



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGH FILL EMBANKMENTS AND DEEP CUTS  
REGIONAL ROAD 17 (EBYCREST ROAD) TO WOOLWICH GUELPH TOWNLINE  
NEW HIGHWAY 7, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**GEOCRES No. 40P09-067**

**Latitude 43.501340 °, Longitude -80.390876 °**

**Report**

**to**

**WSP**

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- Record of Borehole Sheets
- Results of Laboratory Test
- Borehole Locations and Soil Strata Drawing(s)
- Results of Slope Stability Analyses



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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This section of the report presents the factual findings obtained from a foundation investigation completed for proposed high fill embankments of 4.5 m or greater in height and deep cuts from just east of Regional Road 17 (Ebycrest Road) to just east of Woolwich Guelph Townline in the Kitchener-Waterloo area as part of the new Highway 7 project. Thurber Engineering Limited (Thurber) carried out the current field investigation as a sub-consultant to WSP under Assignment No. 3014-E-0013.

The purpose of this investigation was to explore and supplement the previous investigation at the site and based on the data obtained, to prepare a borehole location plan, records of boreholes, stratigraphic profiles, laboratory test results, and a written description of the subsurface conditions.

Reference has been made to the following foundation report that was prepared by Thurber during the first phase of the investigation:

- Preliminary Foundation Investigation and Design Report, High Fills and Deep Cuts, From East of Regional Road 17 to East of Townline Road, Highway 7 New, Kitchener to Guelph, G.W.P. 408-88-00, GEOCRES No. 40P8-171, Report to Ministry of Transportation Ontario Southwestern Region, File 15-64-17, dated September 1, 2009

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

**2 SITE DESCRIPTION**

The proposed new Highway 7 alignment is to the north of the existing Highway 7 alignment and traverses in an east-west direction. The length this section of new Highway 7 is about 5.1 km and is just east of Regional Road 17 (Ebycrest Road) to just west of Woolwich Guelph Townline.

The area surrounding this section of new Highway 7 primarily consists of agricultural and undeveloped lands.



In general, the ground surface along the proposed new Highway 7 alignment is rising gently from west to east.

### **3 SITE INVESTIGATIONS AND FIELD TESTING**

The foundation investigation was carried out in two phases: the first phase, consisting of 15 boreholes, was carried out between May 2008 and February 2009 while the second phase, consisting of 23 boreholes, was conducted between April 2017 and July 2018. The investigation was completed using track mounted drill rigs. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in accordance with ASTM D 1586. The boreholes were advanced to sampled depths ranging from 4.6 m to 21.4 m and 5.2 m to 25.0 m, respectively. Where encountered, 3 m of bedrock was cored.

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

Piezometers of various diameters (19 mm and 25 mm) and slotted screen lengths (1.5 m and 3.0 m) were installed in selected boreholes to allow for measurements of the groundwater level. The piezometer installations are shown on the respective Record of Borehole sheets, provided in Appendix A through Appendix I.

Following completion of the field investigation, all boreholes and standpipe piezometers were decommissioned in general accordance with O. Reg. 903 (as amended).

The locations of the investigated high fill and deep cut areas are shown on Drawings 1 through 3 following the text of the report, while the approximate borehole locations are shown on the respective Borehole Locations and Soil Strata Drawings included in Appendix A through Appendix I. The coordinates and elevation of the boreholes are provided on these drawings and on the individual Record of Borehole sheets included in Appendix A through Appendix I. The borehole elevations and coordinates were provided by WSP.

### **4 LABORATORY TESTING**

All recovered soil samples were subjected to further visual identification and to natural moisture content determination. Selected samples were also subjected to Atterberg Limit testing and grain size analysis. The results of these tests are summarized on the Record of Borehole sheets and shown on laboratory figures included in Appendix A through Appendix I.

### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and the Borehole Location and Soil Strata drawings included in Appendix A through Appendix I.



Summaries of the stratigraphy, based on the conditions encountered in the boreholes, is provided in the following section; however, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions.

The results of the in-situ tests (i.e., SPT) as presented in the record of borehole sheets are in the sections below are uncorrected. The boundaries between the soil deposits on the record of boreholes have been inferred from non-continuous sampling, and therefore, these boundaries represent transitions between soil types rather than exact planes of geological change. It must be recognized that the variation of stratigraphic boundaries will vary between and beyond borehole locations.

#### **5.1 Highway 7: Station 25+050 – 25+600 (08-120, 08-121, ML16 25+140, ML16 25+250, ML16 25+300, ML16 25+350, ML16 25+400, SP16-04, ML16 25+550) – Appendix A**

##### **5.1.1 Topsoil**

Topsoil ranging in thickness from 50 mm to 500 mm was encountered at ground surface in all the boreholes at this location.

##### **5.1.2 Sand to Silty Sand**

A native deposit of sand to silty sand was encountered directly below the topsoil in Boreholes 08-120, ML16 25+300 and ML16 25+550 and below the silty clay layer in Borehole ML16 25+250. The sand was 1.0 m to 2.9 m thick with an underside depth of 1.4 m to 3.4 m (Elevation 328.0 m to 322.1 m) in Boreholes 08-120, ML16 25+300 and ML16 25+550. Borehole ML16 25+250 was terminated within the sand deposit at a depth of 11.3 m below the ground surface (Elevation 318.0 m).

SPT N-Values in the sand to silty sand ranged from 4 blows to greater than 50 blows indicating a loose to very dense relative density. The higher N-values may be due to the presence of cobbles.

Recorded moisture contents ranged from 4 percent to 18 percent. The gradation analyses completed on three samples of the sand to silty sand are illustrated on Figure A1 and A2 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%) Silty Sand	Percentage (%) Sand
Gravel	11	0
Sand	55	81 to 92
Silt	31	8 to 19
Clay	3	



### 5.1.3 Silt to Sandy Silt

Sandy silt was encountered below the topsoil in Boreholes ML16 25+140, ML16 25+350, ML16 25+400, SP16-04 and 08-121. The sandy silt had a thickness of 0.6 m to 7.0 m with an underside depth of 0.7 m to 7.0 m (Elevation 328.5 m to 324.9 m) in Boreholes ML16 25+140, ML16 25+350, ML16 25+400, SP16-04 and 08-121.

A lower silt layer was also encountered below the silty clay in Borehole ML16 25+400. Borehole ML16 25+400 was terminated within the lower silt deposit at a depth of 9.8 m below the ground surface (Elevation 317.5 m).

SPT N-Values in the silt to sandy silt ranged from 4 blows to 39 blows indicating a loose to dense relative density.

Recorded moisture contents ranged from 7 percent to 26 percent. The gradation analyses completed on selected samples of the silt to sandy silt are illustrated on Figure A3 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	3 to 41
Silt	45 to 90
Clay	4 to 18

### 5.1.4 Silty Clay

A deposit of silty clay was encountered below the sand or silt layers in Boreholes ML16 25+300, ML16 25+350, ML16 25+400 to, ML16 25+550, and SP16-04, and below the silty sand to sandy silt till in Borehole ML16 25+250. The silty clay varied in thickness from 1.5 m to 7.5 m with an underside depth of 5.6 m to 9.1 m (Elevation 321.9 m to 318.2 m).

SPT N-Values in the silty clay ranged from 6 blows to greater than 50 blows indicating a firm to hard consistency.

The recorded moisture contents ranged from 9 percent to 28 percent. Atterberg limits testing was completed on selected samples of the silty clay deposit. The results are summarized on the Record of Borehole sheets in Appendix A and illustrated on Figure A4 in Appendix A. The laboratory results indicate the deposit is a silty clay of low to intermediate plasticity (CL to CI).

Parameter	Value
Liquid Limit	30 to 49
Plastic Limit	14 to 19
Plasticity Index	17 to 29

The gradation analyses completed on selected samples of the silty clay are illustrated on Figure A5 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	0
Sand	0 to 14
Silt	36 to 46
Clay	44 to 64

#### 5.1.5 Silty Clay Till

Silty clay till was encountered below the sand or silt layers in Boreholes 08-120 and ML 16 25+140. The silty clay till varied in thickness from 1.7 m to 3.3 m with an underside depth of 6.3 m to 8.7 m (Elevation 324.7 m to 323.2 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty clay till ranged from 18 blows to 38 blows indicating a very stiff to hard consistency.

The recorded moisture contents ranged from 14 percent to 18 percent. Atterberg limits testing was completed on two samples of the silty clay till deposit. The results are summarized on the Record of Borehole sheets in Appendix A and illustrated on Figure A6 in Appendix A. The laboratory results indicate the till is a silty clay of low plasticity (CL).

Parameter	Value
Liquid Limit	23 to 28
Plastic Limit	12 to 15
Plasticity Index	11 to 15

The gradation analyses completed on two samples of the silty clay till are illustrated on Figure A7 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	18 to 20
Silt	50 to 53
Clay	26 to 29

#### 5.1.6 Silty Sand to Sandy Silt Till

A deposit of silty sand to sandy silt till was encountered in all the boreholes at this location except for Borehole ML16 25+400. The silty sand to sandy silt till was encountered below the silty clay till in 08-120 and ML16 25+140, the sandy silt in 08-121, the topsoil in ML16 25+250, the silty clay in ML16 25+300, ML 25+350, ML16 25+550, and SP16-04. The sandy silt till had a thickness of 6.8 m with an underside depth of 7.2 m (Elevation 322.1 m) in Borehole ML16 25+250. Boreholes 08-120, 08-121, ML16 25+140, ML16 25+300, ML16 25+350, SP16-04, ML16 25+550 were terminated within the sandy silt to silty sand till deposit at a depth of 8.1 m to 18.9 m below the ground surface (Elevation 308.1 m to 321.9 m).

It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty sand to sandy silt till ranged from 10 blows to greater than 50 blows indicating a compact to very dense relative density.

Recorded moisture contents in the silty sand to sandy silt till deposit ranged from 4 percent to 28 percent. The gradation analyses completed on selected samples of the silty sand to sandy silt till are illustrated on Figures A8 and A9 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	0 to 8
Sand	23 to 68
Silt	30 to 73
Clay	2 to 16

#### 5.1.7 Groundwater Conditions

Piezometers were installed in Boreholes 08-120, ML16 25+250, and SP16-04 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.



Borehole	Date	Depth (m)	Elevation (m)
08-120	February 19, 2009	2.9	328.1
ML16 25+250	April 30, 2018	5.6	323.7
SP16-04	June 13, 2017	5.4	321.6
	April 30, 2018	5.0	322.0

It should be noted that seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

## 5.2 Highway 7: Station 26+450 – 26+950 (08-134, 08-135, 08-136, 08-138, ML16 26+525, ML16 26+625, ML16 26+800, ML16 26+850, ML16 26+900) – Appendix B

### 5.2.1 Topsoil

Topsoil ranging in thickness from 75 mm to 900 mm was encountered at ground surface in Boreholes ML16 26+525, ML16 26+625, ML16 26+800, ML16 26+850, and ML16 26+900. Recorded moisture contents ranged from 17 percent to 31 percent.

### 5.2.2 Fill

Fill was encountered at ground surface in Borehole 08-138. The fill consisted of sand and gravel and sandy silt. The fill has a thickness of 1.4 m with an underside depth of 1.4 m (Elevation 331.0 m).

A SPT N-Value recorded in the sandy silt fill was 10 blows indicating a compact relative density.

Recorded moisture contents of the sand and gravel and sandy silt was 3 percent and 20 percent, respectively. The gradation analysis completed on the sample of the sand and gravel fill is illustrated on Figure B1 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	37
Sand	50
Silt	13
Clay	

### 5.2.3 Sand and Gravel to Gravelly Sand

Sand and gravel, some silt to gravelly sand was encountered below the topsoil in Boreholes ML16 26+850 and ML16 26+900. Cobbles were observed within the fill in Borehole



ML16 26+900. The sand fill varied in thickness from 2.5 m to 4.9 m with an underside depth of 3.0 m to 5.5 m (Elevation 327.5 m to 326.1 m).

SPT N-Values recorded in the granular layer ranged from 25 blows to greater than 100 blows indicating a compact to very dense relative density.

Recorded moisture contents ranged from 2 percent to 5 percent. The gradation analyses completed on two samples of the sand and gravel to gravelly sand are illustrated on Figure B2 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	37 to 38
Sand	42 to 50
Silt	13 to 20
Clay	

#### 5.2.4 Sand

A deposit of sand was encountered at ground surface in Boreholes 08-134, 08-135 and 08-136 and below the topsoil in Borehole ML16 26+800. The sand deposit ranged from 0.6 m to 1.7 m thick with an underside depth ranging from 0.6 m to 2.6 m (Elevation 330.2 m to 326.5 m). Occasional cobbles were noted in this deposit in Borehole 08-135. Trace to occasional rootlets were also noted.

SPT N-Values in the sand to sand and silt ranged from 2 blows to 42 blows indicating very loose to dense relative density.

Recorded moisture contents ranged from 10 percent to 19 percent. The gradation analyses completed on one sample of the sand is illustrated on Figure B3 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	17
Sand	71
Silt	10
Clay	2

### 5.2.5 Silty Clay Till

Silty clay till was encountered below the fill in Borehole ML16 26+850, below the sand in Boreholes 08-134 and ML16 26+800, and below or within the silty sand to sandy silt till in Boreholes ML16 26+525, 08-136 and ML16 26+625. The silty clay till had a thickness of 1.4 m to 4.7 m with an underside depth of 5.5 m to 10.2 m (Elevation 324.8 m to 322.4 m) in Boreholes 08-134, ML16 26+525, ML16 26+625, ML16 26+800, and ML16 26+850. Borehole 08-136 was terminated within the till deposit at a depth of 8.1 m below the ground surface (Elevation 322.5 m).

It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty clay till ranged from 25 blows to greater than 100 blows indicating a very stiff to hard consistency.

The recorded moisture contents ranged from 2 percent to 19 percent. Atterberg limit testing was completed on selected samples of the silty clay till deposit. The results are summarized on the Record of Borehole sheets in Appendix B and illustrated on Figure B4 in Appendix B. The laboratory results typically indicate the till is a silty clay of low plasticity (CL).

Parameter	Value
Liquid Limit	17 to 30
Plastic Limit	10 to 15
Plasticity Index	7 to 15

The gradation analyses completed on selected samples of the silty clay till are illustrated on Figure B5 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	0 to 9
Sand	7 to 39
Silt	35 to 60
Clay	21 to 38

### 5.2.6 Sand and Gravel

A 3.2 m thick layer of sand and gravel was encountered below the silty clay till in Borehole ML16 26+525 at a depth of 7.0 m below the ground surface (Elevation 323.2 m).

SPT N-Values in the sand and gravel ranged from 46 blows per 0.3 m penetration to 48 blows per 0.075 mm penetration indicating a dense to very dense relative density.



Recorded moisture contents were 9 percent. The gradation analysis completed on one sample of the sand and gravel is illustrated on Figure B6 of Appendix B. The results of the test are summarized below and are presented on the corresponding Record of Borehole sheet in Appendix B.

Soil Particle	Percentage (%)
Gravel	37
Sand	50
Silt	13
Clay	

#### 5.2.7 Silty Sand to Sandy Silt Till

Silty sand to sandy silt till was encountered in all boreholes at this location. The silty sand to sandy silt till had a thickness of 6.4 m with an underside depth of 7.0 m (Elevation 323.5 m) in Borehole 08-136. Boreholes 08-134, ML16 26+525, 08-135, ML16 26+625, 08-138, ML16 26+800, ML16 26+850, and ML16 26+900 were terminated within the till deposit at a depth ranging from 8.0 m to 15.6 m below the ground surface (Elevation 323.6 m to 317.3 m).

Layers of clayey silt and silty clay were encountered within the sandy silt till in Boreholes 08-134 to 08-138 at depths ranging from 6.5 m to 9.0 m (Elevation 326.0 m to 318.5 m). A silt layer was also encountered within the sandy silt till in Borehole 08-136 at a depth of 4.8 m (Elevation 325.7 m). Occasional cobbles were also noted in this deposit. It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty sand to sandy silt till ranged from 7 blows to greater than 100 blows indicating a loose to very dense relative density.

The recorded moisture contents ranged from 3 percent to 19 percent. Atterberg limit testing was completed on five samples of the clayey silt to silty clay layers within the sandy silt till. The results are summarized on the Record of Borehole sheets in Appendix B and illustrated on Figure B7 in Appendix B. The laboratory results indicate the layers within sandy silt till are silty clay of low plasticity (CL-ML).

Parameter	Value
Liquid Limit	17 to 21
Plastic Limit	11 to 11
Plasticity Index	6 to 10

The gradation analyses completed on selected samples of the silty sand to sandy silt till and one sample of the silt layer within the till deposit are illustrated on Figures B8 through B10 of Appendix



B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%) Silty Sand to Sandy Silt Till	Percentage (%) Silt Layer
Gravel	0 to 7	5
Sand	20 to 64	8
Silt	29 to 62	79
Clay	5 to 22	8

### 5.2.8 Groundwater Conditions

Piezometers were installed in Boreholes 08-138, ML16 26+525, ML16 26+900 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.

Borehole	Date	Depth (m)	Elevation (m)
08-138	May 28, 2008	5.9	326.6
	July 23, 2008	1.6	330.9
ML16 26+525	November 27, 2017	5.7	324.4
	May 1, 2018	5.3	324.9
ML16 26+900	May 1, 2018	5.4	326.2

It should be noted that seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

## 5.3 Highway 7: Station 27+350 – 27+900 (08-149, 08-150, 08-151, ML16 27+675) – Appendix C

### 5.3.1 Topsoil/Peat

Topsoil/peat ranging in thickness from 600 mm to 800 mm was encountered at ground surface in Boreholes 08-150, 08-151, and ML16 27+675. Recorded moisture contents ranged from 82 percent to 287 percent.

### 5.3.2 Sand to Silty Sand

Sand to silty sand was encountered at ground surface in Borehole 08-149, below the topsoil in Borehole ML16 27+675, and below the sand and gravel layer in Borehole 08-150. The sand to silty sand had a thickness of 2.2 m to 2.4 m with an underside depth of 2.2 m to 3.1 m (Elevation



323.2 m to 319.6 m) in Boreholes 08-149 and ML16 27+675. Borehole 08-150 was terminated within the sand at a depth of 6.7 m below the ground surface (Elevation 316.3 m).

A 600 mm thick layer of sand was also encountered within the sandy silt till in Borehole 08-149, at a depth of approximately 4.8 m (Elevation 320.6 m).

SPT N-Values in the sand to silty sand ranged from 8 blows to 57 blows indicating a loose to very dense relative density.

Recorded moisture contents ranged from 8 percent to 19 percent. The gradation analyses completed on two samples of the sand to silty sand are illustrated on Figure C1 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.

Soil Particle	Percentage (%) Sand	Percentage (%) Silty Sand
Gravel	8	1
Sand	80	67
Silt	12	27
Clay		5

### 5.3.3 Sandy Silt

A 0.8 m thick later of sandy silt was encountered below the clayey silt in Borehole 08-150 at a depth of 2.2 m below the ground surface (Elevation 320.8 m).

A SPT N-Value of 22 blows was obtained in the sandy silt indicating a compact relative density.

A moisture content of 32 percent was recorded. The gradation analysis completed on a sample of the sandy silt is illustrated on Figure C2 of Appendix C. The results of the test are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	39
Silt	56
Clay	5



#### 5.3.4 Sand and Gravel to Gravelly Sand

A layer of sand and gravel to gravelly sand was encountered below the peat in Borehole 08-151 and below the sandy silt in Borehole 08-150. The thickness of the sand and gravel was 2.4 m to 2.6 m with an underside depth of 3.0 m to 5.6 m (Elevation 319.4 m to 317.4 m).

SPT N-Values in the sand and gravel to gravelly sand ranged from 10 blows to 33 blows indicating a compact to dense relative density.

Recorded moisture contents ranged from 8 percent to 22 percent. The gradation analyses completed on two samples of the sand and gravel to gravelly sand are illustrated on Figure C3 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.

Soil Particle	Percentage (%)
Gravel	24 to 34
Sand	47 to 57
Silt	9 to 29
Clay	

#### 5.3.5 Silty Clay to Clayey Silt

Silty clay to clayey silt was encountered below the peat in Borehole 08-150 and below the silty sand in Borehole ML16 27+675. The clayey silt had a thickness of 1.4 m with an underside depth of 2.2 m (Elevation 320.8 m) in Borehole 08-150. Borehole ML16 27+675 was terminated within the silty clay at a depth of 8.2 m below the ground surface (Elevation 314.5 m).

SPT N-Values in the silty clay to clayey silt ranged from 4 blows to 43 blows indicating a firm to hard consistency.

The recorded moisture contents ranged from 10 percent to 20 percent. Atterberg limit testing was completed on one sample of the silty clay deposit. The results are summarized on the Record of Borehole sheets in Appendix C and illustrated on Figure C4 in Appendix C. The laboratory results indicate the material is a silty clay of low plasticity (CL).

Parameter	Value
Liquid Limit	32
Plastic Limit	16
Plasticity Index	16



A gradation analysis completed on one sample of the silty clay is illustrated on Figure C5 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheet in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	11
Silt	39
Clay	50

#### 5.3.6 Sandy Silt Till

A deposit of sandy silt till was encountered below the sand in Borehole 08-149 and below the gravelly sand in Borehole 08-151. Both boreholes were terminated in the sandy silt till at depths of 6.6 m and 6.2 m (Elevation 318.9 m and 316.1 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the sandy silt till ranged from 14 blows to greater than 100 blows indicating a compact to very dense relative density.

The recorded moisture contents ranged from 6 percent to 19 percent. Atterberg limit testing was completed on one sample of the clayey silt layer within sandy silt till deposit. The results are summarized on the Record of Borehole sheets in Appendix C and illustrated on Figure C6 in Appendix C. The laboratory results indicate the layer within the sandy silt till is a clayey silt of low plasticity (CL-ML).

Parameter	Value
Liquid Limit	17
Plastic Limit	10
Plasticity Index	7

The gradation analyses completed on three samples of the sandy silt till are illustrated on Figures C7 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.



Soil Particle	Percentage (%)
Gravel	1 to 3
Sand	30 to 39
Silt	49 to 63
Clay	6 to 16

#### 5.3.7 Groundwater Conditions

A piezometer was installed in Borehole ML16 27+675 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.

Borehole	Date	Depth (m)	Elevation (m)
ML16 27+675	August 31, 2018	0.5	322.3

It should be noted that seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

#### 5.4 Regional Road 30 (Shantz Station Road) – S-W Ramp: Station 28+400 – 28+500 (08-156, 08-158, SH16-02) – Appendix D

##### 5.4.1 Fill

Sand to gravelly sand fill was encountered at ground surface in Boreholes 08-158 and SH16-02. the fill varied in thickness from 0.5 m to 2.2 m.

SPT N-Values recorded in the sand fill ranged from 8 blows to 20 blows indicating a loose to compact relative density.

Recorded moisture contents ranged from 5 percent to 13 percent.

##### 5.4.2 Clayey Silt

A 1.2 m thick layer of clayey silt was encountered at ground surface in Borehole 08-156 and extended to Elevation 331.5 m. Occasional rootlets and organics were noted within the layer.

SPT N-Values ranged from 6 blows to 15 blows indicating a firm to very stiff consistency.

Recorded moisture contents ranged from 12 percent to 21 percent.

##### 5.4.3 Sand

Sand was encountered below the clayey silt in Borehole 08-156 and within the silty clay till in Borehole SH16-02. The sand had a thickness of 3.0 m with an underside depth of 16.3 m



(Elevation 314.4 m) in Borehole SH16-02. Borehole 08-156 was terminated within the sand at a depth of 8.2 m below the ground surface (Elevation 324.5 m).

SPT N-Values ranged from 26 blows to 80 blows indicating a compact to very dense relative density.

Recorded moisture contents ranged from 5 percent to 19 percent. The gradation analyses completed on selected samples of the sand are illustrated on Figure D1 of Appendix D. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.

Soil Particle	Percentage (%)
Gravel	0 to 21
Sand	56 to 94
Silt	6 to 25
Clay	

#### 5.4.4 Silty Clay to Clayey Silt Till

A deposit of silty clay to clayey silt till was encountered below the fill in Boreholes 08-158 and SH16-02. The silty clay to clayey silt till had a thickness of 17.2 m to 18.7 m with an underside depth of 17.7 m to 20.9 m (Elevation 312.3 m to 309.8 m). A silt layer with a thickness of 0.5 m was encountered in Borehole 08-158 at a depth of 8.8 m (Elevation 321.2 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values ranged from 14 blows to greater than 100 blows indicating a stiff to hard consistency.

The recorded moisture contents ranged from 10 percent to 20 percent. Atterberg limit testing was completed on selected samples of the cohesive till deposit. The results are summarized on the Record of Borehole sheets in Appendix D and illustrated on Figures D2 and D3 in Appendix D. The laboratory results indicate the till is a silty clay to clayey silt of low to intermediate plasticity (CL-ML to CI).

Parameter	Silty Clay Till	Clayey Silt Till
Liquid Limit	25 to 42	20
Plastic Limit	12 to 19	13
Plasticity Index	13 to 23	7

The gradation analyses completed on selected samples of the till, including one sample of silt within the till, are illustrated on Figures D4 through D6 of Appendix D. The results of the tests are



summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.

Soil Particle	Percentage (%) Silty Clay Till	Percentage (%) Clayey Silt Till	Percentage (%) Silt Layer
Gravel	1 to 8	0	1
Sand	6 to 29	5 to 7	16
Silt	29 to 48	75 to 78	76
Clay	28 to 58	15 to 20	7

#### 5.4.5 Silty Sand to Sandy Silt Till

Silty sand to sandy silt till was encountered below the silty clay till in Boreholes 08-158 and SH16-02. The silty sand till had a thickness of 1.0 m with an underside depth of 21.9 m (Elevation 308.7 m) in Borehole SH16-02. Borehole 08-158 was terminated within the sandy silt till at a depth of 21.4 m below the ground surface (Elevation 308.6 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty sand to sandy silt till exceeded 100 blows indicating a very dense relative density.

The recorded moisture contents ranged from 8 percent to 9 percent. Atterberg limit testing was completed on one sample of the clayey silt layer within the sandy silt till deposit. The results are summarized on the Record of Borehole sheets in Appendix D and illustrated on Figure D7 in Appendix D. The laboratory results indicate the layer within the sandy silt till is clayey silt of low plasticity (CL-ML).

Parameter	Value
Liquid Limit	18
Plastic Limit	11
Plasticity Index	7

The gradation analyses completed on one sample of the silty sand till including one sample of clayey silt and sand layer within the till are illustrated on Figures D8 and D9 of Appendix D, respectively. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.



Soil Particle	Percentage (%) Silty Sand	Percentage (%) Clayey Silt and Sand Layer
Gravel	4 to 13	4
Sand	42	42
Silt	33 to 39	40
Clay	12 to 15	14

#### 5.4.6 Bedrock

Limestone bedrock was proven by coring techniques at a depth of 21.9 m (Elevation 308.7 m) in Borehole SH16-02. Runs 1 and 2 obtained a Total Core Recovery (TCR) of 98 percent to 100 percent, a Solid Core Recovery (SCR) of 98 percent to 100 percent, and a Rock Quality Designation (RQD) ranging from 53 percent to 86 percent. Average UCS values of 94 MPa and 138 MPa were measured on recovered core samples from Runs 1 and 2, respectively.

#### 5.4.7 Groundwater Conditions

Piezometers were installed in Boreholes 08-156, 08-158 and SH16-02 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.

Borehole	Date	Depth (m)	Elevation (m)
08-156	January 9, 2009	3.5	329.2
	February 2, 2009	7.1	325.6
08-158	May 28, 2008	6.8	323.2
	June 2, 2008	8.8	321.2
	July 15, 2008	9.0	321.0
	August 20, 2008	6.8	323.2
SH16-02	December 18, 2017	- *	- *

\* Piezometer was damaged prior to taking water level measurements.

It should be noted that seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.



## **5.5 Highway 7: Station 29+950 – 30+150 (08-171, ML16 29+950, ML16 30+000, ML16 30+150) – Appendix E**

### **5.5.1 Topsoil**

Topsoil ranging in thickness from 125 mm to 375 mm was encountered at ground surface in all the boreholes at this location. Recorded moisture contents ranged from 18 percent to 31 percent.

### **5.5.2 Silty Sand**

A layer of silty sand was encountered below the topsoil in Boreholes 08-171 and ML16 30+150. The silty sand had a thickness of 1.0 m to 1.7 m with an underside depth of 1.2 m to 1.8 m (Elevation 329.8 m to 328.6 m).

SPT N-Values in the silty sand layer ranged from 5 blows to 25 blows indicating a loose to compact relative density.

Recorded moisture contents ranged from 8 percent to 19 percent. The gradation analysis completed on one sample of the silty sand is illustrated on Figure E1 of Appendix E. The results of the test are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix E.

Soil Particle	Percentage (%)
Gravel	7
Sand	50
Silt	43
Clay	

### **5.5.3 Sandy Silt Till**

Sandy silt till was encountered below the topsoil in Boreholes ML16 29+950 and ML16 30+000 and below the silty sand in Boreholes 08-171 and ML16 30+150. All four boreholes were terminated in the sandy silt till at depths of 4.6 m to 8.0 m (Elevation 325.2 m to 322.3 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values ranged from 4 blows to greater than 100 blows indicating a loose to very dense relative density.

Recorded moisture contents ranged from 2 percent to 28 percent. The gradation analyses completed on selected samples of the sandy silt till are illustrated on Figure E2 of Appendix E. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix E.



Soil Particle	Percentage (%)
Gravel	0 to 7
Sand	35 to 45
Silt	37 to 46
Clay	12 to 17

#### 5.5.4 Groundwater Conditions

No piezometers were installed in the boreholes at this location. The water level was measured at depths ranging from 0.9 m to 3.8 m in the open boreholes upon completion of drilling.

### 5.6 Regional Road 30 (Shantz Station Road) – N/S-E Ramp: Station 28+420 – 28+600 (08-159) – Appendix F

#### 5.6.1 Topsoil

Topsoil with a thickness of 200 mm was encountered at ground surface in Borehole 08-159.

#### 5.6.2 Fill

Silty clay fill was encountered below the topsoil in Borehole 08-159. The silty clay fill had a thickness of 1.2 m with an underside depth of 1.4 m (Elevation 327.8 m).

A SPT N-Value of 11 blows was obtained in the silty clay fill indicating a stiff consistency.

A moisture content of 20 percent was recorded on a sample of the fill.

#### 5.6.3 Silty Clay Till

A deposit of silty clay till was encountered below the fill in Borehole 08-159. The silty clay till had a thickness of 14.3 m with an underside depth of 15.7 m (Elevation 313.5 m). A 1.5 m thick layer of sandy silt till and a 700 mm thick layer of silt were encountered within the silty clay till at depths of approximately 4.1 m (Elevation 325.1 m) and 10.8 m (Elevation 318.4 m), respectively. It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the silty clay till ranged from 23 blows to greater than 100 blows indicating a very stiff to hard consistency.

The recorded moisture contents ranged from 12 percent to 31 percent. Atterberg limit testing was completed on selected samples of the silty clay till deposit. The results are summarized on the Record of Borehole sheet in Appendix F and illustrated on Figure F1 in Appendix F. The laboratory results indicate the till is a silty clay of low to intermediate plasticity (CL to CI).

Parameter	Value
Liquid Limit	19 to 44
Plastic Limit	11 to 20
Plasticity Index	8 to 24

The gradation analyses completed on selected samples of the silty clay till, and one sample of the silt layer, are illustrated on Figures F2 and F3 of Appendix F. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix F.

Soil Particle	Percentage (%)	Percentage (%) Silt Layer
Gravel	0 to 5	0
Sand	1 to 34	8
Silt	35 to 68	81
Clay	23 to 65	10

#### 5.6.4 Silty Sand to Sandy Silt Till

Silty sand to sandy silt till was encountered within and below the silty clay till in Borehole 08-159. Borehole 08-159 was terminated in the sandy silt till at a depth of 20.0 m (Elevation 309.2 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values in the till exceeded 100 blows indicating a very dense relative density.

Recorded moisture contents ranged from 8 percent to 19 percent. The gradation analyses completed on two samples of the silty sand to sandy silt till are illustrated on Figure F4 of Appendix F. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix F.

Soil Particle	Percentage (%)
Gravel	5 to 16
Sand	41 to 43
Silt	33 to 40
Clay	8 to 15

#### 5.6.5 Groundwater Conditions

No piezometer was installed in Borehole 08-159 but was dry upon completion of drilling.



## **5.7 Regional Road 30 (Shantz Station Road) – E-N/S Ramp: Station 28+625 – 28+675 (08-153) – Appendix G**

### **5.7.1 Fill**

Sandy silty clay fill was encountered at ground surface in Borehole 08-153. The clayey silt fill had a thickness of 0.8 m and extended to Elevation 330.3 m.

A SPT N-Value of 10 blows was obtained within the clayey silt fill indicating a stiff consistency.

A moisture content of 20 percent was recorded on a sample of the fill.

### **5.7.2 Silty Clay Till**

A deposit of silty clay, some sand to sandy till was encountered below the fill in Borehole 08-153. Borehole 08-153 was terminated in the silty clay till at a depth of 6.4 m (Elevation 324.6 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values ranged from 19 blows to greater than 100 blows indicating a very stiff to hard consistency.

The recorded moisture contents ranged from 8 percent to 21 percent. Atterberg limit testing was completed on two samples in the silty clay till. The results are summarized on the Record of Borehole sheet in Appendix G and illustrated on Figure G1 in Appendix G. The laboratory results indicate the till is a silty clay of low plasticity (CL).

Parameter	Value
Liquid Limit	21 to 34
Plastic Limit	12 to 15
Plasticity Index	9 to 19

The gradation analyses completed on two samples in the silty clay till are illustrated on Figure G2 of Appendix G. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix G.

Soil Particle	Percentage (%)
Gravel	0 to 2
Sand	18 to 34
Silt	40 to 47
Clay	17 to 42



### 5.7.3 Groundwater Conditions

A piezometer was installed in Borehole 08-153 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.

Borehole	Date	Depth (m)	Elevation (m)
08-153	January 9, 2009	3.2	327.9
	February 2, 2009	2.0	329.1

It should be noted that seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

## **5.8 Regional Road 30 (Shantz Station Road): Station 8+850 – 9+825 (08-152, SH16 09+880) – Appendix H**

### 5.8.1 Topsoil

Topsoil with a thickness of 175 mm was encountered at ground surface in Borehole 08-152.

### 5.8.2 Fill

Gravelly sand fill was encountered at ground surface in Borehole SH16 09+880. The gravelly sand fill had a thickness of 1.4 m and extended to Elevation 329.4 m.

SPT N-Values in the gravelly sand fill ranged from 29 blows to 30 blows indicating a compact relative density.

The recorded moisture contents ranged from 4 percent to 7 percent.

### 5.8.3 Sand

A 1.2 m thick layer of sand was encountered below the topsoil in Borehole 08-152 with an underside depth of 1.4 m (Elevation 326.2 m).

A SPT N-Value of 17 blows was obtained in the sand layer indicating a compact relative density.

A moisture content of 17 percent was recorded.

### 5.8.4 Sandy Silt to Silt Till

Sandy silt to silt till was encountered below the sand in Borehole 08-152 and below the fill in Borehole SH16 09+880. Both boreholes were terminated in the sandy silt to silt till at depths between 6.7 m and 5.2 m (Elevation 320.9 m and 325.6 m). It should be noted that glacial tills are known to contain cobbles and boulders.



Layers of gravelly sand and silt were encountered within the sandy silt till layer in Borehole 08-152 at approximate depths of 2.1 m and 4.6 m (Elevation 325.5 m and 323.0 m), respectively.

SPT N-Values in the sandy silt till ranged from 22 blows to 90 blows indicating a compact to very dense relative density.

Recorded moisture contents ranged from 5 percent to 21 percent. The gradation analyses completed on two samples of the sandy silt to silt till, one sample within the gravelly silty sand layer, and one sample within the silty sand layer, are illustrated on Figures H1 through H3 of Appendix H. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix H.

Soil Particle	Percentage (%) Sandy Silt to Silt Till	Percentage (%) Gravelly Silty Sand Layer	Percentage (%) Silty Sand Layer
Gravel	0	30	0
Sand	17 to 35	53	54
Silt	60 to 79	17	36
Clay	4 to 5		10

#### 5.8.5 Groundwater Conditions

No piezometers were installed in the boreholes at this location. The water level was measured at a depth of 4.6 m in Borehole SH16 09+880 upon completion of drilling.

### 5.9 Highway 7: Station 29+200 – 29+400 (ML16 29+200, ML16 29+250, ML16 29+300, ML16 29+350, ML16 29+400) – Appendix I

#### 5.9.1 Topsoil

Topsoil ranging in thickness from 300 mm to 600 mm was encountered at ground surface in all the boreholes at this location. Recorded moisture contents ranged from 16 percent to 25 percent.

#### 5.9.2 Clayey Silt to Silty Clay Till

A deposit of clayey silt to silty clay till was encountered below the topsoil in Boreholes ML16 29+200 and ML16 29+400 and below or within the silty clay to clay in Boreholes ML16 29+250 and ML16 29+350. The silty clay till had a thickness of 4.2 m with an underside depth of 8.3 m (Elevation 328.2 m) in Borehole ML16 29+350. Boreholes ML16 29+200, ML16 29+250, and ML16 29+400 were terminated within the silty clay till at a depth of 6.5 m to 9.8 m below the ground surface (Elevation 328.1 m to 326.0 m). It should be noted that glacial tills are known to contain cobbles and boulders.

SPT N-Values ranged from 7 blows to greater than 100 blows indicating a firm to hard consistency (typically hard).



The recorded moisture contents ranged from 7 percent to 18 percent. Atterberg limit testing was completed on two samples of the clayey silt till deposit. The results are summarized on the Record of Borehole sheets in Appendix I and illustrated on Figure I1 in Appendix I. The laboratory results indicate the till is a clayey silt of low plasticity (CL-ML).

Parameter	Value
Liquid Limit	19 to 24
Plastic Limit	14 to 17
Plasticity Index	5 to 7

The gradation analyses completed on selected samples of the silty clay to clayey silt till are illustrated on Figure I2 of Appendix I. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix I.

Soil Particle	Percentage (%)
Gravel	1 to 6
Sand	25 to 43
Silt	39 to 58
Clay	15 to 31

### 5.9.3 Silty Clay to Clay

Silty clay to clay was encountered below the topsoil in Boreholes ML16 29+250 to ML16 29+350. The silty clay had a thickness of 3.6 m to 11.2 m with an underside depth of 4.1 m to 11.7 m (Elevation 331.3 m to 324.7 m) in Boreholes ML16 29+250 and ML16 29+350. Borehole ML16 29+300 was terminated within the silty clay to clay at a depth of 9.8 m below the ground surface (Elevation 326.3 m).

A silt layer was encountered within the silty clay to clay at a depth of approximately 5.08 m (Elevation 330.9 m).

SPT N-Values ranged from 7 blows to 86 blows indicating a firm to hard consistency.

The recorded moisture contents ranged from 9 percent to 26 percent. Atterberg limit testing was completed on three samples of the silty clay to clay deposit. The results are summarized on the Record of Borehole sheets in Appendix I and illustrated on Figure I3 in Appendix I. The laboratory results indicate the deposit ranges from a silty clay of low to intermediate plasticity (CL to CI) to a clay of high plasticity (CH).



Parameter	Value
Liquid Limit	32 to 53
Plastic Limit	16 to 23
Plasticity Index	16 to 30

The gradation analyses completed on four samples of the silty clay, and one sample of the silt layer with the silty clay are illustrated on Figures I4 and I5 of Appendix I, respectively. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix I.

Soil Particle	Percentage (%) Silty Clay	Percentage (%) Silt Layer
Gravel	0 to 1	0
Sand	2 to 15	0
Silt	31 to 40	78
Clay	44 to 67	22

#### 5.9.4 Groundwater Conditions

No piezometers were installed in the four boreholes at this location. The open boreholes were dry upon completion of drilling.

## 6 MISCELLANEOUS

Borehole locations were selected relative to existing site features and anticipated high fill embankment and deep cut locations.

All-Terrain Drilling from Waterloo, Ontario, DBW Drilling from Ajax, Ontario, and Altech Drilling and Investigative Services Limited from Cambridge, Ontario supplied and operated the drill rig to carry out the drilling, sampling, in-situ testing, standpipe installation and borehole decommissioning. The field investigations were supervised by Messrs. Stephane Loranger, Luke Gilarski, Ligang Hao, Troy Mackinnon, Omar Ali, Bryan Lui, Justin Buis, Saeed Bastan, and George Azzopardi of Thurber. Overall supervision of the investigation program was conducted by Mr. Mark Farrant, P.Eng. and Ms. Nancy Berg, P.Eng.



Routine geotechnical laboratory testing was carried out by Thurber's geotechnical laboratory in Oakville, Ontario. Interpretation of the data and preparation of this report were carried out by Messrs. Michael Eastman, P.Eng., and Geoff Lay, P.Eng.. The report was reviewed by Messrs. Christopher Ng, P.Eng., and Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundation Projects.

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**FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGH FILL EMBANKMENTS AND DEEP CUTS  
REGIONAL ROAD 17 (EBYCREST ROAD) TO WOOLWICH GUELPH TOWNLINE  
NEW HIGHWAY 7, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**GEOCRES No. 40P09-067**

**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 GENERAL**

This section of the report provides an interpretation of the factual data from Part 1 of this report and presents foundation design recommendations to assist the project team in the design of the proposed high fill embankments and deep cuts from just east of Regional Road 17 to just east of Woolwich Guelph Townline. The discussion and recommendations presented in this report are based on the information provided by WSP and on the factual data obtained from the foundation investigations. Thurber Engineering Limited (Thurber) carried out the current field investigation as a sub-consultant to WSP under Assignment No. 3014-E-0013.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The construction or design-build contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the subsurface information provided as it may affect equipment selection, proposed construction methods and scheduling.

**7.1 Applicable Codes and Design Considerations**

The geotechnical assessment presented below has been prepared based on the available data regarding the proposed high fill embankments and deep cuts and existing ground conditions and in accordance with the Canadian Highway Bridge Design Code (CHBDC), version CSA S6-14.

As per Section 6.5.3.2 of the CHBDC S6-14, the degree of site prediction model understanding is considered *Typical* based on the current information.

**8 ENGINEERING AND ANALYSIS METHODOLOGY**

**8.1 General**

The subsurface conditions were investigated to assess the stability of the proposed embankment foundations and cut slopes, potential settlement issues under the embankments and anticipated



construction concerns. Analyses were carried out at the critical sections based on embankment heights, gradient of cut slopes, and subsurface conditions. Geotechnical factors governing design of high fill embankments and deep cuts include the following:

- Thickness, extent, and engineering properties of the foundation soils.
- Depth of bedrock or refusal materials.
- Embankment material type.
- Embankment/earth cut geometry including embankment height/cut depth, gradient of side slopes, and requirements for stabilizing berms.
- Temporary and long-term drainage requirements and erosion control for cut slopes.
- Construction and post-construction settlement of embankments.
- Staging of construction.

The foundation design recommendations were developed based on assumptions that are consistent with MTO's standard highway design practices:

- In accordance with OPSS.PROV 206, peat, topsoil, organic deposits, and other deleterious materials will be stripped prior to constructing embankments.
- Benching of the existing slope will be carried out in accordance with OPSD 208.010 where new fill is placed against an existing embankment slope or on a sloping ground surface steeper than 3H:1V.
- The embankments will be constructed using granular fill meeting the specifications of OPSS.PROV 1010 Granular B Type I, Type II, or Select Subgrade Material (SSM).
- High fills and deep cuts will be constructed with side slopes of 2H:1V or flatter.
- A 2 m wide mid-height berm will be incorporated into the overall slope profile for every successive 8 m of embankment fill and 6 m of deep cut.
- Permanent drainage and erosion protection will be provided for all earth cuts and embankment slopes.

## **8.2 Global Stability**

Stability analyses were carried out to assess the global stability of the high fills and deep cuts at the critical embankment sections. The stability analyses were carried out utilizing the commercially available slope stability program Slide2 (Version 9) developed by Rocscience Inc. using Morgenstern Price method of slices.



For the purposes of analysis, it was assumed that the embankments would be constructed with either OPSS.PROV 1010 Granular B Type I or Type II, or SSM. It was also assumed that all high fills and deep cuts will be constructed with side slopes of 2H:1V or flatter.

In accordance with the 2014 CHBDC, a minimum factor of safety of 1.3 and 1.5 is considered acceptable for short-term (temporary) and long-term (permanent) conditions, respectively. In addition, a minimum factor of safety of 1.0 is considered appropriate for seismic conditions.

The analyses under seismic loading were performed using a pseudo-static slope stability analysis. Horizontal seismic coefficient,  $k_h$  of 0.049 g (one-half of the corresponding site peak ground acceleration in accordance with Section 4.6.7 of CHBDC, for a site Class D) was taken for the seismic stability analysis. It should be noted that horizontal seismic coefficient was determined from the peak ground acceleration (PGA) for the site, obtained from the 2015 National Building Code Seismic Hazard Calculation for Site Class C (refer to Appendix J), but amplified by a factor of 1.29 for Site Class D.

The input parameters and soil model used in the stability analyses, including soil stratigraphy, engineering properties, groundwater conditions and model geometry for selected analyses are shown in Appendix A through Appendix I. The material properties used in the analyses were determined from in-situ and laboratory testing, and/or through soil index correlations from published literature.

The results of the stability analysis are provided in Table 1 in Appendix K. In summary, high fills comprised of Granular B Type I or Type II, or SSM, and deep cuts through the native soils may be constructed with side slopes of 2H:1V.

### **8.3 Settlement**

Settlement analyses were carried out using the commercially available settlement program Settle3 (Version 5.0) developed by Rocscience Inc. The material properties used in the analyses were determined from in-situ and laboratory testing conducted during the current study, and/or through soil index correlations from published literature.

For analysis, self-compression of the compacted fill is assumed to be 0.5 percent of the fill height.

In accordance with the MTO's Embankment Settlement Criteria for Design (July 2, 2010), the maximum permissible post-construction total settlement for new embankments is 100 mm or less within 20 years following paving.

The modelling of settlements for the high fill embankments have been carried out based on the results of the field and laboratory program, as well as engineering experiences with other high fill embankments on similar soil conditions. However, it should be noted that the estimated settlements may differ from the magnitude of settlement observed during and/or after construction due to variability of the soil thicknesses and characteristics along the high fill embankments.



Therefore, the results of the settlement analyses should be considered as a likely response of the foundation soils due to embankment loads.

A summary of the results of the settlement analyses at the critical sections along the proposed Highway 7, and interchange ramps at Regional Road 30 (Shantz Station Road) is presented in Table 2 in Appendix K.

The results of the settlement analyses indicate that the estimated settlement of the foundation soils is within the MTO settlement guidelines and as such, waiting periods are not required prior to paving.

#### **8.4 Seismic Considerations**

In accordance with Table 4.1 of the 2014 CHBDC, this site is classified as a Seismic Site Class D based on the energy-corrected penetration resistance,  $\bar{N}_{60}$ . The peak ground acceleration, PGA, for a 2,475-year return period earthquake at this site is 0.076 g as per the National Building Code of Canada (NBCC) for Site Class C before modification for site-specific classification.

### **9 DESIGN AND CONSTRUCTION CONSIDERATIONS**

#### **9.1 Fill Embankment**

As indicated in Section 8.1, embankments constructed with OPSS.PROV 1010 Granular B Type I or Type II, or SSM may be constructed with side slopes inclined at 2H:1V or flatter. In addition, for every successive 8 m of embankment, a 2 m wide mid-height bench should be incorporated into the embankment slope. Mid-height benches should maintain a 2 percent slope to shed surface runoffs.

The subgrade must be adequately prepared prior to fill placement. All vegetation, topsoil, organics, soft/loosened or wet soils should be sub-excavated. All subgrade surfaces should be inspected and any soft spots sub-excavated and replaced with suitable compacted granular materials prior to placing the new embankment fill. The subgrade preparation and placement and compaction of the granular fill must be carried out in the dry.

Embankment construction should be carried out in accordance with OPSS.PROV 206 and OPSS.PROV 501 requirements.

To prevent surface runoff from eroding and gullyng the embankment side slopes, consideration should be given to installing an asphalt barrier curb in accordance with OPSD 601.010.

It is recommended that a vegetative cover to provided on all exposed slope surfaces in accordance with OPSS.PROV 803.



Where embankment fill is placed against existing embankment slopes or earth cuts, benching of the existing slope should be carried out in accordance with OPSD 208.010.

## **9.2 Deep Cuts**

As indicated in Section 8.1, deep cuts should be constructed with side slopes of 2H:1V or flatter. In addition, 2 m wide mid-height benches are to be incorporated along the length of deep cut for every 6 m of cut. Mid-height benches should maintain a 2 percent slope to shed surface runoffs.

Areas where the final subgrade is revealed to be disturbed, softened, organic and/or contain deleterious materials should be sub-excavated and backfilled with compacted granular fill. Geogrid and/or geotextile may be required to allow placement of granular fill above the soft subgrade. Prior to backfilling, the subgrade should be inspected and approved by qualified geotechnical personnel.

To maintain a relatively dry, stable excavation during construction, temporary drainage consisting of ditching on both sides of the highway should be provided to remove water originating from below the natural groundwater table, from seepage from within water-bearing soils (as such silty sands and sandy silts) along the cut slopes, and from precipitation runoffs. It is important that construction be sequenced in such a way as to promote positive drainage away from the cut and avoid ponding of water within the excavation.

Permanent drainage of the cuts should also be provided. Roadside ditches are expected to provide an adequate level of surface drainage. Interceptor ditches should be constructed at the top of the cut slopes as per OPSD 200.020.

In accordance with OPSS.PROV 803, vegetation cover should be established on all cut slopes to protect against surficial erosion. Where required, granular sheeting with a minimum thickness of 0.5 m should be placed in accordance with OPSS.PROV 511 on the cut slope faces to provide protection against surficial erosion and instability.

## **10 CONSTRUCTION CONCERNS**

Potential construction concerns include, but are not necessarily limited to:

- Confirmation is required that all peat, topsoil, and organic deposits within the proposed embankment footprint are stripped and replaced with approved backfill.
- Trafficability of construction equipment may be difficult in areas of soft, loosened, and/or saturated subgrade. Disturbance of the subgrade by construction traffic should be minimized, which may require adjustments to construction operations. In addition, provisions for adequate drainage will be critical to maintain stable subgrade.



- Cobbles and boulders may be encountered during construction and during excavation of cut slopes. Provisions must be made for the removal of cobbles and boulders.

Achieving the target performance is largely dependent on good workmanship and quality control during construction. Subgrade inspection should be carried out by qualified geotechnical personnel to confirm subgrade conditions are consistent with the construction specifications. In addition, the material used as fill as well as the density of the fill should be verified to conform with the material and construction specifications, respectively.

## 11 CLOSURE

Engineering analysis and preparation of this report were carried out by Messrs. Michael Eastman, P.Eng., Geoff Lay, P.Eng., and Ali Rajaei, P.Eng. The report was reviewed by Messrs. Christopher Ng, P.Eng., and Jason Lee, P.Eng., the Designated Principal Contact for MTO Foundation Projects.

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- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
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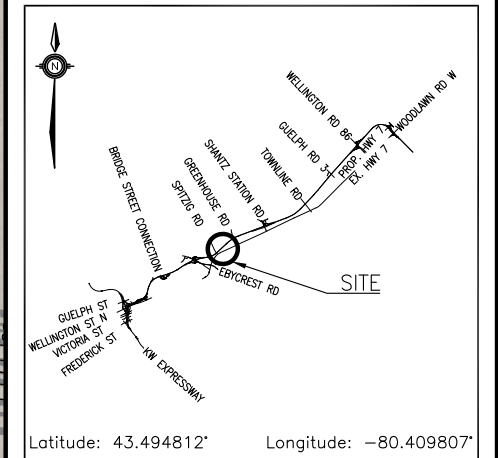
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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No

HIGHWAY 7  
DEEP CUT  
SITE LOCATION PLAN



**THURBER** ENGINEERING LTD.



## KEYPLAN

[illegible]

-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. 40P09-067**

REVISIONS										
	DATE	BY	DESCRIPTION							
DESIGN		CHK		CODE	LOAD		DATE	FEB 2024		
DRAWN	MC	CHK		SITE	STRUCT	DWG 1				

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

CONT No  
WP No

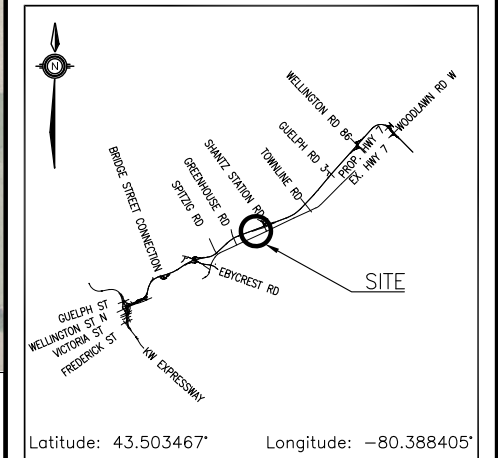


SHEET

HIGHWAY 7  
HIGH FILL/DEEP CUT  
SITE LOCATION PLAN



**THURBER** ENGINEERING LTD.



## KEYPLAN

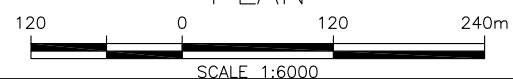
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-NOTES-

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**GEOCRES No. 40P09-067**

## PLAN



REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN		CHK		CODE		LOAD		DATE	FEB 2024
DRAWN	MC	CHK		SITE		STRUCT		DWG	2

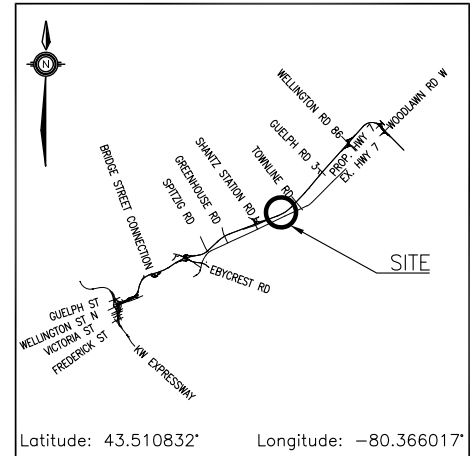


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No

HIGHWAY 7  
HIGH FILL/DEEP CUT  
SITE LOCATION PLAN

THURBER ENGINEERING LTD.



