



PART A - FOUNDATION INVESTIGATION REPORT

for

**HIGHWAY 400 UPGRADING LATERAL SEWER SOUTHERN PART
APPROXIMATELY FROM INNISFIL BEACH ROAD TO MAPLEVIEW
DRIVE**

RETAINER ASSIGNMENT – TASK NO. 2013-E-0039-010

WP 2184-10-00

**TOWN OF INNISFIL AND CITY OF BARRIE, SIMCOE COUNTY,
ONTARIO**

PREPARED FOR MINISTRY OF TRANSPORTATION OF ONTARIO

PETO MacCALLUM LTD.
165 CARTWRIGHT AVENUE
TORONTO, ONTARIO
M6A 1V5
Phone: (416) 785-5110
Fax: (416) 785-5120
Email: toronto@petomaccallum.com

Distribution:

- 1 cc: MTO Project Manager + 1 digital copy
- 3 cc: Foundation Investigation Report only to
MTO Project Manager + 1 digital copy
- 1 cc: MTO, Pavements and Foundations Section
+ 1 digital copy (pdf)
- 1 cc: Foundation Investigation Report only to
MTO, Pavements and Foundations Section
+ 1 digital copy (PDF, AutoCAD, gINT)
- 1 cc: PML Toronto

PML Ref.: 15TF020-4
Index No.: 035FIR
GEOCRES No.: 31D-657
June 30, 2016



PART A - TABLE OF CONTENTS

1. INTRODUCTION	1
2. SITE DESCRIPTION	2
3. FIELD INVESTIGATION PROCEDURES	2
4. LABORATORY TEST PROCEDURES	4
5. SITE GEOLOGY AND SUBSURFACE CONDITIONS	4
5.1 Site Geology	4
5.2 Subsurface Conditions	5
5.2.1 Pavement Structure	5
5.2.2 Sand to Silty Sand, Trace Gravel, Trace Clay (Fill)	6
5.2.3 Sand to Silty Sand, Trace Gravel, Trace Clay	6
5.2.4 Silt to Clayey Silt, Trace Sand	7
5.3 Groundwater	8
6. CLOSURE	8

Figures SRS-GS-1 and SRS-GS-3 – Grain Size Distribution Charts

Figures SRS-PC-1 – Plasticity Chart

Explanation of Terms Used in Report

Record of Borehole Sheets

Key Plan – Drawing 400WM-A

Drawings 400WM-1/25 to 16/25 – Borehole Locations and Soil Strata

PART A
FOUNDATION INVESTIGATION REPORT

For
Highway 400 Upgrading - Lateral Sewers
Southern Part from Innisfil Beach Road to Mapleview Drive
Retainer Assignment – Task No. 2013-E-0039-010, WP2184-10-00
Town of Innisfil and City of Barrie, Simcoe County, Ontario

1. INTRODUCTION

This report presents the factual findings obtained from the geotechnical investigation carried out at the above mentioned site along the median of Highway 400 from Innisfil Beach Road to Mapleview Drive, for the installation of lateral storm sewers, replacement of existing sewer line along the median, and inspection holes (manhole). The field work was carried out between March 7 and 9, 2016. The purpose of the investigation was to explore the subsurface conditions at this site to provide anticipated subsurface conditions influencing the design and installation of the sewer lines and associated inspection holes (Manholes).

Peto MacCallum Ltd. (PML) carried out the investigation and prepared this report for the Ministry of Transportation of Ontario (MTO) as part of the Retainer Assignment task No. 2013-E-0039-010.

The assignment includes preparation of five (5) geotechnical investigation reports for the following locations:

PML REF. No.	FIR AND FIDR DESCRIPTION
15TF020-1	Highway 400 Upgrading - Median Sewers Northern Part from Mapleview Drive to Essa Road
15TF020-2	Highway 400 Upgrading - Lateral Sewers Northern Part from Mapleview Drive to Essa Road
15TF020-3	Highway 400 Upgrading - Median Sewers Southern Part from Innisfil Beach Road to Mapleview Drive
15TF020-4	Highway 400 Upgrading - Lateral Sewers Southern Part from Innisfil Beach Road to Mapleview Drive
15TF020-5	Highway 400 Culvert Headwalls for Culvert 96 and Inlet Headwall for Culvert 107



The scope of project involves the installation of new lateral and longitudinal sewer pipes along the median together with replacement of existing lateral and longitudinal sewer pipes and manholes. This report provides subsurface conditions for the southern part of the assignment covering from Innisfil Beach Road to Mapleview Drive (Sta. 20+214 to Sta. 26 + 297).

It should be noted that the window for carrying out the field work for this investigation was limited. As a result, boreholes were strategically located to obtain an approximate model of subsurface conditions covering the project area. A limited number of boreholes were advanced due to constraints for carrying out the field work. The Contractor shall be advised to carry out additional field investigation, such as excavate test pits to confirm the depth of the fill, especially in the area where there are existing storm sewer lines, which are proposed to be replaced.

2. SITE DESCRIPTION

The topography of the project area is generally flat to gently undulating, except for the highway embankments. The grade of Highway 400 at the crossing of Innisfil Beach Road Overpass is set at approximately 3 m higher than the surrounding area of the interchange. Several commercial developments are intermittently located between the interchanges of Highway 400 and Innisfil Beach Road, and Highway 400 and Mapleview Drive. The site is generally lined by farmland and heavily wooded area along Highway 400.

3. FIELD INVESTIGATION PROCEDURES

A Key Plan of the project site is provided on Drawing 400WM-A. The investigation included advancing ten (10) boreholes numbered SR-BH 1 to SR-BH 10 to maximum depths ranging from 4.7 m to 5.2 m. Borehole locations are shown on the attached Drawing Nos. 1/25 to 16/25.

The underground services at the borehole locations were cleared by the respective utility companies and then the locations were established in the field by portable GPS device. Boreholes were strategically located to provide a minimum safe distance from the existing sewer pipes. PML carried out the survey of the borehole locations and elevations and provided the co-ordinates of



locations in MTM NAD 83 northings and eastings. All elevations reported in this report are referred to Geodetic and expressed in metres.

All of the boreholes were advanced from the shoulder adjoining the median of the Highway 400. Boreholes were advanced using continuous flight solid stem augers, powered by a track-mounted CME-75 drill rig. The drill rig used for drilling was owned and operated by Tri-Phase of Mississauga, Ontario. Tri-Phase is a specialist drilling contractor, was working under the full-time supervision of a member of PML's engineering staff.

Representative soil samples were recovered from the boreholes at 0.75 m intervals using a conventional 51 mm O.D split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

The groundwater conditions at the borehole locations were observed during drilling by visual examination of the soil samples, sampler and drill rods as the samples were retrieved. In addition, water level measurements were taken in open boreholes. A total of five (5) piezometer were installed in Boreholes SR-BH 2, SR-BH 5, SR-BH 6, SR-BH 7 and SR-BH 9 for continuous monitoring of groundwater level. The installation details of the piezometers are provided on the Record of Borehole Sheets. Upon completion of drilling, the boreholes were backfilled with bentonite/cement grout in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures. The piezometers were not decommissioned and are still in place for monitoring of groundwater during construction.

The recovered soil samples were returned to our laboratory for detailed visual examination, and index tests.



4. LABORATORY TEST PROCEDURES

Laboratory tests on representative SPT samples recovered during the field work were carried out by the laboratory owned by PML, located in Toronto. The laboratory testing program included the following:

- Natural moisture content determinations (63)
- Grain size distribution analyses (20)
- Atterberg Limits Tests (8)

The laboratory tests to determine the index properties were performed in accordance with the MTO test procedures, which follow American Society for Testing Materials (ASTM) test procedures, with the exception of hydrometer test (LS-702). The results of the grain size distribution analyses and Atterberg limits tests are presented in Figures SRS-GS-1 to SRS-GS-3 and SRS-PC-1, respectively. All of the test results are summarized on the attached Record of Borehole sheets.

5. SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

The project site is located within the Simcoe Lowlands Physiographic Region of Southern Ontario. The physiographic region of Simcoe Lowlands is bordered by Georgian Bay and Lake Simcoe. This region falls into two major divisions separated by the uplands of Simcoe County. The plains to the west of Simcoe County are draining into Nottawasaga Bay by way of the Nottawasaga River and this area is called “Nottawasaga Basin”. The low lying area to the east of Simcoe County is referred to as the “Lake Simcoe” basin.

The Nottawasaga basin and Lake Simcoe basin are connected at Barrie by a flat-floored valley. Both of these low lands and transverse valleys were flooded by Lake Algonquin and are bordered by shore cliffs, beaches and boulder terraces. Thus these basins are floored by sand, silt and



clay. The surficial soils of these sections of the Simcoe lowlands consist primarily of sand although silt, clay or peat may be found in low-lying areas.

5.2 Subsurface Conditions

In general, the subsoil conditions consist of 400 mm to 800 mm pavement structure consisting of asphalt ranging in thickness from 150 mm to 280 mm, followed by 250 mm to 620 mm of sand with varying proportions of gravel (granular base). Pavement structure is underlain by 400 mm to as thick as 3.7 m sand to silty sand fill. The sandy fill in most of the locations is underlain by sand to silty sand, with varying proportions of gravel, which extends to the depth of termination. In a few of the borehole locations (SR-BH-7 and SR-BH-9), the sandy fill is underlain by silt to clayey silt. For classification purposes, the soils encountered at this site can be divided into four distinct zones.

- a) Pavement Structure
- b) Sand to Silty Sand, Trace Gravel, Trace Clay (Fill)
- c) Sand to Silty Sand, Trace Gravel, Trace Clay
- d) Silt to Clayey Silt, Trace Sand

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the attached Record of Borehole Sheets. The borehole locations and stratigraphic profile sections are shown on Drawings 400WM-1/25 to 400WM-16/25. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary. Description of the soil strata encountered are summarised below.

5.2.1 Pavement Structure

Asphalt layer ranging in thickness from 150 mm to 280 mm was encountered in all the boreholes. Pavement structure consists of compact to very dense sand with varying proportions of gravel. This granular base layer ranges in thickness from 250 mm to 620 mm and extends to a depth of 300 mm to 800 mm (El. 305.5 to El. 279.0). The moisture content of the granular base layer ranged from 1% to 11%.



5.2.2 Sand to Silty Sand, Trace Gravel, Trace Clay (Fill)

The pavement structure is immediately followed by sand to silty sand fill layer in all of the boreholes located on the median. This fill layer ranges in thickness from 400 mm to as high as 3.7 m and extends to a depth ranging from 1.2 m to 4.2 m (El. 302.9 to El. 275.8) from the asphalt surface. The SPT values in this fill layer varies widely ranging from as low as 2 blows/300 mm to 32 blows/300 mm, indicating very loose to dense state of compaction.

The moisture content of this fill material varies from 3% to as high as 22%. The results of the grain size distribution analyses of nine representative samples from this fill layer are shown on Figure SRS-GS-1 appended to this report. The test results reveal that the sand to silty sand fill consists of 0% to 9% gravel, 56% to 86% sand, 9% to 38% silt and 3% to 13% clay.

5.2.3 Sand to Silty Sand, Trace Gravel, Trace Clay

The embankment fill in all of the boreholes, with the exception of SR-BH-7 and SR-BH-9, is underlain by sand to silty sand deposit at a depth ranging from 1.2 m to 3.7 m (El. 302.9 to El. 276.5) below the asphalt surface. In SR-BH-7 and 9, the embankment fill is underlain by silt clayey silt (CL-ML). In all of the boreholes, with the exception of SR-BH-6, this sandy deposit extends to the maximum depth of investigation of 5.2 m (El. 274.9). In SR-BH-6, this sand to silty sand deposit extends only to a depth of 4.5 m (El. 278.6) below the asphalt surface. Occasional cobble layers were encountered in SR-BH-1 and SR-BH-5, which is reflected by the high SPT values. In general, SPT values in this deposit range from 24 blows/300 mm to almost refusal (86 blows/300 mm), indicating compact to very dense state of compaction.

Moisture content of this deposit varies from 3% to 18%. The sand and silt contents of this deposit vary widely. The results of the sieve analysis test performed on six representative samples from this deposit are provided on Figure SRS-GS-2. The test results indicate that the sand to silty sand deposit consists of 0% to 14% gravel, 40% to 79% sand, 17% to 35% silt and 4% to 13% clay. However, the Sample SS7 from SR-BH-4 consisted of 1% gravel, 26% sand, 83% silt, and 8 % clay.



5.2.4 Silt to Clayey Silt, Trace Sand

In Boreholes SR-BH 7 and SR-BH 9, the embankment fill is immediately underlain by this silt to clayey deposit. However, in SR-BH 6, this deposit was observed following the sand to silty sand deposit. This silt to clayey silt deposit extends to the maximum depth of investigation of 5.2 m (El.274.2) at all three locations. The SPT values in this deposit range from 15 blows/300 mm to 37 blows/300 mm, indicating very stiff to hard consistency.

The moisture content of three samples tested varied from 22% to 28%. The results of the sieve analysis test performed on three representative samples from this deposit are provided on Figure SRS-GS-3. The test results indicate that this deposit consists of 0% gravel, 2% to 4% sand, 79% to 94% silt and 4% to 18% clay. Atterberg limit test was performed on one sample and the results are provided on Figure SRS-PC-1. Based on the Atterberg limit values, the soil may be classified as silts of low plasticity (CL-ML) in the Unified Soil Classification System (USCS).



5.3 Groundwater

All of the boreholes, with the exception of SR-BH-6, SR-BH-7 and SR-BH-8, were observed to be dry upon completion of drilling. In SR-BH-1, groundwater was first encountered at a depth of 2.4 m below the ground level and the borehole was found to be dry upon completion. It may be a perched water since the borehole was found to be dry on completion. The groundwater levels in SR-BH-6, SR-BH-7 and SR-BH-8 were measured at a depth of 2.7 m to 3.5 m (El. 276.7 to El. 279.9), below the existing ground surface.

The groundwater levels were monitored from March 7 to April 19, 2016. The groundwater levels measured in the piezometers installed in Boreholes SR-BH 2, SR-BH 5, SR-BH 6, SR-BH 7 and SR-BH 9 are provide in the Table 5.3.

Table 5.3 – Piezometer Water Level

Borehole No.	March 7 to 9, 2016		April 19, 2016	
	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
SR-BH 2	Dry	Dry	Dry	Dry
SR-BH 5	Dry	Dry	3.3	300.5
SR-BH 6	3.2	279.9	2.5	280.6
SR-BH 7	2.7	276.7	3.1	276.3
SR-BH 9	Dry	Dry	3.4	283.9

The groundwater level may be expected to fluctuate due to the influence of precipitation and seasonal changes.

6. CLOSURE

Mr. D. Woodcock and Mr. S. Aziz carried out the field investigation for this study under the supervision of Mr. M. Khorsand, BSc, E.I.T., and Mr. C. M. P. Nascimento, P. Eng., Project Manager. Tri-Phase Drilling Inc. supplied the drill rig for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.



This report was prepared by Mr. M. Khorsand, BSc, E.I.T., and reviewed by Mr. M. Vasavithasan, M.Sc.Eng., P.Eng. Senior Engineer, Geotechnical Services. Mr. C. M. P. Nascimento, P. Eng., MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

A handwritten signature in blue ink, appearing to read "Mansoor", is written over a circular professional seal.

