

FOUNDATION INVESTIGATION AND DESIGN REPORT
DEEP CUT FROM STA. 17+975 to 18+450
INCLUDING ENCROACHMENT INTO A FEN POND
HIGHWAY 11/17 RED ROCK TO NIPIGON
FROM 4.8 KM WEST OF HWY 628 TO 1.5KM WEST OF HWY 585
G.W.P. 647-89-00

Geocres Number: 52A-189

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed highway cut between Sta. 17+975 and 18+450, a portion of which encroaches into a Fen Pond, for the proposed Highway 11/17 four-laning project. The overall project extends from 4.8 km west of Highway 628 to 1.5 km west of Highway 585 between Red Rock and Nipigon and consists of the widening of Highway 11/17 from a two-lane roadway to a four-lane divided highway in the Township of Thunder Bay District, Ontario.

The purpose of the investigation was to explore the subsurface conditions for the proposed highway cut between Sta. 17+975 and 18+450 as well as beneath and surrounding the Fen Pond site and, based on the data obtained, to provide a record of borehole sheets, borehole location plans, stratigraphic profiles, laboratory test results, and a generalized description of the subsurface conditions for this section of the cut. This information provides a model of the anticipated geotechnical conditions influencing design and construction of a cut between Sta. 17+975 and 18+450 and specifically between Sta. 18+050 and 18+190 where the cut section encroaches the Fen Pond.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 6009-E-0019.

2 SITE DESCRIPTION

The site is located along the proposed Highway 11/17 alignment approximately 3.4 km east of Highway 628 and 4.8 km west of Highway 585. The site topography comprises a marshy terrain containing an isolated depression with standing water surrounded by frequent bedrock outcrops and heavily treed rolling hills. The site location is shown in Figure 1 in Appendix A and in the key plan in Appendix E. This section of the highway between Sta. 17+975 and 18+450 will consist of both earth and rock cuts up to 10.5 and 22.0 m deep, respectively.

A Fen Pond is located immediately west of the proposed Highway 11/17 WBL between Sta. 18+050 and 18+190 and the section of the highway cut encroaching into the Fen Pond will be up to 8.0 m deep. The Fen Pond is currently situated within a topographic depression and has an approximate surficial area of 4,000 m². Overhead hydro transmission lines run across the Fen Pond in an approximate north-south and east-west orientation. Drainage in the general area is to the southeast and is mainly controlled by surface water runoff and the water level in the Fen Pond.

The general site area is overlain by intermittent lacustrine deposits comprising varved or massive clay and silt, silty to sandy till and bare bedrock outcrops (ref: Surficial Geological Map of the Ontario Department of Lands and Forest). Layers of recent organic deposits of peat occur in low lying areas. The area is underlain by Precambrian felsic igneous and metamorphic rocks, as well as sedimentary rocks of the Sibley Group (OGS Map No. 2232).

Selected photographs showing the general nature of the site and surrounding lands are included in Appendix F.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this highway cut were carried out in four stages as follows:

- First Stage: Highway 11/17 EBL and WBL Pavement Investigation (10 boreholes between Sta. 18+085 to 18+120) carried out by Thunder Bay Testing and Engineering (TBTE)
- Second Stage: Highway 11/17 EBL and WBL Cut Investigation (14 boreholes between Sta. 17+975 to 18+450) carried out by Thurber between June 1 and June 7, 2012
- Third Stage: Fen Pond Investigation (23 boreholes, FP-04 to FP-26 mainly within the pond) carried out by TBTE between April 22 and April 24, 2014
- Fourth Stage: Fen Pond Investigation (12 boreholes, BH-1 to BH-12 outside of the pond) carried out by Thurber between May 13 and May 16, 2014

The Fen Pond boreholes were typically advanced through the peat and organic deposits and selected boreholes were extended to refusal. Bedrock was proven by coring in selected boreholes.

A summary of the borehole depths is provided in Table A1 in Appendix A. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings included in Appendix E.

The borehole locations were selected by Thurber and laid out by TBTE in the field. The approximate ground surface elevations at the borehole locations for the first and second stage of investigation were interpreted based on available topographic data. The top of borehole elevations for the third and fourth stage of investigation were surveyed by TBTE.

The advancement of selected boreholes within the Fen Pond was carried out from the frozen surface of the pond using a hand auger while boreholes near the edge of the Fen Pond and outside the Fen Pond footprint were advanced using a track-mounted Acker drill rig and a trailer mounted CME 45 in conjunction with hollow stem auger (HSA) and NQ bedrock coring techniques. Prior to commencement of drilling, utility clearances were obtained for all investigated locations. Wooden mats were placed around the boreholes along the perimeter of the pond to minimize ground disturbance.

Soil samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests (SPT). In situ vane shear testing was carried out where practical to assess the undrained shear strength of the peat, organic and cohesive deposits. Sampling of the bedrock was performed in selected boreholes in this project. All rock cores were logged and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed upon completion of the drilling operations. Standpipe piezometers were installed in selected boreholes to monitor groundwater levels after drilling. Completion of the boreholes and standpipe piezometers was carried out in general accordance with the requirement of O.Reg. 903 (as amended by O. Reg. 372/07).

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis for the second and fourth stages of the borehole investigation. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's geotechnical laboratory in Oakville, Ontario and TBTE's geotechnical laboratory in Thunder Bay, Ontario for the second and fourth stage of investigation, respectively, for further examination and testing.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis (hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. All peat samples were subjected to Von Post Modified Classification tests¹ to determine the physical properties of the organic soils. The results of this testing is shown on the Record of Borehole sheets and figures included in their respective appendices.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendices B, C and D and the Borehole Locations and Soil Strata Drawings included in Appendix E. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following sections. However, the factual data presented in the borehole logs shall take precedence over these general descriptions and interpretations of the site conditions. It must be recognized that the soil conditions may vary between and beyond the investigated borehole locations.

5.1 Highway 11/17 EBL and WBL Mainline, Sta. 17+975 to 18+450 (Appendix B)

5.1.1 General

Bedrock outcrops with intermittent sand deposits are predominant in this area. Sand fill were encountered along the existing Highway 11/17 and transmission tower corridor, overlying the native sand deposit. A total of fourteen boreholes were drilled in this area.

¹ A.O. Landva, P.E. Pheeney, Peat Fabric and Structure, Canadian Geotechnical Journal, 17, Appendix A, Pg. 434 to 435, 1980

5.1.2 Topsoil

Topsoil was encountered at the ground surface in Boreholes 18+056 CL, 18+122 35R, 18+200 19L and 18+325 CL. The topsoil was between 50 to 150 mm thick. A moisture content of 69% was recorded for the topsoil.

5.1.3 Asphalt

Asphalt was encountered at the ground surface in Boreholes 18+208 16R and 18+400 17R. The asphalt was between 100 and 150 mm thick.

5.1.4 Sand to Gravelly Sand Fill

Brown to black gravelly sand fill to sand fill with trace gravel containing trace silt and clay was encountered at the surface in all the boreholes drilled along the existing Highway 11/17 and in Boreholes 18+088 21L and 18+150 28L, which were drilled in the proximity of the transmission tower corridor.

The fill thickness encountered was 0.8 to 1.5 m, with the lower boundary at Elev. 272.3 and 277.8 m. Boreholes 18+208 16R and 18+400 17R were terminated within the sand fill upon auger refusal at depths of 1.5 m.

SPT 'N' values ranging from 15 to 66 blows per 0.3 m penetration were recorded, indicating a compact to very dense relative density. Moisture contents ranged from 3 to 23%.

The results of grain size distribution analyses conducted on two fill samples are presented on the Record of Borehole sheets and on Figure B1 of Appendix B. The results of the laboratory tests are summarized as follows:

Gravel %	31 to 43
Sand %	51 to 55
Silt & Clay %	6 to 14

5.1.5 Peat

A layer of dark brown peat was encountered in Borehole 18+150 28L beneath the sand fill. The peat layer was 1.2 m thick with its lower boundary at 2.7 m depth (Elev. 276.4 m).

SPT 'N' values of 4 and 16 blows per 0.3 m penetration were recorded within the peat. The peat had moisture contents between 223% and 337%.

5.1.6 Silty Sand to Gravelly Sand

Brown native silty sand to sand with trace silt containing trace gravel to some gravel and trace clay was encountered in nine boreholes at ground surface and beneath the topsoil, fill and peat. The boreholes were terminated within the native sand upon auger refusal, except in Boreholes 18+050 14L, 18+122 35R and 18+278 17L, which were terminated within the bedrock. A localised layer of cobbles, 600mm thick, was encountered at the base of the sand deposit in Borehole 18+122 35R.

The thickness of the native sand deposit ranged from 0.2 to 8.8 m. The lower boundary of the sand deposit was encountered at depths of 0.2 to 9.4 m (Elev. 269.2 to 282.8 m).

SPT 'N' values measured in the sand deposits ranged from 4 blows per 0.3 m penetration to 64 blows for less than 0.3 m penetration. The high SPT 'N' values were mainly recorded at the base of the native sand above probable bedrock. In general, the sand has a loose to dense relative density. Moisture contents typically ranged from 6 to 23%.

Grain size distribution curves for samples of the sand deposit are presented on the Record of Borehole sheets and on Figures B2 and B3 of Appendix B. The results are summarized as follows:

	<u>Silty Sand</u>	<u>Gravelly Sand</u>
Gravel %	0	13 to 34
Sand %	47 to 84	61 to 81
Silt %	19 to 44	13
Clay %	2 to 9	3
Silt & Clay %	16	4 to 10

5.1.7 Refusal and Bedrock

Bedrock and auger refusal on probable bedrock or boulders were encountered in all boreholes. Bedrock outcrop was encountered at Boreholes 17+975 19L and 18+275 42R. Bedrock and refusal on probable bedrock were encountered at up to 9.4 m depth (Elev. 269.2 to Elev. 291.4 m).

Bedrock was proved in Boreholes 18+050 14L, 18+122 35R and 18+278 17L, by coring 2.8 to 3.0 m into the bedrock. The bedrock was described as fresh granite. Total core recovery (TCR) was 100% and rock quality designation (RQD) values ranged from 92 to 100%, indicating excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 3.

The estimated unconfined compressive strength (UCS) of the rock, interpreted from point load tests, ranged from 82 to 247 MPa, indicating a strong to very strong rock.

5.1.8 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in two boreholes to monitor water levels after completion of drilling. The water levels observed during drilling and measured in the piezometers are summarized in Table 5-1.

Table 5-1 Water Level Observations

Borehole	Date	Water Level		Comment
		Depth (m)	Elev. (m)	
18+050 14L	Jun 21, 12	5.2	273.3	Piezometer
	Jul 15, 12	5.2	273.3	
	Nov 21, 12	5.4	273.1	
18+088 21L	Jun 07, 12	3.7	274.9	Open borehole
18+122 35R	Jun 06, 12	4.0	272.6	Open borehole
18+150 28L	Jun 21, 12	2.2	276.9	Piezometer
	Jul 15, 12	2.6	276.5	
	Nov 21, 12	2.7	276.4	
18+278 17L	Jun 02, 12	0.0	282.9	Open borehole

The recorded groundwater levels are considered short-term readings and seasonal fluctuations of the groundwater level are to be expected, particularly after spring snowmelt as well as periods of prolonged and/or significant precipitation.

5.2 Area outside of Fen Pond, Highway 11/17 Sta. 18+050 to 18+190 (Appendix C)

5.2.1 General

A total of twenty-two boreholes were advanced outside of the Fen Pond footprint. The site stratigraphy encountered generally consists of surface standing water or a surficial layer of peat underlain by a deposit of sand/silt, which was underlain by bedrock.

5.2.2 Surface Standing Water

Water was encountered at the surface in Boreholes BH-01, BH-04, BH-05, BH-06 and BH-07. The depth of the surface water ranged from 0.3 to 0.5 m with an underside elevation varying from Elev. 277.6 to 278.0 m.

5.2.3 Peat

A deposit of peat with trace rootlets and trace wood was encountered below the surface water in Boreholes BH-01, BH-04, BH-05, BH-06 and BH-07; below a 150 mm rootmat in Borehole BH-08; below rock fill/sand fill in Boreholes BH-11 and BH-12 and at the surface of Boreholes BH-02, BH-03, BH-09 and BH-10,. The thickness of the peat varied from 1.4 to 5.4 m with the lower boundary at depths ranging from 1.4 to 5.6 m (Elev. 272.8 to 277.1 m). Peat was also encountered at the surface of the following pavement boreholes: 18+085 19L, 18+090 18L, 18+100 08L, 18+100 18L, 18+100 19L, 18+100 28L, 18+110 18L, 18+120 02L, 18+120 18L and 18+120 28L where the thickness ranged from 20 mm to 4.8 m

SPT N-values of 0 to 6 blows per 0.3 m of penetration were recorded. In situ field vane testing measured an undrained shear strengths of less than 1 kPa, indicating that the peat is typically very soft. The moisture contents ranged from 15 to 1129%, typically 250 to 800%.

The Von Post classifications of the peat samples indicate very slight to complete decomposition with a very low to high water content. The results of the Von Post classification have been reported on the Record of Borehole sheets provided in Appendix C.

5.2.4 Rock Fill/Sand Fill

A layer of rock fill/sand fill with trace to some gravel and trace silt was encountered at the surface in Boreholes BH-11 and BH-12. The thickness of the fill was 1.4 m with an underside elevation of Elev. 276.9 to 277.3 m.

The moisture content varied from 10 to 25%.

5.2.5 Sandy Silt to Sand

A deposit of sands and silts ranging in composition from sandy silt with trace gravel and trace clay to sand with trace to some gravel, trace to some silt, trace clay and trace cobbles was encountered below the peat layer in Boreholes BH-01 to BH-03, BH-05 to BH-08, BH-10 to BH-12, and below the silty clay layer in BH-04. Boreholes BH-01 to BH-03, BH-07, BH-08 and BH-10 to BH-12 were terminated within the sand deposit upon auger refusal occurring at depths ranging from 6.3 to 9.9 m (Elev. 268.4 to 272.4 m). The thickness of the sand deposit varied from 2.7 to 4.7 m with a corresponding lower boundary at depths ranging from 7.3 to 10.2 m (Elev. 267.9 to 271.0 m) in Boreholes BH-04 to BH-06. The deposit of sands and silts was also encountered below the peat layer in the following pavement boreholes: 18+085 19L, 18+100 18L, 18+100 19L, 18+100 28L, 18+110 18L, 18+120 02L, 18+120 18L and 18+120 28L with a thickness ranging from 0.1 to 3.8 m.

SPT N-values between 4 and 38 blows per 0.3 m of penetration were recorded in the deposit, indicating a loose to dense relative density. The moisture content of the deposit ranged from 10 to 31%, typically 15 to 25%.

Grain size distribution testing was carried out on nine samples of the deposit. The results of the testing are presented on the Record of Borehole Sheets included in Appendix C. The grain size distribution curves for the samples are plotted on Figures C1 and C2 in Appendix C. The results of the laboratory test are summarized as follows:

Gravel %	0 to 11
Sand %	34 to 85
Silt %	16 to 58
Clay %	2 to 8
Silt & Clay %	9 to 19

5.2.6 Silty Clay

A thin layer of silty clay was encountered beneath the peat layer in Borehole BH-04. The silty clay layer was 0.3 m thick with the lower boundary at a depth of 5.5 m (Elev. 272.6 m).

A layer of silty clay was also encountered below the sand deposit in Borehole 18+120 02L where the borehole was terminated at a depth of 3.0 m.

5.2.7 Silt

Within the sand deposit in Borehole BH-04 and beneath the sand in BH-05, a layer of silt with trace to some sand and trace clay and trace gravel was encountered. The silt had a thickness ranging from 0.7 to 1.5 m with a lower boundary at a depth varying from 7.6 to 8.4 m (Elev. 269.8 to 270.5 m).

SPT N-values between 12 and 29 blows per 0.3 m of penetration were recorded in the deposit, indicating a compact relative density. The moisture content of the deposit ranged from 15 to 21%.

Grain size distribution testing was carried out on one sample of the silt layer. The results of the testing are presented on the Record of Borehole Sheet included in Appendix C. The grain size distribution curve for the sample is plotted on Figure C3 in Appendix C. The result of the laboratory test is summarized as follows:

Gravel %	0
Sand %	13
Silt %	81
Clay %	6

5.2.8 Bedrock

Bedrock was proven in Boreholes BH-04 and BH-06 by coring 3.0 m into the bedrock. The bedrock was described as grey, fresh granite. The total core recovery (TCR) was 100% and the rock quality designation (RQD) varied from 83 to 100% indicating excellent rock quality. The fracture index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 4.

5.2.9 Groundwater Conditions

Standpipe piezometers were installed in twelve boreholes to monitor seasonal groundwater levels after completion of drilling and a summary of the recorded short term groundwater levels are provided in Table 5-2.

Table 5-2 Water Level Observations

Borehole	Date	Water Level		Comment
		Depth (m)	Elev. (m)	
BH-01	May 16, 2014	1.9	276.3	Piezometer
	May 23, 2014	2.2	276.0	
	Jun. 19, 2014	2.3	275.9	
	Oct. 15, 2014	2.8	275.4	
BH-02	May 16, 2014	3.0	275.5	Piezometer
	May 23, 2014	3.1	275.4	
	Jun. 19, 2014	3.2	275.3	
	Oct. 15, 2014	3.9	274.6	
BH-03	May 16, 2014	1.8	276.5	Piezometer
	May 23, 2014	1.4	276.9	
	Jun. 19, 2014	1.5	276.8	
	Oct. 15, 2014	2.1	276.2	
BH-04	May 23, 2014	2.6	275.5	Piezometer
	Jun. 19, 2014	2.8	275.3	
	Oct. 15, 2014	3.4	274.7	
BH-05	May 23, 2014	2.3	275.9	Piezometer
	Jun. 19, 2014	2.5	275.7	
	Oct. 15, 2014	3.1	275.1	
BH-06	May 23, 2014	1.7	276.6	Piezometer
	Jun. 19, 2014	1.8	276.5	
	Oct. 15, 2014	2.4	275.9	
BH-07	May 16, 2014	1.2	277.0	Piezometer
	May 23, 2014	0.7	277.5	
	Jun. 19, 2014	0.8	277.4	
	Oct. 15, 2014	1.4	276.8	
BH-08	May 23, 2014	0.5	278.0	Piezometer
	Jun. 19, 2014	0.6	277.9	
	Oct. 15, 2014	0.8	277.7	
BH-09	May 23, 2014	0.0	278.5	Piezometer
	Jun. 19, 2014	0.3	278.2	
	Oct. 15, 2014	0.5	278.1	
BH-10	May 16, 2014	3.0	275.5	Piezometer
	May 23, 2014	2.8	275.7	
	Jun. 19, 2014	2.9	275.6	
	Oct. 15, 2014	3.6	274.9	
BH-11	May 16, 2014	2.8	275.9	Piezometer
	May 23, 2014	2.6	276.1	
	Jun. 19, 2014	2.7	276.0	
	Oct. 15, 2014	3.6	275.1	
BH-12	May 23, 2014	4.3	274.0	Piezometer
	Jun. 19, 2014	4.4	273.9	
	Oct. 15, 2014	4.8	273.5	

The recorded groundwater levels are considered short-term readings and seasonal fluctuations of the groundwater level are to be expected, particularly after spring snowmelt as well as periods of prolonged and/or significant precipitation.

5.3 Area within Fen Pond, Highway 11/17 Sta. 18+100 to 18+180 (Appendix D)

5.3.1 General

A total of twenty-three boreholes were advanced within the Fen Pond footprint. Soil sampling and shear vane testing were carried out in nine boreholes FP-4, FP-6 to FP-8, FP-10, FP-11 and FP-24 to FP-26. The remaining fourteen boreholes FP-5, FP-9, FP-12 to FP-23 were probe holes to determine water and peat thicknesses. A table summarizing these probe holes along with their water and peat thicknesses is provided in Appendix D. The site stratigraphy encountered generally consists of surficial ice/standing water underlain by a deposit of peat which was further underlain by a thin layer of silty clay and a deposit of sand and silt.

5.3.2 Snow/Ice/Water

A 0.8 m thick layer of snow was encountered at the surface of Borehole FP-05. A layer of ice with a thickness of 0.6 m and a corresponding underside elevation of Elev. 277.3 m was encountered at the surface of Boreholes FP-04, FP-06 to FP-26.

Water was encountered below the ice in Boreholes FP-04, FP-06 to FP-26. The thickness of the water ranged from 0.2 to 2.4 m with a lower boundary depth ranging from 0.8 to 3.0 m (Elev. 274.9 to 277.1 m).

5.3.3 Peat

A deposit of amorphous and fibrous peat was encountered below the water in Boreholes FP-04 to FP-26. Boreholes FP-05, FP-09, FP-12 to FP-23 were terminated within the peat upon refusal at depths ranging from 3.9 to 7.2 m (Elev. 270.7 to 274.0 m). The thickness of the peat varied from 3.1 to 5.5 m with a corresponding lower boundary at depths ranging from 4.5 to 6.9 m (Elev. 271.0 to 273.4 m) in Boreholes FP-04, FP-06 to FP-08, FP-10, FP-11 and FP-24 to FP-26.

In situ field vane testing measured undrained shear strengths from 4 to 20 kPa indicating that the peat is typically soft. The moisture content of the peat deposit ranged from 364 to 4453%.

The Von Post classifications of the peat indicate very slight to complete decomposition with a high to very high water content as shown in Appendix D.

5.3.4 Silty Clay

A deposit of silty clay was encountered below the peat in Boreholes FP-04, FP-06 to FP-08, FP-10, FP-11 and FP-24 to FP-26. Boreholes FP-04, FP-06, FP-08, FP-10, FP-11, FP-26 were terminated within the silty clay upon refusal at depths ranging from 5.8 to 7.2 m (Elev. 270.7 to 272.1 m). In Borehole FP-07, FP-24, the thickness of the silty clay ranged from 0.2 to 0.5 m with the lower boundary at depths varying between 5.0 and 5.1 m (Elev. 272.8 to 272.9 m).

In situ field vane testing conducted in the silty clay measured an undrained shear strength varying from 11 to 52 kPa, indicating that the clay layer is typically soft to firm. The measured sensitivity of 1 to 3, from remolded field vane testing, indicates that the silty clay is classified as low to medium sensitivity. The moisture content of the silty clay varied between 19 and 63%.

5.3.5 Silt and Sand

A thin layer of silt and sand was encountered within the silty clay deposit in Boreholes FP-04, FP-06, FP-10 and FP-11. The silt and sand had a thickness ranging from 0.1 to 0.3 m with the lower boundary at depths varying from 5.7 to 6.9 m (Elev. 271.0 to 272.2 m).

The silt and sand layer was encountered below the silty clay deposit in Borehole FP-07, FP-24. Boreholes FP-07, FP-24 were terminated within the silt and sand upon refusal at depths between 5.2 and 5.3 m (Elev. 272.6 to 272.7 m).

In Borehole FP-25, the silt and sand layer was encountered below the peat deposit where the borehole was terminated upon refusal at a lower boundary depth of 6.3 m (Elev. 271.6 m).

The moisture content of the silt and sand layer ranged from 21 to 57%.

5.3.6 Groundwater Conditions

The water elevation in the Fen Pond was approximately at Elev. 277.9 m.

6 MISCELLANEOUS

The investigation in the Fen Pond area was conducted by Thunder Bay Testing and Engineering (TBTE) of Thunder Bay, Ontario who supplied and operated the drilling and sampling equipment for the field program. The mainline Highway 11/17 investigation was conducted by George Downing Estate Drilling Ltd. of Hawkesbury, Ontario who supplied and operated the drilling and sampling equipment for the field program. Full time supervision of Thurber's field activities were carried out by Mr. George Azzopardi and Mr. Michael Eastman, E.I.T. of Thurber.

