



**FOUNDATION INVESTIGATION REPORT**

**for**

**PICKEREL RIVER BRIDGE SOUTHBOUND  
HIGHWAY 69 FOUR-LANING**

**SITE NO. 44-429/2**

**W.P. 5268-05-01 (PART OF G.W.P. 5378-02-00)**

**SUDBURY AREA, ONTARIO**

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PML Ref.: 06TF032M  
Index No.: 2416FIR  
GEOCRES No.: 41H-90  
February 4, 2011



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**FOUNDATION INVESTIGATION REPORT**

for  
Pickerel River Bridge Southbound  
Highway 69 Four-Laning  
Site No. 44-429/2  
W.P. 5268-05-01 (Part of G.W.P. 5378-02-00)  
Sudbury Area, Ontario

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**1. INTRODUCTION**

This report summarises the results of the foundation investigation carried out for the proposed construction of a bridge to carry southbound traffic on the realigned Highway 69 over the Pickerel River, about 70 km south of Sudbury, Ontario. The investigation was conducted for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The southbound lanes (SBL) bridge is at approximate Station 19+994, new Highway 69 centreline, in the Township of Mowat (ref. Drawing 1 'Highway 69 – Pickerel River Bridge' prepared by MRC in October 2009).

The report provides subsurface information pertaining to the proposed structure and approaches within about 20 m of the abutments.

All elevations in this report are expressed in meters.

**2. SITE DESCRIPTION AND GEOLOGY**

The site is located on the new Highway 69 alignment at the crossing of the Pickerel River. The bridge will be constructed some 0.5 km downstream (west) from the existing Highway 69 bridge over the river. Highway 69 is oriented in the south-north direction at the bridge location. The Pickerel River flows from east to west and is about 50 m wide at the site. Site photographs are included in Appendix A.

The study area is located in the Precambrian Laurentian peneplane. The topography is irregular in detail with extensive rock outcrops. The north margin of the Pickerel River slopes steeply up at



an average inclination of 2H:1V at the site. Soil cover on both sides of the river is sparse. Numerous large boulders cover the area of the proposed north abutment.

Metasedimentary rocks of the Huronian Supergroup and gneisses of the Grenville Province underlie the alignment. The area has undergone considerable folding, intrusive activity, regional metamorphism and faulting. Bedrock predominantly comprises pink and light grey granitic gneiss. The bedrock in the immediate vicinity of the site is at shallow depths ranging from surface to less than 5 m.

### 3. INVESTIGATION PROCEDURES

The field work for this study was carried out during the period of November 11 to December 3, 2009 and comprised 41 boreholes drilled to depths of 0.0 to 7.2 m at the locations shown on Drawing PRS-1, attached. Further details are summarised in the following table:

LOCATION	BOREHOLE No.	DEPTH (m)		
		AUGER	ROCK CORE	TOTAL
South Approach	S1	0.0	–	0.0
South Abutment	S2	0.0	3.1	3.1
	S2A	0.1	–	0.1
	S3	0.0	3.2	3.2
	S4	0.0	3.2	3.2
	S5	0.0	–	0.0
	S6	0.2	–	0.2
	S7	0.0	3.1	3.1
	APS-S1	0.0	–	0.0
	APS-S2	0.0	–	0.0
	APS-S3	0.0	–	0.0
	APS-S4	0.0	–	0.0
South Pier	S8	0.0	3.2	3.2
	S8A	0.0	–	0.0
	S9	0.0	–	0.0
	S10	0.0	3.1	3.1
	S11	0.0	–	0.0
	S12	0.0	3.1	3.1
	S13	0.0	3.2	3.2
	S13A	0.0	–	0.0





LOCATION	BOREHOLE No.	DEPTH (m)		
		AUGER	ROCK CORE	TOTAL
North Pier	S14	0.0	3.1	3.1
	S15	0.0	–	0.0
	S15A	0.0	–	0.0
	S16	0.0	3.4	3.4
	S16A	0.0	–	0.0
	S17	0.0	–	0.0
	S18	0.0	3.2	3.2
	S18A	0.0	–	0.0
	S19	0.0	3.1	3.1
North Abutment	S20	0.0	–	0.0
	S21	0.6	–	0.6
	S22	3.6	3.2	6.8
	S22A	2.9	–	2.9
	S23	2.2	–	2.2
	S24	2.0	5.2	7.2
	S24A	0.0	–	0.0
	S25	0.5	4.4	4.9
	APN-S1	0.0	–	0.0
	APN-S2	0.0	–	0.0
	APN-S3	0.0	–	0.0
North Approach	S26	0.0	–	0.0

Callon Dietz Inc. staked the borehole locations at each foundation unit for the bridge and provided temporary benchmarks that were used by Peto MacCallum Ltd. (PML) to establish ground surface elevations at the boreholes.

The boreholes were advanced manually or using continuous flight solid stem augers, powered by a track-mounted D-50 Turbo Bombardier drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff. A total of 15 boreholes (within the foundation elements) were extended 3.1 to 3.4 m, locally 4.4 and 5.2 m into bedrock using portable Weka (50 mm diameter concrete bit) and Hilti diamond rock coring equipment supplemented by wash boring techniques.

To access the area of boreholes S20 to S25 drilled within the area of the proposed north abutment, it was necessary to fill over the existing bouldery soil cover due to the steeply sloping



original terrain. Drilling through the existing boulders was attempted from the top of this working platform fill with diamond rotary coring.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The groundwater conditions at the borehole locations were assessed during drilling by visual examination of soil, the sampler and drill rods. Upon completion of drilling, the boreholes were backfilled with bentonite/cement grout in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures.

#### **4. SUMMARISED 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.

The borehole locations, stratigraphic profile and cross-sections prepared from the borehole data are shown on Drawings PRS-1 and PRS-2. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

The subsurface stratigraphy revealed in the boreholes drilled at the site comprised surficial peat, recently placed fill for the drilling access pad and/or boulders mantling bedrock. Boulders were encountered in 8 boreholes drilled at the north riverbank location. The bedrock surface was contacted at depths of 0.0 to 3.6 m.

The strata encountered are summarised below.

##### **4.1 Peat**

A surficial deposit of peat was present at the south abutment in boreholes S2A and S6. The peat had a thickness of 100 mm in the former borehole and 200 mm in the latter and was penetrated at elevation 180.5 and 180.3 respectively.



## **4.2 Fill**

Fill placed for the working pad for the drilling equipment was present surficially in boreholes S21, S22, S22A, S23, S24 and S25 drilled on the north bank of the river. Composed of boulders in a silty sand and gravel matrix (only silty sand and gravel in the last borehole), the fill was 0.5 to 3.6 m thick and penetrated on bedrock at elevation 190.5 to 193.6 in boreholes S22, S24 and S25. The remaining boreholes were terminated in the fill at depths of 0.6 to 2.9 m (elevation 191.0 to 192.3).

## **4.3 Boulders**

Large boulders up to 3 m in size were encountered at original ground surface (before being covered with the fill pad for the drill rig access) in boreholes S20, S21, S22A, S23, APN-S1 and APN-S2. Boreholes S20, S21, S22A and S23 were terminated by refusal on these boulders.

## **4.4 Bedrock**

Bedrock was contacted or inferred by refusal at depths of 0.0 to 0.2 m (elevation 180.1 to 183.9) on the south side of the Pickerel River and 0.0 to 3.6 m (elevation 180.5 to 200.8) on the north side. The bedrock comprises a pink and light grey granitic gneiss.

The measured core recovery varied between 67 and 100%. The RQD determined from the rock cores was generally in a range of 27 to 100%, thus indicating a poor (locally very poor) to excellent quality rock. The rock quality at the north pier was very poor to excellent (RQD of 0 to 99%).

A detailed description of the rock cores retrieved from boreholes S2, S3, S4, S7, S8, S10, S12, S13, S14, S16, S18, S19, S22, S24 and S25 is given in Table A, appended. Photographs of the rock cores are shown in Appendix B.



#### 4.4.1 South Abutment

The bedrock surface was contacted/inferred at depths of 0.0 to 0.2 m (elevation 180.3 to 183.9) in boreholes S2 to S7, APS-S1 to APS-S4. The depth to and surface elevation of the bedrock identified in the boreholes drilled at the south abutment are summarised in the following table.

Location	Borehole No.	Depth to Rock (m)	Bedrock Elevation
South Abutment	S2	0.0*	180.8*
	S2A	0.1	180.5
	S3	0.0*	183.0*
	S4	0.0*	181.4*
	S5	0.0	182.5
	S6	0.2	180.3
	S7	0.0*	183.4*
	APS-S1	0.0	181.7
	APS-S2	0.0	183.9
	APS-S3	0.0	180.6
	APS-S4	0.0	183.2

\* confirmed by rock coring

The bedrock surface has a maximum relief of 3.1 m at the locations of boreholes S2 to S7 and slopes at angles of 11° to 15°. The bedrock comprises a light grey to pink slightly (locally moderately) weathered to unweathered high (locally medium) strength granitic gneiss, with a layer of pink pegmatite in borehole S4.

