February 2011

FOUNDATION INVESTIGATION AND DESIGN REPORT

Relocation of Existing Noise Barrier Wall 4
Widening of Highway 7/8
From 1.9 km West of Fischer-Hallman Road Interchange
Easterly to 0.8 km East of Courtland Avenue Interchange
Kitchener
GWP 131-98-00
Ministry of Transportation, Ontario - West Region

Submitted to:
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REPORT

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PART A

FOUNDATION INVESTIGATION REPORT

RELOCATION OF EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
FROM 1.9 KM WEST OF FISCHER-HALLMAN ROAD INTERCHANGE EASTERLY TO 0.8 KM EAST OF COURTLAND AVENUE INTERCHANGE, KITCHENER
GWP 131-98-00
MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION

February 2011
Report No. 08-1132-084-1-R11H

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out the foundation investigations as part of the detail design work for GWP 131-98-00, the reconstruction and widening of Highway 7/8 within the project limits. This report presents the results of the foundation investigation conducted for a segment of existing noise barrier wall 4 located between Station 10+043 Courtland Avenue E-N/S Ramp and Station 17+240 Lt Highway 7/8. The start of the Courtland Avenue E-N/S ramp has the following chainage equation: Station 10+000 E-N/S ramp = Station 17+232 Highway 7/8.

The purpose of the foundation investigation is to determine the subsurface conditions at the locations of the proposed works by drilling boreholes and carrying out in situ testing and laboratory testing on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal, Golder Associates' proposal P81-3002 dated April 8, 2008, our letters dated July 21 and 22, 2008 and our revised scope of work letter dated April 13, 2010. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated July 4, 2008.

Dillon provided Golder Associates with the location and limits of the noise barrier wall in plan for this project in digital format.

2.0 SITE DESCRIPTION

2.1 General

The project area of Highway 7/8 is located in the south-central area of Kitchener, Ontario. The project extends from 1.9 km west of Fischer-Hallman Road easterly to 0.8 km east of Courtland Avenue. The location of the noise barrier wall is shown on the Key Plan, Figure 1 and the Noise Barrier Wall Location Plan, Figure 2.

This section of Highway 7/8 is currently a four lane divided highway oriented generally east-west. Four overpass structures for Westmount Road, Homer Watson Boulevard, Ottawa Street South and Courtland Avenue East, one underpass structure for Fischer-Hallman Road, as well as an overhead structure for CNR tracks are situated within the project limits.

Land use adjacent to this site is typically urban residential north of Highway 7/8 with predominantly industrial, commercial, institutional and occasional residential areas to the south. The Rockway Municipal Golf Course is north of the site.

Existing noise barrier wall 4 extends along the Courtland Avenue E-N/S ramp from Station 10+166 Courtland E-N/S ramp to Station 17+255 Lt Highway 7/8. The topography in the vicinity of the segment of wall that will be relocated is generally flat to gently undulating. The ground surface in the immediate vicinity of the wall is near elevation 320 metres.

2.2 Site Geology

This project lies within the physiographic region of southwestern Ontario known as the Waterloo Hills[1]. The soils generally consist of sandy hills; some are ridges of sandy till while others are kames or kame moraines, with outwash sands deposited in the valleys. Adjoining the sandy hills is the Grand River spillway system comprised of alluvial terraces of sand and gravel.

Based on the Ministry of Northern Development and Mines Map 2508 entitled “Quaternary Geology, Cambridge Area, Southern Ontario”, the site lies in an area of primarily ice contact sands deposited in the Pleistocene era. A small area indicating Port Stanley Till (silt to sandy silt till) is mapped at the east side of the Courtland Avenue Interchange area.

The Geologic Survey of Canada Map 1263A entitled “Geology, Toronto-Windsor Area, Ontario” indicates that the subcropping bedrock in the area of the site is dolomite and mudstone of the Salina formation of Upper Silurian age. Based on the Ministry of Natural Resources Map P.1985 entitled “Bedrock Topography Series, Cambridge

[1] L.J. Chapman and D.F. Putnam: The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 1984.

Area, Southern Ontario", the bedrock surface at the site is at about elevation 275 metres, or some 45 metres below ground surface.

3.0 INVESTIGATION PROCEDURES

The foundation investigation field work for the design of the relocation of existing noise barrier wall 4 was carried out on May 7 and June 3, 2010 during which time two boreholes were drilled in the vicinity of the existing noise barrier wall 4. The borehole locations are shown on the Borehole Location Plan, Drawing 1.

