



June 15, 2012

## DRAFT FOUNDATION INVESTIGATION AND DESIGN REPORT

### NOISE BARRIER WALL REPLACEMENT HIGHWAY 401 FROM EAST OF PARK ROAD TO EAST OF RITSON ROAD OSHAWA, ONTARIO ASSIGNMENT NO.: 2011-E-0018

**Submitted to:**

Ministry of Transportation, Ontario  
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REPORT

**GeoCres No. Pending**

**Report Number:** 11-1184-0109

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# **PART A - FOUNDATION INVESTIGATION REPORT**

**NOISE BARRIER WALL**

**HIGHWAY 401 FROM PARK ROAD TO OSHAWA CREEK AND FROM EAST  
OF ALBERT STREET TO EAST OF RITSON ROAD**

**OSHAWA, ONTARIO**

**ASSIGNMENT NO.: 2011 - E - 0018**

**DRAFT**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the proposed noise barrier wall at Highway 401, from east of Park Road to east of Ritson Road in the City of Oshawa, Ontario.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen (18) months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid.

This report addresses only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects of the subsurface conditions, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside the terms of reference for this investigation.

The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Assignment Order Form for Agreement No. 2011-E-0018, issued in May 3, 2012.

## **2.0 SITE AND PROJECT DESCRIPTION**

The site is located along the north and south sides of the Highway 401 from east of Park Road to east of Ritson Road, Oshawa, Ontario. The foundation investigation consisted of Work Order #1 and Work Order #2 assignments issued by MTO. The area included in the Work Order #1 foundation investigation is along the north and south sides of Highway 401, from Park Road to Oshawa Creek, a distance of approximately 2 km. The area included in the Work Order #2 foundation investigation is along the north and south sides of Highway 401, from east of Albert Street to east of Ritson Road, a distance of approximately 1.5 km.

The terrain along the proposed noise barrier wall alignment is rolling with ground surface elevations between about Elev. 97 m and Elev. 119 m, referenced to geodetic datum. Berms are present along the north and south sides of Highway 401 from Stn. 11+ 933 to Stn. 12+238. The elevated berms are approximately 3 m to 6 m above the adjacent lanes of Highway 401. Similarly, a berm is present along the south side of Highway 401 from Stn. 13+250 to Stn. 13+400 and this berm is approximately 3 m to 4 m above the adjacent lane of Highway 401. In the remainder of the Work Order areas, the ground surface elevations along the noise barrier wall alignment generally match the elevations of the adjacent lanes of Highway 401.

## **3.0 INVESTIGATION PROCEDURES**

The field work for this investigation was carried out from May 6 to May 18, 2012, at which time sixty-nine (69) boreholes (BH 101 to BH 117, BH 201 to 213, BH 201A to BH 203A, BH 301 to BH 317, BH 401 to BH 417, BH 411A and BH 413A) were advanced at the locations shown on the Borehole Location Plan, Drawing 1.



Forty-six (46) boreholes were located along the Highway 401 shoulder area and advanced to depths ranging from approximately 3.5 m to 6.6 m below the existing ground surface. Twelve (12) boreholes (BH 103 to BH 108, BH 314 to BH 317, BH 414 and BH 416) were located outside of the existing noise barrier walls and were advanced to depths ranging from 3.8 m to 6.5 m below the existing ground surface. Eleven (11) boreholes (BH 410 to BH 413, BH 415, BH 417, BH 411A, BH 413A and BH 201A to BH 203A) were located inside of the Highway 401 right of way at the berm areas immediately adjacent the existing noise barrier walls and advanced to depths ranging from 0.7 m to 3.1 m below the existing ground surface.

Due to access restrictions, Boreholes BH 201, BH 202 and BH 203 were advanced to the proposed depths at the closest locations accessible to a drill rig. Shallow Boreholes (BH 201A, BH 202A and BH 203A) were advanced at locations immediately adjacent to the proposed alignment using manual drilling equipment to provide supplementary soil data. Due to access restrictions, Boreholes BH 410 to BH 413, BH 415 and BH 417 were advanced at the top of the existing berm using manual drilling equipment immediately adjacent to the proposed wall alignment. However, these boreholes were terminated at relatively shallow depths due to practical refusal. Additional shallow boreholes (Boreholes BH 411A and BH 413A) were advanced using manual drilling equipment at lower elevations on the berm slopes to provide supplementary soil data.

The boreholes were drilled using truck-mounted and track-mounted drillrigs supplied and operated by Strong Soil Search Inc., a specialist drilling contractor subcontracted to Golder. Standard penetration testing (SPT) and sampling were carried out at 0.75 m and 1.5 m intervals of depth in each of the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer. Due to site access constraints, as previously noted, eleven (11) boreholes located at the existing berms were advanced using manual drilling equipment supplied and operated by Sonic Soil Sampling Inc., a specialist drilling contractor subcontracted to Golder. Standard Penetration Testing and sampling were carried out at continuous intervals of depth using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling. All boreholes were backfilled to the ground surface upon completion of the drilling operation using bentonite pellets, the boreholes located within paved areas on Highway 401 were patched with cold mix asphalt.

The field work for this investigation was observed by members of our engineering staff who arranged underground service locates, logged the subsurface conditions encountered in the boreholes and cared for the samples obtained. All of the soil samples obtained during the investigation were brought to our Whitby laboratory for further examination, natural water content testing and selected classification testing (i.e. water content, sieve and hydrometer and Atterberg limits).

The borehole locations were staked in the field by Golder as close as possible to the proposed noise barrier walls. The corresponding ground surface elevations and coordinates of the boreholes were obtained from the Global Positioning System (GPS). Since the elevations and coordinates were not surveyed by a professional surveyor, they should be considered to be approximate. The borehole locations (MTM NAD83 northing and easting coordinates), the ground surface elevations (referenced to geodetic datum) and the offset for the



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

Highway 401 centreline are summarized in the following table. MTM NAD83 coordinates and ground surface elevations are also presented on the Record of Borehole sheets and on Drawings 2A, 2B, 2C and 2D.

Borehole Number	Station	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Offset* (m)
BH 101	11+939.9	4860050.0	355614.6	111.3	18.0
BH 102	11+989.9	4860064.7	355662.4	110.4	18.8
BH 103	12+041.3	4860063.6	355716.9	112.9	36.7
BH 104	12+097.9	4860086.2	355769.0	113.0	31.4
BH 105	12+138.6	4860099.0	355807.7	112.8	31.2
BH 106	12+180.1	4860110.8	355847.5	112.8	32.4
BH 107	12+220.0	4860121.9	355885.8	112.6	33.7
BH 108	12+270.7	4860147.6	355930.8	110.7	23.1
BH 109	12+324.2	4860172.8	355978.8	109.3	14.0
BH 110	12+366.2	4860185.8	356018.7	108.5	14.1
BH 111	12+416.00	4860200.6	356066.3	107.1	14.7
BH 112	12+457.9	4860212.2	356106.5	105.0	16.1
BH 113	12+507.6	4860226.5	356154.2	104.1	17.3
BH 114	12+553.7	4860241.1	356197.9	103.1	17.0
BH 115	12+596.4	4860254.6	356238.4	101.9	16.7
BH 116	12+639.2	4860267.2	356279.3	101.2	17.4
BH 117	12+687.5	4860280.9	356325.7	99.6	18.7
BH 201	13+262.6	4860459.9	356872.2	97.0	17.9
BH 201A	13+263.1	4860448.6	356876.4	100.3	29.9
BH 202	13+333.9	4860480.8	356940.4	97.5	19.2
BH 202A	13+334.3	4860470.2	356944.2	100.5	30.4
BH 203	13+393.4	4860493.3	356998.8	98.8	25.3
BH 203A	13+393.3	4860488.2	357000.4	100.2	30.6
BH 204	13+497.1	4860499.8	357105.8	101.1	52.3
BH 205	13+549.7	4860543.9	357146.8	100.2	23.1
BH 206	13+601.7	4860562.6	357195.4	101.3	20.4
BH 207	13+648.2	4860578.3	357239.2	102.8	19.0
BH 208	13+698.7	4860594.8	357286.9	103.3	18.1
BH 209	13+766.2	4860616.4	357350.8	102.3	17.4
BH 210	13+810.4	4860629.6	357393.0	102.9	17.9
BH 211	13+854.5	4860643.3	357434.9	103.6	17.9
BH 212	13+901.3	4860658.9	357479.1	102.3	16.7
BH 213	13+951.3	4860676.2	357526.0	101.4	14.7
BH 301	14+112.4	4860754.8	357669.8	98.6	-15.5
BH 302	14+042.0	4860732.9	357603.0	100.4	-15.2
BH 303	13+997.9	4860719.7	357560.9	99.8	-15.8
BH 304	13+947.0	4860704.5	357512.3	100.9	-16.4
BH 305	13+902.0	4860690.2	357469.7	102.3	-16.0
BH 306	13+857.6	4860679.1	357426.6	102.2	-18.8
BH 307	13+810.1	4860665.3	357381.1	102.4	-19.8
BH 308	13+766.2	4860651.2	357339.5	103.9	-19.3



Borehole Number	Station	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Offset* (m)
BH 309	13+700.1	4860630.8	357276.7	102.8	-19.3
BH 310	13+649.8	4860616.7	357228.4	102.5	-20.9
BH 311	13+600.2	4860604.3	357180.3	102.0	-23.9
BH 312	13+551.7	4860594.1	357132.5	101.2	-29.1
BH 313	13+521.2	4860608.5	357095.7	100.7	-54.2
BH 314	13+492.4	4860607.3	357065.9	110.6	-62.3
BH 315	13+450.4	4860566.3	357035.1	104.3	-32.9
BH 316	13+399.8	4860551.0	356986.8	100.7	-33.2
BH 317	13+353.7	4860540.0	356941.9	100.4	-36.8
BH 401	12+640.1	4860302.4	356268.8	100.6	-19.3
BH 402	12+595.9	4860288.4	356226.9	102.0	-18.9
BH 403	12+554.7	4860275.6	356187.7	103.2	-19.0
BH 404	12+508.6	4860260.3	356144.2	105.0	-17.9
BH 405	12+458.2	4860245.8	356095.9	106.0	-19.1
BH 406	12+415.9	4860231.8	356056.0	107.4	-18.2
BH 407	12+365.3	4860214.0	356008.6	108.1	-15.9
BH 408	12+324.3	4860200.9	355969.7	109.4	-15.5
BH 409	12+276.1	4860185.6	355924.0	109.6	-15.1
BH 410	12+267.5	4860211.5	355906.6	112.5	-45.1
BH 411	12+220.3	4860195.5	355862.1	118.8	-43.7
BH 411A	12+219.9	4860186.4	355864.7	111.5	-34.2
BH 412	12+161.2	4860179.0	355805.4	117.0	-45.6
BH 413	12+108.9.9	4860163.3	355755.4	117.5	-46.2
BH 413A	12+109.1	4860153.7	355758.8	112.5	-35.9
BH 414	12+072.8	4860151.2	355721.4	118.5	-45.1
BH 415	12+040.8	4860135.3	355692.9	116.7	-38.9
BH 416	11+9982.4	4860121.9	355635.8	118.4	-43.8
BH 417	11+926.4	4860100.1	355584.0	110.5	-39.2

\*Notes: offset is from the centerline of Highway 401, '+' denote as south of Highway 401, '-' denote as north of Highway 401.

## 4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

### 4.1 Regional Geological Conditions

The study area for this assignment lies within the physiographic region of Southern Ontario known as the Iroquois Plain. Physiographic mapping in the immediate vicinity indicates that the site lies near the border of clay and till plains (Map 2226, Chapman and Putnam, 1984). This is generally consistent with the results of this investigation which indicate variable lacustrine surficial soil deposits underlain by strata of glacial till and till-like materials.

### 4.2 Site Stratigraphy

The borehole locations, ground surface elevations and interpreted stratigraphic conditions at the site are shown on Drawings 1, 2A, 2B, 2C and 2D. The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on



selected soil samples, are given on the Record of Borehole sheets included in Appendix A and on Figures 1 to 16 included in Appendix B. Lists of Abbreviation and Symbols included in Appendix A also are provided to assist in the interpretation of the borehole logs. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

#### 4.2.1 Overview

In summary, underlying pavement structure or topsoil, fill materials were encountered in most of the boreholes and extended to depths ranging from 0.3 m to 5.3 m below the ground surface. The native subsoils encountered below the fill materials or topsoil generally consisted of silty sand to sandy silt, silty clay to clayey silt and glacial tills ranging in gradation from silty sand till to clayey silt till. Till-like silty clay to clayey silt deposits were encountered in Boreholes BH 315 to BH 317. A brief description of the subsurface conditions encountered in the boreholes is provided in the following sections.

#### 4.2.2 Topsoil

Topsoil was encountered at the ground surface at Boreholes BH 104, BH 201A, BH 202A, BH 203, BH 203A, BH 313 to BH 317, BH 410 to BH 417, BH 411A and BH 413A locations. The thickness of the topsoil encountered at these borehole locations ranged from 100 mm to 200 mm. Layers of topsoil were also encountered below fill materials at depths ranging from 2.0 m to 3.8 m in Boreholes BH 112, BH 209 and BH 307 with topsoil thicknesses ranging from 200 mm to 500 mm at these borehole locations.

#### 4.2.3 Pavement Structure

The existing pavement structure was encountered in the boreholes located within the paved asphalt shoulder along Highway 401, as summarized in the following table:

LOCATION		THICKNESS OF PAVEMENT ELEMENTS			
Road Section	Borehole Nos.	Approximate Ground Surface Elevation (m)	Asphalt (mm)	Granular Base/Subbase (mm)	Subgrade Type
Park Road to Oshawa Creek (south side of Highway 401)	BH 101	111.3	280	640/280	Silty sand fill
	BH 102	110.4	250	170/650	Silty sand and gravel fill
	BH 109	109.3	140	350/330	Silty sand fill
	BH 110	108.5	130	440/330	Sandy silt fill
	BH 111	107.1	120	200/360	Sandy silt fill
	BH 112	105.0	130	370/340	Sandy silt fill
	BH 113	104.1	120	280/440	Sandy silt fill
	BH 114	103.1	140	350/300	Sand and silt fill
	BH 115	101.9	160	200/400	Sandy silt fill
	BH 116	101.2	190	310/200	Clayey silt till
	BH 117	99.6	160	280/460	Silty sand fill



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LOCATION		THICKNESS OF PAVEMENT ELEMENTS			
East of Albert Street to east of Ritson Road (south side of Highway 401)	BH 201	97.0	110	400/240	Clayey silt till
	BH 202	97.5	105	355/410	Silty sand
	BH 204	101.1	150	400/150	Clayey silt fill
	BH 205	100.2	150	350/400	Clayey silt till
	BH 206	101.3	170	330/390	Clayey silt fill
	BH 207	102.8	180	370/390	Clayey silt fill
	BH 208	103.3	170	450/180	Clayey silt to silty clay fill
	BH 209	102.3	135	230/280	Clayey silt to silty clay fill
	BH 210	102.9	120	300/420	Sandy silt fill
	BH 211	103.6	120	360/500	Clayey silt to silty clay fill
	BH 212	102.3	130	370/280	Clayey silt fill
	BH 213	101.4	110	370/270	Sandy silt fill
	East of Albert Street to east of Ritson Road (north side of Highway 401)	BH 301	98.6	100	330/370
BH 302		100.4	120	440/220	Sandy silt fill
BH 303		99.8	110	490/300	Silty sand to sandy silt fill
BH 304		100.9	110	270/620	Clayey silt to silty clay fill
BH 305		102.3	120	450/350	Clayey silt fill
BH 306		102.2	140	380/370	Silty sand fill
BH 307		102.4	120	310/370	Clayey silt fill
BH 308		103.9	170	260/460	Clayey silt fill
BH 309		102.8	150	330/370	Clayey silt fill
BH 310		102.5	150	350/450	Clayey silt fill
BH 311		102.0	120	300/380	Clayey silt fill
BH 312		101.2	190	210/430	Clayey silt till
Park Road to Oshawa Creek (north side of Highway 401)	BH 401	100.6	120	510	Clayey silt and sand fill
	BH 402	102.0	120	410/360	Clayey silt fill
	BH 403	103.2	130	270/500	Silty sand fill
	BH 404	105.0	120	310/430	Silty sand fill
	BH 405	106.0	110	310/380	Silty sand fill
	BH 406	107.4	110	310/400	Silty sand fill
	BH 407	108.1	110	290/430	Sandy silt fill
	BH 408	109.4	125	575	Silty sand to sandy silt fill
	BH 409	109.6	70	530	Clayey silt till

## 4.2.4 Fill Materials

Fill materials were encountered surficially or below the pavement structure/topsoil in all of the boreholes with the exception of Boreholes BH 116, BH 201, BH 202, BH 205, BH 312, BH 315, BH 316, BH 409 to BH 411, BH 411A and BH 413A, and extended to depths ranging from about 0.3 m to 5.3 m below the existing ground surface. The fills generally consisted of clayey silt to silty clay and silty sand to sandy silt. Organic and topsoil inclusions were encountered in the fill materials in some of the boreholes. Standard penetration tests carried out within the clayey silt to silty clay fills gave “N” values ranging from 4 blows to 49 blows per 0.3 m penetration, indicating a soft to hard consistency. Standard penetration tests carried out within the sandy silt to silty sand fills gave “N” values ranging from 3 blows to greater than 100 blows per 0.3 m penetration, indicating a very loose to



very dense compactness. The in-situ water contents of the fill samples ranged from approximately 3 percent to 27 percent.

The results of grain size distribution tests carried out on six samples of the fill materials are shown on Figure 12 to 15 and are also summarized on the Record of Borehole sheets. Atterberg limits testing on three samples of the silty clay to clayey silt fill measured plastic limits between 13 and 16 percent and liquid limits between 26 and 36 percent, with resultant plasticity indices between 10 and 20 percent. These test results, which are plotted on a plasticity chart on Figure 16.

### 4.2.5 Silty Sand Till to Sandy Silt Till

Deposits of native silty sand till to sandy silt till soil containing varying amounts of clay and gravel were encountered in Boreholes BH 101, BH 103 to BH 109, BH 114 to BH 116, BH 204 to BH 206, BH 210 to BH 213, BH 302 to BH 306, BH 310, BH 312, BH 401, BH 402, BH 404 to BH 417, BH 411A and BH 413A. The silty sand till to sandy silt till extended to depths ranging from 0.7 m to 6.6 m below the existing ground surface. Cobbles and boulders were inferred to be present within these deposits as evidenced by auger grinding during drilling. Boreholes BH 101, BH 103, BH 105 to BH 108, BH 114 to BH 116, BH 205, BH 206, BH 210 to BH 213, BH 302, BH 304 to BH 306, BH 310, BH 312, BH 401, BH 402, BH 404, BH 406, BH 407, BH 409 to BH 416, BH 411A and BH 413A were terminated within these deposits.

SPT "N" values measured within the silty sand till to sandy silty till ranged from 11 blows to greater than 100 blows per 0.3 m of penetration, indicating the compactness of the till is typically compact to very dense. The natural water content measured for samples of the till ranged from about 5 percent to 12 percent. The results of grain size distribution tests carried out on seven samples of the silty sand till to sandy silt till, recovered from the 35 mm internal diameter split spoon sampler, are shown on Figure 1, Figure 3 and Figure 7 and are also summarized on the Record of Borehole sheets. The results of Atterberg limits testing on a silt and sand till sample is provided on Figure 2 and is also summarized on the Record of Borehole sheet.

### 4.2.6 Clayey Silt Till

Deposits of native clayey silt till containing varying amounts of sand and gravel were encountered in Boreholes BH 102, BH 104, BH 109 to BH 113, BH 115, BH 116, BH 201, BH 201A, BH 203A, BH 204 to BH 206, BH 308, BH 309, BH 311, BH 312, BH 314 to BH 316, BH 402, BH 404, BH 405, and BH 407 to BH 409. The clayey silt till extended to depths ranging from 1.8 m to 5.0 m below the existing ground surface. Cobbles and boulders were inferred to be present within this deposit as evidenced by auger grinding during drilling. Boreholes BH 104, BH 109 to BH 113, BH 201, BH 201A, BH 203A, BH 204, BH 308, BH 309, BH 311, BH 314, BH 405 and BH 408 were terminated within these deposits.

SPT "N" values measured within the clayey silt till ranged from 8 blows to greater than 100 blows per 0.3 m of penetration, indicating the consistency of the till is typically firm to hard. The natural water contents measured for samples of the till ranged from about 7 percent to 20 percent. The results of grain size distribution tests



carried out on four samples of the clayey silt till, recovered from the 35 mm internal diameter split spoon sampler, are shown on Figure 4 and Figure 10 and are also summarized on the Record of Borehole sheets.

The results of Atterberg limits testing on clayey silt till samples are provided on Figure 5 and Figure 11 and are also summarized on the Record of Borehole sheets. The results of this laboratory testing on the samples of clayey silt till indicated liquid limits between about 17 percent and 32 percent, a plastic limits between about 11 percent and 16 percent, with resultant plasticity indices between 6 percent and 16 percent.

### 4.2.7 Silty Sand to Sandy Silt

Deposits of silty sand to sandy silt were encountered in Boreholes BH 102, BH 202, BH 203, BH 207, BH 301, BH 303, BH 305, BH 307, BH 403, BH 406, BH 410, BH 411, BH 413A, BH 416 and BH 417, and extended to depths ranging from 0.8 m to 5.5 m below the existing ground surface. Boreholes BH 102, BH 203, BH 207, BH 301, BH 303, BH 307, BH 403 and BH 417 were terminated in the silty sand to sandy silt deposit. Standard penetration tests carried out within the silty sand to sandy silt deposit gave “N” values ranging from 1 blow to greater than 100 blows per 0.3 m penetration, indicating a very loose to very dense compactness. The natural water content of silty sand to sandy silt samples were approximately 7 percent and 10 percent. The result of grain size distribution test carried out on a silty sand sample is shown on Figure 6 and is also summarized on the Record of Borehole sheet.

### 4.2.8 Clayey Silt to Silty Clay

Deposits of native clayey silt to silty clay were encountered in Boreholes BH 113, BH 114, BH 201A, BH 202, BH 202A, BH 203A, BH 208, BH 209, BH 310, BH 311, BH 313, BH 315 to BH 317 and BH 403, and extended to depths ranging from 0.7 m to 6.6 m below the existing ground surface. Boreholes BH 202, BH 202A, BH 208, BH 209 and BH 313 were terminated within these deposits.

SPT “N” values measured within the clayey silt to silty clay ranged from 5 blows to 51 blows per 0.3 m of penetration. The undrained shear strengths of the silty clay strata in Borehole BH 313, as determined by in situ vane tests, were about 38 kPa and 100 kPa. The overall data indicated that the silty clay to clayey silt ranged in consistency from firm to hard. The natural water contents measured for samples of the clayey silt to silty clay ranged from about 12 percent to 36 percent. The results of grain size distribution tests carried out on three samples of silty clay, recovered from the 35 mm internal diameter split spoon sampler, are shown on Figure 8 and are also summarized on the Record of Borehole sheets.

The results of Atterberg limits testing on silty clay samples are provided on Figure 9 and are also summarized on the Record of Borehole sheets. The results of this laboratory testing on the samples of silty clay indicated liquid limits between about 35 percent and 39 percent, a plastic limits between about 17 percent and 19 percent, with resultant plasticity indices between 18 percent and 22 percent.



#### **4.2.9 Till – Like Clayey Silt**

Deposits of till-like silty clay to clayey silt were encountered in Boreholes BH 315 to BH 317, and extended to depths of 5.0 m and 6.6 m below the existing ground surface. The till-like clayey silt deposits have the similar gradations to clayey silt tills but generally have lower strengths. Boreholes BH 315 to BH 317 were terminated within these till-like deposits. Standard penetration tests carried out within the till-like deposits gave “N” values ranging from 5 blows to 7 blows per 0.3 m, indicating a firm consistency.

#### **4.3 Shallow Groundwater**

The water levels in the boreholes advanced by Golder in May 2012 were noted during and immediately upon completion of drilling, as noted on the Record of Borehole sheets.

Piezometers were not installed in any of the boreholes advanced during this investigation. The surficial cohesionless fill and/or native sandy/silty deposits, where present, should be expected to be water-bearing, with water “perched” on top of the underlying, less permeable till deposits. The groundwater levels will subject to seasonal fluctuations, and will be higher during wetter periods of the year.

