



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
OVERHEAD SIGN SUPPORT STRUCTURES PACKAGE 3  
HIGHWAY 401, 410, 403, AND QEW  
CENTRAL REGION  
ST. CATHARINES TO BRAMPTON, ONTARIO  
Contract Number: DB 2018-2002**

**GEOCRES No. 30M12-435**

**Report**

to

**Parsons**

Date: January 23, 2018  
File: 22436





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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of Overhead Sign Supports (OSS) at various locations along Highway 401, 403, 410, and QEW. Thurber carried out this investigation as foundation consultant to Parsons Corporation (Parsons) for the Ministry of Transportation Ontario (MTO) Design Build Contract Number 2018-2002.

The purpose of this investigation was to explore the subsurface conditions near the proposed locations of the overhead and cantilevered sign supports and, based on this data, to provide borehole location plans, records of boreholes, laboratory test results and a written description of the subsurface conditions.

The project consists of 23 sign locations, designated as Sites 1 through 23. Sites 1 through 20 required a geotechnical investigation and were completed in three stages designated as Package 1 to 3. This report covers the sites included in Package 3 (Sites 4, 12, 14, 15, 16, 17, 18, 19, and 20).

**2. SITE DESCRIPTION**

The overhead and cantilevered signs are to be located on the QEW between McLeod Road in Niagara Falls, and Cawthra Road in Mississauga; on Highway 403 between Highway 6 in Hamilton and Guelph Line; on Highway 401 between First Line Nassagaweya and Renforth Drive; and on the Highway 410 north bound off ramp at Bovaird Drive.

The signs are to be located at sites numbered 1 to 23. Road side signs are proposed for Sites 21 to 23, and as such a geotechnical investigation was not conducted at those sites and is not included in this report.





At Site 1, the project area is generally located within the physiographic region known as the Haldimand Clay Plains which generally consists of the area lying between the Niagara Escarpment and Lake Erie formerly inundated by Lake Warren. The surficial geology at Site 1 generally consists of coarse textured glaciolacustrine deposits of sand and gravel underlain by fine textured glaciolacustrine deposits of silt and clay. Based on published geologic maps, the underlying bedrock in the area is expected to comprise of sandstone, shale and dolostone of the Guelph Formation.

At Sites 2 to 9, 12, 13, and 18 to 20, the project areas are generally located within the physiographic region known as the Iroquois Plain which consists of low lying areas adjacent to Lake Ontario formerly inundated by glacial Lake Iroquois. The surficial geology generally consists of fine to coarse textured glaciolacustrine deposits of sand and gravel to clay and silt with some areas of shallow bedrock. Based on published geologic maps, the underlying bedrock in the area is expected to consist of shale of the Queenston Formation, with the exception of Site 2 where the underlying bedrock is expected to consist of shale of the Georgian Bay Formation.

At Sites 10 and 11 the project areas are generally located within the physiographic region known as the South Slope. The South Slope is comprised predominantly of the Halton drift (till). The Halton Till is an interbedded complex of clayey silt till and sand. This deposit comprises a slightly hummocky till plain, into which the surface watercourses have eroded to 10 to 15 m deep gullies. Relatively recent fluvial sediments have been deposited in the gullies. Based on published geologic maps, the underlying bedrock in the area is expected to consist of shale of the Queenston Formation to shale of the Georgian Bay Formation.

At Sites 14 to 17 the project areas are generally located within the physiographic region known as the Niagara Escarpment in an area where the surficial geology consists of ice-contact stratified deposits of sand and gravel. Based on the published geologic maps, the underlying bedrock in the area is expected to consist of sandstone, shale and dolostone of the Armabel Formation.

### **3. INVESTIGATION PROCEDURES**

The field investigation of this project was carried out in three stages for Packages 1, 2 and 3. Package 1 consists of Sites 1, 5, 6, 7, 9, and 13 and was carried out between August 12 and August 19, 2018. Package 2 consists of Sites 2, 3, 8, 10, and 11, and was carried out between August 19 and August 29, 2018. Package 3 consists of Sites 4, 12, and 14 to 20 and was carried out between August 11 and November 11, 2018. Boreholes were designated as 18-01 to 18-20, corresponding to their respective sites and were drilled near the locations of the proposed overhead signs. For package 3, boreholes were drilled to depths of between 6.1 m to 8.2 m. The





approximate locations of the boreholes covered in the report are shown on the Borehole Location Plans in Appendix C.

Utility clearances at the borehole locations were obtained prior to the start of drilling. The ground surface elevations for the boreholes were surveyed by Tulloch Geomatics Inc. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

The field investigation was supervised on a full-time basis by a member of Thurber's technical staff who directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions were observed in the open boreholes throughout the drilling operations. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903, as amended. Completion details of the boreholes are summarized in Table 3.1 below.

**Table 3.1 – Package 2 Borehole Completion Details**

<b>Borehole Number</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Completion Details</b>
18-04	8.2 / 71.7	Borehole backfilled with bentonite holeplug and cuttings then asphalt to surface.
18-12	7.7 / 97.6	Borehole backfilled with bentonite holeplug and cuttings then asphalt to surface.
18-14	8.2 / 284.3	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-15	7.6 / 283.9	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-16	8.2 / 271.5	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-17	6.1 / 283.4	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-18	7.7 / 81.8	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-19	7.7 / 82.0	Borehole backfilled with bentonite holeplug and cuttings then asphalt to surface.





Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
18-20	8.2 / 78.9	Borehole backfilled with bentonite holeplug and cuttings then asphalt to surface.

#### 4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

#### 5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions will vary between and beyond borehole locations.

##### 5.1 Package 3 (Sites 4, 12, and 14 to 20)

In general, for Package 3, which consists of sites in the Hamilton, Grimsby, and Milton areas, the subsurface conditions varied depending on location however generally consisted of asphalt overlying sand to sand and gravel fill and silty sand to sandy silt fill, which was further underlain silty clay to clayey silt till, sandy gravel to gravelly sand, sand and silt to silt, silty sand to silt till, and silty clay to clayey silt. In Borehole 18-12, weathered shale bedrock was encountered near the surface. Descriptions of the individual strata are presented below.

##### 5.1.1 Asphalt

All boreholes, with the exception of Borehole 18-12 and 18-16, were drilled through the paved shoulder of either the QEW, Highway 401, or Highway 403 and encountered approximately 150 mm to 275 mm of asphalt.





### 5.1.2 Topsoil

Borehole 18-12 was drilled in the grass median of Highway 403 and Borehole 18-16 was drilled in the grassed shoulder of Highway 401. These boreholes encountered approximately 50 mm to 100 mm of topsoil at the surface.

### 5.1.3 Sand to Sand and Gravel Fill

Sand to sand and gravel fill, containing trace to some silt and trace clay was encountered beneath the asphalt in Boreholes 18-04, 18-14, 18-15, 18-16, 18-17, 18-18, and 18-20. The sand to sand and gravel fill was approximately 0.4 m to 4.2 m thick and extended to depths of between 0.6 m to 3.0 m (Elevations 76.9 m to 290.2 m).

SPT 'N' values within the sand to sand and gravel fill ranged from 15 blows per 0.3 m of penetration to 100 blows for 0.075 m penetration, indicating a compact to very dense condition. The high blow counts may represent the presence of possible cobbles, boulders, or concrete rubble. Moisture contents between 2 to 15 percent were measured in the fill.

The results of a grain size distribution analysis carried out on a selected sample of the sand to sand and gravel fill is presented on the Record of Borehole sheets included in Appendix A and on Figures B1 of Appendix B. The results of the grain size distribution analysis is summarized below:

Soil Particle	Percentage (%)
Gravel	16 to 59
Sand	31 to 62
Silt and Clay	9 to 25

### 5.1.4 Silty Sand Fill

Silty sand fill, containing some gravel and trace clay, was encountered below the asphalt in Borehole 18-19. The silty sand fill was approximately 1.2 m thick and extended to a depth of 1.4 m (Elevations 88.3 m).

A SPT 'N' value taken within the silty sand fill was 26 blows for 0.3 m penetration indicating a compact condition. A moisture content of 7 percent was measured in the fill.

### 5.1.5 Silty Clay to Clayey Silt Till

Silty clay to clayey silt till, containing trace to some sand, and trace gravel was encountered in Boreholes 18-04, 18-18, and 18-19 at depths of between 1.4 m and 5.6 m (Elevations 76.9 m to





88.3 m). The boreholes were terminated within the silty clay to clayey silt till at depths of between 7.7 m to 8.2 m (Elevations 71.7 m to 81.9 m).

SPT 'N' values within the clayey silt to silty clay till ranged from 8 blows per 0.3 m of penetration to 100 blows for 0.075 m penetration, indicating a stiff to hard consistency and possible presence of cobbles and boulders. Moisture contents between 9 percent and 20 percent were measured in the till.

The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the till are presented on the Record of Borehole sheets included in Appendix A and on Figures B2 and B6 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 3
Sand	1 to 21
Silt	40 to 68
Clay	29 to 36

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Liquid Limit	27 to 28
Plasticity Index	10 to 12

The results of the Atterberg Limits testing indicate these cohesive soils to be of low plasticity with group symbol CL. Glacial tills inherently contain cobbles and boulders.

### 5.1.6 Sandy Gravel to Gravelly Sand

Sandy gravel to gravelly sand, containing trace to some silt, and trace clay, was encountered in Boreholes 18-14, 18-15, and 18-17 at depths of between 0.8 m and 3.0 m (Elevation 288.4 m and 290.2 m). Where fully penetrated in Borehole 18-14, the layer was approximately 4.1 m thick and extended to a depth of 6.4 m (Elevation 286.1 m). Boreholes 18-15 and 18-17 were terminated within the layer at depths of 7.6 m and 6.1 m (Elevation 283.8 m and 283.4 m), respectively.

SPT 'N' values within the sandy gravel to gravelly sand ranged from 16 to 114 blows per 0.3 m of penetration, indicating a compact to very dense condition. Moisture contents between 3 percent and 13 percent were measured in the sandy gravel to gravelly sand.

The results of a grain size distribution analyses carried out on selected samples of the sandy





gravel to gravely sand is presented on the Record of Borehole sheets included in Appendix A and on Figures B3 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	34 to 44
Sand	40 to 46
Silt and Clay	12 to 21

#### 5.1.7 Sand and Silt to Silt

Sand and Silt to Silt, containing trace to some sand, trace clay, and trace to some gravel was encountered in Boreholes 18-14, and 18-16 at depths of between 4.3 m to 6.4 m (Elevations 275.4 m to 286.1 m). The above boreholes were terminated within the sand and silt to silt at depths of 8.2 m (Elevations 271.4 m and 284.3 m).

SPT 'N' values within the sand and silt to silt ranged from 20 to 55 blows per 0.3 m of penetration, indicating a compact to very dense consistency. Moisture contents between 4 percent and 20 percent were measured in the sand and silt to silt.