KEYPLAN

NO	ELEVATION	NORTHING	EASTING

-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. 40P09-067



REVISIONS					
DATE	BY	DESCRIPTION			
DESIGN	CHK	CODE	LOAD	DATE	FEB 2024
DRAWN	MC	CHK	SITE	STRUCT	DWG 3

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$


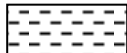



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT      Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
<b>Fresh (FR)</b>	No visible signs of weathering.		
<b>Fresh Jointed (FJ)</b>	Weathering limited to the surface of major discontinuities.		CLAYSTONE
<b>Slightly Weathered (SW)</b>	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
<b>Moderately Weathered (MW)</b>	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
<b>Highly Weathered (HW)</b>	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
<b>Completely Weathered (CW)</b>	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				



## **Appendix A.**

**Highway 7: Station 25+050 – 25+600 (08-120, 08-121, ML16 25+140, ML16 25+250,  
ML16 25+300, ML16 25+350, ML16 25+400, SP16-04, ML16 25+550)**

# RECORD OF BOREHOLE No 08-120

1 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 817 106.5 E 230 586.3 ORIGINATED BY LH  
 DIST HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.14 - 2009.01.14 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100		20 40 60			
331.0	GROUND SURFACE												
0.0	TOPSOIL: (300mm)												
330.7			1	SS	18								
0.3	<b>SAND</b> , trace silt, trace clay Loose to Compact Brown Moist to Wet												
			2	SS	6								
				3	SS	19							
				4	SS	19							
328.0													
3.0	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		5	SS	18								
			6	SS	38								
324.7													
6.3	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace clay Very Dense Brown to Grey Moist to Wet (TILL)		7	SS	66								
			8	SS	23								
			</										

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

# RECORD OF BOREHOLE No 08-121

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 817 138.7 E 230 680.9 ORIGINATED BY LH  
DIST HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.01.14 - 2009.01.14 LATITUDE LONGITUDE CHECKED BY RPR

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						
								20 40 60 80 100						
								20 40 60 80 100						
330.0	GROUND SURFACE													
0.0	TOPSOIL: (450mm)													
329.5														
0.5	Sandy <b>SILT</b> , trace clay, occasional organics Loose to Compact Dark Brown Moist to Wet		1	SS	10/ 0.150									
			2	SS	23									
328.5														
1.5	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace clay Compact to Very Dese Brown Moist to Wet (TILL)		3	SS	35									
			4	SS	69									
			5	SS	63									
			6	SS	42									
			7	SS	26									
			8	SS	100/ 0.225									
321.9														
8.1	END OF BOREHOLE AT 8.1m. WATER LEVEL AT 6.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.													

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 25+140

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 151.0 E 230 632.0 ORIGINATED BY GA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 LATITUDE 43.490599 LONGITUDE -80.416998 CHECKED BY JPL

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 (%)  GR   SA   SI   CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE					w   p                      w                      w   l				
								● QUICK TRIAXIAL      × LAB VANE									
331.9	GROUND SURFACE						20	40	60	80	100	20	40	60			
0.0	<b>TOPSOIL:</b> (50mm)  Sandy <b>SILT</b> , trace clay, trace organics Loose to Compact Dark Brown to Brown Moist		1	SS	4								○				
			2	SS	10								○				
			3	SS	24								○				
			4	SS	22								○				
			5	SS	14								○				
			6	SS	9								○				
			7	SS	19								○				
													○				
324.9																	
7.0	Silty <b>CLAY</b> , some sand, trace gravel Very Stiff Brown Moist (TILL)		8	SS	24								○				
323.2																	
8.7	Sandy <b>SILT</b> , trace clay Very Dense Brown Wet (TILL)		9	SS	52								○				

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 25+140

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 151.0 E 230 632.0 ORIGINATED BY GA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 LATITUDE 43.490599 LONGITUDE -80.416998 CHECKED BY JPL

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 (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE									
	Continued From Previous Page							20	40	60	80	100		W P      W      W L			
	Sandy <b>SILT</b> , trace clay Very Dense Brown Wet (TILL)		10	SS	100/ .275		321										
							320										
			11	SS	100/ .275		319										
							318										
317.6			12	SS	64											0   28   67   5	
14.3	END OF BOREHOLE AT 14.3m. WATER LEVEL AT 8.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No ML16 25+250

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 195.0 E 230 730.5 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.01.31 - 2018.01.31 LATITUDE 43.491005 LONGITUDE -80.415786 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
329.3	GROUND SURFACE												
0.0	TOPSOIL: (350mm)												
328.9			1	SS	7		329						
0.4	Sandy <b>SILT</b> , some clay, trace gravel Loose to Compact Brown Moist (TILL)		2	SS	11		328						
			3	SS	12		327						8 38 39 15
			4	SS	22		326						
			5	SS	15		325						
			6	SS	12		324						
			7	SS	10		323						
			8	SS	23		322						
			9	SS	40		321						0 9 46 45
322.1													
7.2	Silty <b>CLAY</b> , trace sand Hard Grey Moist					322							
320.6													
8.7	<b>SAND</b> , some silt, trace clay Dense to Very Dense Brown Wet		10	SS	39		320						

Continued Next Page

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

# RECORD OF BOREHOLE No ML16 25+250

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 195.0 E 230 730.5 ORIGINATED BY SB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.01.31 - 2018.01.31 LATITUDE 43.491005 LONGITUDE -80.415786 CHECKED BY JPL

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
							20	40	60	80	100	20	40	60			
318.0	Continued From Previous Page  <b>SAND</b> , some silt, trace clay Dense to Very Dense Brown Wet		11	SS	56		319										0 81 17 2
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 4.9m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.04.30 5.6 323.7						348										

# RECORD OF BOREHOLE No ML16 25+300

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 217.3 E 230 771.7 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.01.31 - 2018.01.31 LATITUDE 43.491209 LONGITUDE -80.415280 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  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				
								20 40 60 80 100				
329.1	GROUND SURFACE											
0.0	TOPSOIL: (350mm)		1	SS	8		329					
328.8												
0.4	SAND, some silt, trace gravel Loose to Compact Brown Moist		2	SS	21		328					
327.7												
1.4	Silty CLAY, some sand Firm to Hard Brown to Grey Moist		3	SS	32		327					
			4	SS	29							
			5	SS	22		326					
			6	SS	12		325					
							324					
			7	SS	6		323					
321.9							322					
7.2	Silty SAND, trace clay, trace gravel Compact to Dense Brown Wet (TILL)		8	SS	17		321					
			9	SS	33		320					

Continued Next Page

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

# RECORD OF BOREHOLE No ML16 25+300

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 217.3 E 230 771.7 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.01.31 - 2018.01.31 LATITUDE 43.491209 LONGITUDE -80.415280 CHECKED BY JPL

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				W P      W      W L				GR	SA	SI	CL	
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				WATER CONTENT (%)								
	Continued From Previous Page							20	40	60	80	100								
317.8	Silty <b>SAND</b> , trace clay, trace gravel Compact to Dense Brown Wet (TILL)		10	SS	18		319													
							318													
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 7.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																			

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 25+350

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 242.9 E 230 812.7 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.02.01 - 2018.02.01 LATITUDE 43.491444 LONGITUDE -80.414777 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  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					
328.0	GROUND SURFACE												
0.0	TOPSOIL: (375mm)		1	SS	6								
327.6	Sandy SILT, some clay, trace gravel, trace organics Loose to Compact Brown Moist		2	SS	17		327						
0.4			3	SS	15		326						4 21 57 18
325.8			4	SS	22		325						
2.2	Silty CLAY, trace sand Stiff to Very Stiff Brown to Grey Moist		5	SS	24		324						
			6	SS	18		323						0 0 36 64
			7	SS	14		322						
			8	SS	14		321						
320.8	Sandy SILT, trace clay, trace gravel Compact Brown Wet (TILL)		9	SS	25		320						
7.2			10	SS	27		319						
318.2													
9.8	END OF BOREHOLE AT 9.8m.												

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

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## 2 OF 2

METRIC

[illegible]

# RECORD OF BOREHOLE No ML16 25+400

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 248.4 E 230 871.3 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.02.01 - 2018.02.01 LATITUDE 43.491500 LONGITUDE -80.414053 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
327.3	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (450mm)		1	SS	4		327											
326.8																		
0.5	Sandy SILT, some clay Loose Brown Moist		2	SS	8		326											0 41 45 14
325.7																		
1.5	Silty CLAY, trace sand Very Stiff Brown to Grey Moist		3	SS	21		325											
			4	SS	20													
			5	SS	23		324											0 0 36 64
			6	SS	17		323											
							322											
			7	SS	18		321											
							320											
			8	SS	30													No recovery
							319											
			9	SS	24													
318.2																		
9.1	SILT, trace clay, trace sand Dense Grey Wet		10	SS	39		318											0 3 90 7
317.5																		
9.8	END OF BOREHOLE AT 9.8m.																	

Continued Next Page

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

## 2 OF 2

METRIC







SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT<div>SHEAR STRENGTH kPa<div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div><div>PLASTIC LIMITNATURAL MOISTURE CONTENTLIQUID LIMIT<div>wP            w        wL</div></div><div>WATER CONTENT (%)<div>20      40      60</div></div></div>					
	Continued From Previous Page				
	Water level at 9.1m upon completion. Borehole backfilled with bentonite holeplug and cuttings to surface.				

# RECORD OF BOREHOLE No ML16 25+550

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 333.3 E 230 990.6 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.02.02 - 2018.02.02 LATITUDE 43.492276 LONGITUDE -80.412589 CHECKED BY JPL

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								
								20 40 60 80 100								
								20 40 60 80 100								
325.5	GROUND SURFACE															
0.0	TOPSOIL: (500mm)		1	SS	7		325								11 55 31 3	
325.0																
0.5	Silty <b>SAND</b> , some gravel, trace clay Loose to Very Dense Brown Moist		2	SS	4		324									
			3	SS	24											
	Grinding from 2.4m to 2.5m		4	SS	100/ 0.100		323									
322.1			5	SS	18			322								
3.4	Silty <b>CLAY</b> , some sand trace gravel Very Stiff Grey Moist							321								
			6	SS	17		320									
319.8																
5.6	Sandy <b>SILT</b> , trace clay, trace gravel, occasional cobbles Compact to Very Dense Grey Wet (TILL)		7	SS	60		319							0 45 50 5		
			8	SS	26		318									
317.3																
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

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# RECORD OF BOREHOLE No SP16-04

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Spitzig Road, MTM NAD 83 Zone 10: N 4 817 293.2 E 230 924.7 ORIGINATED BY GA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.05.25 - 2017.05.25 LATITUDE 43.491908 LONGITUDE -80.413398 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  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						
327.0	GROUND SURFACE													
0.0 0.1	TOPSOIL: (75mm)													
326.3 0.7	Sandy <b>SILT</b> , some clay, trace gravel, trace organics Loose Brown Moist		1	SS	7									
	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Brown to Grey Moist		2	SS	60		326							
			3	SS	33		325							
			4	SS	60		324							
			5	SS	23		323							
			6	SS	21		322							
			7	SS	17		321							
319.8 7.2	Sandy <b>SILT</b> , trace to some clay, trace gravel Dense to Very Dense Brown to Grey Wet (TILL)		8	SS	66		320							
			9	SS	100/ .250		319							
							318							

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No SP16-04

2 OF 3

METRIC

GWP# 408-88-00 LOCATION Spitzig Road, MTM NAD 83 Zone 10: N 4 817 293.2 E 230 924.7 ORIGINATED BY GA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.05.25 - 2017.05.25 LATITUDE 43.491908 LONGITUDE -80.413398 CHECKED BY JPL

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				W <sub>p</sub>	W	W <sub>L</sub>			WATER CONTENT (%)	GR	SA
	Continued From Previous Page							20	40	60	80	100							
	Sandy <b>SILT</b> , trace to some clay, trace gravel Dense to Very Dense Brown to Grey Wet (TILL)		10	SS	100/ .250														
							316												0 23 73 4
							315												
			11	SS	44														
							314												
			12	SS	40		313												
							312												
			13	SS	100/ .100														
							311												
			14	SS	100/ .125		310												
							309												
			15	SS	100/ .100														
308.1																			5 26 53 16
18.9	END OF BOREHOLE AT 18.9m. WATER LEVEL AT 7.6m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.																		

Continued Next Page

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

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# RECORD OF BOREHOLE No SP16-04

3 OF 3

METRIC

GWP# 408-88-00 LOCATION Spitzig Road, MTM NAD 83 Zone 10: N 4 817 293.2 E 230 924.7 ORIGINATED BY GA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.05.25 - 2017.05.25 LATITUDE 43.491908 LONGITUDE -80.413398 CHECKED BY JPL

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.13 5.4 321.6 2018.04.30 5.0 322.0													

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ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/23/20

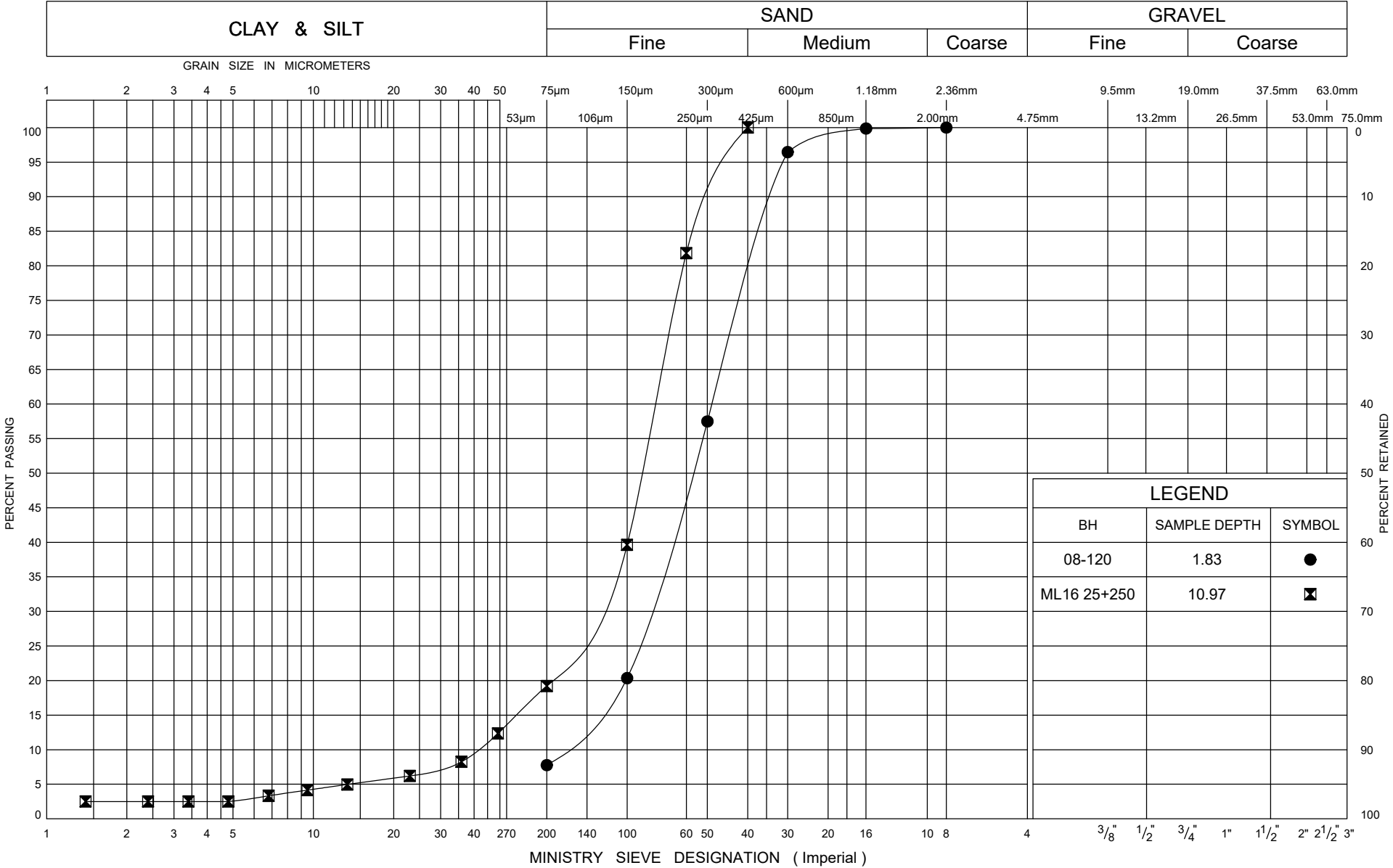
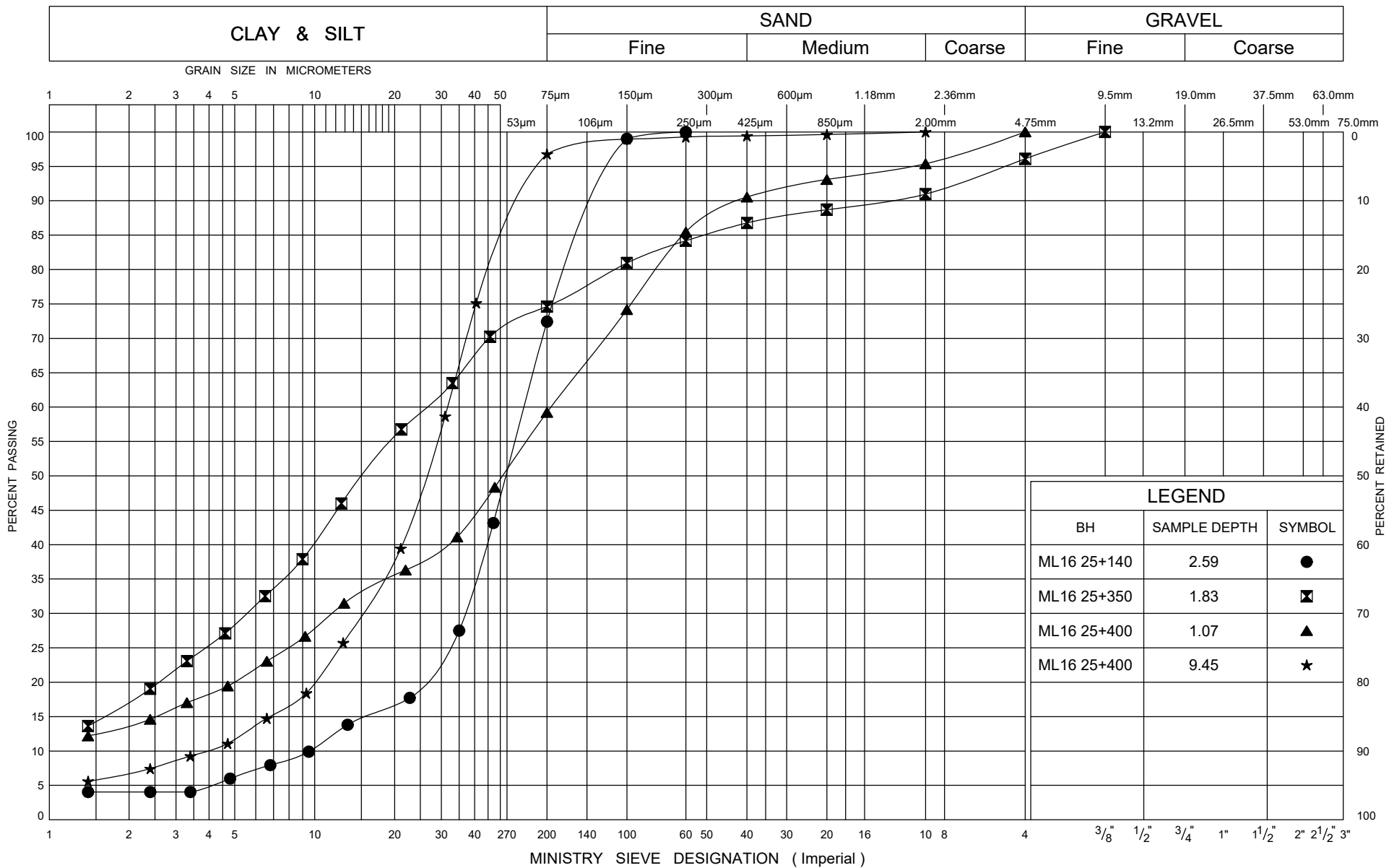
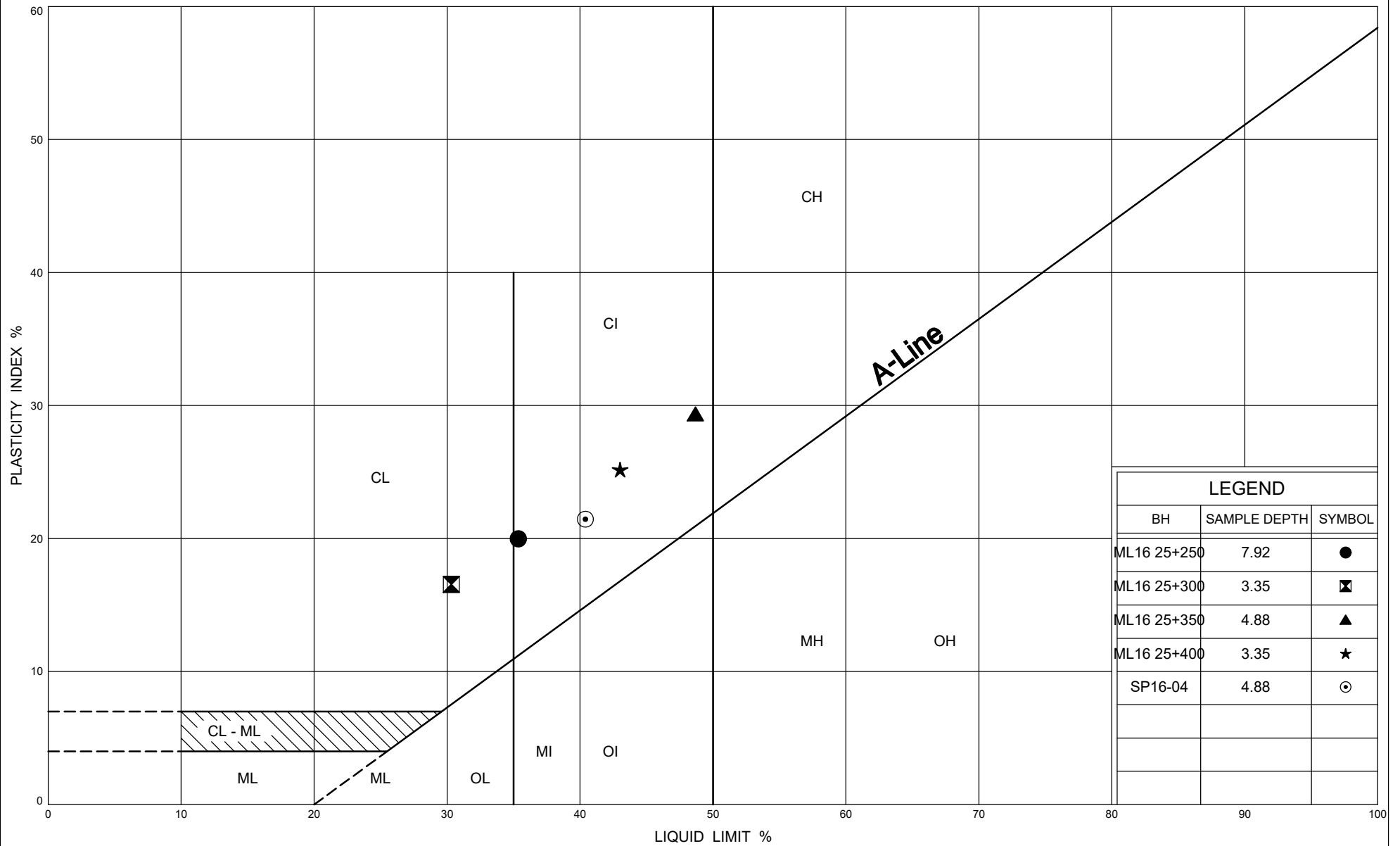




FIG No A2
GWP 408-88-00

ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/23/20





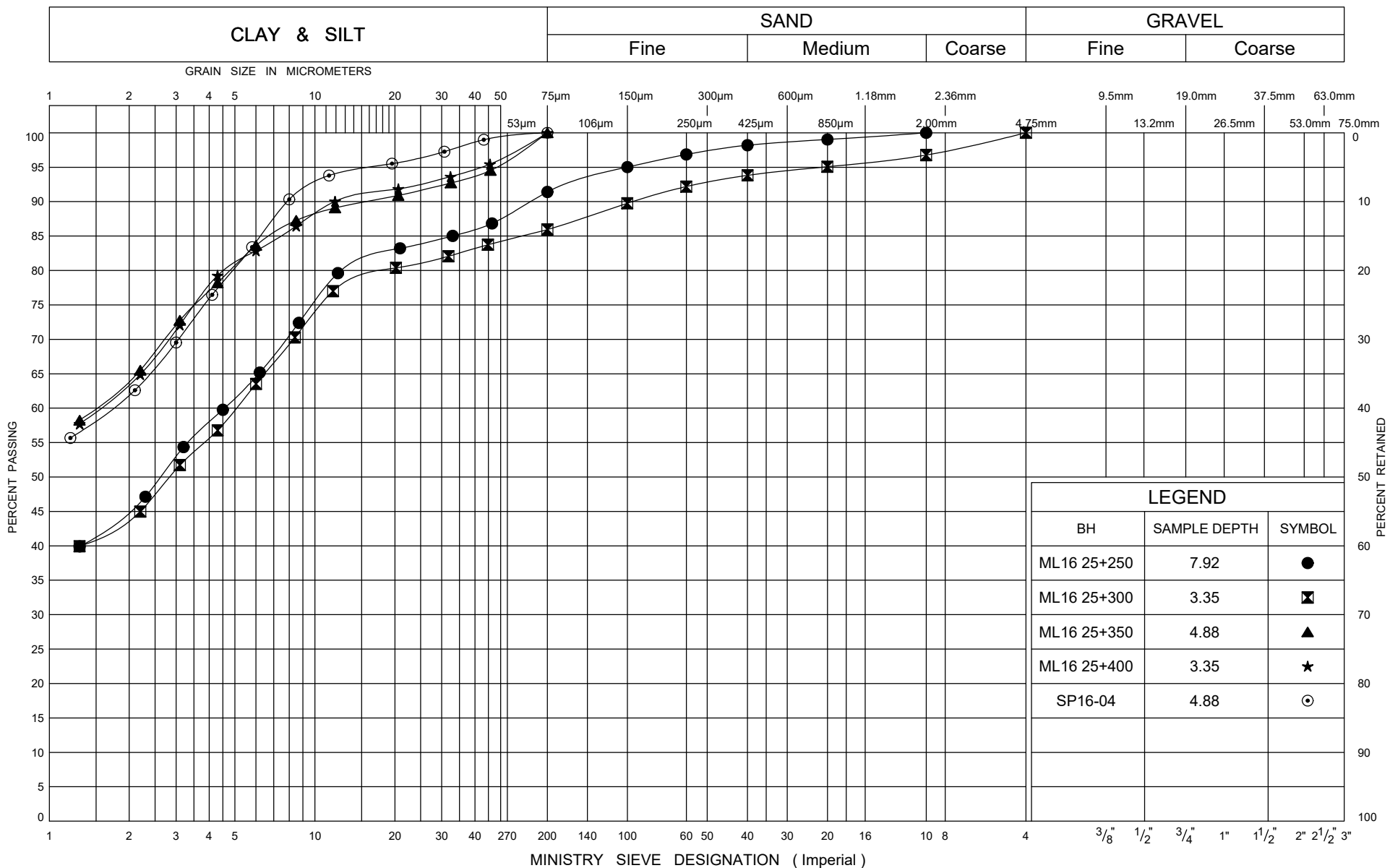
Ministry of  
Transportation

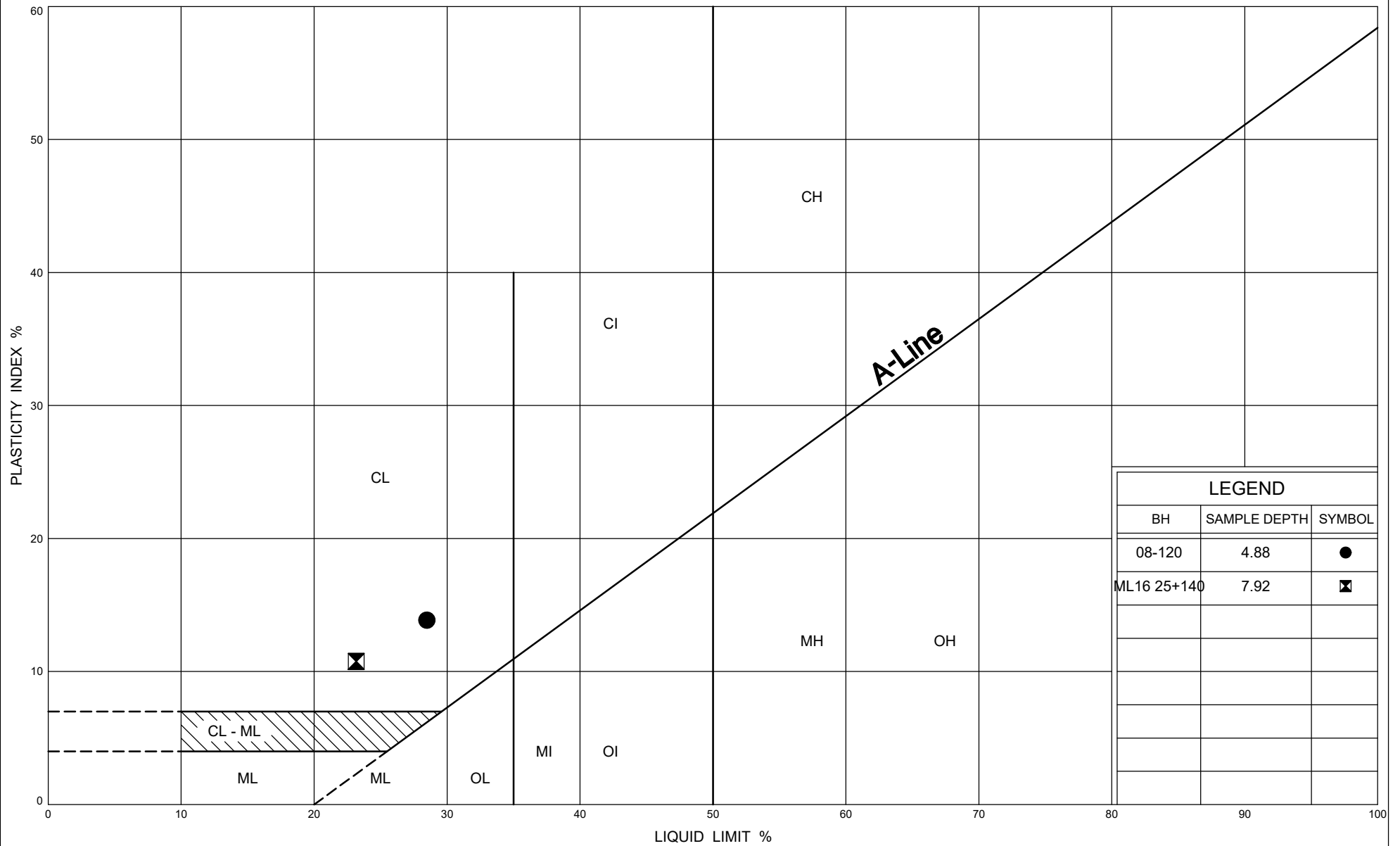
## PLASTICITY CHART

Silty CLAY

FIG No A4

GWP 408-88-00





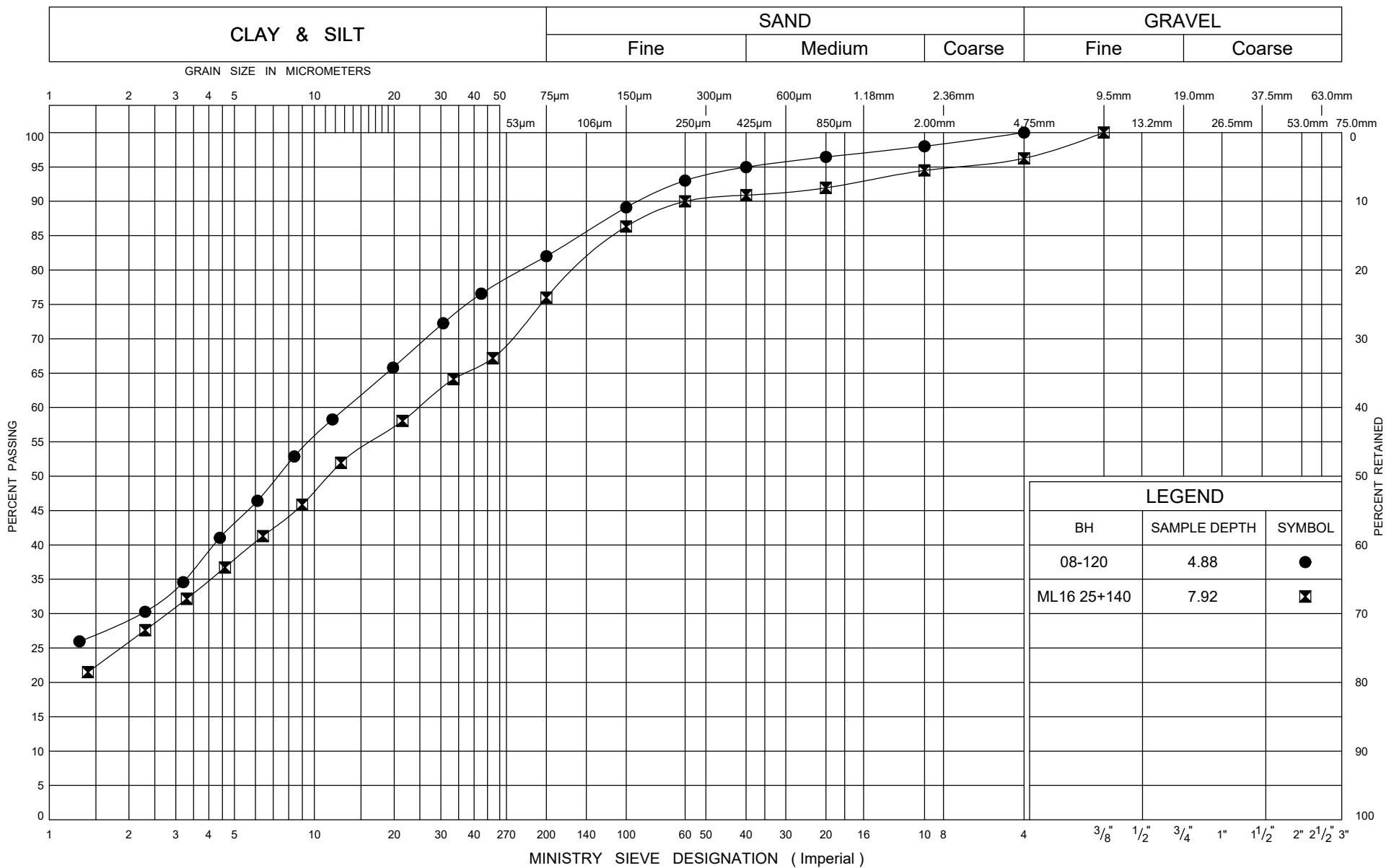
Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY TILL

FIG No A6

GWP 408-88-00



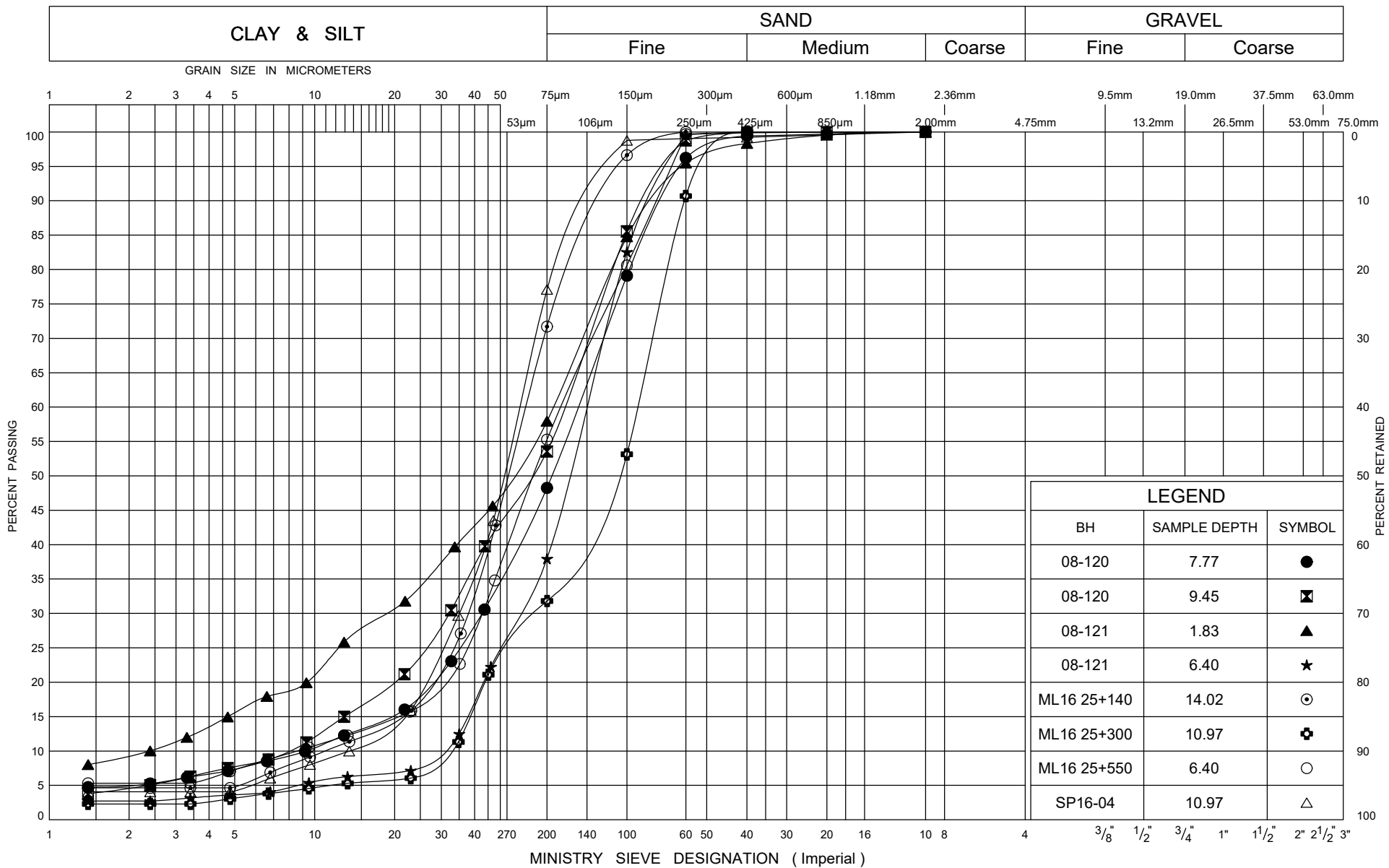
Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

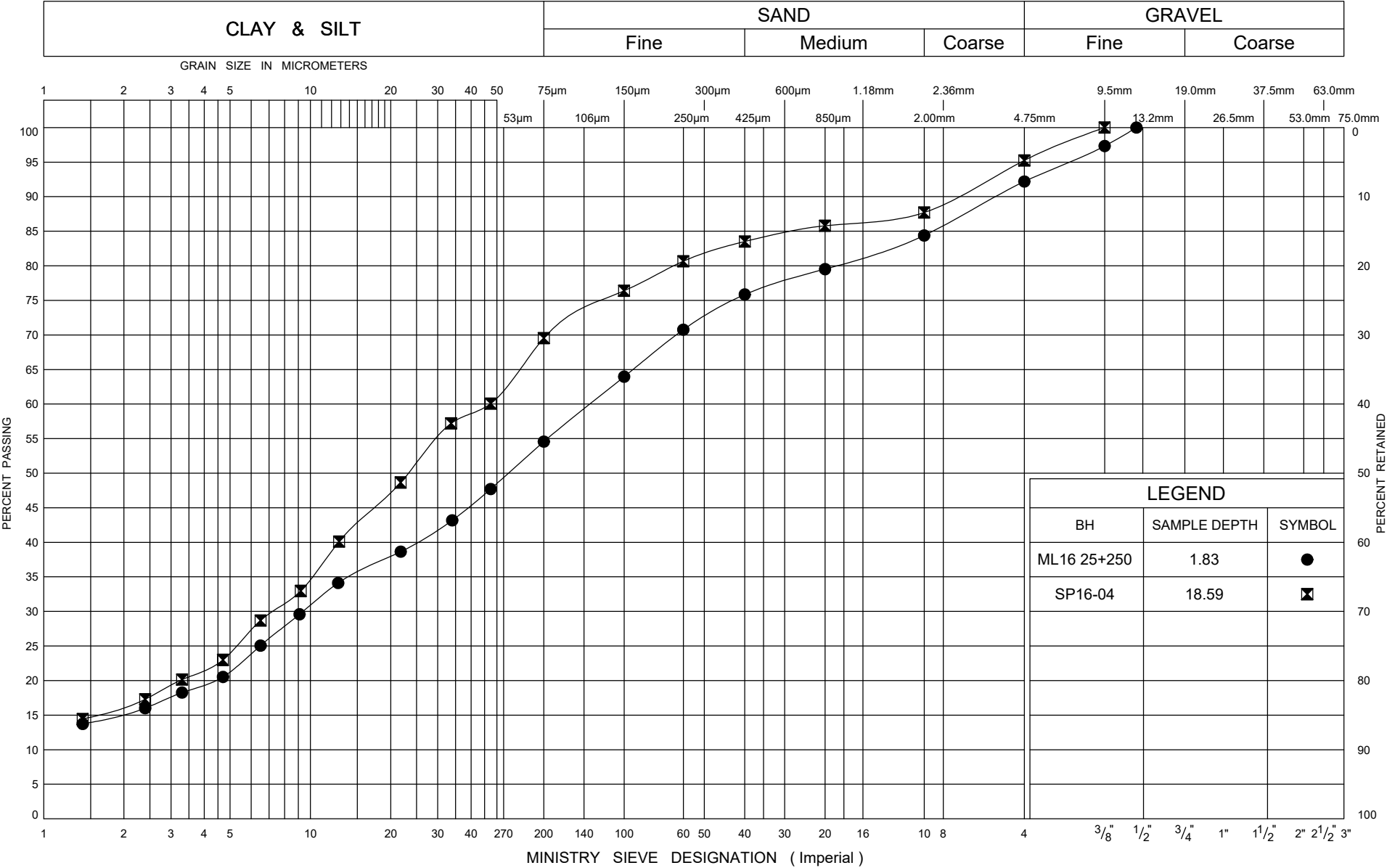
Silty CLAY TILL

FIG No A7

GWP 408-88-00

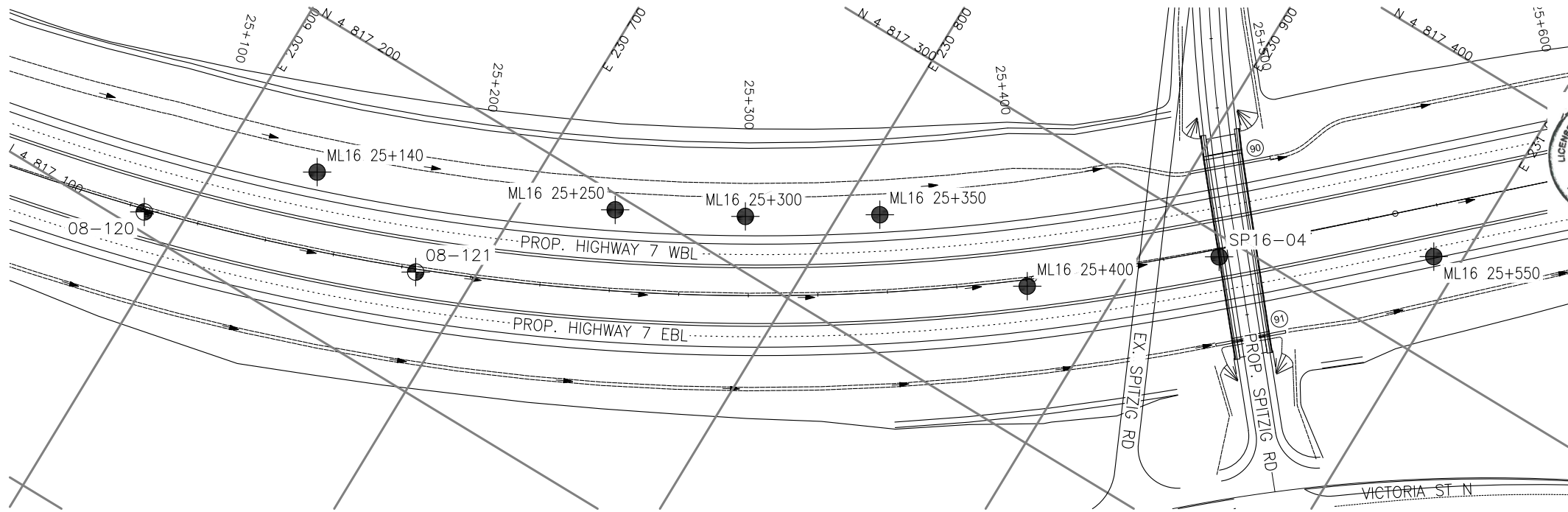


ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 7/18/23

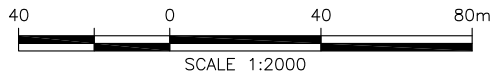


GRAIN SIZE DISTRIBUTION  
Silty SAND to Sandy SILT TILL

FIG No A9  
GWP 408-88-00



PLAN

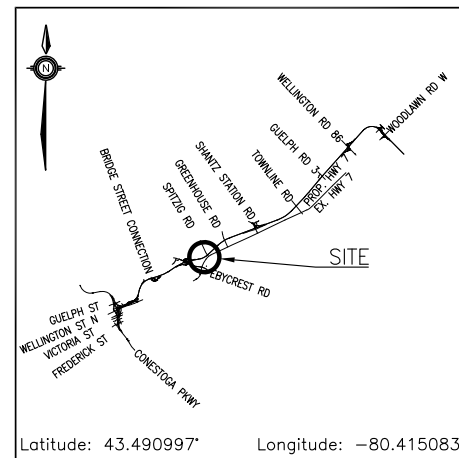


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
GWP No 408-88-00

HIGHWAY 7  
MAINLINE CUT  
25+050 TO 25+600  
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

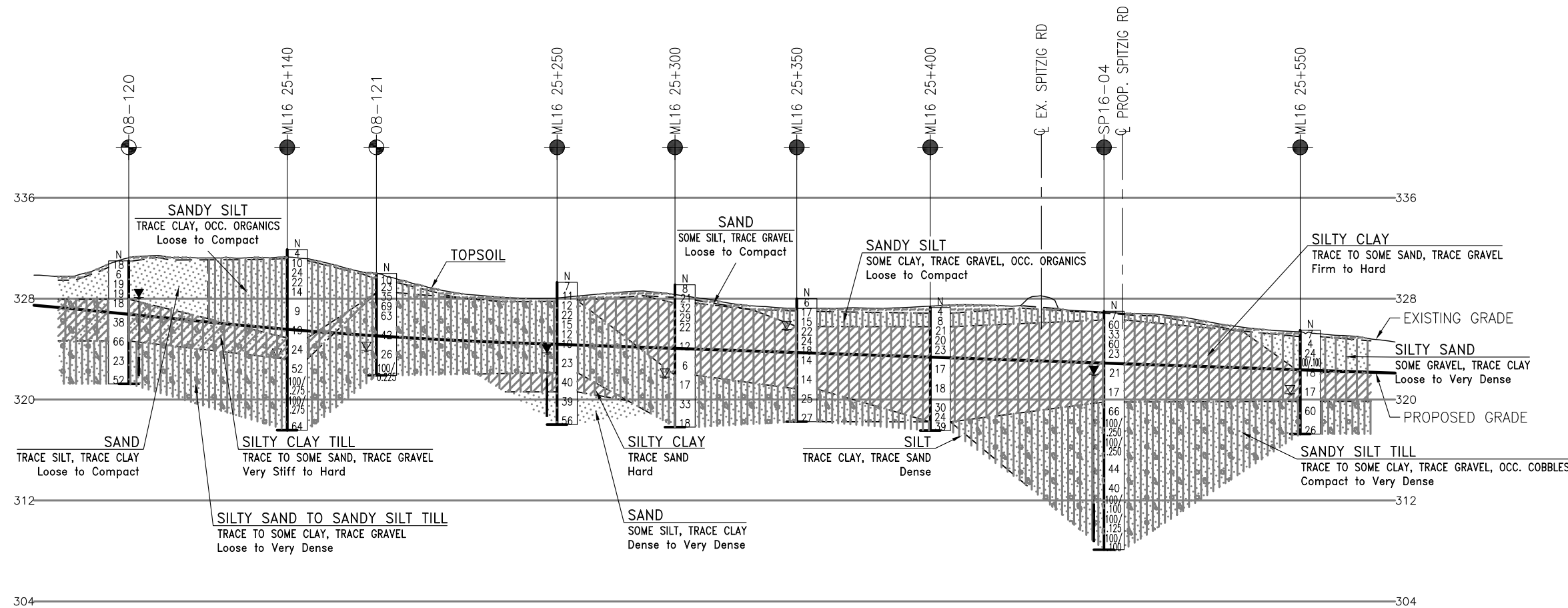
- Borehole (Current Investigation)
- Borehole (2008 Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
ML16 25+140	331.9	4 817 151.0	230 632.0
ML16 25+250	329.3	4 817 195.0	230 730.5
ML16 25+300	329.1	4 817 217.3	230 771.7
ML16 25+350	328.0	4 817 242.9	230 812.7
ML16 25+400	327.3	4 817 248.4	230 871.3
ML16 25+550	325.5	4 817 333.3	230 990.6
SP16-04	327.0	4 817 293.2	230 924.7
08-120	331.0	4 817 106.5	230 586.3
08-121	330.0	4 817 138.7	230 680.9