Supervision of the field program was performed by Mr. Stephen Peters, P.Eng. and Mr. Mark Farrant, P.Eng. and interpretation of the field data and preparation of the report was performed by Mr. Jason Lee, P.Eng. and Mr. Michael Eastman, E.I.T. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
DEEP CUT FROM STA. 17+975 to 18+450
INCLUDING ENCROACHMENT INTO A FEN POND
HIGHWAY 11/17 FOUR-LANING RED ROCK TO NIPIGON
FROM 4.8 KM WEST OF HWY 628 TO 1.5 KM WEST OF HWY 585
G.W.P. 647-89-00**

Geocres Number: 52A-189

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data provided in the factual report and presents foundation design recommendations for a deep cut from Sta. 17+975 to 18+450, a portion of which encroaches into a Fen Pond. The cut is part of the proposed four-laning of Highway 11/17 between Red Rock and Nipigon, Ontario.

The overall project consists of the widening of Highway 11/17 from a two-lane roadway to a four-lane divided highway. The current section of highway to be widened extends from 4.8 km west of Highway 628 to 1.5 km west of Highway 585 in the Township of Thunder Bay District, Ontario.

The mainline deep cut addressed in this report is located approximately 3.4 km east of Highway 628 and 4.8 km west of Highway 585. The deep cut will consist of both earth and rock cuts up to 10.5 and 22.0 m deep, respectively. In addition, approximately 50 m length of the cut up to 8 m deep encroaches into a Fen Pond from Sta. 18+100 to 18+150. The depth of water in the Fen Pond ranges from 0.8 to 3.0 m. The water body is underlain and surrounded by up to 5.4 m thick deposit of very soft peat and organic soils with high moisture contents which is underlain by saturated sands and silts. The proposed highway cut, which will be excavated into these difficult stratigraphic conditions under the Fen Pond, presents special challenges for design of the cut. The geotechnical design of the deep cut is the subject of this report with special consideration to the cut encroaching the Fen Pond.

The project information used for the preparation of this report was provided by MMM Group Limited (MMM) which included plans and profile drawings of the proposed Highway 11/17 alignment as of June 2013. The discussion and recommendations presented in this report are based on the information provided by MMM and the factual data obtained during the course of the investigation.

8 ENGINEERING ANALYSIS METHODOLOGY

8.1 General

The subsurface conditions were investigated to assess the stability of the proposed cut slope, with special consideration to the area where the cut encroaches into the Fen Pond, as well as

anticipated construction concerns. Analyses were carried out based on the soil profiles obtained from the investigation and soil design parameters, selected for critical and less favourable foundation soil conditions. Geotechnical factors to be addressed for design of cut slope on this project include:

- The thickness, extent and engineering properties of the foundation soils, with particular attention to the extent and thickness of peat, topsoil, organic deposits, compressible and/or excessively soft/loose soils.
- The elevation of bedrock or refusal materials.
- Cut slope geometry including height, slope angle and requirements for benches
- The elevation of the current and anticipated long term ground water table
- Temporary and long-term (permanent) drainage and erosion control requirements
- Construction procedures.

For the purpose of preparing geotechnical design recommendations, a number of assumptions have been made that are consistent with MTO's standard highway design practices:

- Peat, topsoil, organic deposits and other deleterious material will be stripped prior to construction (OPSS.PROV 206).
- Rock cuts with depths of 10 m or greater will be constructed with side slope not steeper than 0.25H:1V (OPSD 209.020) and all earth cuts will not be steeper than 2H:1V, unless otherwise stated.
- Earth cuts with depths of 6 m or greater will be provided with a 2 m wide mid-height bench.
- A transition will be provided between rock cuts and earth cuts (OPSD 205.050), rock cuts and granular fills (OPSD 205.030) and rock cuts and rock fills (OPSD 205.020)
- Permanent drainage and erosion protection will be provided for all earth cuts.

8.2 Stability Analysis

Stability analyses were carried out under both static and seismic loading conditions. Based on consideration of the risk involved and past experience with highway design/monitoring, the following factors of safety are considered appropriate:

Foundation Soil Type	Minimum Recommended Factor of Safety		
	Short Term	Long Term	Seismic
Cohesionless	1.3	1.3	>1.0
Cohesive	1.3	1.5	>1.0

Stability analyses were carried out utilizing the commercially available slope stability program Slope/W (Version 7) of the GeoStudio software package developed by Geo-Slope International with the option for Morgenstern-Price method of slices for the limit equilibrium analyses. The stability analysis printouts with input parameters and soil model used in the

stability analyses, including soil stratigraphy, engineering properties, groundwater conditions, and cut slope geometry for selected analysis are shown in Appendix G.

8.3 Seismic Considerations

The stability analyses were checked assuming a horizontal peak ground acceleration (PGA) of 0.011g, where g is the acceleration due to gravity. The PGA value corresponds to a 10% probability of exceedance in 50 years and has been obtained from the CHBDC.

8.4 Design Considerations

As indicated earlier, an 8 m deep cut will encroach into the Fen Pond and the cut will have to be excavated through up to 5.4 m thick deposit of very soft peat and organic soils with high moisture contents which is underlain by saturated sands and silts. In addition there is a 0.8 to 3.0 m head of water at the top of the cut. Standard 2H:1V cut slope construction into these soils is not feasible and hence supplementary analysis was carried out to assess the design and construction alternatives.

Design considerations considered during analysis of the cut slopes typically included the following:

- Provisions for benching and/or slope flattening of cut slopes to improve global stability.
- Ground improvement techniques such as dewatering (i.e. passive drainage) and/or permanent drainage utilizing pumps (i.e. active drainage), replacement of peat and organic deposits with rock fill, interceptor ditches and sub-drains.
- Provisions for cut slope protection treatment such as granular sheeting and erosion protection.

The analyses carried out for this project have indicated that a combination of the treatment measures listed above will be required to address stability issues for this deep cut through the Fen Pond.

An iterative approach was applied for cut slope design through the Fen Pond area to produce a practical and cost-effective solution while achieving acceptable factors of safety against slope instability. The key factors for this cut area are:

1. A suitable method of constructing a cut into a deep peat and organic deposit
2. Lowering the water table and minimizing seepage from the final cut face which will otherwise cause instability.

Alternative design options that were considered to address the cut slope stability encroaching the Fen Pond, but are not recommended and hence not developed further, are as follows:

- i. Flattening the Cut Slope: This design option was not pursued further due to the large extent of the deep peat and organic deposits with very low strength (high moisture content), high groundwater level and the inability to maintain acceptable short-term and long-term stability in the native soils at a reasonable slope inclination.
- ii. Raise the Proposed Highway Grade and Decrease the Median Width: This design option would reduce the magnitude of cut required. It is understood that changing the grade and reducing the median width will change the highway profile and conflict with adjoining private entrance constraints and MTO design standards. Since this option would not eliminate a cut slope through peat and organic deposits and similar design challenges as described above are still prevalent. Therefore this design option was not pursued.
- iii. Continuous Sheet Pile Wall through the Fen Pond: This design option was not pursued further due to anticipated constructability issues, inadequate soil thickness present below the peat deposits for toe fixity, and the inability to obtain lateral wall stability. In addition, it is expected that the flexible characteristics of a sheet pile wall and the number of panel joints would not have satisfactory long term performance. Finally, seepage will eventually occur through and around the wall and the seepage would daylight through the cut face, thus requiring ongoing maintenance and performance monitoring.
- iv. Continuous Caisson Wall through the Fen Pond Socketed into Bedrock: This design option was not pursued further due to anticipated constructability issues, low lateral resistance in the peat and organic deposits, unknown bedrock profile along the wall alignment for toe fixity and the anticipated construction costs when compared to other design options. This design option would also require long term performance monitoring.

Constructability issues and further uncertainties pertaining to design and construction of sheet pile and caisson wall options are as follows:

- Potential negative environmental impacts related to cutting off flow to downstream channels.
- Requirement of a working pad for the sheet pile driving or caisson drilling equipment.
- Physical site constraint and height clearance for site access and construction due to overhead Hydro Power Transmission Lines.
- Due to potential flowing sand conditions and presence of peat and organic deposits, temporary lining will be required for caisson installation, however sealing the liner into bedrock to exclude flow of water and sand running into the liner during installation will be difficult.
- Quality Control (QC) of caisson construction in a swamp environment will be very difficult

Based on the assessment of the above options, a combination of ground improvement techniques which includes: permanently draining the Fen Pond, providing a rock trench

through the peat and organic deposits, provision for drainage measures and a flatter slope are considered a practical and cost-effective method to construct the highway cut.

9 CUT SLOPE DESIGN AND CONSTRUCTION

9.1 Highway 11/17 WBL, Sta. 18+050 to 18+190 (Cut Through the Fen Pond Area)

The highway cut in the Fen Pond area is located within a bedrock valley filled with soft peat and organic deposits and saturated sand and silts (see DWG 4 and 5 in Appendix H). The bedrock surface, inferred from auger refusal or proven by coring, was encountered at depths ranging from 4.0 to 10.2 m below the existing ground surface within the area of the deep cut for the proposed WBL. The thickness of peat, topsoil and/or organic deposits within the bedrock valley ranged from 0 to 5.4 m, generally encountered at the ground surface or below the water in the Fen Pond.

For the proposed maximum cut depth of 8.0 m, the resulting factor of safety against slope instability for a 3H:1V cut slope inclination was less than 1.0 and hence less than the minimum acceptable value (Figure G1). This insufficient factor of safety can be attributed to the low strength and thickness of the native peat and organic soils, the presence of the surface water from the Fen Pond located approximately 25 m west of the proposed WBL and corresponding high groundwater level. The analysis results indicate that standard earth cut slope inclination and construction techniques are not feasible at this location under existing conditions.

As indicated earlier, the design option that is proposed to address the temporary and permanent cut slope stability includes a multiple stage construction approach incorporating:

- permanently draining the Fen Pond,
- replacing a portion of peat and organic soils with rock fill so that the final cut is through the rock fill,
- staged excavation of the cut with a waiting period following each stage, and
- slope flattening.

The proposed design is presented on DWG 4 and 5 in Appendix H. The computed factors of safety of the final configuration of this rock trench design are greater than the minimum requirements as outlined in Section 8.2 (Figure G2). A seismic analysis of this proposed cut design also meets the required factor of safety (Figure G3).

A proposed construction sequence of the cut is as follows:

- i. Acquire property as required to accommodate the proposed design.
- ii. Complete an inventory of water wells and infrastructure within the drawdown zone as a result of the cut.
- iii. Obtain permission/permits to drain the Fen Pond permanently. Measured water depths in the pond range from 0.8 to 3.0 m, most measurements typically ranging from 1.0 to 1.6 m. It is expected that the Contractor will drain the Fen Pond using pumps. This method will require a Permit to Take Water (PTTW). The pumping should be carried out from filtered sumps in the Fen Pond to prevent capturing floating peat and solids. The pump discharge must be clean so as not to discharge water containing peat or solids into the downstream watercourse. Selection of suitable type and number of pump(s) is the Contractors responsibility. The pond must be kept fully drained throughout

construction and therefore the pumps must remain available throughout construction. Pumping is likely to be the most effective way to drain the Fen Pond.

A procedure for discharge of water and an assessment of the impacts of water discharge downstream will be required. Rock lining protection will be required along ditches and at the pump discharge area.

- iv. After obtaining permission, and only after the Fen Pond is fully drained, excavate the peat and organic soils within the proposed trench limits and replace with rock fill in general accordance with OPSS 206 and 209. The rock trench must extend longitudinally (i.e. parallel to the highway alignment) between Sta. 18+050 to 18+190 as shown on DWG 4 in Appendix H. The purpose of the rock filled trench is to replace the low strength native peat and organic soils so that the final highway cut will be made through rock fill. The rock fill will also provide a permeable medium to act as a filter for the remaining peat and native soils behind the rock fill while allowing drainage and groundwater lowering. It may be easier to remove the peat and organic soils and construct the rock filled trench during winter months by allowing the peat to freeze. The design requirements for the rock filled trench are as follows:
 - a. The rock trench should be excavated in short sections (3 to 5 m, parallel to the highway alignment) and backfilled with rock fill immediately, prior to excavating the next section.
 - b. The rock trench must extend to a minimum depth of 1 m below the base of the peat and organic soils and any cohesive soils if encountered. It is expected that a long reach hoe or dragline will be required to excavate the trench to this depth and the excavation will occur below water. All peat and organic soils must be removed from the footprint of the rock fill trench. The boundaries of peat and organic soils have not been fully defined and excavation limits may need to be adjusted during construction.
 - c. All along the slope, the rock trench must have a minimum width of 9 m (i.e. perpendicular to the highway alignment) measured from the final design cut slope.
 - d. A stable temporary side slope in the excavated peat and organic soils is difficult to predict. The Contractor may be able to cut the temporary slope steeper in the winter, however the temporary slope must be limited to an inclination not steeper than 4H:1V in order to maintain a sufficient thickness of rock fill behind the final cut slope. It is expected that the open temporary trench slope will be flatter in the peat and the Contractor must be made aware of the potential for additional rock fill and waste quantities.
 - e. The gradation of the rock must be limited to a maximum diameter of 300 mm
- v. After completion of the rock trench work, start excavating the highway cut for the WBL in stages from east to west. Some seepage induced erosion and associated slope instability may be noted on the cut face. An anticipated sequence would be as follows:
 - a. Stage 1: excavate to within 20 m from the final design cut slope face and provide a waiting period of 1 month to allow the cut to drain.
 - b. Stage 2: excavate to within 10 m from the final design cut face and provide a waiting period of 1 month to allow the cut to drain.

- c. Stage 3: excavate to within 5 m from the final design cut face and provide a waiting period of 1 month to allow the cut to drain.
- d. Stage 4: excavate to the final design cut.
- vi. The final design cut slope through the rock fill shall be 3H:1V with a 2.0 m wide mid-height bench. The cut slope inclination shall also be 3H:1V in the underlying exposed sand and silt and in the areas adjacent to the rock fill. The cut face may experience seepage after completion. The design cut face, where not protected by the rock fill, must be treated with a minimum of 1000 mm thick gravel sheeting. The gravel sheeting must be applied as soon as the cut is completed.
- vii. It is recommended that two 200 mm diameter sub-drains be installed, one at the toe of the cut, and where required one in a mid-height bench. The sub-drains must allow drainage to a frost free outlet. Subdrains are not required in the area of rock fill.

Limited borehole data on either side of the Fen Pond indicates that the cut will be excavated through peat and underlying wet sands and silts. Design recommendations for this cut are presented below:

- The design slope of the cuts adjacent to the Fen Pond area should be no steeper than 3H:1V with 2m wide mid height bench for cut depths greater than 6.0 m (Figure G4).
- Any peat exposed in the upper part of the cut should be subexcavated within 2 m of the design cut slope and replaced with rock fill
- The cut slope should be treated with a minimum of 1000mm thick gravel sheeting
- An overflow culvert will be installed from the Fen Pond to the highway ditch and daylight at the base of the cut to allow for ongoing drainage of the pond. The outlet of the culvert and the associated ditch must be rock lined to prevent erosion.

Where excavations may encounter bedrock, rock cuts should be designed in conformity with the Northwestern Region Rock Cut Design guidelines.

Permanent drainage of the cuts must be provided. Roadside ditches are expected to provide an adequate level of surface drainage in most areas. Temporary and permanent erosion and sedimentation control measures must be in place and maintained at all times so as to prevent any deleterious material or fines from entering into any drainage feature or water course.

9.2 Highway 11/17 EBL, Sta. 17+975 to 18+150 and Highway 11/17 EBL, Sta. 18+410 to 18+450

For the proposed road profile, the design cut depth of up to 10.5 m is expected to be primarily through sand. Slope inclinations in earth cuts should not be steeper than 2H:1V for cuts less than 4.5 m depth and not steeper than 3H:1V for cuts at or deeper than 4.5 m. Mid-height berms comprising of 2 m wide benches should be incorporated along the length of earth cuts with depths at or exceeding 6 m. The bench should maintain a 3% slope (away from the cut face: towards the highway ditch) to shed surface run-off.

The cut should begin at the low end of the highway and proceed northward to allow drainage as excavation progresses. Some cut face sloughing may occur as a result of groundwater seepage during excavation. Where excavations may encounter bedrock, construction of cuts should be carried out in accordance with OPSD 201.020. Rock cuts should be designed in conformity with the Northwestern Region Cut Design Guidelines.

To maintain the short-term and long-term stability of the cut slopes, it is required that drainage measures be incorporated into the design. An interceptor ditch should be provided at the top of the earth cuts, where practical as per OPSD 200.020 and 201.020. Roadside ditches are expected to provide an adequate level of surface drainage in most cases. The finished earth cut slopes should be inspected and a layer of gravel sheeting at least 600 mm in thickness should be provided over the entire cut slope. Temporary and permanent erosion and sedimentation control measures must be in place and maintained at all times so as to prevent any deleterious material or fines from entering into any drainage feature or water course.

Between EBL Sta. 18+120 to 18+150, property constraints will prohibit achieving the recommended cut design geometry. To facilitate construction within the current property limits, the following design changes may need to be considered:

- 18+120 – steepening the slope inclination to 2H:1V
- 18+130 – steepening the slope inclination to 2H:1V and omitting the interceptor ditch
- 18+140 – steepening the slope inclination to 2H:1V, omitting the interceptor ditch and reducing the mid-height bench to 1 m width

It should be noted that these changes to the recommended design will produce a factor of safety which is less than the recommended value of 1.3 (Figure G5) and MTO should be made aware of the risk involved if additional property is not obtained.

9.3 Highway 11/17 EBL, Sta. 18+150 to 18+410 and Highway 11/17 WBL, Sta. 17+975 to 18+050 and Highway 11/17 WBL, Sta. 18+190 to 18+450

For the proposed road profile, the design cut depth up to 22.0 m is expected to be primarily through shallow overburden and bedrock. Standard rock cut and 2H:1V earth cut side slopes will apply and stability is not considered a concern. Construction of cuts through earth and rock should be carried out in accordance with OPSD 201.020. Rock cuts should be designed in conformity with the Northwestern Region Cut Design Guidelines.

Rock blasting must involve blast design by a qualified Engineer/firm, explosive use by a competent blasting contractor, monitoring by a blast monitoring consultant, preparation of a pre-blast survey, and notification of any nearby utility authorities.

Rock mapping should be carried out prior to blast design to determine pertinent conditions such as the locations and orientation of joints and fractures in the rock mass. After blasting, the rock cuts should be examined by a rock slope specialist to identify any areas of unstable rock requiring removal or stabilization.

10 SEISMIC CONSIDERATIONS

Provided construction is carried out in accordance with recommendations provided above, the minimum factor of safety, as outlined in Section 8.2, will be met for seismic loading conditions.

Based on the subsurface conditions encountered at the drilled locations, the potential for liquefaction of the foundation soils during a seismic event is considered to be low in accordance with CHBDC Section C4.6. Some local liquefaction and resulting toe failure may occur during a seismic event, but this is expected to be readily repaired.

11 CONSTRUCTION CONCERNS

Due to the presence of the Fen Pond, the highway cut construction is anticipated to be complex and difficult. During construction, qualified geotechnical staff must be retained to observe all drainage, excavations and rock trench construction activities and advise the Contract Administrator (CA) on construction concerns or issues related to seepage and slope stability.

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

- The thickness and presence of peat and organic deposits were investigated at the borehole locations only. These deposits may extend to greater depths or be encountered at other locations between and beyond the boreholes. Careful inspection of the rock trench construction is crucial to confirm that the all peat, topsoil and organic deposits within the proposed trench are excavated.
- Trafficability of construction equipment may be difficult in areas of organic deposits or excessively soft, loose and/or saturated subgrade. Disturbance of the subgrade by construction traffic must be minimized and the Contractor may have to adjust his operations in these areas. Provisions of adequate site drainage is critical to maintain stable subgrade. Recommended wording for an NSSP addressing this issue is provided in Appendix I.
- Bedrock elevations may vary between and beyond the borehole locations. The limits of sub-excavation and backfilling may require modification during construction based on the conditions encountered in the field. Excavation of the bedrock is not required within the depth of the rock filled trench.
- In areas of culvert construction, care must be exercised during excavation to avoid disturbing the founding subgrade. When the excavation reaches the required elevation, the subgrade should be inspected and approved by qualified geotechnical personnel employed by the Contractor.
- Areas of ongoing seepage emerging from the permanent (ultimate condition) cut slopes may require gravel sheeting or rock protection to provide drainage of the seepage and prevent erosion of the slope face. Control of groundwater seepage is the responsibility of the Contractor.
- Active drainage of the Fen Pond will require a Permit to Take Water (PTTW). The water must be discharged in a controlled manner in compliance with local regulations and as to not cause unwanted discharge of fines entering into any drainage feature or water course downstream. A pre-construction survey may be required and a qualified hydrologist/hydrogeologist should be consulted.
- Draining the Fen Pond and permanent lowering of the groundwater level may also have an effect on water levels, water quality and water yield of local water wells and may cause settlement of foundations. A pre-construction survey may be required and a qualified hydrologist/hydrogeologist should be consulted.

- Rock blasting may be required as part of the construction sequence or for construction on adjacent section of Highway 11/17. The thick deposits of peat and organic soils and saturated underlying native sands and silts will be sensitive to vibration especially during excavation of peat and organics soils.