#### **5.0 CLOSURE**

This Foundation Investigation Report was prepared by Derek Wang, P.Eng., and reviewed by David Liu, P.Eng., a senior geotechnical engineer and project manager, and by Ty Garde, P.Eng., a Principal and Designated MTO Contact for Foundations, conducted an independent quality review of the report.



**GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO**

**GOLDER ASSOCIATES LTD.**

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# **PART B - FOUNDATION DESIGN REPORT**

**NOISE BARRIER WALL**

**HIGHWAY 401 FROM PARK ROAD TO OSHAWA CREEK AND FROM EAST  
OF ALBERT STREET TO EAST OF RITSON ROAD**

**OSHAWA, ONTARIO**

**ASSIGNMENT NO.: 2011 - E - 0018**

DRAFT



## 6.0 ENGINEERING RECOMMENDATIONS

### 6.1 General

This section of the report provides geotechnical parameters and recommendations for the design of the proposed noise barrier wall to be located along the north and south sides of Highway 401, from Park Road to Oshawa Creek and from east of Albert Street to east of Ritson Road. The design parameters and recommendations have been developed based on interpretation of the factual data obtained during subsurface investigations at the site and are intended to provide the designers with geotechnical information to design the proposed noise barrier wall foundations.

Where comments are made on construction, they are provided in order to highlight those aspects that could affect the design of the project, or for which special provisions or operational constraints may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect the equipment selection, proposed construction methods, scheduling and the like.

### 6.2 Noise Barrier Wall Foundation Design

The noise barrier wall foundations should be designed and constructed in accordance with MTO's Special Provision SP799F01. It is recommended that the noise barrier wall be supported using augered caissons with a diameter ranging from 0.6 m to 0.9 m. Geotechnical parameters for design of the caisson foundations are provided in the following table, based on the soil conditions encountered in the boreholes advanced along the proposed noise barrier wall. The stratigraphy presented in the table has been simplified for the purposes of the noise barrier wall foundation design.

**GEOTECHNICAL DESIGN PARAMETERS FOR NOISE BARRIER WALL FOUNDATIONS**

Borehole No.	Stratum	Depth (m)	Elevation (m)	Estimated Design Groundwater Elevation (m)	$c_u$ kPa	$\phi'$	$\gamma$ kN/m	$\gamma'$ kN/m	$K_p$
BH 101	Fill Dense silt and sand till	above 4.0	above 107.3	107	-	28°	18	8	2.8
		below 4.0	below 107.3		-	34°	20	10	3.5
BH 102	Fill Hard clayey silt till Very dense silty sand	above 2.1	above 108.3	109	50	28°	18	8	2.8
		2.1 – 4.0	108.3 – 106.4		-	35°	20	10	3.7
		below 4.0	below 106.4		-	35°	21	11	3.7
BH 103	Fill Compact to very dense sandy silt till Very dense silty sand till	above 0.5	above 112.4	109	-	28°	18	8	2.8
		0.5 – 3.9	112.4 – 109.0		-	33°	21	11	3.4
		below 3.9	below 109.0		-	35	21	11	3.7
BH 104	Fill Very dense sandy silt till Hard clayey silt till	above 0.7	above 112.3	109	-	28°	18	8	2.8
		0.7 – 3.4	112.3 – 109.6		-	35°	21	11	3.7
		below 3.4	below 109.6		50	35°	20	10	3.7
BH 105	Fill Very dense sandy silt till	above 0.3	above 112.5	109	-	28°	18	8	2.8
		below 0.3	below 112.5		-	35°	21	11	3.7



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

Borehole No.	Stratum	Depth (m)	Elevation (m)	Estimated Design Groundwater Elevation (m)	$c_u$ kPa	$\phi'$	$\gamma$ kN/m	$\gamma'$ kN/m	$K_p$
BH 106	Fill Very dense sandy silt till	above 0.3	above 112.5	109	-	28°	18	8	2.8
		below 0.3	below 112.5		-	35°	21	11	3.7
BH 107	Fill Very dense silty sand till	above 0.3	above 112.3	109	-	28°	18	8	2.8
		below 0.3	below 112.3		-	35°	21	11	3.7
BH 108	Fill Dense to very dense sandy silt till	above 0.3	above 110.4	109	-	28°	18	8	2.8
		below 0.3	below 110.4		-	34°	21	11	3.5
BH 109	Fill Compact silt and sand till Hard clayey silt till	above 2.9	above 106.4	108	-	28°	18	8	2.8
		2.9 – 4.4	106.4 – 104.9		-	33°	21	11	3.4
		below 4.4	below 104.9		50	35°	20	10	3.7
BH 110	Fill Hard clayey silt till	above 2.9	above 105.6	107	-	28°	18	8	2.8
		below 2.9	below 105.6		50	35°	20	10	3.7
BH 111	Fill Hard clayey silt till	above 2.1	above 105.0	106	-	28°	18	8	2.8
		below 2.1	below 105.0		50	35°	20	10	3.7
BH 112	Fill Topsoil Hard clayey silt till	above 1.7	above 103.6	103	-	28°	18	8	2.8
		1.7 – 2.0	103.3 – 103.0		-	-	-	-	-
		below 2.0	below 103.0		50	35°	20	10	3.7
BH 113	Fill Very stiff clayey silt Hard clayey silt till	above 3.2	above 100.9	102	-	28°	18	8	2.8
		3.2 – 4.0	100.9 – 100.1		25	32°	19	9	3.3
		below 4.0	below 100.1		50	35°	20	10	3.7
BH 114	Fill Firm to stiff clayey silt Dense sandy silt till	above 2.1	above 101.0	101	-	28°	18	8	2.8
		2.1 – 4.0	101.0 – 99.1		15	28°	17	7	2.8
		below 4.0	below 99.1		-	34°	21	11	3.5
BH 115	Fill Very stiff clayey silt till Very dense sandy silt till	above 2.1	above 99.8	100	-	28°	18	8	2.8
		2.1 – 2.9	99.8 – 99.0		25	32°	19	9	3.3
		below 1.8	below 99.0		-	35°	21	11	3.7
BH 116	Fill Very stiff to hard clayey silt till Very dense sandy silt till	above 0.7	above 100.5	100	-	28°	18	8	2.8
		0.7 – 1.8	100.5 – 99.4		25	32°	19	9	3.3
		below 2.9	below 99.4		-	35°	21	11	3.7
BH 117	Fill Compact sandy silt	above 4.0	above 95.6	97	-	28°	18	8	2.8
		below 4.0	below 95.6		-	30°	20	10	3.0
BH 201	Fill Stiff clayey silt till Very stiff to hard clayey silt till	above 0.8	above 96.2	96	-	28°	18	8	2.8
		0.8 – 2.1	96.2 – 94.9		15	30°	18	8	3.0
		below 2.1	below 94.9		25	32°	19	9	3.3
BH 201A	Fill Stiff to hard clayey silt Hard clayey silt till	above 0.8	above 99.5	98	-	28°	18	8	2.8
		0.8 – 2.3	99.5 – 98.0		15	30°	19	9	3.0
		below 2.3	below 98.0		50	35°	20	10	3.7
BH 202	Fill Loose silty sand Firm clayey silt	above 0.9	above 96.6	96	-	28°	18	8	2.8
		0.9 – 1.4	96.6 – 96.1		-	25°	17	7	2.5
		below 1.4	below 96.1		10	25°	17	7	2.5
BH 202A	Fill Very stiff to hard clayey silt	above 1.8	above 98.7	98	-	28°	18	8	2.8
		below 1.8	below 98.7		25	32°	19	9	3.3
BH 203	Fill Very loose to loose silty sand	above 1.4	above 97.4	97	-	28°	19	9	2.8
		below 1.4	below 96.7		-	25°	17	7	2.5
BH 203A	Fill Stiff clayey silt Very stiff clayey silt till	above 0.8	above 99.4	97	-	28°	18	8	2.8
		0.8 – 1.6	99.4 – 98.6		15	30°	18	8	3.0
		below 1.6	below 98.6		25	32°	19	9	3.3



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

Borehole No.	Stratum	Depth (m)	Elevation (m)	Estimated Design Groundwater Elevation (m)	$c_u$ kPa	$\phi'$	$\gamma$ kN/m	$\gamma'$ kN/m	$K_p$
BH 204	Fill	above 1.4	above 99.7	99	-	28°	18	8	2.8
	Very stiff clayey silt till	1.4 – 2.1	99.7 – 99.0		25	32°	19	9	3.3
	Compact to dense sandy silt till	2.1 – 4.0	99.0 – 97.1		-	33°	20	10	3.4
	Very stiff clayey silt till	below 4.0	below 97.1		25	32°	19	9	3.3
BH 205	Fill	above 0.9	above 99.3	99	-	28°	18	8	2.8
	Firm to very stiff clayey silt till	0.9 – 2.1	99.3 – 98.1		15	28°	18	8	2.8
	Compact silty sand till	below 2.1	below 98.1		-	33°	20	10	3.4
BH 206	Fill	above 2.4	above 98.9	100	-	28°	18	8	2.8
	Very stiff to hard clayey silt till	2.4 – 4.0	98.9 – 97.3		25	32°	19	9	3.3
	Very dense silty sand till	below 4.0	below 97.3		-	35°	21	11	3.7
BH 207	Fill	above 2.9	above 99.9	100	-	28°	18	8	2.8
	Hard clayey silt	2.9 – 4.0	99.9 – 98.8		50	35°	20	10	3.7
	Very dense silty sand	below 4.0	below 98.8		-	35°	21	11	3.7
BH 208	Fill	above 4.0	above 99.3	100	-	28°	18	8	2.8
	Very stiff silty clay	below 4.0	below 99.3		25	32°	19	9	3.3
BH 209	Fill	above 3.2	above 99.1	99	-	28°	18	8	2.8
	Topsoil	3.2 – 3.4	99.1 – 98.8		-	-	-	-	-
	Stiff to very stiff silty clay	below 3.4	below 98.8		15	30°	18	8	3.0
BH 210	Fill	above 4.0	above 98.9	101	-	28°	18	8	2.8
	Very dense silty sand till	below 4.0	below 98.9		-	35°	21	11	3.7
BH 211	Fill	above 3.7	above 99.9	101	-	28°	18	8	2.8
	Dense sandy silt till	below 3.7	below 99.9		-	34°	21	11	3.5
BH 212	Fill	above 4.0	above 98.3	101	-	28°	19	9	2.8
	Dense sandy silt till	below 4.0	below 98.3		-	34°	21	11	3.5
BH 213	Fill	above 5.3	above 96.1	99	-	28°	18	8	2.8
	Very dense sandy silt till	below 5.3	below 96.1		-	35°	21	11	3.7
BH 301	Fill	above 4.0	above 94.6	96	-	28°	18	8	2.8
	Dense sandy silt to silty sand	below 4.0	below 94.6		-	34°	21	11	3.5
BH 302	Fill	above 4.0	above 96.4	99	-	28°	18	8	2.8
	Compact silty sand till	below 4.0	below 96.4		-	33°	20	10	3.4
BH 303	Fill	above 2.1	above 97.7	98	-	28°	18	8	2.8
	Compact to very dense silty sand to silty sand till	below 2.1	below 97.7		33°	20	10	3.4	
BH 304	Fill	above 5.3	above 95.6	98	-	28°	18	8	2.8
	Very dense silty sand till	below 5.3	below 95.6		-	35°	21	11	3.7
BH 305	Fill	above 2.9	above 99.4	100	-	28°	18	8	2.8
	Compact to dense silty sand to silty sand till	below 2.9	below 99.4		-	33°	20	10	3.4
BH 306	Fill	above 4.0	above 98.2	100	-	28°	18	8	2.8
	Very dense silty sand till	below 4.0	below 98.2		-	35°	21	11	3.7
BH 307	Fill	above 3.3	above 99.1	101	-	28°	18	8	2.8
	Topsoil	3.3 – 3.8	99.1 – 98.6		-	-	-	-	-
	Very dense silty sand	below 3.8	below 98.6		35°	21	11	3.7	
BH 308	Fill	above 4.0	above 99.9	102	-	28°	18	8	2.8
	Very stiff clayey silt till	below 4.0	below 99.9		25	32°	19	9	3.3
BH 309	Fill	above 4.0	above 98.8	100	-	28°	18	8	2.8
	Very stiff clayey silt till	below 4.0	below 98.8		25	32°	19	9	3.3
BH 310	Fill	above 2.9	above 99.6	100	-	28°	18	8	2.8
	Very stiff silty clay	2.9 – 4.0	99.6 – 98.5		25	32°	19	9	3.3
	Dense silty sand till	below 4.0	below 98.5		-	34°	21	11	3.5



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

Borehole No.	Stratum	Depth (m)	Elevation (m)	Estimated Design Groundwater Elevation (m)	$c_u$ kPa	$\phi'$	$\gamma$ kN/m	$\gamma'$ kN/m	$K_p$
BH 311	Fill	above 2.1	above 99.9	100	-	28°	18	8	2.8
	Stiff silty clay	2.1 – 2.9	99.9 – 99.1		15	30°	18	8	3.0
	Very stiff to hard clayey silt till	below 4.0	below 99.1		25	32°	19	9	3.3
BH 312	Fill	above 0.8	above 100.4	100	-	28°	18	18	2.8
	Very stiff clayey silt till	0.8 – 2.9	100.4 – 98.3		25	32°	20	10	3.3
	Dense to very dense sandy silt to silty sand till	below 2.9	below 98.3		-	34°	21	11	3.5
BH 313	Fill	above 0.9	above 99.8	98	-	28°	18	8	2.8
	Stiff to very stiff silty clay	below 0.9	below 99.8		15	30°	18	8	3.0
BH 314	Fill	above 2.9	above 107.7	106	-	28°	18	8	2.8
	Very stiff to hard clayey silt till	below 2.9	below 107.7		25	32°	20	10	3.3
BH 315	Firm clayey silt	above 0.7	above 103.6	100	10	25°	17	7	2.5
	Stiff to very stiff clayey silt till	0.7 – 4.0	103.6 – 100.3		15	30°	18	8	3.0
	Firm till-like sandy silty clay	below 4.0	below 100.3		10	25°	17	7	2.5
BH 316	Firm clayey silt	above 0.7	above 100.0	98	10	25°	17	7	2.5
	Firm to very stiff clayey silt till	0.7 – 4.0	100.0 – 96.7		15	30°	18	8	3.0
	Firm till-like clayey silt	below 4.0	below 96.7		10	25°	17	7	2.5
BH 317	Fill	above 0.9	above 99.5	98	-	28°	17	7	2.8
	Firm to stiff clayey silt till	0.9 – 2.9	99.5 – 97.5		15	30°	18	8	3.0
	Firm till-like sandy silty clay	below 2.9	below 97.5		10	25°	17	7	2.5
BH 401	Fill	above 1.4	above 99.2	99	-	28°	18	8	2.8
	Compact to very dense silty sand till	below 1.4	below 99.2		-	33°	20	10	3.4
BH 402	Fill	above 1.1	above 100.9	100	-	28°	17	7	2.8
	Very stiff to hard clayey silt till	1.1 – 2.1	100.9 – 99.9		25	32°	19	9	3.3
	Dense to very dense silty sand till	below 2.1	below 99.9		-	34°	21	11	3.5
BH 403	Fill	above 1.7	above 101.5	102	-	28°	18	8	2.8
	Stiff to very stiff clayey silt	1.7 – 4.0	101.5 – 99.2		15	30°	18	8	3.0
	Very dense silty sand	below 4.0	below 99.2		-	35°	21	11	3.7
BH 404	Fill	above 2.4	above 102.6	102	-	28°	17	7	2.8
	Very stiff to hard clayey silt till	2.4 – 4.0	102.6 – 101.0		25	32°	19	9	3.3
	Very dense sandy silt till	below 4.0	below 101.0		-	35°	21	11	3.7
BH 405	Fill	above 1.8	above 104.3	104	-	28°	18	8	2.8
	Compact to dense sandy silt till	1.8 – 2.9	104.3 – 103.1		-	33°	20	10	3.4
	Hard clayey silt till	below 2.9	below 103.1		50	35°	20	10	3.7
BH 406	Fill	above 1.4	above 106.0	106	-	28°	19	9	2.8
	Compact sandy silt	1.4 – 2.1	106.0 – 105.3		-	30°	20	10	3.0
	Dense to very dense silty sand till	below 2.1	below 105.3		-	34°	21	11	3.5
BH 407	Fill	above 2.1	above 106.0	106	-	28°	18	8	2.8
	Very stiff to hard clayey silt till	2.1 – 4.0	106.0 – 104.1		25	32°	20	10	3.3
	Very dense sandy silt till	below 4.0	below 104.1		-	35°	21	11	3.7
BH 408	Fill	above 2.4	above 107.0	107	-	28°	18	8	2.8
	Compact to very dense silty sand till	2.4 – 4.0	107.0 – 105.4		-	33°	20	10	3.4
	Hard clayey silt till	below 4.0	below 105.4		50	35°	20	10	3.7
BH 409	Fill	above 0.6	above 109.0	107	-	28°	18	8	2.8
	Hard clayey silt till	0.6 – 4.0	109.0 – 105.6		50	35°	20	10	3.7
	Very dense sandy silt till	below 4.0	below 105.6		-	35°	21	11	3.7



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

Borehole No.	Stratum	Depth (m)	Elevation (m)	Estimated Design Groundwater Elevation (m)	$c_u$ kPa	$\phi'$	$\gamma$ kN/m	$\gamma'$ kN/m	$K_p$
BH 410	Loose silty sand	above 0.8	above 111.7	108	-	26°	17	7	2.6
	Dense to very dense silt and sand till	below 0.8	below 111.7		-	34°	21	11	3.5
BH 411	Very loose silty sand	above 0.8	above 119.0	108	-	26°	17	7	2.6
	Compact to dense sand and silt till	below 0.8	below 119.0		-	33°	20	10	3.4
BH 411A	Very dense silty sand till	below 0.2	below 111.3	108	-	35°	21	11	3.7
BH 412	Fill	above 0.8	above 116.2	108	-	28°	18	8	2.8
	Compact to very dense silty sand	below 0.8	below 116.2		-	33°	20	10	3.4
BH 413	Fill	above 0.5	above 117.0	110	-	28°	18	8	2.8
	Very dense silty sand till	below 0.5	below 117.0		-	35°	21	11	3.7
BH 413A	Very loose silty sand	above 0.8	above 111.7	110	-	26°	17	7	2.6
	Dense silty sand till	below 0.8	below 111.7		-	34°	21	11	3.5
BH 414	Fill	above 1.4	above 117.1	113	-	28°	18	8	2.8
	Compact to very dense silty sand till	1.4 – 5.6	117.1 -112.9		-	33°	20	10	3.4
	Very dense sandy silt till	below 5.6	below 112.9		-	35°	21	11	3.7
BH 415	Fill	above 0.6	above 116.1	113	-	28°	18	8	2.8
	Very dense silty sand till	below 0.6	below 116.1		-	35°	21	11	3.7
BH 416	Fill	above 0.7	above 117.7	113	-	28°	18	8	2.8
	Dense to very dense silty sand to sandy silt till	below 0.7	below 117.7		-	34°	21	11	3.5
BH 417	Fill	above 0.8	above 109.7	108	-	28°	18	8	2.8
	Compact to dense sandy silt till	0.8 – 2.2	109.7- 108.3		-	33°	20	10	3.4
	Very dense silty sand	below 2.2	below 108.3		-	35°	21	11	3.7

### NOTES:

- $c_u$  = Undrained shear strength of soil (kPa);
- $\phi'$  = Effective angle of friction of soil (degrees);
- $K_p$  = Passive earth pressure coefficient;
- $\gamma$  = Bulk unit weight of soil (kN/m<sup>3</sup>); and
- $\gamma'$  = Effective unit weight of soil below the groundwater level (kN/m<sup>3</sup>)

In the design of the foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action. The unfactored lateral resistance should be calculated assuming an equivalent width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to the unfactored lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit States (ULS).

Where an undrained shear strength,  $c_u$ , is provided for a cohesive soil layer, the capacity of the caisson should be checked to determine whether the drained or undrained case will govern. In this case, the lateral resistance for the length of the caisson within the cohesive soil should be calculated assuming an unfactored passive lateral pressure distribution varying from  $2 c_u$  at the surface to  $9 c_u$  at and below a depth equivalent to three caisson diameters, acting over the actual width of the caisson. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance at ULS.



The factored unit weight of soil ( $\gamma'$ ) should be used below the groundwater level, where applicable.

For foundation design, full passive resistance will be mobilized only where the width of soil in front and behind the caissons is equal to or greater than eight caisson diameters. If there is lesser width of soil for development of passive resistance (i.e. if there is sloping ground adjacent to the noise barrier wall), the magnitude of the passive resistance may be determined by interpolating between zero passive resistance at ground surface and full passive resistance at the depth where the slope face is greater than eight caisson diameters away from the face of the caisson.

### **6.3 Construction Considerations**

The caisson excavations for the noise barrier wall foundations will be extended through topsoil as well as cohesive and cohesionless fills into native deposits. Portions of the cohesionless sandy silt to silty sand fills as well as the cohesionless native soils will be water-bearing and will be susceptible to disturbance during the caisson foundation installation. Therefore, the use of a temporary liner is recommended during the caisson excavation to minimize disturbance and ground loss during drilling and concrete placement.

In addition, the soils at the site are glacially derived and should be expected to contain cobbles and boulders, as inferred from observations during the borehole drilling. Appropriate equipment and procedures will be required to penetrate obstructions (cobbles and boulders) that are encountered during excavation for noise barrier wall foundations.

It is recommended that Non-Standard Special Provisions (NSSPs) be included in the Contract Documents to warn the Contractor of these conditions; sample NSSPs are provided in Appendix C.

Prior to pouring concrete for the foundations, the bases should be inspected to confirm that they are located in native, undisturbed and competent bearing stratum, which has been cleaned of any ponded water and loosened materials. Concrete for the caisson should be poured as soon as practicable after augering. The bearing soils and fresh concrete must be kept from freezing during cold weather construction.

## **7.0 CLOSURE**

This Foundation Design Report was prepared by Derek Wang, P.Eng., and reviewed by David Liu, P.Eng., a senior geotechnical engineer and project manager, and by Ty Garde, P.Eng., a Principal and Designated MTO Contact for Foundations, conducted an independent quality review of the report.



## GEOTECHNICAL INVESTIGATION, PROPOSED NOISE BARRIER WALL, OSHAWA, ONTARIO

### GOLDER ASSOCIATES LTD.

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Geotechnical Engineering Group

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Senior Geotechnical Engineer

Ty Garde, P.Eng.  
Designated MTO Contact, Principal

DPSW/DBLI/JG/tf

n:\active\2011\1184 pavement materials\11-1184-0109 mto 2011-e-0018 central region retainer\assignment 1 - noise barrier wall- oshawa\reports\draft\11-1184-0109 ph 1000 draft rep 2012\06\15.docx

**METRIC**  
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2011-E-0018  
 WP No.1 and No. 2

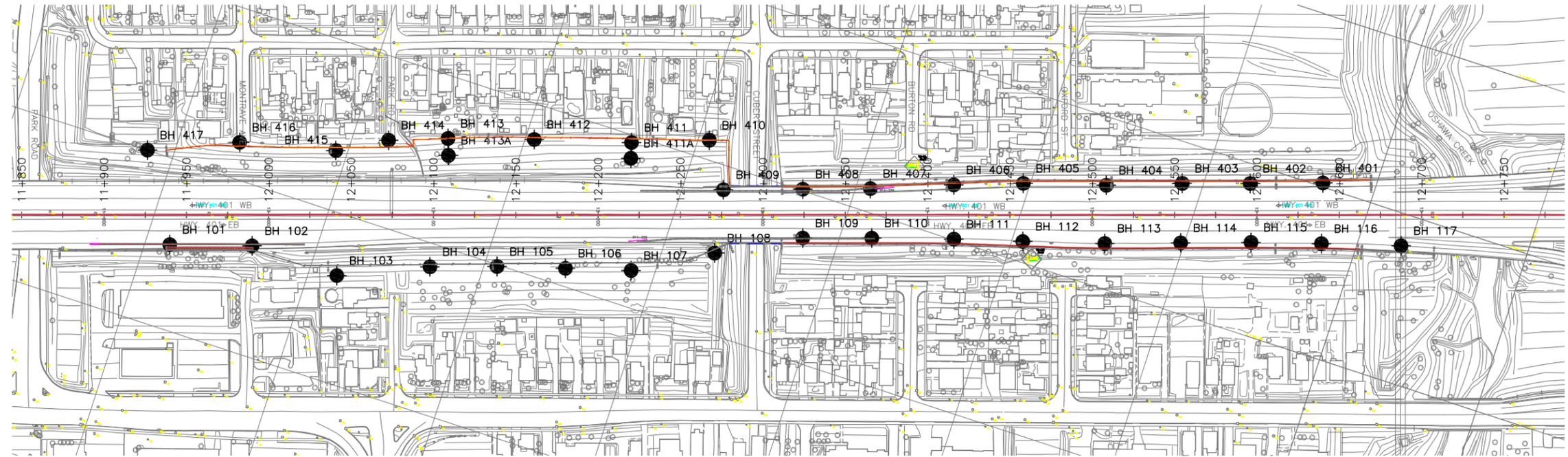


BOREHOLE LOCATION PLAN

SHEET



**Golder Associates Ltd.**  
 WHITBY, ONTARIO, CANADA



PLAN



KEY PLAN  
 N.T.S.



