Peto MacCallum Ltd.
CONSULTING ENGINEERS

FOUNDATION INVESTIGATION REPORT

for

OJIBWAY CANYON BRIDGE PIERS AT STA. 20+803 (SBL) AND STA. 20+809 (NBL), MOWAT TOWNSHIP
HIGHWAY 69 FOUR-LANING
FROM 3.8 KM NORTH OF HWY 522
TO 10.7 KM NORTH OF HWY 522
G.W.P. 5203-06-00 (PART OF G.W.P. 5378-02-00)
SUDBURY AREA, ONTARIO

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TABLE OF CONTENTS

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FOUNDATION INVESTIGATION REPORT
for
Ojibway Canyon Bridge Piers at Sta. 20+803 (SBL) and Sta. 20+809 (NBL),
Township of Mowat
Highway 69 Four-Laning
From 3.8 km North of Hwy 522
To 10.7 km North of Hwy 522
G.W.P. 5203-06-00 (Part of G.W.P. 5378-02-00)
Sudbury Area, Ontario

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1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for Ojibway Canyon bridge piers at southbound and northbound lanes for the realignment and four-laning of the section of Highway 69 that extends from 3.8 km north of Highway 522 to 10.7 km north of Highway 522, District 54, Sudbury, Ontario. Peto MacCallum Ltd. (PML) conducted the foundation investigation for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The proposed new alignment for Highway 69 is crossing the Ojibway Canyon from Sta. 20+775 to 20+837.5, Township of Mowat.

Two alternative crossing schemes were tentatively proposed for the new Highway 69 across the Ojibway Canyon. These alternatives were (1) bridge structures for the southbound and northbound lanes and (2) construction of a culvert at the base of the canyon with a rockfill embankment.

The field work for the culvert/rockfill embankment and two bridge piers at the base of the Ojibway Canyon were carried out concurrently to ensure that all subsurface information was obtained during the winter period when the site was accessible. Due to the favourable soil conditions at the site revealed during the field works and the high construction cost for the two bridges for SBL and NBL, construction of a culvert with rockfill embankment alternative was adopted. Therefore, all boreholes planned for the abutments were cancelled. Accordingly, this report covers only the bridge pier foundations investigation and is prepared for record purposes only.

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BARRIE, HAMILTON, KITCHENER, TORONTO

As indicated previously, construction of a culvert with rockfill embankment was designed for the Ojibway Canyon crossing. The Foundation Investigation and Design Reports for the culvert and swamp / high fill crossing were submitted under separate covers as follows:

- Culvert C8 (PML Ref.: 06TF035C dated March 5, 2010, Geocres No. 41I-250)
- Swamp 314-Highfill Crossing (PML Ref.: 06TF033C-1 dated November 19, 2009, Geocres No. 41H-243).

All elevations in this report are expressed in metres.

2. SITE DESCRIPTION AND GEOLOGY

The Ojibway Canyon crossing for the realignment and four-laning of Highway 69 is planned about 50 km south of Sudbury.

The topography of study area is irregular with shallow bedrock sections and deep swamp deposits. Locally, the canyon walls are up to 20 m high and the base of the canyon is flat and relatively level. The ground cover includes grasses and typical swamp vegetation, bushes and stands of trees.

The study area is located in the Precambrian Laurentian peneplane. Pleistocene lacustrine/fluvial deposits and recent swamp sediments have been laid down in depressions and are probably associated with the Nipissing post-glacial stage of the Great Lakes.

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

The mineral soil cover is typically less than 1 m and may vary greatly over short distances. Locally, the depth of soil cover in swampy lands may extend to depths exceeding 30 m.

3. INVESTIGATION PROCEDURES

The subsurface investigation was carried out during February 18 to 25 and March 2009 and included two sampled boreholes, designated P1-SBL and P2-NBL, were put down at the site. This subsurface investigation was supplemented by data from boreholes C8-1, C8-3 and C8-5 drilled during subsurface investigations for culvert C8 to be located within proximity of the pier sites. The five boreholes were drilled to depths of 2.8 to 5.2 m, elevations 182.3 to 185.2. The five boreholes were extended by coring 3.1 to 4.7 m into bedrock to total depths of 5.9 and 9.7 m elevations 178.0 to 182.1. The locations of the boreholes are shown on the attached Drawing P-1.

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

The boreholes were advanced using continuous flight hollow and solid stem augers and NW washboring, powered by track-mounted D-50 drill rig. The equipment was supplied and operated by a specialist drilling contractor working under the full-time supervision of members of PML engineering staff. All boreholes were extended into bedrock using rotary diamond drilling methods.

Representative soil samples were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

The rock cores were recovered using NQ rock coring equipment. A PML senior geologist examined and classified the recovered rock core samples. Detailed descriptions of the recovered rock core are provided in Appendix A.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open borehole.

