



**FOUNDATION INVESTIGATION REPORT**

for

**PHASE 3 CULVERTS**

**FA-4 (SITE NO. 44-547) STATION 12+347 (FOREST ACCESS ROAD)**

**SX (SITE NO. 44-562/C1 AND 44-562/C2) STATION 19+000**

**C7-1 (SITE NO. 44-556/C1 AND 44-556/C2) STATION 19+378**

**MOWAT TOWNSHIP**

**HIGHWAY 69 FOUR-LANING**

**FROM 3.5 KM NORTH OF HWY 522**

**TO 10.7 KM NORTH OF HWY 522**

**G.W.P. 5203-06-00 (PART OF G.W.P. 5378-02-00)**

**SUDBURY AREA, ONTARIO**

***PHASE 3: STA. 13+100 TO 21+500 (TOWNSHIP OF MOWAT)***

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PML Ref.: 06TF035C-3  
Index No.: 2470FIR  
GEOCRES No.: 41H-101  
December 14, 2011



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## Explanation of Terms Used in Report

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**FOUNDATION INVESTIGATION REPORT**

for

Phase 3 Culverts

FA-4 (Site No. 44-547) Station 12+347 (Forest access Road)

SX (Site No. 44-562/C1 and 44-562/C2) Station 19+000

C7-1 (Site No. 44-556/C1 and 44-556/C2) Station 19+378

Mowat Township

Highway 69 Four-Laning

From 3.5 km North of Hwy 522 to 10.7 km North of Hwy 522

G.W.P. 5203-06-00 (Part of G.W.P 5378-02-00)

Sudbury Area, Ontario

*PHASE 3: Sta. 13+100 to 21+500 (Township of Mowat)*

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**1. INTRODUCTION**

Four-laning of a 7.2 km long section of Highway 69 that extends from 3.5 km north of Highway 522 to 10.7 km north of Highway 522, about 70 km south of Sudbury, is planned. Peto MacCallum Ltd. (PML) prepared this report for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

This report summarizes the results of the foundation investigation carried out for three proposed culverts within the Phase 3 limits that were added to the original scope of culverts identified for foundation investigation. The proposed culvert FA-4 will underlie the proposed Forest Access Road at Sta. 12+347 and the proposed Snowmobile Culverts (SX) and culvert C7-1 will be situated under the new southbound and northbound lanes of Highway 69 at Sta. 19+000 and Sta. 19+378. Reported under separate cover are the four proposed wildlife culvert sites (PML Ref.: 06TF035C-1) located on 14 Mile Island between the Pickernel River and the Ojibway Canyon, culverts C8a (PML Ref.: 06TF032K) and C8 (PML Ref.: 06TF035C) located at the southern edge and within the Ojibway Canyon and the five proposed culverts C3, C4, C4A, C7 and C6-1 (PML Ref.: 06TF035C-2) located within the proposed Highway 69 northbound lanes between Sta. 15+632 and Sta. 19+100 and within the existing Highway 69 embankment (culvert C6-1). The foundation engineering for culvert C6-1 has been deleted from the scope of work.

The installation of a total of thirteen box culverts is planned within Phase 3 of the Highway 69 Four-laning project. The total excludes the deleted foundation engineering for culvert C6-1. For the purpose of this report, the remaining three culverts outside of the original scope will be

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referenced as culvert FA-4 at Sta. 12+347 (Forest Access Road), culvert SX (snowmobile culverts) at Sta. 19+000 and culvert C7-1 at Sta. 19+378, Mowat Township. The subsurface conditions for the remaining culverts in Phase 3 of the project are reported in the Pavement Design Report under separate cover.

This report summarizes the results of the subsurface field investigation conducted at the three culvert locations.

All elevations in this report are expressed in metres.

## **2. SITE DESCRIPTION AND GEOLOGY**

The 7.2 km long section of the existing Highway 69 to be realigned and four-laned is situated about 70 km south of Sudbury in a wooded region with open swampy areas. The proposed Highway 69 will utilize the existing road platform for the new northbound lanes from the southern Phase 3 limit to about 6.6 km north of Highway 522. The new alignment will diverge to the west of the existing Highway 69 within Bucke Lake at around Sta. 16+200 and will not intersect the existing alignment until Sta. 21+300, close to the northern limit of the Phase 3 (Sta. 21+500). The proposed alignment of the new Forest Access Road will run parallel at 200 to 300 m west of the new highway alignment, cross the Nisbet Creek at approximate Sta. 12+347 and terminate at the new Pickerel River Road interchange near Sta. 17+320.

Land use of the study section comprises the existing Highway 69 corridor and tourism and recreation industries near Bucke Lake and Pickerel River. The tourist establishments include fishing and hunting lodges, camps, marinas and hotels along the alignment.

The study area is located in the Precambrian Laurentian Peneplane. The topography of study area is irregular with shallow bedrock sections and deep swamp deposits, particularly near Bucke Lake. The ground cover comprises grasses and typical swamp vegetation, bushes and stands of trees.



Metasedimentary rocks of the Huronian Supergroup and gneisses of the Grenville Province underlie the alignment. The area has undergone considerable folding, intrusive activity, regional metamorphism and faulting. The bedrock outcrops at many locations throughout the project section.

### **3. INVESTIGATION PROCEDURES**

The field work for the three culvert sites included in this study was carried out during the period of February 24 and March 2 to 11, 2010. A total of 12 sampled boreholes and 2 auger probes were conducted for the study. The boreholes and the auger probes for proposed culverts C7-1 and SX were drilled to depths of 0.7 to 10.5 m, elevations 172.5 to 179.6, down to refusal on probable bedrock, excluding boreholes C7-1-1 and C7-1-AP-2, which contacted bedrock at the surface. The boreholes for the proposed culvert FA-4 were extended to 25.0 and 29.6 m, elevation 161.3 and 156.4, into competent cohesionless soils.

The locations of the test holes put down along each of the culvert sites are shown on the attached Drawings FA-4-1, SX-1 and C7-1-1.

The borehole locations were established in accordance with the MTO requirements indicated in the RFP and in general accordance with the requirements of the MTO Northeastern Region Pavement Design Practices and Guidelines (May 20, 1997). Callon Dietz Inc., Ontario Land Surveyors, laid out the reference lines of the new highway in the field and these lines in conjunction with staking along the proposed culvert alignments were used by PML. The ground surface elevations at the boreholes were provided by Callon Dietz Inc.

The boreholes were advanced using continuous flight hollow and solid stem augers and by using wash boring techniques, powered by a track-mounted D-50 and D-25 drill rigs. Manual sampling equipment was utilized for the investigation of the proposed culvert C7-1 due to the varying quality of the ice conditions. The equipment was supplied and operated by a specialist drilling contractor working under the full-time supervision of members of PML engineering staff. The culvert boreholes were taken into competent native soils or to refusal on probable bedrock.



Representative soil samples were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Penetrometer and in-situ vane shear testing (using the MTO 'N' vane) were also performed to further assess the shear strength of the cohesive soils encountered. The penetrometer test results are typically less than the actual values due to sample disturbance. The results of the field tests and observations are reported on the appended Record of Borehole sheets.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open borehole. Upon completion of drilling, all the boreholes were backfilled with a bentonite/cement mixture in accordance with the MTO and MOE Reg. 903 guidelines for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The recovered samples were returned to our laboratory for detailed visual examination and classification. The laboratory testing programme consisted of moisture and organic content determinations, Atterberg plasticity limits tests and grain size distribution analyses. Atterberg plasticity limits were not attempted on samples deemed to be non-plastic by visual and tactile examination.

The results of the laboratory Atterberg plasticity limits and grain size distribution analyses are presented on the appended plasticity charts and grain size distribution figures, which were identified with the respective codes PC and GS.



#### **4. SUMMARIZED SUBSURFACE CONDITIONS**

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, soil boundary elevations, standard penetration resistance values, in-situ vane shear and penetrometer test data and groundwater observations. The results of laboratory Atterberg plasticity limits testing, grain size distribution analyses and moisture content determinations are also shown on the Record of Borehole sheets.

The borehole locations are shown on Drawings FA-4-1, SX-1 and C7-1-1. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

A description of the subsurface stratigraphy at each culvert location is summarised in the following subsections of the report.

##### **4.1 Culvert FA-4 (Site No. 44/547) at Sta. 12+347 (skewed) (Forest Access Road), Mowat Township**

Reference should be made to the previous boreholes conducted in swamp 314 (boreholes 314-9 to 314-13, including the dynamic cone penetration tests 314-10 and 314-12) that are within proximity to the proposed Forest Access Road FA-4 culvert, particularly borehole 314-11 located 3 m north of the centreline of the culvert. The boreholes revealed consistent soil conditions with some 4.7 to 5.1 m thick combined deposits of peat and organic clay/ silty clay extending to elevation 180.5 and 180.9, overlying a combined 3.2 m thick cohesionless sand and sandy silt deposit in borehole 314-9 and a 2.7 m thick silt deposit in borehole 314-13, which in turn overlaid extensive layered cohesive deposits of clayey silt/ silty clay/ clay extending to depths of 23.2 to 25.0 m, elevation 161.0 to 163.2, penetrating into the underlying cohesionless silt deposit below. Refusal on probable bedrock was encountered at depths of 29.7 and 34.4 m, elevation 156.3 and 151.7 in boreholes 314-9 and 314-11, respectively.

Two boreholes designated FA-4-1 and FA-4-2 were drilled along the skewed alignment of proposed culvert FA-4 at Sta. 12+347 (Forest Access Road) in March 2010. The subsurface



stratigraphy revealed below the surficial 300 mm thick layer of ice in the boreholes included peat and organic clayey silt, underlain by very loose sand, silty sand and silt deposits, which in turn overlaid extensive silty clay and clayey silt deposits, underlain by cohesionless silt. Boreholes FA-4-1 and FA-4-2 contacted the cohesionless silt deposit at depths of 25.5 and 22.4 m, elevation 160.5 and 163.9 and were terminated within the silt deposit at depths of 29.6 and 25.0 m, elevation 156.4 and 161.3, respectively. Groundwater was contacted just below the ice during drilling at 0.3 m depth and at the surface upon completion of drilling at elevation 186.0 and 186.3.

#### 4.1.1 Peat

Fine fibrous peat measuring 3.7 and 3.8 m in thickness was encountered at 0.3 m depth below the ice surface in boreholes FA-4-1 and FA-4-2 at elevations 185.7 and 186.0, respectively. A moisture content determination of representative sample of the peat deposit was 813% in borehole FA-4-1. The peat deposit was penetrated at the underlying organic clayey silt at 4.0 and 4.1 m depth, elevation 182.0 and 182.2.

#### 4.1.2 Organic Clayey Silt

Underlying the peat deposits in boreholes FA-4-1 and FA-4-2, a 2.0 to 2.1 m thick organic clayey silt stratum was contacted at 4.0 and 4.1 m depth, elevation 182.0 and 182.2. The organic clayey silt was very soft in consistency. The split spoon sampler penetrated the deposits with the weight of the drilling rods. One sample obtained from the deposit was tested to determine the organic content, the test found 6.6% organic content. The organic clayey silt stratum was penetrated at 6.1 m depth, elevation 179.9 and 180.2 in boreholes FA-4-1 and FA-4-2, respectively.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative sample of the organic clayey silt deposit is presented on Figures PC-FA-4-1 and GS-FA-4-1, respectively.



The liquid limit and plastic limit of the organic clayey silt was 63 and 25, respectively, with a plasticity index value 38. The moisture content of representative samples of the organic clayey silt ranged from 169 to 175%.

#### 4.1.3 Sand and Silty Sand

A sand and silty sand deposit was contacted below the organic clayey silt at 6.1 m depth, elevation 179.9 and 180.2 in boreholes FA-4-1 and FA-4-2, respectively. The very loose cohesionless deposits were 1.5 m thick and contained trace amounts of clay. The split spoon sampler penetrated the sand deposits with the weight of the drilling rods. The moisture content of the deposits ranged from 29 to 38%. The sand and silty sand deposits were penetrated at 7.6 m depth, elevation 178.4 and 178.7.

The results of grain size distribution analyses conducted on a sample of the silty sand deposit is presented on Figure GS-FA-4-2.

#### 4.1.4 Upper Silt

Underlying the silty sand deposit at 7.6 m depth, elevation 178.7 in borehole FA-4-2, was a 1.4 m thick silt deposit. The deposit comprised some clay and trace sand. Slight plasticity (plasticity index of 5) was noted due to the clay content. The silt deposit was very loose in density. The split spoon sampler penetrated the deposit with the weight of the drilling rods. The silt was penetrated at 9.0 m depth, elevation 177.3.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative sample of the silt deposit are presented on Figures PC-FA-4-2 and GS-FA-4-2, respectively.

The liquid limit and plastic limit of the silt was 21 and 16, respectively, with a plasticity index value of 5. The moisture content of silt was 63%.



#### 4.1.5 Silty Clay and Clayey Silt

Underlying the sand and silt deposits at 7.6 and 9.0 m depth, elevation 178.4 and 177.3 in boreholes FA-4-1 and FA-4-2 were 17.9 and 13.4 m thick cohesive deposits of silty clay and clayey silt, respectively. The upper portion of the deposit comprised silty clay measuring 7.4 and 6.0 m in thickness extending to the underlying clayey silt at 15.0 m depth, elevation 171.0 and 171.3. The clayey silt measured 10.5 and 7.4 m in thickness and extended to 25.5 and 22.4 m depth, elevation 160.5 and 163.9 in boreholes FA-4-1 and FA-4-2, respectively.

Both of the deposits comprised trace amounts of sand. Clay layers were observed within the silty clay deposit in borehole FA-4-2 and silty clay layers were observed within the clayey silt deposit in both of the boreholes. The consistency of the silty clay was soft to firm and the clayey silt was firm to stiff. In-situ vane testing conducted in boreholes within the silty clay deposit indicated shear strength values from 22 to 40 kPa, with sensitivity values ranging from 2 to 3. In-situ vane testing conducted in boreholes within the clayey silt deposit indicated shear strength values from 32 to 58 kPa, with sensitivity values ranging from 2 to 4. The N values recorded within the deposits ranged from 0 (the split spoon sampler penetrating the deposits with the weight of the drilling rods or weight of the drilling rods and the hammer) to an N value of 3.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative samples of the silty clay and silty clay/ clay layers are presented on Figures PC-FA-4-3 and GS-FA-4-3, respectively.

The liquid limit and plastic limit of representative samples of the silty clay and silty clay/ clay layers ranged from 41 to 52, and from 17 to 22, respectively, resulting in plasticity index values of 24 to 30. The water content of representative samples of the silty clay and silty clay/ clay layers ranged from 29 to 96%.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative samples of the clayey silt are presented on Figures PC-FA-4-4 and GS-FA-4-4, respectively.



The liquid limit and plastic limit of representative samples of the clayey silt ranged from 26 to 28, and from 15 to 16, respectively, resulting in plasticity index values of 11 and 12. The moisture content of representative samples of the clayey silt ranged from 33 to 59%.

#### 4.1.6 Lower Silt

Underlying the clayey silt deposit at 25.5 and 22.4 m depth, elevation 160.5 and 163.9, was a cohesionless silt deposit in boreholes FA-4-1 and FA-4-2, respectively. The deposit comprised trace to some clay and trace sand. The silt deposit was very loose and loose in density. The N values recorded within the deposit ranged from 0 (the split spoon sampler penetrating the deposits with the weight of the drilling rods and the hammer) to an N value of 7. The boreholes were terminated after 4.1 and 2.6 m depth of sampling within the deposit down to 29.6 and 25.0 m depth, elevation 156.4 and 161.3 in boreholes FA-4-1 and FA-4-2, respectively.

The results of the grain size distribution analyses conducted on representative samples of the silt deposit are presented on Figure GS-FA-4-2. The moisture content of representative samples of the silt ranged from 26 to 37%.

#### 4.1.7 Groundwater

Groundwater was observed in both of the boreholes during the course of the field work in February 2010. Water was contacted below the ice surface at 0.3 m depth, elevation 185.7 to 186.0, within the boreholes during the investigation. Upon completion of drilling the groundwater level was observed at the ice surface at elevation 186.0 and 186.3.

The groundwater level observed during the investigation in March 2008 for boreholes 314-9 to 314-13 within swamp 314, contacted similar groundwater levels at 0.4 to 0.5 m depth below the ice surface at elevation 185.6 to 185.9, and observed at the ice surface afterwards at elevation 186.0 to 186.4.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



## **4.2 Culvert SX (Site No. 44-562/C1 and 44-562/C2) at Sta. 19+000, Mowat Township**

Reference should be made to the previous boreholes conducted in swamp 301 (boreholes 301-1 to 301-5, including the dynamic cone penetration test 301-4) that are within proximity to the proposed culvert SX, particularly boreholes 301-1 and 301-2 located near the centreline of the southbound and northbound culverts. The boreholes revealed consistent soil conditions with thin surficial layers of peat and topsoil overlying 0.8 to 6.6 m thick cohesive deposits of clayey silt, silty clay and clay, extending to elevation 174.6 to 180.9, underlain by 1.2 to 3.9 m thick cohesionless deposits of silt and locally sand. Refusal on probable bedrock was encountered at depths of 2.3 to 8.1 m, elevation 173.4 to 179.7.

Four boreholes designated SX-1 to SX-4 and two auger probes designated SX-AP-1 and SX-AP-2 were drilled along the southbound and northbound alignment of the proposed culvert SX at Sta. 19+000 in February and March 2010.

The subsurface stratigraphy generally revealed in the boreholes comprised a thin layer of surficial topsoil and silty sand fill extending to 0.2 to 1.1 m depth, locally with fill extending to 2.4 m depth in auger probe SX-AP-2, underlain by deposits of cohesive silty clay, clay and clayey silt, which in turn were underlain by cohesionless deposits of silt and locally, sandy silt, gravelly sand/ sand and gravel deposits. Probable bedrock was contacted below the cohesionless deposits at 2.3 to 10.5 m depth, elevation 172.5 to 181.3. Groundwater was measured during drilling at 3.1 to 9.1 m depth, elevation 173.4 to 178.5, and upon completion of drilling at 1.8 to 5.2 m depth, elevation 176.4 to 180.7.