Both boreholes were advanced to a depth of 5.0 metres. The table below summarizes the borehole locations, ground surface elevations at the borehole locations and the borehole depths:

Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
	Northing	Easting	(m)	(m)
68	4 810 581	226 525	319.89	5.03
69	4 810 579	226 576	320.22	5.03

The drilling work was carried out using truck mounted CME 45 power augers supplied and operated by a specialist drilling contractor. In the boreholes, samples of the overburden were obtained at 0.75 metre intervals of depth using 50 millimetres outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. The samplers used in the investigations limit the maximum particle size that can be sampled and tested to about 40 millimetres. Therefore, particles or objects that may exist within the soils that are larger than this dimension will not be sampled or represented in the grain size distributions.

The groundwater conditions were observed throughout the drilling operations and upon completion of drilling. Groundwater monitoring devices were not installed in either of the boreholes. A summary of the groundwater level readings for the boreholes is presented in Table 1. The boreholes were backfilled in accordance with current Ontario Ministry of Transportation (MTO) procedures and Ontario Regulation 372/07.

The field work was monitored on a full-time basis by experienced members of our engineering staff who located the boreholes in the field, monitored the drilling, sampling and in situ testing operations, logged the boreholes and surveyed the borehole locations and elevations. The samples were identified in the field, placed in labelled containers and transported to our London laboratory for further examination and testing. Index and classification tests, consisting of water content determinations, grain size distribution analyses and Atterberg limits determinations, were carried out on selected samples. The results of the testing are shown on the Record of Borehole sheets and in Appendix A.

The locations of the boreholes are shown on the Record of Borehole sheets and on Drawing 1, attached. It should be noted that borehole 68 was relocated after encountering an apparently abandoned sewer pipe at elevation 317.3 metres and was then subsequently advanced to the final depth.

4.0 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

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

The two boreholes drilled at the site generally encountered asphaltic concrete pavement underlain by layers of granular fill, overlying native silt and sandy silt. An abandoned sewer pipe was encountered at about elevation 317.3 metres, 1.5 metres west of the final location of borehole 68.

The borehole locations are shown on Drawing 1. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized below.

4.1.1 Pavements

Asphaltic concrete was encountered at the ground surface in both boreholes. The thicknesses of the asphalt layers were 90 and 80 millimetres in boreholes 68 and 69, respectively.

Granular fill was encountered at elevation 319.8 and 320.1 metres in boreholes 68 and 69, respectively, underlying the asphaltic concrete. The upper 0.3 metres of fill in borehole 68 and the upper 0.2 metres in borehole 69 consisted of granular roadbase materials.

4.1.2 Fill

The granular fill generally comprises sand and gravel and silty sand. The fill was about 2.8 and 0.6 metres thick in boreholes 68 and 69, respectively. It should be noted that the depth of the fill in borehole 68 likely extends to the underside of the pipe or to about elevation 317 metres. Based on conversations with the City of Waterloo, it is understood that this sewer is inactive and has likely been abandoned.

The fill had standard penetration test N values of 8 to 27 blows per 0.3 metres of penetration, indicating a loose to compact relative density. The water contents of three samples of the fill were 8 to 11 per cent.

4.1.3 Silt

Loose to compact layers of silt, underlying the granular fill materials, were encountered at elevations 317.0 metres in borehole 68, and 319.6 and 315.8 metres in borehole 69. A layer of sandy silt was found in between the silt layers at elevation 316.6 metres in borehole 69. Borehole 68 was terminated in the silt after exploring the stratum for about 2.1 metres. The thickness of the upper silt layer in borehole 69 was about 3.0 metres. The lower silt layer was explored for about 0.6 metres before termination of borehole 69.

The silt had N values of 9 to 16 blows per 0.3 metres. Water contents of 22 and 26 per cent were measured in samples of silt obtained during standard penetration testing.

The grain size distribution curves for two silt samples recovered during standard penetration testing are shown on Figure A-1.

4.1.4 Sandy Silt

A 0.8 metre thick layer of sandy silt was found between the silt layers in borehole 69 at elevation 316.6 metres. A single N value of 12 blows per 0.3 metres was measured in the sandy silt indicating a compact relative density.

4.2 Groundwater Conditions

The groundwater conditions in the two boreholes were monitored during and upon completion of drilling. The observed groundwater conditions are noted on the Record of Borehole sheets, and are summarized in the following text and Table 1.

Borehole	Ground Surface Elevation	Encountered Groundwater Level	
		Depth	Elevation
	(m)	(m)	(m)
68	319.89	3.1	316.8
69	320.22	1.7	318.5

During the field work period, the groundwater was encountered between elevations 316.8 and 318.5 metres in the two boreholes. The encountered groundwater levels generally indicate the groundwater table to be located within the silt stratum. It should be noted that the above groundwater level observations are not considered to be representative of the long-term, stabilized groundwater conditions as the readings were taken for a short duration only.