Mansoor Khorsand, BSc, EIT
Project Supervisor, Geotechnical Services

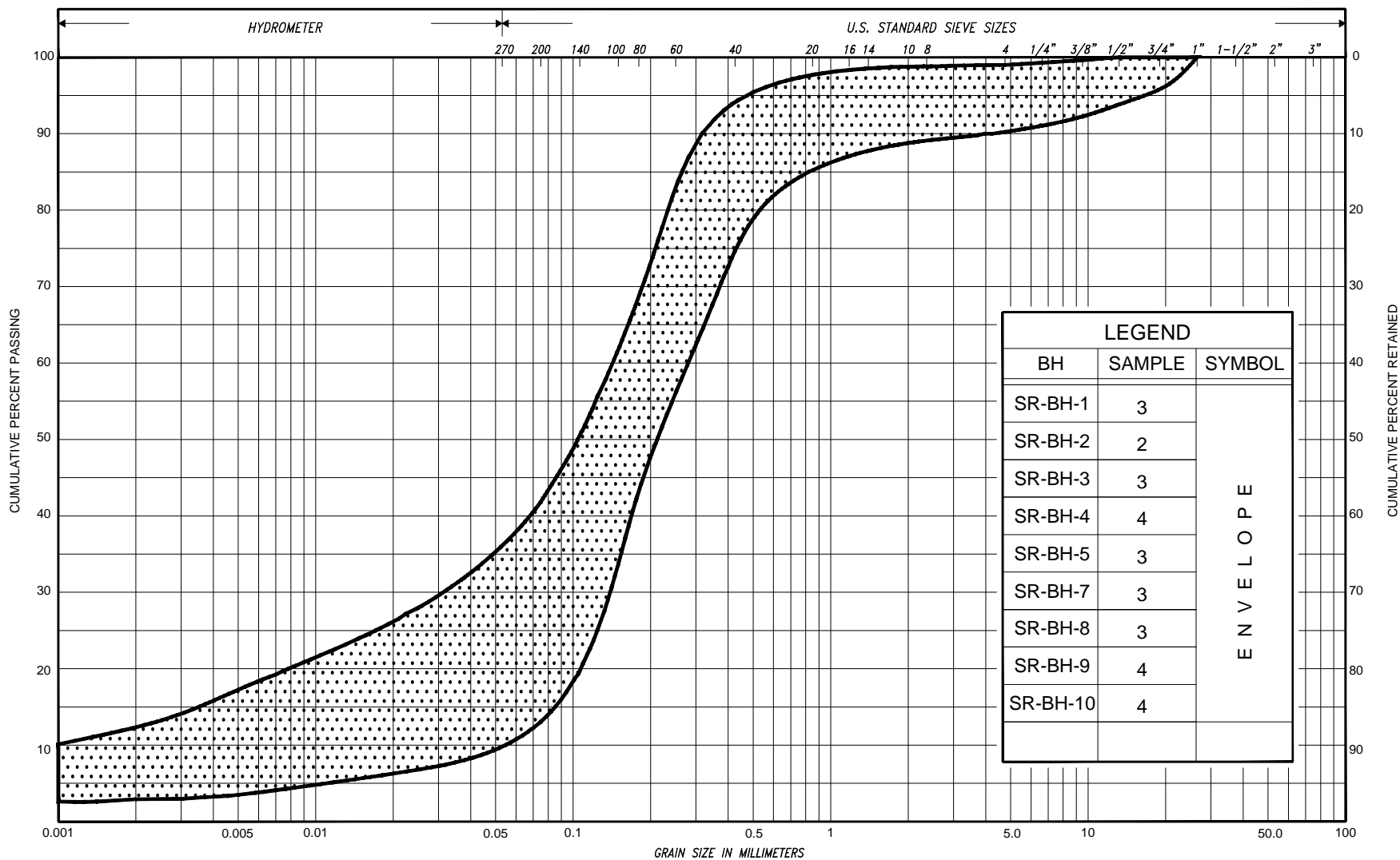


Mark Vasavithasan, M.Sc. Eng., P.Eng.
Senior Engineer, Geotechnical Services



Carlos M.P. Nascimento, P.Eng.
Project Manager and
MTO Designated Principal Contact

MKH/MV/CN:jk



SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED	
CLAY	FINE		MEDIUM		COARSE		SAND										
							FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.	
CLAY			SILT			V. FINE		FINE	MED.	COARSE		GRAVEL					U.S. BUREAU

GRAIN SIZE DISTRIBUTION

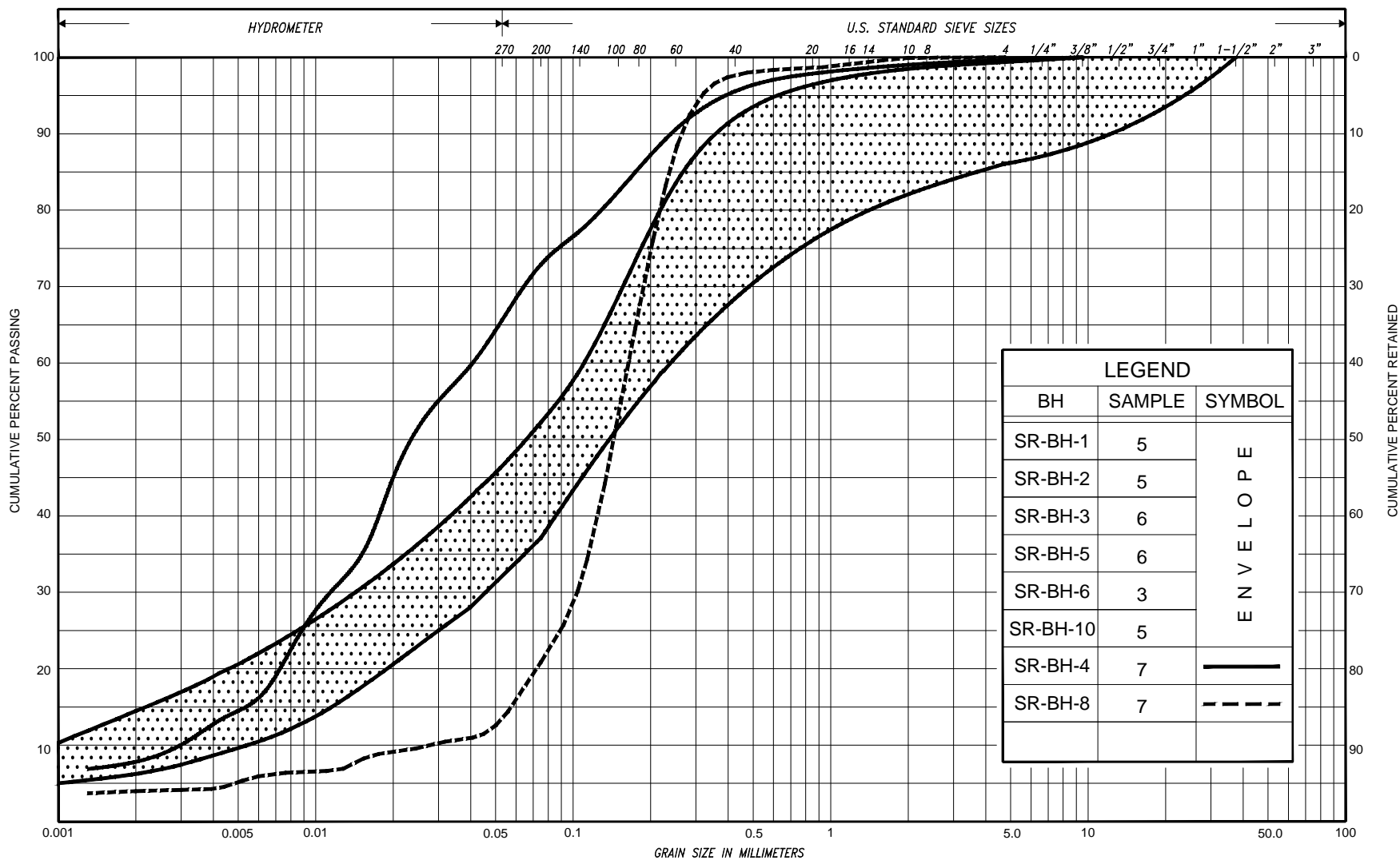
SAND to SILTY SAND, trace to some clay, trace gravel
(FILL)

FIG No. SRS-GS-1

HWY: 400

W.P. No. 2184-10-00





SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED		
					SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT							SAND									
CLAY			SILT				V. FINE	FINE	MED.	COARSE		GRAVEL					U.S. BUREAU
					SAND												



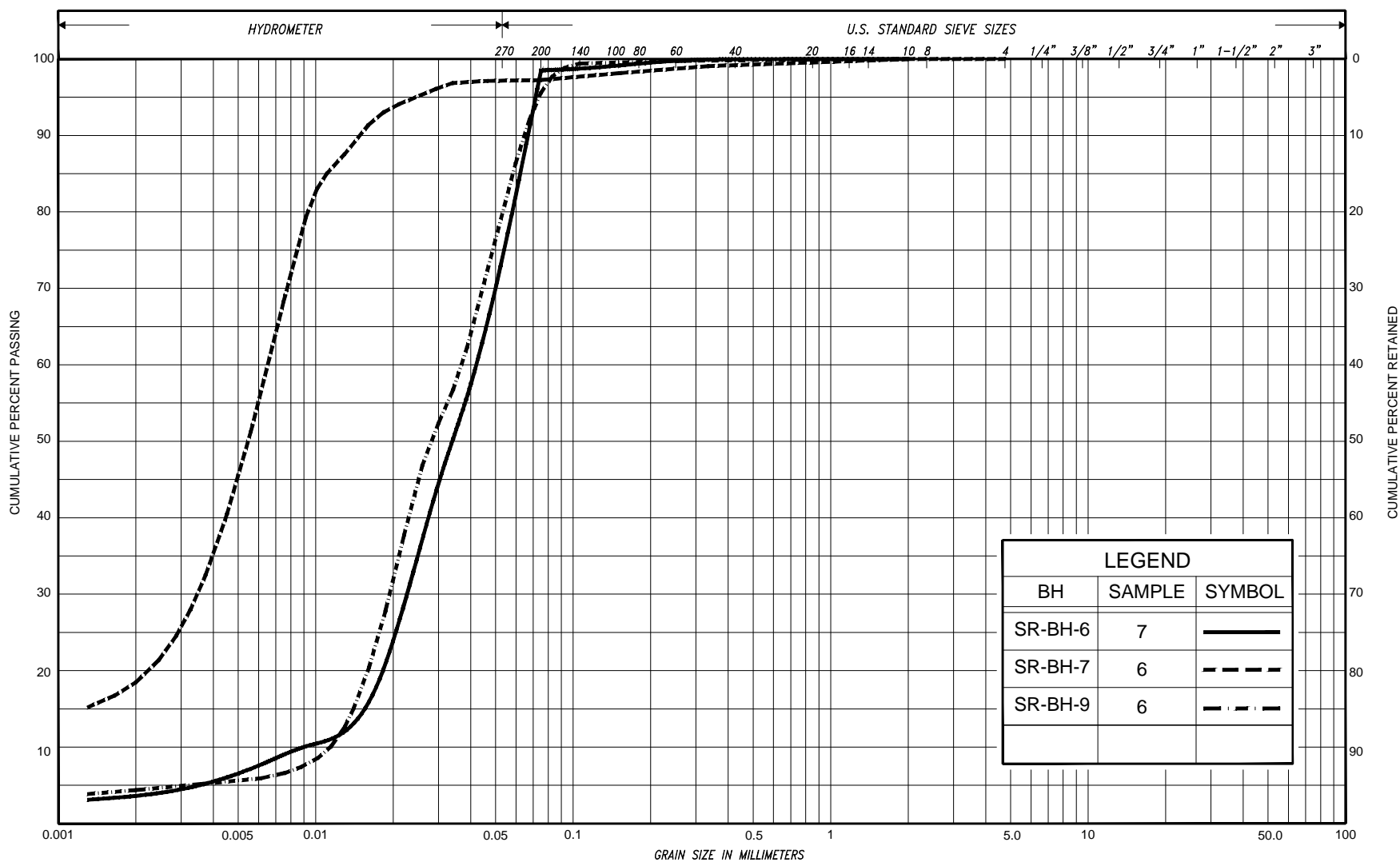
GRAIN SIZE DISTRIBUTION

SAND to SILTY SAND, trace to some clay, trace gravel

FIG No. SRS-GS-2

HWY: 400

W.P. No. 2184-10-00



SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED	
					SAND											
CLAY	FINE		MEDIUM		COARSE	FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT															
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL					U.S. BUREAU
						SAND										



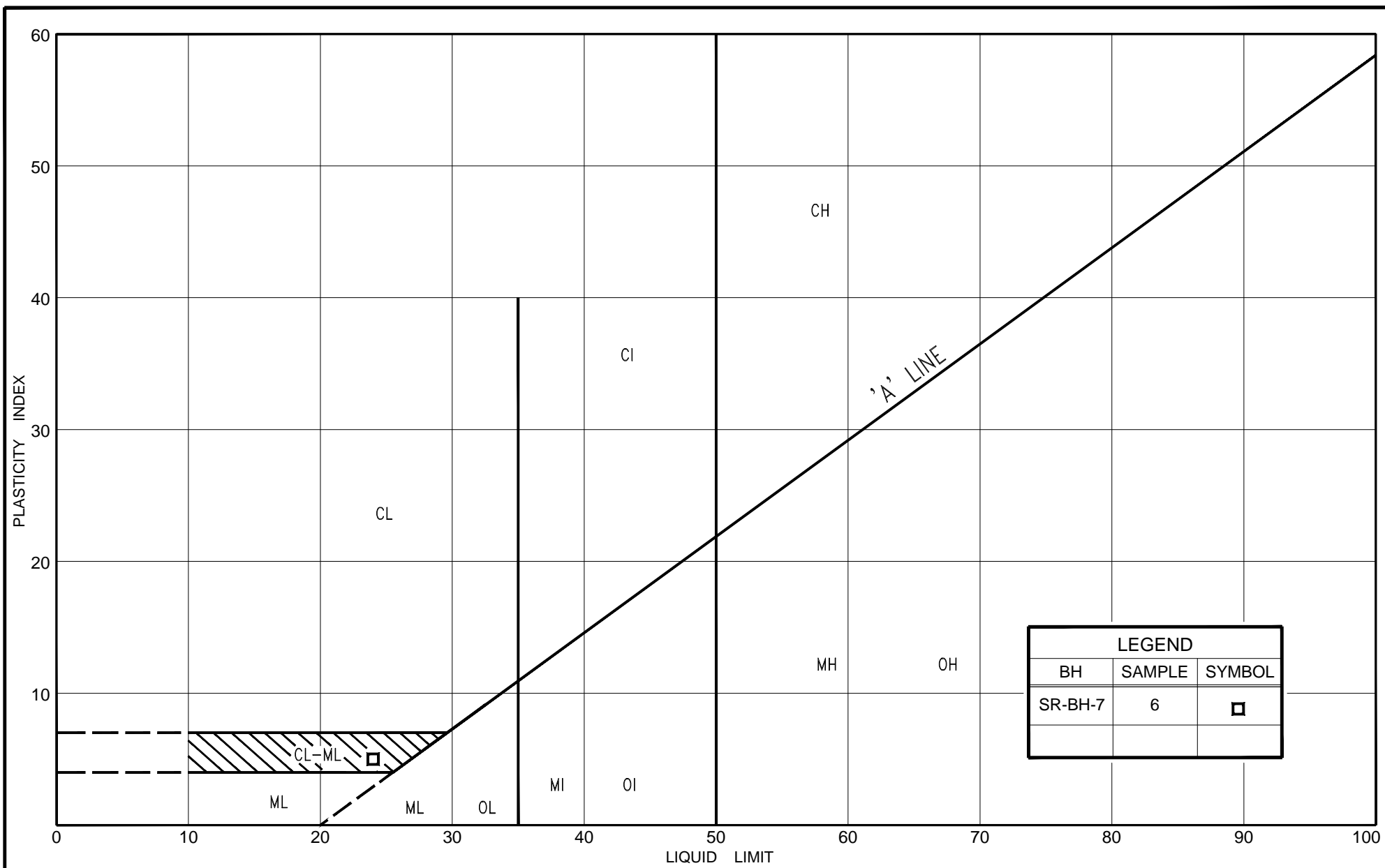
GRAIN SIZE DISTRIBUTION

SILT to CLAYEY SILT, trace sand

FIG No. SRS-GS-3

HWY: 400

W.P. No. 2184-10-00



PLASTICITY CHART

SILT to CLAYEY SILT, trace sand (CL-ML)

FIG No.	SRS-PC-1
HWY:	400
W.P. No.	2184-10-00

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m ³	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m ³	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m ³	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m ³ /s	RATE OF DISCHARGE
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL	WTP		WETTER THAN PLASTIC LIMIT	j	kN/m ³	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No SR-BH-1

1 of 1

METRIC

W.P.	<u>2184-10-00</u>	LOCATION	<u>Co-ords: 4 905 955.2 N; 290 285.6 E</u>	ORIGINATED BY	<u>S.A.</u>
DIST	<u>Central</u>	HWY	<u>400</u>	BOREHOLE TYPE	<u>Continuous Flight Solid Stem Augers</u>
DATUM	<u>Geodetic</u>	DATE	<u>March 07 and 08, 2016</u>	CHECKED BY	<u>M.V.</u>






SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
305.6 0.0	Ground Surface 150mm asphalt over sand	[X]			
305.1 0.5	Compact Grey (PAVEMENT FILL)	[X]	1	SS	28
	Sand to silty sand trace to some clay, trace to some gravel	[X]	2	SS	14
	Compact Grey/ brown (FILL)	[X]	3	SS	17
		[X]	4	SS	27
302.7 2.9	Sand to silty sand trace to some clay, trace to some gravel	[•]	5	SS	23
	Compact to Grey/ very dense brown Moist	[•]			
	cobbles	[•]	6	SS	82/25cm
300.4 5.2	End of borehole				
<p>* 2016 03 07 and 08</p> <p>▽ Water level observed during drilling</p> <p>Upon completion of augering, no free water, no cave-in</p>					