LEGEND

● Borehole - Current Investigation

**DRAFT**



PLAN



NOTES

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NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401		PROJECT NO. 11-1184-0109	DIST.
SUBM'D.	CHKD. DW	DATE: 6/15/2012	SITE:
DRAWN: PJV	CHKD. TG	APPD.	DWG. 1

**METRIC**  
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2011-E-0018  
 WP No. Work Order No. 1

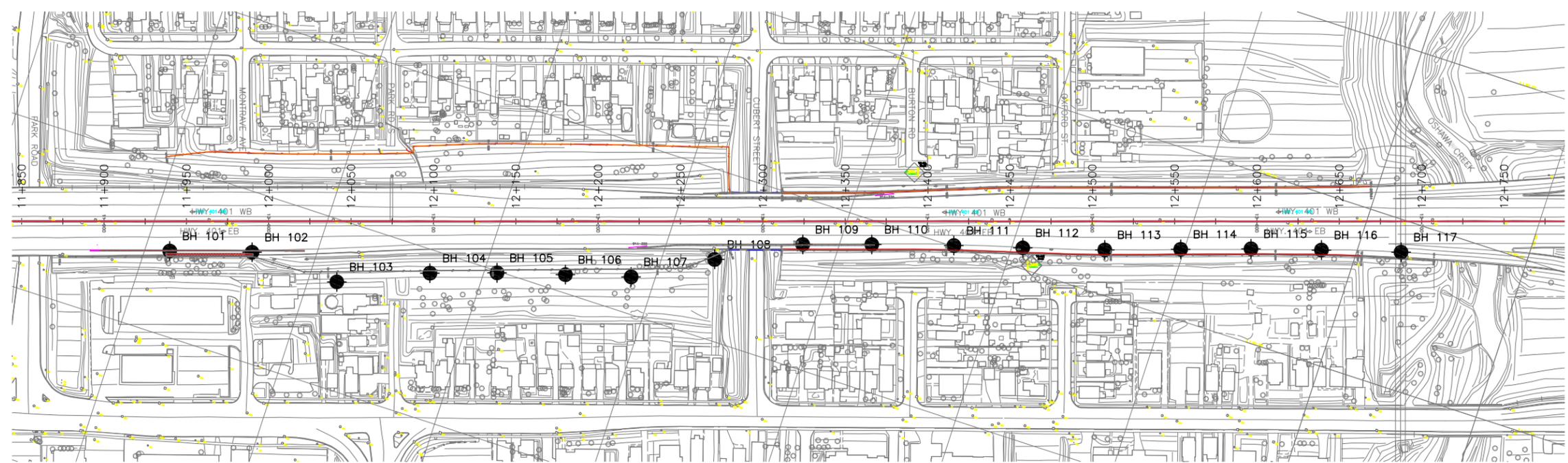


BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 WHITBY, ONTARIO, CANADA



PLAN

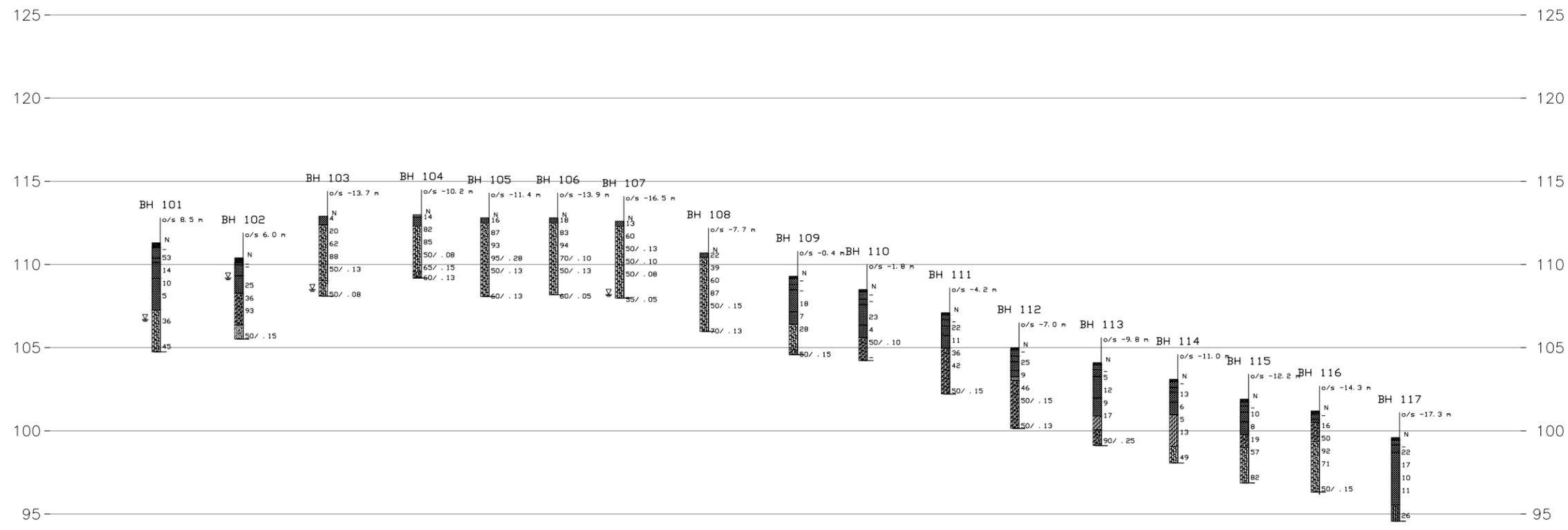


KEY PLAN  
 N.T.S.



LEGEND

- Borehole - Current Investigation



SECTION/PROFILE



BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH 101	111.3	4860050.0	355614.6
BH 102	110.4	4860064.7	355662.4
BH 103	112.9	4860063.6	355716.9
BH 104	113.0	4860086.2	355769.0
BH 105	112.8	4860099.0	355807.7
BH 106	112.8	4860110.8	355847.5
BH 107	112.6	4860121.9	355885.8
BH 108	110.7	4860147.6	355930.8
BH 109	109.3	4860172.8	355978.8
BH 110	108.5	4860185.8	356018.7
BH 111	107.1	4860200.6	356066.3
BH 112	105.0	4860212.2	356106.5
BH 113	104.1	4860226.5	356154.2
BH 114	103.1	4860241.1	356197.9
BH 115	101.9	4860254.6	356238.4
BH 116	101.2	4860267.2	356279.3
BH 117	99.6	4860280.9	356325.7

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**DRAFT**

NO.	DATE	BY	REVISION

Geocres No. \_\_\_\_\_ PROJECT NO. 11-1184-0109 DIST. \_\_\_\_\_

HWY. 401	CHKD. DW	DATE: 6/15/2012	SITE:
SUBM'D.	CHKD. TG	APPD.	DWG. 2A

**METRIC**  
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2011-E-0018  
WP No. Work Order No. 1

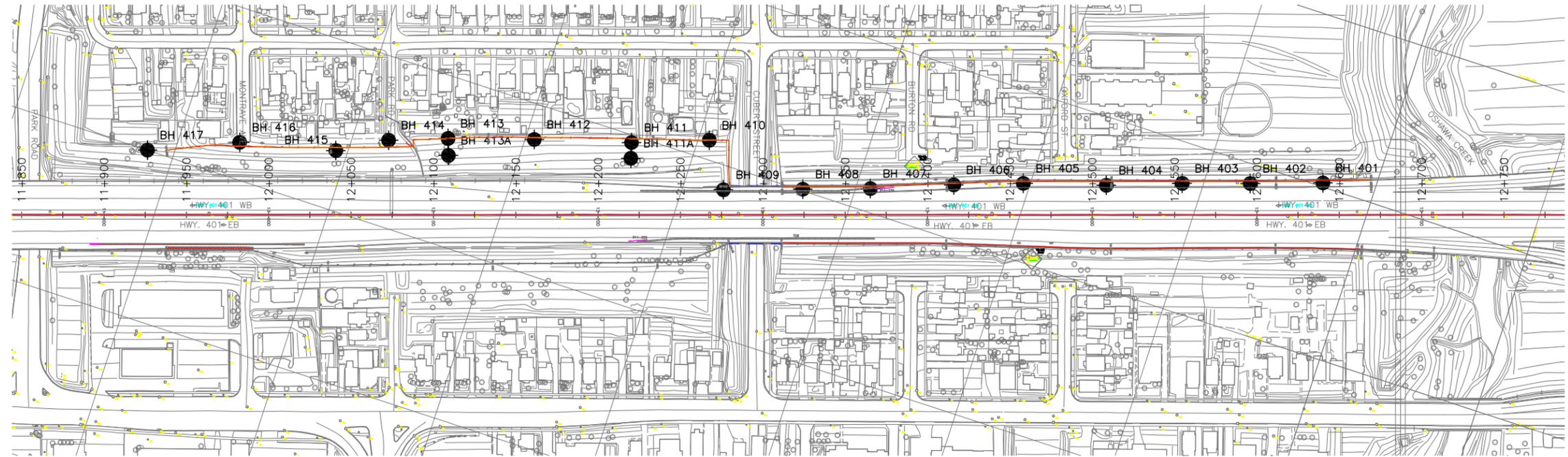


BOREHOLE LOCATIONS AND SOIL STRATA

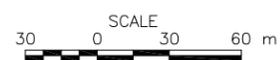
SHEET



**Golder Associates Ltd.**  
WHITBY, ONTARIO, CANADA



PLAN



KEY PLAN  
N.T.S.

LEGEND

● Borehole - Current Investigation

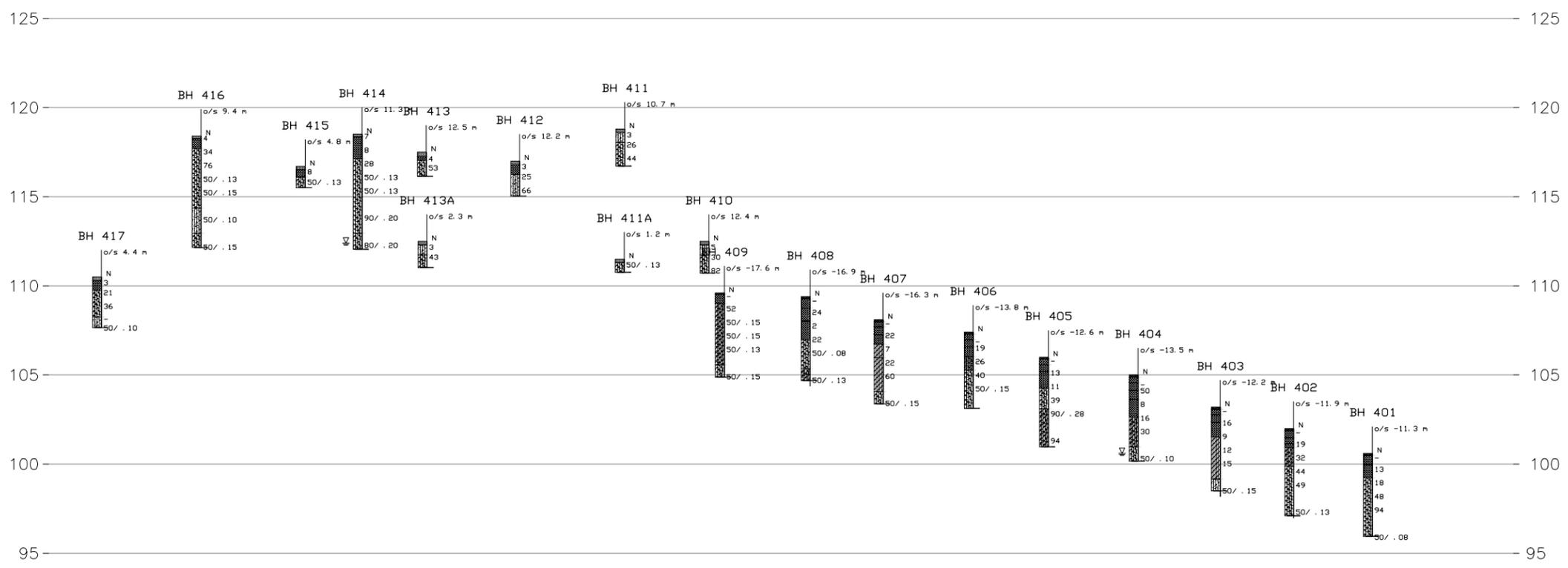
BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH 401	100.6	4860302.4	356268.8
BH 402	102.0	4860288.4	356226.9
BH 403	103.2	4860275.6	356187.7
BH 404	105.0	4860260.3	356144.2
BH 405	106.0	4860245.8	356095.9
BH 406	107.4	4860231.8	356056.0
BH 407	108.1	4860214.0	356008.6
BH 408	109.4	4860200.9	355969.7
BH 409	109.6	4860185.6	355924.0
BH 410	112.5	4860211.5	355906.6
BH 411	118.8	4860195.5	355862.1
BH 411A	111.5	4860186.4	355864.7
BH 412	117.0	4860179.0	355805.4
BH 413	117.5	4860163.3	355755.4
BH 413A	112.5	4860153.7	355758.8
BH 414	118.5	4860151.2	355721.4
BH 415	116.7	4860135.3	355692.9
BH 416	118.4	4860121.9	355635.8
BH 417	110.5	4860100.1	355584.0

**NOTES**

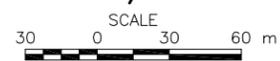
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SECTION/PROFILE



**DRAFT**

NO.	DATE	BY	REVISION

Geocres No. \_\_\_\_\_ PROJECT NO. 11-1184-0109 DIST. \_\_\_\_\_

HWY. 401 SUBM'D. \_\_\_\_\_ CHKD. DW \_\_\_\_\_ DATE: 6/15/2012 SITE: \_\_\_\_\_

DRAWN: PJV CHKD. TG APPD. \_\_\_\_\_ DWG. 2B

**METRIC**  
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2011-E-0018  
 WP No. Work Order No. 2

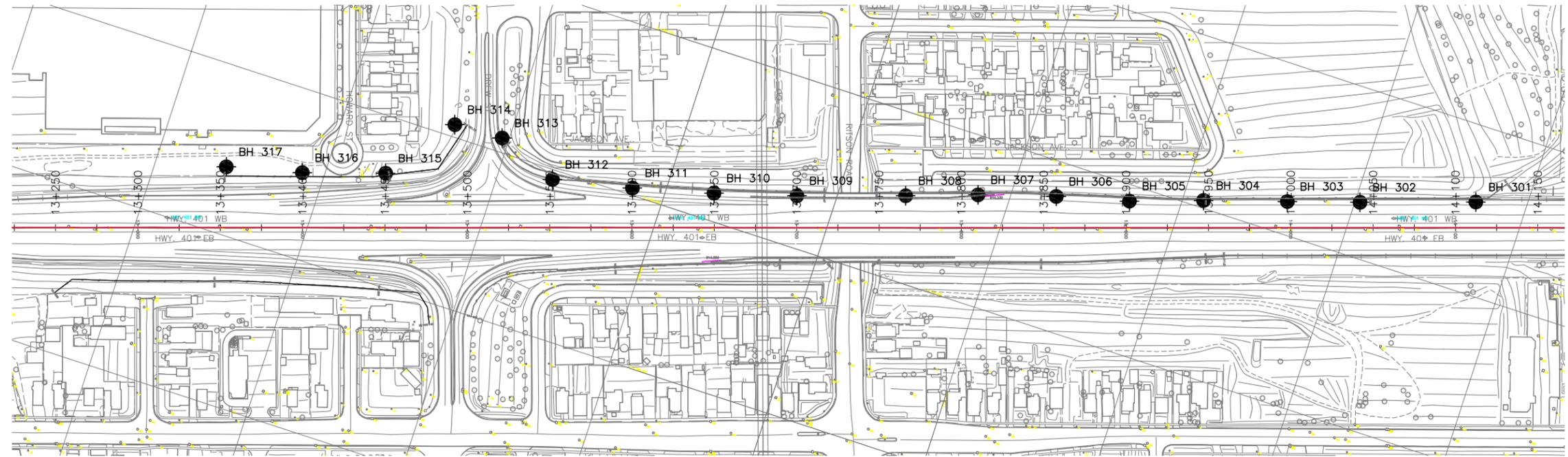


BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 WHITBY, ONTARIO, CANADA



**PLAN**



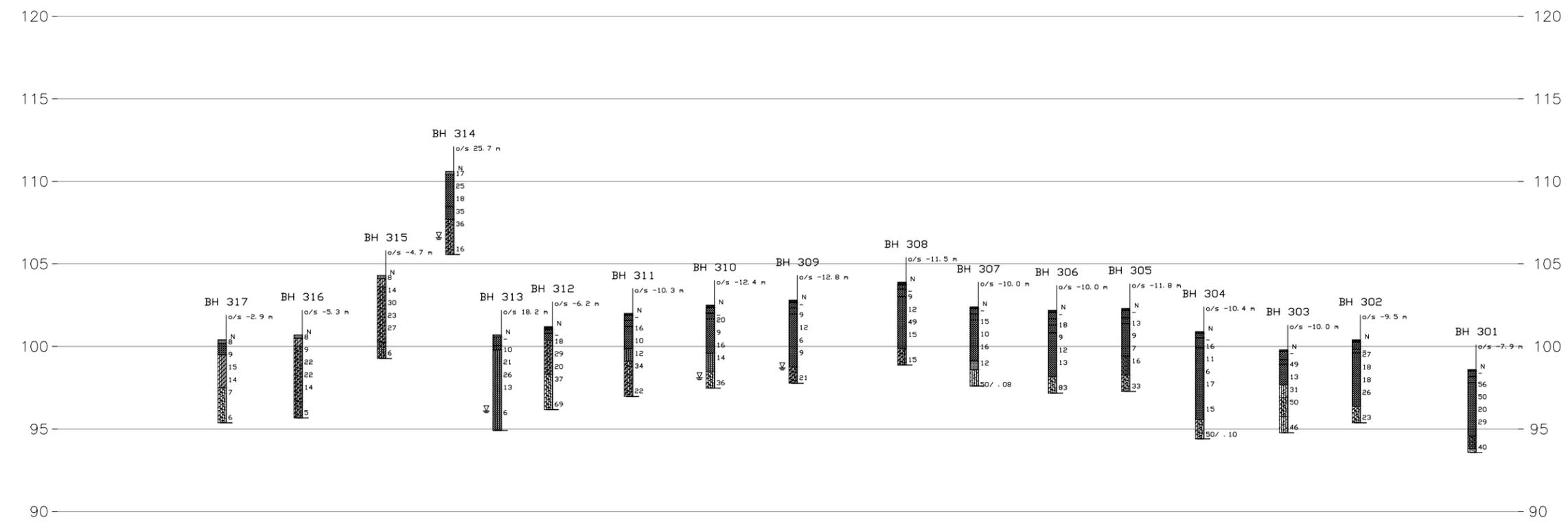
**KEY PLAN**  
 N.T.S.



**LEGEND**

● Borehole - Current Investigation

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH 301	98.6	4860754.8	357669.8
BH 302	100.4	4860732.9	357603.0
BH 303	99.8	4860719.7	357560.9
BH 304	100.9	4860704.5	357512.3
BH 305	102.3	4860690.2	357469.7
BH 306	102.2	4860679.1	357426.6
BH 307	102.4	4860665.3	357381.1
BH 308	103.9	4860651.2	357339.5
BH 309	102.8	4860630.8	357276.7
BH 310	102.5	4860616.7	357228.4
BH 311	102.0	4860604.3	357180.3
BH 312	101.2	4860594.1	357132.5
BH 313	100.7	4860608.5	357095.7
BH 314	110.6	4860607.3	357065.9
BH 315	104.3	4860566.3	357035.1
BH 316	100.7	4860551.0	356986.8
BH 317	100.4	4860540.0	356941.9



**SECTION/PROFILE**



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**DRAFT**

NO.	DATE	BY	REVISION

Geocres No. \_\_\_\_\_

HWY. 401	PROJECT NO. 11-1184-0109	DIST.
SUBM'D.	CHKD. DW	DATE: 6/15/2012
DRAWN: PJV	CHKD. TG	APPD.
		DWG. 2C

**METRIC**  
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2011-E-0018  
 WP No. Work Order No. 2

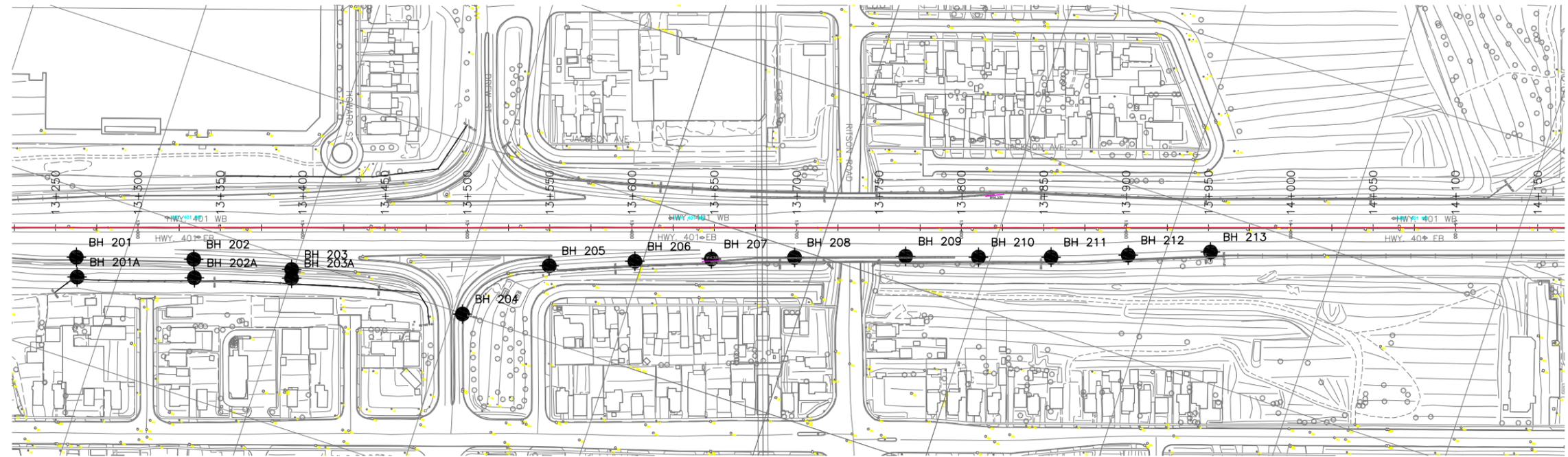


BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 WHITBY, ONTARIO, CANADA



PLAN

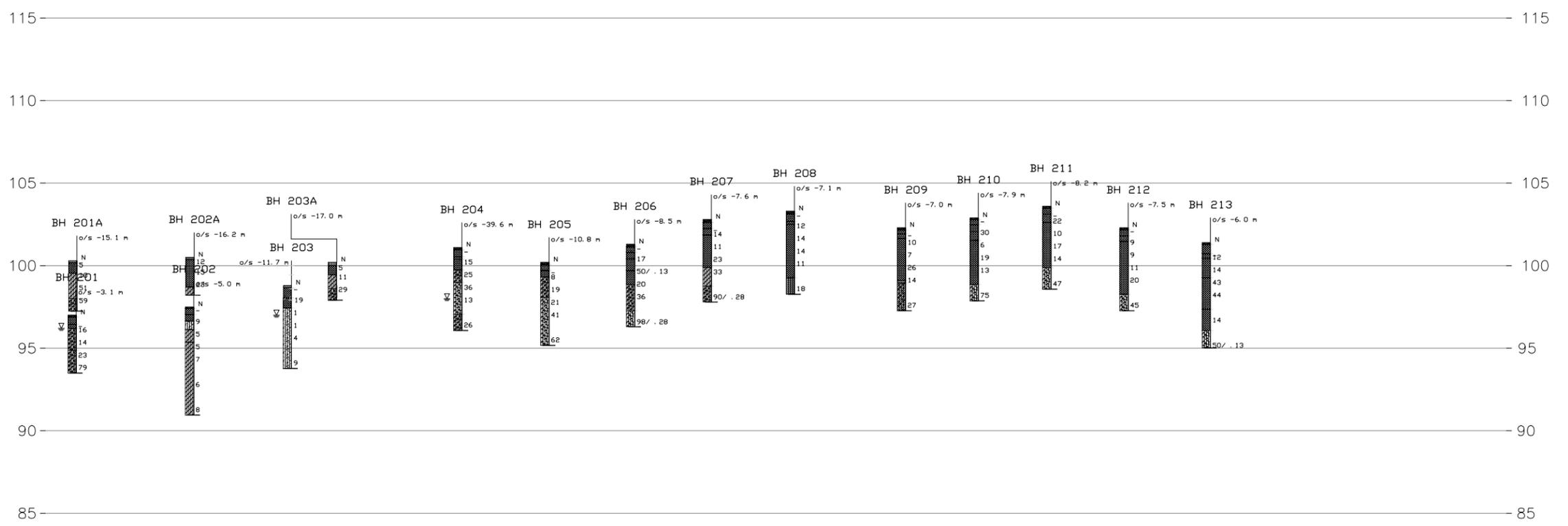


KEY PLAN  
 N.T.S.