The results of a grain size distribution analysis carried out on a selected sample of the silt is presented on the Record of Borehole sheets included in Appendix A and on Figures B4 of Appendix B. The results of the grain size distribution analysis is summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	10
Silt	77
Clay	13

#### 5.1.8 Silt Till

Silt till containing some sand and trace gravel, was encountered in Borehole 18-18 at a depth of approximately 1.4 m (Elevation 88.1 m). The silt till was approximately 4.2 m thick and extended to a depth of approximately 5.6 m (Elevation 83.9 m).

SPT 'N' values within the silt till ranged from 39 blows per 0.3 m of penetration to 100 blows for 0.150 m penetration, indicating a dense to very dense condition and the possible presence of





cobbles and boulders. Moisture contents between 6 percent and 10 percent were measured in the till.

### 5.1.9 Silty Clay to Clayey Silt

Silty clay to clayey silt, containing trace sand and trace gravel was encountered in Boreholes 18-16 and 18-20 at depths of approximately 4.3 m and 0.6 m (Elevations 275.4 m and 86.5 m), respectively. The silty clay layer was approximately 1.8 m thick in Borehole 18-16 and extended to a depth of approximately 6.1 m (Elevation 273.6 m). Borehole 18-20 was terminated in the silty clay layer at a depth of 8.2 m (Elevation 78.9 m). A thin 0.2 m thick layer of silty clay was also encountered beneath the topsoil in Borehole 18-12.

SPT 'N' values within the clayey silt to silty clay ranged from 8 to 35 blows per 0.3 m of penetration, indicating a stiff to hard consistency. Moisture contents between 14 percent and 19 percent were measured in the silty clay to clayey silt.

The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the silty clay to clayey silt are presented on the Record of Borehole sheets included in Appendix A and on Figures B5 and B7 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	23 to 28
Silt	38 to 42
Clay	30 to 35

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Liquid Limit	21 to 31
Plasticity Index	7 to 14

The results of the Atterberg Limits testing indicate these cohesive soils to be of low plasticity with group symbol CL-ML to CL.

### 5.1.10 Bedrock

Weathered red shale of the Queenston Formation was encountered in Boreholes 18-12 at a depth of 0.2 m (Elevation 105.1 m). Borehole 18-12 was advanced through the shale using solid stem





augers to a final depth of 7.7 m. The shale bedrock is expected to get stronger with depth and the bedrock is also known to contain hard rock interbeds.

SPT 'N' values in the weathered shale bedrock ranged from 100 blows for 0.275 m to 100 blows for 0.05 m. Measured moisture contents in the shale bedrock ranged from 3 to 11 percent.

Borehole 18-15 and Borehole 18-17 were terminated on auger refusal at depths of 7.6 m and 6.1 m (Elevations 283.9 m and 283.4 m). The auger refusal may represent possible bedrock. Based on published geological maps, the bedrock in the area of Boreholes 18-15 and 18-17 consists of sandstone, shale, and dolostone of the Armabel Formation.

## 5.2 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling. Most of the boreholes were dry upon completion. The groundwater levels measured in the open boreholes are summarized below.

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
18-04	August 16, 2018	Dry	-	Open Borehole
18-12	November 8, 2018	Dry	-	Open Borehole
18-14	September 14, 2018	6.4	286.1	Borehole caved to 6.4 m
18-15	September 15, 2018	Dry	-	Borehole caved to 2.3 m
18-16	September 14, 2018	Dry	-	Borehole caved to 6.4 m
18-17	September 14, 2018	Dry	-	Borehole caved to 5.2 m
18-18	October 4, 2018	4.9	84.6	Open Borehole
18-19	October 3, 2018	Dry	-	Open Borehole
18-20	October 3, 2018	Dry	-	Open Borehole

The groundwater levels above are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

## 6. MISCELLANEOUS

Thurber obtained subsurface utility clearances at the borehole locations prior to drilling. The northing and easting coordinates and ground surface elevations were surveyed by Tulloch Geomatics Inc. and provided to Thurber.

Drill Tech Drilling Ltd. Of Newmarket, Ontario, and Tri-Phase Drilling of Mississauga, Ontario,





supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. The field investigation was supervised on a full-time basis by Mr. Kevin Kweon and Ms. Judy Mei, of Thurber. Overall supervision of the field program was provided by Mr. Cory Zanatta, P.Eng. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng., and Dr. Sydney Pang, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

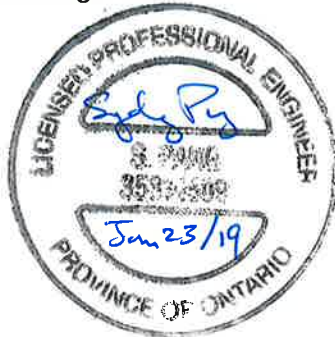




Thurber Engineering Ltd.



Cory Zanatta, P.Eng.  
Geotechnical Engineer



Sydney Pang, P.Eng.  
Senior Geotechnical Engineer



P.K. Chatterji, P.Eng.  
Review Engineer, Designated MTO Contact





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**GEOCRES No. 30M12-435**

**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7. GENERAL**

This section of the report presents foundation recommendations for the design of the proposed Overhead and Cantilevered Sign (OH & CS) supports.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of Parsons Corporation (Parsons) and shall not be used or relied upon for any other purposes or by any other parties. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Parsons and its subcontractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The project includes a total of twenty (20) overhead and cantilevered signs. The sign sites are numbered 1 to 20. The field investigation was split into three stages, denoted as Package 1 through 3. This report addresses the signs in Package 3 (Sites 4, 12, 14, 15, 16, 17, 18, 19, and 20).

Information on the proposed locations of the signs was provided to Thurber by Parsons. Based on the proposed design layout, one borehole was drilled near the location of each proposed sign. The Record of Borehole sheets for these boreholes are presented in Appendix A.

**8. FOUNDATION DESIGN PARAMETERS**

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 1).

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Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) "Guidelines for the Design of High Mast Pole Foundations", Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 2).
- Canadian Highway Bridge Design Code and Commentary (2014). CAN/CSA-S6-00 and S6.1-00 (Reference 3).

It is understood that a typical cantilevered sign support foundation consists of a single conventional augered caisson (drilled shaft), and a typical overhead or tri-chord sign support foundation consists of two conventional augered caissons, one at either end of the sign. Table 1 following the text of this report presents the recommended foundation design parameters for the design of such caissons. For the overhead signs with two supports, both caissons should be designed using the same set of foundation parameters as recommended in Table 1.

MTO's standard designs for the various sign types and other relevant foundation design recommendations in Reference 1 may be used as a basis for the sign support designs. The foundation design parameters in Table 1 should be used in conjunction with Reference 2 to confirm that the standard designs are adequate.

Weathered shale bedrock was encountered within 0.2 m at Borehole 18-12 drilled at site 12. Borehole 18-15 and 18-17 also met refusal at 7.6 m and 6.1 m depths indicating the possible presence of bedrock at these depths. The bedrock encountered in Borehole 18-12 is weathered and cannot be considered as sound bedrock. The bedrock gets stronger with depth and is known to contain very hard interbeds. For design of caissons in weathered bedrock, the parameters recommended for weathered shale in Table 1 should be used. The caisson rig must be able to drill through the bedrock and any hard rock interbeds.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the depth of frost below final grade should be neglected in the foundation design. The depth of frost at these sites is 1.2 m. It is recommended that all topsoil and organics be neglected in determining lateral resistance.

Where downward sloping fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. For foundation design of the caissons, it should be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately four (4) times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the





mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the pile, and full passive resistance at the level where the slope face is at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength,  $q_u$ , ( $q_u = 2 \times C_u$ , undrained shear strength) is provided for a cohesive soil (clayey silt to silty clay fill, silty clay till or clayey silt till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight,  $\gamma'$ , should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

An equivalent caisson width equal to 2 times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

## **9. CAISSON INSTALLATION**

Caisson installation should generally be carried out in accordance with OPSS.PROV 903.

Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers and shale bedrock, which is known to contain hard interbeds, where encountered.

The groundwater levels are estimated to be at the depths shown in Table 1.

Variable types of subsurface materials may be encountered at the locations of the foundations. For construction purposes, it should be assumed that:

- The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
- Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. Obstructions including rubble, cobbles and boulders may also be present within the fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment should be able to dislodge, handle, remove or otherwise penetrate these obstructions





- Weathered bedrock was encountered in Borehole 18-12 at a very shallow depth. Caisson installation equipment should be capable of augering, coring, or otherwise penetrating through the shale to the desired caisson depth. Harder limestone or siltstone slabs should be expected to be present within the shale.
- Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. A number of boreholes caved within the silt layers (see Section 5.2), thus, temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. At locations where water bearing sands and silts are present, a balancing water or slurry head may be required inside the liner to minimize the potential of basal heave and disturbance. Any accumulated water may have to be pumped out from the hole prior to placing concrete. Should it prove to be impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

## **10. CONSTRUCTION CONCERNS**

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils and weathered shale bedrock, soil sloughing and water seepage from caisson sidewalls, and basal instability. Recommendations on how to address these issues have been outlined in the previous sections.

## **11. CONSTRUCTION INSPECTION AND TESTING**

Caisson construction should be monitored by qualified geotechnical personnel (as per OPSS.PROV 903) to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

## **12. CLOSURE**

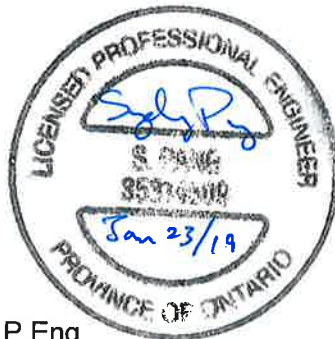
Engineering assessment and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng. The report was reviewed by Mr. Sydney Pang, P.Eng, and Mr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.





Cory Zanatta, P.Eng.  
Geotechnical Engineer



Sydney Pang, P.Eng.  
Senior Geotechnical Engineer



P.K. Chatterji, P.Eng.  
Review Engineer, Designated MTO Contact



**FOUNDATION DESIGN PARAMETERS  
OVERHEAD SIGN SUPPORT  
HIGHWAYS 401, 410, 403, QEW**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$n_h$ (MN/m <sup>3</sup> )	$K_p$	Estimated Groundwater Depth (m) below ground surface
4	BH 18-04	Sand (Fill) Silty Clay (Till)	0.2 to 3.0 3.0 to 8.2	- 120	30 -	19 19	- -	3 -	3.0 -	2
12	BH 18-12	Weathered Shale	0.2 to 7.7	200	-	22	-	-	-	2
14	BH 18-14	Sand and Gravel (Fill)	0.3 to 2.3	-	30	19	-	3	3.0	2
		Sandy Gravel to Gravelly Sand	2.3 to 6.4	-	32	21	11	4.5	3.2	
		Silt	6.4 to 8.2	-	30	19	9	3	3.0	
15	BH 18-15	Sand and Gravel (Fill) Sand and Gravel	0.2 to 3.0 3.0 to 7.6	- -	30 30	20 20	- 10	3 3	3.0 3	2
16	BH 18-16	Sand and Gravel (Fill)	0.1 to 4.3	-	30	20	10	3	3.0	2
		Clayey Silt	4.3 to 6.1	160	-	19	-	-	-	
		Sand and Silt	6.1 to 8.2	-	32	21	11	5	3.3	
17	BH 18-17	Sand and Gravel (Compact to Dense)	0.8 to 2.8	-	30	20	10	3	3	2
		Sand and Gravel (Very Dense)	2.8 to 6.1	-	32	21	11	5	3.3	
18	BH 18-18	Silt (Till) Silty Clay (Till)	1.4 to 5.6 5.6 to 7.7	- 200	32 -	21 22	11 -	5 -	3.3 -	2
19	BH 18-19	Silty Clay (Till) Silty Clay (Till)	1.4 to 2.0 2.0 to 7.7	180 200	- -	20 22	- -	- -	- -	2
20	BH 18-20	Silty Clay	0.6 to 8.2	200	-	19	-	-	-	2

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected.

