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Stantec Consulting
Bedrock Investigation and Test Caisson
Kenaston Underpass Project
Winnipeg, Manitoba

Prepared by:
UMA Engineering Ltd.
1479 Buffalo Place
Winnipeg, MB. R3T 1L7

11 October 2005

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1.0 Introduction

As authorized by Stantec Consulting, acting on behalf of their client, The City of Winnipeg, UMA Engineering Limited (UMA) completed geotechnical investigations for the Kenaston Underpass Project in Winnipeg, Manitoba. Two investigations were completed at the site by UMA. The first investigation focused on the overburden soil conditions, but also included one core hole into bedrock. Based on that information, a generalized geotechnical investigation report dated March 2005 was issued. Stantec had concluded from both a technical and economical perspective, that an additional investigation was justified in order to identify bedrock conditions for the design and construction of rock socketed foundations for the rail bridge. As a result, a further bedrock investigation, consisting of bedrock coring and a test caisson program was conducted to supplement the existing information.

The purpose of the geotechnical investigations was to determine the soil, bedrock and groundwater conditions at the bridge location, and on that basis, provide geotechnical recommendations for the design and construction of rock socketed caissons for the rail bridge.

Recommendations for the design and construction of rock socketed caissons for the rail bridge have been provided under separate cover. The purpose of this study is to provide the result of the core hole drilling and test caisson for tendering information purposes.

2.0 Bedrock Drilling and Test Caisson

The initial investigation conducted in December of 2004 included one test hole (TH-04-42) which included rock coring into the underlying bedrock. Between 11 and 25 August 2005, at total of four test holes (63 mm diameter) were advanced into bedrock by rock coring at selected locations near the proposed rail bridge (TH-05-01 to TH-05-04). The placement of the test holes was largely restricted as a result of the existing roadways, railways and services. All test hole drilling was completed by Paddock Drilling Ltd. of Brandon, Manitoba under the supervision of a representative of UMA.

In addition to the test holes, one 710 mm diameter test caisson was advanced adjacent to TH-05-02. The test caisson was completed by Subterranean (Manitoba) Ltd. under the supervision of a representative of UMA.

Test Hole TH-04-42 was advanced north of Wilkes and west of Kenaston. Bedrock was confirmed at a depth of about 20 m from grade and the core hole was advanced to a depth of about 37 m where drilling was terminated.

Test Hole TH-05-01 was completed north of the CN Tracks and west of Kenaston. Bedrock was confirmed at a depth of about 18.8 m from grade and the core hole was advanced to a depth of about 30.5 m where drilling was terminated.

Test Hole TH-05-02 was advanced south of the CN Tracks and west of Kenaston. Bedrock was confirmed at a depth of about 20 m from grade and the core hole was advanced to a depth of about 35 m where drilling was terminated in the limestone bedrock.

The test caisson was advanced immediately adjacent to TH-05-02. Consistent with TH-05-02, the bedrock contact was identified at a depth of about 20.1 m. The test caisson was advanced to a depth of about 30.5 m where drilling was terminated. Two pump test were completed at depths of about 23 and 30.5 m.

Test Hole TH-05-03 was completed north of the CN Tracks on the median of Kenaston Boulevard. Bedrock was identified at a depth of about 19.7 m from grade and the core hole was advanced to a depth of about 35 m where drilling was terminated.

Test Hole TH-05-04was advanced south of the CN Tracks and east of Kenaston. Bedrock was confirmed at a depth of about 19.5 m from grade and the core hole was advanced to a depth of about 30.5 m where drilling was terminated in the limestone bedrock.

All bedrock observed during drilling of the core holes and test caissons was visually classified on site by UMA's site representative. Continuous rock core samples were collected at the core holes. The rock cores collected were retained in wooden core boxes and transported to UMA's Winnipeg laboratory for detailed examination and testing.

3.0 Laboratory Assessments and Testing

The soil and rock core samples transported to the laboratory were visually examined by UMA's Project Engineer in order to supplement and confirm the field classifications. The Recovery and Rock Quality Designation (RQD) was determined for each core run and has been reported on the test hole logs. Uniaxial compressive strength testing was completed on several samples of the bedrock cores collected. The results of the uniaxial compressive strength testing have been included on the test hole logs opposite the appropriate sample depths.