### **4.2.1 Topsoil**

A 200 to 400 mm thick topsoil layer was encountered surficially in all the test holes except borehole SX-4. The topsoil was underlain by silty clay, clayey silt and fill at elevation 181.3 to 183.4.



#### 4.2.2 Fill

Contacted at the surface in borehole SX-4 and underlying the topsoil in borehole SX-3 and both of the auger probes at elevation 181.7 to 182.4, a 0.3 to 2.0 m thick fill layer was encountered. The fill comprised silty sand in borehole SX-3 and in the auger probes and comprised clayey silt with topsoil inclusions and plastic bags in borehole SX-4. The fill was loose to compact in density within the boreholes. The N values recorded within the boreholes ranged from 7 to 25 (with the upper portion of the fill being frozen in borehole SX-3). The moisture content of representative samples of the fill ranged from 18% for the silty sand fill and 63% for the clayey silt fill. The fill layers extended to the underlying silty clay, locally to the silt in auger probe SX-AP-2, at depths of 0.3 to 2.4 m, elevation 179.7 to 182.7

#### 4.2.3 Silty Clay

Underlying the topsoil and/ or fill layers in all of the test holes, except borehole SX-2 and auger probe SX-AP-2, at 0.3 to 1.1 m depth, elevation 181.3 to 182.7 was a 0.4 to 2.6 m thick silty clay stratum. The silty clay was typically firm in consistency, locally firm to soft in borehole SX-4. The N values obtained within the deposit ranged from 2 to 8 (with the upper portion of the silty clay being frozen in borehole SX-1). An in-situ vane test conducted in borehole SX-1 within the silty clay deposit indicated a shear strength value of 40 kPa, with sensitivity value of 4. The silty clay stratum was penetrated at 1.5 to 2.9 m depth, elevation 178.7 to 181.5, within the test holes. The moisture content of representative samples of the silty clay ranged from 31 to 46%.

#### 4.2.4 Clay

Contacted at depths of 1.5 to 3.7 m, elevation 177.9 to 181.5, a 2.0 to 4.4 m thick clay deposit was encountered underlying the silt or silty clay deposits in all of the test holes, except borehole SX-2 and auger probe SX-AP-2. The clay was generally soft to firm in consistency, locally stiff upon contact in borehole SX-3. Silty clay layers were contacted within the deposit in boreholes SX-3 and SX-4 and in the auger probe SX-AP-1. The split spoon sampler penetrated the deposit with the weight of hammer and the drilling rods in borehole SX-1. The N values recorded within the other boreholes ranged from 1 to 4. In-situ vane testing conducted within the



boreholes indicated a range in shear strength from 24 to 56 kPa. Penetrometer testing on samples of the clay deposit indicated a range of shear strength from 13 to 38 kPa. The clay deposit was penetrated at 3.8 to 5.9 m depth, elevation 179.0 to 175.8.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative samples of the clay are presented on Figures PC-SX-1 and GS-SX-1, respectively.

The liquid limit and plastic limit of a representative sample of the clay deposit was 62 and 23, respectively, resulting in plasticity index value of 39. The moisture content of representative samples of the clay ranged from 38 to 70%.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative sample of the silty clay layer contacted within the clay deposit in borehole SX-4 are presented on Figures PC-SX-1 and GS-SX-3, respectively.

The liquid limit and plastic limit of a representative sample of the silty clay layer contacted within the clay deposit was 41 and 20, respectively, resulting in plasticity index value of 21. The moisture content of this representative sample of the silty clay was 54%.

#### 4.2.5 Clayey Silt

A cohesive firm 0.5 to 2.8 m thick clayey silt layer was encountered below the clay deposit at 4.1 to 5.9 m depth, elevation 175.8 to 178.9 in boreholes SX-1, SX-3 and SX-4 and below the topsoil layer at 0.2 m depth, elevation 183.4 in boreholes SX-2. The clayey silt was firm in consistency. The split spoon sampler penetrated the deposit with the weight of hammer and the drilling rods in boreholes SX-1 and within the lower portion of the deposit in borehole SX-4. The N values ranged from 1 to 5 within the other locations. In-situ vane testing conducted within the boreholes indicated a range in shear strength from 28 to 32 kPa. A single penetrometer test on a sample of the clayey silt deposit from borehole SX-1 indicated a shear strength of 13 kPa. The clayey silt deposit was penetrated at 0.7 to 7.9 m depth, elevation 173.7 to 182.9.



The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative sample of the clayey silt are presented on Figures PC-SX-1 and GS-SX-2, respectively.

The liquid limit and plastic limit of a representative sample of the clayey silt deposit was 34 and 21, respectively, resulting in plasticity index value of 13. The moisture content of representative samples of the clayey silt ranged from 28 to 41%.

#### 4.2.6 Silt/ Sandy Silt

Cohesionless silt deposits measuring 1.4 to 4.8 m in thickness were contacted in all of the test holes, underlying the clayey silt deposit at 0.7 to 7.2 m depth, elevation 175.4 to 182.9 in boreholes SX-2, SX-3 and SX-4 and underlying the silty clay, clay and fill at 2.9, 3.8 and 2.4 m depth, elevation 178.7, 179.0 and 179.7 in borehole SX-1 and in the auger probes SX-AP-1 and SX-AP-2, respectively. The deposits comprised some clay and trace to some sand, locally with trace amounts of gravel. The silt deposits were loose in density. The N values recorded within the deposits ranged from 4 to 50 blows for 3 cm sample penetration. The N value reflects the sampler bouncing at 2.3 m depth, elevation 181.3 on the underlying probable bedrock after 3 cm of penetration in borehole SX-2. The deposit extended to refusal on probable bedrock at 2.3 to 10.5 m depth, elevation 172.5 to 181.3 in boreholes SX-2 and SX-4 and in the auger probe SX-AP-2. The deposits were penetrated at 3.7 to 8.6 m depth, elevation 174.0 to 177.9 within the other test holes.

The results of the grain size distribution analyses conducted on representative samples of the silt deposits are presented on Figure GS-SX-4. Atterberg plasticity limits tests were attempted on samples obtained from borehole SX-2 and the auger probe SX-AP-2, the tests could not be conducted due to the non-plastic nature of the silt. The moisture content of representative samples of the silt ranged from 26 to 37%.

A localized sandy silt deposit was contacted below the clayey silt in borehole SX-1 at 7.9 m depth, elevation 173.7. The 0.6 m thick deposit was compact in density. An N value of 11 was obtained



within the deposit. The sandy silt mantled probable bedrock at 8.5 m depth, elevation 173.1. A moisture content of 28% was obtained.

#### 4.2.7 Sandy Gravel/ Sand and Gravel

Underlying the silt deposit at 8.5 and 8.6 m depth, elevation 174.0 and 174.2 in borehole SX-3 and auger probe SX-AP-1, respectively, deposits of sandy gravel and sand and gravel measuring 1.3 and 0.3 m in thickness were contacted. The sandy gravel deposit in borehole SX-3 was compact in density. An N value of 22 was obtained within the deposit. The deposits mantled probable bedrock at depths 9.8 and 8.9 m, elevation 172.7 and 173.9. A moisture content of 12% was obtained within the sandy gravel deposit in borehole SX-3.

#### 4.2.8 Bedrock

Probable bedrock was contacted at 2.3 to 10.5 m depth, elevation 172.5 to 181.3. The probable bedrock surface is generally sloping downwards to the west and east sides from the proposed southbound culvert centreline.

#### 4.2.9 Groundwater

Groundwater was observed in all of the test holes during the course of the field work. Water was contacted 3.1 to 9.1 m depth, elevation 173.4 to 178.5 within the boreholes during the investigation and upon completion of drilling at 1.8 to 5.2 m depth, elevation 176.4 to 180.7.

The groundwater level observed during the investigation in March 2007 for boreholes 301-3 to 301-5 within swamp 301, contacted similar groundwater levels, ranging from the surface, elevation 181.5 in borehole 301-3, down to 3.7 m depth, elevation 178.8 in borehole 301-5. No groundwater was observed in borehole 301-1 and the groundwater level observed in borehole 301-2 upon completion of drilling was at 0.6 m depth, elevation 182.4, some 1.7 m greater than the highest measured level in 2010.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



#### **4.3 Culvert C7-1 (Site No. 44-556/C1 and 44-556/C2) at Sta. 19+378, Mowat Township**

Reference should be made to the previous boreholes conducted in swamp 301 (boreholes 301-34 to 301-38, including the dynamic cone penetration tests 301-35 and 301-37 and the preliminary borehole D6-9 and dynamic cone penetration test D6-11) that are within proximity to the proposed culvert C7-1, particularly borehole 301-36 and the dynamic cone penetration tests 301-35 and 301-37 located 3.0 m south of the proposed culvert alignment along Sta. 19+375. The boreholes revealed consistent soil conditions with shallow and exposed bedrock in boreholes 301-34 and 301-38 at elevation 180.9 and 183.0. Deposits of peat and organic silt were contacted under the ice and water at 2.8 and 3.6 m in depth, elevation 178.7 and 177.0, in borehole 301-36 and the preliminary borehole D6-9, measuring 2.0 and 3.4 m in thickness. In the preliminary borehole D6-9, underlying the organic silt at 7.0 m depth, elevation 173.6, a 2.9 m thick silt deposit was revealed. Refusal on probable bedrock was encountered at depths of 2.2 to 4.8 m, elevation 176.7 to 179.3 in borehole 301-36 and the dynamic cone penetration tests 301-35 and 301-37 and at 9.9 and 1.5 m depth, elevation 170.7 and 179.1, respectively in the preliminary borehole D6-9 and dynamic cone penetration test D6-11.

A total of six boreholes were put down along the southbound and northbound alignment of the proposed culvert C7-1 at Sta. 19+378 in March 2010. Due to the varying quality of the ice conditions along the culvert alignment manual sampling equipment was utilized.

The subsurface stratigraphy generally revealed below the 0.2 m thick layer of ice to 3.1 m thick combined layers of ice and water in the boreholes included peat underlain by organic silt and locally, by organic clayey silt. Exposed bedrock was encountered at the west end of the proposed southbound culvert and near the centreline of the proposed northbound culvert in boreholes C7-1-1 and C7-1-AP-2 at elevation 180.8 and 180.3. Probable bedrock was contacted below the peat, organic silt or organic clayey silt at 0.7 to 6.9 m depth, elevation 179.6 to 172.2. Groundwater was contacted just below the ice surface during drilling and was observed at the ice surface upon competition of drilling at elevation 179.1 to 180.3.



#### 4.3.1 Peat

Fine fibrous peat measuring 0.4 to 1.8 m in thickness was encountered at depths of 0.2 to 3.1 m below the ice or ice and water layers in all of the boreholes at elevation 176.2 to 180.0, except boreholes C7-1-1 and C7-1-AP-2. A moisture content determination of a representative sample of the peat deposit was 286%. The peat deposit mantled probable bedrock in borehole C7-1-4 at 0.7 m depth, elevation 179.6 and was penetrated at the underlying organic silt or clayey silt at 1.8 to 4.9 m depth, elevation 178.1 to 174.7 within the other boreholes.

#### 4.3.2 Organic Silt

Organic silt was encountered below the peat at 3.7 and 4.9 m depth, elevation 175.4 and 174.7 in boreholes C7-1-2 and C7-1-AP-1, respectively. The organic silt was very loose in density. The split spoon sampler penetrated the deposit with the weight of the drilling rods. One sample obtained from the deposit was tested to determine the organic content, the test found 17.3% organic content. The organic silt was underlain by probable bedrock at 5.6 m depth, elevation 174.0 in borehole C7-1-AP-1 and was penetrated at 6.0 m depth, elevation 173.1 in borehole C7-1-2. A moisture content of a representative sample of the organic silt was 161%.

#### 4.3.3 Organic Clayey Silt

Underlying the peat or organic silt deposits at 6.0 and 1.8 m depth, elevation 173.1 and 178.1 in boreholes C7-1-2 and C7-1-3, respectively, was an organic clayey silt deposit. The organic clayey silt was very soft in consistency. The split spoon sampler penetrated the deposit with the weight of the drilling rods. The organic clayey silt extended to probable bedrock at 6.9 and 2.0 m depth, elevation 172.2 and 177.9 in boreholes C7-1-2 and C7-1-3, respectively.

The results of Atterberg plasticity limits tests and grain size distribution analyses conducted on a representative samples of the organic clayey silt deposit are presented on Figures PC-C7-1 and GS-C7-1, respectively.



The liquid limit and plastic limit of the organic clayey silt was 75 and 55, respectively, with a plasticity index value 20. A moisture content of a representative sample of the organic clayey silt was 119%.

#### 4.3.4 Bedrock

Exposed bedrock was encountered at the west end of the proposed southbound culvert and near the centreline of the proposed northbound culvert in boreholes C7-1-1 and C7-1-AP-2 at elevation 180.8 and 180.3. Probable bedrock was contacted below the peat, organic silt or organic clayey silt at 0.7 to 6.9 m depth, elevation 179.6 to 172.2, within the other boreholes.

#### 4.3.5 Groundwater

No water was observed overlying the exposed bedrock in boreholes C7-1-1 and C7-1-AP-2. Groundwater was observed in all of the other boreholes during the course of the field work in March 2010. Water was contacted just below the ice surface at 0.2 to 0.4 m depth, elevation 178.7 to 180.0 within the boreholes during the investigation and was observed at the ice surface upon completion of drilling at elevation 179.1 to 180.3.

The groundwater level observed during the investigation in March 2007 for boreholes 301-34 and 301-36 and the preliminary borehole D6-9 within swamp 301, contacted similar groundwater levels just below the ice surface during drilling at depths of 0.3 to 0.6, elevation 180.0 to 181.2. The groundwater level observed in the preliminary borehole, D6-9, in March 2004 was at the ice surface at elevation 180.6 upon completion of drilling. It is inferred, although not noted, that a similar pattern occurred within boreholes 301-34 and 301-36 with the water level rising to the ice surface upon completion of drilling to elevation 181.5.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



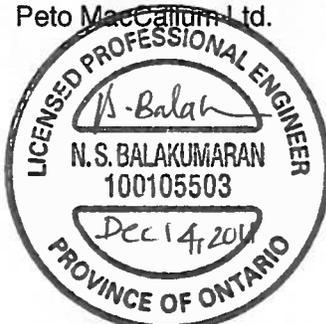
## 5. CLOSURE

The field work was carried out under the supervision of Mr. M. Rapsey, Mr. S. Aziz and Mr. D. Woodcock, under the direction of Mr. M.J. Narduzzi, P.Eng and Mr. C.M.P. Nascimento, P.Eng. Walker Drilling Ltd. supplied the drilling equipment. The laboratory work was carried out in the PML laboratory in Toronto.

This report was prepared by Mr. C.M.P. Nascimento, P.Eng., Senior Project Engineer, with the assistance of Mr. M.J. Narduzzi, P.Eng, and Mrs. N. S. Balakumaran, P.Eng. Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.



Nesam S. Balakumaran, P.Eng.  
Project Engineer



Carlos M. P. Nascimento, P.Eng.  
Senior Project Engineer



Brian R. Gray, MEng, P.Eng.  
MTO Designated Principal Contact

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**COMPOSITION:** SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0-10	10-20	20-30	30-40	>40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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

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

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

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

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

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

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

R Q D (%)	0-25	25-50	50-75	75-90	90-100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

SPACING	50mm	30-300mm	0.3m-1m	1m-3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$kPa^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_{\alpha}$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$m^2/s$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_l$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$kg/m^3$	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE
$\gamma_s$	$kN/m^3$	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\rho_w$	$kg/m^3$	DENSITY OF WATER	$S_r$	%	DEGREE OF SATURATION	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\gamma_w$	$kN/m^3$	UNIT WEIGHT OF WATER	$w_L$	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
$\rho$	$kg/m^3$	DENSITY OF SOIL	$w_p$	%	PLASTIC LIMIT	$D_n$	mm	n PERCENT - DIAMETER
$\gamma$	$kN/m^3$	UNIT WEIGHT OF SOIL	$w_s$	%	SHRINKAGE LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\rho_d$	$kg/m^3$	DENSITY OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
$\gamma_d$	$kN/m^3$	UNIT WEIGHT OF DRY SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	$m^2/s$	RATE OF DISCHARGE
$\rho_{sat}$	$kg/m^3$	DENSITY OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
$\gamma_{sat}$	$kN/m^3$	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
$\rho'$	$kg/m^3$	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
$\gamma'$	$kN/m^3$	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	$kN/m^2$	SEEPAGE FORCE
e	1, %	VOID RATIO						