12 CLOSURE

Engineering analysis and preparation of the foundation design report were carried out by Mr. Jason Lee, P.Eng and Mr. Stephen Peters, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Appendix A

Tables and Figures

Table A1 Summary of Boreholes and Peat and Organic Soil Thickness

Table A2 Piezometer Installation Details

Figure 1 Aerial Photograph

Deep Cut From Sta. 17+975 to 18+450, Including Encroachment Into A Fen Pond
Highway 11/17 - Red Rock to Nipigon

Table A1
Borehole Summary

App.	Borehole	Description	Depth (m)	Max. Depth of Sub-Excavation to Peat, Topsoil and Organics Deposit (m)
B	18+000 23R	Right shoulder of EBL	1.1	0.0 to 0.1
	18+056 CL	CL of highway corridor	4.3	
	18+122 35R	Right toe of EBL	8.0	
	18+208 16R	Left shoulder of EBL	1.5	
	18+275 42R	CL of highway corridor	0.0	
	18+325 CL	CL of highway corridor	0.1	
	18+400 17R	CL of EBL	1.5	0.0 to 1.2
	17+975 19L	CL of WBL	0.0	
	18+050 14L	Right shoulder of WBL	11.9	
	18+088 21L	CL of WBL	9.4	
	18+150 28L	Left shoulder of WBL	4.0	
	18+200 19L	CL of WBL	1.4	
	18+278 17L	Right shoulder of WBL	3.2	
	18+340 19L	CL of WBL	0.8	
C	BH-01	East of Fen Pond	8.2	4.5
	BH-02	East of Fen Pond	8.6	1.4
	BH-03	East of Fen Pond	9.9	3.0
	BH-04	East of Fen Pond	13.3	4.7
	BH-05	East of Fen Pond	8.4	4.9
	BH-06	East of Fen Pond	10.4	4.3
	BH-07	East of Fen Pond	6.9	3.7
	BH-8	West of Fen Pond	7.5	5.6
	BH-9	West of Fen Pond	2.3	2.3
	BH-10	East of Fen Pond	7.7	4.3
	BH-11	East of Fen Pond	6.3	3.7
	BH-12	East of Fen Pond	9.9	3.7
	18+085 19L	CL of WBL	4.0	0.2
	18+090 18L	CL of WBL	0.1	0.1
	18+100 08L	East toe of WBL	0.0	0.0
	18+100 18L	CL of WBL	2.7	2.6
	18+100 19L	CL of WBL	3.7	3.5
	18+100 28L	West toe of WBL	3.9	3.8
	18+110 18L	CL of WBL	5.1	4.8
	18+120 02L	East toe of WBL	3.0	1.2
	18+120 18L	CL of WBL	0.7	0.1
	18+120 28L	West toe of WBL	4.2	4.0
D	FP-04	Within Fen Pond	6.3	3.5
	FP-05	Within Fen Pond	5.0	4.2
	FP-06	Within Fen Pond	6.7	3.9
	FP-07	Within Fen Pond	5.3	3.8
	FP-08	Within Fen Pond	7.2	5.5
	FP-09	Within Fen Pond	5.8	3.8

Deep Cut From Sta. 17+975 to 18+450, Including Encroachment Into A Fen Pond
 Highway 11/17 - Red Rock to Nipigon

Table A1
Borehole Summary

App.	Borehole	Description	Depth (m)	Max. Depth of Sub-Excavation to Peat, Topsoil and Organics Deposit (m)
D	FP-10	Within Fen Pond	6.3	3.6
	FP-11	Within Fen Pond	7.0	4.9
	FP-12	Within Fen Pond	4.0	2.5
	FP-13	Within Fen Pond	6.9	5.7
	FP-14	Within Fen Pond	4.9	1.9
	FP-15	Within Fen Pond	4.7	3.7
	FP-16	Within Fen Pond	7.2	5.2
	FP-17	Within Fen Pond	5.0	2.6
	FP-18	Within Fen Pond	4.5	3.0
	FP-19	Within Fen Pond	4.0	3.0
	FP-20	Within Fen Pond	7.0	5.4
	FP-21	Within Fen Pond	5.7	3.8
	FP-22	Within Fen Pond	5.0	3.5
	FP-23	Within Fen Pond	3.9	2.9
	FP-24	Within Fen Pond	5.2	3.1
	FP-25	Within Fen Pond	6.3	4.4
	FP-26	Within Fen Pond	5.8	3.9

Deep Cut From Sta. 17+975 to 18+450, Including Encroachment Into A Fen Pond
Highway 11/17 - Red Rock to Nipigon

Table A2
Piezometer Installation Details

Borehole	Piezometer Tip Depth (m)	Installation Details
18+050 14L	8.8	Piezometer with 1.5 m slotted screen installed, sand filter from 8.8 to 7.0 m, bentonite seal from 7.0 m to ground surface.
18+150 28L	4.0	Piezometer with 1.5 m slotted screen installed, sand filter from 4.0 to 2.1 m, bentonite from 2.1 m to ground surface.
BH-01	6.9	Piezometer with 1.5 m slotted screen installed, sand filter from 8.2 to 4.7 m, bentonite from 4.7 m to ground surface.
BH-02	8.4	Piezometer with 1.5 m slotted screen installed, sand filter from 8.6 to 6.2 m, bentonite from 6.2 m to ground surface.
BH-03	6.6	Piezometer with 1.5 m slotted screen installed, sand filter from 6.6 to 4.3 m, bentonite from 4.3 m to ground surface.
BH-04	7.6	Piezometer with 1.5 m slotted screen installed, sand filter from 7.9 to 5.8 m, bentonite from 5.8 m to ground surface.
BH-05	7.9	Piezometer with 1.5 m slotted screen installed, sand filter from 7.9 to 5.8 m, bentonite from 5.8 m to ground surface.
BH-06	6.1	Piezometer with 1.5 m slotted screen installed, sand filter from 7.9 to 5.8 m, bentonite from 5.8 m to ground surface.
BH-07	5.8	Piezometer with 1.5 m slotted screen installed, sand filter from 5.8 to 4.0 m, bentonite from 4.0 m to ground surface.
BH-08	7.5	Piezometer with 1.5 m slotted screen installed, sand filter from 7.5 to 5.5 m, bentonite from 5.5 m to ground surface.
BH-09	2.3	Piezometer with 1.5 m slotted screen installed, sand filter from 2.3 to 0.5 m, bentonite from 0.5 m to ground surface.
BH-10	6.4	Piezometer with 1.5 m slotted screen installed, sand filter from 6.4 to 4.6 m, bentonite from 4.6 m to ground surface.
BH-11	6.0	Piezometer with 1.5 m slotted screen installed, sand filter from 6.3 to 3.9 m, bentonite from 3.9 m to ground surface.
BH-12	9.9	Piezometer with 1.5 m slotted screen installed, sand filter from 9.9 to 7.1 m, bentonite from 7.1 m to ground surface.



Figure 1.
Aerial View of Fen Pond and Highway 11/17

Appendix B

Highway 11/17 EBL and WBL Mainline, Sta. 17+975 to 18+450

Record of Borehole Sheets

Laboratory Test Results

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 ⁽¹⁾ '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

C_{pen}

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.

EXPLANATION OF ROCK LOGGING TERMS



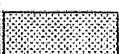


ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

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			

RECORD OF BOREHOLE No 17+975 19L

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 540.0 E 207 101.1 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Visual Inspection COMPILED BY AN
 DATUM Geodetic DATE 2012.06.03 - 2012.06.03 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
274.3 0.0	BEDROCK AT SURFACE. BEDROCK EXPOSED ALL AROUND AT THIS LOCATION.													

RECORD OF BOREHOLE No 18+000 23R

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 561.8 E 207 144.8 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.06 - 2012.06.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
273.0								20	40	60	80	100					
0.0	SAND, trace gravel, trace silt Compact Brown Damp to Moist (FILL)		1	SS	27												
271.9			2	SS	64/												
1.1	END OF BOREHOLE AT 1.1m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				0.15												

RECORD OF BOREHOLE No 18+050 14L

1 OF 2

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 615.1 E 207 113.0 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2012.06.03 - 2012.06.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
278.5																	
0.0	SAND , trace silt to silty, trace clay Loose to Compact Brown Damp		1	SS	4		278										
	trace gravel																
			2	SS	10			277									
			3	SS	12			276									0 74 24 2
	Dense		4	SS	20			275									
			5	SS	30			274									
	Wet	6	SS	34		273									0 84 16 (SI+CL)		
	some gravel	7	SS	39		272									13 82 5 (SI+CL)		

Continued Next Page

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

RECORD OF BOREHOLE No 18+050 14L

2 OF 2

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 615.1 E 207 113.0 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2012.06.03 - 2012.06.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W P W W L WATER CONTENT (%) 20 40 60						
								UNCONFINED + FIELD VANE QUICK TRIAXIAL X LAB VANE						
								20 40 60 80 100						
	Sub-horizontal joint at 10.1m						268						0	RUN #2 TCR=100% SCR=100% RQD=98% UCS=247MPa (Average)
	Horizontal joint at 10.6m												1	
			2	RUN									0	
							267						0	
													0	
266.6														
11.9	END OF BOREHOLE AT 11.9m UPON COMPLETION. BOREHOLE OPEN TO 11.9m AND WATER LEVEL AT 7.2m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 21/12 5.2 273.3 Jul. 15/12 5.2 273.3 Nov. 21/12 5.4 273.1													

RECORD OF BOREHOLE No 18+056 CL

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 619.3 E 207 127.6 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.03 - 2012.06.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
276.4								20 40 60 80 100									
0.0								20 40 60 80 100									
	TOPSOIL: (50mm)																
	SAND, trace to some silt, trace to some gravel, occasional rootlets, occasional cobbles Loose to Dense Brown Moist to Wet		1	SS	8		276										
			2	SS	22		275										
			3	SS	40												
			4	SS	43		274										
			5	SS	18		273										
272.1																	
4.3	END OF BOREHOLE AT 4.3m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																




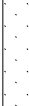

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18+088 21L

1 OF 2

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 654.3 E 207 111.8 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W P W W L								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)								
278.6							20	40	60	80	100									
0.0	SAND , trace gravel, trace silt Compact Brown Damp (FILL)		1	SS	24									○					29 61 10 (SH+CL)	
																○				
277.1																				
1.5	SAND , some gravel to gravelly, trace silt and clay Compact Brown Damp Occasional cobbles		3	SS	20										○					
																○				
	Wet		4	SS	21										○					
																○				
			5	SS	12										○					
	Silty Grey		6	SS	14									○				0 47 43 10		
	Loose		7	SS	7									○						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18+088 21L

2 OF 2

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 654.3 E 207 111.8 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page BOREHOLE OPEN TO 9.4m AND WATER LEVEL AT 3.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOELPLUG TO SURFACE.																

ONTMT4S 05117.GPJ 2012TEMPLATE(MTO).GDT 14-7-3

RECORD OF BOREHOLE No 18+122 35R

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 677.6 E 207 172.7 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ COring COMPILED BY AN
 DATUM Geodetic DATE 2012.06.06 - 2012.06.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE									
								● QUICK TRIAXIAL	×	LAB VANE									
276.6							20	40	60	80	100								
0.0	TOPSOIL: (50mm)																		
	SAND , some gravel, trace to some silt, trace clay Compact to Loose Brown Damp		1	SS	18								○						
			2	SS	10								○						
			3	SS	9								○						
			4	SS	8								○						
	Reddish Brown Wet		5	SS	17								○			20 64 13 3			
	Start coring from 4.6m																		
272.0																			
4.6	COBBLES		1	RUN											FI				
271.4																			
5.2	BEDROCK , granite, fresh, coarse grained, strong to very strong, grey/black/white Horizontal joint at 5.7m, 6.5m, 6.6m Sub-horizontal joint at 5.7m Sub-vertical joint (175mm thick) at 6.3m Sub-vertical joint at 6.9m, 7.1m Horizontal joint at 6.8m, 7.4m, 7.5m, 7.9m		2	RUN											0 1 0 0 2 1 2 3 1	RUN #2 TCR=100% SCR=100% RQD=95% UCS=118MPa (Average)			
			3	RUN															
268.6																			
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE OPEN TO 8.0m AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		




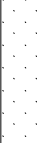
ONTMT4S 05117.GPJ 2012TEMPLATE(MTO).GDT 14-7-3

RECORD OF BOREHOLE No 18+150 28L

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 718.0 E 207 117.1 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE							
279.1								20	40	60	80	100	W P W W L			
0.0	SAND , trace to some gravel Compact Brown Damp (FILL)		1	SS	15									○		
	Rockfill at 1.2m		2	SS	25									○		
277.6																
1.5	PEAT , fibrous, trace rootlets, trace wood fragments Compact to Loose Dark Brown Wet		3	SS	16										337 ○	
276.4			4	SS	4										223 ○	
2.7	SAND , trace to some silt, trace clay Loose Grey Wet													○		
			5	SS	5											
275.1																
4.0	END OF BOREHOLE AT 4.0m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 4.0m AND WATER LEVEL AT 3.0m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 21/12 2.2 276.9 Jul. 15/12 2.6 276.5 Nov. 21/12 2.7 276.4															

+ ³ , × ³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18+200 19L

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 765.4 E 207 138.3 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
280.9																	
0.0	TOPSOIL: (150mm)																
0.2	SAND, trace to some gravel, trace silt Loose to Dense Reddish Brown Damp		1	SS	7												
			2	SS	36												
279.5																	
1.4	END OF BOREHOLE AT 1.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.4m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 18+208 16R

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 763.4 E 207 174.2 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.01 - 2012.06.01 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
276.5																	
0.0	ASPHALT: (150mm)																
0.2	SAND, some gravel to gravelly, trace to some silt Dense to Very Dense Brown/Black Damp (FILL)		1	SS	40												
			2	SS	50											31 55 14 (SI+CL)	
275.0																	
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 1.5m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG FROM 1.5m TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.																

METRIC

[illegible]

RECORD OF BOREHOLE No 18+278 17L

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 840.3 E 207 164.7 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
282.9														
0.0	SAND , trace silt, occasional rootlets Brown Damp BEDROCK , granite, fresh, strong to very strong, coarse grained, red/white Horizontal joints at 0.2m, 0.6m, 0.7m, 0.8m, 1.2m 													



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

RECORD OF BOREHOLE No 18+325 CL

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 878.1 E 207 198.0 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Test Pit & Visual Inspection COMPILED BY AN
 DATUM Geodetic DATE 2012.06.02 - 2012.06.02 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
284.5																	
0.0	TOPSOIL: (50mm)																
0.1	END OF BOREHOLE AT 0.1m UPON BEDROCK.																

RECORD OF BOREHOLE No 18+340 19L

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 899.5 E 207 186.5 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.07 - 2012.06.07 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 γ kN/m ³	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									
281.1 0.0	SAND, trace silt and gravel Compact Brown Damp		1	SS	24		281										
280.3 0.8	END OF BOREHOLE AT 0.8 UPON AUGER REFUSAL ON BEDROCK. PROBING AT TWO ADDITIONAL LOCATIONS IN THE VICINITY OF BOREHOLE ENCOUNTERED REFUSAL ON PROBABLE BEDROCK AT DEPTH OF 0.8m. BOREHOLE OPEN TO 0.8m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 18+400 17R

1 OF 1

METRIC

WP# 647-89-00 LOCATION HWY 11/17 Nipigon, Ontario N 5 428 938.8 E 207 245.0 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.01 - 2012.06.01 CHECKED BY MEF

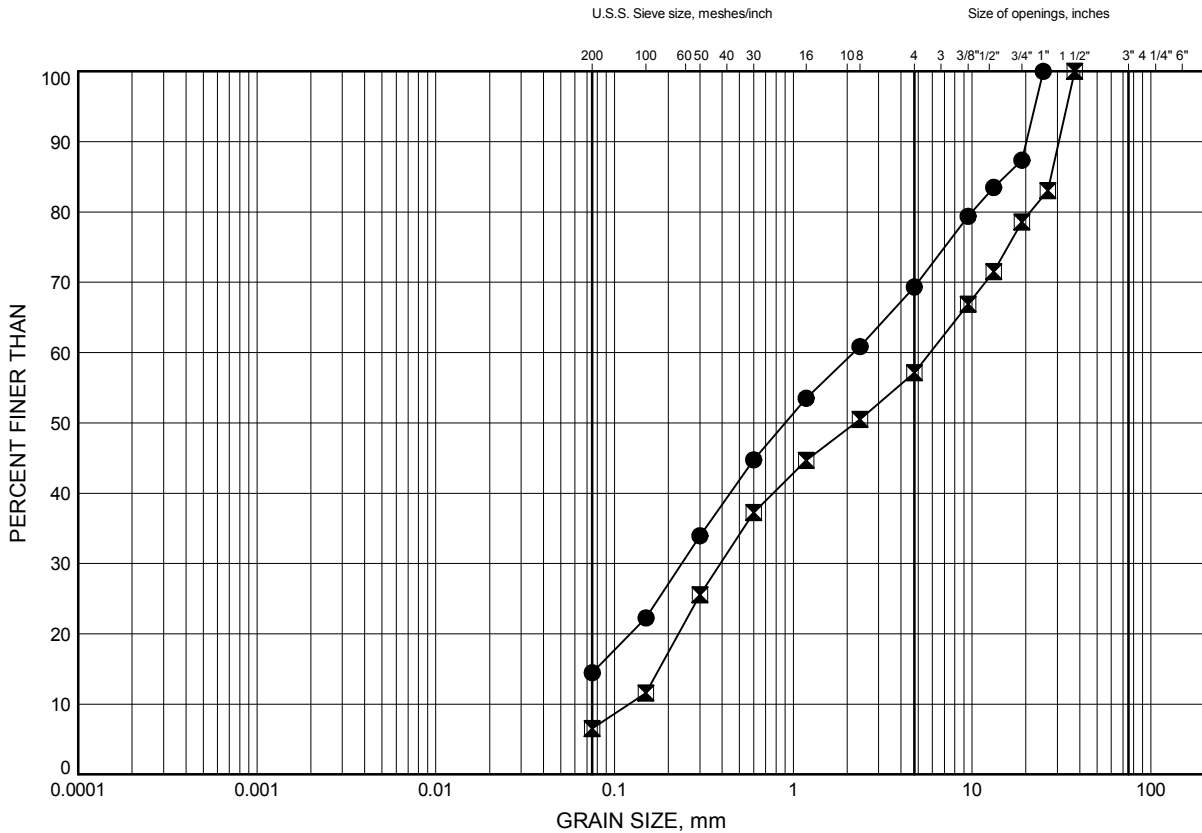
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
276.1								20 40 60 80 100					
0.0	ASPHALT: (100mm)						276						
0.1	SAND and GRAVEL, trace fines Very Dense to Dense Brown Damp (FILL)		1	SS	66								
			2	SS	49		275						43 51 6 (SI+CL)
274.6													
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.5m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG FROM 1.5m TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.												

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

HWY 11/17 Nipigon, Ontario
GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND to GRAVELLY SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18+208 16R	1.07	275.39
⊠	18+400 17R	1.07	275.00

Date October 2014
 WP# 647-89-00

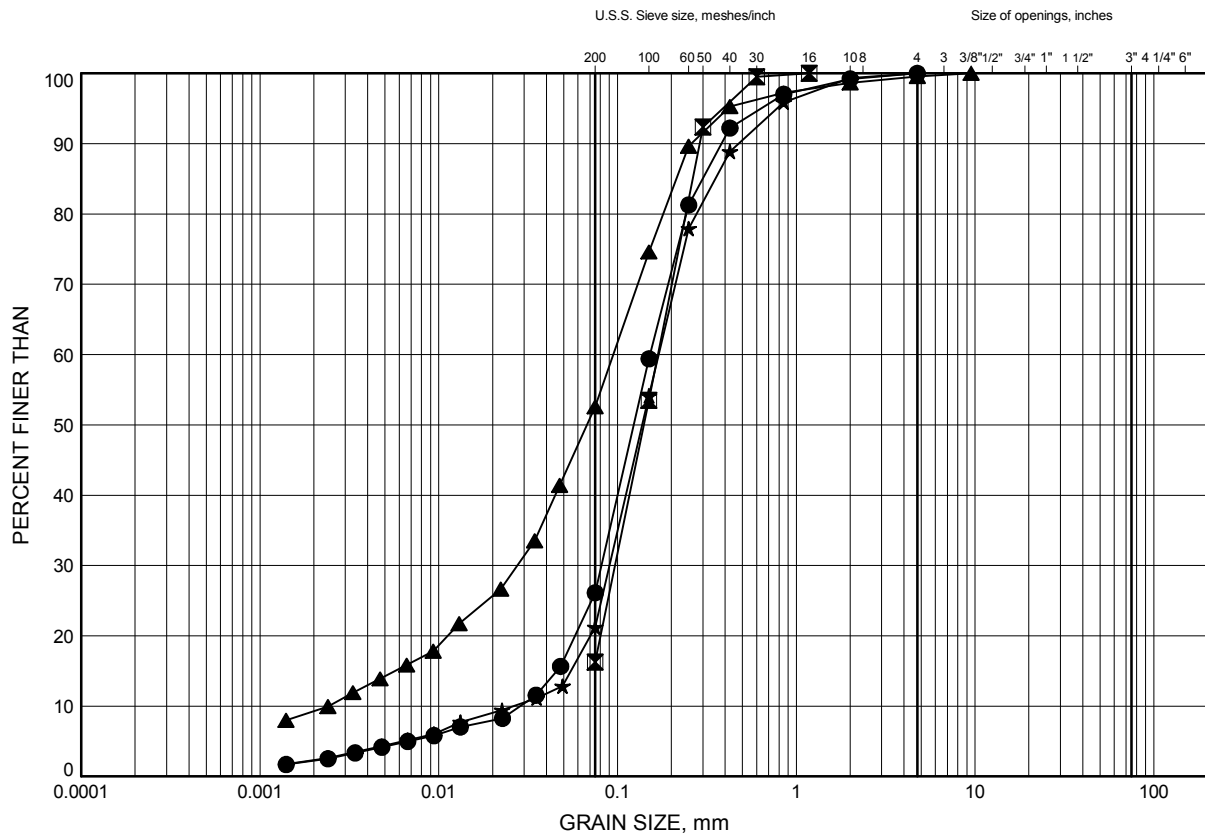


Prep'd AN
 Chkd. MKE

HWY 11/17 Nipigon, Ontario GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18+050 14L	1.83	276.62
⊠	18+050 14L	4.88	273.58
▲	18+088 21L	4.88	273.76
★	18+150 28L	3.35	275.74

Date ..October 2014.....
WP# ..647-89-00.....

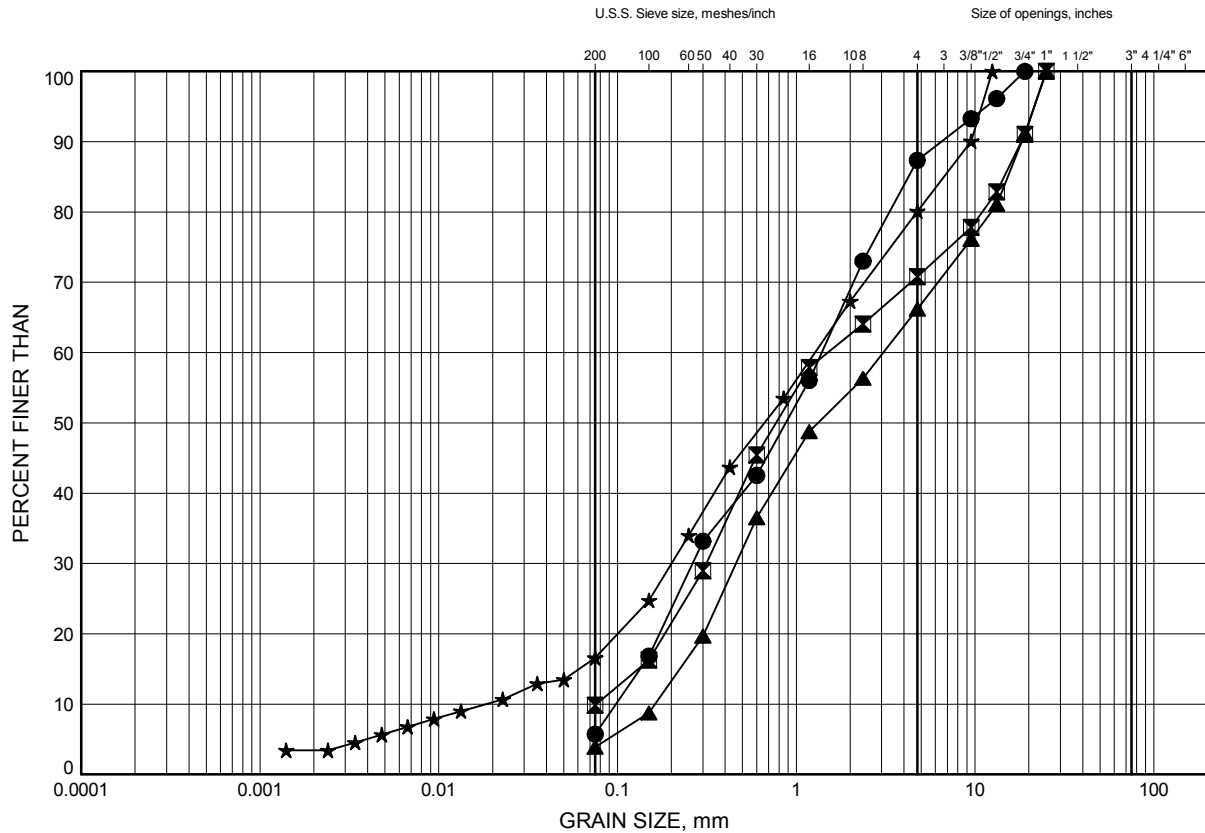


Prep'dAN.....
Chkd.MKE.....

HWY 11/17 Nipigon, Ontario GRAIN SIZE DISTRIBUTION

FIGURE B3

GRAVELLY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18+050 14L	6.40	272.05
⊠	18+088 21L	1.83	276.81
▲	18+088 21L	9.30	269.34
★	18+122 35R	3.35	273.24

Date ..October 2014.....
WP# ..647-89-00.....