The measured core recovery varied between 67 and 100%. The RQD determined from the rock cores was in a range of 31 to 100%, thus indicating a poor to excellent quality rock, with the exception of a 0.4 m portion below the upper 1.0 m core sample in borehole S4 where the rock quality was very poor (RQD of 0%).



#### 4.4.2 South Pier

The bedrock surface was contacted at 0.0 m depth (elevation 180.1 to 181.8) in boreholes S8 to S13 and S13A. The depth to and surface elevation of the bedrock identified in the boreholes drilled at the south pier are summarised in the following table:

Location	Borehole No.	Depth to Rock (m)	Bedrock Elevation
South Pier	S8	0.0*	181.8*
	S8A	0.0	181.5
	S9	0.0	181.0
	S10	0.0*	181.4*
	S11	0.0	181.1
	S12	0.0*	181.7*
	S13	0.0*	180.7*
	S13A	0.0	180.1

\* confirmed by rock coring

The bedrock surface has a maximum relief of 1.7 m and slopes at angles of 3° to 10°. The bedrock comprises a pink unweathered to slightly weathered medium to high strength granitic gneiss, with black biotite rich layers in borehole S13.

The measured core recovery varied between 92 and 100%. The RQD determined from the rock cores was in a range of 27 to 99%, thus indicating a poor to excellent quality rock, with the exception of a 0.5 m portion below the upper 1.8 m in borehole S12 and an upper 0.4 m core sample in borehole S13 where the rock quality was very poor (RQD of 0%).



#### 4.4.3 North Pier

The bedrock surface was contacted at 0.0 m depth (elevation 180.5 to 181.5) in boreholes S14 to S19. The depth to and surface elevation of the bedrock identified in the boreholes drilled at the north pier are summarised in the following table:

Location	Borehole No.	Depth to Rock (m)	Bedrock Elevation
North Pier	S14	0.0*	180.5*
	S15	0.0	181.3
	S15A	0.0	181.5
	S16	0.0*	181.3*
	S16A	0.0	181.1
	S17	0.0	181.5
	S18	0.0*	181.5*
	S18A	0.0	181.3
	S19	0.0*	181.5*

\* confirmed by rock coring

The bedrock surface has a maximum relief of 1.0 m and slopes at angles less than 5° (15° between boreholes S14 and S17). The bedrock comprises a light grey to pink slightly to moderately weathered (locally unweathered) medium to high strength granitic gneiss, with a dark green hornblende in borehole S19.

The measured core recovery varied between 84 and 100%. The RQD determined from the rock cores was in a range of 37 to 99%, thus indicating a poor to excellent quality rock, with the exception of the surficial 0.8, 1.5 and 0.5 m core samples in boreholes S16, S18 and S19 as well as below the upper 1.8 m in borehole S14 to the hole termination depth of 3.1 m.



#### 4.4.4 North Abutment

The bedrock surface was contacted/inferred at depths of 0.0 to 3.6 m (elevation 185.1 to 193.6) in boreholes S20 to S25, APN-S1 to APN-S3. The depth to and surface elevation of the bedrock identified in the boreholes drilled at the north abutment are summarised in the following table.

Location	Borehole No.	Depth to Rock (m)	Bedrock Elevation
North Abutment	S20	>0.0	<189.5
	S21	>0.6	<192.3
	S22	3.6*	190.5*
	S22A	>2.9	<191.0
	S23	>2.2	<191.2
	S24	2.0*	191.8*
	S24A	0.0	193.5
	S25	0.5*	193.6*
	APN-S1	>0.0	<185.8
	APN-S2	>0.0	<187.1
	APN-S3	0.0	185.1

\* confirmed by rock coring

The cores taken from this location were extended into bedrock 3.2, 5.2 and 4.4 m in boreholes S22, S24 and S25 respectively. The two longer than usual 3 m cores were intended to verify that the cores extended into the bedrock and past the large boulders found at the ground surface.

The bedrock surface has a maximum relief of at least 4.1 m at the north abutment location and slopes at angles of 9° to 25°. The bedrock comprises a light grey to pink moderately weathered to unweathered high (locally medium) strength granitic gneiss.

The measured core recovery varied between 96 and 100%. The RQD determined from the rock cores was in a range of 38 to 100%, thus indicating a poor to excellent quality rock.



#### 4.4.5 Approaches

The bedrock surface was at ground surface (elevation 180.6 and 200.8) in boreholes S1 and S26 drilled respectively at the south and north approaches.

#### 4.5 Groundwater

In the course of the field work, no groundwater was observed in any of the boreholes. It is noted, however, that groundwater levels may fluctuate subject to seasonal variations and precipitation patterns.

The water level in the Pickerel River was reported to be at elevation 178.0 on April 17, 2007, with the 100-year high at elevation 179.25.

### 5. CLOSURE

The field work was carried out under the supervision of Mr. M. Rapsey and Mr. F. Portela, Senior Technicians, and direction of Mr. M. Narduzzi, BEng, and Mr. C.M.P. Nascimento, P.Eng., Senior Project Engineer. The equipment was supplied by Walker Drilling Ltd. and City Concrete Drilling Services.





This report was prepared by Mr. G.O. Degil, PhD, P.Eng., Senior Foundation Engineer, and reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Principal Contact. Mr. C.M.P. Nascimento, P.Eng., Senior Project Engineer, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



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**TABLE A**  
**ROCK CORE DESCRIPTIONS**

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S2	1	0.0 – 0.7	93	31	0.0 – 3.1	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, medium to high strength, slightly to moderately weathered, very close to close becoming moderate spaced flat to dipping cross joints, rough planar, slightly altered with oxidation stains and/or scale on partings, poor becoming good to excellent quality.
	2	0.7 – 1.4	100	36		
	3	1.4 – 2.1	100	96		
	4	2.1 – 3.1	92	81		
S3	1	0.0 – 0.8	100	100	0.0 – 3.2	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, high strength, slightly weathered to unweathered, wide spaced dipping cross joints, rough planar, slightly altered with oxidation stains on partings, excellent quality.
	2	0.8 – 2.0	100	100		
	3	2.0 – 3.2	100	100		
S4	1	0.0 – 1.0	100	94	0.0 – 3.2	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, with layer of pink pegmatite, coarse crystalline, high strength, slightly weathered, close to moderate spaced flat to dipping (locally vertical) cross joints, rough planar, slightly altered with oxidation stains on partings, good to excellent (locally very poor) quality.
	2	1.0 – 1.4	67	0		
	3	1.4 – 2.1	100	100		
	4	2.1 – 3.2	100	80		

Originated: FP  
Compiled: JFW  
Checked: GD/ CN



**TABLE A**  
**ROCK CORE DESCRIPTIONS**

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S7	1	0.0 – 1.0	100	100	0.0 – 3.1	GRANITIC GNEISS: Pink, medium to coarse crystalline, flecked with black hornblende, high strength, slightly weathered to unweathered, moderate to wide (locally very close to close) spaced dipping to vertical cross joints, rough planar, slightly altered with oxidation stains, silt and/or scale on partings, fair to excellent quality.
	2	1.0 – 1.5	100	59		
	3	1.5 – 2.1	100	100		
	4	2.1 – 3.1	100	79		
S8	1	0.0 – 0.4	97	87	0.0 – 3.2	GRANITIC GNEISS: Pink, medium crystalline, high strength, slightly weathered, very close to close spaced flat to dipping cross joints, rough planar, tight to slightly altered with oxidation stains and/or silt on partings, with vertical joint at 1.6 m, open 1 mm with dark rust brown oxidation stains, partially infilled with scale and/or silt, good becoming poor to fair quality.
	2	0.4 – 1.2	100	31		
	3	1.2 – 2.1	100	40		
	4	2.1 – 3.2	100	68		
S10	1	0.0 – 1.2	100	76	0.0 – 3.1	GRANITIC GNEISS: Pink, medium to coarse crystalline, high strength, slightly weathered, very close to close spaced flat to dipping cross joints, rough planar, tight to slightly altered with oxidation stains, occasional vertical joints, oxidation stains, good (locally poor) quality.
	2	1.2 – 2.1	95	27		
	3	2.1 – 3.1	92	76		

Originated: FP  
 Compiled: JFW  
 Checked: GD/ CN



**TABLE A**  
**ROCK CORE DESCRIPTIONS**

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S12	1	0.0 – 0.9	100	94	0.0 – 3.1	GRANITIC GNEISS: Pink, medium to coarse crystalline, medium to high strength, unweathered to slightly weathered, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with oxidation stains and/or silt on partings, fair to excellent (locally very poor) quality.
	2	0.9 – 1.8	100	63		
	3	1.8 – 2.0	100	0		
	4	2.0 – 2.1	100	0		
	5	2.1 – 2.3	100	0		
	6	2.3 – 3.1	99	99		
S13	1	0.0 – 0.4	100	0	0.0 – 3.2	GRANITIC GNEISS: Pink, medium to coarse crystalline, with black, biotite rich layers, medium to high strength, slightly weathered, very close to close spaced flat (locally vertical) cross joints, rough planar, slightly altered with oxidation stains on partings, very poor to poor becoming good quality.
	2	0.4 – 1.2	100	50		
	3	1.2 – 2.1	100	33		
	4	2.1 – 2.4	100	43		
	5	2.4 – 3.2	98	83		
S14	1	0.0 – 0.9	100	94	0.0 – 3.1	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, medium to high strength, slightly to moderately weathered, very close to close spaced flat to dipping cross joints, rough planar, slightly altered with oxidation stains, silt and/or scale on partings, excellent to fair becoming very poor quality.
	2	0.9 – 1.8	100	63		
	3	1.8 – 2.7	100	0		
	4	2.7 – 3.1	100	0		