4.0 Subsurface Conditions

4.1 Bedrock Conditions

Carbonate (limestone) bedrock was identified at depths that varied between about 19 and 20 m below ground surface. The conditions of the bedrock at this location are not in some characteristics typical of the Winnipeg area. The bedrock has been observed to consist of an upper rock mass which is comprised of a weathered limestone and a lower rock mass which is comprised of a strong massive limestone. The two layers of bedrock are separated by a 300 to 900 mm thick infilling of clayey silt.

The upper rock mass is generally weathered, mottled yellow and grey, weak to medium strong with small pits and vugs. The upper 300 to 900 mm of the bedrock is generally highly fractured and disturbed. Core recovery in the upper rock mass was generally greater than 90%. The average RQD in the upper rock mass was about 55% and the uniaxial compressive strength ranged between about 38 and 100 MPa.

At a depth of about 25 to 27 m, a 300 to 900 mm thick infilling of clayey silt was identified at all of the test hole locations. While bedding planes infilled with silt and clay are common within the limestone bedrock in the Winnipeg area, it is uncommon to find this thickness of infilling as a stratigraphic unit between bedrock zones .

The lower rock mass generally consists of a massive intact white limestone that is strong to very strong. Core recovery in the lower rock mass was generally greater than 90%, with the exception of some cores that extended below about 30 m. The average RQD in the lower rock mass was about 70% and the uniaxial compressive strength ranged between about 45 and 180 MPa.

4.2 Test Caisson

The test caisson was advanced using a 710 mm core barrel. Core recovery during the test caisson was excellent and no chopping of the bedrock was required to advance the caisson. As a result of the large size of the core barrel and the low speed of coring, the recovered rock cores were generally intact and appeared much better than the cores obtained from the small diameter core holes.

The caisson was visually examined between a depth of about 20.6 and 22.9 m from grade. Between this depth, the bedrock was observed to be weathered, pitted and vuggy. The limestone was weak to medium strong and while fractures were present, they were very tight.

Bedding planes about 150 mm thick and infilled with silt were identified within the test caisson at depths of about 25 and 30 m.

4.3 Groundwater

Pumping rates were measured during the test caisson advancement at two depths. At a depth of about 23 m, seepage was only observed from behind the sleeve and the inflow of groundwater was about 0.4 l/s (7 gpm). At a depth of about 30.5 m the inflow of groundwater was about 3.1 l/s (50 gpm).

5.0 Closure

The findings of this study were based on the results of field and laboratory investigations, combined with an interpolation of soil, bedrock and groundwater conditions between core hole locations and the test caisson. The information provided within this study is provided for bidding purposes only. The contactor should form their own opinion of the site conditions based on the information provided within. It should be appreciated that conditions can be expected to vary across the site.

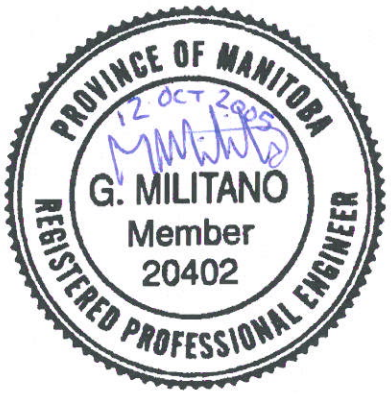
Respectfully Submitted,

UMA Engineering Ltd.

Giovanni Militano, M.Sc., P. Eng.
Geotechnical Engineer

Reviewed by:

W.R. (Bill) Wiesner, M.Sc., P. Eng.
Senior Geotechnical Engineer



APEGM
Certificate of Authorization
UMA Engineering Ltd.
No. 256 Expiry: April 30, 2006

Appendix A

Test Hole Information

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **Test Caisson**
LOCATION: South of CN, West of Kenaston. Adjacent to TH05-02		PROJECT NO.: 4231-040-09
CONTRACTOR: Subterranean	METHOD: SoilMec R312-HD - 710 mm Socket	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▬ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0		GRAVEL (FILL) - 300 mm				0
		CLAY (FILL)				
1						1
2		CLAY with occasional wet SILT layers			Very slight seepage from wet silt layers.	2
3		CLAY - brown to grey with depth - moist, stiff to firm with depth - high plastic				3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12		SILT (TILL) - light grey, loose, wet - trace sand, trace gravel, trace clay - low plastic - damp, medium dense below 12.5 m			Slight seepage from wet till at 11.6 m	12
13						

