

Report

Foundation Investigation
Report
Proposed Overhead Sign
Support Structures
Highway 402
City of Sarnia, Ontario
District - London
G.W.P. 3038-03-00

STANTEC CONSULTING LTD.

PROJECT NO. 1012607
GEOCRES NO. 40J16-82

REPORT NO. 1012607

REPORT TO **Stantec Consulting Limited**
 1400 Rymal Road
 Hamilton, Ontario

FOR **Foundation Investigation Report**

ON **Proposed Overhead Sign Support**
 Structures
 Highway 402
 City of Sarnia, Ontario
 G.W.P. 3038-03-00
 District – London
 GEOCRES NO. 40J16-82

November 7, 2008

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Record of Borehole Sheet
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FOUNDATION INVESTIGATION REPORT

Proposed Overhead Sign Support Structures Highway 402 City of Sarnia, Ontario G.W.P. 3038-03-00 District – London

1.0 INTRODUCTION

Jacques Whitford Limited (Jacques Whitford) was retained by Stantec Consulting Ltd. to complete a Foundation Investigation Report for 11 proposed overhead sign support structures located along Highway 402 between Station (Sta.) 10+989 and Sta. 15+300 in the City of Sarnia, Ontario (W.P. No. 3038-03-00).

The work was carried out under Agreement No. 3005-E-0029 and in accordance with the Subconsultant Agreement dated May 24, 2006. Authorization to proceed with the investigation was provided by Mr. David Emery, P.Eng., of Stantec Consulting Ltd. (Stantec), the prime consultant on this design assignment.

The scope of work for the foundation investigation is incorporated within Stantec's project, which forms part of the above noted subconsultant agreement.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of the foundation investigation and the results of the laboratory testing program.

2.0 SITE DESCRIPTION

The investigation is for 11 proposed overhead signs to be located on Highway 402 from Front Street to Modeland Road, Sta 10+900 to 15+300, in the City of Sarnia, Ontario

Highway 402 is generally oriented in an east-west direction with two east bound and two west bound lanes. The highway is a semi-urban freeway with partially paved shoulders and a wide grass covered centre median. The highway is generally about 2 m to 3 m higher than the grade of the adjacent lands, with 6 m to 9 m high embankments at overpasses.

Drainage is provided by ditches along the sides and in the central median of the highway. The ditches are sloped towards catch basins located along the existing highway. Regional drainage is towards the St. Clair River located approximately 1.4 km to the west of the highway.



3.0 PHYSIOGRAPHY

Based on the physiography of Southern Ontario by Chapman and Putnam (1984), this section of Highway 402 is situated in the physiographic region known as the Huron Fringe, a narrow geological strip between Lake Huron and the adjacent St. Clair Clay Plains. The Huron Fringe is composed mainly of surficial sands, silts and gravels, underlain by lacustrine clayey silt and silty clay.

The bedrock in the area consists of laminated, thinly bedded shale that is black to grey in colour and is of the Kettle Point Formation.

4.0 SCOPE OF WORK

The scope of work for the investigation was as follows:

- To investigate the soil and groundwater conditions at the proposed overhead sign locations by advancing a total of 11 boreholes, one at each sign location (on the right shoulder) as outlined in the following table:

Sign Location by Station	Borehole Number	Borehole Location by Station	Borehole Offset from Centreline of Highway Median
10+985	08-14	10+983	24 m Lt
11+600	08-13	11+600	25 m Lt
11+798	08-15	11+798	14 m Rt
12+200	08-12	12+200	25 m Lt
12+720	08-16	12+730	23 m Rt
13+125	08-11	13+125	16 m Lt
13+474	08-10	13+474	32 m Lt
14+100	08-06	14+098	25 m Lt
14+900	08-01	14+900	23 m Lt
15+090	08-17 A/B	15+090	23 m Rt
15+300	08-18	15+300	42 m Rt

- To conduct a laboratory testing program on selected samples of the soil obtained from the boreholes; and,
- To prepare a Foundation Investigation and Foundation Investigation and Design Report.

It is noted that Boreholes 08-2 to 08-5 and 08-7 to 08-9 were advanced to investigate the subsurface conditions for a proposed noise barrier wall. The factual results of these boreholes are provided under separate cover.

5.0 INVESTIGATION PROCEDURES

5.1 Field Program

Prior to commencing the investigation, the borehole locations were established in the field by Jacques Whitford personnel. The borehole locations were cleared of underground utilities by the various public utility companies.

Freeway traffic control during the drilling program was provided by On Track Safety Limited (OTS), using signs, traffic barrels and blocker vehicles, in accordance with the Ontario Traffic Manual (OTM) Book 7 Temporary Conditions.

The field investigation was carried out on August 7, 8, 10 and 11, 2008. The 11 boreholes (08-1, 08-6 and 08-10 to 08-18) were advanced at the locations identified previously in this report and shown on the drawings provided in **Appendix A**.

The boreholes were advanced to depths consistent with the requirements outlined in the MTO Sign Support Manual, which specifies a depth of approximately 6.6 m below existing grade. The boreholes were advanced using a truck mounted drill rig equipped with 150 mm diameter (outside diameter), solid-stem augers, supplied and operated by London Soils Inc. Soil samples were recovered from the boreholes at regular intervals using a 50 mm Outside Diameter split-spoon sampler by conducting Standard Penetration Tests (SPTs) in general accordance with the procedures outlined in the ASTM specification D1586.

Jacques Whitford field personnel recorded the conditions encountered in the boreholes at the time of the investigation. Soils were described in accordance with the MTO Soils Classification System.

The groundwater levels, where encountered, were measured in the boreholes during and on completion of drilling. The boreholes were backfilled on completion of drilling in accordance with Ontario Ministry of the Environment Regulation 903.

All soil samples recovered from the boreholes were placed in moisture-proof bags and transported to our laboratory for detailed classification and testing as required.

The subsurface conditions encountered in the boreholes are summarized on the Record of Borehole sheets in **Appendix B**. Additional comments are provided in the subsequent sections of this report.

5.2 Survey

The borehole locations were established in the field by Jacques Whitford personal by measuring from the existing features with a known station reference. The borehole locations and offsets are referenced to the stations established for the Highway 402 median centreline.

The ground surface elevations at the respective borehole locations were inferred from drawings provided by Stantec Consulting Limited. It is understood that the drawing elevations are referenced to a Geodetic datum.



5.3 Laboratory Testing

All samples transported to the laboratory were subjected to detailed visual examination and classification. Approximately 25% of the soil samples were submitted for routine testing including grain size distribution, Atterberg Limits and moisture content determination testing. The laboratory results are provided on the Record of Borehole sheets in **Appendix B**. The results of the grain size analyses and Atterberg Limits tests are shown on Figure Nos. 1 to 4 in **Appendix C**.

Unless requested in advance, all samples will be stored in our laboratory for a period of twelve months from the issue date of this report.

6.0 RESULTS OF THE INVESTIGATION

6.1 Subsurface Conditions

The subsurface conditions encountered in the boreholes are summarized on the Record of Borehole sheets provided in **Appendix B**. An explanation of the terms used on the Record of Borehole sheets is provided in **Appendix B**.

A summary of the soil and groundwater conditions encountered in the boreholes is provided below.

It is noted that environmental impacts, if any, will be discussed under separate cover.

6.2 Soil

6.2.1 Asphalt

Asphalt was encountered at the ground surface in Boreholes 08-6 and 08-10 to 08-16. The asphalt was approximately 100 mm to 150 mm thick.

6.2.2 Sand and Gravel Fill (SW) and Sand Fill

Sand and gravel fill and sand fill was encountered at the ground surface in Boreholes 08-1, 08-17 and 08-18, and underlying the asphalt in Boreholes 08-6 and 08-10 to 08-16. The sand and gravel fill ranged in thickness from approximately 0.5 m to 1.6 m.

Sand fill was encountered in Borehole 08-14, underlying fly and bottom ash (described below), at a depth of approximately 2.1 m below existing grade (elevation of approximately 181.8 m). The sand fill was approximately 1.8 m thick.

The sand and gravel fill and sand fill was generally moist and contained varying amounts of silt (trace to some).

Based on the N-Values obtained from the Standard Penetration Tests (SPTs), the compactness of the sand and gravel fill and sand fill was assessed to be compact to very dense.

Laboratory testing conducted on selected samples consisted of moisture content tests. The test results were as follows:

- Moisture Content:
 - 2% to 7%

The results of the moisture content tests are provided on the Record of Borehole sheets in **Appendix B**.

6.2.3 Fly and Bottom Ash Fill (SP-SM)

Fly and bottom ash fill was encountered in Borehole 08-14 at a depth of approximately 0.6 m below existing grade (an elevation of approximately 183.3 m). The thickness of the fly and bottom ash fill was approximately 1.5 m.

The fly and bottom ash was generally damp to wet. With respect to particle size, the fly and bottom ash fill could be characterised as a sand with some gravel and trace silt.

Based on the N-Values obtained from two SPTs, the compactness of the fly and bottom ash fill was assessed to be dense.

Laboratory testing conducted on selected samples consisted of two moisture content tests. The test results were as follows:

- Moisture Content:
 - 16% and 17%

The results of the moisture content tests are provided on the Record of Borehole sheets in **Appendix B**.

