THE
NATIONAL
TESTING
LABORATORIES
LIMITED
Established in 1923

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February 12, 2013

Stantec
100-1355 Taylor Avenue
Winnipeg, Manitoba
R3M 3Y9

Attention: Kevin Amy

Kevin,

Re: Sturgeon Road Bridge Replacement, Winnipeg, Manitoba

The National Testing Laboratories Limited was retained to undertake a geotechnical investigation to verify the bedrock conditions for the proposed bridge structure for the southbound lanes on Sturgeon Road. The initial site investigation conducted in July 2010 revealed sound carbonate bedrock at the testhole locations. Based upon the quality of bedrock encountered in the testholes, shaft resistance values of 150 kPa (0 to 2.5 m below bedrock surface) and 1000 kPa (below 2.5 m) were provided for design of the rock-socketed caissons. During construction of the bridge structure for the northbound lanes, it was evident that the quality of bedrock encountered at the caisson locations was significantly lower than the quality of bedrock observed at the testhole locations. Based upon an evaluation of samples recovered from the caissons, an allowable shaft resistance of 300 kPa was provided for design of the caissons.

Field Drilling Program

On January 17, 2013, a testhole, identified as Testhole TH10, was drilled at the location of the south pier for the bridge structure for the southbound lanes. The testhole location is shown on the drawing provided in Appendix A. The testhole was drilled to auger refusal using a 125 mm diameter solid stem auger and then advanced 12 m into the underlying bedrock with a HQ coring bit. The core sample was returned to our laboratory for examination and testing.

Laboratory Testing

Samples of the bedrock core were selected and tested for uniaxial compressive strength (ASTM D7012) and point load strength index (ASTM D5731). The laboratory test reports are provided in Appendix B and the test data are summarized in the following tables.

Table 1 - Uniaxial Compressive Strength of Rock Cores (ASTM D7012)

Sample Depth Below Existing Grade (m)	Elevation (m)	Uniaxial Compressive Strength (MPa)
11.1	223.12	19
12.3	221.95	7
13.3	220.92	38
14.7	219.52	46
15.8	218.42	26
16.9	217.32	11
17.9	216.32	20
20.1	214.12	17

Table 2 – Point Load Strength Index of Rock Cores (ASTM D5731)

Sample Depth Below Existing Grade (m)	Elevation (m)	Point Load Strength Index (MPa)	Estimated Uniaxial Compressive Strength (MPa)
18.6	215.62	1.67	38
18.7	215.52	1.53	38
21.4	212.82	0.91	21
21.5	212.72	0.60	15
21.6	212.62	0.69	17

The rock quality designation (RQD) of the bedrock core was determined in accordance with ASTM D6032. The RQD is defined as the total length of recovered core pieces greater than 100 mm in length expressed as a percentage of the core drilled. The RQD for the bedrock core is summarized in the following table.

Table 3 – RQD Test Data for Rock Cores (ASTM D6032)

Top Elevation of Core Run (m)	Length of Core Run (m)	RQD (%)
223.52	1.52	81
222.00	1.53	90
220.47	1.50	89
218.97	1.55	77
217.42	1.50	87
215.92	1.55	73
214.37	1.50	62
212.87	1.55	93

The RQD may be used as a general measure of rock quality. Based on the RQD values for the core samples, the bedrock quality is considered to be fair to excellent.

SUBSURFACE CONDITIONS

Soil Profile

The typical stratigraphy at the site, as interpreted from the testhole log, consists of clay fill, clay and silt till underlain by calcareous mudstone. The testhole log is provided in Appendix C.

Clay Fill

Clay fill was encountered at the ground surface in the testhole. The clay fill extended to a depth approximately 2.8 m below the existing bridge deck. The clay fill contained gravel, sand and organic material. The clay fill was black, soft, moist, and of high plasticity.

Clay

Clay was encountered beneath the clay fill in the testhole. The clay was brown to grey, firm, moist, and of high plasticity.

Silt Till

Silt till was encountered beneath the clay at a depth of approximately 6 m below the existing bridge deck. The silt till was tan to red, loose to dense, moist, of low plasticity, and contained some sand and fine to coarse gravel. Although not encountered at the testhole location, it has been reported that boulders are present within the silt till in this area of Winnipeg.

