

FINAL REPORT

Foundation Investigation Report
Front Street / CNR Overpass
(WBL), Site 14-363/2
Highway 402
City of Sarnia, Ontario
District - London
G.W.P. 3038-03-00

STANTEC CONSULTING LTD.

PROJECT NO. 1012607
GEOCRES NO. 40J16-79

REPORT NO. 1012607

REPORT TO	Stantec Consulting Inc. 1400 Rymal Road East Hamilton, ON L8W 3N9
FOR	Foundation Investigation Report
ON	Front Street / CNR Overpass (WBL) Site 14-363/2, Highway 402 City of Sarnia District – London, Ontario G.W.P. 3038-03-00 Geocres. No. 40J16-79

August 25, 2008

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FOUNDATION INVESTIGATION REPORT

**Front Street / CNR Overpass (WBL)
Site 14-363/2, 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 and Design Report for the widening of the Highway 402 Front Street / CNR Overpass (WBL), site 14-363/2, in the City of Sarnia, Ontario, (GWP No. 3038-03-00).

The work was carried out under Agreement No. 3005-E-0029 and in general 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., the prime consultant on this detailed 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 laboratory testing.

2.0 SITE DESCRIPTION

The site location is on Highway 402 at the Front Street Interchange (IC-1) in the City of Sarnia, Ontario.

Highway 402 at Front Street is a semi-urban freeway with wide gravel shoulders and a wide grass covered centre median. Highway 402 is built on embankments that are approximately 8 m to 9 m high at the bridge location. Highway 402 is generally oriented in an east west direction with two east bound lanes, two west bound lanes, and a west bound ramp all passing over Front Street. The east and west bound lanes of the highway at this location are super-elevated, curving to the north.

Front Street is five lanes wide at the structure. The street is generally at or near the ground surface elevation of the surrounding lands and is built with an urban section with concrete curbs. Drainage is provided by concrete gutters and a series of catchbasins located along the sides of the road.

Drainage for Highway 402 is provided by ditches located along the sides and in the central median. The ditches are sloped towards a limited number of catch basins located along the existing highway. Regional drainage is towards the St. Clair River located approximately 0.8 km southwest of the project site.

There are 2 bridge structures that convey Highway 402 over Front Street; one structure for the eastbound lanes and one structure for the west bound lanes. Previously, the bridges also conveyed

the highway over CNR tracks, which have since been replaced with a walking path. The former CNR alignment is located on the east side of Front Street. The structures were reportedly constructed in 1981 and are of similar construction consisting of 5 spans supported on abutments on the east and west side with 4 central piers. The spans range in length from approximately 10 m to 15 m, with the shorter spans located near the abutments. There is approximately 12 m between the two bridge structures. The bridges are reportedly constructed of reinforced and pre-stressed concrete.

Based on Drawing Sheet No. 107, WP 347-65-02 by Nisbet Lethan Limited, it is understood that the existing bridge structures are supported on 325 mm diameter steel pipe piles driven to the underlying bedrock at depths in the range of 38.1 m, (Elev. 140 m) to 47.2 m (Elev. 136.5 m). The drawing indicates that there are 9 piles at each abutment location and 10 piles at each pier location. The piles were installed with an incline of 1:4 (Horizontal to Vertical), and were filled with concrete that was to have a 28 day compressive strength of 30 MPa.

Representative colour photographs of the bridges are provided in **Appendix D**.

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

4.0 BACKGROUND

Previous Investigations

A previous assessment of the site was carried out by Golder Associates Ltd. The results of the assessment were provided in a written report titled:

Preliminary Foundation Investigation and Design Report, Proposed Front Street/CNR Overpass, Structure Widening, Highway 402, Geocres No. 40J16-66, GWP 3038-03-00, Agreement Number 3005-A-000394, Dated July 26, 2006.

This preliminary report was based on factual data contained within the Ministry of Transportation's, Geocres Library, MTO Report Geocres No. 40J16-58 titled:

Foundation Investigation Report for Front Street Overpass and CNR Overhead, W.P. 347-65-02/03, Site 14-363, Highway 402, District 1, Chatham, Dated August 1977.

Nine boreholes were drilled at the site in 1977. The reported subsurface conditions included the following strata types:

Strata	Layer Thickness (m)	Depth to underside of Strata (m)
Sand	1.8 to 3.0	1.8 to 3.0
Clayey Silt	13 to 17	16.8-17.1 5 boreholes were terminated in this layer
Silty Clay	18 to 21	34.7-37.5
Sand	1.5 to 1.9	37 to 40
Bedrock	n/a	Termination depth of the boreholes

The upper sand was generally reported to be very loose to compact, with moisture contents in the range of approximately 11% to 32%.

The clayey silt layer was stated to be firm to very stiff, with actual reported measurements indicating stiff to very stiff conditions. In situ shear vane tests ranged from approximately 31 kPa to >105 kPa (the limit of the equipment), with an average of approximately 64 kPa. Laboratory tests were reported as follows:

- Moisture contents:
 - Crust: approximately 10% to 20%, average of about 16%;
 - Below the crust: approximately 12% to 28%, average of about 22%;
- Average plastic limit of approximately 15%;
- Average liquid limit of approximately 30%;
- Bulk densities ranging from approximately 2,000 to 2,100 kg/m³; and,
- Confined and unconfined triaxial testing yielded shear strengths of approximately 34 kPa to 115 kPa.

The silty clay layer was stated to be stiff. In situ shear vane tests ranged from approximately 55 kPa to 101 kPa with an average of 74 kPa. Laboratory tests were reported as follows:

- Moisture contents ranging from 17% to 36%, average of about 27%;
- Average plastic limit of approximately 20%;
- Average liquid limit of approximately 39%;
- Bulk density of approximately 1,900 kg/m³; and,
- Confined and unconfined triaxial shear strengths ranging from approximately 69 kPa to 79 kPa.

The bedrock was identified as black shale of the Kettle Point formation. The total rock recoveries reported were 77% to 100%.

Groundwater was reported at depths in the range of about 0.8 m to 2.3 m below ground surface, corresponding to elevations between 176 m and 178 m.

5.0 INVESTIGATION PROCEEDURES

5.1 Field Program

The fieldwork for the present investigation was carried out between November 1 to 23, 2006, December 12 to 19, 2006 and January 30, 2007 to February 1, 2007. A total of 5 boreholes were advanced to depths ranging from approximately 40 m to 50 m below existing grade, using track and truck mounted drill rigs equipped with 250 mm (outside diameter), hollow-stem augers and mud-rotary drilling techniques. The drill rigs were supplied and operated by Aardvark Drilling Inc. and London Soils.

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

Soil samples were recovered from the boreholes at regular intervals using a 50 mm Outside Diameter split-tube sampler by conducting Standard Penetration Tests (SPTs) in general accordance with the procedures outlined in ASTM specification D1586-99. Relatively undisturbed samples were obtained by pushing thin walled sample tubes in general accordance with ASTM D1587.

Where cohesive soils were encountered, in situ shear vane testing was carried out using a vane meeting the MTO N-Vane design requirements and following the procedures outlined in ASTM D2573-94.

Rock cores were obtained using HQ wire line rock coring equipment.

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

The groundwater levels, where encountered and where practical, were measured in the boreholes during and on completion of drilling. All boreholes were backfilled in accordance with Ontario Regulation 903, using cement/bentonite slurry.

All soil samples recovered from the boreholes were placed in moisture-proof bags and returned to our laboratory for detailed classification and testing as required. All rock cores were placed in rock core boxes and transported to our laboratory for detailed examination and selected laboratory testing.

5.2 Survey

The borehole locations were established by Jacques Whitford personnel and referenced to the stations on Front Street or Highway 402, as noted on the Record of Borehole sheets. Offsets were referenced looking up chainage. The borehole locations are also referenced to Northing and Easting co-ordinates, which are provided on the Drawing No. 1 in **Appendix A** and on the Record of Borehole sheets in **Appendix B**.

The ground surface elevation at the borehole locations were surveyed by Jacques Whitford Personnel. The boreholes were surveyed to either the benchmark or temporary benchmark noted below:

- BM 860, Cross cut on the southwest corner of the west abutment of the westbound bridge over Front Street, with a reported Geodetic elevation of 186.53 m, as identified on a survey drawing by J. D. Barnes, titled "Pre-Engineering, Sta.: 11+000 to Sat 11+700", with a survey date of August, 2004,

- Temporary BM, a catchbasin on the east side of Front Street, approximately 20 m north of Pier 3, with a Geodetic elevation of 177.54 m, as provided by Stantec, February 2006.

The location of the benchmark and temporary benchmark are shown on Drawing No. 1 in **Appendix A**.

5.3 Laboratory Testing

All samples returned 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 testing, Atterberg Limits testing, moisture content determination testing and unit weight measurement testing. The laboratory results are provided on the Record of Borehole sheets in **Appendix B**. The results of the grain size analyses, Atterberg Limits tests and unit weight measurements are shown on Figure Nos. 1 through 10 in **Appendix C**.

Three rock core samples were submitted for unconfined compressive strength testing. The results of the unconfined compressive strength testing are provided on Figure No. 11 in **Appendix C**.

Unless requested in advance, all samples will be stored in our laboratory for a period of 12 months, after issuance 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 also provided in **Appendix B**. Copies of the Record of Borehole sheets from the 1977 investigation have been included in **Appendix B** for reference.

A Borehole Location Plan and a Strata Plot of the soils encountered in the boreholes are provided on Drawing No. 1 in **Appendix A**.

A summary of the soil and groundwater conditions encountered in the 2006/2007 boreholes is provided below.

6.2 Soil

6.2.1 Asphalt

Asphalt was encountered at the ground surface in Boreholes FS-2 and FS-3 and was approximately 150 mm and 165 mm thick, respectively.

6.2.2 Topsoil

Topsoil was encountered at the ground surface in Boreholes FS-1, FS-4 and FS-5. The thickness of the topsoil ranged from approximately 0.8 m to 1.5 m.

6.2.3 Sand Fill (SW)

Sand fill was encountered underlying the asphalt or topsoil in all boreholes. The sand fill ranged in thickness from approximately 0.7 m to 1.5 m.

The sand fill generally consisted of sand and gravel directly below the asphalt, grading to sand fill, trace gravel with increasing depth. The sand fill contained varying amounts of silt, with to trace, and was generally moist to damp.

Based on the N-Values obtained from the Standard Penetration Tests (SPTs), the compactness of the sand fill was variable ranging from loose to very dense, but was more typically compact to dense.

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

- Moisture Content:
 - 7% to 29%.
- Grain Size Distribution
 - 8% gravel;
 - 64% sand; and,
 - 28% fines (silt and clay).

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

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

6.2.4 Clayey Silt Fill (CL)

Two layers of clayey silt fill were encountered in Borehole FS-5. The first layer was encountered at a depth of approximately 1.4 m, elevation of approximately 184.5 m and was approximately 0.7 m thick. The second layer of clayey silt fill was encountered in Borehole FS-5 at a depth of approximately 2.9 m, elevation of approximately 182.9 m and was approximately 1.2 m thick.

The clayey silt fill contained trace to some sand, trace to some gravel, trace to some organics, topsoil and plant debris, and was generally moist.

Based on the N-Values obtained from the SPTs, the consistency of the clayey silt fill was stiff.

Laboratory testing performed on two samples consisted of moisture content tests. The test results are as follows:

- Moisture Content:
 - 8% and 18%.

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

6.2.5 Silty Sand Fill (SM)

A layer of silty sand fill was encountered underlying the sand fill in Borehole FS-1 at a depth of approximately 1.5 m, elevation of approximately 183.9 m. The silty sand fill was approximately 2.3 m thick.