6.2.4 Silty Sand Fill (SM)

A layer of silty sand fill was encountered underlying the sand and gravel fill in Borehole 08-11 at a depth of approximately 0.8 m (an elevation of approximately 182.7 m). The silty sand fill was approximately 0.8 m thick.

The silty sand fill was generally moist and contained trace gravel.

Based on the N-Value obtained from a single SPT, the compactness of the silty sand fill was assessed to be dense.

Laboratory testing conducted on the sample consisted of a moisture content test. The test result was as follows:

- Moisture Content:
 - 4%

The result of the moisture content test is provided on the Record of Borehole sheets in **Appendix B**.

6.2.5 Silty Clay Fill (CL-ML)

A layer of silty clay fill was encountered underlying the sand and gravel fill in Borehole 08-6 and 08-18 at a depth of approximately 0.8 m and 1.5 m (an elevation of approximately 183.5 m and 179.1 m). The silty clay fill was approximately 2.2 m and 0.7 m thick.

The silty clay fill was generally moist and contained some gravel and trace to some sand.

Based on the N-Value obtained from the SPT's, the consistency of the silty clay fill was assessed to be very hard.

Laboratory testing conducted on selected samples consisted of moisture content and a grain size distribution tests. The test results were as follows:

- Moisture Content:
 - 7% to 13%
- Grain Size Distribution:
 - 1% gravel;
 - 23% sand;
 - 37% silt; and,
 - 39% clay

The results of the moisture content and grain size distribution tests are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution tests are provided on Figure 1 in **Appendix C**.

6.2.6 Native Sand (SM) to Silty Sand (ML)

Native sand to silty sand was encountered in all boreholes, except Borehole 08-1, at depths of approximately 0.8 m to 4.0 m below existing grade (elevations of approximately 178.4 m to 183.1 m). The thickness of the sand ranged from approximately 1.6 m to 5.8 m. Boreholes 08-14, 08-15 and 08-18 were terminated in the sand stratum, at a depth of approximately 6.6 m (elevations of approximately 174.1 m to 177.4 m).

The sand was generally wet to saturated and contained trace gravel and trace to some fines (silt and clay).

A thin layer (0.4 m thick) of sandy silt was encountered over the native sand in Borehole BH08-12.

Based on the N-Values obtained from the SPTs, the compactness of the sand to silty sand was assessed to be loose to very dense, but was more typically compact.

Laboratory testing conducted on selected samples consisted of moisture content and grain size distribution tests. The test results were as follows:

- Moisture Contents:
 - 2% to 25%
- Grain Size Distribution:
 - 0% to 3% gravel;
 - 73% to 93% sand; and,
 - 6% to 27% fines (silt and clay).

The results of the moisture content tests and grain size distribution tests are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution tests are also provided on Figure 2 in **Appendix C**.

6.2.7 Silty Clay (CL)

Silty clay was encountered underlying the fill, sand and silty sand/sandy silt in Boreholes 08-1, 08-6, 08-10 to 08-13, 08-16 and 08-17. The silty clay was encountered at depths in the range of approximately 0.8 m to 6.2 m below existing grade (elevations of approximately 176.7 m to 183.5 m). Boreholes 08-1, 08-6, 08-10 to 08-13, 08-16 and 08-17 were terminated in the silty clay at a depth of approximately 6.6 m below existing grade (elevations of approximately 174.4 m to 178.4 m).

The silty clay was generally moist to damp and contained trace to some sand and trace gravel near the contact with the sand stratum described above, containing less sand with increasing depth.

Based on the N-Values obtained from the SPTs, the consistency of the silty clay was assessed to be stiff to very hard, but was more typically stiff to very stiff.

Laboratory testing conducted on selected samples consisted of moisture content, grain size distribution and Atterberg Limits tests. The test results were as follows:

- Moisture Content:
 - 12% to 25%
- Grain Size Distribution:
 - 0 to 4% gravel;
 - 15% to 27% sand;
 - 36% to 46% silt; and,
 - 36% to 39% clay
- Atterberg Limits:
 - Liquid Limits: 25% to 32%
 - Plastic Limits: 13% to 22%
 - Plasticity Indices: 9% to 17%

The results of the moisture content, grain size distribution and Atterberg Limits tests, are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution tests are provided on Figure 3 in **Appendix C**. The results of the Atterberg Limits tests are provided on Figure 4 in **Appendix C**.

6.3 Borehole Cave and Groundwater Conditions

The following table outlines the cave and groundwater conditions encountered during drilling:

Borehole	Cave on completion of drilling		Groundwater conditions on completion of drilling	
	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
08-1	Open	-	Dry	-
08-6	3.4 m	180.9	3.4	180.9
08-10	2.7	180.6	2.7	180.6
08-11	2.1	181.4	2.1	181.4
08-12	1.8	183.2	1.8	183.2
08-13	2.7	181.3	2.7	181.3
08-14	3.5	180.5	3.5	180.5
08-15	5.3	178.5	5.3	178.5
08-16	2.0	181.5	2.0	181.5
08-17 A/B	1.2	179.8	0.6	180.4
08-18	2.7	178.0	2.7	178.0

It is noted that the groundwater conditions reported were based on measurements obtained during and immediately after drilling and may therefore not be representative of the equilibrated groundwater level. In addition, the levels noted are subject to seasonal fluctuations and in response to weather events.

7.0 CLOSURE

A soil investigation is a limited sampling of a site. The information herein is obtained at specific borehole locations and can only be extrapolated to an undefined limited area around the borehole locations. The extent of the limited area depends on the variability of the soil and groundwater conditions as influenced by geological processes, as well as the history of the site reflecting natural conditions, construction activities and site use. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

We trust the above information meets with your present requirements. Should you have any questions or require further information, please do not hesitate to contact us at your convenience.

Regards,

JACQUES WHITFORD LIMITED

Original Signed by

Geoffrey Creer, P.Eng.
Geotechnical Engineer

Original Signed by

John J. Brisbois, M.Sc.Eng., P.Eng.
Principal

Original Signed by

Fred Griffiths, Ph.D., P.Eng.
Principal
Designated Principal
MTO Foundations Contact



Appendix A

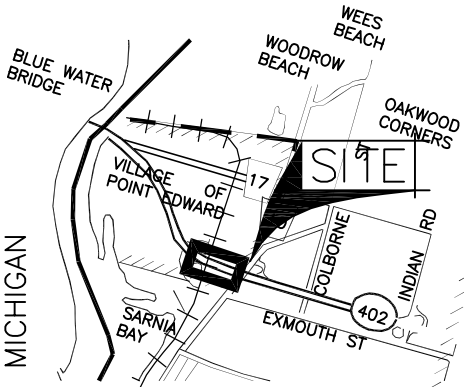
Borehole Location Plans

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN




BOREHOLE LOCATION
10+750 TO 11+180
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402,
SARNIA, ONTARIO

SHEET



LEGEND

 Borehole
(Jacques Whitford, 2008)

BH No.	ELEVATION (m)	STA.	OFFSET
08-14	183.9	10+983	24m LT

0 m 100 m
Scale

NOTE

* Base Plan provided by Stantec Consulting.
* Borehole locations and site features shown are approximate and may vary from that shown.

