



## **Foundation Investigation and Design Report**

**Victoria Street Utilities Relocation**

**City of Kitchener, Ontario**

**MTO Project No. (GWP 3103-15-00)**

**MTO Geocres NO. 40P8-234**

Prepared For:  
MMM GROUP LTD

SPL Project No.: 10001862  
September 28, 2016

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**FOUNDATION INVESTIGATION REPORT**  
**VICTORIA STREET UTILITIES RELOCATION**  
**CITY OF KITCHENER, ON**  
**MTO PROJECT NO. (GWP 3103-15-00)**  
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**FOUNDATION INVESTIGATION REPORT  
VICTORIA STREET UTILITIES RELOCATION  
CITY OF KITCHENER, ON  
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## **1. INTRODUCTION**

SPL Consultants Limited (SPL) was retained by MMM Group Ltd. on behalf of the Ministry of Transportation of Ontario (MTO) to undertake a geotechnical investigation for the Victoria Street Utilities Relocation associated with bridge reconstruction in the City of Kitchener.

The Victoria Street Bridge is located at the interchange of Hwy 85 and Victoria Street North in the City of Kitchener. The bridge will be reconstructed and this reconstruction of the bridge involves widening of the approach east and west embankments as well as proposed new ramps. As a result of this reconstruction the existing utilities present in the area of Victoria Street and Hwy 85 are required to be relocated. A wide range of utilities exist within the project area comprising of watermains, west sanitary sewer, stormwater sewers, watermains, sanitary gravity sewers, forcemains etc. of various sizes ranging from 150mm to over 750mm in diameter and will be relocated. In addition, other utilities such as underground Bell, hydro and Rogers cables are also present in the area which will also be relocated.

A range of watermain sizes and materials (PVC and CPP) will be installed on the east and west of Hwy 85 using open cut. A 600mm dia. CPP watermain from Sta. 0+035 to Sta. 0+160 and from Sta. 0+260 to Sta. 0+340 will be installed using open cut technique, including inside a steel casing primary liner. The watermain at these locations will be 2.2m to 8.3m below ground surface, corresponding to Elev. 314.3 to 321.0m. At Sta. 0+160 to Sta. 0+260 a 600mm watermain will be installed in a 1156mm dia. steel casing primary liner and will cross Hwy 85 and will be installed by means of microtunnelling. The watermain at this location will be 8.6 to 12.5m below ground surface corresponding to Elev. 310m± (**See Watermain Drawings**).

A number of sanitary sewers, storm sewers and forcemains of different diameters will also be relocated due to the reconstruction of the Victoria Street Bridge.

A West sanitary sewer of dia. 300mm to 450mm from Sta. 0+000 to Sta. 0+225 will be installed by means of open cut (**Drawing 3**). From Sta. 0+235 to the entry shaft at Sta. 0+275, a 375mm dia. sanitary sewer in a 600mm dia. RC microtunnel pipe primary liner will be installed by open cut and grouted in place (**Drawing 4**).

A 375mm dia. sanitary sewer in a 600mm RC microtunnel pipe primary liner from about Sta. 0+275 to Sta. 0+387 will be installed by microtunnelling and will be 2.6 to 6.9m below ground surface (**Drawing 4**).

An existing 750mm dia. RCP gravity sanitary sewer from Sta. 0+000 to Sta. 0+160 (**Drawing 5**) which is located on the east side and parallel to Hwy 85, a portion of this gravity sewer will be relocated and will be installed by open cut. A 600 to 1200mm RCP storm sewer on east and west sides of Hwy 85 from Sta. 0+035 to Sta. 0+156 will also be relocated using open cut method (**Drawings 6 and 7**). These RCP sanitary and storm sewers are to be installed using open cut and will be about 2.4 to 8.6m below existing grade.

Other utilities including sanitary CPP, PVC forcemain will also be installed using an open cut technique (**Drawings 8 and 9**). These utilities will be about 3.8 to 5.9m below ground surface, corresponding to Elev. 318.8 to 317.3m. Associated maintenance holes and chambers will also be installed and constructed as part of the new system.

This report deals with the geotechnical issues only. Environmental soil and groundwater issues will be discussed in separate reports.

The main objectives of the investigation were to determine the subsurface conditions at periodic intervals along the proposed utilities alignment by means of ten (10) exploratory boreholes, and to provide associated geotechnical recommendations. In addition, the construction conditions were to be evaluated to assist MMM Group in the preparation of the contract specifications.

The report is presented in two parts. **Part A** of this report presents the factual borehole data, including review of regional geology, the method of investigation, the field and laboratory work, and describes the subsurface conditions encountered during the investigation. **Part B** interprets the ground and groundwater conditions as relevant to the geotechnical design and construction/relocation of the proposed utilities and manholes.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

This report has been prepared for MMM Group Ltd. on behalf of the MTO. Third party use of this report without SPL Consultants Limited consent is prohibited.

## PART A – FACTUAL DATA

### 2. SITE AND REGIONAL GEOLOGY

The project site is located along the interchange of Hwy 85 and Victoria Street North in the City of Kitchener.

The topography of the site slopes down on Hwy 85 from east and west sides of the interchange with elevations ranging from 323.9m± to 318.6m±.

The regional geology of the Victoria Street and Highway 85 area in Kitchener, Ontario originates from the interaction of several glacial lobes. The area is part of the physiographic region known as the Waterloo Sand Hills or Waterloo Moraine (Chapman & Putnam, 1984). The oldest deposit (mapped in the area to the northeast and another to the west of the intersection of Victoria Street and Highway 85) is a sandy silt till to silty sand textured till. This till was reworked and overlain by ice contact stratified sand and gravel, with minor silt, clay and till that were deposited as the ice lobes receded and re-advanced. There are also glaciofluvial major river and delta deposits of sand located to the south of the Victoria Street and Highway 85 intersection, which were laid down as the glacial ice melted and retreated.

### 3. FIELD AND LABORATORY WORK

#### 3.1 Fieldwork

The field investigation consisted of putting down ten (10) boreholes (BH15-1 to BH15-10) to depths ranging from 6.7 to 17.4m below existing ground surface at the approximate locations shown on the attached **Drawing No. 1**. Boreholes BH15-1 through BH15-3, BH15-5 and BH15-8 through BH15-10 were drilled at the four corners of the interchange of Highway 85 and Victoria Street Bridge for the construction of proposed utilities to be installed by means of an open cut technique. Boreholes BH15-2 through BH15-5 and BH15-7 through BH15-9 were drilled on the private properties namely Kitchener Glass and Factory Shoe which are located on the northeast and northwest corners of the interchange. Boreholes BH15-1 and BH15-10 were moved and drilled at lower elevations as per client's instructions because of the access issues with the private property owners at these locations. Boreholes BH15-4, BH15-6 and BH15-7 were drilled for the trenchless installation of the utilities beneath Hwy 85.

The ground surface geodetic elevations at the location of all boreholes are shown on the borehole logs which were surveyed by SPL using differential GPS, based on Benchmark No. 00819648096 located on south side of Highway 7 (Victoria St. North), 61m east of Edna Street (Elevation: 329.13m).

The field investigation work (borehole drilling) was undertaken between June 11 and August 11, 2015 by At Cost Drilling Inc. under subcontract to SPL. Borehole logging services were provided by the engineering staff of SPL. The boreholes were advanced with power auger drilling machines equipped with solid and hollow stem augers. The soil stratigraphy was recorded by observing the quality and

changes of augered materials which were retrieved from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows (SPT 'N'-values) required to drive the sampler 0.3m depth into the undisturbed soil gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the borehole log sheets (Refer to **Appendix A**). Upon completion all of the boreholes which were not equipped with monitoring wells were sealed with bentonite and asphalt cold patch near the road surface.

At a later stage, upon client's request, all monitoring well installations will be decommissioned under the requirements of Ontario Regulation 903 – Wells. Decommissioning wells will generally be completed by grouting the well from the bottom up with cement-bentonite grout using a tremie pipe and then cutting off the top 1.5 m of the well (below ground surface). All decommissioning will be completed under the supervision of a qualified environmental technologist under the supervision of a Qualified Person.

Soil samples were visually classified in the field and later re-evaluated in our laboratory.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. For the purpose of longer term groundwater monitoring, seven (7) boreholes were equipped with 50 mm diameter monitoring wells including boreholes BH15-1, BH15-2, BH15-4 and BH15-7 through BH15-10. The groundwater levels in the monitoring wells were measured on August 11, 2015 and the data are shown in the borehole logs at the end of each log sheet.

### 3.2 Geotechnical Laboratory Testing

The soil samples were taken to SPL laboratory where they were re-examined. Representative soil samples were selected for geotechnical index testing. The testing consisted of the measurement of moisture content of all samples, grain size distribution analyses on twenty six (26) selected soil samples and Atterberg Limit test on thirteen (13) selected samples. The results of the particle size distribution tests and Atterberg Limit tests are in **Appendix B** and are also summarized on the associated borehole log sheets in **Appendix A**.

## 4. SUMMARY OF SUBSURFACE CONDITIONS

### 4.1 Overview

The boreholes revealed the presence of a variety of soil types ranging in texture from pavement structure, fill material, cohesive silty clay and silty clay till to non-cohesive sand, silt, sandy silt and sand and gravel.

For details of the subsurface conditions encountered at the borehole locations, reference should be made to the individual borehole log sheets presented in **Appendix A**. The properties of the main soil types encountered in the boreholes are described briefly in the following sections.

#### **4.2 Pavement Structure, Topsoil and Fill**

All boreholes except (BH15-1) were drilled on the roadway and parking lots of private properties encountered 40 to 250mm of asphalt overlying 200mm to 450mm of granular base and sub-base. BH15-1 was drilled on grass and encountered 150mm of surficial topsoil.

Below the pavement structure and topsoil, fill consisting of silty sand and sand was found. The fill extends to depths ranging from 2.0 to 5.3m below ground surface. The SPT carried out within the fill material recorded 'N' values ranging from 3 to more than 50 blows per 300mm penetration indicating a very loose to very dense state of fill material. High SPT 'N' values infer that boulders/cobbles/buried concrete pieces exist within the fill material. The natural moisture contents ranged from 3% to 21%. Trace to some organics, asphalt pieces and brick fragments were also observed in fill material.

#### **4.3 Sand/Silty Sand/Sand and Gravel**

These cohesionless sandy deposits consisting of sand, silty sand and sand and gravel were encountered below the fill material in Boreholes BH15-2 through BH15-5 and B15-7 through BH15-10. SPT 'N' values in these cohesionless deposits were in the range of 5 to 78 blows per 0.3m penetration corresponding to a loose to very dense state. These cohesionless sandy deposits were also found to be saturated in Boreholes BH15-5 through BH15-10. Water contents were measured to range from 3 % to 21%.

Seven (7) grain size analyses revealed the following ranges of particle size distribution:

27% gravel, 57 to 94% sand; 4 to 36% silt and 2 to 6% clay (See Figure 1 in Appendix B).

#### **4.4 Silt/Sandy Silt**

These cohesionless silt to sandy silt deposits were locally encountered in BH15-4, BH15-8 and BH15-9. SPT 'N' values in these deposits were in the range of 22 to 39 blows per 0.3m penetration corresponding to a compact to dense state. These deposits were found to be saturated in Boreholes BH15-4 and BH15-9. Water contents were measured to 11 to 18%.

One grain size analysis of a silt sample revealed 15% sand; 75% silt and 10% clay (See Figure 2 in Appendix B).

#### **4.5 Silty Clay Till/Clayey Silt Till and Silty Clay**

The silty clay till/clayey silt till deposits were encountered in all boreholes at various depths. Boreholes BH15-4 through BH15-6 and BH15-9 were terminated in this deposit. Wet to saturated interbedded sand

and silt layers were encountered in these deposits at a few borehole locations. Water contents were measured to be from 12 to 15%.

SPT 'N' values of 9 to more than 50 blows per 300mm penetration indicated the cohesive soils to be in a stiff to hard consistency.

Cobbles and boulders should be expected within the silty clay to clayey silt till.

The expected size and percentage of boulders/cobbles within the glacial till are difficult to quantify. Some references regarding excavation and tunnelling within the glacial till in previous projects in the GTA area are presented in **Appendix C**.

Eleven (11) grain size analyses revealed the following range of particles sizes:

1 to 13% gravel; 6 to 33% sand; 38 to 65% silt and 16 to 40% clay (See Figure 3 in Appendix B). Atterberg Limits tests of eleven (11) samples gave Liquid Limits ranging from 17 to 34 (average 25); Plastic Limits of 11 to 15 (average 13); and Plasticity Indices 6 to 19 (average 12). These properties indicate a low plastic silty clay to clayey silt [CL to CL-ML] in the modified Unified Soil Classification System (USCS) (See Figure 5 in Appendix B).

The silty clay was encountered in boreholes BH15-1 through BH15-4 and BH15-6 through BH15-8 below/interbedded the silty clay/clayey silt till deposits. Boreholes BH15-1 through BH15-3, BH15-7 and BH15-8 were terminated in this deposit.

The SPT 'N' values 12 to more than 50 blows per 300mm penetration, indicate a stiff to hard consistency. The water contents ranged from 16% to 25%.

Seven (7) grain size analyses revealed the following range of particle sizes:

1% gravel, 1 to 5% sand; 38 to 61% silt and 39 to 59% clay (See Figure 4). Seven (7) Atterberg limits tests gave Liquid Limits ranges from 33 to 50 (average 41); Plastic Limits of 15 to 19 (average 17); and Plasticity Indices 18 to 31 (average 24). These properties indicate a medium plasticity silty clay [CI] in the modified Unified Soil Classification System (USCS) (See Figure 5).

#### **4.6 Groundwater Conditions**

Seven (7) monitoring wells were installed in Boreholes BH15-1, BH15-2, BH15-4, BH15-7 through BH15-10 with screens set at different levels in different soil formation for the longer-term monitoring of groundwater levels.

The groundwater levels measured within the monitoring wells installed ranged from 0.4 to 5.8m below existing grade (Elev. 312.9 to 320.0). Over the long term, seasonal fluctuations in the groundwater level are expected.

Groundwater measurements in the monitoring wells are shown on the attached borehole logs and are also summarized on Table 4.6.