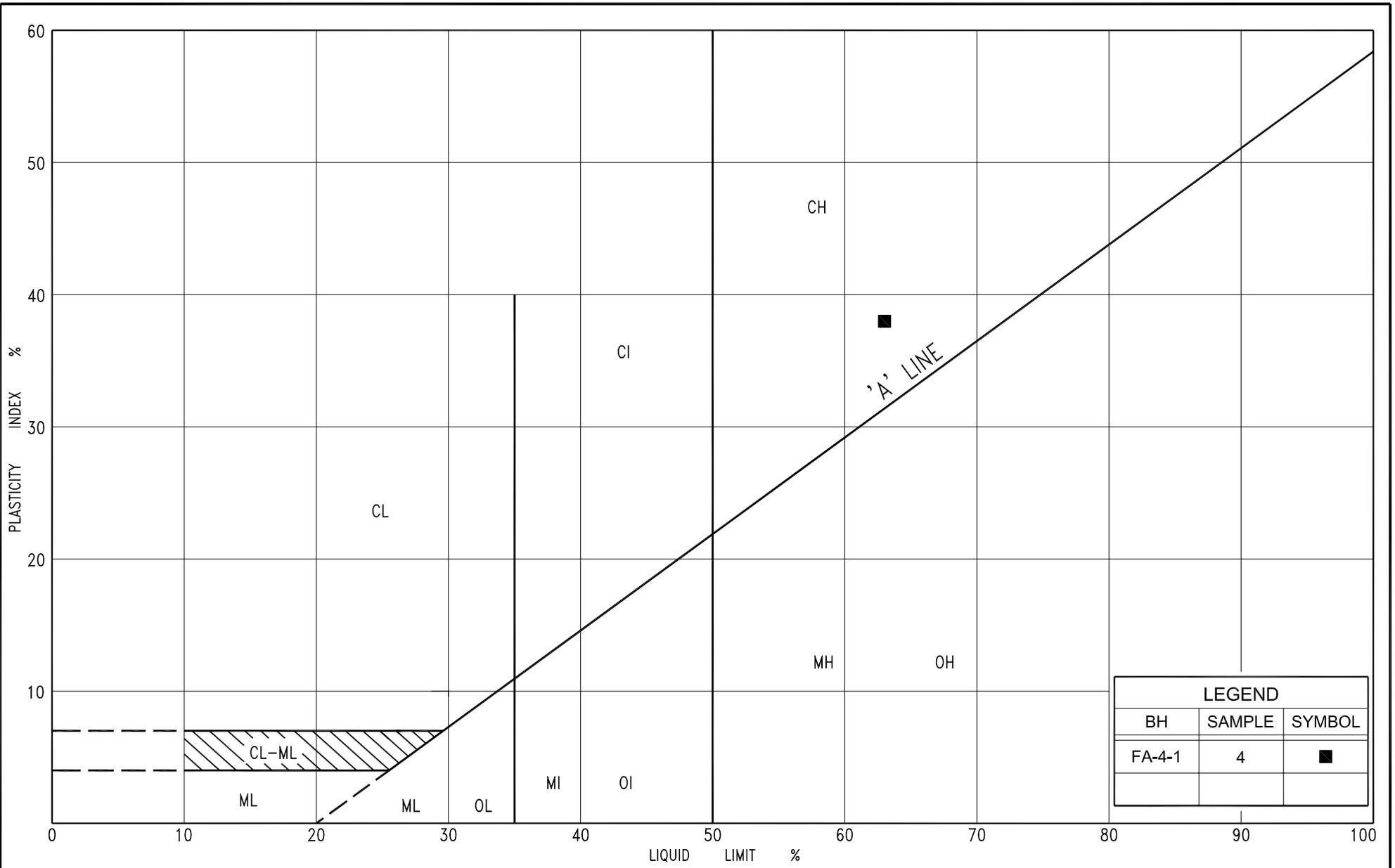
Culvert FA-4 (Site 44-547) at Sta. 12+347 (skewed)  
(Forest Access Road), Mowat Township

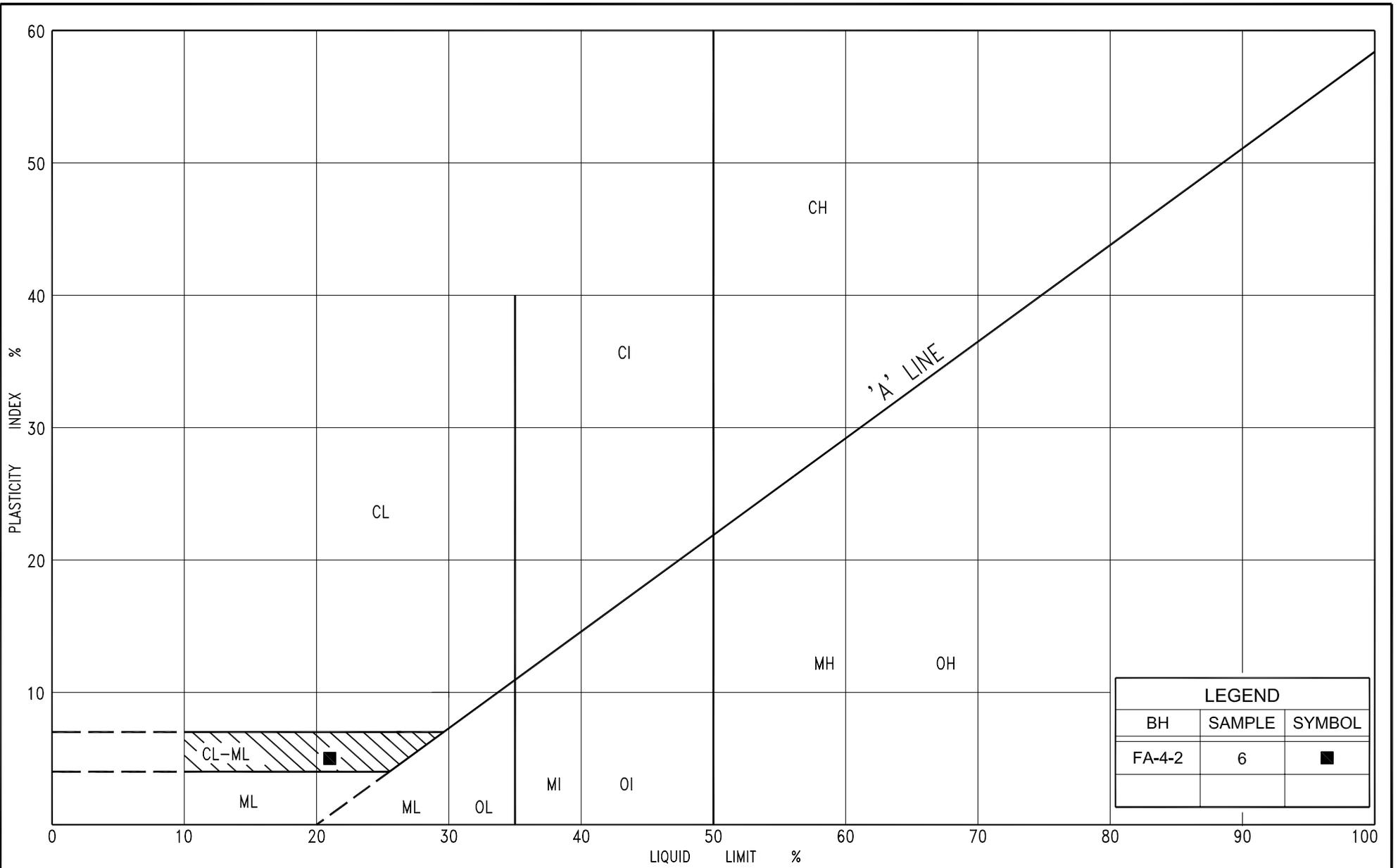
Figures PC-FA-4-1 to PC-FA-4-4 – Plasticity Charts