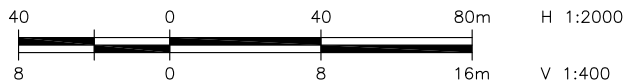
NOTES

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

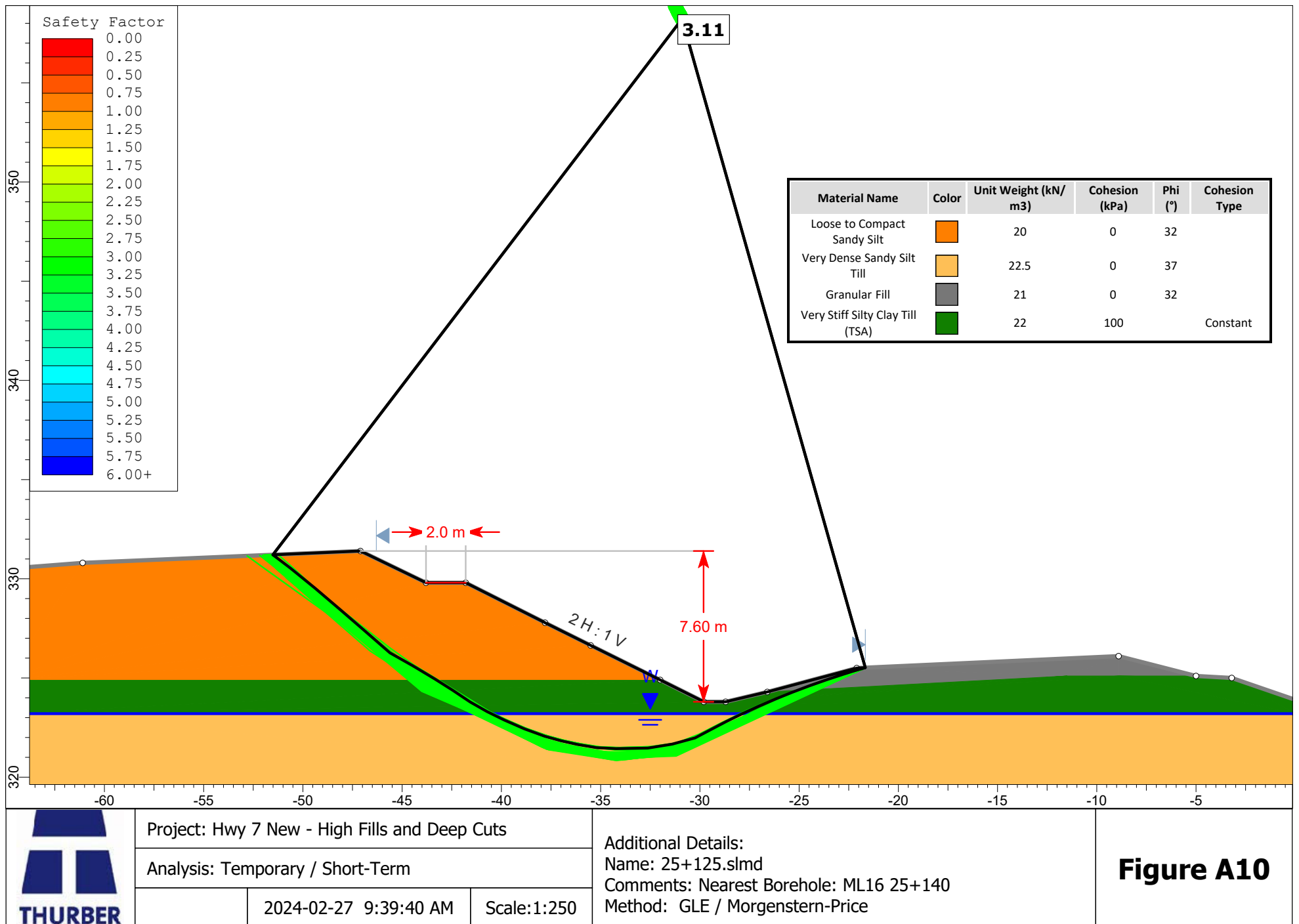
GEOCRES No. 40P09-067



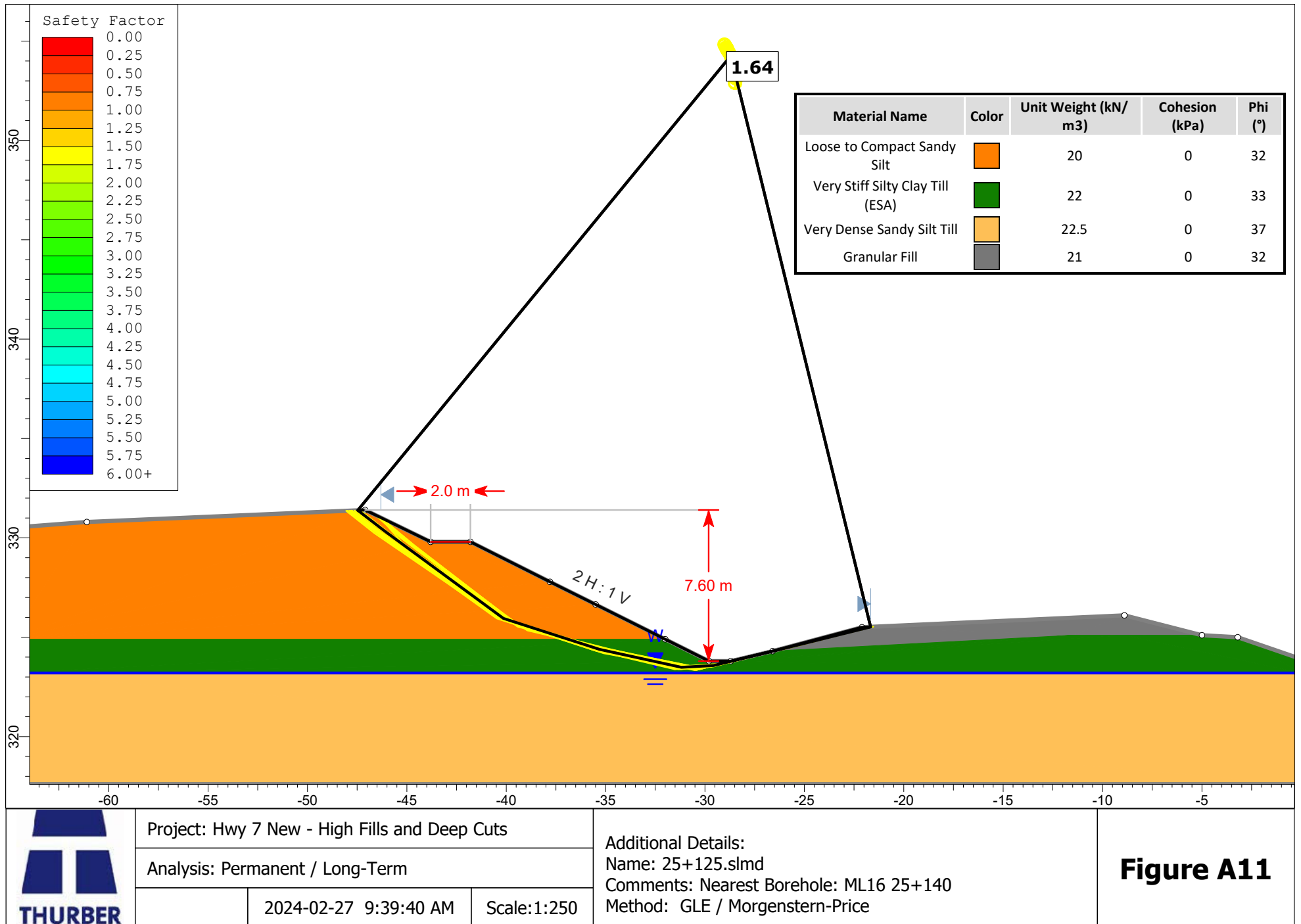
PROFILE ALONG PROPOSED HIGHWAY 7

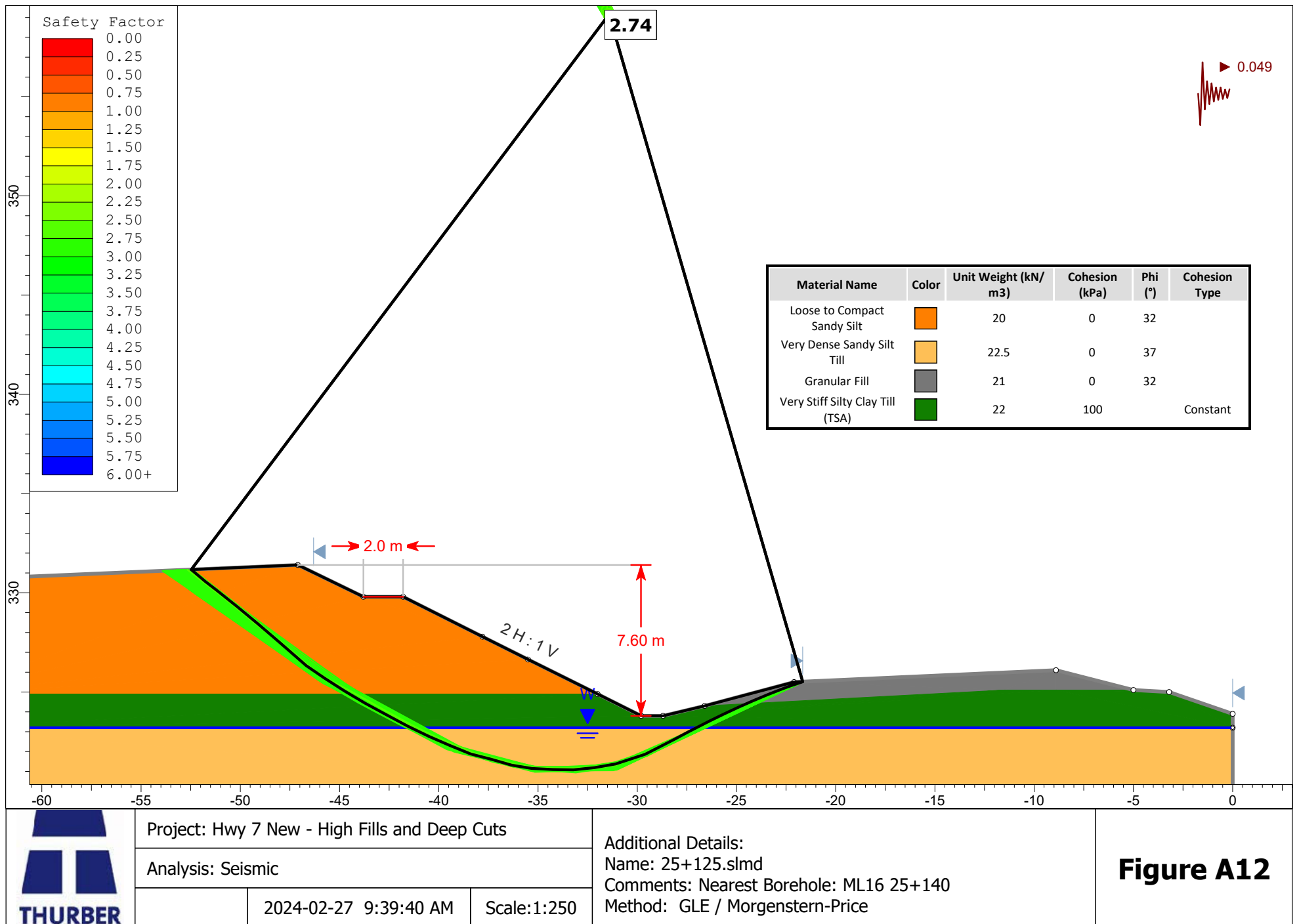


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MKE	CHK	PKC
DRAWN	MFA	CHK	MKE
LOAD			
STRUCT			
DWG			



**Figure A10**







## **Appendix B.**

**Highway 7: Station 26+450 – 26+950 (08-134, 08-135, 08-136, 08-138, ML16 26+525,  
ML16 26+625, ML16 26+800, ML16 26+850, ML16 26+900)**

# RECORD OF BOREHOLE No 08-134

1 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 817 970.1 E 231 673.6 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
327.9	GROUND SURFACE							20	40	60	80	100						
0.0	<b>SAND</b> , some gravel, some silt, trace rootlets Dense Brown Moist to Wet		1	SS	42		327							○				
326.5																		
1.4	Silty <b>CLAY</b> , trace sand Very stiff to hard Brown to Grey Moist (TILL)		2	SS	25		326							○				
			3	SS	49		325							○				
			4	SS	45		324							┌─┐			0	9 60 31
			5	SS	66		323							○				
322.4																		
5.5	Silty <b>SAND</b> , some clay, trace gravel Very Dense Grey Moist to Wet (TILL)		6	SS	100/ .175		322							○			7	44 36 13
							321											
			7	SS	100/ .150		320							○			5	57 29 9
	Difficulty advancing auger						319											
	Layer of silty clay		8	SS	100/ .125		318							○ ┌─┐			1	31 48 20

Continued Next Page

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

RECORD OF BOREHOLE No 08-134

2 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 817 970.1 E 231 673.6 ORIGINATED BY SLL  
DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

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 (%) GR SA SI CL
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>			
317.6	Silty <b>SAND</b> , some clay, trace gravel, trace gravel Very Dense Grey Moist to Wet (TILL)	o															
10.3	Continued From Previous Page  END OF BOREHOLE AT 10.3m. AUGER REFUSAL AT 10.1m UPON PROBABLE BEDROCK OR BOULDER. AUGER GRINDING AT 10.2m. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL AND CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No 08-135

1 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 818 025.8 E 231 756.2 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
331.7	GROUND SURFACE							20	40	60	80	100				
0.0	<b>SAND</b> , trace gravel, occasional rootlets, occasional cobbles Loose Brown Moist		1	SS	7		331							○		
330.2																
1.4	<b>SILT</b> and <b>SAND</b> to Sandy <b>SILT</b> , trace gravel, trace clay Loose to Very Dense Brown to Grey Moist to Wet (TILL)		2	SS	8		330							○		1 45 46 8
			3	SS	83		329							○		
	Occasional cobbles		4	SS	100/ 275		328							○		
	Layer of silty clay and sand		5	SS	79		327							○	11	4 43 41 12
							326									
			6	SS	78		325							○		
							324							○		1 32 60 7
							323									
	Layer of clayey silt		8	SS	100/ 250		322							○	11	0 34 50 16

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-135

2 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 818 025.8 E 231 756.2 ORIGINATED BY SLL  
DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  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									
								20	40	60	80	100					

	Continued From Previous Page															
320.6	Sandy <b>SILT</b> , some clay, trace gravel Very Dense Brown to Grey Moist to Wet (TILL)		9	SS	100/ 175		321								o	
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE OPEN TO 11.0m AND WATER LEVEL AT 9.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.															

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# RECORD OF BOREHOLE No 08-136

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 106.6 E 231 895.2 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				WATER CONTENT (%) w <sub>P</sub> w      w <sub>L</sub>				GR	SA	SI	CL
330.5	GROUND SURFACE							20	40	60	80	100							
0.0	<b>SAND</b> , some silt, trace gravel, occasional rootlets Brown Moist						330												
329.9																			
0.6	Sandy <b>SILT</b> , some clay, trace gravel Loose to Very Dense Brown Moist (TILL)		1	SS	7		329							○					
			2	SS	30		328							○					
	Layer of clayey silt		3	SS	20		327							○					
														H				4   38   44   14	
			4	SS	58		326							○					
							325												
	Layer of silt		5	SS	100/ 275		324							○				5   8   78   9	
							323												
323.5																			
7.0	Silty <b>CLAY</b> , trace sand Hard Grey Moist (TILL)						323												

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-138

1 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 818 075.5 E 231 835.9 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.28 - 2008.05.28 LATITUDE LONGITUDE CHECKED BY RPR

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			W <sub>P</sub>	W	W <sub>L</sub>		
332.5	GROUND SURFACE							20 40 60 80 100							GR SA SI CL
0.0	<b>SAND and GRAVEL</b> trace silt Brown Moist (FILL)		1	AS	-		332								37 50 13 (SI+CL)
331.9															
0.6	Sandy <b>SILT</b> , trace clay, trace gravel, occasional topsoil Compact Brown Moist (FILL)		1	SS	10		331								
331.0															
1.4	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace to some clay, trace gravel, occasional cobbles Compact to Very Dense Brown Moist to Wet (TILL)		2	SS	18		330								5 48 37 10
			3	SS	14		329								
			4	SS	38		328								
			5	SS	100/ .150		327								
			6	SS	50/ .125		326								2 36 40 22
	Layer of silty clay		7	SS	100/ .250		325								
			8	SS	100/ .125		324								
							323								

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-138

2 OF 2

METRIC

GWP# 408-88-00 LOCATION N 4 818 075.5 E 231 835.9 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.28 - 2008.05.28 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
321.4	Continued From Previous Page Sandy SILT, some clay, trace gravel, occasional cobbles Compact to Very Dense Grey Moist (TILL)		9	SS	100/ 275		322										1 21 61 17
11.1	END OF BOREHOLE AT 11.1m. BOREHOLE DRY ON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2008.05.28 5.9 326.6 2008.07.23 1.6 330.9																

# RECORD OF BOREHOLE No ML16 26+525 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 992.7 E 231 710.1 ORIGINATED BY TM  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.04.24 - 2017.04.25 LATITUDE 43.498281 LONGITUDE -80.403783 CHECKED BY JPL

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%) W <sub>P</sub> W                      W <sub>L</sub>				
330.2	GROUND SURFACE							20	40	60	80	100				
0.0 0.1	<b>TOPSOIL:</b> (75mm)  Sandy <b>SILT</b> , some clay, trace gravel, trace organics, occasional cobbles Loose to Very Dense Brown Moist (TILL)		1	SS	4		330							○		
			2	SS	9		329							○		
			3	SS	14		328							○		
			4	SS	29		327							○		
			5	SS	23		326							○		
			6	SS	64		325							○		
324.6							325									
5.6	Sandy Silty <b>CLAY</b> , trace gravel Hard Brown Moist (TILL)		7	SS	100/ .075		324							○		
							323									
323.2							323									
7.0	<b>SAND</b> and <b>GRAVEL</b> , trace silt, trace clay Dense to Very Dense Brown Wet		8	SS	48/ .075		322							○		
							321									
			9	SS	46		321							○		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ML16 26+525 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 817 992.7 E 231 710.1 ORIGINATED BY TM  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2017.04.24 - 2017.04.25 LATITUDE 43.498281 LONGITUDE -80.403783 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  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									
○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE																	
Continued From Previous Page							20	40	60	80	100	20	40	60			
320.0							320										
10.2	Sandy <b>SILT</b> , trace gravel, trace clay Very Dense Grey Wet (TILL)		10	SS	70		319							○			
317.7			11	SS	40/		318							○			
12.4	END OF BOREHOLE AT 12.4m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS DATE            DEPTH(m)    ELEV.(m) 2017.11.27        5.7            324.4 2018.05.01        5.3            324.9				.075												

# RECORD OF BOREHOLE No ML16 26+625 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 050.9 E 231 795.4 ORIGINATED BY TM  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.04.26 - 2017.05.03 LATITUDE 43.498813 LONGITUDE -80.402736 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL LIMIT      MOISTURE      LIQUID CONTENT      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		
								○ UNCONFINED      + FIELD VANE	● QUICK TRIAXIAL      × LAB VANE													
332.9	GROUND SURFACE							20	40	60	80	100	20	40	60							
0.0	TOPSOIL: (75mm)  Silty <b>SAND</b> , trace clay, trace gravel, trace organics, occasional cobbles Very Loose to Dense Brown Moist to Wet (TILL)		1	SS	3																	
0.1																						
				2	SS	8																
				3	SS	16																
			4	SS	12													3	49	40	8	
			5	SS	2																	
			6	SS	100/ .175																	
327.4	Sandy Silty <b>CLAY</b> , trace gravel Hard Grey Moist (TILL)																					
5.5																						
				7	SS	55													2	39	36	23
				8	SS	91																
			9	SS	48														0	27	35	38

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ML16 26+625 2 OF 2 METRIC

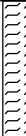

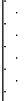


GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 050.9 E 231 795.4 ORIGINATED BY TM  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2017.04.26 - 2017.05.03 LATITUDE 43.498813 LONGITUDE -80.402736 CHECKED BY JPL

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
								20    40    60    80    100	W <sub>P</sub>	W	W <sub>L</sub>								
Continued From Previous Page																			
322.7	Sandy <b>SILT</b> , trace clay, trace gravel Very Dense Grey Wet (TILL)																		
10.2			10	SS	76		322						○						
								321											
				11	SS	100/ .175							○						
								320											
			12	SS	78		319						○						
							318												
317.3	END OF BOREHOLE AT 15.6m. BOREHOLE CAVED TO 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.		13	SS	100/ 250								○						
15.6																			

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RECORD OF BOREHOLE No ML16 26+800 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 133.2 E 231 947.9 ORIGINATED BY SB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.01.25 - 2018.01.25 LATITUDE 43.499568 LONGITUDE -80.400862 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%) W <sub>P</sub> W      W <sub>L</sub>					
330.1	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (900mm)		1	SS	6		330											
329.2																		
0.9	SAND, some gravel, trace silt, trace clay Very Loose to Compact Brown Moist to Wet		2	SS	2													
			3	SS	3													
327.5			4	SS	23													
2.6	Sandy Silty CLAY, trace gravel Very Stiff to Hard Grey Moist (TILL)		5	SS	36													
			6	SS	100/ 0.250													
			7	SS	100/ 0.275													
323.1																		
7.1	Silty SAND, trace clay Compact to Very Dense Grey Wet (TILL)		8	SS	100/ 0.275													
														</				

Continued Next Page

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

## METRIC

GWP#	408-88-00	LOCATION	Mainline, MTM NAD 83 Zone 10: N 4 818 133.2 E 231 947.9			ORIGINATED BY	SB
DIST	HWY 7	BOREHOLE TYPE	Hollow Stem Augers			COMPILED BY	MP
DATUM	Geodetic	DATE	2018.01.25 - 2018.01.25	LATITUDE	43.499568	LONGITUDE	-80.400862
						CHECKED BY	JPL

[illegible]

ONTMT4S2 2020LIBRARY(MTO) - COPY.GLB MTO-11375(GINTDATA).GPJ 7/20/23

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

## 1 OF 1

ORIGINATED BY SB

COMPILED BY MF

CHECKED BY JPI

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

# RECORD OF BOREHOLE No ML16 26+900 1 OF 1 METRIC

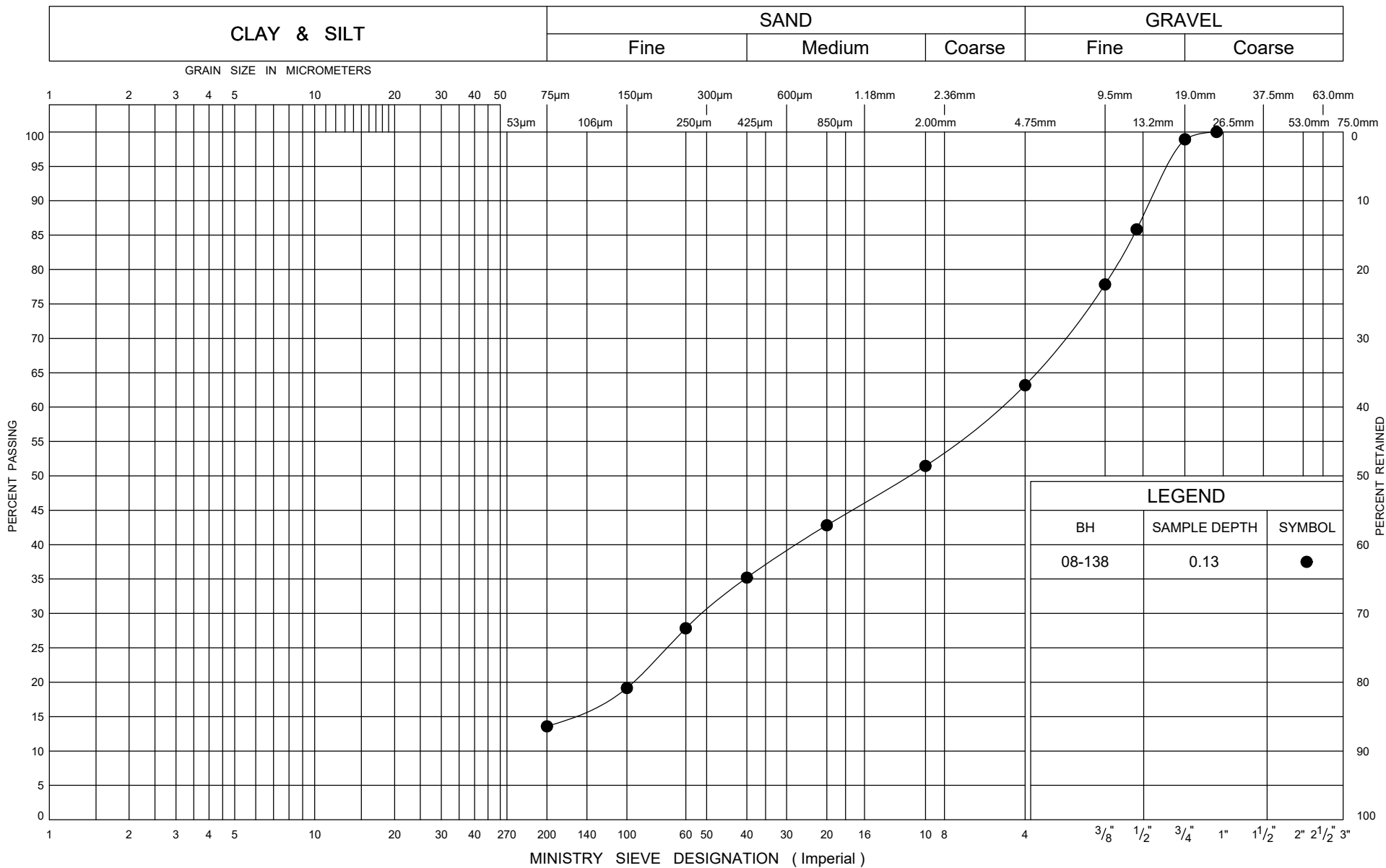
GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 179.5 E 232 046.4 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.01.26 - 2018.01.26 LATITUDE 43.499995 LONGITUDE -80.399650 CHECKED BY JPL

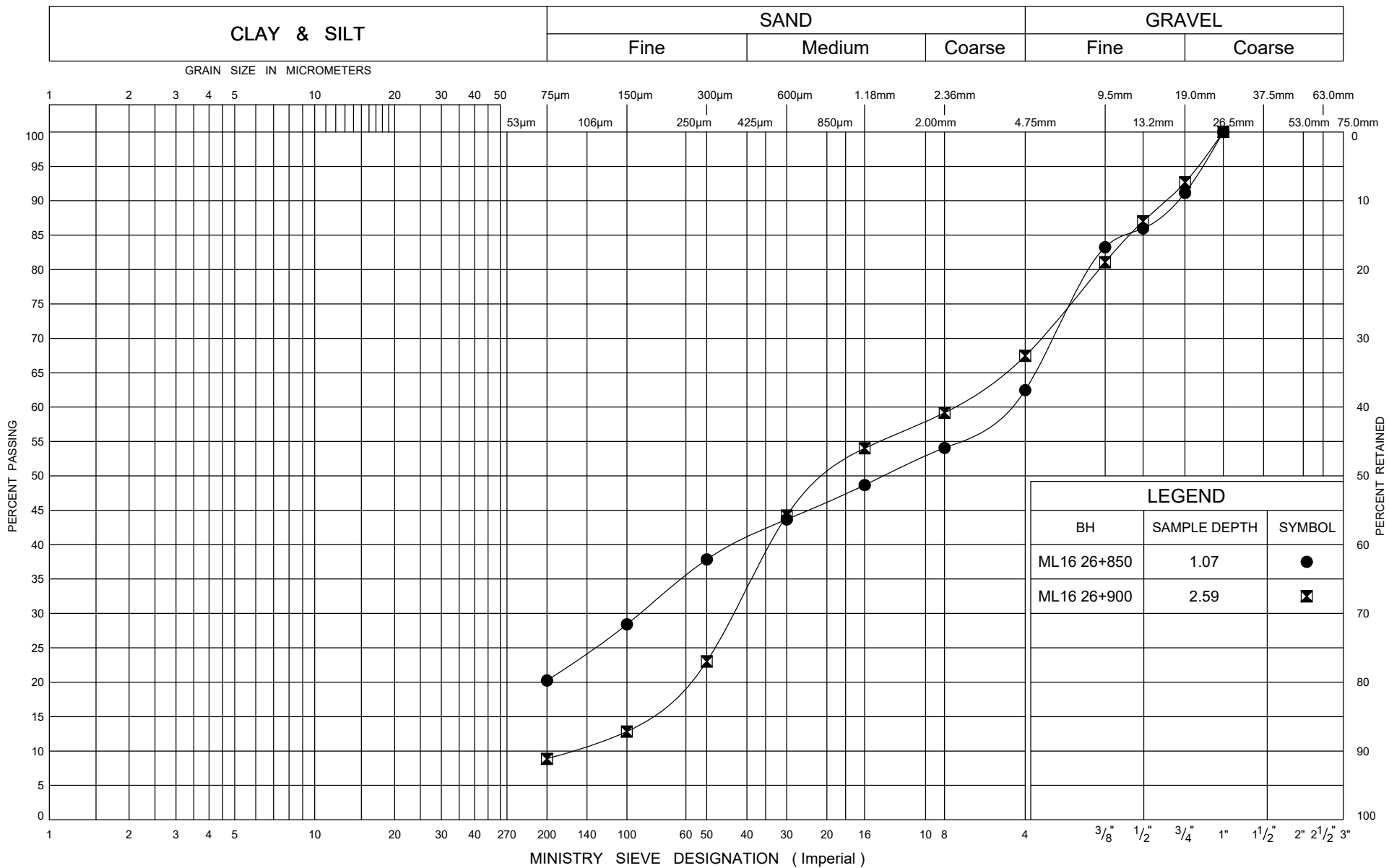
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
331.6	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL: (550mm)		1	SS	6															
331.1																				
0.6	Gravelly <b>SAND</b> , trace silt, occasional cobbles Compact to Very Dense Brown Dry to Moist		2	SS	14															
	Auger grinding at 1.5m		3	SS	100/ 0.275															
			4	SS	57															
	Auger grinding at 3.0m		5	SS	100/ 0.225															
	Auger grinding at 4.9m		6	SS	100/ 0.300															
326.1																				
5.5	Sandy <b>SILT</b> , some clay, trace gravel, occasional cobbles Very Dense Brown Wet (TILL)		7	SS	100/ 0.150															
	Auger grinding at 7.2m																			
323.6			8	SS	100/ 0.225															
8.0	END OF BOREHOLE AT 8.0m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.																			
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.05.01 5.4 326.2																			

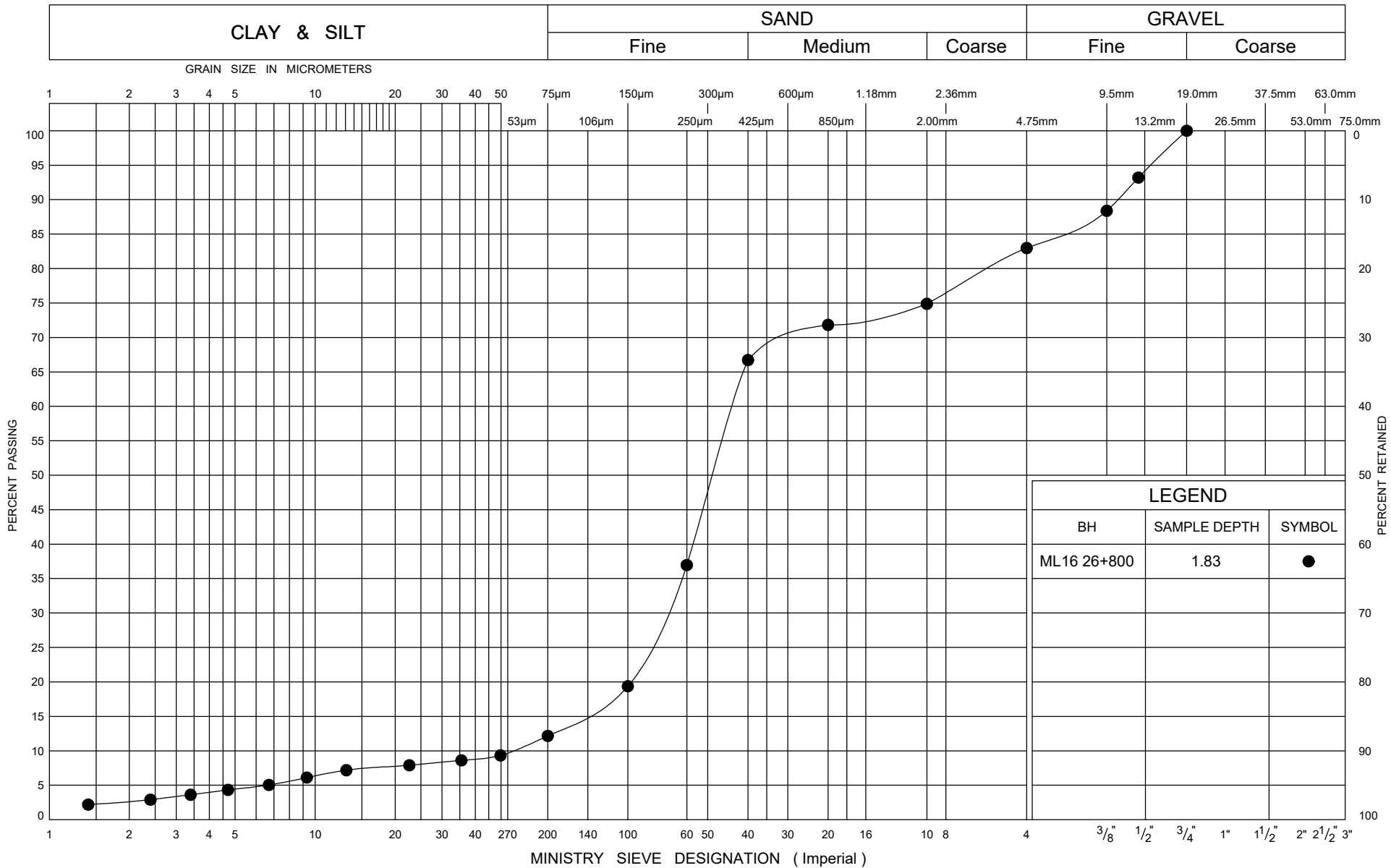
ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-11375(GINTDATA).GPJ 7/20/23

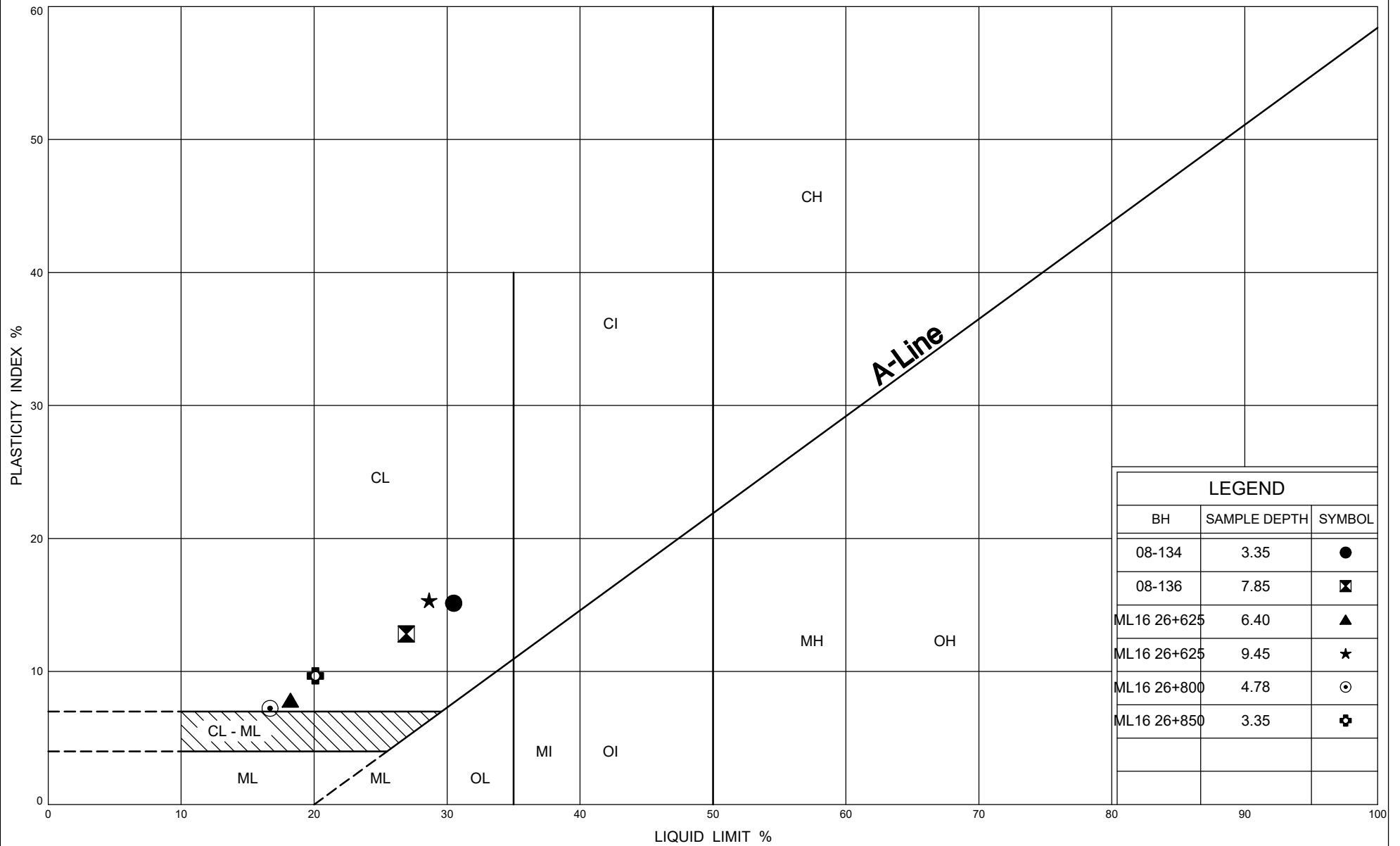
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 (%) STRAIN AT FAILURE

ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 7/6/23









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Transportation

## PLASTICITY CHART

Silty CLAY TILL

FIG No B4

GWP 408-88-00

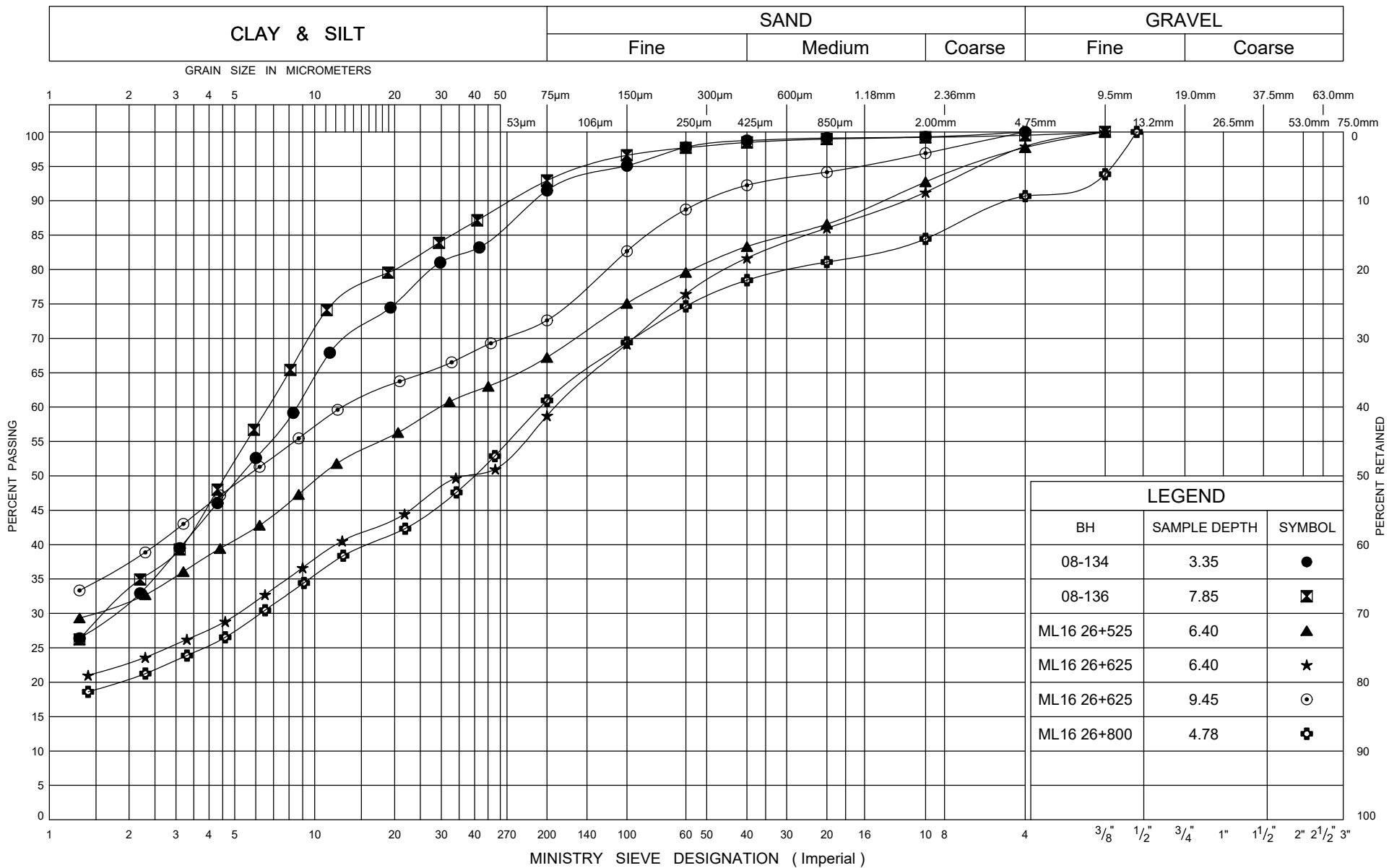
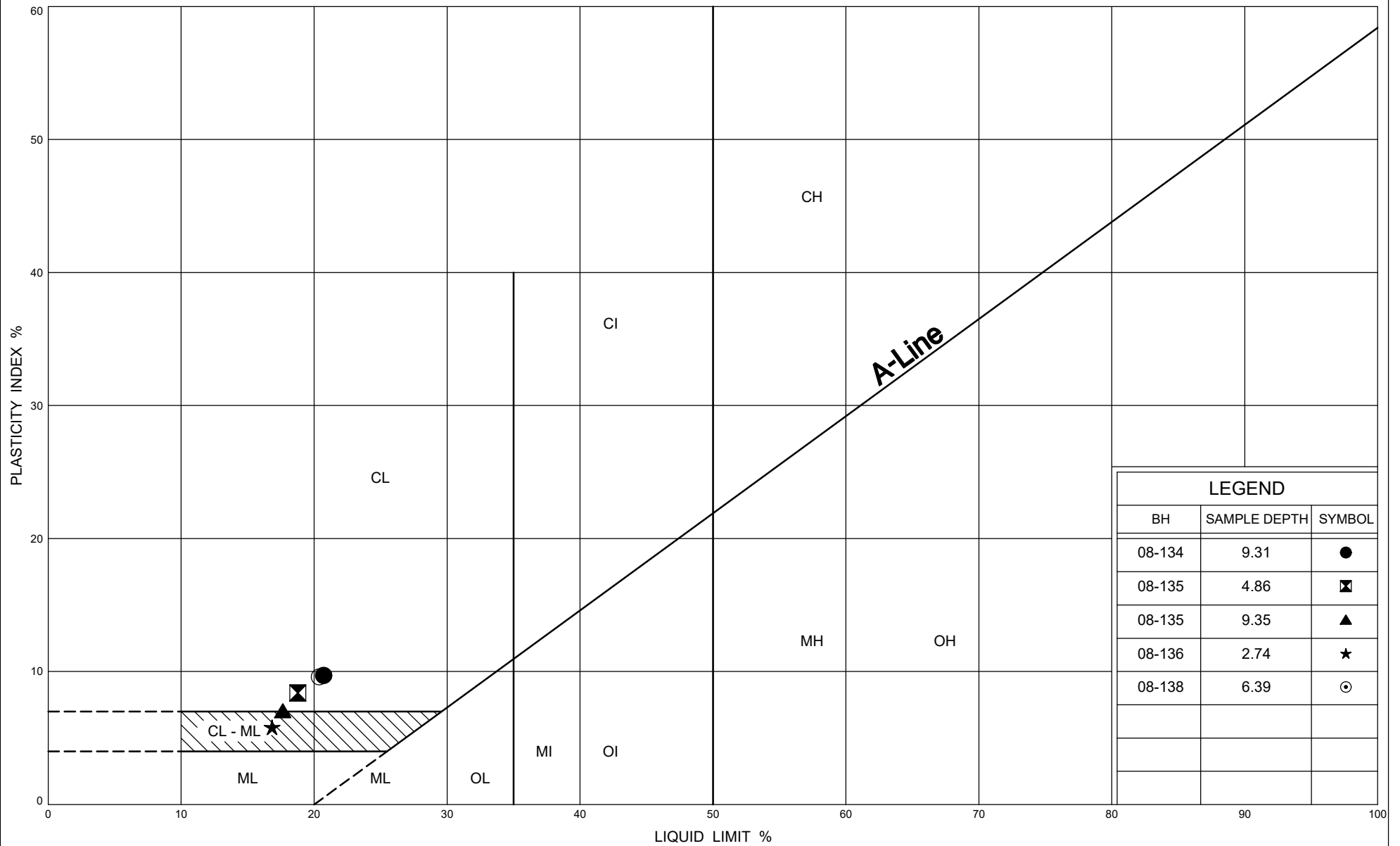




FIG No B6
GWP 408-88-00

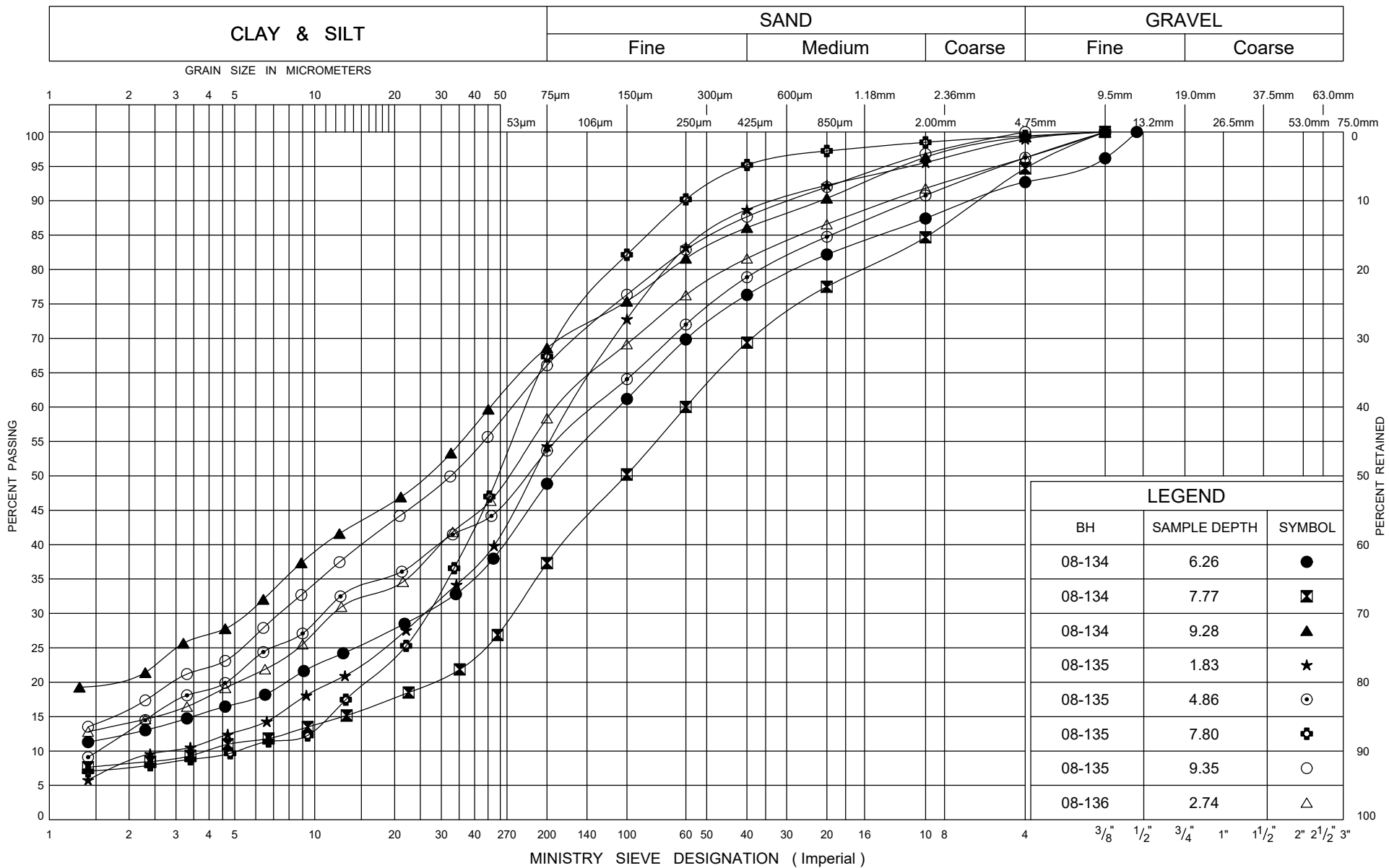


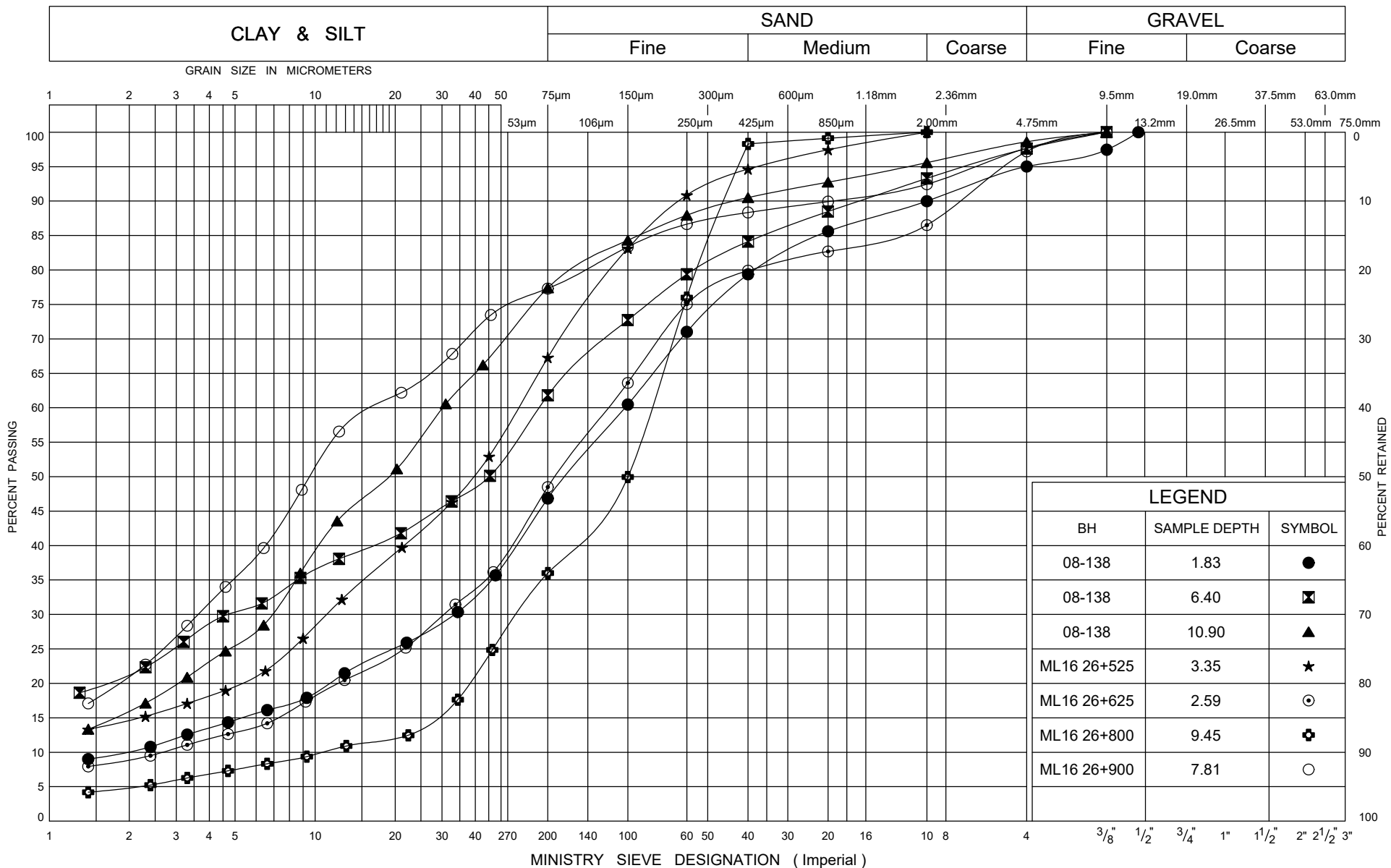
Ministry of  
Transportation

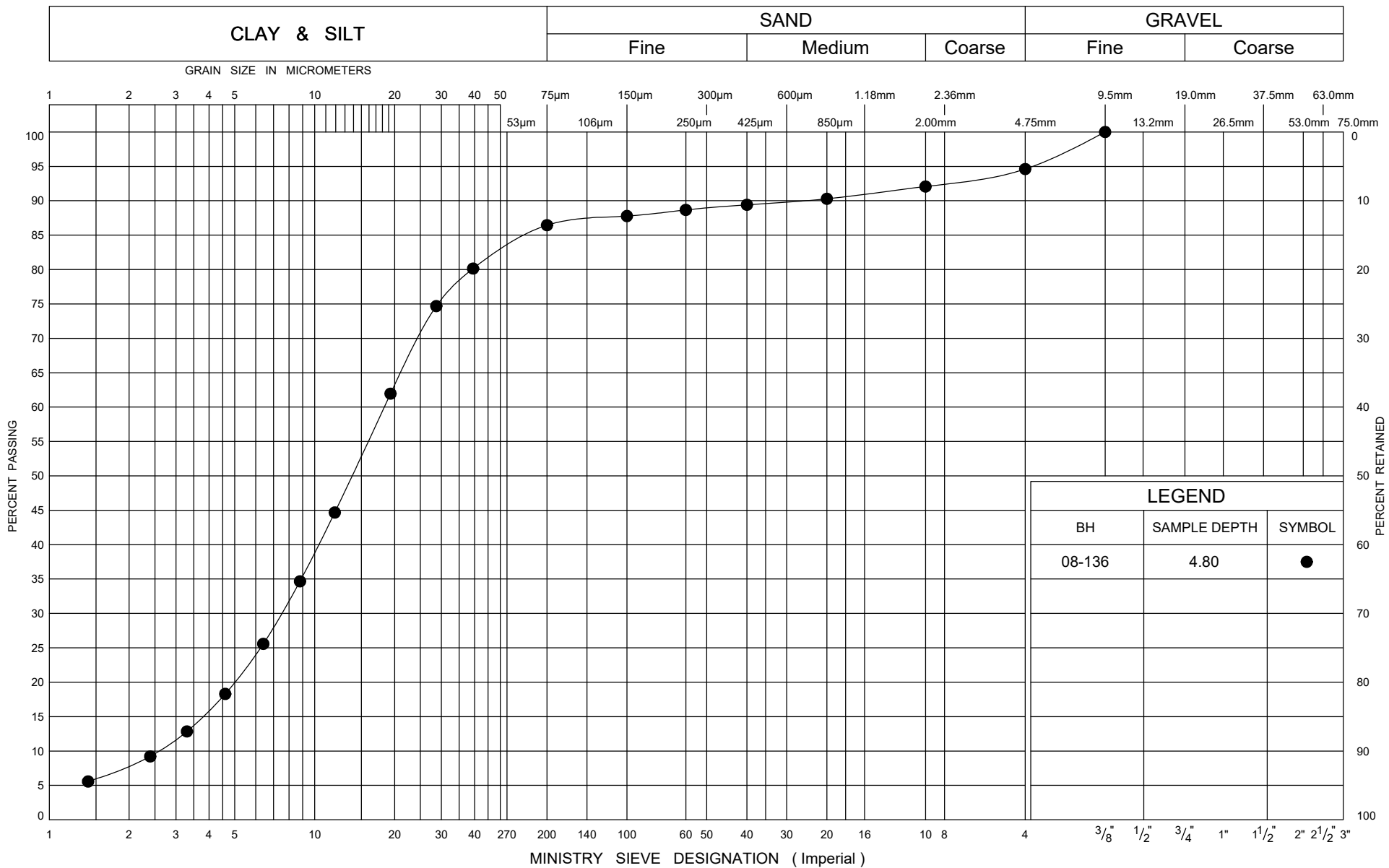
# **PLASTICITY CHART** Silty SAND to Sandy SILT TILL (Clayey SILT to Silty CLAY Layer)