**Table 4.6 - Measured Water Levels in Monitoring Wells**

BH No.	Ground Surface Elev. (m)	Soil Type at Screen Location (Depth, m)	Depth / Water Level Elevation (m)
			Aug. 11/2015
BH15-1	318.7	Fill/Silty Clay Till/Silty Clay (1.5 – 4.6)	0.4/318.3
BH15-2	323.9	Silty Clay Till (6.1 – 7.6)	5.3/318.6
BH15-4	322.5	Clayey Silt Till/Silt (7.6 – 10.7)	4.7/317.8
BH15-7	322.6	Sand/Sandy Silt/Silty Clay Till (6.1 – 9.1)	3.9/318.7
BH15-8	322.9	Sandy Silt/Sand	4.0/318.9
BH15-9	323.2	Fill/Sandy Silt/Sand and Gravel/Sand (3.1 – 9.1)	3.2/320.0
BH15-10	318.7	Sand/Silty Clay Till (3.1 – 6.1)	5.8/312.9

Thank you for the opportunity to be of service to you. Should you have any questions or require further clarification on any aspect of this report, please do not hesitate to contact this office.

Yours very truly,

**SPL CONSULTANTS LIMITED**

Naeem Ehsan, M.Eng., P.Eng.



Laifa Cao, Ph.D., P.Eng.



Scott Peaker, M.A.Sc., P.Eng.  
MTO Designated Tunneling Contact



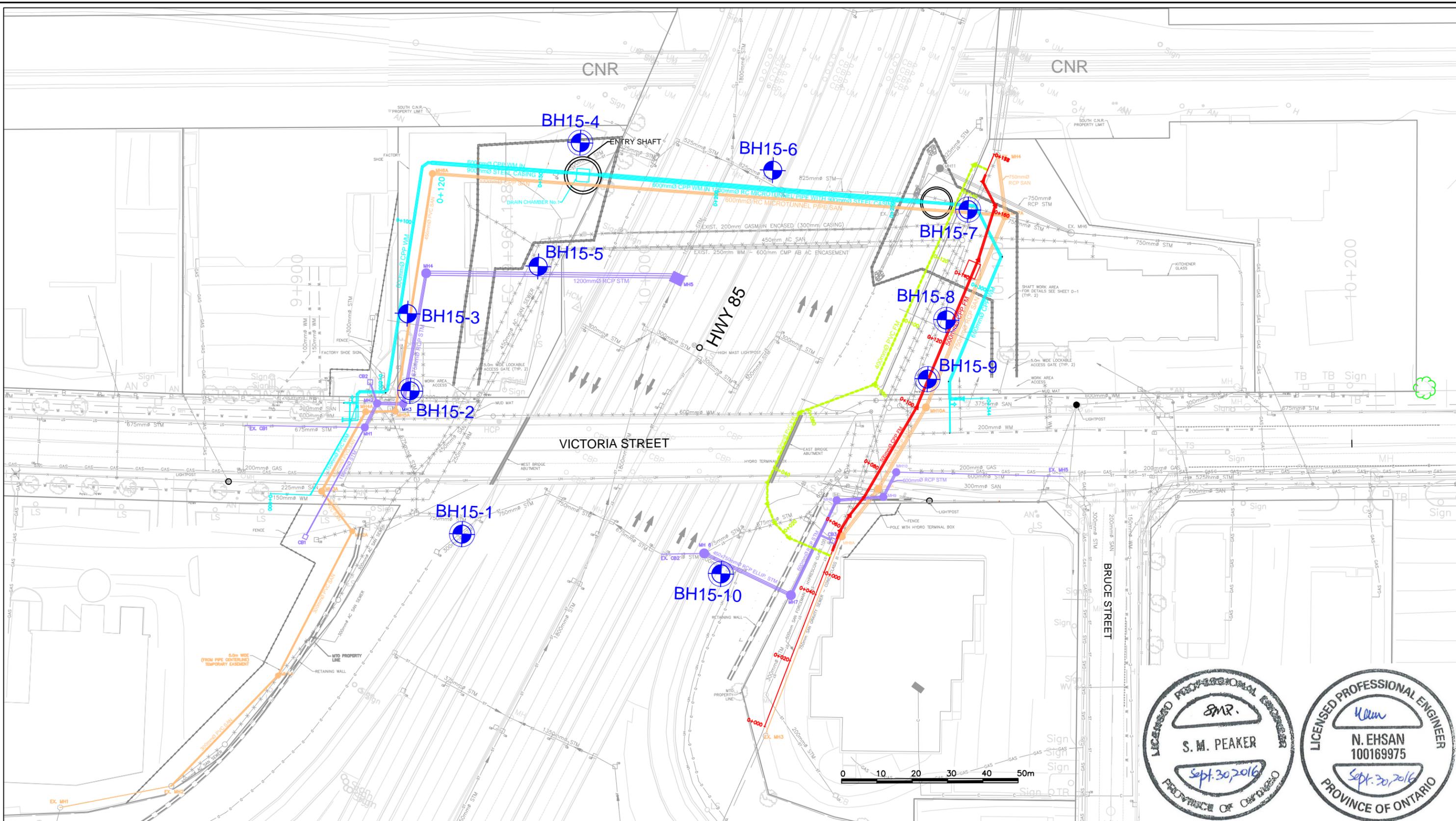
# Drawings

Borehole Location Plan (Drawing No. 1)

Geological Sections (Drawing Nos. 2 to 9)

Earth Pressure Distribution on Braced Excavations (Drawing No. 10)

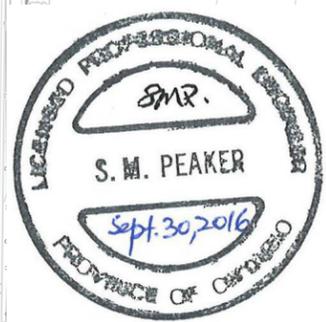
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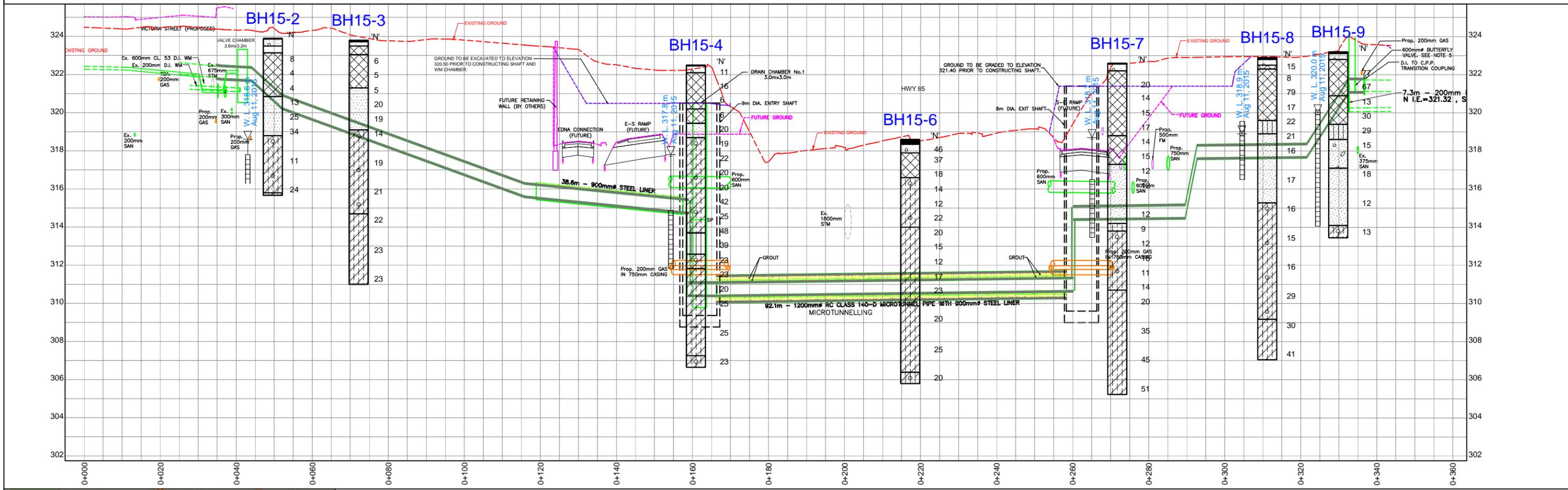
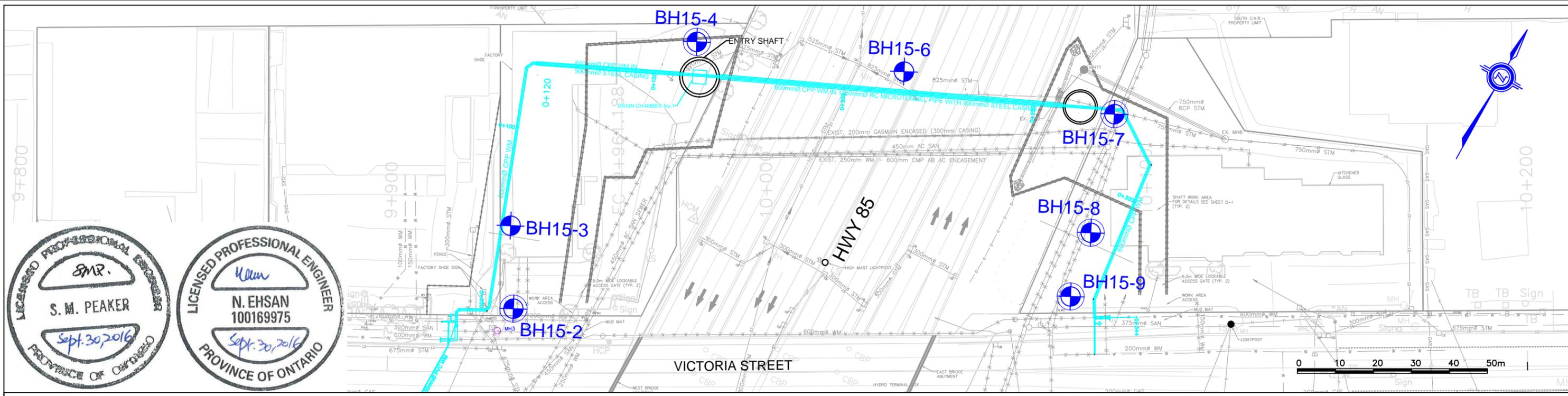


**LEGEND**

- Borehole Location
- Borehole with Monitoring Well Location

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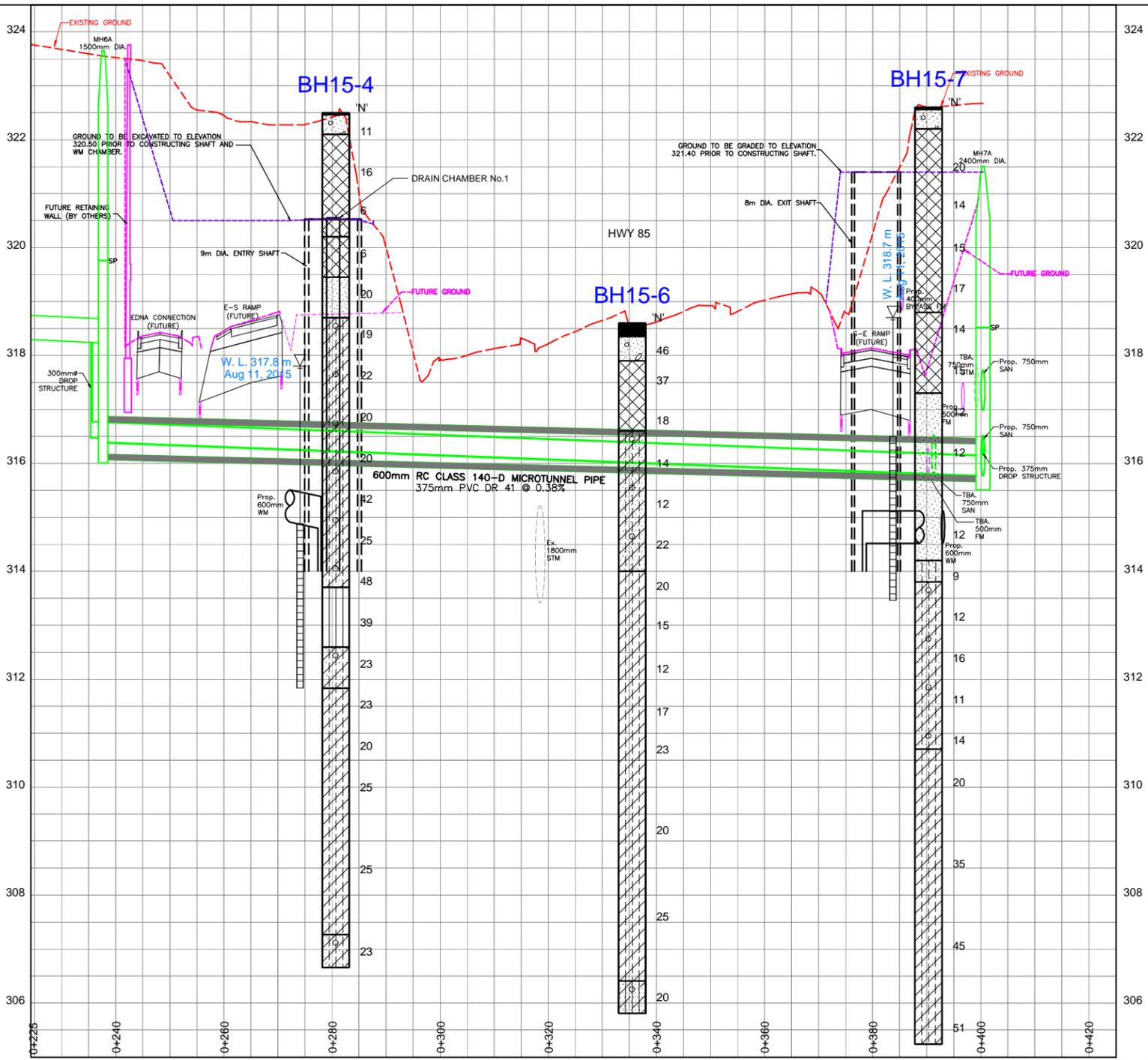
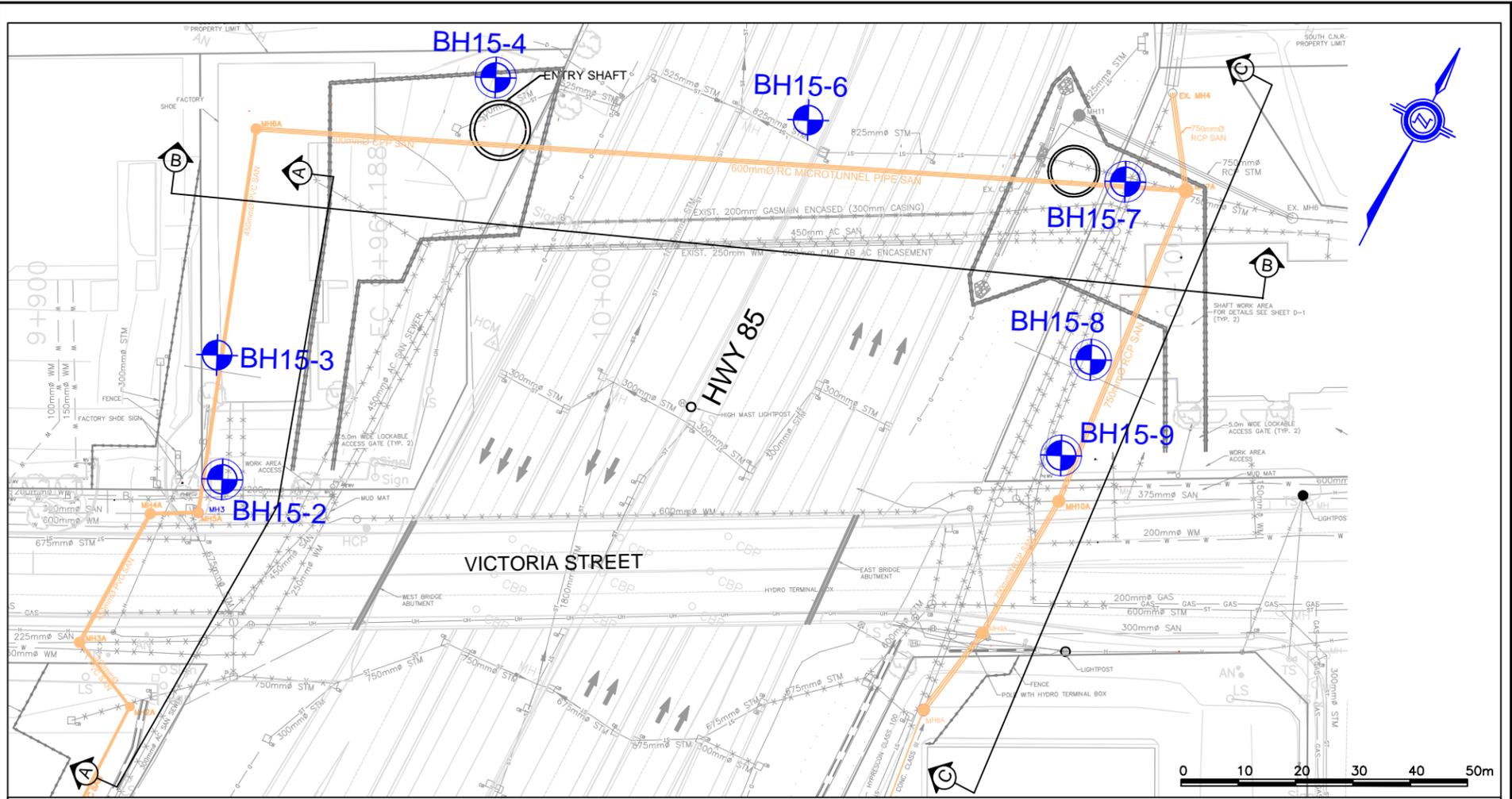
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Asphalt	Topsoil	Fill	Silty Sand	Silty Sand Till	Clayey Silt	Silt
Silty Clay	Clayey Silt Till	Silty Clay Till	Sandy Silt	Silt Till	Sand and Silt Till	Sand
Sandy Silt Till	Sand and Gravel					

