CONTRACT NO. xxxx-xxxx

G.W.P. 3025-14-00

FOUNDATION INVESTIGATION REPORT

HIGHWAY 9, TEESWATER RIVER BRIDGE REHABILITATION

(SITE No. 2-256)

CONTRACT 5B
STRUCTURE REHABILITATION

Ministry Of Transportation

August 2017

DESKTOP FOUNDATION INVESTIGATION REPORT

Teeswater River Bridge Rehabilitation
Site 2-256, Highway 9
Contract 5B Structure Replacements and Rehabilitation
GWP 3025-14-00
Ministry of Transportation, Ontario - West Region

Submitted to:
Mr. Adam Barg, P.Eng., Associate
Stantec Consulting Ltd.
200-835 Paramount Drive
Stoney Creek, Ontario
L8J 0B4

REPORT

Report Number: 1534424-5002C-R01
Geocres No.: 41A-244
Distribution:

8 Copies Stantec Consulting Ltd.
1 E-Copy Golder Associates Ltd.

Golder Associates

Table of Contents

1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Stantec Consulting Ltd. (Stantec) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out a desktop review of the subsurface information available for the Teeswater River bridge on Highway 9 as part of the detail design work for GWP 3025-14-00. The project involves the detailed design of the replacement and rehabilitation of thirty-nine structures along multiple highways in Southwestern Ontario. This report addresses the proposed rehabilitation of the Teeswater River bridge (Site 2-256) on Highway 9 in the Geographic Township of Greenock in Bruce County, Ontario.

The purpose of this report is to provide recommendations based on a site reconnaissance together with the available geotechnical and geological data available from the MTO Geocres Library. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal and in Golder Associates' proposal P1534424 dated September 2, 2015. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated October 26, 2015.

2.0 SITE DESCRIPTION

The subject site is located on Highway 9 approximately 140 metres east of Union Street in the community of Riversdale, in the Geographic Township of Greenock, Bruce County, Ontario. The approximate location of the bridge site is shown on the Key Plan, Figure 1.

This section of Highway 9 is currently a two lane, undivided highway with gravel shoulders. The bridge is oriented approximately east-west. The Teeswater River flows beneath the bridge generally from south to north. Highway 9 has a pavement surface elevation at about 277.5 metres at the bridge site. The existing precast concrete girder structure was constructed in 1969 as a replacement for the original structure. According to MTO's Structure Maintenance and Repair History Report[1], the bridge was rehabilitated in 1975, 1986, 2008 and 2012. The bridge has three spans with a total length of about 43 metres. The area immediately surrounding the site generally consists of flat-lying to gently rolling agricultural and forested lands to the east and the community of Riversdale to the west. Site photographs are provided in Appendix A.

3.0 INVESTIGATION PROCEDURES

The sources of information for this report included a site reconnaissance carried out at the site on February 14, 2017 together with a review of the available information from the MTO Geocres Library and the Ontario Geological Survey (OGS). No additional foundation investigations have been carried out for this assignment.

Geocres Report No. 41A-019 titled "Foundation Investigation Report For Proposed New Structure at Crossing Of Teeswater River and Highway #9, District #5 (Owen Sound), W.J. 67-F-19 – W.P. 101-64", dated April 18, 1967 was reviewed in conjunction with the preparation of this report. The Records of Boreholes and related laboratory test results are attached to this report in Appendix B. The Geocres report presented the results of the laboratory testing on the borehole logs and did not include separate figures illustrating the results.

[1] MTO, undated report: Structure Maintenance/Repair History (MRH Report) for Site Number 2-256, Highway 9 Teeswater River Bridge. This report contains the dates and summary details of rehabilitation works and inspections carried out at this site.

The borehole locations and ground surface elevations at the borehole locations are shown on the original Record of Borehole sheets in Appendix A and on Drawing 1, prepared by Golder. The table below summarizes the coordinates, ground surface elevations and depths of these previous boreholes.

Borehole	Location (m)		Ground Surface / Riverbed Elevation (m)	Depth of Water (m)	Borehole Depth# (m)
	Northing	Easting			
1	4 883 883	397 997	272.49	-	15.45
2*	4 883 870	398 002	273.01	-	4.27
3	4 883 884	398 013	270.45	3.20	10.67
4	4 883 879	398 050	273.50	-	15.24
5	4 883 888	398 031	271.27	1.89	14.84
6*	4 883 876	398 035	271.88	1.28	4.72
7*	4 883 891	398 046	273.01	-	5.15

*These boreholes contain records of dynamic cone penetration testing only.
#For boreholes 3, 5 and 6, the borehole depth includes the water column above the riverbed.