Upon completion of drilling, all the boreholes were backfilled with a bentonite/cement mixture in accordance with the MTO and MOE Reg. 903 guidelines for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The recovered samples were returned to our laboratory for detailed visual examination and classification. The laboratory testing programme consisted of moisture content determinations and grain size distribution analyses. Atterberg plasticity limits were not attempted on any sample since the soils were identified to be cohesionless (non-plastic) by visual and tactile examination. The laboratory testing program comprised the following tests:

- Natural moisture content determinations (10)
- Grain size analyses (5)

The result of grain size distribution analysis is shown on the Record of Borehole Sheets. The grain size distribution chart is presented on Figure P-GS-1.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, soil boundary elevations, standard penetration resistance values, and groundwater observations. The result of laboratory grain size distribution analysis is also shown on the Record of Borehole sheets.

The borehole locations are shown on Drawing P-1. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

A description of the subsurface stratigraphy at piers site is summarised in the following subsections of the report.

4.1. General

The subsurface stratigraphy revealed in the five boreholes generally comprised a surficial peat unit locally covered with a snow/ice layer. The peat unit was underlain by a cohesionless sand deposit which in turn mantled bedrock at depths of 2.8 to 5.2 m, elevations 182.3 to 185.2. Groundwater was observed at depths of 0.3 to 0.6 m below ground surface (elevations 186.2 to 187.1) in all boreholes.

4.2. Snow/Ice

A 300 to 400 mm thick snow/ice layer was contacted in boreholes P2-NBL, C8-3 and C8-5.

4.3. Peat

The peat unit contacted surficial in boreholes P1-SBL and C8-1 and beneath the snow/ice layer in boreholes P2-NBL, C8-3, and C8-5 was 200 to 500 mm thick and was penetrated at 0.3 to 0.8 m depths, elevations 186.6 to 187.6.

4.4. Sand

Underlying the peat unit at 0.3 and 0.8 m depths (elevation 186.6 and 187.6) in all boreholes, a cohesionless sand deposit was contacted. The sand deposit was 2.4 and 4.8 m thick and extended to the underlying bedrock at 2.8 and 5.2 m depths (elevations 182.3 and 185.2). The sand contains trace to with gravel particles, trace to with silt trace clay, and cobbles and boulders The relative density of the deposit was compact to dense. The N values ranged from 13 to 35 blows. High N values were recorded but reflect the presence of cobbles and boulders or interface of soil with bedrock. A single low N value of 4 was also recorded and probably due to hydraulic disturbance during sampling. The moisture content of the sand deposit ranged between 9 to 16%.

The results of grain size distribution analyses conducted on representative samples of the sand deposit are presented in Figure P-GS-1.

4.5. Bedrock

Bedrock was contacted in all boreholes at depths of 2.8 and 5.2 m depths (elevations 182.3 and 185.2). Generally, the bedrock surfaces encountered in the drilled boreholes for culvert C8 and piers slope gently downward (3^{o}) from the west end of the culvert (borehole C8-1) to the SBL pier (borehole P1-SBL) and become relatively flat between the SBL pier and the east end of the culvert (borehole C8-5).

The retrieved rock cores comprise dark green to black and grey gabbro and exhibited high strength. A detailed description of the rock cores retrieved from all boreholes is given in Table A appended.

The measured core recovery was in the range of 95 to 100%. The RQD determined from the rock cores was typically in the range of 63 to 100%, thus indicating a fair to excellent quality rock. Locally, in the culvert borehole C8-3, the RQD determined from the rock cores upper 1.7 m zone, from 4.9 to 6.6 m depths (elevations 182.8 to 181.1), was 15 and 29 % indicating a very poor to poor quality rock. This is due to the presence of very close to closely spaced cross joints in the rock.

4.6. Groundwater

Groundwater was observed in all boreholes at depths of 0.3 to 0.6 m below ground surface (elevations 186.2 to 187.1) upon completion of drilling. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

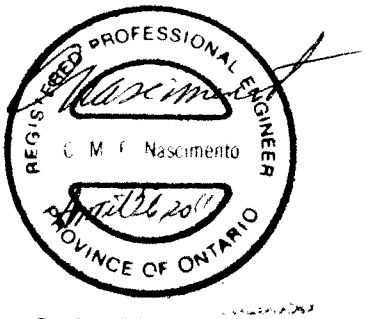
5. MISCELLANEOUS

The field work was carried out under the supervision of Mr. F. Portela, and the direction of Mr. C.M.P. Nascimento, P.Eng., Senior Foundation Engineer. Walker Drilling Ltd. supplied the drilling equipment. The recovered rock core samples were examined and classified by Mr. John Wright, P.Geo. Senior Geologist.

This report was prepared by Mr. Idib (Adeeb) Sadoun, MSc., P.Eng., and Mr. C.M.P. Nascimento, P.Eng., Senior Project Engineer and was independently reviewed by Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact.