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

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LOGGED BY: Giovanni Militano	COMPLETION DEPTH: 30.48 m
REVIEWED BY:	COMPLETION DATE: 27/9/05
PROJECT ENGINEER: Giovanni Militano	Page 1 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **Test Caisson**
LOCATION: South of CN, West of Kenaston. Adjacent to TH05-02		PROJECT NO.: 4231-040-09
CONTRACTOR: Subterranean	METHOD: SoilMec R312-HD - 710 mm Socket	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
13		- small boulder / cobble at 13.1 m - dense below 13.1 m				
14		- boulder at 14.3 m			Chopped boulder at 14.3m.	14
15		- boulder at 14.9 m - very dense below 15.2 m			Chopped boulder at 14.9m. Very hard drilling and sleeve advancement through till below 15.2 m.	15
16		- boulder at 15.7 m - granite boulder at 16.1 m			Chopped boulder at 15.7m. Chopped boulder at 16.1m.	16
17					Drill: 0 to 20.1 m - 6h	17
18						18
19		- wet below 18.6 m			Slight to moderate seepage from wet silt till below 18.6 m.	19
20		LIMESTONE BEDROCK - weathered - mottled yellow and grey - weak to medium strong - pitted and vuggy - very tight fractures - intact below 20.3 m			Slight to moderate seepage at bedrock interface. Drill: 20.1 to 21.3 m - 1h Sleeve bottom at 20.6 m	20
21					Drill: 21.3 to 22.9 m - 1h	21
22		down hole visual evaluation between 20.6 and 22.9 m - weathered, pitted and vuggy - weak to medium strong rock - intact, very tight fractures				22
23		- broken bedrock, frequent vertical and horizontal fractures below 22.9 m			Pump Test: 7 GPM. Water inflow from behind sleeve only. ~75% recovery between 22.9 and 24 m	23
24		- intact, red below 24 m				24
25		SILT (150 mm) - low plastic, light grey, moist to wet, medium dense - intact, mottled light yellow and white below 25 m				25
26						

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

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LOGGED BY: Giovanni Militano	COMPLETION DEPTH: 30.48 m
REVIEWED BY:	COMPLETION DATE: 27/9/05
PROJECT ENGINEER: Giovanni Militano	Page 2 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **Test Caisson**
LOCATION: South of CN, West of Kenaston. Adjacent to TH05-02		PROJECT NO.: 4231-040-09
CONTRACTOR: Subterranean	METHOD: SoilMec R312-HD - 710 mm Socket	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
26		- intact, red below 26 m			Drill: 22.9 to 26.2 m - 2h	
		CLAYEY SILT (600 mm) - low to medium plastic, moist, light grey, medium dense				
27		- massive, intact, white, strong below 26.8 m				27
28		- very strong below 28 m			Drill: 28 to 29.3 m - 2h	28
		- vertical fracture with light oxidation stains between 28 and 29.3 m				
29					Drill: 29.3 to 30.5 m - 1.5h	29
30		SILT (150 mm) - low plastic, light grey, moist to wet, medium dense				30
		- massive, intact, white, very strong below 30.2 m				
		Test caisson terminated at 30.5 m.			Pump Test: 50 GPM	
31		Concrete to 7.5 m, clay cuttings to surface.				31
32						32
33						33
34						34
35						35
36						36
37						37
38						38
39						

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LOGGED BY: Giovanni Militano	COMPLETION DEPTH: 30.48 m
REVIEWED BY:	COMPLETION DATE: 27/9/05
PROJECT ENGINEER: Giovanni Militano	Page 3 of 3

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-01**
LOCATION: North of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0			CLAY (FILL) - silty - grey brown - moist, stiff, medium plasticity - trace organics to 0.6 m				0
1							1
2			CLAY - silty - brown to grey with depth - moist, stiff to firm with depth, high plasticity				2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12			SILT (TILL) - trace sand, trace clay, trace gravel - light greyish brown - moist, compact to dense with depth - low plastic				12
13							