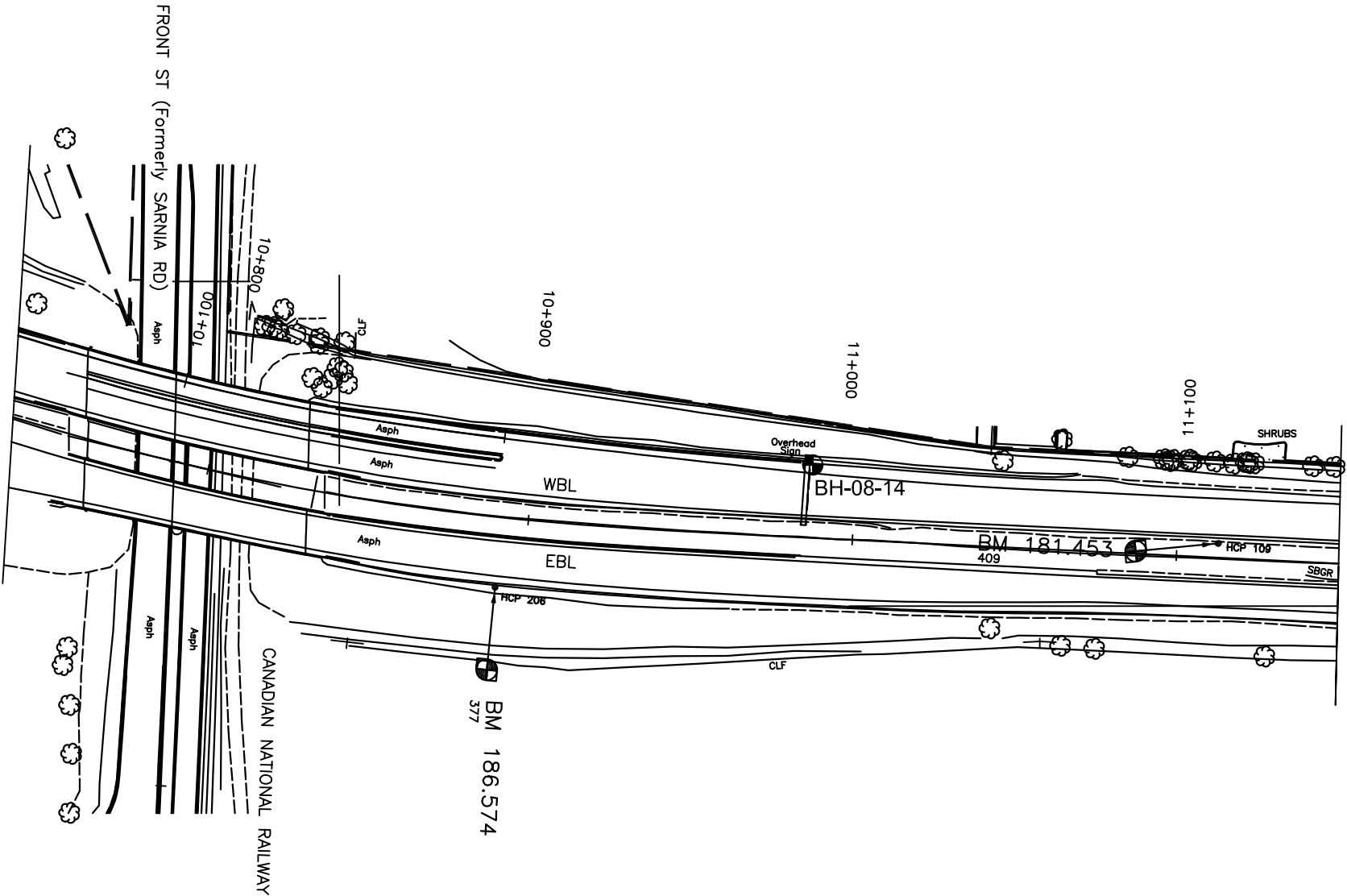
NOTE: 1)The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS			
	DATE	BY	DESCRIPTION

GEOGRES No 40 J16-82

HWY No 402			DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-10-29	SITE -
DRAWN PC/HZ	CHECKED	APPROVED	DWG 1



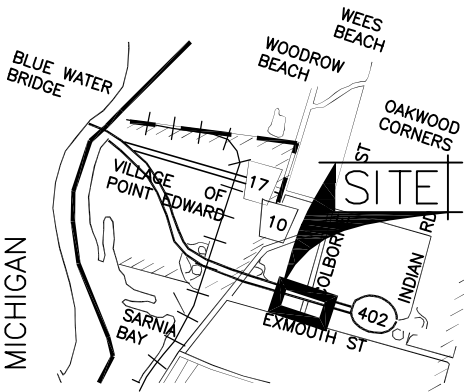
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 3038-03-00



BOREHOLE LOCATION
11+600 TO 12+200
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402,
SARNIA, ONTARIO

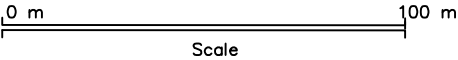
SHEET



LEGEND

- Borehole with
(Jacques Whitford, 2008)

BH No.	ELEVATION (m)	STA.	OFFSET
08-12	185.0	12+200	25 m LT
08-13	183.9	11+600	25 m LT
08-15	183.8	11+798	14 m RT



Scale

=NOTE=

- Base Plan provided by Stantec Consulting.
- Borehole locations and site features shown are approximate and may vary from that shown.

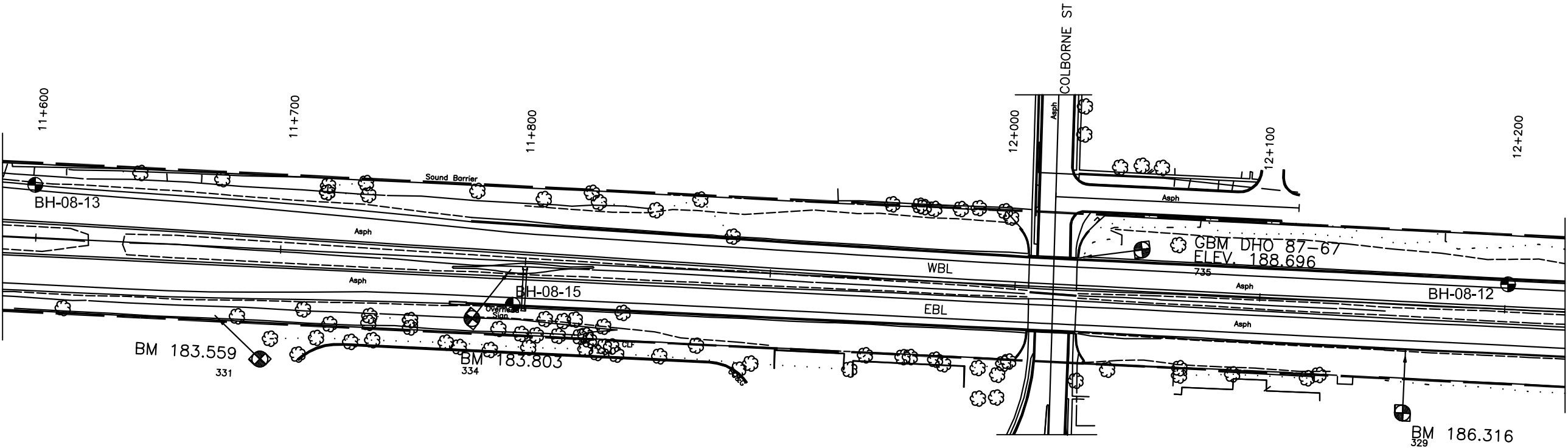
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REVISIONS	DATE	BY	DESCRIPTION
1			
2			

GEOCRES No 40 J16-82

HWY No 402	CHECKED	DATE 2008-10-29	DIST LONDON
SUBM'D GC	CHECKED	APPROVED	SITE -
DRAWN PC/HZ	CHECKED		DWG 2



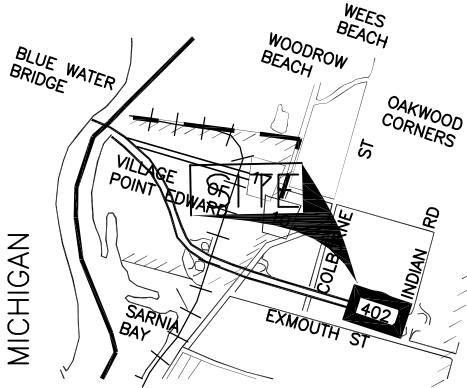
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UNLESS OTHERWISE SHOWN



CONT. No.
WP No. 3038-03-00

BOREHOLE LOCATION
12+700 TO 12+980
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402, SARNIA, ONTARIO

SHEET



LEGEND

- BOREHOLE
(Jacques Whitford, 2008)
- Benchmark

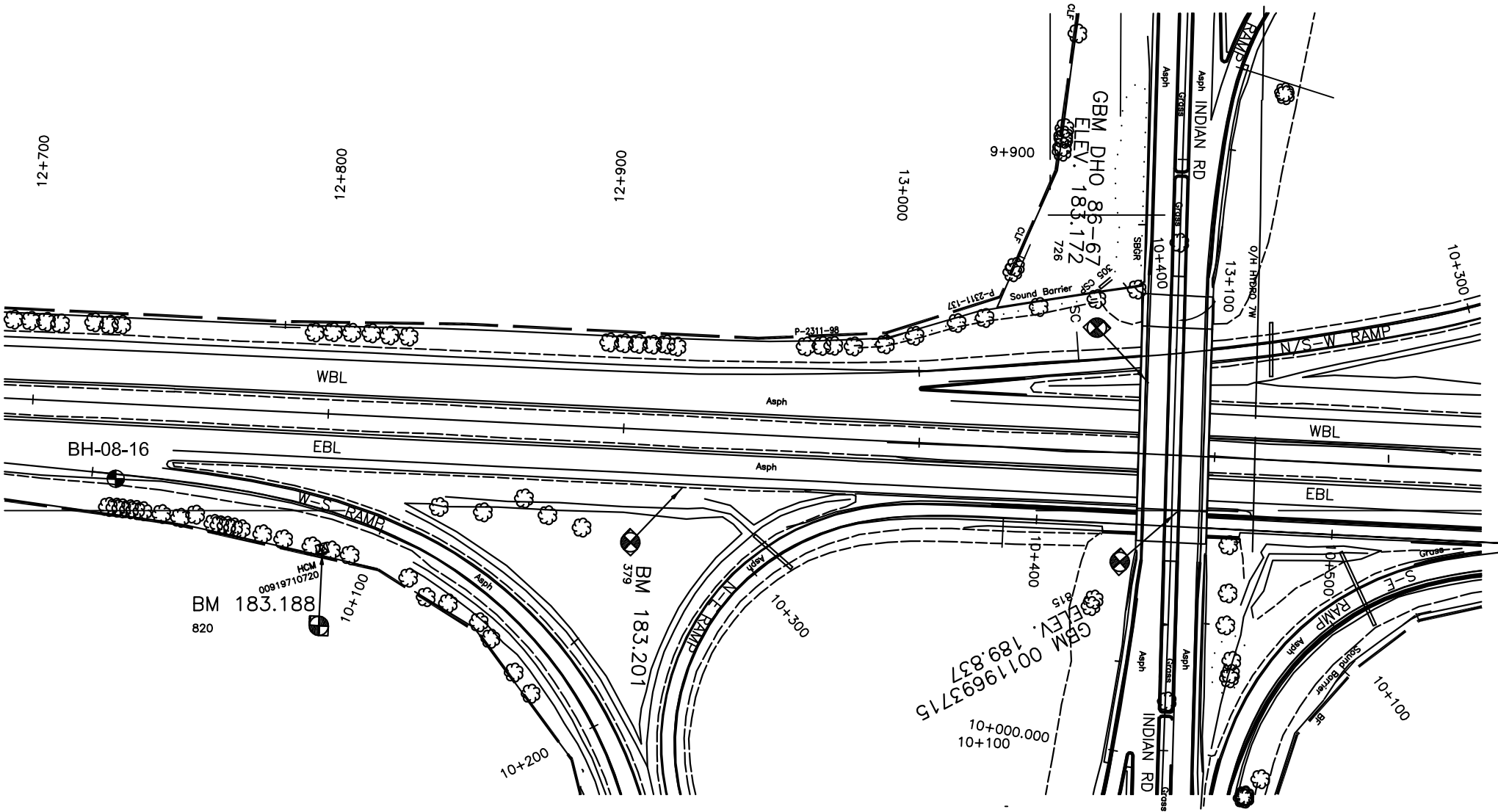
BH No.	ELEVATION (m)	STATION	OFF SET
08-16	183.5	12+730	23 m RT