RECORD OF BOREHOLE No SR-BH-2

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 906 154.0 N; 290 248.2 E ORIGINATED BY S.A.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 07 and 08, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
304.1	Ground Surface					*											
0.0	150mm asphalt over sand																
303.6	Compact Brown/ grey (PAVEMENT FILL)		1	SS	22												
0.5	Sand to silty sand trace clay, trace gravel		2	SS	12											4 62 25 9	
	Loose to Brown/ Moist compact grey (FILL)		3	SS	11												
			4	SS	8												
301.1	Sand to silty sand trace to some clay, trace to some gravel		5	SS	86/28cm											5 48 34 13	
3.0	Very dense Grey/ brown Moist																
			6	SS	82/28cm												
298.9	End of borehole																
5.2																	
	* Borehole dry																
	Upon completion of augering, no cave-in																
	<u>Piezometer Readings:</u>																
	Date Depth Elev.																
	(m)																
	Mar.08/'16 Dry -----																
	Apr.19/'16 Dry -----																
	<u>Piezometer Legend:</u>																
	 Flush cover and concrete																
	 Bentonite seal																
	 Filter sand																
	 Screen																
	 Backfill																

RECORD OF BOREHOLE No SR-BH-3

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 906 451.1 N; 290 193.6 E ORIGINATED BY D.W.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 07, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						w _p	w	w _L		GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE													
306.3	Ground Surface							20	40	60	80	100									
0.0	180mm asphalt over sand, trace gravel						306														
305.5	Dense Brown (PAVEMENT FILL)		1	SS	34									○							
0.8	Sand to silty sand trace clay, trace gravel		2	SS	20									○							
	Loose to Brown Wet compact (FILL)		3	SS	8		305							○							2 56 37 5
			4	SS	4		304							○							
			5	SS	6		303							○							
302.9	Sand to silty sand trace to some clay, trace to some gravel													○							
3.4	Compact Brown		6	SS	27									○							12 40 35 13
			7	SS	30		302							○							
301.1	End of borehole																				
5.2																					
	* Borehole dry Upon completion of augering, no cave-in																				

RECORD OF BOREHOLE No SR-BH-4

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 906 933.5 N; 290 124.4E ORIGINATED BY D.W.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 07, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					WATER CONTENT (%)												
305.8	Ground Surface						20	40	60	80	100						
0.0	250mm asphalt over sand, trace gravel																
305.0	Very dense Brown (PAVEMENT FILL)		1	SS	59												
0.8	Sand to silty sand trace clay, trace gravel		2	SS	32												
	Very loose Brown Moist to wet (FILL)		3	SS	6												
			4	SS	2												
			5	SS	3												
302.1	Silty sand to sandy silt trace clay, trace gravel		6	SS	24												
3.7	Compact Brown Wet to dense		7	SS	39												
300.6	End of borehole																
5.2																	
	* Borehole dry																
	Upon completion of augering, no cave-in																

RECORD OF BOREHOLE No SR-BH-5

1 of 1

METRIC

W.P.	2184-10-00	LOCATION	Co-ords: 4 907 079.5 N; 290 218.1 E	ORIGINATED BY	S.A.
------	------------	----------	-------------------------------------	---------------	------

DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.

DATUM Geodetic DATE March 07 and 08, 2016 CHECKED BY M.V.

[illegible]

RECORD OF BOREHOLE No SR-BH-6

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 908 477.9 N; 290 186.7 E ORIGINATED BY D.W.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 07, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
					20 40 60 80 100					WATER CONTENT (%) 20 40 60							
283.1	Ground Surface																
0.0	230mm asphalt over sand with some gravel																
282.3	Dense Brown (PAVEMENT FILL)		1	SS	41												
0.8	Silty sand, trace gravel		2	SS	30												
281.9	Compact Brown (FILL)																
1.2	Sand to silty sand some gravel, trace clay		3	SS	33											13 48 32 7	
	Dense to Brown Moist/very dense wet		4	SS	33												
			5	SS	25												
			6	SS	63											First water strike at 3.5m	
278.6	Silt to clayey silt trace sand																
4.5	Hard Brown Moist		7	SS	37											0 2 94 4	
277.9	End of borehole																
5.2																	
	* 2016 03 07																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	Water level measured in piezometer																
	Upon completion of augering, free water on 3.2m cave-in at 4m																
	Piezometer Readings:																
	Date Depth Elev.																
	(m)																
	Mar.07/'16 3.2 279.9																
	Apr.19/'16 2.5 280.6																
	Piezometer Legend:																
	Flush cover and concrete																
	Bentonite seal																
	Filter sand																
	Screen																
	Backfill																

RECORD OF BOREHOLE No SR-BH-7

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 908 716.2 N; 290 192.7 E ORIGINATED BY S.A.
 DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
 DATUM Geodetic DATE March 8 and 9, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
279.4	Ground Surface																
0.0	150mm asphalt over sand																
279.0																	
0.4	Dense (PAVEMENT FILL)		1	SS	31												
	Sandy silt to silty sand, trace clay, trace gravel		2	SS	23												
	Compact Brown/ Moist to wet grey		3	SS	18												
	(FILL)		4	SS	21												
			5	SS	14												
275.8	Silt to clayey silt trace sand																
3.6	Stiff to Grey Moist very stiff																
			6	SS	15												
274.2	End of borehole																
5.2																	
						</											

RECORD OF BOREHOLE No SR-BH-8

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 908 825.7 N; 290 202.0 E ORIGINATED BY D.W.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 08, 2016 CHECKED BY M.V.
















SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		× LAB VANE						○		
280.1	Ground Surface						20	40	60	80	100									
0.0	230mm asphalt over sand, trace gravel		1	SS	33															
279.3	Dense Brown (PAVEMENT FILL)		2	SS	15															
0.8	Sand to silty sand some to trace gravel, organic inclusions		3	SS	3															
	Very loose Brown Moist to compact to wet (FILL)		4	SS	15															
			5	SS	14															
276.5	Silty sand, trace clay		6	SS	41															
3.6	Dense Grey Moist		7	SS	30															
274.9	End of borehole																			
5.2																				
	* 2016 03 08																			
	▽ Water level observed during drilling																			
	▼ Water level measured after drilling																			
	Upon completion of augering, free water at 3.5m cave-in at 3.5m																			

RECORD OF BOREHOLE No SR-BH-9

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 909 122.6 N; 290 214.5 E ORIGINATED BY S.A.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE April 14 and 20, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)																	
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE																	
287.3	Ground Surface					*		20	40	60	80	100																							
0.0	150mm asphalt over sand						287																												
286.8	Dense Grey (PAVEMENT FILL)		1	SS	31		287																												
0.5	Sand to silty sand trace clay, trace gravel		2	SS	20		286																												
	Compact Brown Moist (FILL)		3	SS	21		285																												
			4	SS	20		284										1 86 9 4																		
			5	SS	11		283																												
283.1	Silt to clayey silt trace sand						283																												
4.2	Very stiff Grey Moist		6	SS	20												0 4 92 4																		
282.1	End of borehole																																		
5.2																																			
	<p>* Borehole dry</p> <p>Water level measured in piezometer</p> <p>Upon completion of augering, no cave-in</p> <p><u>Piezometer Readings:</u></p> <table><tr><td>Date</td><td>Depth (m)</td><td>Elev.</td></tr><tr><td>Mar.09/'16</td><td>Dry</td><td>-----</td></tr><tr><td>Apr.14/'16</td><td>3.4</td><td>283.9</td></tr></table> <p><u>Piezometer Legend:</u></p> <table><tr><td></td><td>Flush cover and concrete</td></tr><tr><td></td><td>Bentonite seal</td></tr><tr><td></td><td>Filter sand</td></tr><tr><td></td><td>Screen</td></tr><tr><td></td><td>Backfill</td></tr></table>	Date	Depth (m)	Elev.	Mar.09/'16	Dry	-----	Apr.14/'16	3.4	283.9		Flush cover and concrete		Bentonite seal		Filter sand		Screen		Backfill															
Date	Depth (m)	Elev.																																	
Mar.09/'16	Dry	-----																																	
Apr.14/'16	3.4	283.9																																	
	Flush cover and concrete																																		
	Bentonite seal																																		
	Filter sand																																		
	Screen																																		
	Backfill																																		

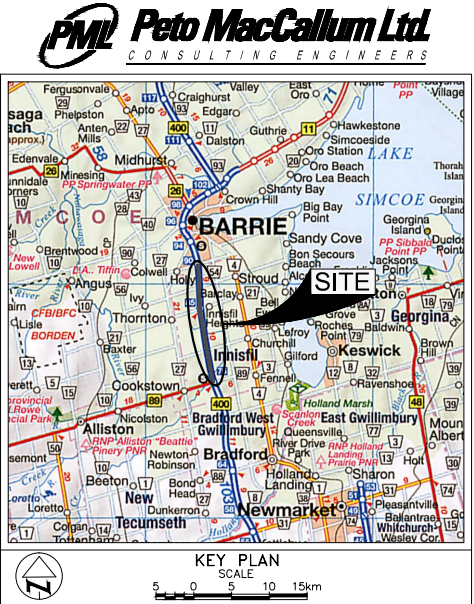
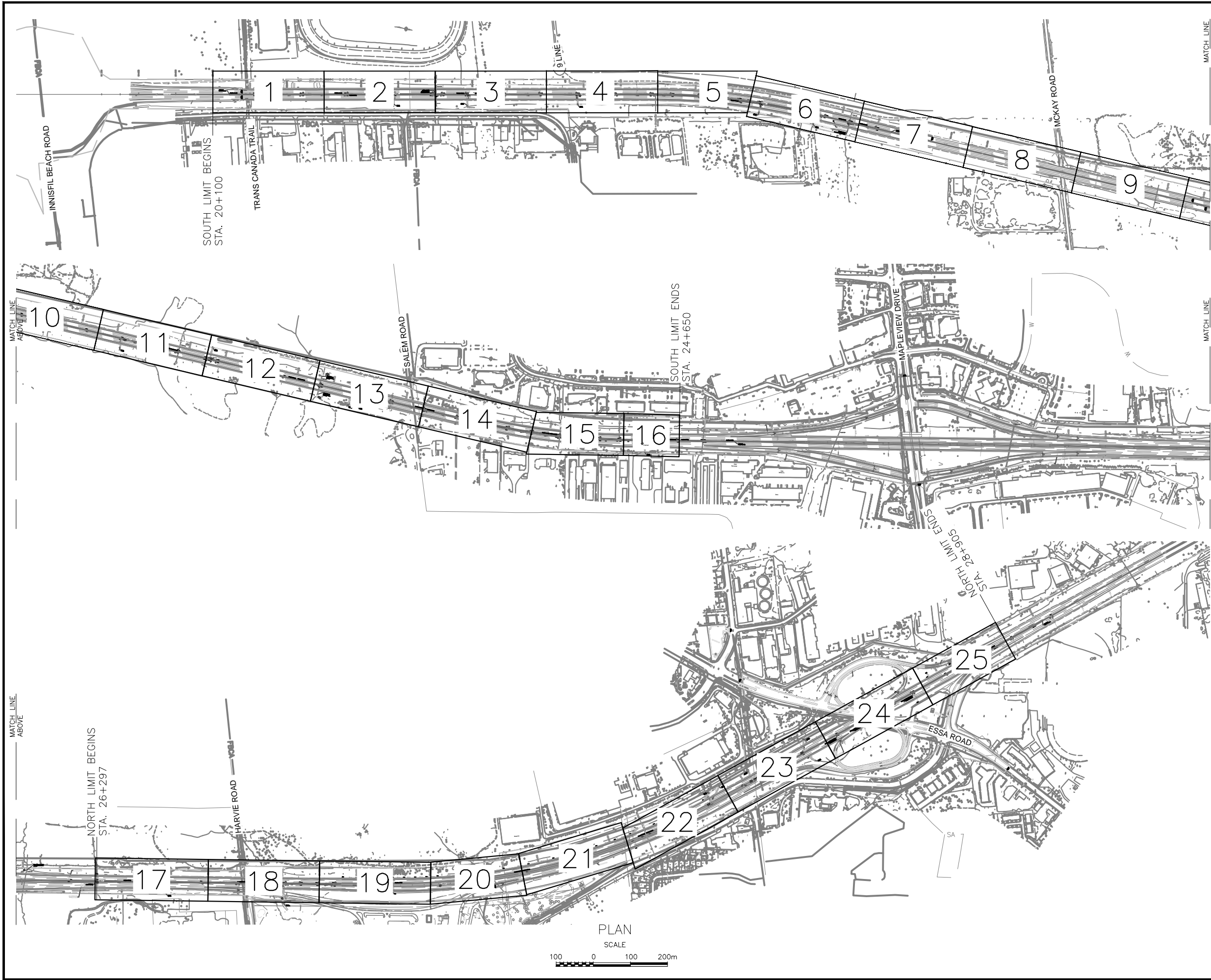
RECORD OF BOREHOLE No SR-BH-10

1 of 1

METRIC

W.P. 2184-10-00 LOCATION Co-ords: 4 909 901.6 N; 290 201.5 E ORIGINATED BY D.W.
DIST Central HWY 400 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.Kh.
DATUM Geodetic DATE March 08, 2016 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
292.5	Ground Surface						20	40	60	80	100									
0.0	280mm asphalt over sand, trace gravel																			
291.7	Very dense Brown (PAVEMENT FILL)		1	SS	51															
0.8	Silty sand to sandy silt trace clay, trace gravel		2	SS	11															
	Very loose Brown Moist to compact (FILL)		3	SS	9															
			4	SS	4											0 76 21 3				
			5	SS	2											1 46 41 12				
289.0																				
3.5	Silty sand to sandy silt trace to some gravel, trace clay		6	SS	60/15cm															
	Very dense Brown																			
287.8			7	SS	60/15cm															
4.7	End of borehole																			