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

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LOGGED BY: Kate Franklin	COMPLETION DEPTH: 30.48 m
REVIEWED BY: GM	COMPLETION DATE: 24/8/05
PROJECT ENGINEER: Giovanni Militano	Page 1 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-01**
LOCATION: North of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
13	- light grey, very dense below 12.2 m				13
14	- granite boulder 320 mm diameter at 13.7 m - occasional cobbles below 14.0 m				14
15					15
16					16
17					17
18	- red brown below 18.2 m				18
19	LIMESTONE (BEDROCK) - weathered - mottled yellow and grey, with white inclusions - weak to medium strong - pitted and vuggy - close to moderately close discontinuities - evidence of water flow in apertures - filling damp, no free water present		C19	Recovery: 100% RQD: 54% (fair)	19
20			C20	Recovery: 95% RQD: 66% (fair)	20
21					21
22			C21	Recovery: 95% RQD: 48% (poor)	22
23					23
24			C22	Recovery: 95% RQD: 57% (fair)	24
25	CLAYEY SILT (400 mm) Below 25.3 m: - massive - white		C23	Recovery: 100% RQD: 62% (fair) Qu = 139.2 MPa	25
26					

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LOGGED BY: Kate Franklin | COMPLETION DEPTH: 30.48 m

REVIEWED BY: GM | COMPLETION DATE: 24/8/05

PROJECT ENGINEER: Giovanni Militano

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-01**
LOCATION: North of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
26			- strong - moderately close discontinuities - no evidence of water flow in apertures - no filling present		C24	Recovery: 100% RQD: 89% (good) Qu = 180.2 MPa	27
28					C25	Recovery: 100% RQD: 74% (fair) Qu = 100.6 MPa	28
29							29
30					C26	Recovery: 60% RQD: 54% (fair)	30
31			END OF TEST HOLE AT 30.5 M IN LIMESTONE BEDROCK. Notes: 1. Solid stem power auger to 12.2 m. 2. HQ coring between 12.2 m and 30.5 m. 3. Standpipe installed at 30.5 m.				31
32							32
33							33
34							34
35							35
36							36
37							37
38							38
39							

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

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LOGGED BY: Kate Franklin	COMPLETION DEPTH: 30.48 m
REVIEWED BY: GM	COMPLETION DATE: 24/8/05
PROJECT ENGINEER: Giovanni Militano	Page 3 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-02**
LOCATION: South of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0		GRAVEL - trace sand, black and grey, damp, angular				
		CLAY (FILL) - silty - grey brown - moist, stiff, medium plasticity				
1						1
2		CLAY - silty - brown to grey with depth - moist, stiff to firm with depth, high plasticity				2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13		SILT (TILL)				

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE GPJ UMA.GDT 11/10/05

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LOGGED BY: Kate Franklin	COMPLETION DEPTH: 35.05 m
REVIEWED BY: GM	COMPLETION DATE: 23/8/05
PROJECT ENGINEER: Giovanni Militano	Page 1 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-02**
LOCATION: South of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
13		- trace sand, trace clay, trace gravel - light grey - moist, compact to dense with depth - low plastic - occasional cobbles, light brown grey, very dense below 13.7 m				
14						14
15						15
16						16
17						17
18						18
19						19
20		LIMESTONE (BEDROCK) - weathered - mottled yellow and grey - weak to medium strong - heavily pitted and vuggy - close discontinuities - evidence of water flow in apertures - filling is dry and has low permeability - some hematite alteration		C9	Recovery: 100% RQD: 61% (fair)	20
21						21
22				C10	Recovery: 100% RQD: 33% (poor)	22
23						23
24				C11	Recovery: 100% RQD: 18% (very poor)	24
25						25
26				C12	Recovery: 100% RQD: 80% (good)	