Yours very truly

Peto MacCallum Ltd.



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

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

CN/BRG:AS:lnr-mi-nk

TABLE A

ROCK CORE DESCRIPTIONS

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
BRIDGE PIER - SBL Borehole P1-SBL	5	5.0 – 6.1	100	86	5.0 – 9.7	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar with occasional horizontal slickensides, with some vertical fissures, tight to open to 1 mm, generally slightly altered with black silty infilling, occasional white scale, good to excellent quality.
	6	6.1 – 7.6	95	91		
	7	7.6 – 9.1	100	88		
	8	9.1 – 9.7	96	85		

RQD = Rock Quality Designation

Originated: JFW
Compiled: FP
Checked: AS / CN

TABLE A

ROCK CORE DESCRIPTION

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
BRIDGE PIER - NBL Borehole P2-NBL	5	4.9 – 6.2	96	87	4.9 – 8.9	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate (locally wide) spaced flat to dipping (locally vertical) cross joints, rough planar (locally with horizontal slickensides, tight to slightly altered with black silty infilling, occasional white scale, fair to excellent quality.
	6	6.2 – 6.9	100	96		
	7	6.9 – 7.6	100	100		
	8	7.6 – 8.9	100	63		

RQD = Rock Quality Designation

Originated: JFW
Compiled: FP
Checked: AS / CN

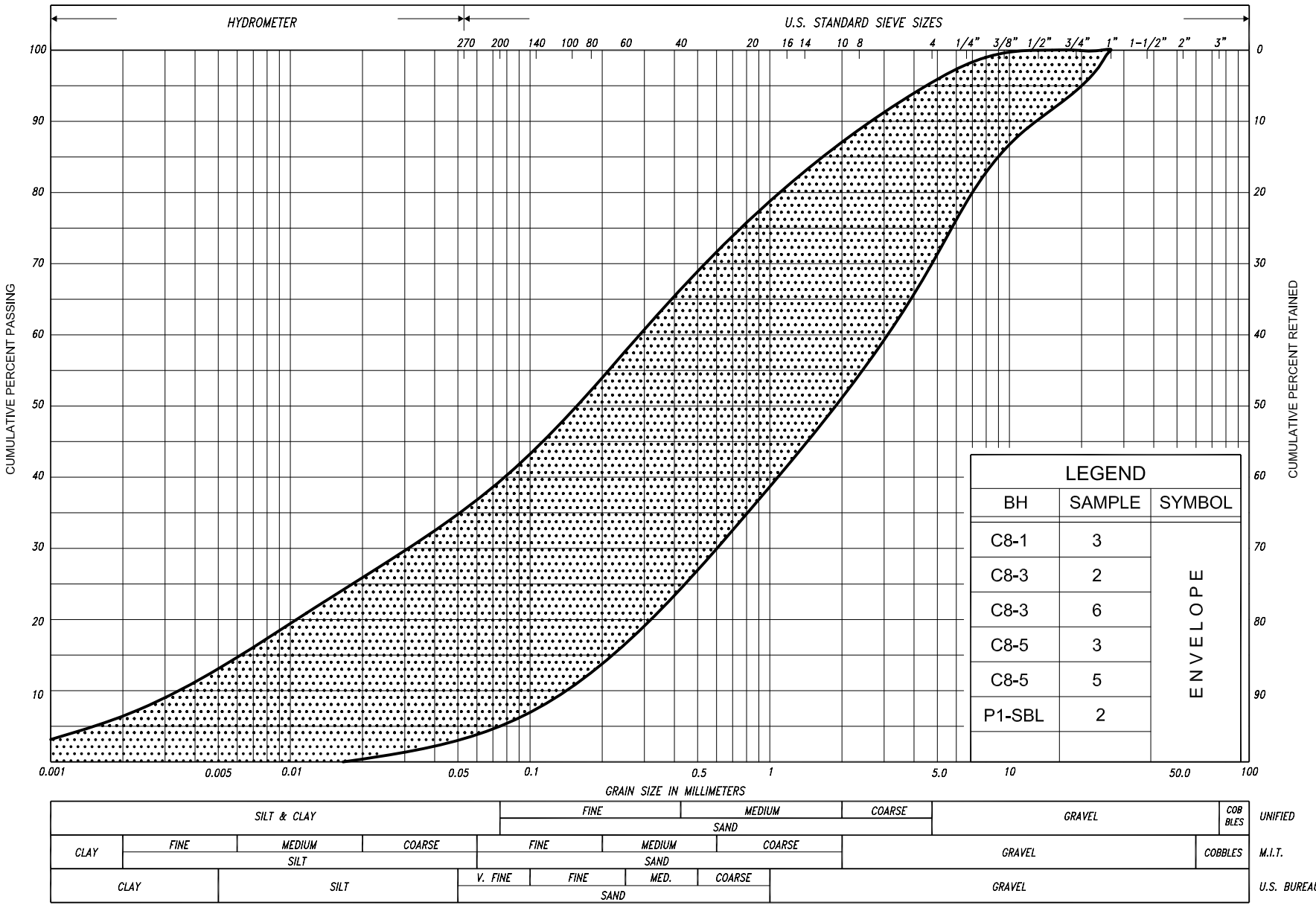
TABLE A

ROCK CORE DESCRIPTIONS

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C8-1	5 6 7	2.8 – 3.1 3.1 – 4.3 4.3 – 5.9	100 100 100	73 70 99	2.8 – 5.9	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar with occasional horizontal slickensides, with some vertical fissures, tight to open to 1 mm, generally slightly altered with black silty infilling, occasional white scale, fair to excellent quality.
C8-3	7 8 9	4.9 – 6.0 6.0 – 7.6 7.6 – 8.1	98 100 100	15 29 100	4.9 – 8.1	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, very close to close spaced (moderate below 7.2 m) flat to dipping cross joints, rough planar with occasional horizontal slickensides, with numerous vertical fissures (some compound), tight to open (5 mm), generally slightly altered with black silty infilling, very poor to poor becoming excellent quality.
C8-5	7 8 9	5.2 – 6.3 6.3 – 7.2 7.2 – 8.3	100 100 100	100 85 95	5.2 - 8.3	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping (locally vertical) cross joints, rough planar, locally open (to 1 mm), tight to slightly altered with black silt infilling, occasional green scale on parting surface, good to excellent quality.

RQD = Rock Quality Designation

Originated: JFW
Compiled: FP
Checked: AS / CN



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GRAIN SIZE DISTRIBUTION

SAND, some to with gravel
trace to with silt, trace clay

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

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 $\tilde{N}$.

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