Bedrock

Testhole TH10 intercepts rocks of the Stony Mountain Formation. The top 1.2 m of the rock core recovered from the testhole is composed of calcareous bioturbated mudstones typical of the Penitentiary Member. The remaining 11 m of the rock core is composed of reddish-purple, burrow-mottled, calcareous mudstones of the Gunn Member. The Gunn Member is interbedded with lenses of packstone and mudstone, and contains a considerable amount of clay. This clay content increases with increasing depth and is concentrated in lenses producing a fissile and friable texture. Photographs of the core samples are provided in Appendix D.

Rock-Socketed Caissons

Based upon a review of the test data and rock cores, the allowable shaft resistance value for rock-socketed caissons is 500 kPa. The quality of the bedrock was poor near the bedrock surface and therefore we recommend that the top 0.3 m be neglected in the design of the rock socket. The rock quality at the surface of the bedrock must be verified in the field to determine the actual length to be neglected below the top of the bedrock. The quality of the rock decreases with depth and the shaft resistance value is based upon socket lengths that do not exceed 6 m. The shaft resistance value is also based upon roughened sockets and a minimum concrete compressive strength of 40 MPa for the rock-socketed caissons. Drilling/coring of the bedrock should provide a rough surface texture to improve bond between the bedrock and concrete. It should be noted that the quality of bedrock can change significantly over short distances and actual bedrock quality at the caisson locations may differ from the bedrock quality observed in the core samples. If the actual bedrock quality is less than the quality assumed in the design of the caisson, the rock socket length must be increased to ensure the design capacity is achieved.

Full time inspection by qualified geotechnical personnel is required to evaluate the bedrock quality and to make recommendations regarding any requirement for socket deepening. A camera should be used to confirm the quality of the rock surface for each caisson prior to concrete placement.

Please contact the undersigned if you have any questions regarding the information provided in this letter.

Don Flatt

Don Flatt, M. Eng., P.Eng.
Senior Geotechnical Engineer

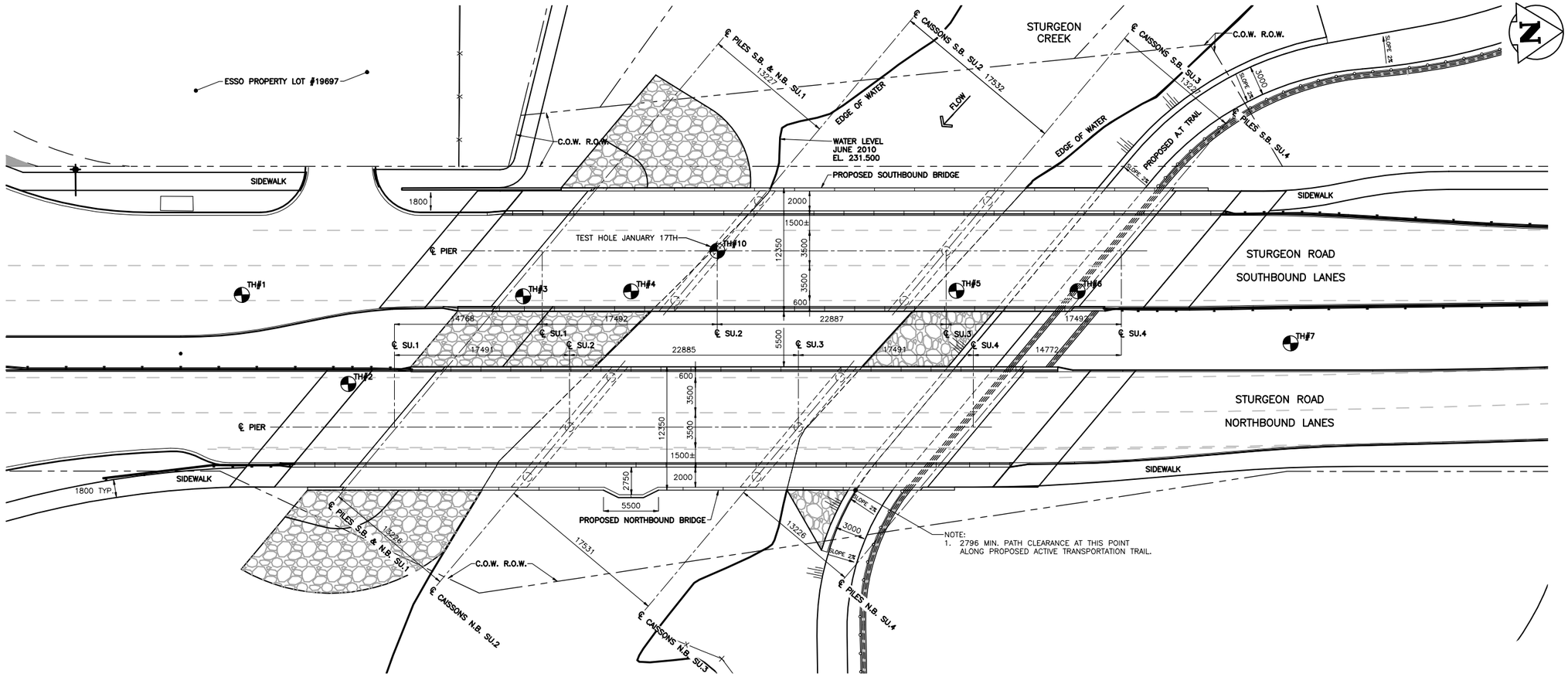
APEGM
Certificate of Authorization
The National Testing Laboratories Limited
No. 690 Date February 12, 2013