0 m 100 m
Scale

NOTE
* Base Plan provided by Stantec Consulting.
* Borehole locations and site features shown are approximate and may vary from that shown.

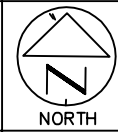
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REVISIONS				
DATE	BY			DESCRIPTION
GEOCRES No 40 J16-82				
HWY No 402				DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-10-29		SITE -
DRAWN PC/HZ	CHECKED	APPROVED		DWG 3



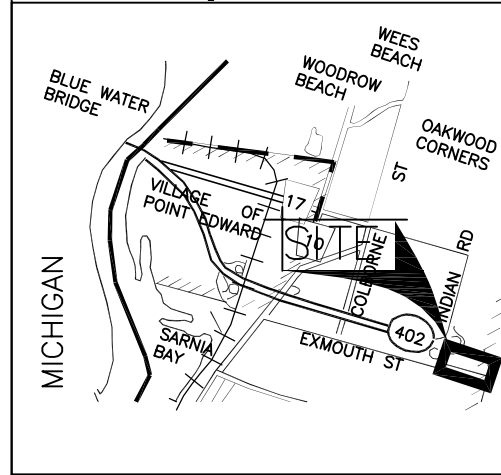
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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 3038-03-00



BOREHOLE LOCATION
13+025+13+480
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402, SARNIA, ONTARIO

SHEET



LEGEND

BOREHOLE
(Jacques Whitford, 2008)

BH No.	ELEVATION (m)	STA.	OFF SET
08-10	183.2	13+474	32 m LT
08-11	183.5	13+125	16 m LT

0 m 100 m
Scale

NOTE

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- * Borehole locations and site features shown are approximate and may vary from that shown.

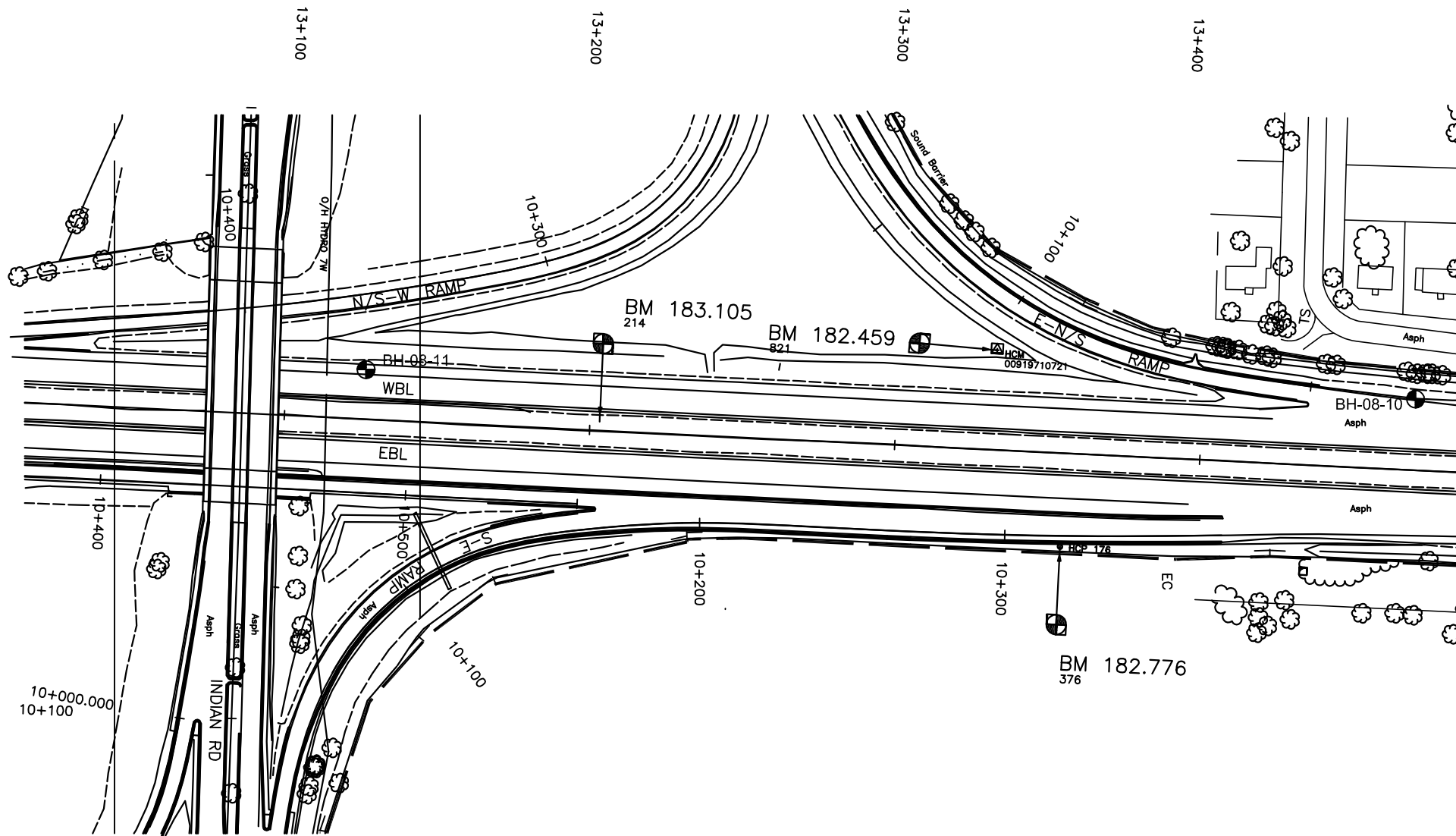
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REVISIONS	DATE	BY	DESCRIPTION
1			
2			

GEOGRES No 40 J16-82

HWY No 402	CHECKED	DATE 2008-10-29	DIST LONDON
SUBM'D GC	CHECKED	APPROVED	SITE -
DRAWN PC/HZ	CHECKED		DWG 4



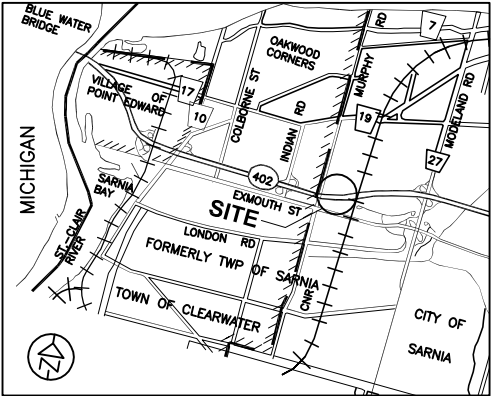
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DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 3038-03-00



BOREHOLE LOCATION
13+900 TO 14+400
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402,
SARNIA, ONTARIO

SHEET



LEGEND

BOREHOLE
(Jacques Whitford, 2008)

BH No.	ELEVATION (m)	STATION	OFFSET
08-6	184.3	14+098	25 m LT

0 m 100 m
Scale

NOTE
* Base Plan provided by Stantec Consulting.
* Borehole locations and site features shown are approximate and may vary from that shown.