**LEGEND**

$q_u$	=	Unconfined Compressive Strength (=2 x $C_u$ , undrained shear strength) (kPa)
$\phi'$	=	Angle of Internal Friction (degrees)
$n_h$	=	Coefficient Related to Soil Density (MN/m <sup>3</sup> ) or X 10 <sup>3</sup> kN/m <sup>3</sup> )
$K_p$	=	Coefficient of Passive Earth Pressure
$\gamma$	=	Soil Unit Weight (kN/m <sup>3</sup> )
$\gamma'$	=	Submerged Soil Unit Weight (kN/m <sup>3</sup> ) - to be used for cohesionless soils below the groundwater table





## **Appendix A**

### **Record of Borehole Sheets**



# RECORD OF BOREHOLE No BH 18-04

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 788 628.1 E 286 836.7 ORIGINATED BY KK  
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.16 - 2018.08.16 LATITUDE 43.237307 LONGITUDE -79.721173 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					GR	SA	SI	CL	
79.9	GROUND SURFACE							20	40	60	80	100									
0.0	ASPHALT: (150mm)							20	40	60	80	100									
0.2	SAND, some gravel, some silt and clay, trace concrete fragments Very Dense Brown Moist (FILL)		1	GS																	
			1	SS	100/ 0.075																
			2	SS	100/ 0.100																
			3	SS	100/ 0.075																
76.9																					
3.0	Silty CLAY, with sand, trace gravel Very Stiff to Stiff Brown Moist (TILL)  Grey below 4.1m		4	SS	26																
			5	SS	8																
			6	SS	8																

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BH 18-12

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 795 067.2 E 273 152.8 ORIGINATED BY SLL  
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.11.08 - 2018.11.08 LATITUDE 43.294820 LONGITUDE -79.890023 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
105.3	GROUND SURFACE							20	40	60	80	100				
0.0	TOPSOIL: (50mm)		1	SS	100/ 0.275		105									
0.2	Silty CLAY, trace sand, trace gravel Auger griding from 0.2m to 1.8m															
	SHALE, weathered Hard Reddish Brown Moist		2	SS	100/ 0.100											
			3	SS	100/ 0.125		104									
			4	SS	100/ 0.050		103									
			5	SS	100/ 0.075		102									
							101									
			6	SS	100/ 0.100		100									
	Auger griding at 5.6m and 5.9m		7	SS	100/ 0.100		99									
	Auger griding at 6.7m						98									
97.6			8	SS	100/ 0.100											
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

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# RECORD OF BOREHOLE No BH 18-14

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 816 154.9 E 264 334.9 ORIGINATED BY JM  
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.09.13 - 2018.09.14 LATITUDE 43.484218 LONGITUDE -80.000250 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
292.5	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (275mm)																		
292.2																			
0.3	SAND to GRAVEL, some silt and clay Compact to Dense Brown Moist (FILL)		1	SS	34		292							○					48 40 12 (SI+CL)
			2	SS	15									○					
							291												
			3	SS	25									○					
290.2																			
2.3	Sandy GRAVEL to Gravelly SAND, trace to some silt, trace clay Compact to Dense Brown Moist to Wet		4	SS	16		290							○					
			5	SS	31		289							○					44 44 12 (SI+CL)
							288												
			6	SS	25									○					
							287												
286.1														○					
6.4	SILT, some sand, some clay Compact Brown Moist		7	SS	22	▽	286							○					0 10 77 13
							285												
			8	SS	20									○					
284.3																			
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.4m AND WATER LEVEL AT 6.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																		

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BH 18-15

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 816 743.8 E 265 136.7 ORIGINATED BY JM  
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.09.14 - 2018.09.15 LATITUDE 43.489562 LONGITUDE -79.990381 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
291.5	GROUND SURFACE																
0.0	ASPHALT: (225mm)																
0.2	SAND and GRAVEL, some silt and clay, occasional cobbles Compact to Dense Brown Moist (FILL)		1	SS	36												
			2	SS	40												
			3	SS	25												
			4	SS	37												
288.4																	
3.0	SAND and GRAVEL, some silt and clay, occasional cobbles Compact to Dense Brown Moist		5	SS	29												
			6	SS	49												
			7	SS	45												
283.8																	
7.6	END OF BOREHOLE AT 7.6m DUE TO AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 2.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																

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# RECORD OF BOREHOLE No BH 18-16

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 817 381.8 E 266 336.1 ORIGINATED BY JM  
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.09.13 - 2018.09.14 LATITUDE 43.495368 LONGITUDE -79.975599 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
279.7	GROUND SURFACE																	
0.0	TOPSOIL: (100mm)																	
0.1	SAND and GARVEL, trace silt and clay Compact Brown Moist (FILL)		1	SS	23		279											59 31 10 (SI+CL)
			2	SS	40		278											
			3	SS	63		277											
			4	SS	100/ 0.225		276											
			5	SS	39		275											37 48 15 (SI+CL)
							274											
275.4	Clayey SILT, with sand, trace gravel Very Stiff Brown Moist		6	SS	22		273											7 35 37 21
							272											
273.6	SAND and SILT, some gravel, occasional cobbles Very Dense Brown Moist		7	SS	55													
6.1																		
			8	SS	53													
271.4	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.4m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																	
8.2																		

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20  
15 10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BH 18-17

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 817 114.6 E 265 558.3 ORIGINATED BY JM  
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.09.13 - 2018.09.14 LATITUDE 43.492921 LONGITUDE -79.985195 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
289.5	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (225mm)							20	40	60	80	100							
0.2	<b>SAND</b> and <b>GRAVEL</b> , trace silt Dense Brown Moist (FILL)  <b>SAND</b> and <b>GRAVEL</b> , some silt and clay, occasional cobbles Compact to Very Dense Brown Moist		1	SS	38		289												52 39 9 (SI+CL)
288.7																			
0.8			2	SS	25		288												
			3	SS	46														
			4	SS	48		287												39 40 21 (SI+CL)
			5	SS	114/ 0.300		286												
			6	SS	100/ 0.300		285												
							284												
283.4																			
6.1	END OF BOREHOLE AT 6.1m DUE TO AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 5.2m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																		

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BH 18-18

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 784 506.2 E 299 252.0 ORIGINATED BY BL  
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.10.04 - 2018.10.04 LATITUDE 43.200395 LONGITUDE -79.568270 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
89.5	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)							20 40 60 80 100					
0.2	SAND and GRAVEL, some silt Dense Grey Moist (FILL)		1	SS	48		89						
88.0							88						
1.4	Clayey SILT, some sand, trace gravel Dense Reddish Brown Moist (TILL) (CL)		2	SS	39								3 15 53 29
87.3													
2.2	SILT, some sand, trace gravel, trace clay Very Dense Reddish Brown Moist (TILL)		3	SS	100/ 0.150		87						
			4	SS	100/ 0.250		86						
			5	SS	100/ 0.150		85						
							84						
83.8													
5.6	Silty CLAY, trace sand, trace gravel Hard Reddish Brown Moist (TILL)		6	SS	100/ 0.100		83						0 1 66 33
							82						
81.8			7	SS	100/ 0.100								
7.7	END OF BOREHOLE AT 7.7m. WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BH 18-19

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 784 634.5 E 298 827.0 ORIGINATED BY AF  
 DIST                      HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.10.03 - 2018.10.03 LATITUDE 43.201547 LONGITUDE -79.573501 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
89.7	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	Silty SAND, some gravel, trace clay Compact Brown Moist (FILL)		1	SS	26		89									
88.3	Silty CLAY, trace sand Hard Reddish Brown Moist to Wet (TILL)		2	SS	48		88								0 3 68 29	
1.4			3	SS	75/ 0.250		87									
			4	SS	98/ 0.225		86								0 2 62 36	
			5	SS	50/ 0.100		85									
			6	SS	75/ 0.075		84									
	pieces of shale		7	SS	50/ 0.100		83									
81.9	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.						82									
7.7																

ONTMT452 MTO-22436.GPJ 2017TEMPLATE(MTO).GDT 1/9/19



# RECORD OF BOREHOLE No BH 18-20

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 783 936.2 E 300 978.8 ORIGINATED BY AF  
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.10.03 - 2018.10.03 LATITUDE 43.195274 LONGITUDE -79.547018 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
87.1	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (150mm)						87										
0.2	SAND and GRAVEL (FILL)																
86.5																	
0.6	Silty CLAY, some sand, trace gravel Stiff to Hard Reddish Brown Moist (CL)		1	SS	8		86										
			2	SS	15		85										0 28 42 30
			3	SS	26		84										0 23 42 35
			4	SS	35		83										
			5	SS	28		82										
			6	SS	24		81										
			7	SS	31		80										4 24 38 34
78.9							79										
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