PROVINCE OF MANITOBA
D.G. FLATT
Member
5062
REGISTERED PROFESSIONAL ENGINEER

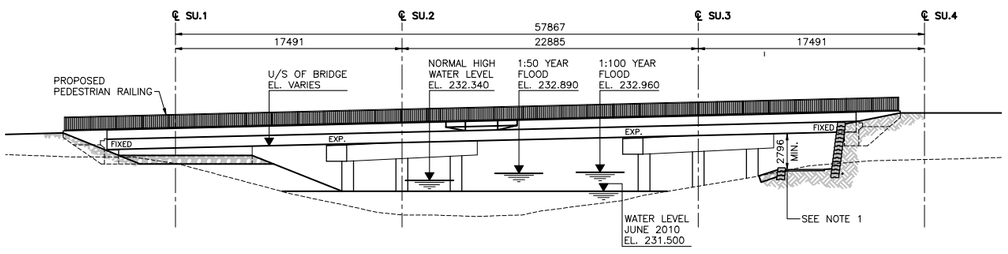
THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

APPENDIX A

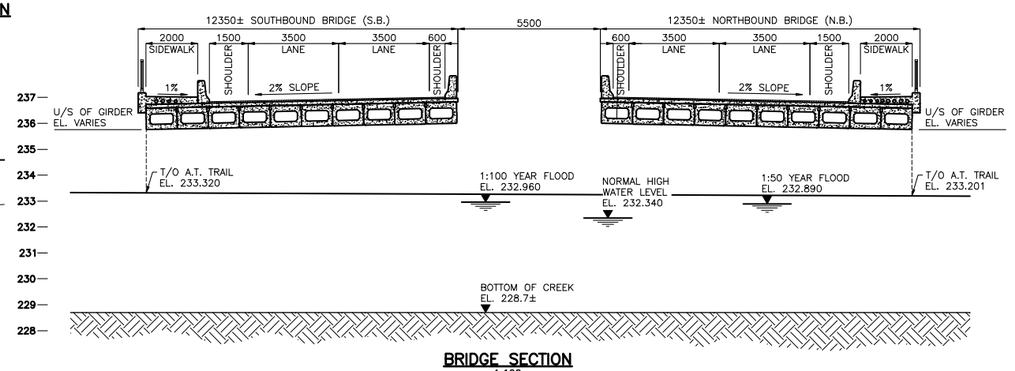
TESTHOLE LOCATION PLAN



BRIDGE PLAN
1:200



BRIDGE ELEVATION
1:200



BRIDGE SECTION
1:100

APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR CONSTRUCTION	12.03.26	
0	ISSUED FOR TENDER	11.12.15	K.S.A.

Stantec Consulting Ltd.
905 Waverley Street, Winnipeg, Manitoba
Tel 204-489-5900 Fax 204-453-9012

DESIGNED BY	K.S.A.	CHECKED BY	K.S.A.
DRAWN BY	J.M.B.	APPROVED BY	B.J.W.
HOR. SCALE:	AS SHOWN	RELEASED FOR CONSTRUCTION:	
VERTICAL:		DATE	
DATE	DEC. 15, 2011		

ENGINEER'S SEAL
ORIGINAL SEALED BY
K. S. AMY
P. ENG.
12.03.26

CONSULTANT DRAWING NO.
S-102

THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

STURGEON ROAD
BRIDGE REPLACEMENT
PORTAGE AVENUE TO HALLONQUIST DRIVE
BRIDGE GENERAL ARRANGEMENT

SHEET	10 OF 81
CAD FILE DRAWING NUMBER	31590s-102-767.dwg
CITY DRAWING NUMBER	B120-12-010

V:\1137\active\112731590\drawing\404_working\sheet_files\31590s-102-767.dwg
Date: 2013 Feb 01 4:58pm Login: Friesen, Vince

