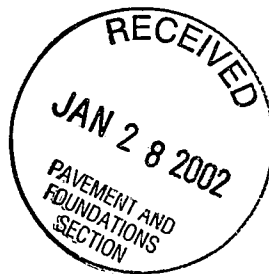


G.I.-30 SEPT. 1976

GEOCRES No. 30M3-216DIST. CR REGION W.P. No. 309-94-00CONT. No. W. O. No. STR. SITE No. HWY. No. QEWLOCATION BRIDGE # 8 STRUCTUREQEW TO RAINBOW BRIDGENo of PAGES - 1=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

**FOUNDATION
INVESTIGATION
REPORT**

CONTRACT NO. 2001- 0022



FOUNDATION INVESTIGATION REPORT
FOR
BRIDGE 8 STRUCTURE
HIGHWAY 420 RECONSTRUCTION
QEW TO RAINBOW BRIDGE ~~214~~
G.W.P. 309-94-00
NIAGARA FALLS, ONTARIO

30 M 03-216

Distribution:

3 cc: Philips Engineering Ltd. for distribution to MTO
1 cc: Philips Engineering Ltd.
1 cc: PML Hamilton
1 cc: PML Toronto

Job No. 98HF100C

January, 2000

TABLE OF CONTENTS

INTRODUCTION	1
SITE DESCRIPTION	1
INVESTIGATION PROCEDURES	2
SUMMARIZED SUBSURFACE CONDITIONS	3
Mixed Fill	3
Silt Fill	3
Silt	4
Silt Till	4
Groundwater	4
CLOSURE	5

FOUNDATION INVESTIGATION REPORT

For
Bridge 8 Structure
Highway 420 Reconstruction
QEW to Rainbow Bridge
G.W.P. 309-94-00
Niagara Falls, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for replacement of the bearings at Bridge 8 (west abutment only) on the ramp from the northbound QEW to eastbound Highway 420 in Niagara Falls, Ontario. The investigation was conducted for Philips Engineering Ltd. on behalf of The Ministry of Transportation Pavements and Foundations Section.

The report pertains to temporary support of the bridge deck at the west abutment of the existing structure. The approximate location of the bridge abutment is Station 593+90 of the S (Q.E.W.) - E (420) ramp.

SITE DESCRIPTION

The site is located at the interchange of Highway 420 and the QEW in the City of Niagara Falls. The existing structure carries traffic on the S (QEW) - E (420) ramp over eastbound Highway 420.

Significant earthworks operations were carried out during construction of the interchange complex. At the west abutment of Bridge 8, an approximate 6 m high embankment was constructed for the bridge approach.

The site is located in the broad physiographic region known as the Haldimand Clay Plain. The overburden is some 10 to 15 m thick and typically comprises deposits of glaciolacustrine clay, silt and sand. Bedrock consists of dolostone of the Lockport Formation.

INVESTIGATION PROCEDURES

The fieldwork was carried out on July 19, 1999 and comprised two boreholes drilled to depths of 6.0 and 11.0 m at the locations shown on Drawing 1. Borehole 2 was terminated upon auger refusal on an obstruction at the base of the abutment approach fill.

The borehole locations were selected by Peto MacCallum Ltd., and were subject to access limitations in the field. The locations of and ground surface elevations at the boreholes were subsequently determined by Philips Engineering Ltd.

The boreholes were advanced using continuous flight solid stem augers, powered by a truck-mounted CME-75 drillrig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Grain size distribution analyses, Atterberg Limits tests were carried out on selected samples.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, elevation of the boundary between stratigraphic units, standard penetration test "N" values, and groundwater observations. The results of laboratory grain size distribution analyses and moisture content determinations are also shown.

The conditions revealed in borehole 1 drilled at the south end of the west abutment are summarized below. Borehole 2 was drilled through the approach fill behind the abutment; this borehole was terminated upon refusal to auger at a depth of 6.0 m (elevation 190.9) and did not penetrate the approach ramp Granular "A" crushed limestone fill. Relocation of borehole 2 to a location within reasonable proximity to the work area was not possible due to access limitations.

The subsurface stratigraphy revealed in borehole 1 (ground surface elevation 194.6) comprised a surficial mixed/silt fill layer to a depth of 2.9 m (elevation 191.7) overlying native compact to loose silt to a depth of 10.0 m (elevation 184.6) underlain by very dense silt till. No free water was observed during or upon completion of augering. The strata encountered are summarized below:

Mixed Fill

Fill comprising zones of cohesive silt and silty clay was encountered surficially to a depth of 1.4 m (elevation 193.2). The moisture content of one sample of the mixed fill was 11%.

Silt Fill

A 1.5 m thick layer of silt fill (slight cohesion) was encountered beneath the mixed fill. The silt fill was loose/stiff becoming soft/loose at 2.1 m depth and penetrated at 2.9 m (elevation 191.7). Moisture contents ranged from 12 to 18%.

Silt

A major deposit of non-cohesive silt of glaciolacustrine origin was encountered below the silt fill at 2.9 m depth (elevation 191.7). The silt was compact, becoming loose at 7.0 m depth. The silt layer had a moisture content range of 17 to 22%, typically 21%. The results of grain size distribution analyses and an Atterberg Limits test conducted on the silt are presented on Figures 1 and 2.

Silt Till

A non-cohesive silt till unit was contacted beneath the silt at 10.0 m depth (elevation 184.6). The till was very dense with a moisture content of 6%. Drilling was terminated within this layer at a depth of 11.0 m.

Groundwater

Free water was not observed in the borehole during or upon completion of augering.

CLOSURE

The fieldwork was carried out under the supervision of Mr. M. Rapsey and direction of Mr. M.R. Anderson, P.Eng. The equipment was supplied by Elite Drilling.

The report was prepared by Mr. P. Cullen, B.Eng., and Mr. M.R. Anderson, P.Eng., Project Engineer. It was reviewed by Mr. D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton.

Yours very truly

Peto MacCallum Ltd.



Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services

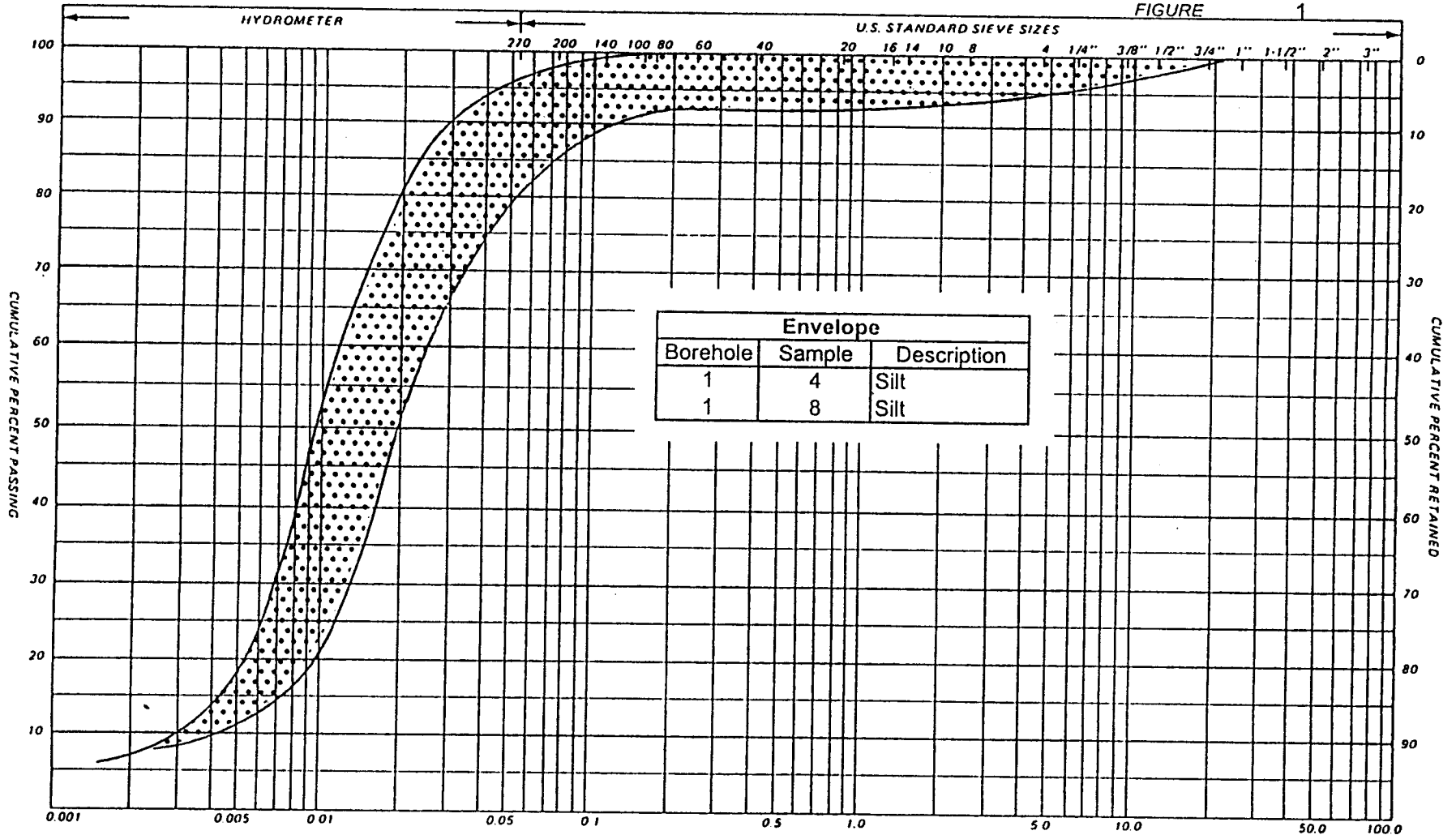


Brian R. Gray, M.Eng., P.Eng.,
Vice-President
Geotechnical and
Geo-Environmental Services

DWK:dl

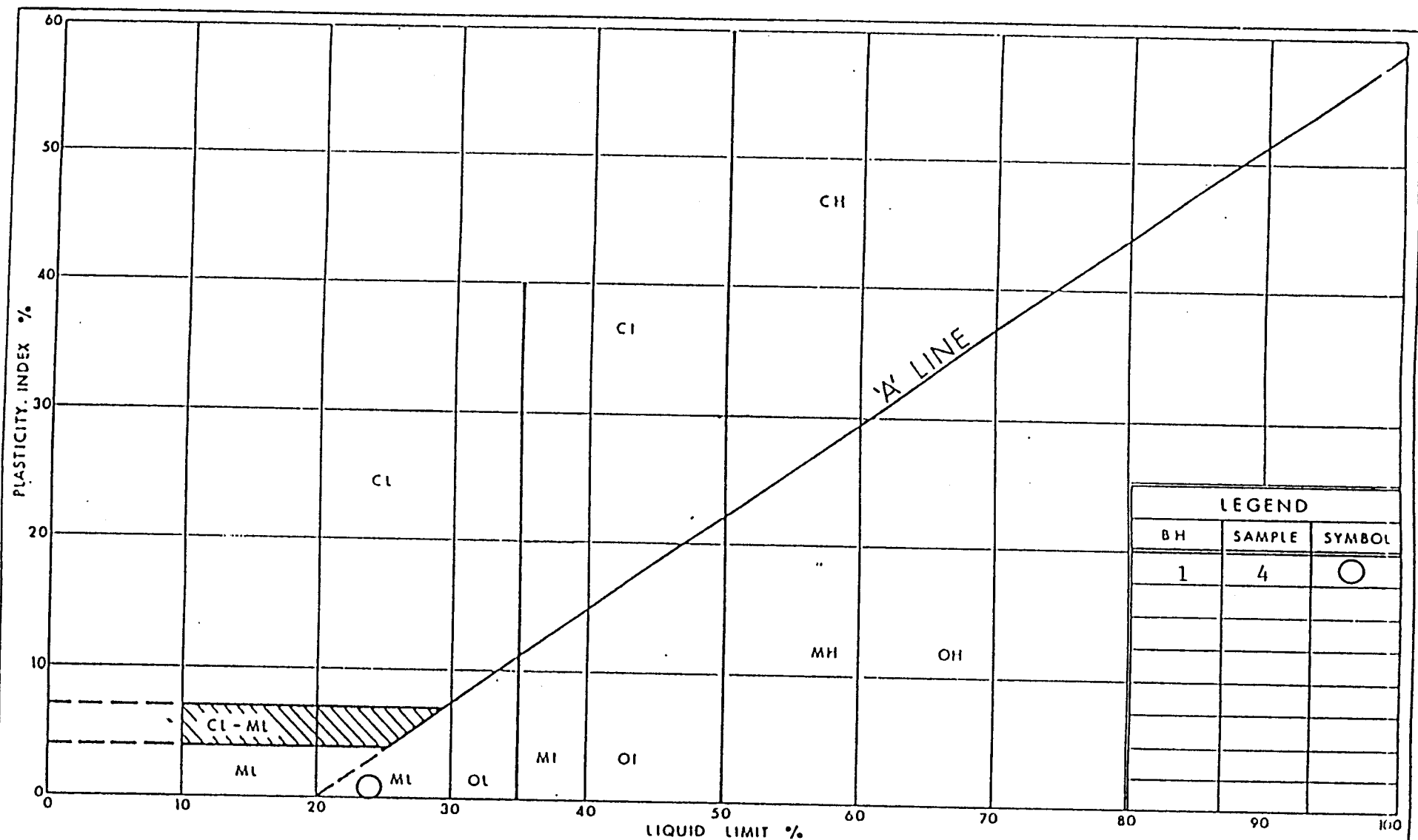
PARTICLE SIZE DISTRIBUTION CHART

PML REF. 98HF100C
REPORT NO. 1
FIGURE 1



GRAIN SIZE IN MILLIMETERS										UNIFIED			
SILT & CLAY				FINE		MEDIUM		COARSE			GRAVEL	COB. (No. 20)	
CLAY	FINE		MEDIUM		COARSE		SAND		GRAVEL				COBBLES
	SILT		FINE		MEDIUM		SAND		COARSE				
CLAY		SILT		V. FINE		FINE		MED.		COARSE		GRAVEL	U.S. BUREAU
				SAND									

REMARKS _____



Ministry of
Transportation

PLASTICITY CHART

SILT

FIG No 2

G.W.P. 309-94-00

Bridge 8

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N'. - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3 m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5 kg HAMMER FALLING FREELY A DISTANCE OF 0.76 m.

DYNAMIC PENETRATION RESISTANCE: - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51 mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS. 0.3 m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J 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/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 – 2	0 – 12	VERY LOOSE	0 – 4
SOFT	2 – 4	12 – 25	LOOSE	4 – 10
FIRM	4 – 8	25 – 50	COMPACT	10 – 30
STIFF	8 – 15	50 – 100	DENSE	30 – 50
VERY STIFF	15 – 30	100 – 200	VERY DENSE	> 50
HARD	> 30	> 200		
W.T.P.L. WETTER THAN PLASTIC LIMIT			D.T.P.L. DRIER THAN PLASTIC LIMIT	
A.P.L. ABOUT PLASTIC LIMIT				

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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

▲, Δ - UNDISTURBED AND REMOULDED SHEAR STRENGTH DETERMINED FROM IN SITU VANE TEST.

■ - UNDRAINED SHEAR STRENGTH DETERMINED FROM POCKET PENETROMETER TEST.