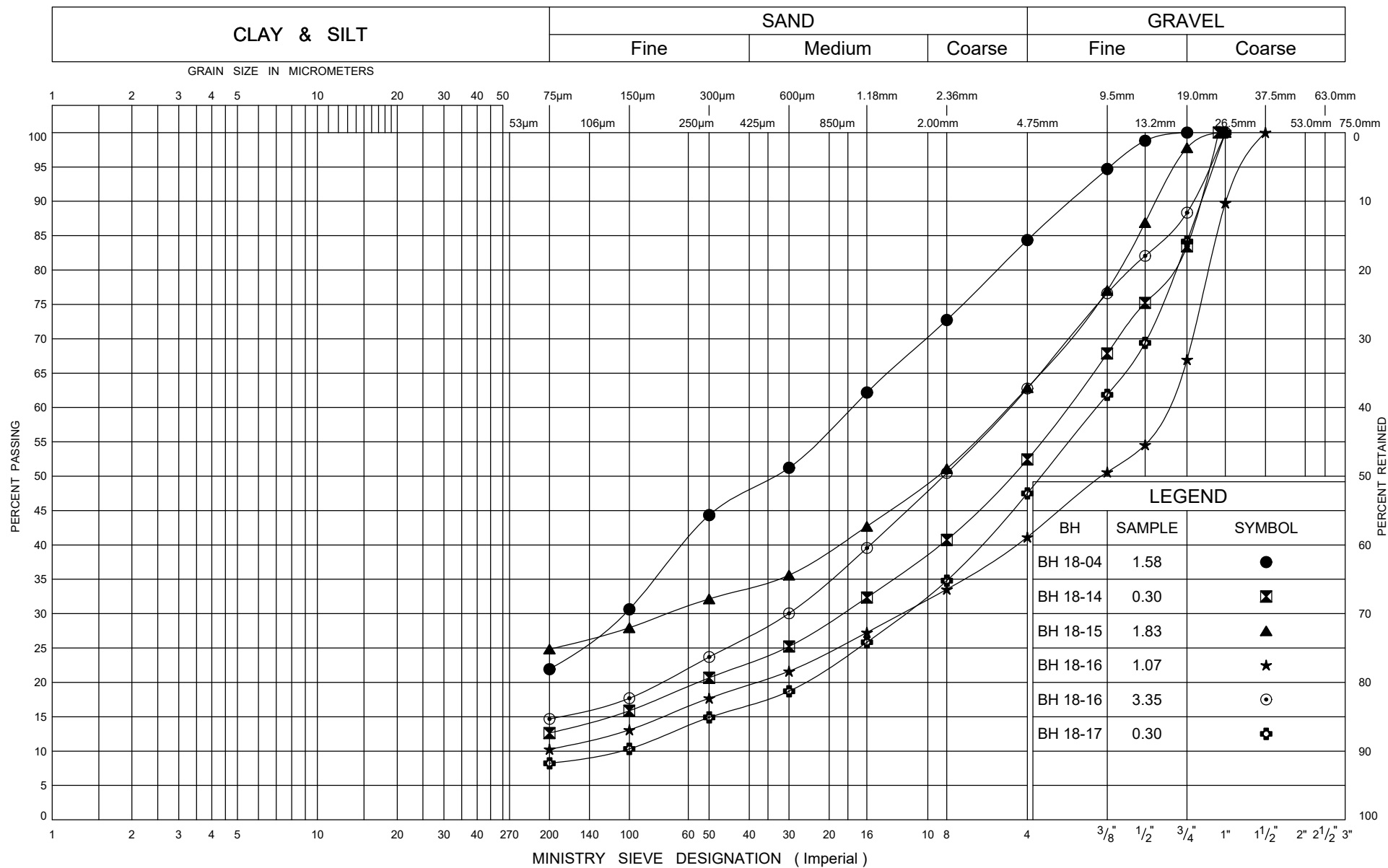




## **Appendix B**

### **Laboratory Test Results**





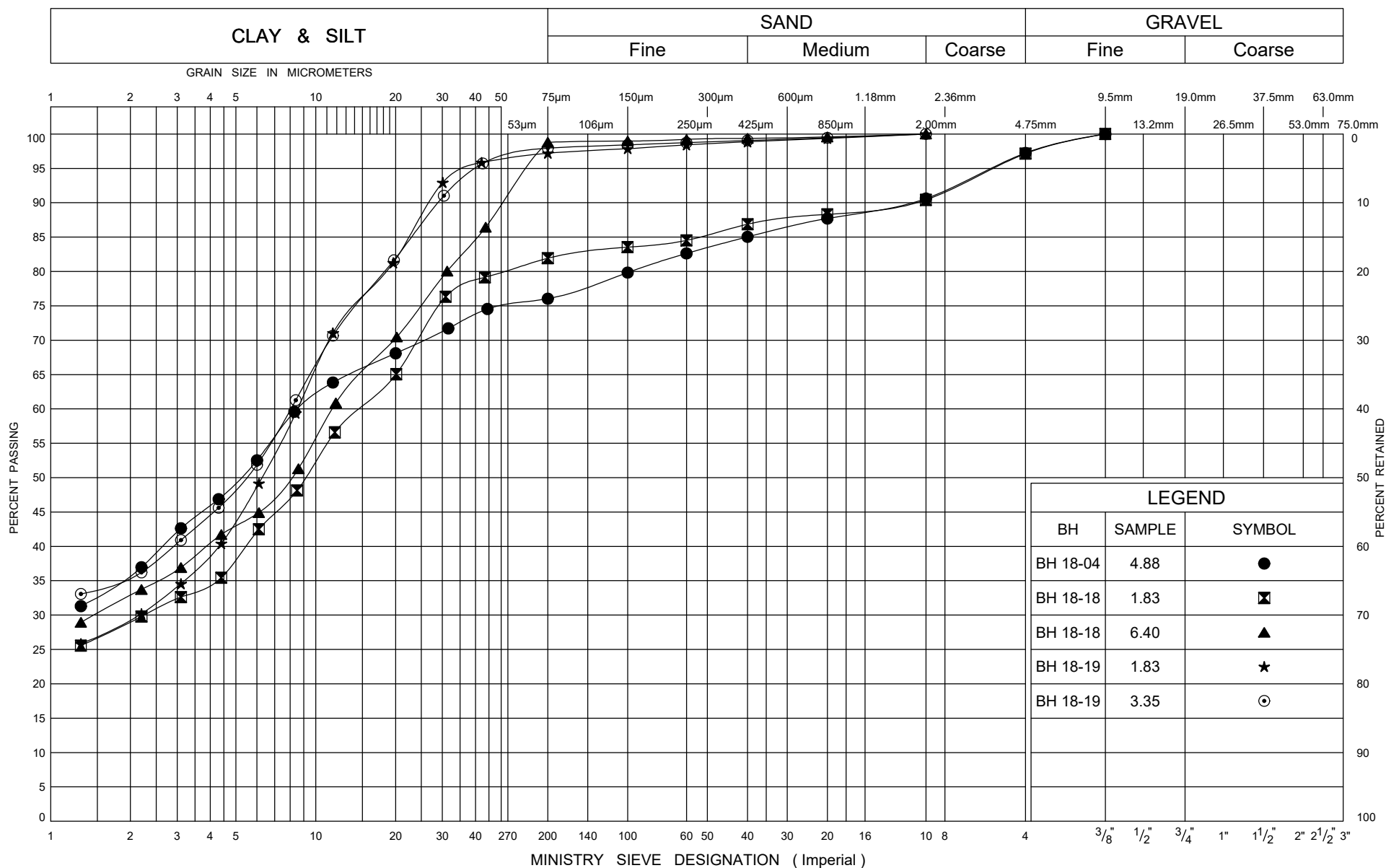
Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION SAND to SAND and GRAVEL FILL