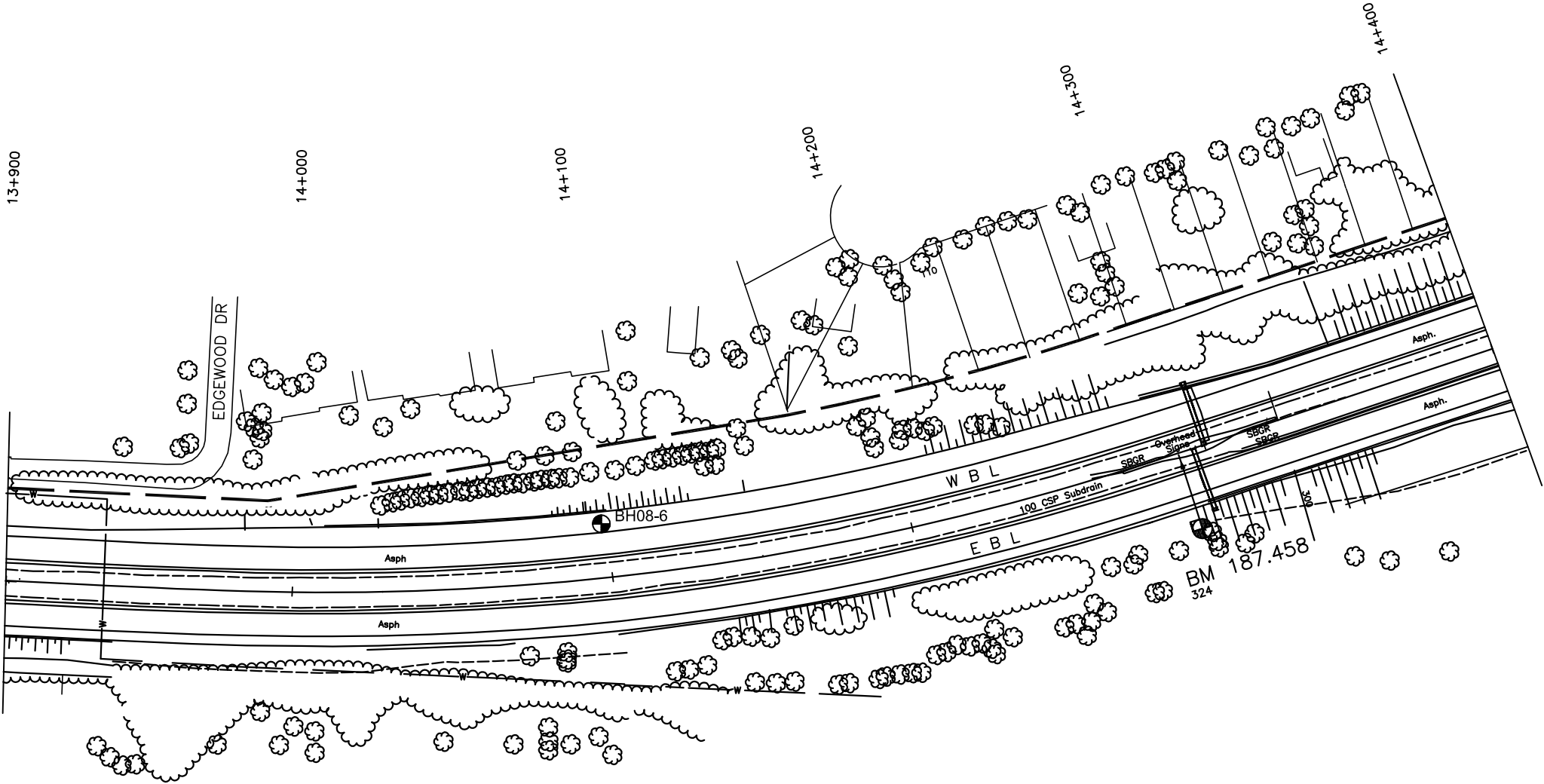
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REVISIONS	DATE	BY	DESCRIPTION
1			


GEOCRES No 40 J16-82

HWY No 402			DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-10-29	SITE -
DRAWN PC/HZ	CHECKED	APPROVED	DWG 5



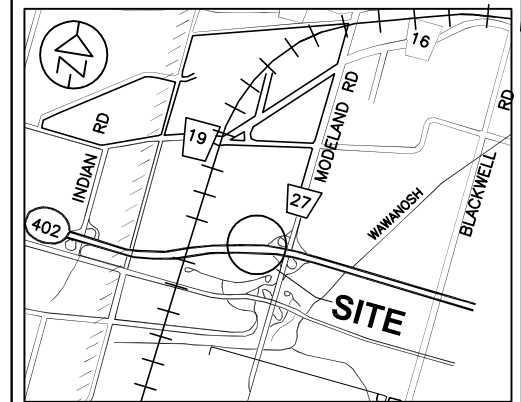
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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT. No.
WP No. 3038-03-00



NORTH

BOREHOLE LOCATION
14+850 to 15+400
PROPOSED SIGN SUPPORT
STRUCTURE,
HIGHWAY 402,
SARNIA, ONTARIO

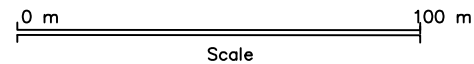
SHEET



LEGEND

 BOREHOLE
(Jacques Whitford, 2008)

BH No.	ELEVATION (m)	NORTHING	EASTING
08-1	184.2	14+900	23 m LT
08-17 A/B	181.0	15+090	23 m RT
08-18	180.7	15+300	42 m RT



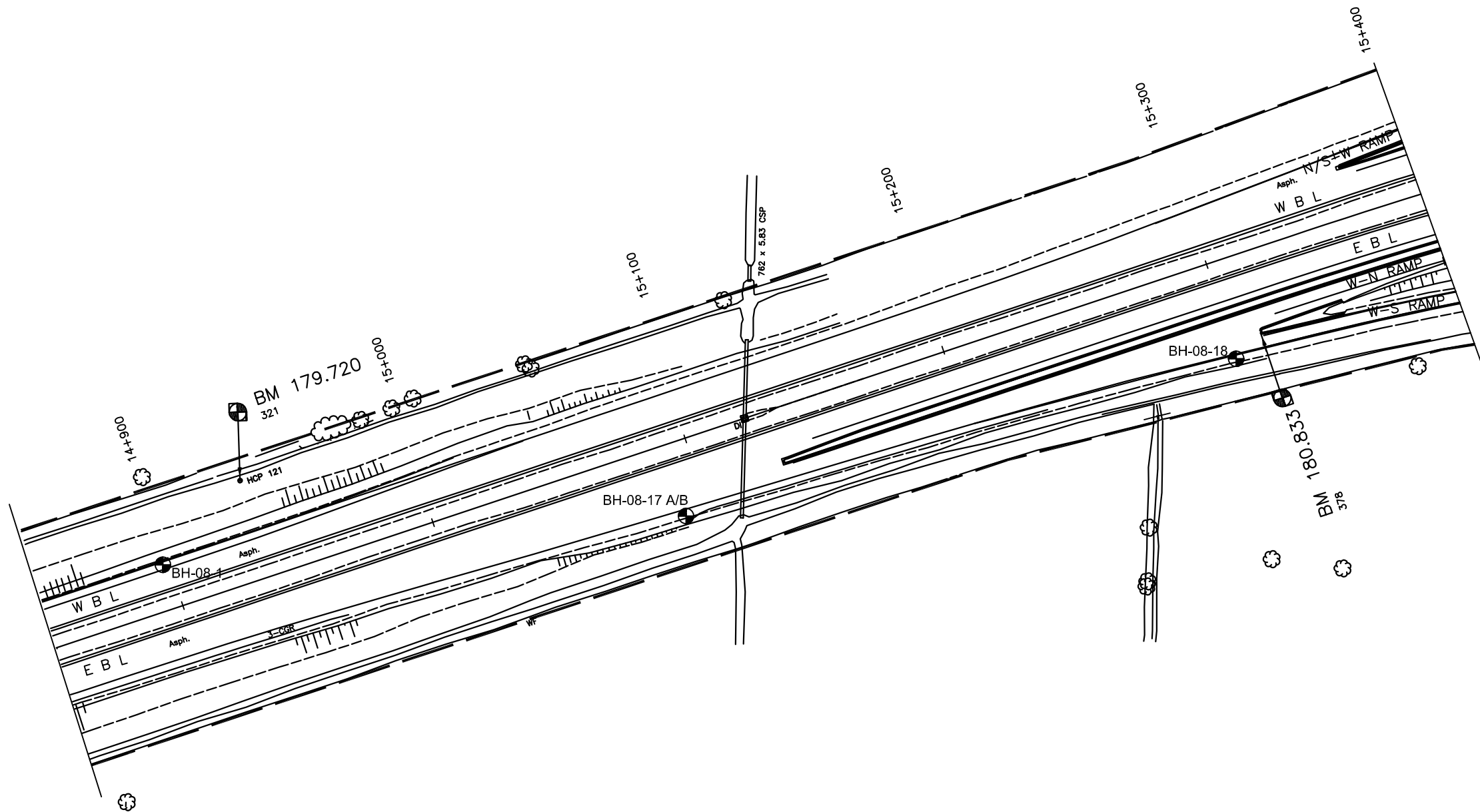
NOTE

* Base Plan provided by Stantec Consulting.
* Borehole locations and site features shown are approximate and may vary from that shown.

