

## REPORT

Foundation Investigation Report  
Kabinakagami River Bridge  
Replacement  
Site No. 39W-009  
Highway 11  
District – New Liskeard

G.W.P. 5411-04-00

LEA CONSULTING LTD.

PROJECT NO. 1015345  
GEOCRES. NO. 42F-19

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# PROJECT NO. 1015345

REPORT TO **Lea Consulting Ltd.  
625 Cochrane Drive  
Suite 900  
Markham, Ontario  
L3R 9R9**

FOR **Foundation Investigation Report**

ON **Kabinakagami River Bridge Replacement  
Site 39W-009, Highway 11  
District – New Liskeard  
G.W.P. 5411-04-00  
Geocres. No. 42F-19**

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**January 15, 2008**

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## Table of Contents

<b>FOUNDATION INVESTIGATION REPORT .....</b>	<b>1</b>
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 SITE DESCRIPTION.....</b>	<b>1</b>
<b>3.0 PHYSIOGRAPHY .....</b>	<b>2</b>
<b>4.0 BACKGROUND.....</b>	<b>2</b>
<b>5.0 INVESTIGATION PROCEEDURES .....</b>	<b>2</b>
5.1 Field Program.....	2
5.2 Survey .....	3
5.3 Laboratory Testing .....	3
<b>6.0 RESULTS OF THE INVESTIGATION .....</b>	<b>4</b>
6.1 Subsurface Conditions .....	4
6.2 Soil .....	4
6.2.1 Topsoil.....	4
6.2.2 Sand, and Sand and Gravel Fill .....	4
6.2.3 Sandy Silt and Silt Fill .....	5
6.2.4 Peat.....	5
6.2.5 Sandy Silt (ML).....	5
6.2.6 Silty Clay (ML-CL) .....	6
6.2.7 Silt (ML).....	7
6.2.8 Sand (SM).....	7
6.2.9 Glacial Till.....	7
6.2.9.1 Silty Sand Till and Sandy Silt Till (SM).....	8
6.2.9.2 Clayey Silt (ML to ML-CL) .....	8
6.3 Bedrock.....	9
6.4 Groundwater .....	10
<b>7.0 CLOSURE.....</b>	<b>10</b>

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## List of Appendices

- APPENDIX A Drawings
- APPENDIX B Terms and Symbols used On the Record of Borehole Sheets  
Record of Borehole Sheets
- APPENDIX C Geotechnical Laboratory Test Results

# FOUNDATION INVESTIGATION REPORT

**Kabinakagami River Bridge Replacement  
Site No. 39W-009, Highway 11  
Near Hearst, Ontario  
G.W.P. 5411-04-00  
District – New Liskeard**

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## 1.0 INTRODUCTION

Jacques Whitford Limited (Jacques Whitford) was retained by Lea Consulting Ltd., to complete a Foundation Investigation and Design Report for the replacement of the Kabinakagami River Bridge on Highway 11, located approximately 32 km west of Hearst, Ontario, (GWP No. 5411-04-00).

The work was carried out under Agreement No. 5005-E-0025. Authorization to proceed with the investigation was provided by Mr. Peter Ojala, P.Eng., Vice President, Head of Bridges and Structures, of Lea Consulting Ltd, the prime consultant on this design assignment.

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.

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## 2.0 SITE DESCRIPTION

The site is located on Highway 11 at the Kabinakagami River, approximately 32 km west of Hearst, Ontario.

Highway 11 at the Kabinakagami River is built on shallow embankments to a rural highway section with wide gravel shoulders. Highway 11 is generally oriented in an east west direction with one east bound lane and one west bound lane. The highway is generally higher than the surrounding lands. Drainage for Highway 11 is provided by ditches located along the sides of the highway, which are sloped to drain towards the Kabinakagami River.

The existing bridge at the Kabinakagami River is a five span structure with steel girders supporting a reinforced concrete deck. The existing bridge is approximately 107 m long and 10 m wide. The bridge conveys one westbound lane and one eastbound lane of Highway 11 over the Kabinakagami River. The structure was reportedly constructed in 1942. The northern half of the bridge deck was reportedly replaced in 2002.

Based on a drawing dated December 1978, it is understood that the existing bridge structure is likely supported on a combination of shallow and deep foundations. The drawings indicate that the East Abutment and Pier 4 are likely supported by shallow foundations placed on bedrock. The drawings indicate the West Abutment and Piers 1, 2 and 3 are likely supported by deep foundations. The drawing does not indicate what the deep foundations are bearing on and the drawing does not identify the type of deep foundation.



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### 3.0 PHYSIOGRAPHY

Based on Map 2518, titled "Surficial Geology of Northern Ontario", dated 1987, by the Ministry of Northern Development and Mines, Highway 11 at the Kabinakagami River is situated on the boundary between a Clay-Silt deposit and a Till Deposit. The clay-silt deposit is noted as a Glaciolacustrine deposit, while the till deposit is noted as an unsorted mixture of boulders, sand, silt and clay sized particles.

Based on Map 2543, titled "Bedrock Geology of Ontario, East-Central Sheet", dated 1991, by the Ontario Ministry of Northern Development and Mines, the bedrock at the site is noted as Metasedimentary rock comprised of wacke, arkos, argillite, slate, marble, chert, iron formation and minor metavolcanic rock intrusions.

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### 4.0 BACKGROUND

A preliminary investigation was carried out by Jacques Whitford Limited. The results of the preliminary investigation were provided in the following draft Preliminary Foundation Investigation and Design report:

- *Draft Report*  
*Preliminary Foundation Investigation and Design Report*  
*Kabinakagami River Bridge Replacement*  
*Site No. 39W-009*  
*Highway 11*  
*District – New Liskeard*  
*GWP 5411-04-00*  
Jacques Whitford project number 1015345  
Draft report dated: April 4, 2007

The factual results from the draft preliminary foundation report, including the Record of Borehole sheets and Laboratory Test data, have been incorporated into this report.

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### 5.0 INVESTIGATION PROCEDURES

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#### 5.1 Field Program

The fieldwork for the preliminary investigation was carried out from January 14 to 20, 2007 and February 2 to 23, 2007. The fieldwork for the detailed foundation investigation was carried out from July 5 to 8, 2007 and on July 18 and 19, 2007. Supplemental investigation at the east abutment was carried out on November 29 and 30, 2007.

A total of 14 boreholes have now been advanced at the site using truck, track and barge mounted drill rigs equipped with 250 mm (outside diameter) continuous flight, hollow-stem augers, 150 mm (outside diameter) continuous flight, solid-stem augers, steel casings and mud-rotary drilling. The following table outlines the borehole locations numbers etc.:

Side of River	Borehole Number	Element
East Side of River	KB-06-4, KB-06-5, KB06-6, KB-07-100, KB07-101, KB-07-102, KB-07-103	East Abutment
	KB07-2	East Pier
	KB-07-4	East Approach Fills
West side of river	KB-06-1, KB-06-2, KB06-3	West Abutment
	KB07-1	West Pier
	KB-07-3	West Approach Fills

Prior to commencing the field investigations, 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.

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 standard NQ 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.

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## 5.2 Survey

The borehole locations were established by Jacques Whitford personnel and referenced to the stations on Highway 11, as noted on the Record of Borehole sheets. Offsets were referenced looking up chainage left or right of the centreline of the proposed highway alignment. The borehole locations 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 the following benchmark:

- Geodetic Canada Benchmark No. 84U024, with a reported Geodetic elevation of 244.859 m.

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## 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, Atterberg Limits and moisture content determination testing. In addition, samples of the rock core were submitted for unconfined compressive strength testing.

The laboratory results are provided on the Record of Borehole sheets in **Appendix B**. The results of the grain size analyses, Atterberg Limits and unconfined compressive strength tests are shown on Figure Nos. 1 through 7 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.

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## 6.0 RESULTS OF THE INVESTIGATION

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### 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 and symbols used on the Record of Borehole sheets is also provided in **Appendix B**.

A Borehole Location Plan and a Strata Plot of the soils encountered in the boreholes are provided on Drawing Nos. 1 and 2 in **Appendix A**.

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

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### 6.2 Soil

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#### 6.2.1 Topsoil

Topsoil was encountered at the ground surface in Boreholes KB-06-01 to KB-06-06. The thickness of the topsoil ranged from approximately 50 mm to 150 mm, with a mean of about 100 mm.

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#### 6.2.2 Sand, and Sand and Gravel Fill

Sand and sand and gravel fill was encountered at the ground surface in Borehole KB-07-4 and KB-07-03 and underlying the topsoil in Boreholes KB-06-2, KB-06-3 and KB-06-6. The thickness of the sand and sand and gravel fill ranged from approximately 0.6 m to 2.0 m.

The sand and sand and gravel fill was generally moist. Wood debris was encountered in the fill material in Borehole KB-06-2.

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

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

- Moisture Content:
  - 9% to 25%

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

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### 6.2.3 Sandy Silt and Silt Fill

Sandy silt and silt fill was encountered underlying the topsoil in Borehole KB-06-5 and underlying the sand and gravel fill in Borehole KB-07-4. The thickness of the sandy silt and silt fill ranged from approximately 1.8 m to 2.9 m.

The sandy silt and silt fill contained trace to some gravel and was generally moist. Fragments of asphalt and wood were generally encountered within the fill.

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

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

- Moisture Content:
  - 16% to 20%
- Grain Size Distribution:
  - 2 % gravel;
  - 11 % sand;
  - 77 % silt; and,
  - 10 % clay.

The results of the moisture content tests are provided on the Record of Borehole sheets in **Appendix B**. The results of the grain size distribution tests on the sandy silt are also provided on Figure 1 in **Appendix C**.