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Original Size:	Tabloid	Rev:	N/A	<b>SPL Consultants Limited</b> Geotechnical • Environmental • Materials • Hydrogeology		

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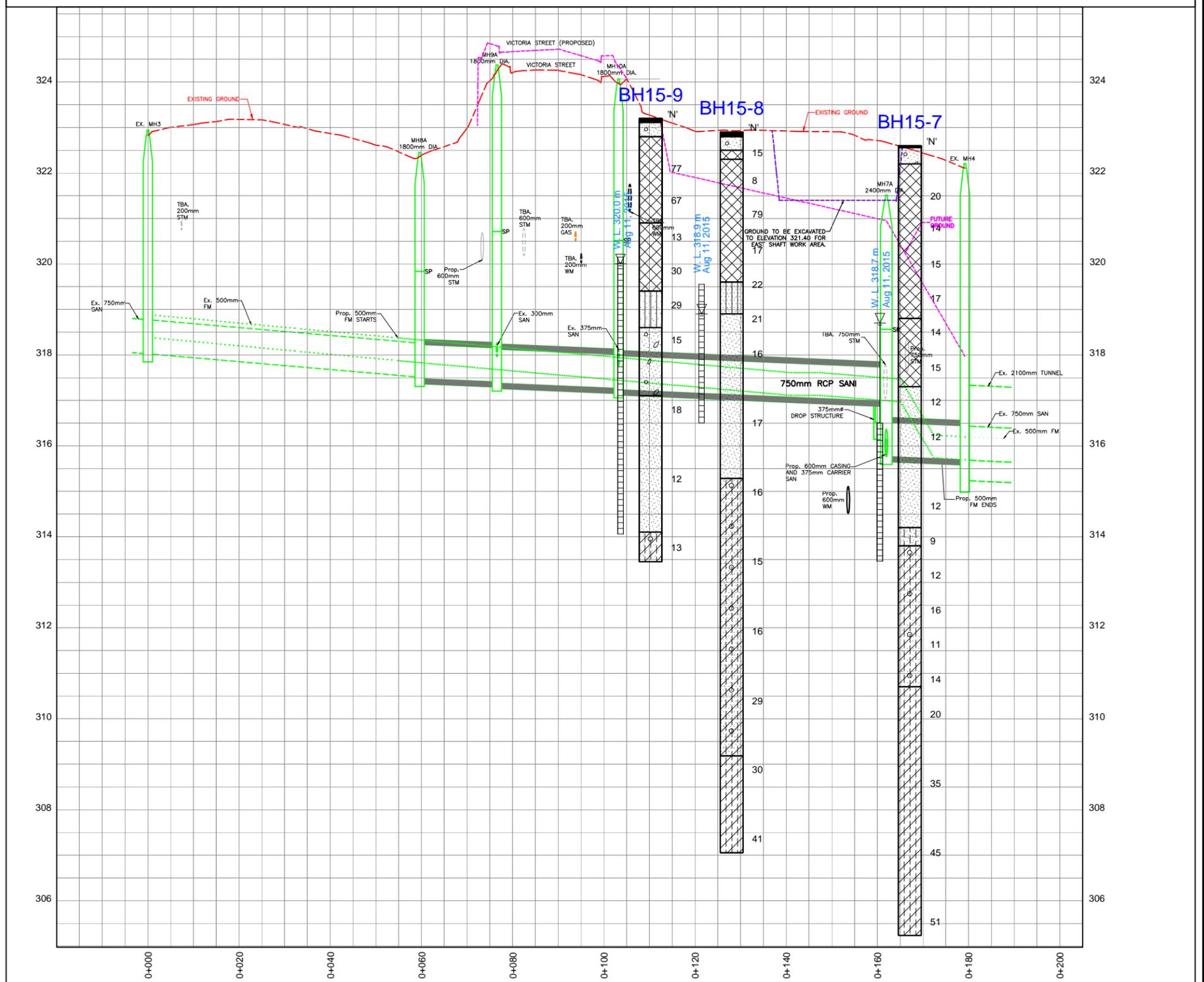
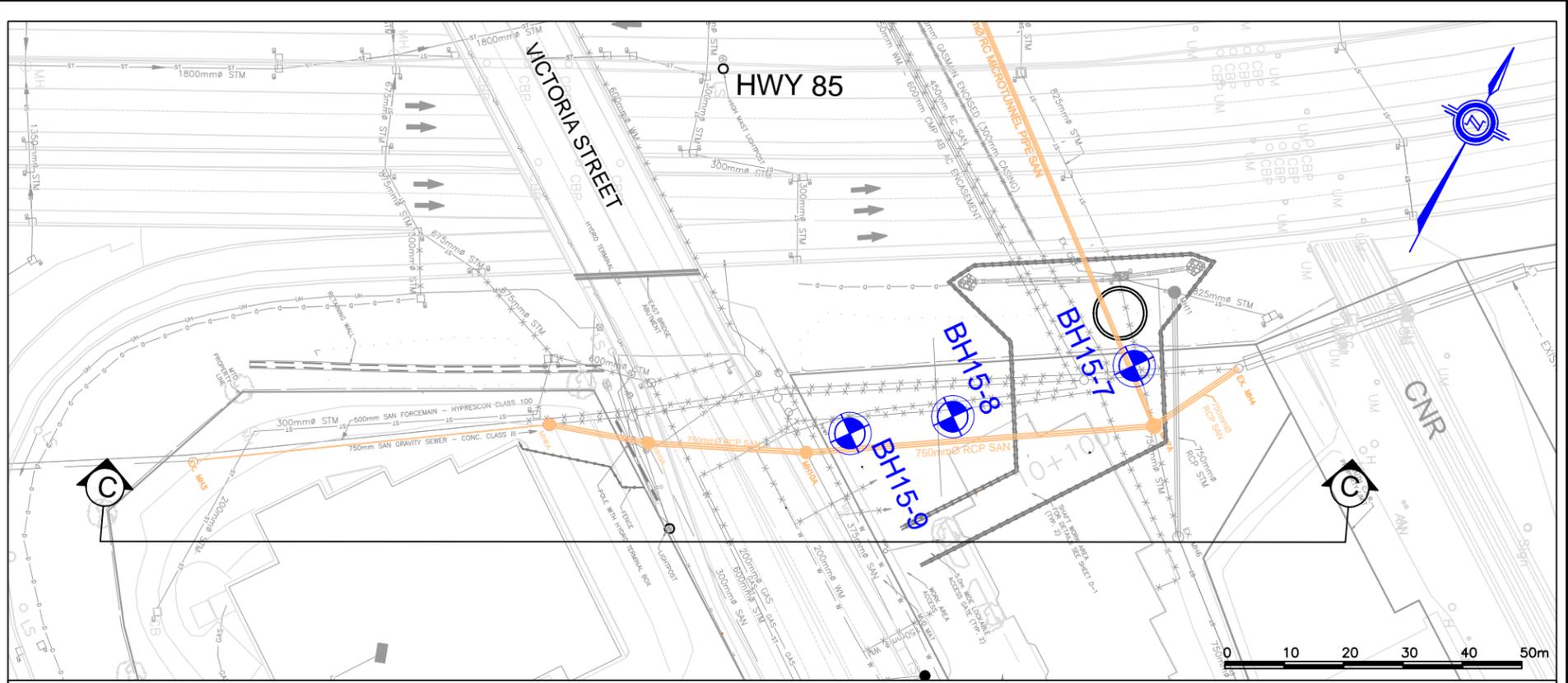
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	Asphalt		Topsoil		Fill		Silty Sand		Silty Sand Till		Clayey Silt		Silt
	Silty Clay		Clayey Silt Till		Silty Clay Till		Sandy Silt		Silt Till		Sand and Silt Till		Sand
	Sandy Silt Till		Sand and Gravel										