The silty sand fill contained some gravel, varying amounts of fly and bottom ash and trace organics. The silty sand fill was generally moist.

Based on the N-Value obtained from a single SPT, the compactness of the silty sand fill was compact.

Laboratory testing performed on the sample consisted of moisture content tests. The test results are as follows:

- Moisture Content:
 - 10% to 18%.

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

6.2.6 Fly and Bottom Ash (SP-SM)

Fly and bottom ash was encountered in Boreholes FS-1 and FS-5 at depths of approximately 3.8 m and 4.1 m below existing grade, or elevations of approximately 181.7 and 181.6, respectively. The thickness of the fly and bottom ash was approximately 3.1 m in FS-1 and 4.6 m in FS-5.

The fly and bottom ash could be characterised as a sandy silt / silty sand with trace to some gravel and trace clay sized particles. The ash was generally moist to wet.

Based on the N-Values obtained from the SPTs, the compactness of the fly and bottom ash ranged from very loose to very dense, but was more typically loose.

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

- Moisture Content:
 - 15% to 37%.
- Grain Size Distribution:
 - 3% to 16% gravel;
 - 31% to 74% sand; and,
 - 9% to 62% silt; and,
 - 1% to 5% clay.
- Atterberg Limits:
 - Liquid Limit: 26%;
 - Plastic Limit: 15%; and,
 - One sample tested indicated non-plastic.

The results of the moisture content tests, 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 and Atterberg Limits tests are provided on Figures 2 and 3 in **Appendix C**.

6.2.7 Native Sand (SM)

Native sand was encountered underlying the fill in Boreholes FS-1, FS-2 and FS-3. The sand was encountered at depths of 8.4 m, 1.5 m, and 1.4 m, respectively, elevations of approximately 176.2 m to

177.1 m. The thickness of the sand ranged from approximately 0.7 m to 2.3 m. The sand was encountered at greater depth in Borehole FS-1, as this borehole was drilled on the top of the approach embankments.

The sand generally contained trace to some gravel, trace to some silt and clay, and was generally wet.

Based on the N-Values obtained from the SPTs, the compactness of the sand ranged from loose to compact.

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

- Moisture Contents:
 - 13% to 24%.
- Grain Size Distribution:
 - 1% gravel;
 - 70% to 82% sand; and,
 - 17% to 30% 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 4 in **Appendix C**.

6.2.8 Silt (ML)

A localized deposit of silt was encountered in Borehole FS-2 at a depth of approximately 6.9 m, elevations of approximately 170.9 m and was approximately 1.5 m thick.

The silt generally contained varying amounts of sand, trace gravel, and was generally wet to saturated.

Based on the N-Values obtained from a single SPT, the compactness of the silt was assessed to be compact.

Laboratory testing performed on a single sample consisted of a moisture content test, a grain size distribution and Atterberg Limits test. The test results are as follows:

- Moisture Content:
 - 18%
- Grain Size Distribution:
 - 1% gravel;
 - 26% sand;
 - 64% silt; and,
 - 9% clay.
- Atterberg Limits:
 - Non-plastic.

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 test are also provided on Figure 5 in **Appendix C**.

6.2.9 Silty Clay (CL)

Silty clay was encountered underlying the sand or fill in all boreholes. The silty clay was encountered at depths in the range of approximately 2.1 m to 10.7 m below existing grade, or elevation of approximately 174.3 m to 177.1 m. The silty clay was approximately 28.2 m to 37.9 m thick and extended to depths in the range of approximately 36.6 m to 46.6 m or elevations of approximately 139.2 m to 141.2 m.

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

Based on the N-Values obtained from the SPTs, the consistency of the silty clay was variable ranging from very soft to very stiff. The upper 2 m of the silty clay generally could be classified as very stiff, indicating this layer is likely a desiccated layer.

In situ shear vane testing was carried out in the silty clay. The results of the testing indicated that the shear strength of the silty clay was variable ranging from approximately 50 kPa to >100 kPa (the upper limit of the testing equipment). The in situ shear vane testing indicated that the consistency of the silty clay could be described as firm to very stiff.

Laboratory testing performed on selected samples consisted of moisture content, grain size distribution, Atterberg Limits and unit weight measurement tests. The test results are as follows:

- Moisture Content:
 - 13% to 37%.
- Grain Size Distribution:
 - 1% to 17% gravel;
 - 10% to 36% sand;
 - 29% to 48% silt; and,
 - 19% to 51% clay.
- Atterberg Limits:
 - Liquid Limits: 24% to 42%; and,
 - Plastic Limits: 14% to 23%.
- Unit Weight Measurements:
 - 22.3 to 22 kN/m³.

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

The results of the grain size distribution tests are provided on Figures 6 and 7 in **Appendix C**. The results of the Atterberg Limits tests are provided on Figures 8 and 9 in **Appendix C**. The results of the unit weight tests are provided on Figure 10 in **Appendix C**.

6.2.10 Bedrock

Bedrock was encountered in all boreholes at depths of approximately 36.6 m to 46.6 m below existing grade, corresponding to elevations of approximately 141.2 to 139.2 m. The bedrock consisted of black shale of the Kettlepoint formation.

Core samples of the bedrock were obtained from Boreholes FS-2, FS-3 and FS-4. The observations of the rock cores are summarized as follows:

- Total Core Recovery (TCR): 15% to 100%, Mean of about 71%;
- Solid Core Recover (SCR): 11% to 99%, Mean of about 53%; and,
- Rock Quality Designation (RQD): 0% to 95%, Mean of about 49%.

Three samples of the rock were submitted for testing the unconfined compressive strength. The test results were as follows:

- Unconfined compressive strength:
 - Sample from FS-2: 95 MPa;
 - Sample from FS-3: 97 MPa;
 - Sample from FS-4: 99 MPa; and,
 - Mean: 97 MPa.

The results of the rock core analysis and unconfined compressive strength test results are provide on the Record of Borehole sheets in **Appendix B**.

The results of the unconfined compressive strength tests are also provided on Figure 11 in **Appendix C**.

6.3 Groundwater

It was not practical to measure the ground water on completion of drilling, given the methods employed to drill the boreholes included the use of drilling mud; the use of drilling mud also prohibited the installation of functional monitoring wells. However, wet conditions were encountered in the boreholes during drilling at depths in the range of approximately 1.4 m to 8.7 m below existing grade, corresponding to elevations in the range of approximately 176.8 m to 177.1 m.

7.0 CLOSURE

A soil investigation is a limited sampling of a site. The information is gathered 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 ground water 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:

Raymond Haché, P.Eng., M. Sc., PMP
Principal, Geotechnical Service Director, and
Designated Principal
MTO Foundations Contact

GC/RH/dd

Enclosures

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Appendix A

Drawings

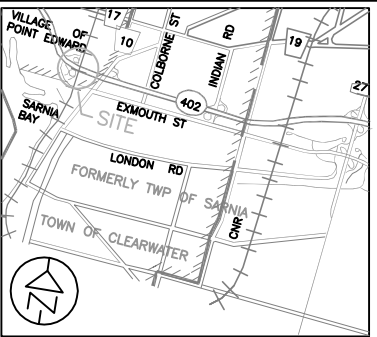
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 402
CONT No —
WP No 3038-03-00



BOREHOLE LOCATION PLAN
HIGHWAY 402 OVERPASS
WIDENING AT FRONT STREET

SHEET



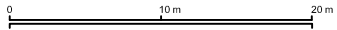
KEY PLAN

N.T.S

LEGEND

- BOREHOLE (BY JACQUES WHITFORD)
- BM BENCH MARK
- TBM TEMPORARY BENCH MARK
- (178.3) ELEVATION (m)
- WL at time of investigation

No	ELEVATION (m)	COORDINATES	
		NORTHING	EASTING
FS-1	185.4	4 760 954.0	312 612.3
FS-2	177.7	4 760 941.8	312 639.0
FS-3	177.7	4 760 948.0	312 654.5
FS-4	178.3	4 760 934.7	312 670.6
FS-5	185.8	4 760 934.1	312 700.8



NOTES

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

NOTES: 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.

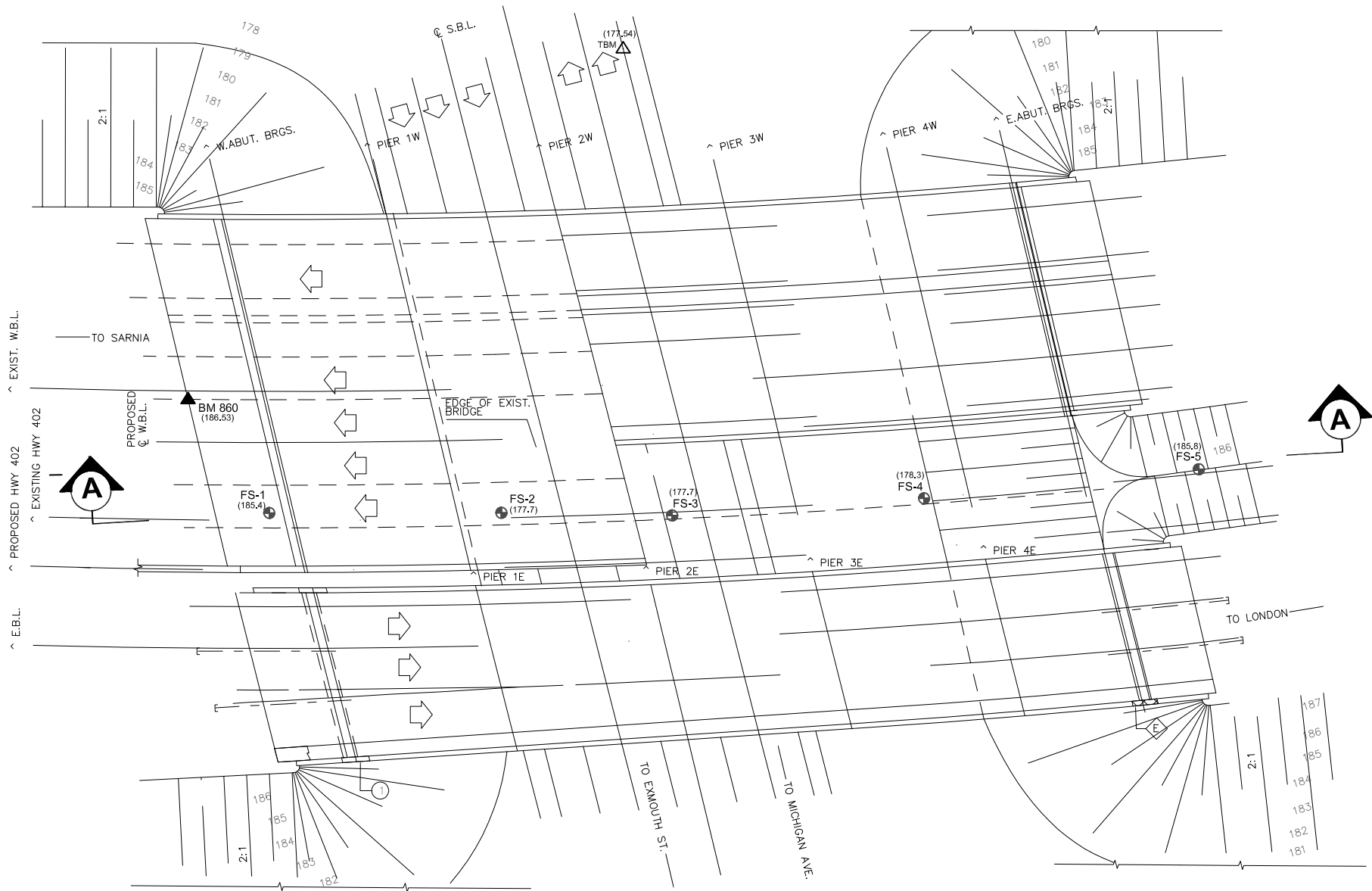
2) Base plan provided by Stantec Consulting Ltd.