Prep'dAN.....
Chkd.MKE.....

Appendix C

Area outside of Fen Pond, Highway 11/17 Sta. 18+050 to 18+190

Record of Borehole Sheets

Laboratory Test Results

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 ⁽¹⁾ '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

C_{pen}

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.

EXPLANATION OF ROCK LOGGING TERMS






ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

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			

RECORD OF BOREHOLE No BH-01

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 690.2 E 207 108.9 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.13 - 2014.05.13 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)					
								○ UNCONFINED		+ FIELD VANE				w P		w		w L	
								● QUICK TRIAXIAL		× LAB VANE									
278.2							20	40	60	80	100								
0.0	Water at surface																		
277.7																			
0.5	PEAT , trace rootlets, trace woods Very Soft Dark Brown Wet		1	SS	1												H B F R W 3 2 2 1 1		
			2	SS	0												5 4 2 1 0		
			3	SS	0												8 3 3 1 0		
			4	SS	1												10 2 1 0 0		
273.2			5	SS	0												5 2 2 2 1 (Remarks: Von Post modified classification)		
5.0	Sandy SILT , trace gravel, trace clay Compact Grey Wet		6	SS	14												0 34 58 8		
			7	SS	15														
	Loose		8	SS	5														
270.6																			
7.6	Silty SAND Loose Grey Wet		9	SS	9														
270.0																			
8.2	END OF BOREHOLE AT 8.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 1.9 276.3 2014.05.23 2.2 276.0																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-02

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 655.2 E 207 080.8 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.14 - 2014.05.14 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
278.5																	
0.0	PEAT , trace rootlets, trace woods Very Soft Dark Brown Wet		1	SS	1		278							404	H B F R W 3 2 3 2 2 (Remarks: Von Post modified classification)		
			2	SS	1									306			
277.1								277									
1.4	SAND , trace to some gravel, trace silt Dense Brown Wet Compact Loose Compact		3	SS	38		276									11 80 9 (SH+CL)	
			4	SS	15												
			5	SS	8		275										
			6	SS	9		274										
			7	SS	11												
273.2								273									
5.3			Silty SAND Loose to Compact Grey Wet		8		SS	14	272								
	9	SS			9												
271.6								271									
6.9	SAND , trace silt, trace gravel Loose to Compact Brown Moist to Wet		10	SS	9												
			11	SS	12												
269.9			12	SS	50/	270											
8.6	END OF BOREHOLE AT 8.6m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 3.0 275.5				0.050												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION			STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W P W W L			
	Continued From Previous Page								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)			γ		
	2014.05.23	3.1	275.4						20 40 60 80 100	20 40 60	kn/m ³	GR SA SI CL			

RECORD OF BOREHOLE No BH-03

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 664.2 E 207 082.7 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.15 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20 40 60 80 100												
						○ UNCONFINED + FIELD VANE			PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT											
						● QUICK TRIAXIAL × LAB VANE			W P W W L											
						20 40 60 80 100			WATER CONTENT (%)											
278.3																				
0.0	PEAT , trace rootlets, trace woods Very Soft Dark Brown Wet		1	SS	1		278													
			2	SS	1															
			3	SS	0															
			4	SS	5															
275.3																				
3.0	SAND , trace to some gravel, trace silt Compact Grey Wet		5	SS	10		275													
			6	SS	19															
			7	SS	12		274													
			8	SS	18		273													
272.2																				
6.1	Silty SAND , trace gravel Compact Brown Wet		9	SS	15		272													
	Loose		10	SS	13		271													
	Some silt		11	SS	5		270													
			12	SS	13															
			13	SS	17		269													
268.4																				
9.9																				

Continued Next Page

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

RECORD OF BOREHOLE No BH-03

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 664.2 E 207 082.7 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.15 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page END OF BOREHOLE AT 9.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 1.8 276.5 2014.05.23 1.4 276.9																

RECORD OF BOREHOLE No BH-04

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 680.7 E 207 104.0 ORIGINATED BY GA
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2014.05.13 - 2014.05.14 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	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
278.1																		
0.0	Water at surface						278											
277.6																		
0.5	PEAT , occasional rootlets Very Soft Dark Brown Wet		1	SS	2		277						451		H B F R W 3 2 3 1 0			
			2	SS	0		276						974		3 3 3 1 0			
							275											
			3	SS	0		274											
			4	SS	0		273						468		9 2 1 0 0			
272.9																		
5.2	Silty CLAY																	
272.6	Grey														(Remarks: Von Post modified classification)			
5.5	SAND , some silt, trace clay Loose to Compact Grey Wet		5	SS	4		272											
			6	SS	10		271								0 13 81 6			
271.2																		
6.9	SILT , trace to some sand, trace clay Compact Grey Wet		7	SS	12		270											
270.5																		
7.6	SAND , trace to some silt, trace gravel Loose to Dense Grey Wet		8	SS	6													
			9	SS	36													
	Gravel and cobbles						269											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-04

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 680.7 E 207 104.0 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2014.05.13 - 2014.05.14 CHECKED BY JPL





SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								20 40 60 80 100											
								20 40 60 80 100											
Continued From Previous Page							<div><div><div></div><div></div><div></div><div></div><div></div></div><div>20 40 60 80 100</div></div> <div><div>○ UNCONFINED</div><div>● QUICK TRIAXIAL</div><div>+</div><div>×</div><div>FIELD VANE</div><div>LAB VANE</div></div> <div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div><div>W_p W W_L</div><div>WATER CONTENT (%)</div><div>20 40 60</div></div>				FI	RUN #1 TCR=100% SCR=100% RQD=100% RUN #2 TCR=100% SCR=92% RQD=90%							
267.9	GRANITE, fresh, medium grained, strong, grey, occasional mechanical breaks Horizontal joint at 10.3m Sub-vertical joint (125mm) at 10.5m Horizontal joint at 12.4m Sub-vertical joint 125mm at 12.2m and 175mm at 12.8m		1	RUN		268									1				
10.2										267									0
			2	RUN						266									0
										265									0
																			1
																			1
																			1
																			1
			264.8																
13.3			END OF BOREHOLE AT 13.3m. BOREHOLE OPEN TO 13.3m AND WATER LEVEL AT SURFACE. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.23 2.6 275.5																

RECORD OF BOREHOLE No BH-05

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 691.4 E 207 102.2 ORIGINATED BY GA
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2014.05.14 - 2014.05.14 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
278.2													
0.0	WATER												
277.7													
0.5	PEAT Very Soft Dark Brown Wet		1	SS	3							306	H B F R W 9 2 1 1 0
			2	SS	2							555	9 3 1 0 0
	Occasional wood fibres		4	SS	2							467	10 2 1 0 0
272.8													(Remarks: Von Post modified classification)
5.4	SAND , some silt, trace clay Loose to Dense Grey Wet		5	SS	4								0 76 16 8
			6	SS	38								
271.3													
6.9	SILT , some sand, trace clay, trace gravel Compact Grey Wet		7	SS	29								
			8	SS	15								
269.8													
8.4	END OF BOREHOLE AT 8.4m ON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 8.4m AND WATER LEVEL AT 4.3m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No BH-06

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 709.7 E 207 099.1 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.14 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
278.3								20	40	60	80	100								
0.0	WATER: (300mm)																			
278.0																				
0.3	PEAT Very Soft Dark Brown Wet																			
			1	SS	3													776	H B F R W 8 2 2 1 0	
			2	SS	2													682	7 2 3 1 0	
			3	SS	0													508	10 2 1 0 0 (Remarks: Von Post modified classification)	
273.7			4	SS	7															
4.6	SAND and SILT , trace clay Loose to Compact Grey Wet		5	SS	10														0 54 42 4	
			6	SS	11															
	Gravel and occasional cobbles		7	SS	50/ 0.0															
271.0																				
7.3	GRANITE , fresh, fine to medium grained, strong, grey		1	RUN															RUN #1 TCR=100% SCR=97% RQD=83%	
	Occasional mechanical breaks																			
	Horizontal joint at 7.4m, 7.5m, 7.6m, 7.8m, 8.0m																			
	Horizontal joint at 8.9m, 9.1m, 9.2m, 9.3m		2	RUN															RUN #2 TCR=100% SCR=97% RQD=85%	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-06

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 709.7 E 207 099.1 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.14 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
267.9	Sub-vertical joint (75mm) at 9.3m						268										
10.4	END OF BOREHOLE AT 10.4m. BOREHOLE OPEN TO 10.4m AND WATER LEVEL AT 3.9m IN AUGERS. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.23 1.7 276.6																

RECORD OF BOREHOLE No BH-07

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 721.6 E 207 094.5 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.15 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W P W W L							
278.2														
0.0	WATER: (300mm)						278							
277.9														
0.3	PEAT , occasional rootlets Very Soft Brown Wet		1	SS	2							646		H B F R W 8 3 3 2 0
			2	SS	1							572		10 3 1 0 0
			3	SS	0							578		10 3 1 0 0
			4	SS	0							598		10 3 1 0 0
274.2														(Remarks: Von Post modified classification)
4.0	SAND , some silt to silty, trace clay Compact to Dense Grey Wet		5	SS	29									
			6	SS	34									
	Compact		7	SS	16									0 74 24 2
271.3														
6.9	END OF BOREHOLE AT 6.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 6.9m AND WATER LEVEL AT 3.8m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 1.2 277.0 2014.05.23 0.7 277.5													

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RECORD OF BOREHOLE No BH-08

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 715.2 E 207 006.4 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.16 - 2014.05.16 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
												W P W W L								
278.5								20	40	60	80	100								
0.0	ROOTMAT: (150mm)																			
0.2	PEAT, occasional rootlets Very Soft Brown Wet		1	SS	2		278											717	H B F R W 8 3 2 1 0	
			2	SS	2													800	8 3 2 1 0	
							277											552	9 3 1 0 0	
			3	SS	0		276													
			4	SS	0		275											653	9 3 2 1 0	
							274											624	9 3 1 1 0	
			5	SS	2														(Remarks: Von Post modified classification)	
							273													
272.9																				
5.6	Silty SAND Compact Grey Wet		6	SS	13		272													
		7	SS	16																
271.0																				
7.5	END OF BOREHOLE AT 7.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 7.5m AND WATER LEVEL AT 4.5m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.23 0.5 278.0																			

ONTMT4S 1237.GPJ 2012TEMPLATE(MTO).GDT 7/14/14

RECORD OF BOREHOLE No BH-09

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 723.9 E 207 990.4 ORIGINATED BY GA
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.16 - 2014.05.16 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
278.5																	
0.0	PEAT Very Soft Dark Brown Wet		1	SS	1										537	H B F R W 8 3 2 1 0	
	Occasional rootlets		2	SS	0										547	8 3 2 1 0	
			3	SS	2										417	9 2 2 1 0	
276.2																(Remarks: Von Post modified classification)	
2.3	END OF BOREHOLE AT 2.3m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.23 0.0 278.5																

RECORD OF BOREHOLE No BH-10

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 691.4 E 207 114.9 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.15 - 2014.05.15 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20 40 60 80 100								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
							WATER CONTENT (%)									
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W P W W L									
278.5																
0.0	PEAT, trace rootlets Dark Brown Wet		1	GS											H B F R W 10 1 0 0 0	
	Trace woods															
			1	SS	6											10 1 0 0 0
	Trace gravel															
			2	SS	2											10 1 0 0 0
		3	SS	0											9 2 1 0 0	
	Some wood															
			4	SS	1										9 2 1 1 1	
		5	SS	1											7 2 1 0 0	
274.2																
4.3	SILT and SAND, trace clay Compact Grey Wet														(Remarks: Von Post modified classification)	
			6	SS	12											
		7	SS	22											0 39 56 5	
272.4																
6.1	Silty SAND, trace gravel Loose to Compact Brown Wet															
			8	SS	6											
		9	SS	26												
270.8																
7.7	END OF BOREHOLE AT 7.7m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		10	SS	50/ 0.050											
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 3.0 275.5 2014.05.23 2.8 275.7															

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RECORD OF BOREHOLE No BH-11

1 OF 1

METRIC

WP# 647-89-00 LOCATION N 5 428 711.0 E 207 109.4 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.16 - 2014.05.16 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)				
278.7								20	40	60	80	100					GR	SA	SI	CL	
0.0	ROCKFILL/SANDFILL Medium Grey/Brown Moist (FILL)		1	GS			278														
	Organics		2	GS																	
277.3																					
1.4	PEAT , trace silt, trace rootlets, trace wood Very Soft Dark Brown Wet Gravelly from 1.5m to 1.8m		1	SS	1		277														
			2	SS	1		276														
			3	SS	1																
275.0							275														
3.7	SAND , trace silt, trace gravel Loose to Compact Grey Wet		4	SS	9																
			5	SS	21		274														
			6	SS	21		273														
272.4			7	SS	50/																
6.3	END OF BOREHOLE AT 6.3m UPON REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.16 2.8 275.9 2014.05.23 2.6 276.1				0.050																



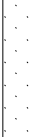


ONTMT4S 1237.GPJ 2012TEMPLATE(MTO).GDT 7/14/14

RECORD OF BOREHOLE No BH-12

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 428 672.4 E 207 130.3 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.16 - 2014.05.16 CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
278.3															
0.0	ROCKFILL/SANDILL Medium Grey/Brown Moist to Wet (FILL)		1	GS											
			2	GS											
276.9															
1.4	PEAT , trace rootlets, trace wood Very Soft Dark Brown Wet		1	SS	2									H B F R W 10 2 1 0 0	
			2	SS	1										
			3	SS	2										
	Some silt													10 2 1 0 0 (Remarks: Von Post modified classification)	
274.6															
3.7	SAND , trace gravel Compact Grey Saturated		4	SS	11										
			5	SS	9										
273.0															
5.3	Sandy SILT , trace gravel Compact to Loose Grey Wet		6	SS	11										
			7	SS	6										
271.4															
6.9	Silty SAND , trace clay, trace gravel Compact Grey Wet		8	SS	11										
			9	SS	11										
			10	SS	5										
	Some silt Loose													0 81 19 (SI+CL)	
	Compact		11	SS	13										
268.4															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-12

2 OF 2

METRIC

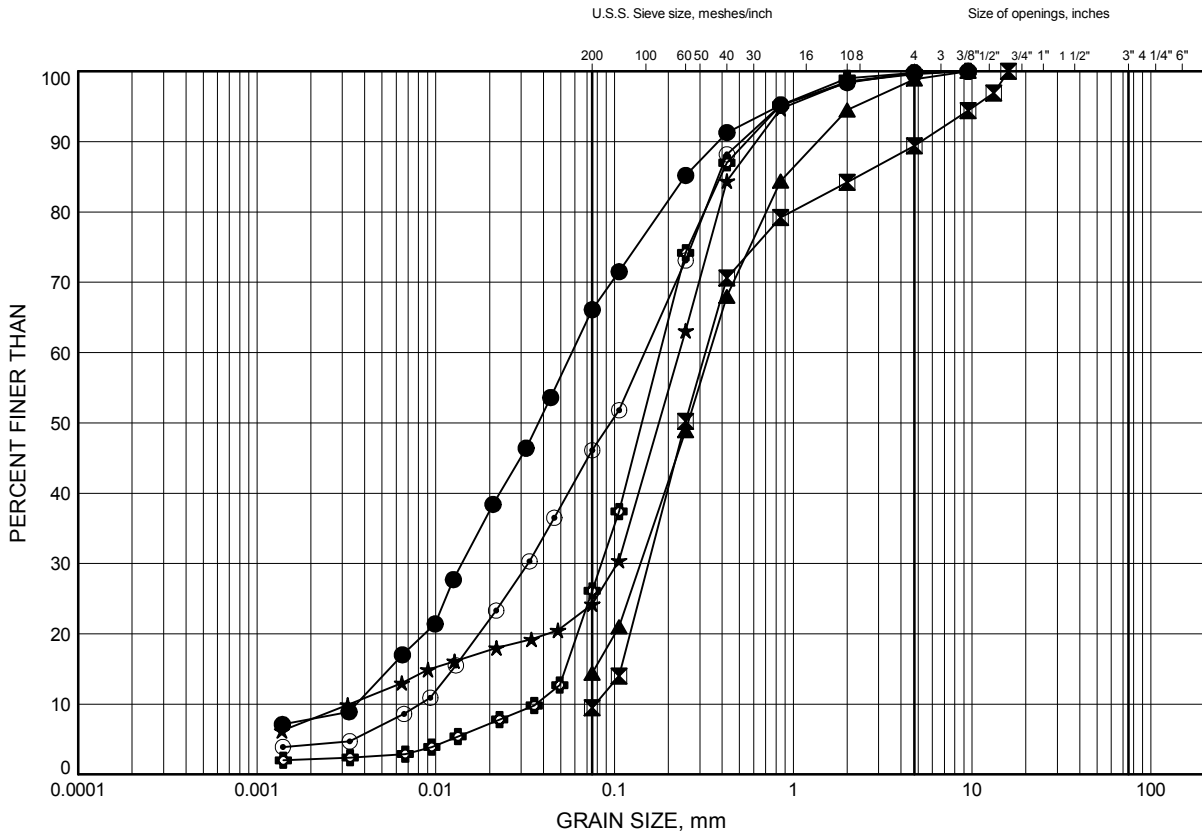
WP# 647-89-00 LOCATION N 5 428 672.4 E 207 130.3 ORIGINATED BY MKE
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2014.05.16 - 2014.05.16 CHECKED BY JPL

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 ³	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 _p	W	W _L			
9.9	Continued From Previous Page END OF BOREHOLE AT 9.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.05.23 4.3 274.0																

Hwy 11/17 - Red Rock to Nipigon
GRAIN SIZE DISTRIBUTION

FIGURE C1

SANDY SILT to SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BH-01	5.64	272.56
⊠	BH-02	2.59	275.91
▲	BH-03	8.69	269.61
★	BH-05	5.64	272.56
⊙	BH-06	5.64	272.66
⊕	BH-07	6.40	271.80

Date October 2014
 WP# 647-89-00

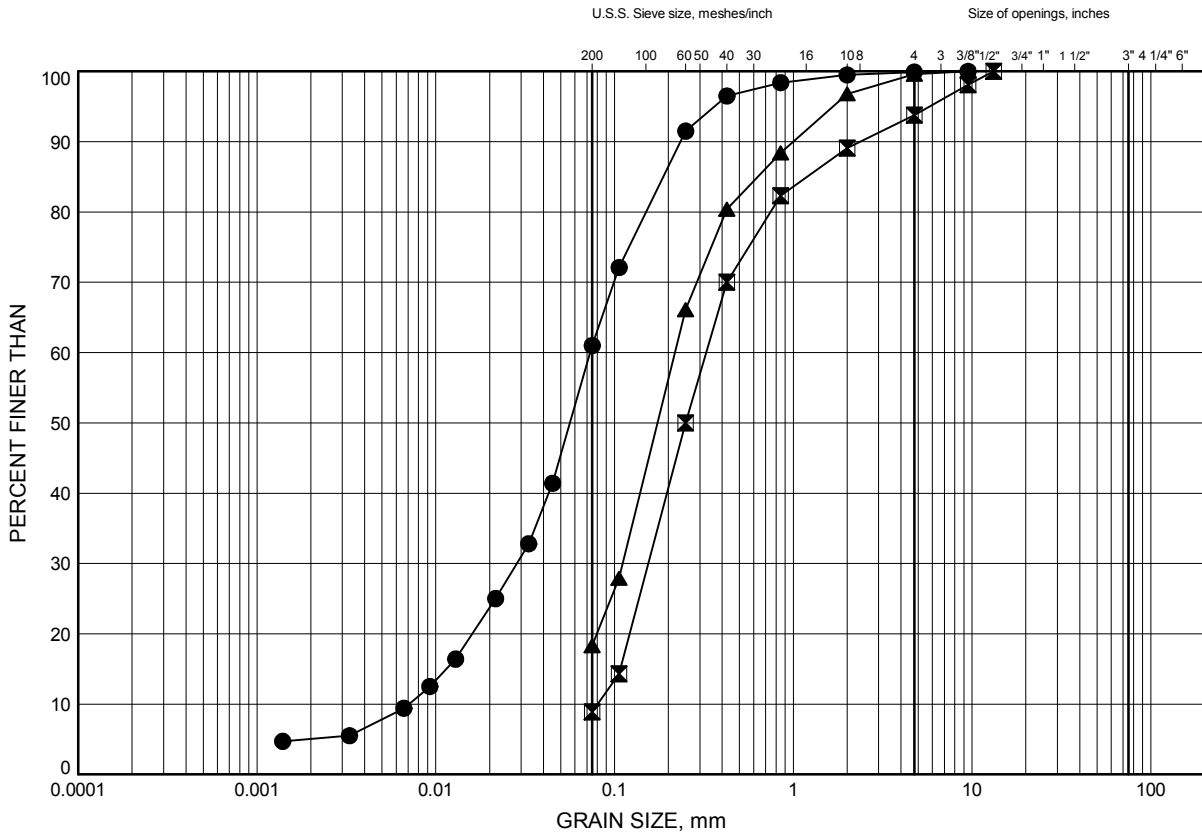


Prep'd AN
 Chkd. MKE

Hwy 11/17 - Red Rock to Nipigon
GRAIN SIZE DISTRIBUTION

FIGURE C2

SANDY SILT to SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BH-10	5.64	272.86
⊠	BH-11	4.11	274.59
▲	BH-12	8.69	269.61

Date October 2014
 WP# 647-89-00

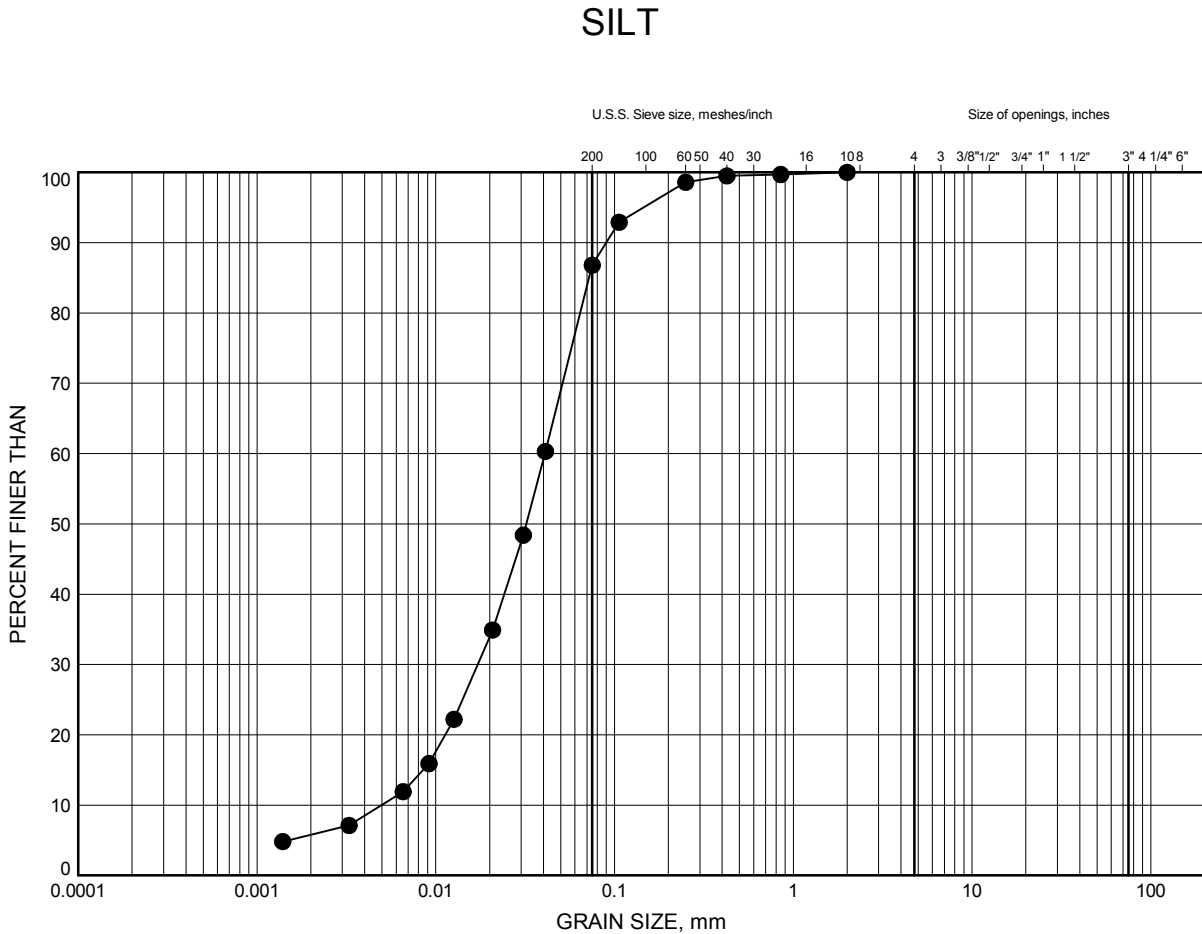


Prep'd AN
 Chkd. MKE

Hwy 11/17 - Red Rock to Nipigon

GRAIN SIZE DISTRIBUTION

FIGURE C3



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BH-04	7.16	270.94

Date October 2014
 WP# 647-89-00



Prep'd AN
 Chkd. MKE

Appendix D

Area within Fen Pond, Highway 11/17 Sta. 18+110 to 18+180

Record of Borehole Sheets

Laboratory Test Results

FIELD LOG

BOREHOLE/TESTPIT No: FP-41

JOB No.: <u>10-087</u>	WATER: <u>1.6 m</u>
PROJECT: <u>Nipigon 41 lane</u>	CAVE:
CLIENT: <u>Thurber</u>	EQUIPMENT:
LOCATION: <u>16 u 5427065 ~ 402319 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24</u>