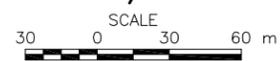


LEGEND

● Borehole - Current Investigation



SECTION/PROFILE



BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH 201	97.0	4860459.9	356872.2
BH 201A	100.3	4860448.6	356876.4
BH 202	97.5	4860480.8	356940.4
BH 202A	100.5	4860470.2	356944.2
BH 203	98.8	4860493.3	356998.8
BH 203A	100.2	4860488.2	357000.4
BH 204	101.1	4860499.8	357105.8
BH 205	100.2	4860543.9	357146.8
BH 206	101.3	4860562.6	357195.4
BH 207	102.8	4860578.3	357239.2
BH 208	103.3	4860594.8	357286.9
BH 209	102.3	4860616.4	357350.8
BH 210	102.9	4860629.6	357393.0
BH 211	103.6	4860643.3	357434.9
BH 212	102.3	4860658.9	357479.1
BH 213	101.4	4860676.2	357526.0

NOTES

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NO.	DATE	BY	REVISION

Geocres No. \_\_\_\_\_

HWY. 401	PROJECT NO. 11-1184-0109	DIST.
SUBM'D.	CHKD. DW	DATE: 6/15/2012
DRAWN: PJV	CHKD. TG	APPD.
		DWG. 2D

**DRAFT**



# **APPENDIX A**

## **List of Abbreviations and Symbols Record of Borehole Logs**

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## LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

### I SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### II PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

#### Dynamic Penetration Resistance; $N_d$ :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ( $Q_t$ ), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

### III SOIL DESCRIPTION

#### (a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

#### (b) Cohesive Soils

Consistency	$c_u, s_u$	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
$\gamma$	unit weight

Note:

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

## LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

### I GENERAL

$\pi$	= 3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10} x$ or $\log x$ ,	logarithm of x to base 10
$g$	acceleration due to gravity
$t$	time
$F$	factor of safety
$V$	volume
$W$	weight

### II STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
$u$	porewater pressure
$E$	modulus of deformation
$G$	shear modulus of deformation
$K$	bulk modulus of compressibility

### III SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )
$e$	void ratio
$n$	porosity
$S$	degree of saturation
*	Density symbol is $\rho$ . Unit weight symbol is $\gamma$ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

#### (a) Index Properties (con't.)

$w$	water content
$w_L$	liquid limit
$w_p$	plastic limit
$I_p$	plasticity Index = $(w_L - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_p) / I_p$
$I_C$	consistency index = $(w_L - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (c) Hydraulic Properties

$h$	hydraulic head or potential
$q$	rate of flow
$v$	velocity of flow
$i$	hydraulic gradient
$k$	hydraulic conductivity (coefficient of permeability)
$j$	seepage force per unit volume

#### (d) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (overconsolidated range)
$C_s$	swelling index
$C_a$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
$U$	degree of consolidation
$\sigma'_p$	pre-consolidation pressure
OCR	Overconsolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (e) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	coefficient of friction = $\tan \delta$
$c'$	effective cohesion
$c_u, s_u$	undrained shear strength ( $\phi = 0$ analysis)
$p$	mean total stress $(\sigma_1 + \sigma_3) / 2$
$p'$	mean effective stress $(\sigma'_1 + \sigma'_3) / 2$
$q$	$(\sigma_1 - \sigma_3) / 2$ or $(\sigma'_1 - \sigma'_3) / 2$
$q_u$	compressive strength $(\sigma_1 - \sigma_3)$
$S_t$	sensitivity

- Notes: 1.  $\tau = c' + \sigma' \tan \phi'$   
2. Shear strength = (Compressive strength)/2

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 101** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860050.0; E 355614.6 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 6, 2012 **CHECKED BY** TG

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
111.3	GROUND SURFACE																			
111.0	ASPHALT (280 mm)																			
0.3	GRANULAR BASE (640 mm)		1	AS	-															
110.4	GRANULAR SUBBASE (280 mm)		2	SS	53															
110.1	Silty sand, trace gravel, trace clay, trace organic inclusions (FILL) Compact Brown Moist		3	SS	14															
1.2																				
109.2																				
2.1	Clayey silt, trace roots, organic topsoil inclusions (FILL) Stiff to firm Dark brown to brown Moist to wet		4	SS	10															
107.3																				
4.0	SILT and SAND, some clay, trace gravel (TILL) Dense Brown to grey Moist		6	SS	36															
104.8																				
6.6	End of Borehole NOTES: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface, May 6, 2012 2. Groundwater measured at a depth of 5.8 m below ground surface upon completion of drilling, May 6, 2012 3. Borehole caved at a depth of 5.9 m below ground surface upon completion of drilling, May 6, 2012		7	SS	45															

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 102** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860064.7; E 355662.4 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 6-7, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
110.4	GROUND SURFACE																	
0.0	ASPHALT (250 mm)																	
110.1			1	AS	-													
0.4	GRANULAR BASE (170 mm)																	
	GRANULAR SUBBASE (650 mm)		2	AS	-													
109.3																		
1.1	Silty sand and gravel, trace to some silt (FILL) Compact Brown Moist to wet		3	SS	25													
108.3																		
2.1	CLAYEY SILT, trace to some sand, trace gravel (TILL) Hard Brown to grey Moist		4	SS	36													
			5	SS	93													
106.4																		
4.0	SILTY SAND, some gravel Very dense Brown Wet		6	SS	50/.15													
105.5																		
4.9	End of Borehole NOTES: 1. Groundwater encountered during drilling at a depth of 2.1 m below ground surface, May 6, 2012 2. Groundwater measured at a depth of 1.2 m below ground surface upon completion of drilling, May 6, 2012 3. Borehole caved at a depth of 1.2 m below ground surface upon completion of drilling, May 6, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 103** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860063.6; E 355716.9 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>	GR
112.9	GROUND SURFACE																	
0.0	Sandy silt, trace to some clay, trace gravel, topsoil inclusion, rootlets (FILL)		1	SS	4													
112.4	Loose Dark brown to brown Moist		2	SS	20													
0.5	Sandy SILT, some clay, trace gravel, containing cobbles/boulders (TILL) Compact to very dense Brown Moist		3	SS	62													
			4	SS	88													
			5	SS	50/.13													
109.0	SILTY SAND, trace to some clay, some gravel, cobbles/boulders (TILL) Very dense Brown - grey Moist to wet		6	SS	50/.08													
3.9																		
108.1	End of Borehole																	
4.8	NOTES: 1. Groundwater measured at a depth of 4.4 m below ground surface upon completion of drilling, May 23, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 104** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860086.2; E 355769.0 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

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
113.0	GROUND SURFACE																			
0.0	TOPSOIL (150 mm)																			
0.2	Sandy silt, some clay, trace to some gravel, rootlets, topsoil inclusions (FILL)		1	SS	14															
112.3	Compact Brown Moist		2	SS	82															5 23 62 10
0.7	Sandy SILT, some clay, trace gravel, containing cobbles/boulders (TILL)		3	SS	85															
	Very dense Brown Moist		4	SS	50/.08															
			5	SS	65/.15															
109.6	CLAYEY SILT, trace sand, trace gravel, zones of silty sand (TILL)		6	SS	60/.13															
109.2	Hard Grey Moist																			
3.8	End of Borehole																			
	NOTES: 1. Borehole dry and open upon completion of drilling, May 23, 2012																			

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 105** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860099.0; E 355807.7 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
112.8	GROUND SURFACE																							
0.0 112.5 0.3	Sandy silt, some clay, trace gravel, rootlets, topsoil inclusions (FILL) Compact Brown Moist		1	SS	16																			
	Sandy SILT, some to trace clay, trace gravel, containing cobbles/boulders (TILL) Very dense Brown to grey Moist		2	SS	87																			
			3	SS	93																			
			4	SS	95 / 28																			
			5	SS	50 / 13																			
108.1	End of Borehole		6	SS	60 / 13																			
4.7	NOTES: 1. Borehole dry and open upon completion of drilling, May 23, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 106** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860110.8; E 355847.5 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
112.8	GROUND SURFACE																	
0.0 112.5 0.3	Sandy silt, trace to some clay, trace gravel, rootlets, topsoil inclusions (FILL) Compact Brown Moist		1	SS	18													
	Sandy SILT, trace to some clay, trace to some gravel, containing cobbles/boulders (TILL) Very dense Brown to grey Moist		2	SS	83													
			3	SS	94													
			4	SS	70/.10													
			5	SS	50/.13													
			6	SS	60/.05													
108.2 4.6	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 23, 2012																	

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 107** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860121.9; E 355885.8 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
112.6	GROUND SURFACE																							
0.0 112.3 0.3	Silty sand, some gravel, trace clay (FILL) Compact Brown Moist		1	SS	13																			
	SILTY SAND, some gravel, trace to some clay, containing cobbles/boulders (TILL) Very dense Brown to grey Moist		2	SS	60																			
			3	SS	50/.13																			
			4	SS	50/.10																			
			5	SS	50/.08																			
108.0 4.6	End of Borehole NOTES: 1. Groundwater measured at a depth of 4.4 m below ground surface upon completion of drilling, May 23, 2012		6	SS	55/.05																			

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 108** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860147.6; E 355930.8 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 23, 2012 **CHECKED BY** TG

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	20
110.7	GROUND SURFACE																							
0.0 110.4 0.3	Sandy silt, some gravel, trace clay, topsoil inclusions, rootlets (FILL) Compact Brown Moist		1	SS	22																			
	Sandy SILT, some clay, trace to some gravel, cobbles/boulders (TILL) Dense to very dense Brown to grey Moist		2	SS	39																			
			3	SS	60																			
			4	SS	87																			
			5	SS	50 / 15																			
106.0 4.7	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 23, 2012		6	SS	70 / 13																			

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 109** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860172.8; E 355978.8 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 7, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
109.3	GROUND SURFACE																	
0.0	ASPHALT (140 mm)																	
108.8	GRANULAR BASE (350 mm)		1	AS	-													
108.5	GRANULAR SUBBASE (330 mm)		2	AS														
0.8	Silty sand, trace gravel, pockets of topsoil, organic inclusions (FILL) Compact Brown to dark brown Moist		3	SS	18													
107.2	Clayey silt, zones of topsoil, organic inclusions (FILL) Firm Black to dark brown Moist		4	SS	7													
106.4	SILT and SAND, some clay, trace gravel (TILL) Compact Brown Moist		5	SS	28													
104.9	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist		6	SS	50 / .15													
104.6	End of Borehole																	
4.7	NOTES: 1. Borehole dry and open upon completion of drilling, May 7, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 110</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860185.8; E 356018.7</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2012</u>	CHECKED BY <u>TG</u>	

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
108.5	GROUND SURFACE																
0.0	ASPHALT (130 mm)																
0.1	GRANULAR BASE (440 mm)		1	AS	-												
107.9	GRANULAR SUBBASE (330 mm)		2	AS	-												
107.6																	
0.9	Sandy silt, some clay, trace gravel, zones of clayey silt (FILL) Compact Brown Moist		3	SS	23												
106.4																	
2.1	Clayey silt, some sand, trace gravel, trace rootlets, brick fragments, zones of topsoil (FILL) Soft		4	SS	4												
105.6	Black to dark brown Moist		5	SS	50/.10												
2.9	CLAYEY SILT, some sand, trace to some gravel, containing cobbles/boulders (TILL) Hard Brown Moist		6	AS	-												
104.2																	
4.3	End of Borehole Due to Auger Refusal NOTES:  1. Borehole dry and open upon completion of drilling, May 7, 2012																

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GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 111** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860200.6; E 356066.3 ORIGINATED BY AZ  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 7, 2012 CHECKED BY TG

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 (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
107.1	GROUND SURFACE																						
0.0	ASPHALT (120 mm)																						
106.7	GRANULAR BASE (200 mm)		1A																				
106.3	GRANULAR SUBBASE (360 mm)		1B	AS	-																		
0.8	Sandy silt, trace clay, trace gravel (FILL)		2	SS	22																		
105.7	Compact Brown Moist																						
1.4	Clayey silt, some sand, trace gravel, organic inclusions (FILL)		3	SS	11																		
105.0	Stiff Dark brown to black Moist		4	SS	36																		
2.1	CLAYEY SILT, some sand, trace to some gravel (TILL)		5	SS	42																		
	Hard Brown Moist																						
102.2	End of Borehole		6	SS	50/.15																		
4.9	NOTES: 1. Borehole dry and open upon completion of drilling, May 7, 2012																						

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 112</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860212.2; E 356106.5</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 7, 2012</u>	CHECKED BY <u>TG</u>	

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
105.0	GROUND SURFACE																							
0.0	ASPHALT (130 mm)																							
104.5	GRANULAR BASE (370 mm)		1	AS	-																			
104.2	GRANULAR SUBBASE (340 mm)																							
0.8	Sandy silt, trace gravel, trace clay (FILL)		2	SS	25																			
103.6	Compact Brown Moist																							
103.3	Silty sand, some gravel, topsoil, organic inclusions (FILL)		3A	SS	9																			
	Loose Brown TOPSOIL		3B	SS																				
2.0	CLAYEY SILT, with sand, trace gravel (TILL)		4	SS	46																			
	Hard Brown Moist		5	SS	50/.15																			7 41 34 18
100.2	End of Borehole		6	SS	50/.13																			
4.9	NOTES: 1. Borehole dry and open upon completion of drilling, May 7, 2012																							

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

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 113** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860226.5; E 356154.2 ORIGINATED BY AZ  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 7, 2012 CHECKED BY TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
104.1	GROUND SURFACE																	
0.0	ASPHALT (120 mm)																	
103.7	GRANULAR BASE (280 mm)																	
0.4	GRANULAR SUBBASE (440 mm)		1	AS	-													
103.3	Sandy silt, trace gravel, zones of clayey silt, organic inclusions (FILL) Compact Brown Moist		2A	SS	5													
0.8			2B															
102.0			3	SS	12													
2.1	Clayey silt, some sand, topsoil/organic inclusions (FILL) Stiff Brown to grey Moist to wet		4	SS	9													
100.9	CLAYEY SILT, some sand Very stiff Brown to grey Moist to wet		5	SS	17													
100.1	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist		6	SS	90 / 25													
99.1	End of Borehole																	
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 7, 2012																	

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GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 114** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860241.1; E 356197.9 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
103.1	GROUND SURFACE																							
0.0	ASPHALT (140 mm)																							
102.6	GRANULAR BASE (350 mm)		1	AS	-																			
102.3	GRANULAR SUBBASE (300 mm)																							
0.8	Sand and silt, some clay, trace gravel (FILL) Compact Brown Moist		2	SS	13																			
101.7	Clayey silt, some sand, organic topsoil inclusions (FILL) Firm Dark brown Moist		3	SS	6																			
101.0	CLAYEY SILT, trace to some sand Firm to stiff Brown Moist to wet		4	SS	5																			
2.1			5	SS	13																			
99.1	SANDY SILT, trace clay, some gravel, zones of clayey silt, pockets of coarse sand and gravel (TILL) Dense Brown Moist		6	SS	49																			
4.0																								
98.1	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 9, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 115** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860254.6; E 356238.4 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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								
101.9	GROUND SURFACE															
0.0	ASPHALT (160 mm)															
	GRANULAR BASE (200 mm)															
	GRANULAR SUBBASE (400 mm)															
101.1			1	AS	-											
0.8	Sandy silt, trace clay, trace gravel (FILL)		2	SS	10											
100.5	Compact Brown Moist															
1.4	Silty clay, some sand, trace gravel (FILL)		3	SS	8											
99.8	Firm Brown Moist															
2.1	CLAYEY SILT, some sand, trace gravel, zones of sandy silt (TILL)		4	SS	19											
99.0	Very stiff Brown Moist															
2.9	SANDY SILT, trace to some clay, some gravel (TILL)		5	SS	57											
	Very dense Brown Moist															
96.9	End of Borehole		6	SS	82											
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 9, 2012															

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 116</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860267.2; E 356279.3</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 9, 2012</u>	CHECKED BY <u>TG</u>	

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						
101.2	GROUND SURFACE															
0.0	ASPHALT (190 mm)															
100.7	GRANULAR BASE (310 mm)		1	AS	-											
	GRANULAR SUBBASE (200 mm)															
0.7	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to hard Moist		2	SS	16											
99.4			3A													
1.8	SANDY SILT, trace clay, some gravel, cobbles/boulders (TILL) Very dense Brown Moist		3B	SS	50											
			4	SS	92											
			5	SS	71											
96.3			6	SS	50/.15											
4.9	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 9, 2012															

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 117** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860280.9; E 356325.7 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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	20	30
99.6	GROUND SURFACE																								
0.0	ASPHALT (160 mm)																								
99.2	GRANULAR BASE (280 mm)																								
0.4	GRANULAR SUBBASE (460 mm)																								
98.7			1	AS	-																				
0.9	Silty sand, trace to some clay, trace to some gravel, organic inclusions (FILL) Compact Brown to dark brown Moist		2	SS	22																				
			3	SS	17																				
				4	SS	10																			
				5	SS	11																			
				6	SS	26																			
95.6	Sandy SILT, some clay, trace roots, zones of clayey silt Compact Dark brown to grey Moist																								
4.0																									
94.6																									
5.0	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 9, 2012																								

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 201** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860459.9; E 356872.2 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
97.0	GROUND SURFACE																							
0.0	ASPHALT (110 mm)																							
0.1	GRANULAR BASE (440 mm)																							
96.5	GRANULAR SUBBASE (240 mm)		1	AS	-																			
0.8	CLAYEY SILT, with sand, trace to some gravel (TILL) Stiff Brown to grey Moist		2	SS	16																			
			3	SS	14																			
94.9	CLAYEY SILT, trace sand, trace gravel, zones of silty sand (TILL) Very stiff to hard Grey		4	SS	23																			
2.1			5	SS	79																			
93.5																								
3.5	End of Borehole NOTES: 1. Groundwater encountered during drilling at a depth of 0.8 m below ground surface, May 9, 2012 2. Groundwater measured at a depth of 1.5 m below ground surface upon completion of drilling, May 9, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 201A</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860448.6; E 356876.4</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 18, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$ 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	W <sub>p</sub>	W		
100.3	GROUND SURFACE															
0.0	TOPSOIL (100 mm)	[Hatched]	1A													
0.1	Silty sand, some gravel, trace organics (FILL)	[Hatched]	1B	SS	5											
99.5	Loose Light brown to dark brown Moist	[Hatched]	2	SS	10											
0.8	CLAYEY SILT, trace gravel, trace sand, oxidization	[Hatched]	3	SS	51											
	Stiff to hard Light brown Moist	[Hatched]	3	SS	51											
98.0	CLAYEY SILT, some sand, some gravel (TILL)	[Hatched]	4	SS	59											
2.3	Hard Light brown Moist to wet	[Hatched]	4	SS	59											
97.3	End of Borehole															
3.1	NOTES: 1. Borehole dry and open upon completion of drilling, May 18, 2012															

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 202</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860480.8; E 356940.4</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 9, 2012</u>	CHECKED BY <u>TG</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
								20	40	60	80	100					
97.5	GROUND SURFACE																
9.0	ASPHALT (105 mm)																
97.0	GRANULAR BASE (355 mm)		1	AS	-												
0.5	GRANULAR SUBBASE (410 mm)																
96.6																	
0.9	SILTY SAND, some gravel		2	SS	9												
96.1	Loose Brown Moist																
1.4	CLAYEY SILT, trace to some sand, some gravel		3	SS	5												
	Firm Brown to grey Moist to wet																
			4	SS	5												
			5	SS	7												
			6	SS	6												
			7	SS	8												
91.0	End of Borehole																
6.6	NOTES:  1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface, May 9, 2012  2. Borehole dry and open upon completion of drilling, May 9, 2012																

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 202A** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860470.2; E 356944.2 **ORIGINATED BY** KF  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Manual Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 18, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.5	GROUND SURFACE																							
0.0	TOPSOIL (100 mm)		1A																					
0.1	Sandy silt, some gravel, trace organics, topsoil inclusions (FILL) Compact Brown to dark brown Moist		1B	SS	12																			
			2	SS	15																			
98.7																								
1.8	CLAYEY SILT, trace sand Hard		3	SS	23																			
98.2	Light brown to grey Moist																							
2.3	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 18, 2012																							

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 203** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860493.3; E 356998.8 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
98.8	GROUND SURFACE																							
0.0	TOPSOIL (130 mm)																							
0.1	GRANULAR BASE (670 mm)																							
98.0	Silty sand, some gravel, zones of sandy silt (FILL)		1	AS	-																			
0.8	Compact Brown Moist		2	SS	19																			
97.4	Silty SAND, some gravel, some clay		3	SS	1	∇																		
1.4	Very loose to loose Brown to grey Moist to wet		4	SS	1																			
			5	SS	4																			
			6	SS	9																			
93.8	End of Borehole																							
5.0	NOTES: 1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface, May 9, 2012 2. Borehole caved at a depth of 1.8 m below ground surface upon completion of drilling, May 9, 2012 3. Borehole located off H																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 203A** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860488.2; E 357000.4 **ORIGINATED BY** KF  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Manual Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 18, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
100.2	GROUND SURFACE																	
0.0	TOPSOIL (200 mm)		1A															
0.2	Clayey silt, trace sand, trace gravel (FILL)		1B	SS	5													
99.4	Firm Light brown to dark brown Moist		2	SS	11													
0.8	CLAYEY SILT, some sand Stiff																	
98.6	Light brown to grey Moist		3	SS	29													
1.6	CLAYEY SILT, some sand, some gravel (TILL)																	
97.9	Very Stiff Light brown Moist																	
2.3	End of Borehole																	
	NOTES: 1. Borehole dry and open upon completion of drilling, May 18, 2012																	