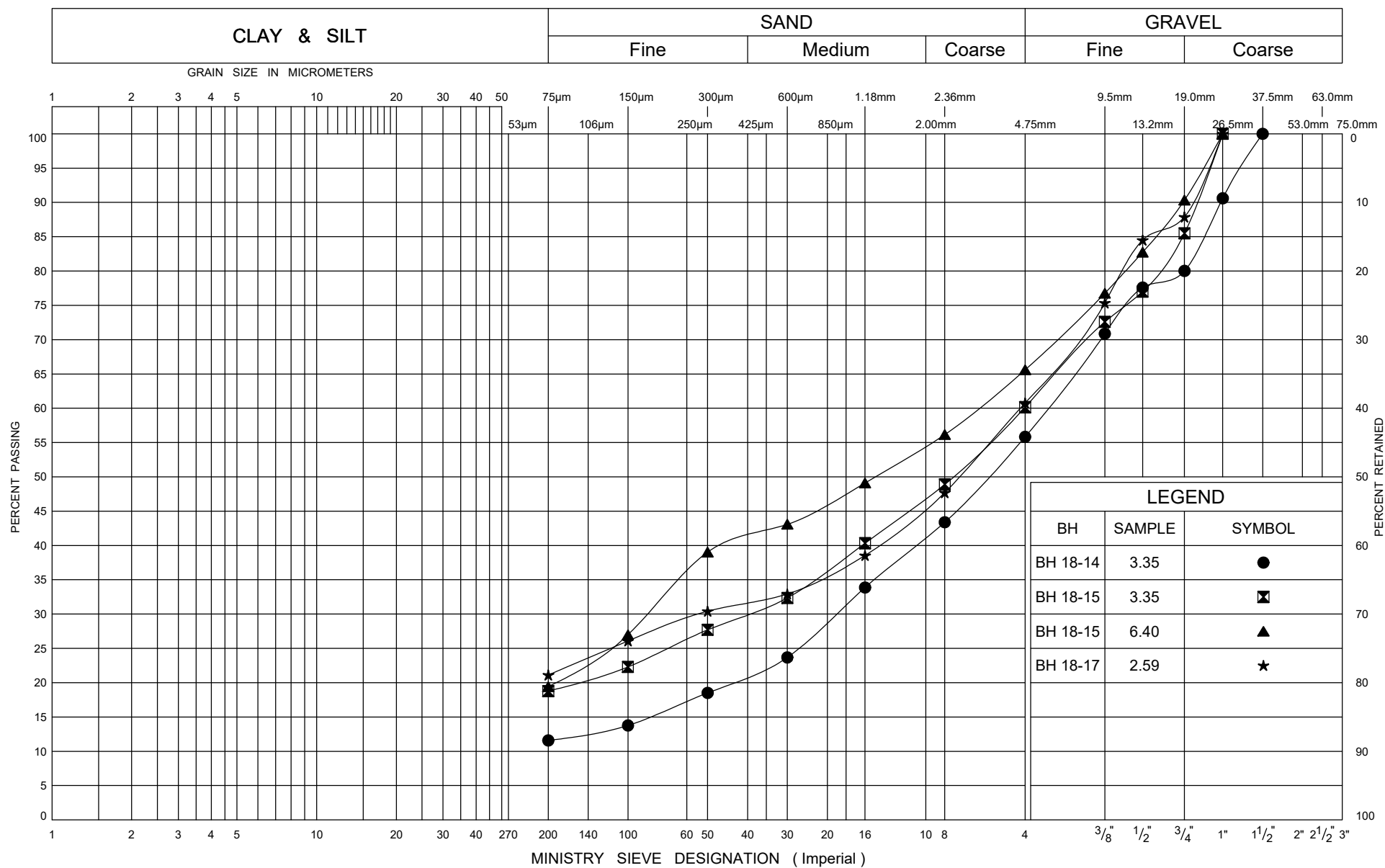
FIG No B1

W P Contract 2018-2002









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Transportation

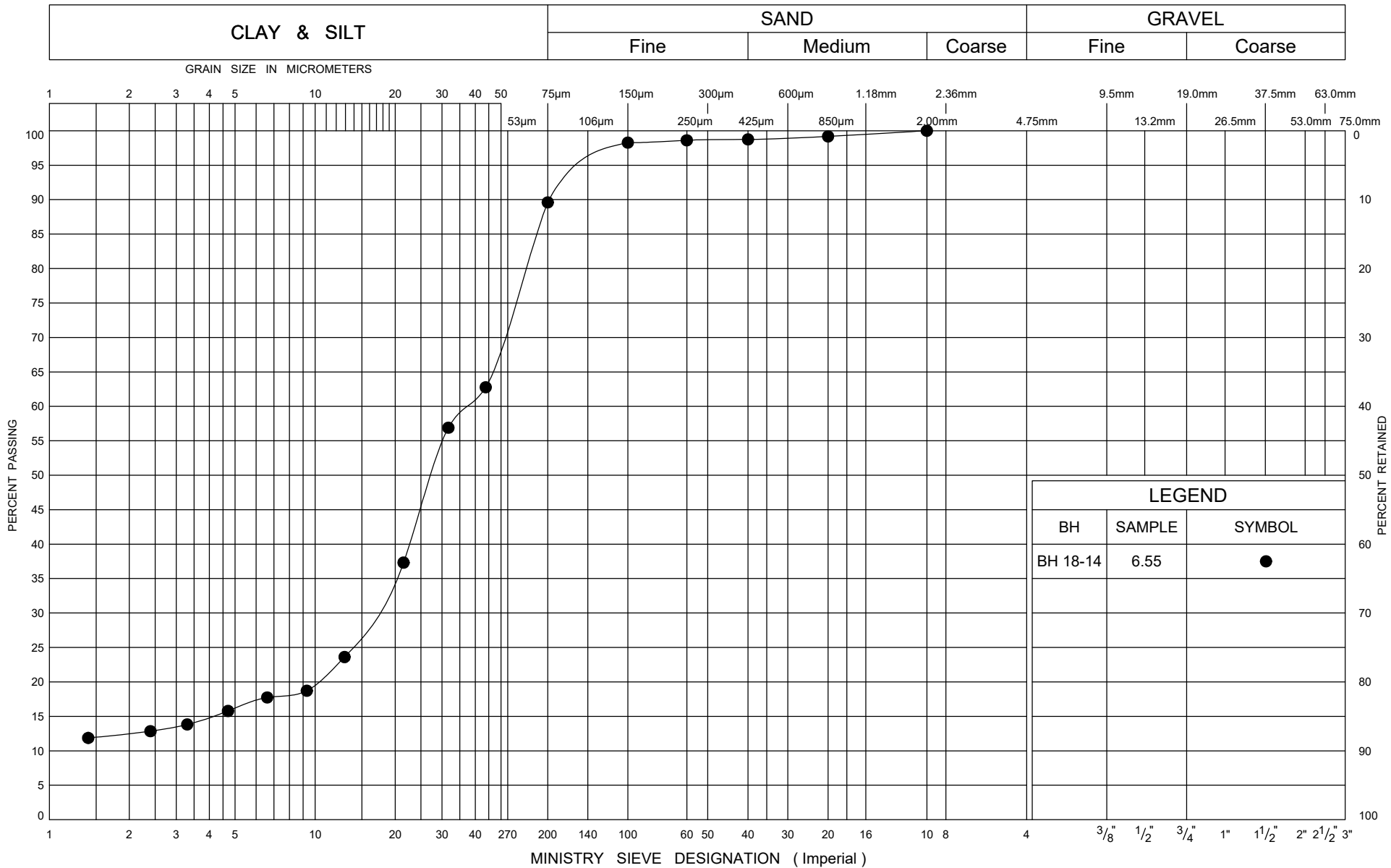
## GRAIN SIZE DISTRIBUTION

### Sandy GRAVEL to Gravelly SAND

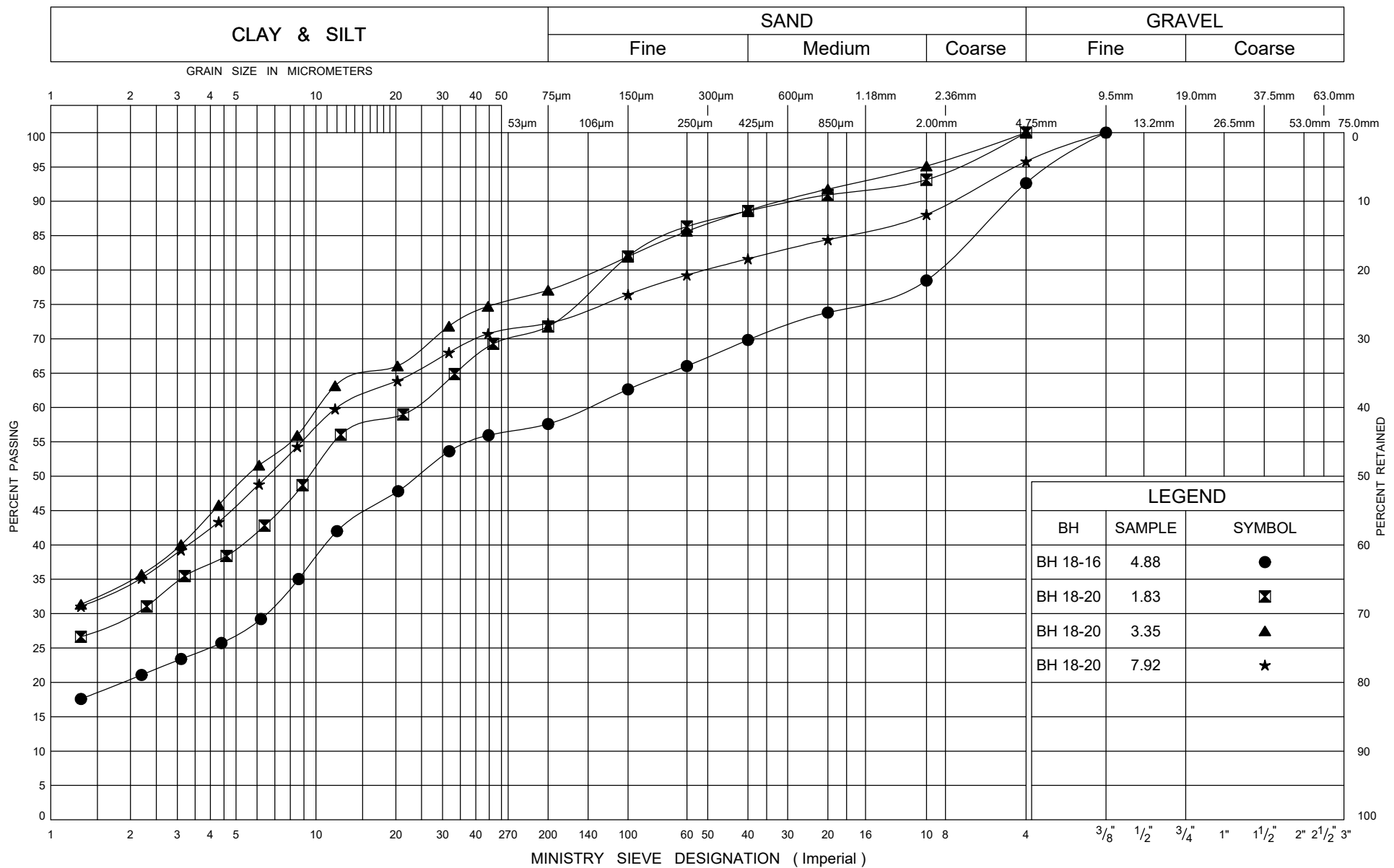
FIG No B3

W P Contract 2018-2002

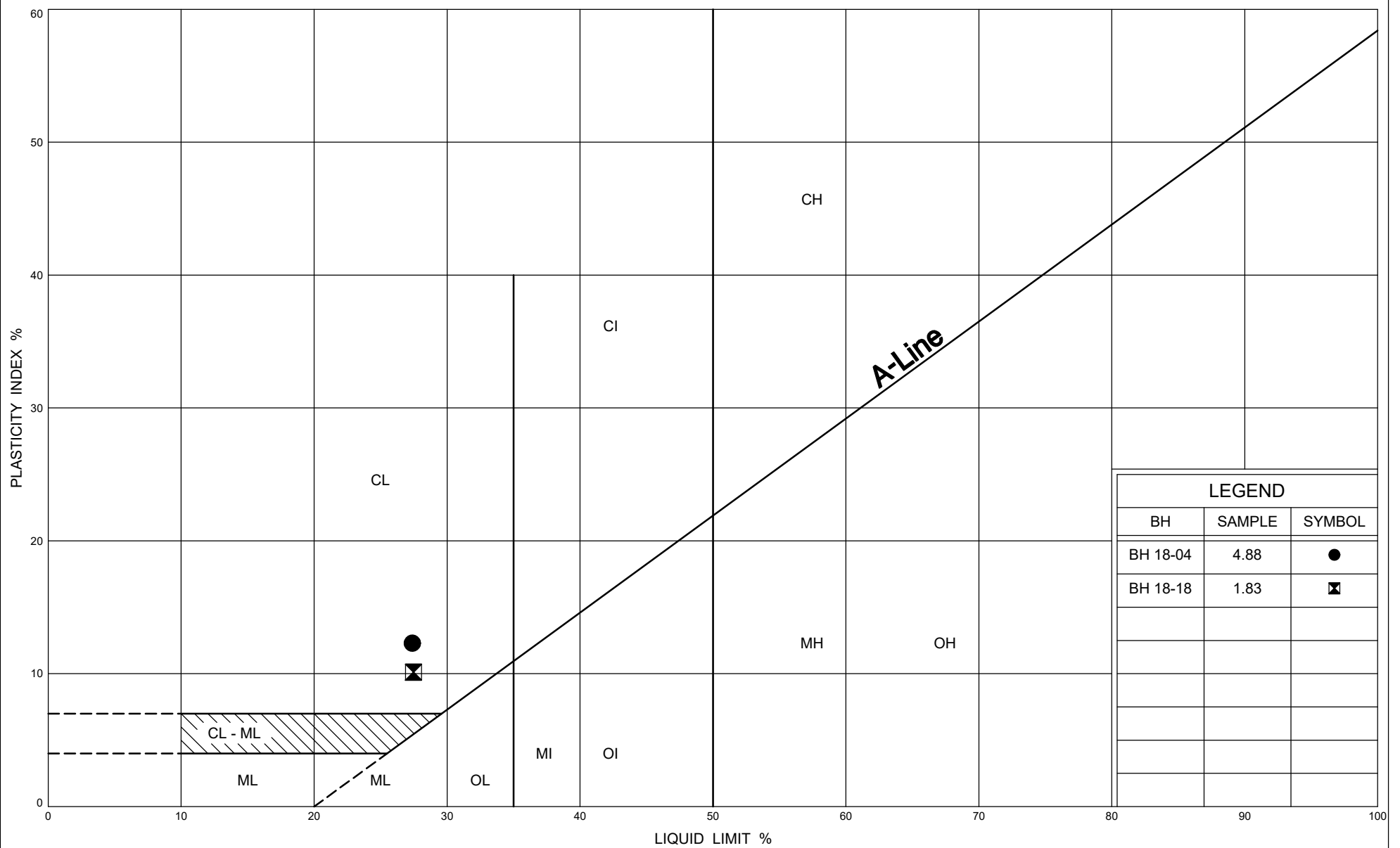




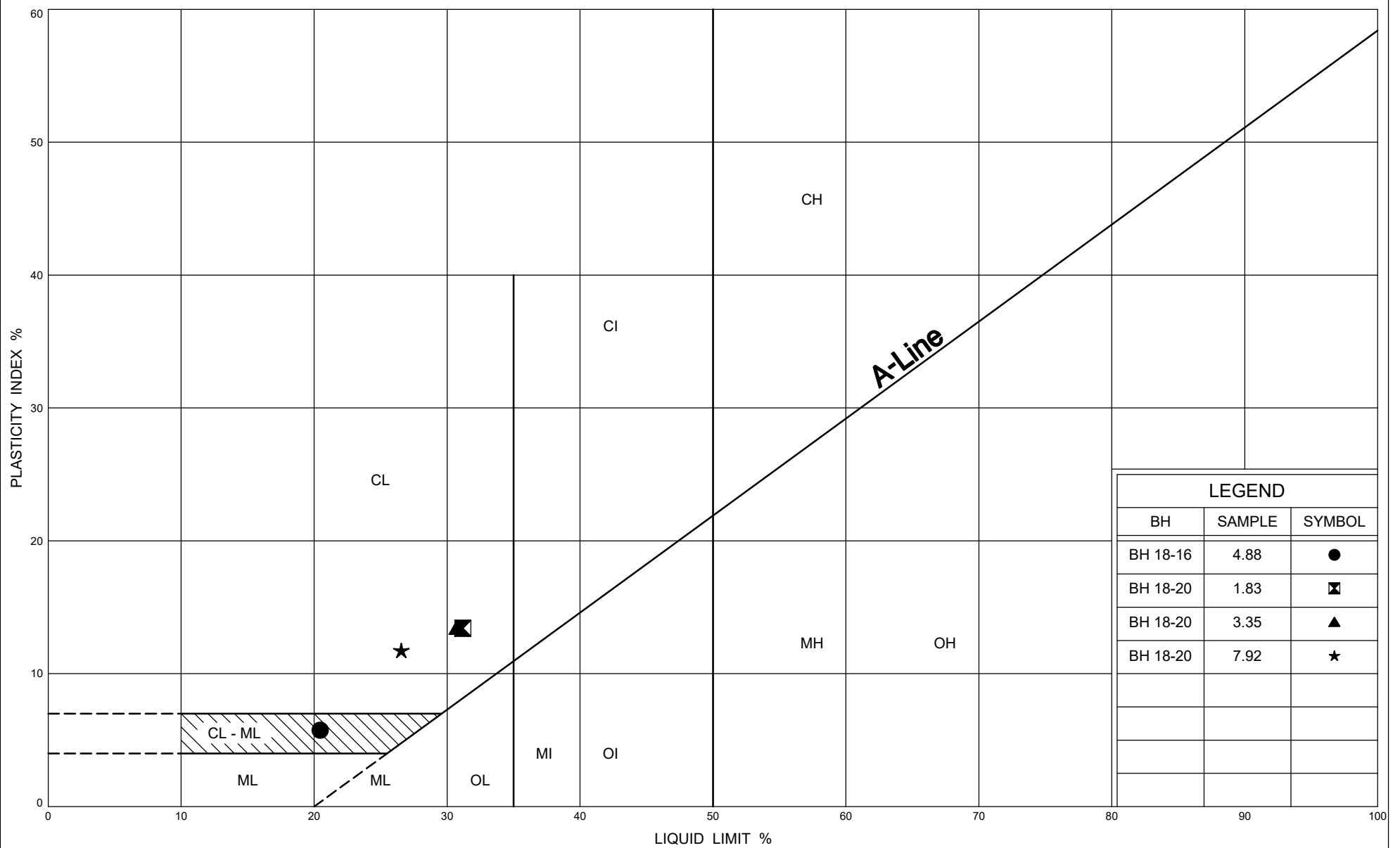












Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY to Clayey SILT

FIG No B7

W P Contract 2018-2002





## **Appendix C**

### **Borehole Locations and Soil Strata Drawing**



METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No



SHEET

Q.E.W.  
SIGN SUPPORT  
WEST OF FRUITLAND ROAD  
BOREHOLE LOCATIONS PLAN



KEYPLAN

LEGEND

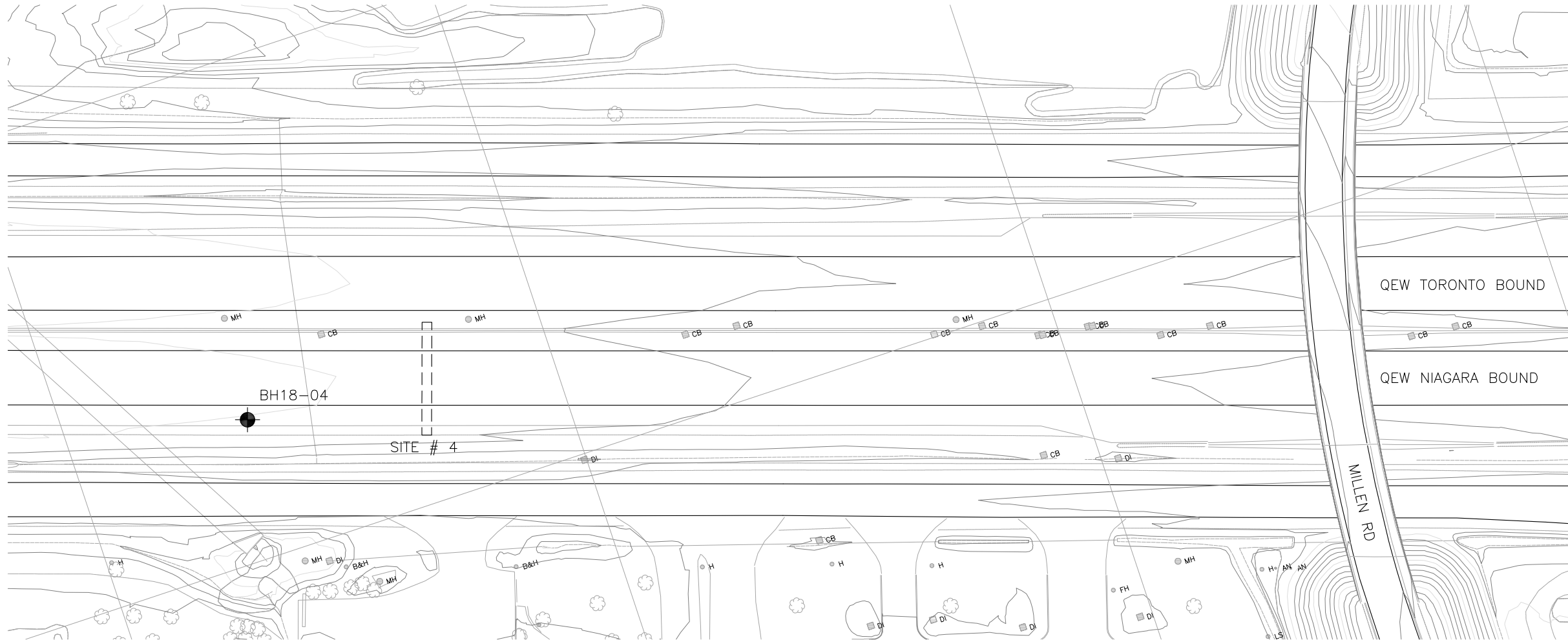
