

REPORT ON

FOUNDATION INVESTIGATION
FISH CREEK (CENTRE) BRIDGE REPLACEMENT
HIGHWAY 23, SITE 25-225, GWP 313-94-00
AGREEMENT NUMBER 3005-A-000078

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TABLE OF CONTENTS

Table of Contents	i
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<u>SECTION</u>	<u>PAGE</u>
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PART A – FOUNDATION INVESTIGATION REPORT

1.0	INTRODUCTION.....	1
2.0	SITE DESCRIPTION	2
3.0	INVESTIGATION PROCEDURES	3
4.0	GENERAL SITE GEOLOGY AND STRATIGRAPHY	4
4.1	Site Geology	4
4.2	Site Stratigraphy	4
	4.2.1 Topsoil and Fill	4
	4.2.2 Sand and Gravel	5
	4.2.3 Clayey Silt Till	5
	4.2.4 Sandy Silt to Silty Sand Till.....	5
4.3	Groundwater Conditions	6

In Order
Following
Page 7

LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORD OF BOREHOLES

FIGURE 1 – Site Location Map

DRAWING 1 - Fish Creek (Centre) Bridge, Site 25-225, Borehole Locations and Soil Strata

DRAWING 2 - Fish Creek (Centre) Bridge, Site 25-225, Soil Strata and Cross Sections

APPENDIX A - Records of Previous Boreholes

APPENDIX B - Laboratory Test Data (Figure B-1)

APPENDIX C - Site Photographs

PART A –FOUNDATION INVESTIGATION REPORT
FISH CREEK (CENTRE) BRIDGE REPLACEMENT
HIGHWAY 23, SITE 25-225, GWP 313-94-00
AGREEMENT NUMBER 3005-A-000078

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by TSH Engineers Architects Planners (TSH) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out a foundation investigation at the sites of three proposed Highway 23 bridge replacements over Fish Creek near Kirkton, Ontario. This report addresses the centre bridge (Site 25-225). MTO has assigned Geocres No. 40P6-19 to this site.

The purpose of the foundation investigation is to determine the subsurface conditions at the site of the proposed replacement bridge, approaches and detour bridge by drilling boreholes, and carrying out in-situ tests and laboratory tests on selected samples. The terms of reference for the scope of work are outlined in our Total Project Management proposal P01-1047, dated February 2000. The work was carried out in accordance with our Quality Control Plan for Foundation Design Services, Agreement No. 3005-A-000078, dated March 2000.

TSH provided Golder with preliminary drawings for the three Highway 23 crossings of Fish Creek. The centreline and stations of the proposed alignments were surveyed by others prior to commencing the foundation field investigation program. The General Arrangement plans showing the proposed abutment layout of the replacement structures and detours had been provided to us in digital format on December 12, 2000. Golder Report No. 931-3077 entitled "Geotechnical Investigation, Proposed Highway 23 and Fish Creek Crossings, Duct Bank Installation, Blanshard Municipal Telephone System, Woodham to Kirkton, Ontario", dated June 7, 1993 has been referenced during the preparation of this report. The relevant borehole records from that report are provided in Appendix A.

2.0 SITE DESCRIPTION

The project area covered by this report extends along Highway 23 at the crossing with Fish Creek in Kirkton, Ontario (see Figure 1). The highway runs approximately northeast-southwest and the creek flows in a westerly direction and meanders towards the North Branch of the Thames River.

The existing bridge deck is at elevation 302.6 metres, the water level in the creek is currently at about elevation 299.9 metres and the creek bed is at about elevation 299.5 metres.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between November 9 and 24, 2000. At that time seven boreholes were put down at the site of the proposed replacement bridge and detour. The boreholes were drilled and sampled to depths ranging from about 2.0 to 9.8 metres. The borehole locations are shown in plan on Drawing 1.

The investigation was carried out using truck and all-terrain vehicle mounted CME-75 and 750 drill rigs supplied and operated by Lantech Drilling Services Inc. The boreholes were advanced using 208 millimetre outside diameter continuous flight hollow stem augers. In the boreholes, samples of the overburden were obtained at regular intervals of depth using 50 millimetre outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedures. Groundwater conditions in the open boreholes were observed throughout the drilling operations. Piezometers were installed in four boreholes to permit monitoring of the groundwater levels at the site. All of the boreholes were backfilled using MTO recommended procedures. Water levels in the installations were obtained on November 29, December 13 and December 20, 2000 to determine stabilized levels.

The field work was supervised on a full-time basis by a member of our engineering staff who located the boreholes in the field, directed the drilling, sampling and in-situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labeled containers and transported back to our laboratory in London, Ontario for further examination. Index and classification tests consisting of grain size analyses, Atterberg limits tests and water content determinations were carried out on selected samples. The results of the field and laboratory testing are given on the Record of Borehole sheets and in Appendix B. Site photographs taken during the drilling operations are provided in Appendix C.

The as-drilled borehole locations and elevations were surveyed by Golder staff using the coordinate system and benchmarks on the drawings provided by TSH. The elevations at the borehole locations were referenced to a tablet set on the east face of the south bridge abutment at Station 18+107.8, 6.4 metres right. The benchmark is numbered 306 (MTO Benchmark 848076) and is understood to have an elevation of 302.289 metres, referred to geodetic datum.

4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

4.1 Site Geology

The site lies within the physiographic region of Southwestern Ontario known as the Stratford Till Plain, specifically an area known as the Lucan Moraine. The soil conditions in the area generally consist of stoney and bouldery clayey silt till. The region is underlain by limestone of the Dundee formation. The rock surface is typically found at depths of about 12 to 27 metres below the ground surface.