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	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_α	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
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
DTPL		DRIER THAN PLASTIC LIMIT
APL		ABOUT PLASTIC LIMIT
WTPL		WETTER THAN PLASTIC LIMIT
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

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RECORD OF BOREHOLE No P1-SBL 1 of 1 METRIC

Coords: 5 096 737.8 N; 221 558.4 E

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 20+803, o/s 18.8m Lt CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and NQ Diamond Coring COMPILED BY A.S.

DATUM Geodetic DATE February 18 and 24, 2009 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.7	Ground Surface										
0.0 / 187.4	Peat, coarse fibrous		1	CS	-	▼* ▽*	187				
0.3	Dark brown										
	Sand, with silt trace clay, trace gravel cobbles and boulders		2	SS	10/8cm						5 55 34 6
	Compact Brown Moist		3	CS	-		186				
			4	CS	-		185				
182.7							184				
5.0	Gabbro bedrock						183				
	Slightly weathered to unweathered		5	RC NQ	REC 100%		182				RQD 86%
	High strength										
	Good to excellent quality		6	RC NQ	REC 95%		181				RQD 91%
			7	RC NQ	REC 100%		180				RQD 88%
178.0			8	RC NQ	REC 96%		179				RQD 85%
9.7	End of borehole						178				

Sample 2: Sampler bouncing on cobbles and boulders, Numerous cobbles and boulders detected during drilling

* 2009 02 24

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

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Foundation Design

RECORD OF BOREHOLE No P2-NBL 1 of 1 METRIC

Coords: 5 096 748.1 N; 221 594.9 E

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 20+809, o/s 18.8m Rt CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and NQ Diamond Coring COMPILED BY A.S.

DATUM Geodetic DATE February 24 and 25, 2009 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.4	Top of Snow							
0.0 / 187.1	Snow/ice							
0.3 / 186.6	Peat, coarse fibrous Dark brown		1	CS	-	▼* ▽*	187	
0.8	Sand with gravel, trace silt cobbles and boulders Compact Brown Wet		2	SS	26		186	
			3	SS	20/8cm		185	
182.5			4	SS	15/15cm		184	
4.9	Gabbro bedrock Slightly weathered to unweathered High strength Fair to excellent quality		5	RC NQ	REC 96%		183	RQD 87%
			6	RC NQ	REC 100%		182	RQD 96%
			7	RC NQ	REC 100%		181	RQD 100%
178.5			8	RC NQ	REC 100%		180	RQD 63%
8.9	End of borehole						179	

Samples 3 and 4: Sampler bouncing on cobbles and boulders.

* 2009 02 25

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

ON_MOT VER3 06TF035C.GPJ ON_MOT.GDT 1/27/2011 10:28:18 AM

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No C8-1 1 of 1 METRIC

Coords: 5 096 737.5 N; 221 518.9 E

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 20+807.3, o/s 58m Lt CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring COMPILED BY A.S.

