



**FOUNDATION INVESTIGATION REPORT**

**for**

**HIGHWAY 607 OVERPASS SOUTHBOUND  
HIGHWAY 69**

**SITE NO. 44-434/2, W.P. 5278-05-01  
DISTRICT 54, SUDBURY, ONTARIO**

***PHASE 2, STA. 10+000 TO 15+070 (TOWNSHIP OF BIGWOOD)  
STA. 20+300 TO 22+485 (TOWNSHIP OF MOWAT)***

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**FOUNDATION INVESTIGATION REPORT**

for

Highway 607 Overpass Southbound

Highway 69

Site No. 44-434/2, W.P. 5278-05-01

District 54, Sudbury, Ontario

*Phase 2, Sta. 10+000 to 15+070 (Township of Bigwood)*

*Sta. 20+300 to 22+485 (Township of Mowat)*

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**1. INTRODUCTION**

This report summarizes the results of the foundation investigation carried out for the proposed Supply Post Road Overpass Southbound on the realigned Highway 69 to be located in the Township of Bigwood, about 66 km south of Sudbury. The investigation was conducted for McCormick Rankin Corporation on behalf of the Ministry of Transportation of Ontario (MTO).

The proposed bridge will carry the new Highway 69 southbound lanes (SBL), between approximate Sta. 11+994 and 12+029, over a new Highway 607 alignment approximately 170 m south of the existing Highway 607 at-grade.

A previous preliminary foundation investigation was carried out by Peto MacCallum Ltd. (PML) (Geocres No.: 41I-178). The results from the preliminary foundation investigation carried out by PML included two boreholes, H607-1 and H607-2.

In addition, four boreholes 202-48, 202-49, 202-51, and 202-54 and one dynamic cone penetration test (DCPT) hole, 202-53, from previous investigation in swamp 202, (Predraft PML Ref. No.: 06TF033B), are also included in the discussion.

This report provides subsurface information pertaining to the foundation of the proposed new Highway 69 southbound overpass and approaches within about 20 m of the abutments, between approximate Sta. 11+974 and 12+049.

All elevations reported are expressed in meters.



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

The site is located approximately 10 km south of existing Highway 69 and Highway 64 intersection and to about 65 m east of the existing Highway 69. Local land use includes farming and forestry. Residences and farmhouses are located in the vicinity of the site.

The local topography is irregular and comprises wooded areas with open ground areas separated by steep rock ridges.

The site is generally located within a structural subdivision of the Canadian Precambrian Shield identified as the Grenville Province. In particular, the study area traverses the western portion of the Central Gneiss Belt within the Grenville Province wherein pink and grey gneisses are predominant.

## **3. INVESTIGATION PROCEDURES**

The field work for the SBL overpass was carried out during the periods from March 10 to 25, 2009. The site photographs are shown in Appendix A.

The scope of the subsurface investigation comprised 8 boreholes, S1 to S8 and six probe holes, AP1 to AP6, that were advanced through the soil cover, excluding borehole S2 and probe hole AP3 where outcrop was encountered, to depths of 1.1 to 5.2 m, elevations ranging from 198.9 to 203.8, at the locations shown on Drawing 607-S, appended. Six of the boreholes, S2 to S4 at the south abutment and S5 to S7 at the north abutment, were cored 3.1 to 3.4 m into the bedrock to 3.3 to 8.1 m depths, elevations 195.8 to 203.7.

In the previous investigations, boreholes H607-1 and H607-2 extended to 8.5 and 1.2 m depth below ground surface, elevations 194.6 and 205.7, respectively and in boreholes 202-48, 202-49, 202-51, 202-54 and DCPT hole 202-54 the soil cover extended to 0.2 to 5.8 m depths, elevations 198.0 to 208.7. Boreholes H607- and H607-2 were cored 3.2 and 3.1 m into the bedrock from 8.5 and 1.2 m depths, elevations 194.6 and 205.7, and extended to 11.7 and 4.3 m depths, elevations 191.4 and 202.6, respectively.





Callon Dietz inc. staked the alignment of Highway 69 at the structure location. Peto MacCallum Ltd. (PML) selected the positions of the boreholes along the staked alignment and determined the ground surface elevations at the borehole locations. Callon Dietz Inc. provided the following temporary benchmark (TBM) established on existing ground level at the working point of the foundation units.

<b>TBM</b>	<b>DESCRIPTION</b>	<b>ELEVATION (*)</b>
W.P. No. 1	Coordinates N 5099391.2; E 335917.0	205.3

(\*) Geodetic, metric; BH - Borehole

Probe hole AP3 was manually probed with a shovel. Boreholes S1 to S8 and the remaining probe holes were advanced using continuous flight solid stem augers powered by a track mounted D-50 bombardier rig , equipped for rotary core (NQ size) drilling, supplied and operated by a specialist drilling contractor. The drilling crews worked under the full-time supervision of a member of our engineering staff. Photographs of the rock cores are shown in Appendix B.

Representative samples of the soils encountered in the boreholes were recovered at 0.75 m depth intervals. In the boreholes advanced with conventional drill rigs, soil samples were obtained using a split spoon sampler in conjunction with standard penetration tests. Field vane testing and penetrometer tests were carried out to estimate the consistency of the encountered soils. The penetrometer tests results typically provide lower shear strength values than the actual values due to sample disturbance. Where standard penetration tests were not carried out in soils containing cobbles and boulders, the consistency/relative density of the encountered soils was estimated from manual examination or the rate (ease) of advances of the augers.

The boreholes were backfilled in accordance with the MTO guidelines and MOE regulation 903 for borehole abandonment procedures using a bentonite/cement mixture grout.

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 boreholes.



Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to our laboratory for detailed visual examination and soil classification. The current laboratory test program comprised the following tests:

- Natural moisture content determinations (30)
- Grain size analyses (8)
- Atterberg limits tests (8)
- Organic content (1)

The results of the laboratory natural moisture content determinations, grain size analyses, and Atterberg limits are shown on the Record of Borehole sheets. The grain size distribution charts are presented on Figures S-GS-1 to S-GS-3. The Atterberg limits are presented on Figures S-PC-1 to S-PC-3. The Atterberg limits and corresponding sample natural water content determinations are listed in the appended Table 1.

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

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, bedrock descriptions, inferred stratigraphy, boundary elevations and groundwater observations. Site photographs are included in Appendix A.

The borehole locations, stratigraphic profile and cross-sections prepared from the borehole data are presented on the foundation Drawing 607-S.

The depth of the soil cover revealed in the boreholes and probe holes varied from 0.2 to 8.5 m, elevations ranging from 194.6 to 208.7, with the exceptions of borehole S2 and probe hole AP3 where bedrock outcrops were encountered. The soil stratigraphy at the borehole locations generally comprised 100 to 300 mm surficial topsoil covering a deposit of stiff to very stiff 0.6 to 3.7 m thick silty clay overlying a discontinuous cohesive firm to very stiff 0.3 to 3.3 m thick clayey silt layer, which in turn was underlain by very loose to dense cohesionless silty and sandy units. The clayey and sandy units mantled the bedrock. Localized cobble and boulder zones, mixed



with clayey units, about 0.3 to 0.4 m thick were encountered in boreholes S3, S6 and S7 immediately over the bedrock surface. Cobbles, mixed with clayey silt unit, were encountered at 4.2 and 3.9 m in probe holes AP1 and AP2.

#### **4.1 Fill**

A 600 mm thick probable surficial fill is encountered in DCPT hole 202-53, extending from 203.6 to 203.0. DCPT values ranged from 1 to 10.

#### **4.2 Topsoil**

A 100 to 300 mm thick surficial layer of topsoil is present in all of the boreholes, excluding borehole S2, and probe holes, excluding probe hole AP3, extending to 0.1 to 0.6 m depths, elevations 202.8 to 208.7. A 300 mm thick ice was overlying the topsoil in borehole S5, extending to 204.6. An organic content determination of a selected topsoil sample obtained 8.0%. Two moisture content determinations obtained are 20 and 22%.

#### **4.3 Clay**

A discontinuous 1.1 and 1.9 m thick cohesive clay unit was encountered at 0.2 and 0.3 m depth below topsoil layer in boreholes S1 and 202-51, respectively, elevations 205.0 and 204.7, and below silty clay at 0.6 m depth, elevation 203.2, in borehole 202-48 and extended to 1.4 to 2.5 m depths, elevations 201.3 to 203.6. The consistency of the clay was very stiff. One penetrometer test obtained 188 kPa shear strength value. N values ranged from 13 to 25.

Grain size distribution chart of a selected clay sample is presented in Figure S-GS-1. The clay comprised 67% clay, 31% silt and 2% sand sized materials. The plasticity chart of the tested clay sample is presented in Figure S-PC-1. The Atterberg liquid and plastic limits obtained are 53 and 23, respectively, with plasticity index value of 30. Moisture contents ranged from 23 to 39%.



#### **4.4 Silty Clay**

A cohesive silty clay layer of 0.6 to 3.7 m thickness was encountered surficially in borehole 202-48, below silt layer at 0.5 m in borehole S4, below clay at 1.4 m in borehole 202-51, below clayey silt at 0.6 m in probe hole AP4 and below the topsoil at 0.1 to 0.3 m in boreholes/probe holes S3, S6, S7, H607-1, AP1, AP2, AP5 and AP6 and, and extended to 0.6 to 4.0 m depth below ground surface, elevations 199.1 to 203.3. Bedrock/probable bedrock was encountered below the silty clay unit in boreholes/ probe holes S6, 202-51 and AP4 to AP6 at 1.4 to 4.0 m depth, elevations 199.9 to 203.3. Cobbles and boulders were encountered mixed with silty clay in borehole S6 at 3.0 m depth, elevation 201.4 and extended to bedrock at elevation 201.0.

The consistency of the silty clay ranged from stiff to very stiff. Penetrometer tests ranged from 62 to 163 kPa and one field vane test obtained 60 kPa with sensitivity of 10. N values ranged from 4 to 27.

Grain size distribution chart of a selected silty clay sample is presented in Figure S-GS-2. The silty clay comprised 55% clay, 44% silt and 1% sand sized materials. The plasticity chart of the silty clay sample is presented in Figure S-PC-2. The Atterberg liquid and plastic limits obtained are 43 and 22, respectively, with plasticity index of 21. Moisture contents determination ranged from about 20 to 38%.

#### **4.5 Clayey Silt/Clayey Silt and Sand**

Cohesive discontinuous clayey silt layer of 0.3 to 3.3 m thickness was encountered below clay at 2.5 m depth in borehole 202-48, below the topsoil layer at 0.3 to 0.6 m depth in boreholes S5, S8 and probe AP4, and below silty clay unit at 2.1 to 3.0 m depth in boreholes/ probe holes S3, S4, S7, AP1 and AP2, and extended to 0.6 to 5.8 m depth below grade, elevations 198.0 to 203.8.



Cobbles and boulders were encountered in the clayey silt matrix in borehole S7 at 4.4 m depth, elevation 199.4 and extended to the bedrock surface found at 4.7 m depth, elevation 199.1. Bedrock/probable bedrock was encountered below the clayey silt unit in boreholes/auger probe holes S4, S5, S7, AP1, AP2 and 202-48 at 1.1 to 5.8, elevations 198.0 to 203.8.

The consistency of the clayey silt ranged from firm to very stiff. N values ranged from 4 to 17. Penetrometer tests obtained ranged from 25 to 125 kPa and one field vane test obtained 76 kPa with sensitivity 7 in borehole S7.

In DCPT hole 202-53, probable clayey silt layer was encountered below fill at 0.6 m depth, elevation 203.0 and extended to 5.3 m depth, elevation 198.3, mantling probable bedrock. DCPT values ranged from 5 to 120 blows for 15 cm penetration, where cone was refused on probable bedrock.

Grain size distribution charts of selected four clayey silt samples are presented in Figure S-GS-3. The clayey silt comprised 17 to 33% clay, 66 to 78% silt, 1 to 4% sand and 0 to 1% gravel sized materials. The plasticity chart of the tested clayey silt samples is presented in Figure S-PC-3. The Atterberg liquid and plastic limits ranged from 25 to 30 and 20 to 21, respectively, with plasticity index ranging from 5 to 9. Moisture contents determination ranged from about 18 to 39%.

Local deposits of stiff to very stiff clayey silt and sand of 0.6 and 1.0 m thickness was encountered in boreholes S3 and S8 at 2.9 and 3.0 m depth, elevation 202.0 and 201.2, below silty clay and clayey silt units, and extended to 3.5 and 4.0 m depth, elevation 201.4 and 200.2, respectively, where the clayey silt and sand unit mantled the bedrock/probable bedrock. Boulders mixed with the clayey silt and sand matrix was encountered at 3.2 m, elevation 201.7, in borehole S3 and extended to bedrock depth 3.5 m, elevation 201.4. N values obtained are 9 and 17 with one local value of 20 blows for 5 cm penetration where the sampler met refusal on probable bedrock.

Grain size distribution charts of selected two clayey silt and sand samples are also presented in Figure S-GS-3. The clayey silt and sand comprised 12 to 13% clay, 51% silt, 34% sand and 2 to 3% gravel sized materials. The plasticity chart of the tested clayey silt and sand samples is also



presented in Figure S-PC-3. The Atterberg liquid and plastic limits ranged from 22 to 23 and 18, respectively, with plasticity index ranging from 4 to 5. Two moisture contents determination obtained are 18 and 23%.

#### **4.6 Silt**

A local deposit of 0.3 and 1.0 m thick silt unit was encountered at 0.2 and 4.0 m depth, elevation 203.8 and 199.1, respectively, in boreholes S4 and H607-1 and extended to 0.5 and 5.0 m depths, elevations 203.5 and 198.1. The consistency of the silt was very loose. One N value obtained is 4. One moisture content determination obtained 19%.

#### **4.7 Silty Sand/Silt and Sand/Sand and Silt**

A discontinuous layer of very loose silty sand was encountered in borehole H607-2 below the topsoil at 0.1 m, elevation 206.8, and extended to 0.7 m, elevation 206.2. One N value of 1 was obtained. A moisture content determined was about 45%. A localized dense deposit of cohesionless sand and silt was encountered in borehole H607-2 below the silty sand at 0.7 m depth, elevation 206.2 and extended to 1.2 m depth, elevation 205.7, mantling the bedrock surface. One N value of 35 was obtained. A moisture content determination was about 18%.

A localized 0.8 m thick deposit of cohesionless compact sand was encountered in borehole H607-1 at 5.0 m depth, elevation 198.1, and extended to 5.8 m depth, elevation 197.3. Below the sand unit, boulders in silty sand matrix was encountered at 5.8 m depth, elevation 197.3, extending to 8.5 m depth, elevation 194.6, mantling bedrock.

#### **4.8 Bedrock**

The presence and quality of the bedrock underlying the site was checked by extracting NQ-size cores from the rock mass. Where rock cores were not obtained, the bedrock surface was inferred by auger and/or split-spoon sampler refusal.



A detailed description of the rock cores retrieved from boreholes S2, S3 and S4 at the south abutment and S5, S6 and S7 at the north abutment is provided in Table 2 and summarized on the record of borehole logs.

In the previous investigations, the bedrock/probable bedrock surface was encountered in boreholes H607-1 and H607-2 at 8.5 and 1.2 m depth, respectively, elevation 194.6 and 205.7, and at 0.2 to 5.8 m depth, elevation ranging from 198.0 to 208.7, in boreholes 202-48, 202-49, 202-51 and 202-54 and in DCPT hole 202-53. In boreholes H607-1 and H607-2, 3.2 and 3.1 m lengths of rock cores retrieved had measured core recovery of 100% and were a high strength, and ranged fair to excellent quality (RQD values of 77 and 100% in borehole H607-1; RQD values of 63 and 98% in borehole H607-2) granitic gneiss.

At the south abutment and approach, the bedrock/probable bedrock surface was encountered at 0.0 (outcrop) to 5.2 m depth, elevations ranging from 198.9 to 207.4 in the boreholes S1 to S4 and in probe holes AP1 to AP3. Where rock cores were not obtained, the bedrock surface was inferred by auger and/or spoon refusal. The following table summarizes the depth of bedrock surface encountered in each borehole.

LOCATION	BOREHOLE No.	DEPTH (m)	BEDROCK ELEVATION	ROCK CORE LENGTH (m)
South Approach	S1	2.1	203.1	-
South Abutment	S2	0.0*	207.0	3.3
	S3	3.5	201.4	3.1
	S4	5.0	199.0	3.1
	AP1	5.2	198.9	-
	AP2	4.4	199.7	-
	AP3	0.0*	207.4	-

The bedrock surface was confirmed at the south abutment location by extracting three cores in boreholes S2, S3 and S4 of lengths 3.3 and 3.1 m into the rock from a depth of 0.0 (outcrop) to 5.0 m, elevations 199.0 to 207.0, and extending to 3.3 to 8.1 m depths, elevations 195.9 to 203.7. The bedrock surface elevations indicate a maximum bedrock surface relief of 8.5 m between



borehole and probe hole locations. The slope of the bedrock surface descends from east to west 5.6 m at an angle of about 32° from borehole S2 to S3, elevation 207.0 to 201.4 and continues dipping 2.4 m at an angle about 17° to borehole S4 from borehole S3. Photographs of the rock cores taken from boreholes S2, S3 and S4 are shown on Photographs 1 to 3, Appendix B.

At the north abutment and approach embankment, the bedrock surface was encountered at 1.1 to 4.7 m depths, elevations 199.1 to 203.8. The table below summarizes the depth of bedrock surface encountered in each borehole:

LOCATION	BOREHOLE No.	DEPTH (m)	BEDROCK ELEVATION	ROCK CORE LENGTH (m)
North Abutment	S5	1.1	203.8	3.1
	S6	3.4	201.0	3.4
	S7	4.7	199.1	3.3
	AP4	4.0	199.9	-
	AP5	1.8	202.8	-
	AP6	1.4	203.3	-
North Approach	S8	4.0	200.2	-

The bedrock surface was confirmed at the north abutment location by drilling three rock cores in boreholes S5, S6 and S7 of 3.1, 3.4 and 3.3 m lengths, respectively. The rock was extracted from a depth of 1.1 to 4.7 m, elevations 199.1 to 203.8, and extending to 4.2 to 8.0 m depths, elevations 195.8 to 200.7. The bedrock surface elevations indicate a maximum bedrock surface relief of 4.7 m between borehole and probe hole locations.

The slope of the bedrock surface between boreholes S5 and S6 dips downward east to west 2.8 m at an angle of about 18° and continues to slope downwards 1.9 m at about 13° to borehole S7. Photographs of the rock cores taken from boreholes S5 to S7 are shown on Photographs 4 to 6, Appendix B.

At the south abutment, the measured core recovery from the boreholes S2 to S4 was typically higher than 98% with two local values of 88 and 45% in boreholes S2 and S3 where the last pieces of cores of about 10 cm and 33 cm, respectively, could not be recovered from depths 2.5





to 3.3 m and 6.0 to 6.6 m. The RQD determined from the rock cores is typically from 92 to 100%, with one isolated value of 54% for the upper 0.7 m rock core length from 5.0 to 5.7 m depth in borehole S4, indicating excellent quality rock with local fair quality rock. The bottom rock core pieces recovered of 70 and 27 cm lengths from borehole S2 and S3, respectively, is of excellent quality and showed no signs of poor recovery due to loss of weathered material.