4.0 SITE GEOLOGY

The site lies within the Horseshoe Moraines physiographic region. This region is characterized by irregular, stony knobs and ridges which are composed mostly of till with some sand and gravel deposits as well as sand and gravel terraces and swampy valley floors[2]. The quaternary geology mapping indicates that the surficial soils in the area of the site generally consist of modern alluvium containing silt, sand and gravel.[3] Based on the available topographic bedrock mapping, the underlying bedrock surface is found at about elevation 256 metres[4] corresponding to an overburden thickness of about 14 to 18 metres. The rock formation is mapped and described as limestone, dolostone and shale of the Detroit River Group of the Onondaga Formation of Middle Devonian age[5].

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes previously drilled at the site (Geocres Report No. 41A-019) are shown in detail on the Record of Borehole sheets in Appendix A. The following discussion has been simplified in terms of major soil or rock strata for the purposes of geotechnical design. The soil boundaries discussed in this report and illustrated on the Records of Boreholes have been inferred from non-continuous samples and observations of drilling resistance and represent a transition from one soil or rock type to another. The boundaries should not necessarily be interpreted to represent exact planes of geological change. Further, subsurface conditions should be expected to vary between and beyond the borehole locations. In addition, post-

[2] Chapman, L.J., and Putnam, D.F., 1984: Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2, 270p.

[3] Cowan, W.R., and Pinch, J.J., 1986: Quaternary Geology of the Walkerton-Kincardine Area. Southern Ontario; Ontario Geological Survey, Map P.2956. Geological Series-Preliminary Map, scale 1:50 000. Geology 1975-1979.

[4] Karrow, P.F. 1962, Bedrock Topography Series, Kincardine-Walkerton Sheet. Ontario Department of Mines, Preliminary Map P.165, Scale 1:50 000.

[5] Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

investigation construction activities at the site may have altered the subsurface conditions from those shown on the previous Records of Boreholes.

The soil descriptions on the previous Records of Boreholes have been interpreted to correspond to standard MTO soil descriptions, using the original laboratory data, where available. Although the majority of the descriptions provided on the Record of Boreholes from Geocres No. 41A-019 have been retained, materials described as sandy gravel have been classified as sand and gravel or silty sand and gravel for the purposes of this report. The sandy silt layer at elevation 264.6 metres in borehole 5 has been classified as silty sand. The standard MTO soil descriptions are used in the discussion below and in the profile on Drawing 1. The subsurface conditions encountered in the boreholes generally consisted of organic silt, granular deposits (silt, sandy silt, silty sand, and sand and gravel), interlayered with clayey silt and silty clay, overlying bedrock. Based on the elevation of the boreholes and dynamic cone penetration hole locations reported in Geocres No. 41A-019, the elevation of the ground surface at the abutments ranged from 272.5 to 273.5 metres at the time of the investigation. The pre-construction riverbed elevation ranged between elevation 270.4 and 271.8 metres at boreholes 3, 5 and 6. The depth of the river at these three borehole locations ranged between 1.3 and 3.2 metres.

Embankment fills were constructed when the existing structure was built. Currently, the nature of this fill is unknown but the grade was raised by approximately 5 m and 3 m to approximate elevation 277.3 and 276.8 metres at the west and east abutments, respectively.

5.1 Site Stratigraphy

A layer of sandy silt was found at ground surface or formed the river substrate at boreholes 1, 3, 4 and 5. The thickness of the sandy silt stratum varied between 0.8 and 2.1 metres. The sandy silt was very loose to compact with standard penetration test (SPT) N values ranging from 4 to 24 blows per 0.3 metres. The sandy silt is of low plasticity based on a single sample with liquid and plastic limits of 39 and 36 per cent, respectively.

Organic silt was encountered at elevation 271.5 metres in borehole 4 below the sandy silt deposit. The organic silt layer was about 1.7 metres thick and had SPT N values of 4 blows per 0.3 metres. The organic silt had water contents of 77 and 95 per cent.