DATUM Geodetic DATE February 18 and March 02, 2009 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.0	Ground Surface										
0.0 / 187.6	Peat, coarse fibrous Dark Wet brown		1	SS	1	▼* ▽*					
0.4	Sand some gravel, trace silt cobbles and boulders Compact to dense Brown Wet		2	SS	15		187				
	Grey		3	SS	28		186		○		16 75 (9)
185.2			4	SS	35						
2.8	Gabbro bedrock Slightly weathered to unweathered Hight strength Fair to excellent quality		5	RC NQ	REC 100%		185				RQD 73%
			6	RC NQ	REC 100%		184				RQD 70%
			7	RC NQ	REC 100%		183				RQD 99%
182.1											
5.9	End of borehole										

Sample 2: Sampler bouncing

* 2009 03 02

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers

+7, ×5: Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No C8-3 1 of 1 METRIC

Coords: 5 096 739.8 N; 221 577.1 E

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 20+803 CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring COMPILED BY A.S.

DATUM Geodetic DATE February 26 and 28, 2009 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.7	Top of Snow										
0.0 / 187.3	Snow and ice										
0.4 / 186.9	Peat, coarse fibrous										
0.8	Dark Wet brown		1	SS	20/5cm	▼* ▽*	187				
	Sand, with gravel some silt, trace clay cobbles and boulders										
	Loose to compact Grey Wet		2	SS	15		186		○		30 52 15 3
			3	SS	4		185		○		
			4	SS	16				○		
			5	SS	24		184				
182.8	with silt, some gravel		6	SS	12/17cm		183		○		15 61 20 4
4.9	Gabbro bedrock										
	Slightly weathered to unweathered		7	RC NQ	REC 98%						RQD 15%
	Hight strength						182				
	Very poor to poor becoming excellent quality		8	RC NQ	REC 100%						RQD 29%
			9	RC NQ	REC 100%		181				RQD 100%
179.6							180				
8.1	End of borehole										

Samples 1 & 6: Sampler bouncing

* 2009 02 28

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers

ON_MOT VER3 06TF035C.GPJ ON_MOT.GDT 1/27/2011 10:30:51 AM

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No C8-5 1 of 1 METRIC

Coords: 5 096 741.7 N; 221 635.2 E

G.W.P. 5203-06-00 LOCATION Hwy 69 (New), Sta. 20+798, o/s 58m Rt CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring COMPILED BY A.S.

DATUM Geodetic DATE February 26, 2009 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.5	Top of Snow										
0.0 / 187.1	Snow and ice										
0.4 / 186.9	Peat, coarse fibrous Dark brown					▼*	187				
0.6	Sand some gravel, trace silt cobbles and boulders Compact Grey Wet		1	SS	30	▽*					
			2	SS	21		186		○		
			3	SS	15		185		○		11 83 (6)
	with gravel some silt, trace clay		4	SS	13				○		
			5	SS	27		184		○		24 61 12 3
182.3			6	SS	25		183		○		
5.2	Gabbro bedrock Slightly weathered to unweathered Hight strength Good to excellent quality		7	RC NQ	REC 100%		182				RQD 100%
			8	RC NQ	REC 100%		181				RQD 85%
179.2			9	RC NQ	REC 100%		180				RQD 95%
8.3	End of borehole										

