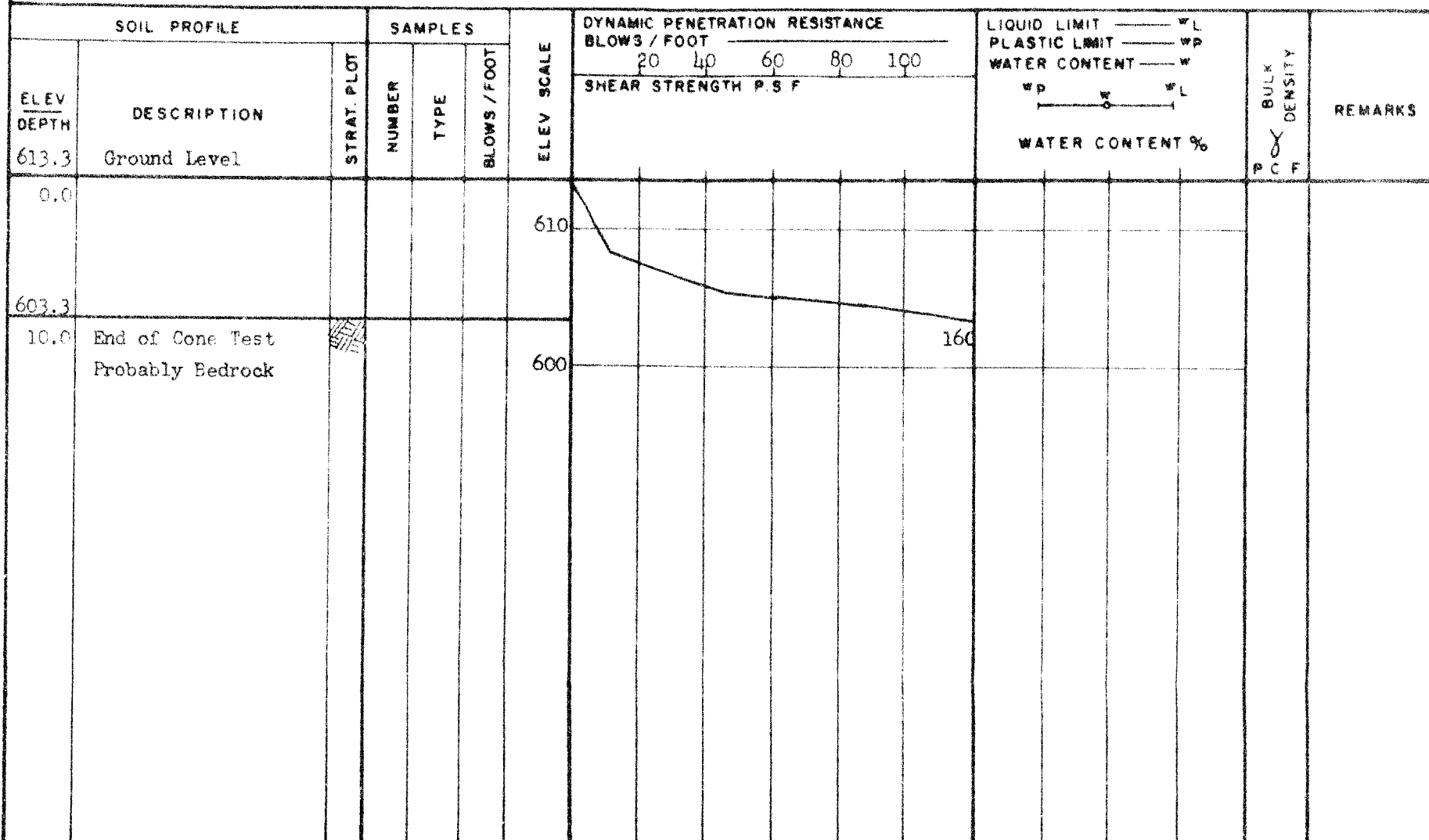
JOB 68-F-24LOCATION Sta. 31 + 29 @ Gilmore Rd. o/s 32' Rt.ORIGINATED BY WHW P 448-65BORING DATE April 11, 1968COMPILED BY TCDATUM GeodeticBOREHOLE TYPE Diamond Drill - WashboringCHECKED BY JK