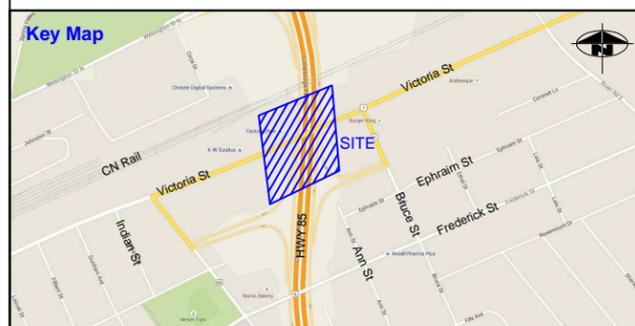


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SECTION C-C

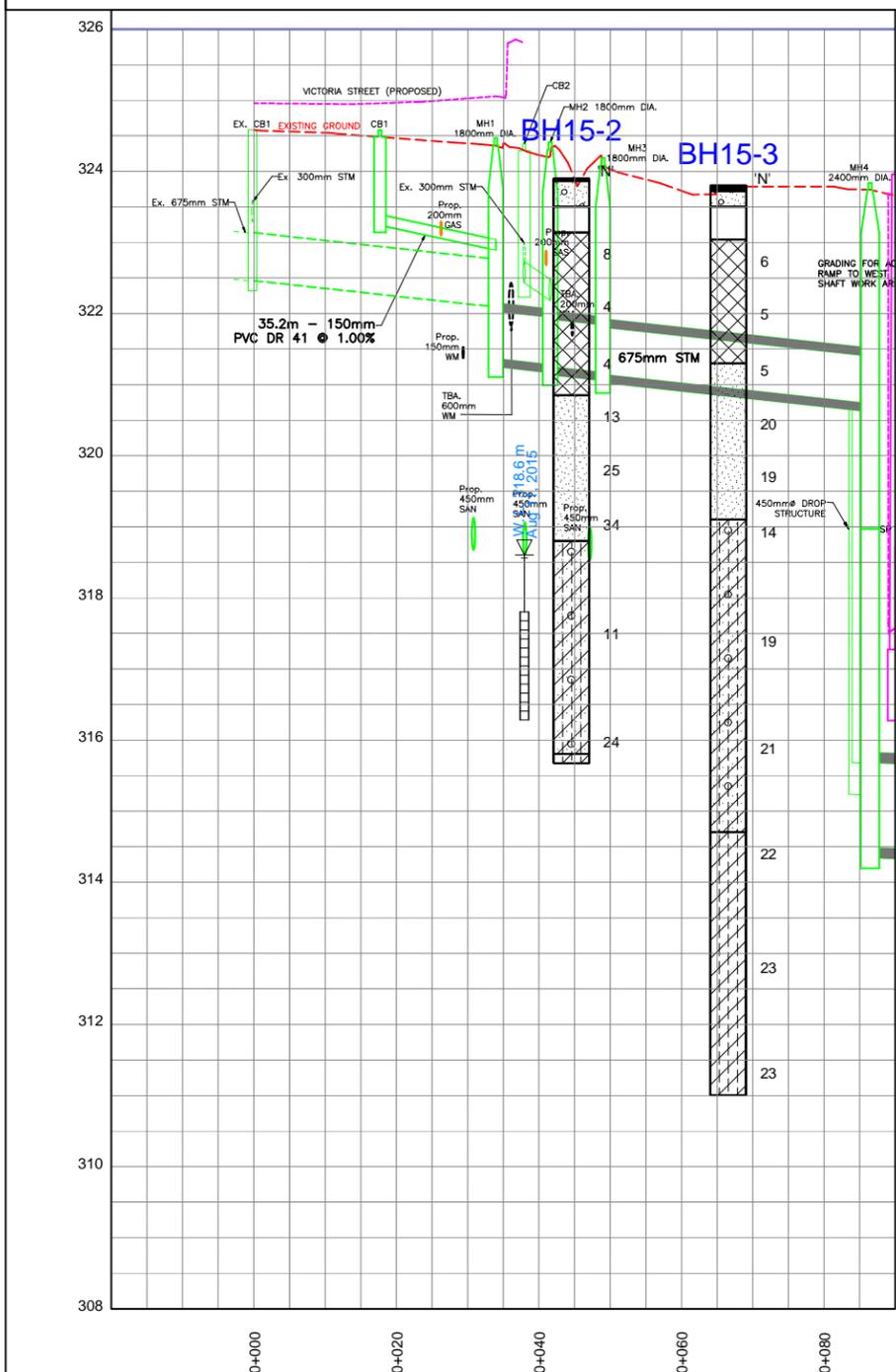
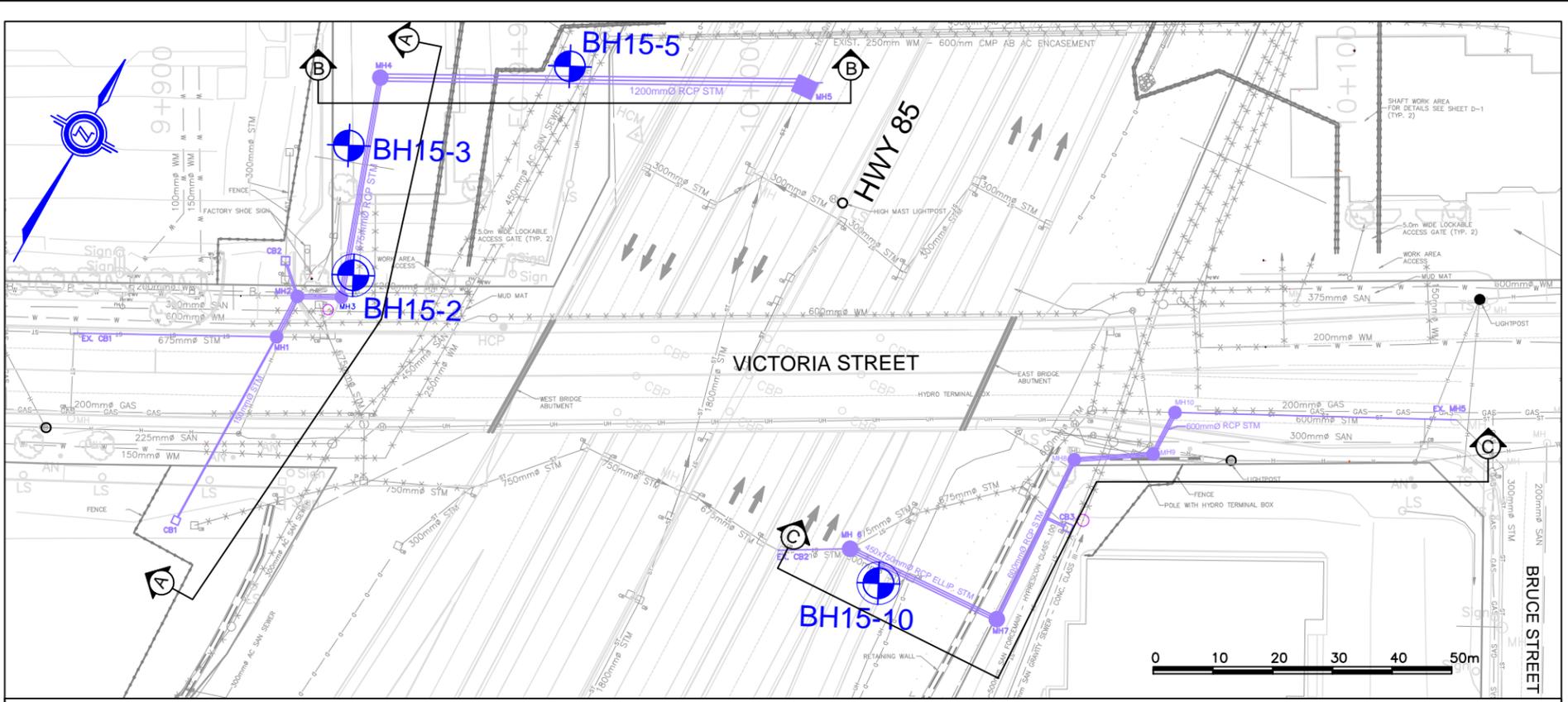


LEGEND	
	Asphalt
	Topsoil
	Fill
	Silt Till
	Silt
	Silty Sand
	Silty Sand Till
	Clayey Silt
	Sandy Silt
	Sandy Silt Till
	Sand and Gravel
	Sand and Silt Till
	Sand
	Silty Clay
	Silty Clay Till
	Clayey Silt Till

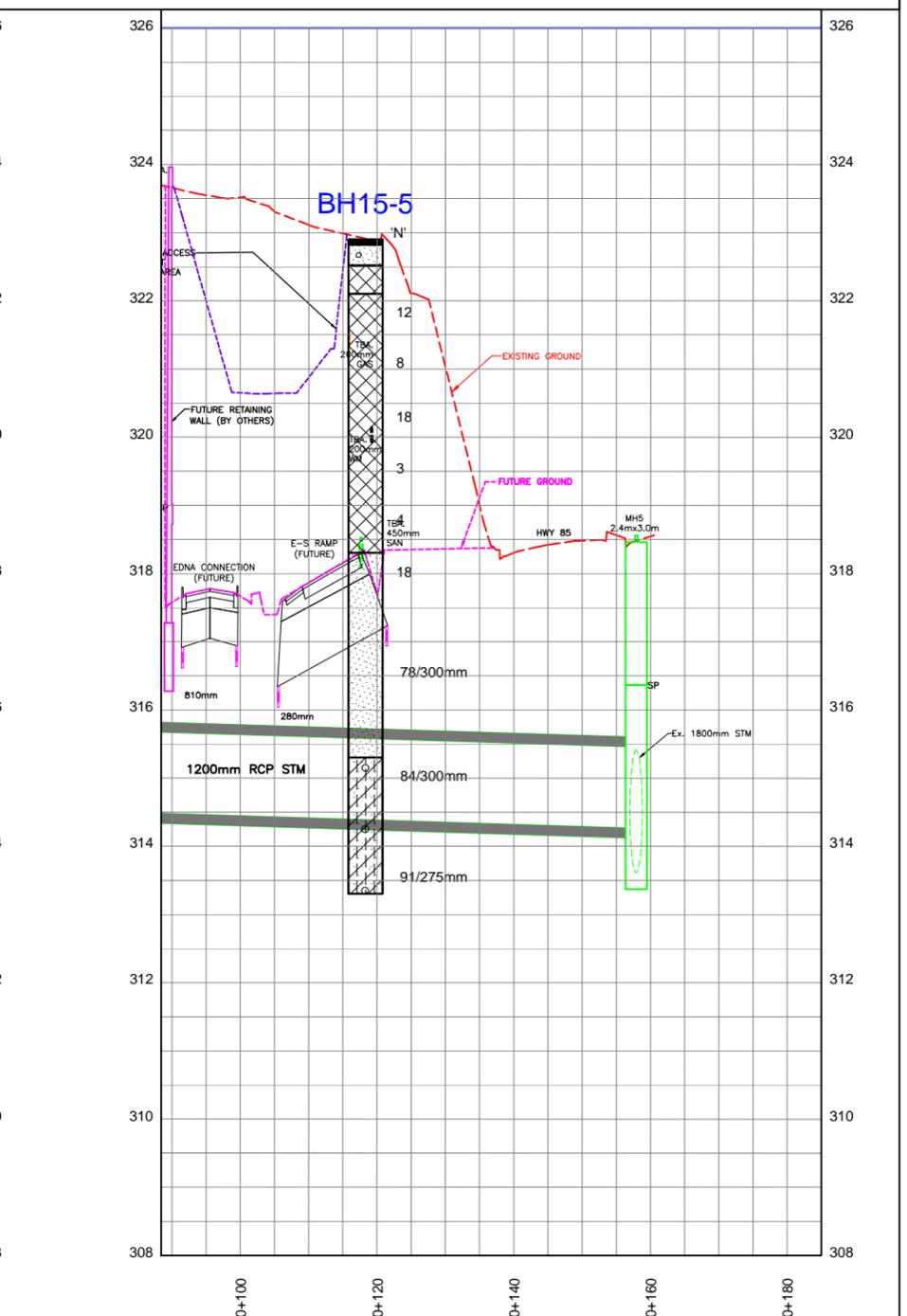
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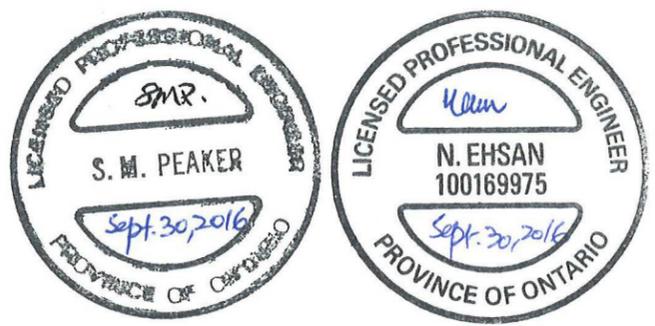
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SECTION A-A



SECTION B-B

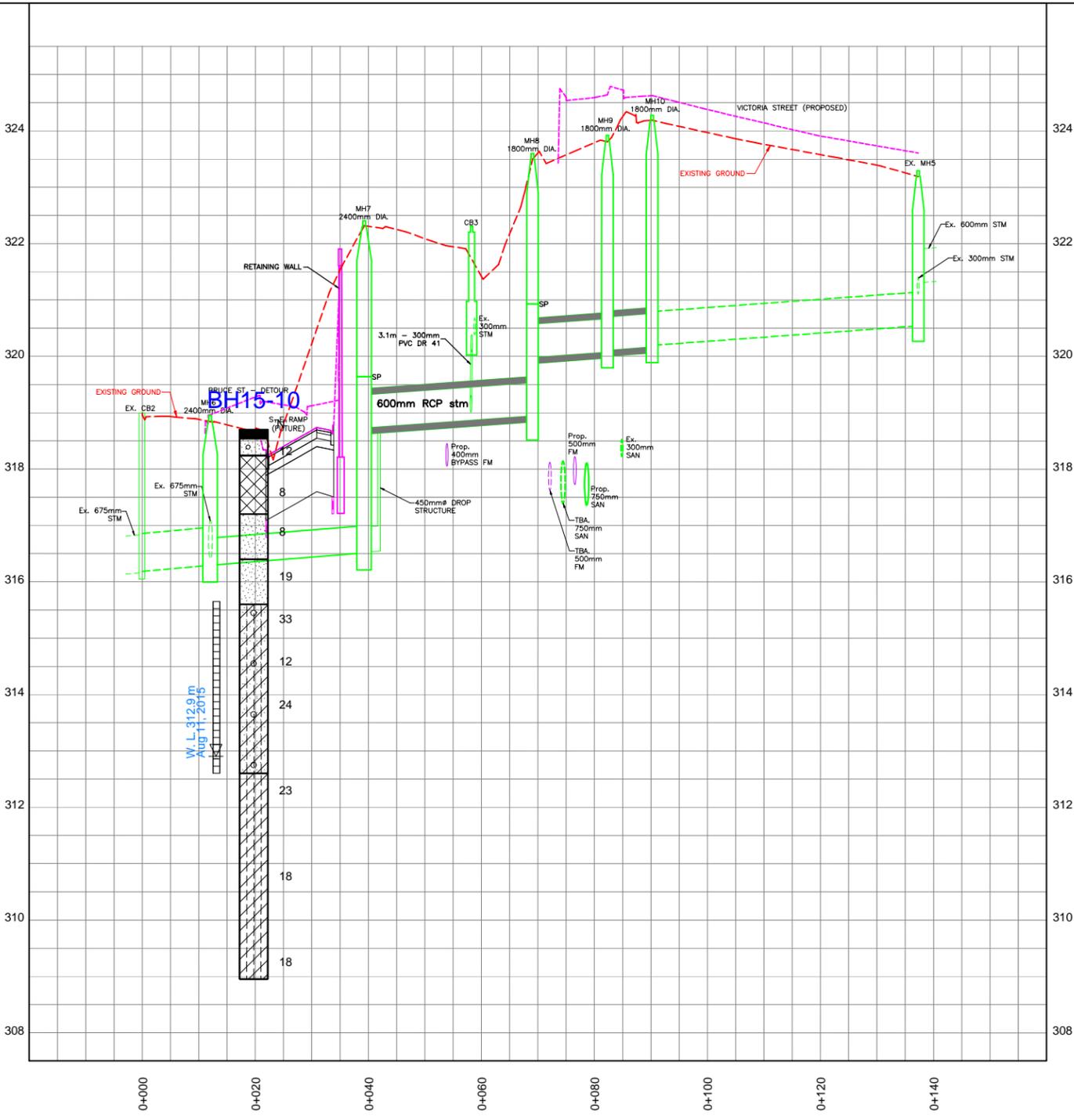
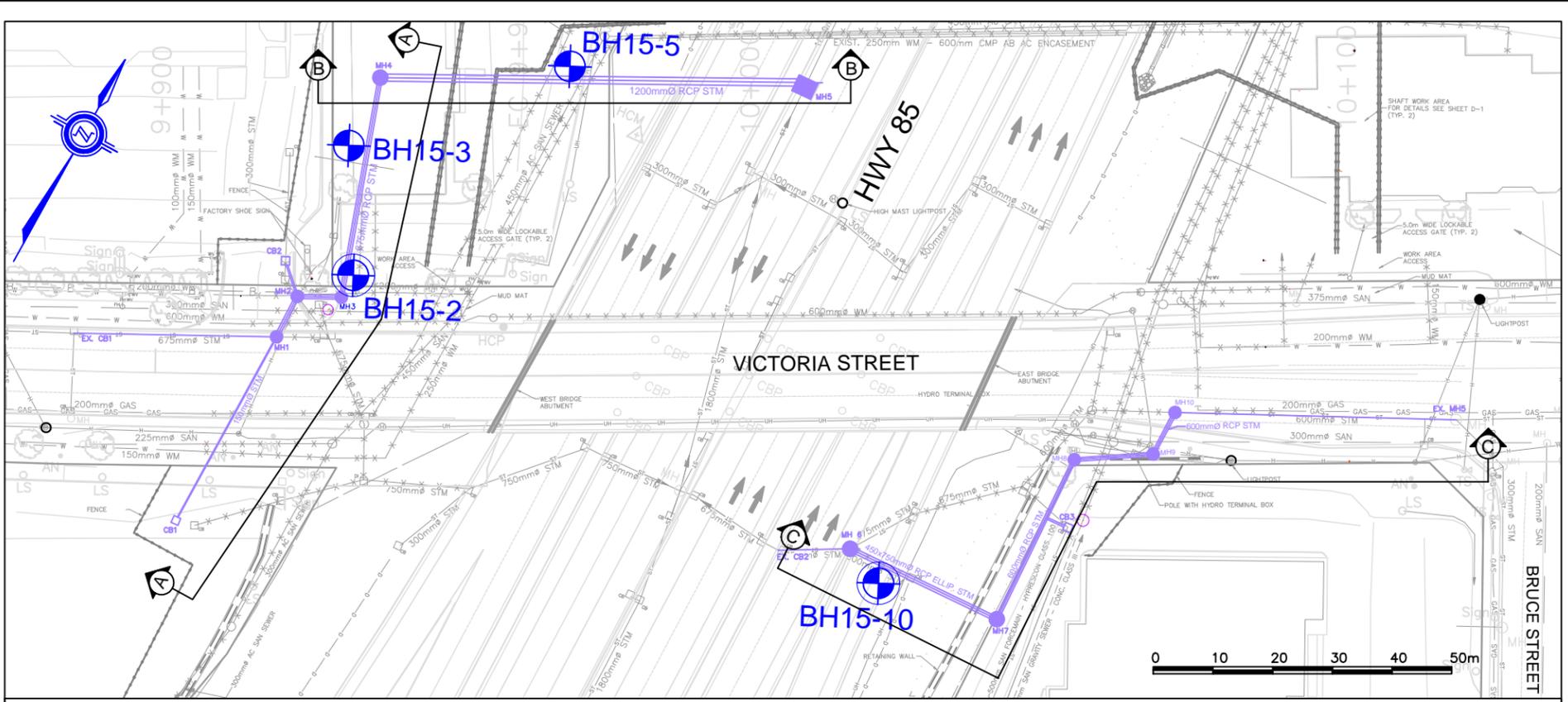


