December 24, 2009

AECOM

PRELIMINARY PAVEMENT ENGINEERING REPORT INVESTIGATION FOR THE CLASS ENVIRONMENTAL ASSESSMENT STUDY OF BURNHAMTHORPE ROAD AT NEYAGAWA BLVD AND NINTH LINE, PROJECT #08-0005

Submitted to:
AECOM
300 Water Street
Whitby, ON L1N 9B6

REPORT

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Report Number: 08-1181-0005

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by AECOM to carry out a preliminary geotechnical investigation for the proposed improvements to Burnhamthorpe Road at Neyagawa Boulevard (Sta. 15+050 to Sta. 16+400) and immediately west of Ninth Line (Sta. 21+600 to Sta 22+050), in the Region of Halton (see key plan Figure 1, following the text of this report). The total length of both sections is approximately 1.8 km. This geotechnical investigation is part of the Class Environmental Assessment Study for the planned improvements being carried out by AECOM on behalf of the Region of Halton (Region).

The Region has identified the need for a new North Oakville Transportation Corridor which involves improvements to Burnhamthrope Road. This report is for the two sections mentioned above, and does not include the realigned sections of Burnhamthorpe Road.

A number of factors have prompted the need for the proposed improvements, including:

- Urbanization;
- Capacity deficiencies;
- Structural condition;
- Safety issues; and
- Changes in land use.

The purpose of this investigation is to determine the condition and adequacy of the existing pavement structure, assess the subsurface soil and groundwater conditions along the alignment, evaluate feasible pavement design alternatives, and provide pavement recommendations for the most cost-effective rehabilitation / reconstruction of the existing lanes and new pavement structures for the proposed widening and urbanization of Burnhamthorpe Road. The project limits are shown on the Borehole Location Plan, Figures 2A and 2B attached to this report.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid.

The preliminary geotechnical information and recommendations provided in this report are for planning purposes only and are not sufficient for final design purposes. Once pertinent design details for the site are available, this preliminary report should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the actual proposed development plans.

2.0 REGIONAL PHYSIOLOGY AND GENERAL SOIL STRATIGRAPHY

The site is located in the physiographic region known as the Peel Plain, which slopes gradually downward towards Lake Ontario. There are no large undrained depressions, swamps or bogs within the project limits. The overburden immediately below the ground surface generally consists of silty clay till and sandy silt till, and at depth consists of alternating deposits of dense lacustrine sands and silts and over-consolidated lacustrine clays and clay tills. The overburden in turn overlies shale bedrock of the Georgian Bay Formation, with interbedded

siltstone and minor limestone (Chapman, L.J. and Putnam, D.F. "The Physiography of Southern Ontario", 3rd Edition, 1984, pages 172 to 176).

3.0 FIELDWORK

The fieldwork consisted of a visual condition survey, asphalt coring and the drilling of a limited number of boreholes.

3.1 Visual Pavement Condition Assessment

A visual condition survey was carried out in May, 2008 on the sections of Burnhamthorpe Road between Ninth Line and west of Neyagawa Blvd., in accordance with MTO's "*Flexible Pavement Condition Rating Manual – Guidelines for Municipalities, SP-022*". The assessment was carried out by an experienced pavement specialist. The results of the pavement condition survey are presented in the "Flexible Pavement Condition Evaluation Forms" attached in Appendix B. The visual survey indicated that the asphalt pavement surface is generally in good condition. The observed pavement conditions were as follow:

BURNHAMTHORPE ROAD **Sta. 15+050 to Sta. 15+450 (Fourth line)**		
Distress	**Severity**	**Density**
Flushing	Severe	Throughout
Wheel Track Rutting	Slight	Frequent
Pavement Edge	Moderate	Frequent
Overall Condition Rating	**Good** (PCR = 72, RCR = 7.0)	
BURNHAMTHORPE ROAD Sta. 15+450 (Fourth Line) to Sta. 16+400 and Sta. 21+600 (West of Ninth Line) to Sta. 22+050 (Ninth Line)		
Distress	**Severity**	**Density**
Flushing	Moderate to Severe	Extensive
Wheel Track Rutting	Slight	Frequent to Extensive
Centre Line	Slight	Intermittent
Pavement Edge	Moderate	Intermittent
Overall Condition Rating	**Good** (PCR = 78, RCR = 8.0)	

3.2 BOREHOLE INVESTIGATION

This section summarizes the results of the borehole investigation carried out for this assignment. The borehole information presented in this report should be read in conjunction with "Important Information and Limitations of This Report" included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

The field work was carried out in July 2008 and consisted of 38 boreholes, generally advanced to a depth of 1.5 m. The borehole locations are shown on the Borehole Location Plan (Figures 2A and 2B) and borehole logs are provided in Appendix C. The asphalt and granular layer thicknesses were noted in each of the boreholes drilled through the existing pavement and representative samples of the granular base, subbase and underlying soils were obtained from selected boreholes. All the samples were brought to Golder's CCIL certified laboratory in Whitby for further inspection and limited laboratory testing.

It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes.

4.0 PAVEMENT AND SOIL DATA

The following sections summarize the thickness of the existing asphalt pavement and the underlying pavement materials, and the condition of the subgrade soils encountered in the boreholes.

4.1 Existing Pavement Structure

Burnhamthorpe Road within the project limits currently has one lane in each direction. Based on the geotechnical investigation, the existing pavement structure can be summarized as follows:

Location	Thickness of Pavement Components					
	MAINLANES				SHOULDER	
	ASPHALT (mm)		GRANULAR BASE (CRUSHED) (mm)		GRANULAR BASE (mm)	
	Range	Typical	Range	Typical	Range	Typical
Both Sections of Burnhamthorpe Road	125-200	150	90-1370	475	50-1400	240
Average	**150**		**475**		**240**	

Buried asphalt 20 and 50 mm in thickness was encountered in BH 19 and 22, respectively, immediately below the granular base material.

4.2 Core Data

The thicknesses of the asphalt measured from the core samples generally confirmed the asphalt thicknesses indicated in the boreholes at the corresponding locations. The following table presents a summary of the asphalt core data.

Location	Range (mm)	Average (mm)
Eastbound Lane	125 – 150	135
Westbound Lane	130 – 195	160
Average	**150**	

4.3 Subgrade Soil

The subgrade soils encountered in the majority of the boreholes generally consisted of brown silty clay with trace to some sand and trace gravel.

4.4 Topsoil

The thickness of the topsoil measured in 8 boreholes drilled along the ditch line on either side of the existing road ranged from 50 to 150 mm and averaged about 75 mm.

4.5 Groundwater Conditions

The subgrade soils encountered in the boreholes drilled through the existing pavement were generally in a moist condition. Groundwater was not encountered in any of the boreholes.

4.6 Bedrock

Bedrock was not encountered in any of the boreholes, generally advanced to a depth of 1.5 m.

4.7 Core Construction

The existing shoulder structure is comprised of a thin layer of granular material, generally about 240 mm in thickness, over silty clay. As the thickness of the pavement structure is about 625 mm, the granular thickness on the shoulders will not be sufficient to provide lateral drainage of the existing pavement. This type of construction known as “Core Construction” was common practice in some municipalities until the late 1970’s.

5.0 LABORATORY TESTING

Gradation testing was carried out on four selected samples of the crushed granular base and the results were compared to the current OPSS 1010 requirements for Granular 'A' base material. The results indicate that three of the granular base samples, do not satisfy the current OPSS 1010 requirements due to excessive amounts of material passing some sieve sizes. The granular sample taken from BH 26 located at 600 m east of Neyagawa Blvd. satisfies the OPSS 1010 requirements for Granular 'A' base material. Typical gradation test results for the granular base samples are shown on Figure D1 (Appendix D).

Laboratory testing was also carried out on selected samples of the native silty clay subgrade material. The results indicate that the average in-situ moisture of the subgrade material was 24.5 percent. The subgrade soils tested generally have a low (LSFH) to moderate (MSFH) susceptibility to frost heave. Typical gradation test results for the subgrade samples are shown on Figure D2 (Appendix D).