Groundwater levels of 317 metres and 318 metres have been inferred west and east of Station 10+000 Courtland Avenue E-N/S ramp, respectively. The groundwater levels are expected to fluctuate due to climatic and seasonal variations.

5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Aardvark Drilling Ltd., who is an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Michael Arthur and Mr. Matthew Rhody under the direction of Mr. David J. Mitchell.

The laboratory testing was carried out at Golder Associates' London laboratory under the direction of Mr. Chris M. Sewell. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing Types C and D aggregates. This report was prepared by the Project Engineer, Dirka U. Prout, P.Eng. under the direction of the Team Leader, Mr. Philip R. Bedell, P.Eng. This report was reviewed by Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

GOLDER ASSOCIATES LTD.

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PART B

FOUNDATION DESIGN REPORT

RELOCATION OF EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
FROM 1.9 KM WEST OF FISCHER-HALLMAN ROAD INTERCHANGE EASTERLY TO 0.8 KM EAST OF COURTLAND AVENUE INTERCHANGE KITCHENER
GWP 131-98-00
MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION

6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical parameters and recommendations for the geotechnical aspects of the design of a segment of existing noise barrier wall 4 which is to be relocated. The subject section is at the north side of Highway 7/8 and extends from Station 10+043 Courtland Avenue E-N/S Ramp to Station 17+240 Highway 7/8. At the beginning of the Courtland Avenue E-N/S Ramp, Station 10+000 is equivalent to Station 17+232 Highway 7/8. The design parameters and recommendations have been developed based on interpretation of the factual data obtained from the boreholes advanced at the site. The interpretation and recommendations provided are intended to provide the designers with sufficient information to design the proposed noise barrier wall foundations. Where comments are made on construction, they are provided in order to highlight those aspects that could affect the design, or for which special provisions or operational constraints may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect the equipment selection, proposed construction methods, scheduling and the like.

The approximately 50 metre long section of existing noise barrier wall 4 that will be relocated with a transition from a right-of-way barrier at Station 10+043 Courtland Avenue E-N/S Ramp to a shoulder mounted barrier.

6.2 Noise Barrier Wall Foundation Design

The noise barrier wall foundations should be designed and constructed in accordance with MTO's SP599F01. It is recommended that the noise barrier wall be supported using conventional augered caissons with a diameter of 0.6 to 0.9 metres. Foundation design parameters for design of the caisson foundations are provided in Table I following the text of this report, based on the soil conditions encountered along the proposed noise barrier wall alignment. The stratigraphy presented in Table I has been simplified for the purposes of the noise barrier wall foundation design. Due to the lack of construction control records and inherent variations in utility trench backfill. No lateral soil resistance should be attributed to the utility trench backfill encountered in borehole 68.

The passive resistance in the upper 1.4 metres below ground should be neglected to account for frost action. In addition, for foundation design, full passive resistance will be mobilized only where the ground surface in front of and behind the caisson is level. Where sloping ground is present adjacent to the noise barrier wall, the K_p values used in the calculation should be adjusted to account for the presence of the sloping ground.

6.3 Construction Considerations

Excavations for construction of the caissons for the noise barrier wall foundations will penetrate the surficial fill and will extend into deposits of silt and sandy silt. These silty soils are susceptible to disturbance during caisson excavation and construction. In addition, excavation of granular materials below the groundwater level will be required along the entire segment of existing noise barrier wall 4 that will be relocated.

Proactive temporary dewatering will be required to maintain the integrity of the soil in the side of the excavation and a temporary liner will be required to support the sides of the excavation and permit cleaning and inspection of the base. Careful cleaning of the base of the caisson should be carried out prior to placement of concrete to remove all loosened or disturbed materials. Alternatively, the foundations could be installed using mud drilling techniques (augering with the hole filled with bentonite slurry) and placement of concrete by tremie. Surface water run off should be directed away from the excavations. It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to alert the Contractor about the requirements for support of the augered excavation and measures to deal with excavation of saturated granular soils below the groundwater level. In addition, an NSSP should be included to advise the Contractor that buried obstructions, such as the abandoned pipe encountered in the original location of borehole 68 are present along the noise barrier wall alignment.

The caissons should be constructed and inspected in accordance with Ontario Provincial Standard Specifications 903 and SP599F01. Following construction, the Quality Verification Engineer shall submit a Certificate of Conformance confirming that the noise barrier wall foundations have been constructed in general conformance with the contract documents.