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W _P WATER CONTENT % 15 30 45	BULK DENSITY Y P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
608.7	Ground Level									608.7
0.0	Clayey silt to silt with sand & some gravel. Very stiff to hard. Brown		1	CS	-					
602.7			2	SS	31					
6.0			4	SS	22					
597.7	Sound siliceous dolomite with some shaley dolomite incls. Grey		5	AXT RC	100% Red					
11.0	End of Borehole									

hammer bouncing

Gr. Sa. Sl. Cl
9 43 37 11

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 3		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB	68-F-24	LOCATION	Sta. 31 + 82 @ Gilmore Rd. o/s 29' Rt.	ORIGINATED BY	WH
W P	118-65	BORING DATE	April 11, 1968	COMPILED BY	TC
DATUM	Geodetic	BOREHOLE TYPE	Dynamic Cone Penetration Test	CHECKED BY	<i>SK</i>



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-24

W P 448-65

DATUM Geodetic

LOCATION Sta. 28 + 11 @ Gilmore Rd. o/s 36' Lt.

BORING DATE April 16, 1968

BOREHOLE TYPE Diamond Drill - Washboring

FOUNDATION SECTION

ORIGINATED BY WH

COMPILED BY TC

CHECKED BY _____

[illegible]

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT _____ WL		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT	PLASTIC LIMIT _____ WP	WATER CONTENT _____ W		
612.8	Ground Level										
610.0						610					
601.0											
11.8	End of Borehole Probably Bedrock					600					

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 68-F-24 LOCATION Sta. 28 + 66 @ Gilmore Rd. o/a 29th Rt. ORIGINATED BY WH
W.P. 448-65 BORING DATE April 16, 1968 COMPILED BY TC
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY SK

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL			BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
609.8	Ground Level						SHEAR STRENGTH P.S.F.					WP ——— WL			PCF	
0.0							Hammer bouncing					WATER CONTENT %				
602.3																
7.5	End of Cone Test Probably Bedrock					600										

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 68-F-24 LOCATION Sta. 29 + 13 @ Gilmore Rd. o/s 33' Rt. ORIGINATED BY WH
W P 448-65 BORING DATE April 16, 1968 COMPILED BY TC
DATUM Geodetic BOREHOLE TYPE Diamond Drill - Washboring CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL			BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.					PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
610.9	Ground Level						20 40 60 80 100						WP WL			
0.0	Silty clay with traces of sand & gravel. Hard.		1			610										
604.9	Reddish Brown		2	SS	35											
6.0	Clayey silt to silt with sand & some grav.		3													
601.6	Very stiff to hard Brown		4	SS	34											
2.3	Sound siliceous dolomite with some shaley dolomite incls. Grey		5	SS	20											
596.6			6	RC	98% Rec.	600										
14.3	End of Borehole					590										

Hammer bouncing

Gr. Sa. Si. Cl

10 32 45

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOE 68-F-24

LOCATION

Sta. 29 + 63 @ Gilmore Rd. o/s 49' Lt.