6.0 RECOMMENDATIONS AND CONSTRUCTION FEATURES

6.1 Existing Pavement Structure

The structural and drainage coefficients for the existing pavement materials used to evaluate the existing structural capacity are as listed in the following table:

Material	Structural Coefficient	Drainage Coefficient	Existing sn
Existing Hot Mix Asphalt	0.28	1.0	42
Existing Granular Base	0.12	0.9	51

The borehole data summary and the evaluation of the existing pavement structural capacity for each road section are provided in the following sections.

The typical pavement structure along these two sections of Burnhamthorpe Road consists of 125 to 200 mm (150 mm typical) of Hot Mix Asphalt (HMA) over about 475 mm of crushed granular base. The typical thickness of the total pavement is about 625 mm. Surface drainage is generally provided by the raised nature of the roadbed and ditches. However, as indicated earlier, these two sections of Burnhamthorpe Road have undergone core construction, i.e. the granular material underneath the pavement do not daylight into the ditches.

The pavement is generally in good condition along both sections. Relatively impermeable silty clay material is present directly beneath the pavement structure or at shallow depths, at most of the borehole locations.

6.2 Traffic Analysis

The traffic information including Annual Average Daily Traffic (AADT), percentages of commercial traffic (% COMM) and proposed number of lanes, were provided by AECOM in an email dated August 18, 2008 and is summarized in the following tables:

BURNHAMTHORPE ROAD		
AADT (2021)	**% COMM**	**NO. OF LANES PROPOSED**
30,000	4.0	4

An average rate of increase in traffic of 2% was assumed for design purposes. Based on the traffic data, the Equivalent Single Axle Loads (ESALs) over a 20 year design period for a four lane urban minor arterial road was calculated using the procedures outlined in the MTO's "*Manual for Estimating Traffic Loads for Pavement Design, November 1995*". For estimation purposes, we have assumed that the upgrades will be completed and the road section will be open to traffic by 2011 east of Trafalgar Road and 2015 west of Trafalgar Road. The results of the ESAL analysis for the two sections on Burnhamthorpe Road are summarised as follows:

Burnhamthorpe Road	DESIGN YEARS	ESALS
West of Trafalgar Road	20	4.9×10^6
East of Trafalgar Road	20	4.6×10^6

6.3 AASHTO Design Analysis

The 1993 AASHTO Guide for Design of Pavement Structures (AASHTO) was used to design the thickness of the pavement structure layers. In accordance with MI-183, the Ontario Ministry of Transportation's pavement design guideline entitled "*Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*", the following design parameters were selected for the AASHTO pavement design analysis:

Design Parameter	Burnhamthorpe Road
Initial Serviceability Index	4.5
Terminal Serviceability Index	2.5
Desired Reliability (%)	90
Estimated Elastic Modulus for Subgrade Soil (MPa)	20 (CL fair)
Standard Deviation	0.45
Layer coefficient of New Asphalt	0.44
Layer coefficient of New Granular A	0.14

The results indicate that the required Structural Number (SN) for both the road sections within the project limit is 147 mm. The detailed ESAL calculation and AASHTO pavement design analysis for the rehabilitation /

reconstruction of the existing lanes and for the widening / new construction of Burnhamthorpe Road are provided in Appendix E.

6.4 Pavement Design Recommendations

Preliminary pavement design recommendations for the rehabilitation/widening/new construction for both sections of Burnhamthorpe Road are provided in the following sections.

The results of the pavement visual condition survey, and the borehole/coring investigation were used in the development of the pavement rehabilitation strategy and the design of the new pavement structures. The objective was to design cost-effective pavement structures that would be able to support the design traffic loading over a period of 20 years.

6.4.1 New Construction / Reconstruction

It is understood that widening is proposed on both sides of existing Burnhamthorpe Road. In addition, installation of storm sewers is proposed at some locations which may require reconstruction of the road. Therefore, in the areas where rehabilitation strategy is not feasible (due to grade raise), reconstruction may be required by removing the existing roadbed.

Based on the results of the investigation and the pavement design analysis, the pavement structure for new construction / reconstruction / widening, where required, is as follows:

- Starting from the edge of the existing pavement (EP), remove the existing asphalt and underlying granular and subgrade materials to a depth of 1.0 m, re-grade, compact and place new granular materials and hot mix asphalt as follows:

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
50 mm	HDBC	(Alternative: SuperPave 19.0)	Upper Binder Course
60 mm	HDBC	(Alternative: SuperPave 19.0)	Lower Binder Course
150 mm	OPSS Granular A		Base
700 mm	OPSS Granular B Type I		Subbase
		Over prepared and approved subgrade	

6.4.2 Rehabilitation of Existing Pavement

(Sta.15+050 to Sta. 16+400 and Sta. 21+600 to Sta. 22+050)

Based on the results of this investigation, the existing pavement is in good condition with the main forms of distress being moderate to severe flushing and moderate intermittent pavement edge cracking. Therefore, in the areas where the proposed road alignment and profile are to remain, consideration was given to rehabilitating the existing pavement in order to salvage the existing road base and subbase material. Based on the evaluation of the existing pavement structure and the analysis of the structural requirement for the proposed upgrading, the existing pavement has a deficiency of about 54 mm (147-93 mm). This deficiency can be corrected by a direct overlay consisting of three lifts of new hot mix asphalt.

A number of different rehabilitation scenarios were considered based on the proposed alignment and profile changes. The following pavement rehabilitation or reconstruction strategies are recommended for the five possible scenarios:

Case 1 – Grade raise less than 90 mm, or grade lowering

- If the proposed profile has a grade-raise less than 90 mm, then full depth reconstruction should be carried out using the new pavement structure as recommended previously for new construction.

Case 2 – Grade raise between 90 mm and 110 mm

- If the proposed profile has a grade-raise between 90 mm and 110 mm, then the recommended rehabilitation strategy is to remove the existing asphalt completely and overlay with 220 mm of new hot mix asphalt as follows:

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
50 mm	HDBC	(Alternative: SuperPave 19.0)	Upper Binder Course
60 mm	HDBC	(Alternative: SuperPave 19.0)	Intermediate Binder Course
70 mm	HDBC	(Alternative: SuperPave 19.0)	Lower Binder Course
		Over top of approved base material	

Where required, asphalt padding should be carried out to raise the grade prior to placing the four lifts of hot mix asphalt.

Case 3 – Grade raise between 110 mm and 150 mm

- If the proposed profile has a grade-raise between 110 mm and 150 mm, the recommended rehabilitation strategy is to mill 40 mm to remove the surficial distresses on the asphalt (i.e. flushing, rutting) and overlay with 150 mm of new asphalt as follows:

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
50 mm	HDBC	(Alternative: SuperPave 19.0)	Upper Binder Course
60 mm	HDBC	(Alternative: SuperPave 19.0)	Lower Binder Course
		Over top of milled asphalt	

Where required, asphalt padding should be carried out to raise the grade prior to placing the three lifts of hot mix asphalt.

Case 4 – Grade raise between 150 mm and 300 mm

- If the proposed profile has a grade-raise between 150 mm and 300 mm, the recommended rehabilitation strategy is a direct overlay with 150 mm of new hot mix asphalt as follows:

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
50 mm	HDBC	(Alternative: SuperPave 19.0)	Upper Binder Course
60 mm	HDBC	(Alternative: SuperPave 19.0)	Lower Binder Course

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
Min. 150 mm		OPSS Granular A Over top of pulverized base material	Base

Where required, asphalt padding should be carried out to raise the grade prior to placing the three lifts of hot mix asphalt.

Case 5 – Grade raise greater than 300 mm

- If the proposed profile has a grade-raise greater than 300 mm, the recommended rehabilitation strategy is to pulverize the existing pavement to a depth of 300 mm and place a minimum 300 mm of Granular A and three lifts of new hot mix asphalt as follows:

40 mm	HL 1	(Alternative: SuperPave 12.5 FC1)	Surface Course
50 mm	HDBC	(Alternative: SuperPave 19.0)	Upper Binder Course
60 mm	HDBC	(Alternative: SuperPave 19.0)	Lower Binder Course
Min. 150 mm		OPSS Granular A Over top of pulverized base material	Base

Note: milling might be necessary at some locations to reduce asphalt thickness to a maximum of 150 mm prior to pulverizing. Where required, the thickness of the Granular A base material should be used to increase the grade to the desired elevation prior to placing the three new lifts of hot mix asphalt.