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

REVISIONS	DATE	BY	DESCRIPTION

GEOCREs No 40J16-79

HWY No 402				DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-08-22	SITE	- - - -
DRAWN PC	CHECKED	APPROVED	DWG 1012607-Geo-FS-01	



PLAN

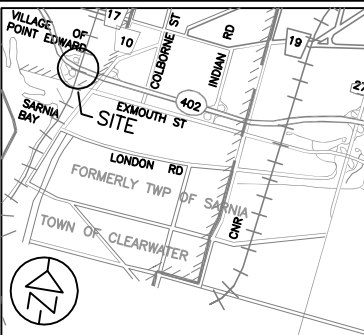
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 402
CONT No —
WP No 3038-03-00



BOREHOLE LOCATION PLAN
HIGHWAY 402 OVERPASS
WIDENING AT FRONT STREET

SHEET



KEY PLAN

N.T.S.

LEGEND

- BOREHOLE (BY JACQUES WHITFORD)
- BM BENCH MARK
- TBM TEMPORARY BENCH MARK
- (178.3) ELEVATION (m)
- WL at time of investigation

No	ELEVATION (m)	COORDINATES	
		NORTHING	EASTING
FS-1	185.4	4 760 954.0	312 612.3
FS-2	177.7	4 760 941.8	312 639.0
FS-3	177.7	4 760 948.0	312 654.5
FS-4	178.3	4 760 934.7	312 670.6
FS-5	185.8	4 760 934.1	312 700.8

0 20m

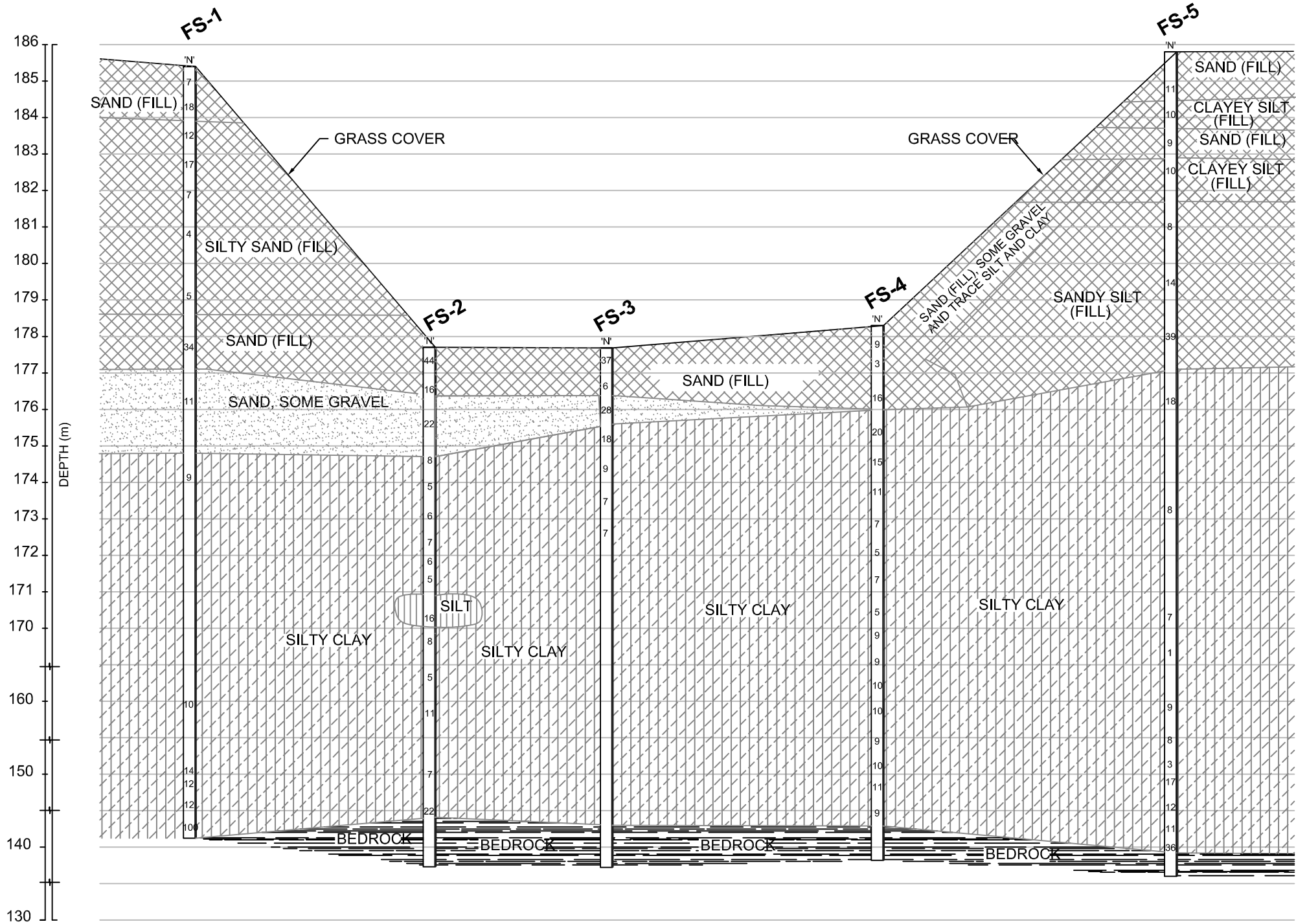
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REVISIONS			DESCRIPTION
	DATE	BY	

GEOCRE No 40J16-79			
HWY No 402			DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-08-22	SITE - - - -
DRAWN PC	CHECKED	APPROVED	DWG 1012607-GEO-FS-02



A-A CROSS SECTION

Appendix B

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

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						

Jacques Whitford
2006/2007 Investigation
Record of Borehole Sheets



RECORD OF BOREHOLE No FS-1

1 OF 3

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn: 10+760 o/s C.L., N4760954.01, E312612.3 ORIGINATED BY RM
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Mudrotary Casing, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 1.30.07 - 2.1.07 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											WATER CONTENT (%)		
								○ UNCONFINED ✕ FIELD VANE											w _p w w _L		
								● QUICK TRIAXIAL ✕ LAB VANE													
185.4 0.0	760 mm TOPSOIL, brown, wet		1	SS	7																
184.7 0.8	SAND (SM) (FILL), trace to some gravel, trace silt, brown, compact, moist		2	SS	18																
183.9 1.5	Silty SAND (SM) (FILL), some gravel, trace organics, with fly ash, brown to dark brown, compact to loose, moist		3	SS	12																
			4	SS	17																
			5	SS	7																
181.6 3.8	Silty SAND/Sandy SILT (SM) (FLY ASH), trace gravel, trace slag fragments, black, very loose to loose, moist																				
			6	SS	4																
			7	SS	5																
178.6 6.9	SAND (SP-SM) (FILL), trace to some gravel, brown, very dense, moist																				
			8	SS	34																
177.1 8.4	SAND (SM), trace gravel, trace to some silt, brown, compact, wet																				
			9	SS	11																
174.8 10.7	Silty CLAY (CL), trace sand, brown, stiff, moist																				
			10	SS	9																
			11	TW																	

Continued Next Page

Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-1

2 OF 3

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn: 10+760 o/s C.L., N4760954.01, E312612.3 ORIGINATED BY RM
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Mudrotary Casing, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 1.30.07 - 2.1.07 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		GR	SA	SI	CL				
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL									✕ LAB VANE	WATER CONTENT (%)		
								20	40	60									80	100	10	20
	Silty CLAY (CL), trace sand, brown, stiff, moist (continued)																					
			12	VT			170															
							169															
							168															
			13	VT			167															
							166															
							165															
			14	VT			164															
							163															
							162															
			15	SS	10		161															
							160															
							159															
			16	VT			158															
							157															
							156															

Continued Next Page

×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-1

3 OF 3

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn: 10+760 o/s C.L., N4760954.01, E312612.3 ORIGINATED BY RM
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Mudrotary Casing, Split Spoon COMPILED BY OL
 DATUM Geodetic DATE 1.30.07 - 2.1.07 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE					
						20	40	60	80	100	10	20	30	
	Silty CLAY (CL), trace sand, brown, stiff, moist <i>(continued)</i>													
			17	TW										
			18	VT					1.54					
			19	SS	14							○		
			20	SS	12							●	○	42
			21	SS	12								○	
141.2			22	SS	50 / 25 mm									
44.2	END OF BOREHOLE at approximately 44.2 m on inferred bedrock.												○	



×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-2

1 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Str.: 10+005 o/s: 9.0 m Rt, Twp of Sarnia; N4760941.8, E312639.0 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.17.06 - 11.23.06 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL						✕ LAB VANE		
177.7	Front St. S.B. Rt. D.L.						20	40	60	80	100							
177.0	150 mm ASPHALT						20	40	60	80	100							
176.9	SAND (SW) (FILL), with gravel, trace silt and clay, wet Brown Dense		1	SS	44								○			1 70 (30)		
176.8	- brown and grey, some silt and clay, trace gravel compact		2	SS	16									○				
176.2	SAND (SM), some silt and clay, trace gravel, wet Brown Compact to loose	3	SS	22										○				
		4	SS	8										○				
174.7	Silty CLAY (CL), with sand, some gravel, moist Brown Firm	5	SS	5										○				
		6	SS	6										○				
		7	SS	7										○				
172.4	- grey, firm	8	SS	6										● ○ ●				
		9	SS	5										○				
170.9	SILT (ML), with sand, trace gravel, wet Grey Compact	10	SS	16										○				
169.3	Silty CLAY (CL), some sand, trace gravel, moist Grey Firm		11	SS	8									○			1 26 64 9	
			12	SS	5									○				

Continued Next Page

Numbers refer to
Sensitivity

STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-2

2 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Stn.: 10+005 o/s: 9.0 m Rt, Twp of Sarnia; N4760941.8, E312639.0 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.17.06 - 11.23.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL	
	Silty CLAY (CL), some sand, trace gravel, moist Grey Firm (continued) - stiff		13	VT			162												
							161												
							160												
			14	VT			159												
							158												
							157												
			15	VT			156												
							155												
							154												
			16	VT			153												
							152												
							151												
			17	VT			150												
							149												
							148												

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


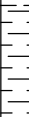
×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-2

3 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Stn.: 10+005 o/s: 9.0 m Rt, Twp of Sarnia; N4760941.8, E312639.0 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.17.06 - 11.23.06 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 (%)				
							20	40	60	80	100	10	20	30	GR	SA	SI	CL	
	Silty CLAY (CL), some sand, trace gravel, moist Grey Firm (continued)		18	VT															
				19	VT														
141.1																			
36.6	Weathered SHALE (BEDROCK)		20	SS	84/250mm														
140.3																			
37.4	TCR= 43% SCR= 23% RQD= 23%		21	HQ															
139.7																			
38.0	TCR= 100% SCR= 57% RQD= 0%		22	HQ															
139.4																			
38.3	TCR= 100% SCR= 89% RQD= 83%		23	HQ															
138.5																			
39.2	TCR= 89% SCR= 79% RQD= 60%		24	HQ															
137.3																			
40.5	END OF BOREHOLE at approximately 40.4 m																		