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH18-04	79.9	4 788 628.3	286 836.7

-NOTES-

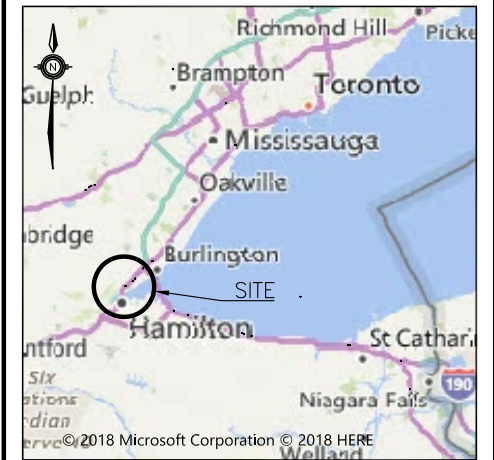
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M12-435








REVISIONS	DATE		BY		DESCRIPTION	
	DESIGN	CZ	CHK	PKC	CODE	LOAD
	DRAWN	MFA	CHK	CZ	SITE	STRUCT
						DWG 1





### LEGEND

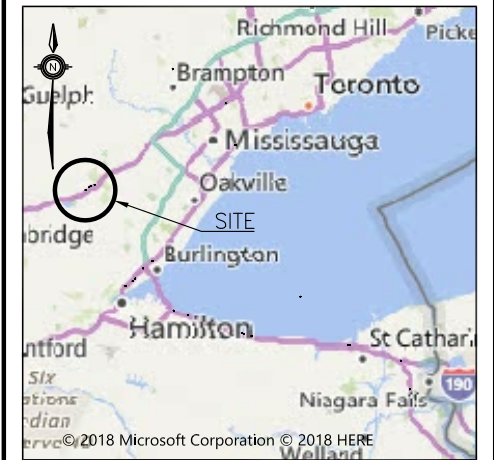
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]






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[illegible]





### LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

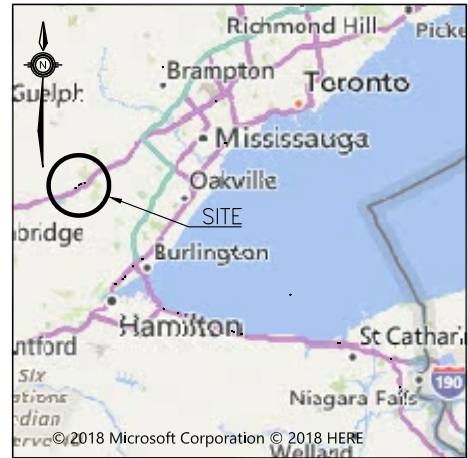
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[illegible]



METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No	
WP No	
HIGHWAY 401 SIGN SUPPORT WEST OF GUELPH LINE BOREHOLE LOCATIONS PLAN	
SHEET	