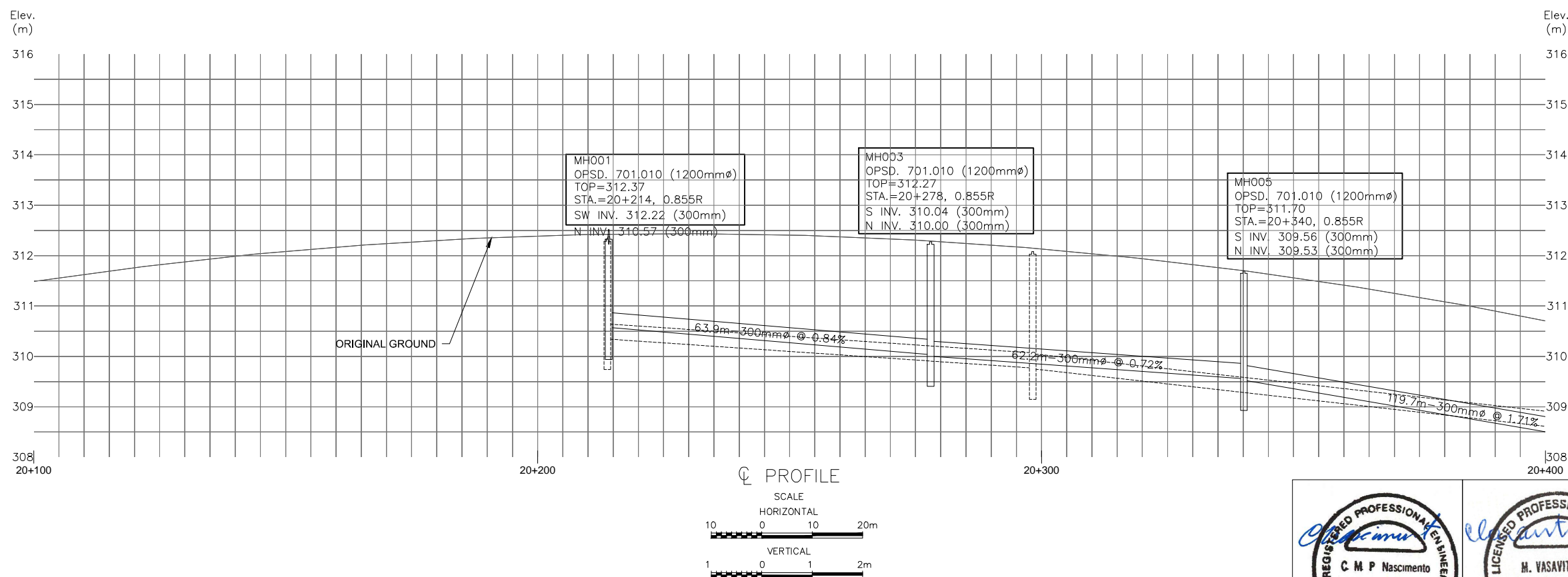
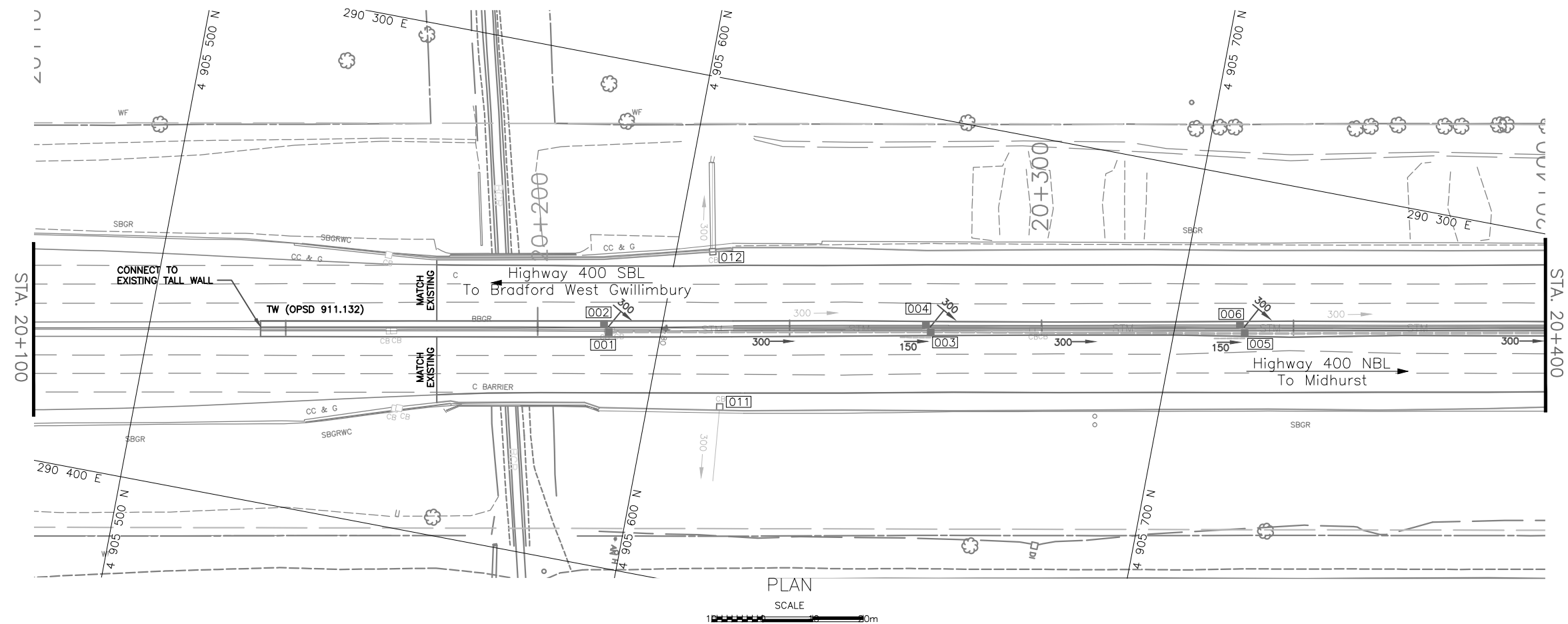


LEGEND	
<div>25</div>	Site Plan Sheet Number

BH No	BOREHOLE LOCATION PLAN
SR-BH-1	Refer to Sheet No. 400WM-2/25
SR-BH-2	Refer to Sheet No. 400WM-3/25
SR-BH-3	Refer to Sheet No. 400WM-4/25
SR-BH-4	Refer to Sheet No. 400WM-6/25
SR-BH-5	Refer to Sheet No. 400WM-6/25
SR-BH-6	Refer to Sheet No. 400WM-11/25
SR-BH-7	Refer to Sheet No. 400WM-12/25
SR-BH-8	Refer to Sheet No. 400WM-12/25
SR-BH-9	Refer to Sheet No. 400WM-13/25
SR-BH-10	Refer to Sheet No. 400WM-16/25

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



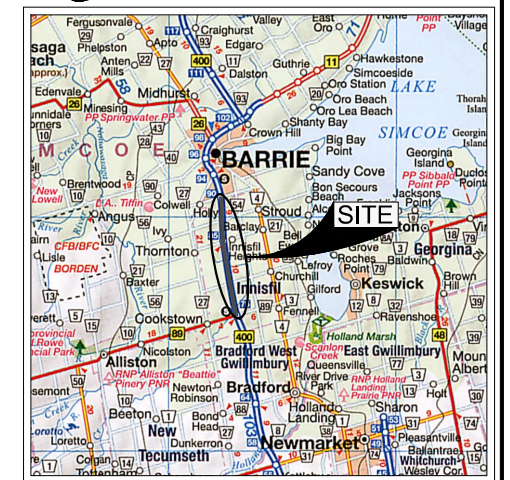
TASK No	2016-E-0039-010
WP No	2184-10-00



HIGHWAY 400 SEWER REPLACEMENT

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN SCALE 			
LEGEND			
<p>----- Existing Sewer</p> <p>———— Replacement/New Sewer</p>			
BH No	ELEVATION	CO—ORDINATES	
		NORTHINGS	EASTINGS

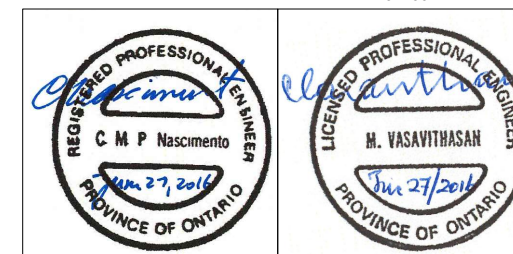
- NOTE -

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

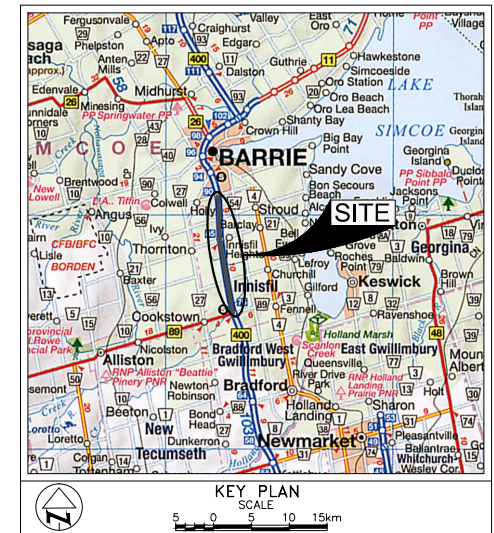
REVISIONS			
	DATE	BY	DESCRIPTION

Geocres No. 31D-657

HWY No	400			DIST	CENTRAL
SUBM'D	NA	CHECKED M.Kh	DATE JUNE 27, 2016	SITE	
DRAWN	NL	CHECKED MV	APPROVED CN	DWG 400WM-1/25	

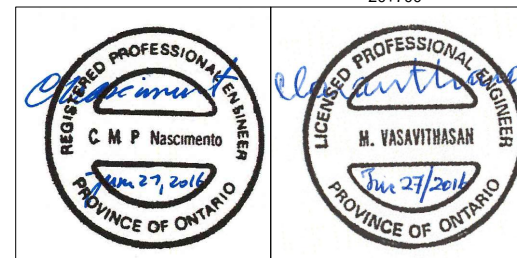
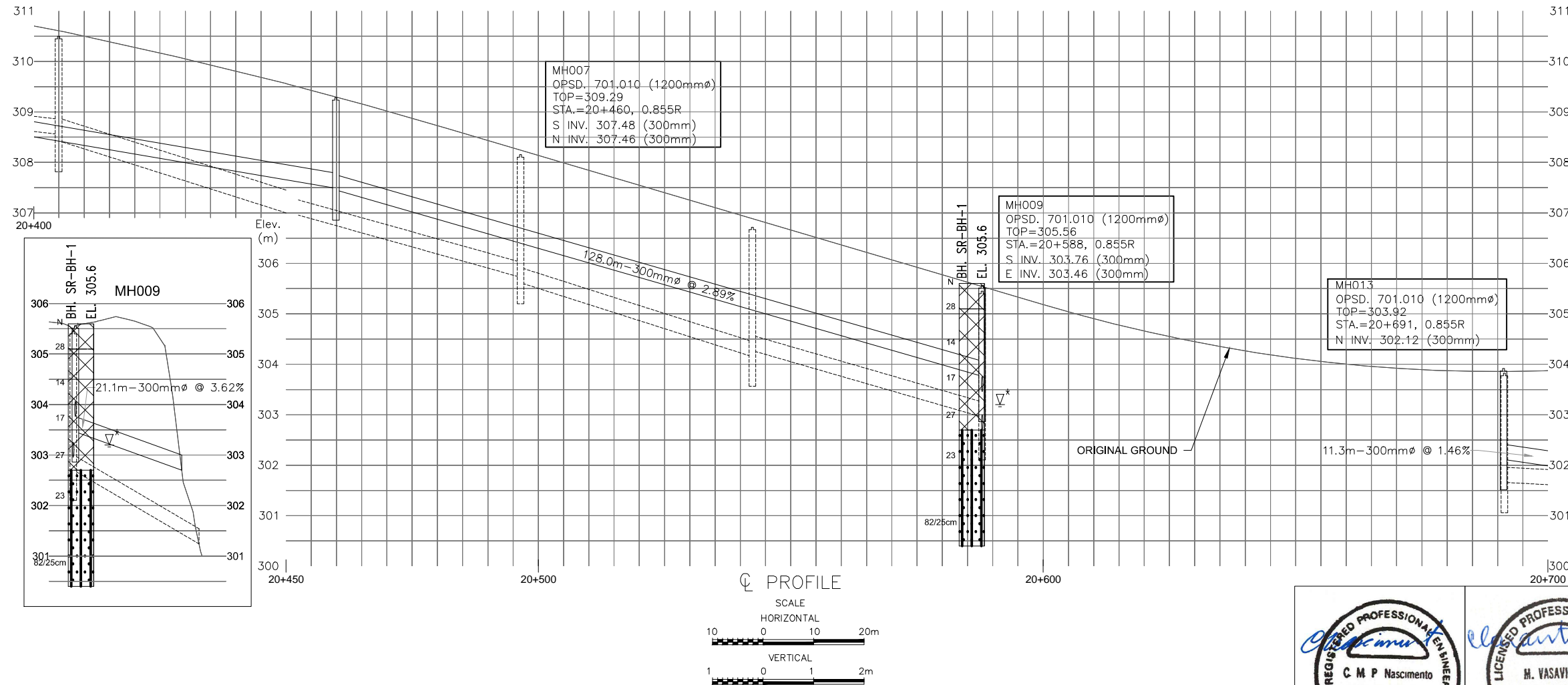
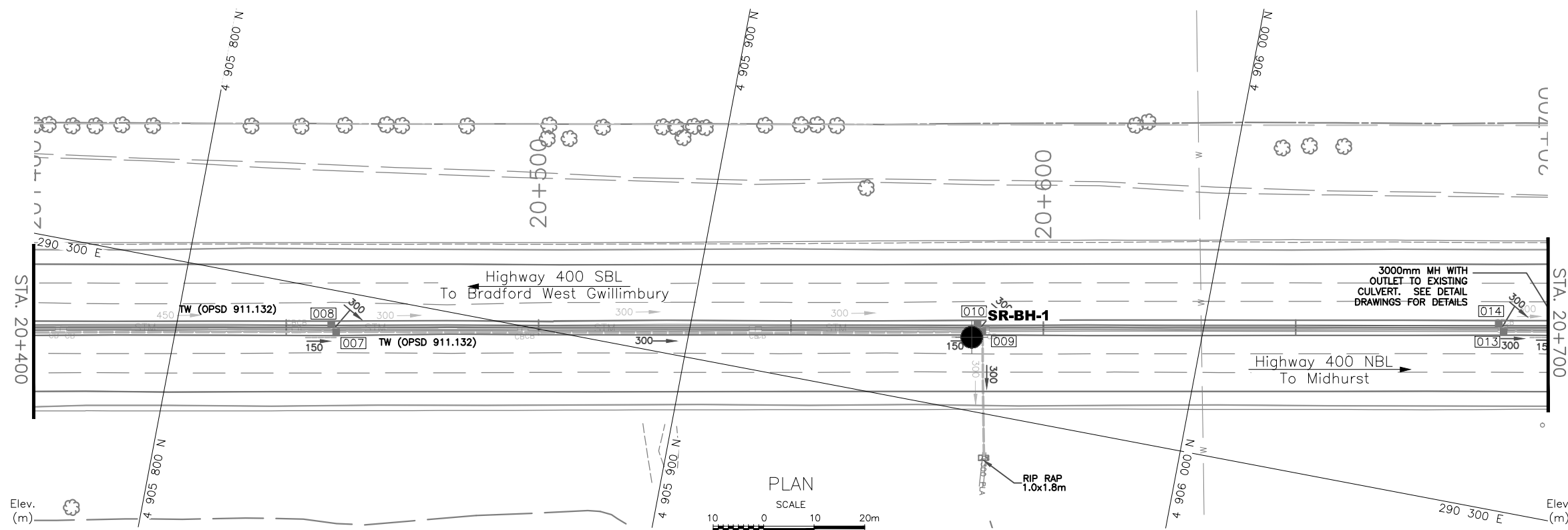


REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.

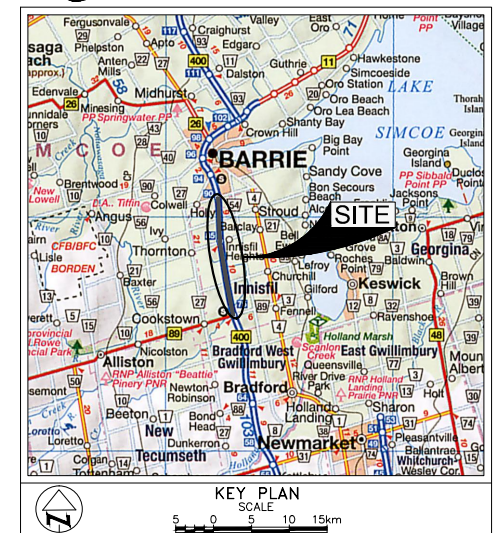


LEGEND				
	Borehole Location			
	Blows/0.3m (Std. Pen Test, 475 J / blow)			
	Piezometer			
	WL observed during drilling (March 2016)			
	Existing Sewer			
	Replacement/New Sewer			
	FILL			
	SAND TO SILTY SAND			
BH No	ELEVATION	CO-ORDINATES		
		NORTHINGS	EASTINGS	
SR-BH-1	305.6	4 905 955.2	290 285.6	

REVISIONS			
DATE	BY	DESCRIPTION	
Geocres No. 31D-657			
HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN
DWG 400WM-2/25			