×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-3

1 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Str.: 9+995 o/s: 3.0 m Lt, Twp of Sarnia; N4760948.0, E312654.5 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 - 11.15.06 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				
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE	WATER CONTENT (%)				
177.7	Front St. N.B. P.L.						20 40 60 80 100							
177.6	165 mm ASPHALT													
0.2	SAND (SW) (FILL), some gravel, trace silt and clay, trace asphalt fragment, moist		1	SS	37					○				
177.0	Brown Dense		2	SS	6							○		
0.8	- 75 mm black fly ash at approximately 0.6 m below grade													
176.4	- brown to dark brown, some silt and clay, some organic matter		3	SS	28						○		1 82 (17)	
1.4	SAND (SM), some silt and clay, trace gravel, wet										○			
175.6	Brown Compact		4	SS	18						○			
2.1	Silty CLAY(CL), trace to some sand, trace gravel, damp		5	SS	9						W _n = 17% ● — ●	22.0	3 19 48 30	
	Brown Firm to very stiff		6	SS	7						○			
			7	SS	7							○		
173.0	- 300 mm sand seam at approximaely 4.4 m below grade													
4.7	- grey, firm below 4.7 m													
			8	VT				✕ 3.375						
	- some sand, trace gravel		9	VT				✕ 1.88						
			10	VT				✕ 1.89						
			11	SS	9							○		

Continued Next Page

×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-3

2 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Stn.: 9+995 o/s: 3.0 m Lt, Twp of Sarnia; N4760948.0, E312654.5 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 - 11.15.06 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				
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
	- grey, firm below 4.7 m <i>(continued)</i>		12	VT			162	2.08						
							161							
							160							
				13	VT		159	1.5						
							158							
							157							
				14	VT		156	>100 kPa						
							155							
							154							
				15	VT		153	1.93						
							152							
							151							
	- with sand			16	SS	7	150							3 23 38 36
							149							
							148							

Continued Next Page

×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

METRIC[illegible]

ONTARIO MOT 1012607.GPJ ONTARIO MOT.GDT 11/19/08

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-4

1 OF 3

METRIC

W.P. 3038-03-00 LOCATION Front St. Stn.: 10+004 o/s: 23.0 m Lt, Twp of Samia; N4760934.7, E312670.6 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Mudrotary Casing, Split Spoon, HQ Core Barrel COMPILED BY MW
 DATUM Geodetic DATE 11.1.06 - 11.8.06 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 (%)	
								○ UNCONFINED	✕ FIELD VANE								
						● QUICK TRIAXIAL	✕ LAB VANE										
178.3	Front St. N.B. Rt. Shldr.							20	40	60	80	100					
0.0	TOPSOIL, with sand, some gravel, trace asphalt fragement, moist Very loose to loose Dark brown to black		1	SS	9		178										
			2	SS	3		177										
176.8																	
1.5	SAND (SM) (FILL), with silt and clay, trace gravel, wet Compact Grey		3	SS	16		176						○			8	64 (28)
176.0																	
2.3	Silty CLAY (CL), some sand, trace gravel, damp Very stiff Grey		4	SS	20		175										
			5	SS	15												
174.2							174										
4.1	Silty CLAY (CL), some sand, trace gravel, wet Firm to stiff Grey		6	SS	11		173										
			7	SS	7		172						●	○	●	1	17 47 35
			8	VT													
			9	VT			171										
			10	SS	5		170										
			11	SS	7		169										
							168										
							167										
							166										
			12	SS	5		165										
							164										

Continued Next Page

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


METRIC

[illegible]

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES				
							SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100		WATER CONTENT (%) 10 20 30	γ kN/m ³	GR SA SI

[illegible]

ONTARIO MOT 1012607.GPJ ONTARIO MOT.GDT 11/19/08

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

RECORD OF BOREHOLE No FS-5

1 OF 4

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 10+835 o/s: C.L., Twp of Sarnia; N4760934.1, E312700.8 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 12.12.06 - 12.19.06 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE	20	40	60						80	100	10
185.8	Hwy 402 median Ditch																			
0.0	Borehole daylighted to approximately 0.8 m below grade																			
185.1																				
0.8	SAND (SP) (FILL), trace gravel, trace to some silt, black, compact, moist		1	SS	11								○							
184.4																				
1.4	Clayey SILT (CL) (FILL), some sand, trace gravel, some topsoil and organics, black, firm, moist		2	SS	10								○							
183.7																				
2.1	SAND (SP), trace silt, trace gravel, brown, loose, moist, black sand particles, moist		3	SS	9									○						
182.9																				
2.9	Clayey SILT (CL) (FILL), some sand, trace to some gravel, brown, moist, plant debris and trace black sand		4	SS	10									○						
181.7																				
4.1	Sandy SILT (SP-SM) (FILL), trace gravel, grey to black, loose to dense (fly ash)		5	SS	8									○						
			6A	SS	14															
	- 50 mm clayey silt seam		6B														3 31 62 5			
	- some gravel		7	SS	39									○			16 74 9 1			
177.1																				
8.7	Silty CLAY (CL), trace gravel, trace sand, wet Firm to stiff Brown		8	SS	18									○						

Continued Next Page

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

RECORD OF BOREHOLE No FS-5

2 OF 4

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 10+835 o/s: C.L., Twp of Sarnia; N4760934.1, E312700.8 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 12.12.06 - 12.19.06 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		
169.1	Silty CLAY (CL), trace gravel, trace sand, wet Firm to stiff Brown (continued)		10	SS	7									
169														
168														
167			11	TW										
166			12	SS	1									
165														
164			13	TW										
163														
162														
161			14	VT										
160														
159														
158			15	SS	9									
157														
156														

Continued Next Page

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

RECORD OF BOREHOLE No FS-5

3 OF 4

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 10+835 o/s: C.L., Twp of Sarnia; N4760934.1, E312700.8 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 12.12.06 - 12.19.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			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	
								<div>○ UNCONFINED</div> <div>● QUICK TRIAXIAL</div>	<div>✕ FIELD VANE</div> <div>✕ LAB VANE</div>	<div>W_p</div> <div>W</div> <div>W_L</div>								
							<div>20406080100</div>	<div>102030</div>										
	- grey (continued)		16	SS	8		155											
							154											
							153											
	- soft		17	SS	3		152											
	- stiff		18	VT			151	✕ 1.67										
							150											
	- very stiff		19	SS	17		149											
							148											
							147											
	- stiff		20	SS	12		146									9 19 39 33		
							145											
							144											
			21	SS	11		143											
							142											
							141											

Continued Next Page



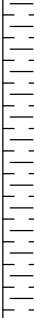
×³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No FS-5

4 OF 4

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 10+835 o/s: C.L., Twp of Sarnia; N4760934.1, E312700.8 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 12.12.06 - 12.19.06 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	- grey (continued)													
139.2	- with black sand seam at approximately 46 m below grade		22	SS	36		140							
46.6	SHALE (BEDROCK) Grey						139							
	Tricone approximately 3.2 m into the bedrock						138							
							137							
136.0	END OF BOREHOLE at approximately 49.8 m						136							
49.8														

1977 Investigation
Record of Borehole Sheets

RECORD OF BOREHOLE NO 1

WP 347-63-02/03 LOCATION Co-ords N 15 619 207 E 1 025 870 ORIGINATED BY RJS
 DIST 1 HWY 402 BORING DATE April 28 1977 COMPILED BY RJS
 DATUM Geodetic BOREHOLE TYPE Bollow Stem Auger CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	IN VALUES		20	40	60	80	100	w_p	w	w_L		
585.9	Ground Level															GR SA SI CL
0.0	Sand Pockets of Silt and Gravel Very Loose 178.6m (0.0m)		1	SS	2	580										9.77 (14)
579.9	Loose 176.8m (1.8m)		2	SS	22											0 24 46 30
6.0	Clayey Silt Some Sand Trace of Gravel Occasional Sand Seams Very Stiff to Firm		3	SS	32											
			4	SS	16											
			5	SS	10	570										
			6	SS	11											
			7	SS	10	560										
			8	SS	9											
			9	SS	9	550										
			10	SS	31											
			11	SS	21	540										
530.9	161.8m (16.8m)															0 14 42 44
55.0	Silty Clay Trace of Sand		12	SS	12	530										
			13	SS	9	520										
			14	SS	12	510										
			15	SS	15	500										
481.9	146.9m (31.7m)					490										
104.0	Continued															

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

9

RECORD OF BOREHOLE No 1 cont

WP 347-65-02103 LOCATION Co-ords N 15 518 207 E 1 025 870 ORIGINATED BY EJS
 DIST 1 HWY 402 BORING DATE April 28, 1977 COMPILED BY EJS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	TV VALUES		20	40	60	80	100			
481.9	Continued													
104.0	Silty Clay Trace of Sand Stiff					480								
			16	SS	16	470								
462.9	141.1m (37.5m)													
123.0	Black Sand					460								
456.6	139.2m (39.4m)													
129.3	Black Shale Bedrock			EXL	77%									
430.9	137.4m (41.1m)		17	RC	Rec									
135.0	End of Borehole													

RECORD OF BOREHOLE NO 2

WP 347-65-02/03 LOCATION Co-ords N 35 619 230 E 1 025 803 ORIGINATED BY PJS
 DIST 1 HWY 402 BORING DATE May 5, 1977 COMPILED BY PJS
 DATUM Canadian BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PROF	NUMBER	TYPE	VALUES		20	40	60	80	100	w_p	w	w_L		
584.7	178.5m (0.0m) Ground Level															
0.0	Sand Pockets of Silt and Gravel very Loose to compact		1	SS	2	580									Org 9.6%	0 88 (12)
577.7	176.1m (2.4m)		2	SS	2											0 76 (24)
8.0	Clayey Silt Some Sand Trace of Gravel Occasional Sand Seams Very Stiff to Firm		3	SS	26											2 30 39 2
			4	SS	26											
			5	SS	23											
			6	SS	12	570										
			7	SS	10											
			8	SS	12											
			9	SS	10	560										
			10	SS	8											
			11	SS	7	550										
			12	SS	6											
			13	SS	10	540										
529.7	161.5m (17.1m)															
56.0	Silty Clay Trace of Sand Stiff		14	SS	12	530										
						520										
						510										
						500										
481.7	146.8m (31.7m)					490										
104.0	Continued															

15 ²⁰ 5 % STRAIN AT FAILURE

RECORD OF BOREHOLE NO 3

WP 367-65-02/03 LOCATION Co-ords N 15 619 266 E 1 025 726 ORIGINATED BY PJS
 DIST 1 HWY 402 BORING DATE May 6, 1977 COMPILED BY PJS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	TV VALUES		20	40	60	80	100	w_p	w	w_L		
586.2	Ground Level															GR SA SI CL
0.0																
576.2	Sand Pockets of Silt and Sand Loose to Compact		1	SS	21	580										
8.0	175.6m (2.4m)		2	SS	12											
			3	SS	27											
	Clayey Silt Some Sand		4	SS	16											
	Trace of Gravel		5	SS	13											
	Occasional Sand Seams		6	SS	8	570										
	Very stiff to firm		7	SS	9											
			8	SS	9											
			9	SS	9	560										
			10	SS	10											
			11	SS	5	550										
			12	SS	11											
			13	SS	14	540										
			14	SS	12											
531.2	161.9m (16.2m)															
53.0	End of Borehole															