7.0 MISCELLANEOUS

This report was prepared by Ms. Dirka U. Prout, P.Eng. under the direction of the Team Leader, Mr. Philip R. Bedell, P.Eng. This report was reviewed by Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

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TABLE I

FOUNDATION DESIGN PARAMETERS FOR
RELOCATION OF EXISTING NOISE BARRIER WALL 4

Widening of Highway 7/8
GWP 131-98-00

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Effective Angle of Friction, ϕ' (°)	Coefficient of Passive Pressure, K_p [1]	Coefficient of Active Pressure, K_a [1]	Unit Weight [2] (kNm^{-3})	
							Bulk, γ	Effective, γ'
10+043 E-N/S Ramp to 17+232 Highway 7/8 BH 68	Loose to compact granular fill Compact silt	Above 317 Below 317	317	- 29	- 2.9	- 0.35	19.0 18.5	9.0 8.5
17+232 to 17+240 Highway 7/8 BH 69	Loose to compact silt to sandy silt	Above 315	318	29	2.9	0.35	18.5	8.5

NOTES:

1. Earth pressure coefficients (K_p and K_a) values are provided for level ground. Adjusted values are to be used if the ground adjacent to the noise barrier wall is sloping.
2. Below the groundwater level, the effective unit weight of the soil (γ') should be used.
3. This table is to be read in conjunction with the accompanying report.

Prepared By: DUP
Checked By: PRB

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60º cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. General

π	3.1416
ln x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
v	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p)/I_p$
I_C	consistency index = $(w_l - w)/I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e)/(e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio = σ'_p/σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

* density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 68

1 OF 1 **METRIC**

PROJECT 08-1132-084-1 | W.P. 131-98-00 | LOCATION N 4810580.9 ;E 226525.3 | ORIGINATED BY MR

DIST | HWY 7/8 | BOREHOLE TYPE POWER AUGER / HOLLOW STEM | COMPILED BY WDF

DATUM GEODETIC | DATE May 7, 2010 and June 3, 2010. | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
319.89	PAVEMENT SURFACE									
0.09	ASPHALT									
0.37	FILL, sand and gravel, crushed Brown									
319.13	FILL, sand and gravel									
0.76	Brown									
	FILL, silty sand, trace topsoil, trace gravel Loose to compact Grey		1	SS	8		319	○		
			2	SS	27		318	○		
317.30			3	SS	18			○		
2.59	Pipe									
316.99							317			
2.90	SILT, trace to some sand, trace clay Compact Brown to grey at about elev. 315.5m		4	SS	12	▽		○		0 20 74 6
			5	SS	14		316			
314.86			6	SS	11		315			
5.03	END OF BOREHOLE Pipe encountered at about elev. 317.3m. Borehole moved approximately 1.5m east. Groundwater encountered at about elev. 316.8m during drilling on June 3, 2010.									

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 69

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

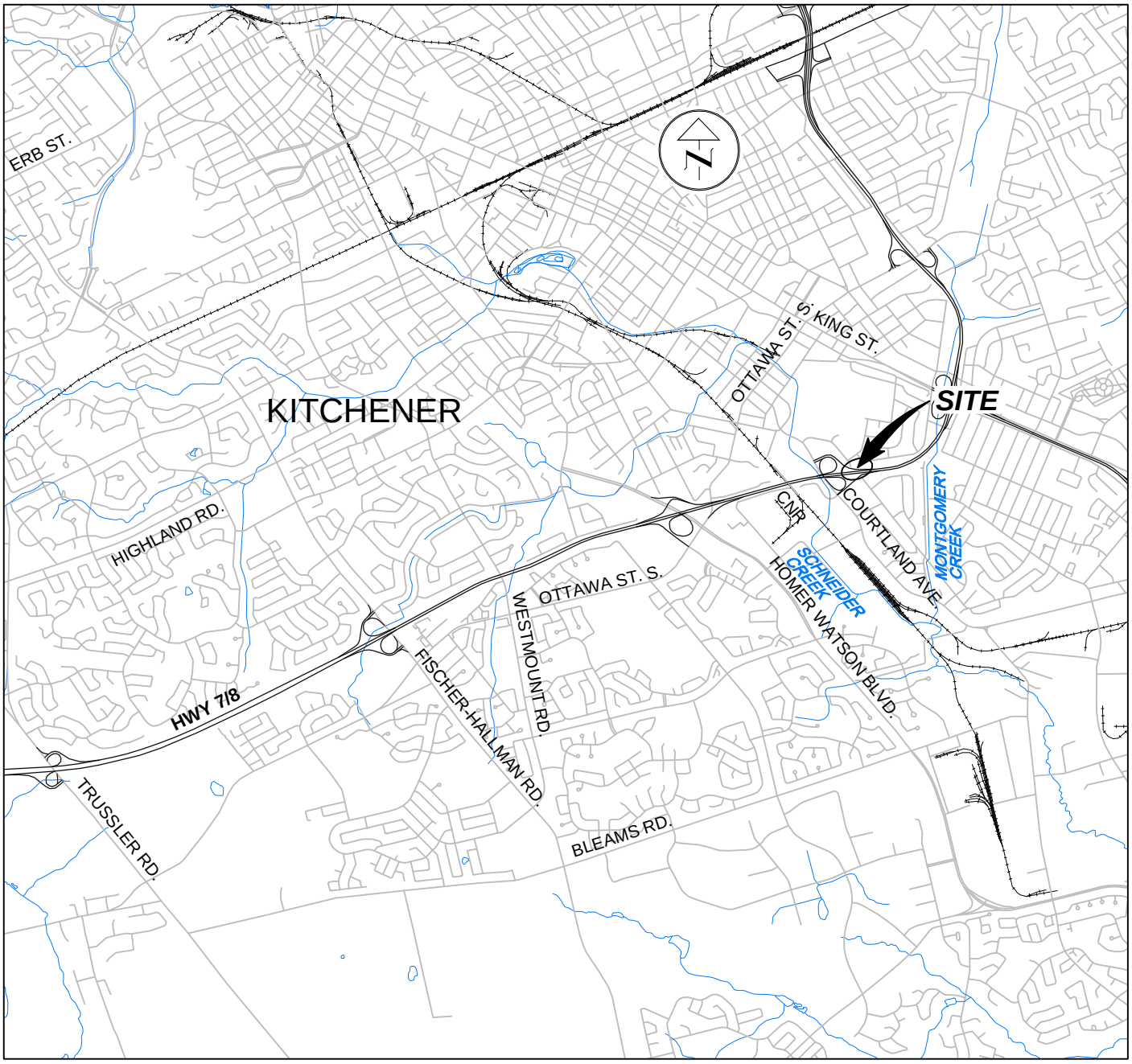
LOCATION N 4810578.6 ;E 226576.0
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 7, 2010