LOG OF BOREHOLE NO. 1

N 4 772 765

E 336 093

PROJECT GWP 309-94-00 HIGHWAY 420 RECONSTRUCTION - QEW to RAINBOW BRIDGE

OUR PROJECT 98HF100C

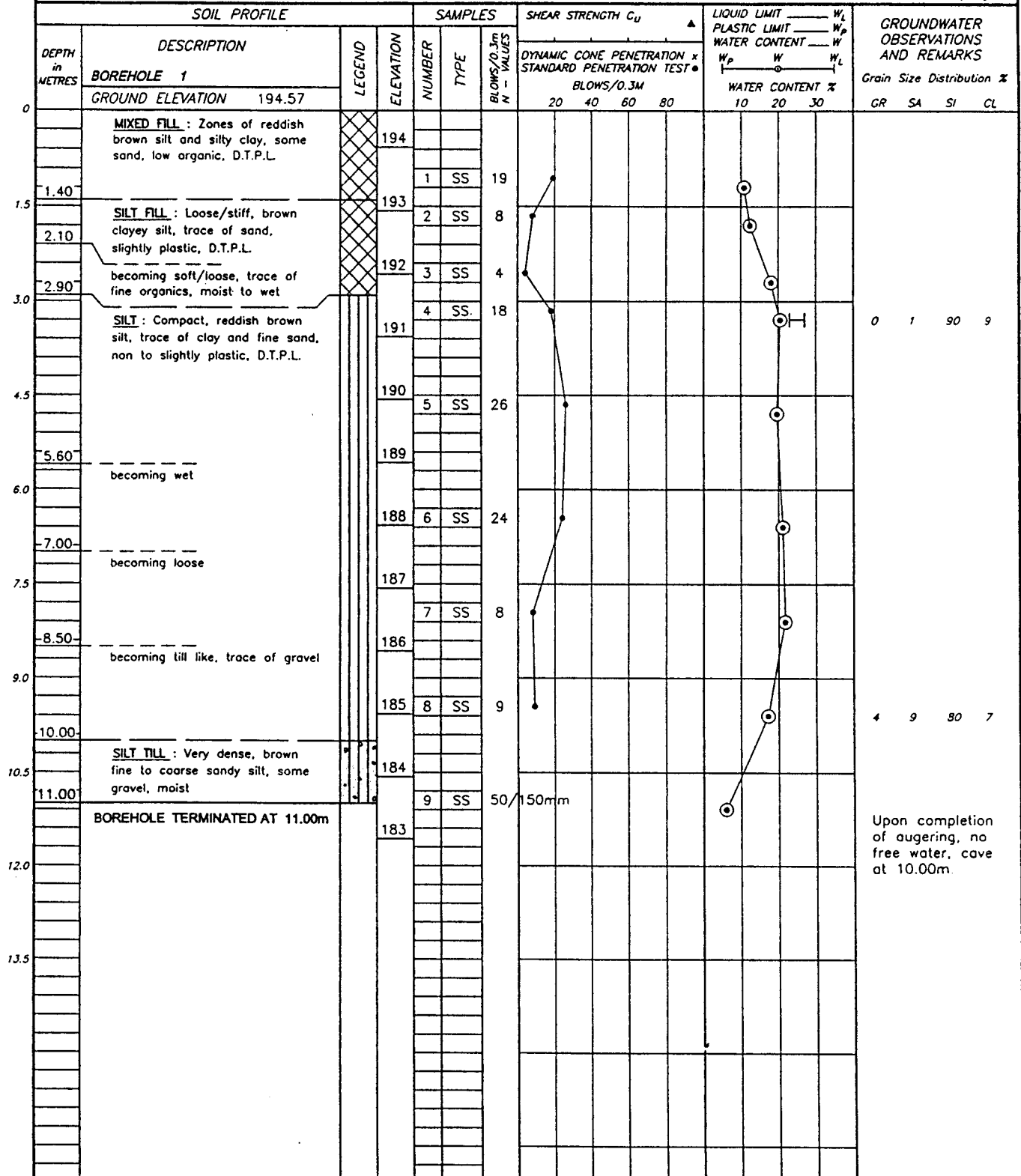
LOCATION Bridge 8 Structure, Niagara Falls, Ontario

BORING DATE July 19, 1999

ENGINEER P. Cullen

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Rapsey



NOTES:

CHECKED BY: 

N 4 772 771

E 336 084


OUR PROJECT 98HF100C

BORING DATE July 19, 1999

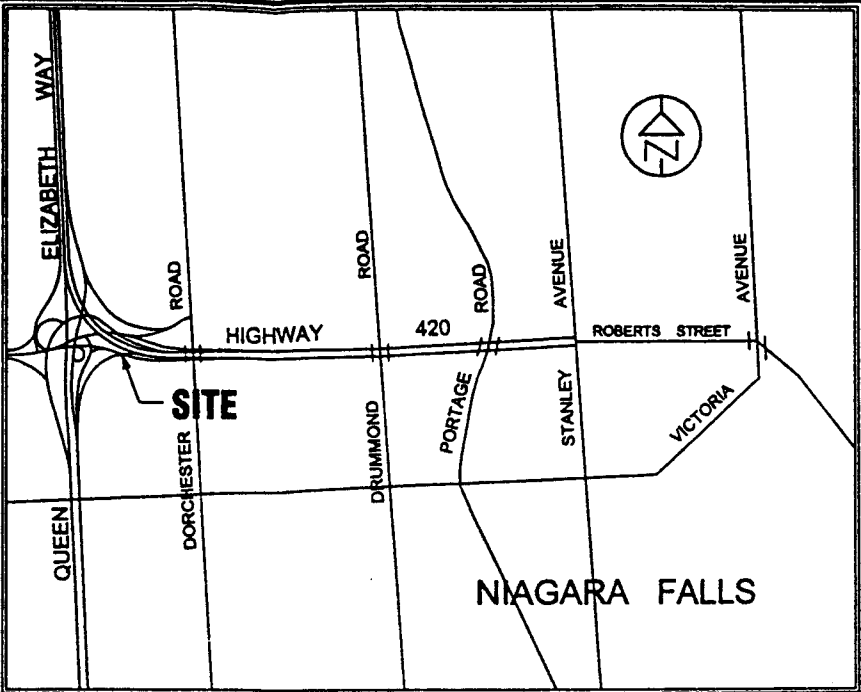
ENGINEER P. Cullen

TECHNICIAN M. Rapsey

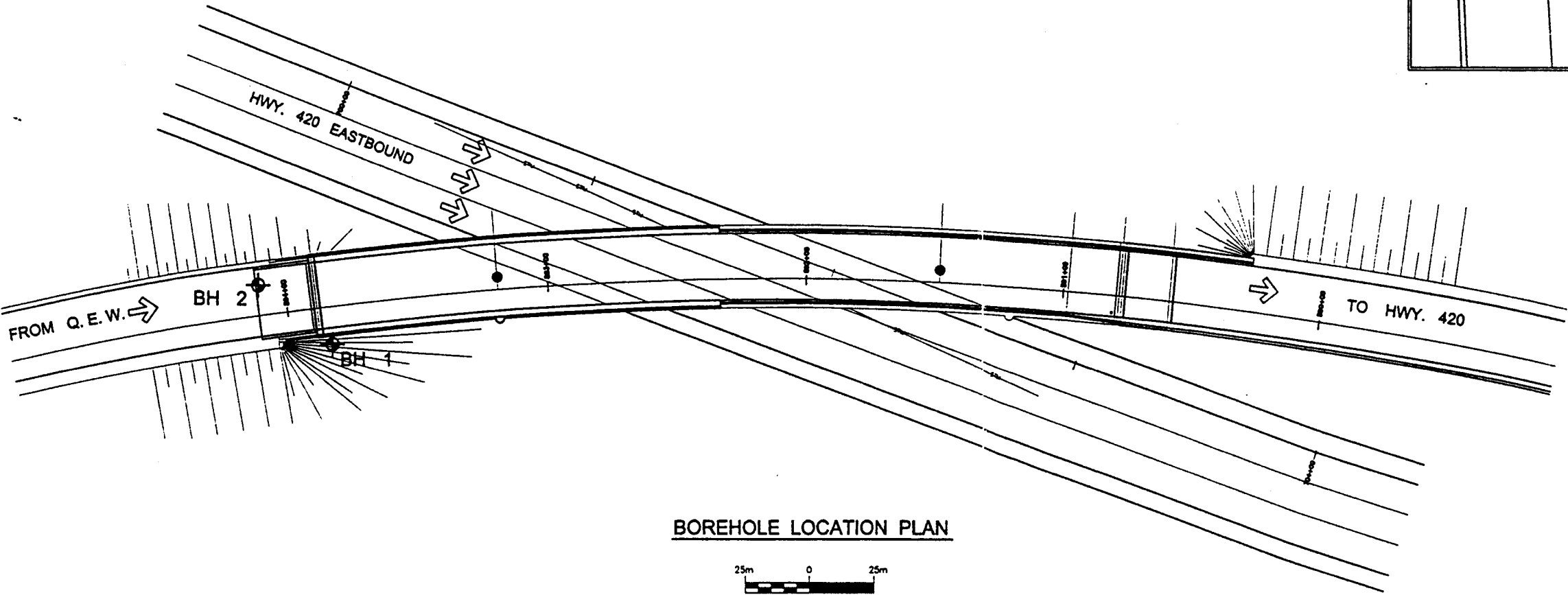
Upon completion
of augering,
no free water,
no cave.

CHECKED BY: 

G.W.P. 309-94-00
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEY PLAN



BOREHOLE LOCATION PLAN

BOREHOLE	NORTHING	EASTING	ELEVATION
BH 1	N 4 772 765	E 336 093	194.57
BH 2	N 4 772 771	E 336 084	196.87

LEGEND

BOREHOLE

NOTE

1. REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.
2. PLAN REPRODUCED FROM UNDATED GENERAL ARRANGEMENT DRAWINGS OF BRIDGE 8, PROVIDED BY PHILIPS PLANNING AND ENGINEERING LIMITED.

BRIDGE NO. 8
AND
HIGHWAY 420
REGIONAL MUNICIPALITY OF NIAGARA

Peto MacCallum Ltd.
CONSULTING ENGINEERS
45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C8

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED	PC	OCT. 1999	AS SHOWN	98HF100C	1
APPROVED	DWK				

BOREHOLE LOCATION PLAN

**FOUNDATION INVESTIGATION REPORT
FOR
CNR BRIDGE
QEW/HIGHWAY 420 INTERCHANGE
W.P. 123-00-01
NIAGARA FALLS, ONTARIO**

Distribution:

- 6 cc: Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Digital copies, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Foundation Investigation Report, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 1 cc: Digital copy, Foundation Investigation Report, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Philips Engineering Ltd.
- 1 cc: Digital copy, Philips Engineering Ltd.
- 1 cc: PML Hamilton
- 1 cc: PML Toronto

PML Ref: 00HF119A
Geocres No. not assigned

May, 2001

TABLE OF CONTENTS

INTRODUCTION	1
SITE DESCRIPTION	1
INVESTIGATION PROCEDURES	2
SUMMARIZED SUBSURFACE CONDITIONS.....	3
Pavement Structure.....	4
Fill	4
Topsoil	4
Clay.....	5
Silt to Fine Sand.....	5
Bedrock.....	6
CLOSURE	8

FOUNDATION INVESTIGATION REPORT

For
CNR Bridge
QEW/Highway 420 Interchange
W.P. 123-00-01
Niagara Falls, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed replacement of the existing single-span structure that carries the southbound lanes of the QEW over the CN railway at the QEW/Highway 420 interchange in Niagara Falls, Ontario. The investigation was conducted for Philips Engineering Ltd. on behalf of the Ontario Ministry of Transportation.

The proposed overpass structure will comprise a single span. The QEW southbound lanes and exit ramp to Lundy's Lane will cross the CN railway at approximate Station 15+666, QEW chainage.

Road grade over the structure will be raised approximately 0.6 m above the existing grade. The CN railway is near elevation 194.4 under the existing bridge.

The report pertains to the proposed bridge structure and approaches within about 20 m of the abutments.

SITE DESCRIPTION

The existing structure carries the southbound lanes of the QEW and the N(QEW) – W(Lundy's Lane) ramp over the CN railway. The QEW is constructed on an approach embankment raised above the grade of the surrounding lands.

The surrounding lands are developed for commercial, light industrial, and residential purposes.

The site is located in the broad physiographic region known as the Haldimand Clay Plain. In general, the topography on the plain is relatively flat to undulating. The overburden is typically some 10 to 15 m thick and typically comprises deposits of glaciolacustrine clay, silt and sand. Bedrock consists of dolostone of the Lockport Formation.

INVESTIGATION PROCEDURES

The fieldwork was carried out during the period January 17 to 19, 2001 and comprised six boreholes drilled at the locations indicated on Drawing 1, appended. Four boreholes were extended to bedrock at the corners of the abutments, two of which were advanced approximately 3.0 m and 4.3 m into bedrock. Two boreholes were drilled to depths of about 8.1 and 9.6 m in the approaches some 20 m beyond the abutments.

The borehole locations were selected by Peto MacCallum Ltd., subject to access limitations in the field. The MTO co-ordinates and ground surface elevations at the boreholes were interpolated from untitled and undated drawings provided by Philips Engineering Ltd.

The boreholes were advanced using continuous flight solid stem augers and NXL rock coring equipment, powered by a truck-mounted CME-75 drillrig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

In the deep boreholes drilled at opposite corners of the north and south abutments, casing was extended to the bedrock surface and an approximate 3.0 and 4.3 m length of rock core was recovered using NXL rock coring equipment.

The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Grain size distribution analyses and Atterberg Limits tests were carried out on selected samples.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, elevation of the boundary between stratigraphic units, standard penetration test "N" values, and groundwater observations. The results of laboratory grain size distribution analyses, Atterberg Limits tests, and moisture content determinations are also shown.

The borehole locations and a stratigraphic profile prepared from the borehole data are presented on Drawing 1.

The subsurface stratigraphy revealed at the CN bridge site generally comprised a surficial pavement structure overlying approach fill over a topsoil layer. The fill/topsoil was underlain by native clay, silt and/or sand deposits mantling bedrock. The strata encountered are summarized below:

Pavement Structure

The surficial pavement structure was encountered in boreholes 1 and 3 to 5, and varied in thickness from 330 to 1200 mm, typically 330 mm to 460 mm. The pavement structure comprised 145 to 255 mm, locally 25 mm, of asphalt over crushed limestone and/or concrete. The concrete thickness ranged from 195 to 305 mm.

Fill

Fill was revealed surficially in boreholes 2 and 6 and below the pavement structure in the remaining boreholes. The fill typically comprised loose to compact, locally dense, non-cohesive silt to silty fine sand and locally stiff cohesive silty clay. The moisture content of the fill ranged from 7 to 25%, typically 15 to 20%. The fill layer ranged from 6.7 to 7.9 m in thickness and was penetrated at depths of 7.2 to 7.9 m (elevation 194.0 to 194.9). Drilling was terminated within the fill in borehole 5 at a depth of 8.1 m. The results of particle size distribution analyses conducted on the fill are presented on Figure 1.

Topsoil

A 0.7 to 1.6 m thick topsoil layer was encountered beneath the fill in three of the abutment boreholes (1, 2 and 3) and one of the approach holes (borehole 6). The topsoil consisted of non-cohesive silt or sandy silt and was loose to very loose. The moisture content of the topsoil ranged from 18 to 27%. The topsoil was contacted at depths ranging from 7.2 to 7.9 m, typically 7.9 m (elevation 194.0 to 194.9) and was penetrated in all four boreholes at depths of 8.6 to 9.5 m (elevation 192.5 to 193.5).

Clay

A layer of cohesive silty clay was encountered below the topsoil in boreholes 1, 2, 3 and 6. The consistency of the clay ranged from very stiff to hard with a moisture content range of 20 to 22%. The clay layer was 0.8 and 1.5 m thick in boreholes 2 and 3 and was penetrated at depths of 10.2 and 10.4 m (elevation 191.7 and 191.9). In situ testing/sampling in borehole 1 was terminated in clay at 9.6 m depth and the hole was extended to bedrock by power augering; drilling was terminated within the clay in borehole 6 at a depth of 9.6 m.

The results of particle size distribution analyses conducted on the clay are presented on Figure 2. Liquid limits of 48 and 53 and plasticity indices of 27 and 30 were determined on two selected samples of the clay, indicating a medium to high plastic clay (refer to Figure 4).

Silt to Fine Sand

A major non-cohesive deposit of silt to fine sand with silt was contacted at 7.3 to 10.4 m depth (elevation 191.7 to 194.6) in boreholes 2, 3 and 4. The relative density of the silt/sand was dense to very dense, locally compact in borehole 4. The silt/sand deposit was 9.0 and 9.7 m thick in boreholes 2 and 3. In situ testing/sampling in borehole 4 was terminated 0.8 m into the silt/sand at 8.1 m depth and the hole was extended to bedrock by power augering.

The results of the grain size distribution analyses conducted on the silt/sand are presented on Figure 3. In general, the silt/sand was non-plastic with a trace of clay, locally with lenses/layers of clay. Moisture contents ranged from 11 to 21%. The silt mantled bedrock in boreholes 2 and 3.

Bedrock

Bedrock or probable bedrock was contacted below the overburden in boreholes 1 to 4 at the following depths and elevations:

Location	Depth to Rock (m)	Bedrock Elevation
North Abutment, East End	19.5	182.5
North Abutment, West End	20.0	182.2
South Abutment, East End	19.2	182.7
South Abutment, West End	18.6	183.3

The bedrock consists of dolostone. A geologic description of the rock cores recovered from boreholes 2 and 3 is provided in Table I. Core recovery was typically 100%, 95% in one run.

The RQD determined from the rock cores ranged from 18 to 30% (very poor to poor quality) in the upper 2.7 m at the east end of the south abutment, increasing to 80% (good quality) in the bottom 1.5 m. The RQD determined from core recovered from the west end of the north abutment ranged from 77 to 85%, indicating good quality rock.

The unconfined compressive strengths of selected rock core samples were as follows:

Borehole	Depth (m)	Unconfined Compressive Strength (MPa)
2	21.9	58.4
2	23.4	17.2
3	20.1	45.2
3	21.7	37.6

Groundwater

Water was observed upon completion of augering in two boreholes at the following depths/elevations:

Borehole	Depth to Water (m)	Elevation
1	16.2	185.8
3	15.3	186.9

Below a depth of 7.6 m, the lower 0.3 m of the fill in borehole 3 was saturated. Water was not detected in the remaining boreholes during the fieldwork.

Observed groundwater levels are subject to seasonal fluctuations and rainfall patterns.

CLOSURE


The fieldwork was carried out under the supervision of Mr. M. Rapsey. Direction of the fieldwork was provided by Mr. M.R. Anderson, P.Eng. and Mr. P. Cullen, B.Eng. The equipment was supplied by Elite Drilling.

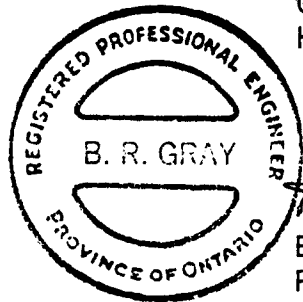
The report was prepared by Mr. P. Cullen, B.Eng. and Mr. M.R. Anderson, P.Eng., Senior Project Engineer, and reviewed by Mr. D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton.


Yours very truly

Peto MacCallum Ltd.




Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services
Hamilton




Brian R. Gray, M.Eng., P.Eng.
President

MRA:lh

TABLE I

**ROCK CORE DESCRIPTION
CNR BRIDGE
QEW/HIGHWAY 420 INTERCHANGE
W.P. 123-00-01
NIAGARA FALLS, ONTARIO**

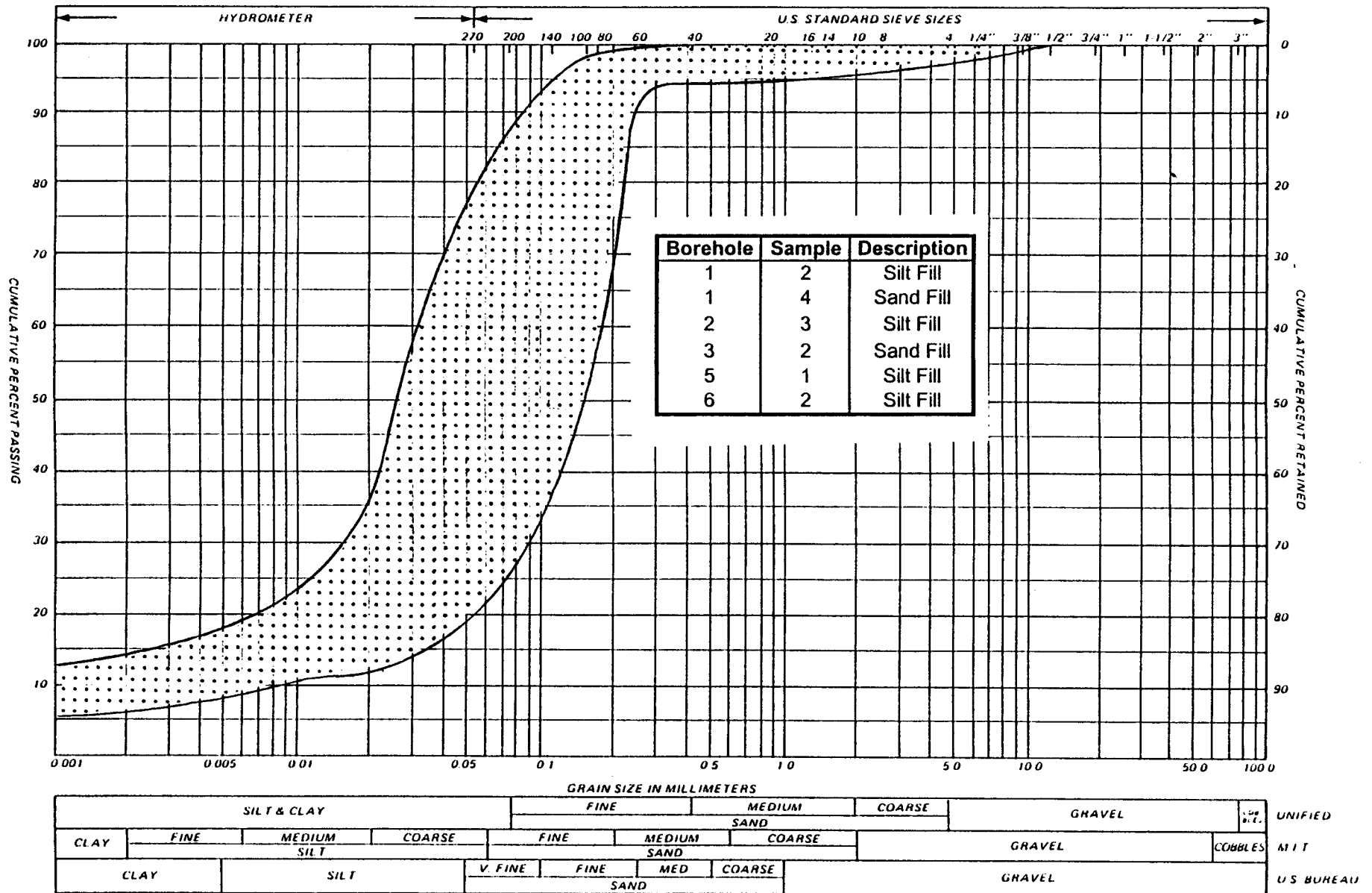
CORE RECOVERY					CORE DESCRIPTION	
BOREHOLE	CORE NO.	RUN (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
2	11	19.20 – 20.40	100	30	19.20 – 23.45	DOLOSTONE: Dark grey to grey aphanitic to fine crystalline; medium to high strength; unweathered to moderately weathered; occ black shaly/petroliferous partings, occ vugs with calcite, quartz, sphalerite, very porous with occ solution cavities, occ styolitic partings; very close to wide spaced flat to dipping partings, smooth planar, tight/slightly altered with red encrustation or clay filling; poor to good quality.
	12	20.40 – 21.93	100	18		
	13	21.93 – 23.45	95	80		
3	11	20.00 – 21.53	100	77	20.00 – 23.05	DOLOSTONE: Grey fine crystalline; high strength; slightly weathered; occ vugs with calcite, quartz, occ styolitic partings; very close to moderate spaced flat partings, smooth planar, tight/slightly altered with red or white encrustation or clay filling; good to excellent quality.
	12	21.53 – 23.05	100	85		

RQD = Rock Quality Designation

Logged by J. Wright

PARTICLE SIZE DISTRIBUTION CHART

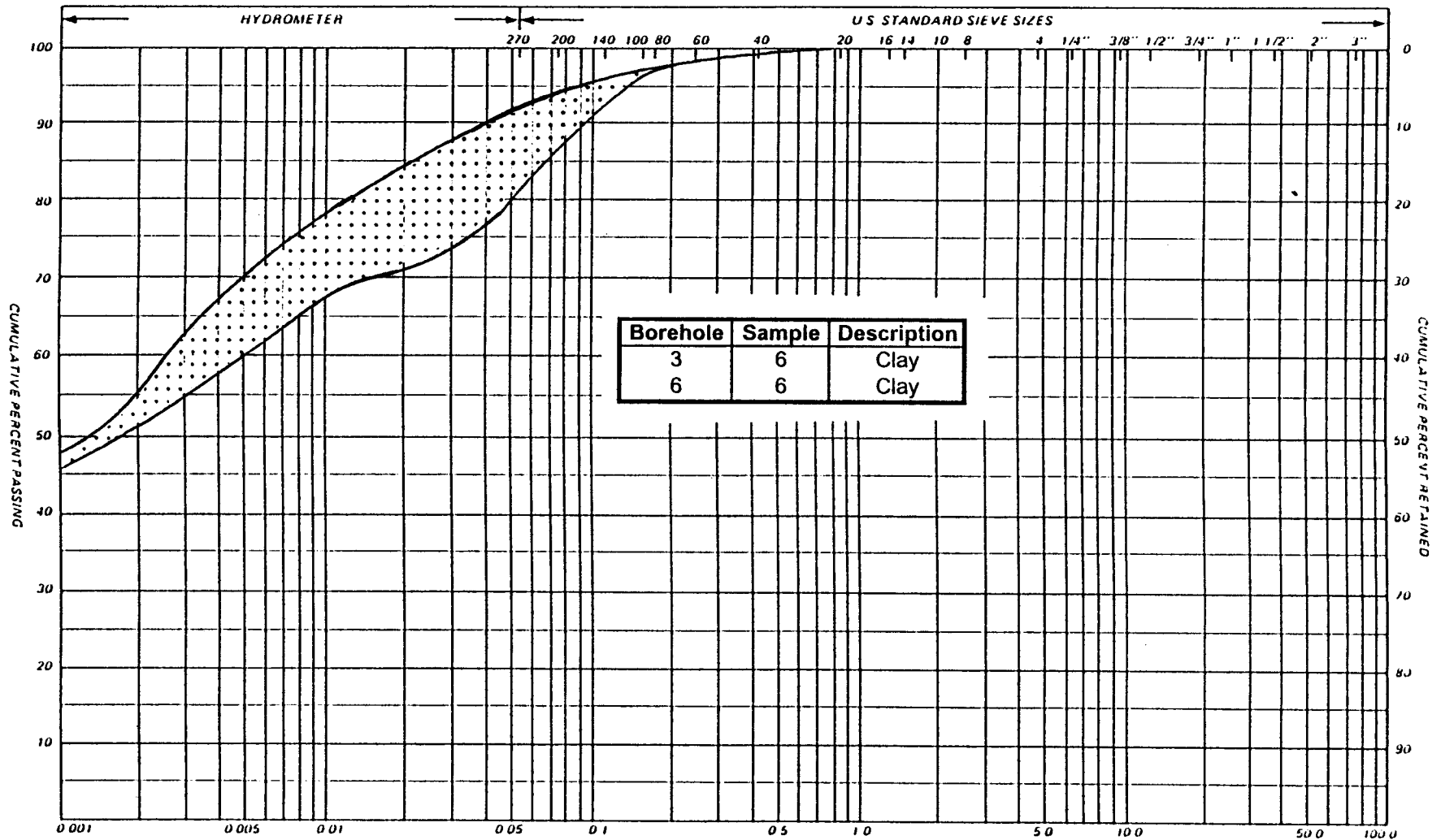
PML REF. 00HF119A
W.P. No. 123-00-01
FIGURE 1



REMARKS Silt/Sand Fill

PARTICLE SIZE DISTRIBUTION CHART

PML REF. 00HF119A
W.P. No. 123-00-01
FIGURE 2

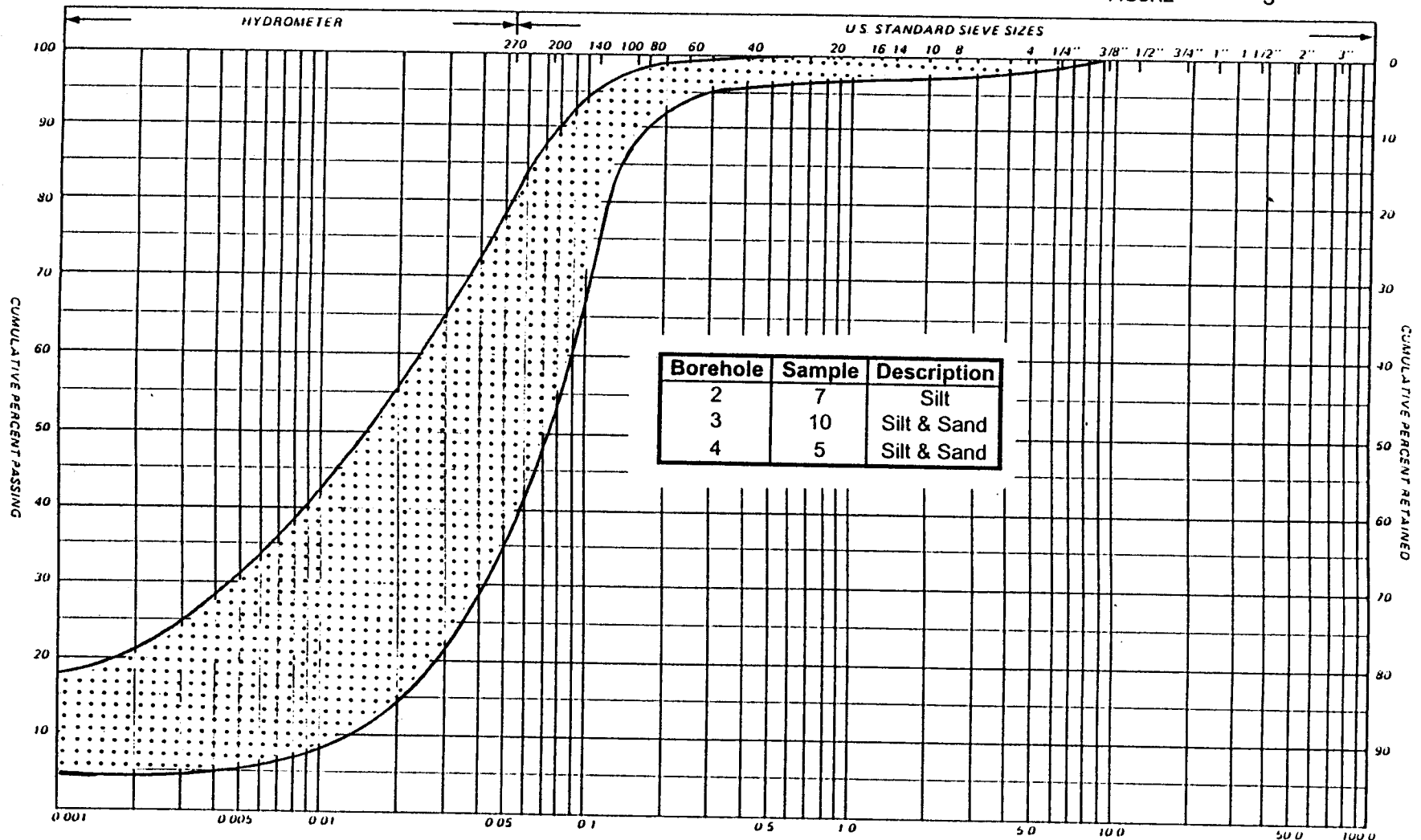


GRAIN SIZE IN MILLIMETERS										UNIFIED
SILT & CLAY				FINE		MEDIUM SAND		COARSE	GRAVEL	
CLAY	FINE		MEDIUM SILT	COARSE	FINE	MEDIUM SAND		COARSE	GRAVEL	LIABLES
CLAY		SILT		V. FINE	FINE	MED	COARSE	SAND		GRAVEL
										U.S. BUREAU

REMARKS Clay

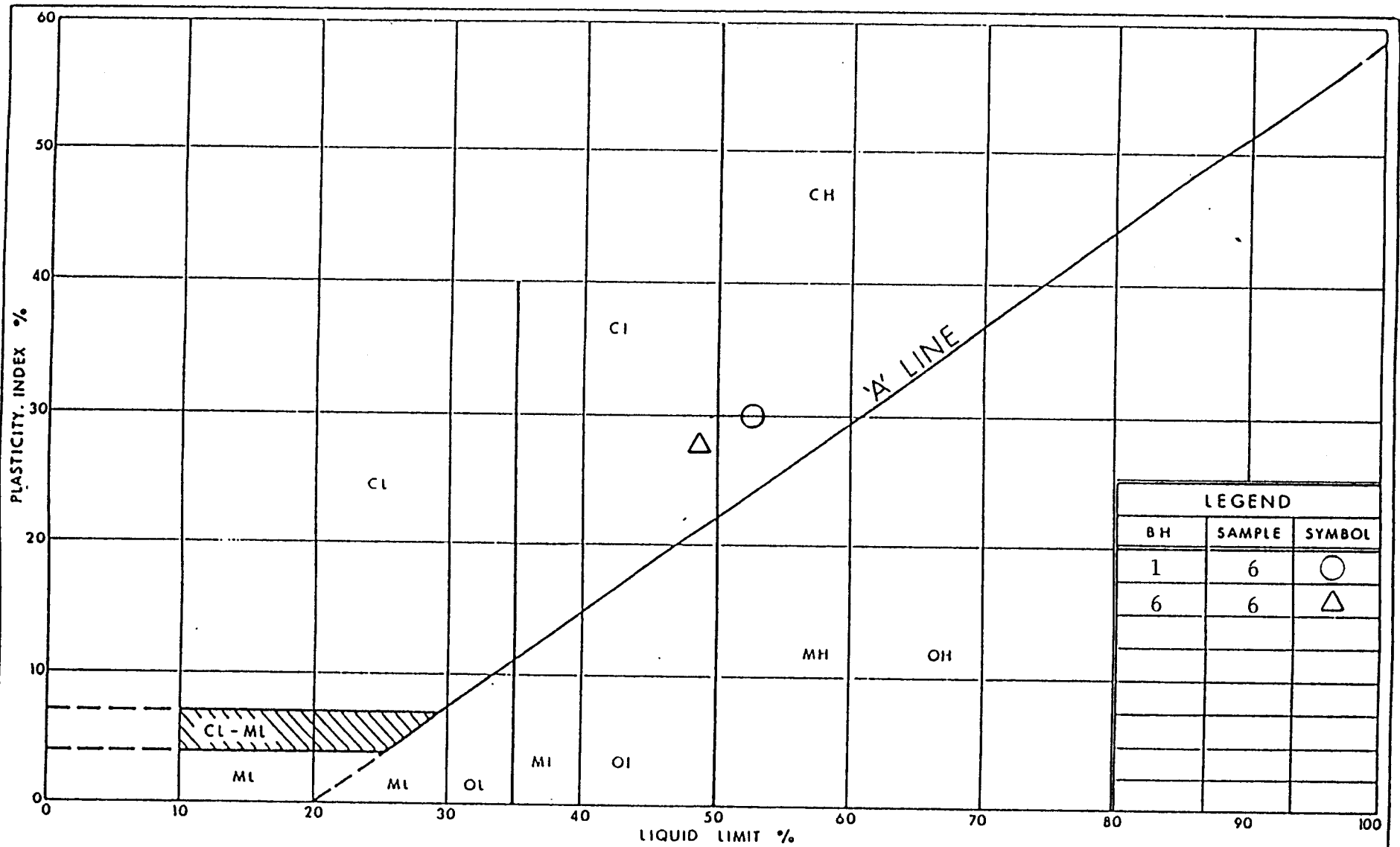
PARTICLE SIZE DISTRIBUTION CHART

PML REF. 00HF119A
W.P. No. 123-00-01
FIGURE 3



GRAIN SIZE IN MILLIMETERS									
SILT & CLAY				FINE SAND			MEDIUM SAND		
CLAY		FINE SILT		COARSE SILT		FINE SAND		COARSE SAND	
CLAY		SILT		V. FINE SAND		FINE SAND		COARSE SAND	

REMARKS Silt/Sand



LEGEND		
BH	SAMPLE	SYMBOL
1	6	○
6	6	△



Ministry of
Transportation

PLASTICITY CHART CLAY

FIG No 4

WP123-00-01

00HF119A

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 0.3m INTO THE SUBSOIL, THE DRIVING ENERGY BEING 475 J 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/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

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	UNOAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNOAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL		

▲, Δ - Undisturbed and remoulded shear strength determined from in situ vane test.