Layers of clayey silt and/or silty clay were encountered beneath the sandy silt in boreholes 1, 3 to 5 and beneath the organic silt in borehole 4. These cohesive soils were encountered between elevation 269.2 and 271.5 metres and were 1.8 to 3.7 metres thick. The very stiff to hard cohesive soils had SPT N values of 15 to 41 blows per 0.3 metres and water contents of about 13 to 18 per cent. The cohesive deposits are of low to intermediate plasticity based on liquid limits of 18 to 38 per cent and plastic limits of 13 to 20 per cent.

Granular deposits, ranging in gradation from silt to sand and gravel, were encountered in boreholes 1 and 3 to 5 beneath the clayey silt from elevation 266.2 and 269.7 metres. The thickness of the granular layers ranged from about 6.9 to 7.3 metres thick.

Borehole 3 was terminated in a sand and gravel layer after exploring it for about 3.1 metres. The granular deposits had SPT N values of 15 to over 100 blows per 0.3 metres. The sand and gravel deposits below approximate elevation 263.7 metres were very dense while the overlying silt to silty sand deposits were loose to dense. Boulders were noted in the sand and gravel deposits. Water contents ranged between 8 to 25 per cent with silt layers having water contents of 21 per cent and above. The silt deposits contain clay layers and are of low plasticity based on liquid limits of 25 and 27 per cent and plastic limits of 19 and 20 per cent.

Limestone bedrock was encountered beneath the sand and gravel layer in borehole 1 at elevation 260.8 metres or a depth of 11.7 metres. Borehole 1 was terminated in the bedrock after it was cored to a depth of 3.7 metres below the bedrock surface. The bedrock in borehole 1 was described as weathered from elevation 259.0 to 260.8 metres, and sound from elevation 257.0 to 259.0 metres. Boreholes 4 and 5 were terminated in inferred bedrock at elevations 259.0 and 259.5 metres after penetrating the rock for 0.8 and 1.2 metres, respectively.

5.2 Groundwater Conditions

Based on the information provided in the Geocres report, artesian groundwater conditions were encountered in boreholes 1, 3, 4 and 5. The encountered groundwater elevation was not indicated on the borehole logs or in the report except to indicate that the water rose 1.2 m in borehole 1 and the water rose only 0.3 m in the other three boreholes. Based on our review of the borehole logs the groundwater level cannot be confirmed.

Borehole 3 was drilled in the river and the reported river water level during drilling on March 30, 1967 was elevation 273.6 metres. Boreholes 5 (drilled March 28 and 29, 1967) and 6 (drilled March 23, 1967) were advanced in the river floodplain and reported a river water level and an ice level above the ground surface, respectively, both corresponding to elevation 273.2 metres. A river water level of 271.8 metres in January 1967 was also reported in the Geocres report. The preliminary General Arrangement drawing provided by Stantec indicated a river water level of 272.4 metres in April 2016.

The reported water levels are not necessarily considered to be representative of the long-term, stabilized groundwater conditions. The groundwater levels should be expected to fluctuate seasonally and be higher during periods of sustained precipitation or during spring snow melt conditions.

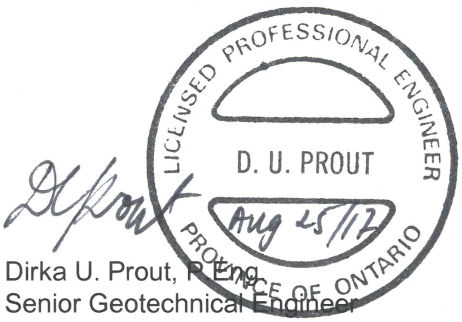
6.0 SITE RECONNAISSANCE

A site reconnaissance was carried out at the site on February 14, 2017 by a member of our geotechnical engineering staff. In general, the approach embankments and abutment foreslopes appeared to be stable with no visible signs of movement. The foreslopes were covered with rip rap largely consisting of concrete pieces. The abutments appeared to be performing adequately with no observable movement(s) noted, although the east pile cap is partially exposed. Some concrete spalling and exposed rebar was noted at the abutment locations. The piers were in generally good condition although there appeared to be some exposed reinforcing steel in one of the columns at the east pier. Areas of delaminations and spalling were noted at the ends of some of the concrete girders. The bridge soffit is in generally good condition although some concrete spalling and exposed rebar was noted. The asphalt riding surface was in fair condition at the approaches, with some minor to moderate cracking, and in poor condition in the area of the bridge deck with more severe cracking. Photographs from the site reconnaissance are shown in Appendix B.