THE NATIONAL TESTING LABORATORIES LIMITED
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APPENDIX B

LABORATORY TEST REPORTS

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	36.5' - 37.7'	**Area (mm²)**	3142	**L (mm)**	133.25	**D (mm)**	63.25

Axial Tolerance	Axial		End Surface Flatness				Perpendicularity Tolerance		
	Min	Max	D_1	D_2	D_3	D_4			
L_1	0.000	0.006	0.000	0.000	0.000	0.000	D_1 Δ	0.001	
L_2	0.000	0.008	0.001	0.004	0.002	0.005	D_2 Δ	0.004	
L_3	0.000	0.009					D_3 Δ	0.002	
							D_4 Δ	0.005	
L_1 Δ	0.006								
L_2 Δ	0.008						L/D Ratio	2.1	
L_3 Δ	0.009						L/D Meets Spec		
Maximum Axial Deviation (in) 0.009							Δ Max	0.005	
							Δ Max / D	0.002	
Axial Deviation Meets Spec							Perpendicularity Meets Spec		

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	59.9	Compressive Strength, MPa	19	Unit Weight, g/cm³	2.310
Tested By	MVG	Date Jan.25.2013	Remarks		

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	43.6' - 44.3'	**Area (mm²)**	3142	**L (mm)**	151.75	**D (mm)**	63.25

Axial Tolerance	Axial		End Surface Flatness				Perpendicularity Tolerance		
	Min	Max	D_1	D_2	D_3	D_4			
L_1	0.000	0.011	0.000	0.000	0.000	0.000	D_1 Δ	0.005	
L_2	0.000	0.009	0.005	0.007	0.006	0.006	D_2 Δ	0.007	
L_3	0.000	0.010					D_3 Δ	0.006	
							D_4 Δ	0.006	
L_1 Δ	0.011								
L_2 Δ	0.009						L/D Ratio	2.4	
L_3 Δ	0.010						L/D Meets Spec		
Maximum Axial Deviation (in) 0.011							Δ Max	0.007	
							Δ Max / D	0.003	
Axial Deviation Meets Spec							Perpendicularity Meets Spec		

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	120.9	Compressive Strength, MPa	38	Unit Weight, g/cm³	2.411
Tested By	MVG	Date Jan.25.2013	Remarks		

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	40.3' - 40.9'	**Area (mm²)**	3142	**L (mm)**	94.00	**D (mm)**	63.25

Axial Tolerance	Axial Min	Axial Max	End Surface Flatness D_1	D_2	D_3	D_4	Perpendicularity Tolerance	
L_1	0.000	0.009	0.000	0.000	0.000	0.000	D_1 Δ	0.005
L_2	0.000	0.007	0.005	0.007	0.004	0.005	D_2 Δ	0.007
L_3	0.000	0.009					D_3 Δ	0.004
							D_4 Δ	0.005

L_1 Δ	0.009		
L_2 Δ	0.007	L/D Ratio	1.5
L_3 Δ	0.009	L/D Out of Spec	
Maximum Axial Deviation (in)		Δ Max	0.007
0.009		Δ Max / D	0.003
Axial Deviation Meets Spec		Perpendicularity Meets Spec	

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	22.4	Compressive Strength, MPa	7	Unit Weight, g/cm³	2.371
Tested By	MVG	Date Jan.25.2013	Remarks	L/D Ratio does not meet specifications	

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	55.4' - 56.2'	**Area (mm²)**	3167	**L (mm)**	101.00	**D (mm)**	63.50

Axial Tolerance	Axial Min	Axial Max	End Surface Flatness D_1	D_2	D_3	D_4	Perpendicularity Tolerance	
L_1	0.000	0.007	0.000	0.000	0.000	0.000	D_1 Δ	0.004
L_2	0.000	0.007	0.004	0.007	0.006	0.007	D_2 Δ	0.007
L_3	0.000	0.008					D_3 Δ	0.006
							D_4 Δ	0.007

L_1 Δ	0.007		
L_2 Δ	0.007	L/D Ratio	1.6
L_3 Δ	0.008	L/D Out of Spec	
Maximum Axial Deviation (in)		Δ Max	0.007
0.008		Δ Max / D	0.003
Axial Deviation Meets Spec		Perpendicularity Meets Spec	