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 204** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860499.8; E 357105.8 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 15-16, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
101.1	GROUND SURFACE																							
0.0	ASPHALT (150 mm)																							
	GRANULAR BASE (400 mm)		1	AS	-																			
100.6	GRANULAR SUBBASE (150 mm)																							
0.7	Clayey silt, some sand, trace to some gravel, trace rootlets, zones of topsoil (FILL)		2	SS	15																			
99.7	Very stiff Dark brown to grey Moist																							
1.4	CLAYEY SILT, some sand, trace gravel (TILL)		3	SS	25																			
99.0	Very stiff Brown Moist																							
2.1	SANDY SILT, some clay, some gravel (TILL)		4	SS	36																			
	Dense to compact Brown Moist to wet																							
97.1	CLAYEY SILT, some sand, some gravel (TILL)		5	SS	13																			
4.0	Very stiff Grey Wet																							
96.1	End of Borehole		6	SS	26																			
5.0	NOTES: 1. Groundwater encountered during drilling at a depth of 3.1 m below ground surface, May 15-16, 2012 2. Groundwater measured at a depth of 4.5 m below ground surface upon completion of drilling, May 15-16, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 205** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860543.9; E 357146.8 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 16, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.2	GROUND SURFACE																							
0.0	ASPHALT (150 mm)																							
99.7	GRANULAR BASE (350 mm)																							
99.3	GRANULAR SUBBASE (400 mm)		1	AS	-																			
99.3	CLAYEY SILT, trace to some sand, trace to some gravel (TILL) Firm to very stiff Brown Moist		2	SS	8																			
98.1			3	SS	19																			
98.1			4	SS	21																			
98.1	Gravelly SILTY SAND, trace clay (TILL) Compact to very dense Brown to grey Moist		5	SS	41																			
95.2			6	SS	62																			
95.2	End of Borehole																							
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 16, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 206</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860562.6; E 357195.4</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 16, 2012</u>	CHECKED BY <u>TG</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
101.3	GROUND SURFACE																
0.0	ASPHALT (170 mm)																
100.8	GRANULAR BASE (330 mm)		1	AS	-		101										
100.4	GRANULAR SUBBASE (390 mm)																
0.9	Clayey silt, some sand, zones of topsoil/organic (FILL) Very stiff to hard		2	SS	17		100										
99.7	Dark brown to black		3	SS	50/ 13												
1.6	Sandy silt, trace clay, some gravel, containing cobbles/boulders (FILL) Very dense to compact																
98.9	Brown to dark brown Moist		4A 4B	SS	20		99										
2.4	CLAYEY SILT, trace sand, trace gravel (TILL) Very stiff to hard		5	SS	36		98										
	Brown Moist																
97.3	SILTY SAND, trace clay, some gravel (TILL) Very dense						97										
4.0	Brown Moist		6	SS	98/ 28												
96.3	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 16, 2012																

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 207</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860578.3; E 357239.2</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 10, 2012</u>	CHECKED BY <u>TG</u>	

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
102.8	GROUND SURFACE															
0.0	ASPHALT (180 mm)															
	GRANULAR BASE (370 mm)															
102.3	GRANULAR SUBBASE (390 mm)		1	AS	-											
101.9	Clayey silt, some sand, trace gravel, topsoil inclusions, trace rootlets, zones of sandy silt (FILL) Stiff to very stiff Brown to grey Moist		2	SS	14											
0.9			3	SS	11											
			4	SS	23											
99.9			5	SS	33											
2.9	CLAYEY SILT, some sand, some gravel, trace rootlets, containing cobbles Hard Brown to grey															
98.8	Sandy SILT, some clay, some gravel Very dense Brown Moist		6	SS	90 / 28											
4.0																
97.8	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 10, 2012															
5.0																

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 208</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860594.8; E 357286.9</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 9-10, 2012</u>	CHECKED BY <u>TG</u>	

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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100				10	20	30	kN/m <sup>3</sup>	GR SA SI CL	
103.3	GROUND SURFACE																		
0.0	ASPHALT (170 mm)																		
0.2	GRANULAR BASE (450 mm)		1	AS	-														
102.7	GRANULAR SUBBASE (180 mm)																		
0.8	Clayey silt to silty clay, some sand, trace gravel, zones of topsoil (FILL) Stiff Dark brown to brown Moist		2	SS	12														
			3	SS	14														
			4	SS	14														
			5	SS	11														
99.3	SILTY CLAY, some sand, trace to some gravel Very stiff Brown Moist		6	SS	18														
4.0																			
98.3	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 9-10, 2012																		
5.0																			

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 209** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860616.4; E 357350.8 ORIGINATED BY AZ  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 9, 2012 CHECKED BY TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
102.3	GROUND SURFACE																							
0.0	ASPHALT (135 mm)																							
	GRANULAR BASE (230 mm)																							
101.7	GRANULAR SUBBASE (280 mm)		1	AS	-																			
0.7	Clayey silt to silty clay, some sand, trace gravel, trace rootlets, zones of topsoil/organic (FILL) Stiff to very stiff Dark brown to brown Moist		2	SS	10																			
			3	SS	7																			
			4	SS	26																			
99.1			5	SS	14																			
3.4	TOPSOIL SILTY CLAY, trace sand Stiff to very stiff Brown Moist		6	SS	27																			
97.3	End of Borehole																							
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 9, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 210** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860629.6; E 357393.0 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
102.9	GROUND SURFACE																	
0.0	ASPHALT (120mm)																	
102.5	GRANULAR BASE (300 mm)		1	AS	-													
0.4	GRANULAR SUBBASE (420 mm)																	
102.1																		
0.8	Sandy silt, some clay, trace to some gravel (FILL)		2	SS	30													
101.5	Compact Brown Moist																	
1.4	Silty clay to clayey silt, trace to some sand, trace gravel, topsoil and organic inclusions (FILL)		3	SS	6													
	Firm to very stiff																	
	Dark brown to brown Moist		4	SS	19													
			5	SS	13													
98.9																		
4.0	SILTY SAND, trace to some clay, some gravel (TILL)																	
	Very dense																	
	Brown Moist		6	SS	75													
97.9																		
5.0	End of Borehole																	
	NOTES:																	
	1. Borehole dry and open upon completion of drilling, May 9, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 211</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860643.3; E 357434.9</u>		ORIGINATED BY <u>AZ</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 9, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> 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					
103.6	GROUND SURFACE																
0.0	ASPHALT (120mm)																
103.1	GRANULAR BASE (360 mm)																
0.5	GRANULAR SUBBASE (500 mm)		1	AS	-												
102.6			2	SS	22												
1.0	Clayey silt to silty clay, trace to some sand, trace to some gravel, zones of topsoil at approximately 3.20 m below ground surface (FILL) Stiff to very stiff Brown to dark brown Moist		3	SS	10												
			4	SS	17												
			5	SS	14												
99.9				6	SS	47											
3.7	SANDY SILT, some clay, some gravel (TILL) Dense Brown Moist																
98.6	End of Borehole																
5.0	NOTES:  1. Borehole dry and open upon completion of drilling, May 9, 2012																

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 212** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860658.9; E 357479.1 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 9, 2012 **CHECKED BY** TG

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 (%)								
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL		
102.3	GROUND SURFACE																								
0.0	ASPHALT (130mm)																								
101.8	GRANULAR BASE (370 mm)		1	AS	-																				
101.5	GRANULAR SUBBASE (280 mm)																								
0.8	Clayey silt, trace to some sand, trace gravel (FILL) Stiff to very stiff Brown to dark brown		2	SS	9																				
			3	SS	9																				
			4	SS	11																				
			5	SS	20																				
98.3	SILTY SAND, trace clay, some gravel, pockets of coarse sand (TILL) Dense Brown Moist		6	SS	45																				
4.0																									
97.3	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 9, 2012																								
5.0																									

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 213** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860676.2; E 357526.0 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 10, 2012 **CHECKED BY** TG

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 (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
101.4	GROUND SURFACE																						
0.0	ASPHALT (110mm)																						
0.1	GRANULAR BASE (370 mm)																						
100.7																							
100.5	GRANULAR SUBBASE (270 mm)																						
1.0	Sandy silt, some clay, trace to some gravel, zones of clayey silt (FILL) Compact Brown		2	SS	12																		
99.3																							
2.1	Silty sand, trace clay, some gravel (FILL) Dense Brown Moist		4	SS	43																		

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 301</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860754.8; E 357669.8</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 10, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
98.6	GROUND SURFACE																
98.2	ASPHALT (100mm) GRANULAR BASE ( 330 mm) GRANULAR SUBBASE ( 370 mm)		1	AS	-												
97.8							98										
0.8	Silty sand and gravel, trace clay (FILL) Very dense to compact Brown Moist		2	SS	56												
			3	SS	50		97										36 43 17 4
			4	SS	20		96										
			5	SS	29		95										
94.6																	
4.0	Sandy SILT, some clay, trace gravel Dense Brown																
93.8			6	SS	40		94										
5.0	SILTY SAND, some gravel, trace clay Dense Brown End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 10, 2012																

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 302** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860732.9; E 357603.0 ORIGINATED BY AZ  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 10, 2012 CHECKED BY TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
100.4	GROUND SURFACE																	
0.0	ASPHALT (120mm)																	
0.1	GRANULAR BASE (440 mm)																	
99.8	GRANULAR SUBBASE (220 mm)		1	AS	-													
0.8	Sandy silt, some clay, some gravel (FILL) Compact Brown Moist		2	SS	27													
			3	SS	18													
			4	SS	18													
			5	SS	26													
96.4	SILTY SAND, trace to some gravel, trace clay (TILL) Compact Brown Moist		6	SS	23													
4.0																		
95.4	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 10, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 303</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860719.7; E 357560.9</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 10-11, 2012</u>	CHECKED BY <u>TG</u>	

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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
99.8	GROUND SURFACE																
99.0	ASPHALT (110mm)																
99.2	GRANULAR BASE (490 mm)		1	AS	-												
98.9	GRANULAR SUBBASE (300 mm)		2	SS	49		99										
0.9	Silty sand to sandy silt, trace to some gravel, trace clay, zones of clayey silt (FILL) Dense to compact Brown Moist		3	SS	13		98										
97.7	SILTY SAND, some gravel Compact Brown Moist		4	SS	31		97										
96.9	SILTY SAND, trace clay, trace to some gravel (TILL) Very dense Brown Moist		5	SS	50		96										10 46 36 8
95.8	SILTY SAND, some gravel Dense Brown Moist		6	SS	46		95										
94.8	End of Borehole																
5.0	NOTES:  1. Borehole dry and open upon completion of drilling, May 10-11, 2012																

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 304</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860704.5; E 357512.3</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 11, 2012</u>	CHECKED BY <u>TG</u>	

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						
100.9	GROUND SURFACE															
9.0	ASPHALT (110mm)															
100.5	GRANULAR BASE (270 mm)															
0.4	GRANULAR SUBBASE (620 mm)		1	AS	-											
99.9			2	SS	16											
1.0	Clayey silt to silty clay, some sand, trace gravel, zones of organic and topsoil (FILL) Firm to very stiff Brown to black Moist		3	SS	11											
			4	SS	6											
			5	SS	17											
			6	SS	15											
95.6																
5.3	SILTY SAND, trace clay, trace to some gravel (TILL) Very dense Brown Moist		7	SS	50 / 10											
94.4																
6.5	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 11, 2012															

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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



PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 306** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860679.1; E 357426.6 ORIGINATED BY AZ  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 11, 2012 CHECKED BY TG

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 (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
102.2	GROUND SURFACE																						
0.0	ASPHALT (140mm)																						
101.7	GRANULAR BASE (380 mm)		1	AS	-																		
101.3	GRANULAR SUBBASE (370 mm)																						
0.9	Silty sand, some gravel (FILL) Compact		2	SS	18																		
100.8	Brown to grey Moist																						
1.4	Sandy clayey silt, some sand, trace gravel, trace rootlets, zones of topsoil (FILL) Stiff		3	SS	9																		
	Brown to black Moist		4	SS	12																		4 24 42 30
			5	SS	13																		
98.2																							
4.0	SILTY SAND, trace clay, some gravel (TILL) Very dense																						
97.2	Brown Moist		6	SS	83																		
5.0	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 11, 2012																						

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 307</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860665.3; E 357381.1</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 11, 2012</u>	CHECKED BY <u>TG</u>	

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100
102.4	GROUND SURFACE																					
0.0	ASPHALT (120mm)																					
102.0	GRANULAR BASE (310 mm)		1	AS	-		102															
101.6	GRANULAR SUBBASE (370 mm)																					
0.8	Clayey silt, some sand, trace gravel, trace rootlets, topsoil/organic inclusions (FILL) Stiff to very stiff Dark brown to brown Moist		2	SS	15		101															
			3	SS	10																	
			4	SS	16		100															
			5A																			
99.1	TOPSOIL		5B	SS	12		99															
3.3																						
98.6	SILTY SAND, trace to some gravel Very dense Brown Moist						98															
3.8			6	SS	50 / .08																	
97.6	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 11, 2012																					
4.8																						

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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



PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 309</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860630.8; E 357276.7</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 13, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
102.8	GROUND SURFACE																	
0.0	ASPHALT (150mm)																	
102.3	GRANULAR BASE (330 mm)		1	AS	-													
	GRANULAR SUBBASE (370 mm)																	
102.0	Clayey silt, some sand, trace gravel, trace rootlets, zones of topsoil (FILL) Firm to stiff Dark brown to grey Moist		2	SS	9		102											
0.9																		
				3	SS	12		101										
				4	SS	6		100										
				5	SS	9		99										
98.8	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Brown Moist to wet																	
4.0			6	SS	21		98											
97.8	End of Borehole NOTES:  1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface, May 13, 2012  2. Groundwater measured at a depth of 4.1 m below ground surface upon completion of drilling, May 13, 2012																	
5.0																		

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 310** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860616.7; E 357228.4 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 13, 2012 **CHECKED BY** TG

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 (%)					
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR SA SI CL		
102.5	GROUND SURFACE																					
0.0	ASPHALT (150mm)																					
102.0	GRANULAR BASE (350 mm)																					
	GRANULAR SUBBASE (450 mm)		1	AS	-																	
101.7	Clayey silt, some sand, trace gravel, trace rootlets, organic inclusions, zones of topsoil (FILL) Stiff to very stiff Black to grey Moist		2	SS	20																	
0.8			3	SS	9																	
			4	SS	16																	
99.6			5	SS	14																	
2.9	SILTY CLAY, some sand Very stiff Brown to grey Moist		6	SS	36																	
98.5	SILTY SAND, trace clay, some gravel, zones of sand (TILL) Dense Brown Wet																					
4.0																						
97.5																						
5.0	End of Borehole NOTES: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface, May 13, 2012 2. Groundwater measured at a depth of 4.4 m below ground surface upon completion of drilling, May 13, 2012																					

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 311</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860604.3; E 357180.3</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 13-14, 2012</u>	CHECKED BY <u>TG</u>	

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								
102.0	GROUND SURFACE															
0.0	ASPHALT (120mm)															
101.6	GRANULAR BASE (300 mm)		1	AS	-											
	GRANULAR SUBBASE (380 mm)															
101.2																
0.8	Clayey silt, some sand, trace gravel, zones of topsoil/organic (FILL) Stiff Dark brown to grey Moist		2	SS	16											
99.9																
2.1	SILTY CLAY, trace sand Stiff Brown Moist		4	SS	12											
99.1																
2.9	CLAYEY SILT, trace to some sand, trace gravel (TILL) Hard to very stiff Brown to grey Moist		5	SS	34											
97.0																
5.0	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 13-14, 2012		6	SS	22											

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 312</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860594.1; E 357132.5</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 14, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100
101.2	GROUND SURFACE													
0.0	ASPHALT (190mm)													
	GRANULAR BASE (210 mm)													
0.4	GRANULAR SUBBASE (430 mm)		1	AS	-									
100.4														
0.8	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff Brown Moist		2	SS	18									
			3	SS	29									
			4	SS	20									
98.3														
2.9	SANDY SILT to SILTY SAND, trace to some clay, trace to some gravel (TILL) Dense to very dense Brown Moist		5	SS	37									
			6	SS	69									
96.2	End of Borehole													
5.0	NOTES:  1. Borehole dry and open upon completion of drilling, May 14, 2012													

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 313** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860608.5; E 357095.7 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
100.7	GROUND SURFACE																	
0.0	TOPSOIL (130 mm)																	
0.1	GRANULAR BASE (520 mm)		1	AS	-													
100.1																		
0.9	Silty clay, some sand, topsoil inclusions (FILL) Stiff Brown		2	SS	10													
	SILTY CLAY, trace to some sand, pockets of sand and gravel Very stiff Brown to grey Moist to wet		3	SS	21													
			4	SS	26													
			5	SS	13													
			6	SS	6													
94.9	End of Borehole																	
5.8	NOTES: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface, May 14, 2012 2. Borehole dry and open upon completion of drilling, May 14, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 314** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860607.3; E 357065.9 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** TG

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 (%)
110.6	GROUND SURFACE																
0.0	TOPSOIL (200 mm)																
0.2	CLAYEY SILT, some sand, some gravel, topsoil inclusions, rootlets, wood pieces (FILL) Compact Dark brown to brown Moist		1	50 DO	17												
			2	50 DO	25												
			3	50 DO	18												
108.5	SAND and GRAVEL, trace to some non-plastic fines, wood pieces (FILL) Dense Grey Moist to wet		4	50 DO	35												
2.1			5	50 DO	36												
107.7	CLAYEY SILT, with sand, some gravel (TILL) Very stiff to hard Brown to grey Moist to wet		6	50 DO	16												
2.9																	
105.6	End of Borehole																
5.0	NOTES: 1. Groundwater measured at a depth of 1.8 m below ground surface upon completion of drilling, May 17, 2012 2. Borehole caved at a depth of 4.0 m below ground surface upon completion of drilling, May 17, 2012																

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 315** SHEET 1 OF 1 **METRIC**  
 LOCATION N 4860566.3; E 357035.1 ORIGINATED BY TR  
 DIST Central HWY 401 BOREHOLE TYPE Truck Mounted, Solid Stem, Auto Hammer COMPILED BY DW  
 DATUM Geodetic DATE May 17, 2012 CHECKED BY TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
104.3	GROUND SURFACE																							
0.0	TOPSOIL (200 mm)																							
0.2	CLAYEY SILT, some sand, trace to some gravel, topsoil inclusions, rootlets Firm Dark brown Moist CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		1	50 DO	8																			
103.6			2	50 DO	14																			
0.7				3	50 DO	30																		
				4	50 DO	23																		
				5	50 DO	27																		
				6	50 DO	6																		
100.3	Sandy SILTY CLAY, some gravel (TILL-LIKE) Firm Grey Wet																							
4.0																								
99.3	End of Borehole																							
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 17, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 316** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860551.0; E 356986.8 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.7	GROUND SURFACE																							
0.0	TOPSOIL (200 mm)																							
0.2	CLAYEY SILT, some sand, some gravel, topsoil inclusions, rootlets Firm		1	50 D0	8																			
100.0	Dark brown to brown Moist		2	50 D0	9																			
0.7	CLAYEY SILT, trace to some sand, trace to some gravel (TILL) Firm to very stiff Brown Moist		3	50 D0	22																			
			4	50 D0	22																			
			5	50 D0	14																			
96.7																								
4.0	CLAYEY SILT, some sand, some gravel (TILL-LIKE) Firm Grey Wet		6	50 D0	5																			
95.7																								
5.0	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 17, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 317** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860540.0; E 356941.9 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** TG

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 (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
100.4	GROUND SURFACE																						
0.0	TOPSOIL (200 mm)																						
0.2	Clayey silt, some sand, trace to some gravel, topsoil inclusions, rootlets (FILL)		1	50 DO	8																		
99.5	Firm Dark brown Moist		2	50 DO	9																		
0.9	CLAYEY SILT, trace sand Firm to stiff Brown to grey Moist		3	50 DO	15																		
			4	50 DO	14																		
97.5	Sandy SILTY CLAY, some gravel (TILL-LIKE) Firm Grey Wet		5	50 DO	7																		
2.9			6	50 DO	6																		
95.4	End of Borehole																						
5.0	NOTES: 1. Borehole dry and open upon completion of drilling, May 17, 2012																						

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 401** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860302.4; E 356268.8 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.6	GROUND SURFACE																							
0.0	ASPHALT (120mm)																							
0.1	GRANULAR BASE (510 mm)																							
100.0			1	AS	-																			
0.6	Clayey silt and sand, trace gravel (FILL)		2	SS	13																			
99.2	Compact Brown Moist																							
1.4	SILTY SAND, trace to some clay, trace to some gravel, cobbles/boulders (TILL)		3	SS	18																			
	Compact to very dense Brown Moist		4	SS	48																			
			5	SS	94																			
96.0																								
4.7	End of Borehole		6	SS	50/08																			
	NOTES: 1. Borehole dry and open upon completion of drilling, May 14, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 402** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860288.4; E 356226.9 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
102.0	GROUND SURFACE																	
0.0	ASPHALT (120mm)																	
0.1	GRANULAR BASE (410 mm)		1	AS	-													
101.5	GRANULAR SUBBASE (360 mm)																	
101.1			2A	SS	19													
1.1	Clayey silt, some sand, layers of topsoil, zones of sandy silt (FILL) Very stiff Dark brown to brown Moist		3	SS	32													
99.9	CLAYEY SILT, some sand, trace to some gravel, zones of coarse sand (TILL) Very stiff to hard Brown Moist		4	SS	44													
2.1	SILTY SAND, trace clay, some gravel, containing cobbles/boulders (TILL) Dense to very dense Brown Moist		5	SS	49													
97.1			6	SS	50/.13													
4.9	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 14, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 403** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860275.6; E 356187.7 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
103.2	GROUND SURFACE																							
0.0	ASPHALT (130 mm)																							
102.8	GRANULAR BASE (270 mm)		1	AS	-																			
0.4	GRANULAR SUBBASE (500 mm)																							
102.4																								
0.9	Silty sand, some gravel, topsoil inclusions, zones of clayey silt (FILL)		2	SS	16																			
101.5	Compact Brown Moist		3A																					
1.7	CLAYEY SILT, trace to some sand, trace gravel from approximately 2.44 m below ground surface		3B	SS	9																			
	Stiff to very stiff		4	SS	12																			
	Brown Moist		5	SS	15																			
99.2																								
4.0	SILTY SAND, some gravel																							
	Very dense																							
98.5	Brown Moist		6	SS	50 / 15																			
4.7	End of Borehole																							
	NOTES:																							
	1. Borehole dry and open upon completion of drilling, May 14, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 404** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860260.3; E 356144.2 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

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 (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
105.0	GROUND SURFACE																							
0.0	ASPHALT (120 mm)																							
104.6	GRANULAR BASE (310 mm)																							
0.4	GRANULAR SUBBASE (430 mm)																							
104.1			1	AS	-																			
0.9	Silty sand, some gravel (FILL) Dense to very dense Brown Moist		2	SS	50																			
103.6																								
1.4	Clayey silt, some sand, zones of topsoil/organic (FILL) Firm to stiff Dark brown to brown Moist to wet		3	SS	8																			
102.6																								
2.4	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard Brown		4A 4B	SS	16																			
102.2																								
5			5	SS	30																			
101.0																								
4.0	SANDY SILT, trace clay, some gravel, zones of clayey silt, containing cobbles/boulders (TILL) Very dense Brown Moist to wet		6	SS	50/.10																			
100.2																								
4.8	End of Borehole NOTES:  1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface, May 14, 2012  2. Groundwater measured at a depth of 4.4 m below ground surface upon completion of drilling, May 14, 2012  3. Borehole dry and open upon completion of drilling, May 14, 2012																							

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 405** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860245.8; E 356095.9 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 14, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>	GR
106.0	GROUND SURFACE																	
9.0	ASPHALT (110 mm)																	
105.6	GRANULAR BASE (310 mm)		1	AS	-													
	GRANULAR SUBBASE (380 mm)																	
105.2																		
0.8	Silty sand, some gravel, trace clay, topsoil/organic inclusions (FILL) Compact Brown to dark brown Moist		2	SS	13													
104.3																		
1.8	SANDY SILT, some clay, trace to some gravel, zones of clayey silt (TILL) Compact to dense Brown Moist		3A 3B	SS	11													
104																		
4			4	SS	39													
103.1																		
2.9	CLAYEY SILT, trace to some sand, some gravel, containing cobbles/boulders (TILL) Hard Brown to grey Moist		5	SS	90 / 28													
103																		
102																		
101.0			6	SS	94													
5.0	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 14, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 406</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860231.8; E 356056.0</u>	ORIGINATED BY <u>AZ</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Truck Mounted, Solid Stem, Auto Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 15, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> 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					
107.4	GROUND SURFACE																
9.0	ASPHALT (110 mm)																
107.0	GRANULAR BASE (310 mm)																
	GRANULAR SUBBASE (400 mm)		1	AS	-		107										
106.6	Silty sand, some gravel (FILL)		2	SS	19												
0.8	Compact Grey Moist																
106.0	SANDY SILT, trace clay, zones of clayey silt		3	SS	26		106										
1.4	Compact Brown																
105.3	SILTY SAND, trace clay, trace to some gravel, containing cobbles/boulders (TILL)		4	SS	40		105										
2.1	Dense to very dense Brown Moist		5	SS	50/.15		104										
103.1	End of Borehole																
4.3	NOTES:  1. Borehole dry and open upon completion of drilling, May 15, 2012																