RECORD OF BOREHOLE NO 4

WP 347-65-02/03

LOCATION Concorda H 15 619 288 E 1 025 623

ORIGINATED BY PJS

DIST 1 HWY A02

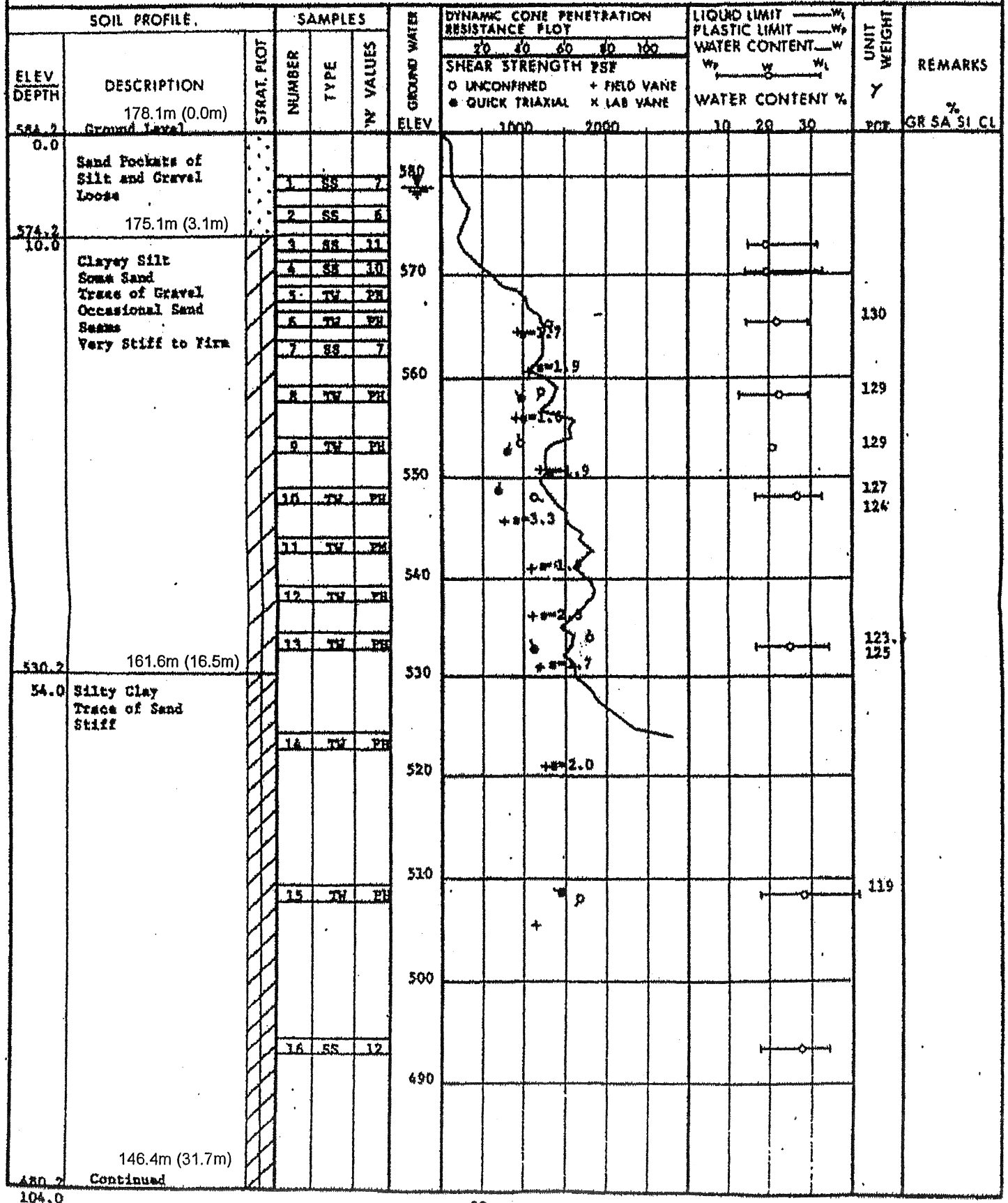
BORING DATE May 2, 1977

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY



RECORD OF BOREHOLE No. 4 cont

WP 347-65-02/03 LOCATION Corridor E 15 629 288 E 1 025 623 ORIGINATED BY PJS
 DIST 1 HWY A02 BORING DATE May 2, 1977 COMPILED BY PJS
 DATUM Geodetic BOREHOLE TYPE Roller Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PROF.	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
481.7 104.0	Continued		17	SS	14	480										GR SA SI CL
471.7 114.0	Silty Clay Trace of Sand Stiff					470										
464.2 120.0	Black Sand		18	SS												7 81 (12)
456.3 127.9	Black Shale Bedrock					460										
	End of Borehole		19	NC	Yes											

RECORD OF BOREHOLE NO 6

WP 367-65-02/03

LOCATION Co-ords N 15 619 172 E 1 025 637

ORIGINATED BY PJS

DIST 1 HWY 602

BORING DATE May 10, 1977

COMPILED BY PJS

DATUM Gageitic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ PCF	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N VALUES		20	40	60	80	100	w_p	w	w_L		
584.4	Ground Level															
0.0																
575.4	Sand, Pockets of Silt and Gravel Loose to Compact		1	SS	6	580										
			2	SS	8											
	175.4m (2.7m)		3	SS	18											
9.0	Clayey Silt Some Sand Trace of Gravel Occasional Sand Seams Very Stiff to Firm		4	SS	16	570										
			5	SS	13											
			6	TV	PH											
			7	TV	PH											
			8	TV	PH	560										
553.4	168.7m (9.5m)		9	TV	PH											
31.0	End of Borehole															

RECORD OF BOREHOLE NO 7

WP 347-65-02103 LOCATION Coastal N 15 619 156 E 2 025 689 ORIGINATED BY RJS
 DIST 1 HWY 402 BORING DATE May 10, 1977 COMPILED BY RJS
 DATUM Canadian BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
584.5	Ground Level						1000	2000				10	20	30	GR SA SI CL
0.0	Sand, Pockets of Silt and Gravel Compact		1	SS	14	580									1 56 39 4
576.5	175.7m (2.4m)		2	SS	10										6 19 42 33
8.0	Clayey Silt Some Sand Trace of Gravel Occasional Sand Seams Vary Stiff to Firm		3	SS	23										
			4	SS	15										
			5	SS	15										
			6	SS	11	570									
			7	SS	9										
			8	SS	9										
			9	SS	19	560									
			10	SS	55										
			11	SS	12	550									
			12	SS	8										
			13	SS	7	540									
530.5	161.7m (16.5m)														
54.0	Silty Clay Trace of Sand Stiff		14	SS	15	530									
						520									
						510									
						500									
						490									
530.5	146.5m (31.7m)														
54.0	Continued														

RECORD OF BOREHOLE NO 7 cont

WP 347-55-02103

LOCATION Co-ords N 15 619 156 E 1 025 689

ORIGINATED BY EJS

DIST 1 HWY 402

BORING DATE May 10, 1977

COMPILED BY EJS

DATUM Gneiss

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w		
480.5 104.0	146.5m (31.7m) Continued					480									GR SA SI CL
	Silty Clay Trace of Gravel Stiff					470									
454.5 120.0	141.6m (36.6m) Black Sand					460									
459.5 125.0	140.1m (38.1m) End of Borehole Probable Bedrock														
	NOTE Water Level not established														

RECORD OF BOREHOLE NO 8

WP 347-65-02/03

 LOCATION Canada H 15 619 135 R 1 025 792

 ORIGINATED BY EIS

 DIST 1 HWY A02

 BORING DATE May 9, 1977

 COMPILED BY EJS

 DATUM Geodetic

 BOREHOLE TYPE Hollow Stem Auger

CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ pcf	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES	20	40	60	80	100	w_p	w	w_L		
585.8	Ground Level														
0.0															
579.8	Sand, Pockets of Silt and Gravel Loose 176.7m (1.8m)		1	SS	6										1 38 56 3
6.0			2	SS	18										
	Clayey Silt		3	SS	24										6 27 41 26
	Some Sand		4	SS	27										
	Trace of Gravel		5	SS	18										
	Occasional		6	SS	12										
	Sand Somewhat		7	TV	PH									131	
	Very Stiff to Firm		8	TV	PH									131	
			9	TV	PH									129	
552.8	168.5m (11.6m)		10	TV	PH										
33.0	End of Borehole														

RECORD OF BOREHOLE NO 9

WP 347-65-02/03 LOCATION Co-ordin N 15 619 335 E 1 025 864 ORIGINATED BY EJS
 DIST 1 HWY 402 BORING DATE May 9, 1977 COMPILED BY RYS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20	40	60	80	100	w_p	w	w_L		
586.5	Ground Level															
0.0	Sand, Pockets of Silt and Gravel															
579.5	Compact		1	SS	12	580										
7.0	Clayey Silt, Some Sand		2	SS	28											
	Trace of Gravel		3	SS	30											
	Occasional Sand		4	SS	16											
	Seams		5	TV	PH	570									131	
	Very Stiff To Firm		6	TV	PH											132
			7	SS	10											
			8	TV	PH	560										131
			9	SS	10											
			10	SS	10	550										
			11	TV	PH											
563.5	165.7m (13.1m)															
43.0	End of Borehole															

RECORD OF BOREHOLE NO 11

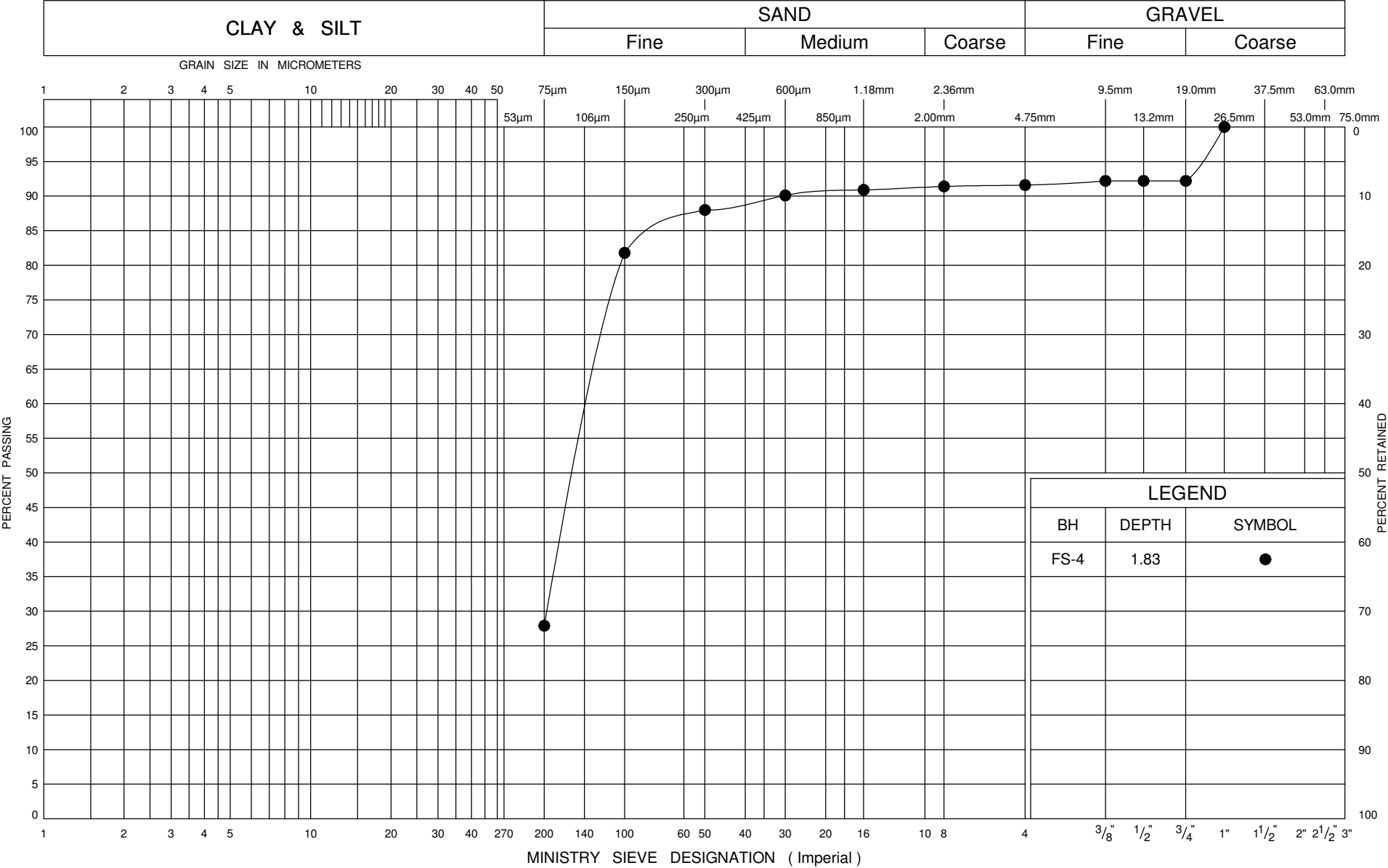
WP 347-65-02/03 LOCATION Co-ords N 15 619 257 E 1 025 649 ORIGINATED BY FJS
 DIST 1 HWY 402 BORING DATE May 11, 1977 COMPILED BY FJS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	W _p VALUES		20	40	60	80	100	w_p w w_L				
							SHEAR STRENGTH PSF					WATER CONTENT %				
585.5	Ground Level						1000		2000		10	20	30		GR SA SI CL	
0.0	Sand, Pockets of Silt and Gravel Loose to Compact		1	SS	5	580										
576.5	175.7m (2.7m)		2	SS	13										6 68 23 3	
9.0	Clayey Silt Some Sand Trace of Gravel Occasional Sand Stems Very Stiff to Firm		3	SS	13											
			4	SS	13											
			5	SS	9	570										
			6	SS	9											
			7	SS	8											
			8	SS	8	360										
557.5	169.9m (8.5m)															
28.0	End of Borehole															