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### 6.2.4 Peat

A 25 mm thick seam of peat was encountered underlying the fill material in Borehole KB-06-6 at depth of approximately 1.6 m below existing grade, elevation of approximately 244.0 m

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### 6.2.5 Sandy Silt (ML)

Sandy silt was encountered underlying the topsoil or sand and gravel fill in Boreholes KB-06-1 to KB-06-4 and KB-06-6, and underlying the silty clay (discussed below) in Borehole KB-07-3 at depths in the range of approximately 0.1 m to 2.7 m, elevations of approximately 240.0 m to 247.2 m). Sandy silt was also encountered at the bottom of the river in Boreholes KB-07-1 and KB-07-2, at depths of approximately 1.1 m and 0.9 m below the surface of the river at the time of the investigation, elevations of approximately 239.3 m and 239.5 m.

The sandy silt generally contained trace gravel, trace clay, and was generally wet to saturated. Trace organic material was encountered in the boreholes advanced in the river.

Based on the N-Values obtained from the SPTs, the compactness of the sandy silt was variable ranging from very loose to very dense, but was typically loose to compact.

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

- Moisture Contents:
  - 12% to 33%, (higher moisture contents were associated with the samples obtained from the river bottom).

- Grain Size Distribution:
  - 0% to 2% gravel;
  - 18% to 36% sand;
  - 53% to 76% silt; and,
  - 6% to 9% clay.

Atterberg Limits testing was attempted on 3 selected samples. The results indicated the material was non-plastic.

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 on the sandy silt are also provided on Figure 2 in **Appendix C**.

#### 6.2.6 Silty Clay (ML-CL)

Silty clay was encountered underlying the fill in Borehole KB-06-5, the sandy silt and silt in KB-06-1, KB-06-2, KB-06-6, KB-07-1, KB-07-2 and KB-07-3. The silty clay was encountered at depths in the range of approximately 2.0 m to 4.7 m, elevations of approximately 236.7 m to 243.0 m. The thickness of the silty clay was variable ranging from approximately 0.2 m to 5.5 m with the thickest silty clay deposit encountered in Borehole KB-06-2.

The silty clay generally contained trace sand and was generally moist to wet. Rock fragments were encountered in the silty clay obtained from Borehole KB-07-2.

In situ shear vane testing was carried out in the thickest deposit of silty clay. The results of a single test indicated that the shear strength of the silty clay was approximately 40 kPa. The in situ shear vane testing indicated that the consistency of the silty clay could be described as firm. It is noted that N-values from the SPTs indicated that the consistency of the silty clay increased with depth from soft to become very stiff to hard.

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

- Moisture Content:
  - 19% to 68%
- Grain Size Distribution:
  - 0% to 9% gravel;
  - 3% to 13% sand;
  - 40% to 65% silt; and,
  - 30% to 38% clay.
- Atterberg Limits:
  - Liquid Limits: 24 to 26
  - Plastic Limits: 14 to 15

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**.

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### 6.2.7 Silt (ML)

Silt was encountered underlying the silty clay in Boreholes KB-06-1, KB-06-2 and KB-07-1 at depths of in the range of approximately 3.8 m to 10.1 m, elevations of approximately 239.2 m to 232.5 m. The thickness of the silt ranged from approximately 2.1 m to 5.3 m.

The silt contained trace sand and trace to some clay. Trace rock and wood fragments were encountered in Borehole KB-06-2.

Based on the N-Values obtained from the SPTs, the compactness of the silt was very loose to compact.

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

- Moisture Contents:
  - 18% to 24%
- Grain Size Distribution:
  - 0% to 1% gravel;
  - 0% to 7% sand;
  - 81% to 94% silt; and
  - 6% to 17 % clay.

Atterberg Limits testing was attempted on two selected samples. The results indicated the material was non plastic.

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 5 in **Appendix C**.

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### 6.2.8 Sand (SM)

Sand was encountered underlying the silt and sandy silt in Boreholes KB-06-1 and KB-06-3. The sand was encountered at depths of approximately 9.1 m and 8.7 m, corresponding to elevations of approximately 233.9 m and 235.4 m, in Boreholes KB-06-1 and KB-06-3, respectively. The sand was approximately 2 m thick in all boreholes.

The sand generally contained some silt, trace gravel, and was generally saturated.

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

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

- Moisture Content:
  - 11% to 15%.

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

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### 6.2.9 Glacial Till

Glacial till was encountered in Boreholes KB-06-1 to KB-06-3, KB07-1 and KB-07-3 drilled on the west side of the river. The glacial till generally consisted of sandy silt to silty sand till and clayey silt till.

### 6.2.9.1 Silty Sand Till and Sandy Silt Till (SM)

Silty sand till and sandy silt till was encountered in Boreholes KB-06-1 to KB06-3 and KB-07-3. The Silty sand till and sandy silt till was encountered at depths in the range of approximately 7.3 m to 12.2 m below existing grade, elevations in the range of approximately 231.4 m to 237.8 m. The till ranged in thickness from approximately 3.8 m to 6.7 m.

The till contained varying amounts of gravel and clay, and was generally wet to saturated.

Cobbles and boulders were encountered throughout the till during drilling.

Based on the N-Values obtained from the SPTs, the compactness of the till was variable ranging from compact to very dense.

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

- Moisture Content:
  - 8% to 21%
- Grain Size Distribution:
  - 6% to 25% gravel;
  - 31% to 53% sand;
  - 19% to 45% silt; and,
  - 3% to 16% clay

Atterberg Limits testing was attempted on a single selected sample of the sandy silt till. The results indicated the material was non-plastic.

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 6 in **Appendix C**.

### 6.2.9.2 Clayey Silt (ML to ML-CL)

Clayey silt till was encountered in Boreholes KB-06-2, KB-07-1 and KB-07-3 at depths in the range of approximately 10.7 m to 16.8 m below existing grade, elevations of approximately 226.8 m to 234.0 m. The till ranged in thickness from approximately 5.8 m to 8.8 m. Borehole KB-07-3 was terminated in the clayey silt till stratum at a depth of approximately 11.3 m, elevation of approximately 233.7 m.

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

Cobbles and boulders were encountered throughout the till during drilling.

Based on the N-Values obtained from the SPTs, the consistency of the silty clay will was considered to be very stiff to hard.

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

- Moisture Content:
  - 5% to 18%

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

### 6.3 Bedrock

Bedrock was encountered in all boreholes except Borehole KB-07-3 and consisted of grey and pink gneiss. The following table outlines the depth and elevation at which bedrock was encountered:

Area	Borehole Number	Depth Below Existing Grade to Bedrock Surface (m)	Elevation of Bedrock Surface (m)
West side of River (West Abutment)	KB-06-1	17.4	225.6
	KB-06-2	22.6	221.0
	KB-06-3	17.4	226.7
West Pier	KB-07-1	19.5	220.9
East Pier	KB-07-2	4.4	236.0
East side of River (East Abutment)	KB-06-4	3.4	243.9
	KB-06-5	3.8	241.4
	KB-06-6	4.9	240.8
	KB-07-4	2.4 *	244.2*
	KB-07-100	3.5 *	241.9*
	KB-07-101	6.5	241.6
	KB-07-102	4.6*	240.4*
KB-07-103	5.8	238.5	

Notes: \* Boreholes terminated at auger refusal on inferred bedrock surface.

All boreholes except Boreholes KB-07-3, KB-07-4, KB-07-100 and KB-07-102 were terminated in the bedrock after confirmation coring was completed. Borehole KB-07-4, KB-07-100 and KB-07-102 were terminated at auger refusal, at a depths of approximately 2.4 m to 4.6 m below existing grade, elevations of approximately 244.2 m to 240.4 m, on inferred bedrock.

The observations of the rock cores are summarized as follows:

- Total Core Recovery (TCR): 100% to 86%, mean of approximately 100%;
- Solid Core Recover (SCR): 100% to 41%, mean of approximately 76%; and,
- Rock Quality Designation (RQD): 99% to 24%, mean of approximately 72%.

Laboratory testing performed on two samples of the rock consisted of unconfined compressive strength tests. The test results are as follows:

- Unconfined Compressive Strength:
  - 68 MPa and 104 MPa

The results of the rock core analysis are provided on the Record of Borehole sheets in **Appendix B**.

The results of the unconfined compressive strength are provided on Figure 7 in **Appendix C**.

## 6.4 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. However, water was encountered on the split spoon sampler during drilling at the depths and elevations noted in the following table:

Borehole Number	Groundwater First Encountered	
	Depth Below Existing Grade (m)	Elevation (m)
KB-06-1	1.5	241.5
KB-06-2	0.8	242.8
KB-06-3	1.5	242.6
KB-06-4	3.0	244.3
KB-06-5	1.5	243.7
KB-06-6	2.0	243.7
KB-07-1	Drilled in river	240.4 surface of river
KB-07-2	Drilled in river	240.4 surface of river
KB-07-3	3.9	241.1
KB-07-4	2.2	244.4

The river level was surveyed in July, 2007.