* 2009 02 28

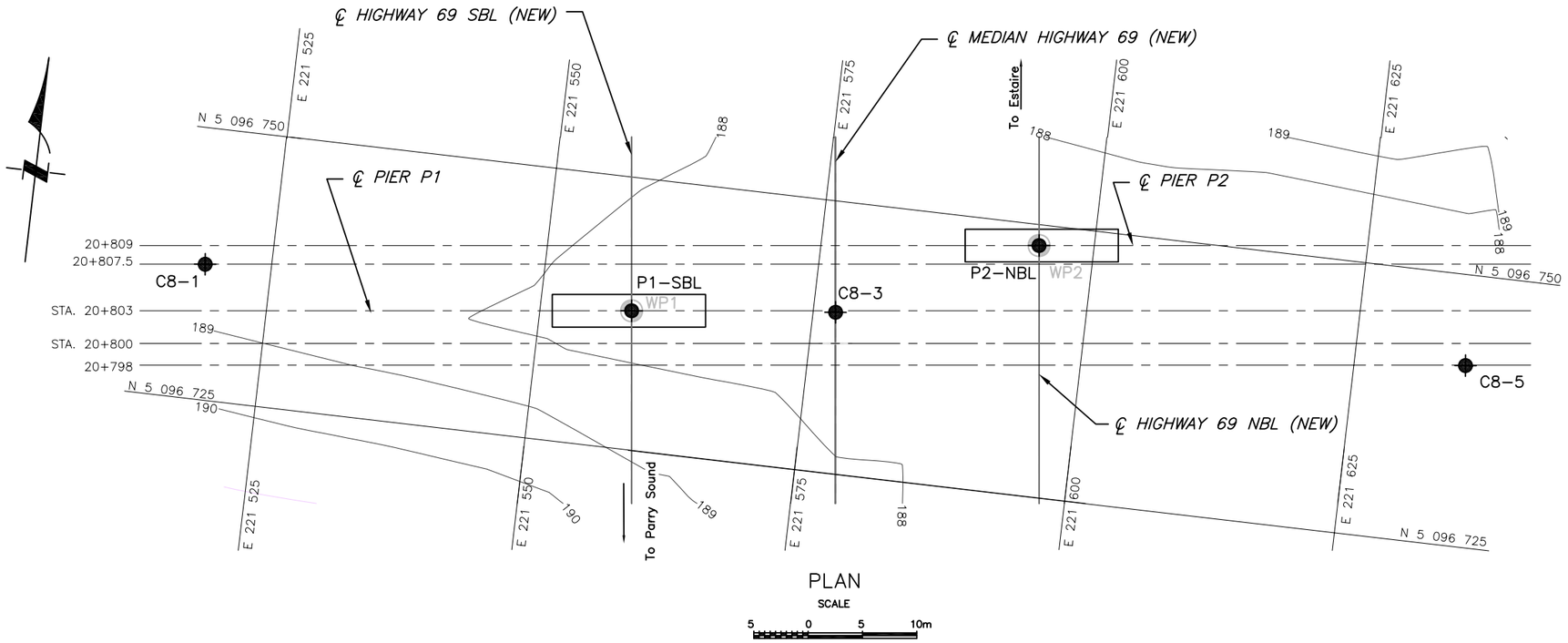
▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers

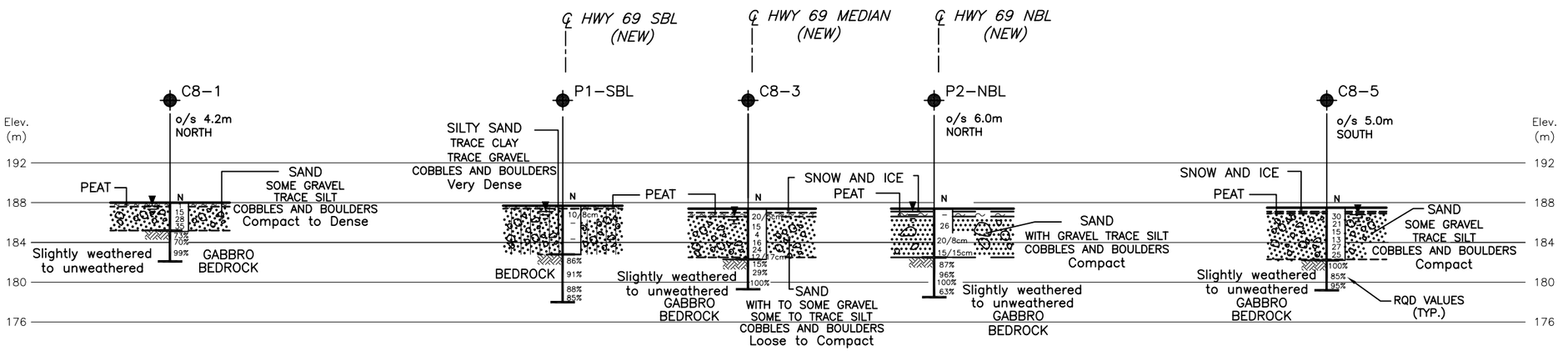
+7, ×5: Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE



PLAN

SCALE 5 0 5 10m



CROSS–SECTION AT STATION 20+803

SCALE 5 0 5 10m

NOTES:

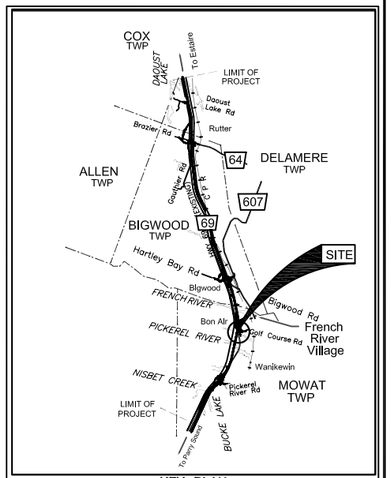
1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
2. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
3. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

CONT No
GWP No 5203–06–00

OJIBWAY CANYON – BRIDGE PIERS
HIGHWAY 69 FOUR–LANING
STA. 20+803 (SBL) & 20+809 (NBL) MOWAT TWP
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE 2 0 2 4 6km

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 Feb–Mar 2009
- Head ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	CO–ORDS NORTHING	EASTING
C8–1	188.0	N 5 096 737.5	E 221 518.9
C8–3	187.7	N 5 096 739.8	E 221 577.1
C8–5	187.5	N 5 096 741.7	E 221 635.2
P1–SBL	187.7	N 5 096 737.8	E 221 558.4
P2–NBL	187.4	N 5 096 748.1	E 221 594.9