ORIGINATED BY

W

W. P. 1118-65

Boring Date

April 17, 1968

COMPILED BY

TC

DATUM Geodetic

BOREHOLE TYPE

Diamond Drill - Washboring

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W	WATER CONTENT %		
615.5	Ground Level											
0.0	Clay to silty clay with traces of sand. Stiff to hard.		1	SS	14	610						
608.0	Reddish Brown		2	SS	64							
7.5	Clayey silt to silt with gravel sand & some gravel.		3	SS	37							
	Very stiff to hard.		4	SS	22							
600.4	Brown		5	SS	24							
15.1	Sound siliceous dolomite with some shaly dolomite incls. Grey		6	AXT RC	94% Rec	600						
			7	AXT RC	98% Rec							
591.0						590						
24.5	End of Borehole											

FOUNDA TION SECTION

ORIGINATED BY WH

COMPILED BY _____

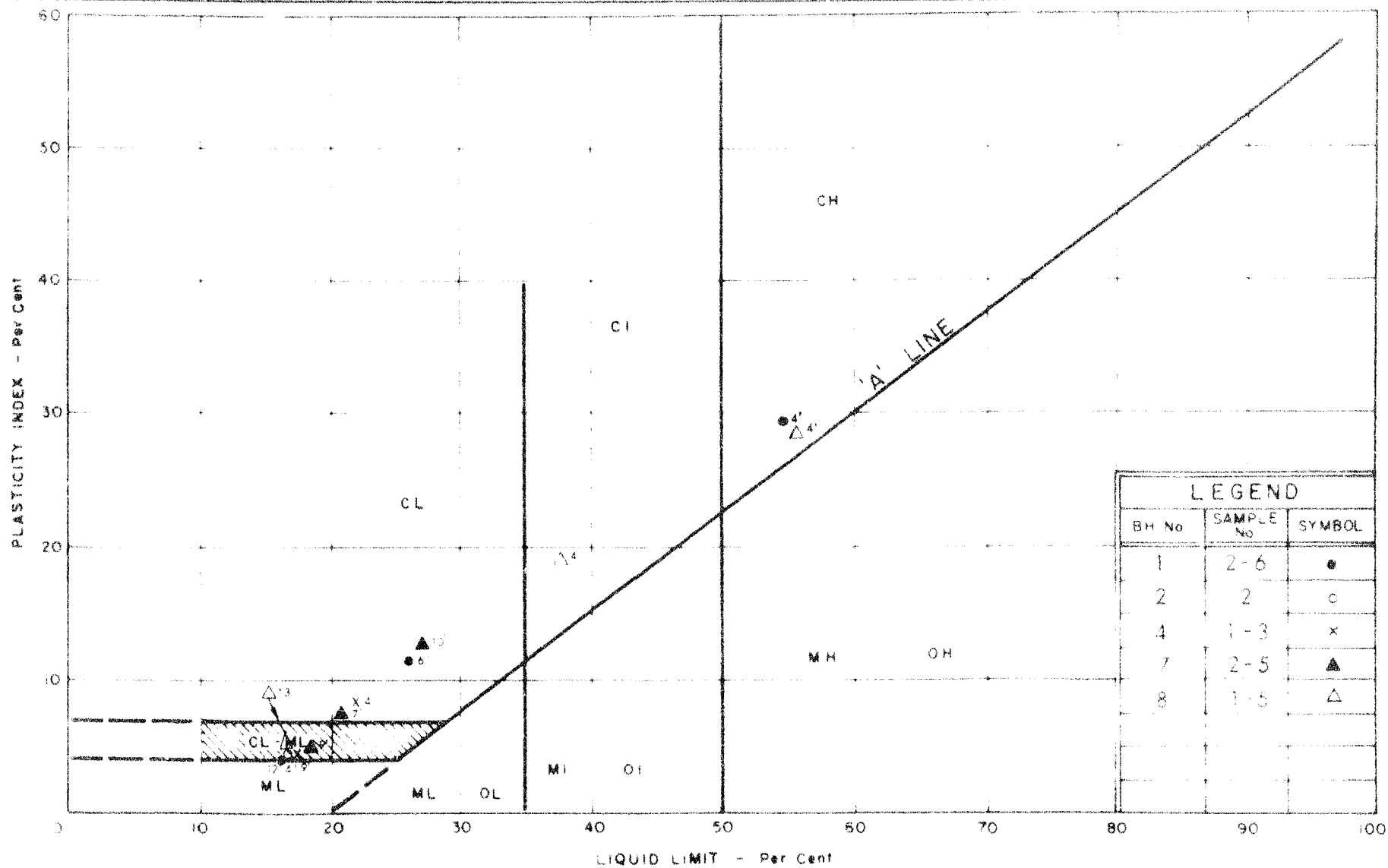
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SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— W _L Plastic Limit ——— W _P Water Content ——— W	BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	W _P ——— W ——— W _L WATER CONTENT %		
615.1	Ground Level									
0.0						610				
601.3										
13.8	End of Cone Test Probably Bedrock					600				