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 407** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860214.0; E 356008.6 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 15, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>	GR
108.1	GROUND SURFACE																	
0.0	ASPHALT (110 mm)		1	AS	-													
107.7	GRANULAR BASE (290 mm)																	
0.4	GRANULAR SUBBASE (430 mm)																	
107.3																		
0.8	Sandy silt, trace clay, trace gravel, topsoil inclusions (FILL)		2	SS	22													
106.7	Compact Brown Moist																	
1.4																		
106.0	Clayey silt, some sand with zones of topsoil (FILL)		3	SS	7													
2.1	Firm Dark brown to black Moist																	
	CLAYEY SILT, trace to some sand, trace gravel (TILL)		4	SS	22													
	Very stiff to hard Brown Moist																	
105			5	SS	60													
104.1																		
4.0	SANDY SILT, trace clay, some gravel (TILL)																	
103.4	Very dense Brown Moist		6	SS	50 / .15													
4.7	End of Borehole																	
	NOTES:																	
	1. Borehole dry and open upon completion of drilling, May 15, 2012																	

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 408** **SHEET 1 OF 1** **METRIC**  
**LOCATION** N 4860200.9; E 355969.7 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 15, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
109.4	GROUND SURFACE																	
0.0	ASPHALT (125 mm)																	
0.1	GRANULAR BASE (575 mm)																	
108.8			1	AS	-													
0.7	Silty sand to sandy silt, some gravel (FILL) Compact Brown Moist		2	SS	24													
108.0																		
1.4	Clayey silt, some sand, layer of topsoil, zones of sandy silt, zones of silty sand (FILL) Very soft Dark brown to black		3	SS	2													
107.0																		
2.4	SILTY SAND, trace clay, trace to some gravel (TILL) Compact to very dense Brown Moist		4A 4B	SS	22													
105.4																		
4.0	CLAYEY SILT, with sand, trace gravel (TILL) Hard Brown to grey Moist		5	SS	50 / .08													
104.7																		
4.7	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 15, 2012		6	SS	50 / .13													8 16 40 40

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 409** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860185.6; E 355924.0 **ORIGINATED BY** AZ  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 15, 2012 **CHECKED BY** TG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>	GR	SA	SI
109.6	GROUND SURFACE																			
0.7	ASPHALT (70 mm)		1	AS	-															
	GRANULAR BASE (530 mm)																			
109.0	CLAYEY SILT, trace to some sand, trace to some gravel, containing cobbles/boulders (TILL) Hard Brown to grey Moist		2	SS	52															
0.6			3	SS	50 / .15															
			4	SS	50 / .15															
			5	SS	50 / .13															
		6	SS	50 / .15																
105.6	SANDY SILT, some clay, trace to some gravel (TILL) Very dense Brown Moist																			
4.0	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 15, 2012																			
104.9																				
4.7																				

GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 410</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860211.5; E 355906.6</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ 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	W <sub>p</sub>	W			W <sub>L</sub>	
112.5	GROUND SURFACE	[Hatched]	1A															
0.0	TOPSOIL	[Hatched]																
0.2	SILTY SAND, some gravel Loose Light brown	[Dotted]	1B	SS	5													
111.7	Moist	[Dotted]																
0.8	SAND and SILT, trace clay, trace gravel (TILL) Dense to very dense Light brown to grey	[Dotted]	2	SS	30						o				3	46	43	8
110.7	Moist	[Dotted]																
1.8	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 17, 2012	[Dotted]	3	SS	82													

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 411</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860195.5; E 355862.1</u>	ORIGINATED BY <u>KF</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$ 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	W <sub>p</sub>	W		
118.8	GROUND SURFACE	[Symbol]	1A													
0.0	TOPSOIL (200 mm)	[Symbol]														
0.2	SILTY SAND Very loose Brown Moist	[Symbol]	1B	SS	3											
118.0						118										
0.8	SAND and SILT, trace clay, trace gravel (TILL) Compact to dense Brown Moist	[Symbol]	2	SS	26											
116.7						117										
2.1	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 17, 2012															

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 411A</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860186.4; E 355864.7</u>	ORIGINATED BY <u>KF</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> 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					
111.5	GROUND SURFACE															
0.0	TOPSOIL (200 mm)	[Pattern]	1A													
0.2	SILTY SAND, trace gravel (TILL) Very dense Brown	[Pattern]	1B	SS	50/.13											
110.8	Moist															
0.7	End of Borehole Due to refusal NOTES:  1. Borehole dry and open upon completion of drilling, May 17, 2012															

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 412</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860179.0; E 355805.4</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

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 <b>γ</b> kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
117.0	GROUND SURFACE																
0.0	TOPSOIL		1A														
0.2	Silty sand, trace gravel (FILL) Very loose Brown to dark brown Moist		1B	SS	3												
116.2																	
0.8	SILTY SAND, trace gravel Compact to very dense Brown Moist		2	SS	25		116										
115.0																	
2.0	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 17, 2012																

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 413</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860163.3; E 355755.4</u>	ORIGINATED BY <u>KF</u>		
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W		
117.5	GROUND SURFACE															
0.0	TOPSOIL		1A													
0.5	Sandy silt, trace gravel (FILL) Loose Brown Moist		1B	SS	4											
116.2	SILTY SAND, trace to some gravel (TILL)		2	SS	53											
1.4	Very dense Brown Moist															
	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 17, 2012															

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 413A</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860153.7; E 355758.8</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 17, 2012</u>	CHECKED BY <u>TG</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W		
112.5	GROUND SURFACE															
0.0	TOPSOIL (200 mm)	[Pattern]	1A													
0.2	SILTY SAND Very Loose Brown Moist	[Pattern]	1B	SS	3											
111.7																
0.8	SILTY SAND (TILL) Dense Brown Moist	[Pattern]	2	SS	43											
111.0																
1.5	End of Borehole NOTES:  1. Borehole dry and open upon completion of drilling, May 17, 2012															

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 414** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860151.2; E 355721.4 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** TG

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	20	40
118.5	GROUND SURFACE																		
0.0	TOPSOIL (200 mm)																		
0.2	Sandy SILT, trace gravel, rootlets, topsoil inclusions (FILL) Loose Dark brown to brown Moist		1	50 D0	7														
			2	50 D0	8														
117.1	SILTY SAND, trace gravel (TILL) Compact to very dense Brown Moist		3	50 D0	28														
1.4			4	50 D0	50 / 13														
			5	50 D0	50 / 13														
			6	50 D0	90 / 20														
112.9	Sandy SILT, trace gravel (TILL) Very dense Brown to grey Moist to wet		7	50 D0	80 / 20														
5.6																			
112.1	End of Borehole NOTES: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface, May 17, 2012 2. Borehole dry and open upon completion of drilling, May 17, 2012																		
6.5																			

GTA-MTO 001 111840109.GPJ GAL-MAISS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 415</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860135.3; E 355692.9</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 18, 2012</u>	CHECKED BY <u>TG</u>	

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	20
116.7	GROUND SURFACE																							
0.0	TOPSOIL (200 mm)		1A																					
0.2	Silty sand, trace gravel, some oxidation (FILL)		1B	SS	8																			
116.1	Loose Light brown to grey Moist		2	SS	50/.13																			
0.6																								
115.5	SILTY SAND, trace gravel (TILL) Very dense Brown Moist																							
1.2	End of Borehole																							
NOTES:																								
1. Borehole dry and open upon completion of drilling, May 18, 2012																								

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GTA-MTO 001 111840109.GPJ GAL-MISS.GDT 6/15/12 GPC

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

**PROJECT** 11-1184-0109(1000) **RECORD OF BOREHOLE No BH 416** SHEET 1 OF 1 **METRIC**  
**LOCATION** N 4860121.9; E 355635.8 **ORIGINATED BY** TR  
**DIST** Central **HWY** 401 **BOREHOLE TYPE** Truck Mounted, Solid Stem, Auto Hammer **COMPILED BY** DW  
**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** TG

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 (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
118.4	GROUND SURFACE																						
0.0	TOPSOIL (200 mm)																						
0.2	Sandy SILT, some gravel, rootlets, organics (FILL)		1	50 D0	4																		
117.7	Loose Dark brown Moist		2	50 D0	34																		
0.7	SILT and SAND, some clay, trace gravel (TILL)		3	50 D0	76																		
	Dense to very dense Brown Moist		4	50 D0	50/.13																		
			5	50 D0	50/.15																		
114.4	SILTY SAND, fine to medium Very dense Brown Moist		6	50 D0	50/.10																		
112.9	Sandy SILT, trace to some gravel (TILL)																						
5.5	Very dense Brown to grey Moist		7	50 D0	50/.15																		
112.2	End of Borehole																						
6.3	NOTES: 1. Borehole dry and open upon completion of drilling, May 17, 2012																						

GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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

PROJECT <u>11-1184-0109(1000)</u>	<b>RECORD OF BOREHOLE No BH 417</b>	SHEET 1 OF 1	<b>METRIC</b>
LOCATION <u>N 4860100.1; E 355584.0</u>		ORIGINATED BY <u>KF</u>	
DIST <u>Central</u> HWY <u>401</u>	BOREHOLE TYPE <u>Manual Hammer</u>	COMPILED BY <u>DW</u>	
DATUM <u>Geodetic</u>	DATE <u>May 18, 2012</u>	CHECKED BY <u>TG</u>	

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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
110.5	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL		1A														
0.2	Sandy silt, trace gravel, trace organics (FILL) Very loose		1B	SS	3		110										
109.7	Brown to dark brown Moist																
0.8	Sandy SILT, trace gravel, some sand seams, trace oxidization (TILL) Compact to dense		2	SS	21		109										
108.3	Light brown Moist		3	SS	36												
2.2	SILTY SAND, some sand seams Very dense		4	SS	-		108										
107.7	Light brown to grey Moist		5	SS	50/ 10												
2.8	End of Borehole NOTES: 1. Borehole dry and open upon completion of drilling, May 18, 2012																

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GTA-MTO 001 111840109.GPJ GAL-MASS.GDT 6/15/12 GPC

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



# **APPENDIX B**

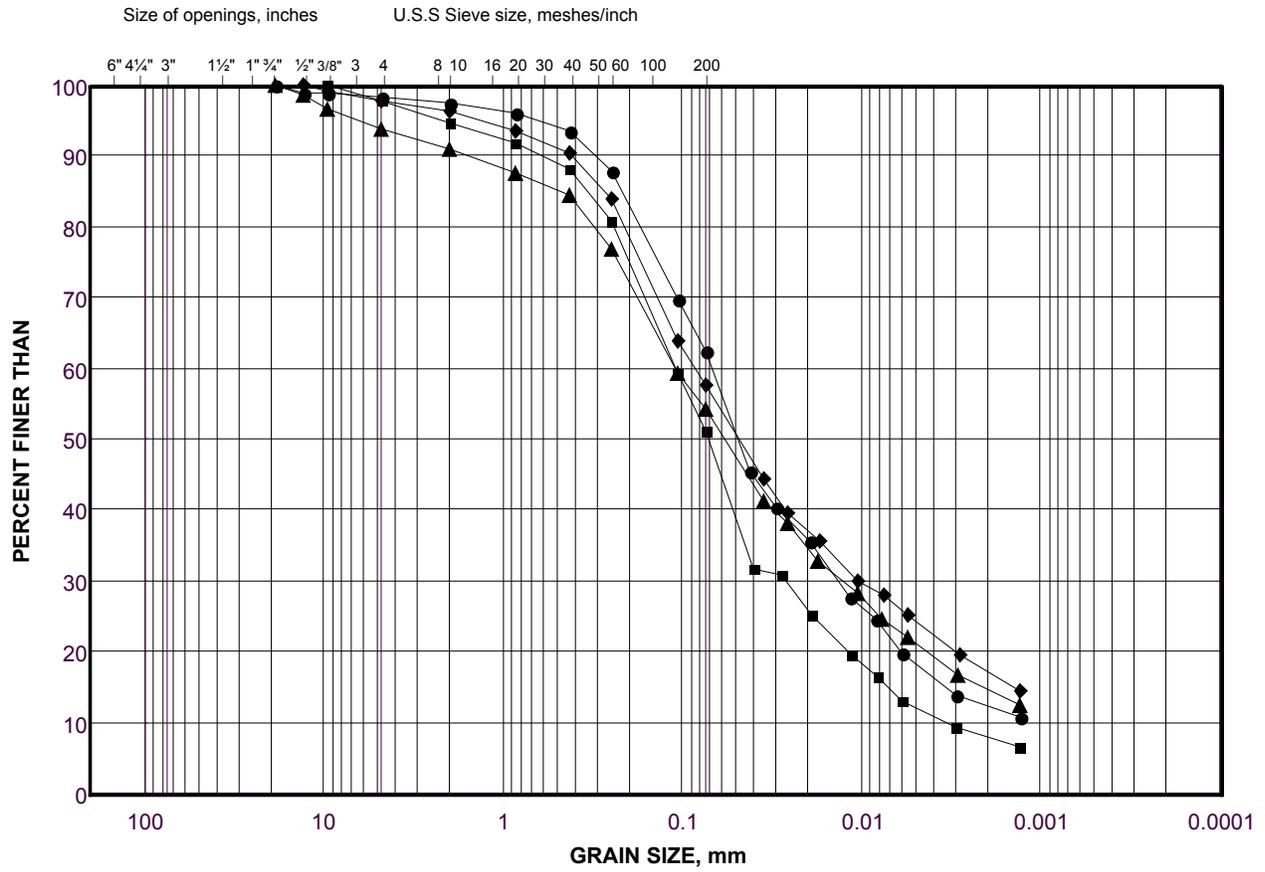
## **Laboratory Test Data**

**DRAFT**

# GRAIN SIZE DISTRIBUTION

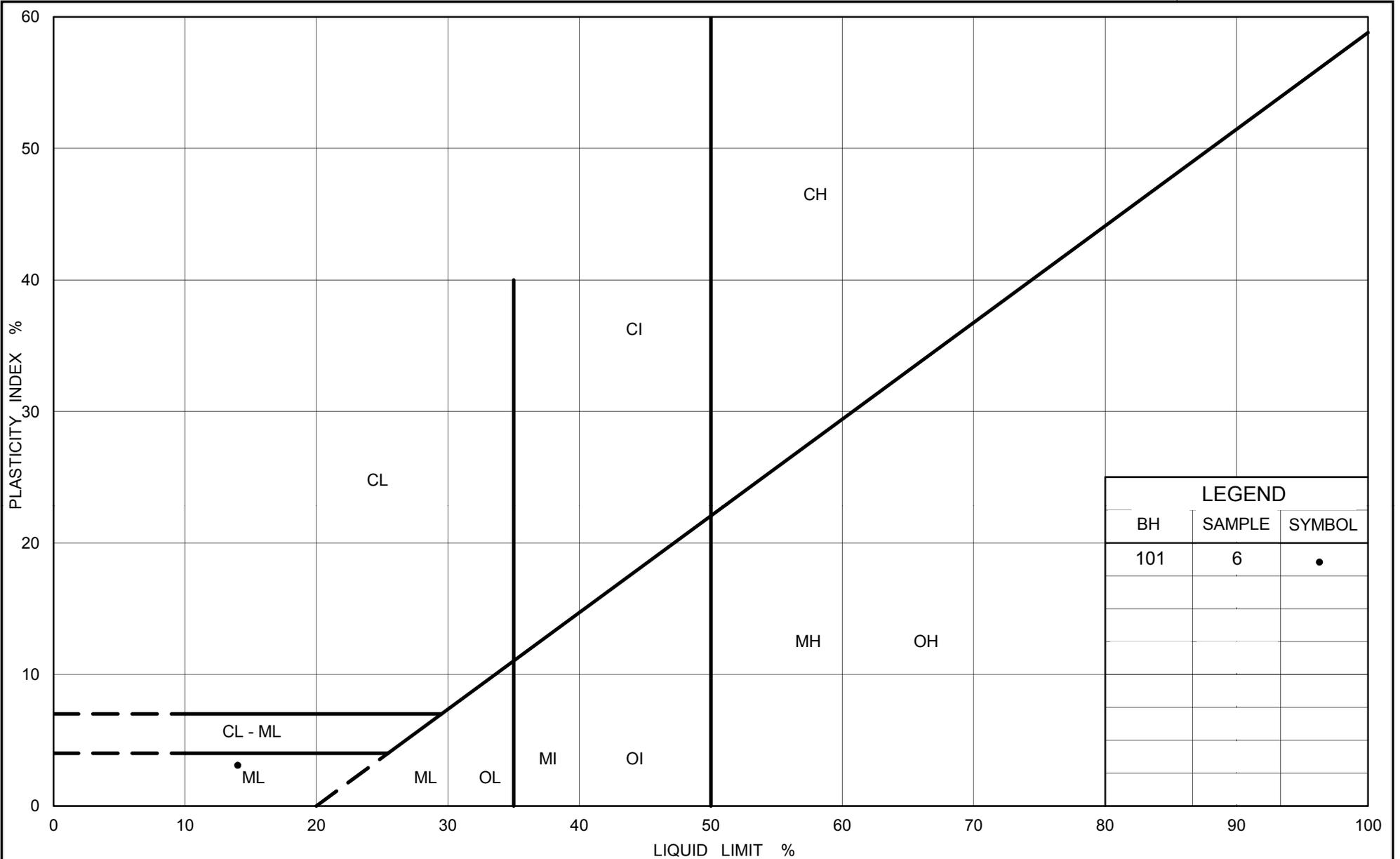
## SILT and SAND (TILL)

FIGURE 1



**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	416	2	0.76 ~ 1.22
■	410	2	0.76 ~ 1.53
◆	109	5	3.05 ~ 3.51
▲	101	6	4.57 ~ 5.03



LEGEND		
BH	SAMPLE	SYMBOL
101	6	•



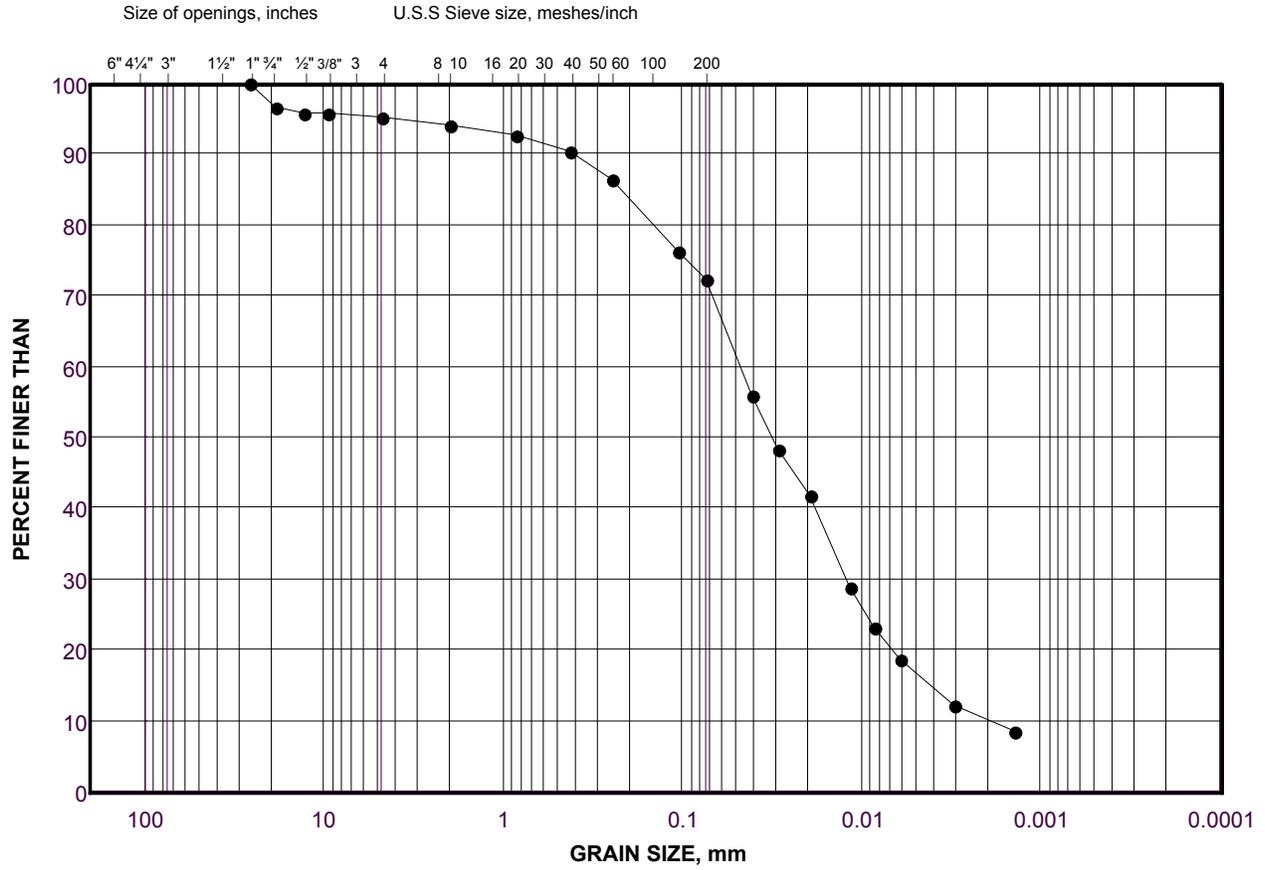
**PLASTICITY CHART  
SILT and SAND (TILL)**

Figure No.	2
Project No.	11-1184-0109
Checked By:	

# GRAIN SIZE DISTRIBUTION

## SANDY SILT (TILL)

FIGURE 3



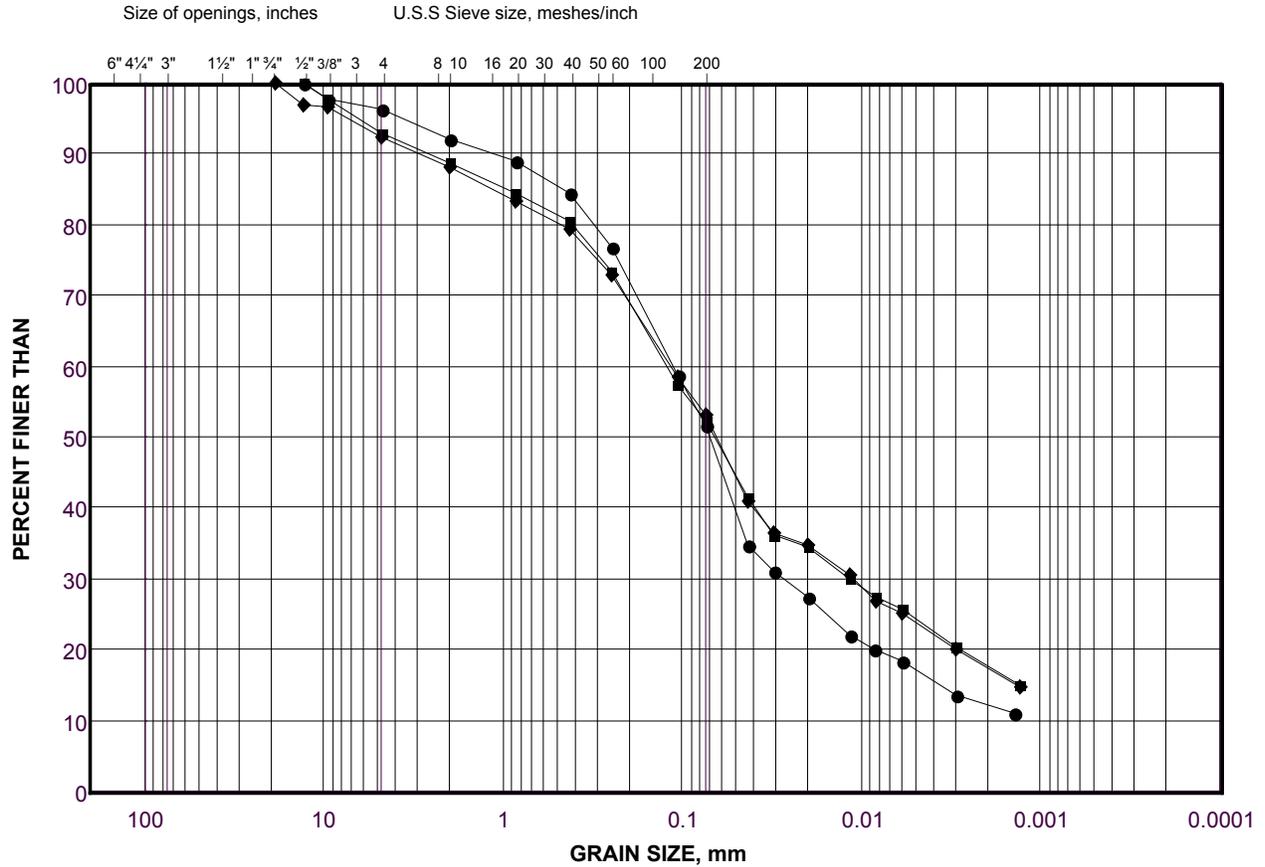
<b>COBBLE</b>	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
<b>SIZE</b>	GRAVEL SIZE		SAND SIZE			FINE GRAINED