In the north abutment boreholes, the measured core recovery was typically 100%, with one isolated value of 95% in borehole S6 at 5.3 to 6.8 m depth, where a 7.5 cm length bottom rock core piece could not be recovered. The RQD determined from the north abutment rock cores is typically greater than 84%, with an isolated value of 38% in borehole S7, indicating good to excellent quality rock with local upper 0.4 m poor quality rock (borehole S7).

#### **4.9 Groundwater**

In the previous investigations, groundwater was observed during augering in boreholes 202-48 and 202-51 at 3.6 and 2.4 m depths, elevations 200.2 and 202.6. Upon completion of augering, the groundwater depths were established at 4.6 and 2.7 m depths, elevations 199.2 and 202.3, respectively, in boreholes 202-48 and 202-51.

Groundwater was observed during augering in boreholes/ probe holes S1, S3, S4, S6, S7, AP1 and AP2 at 0.3 to 4.0 m depths, elevations 199.8 to 204.3. Upon completion of augering, groundwater was observed in boreholes S1, S6 and S7 at 1.2 to 4.0 m depths below ground surface, elevations 199.8 to 204.0.

The groundwater is subject to fluctuations at the site due to seasonal conditions and rainfall patterns.



## 5. CLOSURE

The field work was carried out under the supervision of Frank Portela, Senior Technician and Mike Rapsey, Senior Technician, and direction of Mr. C. M. P. Nascimento, P.Eng., Senior Project Engineer. Walker Drilling Co. Ltd. supplied the soil and rock drilling equipment.

The report was prepared by Mr. C. M. P. Nascimento, P.Eng. with the assistance of Mr. N. Rahman, BASc and reviewed by Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact, carried out an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



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



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



**TABLE 1**  
**LIST OF ATTERBERG LIMITS**

<b>SOIL TYPE</b>	<b>BOREHOLE NO.</b>	<b>SAMPLE NO.</b>	<b>LIQUID LIMIT</b>	<b>PLASTIC LIMIT</b>	<b>PLASTICITY INDEX</b>	<b>MOISTURE CONTENT (%)</b>
Clay	S1	2	53	23	30	39
Silty Clay	S6	3	43	22	21	35
Clayey Silt	S4	5	30	21	9	29
	S4	6	25	20	5	27
	S7	5	29	20	9	26
	S8	4	30	21	9	30
Clayey Silt and Sand	S3	5	22	18	4	24
	S8	5	23	18	5	18



**TABLE 2**  
**ROCK CORE DESCRIPTIONS**

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S2	1	0.0 – 1.0	100	100	0.0 – 3.3	GRANITIC GNEISS/MIGMATITE: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, moderate (locally close) spaced dipping cross joints, generally associated with biotite layers, rough planar, tight to slightly altered with brown silt on some partings, excellent quality.  Note: * Last piece of 10 cm core remained down hole.
	2	1.0 – 2.5	100	100		
	3	2.5 – 3.3	88*	88*		
S3	6	3.5 – 4.5	100	100	3.5 – 6.6	GRANITIC GNEISS: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, moderate (locally close) spaced dipping cross joints, generally associated with biotite layers, rough planar, tight to slightly altered with brown silt on some partings, excellent quality.  Note: * Last piece of 33 cm core remained down hole.
	7	4.5 – 6.0	98	92		
	8	6.0 – 6.6	45*	45*		
S4	8	5.0 – 5.7	100	54	5.0 – 8.1	GRANITIC GNEISS: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, close to moderate spaced dipping cross joints, generally associated with biotite layers, rough planar, tight, fair to excellent quality.
	9	5.7 – 7.3	100	100		
	10	7.3 – 8.1	100	100		
S5	2	1.1 – 2.3	100	84	1.1 – 4.2	GRANITIC GNEISS/MIGMATITE: Black and white, changing to pink and grey with slight banding, with dipping black biotite rich layers, trace pyrite, garnetiferous, fine to medium grained, high strength, unweathered, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with scale on some partings, good to excellent quality.
	3	2.3 – 2.9	100	100		
	4	2.9 – 4.2	100	92		

Originated: FP and MR

Compiled: PML

Checked: CN



TABLE 2  
 ROCK CORE DESCRIPTIONS

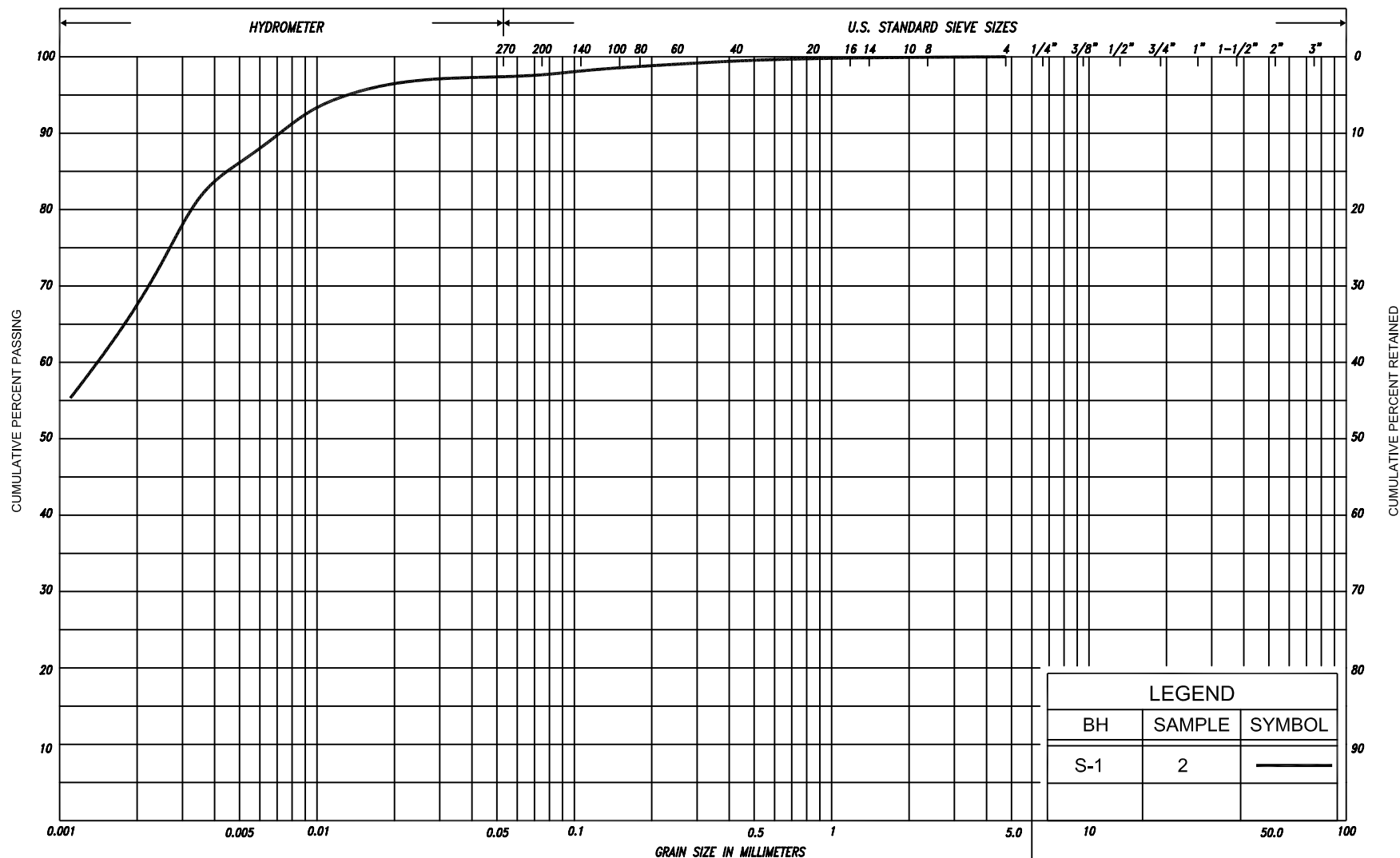
CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S6	7	3.4 – 4.3	100	100	3.4 – 6.8	GRANITIC GNEISS/BIOTITE GNEISS: Black and white, changing to pink and grey with dipping bands, with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, wide (locally close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with silt, excellent quality.  Note: * Last piece of 7.5 cm core remained down hole.
	8	4.3 – 5.3	100	100		
	9	5.3 – 6.8	95*	95*		
S7	7	4.7 – 5.1	100	38	4.7 – 8.0	MIGMATITE/BIOTITE GNEISS: Black and white, banded, fine to medium grained, high strength, unweathered, close (locally very close, becoming medium to wide spaced flat to dipping cross joints, rough planar, tight, poor to excellent quality.
	8	5.1 – 5.8	100	100		
	9	5.8 – 7.3	100	100		
	10	7.3 – 8.0	100	100		

NOTE: RQD = Rock Quality Designation

Originated: FP and MR

Compiled: PML

Checked: CN



SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED	
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											