The drawings provided indicate that the water level in July 2006 was at elevation 240.3 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 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:**

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



# Appendix A

## Drawings

CONT No 2007-5104  
WP No 5411-04-00



KABINAKAGAMI RIVER  
REPLACEMENT BRIDGE  
BOREHOLE LOCATIONS AND  
SOIL STRATA

SHEET



LEGEND:

- BOREHOLE
- GROUNDWATER LEVEL

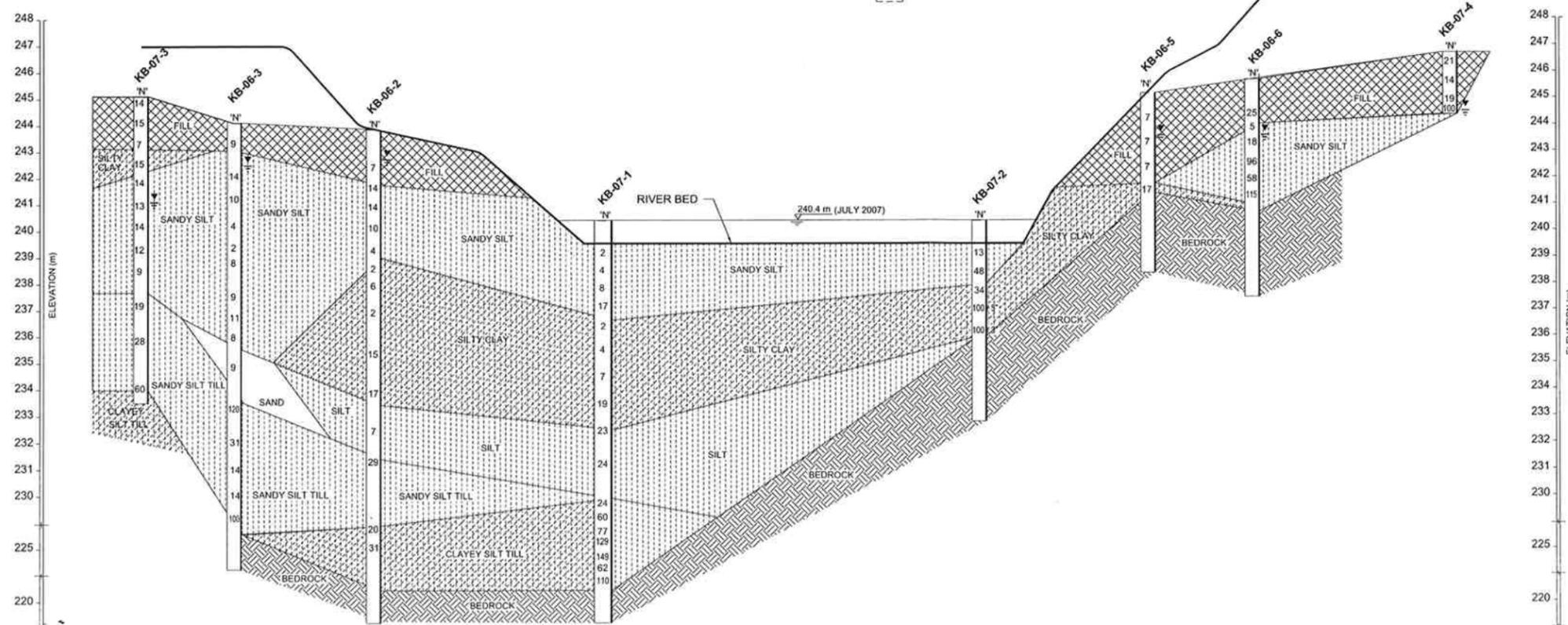
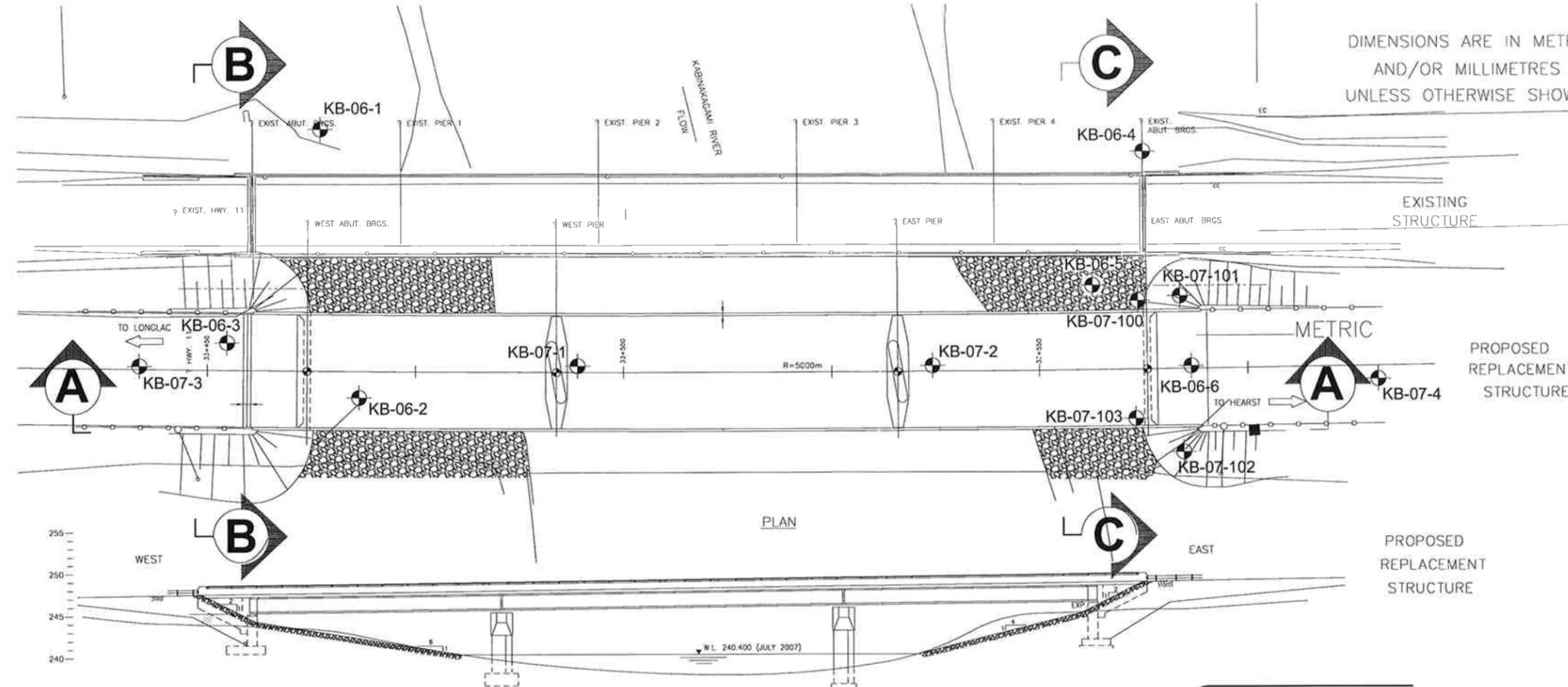
BOREHOLE No.	STATION	OFFSET	ELEVATION
KB-06-1	23+463	29m Lt	243.0 m
KB-06-2	23+468	3m Rt	243.6 m
KB-06-3	23+451	3m Lt	244.1 m
KB-06-4	23+562	21m Lt	247.3 m
KB-06-5	23+555	10m Lt	245.2 m
KB-06-6	23+567	0.5m Lt	245.7 m
KB-07-1	23+495	0.5m Lt	240.4 m
KB-07-2	23+537	0.5m Lt	240.4 m
KB-07-3	23+442	0.5m Lt	245.0 m
KB-07-4	23+590	1.5m Rt	246.6 m
KB-07-100	23+562	8m Lt	245.3 m
KB-07-101	23+567	9m Lt	248.1 m
KB-07-102	23+567	10m Lt	245.1 m
KB-07-103	23+562	6m Rt	244.3 m

NOTES:

1. The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2. 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.
3. Base plan provided by LEA Consulting Ltd.
4. This drawing is for subsurface information only. Surface details and features are for conceptual illustration only. The proposed structure location and features are shown for information purposes only.
5. GEOCREs No. 42F-19



DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



**A-A CROSS SECTION**

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	AA	CHK	CC	CODE	CHRG	BB	LOAD	DNT	CL	EST	DATE	2008-01-10
DRAWN	EC	CHK	FG	SITE	39W-009	STRUCT	SCHEME	DWG	1			

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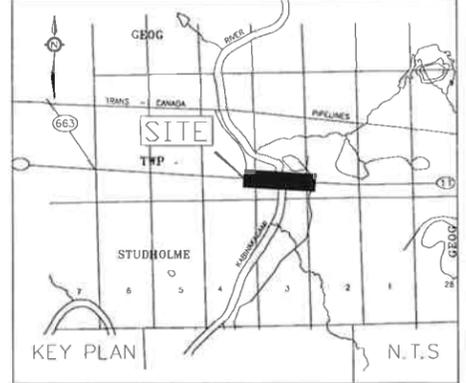
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No 2007-5104  
WP No 5411-04-00

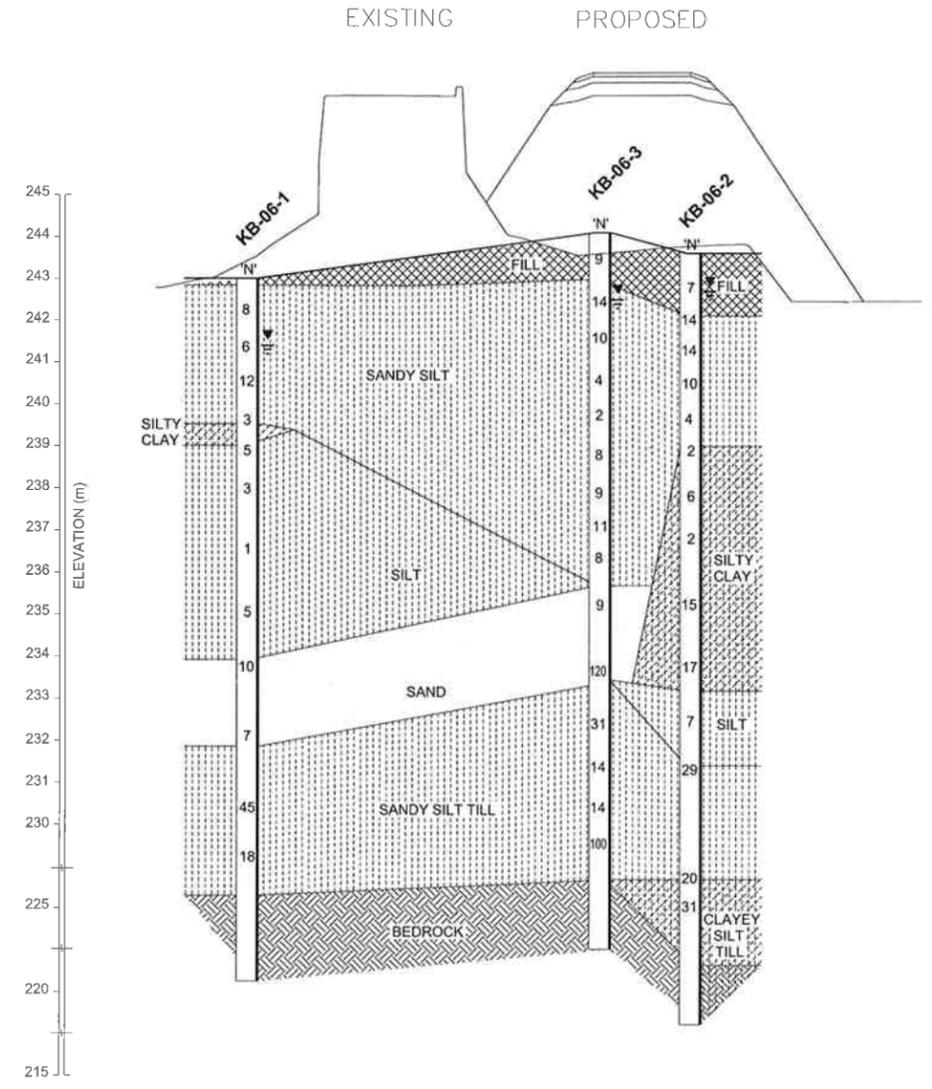


KABINAKAGAMI RIVER  
REPLACEMENT BRIDGE  
SOIL STRATA PLOTS  
(SECTIONS B-B, C-C)