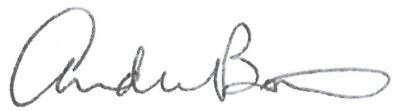
7.0 MISCELLANEOUS

The site reconnaissance and preparation of the report was carried out by Mr. Daniel Hyland, E.I.T. under the direction of the Project Engineer, Ms. Dirka U. Prout, P.Eng. The report was reviewed by Mr. André Bom, P.Eng., an Associate with Golder Associates. Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment, conducted an independent quality review of the report.

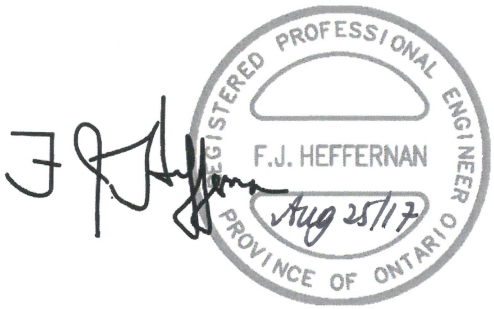
GOLDER ASSOCIATES LTD.



Dirka U. Prout, P.Eng.
Senior Geotechnical Engineer



André Bom, P.Eng.
Associate



Fintan J. Heffernan, P.Eng.
MTO Designated Contact

DH/DUP/AB/FJH/cr

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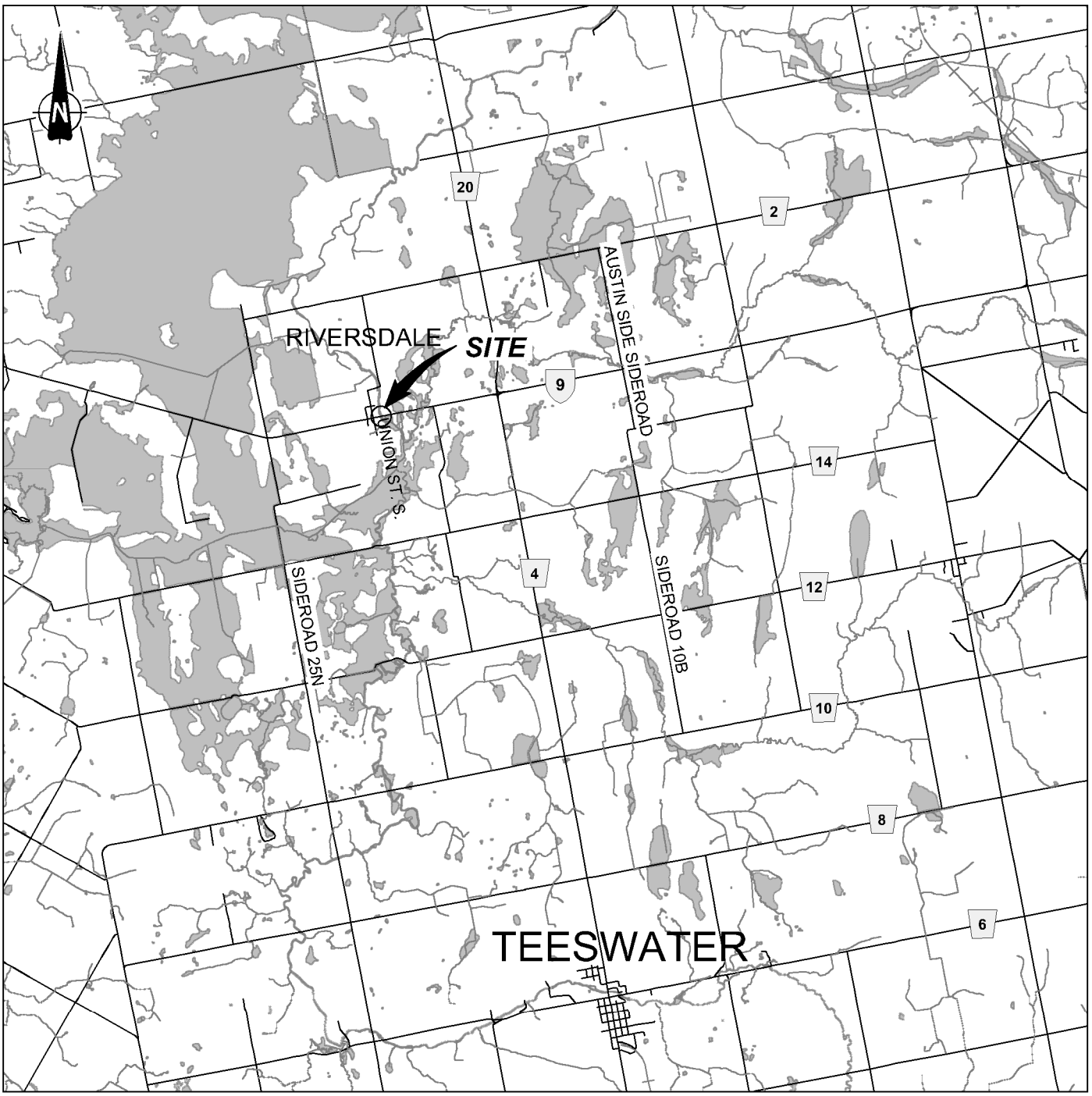