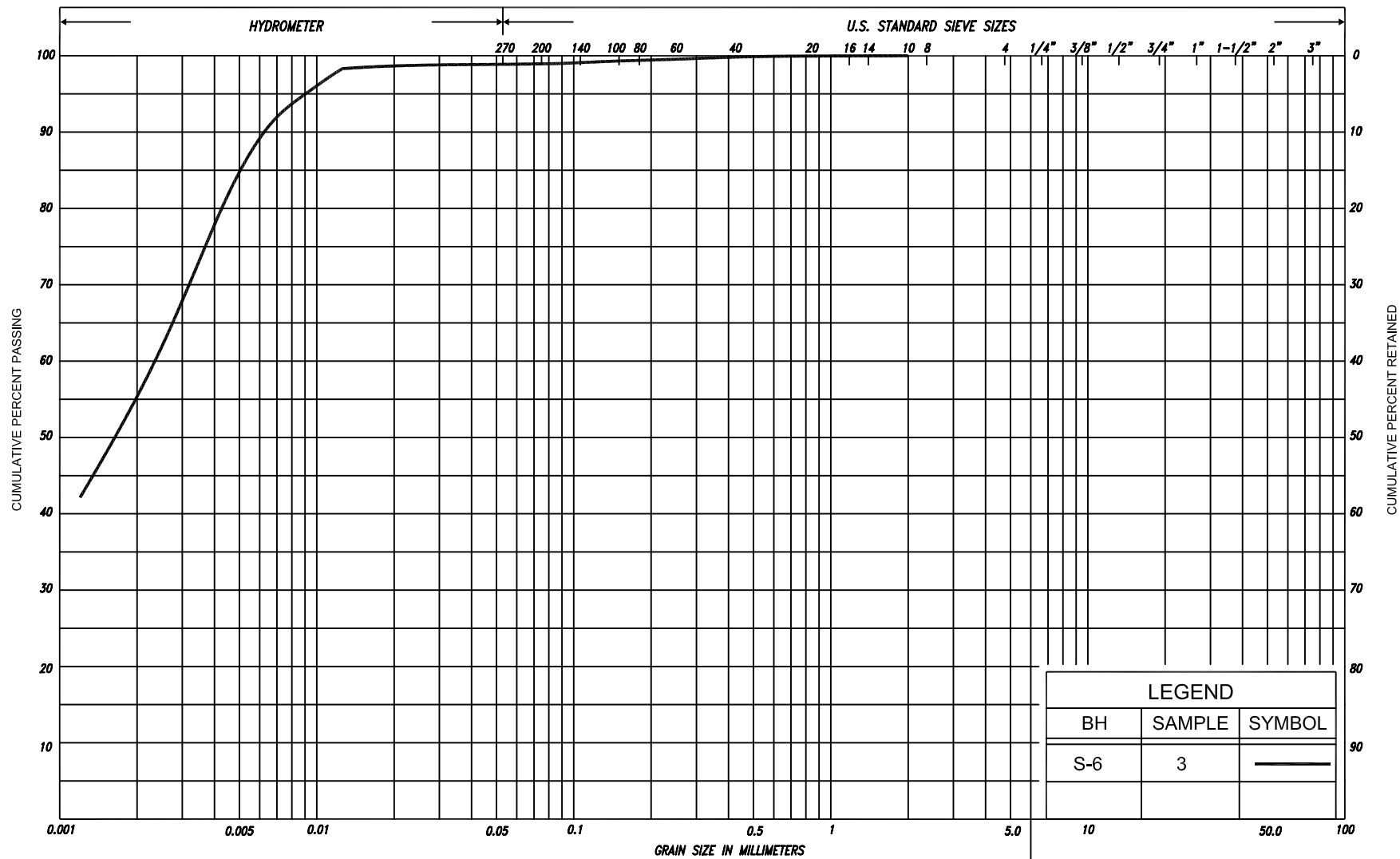
# GRAIN SIZE DISTRIBUTION

CLAY, trace sand

FIG No. S-GS-1

HWY: 69

W.P. No. 5278-05-01



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

## GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

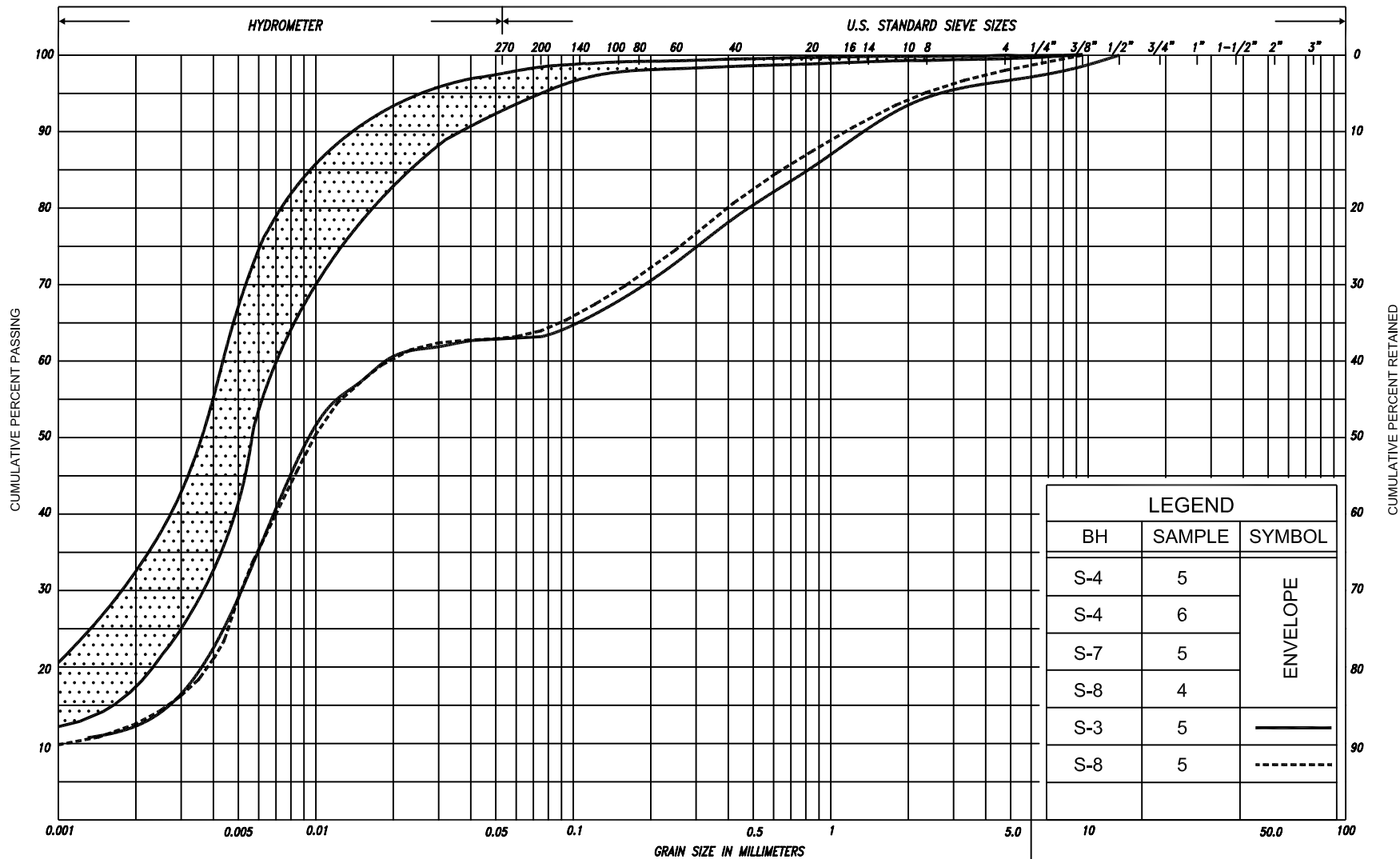


Ministry of  
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Ontario

FIG No. S-GS-2

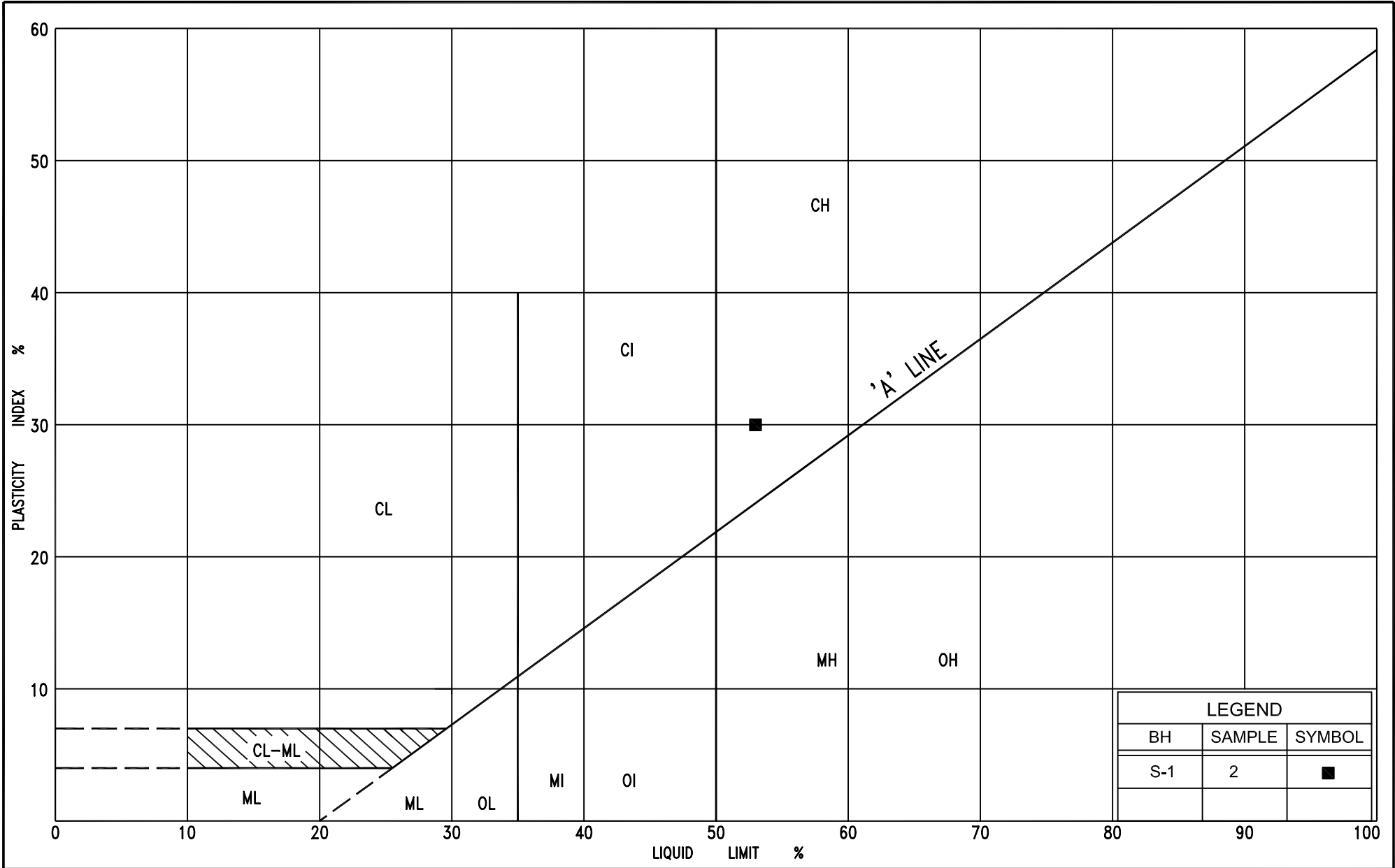
HWY: 69

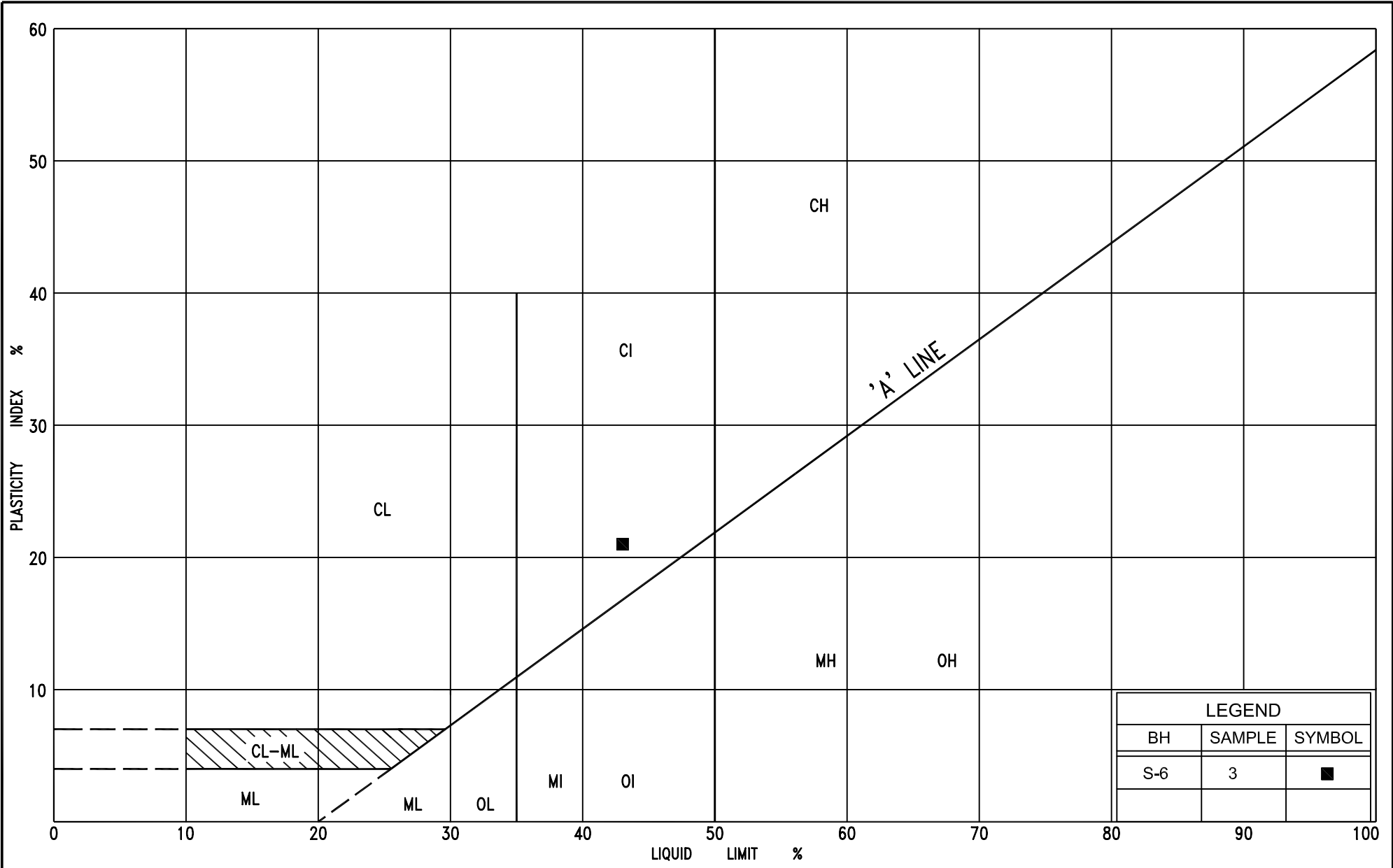
W.P. No. 5278-05-01

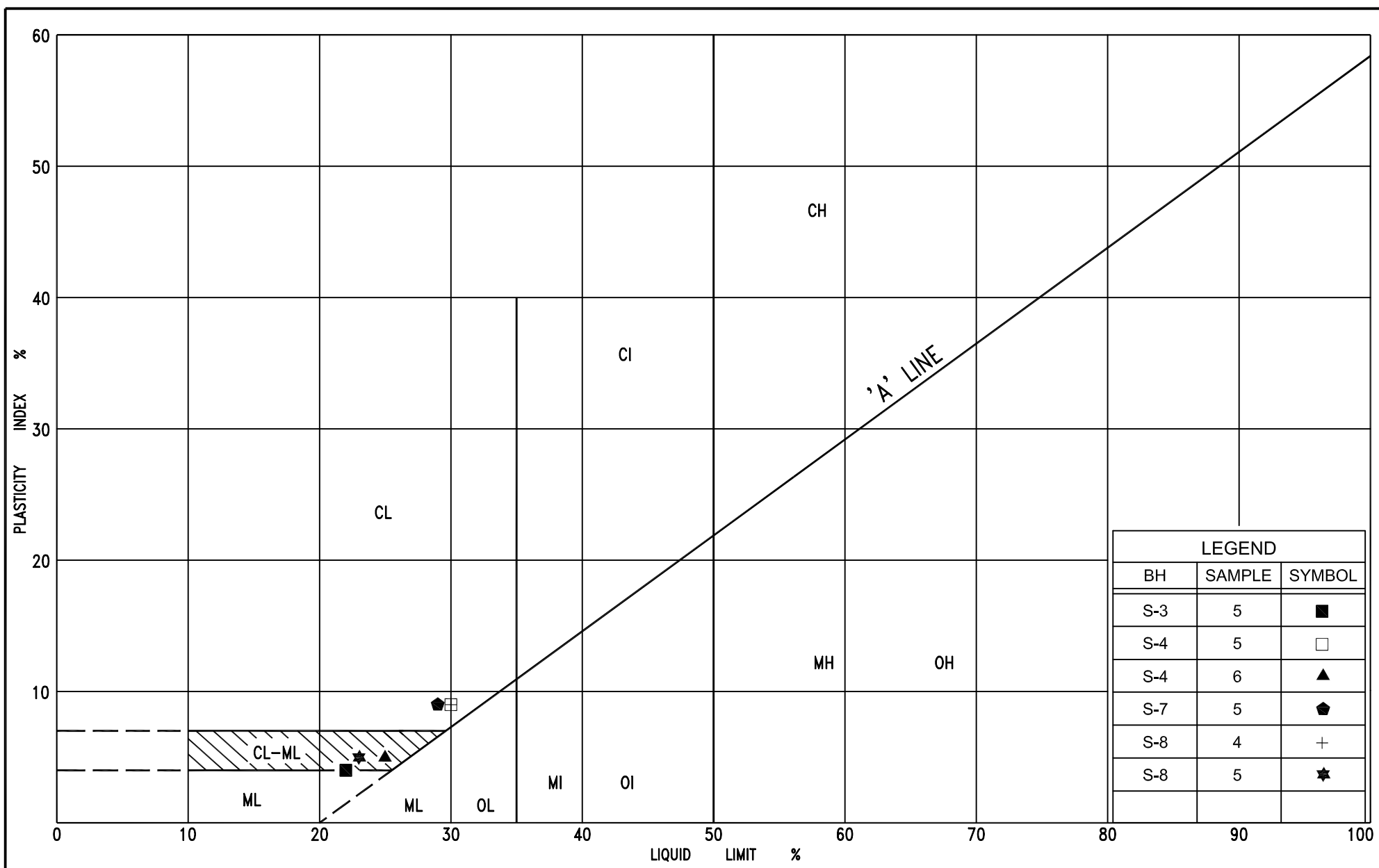


SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED		
					SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT																
CLAY		SILT			V. FINE	FINE	MED.	COARSE	GRAVEL							U.S. BUREAU	
					SAND												









## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
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
$S_t$	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	$m^3/s$	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	$kN/m^3$	SEEPAGE FORCE
e	1, %	VOID RATIO						

**METRIC**






(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No AP2**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 385.5 N; 335 912.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 25, 2009 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									
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
204.1 0.0	Ground Surface						20	40	60	80	100						
204.0 0.1	Topsoil Silty clay, trace sand Very stiff Brown      Moist																
202.0 2.1	Clayey silt, trace sand Stiff      Brown      Moist to grey																
199.7 4.4	cobbles																
	End of auger probe Refusal on probable bedrock																
	*      2009   03   25  ▽      Water level observed during drilling																

**RECORD OF BOREHOLE No AP3**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 396.5 N; 335 921.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY N.R.  
 DATUM Geodetic DATE March 25, 2009 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
						○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
207.4	Ground Surface									20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

**RECORD OF BOREHOLE No AP4**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 408.8 N; 335 886.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 11, 2009 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 ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE										WATER CONTENT (%)
203.9	Ground Surface					*		20	40	60	80	100		20	40	60		
0.0 203.6	Topsoil																	
0.3 203.3	Clayey silt, trace sand																	
0.6	Stiff Brown Wet Silty clay, trace sand Very stiff Brown Moist to stiff						203											
							202											
							201											
199.9 4.0	End of borehole Refusal on probable bedrock						200											
	* Borehole dry																	





**RECORD OF BOREHOLE No AP5**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 419.2 N; 335 899.0 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 10, 2009 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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
204.6	Ground Surface					*														
0.0	Topsoil							20	40	60	80	100								
204.4	Silty clay, trace sand																			
0.2	Very stiff Brown Moist to stiff																			
202.8	End of borehole Refusal on probable bedrock																			
1.8																				
	* Borehole dry																			

**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No S1**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 374.3 N; 335 928.1 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 16, 2009 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													
								○ UNCONFINED			+ FIELD VANE										
205.2	Ground Surface		1	SS	13	  	205														
0.0	Topsoil																				
205.0	Clay, trace sand			2	SS		13	204													
0.2	Stiff to very stiff																				
203.1	End of borehole		3	SS	25																
2.1	Refusal on probable bedrock																				
<div>* 2009 03 16</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div> <div> Penetrometer test</div>																					

\* 2009 03 16

▽ Water level observed  
during drilling

▼ Water level measured  
after drilling

■ Penetrometer test

**RECORD OF BOREHOLE No S2**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 394.2 N; 335 923.0 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 13, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub> W      W <sub>L</sub>				GR	SA	SI	CL
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%)							
207.0	Ground Surface						20	40	60	80	100									
0.0	Granitic Gneiss/Migmatite Bedrock		1	RC NQ	REC 100%	206													RQD 100%	
	2		RC NQ	REC 100%	205													RQD 100%		
	3		RC NQ	REC 88%**			204											RQD 88%**		
203.7	End of borehole																			
3.3																				
	* Borehole charged with drilling water																			
	** Bottom 10cm core could not be recovered.																			

\* Borehole charged with  
drilling water  
 \*\* Bottom 10cm core could  
not be recovered.

**METRIC**

(%) STRAIN AT FAILURE

**METRIC**

**+<sup>7</sup>, ×<sup>5</sup>:** Numbers refer to Sensitivity

**RECORD OF BOREHOLE No S5**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 420.5 N; 335 900.5 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 12, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>							
								○ UNCONFINED	+	FIELD VANE								WATER CONTENT (%)				
204.9	Top of Ice							20	40	60	80	100							GR	SA	SI	CL
0.0 204.6	Ice and Snow																					
0.3 204.3	Topsoil																					
0.6 203.8	Clayey silt, trace sand		1	SS	21		204															
1.1 200.7	Very stiff Brown Wet																					
	Granitic Gneiss/Migmatite Bedrock		2	RC NQ	REC 100%		203															RQD 84%
	Unweathered		3	RC NQ	REC 100%		202															RQD 100%
	High strength		4	RC NQ	REC 100%		201															RQD 92%
200.7 4.2	End of borehole																					
<div>* Borehole charged with drilling water</div> <div>■ Penetrometer test</div> <div>C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</div>																						

\* Borehole charged with  
drilling water  
 ■ Penetrometer test  
 C.F.S.S.A. denotes  
Continuous Flight Solid Stem  
Augers

**RECORD OF BOREHOLE No S6**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 415.8 N; 335 892.7 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 12 and 15, 2009 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE										
204.4	Ground Surface						20	40	60	80	100							
0.0	Topsoil		1	SS	9	▼* ▼*	204									Org. 8.0%	Top 0.3m frozen	
0.3	Silty clay, trace sand																	
	Stiff      Brown      Moist to wet		2	SS	12													
				3	SS		9											
	layers of clayey silt																	
	sand layers		4	SS	10													
	cobbles and boulders		5	SS	12/15cm													
201.0			6	SS	15/15cm													
3.4	Granitic/ Biotite Gneiss Bedrock					201												
	Unweathered		7	RC NQ	REC 100%												RQD 100%	
	High strength																	
	Excellent quality		8	RC NQ	REC 100%													RQD 100%
						199												
			9	RC NQ	REC 95%**												RQD 95%**	
197.6	End of borehole					198												
6.8																		



# RECORD OF BOREHOLE No S7

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 411.1 N; 335 884.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 11 and 16, 2009 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												
						○ UNCONFINED			+ FIELD VANE									
						● QUICK TRIAXIAL			× LAB VANE									
203.8	Ground Surface																	
0.0 203.5	Topsoil		1	SS	20/8cm												Top 0.4m frozen	
0.3	Silty clay, trace sand  Very stiff Brown Wet to stiff																	
			2	SS	8													
			3	SS	6													
				FV														
			4	SS	4													
200.8	Clayey silt, trace sand																	
3.0	Stiff to Brown Wet very stiff																0 2 73 25	
			5	SS	4													
				FV														
			6	SS	17													
	layers of sand																	
	cobbles and boulders																	
199.1	Migmatite/Biotite Gneiss Bedrock		7	RC NQ	REC 100%												RQD 38%	
4.7	Unweathered  High strength  Poor to excellent quality																RQD 100%	
			8	RC NQ	REC 100%													
			9	RC NQ	REC 100%										RQD 100%			
			10	RC NQ	REC 100%												RQD 100%	
195.8	End of borehole																	
8.0																		

**RECORD OF BOREHOLE No S8**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 431.0 N; 335 879.7 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 16, 2009 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									
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
204.2	Ground Surface							20	40	60	80	100					
0.0	Topsoil		1	SS	2		204										
203.9	Clayey silt, trace sand Very stiff Brown Wet to firm						203										1 2 71 26
0.3			2	SS	11												
				3	SS	8											
				4	SS	5	202										
201.2	Clayey silt and sand trace gravel  Stiff Grey Wet						201										2 34 51 13
3.0			5	SS	9												
200.2			6	SS	20/5cm												
4.0	End of borehole Refusal on probable bedrock  Sample 6: Sampler bouncing   																

**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10

**METRIC**

(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No 202-51**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Hwy 69 (New), Sta. 12+000, o/s 18.8m Lt. CL Med. ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.  
 DATUM Geodetic DATE September 13, 2007 CHECKED BY G.D.

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									
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
205.0	Ground Surface							20	40	60	80	100					
0.0 204.7	Topsoil		1	SS	17												
0.3	Clay, trace sand																
	Stiff to Brown Moist very stiff		2	SS	36		204										0 1 30 69
203.6	Silty clay, trace sand																
1.4	Stiff Brown Moist		3	SS	13		203										0 2 48 50
	thin layers of sand and silty sand																
	Wet																
201.2	thin layers of sand		4	SS	8		202										
3.8	End of borehole Refusal on probable bedrock																
<div>* 2007 09 13</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div> <div> Penetrometer test</div>																	

1 of 1 **METRIC**

[illegible]

**METRIC**





























(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No H607-1**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Highway 607 Underpass ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY M.R.  
 DATUM Geodetic DATE May 26, 2004 CHECKED BY D.W.K.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT LIMIT CONTENT LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE					○				
								● QUICK TRIAXIAL × LAB VANE									
203.1	Ground Surface						20	40	60	80	100						
0.0	Topsoil		1	SS	WH**		203							○			
0.3	Silty clay, trace sand blueish grey fissures																
	Soft Brown WTPL to firm																
			2	SS	7									○			
																	
	Numerous layers of grey silt																
			3	SS	4									○			
199.1																	
4.0	Silt, trace clay						199										
	Compact Grey Wet																
			4	SS	11									○			
198.1																	
5.0	Sand, fine to coarse with gravel, trace silt						198										
	Compact Grey Wet																
197.3																	
5.8	Boulders in silty sand matrix																
	Compact Grey Wet																
			5	RC NQ	RC***		197										
																	
							196										
																	
							195										
194.6																	
8.5	Bedrock																
	Granitic Gneiss																
	High strength																
	Good to excellent quality		6	RC NQ	REC 100%		194									RQD 100%	
																	
							193										
			7	RC NQ	REC 100%											RQD 77%	
							192										
191.4																	
11.7	End of borehole																
	* Borehole charged with drilling water																
	WH** Refers to penetration under weight of rods and hammer																
	RC*** Rock core attempted after refusal on suspect bedrock																



**RECORD OF BOREHOLE No H607-2**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Highway 607 Underpass ORIGINATED BY M.R.  
 Co-ords. 5 099 417 N; 335 920 E  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY M.R.  
 DATUM Geodetic DATE May 25, 2004 CHECKED BY D.W.K.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						w <sub>p</sub>	w	w <sub>L</sub>						
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE														
206.9 0.0	Ground Surface							20	40	60	80	100										
206.8 0.1	Topsoil		1	SS	1		206															
206.2 0.7	Silty sand																					
206.2 0.7	Very Rusty Wet loose brown		2	SS	35																	
205.7 1.2	Sand and silt, trace clay																					
205.7 1.2	Dense Brown Dry Bedrock																					
	Granitic Gneiss		3	RC NQ	REC 100%		205													RQD   63%		
	High strength Excellent quality						204															
			4	RC NQ	REC 100%		203													RQD   98%		
202.6 4.3	End of borehole																					
	*    Borehole charged with drilling water																					

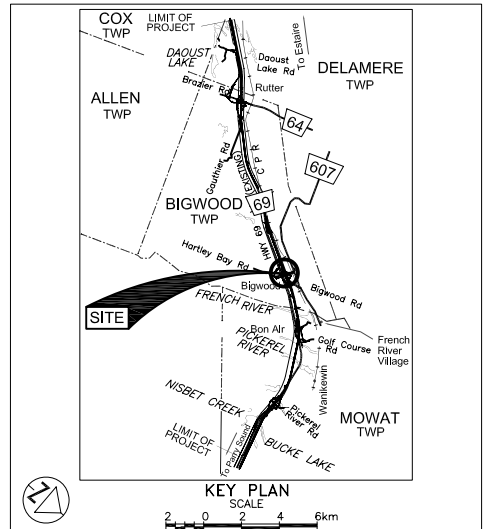
CONT No  
WP No 5278-05-01

HIGHWAY 607 OVERPASS SBL  
HIGHWAY 69  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