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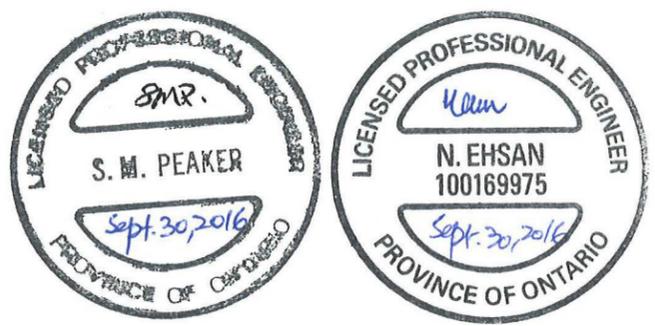

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Date:	March 23, 2016	Scale: As Shown
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Project:	Geotechnical Investigation - Victoria Street Utilities Relocations for the Bridge Reconstruction, Town of Kitchener, Ontario		
 <b>SPL Consultants Limited</b> Geotechnical • Environmental • Materials • Hydrogeology			

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SECTION C-C

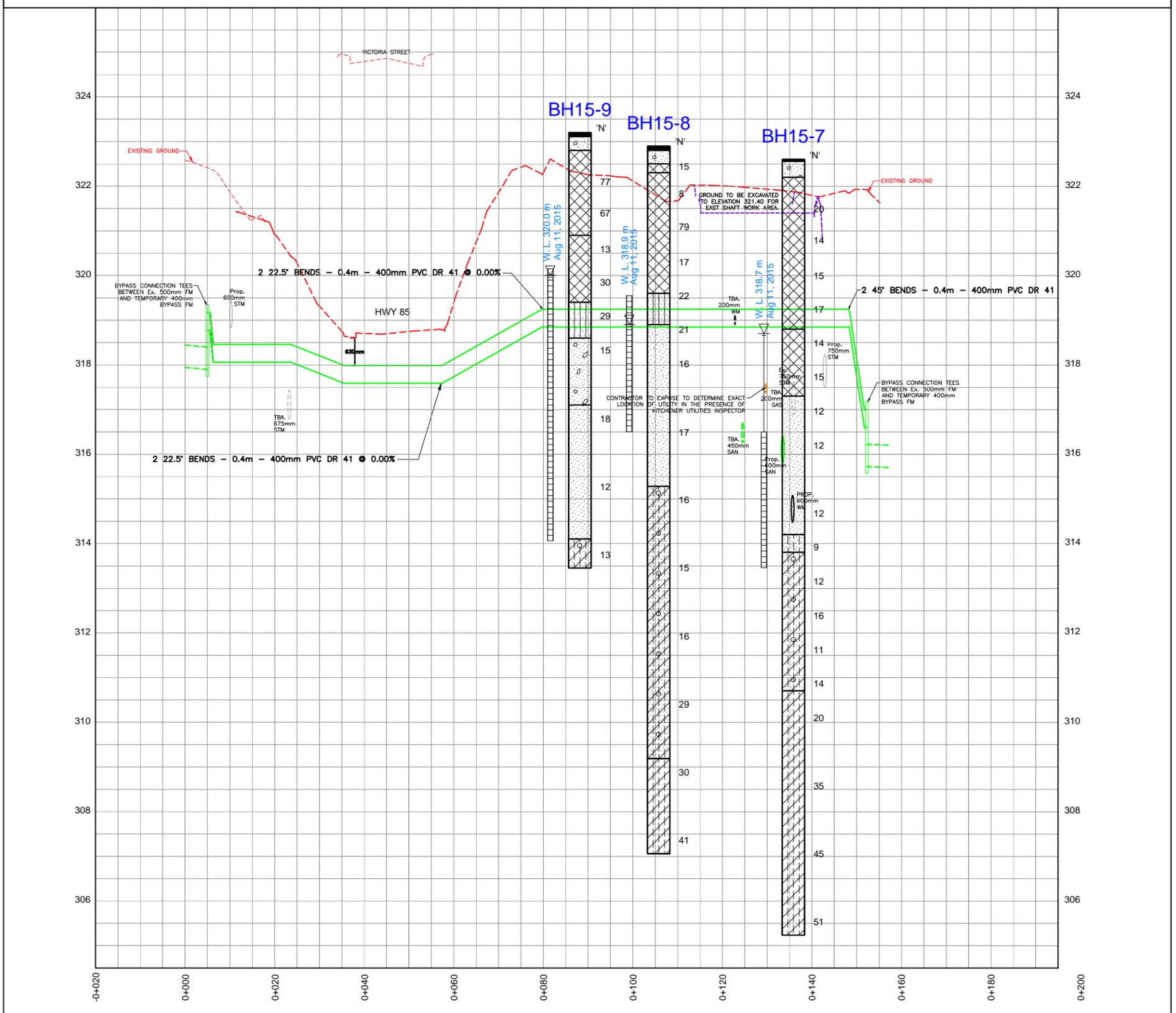
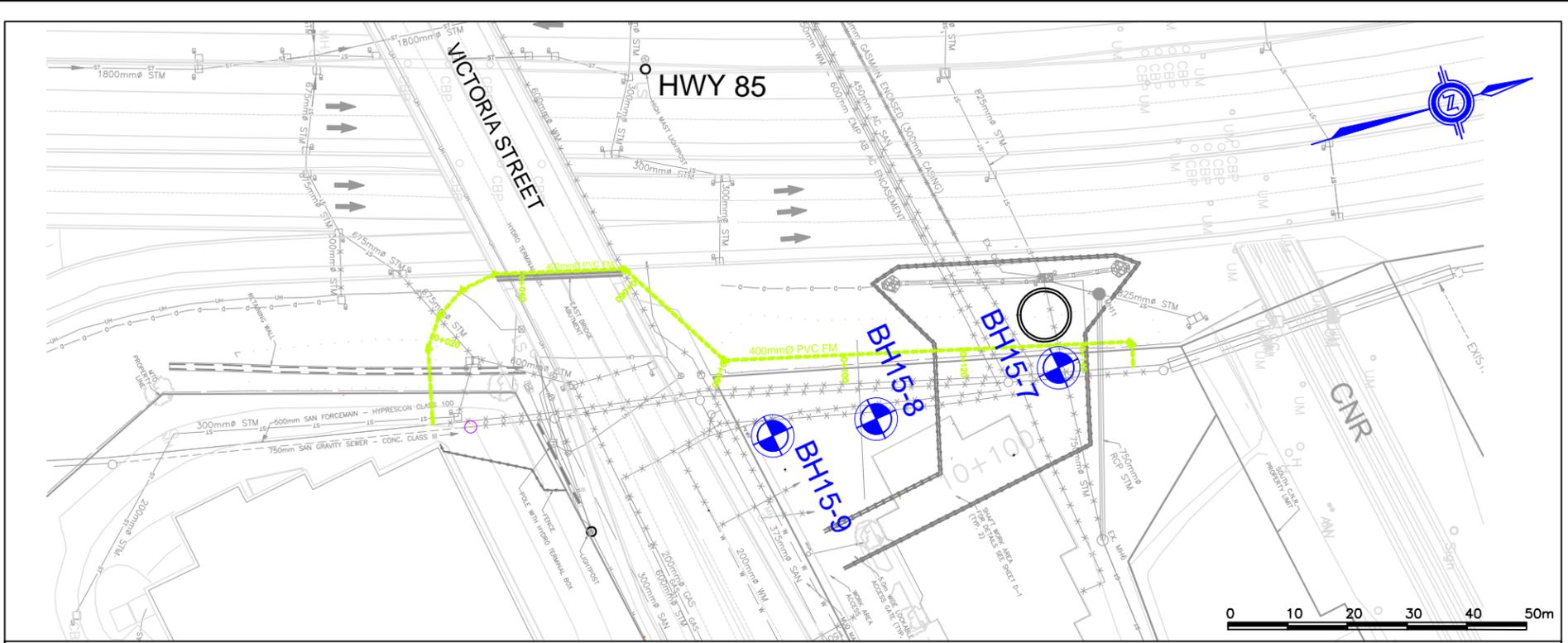


LEGEND	
	Asphalt
	Topsoil
	Fill
	Silt Till
	Silt
	Silty Sand
	Silty Sand Till
	Clayey Silt
	Sandy Silt
	Sandy Silt Till
	Sand and Gravel
	Sand and Silt Till
	Sand
	Silty Clay
	Silty Clay Till
	Clayey Silt Till

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Date:	March 23, 2016	Scale:	As Shown	Project: Geotechnical Investigation - Victoria Street Utilities Relocations for the Bridge Reconstruction, Town of Kitchener, Ontario	
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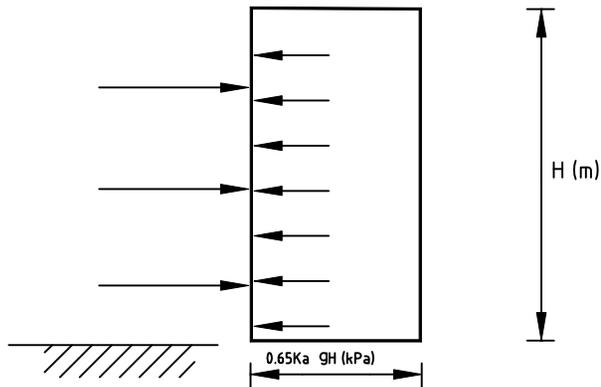


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Drawn:	<b>ZMO</b>	Approved: <b>LC</b>
Date:	<b>March 23, 2016</b>	Scale: <b>As Shown</b>
Original Size:	<b>Tabloid</b>	Rev: <b>N/A</b>

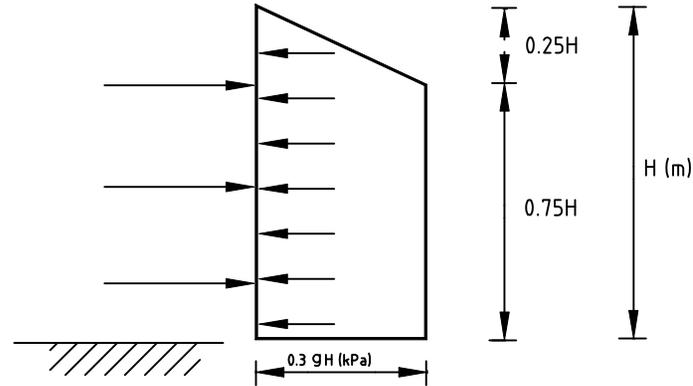
Project No.:	<b>10001862</b>	Drawing No.:	<b>9</b>
Title:	<b>Geological Sections - Sanitary PVC Forcemain</b>		
Project:	<b>Geotechnical Investigation - Victoria Street Utilities Relocations for the Bridge Reconstruction, Town of Kitchener, Ontario</b>		
 <b>SPL Consultants Limited</b> Geotechnical • Environmental • Materials • Hydrogeology			

T:\Geotech\1001-2000 Projects\10001862 - Victoria St. Kitchener\Drawings\March23-2016\10001862-Profile-Victoria-Sept30-2016.dwg