ORIGINATED BY MA
COMPILED BY WDF
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
320.22	PAVEMENT SURFACE										
0.08	ASPHALT										
0.27	FILL, sand and gravel, crushed Brown										
319.55											
0.67	FILL, sand, trace gravel, trace silt Brown										
	SILT, trace sand, trace clay Loose to compact Brown		1	SS	16		320				
			2	SS	11	▽	319		○		0 4 92 4
			3	SS	9		318				
			4	SS	12		317				
316.56											
3.66	SANDY SILT, Compact Brown		5	SS	12		316				
315.80											
4.42	SILT, trace sand Compact Brown		6	SS	14						
315.19											
5.03	END OF BOREHOLE Groundwater encountered at about elev. 318.5m during drilling on May 7, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 23/02/11



SCALE IN METRES

0 1000 2000

1:50000

REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2005.4.

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE

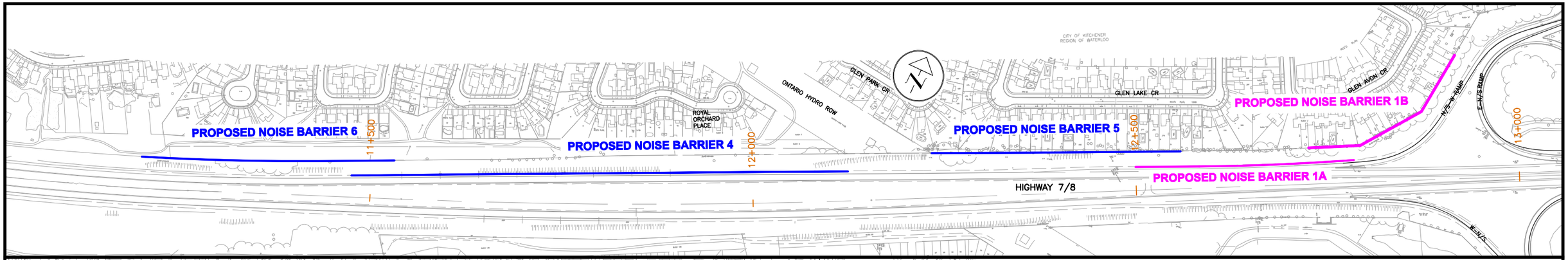
KEY PLAN

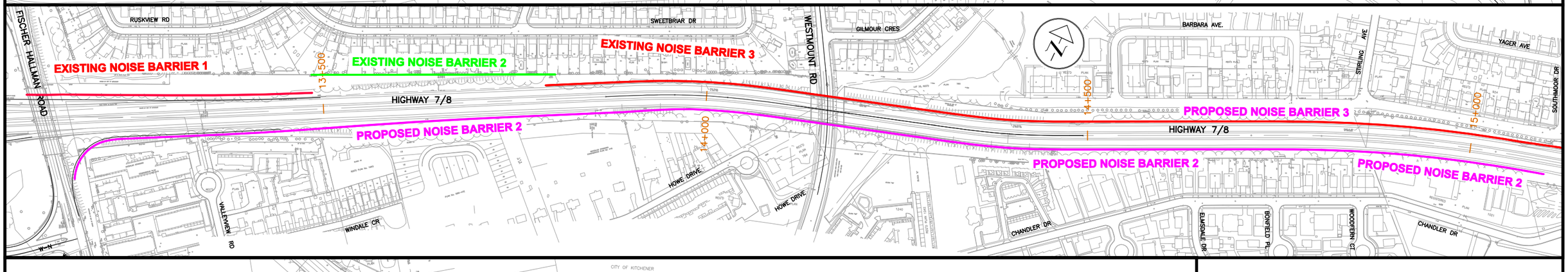
Golder Associates
LONDON, ONTARIO

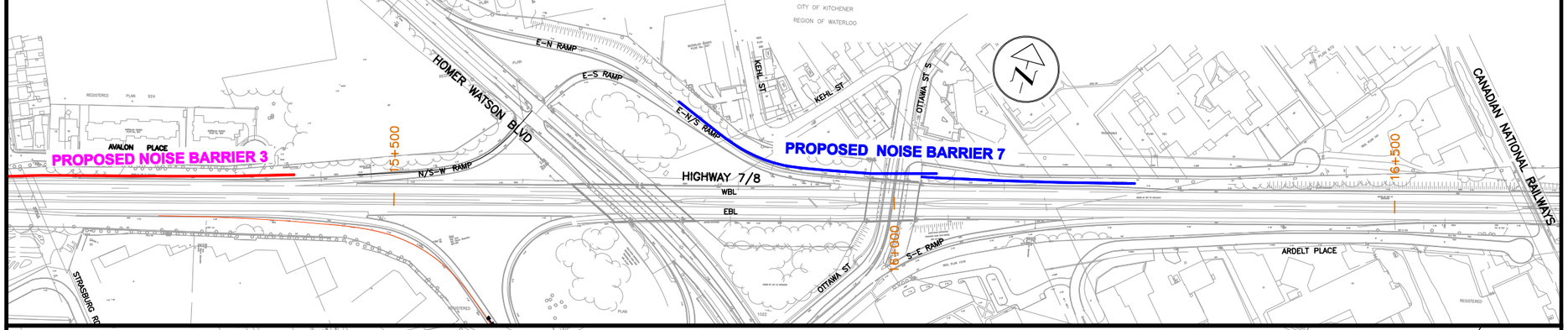
PROJECT No.	08-1132-084-1		FILE No.	0811320841-F11H001
			SCALE	AS SHOWN REV.
CADD	WDF	Feb. 23/11		
CHECK				

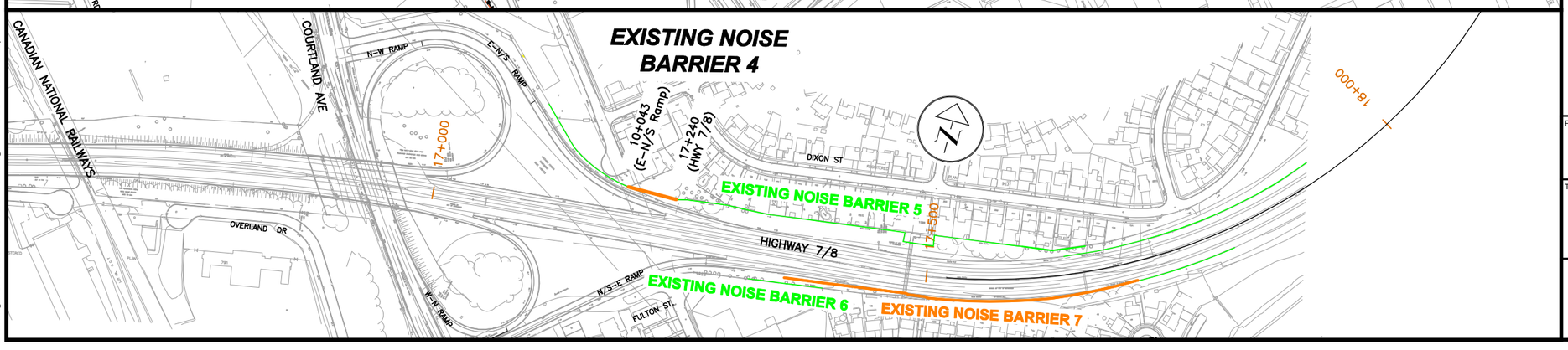
FIGURE 1

Drawing file: 0811320841-F11H001.DWG Feb 23, 2011 - 1:24pm









SCALE IN METRES
0 100 200 m
1:5000

REFERENCE

BASE PLANS PROVIDED IN DIGITAL FORMAT
BY DILLON CONSULTING.