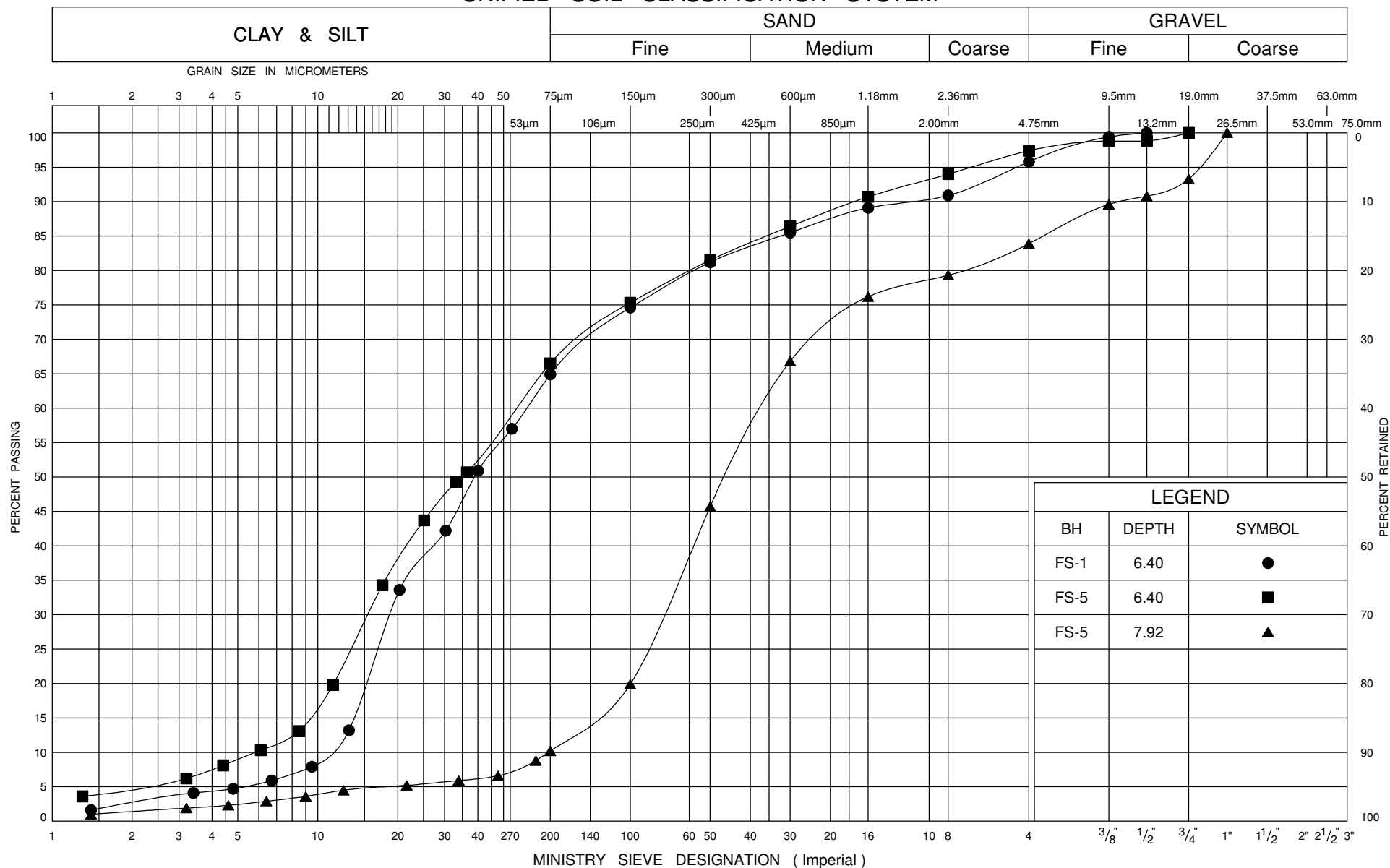
Appendix C

Geotechnical Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

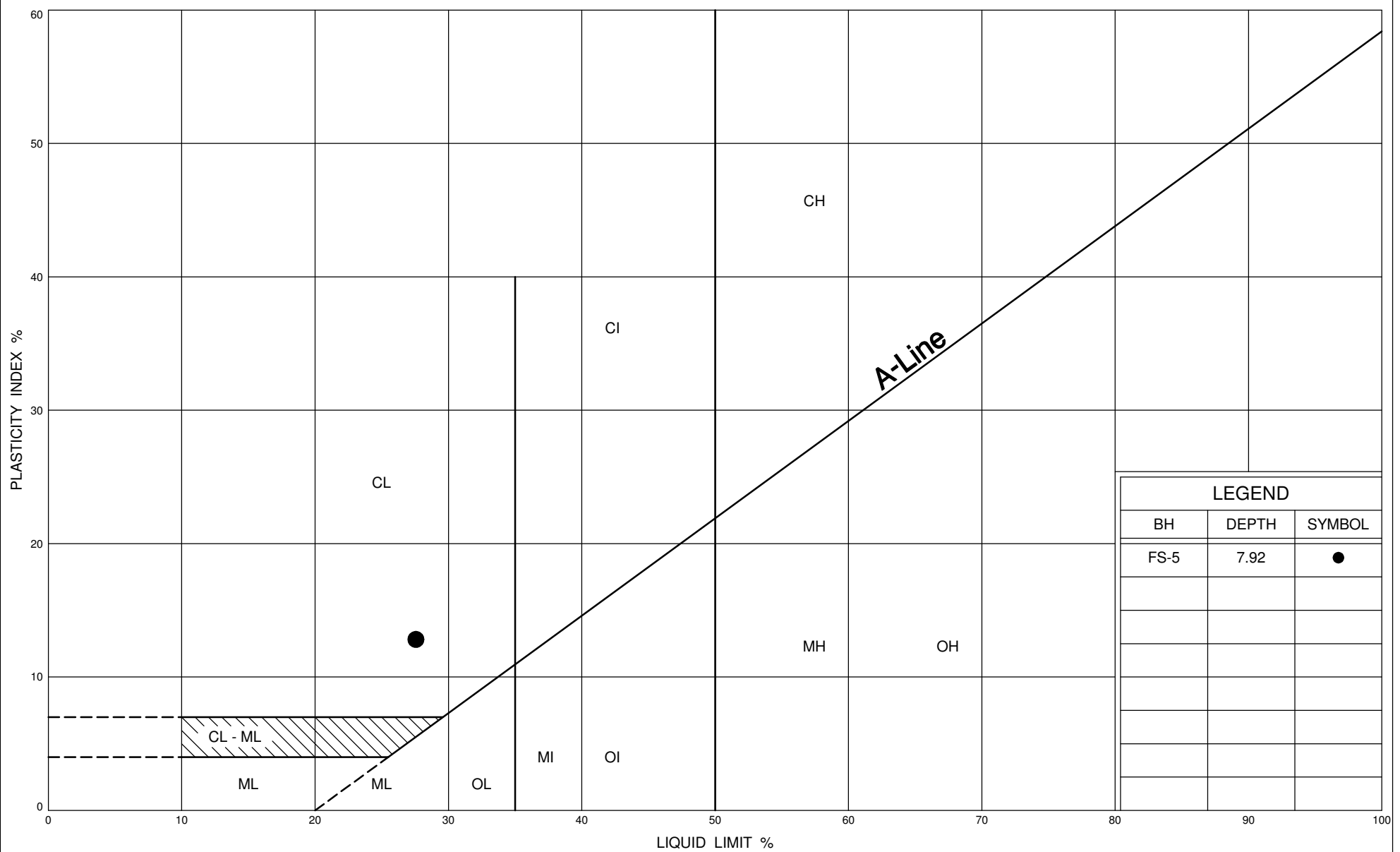
GRAIN SIZE DISTRIBUTION

Fly and Bottom Ash

FIG No 2

W P 3038-03-00

Hwy 402, Township of Sarnia



Ministry of
Transportation

PLASTICITY CHART

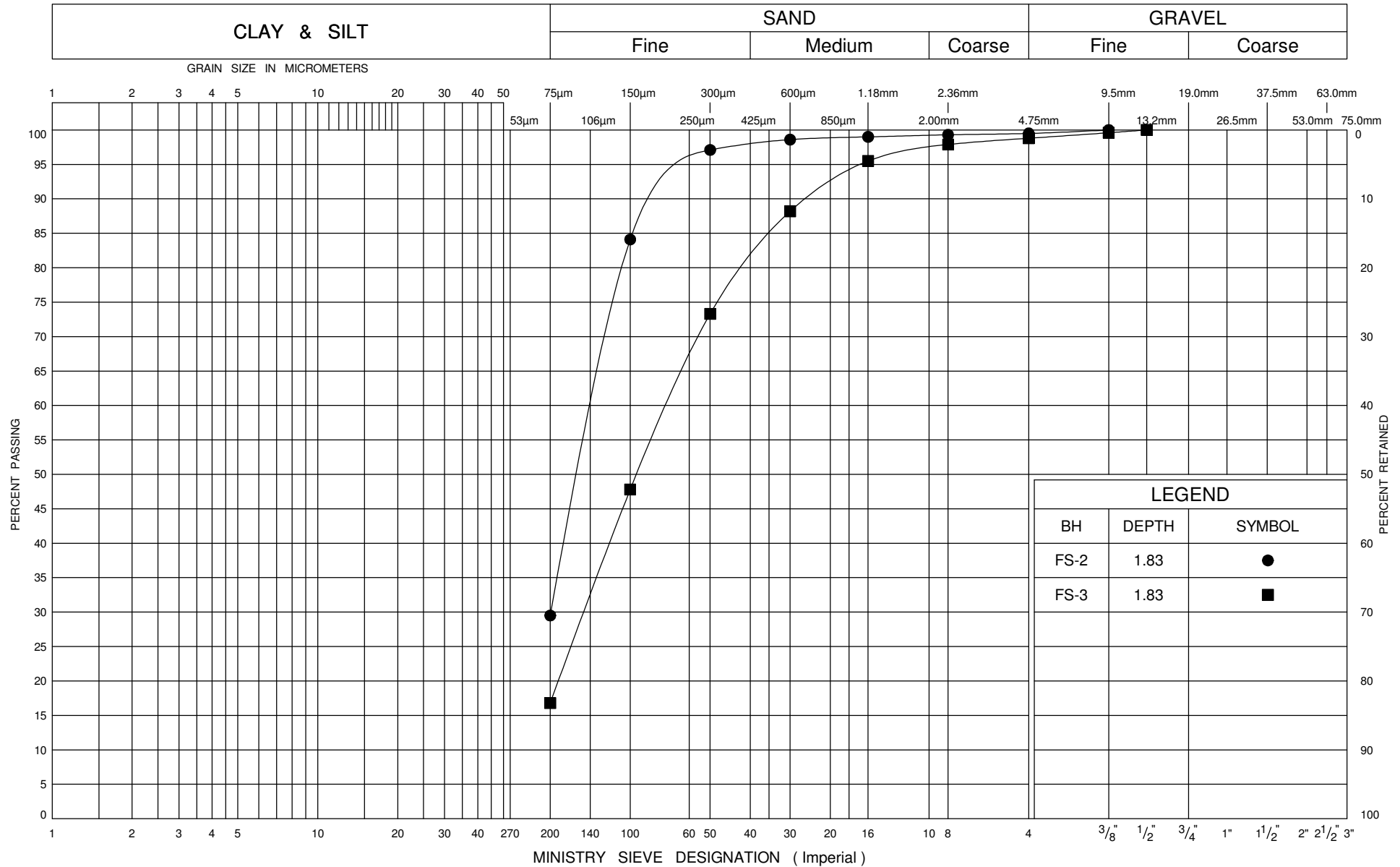
Fly and Bottom Ash

FIG No 3