SCALE IN METRES
0 2000 4000m
1:100,000

REFERENCE

PLAN BASED ON CANMAP STREETFILES V.2008.4.

NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.
ALL LOCATIONS ARE APPROXIMATE ONLY.

PROJECT
TEESWATER RIVER BRIDGE REHABILITATION, SITE 2-256
HIGHWAY 9
GWP 3025-14-00

TITLE
KEY PLAN

Golder Associates

PROJECT No.		1534424	FILE No.	1534424-5002C-F01001
			SCALE AS SHOWN	REV. 0
CADD	LMK	May 30/17		
CHECK				

FIGURE 1

Drawing file: 1534424-5002C-F01001.dwg May 30, 2017 - 12:59pm

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

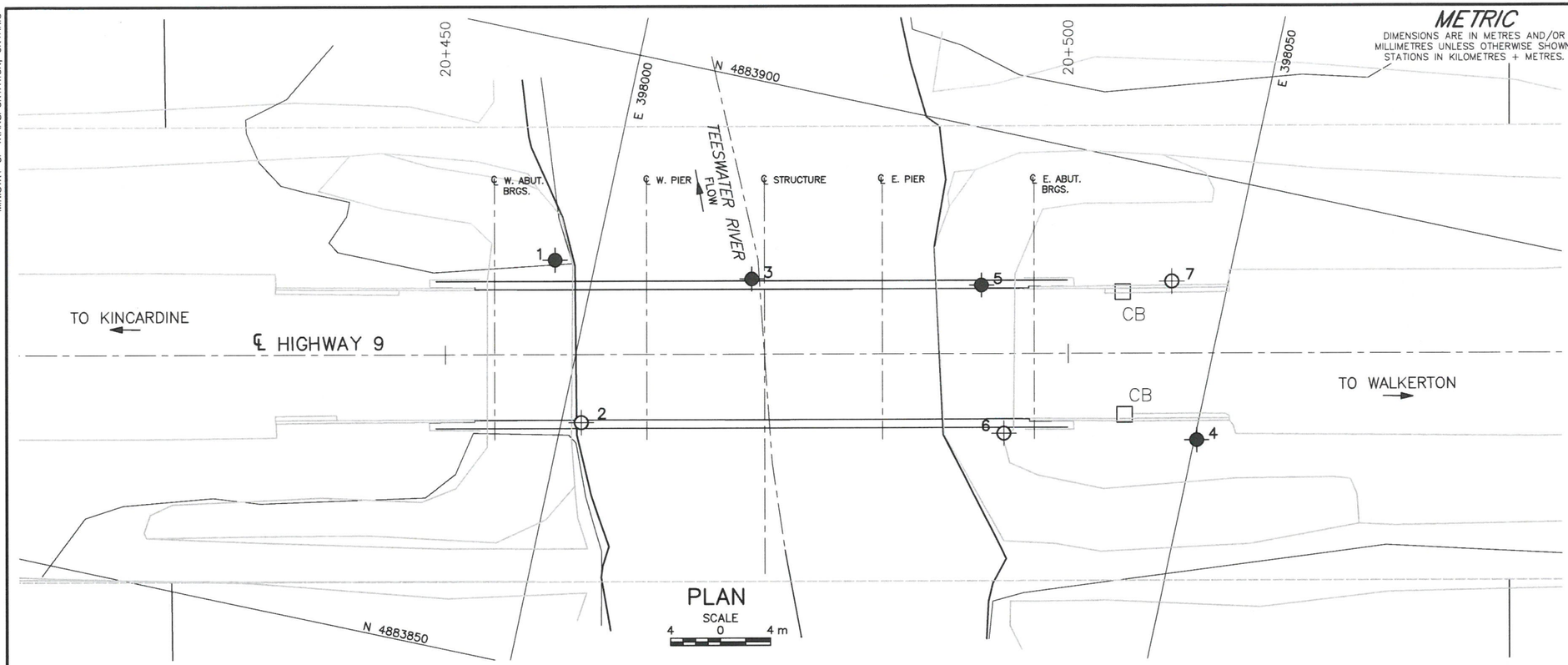
CONT No.
WP No. 3025-14-00

SHEET

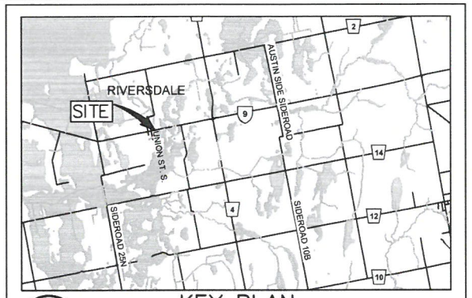
TEESWATER RIVER BRIDGE

STRUCTURE REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
LONDON, ONTARIO, CANADA



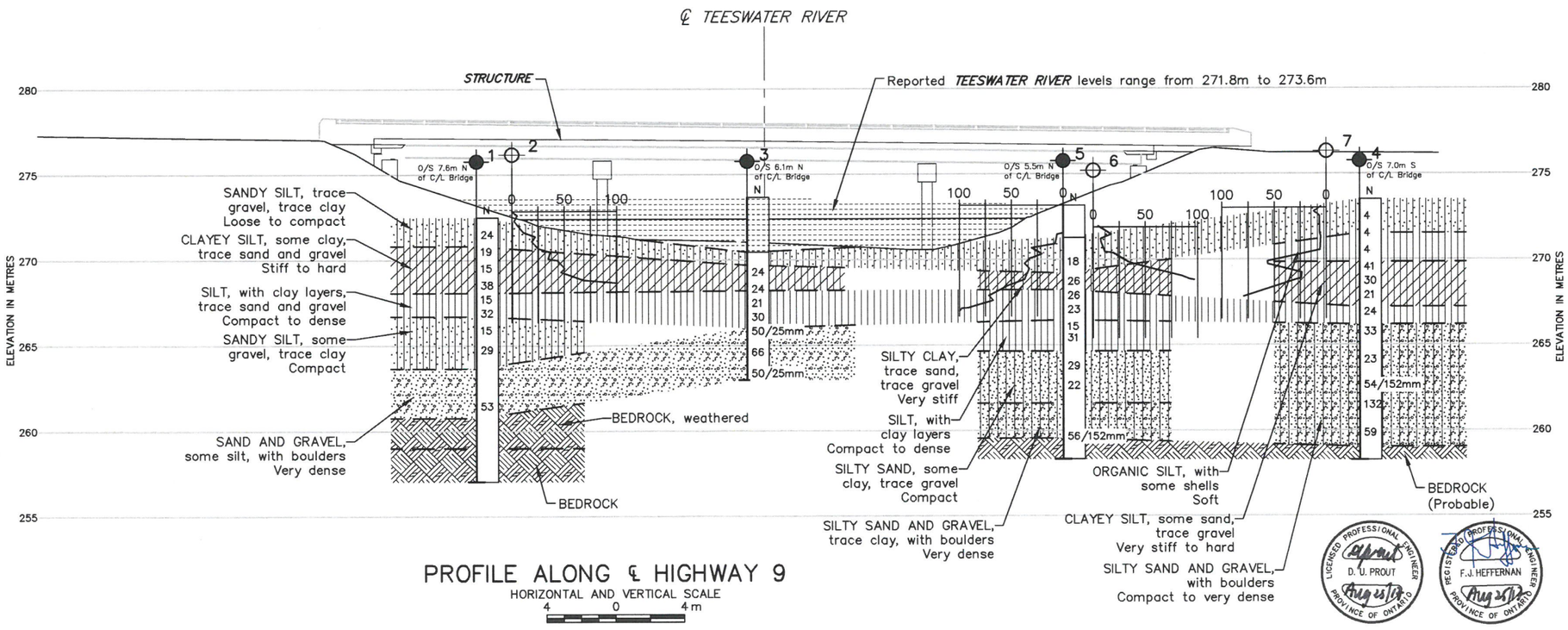
PLAN
SCALE
4 0 4 m



KEY PLAN
SCALE IN KILOMETRES
0 2 4

LEGEND

- Borehole (from Geocres Report 41A-019)
- Cone Penetration (from Geocres Report 41A-019)
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Dynamic Cone Penetration Test