Originated: FP  
 Compiled: JFW  
 Checked: GD/ CN



**TABLE A**  
**ROCK CORE DESCRIPTIONS**

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S16	1	0.0 – 0.8	100	0	0.0 – 3.4	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, with numerous irregular near vertical fine bluish grey veins, medium strength, slightly to moderately weathered, very close to close spaced flat to dipping cross joints, rough planar, slightly altered with oxidation stains and/or scale (locally bluish green) on partings, very poor becoming poor to fair quality.
	2	0.8 – 1.5	100	52		
	3	1.5 – 2.7	100	37		
	4	2.7 – 3.4	100	48		
S18	1	0.0 – 0.5	100	0	0.0 – 3.2	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, medium to high strength, slightly weathered to unweathered, very close to close becoming moderate spaced flat cross joints, rough planar, tight to slightly altered with oxidation stains, silt and/or scale on partings, very poor becoming fair to excellent quality.
	2	0.5 – 0.8	100	0		
	3	0.8 – 1.2	100	0		
	4	1.2 – 1.5	100	0		
	5	1.5 – 2.1	84	71		
	6	2.1 – 3.2	99	99		
S19	1	0.0 – 0.5	100	0	0.0 – 3.1	GRANITIC GNEISS: Light grey, medium to coarse crystalline, with dark green hornblende, medium to high strength, moderately to slightly weathered, very close to close becoming close to moderate spaced flat to dipping cross joints, rough planar, slightly altered with oxidation stains and/or silt on partings, brecciated appearance below 1.4 m, very poor to poor becoming good to excellent quality.
	2	0.5 – 1.4	100	50		
	3	1.4 – 2.0	100	77		
	4	2.0 – 3.1	95	95		

Originated: FP  
 Compiled: JFW  
 Checked: GD/ CN



**TABLE A**  
**ROCK CORE DESCRIPTIONS**

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
S22	1	3.6 – 4.7	100	45	3.6 – 6.8	GRANITIC GNEISS: Pink, medium to coarse crystalline, near vertical banding, high strength, slightly weathered, very close to close becoming close to moderate spaced dipping cross joints, rough planar, slightly altered with oxidation stains and occasional silt on partings, poor to fair becoming excellent quality.
	2	4.7 – 6.2	100	73		
	3	6.2 – 6.8	100	100		
S24	1	2.0 – 3.3	100	84	2.0 – 7.2	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, near vertical banding, high strength, unweathered to slightly weathered, close to wide spaced flat to dipping (locally vertical) cross joints, rough planar, tight to slightly altered with oxidation stains on partings, good to excellent (locally poor) quality.
	2	3.3 – 4.7	100	95		
	3	4.7 – 6.3	100	38		
	4	6.3 – 7.2	98	98		
S25	1	0.5 – 1.7	100	67	0.5 – 4.9	GRANITIC GNEISS: Light grey to pink, medium to coarse crystalline, near vertical banding, medium to high strength, moderately to slightly weathered, close to moderate spaced flat to dipping cross joints, rough planar, slightly altered with oxidation stains, occasional silt on partings, fair becoming excellent quality.
	2	1.7 – 1.9	100	71		
	3	1.9 – 3.4	100	96		
	4	3.4 – 4.9	96	91		

RQD = Rock Quality Designation

Originated: FP  
 Compiled: JFW  
 Checked: GD/ CN

## 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

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	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

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

**RECORD OF BOREHOLE No S1**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 840.7 N; 221 661.7 E ORIGINATED BY M.R.  
DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
DATUM Geodetic DATE December 03, 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
180.6	Ground Surface					*											GR SA SI CL
0.0	Bedrock at surface																
	* Borehole dry																



**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No S2A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 863.9 N; 221 656.8 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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							w <sub>p</sub> w                      w <sub>L</sub>				WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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**METRIC**

W.P. <u>5268-05-01</u>	LOCATION <u>Coords: 5 095 864.2 N; 221 667.1 E</u>	ORIGINATED BY <u>M.R.</u>
DIST <u>54</u> HWY <u>69</u>	BOREHOLE TYPE <u>Rotary Diamond Coring</u>	COMPILED BY <u>G.D.</u>
DATUM <u>Geodetic</u>	DATE <u>November 25, 2009</u>	CHECKED BY <u>C.N.</u>

[illegible]

## 1 of 1

METRIC

SOIL PROFILE										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
181.4 0.0	Ground Surface Granitic Gneiss bedrock  Slightly weathered High strength Good to excellent (locally very poor) quality		NUMBER TYPE "N" VALUES	*		20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%)	kN/m³	GR SA SI CL	
			1 RC NQ REC 100%		181					RQD 94%
			2 RC NQ REC 67%		180					RQD 0%
			3 RC NQ REC 100%							RQD 100%
			4 RC NQ REC 100%		179					
178.2 3.2	End of borehole									
	* Borehole charged with drilling water									

**RECORD OF BOREHOLE No S5**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 867.0 N; 221 663.4 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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 (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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**METRIC**


20  
15 — 5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No S7**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 868.0 N; 221 666.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 25, 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		20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
183.4	Ground Surface															
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 100%	183										RQD 100%
	Slightly weathered to unweathered		2	RC NQ	REC 100%	182										RQD 59%
	High strength		3	RC NQ	REC 100%	181										RQD 100%
	Fair to excellent quality		4	RC NQ	REC 100%											RQD 79%
180.3	End of borehole															
3.1	* Borehole charged with drilling water															

**RECORD OF BOREHOLE No S8**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 892.7 N; 221 652.6 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 24, 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					WATER CONTENT (%)							
								<div><div><div></div><div></div><div></div><div></div><div></div></div><div>20406080100</div></div> <div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE</div>					<div><div><div></div><div></div><div></div></div><div>W<sub>p</sub>Ww<sub>L</sub></div></div>							
181.8	Ground Surface																			
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 97%		181												RQD 87%	
	Slightly weathered		2	RC NQ	REC 100%															RQD 31%
	High strength		3	RC NQ	REC 100%															RQD 40%
	Good becoming poor to fair quality		4	RC NQ	REC 100%															RQD 68%
178.6	End of borehole						179													
3.2																				
	* Borehole charged with drilling water																			



**RECORD OF BOREHOLE No S8A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 892.5 N; 221 651.2 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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 (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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**RECORD OF BOREHOLE No S9**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 893.8 N; 221 662.2 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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 (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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**METRIC**

(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No S11**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 893.3 N; 221 657.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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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181.1	Ground Surface					*					20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

**METRIC**

(%) STRAIN AT FAILURE

**METRIC**

20  
15 — 5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No S13A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 896.8 N; 221 661.9 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 24, 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 (%)	GR	SA		SI	CL			
						○ UNCONFINED			● QUICK TRIAXIAL	+	×	FIELD VANE	LAB VANE									
180.1	Ground Surface																					
0.0	Bedrock at surface																					
	*     Borehole dry																					

**RECORD OF BOREHOLE No S14**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 971.6 N; 221 642.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 11, 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      x LAB VANE					WATER CONTENT (%)							
180.5	Ground Surface							20	40	60	80	100								
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 100%	180												RQD 94%		
	Slightly to moderately weathered		2	RC NQ	REC 100%	179												RQD 63%		
	Medium to high strength																			
	Excellent to fair becoming very poor quality		3	RC NQ	REC 100%	178												RQD 0%		
			4	RC NQ	REC 100%													RQD 0%		
177.4	End of borehole																			
3.1																				
	* Borehole charged with drilling water																			



**RECORD OF BOREHOLE No S15**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 973.6 N; 221 651.9 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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 (%)	GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE	LAB VANE								
181.3	Ground Surface					*															
0.0	Bedrock at surface																				
	*     Borehole dry																				

**RECORD OF BOREHOLE No S15A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 974.9 N; 221 650.1 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
181.5	Ground Surface					*											GR SA SI CL
0.0	Bedrock at surface																
	* Borehole dry																

**RECORD OF BOREHOLE No S16**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 974.9 N; 221 647.4 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 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									
181.3	Ground Surface						20	40	60	80	100						
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 100%		181										RQD 0%
	Slightly to moderately weathered		2	RC NQ	REC 100%		180									RQD 52%	
	Medium strength		3	RC NQ	REC 100%		179								RQD 37%		
	Very poor becoming poor to fair quality													RQD 48%			
177.9	End of borehole																
3.4																	
	* Borehole charged with drilling water																

**RECORD OF BOREHOLE No S16A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 973.4 N; 221 647.6 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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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181.1	Ground Surface									20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