■ - Undrained shear strength determined from pocket penetrometer test.

RECORD OF BOREHOLE No 1

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario
DIST. HWY. QEW BÓRING DATE Jan. 19, 2001
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY M.R.A.

[illegible]

N 4 773 186
E 335 670

RECORD OF BOREHOLE No 1 Cont'd

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario ORIGINATED BY M.R.
DIST. HWY. QEW BORING DATE Jan. 19, 2001 COMPILED BY P.C.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers CHECKED BY M.R.A.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION					LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	N - VALUES		RESISTANCE PLOT	STANDARD PENETRATION TEST	SHEAR STRENGTH (kPa)		PLASTIC LIMIT		WATER CONTENT			
								20	40	60	80	100	W _p	W	W _L	
16.5	Ground Level															
						185										
18.0	184.0					184										
	18.00 becoming gravelly															
						183										
19.5	182.5					182										
	19.50 End of Borehole Probable Bedrock Refusal to Auger															
21.0																
22.5																
24.0																
25.5																
27.0																
28.5																
30.0																
32.5																
34.0																

UPON COMPLETION
OF AUGERING,
WATER AT 16.20m.
NO CAVE IN

RECORD OF BOREHOLE № 2

Page 1 of 2

N 4 773 144

E 335 677

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario

ORIGINATED BY M.R.

DIST. _____ HWY. OE BORING DATE Jan. 17, 2001

COMPILED BY P.C.

DATUM Geodetic **BOREHOLE TYPE** Cont. Flight Solid Stem Augers/NXL Rock Coring

CHECKED BY M.R.A.

[illegible]

N 4 773 144
E 335 677

ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY M.R.A.

[illegible]

RECORD OF BOREHOLE № 3

ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY M.R.A.

[illegible]

RECORD OF BOREHOLE No 3 Cont'd

N 4 773 175
E 335 647

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario ORIGINATED BY M.R.
DIST. HWY. QEW BORING DATE Jan. 18, 2001 COMPILED BY P.C.
DATUM Geodetic BOREHOLE TYPE Cont. Flight Solid Stem Augers/NXL Rock Coring CHECKED BY M.R.A.

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION		LIQUID LIMIT		UNIT WEIGHT	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N - VALUES	RESISTANCE PLOT	PLASTIC LIMIT	WATER CONTENT			
						20 40 60 80 100	W _L	W _P			
16.5	Ground Level										
16.75	Silt and fine sand trace of clay										
	Saturated										
18.0	Dense Brown										
18.3			10	SS	49						
18.75	gravelly										
19.5											
182.2											
20.00	Bedrock, Dolostone										
21.0			11	RC		1525	100	77			
22.5			12	RC		1525	100	85			
179.2											
23.05	End of Borehole										
24.0											
25.5											
27.0											
28.5											
30.0											
32.5											
34.0											

UPON COMPLETION
OF AUGERING,
WATER AT
15.30m.

SOIL PROFILE			SAMPLES			GROUND WATER		DYNAMIC CONE PENETRATION		LIQUID LIMIT		UNIT WEIGHT	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	N - VALUES	ELEV.	RESISTANCE PLOT	STANDARD PENETRATION TEST	WATER CONTENT	PLASTIC LIMIT	WATER CONTENT		
0.00	Ground Level												
0.33	Pavement Structure, 25mm asphalt over 305mm concrete												
1.5	Fill, Silt, trace of fine sand		1	SS	4	201							
3.0	Loose Brown		2	SS	3	200							
4.5			3	SS	8	199							
6.0	mottled dark brown, trace of clay		4	SS	9	198							
7.5	Silt and fine sand, occasional inclusions of brown clayey silt, wet		5	SS	10	197							
8.10	Compact Brown					196							
9.0	End of Sampled Borehole					195							
10.5						194							
12.0						193							
13.5						192							
15.0						191							
16.5						190							
						189							
						188							
						187							
						186							
						185							

RECORD OF BOREHOLE No 4 Cont'd

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario
 DIST. HWY. QEW BORING DATE Jan. 17, 2001
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
 COMPILED BY P.C.
 CHECKED BY M.R.A.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N - VALUES		20	40	60	80	100	W_p	W	W_L		
16.5	Ground Level															
						185										
						184										
18.0																
183.3																
18.60	End of Borehole Probable Bedrock Refusal to Auger					183										
19.5																
21.0																
22.5																
24.0																
25.5																
27.0																
28.5																
30.0																
32.5																
34.0																

UPON COMPLETION
OF AUGERING, NO
WATER, NO CAVE.

N	4	773	208
E		335	668

ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY M.R.A.

[illegible]

RECORD OF BOREHOLE No 6

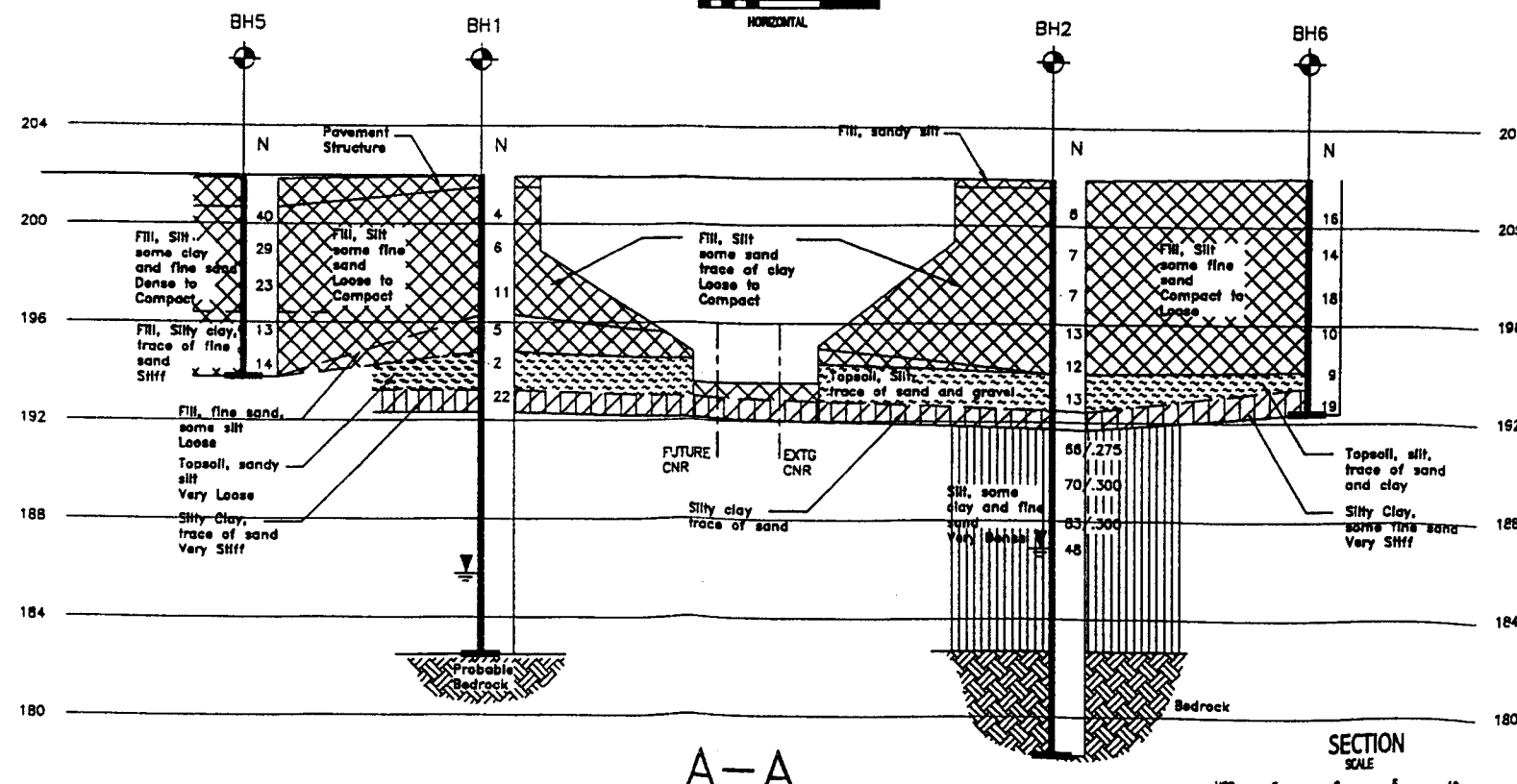
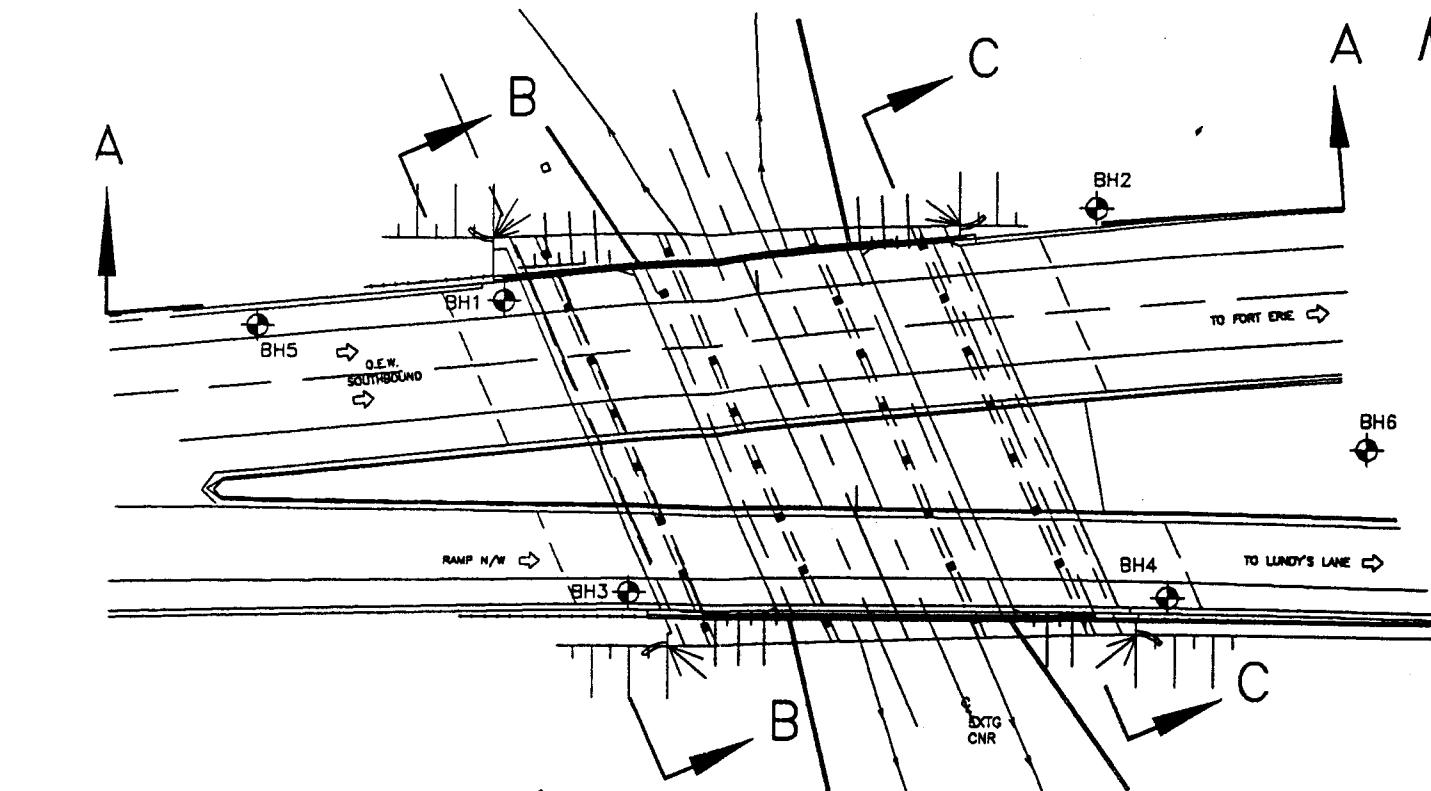
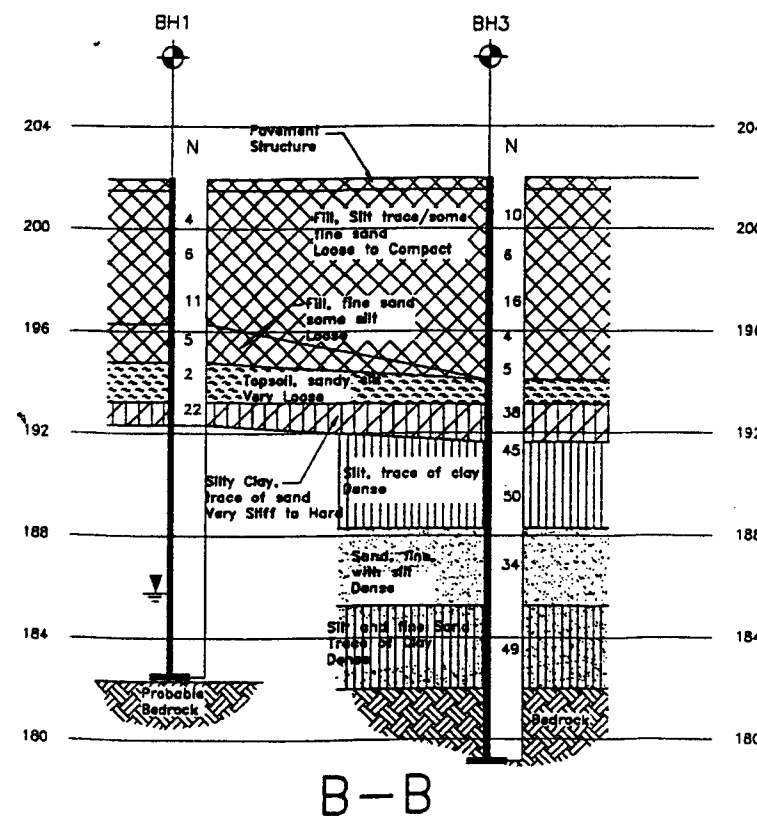
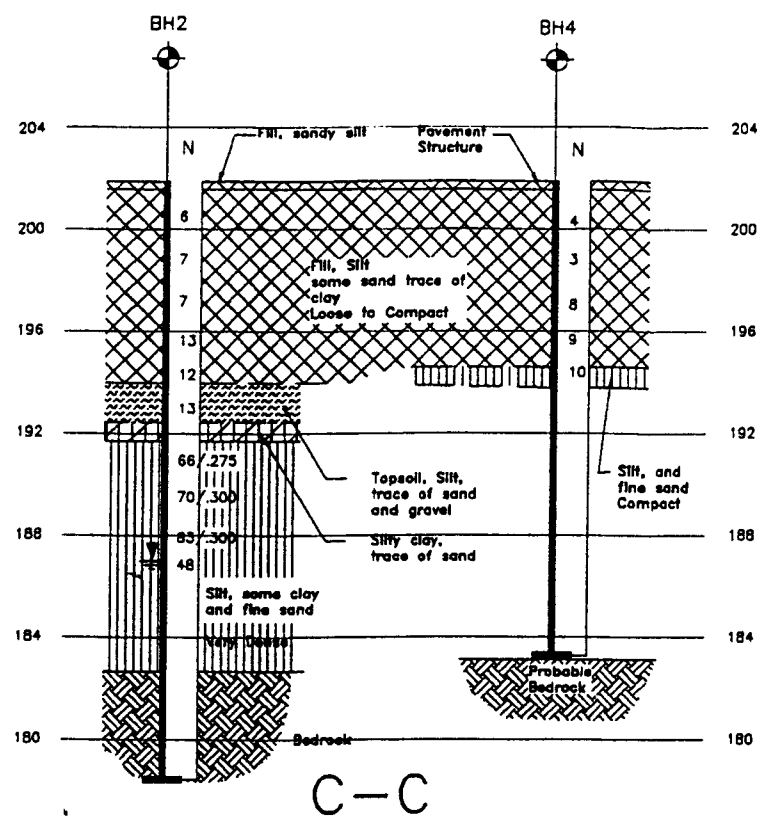
N 4 773 119
E 335 659

W.P. 123-00-01 LOCATION Hwy. 420/QEW CNR Bridge, Niagara Falls, Ontario
DIST. HWY. QEW BORING DATE Jan. 19, 2001
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY M.R.A.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION * RESISTANCE PLOT STANDARD PENETRATION TEST *				LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			UNIT WEIGHT Y kN/m ³	REMARKS % GR. SA. SI. CL.			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N - VALUES		20	40	60	80	100	W _P	W	W _L				
202.0	Ground Level																	
0.00	Fill, Sand and Gravel with silt																	
201.6																		
0.41	Brown																	
1.5	Fill, Silt, some fine sand																	
	Compact Brown		1	SS	16													
199.6																		
2.40	with occasional lenses of brown silty clay																	
3.0			2	SS	14												0	16 71 13
198.0																		
4.00	with occasional lenses of dark brown sandy silt topsoil																	
4.5			3	SS	18													
196.5	becoming loose																	
5.50																		
6.0			4	SS	10													
195.5	Layer of sandy silt topsoil																	
6.55																		
195.3	dark brown																	
7.00	wet																	
194.1																		
7.90	Topsoil, silt, trace of sand and clay		5	SS	9													
193.8	dark brown																	
8.55																		
9.0	Silty clay, some fine sand, fissured																	
192.4			6	SS	19												0	13 35 52
9.60	very stiff Brown																	
10.5	End of Borehole																	
12.0																		
13.5																		
15																		
16.5																		

UPON COMPLETION OF AUGERING, NO WATER, NO CAVE-IN.