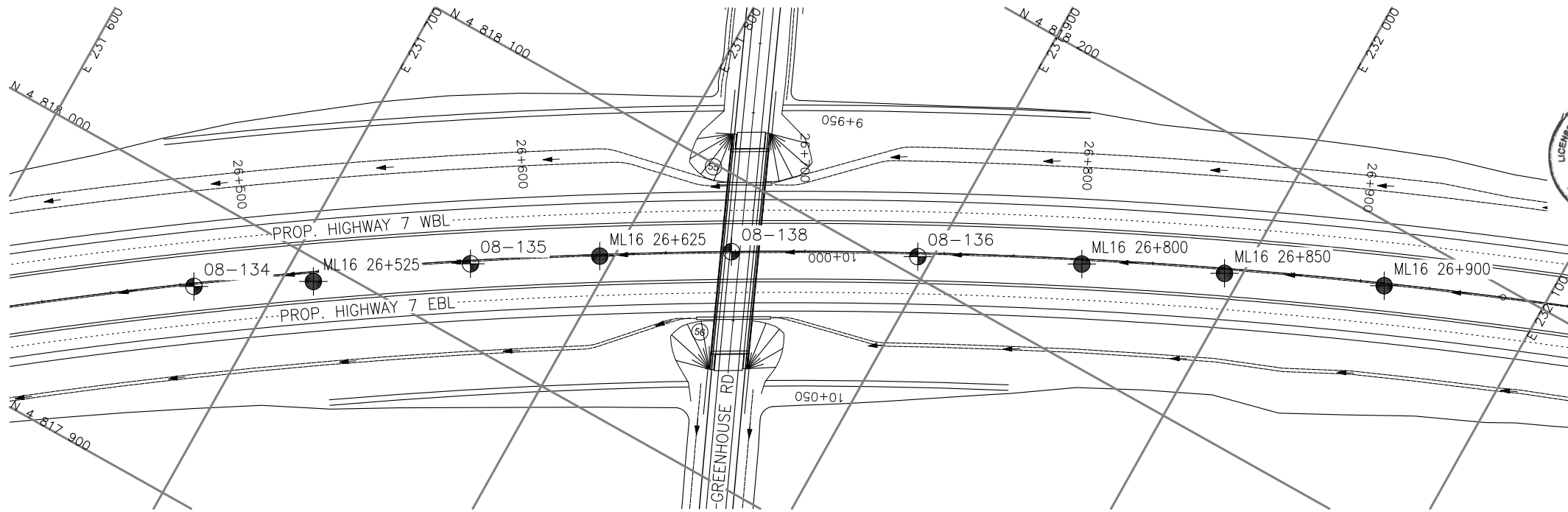
FIG No B7

GWP 408-88-00

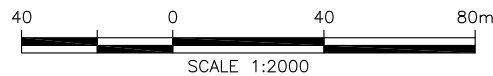








PLAN



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

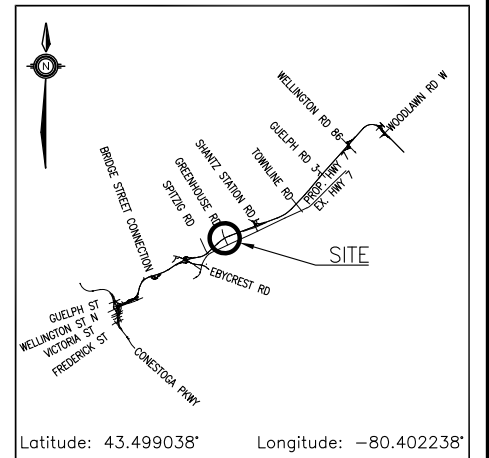


CONT No  
GWP No 408-88-00

HIGHWAY 7  
MAINLINE CUT  
26+450 TO 26+950  
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

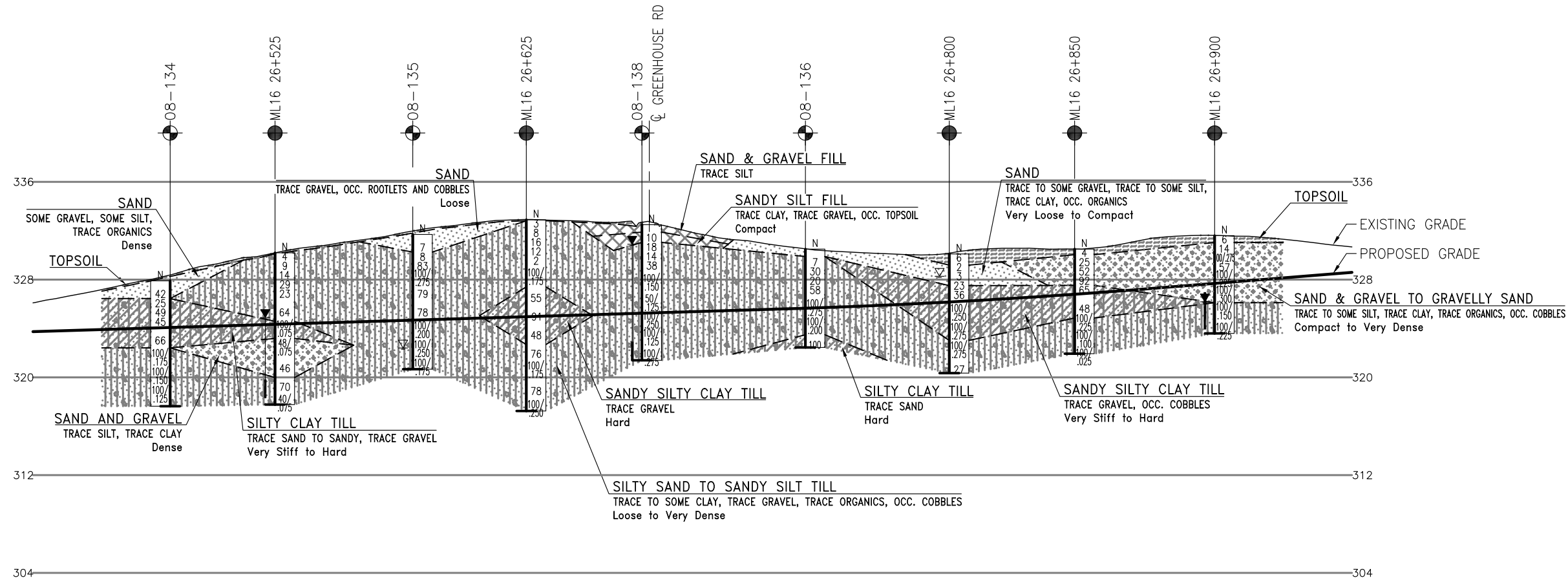
	Borehole (Current Investigation)
	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
ML16 26+525	330.2	4 817 992.7	231 710.1
ML16 26+625	332.9	4 818 050.9	231 795.4
ML16 26+800	330.1	4 818 133.2	231 947.9
ML16 26+850	330.5	4 818 155.3	231 994.2
ML16 26+900	331.6	4 818 179.5	232 046.4
08-134	327.9	4 817 970.1	231 673.6
08-135	331.7	4 818 025.8	231 756.2
08-136	330.5	4 818 106.6	231 895.2
08-138	332.5	4 818 075.5	231 835.9

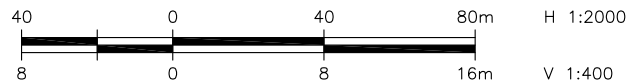
NOTES-

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

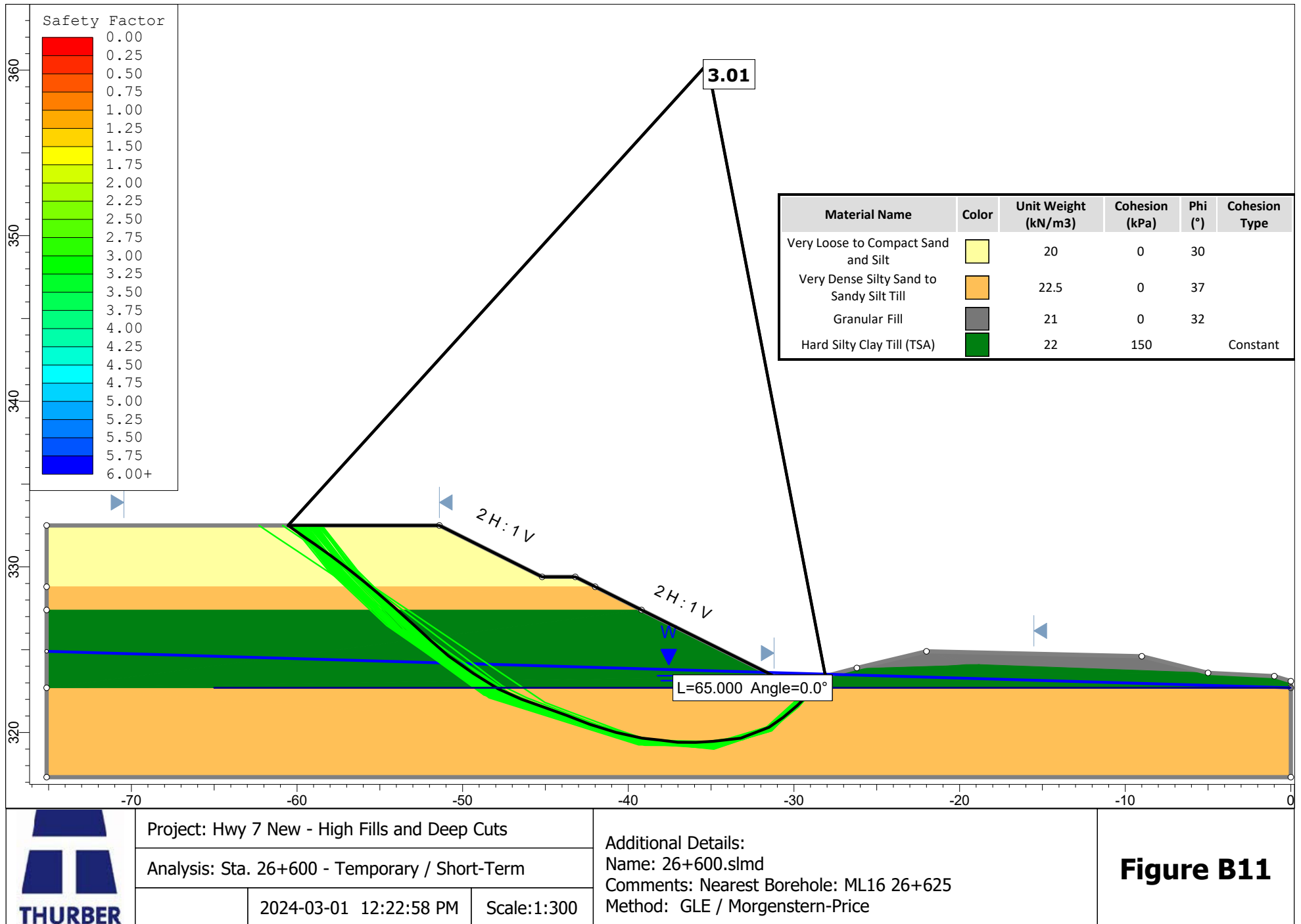
GEOCRES No. 40P09-067



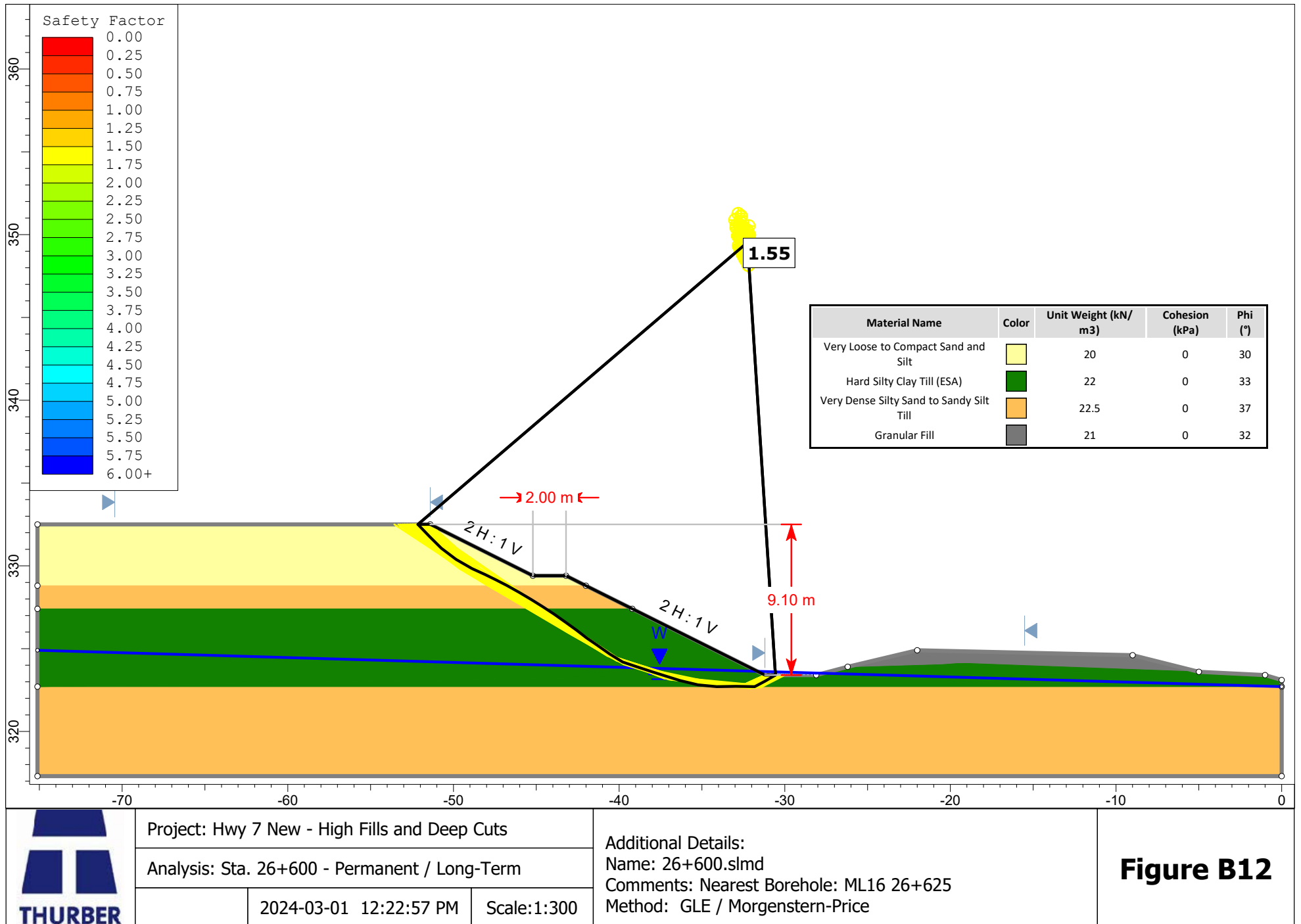
PROFILE ALONG PROPOSED HIGHWAY 7

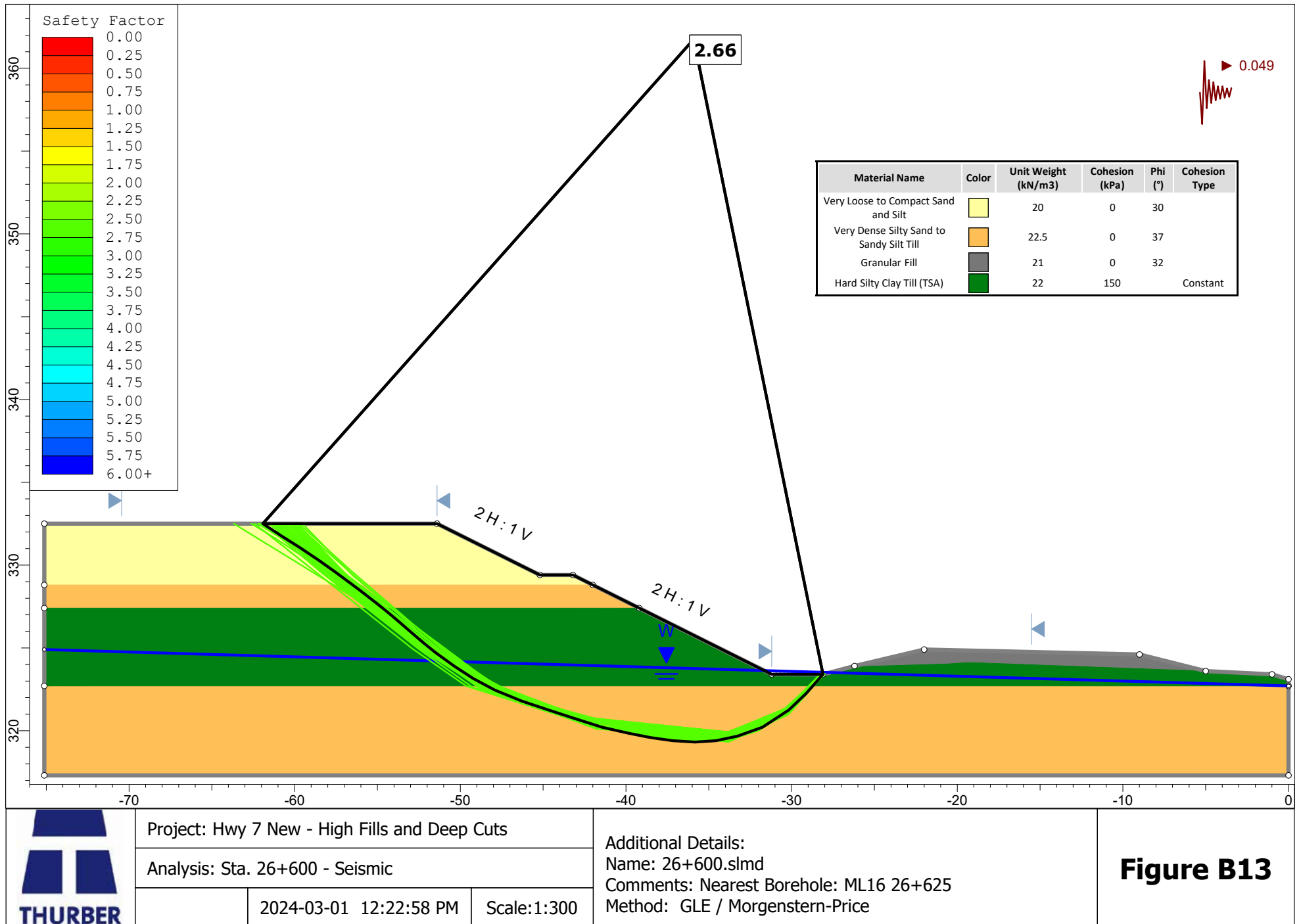


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MKE	CHK	PKC
DRAWN	MFA	CHK	MKE
LOAD			
STRUCT			
DWG	1		



**Figure B11**







## **Appendix C.**

**Highway 7: Station 27+350 – 27+900 (08-149, 08-150, 08-151, ML16 27+675)**

# RECORD OF BOREHOLE No 08-149

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 407.3 E 232 646.0 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 LATITUDE LONGITUDE CHECKED BY RPR

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 (%)										
325.4	GROUND SURFACE							20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>	kN/m <sup>3</sup>	GR	SA	SI	CL		
0.0	<b>SAND</b> , some gravel, some silt Loose Brown Moist						325															
			1	SS	9									○								
							324															
			2	SS	8									○								
323.2																						
2.2	Sandy <b>SILT</b> , trace to some clay, trace gravel Compact to Very Dense Brown to Grey Wet (TILL)		3	SS	22		323							○								
			4	S	38		322							○					1	30	63	6
	Layer of sand: (600mm)		5	SS	55		321							○					8	80	12	(SI+CL)
							320															
														○								
318.9	Layer of sandy silty clay		6	SS	100		319							○					3	31	50	16
6.6	END OF BOREHOLE AT 6.6m. BOREHOLE OPEN TO 4.6m AND WATER LEVEL AT 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.																					

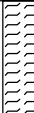

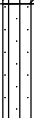

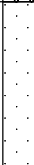
ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-11375(GINTDATA).GPJ 7/6/23

# RECORD OF BOREHOLE No 08-150

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 432.6 E 232 715.8 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.29 - 2008.05.29 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
323.0	GROUND SURFACE					▽										
0.0	<b>PEAT</b> , fibrous, occasional roots and wood fragments Brown (800mm)		1	AS	-											
322.2																
0.8	Clayey <b>SILT</b> , some sand Firm to Stiff Dark Brown Moist		1	SS	4											
			2	SS	12											
320.8																
2.2	Sandy <b>SILT</b> , trace clay Compact Brown Wet		3	SS	22											
320.0																
3.0	<b>SAND</b> and <b>GRAVEL</b> , trace silt, trace clay Compact to Dense Grey Wet		4	SS	33											
			5	SS	26											
317.4																
5.6	<b>SAND</b> , some silt Compact Grey Wet		6	SS	20											
316.3																
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 0.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.															

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

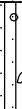
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-151

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 463.1 E 232 795.4 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.29 - 2008.05.29 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE				WATER CONTENT (%) w <sub>P</sub> w   w <sub>L</sub>					
322.4	GROUND SURFACE							20	40	60	80	100					
0.0	<b>PEAT</b> , wood fragments Black (600)		1	AS	-		322										
321.8																	
0.6	Gravelly <b>SAND</b> , some silt, some clay Compact Brown Moist		1	SS	10		321										
			2	SS	27		320										
			3	SS	19		319										
319.4																	
3.0	Sandy <b>SILT</b> , some clay, trace gravel Compact to Very Dense Grey Moist (TILL)		4	SS	14		318										
			5	SS	100/ .150		317										
316.1			6	SS	100/ .150												
6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO 1.9m AND WATER LEVEL AT 1.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.				.150												

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# RECORD OF BOREHOLE No ML16 27+675 1 OF 1 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 447.2 E 232 761.9 ORIGINATED BY JPL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.11 - 2018.07.12 LATITUDE 43.502474 LONGITUDE -80.390839 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  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 ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W    LIQUID LIMIT W <sub>L</sub>		
322.7	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (700mm)		1	SS	2												187
322.0							322										
0.7	Silty <b>SAND</b> , trace clay, trace gravel, occasional cobbles Compact to Very Dense Brown to Grey Moist to Wet Auger grinding at 1.2m		2	SS	57												
			3	SS	12		321										1 67 27 5
			4	SS	36		320										
	Auger grinding at 2.7m																
319.6																	
3.1	Silty <b>CLAY</b> , some sand, trace gravel Stiff to Hard Grey Moist		5	SS	15		319										
			6	SS	12		318										
							317										
			7	SS	41												
							316										
							315										0 11 39 50
314.5			8	SS	43												
8.2	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen.																
	WATER LEVEL READINGS DATE                  DEPTH(m)    ELEV.(m) 2018.08.31                  0.5                  322.3																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

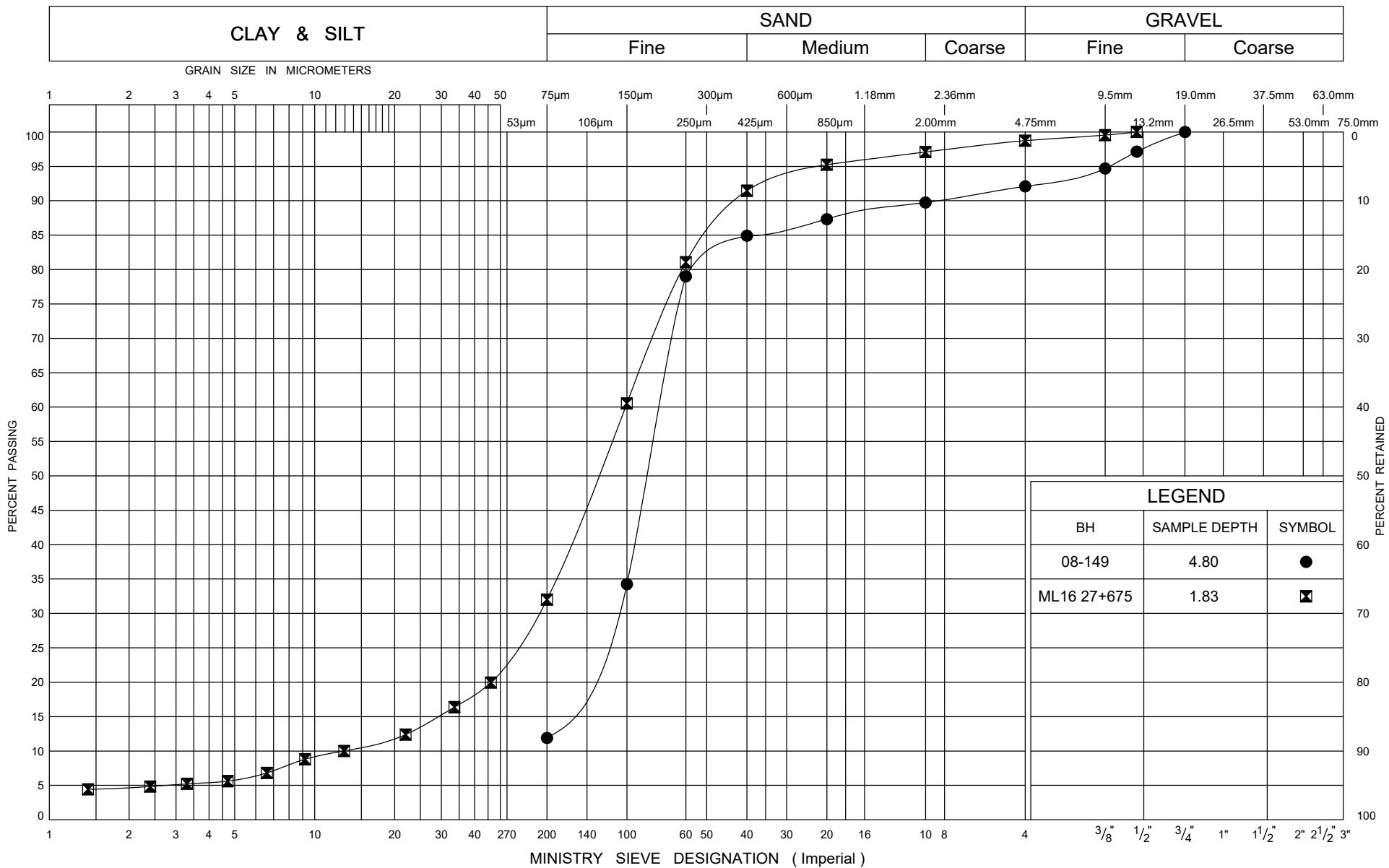
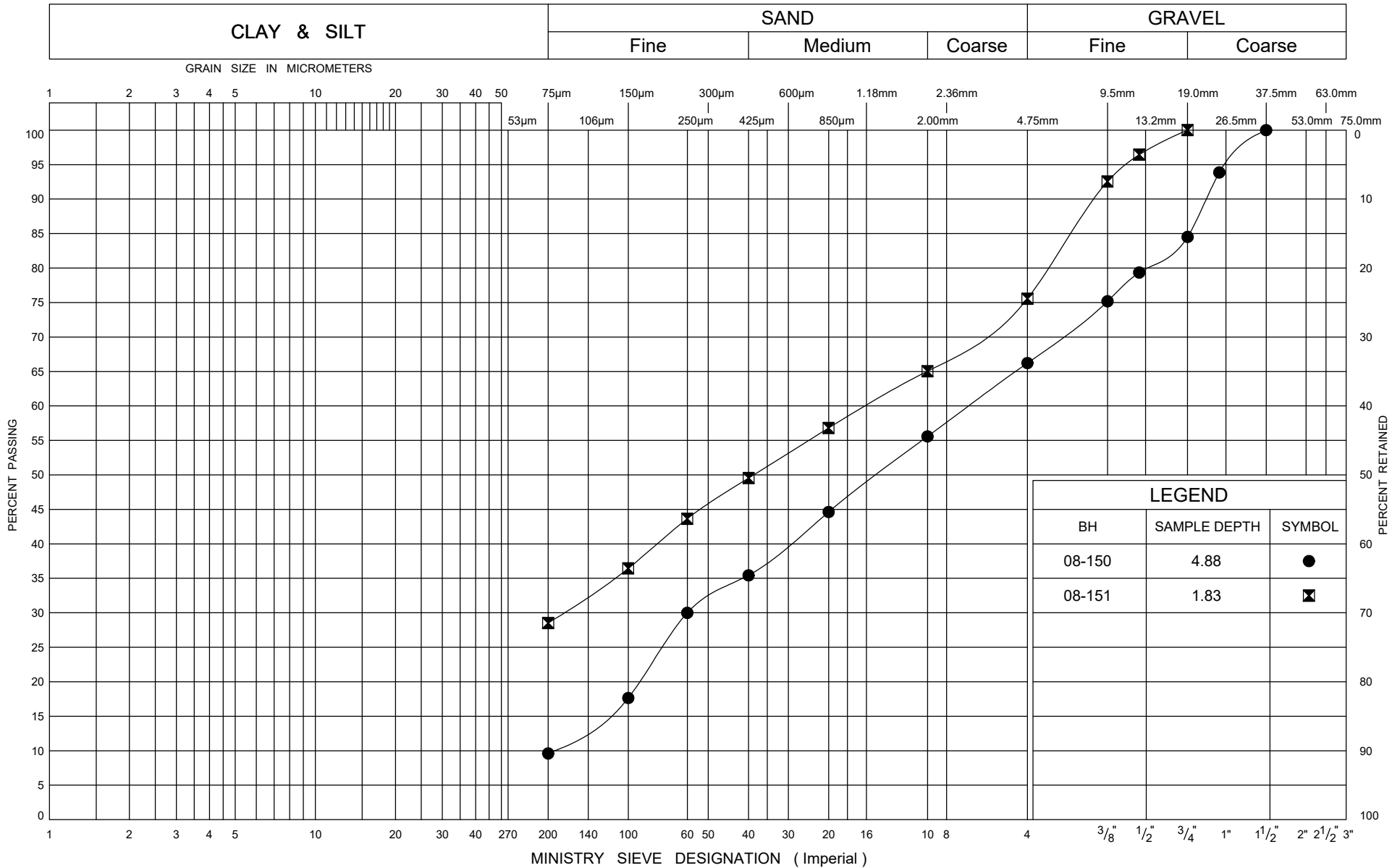




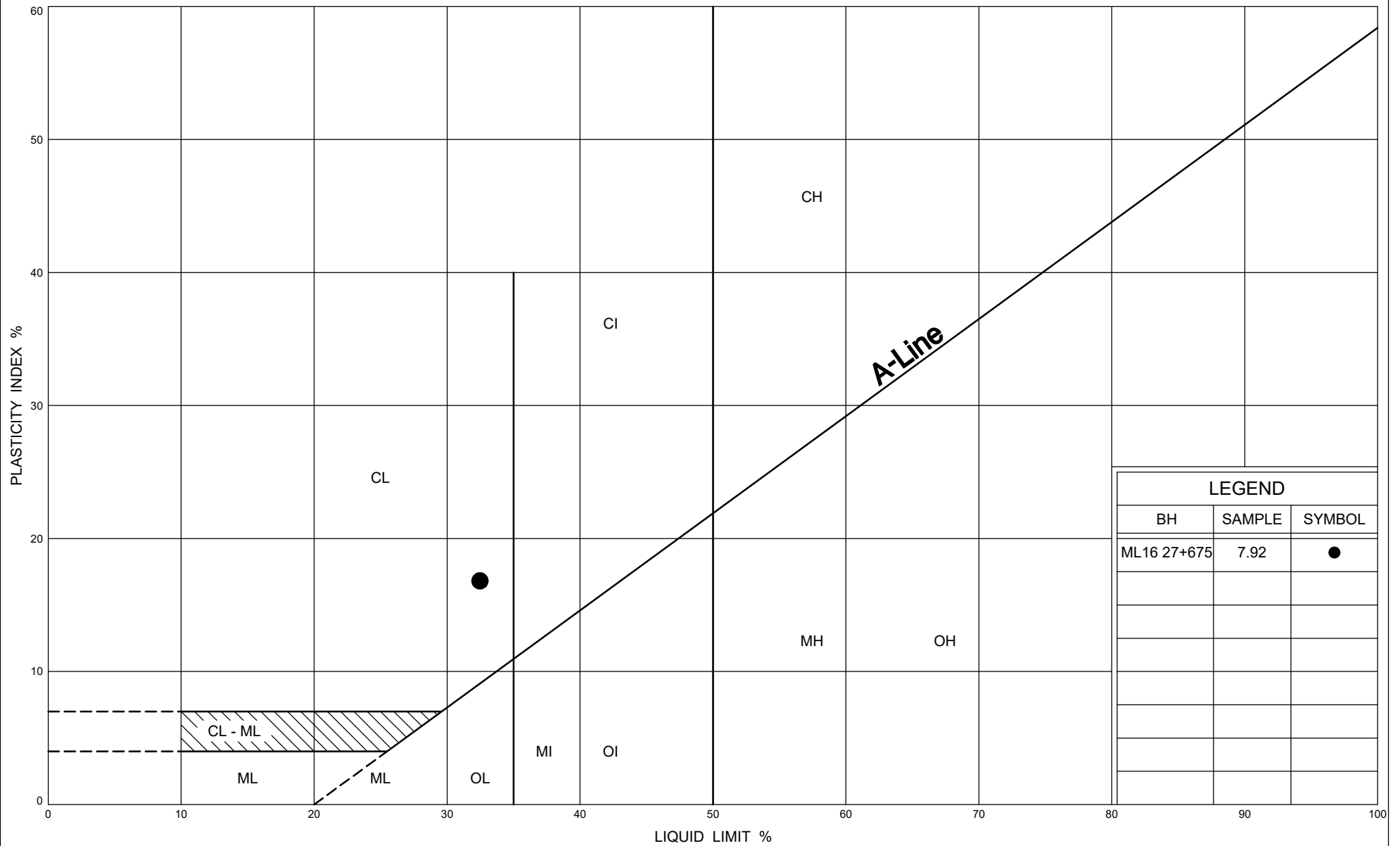
FIG No C2
GWP 408-88-00

ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 3/12/20



# GRAIN SIZE DISTRIBUTION SAND and GRAVEL to Gravelly SAND

FIG No C3  
GWP 408-88-00



Ministry of  
Transportation

## PLASTICITY CHART

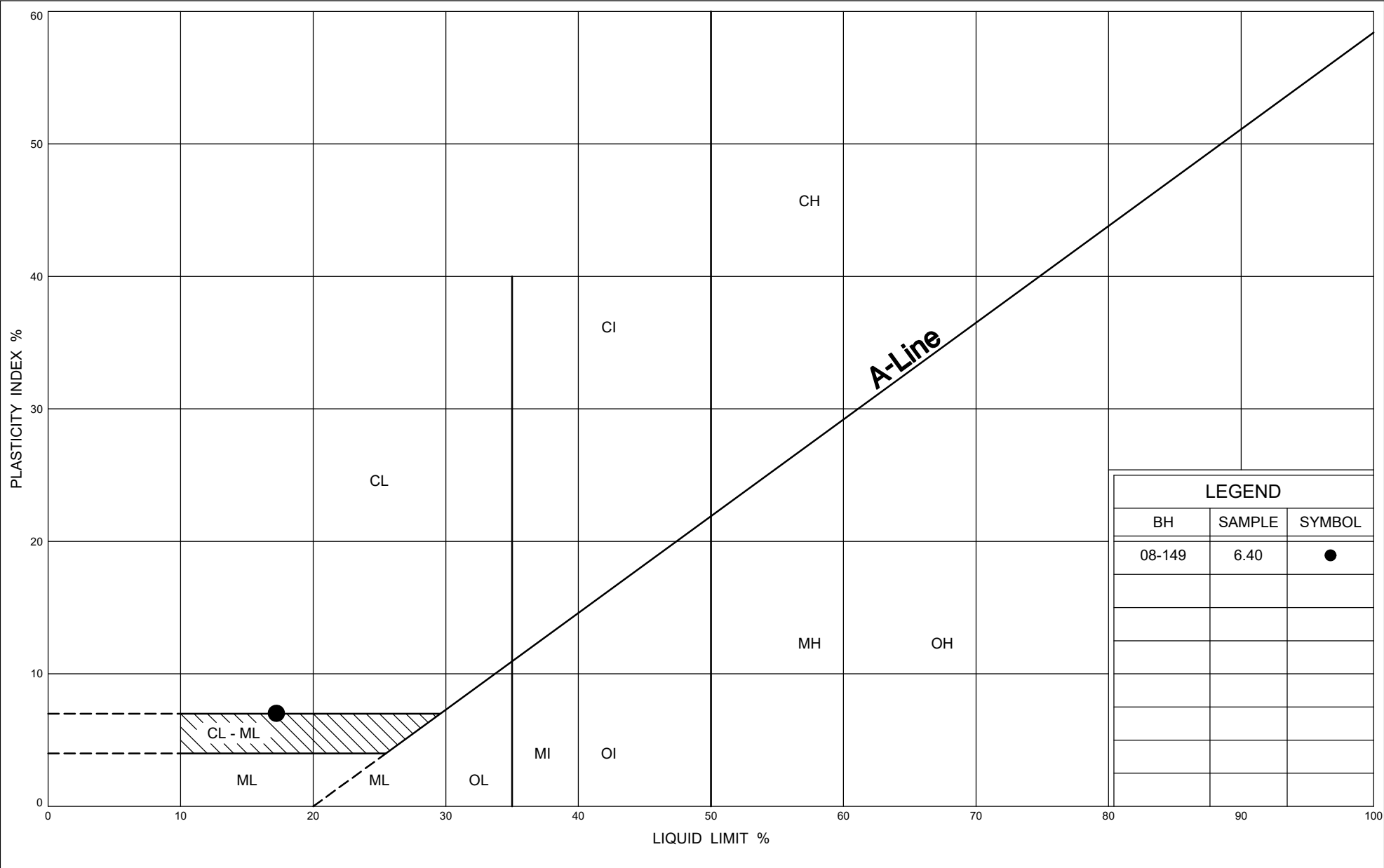
Silty CLAY

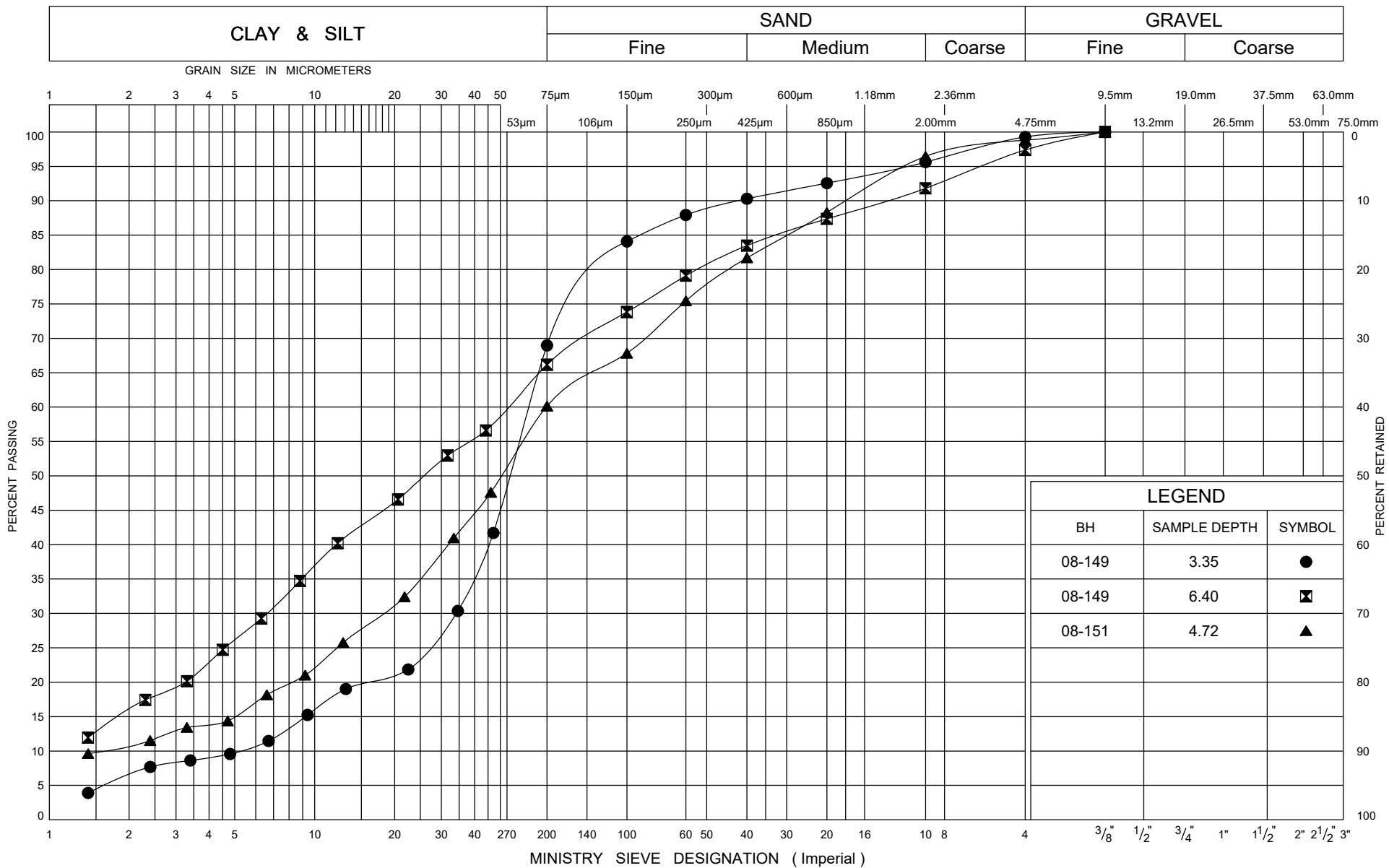
FIG No C4

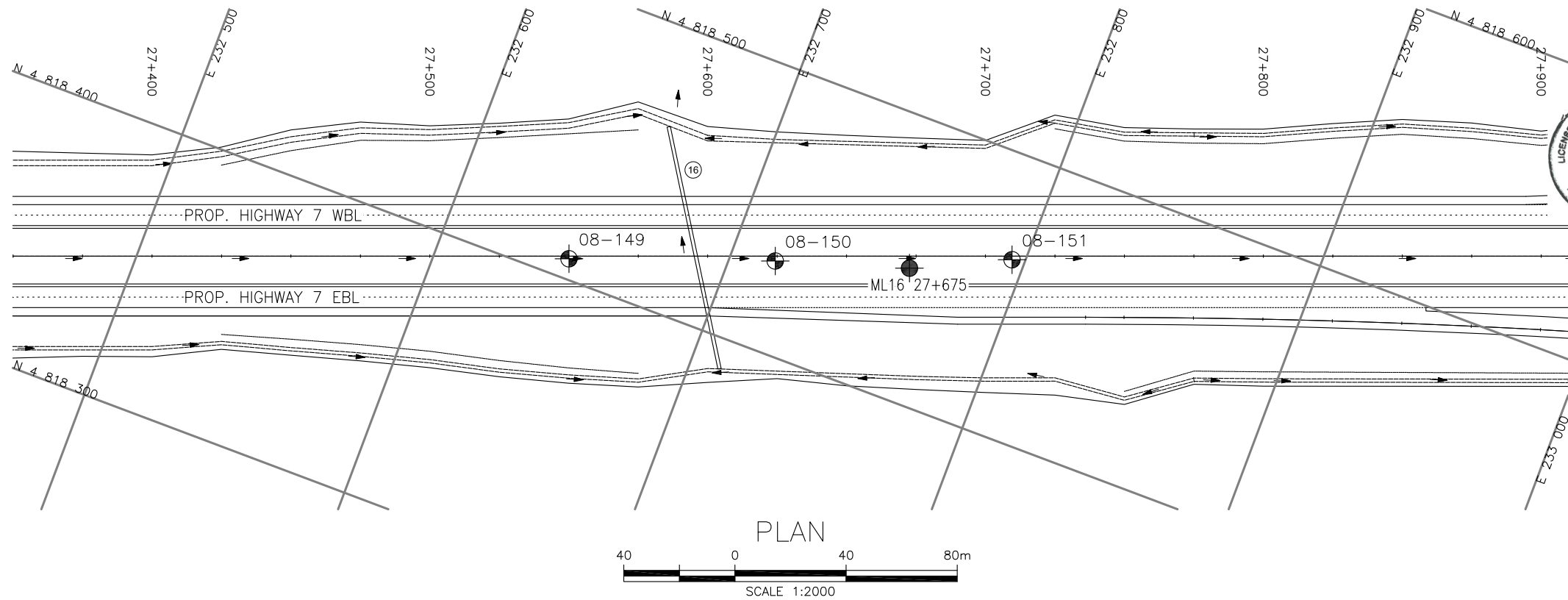
GWP 408-88-00



FIG No C5
GWP 408-88-00







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

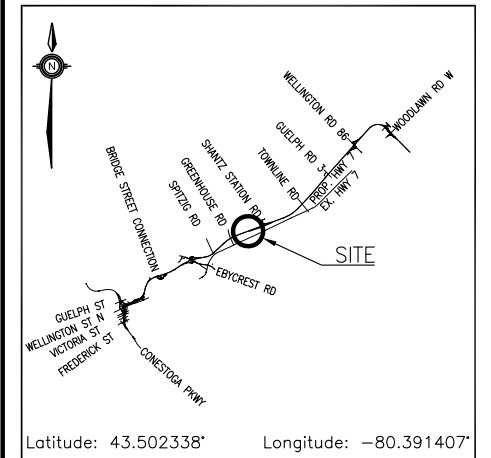


CONT No  
GWP No 408-88-00

HIGHWAY 7  
MAINLINE FILL  
27+350 TO 27+900  
BOREHOLE LOCATIONS AND SOIL STRATA



**THURBER** ENGINEERING LTD.



## KEYPLAN

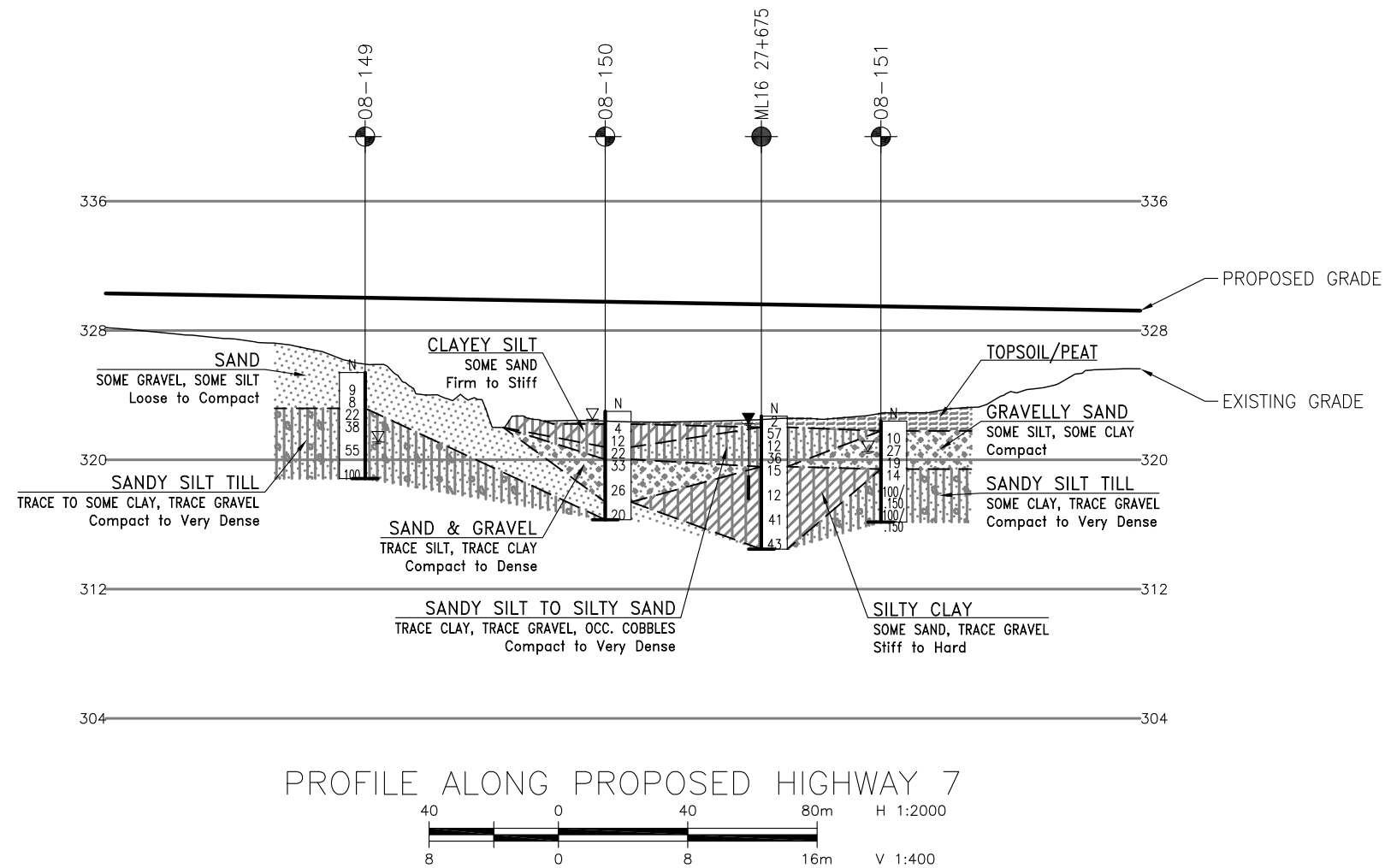
### LEGEND

[illegible]

-NOTES-

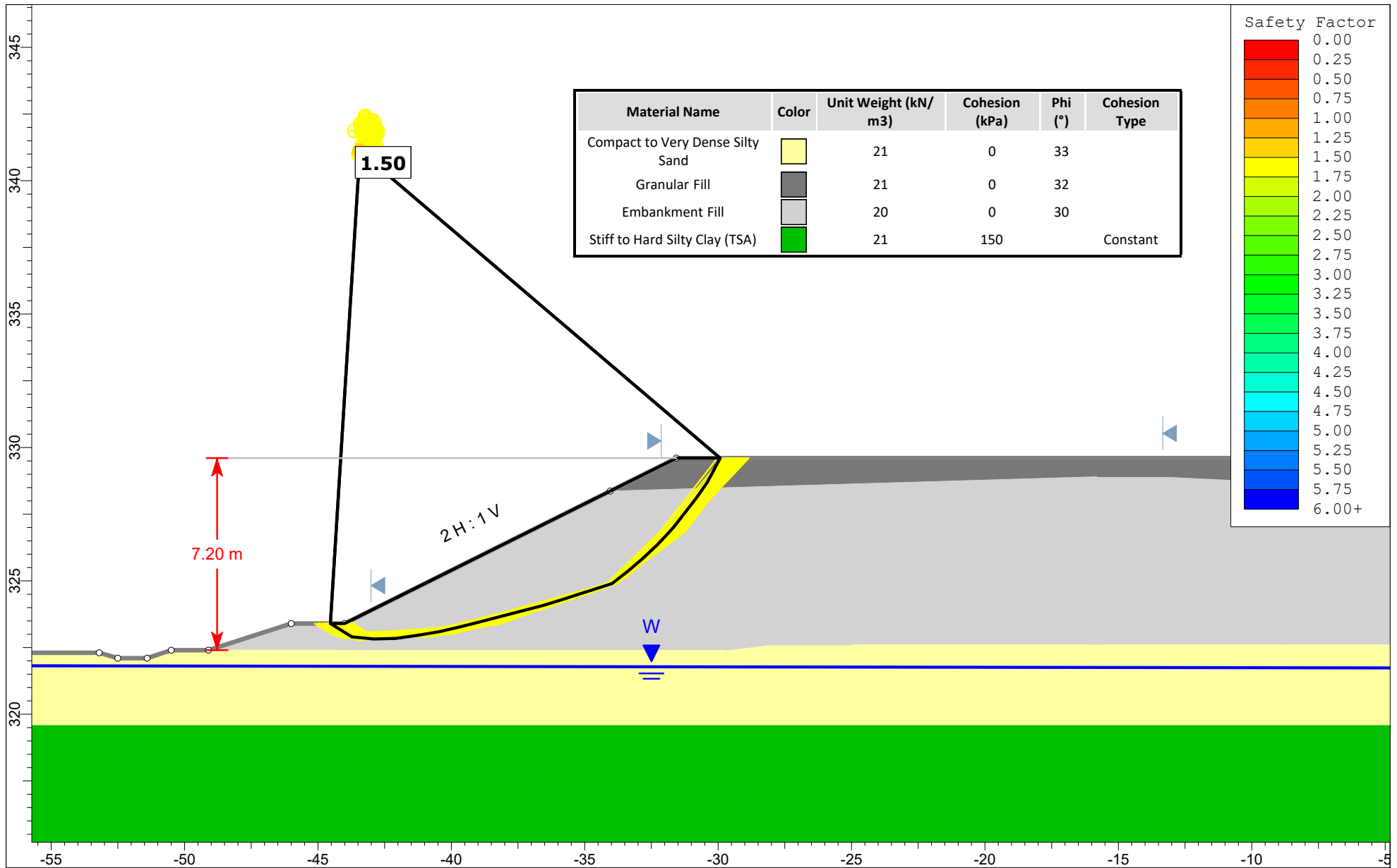
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is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

**GEOCRES No. 40P09-067**



## PROFILE ALONG PROPOSED HIGHWAY 7

[illegible]