As mentioned previously the existing road platform was constructed using a “Core Construction” method. Therefore, in order to provide adequate lateral drainage for the existing roadbed in areas where widening is proposed, the widening construction should start from the existing edge of pavement. The total pavement thickness on the widening should be greater than the thickness of the existing pavement and any grade raise resulting from the rehabilitation of the existing lanes.

Reconstruction of Shoulders

If a rural cross section is maintained at some locations, (i.e. project limits), reconstruction of the shoulder will be required. The recommended pavement structure for the reconstruction of the shoulders is as follows:

New Hot Mix Asphalt	-	90 mm
New Granular A, Base	-	210 mm
New Granular B Type I, Subbase	-	700 mm
Total Thickness		**1000 mm**

The top two lifts of the asphalt should extend over the full width of the new shoulders. The excavation for the reconstruction of the shoulders should commence from the existing edge of pavement. To facilitate drainage, the base and subbase granulars should extend across the full width of the roadway and daylight into the ditches.

6.5 Asphalt Cement

It is recommended that PG 58-28 asphalt cement be used for all Superpave mixes used on this project.

6.6 Topsoil Stripping

As indicated previously, topsoil was generally encountered at shallow depths in the majority of the boreholes advanced through the existing ditchline. The thickness of topsoil encountered within the project limits varied from 30 mm to 150 mm and averaged about 75 mm. It is recommended that any topsoil and fill material mixed with rootlets/organics that is within 1.2 m of finished grade and directly underlying the footprint of the proposed road platform, (including the paved shoulders, where required) be removed completely and replaced with approved fill. If the proposed widening is located over existing ditches, the topsoil should be removed and replaced, regardless of the depth from profile grade.

6.7 Groundwater Seepage

Free water was not encountered in any of the boreholes advanced for this project. At the relatively shallow depths drilled, the native soils were generally in a moist condition. However, the groundwater levels are expected to fluctuate, being higher in wet periods (i.e spring thaw) and lower during drier, summer period.

6.8 Embankment Slopes

At any location where the existing embankment has to be widened, the new fill material should be benched into the existing slope as per current OPSD 208 standards. To ensure proper construction and uniform settlement of the embankments, organic soils, if encountered within the footprint of the widening should be removed to a depth of 1.2 m below the bottom of the pavement structure, and the embankment reconstructed using approved fill.

Slope stability problems are not anticipated provided that 2H:1V slopes minimum are maintained. Vegetation should be established as early as possible to control erosion. Earth grading should be carried out in accordance with OPSD 200 Series.

6.9 Drainage

We understand that Burnhamthorpe Road within the project limits will be reconstructed and urbanized. As such, a subdrain system is necessary to provide proper drainage of the pavement. The drainage system should consist of a 150 mm diameter perforated pipe, placed inside a trench and surrounded by clear stone or concrete sand. The trench should be lined with a suitable geotextile prior to placing the clear stone/concrete sand. At the top of the trench, the geotextile should overlap a minimum of 100 mm. The geotextile shall conform to OPSS 1860, Class 1 and be non-woven with a F.O.S. in the range of 75 to 150 micron. The drain invert should be at least 1.2 m below top of finished pavement. A typical subdrain detail is shown on Figure F1, Appendix F.

In areas where the rural cross section will be maintained, (ie. project limits) ditching is required on both side of the roadbed. As a minimum, the invert of ditches should be 0.5 m below the bottom of the adjacent subbase

layer. The granular materials for base and subbase should extend across the full width of the roadway and daylight in ditches to facilitate drainage.

6.10 Soils Erodibility Factor

Gradation testing carried out on selected subgrade samples indicates that the soil erodibility factor "K" ranges from 0.33 to 0.42. The erodibility can be described as moderate.

7.0 CLOSING

We trust that this report provides sufficient preliminary pavement / geotechnical information for the Class Environmental Assessment Study being undertaken by AECOM. If you have any questions, or require any additional information, please do not hesitate to contact us.

Report Signature Page

Darrin R. Sellick
Senior Geotechnical Technologist

Andrew C. Balasundaram, P.Eng.
Principal, Pavement and Materials Engineering

LICENSED PROFESSIONAL ENGINEER
A.C. BALASUNDARAM
PROVINCE OF ONTARIO

DRS/ACB/tf

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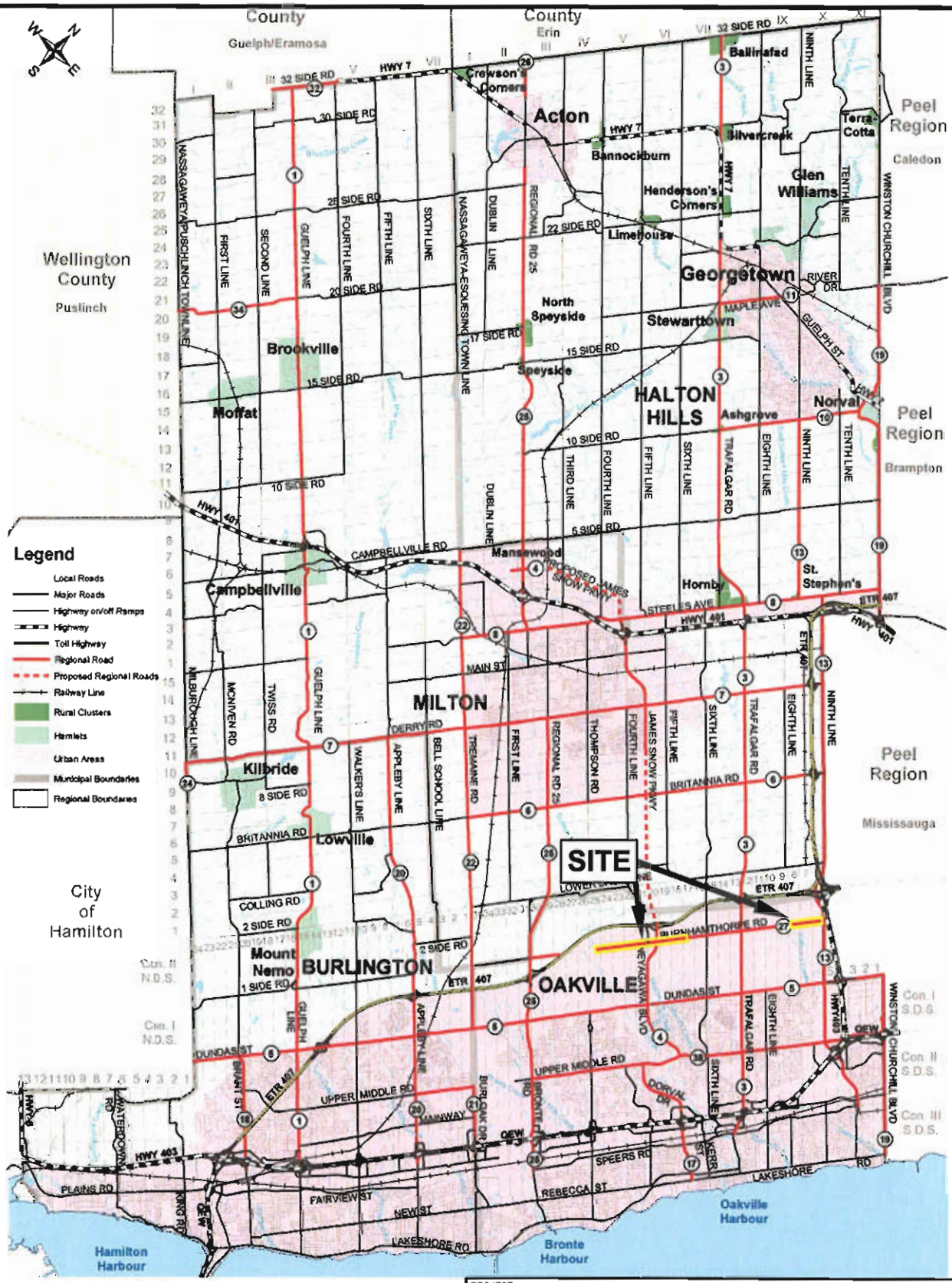


ALL LOCATIONS ARE APPROXIMATE

REFERENCE

Base map entitled *"Regional Municipality of Halton, Planning and Public Works"*, dated July 2008.