FOUNDATION SECTION

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT _____ % PLASTIC LIMIT _____ % WATER CONTENT _____ %			BULK DENSITY pcf	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	WATER CONTENT % #P #L			
611.2	Ground Level														
0.0						610									
600.7															
10.5	End of Cone Test Probably Bedrock	THIN TEXT				600									
</															



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

WP No. 448-65

JOB No. 68-F-24

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE (N) - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL. DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>N' BLOWS/FT.</u>	<u>c LB./SQ FT.</u>	<u>DENSENESS</u>	<u>N' BLOWS/FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H	SAMPLE ADVANCED HYDRAULICALLY	
	P.M	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
Q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
C_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR $= \frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	* 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
e	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
K_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

MEMORANDUM

To: Mr. C. J. Irboski,
Bridge Design Engineer,
Bridge Office,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

ATTENTION:

DATE: April 6, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

Gilmore Road and Q.E.W. Underpass --
W.P. 443-65; Site 34-207; W.J. 68-7-24
Q.E.W., District No. 4 (Hamilton) --

We have reviewed the Final Bridge Drawings for the above mentioned structure and submit the following comment:

As mentioned in our memo, dated January 29, 1969, for the Preliminary Bridge Drawing, a dewatering scheme will be required for the construction of the pier footing on bedrock.

RD/MdeP

M. Devate
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. J. McComble
R. C. Melnyshyn

Foundations Office Files
Gen. Files

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: March 12, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Gilmore Road & Q.E.W. Underpass
W.P. 448-65, Site 34-207
Q.E.W., District No. 4

65 F-24


Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.

CSG:rd

Attach.

c.c. Foundation Office


C.S. Grebski,
Bridge Design Engineer

Comment made Apr 3/70
M.D.



Telephone: 243-3446

Mr. W. Wigle,
Program Engineer,
Administration Bldg.

E.J. McCabe,
Toronto Regional Road Design.

March 13, 1968.

Re: Queen Elizabeth Way from
Highway 405 to Fort Erie,
District 4, Hamilton.

Your letter of February 12, 1968 requesting a program for placement of early fills as recommended by the Foundation Section has been passed on to me for comment.

This afternoon Mr. Davata, Foundations Section, Mr. Molinsky, Bridge Planning Section, and the writer met to consider our needs for early fill placement. It was determined that early fill would be placed:

- 1) If required for bridge construction.
- 2) If required for grading purposes. A 6" settlement or more was used as a basis to determine the need for early fill placement for grading purposes.

The following is a summary of our conclusions:

- 1) Mountain Road Interchange - W.P. 154-64.

Bridge Office to decide in one month whether early fill placement required for bridge purposes.

- 2) Thorold Stone Road - W.P. 155-64-03.

No early fill placement required.

- 3) McLeod Road - W.P. 156-64.
- 4) Northbound West Service Road - W.P. 157-64-2.

Both bridges will be on piles. An 8 1/2" settlement is predicted. We propose delaying the final paving of the fill areas from one to two years.

March 13, 1968.

Mr. W. Wigle - Re: Queen Elizabeth Way.