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Temporary / Short-Term

2024-02-27 9:54:34 AM

Scale: 1:200

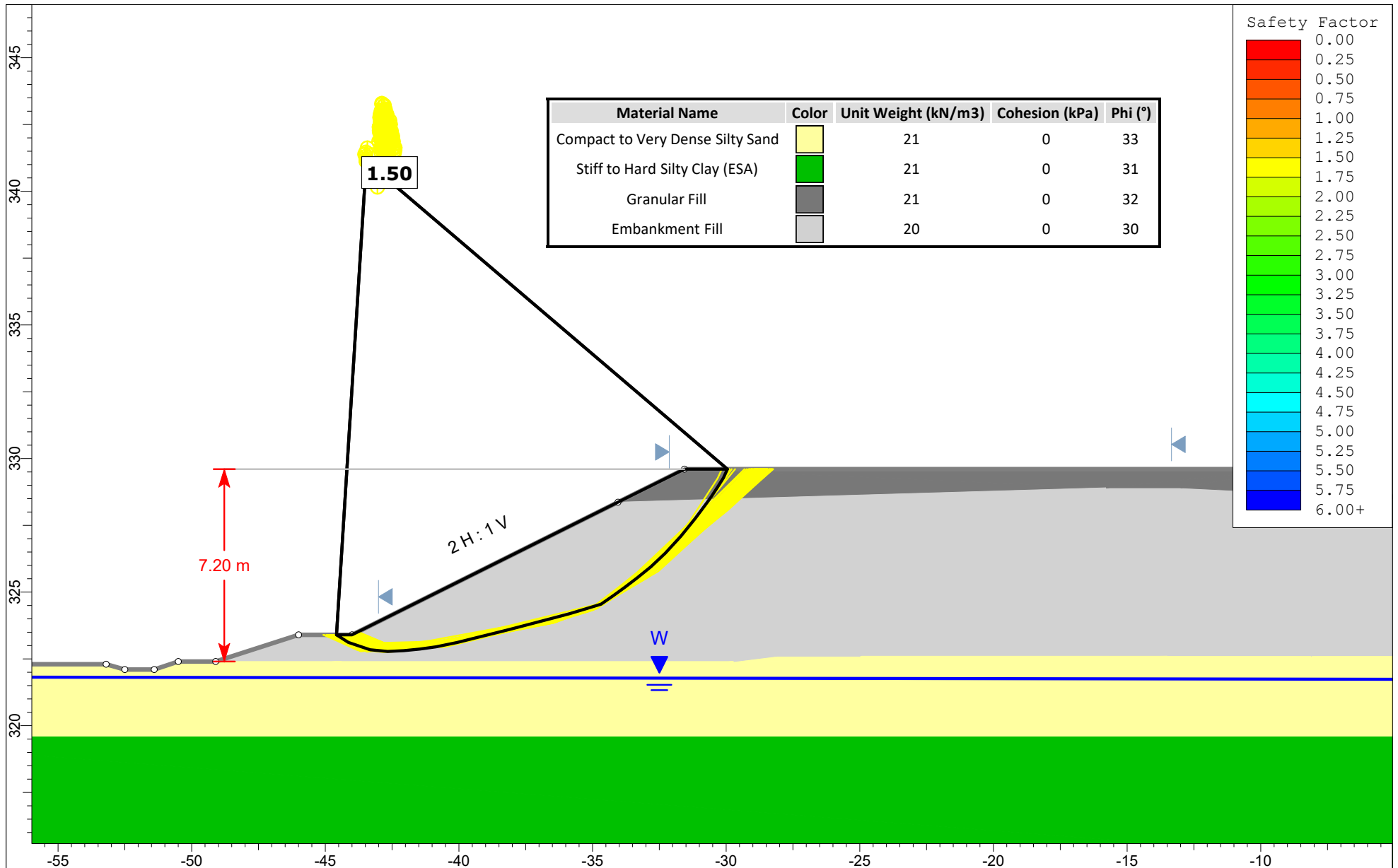
Additional Details:

Name: 27+625.slmd

Comments: Nearest BH ML 16 27+675

Method: GLE / Morgenstern-Price

**Figure C8**



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Permanent / Long-Term

2024-02-27 9:54:33 AM

Scale: 1:200

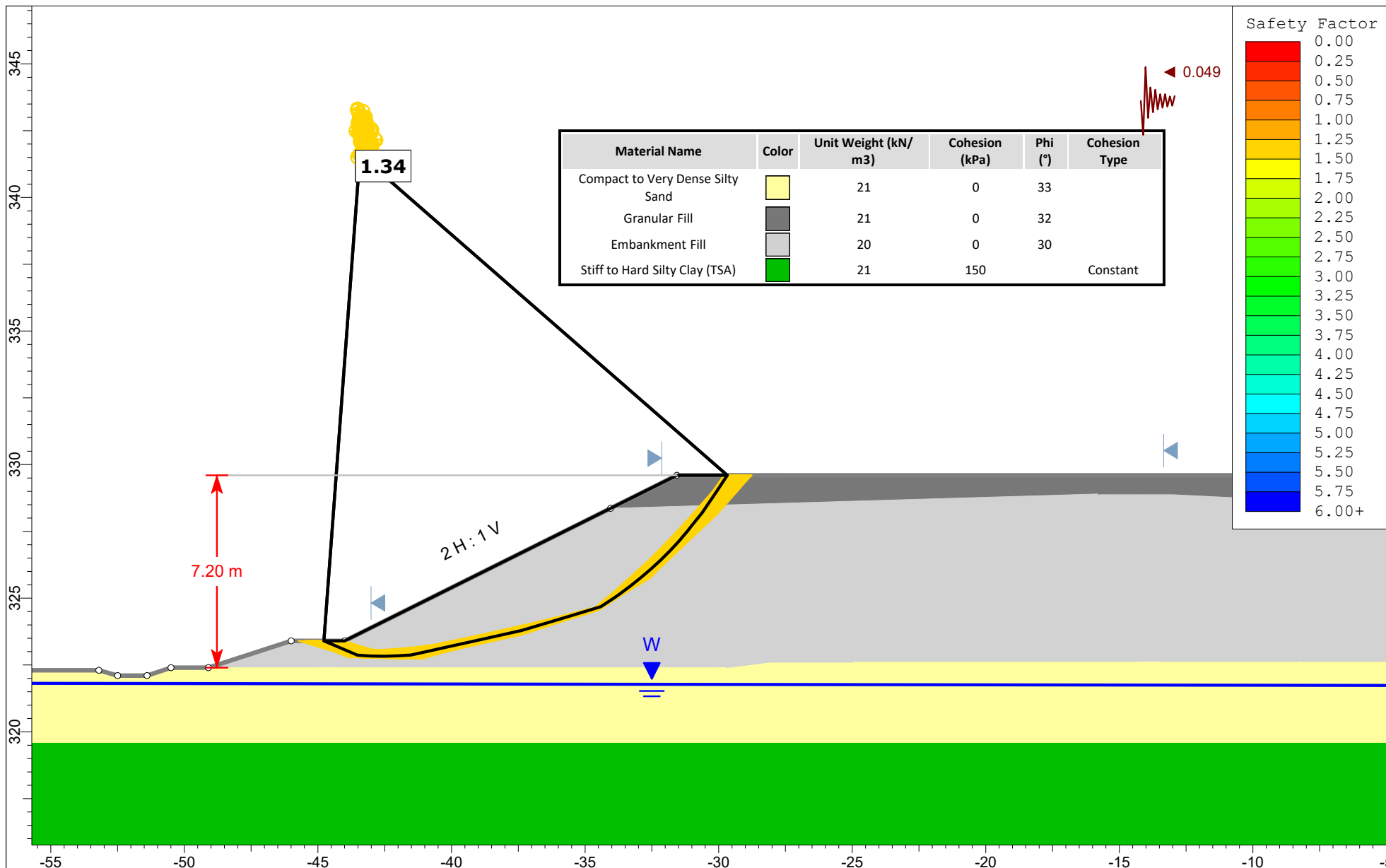
Additional Details:

Name: 27+625.slmd

Comments: Nearest BH ML 16 27+675

Method: GLE / Morgenstern-Price

**Figure C9**



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Seismic

2024-02-27 9:54:34 AM

Scale: 1:200

Additional Details:

Name: 27+625.slmd

Comments: Nearest BH ML 16 27+675

Method: GLE / Morgenstern-Price

**Figure C10**



#### **Appendix D.**

**Regional Road 30 (Shantz Station Road) S-W Ramp: Station 28+400 – 28+500 (08-156, 08-158, SH16-02)**

# RECORD OF BOREHOLE No 08-156

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 791.8 E 233 498.4 ORIGINATED BY LG  
 DIST HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.02 - 2008.12.02 LATITUDE LONGITUDE CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)									
332.7	GROUND SURFACE							20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>	GR	SA	SI	CL		
0.0	Clayey <b>SILT</b> , trace sand, occasional rootlets, occasional organics Firm to Very Stiff Black to Brown Moist		1	SS	6																
331.5			2	SS	15																
1.2	<b>SAND</b> , trace silt to silty, trace gravel to gravelly Compact to Dense Brown to Grey Moist		3	SS	36													21	56	23 (SI+CL)	
			4	SS	27																
			5	SS	26														8	66	26 (SI+CL)
			6	SS	80																
			7	SS	55																
					</																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-158

1 OF 3

METRIC

GWP# 408-88-00 LOCATION N 4 818 713.0 E 233 462.6 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  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 ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									WATER CONTENT (%)
330.0	GROUND SURFACE							20	40	60	80	100					
0.0	<b>SAND</b> , some gravel, some clay, occasional topsoil Dark Brown (FILL)													○			
329.5																	
0.5	Silty <b>CLAY</b> , some sand to sandy, trace gravel, occasional cobbles Stiff to Hard Brown to Grey Moist (TILL)		1	SS	14									○			
			2	SS	40									○			
			3	SS	67									○			
			4	SS	74									○			2 22 48 28
			5	SS	46									○			
			6	SS	83									○			
			7	SS	61									○			1 18 48 33
320.7	Layer of silt													○			1 16 77 6
9.3	Clayey <b>SILT</b> , trace sand, trace gravel Very Stiff to Hard Grey (TILL)		8	SS	20									○			

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT  γ 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		WATER CONTENT (%)					
							○ UNCONFINED	+ FIELD VANE	w <sub>p</sub>	w	w <sub>L</sub>			
	Continued From Previous Page						20 40 60 80 100		20 40 60					
316.7 13.3	Clayey <b>SILT</b> , trace sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		9	SS	51								0 5 75 20	
			10	SS	125								0 7 77 16	
312.3 17.7	Silty <b>CLAY</b> , trace sand, trace gravel Hard Grey Moist (TILL)		11	SS	55									
			12	SS	31								1 6 35 58	
	Slow augering		13	SS	33									
	Sandy <b>SILT</b> , some clay, trace gravel Very Dense Grey Moist (TILL)  Layer of clayey silt and sand		14	SS	100/ .175								4 42 40 14	
			15	SS	100/									

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

RECORD OF BOREHOLE No 08-158

3 OF 3

METRIC

GWP# 408-88-00 LOCATION N 4 818 713.0 E 233 462.6 ORIGINATED BY SLL  
DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
DATUM Geodetic DATE 2008.05.22 - 2008.05.23 LATITUDE LONGITUDE CHECKED BY RPR


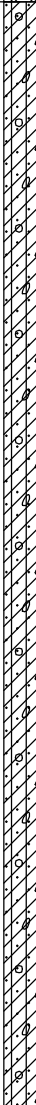
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
308.6	Sandy SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		16	SS	100/		309										
21.4	END OF BOREHOLE AT 21.4m, AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2008.05.28 6.8 323.2 2008.06.02 8.8 321.2 2008.07.15 9.0 321.0 2008.08.20 6.8 323.2				100												

# RECORD OF BOREHOLE No SH16-02

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 751.2 E 233 451.1 ORIGINATED BY OA  
 DIST HWY BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2017.07.25 - 2017.07.26 LATITUDE 43.505276 LONGITUDE -80.382356 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  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								
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
					WATER CONTENT (%)											
					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT											
					w P w w L											
330.7	GROUND SURFACE						20 40 60 80 100									
0.0	Gravelly <b>SAND</b> , some silt Loose to Compact Brown Moist (FILL)		1	SS	20											
			2	SS	8											
			3	SS	11											
328.5																
2.2	Sandy Silty <b>CLAY</b> , trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		4	SS	16											
			5	SS	40											
			6	SS	27											
			7	SS	23											
			8	SS	38											
			9	SS	78											

Continued Next Page

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

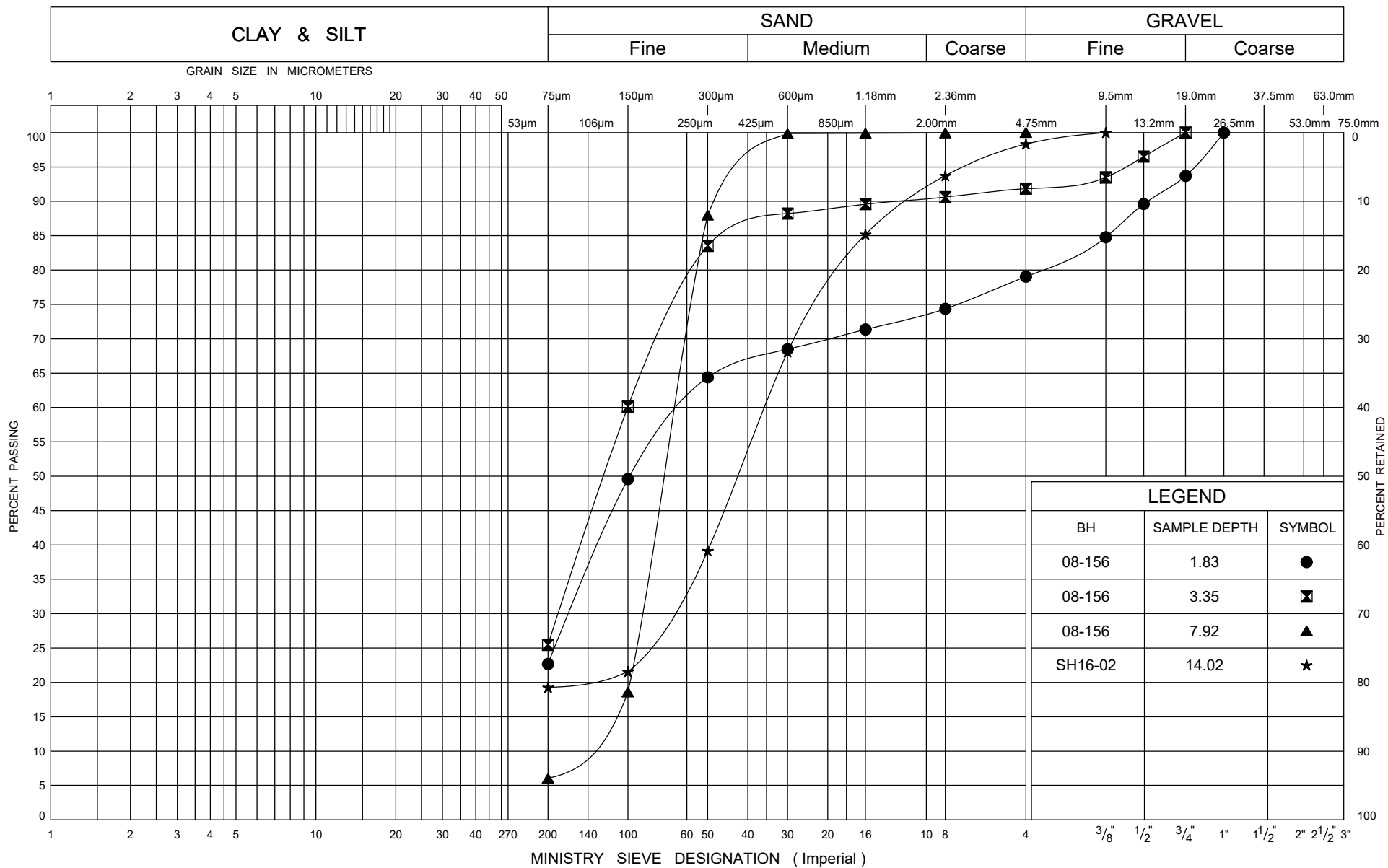
## METRIC

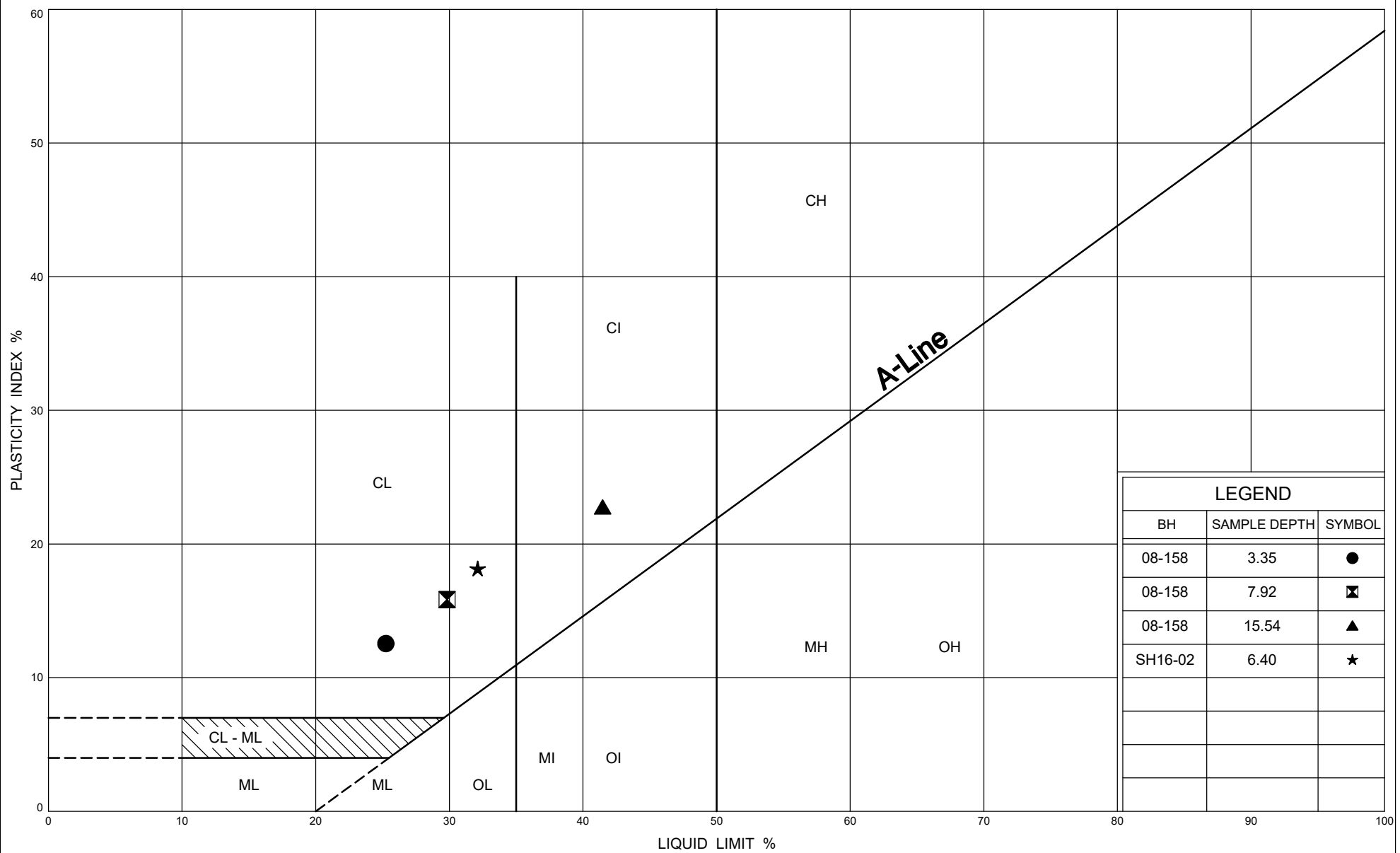
Continued Next Page

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

## METRIC

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





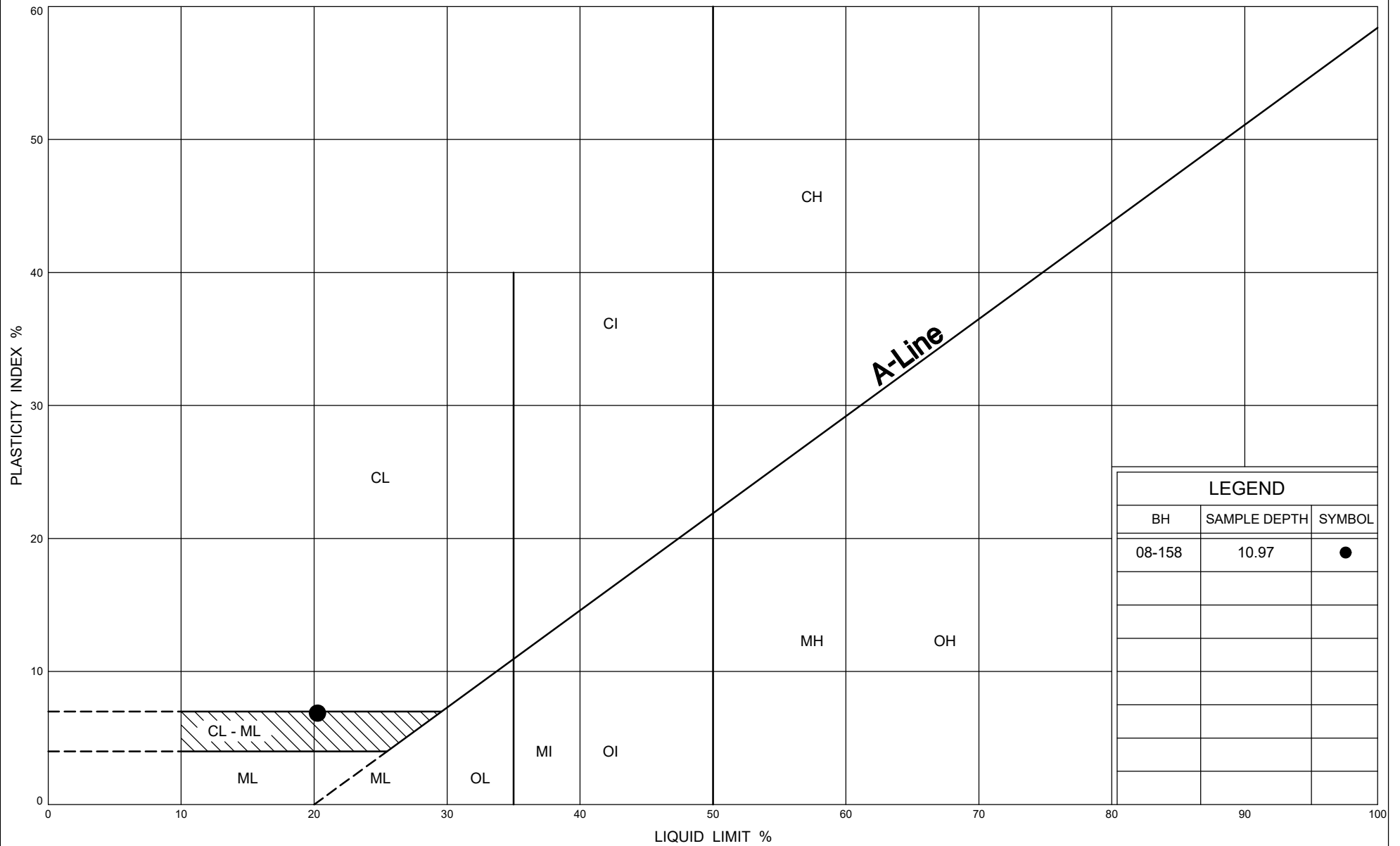
Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY TILL

FIG No D2

GWP 408-88-00



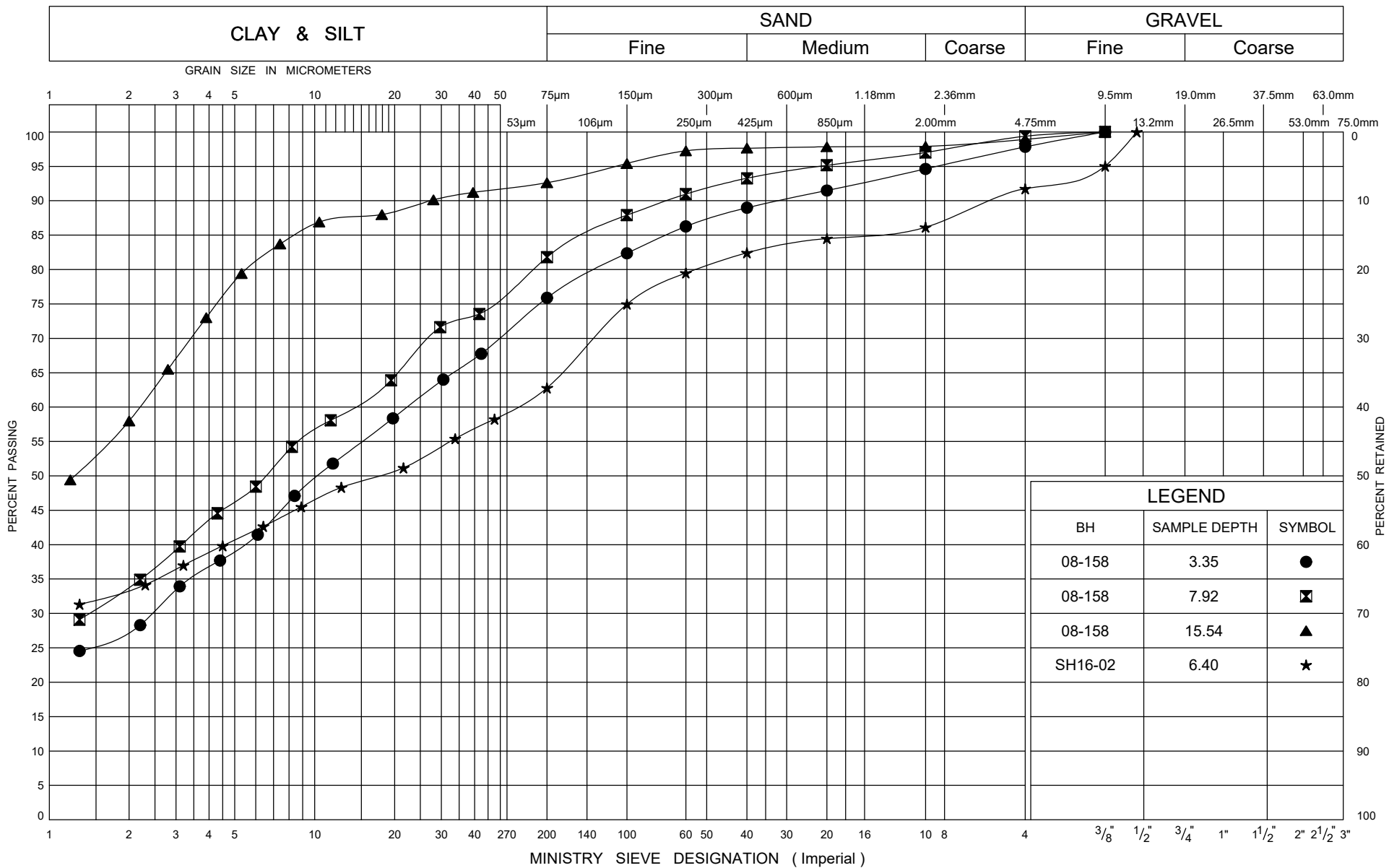
Ministry of  
Transportation

## PLASTICITY CHART

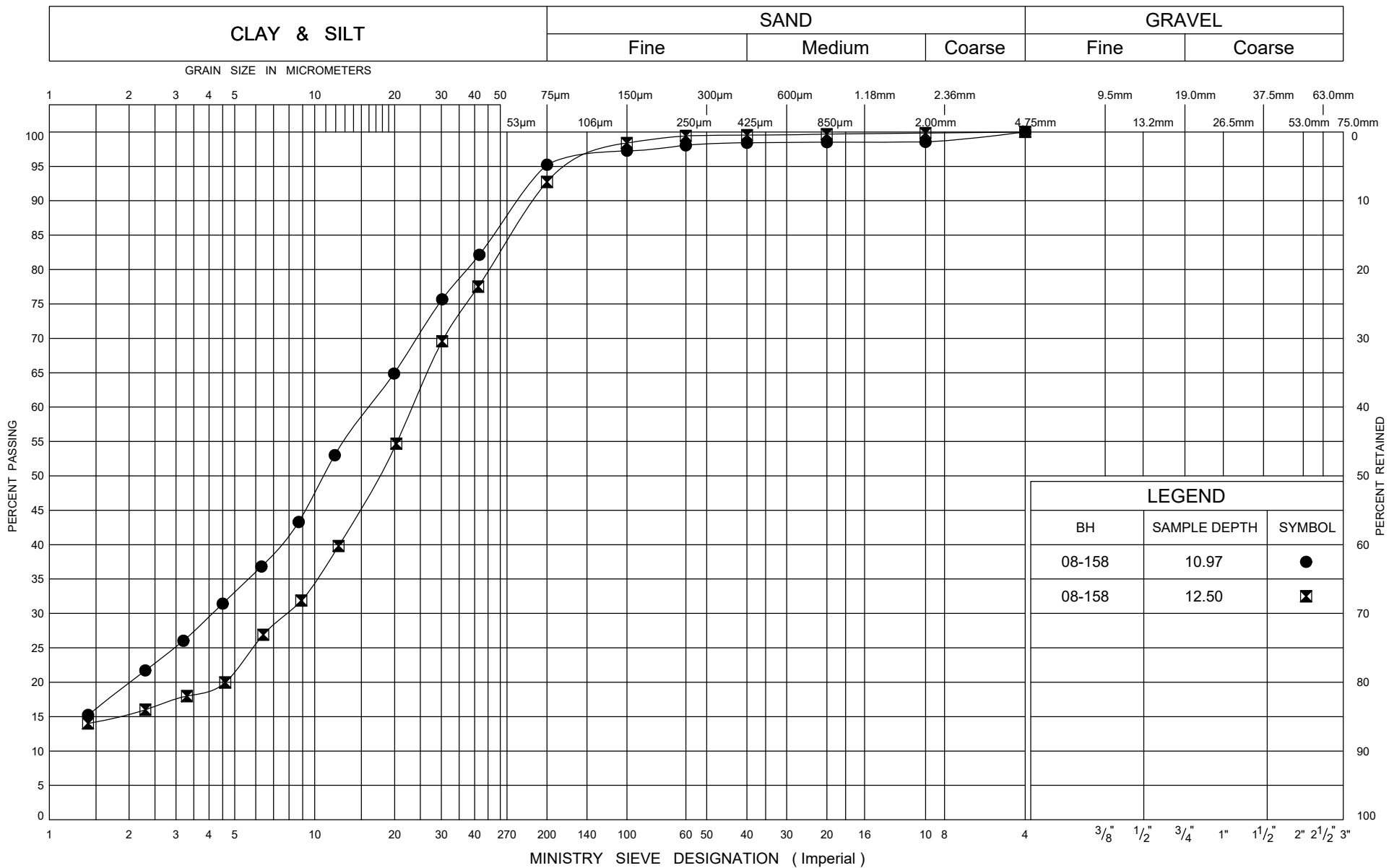
Clayey SILT TILL

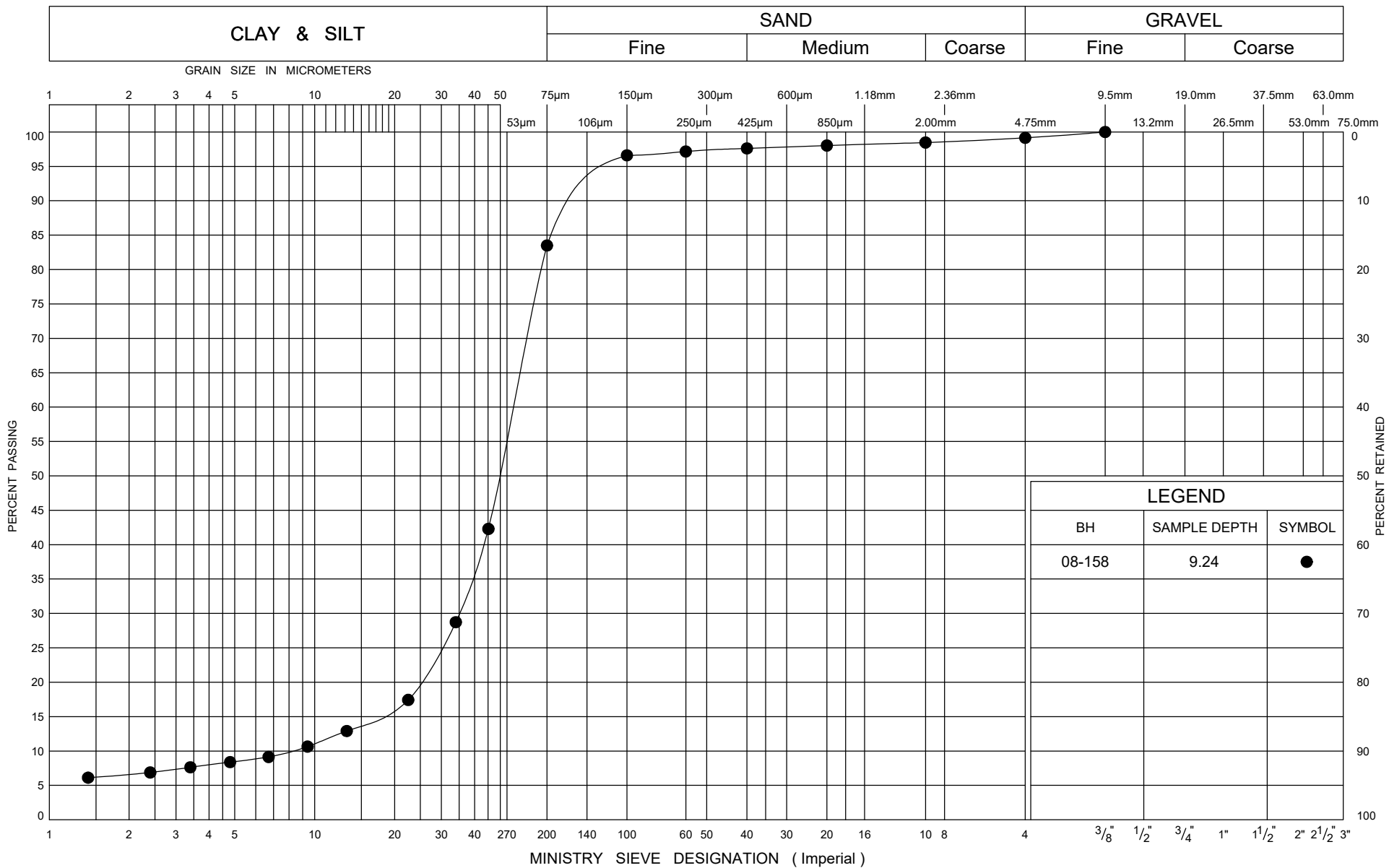
FIG No D3

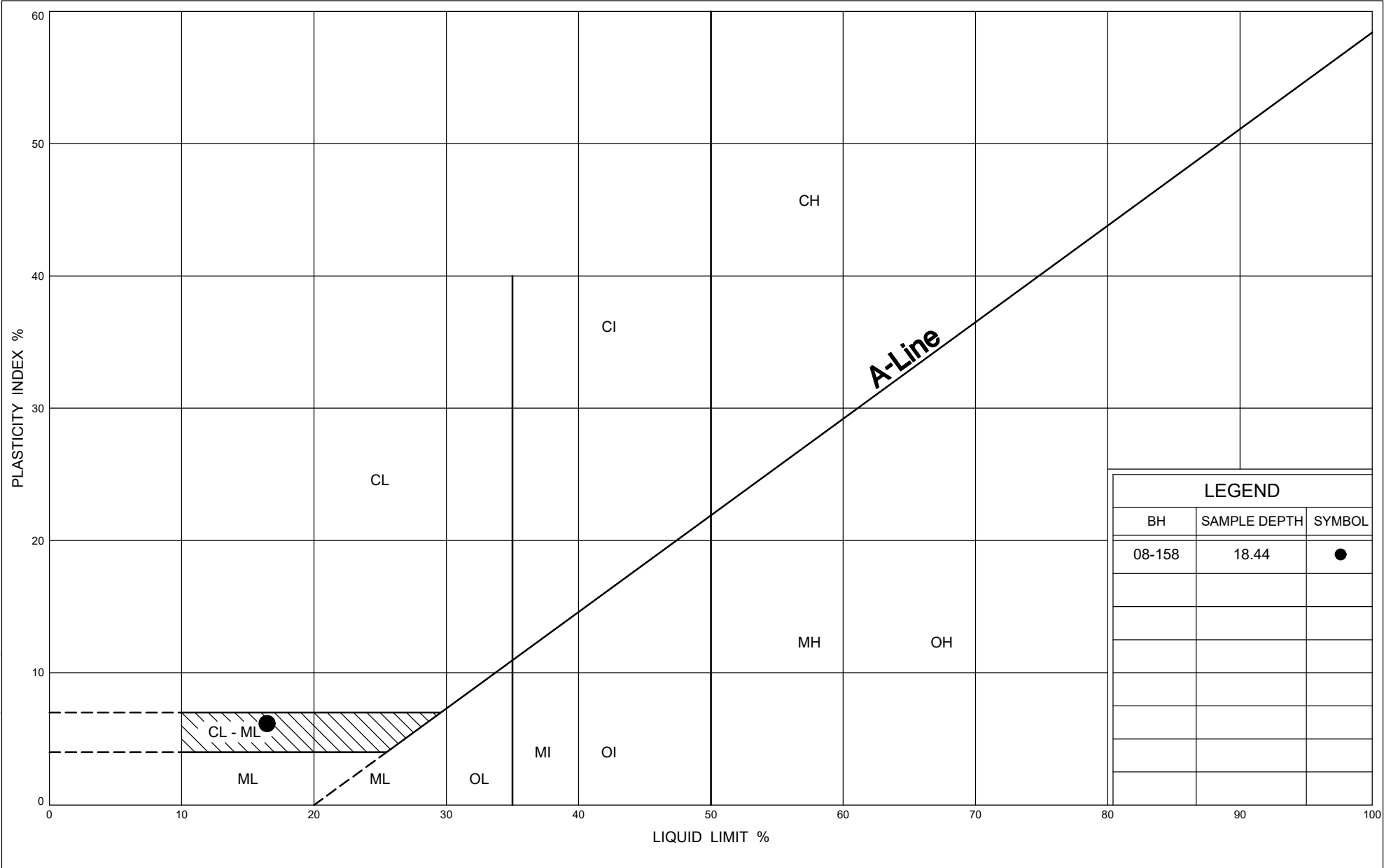
GWP 408-88-00



ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 3/16/20







**PLASTICITY CHART**  
Sandy SILT TILL  
(Clayey SILT and SAND Layer)

FIG No D7  
GWP 408-88-00

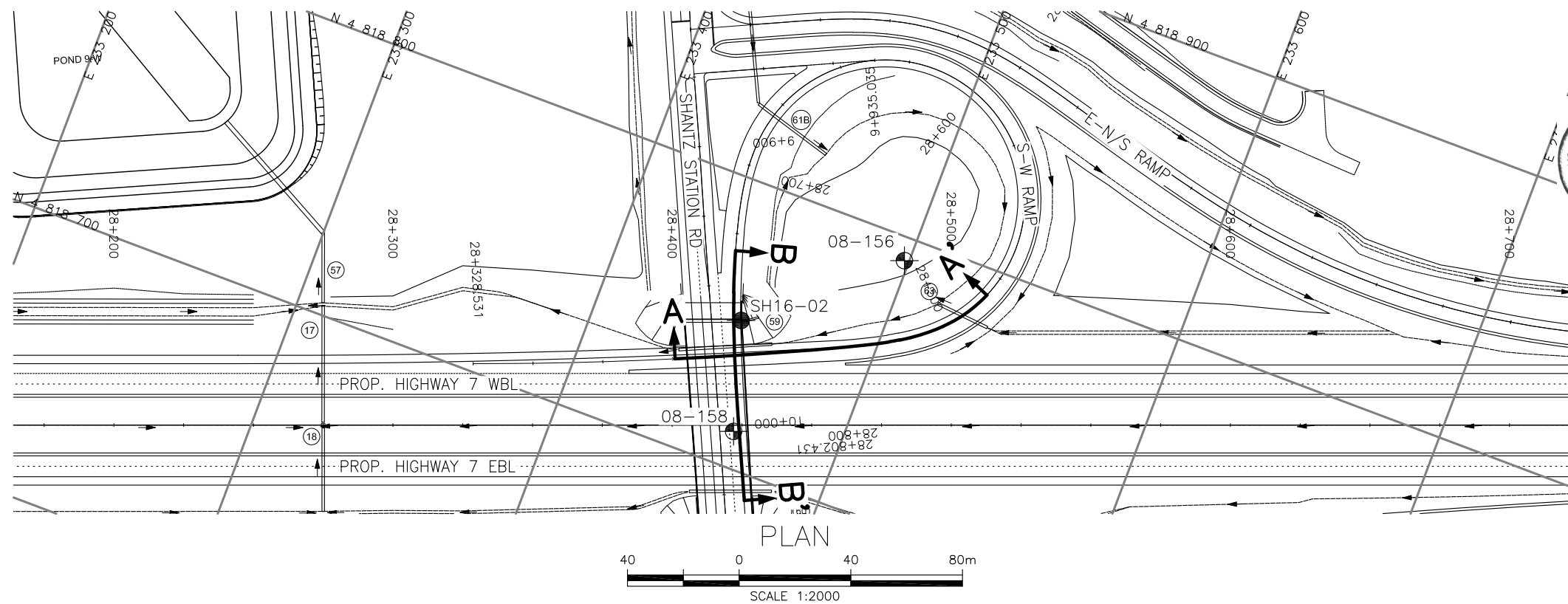




FIG No D8
GWP 408-88-00



FIG No D9
GWP 408-88-00



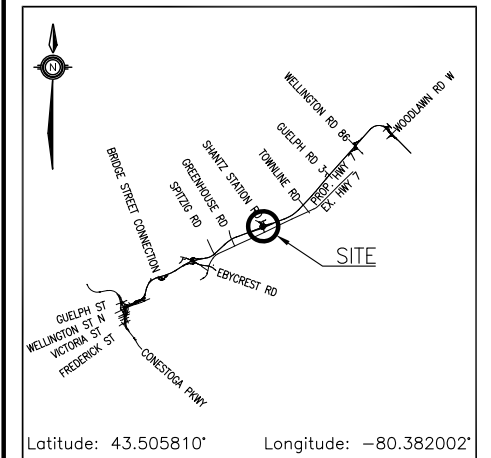
METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWNCONT No  
GWP No 408-88-00REGIONAL ROAD 30  
(SHANTZ STATION ROAD)  
S-W RAMP CUT/FILL  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

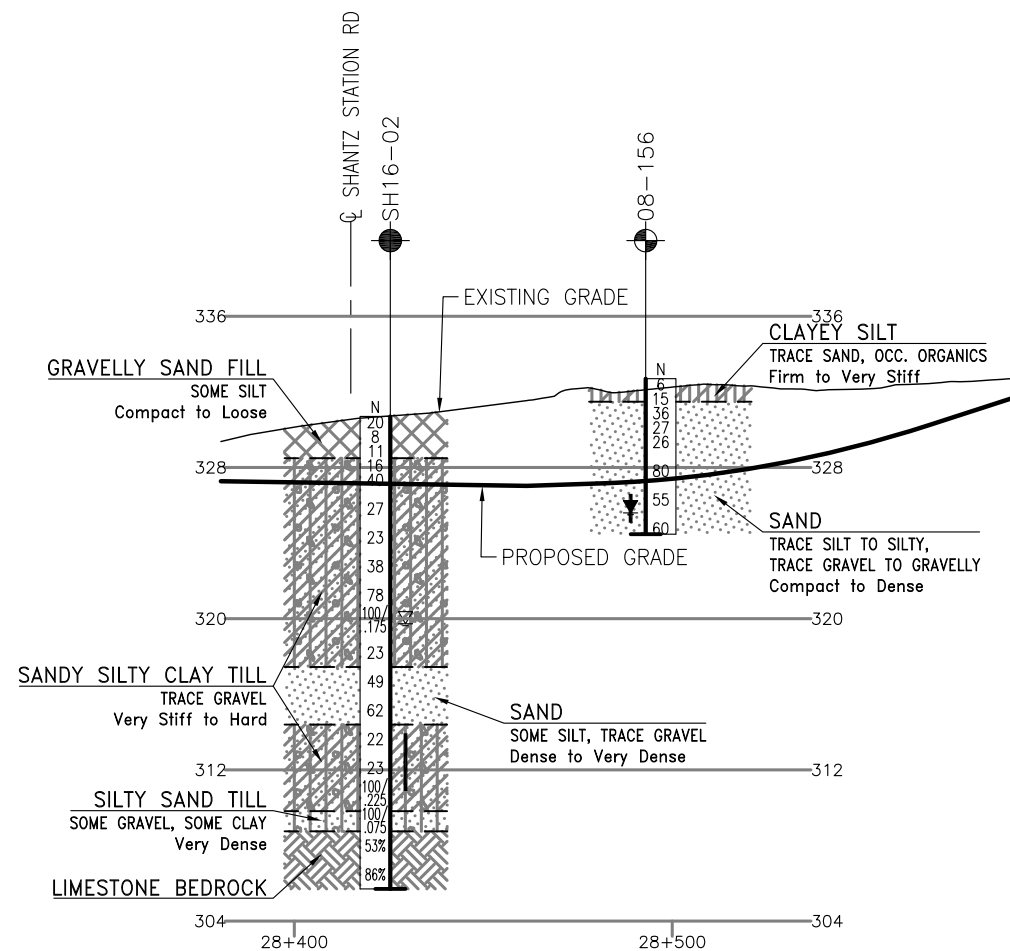
	Borehole (Current Investigation)
	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SH16-02	330.7	4 818 751.2	233 451.1
08-156	332.7	4 818 791.8	233 498.4
08-158	330.0	4 818 713.0	233 462.6

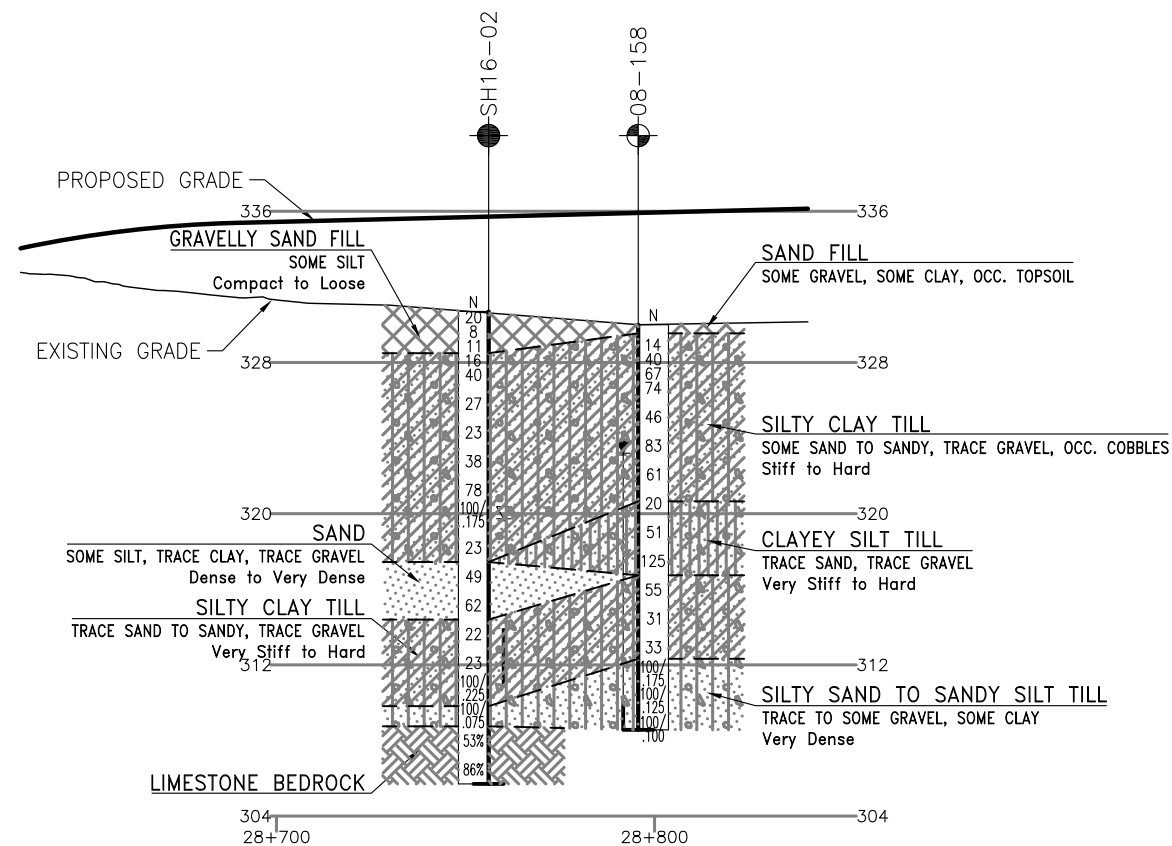
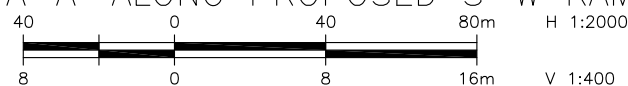
## -NOTES-

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

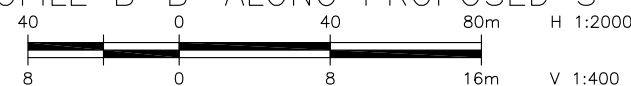
GEOCRES No. 40P09-067



PROFILE A-A' ALONG PROPOSED S-W RAMP

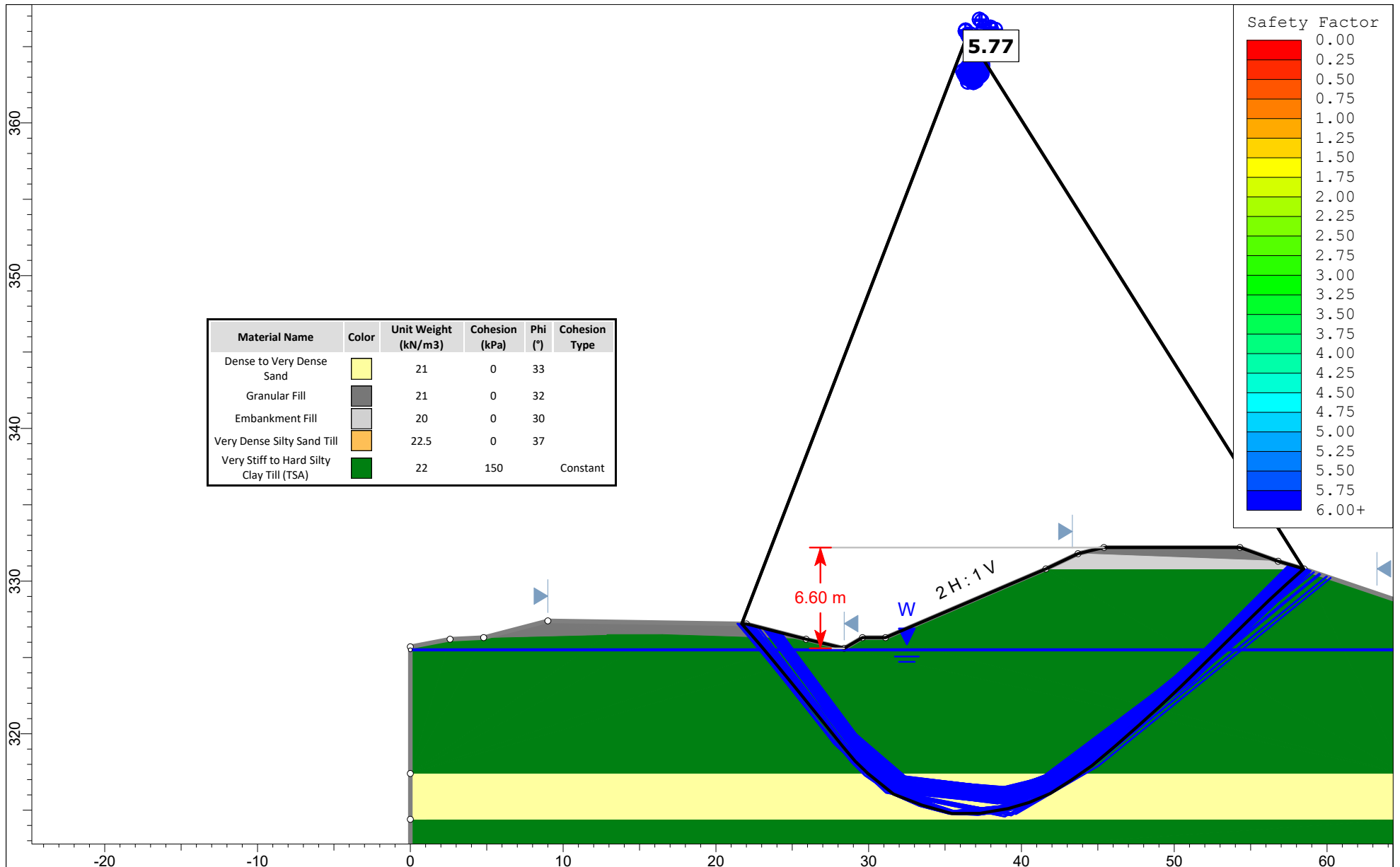


PROFILE B-B' ALONG PROPOSED S-W RAMP



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	MKE	CHK	PKC	CODE	LOAD	DATE	FEB 2024
DRAWN	MFA	CHK	MKE	SITE	STRUCT	DWG	1