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	104	2	7.63 ~1.22

# GRAIN SIZE DISTRIBUTION CLAYEY SILT (TILL)

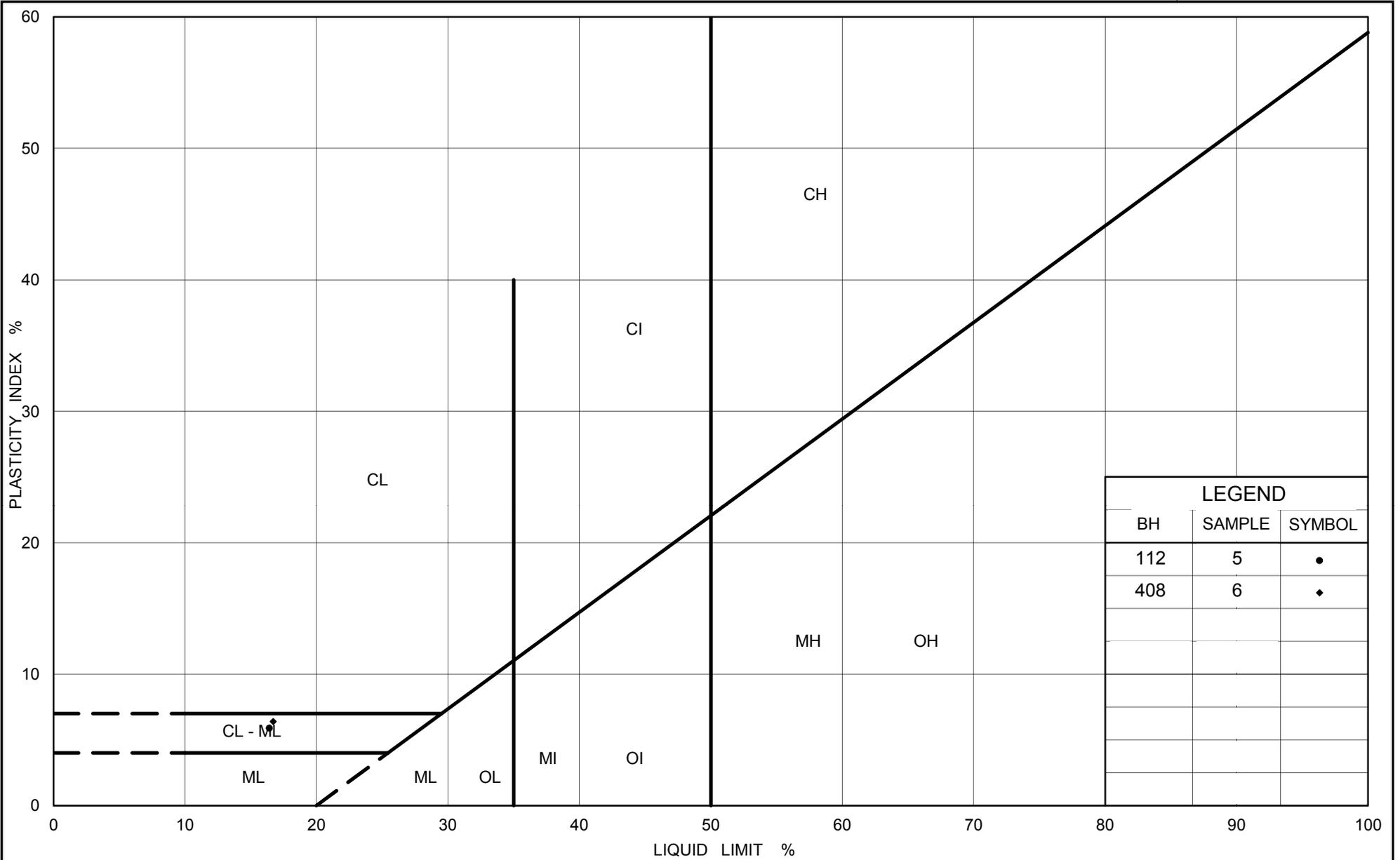
FIGURE 4



<b>COBBLE</b>	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	<b>GRAVEL SIZE</b>		<b>SAND SIZE</b>			<b>FINE GRAINED</b>
<b>SIZE</b>						

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	201	3	1.53 ~ 1.98
■	112	5	3.05 ~ 3.36
◆	408	6	4.58 ~ 4.71



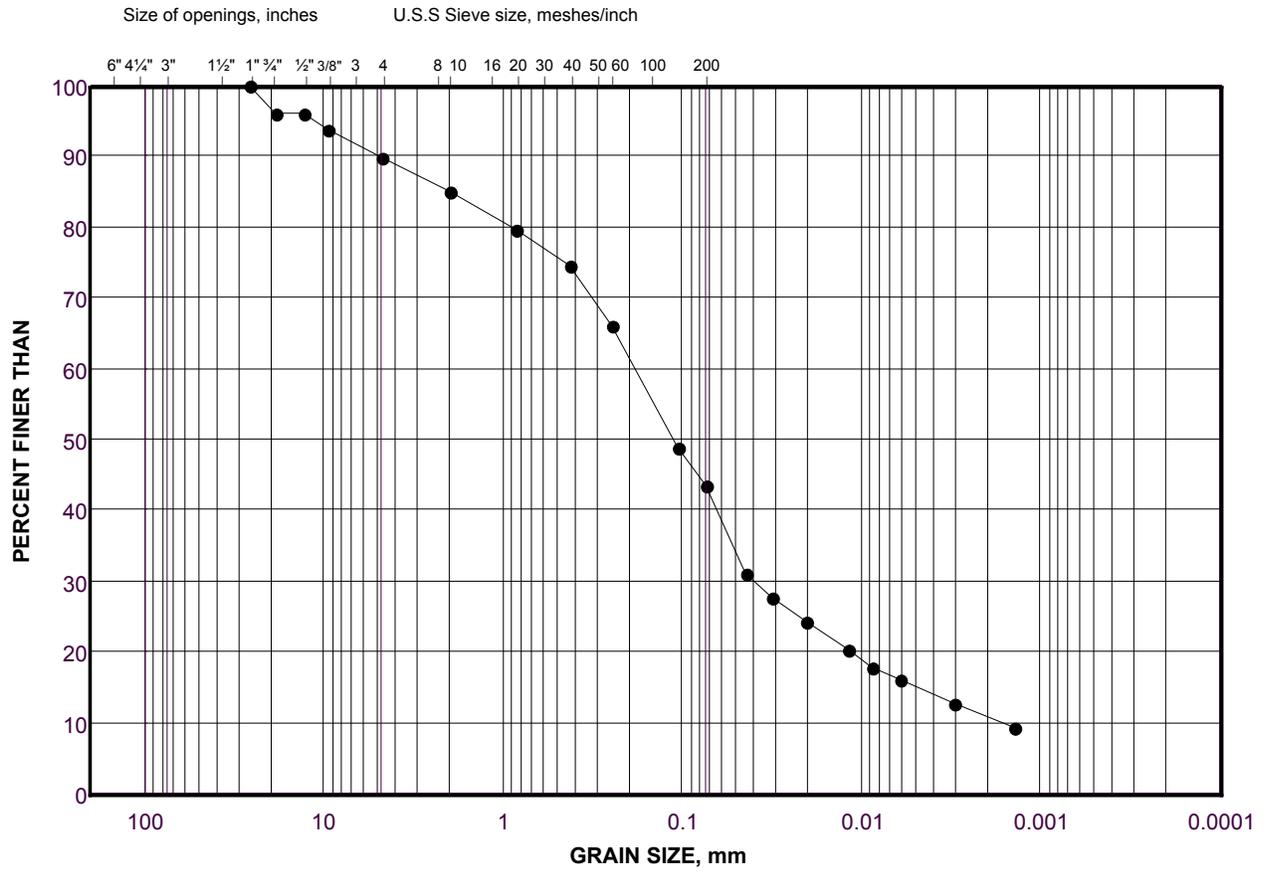
**PLASTICITY CHART  
CLAYEY SILT (TILL)**

Figure No.	5
Project No	11-1184-0109
Checked By:	

# GRAIN SIZE DISTRIBUTION

## SILTY SAND

FIGURE 6



<b>COBBLE</b>	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	<b>GRAVEL SIZE</b>		<b>SAND SIZE</b>			<b>FINE GRAINED</b>
<b>SIZE</b>						

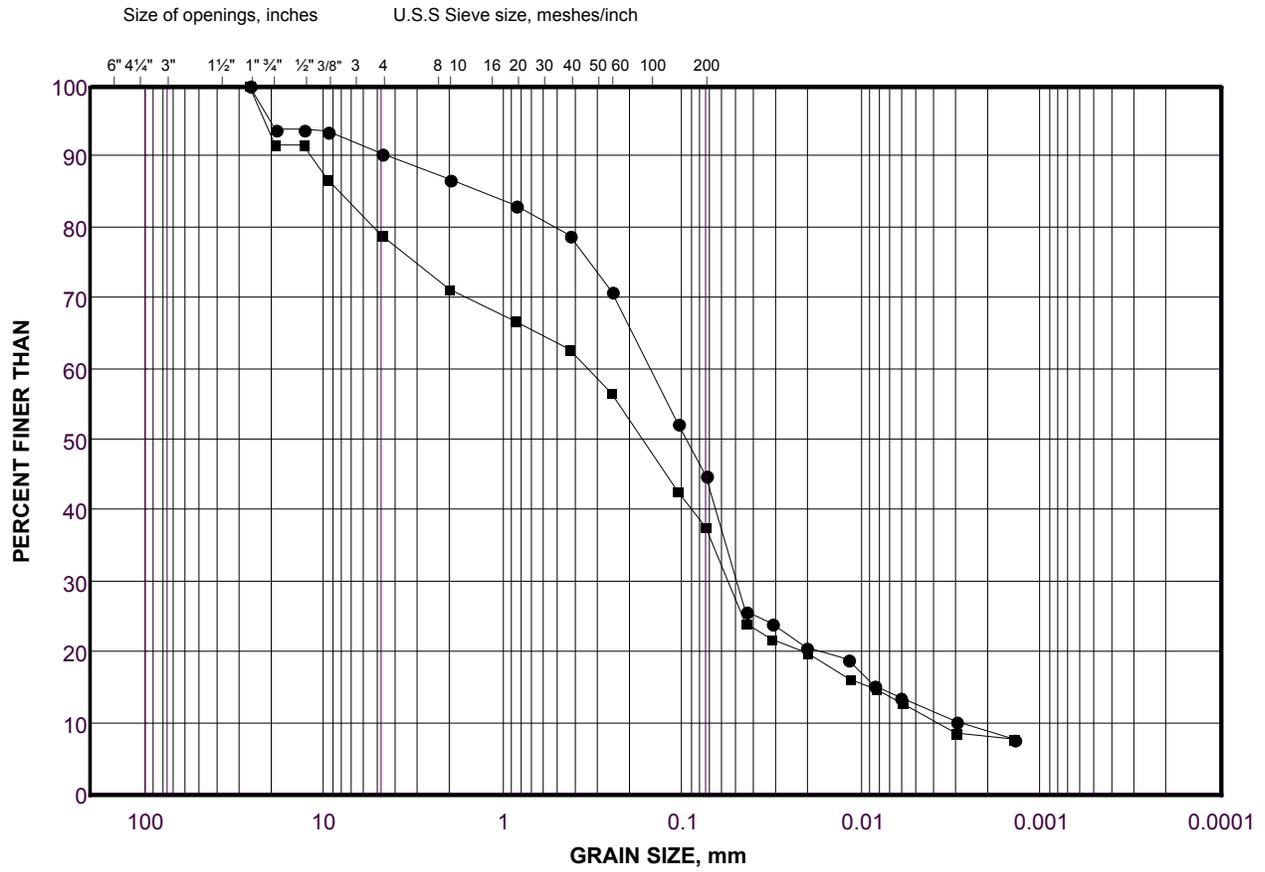
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	203	4	2.29 - 2.75

# GRAIN SIZE DISTRIBUTION

## SILTY SAND (TILL)

FIGURE 7



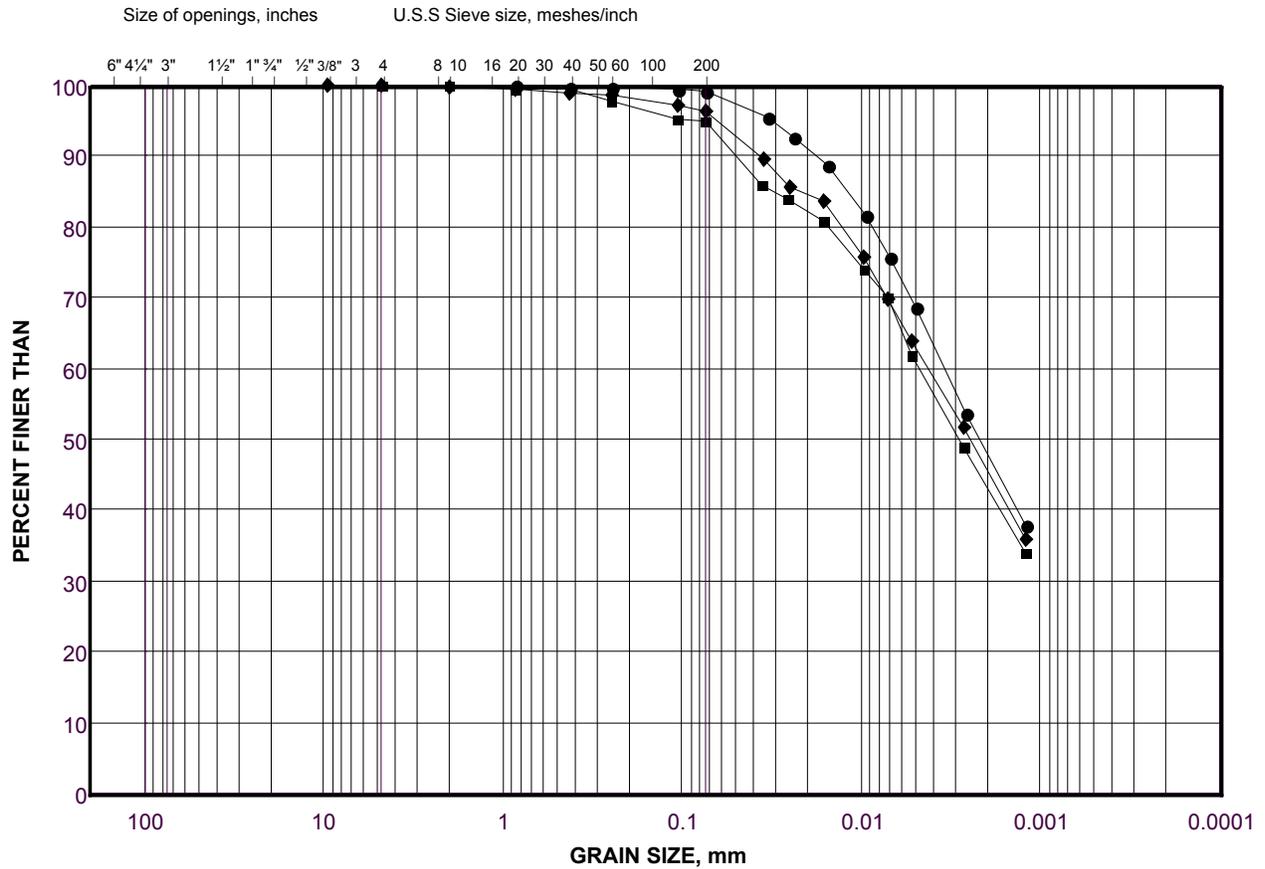
<b>COBBLE</b>	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
<b>SIZE</b>	<b>GRAVEL SIZE</b>		<b>SAND SIZE</b>			<b>FINE GRAINED</b>

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	303	5	3.05 - 3.51
■	205	6	4.58 - 5.03

# GRAIN SIZE DISTRIBUTION SILTY CLAY

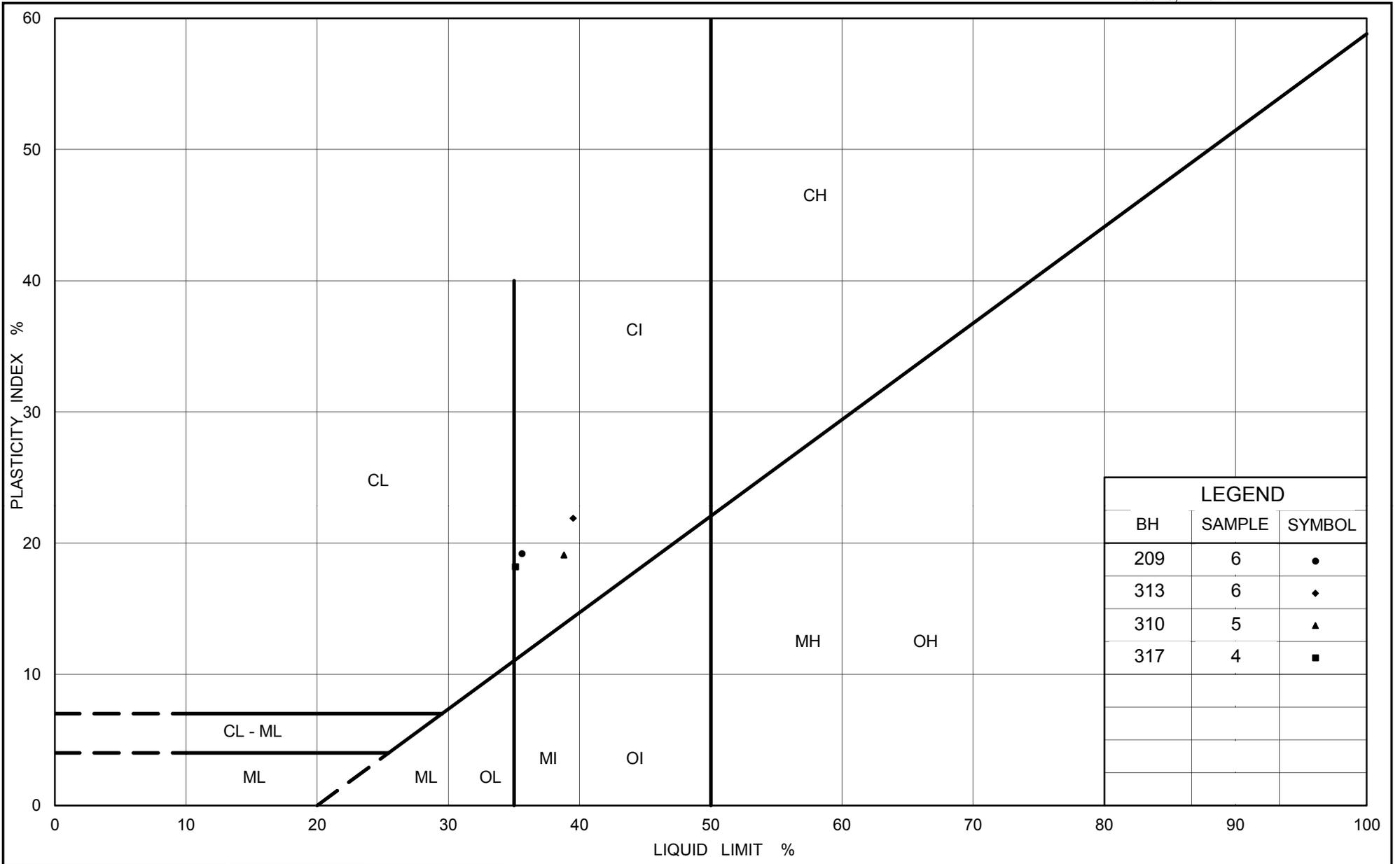
FIGURE 8



<b>COBBLE</b>	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	<b>GRAVEL SIZE</b>		<b>SAND SIZE</b>			<b>FINE GRAINED</b>
<b>SIZE</b>						

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	317	4	2.29 - 2.75
■	313	6	4.58 - 5.03
◆	209	6	4.58 - 5.03

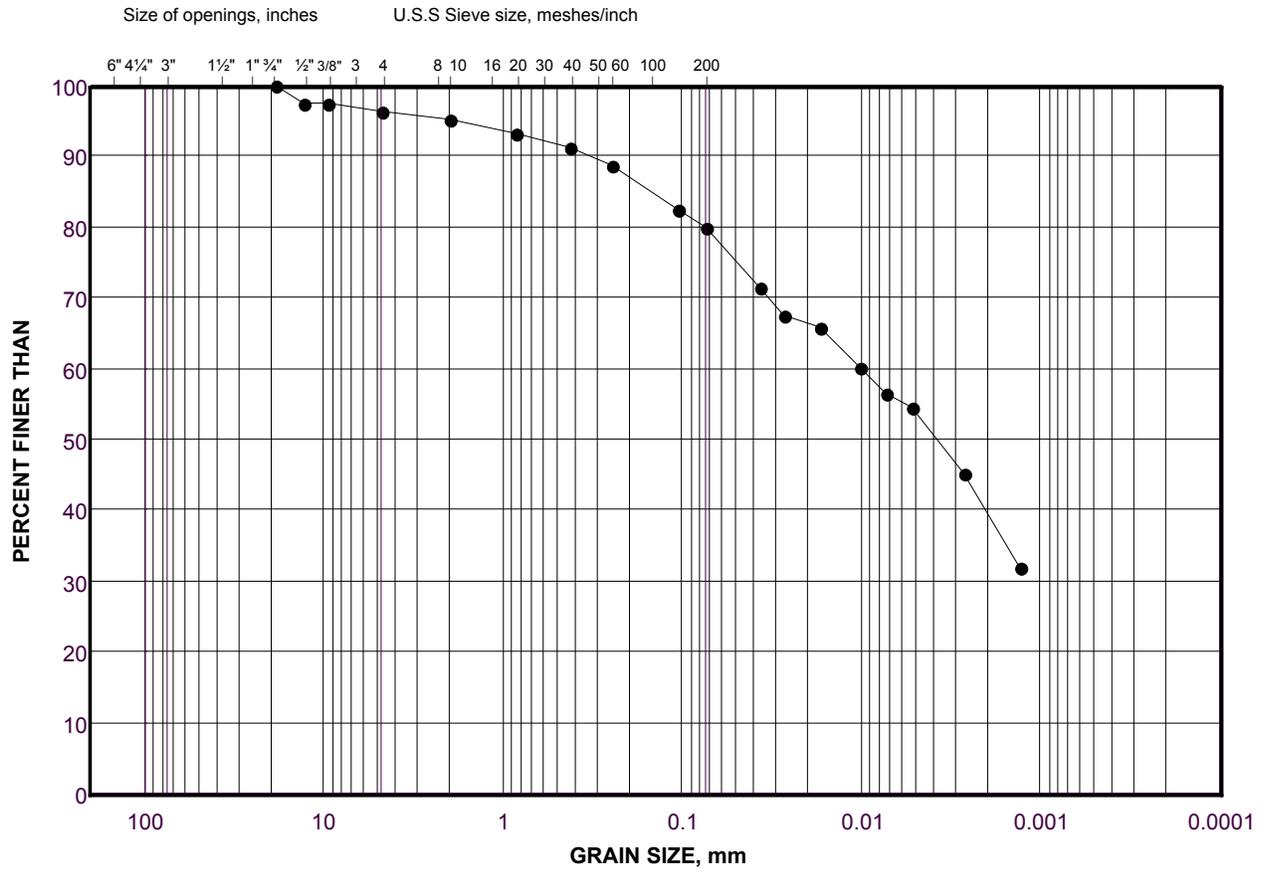


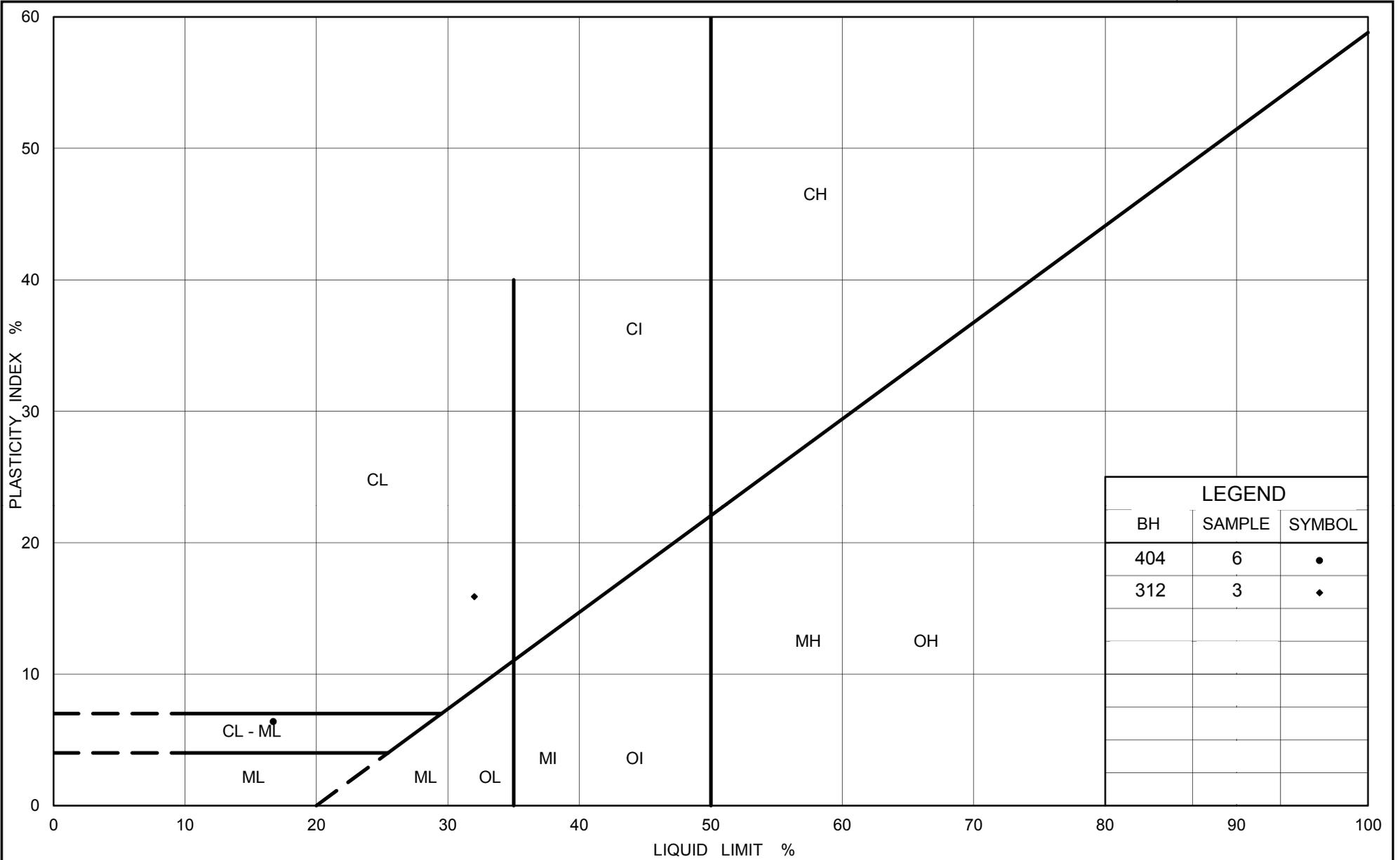
PLASTICITY CHART  
SILTY CLAY

Figure No.	9
Project No	11-1184-0109
Checked By:	