METRIC

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

CONT No

WP No 123-00-01

Q.E.W./HWY 420 - CNR BRIDGE

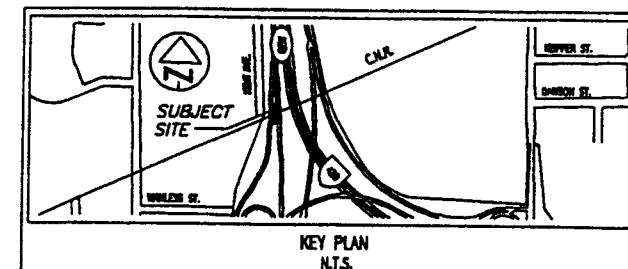
Q.E.W./HWY 420 INTERCHANGE

BOREHOLE LOCATION & SOIL STRATA



SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Blows/0.3m (Std. Pen Test, 475 J / blow)
- Water level observed during drilling

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	202.0	4 773 186	335 670
2	201.9	4 773 144	335 677
3	202.2	4 773 175	335 647
4	201.9	4 773 136	335 647
5	201.9	4 773 208	335 668
6	202.0	4 773 119	335 659

NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

Geocres No.	
HWY No. Q.E.W.	DIST
SUBM'D P.C. CHECKED P.C.	DATE 2001 05 09 SITE
DRAWN M.M. CHECKED M.R.A.	APPROVED D.W.K. DWG 1

**FOUNDATION INVESTIGATION REPORT
FOR
HIGH MAST LIGHT FOUNDATIONS
HIGHWAY 420 AND QEW
W.P. 309-94-00
NIAGARA FALLS, ONTARIO**

Distribution:

- 6 cc: Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Digital copies, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Foundation Investigation Report, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 1 cc: Digital copy, Foundation Investigation Report, Philips Engineering Ltd. for distribution to Ministry of Transportation
- 2 cc: Philips Engineering Ltd.
- 1 cc: Digital copy, Philips Engineering Ltd.
- 1 cc: PML Hamilton
- 1 cc: PML Toronto

TABLE OF CONTENTS

INTRODUCTION	1
SITE DESCRIPTION	1
INVESTIGATION PROCEDURES	2
SUMMARIZED SUBSURFACE CONDITIONS.....	3
Pavement Structure	3
Fill	4
Topsoil	4
Localized Clay and Sand Layers	5
Silt.....	5
Silt Till	6
Groundwater	7
CLOSURE	8

FOUNDATION INVESTIGATION REPORT

For
High Mast Light Foundations
Highway 420 and QEW
W.P. 309-94-00
Niagara Falls, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for construction of 23 High Mast Light Foundations within the Highway 420/QEW interchange, from approximately 500 m north of Highway 420 to approximately 350 m east of Dorchester Road, and south to Lundy's Lane in Niagara Falls, Ontario. The investigation was conducted for Philips Engineering Ltd. Authorization to proceed with this project was provided verbally by Mr. Bob McLaughlin, P.Eng.

The purpose of this investigation was to define the subsurface conditions at the site and to provide geotechnical parameters for design of the high mast light foundations within the project limits (Station 10+000 to 12+000 N(QEW)-E(420) chainage, and Station 16+100 to 16+750 QEW chainage).

SITE DESCRIPTION

The site comprises the existing Highway 420/QEW interchange and extends southerly from approximately 500 m north of Highway 420 to Lundy's Lane along the QEW and east along Highway 420, to approximately 350 m north of Dorchester Road in Niagara Falls, Ontario.

The site is located in the broad physiographic region known as the Haldimand Clay Plain. In general, the topography on the plain is relatively flat to undulating. The overburden is some 10 to 15 m thick and typically comprises deposits of glaciolacustrine clay, silt and sand.

Bedrock consists of dolostone of the Lockport Formation.

INVESTIGATION PROCEDURES

The fieldwork was carried out during the period November 7 to 12, 2000 and comprised six boreholes (Nos. 1, 4, 5, 6, 11 and 12) drilled along the median shoulder of the N(QEW) Highway 420 ramp and the QEW south of Highway 420, SBL & NBL and six boreholes (Nos. 2, 3, 7, 8, 9 and 10) drilled within the QEW/420 interchange ramps. The boreholes were extended to depths of 6.7 to 9.6 m; four boreholes were terminated upon auger refusal. The borehole locations are shown on Drawings 1 to 3. The light pole locations relative to the respective boreholes are presented on Table I.

The borehole locations were selected by Peto MacCallum Ltd., subject to access limitations in the field. The MTO co-ordinates and ground surface elevations at the boreholes drilled off of the paved roadway were subsequently provided by Philips Engineering Ltd. Co-ordinates/ elevations of boreholes drilled within the paved median shoulders were interpolated from untitled and undated drawings provided by Philips Engineering Ltd.

The boreholes were advanced using continuous flight solid stem augers, powered by a truck-mounted CME-75 drillrig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Dynamic cone penetration testing was carried out at one location (borehole 8) to confirm the relative density of the soils.

The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork.

Piezometers were installed in boreholes 2, 7, 8 and 10 on November 12 and the water levels measured on November 20, 2000.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Grain size distribution analyses and Atterberg Limit tests were carried out on selected samples (Figures 1 to 7).

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard penetration test "N" values, and groundwater observations. The results of laboratory grain size distribution analyses and moisture content determinations are also shown.

The subsurface stratigraphy revealed along the site generally comprised a pavement, fill and/or topsoil layer overlying embankment fill or native silt deposits. Silt till, probable bedrock, and concrete were contacted below the silt locally. The strata encountered are summarized below:

Pavement Structure

A pavement structure was encountered in boreholes 1, 4, 5, 6 and 11 drilled within the paved median shoulder. The pavement consisted of 110 to 170 mm asphaltic concrete over 365 to 580 mm of crushed limestone/sand and gravel.

Borehole 12 was drilled within an area of the median shoulder where the asphalt was stripped for construction in the section to the south. A total granular thickness of 760 mm was revealed in this borehole.

Fill

Fill was encountered surficially in boreholes 3 and 10, and beneath the pavement structure/topsoil in boreholes 1, 4, 5, 6 and 9. The fill primarily comprised clayey silt to silt with a trace of clay. Occasional zones of topsoil, clay or granular material were revealed within the silt locally. In general, the fill was well compacted with moisture contents ranging from 11 to 19%.

The results of the grain size distribution analyses conducted on samples of the silt fill are presented on Figure 1. The results of Atterberg Limits tests conducted on samples exhibiting plasticity are presented on Figure 5. Plastic and liquid limits of 17 to 18 and 25 to 28, respectively, indicate a low plastic clayey silt to silty clay.

The fill was penetrated at depths of 1.1 to 2.5 m (elevation 190.5 to 194.4) in boreholes 3, 4, 6, 9 and 10. Drilling was terminated within the fill in borehole 1 at 9.6 m depth (elevation 193.3). Probable concrete was contacted below the fill at 8.1 m depth (elevation 185.0) in borehole 5 drilled adjacent to a hydro canal passing under Highway 420 near Dorchester Road.

Topsoil

A layer of clayey silt topsoil ranging from 130 to 150 mm in thickness was encountered surficially in boreholes 2, 7, 8 and 9, and beneath the fill in borehole 3. A 360 mm thick layer of topsoil fill was revealed below the pavement structure in borehole 5. The topsoil was penetrated at depths of 2.5 and 1.0 m (elevation 194.2 and 192.1) in boreholes 3 and 5 respectively.

Localized Clay and Sand Layers

Localized partings, lenses and layers of clay and sand were encountered within the overburden at various locations. Of note are the following layers:

- A 1.5 m thick layer of hard silty clay between 4.0 to 5.5 m depth in borehole 3.
- A 950 and 400 mm thick layer of clay encountered beneath the fill in borehole 10 and the pavement structure in borehole 11.
- Successive 400 to 700 mm thick layers of clay, sand, clay, silt, and clay encountered beneath the pavement structure in borehole 12. The layers were loose to compact/stiff to very stiff with moisture contents of 23 to 24%. The bottom clay layer was penetrated at a depth of 3.6 m (elevation 190.3).

The results of grain size distribution analyses conducted on samples of the clay are presented on Figure 2. The results of Atterberg Limits tests are presented on Figure 6. Liquid limits ranged from 33 to 42 and plastic limits ranged from 18 to 20, indicating a low to medium plastic clay.

Silt

A native non-cohesive silt deposit was contacted below the pavement structure, fill, topsoil and/or localized clay layers in all boreholes except 1 and 5. Locally in borehole 12, the upper 1.1 m of this unit was clayey.

The silt deposit was generally compact to dense, locally loose below 5.5 m depth in boreholes 4 and 7. A loose zone was also identified between 4.2 to 5.1 m in borehole 8; it was confirmed by dynamic cone penetration testing. Moisture contents ranged from 4 to 27%, typically 8 to 18%, increasing to 18 to 25% below 5 to 6 m depth. The results of grain size distribution analyses conducted on samples of the silt are presented on Figure 3.

The silt was penetrated at depths of 5.8 to 8.7 m (elevation 184.3 to 184.7) in boreholes 2, 4, 7 and 9. Drilling was terminated within the silt at 9.6 m depth in boreholes 3, 6, 10, 11 and 12. The silt mantled probable bedrock inferred at 7.3 m depth (elevation 181.4) in borehole 8.

Silt Till

A deposit of non to slightly cohesive dense to very dense silt till was encountered below the silt in boreholes 2, 4, 7 and 9, at depths of 5.8 to 8.7 m (elevation 184.3 to 184.7). The moisture content ranged from 8 to 12%.

The results of grain size distribution analyses conducted on samples of the silt till are presented on Figure 4. The results of Atterberg Limits tests conducted on samples exhibiting plasticity are presented on Figure 7. Liquid and plastic limits of 17 to 19 and 13 to 15, respectively, indicate the deposit is non to slightly plastic.

Boreholes 2 and 7 were terminated on probable bedrock inferred below the silt till at depths of 6.7 and 9.3 m (elevation 183.5 and 182.3). Boreholes 4 and 9 were terminated in the till at 9.6 m.

Groundwater

Water and cave was observed in boreholes 4, 11 and 12 at depths of 6.2 to 8.5 m (elevation 185.3 to 187.1) upon completion of augering. The native silt became wet below depths of about 4.5 to 9.0 m in boreholes 2, 3, 6, 7, 9, 11 and 12. Water was not encountered in the remaining boreholes during augering. The water levels measured in the piezometers installed in four of the boreholes were as follows:

Borehole	Date	Depth to Water (m)	Elevation
2	November 20	4.95	185.3
7	November 20	6.65	184.9
8	November 12	7.0	181.7
	November 20	4.6	184.1
10	November 20	8.3	185.0

Observed groundwater levels are subject to seasonal variations and rainfall patterns.

CLOSURE

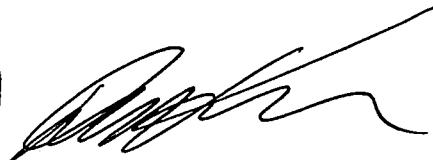
The fieldwork was carried out under the supervision of Mr. M. Rapsey and direction of Mr. M.R. Anderson, P.Eng. The drilling equipment was supplied by Elite Drilling.

The report was prepared by Mr. P. Cullen, B.Eng., and Mr. M.R. Anderson, P.Eng., Project Engineer. It was reviewed by Mr. D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton.

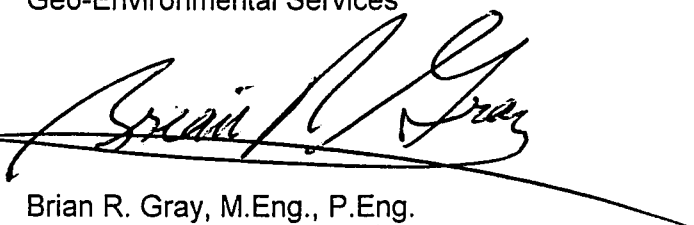
Yours very truly

Peto MacCallum Ltd.




Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services




Brian R. Gray, M.Eng., P.Eng.
President

MRA/PC:ld

TABLE I

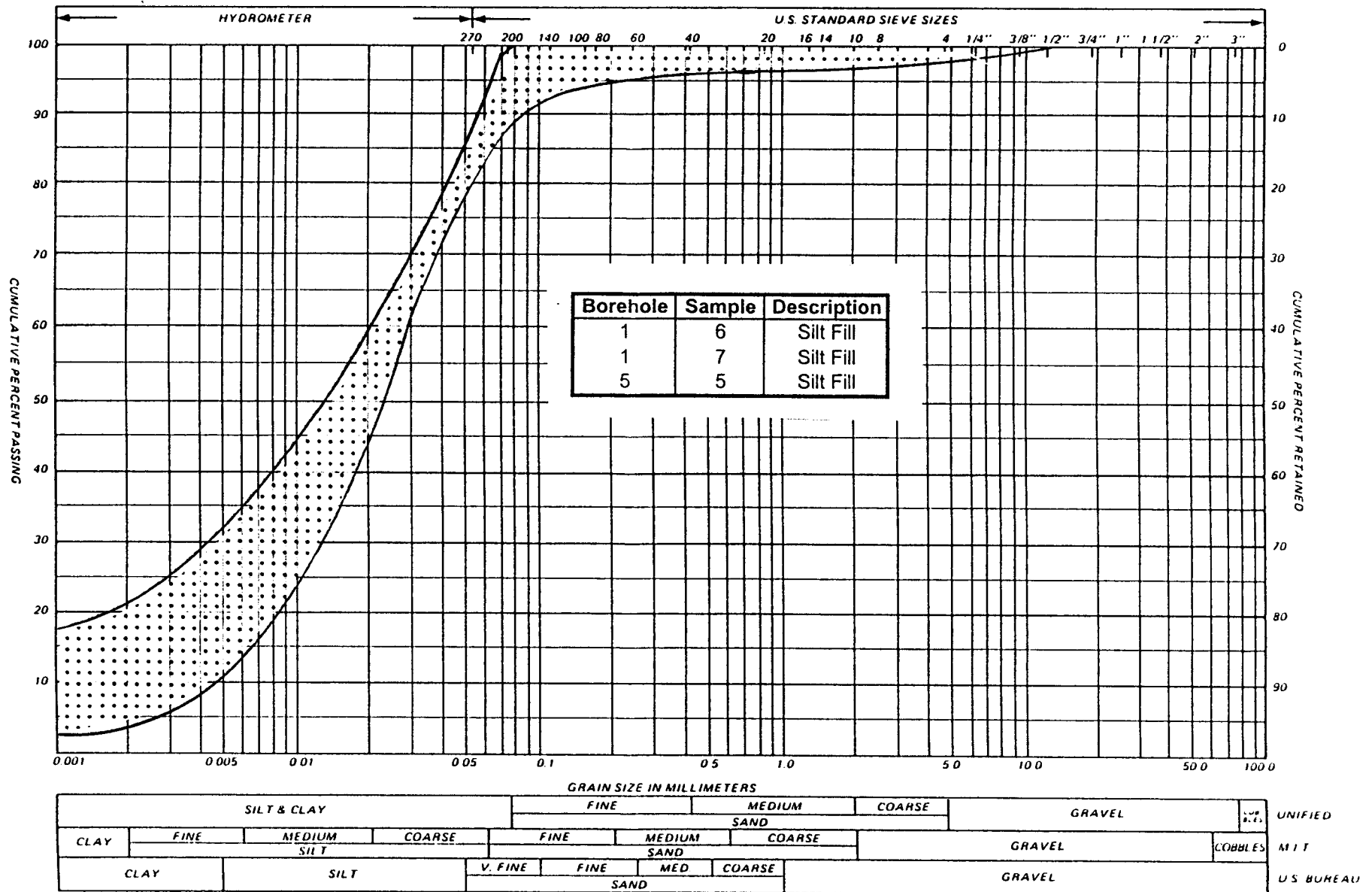
BOREHOLE AND LIGHT POLE LOCATIONS

**HIGH MAST LIGHT FOUNDATIONS
HIGHWAY 420 AND QEW
W.P. 309-94-00
NIAGARA FALLS, ONTARIO**

HIGH MAST LIGHT			BOREHOLE		
Pole No.	Northing	Easting	No.	Northing	Easting
P1 P2	4 773 418 4 773 295	335 800 335 815	1	4 773 308	335 790
P3 P4	4 773 178 4 773 076	335 840 335 899	2	4 773 073	335 910
P6 P8	4 772 990 4 772 923	335 986 336 061	3	4 772 922	336 059
P10 P11	4 772 845 4 772 798	336 158 336 269	4	4 772 798	336 269
P13 P14	4 772 762 4 772 736	336 384 336 520	5	4 772 736	336 520
P15 P16	4 772 726 4 772 730	336 660 336 800	6	4 772 730	336 800
P12	4 772 886	336 369	7	4 772 884	336 371
P17 P19	4 772 794 4 772 740	336 010 335 882	8	4 772 797	336 007
P5 P18	4 773 020 4 772 872	335 801 335 870	9	4 772 883	335 863
P7 P9	4 772 880 4 772 746	335 705 335 723	10	4 772 733	335 706
P20 P21	4 772 629 4 772 484	335 790 335 789	11	4 772 484	335 789
P22 P23	4 772 340 4 772 195	335 795 335 801	12	4 772 195	335 801