PROJECT

AECOM
Class EA Study of Burnhamthorpe Road
Halton Region, Ontario

TITLE

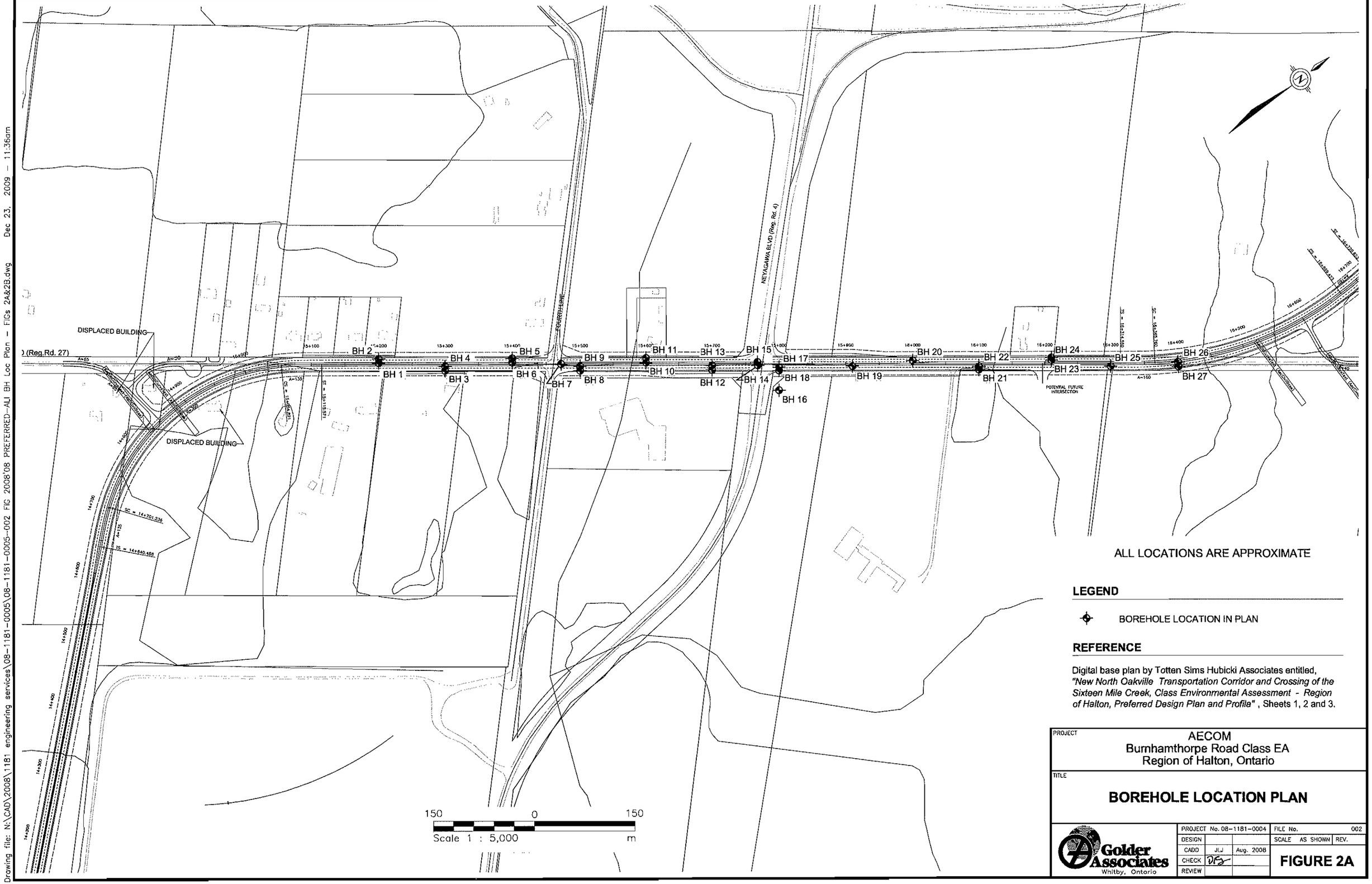
KEY PLAN

Golder Associates
Whitby, Ontario

PROJECT No. 08-1181-0005		FILE No.	001
DESIGN		SCALE AS SHOWN	REV.
CADD	BHJ	Aug. 2008	
CHECK			
REVIEW			

FIGURE 1

Drawing file: N:\CAD\2008\1181 engineering services\08-1181-0005\08-1181-0005-001 FIG 2008'08 Burnhamthorpe Rd Oakville - FIG 1-KP.dwg Dec 23, 2009 - 11:35am



ALL LOCATIONS ARE APPROXIMATE

LEGEND

⌖ BOREHOLE LOCATION IN PLAN

REFERENCE

Digital base plan by Totten Sims Hubicki Associates entitled, *"New North Oakville Transportation Corridor and Crossing of the Sixteen Mile Creek, Class Environmental Assessment - Region of Halton, Preferred Design Plan and Profile"* , Sheets 1, 2 and 3.

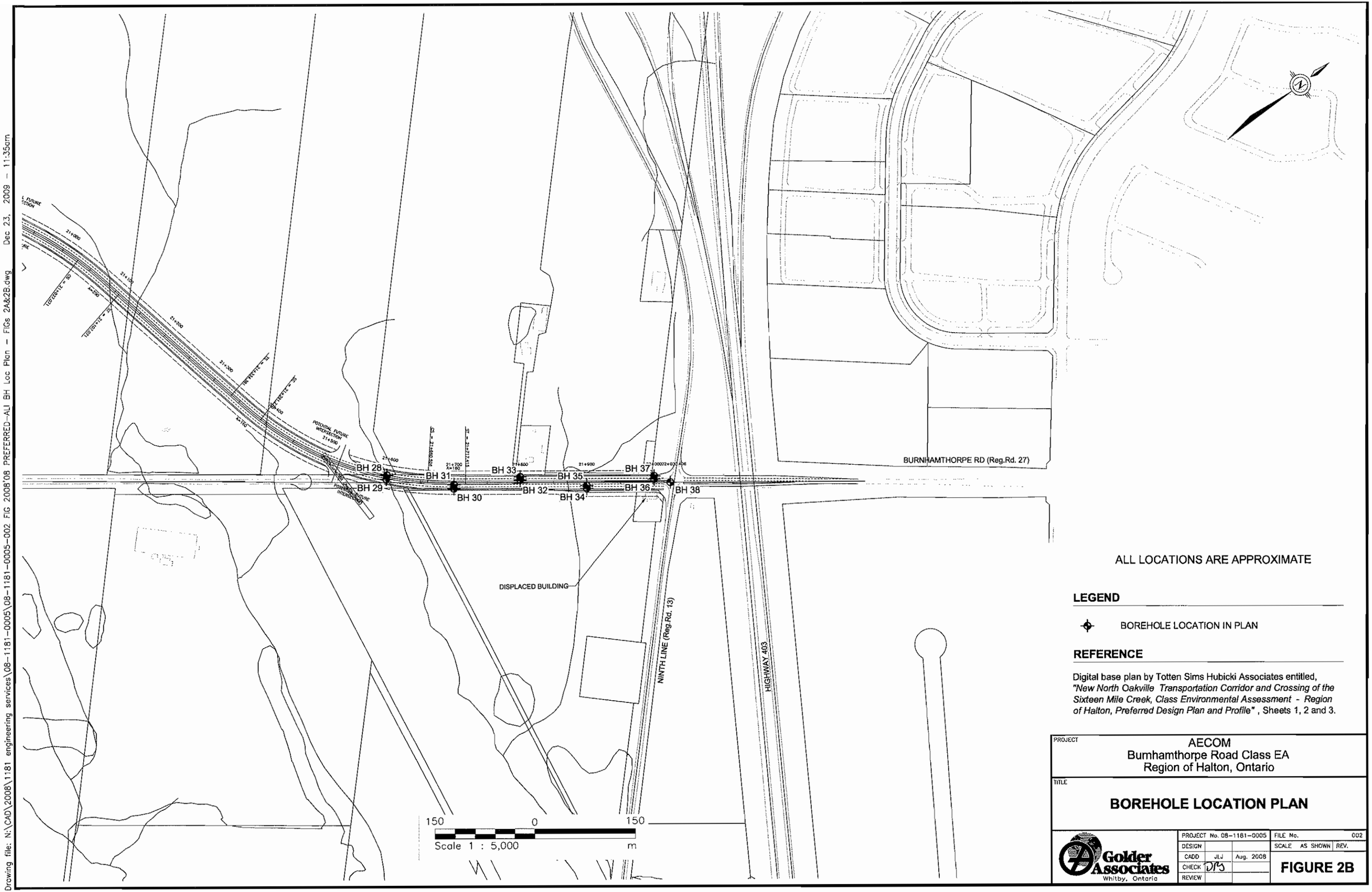
PROJECT
AECOM
Burnhamthorpe Road Class EA
Region of Halton, Ontario