Figures GS-FA-4-1 to GS-FA-4-4 – Grain Size Distribution Charts

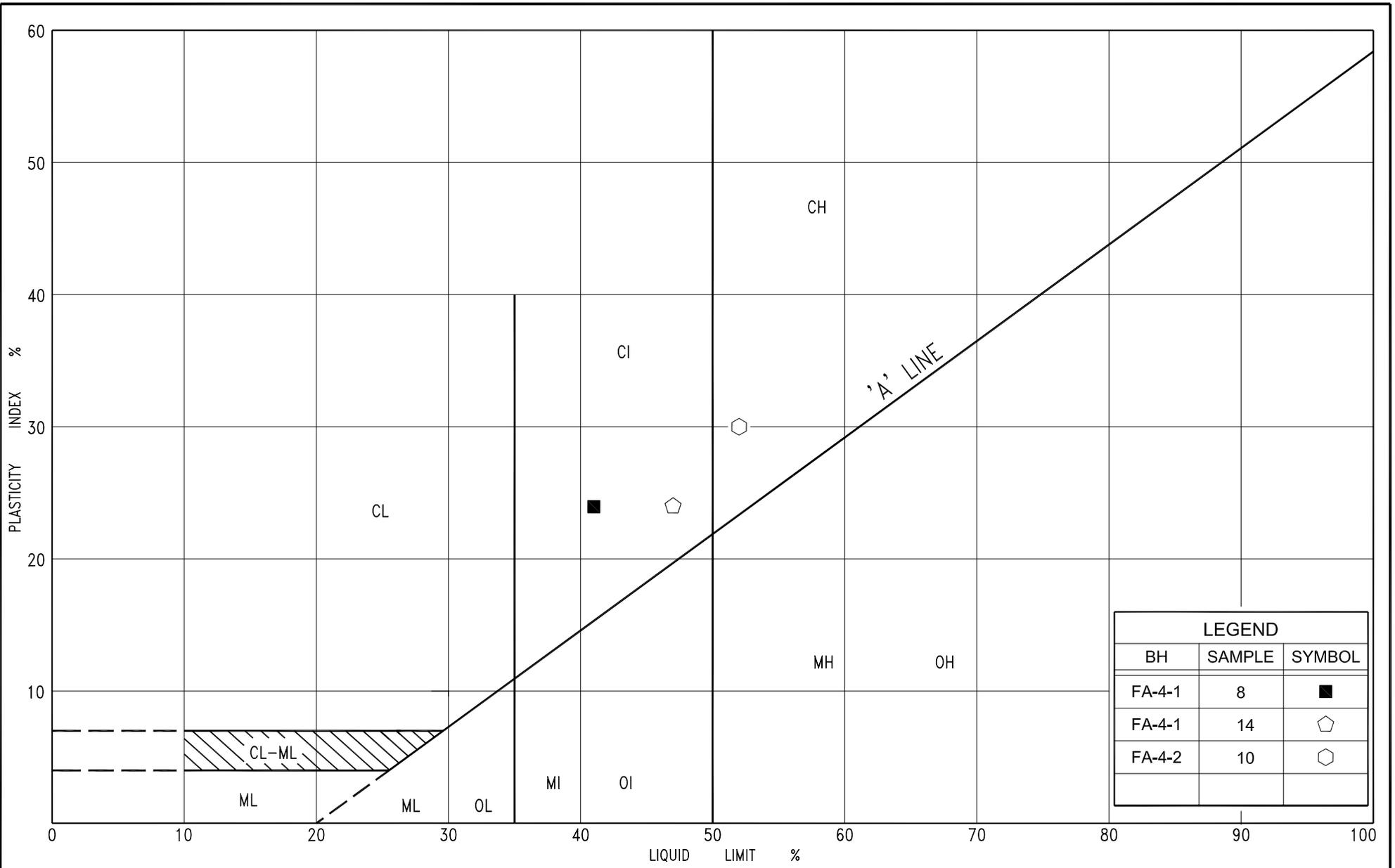
Record of Borehole Sheets

Drawing FA-4-1 – Borehole Locations and Soil Strata





LEGEND		
BH	SAMPLE	SYMBOL
FA-4-2	6	■

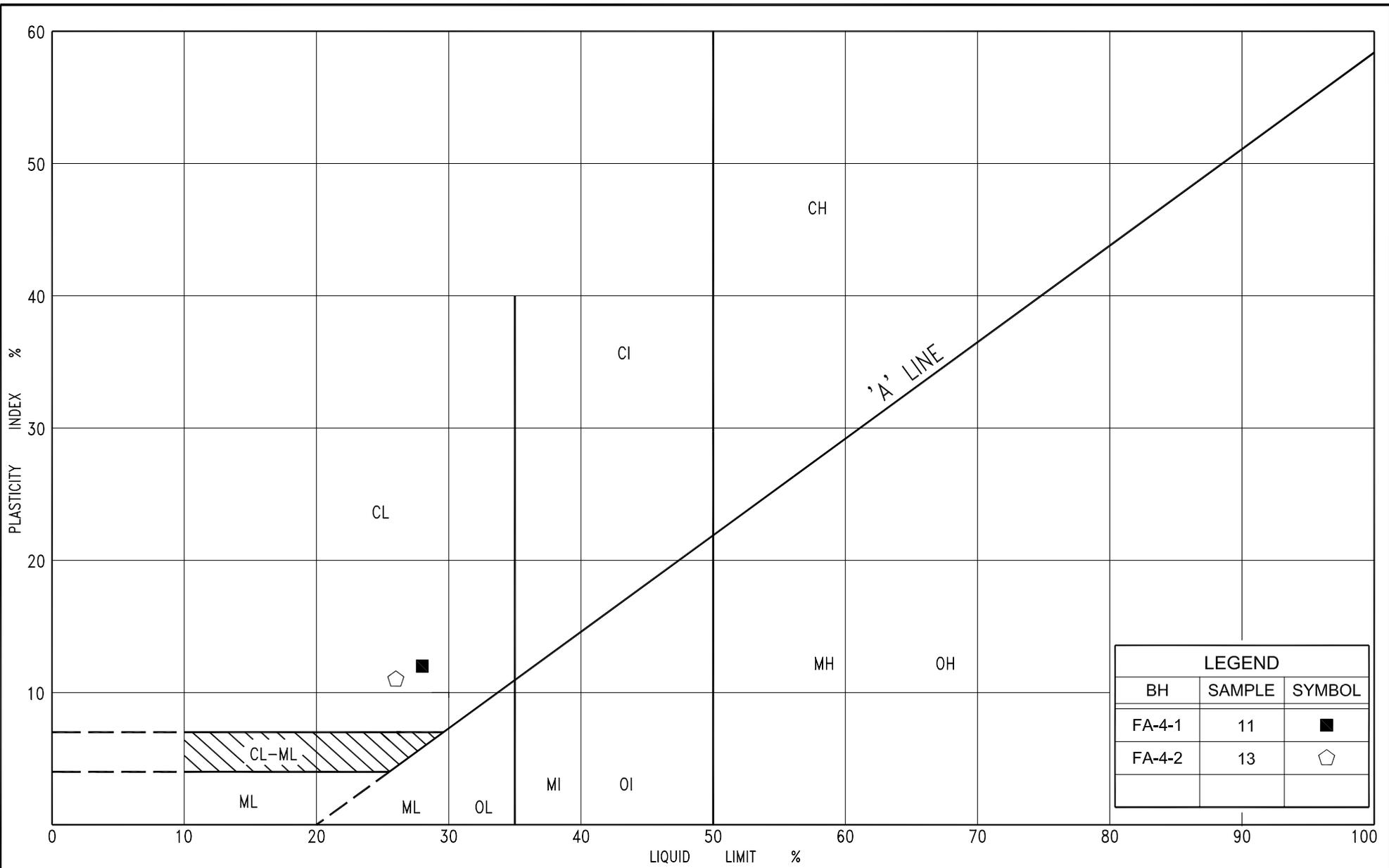


LEGEND		
BH	SAMPLE	SYMBOL
FA-4-1	8	■
FA-4-1	14	⬠
FA-4-2	10	⬡



**PLASTICITY CHART**  
**SILTY CLAY / CLAY**

FIG No. PC-FA-4-3  
 HWY: 69  
 G.W.P. No. 5203-06-00

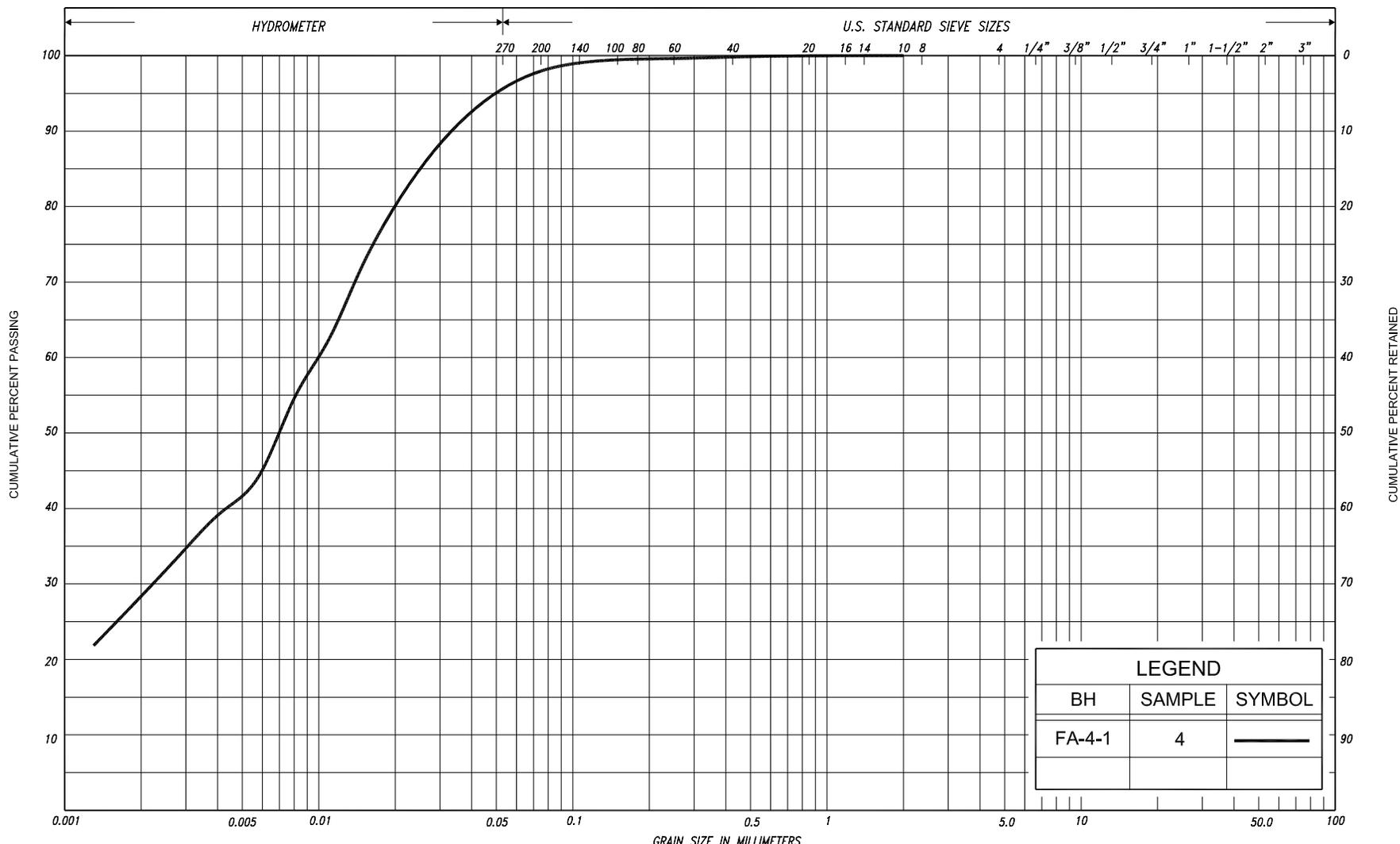


LEGEND		
BH	SAMPLE	SYMBOL
FA-4-1	11	■
FA-4-2	13	◡



**PLASTICITY CHART**  
CLAYEY SILT

FIG No. PC-FA-4-4  
HWY: 69  
G.W.P. No. 5203-06-00



LEGEND		
BH	SAMPLE	SYMBOL
FA-4-1	4	—

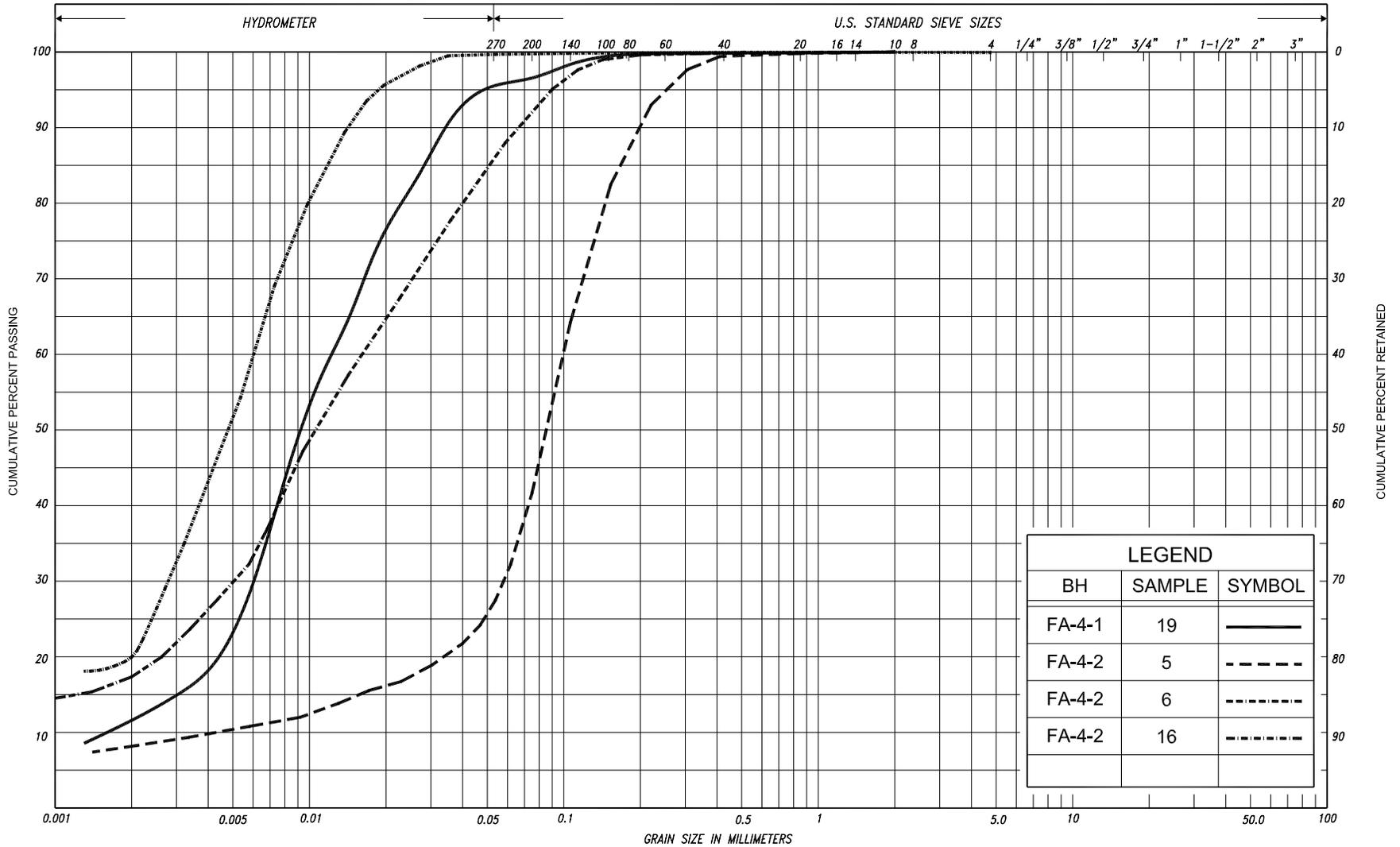
SILT & CLAY			FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			COBBLES	UNIFIED
CLAY	FINE SILT		MEDIUM SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL			COBBLES	M.I.T.
CLAY		SILT			V. FINE SAND		FINE SAND		MED. SAND		COARSE SAND		GRAVEL			U.S. BUREAU

## GRAIN SIZE DISTRIBUTION

ORGANIC CLAYEY SILT



FIG No. GS-FA-4-1  
 HWY: 69  
 G.W.P. No. 5203-06-00



SILT & CLAY			FINE		MEDIUM		COARSE		GRAVEL		COBBLES	UNIFIED		
CLAY			FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.		
CLAY			SILT		V. FINE		FINE		MED.		COARSE		GRAVEL	U.S. BUREAU

## GRAIN SIZE DISTRIBUTION

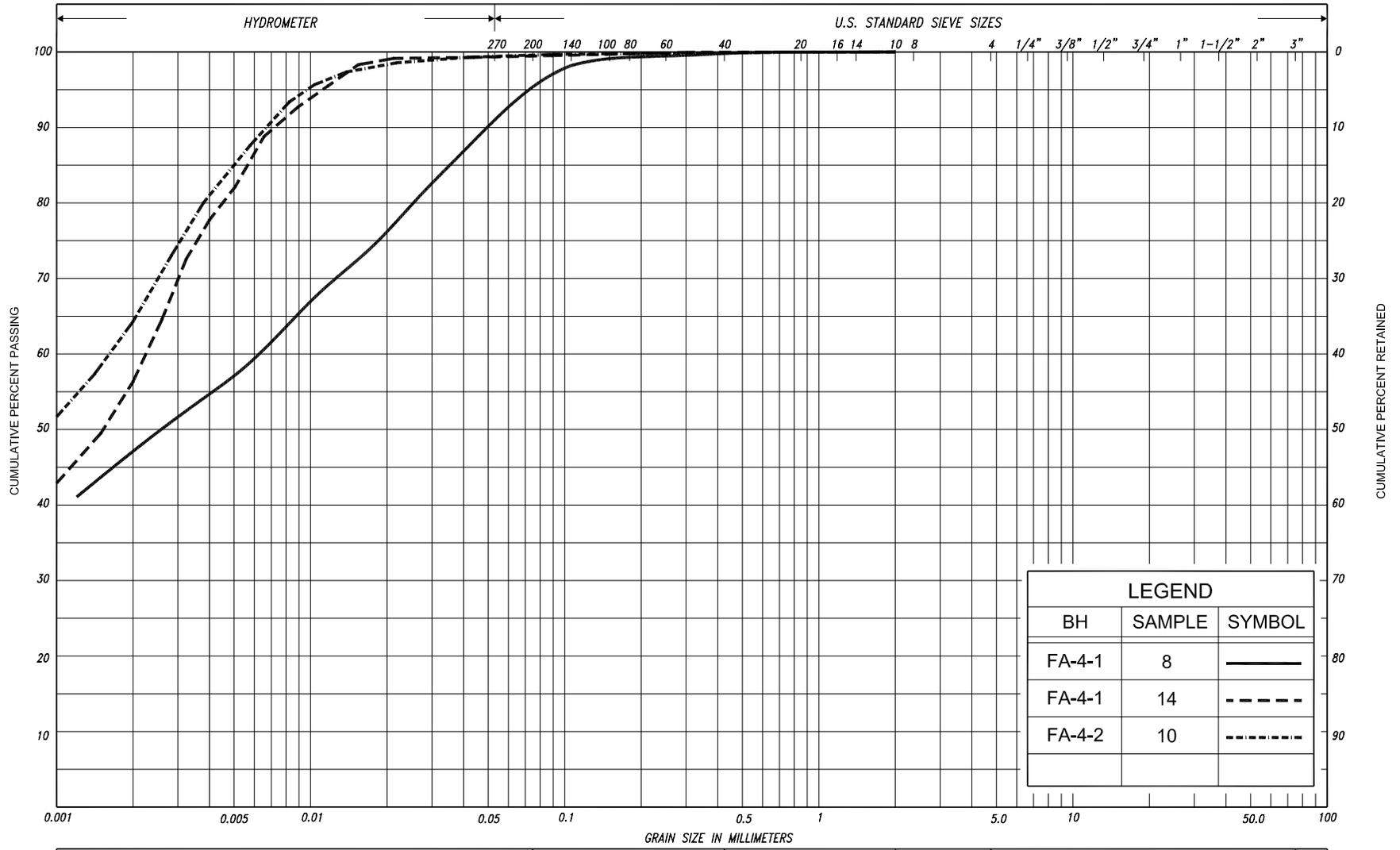
SILTY SAND / SILT



FIG No. GS-FA-4-2

HWY: 69

G.W.P. No. 5203-06-00



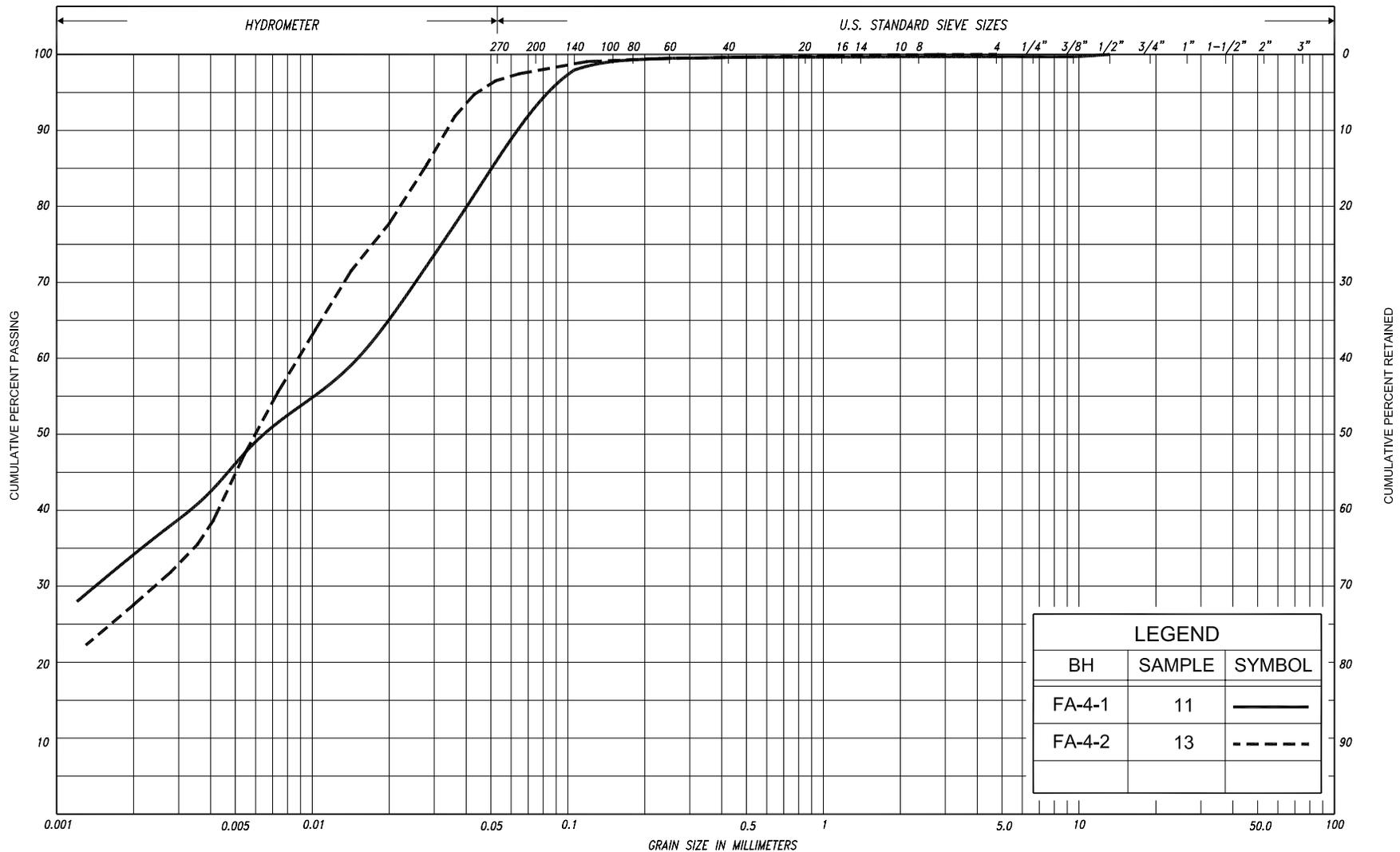
LEGEND		
BH	SAMPLE	SYMBOL
FA-4-1	8	—————
FA-4-1	14	- - - - -
FA-4-2	10	- · - · - ·

SILT & CLAY			FINE			MEDIUM			COARSE			GRAVEL			COBBLES	UNIFIED
CLAY			SAND			SAND			SAND			GRAVEL			COBBLES	M.I.T.
CLAY			SILT			SAND			SAND			GRAVEL				U.S. BUREAU

**GRAIN SIZE DISTRIBUTION**  
**SILTY CLAY / CLAY**

FIG No. GS-FA-4-3  
HWY: 69  
G.W.P. No. 5203-06-00





LEGEND		
BH	SAMPLE	SYMBOL
FA-4-1	11	————
FA-4-2	13	- - - - -

SILT & CLAY			FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			COBBLES	UNIFIED	
CLAY	FINE SILT		MEDIUM SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL			COBBLES	M.I.T.	
CLAY		SILT			V. FINE SAND		FINE SAND		MED. SAND		COARSE SAND		GRAVEL			COBBLES	U.S. BUREAU



# GRAIN SIZE DISTRIBUTION

## CLAYEY SILT

FIG No. GS-FA-4-4  
 HWY: 69  
 G.W.P. No. 5203-06-00

**RECORD OF BOREHOLE No FA-4-1 1 of 3 METRIC**

Coords: 5 092 395.4 N; 220 941.8 E

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+347, o/s 13m Lt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Casing and Washboring COMPILED BY M.N.  
 DATUM Geodetic DATE March 09, 2010 CHECKED BY C.N.

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
186.0	Ground Surface																		
0.0	Ice																		
185.7	Peat, fine fibrous Dark brown																		
0.3			1	SS	WR**														
			2	SS	WR														
			3	SS	WR									813					
182.0	Organic clayey silt trace sand Very soft Dark Wet grey																		
4.0			4	SS	WR									169	Org. 6.6%	0	2	70	28
179.9	Sand some silt to silty trace clay Very loose Grey Wet																		
6.1			5	SS	WR														
178.4	Silty clay, trace sand Soft to Grey Wet firm																		
7.6			6	SS	WH***														
				FV															
			7	SS	WH														
			8	SS	WR														
				FV															
			9	SS	WR														
			10	SS	WR														
				FV															
171.0																			

Cont'd

+7, X<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15—○—5 (% STRAIN AT FAILURE)  
 10

**RECORD OF BOREHOLE No FA-4-1 2 of 3 METRIC**

Coords: 5 092 395.4 N; 220 941.8 E

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+347, o/s 13m Lt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Casing and Washboring COMPILED BY M.N.  
 DATUM Geodetic DATE March 09, 2010 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
171.0 15.0	Clayey silt, trace sand Firm Grey Wet		11	SS	WR											0 7 59 34	
			12	SS	WH												
					FV												
			13	SS	1												
	silty clay, trace sand layers		14	SS	1											0 1 43 56	
					FV												
			15	SS	1												
			16	SS	1												
					FV												
			17	SS	WR												
160.5 25.5	Silt, trace to some clay trace sand Loose Grey Wet		18	SS	7												
			19	SS	4											0 3 85 12	
			20	SS	5												
156.4 29.6	End of borehole																

**RECORD OF BOREHOLE No FA-4-1      3 of 3      METRIC**

Coords: 5 092 395.4 N; 220 941.8 E

G.W.P. 5203-06-00      LOCATION Forest Access Road, Sta. 12+347, o/s 13m Lt. CL Med.      ORIGINATED BY D.W.  
 DIST 54      HWY 69      BOREHOLE TYPE Casing and Washboring      COMPILED BY M.N.  
 DATUM Geodetic      DATE March 09, 2010      CHECKED BY C.N.

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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>			
	* 2010 03 09																
	∇ Water level observed during drilling																
	▼ Water level measured after drilling																
	WR** Penetration due to weight of rods only																
	WH*** Penetration due to weight of rods and hammer																

**RECORD OF BOREHOLE No FA-4-2 1 of 2 METRIC**

Coords: 5 092 377.8 N; 220 964.0 E

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+337, o/s 13.5m Rt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Casing and Washboring COMPILED BY M.N.  
 DATUM Geodetic DATE March 10, 2010 CHECKED BY C.N.