(ft) (m)		SAMPLE DESCRIPTION	(ft) (m)		SAMPLE TYPE		SPT (N)	REMARKS
			VANE					
		ICE						
-1	-0.3		-1	-0.3				
-2	-0.6	0.6 WATER	-2	-0.6				
-3	-0.9		-3	-0.9				
-4	-1.2		-4	-1.2				
-5	-1.5		-5	-1.5				
-6	-1.8	1.6 Amorphous Organics	-6	-1.8				
-7	-2.1		-7	-2.1				
-8	-2.4		-8	-2.4				
-9	-2.7		-9	-2.7				
-10	-3.0		-10	-3.0				
-11	-3.3		-11	-3.3	Vane 3	4/2		
-12	-3.6		-12	-3.6	AS-028			
-13	-3.9		-13	-3.9				
-14	-4.2		-14	-4.2				
-15	-4.5		-15	-4.5				
-16	-4.8		-16	-4.8	Vane 3	8/5		
-17	-5.1		-17	-5.1	AS-029			
-18	-5.4	5.1 grey Si (4) CL	-18	-5.4	Vane 3	18/12		WELL DESCRIPTION
-19	-5.7	5.5 grey Si and F-M Sn	-19	-5.7	AS-030			
-20	-6.0	5.7 grey Si (4) CL & F Sn	-20	-6.0				
		6.3 EOH			AS-031			WELL DEPTH TO _____

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-6

JOB No.: <u>10-087</u>	WATER: <u>1.6</u>
PROJECT: <u>Nipigon 4 LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 u 5427068 ~ 402305 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE	SPT (N)	REMARKS
					VANE		
		ICE					
-1	-0.3		-1	-0.3			
-2	-0.6	600 WATER	-2	-0.6			
-3	-0.9		-3	-0.9			
-4	-1.2		-4	-1.2			
-5	-1.5		-5	-1.5			
-6	-1.8	1.6 Amorphous Organics	-6	-1.8	AS-005		
-7	-2.1		-7	-2.1			
-8	-2.4		-8	-2.4			
-9	-2.7		-9	-2.7			
-10	-3.0		-10	-3.0	AS-006		
-11	-3.3		-11	-3.3			
-12	-3.6		-12	-3.6			
-13	-3.9		-13	-3.9			
-14	-4.2		-14	-4.2			
-15	-4.5		-15	-4.5			
-16	-4.8		-16	-4.8	Vane 3	2 1/2	
-17	-5.1		-17	-5.1	AS-007		
-18	-5.4		-18	-5.4			
-19	-5.7	5.5 sm Si (ly) CL	-19	-5.7	Vane 3	1 1/5	
-20	-6.0		-20	-6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG BOREHOLE/TESTPIT No: FP-6

JOB No.: <u>10-087</u>	WATER: <u>1.6</u>
PROJECT:	CAVE:
CLIENT:	EQUIPMENT:
LOCATION:	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24 / 2011</u>

SAMPLE DESCRIPTION			SAMPLE TYPE			REMARKS	
(ft)	(m)		(ft)	(m)	VANE		SPT (N)
1	0.3	gry Si (h) CL	1	0.3	AS-042		
2	0.6	6.5 gry Si and F-M Sa	2	0.6	AS-043		
		6.6 gry Si (h) CL			AS-044		
3	0.9	6.7 EOH	3	0.9			
4	1.2		4	1.2			
5	1.5		5	1.5			
6	1.8		6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4			
9	2.7		9	2.7			
10	3.0		10	3.0			
11	3.3		11	3.3			
12	3.6		12	3.6			
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5			
16	4.8		16	4.8			
17	5.1		17	5.1			
18	5.4		18	5.4			
19	5.7		19	5.7			
20	6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-7

JOB No.: 10-087	WATER: 1.1
PROJECT: Nipigon 4 Lane	CAVE:
CLIENT: THURBER	EQUIPMENT:
LOCATION: 16 W 5427078 402307	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: April 24 / 2014

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE		REMARKS
					VANE	SPT (N)	
		ICE					
1	0.3		1	0.3			
2	0.6	600 WATER	2	0.6			
3	0.9		3	0.9			
4	1.2	1st Amorphous Organics	4	1.2			
5	1.5		5	1.5			
6	1.8		6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4			
9	2.7		9	2.7			
10	3.0		10	3.0			
11	3.3		11	3.3			
12	3.6		12	3.6			
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5			
16	4.8	V	16	4.8	Vane 3	7/2	
17	5.1	4.9 gy Si (ly) CL	17	5.1	AS-046		
18	5.4	5.1 gy Si and Fsa	18	5.4	AS-047		
19	5.7	5.3 EOH	19	5.7			
20	6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-8

JOB No.: <u>10-087</u>	WATER: <u>1.4</u>
PROJECT: <u>NIPISGON 4 LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 W 5427071 N 402290 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 22 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE	SPT (N)	REMARKS
					VANE		
		ICE					
1	0.3		1	0.3			
2	0.6	600 WATER	2	0.6			
3	0.9		3	0.9			
4	1.2		4	1.2			
5	1.5	1.4 Amorphous Organics	5	1.5			
6	1.8		6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4	AS-09		
9	2.7		9	2.7			
10	3.0		10	3.0			
11	3.3		11	3.3			
12	3.6		12	3.6	AS-010		
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5			
16	4.8		16	4.8			
17	5.1		17	5.1			
18	5.4		18	5.4			
19	5.7		19	5.7			
20	6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG BOREHOLE/TESTPIT No: FP-8

JOB No.: <u>10-087</u>	WATER: <u>1.4</u>
PROJECT:	CAVE:
CLIENT:	EQUIPMENT:
LOCATION:	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 22 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE	SPT (N)	REMARKS
					VANE		
1	0.3	Amorphous Organics ↓ 6.9 sry Si (14) CL	1	0.3			
2	0.6		2	0.6			
3	0.9		3	0.9	AS-011		
4	1.2	7.2 EDH	4	1.2			
5	1.5		5	1.5			
6	1.8		6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4			
9	2.7		9	2.7			
10	3.0		10	3.0			
11	3.3		11	3.3			
12	3.6		12	3.6			
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5			
16	4.8		16	4.8			
17	5.1		17	5.1			
18	5.4		18	5.4			
19	5.7		19	5.7			
20	6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-10

JOB No.: <u>10-087</u>	WATER: <u>1.6</u>
PROJECT: <u>NIPIGON 4 LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 W 5427060 N 402313 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE		REMARKS
					VANE	SPT (N)	
		ICE					
-1	-0.3		1	-0.3			
-2	-0.6		2	-0.6			
		600 WATER					
-3	-0.9		3	-0.9			
-4	-1.2		4	-1.2			
-5	-1.5		5	-1.5			
		1.6 Amorphous Organics					
-6	-1.8		6	-1.8			
-7	-2.1		7	-2.1			
-8	-2.4		8	-2.4			
-9	-2.7		9	-2.7			
-10	-3.0		10	-3.0			
-11	-3.3		11	-3.3			
-12	-3.6		12	-3.6	AS-032		
-13	-3.9		13	-3.9			
-14	-4.2		14	-4.2			
-15	-4.5		15	-4.5			
-16	-4.8		16	-4.8	Vane 3 8/2		
-17	-5.1		17	-5.1	AS-033		
		5.2 gr Si(l) CL					
-18	-5.4		18	-5.4	Vane 3 25/10		
-19	-5.7		19	-5.7			
		5.8 gr Si and F-Sa			AS-034		
-20	-6.0		20	-6.0			

WELL DESCRIPTION

WELL DEPTH TO _____



FIELD LOG

BOREHOLE/TESTPIT No: FP-10

JOB No.:	WATER: <u>1.6</u>
PROJECT:	CAVE:
CLIENT:	EQUIPMENT:
LOCATION:	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE	SPT (N)	REMARKS
					VANE		
-1	-0.3	6.1 sry Si (4) CL 6.3 EOH	-1	-0.3	AS-035		
-2	-0.6		-2	-0.6			
-3	-0.9		-3	-0.9			
-4	-1.2		-4	-1.2			
-5	-1.5		-5	-1.5			
-6	-1.8		-6	-1.8			
-7	-2.1		-7	-2.1			
-8	-2.4		-8	-2.4			
-9	-2.7		-9	-2.7			
-10	-3.0		-10	-3.0			
-11	-3.3		-11	-3.3			
-12	-3.6		-12	-3.6			
-13	-3.9		-13	-3.9			
-14	-4.2		-14	-4.2			
-15	-4.5		-15	-4.5			
-16	-4.8		-16	-4.8			
-17	-5.1		-17	-5.1			
-18	-5.4		-18	-5.4			
-19	-5.7		-19	-5.7			
-20	-6.0		-20	-6.0			

WELL DESCRIPTION

WELL DEPTH TO _____



FIELD LOG

BOREHOLE/TESTPIT No: FP-11

JOB No.: <u>10-087</u>	WATER: <u>800</u>
PROJECT: <u>NIPISGON 4-LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 U 5427059 ~ 402303 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 24 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE	SPT (N)	REMARKS
					VANE		
		<u>ICE</u>					
-1	-0.3		1	-0.3			
-2	-0.6	<u>600 WATER</u>	2	-0.6			
-3	-0.9	<u>800 Amorphous Organics</u>	3	-0.9			
-4	-1.2		4	-1.2			
-5	-1.5		5	-1.5			
-6	-1.8		6	-1.8			
-7	-2.1		7	-2.1			
-8	-2.4		8	-2.4			
-9	-2.7		9	-2.7			
-10	-3.0		10	-3.0			
-11	-3.3		11	-3.3	<u>Vane 3</u>	<u>8/2</u>	
-12	-3.6		12	-3.6			
-13	-3.9		13	-3.9			
-14	-4.2		14	-4.2			
-15	-4.5		15	-4.5			
-16	-4.8		16	-4.8			
-17	-5.1		17	-5.1			
-18	-5.4		18	-5.4			
-19	-5.7	<u>5.7 grey silty CL</u>	19	-5.7	<u>AS-038</u>	<u>11/9</u>	
-20	-6.0		20	-6.0	<u>Vane 3</u>		

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-11

JOB No.: <u>10-087</u>	WATER: <u>200</u>
PROJECT:	CAVE:
CLIENT:	EQUIPMENT:
LOCATION:	HOLE DIAMETER:
SURFACE ELEVATION:	DATE:

SAMPLE DESCRIPTION			SAMPLE TYPE			REMARKS	
(ft)	(m)		(ft)	(m)	VANE		SPT (N)
1	0.3	5.7 Si (ly) CL ↓	1	0.3			
2	0.6		2	0.6	Vane 3	34/26	
3	0.9	6.8 5.7 Si and F Sa	3	0.9	AS-40		
		6.9 5.7 Si (ly) CL			AS-39		
4	1.2	7.0 EOH	4	1.2			
5	1.5		5	1.5			
6	1.8		6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4			
9	2.7		9	2.7			
10	3.0		10	3.0			
11	3.3		11	3.3			
12	3.6		12	3.6			
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5			
16	4.8		16	4.8			
17	5.1		17	5.1			
18	5.4		18	5.4			
19	5.7		19	5.7			
20	6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-24

JOB No.: <u>10-087</u>	WATER: <u>1.4</u>
PROJECT: <u>NIPISQUEN LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 W 5427073 N 402324 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 23 / 2014</u>

SAMPLE DESCRIPTION		(ft) (m)		SAMPLE TYPE		SPT (N)	REMARKS
(ft)	(m)	(ft)	(m)	VANE	VANE		
	ICE						
1	0.3	1	0.3				
2	0.6	2	0.6				
	600 WATER						
3	0.9	3	0.9				
4	1.2	4	1.2				
5	1.5	5	1.5				
	1.4 Amorphous Organics						
6	1.8	6	1.8				
7	2.1	7	2.1				
8	2.4	8	2.4				
9	2.7	9	2.7	AS-16			
10	3.0	10	3.0	Vane 3	8/6		
11	3.3	11	3.3				
12	3.6	12	3.6				
13	3.9	13	3.9				
14	4.2	14	4.2	AS-17			
15	4.5	15	4.5	Vane 3	4/1/14		
16	4.8	16	4.8				
	4.5 grey Si (1) CL						
17	5.1	17	5.1	AS-18			
	5.0 grey ST and Fsa						
18	5.4	18	5.4				
	5.2 EOH						
19	5.7	19	5.7				
20	6.0	20	6.0				

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-25

JOB No.: <u>10-087</u>	WATER: <u>1.6</u>
PROJECT: <u>NIPIGON Y LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16' U 5427060 ~ 402324 E</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 23 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE		REMARKS
					VANE	SPT (N)	
1	0.3		1	0.3			
2	0.6	600 WATER	2	0.6			
3	0.9		3	0.9			
4	1.2		4	1.2			
5	1.5		5	1.5			
6	1.8	1.6 Amorphous Organics	6	1.8			
7	2.1		7	2.1			
8	2.4		8	2.4			
9	2.7		9	2.7			
10	3.0		10	3.0	Vane 3 4/2		
11	3.3		11	3.3			
12	3.6		12	3.6			
13	3.9		13	3.9			
14	4.2		14	4.2			
15	4.5		15	4.5	Vane 3 20/8		
16	4.8		16	4.8			
17	5.1		17	5.1			
18	5.4		18	5.4			
19	5.7		19	5.7	AS-22		
20	6.0	6.0' grey Si (ly) CL	20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____

FIELD LOG

BOREHOLE/TESTPIT No: FP-25

JOB No.: <u>10-087</u>	WATER:
PROJECT:	CAVE:
CLIENT:	EQUIPMENT:
LOCATION:	HOLE DIAMETER:
SURFACE ELEVATION:	DATE:

(ft) (m)		SAMPLE DESCRIPTION	(ft) (m)		SAMPLE TYPE		REMARKS
					VANE	SPT (N)	
		<u>6.0 sry Si (y) cl</u>			<u>AS-23</u>		
-1	-0.3		1	0.3			
		<u>6.3 EOH</u>					
-2	-0.6		2	0.6			
-3	-0.9		3	0.9			
-4	-1.2		4	1.2			
-5	-1.5		5	1.5			
-6	-1.8		6	1.8			
-7	-2.1		7	2.1			
-8	-2.4		8	2.4			
-9	-2.7		9	2.7			
-10	-3.0		10	3.0			
-11	-3.3		11	3.3			
-12	-3.6		12	3.6			
-13	-3.9		13	3.9			
-14	-4.2		14	4.2			
-15	-4.5		15	4.5			
-16	-4.8		16	4.8			
-17	-5.1		17	5.1			
-18	-5.4		18	5.4			
-19	-5.7		19	5.7			
-20	-6.0		20	6.0			

WELL DESCRIPTION

WELL DEPTH TO _____



FIELD LOG

BOREHOLE/TESTPIT No: FP-26

JOB No.: <u>10-087</u>	WATER: <u>1.6</u>
PROJECT: <u>NIDBON 4 LANE</u>	CAVE:
CLIENT: <u>THURBER</u>	EQUIPMENT:
LOCATION: <u>16 U 5427054 402317</u>	HOLE DIAMETER:
SURFACE ELEVATION:	DATE: <u>April 23 / 2014</u>

(ft)	(m)	SAMPLE DESCRIPTION	(ft)	(m)	SAMPLE TYPE		SPT (N)	REMARKS
					VANE			
		ICE						
-1	-0.3		-1	-0.3				
-2	-0.6	600 WATER	-2	-0.6				
-3	-0.9		-3	-0.9				
-4	-1.2		-4	-1.2				
-5	-1.5		-5	-1.5				
-6	-1.8	1.6 Amorphous Organics	-6	-1.8				
-7	-2.1		-7	-2.1				
-8	-2.4		-8	-2.4				
-9	-2.7		-9	-2.7				
-10	-3.0		-10	-3.0	Vane 3	4 1/2		
-11	-3.3		-11	-3.3				
-12	-3.6		-12	-3.6				
-13	-3.9		-13	-3.9				
-14	-4.2		-14	-4.2	AS-24			
-15	-4.5		-15	-4.5	Vane 3	6 1/2		
-16	-4.8		-16	-4.8				
-17	-5.1		-17	-5.1	AS-25			
-18	-5.4		-18	-5.4	Vane 3	5 1/2		
-19	-5.7	5.5 37 Si (4) CL	-19	-5.7	AS-26			
-20	-6.0	5.8 EOH	-20	-6.0				

WELL DESCRIPTION

WELL DEPTH TO _____



Borehole	Approximate Station	Approximate offset from median (Lt)	UTM Zone	Northing	Easting	Elevation	Snow Thickness (m)	Ice Thickness (m)	Water Thickness (m)	Organics Thickness (m)
FP-05	18+130	50.0	16 U	5427075	402321	277.9	0.8	-	-	4.2
FP-09	18+130	80.0	16 U	5427081	402292	277.9		0.6	1.4	3.8
FP-12	18+142	67.3	16 U	5427091	402307	277.9		0.6	0.9	2.5
FP-13	18+115	80.7	16 U	5427065	402288	277.9		0.6	0.6	5.7
FP-14	18+138	75.7	16 U	5427089	402298	277.9		0.6	2.4	1.9
FP-15	18+150	72.4	16U	5427101	402304	277.9		0.6	0.4	3.7
FP-16	18+120	101.2	16U	5427075	402269	277.9		0.6	1.4	5.2
FP-17	18+131	97.6	16U	5427086	402275	277.9		0.6	1.8	2.6
FP-18	18+143	94.2	16U	5427098	402281	277.9		0.6	0.9	3.0
FP-19	18+156	91.2	16U	5427111	402287	277.9		0.6	0.4	3.0
FP-20	18+131	117.0	16U	5427090	402256	277.9		0.6	1.0	5.4
FP-21	18+144	113.8	16U	5427103	402262	277.9		0.6	1.3	3.8
FP-22	18+156	110.9	16U	5427116	402268	277.9		0.6	0.9	3.5
FP-23	18+168	107.9	16U	5427128	402274	277.9		0.6	0.4	2.9

Natural Moisture Content Determination

Client:	MMM Group	TBTE Project No	10-087 (CO 12A)
MTO Project No.:	WP 647-89-01	Tested By/Date:	Forch Valela / April 30, 2014
Project Description:	Hwy 11/17 (New) Nipigon	Reported By:	Forch Valela
Report To:	Stephen Peters	Reviewed By:	Tim Fummerton <i>TF</i>

Lab No.	BH ID	Sample No.	Depth (m)	NMC %	Soil Description
19033	FP-06	AS-05	1.6-2.0	4453.4	Free water, trace of organics & fine sand H3 B5 F1 R1 W0 N0
19034	FP-06	AS-06	3.0-3.4	1461.0	Coarse amorphous organics H8 B4 F2 R1 W1 N0
19035	FP-06	AS-07	4.8-5.2	1185.5	Amorphous organics H9 B4 F1 R1 W0 N0
19036	FP-06	AS-42	6.1-6.3	60.2	Grey silty clay
19037	FP-06	AS-43	6.5-6.6	21.7	Grey silt trace of fine sand
19038	FP-06	AS-44	6.6-6.7	40.1	Grey silty clay
19039	FP-08	AS-09	2.4-2.8	4238.5	Free water trace of organics H3 B5 F3 R0 W0 N0
19040	FP-08	AS-10	3.4-3.8	2328.8	Free water with organics H5 B5 F1 R0 W0 N0
19041	FP-08	AS-11	6.9-7.2	45.3	Grey silty clay
19042	FP-24	AS-16	2.6-3	988.9	Amorphous organics
19043	FP-24	AS-17	4.1-4.5	647.4	Amorphous organics trace of fine fibers H9 B3 F1 R0 W0 N0
19044	FP-24	AS-18	5.0-5.2	57.1	Grey silt with fine sand trace of organics
19045	FP-25	AS-22	5.6-6.0	363.6	Black amorphous organics H10 B2 F1 R0 W0 N0
19046	FP-25	AS-23	6.0-6.3	40.1	Grey silt with fine sand
19047	FP-26	AS-24	4.1-4.5	975.0	Amorphous organics H8 B3 F1 R0 W0 N0
19048	FP-26	AS-25	5.3-5.5	516.7	Amorphous organics H9 B3 F1 R1 W0 N0
19049	FP-26	AS-26	5.5-5.8	44.5	Grey silt trace of fine /coarse sand & gravel/clay
19050	FP-04	AS-28	3.6-3.8	936.0	Amorphous organics H8 B3 F1 R1 W0 N0
19051	FP-04	AS-29	4.8-5.1	951.9	Amorphous organics H9 B3 F1 R0 W0 N0
19052	FP-04	AS-30	5.5-5.7	21.1	Grey silt with fine & medium sand
19053	FP-04	AS-31	6.2-6.3	25.4	Grey silt with fine sand