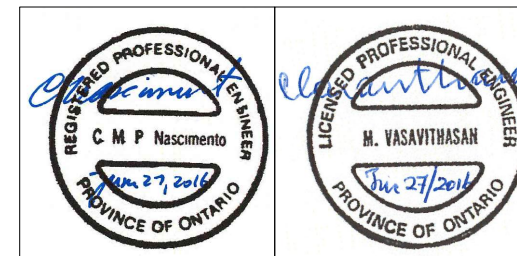
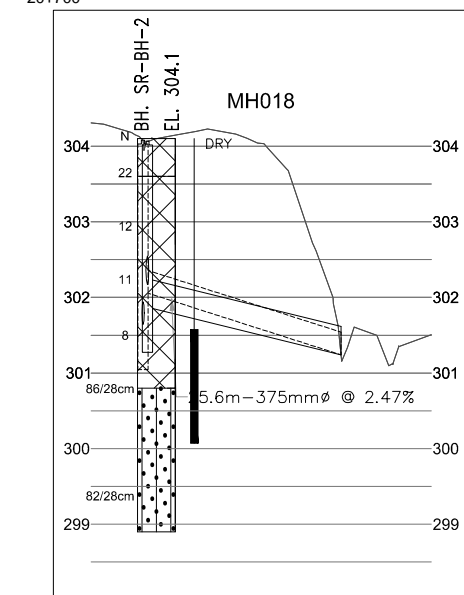
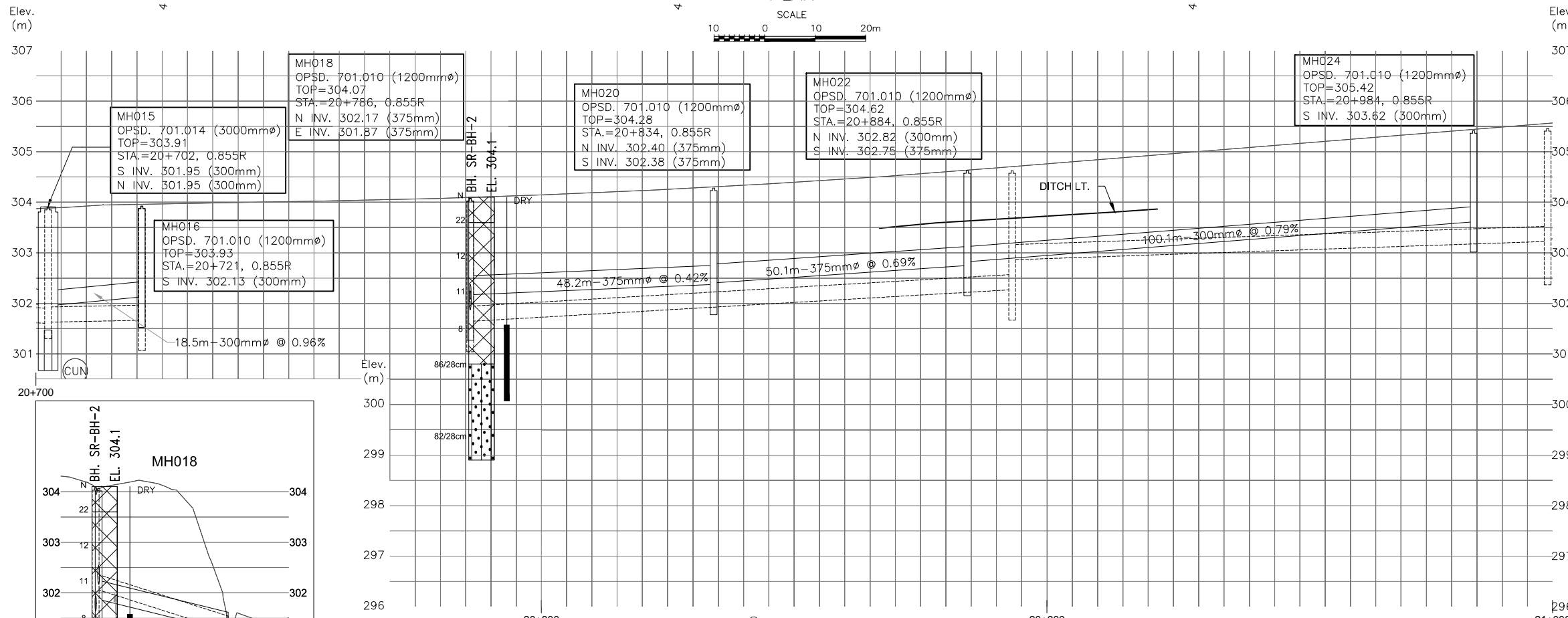
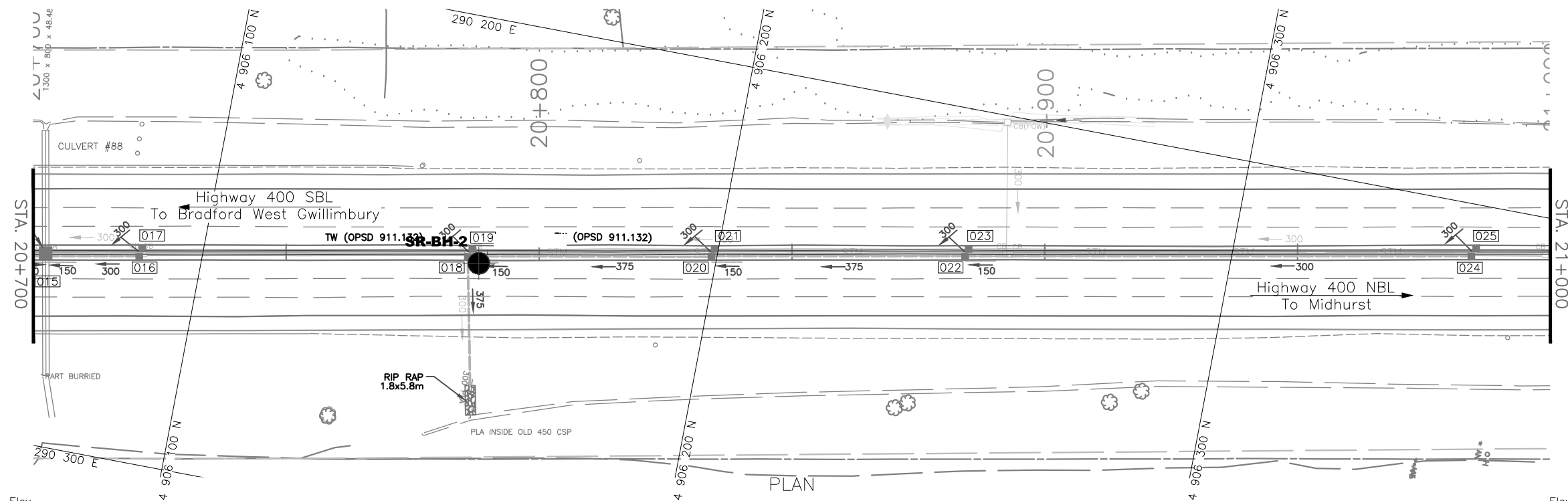


REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.

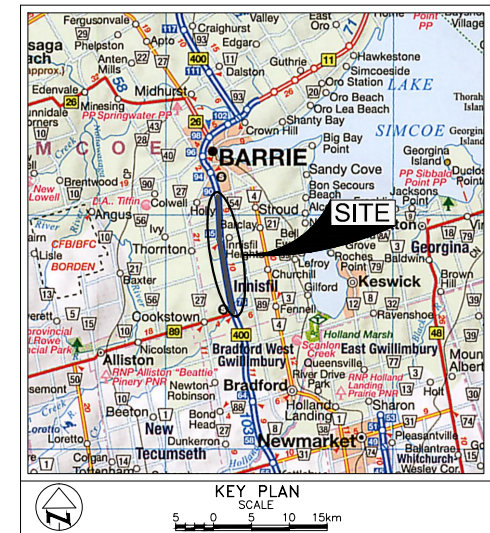


LEGEND				
	Borehole Location			
	Blows/0.3m (Std. Pen Test, 475 J / blow)			
	Piezometer			
	Existing Sewer			
	Replacement/New Sewer			
	FILL			
	SAND TO SILTY SAND			
BH No	ELEVATION	CO-ORDINATES		
		NORTHINGS	EASTINGS	
SR-BH-2	304.1	4 909 154.0	290 248.2	

REVISIONS			
DATE	BY	DESCRIPTION	
Geocres No. 31D-657			
HWY No	400	DIST	CENTRAL
SUBM'D NA	CHECKED M.KH	DATE JUNE 27, 2016	SITE
DRAWN NL	CHECKED MV	APPROVED CN	DWG 400WM-3/25



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



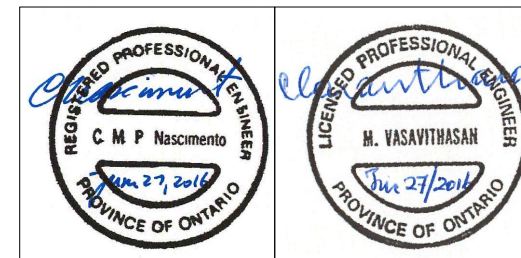
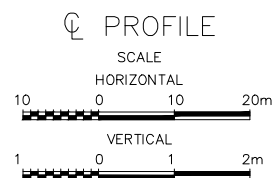
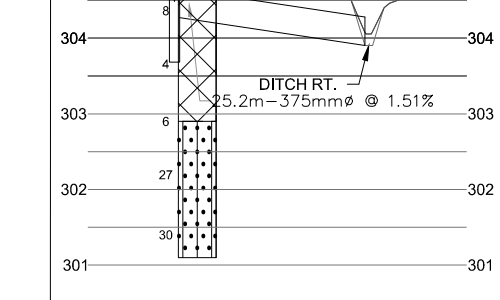
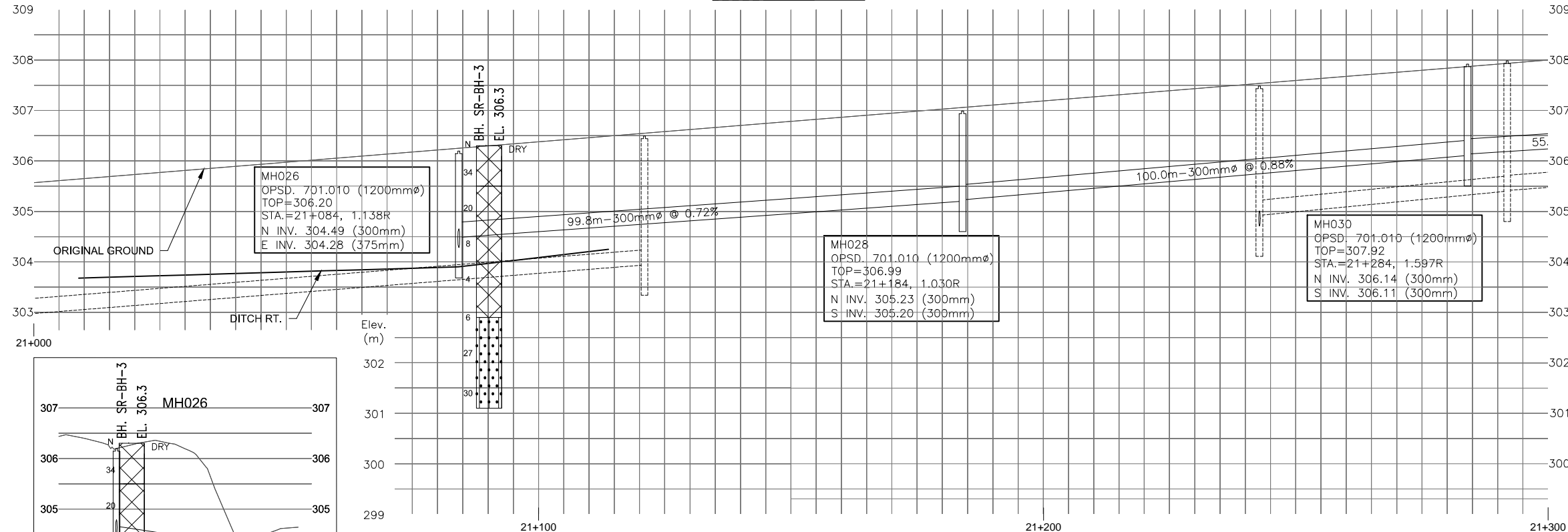
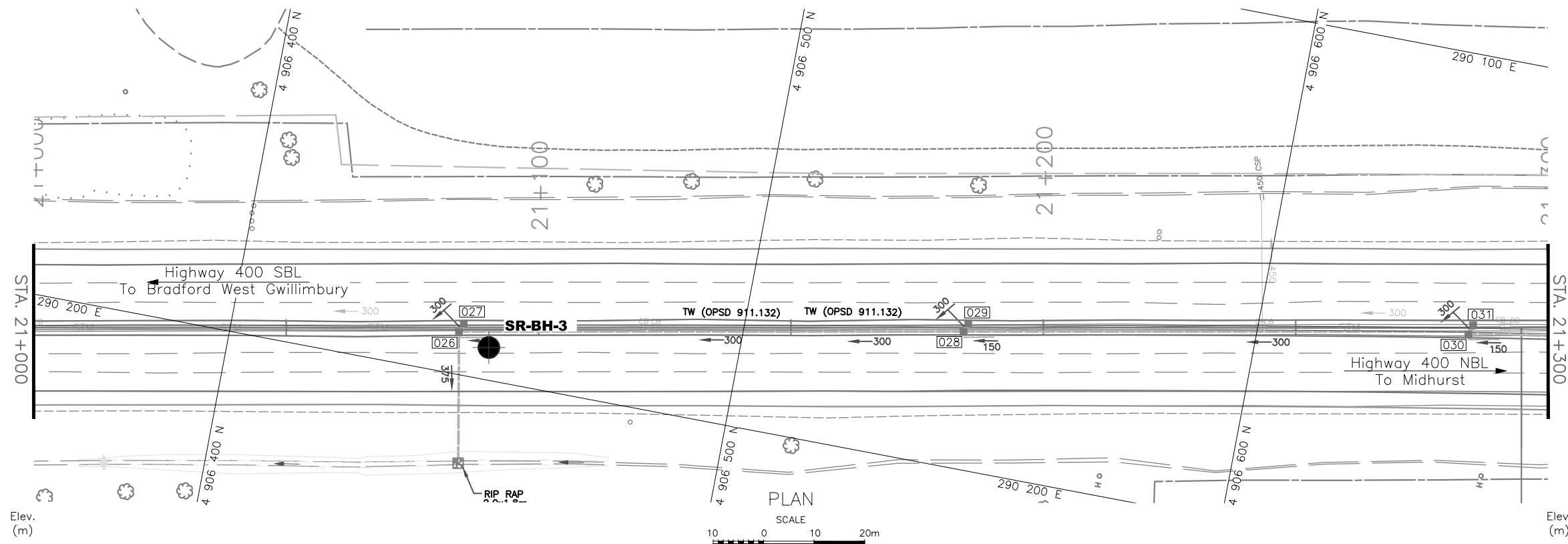
LEGEND			
	Borehole Location		
	Blows/0.3m (Std. Pen Test, 475 J / blow)		
	Piezometer		
	Existing Sewer		
	Replacement/New Sewer		
	FILL		
	SAND TO SILTY SAND		
BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
SR-BH-3	306.3	4 906 451.1	290 193.6

- NOTE -

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

REVISIONS

	</	



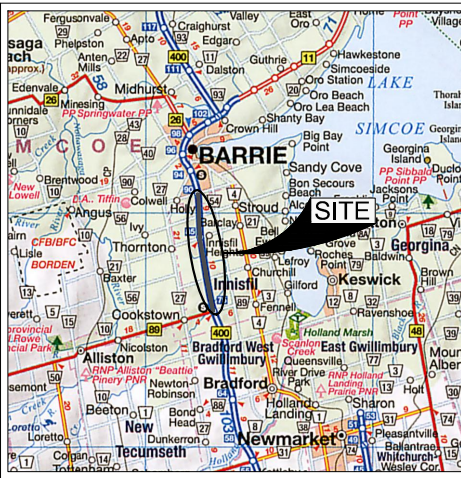
REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.

TASK No 2016-E-0039-010
WP No 2184-10-00



HIGHWAY 400 SEWER REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN
SCALE
5 0 5 10 15km