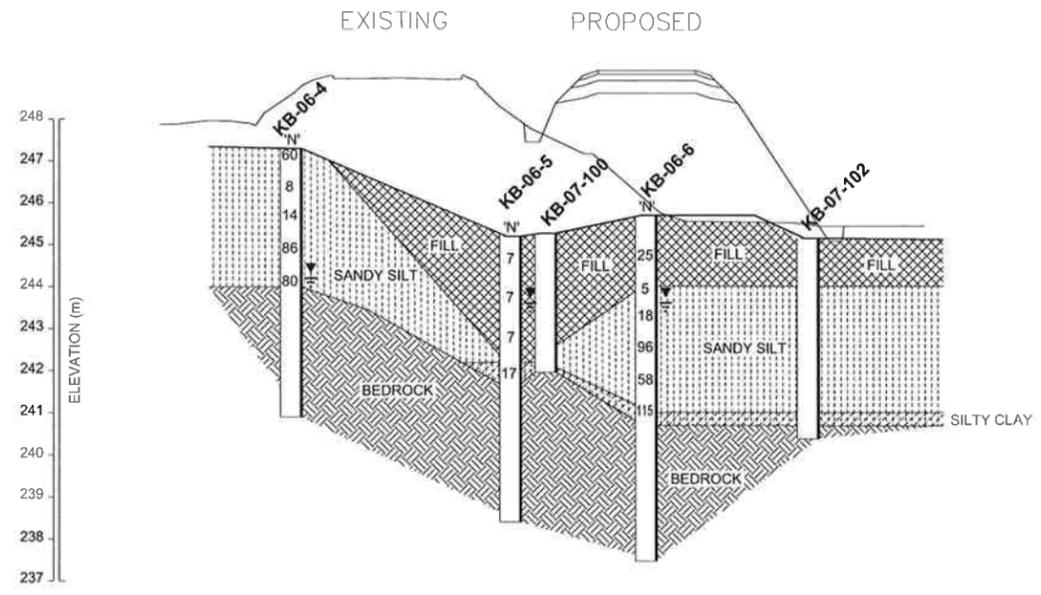
SHEET



**B-B CROSS SECTION**



**C-C CROSS SECTION**



LEGEND:

- BOREHOLE
- GROUNDWATER LEVEL

BOREHOLE No.	STATION	OFFSET	ELEVATION
KB-06-1	23+463	29m Lt	243.0 m
KB-06-2	23+468	3m Rt	243.6 m
KB-06-3	23+451	3m Lt	244.1 m
KB-06-4	23+562	21m Ll	247.3 m
KB-06-5	23+555	10m Lt	245.2 m
KB-06-6	23+567	0.5m Lt	245.7 m
KB-07-1	23+495	0.5m Lt	240.4 m
KB-07-2	23+537	0.5m Lt	240.4 m
KB-07-3	23+442	0.5m Lt	245.0 m
KB-07-4	23+590	1.5m Rt	246.6 m
KB-07-100	23+562	8m Ll	245.3 m
KB-07-101	23+567	9m Lt	248.1 m
KB-07-102	23+567	10m Ll	245.1 m
KB-07-103	23+562	6m Rt	244.3 m

NOTES:

1. The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2. 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.
3. Base plan provided by LEA Consulting Ltd.
4. This drawing is for subsurface information only. Surface details and features are for conceptual illustration only. The proposed structure location and features are shown for information purposes only.
5. GEOCREs No. 42F-19



DRAWING NAME: T:\nuccod\Drawings\Project Drawings\2008\1013\MS\1013\545 - 2007\016 - MSNA-Section B and C.dwg  
CREATED: Jan 14, 2008 5:29pm

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	AA	CHK	CC	CODE	CHBCC-00	LOAD CNT	CL-625	DATE	2008-01-14
DRAWN	EG	CHK	EG	SITE	19W-009	STRUCT	SCHEVE	DWG	2

# Appendix B

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

## SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

### SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	-	mixture of soil and humus capable of supporting good vegetative growth
<i>Peat</i>	-	fibrous fragments of visible and invisible decayed organic matter
<i>Till</i>	-	unstratified and unsorted glacial deposit which may include particle sizes from clay to boulders
<i>Fill</i>	-	materials not identified as deposited by natural geological processes

Terminology describing soil structure:

<i>Desiccated</i>	-	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	-	material breaks along plane of fracture
<i>Varved</i>	-	composed of regular alternating layers of silt and clay
<i>Stratified</i>	-	alternating layers or beds greater than 6mm (1/4") thick
<i>Laminated</i>	-	alternating layers or beds less than 6mm (1/4") thick
<i>Blocky</i>	-	material can be broken into small and hard angular lumps
<i>Lensed</i>	-	irregular shaped pockets of soil with differing textures
<i>Seam</i>	-	a thin, confined layer of soil having different particle size, texture, or color from materials above and below
<i>Well Graded</i>	-	having wide range in grain sizes and substantial amounts of all intermediate particles sizes
<i>Uniformly Graded</i>	-	predominantly one grain size

Soil descriptions and classification are based on the Unified Soil Classification System (USCS) (ASTM D-2488), which classifies soils on the basis of engineering properties. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. This system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with the standard of the Ministry of Transportation of Ontario:

<i>Trace or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>With</i>	20-30%

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N'-value\*.

Compactness	'N'-value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

## SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

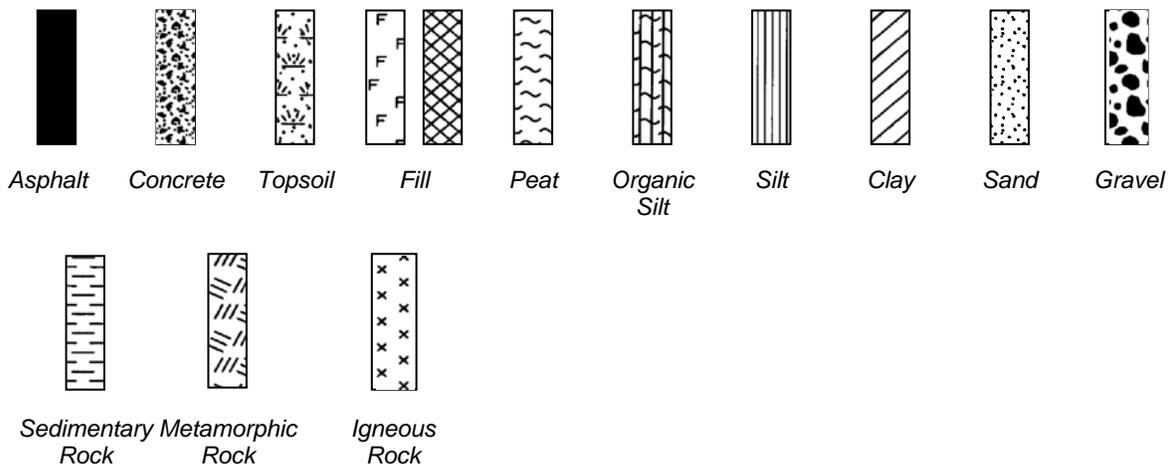
The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis. Standard Penetration Test 'N'-values\* can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils.

Consistency	Undrained Shear Strength (kPa)	'N'-Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

**Note: \*\*N'-VALUE-** The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in millimeters (e.g. 50/75).

### STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



### WATER LEVEL MEASUREMENT



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe

### SAMPLE TYPE

SS	Split spoon sample (obtained from the Standard Penetration Test)	BS	Bulk sample
TW	Thin Wall Sample or Shelby Tube	WS	Wash sample
PS	Piston sample	HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits.
GS	Grab sample		
AS	Auger sample		
VT	Vane Test		

RECORD OF BOREHOLE No KB-06-1

1 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+463 o/s 29 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.20 - 07.02.20 CHECKED BY GTC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
243.0	100 mm TOPSOIL		1	AS	-										
240.0	Fine Sandy SILT(ML), moist to saturated Loose Brown		2	SS	8										
	- compact		3	SS	12										
	- loose		4	SS	6										
	- very loose		5	SS	3										
239.6	Silty CLAY, trace sand, moist Firm Brown		6	SS	5										
3.4			7	SS	3										
239.2	SILT(ML), trace sand, trace clay, saturated Loose to very loose Grey		8	SS	WH										
3.8			9	SS	1										
	- loose		10	SS	5										
233.9	SAND(SM), trace gravel, saturated Compact to loose Brown		11	SS	10										
			12	SS	7										
231.9	Sandy SILT(ML)(TILL), some gravel, wet to saturated Loose Grey - cobbles and/or boulders  - dense		13	SS	45										
			14	SS	18										