**RECORD OF BOREHOLE No S17**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 974.3 N; 221 644.6 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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																	
181.5	Ground Surface					*				20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.0	Bedrock at surface																						
	*    Borehole dry																						

**RECORD OF BOREHOLE No S18**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 976.7 N; 221 641.4 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 18, 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  $\gamma$  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>					WATER CONTENT (%)			
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      x LAB VANE													
181.5	Ground Surface							20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 100%	181														RQD 0%	
	Slightly weathered to unweathered		2	RC NQ	REC 100%																RQD 0%
	Medium to high strength		3	RC NQ	REC 100%		180														RQD 0%
	Very poor becoming fair to excellent quality		4	RC NQ	REC 100%																
			5	RC NQ	REC 84%	179															RQD 71%
			6	RC NQ	REC 99%																
178.3	End of borehole																				
3.2																					
	* Borehole charged with drilling water																				

**RECORD OF BOREHOLE No S18A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 975.4 N; 221 641.5 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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 (%)  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					WATER CONTENT (%)							
181.3	Ground Surface							20	40	60	80	100	20	40	60					
0.0	Bedrock at surface																			
	*    Borehole dry																			

**RECORD OF BOREHOLE No S19**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 976.7 N; 221 652.6 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 19, 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>		
181.5	Ground Surface						20	40	60	80	100					
0.0	Granitic Gneiss bedrock		1	RC NQ	REC 100%											RQD 0%
	Moderately to slightly weathered		2	RC NQ	REC 100%	181										RQD 50%
	Medium to high strength		3	RC NQ	REC 100%	180										RQD 77%
	Very poor to poor becoming good to excellent quality		4	RC NQ	REC 95%	179										RQD 95%
178.4	End of borehole															
3.1																
	* Borehole charged with drilling water															



**RECORD OF BOREHOLE No S20**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 000.4 N; 221 637.2 E ORIGINATED BY M.R.  
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.  
DATUM Geodetic DATE November 26, 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
189.5	Ground Surface																
0.0	Boulders at surface																
	NOTE: Up to 2m of fill has been added to build a working pad for drill rig access.																
	* Borehole dry																

**RECORD OF BOREHOLE No S21**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 002.1 N; 221 651.1 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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					WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE										
192.9	Ground Surface					*			20	40	60	80	100	20	40	60	kn/m³	GR SA SI CL
0.0	Boulders in a silty sand and gravel matrix (FILL)																	
192.3	End of borehole																	
0.6	Refrusal on probable boulders																	
	* Borehole dry																	
	Note: Large boulders and steep slope did not permit augering.																	

**RECORD OF BOREHOLE No S22**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 004.5 N; 221 644.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE December 01 & 02, 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 (%)  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										
194.1 0.0	Ground Surface  Boulders in a silty sand and gravel matrix with wood fragments  (FILL)						194													
							193													
							192													
							191													
190.5 3.6	Granitic Gneiss bedrock  Slightly weathered  High strength  Poor to fair becoming excellent quality			1	RC NQ	REC 100%	190											RQD 45%		
				2	RC NQ	REC 100%	189											RQD 73%		
				3	RC NQ	REC 100%	188											RQD 100%		
187.3 6.8	End of borehole          *    Borehole charged with drilling water  NOTE:    Fill added to build a working pad for drill rig access.																			

**RECORD OF BOREHOLE No S22A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 002.8 N; 221 644.2 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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 (%)				GR	SA	SI	CL
								20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>					
193.9	Ground Surface					*														
0.0	Boulders in a silty sand and gravel matrix						193													
	(FILL)						192													
191.0	End of borehole						191													
2.9	Refusal on probable boulders																			
	* Borehole dry																			
	NOTES:																			
	1. Large boulders present at north abutment location.																			
	2. Fill added to build a working pad for drill rig access.																			

**RECORD OF BOREHOLE No S23**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 004.2 N; 221 636.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE November 26, 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									
193.4	Ground Surface						20	40	60	80	100						
0.0	Boulders in a silty sand and gravel matrix						193										
	(FILL)						192										
191.2	End of borehole																
2.2	Refusal on probable boulders																
	*    Borehole dry																
	NOTES:  1.    Large boulders present at north abutment location.  2.    Fill added to build a working pad for drill rig access.																

**RECORD OF BOREHOLE No S24**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 006.4 N; 221 636.5 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE December 02, 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 (%)  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						WATER CONTENT (%)			
						● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100	20	40	60			
193.8	Ground Surface						193										
0.0	Boulders in a silty sand and gravel matrix with wood fragments						192										
	(FILL)																
191.8	Granitic Gneiss bedrock						191										
2.0	Unweathered to slightly weathered		1	RC NQ	REC 100%		190										
	High strength		2	RC NQ	REC 100%		189										
	Good to excellent (locally poor) quality		3	RC NQ	REC 100%		188										
			4	RC NQ	REC 98%		187										
186.6	End of borehole																
7.2																	
	*    Borehole charged with drilling water																
	NOTE:    Fill added to build a working pad for drill rig access.																

**RECORD OF BOREHOLE No S24A**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 005.7 N; 221 630.5 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
193.5	Ground Surface																
0.0	Bedrock at surface																
	* Borehole dry																

**RECORD OF BOREHOLE No S25**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 005.2 N; 221 650.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring COMPILED BY G.D.  
 DATUM Geodetic DATE December 01, 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					w <sub>p</sub>	w	w <sub>L</sub>		
								○ UNCONFINED      + FIELD VANE						WATER CONTENT (%)			
						● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100	20	40	60			
194.1	Ground Surface						194										
0.0	Silty sand and gravel (FILL)																
193.6	Granitic Gneiss bedrock																
0.5	Moderately to slightly weathered		1	RC NQ	REC 100%		193									RQD 67%	
	Medium to high strength		2	RC	REC 100%		192									RQD 71%	
	Fair becoming excellent quality		3	RC NQ	REC 100%		191									RQD 96%	
			4	RC NQ	REC 96%		190									RQD 91%	
189.2	End of borehole																
4.9																	
	*    Borehole charged with drilling water																
	NOTE:   Fill added to build a working pad for drill rig access.																



**RECORD OF BOREHOLE No S26**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 096 024.9 N; 221 641.6 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE November 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																			
200.8	Ground Surface					*					20	40	60	80	100							GR	SA	SI	CL
0.0	Bedrock at surface																								
	*      Borehole dry																								

## METRIC

$+^7, \times^5$ : Numbers refer to Sensitivity

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	SHEAR STRENGTH kPa	WATER CONTENT (%)								
187.1	Ground Surface					○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						kN/m³	GR SA SI CL		

ON\_MOT VER 3A 06TF032M.GPJ ON\_MOT.GDT 1/29/2010 11:45:04 AM

$+^7, \times^5$ : Numbers refer to Sensitivity

**RECORD OF BOREHOLE No APN-S3**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 991.5 N; 221 650.8 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
185.1	Ground Surface					*											
0.0	Bedrock at surface																
	* Borehole dry																

**RECORD OF BOREHOLE No APS-S1**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 858.8 N; 221 650.1 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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 (%)	kN/m <sup>3</sup>	GR		SA	SI	CL		
						20			40	60	80	100	○ UNCONFINED								+ FIELD VANE	● QUICK TRIAXIAL
181.7	Ground Surface					*																
0.0	Bedrock at surface																					
	*     Borehole dry																					

**RECORD OF BOREHOLE No APS-S2**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 861.2 N; 221 671.0 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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																	
183.9	Ground Surface					*				20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.0	Bedrock at surface																						
	*    Borehole dry																						

**RECORD OF BOREHOLE No APS-S3**

1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 869.4 N; 221 648.9 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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												
180.6	Ground Surface					*		20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR	SA	SI	CL
0.0	Bedrock at surface																			
	*    Borehole dry																			