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

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS				
	--	--		
	DATE	BY	DESCRIPTION	
GEOCRES No 40J16-82				
HWY No 402			DIST LONDON	
SUBM'D GC	CHECKED	DATE 2008-10-29	SITE --	
DRAWN PC/HZ	CHECKED	APPROVED	DWG 6	



Appendix B

Terms and Symbols Used on the Record of Borehole Sheet
Record of Borehole Sheet

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
P	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ²	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No 08-14

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 10+983 o/s: 24 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED ✕ FIELD VANE ● QUICK TRIAXIAL ✕ LAB VANE									
183.9	Hwy 402 W.B. Rt. Shoulder						20	40	60	80	100						
180.6	150 mm ASPHALT																
0.2	SAND and GRAVEL (FILL), damp, dark brown																
183.3																	
0.6	SAND, some gravel, trace silt, moist, dense, black (Fly and bottom Ash)		1	SS	37									○			
			2	SS	49									○			
181.8																	
2.1	Sand, some gravel, trace silt (FILL), moist, compact		3	SS	42								○				
	- compact																
			4	SS	19								○				
180.0																	
4.0	SAND, some silt, trace gravel, dense to loose, moist to wet, grey		5	SS	32										○		
177.4			6	SS	9									○			
6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 3.5 m (Elev. 180.5 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 3.5 m (Elev. 180.5 m) below existing grade on completion of drilling																

RECORD OF BOREHOLE No 08-13

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 11+600 o/s: 25 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.10.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								○ UNCONFINED	✕ FIELD VANE											
								● QUICK TRIAXIAL	✕ LAB VANE											
183.9	Hwy 402 W.B. Rt. Shoulder																			
180.0	150 mm ASPHALT																			
0.2	SAND and GRAVEL (FILL), damp, brown																			
182.4			1	SS	46															
1.5	SAND, some silt and clay, dense to compact, moist, brown (SM)		2	SS	36															
			3	SS	24															
			4	SS	18															
	- dense		5	SS	37															
177.9																				
6.1	Silty CLAY, very stiff, moist to wet, grey (CL)		6	SS	24															
177.4																				
6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 2.7 m (Elev. 181.3 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 2.7 m (Elev. 181.3 m) below existing grade on completion of drilling.																			

RECORD OF BOREHOLE No 08-15

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 11+798 o/s: 14 m Rt, Twp of Sarnia; ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L				GR	SA	SI	CL
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100					10 20 30						
183.8	Hwy 402 E.B. Rt. Shoulder																			
183.0	100 mm ASPHALT																			
183.0	SAND and GRAVEL (FILL), damp, brown																			
0.8	SAND, some to trace gravel, some silt, very dense to dense, moist, brown (SM)		1	SS	55		183							○						
			2	SS	35		182							○						
			3	SS	41		181							○					0 92 (8)	
			4	SS	50		180							○						
			5	SS	37		179							○						
							178													
177.7	Medium SAND, some to trace gravel, compact, saturated, grey		6	SS	19										○				1 89 (11)	
6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 5.3 m (Elev. 178.5 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 5.3 m (Elev. 178.5 m) below existing grade on completion of drilling																			

RECORD OF BOREHOLE No 08-12

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 12+200 o/s: 25 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.10.08 - 8.10.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								○ UNCONFINED ✕ FIELD VANE ● QUICK TRIAXIAL ✕ LAB VANE												
								20 40 60 80 100												
						20 40 60 80 100					10 20 30									
185.0	Hwy 402 W.B. Rt. Shoulder																			
184.9	140 mm ASPHALT																			
0.1	SAND and GRAVEL (FILL), damp, brown																			
183.6			1	SS	23		184													
1.4	Sandy SILT, with organics, trace clay, compact, moist, brown (SM)																			
183.1			2	SS	29		183													
1.8	SAND, some silt, trace gravel, compact, moist, brown (SM)																			
			3	SS	24		182													
			4	SS	18		181													
			5	SS	46		180													
	- dense - wet						179													
178.7			6	SS	50															
6.2	Silty CLAY, trace sand, hard, moist, grey (CL)																			
178.4																				
6.6	END OF BOREHOLE at approximately 6.6 m																			
	Borehole caved to a depth of approximately 1.8 m (Elev. 183.2 m) below existing grade on completion of drilling																			
	Groundwater measured in caved borehole at a depth of approximately 1.8 m (Elev. 183.2 m) below existing grade on completion of drilling																			

RECORD OF BOREHOLE No 08-16

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 12+730 o/s: 23 m Rt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80						100
						○ UNCONFINED ✕ FIELD VANE											
						● QUICK TRIAXIAL ✕ LAB VANE											
183.5	Hwy 402 E.B. Rt. Ramp Shoulder					▽											
180.4	100 mm ASPHALT																
181.9	SAND and GRAVEL (FILL), damp, brown		1	SS	22												
181.5	Silty SAND, trace gravel, compact, moist, brown (SM)		2	SS	21												
	- wet		3	SS	23												
180.1			4	SS	25												
177.4	- grey																
	- silty, wet		5	SS	28												
176.9	Silty CLAY, very stiff, saturated, grey (CL)		6	SS	27												
6.6	END OF BOREHOLE at approximately 6.6 m																
	Borehole caved to a depth of approximately 2.0 m (181.5 m) below existing grade on completion of drilling																
	Groundwater measured in caved borehole at a depth of approximately 2.0 m (181.5 m) below existing grade on completion of drilling																

RECORD OF BOREHOLE No 08-11

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 13+125 o/s: 16 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.8.08 - 8.8.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L				
183.5	Hwy 402 W.B. Rt. Shoulder													GR SA SI CL
180.4	100 mm ASPHALT													
182.7	SAND and GRAVEL (FILL), damp, brown													
0.8	Silty SAND (FILL), trace gravel, damp to moist, brown		1	SS	37									
181.9														
1.5	SAND, trace gravel, silt and clay, compact, moist, brown (SM)		2	SS	20									
			3	SS	18									
180.4														
3.0	- grey - wet		4	SS	24									
	- dense		5	SS	30									
177.2														
6.2	Silty CLAY, very stiff, moist to wet, grey (CL)		6	SS	25									
176.9														
6.6	END OF BOREHOLE at approximately 6.6 m													
	Borehole caved to a depth of approximately 2.1 m (Elev. 181.4 m) below existing grade on completion of drilling													
	Groundwater measured in caved borehole at a depth of approximately 2.1 m (Elev. 181.4 m) below existing grade on completion of drilling													

RECORD OF BOREHOLE No 08-10

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 13+474 o/s: 32 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.8.08 - 8.8.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
						○ UNCONFINED ✕ FIELD VANE ● QUICK TRIAXIAL ✕ LAB VANE				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)					
183.2	Hwy 402 W.B. Rt. Shoulder					▽	183								
180.9	100 mm ASPHALT		1	AS	--										
180.1	SAND and GRAVEL (FILL), damp, brown		2	SS	50 / 75 mm										
181.7	SAND, trace gravel, trace silt and clay, dense to compact, moist, brown (SM)		3	SS	30										
1.5			4	SS	20										
			5	SS	14										
178.7	- grey - wet		6	SS	17										
177.6	Silty CLAY, with sand, stiff, wet, grey (CL)														
5.6			7	SS	12										
176.7	END OF BOREHOLE at approximately 6.6 m														
6.6	Borehole caved to a depth of approximately 2.7 m (Elev. 180.6 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 2.7 m (Elev. 180.6 m) below existing grade on completion of drilling														

Numbers refer to Sensitivity
 STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-6

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 14+098 o/s: 25 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.7.08 - 8.7.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED ✕ FIELD VANE ● QUICK TRIAXIAL ✕ LAB VANE					W _p W W _L WATER CONTENT (%)				GR	SA	SI	CL
184.3	Hwy 402 W.B. Rt. Shoulder					▽														
184.0	150 mm ASPHALT																			
0.2	SAND and GRAVEL (FILL), damp, brown						184													
183.5																				
0.8	Silty CLAY (FILL), trace to some gravel, very stiff, damp, brown (CL)		1	SS	17		183							○						
			2	SS	26		182							○						
			3	SS	16									○					1 23 37 39	
181.2																				
3.0	Silty SAND, trace gravel, dense, wet, grey (SM)		4	SS	35	181							○							
						180														
179.7	Silty CLAY, moist to wet, stiff to hard, grey (CL)		5	SS	9	179								○						
4.6																				
						178								○						
177.7			6	SS	35															
6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 3.4 m (Elev. 180.9 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 3.4 m (Elev. 180.9 m) below existing grade on completion of drilling																			

RECORD OF BOREHOLE No 08-1

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 14+900 o/s: 23 m Lt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.6.08 - 8.6.08 CHECKED BY GC


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L						
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)									
184.2	Hwy 402 W.B. Rt. Shoulder							20	40	60	80	100						
0.0	SAND and GRAVEL (FILL), damp Brown		1	SS	58		184											
183.4																		
0.8	Silty CLAY, moist, hard, brown (CL)		2	SS	40		183											
182.6																		
1.5	- grey - very stiff to hard		3	SS	24		182											
	- trace to some gravel		4	SS	32													
			5	SS	32		181											
							180											
	- very moist - stiff to very stiff		6	SS	12		179											
177.6			7	SS	19		178											
6.6	END OF BOREHOLE at approximately 6.6 m Borehole open and dry on completion of drilling																	

RECORD OF BOREHOLE No 08-17A

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn: 15+090 o/s: 23 m Rt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
							20	40	60	80	100	W _p	W	W _L		
181.0	Hwy 402 E.B. Rt. Shoulder															
0.0	SAND and GRAVEL (FILL), trace silt, wet, brown		1	SS	12	180										
179.4	END OF BOREHOLE at approximately 1.6 m															
1.6	Borehole encountered obstruction at a depth of approximately 1.6 m. Borehole relocated to approximately 1.5 m east (BH 08-17B).															