PROFILE ALONG ℄ HIGHWAY 9
HORIZONTAL AND VERTICAL SCALE
4 0 4 m

No.	ELEVATION	CO-ORDINATES (MTM NAD83 ZONE 11)	
		NORTHING	EASTING
GEOCRES	NO. 41A-019		
1	272.49	4 883 882.5	397 996.8
2	272.86	4 883 870.1	398 001.6
3	273.65	4 883 884.3	398 012.5
4	273.50	4 883 879.1	398 050.2
5	273.16	4 883 887.6	398 030.7
6	271.88	4 883 876.3	398 034.9
7	273.01	4 883 891.1	398 045.6

NOTES

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

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

REFERENCE

Base plans provided by Stantec.

D. U. PROUT — LICENSED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO — August 25

F.J. HEFFERNAN — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO — Aug 25/17

NO.	DATE	BY	REVISION

Geocres No. 41A-244

HWY. 9	PROJECT NO. 1534424		DIST.
SUBM'D. DH	CHKD. DH	DATE: Aug. 21/17	SITE: 2-256
DRAWN: LMK	CHKD. DUP	APPD. FJH	DWG. 1

PLOT DATE: August 25, 2017
FILENAME: N:\Active\2015\3_Proj\1534424_Stantec_Mega 5_3015-E-0008_SWK\3-Drafting\PRODUCTION\AutoCAD Files\1534424-S002C-001001.dwg

APPENDIX A

Site Photographs

Photograph 1: East end of bridge, looking west.

Photograph 2: East end of bridge, looking west.

Photograph 3: South elevation.

Photograph 4: Embankment sideslope in northeast quadrant.

Photograph 5: West abutment, looking north.

Photograph 6: Looking east under bridge.

Photograph 7: East abutment, looking north.

Photograph 8: Partially exposed pile cap at east abutment.

APPENDIX B

Records of Boreholes - Geocres Report No. 41A-019

FORM OB-MT-126
66-4646

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 66 / 42 ℄ Hwy.#9 and 24' o/s to Rt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 14, 15, 16, 17 & 20, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX' BX & AX Casing, AXT, R.C. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
272.49m 894.0	GROUND LEVEL					
0.0	Sandy silt					
	Compact		1	SS	24	890
888.5	270.8m (1.68m)					
5.5	Clayey silt, trace of sand and gravel.		2	SS	19	
			3	SS	15	
	Stiff to Hard					
879.5	268.07m (4.42m)		4	SS	38	880
14.5	Silt with occasional layers of clay		5	SS	15	
875.0			6	SS	32	
19.0	Sandy silt with some gravel and trace of clay.		7	SS	15	
266.70m						870
(5.79m)	Compact.		8	SS	29	
865.0	263.65m (8.84m)					
29.0	Sandy gravel, some silt, occasional boulders.					
260.76m	(11.73m)		12	SS	53	860
	Very Dense.					
855.5						
38.5	Weathered Bedrock		13	AXT RC	Rec 75%	
849.7	258.99m		14	AXT RC	Rec. 85%	850
	Sound Limestone Bedrock		15	AXT RC	Rec.	
843.3	257.04m (15.45m)					
50.7	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.