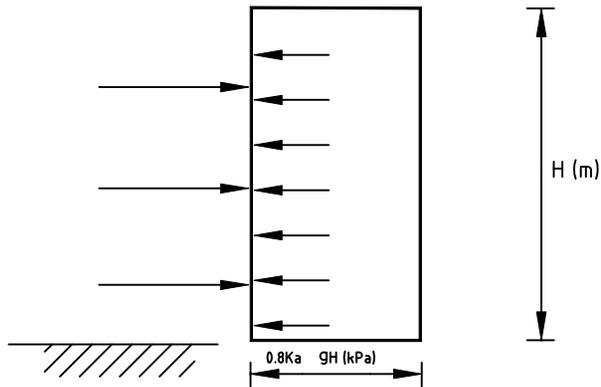
$g$  = unit weight of soil = 21.0 kN/m<sup>3</sup>  
 $g'$  = submerged unit weight of soil (i.e. below ground water level)= 11.2 kN/m<sup>3</sup>  
 $K_a = 0.3$

**IN COMPACT TO VERY DENSE NON-COHESIVE SOILS (SANDS AND SILTS)**



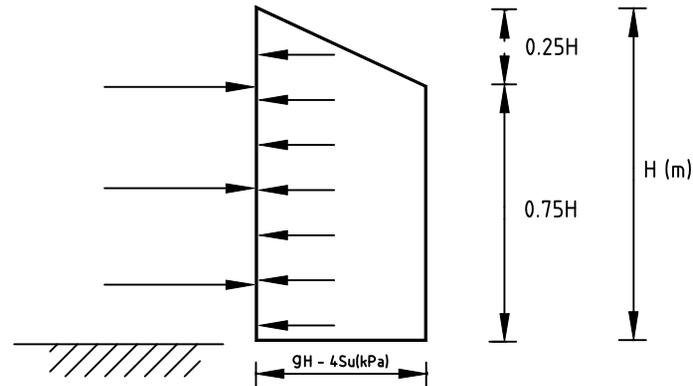
$g$  = unit weight of soil = 21.5 kN/m<sup>3</sup>  
 $g'$  = submerged unit weight of soil (i.e. below ground water level)= 11.7 kN/m<sup>3</sup>

**IN COHESIVE CLAYS OR CLAYEY SOILS**



$g$  = unit weight of soil = 19.0 kN/m<sup>3</sup>  
 $g'$  = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m<sup>3</sup>  
 $K_a = 0.36$

**IN LOOSE OR DISTURBED NON-COHESIVE SOILS (SANDS AND SILTS)**



$g$  = unit weight of soil = 19.0 kN/m<sup>3</sup>  
 $g'$  = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m<sup>3</sup>  
 $S_u = 10$  KPa

**IN VERY SOFT TO FIRM COHESIVE CLAYS OR CLAYEY SOILS**

**Notes:**

1. Check system for partial excavation condition.
2. If the free water level is above the base of the excavation, the hydrostatic pressure must be added to the above pressure distribution.
3. If surcharge loadings are present near the excavation, these must be included in the lateral pressure calculation.

Client: <b>Region of Peel</b>		Project No.: <b>10001862</b>	Drawing No.: <b>10</b>
Drawn: <b>ZMO</b>	Approved: <b>NE</b>	Title: <b>Earth Pressure Distribution on Braced Excavations</b>	
Date: <b>August, 2015</b>	Scale: <b>N.T.S</b>	Project: <b>Geotechnical Investigation Victoria Street Utilities Services Relocation, Kitchener, ON</b>	
Original Size: <b>Letter</b>	Rev: <b>1</b>	 <b>SPL Consultants Limited</b> Geotechnical * Environmental * Materials * Hydrogeology	

# APPENDIX A

Explanation of Terms Used in the Record of Borehole

Borehole Logs (BH15-1 through BH15-10)

## Explanation of Terms Used in the Record of Boreholes

### Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube Sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### 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) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under “weight of hammer”

#### 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, 60° cone attached to “A” size drill rods for a distance of 300 mm (12 in).

### Textural Classification of Soils

Classification	Particle Size
Boulders	> 200 mm
Cobbles	75 mm - 200 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm – 4.75 mm
Silt	0.002 mm-0.075 mm
Clay	<0.002 mm

### Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

### Soil Description

#### a) Cohesive Soils(\*)

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

#### (\*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT “N” value
5. Pocket penetrometer

#### b) Cohesionless Soils

Density Index (Relative Density)	SPT “N” Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

### Soil Tests

w	Water content
$w_p$	Plastic limit
$w_l$	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
$D_R$	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
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
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
$\gamma$	Unit weight

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812217 E 542745

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203 mm  
 Date: Jul/29/2015  
 REF. NO.: 10001862  
 ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
318.7															
318.6	<b>TOPSOIL:</b> 150mm														
0.2	<b>FILL:</b> silty sand to sand, trace gravel, trace clay, trace organics, brown to grey, moist to saturated, very loose to loose sand and gravel, trace asphalt		1	SS	4										
			2	SS	8										
	trace silty clay pockets		3	SS	3										
316.7															
2.0	<b>SILTY CLAY TILL:</b> some sand, trace gravel, occasional cobble/boulder, brown, moist, very stiff		4	SS	16										
315.6															
3.1	<b>SILTY CLAY:</b> trace sand, occasional gravel, contains wet sand seams, grey, moist, very stiff		5	SS	20										
			6	SS	22										
			7	SS	26										
			8	SS	27										
312.0															
6.7	<b>END OF BOREHOLE</b> Notes: 1) Ground water level was at 3.1m during drilling. 2) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date August 11, 2015 W.L (bgl)(m) 0.4														

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement 1st 2nd 3rd 4th

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812248 E 542714

**DRILLING DATA**  
 Method: Solid Stem auger  
 Diameter: 152 mm  
 Date: Jun/23/2015  
 REF. NO.: 10001862  
 ENCL NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)										WATER CONTENT (%)			GR
323.9	ASPHALT: 40mm																				
323.6	GRANULAR BASE/SUBBASE: 350mm (sand and gravel)		1	AS																	
323.5	FILL: sand, trace to some silt, some gravel, trace clay, brown, moist																				
323.1	FILL: silty sand, trace clay, brown to dark brown, moist to saturated, loose		2	SS	8		323														
323.1			3	SS	4																
323.1			4	SS	4																
320.9							holeplug														
320.9	SAND: trace to some silt, trace clay, brown, moist, compact to dense		5	SS	13																
320.9			6	SS	25		320														
320.9	layer of gravelly sand, occasional cobble at 4.6m		7	SS	34		319										27	62	8	3	
318.8	SILTY CLAY TILL: sandy, trace gravel, occasional cobble/boulder, grey, moist, stiff to hard																				
318.8							W. L. 318.6 m Aug 11, 2015														
318.8	saturated silt/sand seams, grey below 6.1m		8	SS	11													1	22	52	25
318.8							Screen														
315.8	200mm thick layer of silty sand and silt, saturated at 8.0m		9	SS	24																
315.8	SILTY CLAY: trace to some sand,						Holeplug														
315.8	occasional gravel, contains sand/silt seams, grey, moist, very stiff																				
315.8	<b>END OF BOREHOLE</b>																				
315.8	Notes: 1) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date August 11, 2015 W.L (bgl)(m) 5.3																				

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015 GPJ SPL GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement 1st 2nd 3rd 4th

**GRAPH NOTES** + 3, x 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812257 E 542708

**DRILLING DATA**  
 Method: Solid Stem auger  
 Diameter: 152 mm  
 Date: Jun/23/2015  
 REF. NO.: 10001862  
 ENCL NO.: 4

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
323.8	ASPHALT: 80mm															
323.5	GRANULAR BASE/SUBBASE: 200mm (silty sand, some gravel)		1	AS												
323.0	FILL: sand, trace silt, trace clay, brown, moist															
321.3	FILL: silty sand, trace clay, trace organics, brown, moist, loose		2	SS	6											
			3	SS	5											
			4	SS	5											
	SAND: trace silt, trace clay, brown, moist, loose to compact		5	SS	20											0 87 8 5
			6	SS	19											
319.1	SILTY CLAY TILL: sandy, contains sand seams, trace gravel, occasional cobble/boulder, grey, moist, stiff to very stiff		7	SS	14											
			8	SS	19											1 22 53 24
			9	SS	21											
	100mm thick layer of sandy silt, trace gravel, saturated at 7.9m															
314.7	SILTY CLAY: trace to some sand, occasional gravel, some sand/silt seams, grey, moist, very stiff		10	SS	22											

SPL SOIL LOG: 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity  
 ○ ε=3% Strain at Failure



PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812332 E 542729

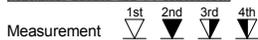
**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203 mm  
 Date: Jun/17/2015  
 REF. NO.: 10001862  
 ENCL NO.: 5

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
322.5	ASPHALT: 40mm															
322.0	GRANULAR BASE/SUBBASE: 350mm (silty sand, trace gravel)		1	SS	11											
322.1	FILL: silty sand, trace clay, trace to some gravel, brown, moist, loose to compact		2	SS	16											
0.4	trace to some organics, dark grey to black at 1.5m		3	SS	6											
320.2	FILL: sand, trace silt, trace clay, brown, moist, loose		4	SS	6											
2.3	SAND: trace silt, brown, moist, compact		5	SS	20											
319.5	SILT: some sand, trace gravel, occasional cobble/boulder, brown, moist, very stiff to hard		6	SS	19											
3.1	grey below below 4.6m		7	SS	22											
318.7	300mm thick layer of wet to saturated silt to sandy silt at 7m		8	SS	20											11 20 47 22
3.8	75mm thick wet sand layer at 8.7m		9	SS	20											7 53 40
4	SILT: some sand, trace clay, occasional gravel, grey, saturated, dense		10	SS	42											
5			11	SS	25											
6			12	SS	48											
7			13	SS	39											15 75 10

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015 GPJ SPL GDT 10/22/15

Continued Next Page

GROUNDWATER ELEVATIONS



GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity  
 ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812332 E 542729

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203 mm  
 Date: Jun/17/2015  
 REF. NO.: 10001862  
 ENCL NO.: 5

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60	80	100	20
9.9	<b>SILTY CLAY TILL:</b> some sand, trace gravel, trace wet silt layers, occasional cobble/boulder, grey, moist, very stiff(Continued)		14	SS	23														
311.8																			
10.7			<b>SILTY CLAY:</b> trace sand, contains silt/sand seams, occasional gravel, grey, moist, very stiff		15	SS	23											5 56 39	
11																			
12																			
13																			
14			16	SS	20														
15			17	SS	25											1 2 38 59			
307.3	<b>SILTY CLAY TILL:</b> sandy, contains silt/sand seams, trace gravel, occasional cobble/boulder, grey, moist, very stiff		18	SS	25														
15.2																			
306.7			19	SS	23											8 25 40 27			
15.9	<b>END OF BOREHOLE</b> Notes: 1) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date August 11, 2015      W.L (bgl)(m) 4.7																		

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure



PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812295 E 542733

**DRILLING DATA**  
 Method: Solid Stem Augers  
 Diameter: 152 mm  
 Date: Jun/23/2015  
 REF. NO.: 10001862  
 ENCL NO.: 6

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)
	and caved-in at 8.8m upon completion of drilling.																	

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure



PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812347 E 542782

**DRILLING DATA**  
 Method: Solid Stem auger  
 Diameter: 152 mm  
 Date: Jul/17/2015  
 REF. NO.: 10001862  
 ENCL NO.: 7

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							WATER CONTENT (%)
							20	40	60	80	100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	GR SA SI CL
308	<b>SILTY CLAY:</b> trace sand, trace gravel, contains sand/silt seams/pockets, grey, moist, stiff to very stiff(Continued)		13	SS	25										5 61 34
306.4	<b>CLAYEY SILT TILL:</b> sandy, trace to some gravel, contains wet sand seams, occasional cobble/boulder, grey, moist, very stiff		14	SS	20										13 33 38 16
12.8	<b>END OF BOREHOLE</b> Notes: 1) Ground water level was at 10.7m during drilling.														

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** + 3, x 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812361 E 542842

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203 mm  
 Date: Jun/12/2015  
 REF. NO.: 10001862  
 ENCL NO.: 8

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>
322.6	ASPHALT: 40mm																	
322.2	GRANULAR BASE/SUBBASE: 350mm (silty sand, some gravel)		1	AS														
0.4	FILL: silty sand to sandy silt, trace to some gravel, trace asphalt pieces, trace brick fragments, dark grey to black, moist to wet, compact		2	SS	20													
	brick pieces at 2m		3	SS	14													
	some gravel, trace brick fragments at 3.1m		4	SS	15													
			5	SS	17													
318.8	FILL: sand, some silt, some gravel, trace rootlets, trace brick fragments, trace asphalt, brown to grey, wet to saturated, compact		6	SS	14													
3.8			7	SS	15													
			8	SS	12													
317.3	SAND: trace silt, trace clay, occasional gravel, brown, saturated, compact		9	SS	12													
5.3			10	SS														
	disturbed sample		11	SS	12													
314.2	SILTY SAND: trace clay, occasional gravel, grey, saturated, loose		12	SS	9													
8.4			13	SS	12													
313.8	SILTY CLAY TILL: some sand, trace gravel, contains wet sand/silt seams, occasional cobble/boulder, grey, moist, stiff to very stiff																	
8.8																		

SPL SOIL LOG: 10001862 GINT FILE: AUGUST 12, 2015.GPJ SPL.GDT: 10/22/15

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, x3: Numbers refer to Sensitivity  
 ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation CLIENT: MMM Group Limited PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON DATUM: Geodetic BH LOCATION: N 4812361 E 542842	DRILLING DATA Method: Hollow Stem Auger Diameter: 203 mm Date: Jun/12/2015 REF. NO.: 10001862 ENCL NO.: 8
---	--

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)										
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)							WATER CONTENT (%)			GR	SA	SI	CL			
312	SILTY CLAY TILL: some sand, trace gravel, contains wet sand/silt seams, occasional cobble/boulder, grey, moist, stiff to very stiff(Continued) 100mm thick sand, trace gravel layer at 10.3m 75mm thick sandy silt layer at 10.9m	[Hatched]	14	SS	16	[Solid Black]	Holeplug																	
311			15	SS	11																	6 65 29		
310.7			16	SS	14																			
311.9	SILTY CLAY: trace sand, contains silt/sand seams, occasional gravel, grey, moist, stiff to hard	[Hatched]	17	SS	20	[Cross-hatched]	caved														0 4 51 45			
310			18	SS	35																			
309			19	SS	45																			
308			20	SS	51																			
307																								
306																								
305.2																								