\times^3, \times^3 : Numbers refer to Sensitivity \bigcirc 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-17B

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn: 15+090 o/s: 23 m Rt, Twp of Sarnia ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE																
181.0 0.0	Hwy 402 E.B. Rt. Shoulder Borehole augered to 1.5 m.						▽																	
179.4 1.5	Silty SAND, compact, moist, brown (SM)		1	SS	24																			
			2	SS	25																			
176.7 4.3	Silty CLAY, stiff, wet, grey (CL)		3	SS	9																			
174.4 6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 1.2 m below existing grade (Elev. 179.8 m) on completion of drilling Groundwater measured in caved borehole at a depth of approximately 0.6 m below existing grade (Elev. 180.4 m) on completion of drilling		4	SS	10																			

RECORD OF BOREHOLE No 08-18

1 OF 1

METRIC

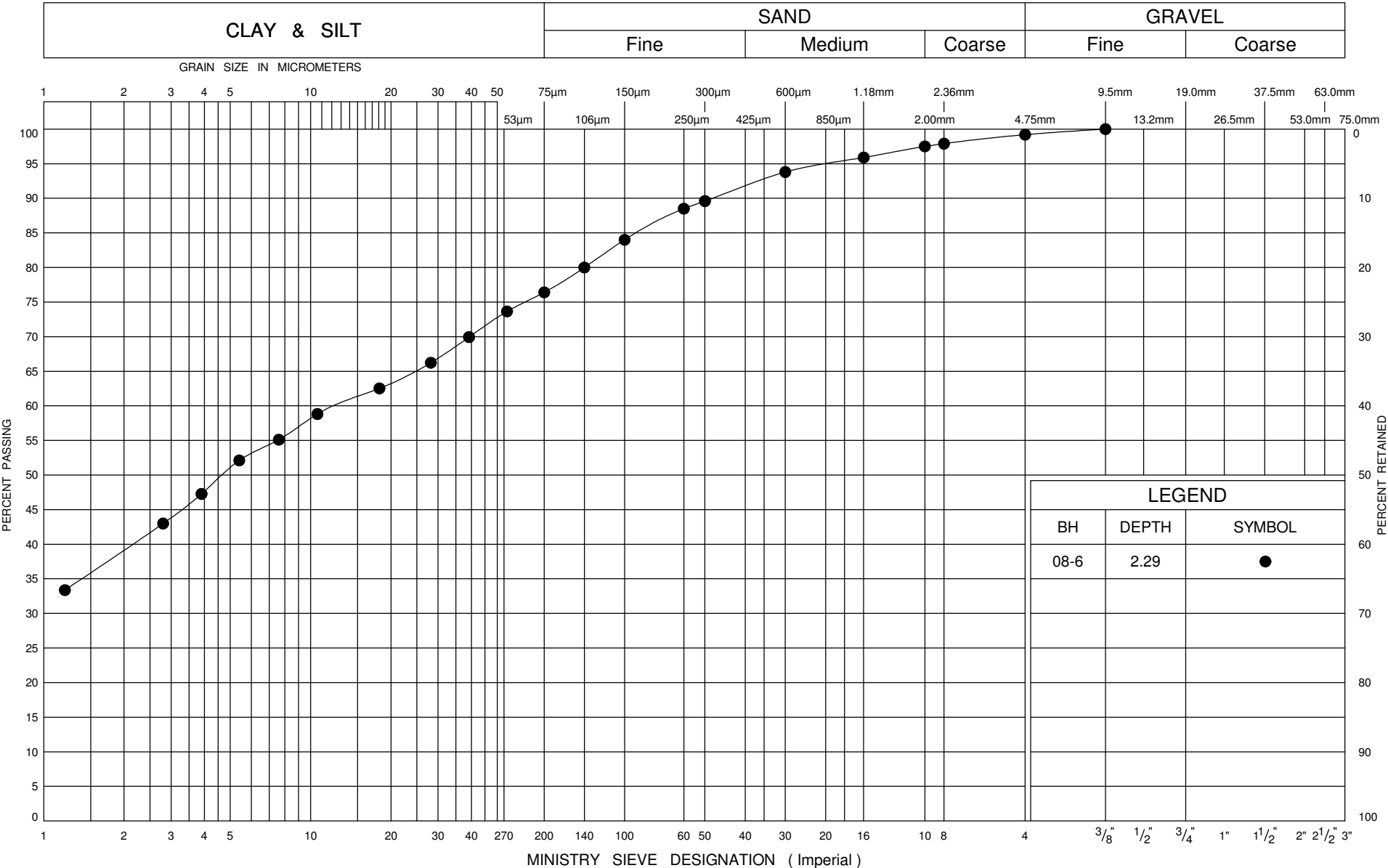
W.P. 3038-03-00 LOCATION Highway 402, Stn: 15+300 o/s: 42 m Rt, Twp of Sarnia; ORIGINATED BY OL
 DIST London HWY 402 BOREHOLE TYPE Solid Stem Auger, Hollow Stem Auger, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 8.11.08 - 8.11.08 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
180.7	Hwy 402 E.B. Rt. Shoulder					▽	180							
0.0	SAND and GRAVEL (FILL), damp, brown													
179.1														
1.5	Silty clay, some gravel, trace to some sand, moist, hard, brown (FILL)		1	SS	50 / 150 mm									
178.4														
2.3	SAND, some silt, trace to some gravel, loose to compact, wet to saturated, grey (SM)													
			2	SS	8									
			3	SS	6									
174.1			47	SS	12		175							
6.6	END OF BOREHOLE at approximately 6.6 m Borehole caved to a depth of approximately 2.7 m (Elev. 178.0 m) below existing grade on completion of drilling Groundwater measured in caved borehole at a depth of approximately 2.7 m (Elev. 178.0 m) below existing grade on completion of drilling													