**RECORD OF BOREHOLE No APS-S4**

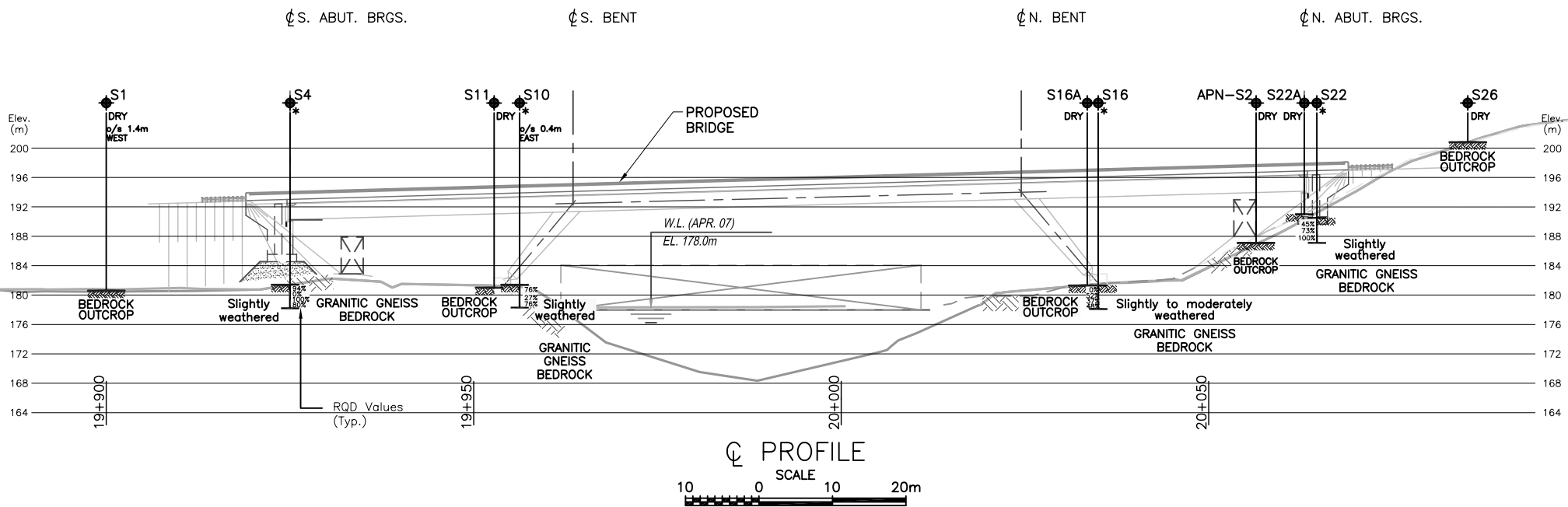
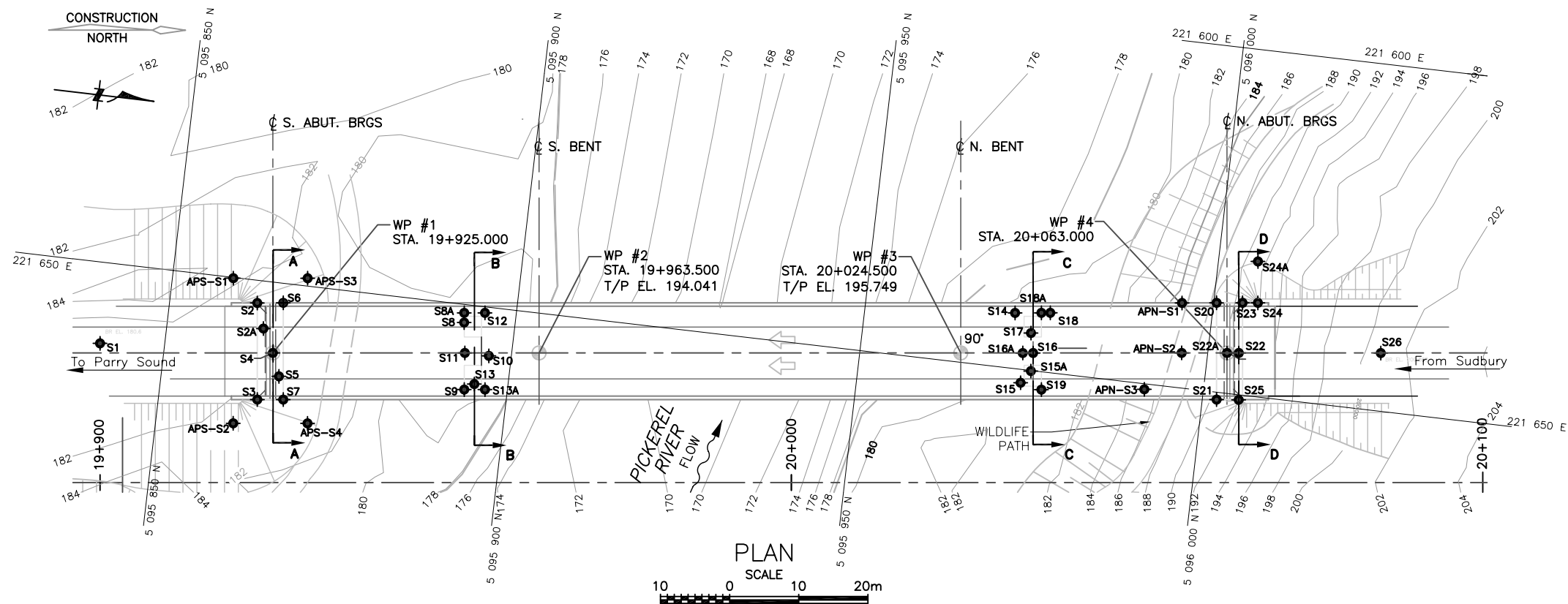
1 of 1

**METRIC**

W.P. 5268-05-01 LOCATION Coords: 5 095 871.9 N; 221 669.7 E ORIGINATED BY M.R.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY G.D.  
 DATUM Geodetic DATE December 03, 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE						LAB VANE		
183.2	Ground Surface					*										GR	SA	SI	CL	
0.0	Bedrock at surface																			
	* Borehole dry																			





(Legend Continued)

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
S11	181.1	5 095 893.3	221 657.0
S12	181.7	5 095 895.5	221 650.9
S13	180.7	5 095 895.2	221 661.3
S13A	180.1	5 095 896.8	221 661.9
S14	180.5	5 095 971.6	221 642.0
S15	181.3	5 095 973.6	221 651.9
S15A	181.5	5 095 974.9	221 650.1
S16	181.3	5 095 974.9	221 647.4
S16A	181.1	5 095 973.4	221 647.6
S17	181.5	5 095 974.3	221 644.6
S18	181.5	5 095 976.7	221 641.4
S18A	181.3	5 095 975.4	221 641.5
S19	181.5	5 095 976.7	221 652.6
S20	189.5	5 096 000.4	221 637.2
S21	192.9	5 096 002.1	221 651.1

(Legend Continues)

- NOTES:
- DRAWING PRS-1 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.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

(Legend Continued)

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
APS-S1	181.7	5 095 858.8	221 650.1
APS-S2	183.9	5 095 861.2	221 671.0
APS-S3	180.6	5 095 869.4	221 648.9
APS-S4	183.2	5 095 871.9	221 669.7
APN-S1	185.8	5 095 995.5	221 637.8
APN-S2	187.1	5 095 996.3	221 644.9
APN-S3	185.1	5 095 991.5	221 650.8

(Legend Continued)

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
S22	194.1	5 096 004.5	221 644.0
S22A	193.9	5 096 002.8	221 644.2
S23	193.4	5 096 004.2	221 636.7
S24	193.8	5 096 006.4	221 636.5
S24A	193.5	5 096 005.7	221 630.5
S25	194.1	5 096 005.2	221 650.7
S26	200.8	5 096 024.9	221 641.6

(Legend Continues)



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: Nov-Dec. 2009
- \* Water level not established
- Head
- ARTESIAN WATER
- Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
S1	180.6	5 095 840.7	221 661.7
S2	180.8	5 095 862.6	221 653.3
S2A	180.6	5 095 863.9	221 656.8
S3	183.0	5 095 864.2	221 667.1
S4	181.4	5 095 865.7	221 660.2
S5	182.5	5 095 867.0	221 663.4
S6	180.5	5 095 866.3	221 652.8
S7	183.4	5 095 868.0	221 666.7
S8	181.8	5 095 892.7	221 652.6
S8A	181.5	5 095 892.5	221 651.2
S9	181.0	5 095 893.8	221 662.2
S10	181.4	5 095 896.8	221 657.0

(Legend Continues)

- NOTE -

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41H-90

HWY No	69	DIST	54
SUBM'D	MN	CHECKED	GD
DRAWN	NA	CHECKED	CN
DATE	FEB. 03, 2010	SITE	44-429/2
APPROVED	BRG	DWG	PRS-1

CONT No  
WP No 5268-05-01

PICKEREL RIVER SBL BRIDGE  
HIGHWAY 69  
BOREHOLE LOCATIONS AND SOIL STRATA

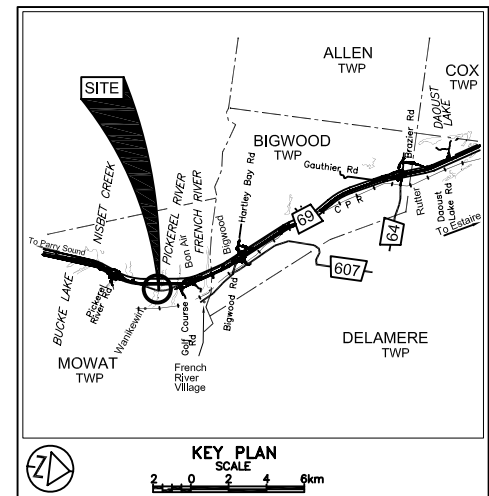
Peto MacCallum Ltd.  
CONSULTING ENGINEERS

KEY PLAN  
SCALE  
2 0 2 4 6km

LEGEND

LEGEND

LEGEND

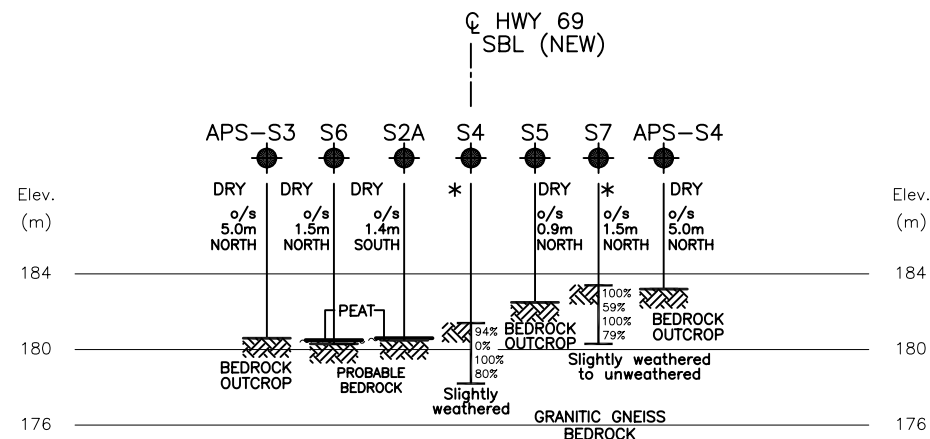


LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60 Cone, 475 J/blow)		
	W L at time of investigation: Nov-Dec. 2009		
*	Water level not established		
	Head		
	ARTESIAN WATER		
	Encountered		
	PIEZOMETER		
BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
SEE DRAWING PRS-1 FOR DETAILS.			