**PML Peto MacCallum Ltd.**  
CONSULTING ENGINEERS



- 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)
  - W L at time of investigation Mar 2009; 200 Series April and Sept 2007; H607 Series May 2004
  - Head
  - ARTESIAN WATER
  - Encountered
  - \* Water level not established
  - PIEZOMETER

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
S1	205.2	5 099 374.3	335 928.1
S2	207.0	5 099 394.2	335 923.0
S3	204.9	5 099 389.5	335 915.1
S4	204.0	5 099 384.8	335 907.3
S5	204.9	5 099 420.5	335 900.5
S6	204.4	5 099 415.8	335 892.7
S7	203.8	5 099 411.1	335 884.9
S8	204.2	5 099 431.0	335 879.7
AP1	204.1	5 099 382.6	335 928.1
AP2	204.1	5 099 385.5	335 912.7
AP3	207.4	5 099 396.5	335 921.0

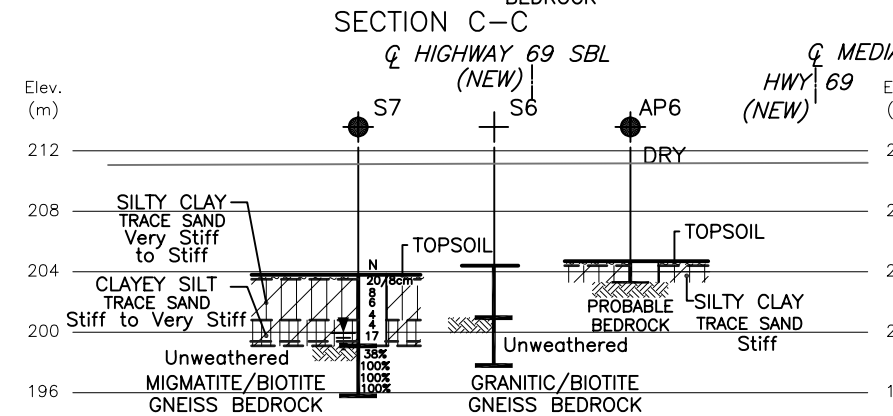
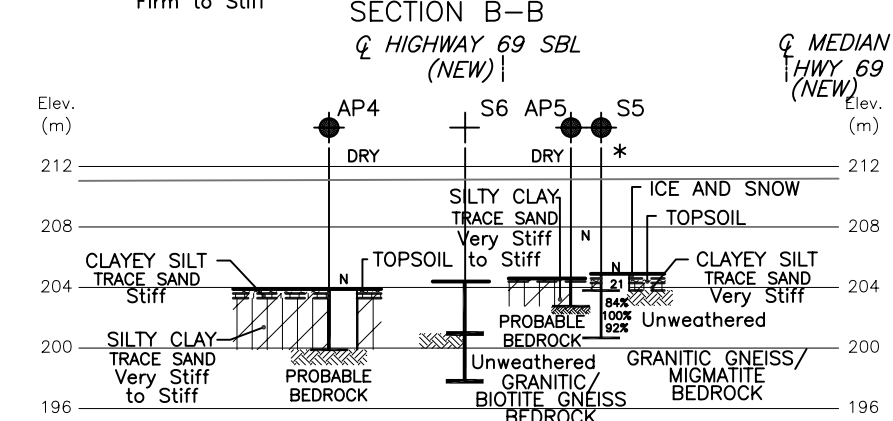
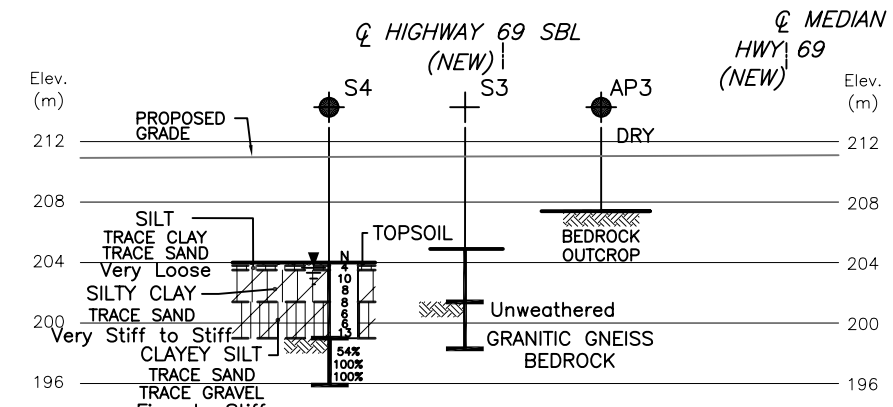
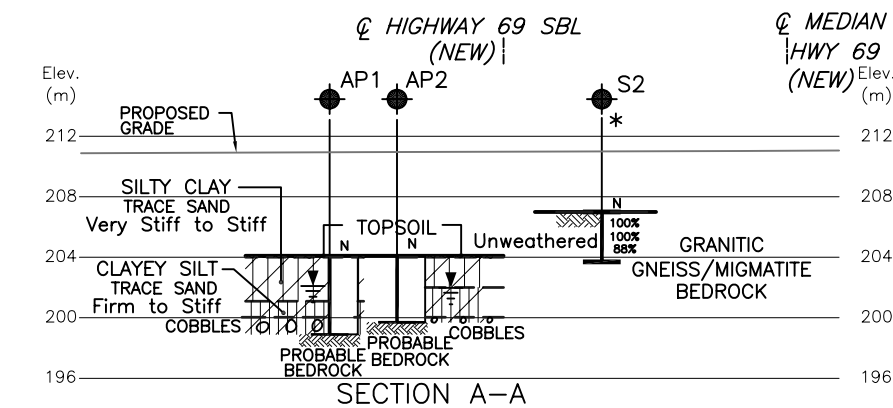
(Legend Continues)

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

DATE	BY	DESCRIPTION

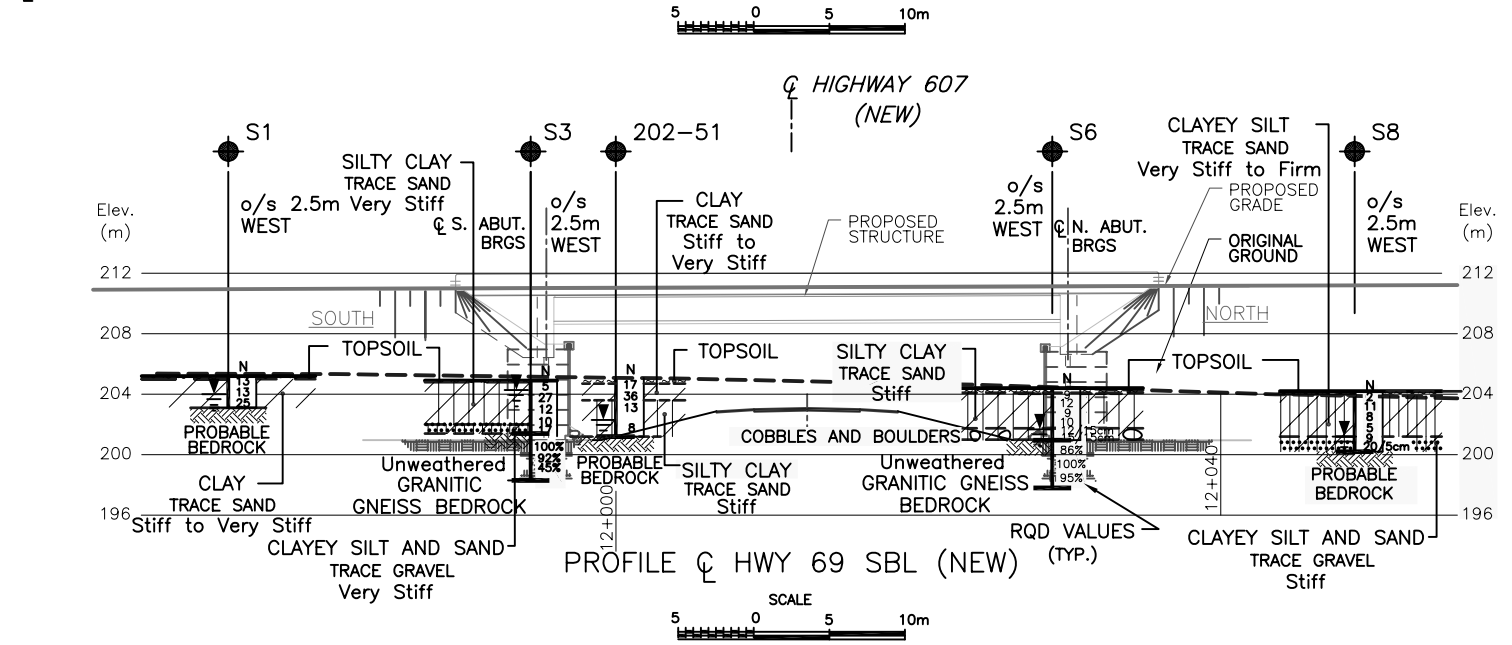
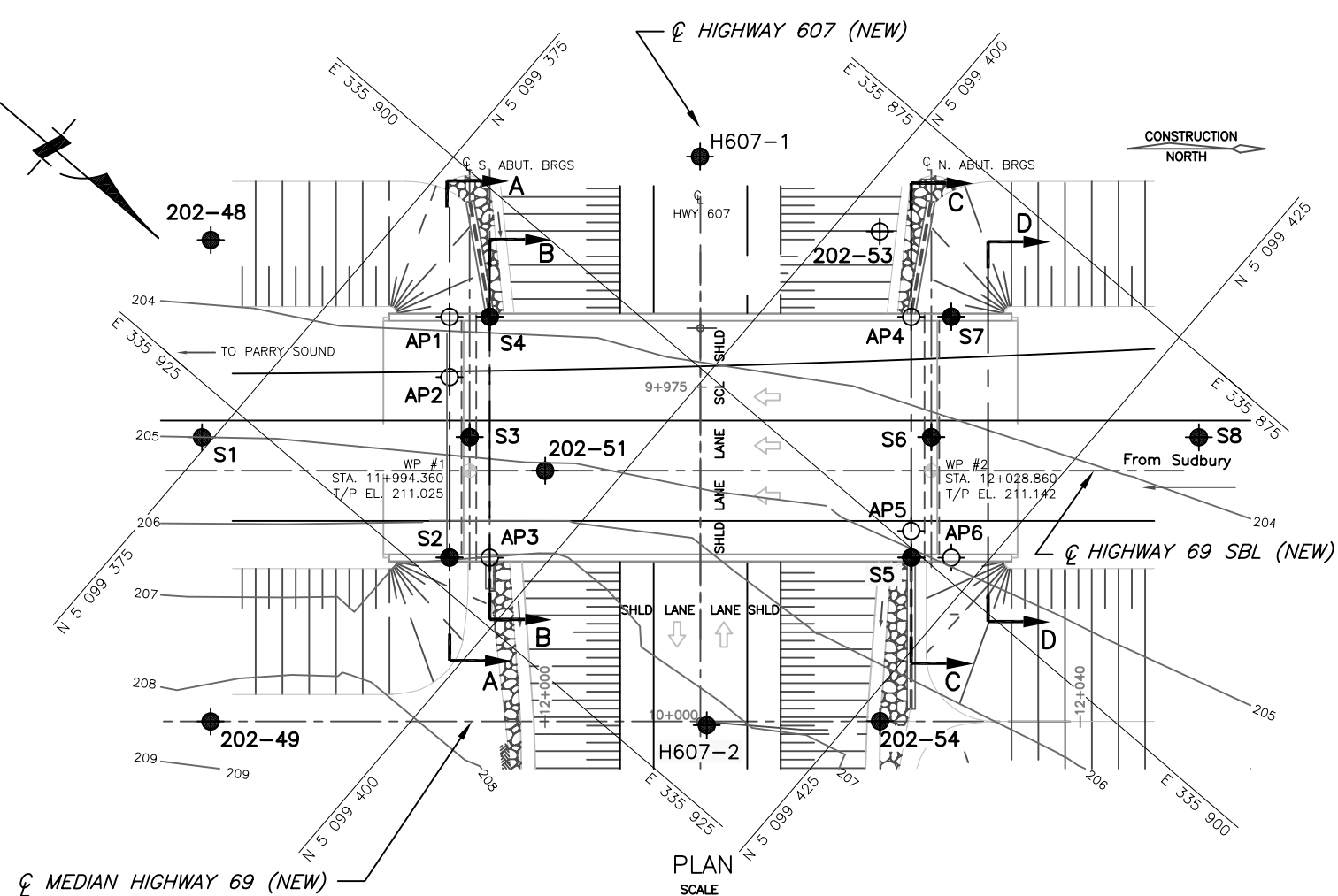
Geocres No. 411-239

HWY No 69  
SUBM'D NR CHECKED NR DATE AUG. 26, 2009 SITE 44-434/2  
DRAWN NA CHECKED CN APPROVED BRG DWG 607-S



**NOTES:**

- DRAWING 607-S SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- BOREHOLES H607-1 AND H607-2 WERE DRILLED FOR THE PRELIMINARY INVESTIGATION IN 2004 (GEOCRES No. 411-178) AND 202-48, 202-49, 202-51, 202-53 AND 202-54 WERE DRILLED FOR SWAMP 202 (PML REFERENCE 06TFO33B).
- COORDINATES OF BOREHOLES WERE PROVIDED BY MRC IN REFERENCED GA DRAWING.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



(Legend Continued)

BH No	ELEVATION	STA BIGWOOD TWP	o/s CL MED
202-48	203.8	11+975	36.0m Lt.
202-49	208.9	11+975	CL
202-51	205.0	12+000	18.8m Lt.
202-53	203.6	12+025	36.6m Lt.
202-54	206.5	12+025	CL

(Legend Continued)

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
AP4	203.9	5 099 408.8	335 886.9
AP5	204.6	5 099 419.2	335 899.0
AP6	204.7	5 099 422.8	335 898.6
H607-1	203.1	5 099 389.0	335 888.0
H607-2	206.9	5 099 417.0	335 920.0

(Legend Continues)



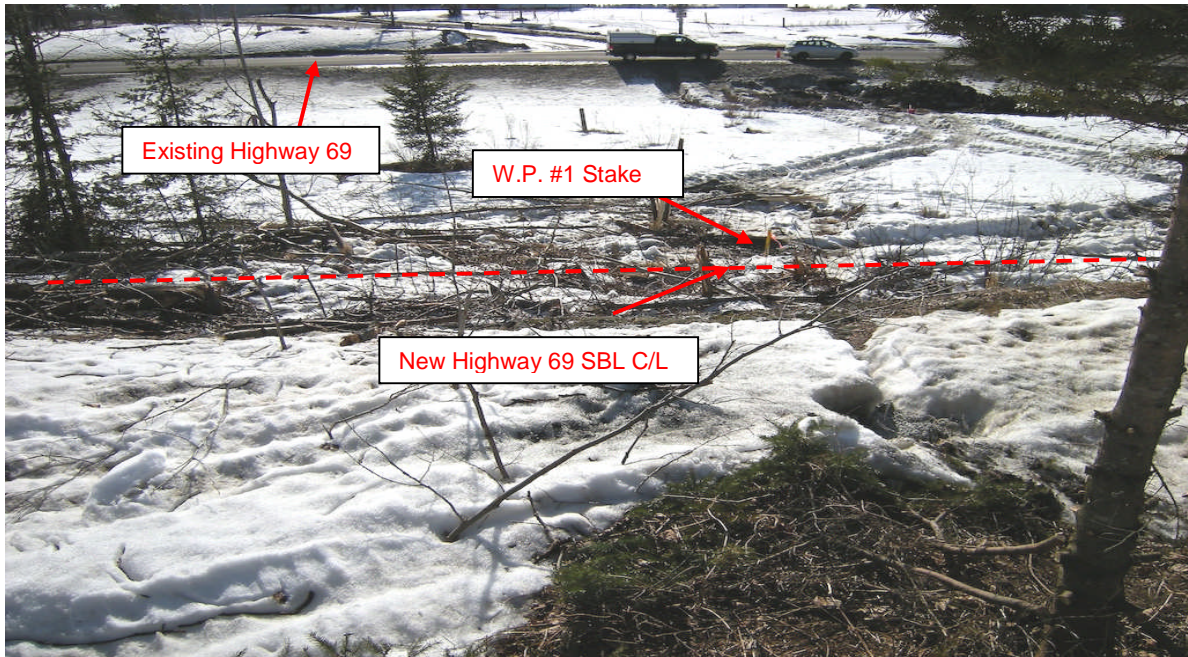
REF No. MRC Drawings: H6454xb02 contours zone 12.dwg;  
S6454-325-001GA.dwg Modified March 2009



## **APPENDIX A**

### Site Photographs



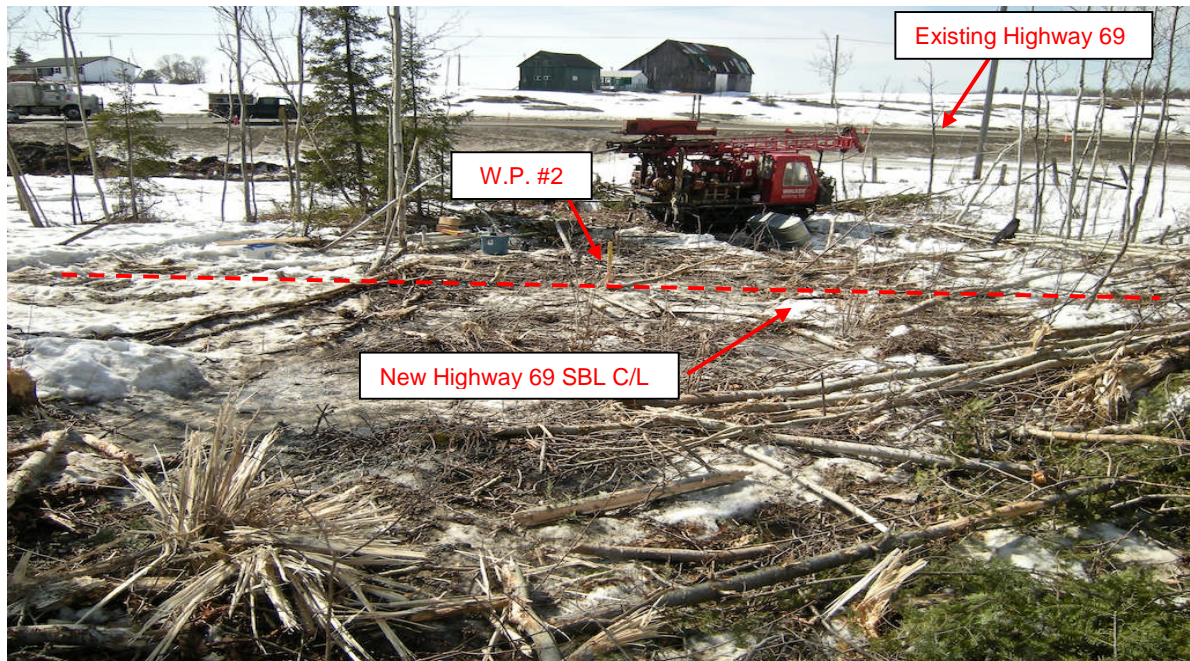


**Photograph 1:** Looking west from the south abutment, Station 11+994. Existing Highway 69 in the background of the photograph. Note W.P. #1 stake on the ground at the toe of the slope at the centre of the photograph.