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	36.3	Compressive Strength, MPa	11	Unit Weight, g/cm³	2.398
Tested By	MVG	Date Jan.25.2013	Remarks	L/D Ratio does not meet specifications	

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	48.3' - 49.1'	**Area (mm²)**	3142	**L (mm)**	147.25	**D (mm)**	63.25

Axial Tolerance	Axial Min	Axial Max	End Surface Flatness D_1	D_2	D_3	D_4	Perpendicularity Tolerance	
L_1	0.000	0.006	0.000	0.000	0.000	0.000	D_1 Δ	0.009
L_2	0.000	0.004	0.009	0.007	0.007	0.006	D_2 Δ	0.007
L_3	0.000	0.008					D_3 Δ	0.007
							D_4 Δ	0.006

L_1 Δ	0.006
L_2 Δ	0.004
L_3 Δ	0.008

L/D Ratio	2.3
L/D Meets Spec	

Maximum Axial Deviation (in)	
0.008	
Axial Deviation Meets Spec	

Δ Max	0.009
Δ Max / D	0.004
Perpendicularity Meets Spec	

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	144.4	Compressive Strength, MPa	46	Unit Weight, g/cm³	2.544
Tested By	MVG	Date Jan.25.2013	Remarks		

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	51.8' - 52.9'	**Area (mm²)**	3142	**L (mm)**	138.25	**D (mm)**	63.25

Axial Tolerance	Axial Min	Axial Max	End Surface Flatness D_1	D_2	D_3	D_4	Perpendicularity Tolerance	
L_1	0.000	0.009	0.000	0.000	0.000	0.000	D_1 Δ	0.006
L_2	0.000	0.008	0.006	0.007	0.006	0.008	D_2 Δ	0.007
L_3	0.000	0.009					D_3 Δ	0.006
							D_4 Δ	0.008

L_1 Δ	0.009
L_2 Δ	0.008
L_3 Δ	0.009

L/D Ratio	2.2
L/D Meets Spec	

Maximum Axial Deviation (in)	
0.009	
Axial Deviation Meets Spec	

Δ Max	0.008
Δ Max / D	0.003
Perpendicularity Meets Spec	

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	82.7	Compressive Strength, MPa	26	Unit Weight, g/cm³	2.490
Tested By	MVG	Date Jan.25.2013	Remarks		

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	58.6' - 59.6'	**Area (mm²)**	3142	**L (mm)**	132.50	**D (mm)**	63.25

Axial Tolerance	Axial		End Surface Flatness				Perpendicularity Tolerance		
	Min	Max	D_1	D_2	D_3	D_4			
L_1	0.000	0.008	0.000	0.000	0.000	0.000	D_1 Δ	0.005	
L_2	0.000	0.009	0.005	0.007	0.006	0.008	D_2 Δ	0.007	
L_3	0.000	0.007					D_3 Δ	0.006	
							D_4 Δ	0.008	

L_1 Δ	0.008		
L_2 Δ	0.009	L/D Ratio	2.1
L_3 Δ	0.007	L/D Meets Spec	
Maximum Axial Deviation (in)		Δ Max	0.008
0.009		Δ Max / D	0.003
		Perpendicularity Meets Spec	
Axial Deviation Meets Spec			

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	63.7	Compressive Strength, MPa	20	Unit Weight, g/cm³	2.397
Tested By	MVG	Date Jan.25.2013	Remarks		

Stantec Ltd.

ROCK CORE DIMENSIONAL and SHAPE TOLERANCES ASTM D 4543

Project Name	Sturgeon Creek Bridge			Project Location	Winnipeg			Project Number	121615644
Testhole	1	**Depth**	65.8' - 66.5'	**Area (mm²)**	3142	**L (mm)**	133.00	**D (mm)**	63.25

Axial Tolerance	Axial		End Surface Flatness				Perpendicularity Tolerance		
	Min	Max	D_1	D_2	D_3	D_4			
L_1	0.000	0.006	0.000	0.000	0.000	0.000	D_1 Δ	0.007	
L_2	0.000	0.007	0.007	0.008	0.006	0.006	D_2 Δ	0.008	
L_3	0.000	0.007					D_3 Δ	0.006	
							D_4 Δ	0.006	

L_1 Δ	0.006		
L_2 Δ	0.007	L/D Ratio	2.1
L_3 Δ	0.007	L/D Meets Spec	
Maximum Axial Deviation (in)		Δ Max	0.008
0.007		Δ Max / D	0.003
		Perpendicularity Meets Spec	
Axial Deviation Meets Spec			

COMPRESSIVE STRENGTH of INTACT ROCK CORE ASTM D 7012

Load, kN	53.2	Compressive Strength, MPa	17	Unit Weight, g/cm³	2.374
Tested By	MVG	Date Jan.25.2013	Remarks		

STANTEC CONSULTING LTD.