LEGEND

----- Existing Sewer
—— Replacement/New Sewer

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS

NOTE

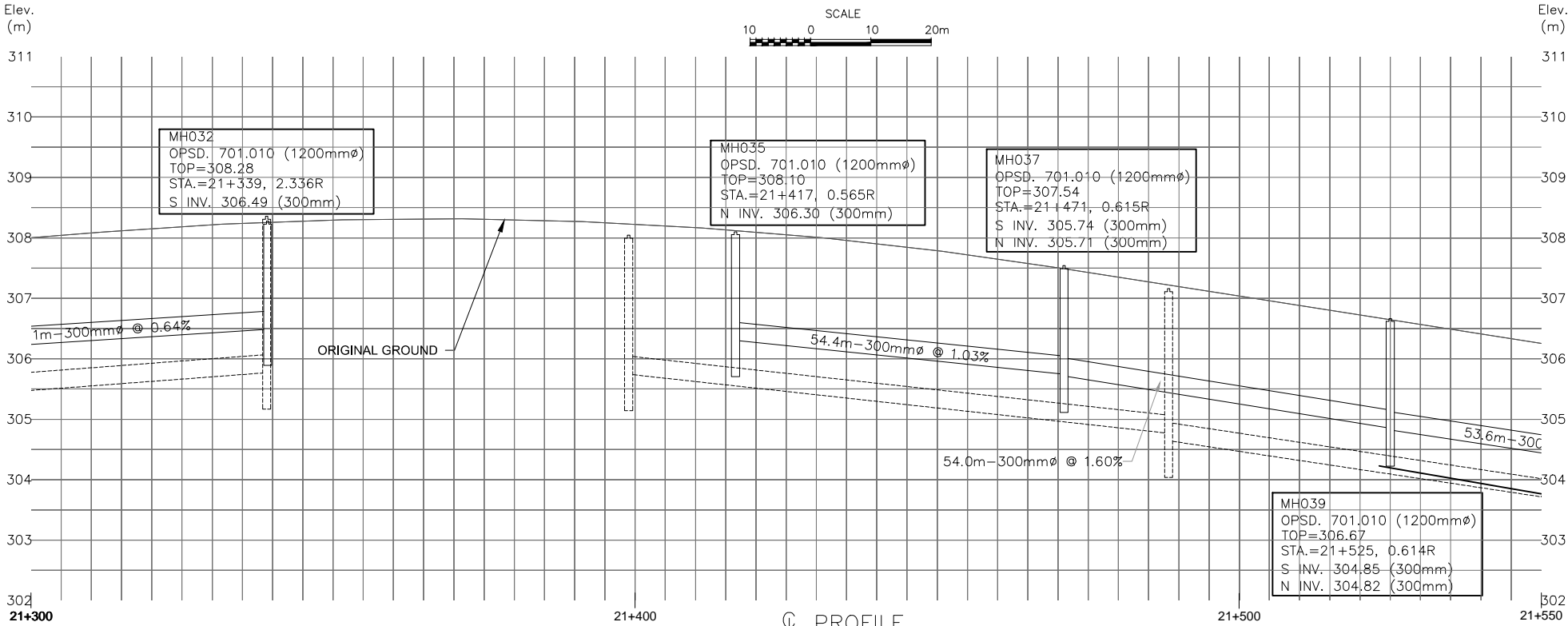
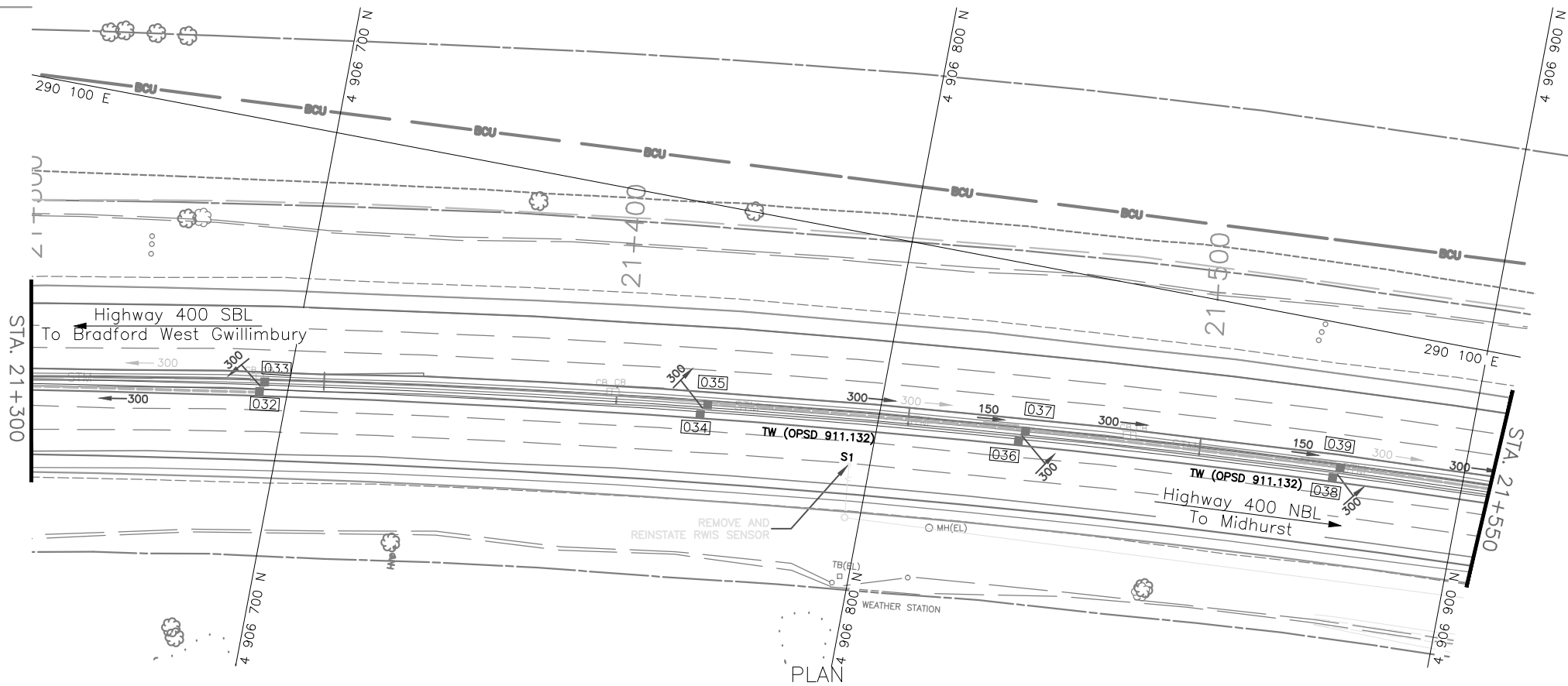
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 31D-657

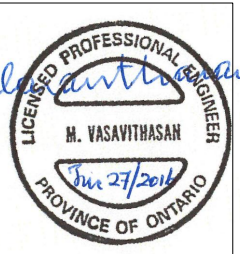
HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN

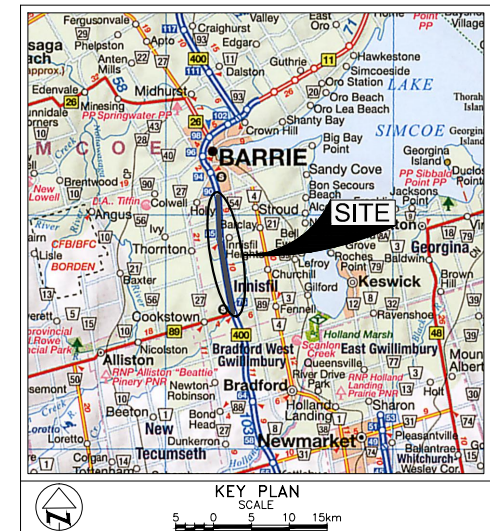
REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



PROFILE

SCALE
HORIZONTAL
10 0 10 20m
VERTICAL
1 0 1 2m





LEGEND				
	Borehole Location			
	Blows/0.3m (Std. Pen Test, 475 J / blow)			
	Piezometer			
	WL in Piezometer (April 2016)			
	Existing Sewer			
	Replacement/New Sewer			
	FILL			
	SILTY SAND TO SANDY SILT			
	SAND TO SILTY SAND			
BH No	ELEVATION	CO-ORDINATES		
		NORTHINGS	EASTINGS	
SR-BH-4	305.8	4 906 933.5	290 124.4	
SR-BH-5	303.8	4 907 079.5	290 218.1	

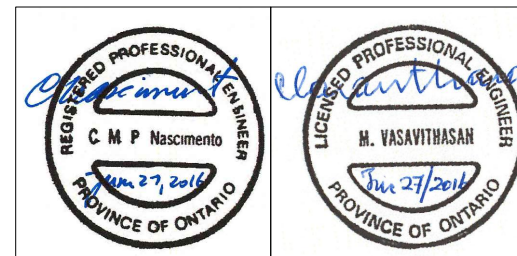
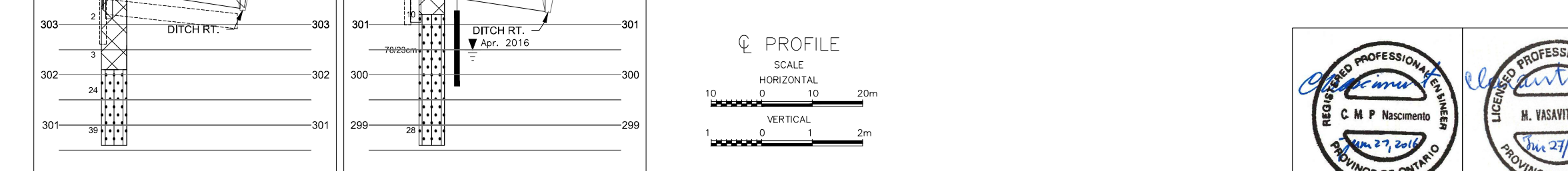
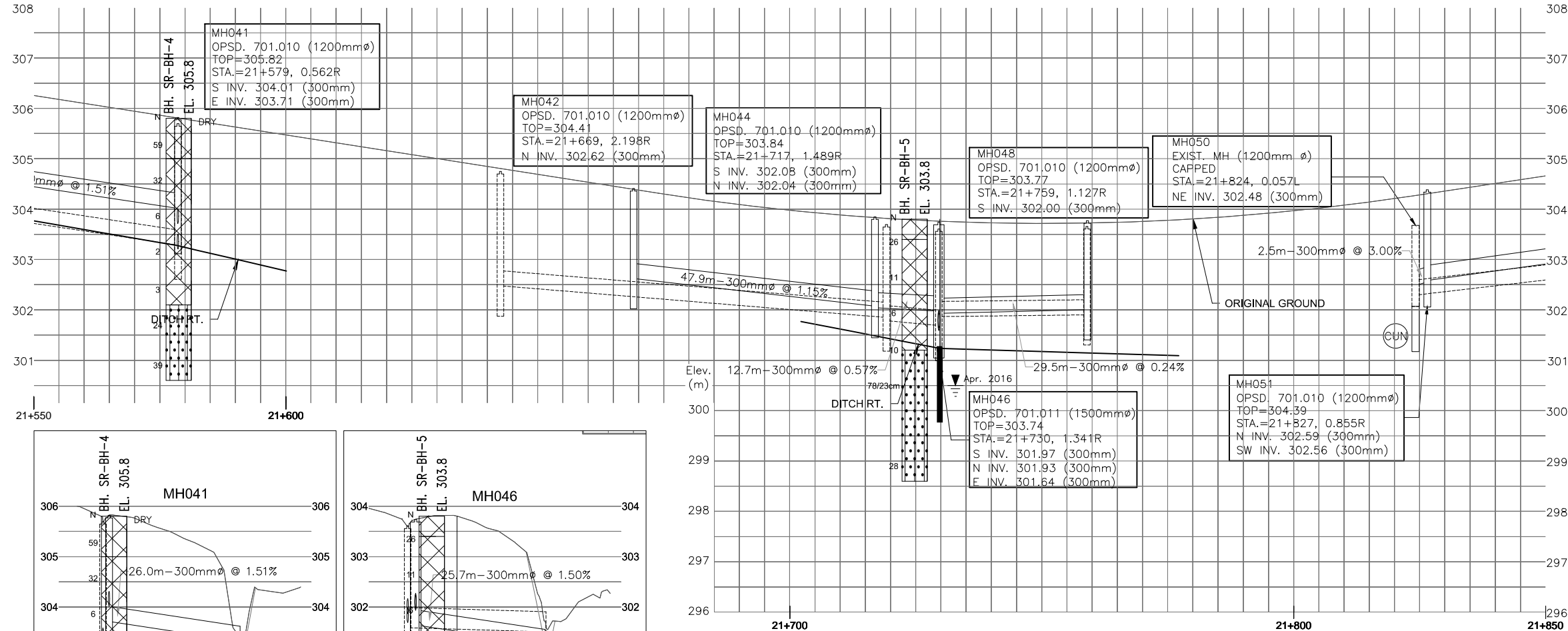
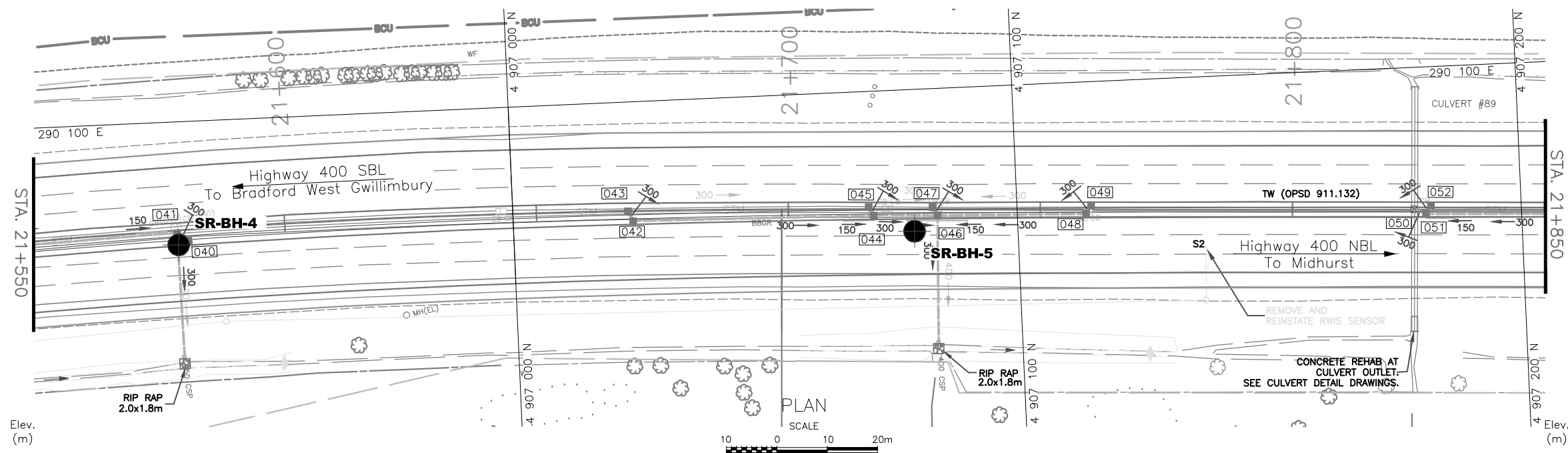
NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 31D-657

HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN

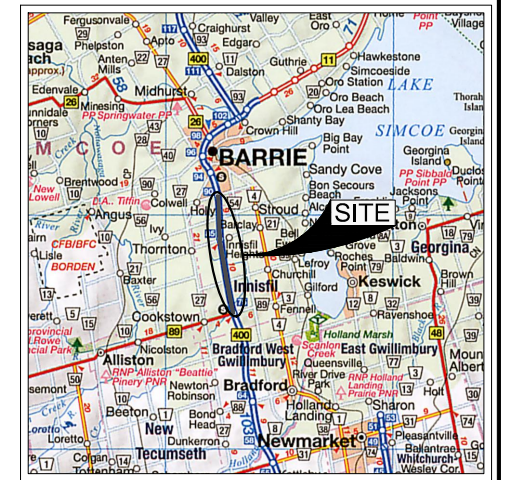
REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg; dated January 13, 2016 & January 12, 2016, respectively.





SHEET

1000



LEGEND

[illegible][illegible][illegible][illegible]

--	--	--	--	--	--

--	--	--	--	--	--

--	--	--	--	--	--

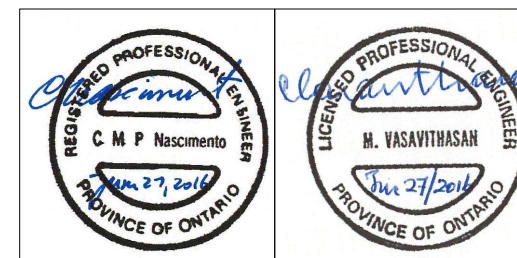
boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION
Geocres No. 31D-657		



SCALE

VERTICAL



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



SHEET

1000



LEGEND

[illegible]