KEYPLAN

LEGEND

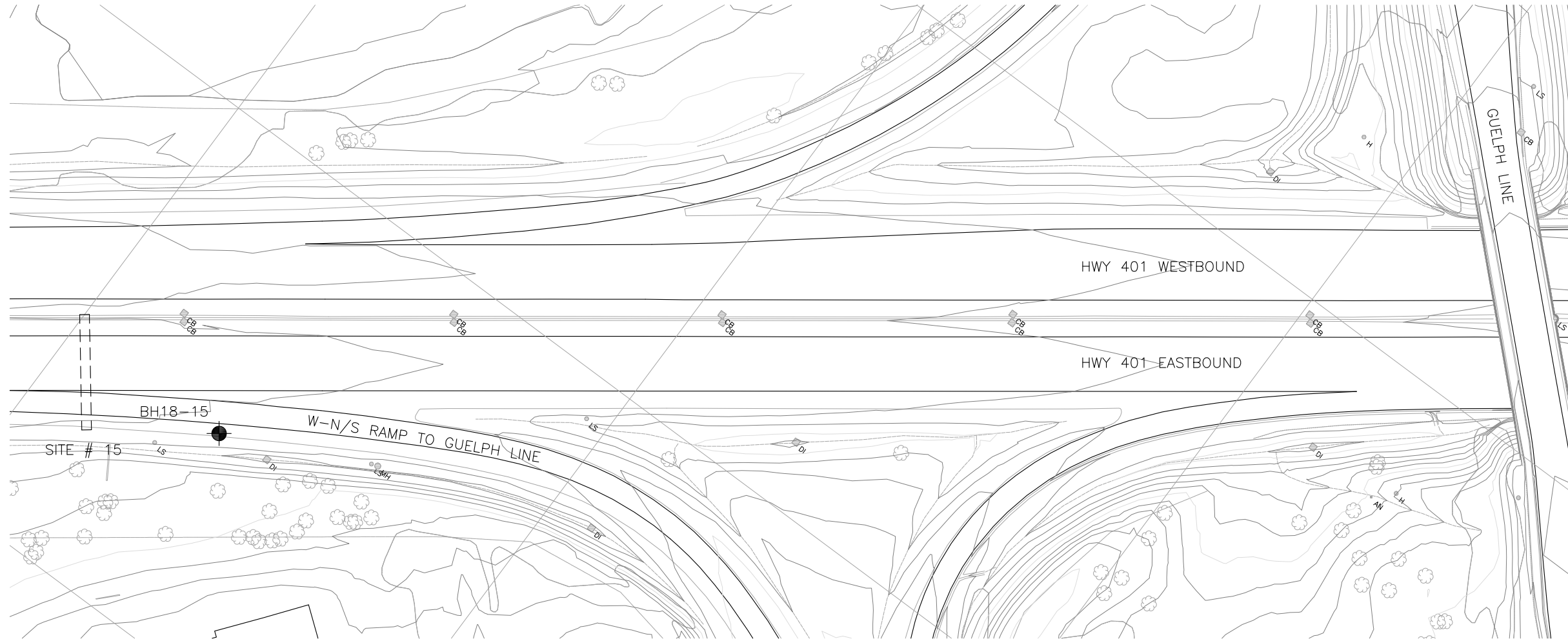
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	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH18-15	291.5	4 816 744.1	265 136.7

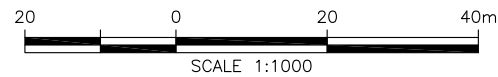
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GEOCRES No. 30M12-435



PLAN

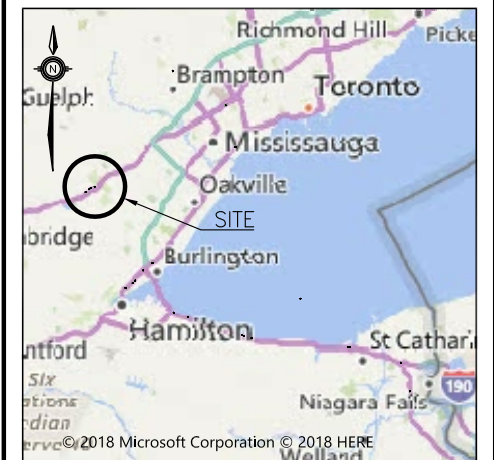


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CZ	CHK PKC	CODE
DRAWN	MFA	CHK CZ	SITE
			LOAD
			DATE
			JAN 2019
			STRUCT
			DWG 1










**THURBER** ENGINEERING LTD.



## KEYPLAN

L E G E N D

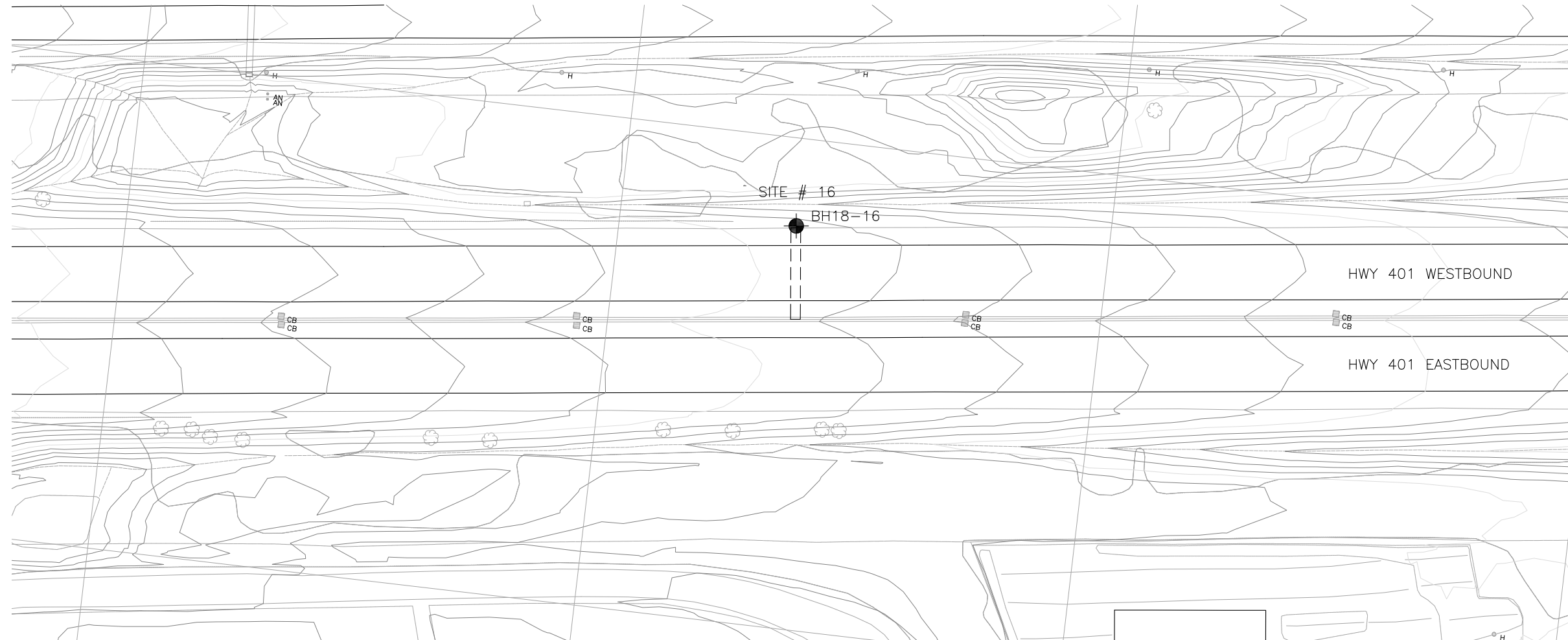
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	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
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[illegible]

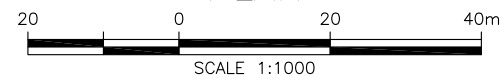
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**GEOCRES No. 30M12-435**



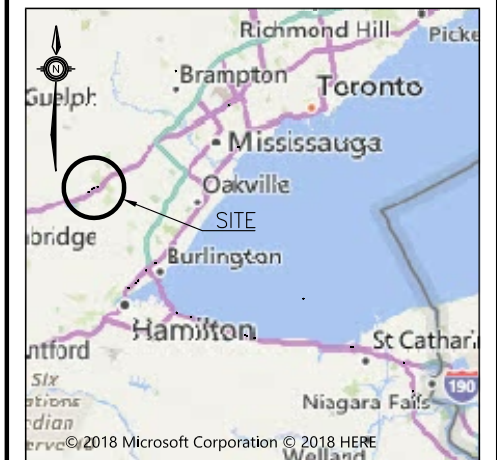
## PLAN

[illegible]










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## KEYPLAN

### LEGEND

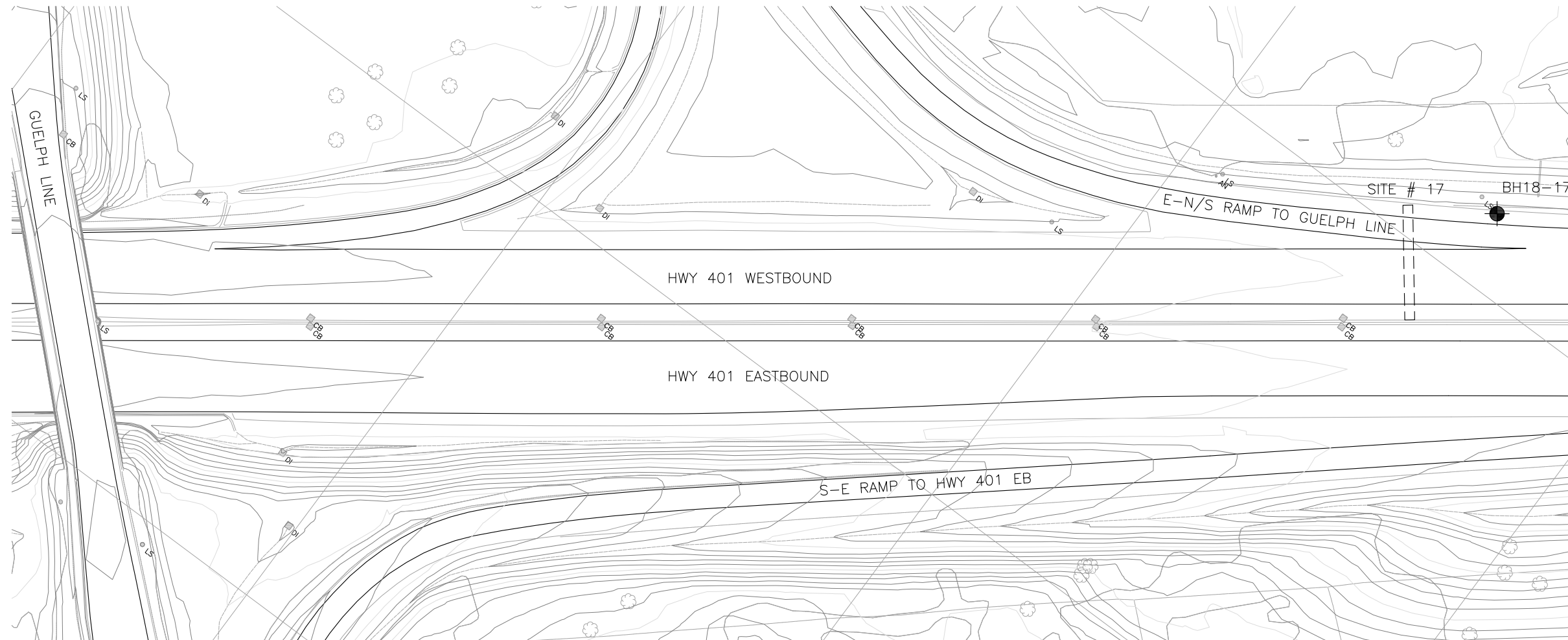
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	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
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[illegible]

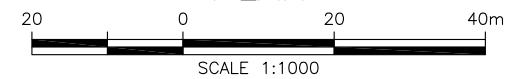
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**GEOCRES No.** 30M12-435



## PLAN








REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	CZ	CHK	PKC			LOAD		DATE	JAN 2019
DRAWN	MFA	CHK	CZ			SITE	STRUCT	DWG	1