W P 3038-03-00

Hwy 402, Township of Sarnia

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Native SAND

FIG No 4

W P 3038-03-00

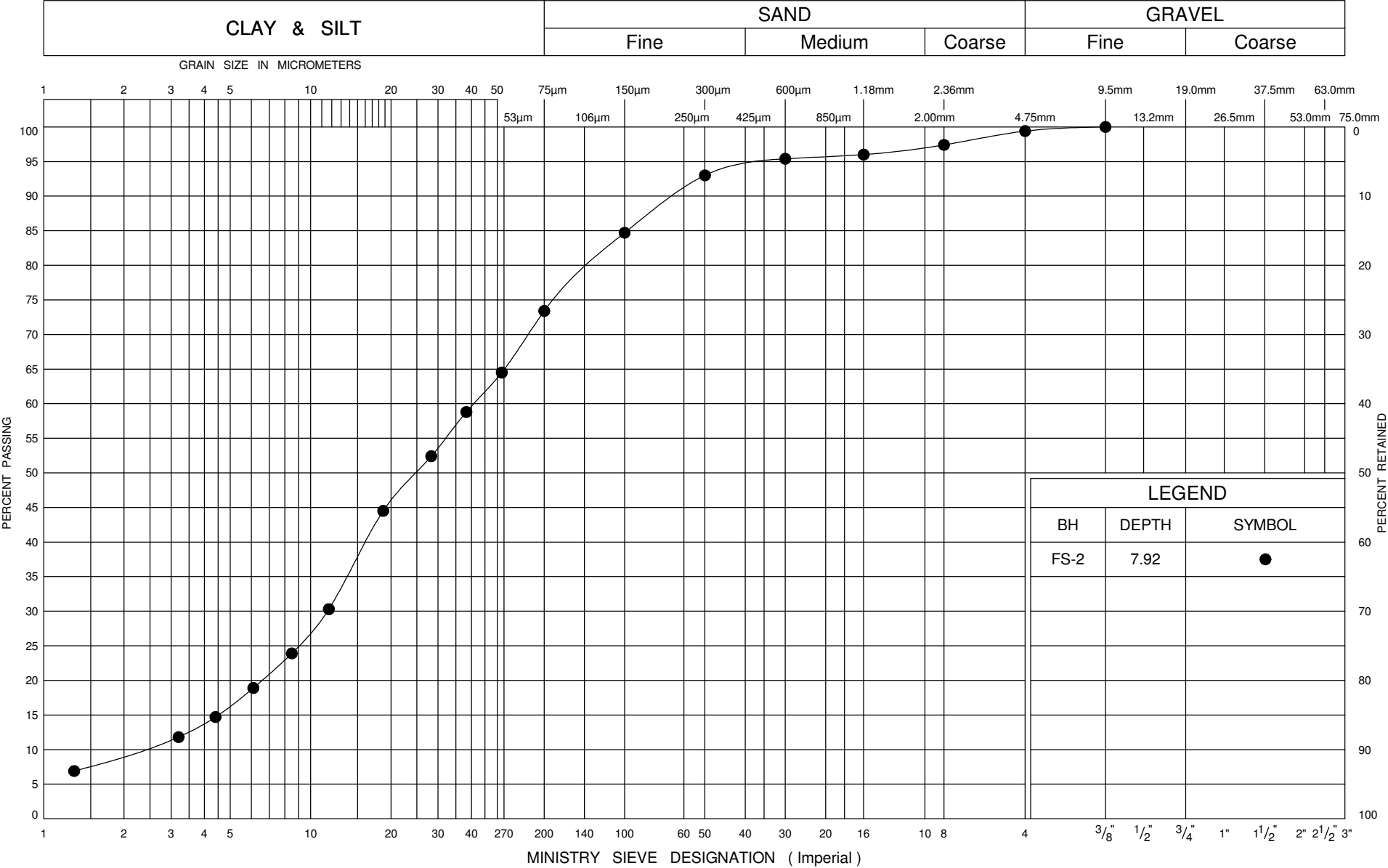
Hwy 402, Township of Sarnia



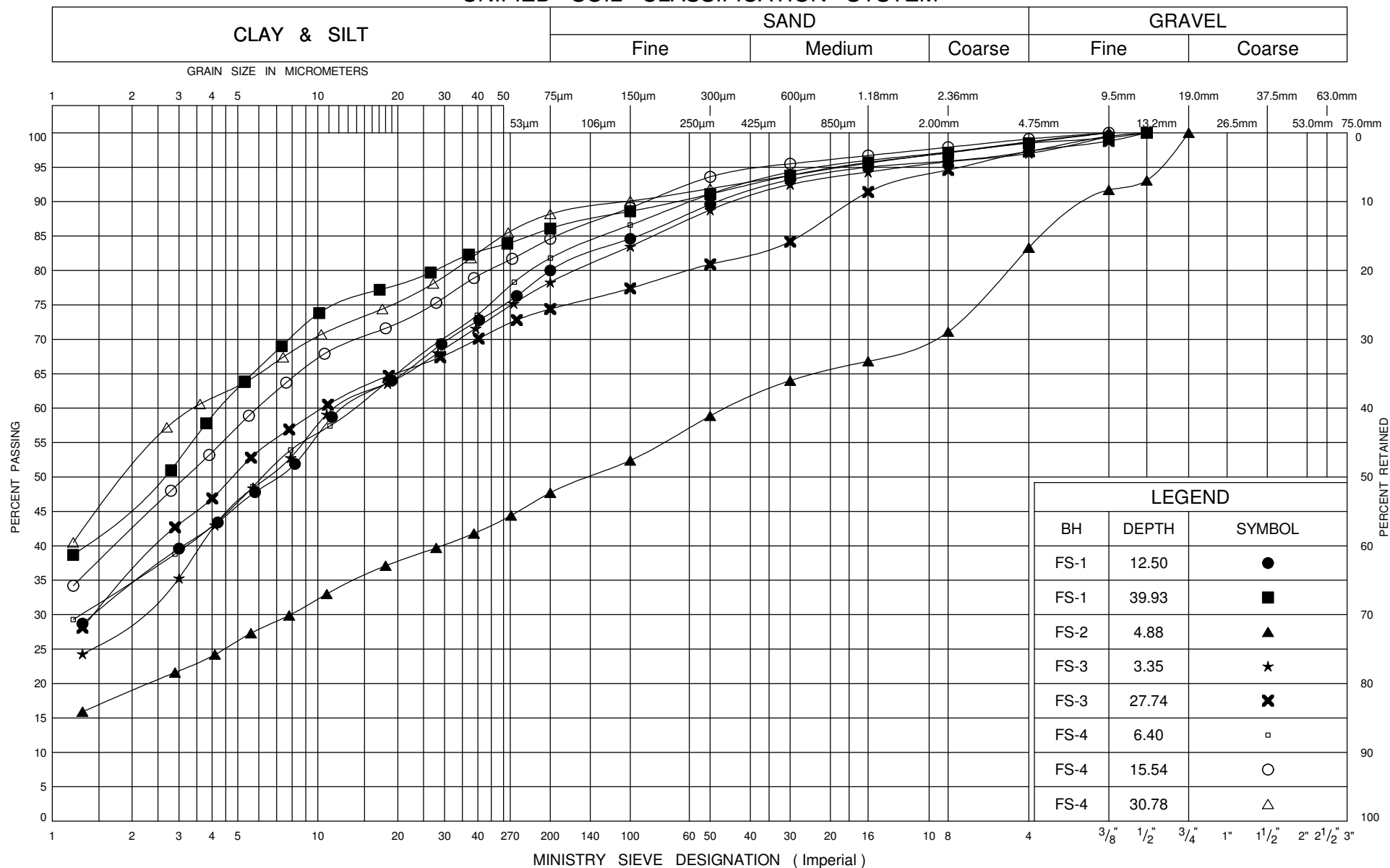
Ministry of
Transportation

Ontario

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Silty CLAY, some sand, trace gravel