PARTICLE SIZE DISTRIBUTION CHART

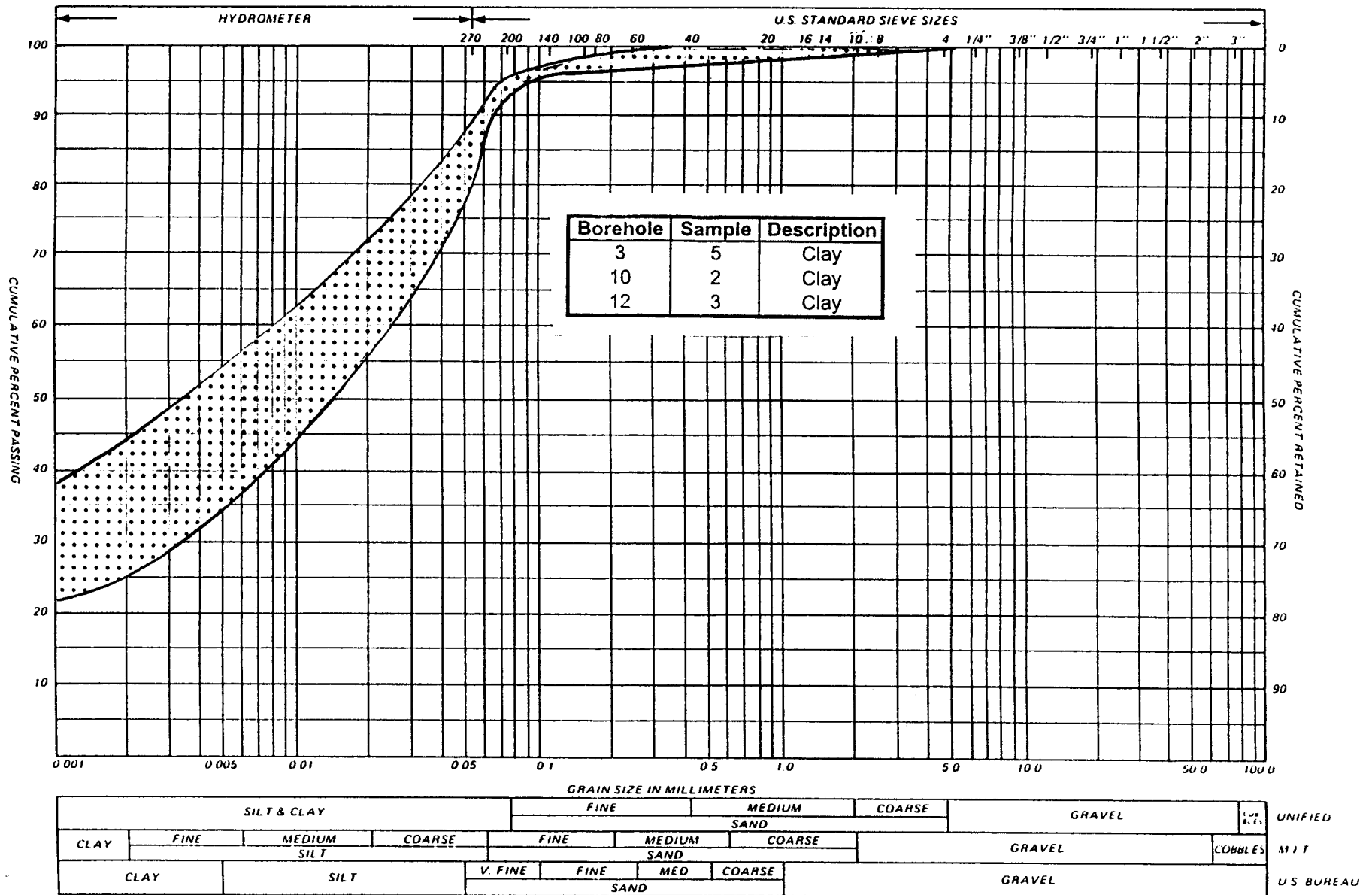
PML REF. 00HF119
REPORT NO. WP 309-94-00
FIGURE 1



REMARKS Silt Fill

PARTICLE SIZE DISTRIBUTION CHART

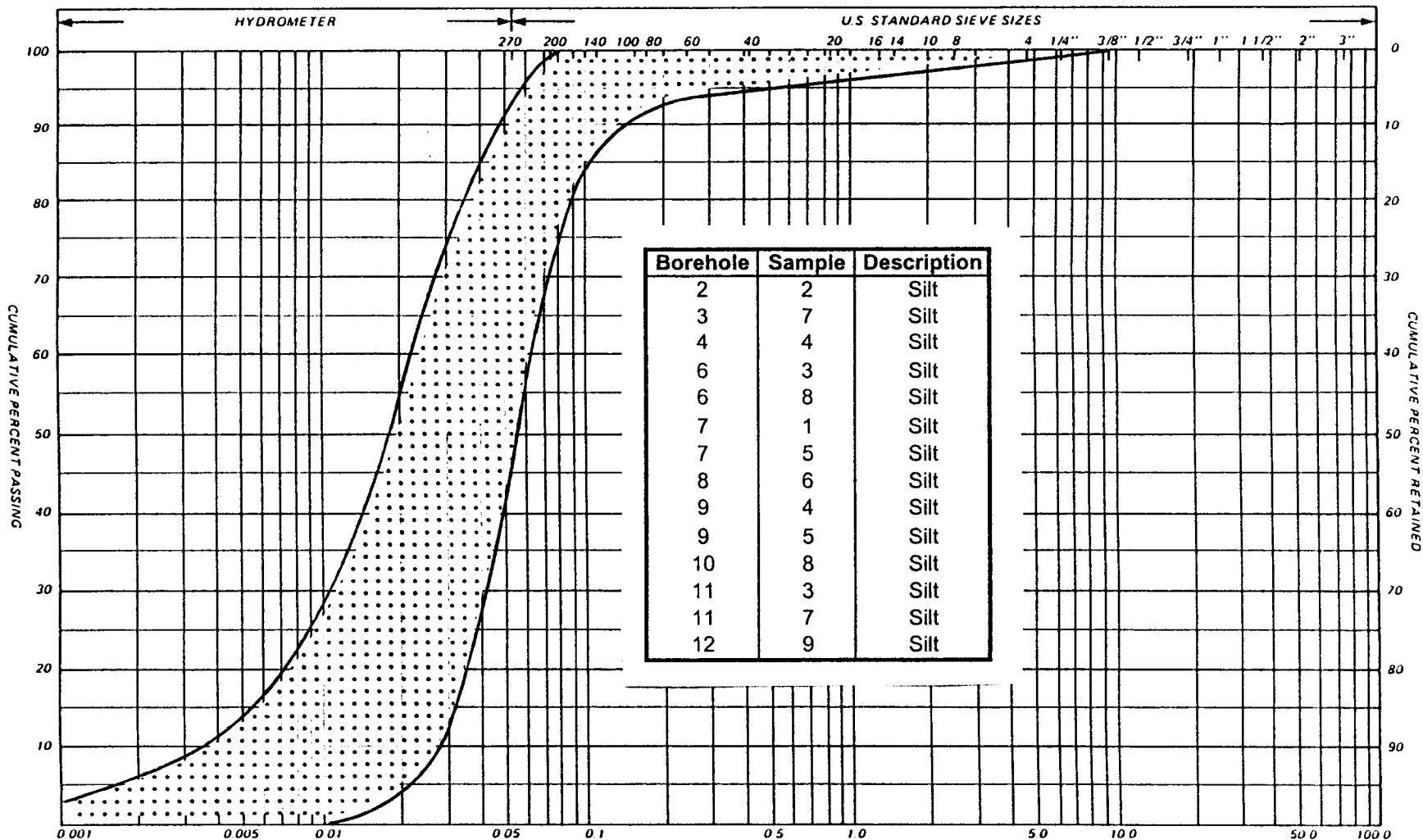
PML REF. 00HF119
REPORT NO. WP 309-94-00
FIGURE 2



REMARKS Clay

PARTICLE SIZE DISTRIBUTION CHART

PML REF. 00HF119
REPORT NO. WP 309-94-00
FIGURE 3



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				UNIFIED						
CLAY		FINE		MEDIUM		COARSE		SAND		FINE		MEDIUM			COARSE		GRAVEL	COBBLES	MIT	
CLAY		SILT		V. FINE		FINE		MED.		COARSE		SAND				GRAVEL				U S B U E A U

REMARKS Silt

PARTICLE SIZE DISTRIBUTION CHART

PML REF.

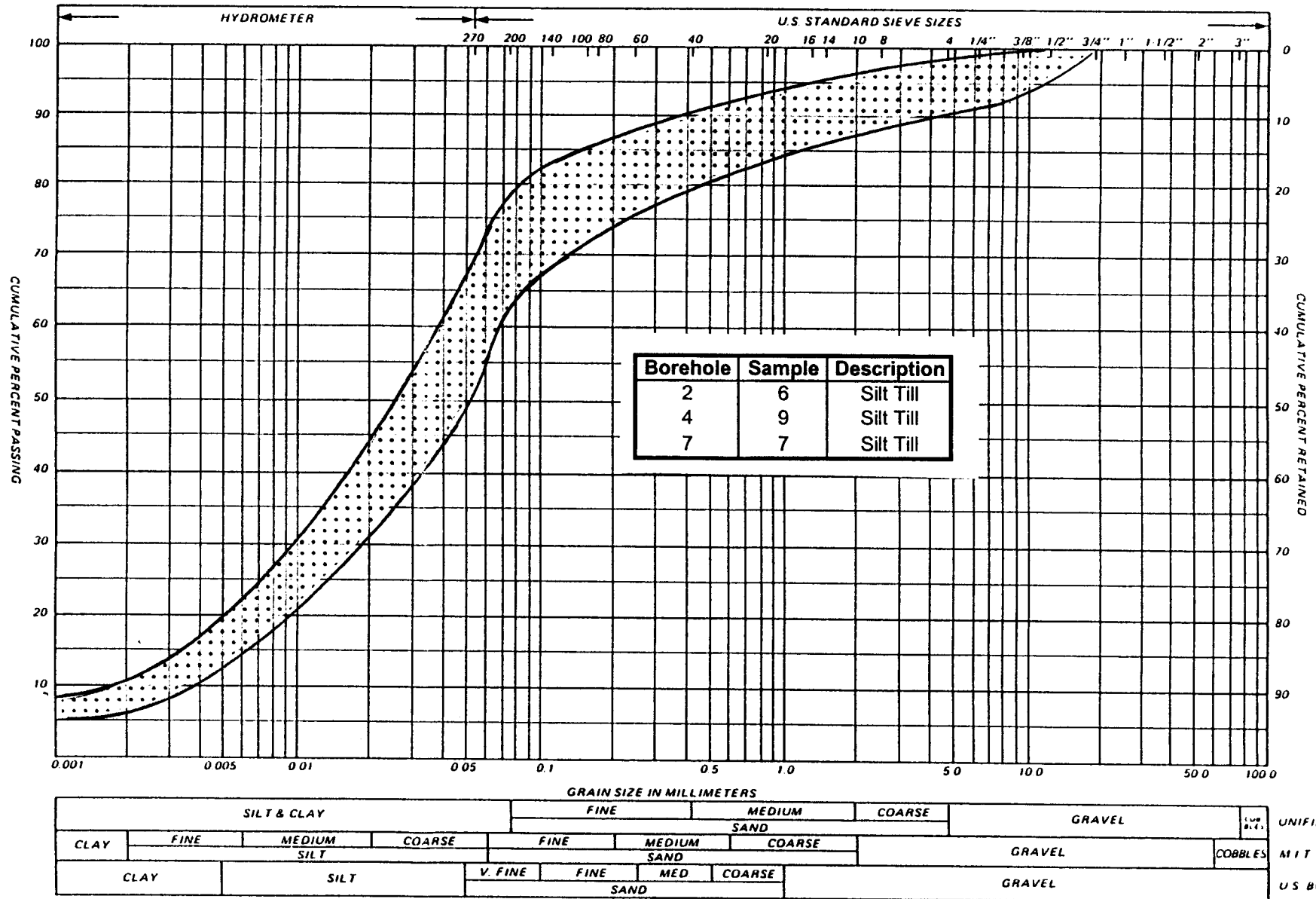
00HF119

REPORT NO.