TITLE
BOREHOLE LOCATION PLAN

Golder Associates
Whitby, Ontario

PROJECT No. 08-1181-0004			FILE No. 002
DESIGN			SCALE AS SHOWN REV.
CADD	JLJ	Aug. 2008	
CHECK	DFS		FIGURE 2A
REVIEW			

Drawing file: N:\CAD\2008\1181 engineering services\08-1181-0005\08-1181-0005-002 FIG 2008'08 PREFERRED-ALI BH Loc Plan - FIGs 2A&2B.dwg Dec 23, 2009 - 11:36am



ALL LOCATIONS ARE APPROXIMATE

LEGEND

BOREHOLE LOCATION IN PLAN

REFERENCE

Digital base plan by Totten Sims Hubicki Associates entitled, *"New North Oakville Transportation Corridor and Crossing of the Sixteen Mile Creek, Class Environmental Assessment - Region of Halton, Preferred Design Plan and Profile"* , Sheets 1, 2 and 3.

PROJECT
AECOM
Burnhamthorpe Road Class EA
Region of Halton, Ontario

TITLE
BOREHOLE LOCATION PLAN

Golder Associates
Whitby, Ontario

PROJECT No. 08-1181-0005			FILE No.	002
DESIGN			SCALE AS SHOWN	REV.
CADD	JLJ	Aug. 2008		
CHECK	DRS		**FIGURE 2B**	
REVIEW				

Drawing file: N:\CAD\2008\1181 engineering services\08-1181-0005\08-1181-0005-002 FIG 2008'08 PREFERRED-ALI BH Loc Plan - FIGs 2A&2B.dwg Dec 23, 2009 - 11:35am

APPENDIX A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Summary of Visual Pavement Condition Evaluations

Flexible Pavement Condition Evaluation Form

Location: Burnhamthorpe Road

From: Station 15+050 To: Station 15+450

LHRS ( ) ( ) km (Begins / Offset) Section Length 0.4 Km District ( )

Survey Date 08 (Year) 05 (Month) PCR 72 RCR 7.0 Traffic Direction B (B Both Directions; N North Bound; S South Bound; E East Bound; W West Bound) Highway ( )

Contract No. ( ) - ( ) WP No. ( ) Facility A (A All Lanes; C Collector; E Express; O Others (Additional Lanes)) Class L (F Freeway; A Arterial; C Collector; L Local; S Secondary)

Ride Condition Rating (at 80 km/hr)

10 Excellent — Smooth and Pleasant
8 Good — Comfortable
6 Fair — Uncomfortable
4 Poor — Very rough and bumpy
2 Very Poor — Dangerous at 80 km/h
0

Pavement			Severity of Distress: Very Slight (1)	Slight (2)	Moderate (3)	Severe (4)	Very Severe (5)	Density of Distress (Extent of Occurance, %): Few <10 (1)	Intermittent 10-20 (2)	Frequent 20-50 (3)	Extensive 50-80 (4)	Throughout 80-100 (5)
SURFACE DEFECT	Raveling & C. Agg Loss	1										
	Flushing	2				√						√
SURFACE DEFORMATION	Rippling and Shoving	3										
	Wheel Track Rutting	4		√						√		
	Distortion	5										
CRACKING — Longitudinal Wheel Track	Single and Multiple	6										
	Alligator	7										
CRACKING — Centre Line	Single and Multiple	8										
	Alligator	9										
CRACKING — Pavement Edge	Single and Multiple	10			√					√		
	Alligator	11										
CRACKING — Transverse	Half, Full and Multiple	12										
	Alligator	13										
CRACKING — Longitudinal Meander and Midlane		14										
CRACKING — Map		15										

Distress Comments (Items not covered above)

Chip seal delaminated in a few places.

Shoulders		Distress	Severity of Distress: RIGHT Mod (1)	RIGHT Sev (2)	LEFT Mod (1)	LEFT Sev (2)	Density of Distress (Extent of occurrence, %): RIGHT 10-30 (1)	RIGHT >30 (2)	LEFT 10-30 (1)	LEFT >30 (2)
PAVED FULL	✓	Cracking								
PAVED PARTIAL		Pavement Edge / Curb Separation								
SURFACE TREATED		Distortion								
PRIMED		Breakup / Separation								
GRAVEL		Edge Break								

Maintenance Treatment		EXTENT OF OCCURRENCE, %: <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
PAVEMENT	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
SHOULDERS	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Other Comments (e.g. subsections, additional contracts) Chip seal over asphalt.

Evaluated by: Rob Douglas

Flexible Pavement Condition Evaluation Form

Location: Burnhamthorpe Road

From: Station 15+450 **To:** Station 15+750

LHRS Begins ____ Offset ____ km **Section Length** 0.3 Km **District** ____

Survey Date Year 0 0 Month 0 5 **PCR** 78 **RCR** 8.0 **Traffic Direction** B (B Both Directions, N North Bound, S South Bound, E East Bound, W West Bound) **Highway** ____

Contract No. ____ - ____ **WP No.** ____ - ____ - ____ **Facility** A (A All Lanes, C Collector, E Express, O Others (Additional Lanes)) **Class** L (F Freeway, A Arterial, C Collector, L Local, S Secondary)

Ride Condition Rating (at 80 km/hr)

- 10 **Excellent** Smooth and Pleasant
- 8 **Good** Comfortable
- 6 **Fair** Uncomfortable
- 4 **Poor** Very rough and bumpy
- 2 **Very Poor** Dangerous at 80 km/h
- 0

Pavement			Severity of Distress: Very Slight (1)	Slight (2)	Moderate (3)	Severe (4)	Very Severe (5)	Density of Distress Extent of Occurance, %: Few <10 (1)	Intermittent 10-20 (2)	Frequent 20-50 (3)	Extensive 50-80 (4)	Throughout 80-100 (5)
SURFACE DEFECT	Ravelling & C. Agg. Loss	1										
	Flushing	2										
SURFACE DEFORMATION	Rippling and Shoving	3										
	Wheel Track Rutting	4		✓						✓		
	Distortion	5										
CRACKING – Lonitudinal Wheel Track	Single and Multiple	6										
	Alligator	7										
CRACKING – Centre Line	Single and Multiple	8		✓					✓			
	Alligator	9										
CRACKING – Pavement Edge	Single and Multiple	10			✓				✓			
	Alligator	11										
CRACKING – Transverse	Half, Full and Multiple	12										
	Alligator	13										
CRACKING – Longitudinal Meander and Midlane		14										
CRACKING – Map		15										

Distress Comments (items not covered above)

Shoulders			Severity of Distress RIGHT Mod (1)	RIGHT Sev (2)	LEFT Mod (1)	LEFT Sev (2)	Density of Distress Extent of occurrence, % RIGHT 10-30 (1)	RIGHT >30 (2)	LEFT 10-30 (1)	LEFT >30 (2)
PAVED FULL		Cracking								
PAVED PARTIAL		Pavement Edge / Curb Separation								
		Distortion								
SURFACE TREATED	✓	Breakup / Separation								
		Edge Break								
PRIMED		Breakup / Separation								
GRAVEL										

Maintenance Treatment		EXTENT OF OCCURRENCE, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
PAVEMENT	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
SHOULDERS	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Other Comments (e.g. subsections, additional contracts) ____