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

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento PROVINCE OF ONTARIO April 26

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY APRIL 26, 20 PROVINCE OF ONTARIO

REF.: MRC DRAWINGS: S6454–329–PRCRDS.DWG.dwg; H6454xb2 contours zone 10.dwg;

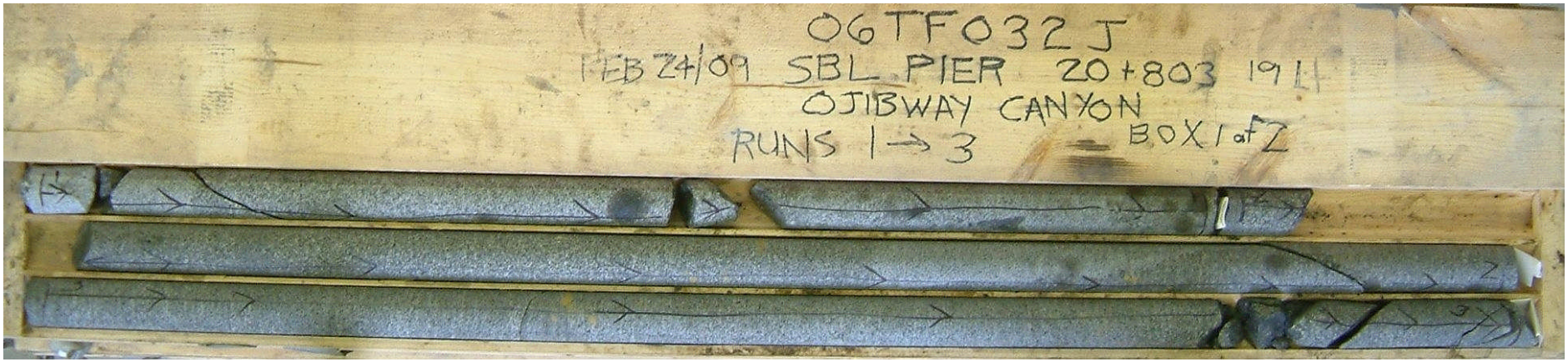
REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 41I–269

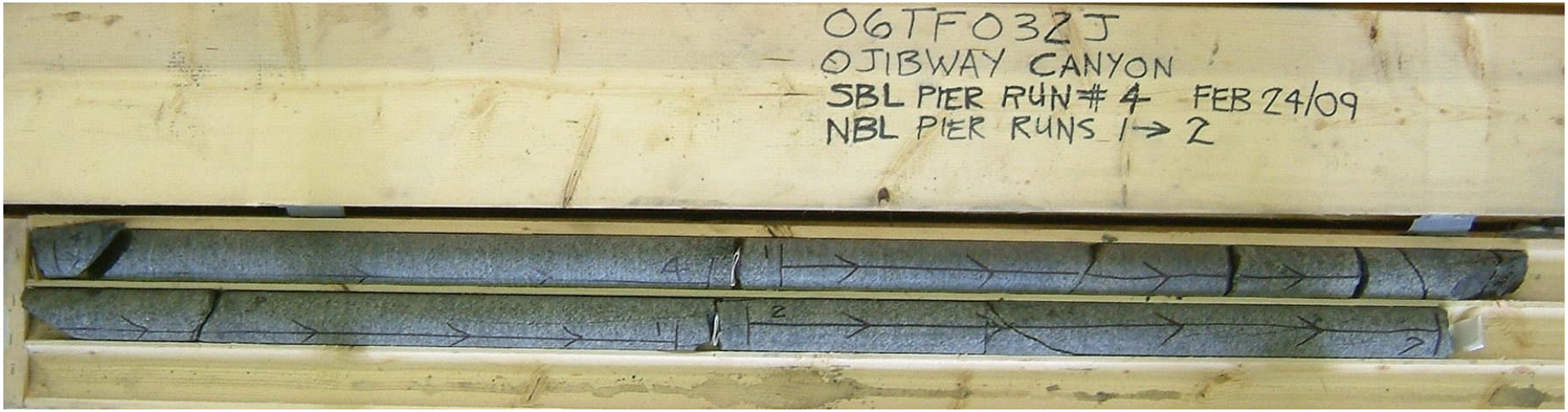
HWY No	69			DIST	54
SUBM'D	AS	CHECKED	AS	DATE APR. 26, 2011	SITE --
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG P–1