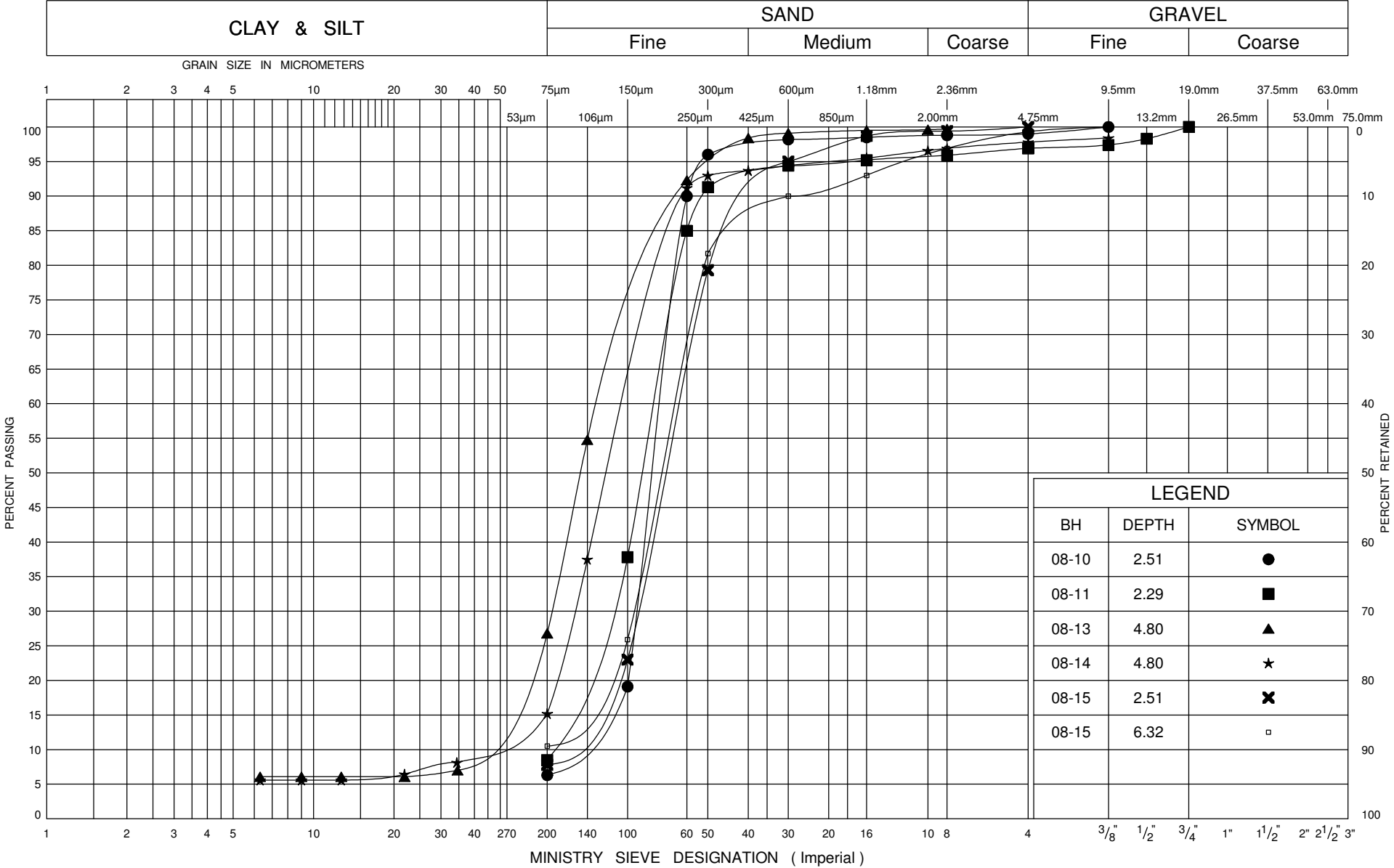
Appendix C

Geotechnical Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

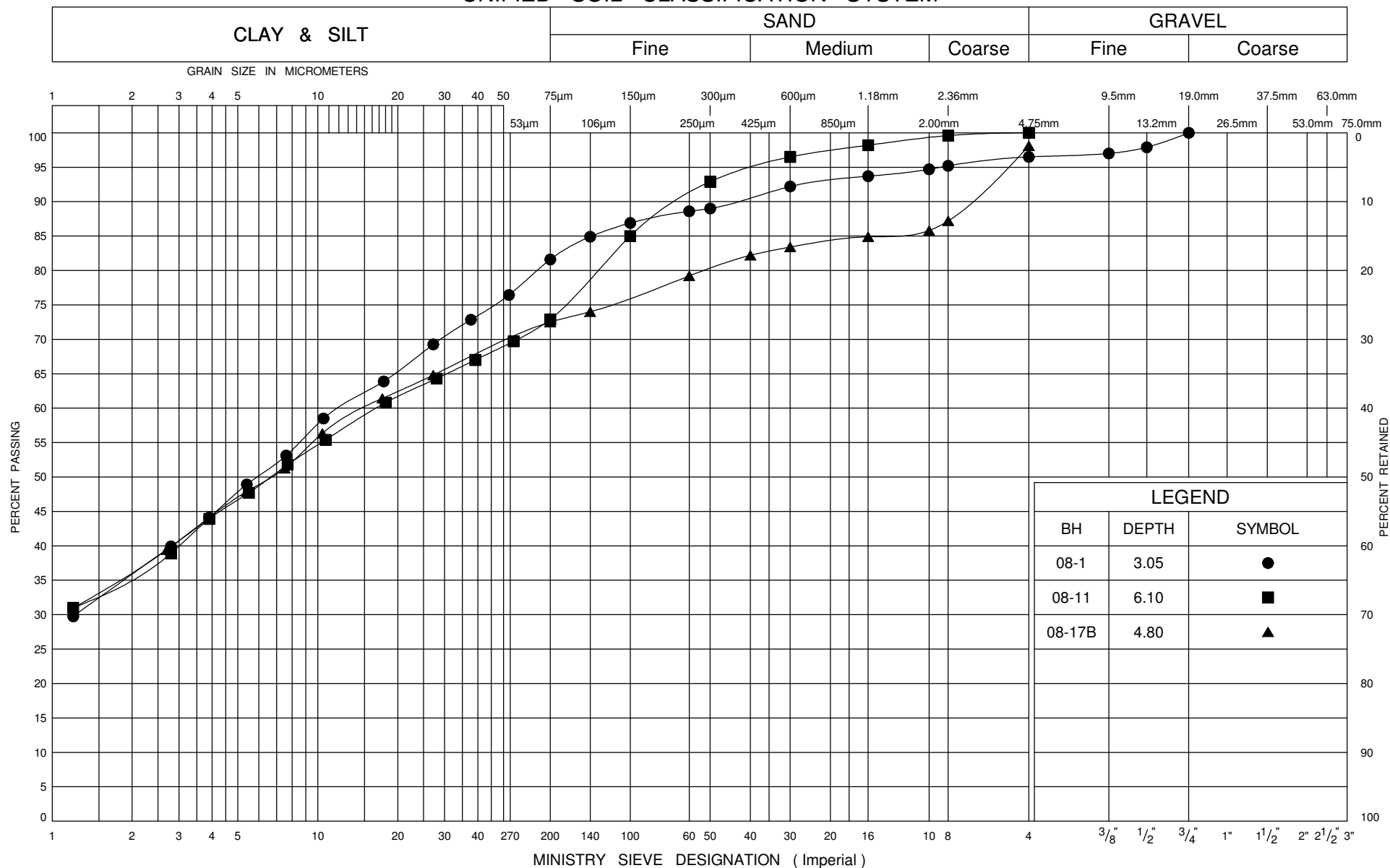
Native SAND

FIG No 2

W P 3038-03-00

Hwy 402, Township of Sarnia

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Silty CLAY (CL)

FIG No 3

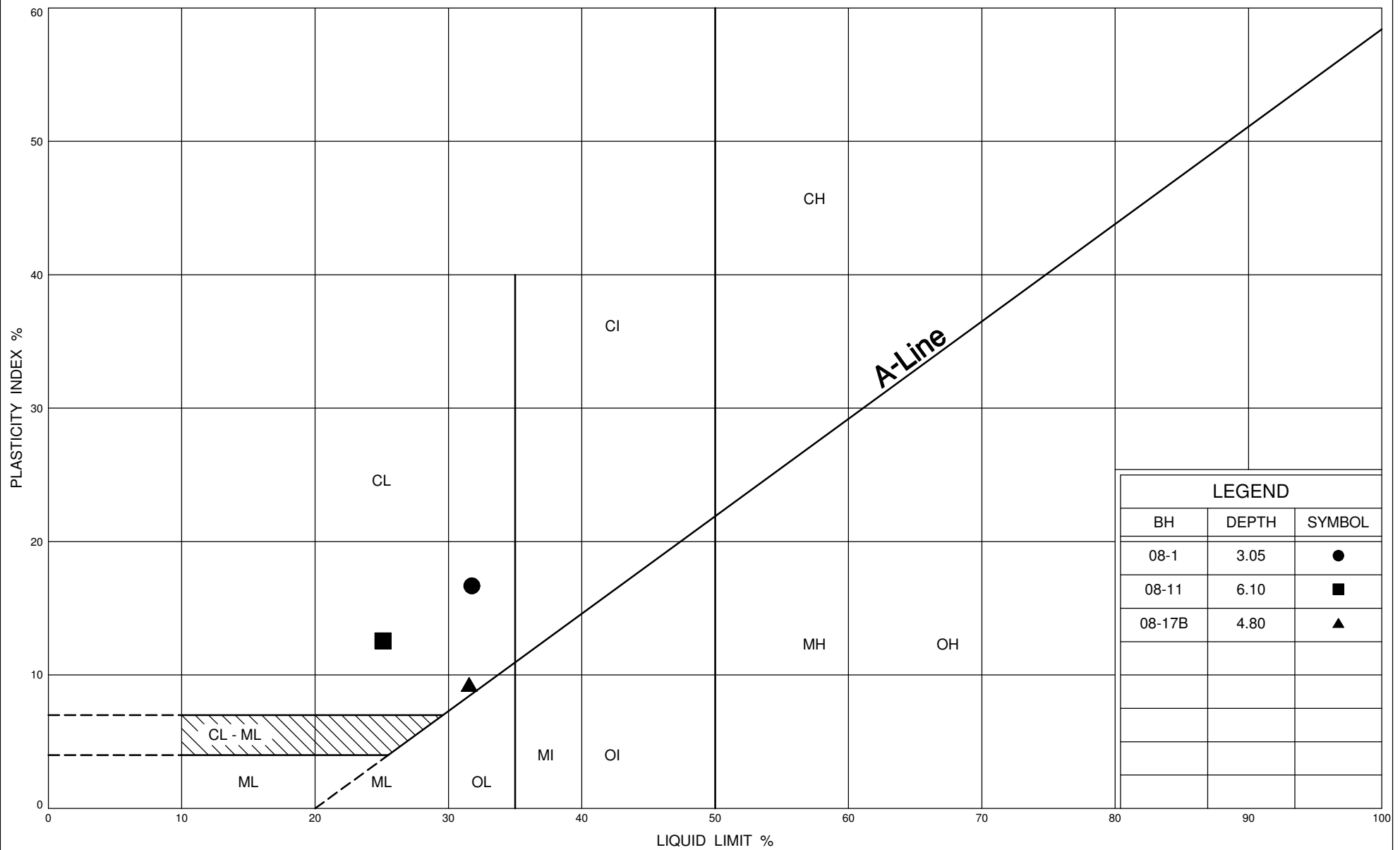
W P 3038-03-00

Hwy 402, Township of Sarnia



Ministry of
Transportation

Ontario



Ministry of
Transportation

PLASTICITY CHART

Silty CLAY (CL)

FIG No 4

W P 3038-03-00

Hwy 402, Township of Sarnia