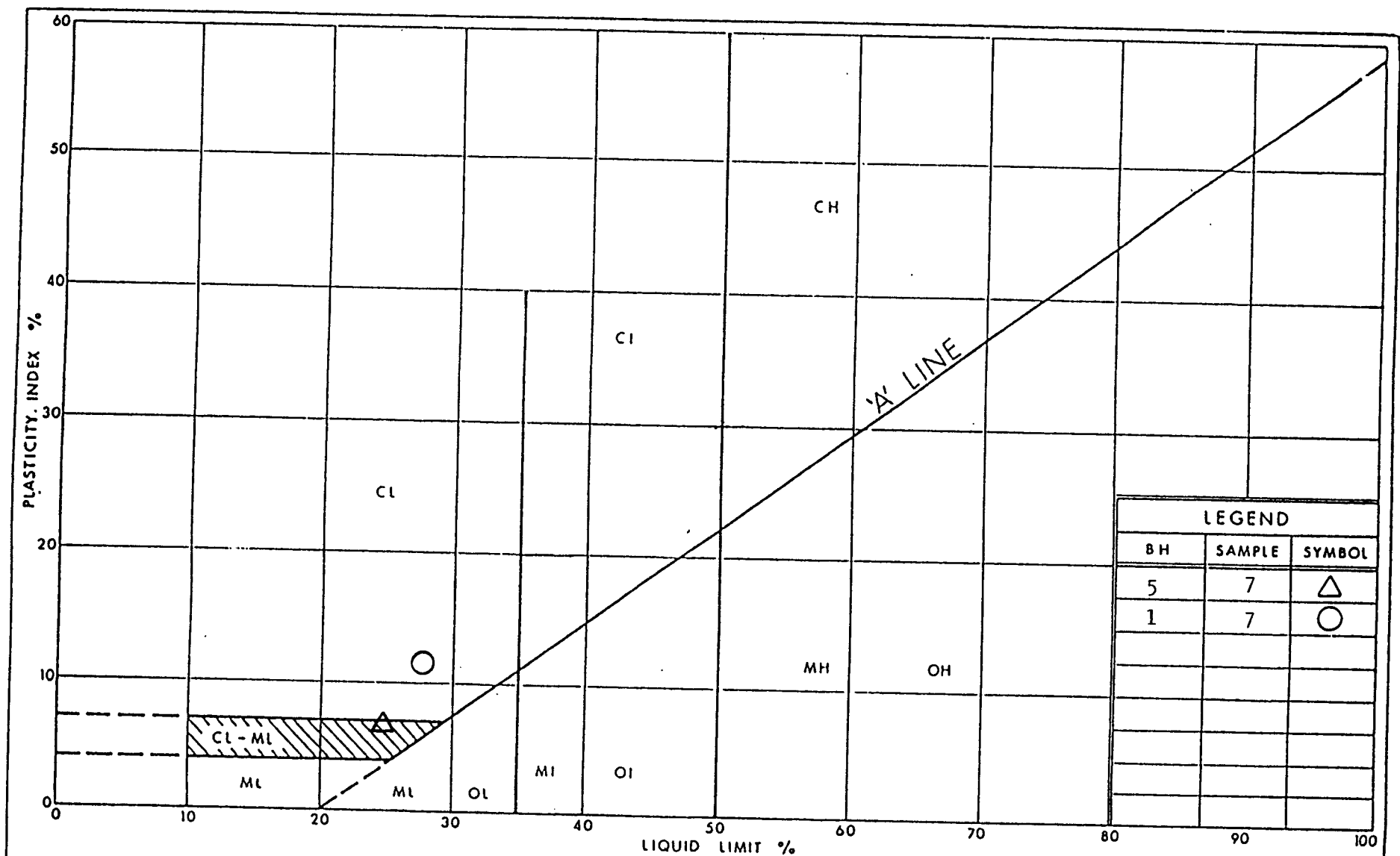
WP 309-94-00

FIGURE

4



REMARKS Silt Till



Ministry of
Transportation

Ontario WP 309-94-00

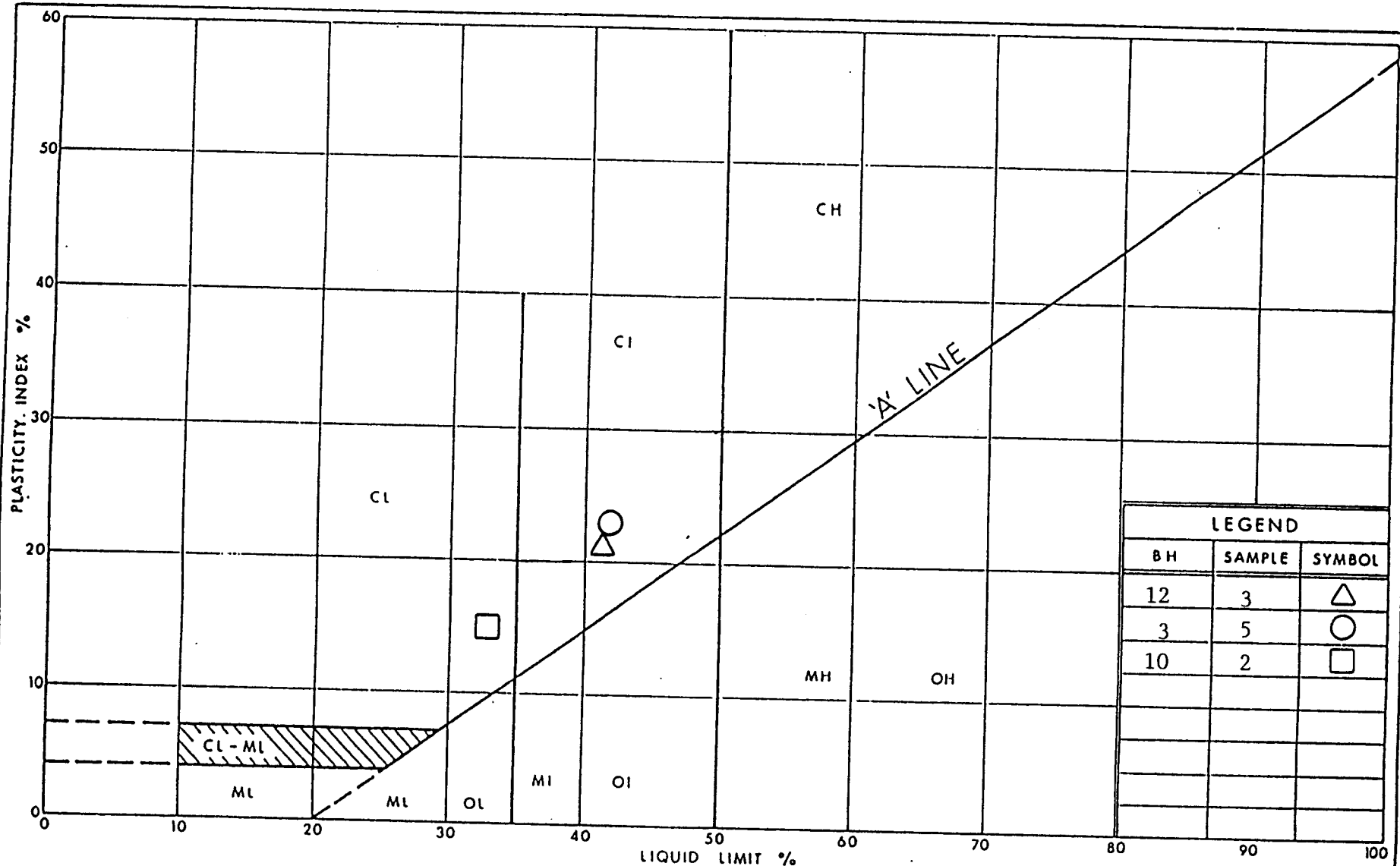
PLASTICITY CHART

SILT/CLAY FILL

FIG No 5

PML Ref: 00HF119

High Mast Light Foundation



Ministry of
Transportation

Ontario

WP 309-94-00

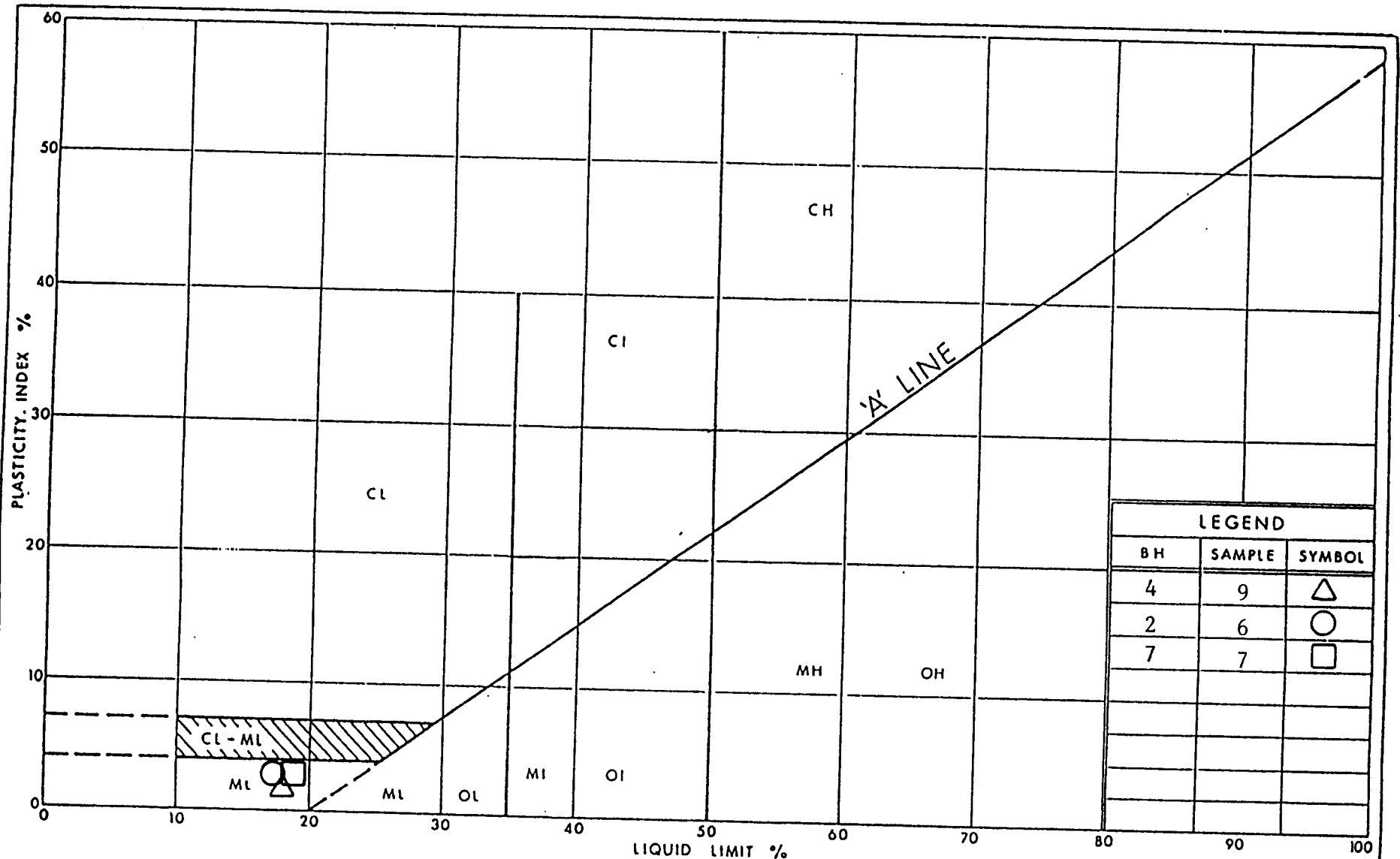
PLASTICITY CHART

CLAY

FIG No 6

PML Ref: 00HF119

High Mast Light Foundation



Ministry of
Transportation

Ontario

WP 309-94-00

PLASTICITY CHART

SILT TILL

FIG No 7

PML Ref: 00HF119

High Mast Light Foundation

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 0.3m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J 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/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

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		

▲, Δ - Undisturbed and remoulded shear strength determined from in situ vane test.

■ - Undrained shear strength determined from pocket penetrometer test.

RECORD OF BOREHOLE No 2

N 4 773 073
E 335 910

W.P. 309-94-00	LOCATION Hwy. 420 and QEW, Niagara Falls	ORIGINATED BY M.R.
DIST. HWY. 420	BORING DATE Nov. 12, 2000	COMPILED BY M.R.A.
DATUM Geodetic	BOREHOLE TYPE Continuous Flight Solid Stem Augers	CHECKED BY P.C.

SOIL PROFILE		SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	UNIT WEIGHT γ kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE					
190.20	Ground Level								
190.08 0.15	Topsoil, clayey silt Dark brown		1	SS	60	189.0			
1.5	Silt, trace of clay and very fine sand, damp very dense reddish brown		2	SS	51	188.0			
3.0			3	SS	76	187.0			
			4	SS	66	186.0			
4.5	Layers of fine sand and silt, wet		5	SS	42	185.0			
6.0	Silt Till, Clayey, some sand and gravel, moist		6	SS	68	184.0			
6.70	Very dense Brown					183.0			
7.5	End of Borehole Refusal on probable Bedrock								
9.0									
10.5									
12.0									
13.5									
15									
16.5									

190.00

189.00

188.00

187.00

186.00

185.00

184.00

183.00

Bentonite Seal

0 1 98 1

19mm Ø PVC Pipe

Native Backfill

Filter Sand

7 30 54 9

Date	Depth to water (m)
Nov. 20	4.95

RECORD OF BOREHOLE №3

N 4 772 922

W.P. 309-94-00

LOCATION Hwy. 420 and QEW, Niagara Falls

ORIGINATED BY M.R.

DIST. _____ HWY. 420

BORING DATE Nov. 12, 2000

COMPILED BY M.R.A.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Solid Stem Augers

CHECKED BY P.C.

[illegible]

RECORD OF BOREHOLE № 4

N	4	772	798
E		336	269

W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls
 DIST. HWY. 420 BORING DATE Nov. 12, 2000
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
COMPILED BY M.R.A.
CHECKED BY P.C.

[illegible]

N	4	772	736
E		336	520

ORIGINATED BY M.R.

COMPILED BY M.R.A.

CHECKED BY P.C.

UPON COMPLETION
OF AUGERING,
NO WATER, NO
CAVE.

RECORD OF BOREHOLE No 6

N 4 772 730
E 336 800

W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls ORIGINATED BY M.R.
DIST. HWY. 420 BORING DATE Nov. 12, 2000 COMPILED BY M.R.A.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers CHECKED BY P.C.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST SHEAR STRENGTH (kPa) UNCONFINED + FIELD VANE PENETROMETER x LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS % GR. SA. SL. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N - VALUES					
0	194.17	Ground Level								
	193.64	Pavement Structure: 150mm Asphalt over 380mm Brown crushed sand and gravel								
	0.53									
1.5		Fill, Silt, trace of clay and fine sand, damp		1	SS	32				
	192.07	Dense to Compact Brown		2	SS	14				
	2.10									
3.0		Silt, trace of clay and fine sand, damp		3	SS	37				
		Brown Dense to very dense		4	SS	56				
4.5				5	SS	60				
6.0				6	SS	45				
	97.17									
	7.00	Compact		7	SS	22				
7.5										
	185.77									
	8.40	Wet		8	SS	21				
9.0										
	184.57									
	9.60	End of Borehole								
10.5										
12.0										
13.5										
15										
16.5										

UPON COMPLETION
OF AUGERING,
NO WATER, NO
CAVE.

RECORD OF BOREHOLE № 7

N	4	772	884
E		336	371

W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls
 DIST. HWY. 420 BORING DATE Nov. 12, 2000
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
COMPILED BY M.R.A.
CHECKED BY P.C.

[illegible]

RECORD OF BOREHOLE No 8

N 4 772 797
E 336 007

W.P. 309-94-00	LOCATION Hwy. 420 and QEW, Niagara Falls	ORIGINATED BY M.R.
DIST. HWY. 420	BORING DATE Nov. 12, 2000	COMPILED BY M.R.A.
DATUM Geodetic	BOREHOLE TYPE Continuous Flight Solid Stem Augers	CHECKED BY P.C.

SOIL PROFILE		SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	UNIT WEIGHT γ kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
188.72	Ground Level								
188.54	Topsoil, clayey silt, dark brown								
188.15									
1.5	Silt, trace to some fine sand		1	SS	18				
	Compact		2	SS	24				
3.0			3	SS	22				
	Brown to reddish brown		4	SS	18				
4.5									
184.52									
4.20	Loose, with thin partings of grey clay and fine sand		5	SS	6				
183.62									
5.10									
6.0			6	SS	28				
7.5	End of Borehole Refusal on probable Bedrock								
9.0									
10.5									
12.0									
13.5									
15									
16.5									

Bentonite Seal

19mm Ø PVC Pipe

Native Backfill

0 4 94 2

Filter Sand

Date	Depth to Water (m)
Nov. 12	7.00
Nov. 20	4.60

RECORD OF BOREHOLE No 9

N 4 772 883
E 335 863

W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls ORIGINATED BY M.R.
DIST. HWY. 420 BORING DATE Nov. 12, 2000 COMPILED BY M.R.A.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers CHECKED BY P.C.

SOIL PROFILE		STRAT. PLT	SAMPLES		GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			UNIT WEIGHT Y kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE			W _P	W	W _L		
193.08	Ground Level										
0.15	Topsoil, clayey silt, dark brown		1	SS 22	192.0						
1.5	Silt Fill, trace of clay and sand, occ. thin lenses of grey silty clay		2	SS 25	191.0						
190.58	Compact Brown		3	SS 60	190.0						
2.45	Silt, trace of fine sand very dense to dense		4	SS 59	189.0						
3.0	Reddish Brown		5	SS 80	188.0						
4.5			6	SS 41	187.0						
5.70	wet		7	SS 68	185.0						
8.0			8	SS 50	184.0						
8.70	Silt till, gravelly, some sand				183.0						
9.0	Very dense Reddish brown										
9.60	End of Borehole										
10.5											
12.0											
13.5											
15											
16.5											

UPON COMPLETION OF AUGERING, NO WATER, NO CAVE.

RECORD OF BOREHOLE No 10

N 4 772 733
E 335 706

W.P. 309-94-00	LOCATION Hwy. 420 and QEW, Niagara Falls	ORIGINATED BY M.R.
DIST. HWY. 420	BORING DATE Nov. 12, 2000	COMPILED BY M.R.A.
DATUM Geodetic	BOREHOLE TYPE Continuous Flight Solid Stem Augers	CHECKED BY P.C.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	UNIT WEIGHT γ kN/m ³	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N - VALUES					
0	193.25	Ground Level				193.0				
		Silt Fill, clayey, some sand, with lenses of fine sand								
	192.10	Stiff Brown								
1.5	1.15	Silty clay, trace of sand				192.0				
	191.15	Stiff Brown								
	2.10	Silt, some fine sand				191.0				
3.0	190.25	Trace of clay and fine sand				190.0				
	3.00	Compact to very dense Brown								
						189.0				
4.5						188.0				
		Occ. thin lenses of grey silty clay				187.0				
6.0						186.0				
7.5						185.0				
9.0						184.0				
	183.65									
	9.60	End of Borehole				183.0				
10.5										
12.0										
13.5										
15										
16.5										

0 6 69 25

Bentonite Seal

*-50mm for last 150mm

19mm Ø PVC Pipe

Native Backfill

Filter Sand

1 12 81 6

Date Depth to Water (m)

Nov. 20 8.30

RECORD OF BOREHOLE № 11

N	4	772	484
E		335	789

W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls

ORIGINATED BY M.R.

DIST. _____ HWY. 420 BORING DATE Nov. 7, 2000

COMPILED BY M.R.A.

DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

CHECKED BY P.C.

[illegible]

RECORD OF BOREHOLE No 12

N 4 772 195
E 335 801

G.W.P. 309-94-00 LOCATION Hwy. 420 and QEW, Niagara Falls
DIST. HWY. 420 BORING DATE Nov. 7, 2000
DATUM Geodetic BOREHOLE TYPE Continuous Flight Solid Stem Augers

ORIGINATED BY M.R.
COMPILED BY M.R.A.
CHECKED BY P.C.