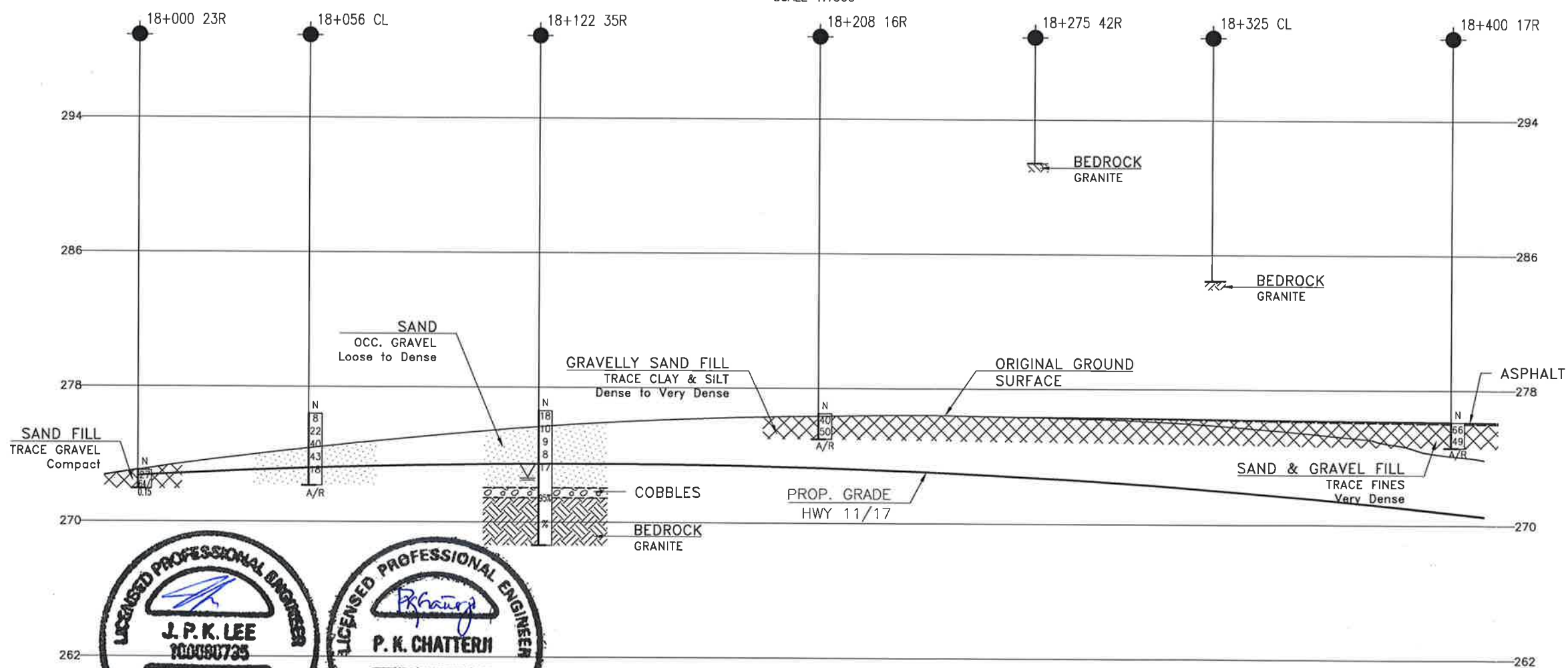
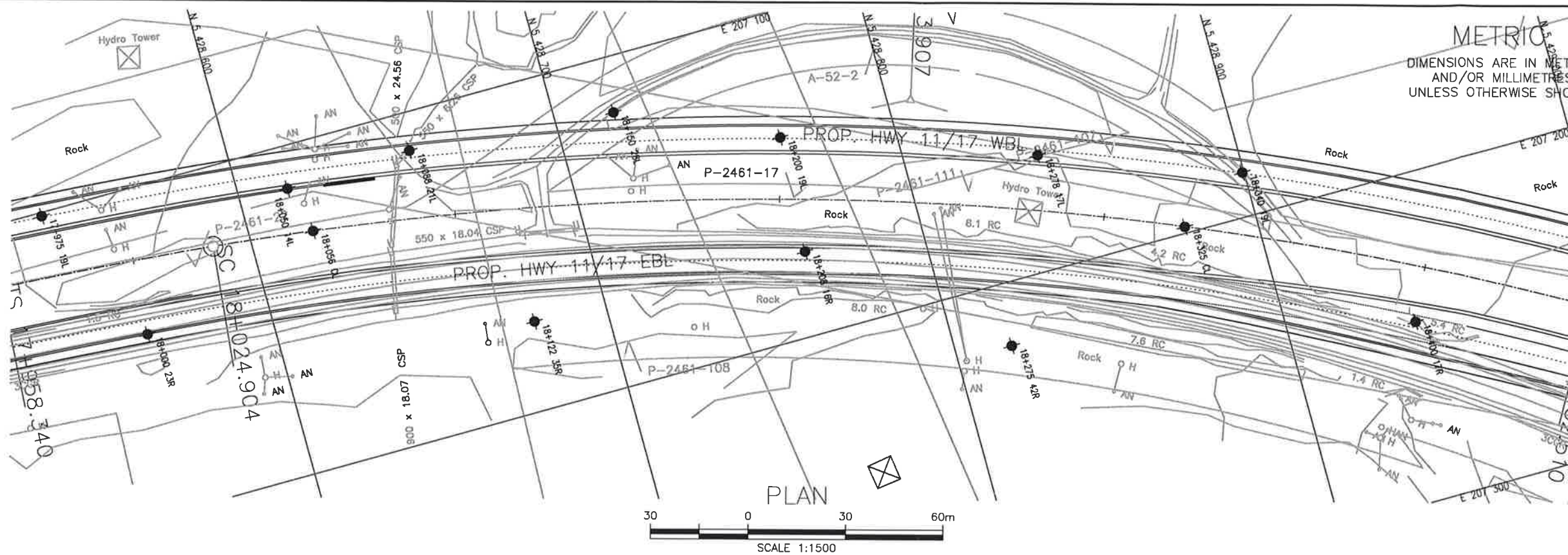
Natural Moisture Content Determination

Client:	MMM Group	TBTE Project No	10-087 (CO 12A)
MTO Project No.:	WP 647-89-01	Tested By/Date:	Forch Valela / April 30, 2014
Project Description:	Hwy 11/17 (New) Nipigon	Reported By:	Forch Valela
Report To:	Stephen Peters	Reviewed By:	Tim Fummerton 

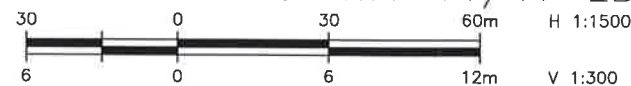
Lab No.	BH ID	Sample No.	Depth (m)	NMC %	Soil Description
19054	FP-10	AS-32	3.7-3.9	776.2	Amorphous organics H8 B3 F1 R0 W0 N0
19055	FP-10	AS-33	5.0-5.2	927.8	Amorphous organics H8 B3 F1 R0 W0 N0
19056	FP-10	AS-34	5.8-6.1	25.7	Grey silt with fine sand trace of organics
19057	FP-10	AS-35	6.1-6.3	63.1	Grey silty clay trace of organics
19058	FP-11	AS-38	5.7-6.1	43.3	Grey silty clay trace of organics
19059	FP-11	AS-39	6.9-7.0	18.7	Grey silt with fine sand trace of coarse sand
19060	FP-11	AS-40	6.8-6.9	37.5	Grey silty clay
19061	FP-07	AS-46	4.9-5.1	33.4	Grey silt with fine sand trace of clay and organics
19062	FP-07	AS-47	5.1-5.3	32.1	Grey silt with fine sand trace of organics

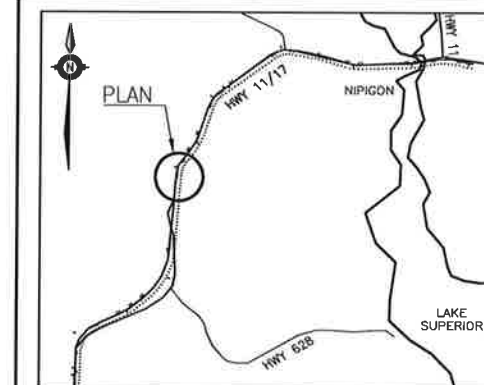
Appendix E

Borehole Locations and Soil Strata Drawings



PROFILE ALONG HWY 11/17 EBL

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWINGMETRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWNCONT No 2014-6026
GWP No 647-89-00HIGHWAY 11/17 FOUR LANE
EASTBOUND LANE - C4
(STA. 17-795 TO 18+450)
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

- Borehole
- ⊕ Dynamic Cone Penetration Test (DCPT)
- ⊗ Borehole and Cone
- ⊕ TBT Borehole
- ⊕ Piezocone
- 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

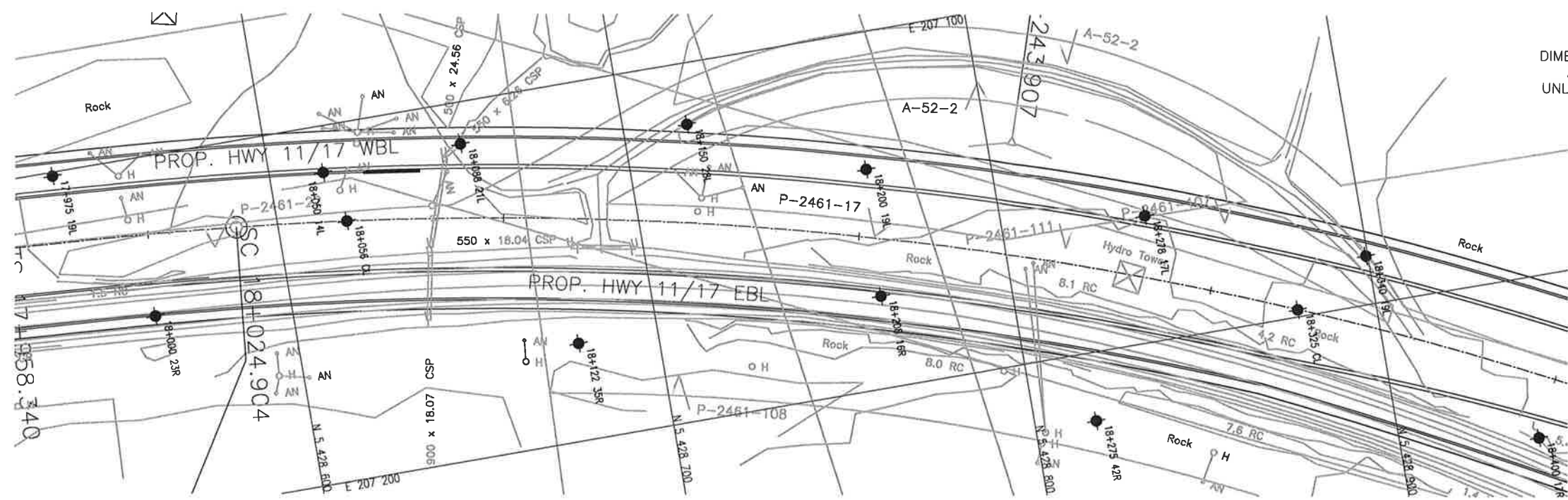
NO	ELEVATION	NORTHING	EASTING
18+000 23R	273.0	5 428 561.8	207 144.8
18+056 CL	276.4	5 428 619.3	207 127.6
18+122 35R	276.6	5 428 677.6	207 172.7
18+208 16R	276.5	5 428 763.5	207 174.2
18+275 42R	291.4	5 428 817.2	207 219.1
18+325 CL	284.5	5 428 878.1	207 198.0
18+400 17R	276.1	5 428 938.8	207 245.0

-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.

GEOCRES No. 52A-189

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SBP	CHK JPL	CODE
DRAWN	MFA	CHK SBP	SITE
			LOAD
			STRUCT
			DWG 19
			DATE JAN 2015



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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

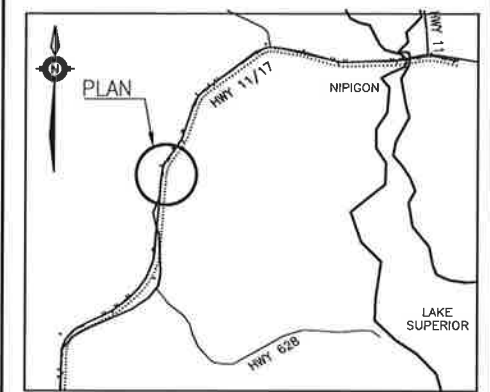
CONT No 2014-6026
GWP No 647-89-00

HIGHWAY 11/17 FOUR LANING
WESTBOUND LANE - C9
(STA. 17+795 TO 18+450)
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP

THURBER ENGINEERING LTD.

SHEET



KEYPLAN
LEGEND

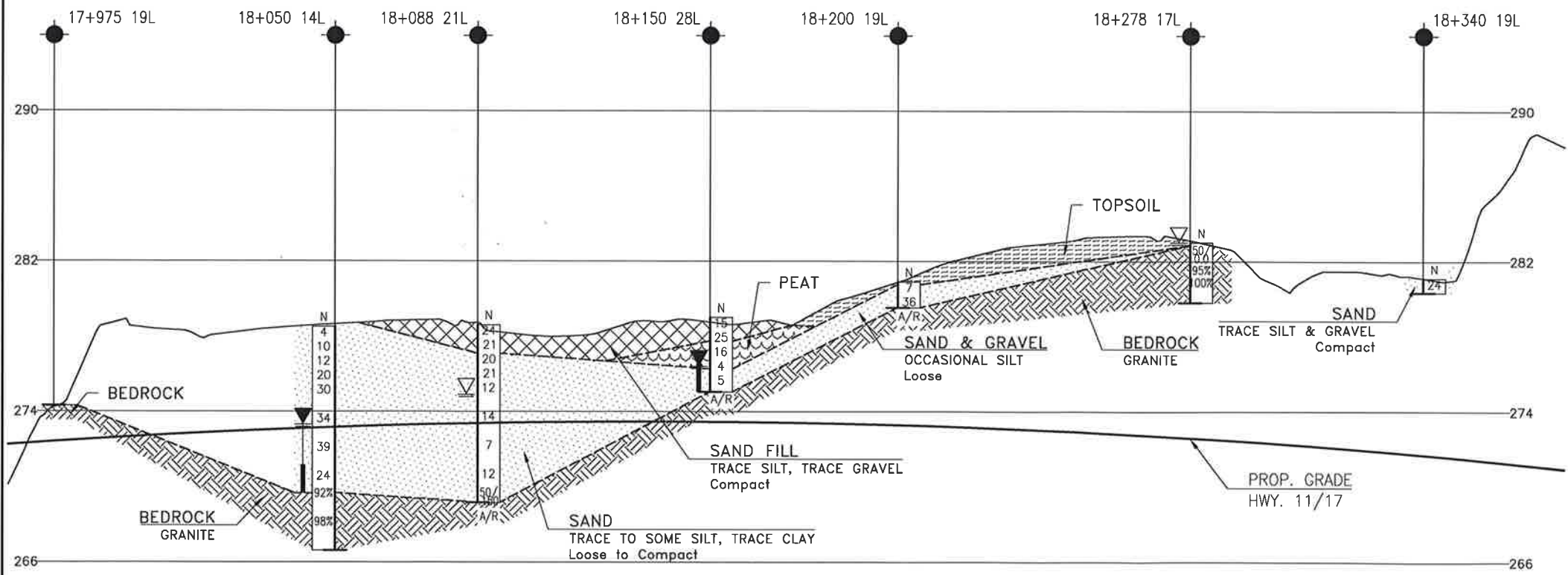
- Borehole
- ⊕ Dynamic Cone Penetration Test (DCPT)
- ⊕ Borehole and Cone
- ⊕ TBT Borehole
- ⊕ Piezocone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ⊕ Water Level
- ⊕ Head Artesian Water
- ⊕ Piezometer
- 90% Rock Quality Designation (RQD)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

NO	ELEVATION	NORTHING	EASTING
17+975 19L	274.3	5 428 540.0	207 101.1
18+050 14L	278.5	5 428 615.1	207 113.0
18+088 21L	278.6	5 428 654.3	207 111.8
18+150 28L	279.1	5 428 718.0	207 117.1
18+200 19L	280.9	5 428 765.4	207 138.3
18+278 17L	282.9	5 428 840.3	207 164.7
18+340 19L	281.1	5 428 899.5	207 186.5

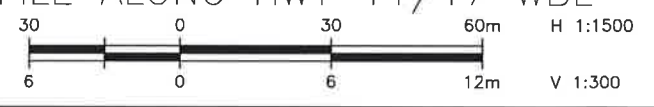
-NOTES-

- 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.

GEOCRES No. 52A-189



PROFILE ALONG HWY 11/17 WBL



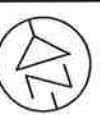
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
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			LOAD
			STRUCT
			DWG 20
			DATE JAN 2015

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DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 647-89-00

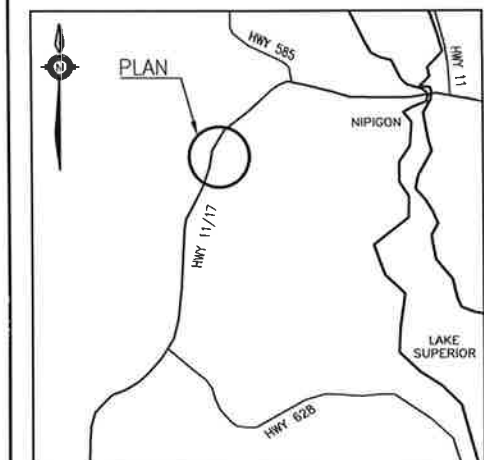
HWY 11/17 FOUR LANING
FEN POND INVESTIGATION
BOREHOLE LOCATIONS PLAN



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

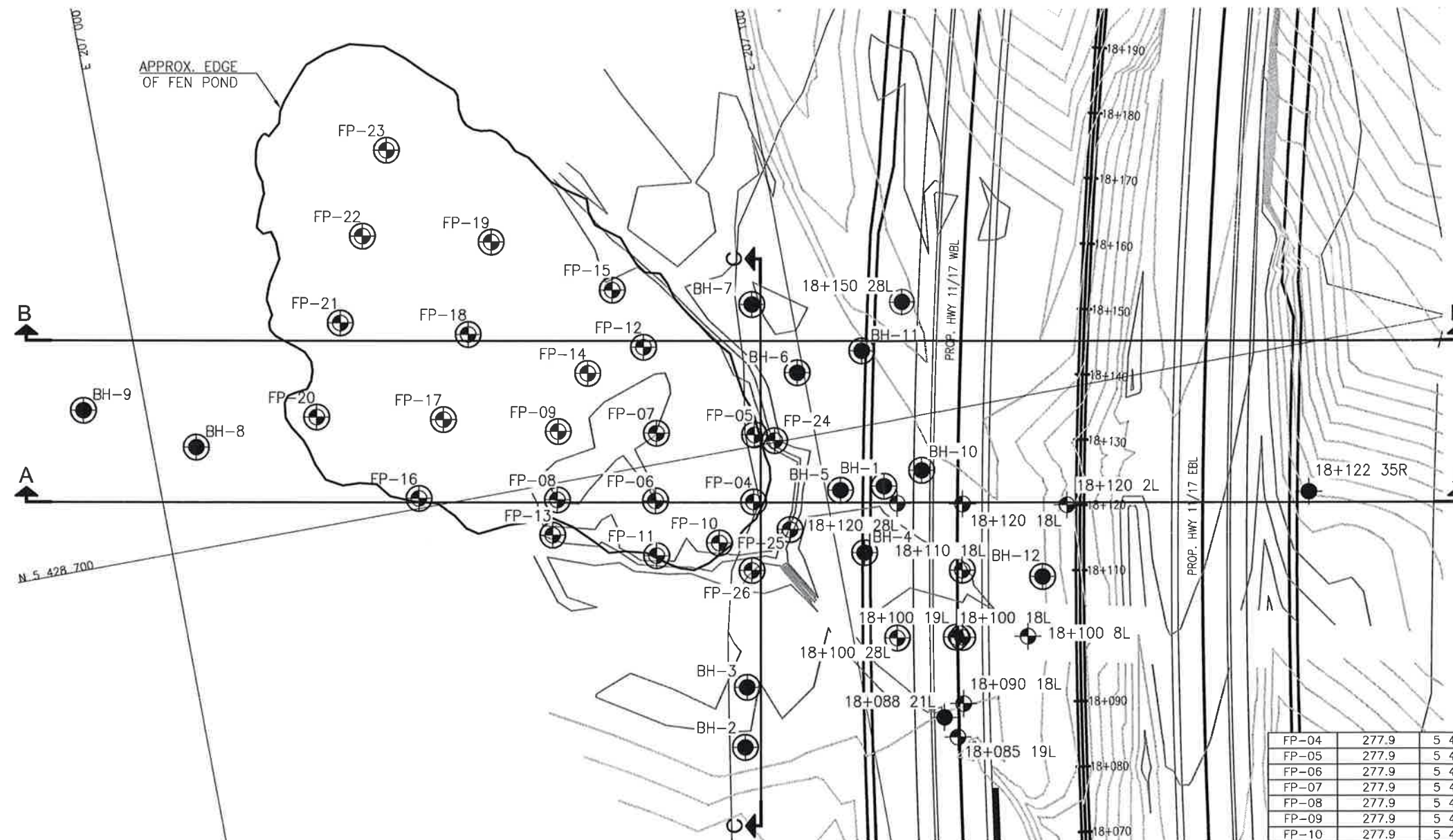
- Borehole By Thurber
- ◆ Borehole By TBTE
- Borehole With Peat
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- ▽ Water Level
- ↑ Head Artesian Water
- ⊥ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH-1	278.2	5 428 690.2	207 108.9
BH-2	278.5	5 428 655.2	207 080.8
BH-3	278.3	5 428 664.2	207 082.7
BH-4	278.1	5 428 680.7	207 104.0
BH-5	278.2	5 428 691.4	207 102.2
BH-6	278.3	5 428 709.7	207 099.1
BH-7	278.2	5 428 721.6	207 094.5
BH-8	278.5	5 428 715.2	207 006.4
BH-9	278.5	5 428 724.0	207 990.4
BH-10	278.5	5 428 691.4	207 114.9
BH-11	278.7	5 428 711.0	207 109.4
BH-12	278.3	5 428 672.4	207 130.2

NOTES

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- This drawing is for subsurface information only. surface details and features are for conceptual illustration.
- Borehole elevations and co-ordinates provided by TBTE.
- Base plan provided by MMM.