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
186.3	Ground Surface																		
0.0	Ice																		
186.0	Peat, fine fibrous																		
0.3	Dark brown																		
			1	SS	WR**														
			2	SS	WR														
			3	SS	WR														
182.2	Organic clayey silt trace sand																		
4.1	Very soft Dark grey Wet		4	SS	WR									175					
	wood fragments																		
180.2	Silty sand, trace clay																		
6.1	Very loose Grey Wet		5	SS	WR											0	58	34	8
178.7	Silt some clay, trace sand																		
7.6	Very loose Grey Wet		6	SS	WR											0	8	75	17
177.3	Silty clay, trace sand																		
9.0	Soft to firm Grey Wet		7	SS	WR														
				FV															
			8	SS	WR														
			9	SS	WH***														
				FV															
	clay layers																		
			10	SS	WH														
														88		0	1	34	65
171.3																			

**RECORD OF BOREHOLE No FA-4-2 2 of 2 METRIC**

Coords: 5 092 377.8 N; 220 964.0 E

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+337, o/s 13.5m Rt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Casing and Washboring COMPILED BY M.N.  
 DATUM Geodetic DATE March 10, 2010 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
171.3 15.0	Clayey silt, trace sand Firm to Grey Wet stiff  silty clay layers		11	SS	WH											
					12	SS	WH									
					13	SS	1									0 2 71 27
					14	SS	3									
					15	SS	2									
163.9 22.4	Silt, trace to some clay Very loose Grey Wet															
					16	SS	WH									0 1 79 20
161.3 25.0	End of borehole															
					17	SS	2									

RECORD OF BOREHOLE No 314-9

1 of 3

METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+325, 12.0m Lt. CL ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 07, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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					
186.0	Top of Ice														
0.0	Ice														
185.6															
0.4	Peat, fine fibrous Dark brown														
			1	SS	WH									591	Org. 52.4%
			2	SS	WH										
182.3															
3.7	Organic clay Very soft Dark Wet to firm brown														
			3	SS	WH										
			4	SS	WH										
180.5															
5.5	Sand trace silt, trace gravel organic inclusions Very loose Grey Wet														
			5	SS	1										1 94 (5)
179.0															
7.0	Sandy silt, trace clay clayey silt seams Very loose Grey Wet														
			6	SS	1										
177.3															
8.7	Silty clay, trace sand Soft to Grey Wet firm														
			7	SS	WH										0 1 47 52
			8	SS	WH										
			9	SS	WH										
			10	SS	1										
171.0															

RECORD OF BOREHOLE No 314-9 2 of 3 METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+325, 12.0m Lt. CL ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 07, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		"N" VALUES	ELEVATION SCALE					
171.0 15.0	Silty clay, trace sand Soft to Grey Wet firm		11	SS	1							
169.6 16.4	Clayey silt, trace sand Firm to Grey Wet stiff		12	SS	WH							0 2 79 19
			13	SS	1							
			14	SS	7							0 1 72 27
162.8 23.2	Silt trace clay, trace sand Very loose Grey Wet											
161.0 25.0	End of borehole Probable silt Very loose to compact		15	SS	1							
156.3 29.7												

**RECORD OF BOREHOLE No 314-9**

3 of 3

**METRIC**

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+325, 12.0m Lt. CL ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B  
 DATUM Geodetic DATE March 07, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	End of dynamic cone penetration test Refusal on probable bedrock  Sample 15: N value affected by hydraulic disturbances  * 2008 03 07  ▽ Water level observed during drilling ▼ Water level measured after drilling  WH** Penetration due to weight of rods and hammer C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers															



RECORD OF PENETRATION TEST No 314-10

2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+325, 12.0m Rt. CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 06, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
171.1	Probable silty clay Soft to firm															
	Probable silt Compact															
	Probable sand Compact															
159.0	End of dynamic cone penetration test															

RECORD OF BOREHOLE No 314-11

1 of 3

METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+350, CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B  
 DATUM Geodetic DATE March 05 & 06, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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						
186.1	Top of Ice															
0.0	Ice															
185.6	Peat, fine fibrous Dark brown		1	SS	1											
0.5			2	SS	WH**											
			3	SS	WH									648		
			4	SS	WH									447		
182.7	Organic clay Very soft Grey Wet		5	SS	WH								179			
3.4			6	SS	WH								90			
			7	SS	WH										0 29 44 27	
180.9	Clayey silt, with sand Soft Grey Wet  thin layers of sandy silt			FV												
5.2			8	SS	WH											
				FV												
			9	SS	1											
177.1	Clay, trace sand Soft to firm Grey Wet			FV												
9.0			10	SS	2											
				FV												
			11	SS	1										0 1 25 74	
				FV												
			12	SS	1											
				FV												
171.1																



RECORD OF BOREHOLE No 314-11 3 of 3 METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+350, CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B  
 DATUM Geodetic DATE March 05 & 06, 2008 CHECKED BY C.N.

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
156.1																		
30.0	Silt trace clay, trace sand Very loose Grey Wet to loose		23	SS	8													
154.7																		
31.4	Sand, trace silt Loose to Grey Wet compact		24	SS	6													
153.5																		
32.6	End of borehole Probable sand Loose to compact																	
151.7																		
34.4	End of dynamic cone penetration test Refusal on probable bedrock																	
	* 2008 03 05																	
	∇ Water level observed during drilling																	
	▼ Water level measured after drilling																	
	WH** Penetration due to weight of rods and hammer																	
	WR*** Penetration due to weight of rods only																	
	C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																	



RECORD OF PENETRATION TEST No 314-12 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+375, 12.0m Lt. CL ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B  
 DATUM Geodetic DATE March 10, 2008 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
171.2 15.0	Probable silty clay Soft						20 40 60 80 100						
	Probable clayey silt Soft to firm						20 40 60 80 100						
	Probable silt Compact						20 40 60 80 100						
159.1 27.1	End of dynamic cone penetration test						20 40 60 80 100						

RECORD OF BOREHOLE No 314-13

1 of 3

METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+375, 12.0m Rt. CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 10, 2008 CHECKED BY C.N.

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
186.4 0.0	Top of Ice Ice																	
185.9 0.5	Peat, fine fibrous Dark brown		1	SS	1													
182.7 3.7	Organic silty clay Very soft Dark grey Wet		2	SS	1													
			3	SS	1													
			4	SS	1													
180.9 5.5	Silt trace clay, trace sand clayey silt layers Very loose Grey Wet		5	SS	1													
			6	SS	1													
178.2 8.2	Clayey silt Soft to firm Grey Wet		7	SS	1													
				FV														
			8	SS	WH**													
				FV														
	thin silty clay layers		9	SS	1													
				FV														
	red/grey		10	SS	1													
				FV														
171.4																		

Cont'd

RECORD OF BOREHOLE No 314-13 2 of 3 METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+375, 12.0m Rt. CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B  
 DATUM Geodetic DATE March 10, 2008 CHECKED BY C.N.

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
171.4 15.0	grey		11	SS	1													
				FV														
			12	SS	1													
				FV														
			13	SS	2													
				FV														
			14	SS	WR***													
163.2 23.2	Silt trace clay, trace sand thin layers of clayey silt Very loose Grey Wet																	
			15	SS	WH													
161.4 25.0	End of borehole Probable silt Very loose to compact																	
156.4																		

+7, X<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15 5 10 (% STRAIN AT FAILURE)

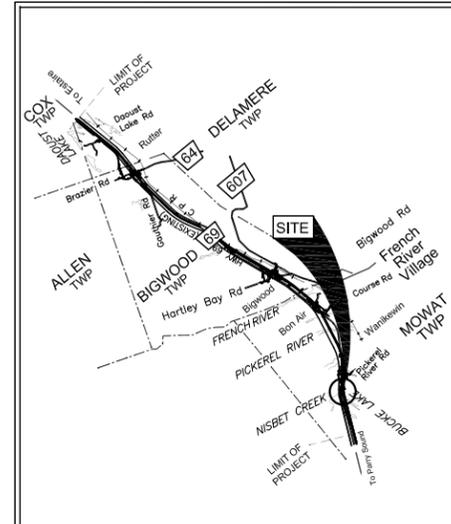
RECORD OF BOREHOLE No 314-13

3 of 3

METRIC

G.W.P. 5203-06-00 LOCATION Forest Access Road, Sta. 12+375, 12.0m Rt. CL ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 10, 2008 CHECKED BY C.N.

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
156.4																		
30.0	Probable silt Very loose to compact																	
	Probable sand Dense																	
153.5																		
32.9	End of dynamic cone penetration test																	
	* 2008 03 10																	
	∇ Water level observed during drilling																	
	▼ Water level measured after drilling																	
	WH** Penetration due to weight of rods and hammer																	
	WR*** Penetration due to weight of rods only																	
	C.F.H.S. A. Denotes Continuous Flight Hollow Stem Augers																	



KEY PLAN  
SCALE  
0 2 4 6 km

LEGEND

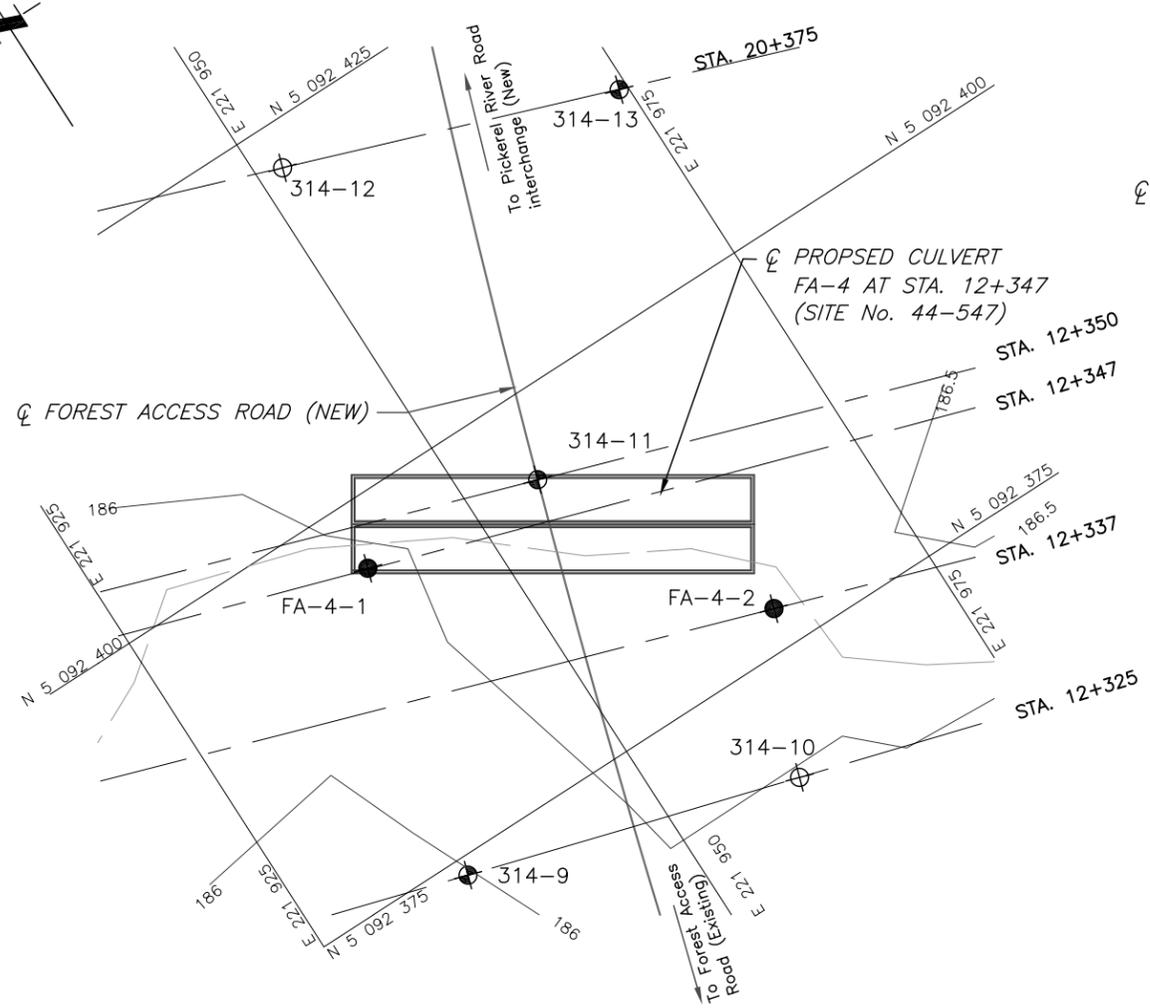
- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- WR Penetration due to weight of rods only
- W L at time of investigation March 2010
- Head Artesian Water Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
FA-4-1	186.0	N 5 092 395.4	E 220 941.8
FA-4-2	186.3	N 5 092 377.8	E 220 964.0

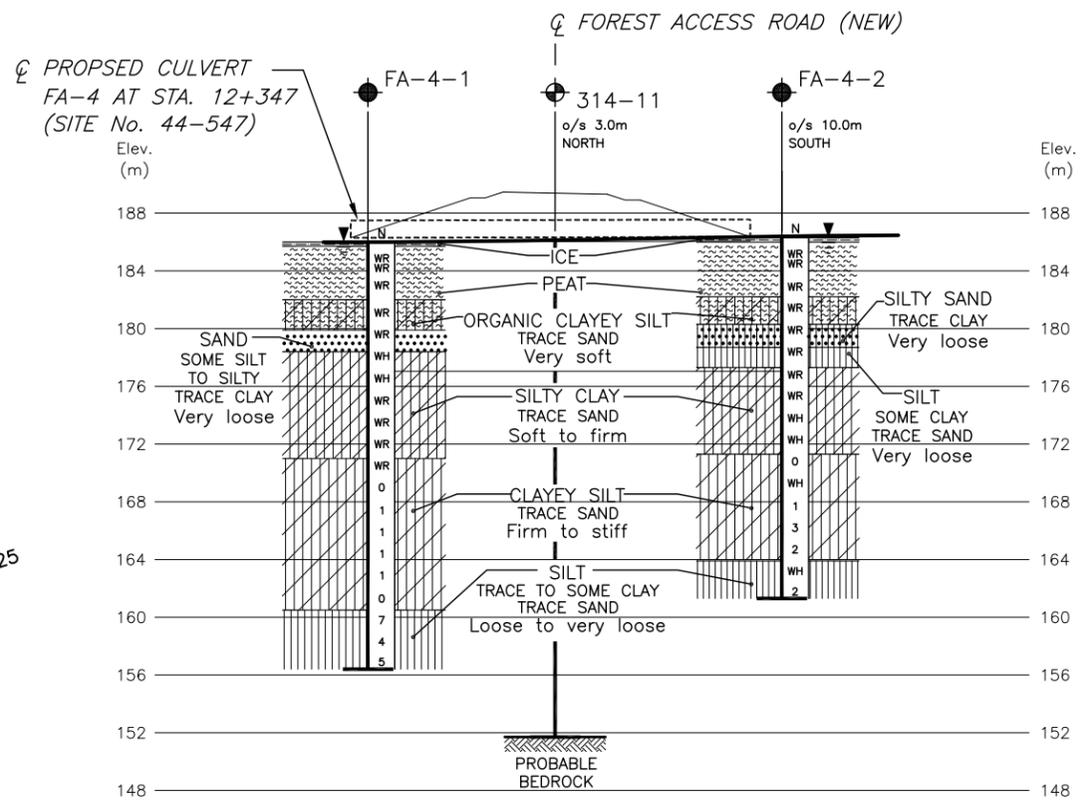
(Legend Continues)

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

REVISIONS	DATE	BY	DESCRIPTION



PLAN  
SCALE  
5 0 5 10m

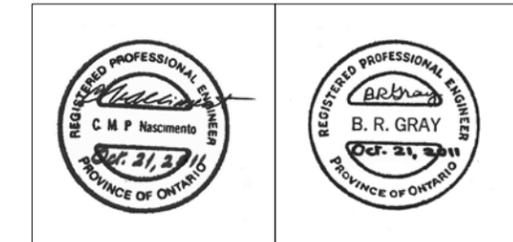


PROFILE  $\zeta$  CULVERT FA-4 AT STA. 12+347 (SKEWED)(FOREST ACCESS ROAD)

SCALE  
5 0 5 10m

(Legend Continued)

BH No	ELEVATION	STA FOREST ACCESS ROAD	o/s CL
314-9	186.0	12+325	12.0m Lt.
314-10	186.1	12+325	12.0m Rt.
314-11	186.1	12+350	CL
314-12	186.2	12+375	12.0m Lt.
314-13	186.4	12+375	12.0m Rt.