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS

S			

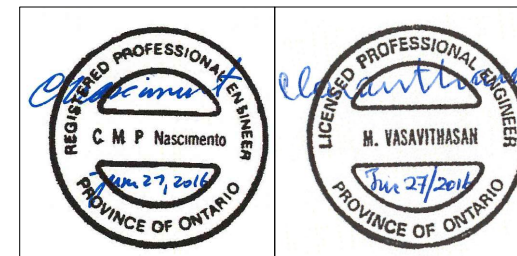
Geocres No. 31D-657

SUBM'D	NA	CHECKED M.Kh	DATE JUNE 27, 2016	SITE
DRAWN	NL	CHECKED MV	APPROVED CN	DWG 400WM-8/25



SCALE

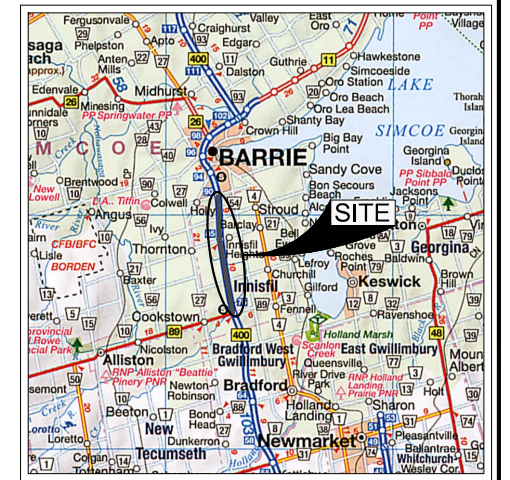
VERTICAL



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



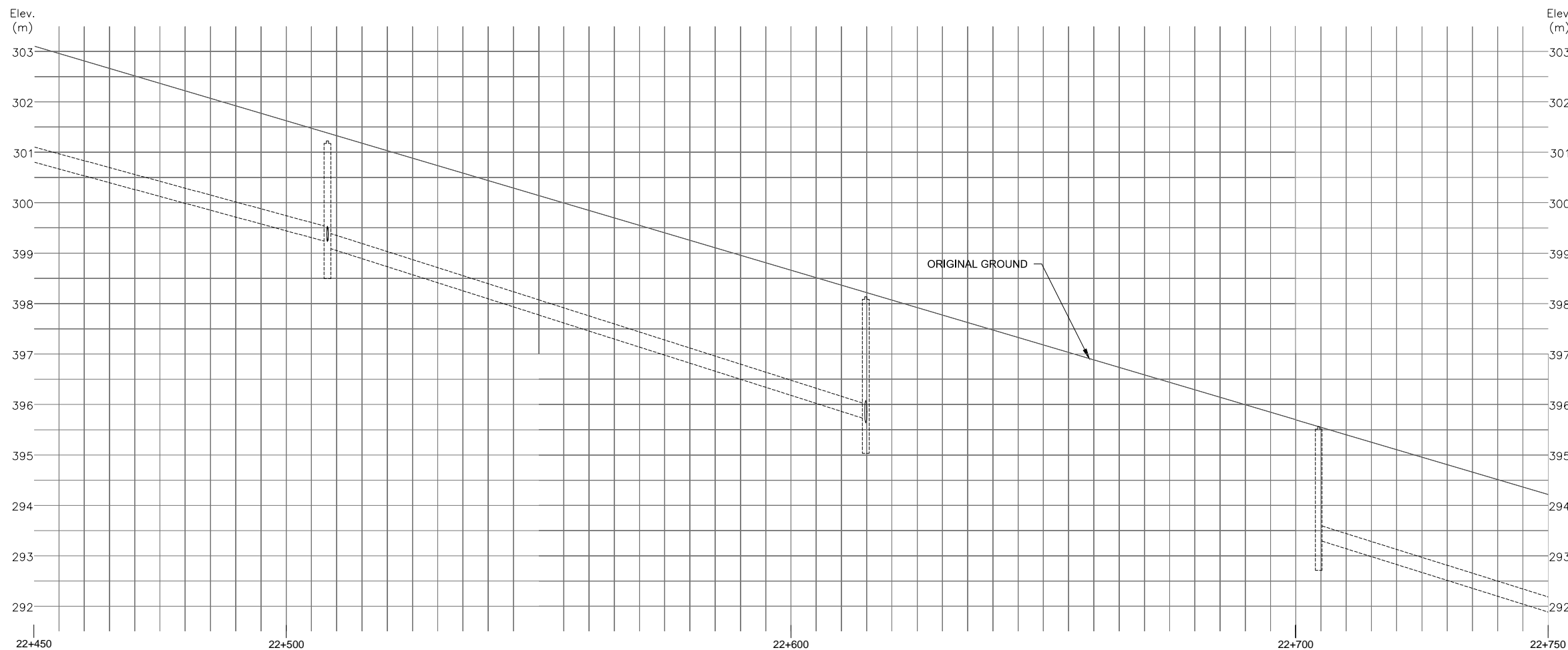
SHEET 11

[illegible]


----- Existing Sewer
 ————— Replacement/New Sewer

- NOTE -

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


Geocres No. 31D-657

SCALE
HORIZONTAL

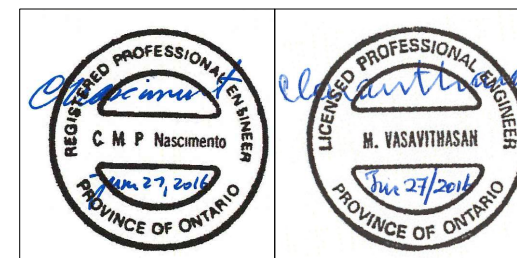


10 0 10 20m

VERTICAL



1 0 1 2m



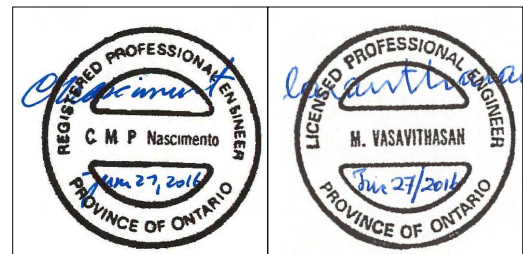
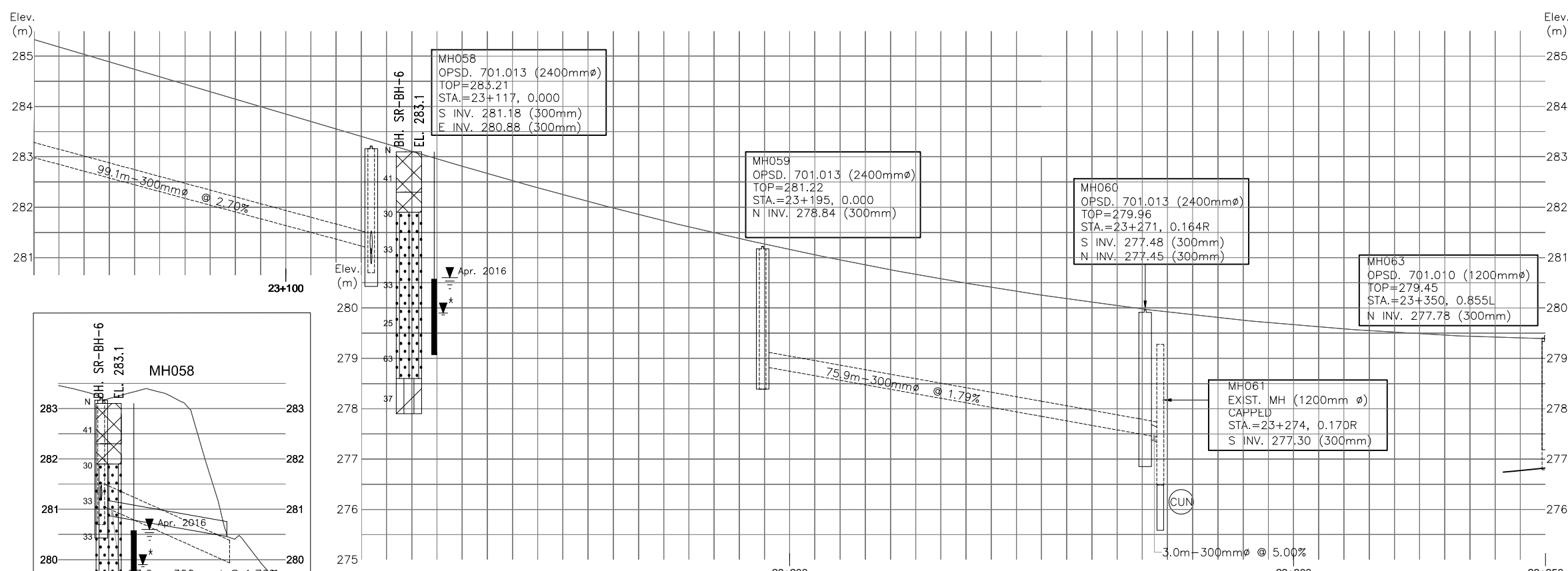
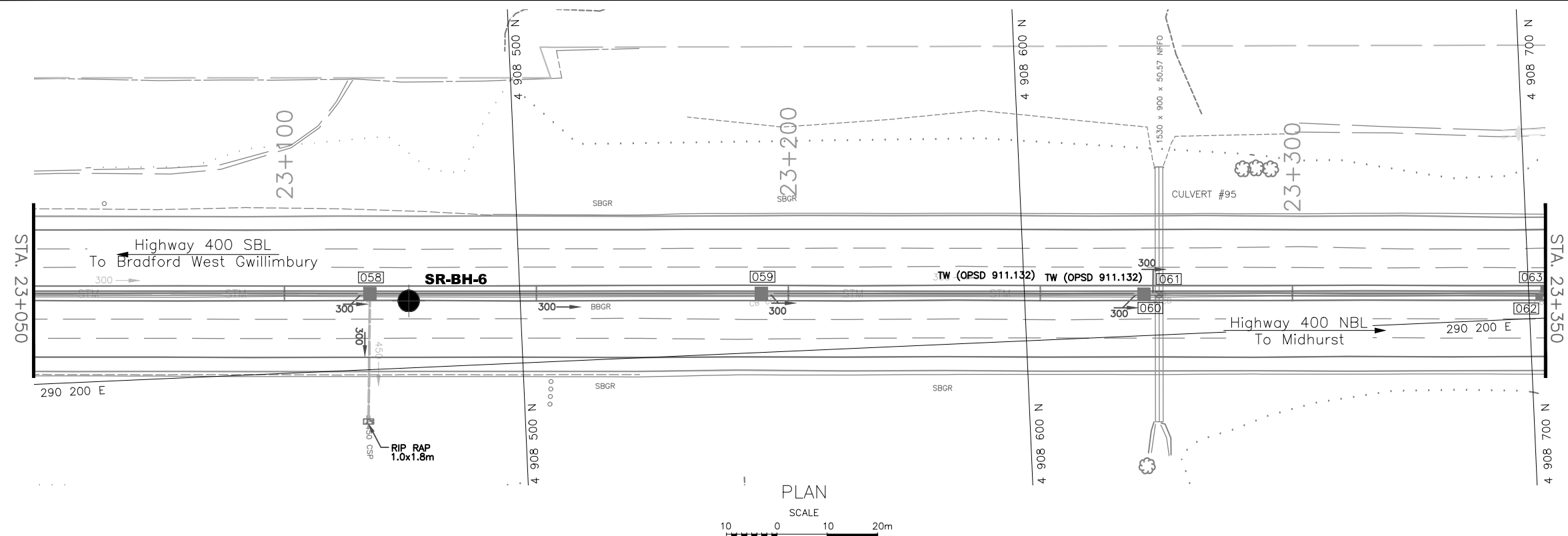
REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



LEGEND				
	Borehole Location			
	Blows/0.3m (Std. Pen Test, 475 J / blow)			
	Piezometer			
	WL at time of investigation (March 2016)			
	WL in Piezometer (April 2016)			
	Existing Sewer			
	Replacement/New Sewer			
	FILL			
	SAND TO SILTY SAND			
	SILT TO CLAYEY SILT			
BH No	ELEVATION	CO-ORDINATES		
		NORTHINGS	EASTINGS	
SR-BH-6	283.1	4 908 477.9	290 186.7	

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
DATE	BY	DESCRIPTION	
Geocres No. 31D-657			
HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN
DWG 400WM-11/25			



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg; dated January 13, 2016 & January 12, 2016, respectively.



LEGEND

Borehole Location

Blows/0.3m (Std. Pen Test, 475 J / blow)

Piezometer

WL at time of investigation (March 2016)

WL in Piezometer (April 2016)

Existing Sewer

Replacement/New Sewer

FILL

SILT TO CLAYEY SILT

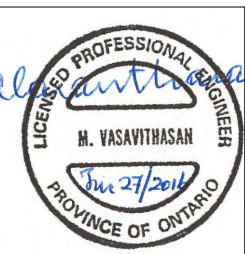
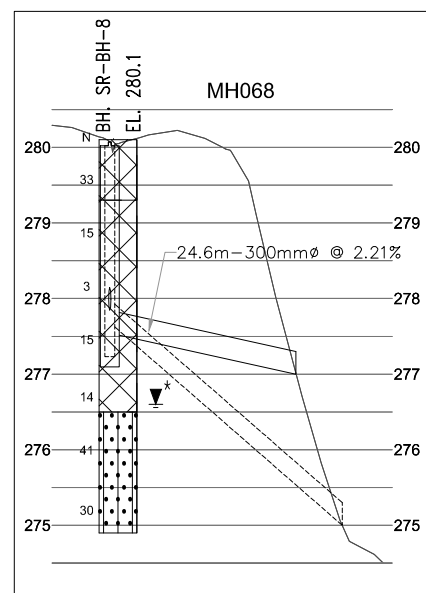
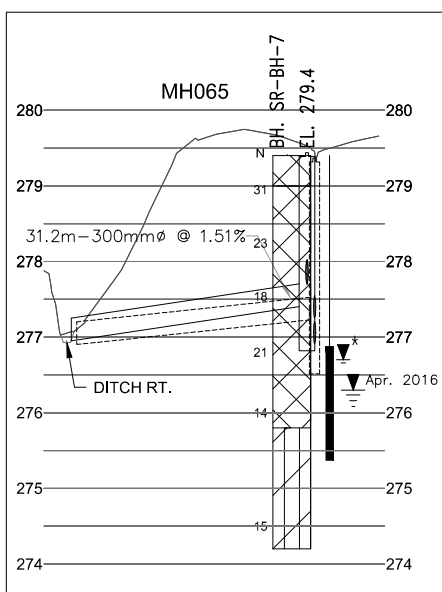
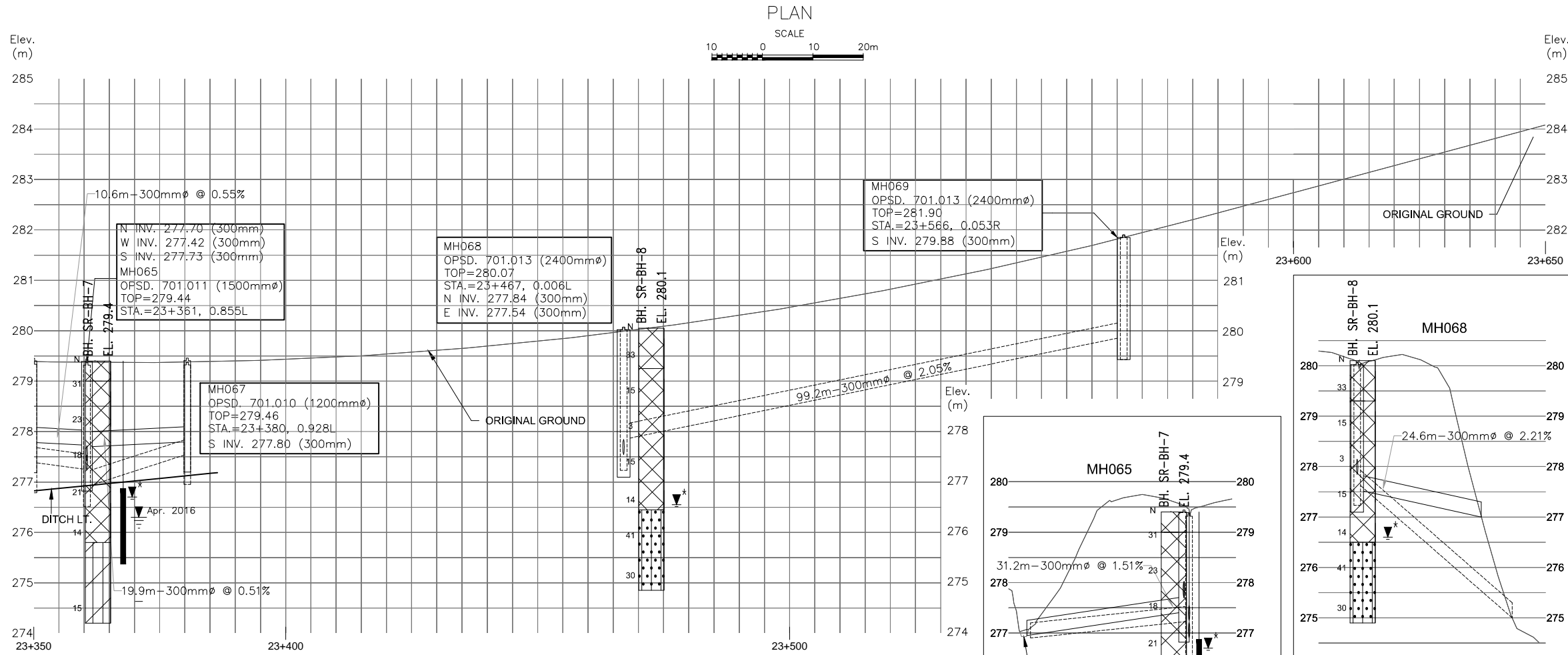
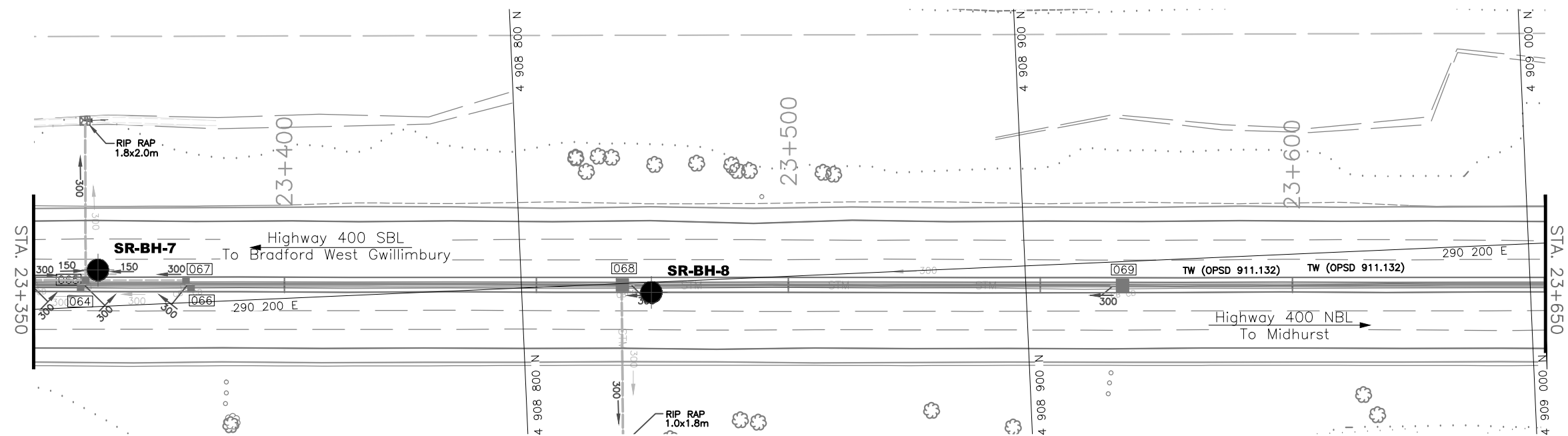
SILTY SAND