- 5) Lyons Creek - W.P. 153-64-01.
- 6) Beck Road - W.P. 442-65.
- 7) Bossert Road - W.P. 443-65.
- 8) Sodon Road - W.P. 159-64.
- 9) Baker Road - W.P. 445-65.
- 10) Townline Road, Black Creek, Service Road - W.P. 167-64.
- 11) Ridgemount Road - W.P. 165-64.
- 12) Bowen Road
- 13) Sunset Drive - W.P. 447-65.
- ✓ 14) Gilmore Road - W.P. 448-65 68-F-24

Considerable settlement can be anticipated for the above structure sites and approach thereto. We propose that early fill placement be considered two years in advance of the current construction program year.

- 15) West-North and South Ramp - W.P. 162-64-2.
- 16) Thompson Road - W.P. 162-64-1.
- 17) - W.P. 162-64-3.
- 18) C.N.R. Widening - W.P. 162-64-05.
- 19) Concession Road (Erie St.) - W.P. 161-64.
- 20) North Street Revision - W.P. 160-64.

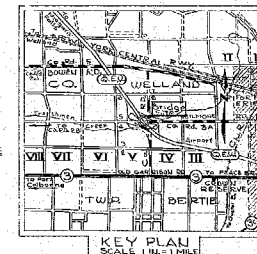
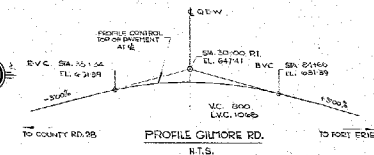
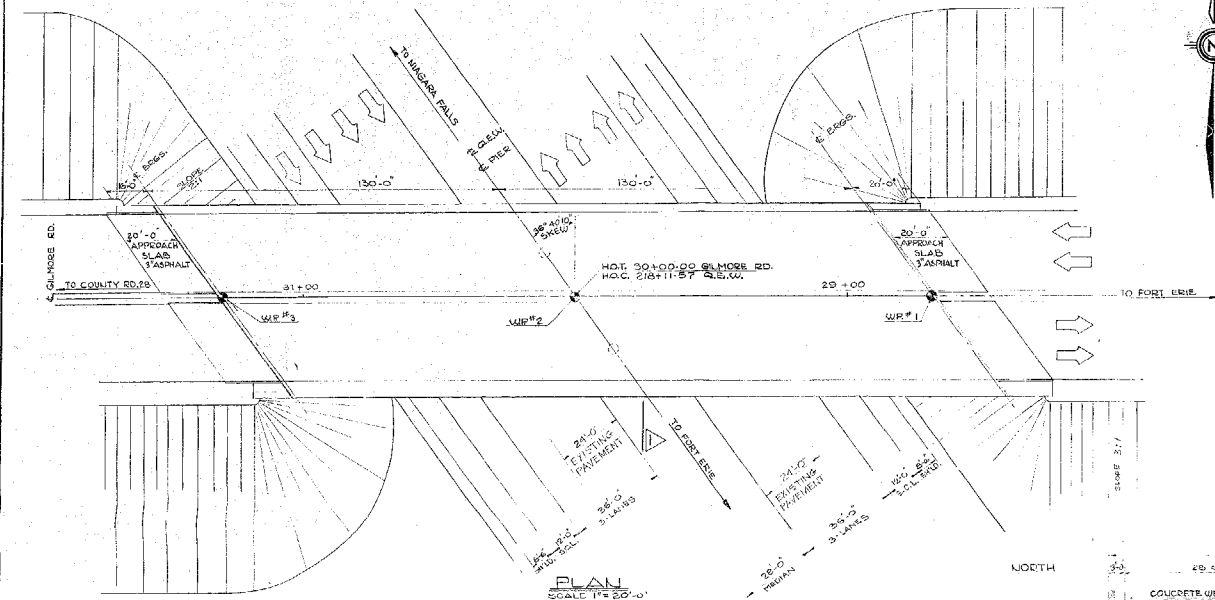
No early fill placement required at these sites.