ONTARIO MOT 1015345 KABINA 06.GPJ ONTARIO MOT.GDT 08/01/14

Continued Next Page

×<sup>3</sup>, ×<sub>3</sub>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No KB-06-1

2 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+463 o/s 29 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.20 - 07.02.20 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)
225.6	Sandy SILT(ML)(TILL), some gravel, wet to saturated Loose Grey - cobbles and/or boulders (continued)													
17.4	- Refusal to further augering (probable bedrock). Casing installed to Elev. 224.4 m before coring started.													
224.4	GNEISS BEDROCK Grey TCR = 100% SCR = 66% RQD = 66%  TCR = 97% SCR = 58% RQD = 48%  TCR = 97% SCR = 83% RQD = 81%		15	NQ	-									
18.6			16	NQ	-									
18.6			17	NQ	-									
220.7	END OF BOREHOLE at approximately 22.3 m  Groundwater first encountered during drilling on spoon at a depth of approximately 1.5 m below existing grade, Elev. 241.5 m													
22.3														

ONTARIO MOT. 1015345 KABINA 06.GPJ ONTARIO.MOT.GDT 08/01/14

×<sup>3</sup>, ×<sub>3</sub>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

**RECORD OF BOREHOLE No KB-06-2**

1 OF 2

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+468 o/s 3 m Rt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.20 - 07.01.20 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60	80	100	10
243.6	50 mm TOPSOIL		1	AS	-																		
241.9	SAND and GRAVEL (FILL), some wood fragments, moist Loose to compact Brown		2	SS	7																		
241.9	- 100 mm wood debris		3	SS	14																		
1.7	Sandy SILT (ML), moist Compact to very loose Brown		4	SS	14																		
	- 125 mm wood debris		5	SS	10																		
	- Organic matter, wood fragments and roots.		6	SS	4																		
239.0	Silty CLAY (CL), trace to some sand, wet Grey - firm		7	SS	2																		
4.6			8	SS	6																		
			9	SS	2																		
			10	SS	15																		
	- some rootlets - stiff		11	SS	17																		
	- very stiff		12	SS	7																		
233.5	SILT (ML), some clay, trace rock fragments and wood fragments, saturated Loose Grey		13	SS	29																		
10.1																							
231.4	Sandy SILT (SM)(TILL), some to trace gravel, moist Compact Grey - cobbles and/or boulders																						
12.2																							

ONTARIO MOT 1015345 KABINA 05.GPJ ONTARIO MOT.GDT 08/01/08

Continued Next Page

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

**RECORD OF BOREHOLE No KB-06-2**

2 OF 2

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+468 o/s 3 m Rt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.20 - 07.01.20 CHECKED BY GTC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
226.8	Sandy SILT(SM)(TILL), some to trace gravel, moist Compact Grey (continued)		14	GS	--												
16.8	Clayey SILT(ML)(TILL), with rock fragments, some sand, wet Very stiff to hard Grey		15	SS	20												
			16	SS	31												
			17	GS	--												
221.0	GNEISS BEDROCK Grey and pink TCR = 98% SCR = 53% RQD = 47%		18	NQ	--												
22.6	TCR = 100% SCR = 100% RQD = 98%		19	NQ	--												
218.0	END OF BOREHOLE at approximately 25.6 m																
25.6	Groundwater first encountered during drilling on spoon at a depth of approximately 0.8 m below existing grade, Elev. 242.8 m																

ONTARIO MOT 1015345 KABINA 06.GPJ ONTARIO MOT.GDT 08/01/08

✕ 3 . ✕ 3 : Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No KB-06-3

1 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+451 o/s 3 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.02.15 - 07.02.15 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
244.1	150 mm TOPSOIL		1	AS	-	244							
240.0	SAND and GRAVEL (FILL), moist Brown Loose		2	SS	9	243							
243.0	Sandy SILT (ML), some gravel, moist Loose to compact Brown		3	SS	14	242							
1.1			4	SS	10	241							
	- loose		5	SS	4	240							
	- very loose		6	SS	2	239							
	- loose		7	SS	8	238							
			8	SS	9	237							
	- compact		9	SS	11	236							
			10	SS	8	235							
235.4	SAND (SM), some silt, saturated Loose Brown		11	SS	9	234							
233.4	Sandy SILT (ML)(TILL), some clay, wet to saturated Dense to very dense Grey - cobbles and/or boulders		12	SS	120	233							
			13	SS	31	232							
	- compact		14	SS	14	231							
						230							

ONTARIO MOT. 1015345 KABINA 06 GP J ONTARIO MOT. GDT. 08/01/14

Continued Next Page

✕<sup>3</sup>, ✕<sub>3</sub>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

6 39 45 10  
Limit Results:  
Non-Plastic

RECORD OF BOREHOLE No KB-06-3

2 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagami River Sta 23+451 o/s 3 m LT ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.02.15 - 07.02.15 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
229	Sandy SILT (ML)(TILL), some clay, wet to saturated Dense to very dense Grey - cobbles and/or boulders (continued)		15	SS	14								
228	- Silty SAND (SM) - very dense, rock fragments		16	SS	100							25 53 19 3	
226.7													
17.4	GNEISS BEDROCK Grey and pink TCR = 100% SCR = 93% RQD = 92%		17	NQ									
225	TCR = 100% SCR = 91% RQD = 91%		18	NQ									
223.7													
20.4	END OF BOREHOLE at approximately 20.4 m  Groundwater first encountered during drilling on spoon at a depth of approximately 1.5 m below existing grade, Elev. 242.6 m												

ONTARIO MOT 1015345 KABINA 06.GPJ ONTARIO MOT.GDT 08/01/14

✕<sup>3</sup>, ✕<sub>3</sub>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

RECORD OF BOREHOLE No KB-06-4

1 OF 1

METRIC

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+562 o/s 21 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.17 - 07.01.17 CHECKED BY GTC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100							
								20 40 60 80 100						
247.3	100 mm TOPSOIL													
246.1	Sandy SILT(ML), trace to some clay, trace gravel, wet Very dense Brown - loose		1	NR	60		247							
			2	SS	8									
	- trace gravel and rock fragements compact		3	SS	14		246							
	- very dense		4	SS	86		245							
243.9	GNEISS BEDROCK		5	SS	80		244							
3.4	Grey and pink TCR = 100% SCR = 83% RQD = 75%		6	NQ	-		243							
	TCR = 100% SCR = 99% RQD = 97%		7	NQ	-		242							
240.9	END OF BOREHOLE at approximately 6.4 m						241							
6.4	Groundwater first encountered during drilling on spoon at a depth of approximately 3 m below existing grade, Elev. 244.3 m													

ONTARIO MOT 1015345 KABINA 06 GPJ ONTARIO MOT GDT 08/01/14

×<sup>3</sup>, ×<sub>3</sub>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

**RECORD OF BOREHOLE No KB-06-5**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagami River Sta 23+555 o/s 10 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 1.18.07 - 1.18.07 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
245.2	100 mm TOPSOIL		1	NR	--								
240.9	Sandy SILT (FILL), some asphalt, moist Brown Loose		2	SS	7								
			3	SS	7								
	- some wood fragments		4	SS	7								
242.2	Silty CLAY (ML-CL), trace sand, some wood fragments, wet Very stiff Brown		5	SS	17								
241.4													
241.4	GNEISS BEDROCK Grey and pink TCR = 100% SCR = 98% RQD = 78%		6	NQ	--								
	TCR = 100% SCR = 100% RQD = 99%		7	NQ	--								
238.3	END OF BOREHOLE at approximately 6.6 m  Groundwater first encountered during drilling on spoon at a depth of approximately 1.5 m below existing grade, Elev. 243.7 m												

ONTARIO MOT 1015345 KABINA 06.GPJ ONTARIO MOT.GDT 1/10/08

×<sup>3</sup>, ×<sub>3</sub>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No KB-06-6**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagami River Sta. 23+567 o/s 0.5 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY JL  
 DATUM Geodetic DATE 07.01.20 - 07.01.20 CHECKED BY GTC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40					
245.7 240.0 5.7	100 mm TOPSOIL SAND (FILL), some gravel, some silt, moist Compact Brown	[Cross-hatched]	1	NR	-	▽								
			2	SS	25		245							
244.0	- loose 25 mm PEAT Brown	[Dotted]	3	SS	5		244							
244.0 1.7	Sandy SILT (ML), some gravel, trace to some clay, moist Loose to compact Brown	[Vertical lines]	4	SS	18		243							
	- very dense - rock fragments		5	SS	96/ 150 mm		242							
	- trace rock fragments		6	SS	58		241							
241.0	150 mm varved Silty CLAY (CL), trace sand, moist Hard Grey	[Diagonal lines]	7	SS	115/ 150 mm		240							
240.8 4.9	GNEISS BEDROCK Grey and pink TCR = 100% SCR = 93% RQD = 78%	[Diagonal lines]	8	NQ	--		239							
	TCR = 100% SCR = 83% RQD = 73%		9	NQ	--		238							
	TCR = 100% SCR = 93% RQD = 93%		10	NQ	--		237.5							
237.5 8.2	END OF BOREHOLE at approximately 8.2 m  Groundwater first encountered during drilling on spoon at a depth of approximately 2.0 m below existing grade, Elev. 243.7 m													

ONTARIO MOT 1015345-KABINA.06.GPJ ONTARIO MOT.GDT 08/01/08

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

RECORD OF BOREHOLE No KB-07-1

1 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+495 o/s 0.5 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Steel Casing, Split Spoon COMPILED BY NH  
 DATUM Geodetic DATE 07.07.05 - 07.07.07 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)
240.4 0.0	River Surface WATER													
239.3 1.1	Sandy SILT (ML), trace organic matter, trace wooden fragments, saturated Very loose to compact Grey	[Strat Plot]	1	SS	2									
			2	SS	4									
			3	SS	8									
			4	SS	17									
236.7 3.7	Silty CLAY (CL), trace gravel, trace sand, saturated Soft to very stiff Grey	[Strat Plot]	5	SS	2									
			6	SS	4								2 3 65 30	
			7	SS	7									
			8	SS	19									
232.5 7.9	SILT (ML), some clay, trace sand, trace gravel, saturated Compact Grey	[Strat Plot]	9	SS	23								1 1 81 17	
			10	SS	24									
229.7 10.7	Clayey SILT (ML) TILL, some sand, trace gravel, moist Very stiff to hard Grey	[Strat Plot]	11	SS	24									
			12	SS	60									
			13	SS	77									