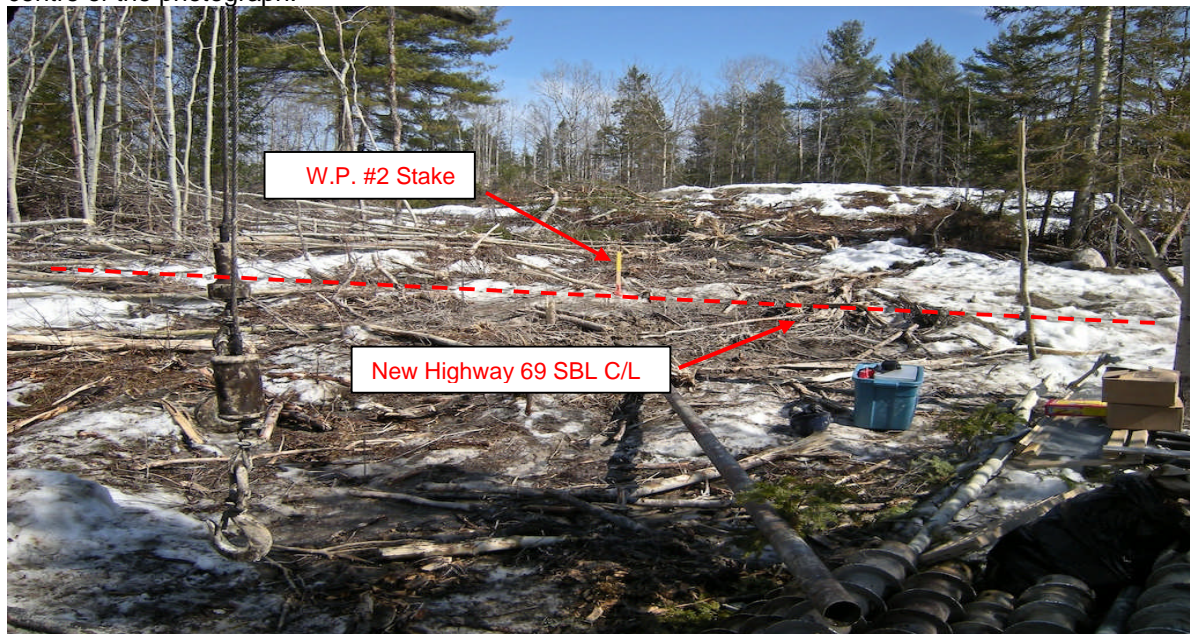


**Photograph 2:** Looking east from the south abutment, Station 11+994. Outcrop in the foreground and wooded areas in the background of the photograph.





**Photograph 3:** Looking west from the north abutment, Station 12+029. Viewing farm houses and existing Highway 69 in the background of the photograph. Note W.P.# 2 stake on the ground at the centre of the photograph.



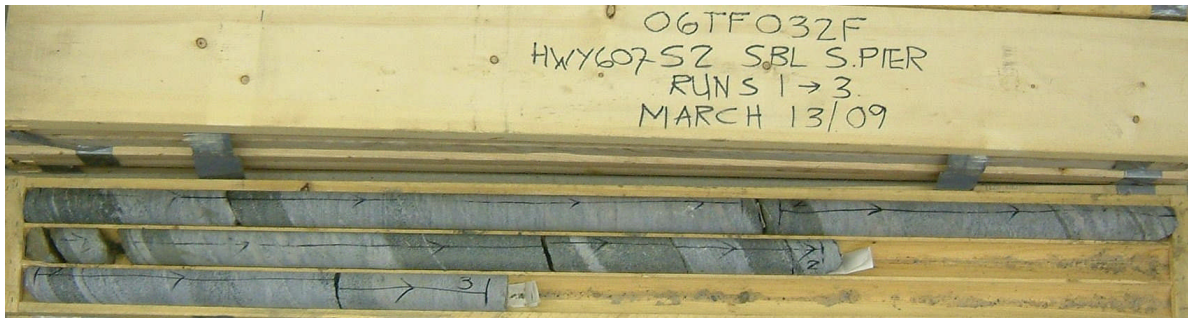
**Photograph 4:** Looking east from the north abutment, Station 12+029. Sparse woodland with open areas is in view at the background of the photograph. Note W.P. #2 stake on the gentle sloping ground at the centre of the photograph.



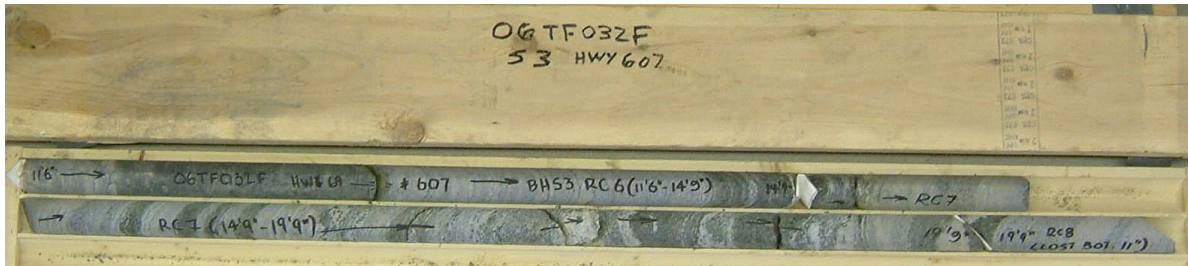
## **APPENDIX B**

### Rock Core Photographs





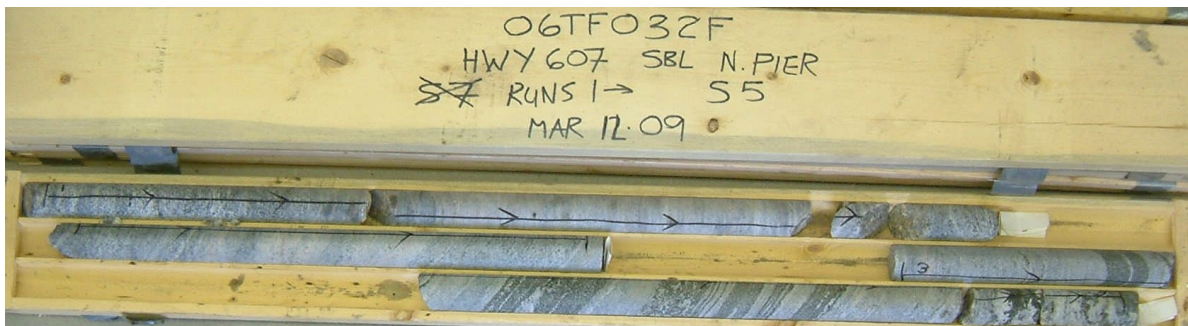
**Photograph 1:** Cores retrieved from Borehole S2. Runs 1 to 3 from depth 0.0 to 3.3 m depth. Last piece of 10 cm core remained down hole. RQD ranged from 88 (last run) to 100%. Rock quality is excellent.



**Photograph 2:** Cores retrieved from Borehole S3. Runs 6 to 8 from depth 3.5 to 6.6 m depth. Last piece of 33 cm core could not be recovered. RQD ranged from 45 (last run) to 100%. Rock quality is excellent.



**Photograph 3:** Cores retrieved from Borehole S4. Runs 8 to 10 from 5.0 to 8.1 m depth. RQD ranged from 54 to 100%. Upper 0.7 m rock, from 5.0 to 5.7 m depth, is fair quality, remainder excellent quality.



**Photograph 4:** Cores retrieved from Borehole S5. Runs 2 to 4 from 1.1 to 4.2 m depth. RQD ranged from 84 to 100%. Rock quality ranged from good to excellent.



**Photograph 5:** Cores retrieved from Borehole S6. Runs 7 to 9 from depth 3.4 to 6.8 m. Last 7.5 cm rock piece remained down hole. RQD ranged from 95 to 100%, excellent quality.



**Photograph 6:** Cores retrieved from Borehole S7. Runs 7 to 10 from depth 4.7 to 8.0 m. RQD ranged from 38 to 100%. Upper 0.4 m rock exhibited poor quality, remainder excellent quality.





**TABLE 1**  
**LIST OF ATTERBERG LIMITS**

<b>SOIL TYPE</b>	<b>BOREHOLE NO.</b>	<b>SAMPLE NO.</b>	<b>LIQUID LIMIT</b>	<b>PLASTIC LIMIT</b>	<b>PLASTICITY INDEX</b>	<b>MOISTURE CONTENT (%)</b>
Clay	S1	2	53	23	30	39
Silty Clay	S6	3	43	22	21	35
Clayey Silt	S4	5	30	21	9	29
	S4	6	25	20	5	27
	S7	5	29	20	9	26
	S8	4	30	21	9	30
Clayey Silt and Sand	S3	5	22	18	4	24
	S8	5	23	18	5	18



**TABLE 2**  
**ROCK CORE DESCRIPTIONS**

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S2	1	0.0 – 1.0	100	100	0.0 – 3.3	GRANITIC GNEISS/MIGMATITE: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, moderate (locally close) spaced dipping cross joints, generally associated with biotite layers, rough planar, tight to slightly altered with brown silt on some partings, excellent quality.  Note: * Last piece of 10 cm core remained down hole.
	2	1.0 – 2.5	100	100		
	3	2.5 – 3.3	88*	88*		
S3	6	3.5 – 4.5	100	100	3.5 – 6.6	GRANITIC GNEISS: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, moderate (locally close) spaced dipping cross joints, generally associated with biotite layers, rough planar, tight to slightly altered with brown silt on some partings, excellent quality.  Note: * Last piece of 33 cm core remained down hole.
	7	4.5 – 6.0	98	92		
	8	6.0 – 6.6	45*	45*		
S4	8	5.0 – 5.7	100	54	5.0 – 8.1	GRANITIC GNEISS: Pink and grey with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, close to moderate spaced dipping cross joints, generally associated with biotite layers, rough planar, tight, fair to excellent quality.
	9	5.7 – 7.3	100	100		
	10	7.3 – 8.1	100	100		
S5	2	1.1 – 2.3	100	84	1.1 – 4.2	GRANITIC GNEISS/MIGMATITE: Black and white, changing to pink and grey with slight banding, with dipping black biotite rich layers, trace pyrite, garnetiferous, fine to medium grained, high strength, unweathered, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with scale on some partings, good to excellent quality.
	3	2.3 – 2.9	100	100		
	4	2.9 – 4.2	100	92		

Originated: FP and MR

Compiled: PML

Checked: CN



TABLE 2  
 ROCK CORE DESCRIPTIONS

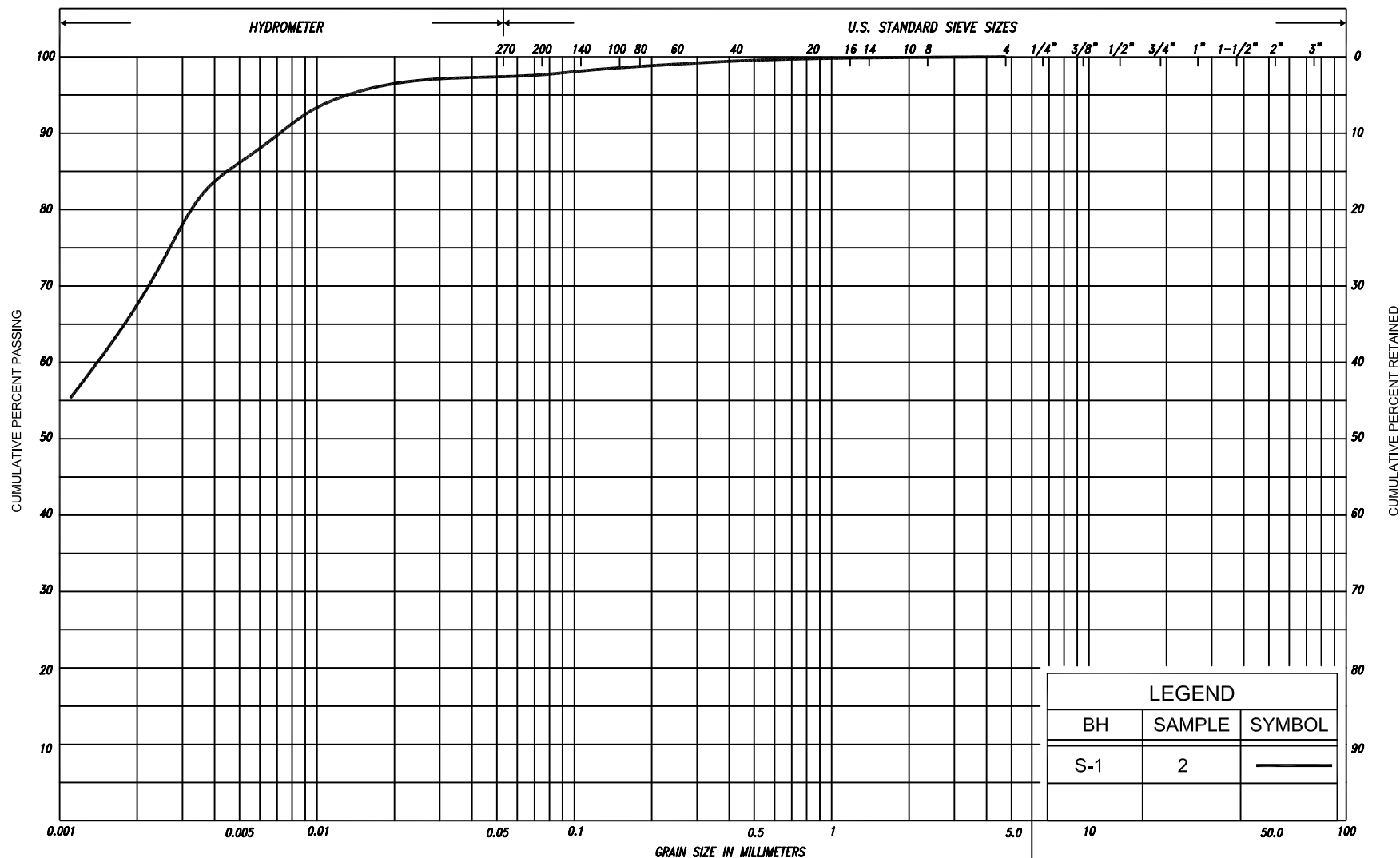
CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S6	7	3.4 – 4.3	100	100	3.4 – 6.8	GRANITIC GNEISS/BIOTITE GNEISS: Black and white, changing to pink and grey with dipping bands, with dipping black biotite rich layers, fine to medium grained, high strength, unweathered, wide (locally close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with silt, excellent quality.  Note: * Last piece of 7.5 cm core remained down hole.
	8	4.3 – 5.3	100	100		
	9	5.3 – 6.8	95*	95*		
S7	7	4.7 – 5.1	100	38	4.7 – 8.0	MIGMATITE/BIOTITE GNEISS: Black and white, banded, fine to medium grained, high strength, unweathered, close (locally very close, becoming medium to wide spaced flat to dipping cross joints, rough planar, tight, poor to excellent quality.
	8	5.1 – 5.8	100	100		
	9	5.8 – 7.3	100	100		
	10	7.3 – 8.0	100	100		