E.J. McCabe

E.J. McCabe
Expressway Consultant Control Engineer
For:
C.K. Hunter
Regional Road Design Engineer

RJM/15

c.c. M. Devata
W. Melnyshyn
A.J. Fletcher
E.A. Fletcher



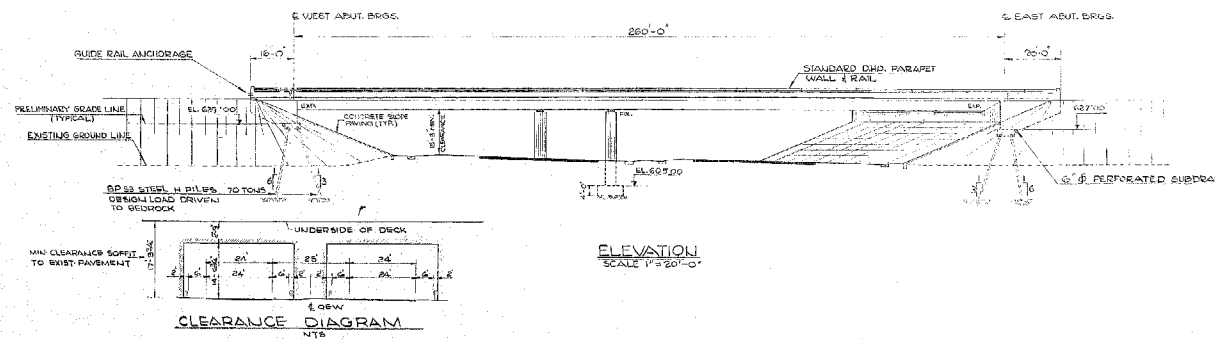
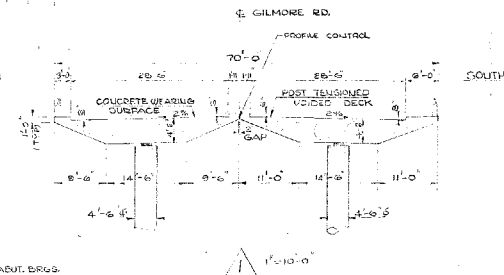
LIST OF DRAWINGS

- D6511-1 GENERAL PLAN
- 2 BORE HOLE LOCATIONS & SOIL STRATA
- 3 FOOTING DIMENSIONS & REINFORCING
- 4 ABUTMENT DIMENSIONS
- 5 EAST ABUTMENT REINFORCING
- 6 WEST ABUTMENT REINFORCING
- 7 PIER DETAILS
- 8 CURB DETAILS
- 9 DECK DIMENSIONS & SKEED ELEVATIONS
- 10 DECK REINFORCING
- 11 PARAPET WALL DETAIL
- 12 APPROACH SLAB
- 13 DETAILS OF CON. SLOPE DOWNS
- 14 STANDARD STEEL PARAPET RAIL
- 15 STANDARD DETAILS

NOTES

- CLASS OF CONCRETE
ABUTMENT & FOOTINGS 3,000 P.S.I.
PIER'S 5,000 P.S.I.
DECK, CURBS & PARAPET WALLS 5,000 P.S.I.
APPROACH SLABS 3,000 P.S.I.
- CLEAR COVER TO REINFORCING STEEL
ABUTMENT & PIER FOOTINGS 3"
ABUTMENTS & PIERS 2"
DECK TOP 2"
DECK BOTTOM & PARAPET WALLS 1 1/2"
CURBS 2"
APPROACH SLAB 4"

NORTH



PRINT RECORD	No.	DATE
	1	11/27/1988

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION		68-F-24	
GILMORE ROAD & Q.E.W. UNDERPASS			
KING'S HIGHWAY No. Q.E.W.		DIST. No. 4	
CO. WELLAUD		LOT 445 CON. 3'	
TWP. BERTIE			
GENERAL PLAN			
DESIGN	P. D. LESTER	CONTRACT	34-207 445 65-2
DRAWING	NO. 11-2	DRAWING	D6511-1
DATE	FEB 70	LOADING	15-10-44