ONTARIO MOT. 1015345 KABINA JULY07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/11

Continued Next Page

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

RECORD OF BOREHOLE No KB-07-1

2 OF 2

METRIC

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+495 o/s 0.5 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Steel Casing, Split Spoon COMPILED BY NH  
 DATUM Geodetic DATE 07.07.05 - 07.07.07 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100						
	Clayey SILT (ML) TILL, some sand, trace gravel, moist Very stiff to hard Grey (continued)		14	SS	129										
					15	SS	149								
					16	NQ	-								
					17	SS	62								
					18	SS	110								
220.9	- boulders and cobbles at 19.2 m to 19.5 m		19	NQ	-										
19.5	Poor to fair quality reddish grey GNEISS - close to moderate joint spacing, dip 10 degrees and 80 degrees - fresh TCR = 100% SCR = 71% RQD = 65%		1	NQ	-										
	TCR = 100% SCR = 63% RQD = 58%		2	NQ	-										
	TCR = 100% SCR = 75% RQD = 49%		3	NQ	-										
218.0	END OF BOREHOLE at approximately 22.4 m														
22.4															

ONTARIO MOT 1015345 KABINA JULY07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/11

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

RECORD OF BOREHOLE No KB-07-2

1 OF 1

METRIC

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+537 o/s 0.5 m Lt. ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Steel Casing, Split Spoon COMPILED BY NH  
 DATUM Geodetic DATE 07.07.08 - 07.07.08 CHECKED BY GTC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	20 40 60 80 100	10 20 30					GR SA SI CL
240.4	River Surface													
0.0	WATER													
239.5	Sandy SILT (ML), trace clay, trace gravel, saturated Compact to dense Brown		1	SS	13									
			2	SS	48									
238.0	Silty CLAY (CL-ML), some sand, trace gravel, trace rock fragments, saturated Hard Brown		3	SS	34									
237			4	SS	100/5"									9 13 40 38
236.0			5	SS	100/3"									
4.4	Very poor to poor quality grey GNEISS - close to moderate joint spacing, dip 10 degrees and 90 degrees - thin bedding, dip 0-15 degrees - fresh to slightly weathered TCR = 100% SCR = 49% RQD = 49% TCR = 100% SCR = 56% RQD = 24%		1	NQ	-									
234			2	NQ	-									
232.8	END OF BOREHOLE at approximately 7.6 m													
7.6														

ONTARIO MOT 1015345 KABINA JULY07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/11

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

**RECORD OF BOREHOLE No KB-07-3**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabineakagmi River Sta. 23+442 o/s 0.5 m Lt. ORIGINATED BY NH  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY NH  
 DATUM Geodetic DATE 07.07.19 - 07.07.19 CHECKED BY GTC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
245.0	Grass													
0.0	SAND to Silty SAND Fill (SM), with gravel, moist to 1.9 m Compact Brown		1	SS	14									
			2	SS	15									
243.0			3	SS	7									
2.0	Silty CLAY (CL-ML), wet Stiff Brown		4	SS	15									
242.3			5	SS	14									
2.7	Sandy SILT (ML), some clay, moist to wet Loose to compact Brown		6	SS	13									
			7	SS	14									
			8	SS	12									
			9	SS	9									
237.8			10	SS	19									
7.2	Sandy SILT Till (ML), some gravel, some clay, wet Compact Brown to grey		11	SS	28									
234.0			12	SS	60									
11.0	Clayey SILT Till (ML), trace sand, trace gravel, wet Hard Grey													
233.7														
11.3	END OF BOREHOLE at approximately 11.3 m  Water first encountered on spoon at a depth of approximately 1.9 m, below existing grade, elevation of about 243.1 m  Groundwater level was measured at a depth of approximately 3.9 m below existing grade, elevation about 241.1 m in borehole on completion of drilling.													11 31 42 16

ONTARIO MOT - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/14

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

RECORD OF BOREHOLE No KB-07-4

1 OF 1

METRIC

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+590 o/s 1.5 m RL. ORIGINATED BY NH  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY NH  
 DATUM Geodetic DATE 07.07.18 - 07.07.18 CHECKED BY GTC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
246.6	Grass																
0.0	SAND and GRAVEL Fill, trace silt, moist at 0.6 m Compact Brown		1	SS	21												
246.0																	
0.6	SILT Fill, with wood fragments, moist to wet Compact Grey to brown  - some sand, some clay, trace gravel		2	SS	14												
			3	SS	19												2 11 77 10
244.2																	
2.4	END OF BOREHOLE at approximately 2.4 m  Auger refusal at a depth of approximately 2.4 m below existing grade (Elev. 244.2 m) on inferred Bedrock.  Groundwater level was measured at a depth of approximately 2.2 m below existing grade, (Elev. 244.4 m) in borehole on completion of drilling.		4	SS	100												

ONTARIO MOT - 1015345 KABINA JULY07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/11

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

**RECORD OF BOREHOLE No KB-07-100**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+562 o/s 8 m Lt ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Solid Stem Auger COMPILED BY OL  
 DATUM Geodetic DATE 11.30.07 - 11.30.07 CHECKED BY GTC

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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100							
245.3	Snow Covered Ground Surface																
0.0	Auger to bedrock.																
							245										
							244										
							243										
							242										
241.9	END OF BOREHOLE at approximately 3.5 m.																
3.5	Auger refusal at a depth of approximately 3.5 m below existing grade (Elev. 241.9 m) on inferred bedrock.																
	Borehole caved to a depth of approximately 3.3 m (Elev. 242.0 m) below existing grade on completion of drilling.																

ONTARIO MOT. 1015345 KABINA DEC07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 1/10/08

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

**RECORD OF BOREHOLE No KB-07-101**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+567 o/s 9 m Lt ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Steel Casing, Solid Stem Auger COMPILED BY OL  
 DATUM Geodetic DATE 07.11.30 - 07.11.30 CHECKED BY GTC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
248.1 0.0	Snow Covered Ground Surface Auger to bedrock.															
241.6 6.5	Very poor to poor quality grey GNEISS - close to moderate joint spacing, dip 10 degrees and 90 degrees - thin bedding, dip 0-15 degrees - fresh to slightly weathered TCR = 86% SCR = 41% RQD = 51% TCR = 100% SCR = 83% RQD = 92%	[Strat Plot]	1	NQ	-											
239.7 8.5			2	NQ	-											
	END OF BOREHOLE at approximately 8.4 m.															

ONTARIO MOT 1015345 KABINA DEC07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 08/01/08

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

**RECORD OF BOREHOLE No KB-07-102**

1 OF 1

**METRIC**

W.P. 5411-04-00 LOCATION Kabinakagmi River Sta. 23+567 o/s 10 m Rt ORIGINATED BY DS  
 DIST New Liskeard HWY 11 BOREHOLE TYPE Solid Stem Auger COMPILED BY OL  
 DATUM Geodetic DATE 11.30.07 - 11.30.07 CHECKED BY GTC

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100							
245.1 0.0	Snow Covered Ground Surface Auger to bedrock																
240.4 4.6	END OF BOREHOLE at approximately 4.6 m.  Auger refusal at a depth of approximately 4.6 m (Elev. 240.4 m) below existing grade on inferred bedrock.  Borehole caved to a depth of approximately 3.5 m (Elev. 241.6 m) below existing grade on completion of drilling.																