SOIL PROFILE		STRAT. PLT	SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT STANDARD PENETRATION TEST				LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			UNIT WEIGHT Y KN/m ³	REMARKS %			
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	N - VALUES		20	40	60	80	100	W _P	W	W _L				
0	193.90 Ground Level																	
1.5	Gravel Fill: 530mm of grey crushed sandy gravel over 230mm of brown crushed gravel and sand		1	SS	13	193.0												
1.80	Clay: silty, trace of sand stiff Brown		2	SS	3	192.0												
3.0	Sand: fine to medium, some gravel and silt damp		3	SS	23	191.0												
3.60	Loose Brown		4	SS	19	190.0												
4.5	Clay: silty, trace of sand stiff Brown		5	SS	8	189.0												
6.0	Silt: trace of clay and fine sand Brown		6	SS	14	188.0												
7.5	Clay: silty, trace of sand with distorted lenses of silt, dilatent, wet Silt: clayey, some sand Stiff Brown		7	SS	37	187.0												
9.0	Trace of sand and clay compact to dense wet reddish brown		8	SS	49	186.0												
9.60	End of borehole		9	SS	16	185.0												
10.5						184.0												
12.0																		
13.5																		
15																		
16.5																		

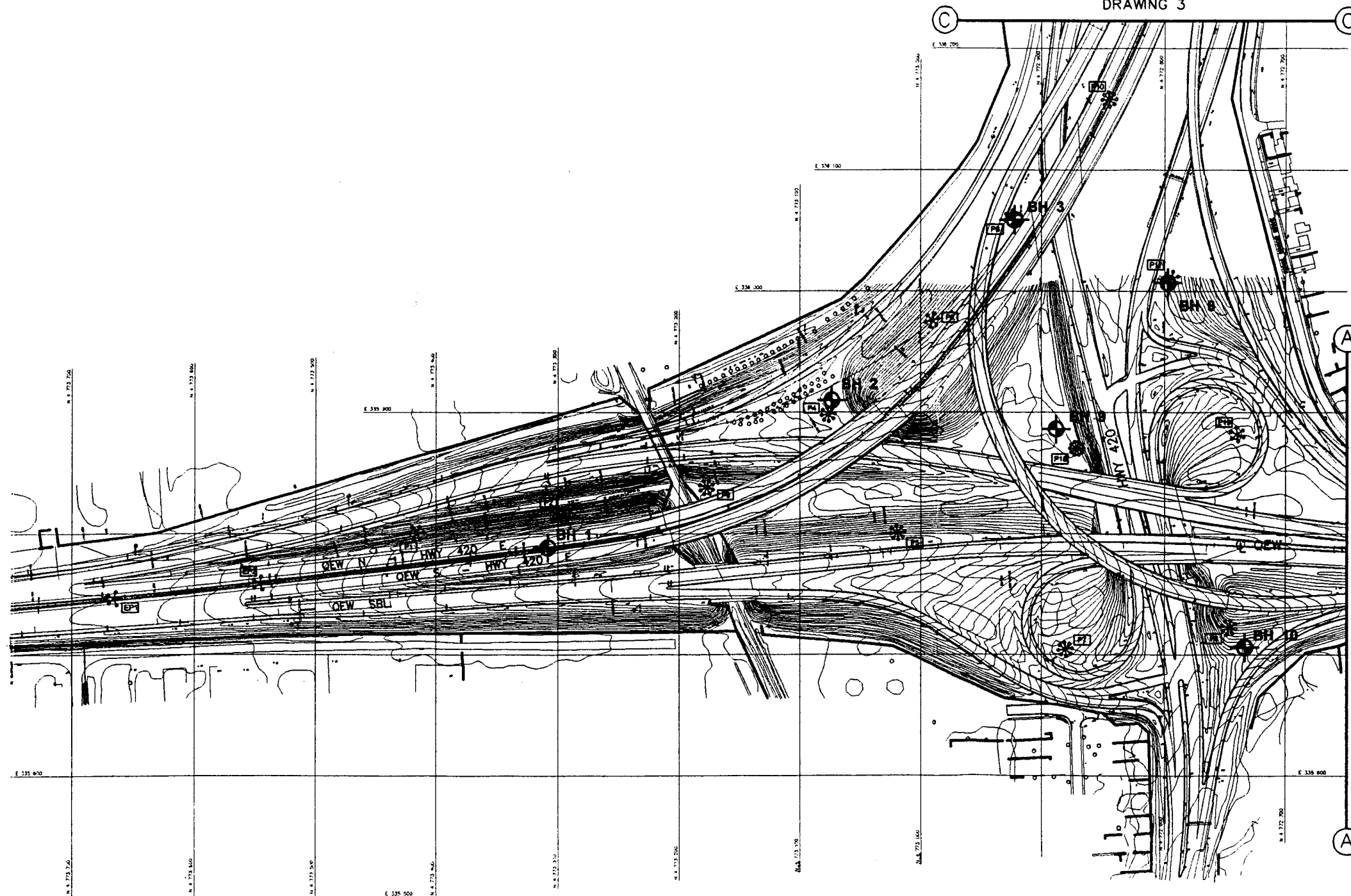
UPON
COMPLETION
OF AUGERING
WATER AND
CAVE AT
8.35m

BOREHOLE	NORTHING	EASTING	ELEVATION
BH 1	N 4 773 308	E 335 790	202.92
BH 2	N 4 773 073	E 335 910	190.20
BH 3	N 4 772 922	E 336 059	196.72
BH 8	N 4 772 797	E 336 007	188.72
BH 9	N 4 772 883	E 335 863	193.03
BH 10	N 4 772 733	E 335 706	193.25

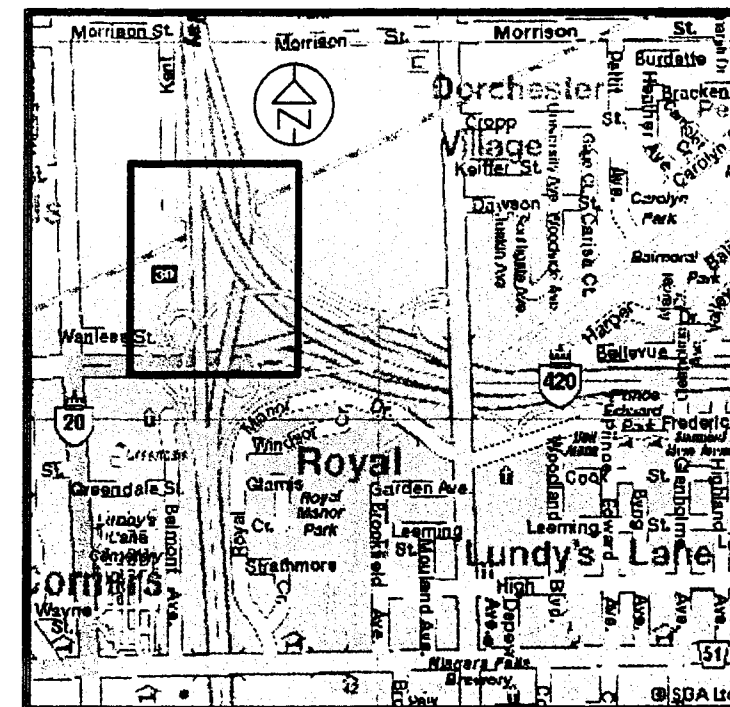
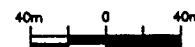
W.P. 309-94-00
METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN



MATCH TO LINE 'D'
 DRAWING 3



MATCH TO LINE 'B'
 DRAWING 2



KEY PLAN



LEGEND

BOREHOLE

NOTE

1. REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.

Q.E.W./HWY 420 – HIGH MAST LIGHTING
QEW/HWY 420 INTERCHANGE EAST TO
DRUMMOND ROAD AND SOUTH TO LUNDY'S LANE
 NIAGARA FALLS, ONTARIO

Peto MacCallum Ltd.
 CONSULTING ENGINEERS

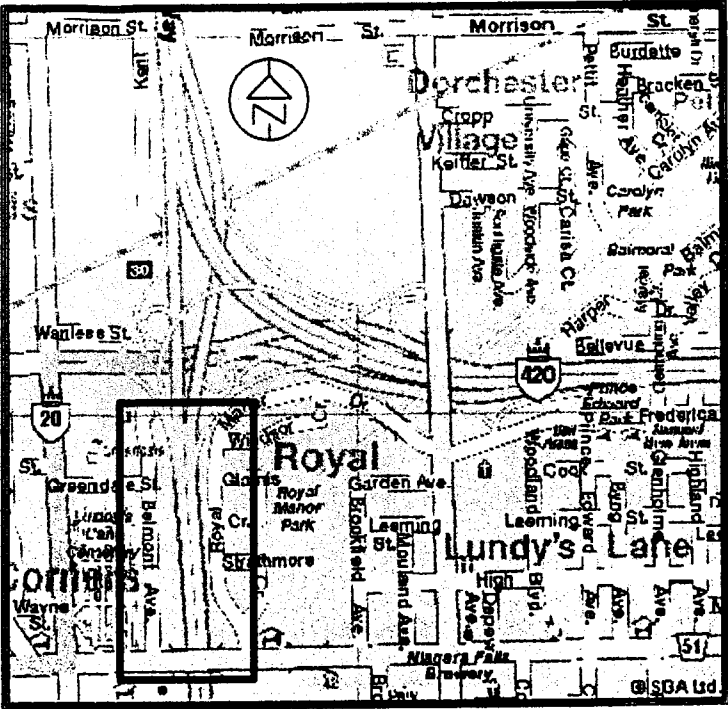
45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED		DEC. 2000	AS SHOWN	00HF119	1
APPROVED					

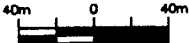
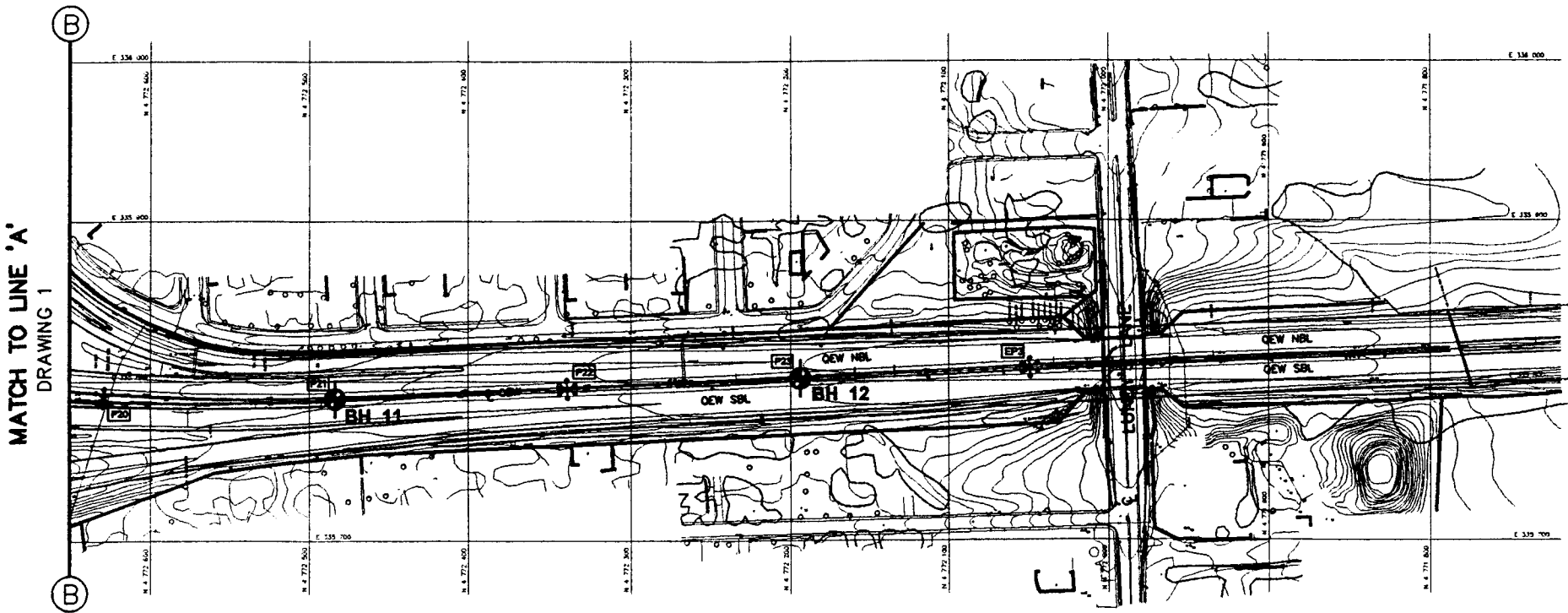
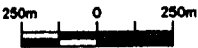
BOREHOLE LOCATION PLAN

BOREHOLE	NORTHING	EASTING	ELEVATION
BH 11	N 4 772 484	E 335 789	193.75
BH 12	N 4 772 195	E 335 801	193.90

W.P. 309-94-00
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEY PLAN



LEGEND

BOREHOLE

NOTE

1. REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.

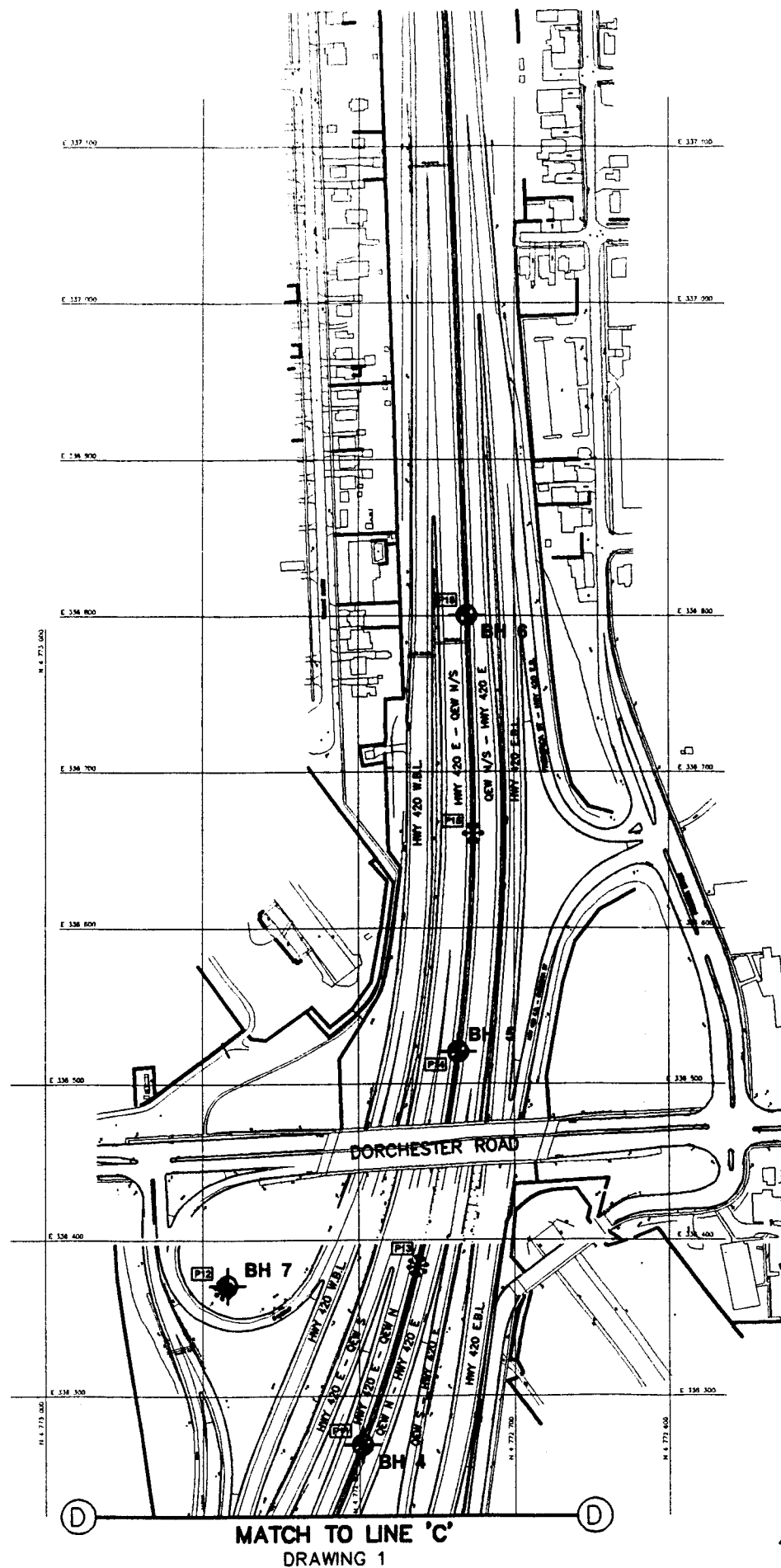
Q.E.W/HWY 420 – HIGH MAST LIGHTING
QEW/HWY 420 INTERCHANGE EAST TO
DRUMMOND ROAD AND SOUTH TO LUNDY'S LANE
NIAGARA FALLS, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS
45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C8

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED		DEC. 2000	AS SHOWN	00HF119	2
APPROVED					

BOREHOLE LOCATION PLAN

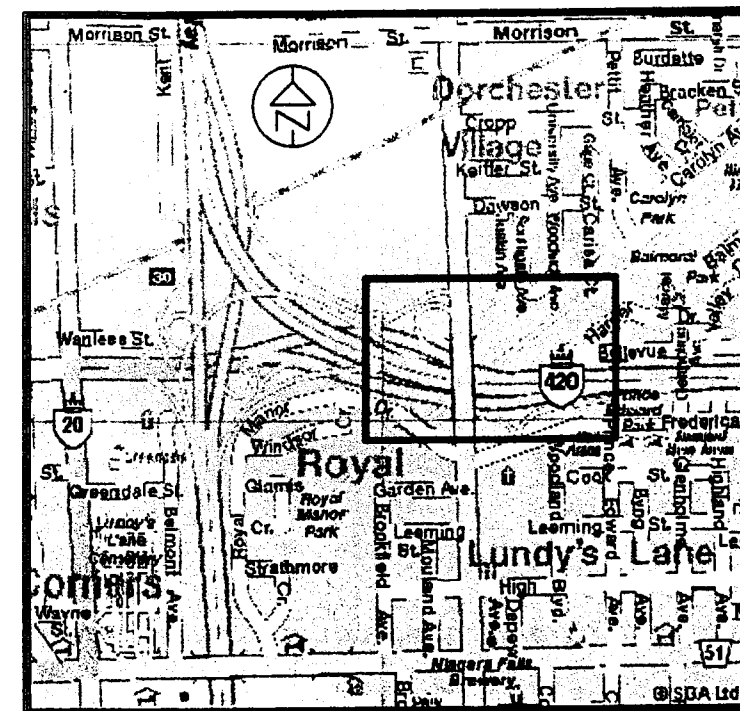
BOREHOLE	NORTHING	EASTING	ELEVATION
BH 4	N 4 772 798	E 336 269	193.21
BH 5	N 4 772 736	E 336 520	193.08
BH 6	N 4 772 730	E 336 800	194.17
BH 7	N 4 772 884	E 336 371	191.56



W.P. 309-94-00

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEY PLAN



LEGEND

 BOREHOLE

NOTE

1. REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.

Q.E.W/HWY 420 – HIGH MAST LIGHTING

**QEW/HWY 420 INTERCHANGE EAST TO
DRUMMOND ROAD AND SOUTH TO LUNDY'S LANE
NIAGARA FALLS, ONTARIO**

Peto MacCallum Ltd.
CONSULTING ENGINEERS

45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED		DEC. 2000	AS SHOWN	00HF119	3
APPROVED					

BOREHOLE LOCATION PLAN