NOTE: RQD = Rock Quality Designation

Originated: FP and MR

Compiled: PML

Checked: CN



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

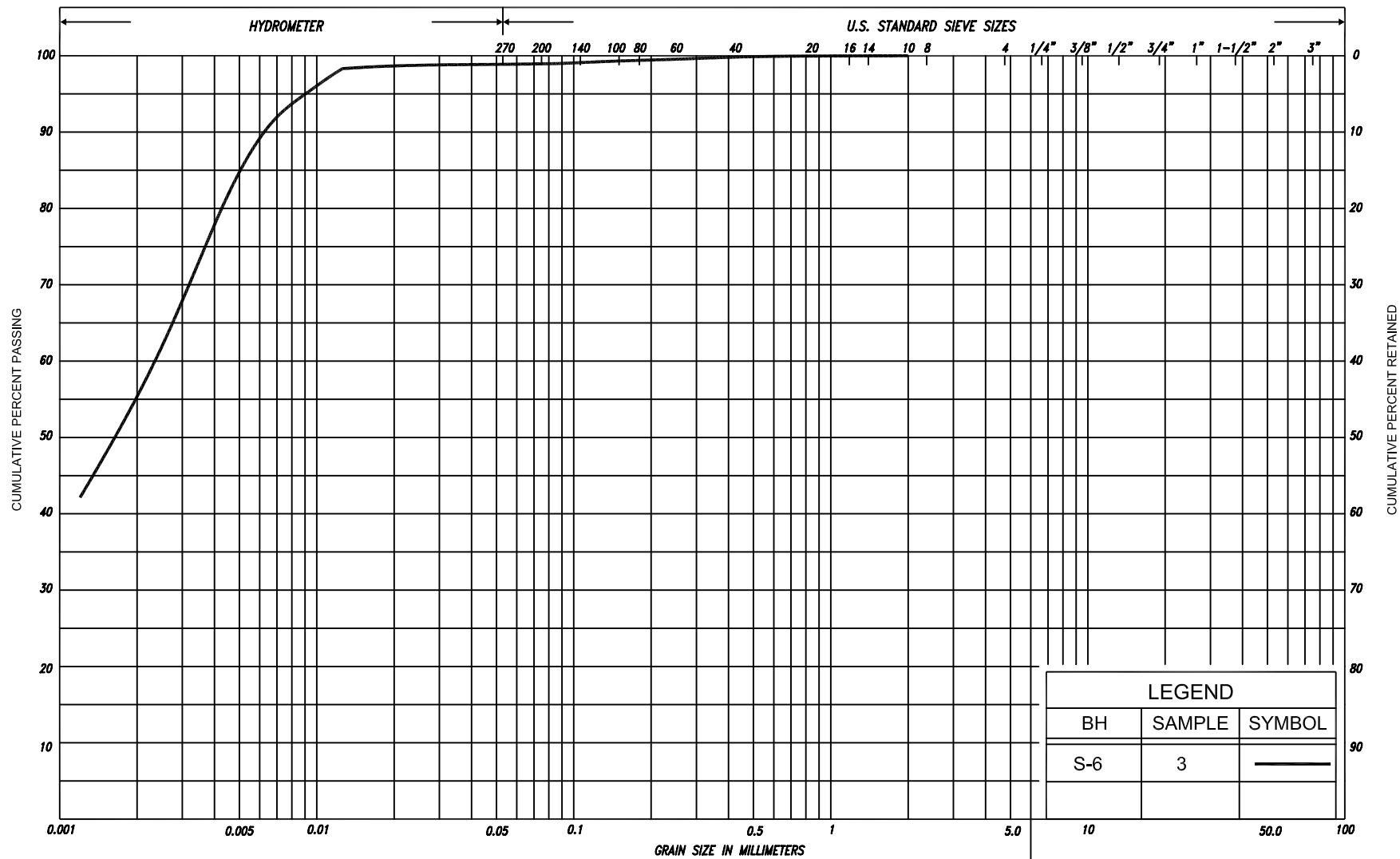
# GRAIN SIZE DISTRIBUTION

CLAY, trace sand

FIG No. S-GS-1

HWY: 69

W.P. No. 5278-05-01



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

SILTY CLAY, trace sand

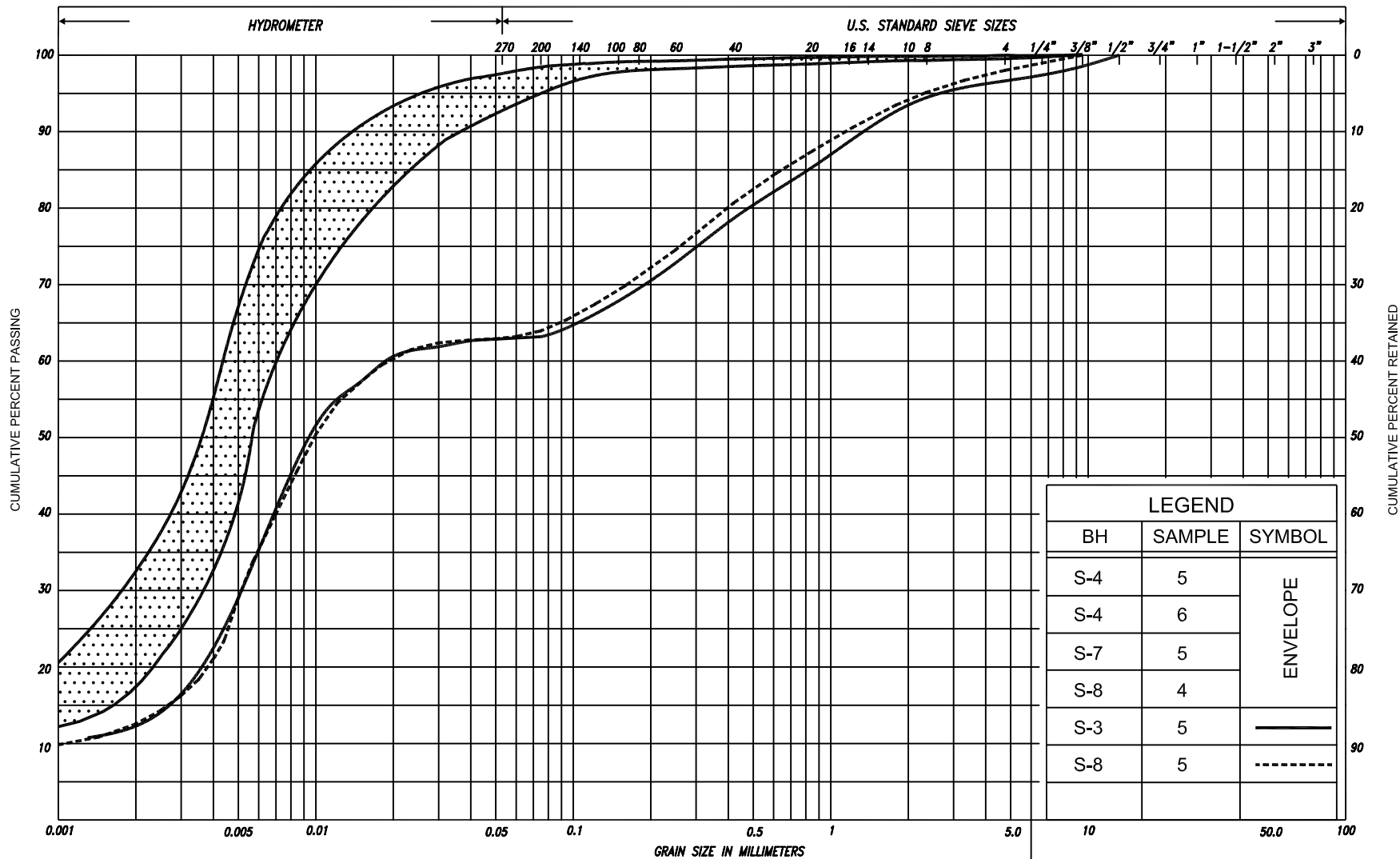


Ministry of  
Transportation  
Ontario

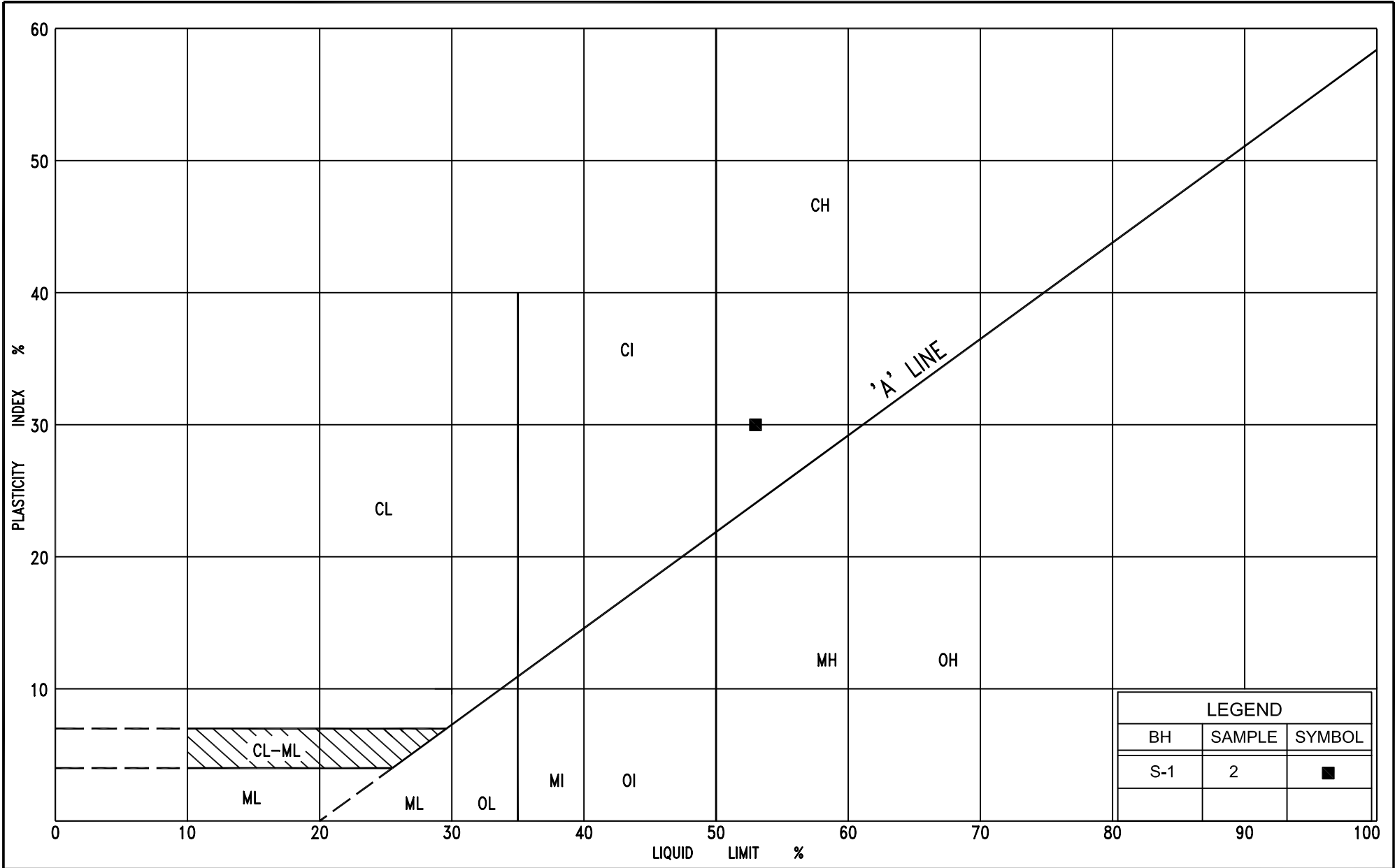
FIG No. S-GS-2

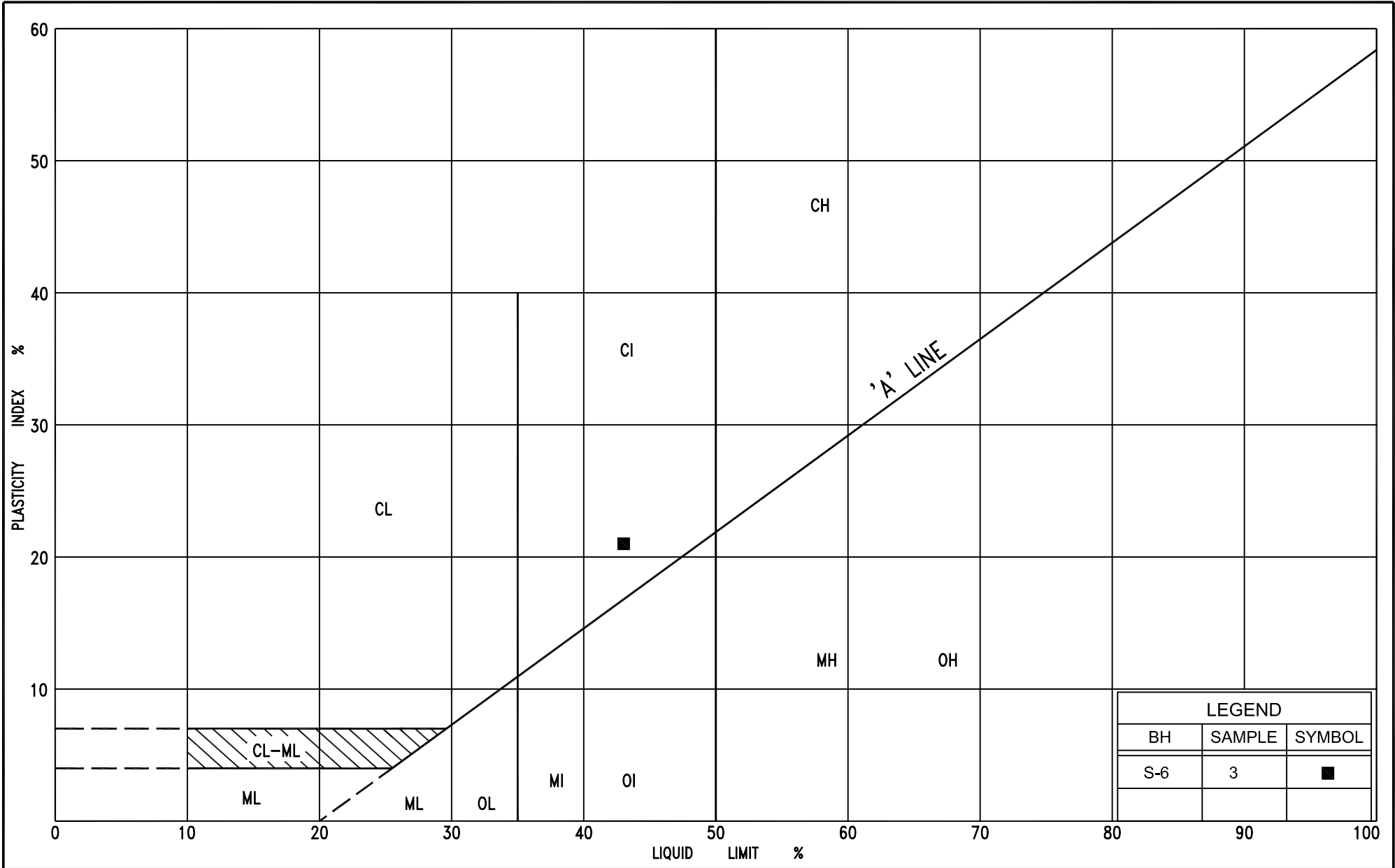
HWY: 69

W.P. No. 5278-05-01

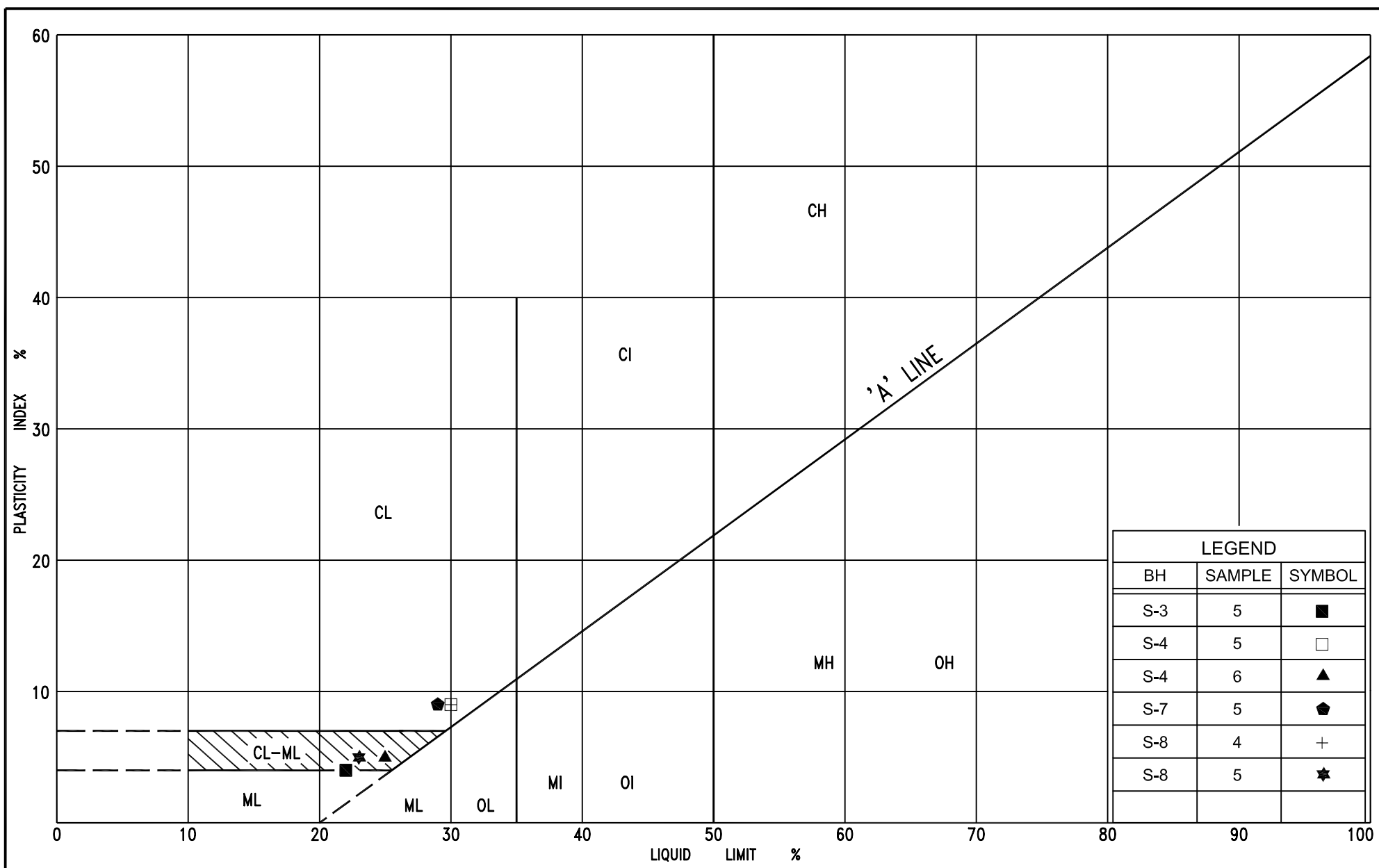


SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED		
					SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT																
CLAY		SILT			V. FINE	FINE	MED.	COARSE	GRAVEL								U.S. BUREAU
					SAND												









## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
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
$S_t$	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	$m^3/s$	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	$kN/m^3$	SEEPAGE FORCE
e	1, %	VOID RATIO						

**METRIC**

(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No AP2**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 385.5 N; 335 912.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 25, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
204.1 0.0	Ground Surface							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		GR SA SI CL
204.0 0.1	Topsoil Silty clay, trace sand Very stiff Brown Moist						204										
							203										
202.0 2.1	Clayey silt, trace sand Stiff Brown Moist to grey						202										
							201										
	cobbles						200										
199.7 4.4	End of auger probe Refusal on probable bedrock																
	<div>* 2009 03 25</div> <div>▽ Water level observed during drilling</div>																

**RECORD OF BOREHOLE No AP3**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 396.5 N; 335 921.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY N.R.  
 DATUM Geodetic DATE March 25, 2009 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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**RECORD OF BOREHOLE No AP4**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 408.8 N; 335 886.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 11, 2009 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 ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE										WATER CONTENT (%)
203.9	Ground Surface					*		20	40	60	80	100		20	40	60		
0.0 203.6	Topsoil																	
0.3 203.3	Clayey silt, trace sand																	
0.6	Stiff Brown Wet Silty clay, trace sand Very stiff Brown Moist to stiff						203											
							202											
							201											
							200											
199.9 4.0	End of borehole Refusal on probable bedrock																	
	* Borehole dry																	

**RECORD OF BOREHOLE No AP5**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 419.2 N; 335 899.0 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 10, 2009 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 (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
204.6	Ground Surface					*															
0.0	Topsoil							20	40	60	80	100									
204.4	Silty clay, trace sand																				
0.2	Very stiff Brown Moist to stiff																				
202.8	End of borehole Refusal on probable bedrock																				
1.8	* Borehole dry																				

**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10



**RECORD OF BOREHOLE No S1**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 374.3 N; 335 928.1 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 16, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w <sub>p</sub> w w <sub>L</sub>							
205.2	Ground Surface							20	40	60	80	100								
0.0	Topsoil		1	SS	13	▼* ▼*	205													
205.0 0.2	Clay, trace sand  Stiff to Brown Moist very stiff to dry																			
			2	SS	13															
203.1			3	SS	25		204													
2.1	End of borehole  Refusal on probable bedrock																			
<div>* 2009 03 16</div> <div>▼ Water level observed during drilling</div> <div>▼* Water level measured after drilling</div> <div>■ Penetrometer test</div>																				

\* 2009 03 16

▽ Water level observed  
during drilling

▼ Water level measured  
after drilling

■ Penetrometer test

**METRIC**

(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No S3**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 389.5 N; 335 915.1 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 12, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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**METRIC**

**+<sup>7</sup>, ×<sup>5</sup>:** Numbers refer to Sensitivity

**RECORD OF BOREHOLE No S5**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 420.5 N; 335 900.5 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 12, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>					
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
204.9	Top of Ice							20	40	60	80	100								
0.0 204.6	Ice and Snow																			
0.3 204.3	Topsoil																			
0.6 203.8	Clayey silt, trace sand		1	SS	21		204													
1.1 203.8	Very stiff Brown Wet																			
	Granitic Gneiss/Migmatite Bedrock		2	RC NQ	REC 100%		203											RQD 84%		
	Unweathered		3	RC NQ	REC 100%		202											RQD 100%		
	High strength		4	RC NQ	REC 100%		201											RQD 92%		
200.7	Good to excellent quality																			
4.2 200.7	End of borehole																			
<div>*    Borehole charged with drilling water</div> <div>■    Penetrometer test</div> <div>C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</div>																				

\* Borehole charged with  
drilling water  
 ■ Penetrometer test  
 C.F.S.S.A. denotes  
Continuous Flight Solid Stem  
Augers

**RECORD OF BOREHOLE No S6**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 415.8 N; 335 892.7 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 12 and 15, 2009 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										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE								○		
204.4	Ground Surface						20	40	60	80	100									
0.0	Topsoil		1	SS	9	▼* ▼*	204									Org. 8.0%	Top 0.3m frozen			
0.3	Silty clay, trace sand																			
	Stiff Brown Moist to wet		2	SS	12															
			3	SS	9															
	layers of clayey silt																			
	sand layers		4	SS	10															
	cobbles and boulders		5	SS	12/15cm															
201.0			6	SS	15/15cm		201													
3.4	Granitic/ Biotite Gneiss Bedrock		7	RC NQ	REC 100%												RQD 100%			
	Unweathered																			
	High strength		8	RC NQ	REC 100%		200										RQD 100%			
	Excellent quality																			
			9	RC NQ	REC 95%**		199										RQD 95%**			
197.6							198													
6.8	End of borehole																			