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Temporary / Short-Term

2024-02-27 9:31:37 AM

Scale: 1:350

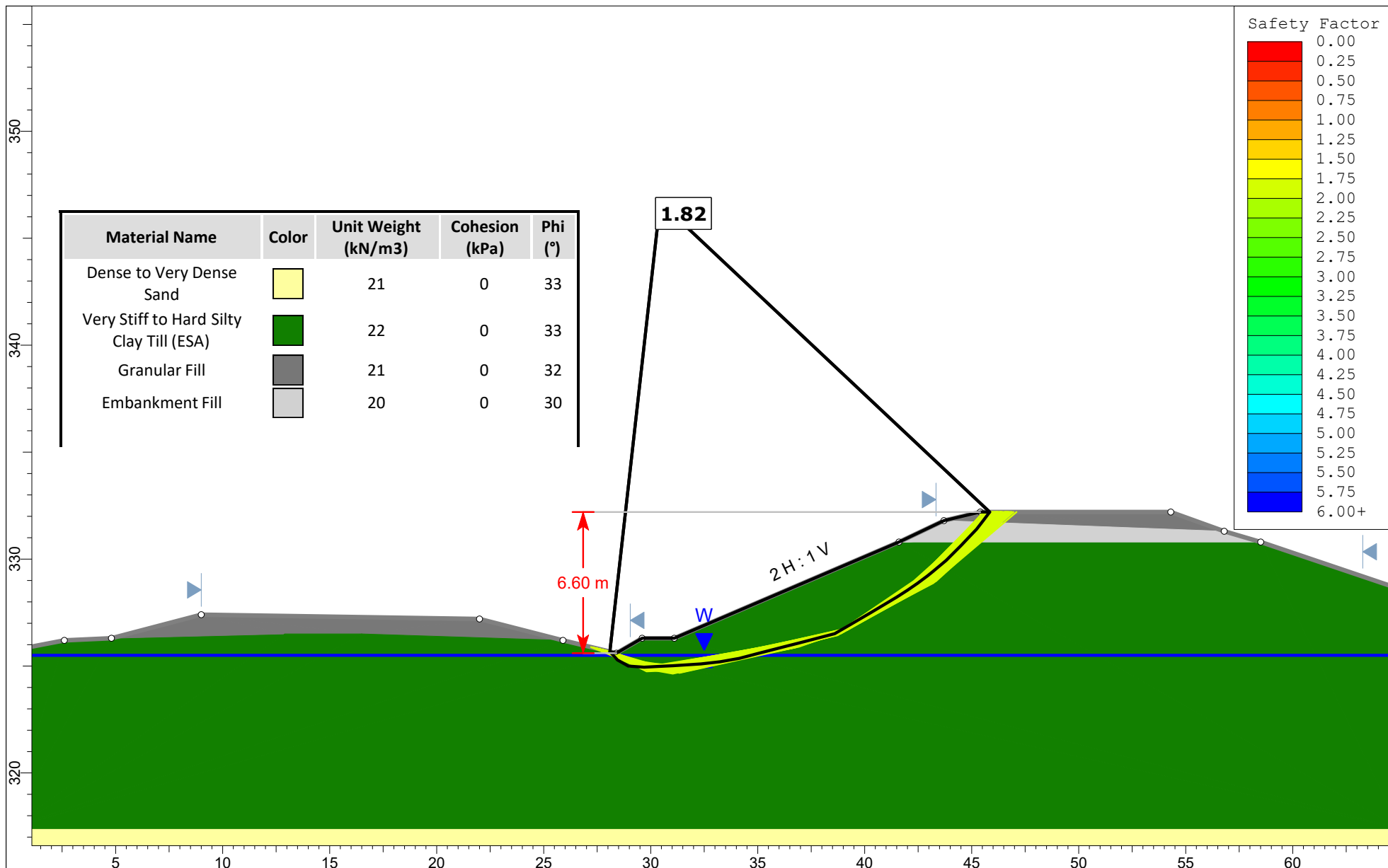
Additional Details:

Name: 28+500.slmd

Comments: Nearest Borehole: SH16-02

Method: GLE / Morgenstern-Price

**Figure D10**



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Permanent / Long-Term

2024-02-27 9:31:37 AM

Scale: 1:250

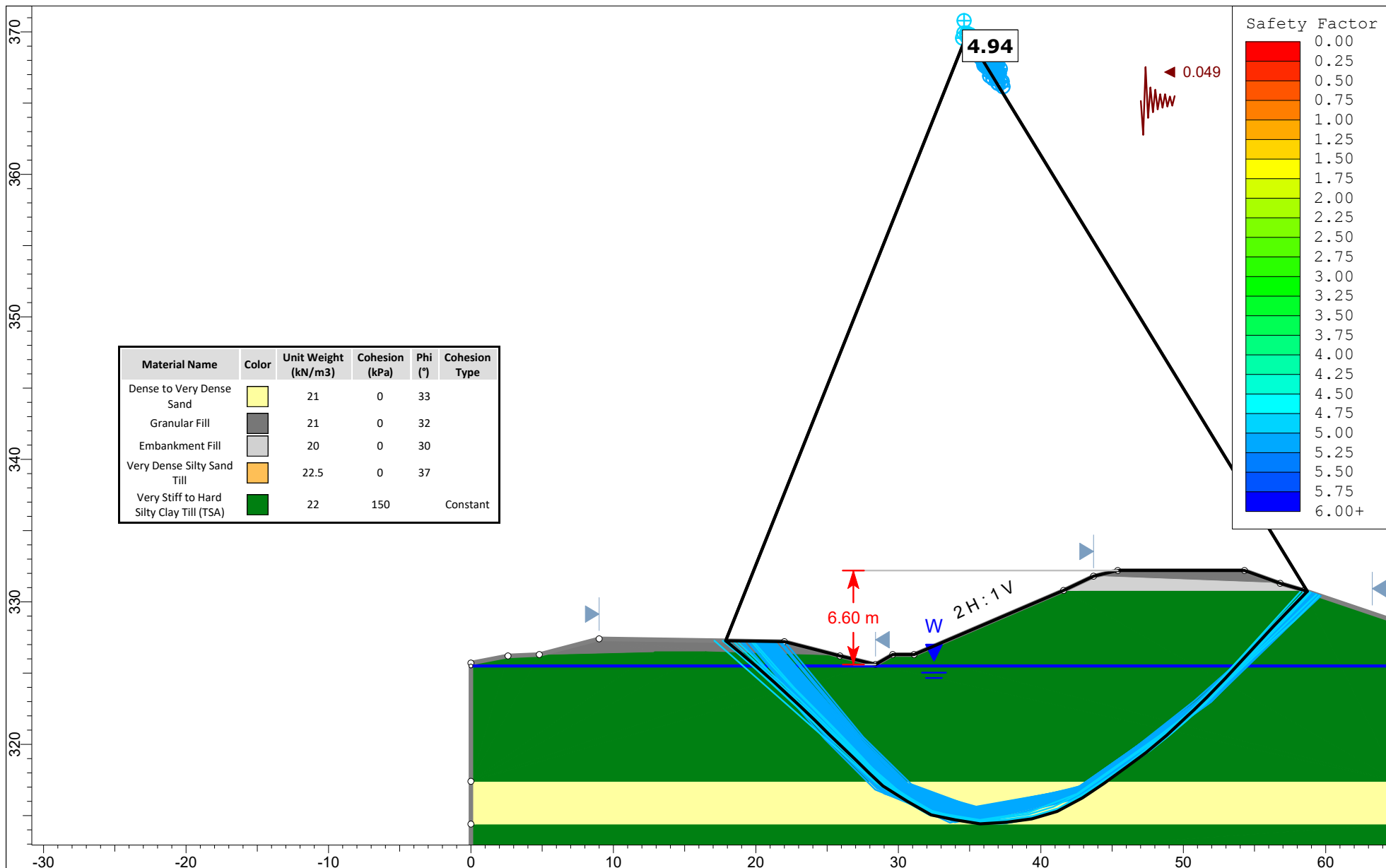
Additional Details:

Name: 28+500.slmd

Comments: Nearest Borehole: SH16-02

Method: GLE / Morgenstern-Price

**Figure D11**



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Seismic

2024-02-27 9:31:37 AM

Scale: 1:375

Additional Details:

Name: 28+500.slmd

Comments: Nearest Borehole: SH16-02

Method: GLE / Morgenstern-Price

**Figure D12**



## **Appendix E.**

**Highway 7: Station 29+950 – 30+150 (08-171, ML16 29+950, ML16 30+000, ML16 30+150)**

# RECORD OF BOREHOLE No 08-171

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 819 340.3 E 235 014.0 ORIGINATED BY ARA  
 DIST HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.05.20 - 2008.05.20 LATITUDE LONGITUDE CHECKED BY RPR

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							
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							
329.8	GROUND SURFACE						20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	TOPSOIL: (200mm)														
0.2	Silty <b>SAND</b> , trace clay Loose Brown Moist		1	SS	5										
328.6			2	SS	5										
1.2	Sandy <b>SILT</b> , trace gravel, trace clay Compact to Very Dense Brown Moist (TILL)														
			3	SS	15										
			4	SS	34										
			5	SS	50/ 0.100										
325.2															
4.6	END OF BOREHOLE AT 4.6m.		6	SS	50/ 0.05										

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 29+950 1 OF 1 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 271.8 E 234 884.7 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.510097 LONGITUDE -80.364697 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL LIMIT      MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  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 ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE			WATER CONTENT (%) W <sub>P</sub> W      W <sub>L</sub>				
331.3	GROUND SURFACE							20	40	60	80	100			
0.0	TOPSOIL: (375mm)														
330.9			1	SS	12		331								
0.4	Sandy <b>SILT</b> , some clay, trace gravel Loose to Very Dense Brown to Grey Moist to Wet (TILL)														
			2	SS	4		330								
			3	SS	7		329								6   42   37   15
			4	SS	30		328								
			5	SS	99		327								
			6	SS	100/ 0.275		326								
			7	SS	67		325								0   45   41   14
324.6	END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 5.5m AND WATER LEVEL AT 3.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.														
6.7															

ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-11375(GINTDATA).GPJ 7/6/23

RECORD OF BOREHOLE No ML16 30+000 1 OF 1 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 291.5 E 234 927.3 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.06.28 - 2018.06.28 LATITUDE 43.510278 LONGITUDE -80.364172 CHECKED BY JPL

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									
								20 40 60 80 100									
330.3	GROUND SURFACE																
0.0	TOPSOIL: (250mm)																
330.1																	
0.3	Sandy <b>SILT</b> , some clay, trace gravel Compact to Very Dense Brown Moist to Wet (TILL)		1	SS	15		330										
			2	SS	20		329										1 40 43 16
			3	SS	14		328										
			4	SS	35		327										
			5	SS	54	326											
			6	SS	86	325											
			7	SS	83	324											
						323											
			8	SS	100/ 0.225											7 35 46 12	
322.3																	
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-11375(GINTDATA).GPJ 7/6/23

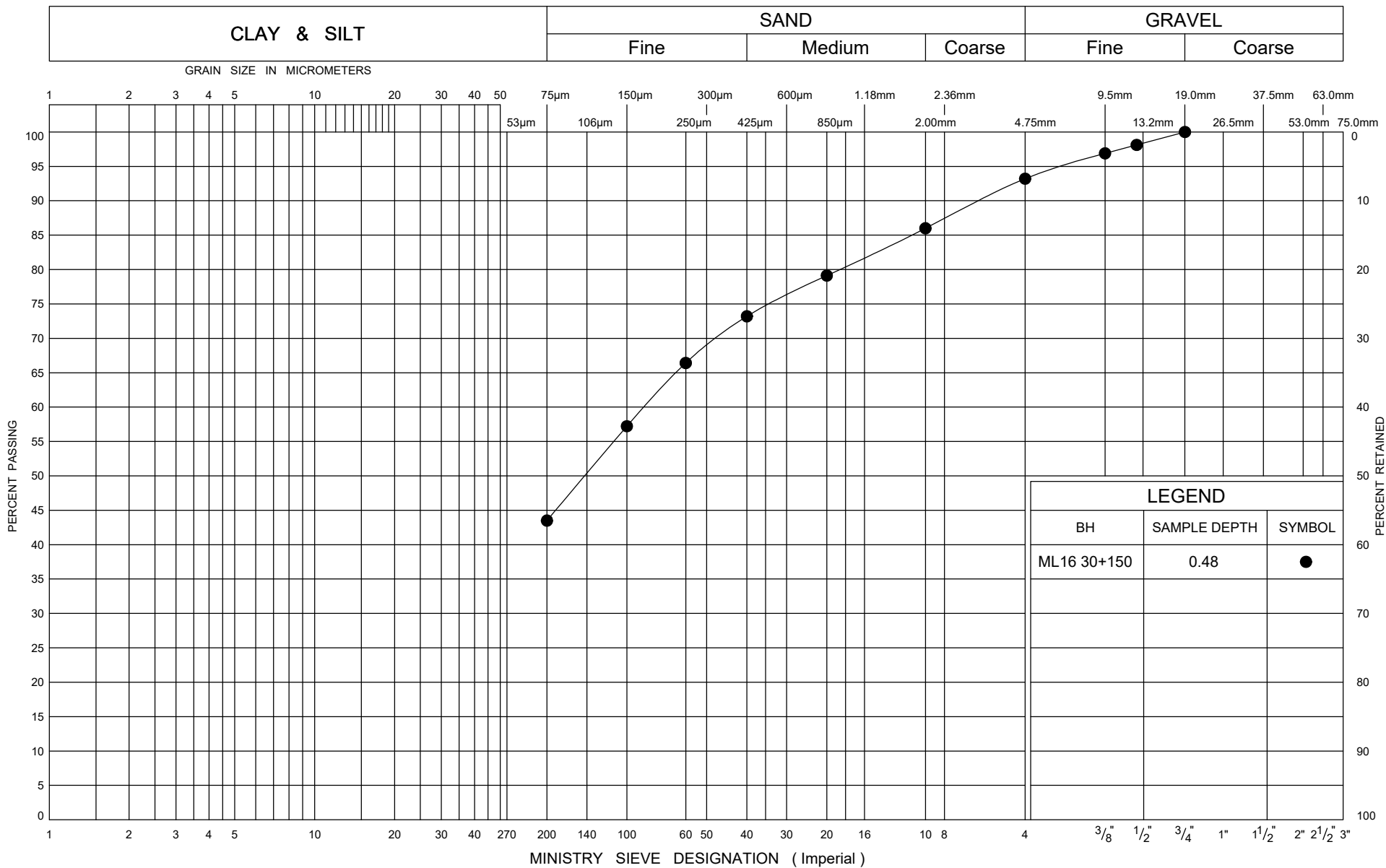
# RECORD OF BOREHOLE No ML16 30+150 1 OF 1 METRIC

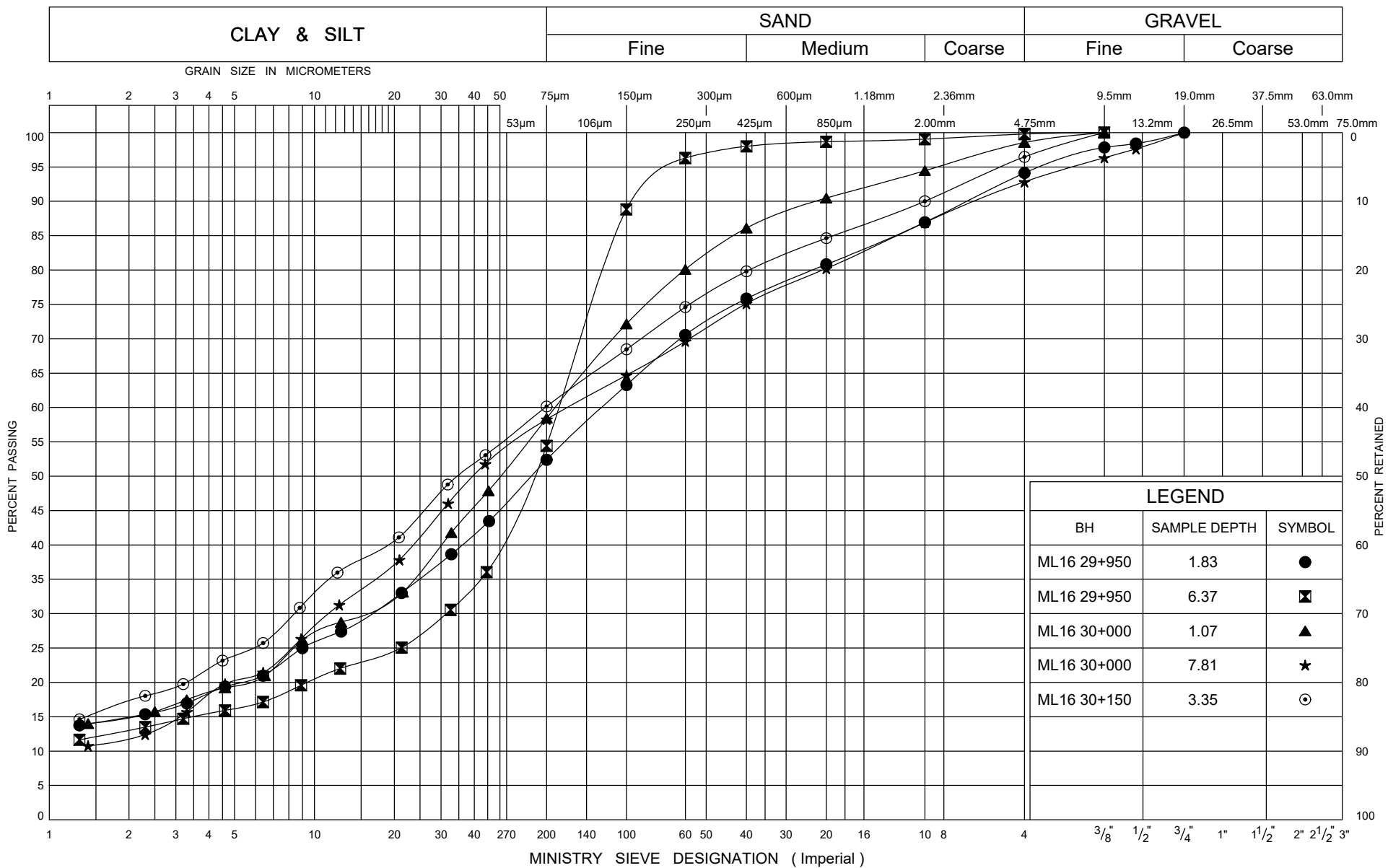
GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 351.9 E 235 071.0 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.01.28 - 2018.01.28 LATITUDE 43.510835 LONGITUDE -80.362404 CHECKED BY JPL

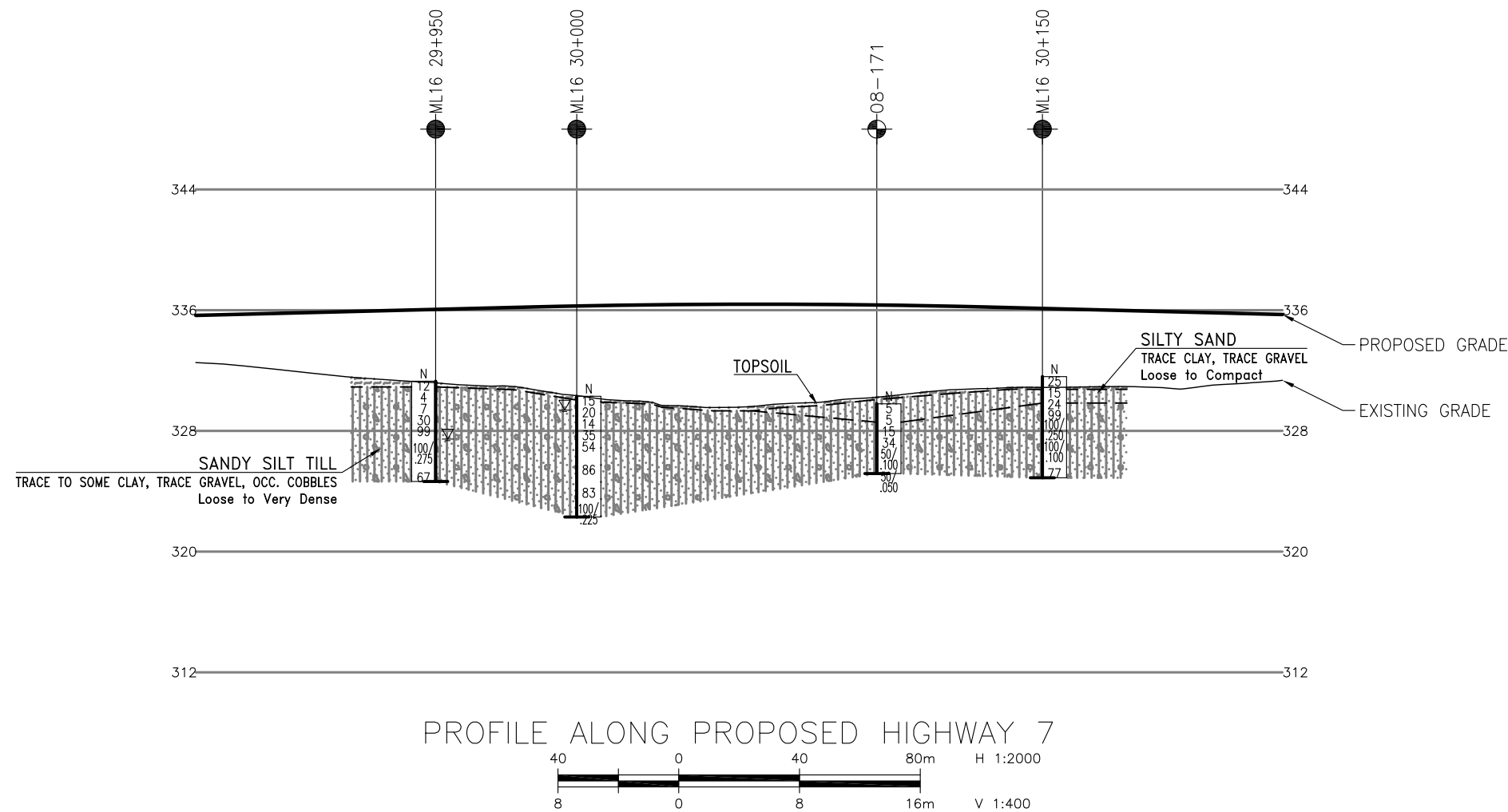
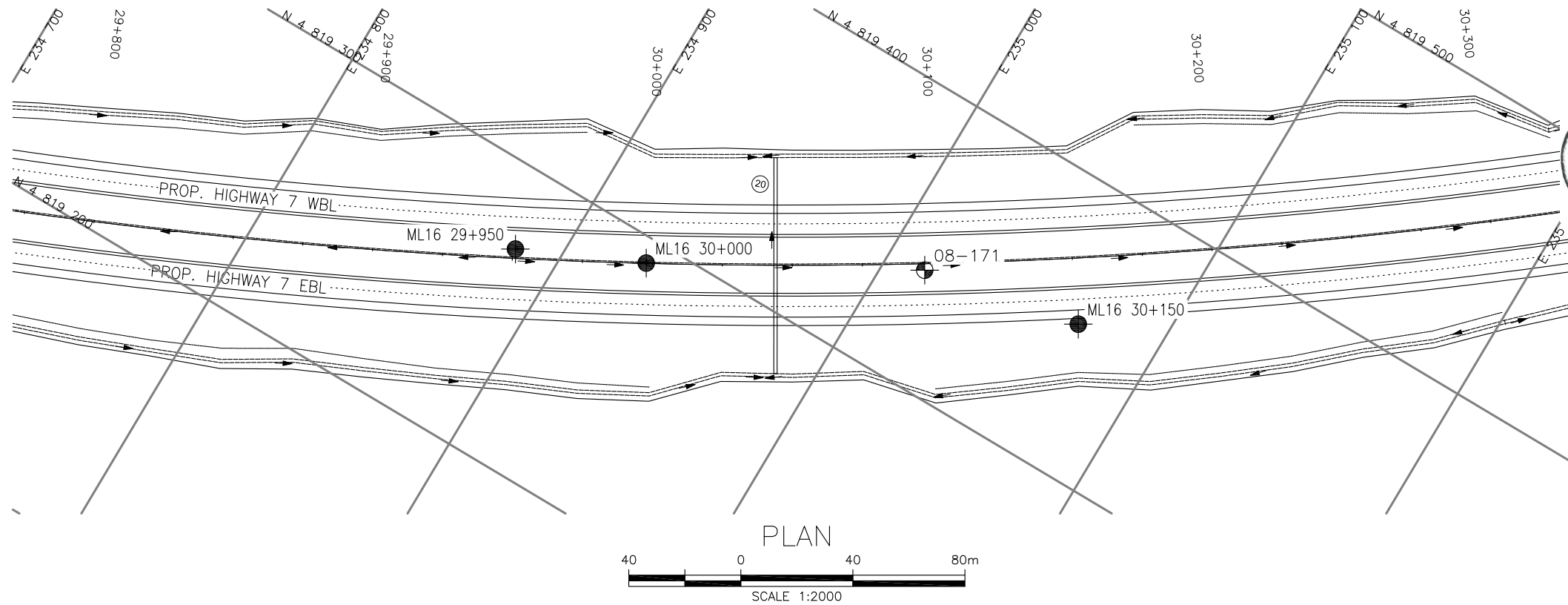
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							WATER CONTENT (%) w <sub>p</sub> w                      w <sub>L</sub>			
331.6	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (125mm)							20	40	60	80	100						
0.1	Silty <b>SAND</b> , trace clay, trace gravel Compact Brown Moist		1	SS	25		331								○			7 50 34 9
															○			
			2	SS	15										○			
															○			
329.8							330											
1.8	Sandy <b>SILT</b> , some clay, trace gravel, occasional cobbles Compact to Very Dense Brown Moist (TILL)		3	SS	24										○			
															○			
			4	SS	99		329								○			
			5	SS	100/ 0.250										○			4 36 43 17
							328											
			6	SS	100/ 0.100		327								○			
							326											
			7	SS	77										○			
324.9							325											
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.7m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 5.5m, THEN AUGER CUTTINGS TO SURFACE.																	

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 3/12/20







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

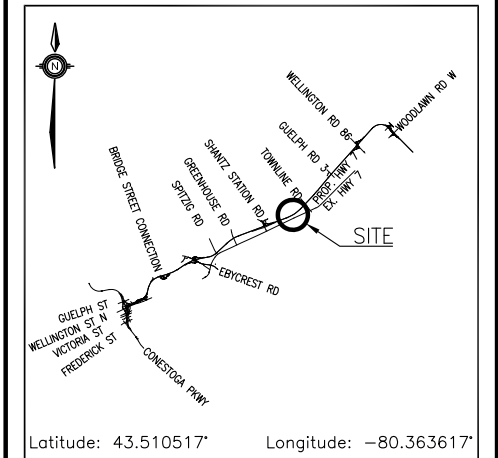


CONT No  
GWP No 408-88-00

HIGHWAY 7  
MAINLINE FILL  
29+950 TO 30+150  
BOREHOLE LOCATIONS AND SOIL STRATA



**THURBER** ENGINEERING LTD.



## KEYPLAN

### LEGEND

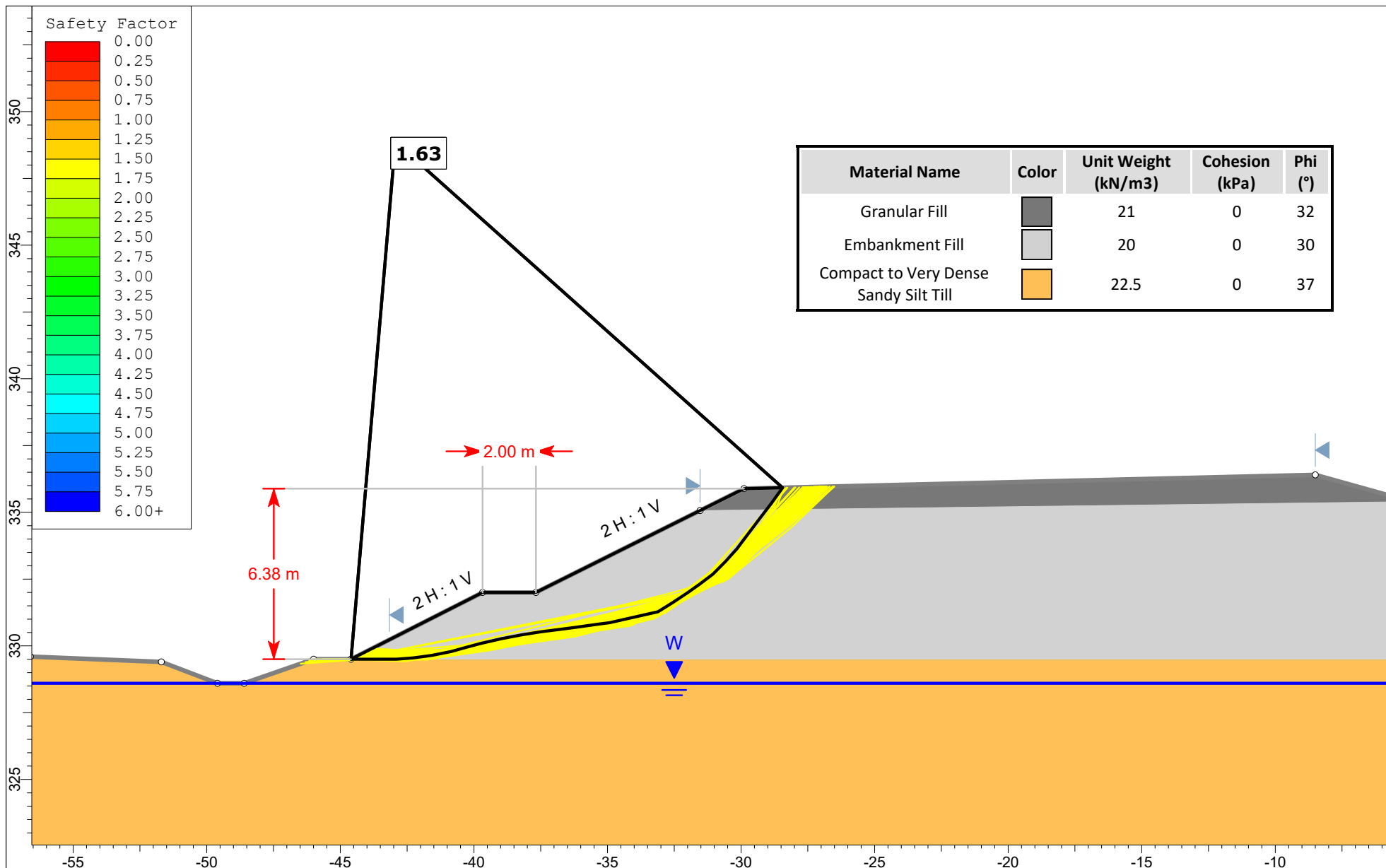
[illegible]

-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. 40P09-067**

REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	MKE	CHK	PKC			LOAD		DATE	FEB 2024
DRAWN	MFA	CHK	MKE			SITE	STRUCT	DWG	1



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Temporary / Short-Term

2024-02-27 10:00:19 AM

Scale: 1:200

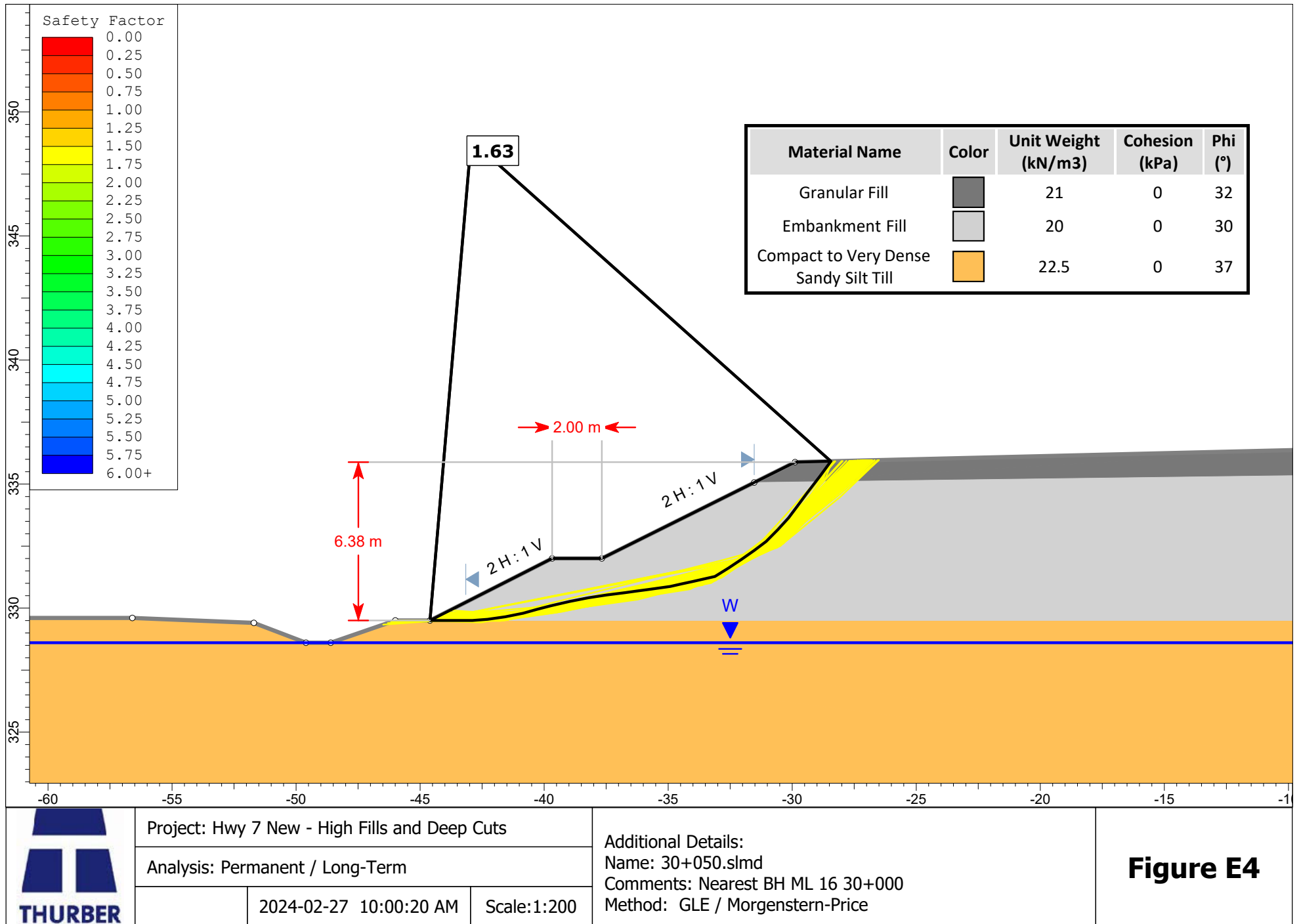
Additional Details:

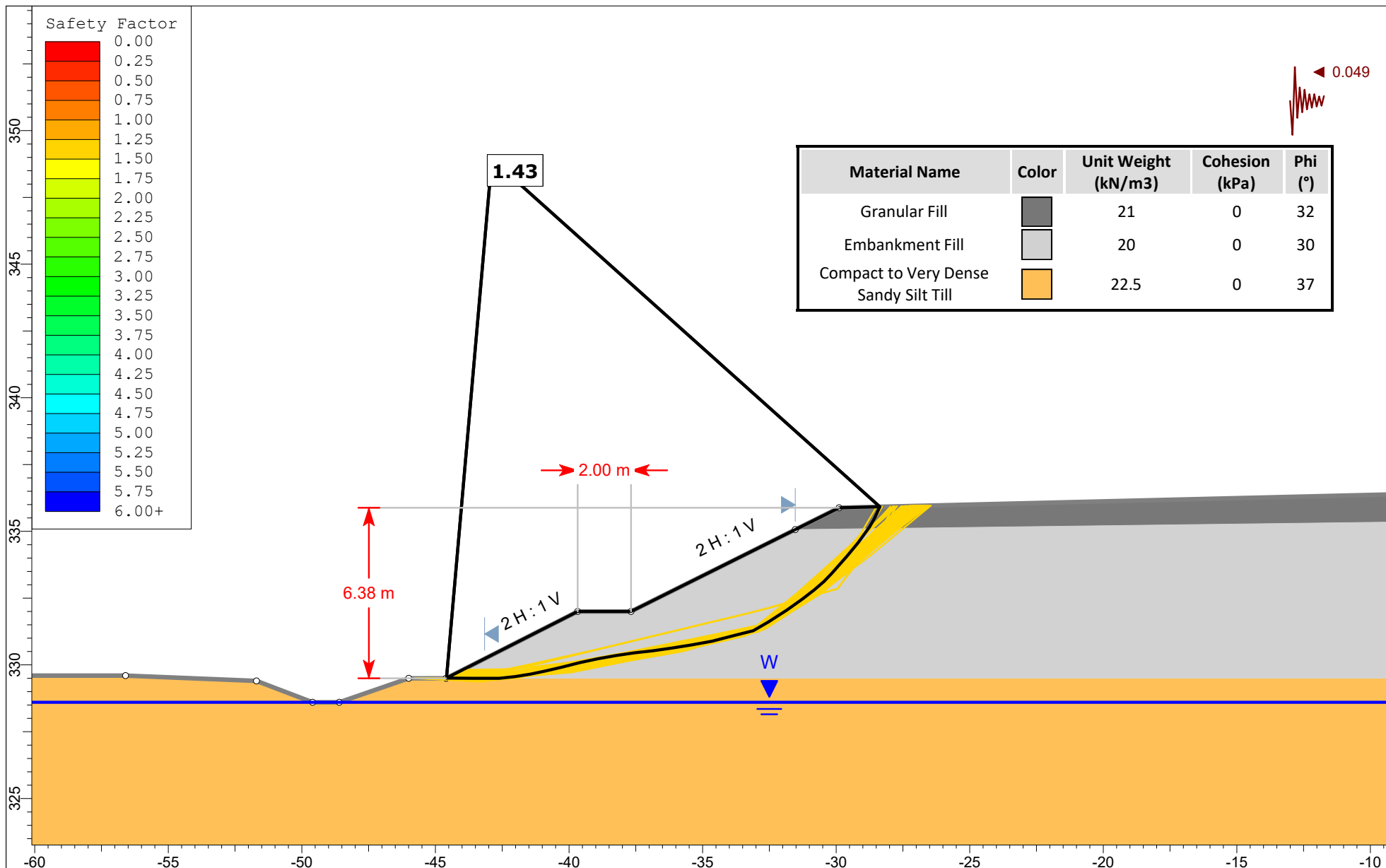
Name: 30+050.slmd

Comments: Nearest BH ML 16 30+000

Method: GLE / Morgenstern-Price

**Figure E3**





Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Seismic

2024-02-27 10:00:20 AM

Scale: 1:200

Additional Details:

Name: 30+050.slmd

Comments: Nearest BH ML 16 30+000

Method: GLE / Morgenstern-Price

**Figure E5**



## **Appendix F.**

**Regional Road 30 (Shantz Station Road) – N/S-E Ramp: Station 28+420 – 28+600 (08-159)**

# RECORD OF BOREHOLE No 08-159

1 OF 3

METRIC

GWP# 408-88-00 LOCATION N 4 818 686.0 E 233 462.0 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 LATITUDE LONGITUDE CHECKED BY RPR

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				
329.2	GROUND SURFACE							20 40 60 80 100				
0.0	TOPSOIL: (200mm)							20 40 60 80 100				
0.2	Silty <b>CLAY</b> , trace gravel, occasional topsoil staining Stiff Brown Moist (FILL)		1	SS	11		329					
327.8							328					
1.4	Silty <b>CLAY</b> , some sand, trace gravel Hard Brown Moist (TILL)		2	SS	63		327					
			3	SS	42							0 15 40 45
			4	SS	64		326					
325.1							325					
4.1	Sandy <b>SILT</b> , some clay, trace to some gravel Very Dense Grey Moist (TILL)		5	SS	100/ .150		324					5 41 40 14
323.6							323					
5.6	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist (TILL)		6	SS	47							0 6 39 55
							322					
			7	SS	29		321					
	Occasional sand seams						320					0 3 68 29
			8	SS	46							

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-159

2 OF 3

METRIC

GWP# 408-88-00 LOCATION N 4 818 686.0 E 233 462.0 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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 (%)	
								○ UNCONFINED    + FIELD VANE										
						● QUICK TRIAXIAL    × LAB VANE												
						20    40    60    80    100												
						20    40    60    80    100												
	Continued From Previous Page						319											
	Silty <b>CLAY</b> , trace sand to sandy, trace gravel Very Stiff to Hard Grey Moist (TILL) Layer of silt till (700mm)		9	SS	100/ .150		318						○			0    8    81    11		
			10	SS	28		317						○					
							316											
			11	SS	23		315						○			0    1    35    64		
							314											
313.5			12	SS	50								○			5    34    38    23		
15.7	Silty <b>SAND</b> , some gravel, trace clay Very Dense Grey Wet (TILL)						313						○					
			13	SS	50/ .075		312						○			16    43    33    8		
			14	SS	100/ .050		311											
							310											
309.2																		

Continued Next Page

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

RECORD OF BOREHOLE No 08-159

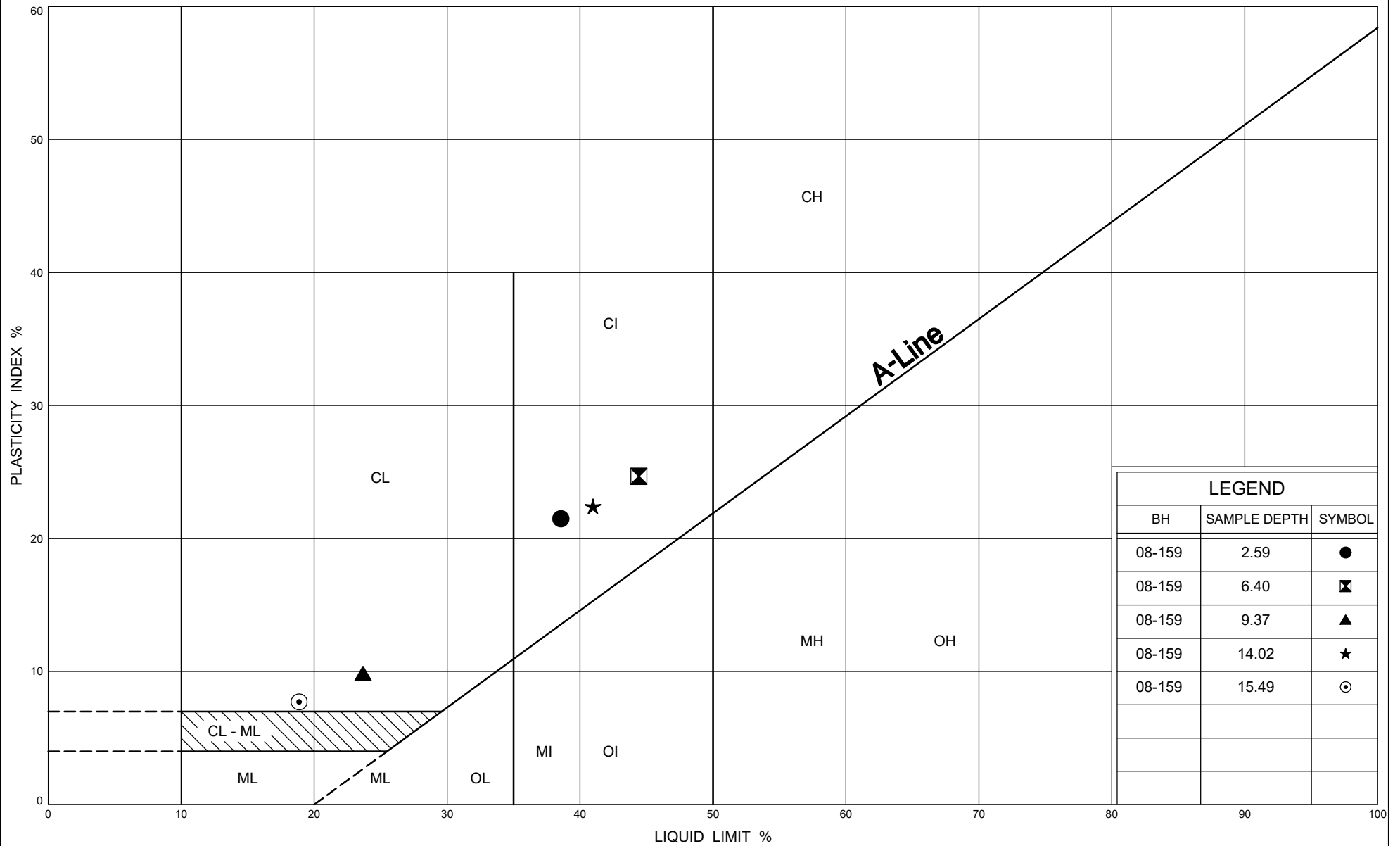
3 OF 3

METRIC

GWP# 408-88-00 LOCATION N 4 818 686.0 E 233 462.0 ORIGINATED BY SLL  
DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
DATUM Geodetic DATE 2008.06.03 - 2008.06.03 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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									
20.0	Continued From Previous Page END OF BOREHOLE AT 20.0m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH GROUT TO 15.0m, HOLEPLUG TO 3.0m, THEN AUGER CUTTINGS TO SURFACE.		15	SS	100/ .025												

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Ministry of  
Transportation

## PLASTICITY CHART

### Silty CLAY TILL

FIG No F1

GWP 408-88-00

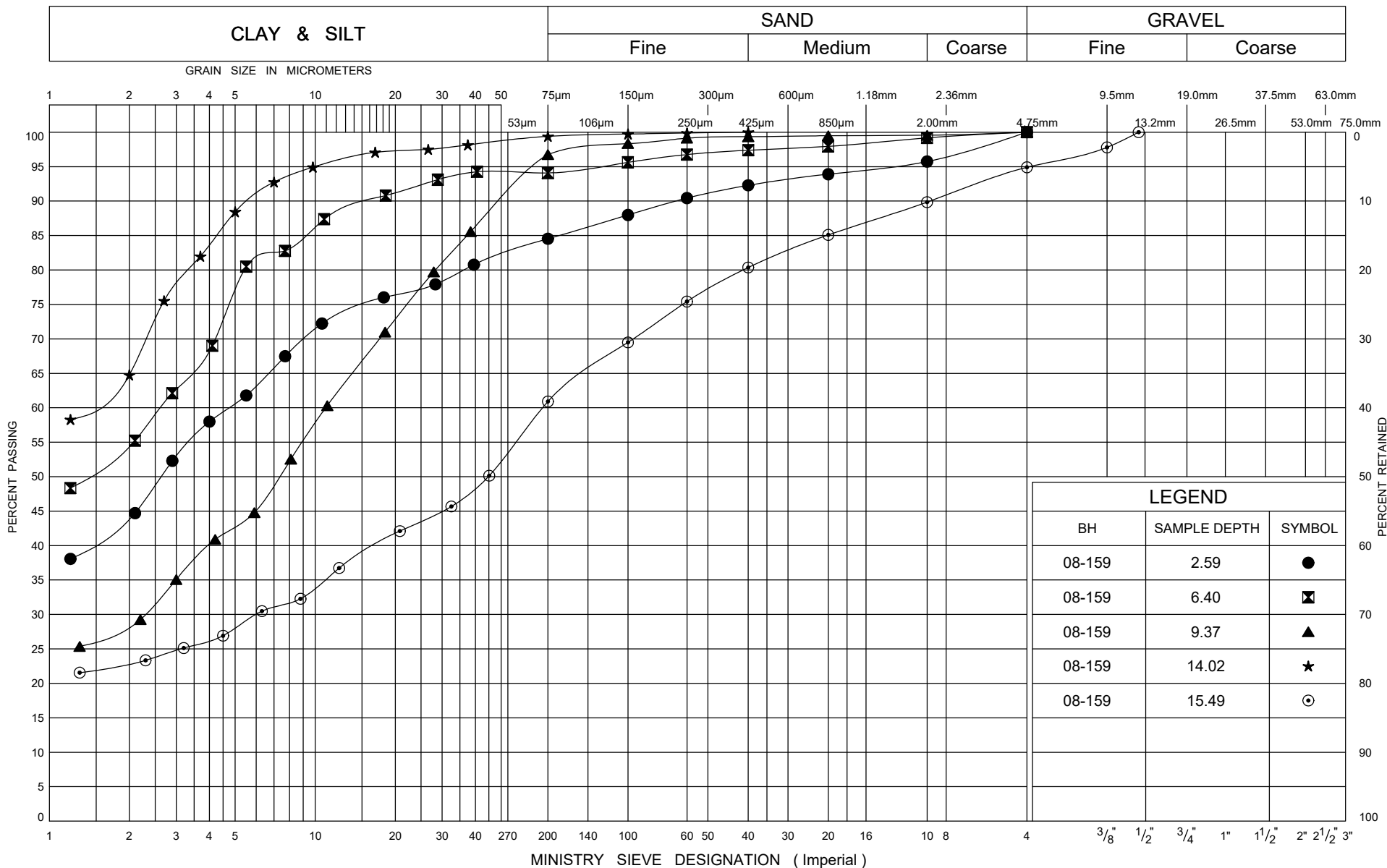
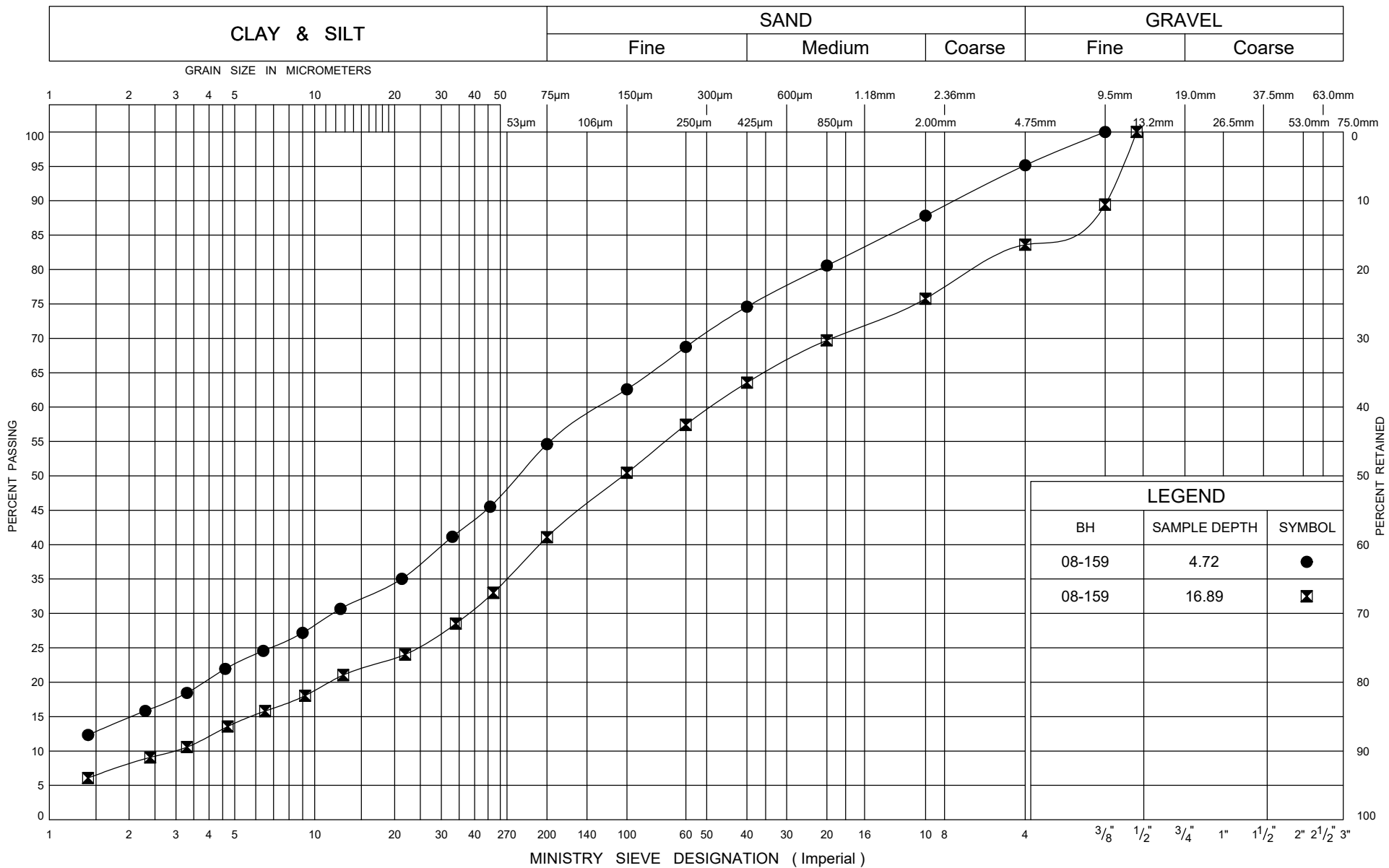
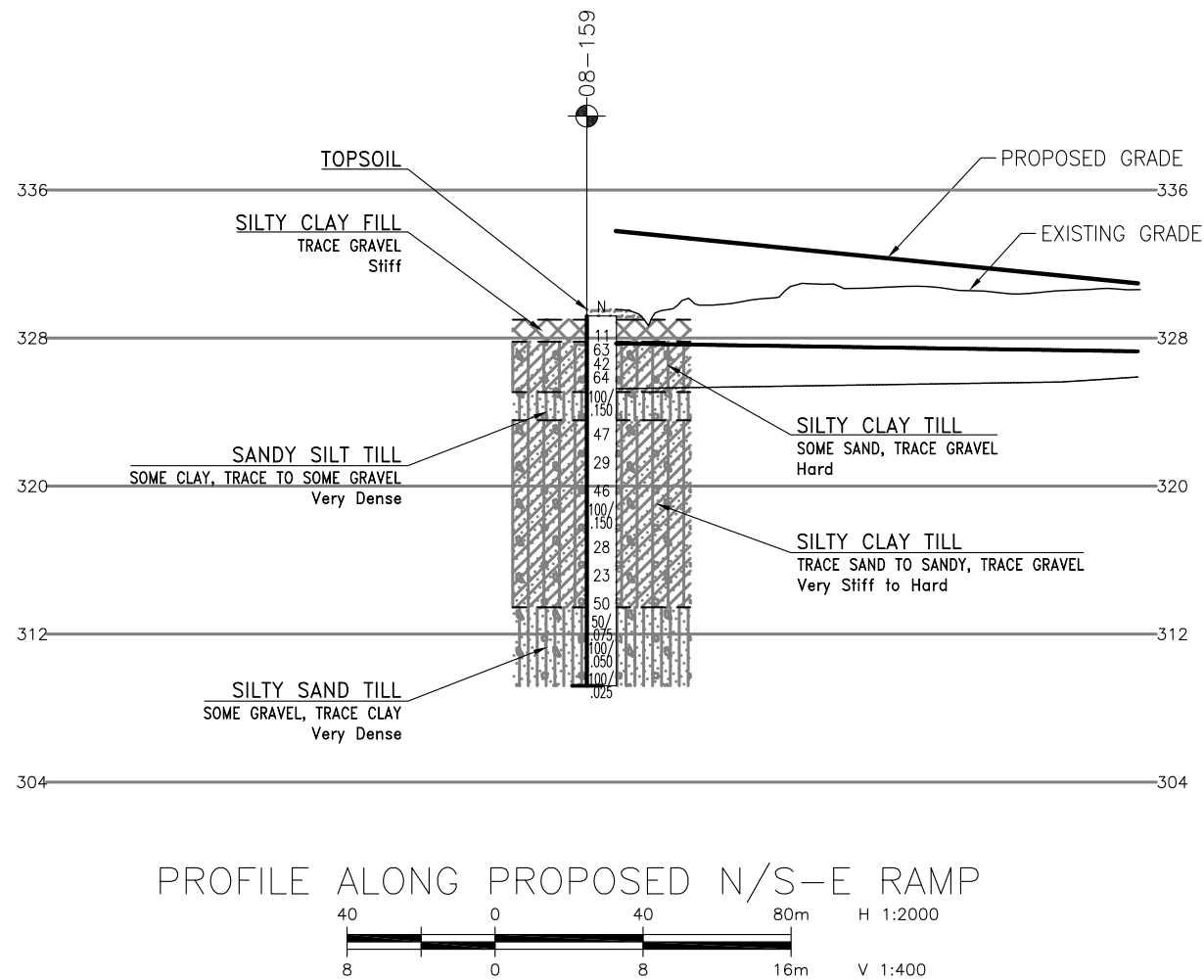
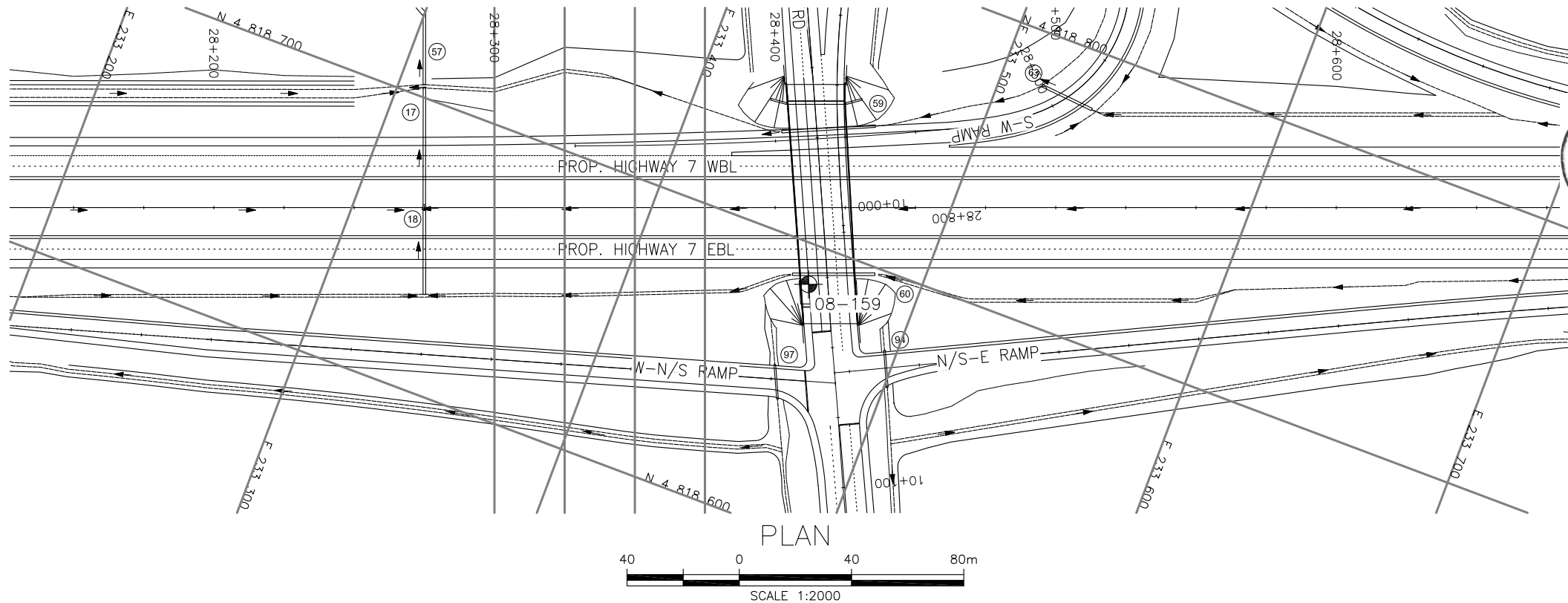