4.2 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole sheets following the text of this report and in Appendix B. The stratigraphic boundaries shown on the borehole sheets are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In summary, the subsoils at the site generally consist of a variable thicknesses of topsoil and fill materials to about elevations 298.9 to 301.1 metres underlain by clayey silt till and sandy silt till materials. Sand and gravel layers were encountered above and below the till layers at two borehole locations.

Locations and elevations of the borings, together with the interpreted stratigraphical profile and sections, are shown on the attached Drawings 1 and 2. A detailed description of the subsurface conditions encountered in the boreholes for this investigation is provided on the Record of Borehole sheets and is summarized in the following sections.

4.2.1 Topsoil and Fill

Topsoil and/or fill layers were encountered in all of the boreholes. Topsoil layers 0.1 to 0.2 metres thick were encountered at ground surface in boreholes 2, 3, 6 and 7.

Layers of sand and gravel fill underlain by clayey silt fill were encountered under 50 millimetres of asphalt in borehole 1, at ground surface in boreholes 4 and 5 and beneath the topsoil in

boreholes 2, 3, 6 and 7. Cobbles and boulders were noted in the fill layers in boreholes 3, 6 and 7. Auger refusal was met within the fill in borehole 3 on a probable boulder and the borehole had to be advanced at a second adjacent location in order to penetrate the fill. The fill layers were 1.4 to 3.7 metres thick and had N values between 6 and 24 blows per 0.3 metres of penetration and water contents between about 15 and 25 per cent.

4.2.2 Sand and Gravel

Beneath the fill in borehole 2, a layer of sand and gravel 0.3 metres thick was encountered at elevation 299.8 metres. Borehole 3 was terminated in a sand and gravel deposit beneath the sandy silt till at elevation 292.64 metres after exploring it for 1.2 metres. The sand and gravel layer in borehole 3 had a standard penetration test N value of 111 blows per 0.3 metres penetration and a water content of about 10 per cent, based on the single sample collected.

4.2.3 Clayey Silt Till

Beneath the fill in borehole 4, a 0.9 metre thick layer of clayey silt till was encountered at elevation 299.7 metres. The clayey silt till had a standard penetration test N value of 36 blows per 0.3 metres penetration and a water content of about 20 per cent, based on the single sample collected.

4.2.4 Sandy Silt to Silty Sand Till

All of the boreholes encountered brown and grey sandy silt to silty sand till below elevation 298.9 to 301.1 metres and all of the boreholes, except borehole 3, were terminated in the till stratum at elevations between 297.7 and 300.4 metres after penetrating it for some 0.6 to 6.0 metres. Borehole 3 encountered 5.3 metres of sandy silt till and was terminated in a sand and gravel deposit. Boreholes 2 and 4 to 7 were terminated after refusal to further auger penetration within the till. The till deposit contained cobbles and boulders. In boreholes 2, 4 and 7, auger refusal on probable boulders was met at relatively shallow depths into the till and the boreholes had to be put down at a second and third adjacent location in order to penetrate the till to a sufficient depth. Standard penetration test N values of 14 blows per 0.3 metres penetration to 100 blows per 50 millimetres penetration were measured within the till, with an average N value in the order of 45 blows per 0.3 metres penetration. Based on these N values, the density of the till is considered to

be compact to very dense. Figure B-1 in Appendix B shows gradation curves for three samples recovered from the till deposit.

The water contents of selected sandy silt till samples were between about 6 and 12 per cent, with an average of about 9 per cent. The average plastic and liquid limits for the sandy silt till, based on 2 of 3 samples tested, are 12 and 15 per cent, respectively, with an average plasticity index of 3 per cent. One of the samples tested (sample 5 from borehole 4) was non-plastic.

4.3 Groundwater Conditions

Water levels were noted in the open boreholes during and upon completion of the drilling operations. These levels are shown on the attached Record of Borehole sheets. A standpipe was installed in borehole 2 and piezometers were sealed in boreholes 2, 3 and 6 to permit the monitoring of the groundwater levels at the site. Details of the piezometer installations and water level measurements are shown on the attached Record of Borehole sheets.

Water was noted during drilling in all of the open boreholes, except boreholes 5 and 6, at elevations between 293.8 and 299.8 metres. The encountered water levels and those measured in the piezometers on November 29, December 13 and December 20, 2000 are summarized in the following table. It should be noted that the groundwater level is subject to seasonal fluctuations.

Borehole Number	Installation	Ground Surface Elevation (m)	Groundwater Level Encountered During Drilling		Water Levels in Piezometers			
			Depth (m)	Elevation (m)	November 29, 2000		December 13/20, 2000	
					Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
1		302.72	3.81	298.91				
2	Standpipe Piezometer	302.52	2.74	299.78	1.98 2.16	300.54 300.36	2.77 2.13	299.75 300.39
3	Piezometer	302.58	8.79	293.79	3.09	299.49	2.97	299.61
4		302.47	2.74	299.73				
5		302.42	Dry					
6	Piezometer	301.93	Dry		6.92	295.01	3.66	298.27
7		302.33	3.81	298.52				

The measured water level in the creek was at elevation 299.9 metres on December 13, 2000.

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AMH/ASP/FJH/cb
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APPENDIX A

RECORD OF PREVIOUS BOREHOLES

A P P E N D I X B

LABORATORY TEST DATA (FIGURE B-1)

APPENDIX C

SITE PHOTOGRAPHS