



Foundation Investigation Report

Highway 8
Richardson Drain Culvert Replacement
Station 17+696
Township of Perth South
Site No. 25-319-C

G.W.P. 344-97-00
W.P. 3043-06-04

Geocres No. 40P6-21

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FOUNDATION INVESTIGATION REPORT

For

G.W.P 344-97-00

W.P. 3043-06-04

Highway 8 – Richardson Drain Culvert Replacement

Station 17+696

Site No. 25-319-C

Township of Perth South

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by the Ministry of Transportation, Ontario (MTO) to undertake the detailed design for the replacement of an existing centreline culvert for the Richardson Drain at approximately Station 17+696 on Highway 8, between Sebringville and Stratford, in the Township of Perth South, Ontario.

This Foundation Investigation Report has been prepared specifically and solely for the replacement of the centreline culvert for the following project:

Project Number: WP 344-97-00

Project Location: Highway 8, 1.6 km east of Perth County Road 135
Centreline Culvert Replacement, approximate Station 17+696

2.0 Site Description and Geology

Site Location

The site location is shown on the Key Plan inset to Drawing No. 1, provided in Appendix A. It is noted that for project orientation purposes, Highway 8 will be assumed to run east-west at this location, with chainage increasing from west to east.

General Site Description

Although within the project limits Highway 8 is classified as a two-lane Rural Arterial Undivided highway (see Photos 1 and 2 in Appendix A), the section in the immediate vicinity of the culvert is two lanes with curbs and gutter, and sidewalk on both sides. Drainage is provided via catchbasins.

At the culvert, an embankment approximately 2.2 m high with 2H:1V side slopes is present on both sides (see Photos 3 and 4 in Appendix A). On the north side, away from the culvert, the highway is at approximately the same grade as the adjacent properties. On the south side, the adjacent properties are slightly lower than the elevation of the highway.

Existing Culvert

The existing culvert is a concrete open footing culvert 3 m by 1.5 m by 20 m with a CSP extension at the north end comprised of two 1.8 m diameter Corrugated Steel Pipes (CSP) (Photos 3 and 4, Appendix A). The portion of the concrete culvert from the south end to approximately the north curb line has a skew of approximately 36° relative to a perpendicular from the road. Just behind the north curb line the concrete culvert bends to the north so that it is almost perpendicular to the road (approximately a 4° skew). The CSP extension on the north end is approximately 2 m in length and is aligned at a skew of approximately 20° relative to a perpendicular from the road (See Photo No. 5 in Appendix A). The approximate alignment of the existing culvert is shown on Dwg. 1 in Appendix A. Flow in the culvert is from north to south.

The east CSP on the north side is partially blocked with stones, soil and tree branches (see Photo 6, Appendix A).

The outlet of the culvert is visible at the base of the embankment on the east side, approximately 2.1 m below the pavement surface (see Photos 3 and 4 in Appendix A).

Physiographic Description

The site is located within a physiographic region known as the Stratford till plain (Chapman and Putnam, The Physiography of Southern Ontario, 3rd Edition, 1984). This region is situated on a broad clay plain and is characterized by ground moraines. The till is described as fairly uniform, consisting of calcareous silty clay. The silt and clay contents vary as does the stoniness of the till, however, it is seldom classified as a stony till.

Drainage within the Stratford till plain is generally toward the southwest. The site is within the Thames River Watershed. In the immediate vicinity of the site, drainage is provided via storm sewers.

3.0 Method of Investigation

3.1 DRILLING INVESTIGATION

The foundation field investigation required for the culvert replacement consisted of four (4) boreholes. The boreholes were designated BH10-1 to BH10-4 and their locations are shown on the Borehole Location Plan, Drawing No.1 in Appendix A.

Prior to carrying out the investigation, Stantec contacted the public utility authorities to clear the borehole locations of both private and public utilities.

The field drilling program was carried out from May 25th to 27th, 2010. The boreholes were advanced with hollow stem augers using a rubber track-mounted Diedrich D-50 equipped for soil and bedrock sampling. A Dynamic Cone Penetration Test was carried out in one borehole, BH10-2, from a depth of 6.1 m to refusal at 8.2 m. The drilling equipment was owned and operated by London Soil Test of London, Ontario.

The subsurface stratigraphy encountered in each borehole was recorded in the field by an experienced Stantec Field Technologist. Split spoon samples were collected at regularly spaced intervals (typically every 760 mm). All samples recovered were returned to our Ottawa laboratory for detailed classification and testing. Boreholes were backfilled with auger cuttings mixed with bentonite to match observed stratigraphy, and road holes were topped with cold patch asphalt.

One piezometer was installed in BH10-1 on the morning of May 25th, 2010. The water level was measured late in the day on May 26th and the piezometer was removed using the winch on the drilling rig. The remaining opening was filled with bentonite to surface. The water level in the culvert was surveyed on May 27th, 2010.

3.2 SURVEY

Borehole locations were established in the field by Stantec personnel relative to the centerline of the existing alignment and the existing culvert. The ground surface elevation at each borehole location was surveyed by Stantec personnel with reference to a Geodetic Benchmark provided by MTO. The benchmark was an iron bar at station 17+633.491, along the sidewalk north of Highway 8. The Geodetic elevation of this benchmark is reported to be 356.6 m.