# GRAIN SIZE DISTRIBUTION CLAYE SILT (TILL)

FIGURE 10





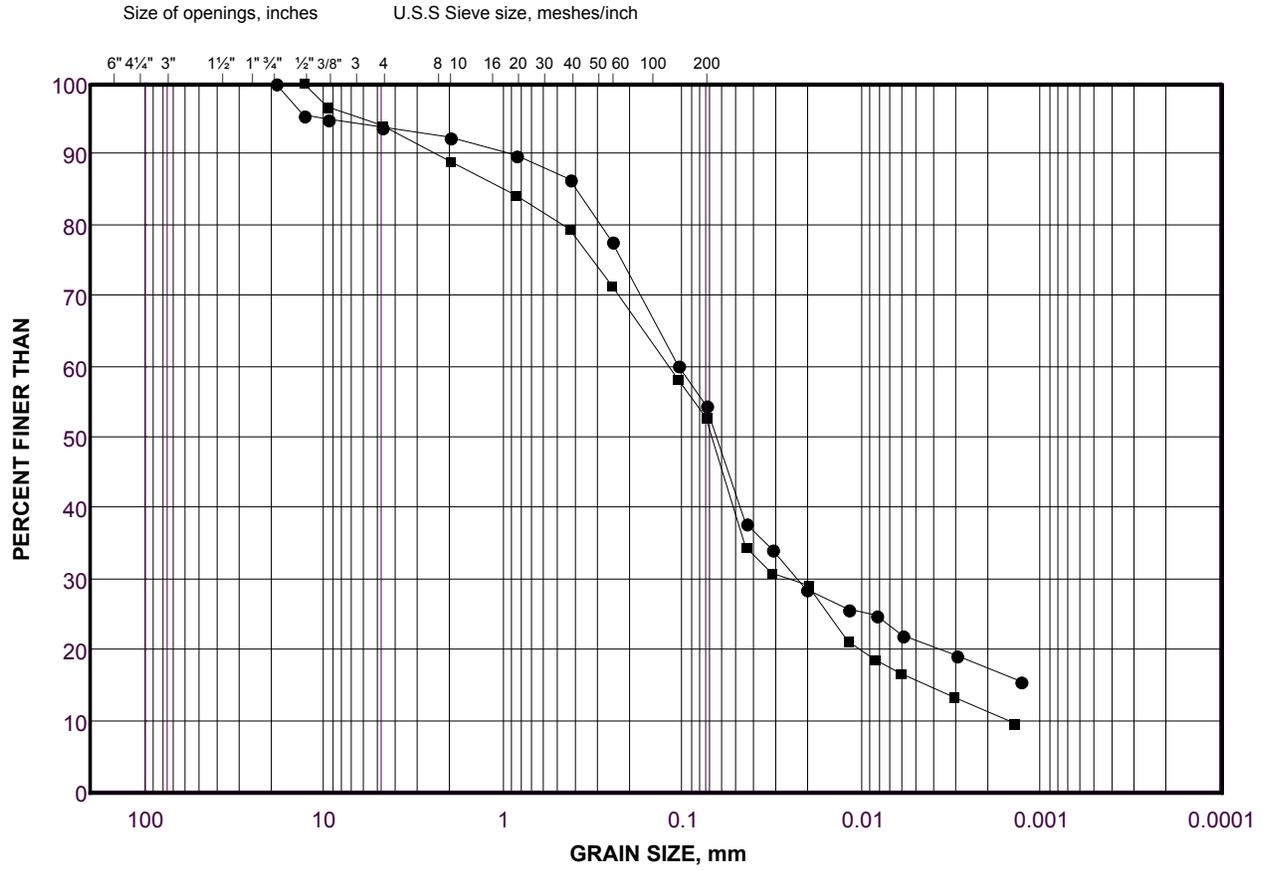
**PLASTICITY CHART  
CLAYEY SILT (TILL)**

Figure No.	11
Project No	11-1184-0109
Checked By:	

# GRAIN SIZE DISTRIBUTION

Clayey Silt and Sand (FILL)

FIGURE 12



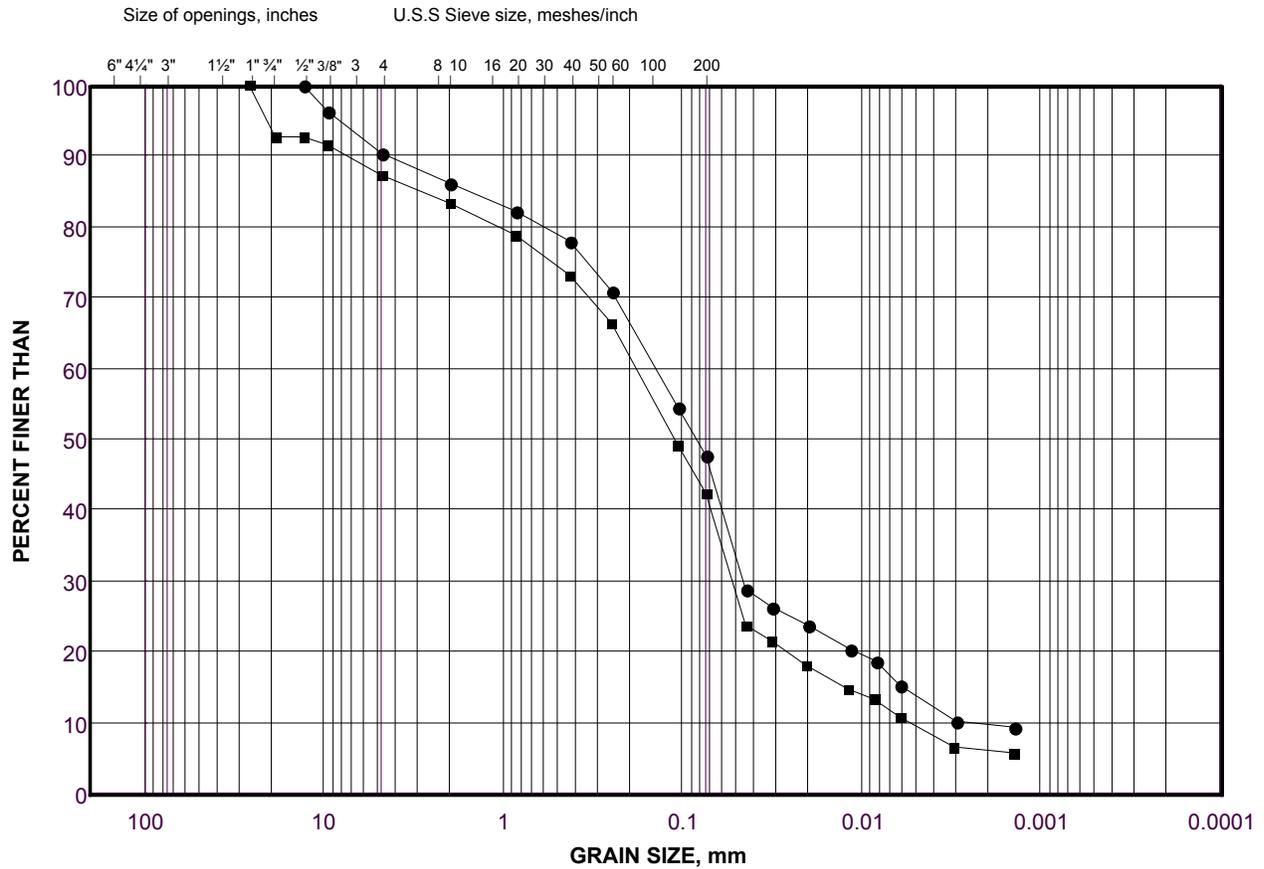
## LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	401	2	0.76 ~ 1.22
■	114	2	0.76 ~ 1.22

# GRAIN SIZE DISTRIBUTION

Silty Sand (FILL)

FIGURE 13



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	117	3	1.53 ~ 1.98
■	213	5	3.05 ~ 3.51

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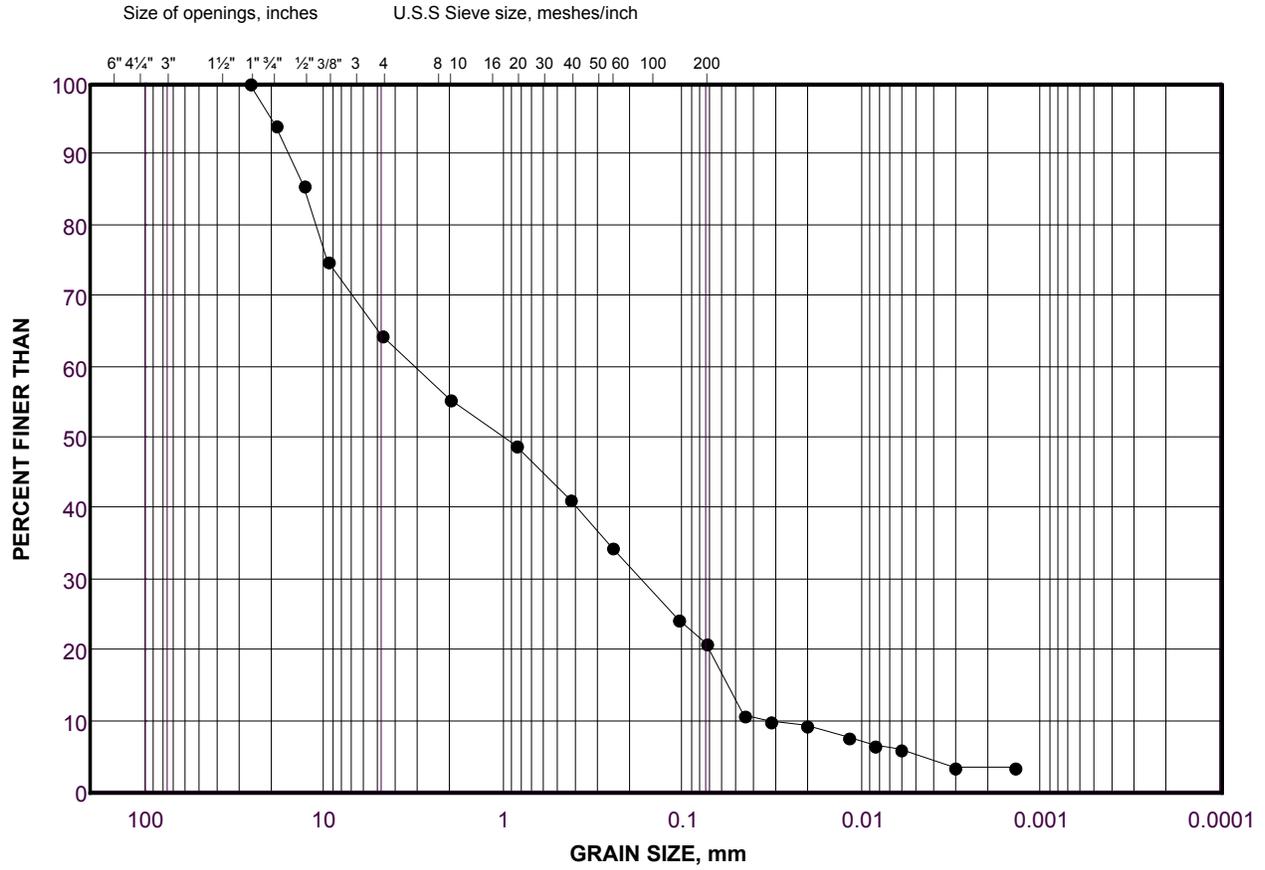
**Golder Associates**

Date: 04-Jun-12

# GRAIN SIZE DISTRIBUTION

Silty Sand and Gravel (FILL)

FIGURE 14



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES FINE GRAINED
	GRAVEL SIZE		SAND SIZE			

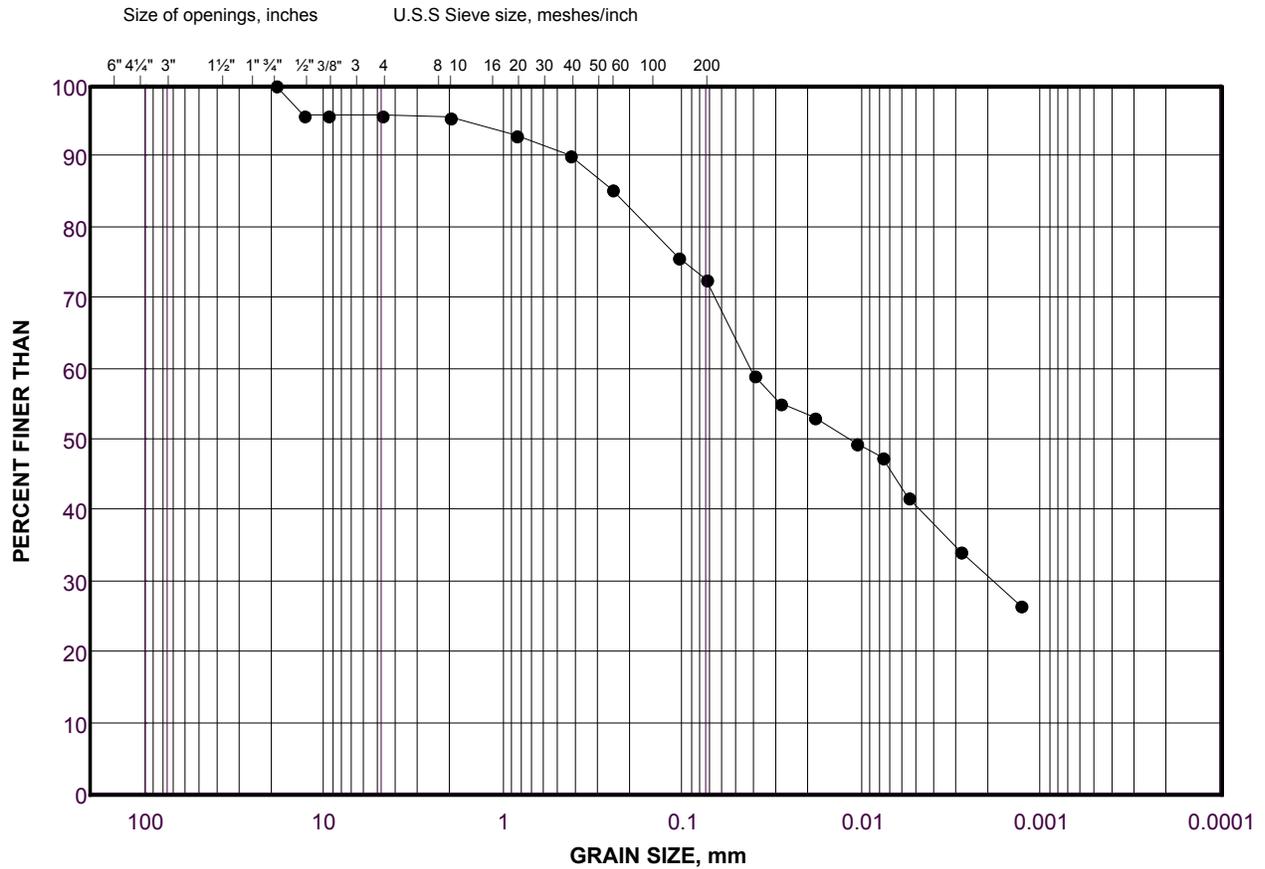
## LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	301	3	1.53 ~ 1.98

# GRAIN SIZE DISTRIBUTION

Sandy Silty Clay (FILL)

FIGURE 15



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	GRAVEL SIZE		SAND SIZE			

## LEGEND

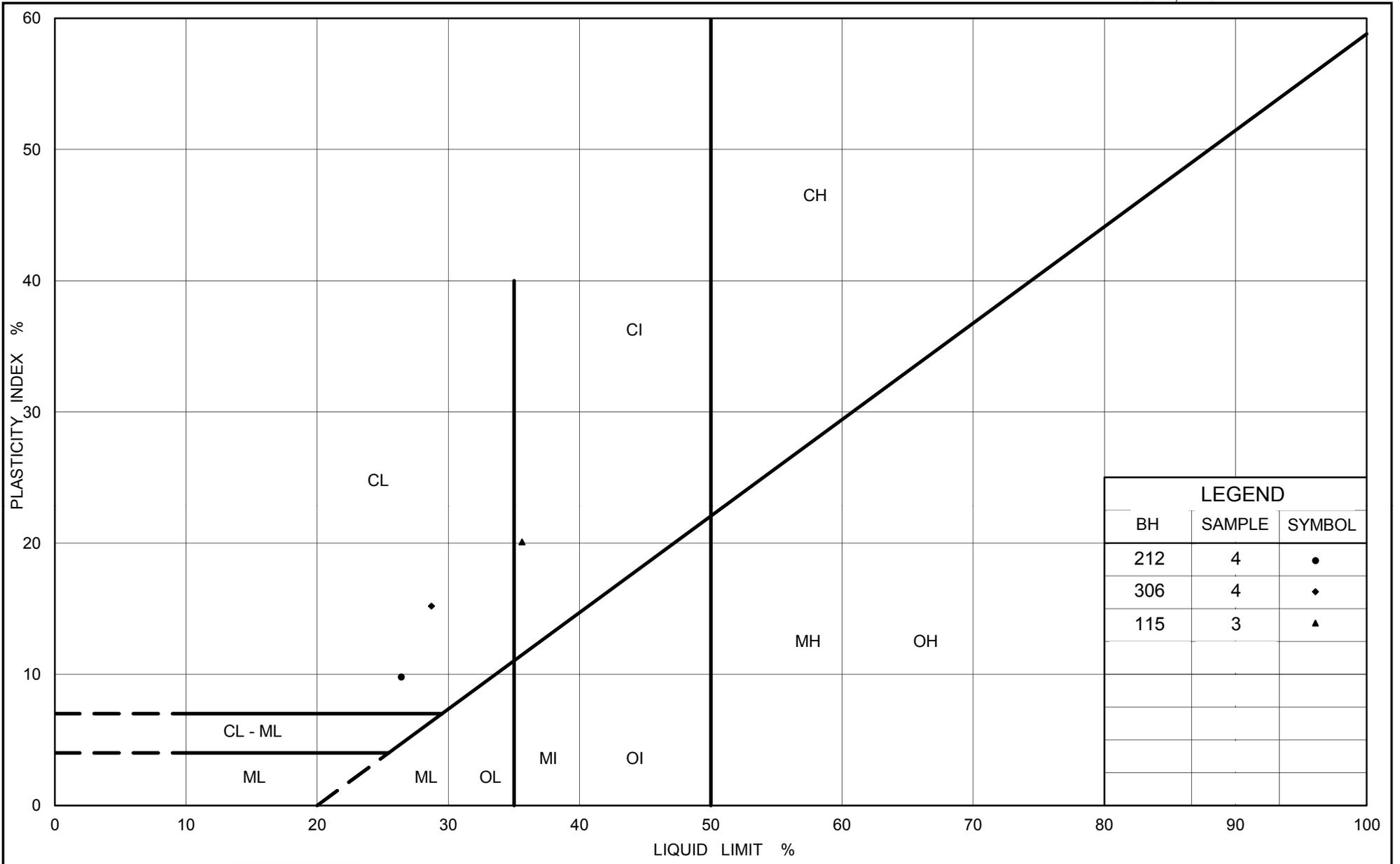
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	306	4	2.29 ~ 2.75

Project Number: 11-1184-0109

Checked By: \_\_\_\_\_

**Golder Associates**

Date: 04-Jun-12



**PLASTICITY CHART**  
 Clayey Silt to Silty Clay, Some Sand to Sandy (FILL)

Figure No.	16
Project No	11-1184-0109
Checked By:	



# **APPENDIX C**

## **Non-Standard Special Provisions**

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## **EXCAVATION FOR NOISE BARRIER WALL FOUNDATIONS – ITEM NO.**

Special Provision June 2012

### **1.0 Scope**

The foundation excavations for the noise wall will be carried out through topsoil, cohesive and cohesionless fills into clayey silt till, sandy silty to silty sand till, sand and silt. The cohesionless soils (including the silty sand till to sandy silt till, sand and silt) will be susceptible to disturbance during the caisson installation. A temporary liner should be used during excavation for the caisson holes in order to minimize ground loss during drilling and concrete placement.

### **2.0 Basis of Payment**

Payment at the contract price for the above tender item shall include full compensation for all labour and materials to complete the work.

END OF SECTION

## **BOULDERS/OBSTRUCTIONS DURING EXCAVATION FOR NOISE BARRIER WALL**

FOUNDATIONS – ITEM NO.

Special Provision June 2012

### **1.0 Scope**

The soils at the site are glacially-derived and should be expected to contain cobbles and boulders. Appropriate equipment and procedures will be required to penetrate obstructions (cobbles and boulders) that are encountered during excavation for noise barrier wall foundations.

### **2.0 Basis of Payment**

Payment at the contract price for the above tender item shall include full compensation for all labour and materials to complete the work.

END OF SECTION

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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