ONTARIO MOT 1015345 KABINA DEC07 - FOUNDATIONS.GPJ ONTARIO MOT.GDT 1/10/08

×<sup>3</sup> ×<sup>3</sup> Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

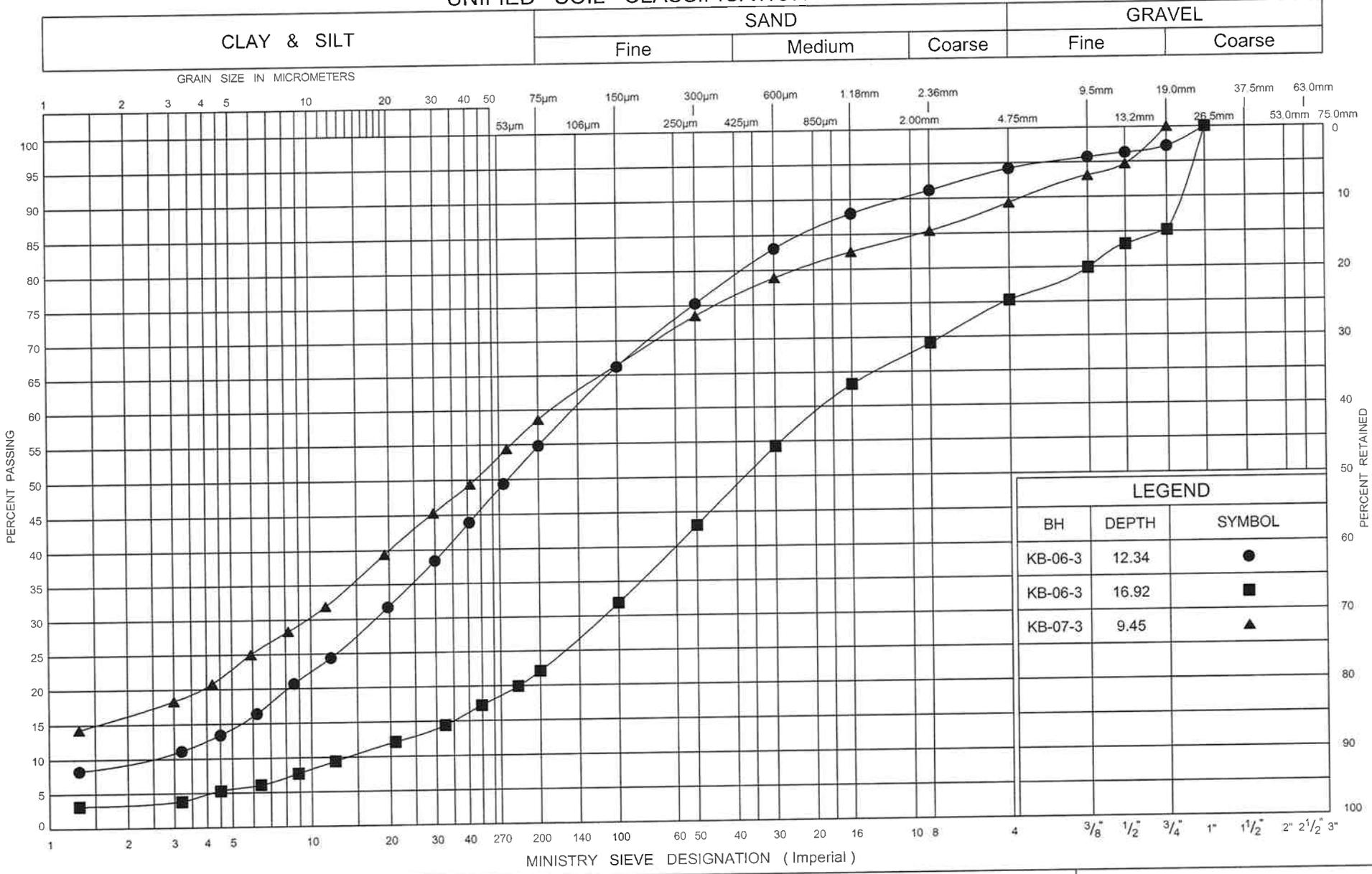


# Appendix C

## Geotechnical Laboratory Test Results



### UNIFIED SOIL CLASSIFICATION SYSTEM



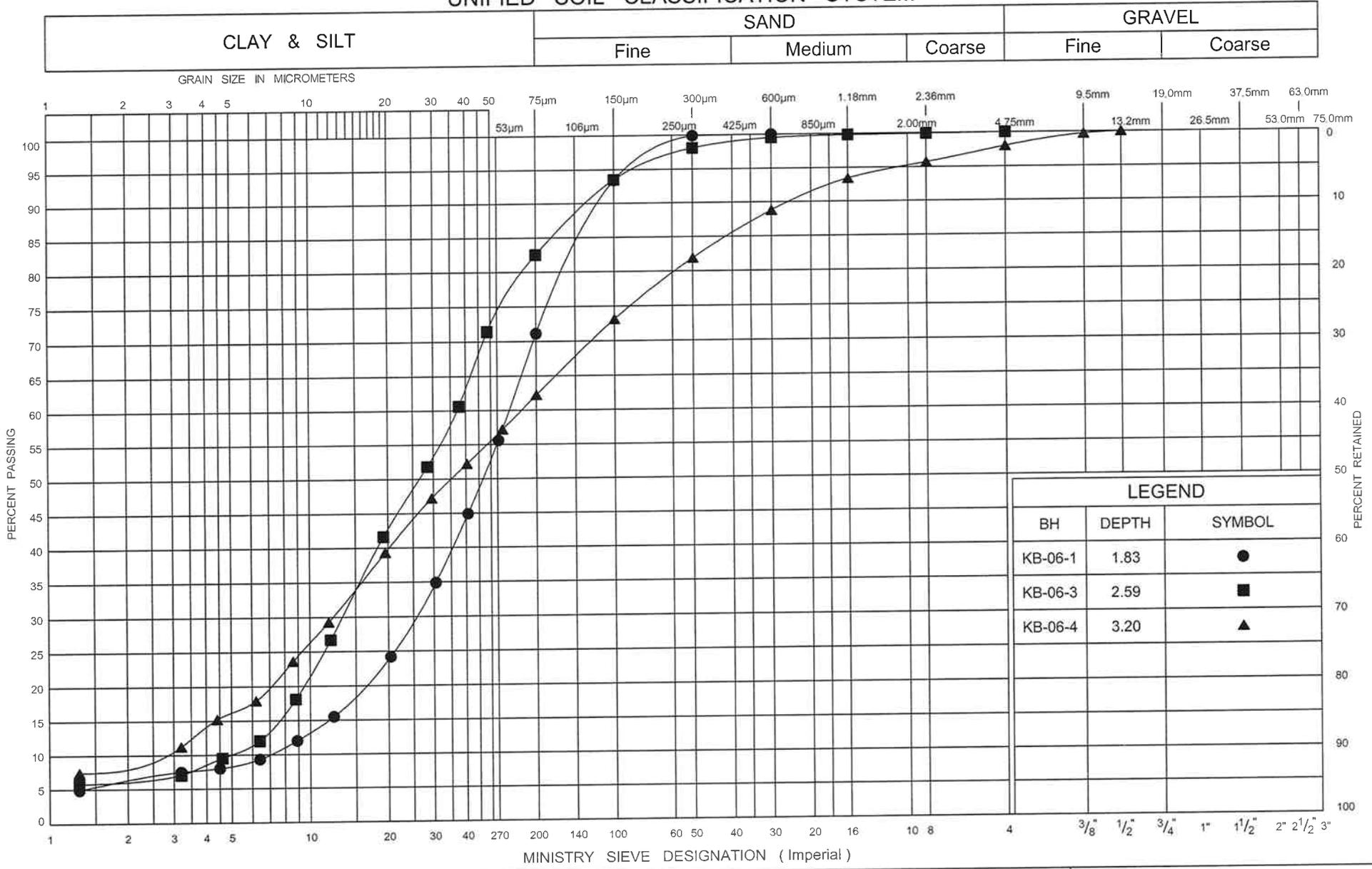
ONTARIO MOT GRAIN SIZE 1015345 KABINA 06.GPJ ONTARIO MOT\_GDT\_08/01/08



**GRAIN SIZE DISTRIBUTION**  
 Sandy SILT Till (ML) to Silty SAND Till (SM)

FIG No 6  
 W P 5411-04-00  
 Kabina River/Hwy 11, Hearst, Ont.

### UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE 1015345 KABINA 06.GPJ ONTARIO MOT.GDT 08/01/08

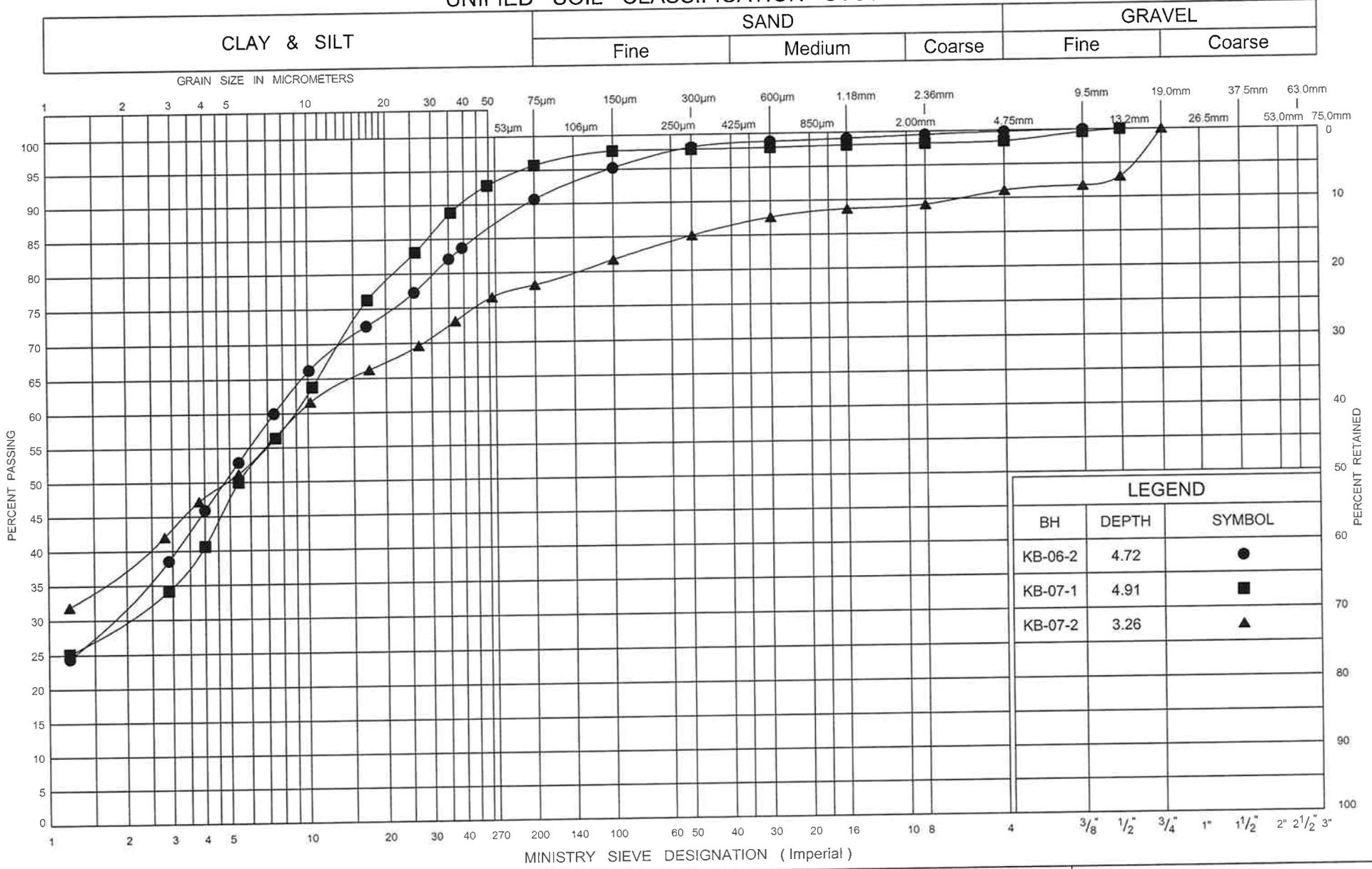


## GRAIN SIZE DISTRIBUTION

### Sandy SILT (ML)

FIG No 2  
W P 5411-04-00  
Kabina River/Hwy 11, Hearst, Ont.