FIG No F3
GWP 408-88-00





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



CONT No  
GWP No 408-88-00

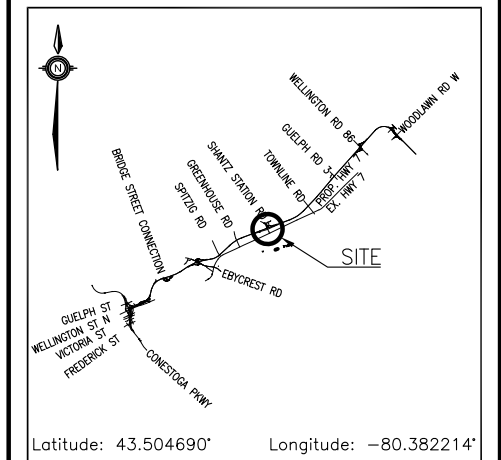
REGIONAL ROAD 30  
(SHANTZ STATION ROAD)  
N/S-E RAMP CUT/FILL  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET








**THURBER** ENGINEERING LTD.



## KEYPLAN

### LEGEND

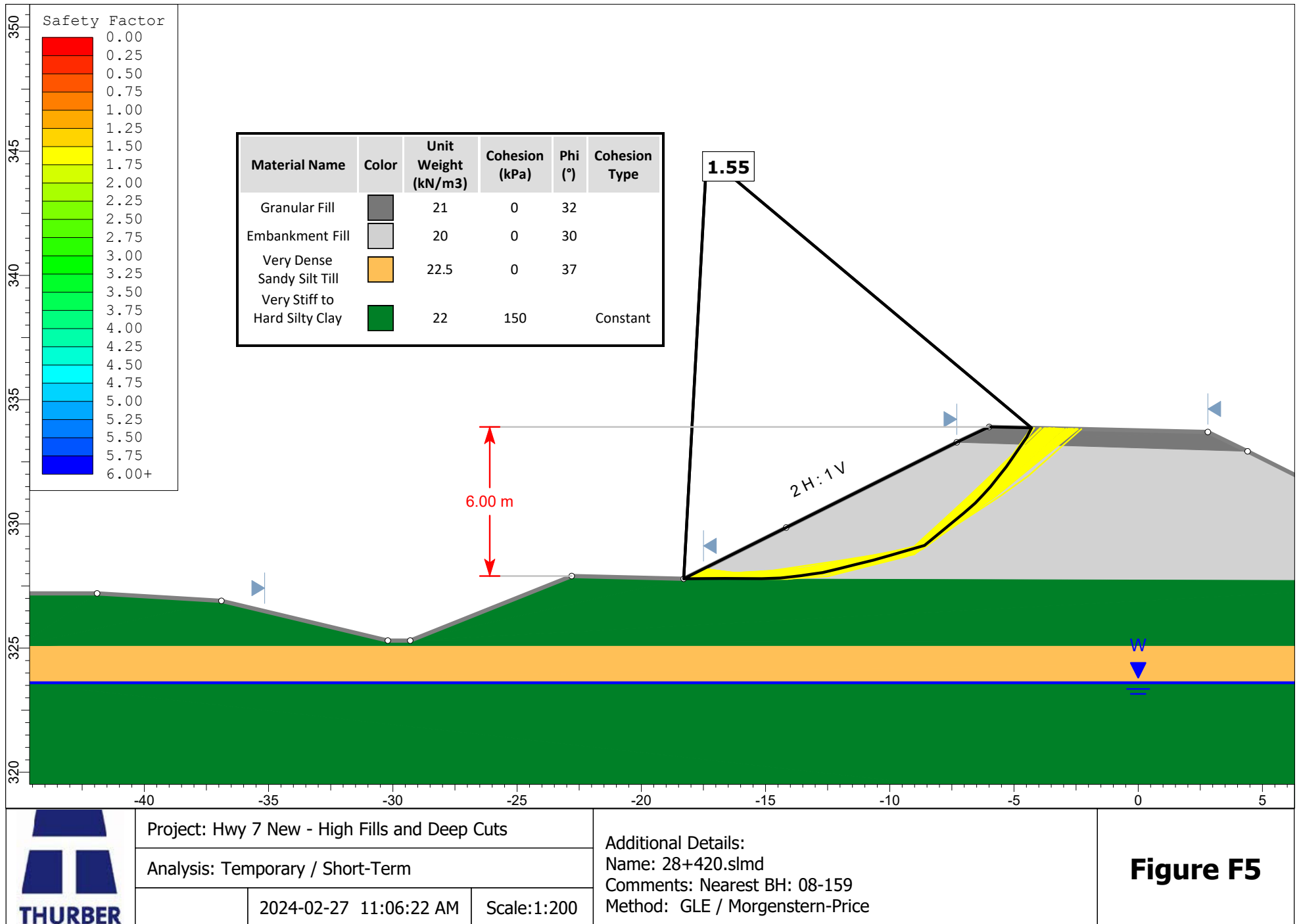
	Borehole (Current Investigation)
	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

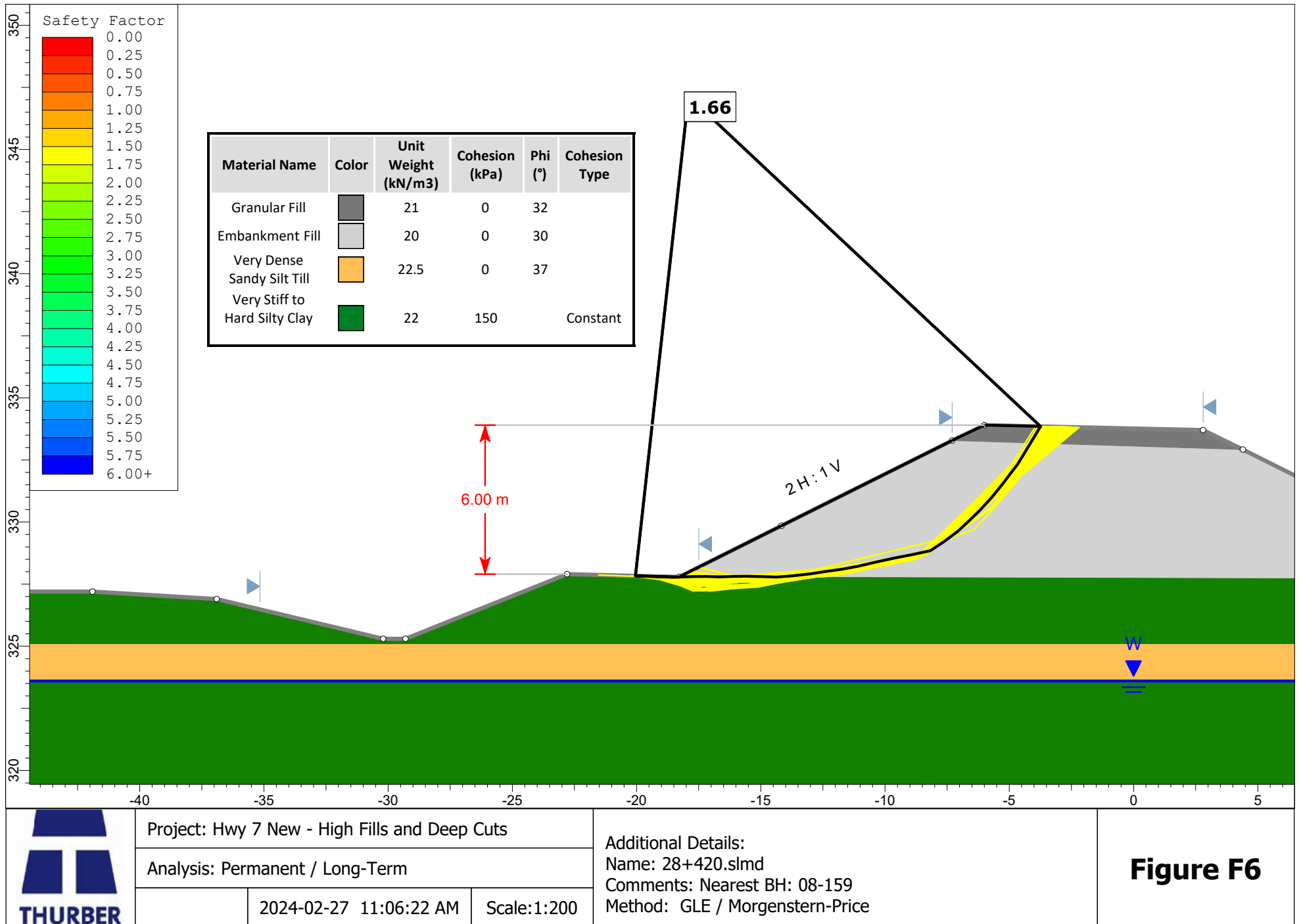
-NOTES-

- 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. 40P09-067**

[illegible]









## **Appendix G.**

**Regional Road 30 (Shantz Station Road) – E-N/S Ramp: Station 28+625 – 28+675 (08-153)**

# RECORD OF BOREHOLE No 08-153

1 OF 1

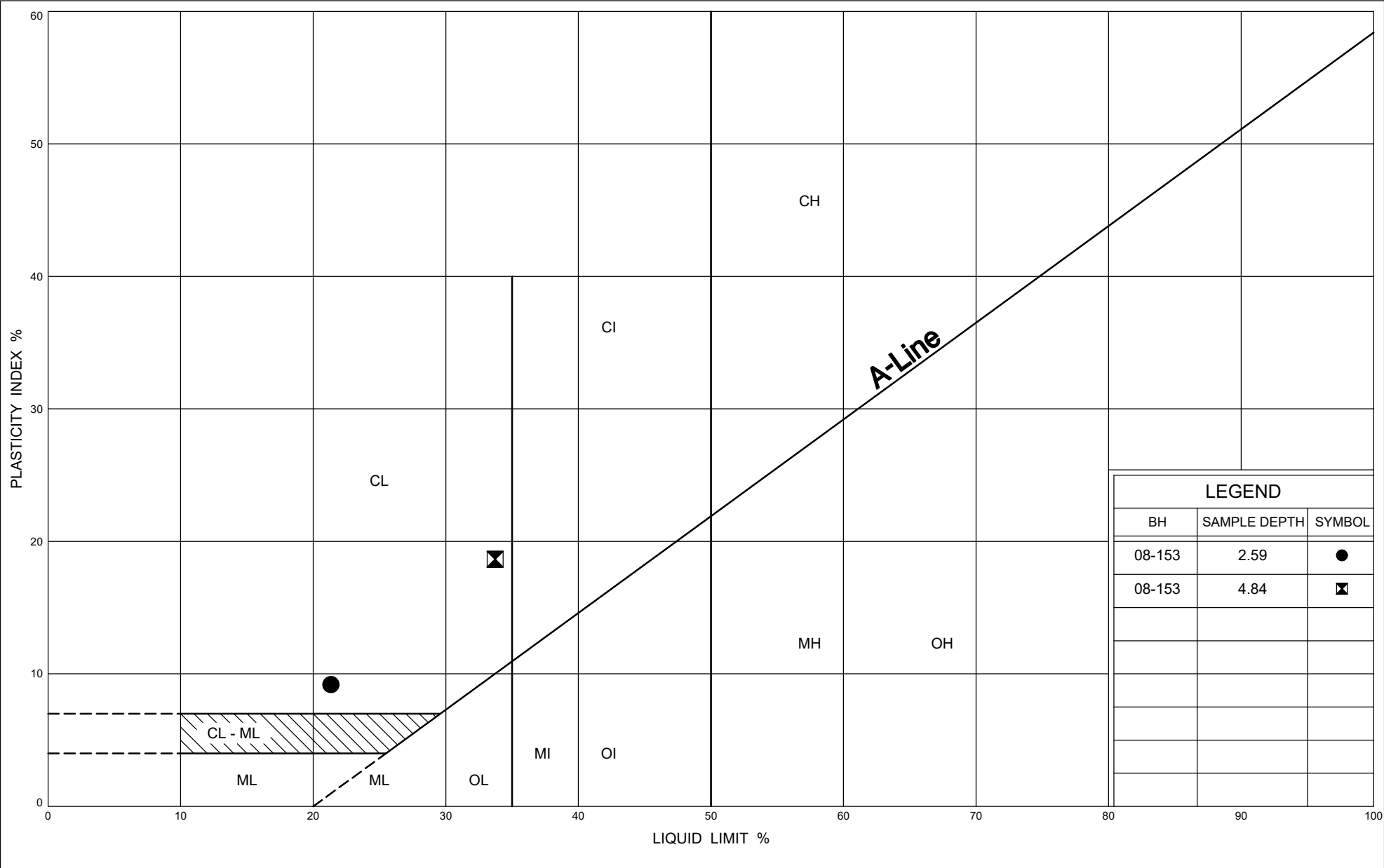
METRIC

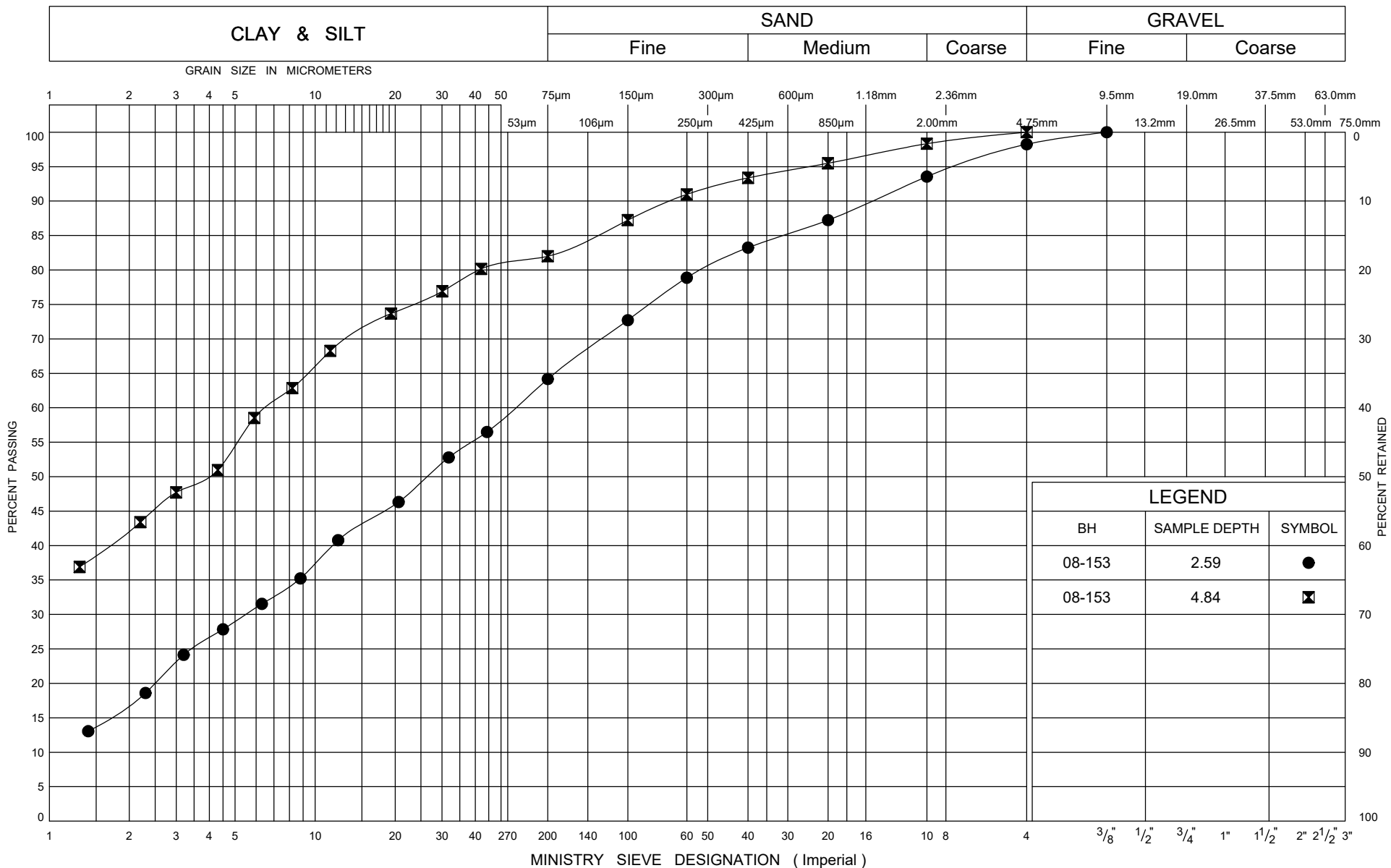
GWP# 408-88-00 LOCATION N 4 818 869.9 E 233 564.1 ORIGINATED BY LG  
DIST HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2008.12.02 - 2008.12.02 LATITUDE LONGITUDE CHECKED BY MEF

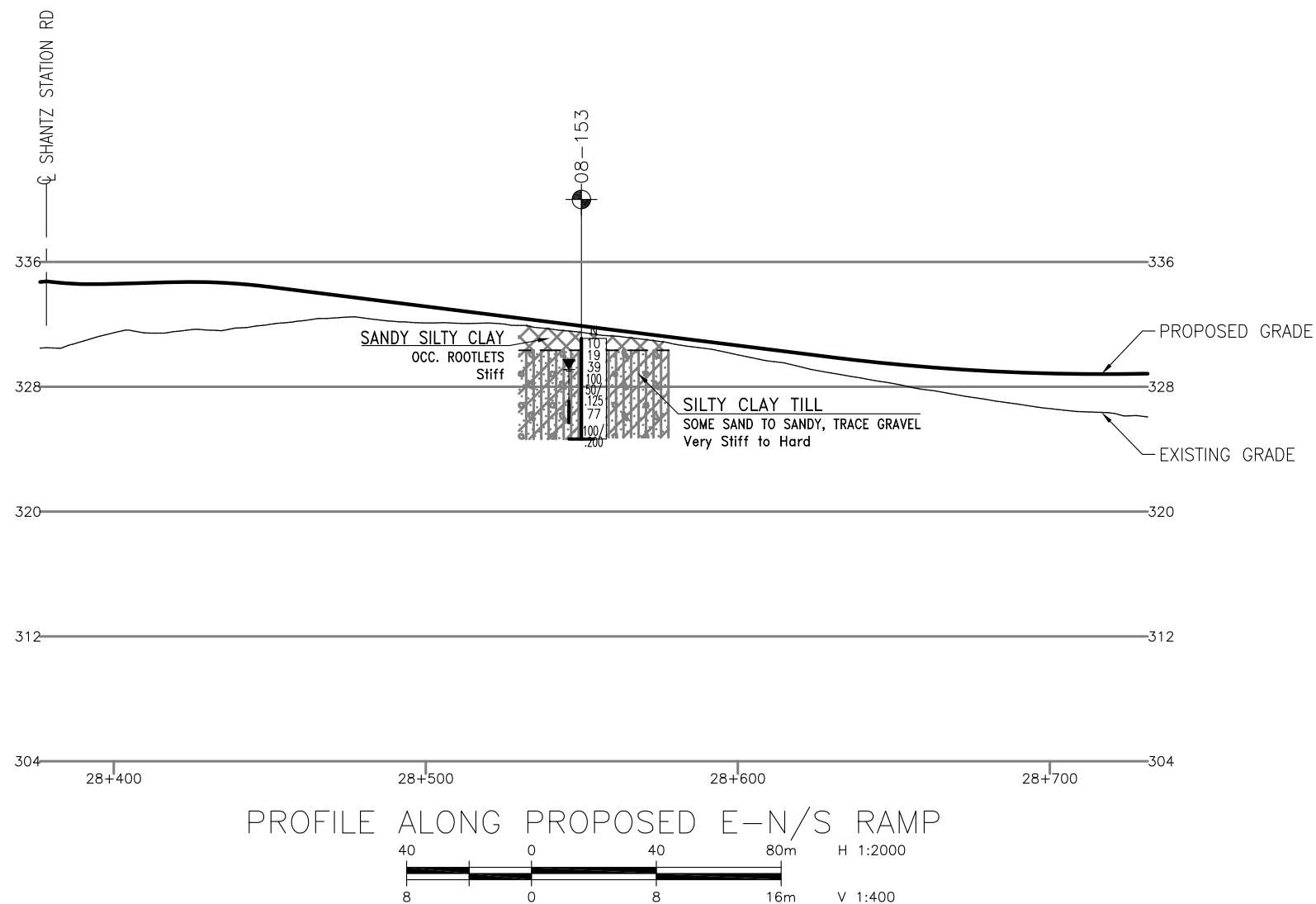
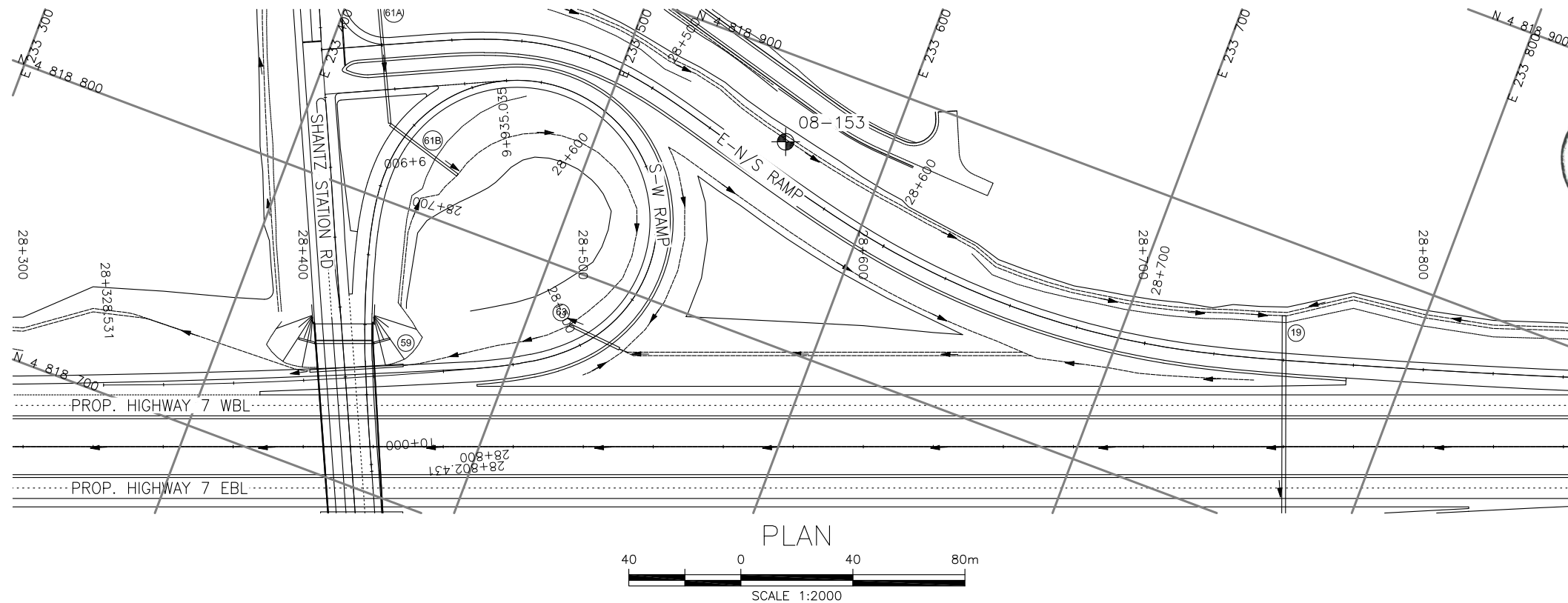
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
331.1	GROUND SURFACE							20 40 60 80 100					
0.0	Sandy silty <b>CLAY</b> , occasional rootlets Stiff Black Moist (FILL)		1	SS	10		331						
330.3													
0.8	Silty <b>CLAY</b> , some sand to sandy, trace gravel Very Stiff to Hard Brown Moist (TILL)		2	SS	19		330						
			3	SS	39		329						
			4	SS	100		328						2 34 47 17
			5	SS	50/ 0.125		327						
							326						0 18 40 42
							325						
324.6			7	SS	100/ 0.200								
6.4	END OF BOREHOLE AT 6.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS DATE        DEPTH(m)    ELEV.(m) 2009.01.09        3.2        327.9 2009.02.02        2.0        329.1												

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

20  
15  
10  
(%) STRAIN AT FAILURE







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

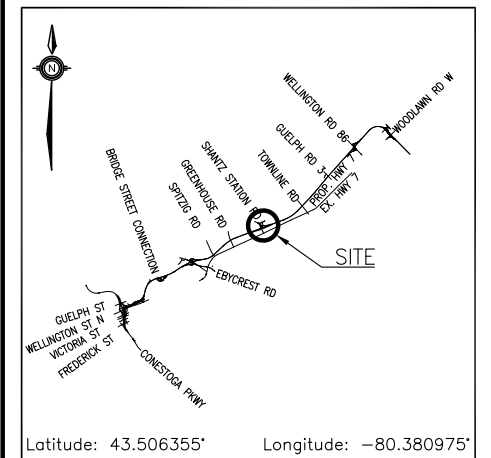


CONT No  
GWP No 408-88-00

REGIONAL ROAD 30  
(SHANTZ STATION ROAD)  
E-N/S RAMP CUT  
BOREHOLE LOCATIONS AND SOIL STRATA








**THURBER** ENGINEERING LTD.



## KEYPLAN

## LEGEND

	Borehole (Current Investigation)
	Borehole (2008 Investigation)
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

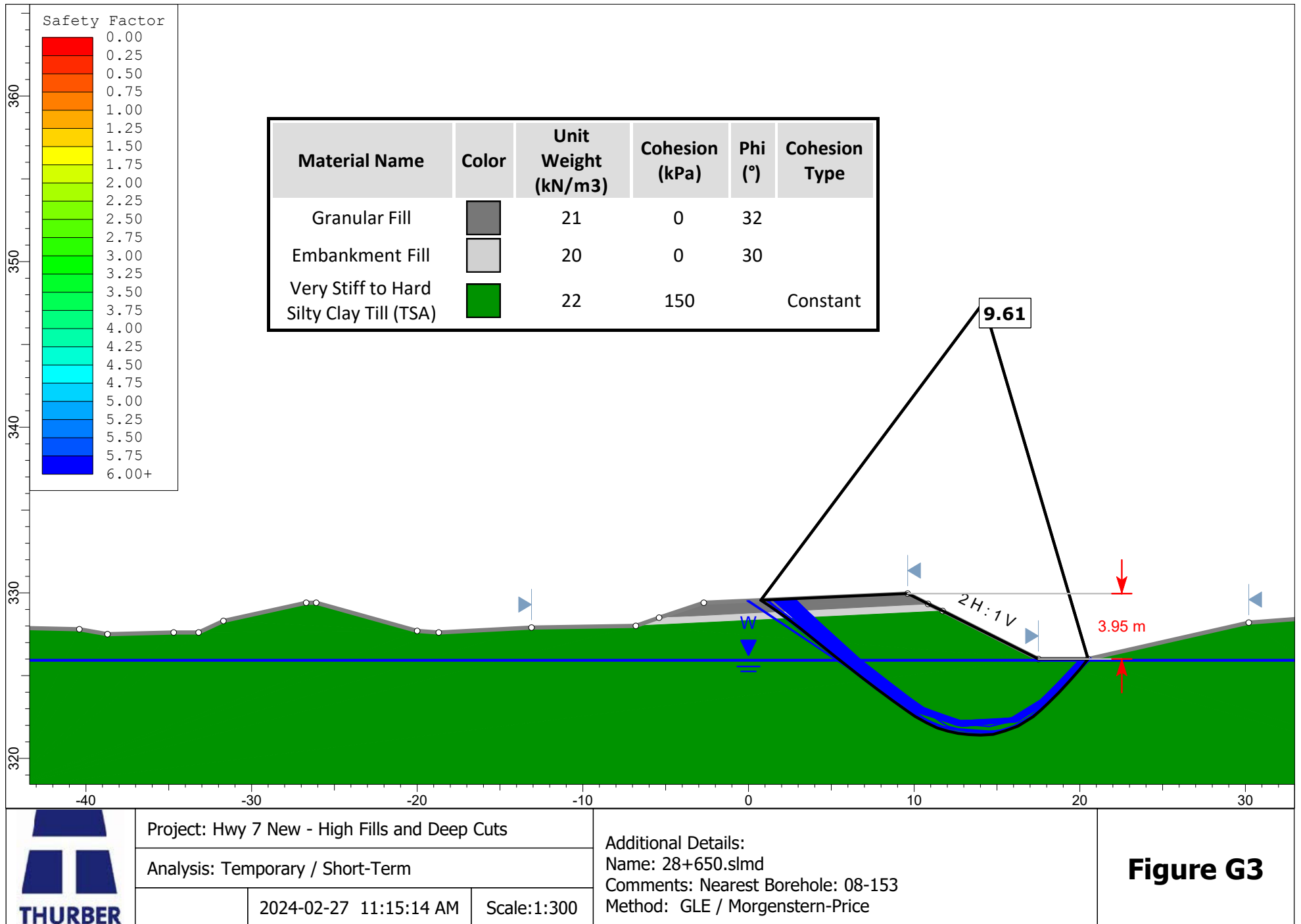
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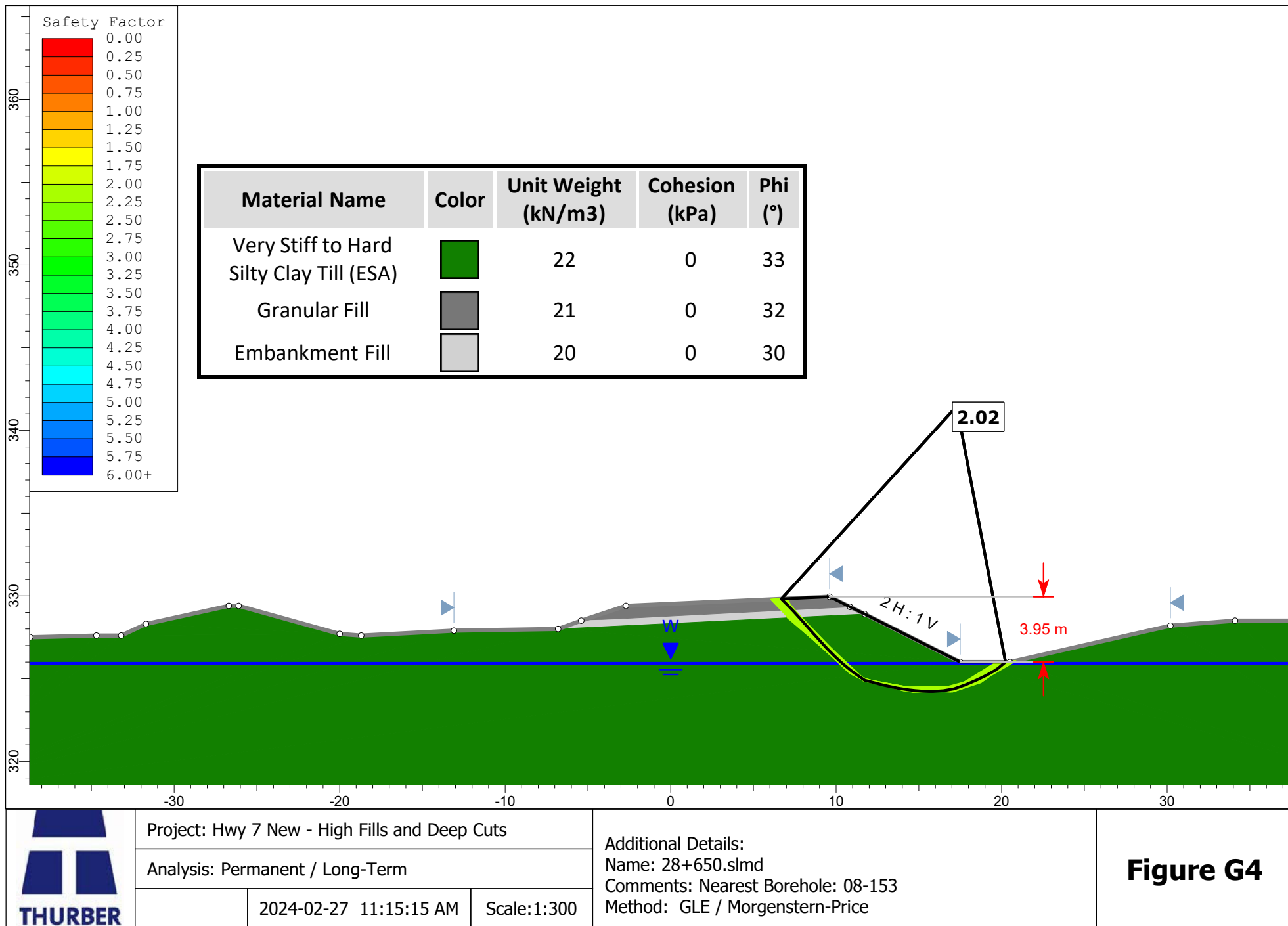
-NOTES-

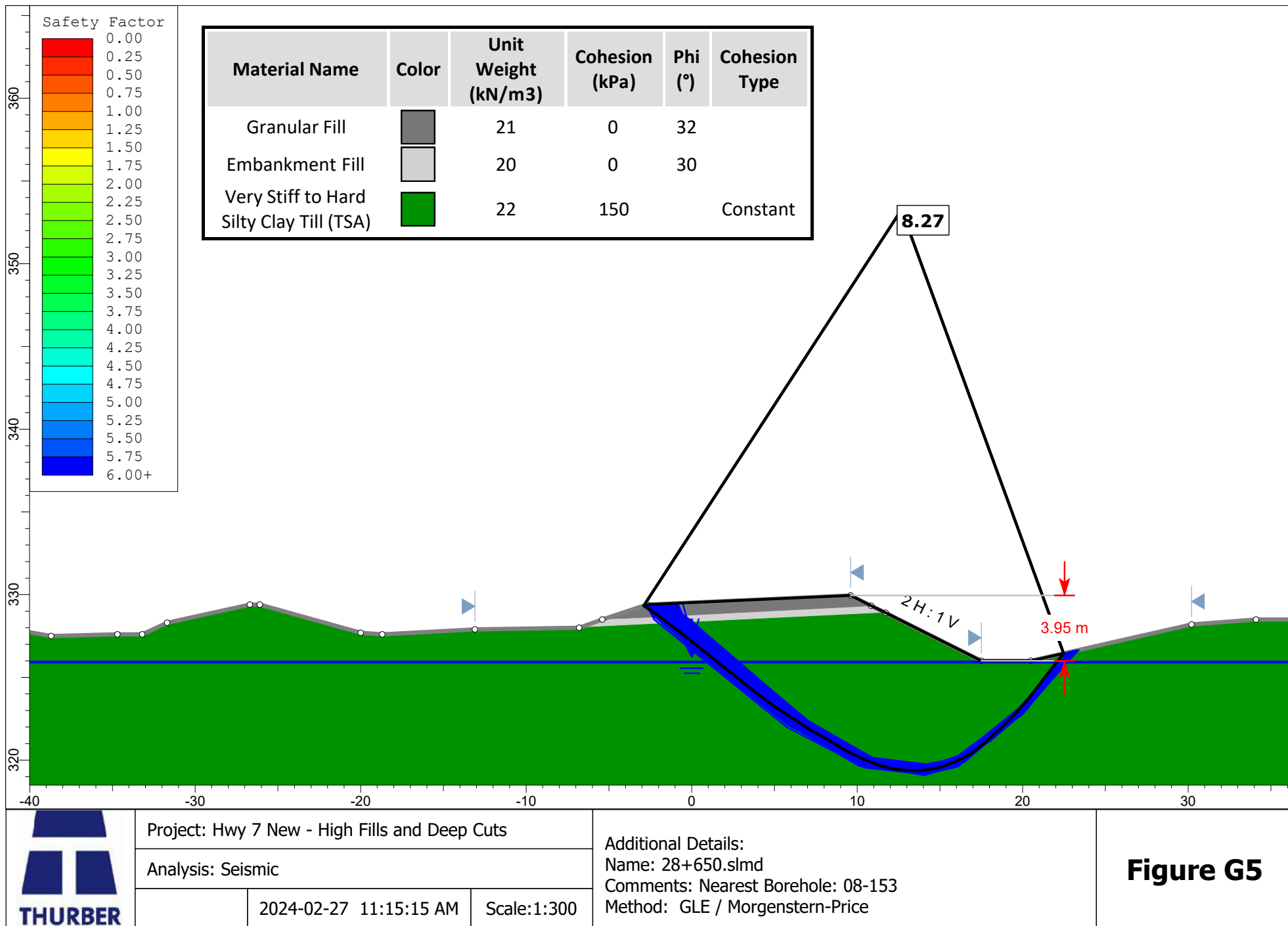
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is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

**GEOCRES No. 40P09-067**

REVISIONS										
	DATE	BY	DESCRIPTION							
DESIGN	MKE	CHK	PKC	CODE	LOAD	DATE	FEB 2024			
DRAWN	MFA	CHK	MKE	SITE	STRUCT	DWG	1			









## **Appendix H.**

**Regional Road 30 (Shantz Station Road): Station 8+850 – 9+925 (08-152, SH16 09+880)**

# RECORD OF BOREHOLE No 08-152

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 818 786.0 E 233 381.2 ORIGINATED BY SLL  
 DIST HWY 7 - New BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.05.30 - 2008.05.30 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  <b>γ</b>  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								
327.6	GROUND SURFACE															
0.0	TOPSOIL: (175mm)															
0.2	SAND, some silt, occasional rootlets Compact Dark Brown Wet		1	SS	17		327									
326.2																
1.4	SILT, some sand to sandy, some clay, trace gravel Compact to Very Dense Brown Moist (TILL)		2	SS	27		326									
	Layer of gravelly silty sand, occasional cobbles		3	SS	90		325								30 53 17 (SI+CL)	
	Layer of silty sand		4	SS	24		324								0 54 36 10	
			5	SS	75		323								0 17 79 4	
							322									
			6	SS	30		321									
320.9	END OF BOREHOLE AT 6.7m. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL AND AUGER CUTTING TO SURFACE.															
6.7																

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# RECORD OF BOREHOLE No SH16 09+880

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 822.3 E 233 406.9 ORIGINATED BY OA  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2017.06.30 - 2017.06.30 LATITUDE LONGITUDE CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  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						
								20 40 60 80 100						
330.8	GROUND SURFACE													
0.0	Gravelly <b>SAND</b> , some silt Compact Brown to Grey Moist (FILL)		1	SS	29		330							
			2	SS	30									
329.4														
1.4	Sandy <b>SILT</b> , trace clay Compact to Dense Brown to Grey Moist to Wet (TILL)		3	SS	22		329							
			4	SS	44		328							
			5	SS	37									
							327							
			6	SS	44		326							
325.6														
5.2	END OF BOREHOLE AT 5.2m. WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

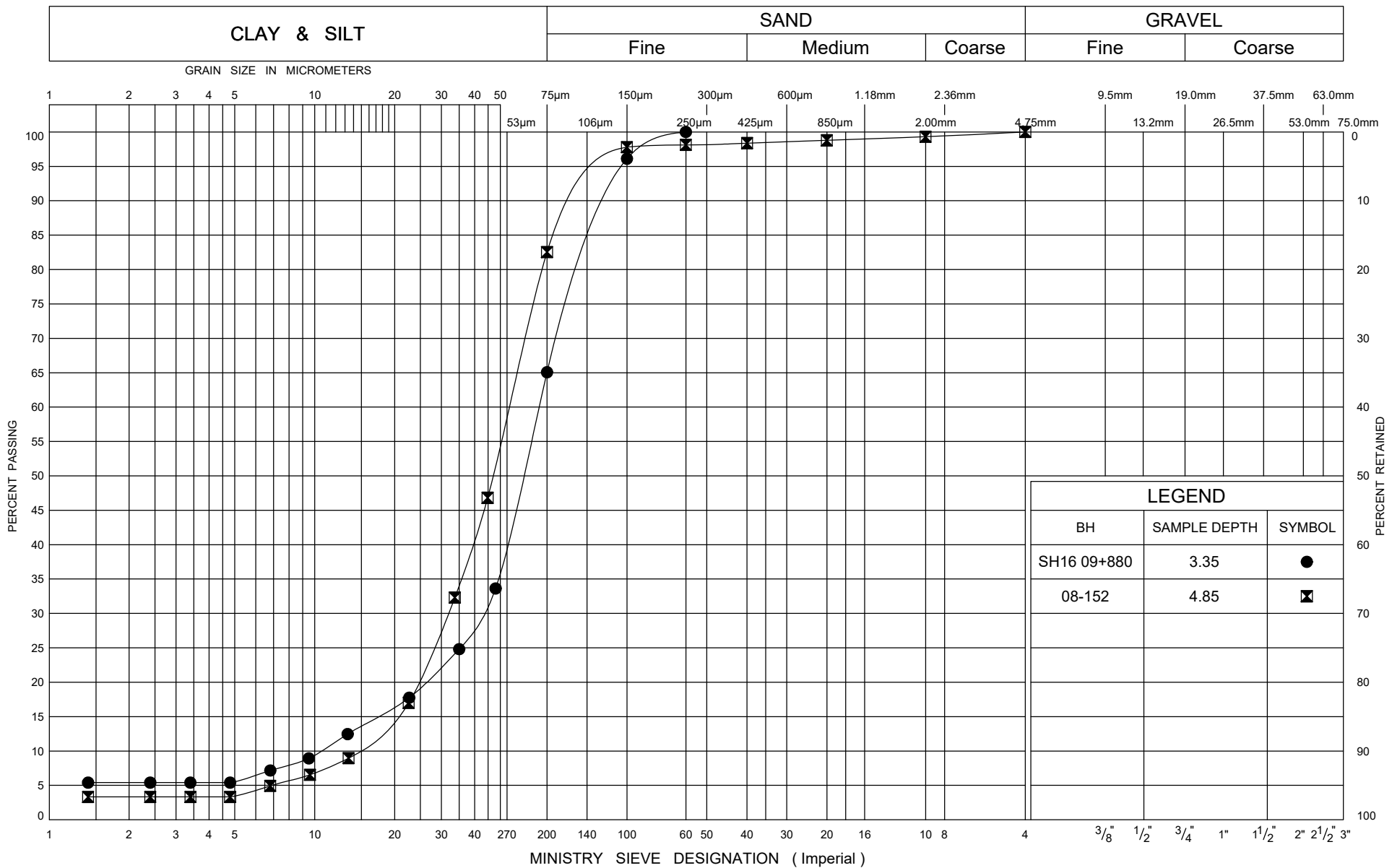
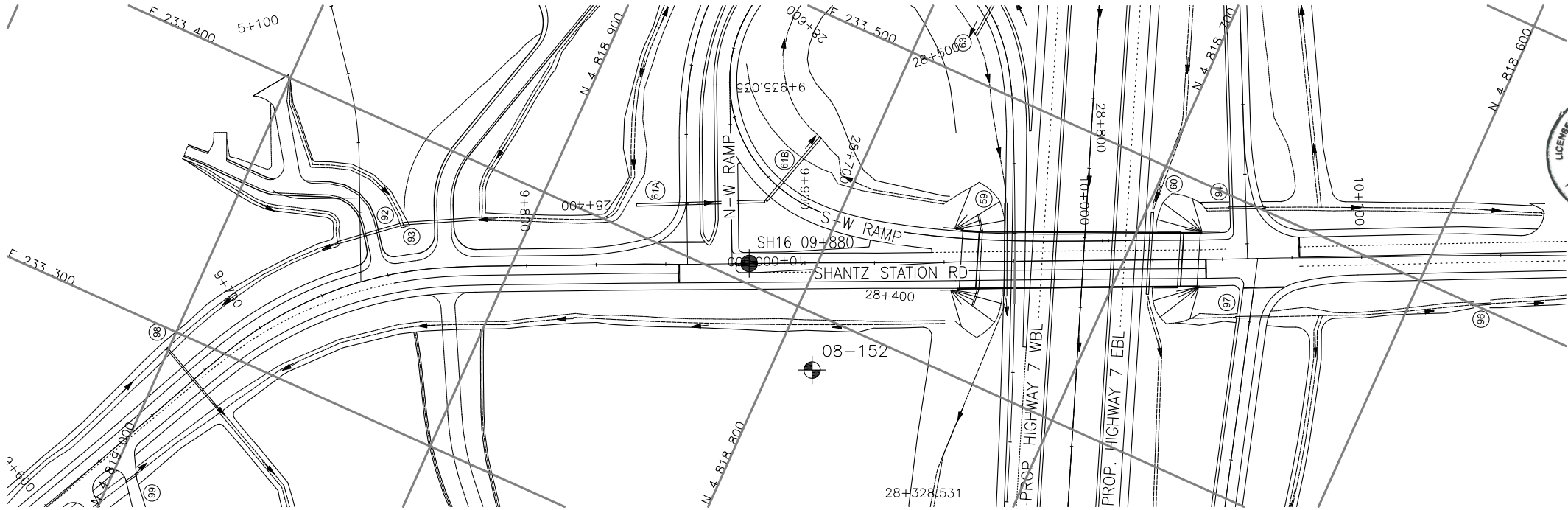




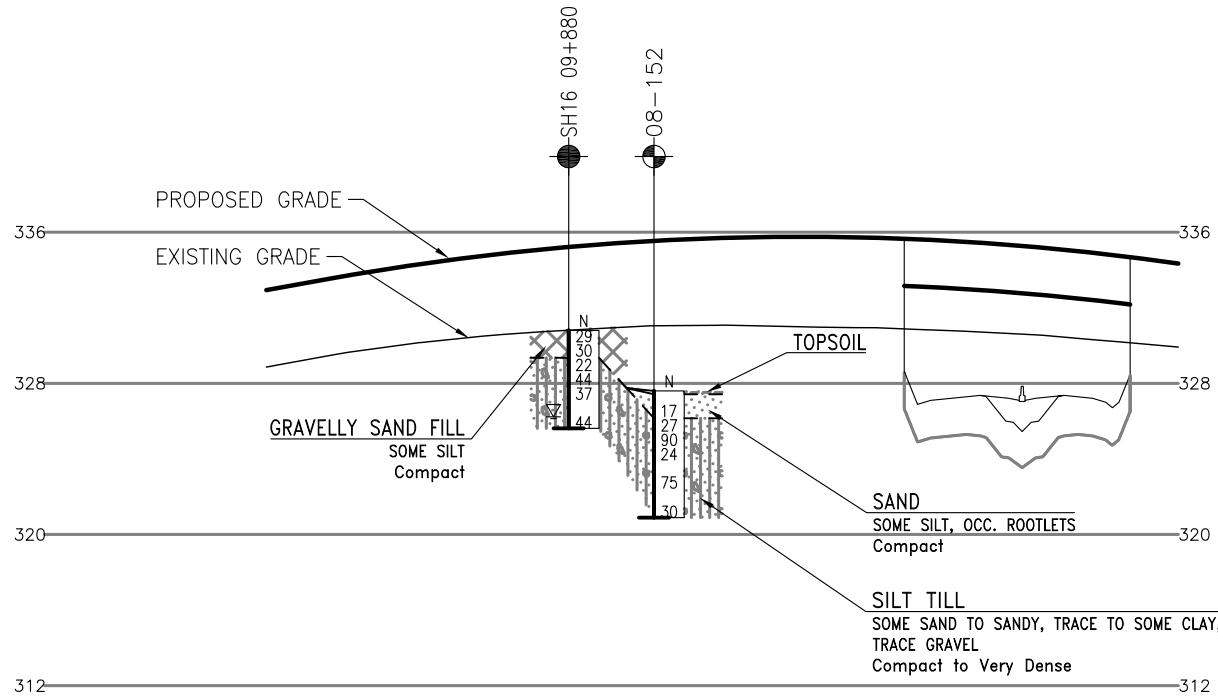
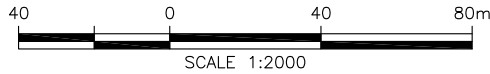
FIG No H2
GWP 408-88-00



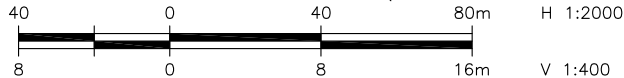
FIG No H3
GWP 408-88-00



PLAN



PROFILE ALONG REGIONAL ROAD 30 (SHANTZ STATION ROAD)



METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
GWP No 408-88-00

REGIONAL ROAD 30  
(SHANTZ STATION ROAD)

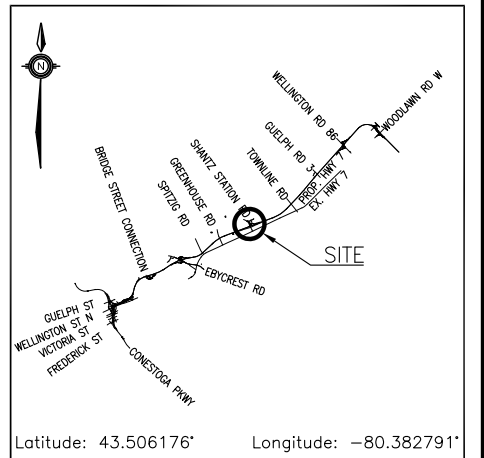
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole (Current Investigation)
	Borehole (2008 Investigation)
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