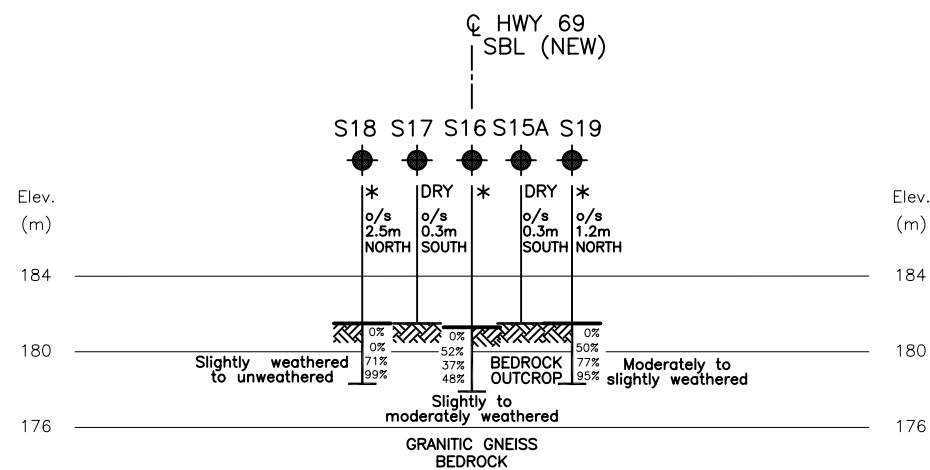
**- NOTE -**

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

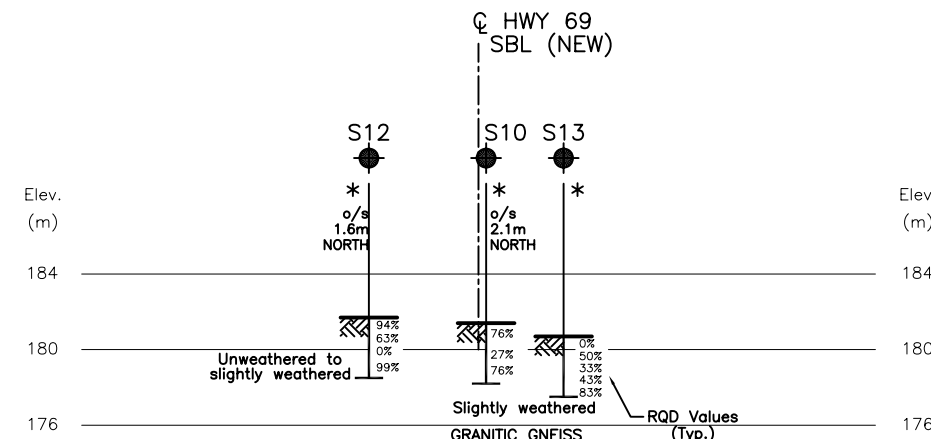
REVISIONS									
	DATE	BY	DESCRIPTION						
Geocres No. 41H-90									
	HWY No	69						DIST	54
	SUBM'D	MN	CHECKED	GD	DATE FEB. 03, 2010			SITE	44-429/2
	DRAWN	NA	CHECKED	CN	APPROVED	BRG			DWG PRS-2



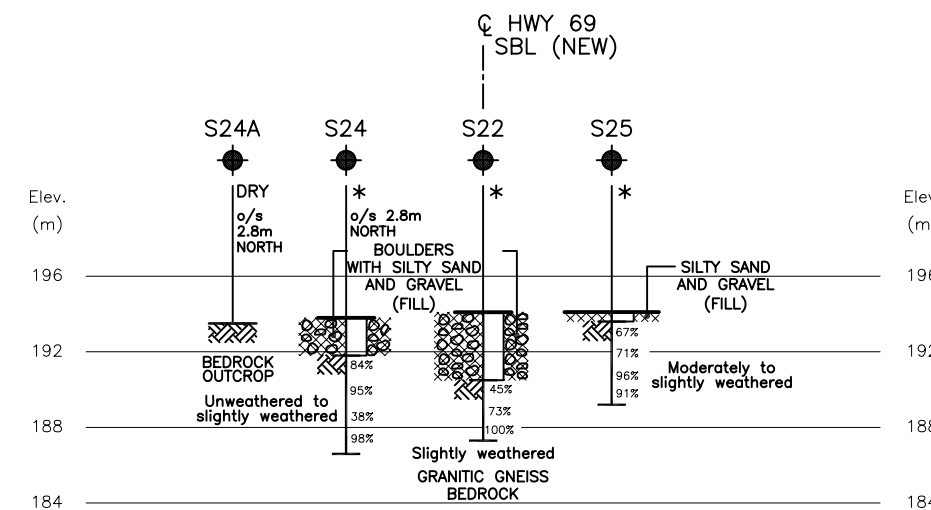
SECTION A - A



SECTION C - C



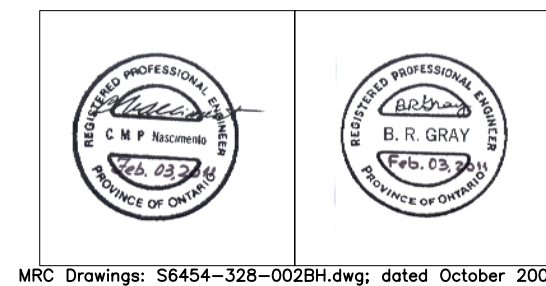
SECTION B - B



SECTION D - D



- NOTES:
- DRAWING PRS-2 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.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



Pickerel River Bridge Southbound  
Highway 69 Four-Laning, Site No. 44-429/2  
W.P. 5268-05-01 (Part of G.W.P. 5378-02-00), Index No.: 2416FIR  
PML Ref.: 06TF032M, February 4, 2011