Stantec

POINT LOAD STRENGTH INDEX

Project Name	Sturgeon Creek Bridge	Project Location	Winnipeg	Project No.	121615644

* Indicate Type of Test Using D for Diametral, A for Axial and B for Block Sample
Entry of Length is required for Type A and B only.

Testhole	Depth Interval		Type of	Diam.	Length	Load	Pt. Load	IS(50)	Inferred	Remarks
	From	To	Test	D (mm)	L (mm)	P (kN)	Is (MPa)	(MPa)	QU (MPa)	
1	61.0'	61.1'	A	63.4	32.1	4.3	1.66	1.67	38	Tested perp. To bedding
1	61.1'	61.2'	A	63.3	44.9	5.1	1.41	1.53	38	Tested perp. To bedding
1	70.4'	70.5'	A	63.3	31.6	2.3	0.90	0.91	21	Tested perp. To bedding
1	70.5'	70.6'	A	63.3	44.6	2.0	0.56	0.60	15	Tested perp. To bedding
1	70.6'	70.7'	A	63.3	39.7	2.1	0.66	0.69	17	Tested perp. To bedding

Tested By	M. Glawson	Date	Jan. 25, 2013	Checked By		Date	

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APPENDIX C

TESTHOLE LOG

TESTHOLE TH10

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Sturgeon Creek Bridge Replacement
Project Location: Sturgeon Creek Bridge
Client: Stantec
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger / 65 mm HQ Coring Bit

Date Drilled: January 17, 2013
Depth of Testhole: 22.9 m
Logged by: German Leal
Reviewed by: Don Flatt
Testhole Elevation: 234.22 m

Depth (m)	Elevation (m)	Symbol	Description	Sample Length (mm)	Recovery Length (mm)	RQD (%)	◆ Uniaxial Compressive Strength (MPa) 20 40 60 80
	234.02		**Concrete Bridge Deck**				
1.0							
	232.42		**Clay Fill** - black, soft, moist, high plasticity				
2.0							
	231.47		**Clay** - brown, moist, high plasticity				
3.0							
4.0							
5.0							

TESTHOLE TH10

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Project Name: Sturgeon Creek Bridge Replacement
Project Location: Sturgeon Creek Bridge
Client: Stantec
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger / 65 mm HQ Coring Bit

Date Drilled: January 17, 2013
Depth of Testhole: 22.9 m
Logged by: German Leal
Reviewed by: Don Flatt
Testhole Elevation: 234.22 m

Depth (m)	Elevation (m)	Symbol	Description	Sample Length (mm)	Recovery Length (mm)	RQD (%)	◆ Uniaxial Compressive Strength (MPa) 20 40 60 80
			Clay - brown, moist, high plasticity *(continued)*				
6.0	228.22		**Silt Till** - red, soft, moist, saturated, low plasticity				
7.0							
8.0							
9.0							
10.0							

TESTHOLE TH10

THE NATIONAL TESTING LABORATORIES LIMITED
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Project Name: Sturgeon Creek Bridge Replacement
Project Location: Sturgeon Creek Bridge
Client: Stantec
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger / 65 mm HQ Coring Bit

Date Drilled: January 17, 2013
Depth of Testhole: 22.9 m
Logged by: German Leal
Reviewed by: Don Flatt
Testhole Elevation: 234.22 m