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE GPJ UMA.GDT 11/10/05

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LOGGED BY: Kate Franklin	COMPLETION DEPTH: 35.05 m
REVIEWED BY: GM	COMPLETION DATE: 23/8/05
PROJECT ENGINEER: Giovanni Militano	Page 2 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-02**
LOCATION: South of CN Tracks, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▬ BULK ⊘ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
26		CLAYEY SILT (600 mm)				
		Below 26.5 m: - massive - white - strong - moderately close discontinuities - no evidence of water flow in apertures - filling is dry and has low permeability		C13	Recovery: 89% RQD: 56% (fair)	
27						27
28				C14	Recovery: 100% RQD: 91% (excellent) Qu = 157.1 MPa	28
29						29
30				C15	Recovery: 100% RQD: 45% (poor) Qu = 121.4 MPa	30
31				C16	Recovery: 100% RQD: 83% (good) Qu = 86.1 MPa	31
32						32
33				C17	Recovery: 95% RQD: 66% (fair) Qu = 110.9 MPa	33
34				C18	Recovery: 50% RQD: 47% (poor)	34
35		END OF TEST HOLE AT 35 m IN LIMESTONE BEDROCK. Notes: 1. Solid stem power auger to 13.7 m. 2. HQ coring between 13.7 m and 35 m. 3. Test hole not backfilled.				35
36						36
37						37
38						38
39						

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE GPJ UMA GDT 11/10/05

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LOGGED BY: Kate Franklin	COMPLETION DEPTH: 35.05 m
REVIEWED BY: GM	COMPLETION DATE: 23/8/05
PROJECT ENGINEER: Giovanni Militano	Page 3 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-03**
LOCATION: North of CN Tracks, Median (Center) of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0		CLAY (FILL) - silty - trace gravel to 1.0 m - grey brown - moist, stiff, medium plasticity				0
3		CLAY - silty - brown to grey with depth - moist, stiff to firm with depth, high plasticity				3
13						13

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LOGGED BY: Kate Franklin
REVIEWED BY: GM
PROJECT ENGINEER: Giovanni Militano

COMPLETION DEPTH: 35.05 m
COMPLETION DATE: 25/8/05

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-03**
LOCATION: North of CN Tracks, Median (Center) of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
13						
14		SILT (TILL) - trace sand, trace clay, trace gravel - light grey brown - moist, compact to dense with depth - low plastic - trace cobbles, light brown grey, very dense below 13.7 m				14
15						15
16						16
17						17
18		- red brown below 18.3 m				18
19						19
20		LIMESTONE (BEDROCK) - weathered - mottled yellow and grey with white inclusions - weak to medium strong - pitted and vuggy - close to moderately close discontinuities - evidence of water flow in apertures - filling is damp, no free water present		C27	Recovery: 92% RQD: 92% (excellent)	20
21				C28	Recovery: 100% RQD: 89% (good)	21
22				C29	Recovery: 100% RQD: 62% (fair)	22
23						23
24				C30	Recovery: 90% RQD: 28% (poor)	24
25				C31	Recovery: 100% RQD: 63% (fair)	25
26						

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 35.05 m
REVIEWED BY: GM	COMPLETION DATE: 25/8/05
PROJECT ENGINEER: Giovanni Militano	Page 2 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-03**
LOCATION: North of CN Tracks, Median (Center) of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
26		CLAYEY SILT (900 mm)				
27		Below 27 m: - massive - white - strong - moderately close to wide discontinuities - no evidence of water flow in apertures - no filling		C32	Recovery: 90% RQD: 21% (very poor)	27
28				C33	Recovery: 95% RQD: 56% (fair) Qu = 123.6 MPa	28
29						29
30				C34	Recovery: 100% RQD: 52% (fair) Qu = 147.1 MPa	30
31				C35	Recovery: 100% RQD: 80% (good) Qu = 104 MPa	31
32						32
33				C36	Recovery: 100% RQD: 79% (good) Qu = 45.6 MPa	33
34				C37	Recovery: 100% RQD: 90% (excellent) Qu = 116.4 MPa	34
35		END OF TEST HOLE AT 35 m IN LIMESTONE BEDROCK. Notes: 1. Solid stem power auger to 13.7 m. 2. HQ coring between 13.7 m and 35 m. 3. Test hole backfilled with grout.				35
36						36
37						37
38						38
39						