Evaluated by: Rob Douglas

Flexible Pavement Condition Evaluation Form

Location: Burnhamthorpe Road

From: Station 15+750 **To:** Station 16+400

LHRS _____ Begins _____ km Offset **Section Length** 7 Km **District** _____

Survey Date 08 Year 05 Month **PCR** 80 **RCR** 8.0 **Traffic Direction** B (B Both Directions, N North Bound, S South Bound, E East Bound, W West Bound) **Highway** _____

Contract No. _____ - _____ **WP No.** _____ - _____ - _____ **Facility** A (A All Lanes, C Collector, E Express, O Others (Additional Lanes)) **Class** L (F Freeway, A Arterial, C Collector, L Local, S Secondary)

Ride Condition Rating (at 80 km/hr)

10 **Excellent** Smooth and Pleasant
8 **Good** Comfortable
6 **Fair** Uncomfortable
4 **Poor** Very rough and bumpy
2 **Very Poor** Dangerous at 80 km/h
0

Pavement			Severity of Distress: Very Slight (1)	Slight (2)	Moderate (3)	Severe (4)	Very Severe (5)	Density of Distress Extent of Occurance, %: Few <10 (1)	Intermittent 10-20 (2)	Frequent 20-50 (3)	Extensive 50-80 (4)	Throughout 80-100 (5)
SURFACE DEFECT	Ravelling & C. Agg. Loss	1										
	Flushing	2				√				√		
SURFACE DEFORMATION	Rippling and Shoving	3										
	Wheel Track Rutting	4		√							√	
	Distortion	5										
CRACKING: Lonitudinal Wheel Track	Single and Multiple	6										
	Alligator	7										
CRACKING: Centre Line	Single and Multiple	8										
	Alligator	9										
CRACKING: Pavement Edge	Single and Multiple	10			√				√			
	Alligator	11										
CRACKING: Transverse	Half, Full and Multiple	12										
	Alligator	13										
CRACKING: Longitudinal Meander and Midlane		14										
CRACKING: Map		15										

Distress Comments (items not covered above)

Shoulders			Severity of Distress RIGHT Mod (1)	RIGHT Sev (2)	LEFT Mod (1)	LEFT Sev (2)	Density of Distress Extent of occurrence, % RIGHT 10-30 (1)	RIGHT >30 (2)	LEFT 10-30 (1)	LEFT >30 (2)
Dominant Type	One	Distress								
PAVED FULL		Cracking								
PAVED PARTIAL		Pavement Edge / Curb Separation								
		Distortion								
SURFACE TREATED	√	Breakup / Separation								
		Edge Break								
PRIMED		Breakup / Separation								
GRAVEL										

Maintenance Treatment		EXTENT OF OCCURRENCE, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
PAVEMENT	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
SHOULDERS	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Other Comments (e.g. subsections, additional contracts) _____

Evaluated by: Rob Douglas

Flexible Pavement Condition Evaluation Form

Location: Burnhamthorpe Road

From: Station 21+650 **To:** Station 22+000

LHRS Begins: | | | | | | Offset: | | | • | | km **Section Length** | | • | 4 | Km **District** | |

Survey Date Year: 0 8 Month: 0 5 **PCR** | 8 | 0 **RCR** 8 • 0 **Traffic Direction** B (B Both Directions, N North Bound, S South Bound, E East Bound, W West Bound) **Highway** | | | |

Contract No. | | - | | | | **WP No.** | | | - | | - | | | **Facility** A (A All Lanes, C Collector, E Express, O Others (Additional Lanes)) **Class** L (F Freeway, A Arterial, C Collector, L Local, S Secondary)

Ride Condition Rating (at 80 km/hr)

- 10 **Excellent** Smooth and Pleasant
- 8 **Good** Comfortable
- 6 **Fair** Uncomfortable
- 4 **Poor** Very rough and bumpy
- 2 **Very Poor** Dangerous at 80 km/h
- 0

Pavement			Severity of Distress: Very Slight (1)	Slight (2)	Moderate (3)	Severe (4)	Very Severe (5)	Density of Distress, Extent of Occurance, %: Few <10 (1)	Intermittent 10-20 (2)	Frequent 20-50 (3)	Extensive 50-80 (4)	Throughout 80-100 (5)
SURFACE DEFECT	Ravelling & C Agg. Loss	1										
	Flushing	2			√					√		
SURFACE DEFORMATION	Rippling and Shoving	3										
	Wheel Track Rutting	4		√							√	
	Distortion	5										
CRACKING: Lonitudinal Wheel Track	Single and Multiple	6										
	Alligator	7										
Centre Line	Single and Multiple	8										
	Alligator	9										
Pavement Edge	Single and Multiple	10		√							√	
	Alligator	11										
Transverse	Half, Full and Multiple	12										
	Alligator	13										
Longitudinal Meander and Midlane		14										
Map		15										

Distress Comments (Items not covered above)

Shoulders			Severity of Distress: RIGHT Mod (1)	RIGHT Sev (2)	LEFT Mod (1)	LEFT Sev (2)	Density of Distress, Extent of occurrence, %: RIGHT 10-30 (1)	RIGHT >30 (2)	LEFT 10-30 (1)	LEFT >30 (2)
PAVED FULL		Cracking								
PAVED PARTIAL		Pavement Edge / Curb Separation								
		Distortion								
SURFACE TREATED	√	Breakup / Separation								
		Edge Break								
PRIMED		Breakup / Separation								
GRAVEL										

Maintenance Treatment		EXTENT OF OCCURRENCE, %: <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
PAVEMENT	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
SHOULDERS	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Other Comments (e.g. subsections, additional contracts)

Evaluated by: Rob Douglas

APPENDIX C

Borehole Logs

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation
Location	Sta. 15+200 1.75m N of C/L. D - 0						
BH 1	0	-	190	Asphalt			
	190	-	280	Brown crushed granular	190-280	6.3	Uncceptable Gran A
	280	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 15+200 2.80m N of C/L, D - 0.05						
BH 2	0	-	100	Topsoil			
	100	-	180	Brown crushed granular			
	180	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 15+300 5.0m S of C/L, D -0 05						
BH 3	0	-	50	Topsoil			
	50	-	1.5	Brown silty clay, trace gravel, trace sand, moist	700-1000	25.2	
Location	Sta. 15+300 3.5m S of C/L, D + 0.05						
BH 4	0	-	80	Topsoil			
	80	-	170	Brown crushed granular			
	170	-	1.5	Brown silty clay, trace gravel, trace sand, moist	900-1200	20.4	
Location	Sta. 15+400 3.50m N of C/L, D - 0.10						
BH 5	0	-	100	Brown crushed granular			
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist			

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation
Location	Sta. 15+400 2.30m N of C/L, D - 0						
BH 6	0	-	200	Asphalt			
	200	-	340	Brown crushed granular			
	340	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	12.8	
Location	Sta. 15+470 1.90m E of C/L, D - 0						
BH 7	0	-	130	Asphalt			
	130	-	220	Brown crushed granular	130-220	4	
	220	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 15+500, 5.0m S of C/L, D - 0.05						
BH 8	0	-	640	Brown crushed granular	300-600	3	
	640	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 15+500 3.30m S of C/L, D - 0.05						
BH 9	0	-	170	Asphalt			
	170	-	410	Brown crushed granular			
	410	-	1.5	Brown silty clay, trace gravel, trace sand, moist	700-1000	21	
Location	Sta. 15+600 1.80m N of C/L, D - 0						
BH 10	0	-	140	Asphalt			
	140	-	330	Brown crushed granular			
	330	-	1.5	Brown silty clay, trace gravel, trace sand, moist			

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING		
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation	
Location	Sta. 15+600 3.80m N of C/L, D - 0							
BH 11	0	-	50	Topsoil				
	50	-	180	Brown crushed granular				
	180	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	23.7		
Location	Sta. 15+700 7.0m S of C/L, D - 0.15							
BH 12	0	-	100	Topsoil				
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 15+700 5.0m S of C/L, D - 0							
BH 13	0	-	140	Asphalt				
	140	-	1.0	Brown crushed granular				
	1.0	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 15+770 7.0m of W of Neyagawa Road, D - 0							
BH 14	0	-	140	Asphalt				
	140	-	660	Brown crushed granular	350-650	3.4	Acceptable Gran A	
	660	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 15+780 7.5m W of Neyagawa Median, D - 0							
BH 15	0	-	130	Asphalt				
	130	-	620	Brown crushed granular				
	620	-	1.5	Brown silty clay, trace gravel, trace sand, moist				