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

**EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
GWP 131-98-00**

TITLE

NOISE BARRIER WALL LOCATION PLAN

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F11H002	
			SCALE	AS SHOWN	REV. 0
CADD	WDF	Feb. 23/11			
CHECK					

FIGURE 2

Drawing file: 0811320841-F11H002.dwg Feb 23, 2011 - 1:29pm

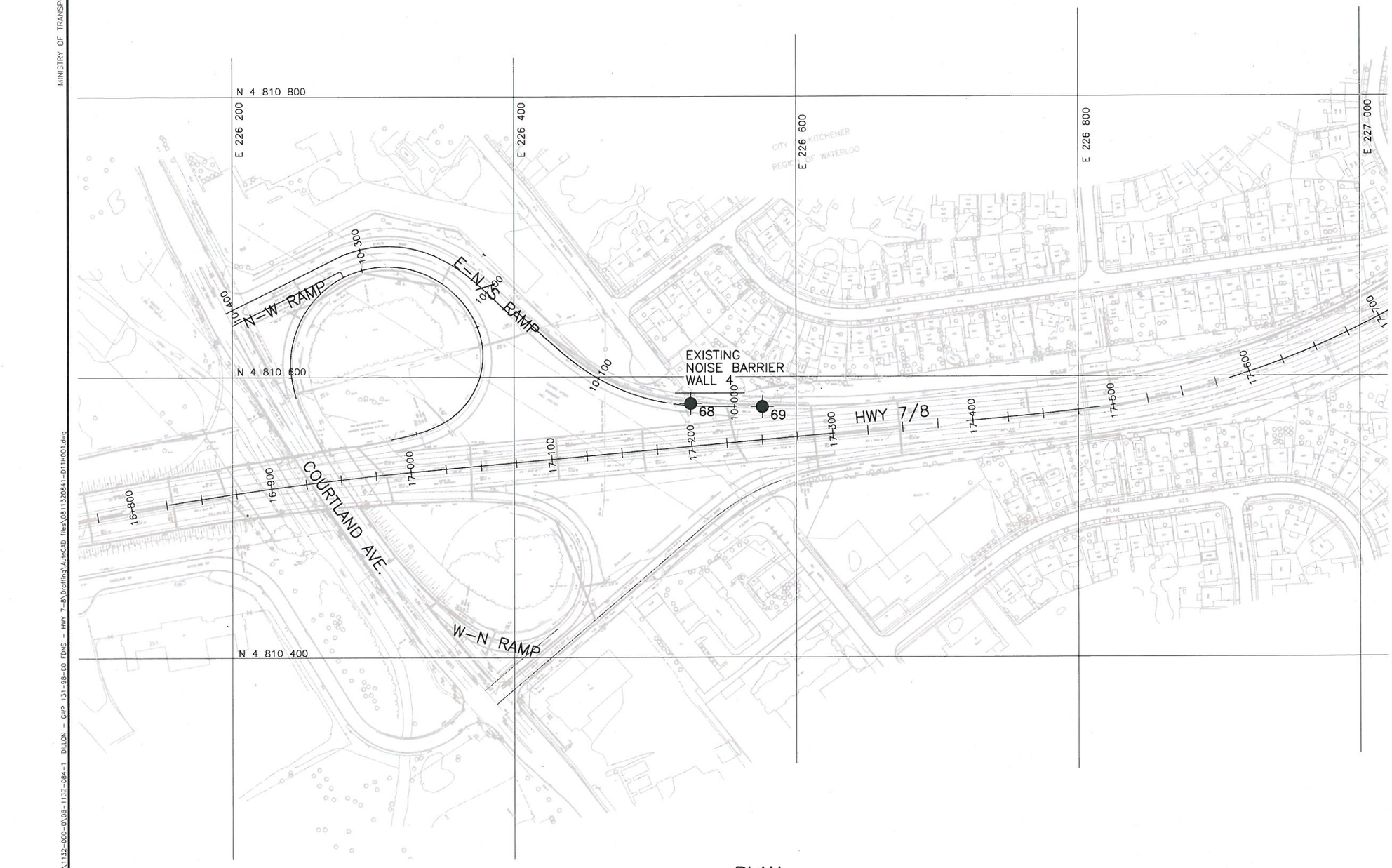
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 131-98-00

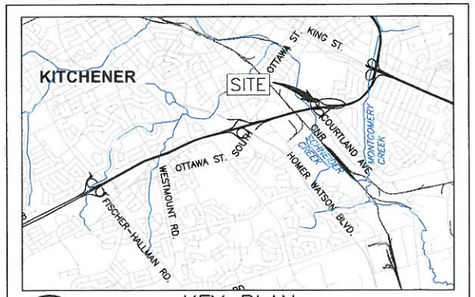
SHEET

EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
BOREHOLE LOCATIONS

Golder Associates Ltd.
LONDON, ONTARIO, CANADA



PLAN
SCALE
30 0 30 m



KEY PLAN
SCALE IN KILOMETRES
0 1 2

LEGEND

Borehole – Current Investigation

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10) NORTHING	EASTING
68	319.89	4 810 580.9	226 525.3
69	320.22	4 810 578.6	226 576.0

D.J. PROUT
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
Feb. 24/11

F.J. HEFFERNAN
REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
Feb. 24/11

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

REFERENCE
Base plans provided in digital format by Dillon Consulting.