FIG No 6

W P 3038-03-00

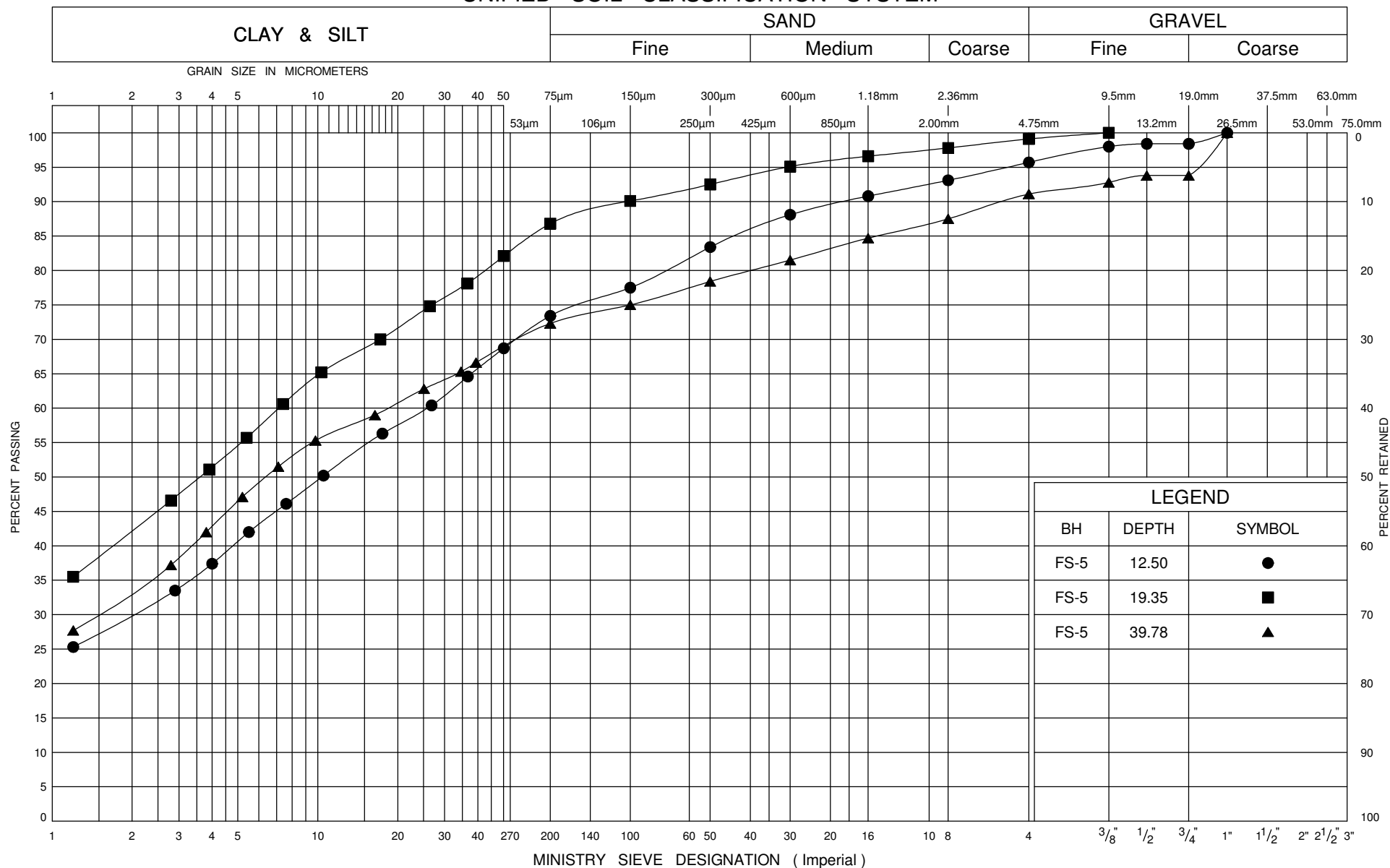
Hwy 402, Township of Sarnia



Ministry of
Transportation

Ontario

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

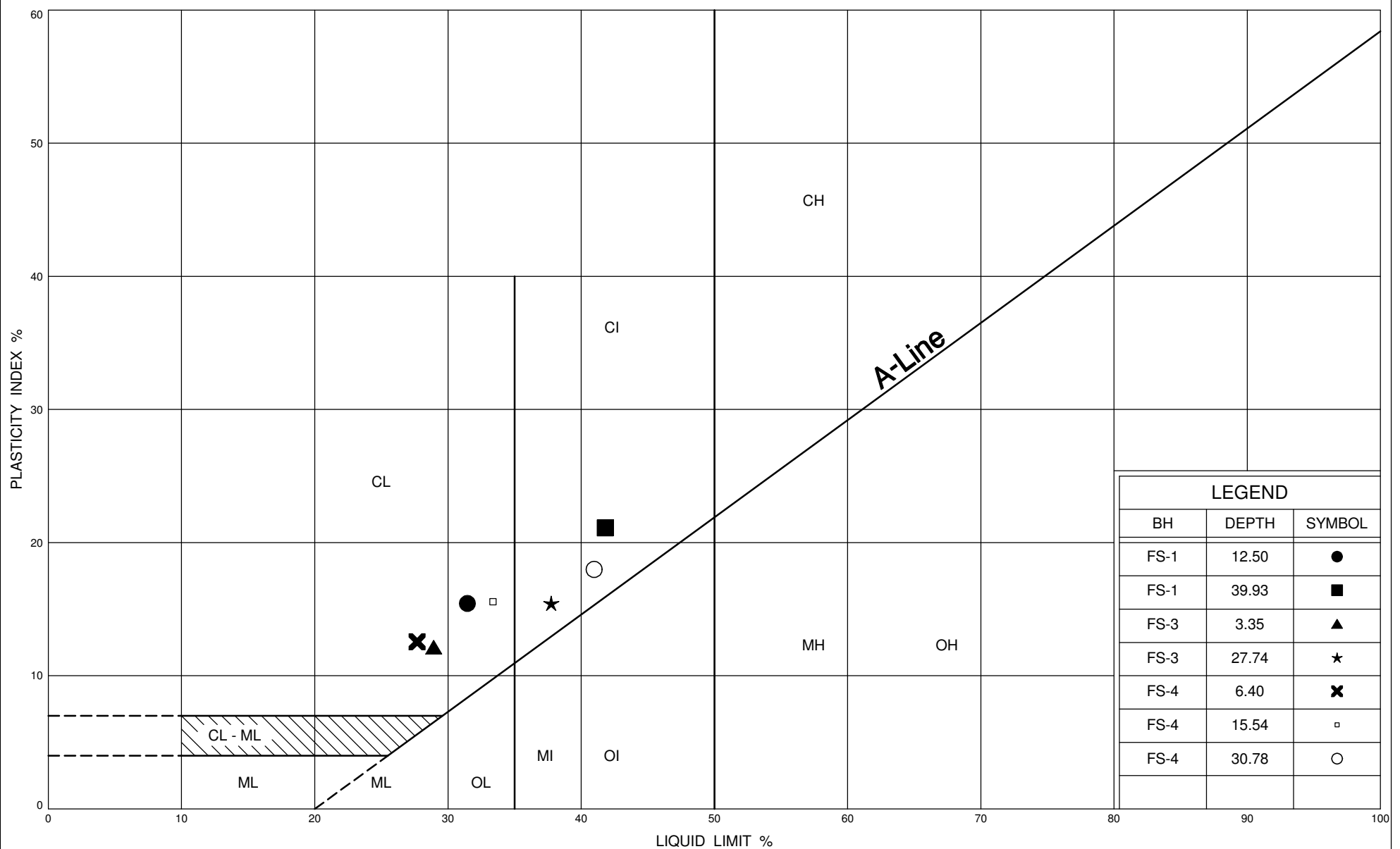
Ontario

GRAIN SIZE DISTRIBUTION
Silty CLAY, some sand, trace gravel

FIG No 7

W P 3038-03-00

Hwy 402, Township of Sarnia



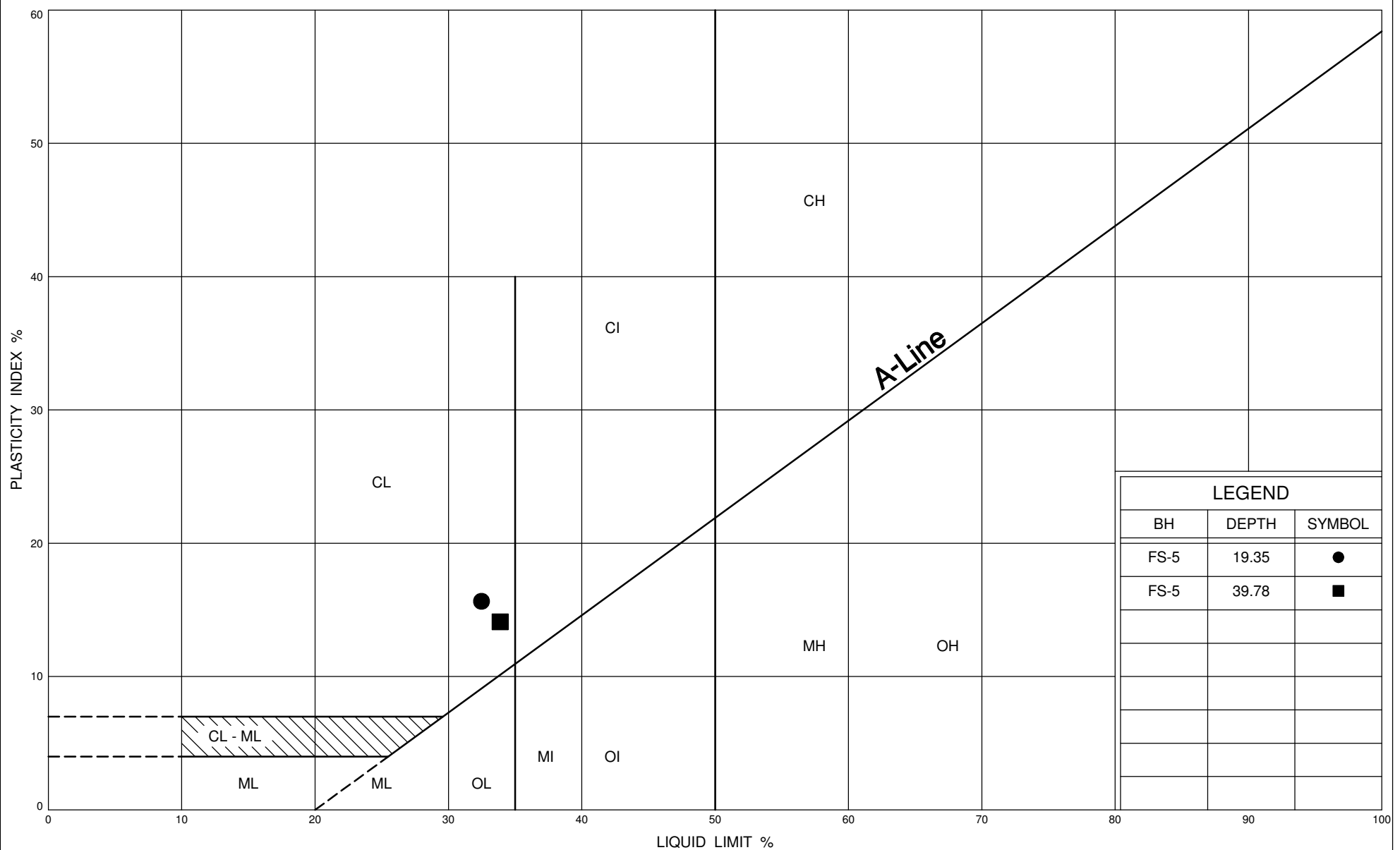
Ministry of
Transportation

PLASTICITY CHART Silty CLAY, some sand, trace gravel

FIG No 8

W P 3038-03-00

Hwy 402, Township of Sarnia



Ministry of
Transportation

PLASTICITY CHART

Silty CLAY, some sand, trace gravel

FIG No 9

W P 3038-03-00

Hwy 402, Township of Sarnia



**Jacques Whitford
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Density/Bulk Unit Weight Of Soil Specimen

Figure: 10

Location: Highway402, Sarnia, Ontario.

Project No.: 1012607

Date Sampled: 01 Dec. 2006

Date Tested: 20 Dec. 2006

Tested By: HW

	<i>Unit</i>		1	2	3
Borehole No.			BH(FS2-5)	BH(FS3-5)	BH(FS4-5)
Weight of soil specimen in air	<i>gms</i>	A	193.2	153.4	123.7
Weight of soil specimen in liquid (oil)	<i>gms</i>	B	119.0	93.7	74.6
Mass of Liquid displaced	<i>gms</i>	(A-B)	74.2	59.7	49.1
Specific Gravity of Liquid (oil)		γ_L	0.8714	0.8714	0.8714
Density of soil sample	<i>Kg/m³</i>	$D = 1000A*\gamma_L / (A-B)$	2269	2239	2195
Unit Weight of soil sample	<i>KN/m³</i>	$U = D*0.009807$	22.3	22.0	21.5



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**Rock Core Compressive
Strength Test Report**

Figure: 11

Location: Highway 402, Sarnia, Ontario

Project No.: 1012607

Core Number	FS-2	FS-3	FS-4
Average Height (mm)	58.84	70.75	91.85
Average Diameter (mm)	47.18	47.17	47.17
H/D Ratio	1.247	1.500	1.947
Correction Factor	0.929	0.960	0.996
Compressive Strength (MPa)	102.2	101.1	99.2
Corrected Compressive Strength (MPa)	94.7	97.1	98.8

Appendix D

Representative Site Photographs



Photo 1: Front Street / CNR Overpasses - May 2006



Photo 2: Font Street / CNR Overpasses - July 2006