REMARKS

Gr.0, Sa.6
Si.81, Cl.13

Gr.17, Sa.37
Si.40, Cl.6

Gr.53, Sa.37
Si.& Cl. 10

FORM DB-MT-126
56-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 66 ± 35 ℄ Hwy.#9 and 19' o/s to Lt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 20, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT / PLASTIC LIMIT / WATER CONTENT		
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT: 20 40 60 80 100 — SHEAR STRENGTH P.S.F.	w_L — w_P — w — WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
895.7	GROUND LEVEL									
0.0	273.01m					890				
881.7	268.74m (4.27m)									
14.0	End of Borehole									

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 65 ± 91 & Hwy.#9 and 20' o/s to Rt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 30, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing and Washbore CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 15 30 45	BULK DENSITY γ P.C.F.	REMARKS
897.8	WATER LEVEL									
0.0	273.65m									
270.45m (3.2m)						890				
887.3	GROUND LEVEL									
10.5	Sandy silt.									
267.86m (3.96m)	Clayey silt, trace of sand and gravel.		1	SS	24			o		
269.69m	Very stiff.		2	SS	24	880		o		
(5.79m)	Silt with occasional layers of clay		3	SS	21					
			4	SS	30			H-H		
872.8	266.03m (7.62m)									
25.0	Sandy gravel, some silt, occ. boulders.		5	SS	50/3"	870				
	Very dense.		6	SS	66			o		
862.8	262.98m (10.67m)		7	SS	50/3"					
35.0	End of Borehole									

FORM OB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 64 + 73 ℄ Hwy.#9 and 20' o/s to Lt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 21, 22 and 23, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX, BX & AX Casing, BXL & AXT. R.C. CHECKED BY AK

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
273.50m						
897.3	GROUND LEVEL					
0.0	Sandy silt with traces of gravel. Very loose.		1	SS	4	
890.8	271.52m (1.98m)		2	SS	4	890
6.5	Organic Silt with some shells.		3	SS	4	
269.84m	Very soft.		4	SS	41	
(3.66m)	Clayey silt with some sand and traces of gravel. Very stiff to hard.		5	SS	30	880
			6	SS	21	
			7	SS	24	
873.3	266.18m (7.32m)					
24.0	Sandy gravel, some silt, occ. boulders		8	SS	33	870
	Very dense.		9	SS	23	
			10	SS	54/6"	860
			11	SS	132	
849.8	259.02m (14.48m)		14	SS	59	850
47.5	Probable Bedrock					
847.3						
50.0	End of Borehole					
258.26m						
(15.24m)						

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.

REMARKS
77%
94.5%
Gr.1,Sa.20 Si.69,Cl.10
Gr.47,Sa.37 Si.& Cl.16
Gr.33,Sa.40 Si.& Cl.27

FORM 08-MT-125
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 65 ± 30 Ø Hwy. #9 and 20' o/s to Rt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 28 and 29, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Washbore, BXL R.C. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
896.2	WATER LEVEL					
0.0	273.16m					
	271.27m (1.89m)					
890.0	GROUND LEVEL					890
6.2	Sandy silt with traces of clay and gravel. Compact.		1	SS	18	
883.2	269.20m. (3.96m)					
13.0	Clayey silt trace of sand and gravel. Very stiff		2	SS	26	880
			3	SS	26	
874.2	266.46m 6.71m)		4	SS	23	
22.0	Silt with occasional layers of clay Compact to dense.		5	SS	15	
			6	SS	31	870
868.2	264.63m. (8.53m)					
28.0	Sandy silt with some clay and trace of gravel. Compact.		7	SS	29	
			8	SS	22	860
858.2	261.58m (11.58m)					
38.0	Sandy gravel, some silt, occ. boulders. Very Dense		11	SS	56/6"	
851.5	259.54m. (13.62m)					
44.7	Probable Bedrock		12	BXL RC	Rec 50%	850
847.5	258.32m. (14.84m)					
48.7	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.

REMARKS

Gr.3,Sa.30
Si.59,Cl.8

Gr.0,Sa.9
Si.77,Cl.14

Gr.9,Sa.41
Si.40,Cl.10

Gr.26,Sa.39
Si.29,Cl.6

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 65 + 24 @ Hwy.#9 and 19' o/s to Lt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 23, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / w_P w w_L / WATER CONTENT %	BULK DENSITY Y P.C.F.	REMARKS
896.2	ICE LEVEL									
	273.16m									
892.0	GROUND LEVEL									
4.2	271.88m (1.28m)					890				
880.7	268.44m (4.72m)									
15.5	End of Borehole									

FORM OB-MT-126
66-4846

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 67-F-19 LOCATION Sta. 64 ± 80 C/ Hwy. #9 and 22' o/s to Rt. ORIGINATED BY AMS
W.P. 101-64 BORING DATE March 23, 1967 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
895.7	GROUND LEVEL									
0.0	273.01m					890				
878.8	267.86m (5.15m)					880				
16.9	End of Borehole									

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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