17.4 **END OF BOREHOLE**  
 Notes:  
 1) 50mm diameter monitoring well installed on completion of drilling.  
 Water level readings:  
 Date August 11, 2015      W.L (bgl)(m) 3.9

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015 GPJ SPL GDT 10/22/15

GROUNDWATER ELEVATIONS      GRAPH NOTES      + 3, x 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

Measurement      1st      2nd      3rd      4th



PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812329 E 542844

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203 mm  
 Date: Jun/16/2015  
 REF. NO.: 10001862  
 ENCL NO.: 9

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)							
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80							100	20	40	60	80	100	10
312	<b>SILTY CLAY TILL:</b> some sand, trace gravel, contains wet sand/silt seams, occasional cobble/boulder, grey, moist, very stiff(Continued)  70mm thick sand layer at 10.7m		11	SS	16																			
311			12	SS	29																9	17	47	27
309.2	<b>SILTY CLAY:</b> trace to some sand, contains silt/sand seams, embedded clayey silt layers, grey, moist, hard		13	SS	30																			
309			14	SS	41																			
308			15	SS	41																			
307.1	<b>END OF BOREHOLE</b> Notes: 1) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date August 11, 2015      W.L (bgl)(m) 4.0																							

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812312 E 542846

**DRILLING DATA**  
 Method: Hollow Stem Auger/Solid Stem Auger  
 Diameter: 203mm/152mm  
 Date: Jun/11/2015  
 REF. NO.: 10001862  
 ENCL NO.: 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40							60
323.2	ASPHALT: 90mm															
322.8	GRANULAR BASE/SUBBASE: 300mm (sand and gravel)		1	AS												
320.9	FILL: sandy silt, some gravel, trace asphalt, brown to grey, moist, very dense		2	SS	77											
			3	SS	67											
	100mm thick sand and gravel layer at 2.0m															
319.4	FILL: sandy silt, trace gravel, trace to some organics, dark grey, moist to saturated, compact to dense		4	SS	13											
318.6	SANDY SILT: some gravel, trace clay, brown, saturated, compact		6	SS	29											
317.1	SAND AND GRAVEL: trace silt, trace clay, brown, saturated, compact		7	SS	15											
314.1	SAND: trace silt, trace gravel, trace clay, grey, saturated, compact		8	SS	18											
313.5	SILT CLAY TILL: some sand, trace gravel, contains wet sand/silt seams, occasional cobble/boulder, grey, moist, stiff		10	SS	13											
313.5	END OF BOREHOLE															

SPL SOIL LOG: 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

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GROUNDWATER ELEVATIONS  
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity  
 ○ ε=3% Strain at Failure

switched to hollow stem auger at 7.6m  
 8 80 8 4

PROJECT: Geotechnical Investigation -Utilities Services Relocation CLIENT: MMM Group Limited PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON DATUM: Geodetic BH LOCATION: N 4812312 E 542846	<b>DRILLING DATA</b> Method: Hollow Stem Auger/Solid Stem Auger Diameter: 203mm/152mm Date: Jun/11/2015 REF. NO.: 10001862 ENCL NO.: 10
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)					W <sub>p</sub>	w	W <sub>L</sub>				GR
	Notes: 1) Groundwater level at 2.7m upon completion of drilling. 2) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date                      W.L (bgl)(m) August 11, 2015        3.2																	

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

GROUNDWATER ELEVATIONS  
 Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812238 E 542816

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203mm  
 Date: Aug/10/2015  
 REF. NO.: 10001862  
 ENCL NO.: 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100
318.7	ASPHALT: 160mm														
318.0	GRANULAR BASE/SUBBASE: 300mm (sand and gravel)		1	SS	12										
318.3	FILL: clayey silt, trace gravel, brown, moist, stiff														
0.5	400mm thick layer of organic clayey silt, dark grey to black, moist		2	SS	8										
317.2	SAND: some gravel, trace clay, brown to grey, wet, loose		3	SS	8										
316.4	SAND: some silt, trace clay, brown, wet, compact		4	SS	19										
315.6	SILTY CLAY TILL: some sand, trace gravel, occasional cobble/boulder, grey, moist, stiff to hard		5	SS	33										
3.1			6	SS	12										
	wet sand seams at 4.6m		7	SS	24										9 16 52 23
312.6	SILTY CLAY: trace sand, occasional gravel, grey, moist, very stiff		8	SS	23										
6.1			9	SS	18										
			10	SS	18										
309.0	END OF BOREHOLE														

SPL SOIL LOG - 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation -Utilities Services Relocation  
 CLIENT: MMM Group Limited  
 PROJECT LOCATION: 800 Victoria St., (Bridge), Kitchner, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4812238 E 542816

**DRILLING DATA**  
 Method: Hollow Stem Auger  
 Diameter: 203mm  
 Date: Aug/10/2015  
 REF. NO.: 10001862  
 ENCL NO.: 10

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)
	Notes: 1) Groundwater level at 5.8m upon completion of drilling. 2) 50mm diameter monitoring well installed on completion of drilling. Water level readings: Date August 11, 2015      W.L (bgl)(m) 5.8																	

SPL SOIL LOG 10001862 GINT FILE AUGUST 12, 2015.GPJ SPL.GDT 10/22/15

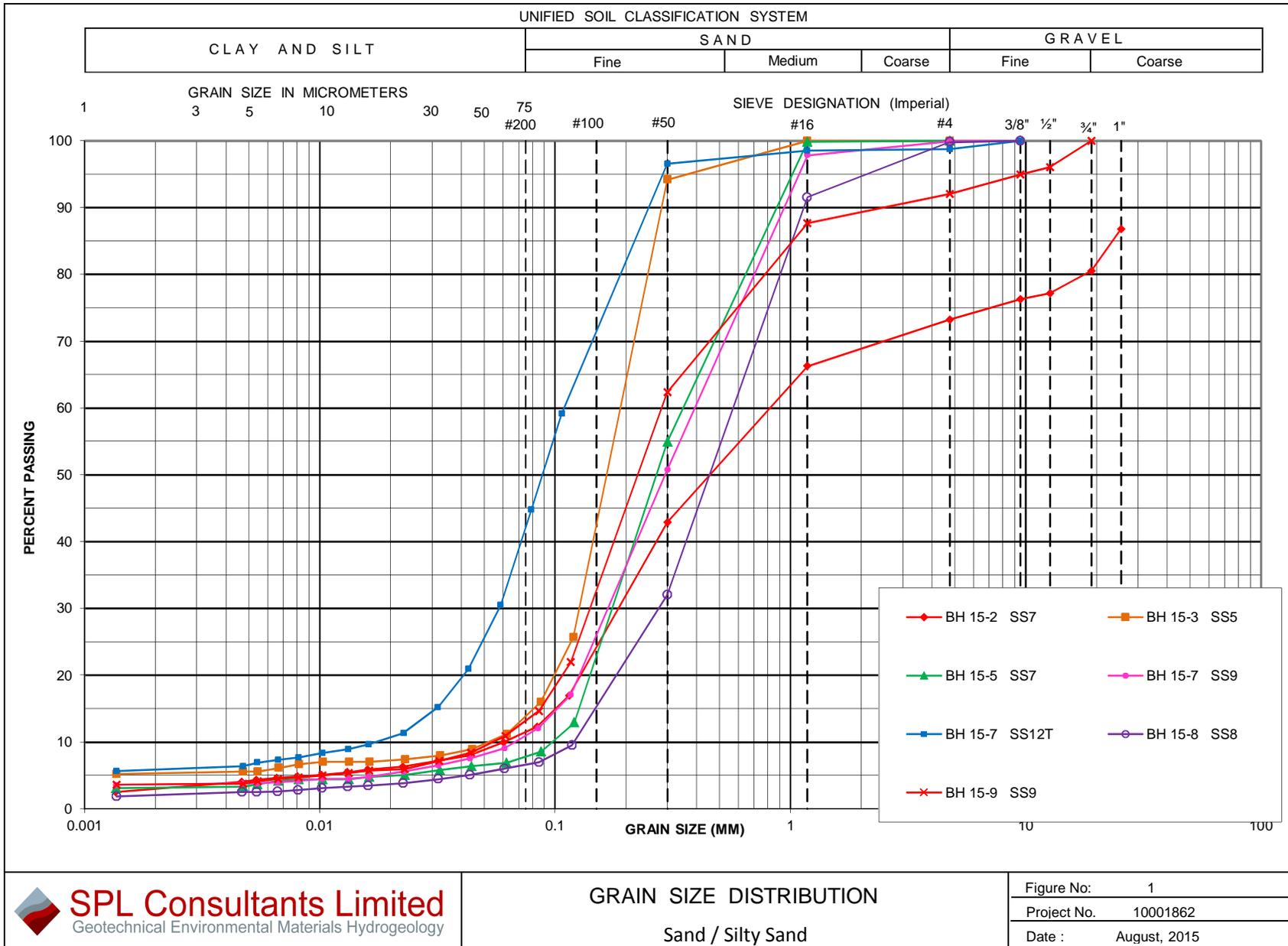
**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