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation
Location	Sta. 15+800 4.0m S of C/L, D - 0						
BH 16	0	-	130	Asphalt			
	130	-	1.5	Brown crushed granular			
Location	Sta. 15+800 5.20m S of C/L, D - 0.05						
BH 17	0	-	100	Topsoil			
	100	-	1.5	Crushed granular	1200-1500	4.5	
Location	Sta. 15+800 8.0m S of C/L, D - 0						
BH 18	0	-	50	Topsoil			
	50	-	1.5	Brown silty clay, trace gravel, trace sand, moist	600-900	19.2	
Location	Sta. 15+910 4.0m S of C/L, D - 0						
BH 19	0	-	120	Brown crushed granular			
	120	-	140	Asphalt			
	140	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	12.6	
Location	Sta. 16+000 4.20m N of C/L, D - 0						
BH 20	0	-	50	Topsoil			
	50	-	120	Brown crushed granular			
	120	-	1.5	Brown silty clay, trace gravel, trace sand, moist			

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING		
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation	
Location	Sta. 16+100 7.0m S of C/L, D - 1.0							
BH 21	0	-	100	Topsoil				
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 16+100 4.30m S of C/L, D - 0.10							
BH 22	0	-	30	Topsoil				
	30	-	150	Brown crushed granular				
	150	-	200	Asphalt				
	200	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	17.8		
Location	Sta. 16+210 4.50m N of C/L, D - 0.10							
BH 23	0	-	100	Topsoil				
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 16+210 6.20m N of C/L, D - 0.50							
BH 24	0	-	120	Topsoil				
	120	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 16+300 4.50m S of C/L, D - 0.10							
BH 25	0	-	50	Brown crushed granular				
	50	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	12.6		

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG						LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation	
Location	Sta. 16+400 2.0m S of C/L, D - 0							
BH 26	0	-	160	Asphalt				
	160	-	290	Brown crushed granular	160-290	4.4	Acceptable Gran A	
	290	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 16+400 3.70m S of C/L, D - 0.25							
BH 27	0	-	120	Topsoil				
	120	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 21+600 2.60m N of C/L, D - 0							
BH 28	0	-	140	Asphalt				
	140	-	460	Brown crushed granular				
	460	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1100-1400	14.7		
Location	Sta. 21+600 3.70m S of C/L, D - 0.20							
BH 29	0	-	100	Brown crushed granular				
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist				
Location	Sta. 21+700 3.80m S of C/L, D - 0							
BH 30	0	-	100	Brown crushed granular				
	100	-	1.5	Brown silty clay, trace gravel, trace sand, moist				

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation
Location	Sta. 21+700 2.80m S of C/L, D - 0						
BH 31	0	-	150	Asphalt			
	150	-	450	Brown crushed granular	150-450	4.3	Unacceptable Gran A
	450	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta.21+800 4.10m N of C/L, D - 0						
BH 32	0	-	120	Brown crushed granular			
	120	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	29.1	
Location	Sta. 21+800 6.20m N of C/L, D - 0.75						
BH 33	0	-	120	Topsoil			
	120	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 21+900 9.0m S of C/L, D - 0.90						
BH 34	0	-	150	Topsoil			
	150	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 21+900 4.50m S of C/L, D - 0.10						
BH 35	0	-	850	Brown crushed granular			
	850	-	1.5	Brown silty clay, trace gravel, trace sand, moist			

RECORD OF BOREHOLES

APPENDIX C

Geotechnical Services for Class Environmental Assessment Study of Burnhamthorpe Road

BOREHOLE	BOREHOLE LOG					LABORATORY TESTING	
	Depth (mm)			Description	Sample Depth (mm)	Water Content (%)	Gradation
Location	Sta. 22+000 4.60m N of C/L, D - 0						
BH 36	0	-	140	Asphalt			
	140	-	720	Brown crushed granular			
	720	-	1.5	Brown silty clay, trace gravel, trace sand, moist	1200-1500	13.9	
Location	Sta. 22+000 7.0m N of C/L, D - 0.80						
BH 37	0	-	130	Topsoil			
	130	-	1.5	Brown silty clay, trace gravel, trace sand, moist			
Location	Sta. 22+030 5.75m W of Ninth Line, D - 0						
BH 38	0	-	150	Asphalt			
	150	-	1.5	Brown crushed granular	1000-1300	3.7	

Inputted by: TF

Checked by:

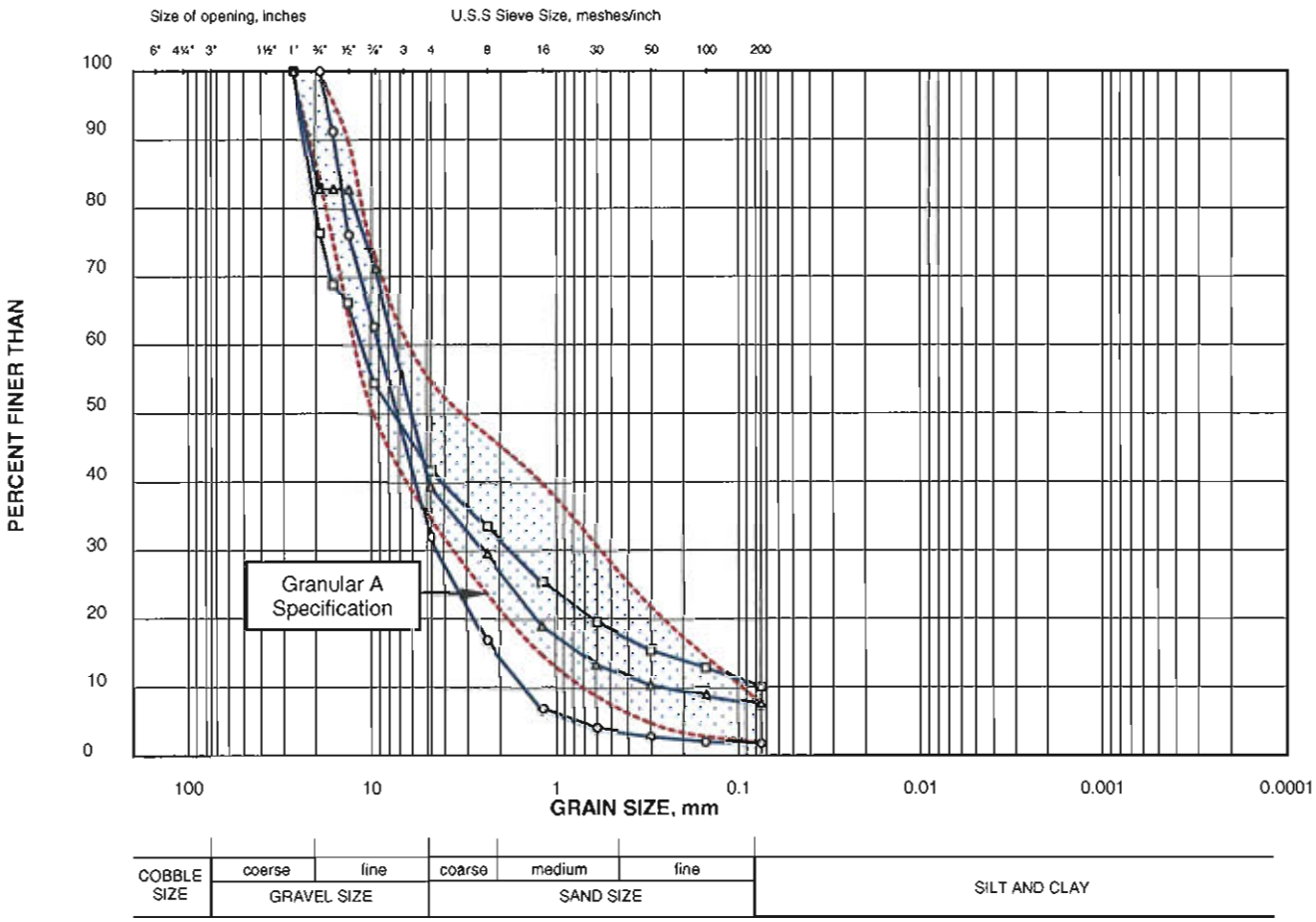
APPENDIX D

Typical Grain Size Distribution

GRAIN SIZE DISTRIBUTION

FIGURE D1

TYPICAL GRANULAR BASE MATERIAL



LEGEND

SYMBOL	BOREHOLE #	STATION	OFFSET	SAMPLE #	DEPTH (m)
o	1	15+200	1.8 M N of C/L	1	190-280
□	14	15+770	7.0 M W of C/L	1	350-650
△	26	16+400	2.0 M S of C/L	1	160-290