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
SR-BH-7	279.4	4 908 716.2	290 192.7
SR-BH-8	280.1	4 908 825.7	290 202.0

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
SR-BH-7	279.4	4 908 716.2	290 192.7
SR-BH-8	280.1	4 908 825.7	290 202.0

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
DATE	BY	DESCRIPTION	
Geocres No. 31D-657			
HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN
DWG 400WM-12/25			



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



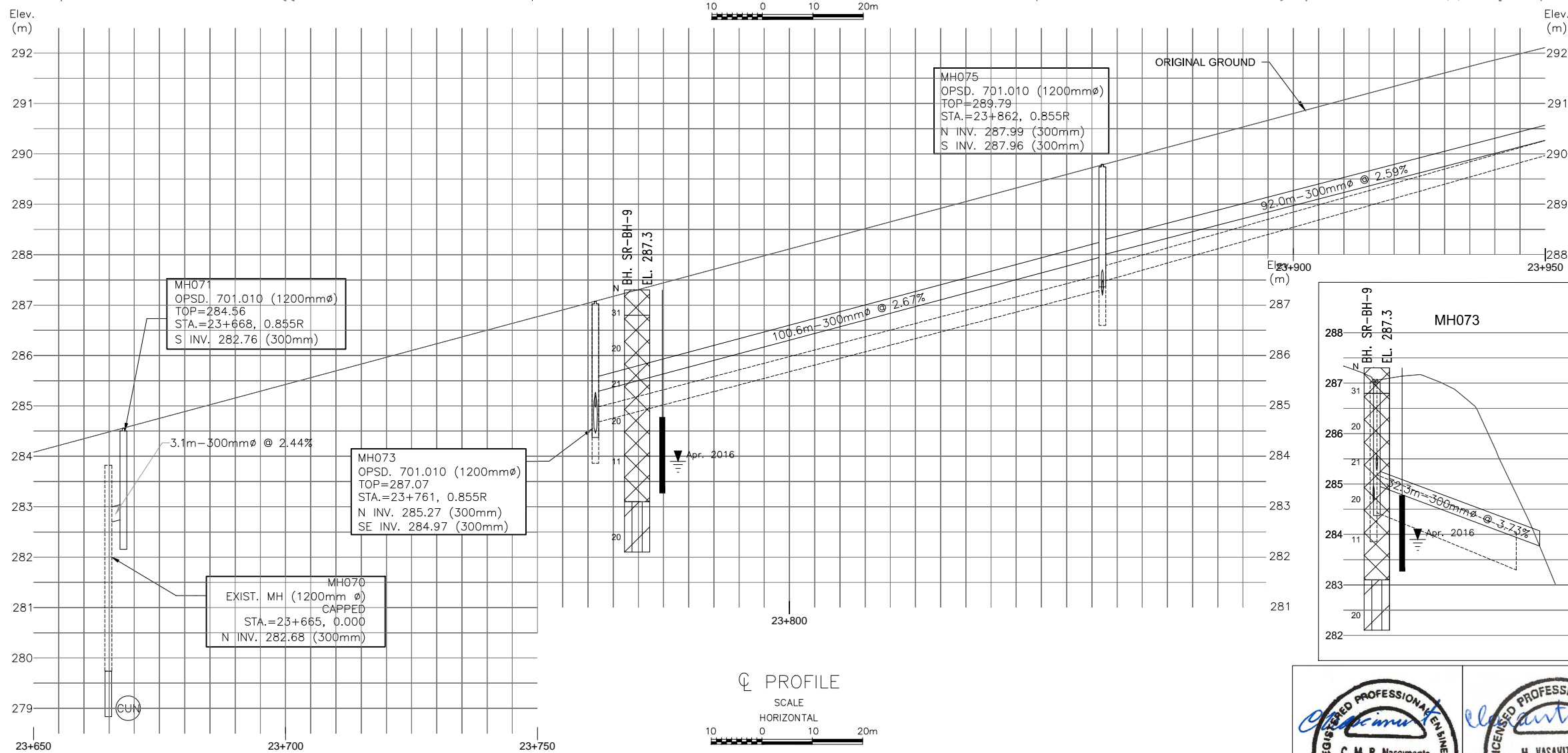
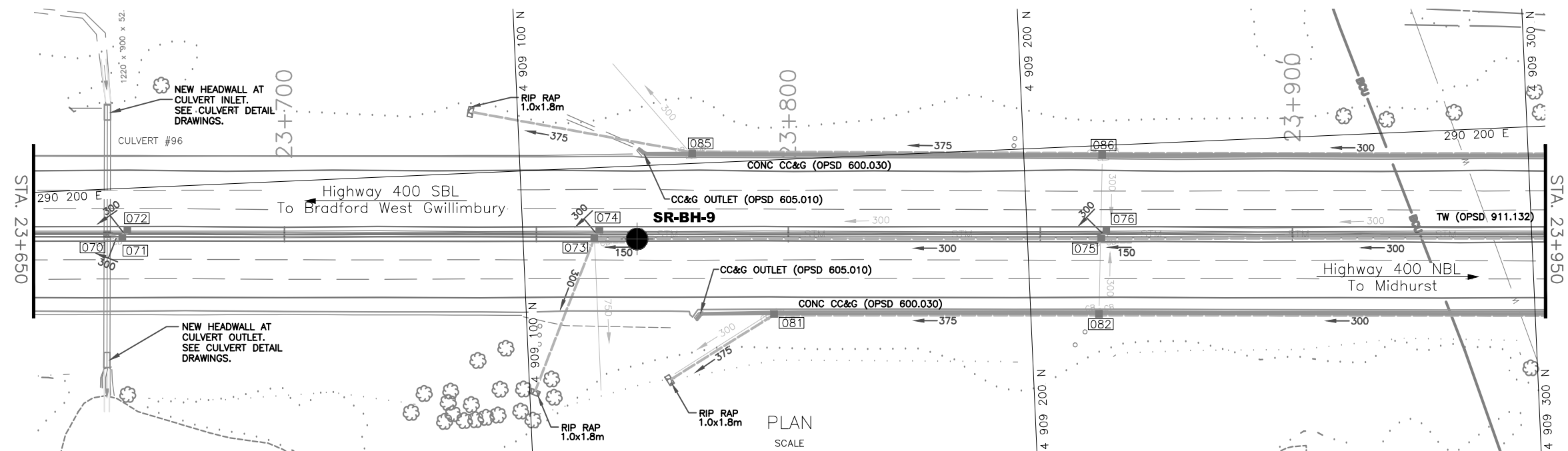
LEGEND				
	Borehole Location			
	Blows/0.3m (Std. Pen Test, 475 J / blow)			
	Piezometer			
	WL in Piezometer (April 2016)			
	Existing Sewer			
	Replacement/New Sewer			
	FILL			
	SILT TO CLAYEY SILT			
BH No	ELEVATION	CO-ORDINATES		
		NORTHINGS	EASTINGS	
SR-BH-9	287.3	4 909 122.6	290 214.5	

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 31D-657

HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED	M.K.H
DRAWN	NL	CHECKED	MV
DATE	JUNE 27, 2016	APPROVED	CN
DATE	JUNE 27, 2016	APPROVED	CN



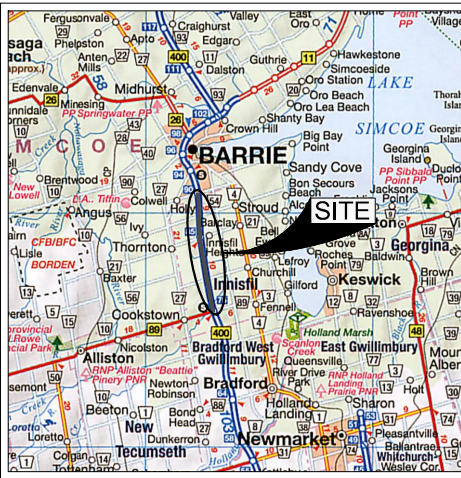
TASK No 2016-E-0039-010
WP No 2184-10-00



HIGHWAY 400 SEWER REPLACEMENT

SHEET

BOREHOLE LOCATIONS AND SOIL STRATA



KEY PLAN
SCALE
0 5 10 15km

LEGEND

- Borehole Location
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- Piezometer
- Existing Sewer
- Replacement/New Sewer
- FILL
- SILTY SAND TO SILTY SAND

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
SR-BH-10	292.5	4 909 901.6	290 201.5

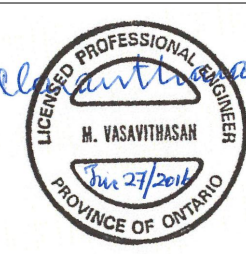
NOTE

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

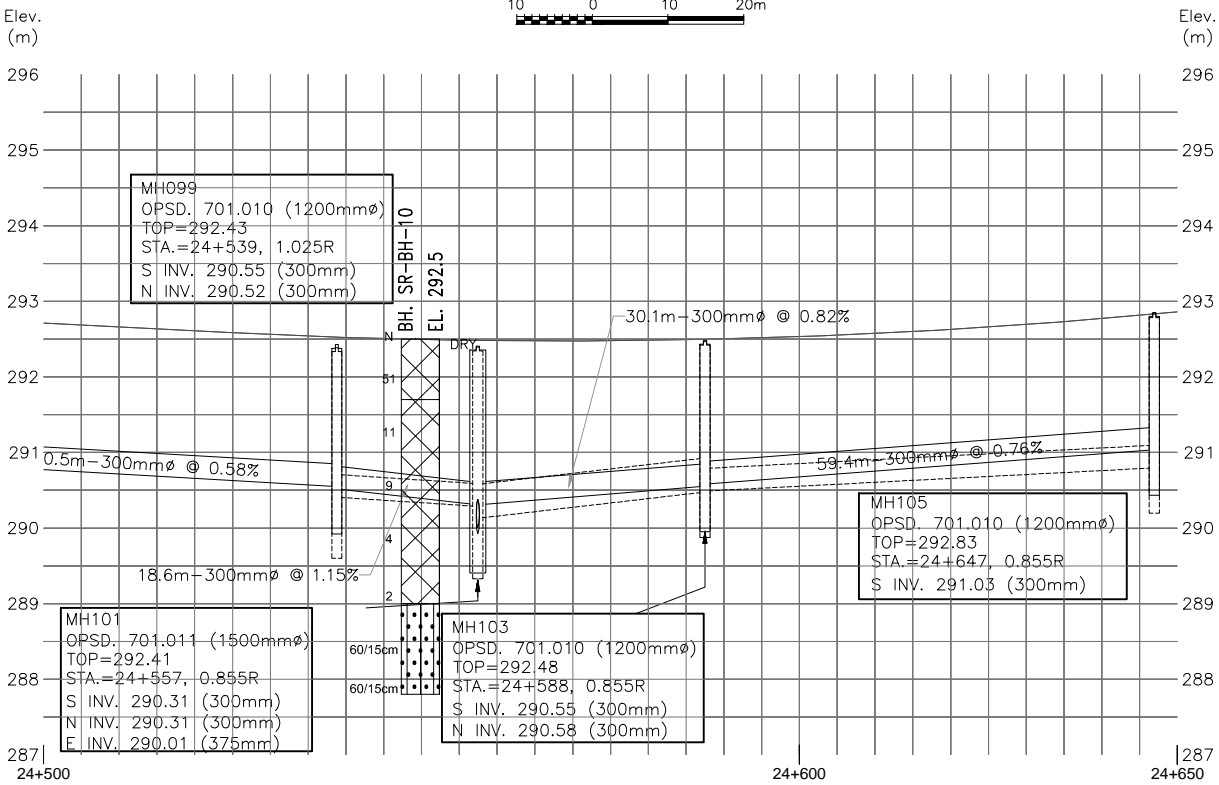
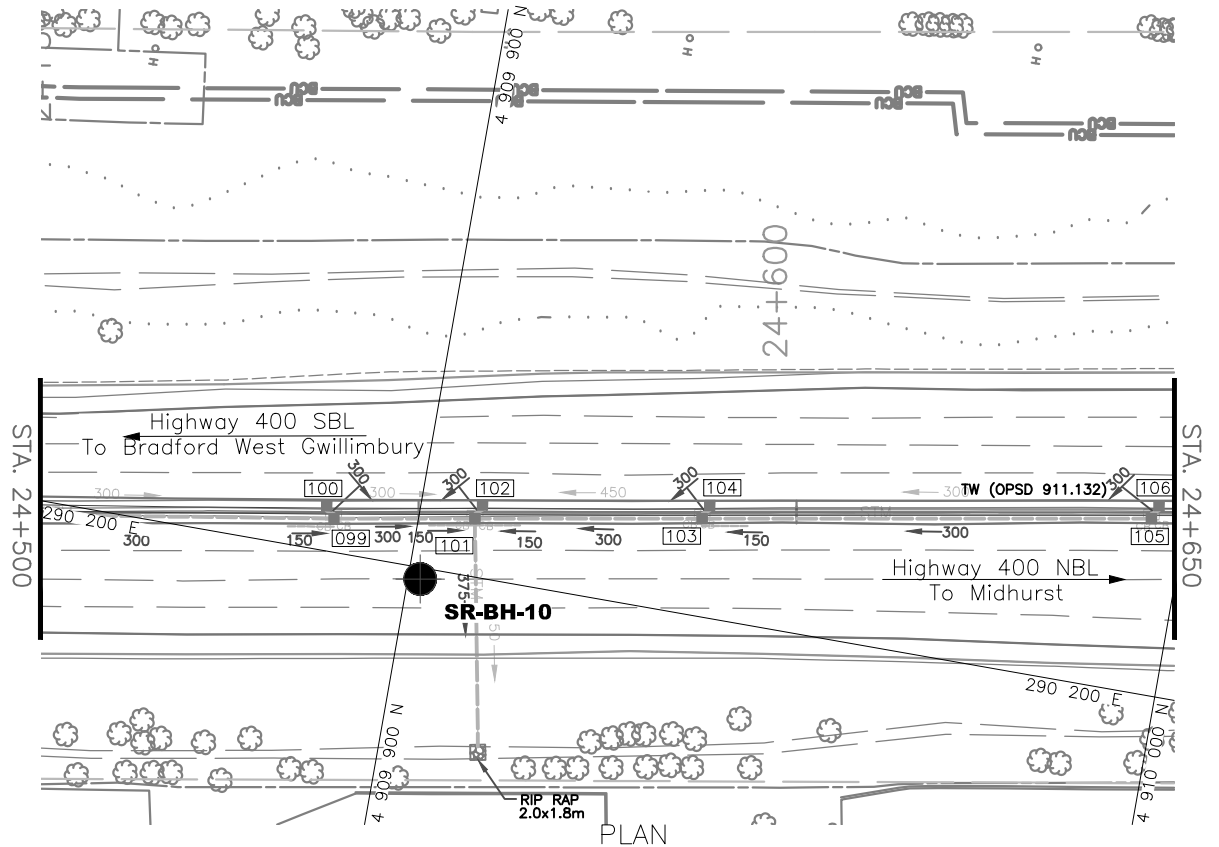
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 31D-657

HWY No	400	DIST	CENTRAL
SUBM'D	NA	CHECKED M.KH	DATE JUNE 27, 2016
DRAWN	NL	CHECKED MV	APPROVED CN



REF MTO Drawings; 09.NEWCONS-For FDN.dwg & 10.PROFILES.dwg;
dated January 13, 2016 & January 12, 2016, respectively.



PROFILE

SCALE
HORIZONTAL
10 0 10 20m
VERTICAL
1 0 1 2m