Table 3.1: Borehole Summary

	Boreholes			
	BH10-1	BH10-2	BH10-3	BH10-4
MTM Zone 10 Coordinates				
Northing	4808047	4808033	4808039	4808023
Easting	422083	422082	422064	422069
Station	17+696	17+703	17+683	17+697
Offset	15.0 Lt	1.9 Lt	2.2 Rt	12.5 Rt
Ground Surface Elevation, m	356.3	356.2	356.1	355.9
Total Depth Drilled, m	14.0	8.2	14.0	9.5
End of Borehole Elevation, m	342.4	348.0	342.2	346.4
Depth Augered, m	14.0	6.1	14.0	9.5
Number of Soil Samples	16	8	16	13
Depth Cored, m	0	0	0	0

3.3 LABORATORY TESTING

All samples were taken to our Ottawa laboratory where they were subjected to a detailed visual examination by a Geotechnical Engineer. Selected soil samples underwent plasticity testing (6 samples), gradation analysis (13 samples) and moisture content testing (16 samples).

It is noted that a nominal size of 0.005 mm has been utilized to distinguish between silt and clay sized particles.

Samples remaining after testing will be placed in storage for a period of one year after issuance of the final report. After the storage period, the samples will be discarded unless we are directed otherwise by MTO.

4.0 Subsurface Conditions

4.1 SUBSURFACE PROFILE

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided.

In general, the subsurface stratigraphy consists of a pavement structure over a sandy clay to silty sand fill material overlying a sandy silty clay to silty clayey sand till material with gravel.

Borehole location plans and stratigraphic sections of the soils encountered within the boreholes are provided on Drawing No. 1 in Appendix A. An explanation of the symbols and terms used for these Borehole Records has been included in Appendix B.

4.1.1 Pavement Structure

The pavement structure was observed in Boreholes BH10-2 and BH10-3 and consists of 110 to 120 mm asphalt over about 180 mm of granular base and approximately 600 mm of granular subbase.

Grain size analysis (see Figure 1 in Appendix C) and moisture content testing on three samples of the material beneath the asphalt yielded the following results:

- 38% to 42% Gravel
- 44% to 49% Sand
- 12 to 14% Fines (silt and clay size particles)
- Moisture Content 2% to 3%

Based on the grain size distribution, the material may be classified as silty sand with gravel.

4.1.2 Sandy Clay Fill

A sandy clay fill layer was observed beneath the pavement structure in Boreholes BH10-2 and BH10-3, at ground surface in BH10-1 and beneath a 610 mm sandy topsoil in Borehole BH10-4. The fill layer was between 0.9 m and 1.6 m thick, with a base elevation of 353.6 m and 354.1 m.

The results of the gradation analyses on one sample indicates that the fill deposit contained 14% gravel, 31% sand, 37% silt and 18% clay size particles. The results of the gradation analyses are shown on Figure 2 in Appendix C. Atterberg Limit tests were performed on Sample BH10-3, SS3 from this deposit. It was found to have a liquid limit of 26 and a plastic limit of 16; the moisture content of the tested sample was 21%. (see Figure 5 in Appendix C).

This material is classified as sandy clay (CL). Trace organic material was observed in Borehole BH10-4. Pieces of wood were observed within the fill strata in Borehole BH10-2.

4.1.3 Sandy Silty Clay to Silty Clayey Sand Till

Sandy silty clay to silty clayey sand till with varying gravel content was found in all boreholes. All boreholes were terminated in this layer at depths ranging from 8.2 to 14.0 m below ground surface (El. 348.0 m to 342.2 m).

Standard Penetration Testing in this unit yielded N-values ranging from 12 to greater than 100 blows per 0.3 m, indicating compact to very dense material. It is noted that blow counts typically increased with depth.

The gradation of the till material varied with the coarse fraction generally increasing with depth.

Gradation tests were carried out on nine samples and the results are presented on Figures 3 and 4 in Appendix C. Atterberg Limit Tests were carried out on five samples and the results presented on Figure 5 in Appendix C. The test results are summarized as follows.

- 1% to 30% Gravel
- 9% to 39% Sand
- 42% to 90% Fines (silt and clay size particles)
- 15 to 19 Liquid Limit
- 10 to 12 Plastic Limit
- 7% to 18% Moisture Content

The till unit varies in classification from a CL-ML to SC-SM to GC-GM. Cobbles may be present within the till layer.

One sample of the till was submitted to Paracel Laboratories in Ottawa, Ontario, for analysis of pH, water soluble sulphate and chloride concentrations, and resistivity. The analysis results are provided in Table 4.1.

Table 4.1: Results of Chemical Analysis

Borehole No	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-m)
BH10-2	SS5	3.1 to 3.7	7.99	102	22	50.0

4.2 BEDROCK

Bedrock was not encountered within the depth of exploration during this investigation.

4.3 GROUNDWATER

The water level at the culvert outlet was surveyed on May 27, 2010, and was found to be at 354.6 m geodetic. This corresponded to a depth of water of approximately 500 mm in the stream channel.

A monitoring well was installed in BH10-1 on the morning of May 25, 2010. The water level was measured on the afternoon of May 26, 2010, to be at 1.65 m below ground surface, corresponding to an elevation of 354.6 m.

Fluctuations in the groundwater and culvert water level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.0 Closure

A subsurface investigation is a limited sampling of a site. The subsurface conditions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

This report has been prepared by Paul Carnaffan and Fred Griffiths. A technical review was carried out by Raymond Haché.

Respectively Submitted;

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APPENDIX A

Drawing No. 1 – Borehole Location Plan and Soil Strata
Site Photos

APPENDIX B

Symbols and Terms Used on Borehole Records
Borehole Records

APPENDIX C

Laboratory Test Results