REF.: MRC DRAWINGS  
H6454\_PHASE3\_XA01.dwg; H6454\_PHASE3\_XN01.dwg;  
Phase\_3\_Culvert\_Plan\_View\_100205;  
Phase\_3\_Culvert\_Cross\_Sections\_-\_FAR\_&\_IC\_Ramps\_090722;  
H6454xb1 zone 10; H6454xb2 contours zone 10

- NOTES:
- DRAWING FA-4-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
  - CULVERT AT STA. 12+347 WAS DESIGNATED AS CULVERT FA-4 FOR THE INVESTIGATION.
  - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

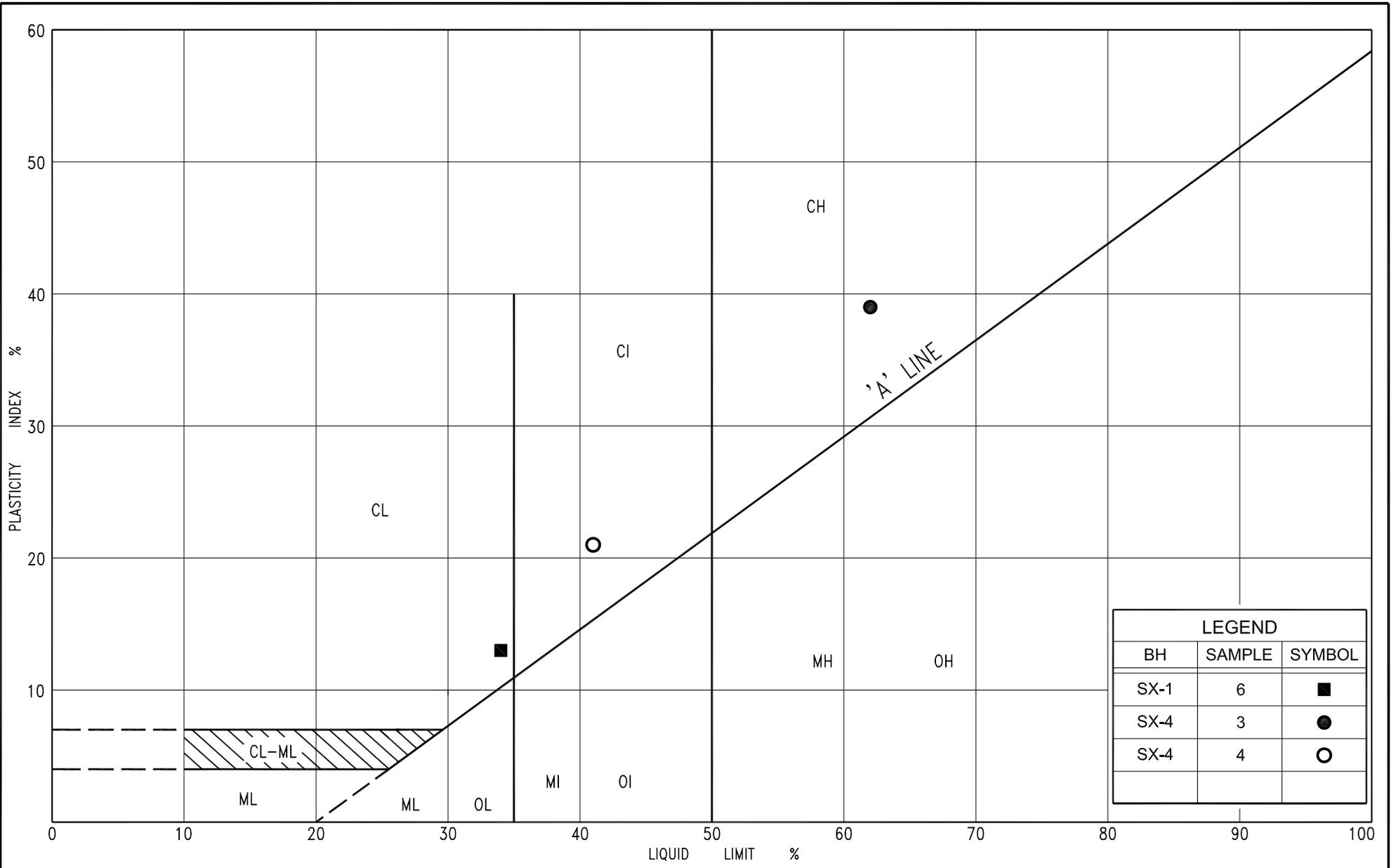
**Culvert SX (Site No. 44-562/C1 and 44-562/C2)  
at Sta. 19+000, Mowat Township**

Figure PC-SX-1 – Plasticity Chart

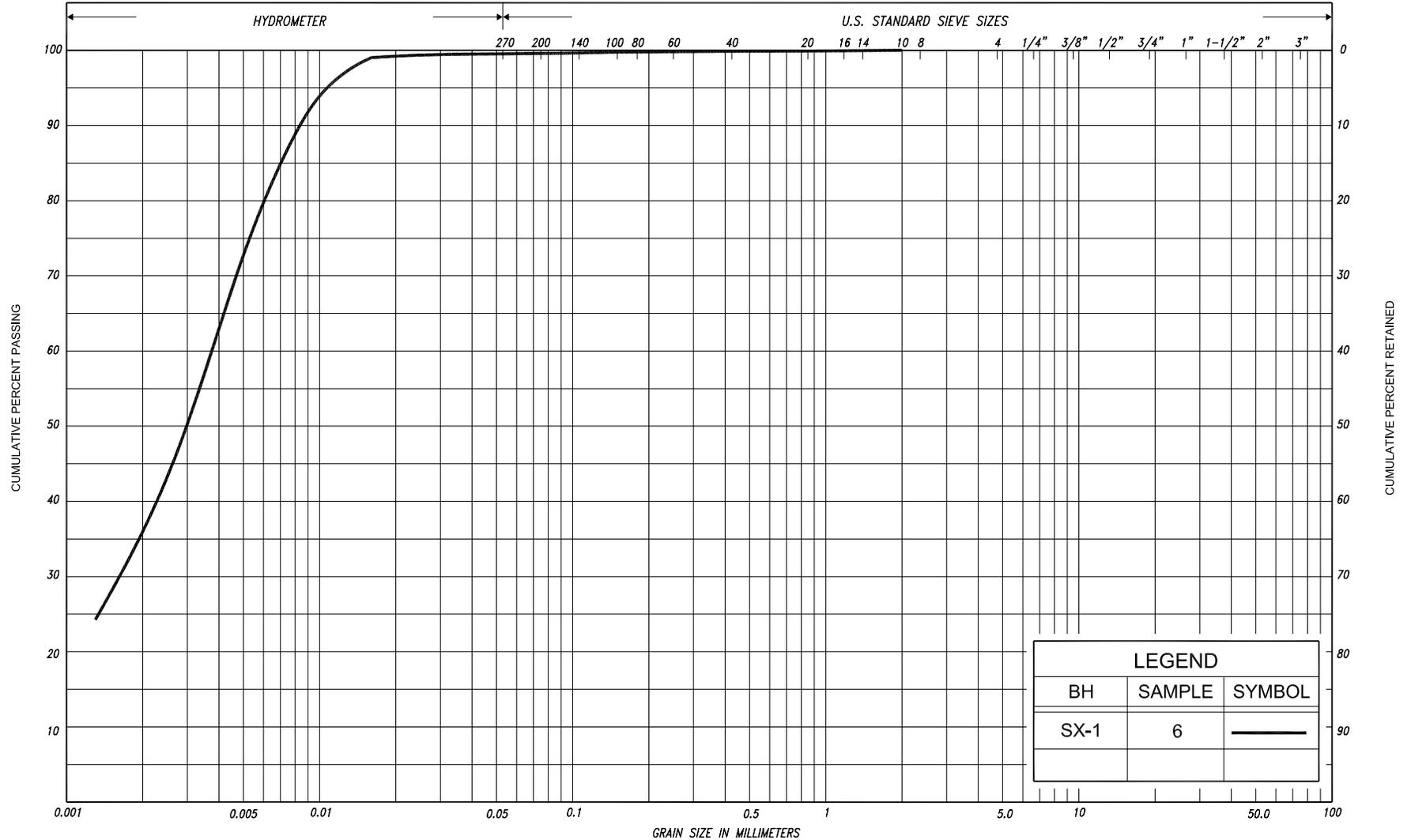
Figures GS-SX-1 to GS-SX-4 – Grain Size Distribution Charts

Record of Borehole and Auger Probe Sheets

Drawing SX-1 – Borehole Locations and Soil Strata







LEGEND		
BH	SAMPLE	SYMBOL
SX-1	6	—

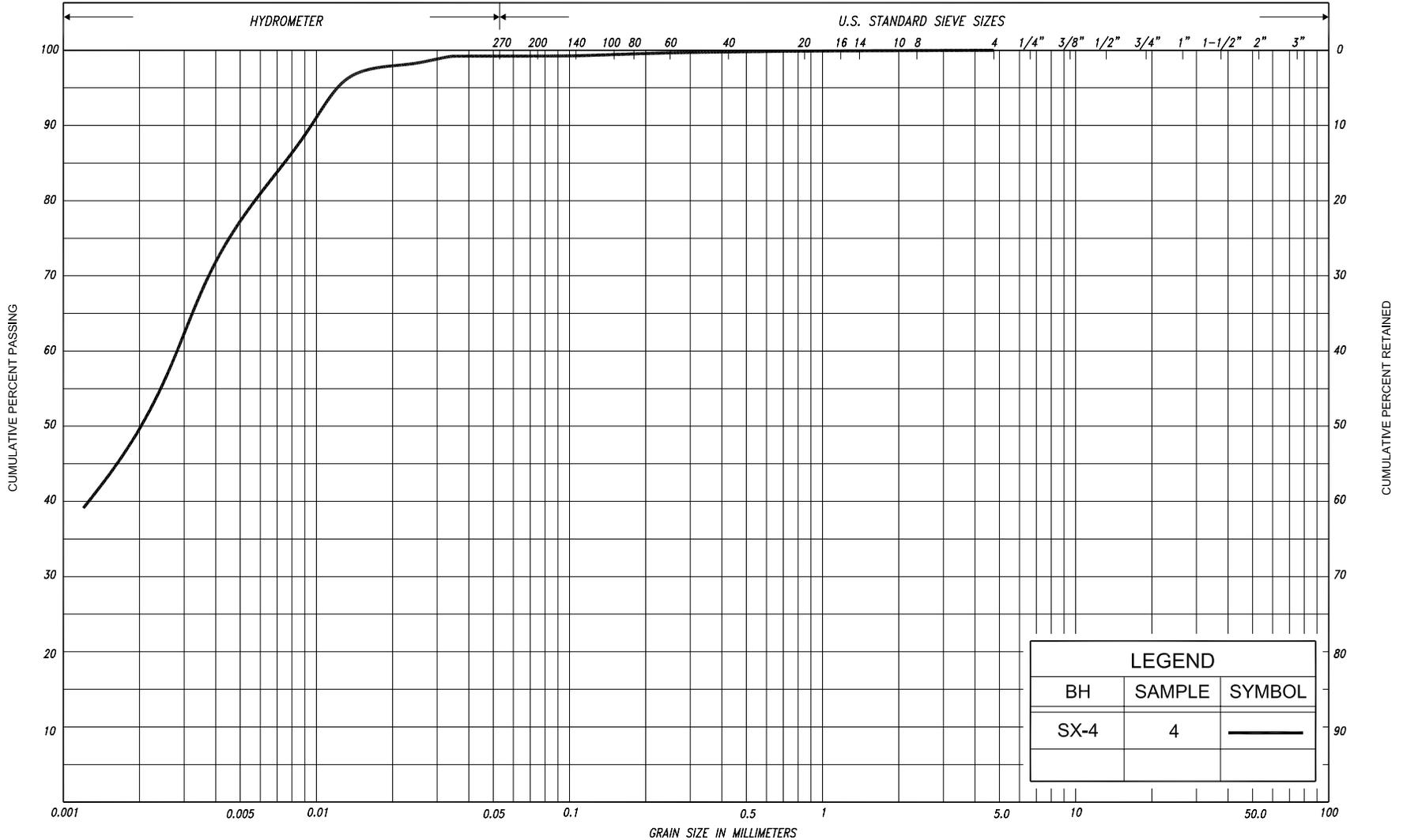
SILT & CLAY			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL		COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL		COBBLES	M.I.T.
CLAY	SILT		V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			U.S. BUREAU



## GRAIN SIZE DISTRIBUTION

### CLAYEY SILT, trace sand

FIG No. GS-SX-2  
 HWY: 69  
 G.W.P. No. 5203-06-00



LEGEND		
BH	SAMPLE	SYMBOL
SX-4	4	—

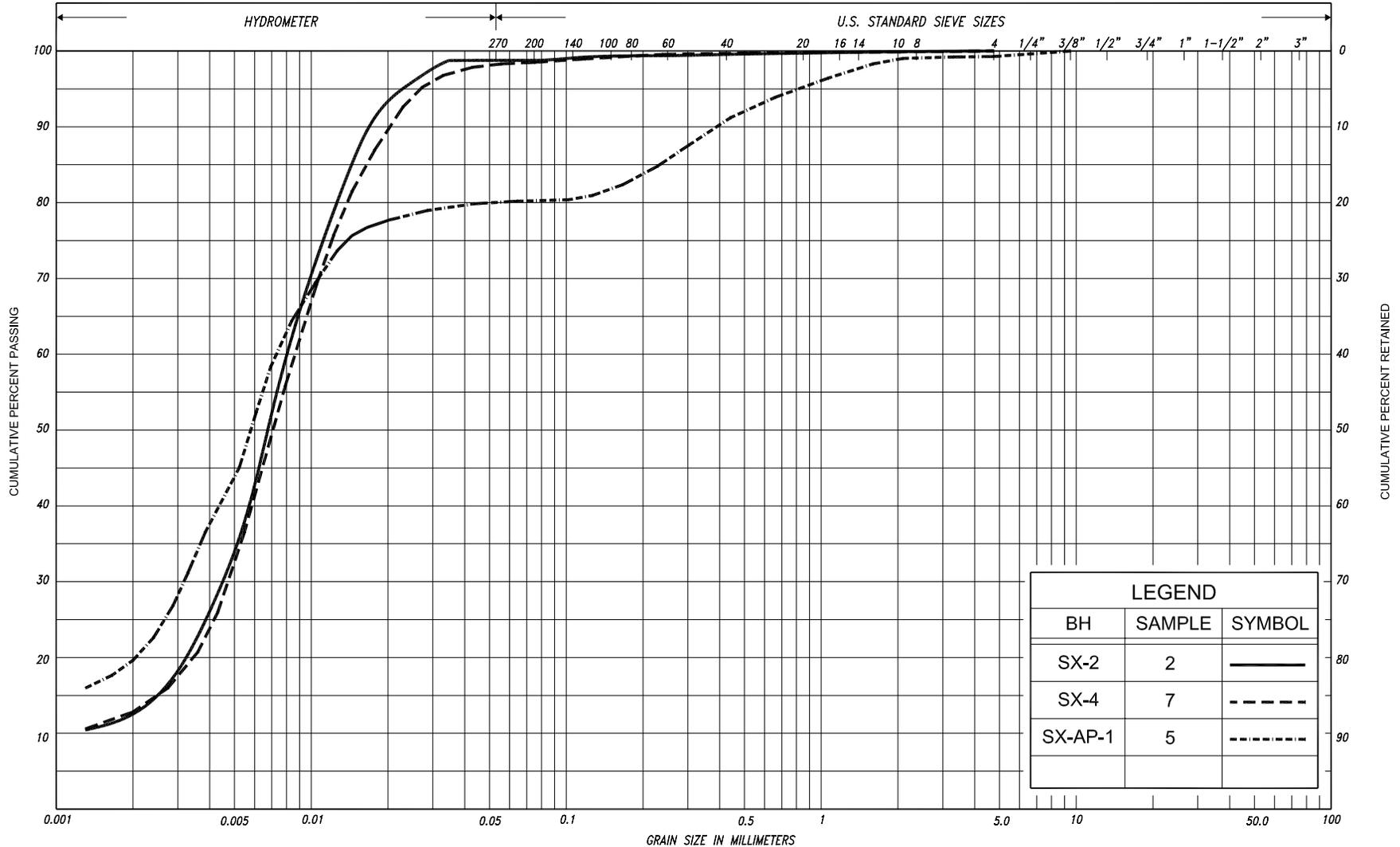
SILT & CLAY			FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			COBBLES	UNIFIED
CLAY	FINE SILT		MEDIUM SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL			COBBLES	M.I.T.
CLAY		SILT			V. FINE SAND		FINE SAND		MED. SAND		COARSE SAND		GRAVEL			U.S. BUREAU



## GRAIN SIZE DISTRIBUTION

### SILTY CLAY, trace sand

FIG No. GS-SX-3  
 HWY: 69  
 G.W.P. No. 5203-06-00



LEGEND		
BH	SAMPLE	SYMBOL
SX-2	2	—————
SX-4	7	- - - - -
SX-AP-1	5	- · - · - ·

SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL		COBBLES	UNIFIED		
CLAY				FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.		
CLAY				SILT		V. FINE		FINE		MED.		COARSE		GRAVEL	U.S. BUREAU
				SAND											



**GRAIN SIZE DISTRIBUTION**  
 SILT, some clay, trace to some sand

FIG No. GS-SX-4  
 HWY: 69  
 G.W.P. No. 5203-06-00

**RECORD OF BOREHOLE No SX-1 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 094 946.6 N; 221 753.6 E ORIGINATED BY S.A.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE March 03, 2010 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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								
181.6	Ground Surface																	
0.0	Topsoil																	
181.3	Silty clay Firm Brown Moist to grey	[Strat Plot]	1	SS	8											Top 0.3m frozen		
0.3			2	SS	4													
			3	SS	2													
				FV														
178.7	Silt some clay, trace sand Loose Grey Wet	[Strat Plot]	4	SS	5													
2.9																		
177.9	Clay, trace sand Soft to Grey Wet firm	[Strat Plot]	5	SS	WH**											0 1 10 79		
3.7																		
175.8	Clayey silt, trace sand Firm Grey Wet	[Strat Plot]	6	SS	WH											0 1 63 36		
5.8																		
173.7	Sandy silt Compact Grey Wet	[Strat Plot]	7	SS	11													
7.9																		
173.1	End of borehole Refusal on probable bedrock	[Strat Plot]																
8.5																		

**RECORD OF BOREHOLE No SX-2 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 094 948.0 N; 221 772.6 E Hwy 69(New), Sta. 19+000, o/s 11m Lt. CL Med. ORIGINATED BY S.A.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE March 02, 2010 CHECKED BY C.N.

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
183.6 0.0	Ground Surface																	
183.4 0.2	Topsoil																	
182.9 0.7	Clayey silt, trace sand		1	SS	5													
	Firm Brown Moist																	
	Silt some clay, trace sand		2	SS	7													0 1 86 13
	Loose Brown Moist to grey																	
			3	SS	7													
181.3 2.3	End of borehole		4	SS	50/3cm													
	Refusal on probable bedrock																	
	Sample 4: Sampler bouncing																	
	* Borehole dry																	



**RECORD OF BOREHOLE No SX-4** 1 of 1 **METRIC**

Coords: 5 094 951.1 N; 221 813.5 E

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 19+000, o/s 30m Rt. CL Med. ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE February 24, 2010 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) 20 40 60					
183.0	Ground Surface															
0.0	Clayey silt, some sand	[Strat Plot]	1	SS	10											
182.7	topsoil inclusions and plastic bags															
0.3	Dark brown Wet															
	Silty clay, trace sand		2	SS	3											
181.5	Firm to soft															
1.5	Brown Moist															
	Clay, trace sand		3	SS	1											0 1 23 76
	Soft to firm															
	Grey Wet															
	silty clay layer		4	SS	1											0 1 49 50
178.9																
4.1	Clayey silt															
	Firm Grey Wet		5	SS	1											
175.8																
4.1																
175.8																
7.2	Silt some clay, trace sand															
	Loose Grey Wet		7	SS	4											0 1 86 13
172.5																
10.5	End of borehole															
	Refusal on probable bedrock															

**RECORD OF AUGER PROBE No SX-AP-1 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 094 954.1 N; 221 787.2 E ORIGINATED BY S.A.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE March 03, 2010 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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
182.8	Ground Surface																	
0.0	Topsoil		1	AS	-													Top 0.4m frozen
182.4	Silty sand, trace gravel		2	AS	-													
182.0	Brown (FILL)																	
0.8	Silty clay		3	AS	-													
	Grey																	
181.0	Clay, trace sand layers of silty clay		4	AS	-													
1.8	Grey																	
179.0	Silt, some sand some clay, trace gravel		5	AS	-													1 19 61 19
3.8	Grey																	
174.2	Sand and gravel																	
8.6	Grey																	
173.9	End of borehole																	
8.9	Refusal on probable bedrock																	

\* 2010 03 03  
 Water level measured after drilling

**RECORD OF AUGER PROBE No SX-AP-2 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 094 947.0 N; 221 759.6 E ORIGINATED BY S.A.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE March 03, 2010 CHECKED BY C.N.