GEOCREs No. 52A-189

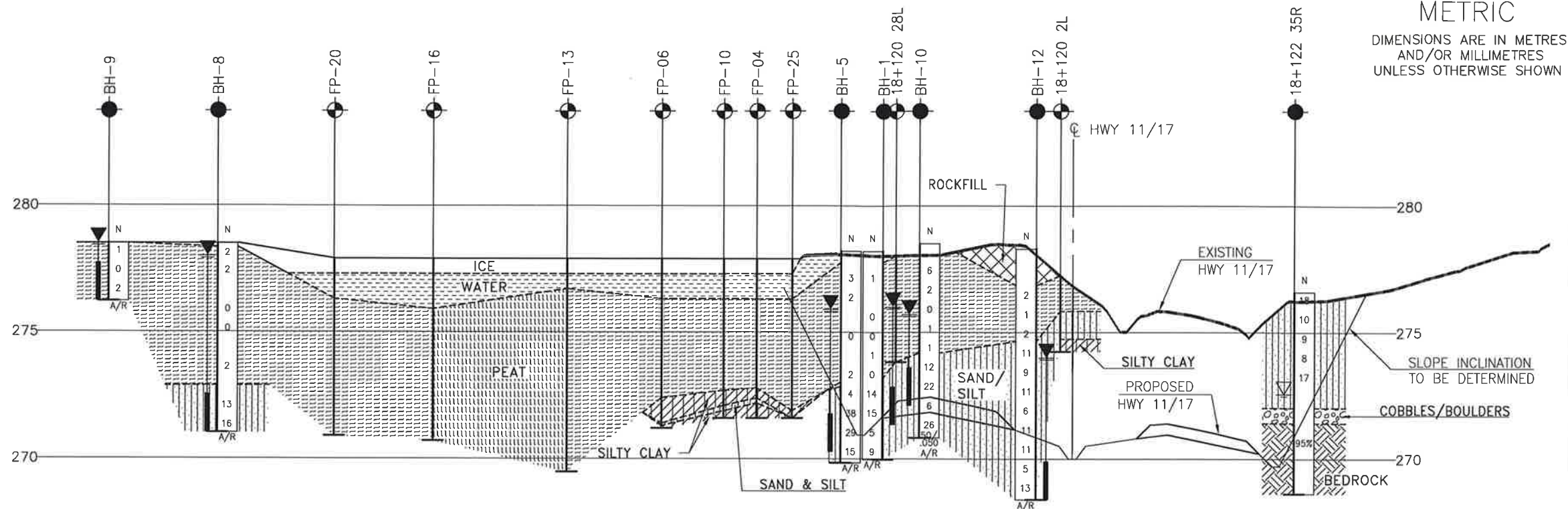


PLAN

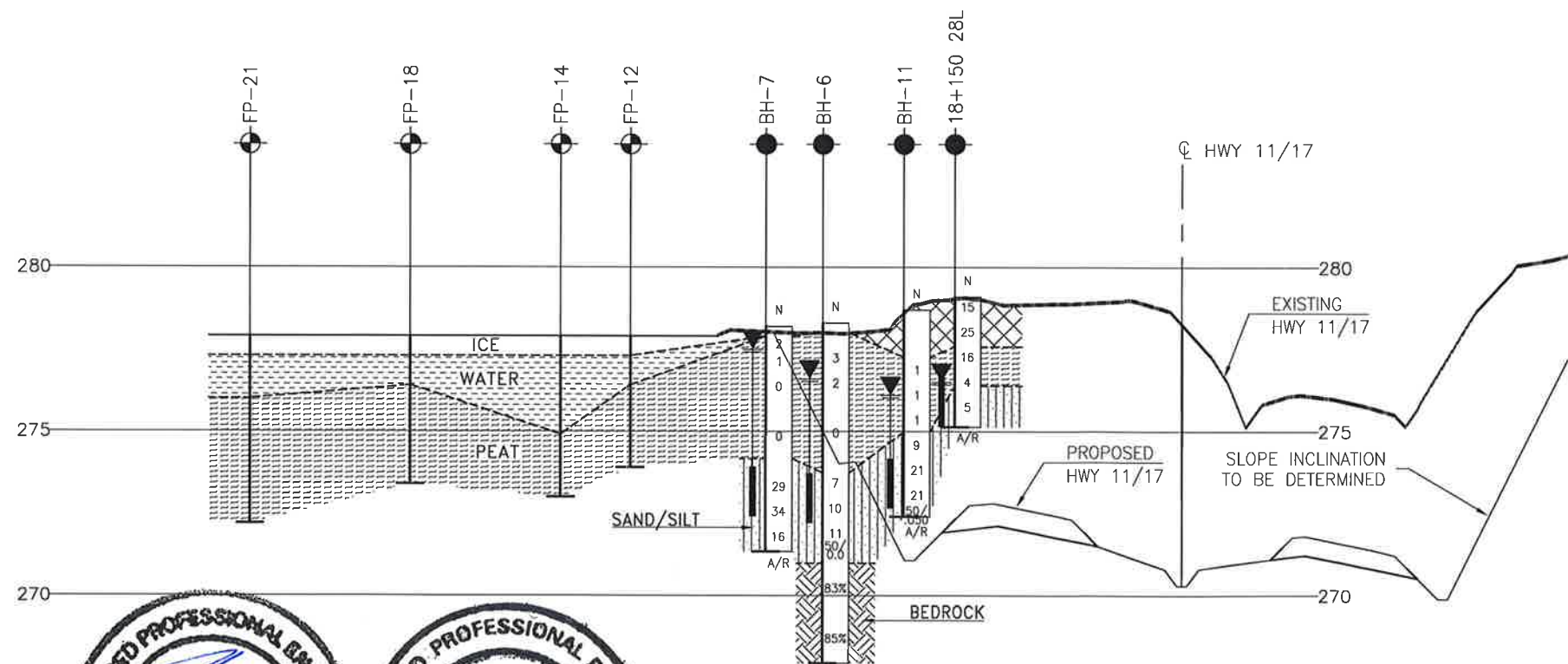
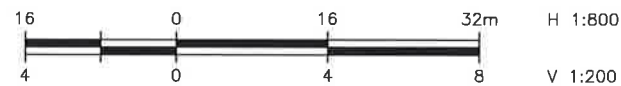


18+085 19L	—	5 428 650.6	207 113.0	FP-14	277.9	5 428 715.6	207 067.5
18+088 21L	278.6	5 428 653.9	207 111.5	FP-15	277.9	5 428 727.4	207 073.5
18+090 18L	—	5 428 655.4	207 114.8	FP-16	277.9	5 428 701.5	207 038.6
18+100 08L	—	5 428 663.7	207 126.3	FP-17	277.9	5 428 712.7	207 044.5
18+100 18L	—	5 428 665.4	207 116.5	FP-18	277.9	5 428 724.8	207 050.6
18+100 19L	—	5 428 665.6	207 115.5	FP-19	277.9	5 428 738.0	207 056.7
18+100 28L	—	5 428 667.2	207 106.6	FP-20	277.9	5 428 716.6	207 025.5
18+110 18L	—	5 428 675.5	207 118.3	FP-21	277.9	5 428 730.1	207 031.7
18+120 02L	277.2	5 428 682.4	207 135.9	FP-22	277.9	5 428 742.5	207 037.5
18+120 18L	278.2	5 428 685.5	207 120.2	FP-23	277.9	5 428 754.7	207 043.5
18+120 28L	278.0	5 428 687.4	207 110.4	FP-24	277.9	5 428 700.3	207 093.7
18+122 35R	276.6	5 428 677.6	207 172.7	FP-25	277.9	5 428 686.5	207 093.5
18+150 28L	—	5 428 717.6	207 116.8	FP-26	277.9	5 428 681.4	207 086.7

REVISIONS	DATE	BY	DESCRIPTION
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DRAWN	AN	CHK PKC	SITE
		LOAD	STRUCT
			DWG 1
			DATE FEB 2015



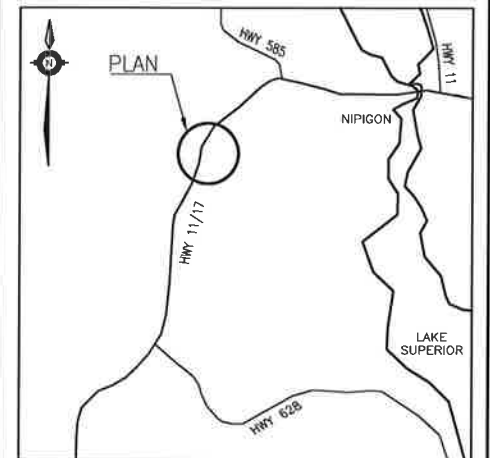
SECTION ALONG A-A



SECTION ALONG B-B

CONT No
WP No 647-89-00HWY 11/17 FOUR LANING
FEN POND INVESTIGATION
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

●	Borehole By Thurber
⊙	Borehole By TBTE
○	Borehole With Peat
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH-1	278.2	5 428 690.4	207 108.9
BH-2	278.5	5 428 655.0	207 080.7
BH-3	278.3	5 428 664.0	207 082.7
BH-4	278.1	5 428 680.9	207 104.1
BH-5	278.2	5 428 691.0	207 102.2
BH-6	278.3	5 428 709.9	207 099.0
BH-7	278.2	5 428 721.4	207 094.1
BH-8	278.5	5 428 715.4	207 006.6
BH-9	278.5	5 428 724.1	207 990.6
BH-10	278.5	5 428 691.7	207 115.0
BH-11	278.7	5 428 711.3	207 109.3
BH-12	278.3	5 428 672.3	207 130.2

-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.
- Borehole elevations and co-ordinates provided by TBTE.
- Proposed highway cross-sections provided by MMM.

GEOCRES No. 52A-189

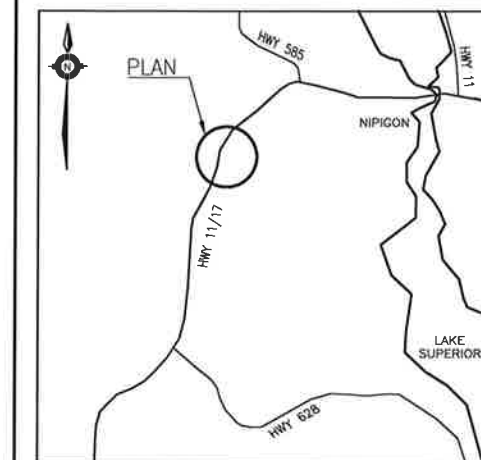
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JPL	CHK	JPL
DRAWN	AN	CHK	SITE
LOAD			
STRUCT			
DWG	2		
DATE	JAN 2015		

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

CONT No
WP No 647-89-00

HWY 11/17 FOUR LANING
FEN POND INVESTIGATION
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN
LEGEND

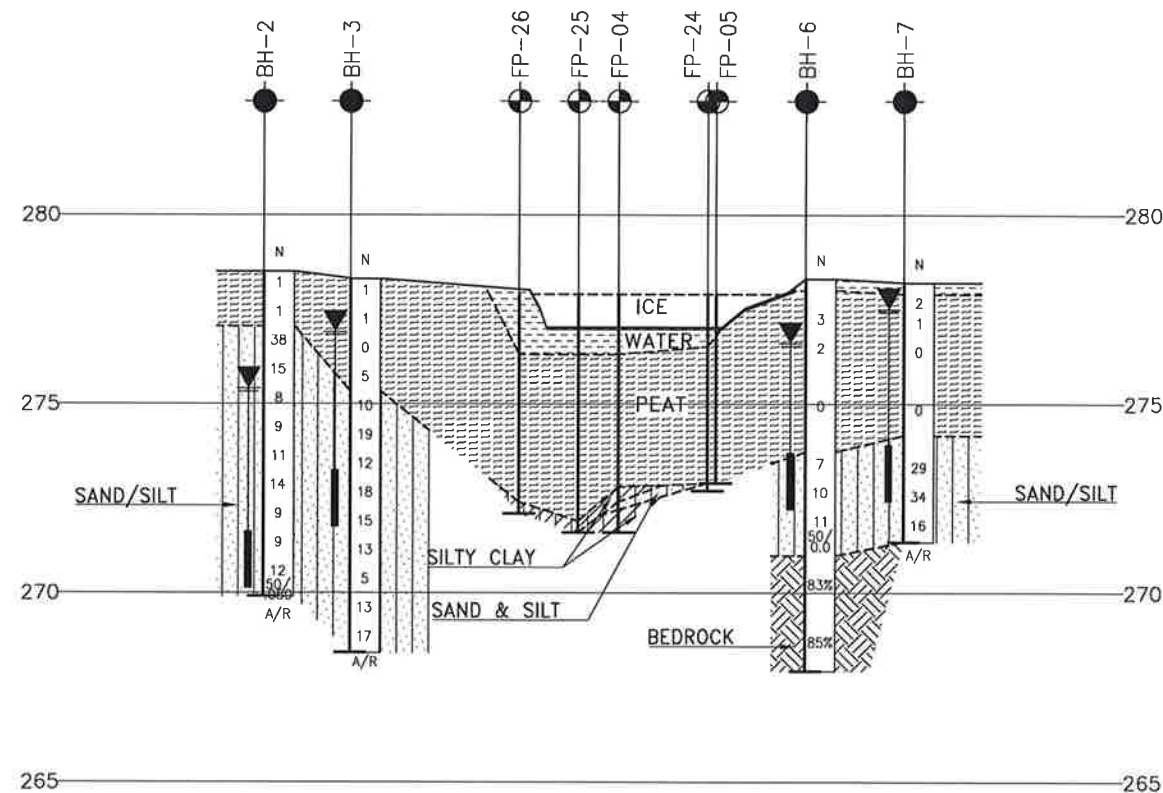
- Borehole By Thurber
⊕ Borehole By TBTE
○ Borehole With Peat
N Blows /0.3m (Std Pen Test, 475J/blow)
CONE Blows /0.3m (60° Cone, 475J/blow)
▽ Water Level
⊕ Head Artesian Water
⊕ Piezometer
90% Rock Quality Designation (RQD)
A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH-1	278.2	5 428 690.4	207 108.9
BH-2	278.5	5 428 655.0	207 080.7
BH-3	278.3	5 428 664.0	207 082.7
BH-4	278.1	5 428 680.9	207 104.1
BH-5	278.2	5 428 691.0	207 102.2
BH-6	278.3	5 428 709.9	207 099.0
BH-7	278.2	5 428 721.4	207 094.1
BH-8	278.5	5 428 715.4	207 006.6
BH-9	278.5	5 428 724.1	207 990.6
BH-10	278.5	5 428 691.7	207 115.0
BH-11	278.7	5 428 711.3	207 109.3
BH-12	278.3	5 428 672.3	207 130.2

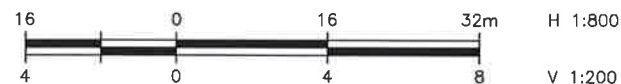
-NOTES-

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- Borehole elevations and co-ordinates provided by TBTE.

GEOCRES No. 52A-189



SECTION ALONG C-C



FP-04	277.9	5 428 691.7	207 088.8
FP-05	277.9	5 428 701.7	207 090.9
FP-06	277.9	5 428 694.6	207 074.1
FP-07	277.9	5 428 704.7	207 076.2
FP-08	277.9	5 428 697.4	207 059.4
FP-09	277.9	5 428 707.7	207 061.5
FP-10	277.9	5 428 686.4	207 082.5
FP-11	277.9	5 428 686.3	207 072.7
FP-12	277.9	5 428 718.0	207 076.6
FP-13	277.9	5 428 692.3	207 057.7
FP-14	277.9	5 428 715.6	207 067.5
FP-15	277.9	5 428 727.4	207 073.5
FP-16	277.9	5 428 701.5	207 038.6
FP-17	277.9	5 428 712.7	207 044.5
FP-18	277.9	5 428 724.8	207 050.6
FP-19	277.9	5 428 738.0	207 056.7
FP-20	277.9	5 428 716.6	207 025.5
FP-21	277.9	5 428 730.1	207 031.7
FP-22	277.9	5 428 742.5	207 037.5
FP-23	277.9	5 428 754.7	207 043.5
FP-24	277.9	5 428 700.3	207 093.7
FP-25	277.9	5 428 686.5	207 093.5
FP-26	277.9	5 428 681.4	207 086.7
18+085 19L	-	5 428 650.6	207 113.0
18+088 21L	278.6	5 428 653.9	207 111.5
18+090 18L	-	5 428 655.4	207 114.8
18+100 08L	-	5 428 663.7	207 126.3
18+100 18L	-	5 428 665.4	207 116.5
18+100 19L	-	5 428 665.6	207 115.5
18+100 28L	-	5 428 667.2	207 106.6
18+110 18L	-	5 428 675.5	207 118.3
18+120 02L	277.2	5 428 682.4	207 135.9
18+120 18L	278.2	5 428 685.5	207 120.2
18+120 28L	278.0	5 428 687.4	207 110.4
18+122 35R	276.6	5 428 677.6	207 172.7
18+150 28L	-	5 428 717.6	207 116.8

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JPL	CHK	JPL
DRAWN	AN	CHK	SITE
DATE	JAN 2015	DATE	JAN 2015
DWG	3	STRUCT	DWG 3

Appendix F

Selected Site Photographs



Photograph 1 – Looking North at Fen Pond



Photograph 2 – Looking North at Fen Pond



Photograph 3 – Looking South at Fen Pond



Photograph 4 – Looking North at Back of Fen Pond



Photograph 5 – Looking North at Existing Fen Pond Outlet into WBL Ditch

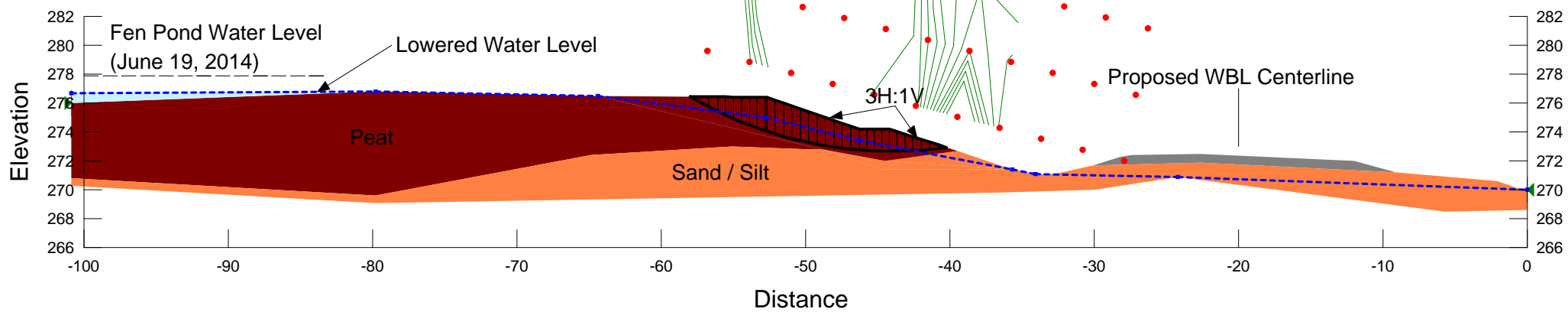
Appendix G

Selected Slope Stability Analysis Figures

Title: Area Inside Fen Pond
 Comments: Sta. 18+110
 Name: 3H:1V Slope in Peat

Peat	12 kN/m ³	2 kPa	0 °	1
Sand/Silt	20 kN/m ³	0 kPa	30 °	1
Granular Fill	22 kN/m ³	0 kPa	32 °	1

Horz Seismic Load: 0 g



Last Edited By: Michael Eastman

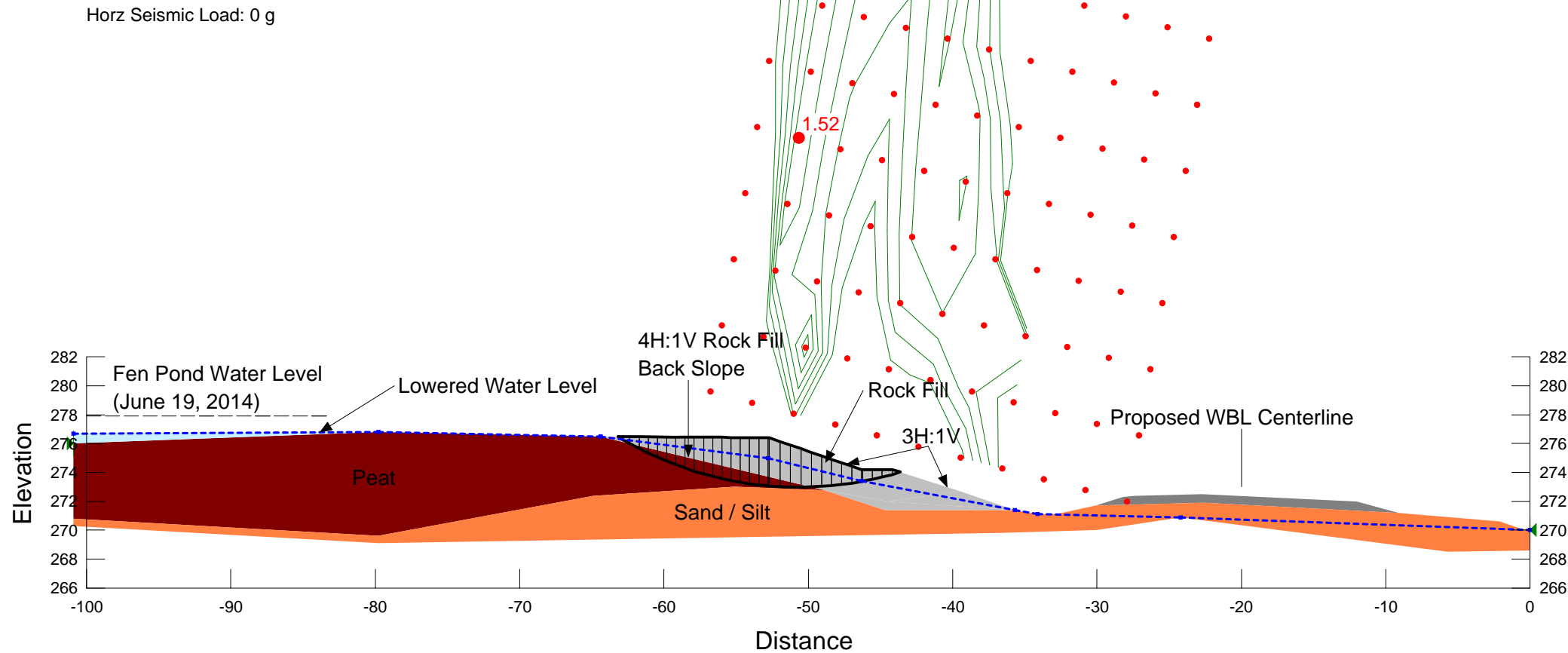
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Figure G1

Title: Area Inside Fen Pond
 Comments: Sta. 18+110
 Name: 4H:1V Back Slope in Rock Trench

Rock Fill (<= 300 mm dia)	19 kN/m ³	0 kPa	36 °	1
Peat	12 kN/m ³	2 kPa	0 °	1
Sand/Silt	20 kN/m ³	0 kPa	30 °	1
Granular Fill	22 kN/m ³	0 kPa	32 °	1

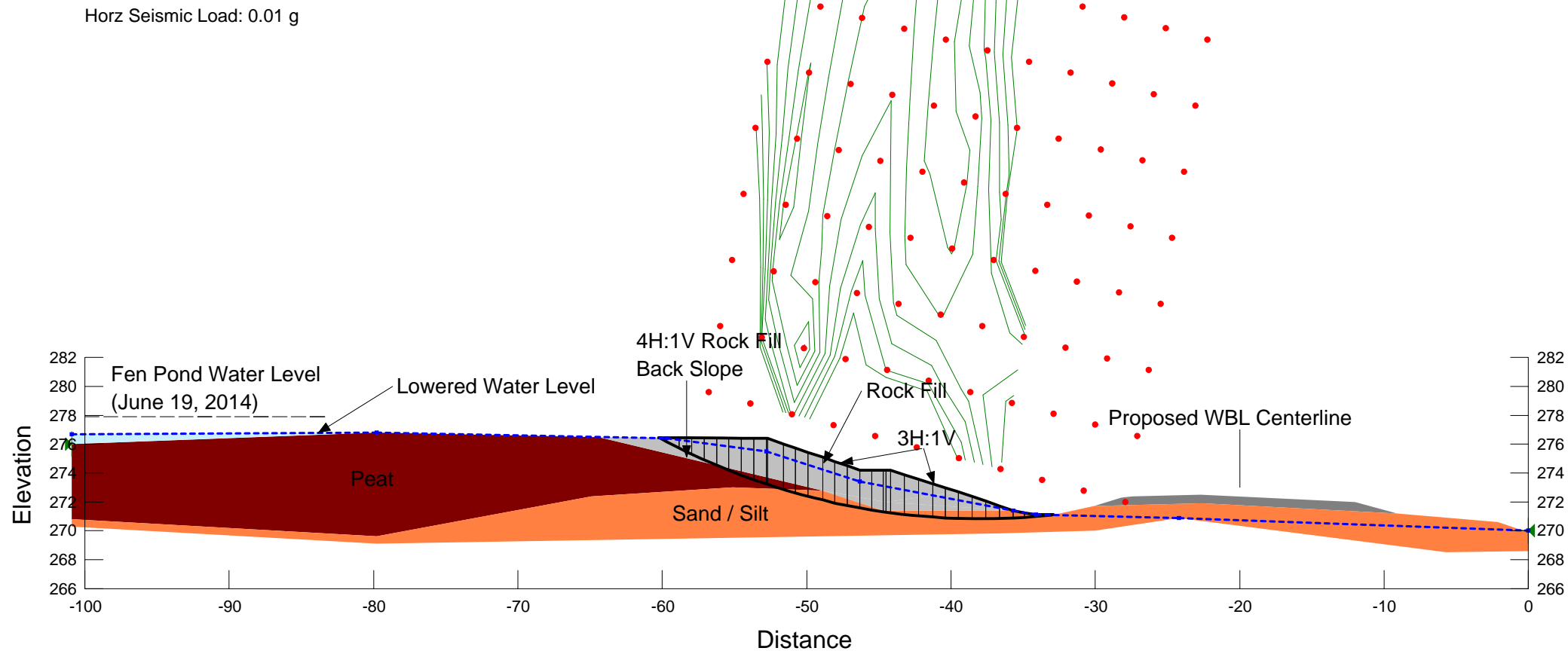


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Figure G2

Title: Area Inside Fen Pond
 Comments: Sta. 18+110
 Name: 4H:1V Back Slope in Rock Trench (Seismic)