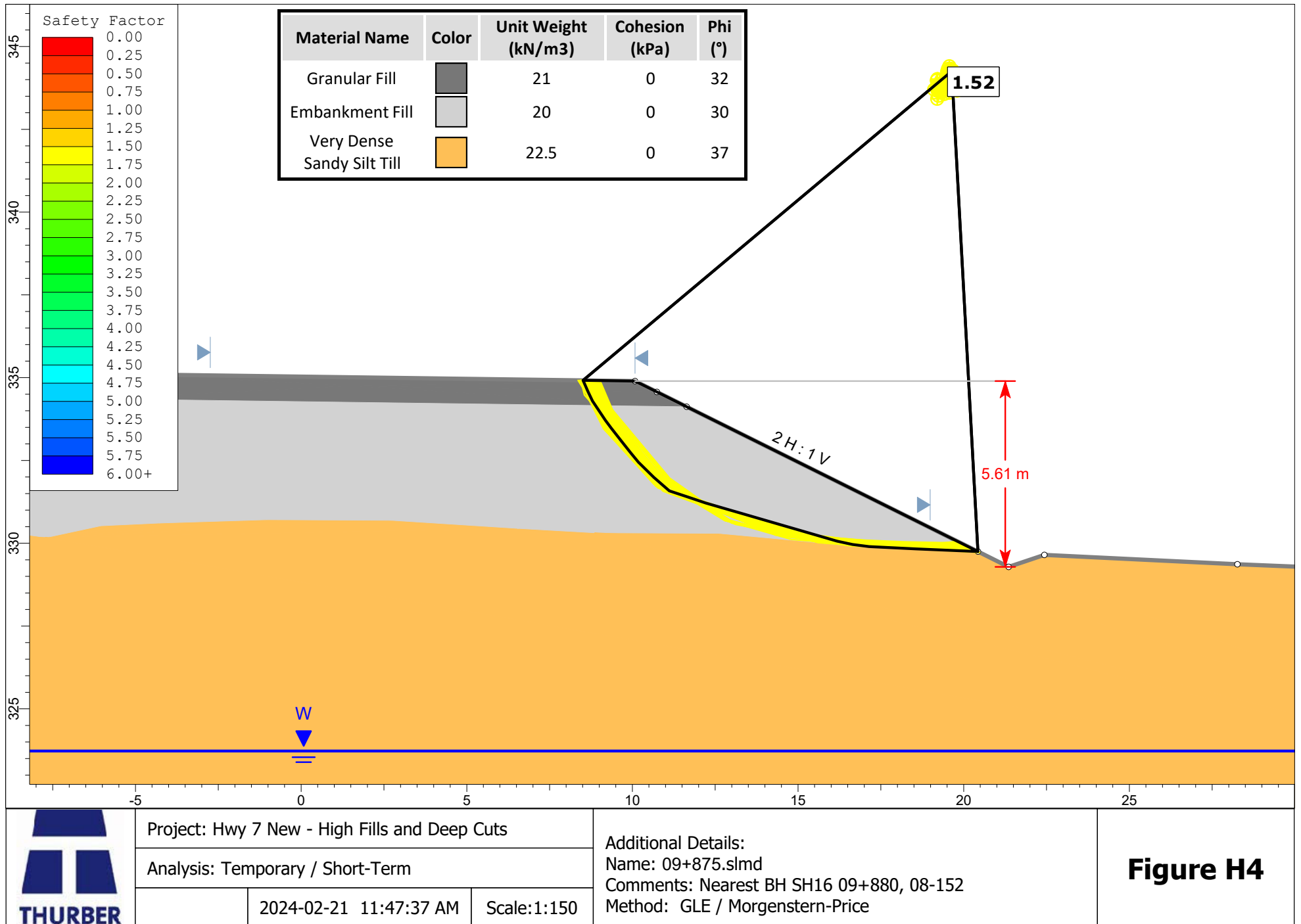
NO	ELEVATION	NORTHING	EASTING
SH16 09+880	330.8	4 818 822.3	233 406.9
08-152	327.6	4 818 786.0	233 381.2

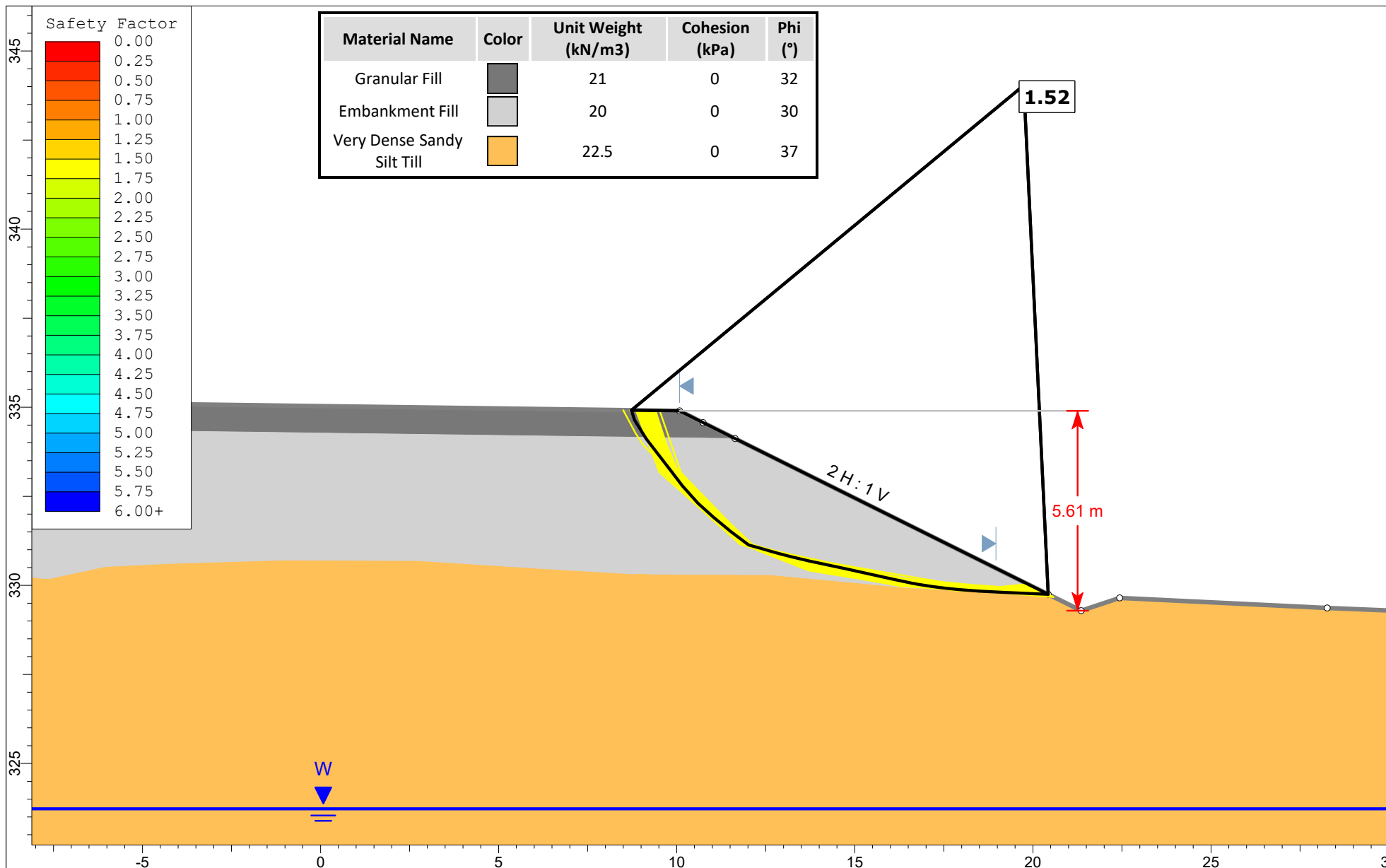
-NOTES-

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

GEOCRES No. 40P09-067

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MKE	CHK	PKC
DRAWN	MFA	CHK	MKE
LOAD			
STRUCT			
DWG	1		
DATE	FEB 2024		





Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Permanent / Long-Term

2024-02-21 11:47:37 AM

Scale:1:150

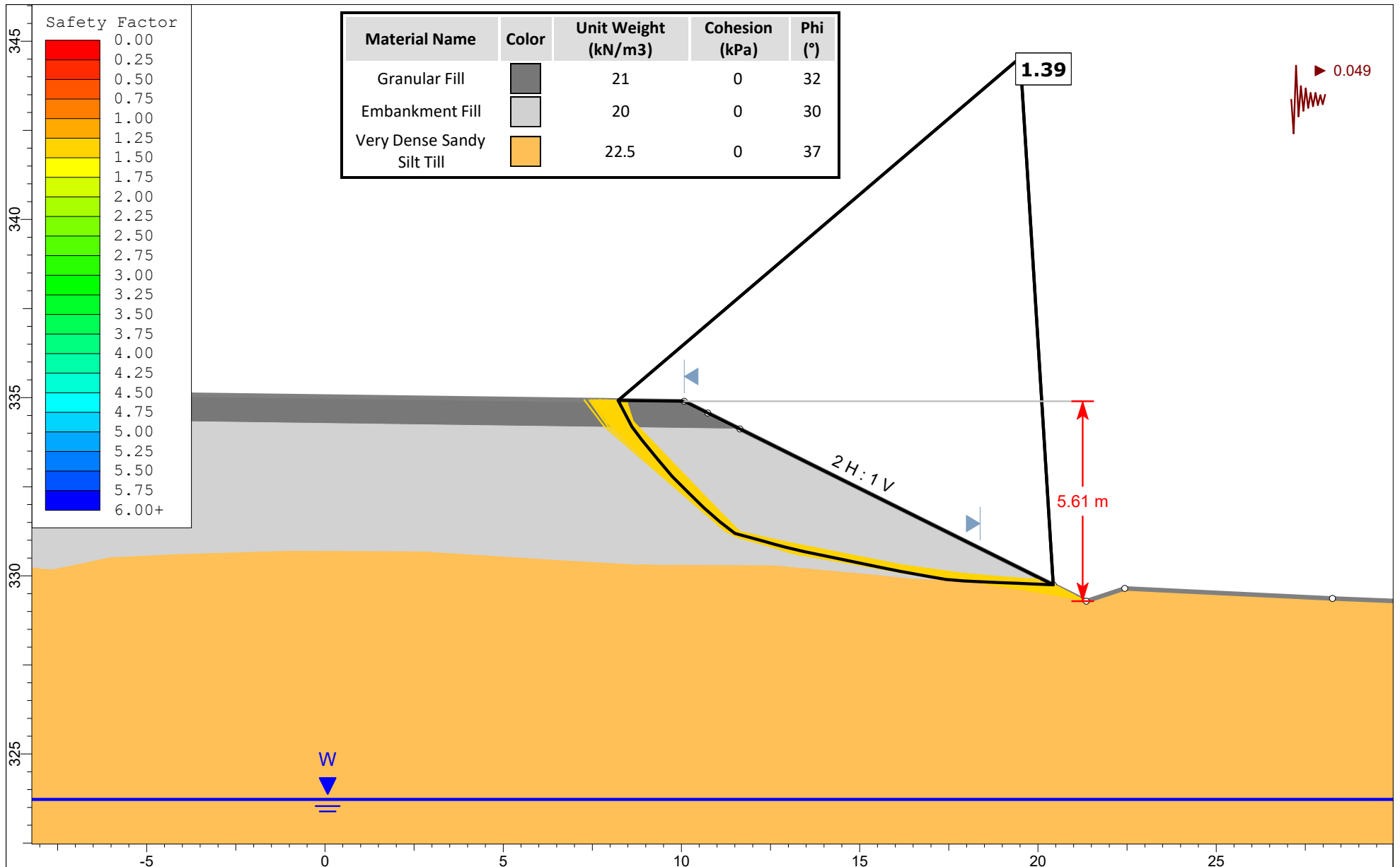
Additional Details:

Name: 09+875.slmd

Comments: Nearest BH SH16 09+880, 08-152

Method: GLE / Morgenstern-Price

**Figure H5**



Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Seismic

2024-02-21 11:47:37 AM

Scale:1:150

Additional Details:

Name: 09+875.slmd

Comments: Nearest BH SH16 09+880, 08-152

Method: GLE / Morgenstern-Price

**Figure H6**



## **Appendix I.**

**Highway 7: Station 29+200 – 29+400 (ML16 29+200, ML16 29+250, ML16 29+300,  
ML16 29+350, ML16 29+400)**

# RECORD OF BOREHOLE No ML16 29+200 1 OF 1 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 818 990.1 E 234 196.1 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507497 LONGITUDE -80.373176 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
334.6	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL: (300mm)																			
334.3			1	SS	7															
0.3	ClayeySILT, and sand, trace gravel Firm to Stiff Brown Moist (TILL)																			
			2	SS	10															
			3	SS	15															
332.4																				
2.2	Sandy Silty CLAY, trace gravel, occasional cobbles Hard Brown Moist (TILL)		4	SS	53															
			5	SS	100/ 0.275															
	Auger grinding at 3.8m																			
			6	SS	93															
328.1			7	SS	100/ 0.250															
6.5	END OF BOREHOLE AT 6.5m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO SURFACE.																			

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 29+250 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 007.0 E 234 236.6 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507653 LONGITUDE -80.372677 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  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										
335.4	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (450mm)		1	SS	7		335											
334.9																		
0.5	Silty <b>CLAY</b> , trace sand, trace gravel Firm to Very Stiff Brown Moist		2	SS	7		334											
			3	SS	21		333											1 8 34 57
			4	SS	28		332											
			5	SS	24		331											
331.3																		
4.1	Sandy Silty <b>CLAY</b> , trace gravel, occasional cobbles Hard Brown Moist (TILL)		6	SS	58		330											
	Auger grinding at 6.1m		7	SS	64		329											
							328											
			8	SS	54		327											1 26 42 31
	Auger grinding at 8.7m																	
326.0			9	SS	100/													
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH				0.050													

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ML16 29+250 2 OF 2 METRIC



GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 007.0 E 234 236.6 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507653 LONGITUDE -80.372677 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page AUGER CUTTINGS TO SURFACE.																

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# RECORD OF BOREHOLE No ML16 29+300 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 024.7 E 234 283.7 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507816 LONGITUDE -80.372097 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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										WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
336.0	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL: (600mm)		1	SS	5									○						
335.4																				
0.6	Silty <b>CLAY</b> , trace to some sand, trace gravel, occasional cobbles Stiff to Hard Brown to Grey Moist		2	SS	14		335							○						
			3	SS	30		334							○						
			4	SS	25									○						
							333													
			5	SS	24									○						
							332													
	Layer of silt		6	SS	34		331							○			0 0 78 22			
														○						
							330													
			7	SS	51									○						
							329													
			8	SS	52		328							○						
	Auger grinding at 8.5m						327													
326.3			9	SS	30									○	—		0 15 31 54			
9.8	END OF BOREHOLE AT 9.8m.																			

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 29+300 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 024.7 E 234 283.7 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507816 LONGITUDE -80.372097 CHECKED BY JPL

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 (%) GR SA SI CL
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>			
	Continued From Previous Page																
	BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO SURFACE.																

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# RECORD OF BOREHOLE No ML16 29+350 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 039.5 E 234 323.0 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507954 LONGITUDE -80.371613 CHECKED BY JPL

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			20   40   60   80   100	○ UNCONFINED      + FIELD VANE	W <sub>P</sub> W      W <sub>L</sub>	WATER CONTENT (%)					
336.5	GROUND SURFACE															
0.0	TOPSOIL: (450mm)		1	SS	10											
336.0																
0.5	Silty <b>CLAY</b> , some sand, trace gravel, occasional cobbles Stiff to Hard Brown to Grey Moist		2	SS	12											
			3	SS	24											
			4	SS	86											
			5	SS	55											
332.4																
4.1	Sandy Silty <b>CLAY</b> , trace gravel Hard Brown Moist (TILL)		6	SS	34											

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ML16 29+350 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 039.5 E 234 323.0 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.507954 LONGITUDE -80.371613 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	Continued From Previous Page							20 40 60 80 100					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub>					GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
	Silty <b>CLAY</b> to <b>CLAY</b> , trace sand Very Stiff Grey Moist		11	SS	20		326																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						</

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No ML16 29+400 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 057.6 E 234 376.7 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.508122 LONGITUDE -80.370951 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
336.5	GROUND SURFACE							20	40	60	80	100	PLASTIC LIMIT w <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	TOPSOIL: (375mm)		1	SS	5											
336.1																
0.4	Sandy clayey <b>SILT</b> , trace gravel, occasional cobbles Firm to Very Stiff Brown Moist (TILL)		2	SS	20		336									1 26 58 15
			3	SS	20		335									
334.3																
2.2	Sandy silty <b>CLAY</b> , trace gravel, occasional cobbles Hard Brown to Grey Moist (TILL)		4	SS	50		334									
			5	SS	69		333									
							332									
			6	SS	73											
							331									
			7	SS	55		330									
			8	SS	43		329									
			9	SS	70		328									
							327									1 25 49 25
326.7			10	SS	47											
9.8	END OF BOREHOLE AT 9.8m.															

Continued Next Page

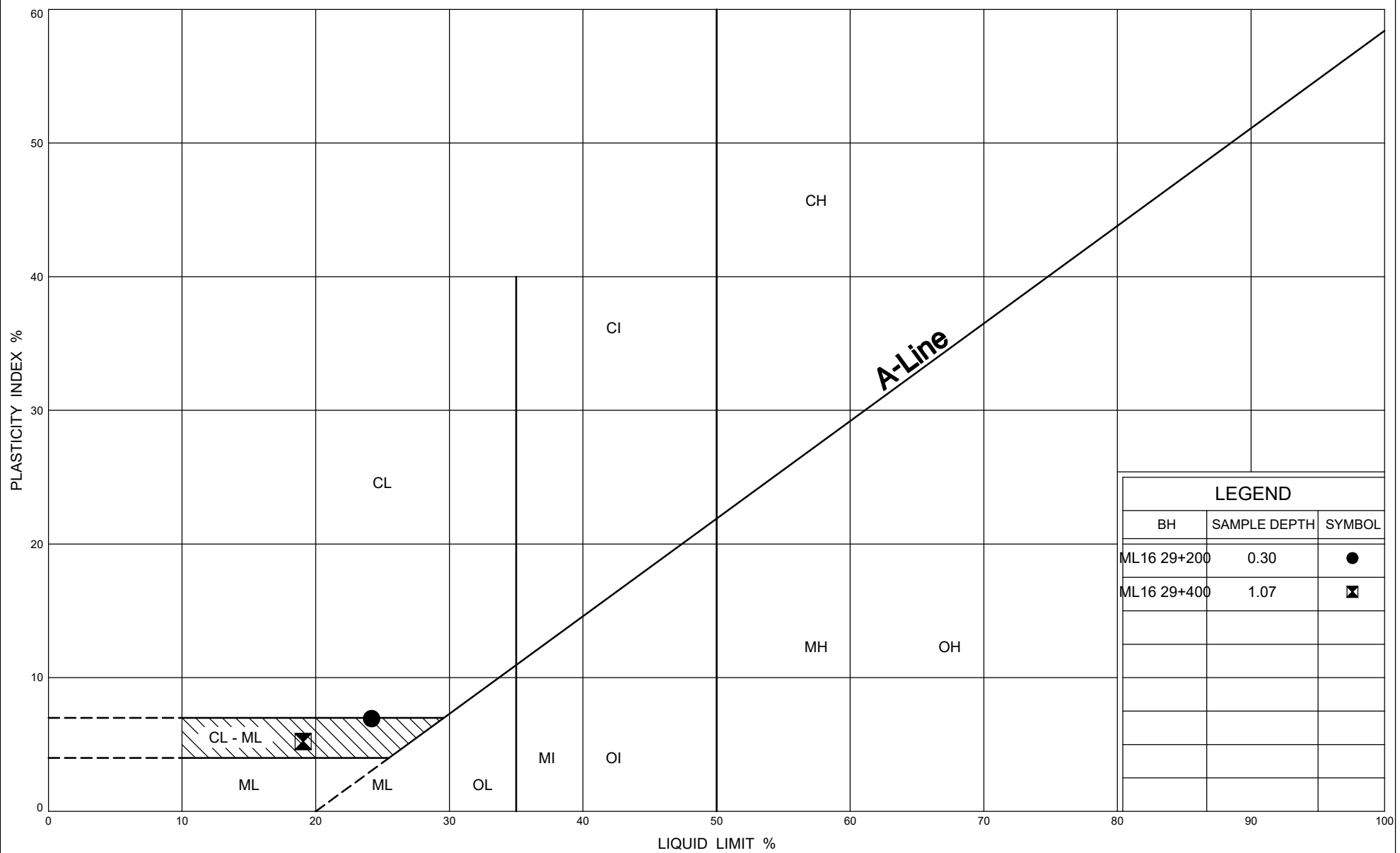
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

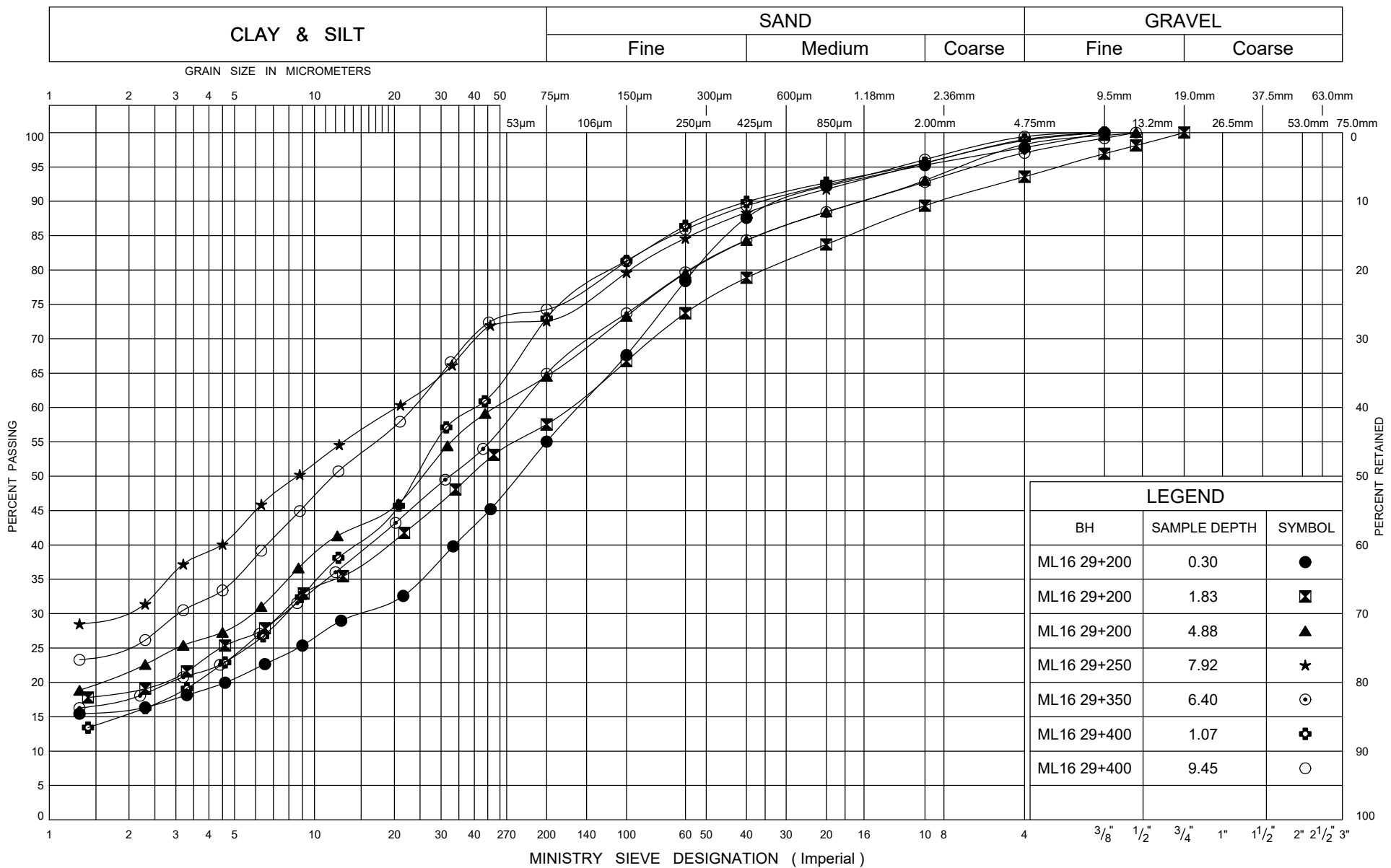
20  
15  
10  
(%) STRAIN AT FAILURE

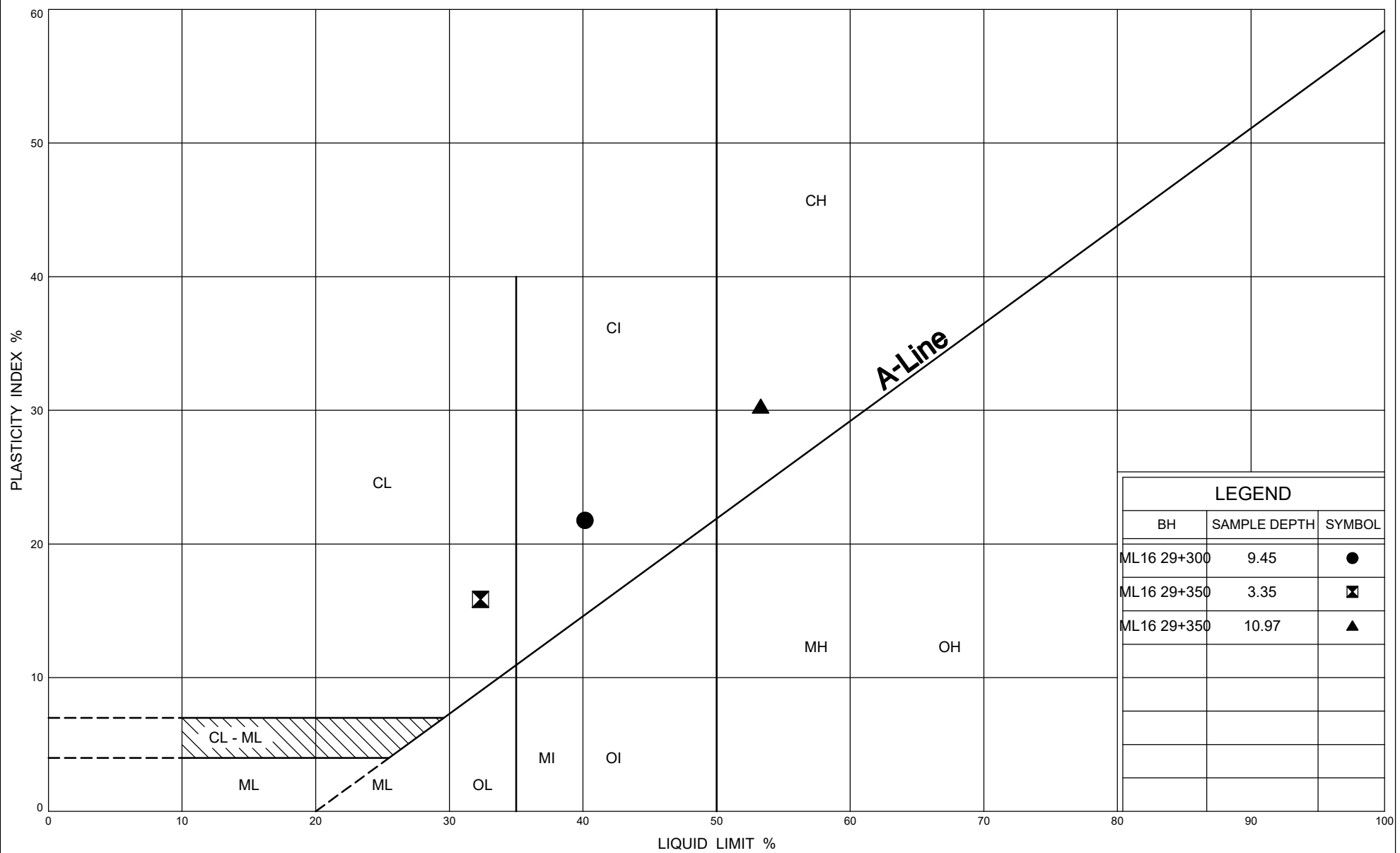
# RECORD OF BOREHOLE No ML16 29+400 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Mainline, MTM NAD 83 Zone 10: N 4 819 057.6 E 234 376.7 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.06.26 - 2018.06.26 LATITUDE 43.508122 LONGITUDE -80.370951 CHECKED BY JPL

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 (%)				
	Continued From Previous Page							20	40	60	80	100					
	BOREHOLE CAVED TO 9.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO SURFACE.																







LEGEND		
BH	SAMPLE DEPTH	SYMBOL
ML 16 29+300	9.45	●
ML 16 29+350	3.35	⊠
ML 16 29+350	10.97	▲

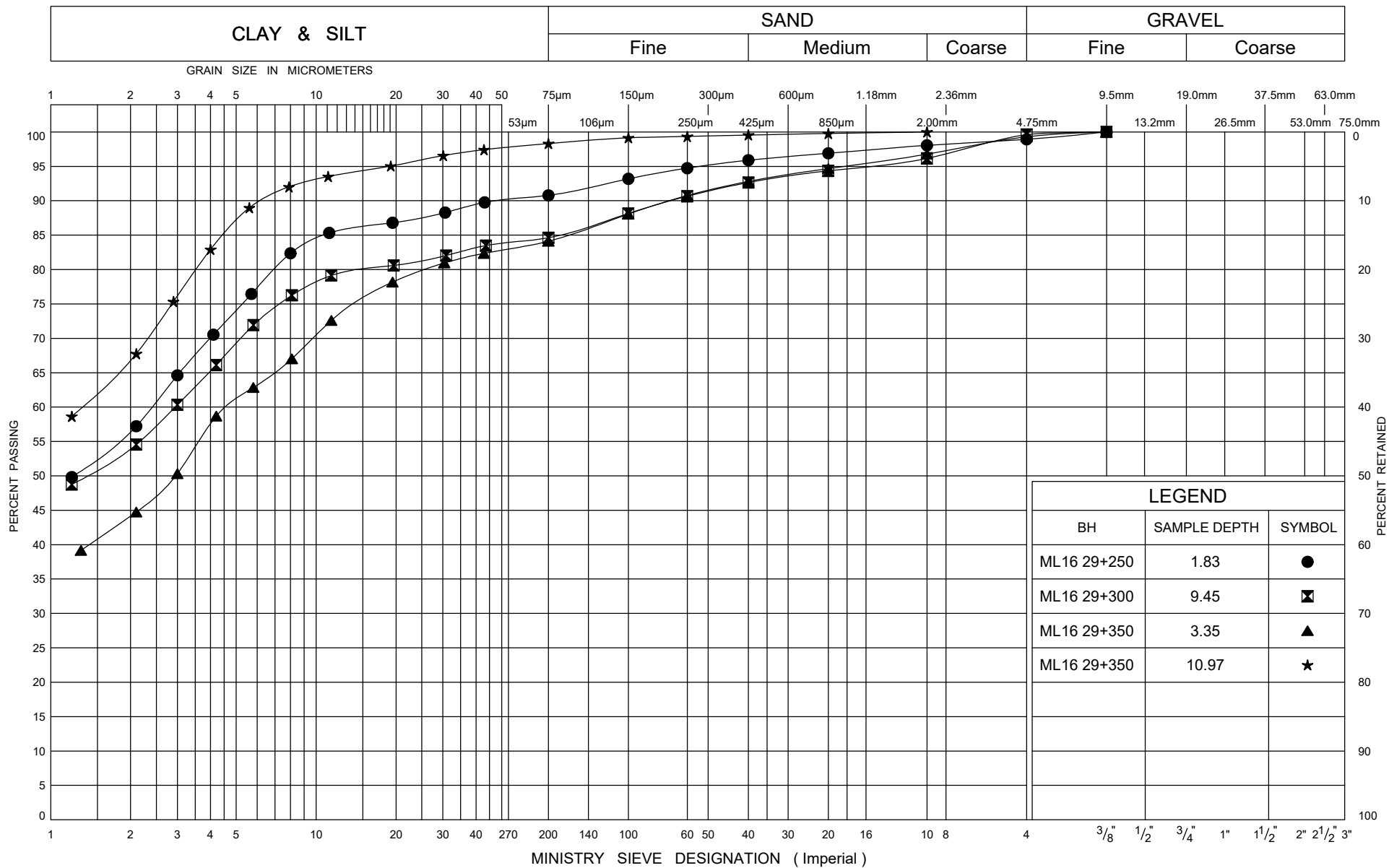




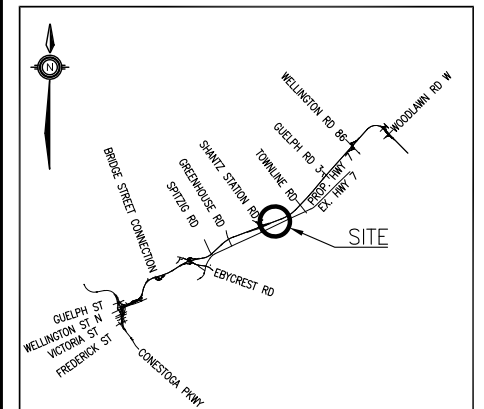
FIG No 15
GWP 408-88-00



SHEET








**THURBER** ENGINEERING LTD.



Longitude: -80.372098°

## LEGEND

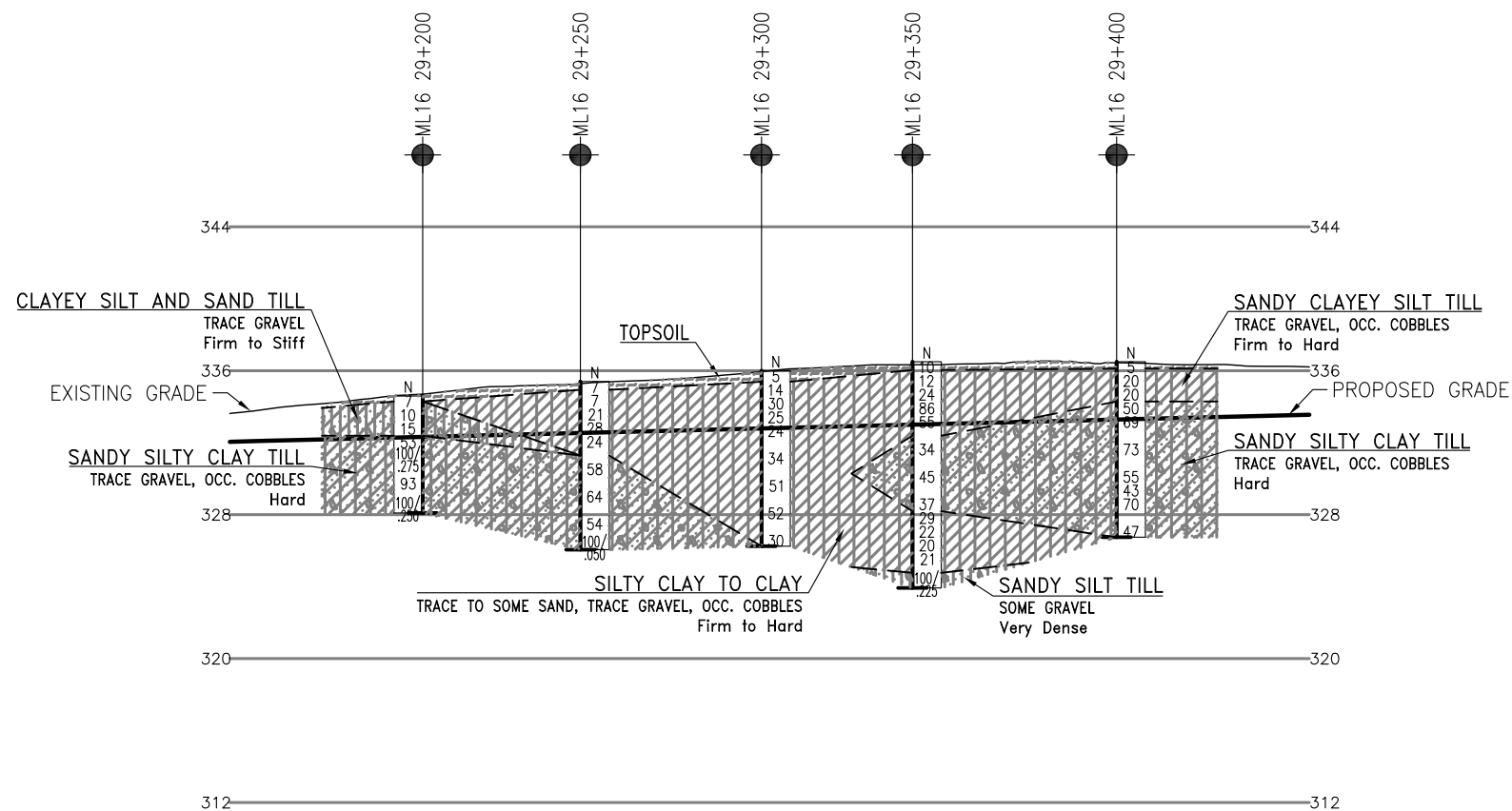
	Borehole (Current Investigation)
	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

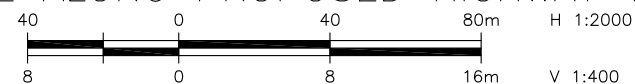
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is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

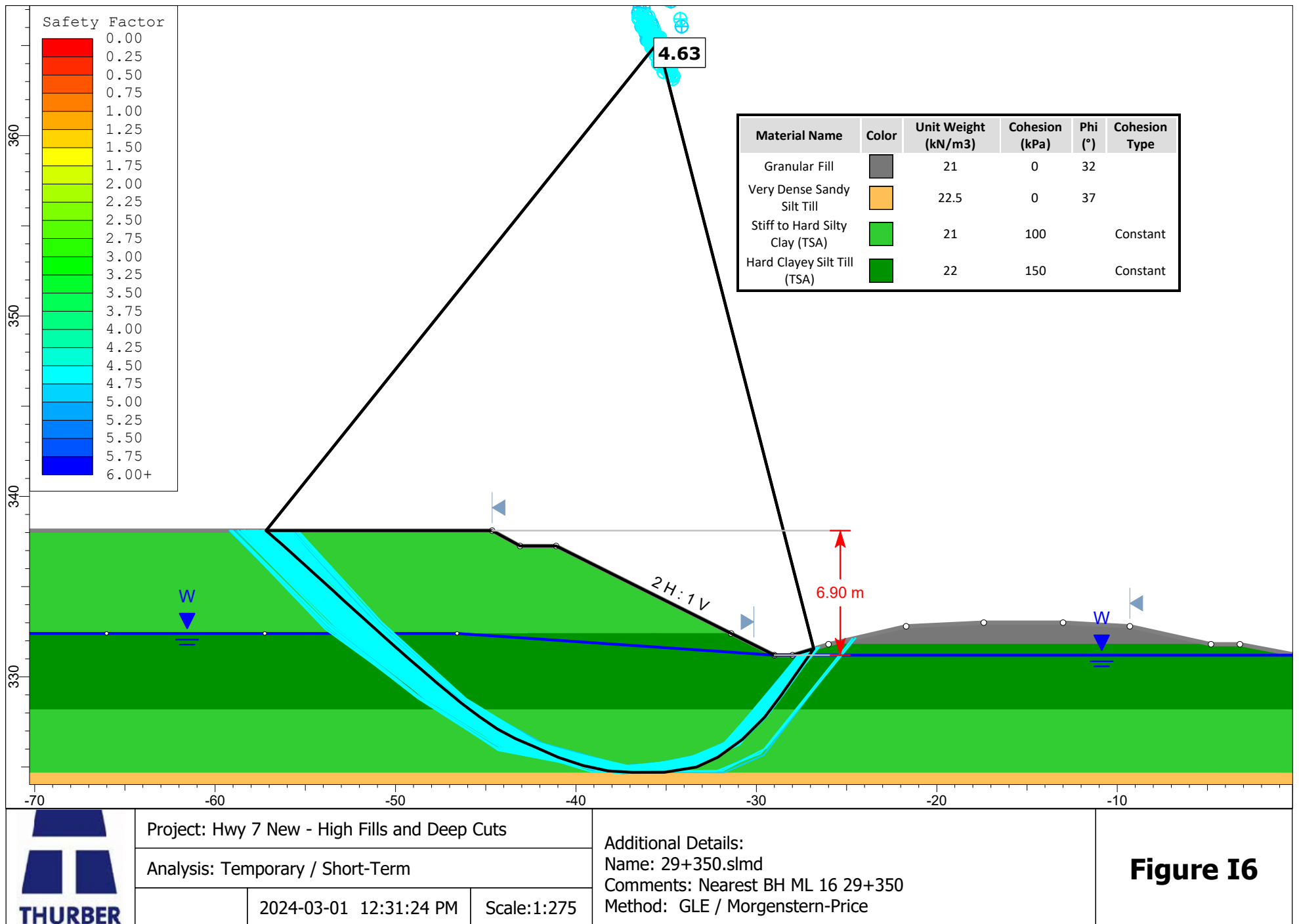
[illegible]

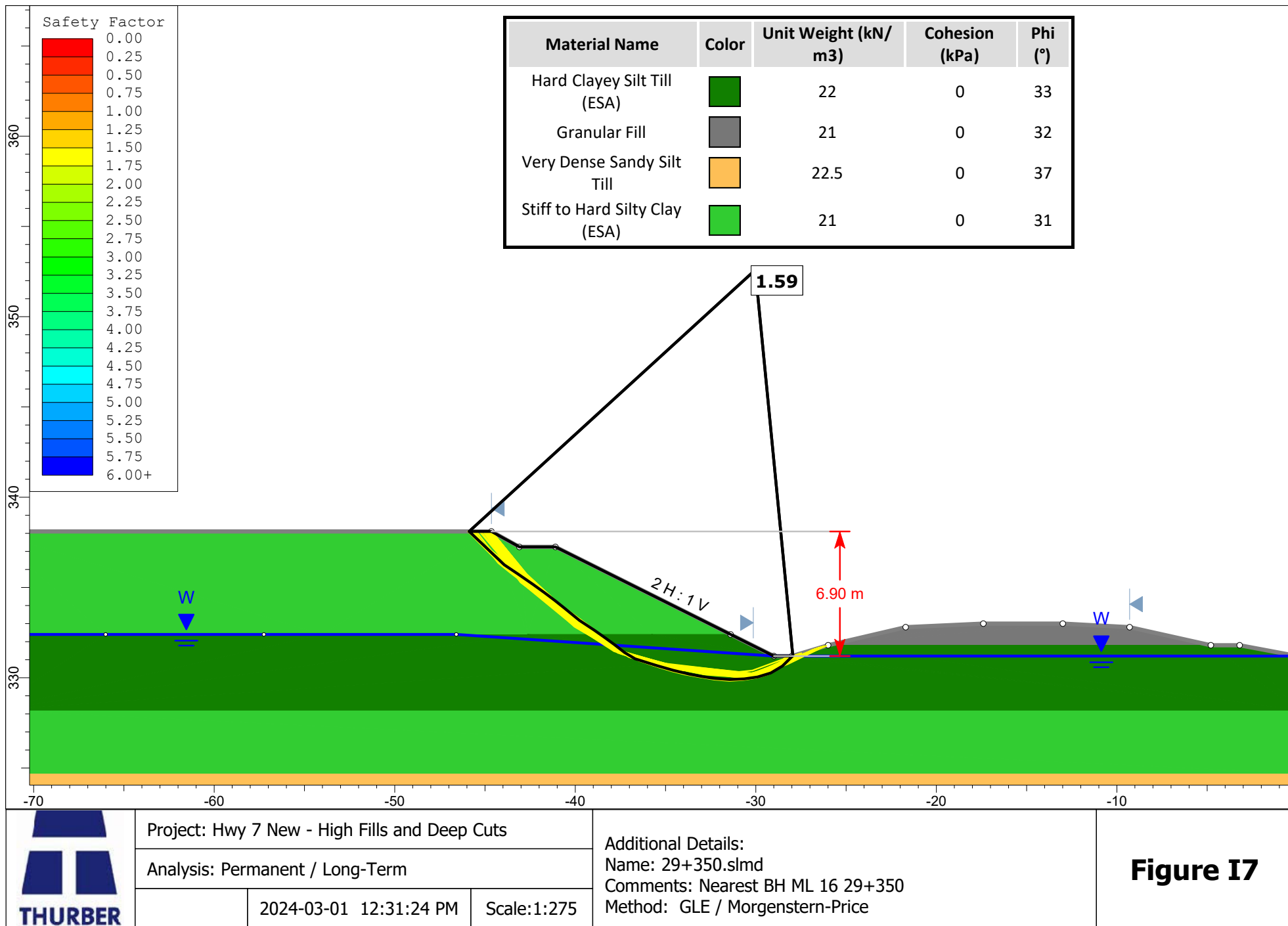
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PLOTDATE: 2/25/2024 4:18 PM

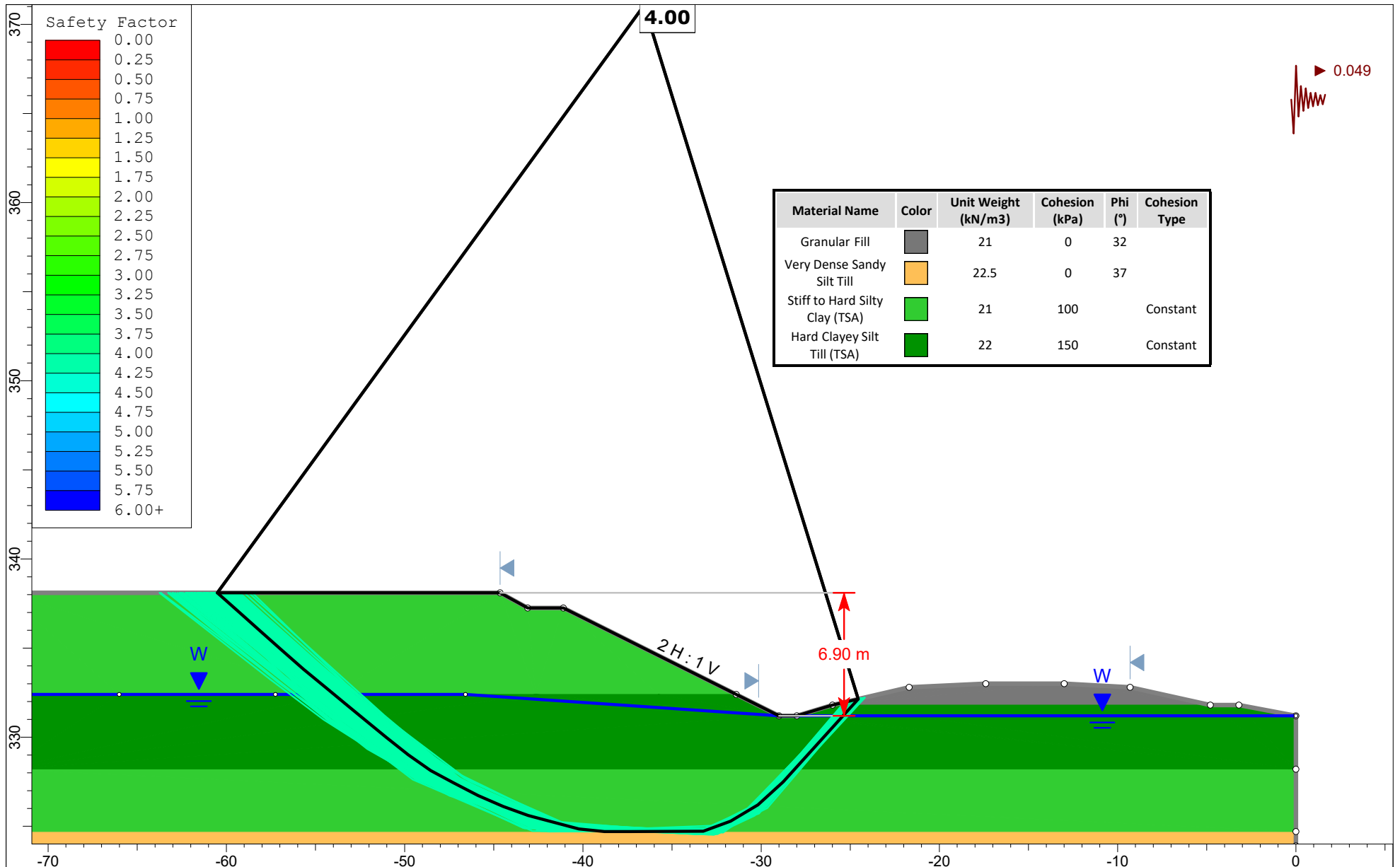


## PROFILE ALONG PROPOSED HIGHWAY 7









Project: Hwy 7 New - High Fills and Deep Cuts

Analysis: Seismic

2024-03-01 12:31:24 PM

Scale: 1:300

Additional Details:

Name: 29+350.slmd

Comments: Nearest BH ML 16 29+350

Method: GLE / Morgenstern-Price

**Figure I8**



## **Appendix J.**

### **GSC Seismic Hazard Calculation**

# 2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836  
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 43.532N 80.336W

2020-04-13 12:54 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.108	0.061	0.036	0.010
Sa (0.1)	0.141	0.084	0.052	0.015
Sa (0.2)	0.128	0.078	0.050	0.017
Sa (0.3)	0.103	0.065	0.043	0.015
Sa (0.5)	0.080	0.051	0.034	0.012
Sa (1.0)	0.046	0.030	0.020	0.006
Sa (2.0)	0.023	0.015	0.009	0.002
Sa (5.0)	0.006	0.003	0.002	0.001
Sa (10.0)	0.002	0.001	0.001	0.000
PGA (g)	0.078	0.046	0.029	0.008
PGV (m/s)	0.064	0.039	0.025	0.007

**Notes:** Spectral ( $S_a(T)$ , where  $T$  is the period in seconds) and peak ground acceleration (PGA) values are given in units of  $g$  ( $9.81 \text{ m/s}^2$ ). Peak ground velocity is given in  $\text{m/s}$ . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity  $450 \text{ m/s}$ ). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

## References

**National Building Code of Canada 2015 NRCC no. 56190;** Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

**Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)**  
**Commentary J:** Design for Seismic Effects

**Geological Survey of Canada Open File 7893** Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites [www.EarthquakesCanada.ca](http://www.EarthquakesCanada.ca) and [www.nationalcodes.ca](http://www.nationalcodes.ca) for more information



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada



## **Appendix K.**

### **Tables**

**Table 1**  
**Summary of Slope Stability Analysis**  
**New Highway 7 - High Fill Embankments and Deep Cuts**  
**Regional Road 17 (Ebycrest Road) to Woolwich Guelph Townline**

Highway / Roadway / Ramp	Approx. Station	Analyzed Station	Reference Appendix	Cut and/or Fill	Depth of Cut / Height of Embankment (m)	Analysis	Factor of Safety	Figure
Highway 7	25+050 - 25+600	25+125	A	Cut	5.0 - 6.0	Temporary / Short-Term	2.67	A10
						Permanent / Long-Term	1.63	A11
						Seismic	2.36	A12
Highway 7	26+450 - 26+950	26+600	B	Cut	5.0 - 9.0	Temporary / Short-Term	3.01	B11
						Permanent / Long-Term	1.55	B12
						Seismic	2.66	B13
Highway 7	27+350 - 27+900	27+625	C	Fill	4.5 - 7.0	Temporary / Short-Term	1.50	C8
						Permanent / Long-Term	1.50	C9
						Seismic	1.34	C10
Regional Road 30 (Shantz Station Road) - S-W Ramp	28+400 - 28+500	28+500	D	Cut	C: 5.0 - 6.5	Temporary / Short-Term	5.77	D10
						Permanent / Long-Term	1.82	D11
						Seismic	4.94	D12
Highway 7	29+950 - 30+150	30+000	E	Fill	5.0 - 7.0	Temporary / Short-Term	1.62	E3
						Permanent / Long-Term	1.62	E4
						Seismic	1.42	E5
Regional Road 30 (Shantz Station Road) - N/S-E Ramp	28+420 - 28+600	28+420	F	Cut / Fill	C: 4.5 - 6.0 F: 1.0 - 4.0	Temporary / Short-Term	1.55	F5
						Permanent / Long-Term	1.67	F6
						Seismic	1.48	F7
Regional Road 30 (Shantz Station Road) - E-N/S Ramp	28+625 - 28+675	28+650	G	Cut	1.0 - 3.5	Temporary / Short-Term	9.60	G3
						Permanent / Long-Term	2.03	G4
						Seismic	8.27	G5
Regional Road 30 (Shantz Station Road)	9+850 - 9+925	9+875	H	Fill	4.0 - 4.5	Temporary / Short-Term	1.52	H4
						Permanent / Long-Term	1.52	H5
						Seismic	1.39	H6
Highway 7	29+200 - 29+400	29+350	I	Cut	6.0	Temporary / Short-Term	4.63	I6
						Permanent / Long-Term	1.59	I7
						Seismic	4.00	I8

**Table 2**  
**Summary of Settlement Analysis**  
**New Highway 7 - High Fill Embankments and Deep Cuts**  
**Regional Road 17 (Ebycrest Road) to Woolwich Guelph Townline**

Highway / Roadway / Ramp	Approx. Station	Reference Appendix	Cut and/or Fill	Depth of Cut / Height of Embankment (m)	Foundation Settlement (mm)	Embankment Compression (mm)	Total Estimated Settlement (mm)
Highway 7	25+050 - 25+600	A	Cut	5.0 - 6.0	-	-	-
Highway 7	26+450 - 26+950	B	Cut	5.0 - 9.0	-	-	-
Highway 7	27+350 - 27+900	C	Fill	4.5 - 7.0	55	35	90
Regional Road 30 (Shantz Station Road) - S-W Ramp	28+400 - 28+500	D	Cut	C: 5.0 - 6.5	20	20	40
Highway 7	29+950 - 30+150	E	Fill	5.0 - 7.0	10	35	45
Regional Road 30 (Shantz Station Road) - N/S-E Ramp	28+420 - 28+600	F	Cut / Fill	C: 4.5 - 6.0 F: 1.0 - 4.0	35	25	60
Regional Road 30 (Shantz Station Road) - E-N/S Ramp	28+625 - 28+675	G	Cut	1.0 - 3.5	-	-	-
Regional Road 30 (Shantz Station Road)	9+850 - 9+925	H	Fill	4.0 - 4.5	10	25	35
Highway 7	29+200 - 29+400	I	Cut	6.0	-	-	-