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## **APPENDIX A**

Site Photographs





**Photograph 1:** South abutment, facing south

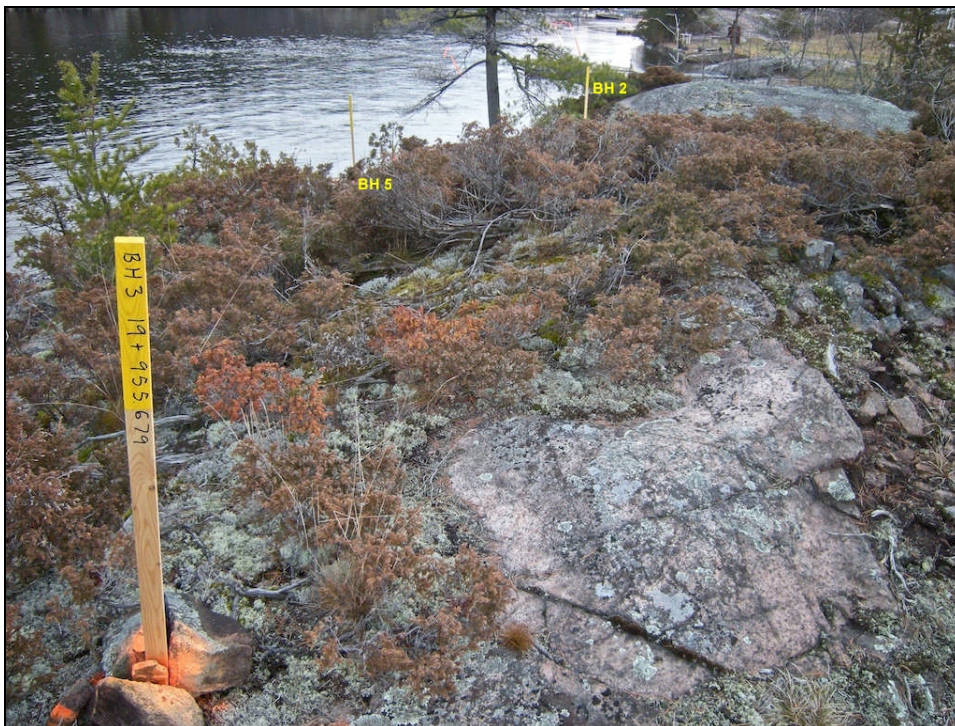


**Photograph 2:** South abutment, facing west





**Photograph 3:** South abutment and south pier, facing northwest



**Photograph 4:** South pier, facing northeast





**Photograph 5:** Looking north from south bank of Pickerel River



**Photograph 6:** North pier, facing north



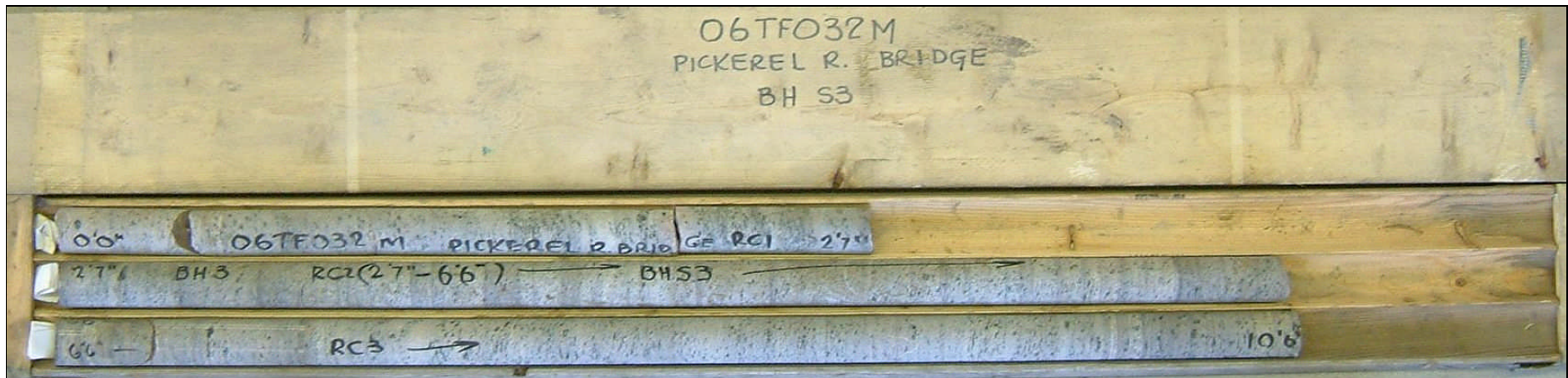
## **APPENDIX B**

### Rock Core Photographs





**Photograph 1:** Borehole S2, samples RC-1 to RC-4 from 0.0 to 3.1 m depth. The RQD values ranged from 31 to 96%, indicating poor becoming good to excellent quality bedrock.



**Photograph 2:** Borehole S3, samples RC-1 to RC-3 from 0.0 to 3.2 m depth. The RQD values were 100%, indicating excellent quality bedrock.



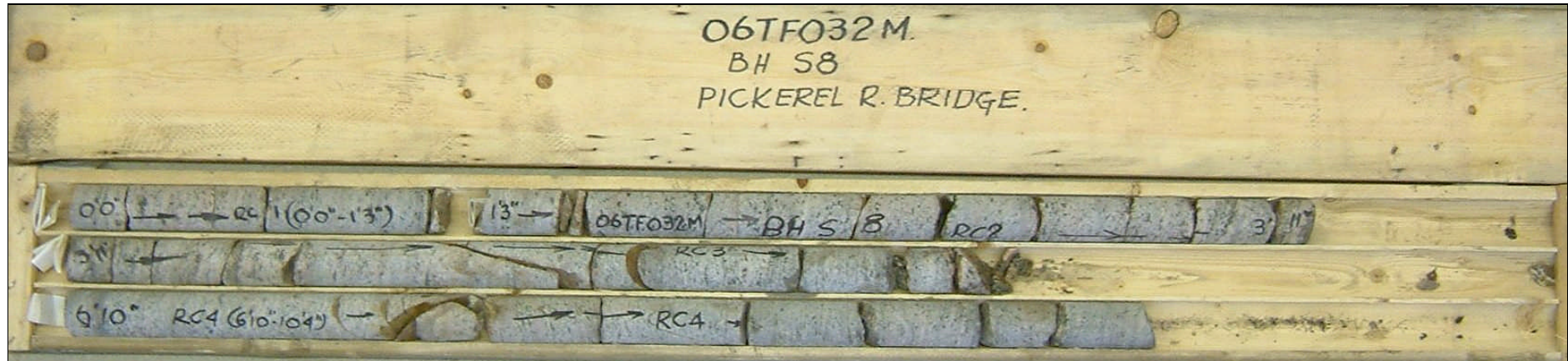


**Photograph 3:** Borehole S4, samples RC-1 to RC-4 from 0.0 to 3.2 m depth. The RQD values ranged from 0 to 100%, indicating good to excellent (locally very poor) quality bedrock.

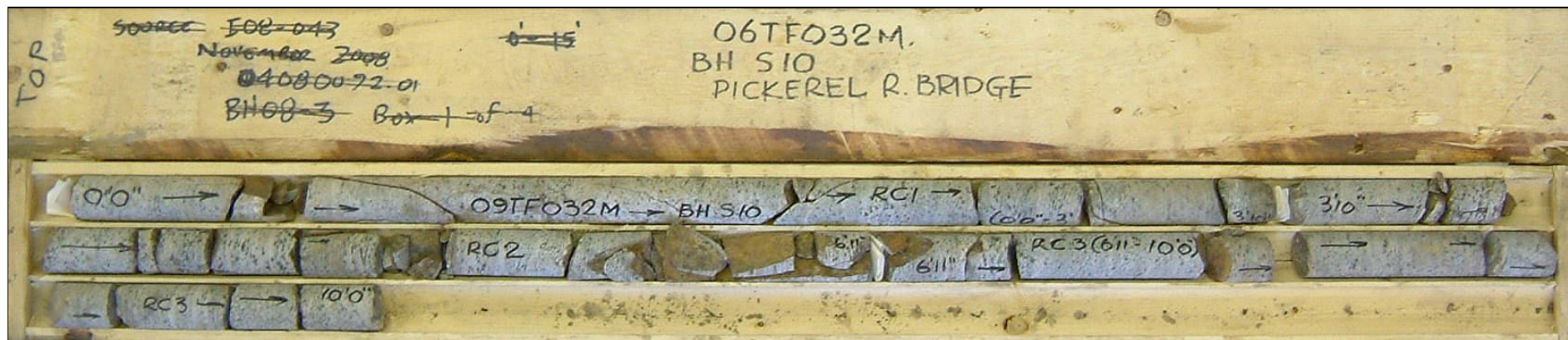


**Photograph 4:** Borehole S7, samples RC-1 to RC-4 from 0.0 to 3.1 m depth. The RQD values ranged from 59 to 100%, indicating fair to excellent quality bedrock.





**Photograph 5:** Borehole S8, samples RC-1 to RC-4 from 0.0 to 3.2 m depth. The RQD values ranged from 31 to 87%, indicating good becoming poor to fair quality bedrock.



**Photograph 6:** Borehole S10, samples RC-1 to RC-3 from 0.0 to 3.1 m depth. The RQD values ranged from 27 to 76%, indicating good (locally poor) quality bedrock.





**Photograph 7:** Borehole S12, samples RC-1 to RC-6 from 0.0 to 3.1 m depth. The RQD values ranged from 0 to 99%, indicating fair to excellent (locally very poor) quality bedrock.

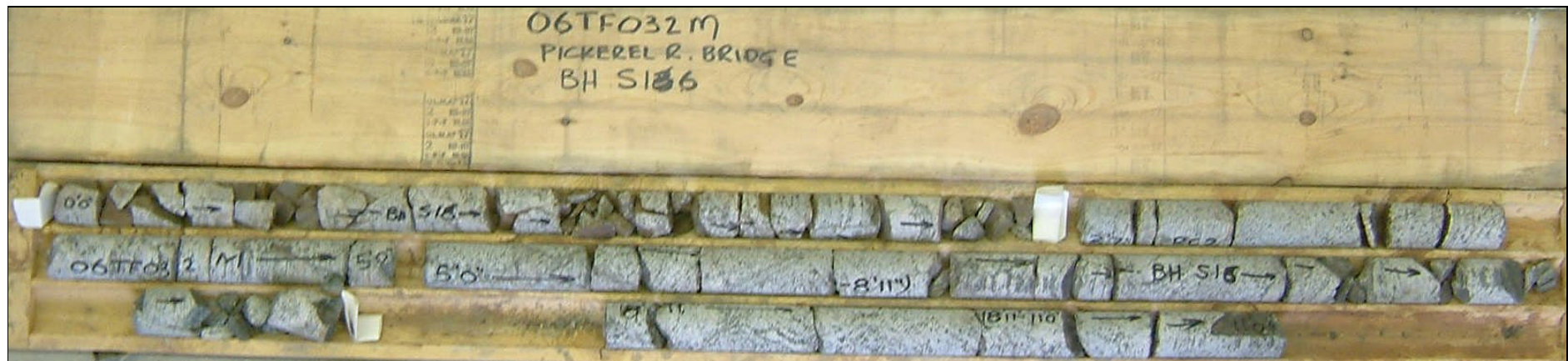


**Photograph 8:** Borehole S13, samples RC-1 to RC-5 from 0.0 to 3.2 m depth. The RQD values ranged from 0 to 83%, indicating very poor to poor becoming good quality bedrock.