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 35.05 m
REVIEWED BY: GM	COMPLETION DATE: 25/8/05
PROJECT ENGINEER: Giovanni Militano	Page 3 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-04**
LOCATION: South of CN Tracks, East of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0			GRAVEL - some sand, trace silt, trace clay - brown - moist, compact, angular				0
1							1
			CLAY (FILL) - silty - grey brown, moist, stiff, medium plasticity, trace organics to 0.6 m				
2			CLAY - silty - brown to grey with depth - moist, stiff to firm with depth, high plasticity				2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12							12
13							

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 30.48 m
REVIEWED BY: GM	COMPLETION DATE: 11/8/05
PROJECT ENGINEER: Giovanni Militano	Page 1 of 3

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting	TESTHOLE NO: **TH-05-04**
LOCATION: South of CN Tracks, East of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
13				
14	SILT (TILL) - trace sand, trace clay, trace gravel - light grey - moist, compact to dense with depth - low plastic - limestone boulder 300 mm diameter at 13.7 m - very dense below below 14.0 m			
15	- occasional cobbles below 15.2 m			
16				
17				
18				
19				
20	LIMESTONE (BEDROCK) - weathered - mottled yellow, grey, and white - weak to medium strong - highly pitted and vuggy - weakness on sponges/corals calcerous chalky nodes - close to moderately close discontinuities - evidence of water flow, solution cavities in apertures - dry, low permeability filling		C1	Recovery: 70% RQD: 0% (very poor)
21			C2	Recovery: 100% RQD: 68% (fair) Qu = 99.7 MPa
22			C3	Recovery: 100% RQD: 64% (fair)
23				
24			C4	Recovery: 100% RQD: 70% (fair) Qu = 37.9 MPa
25	Below 24.4 m: - mottled grey and yellow, less distinct mottling - medium to strong, moderately close discontinuities - evidence of water flow in apertures , dry, low permeability filling		C5	Recovery: 100% RQD: 79% (good)
26				

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 30.48 m
REVIEWED BY: GM	COMPLETION DATE: 11/8/05
PROJECT ENGINEER: Giovanni Militano	Page 2 of 3

PROJECT: Kenaston Underpass - CN Bridge	CLIENT: Stantec Consulting		TESTHOLE NO: **TH-05-04**
LOCATION: South of CN Tracks, East of Kenaston			PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling	METHOD: Nodwell - HQ (63 mm) Coring		ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
26			CLAYEY SILT (350 mm)				
			Below 26.3 m:				
			- massive				
			- white				
27			- strong		C6	Recovery: 54% RQD: 18% (very poor)	27
			- moderately close discontinuities				
			- water flow not possible in apertures				
28			- dry, low permeability filling		C7	Recovery: 100% RQD: 57% (fair) Qu = 102.0 MPa	28
29					C8	Recovery: 100% RQD: 48% (poor)	29
30							30
			END OF TEST HOLE AT 30.5 M IN LIMESTONE BEDROCK.				
			Notes:				
31			1. Solid stem power auger to 12.2 m.				31
			2. HQ coring between 12.2 m and 30.5 m.				
32			3. Standpipe installed at 30.5 m.				32
33							33
34							34
35							35
36							36
37							37
38							38
39							

LOG OF TESTHOLE KENASTON UNDERPASS - CN BRIDGE.GPJ UMA.GDT 11/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 30.48 m
REVIEWED BY: GM	COMPLETION DATE: 11/8/05
PROJECT ENGINEER: Giovanni Militano	Page 3 of 3

PROJECT: Kenaston Underpass	CLIENT: Stantec Consulting Ltd.	TESTHOLE NO: **TH-04-42**
LOCATION: North of Wilkes, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Acker - 125 mm Solid Stem Augers	ELEVATION (m): 234.291