Rock Fill (<= 300 mm dia)	19 kN/m ³	0 kPa	30 °	1
Peat	12 kN/m ³	2 kPa	0 °	1
Sand/Silt	20 kN/m ³	0 kPa	30 °	1
Granular Fill	22 kN/m ³	0 kPa	32 °	1

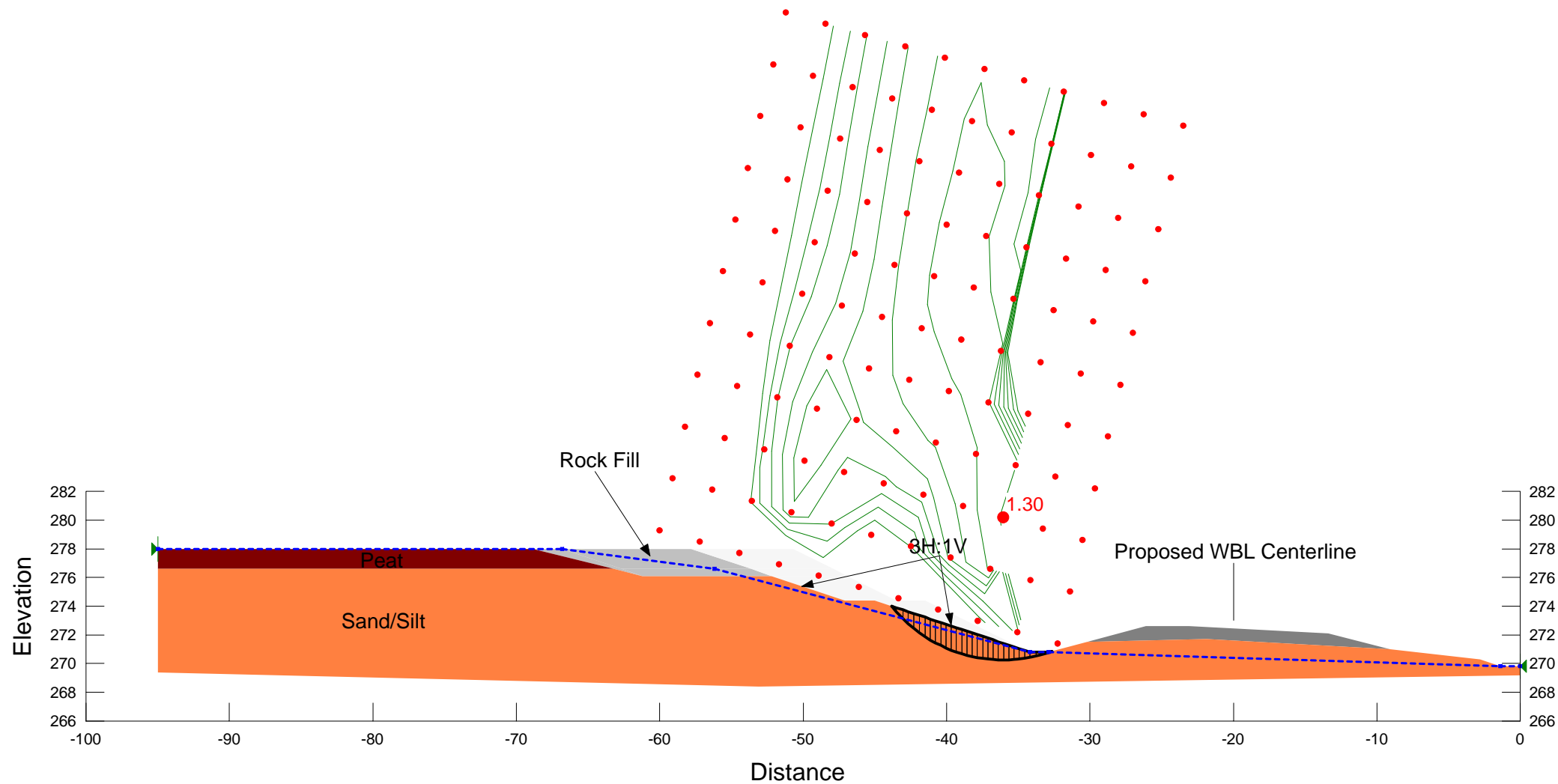


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Figure G3

Title: Area Outside Fen Pond
 Comments: Sta. 18+090
 Name: 3H:1V Slope in Sand/Silt

Rock Fill (<= 300 mm dia)	19 kN/m ³	0 kPa	36 °	1
Peat	12 kN/m ³	2 kPa	0 °	1
Sand/Silt	20 kN/m ³	0 kPa	31 °	1
Granular Fill	22 kN/m ³	0 kPa	32 °	1

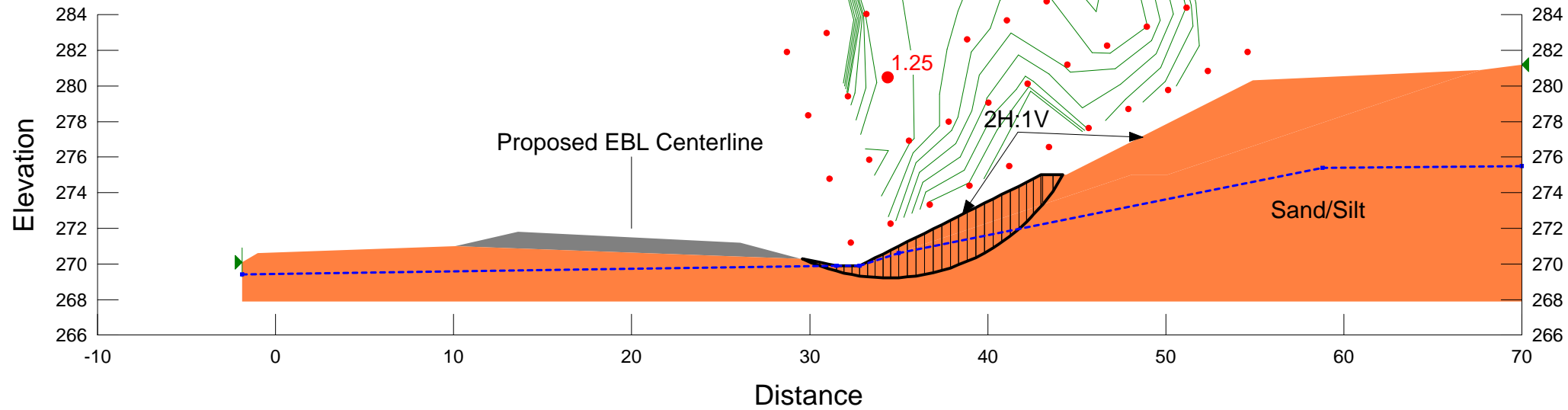


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Figure G4

Title: Area Outside Fen Pond
Comments: Sta. 18+140
Name: 2H:1V Slope in Sand/Silt

Sand/Silt	20 kN/m ³	0 kPa	31 °	1
Granular Fill	22 kN/m ³	0 kPa	32 °	1



Last Edited By: Michael Eastman

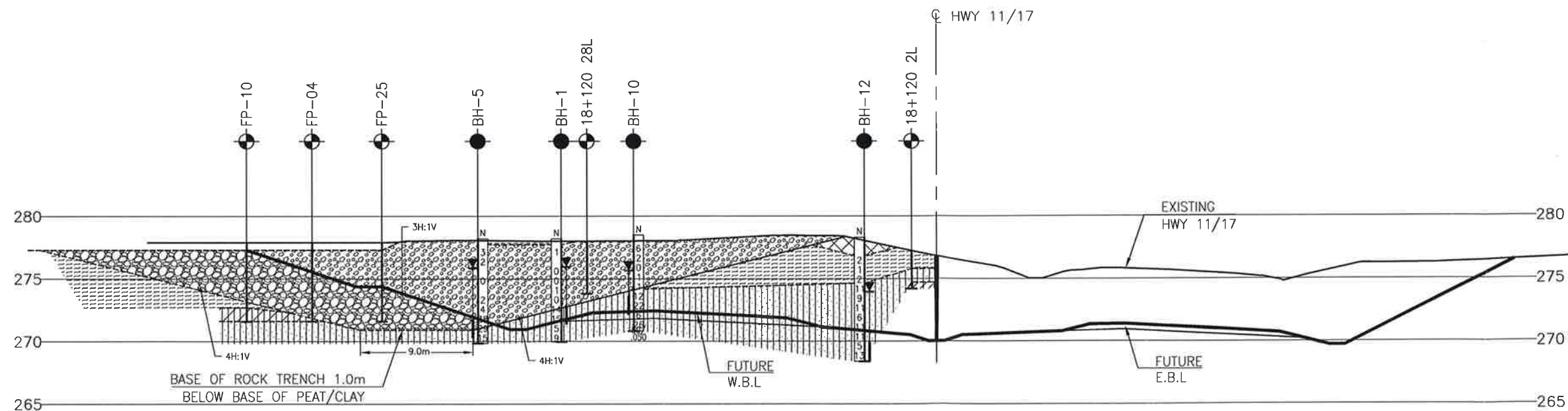
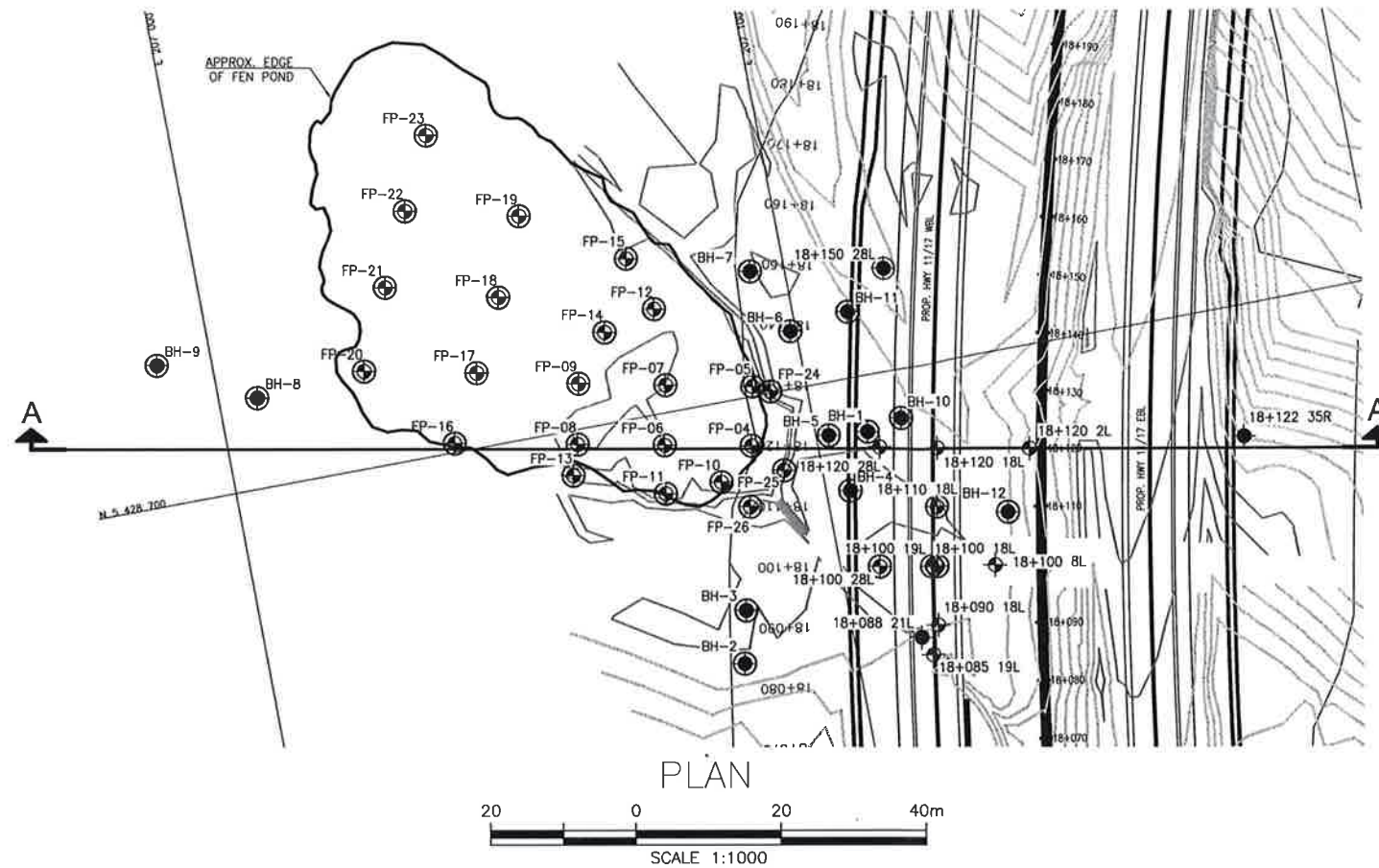
Last Solved Date: 1/17/2015, 12:00:38 PM

Directory: H:\19\1605\117 Hwy 11-17 Nipigon\Analysis\Analysis (17+795 to 18+450)\18+140 2H1V Slope in Sand 2015.01.19.gsz

Figure G5

Appendix H

Schematic Rock Trench Design Drawing



LEGEND:

- FILL
- PEAT
- SAND/SILTY SAND
- PERM. ROCK TRENCH
- TEMP. ROCK TRENCH

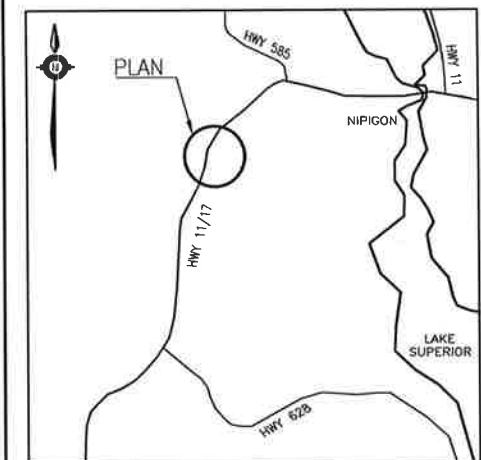
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 647-89-00

HWY 11/17 FOUR LANING
FEN POND
ROCK TRENCH DESIGN

MMM GROUP

THURBER ENGINEERING LTD.



LEGEND

- Borehole By Thurber
- Borehole By TBTE
- Borehole With Peat
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60' Cone, 475J/blow)
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING

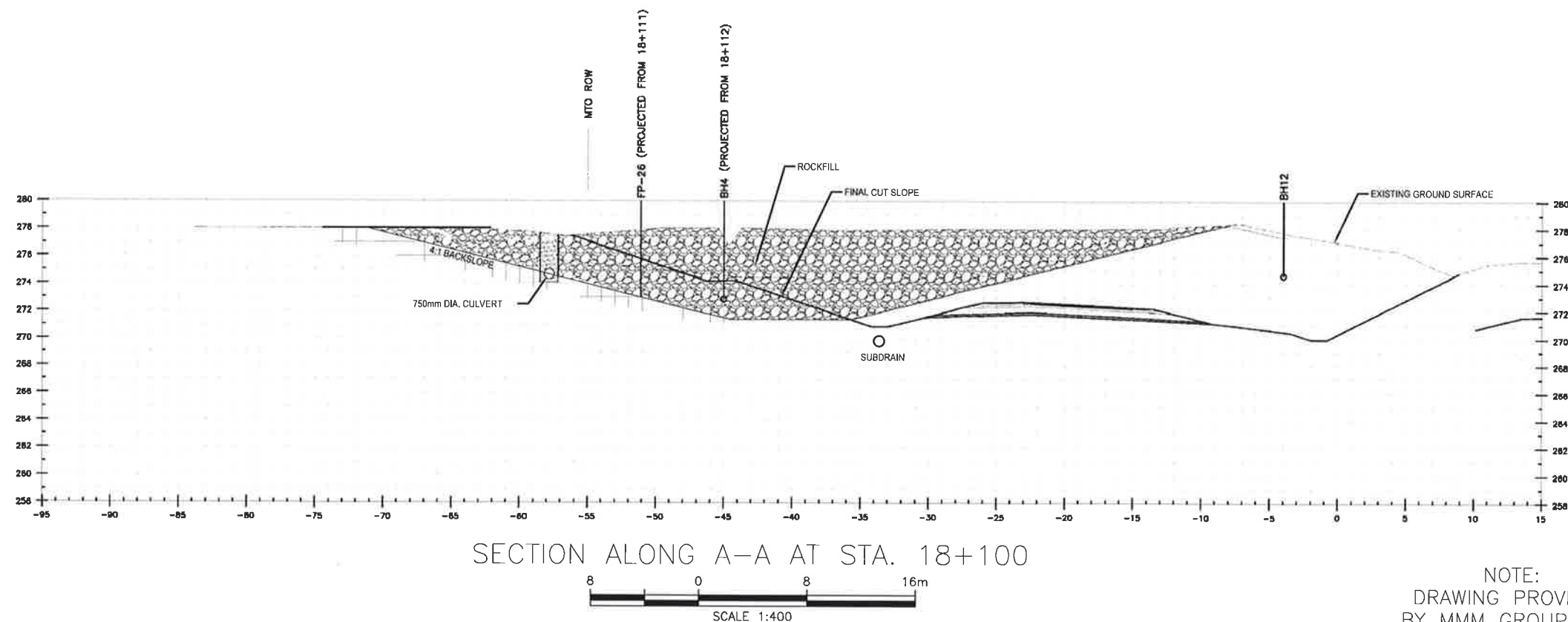
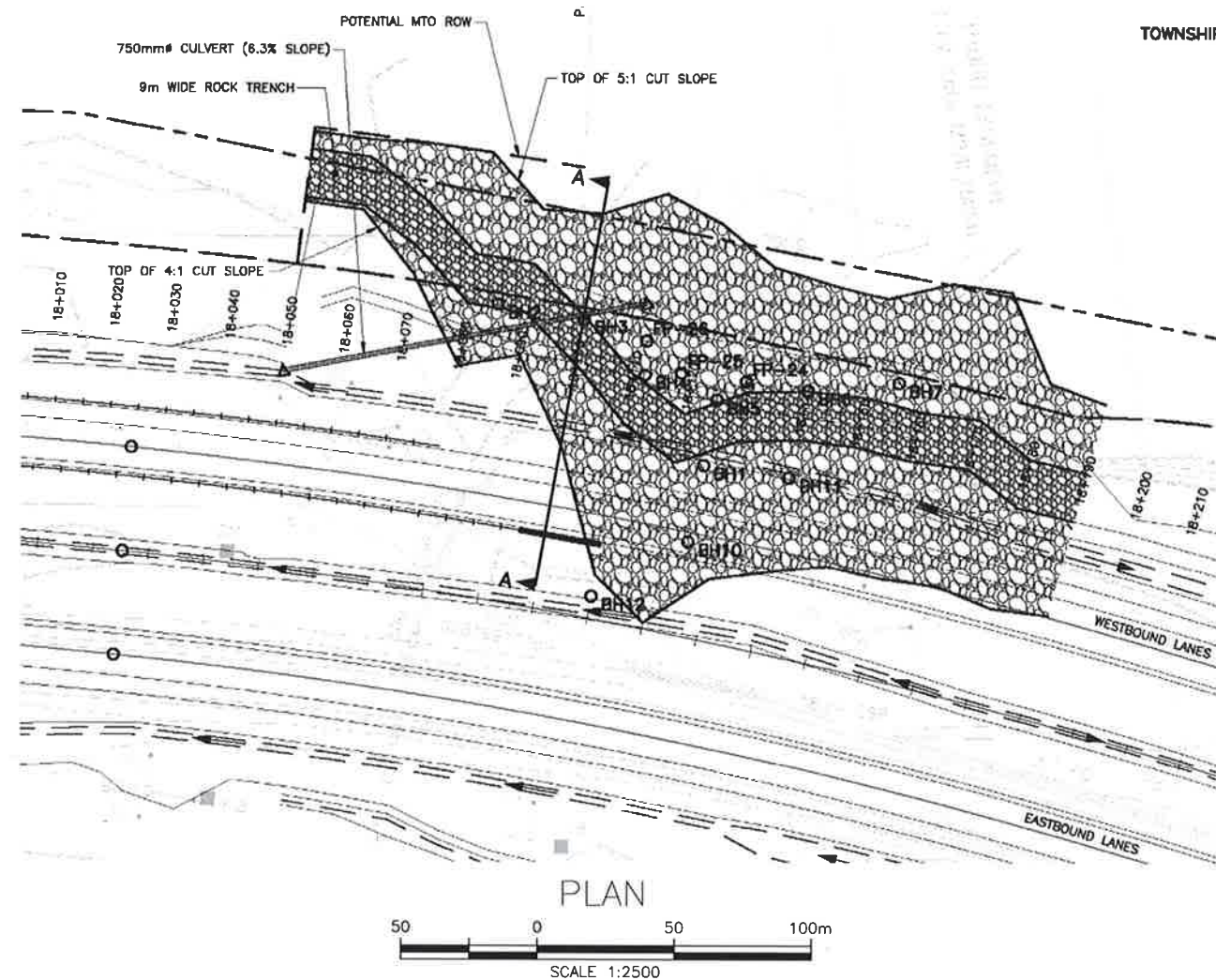
-NOTES-

- 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.
- Borehole elevations and co-ordinates provided by TBTE.

GEOCRES No.



REVISIONS	DATE	BY	DESCRIPTION



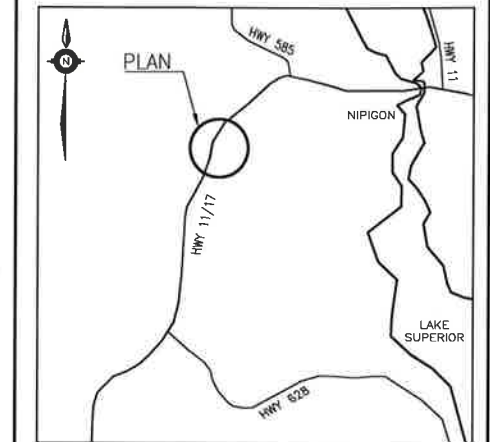
NOTE:
DRAWING PROVIDED
BY MMM GROUP LTD.

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









CONT No
WP No 647-89-00

HWY 11/17 FOUR LANING
FEN POND
ROCK TRENCH DESIGN



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole By Thurber |
|  | Borehole By TBTE |
|  | Borehole With Peat |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60' Cone, 475J/blow) |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

[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. Borehole elevations and co-ordinates provided by TBTE.

GEOCRES No.

[illegible]

Appendix I

List of Special Provisions and OPSS Documents Referenced in this Report

- 1) The following Standard Specifications and Special Provisions are reference din this report

OPSS.PROV 206

OPSS 209

OPSD 200.020

OPSD 201.020

OPSD 205.020

OPSD 205.030

OPSD 205.050

OPSD 209.020

- 2) Recommended wording for “NSSP – Trafficability”

Trafficability of construction equipment may be difficult in areas of organic deposits or excessively soft, loose and/or saturated subgrade. Disturbance of the subgrade by construction traffic must be minimized and the Contractor may have to adjust his operations in these areas. Provisions of adequate site drainage is critical to maintain stable subgrade.