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	SHEAR STRENGTH kPa
182.1	Ground Surface																	
0.0	Topsoil		1	AS	-													
181.7	Silty sand Brown (FILL)		2	AS	-													
0.4																		
					3	AS	-											
179.7	Silt some sand, some clay Grey  clayey silt layers		4	AS	-													
2.4																		
					5	AS	-											
176.1	End of borehole Refusal on probable bedrock																	
6.0																		

**RECORD OF BOREHOLE No 301-1**

1 of 1

**METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+000, o/s 18.8m Lt. CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 13, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
182.0	Ground Surface															
0.0	Topsoil															
0.20	Clayey silt, trace sand															
	Firm Mottled Moist brown/reddish brown		1	SS	5											
180.90	Silt, some clay															
1.10	Loose Mottled Moist brown/grey		2	SS	6											
179.70	End of borehole															
2.30	Refusal on probable bedrock															
	* Borehole dry upon completion of drilling															



RECORD OF BOREHOLE No 301-3

1 of 1

METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+025, o/s 44.5m Lt. CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 14, 2007 CHECKED BY C.N.

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
181.5	Ground Surface																	
0.0	Peat, fine fibrous Dark brown Wet																	
0.30	Silty clay, trace sand layers of silt																	
	Very soft Mottled brown/grey		1	SS	WH**													
			2	SS	1													
179.10	Clay																	
2.40	Soft Grey Wet																	
	thin layers of silt																	
	Brown/grey		3	SS	1													
	layers of silt																	
	Firm		4	SS	1													
			5	SS	WH													
174.60	Silt, trace clay																	
6.90	Loose to compact Grey Wet																	
			6	SS	10													
173.40	End of borehole																	
8.10	Refusal on probable bedrock																	

\* 2007 03 14  
 ∇ Water level observed during drilling  
 ▼ Water level measured after drilling  
 WH\*\* Denotes penetration due to weight of rods and hammer

RECORD OF PENETRATION TEST No 301-4

1 of 1 METRIC

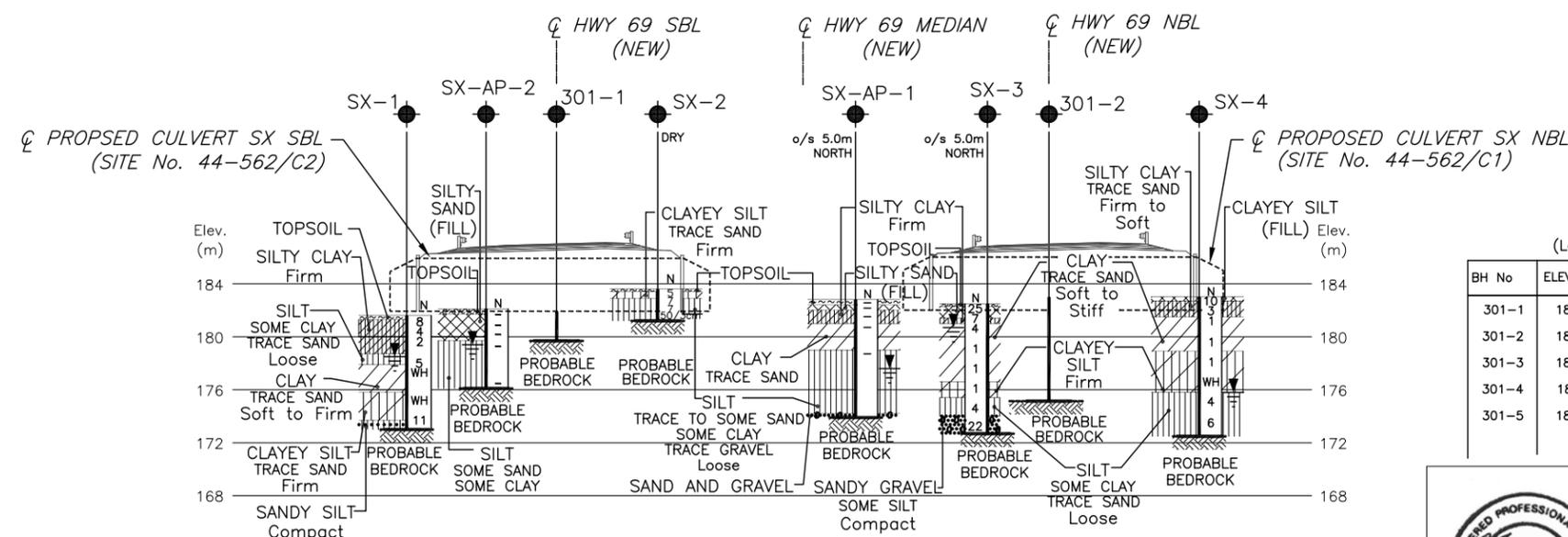
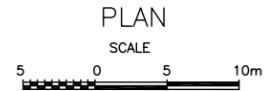
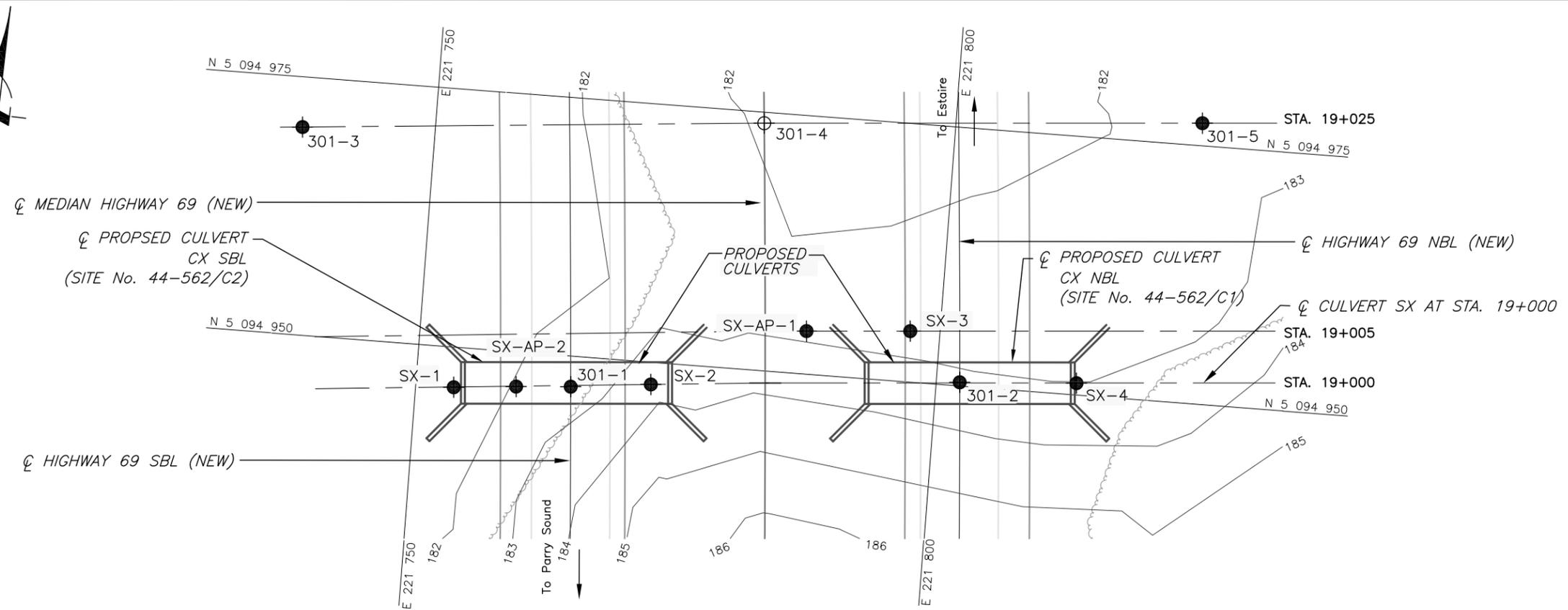
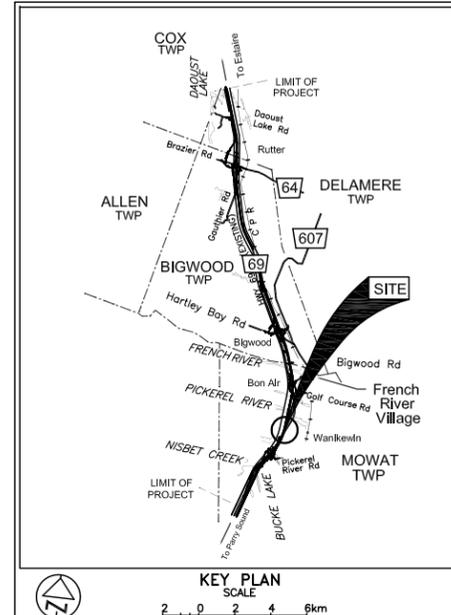
G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+025 CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 13, 2007 CHECKED BY C.N.

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
182.1 0.0	Ground Surface Probable peat Probable silty clay Firm to soft																	
	Probable clay Soft																	
	Probable silt Loose to compact																	
174.2 7.9	End of dynamic cone penetration test Refusal on probable bedrock									120/25cm								

RECORD OF BOREHOLE No 301-5 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+025, o/s 42.5m Rt. CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 13, 2007 CHECKED BY C.N.

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					
182.5	Ground Surface															
0.0	Peat, fine fibrous Dark brown Wet															
0.20	Silty clay															
	Firm Mottled brown/grey Moist		1	SS	5											
			2	SS	5											
180.00																
2.50	Silt, some clay layers of silty clay															
	Loose Grey Moist to wet		3	SS	6											
177.70																
4.80	Sand, trace silt		4	SS	7/15cm											
177.60	Compact Grey Wet															
4.90	End of borehole															
	Refusal on probable bedrock															
	Sample 4: Sampler bouncing															
	* 2007 03 13															
	Water level measured after drilling															



(Legend Continued)

BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
301-1	182.0	19+000	18.8m Lt.
301-2	183.0	19+000	18.8m Rt.
301-3	181.5	19+025	44.5m Lt.
301-4	182.1	19+025	CL
301-5	182.5	19+025	42.5m Rt.

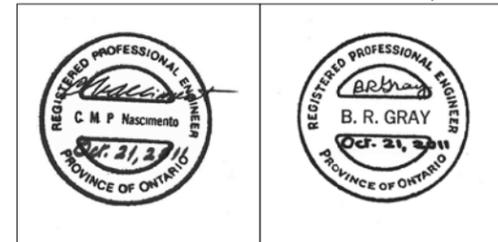
LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- W L at time of investigation Feb & Mar 2010
- Head ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
SX-1	181.6	N 5 094 946.6	E 221 753.6
SX-2	183.6	N 5 094 948.0	E 221 772.6
SX-3	182.5	N 5 094 954.9	E 221 797.1
SX-4	183.0	N 5 094 951.1	E 221 813.5
SX-AP-1	182.8	N 5 094 954.1	E 221 787.2
SX-AP-2	182.1	N 5 094 947.0	E 221 759.6

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

- NOTES:
- DRAWING SX-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
  - CULVERTS AT STA. 19+000 WERE DESIGNATED AS CULVERT SX FOR THE INVESTIGATION.
  - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF.: MRC DRAWINGS  
H6454\_PHASE3\_XA01.dwg; H6454\_PHASE3\_XN01.dwg;  
Phase\_3\_Culvert\_Plan\_View\_100205;  
Phase\_3\_Culvert\_Cross\_Sections\_-\_Mainline\_-\_100205;  
H6454xb1 zone 10; H6454xb2 contours zone 10

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41H-101

HWY No	69	DIST	54 (Sudbury)
SUBM'D	MN	CHECKED	MN
DATE	OCT. 21, 2011	SITE	44-562/c1&c2
DRAWN	NA	CHECKED	CN
APPROVED	BRG	DWG	SX-1

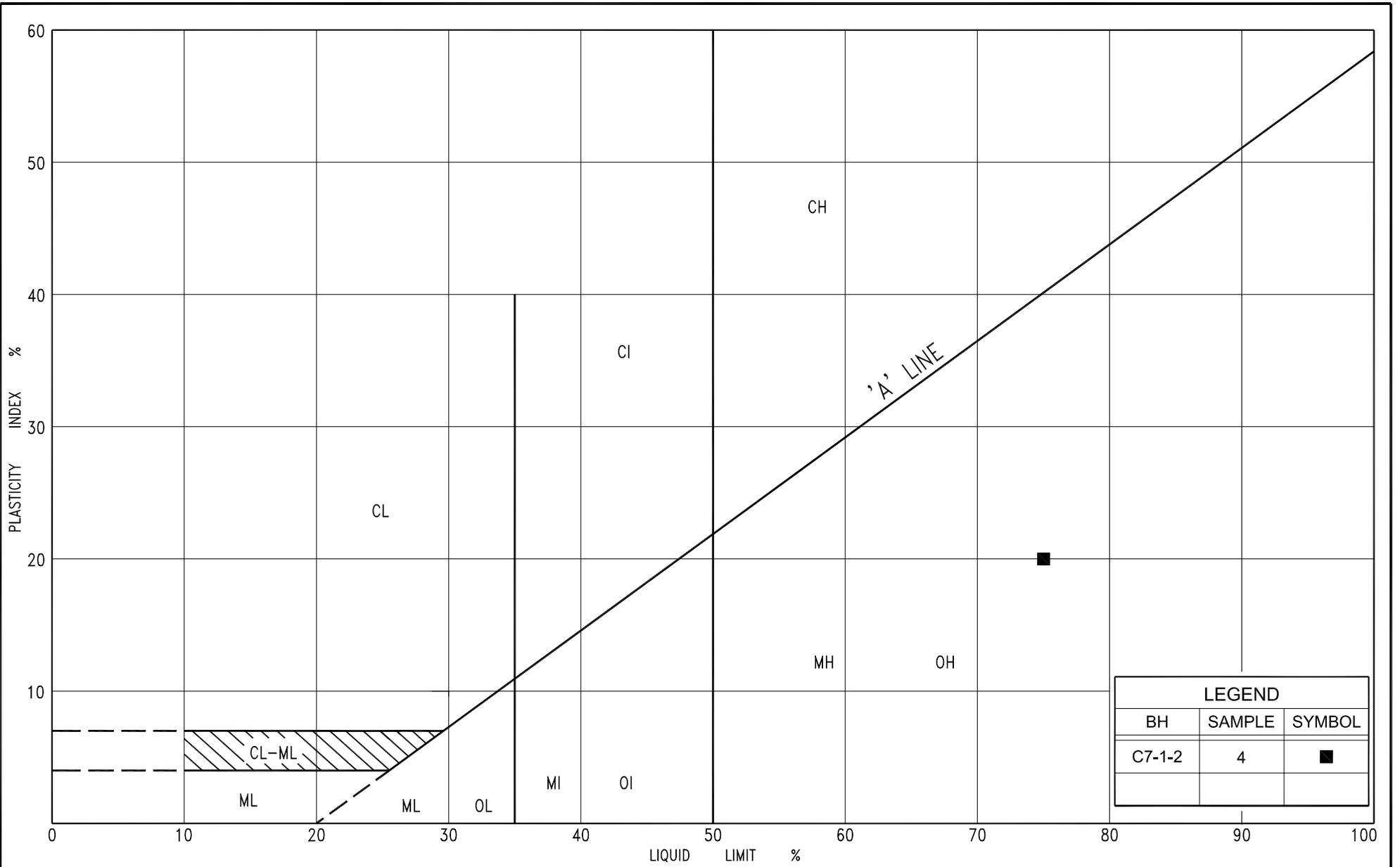
Culvert C7-1 (Site No. 44-556/C1 and 44-556/C2)  
at Sta. 19+378, Mowat Township