### UNIFIED SOIL CLASSIFICATION SYSTEM

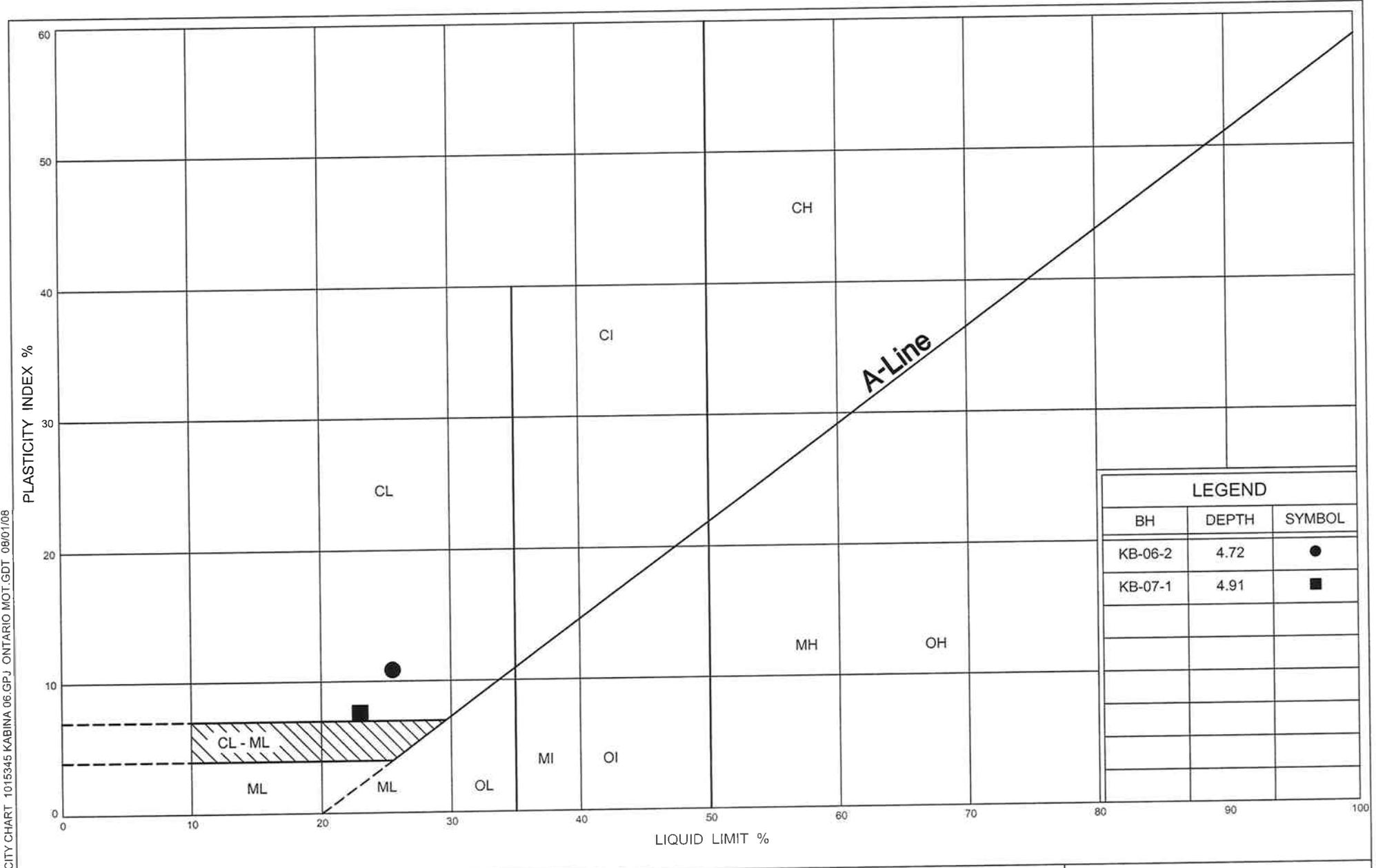


ONTARIO MOT GRAIN SIZE 1015345 KABINA.06.GPJ ONTARIO.MOT.GDT.08/01/08



**GRAIN SIZE DISTRIBUTION**  
Silty CLAY (CL)

FIG No 3  
W P 5411-04-00  
Kabina River/Hwy 11, Hearst, Ont.



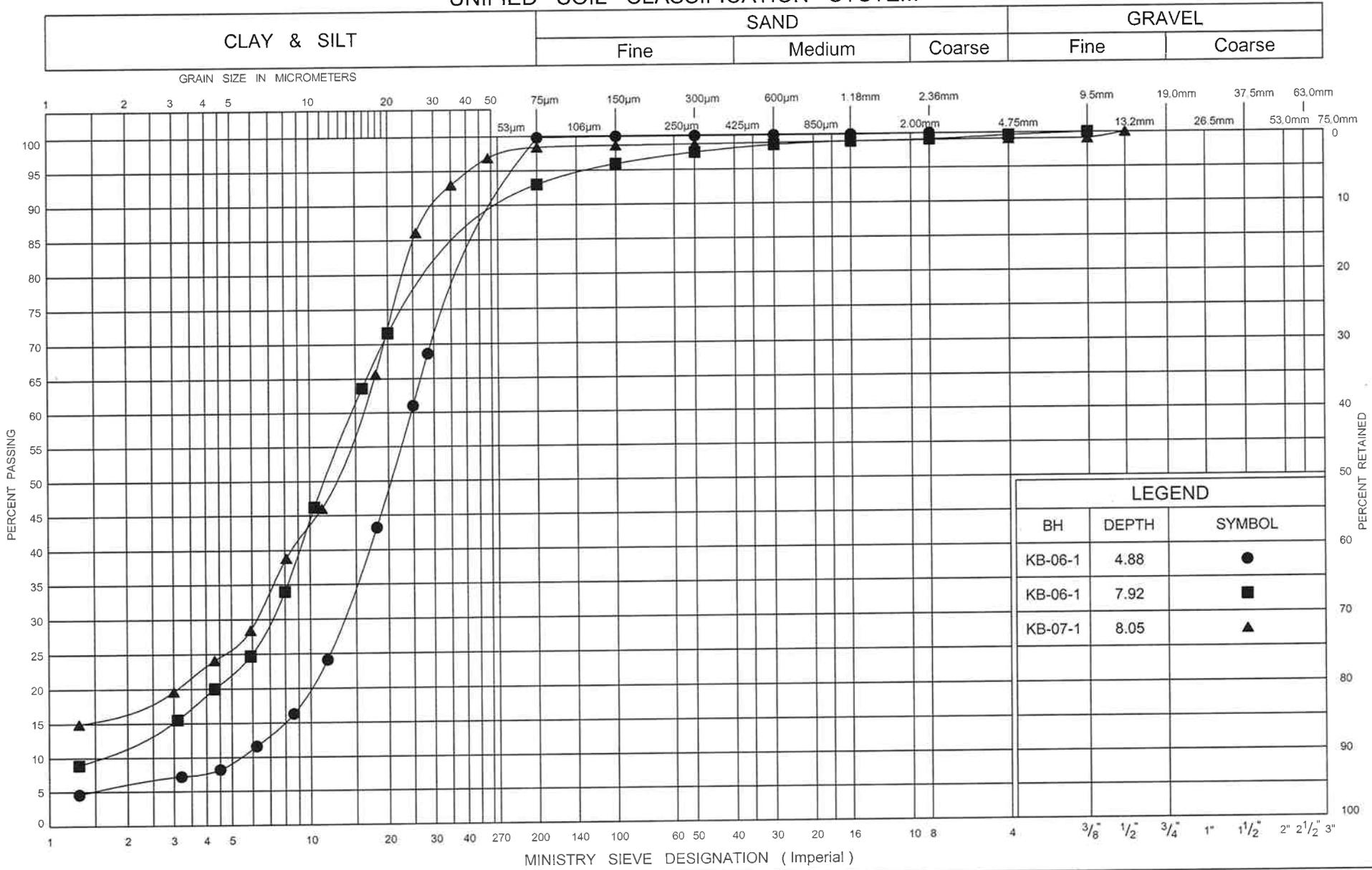
ONTARIO MOT PLASTICITY CHART 1015345 KABINA.06.GPJ ONTARIO MOT.GDT\_08/01/06



PLASTICITY CHART  
Silty CLAY (CL)

FIG No 4  
W P 5411-04-00  
Kabina River/Hwy 11, Hearst, Ont.

### UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE 1015345 KABINA.06.GPJ ONTARIO MOT\_GDT\_08/01/08



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION SILT (ML)

FIG No 5

W P 5411-04-00

Kabina River/Hwy 11, Hearst, Ont.



**Jacques Whitford  
Limited**

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Markham, Ontario  
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Fax: (905) 479-9326

**Rock Core Compressive  
Strength Test Report**

Figure 7

**PROJECT NO: 1015345**

**Client: Lea Consulting Ltd. MTO**

**Project: Hwy 11, at the Kabinakagami River Bridge, Hearst, Ontario**

**Date Tested: 26 Mar, 2007**

<b>Core Number</b>	<b>KB-06-1 SA 4</b>	<b>KB-06-6 SA 1</b>
Average Height (mm)	85.36	82.40
Average Diameter (mm)	48.22	47.52
H/D Ratio	1.770	1.734
Correction Factor	0.9816	0.9787
Compressive Strength (MPa)	105.8	69.1
Corrected Compressive Strength (MPa)	103.9	67.6

Tests carried out in accordance with CAN/CSA-A23.2 – 04, Unless otherwise noted