## KEYPLAN

L E G E N D

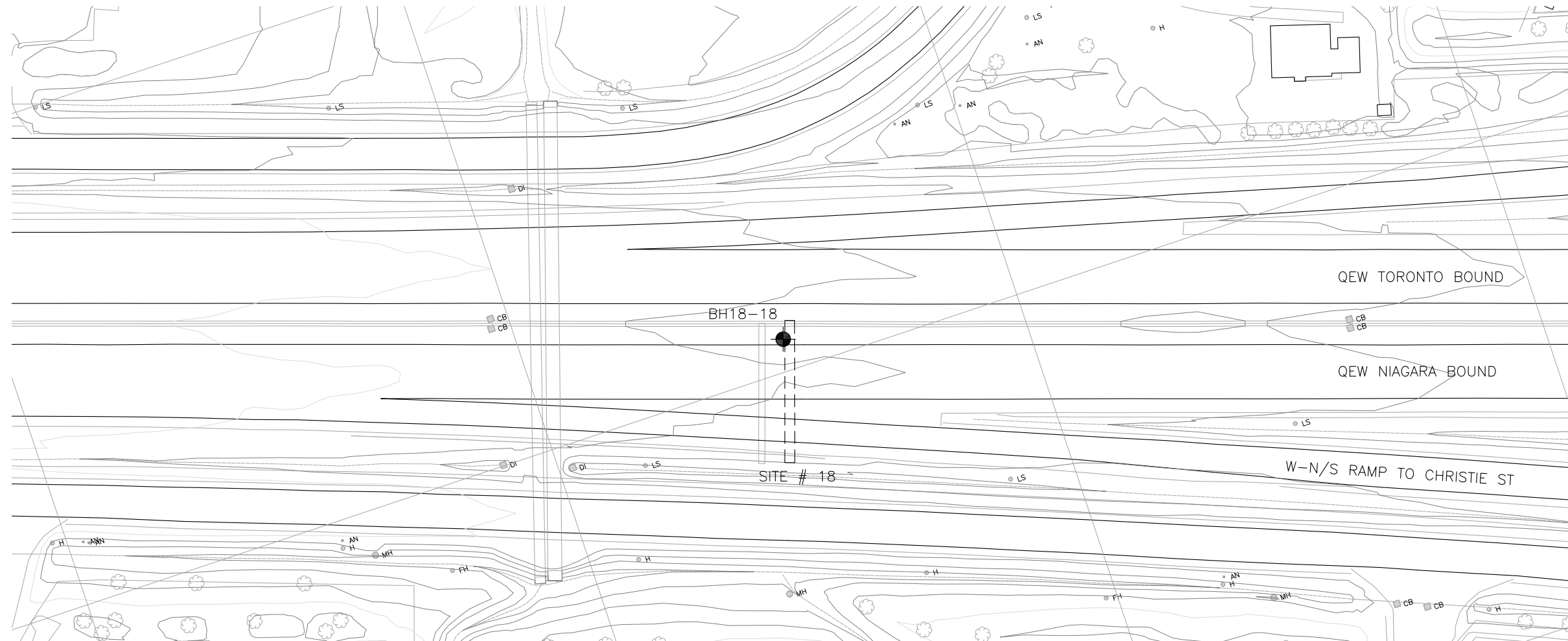
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	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
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	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

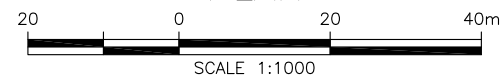
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**GEOCRES No. 30M12-435**



## PLAN

[illegible]










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## KEYPLAN

L E G E N D

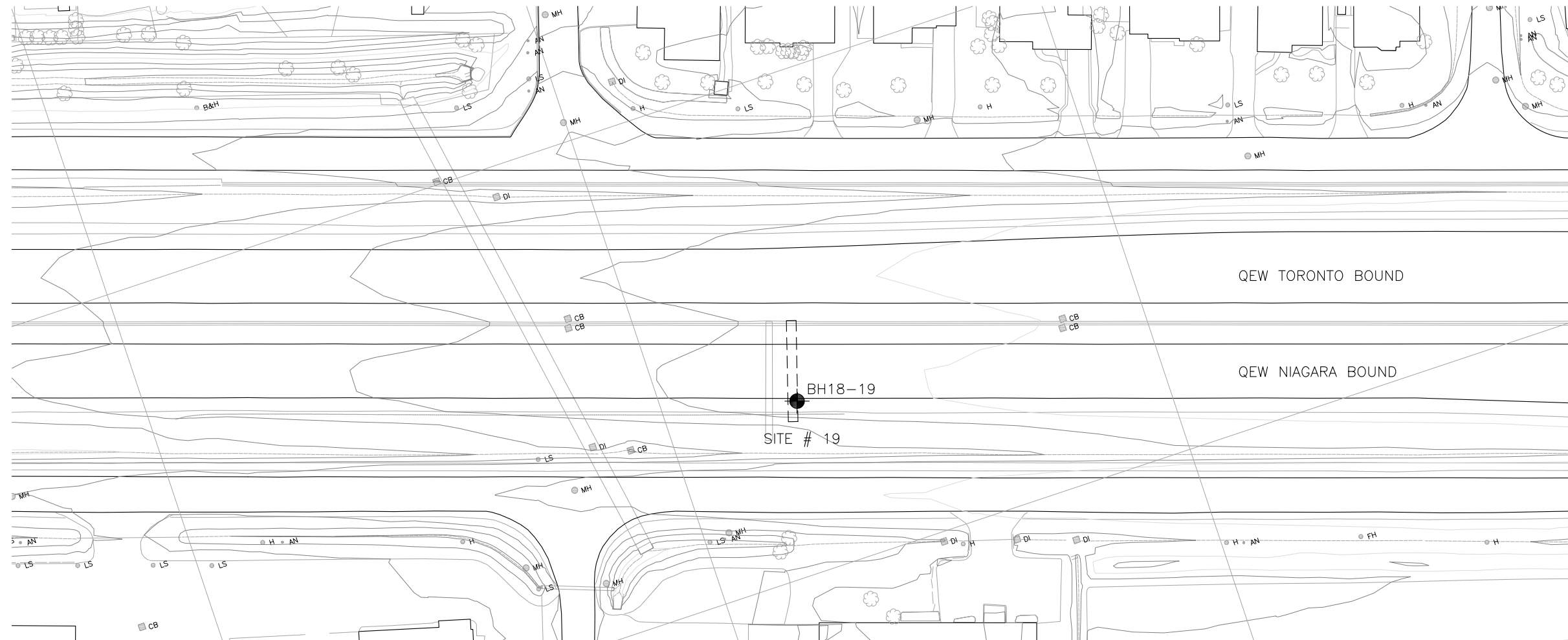
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[illegible]

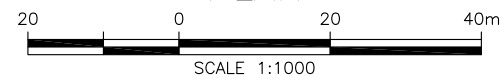
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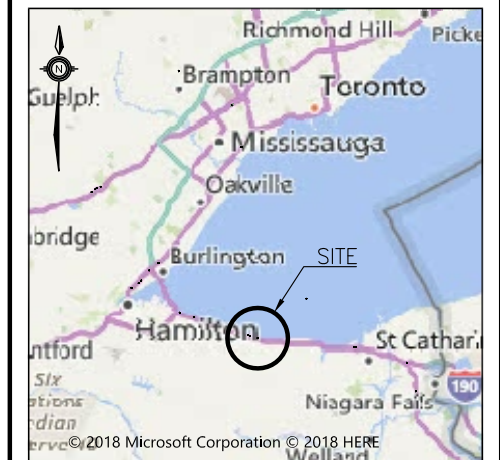
**GEOCRES No. 30M12-435**



## PLAN






[illegible]





## KEYPLAN

### LEGEND

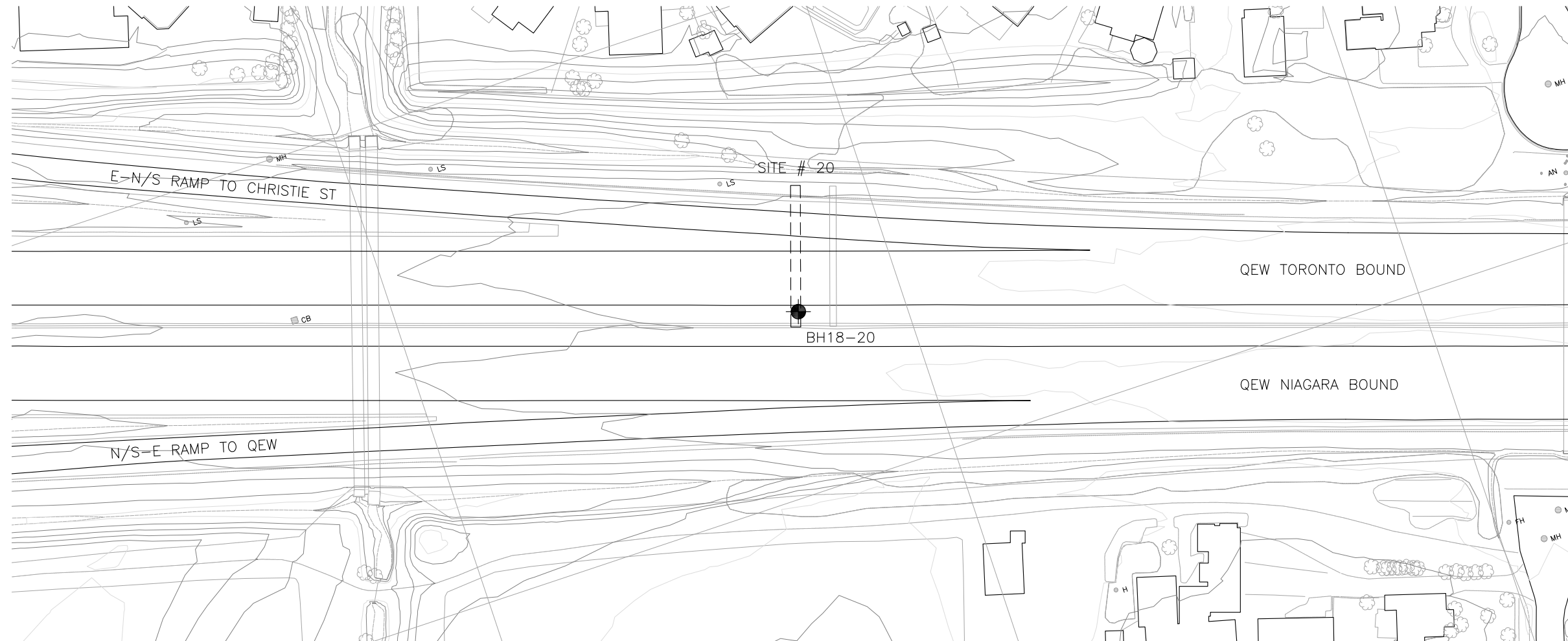
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	Borehole and Cone
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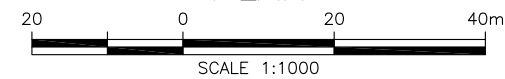
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**GEOCRES No. 30M12-435**



## PLAN



REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	CZ		CHK	PKC			LOAD	DATE	JAN 2019
DRAWN	MFA		CHK	CZ	CODE		STRUCT	DWG	1