**Photograph 9:** Borehole S14, samples RC-1 to RC-4 from 0.0 to 3.1 m depth. The RQD values ranged from 0 to 94%, indicating excellent to fair becoming very poor quality bedrock.



**Photograph 10:** Borehole S16, samples RC-1 to RC-4 from 0.0 to 3.4 m depth. The RQD values ranged from 0 to 52%, indicating very poor becoming poor to fair quality bedrock.

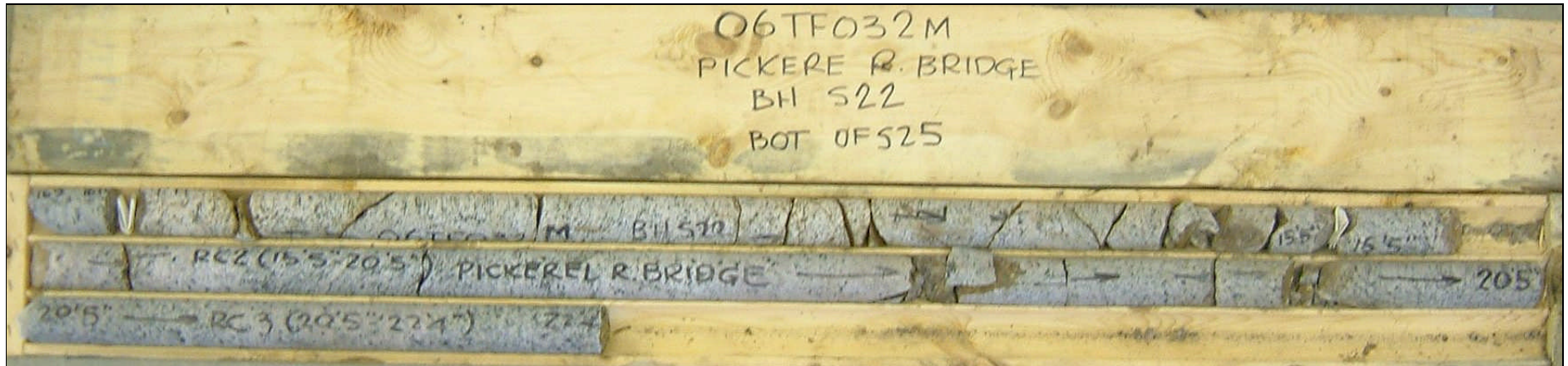




**Photograph 11:** Borehole S18, samples RC-1 to RC-6 from 0.0 to 3.2 m depth. The RQD values ranged from 0 to 99%, indicating very poor becoming fair to excellent quality bedrock.

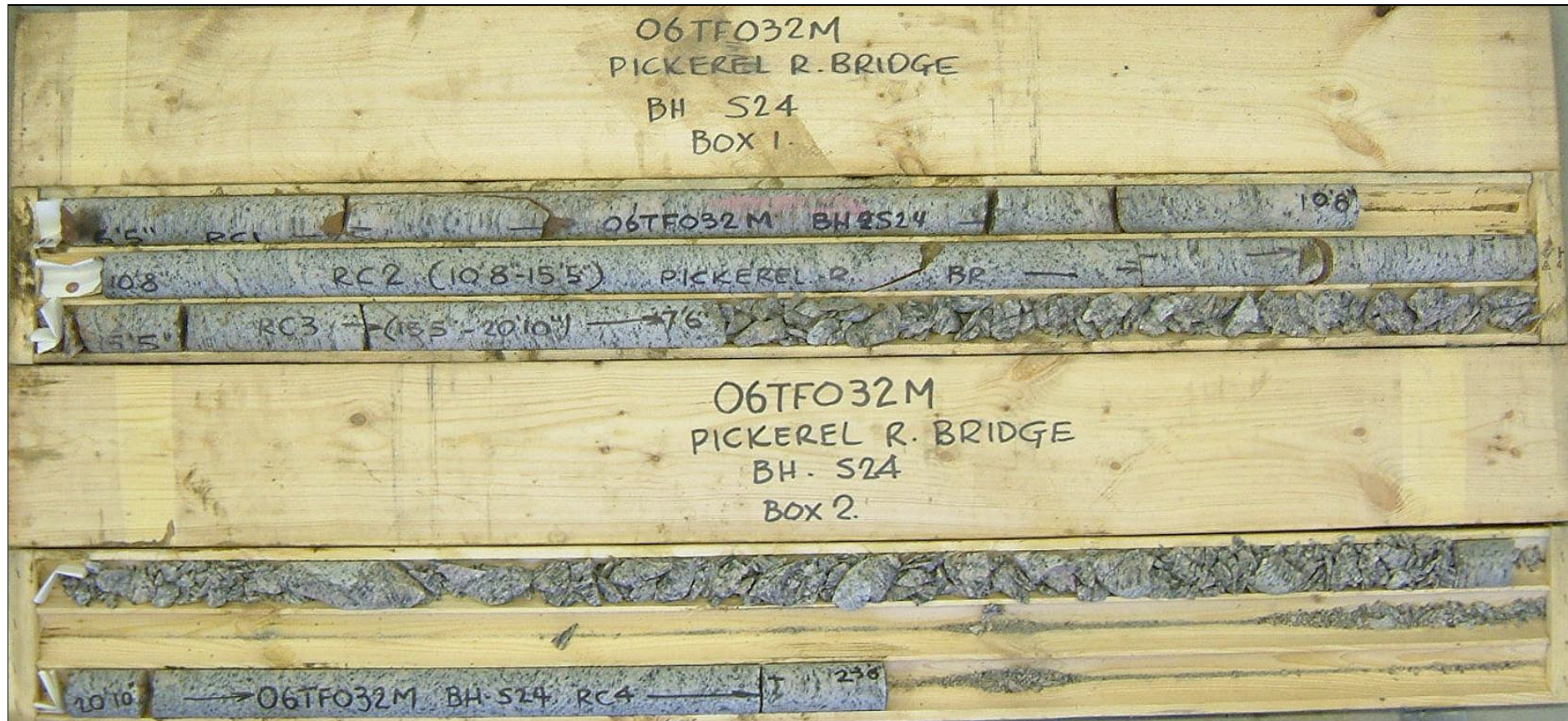


**Photograph 12:** Borehole S19, samples RC-1 to RC-4 from 0.0 to 3.1 m depth. The RQD values ranged from 0 to 95%, indicating very poor to poor becoming good to excellent quality bedrock.



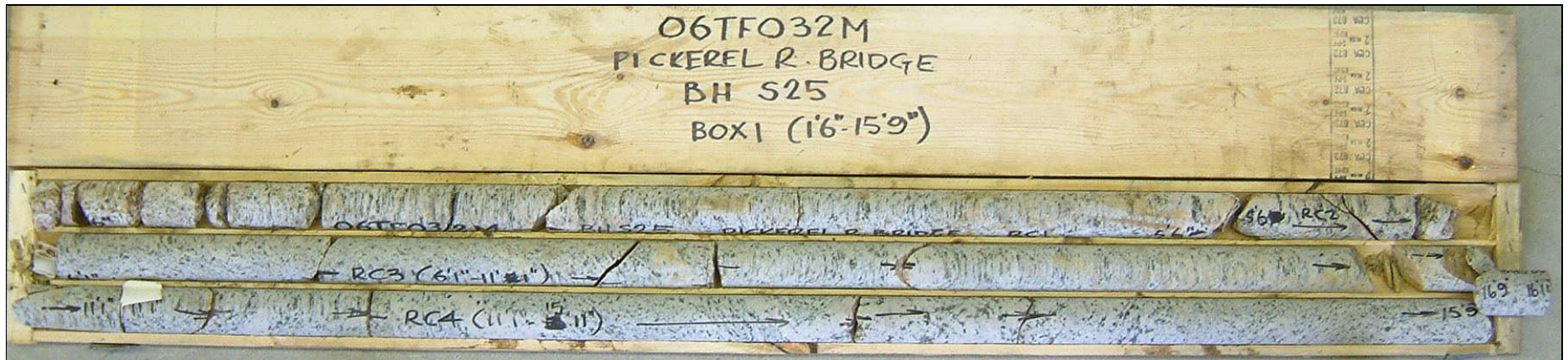
**Photograph 13:** Borehole S22, samples RC-1 to RC-3 from 3.6 to 6.8 m depth. The RQD values ranged from 45 to 100%, indicating poor to fair becoming excellent quality bedrock.





**Photograph 14:** Borehole S24, samples RC-1 to RC-4 from 2.0 to 7.2 m depth. The RQD values ranged from 38 to 98%, indicating good to excellent (locally poor) quality bedrock.





**Photograph 15:** Borehole S25, samples RC-1 to RC-4 from 0.5 to 4.9 m depth. The RQD values ranged from 67 to 96%, indicating fair becoming excellent quality bedrock.