Date August 2008

Project 08-1181-0005

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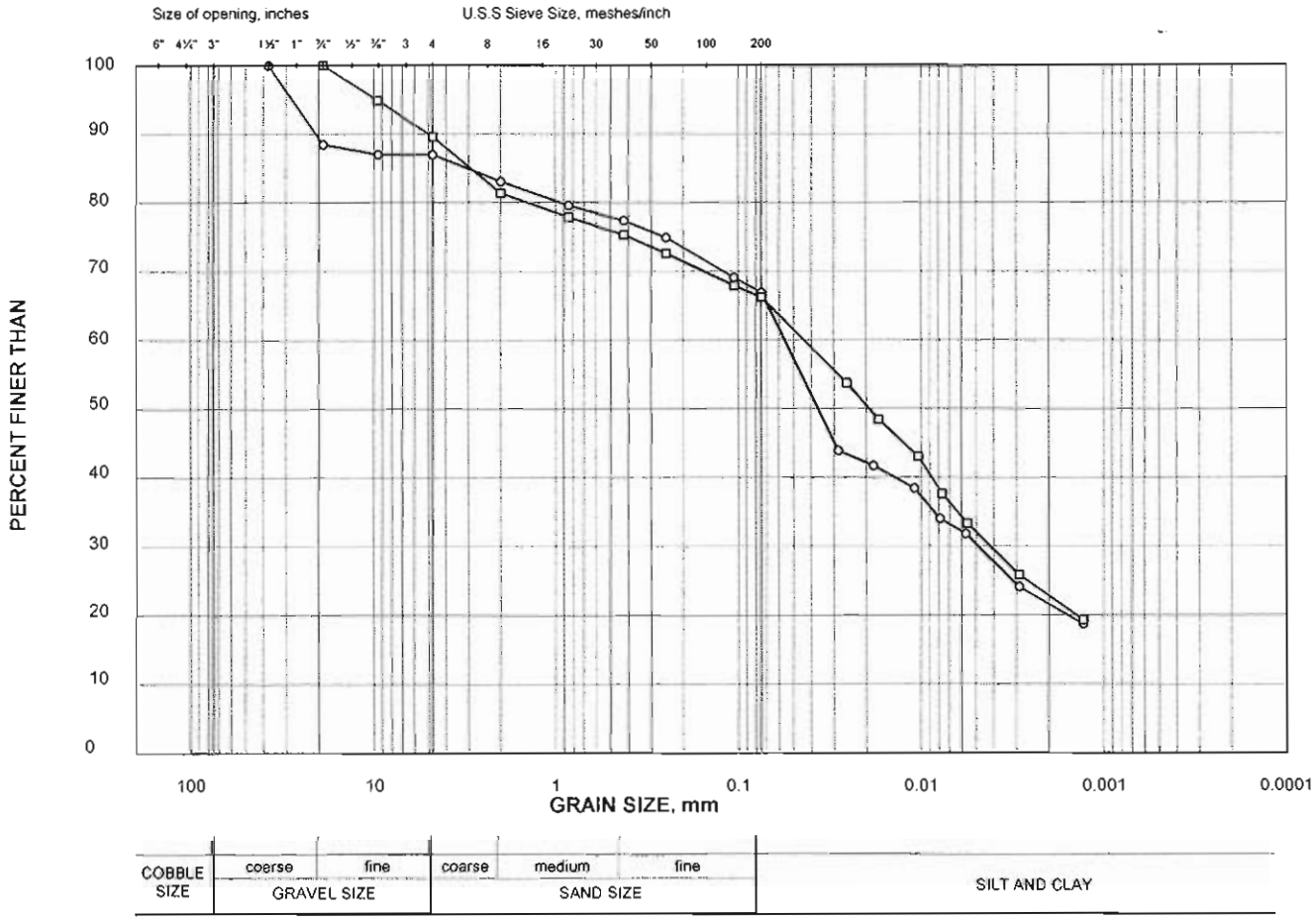
GRAIN SIZE DISTRIBUTION

FIGURE D2

TYPICAL SILTY CLAY SUBGRADE



LEGEND

SYMBOL	BORE HOLE #	STATION	OFFSET	SAMPLE #	DEPTH (m)
o	11	15+600	3.8 M N of C/L	1	1.2-1.5
□	22	16+100	4.3 M S of C/L	1	1.2-1.5

Date August 2008
Project 08-1181-0005

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APPENDIX E

Design Analysis

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Appendix E 2
GEOTECHNICAL ENGINEERING SERVICES (PAVEMENTS)
CLASS ENVIRONMENTAL ASSESSMENT STUDY
WIDENING / NEW CONSTRUCTION / RECONSTRUCTION OF BURNHAMTHORPE ROAD

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	4,900,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	20,000 kPa
Stage Construction	1
Calculated Design Structural Number	147 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(min)	Width (m)	Calculated SN (mm)
1	Hot Mix Asphalt	0.44	1	150	-	66
2	Granular A Base	0.14	1	150	-	21
3	Granular B Type I Subbase	0.09	1	700	-	63
Total	-	-	-	1,000	-	150

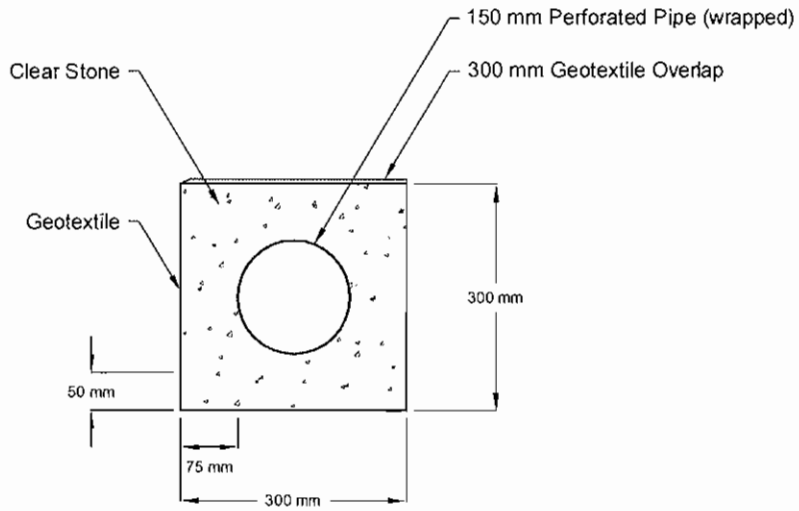
Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
1	Hot Mix Asphalt	0.44	1	-	100	2,700,000	-	150	66
2	Granular A Base	0.14	1	-	150	210,000	-	150	21
3	Granular B Type I	0.09	1	-	200	140,000	-	668	60
Total	-	-	-	-	-	-	-	967	147

APPENDIX F

Subdrain Details



NOT TO SCALE

PROJECT

Preliminary Pavement Engineering Investigation for
Class Environmental Assessment Study of
Burnhamthorpe Road at Neyagawa Boulevard and Ninth Line

TITLE

SUBDRAIN DETAIL

Golder Associates
Whitby, Ontario

PROJECT No 08-1181-0005			FILE No	003
DESIGN			SCALE	NTS REV
CADD	JLJ	Aug. 2008		
CHECK	DKS			FIGURE F1
REVIEW				

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
100, Scotia Court
Whitby, Ontario, L1N 8Y6
Canada
T: +1 (905) 723 2727

Golder Associates