APPENDIX A

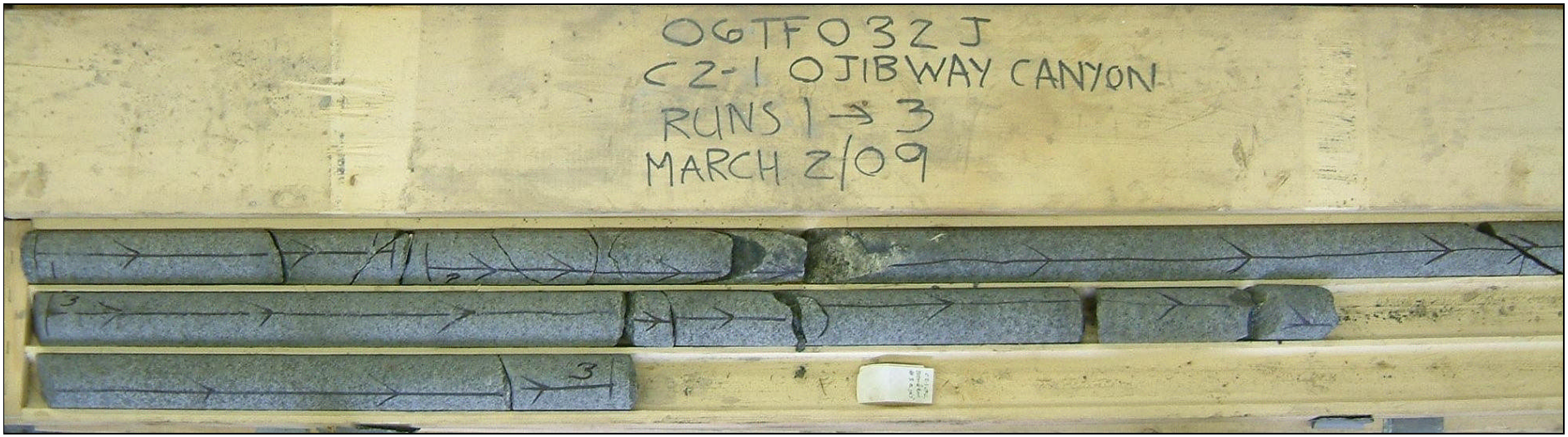
ROCK CORE PHOTOGRAPHS



Photograph 1: Bridge Pier 1 at station 20+803 (SBL), borehole P1-SBL, samples RC-5 to RC-8.

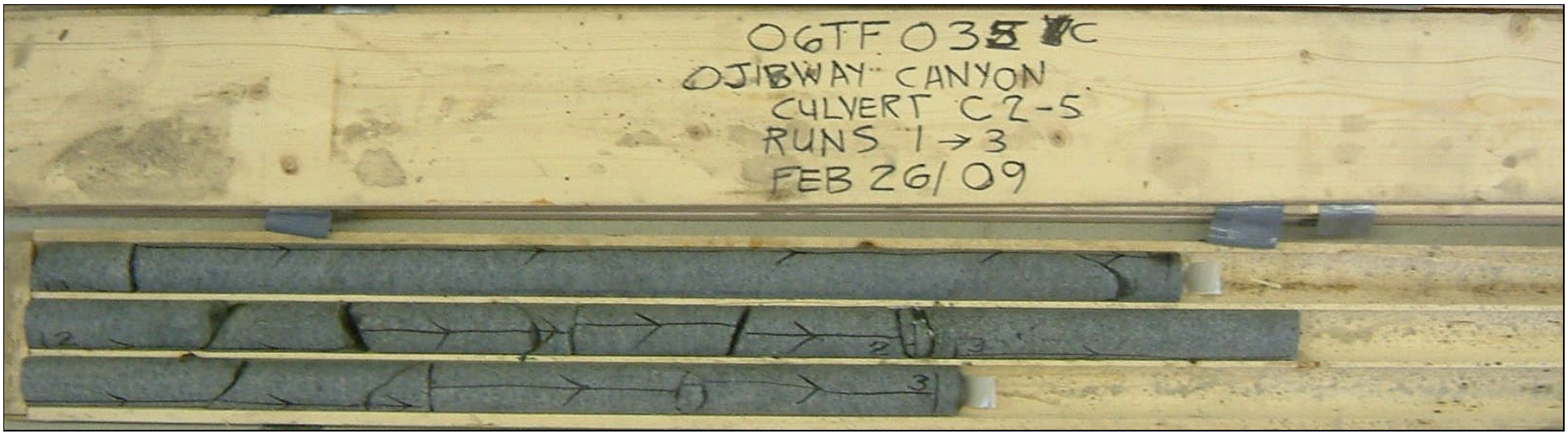


Photograph 2: Bridge Pier at station 20+809 (NBL), borehole P2-NBL, samples RC-5 to RC-8.



Photograph 3: Culvert C8, borehole C8-1, RC-5 to RC-7.

Photograph 4: Culvert C8, borehole C8-3, RC-7 to RC-9.



Photograph 5: Culvert C8, borehole C8-5, RC-7 to RC-9