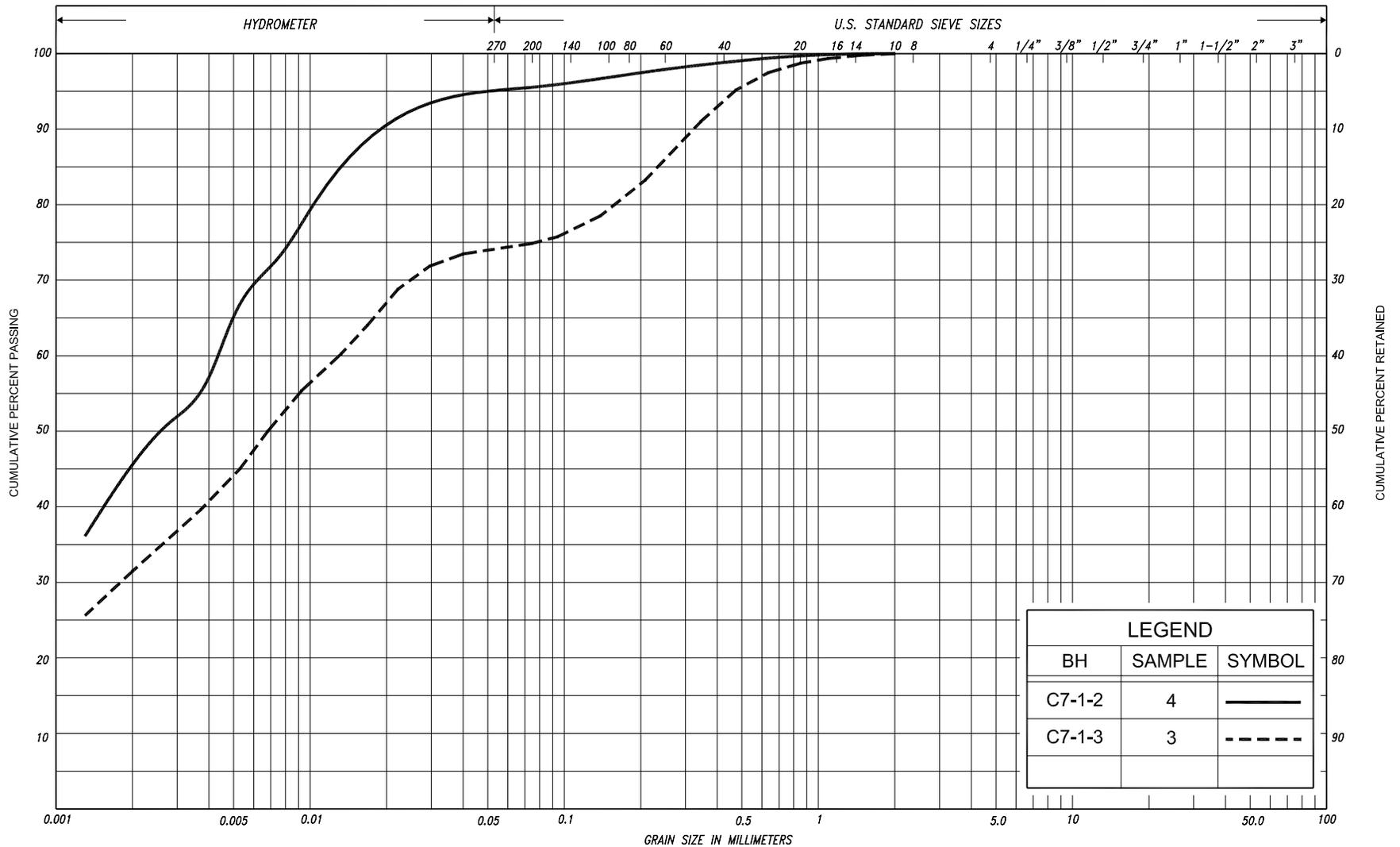
Figure PC-C7-1 – Plasticity Chart

Figure GS-C7 -1 – Grain Size Distribution Chart

Record of Borehole Sheets

Drawing C7-1-1 – Borehole Locations and Soil Strata





LEGEND		
BH	SAMPLE	SYMBOL
C7-1-2	4	—
C7-1-3	3	- - -

SILT & CLAY			FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED		
			SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL	COBBLES	M.I.T.
			SILT												
CLAY		SILT			V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU	
					SAND										



## GRAIN SIZE DISTRIBUTION

### ORGANIC CLAYEY SILT

FIG No. GS-C7-1  
 HWY: 69  
 G.W.P. No. 5203-06-00

**RECORD OF BOREHOLE No C7-1-1      1 of 1      METRIC**

Coords: 5 095 321.0 N; 221 711.9 E

G.W.P. 5203-06-00      LOCATION Hwy 69(New), Sta. 19+000, o/s 30.5m Lt. CL Med.      ORIGINATED BY D.W.  
 DIST 54      HWY 69      BOREHOLE TYPE Manual Probe      COMPILED BY M.N.  
 DATUM Geodetic      DATE March 11, 2010      CHECKED BY C.N.

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	WATER CONTENT (%)					
180.8	Ground Surface																
0.0	Bedrock at surface																
	* Borehole dry																

**RECORD OF BOREHOLE No C7-1-2 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 095 323.6 N; 221 734.3 E ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling Equipment COMPILED BY M.N.  
 DATUM Geodetic DATE March 11, 2010 CHECKED BY C.N.

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
179.1 0.0	Ground Surface Ice water																	
176.2 2.9	Peat, fine fibrous Dark brown		1	SS	WR**													
175.4 3.7	Organic silt Very loose Dark Wet brown to dark grey		2	SS	WR													
			3	SS	WR								161					
173.1 6.0	Organic clayey silt trace sand Very soft Dark Wet grey		4	SS	WR								119					0 5 50 45
172.2 6.9	End of borehole Refusal on probable bedrock																	

**RECORD OF BOREHOLE No C7-1-3 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 095 325.5 N; 221 750.2 E Hwy 69(New), Sta. 19+378, o/s 8m Rt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling Equipment COMPILED BY M.N.  
 DATUM Geodetic DATE March 11, 2010 CHECKED BY C.N.

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
179.9 0.0	Ground Surface																	
179.7 0.2	Ice																	
	Peat, fine fibrous Black to dark brown		1	SS	WR**													
			2	SS	WR													
178.1 1.8	Organic clayey silt with sand		3	SS	WR													0 25 43 32
177.9 2.0	Very soft Dark grey End of borehole Refusal on probable bedrock																	

\* 2010 03 11  
 Water level observed during drilling  
 Water level measured after drilling  
 WR\*\* denotes penetration due to weight of rods only



**RECORD OF BOREHOLE No C7-1-AP-1 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Coords: 5 095 322.4 N; 221 723.3 E ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling Equipment COMPILED BY M.N.  
 DATUM Geodetic DATE March 11, 2010 CHECKED BY C.N.

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
179.6 0.0	Ground Surface Ice					▽*												
	water																	
176.5 3.1	Peat, fine fibrous Dark brown		1	SS	WR**													
174.7 4.9	Organic silt																	
174.0 5.6	Very loose Dark grey		2	SS	WR													
	End of Auger Probe Refusal on probable bedrock																	

**RECORD OF BOREHOLE No C7-1-AP-2 1 of 1 METRIC**

Coords: 5 095 326.8 N; 221 761.1 E

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 19+378, o/s 19m Rt. CL Med. ORIGINATED BY D.W.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY M.N.  
 DATUM Geodetic DATE March 11, 2010 CHECKED BY C.N.

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	WATER CONTENT (%)					
180.3	Ground Surface																
0.0	Bedrock at surface																
	* Borehole dry																

**RECORD OF BOREHOLE No 301-34 1 of 1 METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+350, o/s 18.8m Rt. CL Med. ORIGINATED BY W.L.  
 DIST 54 HWY 69 BOREHOLE TYPE Power Augering COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 20, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
181.5	Top of Ice															
0.0	Ice															
0.3	Water															
180.9																
0.6	End of borehole Refusal on probable bedrock															
	* 2007 03 20															
	▽ Water level observed during drilling															

RECORD OF PENETRATION TEST No 301-35

1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+375, o/s 40.5m Lt. CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 19, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
181.5 0.0	Top of Ice Ice and water															
	Probable peat															
178.8 2.7	End of dynamic cone penetration test Refusal on probable bedrock									120/0cm						

RECORD OF BOREHOLE No 301-36

1 of 1

METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+375 CL Med. ORIGINATED BY N.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 19, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
181.5	Top of Ice															
0.0	Ice and water															
178.7	Peat, fine fibrous Dark brown															
178.0	Organic silt, with sand some gravel, trace clay Very loose Dark Wet grey		1	SS	WH**									253	Org. 12.6%	
176.7	End of borehole Refusal on probable bedrock		2	SS	1									314	Org. 22.1%	17 26 49 8

RECORD OF PENETRATION TEST No 301-37 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 19+375, o/s 40.5m Rt. CL Med. ORIGINATED BY N.L.B.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 19, 2007 CHECKED BY C.N.

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
181.5 0.0	Top of Ice Ice and water																	
	Probable peat																	
179.3 2.2	End of dynamic cone penetration test Refusal on probable bedrock									120/0cm								

**RECORD OF BOREHOLE No 301-38**

1 of 1

**METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 19+400, o/s 18.8m Lt. CL Med. ORIGINATED BY N.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY N.S.B.  
 DATUM Geodetic DATE March 29, 2007 CHECKED BY C.N.

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 $\gamma$ 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					
183.0	Ground Surface																
0.0	Bedrock at surface																
	* Borehole dry																

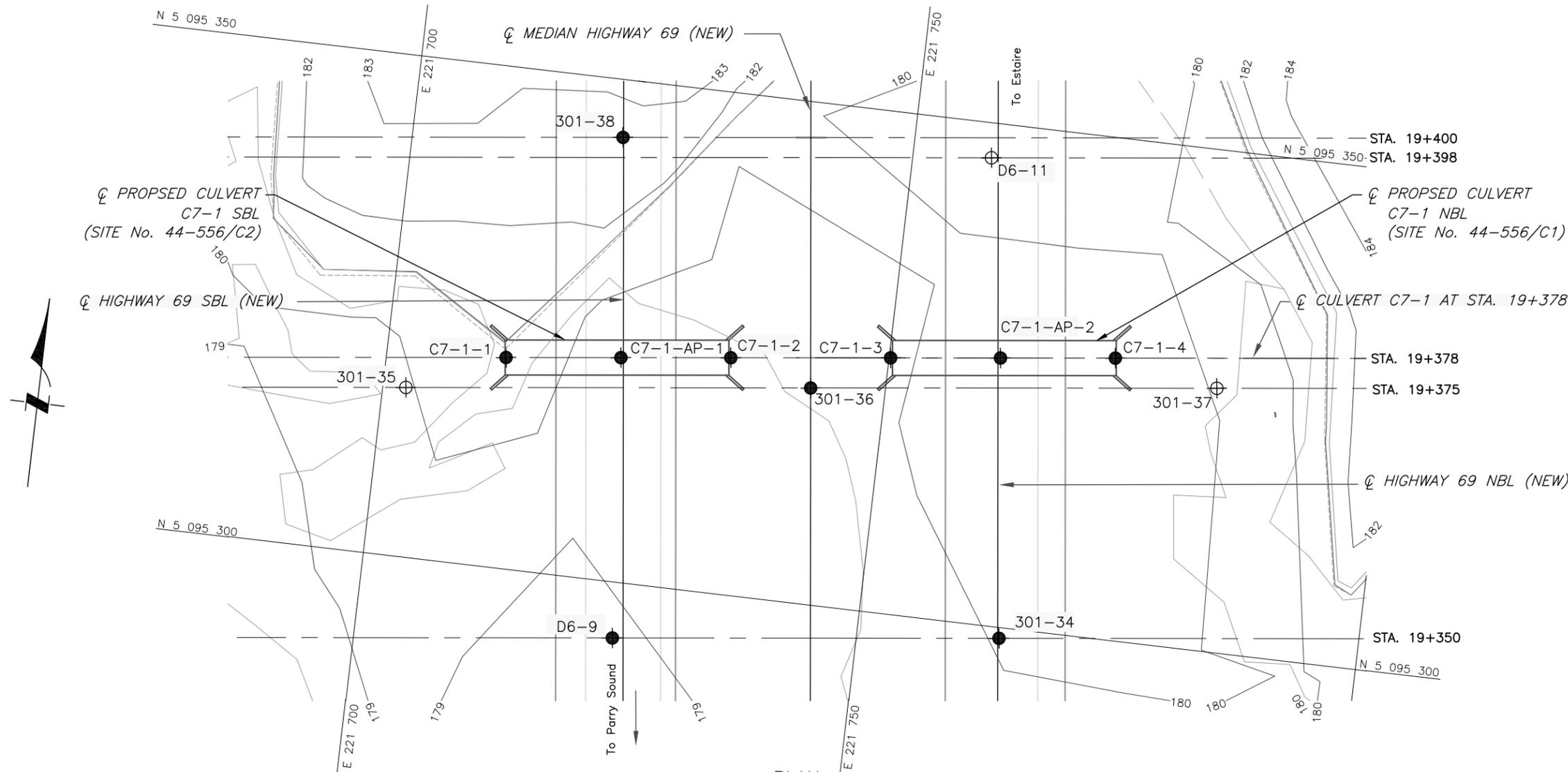
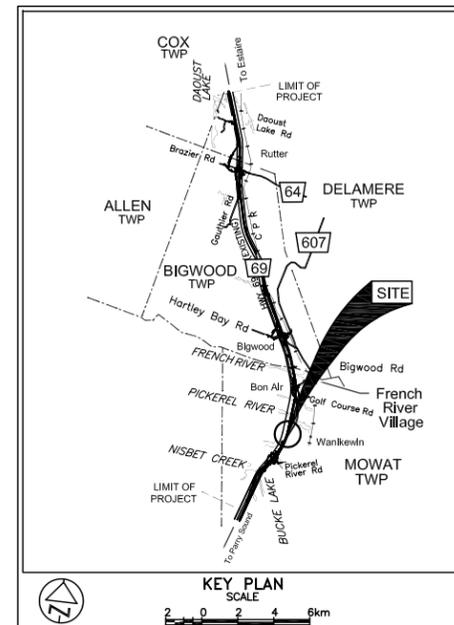


RECORD OF PENETRATION TEST No D6-11

1 of 1 METRIC

G.W.P. 5378-02-00 LOCATION Hwy. 69 (New) Sta. 19+398, o/s 18m Rt. CL Med. ORIGINATED BY R.E.  
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY R.E.  
 DATUM Geodetic DATE March 15, 2004 CHECKED BY C.N.

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
180.6 0.0	Top of Ice Ice																	
	Probable Peat and Alluvium Very loose					180												
179.1 1.5	End of dynamic cone penetration test Refusal on probable bedrock																	



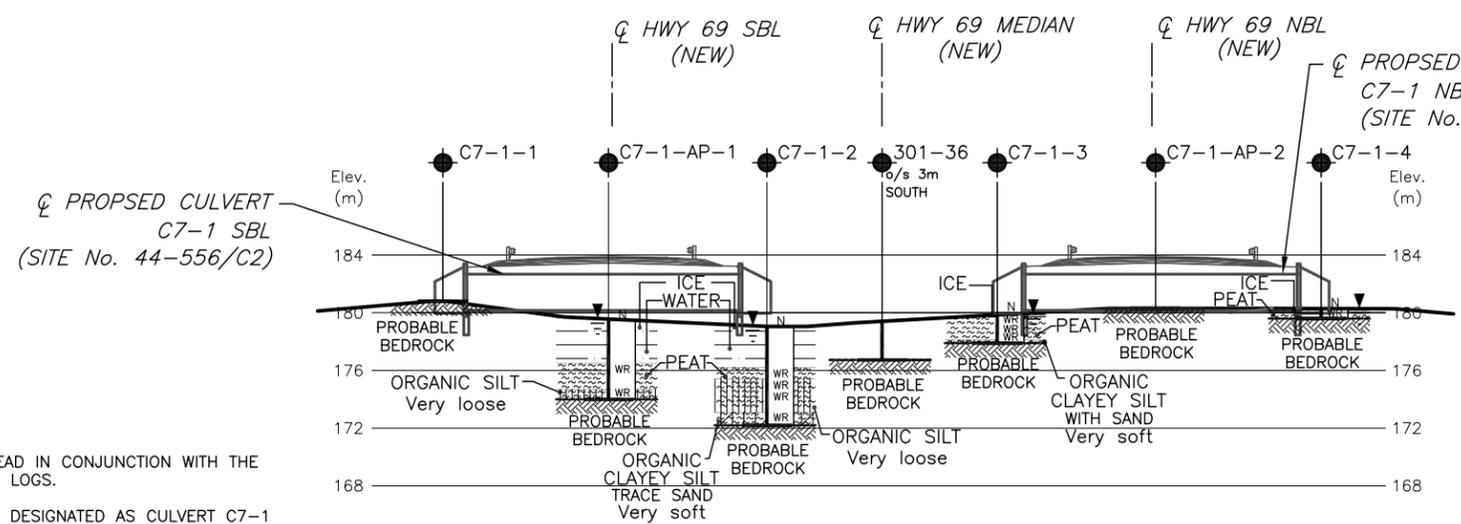
(Legend Continued)

BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
301-34	181.5	19+350	18.8m Rt.
301-35	181.5	19+375	40.5m Lt.
301-36	181.5	19+375	CL
301-37	181.5	19+375	40.5m Rt.
301-38	183.0	19+400	18.8m Lt.
D6-9	180.6	19+350	20m Lt.
D6-11	180.6	19+398	18m Rt.

LEGEND

- Borehole
- ⊕ Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- WR Penetration due to weight of rods only
- W L at time of investigation Mar 2010
- ▽ Head
- ▽ ARTESIAN WATER Encountered
- PIEZOMETER

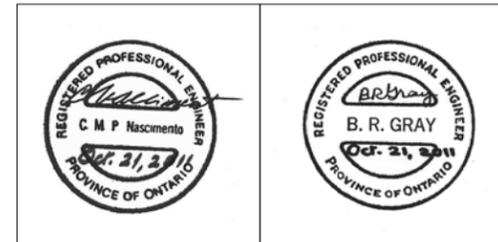
BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
C7-1-1	180.8	N 5 095 321.0	E 221 711.9
C7-1-2	179.1	N 5 095 323.6	E 221 734.3
C7-1-3	179.9	N 5 095 325.5	E 221 750.2
C7-1-4	180.3	N 5 095 328.1	E 221 772.5
C7-1-AP-1	179.6	N 5 095 322.4	E 221 723.3
C7-1-AP-2	180.3	N 5 095 326.8	E 221 761.1



PROFILE CULVERT C7-1 AT STA. 19+378



- NOTES:
- DRAWING C7-1-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
  - CULVERTS AT STA. 19+378 WERE DESIGNATED AS CULVERT C7-1 FOR THE INVESTIGATION.
  - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF.: MRC DRAWINGS  
 H6454\_PHASE3\_XA01.dwg; H6454\_PHASE3\_XN01.dwg;  
 Phase\_3\_Culvert\_Plan\_View\_100205;  
 Phase\_3\_Culvert\_Cross\_Sections\_-\_Mainline\_-\_100205;  
 H6454xb1 zone 10; H6454xb2 contours zone 10

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41H-101

HWY No	69	DIST	54 (Sudbury)
SUBM'D	MN	CHECKED	MN
DATE	OCT. 21, 2011	SITE	44-556/C1&C2
DRAWN	NA	CHECKED	CN
APPROVED	BRG	DWG	C7-1-1