**RECORD OF BOREHOLE No S7**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 411.1 N; 335 884.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + Rotary Diamond Drilling COMPILED BY N.R.  
 DATUM Geodetic DATE March 11 and 16, 2009 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED		+ FIELD VANE							
								● QUICK TRIAXIAL		x LAB VANE							
203.8	Ground Surface																
0.0 203.5	Topsoil		1	SS	20/8cm											GR SA SI CL	
0.3	Silty clay, trace sand  Very stiff Brown Wet to stiff															Top 0.4m frozen	
			2	SS	8												
			3	SS	6												
				FV													
			4	SS	4												
200.8	Clayey silt, trace sand																
3.0	Stiff to Brown Wet very stiff		5	SS	4											0 2 73 25	
				FV													
			6	SS	17												
	layers of sand																
	cobbles and boulders																
199.1	Migmatite/Biotite Gneiss Bedrock		7	RC NQ	REC 100%											RQD 38%	
4.7	Unweathered  High strength  Poor to excellent quality		8	RC NQ	REC 100%											RQD 100%	
			9	RC NQ	REC 100%									RQD 100%			
			10	RC NQ	REC 100%									RQD 100%			
195.8	End of borehole																
8.0																	

**RECORD OF BOREHOLE No S8**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Co-ords.: 5 099 431.0 N; 335 879.7 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.  
 DATUM Geodetic DATE March 16, 2009 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	×					
204.2	Ground Surface						20	40	60	80	100						
0.0 203.9	Topsoil		1	SS	2												
0.3	Clayey silt, trace sand Very stiff Brown Wet to firm																
			2	SS	11												
			3	SS	8												
			4	SS	5												
201.2	Clayey silt and sand trace gravel																
3.0	Stiff Grey Wet		5	SS	9												1 2 71 26
200.2																	2 34 51 13
4.0	End of borehole Refusal on probable bedrock  Sample 6: Sampler bouncing  																






**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10


**METRIC**

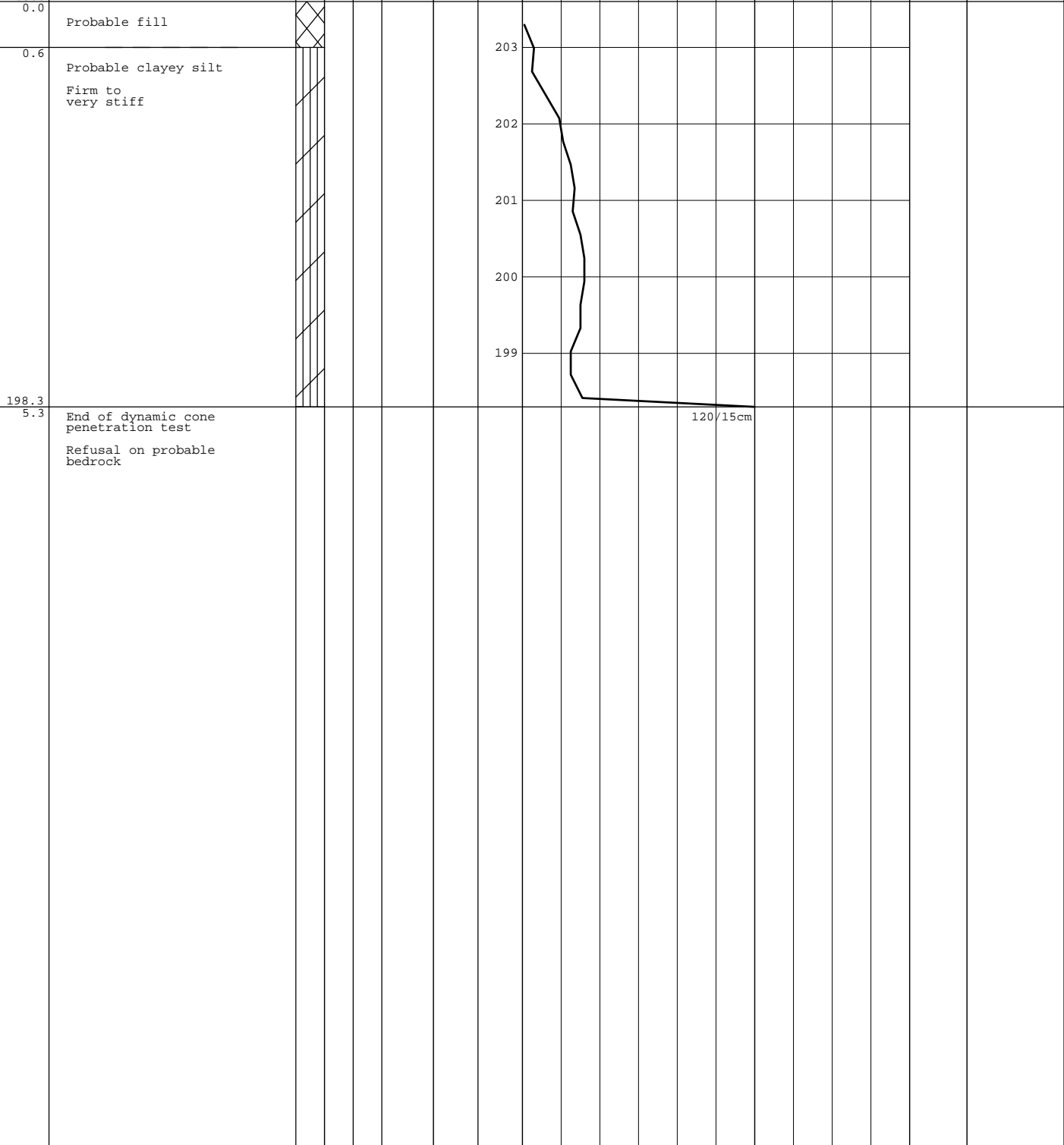
**+<sup>7</sup>, ×<sup>5</sup>:** Numbers refer to Sensitivity



(%) STRAIN AT FAILURE

1 of 1 **METRIC**

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 					
203.6	Ground Surface											kN/m³	GR SA SI CL



**METRIC**






20  
15 — 5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No H607-1**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Highway 607 Underpass ORIGINATED BY M.R.  
 Co-ords. 5 099 389 N; 335 888 E  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY M.R.  
 DATUM Geodetic DATE May 26, 2004 CHECKED BY D.W.K.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
													w <sub>p</sub> w                      w <sub>L</sub>							
203.1 0.0 202.8 0.3	Ground Surface Topsoil  Silty clay, trace sand blueish grey fissures  Soft            Brown            WTPL to firm    Numerous layers of grey silt		1	SS	WH**	*	203													
							202													
			2	SS	7		201													
							200													
			3	SS	4		199													
199.1 4.0	Silt, trace clay Compact            Grey            Wet						198													
198.1 5.0	Sand, fine to coarse with gravel, trace silt Compact            Grey            Wet						197													
197.3 5.8	Boulders in silty sand matrix Compact            Grey            Wet		5	RC NQ	RC***		196													
							195													
194.6 8.5	Bedrock Granitic Gneiss  High strength Good to excellent quality		6	RC NQ	REC 100%		194													
			7	RC NQ	REC 100%		193													
							192													
191.4 11.7	End of borehole   *        Borehole charged with drilling water  WH**   Refers to penetration under weight of rods and hammer  RC***   Rock core attempted after refusal on suspect bedrock																			

**RECORD OF BOREHOLE No H607-2**

1 of 1

**METRIC**

W.P. 5278-05-01 LOCATION Highway 607 Underpass ORIGINATED BY M.R.  
 Co-ords. 5 099 417 N; 335 920 E  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY M.R.  
 DATUM Geodetic DATE May 25, 2004 CHECKED BY D.W.K.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>						
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE													
206.9 0.0	Ground Surface							20	40	60	80	100									
206.8 0.1	Topsoil		1	SS	1		206														
206.2 0.7	Silty sand																				
	Very Rusty Wet loose brown		2	SS	35																
205.7 1.2	Sand and silt, trace clay																				
	Dense Brown Dry Bedrock																				
	Granitic Gneiss		3	RC NQ	REC 100%		205												RQD   63%		
	High strength Excellent quality						204														
			4	RC NQ	REC 100%		203												RQD   98%		
202.6 4.3	End of borehole																				
	*    Borehole charged with drilling water																				

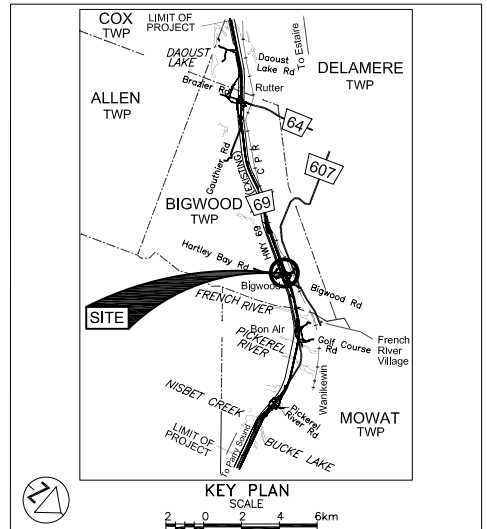
CONT No  
WP No 5278-05-01

HIGHWAY 607 OVERPASS SBL  
HIGHWAY 69  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

**PML Peto MacCallum Ltd**  
CONSULTING ENGINEERS



#### 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)
- W L at time of investigation Mar 2009;  
200 Series April and Sept 2007;  
H607 Series May 2004
- Head
- ARTESIAN WATER  
Encountered
- \* Water level not established
- PIEZOMETER

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
S1	205.2	5 099 374.3	335 928.1
S2	207.0	5 099 394.2	335 923.0
S3	204.9	5 099 389.5	335 915.1
S4	204.0	5 099 384.8	335 907.3
S5	204.9	5 099 420.5	335 900.5
S6	204.4	5 099 415.8	335 892.7
S7	203.8	5 099 411.1	335 884.9
S8	204.2	5 099 431.0	335 879.7
AP1	204.1	5 099 382.6	335 928.1
AP2	204.1	5 099 385.5	335 912.7
AP3	207.4	5 099 396.5	335 921.0

(Legend Continues)

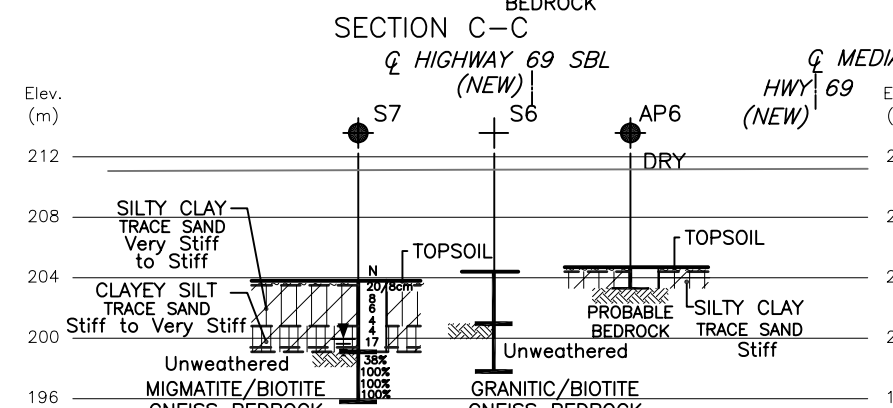
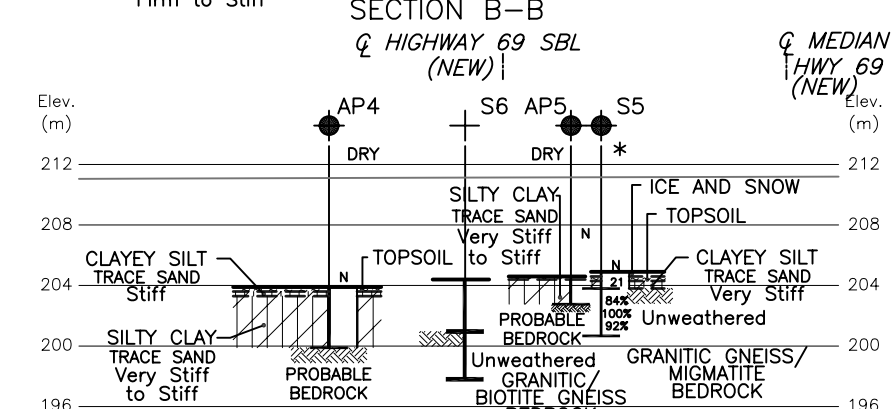
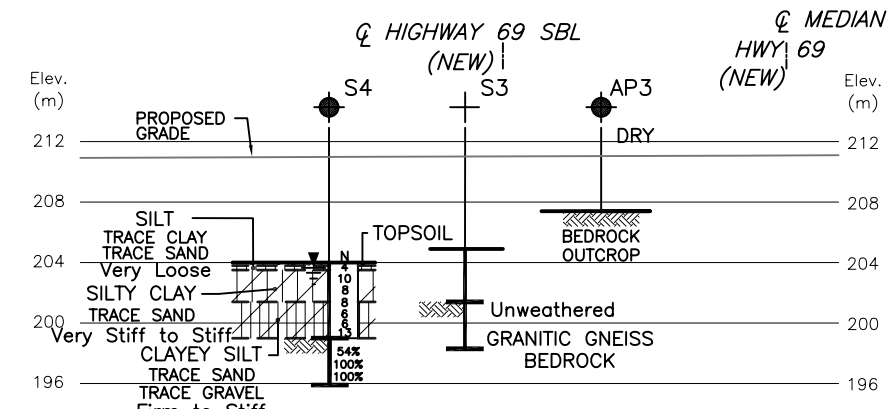
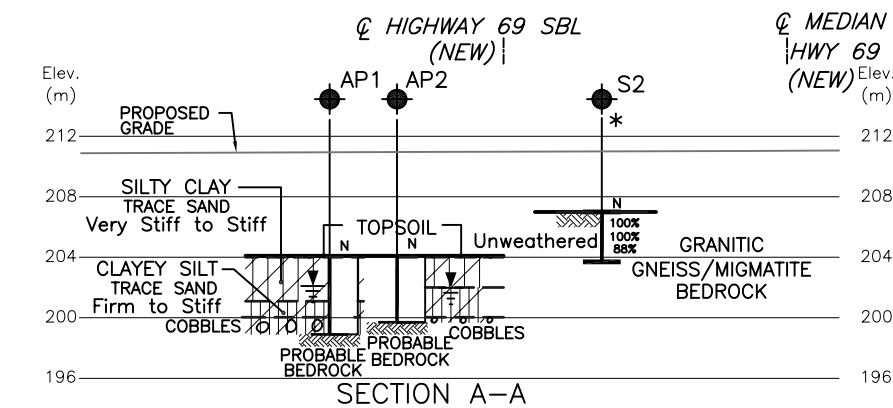
#### - NOTE -

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

DATE	BY	DESCRIPTION

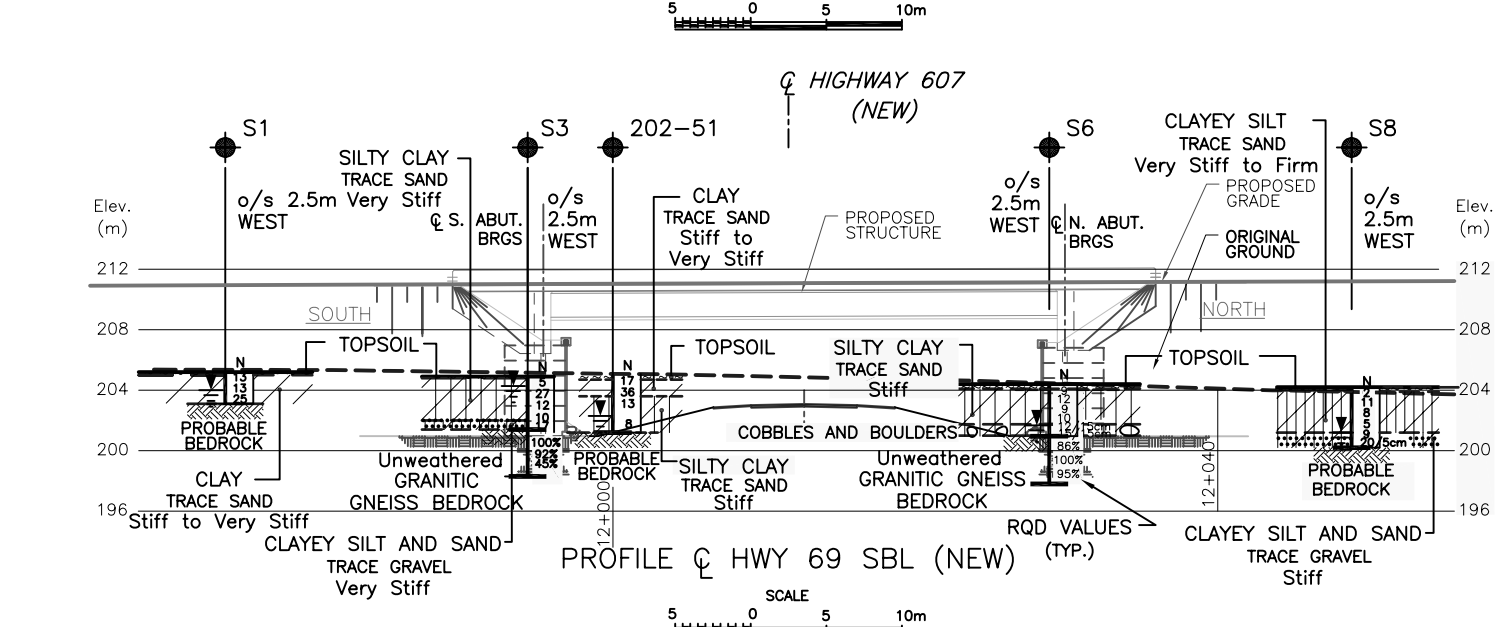
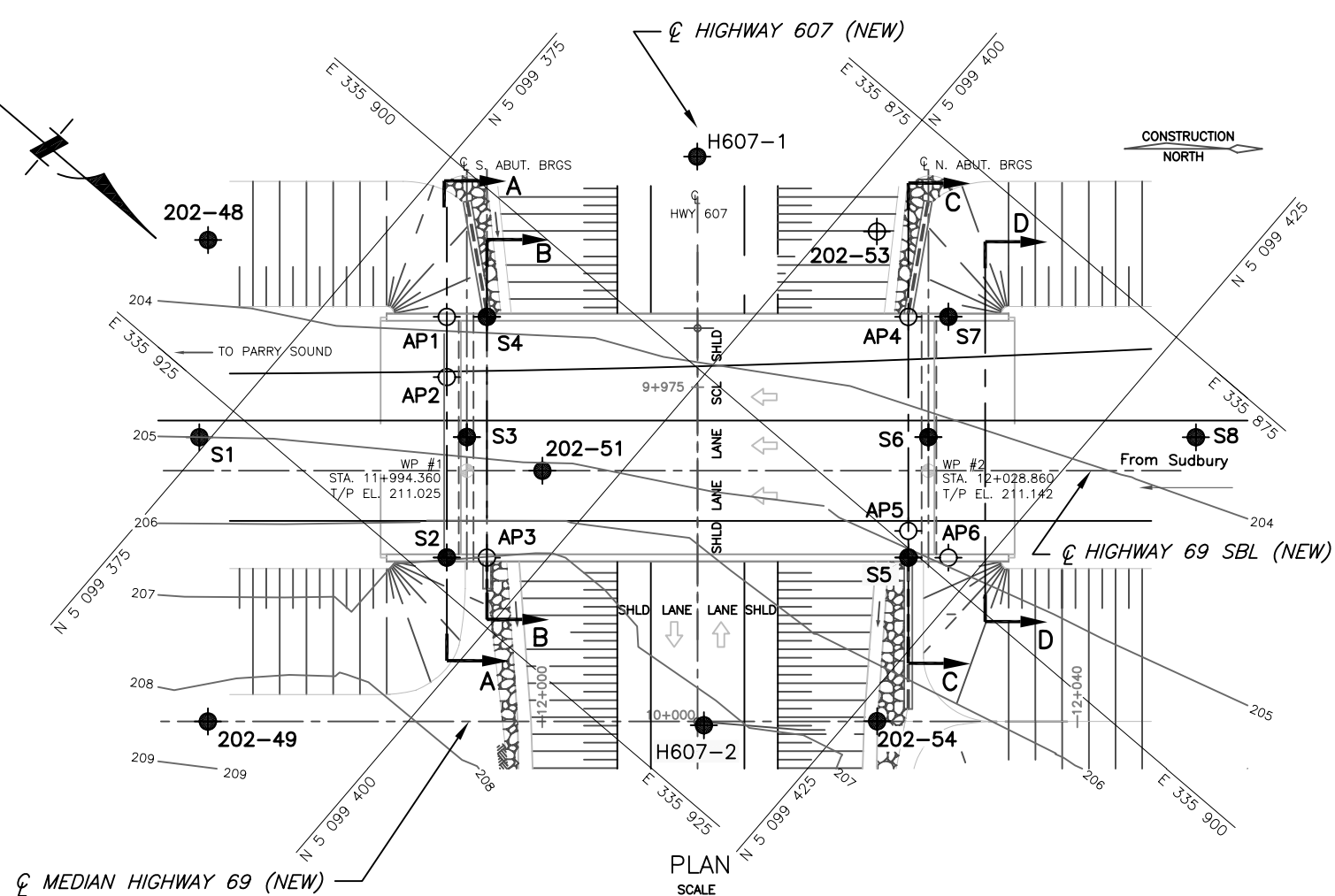
Geocres No. 411-239