Depth (m)	Elevation (m)	Description	Sample Length (mm)	Recovery Length (mm)	RQD (%)	Uniaxial Compressive Strength (MPa)
		Silt Till - red, soft, moist, saturated, low plasticity *(continued)*				
	223.52					
11.0		**Penitentiary Member** -Calcareous bioturbated mudstone; buff with reddish purple mottling; lenses of reddish purple bioturbated mudstone; bioturbation mottling 30-60%, diameter 3-5mm; low porosity, mostly interparticle with some vuggy (up to 5mm) infilled with free growth calcite; trace bioclastic material.	1524	1524	80.0	19
	222.34					
12.0		**Gunn Member** -Calcareous bioturbated mudstone with argillaceous partings; reddish purple with greyish-buff intervals (2-3cm thick) and reddish partings; bioturbation mottling 60-100%, diameter 1-2mm; low porosity, mostly interparticle with some vuggy (up to 5mm) infilled with free growth calcite (esp. 42.5-44'); trace bioclastic material. Gradational contact with overlying Penitentiary Member over 1m.				7
13.0			1524	1524	90.0	38
	220.81	**Gunn Member** -Calcareous bioturbated mudstone with argillaceous partings; reddish purple with greyish-buff partings; bioturbation mottling 60-100%, diameter 1-2mm; low porosity, mostly interparticle; trace bioclastic material.				
14.0						
	219.98	**Gunn Member** -Calcareous bioturbated mudstone with argillaceous partings with lenses of packstone; reddish purple with greyish-buff partings; bioturbation mottling 30-50%, diameter 1-2mm; low porosity, mostly interparticle; abundant lenses of packstone 1-10cm thick, comprised of abraded brachiopods, solitary rugose corals, echinoderm fragments.	1524	1524	89.0	46
15.0						

TESTHOLE TH10

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Sturgeon Creek Bridge Replacement
Project Location: Sturgeon Creek Bridge
Client: Stantec
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger / 65 mm HQ Coring Bit

Date Drilled: January 17, 2013
Depth of Testhole: 22.9 m
Logged by: German Leal
Reviewed by: Don Flatt
Testhole Elevation: 234.22 m

Depth (m)	Elevation (m)	Description	Sample Length (mm)	Recovery Length (mm)	RQD (%)	◆ Uniaxial Compressive Strength (MPa) 20 40 60 80
		Gunn Member -Calcareous bioturbated mudstone with argillaceous partings with lenses of packstone; reddish purple with greyish-buff partings; bioturbation mottling 30-50%, diameter 1-2mm; low porosity, mostly interparticle; abundant lenses of packstone 1-10cm thick, comprised of abraded brachiopods, solitary rugose corals, echinoderm fragments. *(continued)*	1524	1524	89.0	
			1524	1524	77.0	◆ 26
16.0	218.07	**Gunn Member** -Calcareous argillaceous mudstone with shaley partings and lenses of packstone; reddish purple with greyish-green partings; remnant bioturbation mottling; increasing shale content; low porosity, mostly interparticle; lenses of packstone 1-5cm thick, comprised of abraded brachiopods, solitary rugose corals, echinoderm fragments.				◆ 11
17.0	216.85	**Gunn Member** -Calcareous laminated mudstone with lenses of packstone; greyish-green with reddish purple partings; thinly laminated with argillaceous material; dense with very low porosity, mostly interparticle; lenses of packstone at top and bottom 10cm thick, comprised of slightly abraded brachiopods, solitary rugose corals, echinoderm fragments.	1524	1524	86.0	
	216.50	**Gunn Member** -Calcareous argillaceous mudstone with shaley partings and lenses of packstone; reddish purple with greyish-green partings; increasing shale content; moderate porosity, mostly interparticle and interstitial; several lenses of packstone 1-10cm thick, comprised of brachiopods, solitary rugose corals, echinoderm fragments.				◆ 20
18.0						◆ 38
19.0	215.17	**Gunn Member** -Calcareous mudstone with lenses of packstone; greyish-green with reddish purple partings; remnant bioturbation, diameter 1-2mm; low porosity, mostly interparticle; lenses of packstone 2-4cm thick, comprised of brachiopods, solitary rugose corals, echinoderm fragments.	1524	1524	73.0	
	214.79	**Gunn Member** -Calcareous laminated mudstone; greyish-green with reddish purple partings; thinly laminated with argillaceous material; dense but moderate porosity, mostly interparticle and interstitial; trace bioclastic material.				
	214.53					
	214.41	**Gunn Member**	1524	1524	62.0	
20.0						◆ 17