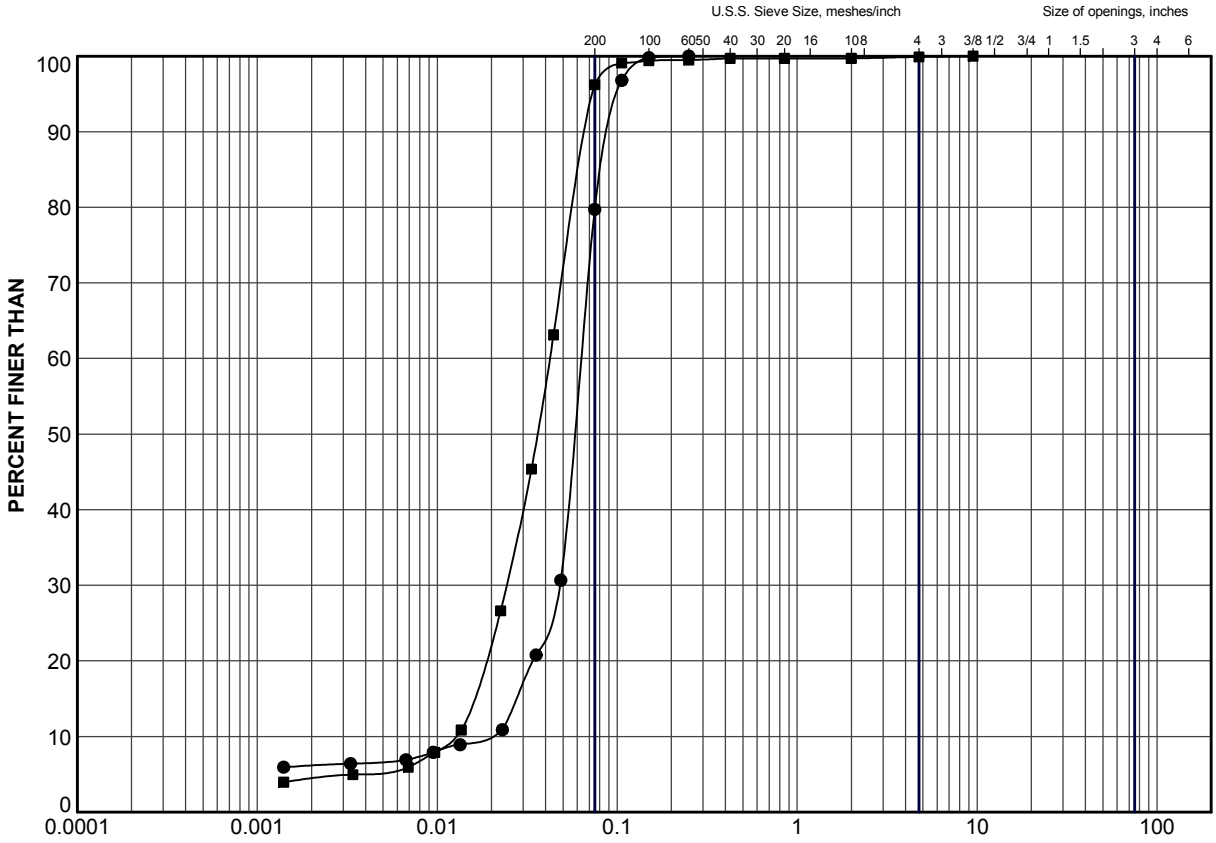
NO.	DATE	BY	REVISION

Geocres No. 40P8-189

HWY. 7/8	PROJECT NO. 08-1132-084-1		DIST.
SUBM'D. ML	CHKD.	DATE: Feb. 23/11	SITE:
DRAWN: WDF	CHKD.	APPD.	DWG. 1

APPENDIX A

Laboratory Test Data



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	68	4	316.6
■	69	2	318.5

PROJECT

EXISTING NOISE BARRIER WALL 4
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE

GRAIN SIZE DISTRIBUTION

SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No. 0811320841-F11H0A1
			SCALE N/A REV.
DRAWN	WDF	Feb. 23/11	
CHECK			**FIGURE A-1**

LDN_MTO_NEW GLDR_LDN.GDT

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