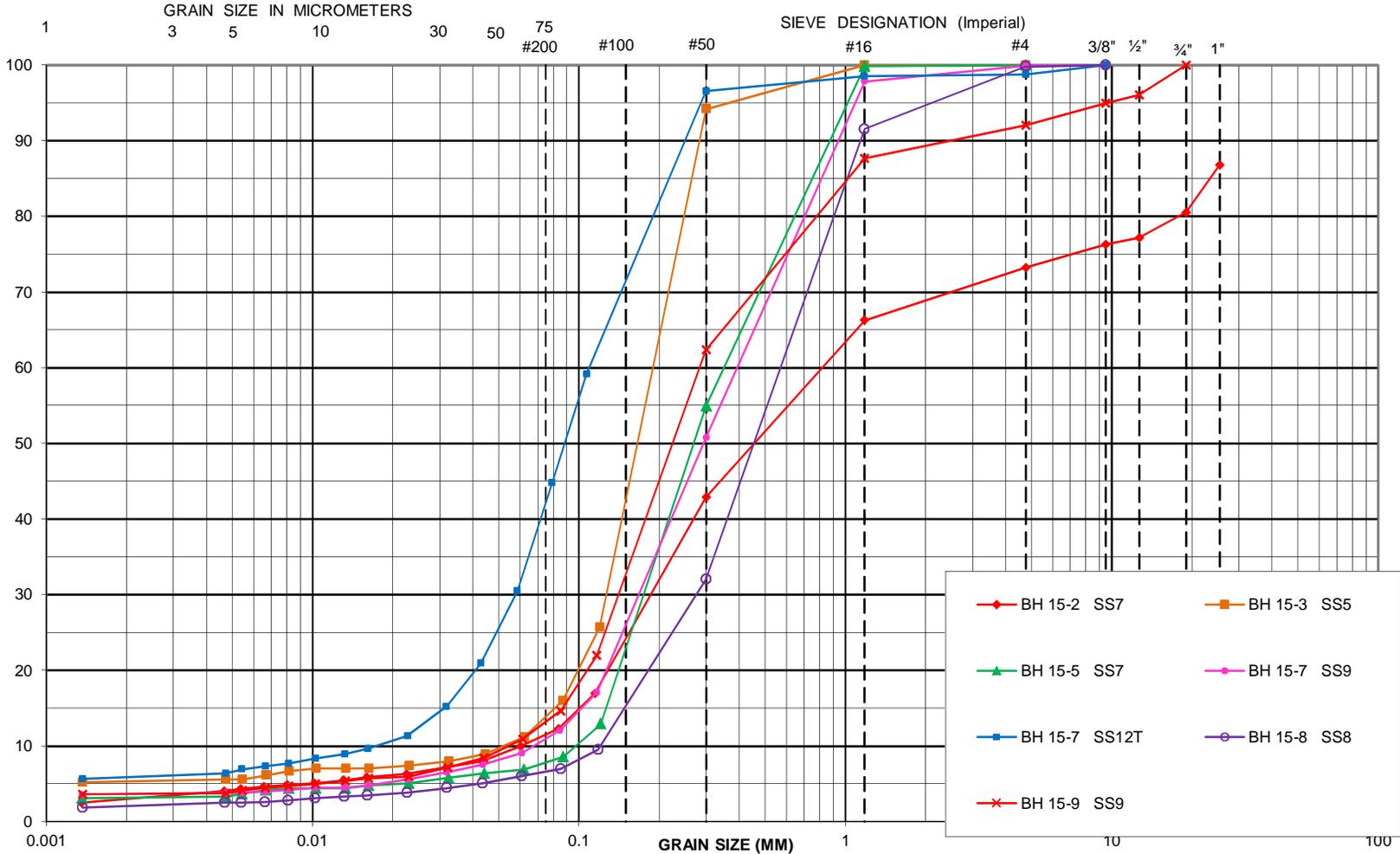
# APPENDIX B

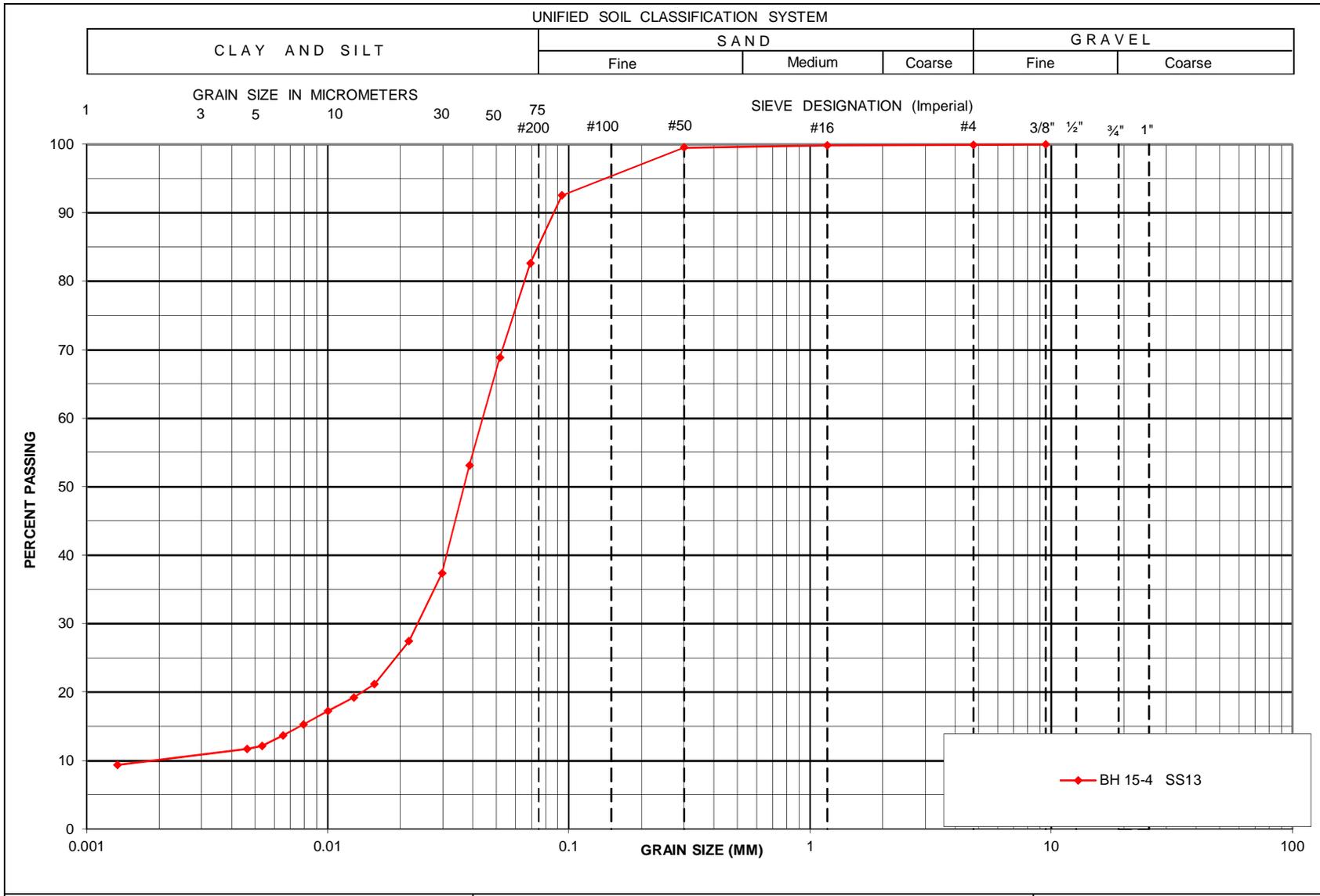
Grain Size Distribution Curves (Figures 1 to 4)

Plasticity Charts (Figure 5)



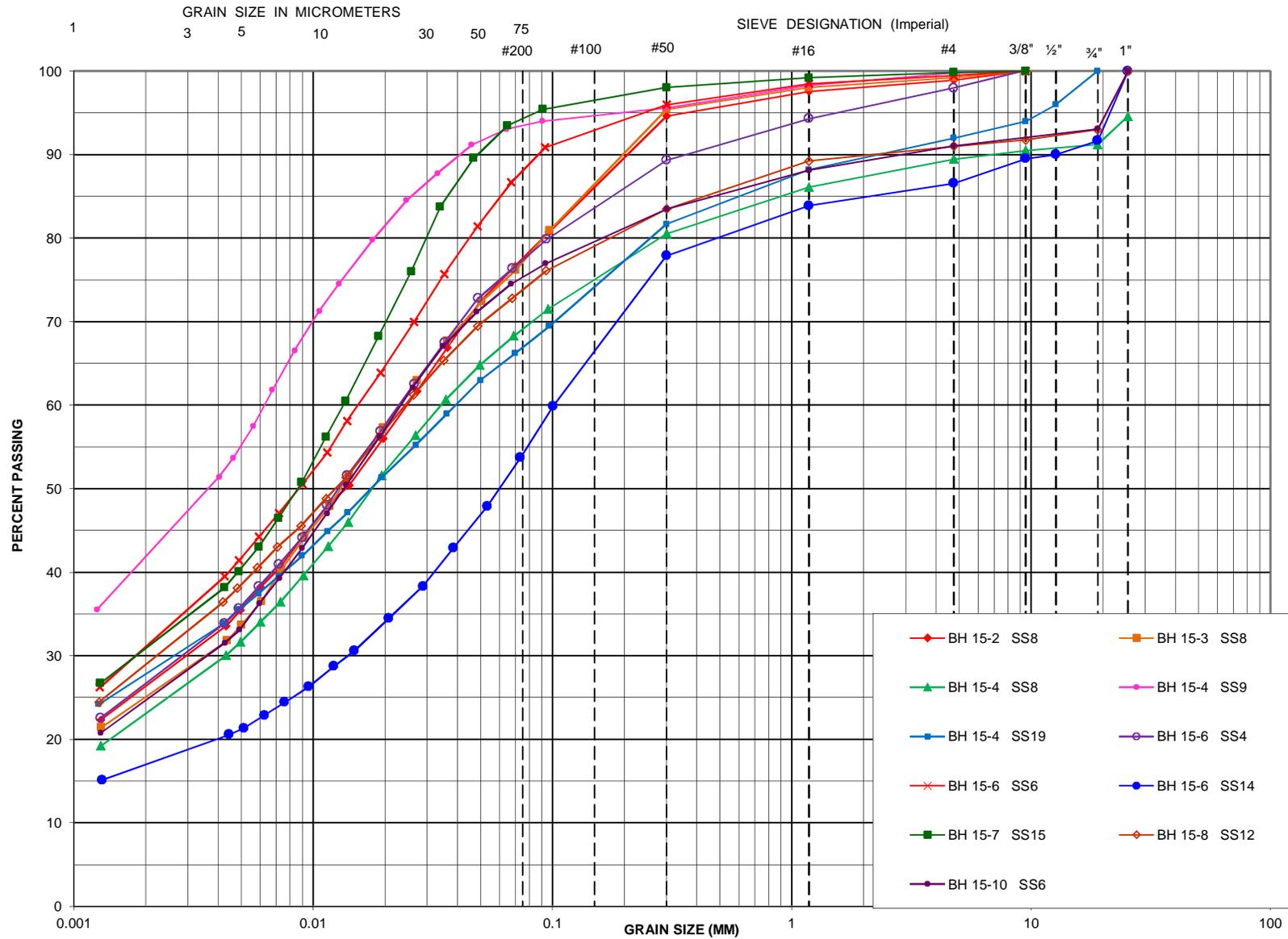
PERCENT PASSING





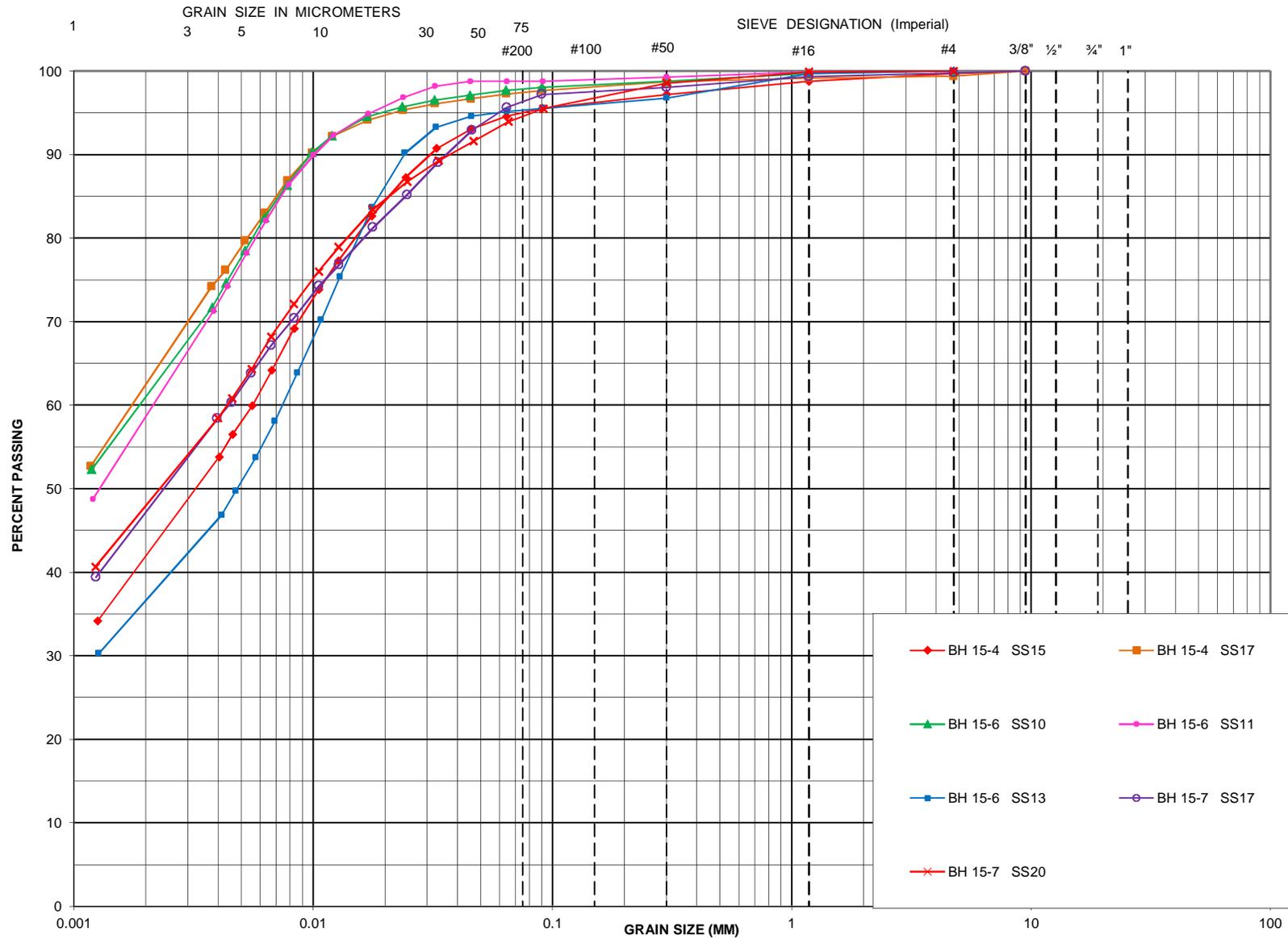
UNIFIED SOIL CLASSIFICATION SYSTEM

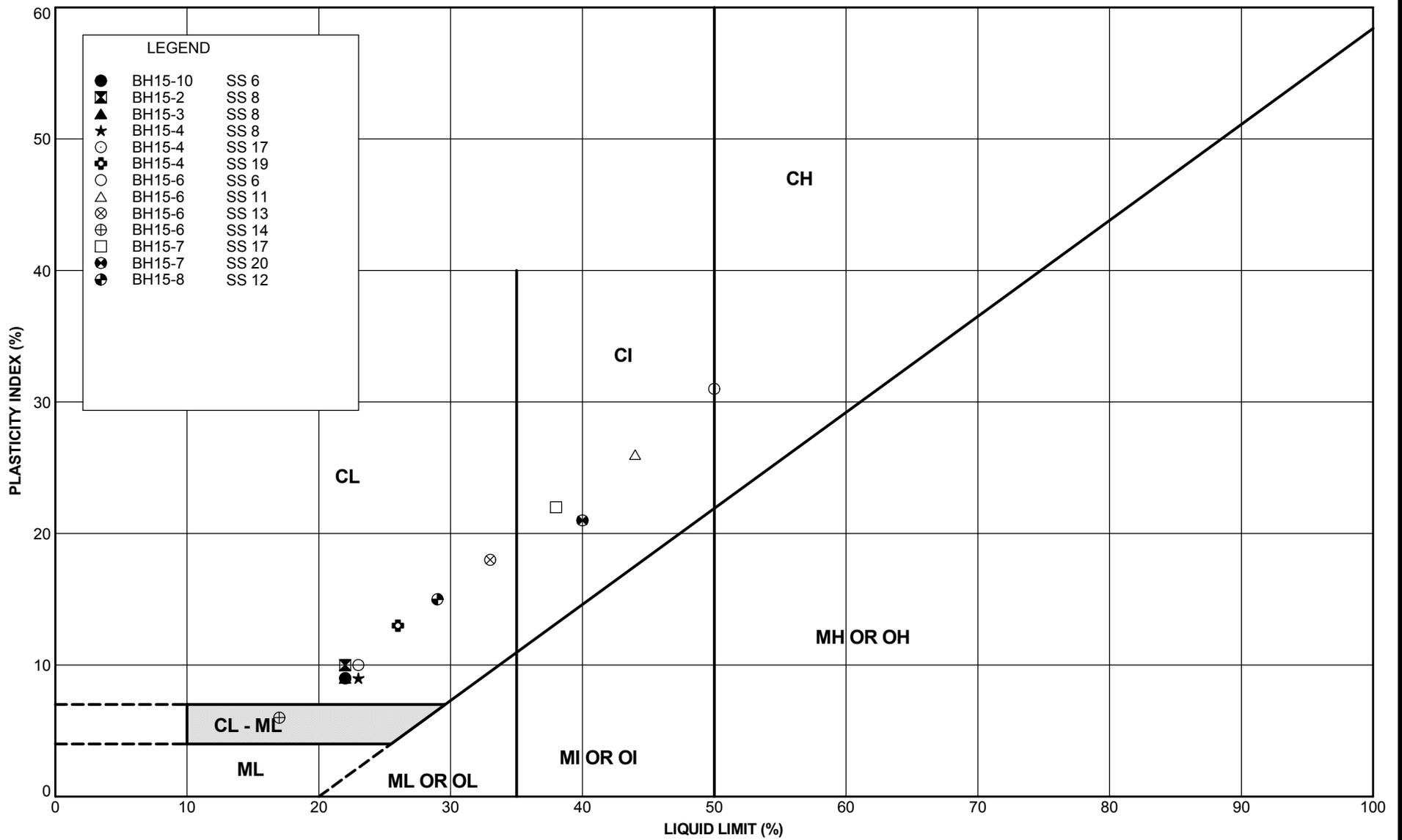
CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse





PLASTICITY CHART

FIGURE NO.	5.
JOB NO.	10001862
DATE	August 14, 2015