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	+ Torvane (Su) + (kPa) 50 100 150 200 / □ Lab Vane (Su) □ (kPa) 50 100 150 200 / △ Pocket Pen. (Su) △ (kPa) 50 100 150 200 / PLASTIC M.C. LIQUID 20 40 60 80	COMMENTS	ELEVATION (m)
0	SAND AND GRAVEL (FILL) - brown, frozen					234
	CLAY (FILL) - silty, trace to some sand - dark grey to black - moist, very stiff, medium plasticity - mottled brown below 0.6 m		G112			
2	- black, trace gravel, trace organics below 1.2 m					232
	CLAY - silty, trace sand - mottled brown and grey - moist, very stiff, medium plasticity - silt layer ~2 mm thick at 3.0 m		G113 T114			
4	below 3.0 m: - no sand - brown - stiff, high plasticity - trace silt inclusions - slightly mottled grey below 3.7 m		G115			230
6	- grey, trace silt inclusions below 6.1 m		G116 T117			228
8			G118 G119			226
9	- trace silt (till) inclusions, trace fine gravel below 9.1 m		T120			225
10			G121			224
11			T122			223
	SILT TILL - trace clay, trace sand - light grey - moist, loose, low plasticity		G123			222
12	below 12.5 m: - no clay, some sand to sandy, trace gravel - light greyish pink - dry, dense, no plasticity - trace cobbles, trace granite boulders below 13.4 m		G124			221
14	- trace limestone boulders below 14.3 m		G125			220
15			G126			219
16			C127			218
17			C128			217
18			C129			216
19						215
20			C130			

LOG OF TESTHOLE KENASTON UNDERPASS.GPJ UMA.GDT 7/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 37.20 m
REVIEWED BY: Jeff Tallin	COMPLETION DATE: 9/12/04
PROJECT ENGINEER: Bill Wiesner	Page 1 of 2

PROJECT: Kenaston Underpass	CLIENT: Stantec Consulting Ltd.	TESTHOLE NO: **TH-04-42**
LOCATION: North of Wilkes, West of Kenaston		PROJECT NO.: 4231-040-09
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Acker - 125 mm Solid Stem Augers	ELEVATION (m): 234.291

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	+ Torvane (Su) + (kPa) 50 100 150 200 / □ Lab Vane (Su) □ (kPa) 50 100 150 200 / △ Pocket Pen. (Su) △ (kPa) 50 100 150 200 / PLASTIC M.C. LIQUID 20 40 60 80	COMMENTS	ELEVATION (m)
20			LIMESTONE - light brownish grey to white - pitted, cemented - signs of acidic dissolving and calcite precipitation - fractured and jointed - slight oxidation between 20.4 m and 23.4 m				Recovery: 90 % RQD: 46%	214
21					C131			213
22			- core in 30 to 300 mm pieces between 22.0 and 23.5 m				Recovery: 90 % RQD: 20%	212
23					C132			211
24			- core largely fractured < 100 mm lengths between 23.5 m and 25.0 m		C133		Recovery: 85 % RQD: 42%	210
25			- mottled light grey and light brown to white below 24.5 m - pale light yellow, no signs of weathering, fresh faces on fractures, no alteration below 25.0 m				Recovery: 87 % RQD: 44%	209
26			- possible solution cavity, infilled with very fine grain silt material, between 25.6 m and 26.2 m		C134		Recovery: 100 % RQD: 86%	208
27					C135			207
28					C136		Recovery: 100 % RQD: 80%	206
29							Recovery: 100 % RQD: 61%	205
30					C137			204
31					C138		Recovery: 100 % RQD: 57%	203
32								202
33					C139			201
34							Recovery: 100 % RQD: 79%	200
35			- coring procedure lost water circulation at approximately 34.7 m		C140			199
36							Recovery: 100 % RQD: 94%	198
37					C141		Recovery: 100 % RQD: 79%	197
38			END OF TEST HOLE AT 37.2 m IN BEDROCK. Notes: - Seepage and Sloughing from silt layer, and clay and silt layer to approximately 6.0 m. - Power auger refusal at 13.4 m. - HQ cored from 13.4 m to 37.2 m. - Standpipe piezometer (SP-04-42) installed at 26.5 m depth.					196
39								195
40								

LOG OF TESTHOLE KENASTON UNDERPASS.GPJ UMA.GDT 7/10/05

UMA | AECOM

LOGGED BY: Kate Franklin	COMPLETION DEPTH: 37.20 m
REVIEWED BY: Jeff Tallin	COMPLETION DATE: 9/12/04
PROJECT ENGINEER: Bill Wiesner	Page 2 of 2