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Depth (m)	Elevation (m)	Symbol	Description	Sample Length (mm)	Recovery Length (mm)	RQD (%)	◆ Uniaxial Compressive Strength (MPa) 20 40 60 80
	213.96		-Calcareous packstone with argillaceous partings; greyish-green to reddish purple; thinly laminated argillaceous material interspersed with the fossil lense material; increased porosity, mostly interparticle and interstitial; fossil content comprised of complete brachiopods, solitary rugose corals, echinoderm fragments.				◆ 17
			Gunn Member -Calcareous argillaceous mudstone; greyish-purple with reddish and greenish partings; fissile texture; thinly laminated with argillaceous material; moderate porosity, mostly interparticle; high clay content, decreased carbonate content; trace bioclastic material. *(continued)*	1524	1524	62.0	
21.0			**Gunn Member** -Calcareous mudstone with argillaceous partings and lenses of packstone; greyish purple; fissile texture; moderate porosity, mostly interparticle; decreased carbonate content and increased clay content; thinner lenses of packstone 8-10 cm thick, comprised of brachiopods, solitary rugose corals, echinoderm fragments.				
	212.84		**Gunn Member** -Calcareous argillaceous mudstone; greyish-purple with reddish and greenish partings; fissile texture; thinly laminated with argillaceous material; moderate porosity, mostly interparticle; high clay content, decreased carbonate content; trace bioclastic material				◆ 21 ◆ 17
22.0				1524	1524	92.0	
	211.35						
23.0			• No groundwater seepage observed due to added water for coring process. • Soil sloughing observed in the silt till at a depth of 9.1 m. • Auger refusal at a depth of 10.4 m in dense till. • HQ coring conducted below a depth of 10.7 m. • Testhole backfilled with 226 kg of bentonite chips.				
24.0							
25.0							

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APPENDIX D

BEDROCK CORE PHOTOGRAPHS

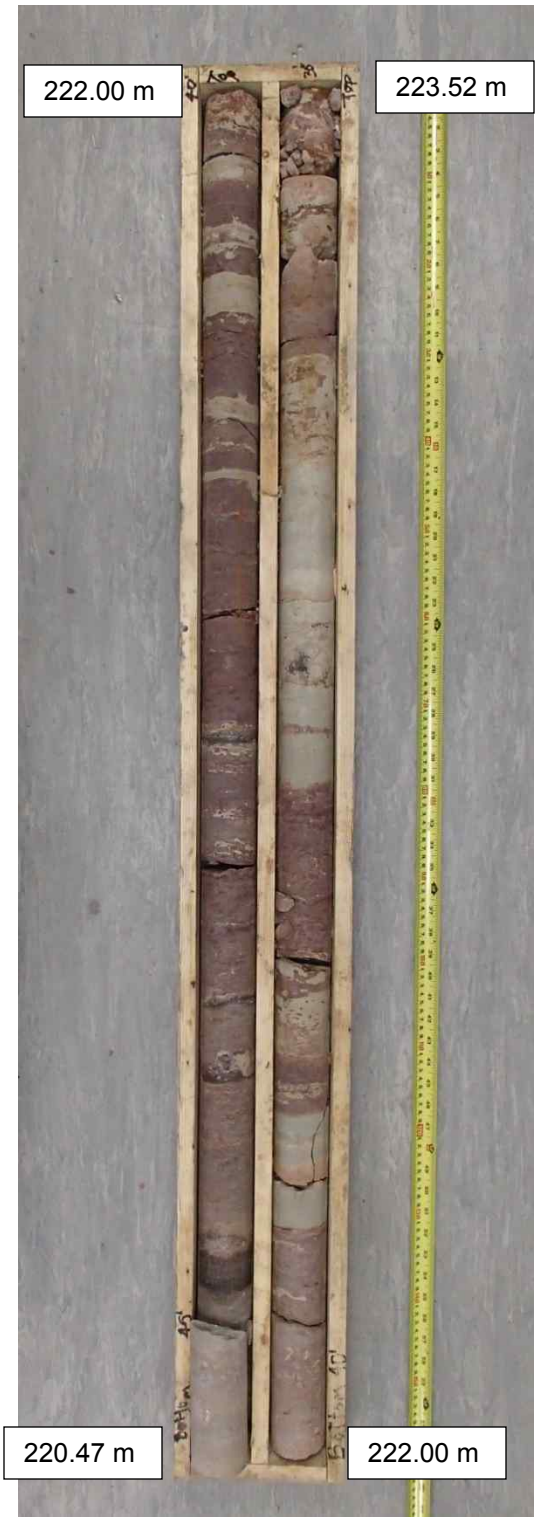

Photo 1 – TH1 from 10.67 m to 13.72 m (Elev. 223.52 to 220.47 m)

Photo 2 – TH1 from 13.72 m to 16.77 m (Elev. 220.47 to 217.42 m)

Photo 3 – TH1 from 16.77 m to 19.82 m (Elev. 217.42 to 214.37 m)

Photo 4 – TH1 from 19.82 m to 22.87 m (Elev. 214.37 to 211.32 m)