HWY No 69	DIST 54
SUBM'D NR	CHECKED NR
DATE AUG. 26, 2009	SITE 44-434/2
DRAWN NA	CHECKED CN
APPROVED BRG	DWG 607-S



#### NOTES:

- DRAWING 607-S SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- BOREHOLES H607-1 AND H607-2 WERE DRILLED FOR THE PRELIMINARY INVESTIGATION IN 2004 (GEOCREs No. 411-178) AND 202-48, 202-49, 202-51, 202-53 AND 202-54 WERE DRILLED FOR SWAMP 202 (PML REFERENCE 06TFO33B).
- COORDINATES OF BOREHOLES WERE PROVIDED BY MRC IN REFERENCED GA DRAWING.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



#### (Legend Continued)

BH No	ELEVATION	STA	o/s CL MED
202-48	203.8	11+975	36.0m Lt.
202-49	208.9	11+975	CL
202-51	205.0	12+000	18.8m Lt.
202-53	203.6	12+025	36.6m Lt.
202-54	206.5	12+025	CL

#### (Legend Continued)

BH No	ELEVATION	CO-ORDINATES
AP4	203.9	5 099 408.8 335 886.9
AP5	204.6	5 099 419.2 335 899.0
AP6	204.7	5 099 422.8 335 898.6
H607-1	203.1	5 099 389.0 335 888.0
H607-2	206.9	5 099 417.0 335 920.0

(Legend Continues)



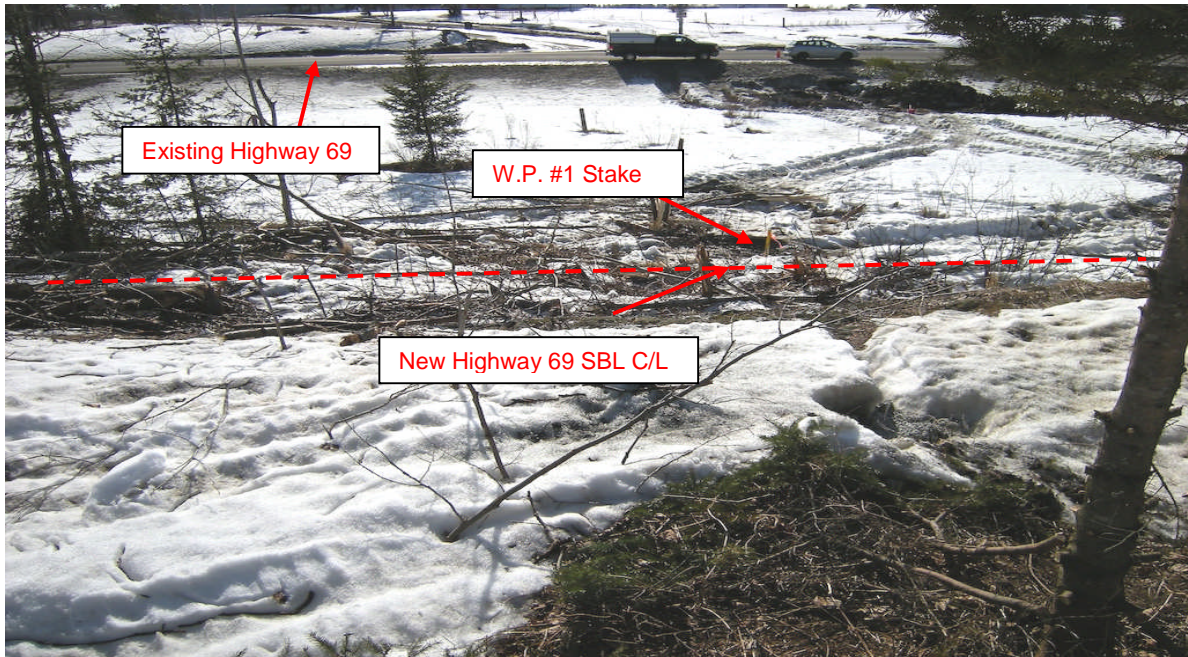
REF No. MRC Drawings: H6454xb02 contours zone 12.dwg;  
S6454-325-001GA.dwg Modified March 2009



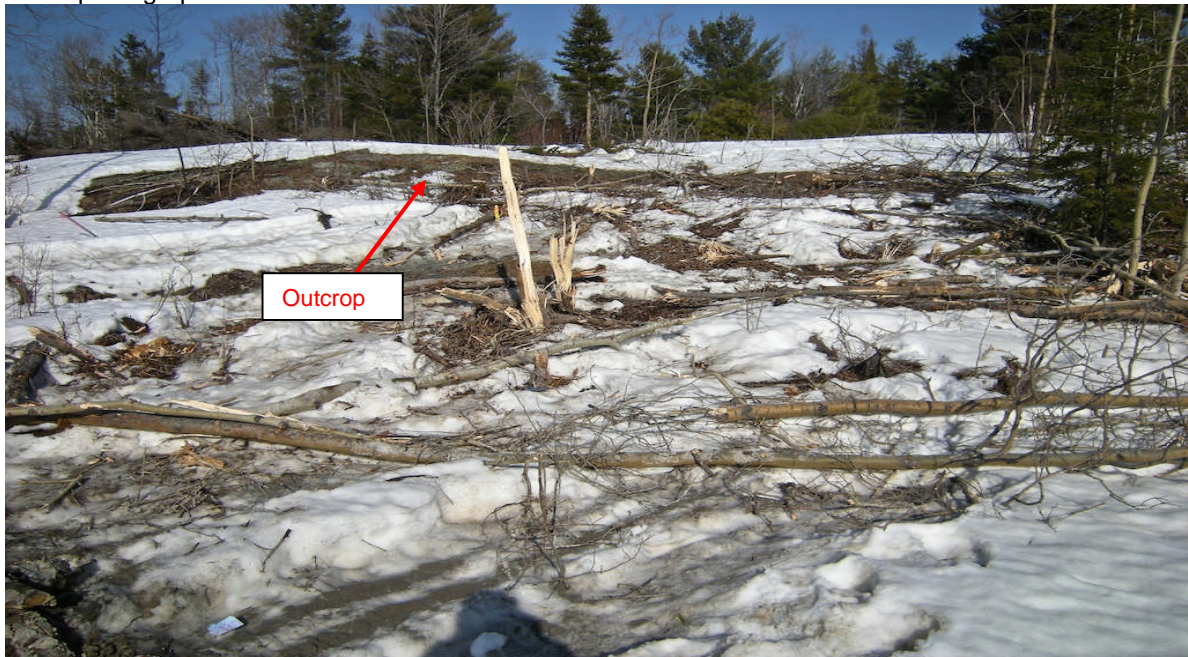


## **APPENDIX A**

### Site Photographs

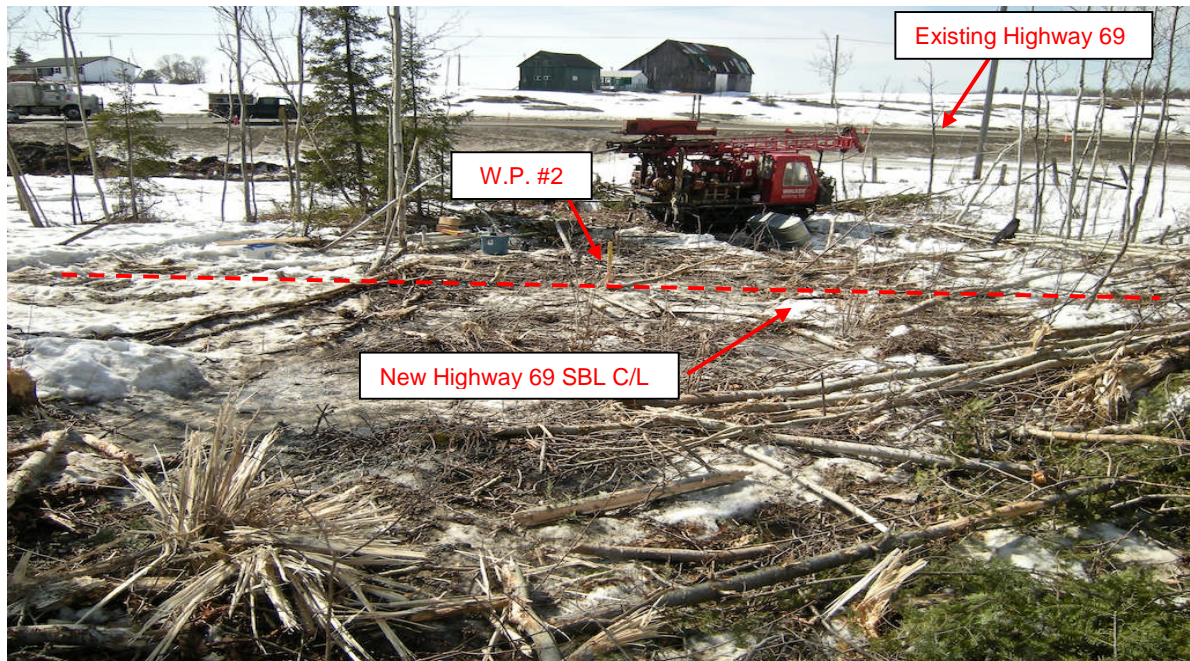


**Photograph 1:** Looking west from the south abutment, Station 11+994. Existing Highway 69 in the background of the photograph. Note W.P. #1 stake on the ground at the toe of the slope at the centre of the photograph.

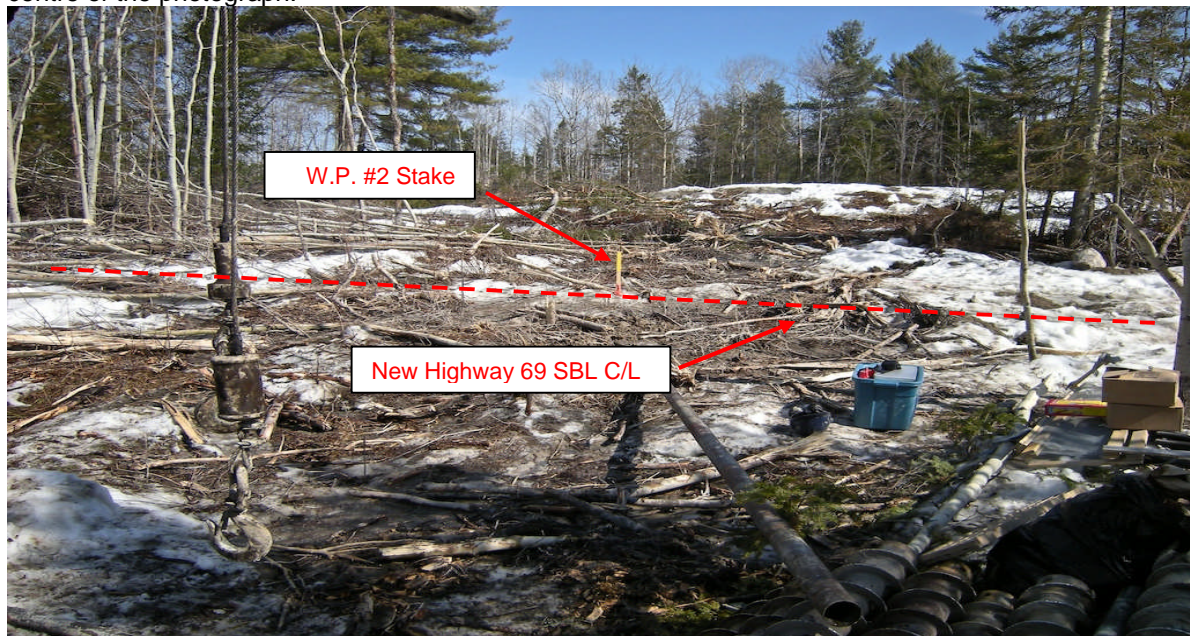


**Photograph 2:** Looking east from the south abutment, Station 11+994. Outcrop in the foreground and wooded areas in the background of the photograph.





**Photograph 3:** Looking west from the north abutment, Station 12+029. Viewing farm houses and existing Highway 69 in the background of the photograph. Note W.P.# 2 stake on the ground at the centre of the photograph.



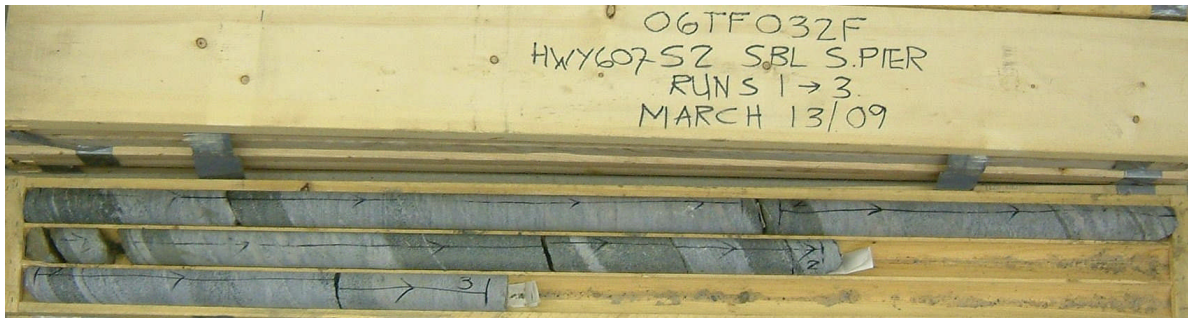
**Photograph 4:** Looking east from the north abutment, Station 12+029. Sparse woodland with open areas is in view at the background of the photograph. Note W.P. #2 stake on the gentle sloping ground at the centre of the photograph.



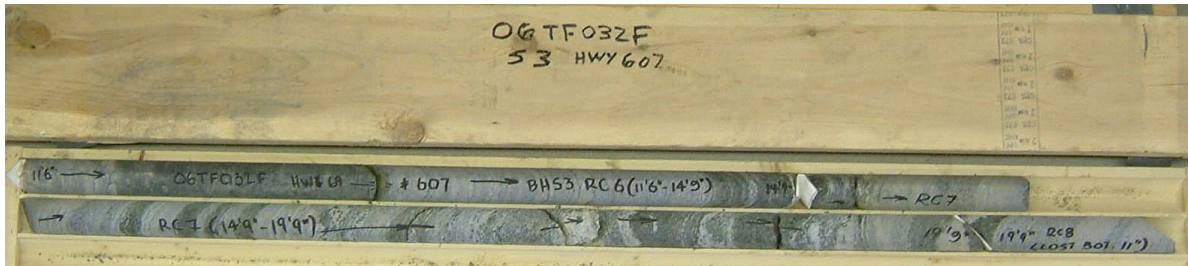
## **APPENDIX B**

### Rock Core Photographs





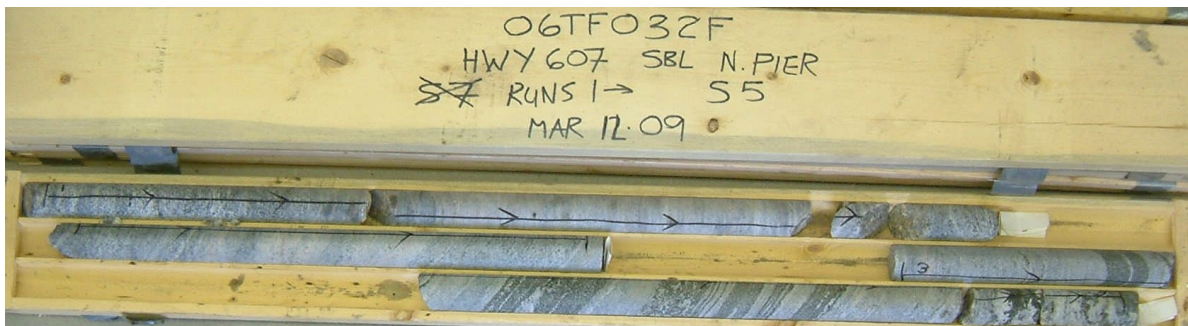
**Photograph 1:** Cores retrieved from Borehole S2. Runs 1 to 3 from depth 0.0 to 3.3 m depth. Last piece of 10 cm core remained down hole. RQD ranged from 88 (last run) to 100%. Rock quality is excellent.



**Photograph 2:** Cores retrieved from Borehole S3. Runs 6 to 8 from depth 3.5 to 6.6 m depth. Last piece of 33 cm core could not be recovered. RQD ranged from 45 (last run) to 100%. Rock quality is excellent.



**Photograph 3:** Cores retrieved from Borehole S4. Runs 8 to 10 from 5.0 to 8.1 m depth. RQD ranged from 54 to 100%. Upper 0.7 m rock, from 5.0 to 5.7 m depth, is fair quality, remainder excellent quality.



**Photograph 4:** Cores retrieved from Borehole S5. Runs 2 to 4 from 1.1 to 4.2 m depth. RQD ranged from 84 to 100%. Rock quality ranged from good to excellent.



**Photograph 5:** Cores retrieved from Borehole S6. Runs 7 to 9 from depth 3.4 to 6.8 m. Last 7.5 cm rock piece remained down hole. RQD ranged from 95 to 100%, excellent quality.



**Photograph 6:** Cores retrieved from Borehole S7. Runs 7 to 10 from depth 4.7 to 8.0 m. RQD ranged from 38 to 100%. Upper 0.4 m rock exhibited poor quality, remainder excellent quality.